

# FURUNO

## SERVICE MANUAL

SSB RADIOTELEPHONE

MODEL FS-5000



**FURUNO ELECTRIC CO., LTD.**  
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(TOSA)

PUB. No. SME-55190-B  
FS-5000

## FS-5000/8000 Modification of PA and COUP Boards

	<u>Necessary Parts</u> (See table below.)	<u>Refer to</u> <u>page:</u>
<b>1. Tuning error on MF band -----</b>	<b>Ⓐ -----</b>	<b>2</b>
<b>2. Burned-out COUP board ----- (on MF band)</b>	<b>Ⓑ -----</b>	<b>4</b>
<b>3. Burned-out PA board over 22MHz ----- (continuous transmission for about 2 minutes at full power)</b>	<b>Ⓒ -----</b>	<b>13</b>

Table

	Necessary Parts	Type	Code No.	Required for:
*	ROM (U3)	0550132102	005-927-430	Ⓐ (on COUP Board)
*	Silicone Sealant	KE-348T	000-801-041	
*	Resistors (R5/R8, 2 pcs.)	ERD-25PJ472 4.7K, 1/4W	000-330-373	
	Silicone Sealant	KE-348T	000-801-041	Ⓑ Installation of shunt capacitor on DUMMY LOAD PCB.
	DUMMY LOAD PCB	OP05-34	005-925-830	
	Antenna Capacitor (ceramic, for shunting)	DC-40, 50 pF or DC-40, 100 pF	000-258-695 000-258-696	
	Crimp-on lug (M4), Lug (M4), SWs (M4), Nut (M4), Screw M4 × 12, some wires 1.25 sq.			
*	Arrester Fixing Metal	05-039-6314	100-134-990	Ⓒ Installation of arrester fixing metal on AN- TENNA COUPLER.
*	Ground Cable (with lugs at both ends)	—	—	
*	Cable Clamp (3 pcs.)	CK-05H	000-570-247	
	M4 Nut, Screw M4 × 25			
*	Transformer (T4)	5T814	000-122-137	Ⓒ (on PA Board) delivered as an assemb- ly
*	Coaxial Cable	05S0689-0	000-119-452	
*	Transformer Clamp	05-039-6124	100-144-010	
*	Copper Strap (2 pcs.)	—	—	

(\*): Free of charge

# 1. Tuning error on MF band (Modification on COUP board)

Factory-modified Units:

FS-5000	FS-8000
2508-0095, 0096, 0105 and after	2522-0013 and after

## Modifications:

- ① **Replacement of ROM. (05501-32-101 → 05501-32-102)**  
Refer to Fig. 1 for the location.
- ② **Reducing number of turns of L8 and L9 by one turn.**  
(L8: 12.5T → 11.5T, L9: 19.5T → 18.5T)  
See the next page.
- ③ **Change of resistance values of R5 and R8.**  
(10K ohms → 3.3 K ohms)  
Refer to Fig. 1 for the locations.

*NOTE: If there is a black label (●) at the bottom of the Antenna Coupler (near the earth clamp), the above modifications have been already done at factory.*

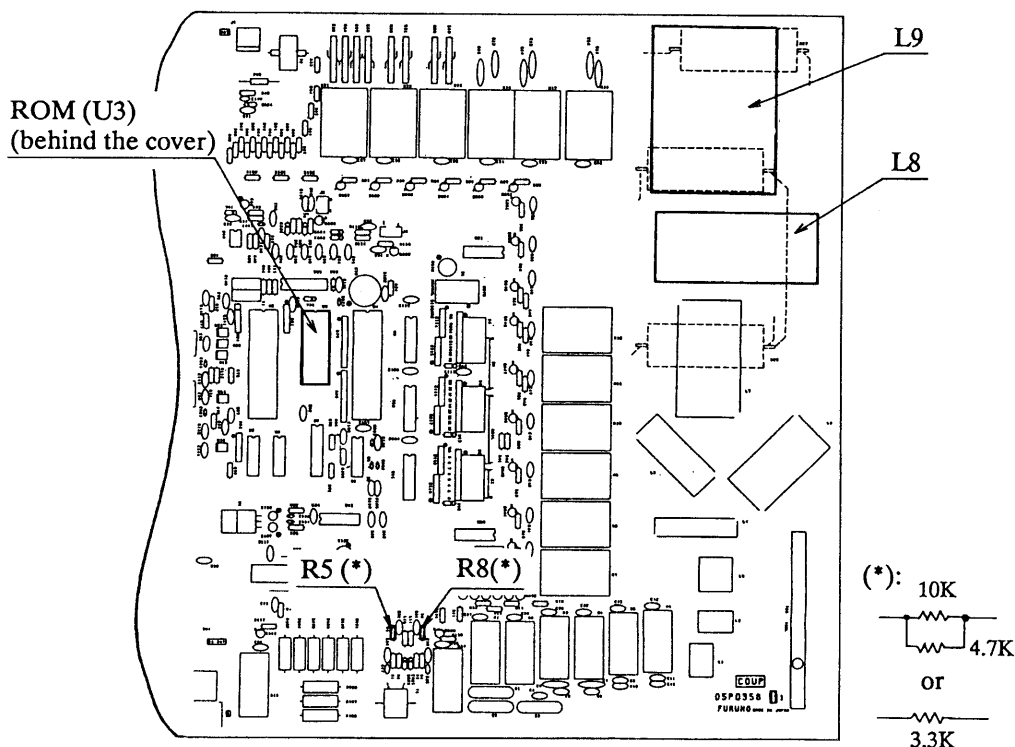
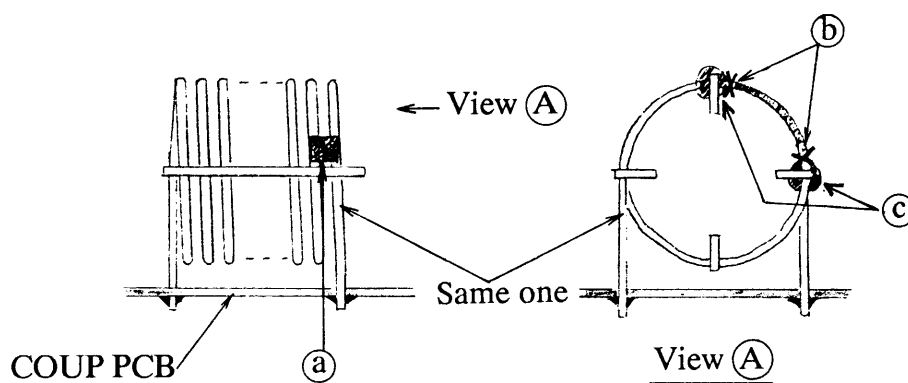


Fig. 1 COUP Board

## Reducing number of turns (L8/L9)



### Procedure

1. Solder **(a)** to shortcircuit the two cores.
2. Cut the two points **(b)** to remove 1/4 turns of a core.
3. Apply silicone sealant (supplied) to **(c)** to secure remaining cores.

## 2. Burned-out COUP board (occurred on MF band)

### Factory-modified Units:

Modification	FS-5000	FS-8000
① ②	2508-0095, 0096, 0105 and after	2522-0013 and after
③	2508-0070, 0071, 0072, 0074, 0077, 0078, 0080 and after	from first set
④	2508-0109, 0111, 0114 and after	2522-0017 and after

If the length of the antenna is proper (antenna impedance: 5 ohms, 200 pF or high) and no abnormality is found on the COUP board by voice test, omit this modification.

### Modifications

	<u>Page</u>
① Clearance check of L8, L9, C19 to C26 (COUP PCB). -----	6
② Applying silicone sealant to the following parts: -----	6
[ K25 to K27, T2 (COUP PCB) ----- Fig. 2 ]	
[ K1 to K2, J1 to J2 (DUMMY LOAD PCB) ----- Fig. 3 ]	
③ Mounting arrester fixing metal to Antenna Coupler. -----	7
<i>NOTE: If there is a black label (●) at the bottom of the Antenna Coupler (near the earth clamp), the above modifications have been already done at factory.</i>	
④ Power reduction on 2.5 MHz or lower. -----	8
⑤ After making modifications, check for a sparking in the Antenna Coupler. -----	9

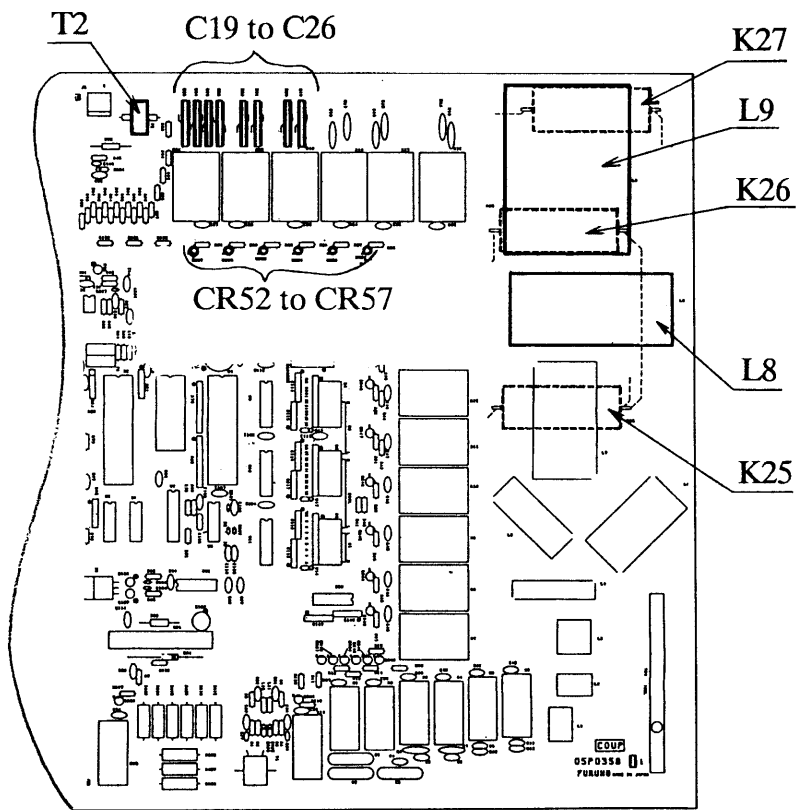


Fig. 2 COUP Board

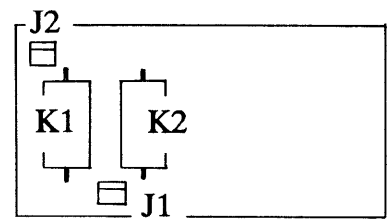
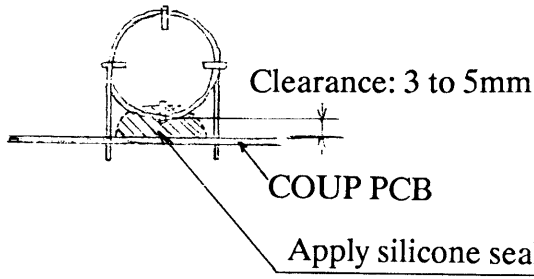


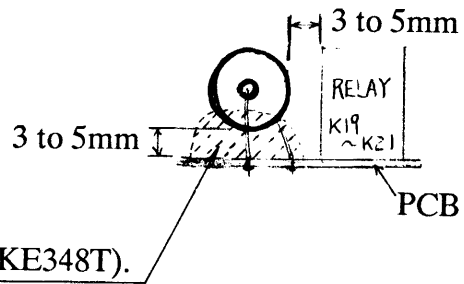
Fig. 3 DUMMY LOAD Board

①

Coils L8 and L9

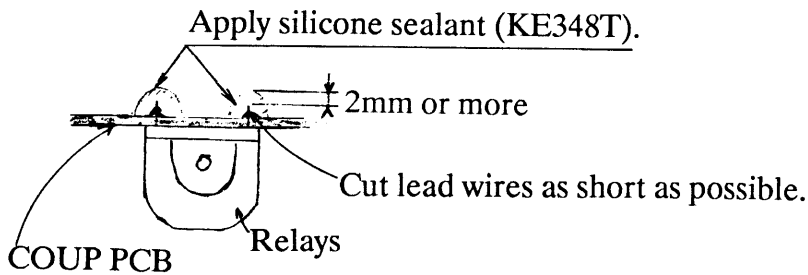


Capacitors C19 to C26

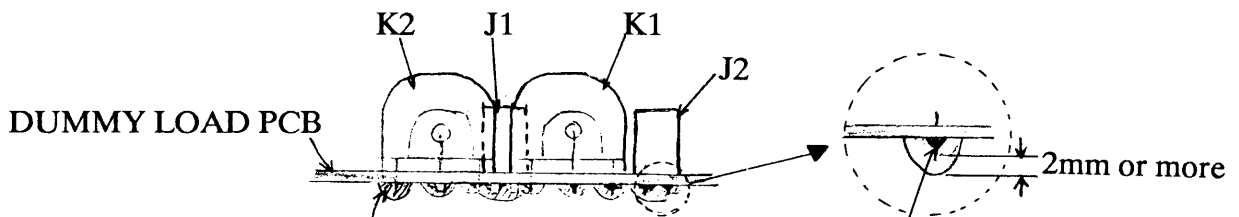
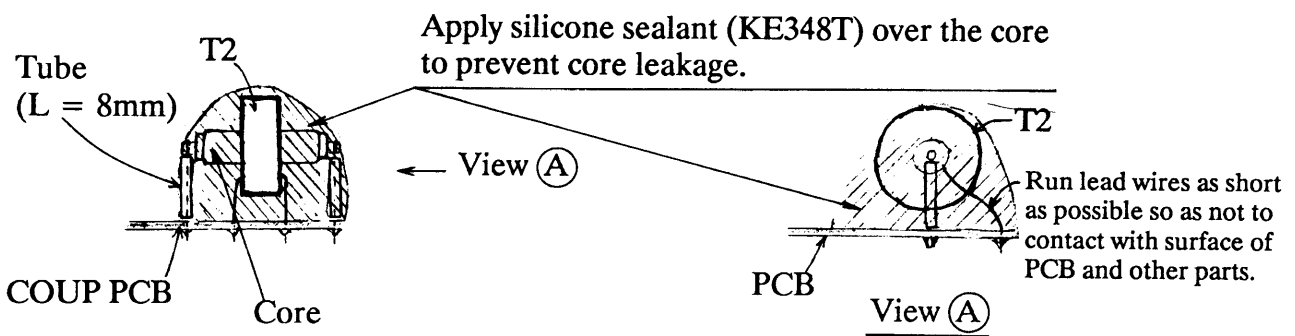


②

Relays K25 to K27 (Soldering Side)



Transformer T2



### ③ Mounting arrester fixing metal

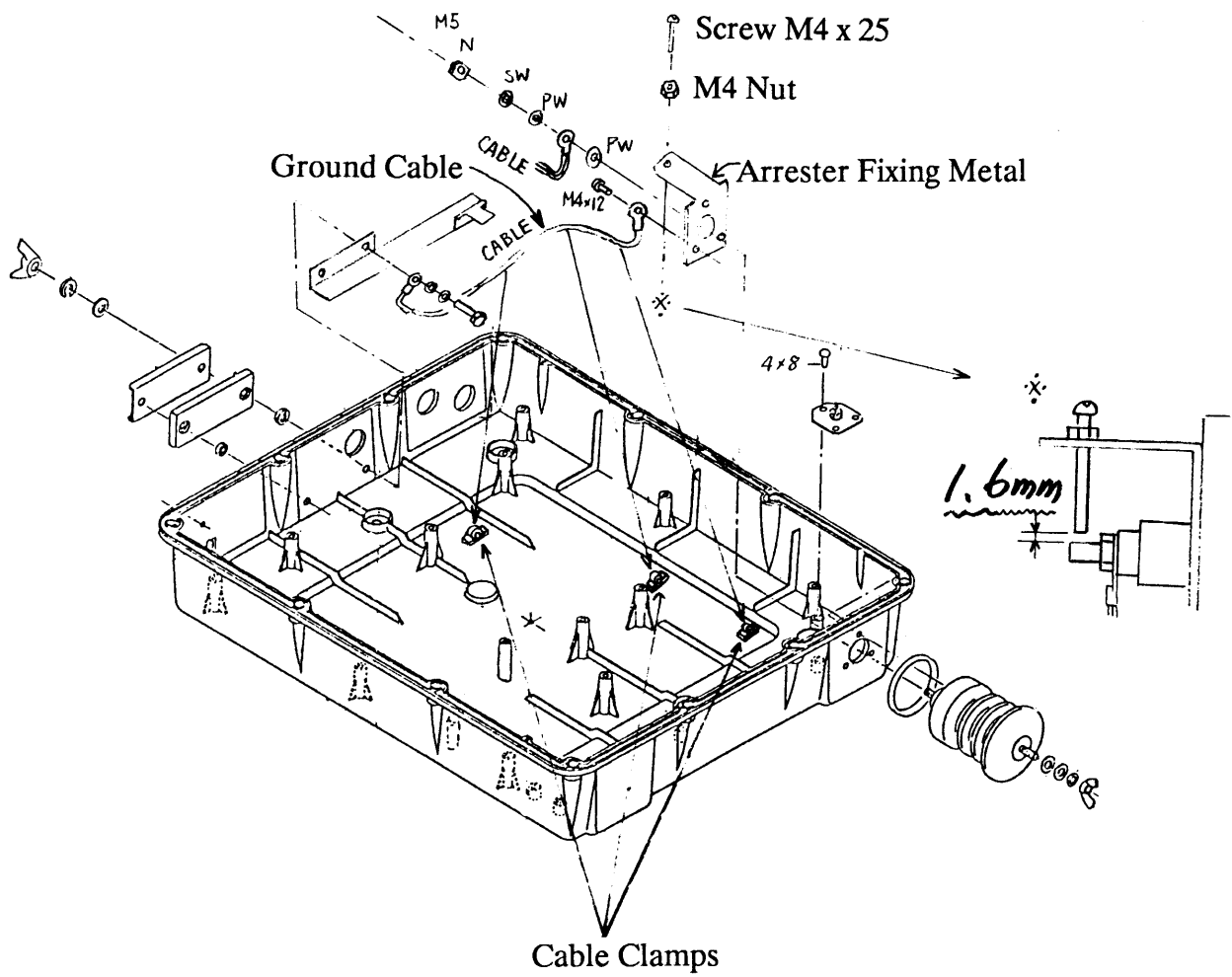


Fig. 4 Antenna Coupler

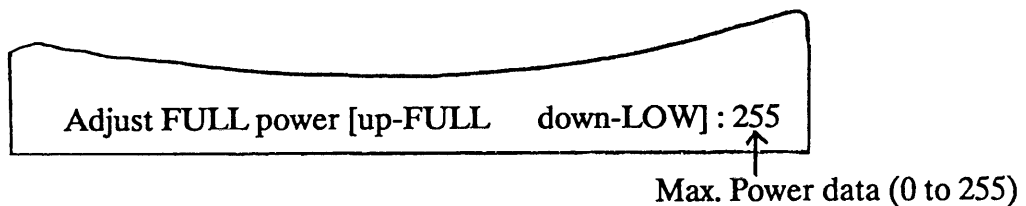
#### ④ Power reduction on 2.5 MHz or lower

Reduce power data to 225 for the FS-5000, 160 for the FS-8000. (About 320 Wpep at transceiver unit).

Channel	Resolution of Memory
User channel	Each channel
Free direct key-in ITU channel	500 kHz steps. That is, reduce the power <u>for two frequencies</u> . (One frequency between 1606.5 and 1999.9 kHz. The other frequency between 2000.0 and 2499.9 kHz.)

#### Procedure

1. Press the **STO** key followed by the **FULL** key. The screen should look something like this:



2. Press and hold down the **LOW** key until the "power data" is 225 for the FS-5000 or 160 for the FS-8000.
3. Press the **ENT** key to memorize the power data.

## ⑤ Spark check

After completing of items ① to ④, check for sparking.

### Procedure

1. Set the TX frequency to the lowest one in use. (ex. 1632.5 kHz)
2. Press the TX TUNE key.
3. Observe the LEDs CR52 to CR57 (Fig. 2). Are they all OFF?
4. If they are not off, increase the TX frequency, then press the TX TUNE key to check the LEDs. Repeat this procedure until CR52 to CR57 are off.
5. Communicate with the handset (voice).
6. Check for sparking at the arrester.
7. If there is sparking (due to insufficient antenna capacity), do either remedy (1) or remedy (2).

Remedy (1): Reduce the power data until there is no sparking.

Remedy (2): Mount the provided antenna capacitor (for shunting, 50 pF or 100 pF) on the DUMMY LOAD board between the antenna terminal and ground. Further, modify this board to enable control of capacitor on and off. See the next page for these modifications.

**Modification of DUMMY LOAD board**  
(installation of antenna capacitor)

This modification enables the antenna capacitor to be turned on in the specific range set by the system settings 9924 and 9925.

Procedure

1. Prepare optional DUMMY LOAD board (code no. 005-925-830).
2. Remove K1, C1 – C2 and R1 – R3.
3. Drill fixing hole for antenna capacitor. See Fig. 5.
4. Add a jumper wire as shown below to make shortcircuit between J1 and J2.

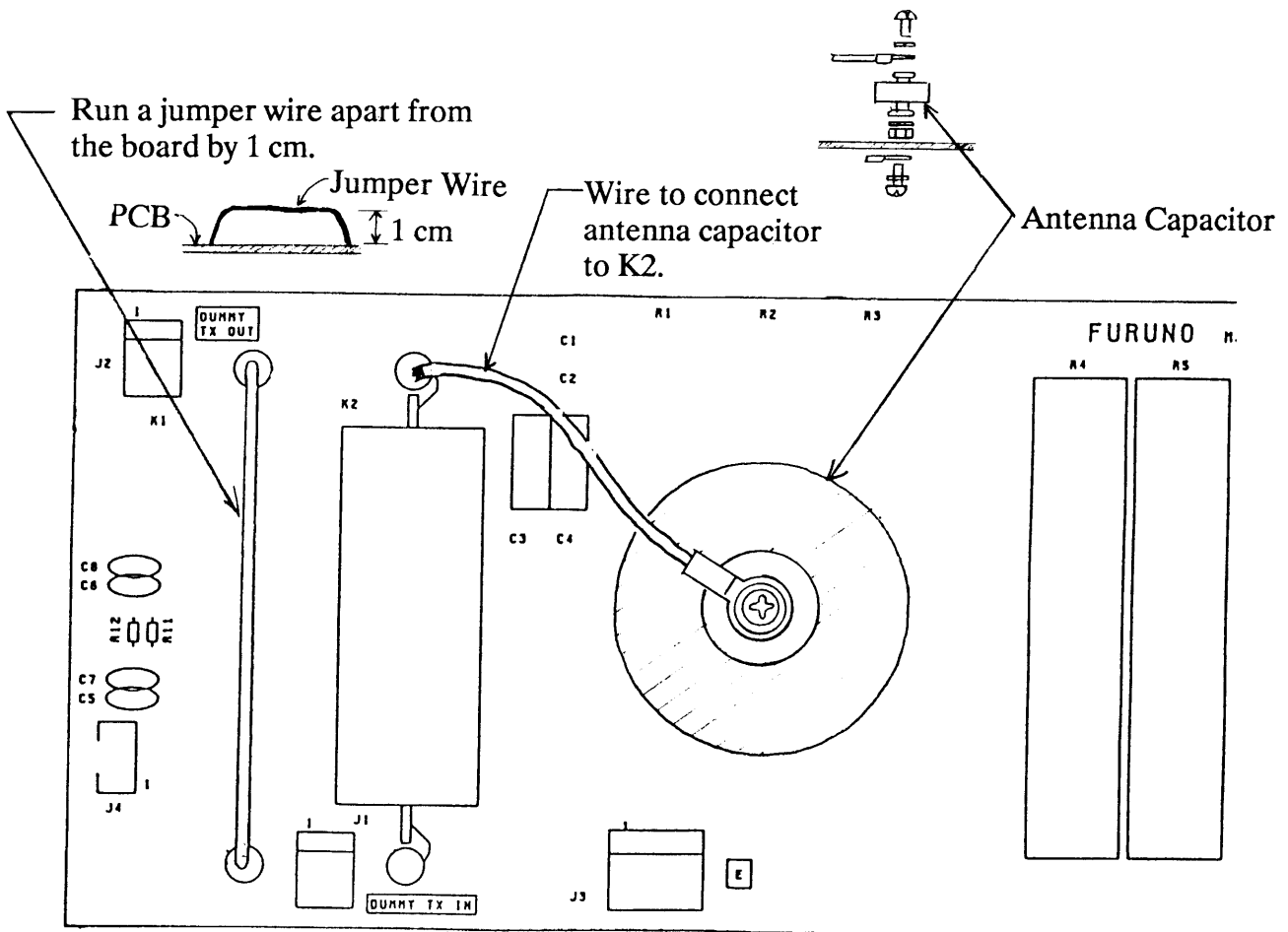


Fig. 5 DUMMY LOAD Board (Parts Side)

5. Referring to Fig. 5, fix antenna capacitor to board.
6. Solder a lug (supplied) to the earth pattern on the board.

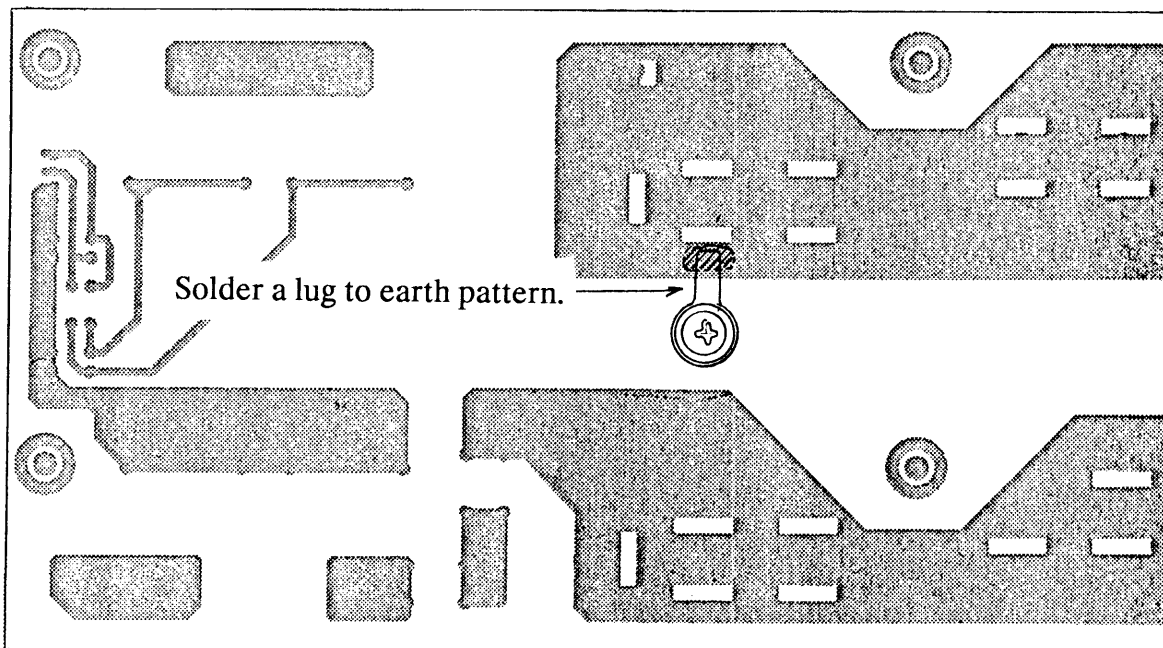
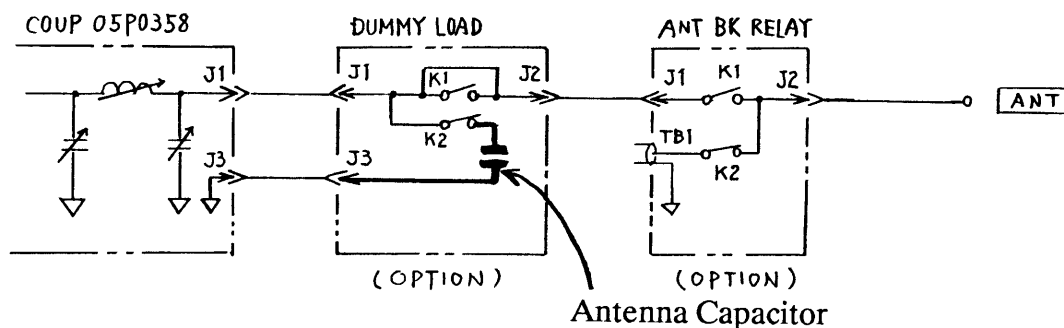


Fig. 6 DUMMY LOAD Board (Soldering Side)

7. Apply silicone sealant (KE348T) to lead wires of J1, J2 and K2 to prevent leakage of high voltage.
8. Install the DUMMY LOAD board to the Antenna Coupler.
9. Be sure wiring does not contact other wirings and parts.



10. Change the system settings through keyboard.

- ① **STO** → 9923 → **ENT** → 2 → **ENT**
  - ② **STO** → 9924 → **ENT** → 1606.5 → **ENT**  
(Lower limit)
  - ③ **STO** → 9925 → **ENT** → 2500.0 → **ENT**  
(Upper Limit)
- } Frequency range in which antenna capacitor turns on.

11. Confirm that the LCD displays "S. CAP" when the frequency within the range set by 9924 and 9925 is used. Further, check that the **DUMMY** key turns the antenna capacitor on and off.

*Note: The DUMMY LOAD board nullifies the dummy load function. If the dummy load is required, install an external dummy load.*

### 3. Burned-out PA board over 22 MHz (Modification on PA board)

Continuous transmission for about 2 minutes at full power by single tone may damage the PA board.

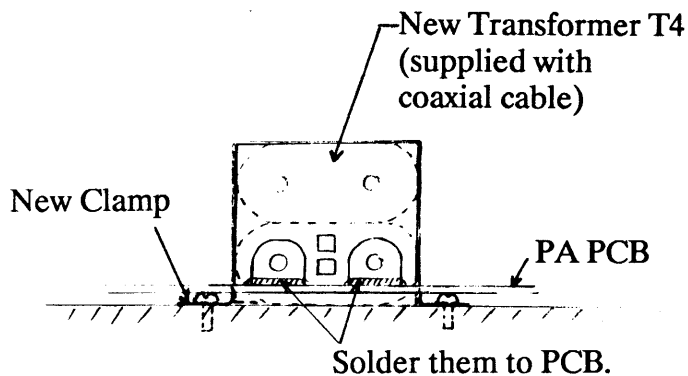
#### Factory-modified Units:

FS-5000	FS-8000
2508-0071, 0073, 0074, 0078 and after	2522-0016 and after

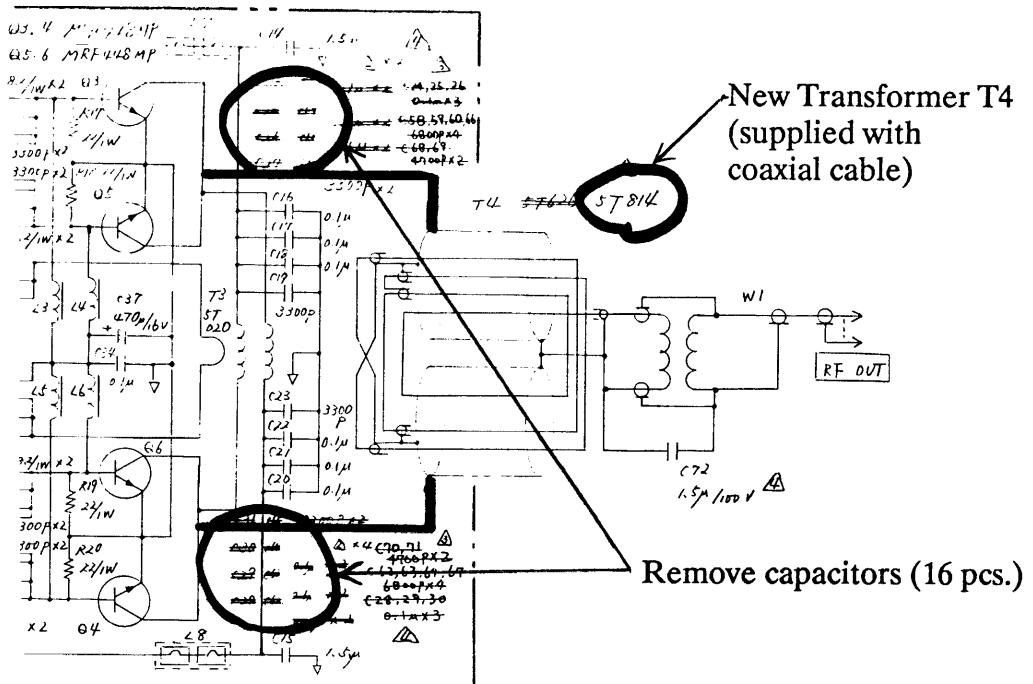
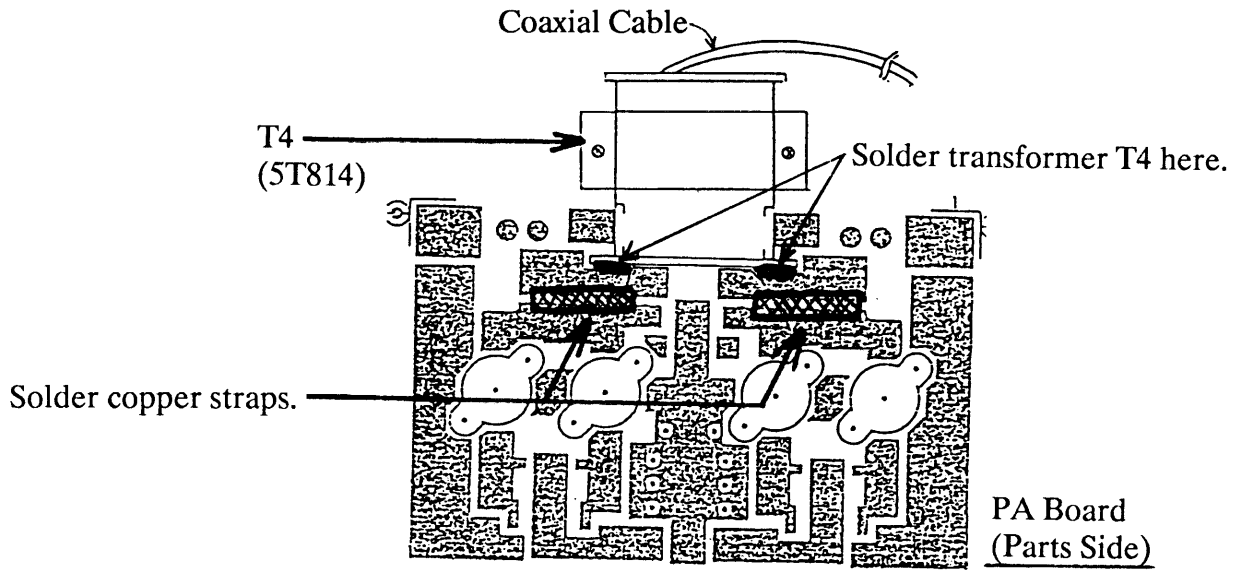
#### Modifications:

- ① Replacement of transformer T4 (5T626 → 5T814)

Double-mounted transformer



- ② Removal of capacitors (16 pcs.) in hatched portions and soldering copper straps there.



Addenda No. 2 to Service Manual of FS-5000 Series SM-E5519



### FS-5000/8000

## Adjustment of Operating Temperature of Fan Motors

A potentiometer (R48) has been added on the PA board to enable adjustment of the operating temperature of fan motors, from the production in July 1991. In addition, the resistance value of R27 on the PA CHECK board has been changed to 1k ohms. When you replace previous versions of the PA board or the PA CHECK board, do the following adjustment.

### 1. Replacement of previous PA board with current PA board

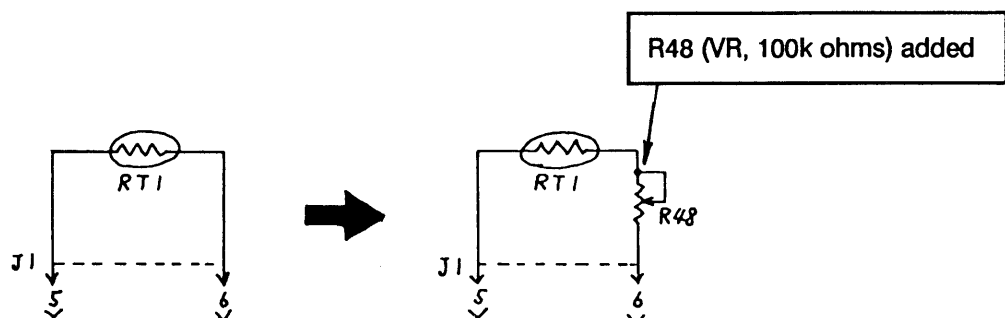
#### Procedure

- (1) Change resistance value of R27 on the PA CHECK board to 1k ohms.
- (2) Turn on the unit and measure the temperature of the heat sink with a thermometer. Confirm that the measured temperature is nearly the same as the temperature indication on the LCD (25 °C to 35 °C). If it is not, adjust R48 on the PA board.

### 2. Replacement of previous PA CHECK board with current PA CHECK board

#### Procedure

- (1) Change resistance value of R27 on the PA CHECK board to 1k ohms.
- (2) Turn on the unit and measure the temperature of the heat sink with a thermometer. Confirm that the measured temperature is nearly the same as the temperature indication on the LCD (25 °C to 35 °C). If it is not, change resistance value of R27 so they agree, or add R48 on the PA board and adjust it.



# FURUNO

## Information

NO. : FQ5-91-010 <sup>1/2</sup>

Date : 1991 - 8

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 3 to Service Manual of FS-5000 Series SM-E5519



### FS-5000/8000 New EXC PCB and REG Assy.

The above units are equipped with a new EXC board and new REG assy. (incl. REG, REG CONT and REG SW boards). These new boards are not compatible with their previous versions.

#### 1. EXC Board

Not compatible

	Type	Code No.
Previous	05P0349	005-594-240
	05P0349A	005-931-840
Current	05P0349-Z	005-943-070
	05P0349A-Z	005-943-100

Note : Suffix A represents FS-8000.

(1) Contents of Modification: Reference Oscillator section is deleted from previous EXC board. The REF OSC board (05P0414) is newly added.

(2) Factory Modification:

Model	Serial No.
FS-5000	2508-0114 to 0137, 0139 and after
FS-8000	2522-0017 and after

①

②

③

④

⑤

⑥

⑦

⑧

## 2. REG Assy.

	Name	Code No.
Previous	REG Assy.(24V)	005-942-450
	REG Assy.(32V)	005-931-830
Current	REG Assy.(24V)-Z...(Note 2)	005-943-040
	REG Assy.(32V)-Z...(Note 2)	005-943-050

Not compatible

*Note 1. Current REG, REG CONT and REG SW boards are not compatible with previous ones, respectively.*

*2. REG assy. having version no. 3 on each of its boards represents current REG assy.*

(1) Contents of Modification: Quantity (8pcs. →6pcs.) and fixing position of FETs on the REG SW board are changed.  
In addition, the shape of heat sink has been changed.

(2) Factory Modification: Production in July 1991 and after.

# FURUNO

## Information

NO. : FQ5-91-011  $\frac{1}{2}$

Date: 1991 - 8

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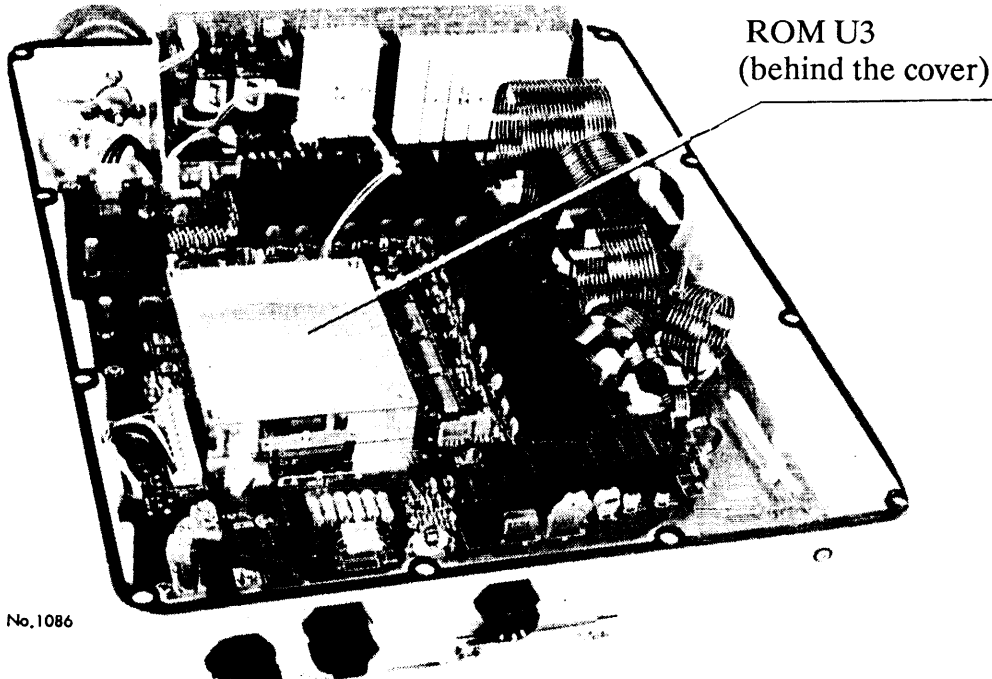
Addenda No. 4 to Service Manual of FS-5000 Series SM-E5519

### FS-5000/8000

## Program of ROM in Antenna Coupler Changed

The program of the ROM U3 on the COUP board in the Antenna Coupler has been changed, from version no. 2 to 3.

	Type	Code No.	S/No.
ROM	PROM05-501-32-103	592-743-000	FS-5000: 2508-0154 and after FS-8000: 2522-0017 and after



COUP Board

### Reason for Modification

Automatic tuning sequence has been changed to allow use of the pi-network on 1.6 to 3.4 MHz, because these frequencies cannot be tuned on some long wire antenna installations.

Tuning Method

→  
Automatic Tuning (3 times)

Band (MHz)	First		Second		Third		At retuning
	Network	SWR	Network	SWR	Network	SWR	SWR
Less than 2.56	Gamma	$\leq 3.0$	Gamma	$\leq 3.0$	Pi	$\leq 3.0$	$\leq 2.0$
2.56 to 3.36	Gamma	$\leq 2.0$	Gamma	$\leq 2.0$	Pi	$\leq 2.0$	$\leq 2.0$
3.36 to 5.12	Gamma	$\leq 2.0$	Pi	$\leq 2.0$			$\leq 2.0$
5.12 to 10.24	Pi	$\leq 2.0$	Gamma	$\leq 2.0$			$\leq 2.0$
More than 10.24	Pi	$\leq 2.0$	Pi	$\leq 2.0$			$\leq 2.0$

Newly added

Addenda No. 5 to Service Manual of FS-5000 Series SM-E5519

### FS-1600/2500/5000/8000

### Code No. Lists of Current PCBs & Assemblies

#### 1. New REG Assy. added

	Name	Code No.	Remarks
Previous	REG Assy. (24V)	005-942-450	FOR 24VDC
	REG Assy. (32V)	005-931-830	FOR 32VDC
Current (*1)	REG Assy. (24V)-Z	005-943-040	FOR 24VDC
	REG Assy. (32V)-Z	005-943-050	FOR 32VDC

Quantity and fixing position of FETs are changed.

(\*1) : Current REG assy. which consists of new REG/REG CONT/REG SW boards has a suffix Z or version no. 3 on its boards. If current REG assy. is used, use current PA PCB assy. shown in the list below, since current REG assy. can be combined with only new heat sink of PA PCB assy.

#### 2. New PA PCB assy. (PA PCB plus heat sink) added

	Name	Code No.
Previous	PA PCB Assy.	005-941-810
Current (*2)	PA PCB Assy. (New)	005-943-060

Heat sinks of previous and current ones are different.

(\*2) : New heat sink for current REG assy. is included.

#### 3. PA/REG Assy. (New REG assy. plus New PA PCB assy. plus PA CHECK PCB) added

Power Supply	Name	Code No.
24VDC	PA/REG Assy.(24V)	005-943-020
32VDC	PA/REG Assy.(32V)	005-943-030

**4. New EXC PCB added**

EXC PCB	FS-5000		FS-8000	
	Type	Code No.	Type	Code No.
Previous	05P0349	005-594-240	05P0349A	005-931-840
Current	05P0349-Z	005-943-070	05P0349A-Z	005-943-100

} Not compatible

**5. REF OSC PCB added ... 05P0414 (Code No. : 005-943-080)****6. INTERFACE PCB**

Power Supply	FS-5000/8000		FS-8000	
	Type	Code No.	Type	Code No.
24VDC	05P0354	005-927-250	05P0362	005-594-990
32VDC	05P0354A	005-943-090	05P0362A	005-943-120

**7. TX FIL PCB**

FS-5000		FS-8000	
Type	Code No.	Type	Code No.
05P0350	005-927-240	05P0350A	005-943-110

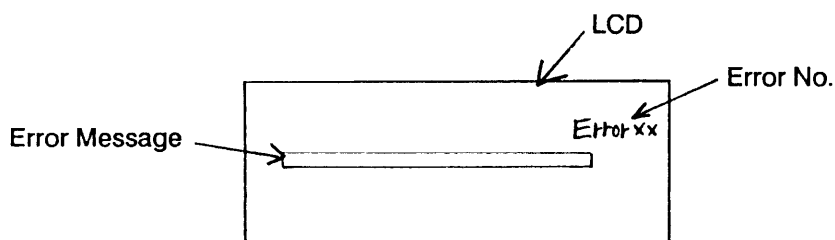
**8. UNBALANCE DET PCB (only for FS-8000)... 05P0437 (Code No. : 005-943-130)****9. SWR PICK UP PCB (only for FS-8000)... 05P0413 (Code No. : 005-595-010)**

*Note : Maintenance Parts List for Optional Supply*

Name	Code No.
ANT BK RELAY PCB	005-594-710
CONTROLLER SW PCB	005-594-730
Dummy Load Assy.	005-927-610

## ERROR MESSAGE LIST FOR SELF-TEST

If one of error messages listed below appears at self-test, check the corresponding parts.



Test No.	Error No.	Error Message	Check Point
9915/9916	1	CPU/Communication error	CPU board (in the transceiver unit) or Interconnection cable
9924/9925	1	CPU/Communication error	CPU board (in the control unit) or Interconnection cable
9923	2	No Tx AF signal on AF PCB	AF board
	3	No Rx AF sig. on AF PCB or TRx unit	
	4	No SQ AF signal on AF PCB	
	5	SQ not open on AF PCB	
	6	SQ not closed on AF PCB	
9913	7	Unlock freq. xxxx.xx kHz on RX PCB	RX board
9911	8	Unlock freq. xxxx.xx kHz on EXC PCB	EXC board
9914	9	No Rx signal through BPF on RX PCB	RX board
	10	No Rx signal through Pre-sel on RX PCB	
	11	No Rx signal on RX PCB	
	12	No S signal on RX PCB	
	13	Unable to control sensitivity on RX	
	14	Unable to mute Rx on RX PCB	

Continued

Test No.	Error No.	Error Message	Check Point
9912	15	No Mic signal from Control Unit on EXC	AF board, EXC board or Interconnection cable
	16	No Tx signal on EXC PCB	EXC board
	17	Unwanted Tx signal on EXC PCB	
	18	Insufficient source voltage	REG Unit (+ 18V line voltage)
	19	Insufficient PA Vc	REG Unit (+ 45V line voltage)
	20	Excessive PA idle current	PA board
	21	High temperature on PA	Temperature at PA board exceeds 80 °C.
	26	Unwanted Tx signal on PA or TX FIL PCB	PA board or TX FIL board
	29	No Tx signal on PA or TX FIL PCB	PA board, TX FIL board or Interconnection cable
9930	32	No acknowledge signal from Coupler	COUP board
	33	No Tx signal on PA	PA board
	35	No Tx signal on TX FIL PCB	TX FIL board

# FURUNO

## Information

NO. : FQ5-91-014 <sup>1/2</sup>

Date : 1991 - 9

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QUALITY ASSURANCE DEPARTMENT

Addenda No. 7 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 ROM PROGRAM CHANGE (Ver. 7)

ROMs on the Control and Transceiver Units have been changed from "6" to "7" from August 1991.

	Type	Code No.
NEW ROM	PROM 05-501-31-107	005-927-440

#### Contents of Modification

##### 1. Receiver Functions

- (1) The beep associated with the following function keys has been disabled as it has proved to be a hindrance.

**[TUNE], [PRESELECTOR], [SENSITIVITY], [VOLUME]**

- (2) Automatic selection of duplex filter and preselector in duplex mode, depending on the RX frequency.

RX freq.	Preselector	Duplex filter
4MHz or less	ON	OFF
4 to 4.5 MHz	OFF	ON

Note that preselector status is restored to previous setting when simplex mode is selected on 4 to 4.5MHz.

- (3) Speaker is automatically switched on when changing the communication mode from DUPLEX to SIMPLEX.

##### 2. Transmitter Functions

- (1) A beep(s) has been added after completion of TX TUNE operation.

OK result: "beep"  
Error result: "beep-beep-beep"

- (2) The time interval for detection of PA temperature has been lengthened to protect rapid power reduction due to high temperature at PA.

Interval:    Previous            Current  
 Interval:    2 seconds    →    5 minutes

- (3) Automatic turn-off for dummy load: If TX frequency is changed with the dummy load turned ON, the dummy load will automatically be turned OFF. (For FS-8000, the DUMMY operation is inactive on the HF band.)

### 3. System Settings

- (1) Additional system setting allowing free selection of TX frequency within marine bands; by entering the following commands:

**[STO] 9901 [ENT] 3 [ENT]**

Any frequency in the following bands may be transmitted.

1606.5- 4438, 6200 - 6525, 8100 - 8815, 12230 -13200, 16360 -17410,	18780-18900, 19680-19800, 22000-22855, 25070-25210, 26100-26175	(unit: kHz)
---	---	-------------

- (2) System setting #9902 has been deleted.  
 (New ITU frequencies are now in use.)
- (3) Change of setting range of #9913 (System delay time).  
 (10 to 99ms → 5 to 99ms)  
 Note that system delay time is now 10ms (minimum) even if you set #9913 for "5ms".

# FURUNO

## Information

NO. : FQ5-91-015

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QUALITY ASSURANCE DEPARTMENT

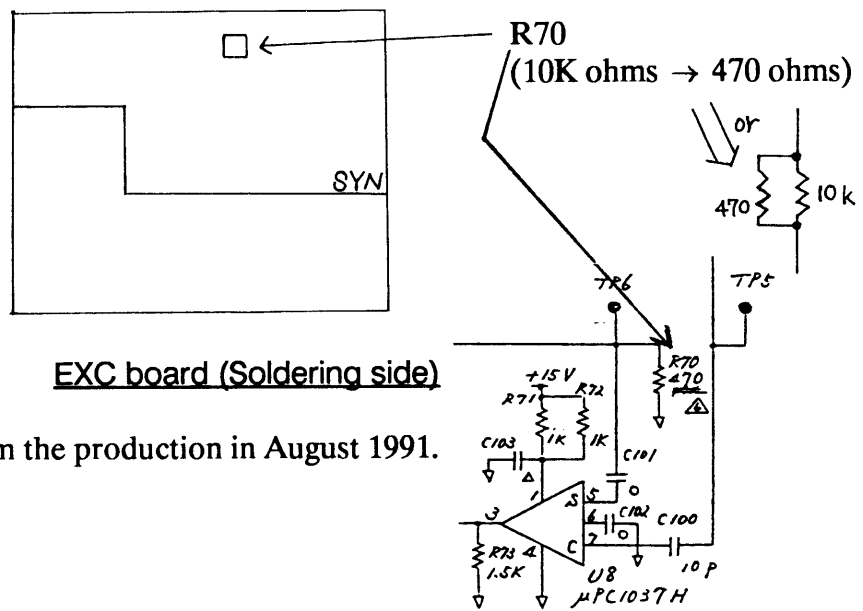
Addenda No. 8 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 Remedy for TX Frequency Deviation

**Symptom:** You can not transmit due to synthesizer unlock, or another station can not receive your signal clearly.

**Cause:** 3rd local oscillation unlocks because of excessive input level of U8 (mixer) in the SYN section on the EXC board.

**Remedy:** Change R70 from 10K ohms to 470 ohms (Code No.: 000-117-177), or add 470 ohms in parallel with R70. Do this remedy at next ship visit.



Factory Modification: From the production in August 1991.

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# FS-5000/8000 Maintenance Parts List Changed

The following shows current maintenance parts list.

\*1:DEPOT MAINTENANCE PARTS FOR 10 SETS IN 2 YEARS  
\*2:SHIPBORNE RUNNING PARTS FOR 1 SET IN 2 YEARS

CODE NO.	NAME OF PARTS	TYPE	SPECIFICATIONS	QUANTITY *1 *2	REMARKS
000-119-440	TRANSISTOR	MRF-448MP	05S0546-1	6 2	PA PCB (2 PAIRS)
000-121-823	MOS FET	IRFP150		6 2	REG SW PCB
000-104-429	DIODE	05AZ18Z	ZENER	6 2	REG SW PCB
000-106-066	RELAY	JR1-DC12V	AJR3221	1 1	TX FIL PCB (50 OHMS BK)
000-106-068	RELAY	JC1AF-DC12V	AR321173	3 1	COUP PCB
000-106-069	RELAY	FRD-12023		3 1	COUP PCB
000-106-216	RELAY	JC2AF-DC12V	AR322173	3 1	COUP PCB
000-116-371	RELAY	HD1-M-DC12V	AG4013	1 1	RX PCB
000-119-485	RELAY	JR1A-DC12V	AJR3211	3 1	COUP PCB
000-445-356	RELAY	JH2A-DC24V	AR5222	1 1	INTERFACE PCB
000-113-376	CRYSTAL	05S0402-0	49.5MHZ 05S0402-0	1 1	EXC PCB
000-119-322	FAN MOTOR	MD1225A-24		1 1	FOR PA COOLING
000-121-337	MOTOR	109E0824H402		1 1	
000-580-091	LOUDSPEAKER	EAS-65P16S	8, 2W	1 1	
000-112-623	HANDSET WITH CURL CORD	HS6000FZ5		1 1	
000-835-126	NI-CD BATTERY	N-50S83		2	
005-594-140	PRINTED CIRCUIT BOARD	05P0367	PA CHECK	3 1	
005-594-200	PRINTED CIRCUIT BOARD	05P0347	CPU	3 1	TRANSCEIVER UNIT
005-594-220	PRINTED CIRCUIT BOARD	05P0348	RX	3 1	
005-594-240	PRINTED CIRCUIT BOARD	05P0349	EXC	3 1	OLD ONE. ONLY FOR FS-5000
005-594-290	PRINTED CIRCUIT BOARD	05P0358	COUPLER	3 1	
005-594-520	PRINTED CIRCUIT BOARD	05P0357	KEY	3 1	
005-594-540	PRINTED CIRCUIT BOARD	05P0355	CPU	3 1	CONTROL UNIT
005-594-560	PRINTED CIRCUIT BOARD	05P0356	AF	3 1	
005-594-710	PRINTED CIRCUIT BOARD	05P0359	ANT BK RELAY	1	OPTION
005-594-730	PRINTED CIRCUIT BOARD	05P0368	CONTROLLER SW	1	OPTION
005-594-990	PRINTED CIRCUIT BOARD	05P0362	I/F 24V	3 1	ONLY FOR FS-8000/24VDC
005-595-010	PRINTED CIRCUIT BOARD	05P0413	SWR PICKUP	3 1	ONLY FOR FS-8000
005-927-240	PRINTED CIRCUIT BOARD	05P0350	TX FIL	3 1	ONLY FOR FS-5000
005-927-250	PRINTED CIRCUIT BOARD	05P0354	I/F 24V	3 1	FOR 24VDC SET
005-927-460	PRINTED CIRCUIT BOARD	LM24008M	LCD	3 1	
005-927-610	DUMMY LOAD PCB ASSEMBLY	05P0360		1	OPTION. W/MOUNTING PLATE
005-931-830	REG ASSEMBLY (32V)	FS-5000/8000T		3 1	OLD ONE. FOR 32VDC SET
005-931-840	PRINTED CIRCUIT BOARD	05P0363	W/HEAT SINK	3 1	OLD ONE. ONLY FOR FS-8000
005-941-810	PA PCB ASSEMBLY	FS-5000/8000T		3 1	OLD ONE.
005-942-650	REG ASSEMBLY (24V)	FS-5000/8000T		3 1	OLD ONE. FOR 24VDC SET
005-943-020	PA/REG ASSEMBLY (24V)	05P0363	W/REG.SHIELD	1 1	FOR 24VDC SET
005-943-030	PA/REG ASSEMBLY (32V)	05P0363A	W/REG COVER	1 1	FOR 32VDC SET
005-943-040	REG ASSEMBLY (24V)-Z	05P0352Z/353Z/398Z		3 1	NEW ONE. FOR 24VDC SET

DATE 7/10/91

NO. M61900

MAINTENANCE PARTS LIST  
FOR FS-5000/8000

CODE NO.	NAME OF PARTS	TYPE	SPECIFICATIONS	QUANTITY *1 *2	REMARKS
005-943-050	REG ASSEMBLY (32V)-Z	05P0352Z	FS-5000T/8000T	3	NEW ONE. FOR 32VDC SET
005-943-060	PA PCB ASSEMBLY-Z	05P0363	FS-5000T/8000T	3	NEW ONE
005-943-070	PRINTED CIRCUIT BOARD	05P0349-Z	FS-5000T	3	NEW ONE. ONLY FOR FS-5000
005-943-080	PRINTED CIRCUIT BOARD	05P0414	FS-5000T/8000T	3	
005-943-090	PRINTED CIRCUIT BOARD	05P0354A	FS-5000T/8000T	3	FOR 32VDC SET
005-943-100	PRINTED CIRCUIT BOARD	05P0349A-Z	FS-8000T	3	NEW ONE. ONLY FOR FS-8000
005-943-110	PRINTED CIRCUIT BOARD	05P0350A	FS-8000T	3	ONLY FOR FS-8000
005-943-120	PRINTED CIRCUIT BOARD	05P0362A	FS-8000T	3	ONLY FOR FS-8000/32VDC
005-943-130	PRINTED CIRCUIT BOARD	05P0437	FS-8000T	3	ONLY FOR FS-8000
000-119-467	FLEXIBLE CABLE	SMCD-1.25-20-400-NBD		1	CONTROL UNIT

2/2

# FURUNO

## Information

NO. : FQ5-91-018

1/5

Date: 1991 - 10

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 10 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 New Version ROM (No. 8)

The version no. of the ROMs on the control and transceiver units have been changed from 7 to 8 in September 1991.

#### CONTENTS OF MODIFICATION

##### 1. ITU Frequency Table for USA has been added. (SSB only)

.....Selectable with new system setting 9961.

##### Calling Procedure

① [STO] "9961" [ENT]

The following menu appears:

ITU Freq. Table [0-INT, 1-USA]

② "1" [ENT]

Details of ITU Frequency Table for USA ...Refer to attached sheet.

(1) The following channels were omitted from standard ITU Frequency Table as they are not specified by the FCC:

429-452 609-611 833-835 838-870 1238-1246 1650-1663 1816-1822  
2248-2260 2511-2517

(2) Simplex channels are re-arranged to start from No. 61 as follows:

461:4146 661:6224 861:8294 1261:12353 1661:16528 1861:18840  
462:4149 662:6227 862:8297 1262:12356 1662:16531 1862:18843  
463:4417 663:6230 1263:12359 1663:16534  
664:6516

2261:22159 2561:25115  
2262:22162 2562:25118  
2263:22165  
2264:22168  
2265:22171

(3) Mississippi River channels are re-arranged to start from No. 71 as follows:

471:4065	671:6209	871:8201	1271:12362	1671:16543
472:4089	672:6212	872:8213	1272:12365	1672:16546
473:4116	673:6510	873:8725		
474:4408	674:6513	874:8737		

(4) Alaska Radio channels are re-arranged to start from No. 81 as follows:

481:4366  
 482:4369  
 483:4396  
 484:4402  
 485:4420  
 486:4423

(5) Transmission frequencies of three duplex channels have been changed as follows:

	<u>Previous T-R</u>	<u>Current T-R</u>
428:	4351-4351	4060-4351
836:	8713-8713	8113-8713
837:	8716-8716	8128-8716

(6) Distress channel numbers are re-arranged so that they all end with a zero.

300:3023  
 400:4125  
 500:5680  
 600:6215  
 800:8291  
 1200:12290  
 1600:16420

**2. In standard ITU Frequency Table, distress channel numbers are re-arranged as follows:**

300:3023  
 400:4125  
 500:5680  
 600:6215  
 800:8291  
 1200:12290  
 1600:16420

**3. 5680 kHz has been added to the "Marine Band" ("9901") Table.**

**4. GMDSS Frequency changes ... (Calling Procedure: [DSC] "Channel No." [ENT])**

<u>Ch. No.</u>	<u>Frequency</u>	<u>Remarks</u>
7	500	moved from CH10
8	3023	added (SSB)
9	5680	added (SSB)
51	T2189.5-R2177	corrected (Telex)
52	T2177-R2177	corrected (Telex)

**5. High temperature threshold of thermal protection circuit on PA section has been changed from 80°C to 90°C.**

**6. Software bug amended: Tuning was sometimes done twice.**

**FACTORY MODIFICATION**

Model	Serial Number
FS-5000	2508-0223 to 0227, 0232 and after
FS-8000	2522-0019 and after

**ROM CODE NUMBER**

Type	Code No.
PROM 05-501-31-108	005-927-440





Addenda No. 11 to Service Manual of FS-5000 SM-E5519

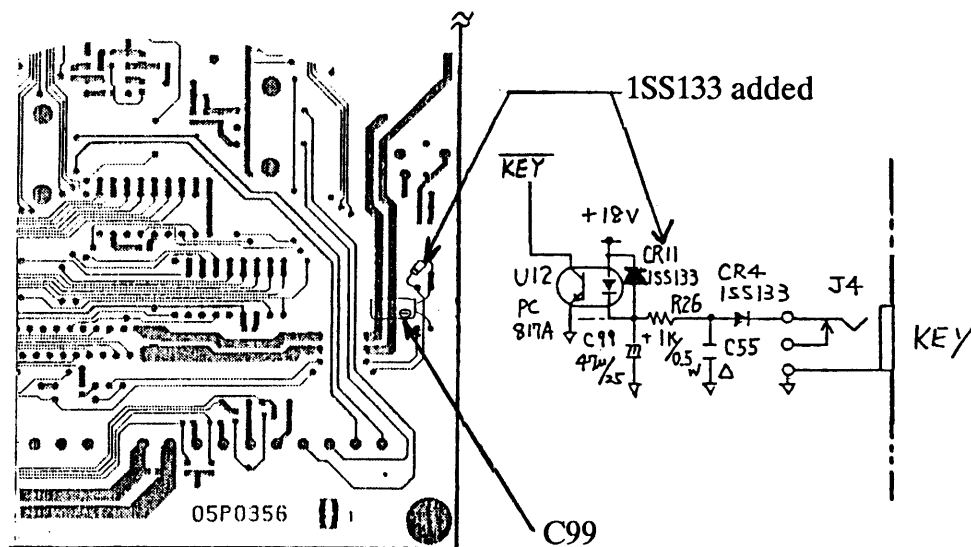
### FS-5000/8000

## Photo Coupler for Telegraph Key Input Damaged

- Symptom : Telegraph key input does not function.
- Cause : When the POWER switch is turned off, the voltage charged by C55 on the AF board in the Control Unit is fed to photo coupler U12 (diode) and may cause U12 to be damaged.

C55 Charging voltage : 18V  
 U12 Reverse voltage (max.) :  $V_R = 6V$

- Remedy : Replace U12 with a new one and add diode 1SS133 (code no. : 000-103-097) in parallel with U12 as shown in the figure below.



AF board (Soldering side)

*Note: If more than 40V is fed to the key input line, CR4 and U12 may be damaged. Confirm that key input line is not connected to other equipment.*

Factory Modification : Delivery from October 1991 and after.

# FURUNO

## Information

NO. : FQ5-92-012

Date: 1992 - 4

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 12 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 Modification of TX FIL PCB

**Symptom** : "Excessive IC on PA" is observed on 12MHz.  
(Power is automatically reduced, or the breaker of the PR-850 is shut down.)

**Cause** : Impedance on 12MHz in the TX FIL board viewed from the PA board is less than 50 ohms.

#### **Factory**

**Modification** : Capacitance (for 12MHz or higher) in the TX FIL board has been changed as follows.

- C41 : Deleted (100pF)
- C43 : 27pF ⇒ 56pF (27pF added in parallel with C43)
- C47 : 82pF ⇒ 100pF (22pF added in parallel with C47)
- C49 : 68pF ⇒ 47pF

Model	Serial No.
FS-5000	2508-0367 and after
FS-8000	2522-0046 and after

#### **Field**

**Modification** : Power data on each band should be reduced until IC on PA board becomes less than 21A.

#### **Power data adjustment procedure:**

1. Set TX frequency to desired band. (ex. 12MHz)
2. Press [STO] key followed by [FULL] key.
3. Press and hold [LOW] key to decrease the power data.
4. Transmit single tone. (Press [TEST TONE] key, then press PTT switch.)... *Note 1*
5. Check IC indication on the LCD. If IC display does not exceed 21A, release the PTT switch then press [ENT] key to memorize the power data.
6. Repeat steps 1 to 5 for all bands.

**Note 1:** To use test tone, change system setting as follows.

[STO] 9926 [ENT] 0 [ENT]

# FURUNO

## Information

NO. : FQ5-92-007

Date : 1992 - 4

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 13 to Service Manual of FS-5000 SM-E5519



### FS-5000/8000 Modification for Power Failure

**Symptom** : Power can not be supplied when pressing the [POWER] key. ①

**Cause** : Transmission signal from the FS-5000 itself is induced to the AF and INTERFACE boards due to improper ground, etc. (self-induction) ②

**Remedy** : Change resistance values (chip resistors) in the AF and INTERFACE boards as follows. ③

AF board

R70/R71 : 100 ohms  $\Rightarrow$  330 ohms. (Carbon, 1/6W) ④

INTERFACE board

R18/R19 : 100 ohms  $\Rightarrow$  330 ohms. (Carbon, 1/6W)



⑤

⑥

⑦

⑧

# FURUNO

## Information

NO. : FQ5-92-006

Date : 1992 - 4

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 14 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 Change of MIC Gain Adjustment

The MIC gain adjustment has been changed as below from Jan. 1992 to facilitate the factory adjustment.

Please amend pages 2-4 and 2-14 of the FS-5000 Service Manual.

#### Pages 2-4 and 2-14

#### Previous

Adjust **R6** on the EXC board for the output power of 100W for FS-5000, 200W for FS-8000.

(TX freq: 16MHz, SSB,

MIC input level: 1500Hz, **-54dBm**,

PTT: ON, Power data: 255)



#### New

Find the frequency (1.6 to 25MHz) which the output power of the transceiver unit is the lowest, when the MIC input level is **-53dBm** of single tone. Then adjust **R8** on the EXC board for the output power of 100W for FS-5000, 200W (100W on MF band) for FS-8000.

Note: Power data

FS-5000 ... 255 (HF)  
FS-8000 ... 255(HF)  
180 (MF)

This adjustment is done at the factory. When you change the EXC or PA board locally, confirm the MIC gain adjustment if possible.

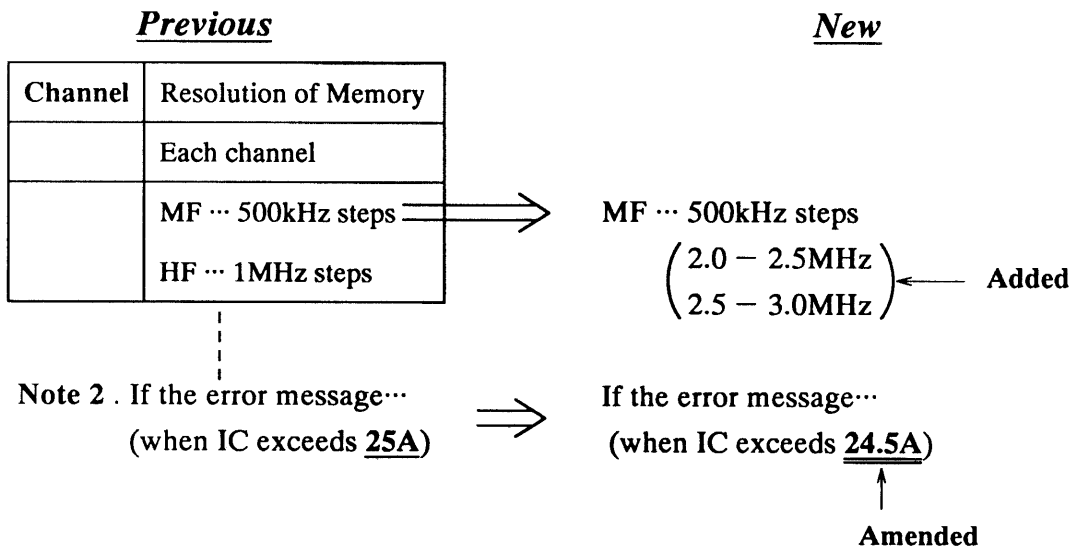
Addenda No. 15 to Service Manual of FS-5000 SM-E5519

### Errata and Addition of MIF Description for FS-5000 Service Manual

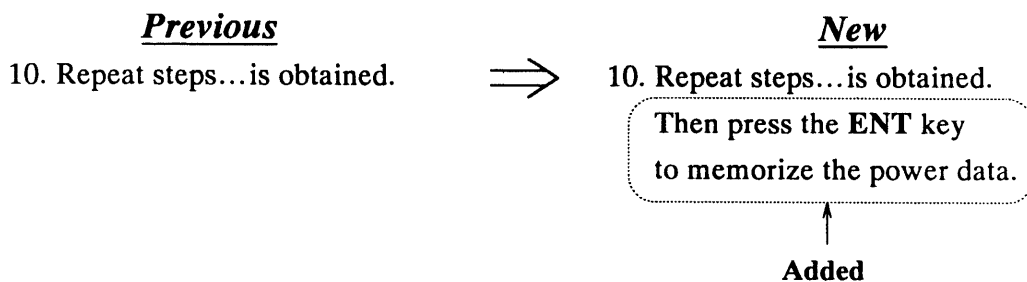
#### 1. Amendment

Please amend the following pages of the Service Manual.

##### (1) Page AP2-8



##### (2) Page AP2-9



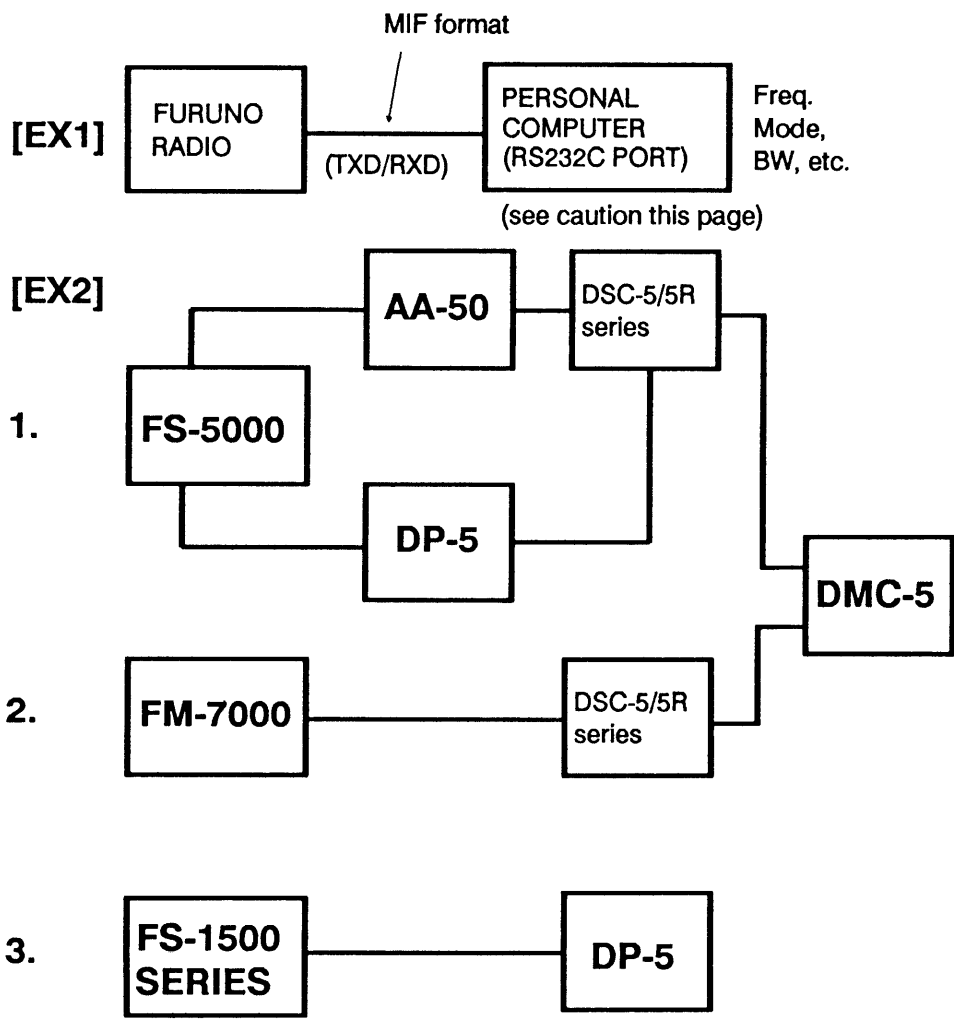
#### 2. Addition of MIF description

We use MIF (Furuno Radio Interface), a handshaking type signal exchange system using TXD and RXD, for remote operation. Refer to the next page.

# MIF FORMAT

MIF is a handshaking type signal exchange system developed by FURUNO for remote control of newly developed FURUNO radio equipment; for example, DP-5, FS-5000, FS-8000, DSC-5 and others.

## Example for interconnection



\* All data are communicated in MIF format.

**CAUTION**

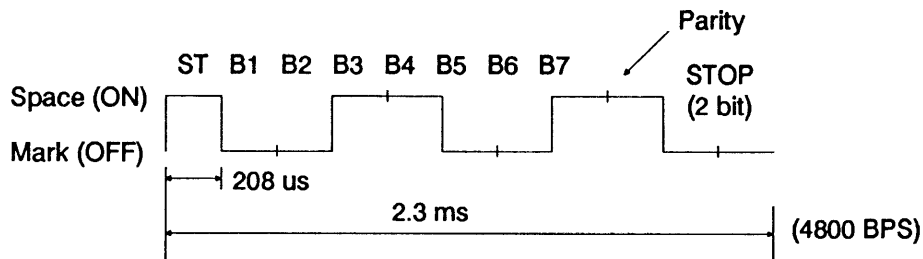
Furuno will assume no responsibility for the inconvenience/disturbance to communications or unlawful emission due to inadequate command from personal computer.

# SPECIFICATION OF MIF

1. Communication System: Serial asynchronous (half-duplex)

2. Baud Rate: 4800 BPS standard  
(1200/2400/9600 BPS selectable)

3. Character Format



[	Start	:	1 bit	]	
	Data	:	7 bit		
	(B1 to B7)				
	Parity	:	1 bit (Even)		
	Stop	:	2 bit		
					-----> 11 bit

4. Signal Level (RS-232C compatible, except FM-7000)

Name	Space	Mark
Logic	0 (ON)	1 (OFF)
Output	+ 5 to + 15 V	- 15 to - 5 V
Input	≥ 3 V	≤ - 3 V

\* FM-7000 ----- Current Loop ( $\pm 20$  mA)

## 5. Pin Arrangement (except FM-7000) (DTE: Data Terminal Equipment)

Pin No.	Name	Function	Signal Logic	
			Positive Voltage	Negative Voltage
1	FG	Frame Ground	—	—
2	TXD	Transmission Data	Space (0)	Mark (1)
3	RXD	Reception Data	Space (0)	Mark (1)
4	RTS (Not used)	Request to Send	Valid	Invalid
5	CTS (Not used)	Clear to Send	—	—
6	DSR (Not used)	Data Set Ready	Valid	Invalid
7	SG	Signal Ground	—	—
20	DTR (Not used)	Data Transmit Ready	Valid	Invalid

Jumper wire required → (pins 4, 5, 6, 7, 20)

* FM-7000	Pin No.	Name
	1	TXD (H)
	2	TXD (C)
	3	RXD (H)
	4	RXD (C)
	5	FG
	9	SG

## 6. Command Input: ASCII code, Alphanumerals (Alphabet: 2 digits, numeral: more than 1 digit) End of Data ----- CR, LF or CR

### Example

F R 1 2 3 4 5 6 7 CR (,LF)  
 ↑            ↑  
 Command ID    Data (Parameter)

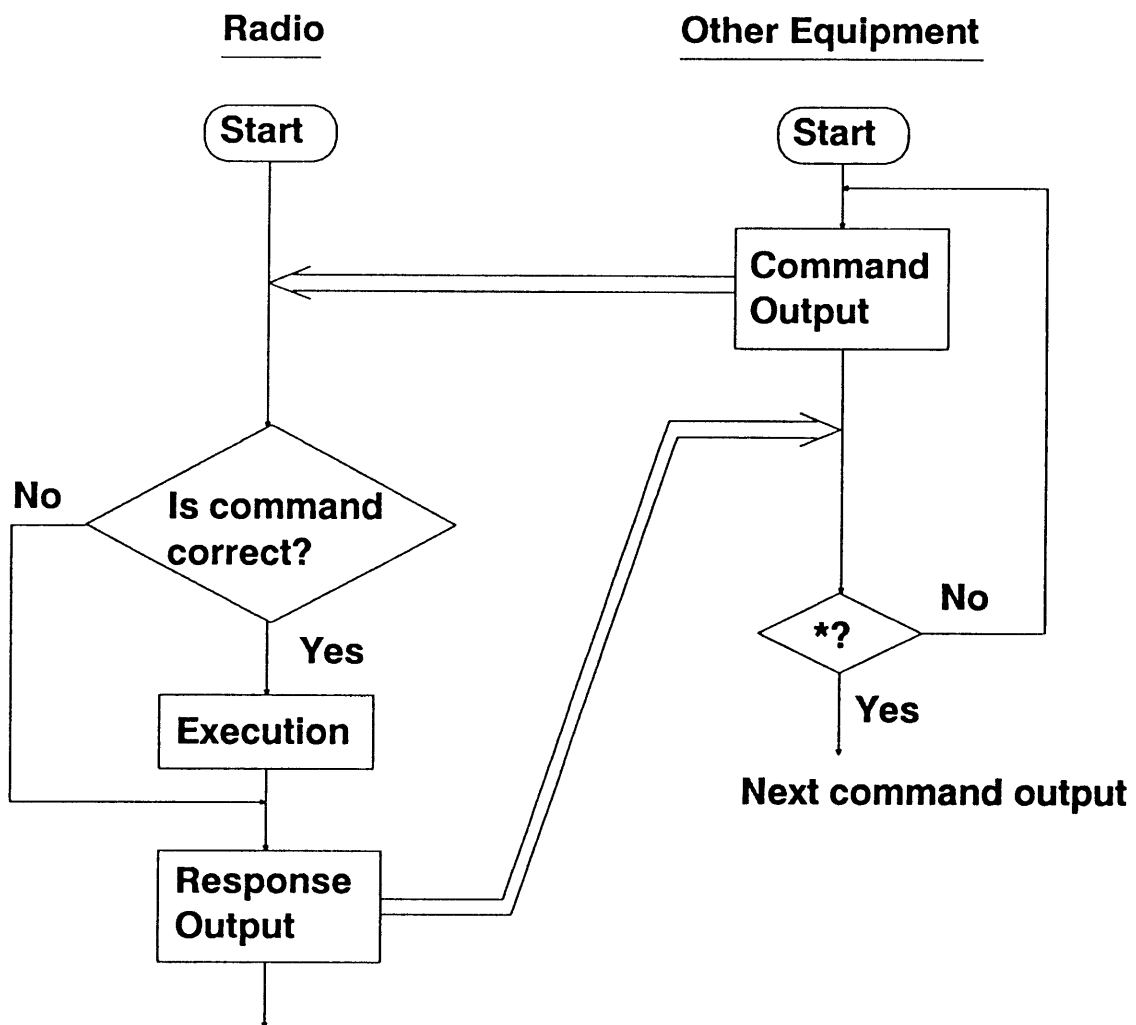
### 7. Response Output

1 \* CR (LF) ----- When the command is correctly executed.

2 ? CR (LF) ----- When incorrect command is input, or error takes place during execution of the command.

Time out: 1 sec.

Retry: 3 times (60 sec only for tune command ("TU"))



## 8. Command Tables

The command tables show the function and valid parameter for each command. Note that some commands may not be valid depending on transceiver/transmitter/receiver connected.

Control	Command	Parameter														
TRANSMISSION FREQUENCY	FT	6 digits/7 digits (last unit must be 10 Hz place)  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> <td style="text-align: center;">5</td> <td style="text-align: center;">6</td> <td style="text-align: center;">7</td> </tr> <tr> <td style="text-align: center;">10 MHz</td> <td style="text-align: center;">1 MHz</td> <td></td> <td></td> <td style="text-align: center;">1 kHz</td> <td></td> <td style="text-align: center;">10 Hz</td> </tr> </table>	1	2	3	4	5	6	7	10 MHz	1 MHz			1 kHz		10 Hz
1	2	3	4	5	6	7										
10 MHz	1 MHz			1 kHz		10 Hz										
RECEPTION FREQUENCY	FR	same as above														
CLASS OF EMISSION	EM	0 to 6 : 1 digit  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0: LSB</td> <td style="text-align: center;">4: CW</td> </tr> <tr> <td style="text-align: center;">1: USB</td> <td style="text-align: center;">5: FSK (TELEX)</td> </tr> <tr> <td style="text-align: center;">2: AM</td> <td style="text-align: center;">6: FAX</td> </tr> <tr> <td style="text-align: center;">3: R3E</td> <td></td> </tr> </table> A1A : 3 digits For USB, enter "J3E".	0: LSB	4: CW	1: USB	5: FSK (TELEX)	2: AM	6: FAX	3: R3E							
0: LSB	4: CW															
1: USB	5: FSK (TELEX)															
2: AM	6: FAX															
3: R3E																
BANDWIDTH	BW	0 to 7 : 1 digit  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0: W-FM (25 kHz)</td> <td style="text-align: center;">4: FSK (1kHz)</td> </tr> <tr> <td style="text-align: center;">1: FM (16 kHz)</td> <td style="text-align: center;">5: N-CW (0.5 kHz)</td> </tr> <tr> <td style="text-align: center;">2: AM (6 kHz)</td> <td style="text-align: center;">6: N-CW (0.3 kHz)</td> </tr> <tr> <td style="text-align: center;">3: SSB (3 kHz)</td> <td style="text-align: center;">7: VERY-N (0.2 kHz)</td> </tr> </table> 030 : 3 digits (10 kHz, 1 kHz, 100 Hz places)	0: W-FM (25 kHz)	4: FSK (1kHz)	1: FM (16 kHz)	5: N-CW (0.5 kHz)	2: AM (6 kHz)	6: N-CW (0.3 kHz)	3: SSB (3 kHz)	7: VERY-N (0.2 kHz)						
0: W-FM (25 kHz)	4: FSK (1kHz)															
1: FM (16 kHz)	5: N-CW (0.5 kHz)															
2: AM (6 kHz)	6: N-CW (0.3 kHz)															
3: SSB (3 kHz)	7: VERY-N (0.2 kHz)															
AGC	AG	S : 1 digit  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0: AGC OFF</td> <td style="text-align: center;">S: AGC ON</td> </tr> <tr> <td style="text-align: center;">1: AGC ON (SLOW)</td> <td style="text-align: center;">R: AGC OFF</td> </tr> <tr> <td style="text-align: center;">2: AGC ON (FAST)</td> <td></td> </tr> <tr> <td style="text-align: center;">3: AGC ON (MID)</td> <td></td> </tr> </table>	0: AGC OFF	S: AGC ON	1: AGC ON (SLOW)	R: AGC OFF	2: AGC ON (FAST)		3: AGC ON (MID)							
0: AGC OFF	S: AGC ON															
1: AGC ON (SLOW)	R: AGC OFF															
2: AGC ON (FAST)																
3: AGC ON (MID)																
BFO	BF	+ 0 8 0 0 : 5 digits (+/-, 1kHz, 100 Hz, 10 Hz, 1 Hz)  S : 1 digit  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">S: BFO ON</td> <td style="text-align: center;">U: BFO UP</td> </tr> <tr> <td style="text-align: center;">R: BFO OFF</td> <td style="text-align: center;">D: BFO DOWN</td> </tr> </table>	S: BFO ON	U: BFO UP	R: BFO OFF	D: BFO DOWN										
S: BFO ON	U: BFO UP															
R: BFO OFF	D: BFO DOWN															
CLARIFIER	CL	+ 0 1 0 0 : 5 digits (+/-, 1kHz, 100 Hz, 10 Hz, 1 Hz)  S : 1 digit  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">S: Clarifier ON</td> <td style="text-align: center;">U: Clarifier UP</td> </tr> <tr> <td style="text-align: center;">R: Clarifier OFF</td> <td style="text-align: center;">D: Clarifier DOWN</td> </tr> </table>	S: Clarifier ON	U: Clarifier UP	R: Clarifier OFF	D: Clarifier DOWN										
S: Clarifier ON	U: Clarifier UP															
R: Clarifier OFF	D: Clarifier DOWN															

continued

Control	Command	Parameter
SQUELCH	SQ	10 : 2 digits  To adjust squelch threshold, enter hexadecimal code; FF provides tightest squelch.  S : 1 digit  S: Squelch ON R: Squelch OFF
NOISE BLANKER	NB	S : 1 digit  S: Noise Blanker ON R: Noise Blanker OFF  10 : 2 digits  To adjust sensitivity of noise blanker, enter hexadecimal code (00-FF); FF is highest threshold.
SPEAKER CONTROL	SP	S : 1 digit  S: Speaker ON R: Speaker OFF
MUTE	MU	S : 1 digit  S: Mute ON R: Mute OFF
BK	BK	S : 1 digit  S: BK ON R: BK OFF
TX	TX	S : 1 digit  S: TX ON R: TX OFF
EXCITER	EX	S : 1 digit  S: Exciter ON R: Exciter OFF
TUNING	TU	No fixed parameter (Time out: 15 sec)
SPEAKER VOLUME	AF	U : 1 digit  U: Increase Volume D: Decrease Volume  10 : 2 digits  Enter hexadecimal code (00-FF); FF for maximum volume
SENSITIVITY	RF	U : 1 digit, same as "speaker volume"  10 : 2 digits, same as speaker volume.

continued

Control	Command	Parameter
DIMMER	DI	S : 1 digit S: Dimmer ON U: Brighten R: Dimmer OFF D: Dim 0 F : 2 digits Enter hexadecimal code (00-FF); FF for maximum brightness.
RF POWER	PO	0 to 3 : 1 digit 3: Full Power 1: Low Power 2: Mid Power 0: Zero Power 1 0 : 2 digits Enter hexadecimal code (00-FF); FF for maximum RF power.
RAISE FREQUENCY, CHANNEL	UP	0 to 7 : 1 digit 0: Raise Channel by one 4: Raise Freq. by 10 kHz 1: Raise Freq. by 10 Hz 5: Raise Freq. by 100 kHz 2: Raise Freq. by 100 Hz 6: Raise Freq. by 1 MHz 3: Raise Freq. by 1 kHz 7: Raise Freq. by 10 MHz
LOWER FREQUENCY, CHANNEL	DN	1 : 1 digit Same as above
CHANNEL NUMBER	CH	0001 : 4 digits --- retain current channel number. U001 : 4 digits --- U (W, N or P) + 3 digit ch. No. [U: USA, W: Weather, N: International, P: Private] PF01 : 4 digits --- PX + 2 digit ch. No. [X: F, P, L or M] G0101 : 5 digits --- G + 2 digit group No. + 2 digit ch. No. (for group ch.) I01001 : 6 digits --- I + 2 digit band No. + 3 digit ch. No. (for ITU ch.)
WRITE TO MEMORY	ST	Same as for channel number
RECALL FROM MEMORY	RC	Same as for channel number
FSK SHIFT WIDTH	FS	0 to 2 : 1 digit 0: 850 Hz 1: 425 Hz 2: 170 Hz 850 : 3 digits (desired width in Hz)
DUPLEX, SIMPLEX	DU	S : 1 digit S: Duplex ON 0: Full Duplex R: Duplex OFF 1: Semi Duplex 2: Simplex
FREQUENCY SCANNING	SC	S : 1 digit S: Start R: Stop

continued

Control	Command	Parameter
SCAN MODE	SM	1 to 4 : 1 digit  1: Scan Channel 2: Group Scan 3: Frequency Scan 4: Sweep
DATE	DT	10 digits:  <u>Example: March 20, 1991</u>  <u>1</u> <u>9</u> <u>9</u> <u>1</u> / <u>0</u> <u>3</u> / <u>2</u> <u>0</u> Year Month Day
TIME OF DAY	TI	8 digits:  <u>Example: 13:25:30</u>  <u>1</u> <u>3</u> / <u>2</u> <u>5</u> / <u>3</u> <u>0</u> Hour Minute Second
TIMER START & STOP	TS	S: :1 digit  S: Start R: Stop
WAKE-UP TIMER	TM	1 to 4 : 1 digit  1: Timer 1 2: Timer 2 3: Timer 3 4: Timer 4
TIMER ON & OFF SETTING	TP	as desired
ATTENUATION ON & OFF	AT	S: :1 digit  S: Receiver front end attenuator ON R: Receiver front end attenuator OFF
BAND	BA	1 : 1 digit  0: BAND 0 ? F: BAND 15
FILTER SETTING	FL	1 : 1 digit  0: FILTER 0 ? F: FILTER 15
SWITCH SETTING	SW	1 S : 2 digits  0S: SW 0 ON 0R: SW 0 OFF ? FS: SW 15 ON FR: SW 15 OFF

continued

Control	Command	Parameter
TRANSCEIVER CONDITION	CA	FT : 2 digits  Type CA followed by desired command.  Example: To show current receive frequency, enter CAFR.
TRANSCEIVER MODEL NAME	CA	ID : 2 digits  Example # ID FS5000
S-METER LEVEL	CA	SL : 2 digits  Example # SLOF (OF = hexadecimal)
OPERATION LOCK	FZ	S : 1 digit  S: Prevents operation of the transceiver. R: Releases the transceiver.
DISTRESS TRANSMISSION	DR	S : Start distress R : Stop distress
SELCALL TRANSMISSION	SE	S (ID CODE):  S: Own Station ID setting G: Group ID setting C: Selcall Transmission
AUTOMATIC PUBLIC TELEPHONE DIALING	TL	Telephone Number  Example: <u>TL</u> <u>0798</u> <u>65</u> <u>2111</u>  Command        Parameter
INTERCOM	IC	1 digit Intercom Number, or S or R:  If calling from a controller, command and parameter are transmitted.  <u>IC</u> <u>3</u> <u>S</u>  Command                                  S: Intercom ON R: Intercom OFF
RESET	RE	No parameters required. SSB generates "RE" command when it turns on, to try to receive again the command sent previously.
OPTION	OP	Unique command for an equipment. ex: OP FR xxxxxxxxxxxx  } 10 digits

Note: For FS-5000 (8000) and FM-7000 radiotelephones, the following commands are available.

FS-5000(8000)  
 { FT/FR/EM (0 to 6)/BW/TU/CH/ST/R/C/ }  
 { FZ/DR/RE/TX/CAFT/CAFR/CAID/ }  
 { CAEM/CASL/CASQ/CABF, etc. }  
 }

FM-7000  
 { CH/DU/FZ/DR/RE/ }  
 { CACH/CAID, etc. }  
 }

# FURUNO

## Information

NO. : FQ 5-92-009 <sup>1/3</sup>

Date : 1992 - 4

Issued by : FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

Addenda No. 16 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 Improvement of Duplex Communication

To reduce transmission noise in duplex communication, the EXC and RX boards have been modified for the sets having the serial numbers shown below. Refer to new schematic diagrams attached.

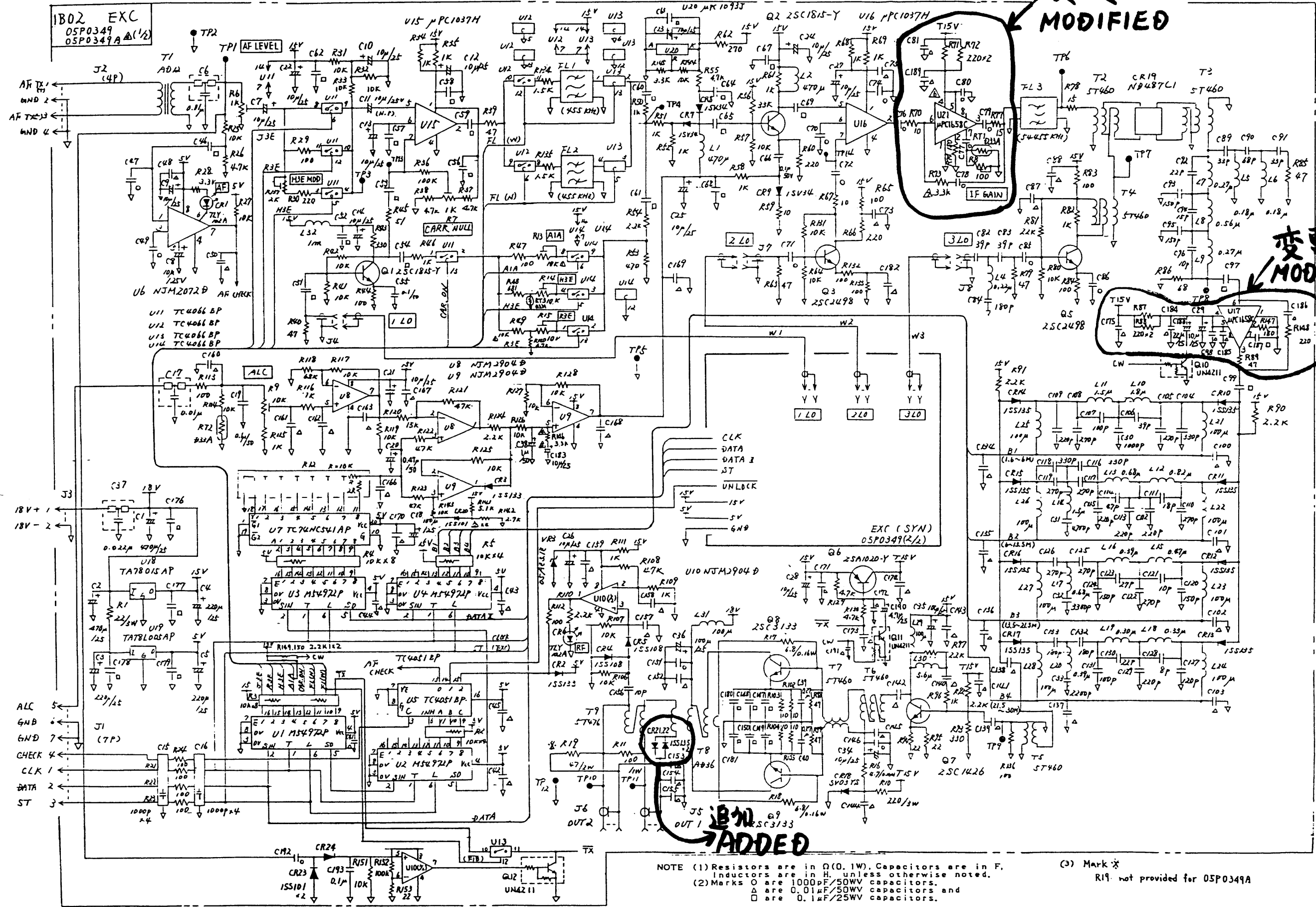
Model	Serial No.
FS-5000	2908-0225 to 0227, 0303 and after
FS-8000	2522-0041 and after

This modification improves duplex communication quality provided the receiving antenna is separated at least 5 meters from the transmitting antenna. (Of course, it is better to install the receiving antenna far away from the transmitting antenna.)

To reduce transmission noise, we recommend setting AGC and NB (Noise Blanker) to FAST and ON, respectively.

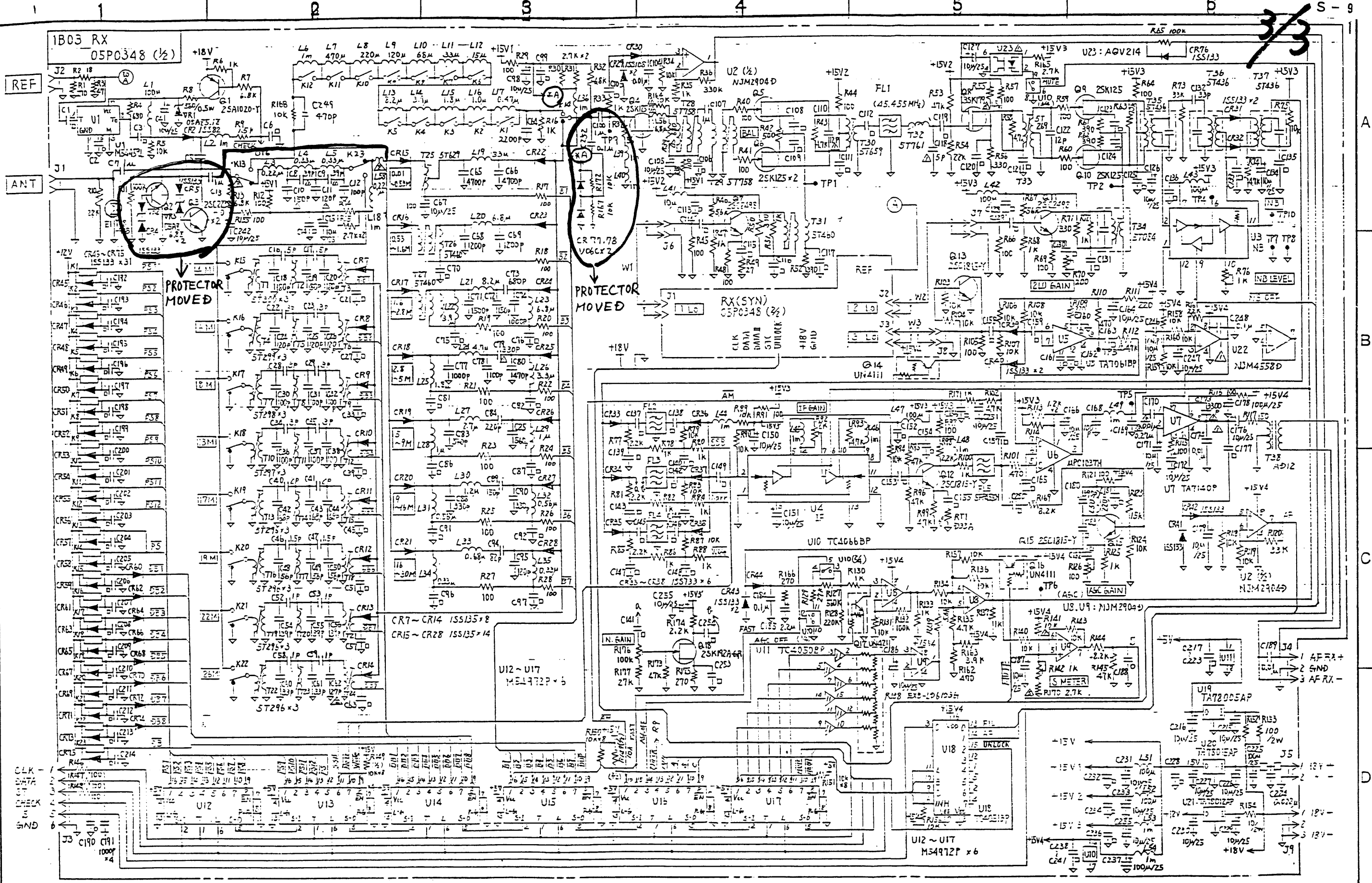
変更  
MODIFIED

変更  
MODIFIED



NOTE (1) Resistors are in  $\Omega$  (0.1W). Capacitors are in F. Inductors are in H, unless otherwise noted.  
 (2) Marks  $\Delta$  are 1000pF/50WV capacitors.  $\triangle$  are 0.01 $\mu$ F/50WV capacitors and  $\square$  are 0.1 $\mu$ F/25WV capacitors.  
 (3) Mark \* R19, not provided for 05P0349A

主機種	FS-5000	コード		SHEET NO.	1/2
課長	検図	設計	製図	TITLE	1B02 (1/2) EXC (TRANSCIVER UNIT)
				FIG. No.	C5519-K09-D



Note. 1) Marks 0 are 1000 PF 50WV Capacitors.  
 2) Marks Δ are 0.01μF 50WV Capacitors.  
 3) Marks Ⓜ are 0.1μF 25WV Capacitors.  
 4) Resistors are in Ω (0.1w), Capacitors are in F, Inductors are in H, unless otherwise noted.

機種種	FS-5000	コード		SHEET NO.	1/2
課長	検	設計	製	TITLE	1B03 (1/2) RX (TRANSCIEVER UNIT)
				DWG. No.	C5519-K02-D

# FURUNO

## Information

NO. : FQ5-92-010

Date : 1992 - 4

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QUALITY ASSURANCE DEPARTMENT

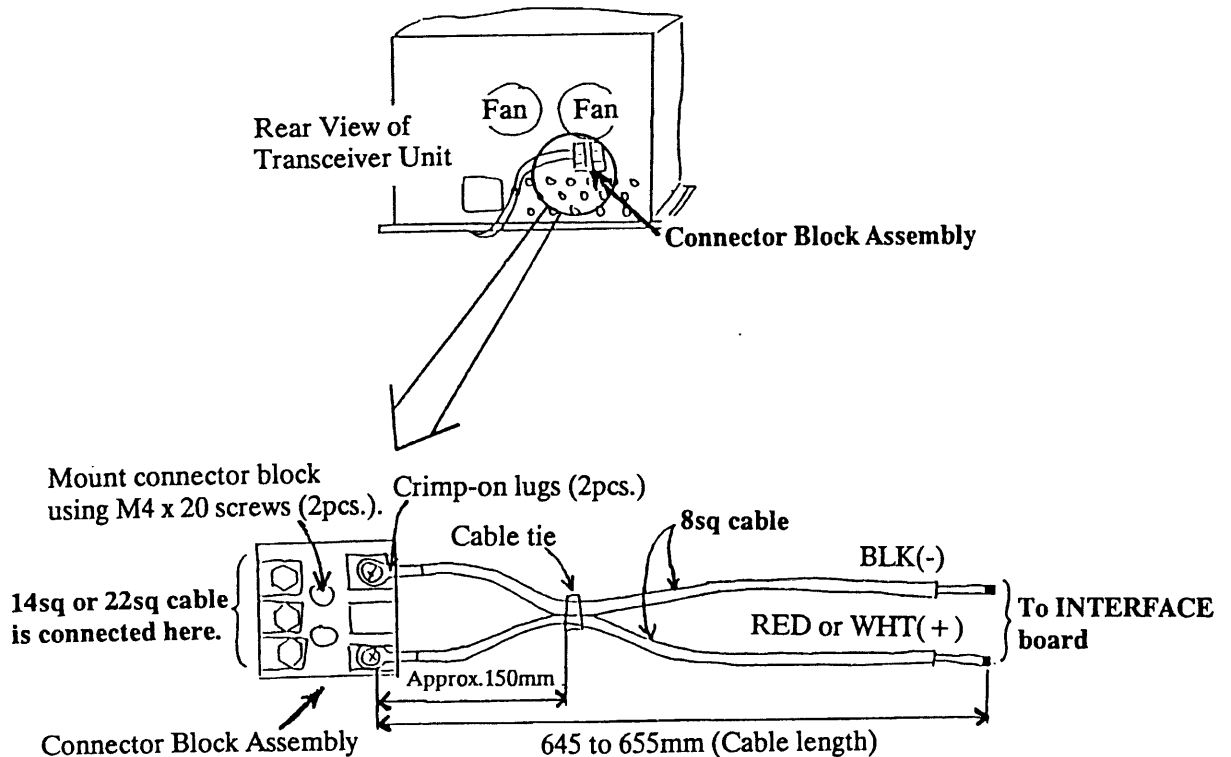
Addenda No. 17 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 Optional Supply of Connector Block Assembly (Terminal Board for power cable)

If the 14sq or 22sq power cable is used instead of the 8sq cable, it can not be connected to the power terminals, whose diameters are for 8sq cable, on the INTERFACE board in the transceiver unit.

To solve this problem, the connector block assembly is optionally supplied. The assembly mounts on the rear panel of the transceiver unit as shown below.

Name	Type	Code No.	Remarks
Connector Block Assembly	OP05-49	005-841-200	For FS-5000
	OP05-48	005-841-190	For FS-8000



# FURUNO

## Information

NO. : FQ5-92-011 <sup>1/6</sup>

Date : 1992 - 4

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QUALITY ASSURANCE DEPARTMENT

Addenda No. 18 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 ROM Program Change (Ver. 10)

The program version of the ROMs on the control and transceiver units has been changed to "10" from March 1992.

#### Version 8 → 9

##### 1. Contents of Modification

① Highest Priority of Distress Command ("DRS")

The "DRS" (Distress Set) command has the highest priority in the MIF data protocol.

The FS-5000/8000 accepts the "DRS" command from the DSC terminal to transmit a distress alert, even while transmitting.

② TX ON Command (TXS, TXR) added.

③ Frequency on DSC channel 9 amended. (5389kHz → 5380kHz)

#### Version 9 → 10

##### 1. Contents of Modification

① Additional System Settings (See next page.)

([STO] → Channel No. → [ENT])

Channel No.	LCD Display	Description									
9947	SQ on Telex [0-Def, 1-OFF]	The "1" setting automatically turns off the SQ (if ON) when class of emission is changed to TELEX. (Note that AF signal to DP-5 is not passed through squelch circuit, so this setting is normally not necessary for DP-5 connection.)									
9948	NB on Telex [0-Def, 1-OFF]	The "1" setting automatically turns off the NB (if ON) when class of emission is changed to TELEX.									
9949	AGC on Telex [0-Def, 1-FAST]	The "1" setting sets AGC to FAST when class of emission is changed to TELEX.									
9950	Duplex on Telex [0-Def, 1-OFF]	The "1" setting inhibits DUPLEX mode (unnecessary on TELEX) when class of emission is changed to TELEX.									
9961	ITU Freq. Table [0-INT, 1-USA, 2-EU]	MF band ITU frequency list added. (at [2-EU] selection)									
9980	Country Code [44] (Enter numerals.)	Returns to default setting depending on country. See the next page.									
9981	Dummy Load [0-NO, 1-YES]	Determines the functions of both 9911 and 9923 as follows: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>9981</th> <th>[0] NO</th> <th>[1] YES</th> </tr> </thead> <tbody> <tr> <td>9911 : Alarm</td> <td>0-Receive</td> <td>1-Transmit</td> </tr> <tr> <td>9923 : Dummy</td> <td>1-Inhibit</td> <td>0-Enable</td> </tr> </tbody> </table>	9981	[0] NO	[1] YES	9911 : Alarm	0-Receive	1-Transmit	9923 : Dummy	1-Inhibit	0-Enable
9981	[0] NO	[1] YES									
9911 : Alarm	0-Receive	1-Transmit									
9923 : Dummy	1-Inhibit	0-Enable									
9982	A. BK relay or R. ANT [0-NO, 1-YES]	Determines the functions of both 9913 and 9917 as follows: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>9982</th> <th>[0] NO</th> <th>[1] YES</th> </tr> </thead> <tbody> <tr> <td>9913 : System Delay</td> <td>30ms</td> <td>10ms</td> </tr> <tr> <td>9917 : 50 ohm BK Relay</td> <td>0-on/off</td> <td>1-Permanently on (fixed)</td> </tr> </tbody> </table>	9982	[0] NO	[1] YES	9913 : System Delay	30ms	10ms	9917 : 50 ohm BK Relay	0-on/off	1-Permanently on (fixed)
9982	[0] NO	[1] YES									
9913 : System Delay	30ms	10ms									
9917 : 50 ohm BK Relay	0-on/off	1-Permanently on (fixed)									
9989	Power setting for [1-EU, 2-NOR]	Setting of power data. <u>"EU" (Europe)</u> <span style="float: right;"><u>Power data</u></span> 1.6~2.5MHz : FS-5000 ..... 225 FS-8000 ..... 160 <u>"NOR" (Norway)</u> <span style="float: right;"><u>Power data</u></span> 1.6~2.5MHz : FS-5000 only ... 200 2.5~4.0MHz : FS-5000 only ... 210 4.0~30 MHz : FS-5000 only ... 225									

Setting Number	Function	Default 0	Country Code					Result of selection
			Japan 81	USA 1	Europe 44	Norway 47	Holland 31	
9901	TX freq. selection	0				3		Marine
9903	TX o/p on MF band	0	2	1				50/150
9904	Class of emission on 2182 KHz	0		1				J3E
9907	Time display format	0		1	2	2	2	USA/EU
9910	Check meter numerics	0	1					
9913	System delay	30				10		
9917	50 ohm BK relay	0				1		on
9923	Dummy load	0	1	1	1	1	1	off
9926	Test tone	0		1	1	1	1	off
9927	Power reduction enable	0		1	1	1	1	2182
9928	Min o/p power	0		1	1	1	1	more than 60w
9947	SQ on TLX	0					1	off
9948	NB on TLX	0					1	off
9949	AGC FAST on TLX	0					1	FAST
9950	DUPLEX on TLX	0					1	Inhibit
9953	AM Operation	0		3	3	3	3	2182
9954	R3E Operation	0	1		1	1	1	RX
9955	FAX Operation	0	1		1	1	1	RX
9956	LSB Operation	0	1		1	1	1	RX
9961	ITU Freq. Table	0		1	2	2	2	USA/EU

Note: Where no data appears, default setting applies.

② Default Setting of System Delay for FS-8000 : 10ms

③ ITU Frequency Table and class of Emission

For previous software, if an operator changes class of emission after entering an ITU channel number, the channel did not change; only the class of emission changed. Now, the channel changes to the one corresponding to the class of emission selected.

(e.g.) Enter ITU401(SSB). → Change class of emission to TELEX. → Frequency changes to ITU4001.

④ Reduction ratio of power data is incorrectly published as decreasing in steps of 50.

55 is correct

<u>LCD display</u>	<u>Power data</u>	
Full	255	} -55
LOW1	200	
LOW2	145	} -55

⑤ MIF data (except for distress command “DRS” from DSC terminal) is ignored when both TX and RX frequencies are set at 2182kHz.

## 2. Factory Modification

Model	Serial Number
FS-5000	2508-0367 and after
FS-8000	2522-0046 and after

## 3. ROM Code Number

Type	Code No.
ROM05-501-31-110	005-927-440

## MF BAND ITU TELEX FREQUENCY TABLE

Channel No.	Coast station (NBDP) (DSC) (kHz)	Ship station (NBDP) (DSC) (kHz)
201	1607	2142
202	1607.5	2142.5
203	1608	2143
204	1608.5	2143.5
205	1609	2144
206	1609.5	2144.5
207	1610	2145
208	1610.5	2145.5
209	1611	2146
210	1611.5	2146.5
211	1612	2147
212	1612.5	2147.5
213	1613	2148
214	1613.5	2148.5
215	1614	2149
216	1614.5	2149.5
217	1615	2150
218	1615.5	2150.5
219	1616	2151
220	1616.5	2151.5
221	1617	2152
222	1617.5	2152.5
223	1618	2153
224	1618.5	2153.5
225	1619	2154
226	1619.5	2154.5
227	1620	2155
228	1620.5	2155.5
229	1621	2156
230	1621.5	2156.5
231	1622	2157
232	1622.5	2157.5
233	1623	2158
234	1623.5	2158.5
235	1624	2159
236	1624.5	2159.5

## MF BAND ITU SSB FREQUENCY TABLE

Channel No.	Coast station assigned frequency (kHz)	Ship station assigned frequency (kHz)	Channel No.	Coast station assigned frequency (kHz)	Ship station assigned frequency (kHz)
241	1636.4 (1635)	2061.4 (2060)	271	1726.4 (1725)	2070.4 (2069)
242	1639.4 (1638)	2064.4 (2063)	272	1729.4 (1728)	2073.4 (2072)
243	1642.4 (1641)	2067.4 (2066)	273	1732.4 (1731)	2076.4 (2075)
244	1645.4 (1644)	2070.4 (2069)	274	1735.4 (1734)	2079.4 (2078)
245	1648.4 (1647)	2073.4 (2072)	275	1738.4 (1737)	2082.4 (2081)
246	1651.4 (1650)	2076.4 (2075)	276	1741.4 (1740)	2085.4 (2084)
247	1654.4 (1653)	2079.4 (2078)	277	1744.4 (1743)	2088.4 (2087)
248	1657.4 (1656)	2082.4 (2081)	278	1747.4 (1746)	2091.4 (2090)
249	1660.4 (1659)	2085.4 (2084)	279	1750.4 (1749)	2094.4 (2093)
250	1663.4 (1662)	2088.4 (2087)	280	1753.4 (1752)	2097.4 (2096)
251	1666.4 (1665)	2091.4 (2090)	281	1756.4 (1755)	2100.4 (2099)
252	1669.4 (1668)	2094.4 (2093)	282	1759.4 (1758)	2103.4 (2102)
253	1672.4 (1671)	2097.4 (2096)	283	1762.4 (1761)	2106.4 (2105)
254	1675.4 (1674)	2100.4 (2099)	284	1765.4 (1764)	2109.4 (2108)
255	1678.4 (1677)	2103.4 (2102)	285	1768.4 (1767)	2112.4 (2111)
256	1681.4 (1680)	2106.4 (2105)	286	1771.4 (1770)	2115.4 (2114)
257	1684.4 (1683)	2109.4 (2108)	287	1774.4 (1773)	2118.4 (2117)
258	1687.4 (1686)	2112.4 (2111)	288	1777.4 (1776)	2121.4 (2120)
259	1690.4 (1689)	2115.4 (2114)	289	1780.4 (1779)	2124.4 (2123)
260	1693.4 (1692)	2118.4 (2117)	290	1783.4 (1782)	2127.4 (2126)
261	1696.4 (1695)	2121.4 (2120)	291	1786.4 (1785)	2130.4 (2129)
262	1699.4 (1698)	2124.4 (2123)	292	1789.4 (1788)	2133.4 (2132)
263	1702.4 (1701)	2127.4 (2126)	293	1792.4 (1791)	2136.4 (2135)
264	1705.4 (1704)	2130.4 (2129)	294	1795.4 (1794)	2139.4 (2138)
265	1708.4 (1707)	2133.4 (2132)	295	1798.4 (1797)	2061.4 (2060)
266	1711.4 (1710)	2136.4 (2135)			
267	1714.4 (1713)	2139.4 (2138)			
268	1717.4 (1716)	2061.4 (2060)			
269	1720.4 (1719)	2064.4 (2063)			
270	1723.4 (1722)	2067.4 (2066)			

( ): CARRIER FREQUENCY

# FURUNO

## Information

NO. : FQ5-92-005 1/2

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QUALITY ASSURANCE DEPARTMENT

Addenda No. 19 to Service Manual of FS-5000 SM-E5519.

### FS-5000/8000 System Setting for Connection to NBDP

#### FS-5000

1. In case that a receiving antenna or ANT BK RELAY board is installed.

(1) System setting of FS-5000

50 ohm BK relay and TX delay time should be set to "ON" (fixed) and 10 ms, respectively.

STO 9982 ENT 1 ENT

(2) System setting of NBDP

① When DP-5 is connected ("Terminal" menu setting)

Slave Delay	:	4ms
BK Timing Pre tone	:	10ms
Post tone	:	0ms
Mute Timing Pre BK	:	0ms
Post BK	:	0ms

② When TT-1600 is connected

Receiver Post Mut	:	0×1.25ms
Transmitter Pre Key	:	8×1.25ms
Transmitter Post Key	:	0×1.25ms
Slave Delay	:	8×1.25ms

2. In case that 50 ohm BK relay is used.

(1) System setting of FS-5000

50 ohm BK relay and TX delay time should be set to "ON/OFF" and 30 ms, respectively.

**STO 9982 ENT 0 ENT**

(2) System setting of NBDP

① When DP-5 is connected

Slave Delay	:	30ms
BK Timing Pre tone	:	30ms
Post tone	:	0ms
Mute Timing Pre BK	:	0ms
Post BK	:	0ms

② When TT-1600 is connected

Receiver Post Mute	:	0×1.25ms
Transmitter Pre Key	:	24×1.25ms
Transmitter Post Key	:	0×1.25ms
Slave Delay	:	24×1.25ms

## **FS-8000**

(1) System setting of FS-8000

TX delay time should be set to 10ms.

**STO 9913 ENT 10 ENT**

(2) System setting of NBDP

① When DP-5 is connected ("Terminal" menu setting)

Slave Delay	:	4ms
BK Timing Pre tone	:	10ms
Post tone	:	0ms
Mute Timing Pre BK	:	0ms
Post BK	:	0ms

② When TT-1600 is connected

Receiver Post Mute	:	0×1.25ms
Transmitter Pre Key	:	8×1.25ms
Transmitter Post Key	:	0×1.25ms
Slave Delay	:	8×1.25ms

# FURUNO

## Information

NO. : FQ5-92-013 1/7

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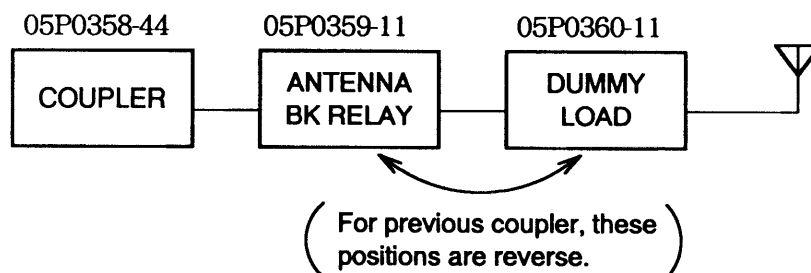
Addenda No. 20 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000 New Antenna Coupler

The Antenna Coupler AT-5000 has been modified to withstand a higher voltage on MF band (induced by a short antenna). Production of new coupler starts in May 1992. A heavy duty type stainless steel coupler is optionally available, for preventing icing, etc.

The following are the changes incorporated in the new coupler.

1. In the tuning circuit, voltage tolerance and capacitance of each element are remarkably increased. The COUPLER board is completely changed. Note that a new COUPLER board (05P0358-44) is interchangeable with a previous one (05P0358-33).
2. Antenna tuning sequence is changed. Refer to attached sheet.
3. A shortening capacitor and coupling capacitor (shunt capacitor) are automatically connected according to antenna length.
4. Memory device to store tuning data is changed from a RAM to a E<sup>2</sup>PROM, to store the data permanently.
5. CPU is changed. (ROM/RAM/AD converter incorporated)
6. DUMMY LOAD and ANT BK RELAY boards are modified to withstand a higher voltage. (Both boards can be used in a previous version antenna coupler; but both previous boards can not be used in a new coupler.)
7. Interconnection of COUPLER, DUMMY LOAD and ANT BK RELAY boards is changed.



8. Arrester gap is changed to 3mm.

9. Fixing method of coaxial cable is changed. (Two cable clamps are supplied.)

**Types of New Antenna Coupler, Dummy Load PCB Assy. and Antenna BK Relay PCB Assy.**

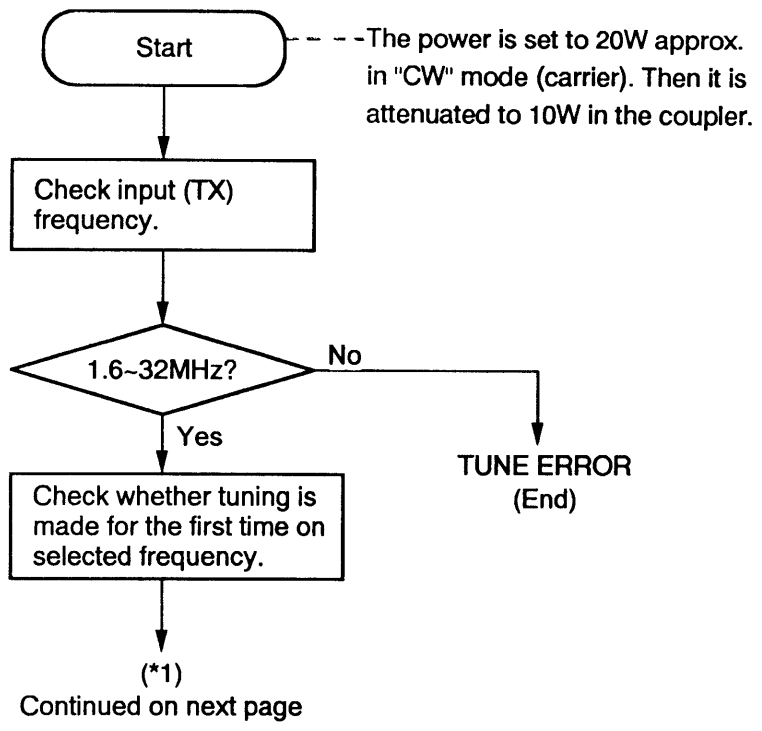
	New Antenna Coupler	Dummy Load PCB Assy.	Antenna BK Relay PCB Assy.
Type	AT-5000-H (Plastic)	OP05-34-H (for plastic antenna coupler)	OP05-35-H
	AT-5000-HS (Stainless Steel)	OP05-51-H...Note 1 (for stainless steel antenna coupler)	

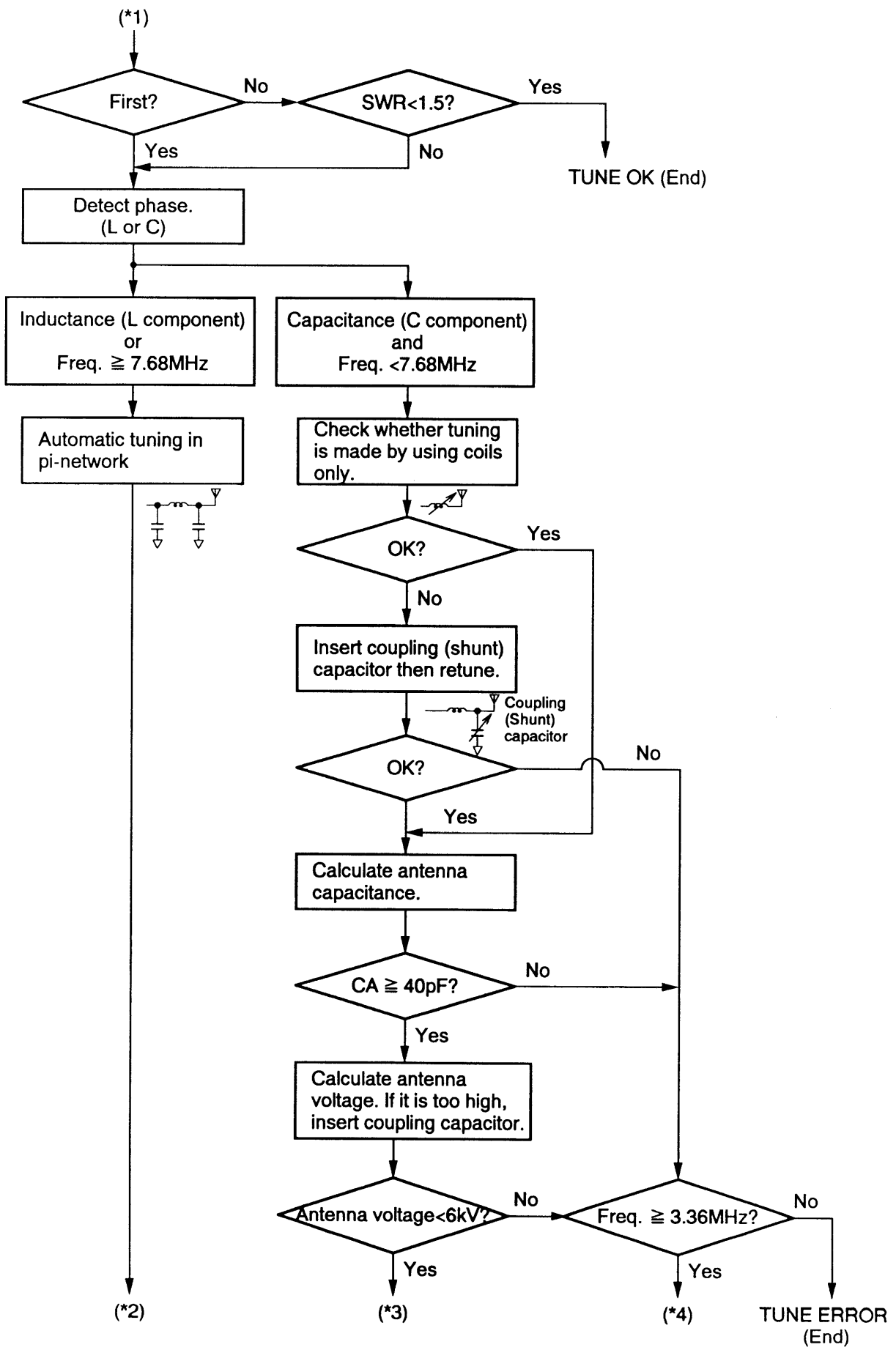
Note 1: Fixing screws are different.

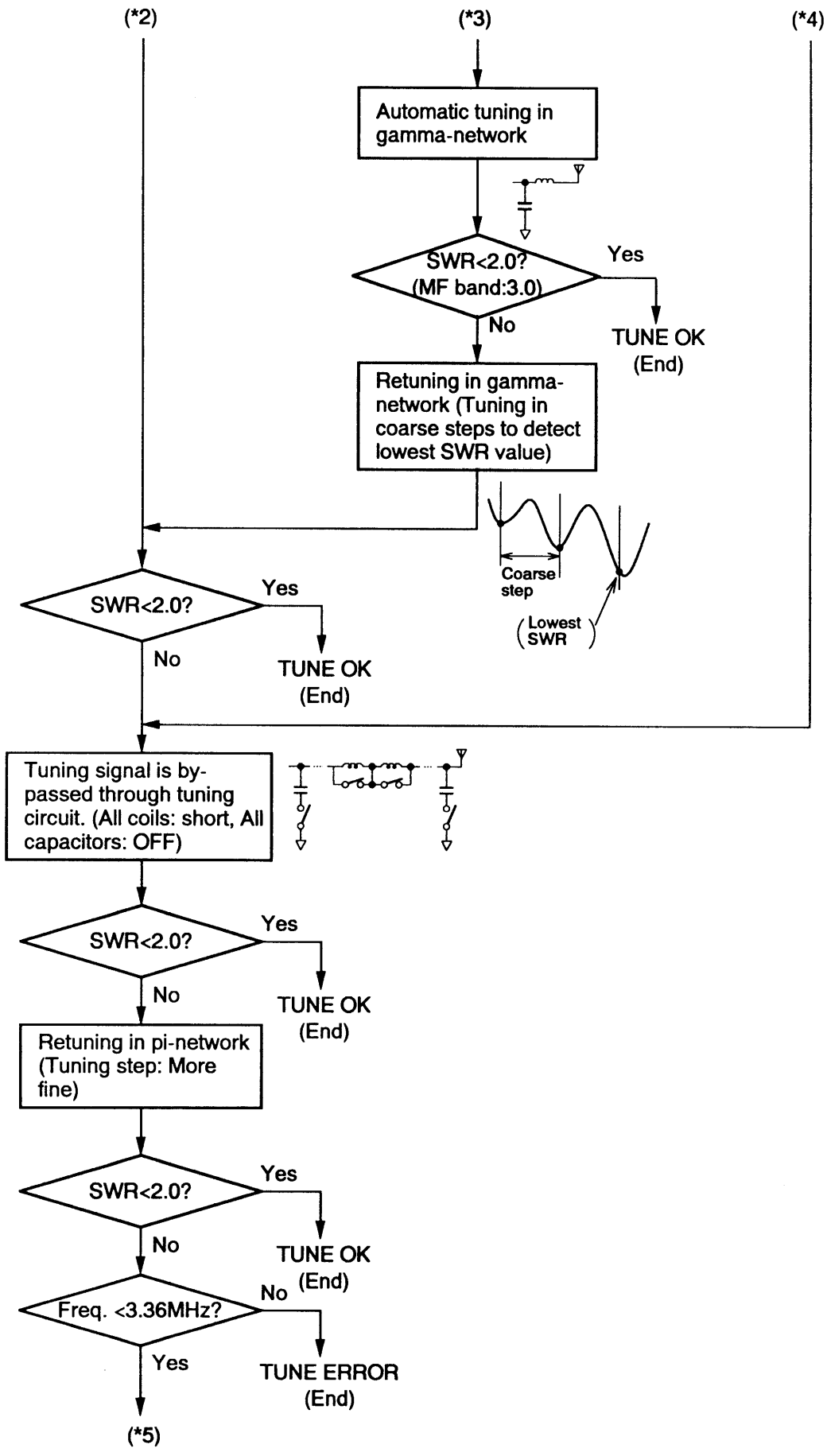
**Factory Modification**

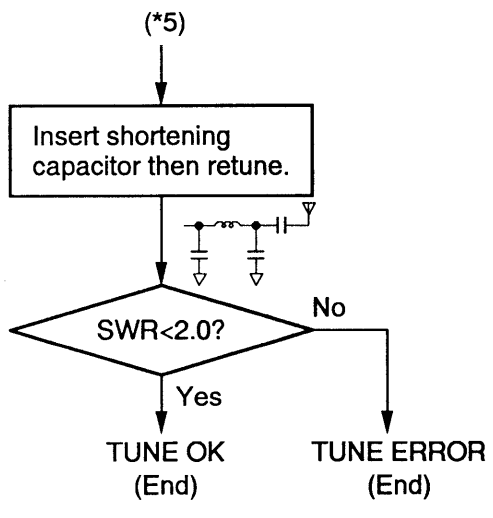
Numbering of the new coupler begins from 1001.

**Antenna Tuning Sequence**







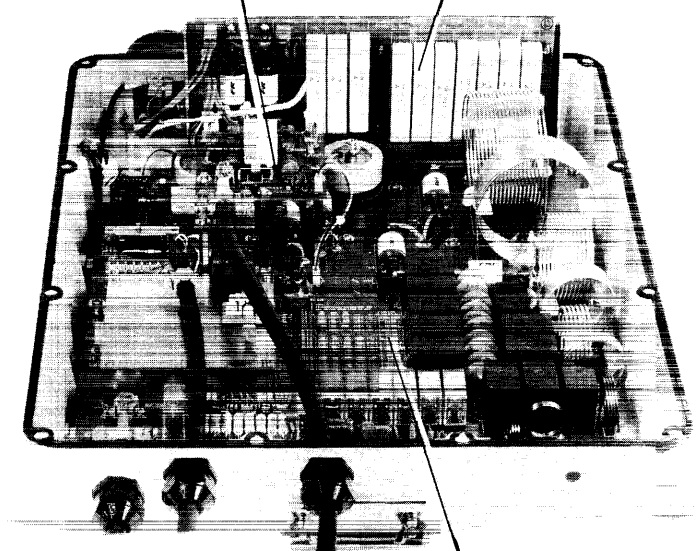


**TUNE OK:** Relay status retained. (Data is stored in E<sup>2</sup>PROM.)  
 "TUNE OK" command is sent to transceiver unit.

**TUNE ERROR:** Tuning circuit is bypassed.  
 "TUNE ERROR" command is sent to transceiver unit.

ANT BK RELAY Board (05P0359-11)

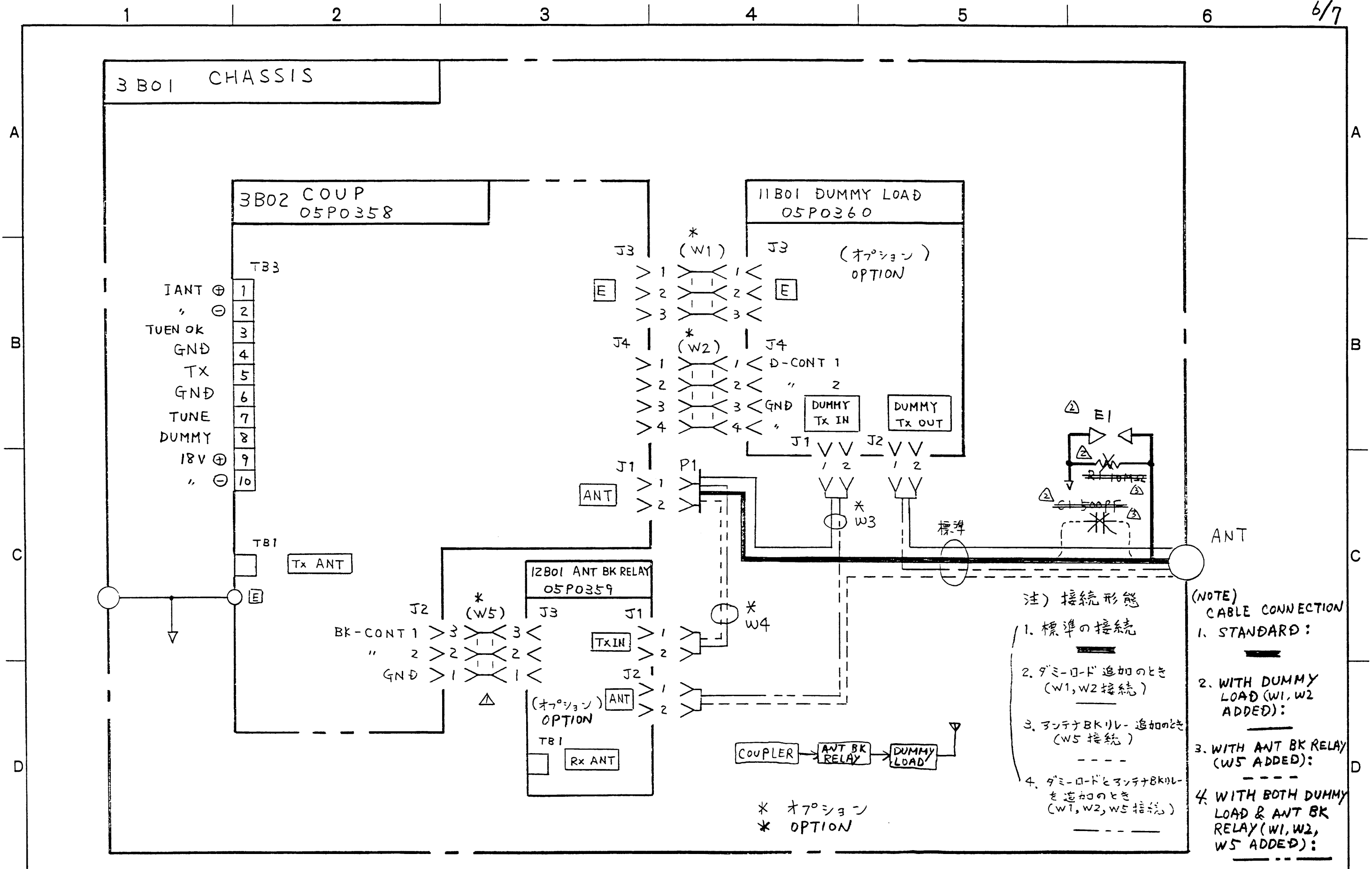
DUMMY LOAD Board (05P0360-11)



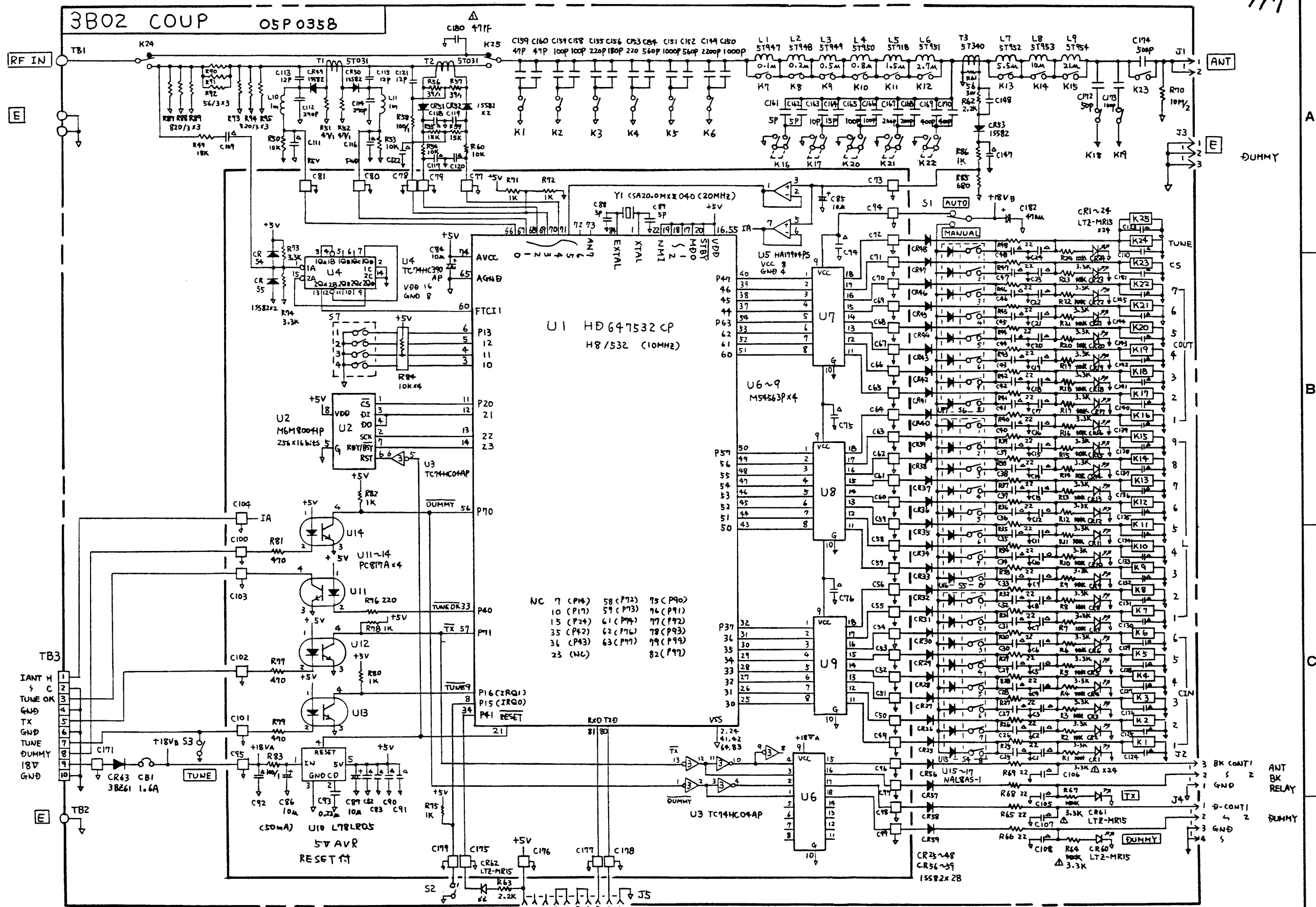
T Photo No.1257

COUPLER Board (05P0358-44)

**New Antenna Coupler (AT-5000-H)**



05E3-1812	4	4.3.16	ダミー+ANTBK配線経路変更	山本	x1	主機種 FS-5000 FS-2500 FS-1600 課長 検 図 設計 製 図 分類 名称 89.10.11 89.10.9 89.10.9 10012 六影 迫 家 家 田 城 城	コード 型名 SHEET NO. 1/1
05E3-1775	3	3.12.9	CI, R1 削除	山本	x2		
05E3-1601	2	2.5.10	CI, E1, R1 追加	山本	x3		
05E3-1566	1	2.1.12	誤記訂正	家城			
変更通知書番号	符号	訂正年月日	訂正記事	担当			3B01 CHASSIS (COUPLER UNIT) 05-001-3334-4



NOTE (1) Resistors are in Ω (0.16w), Capacitors are in F, Inductors are in H, unless otherwise noted.  
 (2) Mark Δ are 0.1μF/25V Capacitors and □ are 0.01μF/16V Capacitors with beads core.

OSE3-1812	4.3.13	LED輝度、検出回路の保護	山本	*4
OSE3-1775	3.12.2	新回	山本	
変更通知書番号	符号	訂正年月日	訂正記事	担当

主機種	FS-5000	コード		SHEET NO.	1/1
	FS-8000	型名			
課長	3.12.10	設計	山本	分類	3B02 COUP
検図	3.12.10	製図	山本	図番	05-001-3443-1

# FURUNO

## Information

NO. : FQ5-92-020

Date: 1992 - 7

Issued by: FURUNO ELECTRIC CO., LTD.  
QUALITY ASSURANCE DEPARTMENT

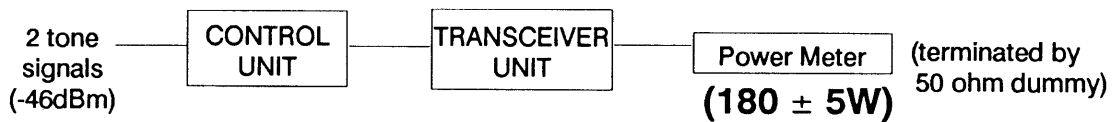
Addenda No. 21 to Service Manual of FS-5000 SM-E5519

### FS-5000/8000

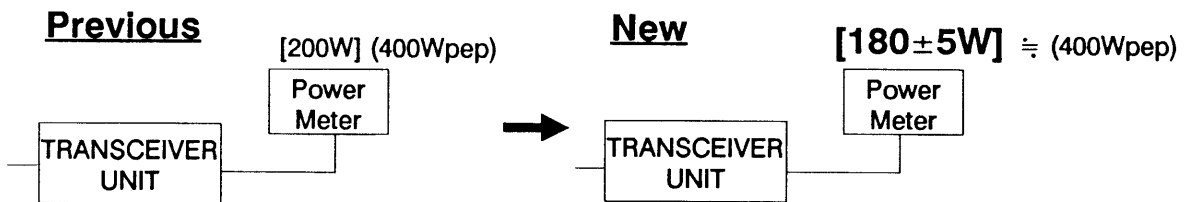
## Change of ALC Adjustment

#### FS-5000

Since the EXC board was modified in January 1992, ALC adjustment at factory has been changed as follows.



Please amend page 2-14 of the FS-5000 Service Manual.



#### Procedure

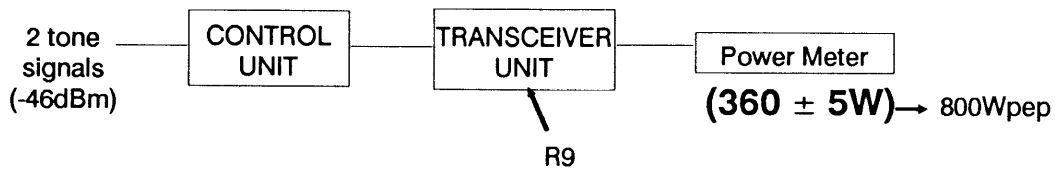
- 1.
2. Turn R9 ... indicates **240W**.
3. Adjust it for meter indication of **200W**.

#### Procedure

- 1.
2. Turn R9 ... indicates **190W**.
3. Adjust it for meter indication of **180W**.

**FS-8000**

R9 (ALC) on the EXC board is adjusted at factory as below.



**Procedure**

Adjust R9 for power meter indication of 360W.

# FURUNO

## Information

NO. : FQ5-92-025 1/2

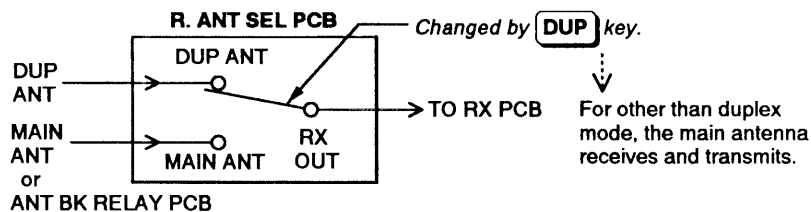
Date: 1992 - 9

Issued by : FURUNO ELECTRIC CO., LTD.

Addenda No. 22 to Service Manual FS-5000 SM-E5519

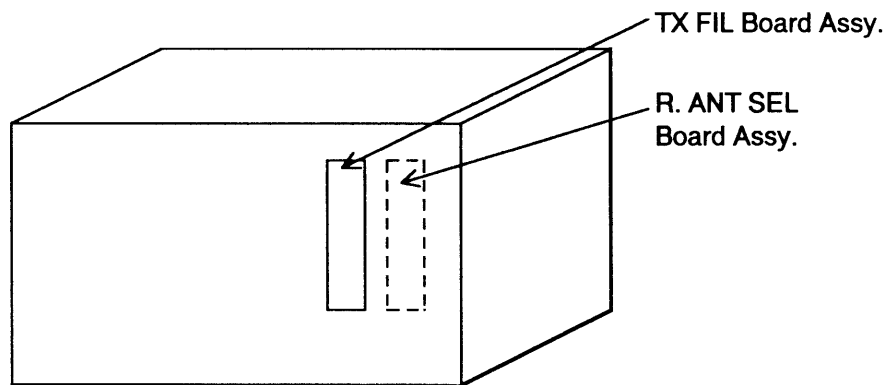
### FS-5000/8000 Optional R. ANT SEL Board

Some ships which use duplex communications may have a very long coax. cable for receiving antenna. This condition greatly lowers receiving sensitivity on MF band communications over modes other than duplex. To solve this problem, the R. ANT SEL Board is now optionally available.



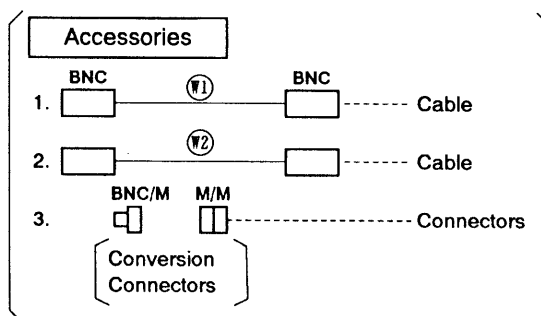
Part	Type	Code No.
R. ANT SEL Board Assy	OP05-53	005-861-350

This board is installed next to the TX FIL Board inside the transceiver unit.



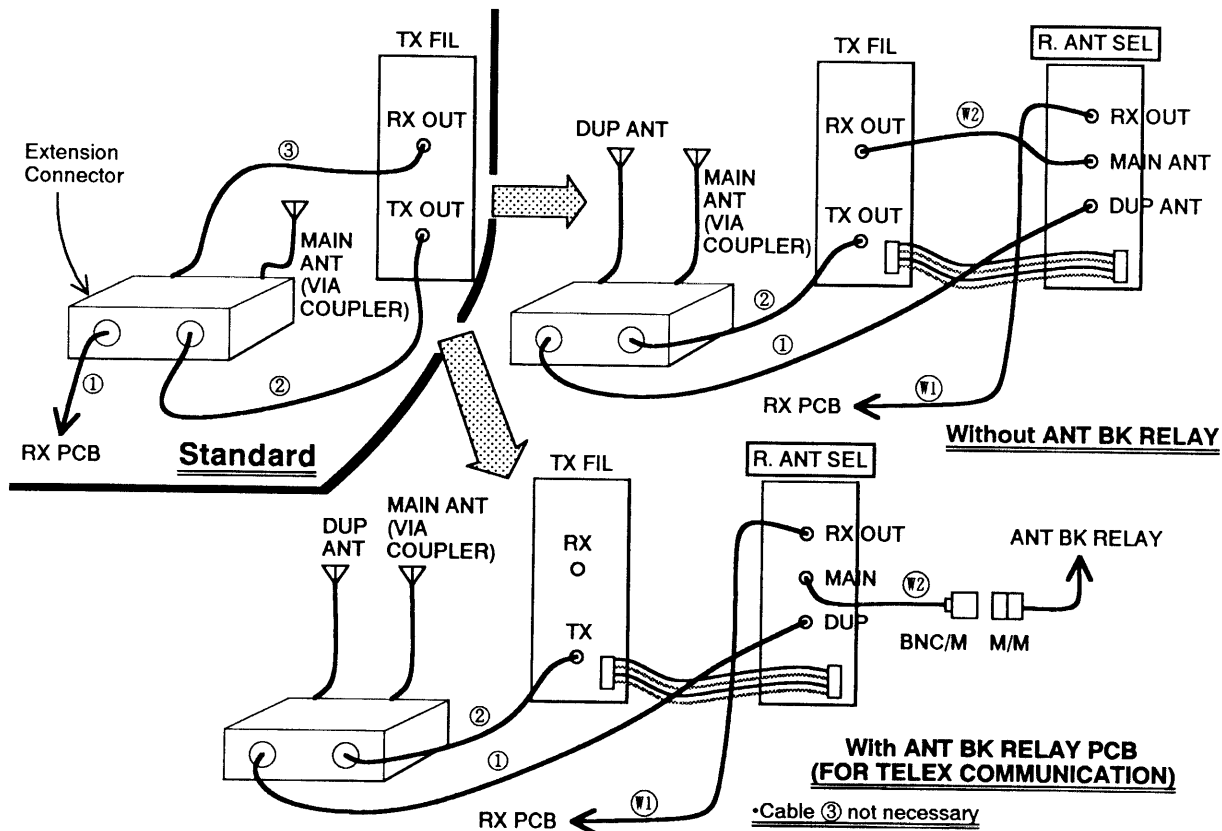
**Transceiver Unit**

The following accessories are supplied to connect the R. ANT SEL Board to the unit.

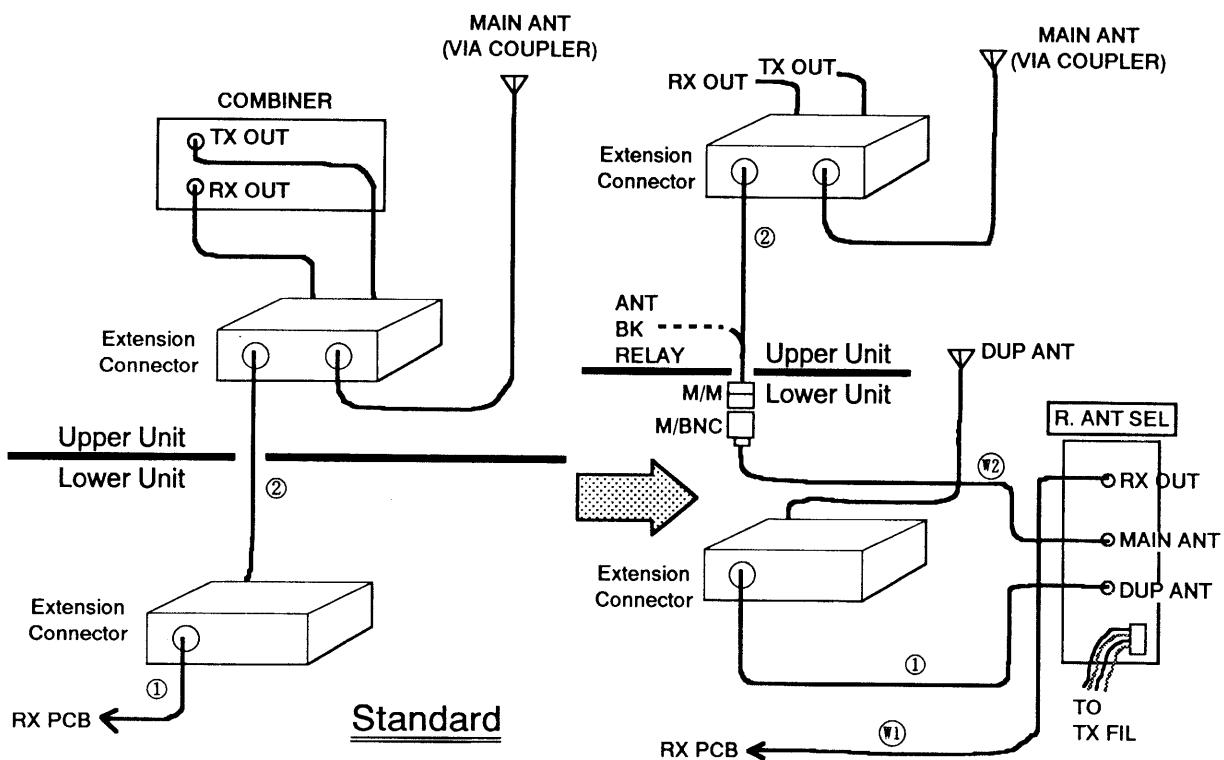


# Interconnection

## 1. FS-5000



## 2. FS-8000



# FURUNO

## Information

NO. : FQ5-92-034

Date : 1992 - 12

Issued by : FURUNO ELECTRIC CO., LTD.

TECHNICAL DOCUMENTATION SECTION

Addenda No. 23 to Service Manual FS-5000 SM-E5519



## FS-1600/2500/5000/8000 ROM Program Change (Ver. 11)

### Contents of Modification (Version 10 → 11)

#### 1. Additional System Settings

Channel No.	Function	Setting			
		0	1	2	3
9916	Selection of [*] key function	not used	key lock	intercom call	—
9951	Receiving antenna on telex communication (Only when optional R ANT SEL board is installed.)	used	not used	—	—
9957	Cypher communication	disable	enable	—	—
9962	MF (405—526.5kHz) band for TX	not used	used (Note 1)	—	—
9963	User programming	enable	disable	—	—
9964	Check meter indication for both upper and lower transceiver units (FS-8000 only)	no	yes	—	—



Factory Setting

Note 1: Optional antenna coupler AT-410 (under development) is required.

#### 2. Intercom function added.

(Set channel 9916 to "2" to use the [\*] key for intercom call.)

Note that the AF board 05P0356-33 in the Control Unit is required.

(This board is under development.)

#### 3. Low power data changed.

	MF band	HF band
FS-5000	100 ⇔ 115	100 ⇔ 110
FS-8000	70 ⇔ 90	70 ⇔ 75

#### 4. TX tuning error indication added.

Error indication "TX TUNE is off" appears when [TX TUNE] key is pressed with system setting 9905 ([TX TUNE] key function) set to "OFF".

### Modified Sets

From the production in November 1992.

### ROM Code Number

Type: PROM 0550131111

Code No.: 005-927-440

# FURUNO

## Information

NO. : FQ5-93-001 <sup>1/2</sup>Date: 1993 - 02Issued by : FURUNO ELECTRIC CO., LTD.  
TECHNICAL DOCUMENTATION SECTION

Addenda No. 24 to Service Manual of FS-5000 SM-E5519

*M. Med.*

### FS-5000/8000 ROM PROGRAM CHANGE

The program of the ROMs (three) in the Control Unit, Transceiver Unit and Antenna Coupler has been changed as follows from the production of February 1992.

Unit	Control	Transceiver	Antenna Coupler
ROM Version No.	1.12 (CPU board)	Same as left.	1.02 (COUPLER board)
Program No.	05-501-31-112		05-501-54-102
Code No.	005-927-440-00		005-860-330-00

#### Modification

##### **ROMs for Control and Transceiver Units (Ver. 1.12)**

- (1) When the circuit of the EXC board (05P0349) was changed to "suffix-33" in January 1992 to reduce transmission noise on duplex communication (refer to Furuno Information FQ5-92-009 issued in April 1992), tuning power of the FS-8000 was reduced, which caused tuning error. To resolve this problem, the tuning power of the FS-8000 has been increased.
- (2) A terminal board on the INTERFACE board (05P0354) was newly added for detection of the AC mains failure in December 1992. For the sets produced in December 1992 and after (incl. RC-5000/8000 series):
  1. The software bug, that the output power is not always reduced automatically when AC mains cuts off, has been removed. (RC-5000/8000 series only)
  2. Automatic power reduction data (power data) when AC mains fails can be adjusted as shown below.
    - [STO] → [LOW] → press and hold [LOW] or [FULL] → [ENT]

(For previous ROM, the above data was determined by maximum power data setting.)

- (3) The minimum output power, when system setting 9928 ([STO] 9928) is set to "1" (60W or higher), is increased to get 60W power securely.

When you select system setting 9928 to "1", the minimum power data is automatically set as below, and the maximum power data is preset to the default setting ("255").

Model	Minimum Power Data
FS-5000	MF: 115, HF: 110
FS-8000	MF: 90, HF: 85

- (4) For system setting 9980, when "31" (Netherlands) is entered, system setting 9901 is automatically set to "3" (Marine free).

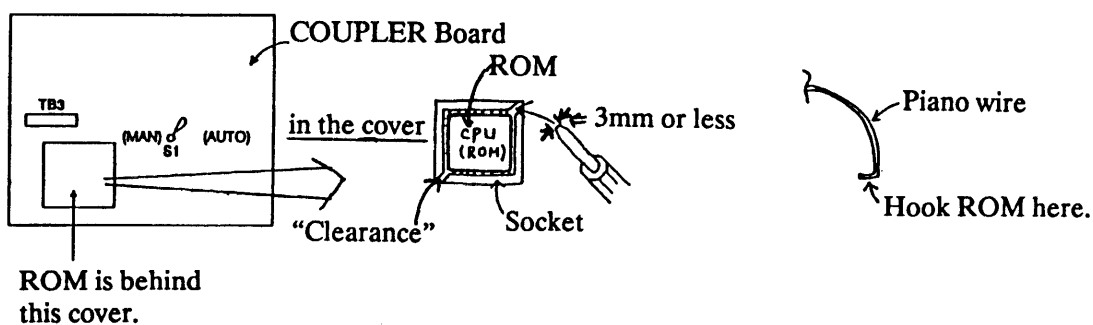
### ROM for Antenna Coupler (Ver. 1.02)

- (1) The software bug described below has been removed.

The "Tuning error" occurs on the frequency higher than 3.36 MHz. This is because the pi-network tuning sequence is skipped (software bug) if the gamma-network cannot be tuned.

### How to remove ROM on the COUPLER board

Using a slotted-head screwdriver (blade width 3mm or less), remove ROM by inserting it into "clearance" between ROM and socket as shown below. (Piano wire may be used instead of a screwdriver.)



### Relationship between Model & ROM to be replaced

Model	ROM to be replaced
RC-5000/8000 series	All ROMs (Three ROMs)
FS-8000 in which tuning error occurs.	
FS-5000 in which tuning error occurs.	ROM in the antenna coupler only.

# FURUNO

## Information

NO. : FQ5-93-012

Date : 1993 - 04

Issued by : FURUNO ELECTRIC CO., LTD.  
TECHNICAL DOCUMENTATION SECTION

Addenda No. 25 to Service Manual of FS-5000 SM-E5519



### FS-5000/8000

## 1. Protection of PA Transistors

## 2. Installation of ANTENNA EARTH RELAY Board (for Grounding TX Antenna)

### 1. Protection of PA Transistors (Overcurrent protection: max. 21A)

Excessive current may flow into the PA transistors momentarily when the matching status between an antenna and a coupler changes, damaging the transistors. To solve this problem, the PA CHECK board has been changed from 12/92. (The new PA CHECK board (05P0367-22) detects current flowing into the PA transistors and delivers its output to the ALC circuit of the EXC board.)

The next page shows how to mount and adjust the new PA CHECK board locally. This modification can be done for the sets having suffix number shown below. (Production in 11/92 and earlier)

{ INTERFACE board: 05P0354-11  
INTERFACE board: 05P0362-11 (FS-8000)  
PA CHECK board: 05P0367-11 }

### 2. Installation of ANTENNA EARTH RELAY Board

To connect a transmission antenna to ground automatically while the unit is not transmitting, install the ANTENNA EARTH RELAY board in the antenna coupler. This protects the transmission circuit against lightning when the 50 ohm BK relay in the TX FIL board is turned on, that is, the transmission circuit is connected to the antenna. The procedure for installation is on page 6/8.

Applicable equipment: Units using new antenna coupler  
(Serial No. 1001 and after)

## Modification for protection of PA transistors (For FS-5000)

	<u>Qty</u>
Necessary Parts: 1. New PA CHECK Board.....	1
2. PH Connector Assy. (2P-10P) .....	1
3. Carbon Resistor (680, 1/6W) .....	1

### Procedure

Before replacing the PA CHECK board, measure the  $I_c$  current, using the existing PA CHECK board.

#### Conditions

Frequency : 4MHz (SSB)

Output Power : LOW1

Tone : Single tone

[STO] [9926] [ENT] [0] [ENT]

$I_c$  Indication : ON

[STO] [9910] [ENT] [1] [ENT]

1. Turn off the power and replace the PA CHECK board with new one.
2. Turn on the power and measure the  $I_c$  current using the same conditions mentioned above.
3. Compare both values of  $I_c$ . If they are not the same, adjust R4 on the new PA CHECK board for coincidence.
4. Turn off the power and connect a PH connector assembly between J4 on the PA CHECK board and J9 (ALC terminal) on the INTERFACE board.
5. Change resistance value of R146 on the EXC board from 3.3k ohms to 560 ohms by inserting a 680 ohm resistor in parallel with R146.
6. Turn on the power, set the output power to FULL and transmit by single tone (SSB) on all bands.
7. Confirm that  $I_c$  indication does not exceeds 21A on all bands. If it exceeds 21A, adjust R35 (clockwise) on the PA CHECK board.
8. Restore "Tone" and " $I_c$  Indication" system settings to previous settings.

## Modification for protection of PA transistors (For FS-8000)

	<u>Qty</u>
Necessary Parts: 1. New PA CHECK Board.....	2
2. PH Connector Assy. (2P-10P) .....	2
3. PH Connector Assy. (10P-).....	2
4. Carbon Resistor (680, 1/6W) .....	1
5. ROM (Ver. 1.11 or 1.12) .....	2

### Procedure

1. Replace ROMs on the CPU board in the control unit and transceiver unit with new ones.  
(Ver 1.11 or 1.12)
2. Turn on the power and change the system setting **9964** as shown below, to display respective Ic indication of the upper and lower units.

**[STO] [9964] [ENT] [1] [ENT]**

3. Before replacing the two PA CHECK boards, measure Ic current of both the upper and lower units using the existing PA CHECK board.

### Conditions

Frequency :4MHz (SSB)

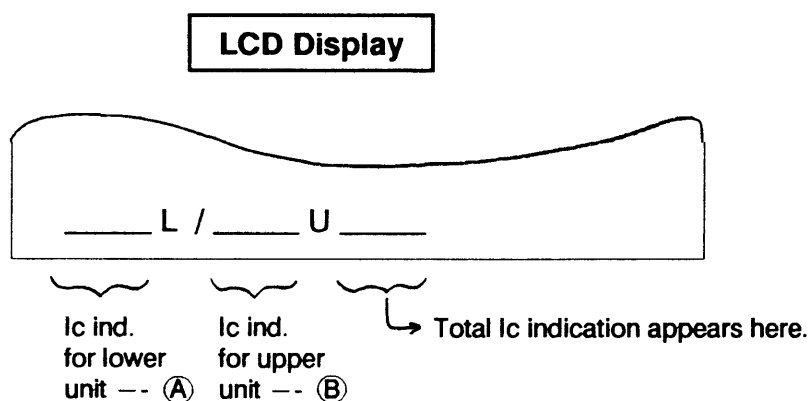
Output Power :LOW 1

Tone : Single tone

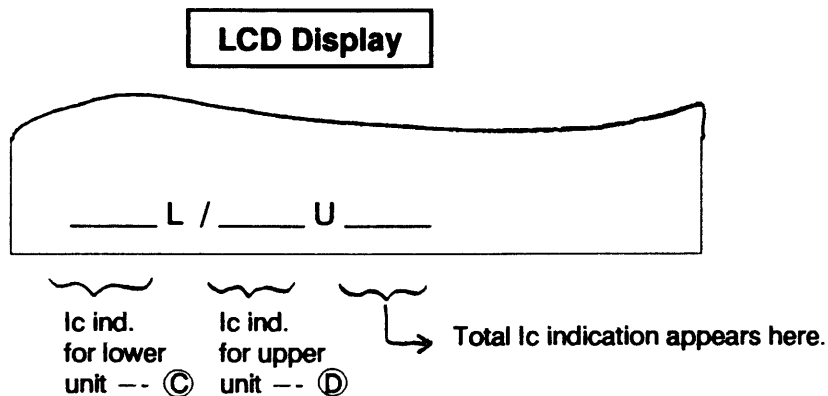
**[STO] [9926] [ENT] [0] [ENT]**

Ic Indication : ON

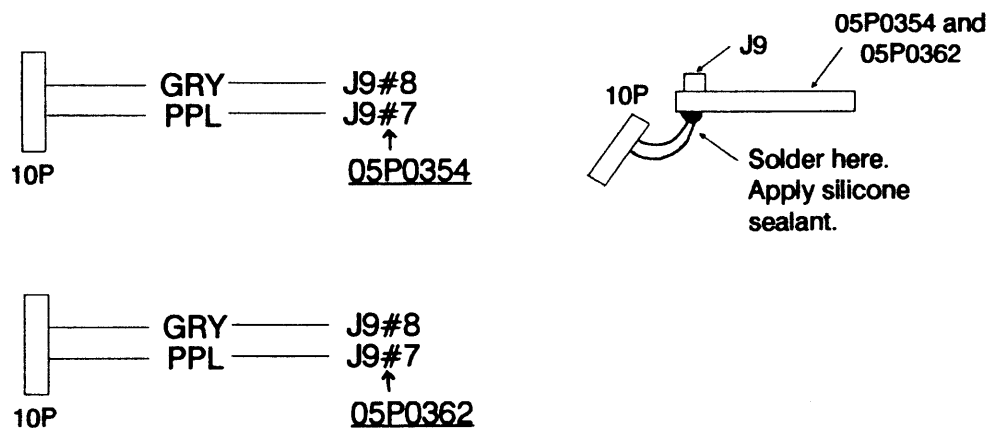
**[STO] [9910] [ENT] [1] [ENT]**



- Turn off the power and replace the PA CHECK boards with new ones.
- Turn on the power and measure the  $I_c$  current of both the upper and lower units using the same conditions mentioned earlier.



- Compare values of **A** and **C**. If they are not the same, adjust R4 on the new PA CHECK board in the lower unit.
- Adjust R4 on the new PA CHECK board in the upper unit if the values of **B** and **D** are not the same.
- Turn off the power and solder two flying wires from a PH connector assembly (10P-) to J9 on the INTERFACE boards (05P0354 and 05P0362) as shown below.



- Connect a PH Connector assembly (2P-10P) between J4 on the PA CHECK board and 10P connector from the INTERFACE board (05P0354) in the lower unit, and between J4 on the PA CHECK board and 10P connector from the INTERFACE board (05P0362) in the upper unit.

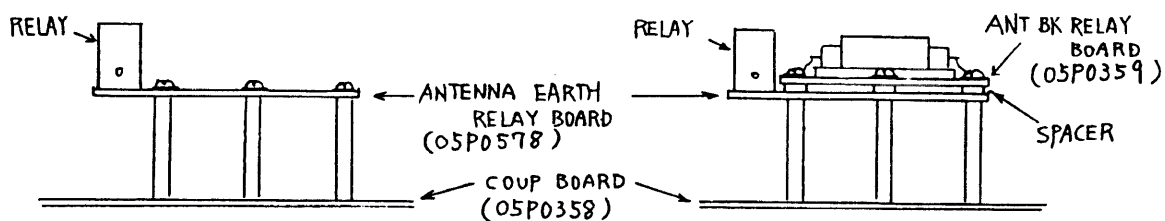
10. Change resistance value of R146 on the EXC board from 3.3k ohms to 560 ohms by inserting a 680 ohm resistor in parallel with R146.
11. Turn on the power, set the output power to FULL and transmit by single tone (SSB) on all bands.
12. Confirm that Ic indication does not exceed 21A on all bands (for both lower and upper units). If it exceeds 21A, adjust R35 (clockwise) on the PA CHECK board.
13. Restore the system settings to the previous settings.

## Mounting ANTENNA EARTH RELAY PCB on Antenna Coupler (New Coupler)

Necessary Parts:	Q'ty
① ANTENNA EARTH RELAY PCB (05P0578, with cables) .....	1
② Spacer for mounting ANT BK RELAY PCB .....	5
③ CK clamp (CK-05H) .....	1
④ Panhead screw B (M3 × 10) .....	5

### Procedure

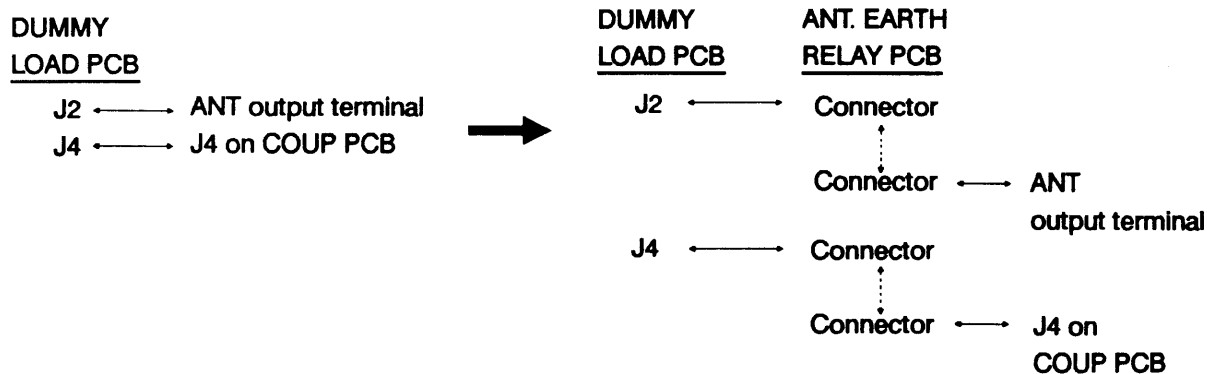
1. Mount the board on the COUPLER board by using screws and spacers (if necessary).



Without ANT BK RELAY PCB

With ANT BK RELAY PCB

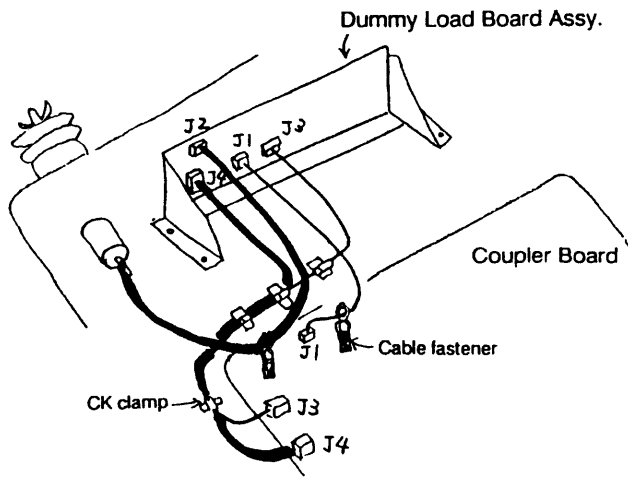
2. Change wire connections as shown below.



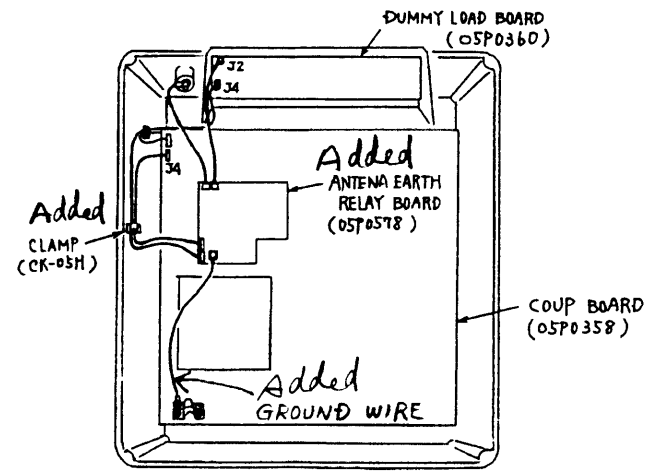
(\* ) Connect ground wire as shown on the next page.

Previous

New



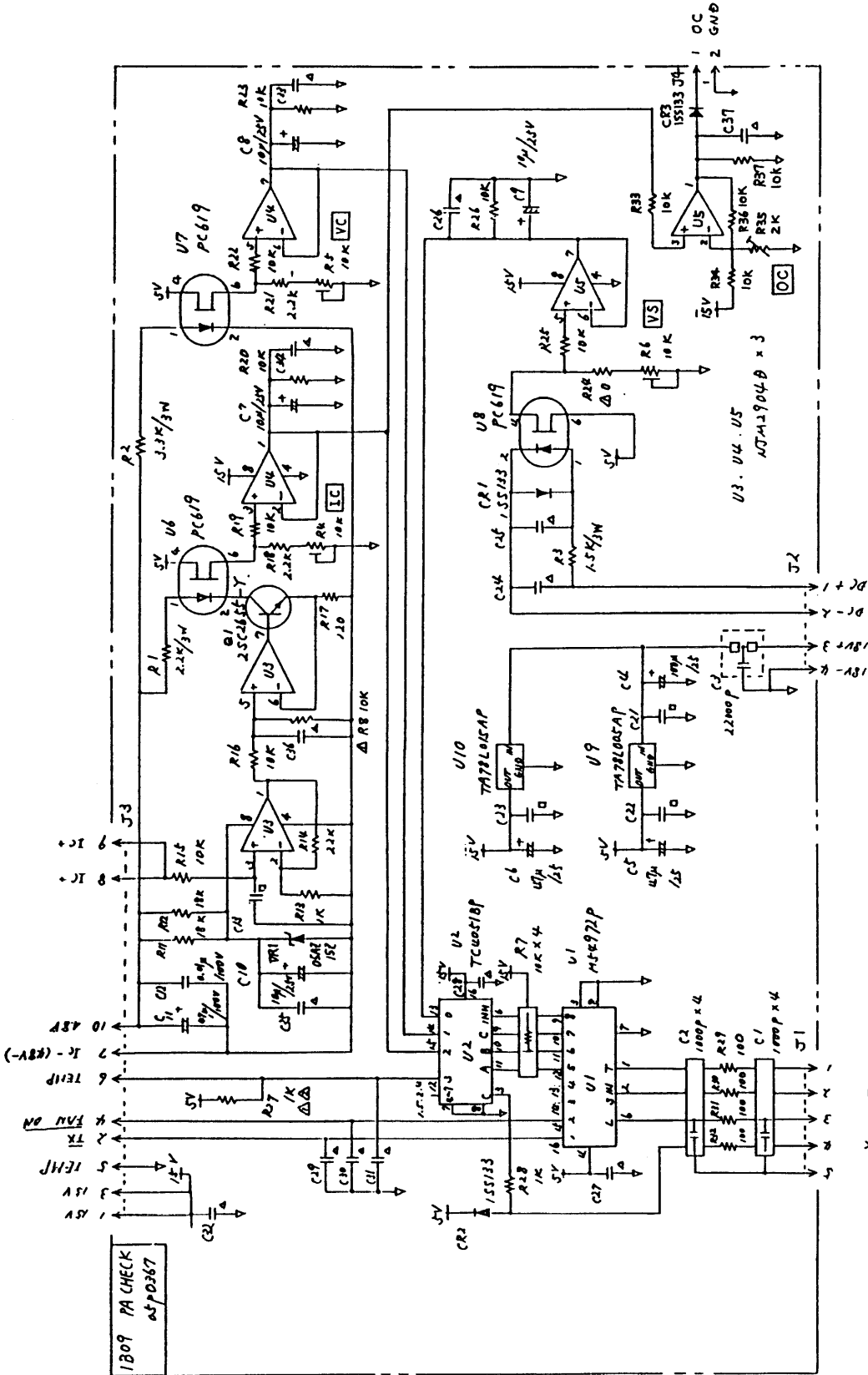
**Previous**



**New**

Operation: When the DUMMY key is on or the power is turned off, a transmission antenna is automatically connected to ground to protect the transmission circuit in the transceiver unit against lightning.

# PA CHECK BOARD



NOTE (1) Resistors are in Ω (O, IW). Capacitors are in F.  
 Inductors are in H, unless otherwise noted.  
 (2) Marks  $\square$  are 0.01μF/50WV capacitors, and  $\square$  are 0.1μF/25WV capacitors.

FS-1600	コード	SHEET	1/1
FS-2500	型名	NO.	
FS-5000	設計		
1809	製造		
PA CHECK (TRANSMITTER UNIT)	図		
C5519-K07-D	部品		
古野電気株式会社			

# Information

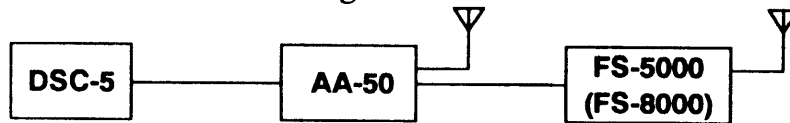
No. : FQ5-93-016Date : 1993 - 05Issued by: **FURUNO ELECTRIC CO., LTD.**  
**TECHNICAL DOCUMENTATION SECTION**

Addenda No.26 to  
FS-5000 SM-E5519.  
Addenda No.3 to  
FS-8000 SM-E5521.  
Addenda No.2 to  
DSC-5 SM-E5522.

## FS-5000/8000 series, DSC-5 Remedy for Key Lock up

*M. Mochizuki*

The keyboard of the FS-5000/8000 and/or the SCAN key of the DSC-5 may lock when equipment is connected as shown in the figure below.



### Symptom

The keyboard of the FS-5000/8000 and/or the SCAN key of the DSC-5 may lock when the AA-50 detects a dot pattern while the FS-5000/8000 scans the DSC frequency through the DSC-5 (preselector: ON).

(To restart operation, turn the power switch or the breaker off and turn it on again.)

### Cause

Software bug.

### Local Remedy

Replace three ROMs.

Name	Type	Code no.	Qty
FS-5000	05501-31-113 (Ver. 13)	005-927-440-02	2
DSC-5	05501-39-115 (Ver. 15)	005-996-140-02	1



### Contents of ROM Change

Refer to the following Furuno Information.

- FS-5000/8000 ROM Program Change
- DSC-5 ROM Program Change

### Urgency

Immediately replace ROMs when returning to port.

### Factory Modification

From the production in May 1993.

**Factory Modification** From the production in May 1993.

**Urgency** Replace ROM immediately in case of item (1).

**Program Number** 05501-31-113

**Code Number** 005-927-440-02

**Remarks** For the RC-5000/8000 radio console sets having ROM version number 11 or earlier, adjust automatic power reduction data (minimum power data) after replacing ROM, referring to Furuno Information FQ5-93-001 issued in March 1993.

Applicable Operator's Manual for Version No. 13:  
OM-E5519-0K (FS-5000)  
OM-E5521-0F (FS-8000)

Addenda No. 27 to FS-5000 SM-E5519

Addenda No. 4 to FS-8000 SM-E5521

**FS-5000/8000  
ROM PROGRAM CHANGE (Ver. 13)****Contents of  
ROM Change**

(1) In the series connections of the DSC-5/AA-50/FS-5000 (8000), the keyboard of the FS-5000 may lock when the FS-5000 scans the DSC frequency through the DSC-5 with the PRESELECTOR key turned on. This software bug has been removed.

(2) System setting 9952 is added.

[STO]→ [9952]→ Tx antenna status at reception

{ 0: OFF (No change)→Default  
1: ON (Connected to GND)· (\*1) }

(\*1) This function is available only when the Rx antenna is installed and dummy load board with antenna earth relay is mounted in the coupler.

If you want to connect the Tx antenna to ground manually (irrespective of 9952 setting), press the [DUMMY] key. (For HF band of the FS-8000, this function is operative only when the output power is selected for "Low2" or less.)

(3) Tuning is automatically done when pressing the PTT switch after turning on or off the [DUMMY] key.

(4) If sensitivity setting is less than "7", the AGC and sensitivity settings are automatically changed to "ON" and "maximum", respectively when the [2182] or [2187.5] key is pressed or the "DR" command from other equipment is received.

(5) System setting 9951 is amended as below.

<u>Incorrect</u>	<u>Correct</u>
[ 0: <b>YES</b> , 1: NO ]	[ 0: NO, 1: <b>YES</b> ]

Shading shows default setting.

## ROM Replacement

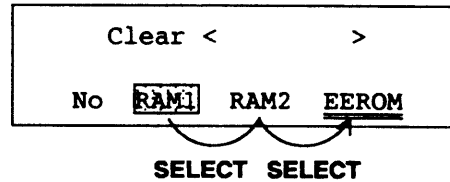
### FS-5000/8000

1. Replace the ROMs on the CPU board in the Control and the Transceiver Units with new ones.

### DSC-5

(Clearing EEPROM is required.)

1. Replace the ROM on the Control board.
2. Turn the power on. The following screen appears.



3. Press **SELECT** twice to advance the cursor to "EEPROM."
4. To print out the contents of the EEPROM, press **0**. The ship's ID number, "COMM" setting, etc. will be printed.
5. Press **ENT** to clear the contents of the EEPROM.
6. Restore the system settings as they were before.

Addenda No. 28 to Service Manual FS-5000 SM-E5519  
 Addenda No. 5 to Service Manual FS-8000 SM-E5521

## FS-5000/8000 SSB RADIOTELEPHONE New Version AF Board (-33)

①

The FS-5000/8000 will have a new version AF Board from the production in August 1993. The new version no. is 05P0356-33. This technical information describes the changes made to this board.

②

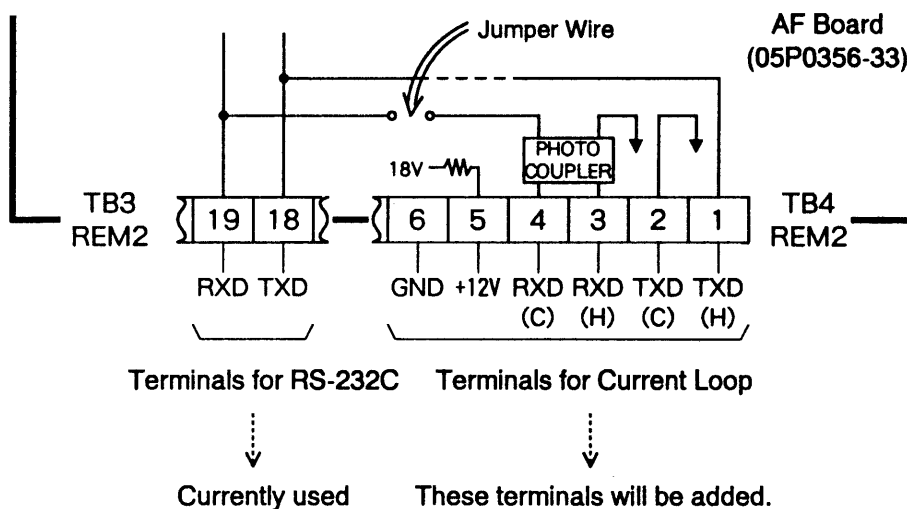
### Changes

#### Connection of Remote Station RB-500

③

- 1) The new version AF Board has terminals for current loop. They are on the REM2 terminal and are connected as follows.

④



⑤

⑥

The new version AF Board has the terminals for current loop (TB4 #1-#4). Because of the addition of those terminals, the terminals for connection of CIF/NMEA will be changed from TB4 #1-#4 to #7-#10.

⑦

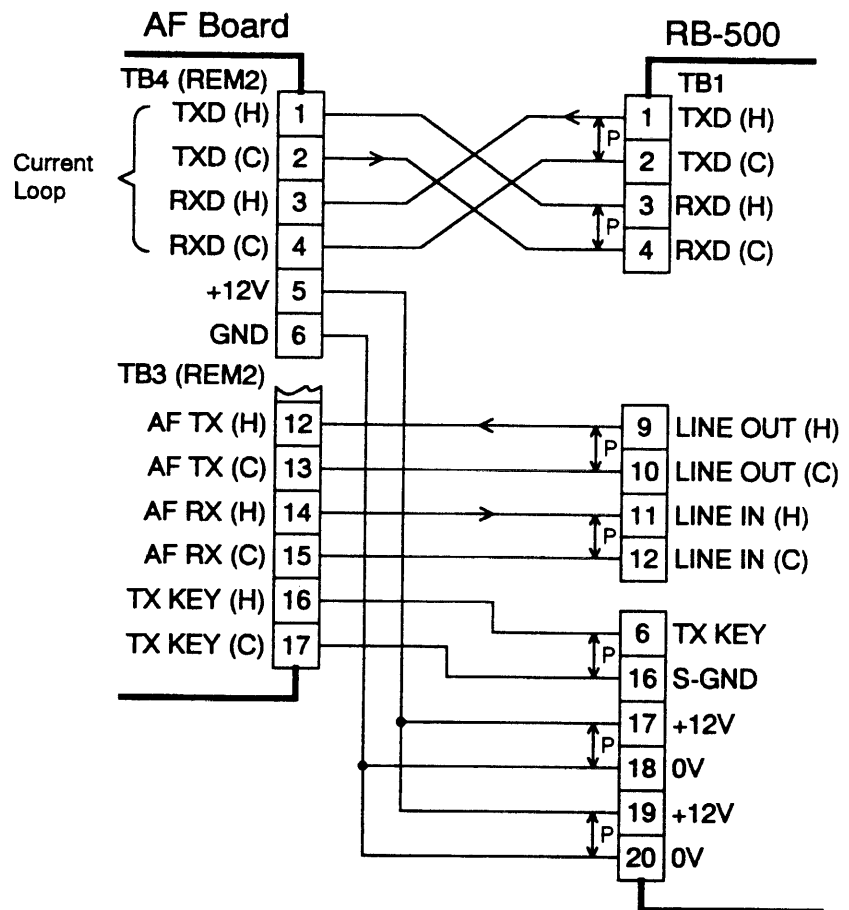
You set the data format of equipment connected to the REM2 by jumper wire, as shown in the table below.

⑧

Jumper Wire (see drawing on page 4/6)	Format
Short	Current Loop
Open (factory setting)	RS-232C

- 2) As shown in the illustration on the previous page, +12 V power for the RB-500 is taken from the #5 terminal of TB4. (Currently +18 V is taken from the #9 terminal of TB1 and a resistor is inserted on the RB-500 to lower voltage to +12 V.)

As the result the new version AF Board is connected to the RB-500 as follows.



- 3) Squelch function will be available at the RB-500. (Currently the AF signal comes to the line output (AF RX) terminal on the FS-5000 without passing through the squelch circuit. In the new version AF board it passes through the squelch circuit.)

### **Intercom function available with RB-500 connection**

The intercom function was added to the FS-5000 in November 1992, by ROM version 1.11. No hardware was available at that time; however, the new version AF Board has an intercom circuit. You can enable the intercom function by pressing the following keys

[STO] [9916] [ENT] [2] [ENT]

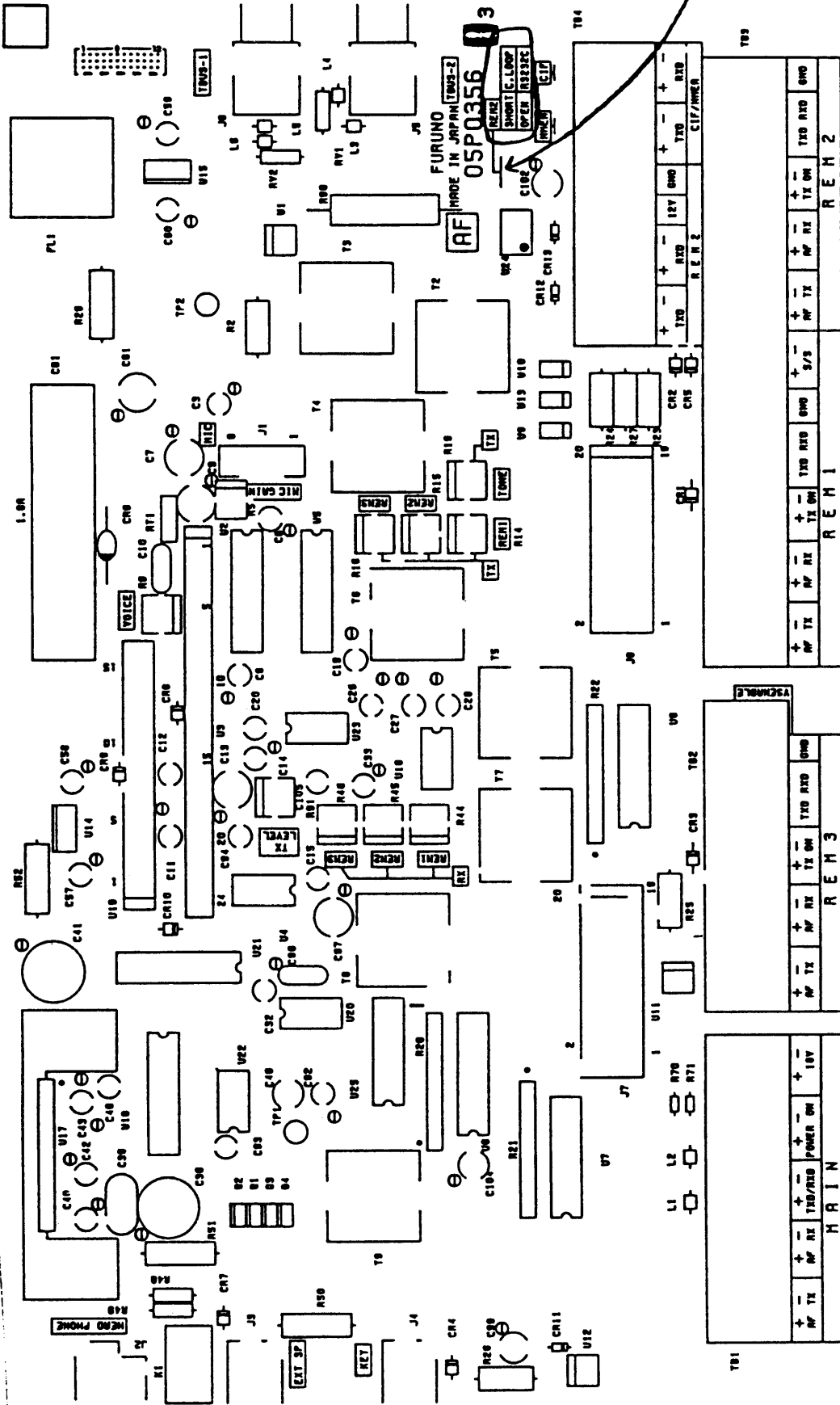
You operate the intercom function on the front panel by using [\*], [ENT], [CLEAR] keys.

- Calling: [\*], (terminal no.), [ENT], then communicate
- Ending communications: [CLEAR]
- Answering: [ENT], then communicate

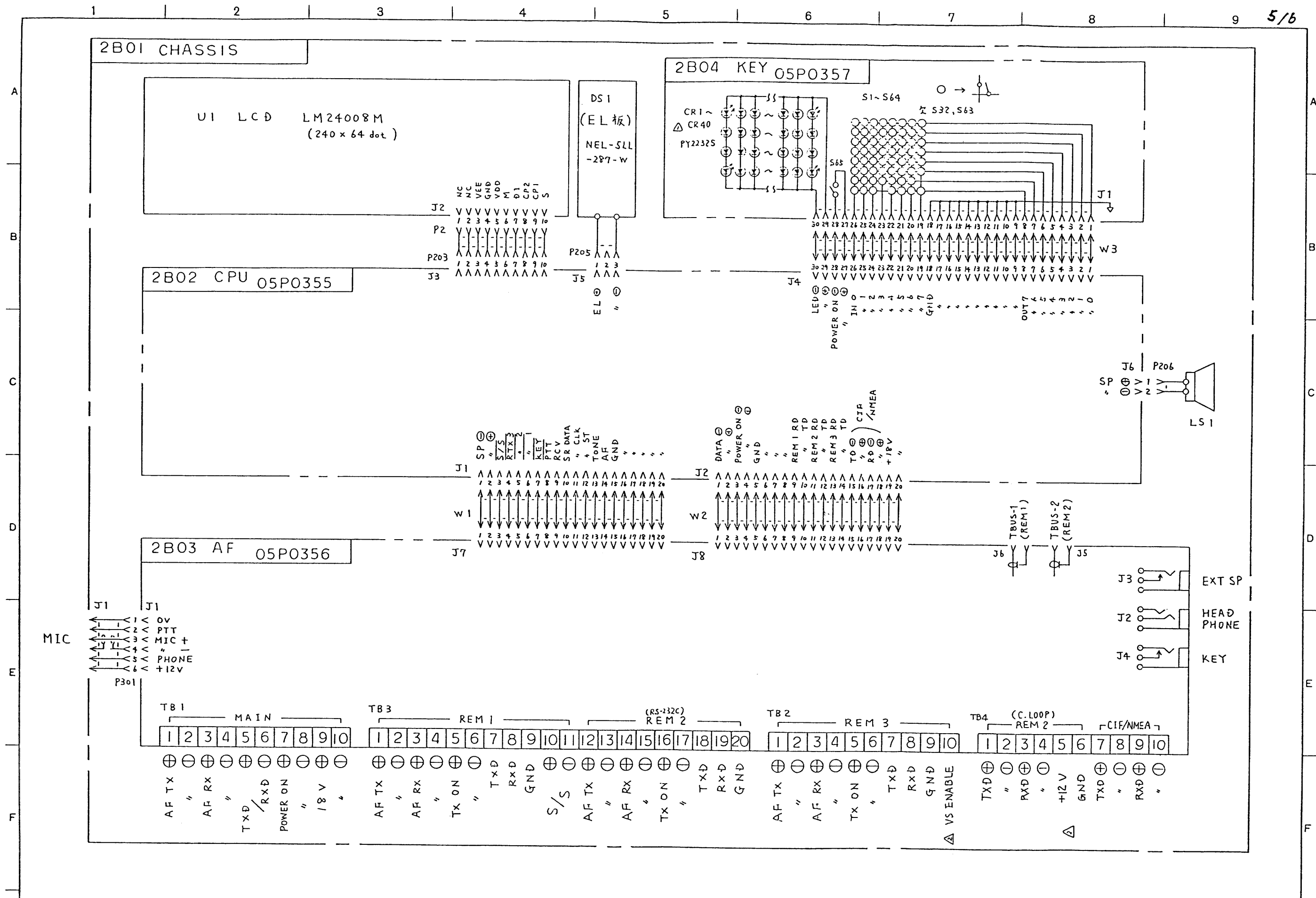
### **Potentiometer for adjustment of MIC gain**

A potentiometer for adjustment of MIC gain (R5: MIC GAIN) is added. Adjust it when MIC gain is too high.

Jumper Wire

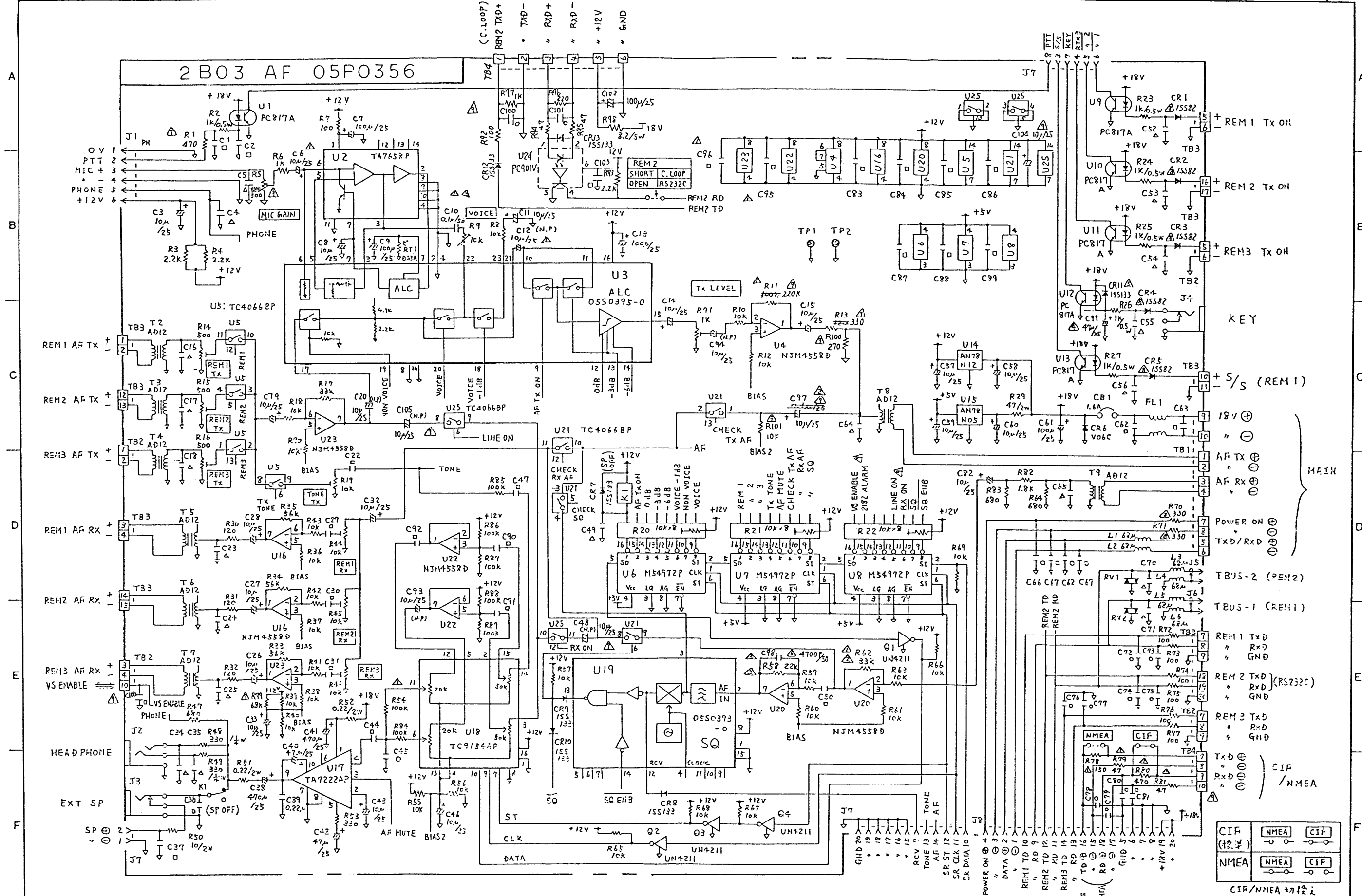


AF Board (05P0356-33)



05E3-1399	2.10.30	11元-11元池計対応 101号	通同
05E3-1601	2.5.10	LED 281個 → 40個	出本
変更通知番号	符号	訂正年月日	訂正記事

機種種	FS-5000 FS-2500 FS-1600	コード		SHEET NO.	1/1
課長	検査	設計	製図	分類	名称
10.12	10.11	10.3	10.3		2B01 CHASSIS (CONTROLLER UNIT)
大山	迫	山	家	図番	05-001-3331-2



05E3-1741	3.9.26	7+1+1の逆起保線	追加
05E3-1546	2.10.19	4+1+1の防止(C99)	山本
05E3-1585	2.3.8	Tx Freq改定 4.4MHzに改定	家城
05E3-1566	2.1.12	Rx Freq改定 4.4MHzに改定	家城
05E3-1559	1.11.6	記録装置 C1F/NMEA切替	家城
変更通知番号	符号	訂正年月日	訂正記号
			担当

NOTE (1) Resistors are in Ω (0.1W). Capacitors are in F. Inductors are in H, unless otherwise noted. (2) Marks ○ are 1000pF/50WV capacitors. △ are 0.01μF/50WV capacitors and □ are 0.1μF/25WV capacitors.

機種	FS-5000	コード		SHEET	1/1
型名				NO.	
課長	1/10/12	設計	6/12/15	分類	2B03
検図	1/10/12	製図	6/12/15	名称	AF (CONTROLLER UNIT)
分		名		番	05-001-3333-9
図		番			

Addenda No. 29 to  
FS-5000 SM-E5519  
Addenda No. 6 to  
FS-8000 SM-E5521

*M. Mada*

## FS-5000/8000 Remedy for Garbled Audio

### Symptom

Your partner cannot hear your voice clearly.

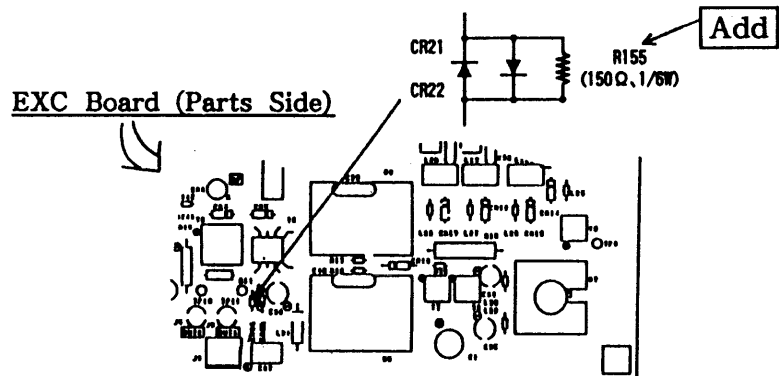
### Cause

Low level audio is cut off by CR21 and CR22 on the EXC board (05P0349-33), which were added for noise reduction (reduction of interference from own transmitter to receiver) on duplex communication, in January 1992.

### Field remedy

(1) Note white noise level by pressing PTT switch on duplex mode; (2) **Add a resistor** (R155: 150 ohms, 1/6W, 000-329-017) in parallel with CR21 and CR22 on the EXC board, and (3) Compare the level of white noise with that of before modification.

White noise should increase slightly. If necessary, adjust resistance of R155; the higher the resistance (max. 220 ohms), the lower the level of the white noise on the duplex mode but the worse the clarification.



### Urgency

Tick	Action
	Immediately (ask ship's captain to remedy if the ship is out)
	As soon as the ship returns to port
	When it is convenient
✓	When symptom occurs

### Factory modification

From the production in July 1993.

### Remarks

If the duplex mode is not used, short CR21 and CR22 to clarify voice.

Addenda No. 30 to  
FS-5000 SM-E5519  
Addenda No. 7 to  
FS-8000 SM-E5521**FS-5000 Series**  
**ROM Program Changes (Ver. 15)****Changes made  
to ROM program**

- The following problems were eliminated.
  1. Frequency cannot be set 30 seconds to one minute after turning on the power and the error message "Tx frequency unlock" appears.
  2. Telex communication errors; NBDP terminal DP-5 cannot receive message completely, or connection is broken.
- The factory settings of the system channels were changed as follows.

System CH	Function	Factory Setting
9947	Squelch in telex mode	1 (OFF)
9948	Noise blanker in telex mode	1 (OFF)
9949	AGC in telex mode	1 (FAST)
9965	Scan response time	1 (FAST)

**Program number**

PROM0550131115

**Note for replacement of ROM  
in the field**

After replacing the ROM, display the system channels and set them as shown in above table.  
setting procedure (key operation)

[STO] [9] [9] [ ] [ ] [ENT] [ ] [ENT]

|  
 system channel      setting

**Factory  
modification**

From the production in July 1993.

**Remarks**

The ROM program version number of the DP-5 is now 2.00. (It eliminates Telex Communication problems.)  
We recommend that the DP-5 having new ROM (ver. 2.00) be used with FS-5000 series.

Addenda No. 31 to FS-5000  
Service Manual SM-E5519Addenda No. 8 to FS-8000  
Service Manual SM-E5521*M. Meads***FS-5000/8000**  
**ROM Program Changes (Ver. 17)****Changes made  
to ROM program**System setting 9966 is added so as to determine whether  
the transmission of two-tone alarm is restricted or not.Procedure: [STO] → **9966** → [ENT]In accordance with both the above setting and system  
setting 9953 (Operation on AM mode), the transmission  
of two-tone alarm on AM mode is as follows:

System setting 9966 Setting No.	System setting 9953 Setting No.	TX of two-tone alarm on AM mode
0 (FREE) (Factory setting)	0 (TX/RX)	Possible on all frequencies.
	1 (RX only)	
	2 (No)	Disabled
	3 (2182)	Possible on all frequencies.
1 (LIMITED)	0 (TX/RX)	Possible on all frequencies.
	1 (RX only)	Disabled
	2 (No)	
	3 (2182)	Possible on 2182 kHz only.



**Program number** PROM 0550131117

**Code number** 005-927-440

**Factory modification** From the production in Feb. 1994

**Remarks** The version no. of the ROM on the COUPLER board in the antenna coupler will be changed from 03 to 05 in April 1994 (Minor change). However, ROM version no. 3 remains compatible with the transceiver unit having ROM version no. 17.

Addenda No.32 to FS-5000 Service Manual SM-E5519  
 Addenda No.9 to FS-8000 Service Manual SM-E5521

## FS-5000/8000 New Software (V. 21)

The Convention and the International Regulations were changed and H3E 2182 kHz watch receiver need not be fitted on board a ship after full implementation of GMDSS. Now 2182 kHz is transmitted only on J3E.

According to this change, the software for the FS-5000 was changed as follows.

New software: 05-501-31-121

**Factory-modified sets**

FS-5000 (Control Unit): 2508-1979 and after  
 FS-5000T: 3423 and after  
 FS-8000: From the next production

**Changes to be made**

- 1) System channel 9904 (Emission mode on 2182 kHz): "2:J3E FIX" is added.
- 2) System channel 9923 (Dummy): Default is changed to 1: Prohibited.
- 3) System channel 9953 (AM operation): Default is changed to 0: TX/RX for Japan and 1: RX for other countries.
- 4) System channel 9966 (Two-tone alarm TX): "2: TX prohibited" is added. Default is 0: Free for all countries. If "2: TX prohibited" is selected, regardless of 9953 setting, two-tone alarm is not emitted.
- 5) Two-tone alarm test with dummy load functions as follows.  
 With system channel 9911 set to 1: TX, emission mode depends on the setting on 9904, and output power is Full on H3E and Low-1 on J3E.
- 6) GGA (NMEA sentence) is receivable.
- 7) With 9937 to 9939 (emission mode of TX for REMOTE) set to other than 0: No change, every time after transmission on an ITU channel by the TX KEY, tuning is made. This problem is solved.
- 8) With 9937 to 9939 (emission mode of TX for REMOTE) set to 1: AM, TX cannot be stopped by setting TX KEY to OFF if 9953 is set to other than 1. This problem is solved.
- 9) RX self-test (9914) sometimes ends with NG if AGC is set to SLOW in CW and AM modes. This problem is solved.
- 10) With system channel 9949 set to 1: FAST, AGC remains FAST when the mode is changed from TELEX to SSB. This problem is solved.
- 11) Default of MF power data (FS-2500) is changed to 200 and its upper limit to 255.

⑤

SSB

# Information

Issued by: FURUNO ELECTRIC CO., LTD

APPROVED BY *[Signature]*

SERVICE MANAGEMENT & COMMANDING DEPARTMENT

WRITTEN BY *[Signature]*

Addenda No. 33 to FS-5000 service manual, Pub. No. SME-5519

Addenda No. 10 to FS-8000 service manual, Pub. No. SME-5521

## FS-5000/8000 New CPU/EXC/RX Boards

**Urgency:** When servicing

Three printed circuit boards, CPU, EXC, and RX are modified because the production of PLL IC, M54927P is discontinued. New CPU board recognizes EXC and RX board type, so new CPU board is used with old EXC and/or RX board without modification.

Table 1 lists type and code number of new boards and table 2 shows the compatibility between old and new boards.

Table 1 New p.c. boards

Board name	Type	Code number	Usage
CPU board	05P0347A	005521030	FS-5000T/8000T
RX board	05P0348A	005521140	FS-5000T/8000T
EXC board	05P0349B	005521160	FS-5000T
EXC board	05P0349C	005521170	FS-8000T

⑤

SSB

Table 2 Compatibility between old and new p.c. boards

Board		New transceiver	Old transceiver	Usage
New CPU	05P0347A	X	X	FS-5000T FS-8000T
Old CPU	05P0347	N.A	X	
New RX	05P0348A	X	See next page.	FS-5000T FS-8000T
Old RX	05P0348	X	X	
New EXC	05P0349B	X	See next page.	FS-5000T
Old EXC	05P0349-Z	X	X	
New EXC	05P0349C	X	See next page.	FS-8000T
Old EXC	05P0349A-Z	X	X	

**Factory-modified sets**

FS-2500T/5000T: 2990, 2994, and after

FS-8000T: 0279, and after

## How to use new board in old transceiver

To use new EXC and/or RX board in the old transceiver, follow the procedure below.

1. Change CPU board to new one.
2. Change PROM in FS-5000C to Ver. 0550131124.
3. Change EXC and/or RX board with new one.
4. Connect new CPU board with new EXC (RX) board.

J7 (4P) on CPU board (05P0347A) <<<<>>>> J10 (4P) on EXC board (05P0348B/C)  
 J8 (5P) on CPU board (05P0347A) <<<<>>>> J10 (5P) on RX board (05P0348A)

### Necessary parts

Parts name	Type	Code number	Remarks
PH connector assy.	PH04DK-320	000149706	RX/CPU
PH connector assy.	PH05DK-400	000149707	EXC/CPU
PROM	05501311 <u>24</u>	00592744005	For FS-5000C

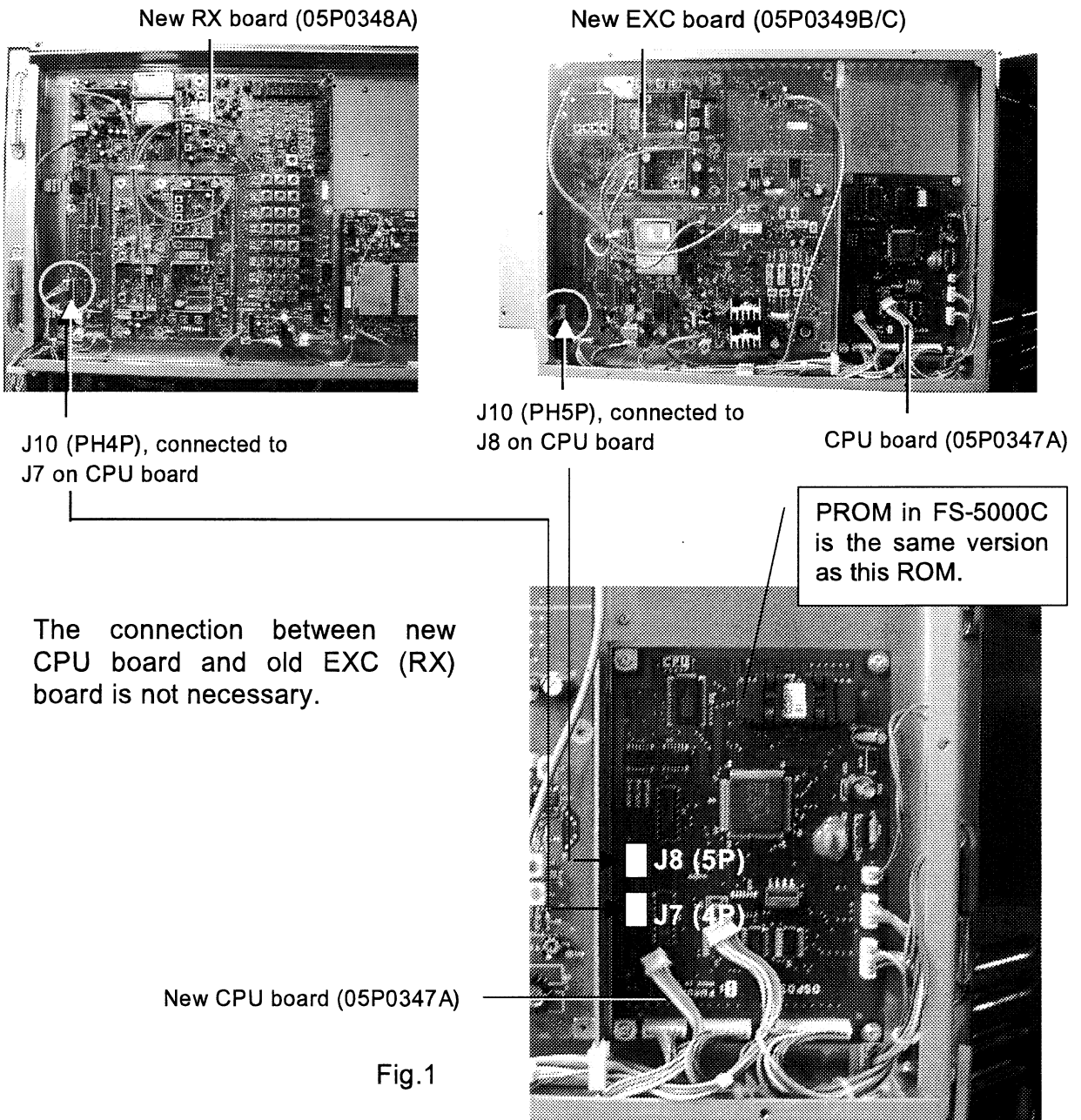


Fig.1

## Automatic board recognition

Board type signal, or "p.c.b type" signal is connected to EXC and RX boards as shown in Fig. 2. The CPU sets the signal to both L and H levels and if the CPU detects the set level, the board is new.

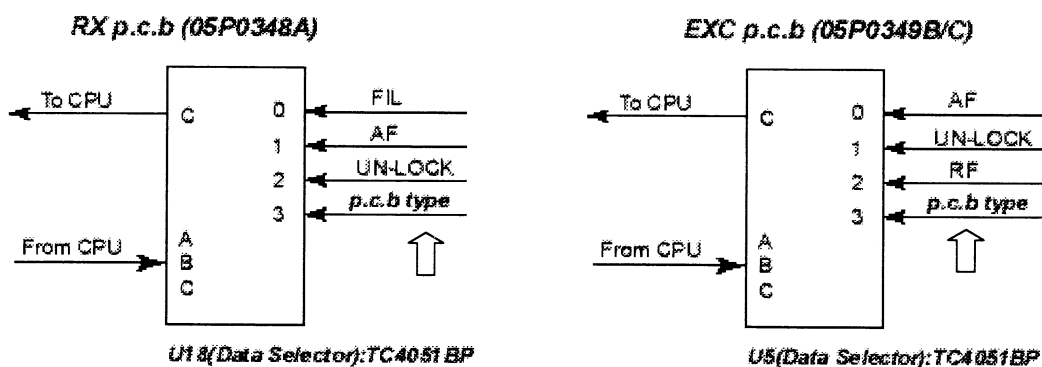
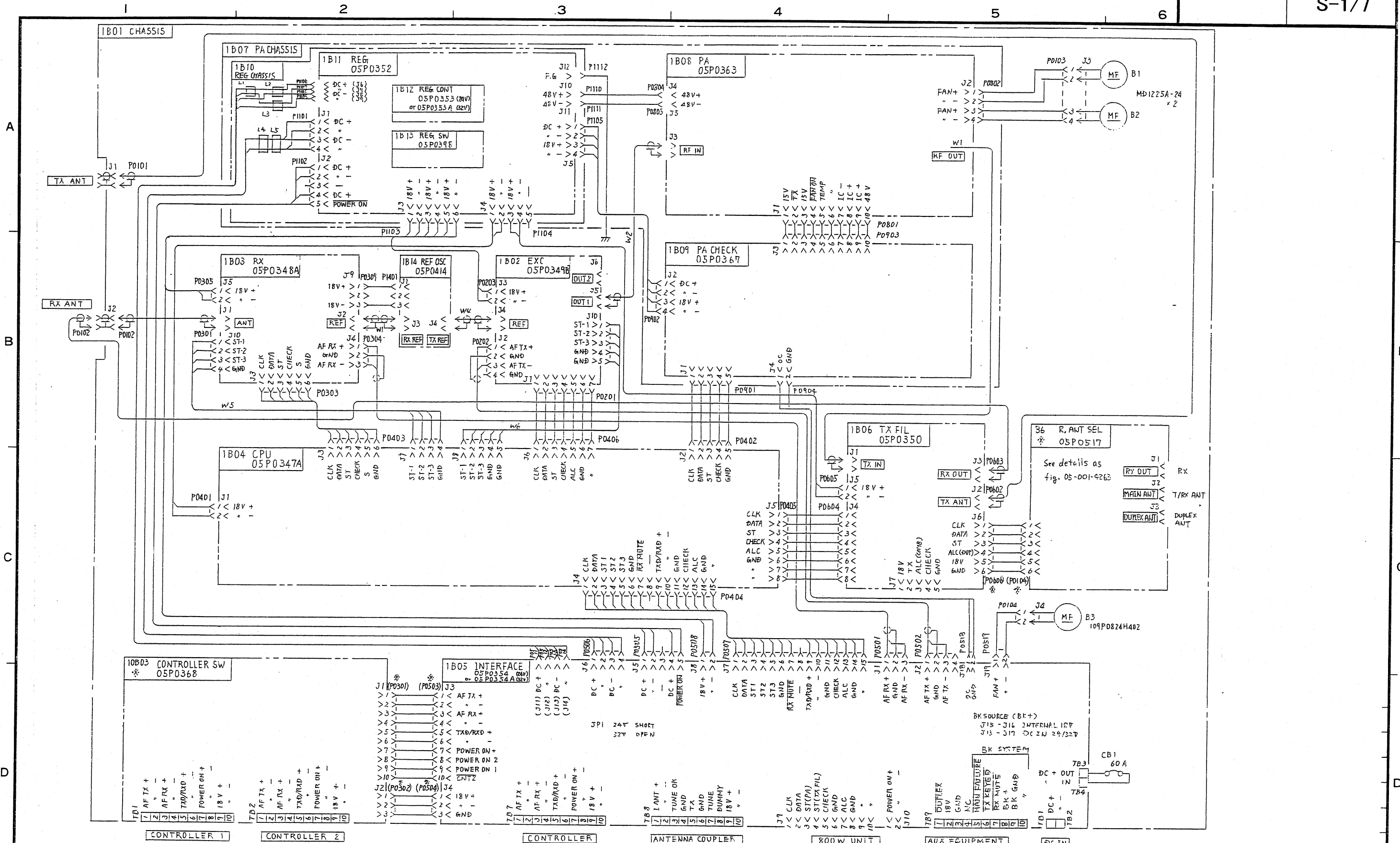


Fig. 2 "p.c.b type" signal lines on EXC and RX boards

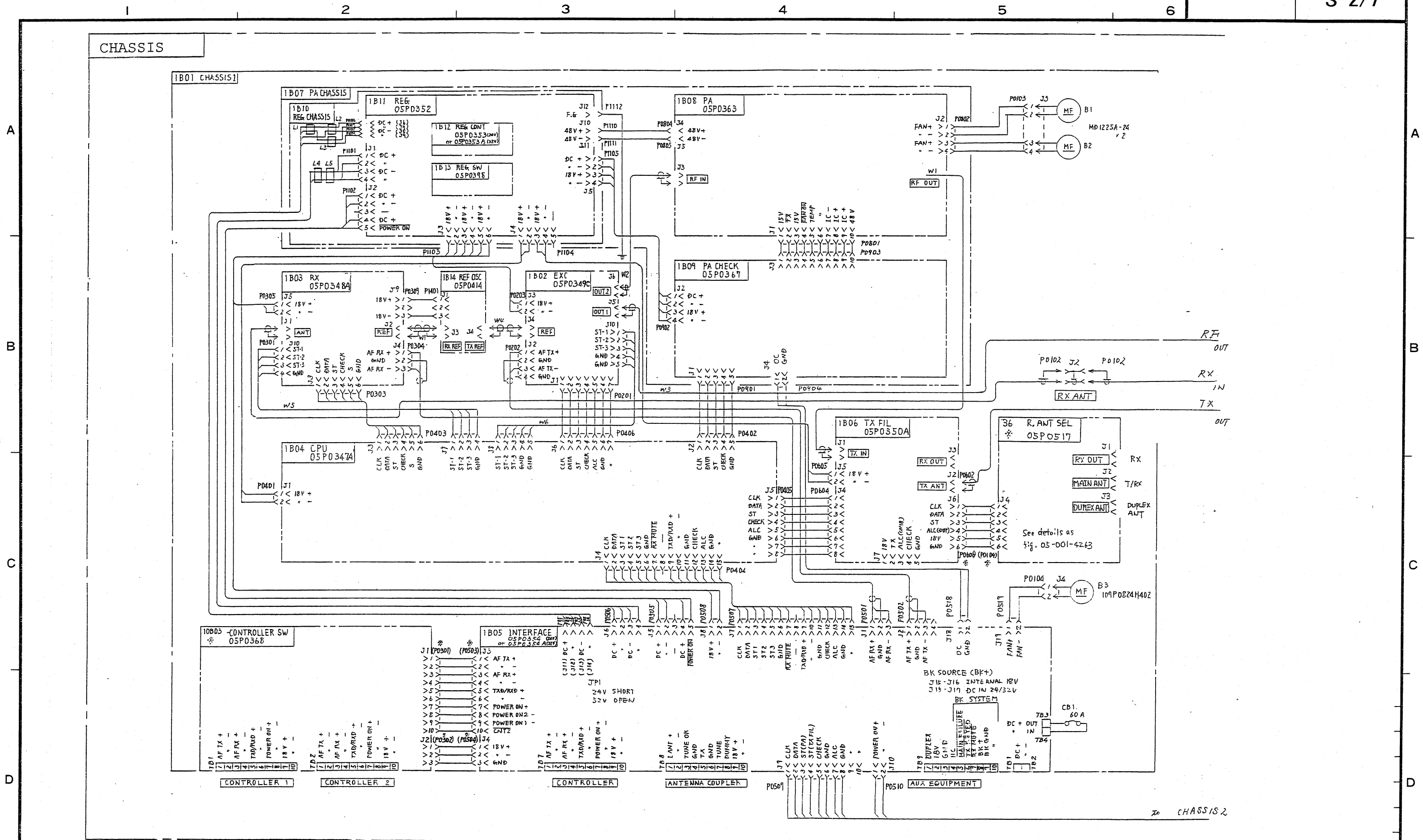
## Difference between 05P0349B and 05P0349C

The EXC board for FS-5000, 05P0349B has a 50-ohm terminator at OUT-2 port, but one for FS-8000, 05P0349C does not. With the FS-5000, the PA is connected to OUT-1 port.



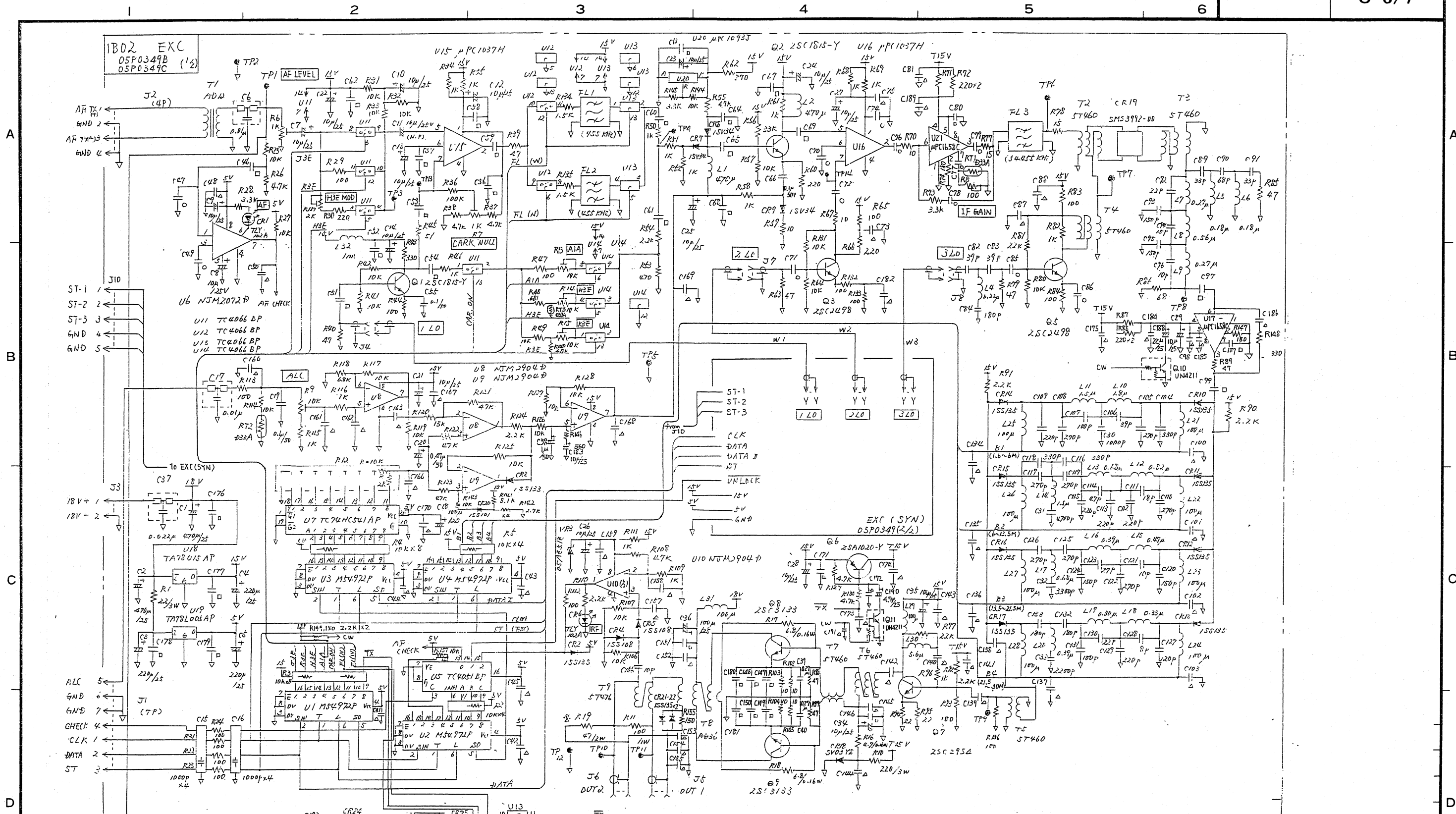
NOTE  
Marks \* are options.

DRAWN 04/03/03 T. YAMASAKI	FS-1600	TYPE FS-500T
CHECKED 04/03/03 T. Takano	FS-2500	名称 送受信部 (総合)
APPROVED 04/03/11 H. Idagawa	FS-5000	回路図
SCALE MASS	MODEL BLOCK No.	NAME TRANSCEIVER UNIT (GENERAL)
Dwg No. C5519-K12-E	05-001-3322-8	SCHMATIC DIAGRAM



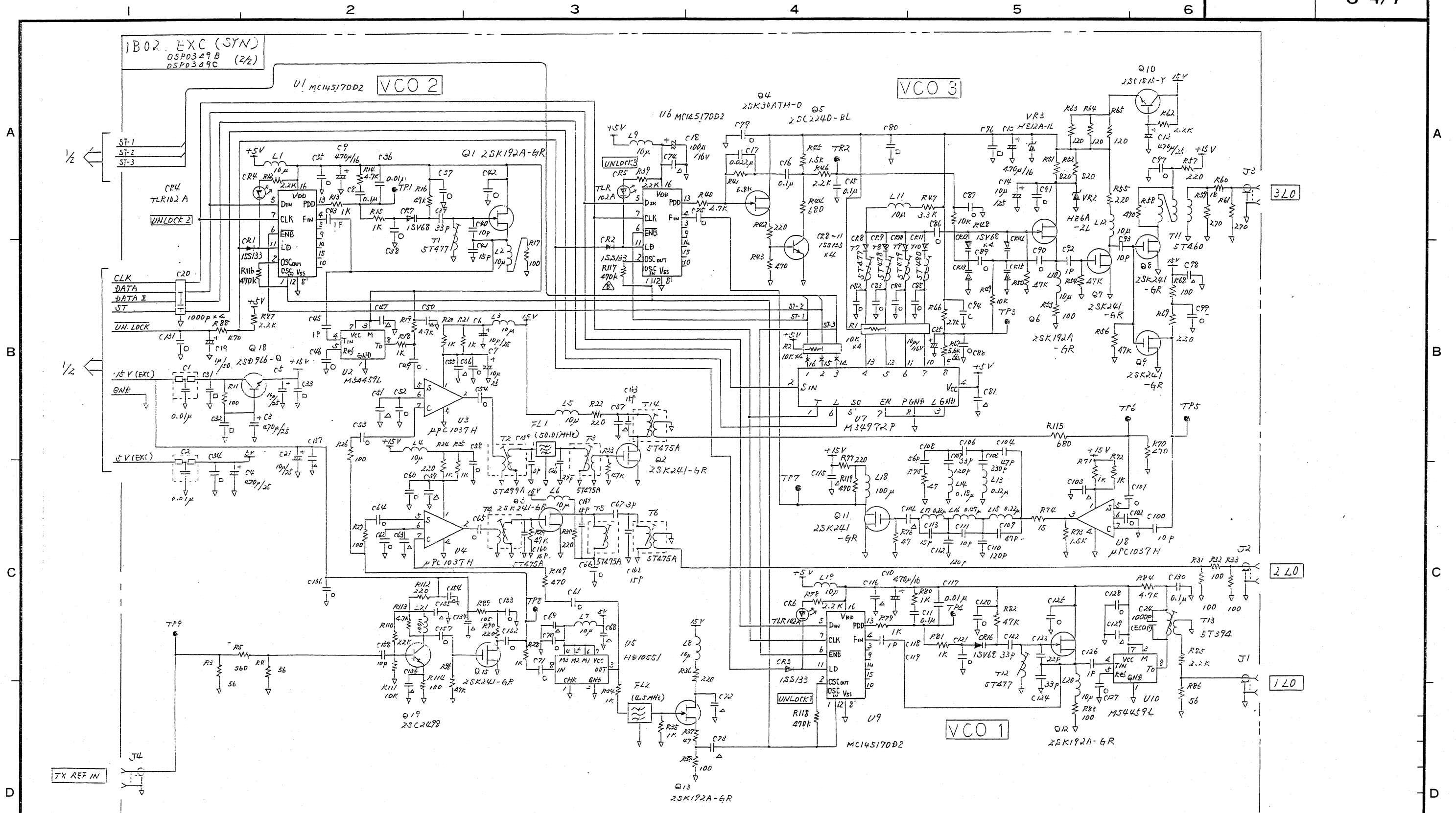
NOTE  
Marks ※ are options.

DRAWN 04/03/03 T. YAMASAKI	TYPE FS-8000T (1/2)
CHECKED 04/03/03 T. Yamasaki	名称 送受信部 (下部)
APPROVED 04/03/11 H. Iwayashi	回路図
SCALE MASS	MODEL FS-8000
Dwg No. C5521-K03-C	BLOCK No. 1B 01
	NAME TRANSCEIVER UNIT (LOWER)
	SCHMATIC DIAGRAM



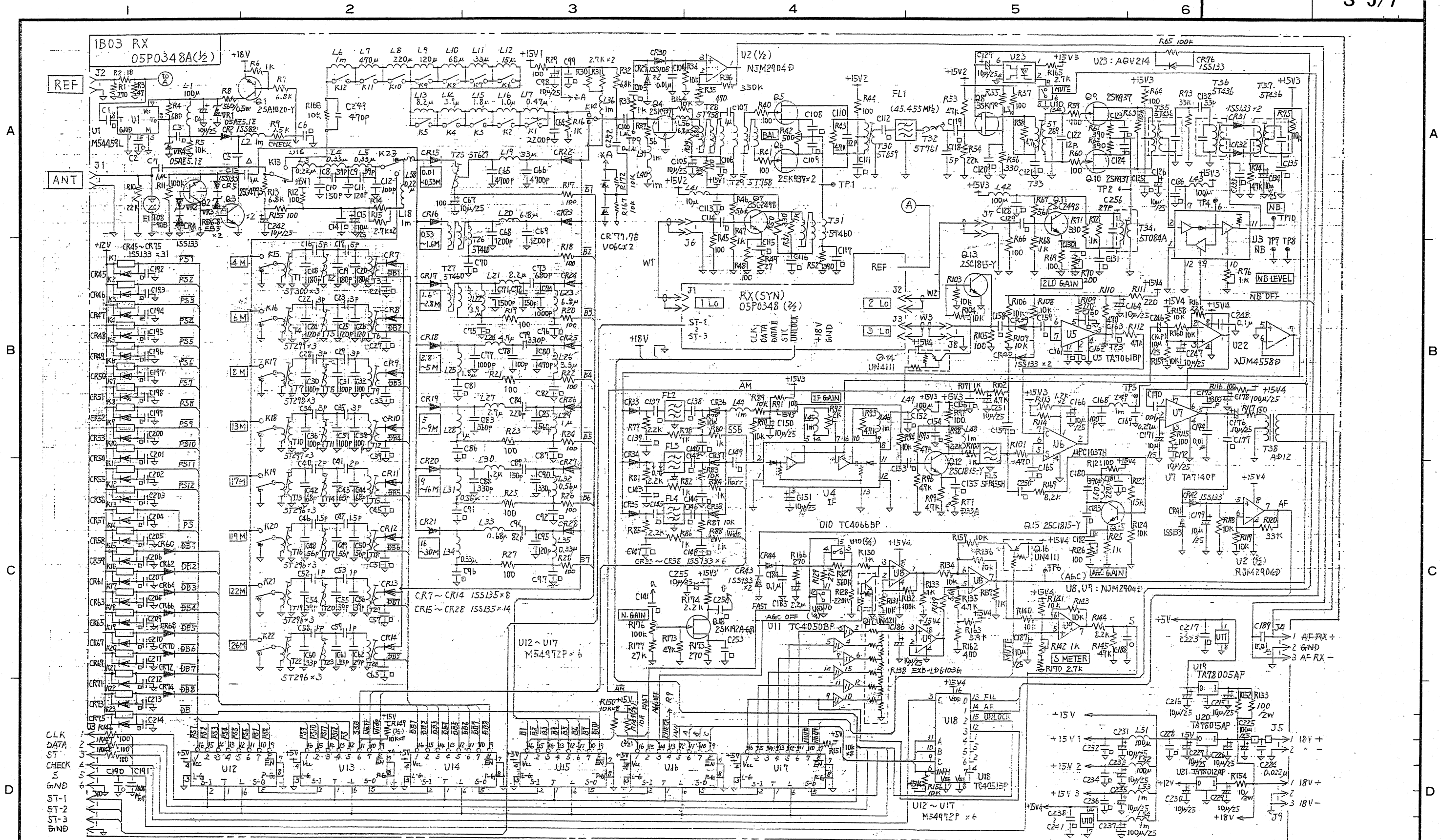
NOTE (1) Resistors are in Ω (0.1W). Capacitors are in F. Inductors are in μH, unless otherwise noted.  
 (2) Marks ○ are 100PF/50WV capacitors. △ are 0.01μF/50WV capacitors and □ are 0.1μF/25WV capacitors.  
 (3) Mark \* R19 not provided for 05P0349A

DRAWN 04/03/03 T. YAMASAKI	TYPE 05P0349B/C (1/2)
CHECKED 04/03/04 T. YAMASAKI	名称 EXC 基板
APPROVED 04/03/04 T. YAMASAKI	回路図
SCALE MASS	NAME EXC PCB
Dwg No. C5519-K09-G	MODEL BLOCK No. 1B 02
	05-001-3323-15
	SCHEMATIC DIAGRAM



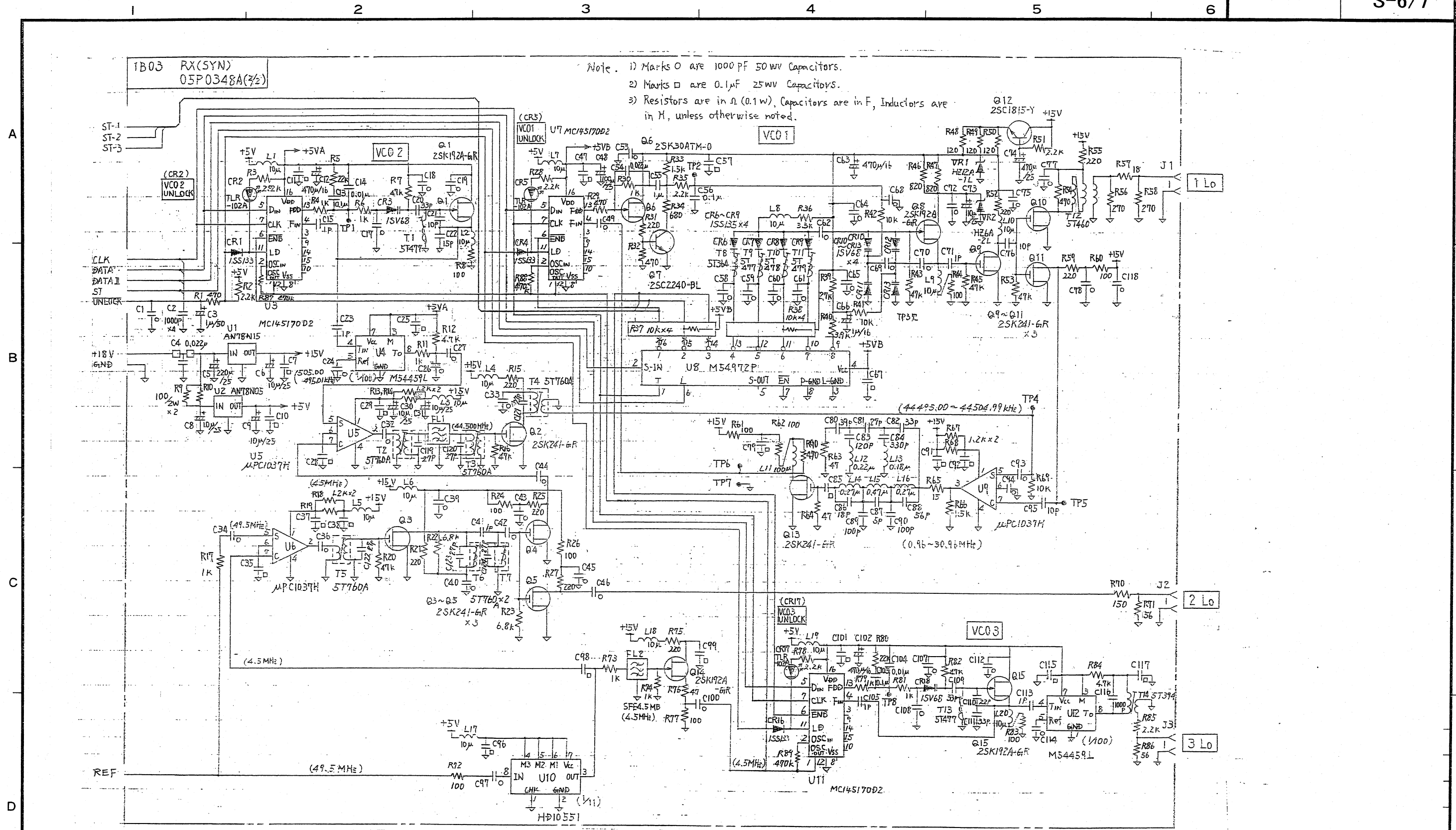
NOTE (1) Resistors are in  $\Omega$  (0.1W), Capacitors are in F.  
 Inductors are in H, unless otherwise noted.  
 (2) Marks  $\circ$  are 1000pF/50WV capacitors.  
 $\triangle$  are 0.01 $\mu$ F/50WV capacitors and  
 $\square$  are 0.1 $\mu$ F/25WV capacitors.

DRAWN 04/03/03 T. YAMASAKI	TYPE 05P0349B/C (1/2)
CHECKED 14/03/04 T. Takano	名称 EXC (SYN) 基板
APPROVED 04/03/11 14. Hayashi	回路図
SCALE MASS	FS-5000T 1B 02
MODEL BLOCK No.	NAME EXC(SYN) PCB
Dwg No. C5519-K10-G	05-001-3323-8
SCHEMATIC DIAGRAM	



Note  
 1) Marks ○ are 1000pF/50WV Capacitors.  
 2) Marks △ are 0.01μF/50WV Capacitors.  
 3) Marks □ are 0.01μF/50WV Capacitors.

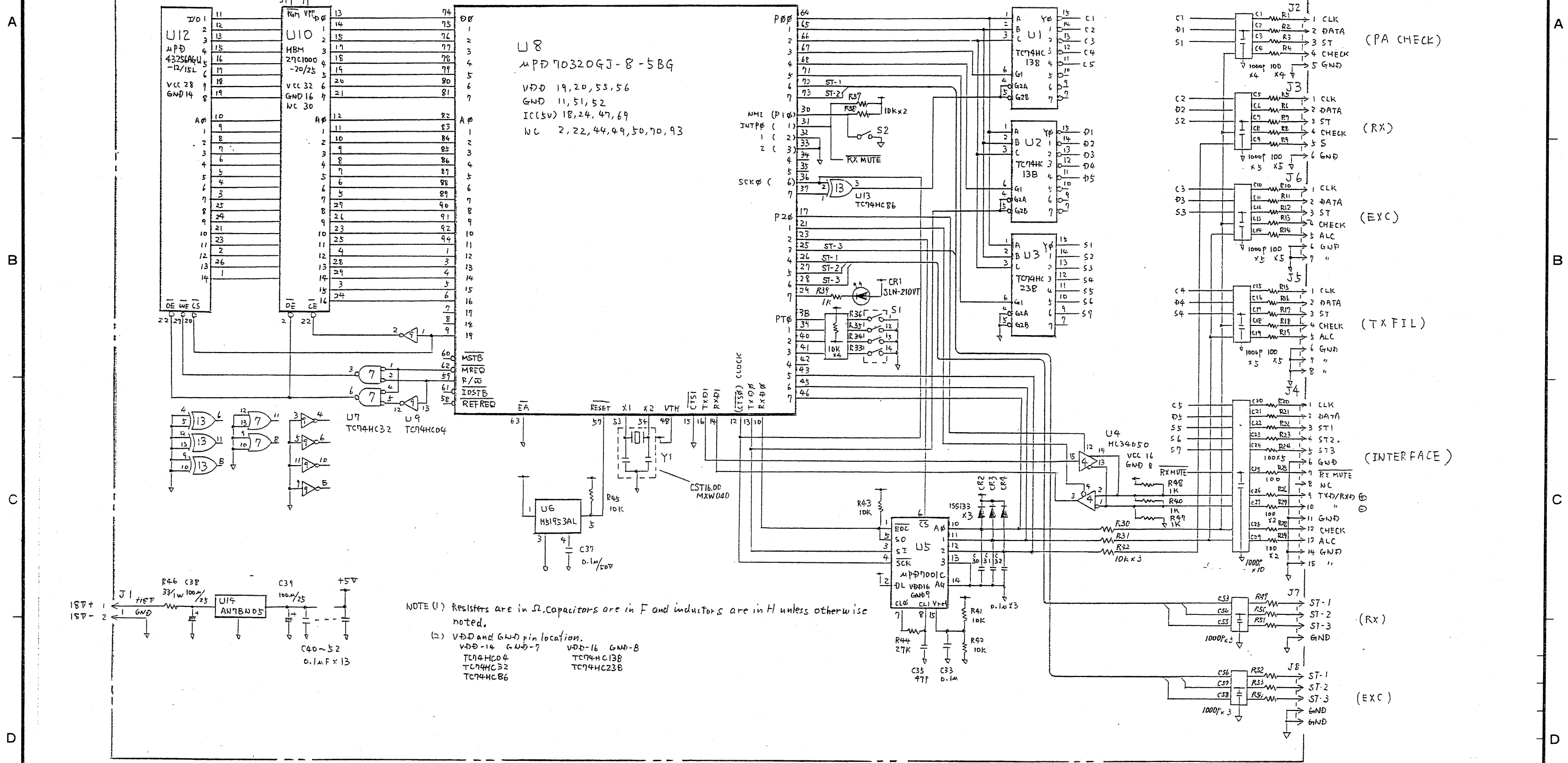
DRAWN 04/03/03 T. YAMASAKI	TYPE 05P0348A (1/2)
CHECKED 04/03/04 T. Takano	名称 RX 基板
APPROVED 04/03/11 M. Suganoh	回路図
SCALE MASS	NAME RX PCB
Dwg No. C5519-K02-F	MODEL BLOCK No.
05-001-3324-16	SCHMATIC DIAGRAM



Note. 1) Marks O are 1000 pF 50WV Capacitors.  
 2) Marks □ are 0.1μF 25WV Capacitors.  
 3) Resistors are in Ω (0.1W), Capacitors are in F, Inductors are in H, unless otherwise noted.

DRAWN 04/03/03 T. YAMASAKI	TYPE 05P0348A (2/2)
CHECKED 04/03/04 T. Takai	名称 RX (SYN) 基板
APPROVED 04/03/11 H. Hayashi	回路図
SCALE MASS	FS-5000T 1B 03
Dwg No. C5519-K03-F	MODEL BLOCK No. NAME 05-001-3324-4 RX(SYN) PCB
	SCHEMATIC DIAGRAM

1B04 CPU  
05P0347A



DRAWN 04/03/03 T. YAMASAKI	TYPE 05P0347A
CHECKED <i>[Signature]</i>	名称 CPU 基板
APPROVED <i>[Signature]</i>	回路図
SCALE MASS	MODEL BLOCK No.
Dwg No. C5519-K08-D	NAME CPU PCB
05-001-3325-2	SCHEMATIC DIAGRAM

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# SPECIFICATIONS OF FS-5000

## GENERAL

- 1) Communication System                      Full duplex, semi-duplex or simplex  
(duplex operation requires receiving antenna)
- 2) Class of Emission                            J3E, (USB, LSB), H3E, R3E, A1A,  
F1B (J2B), J3C
- 3) Frequency Range                            1.6 MHz to 30 MHz
- 4) Number of Channels                      Preset (User):                      400 TX/RX pairs  
ITU SSB:                              current: 192; future: 341  
ITU TELEX:                            current: 338, future: 891  
ITU CW:                                current: 873; future: 518  
DSC:                                    27
- Distress
- DSC:                                    6  
SSB:                                    7  
TELEX:                                 17
- 5) Frequency Accuracy                      ± 10Hz (-20°C to +50°C)
- 6) Dimensions

Unit	Width	Height	Depth	Wt (kg)
Control Unit	358	250	70	2.5
Transceiver Unit	545	377	284	20
Antenna Coupler	400	528	159	5.4

*(dimensions in millimeters)*

- 7) Ambient Temperature Range            -20°C to 55°C
- 8) Power Supply                                24/32 VDC +30%, -10%
- Consumption at 24 VDC  
Receive ----- 3A  
Transmit (SSB) ---- Peak 60A
- 100/110/120/200/220/240 VAC, 1 $\phi$ , 50/60 Hz,  
2.4 kVA (by Rectifier Unit PR-850,  
optional supply)
- 9) Coating Color                              Control Unit front panel:    Munsell N-3.0  
Transceiver Unit:                      2.5GY5/1.5  
Antenna Coupler:                      White

## TRANSMITTER

- 1) Frequency Range 1.6065 MHz to 29.9999 MHz  
(100 Hz steps)
- 2) RF Output Power 400 W pep +0/-1.4 dB (1.6 - 25.5 MHz)  
at 50 ohm load  
(@ 24 VDC, IEC rec.)  
Reduction to 60 W pep or less
- 3) Modulation AF Response 350 Hz to 2700 Hz
- 4) Keying Speed CW: 25 bauds    TELEX: 100 bauds
- 5) AF Input -46 dBm/600 ohms
- 6) Tone Frequency 1500 Hz
- 7) Accessories Two-tone alarm generator

## RECEIVER

- 1) Receiving System Double conversion superheterodyne  
IF: 45455 kHz and 455 kHz
- 2) Frequency Range 10 kHz to 29.9999 MHz  
(10 Hz steps)
- 3) Sensitivity Input level at 50 ohms to produce  
SINAD 20 dB

Frequency Range	SSB	AM
100 kHz to 300 kHz	25 dBuV	30 dBuV
300 kHz to 1.6 MHz	15 dBuV	29 dBuV
1.6 MHz to 30 MHz	3 dBuV	17 dBuV

- 4) Intermodulation 90 dB $\mu$ V (CEPT method test)
- 5) Cross Modulation 94 dB $\mu$ V (CEPT method test)
- 6) Selectivity J3E/R3E: 350 to 2700 Hz  
H3E:  $\pm$ 3 kHz  
A1A/F1B:  $\pm$ 150 Hz
- 7) AF Output Power Internal speaker: 2 W/8 ohms  
External speaker: 4 W/4 ohms  
Handset: 10 mW/200 ohms
- 8) Standard Features Scan, Sweep, Noise Blanker, Voice-activated  
Squelch, Preselector (for MF)

## ANTENNA COUPLER

- |                               |   |
|-------------------------------|---|
| 1) Tuning System              | CPU controlled<br>manual tuning possible for 2182 kHz |
| 2) Frequency Range            | 1.6 MHz to 30 MHz                                     |
| 3) Input Impedance            | 50 ohms   |
| 4) Required Antenna           | 7 to 18 meter wire and/or whip                        |
| 5) Tuning Power               | 10 W  |
| 6) VSWR                       | 1.5 max.  |
| 7) Tuning Speed               | 0.2 to 2 sec. typical. 15 sec. max.                   |
| 8) SOLAS Dummy Load           | Internal (10 ohms + 250 pF), optional supply          |
| 9) Antenna BK Relay           | Internal, optional supply                             |
| 10) Ambient Temperature Range | -30°C to +70°C  |
| 11) Relative Humidity         | 95% @ 35°C  |

## MISCELLANEOUS FUNCTIONS

- 1) Ship's L/L Position display (inputs for CIF/NMEA format sentences)
- 2) Timer
- 3) Digital Selective Calling (DSC) & Narrow Band Direct Printing (NBDP) possible
- 4) Intership FAX connection possible

## COMPASS SAFE DISTANCE

	Standard (m)	Steering (m)
Control Unit	0.9	0.7
Transceiver Unit	2.0	1.5
Antenna Coupler	1.0	0.7
Rectifier Unit	1.5	1.2

# CHAPTER 1 BLOCK DESCRIPTION

---

## 1. GENERAL

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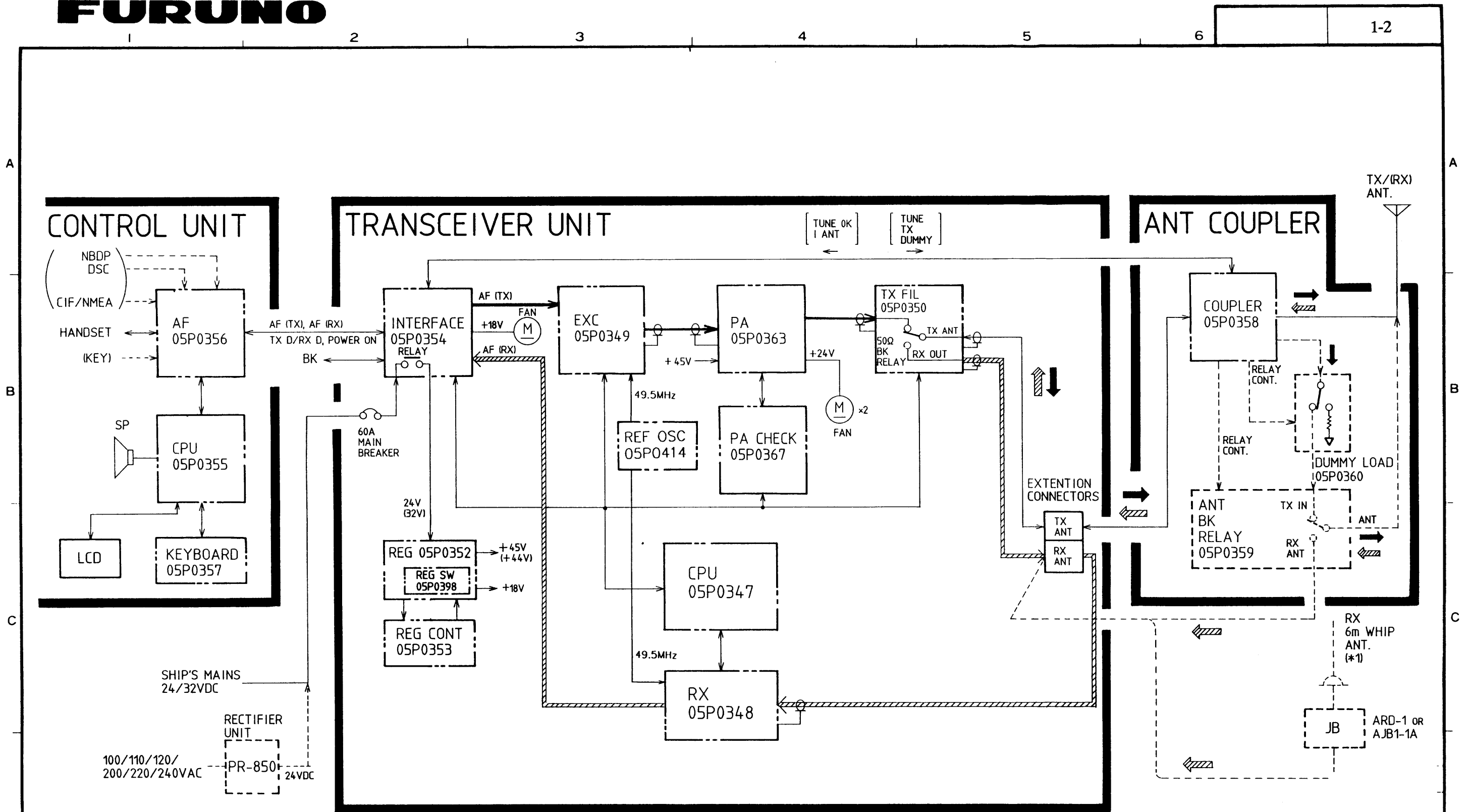
As shown in the block diagram on the next page, the FS-5000 consists mainly of a Control Unit, a Transceiver Unit and an Antenna Coupler, and operates from 24/32VDC mains. For AC mains, a rectifier unit (PR-850) is required.

MIC signal amplified thru the AF board is converted to SSB signal in the EXC board. SSB signal is amplified in the PA board to produce 400W<sub>pep</sub> output power at the transceiver unit. The signal is then fed to the COUPLER board in the antenna coupler via a 50 ohm BK relay in the TX FIL board, to make impedance matching (automatic tuning) between the transceiver unit and antenna.

RF signal received by the antenna passes through the COUPLER board (tuned for TX frequency) and the TX FIL board, and is fed to the RX board which converts it to AF signal. The AF signal is amplified in the AF board up to the level high enough to drive the speaker. If the ANT BK RELAY board (optional) is mounted in the antenna coupler or a speciality receiving antenna is installed, the RF signal is directly applied to the RX board. (Signal does not pass thru the COUPLER board.)

Data communication between the CPU boards in the control and transceiver units is executed thru the AF and INTERFACE boards. And data communication between the CPU board in the transceiver unit and the CPU in the COUPLER board is done thru the INTERFACE board.

The ship's mains of 24VDC (or 32VDC) is applied to the REG board in the transceiver unit via the INTERFACE board to produce +18V and +45V (or +44V) for the PA board.



(\*1) WHEN DUPLEX COMMUNICATION IS REQUIRED, INSTALL JUNCTION BOX AND RX ANT. OPTIONALLY.  
 (\*2) BROKEN LINES-----OPTIONAL SUPPLY.

承認 APPROVED	JUN. 20. '90 T. NAKANO	名称 TITLE	FS-5000 BLOCK DIAGRAM
検図 CHECKED	JUNE 20. '90 M. IKEDA	図番 DWG. NO.	E5519-B04-B
製図 DRAWN	JUNE 20. '90 T. SAITO		

## 2. FUNCTION OF EACH BOARD

Unit	Board Name	Major Function
Control Unit	AF (05P0356)	<ul style="list-style-type: none"> <li>● Amplification of AF and MIC signals (-46dBm → 0dBm).</li> <li>● Squelch control</li> <li>● Interface with combined equipment (REM 1 to 3).</li> <li>● Driving loudspeaker.</li> </ul>
	CPU (05P0355)	<ul style="list-style-type: none"> <li>● Data communications with keyboard and Transceiver Unit.</li> <li>● Control of wake-up timer, LCD contrast and keyboard dimmer.</li> <li>● Storing power data &amp; user channel data in E<sup>2</sup>PROM.</li> </ul>
Transceiver Unit	EXC (05P0349)	<ul style="list-style-type: none"> <li>● Power control (by ALC voltage &amp; power data).</li> <li>● Conversion of TX signal from AF to RF.</li> <li>● Control of synthesizer circuit (PLL).</li> </ul>
	PA (05P0363)	<ul style="list-style-type: none"> <li>● Power Amplification (31dB approx.).</li> <li>● Detection of high temp. (≥ 80°C) &amp; excessive collector current (≥24.5A), for power reduction.</li> </ul>
	PA CHECK (05P0367)	<ul style="list-style-type: none"> <li>● Indication of Ic, Vc and Vs (ship's mains).</li> </ul>
	TX FIL (05P0350)	<ul style="list-style-type: none"> <li>● SWR detection for power reduction.</li> <li>● Detection of ALC peak voltage.</li> </ul>
	RX (05P0348)	<ul style="list-style-type: none"> <li>● RF amplification.</li> <li>● AGC &amp; NB controls.</li> <li>● Conversion of RX signal from RF to AF.</li> <li>● Control of synthesizer circuit (PLL).</li> </ul>
	REF OSC (05P0414)	<ul style="list-style-type: none"> <li>● Reference oscillation of 49.5MHz for EXC/RX boards.</li> </ul>
	CPU (05P0347)	<ul style="list-style-type: none"> <li>● Data communications with Control Unit and Antenna Coupler.</li> <li>● Read-in check signals (check meter data &amp; self check data) from each board.</li> </ul>
	INTERFACE (05P0354)	<ul style="list-style-type: none"> <li>● Starter of power supply.</li> <li>● Interface among three units.</li> </ul>
	REG/REG SW/ REG CONT	<ul style="list-style-type: none"> <li>● Producing +18V and +45V (or +44V).</li> </ul>
Antenna Coupler	COUPLER (05P0358)	<ul style="list-style-type: none"> <li>● Automatic tuning (by detecting SWR and antenna current).</li> </ul>

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## 3. TX SIGNAL

---

Refer to the block diagram on the next page.

MIC signal of  $-46\text{dBm}/600\text{ ohms}$  is amplified up to  $0\text{dBm}$  by U2 and U3 on the AF board, and sent to the EXC board to produce SSB signal. If the input signal level at TP1 exceeds a threshold level, CR1 (AF) lights. The AF signal is mixed with the 1st local oscillation frequency at U15 and passes through filter FL1 (SSB) or FL2 (telex). R13/R14/R15 function to adjust the carrier injection level for A1A/H3E/R3E, respectively.

The power control circuit composed of PIN diodes is on the EXC board. Both the ALC (Automatic Level Control) voltage picked up by the TX FIL board and the power data read out from the CPU board control the output power of the transceiver unit by changing the resistance of PIN diodes according to the voltage at U9 output. ALC pot (R9) is adjusted so that the output power is limited to  $400\text{W}_{\text{pep}}$ .

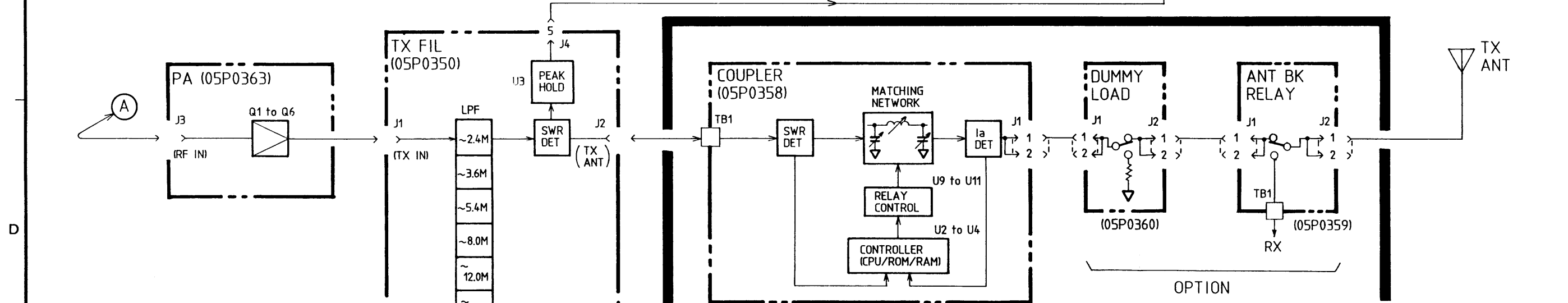
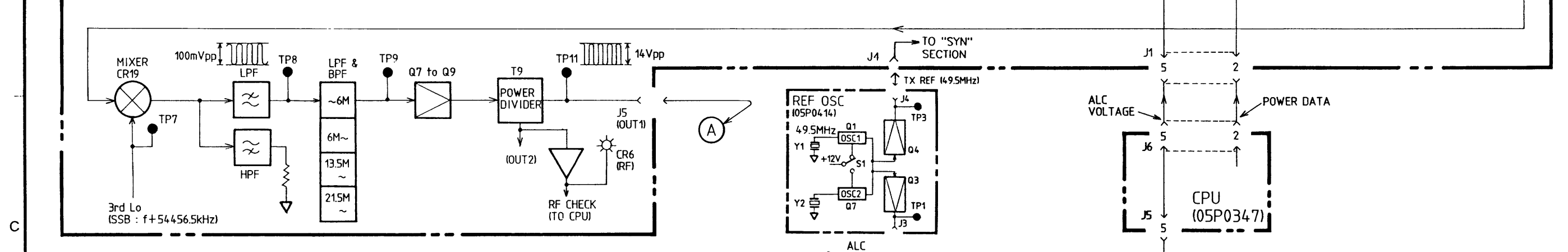
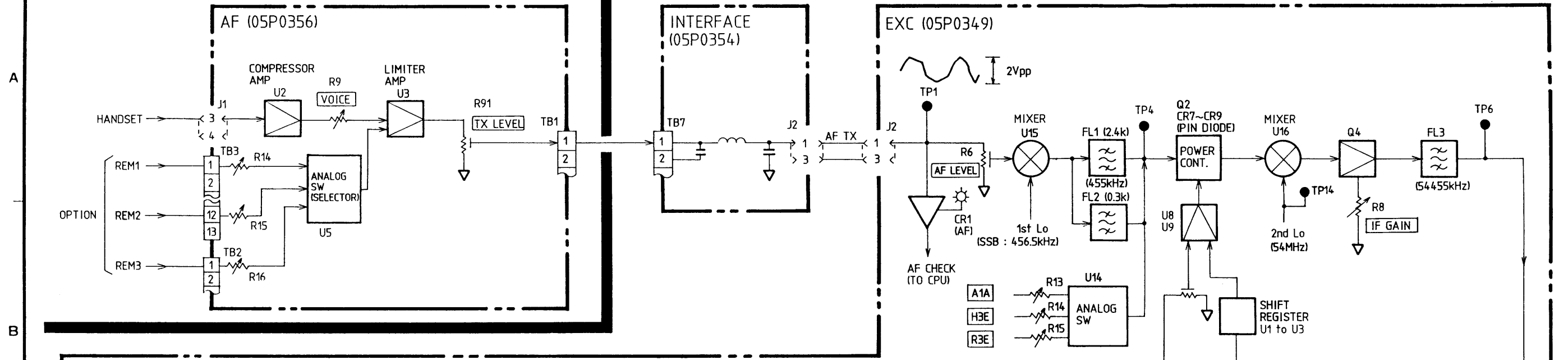
After the signal is mixed with the 3rd local oscillation frequency at CR19, it passes through a diplexer made up of a LPF and a HPF to reduce harmonic frequencies with minimum power loss. The amplified signal thru Q7 to Q9 is divided into two lines ("out 1" & "out 2" terminals). The "out 1" terminal is used in the FS-5000 and both the "out 1" & "out 2" terminals are for the FS-8000 ( $800\text{W}$ ).  $14\text{V}_{\text{pp}}$  approx. is obtained at TP11.

The PA board amplifies the signal by  $31\text{dB}$  approx. The signal from the PA board is fed to the TX FIL board, composed of filters, and is sent to the COUPLER board.

The COUPLER board has a CPU which keeps a close watch on SWR and antenna current ( $I_a$ ). The CPU drives the relays which select optimum L-C combination so that SWR gets below 2.0 and  $I_a$  is maximum. If the best tuning point is not detected, the RF output signal bypasses the matching network.

## CONTROL UNIT

## TRANSCEIVER UNIT



## ANTENNA COUPLER

承認 APPROVED	JUN. 20. '90 T. NAIKANO	名称 TITLE	BLOCK DIAGRAM OF TRANSMITTER
検図 CHECKED	June 20. '90 M. IKEDA	図番 DWG. NO.	E5519-B05-B
製図 DRAWN	JUNE 20. '90 T. SAITO		

FS-5000

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## 4. RX SIGNAL

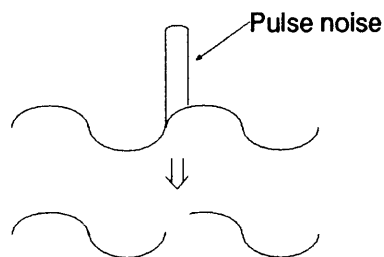
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Refer to the block diagram on page 1-8. Unless a speciality receiving antenna or "Antenna BK Relay" is connected, the RF signal passes through the matching network of the COUPLER board which is tuned to the TX frequency (if the difference between TX freq. and RX freq. is large, some of the received signal may be lost in the matching network), and is applied to the RX board. If the ANTBKRELAY board or the receiving antenna is installed, the RF signal is directly applied to the RX board (in this case, signal is not attenuated by the matching network).

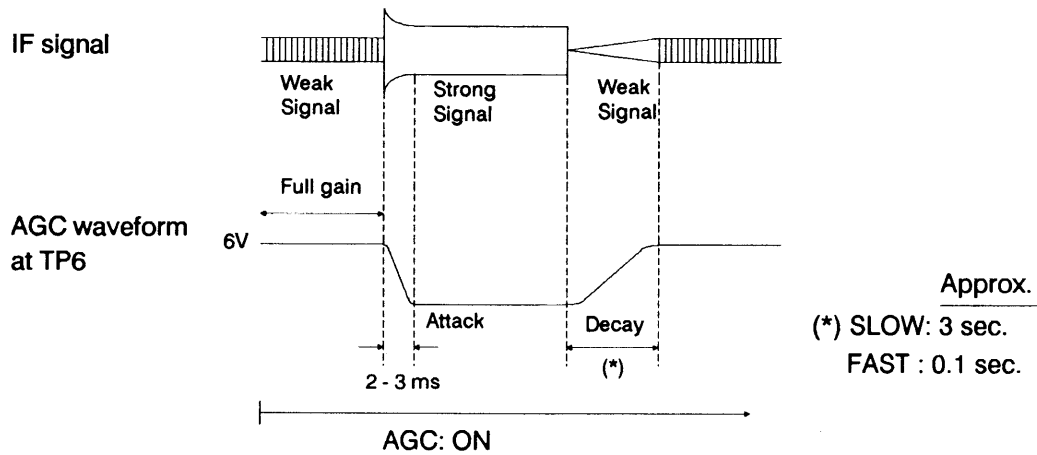
Relay K13 turns on if the [ON] key is pressed when the frequency is below 4.5MHz. When K13 turns on, the coils which form a preselector circuit are relay-controlled to tune the receiver to the antenna (for cancellation of capacitance components of antenna).

When the receiving frequency is higher than 4.5MHz, the RF signal passes through the protector (limiter) to cut off the signal more than 14Vpp, and is applied to the band-pass filter or duplex filter (for duplex operation) depending on the key command selected.

The second IF signal is fed to the noise blanker (NB) circuit. When the [NB] key is pressed, the NB detector (U3) becomes conductive and detects pulse noise, whose threshold level is controlled by R76. Since the NB gate consisting of CR31/CR32 turns off during "pulse" period, the noise can not pass thru the gate.

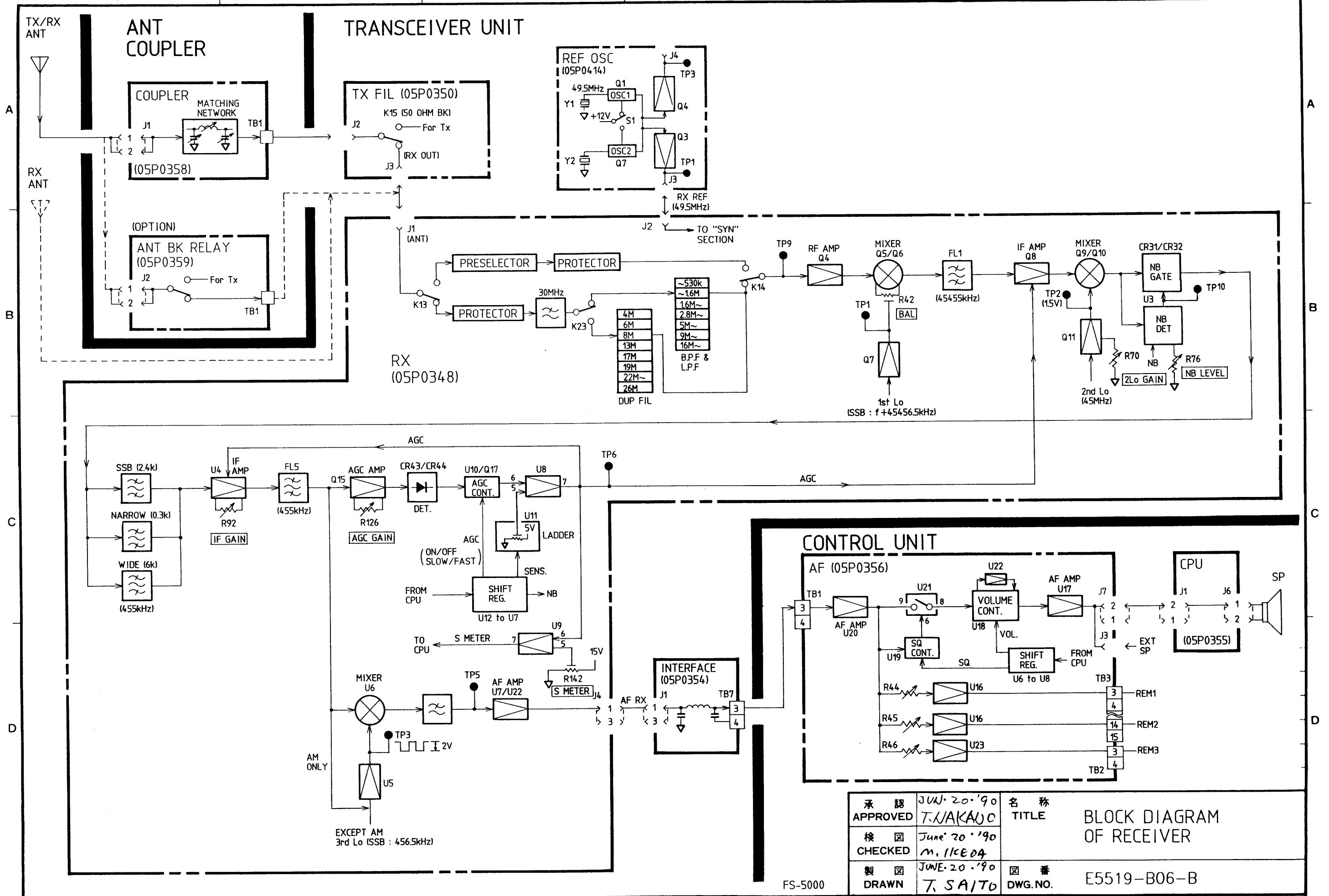


The 455kHz IF signal is amplified by U4 and divided into two lines; one is for the AGC circuit (composed of Q15, CR43/CR44, Q17, U8 to U10), the other for audio output. The IF signal amplified by Q15 is detected by CR43/CR44. When AGC is turned off through the keyboard, the IF signal does not pass through the AGC circuit, causing the voltage at TP6 (output of differential amplifier U8) to vary depending on the sensitivity setting (pin #5 of U8) selected through the keyboard (2V to 6V). When AGC is on, the voltage at TP6 changes according to the IF signal level as well as the sensitivity setting. The output of U8 is applied to IF amplifiers Q8/U4 and differential amplifier U9 which detects signal strength for the S meter. The voltage at pin #5 of U9 is adjusted for 6V approx. by R142 (S METER) at the factory.



The IF signal is mixed with the 3rd local oscillator frequency to convert it to the AF signal. The AF signal is amplified by U20 on the AF board and applied to the SQ (squelch) circuit composed of U19/U21. When the SQ circuit is turned on through the keyboard, U19 functions so that voice signal, of which the frequency is lower than 1kHz (60ms or more consecutively), passes thru U21 and noise consisting of frequency higher than 1kHz (1.3 sec or more consecutively) does not pass.

R44 thru R46 serve to adjust the line out level for peripheral equipment such as NBDP, DSC terminal, selcall, etc.



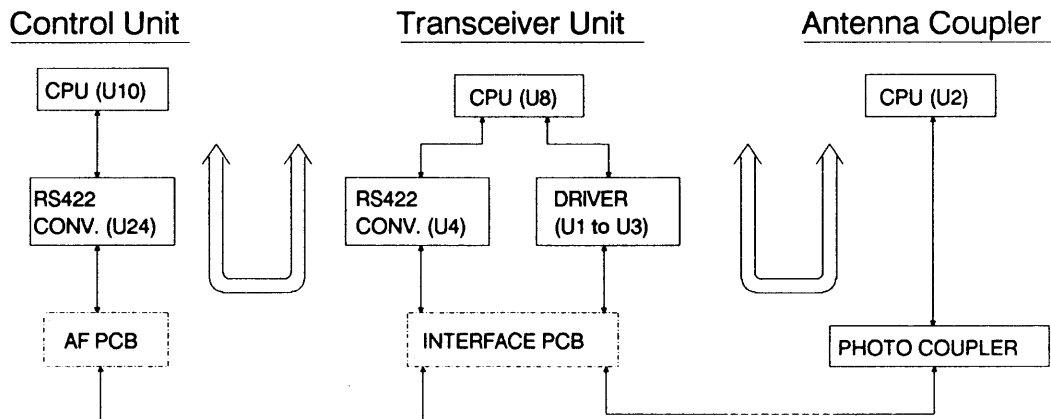
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## 5. SYSTEM CONTROL

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### 5.1 CPU's Data Communications

The figure below and the block diagram on page 1-11 show CPU's data communications among three units.



### 5.2 CPU Board in the Control Unit

The CPU (U10) in the Control Unit controls the following:

- 1 Command from/to keyboard
- 2 IRQ (Interrupt Request) command (U16)
- 3 LCD driver (U14)
- 4 LCD contrast & keyboard dimmer
- 5 Input/Output of CIF/NMEA data & REM1 to REM3 data

E<sup>2</sup>PROM U1 memorizes the power data and user channel data entered through the keyboard. ROM U9 memorizes all the ITU/DSC frequency data.

When the present time agrees with the wake-up time set by operator, the ALARM signal is produced in the RTC (Real Time Control, U11) to activate U20, causing the power supply circuit in the transceiver unit to turn on.

The CPU (U10) transfers the frequency, class of emission and bandwidth data to the CPU of the transceiver unit and receives the check data, such as data for check meter and results of self-check. CR1 blinks when the CPU is operating properly.

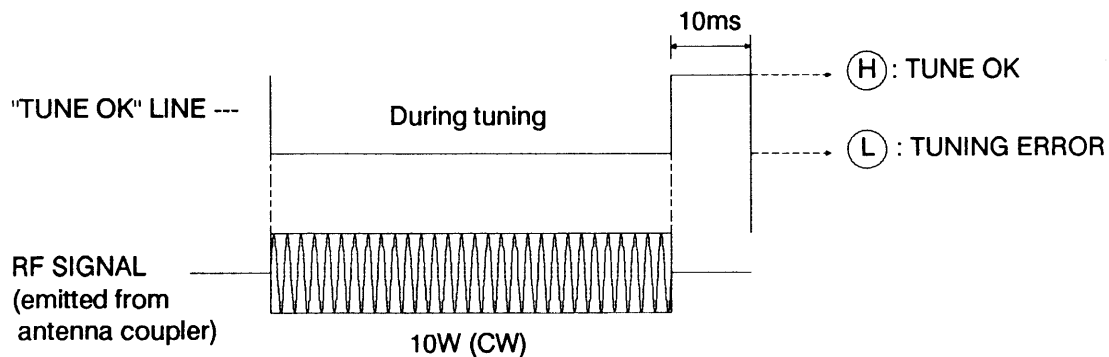
### 5.3 CPU Board in the Transceiver Unit

Data transfer and reception in the CPU (U8) in the Transceiver Unit are executed via drivers U1 to U3 and AD converter U5, respectively. The serial data produced by the CPU is converted into parallel data by the shift registers on each board in the Transceiver Unit.

The CPU sends the "TUNE", "TX" and "DUMMY" commands to the antenna coupler and receives "TUNE OK" command and antenna current data from the coupler.

### 5.4 COUPLER Board in the Antenna Coupler

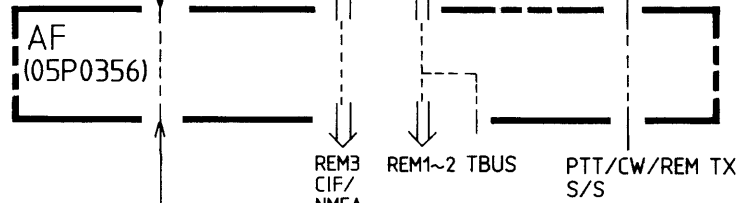
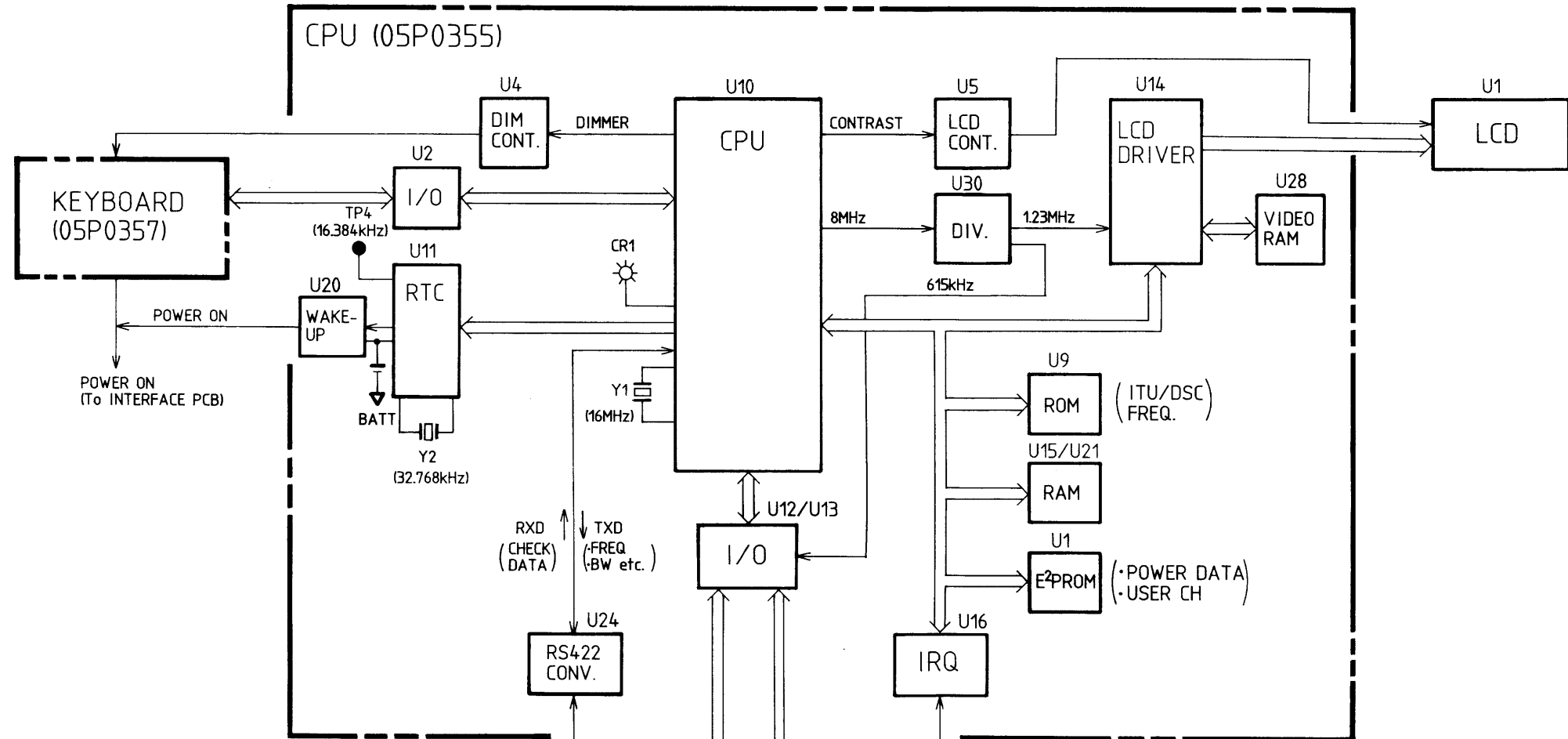
When the CPU (U2) in the Antenna Coupler acknowledges the "TUNE" command from the transceiver unit, it begins driving the relays whose function is to select the components of the matching network for best tuning by checking the SWR and antenna current. For instance, the relays are activated so that the SWR value becomes the lowest ( $< 2.0$ ) and antenna current becomes maximum. If the best tuning point is detected, the "TUNE OK" command is outputted from the CPU to the transceiver unit, since "TUNE OK" line level goes high 10ms after tuning is completed. If it is not detected, the "TUNING ERROR" command is outputted because "TUNE OK" line level goes low. The TX signal is divided by counter U12 and fed to RAM U4 as a address data for automatic tuning. For details of the automatic tuning circuit, refer to page 1-12. The contents of the RAM are preserved for approximately one week by the charge in C79 (0.1F).



For automatic tuning without keyboard operation press the [TUNE] button (S3) on the COUPLER board.

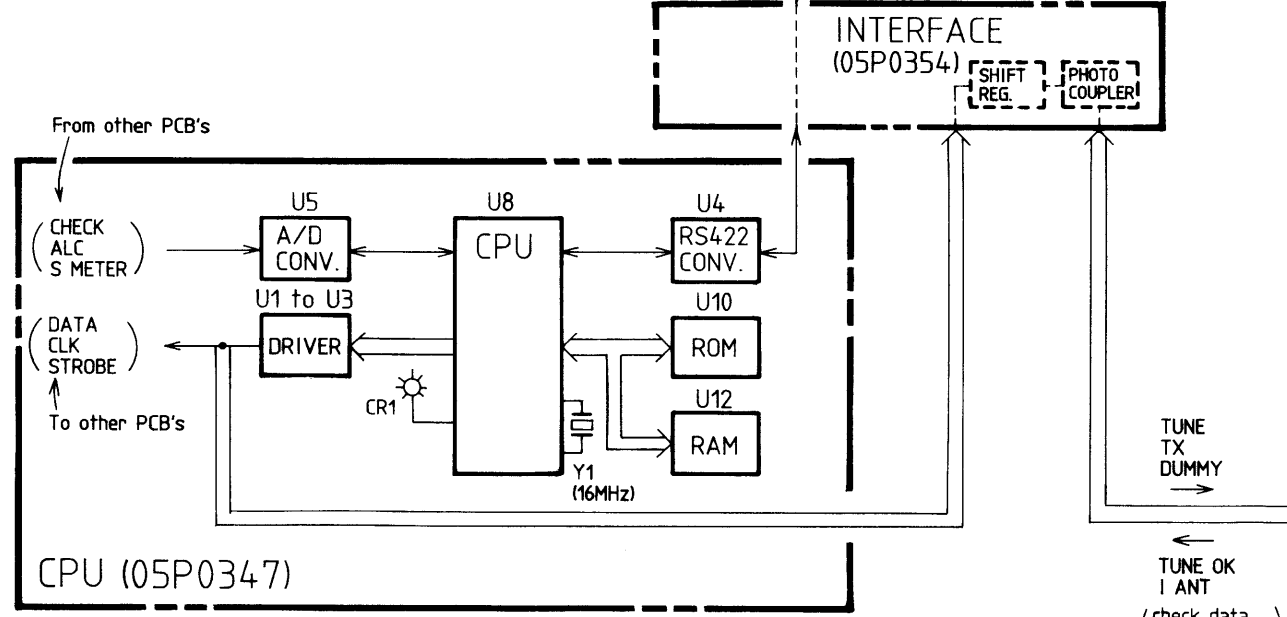
To check the Antenna Coupler for proper operation, press the [CHECK] button (S2) on the COUPLER board. The relays start chattering and LEDs CR37 to CR57 blink one by one in ascending order. If device failure is found, an appropriate LED lights to indicate the offending device:

<u>Device</u>	<u>LED</u>
ROM (U3) -----	CR37
RAM (U4) -----	CR38
A/D Converter IC (U8) -----	CR39

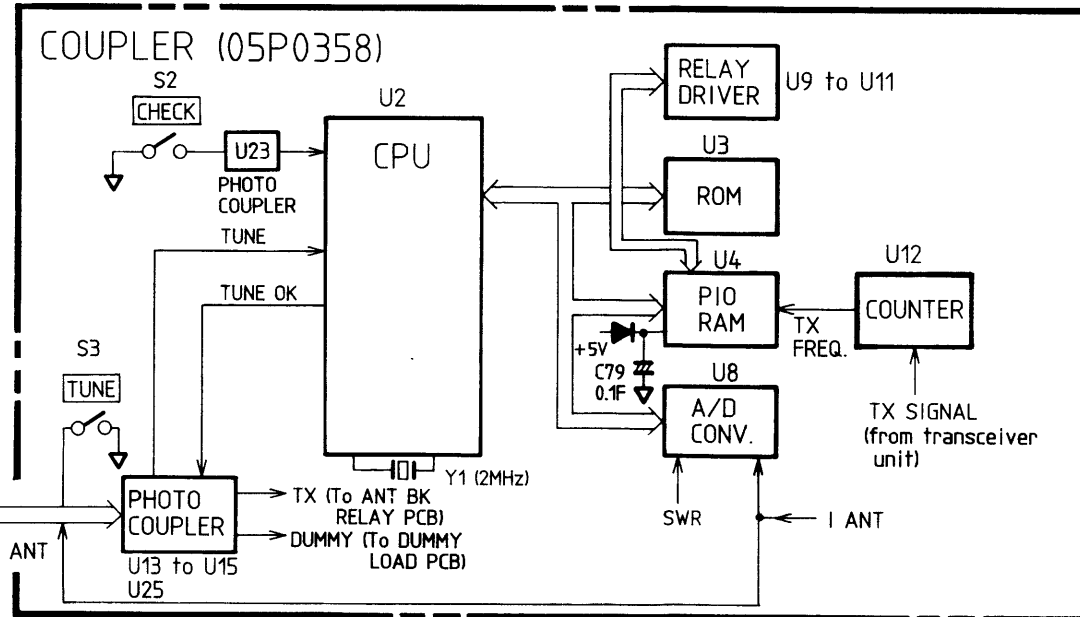


**CONTROL UNIT**

**TRANSCEIVER UNIT**

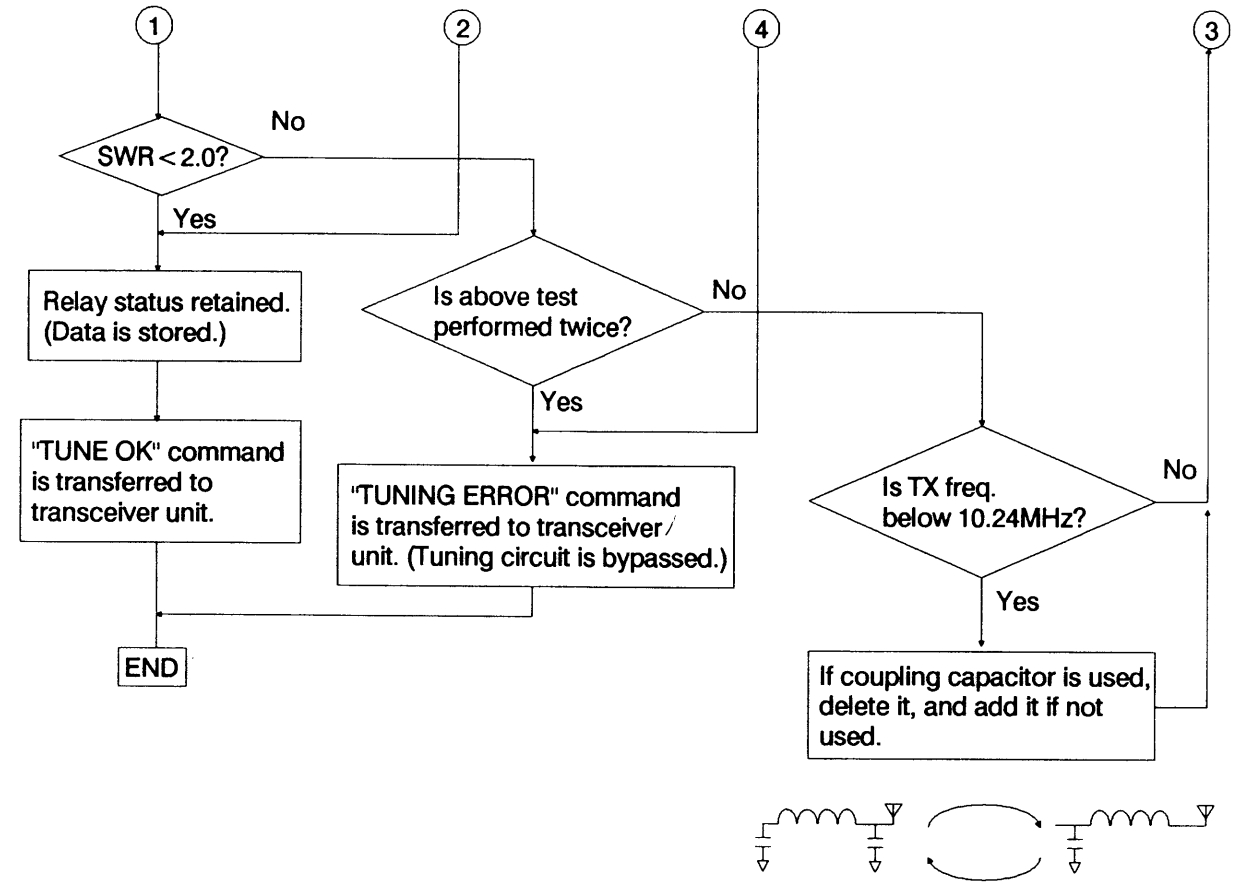
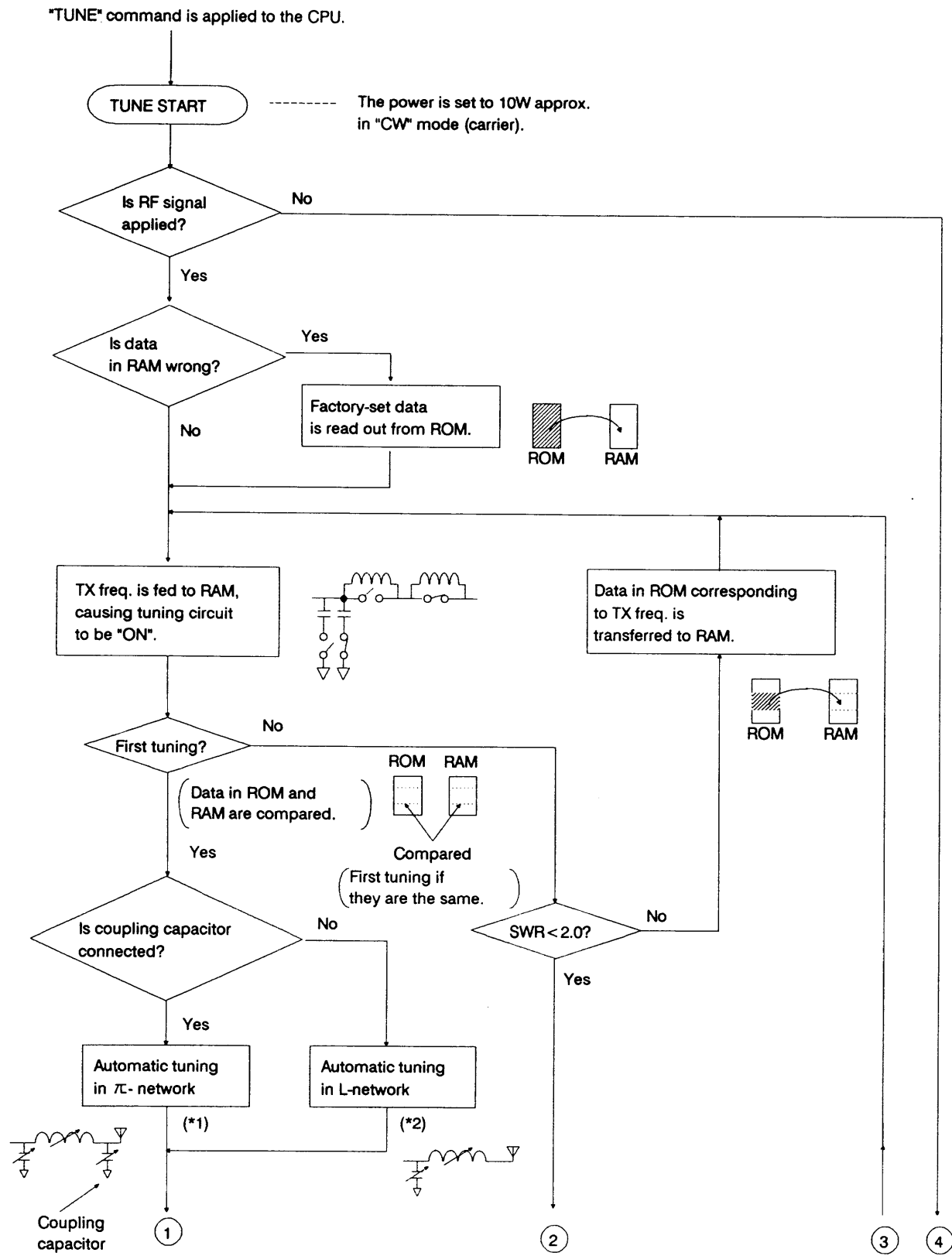


**ANT COUPLER**

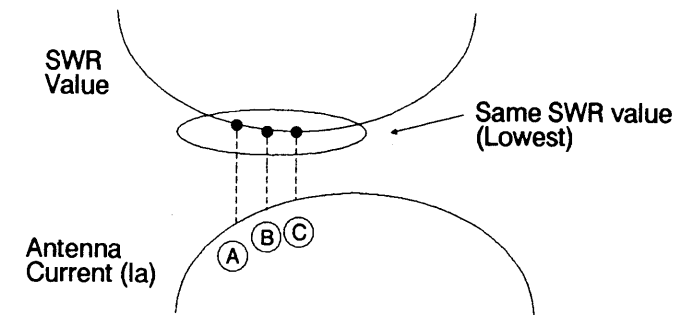


**SYSTEM CONTROL**

# 6. AUTOMATIC TUNING CIRCUIT



(\*1)/(\*2): The best tuning point is searched for observing SWR value; that is, best tuning point is where the SWR is the lowest. If three SWR values are the same (see below), the tuning data at the point (C), where Ia value is the largest among them, is used.



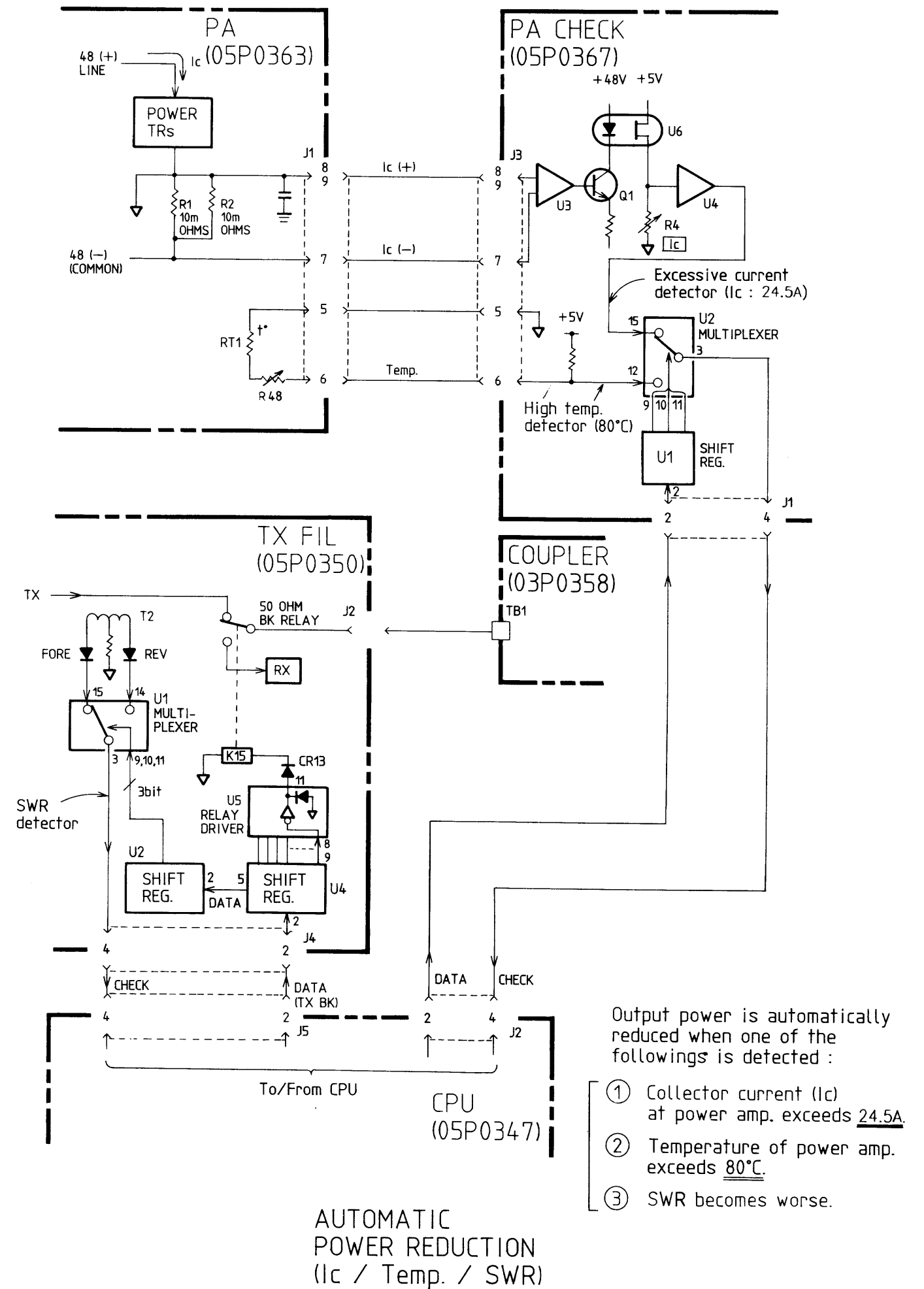
(\*2): If the tuning point is not found on 2.56MHz or less, a shunt capacitor is inserted and tuning is restarted.

## 7. AUTOMATIC POWER REDUCTION

Power is automatically reduced in the following instances:

1. Excessive collector current ( $\geq 24.5A$ )
2. High temperature at power amplifiers ( $\geq 80^\circ C$ )
3. High SWR value

1. The collector current ( $I_c$ ) detected by R1/R2 on the PA board is amplified in U3 and passed through the multiplexer (U2) on the PA CHECK board, then fed to the CPU board for AD conversion. If  $I_c$  exceeds 24.5A (adjusted by R4 on the PA CHECK board at the factory), the CPU reduces the value of the "power data" for the exciter power control circuit.
2. Posistor RT1 detects the temperature of the power amplifiers. When the temperature exceeds  $80^\circ C$ , the CPU reduces the value of the "power data". R48 on the PA board is adjusted at the factory so that the temperature indication on the LCD is the same value as the temperature of the power amplifiers (heat sink).
3. The forward and reverse current are picked p by T2 on the TX FIL board and fed to the CPU board via the multiplexer (U1) to calculate the SWR value. If the CPU acknowledges the SWR value as too high, the "power data" is reduced.



## 8. SYNTHESIZER CIRCUIT

This equipment incorporates two synthesizer circuits: one is a TX synthesizer on the EXC board and the other a RX synthesizer on the RX board.

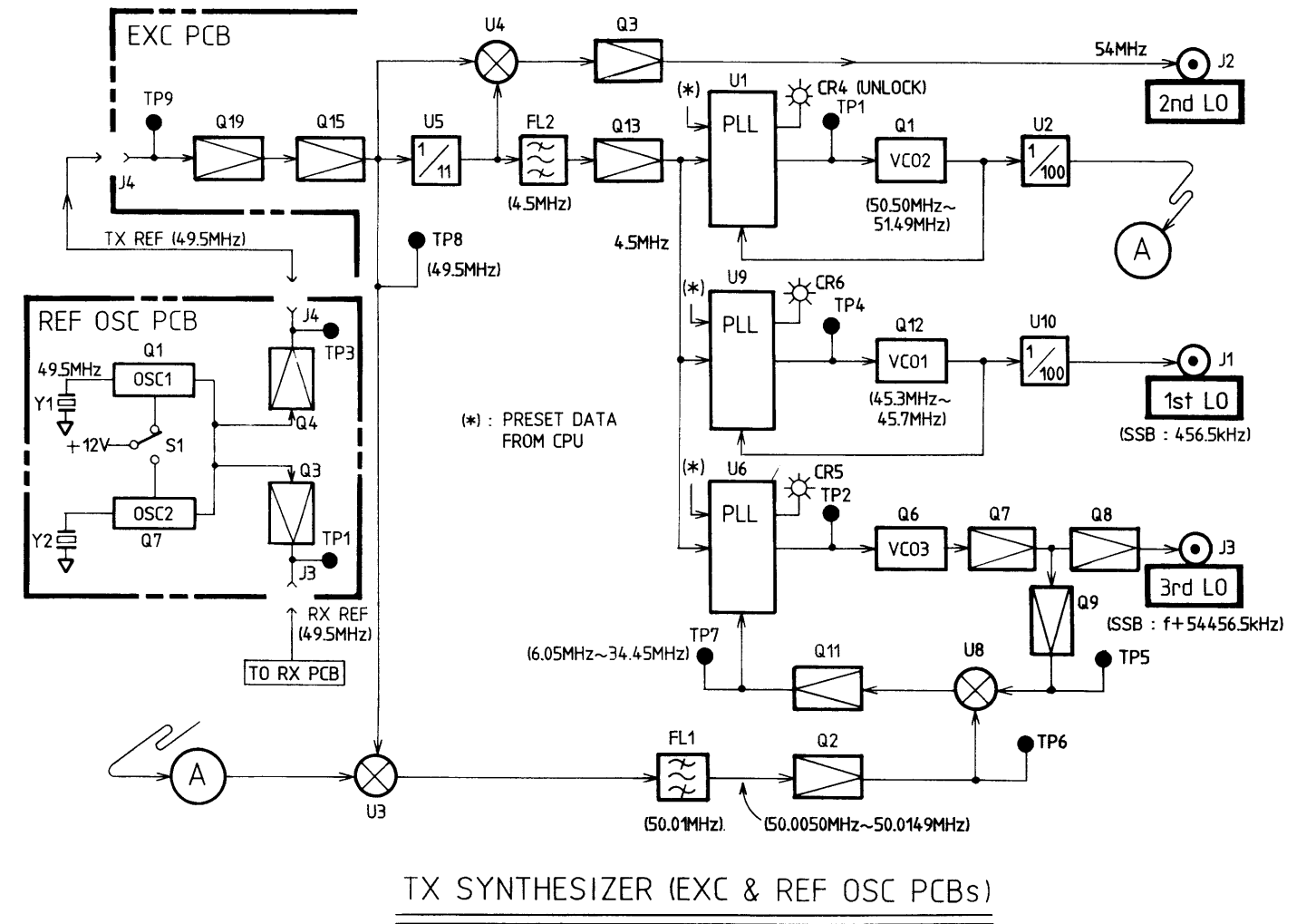
### 8.1 TX Synthesizer (EXC board)

Either of two crystals Y1 and Y2 which oscillate on 49.5MHz on the REF OSC board are selected with slide switch S1. The 49.5MHz amplified thru Q3 on the REF OSC board is fed to J3 to be used as a reference signal of the RX synthesizer on the RX board.

Three PLL circuits are employed. The reference frequency for the PLL circuits is 4.5MHz which is obtained by dividing the 49.5MHz signal. The PLL circuit (VC02) composed of U1 and Q1 controls the lower two digits of the transmission frequency (that means the output frequency of VC02 is changed depending on the value of the lower two digits of the transmission frequency), and then mixed with the other PLL circuit (VC03) composed of U6 and Q6 which controls the upper four digits, resulting in the generation of the 3rd local oscillation frequency.

The table below shows the output frequencies of each local oscillation.

	Output Frequency (kHz)					Test Point	LED (lit in unlock)	Remarks
	USB H3E	LSB	F1B	A1A	FAX			
1st Lo	456.5	453.5	456.7	455	456.9	J1	CR6	VC01
2nd Lo	54MHz					J2		
3rd Lo	Ft + 54456.5	Ft + 54453.5	Ft + 54456.7	Ft + 54455	Ft + 54456.9	J3	CR5	VC03

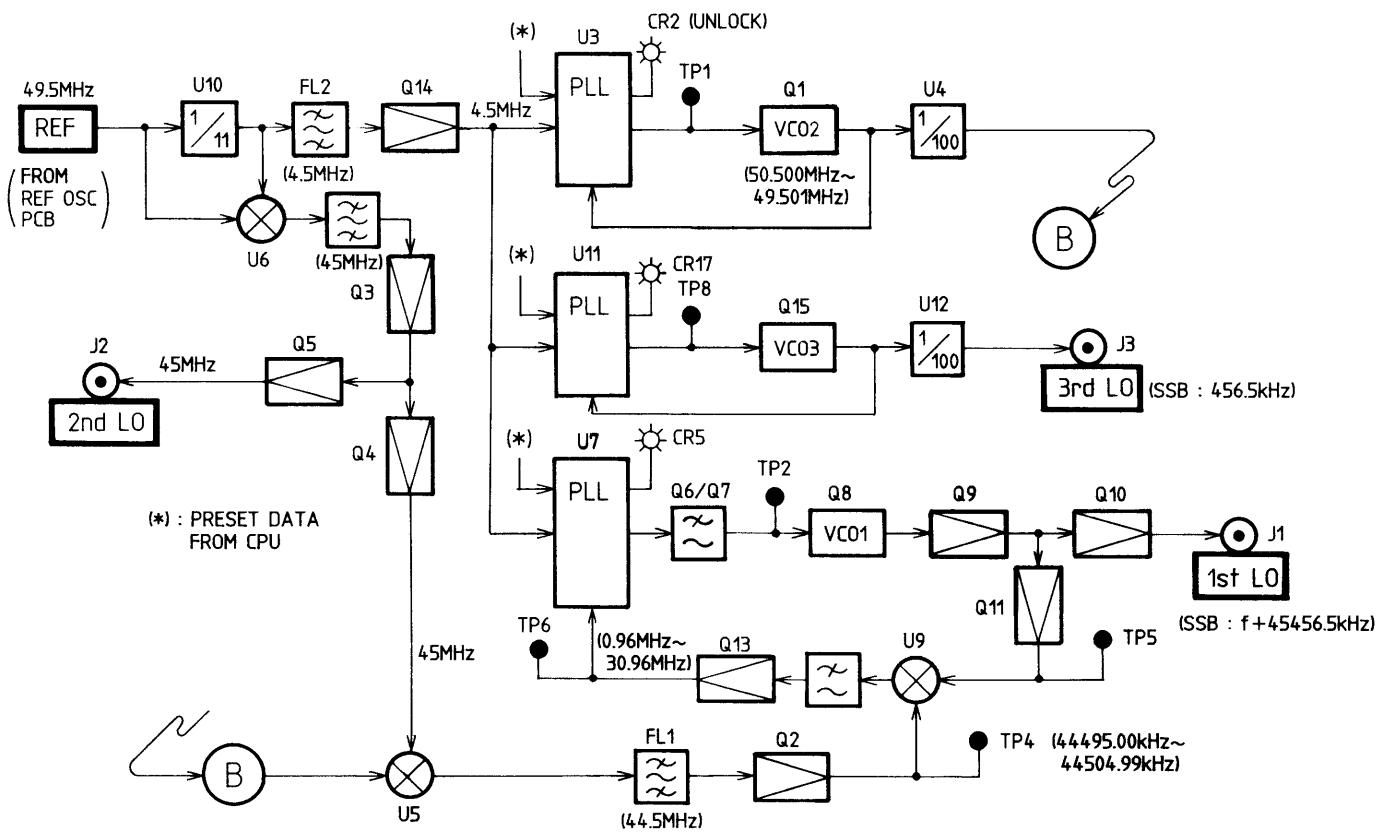


## 8.2 RX Synthesizer (RX board)

This synthesizer functions almost the same as the TX synthesizer. The RX synthesizer circuit starts operating by the reference signal (49.5MHz) derived from the REF OSC board.

The table below shows the output frequencies of each local oscillation frequency.

	Output Frequency (kHz)						Test Point	LED (lit in unlock)	Remarks
	USB	LSB	H3E	F1B	A1A	FAX			
1st Lo	Fr + 45456.5	Fr + 45453.5	Fr + 45455				J1	CR5	VCO1
2nd Lo	45MHz						J2		
3rd Lo	456.5	453.5	OFF	456.7	455.8	456.9	J3	CR17	VCO3
	Changeable by BFO frequency.								



RX SYNTHESIZER (RX PCB)

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## 9. POWER SUPPLY

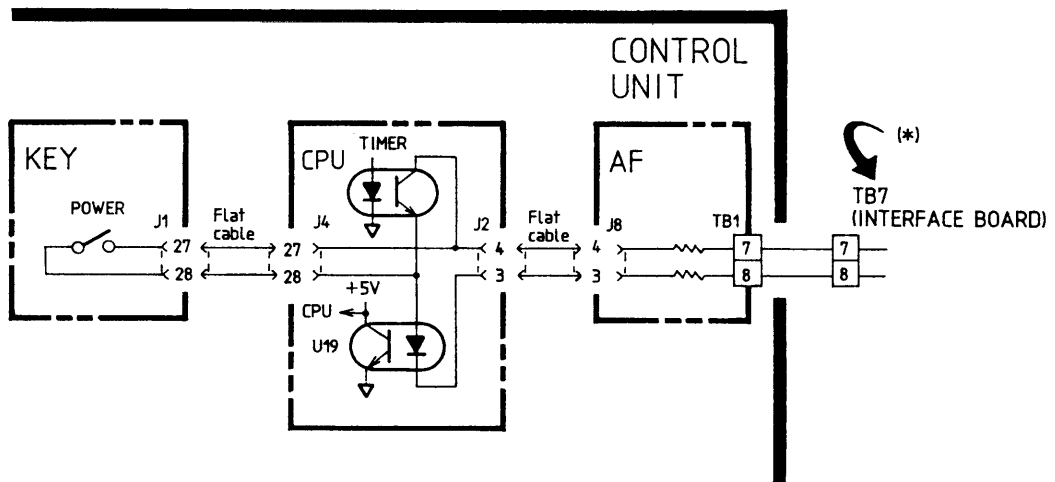
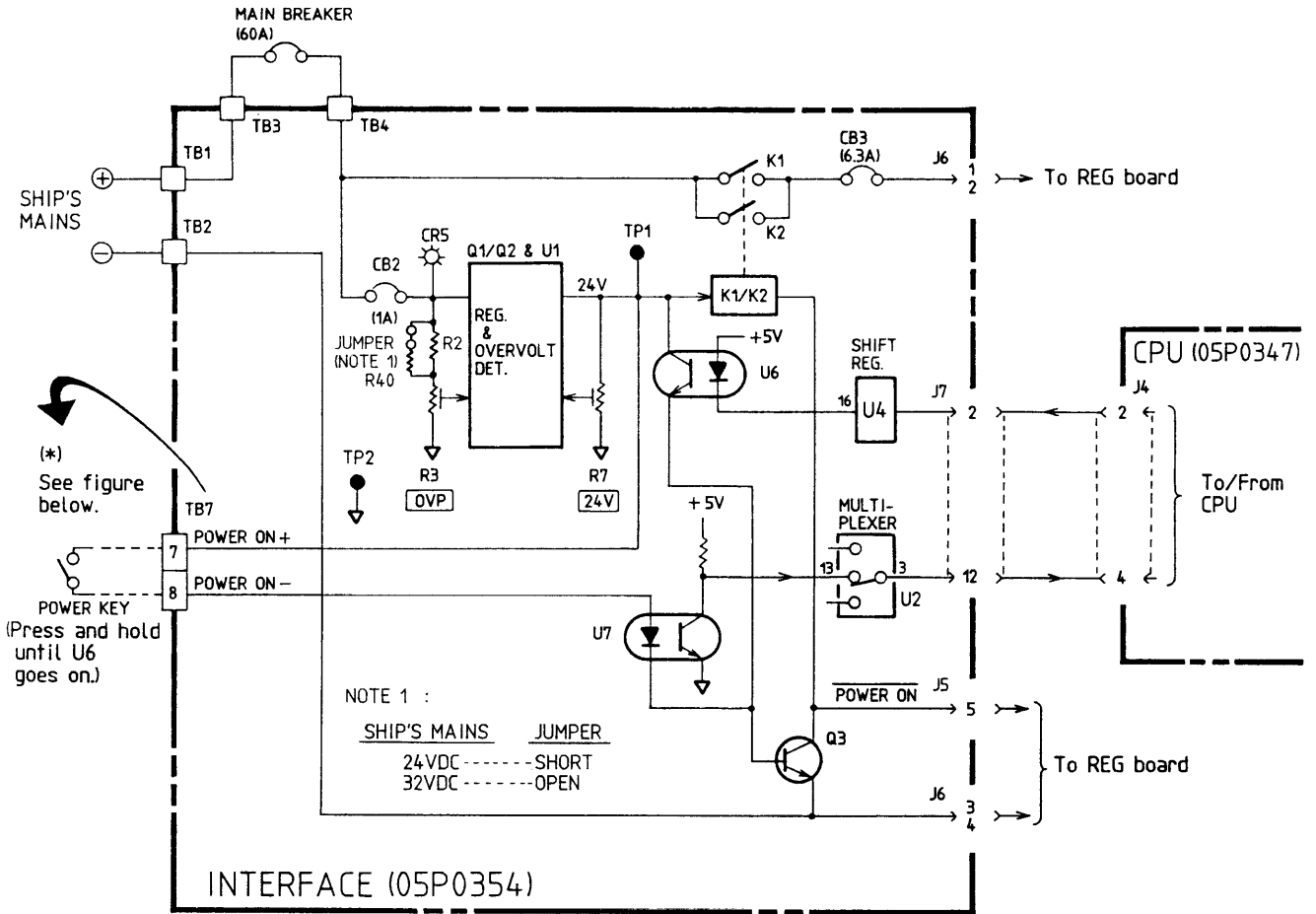
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### 9.1 Starter Circuit

The starter circuit is on the INTERFACE board. Refer to the next page. When the [POWER] key is pressed, photo coupler U7 goes on, causing Q3 to go on. Then the CPU receives the command ("L" status) derived from U7 via multiplexer U2 and sends the command ("L" status) to photo coupler U6 via shift register U4. Consequently U6 is kept on, causing Q3 to be kept on even if the [POWER] key is released. It takes 1 second approx. to make U6 conductive when the [POWER] key has been pressed. When Q3 goes on, relays K1 and K2 turn on and the ship's mains is supplied to the REG board.

Q1/Q2 and U1 function to produce regulated +24V for the relays. CR5 lights when the ship's mains is correctly supplied to the INTERFACE board. R3 and R7 are for adjustment of overvoltage protection and 24V output, respectively.

When the present time coincides with the wake-up time set by operator, the timer on the CPU board turns on, and the relays (K1/K2) turn on in the same manner as mentioned above.



POWER SUPPLY CIRCUIT (1)  
(STARTER)

## 9.2 Power Supply

Refer to the block diagram on the next page.

The ship's mains supply is applied to the following circuits thru the INTERFACE and REG boards.

- ① input voltage check circuit ("VS")
- ② + 18V switching regulator (+ 18V output)
- ③ Starter circuit for two switching regulators
- ④ + 21V (or + 12V) switching regulator (+ 45V or + 44V output)

① : Ship's mains is directly sent to the PA CHECK board to display the input voltage by bar graph and/or numeral. R6 adjusts the value of "VS" indication.

② : When relays K1 and K2 are activated, ship's mains supply is fed to the + 18V switching regulator thru the + 16V regulator composed of Q9 to Q12. + 18V is obtained at TP1 on the REG board.

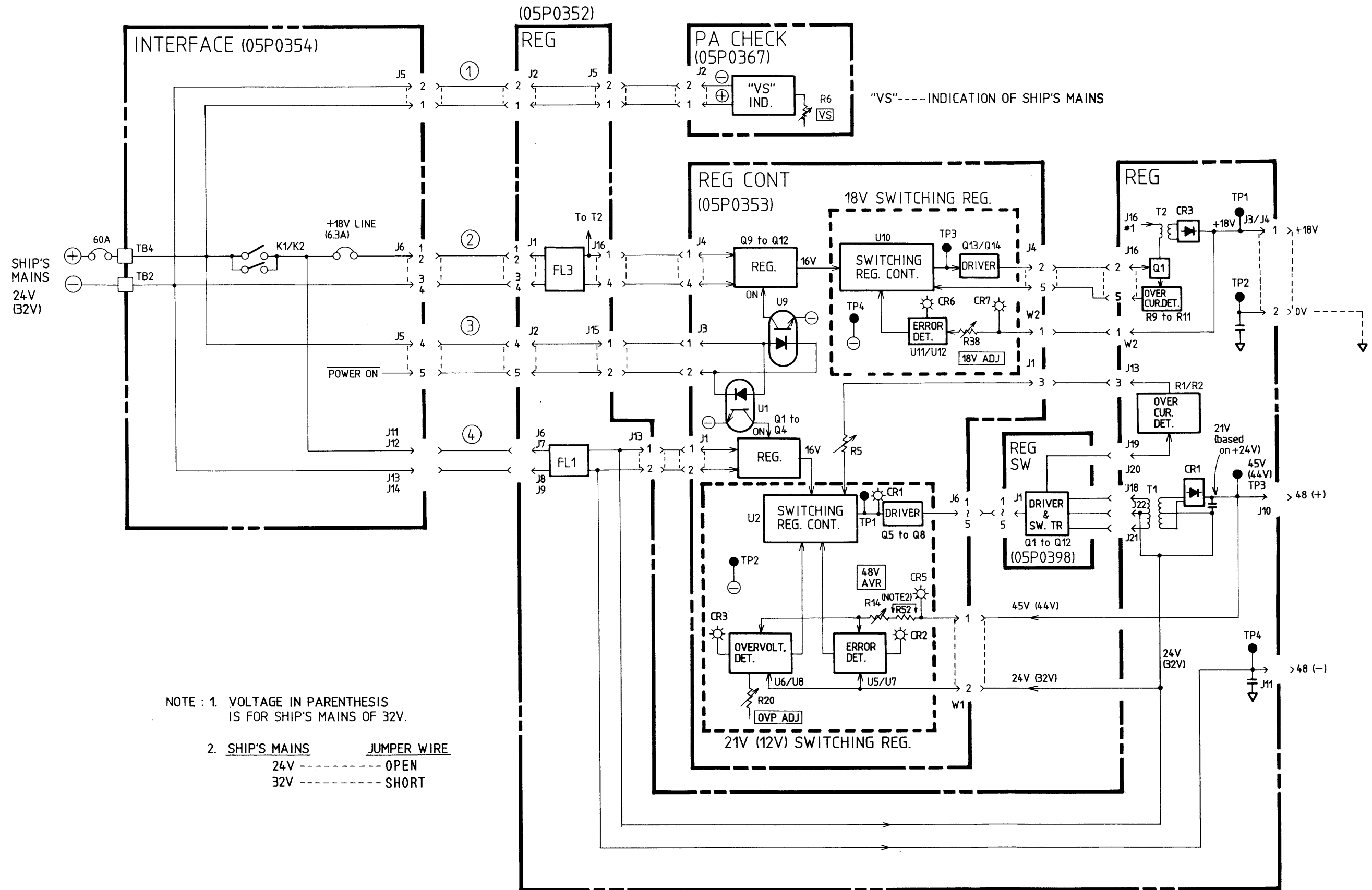
R38 is for adjustment of + 18V. CR7 lights when + 18V is correctly produced.

③ : After the power supply starter circuit (see page 1-16) becomes active, POWER ON signal ("L" status) on the INTERFACE is fed to photo couplers U9 and U1 on the REG CONT board, causing two + 16V regulators to go on.

④ : The + 21V switching regulator produces "+ 45V" for the PA board. The output from the REG SW board is rectified by CR1 on the REG board, producing + 21V on the basis of the hot line (+ 24V) of ship's mains, for instance, + 45V (+ 24V plus + 21V) is obtained at TP3.

R14 and R20 are for adjustment of + 45V and overvoltage protection, respectively. R5 adjusted for overcurrent protection (24A approx.). CR5 lights when + 45V is correctly supplied. CR3 lights at the moment the overvoltage protector trips.

As for alteration of ship's mains, refer to pages AP1-1 to AP1-3.



- NOTE : 1. VOLTAGE IN PARENTHESIS IS FOR SHIP'S MAINS OF 32V.
2. SHIP'S MAINS JUMPER WIRE  
 24V ----- OPEN  
 32V ----- SHORT

POWER SUPPLY CIRCUIT (2)

---

## 10. SELF TEST

---

### 10.1 TX Check

Refer to the block diagram on the next page.

The "TONE" signal (1.5kHz) is derived from the CPU (U10) of the control unit at the moment the TX circuit test is started. It is fed to the AF board and divided into two lines: one is fed back to the CPU thru the analog switch (U21) to check the AF board, the other sent to the EXC board.

If the test signal level at the input of U6 on the EXC board is more than -36dBm, CR1 lights (MIC input test) and the signal is fed to the multiplexer (U5) which selects each test signal of MIC input/output and local oscillator. If the output signal of T9 is sufficient in level, CR6 lights (MIC output test).

The test signal from the EXC board passes through the PA board to check collector voltage (Vc) and current (Ic) and is then sent to the TX FIL board to check the SWR detection circuits, LPF and connection to the antenna coupler.

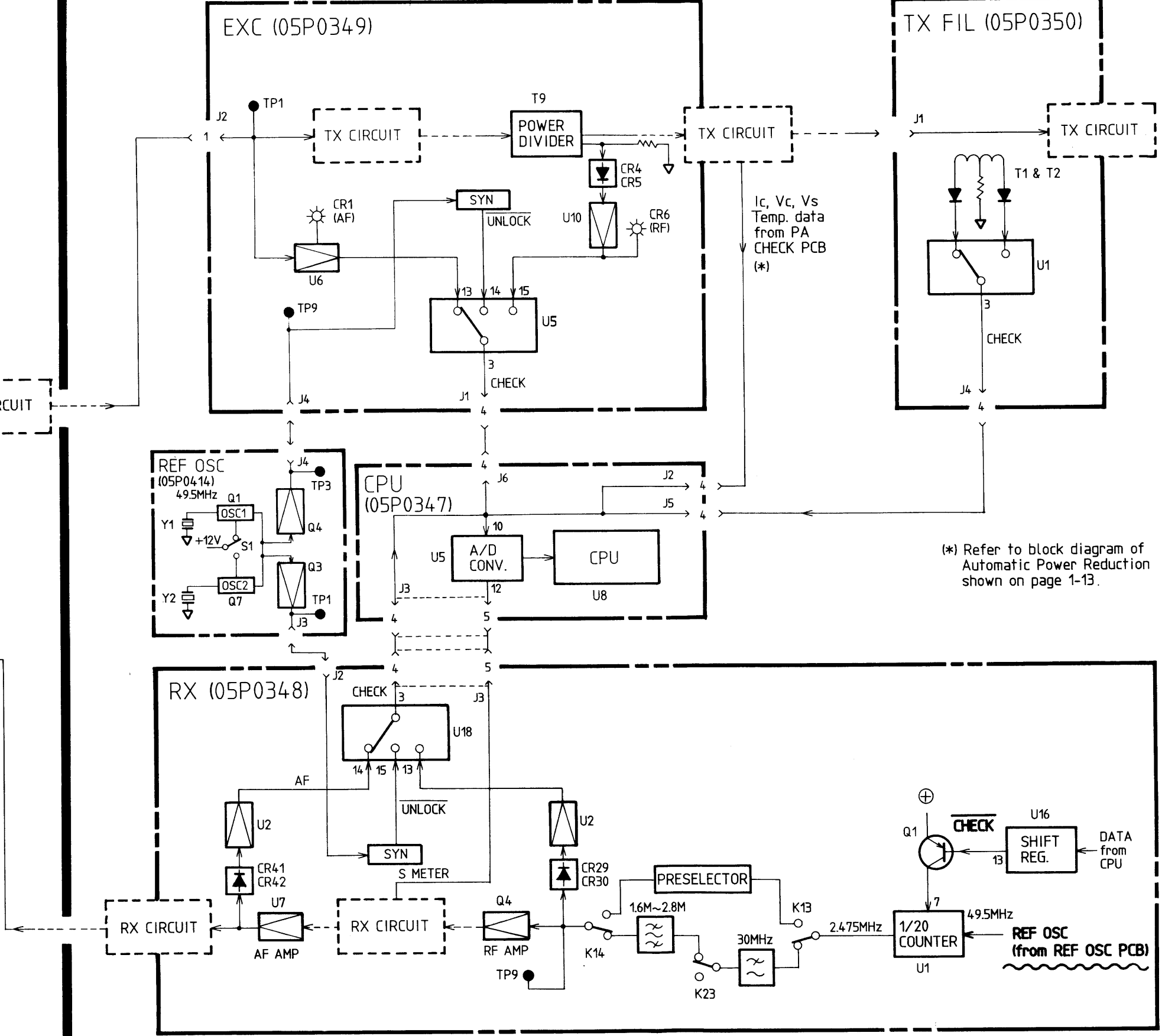
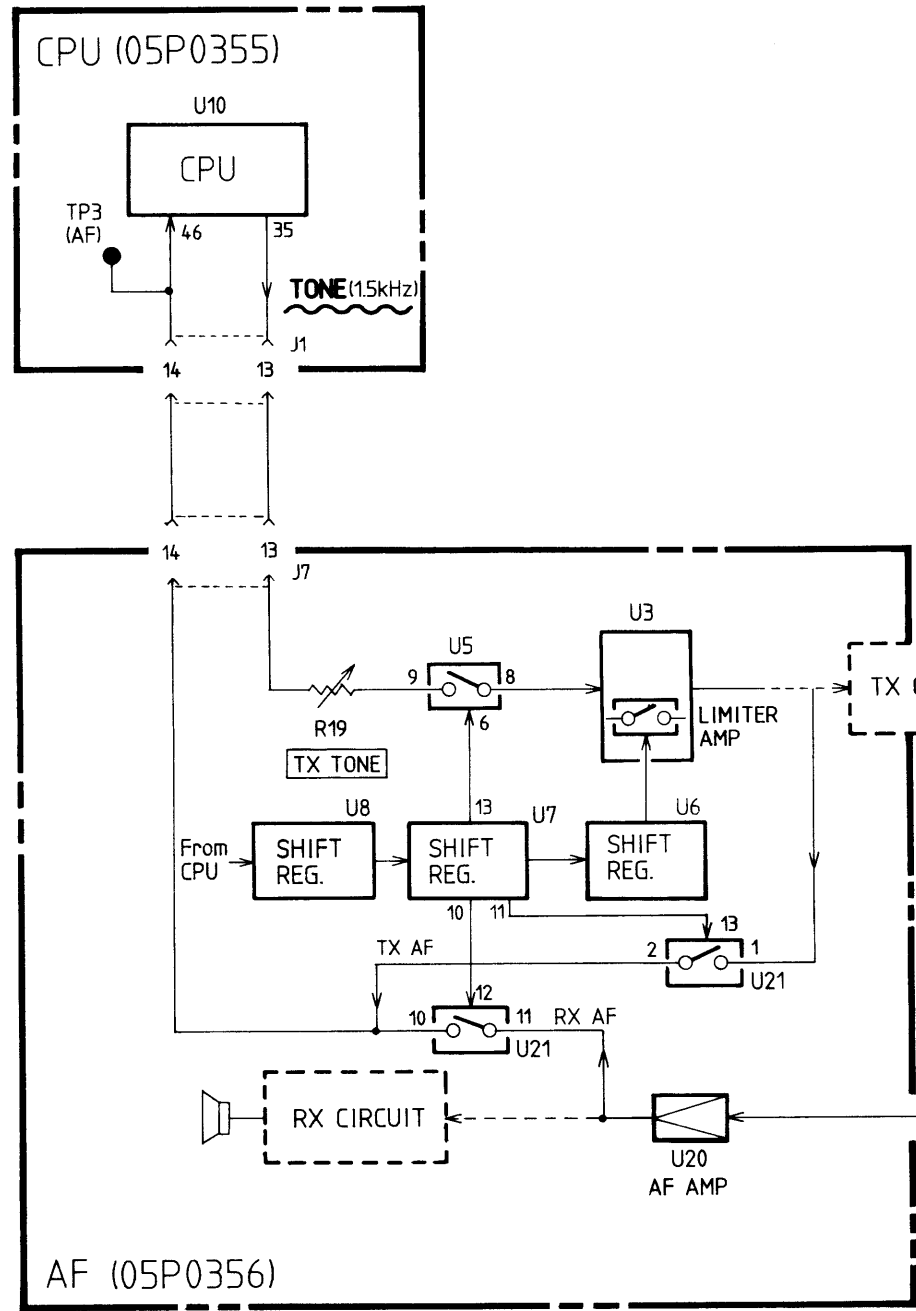
### 10.2 RX Check

When the unit is in the RX test sequence, the CPU (U8) of the transceiver unit sends the "CHECK" signal to the shift register (U16) on the RX board, causing counter U1 to start operating. U1 divides 49.5MHz from the REF OSC board by 20, resulting that the 2.475MHz test signal is produced. It passes through the preselector and filters composed of 30 MHz (LPF) and 1.6MHz to 2.8MHz (BPF). It is then detected by CR29/30 and fed to the multiplexer (U18) which selects each test signal. The output signal is divided into two lines: one is fed to U18 to check the RX board, the other to the AF board.

The test signal from the RX board is amplified by U20 on the AF board and fed to the CPU (U10) on the CPU board in the control unit via the analog switch (U21).

# CONTROL UNIT

# TRANSCEIVER UNIT



(\*) Refer to block diagram of Automatic Power Reduction shown on page 1-13.

SELF CHECK SIGNAL FLOW

# CHAPTER 2 ADJUSTMENT

## 1. NECESSARY MEASURING INSTRUMENTS

No.	Measuring Instrument	Specifications / Remarks
1	Standard Signal Gen. (SSG)	0.1 to 40 MHz, -10 to +30dB $\mu$ V, 50ohms
2	AF Signal Gen.(AF SG)	1 to 3kHz, -60 to +10dBm, 600ohms (2 sets required for two-tone test)
3	Electronic Voltmeter (VTVM)	0.1 to 10kHz, -20 to +20dBm, with RF probe
4	Oscilloscope	DC to 100MHz
5	Frequency Counter	DC to 100MHz
6	Digital Multimeter	10mV to 50V
7	Variable DC power supply	50V(max), 3A (only for overvoltage protector)
8	Ampere Meter	2A, 20A
9	Power Meter	50ohms, 500W, terminated type or thru-line type and 50ohm dummy
10	Dummy Load	For 1.6 to 4MHz, 10ohms + 250pF, with 10A RF ammeter

## 2. ADJUSTING POINTS & RATINGS

Item	Ratings	Adjuster	Check Point	PCB's / Remarks
<b>CONTROL UNIT</b>				
Frequency of RTC	16.384 to 16.3841kHz	C3	TP4(+)-TP1(-)	CPU PCB (Page 2 - 8)
AF Gain	① 0dBm ±0.5dBm	R91	TB 1 #1(+)-#2(-) Dummy: 600 ohms	AF PCB (Adjustment ① and ② should be done in this order) (Page 2-8)
	<u>Conditions</u> R14: Turned fully clockwise(max) REM 1 AF TX: 1500Hz, -15dBm(TB3 #1/#2) REM 1 TX ON			
②	0dBm ±0.5dBm	R9		
	<u>Conditions</u> MIC Input: 1500Hz, PTT: ON -35dBm(J1 #3/#4)			
REM 1 Line-in	0dBm ±0.5dBm	R14	TB1 #1(+)-#2(-) Dummy: 600 ohms	AF PCB (Do this adjustment after completion of MIC gain adjustment.) (Page 2-9)
REM 2 Line-in	REM[ ] line-in level: 1500Hz, 0dBm	R15		
REM 3 Line-in	REM TX ON	R16		
TX Tone Level	0dBm ±0.5dBm (TONE: ON PTT: ON)	R19	TB1 #1(+)-#2(-) Dummy: 600 ohms	AF PCB (Page 2-9)
REM1 Line-out	0dBm ±0.5dBm	R44	TB3 #3(+)-#4(-) Dummy: 600 ohms	AF PCB (Page 2-9)
REM 2 Line-out	AF input: 1500Hz, 5dBm(TB1#3/#4)	R45	TB3 #14(+)-#15(-) Dummy: 600 ohms	
REM 3 Line-out		R46	TB2 #3(+)-#4(-) Dummy: 600 ohms	
<b>TRANSCEIVER UNIT</b>				
RX 2nd Lo level	1.5±0.1Vpp	R70	TP2(+)-TP7(-)	RX PCB
RX 1st Lo level	3.0Vpp or more	Confirmation	TP1(+)-TP7(-)	(See next page.)

Continued

Item	Ratings	Adjuster	Check Point	PCB's / Remarks
RF Gain	-10dBm±1dBm	R92	J4	RX PCB (Mode: SSB, BW: 3kHz, SENS: Max, NB: OFF, PRESELECTOR: OFF, RX freq: 4200kHz, SSG: 4201kHz) (Page 2-10)
	<u>Conditions</u> RF input(J1):-5dB <sub>μ</sub> V,AGC:OFF		#1(+)-#3(-) Dummy: 600 ohms	
Mixer Balance	Minimum noise level	R42	With SSG	
	<u>Conditions</u> RF input(J1); OFF, AGC: OFF, RX freq: 100kHz		output set to OFF, adjust R42 for minimum noise level.	
AGC Voltage	5.8±0.1V	R126	TP6	
	<u>Conditions</u> RF input(J1): 5dB <sub>μ</sub> V AGC: FAST		(Page 2-11)	
S Meter Level	0.51 to 0.55V	R142	J3	
	<u>Conditions</u> RF input(J1): OFF AGC: FAST		#5(+)-#6(-) (Page 2-11)	
NB(Noise Blanker)	Center position	R76 (RX board)	Turn R76 counterclockwise to increase effectiveness of NB. (Page 2-10)	
REF OSC Frequency	49.5MHz ±20Hz	C1: For OSC1 C31: For OSC2	TX: TP3(+)-chassis	REF OSC PCB Select s1 (osc1 or osc2) (page 2-11)
REF OSC Level	1.5Vpp or more (Dummy: 50 ohms)	Confirmation	RX: TP1(+)-chassis	
TX AF level	250±10mVpp (PTT: ON)	R6	TP3(+)-TP5(-)	EXC PCB Mode: SSB, TX freq: 4MHz AF input: 1500Hz 0dBm(J2#1) (page 2-12)
Tx IF Gain	14±0.5Vpp (PTT: ON)	R8	TP11(+)-TP5(-) Dummy: 50 ohms 2W	
Carrier Injection level (Coarse)	12±0.5Vpp	R13(A1A)	TP11(+)-TP5(-) Dummy: 50 ohms 2W	EXC PCB TX freq: 4MHz, AF input: OFF(J2#1) (page 2-12)
	7.0±0.5Vpp	R14(H3E)		
	1.4±0.1Vpp	R15(R3E)		
Line Voltage (with load)	18±0.1V	R38 (REG CONT)	TP1(+)-TP2(-) (REG PCB)	(Page 2-13)
	21±0.1V(for 24V) 12±0.1V(for 32V)	R14 (REG CONT)	Across C10 (REG PCB)	
Overvoltage Protector of Switching Reg.	See page 2-13	R20 (REG CONT)	TP3(+)-TP4(-) (REG PCB)	

Continued

Item	Ratings	Adjuster	Check Point	PCB's / Remarks
Relay Drive Voltage	24±0.5V (For 27V input voltage or more)	R7	TP1(+)-TP2(-)	INTERFACE PCB (Page 2- 13)
Overvoltage Protector of Ship's Mains	15V±1V <u>Conditions</u> Input voltage: 34V for 24V set 44V for 32V set	R3		
ALC (Automatic Level Control)	400W pep <u>Conditions</u> TX freq: 4100kHz, SSB Two tone signals, PTT: ON (Power data: 255)	R9	Power meter connected to Transceiver Unit	EXC PCB (Page 2-14)
MIC Gain	Adjust R6 on the EXC board for the output power of 100W. See page 2-14. (TX freq: 16M, SSB, MIC input level: 1500Hz, -54dBm, PTT: ON, Power data: 255)			
Carrier Level Confirmation	See page 2-15.			
"VS" Indication	LCD indication is the same value as input voltage	R6 (PA CHECK)	TB1(+)-TB2(-) (INTERFACE)	(Page 2-15)
"VC" Indication	LCD indication is the same value as collector voltage	R5 (PA CHECK)	J4(+)-J5(-) (PA PCB)	
"IC" Indication (with fan motors inoperative)	<u>Total current</u> flowing into PA PCB (at "LOW1") <u>minus 2A</u>	R4 (PA CHECK)	Ampere meter connecting to PA PCB (Refer to page 2-15.)	
"TEMP" indication	LCD indication is the same value as the thermometer indication on the heat sink.	R48 (PA PCB)	Thermometer placed on the heat sink	Fan motors: OFF, at more than 30°C (Page 2-15)
<b>IDLING CURRENT</b> (collector current) on PA PCB(When replacing transistors)				
For Power Transistors (Q3 to Q6)	1.5A ± 10mA	R47	See Fig. 2-1	PA PCB (SSB, AF: OFF, PTT: ON, Fan motors: OFF) (Page 2-5)
For Driver Transistors (Q1/Q2)	150±10mA	R41	See Fig. 2-2	

# Idling Current (PA PCB)

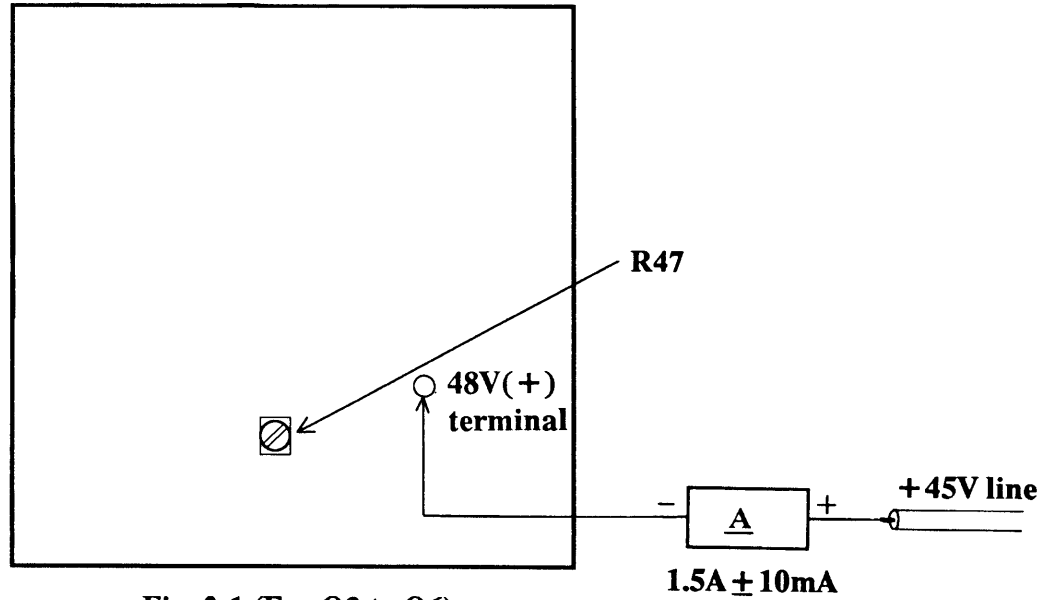


Fig. 2-1 (For Q3 to Q6)

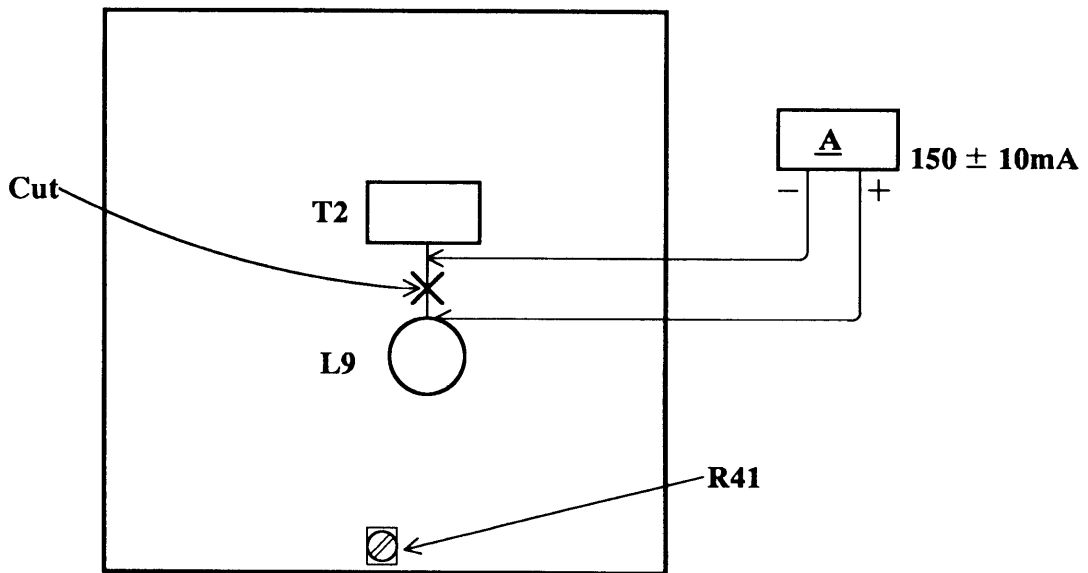


Fig. 2-2 (For Q1/Q2)

*Note: After completing this adjustment, solder coil (wire L9) securely.*

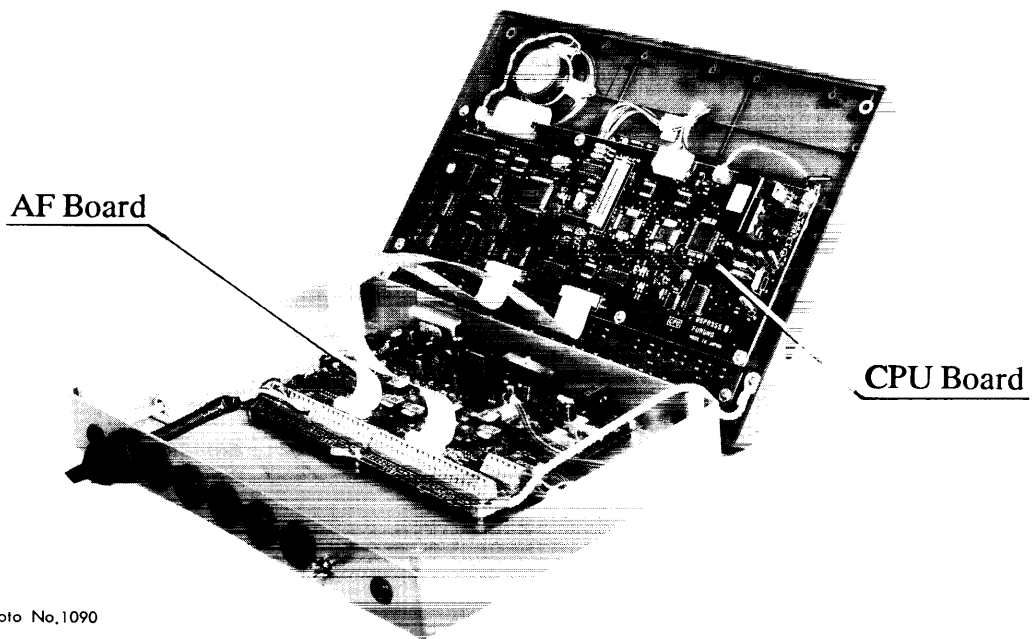


Fig. 2-3 Control Unit

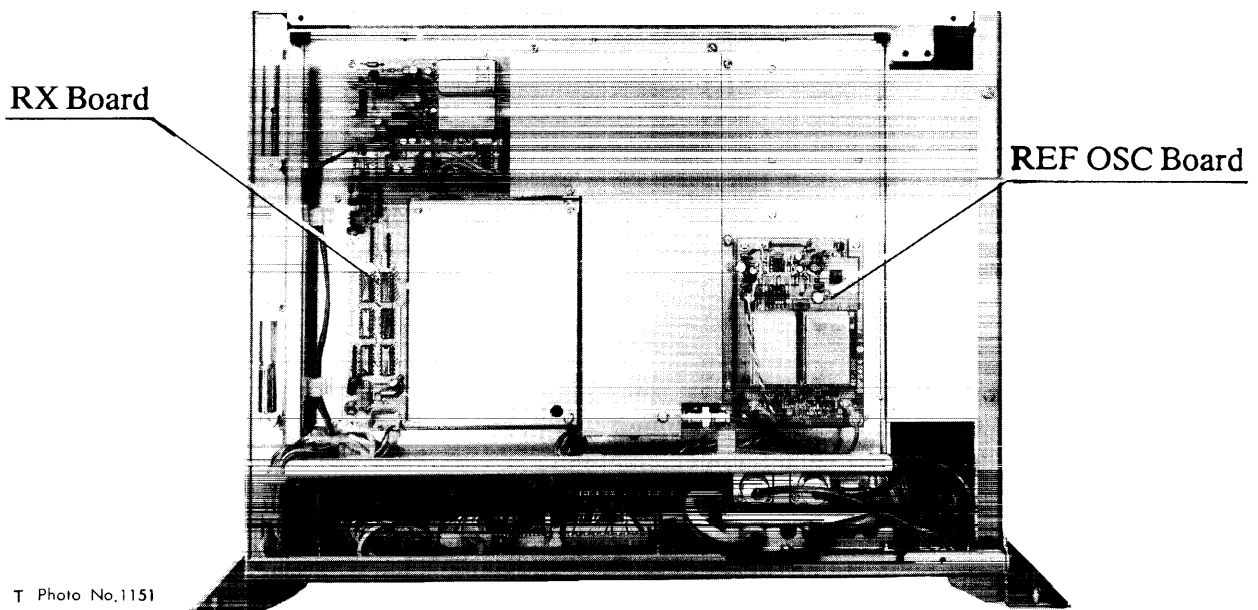


Fig. 2-4 Transceiver Unit with front cover removed

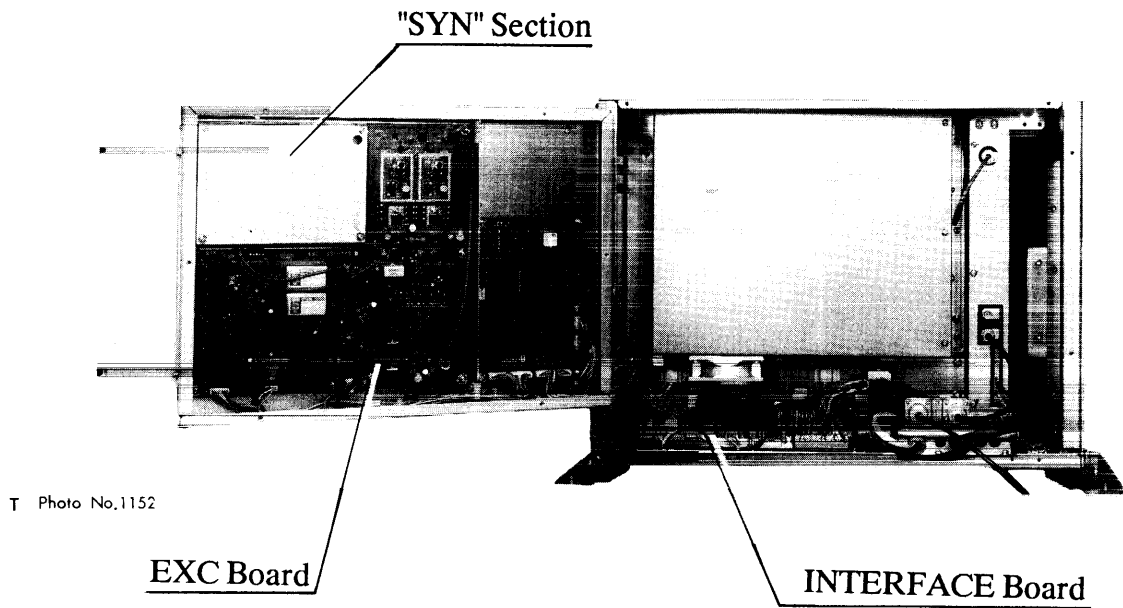


Fig. 2-5 Transceiver Unit with front door opened

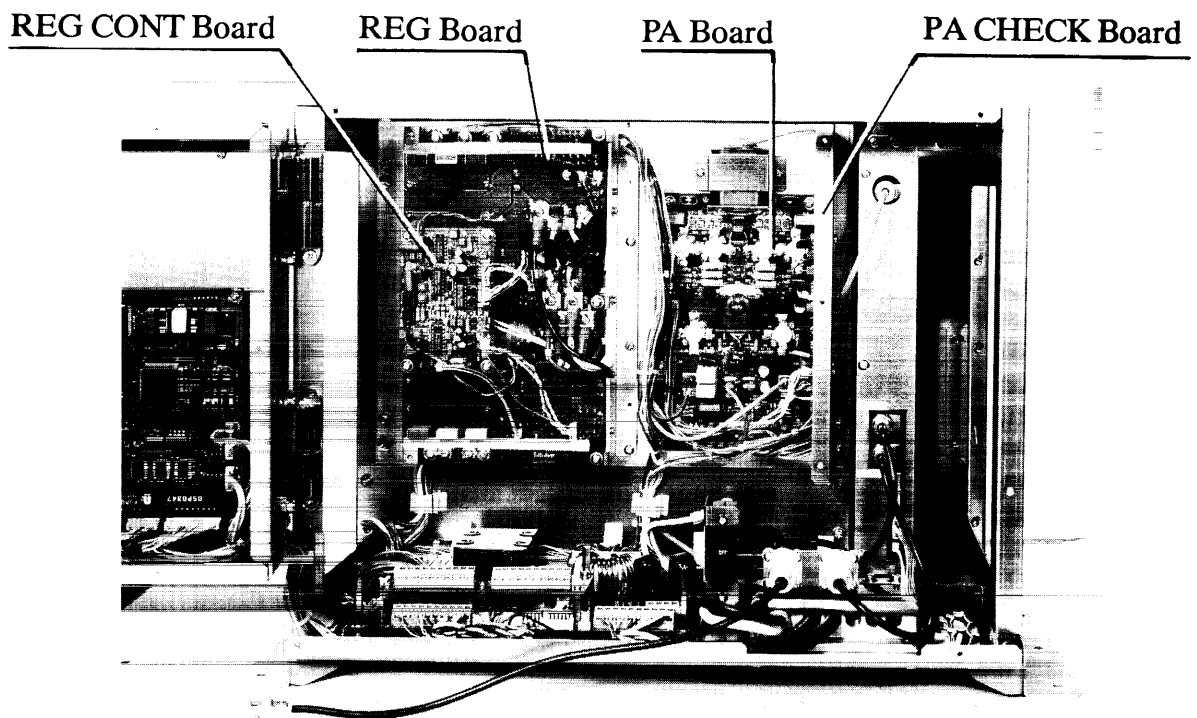
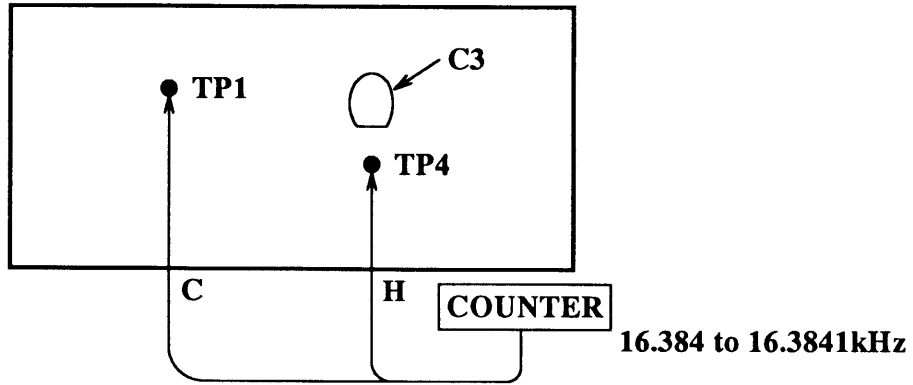


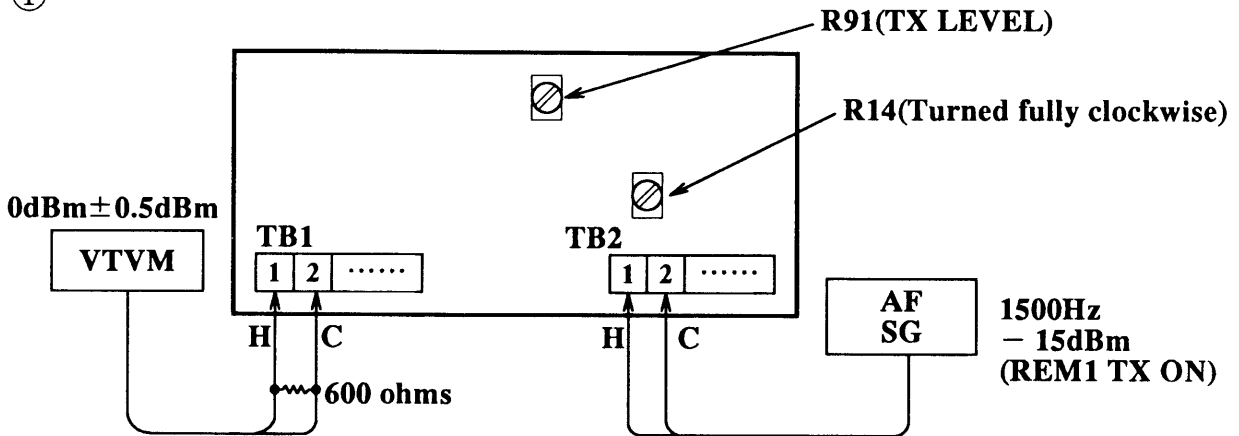
Fig. 2-6 Transceiver Unit with inner cover removed

## Frequency of RTC (CPU PCB)

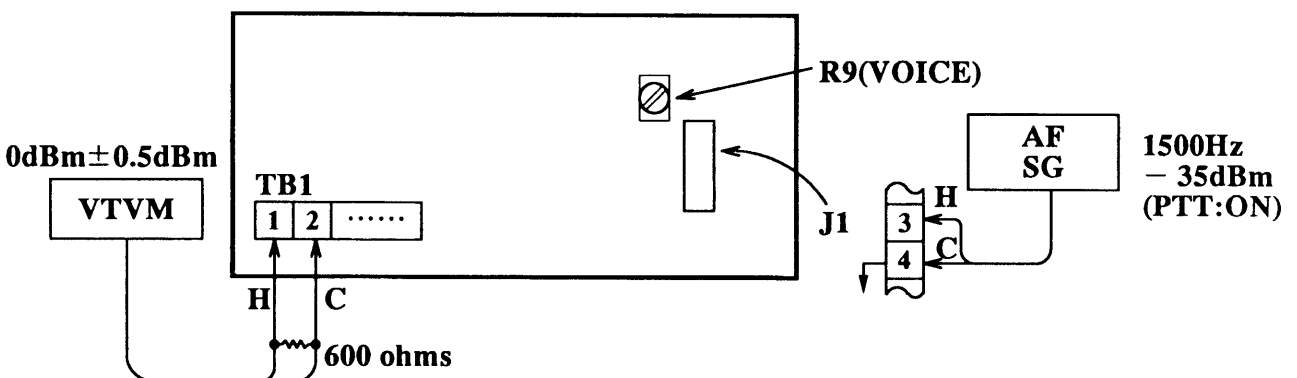


## AF Gain (AF PCB)

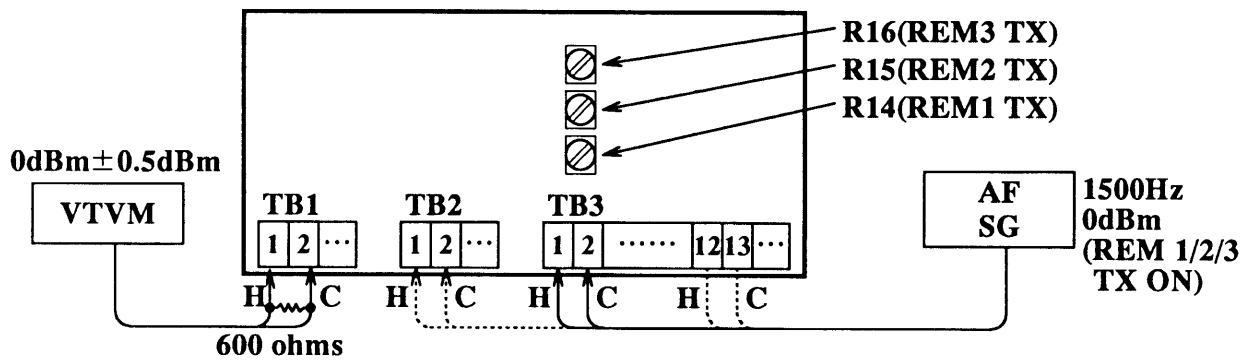
①



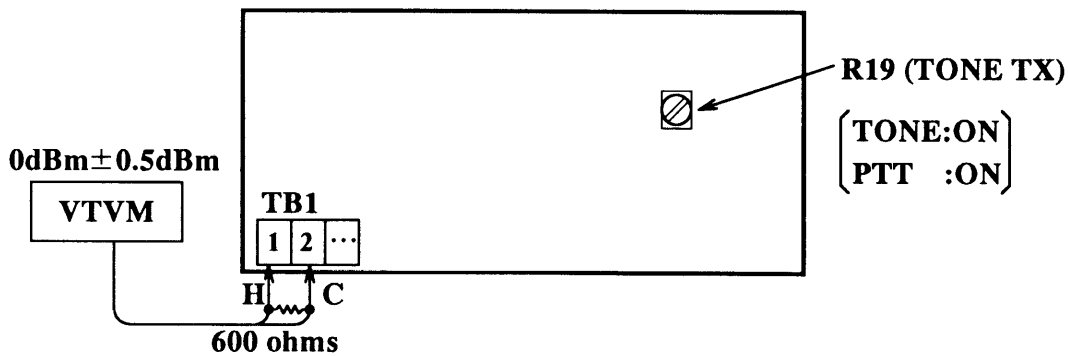
②



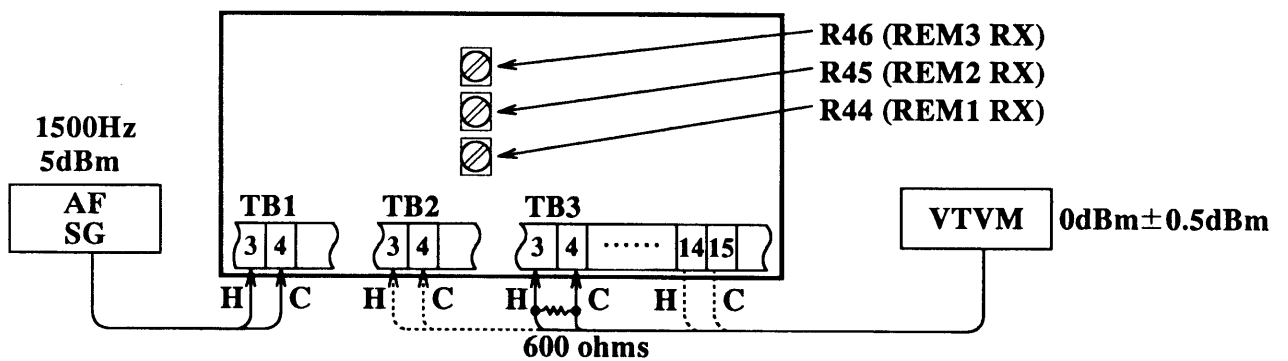
## REM1 to REM3 Line-in (TX) (AF PCB)



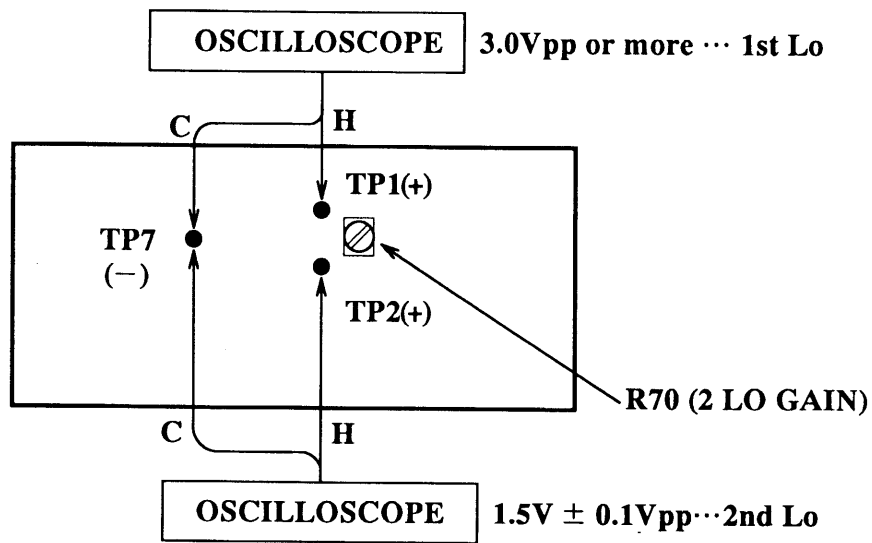
## TX Tone Level (AF PCB)



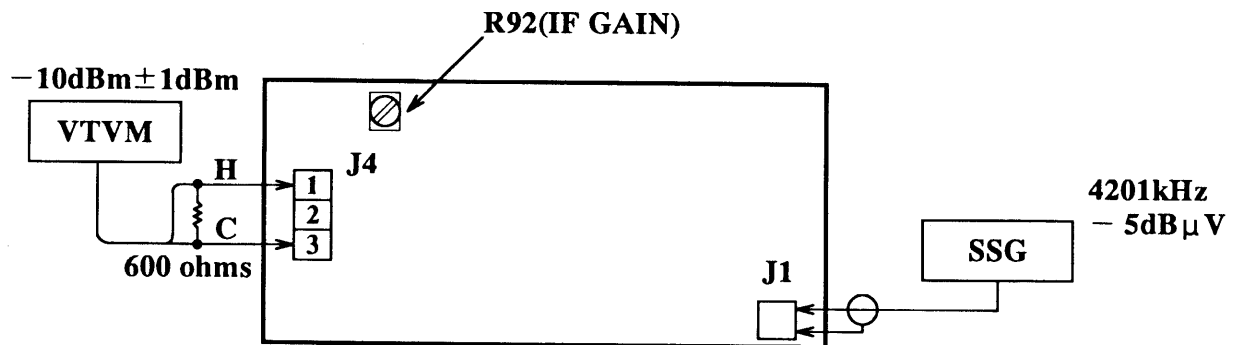
## REM1 to REM3 Line-out (RX) (AF PCB)



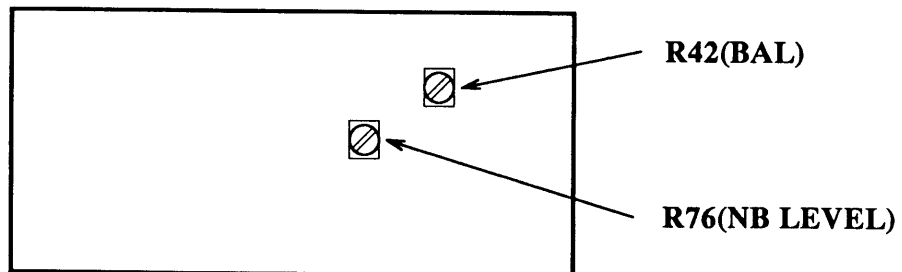
## RX 2nd Lo/1st Lo Level (RX PCB)



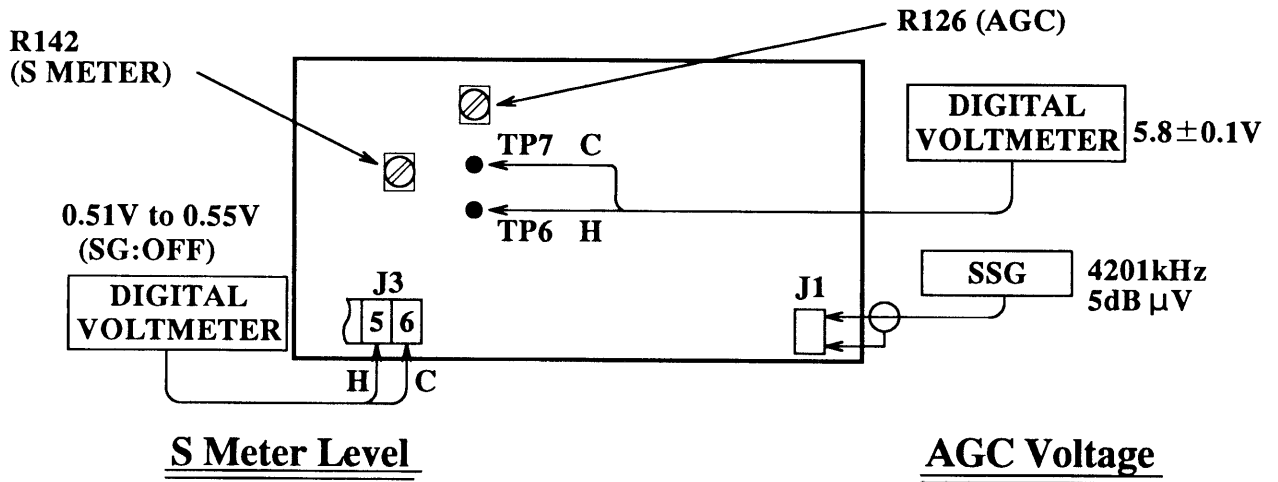
## RF Gain (RX PCB)



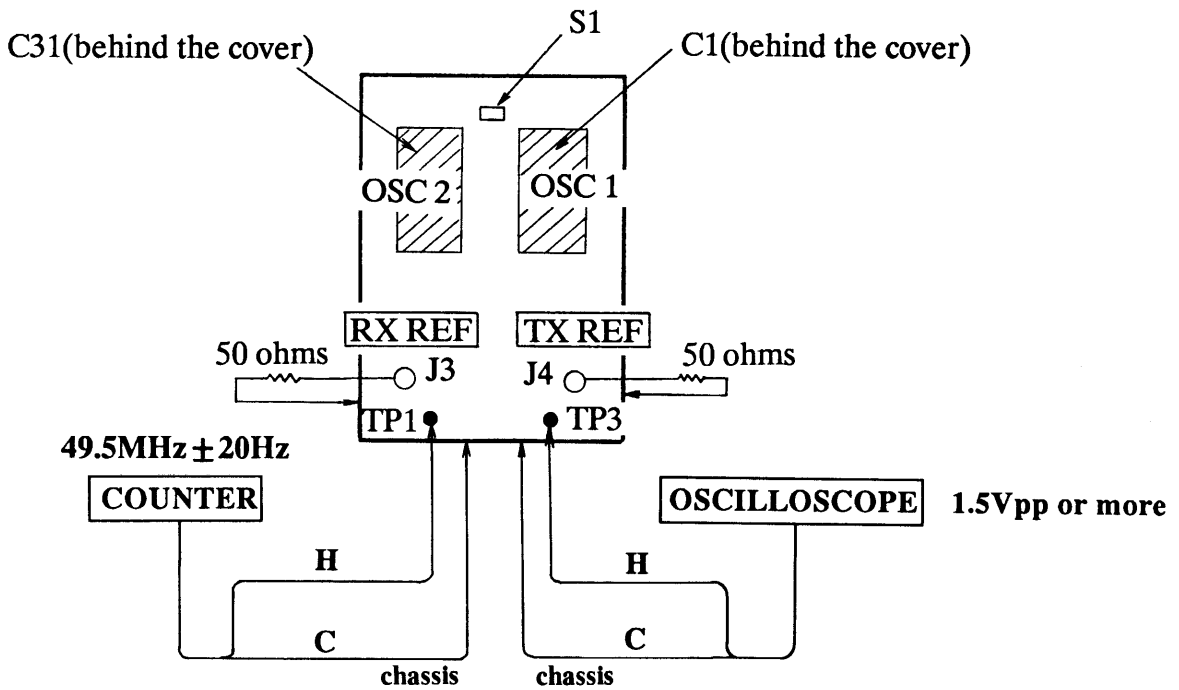
## Mixer Balance & NB Level (RX PCB)



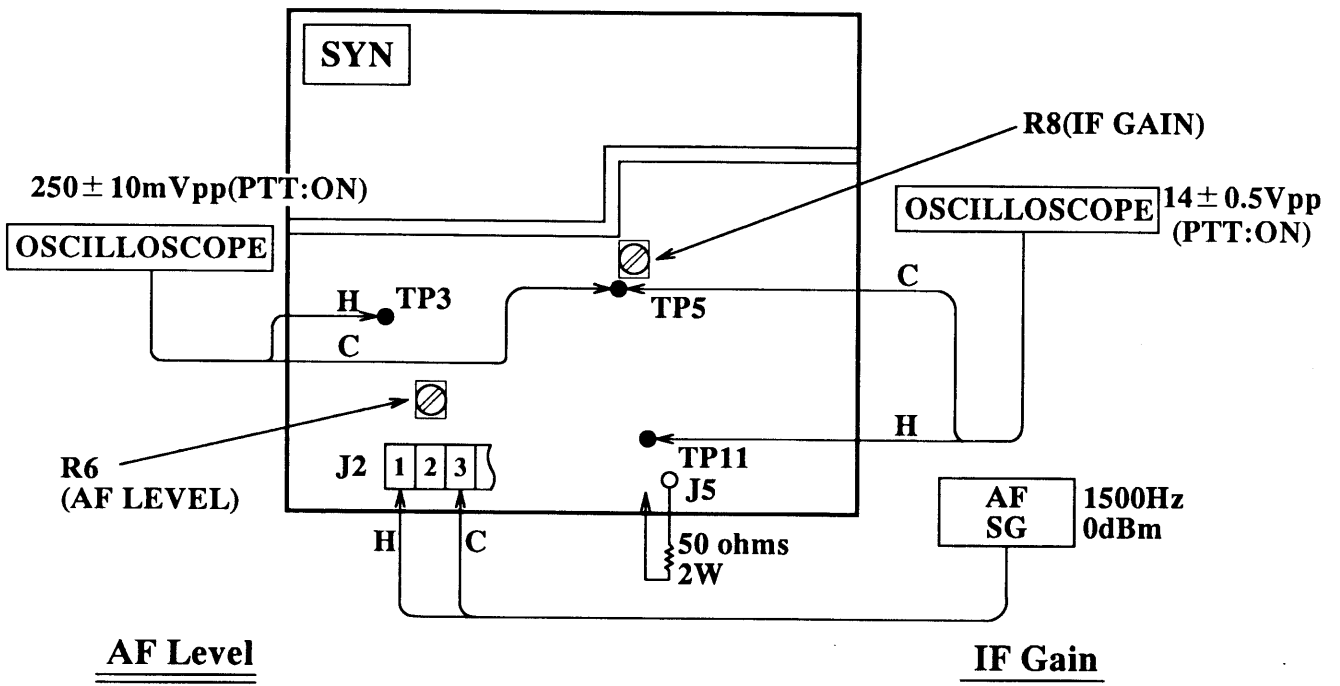
## AGC Voltage & S Meter Level (RX PCB)



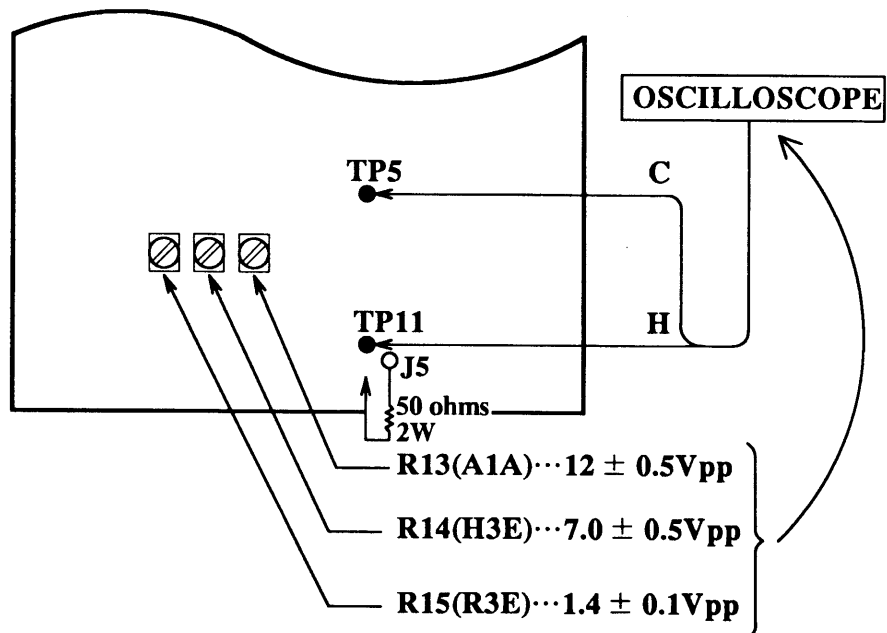
## REF OSC Frequency & Level (REF OSC PCB)



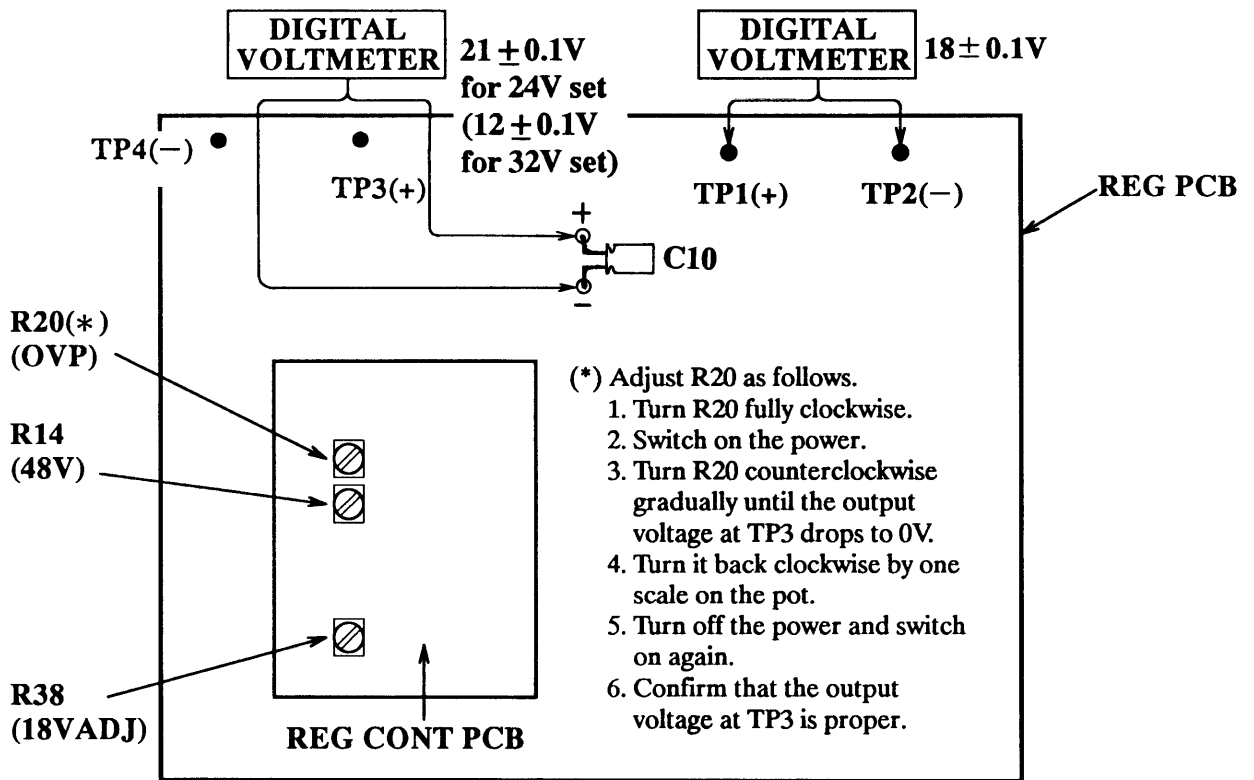
## TX AF Level & RX IF Gain (EXC PCB)



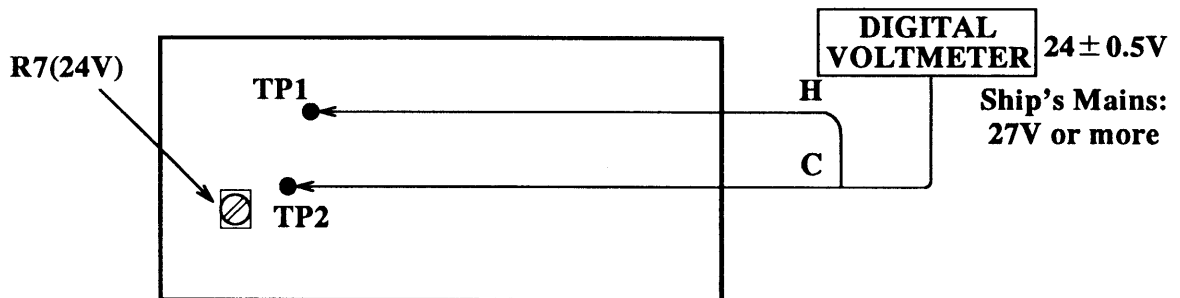
## Carrier Injection Level (EXC PCB)



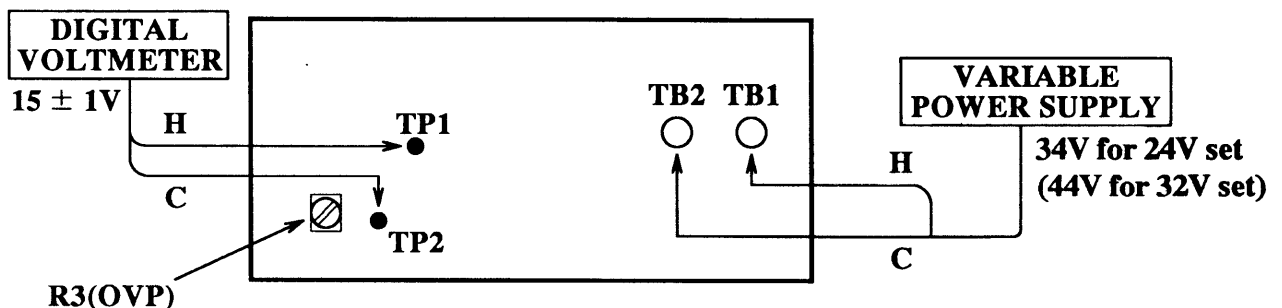
## Line Voltage (REG & REG CONT PCBs)···with load



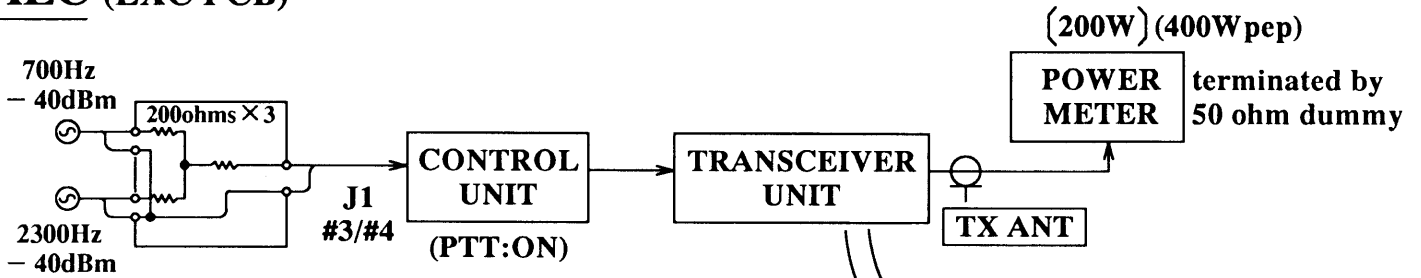
## Relay Drive Voltage (INTERFACE PCB)



## Overvoltage Protector of Ship's Mains (INTERFACE PCB)

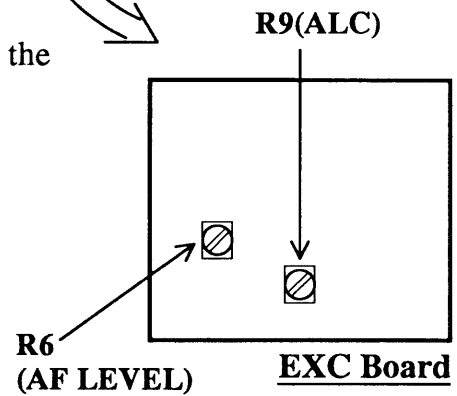


## ALC (EXC PCB)

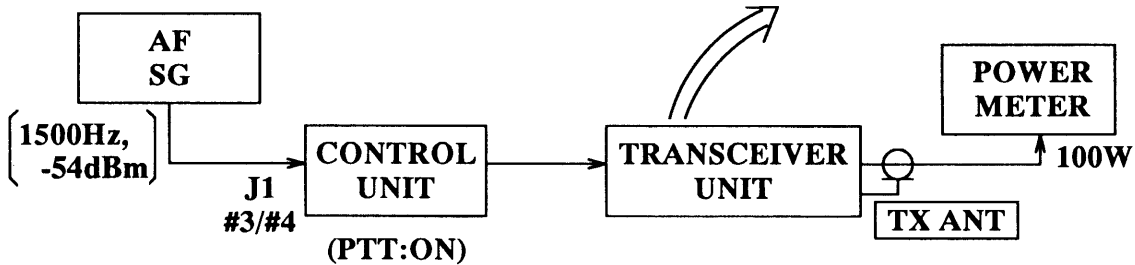


### Procedure

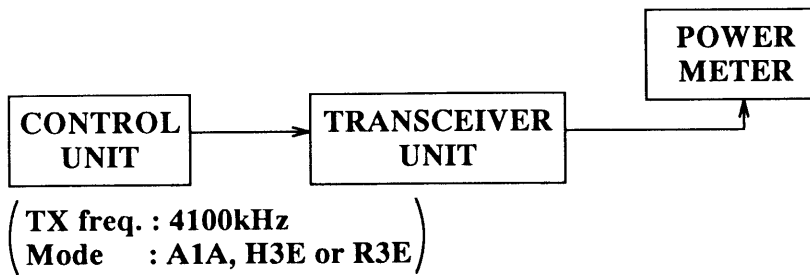
1. Turn R9 fully counterclockwise, then transmit by pressing the PTT switch.
2. Turn R9 clockwise gradually until the power meter indicates 240W.
3. Adjust it for meter indication of 200W.



## MIC Gain (EXC PCB)

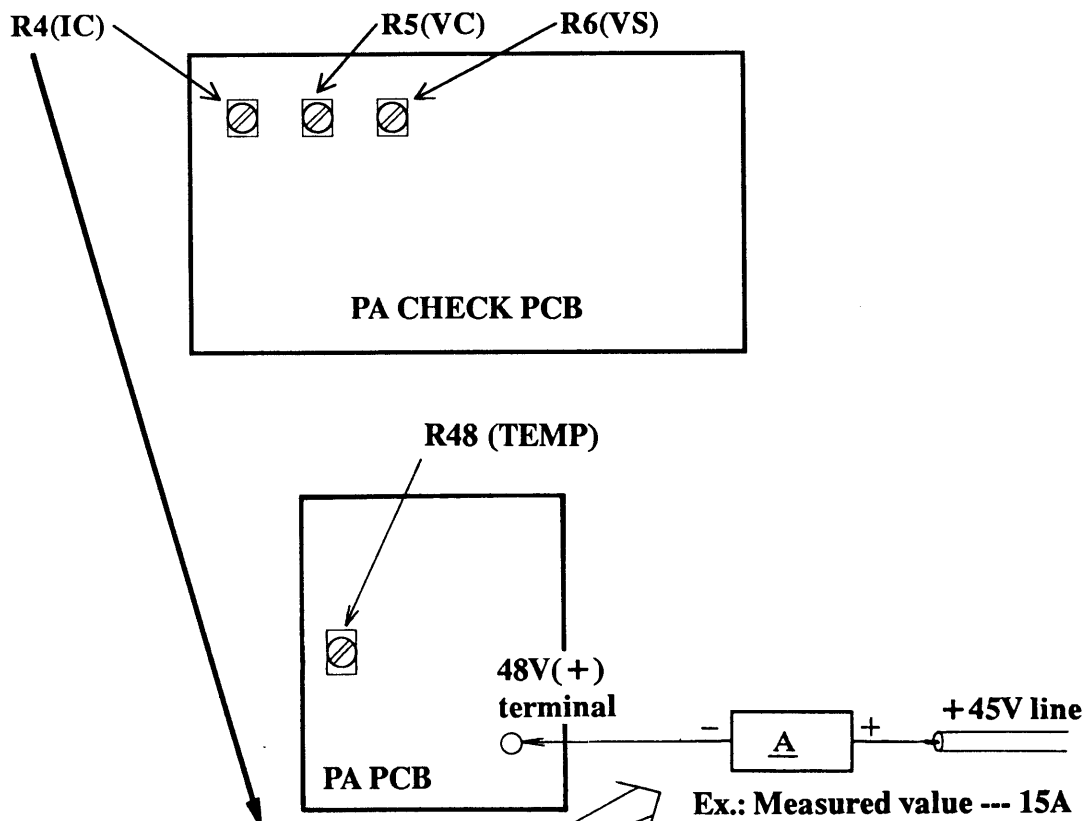


## Carrier Injection Level (Confirmation)



A1A...350 to 380W (R13)  
(keying)  
H3E...100 ± 10W (R14)  
(PTT: ON)  
R3E...6 ± 1W (R15)  
(PTT: ON)

## "VS", "VC", "IC" & "TEMP" Indications



**Conditions:**  
TX freq.: 4MHz  
Power indication: "LOW1"  
TEST TONE: ON  
PTT: ON

Adjust R4 on the PA CHECK PCB  
for 13A on the LCD indication.  
↓  
(15A-2A)

# CHAPTER 3

## LED CHECK & SWITCH SETTING

### 1. LED CHECK

Several boards have LEDs which indicate unit status. The location, status and function of these LEDs are tabulated below and on the next page.

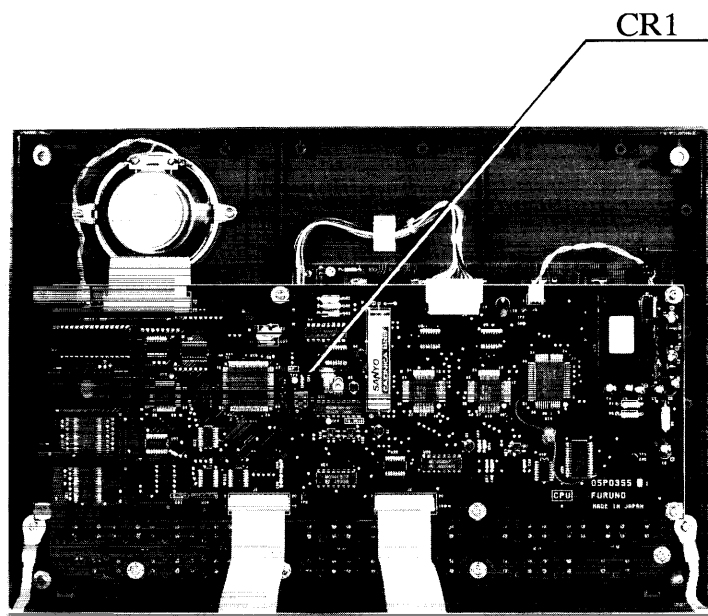
NOTE: The LEDs status is shown in tables as follows:

○ : lit                      ◐ :blinking                      ● : not lit (OFF)

PCB Name	LED No.	Status	Remarks
<b>Control Unit</b>			
CPU (05P0355)	CR1	◐	Blinks when the CPU is operating normally.
<b>Transceiver Unit</b>			
CPU (05P0347)	CR1	◐	Blinks when the CPU is operating normally.
INTERFACE (05P0354)	CR5 (DC IN)	○	Lights when turning on the main breaker.
REG CONT (05P0353)	CR1 (OSC)	○	Lights when the +21V switching regulator control (U2) is operating normally.
	CR2 (48V AVR)	○	Lights dimly when +45V feedback circuit operates normally.
	CR3 (OVP)	●	Lights at the moment overvoltage is detected on +45V line.
	CR5 (48V)	○	Lights when +45V output is correctly produced.
	CR6 (18V AVR)	○	Lights dimly when +18V feed back circuit is operating normally.
	CR7 (18V)	○	Lights when +18V output is correctly produced.

continued

PCB Name	LED No.	Status	Remarks
EXC "SYN" (05P0349)	CR4 (UNLOCK 2)	●	Lights when PLL circuit of VCO2 is unlocked.
	CR5 (UNLOCK 3)	●	Lights when PLL circuit of VCO3 is unlocked.
	CR6 (UNLOCK 1)	●	Lights when PLL circuit of VCO1 is unlocked.
EXC (05P0349)	CR1 (AF)	○	Lights when sufficient input signal is applied to the board.
	CR6 (RF)	○	Lights when signal is correctly outputted in level.
RX "SYN" (05P0348)	CR2 (VCO2 UNLOCK)	●	Lights when PLL circuit of VCO2 is unlocked.
	CR5 (VCO1 UNLOCK)	●	Lights when PLL circuit of VCO1 is unlocked.
	CR17 (VCO3 UNLOCK)	●	Lights when PLL circuit of VCO3 is unlocked.
<b>Antenna Coupler</b>			
COUPLER (05P0358)	CR59	○	Lights when the PTT switch is pressed.
	CR65	○	Lights when the <b>DUMMY</b> key is pressed.

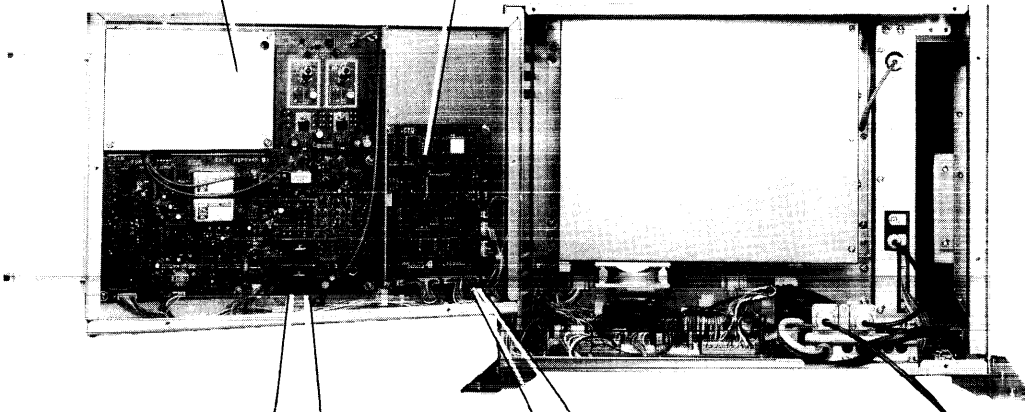


T Photo No.1091

Fig. 3-1 CPU Board (Control Unit)

EXC Board

CPU Board

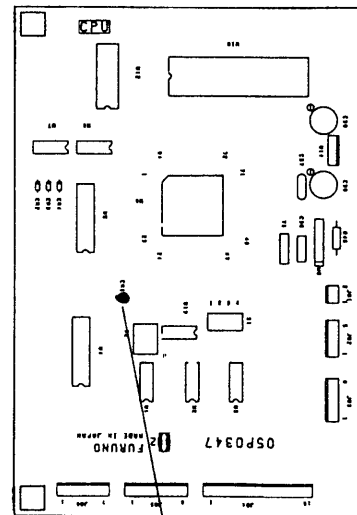
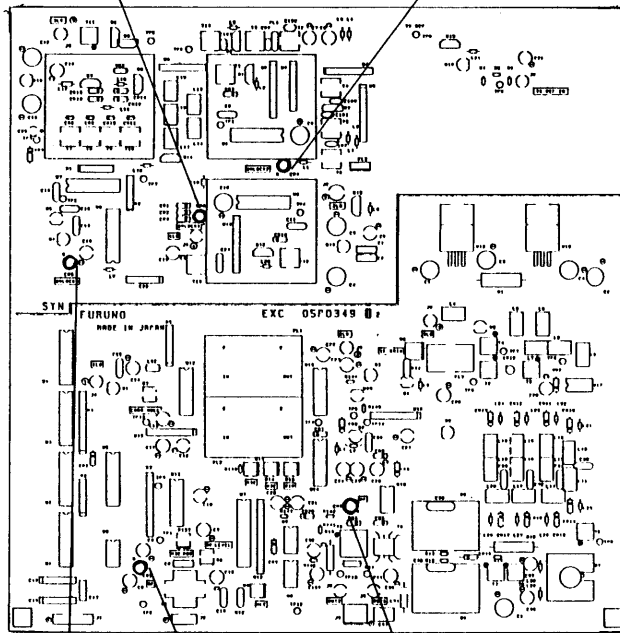


T Photo No.1152

Fig. 3-2 Transceiver Unit  
with front door opened

CR6

CR4



CR5

CR1

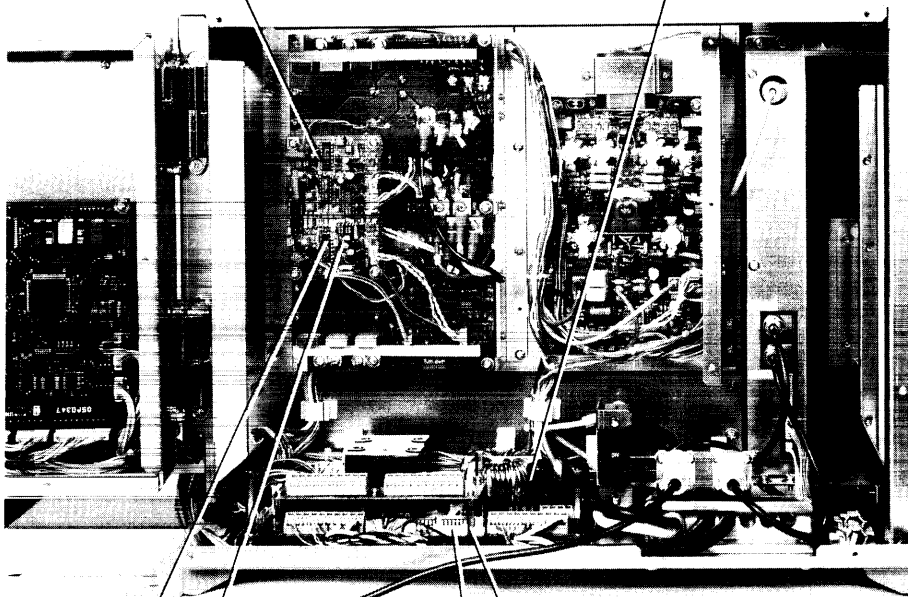
CR6

EXC Board

CPU Board

REG CONT Board

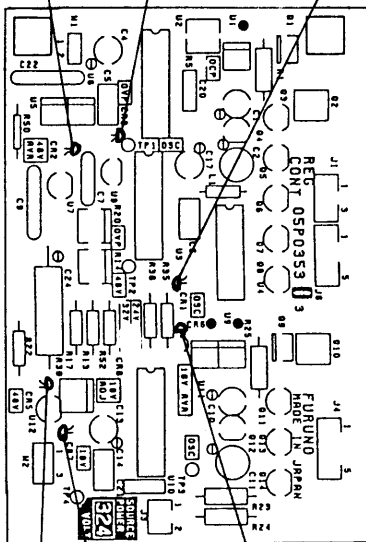
INTERFACE Board



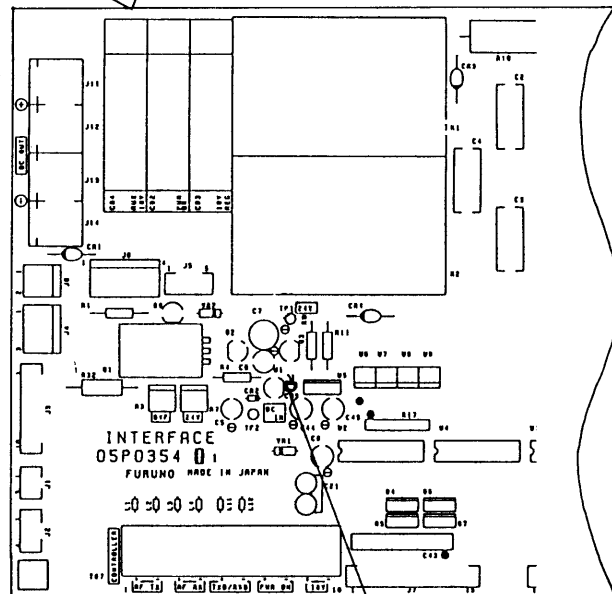
T Photo No.1107

Fig. 3-3 Transceiver Unit  
with inner cover removed

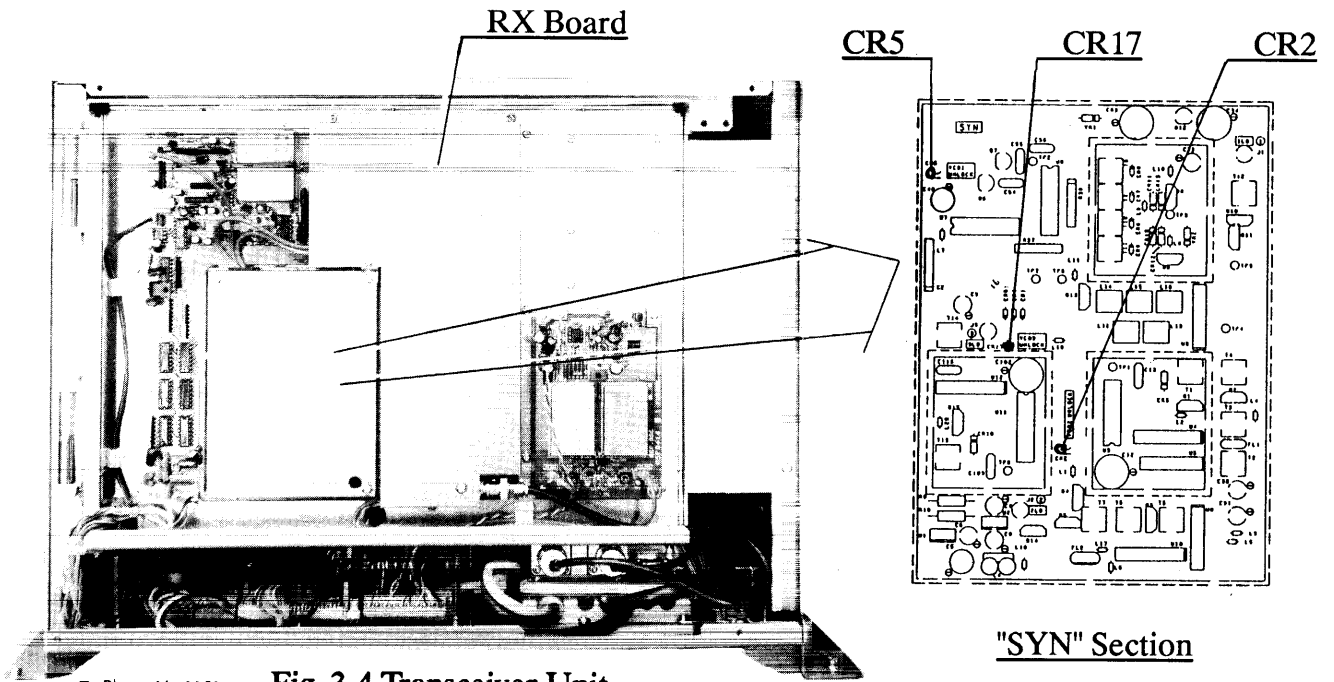
CR2 CR3 CR1



REG CONT Board

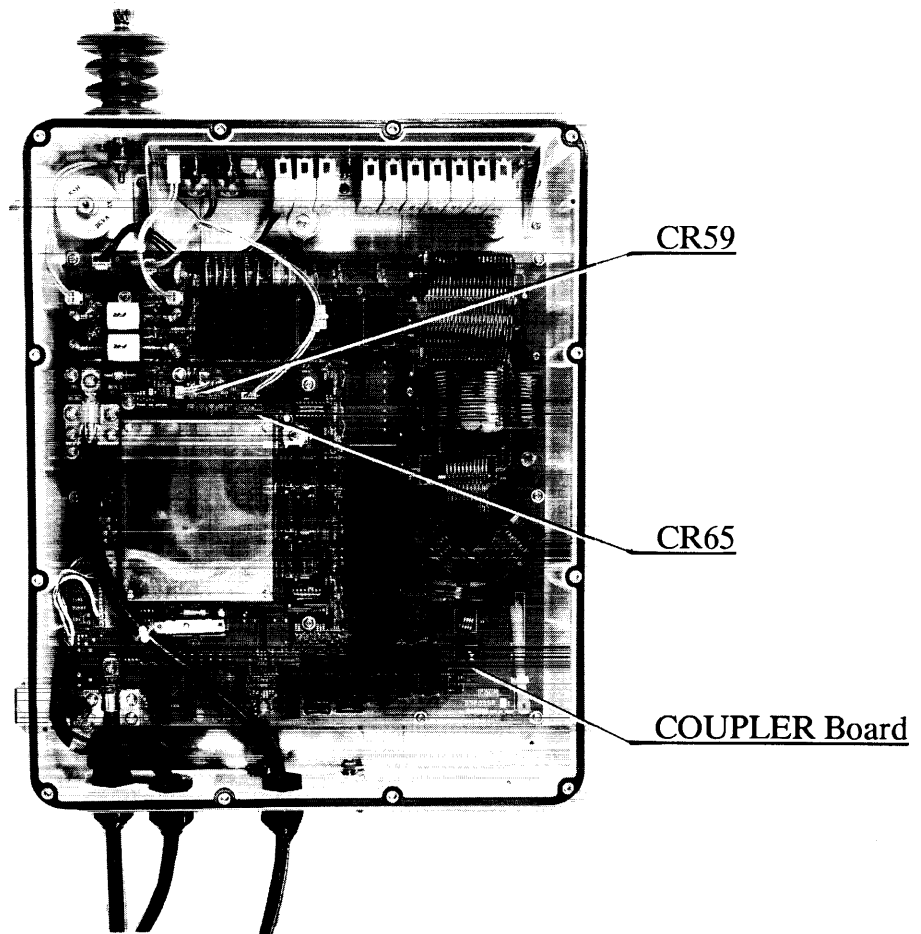


INTERFACE Board



T Photo No.1151

**Fig. 3-4 Transceiver Unit**  
with front cover removed



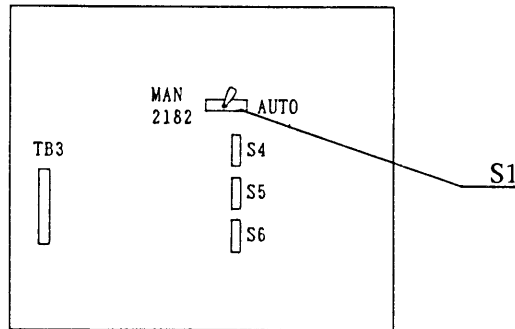
T Photo No.1085

**Fig. 3-5 Antenna Coupler**

## 2. SWITCH SETTING

### Antenna Coupler

DIP Switch S1 permits manual transmission of 2182kHz in the event the automatic tuning circuit fails.

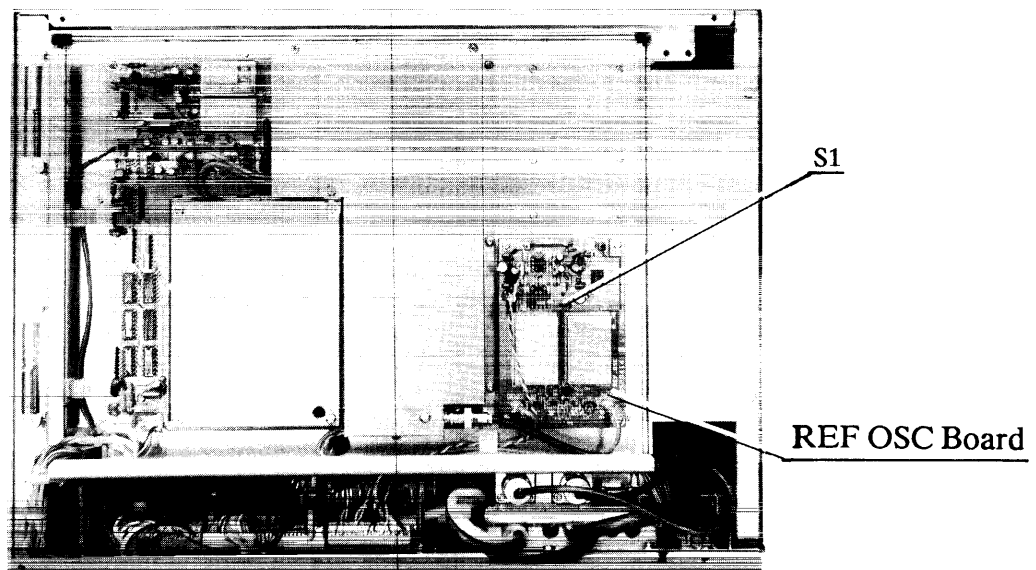


Note that frequencies other than 2182kHz can also be transmitted manually by changing the settings of DIP Switches S4 thru S6. Record the status of LEDs CR37 to CR57 during automatic tuning of an often-used frequency and set DIP switches S4 thru S6 according to LED status.

DIP Switch		LED
S4	4	CR57
	5	CR56
	⋮	⋮
	8	CR53
S5	1	CR52
	2	CR51
	⋮	⋮
	8	CR45
S6	1	CR44
	2	CR43
	⋮	⋮
	8	CR37

### REF OSC Board

Slide Switch S1 provides for selection of local oscillator, OSC1 or OSC2. When one is malfunctioning, select the other.



# CHAPTER 4 PARTS LOCATION

## 1. CONTROL UNIT

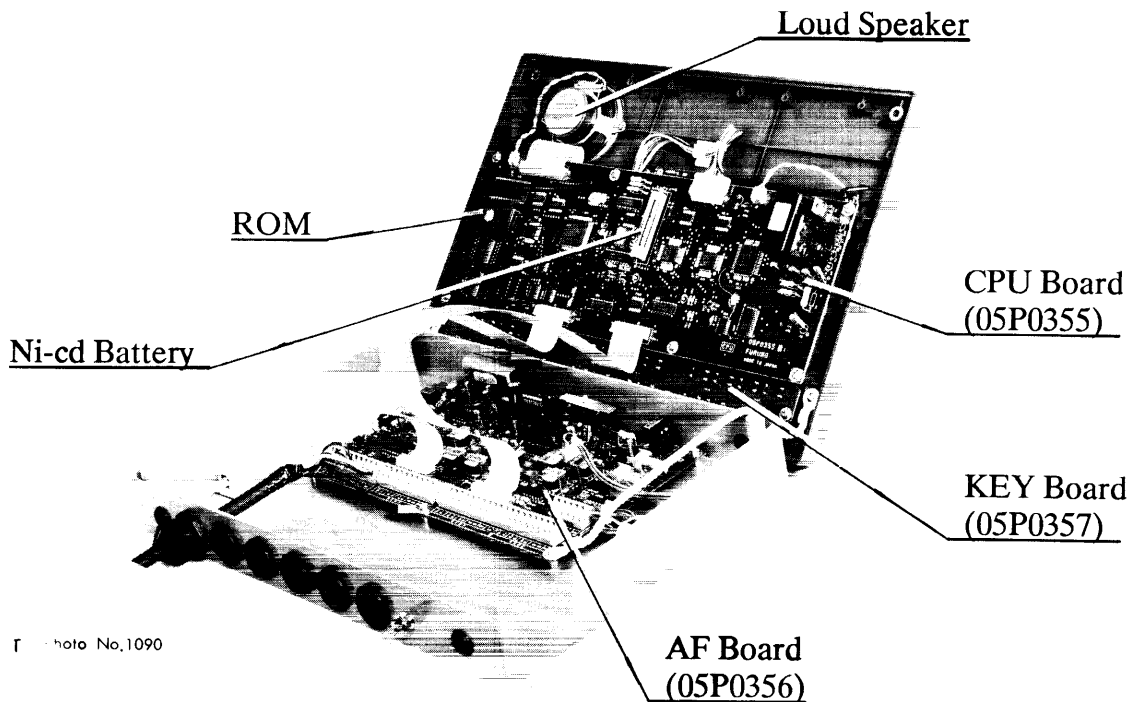


Fig. 4-1

## 2. TRANSCEIVER UNIT

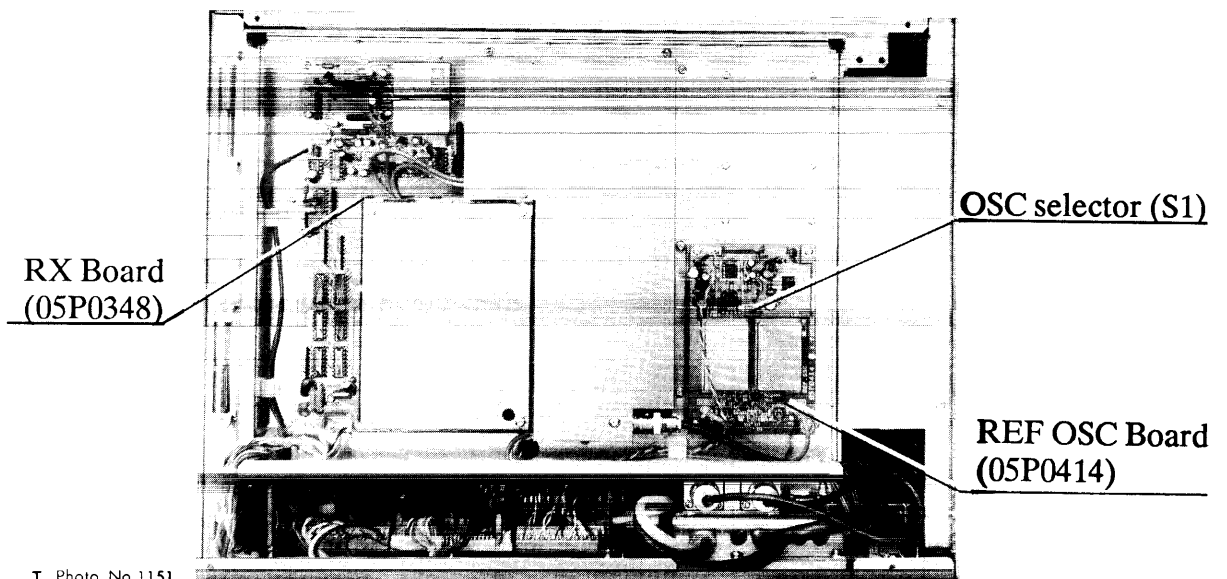


Fig. 4-2

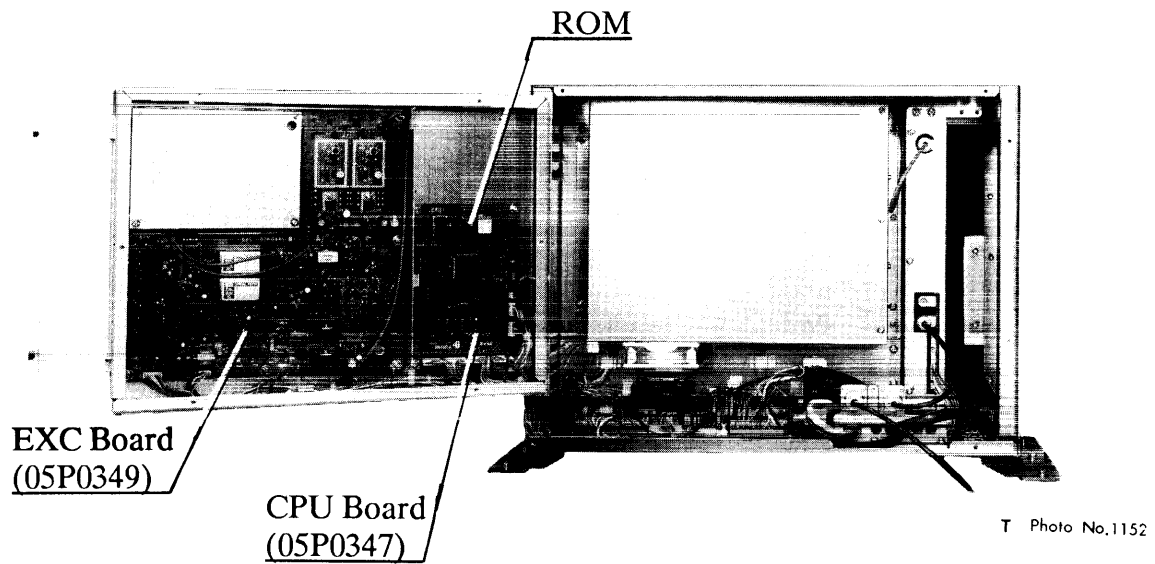


Fig. 4-3

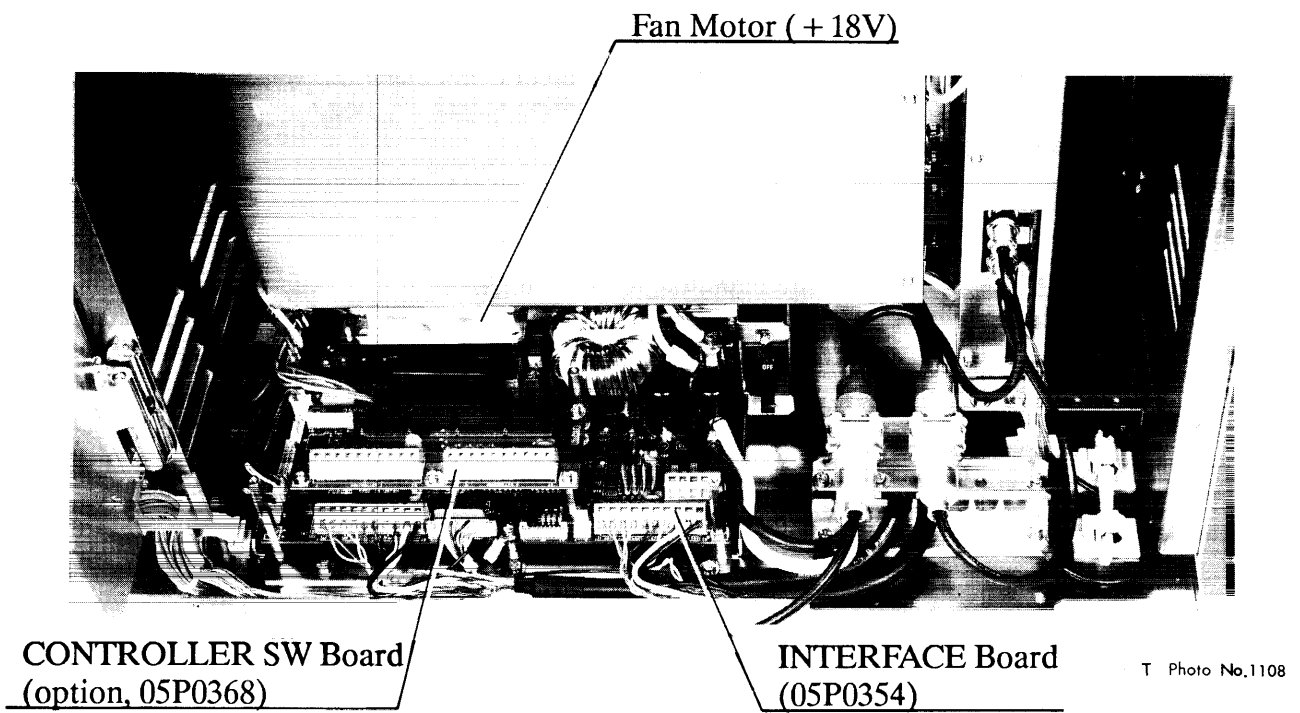
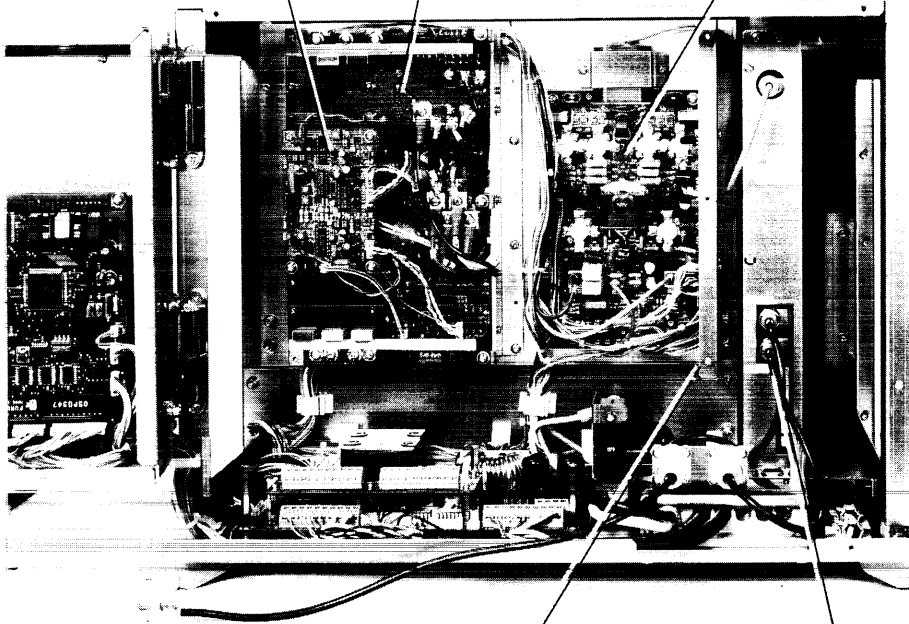


Fig. 4-4

REG CONT Board  
(05P0353)  
(mounted above  
the REG board)

REG Board  
(05P0352)

PA Board  
(05P0363)

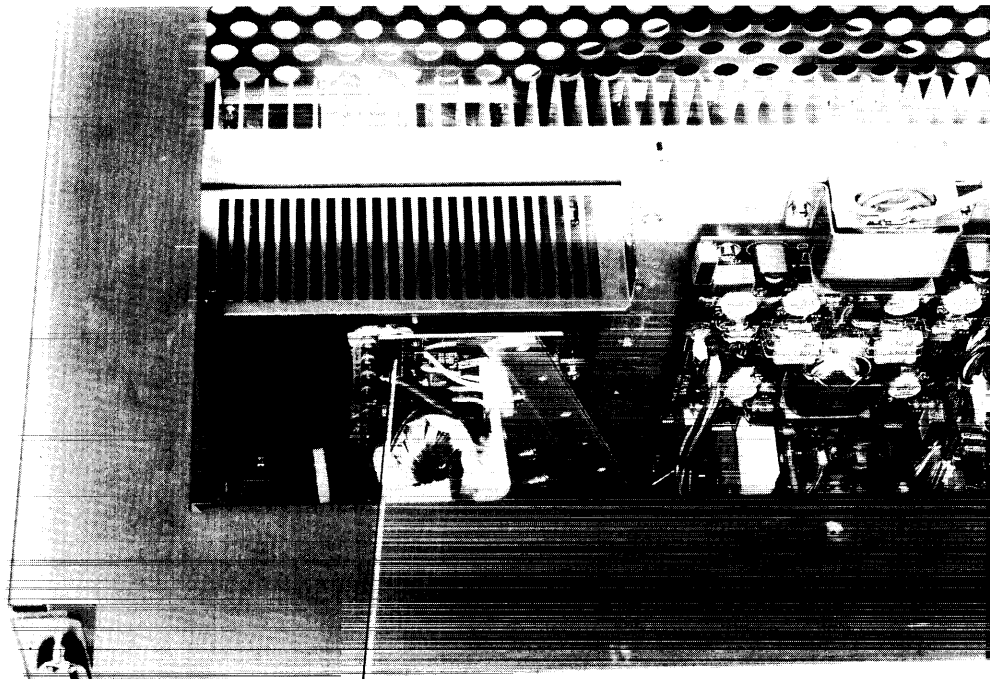


T Photo No.1107

PA CHECK Board (05P0367)

TX FIL Board  
(05P0350)

Fig. 4-5



T Photo No.1109

REG SW Board  
(05P0398)

Fig. 4-6

### 3. ANTENNA COUPLER

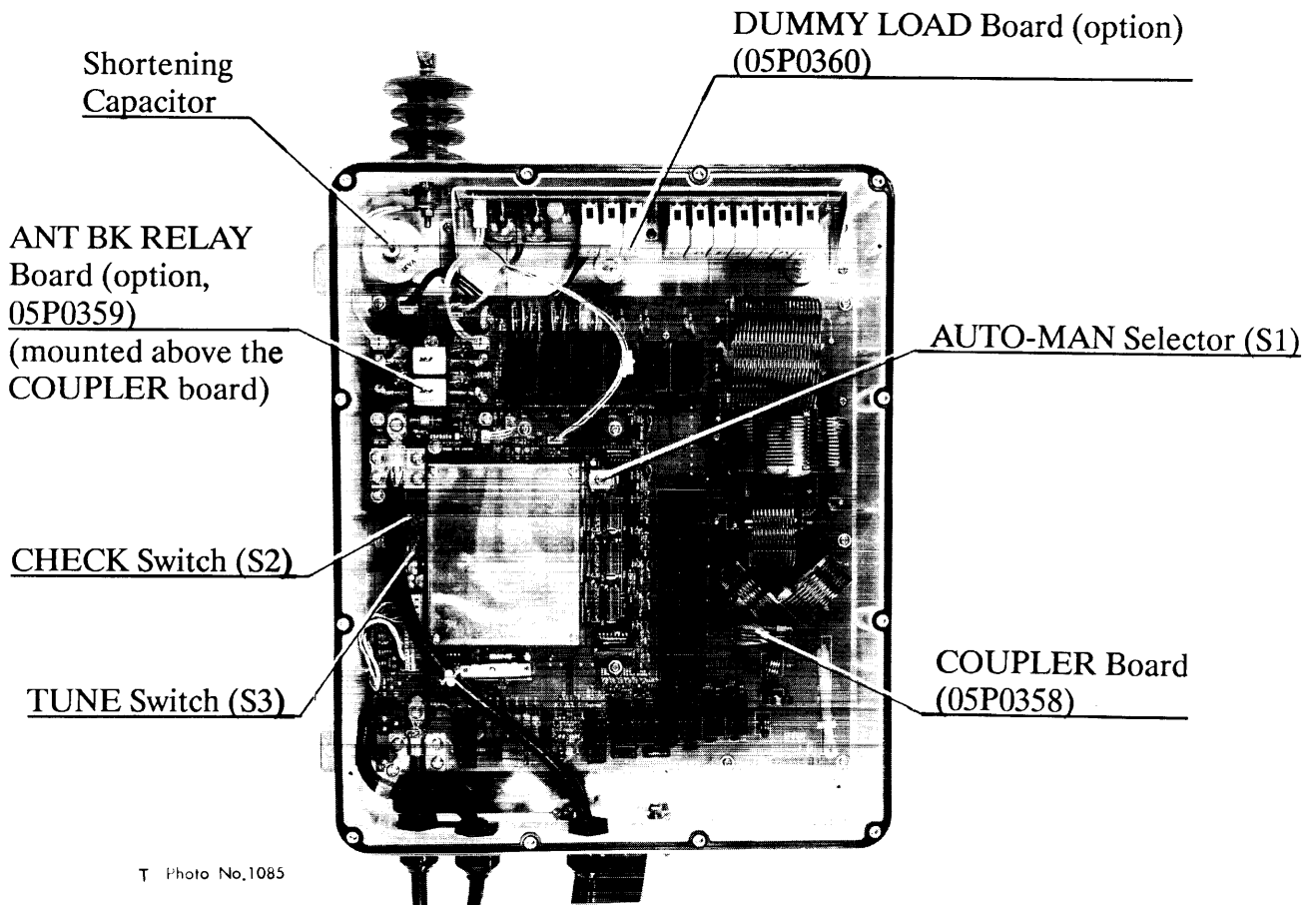
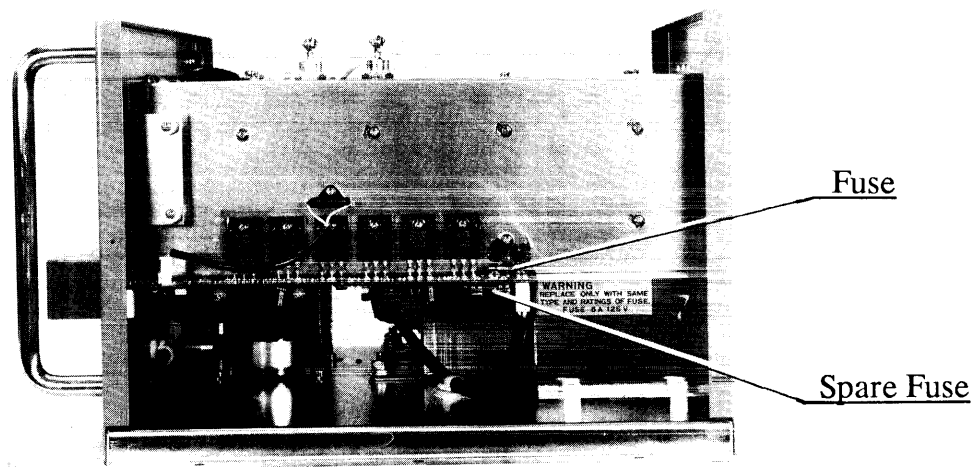


Fig. 4-7 Front cover removed

### 4. RECTIFIER UNIT (OPTION)



T Photo No.1094

Fig. 4-8 Cover removed

# CHAPTER 5 TROUBLESHOOTING

## 1. SELF-DIAGNOSIS TEST

### 1.1 Control Unit & Transceiver Unit

To execute a self test, press the [RCL] key, enter a test number and hit the [ENT] key. The LCD displays an appropriate indication during testing, and, after completion of the test, the results, either OK or an error message.

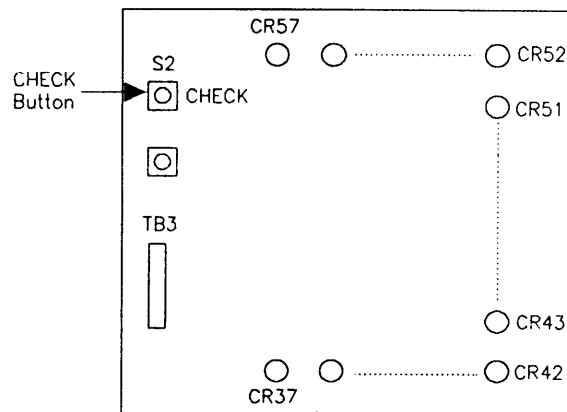
To escape from a self test, press any key after the test is completed.

Test No.	Test	Indication During Testing
9900	All self tests except the key/LCD test	
<b>TRANSCEIVER UNIT</b>		
9910	Consecutive execution of tests 9911 to 9916	
9911	TX synthesizer on the EXC Board (PLL)	Checking Tx Local OSC
9912	MIC Input/Output on EXC Board Vc/Ic on PA Board SWR detection on TX FIL Board	Checking Tx board
9913	RX synthesizer on the RX Board (PLL)	Checking Rx Local OSC
9914	RX Board	Checking Rx board
9915	ROM (U10) on CPU Board	Checking TRx ROM
9916	RAM (U12) on CPU Board	Checking TRx RAM
<b>CONTROL UNIT</b>		
9920	Consecutive execution of tests 9921-9925	
9921	<u>Key Check</u> The name of each key appears on the LCD. Press each key one by one, and its corresponding indication will be highlighted if the key is functioning properly.	
9922	<u>LCD Check</u> Properly functioning LCD segments appear in highlight.	
9923	AF Board	Checking AF board
9924	ROM (U9) on the CPU Board	Checking Control ROM
9925	RAM (U15/U21) on the CPU Board	Checking Control RAM
<b>Connection between Transceiver Unit and Antenna Coupler</b>		
9930	Connection between Transceiver Unit and Antenna Coupler	Checking ATU

## 1.2 Antenna Coupler

To check the Antenna Coupler for proper operation, press the [CHECK] button (S2) on the COUPLER Board. The relays start chattering and LEDs CR37 to CR57 blink one by one in ascending order. If device failure is found, an appropriate LED lights to indicate the offending device:

<u>Device</u>	<u>LED</u>
ROM (U3) -----	CR37
RAM (U4) -----	CR38
A/D Converter IC (U8) -----	CR39



COUPLER Board

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






## 2. TROUBLESHOOTING MATRIX TABLE

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This section provides a troubleshooting matrix table which helps the service technician to quickly identify defective pcb's or blocks. To use the table, locate the symptom in one of the three columns of the table. Possibly defective circuits and their likelihood of defectiveness, indicated by a circle, star or triangle, corresponding to 70 - 80%, approximately 20% and a few percent respectively, are listed in each column. Numeral inside circle shows degrees of possibility; the smaller the number, the higher the possibility.

*NOTE: 1. Check the ship's mains (input supply voltage: 24 or 32VDC) for proper voltage before using the matrix table.*

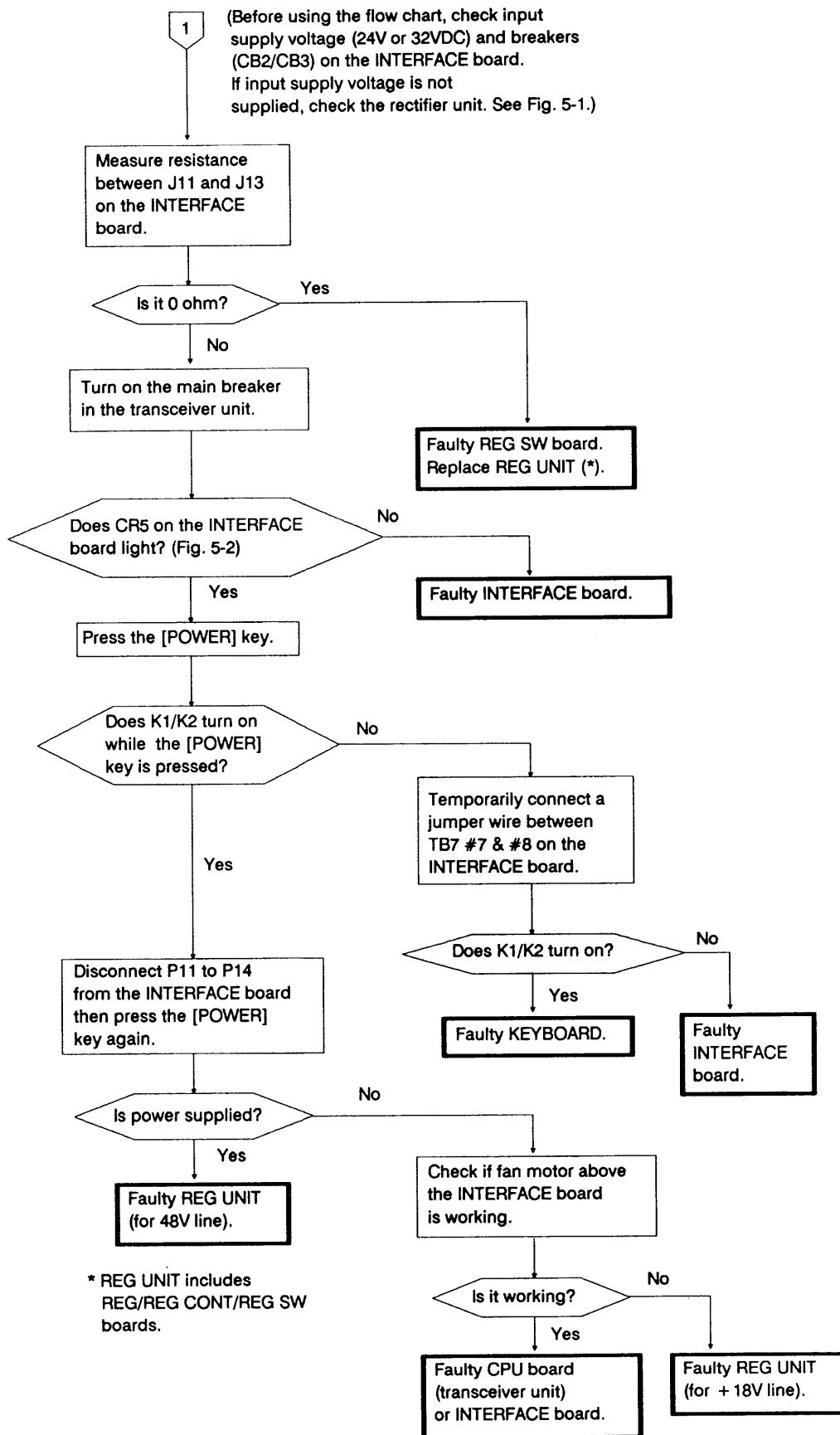
*2. If more extensive troubleshooting is required, refer to the troubleshooting flow chart number given below the symptom number.*

Symptom		① Power can not be supplied.			④ CIF/NMEA data is not input.			⑦ Output power is insufficient.		
		② Power is supplied but nothing appears on the LCD.			⑤ Cannot hear receiving signal.					
Flow Chart No. → 		③ Keyboard locks.			⑥ No automatic tuning.					
Ref. Page → ( )		1	2	3	4	5	6	7	9	
Check Points		 (5-5)	 (5-7)	 (5-8)	 (5-8)	 (5-9)	 (5-11)	 (5-12)		
CONTROL UNIT	AF PCB (05P0356)				△	②		③		
	CPU PCB (05P0355)		①	①	①					
	KEYBOARD (05P0357)	△		②						
	LCD ASSY		②							
	SPEAKER					☆				
TRANSCEIVER UNIT	INTERFACE PCB (05P0354)	①					②			
	EXC PCB (05P0349)							②		
	PA PCB (05P0363)							①		
	TX FIL PCB (05P0350)					△		☆		
	PA CHECK PCB (05P0367)									
	RX PCB (05P0348)					①				
	REF OSC PCB (05P0414)					☆				
	CPU PCB (05P0347)	☆					☆	☆		
	REG PCB (05P0352) (*1)	△								
	REG CONT PCB (05P0353) (*1)	③								
REG SW PCB (05P0398) (*1)	②									
ANTENNA COUPLER	COUPLER PCB (05P0358)						①			
	ANT BK RELAY PCB (05P0359, option)						△			
	DUMMY LOAD PCB (05P0360, option)									
RECTIFIER UNIT (PR-850, option)	RECTIFIER UNIT	△								
	(PR-850, option)									
(*1): These are supplied as a REG UNIT.										

**Likelihood of defectiveness**

- 70 to 80%
- ☆-----20% approx.
- △-----a few percent

# Symptom 1 Power can not be supplied.



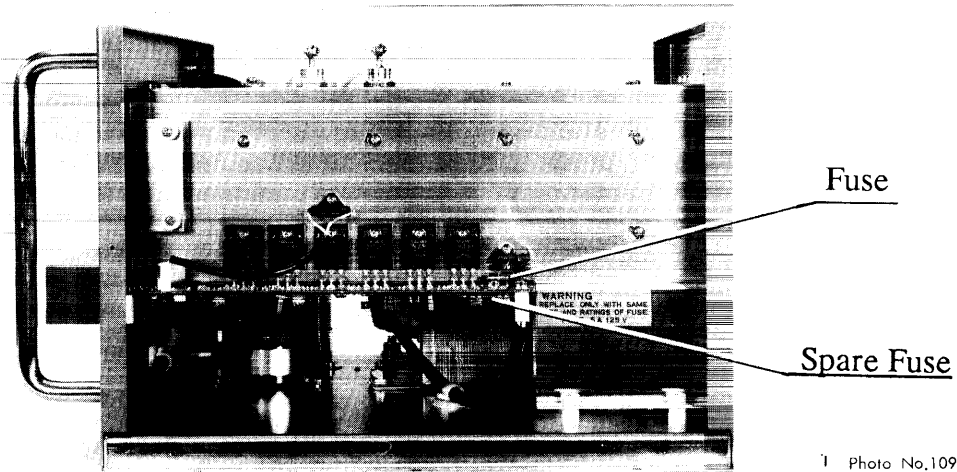


Photo No.1094

Fig. 5-1 Rectifier Unit

**REG UNIT**

REG/REG CONT/REG SW

Boards are located behind the cover.

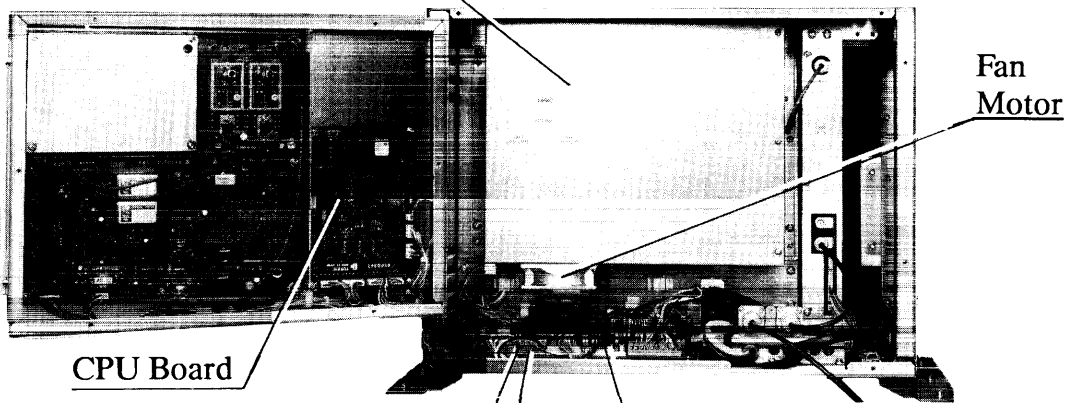


Photo No.1152

CB2/CB3

INTERFACE Board

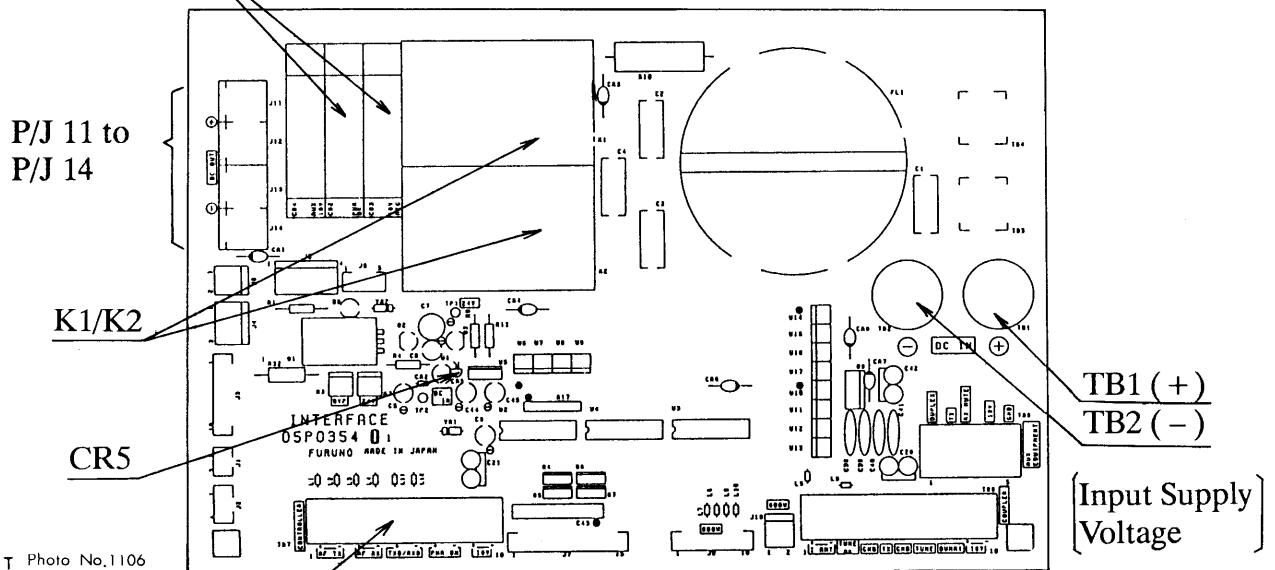


Photo No.1106

Fig. 5-2 Transceiver Unit

## Symptom 2 Nothing appears on the LCD.

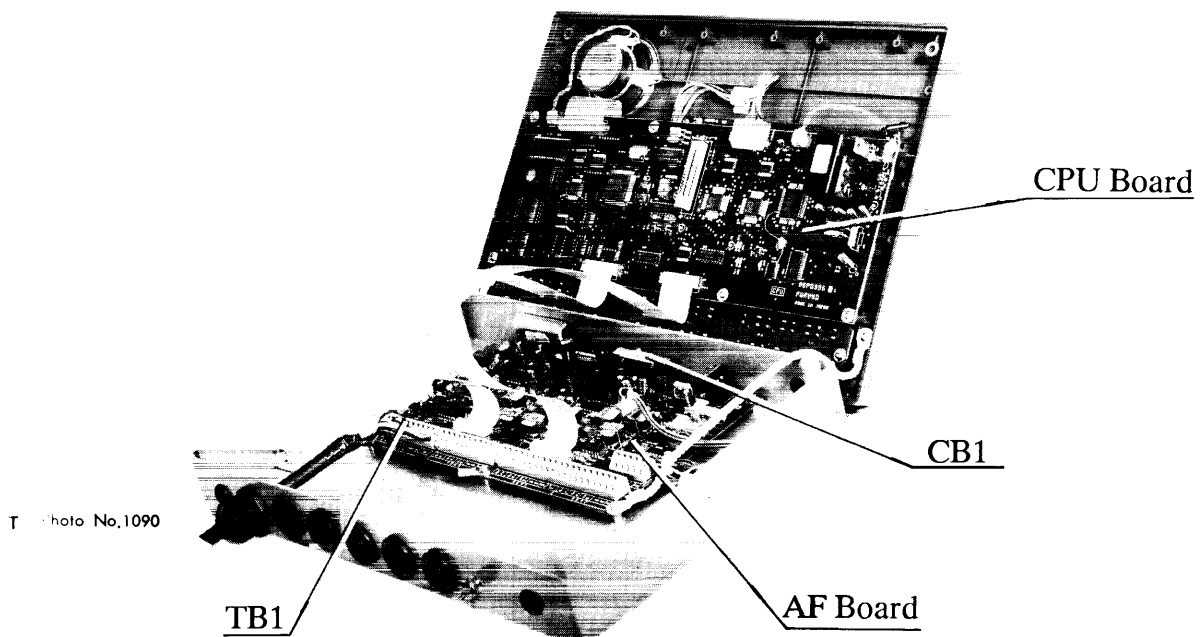
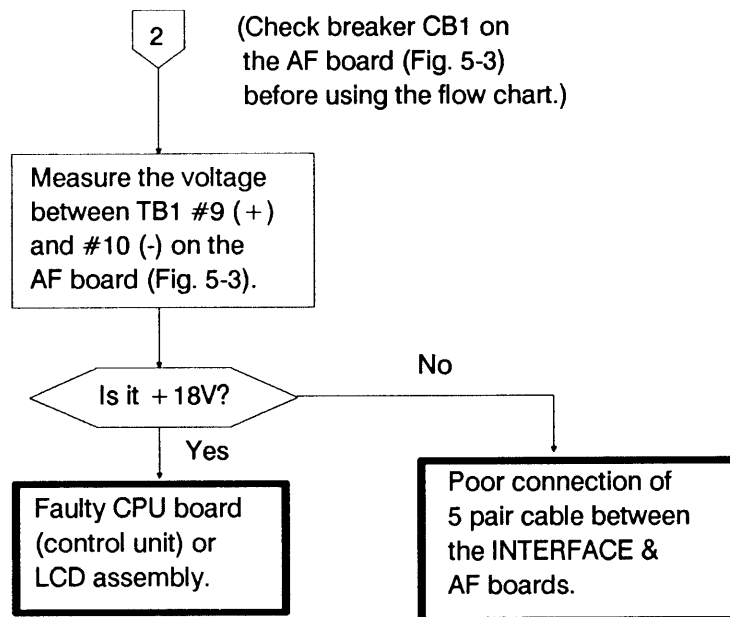
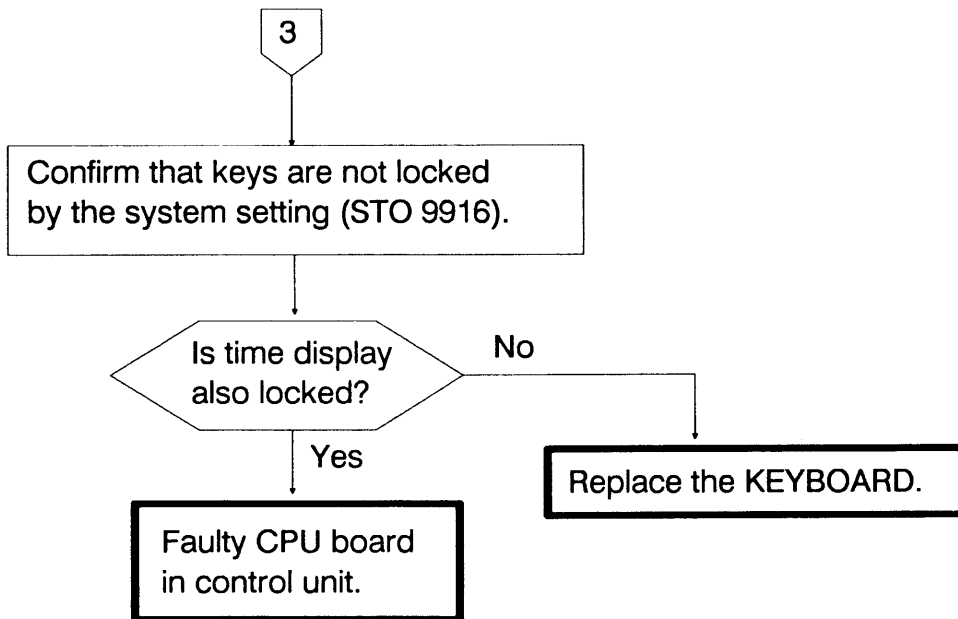


Fig. 5-3 Control Unit

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## Symptom 3 Keyboard locks.

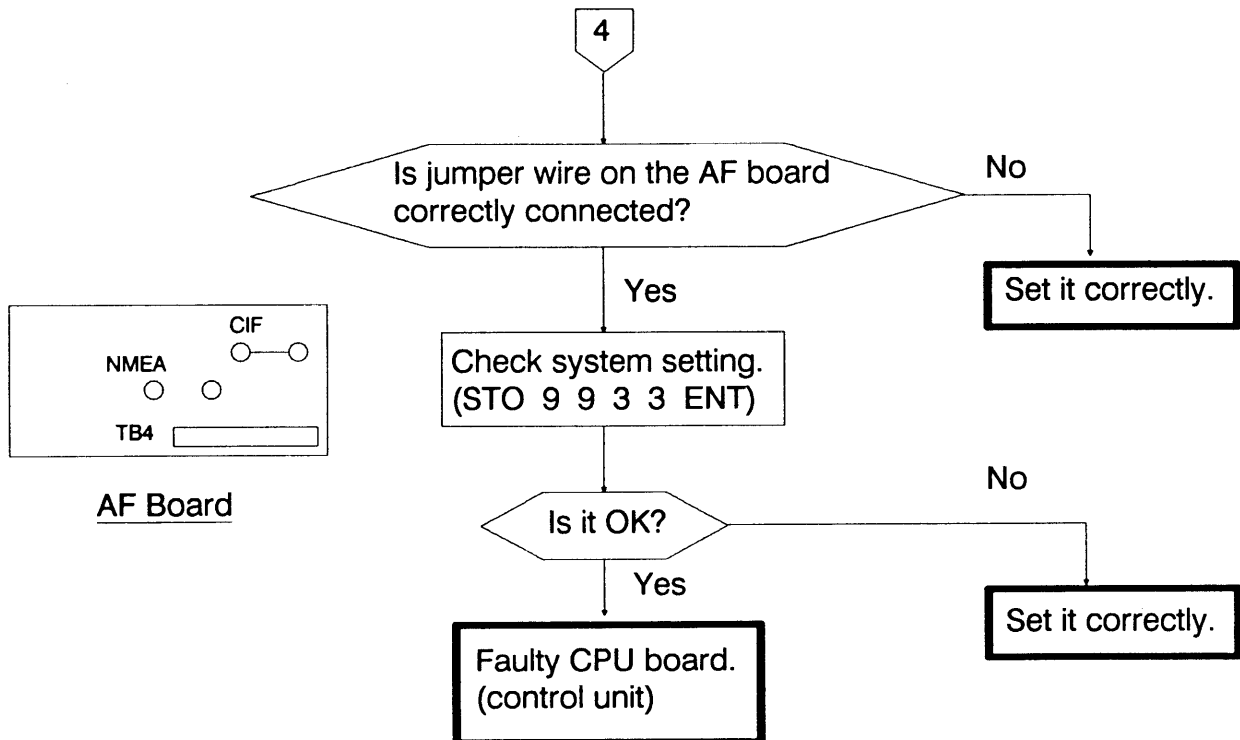
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## Symptom 4 CIF/NMEA data is not input.

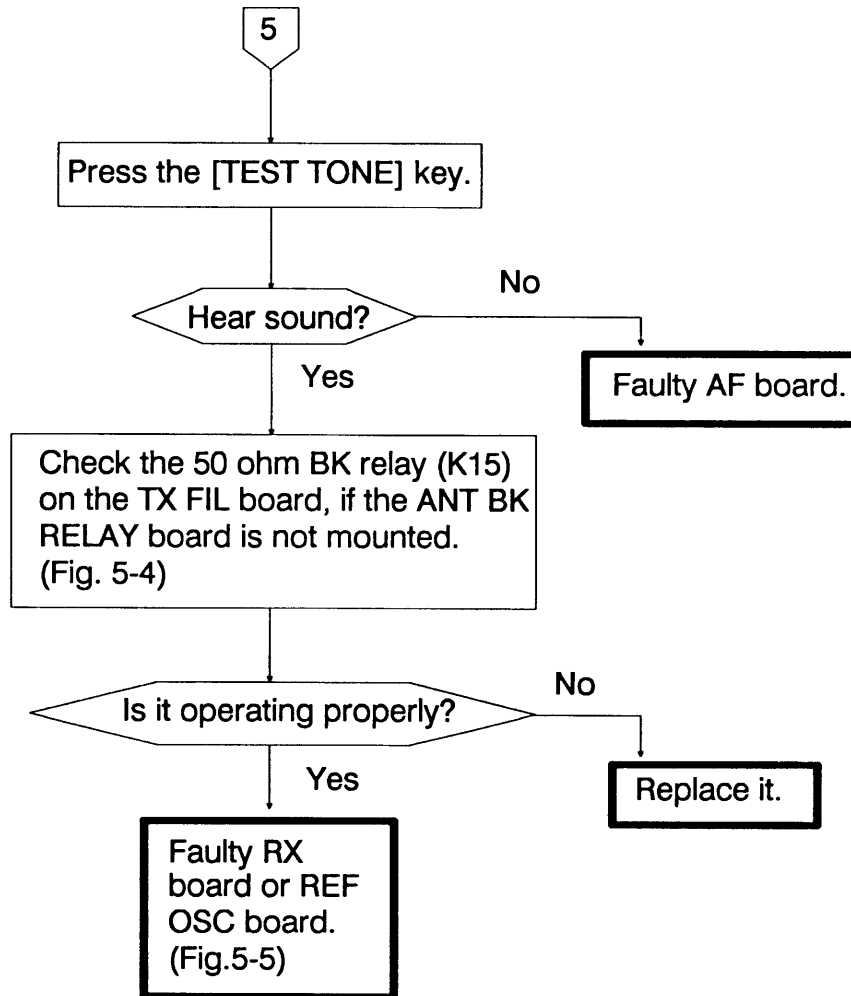
---



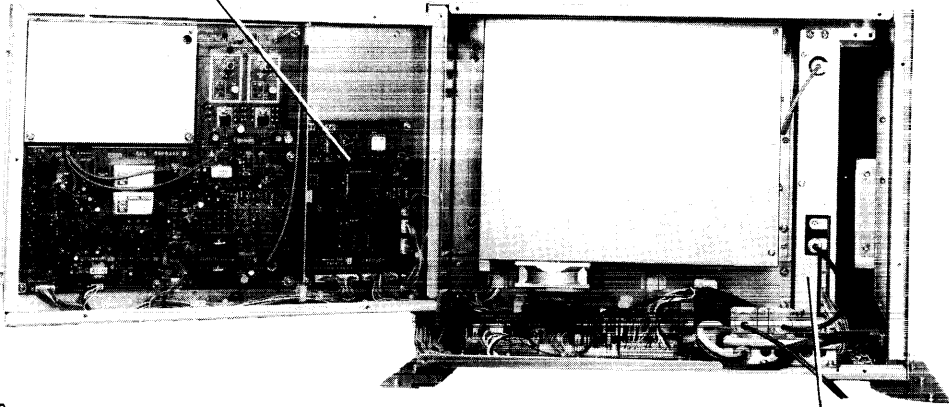
---

## Symptom 5 Cannot hear receiving signal.

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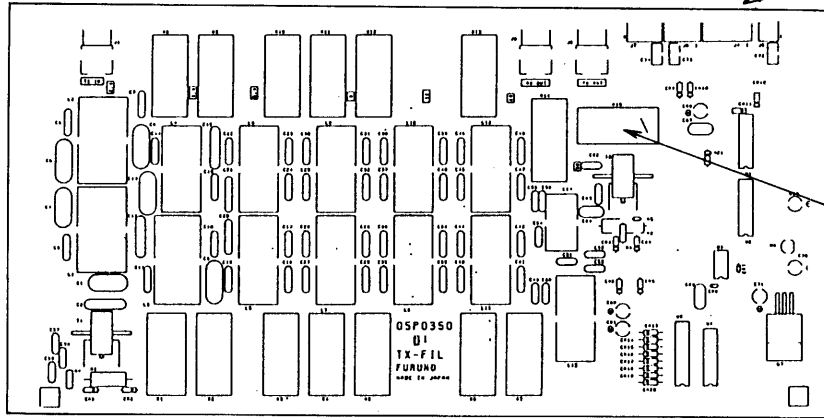


CPU Board



T Photo No.1152

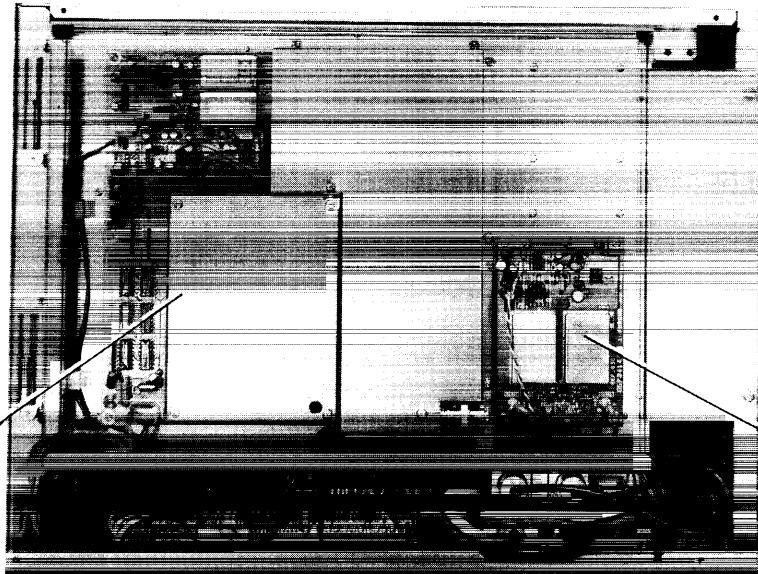
TX FIL Board



K15

Fig. 5-4 Transceiver Unit

RX Board

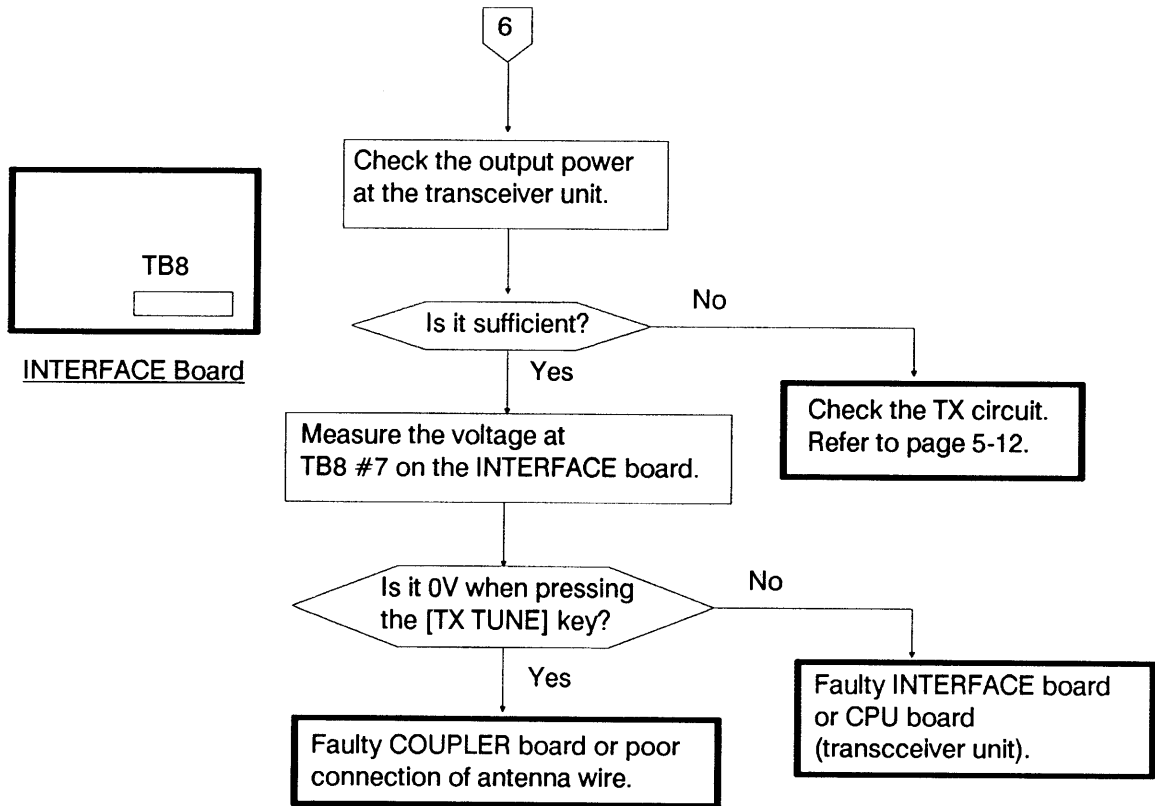


REF OSC Board

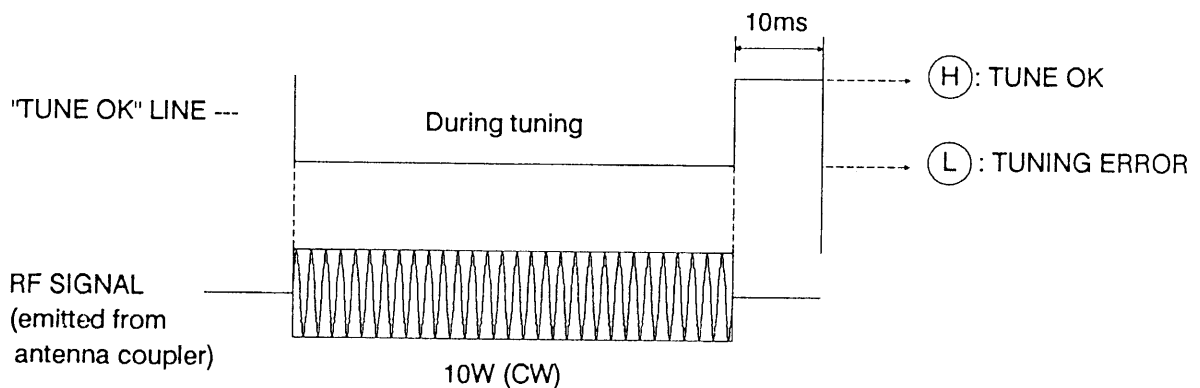
T Photo No.1151

Fig. 5-5 Transceiver Unit

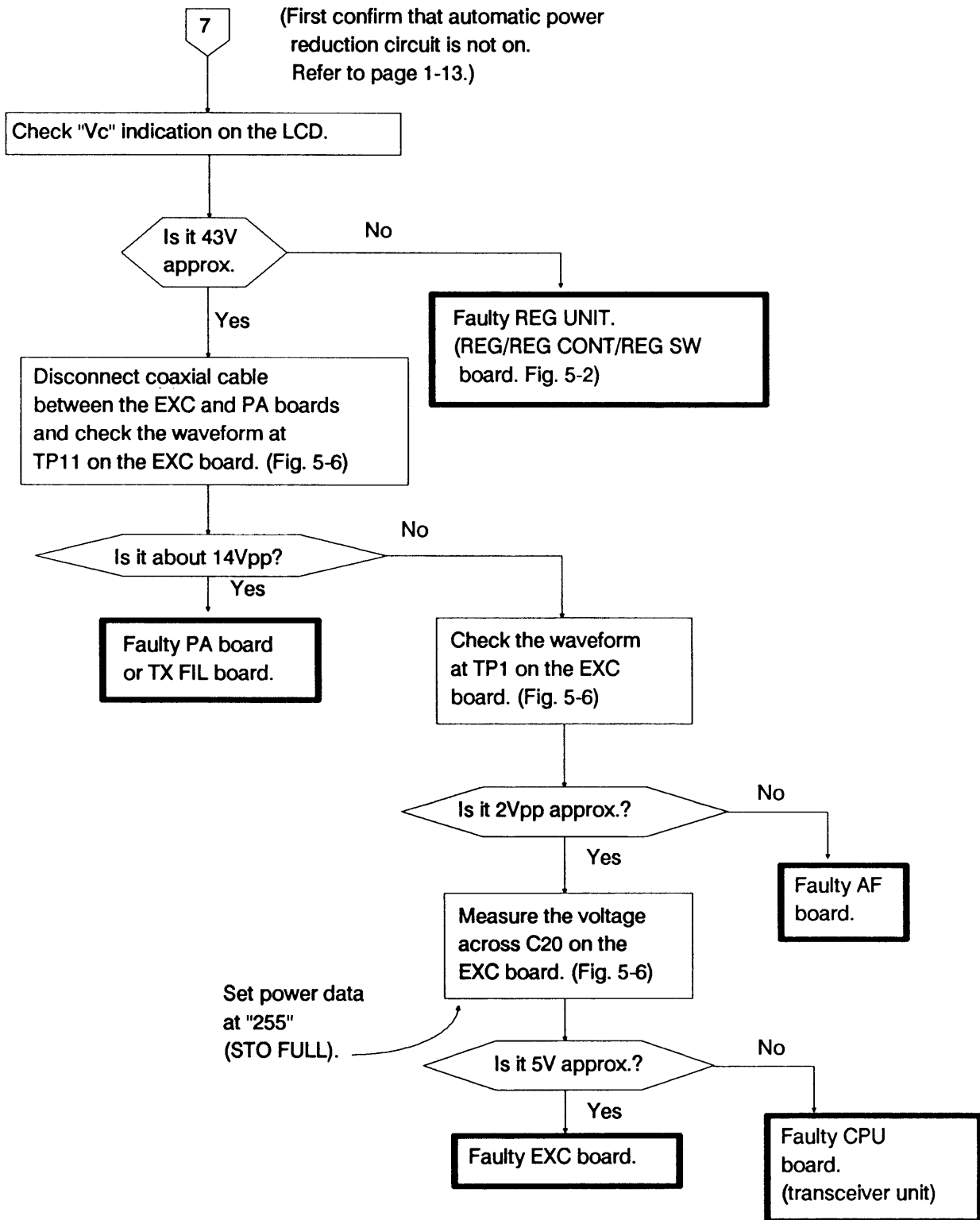
## Symptom 6 No automatic tuning.

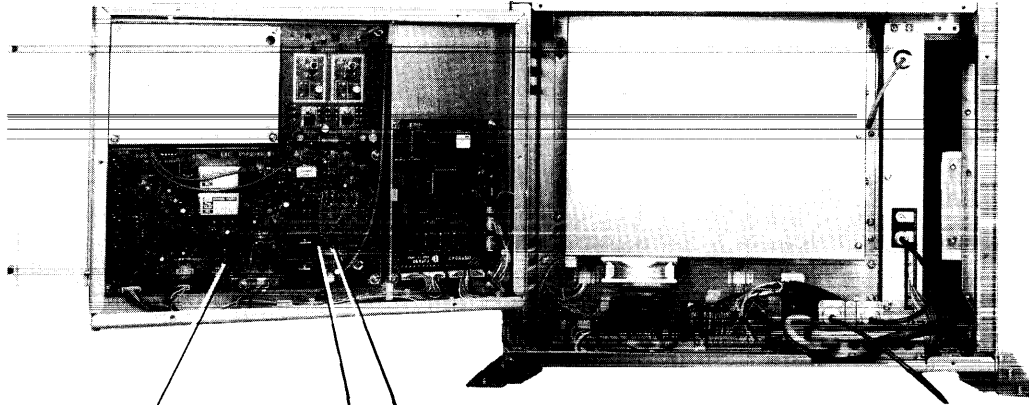


*Note: After tuning is completed, TUNE OK line level at TB8 #3 on the INTERFACE board goes low when best tuning point could not be found. ("TUNING ERROR" is displayed.)*



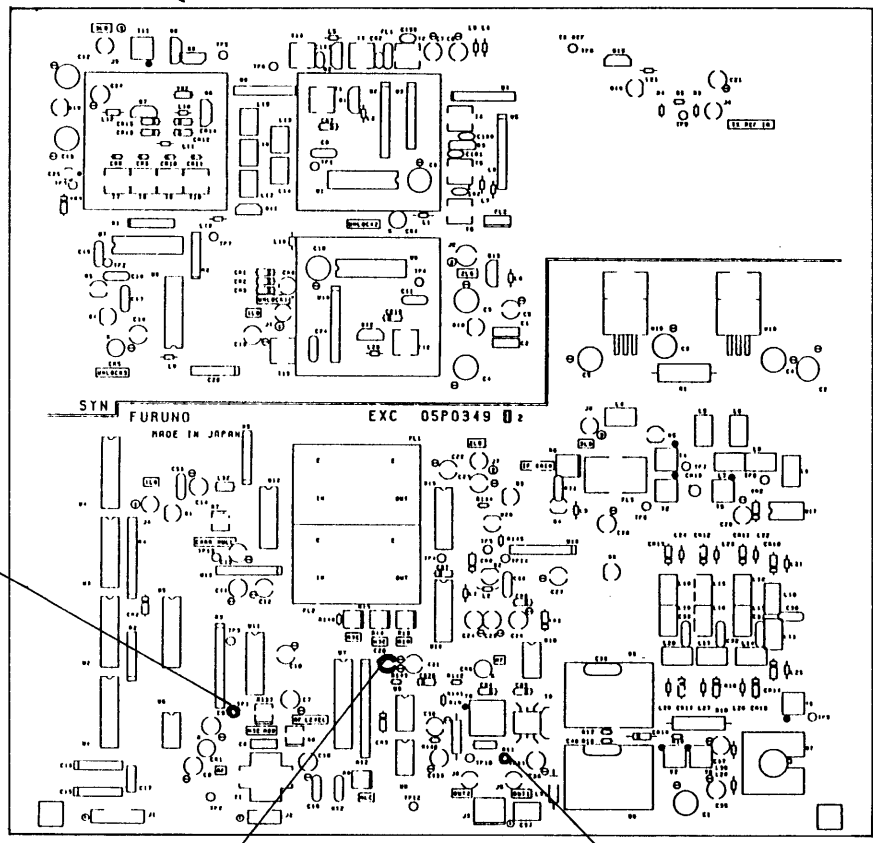
# Symptom 7 Output power is insufficient.





EXC Board

T Photo No.1152



TP1

C20

TP11

Fig. 5-6 Transceiver Unit

**FURUNO**ELECTRICAL PARTS LIST  
電気部品表

1991- 2

MODEL	FS-5000		
UNIT	TRANSCIVER UNIT トランシーバ ユニット		PAGE
REF. DWG.	C5519-K12-C	BLOCK NO.	1B00
			1

SYMBOL 記号	T Y P E 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
PRINTED CIRCUIT BOARD		プリント基板		
1B02A0002	05P0349 EXC	FS-5000T	005-594-240	
1B03A0003	05P0348 RX	FS-5000T	005-594-220	
1B04A0004	05P0347 CPU	FS-5000T	005-594-200	
1B05A0005	05P0354 I/F	FS-5000T	005-927-250	24VDC
	05P0354A I/F	FS-5000T	005-595-750	32VDC
1B06A0006	05P0350 TX FIL	FS-5000T	005-927-240	
1B08A0008	05P0363 PA	FS-5000T	005-594-040	
1B09A0009	05P0367 PA CHECK	FS-5000T	005-594-140	
1B14A0014	05P0414 REF OSC	FS-5000T	005-595-600	
ASSEMBLY		クミヒン		
1B10A*0001	REG UNIT (24VDC)	REG/R CONT.P.	005-927-220	INCL. 05P0352 05P0353 05P0398
1B10A*0001	REG UNIT (32VDC)	REG/R CONT.P.	005-931-830	INCL. 05P0352 05P0353A 05P0398
MOTOR		モーター		
1B01B0001	MD1225A-24		000-119-322	
1B01B0002	MD1225A-24		000-119-322	
1B01B0003	109E0824H402		000-121-337	
CIRCUIT BREAKER		サーキットブレーカー		
1B01CB0001	APL-1-500-60A	05S0678-0	000-119-323	
JACK		ジャック		
1B01J0001	PANEL ADAPTOR M-PA	FMA-2A	000-500-720	
1B01J0002	PANEL ADAPTOR M-PA	FMA-2A	000-500-720	
COIL		コイル		
1B10L0001	RIB 8X14X13	3A6	000-426-130	
1B10L0002	RIB 8X14X13	3A6	000-426-130	
1B10L0003	RIB 8X14X13	3A6	000-426-130	
1B10L0004	RIB 8X14X13	3A6	000-426-130	
1B10L0005	RIB 8X14X13	3A6	000-426-130	
PLUG		プラグ		
1B01P0101	M-P-3 FMP-5A FOR :	3C(D)-2V ETC	000-500-510	
1B01P0102	M-P-3 FMP-5A FOR :	3C(D)-2V ETC	000-500-510	
	M-P-3 FMP-5A FOR :	3C(D)-2V ETC	000-500-510	









UNIT TRANSCEIVER UNIT REF. DWG. C5519-K10-C BLOCK NO. 1B02 18. SYMBOL TYPE SPECIFICATIONS CODE NO. REMARKS. TRANSFORMER, TEST POINT, INTEGRATED CIRCUIT, ZENER DIODE.

UNIT TRANSCEIVER UNIT REF. DWG. C5519-K02-C BLOCK NO. 1B03 20. SYMBOL TYPE SPECIFICATIONS CODE NO. REMARKS. CAPACITOR.

UNIT TRANSCEIVER UNIT REF. DWG. C5519-K02-C BLOCK NO. 1B03 19. SYMBOL TYPE SPECIFICATIONS CODE NO. REMARKS. PRINTED CIRCUIT BOARD, CAPACITOR.

UNIT TRANSCEIVER UNIT REF. DWG. C5519-K02-C BLOCK NO. 1B03 21. SYMBOL TYPE SPECIFICATIONS CODE NO. REMARKS. CAPACITOR.







Table with columns: UNIT, TRANSCIVER UNIT, REF. DWG., C5519-K03-C, BLOCK NO., 1B03, 34. Includes sub-headers for CAPACITOR and COIL.

Table with columns: UNIT, TRANSCIVER UNIT, REF. DWG., C5519-K03-C, BLOCK NO., 1B03, 36. Includes sub-headers for COIL and TRANSISTOR.

Table with columns: UNIT, TRANSCIVER UNIT, REF. DWG., C5519-K03-C, BLOCK NO., 1B03, 35. Includes sub-headers for CAPACITOR, DIODE, FILTER, and JACK.

Table with columns: UNIT, TRANSCIVER UNIT, REF. DWG., C5519-K03-C, BLOCK NO., 1B03, 37. Includes sub-headers for RESISTOR.















UNIT	TRANSCEIVER UNIT		REF. DWG.	C5519-K22-A	BLOCK NO.	1B14	66
SYMBOL	T Y P E	SPECIFICATIONS		CODE NO.	REMARKS		
記号	型名	規格		コード番号	備考		
RESISTOR							
抵抗器							
R	41	ERD-16TJ152	0.16W 1.5K	000-329-039			
R	42	ERD-16TJ101	0.16W 100	000-329-013			
R	43	ERD-16TJ473	0.16W 47K	000-330-814			
R	44	ERD-16TJ223	0.16W 22K	000-330-810			
R	45	ERD-16TJ222	0.16W 2.2K	000-330-809			
R	46	ERD-16TJ101	0.16W 100	000-329-013			
R	47	ERD-16TJ102	0.16W 1K	000-330-801			
R	48	ERD-16TJ102	0.16W 1K	000-330-801			
THERMISTOR							
熱敏抵抗器							
RT	1	D-22A		000-180-617			
RT	2	D-22A		000-180-617			
RT	3	D-22A		000-180-617			
RT	4	D-22A		000-180-617			
SWITCH							
スイッチ							
S	1	SS-22SDP2		000-115-733			
TRANSFORMER							
トランス							
T	1	ST513	05S0425-0	000-113-373			
T	2	ST460	05S0355-0	000-109-054			
T	3	ST460	05S0355-0	000-109-054			
T	4	ST513	05S0425-0	000-113-373			
TEST POINT							
テストポイント							
TP	1	LC-2-S-YELLOW		000-537-970			
TP	2	LC-2-S-BLACK		000-537-971			
TP	3	LC-2-S-YELLOW		000-537-970			
INTEGRATED CIRCUIT							
集積回路							
U	1	TA78L012AP		000-163-609			
U	2	TA78015AP		000-163-306			
U	3	NJM2904D		000-113-434			
CRYSTAL							
水晶							
Y	1	05S0402-0	49.5MHZ 05S0402-0	000-113-376			
			49.5MHZ 05S0593-0	000-116-695			
Y	2	05S0402-0	49.5MHZ 05S0402-0	000-113-376			
			49.5MHZ 05S0593-0	000-116-695			

**FURUNO**ELECTRICAL PARTS LIST  
電気部品表

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MODEL	FS-5000		
UNIT	CONTROL UNIT コントローラ部		PAGE
REF. DWG.	C5519-K13-B	BLOCK NO.	2B00
			67

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
PRINTED CIRCUIT BOARD		プリント基板		
2B02A0002	05P0355 CPU	FS-5000C	005-594-540	
2B03A0003	05P0356 AF	FS-5000C	005-594-560	
2B04A0004	05P0357 KEY	FS-5000C	005-594-520	
ASSEMBLY		クミヒン		
2B01B*0001	LM24008M LCD	FS-5000C	005-927-460	
LOUDSPEAKER		スピーカ-		
2B01LS0001	EAS-65P16S	8, 2W	000-580-091	







UNIT	CONTROL UNIT	REF. DWG.	C5519-K13-B	BLOCK NO.	2B04	80
SYMBOL	T Y P E	SPECIFICATIONS		CODE NO.	REMARKS	
記号	型名	規	格	コード番号	備	考
SWITCH		スイッチ				
S 2	SKHCAC037A			000-100-871		
S 3	SKHCAC037A			000-100-871		
S 4	SKHCAC037A			000-100-871		
S 5	SKHCAC037A			000-100-871		
S 6	SKHCAC037A			000-100-871		
S 7	SKHCAC037A			000-100-871		
S 8	SKHCAC037A			000-100-871		
S 9	SKHCAC037A			000-100-871		
S 10	SKHCAC037A			000-100-871		
S 11	SKHCAC037A			000-100-871		
S 12	SKHCAC037A			000-100-871		
S 13	SKHCAC037A			000-100-871		
S 14	SKHCAC037A			000-100-871		
S 15	SKHCAC037A			000-100-871		
S 16	SKHCAC037A			000-100-871		
S 17	SKHCAC037A			000-100-871		
S 18	SKHCAC037A			000-100-871		
S 19	SKHCAC037A			000-100-871		
S 20	SKHCAC037A			000-100-871		
S 21	SKHCAC037A			000-100-871		
S 22	SKHCAC037A			000-100-871		
S 23	SKHCAC037A			000-100-871		
S 24	SKHCAC037A			000-100-871		
S 25	SKHCAC037A			000-100-871		
S 26	SKHCAC037A			000-100-871		
S 27	SKHCAC037A			000-100-871		
S 28	SKHCAC037A			000-100-871		
S 29	SKHCAC037A			000-100-871		
S 30	SKHCAC037A			000-100-871		
S 31	SKHCAC037A			000-100-871		
S 33	SKHCAC037A			000-100-871		
S 34	SKHCAC037A			000-100-871		
S 35	SKHCAC037A			000-100-871		
S 36	SKHCAC037A			000-100-871		
S 37	SKHCAC037A			000-100-871		
S 38	SKHCAC037A			000-100-871		
S 39	SKHCAC037A			000-100-871		
S 40	SKHCAC037A			000-100-871		
S 41	SKHCAC037A			000-100-871		
S 42	SKHCAC037A			000-100-871		
S 43	SKHCAC037A			000-100-871		
S 44	SKHCAC037A			000-100-871		
S 45	SKHCAC037A			000-100-871		
S 46	SKHCAC037A			000-100-871		
S 47	SKHCAC037A			000-100-871		
S 48	SKHCAC037A			000-100-871		
S 49	SKHCAC037A			000-100-871		
S 50	SKHCAC037A			000-100-871		
S 51	SKHCAC037A			000-100-871		
S 52	SKHCAC037A			000-100-871		
S 53	SKHCAC037A			000-100-871		

UNIT	CONTROL UNIT	REF. DWG.	C5519-K13-B	BLOCK NO.	2B04	81
SYMBOL	T Y P E	SPECIFICATIONS		CODE NO.	REMARKS	
記号	型名	規	格	コード番号	備	考
SWITCH		スイッチ				
S 54	SKHCAC037A			000-100-871		
S 55	SKHCAC037A			000-100-871		
S 56	SKHCAC037A			000-100-871		
S 57	SKHCAC037A			000-100-871		
S 58	SKHCAC037A			000-100-871		
S 59	SKHCAC037A			000-100-871		
S 60	SKHCAC037A			000-100-871		
S 61	SKHCAC037A			000-100-871		
S 62	SKHCAC037A			000-100-871		
S 64	SKHCAC037A			000-100-871		
S 65	SKHCAC037A			000-100-871		

**FURUNO**

MODEL	FS-5000		
UNIT	ANTENNA COUPLER アンテナカップラ		PAGE
REF. DWG.	C5519-K18-B	BLOCK NO.	3B01
			82

ELECTRICAL PARTS LIST

電気部品表

1991- 2

SYMBOL	T Y P E	SPECIFICATIONS	CODE NO.	REMARKS
記号	型名	規格	コード番号	備考
PRINTED CIRCUIT BOARD		プリント基板		
3B02A0002	05P0358 COUPLER	AT-5000	005-594-290	
CAPACITOR		コンデンサー		
3B01C0001	DC-40	500PF	000-258-703	
RESISTOR		抵抗		
3B01R0001	GS-2A10MJ		000-121-822	





**FURUNO**ELECTRICAL PARTS LIST  
電気部品表

1991- 2

MODEL	FS-5000		
UNIT	P. C. B. FOR NO. 2 CONT 追加コントローラ用基板 (OPTION)		PAGE
REF. DWG.	C5519-K01-B	BLOCK NO.	10B03
			91

SYMBOL	T Y P E	SPECIFICATIONS	CODE NO.	REMARKS
記号	型名	規格	コード番号	備考
PRINTED CIRCUIT BOARD		プリント基板		
	05P0368	CONTROLLER SW	005-594-730	
CAPACITOR		コンデンサ		
C	1	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	2	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	3	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	4	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	5	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	6	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	7	ECU-X1H102KBN	1000PF 50V	000-114-489
C	8	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	9	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	10	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	11	DSS310-55D-223S50V	0.022UF 50V	000-252-450
C	12	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	13	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	14	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	15	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	16	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	17	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	18	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	19	ECU-X1H102KBN	1000PF 50V	000-114-489
C	20	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	21	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	22	ECU-X1H103KBG	0.01UF 50V	000-119-283
C	23	DSS310-55D-223S50V	0.022UF 50V	000-252-450
C	24	ECU-X1H103KBG	0.01UF 50V	000-119-283
DIODE		ダイオード		
CR	1	1SS82		000-114-021
CR	2	1SS82		000-114-021
CR	3	1SS82		000-114-021
CR	4	1SS82		000-114-021
RELAY		リレー		
K	1	G6A-274P-DC12V		000-107-599
K	2	G6A-274P-DC12V		000-107-599
K	3	G6A-274P-DC12V		000-107-599
K	4	G6A-274P-DC12V		000-107-599
COIL		コイル		
L	1	LAL02NA101K	100UH	000-116-373
L	2	LAL02NA101K	100UH	000-116-373

UNIT	P. C. B. FOR NO. 2 CONT			REF. DWG.	C5519-K01-B	BLOCK NO.	10B03	92
SYMBOL	T Y P E		SPECIFICATIONS		CODE NO.		REMARKS	
記号	型名		規格		コード番号		備考	
COIL			コイル					
L	3	LAL02NA101K	100UH		000-116-373			
L	4	LAL02NA101K	100UH		000-116-373			
L	5	LAL02NA101K	100UH		000-116-373			
L	6	LAL02NA101K	100UH		000-116-373			
L	7	LAL02NA101K	100UH		000-116-373			
L	8	LAL02NA101K	100UH		000-116-373			
L	9	LAL02NA101K	100UH		000-116-373			
L	10	LAL02NA101K	100UH		000-116-373			
L	11	LAL02NA101K	100UH		000-116-373			
L	12	LAL02NA101K	100UH		000-116-373			
RESISTOR			テイクウ					
R	1	ERJ-6GMYJ101	0.06W 100		000-117-154			
R	2	ERJ-6GMYJ101	0.06W 100		000-117-154			
R	3	ERJ-6GMYJ101	0.06W 100		000-117-154			
R	4	ERJ-6GMYJ101	0.06W 100		000-117-154			
R	5	ERJ-6GMYJ331	330		000-117-172			
R	6	ERJ-6GMYJ331	330		000-117-172			
R	7	ERJ-6GMYJ331	330		000-117-172			
R	8	ERJ-6GMYJ331	330		000-117-172			
TERMINAL BOARD			ターミナルボード					
TB	1	236-110M(1-10)	06S9000-0		000-104-300			
TB	2	236-110M(1-10)	06S9000-0		000-104-300			

**FURUNO**ELECTRICAL PARTS LIST  
電気部品表

1991- 2

MODEL	FS-5000		
UNIT	DUMMY LOAD (OPTION) ダミーロード		PAGE
REF. DWG.	C5519-K16-B	BLOCK NO.	11B01
			93

SYMBOL	T Y P E	SPECIFICATIONS	CODE NO.	REMARKS
記号	型名	規格	コード番号	備考
PRINTED CIRCUIT BOARD		プリント基板		
	05P-0360 DUMMY LOAD	OP05-34	005-927-610	INCL.WIRES
CAPACITOR		コンデンサー		
C	1	DE1207SL271J2KV	000-106-611	
C	2	DE1107SL221J2KV	000-106-612	
C	3	DE1107SL221J2KV	000-106-612	
C	4	DE1207SL271J2KV	000-106-611	
C	5	DD109E103P50V	0.01UF 50V	000-253-436
C	6	DD109E103P50V	0.01UF 50V	000-253-436
C	7	DD109E103P50V	0.01UF 50V	000-253-436
C	8	DD109E103P50V	0.01UF 50V	000-253-436
RELAY		リレー		
K	1	FRD-12023	000-106-069	
K	2	FRD-12023	000-106-069	
RESISTOR		抵抗		
R	1	ERF-20ZXJ101	000-106-613	
R	2	ERF-20ZXJ101	000-106-613	
R	3	ERF-20ZXJ101	000-106-613	
R	4	ERF-20ZXJ101	000-106-613	
R	5	ERF-20ZXJ101	000-106-613	
R	6	ERF-20ZXJ101	000-106-613	
R	7	ERF-20ZXJ101	000-106-613	
R	8	ERF-20ZXJ101	000-106-613	
R	9	ERF-20ZXJ101	000-106-613	
R	10	ERF-20ZXJ101	000-106-613	
R	11	ERD-16TJ100	0.16W 10	000-330-839
R	12	ERD-16TJ100	0.16W 10	000-330-839

**FURUNO**ELECTRICAL PARTS LIST  
電気部品表

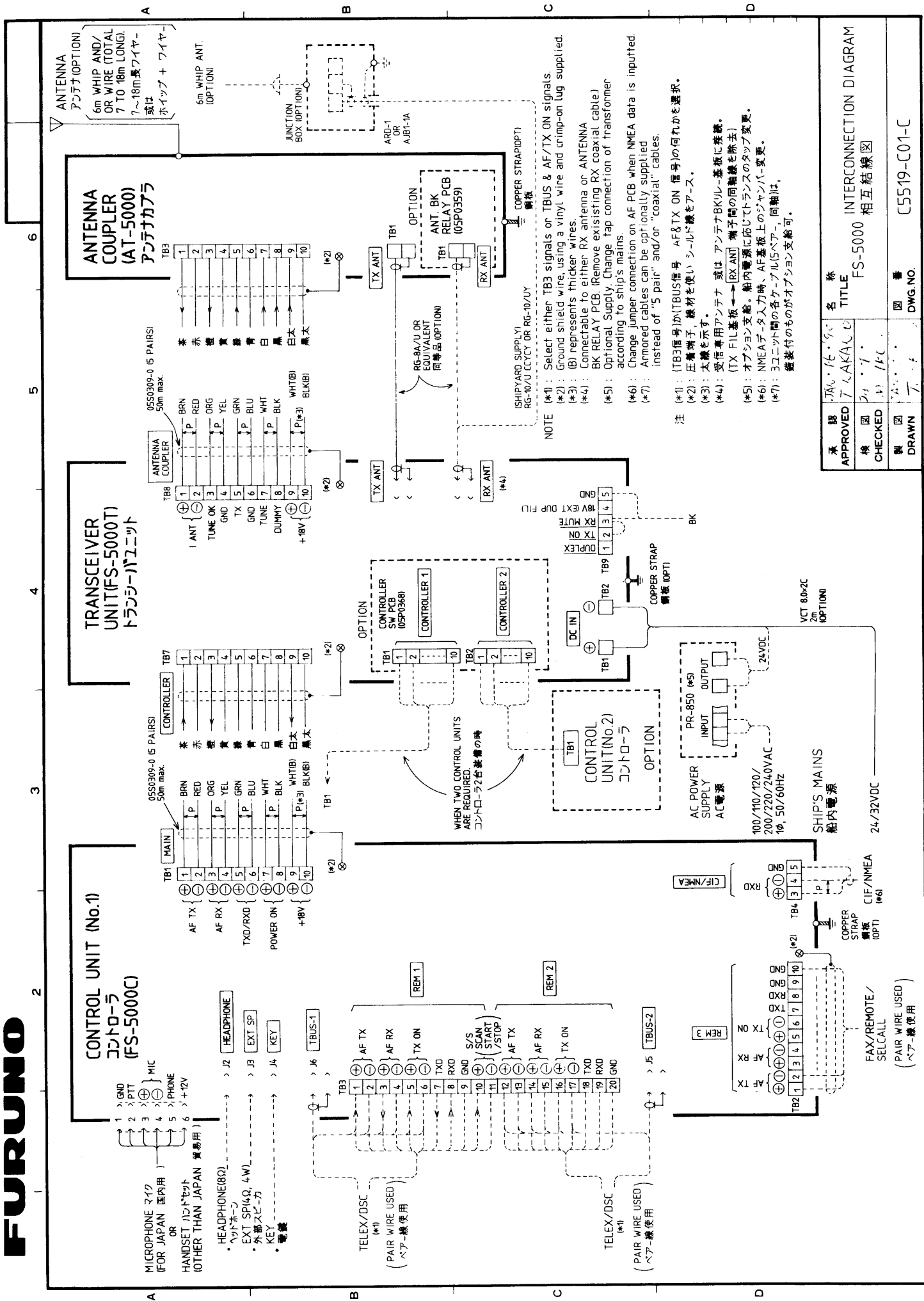
1991- 2

MODEL	FS-5000		
UNIT	ANTENNA BK RELAY アンテナ BK リレー (OPTION)	PAGE	
REF. DWG.	C5519-K17-B	BLOCK NO.	12B01
		94	

SYMBOL 記号	T Y P E 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
PRINTED CIRCUIT BOARD		プリント基板		
	05P0359	ANT BK RELAY	005-594-710	
CAPACITOR		コンデンサー		
C	1	DD109E103P50V	0.01UF 50V	000-253-436
C	2	DD109E103P50V	0.01UF 50V	000-253-436
C	3	DD109E103P50V	0.01UF 50V	000-253-436
C	4	DD109E103P50V	0.01UF 50V	000-253-436
ARRESTER		アレスタ		
E	1	T08-90B V-1701		000-542-600
RELAY		リレー		
K	1	FRD-12023		000-106-069
K	2	FRD-12023		000-106-069
RESISTOR		抵抗		
R	1	ERD-16TJ100	0.16W 10	000-330-839
R	2	ERD-16TJ100	0.16W 10	000-330-839
R	3	ERD-25PJ473	0.25W 47K	000-330-397
TERMINAL BOARD		ターミナルボード		
TB	1	P-100M4		000-106-217

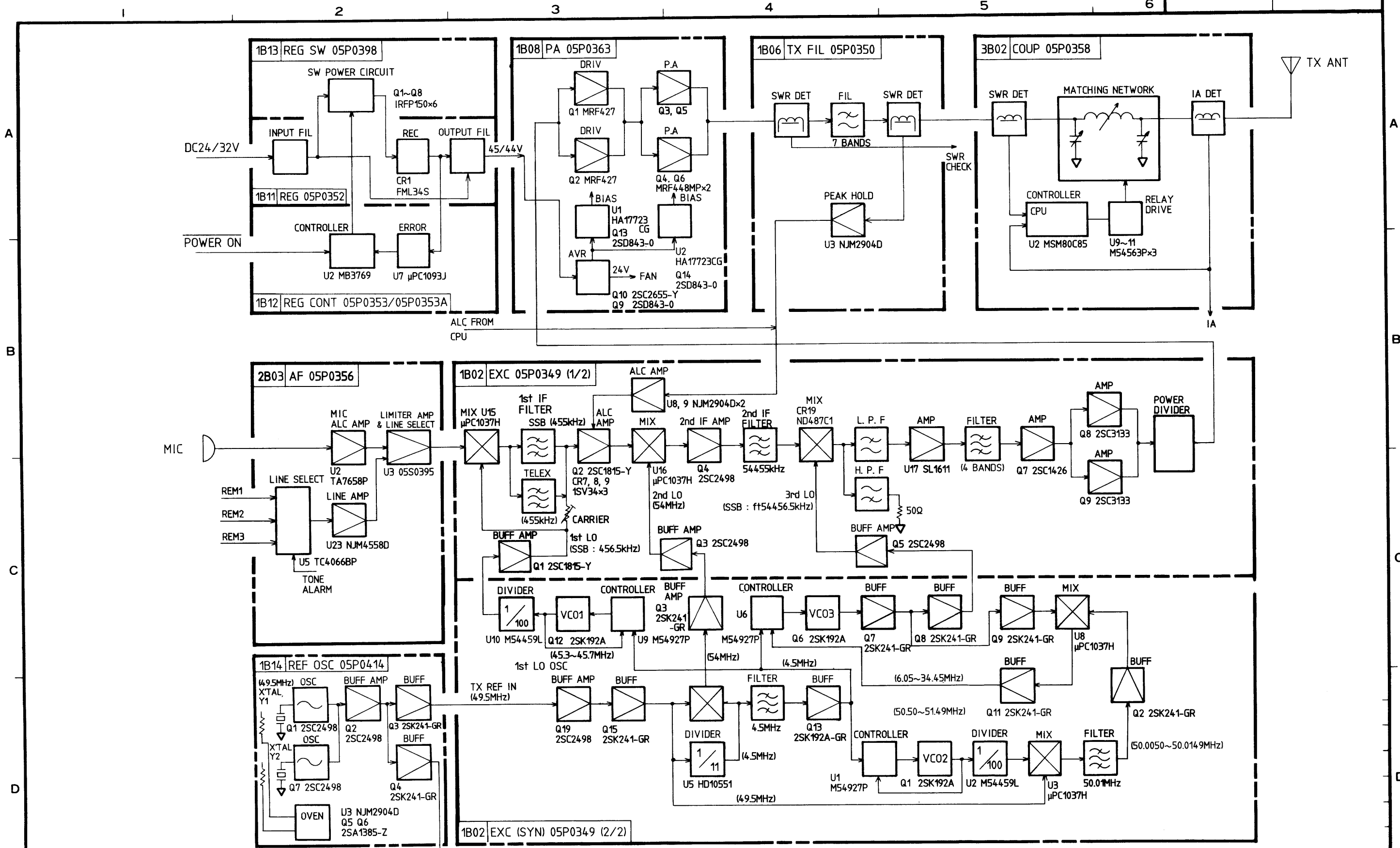
## LIST OF SCHEMATIC DIAGRAMS

Block No.	Name	Drawing No.	Page
	Interconnection Diagram	C5519-C01	S-2
	Transmitter Block Diagram	C5519-B02	S-3
	Receiver Block Diagram	C5519-B01	S-4
	Control System Block Diagram	C5519-B03	S-5
<b>TRANSCEIVER UNIT</b>			
1B01	Transceiver Unit, General	C5519-K12	S-6
1B02	Exciter Board (1/2)	C5519-K09	S-7
1B02	Exciter Board (2/2)	C5519-K10	S-8
1B03	RX Board (1/2)	C5519-K02	S-9
1B03	RX Board (2/2)	C5519-K03	S-10
1B04	CPU Board	C5519-K08	S-11
1B05	Interface Board	C5519-K04	S-12
1B06	TX Filter Board	C5519-K05	S-13
1B08	PA Board	C5519-K06	S-14
1B09	PA Check Board	C5519-K07	S-15
1B10	Transceiver Unit Power Supply	C5519-K11	S-16
1B13	REG SW Board	C5519-K21	S-17
1B14	REF OSC Board	C5519-K22	S-18
<b>CONTROL UNIT</b>			
2B01	Control Unit, General	C5519-K13	S-19
2B02	CPU Board	C5519-K15	S-20
2B03	AF Board	C5519-K14	S-21
<b>ANTENNA COUPLER</b>			
3B01	Antenna Coupler, General	C5519-K18	S-22
3B02	Coupler Board	C5519-K19	S-23
<b>OPTIONAL BOARDS/UNIT</b>			
10B03	Controller SW Board	C5519-K01	S-24
11B01	Dummy Load Board	C5519-K16	S-25
12B01	Antenna BK Relay Board	C5519-K17	S-26
	Rectifier Unit (PR-850)	C5519-K20	S-27



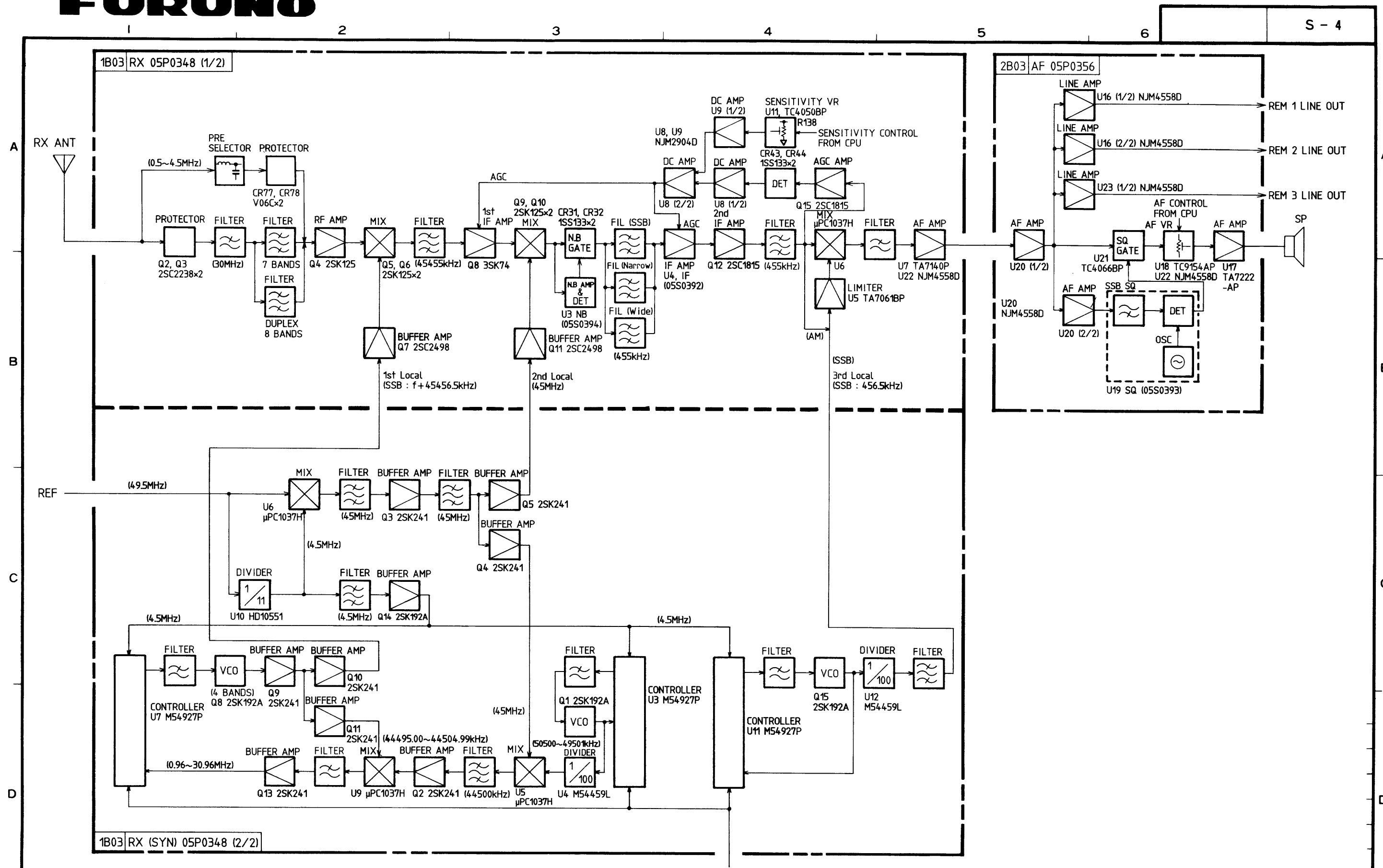
承認	承認者	名称
検査	検査者	TITLE
製図	製図者	FS-5000 相互結線図
描画	描画者	図番
		DWG. NO
		C5519-C01-C

REV: MAY '91 JAN '91



承認 APPROVED	FEB. 28 '90 T. I. AKAI	名称 TITLE	送信部 TRANSMITTER
検図 CHECKED	FEB. 28 '90 M. IKEDA	図番 DWG. NO.	C5519-B02-B
製図 DRAWN	FEB. 28 '90 T. SAITO		

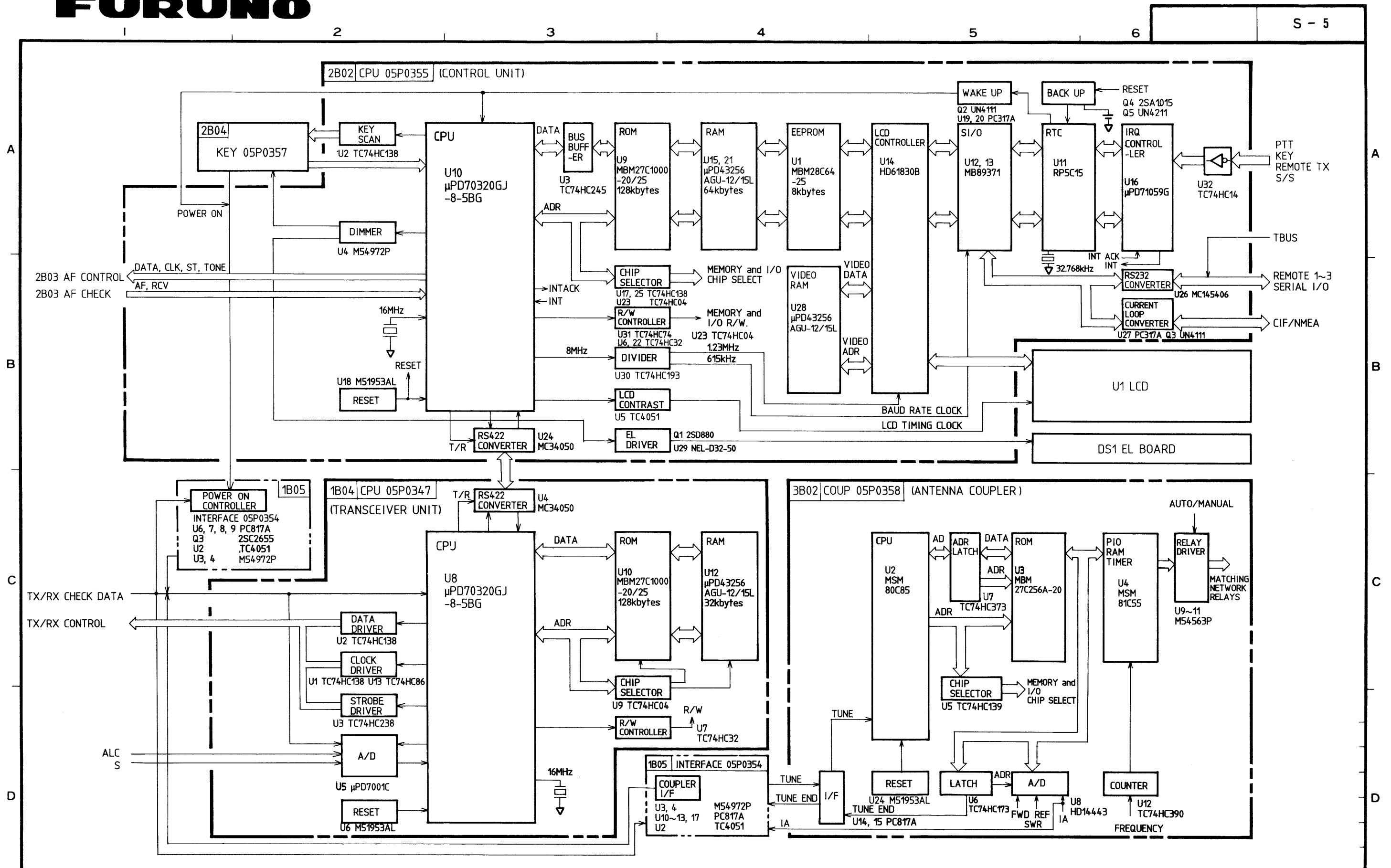
FS-1600  
FS-2500  
FS-5000



承認 APPROVED	FEB. 28 '90 T. OKAWA	名称 TITLE	受信部 RECEIVER
検図 CHECKED	FEB. 28 '90 M. IKEDA	図番 DWG. NO.	C5519-B01-B
製図 DRAWN	FEB. 28 '90 T. SAITO		

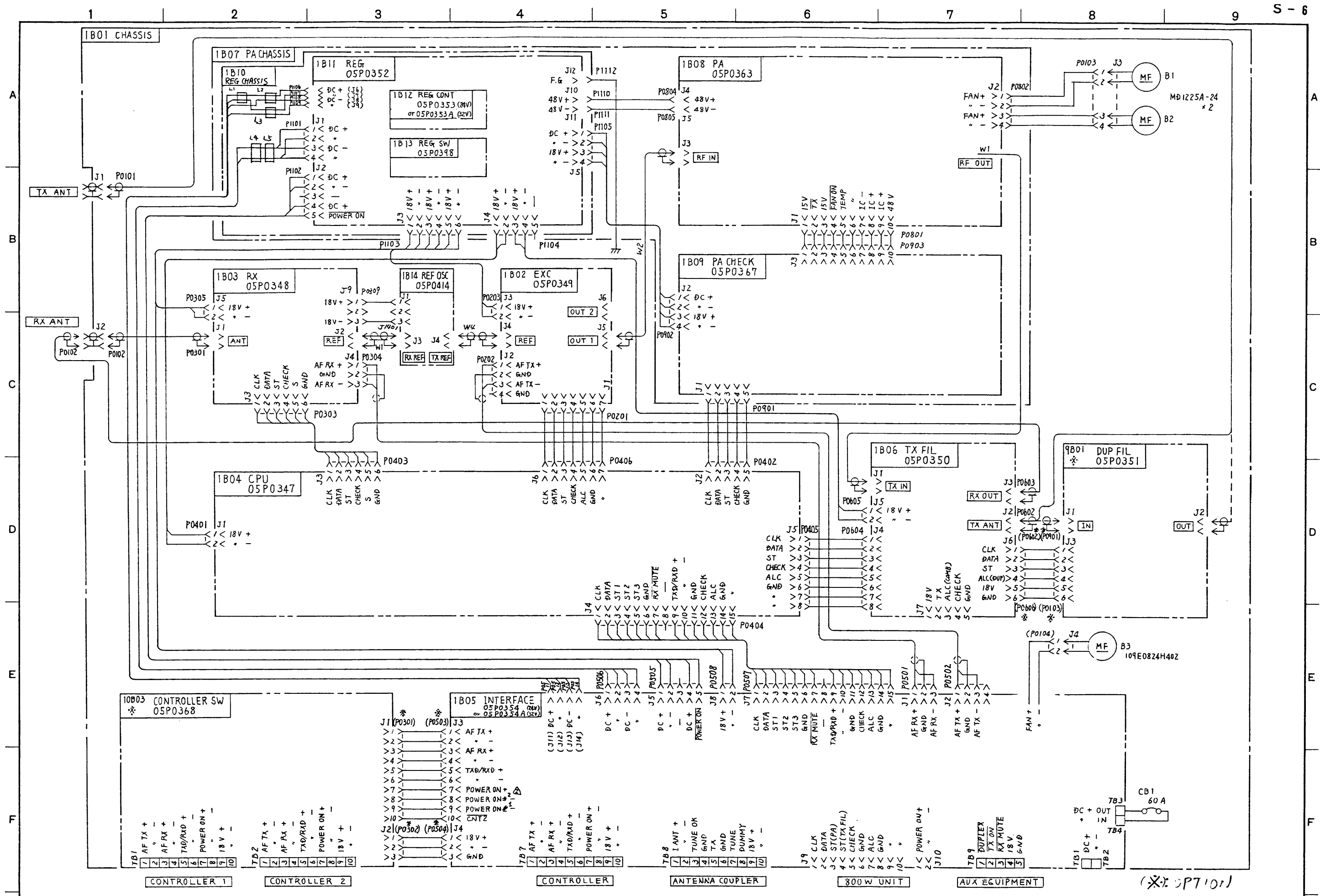
FS-1600  
FS-2500  
FS-5000

REV : JAN. '91



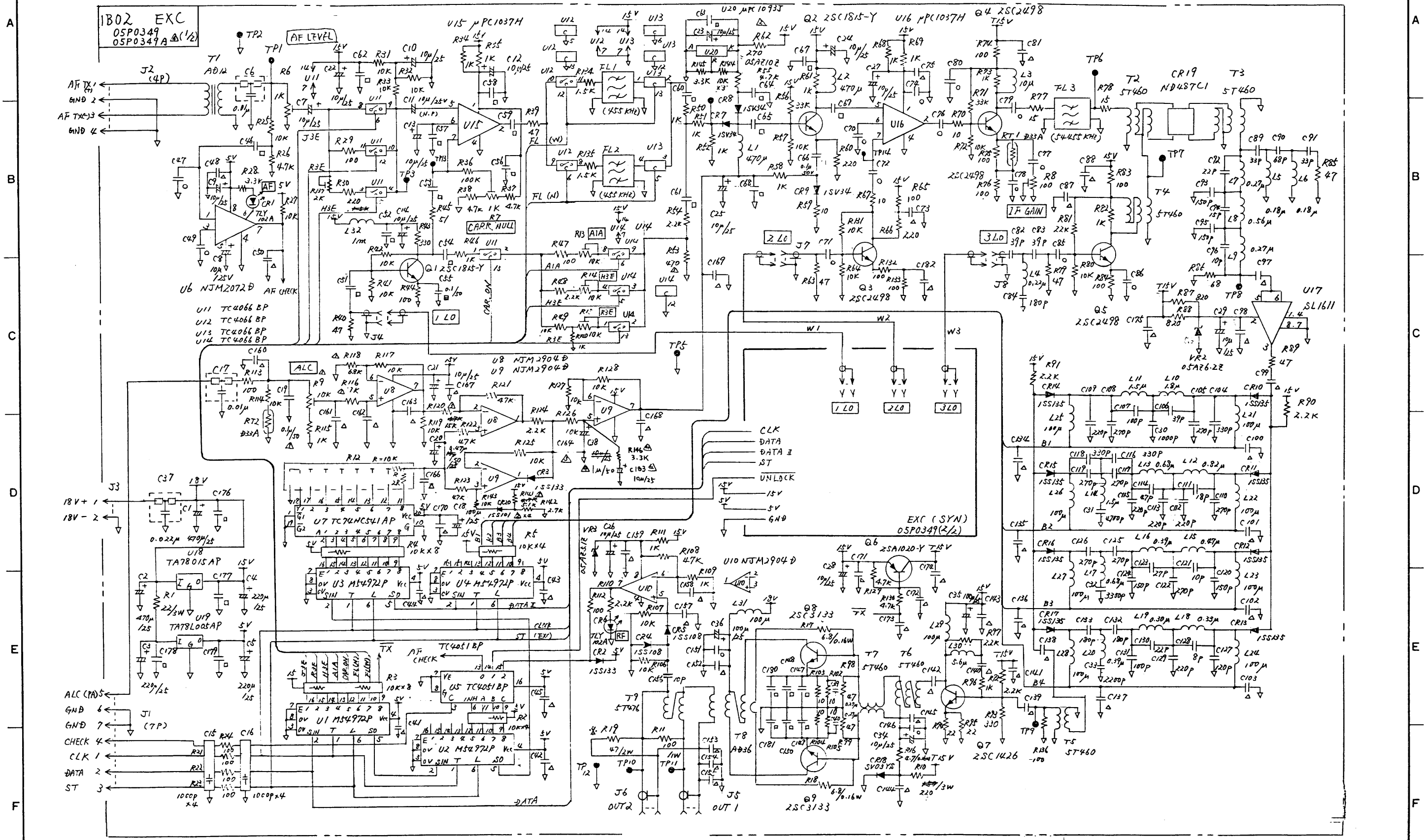
承認 APPROVED	FEB. 28 '90 T. NAKANO	名称 TITLE	制御部 SYSTEM CONTROL
検図 CHECKED	FEB. 28 '90 M. IKEDA	製図 DRAWN	図番 DWG. NO.
	FEB. 28 '90 T. SAITO		C5519-B03-A

FS-1600  
FS-2500  
FS-5000



Note. Marks \* are options.

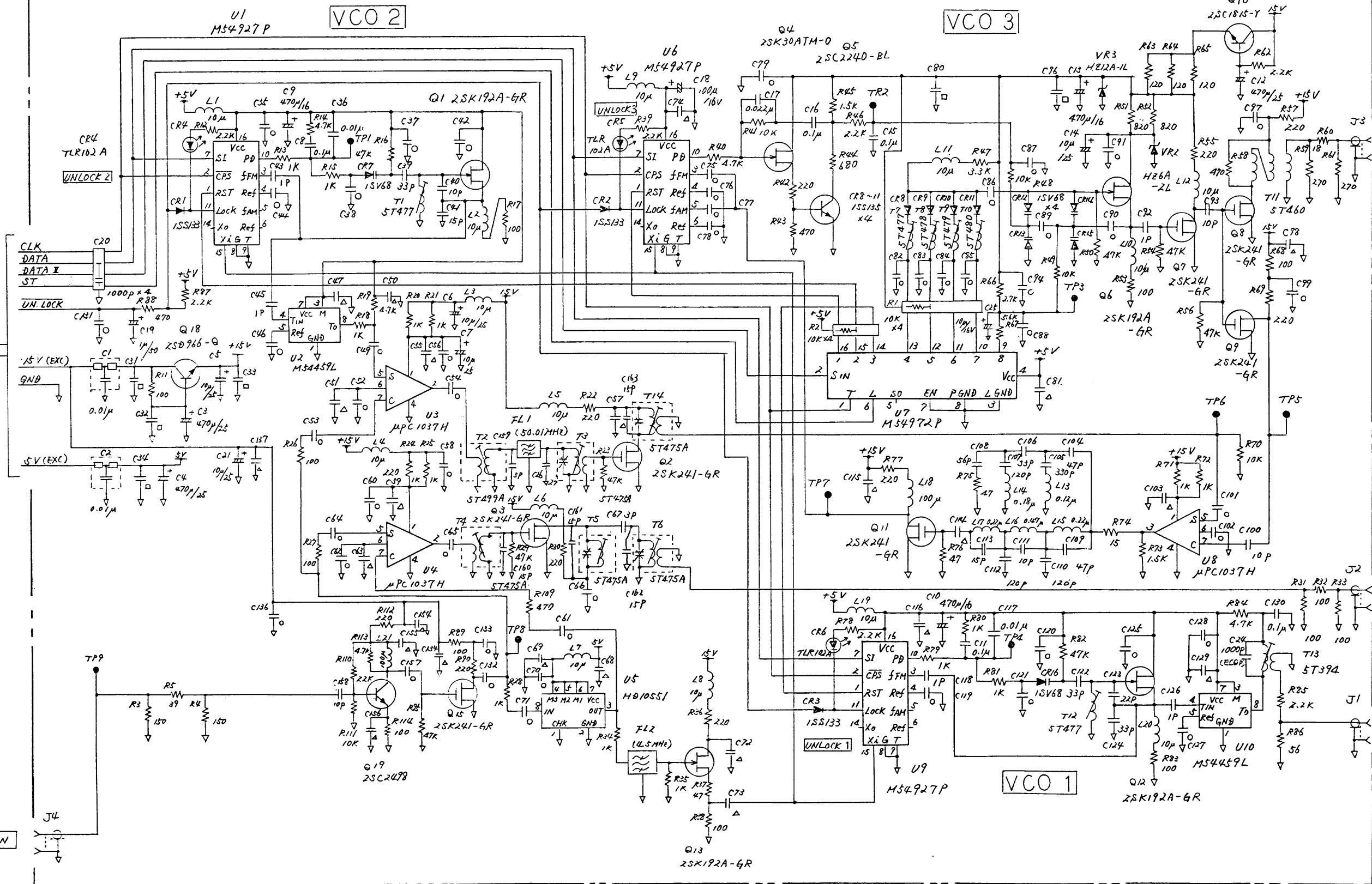
主種 FS-1600 FS-2500 FS-5000	コード 型名	SHEET NO. 1/1
課長 検 図 設 計 製 図	IB01 CHASSIS (TRANSCIVER UNIT)	
	C5519-K12-C	



NOTE (1) Resistors are in  $\Omega$  (0.1W), Capacitors are in F, Inductors are in H, unless otherwise noted.  
 (2) Marks  $\bigcirc$  are 1000pF/50WV capacitors,  $\Delta$  are 0.01 $\mu$ F/50WV capacitors and  $\square$  are 0.1 $\mu$ F/25WV capacitors.  
 (3) Mark  $\times$  R19 not provided for 05P0349A

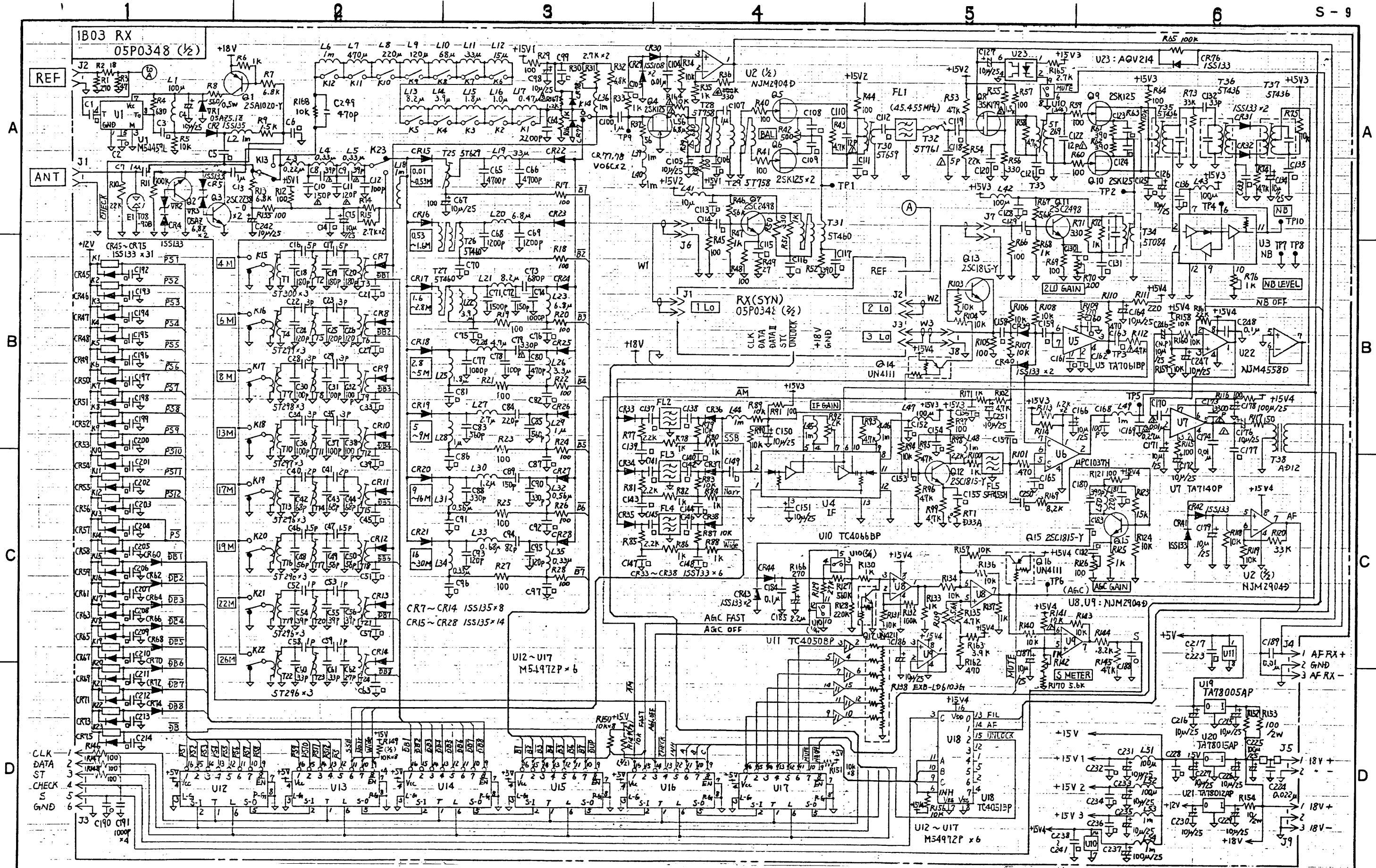
主機種	1S-1600 1S-2500 FS-500C	コード		SHEET NO.	1/2
型名		設計		TITLE	
課長		検図		1B02 (1/2) EXC (TRANSCIVER UNIT)	
製造		製図		C5519-K09-C	

1B02 EXC (SYN)  
OSP0349  
OSP0349A (2/2)



NOTE (1) Resistors are in  $\Omega$  (0.1W). Capacitors are in F.  
Inductors are in H, unless otherwise noted.  
(2) Marks  $\circ$  are 1000pF/50WV capacitors.  
 $\Delta$  are 0.01 $\mu$ F/50WV capacitors and  
 $\square$  are 0.1 $\mu$ F/25WV capacitors.

主機種	FS-2500	コード		SHEET NO.	2/2
課長		型名		TITLE	1B02 (2/2) EXC (SYN) (TRANSCIVER UNIT)
検		設計		Fig. No.	C5519-K10-C
関		製			
設		図			

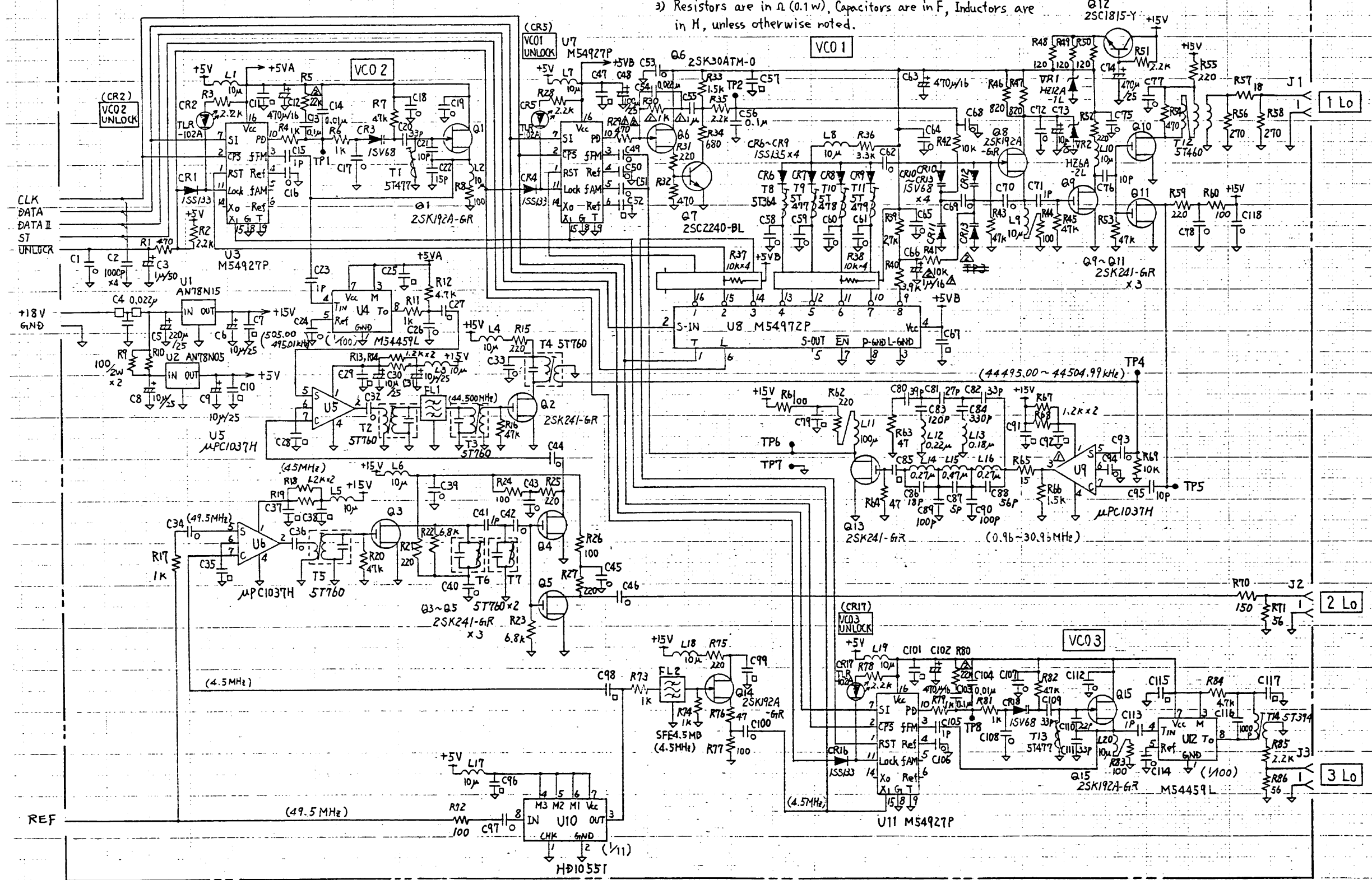


Note. 1) Marks 0 are 1000 PF 50WV Capacitors.  
 2) Marks Δ are 0.01μF 50WV Capacitors.  
 3) Marks □ are 0.1μF 25WV Capacitors.  
 4) Resistors are in Ω (0.1W), Capacitors are in F, Inductors are in H, unless otherwise noted.

機種種	FS-1600 FS-2500 FS-5000	コード														SHEET NO.	1/2
課長	検	設計	製	図	1B03 (1/2)						RX (TRANSCIVER UNIT)						
TITLE												C5519-K02-C					
VWG. No.																	

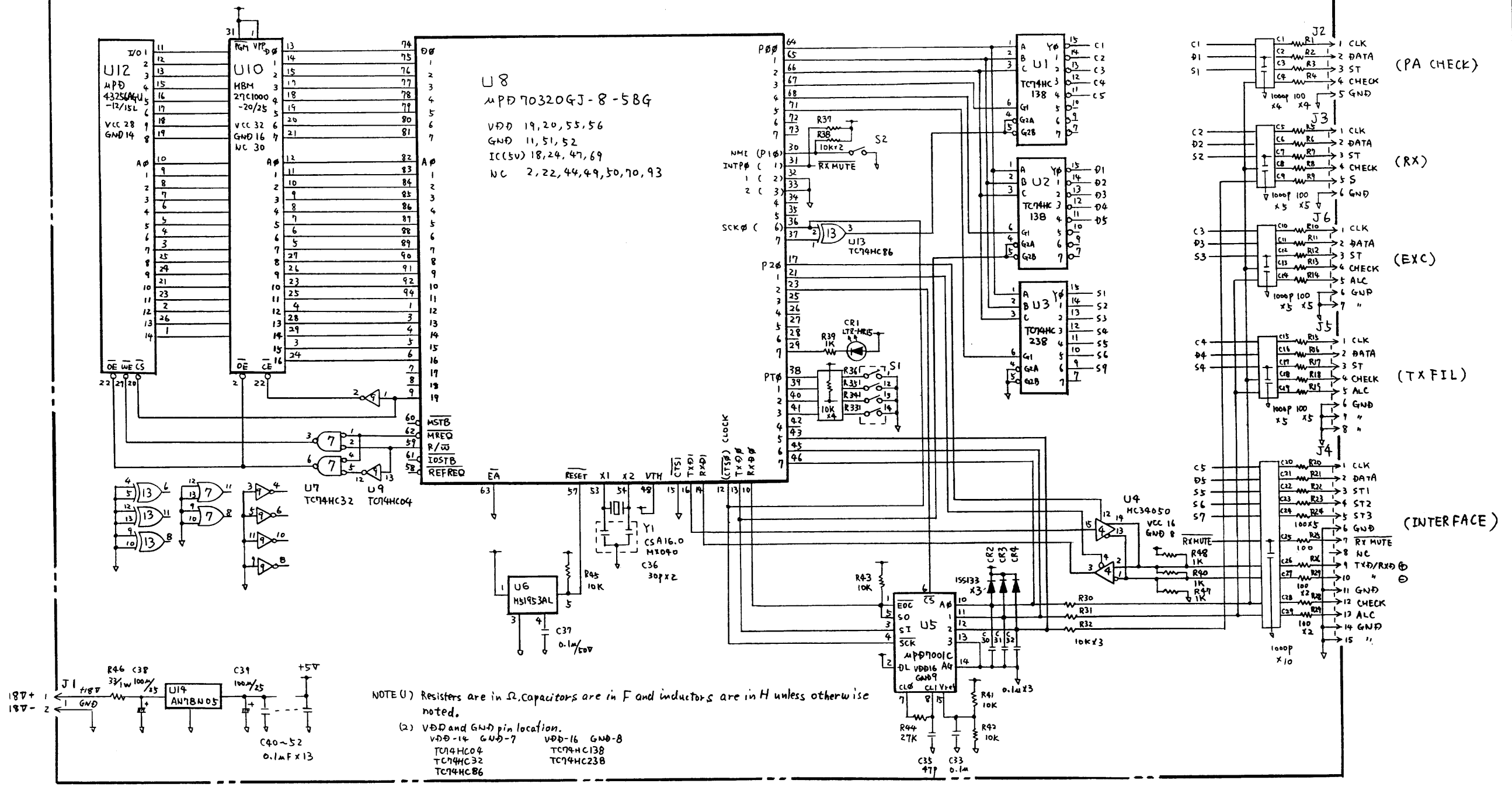
1B03 RX(SYN)  
05P0348(2/2)

Note. 1) Marks O are 1000 pF 50wv Capacitors.  
2) Marks □ are 0.1μF 25wv Capacitors.  
3) Resistors are in Ω (0.1w), Capacitors are in F, Inductors are in H, unless otherwise noted.

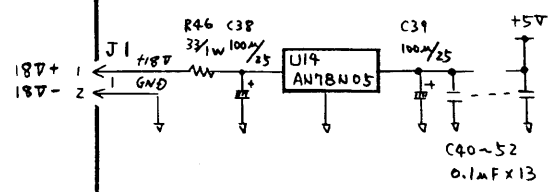


機種種	FS-1600 FS-2500 FS-5000	コード		SHEET NO.	2/2
課長	検図	設計	製図	TITLE	1B03 (2/2) RX (SYN) (TRANSCIVER UNIT) C5519-K03-C

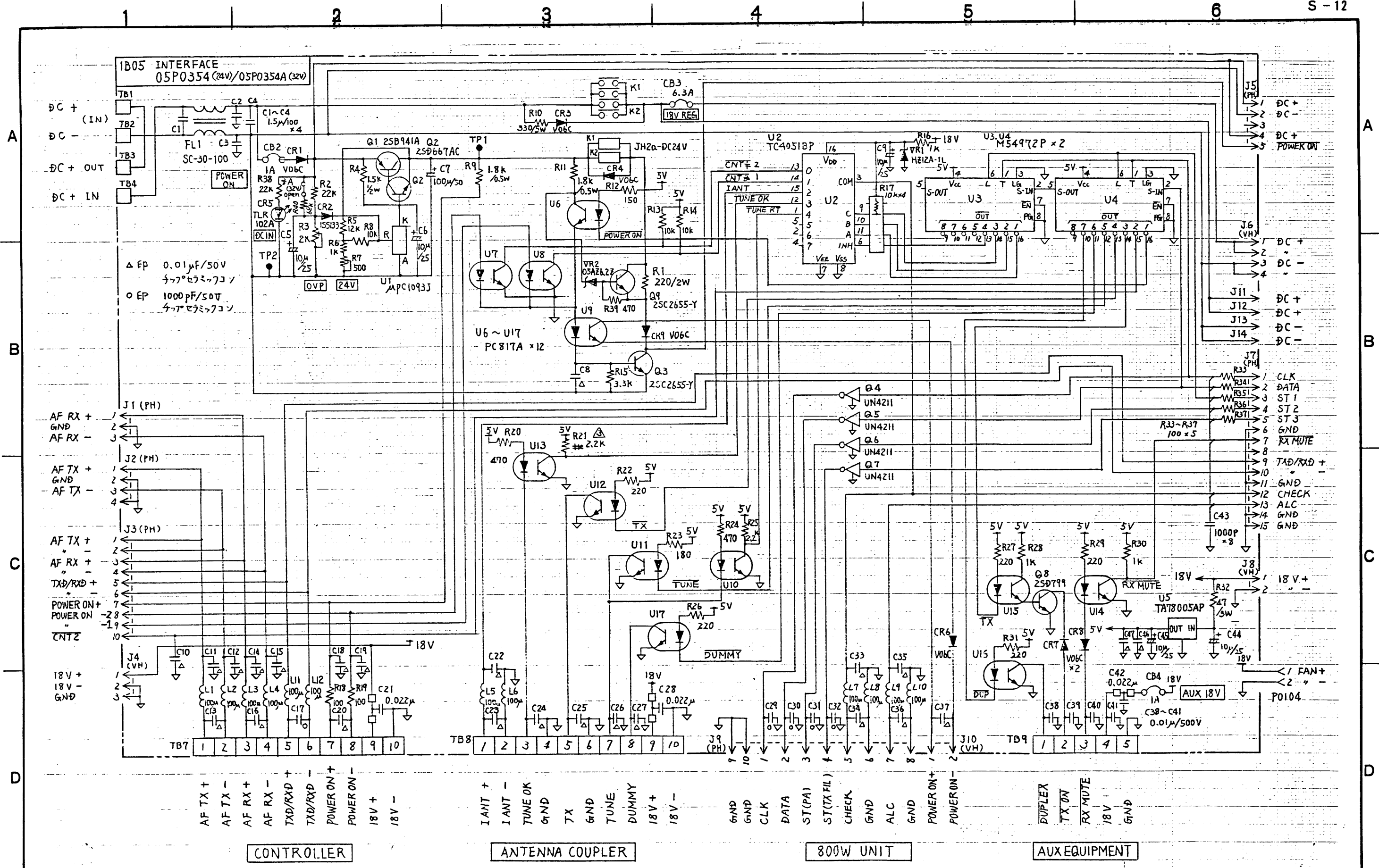
1804 CPU 05P0347



NOTE (1) Resistors are in  $\Omega$ , capacitors are in F and inductors are in H unless otherwise noted.  
 (2) VDD and GND pin location.  
 VDD-14 GND-7 VDD-16 GND-8  
 TC14HC04 TC14HC138 TC14HC32 TC14HC238 TC14HC86



主機種	FS-1600 FS-2500 FS-2700	コード		SHEET NO.	1/1
課長	検図	設計	製図	1804 CPU (TRANSCIEVER UNIT)	
TITLE				C5519-K08-B	



△ EP 0.01μF/50V  
 477°セラミックコン  
 ○ EP 1000pF/50V  
 477°セラミックコン

AF TX +  
 AF TX -  
 AF RX +  
 AF RX -  
 TXD/RXD +  
 TXD/RXD -  
 POWER ON +  
 POWER ON -  
 18V +  
 18V -

CONTROLLER

I ANT +  
 I ANT -  
 TUNE OK  
 GND  
 TX  
 GND  
 TUNE  
 DUMMY  
 18V +  
 18V -

ANTENNA COUPLER

GND  
 GND  
 CLK  
 DATA  
 ST (PA)  
 ST (TX FIL)  
 CHECK  
 GND  
 ALC  
 GND  
 POWER ON +  
 POWER ON -

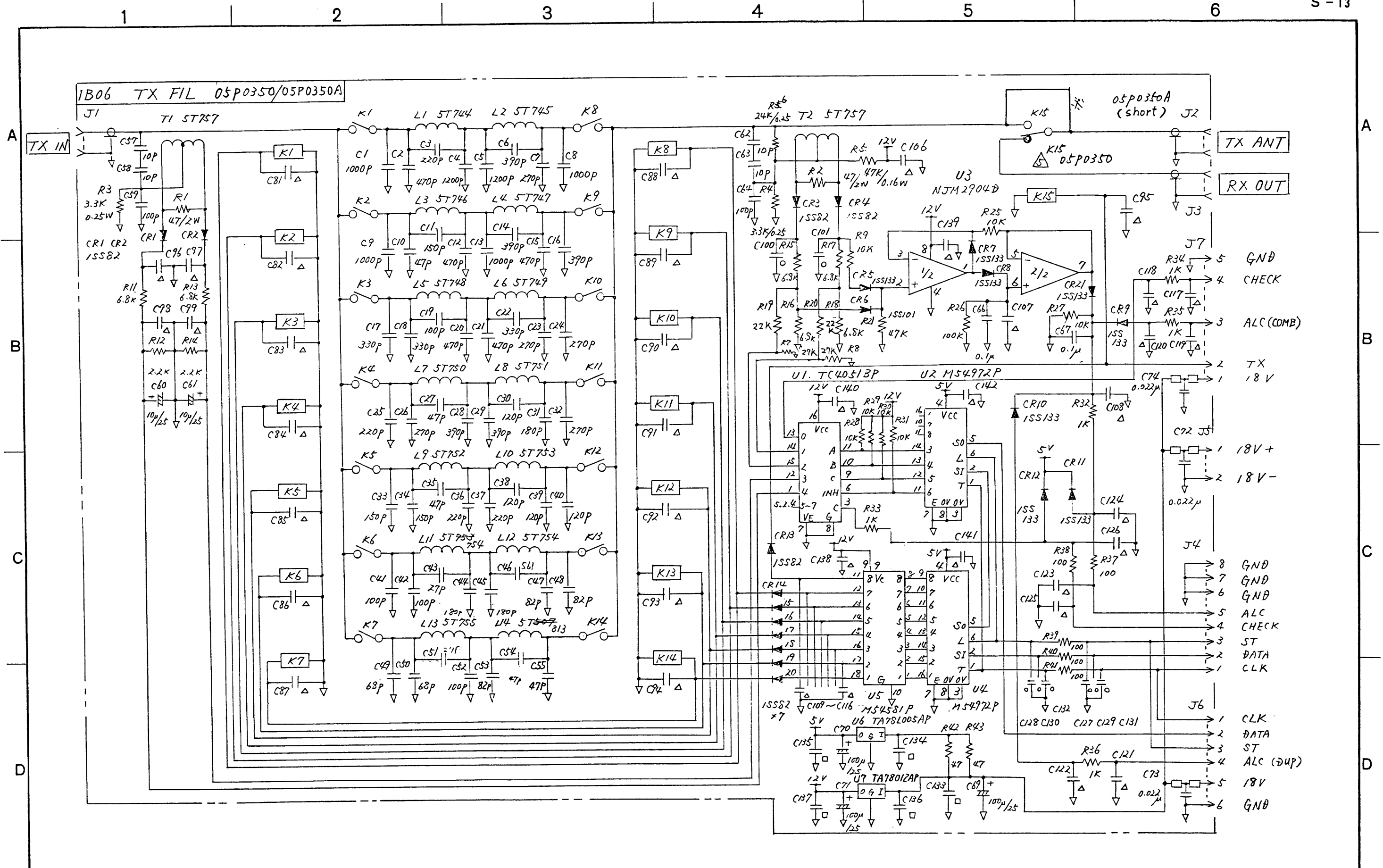
800W UNIT

DUPLEX  
 TX ON  
 RX MUTE  
 18V +  
 18V -  
 GND

AUX EQUIPMENT

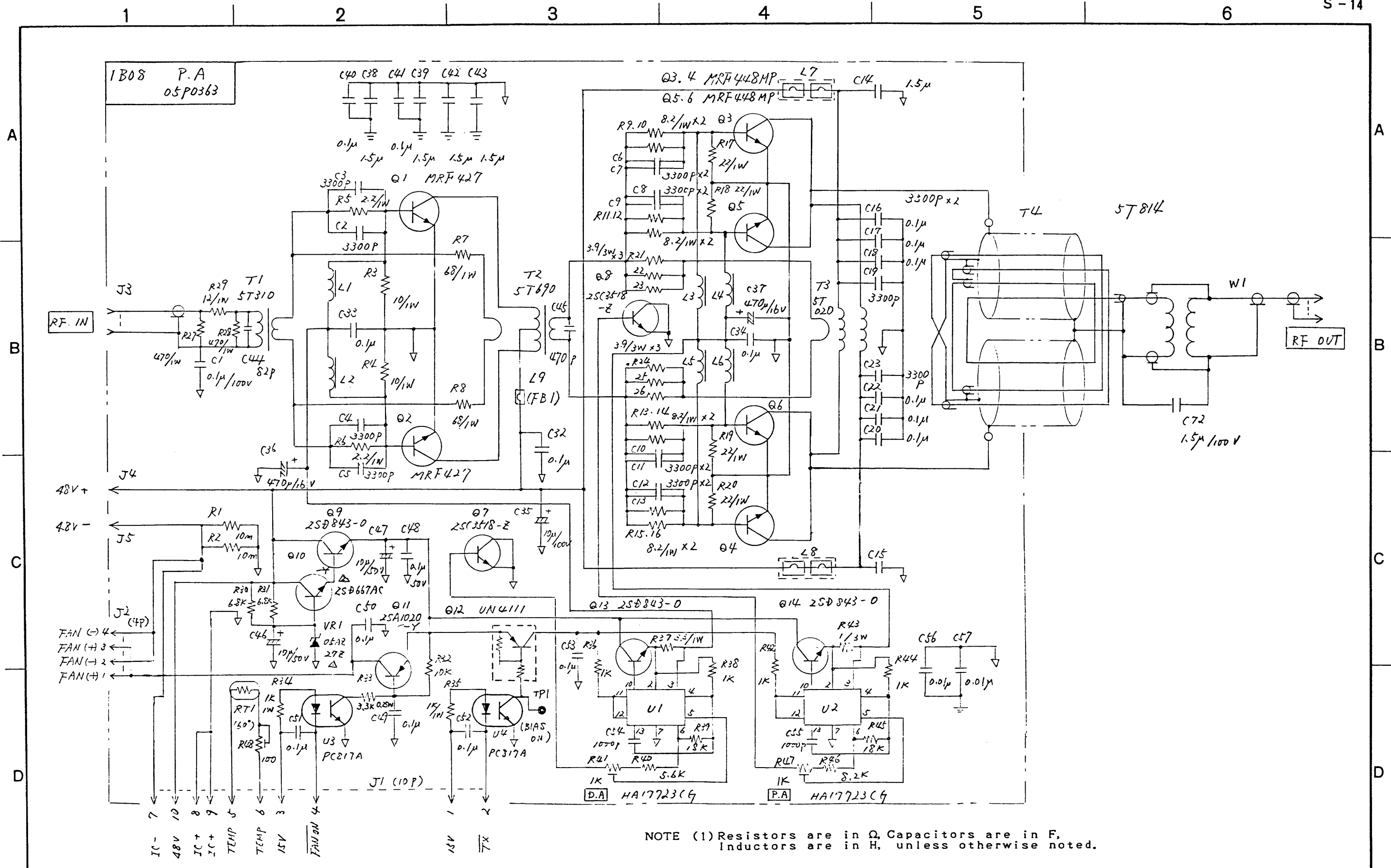
Note. 1) Marks ○ are 1000 pF 50WV Capacitors.  
 2) Marks △ are 0.01μF 50WV Capacitors.  
 3) Resistors are in Ω (0.1W), Capacitors are in F, Inductors are in H, unless otherwise noted.

主機種	FS-2500	コード		SHEET NO.	1/1
型名		設計		製	
課長	検	図	設計	製	図
			1B05		
INTERFACE (TRANSCIVER UNIT)					
C5519-K04-C					



NOTE (1) Resistors are in Ω (0.1W). Capacitors are in F.  
 Inductors are in H, unless otherwise noted.  
 (2) Marks ○ are 1000pF/50WV capacitors.  
 △ are 0.01μF/50WV capacitors and  
 □ are 0.1μF/25WV capacitors.

主機種	1S-2500	コード		SHEET NO.	1/1
課長	検	設計	製	型名	IB06 TX FIL (TRANSCIVER UNIT)
				TITLE	C5519-K05-C

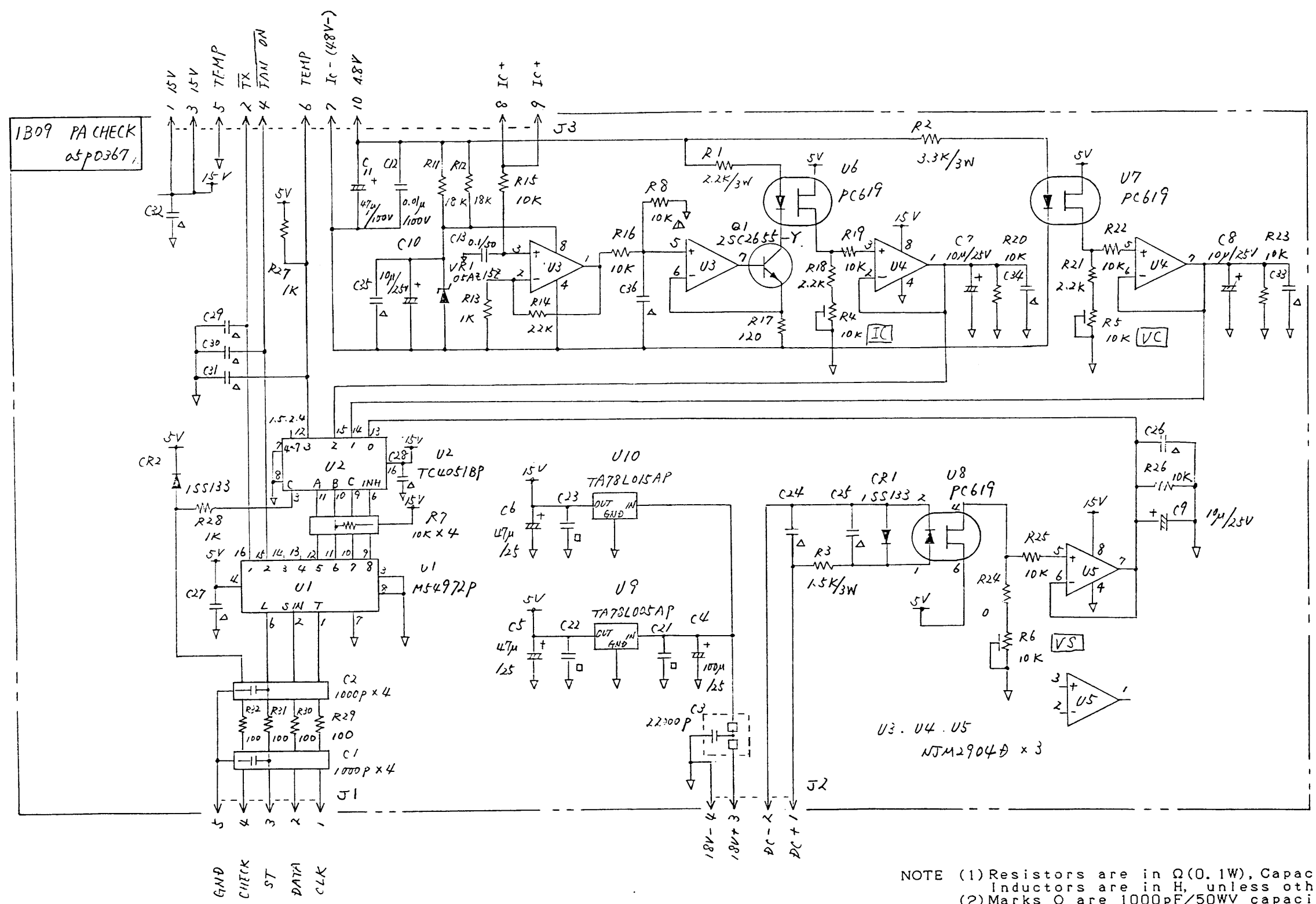


NOTE (1) Resistors are in Ω, Capacitors are in F, Inductors are in H, unless otherwise noted.

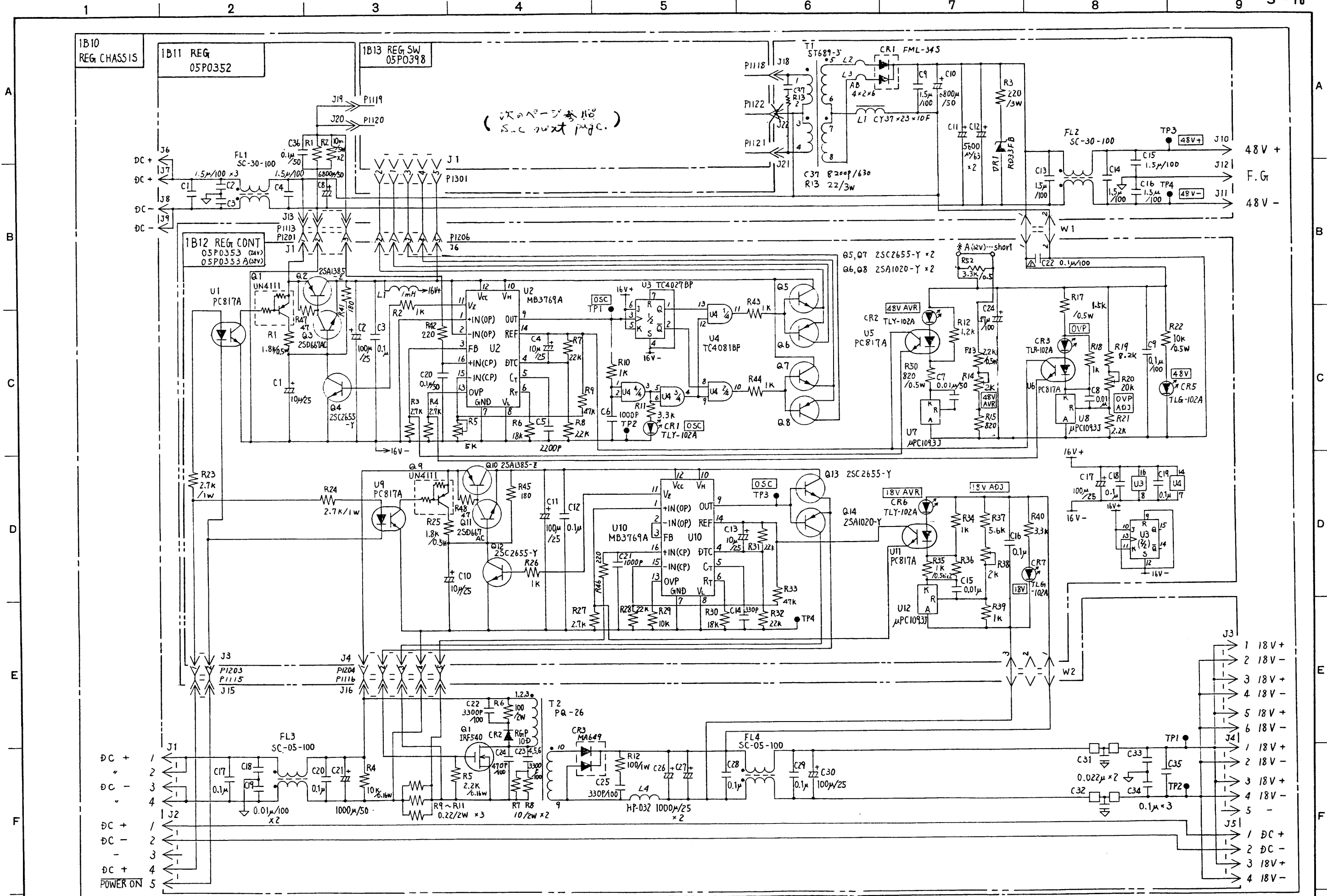
主機種	AS-2500	コード														SHEET NO.	1/1
課長	検	図	設計	製	図												
														1B08 PA (TRANSCIVER UNIT)			
														C5519-K06-C			

1 2 3 4 5 6

A B C D

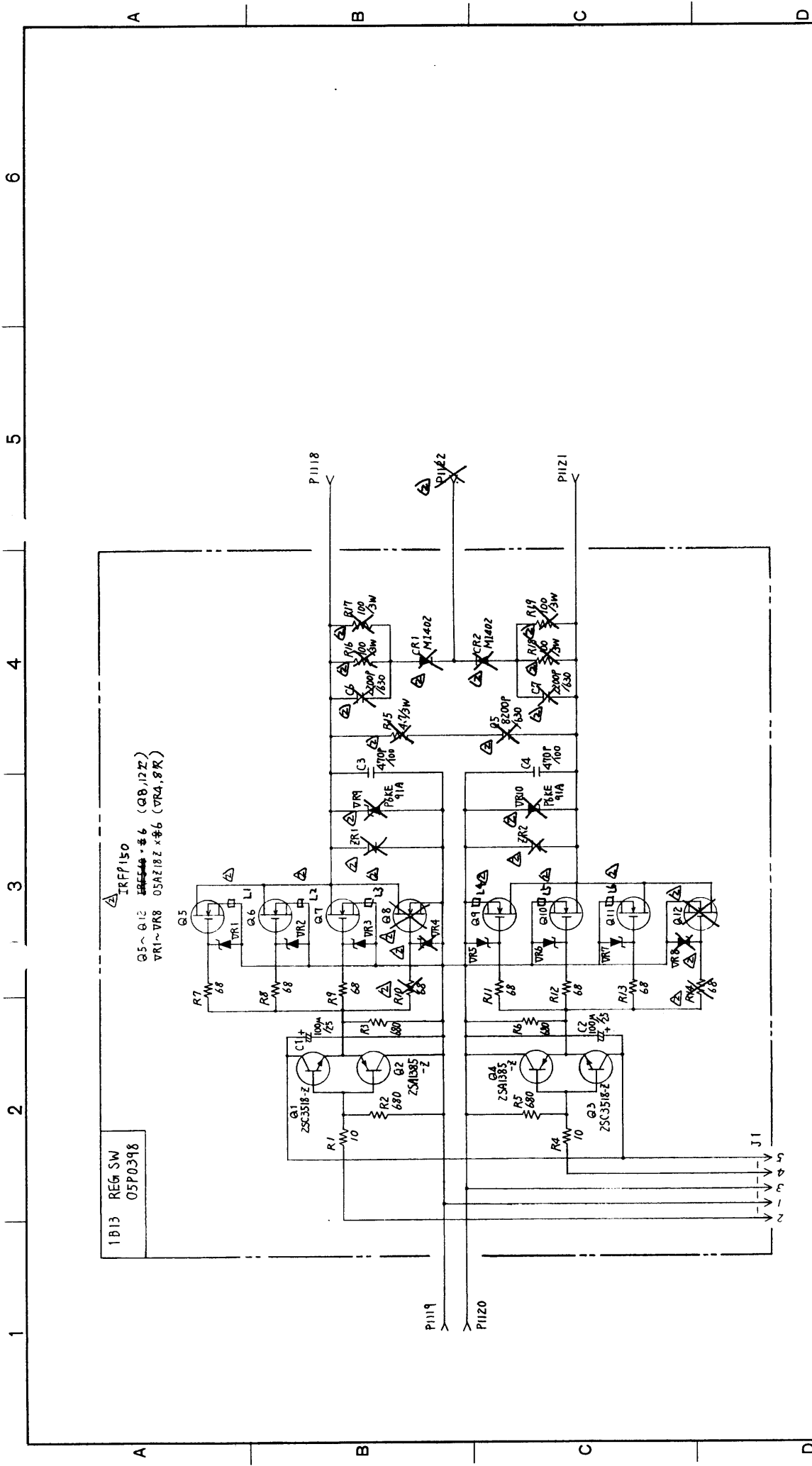


主機種	FS-2500	コード		SHEET NO.	1/1
課長	検 図	設計	製 図	型 名	1B09 PA CHECK (TRANSCEIVER UNIT)
				TITLE	C5519-K07-C



Note. Resistors are in Ω (0.1w), Capacitors are in F, Inductors are in H, unless otherwise noted.

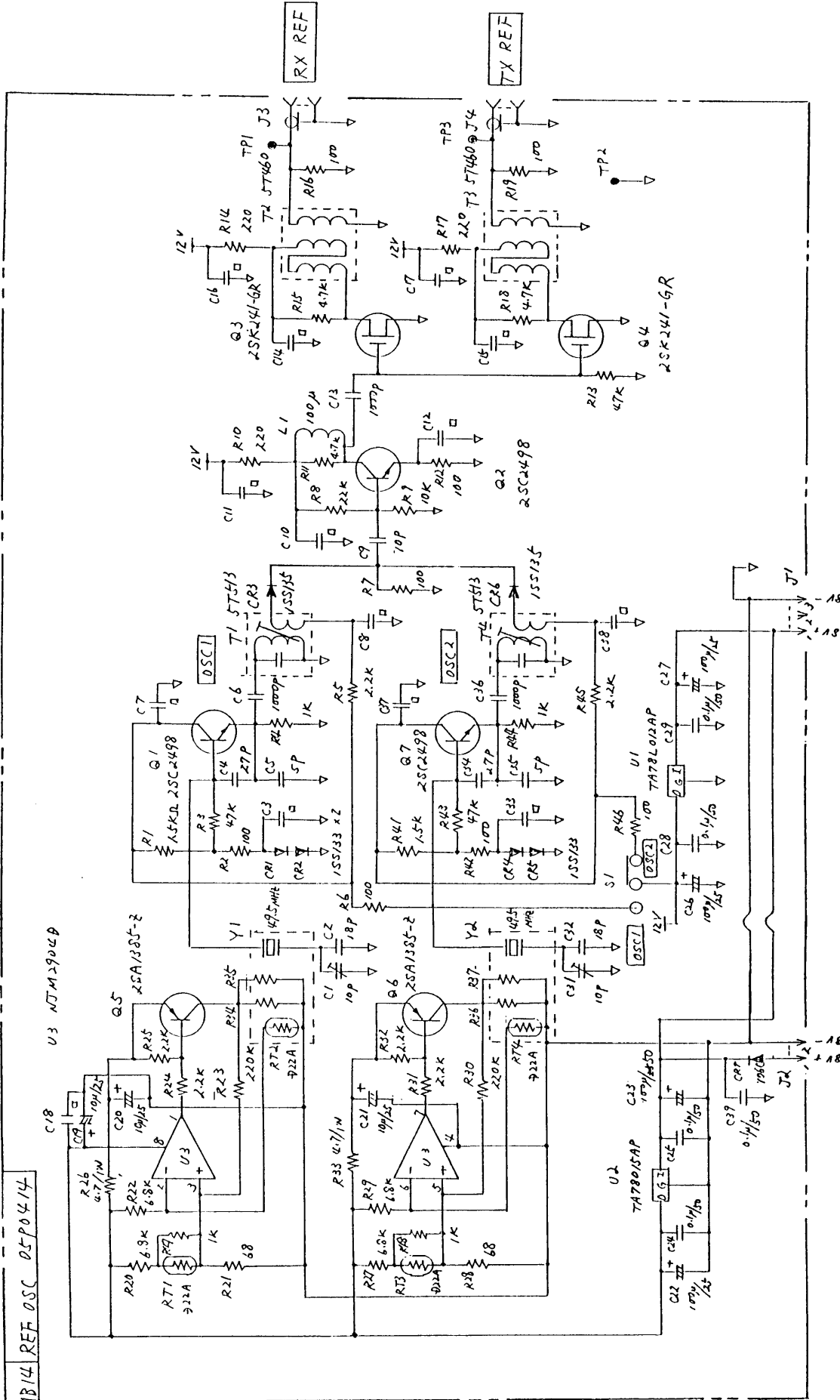
主機種	FS-2500	コード		SHEET NO.	1/1
型名		設計		1B10 REG CHASSIS (TRANSMITTER UNIT)	
設計		製		(1B11 REG, 1B12 REG CONT, 1B13 REG SW)	
製		調		C5519-K11-D	



Note. Resistors are in Ω (0.25w), Capacitors are in μF, unless otherwise noted.

X28

主機種	F-5-1600	コード		シート	2
機種	FS-2500	型名		NO.	2
課長	FS-5000	設計		1B10 REG CHASSIS (TRANSMITTER UNIT)	
課長		製		(1B13 REG SW)	
課長		製		TITLE	
課長		製		DRAWING	
課長		製		C5519-K21-A	



NOTE (1) Resistors are in  $\Omega$ . Capacitors are in F. Inductors are in H, unless otherwise noted.  
 (2) Marks  $\square$  are 100PF/50WV capacitors.  $\circ$  are 0.01 $\mu$ F/50WV capacitors. and  $\square$  are 0.1 $\mu$ F/25WV capacitors.

主 機 種 別	FS-677D 2.770 7.670	コード 型名	13/4	SHEET NO.	1/1
課 長	校 図	設 計	製 図	TITLE	REF OSC (TRANSCIVER UNIT)
				DWG No.	C5519-K22-A

1 2 3 4 5 6

1 2 3 4 5 6

1B14 REF OSC 05P0414

U3 NJM12904B

Q5 2SC2498

Q6 2SC2498

Q7 2SC2498

Q8 2SC2498

Q9 2SC2498

Q10 2SC2498

Q11 2SC2498

Q12 2SC2498

Q13 2SC2498

Q14 2SC2498

Q15 2SC2498

Q16 2SC2498

Q17 2SC2498

Q18 2SC2498

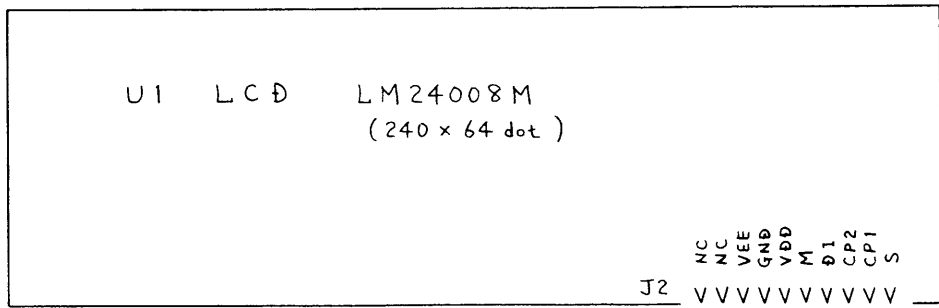
Q19 2SC2498

Q20 2SC2498

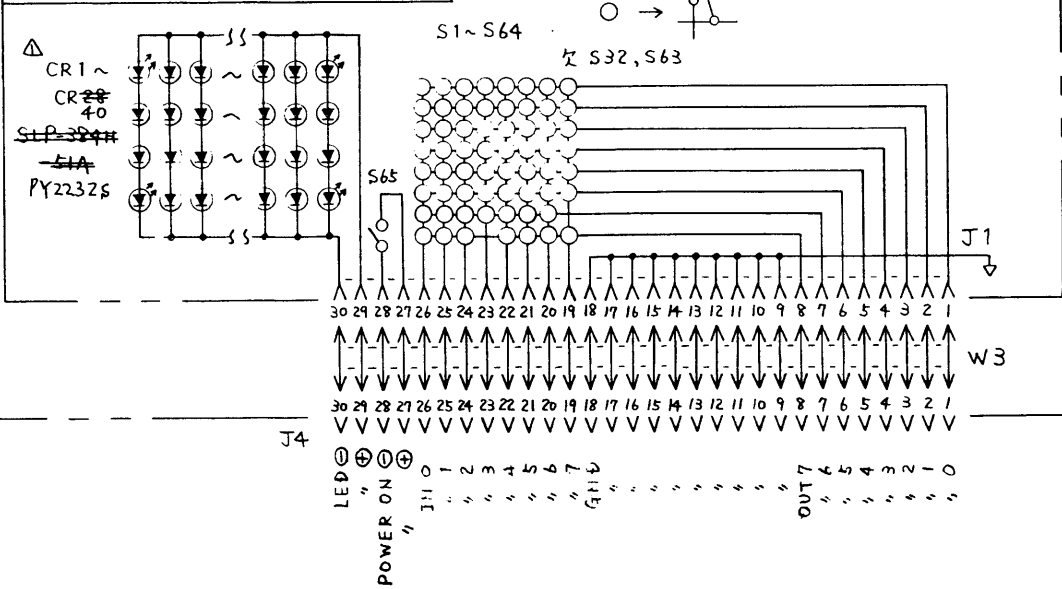
Q21 2SC2498

Q22 2SC2498

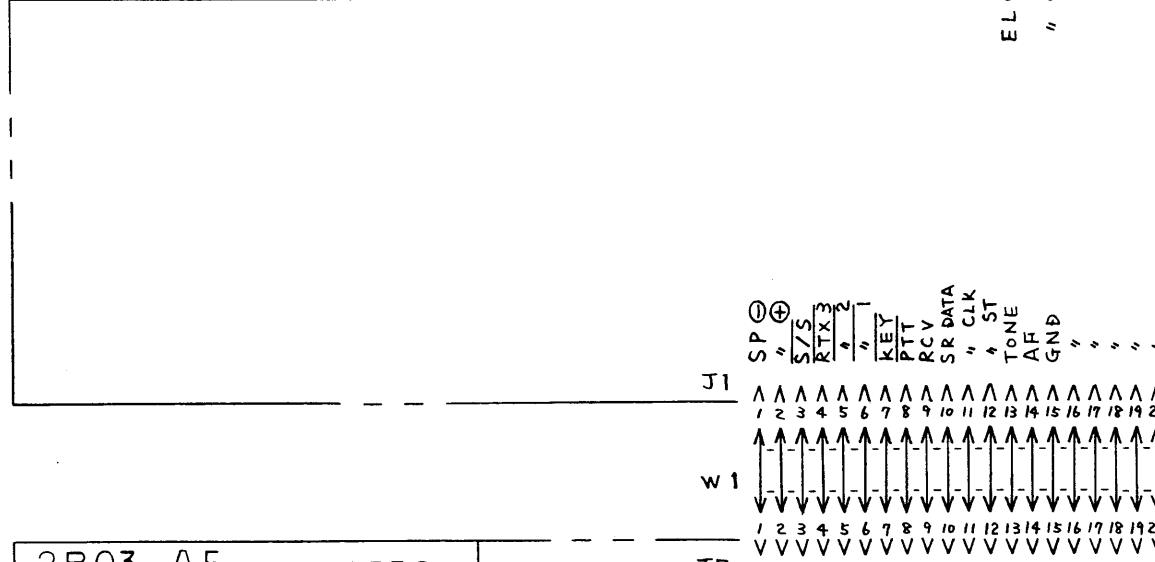
2B01 CHASSIS



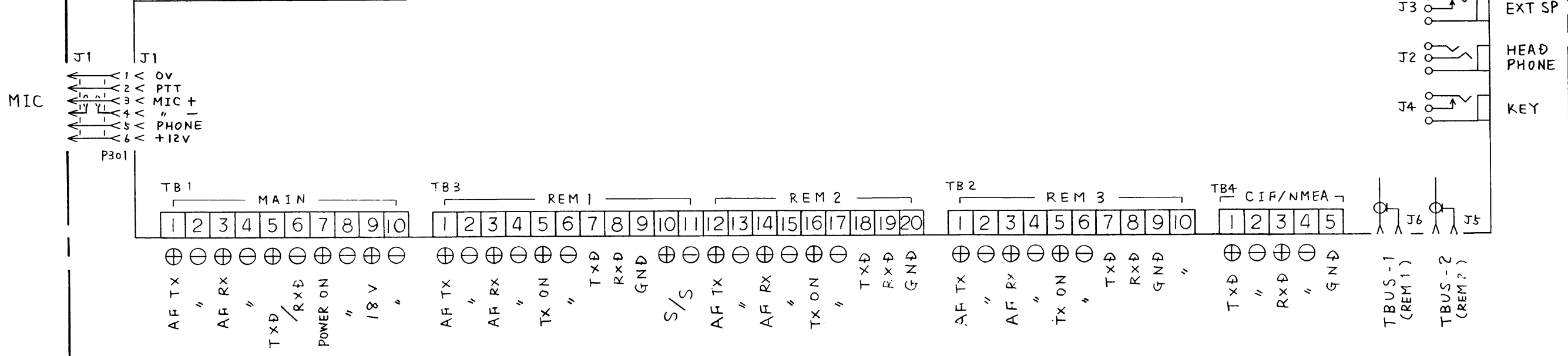
2B04 KEY 05P0357



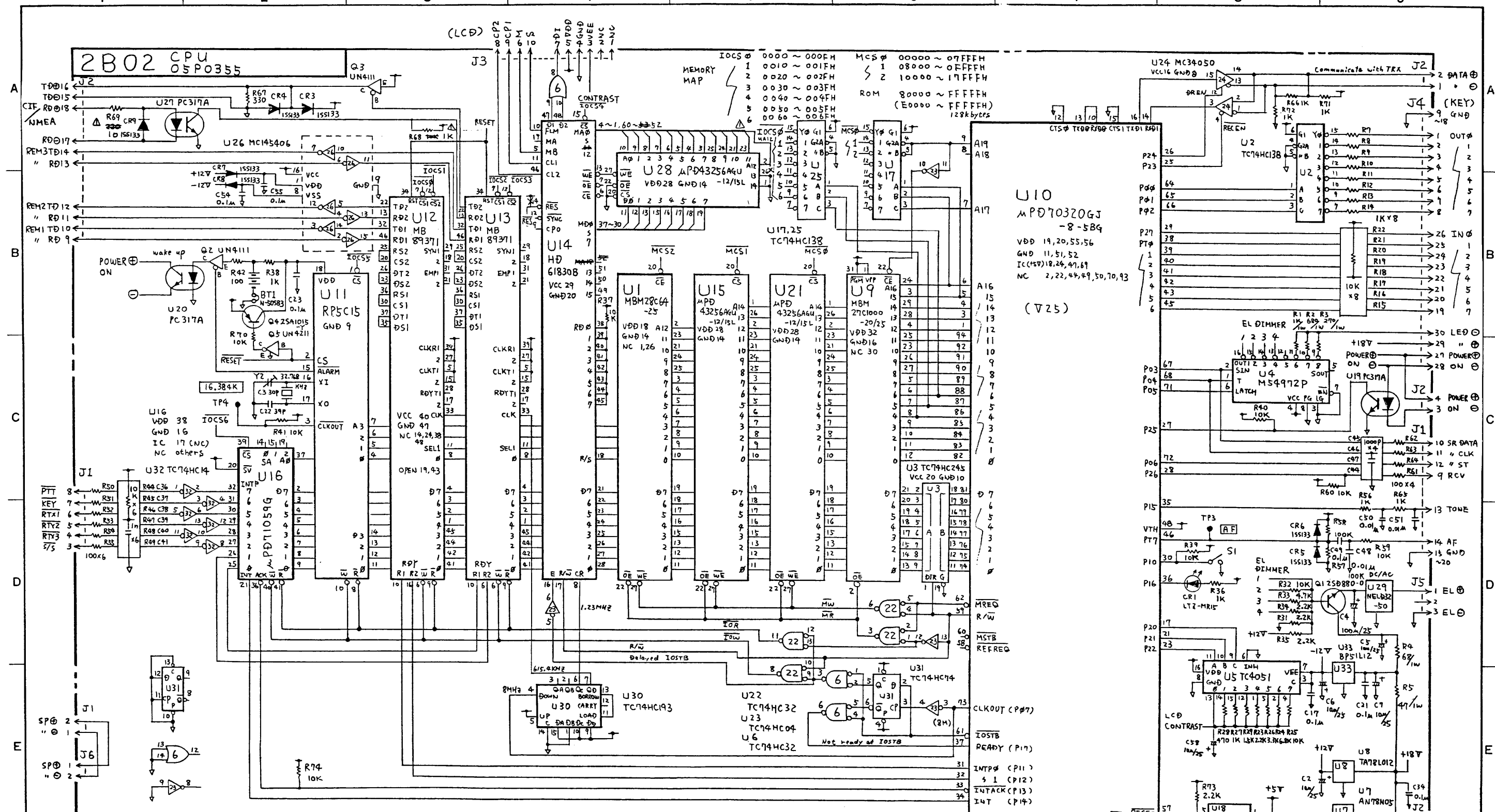
2B02 CPU 05P0355



2B03 AF 05P0356



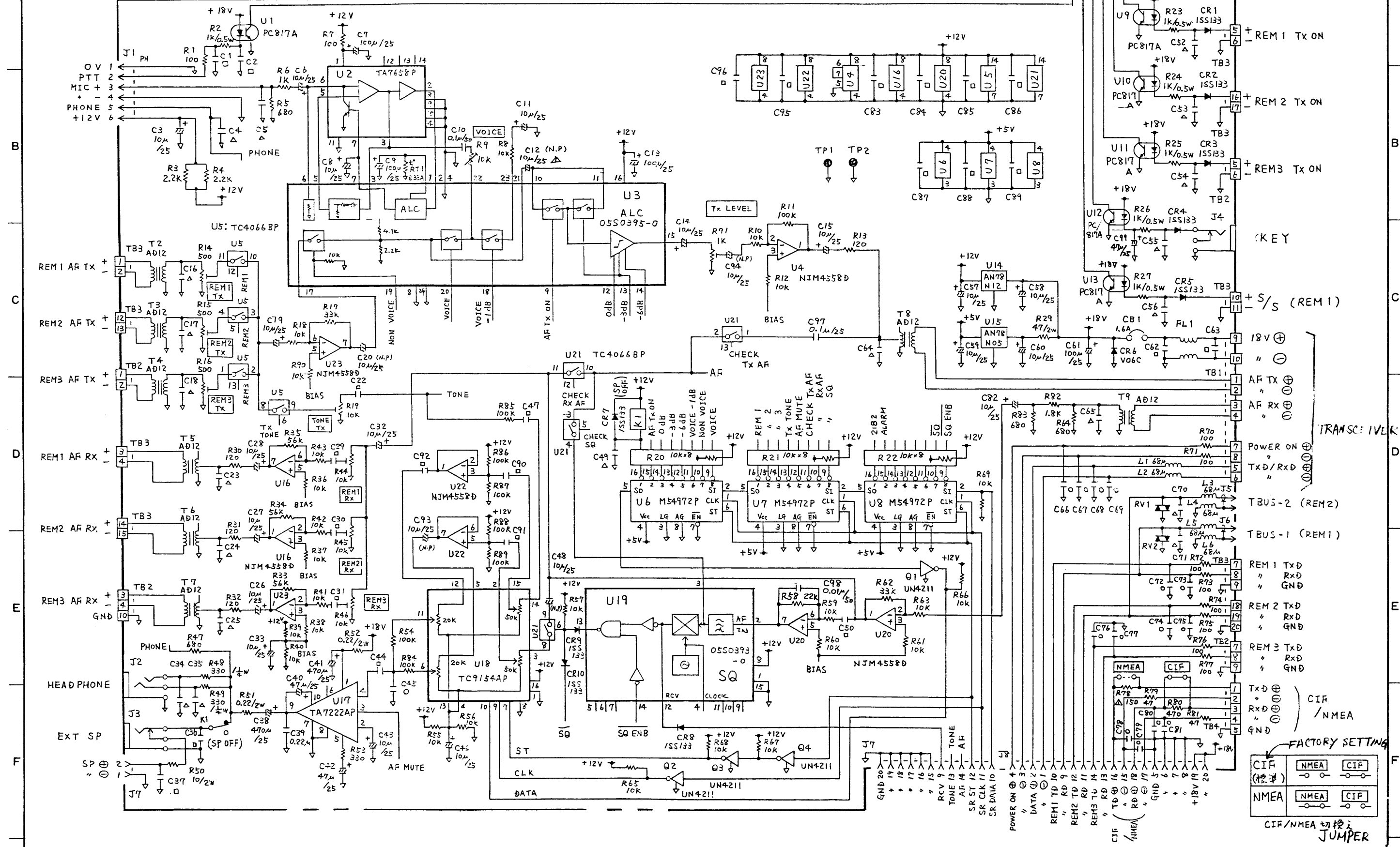
主機種 FS-1600 FS-2500 FS-5000	コード	型名	SHEET NO. 1/1
	課長	検図	設計
	製図		
TITLE			2B01 CHASSIS (CONTROLLER UNIT)
C5519-K13-B			



NOTE (1) Resistors are in  $\Omega$ , capacitors are in F and inductors are in H unless otherwise noted.  
 (2) VDD and GND pin location.  
 VDD-14 GND-7  
 TC74HC04  
 TC74HC14  
 TC74HC32  
 VDD-16 GND-8  
 TC74HC193  
 TC74HC138

主機種	FS-2500	FS-5000	コード		SHEET NO.	1/1
課長	検	図	設計	製	図	
2B02					CPU (CONTROLLER UNIT)	
TITLE					C5519-K15-C	

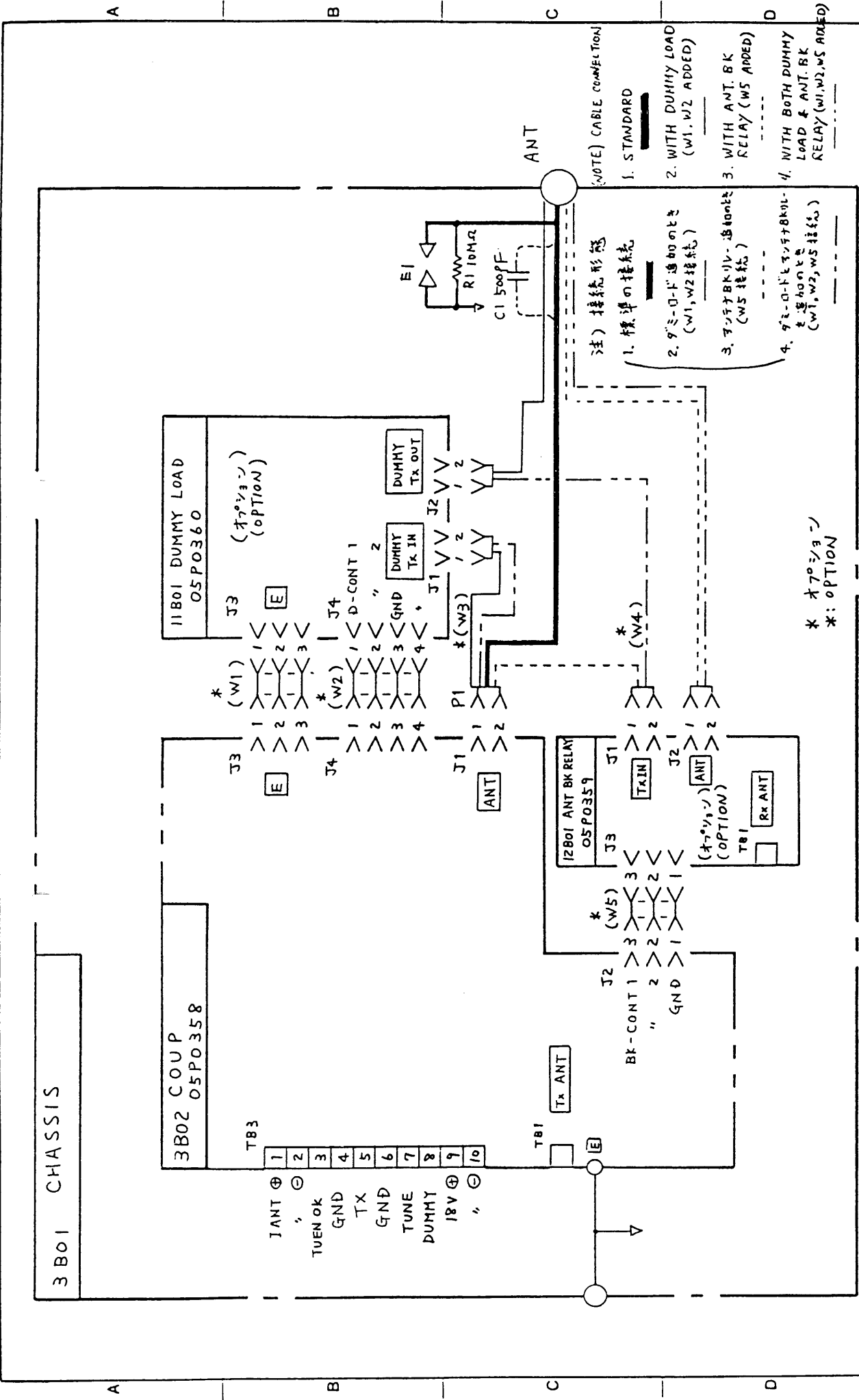
# 2B03 AF 05P0356



NOTE (1) Resistors are in Ω (0.1W), Capacitors are in F.  
 Inductors are in H, unless otherwise noted.  
 (2) Marks ○ are 1000pF/50WV capacitors.  
 △ are 0.01μF/50WV capacitors and  
 □ are 0.1μF/25WV capacitors.

機種種	FS-1600	コード		SHEET NO.	1/1
型名		設計		TITLE	2B03 AF (CONTROLLER UNIT)
課長		設計			C5519-K14-C
検		製			
図		図			

古野電気株式会社



(NOTE) CABLE CONNECTION

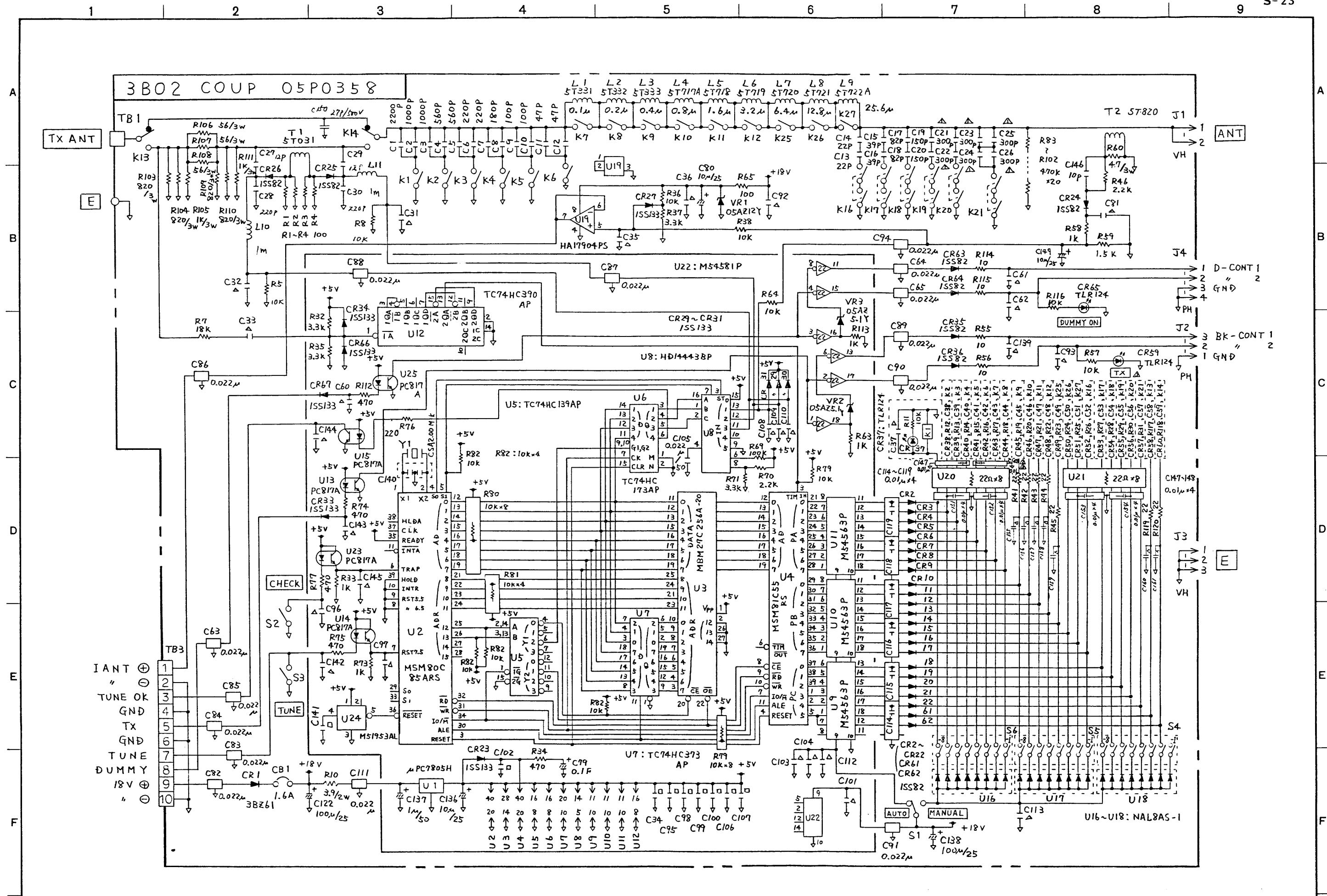
1. STANDARD
2. WITH DUMMY LOAD (W1, W2 ADDED)
3. WITH ANT. BK RELAY (W5 ADDED)
4. WITH BOTH DUMMY LOAD & ANT. BK RELAY (W1, W2, W5 ADDED)

注) 接続形態

1. 標準の接続
2. ダミーロード追加のとき (W1, W2 接続)
3. アンテナバックリレー追加のとき (W5 接続)
4. ダミーロードとアンテナバックリレー追加のとき (W1, W2, W5 接続)

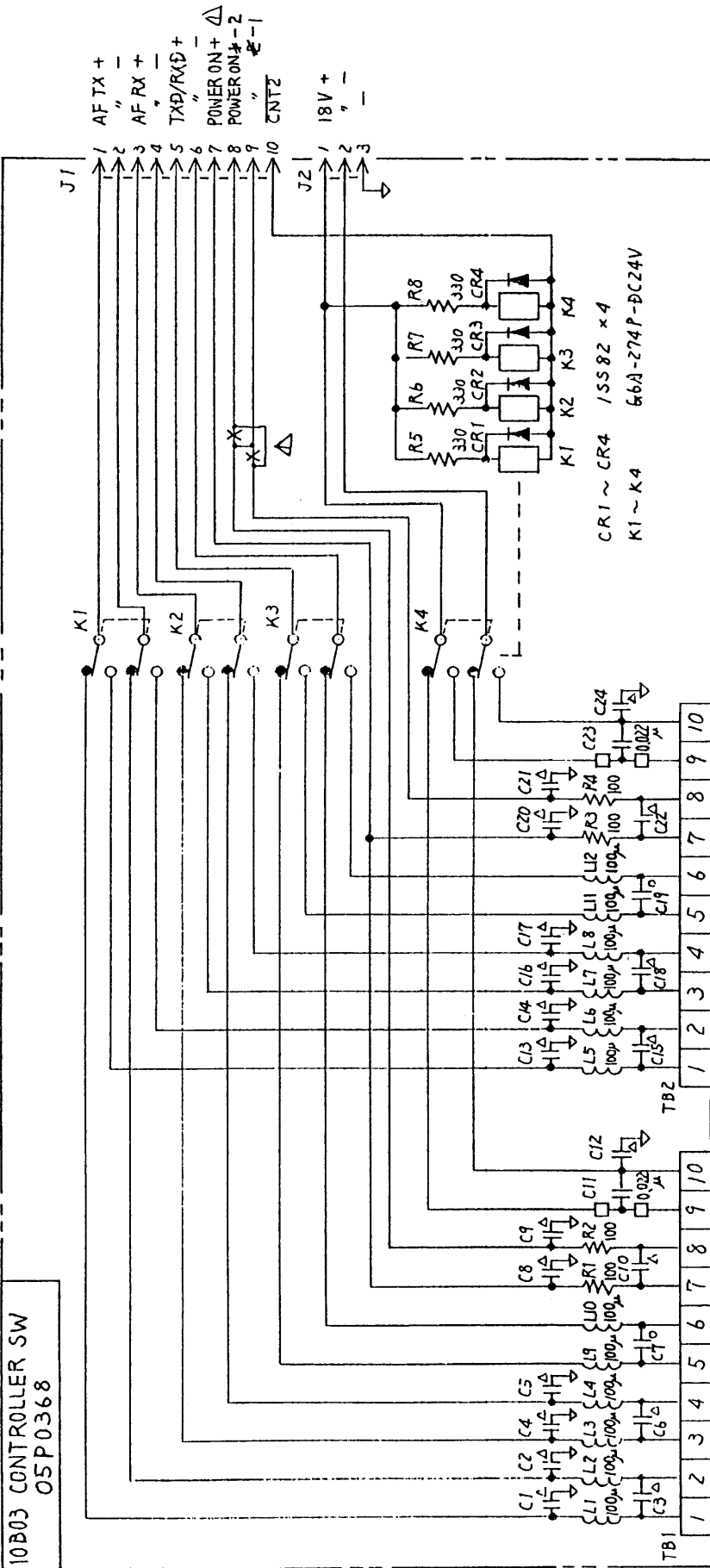
\* オプション  
\*: OPTION

主	FS-1600	コード		シート	1
機	FS-2500	型名		NO.	1
種	FS-5000	設計		3B01 CHASSIS	
課長	検図	設計		(COUPLER UNIT)	
		製図		TITLE	
				C5519-K18-B	



NOTE (1) Resistors are in Ω (0.1W), Capacitors are in F.  
 Inductors are in H unless otherwise noted.  
 (2) Marks ○ are 1000pF/50WV capacitors.  
 △ are 0.01μF/50WV capacitors, and  
 □ are 0.1μF/25WV capacitors.

主機種	FS-1600	コード		SHEET	1/1
機種	FS-1600	型名		NO.	
課長		設計		3B02 COUPLER PCB (COUPLER UNIT)	
検		製		C5519-K19-C	
図		図		古野電気株式会社	



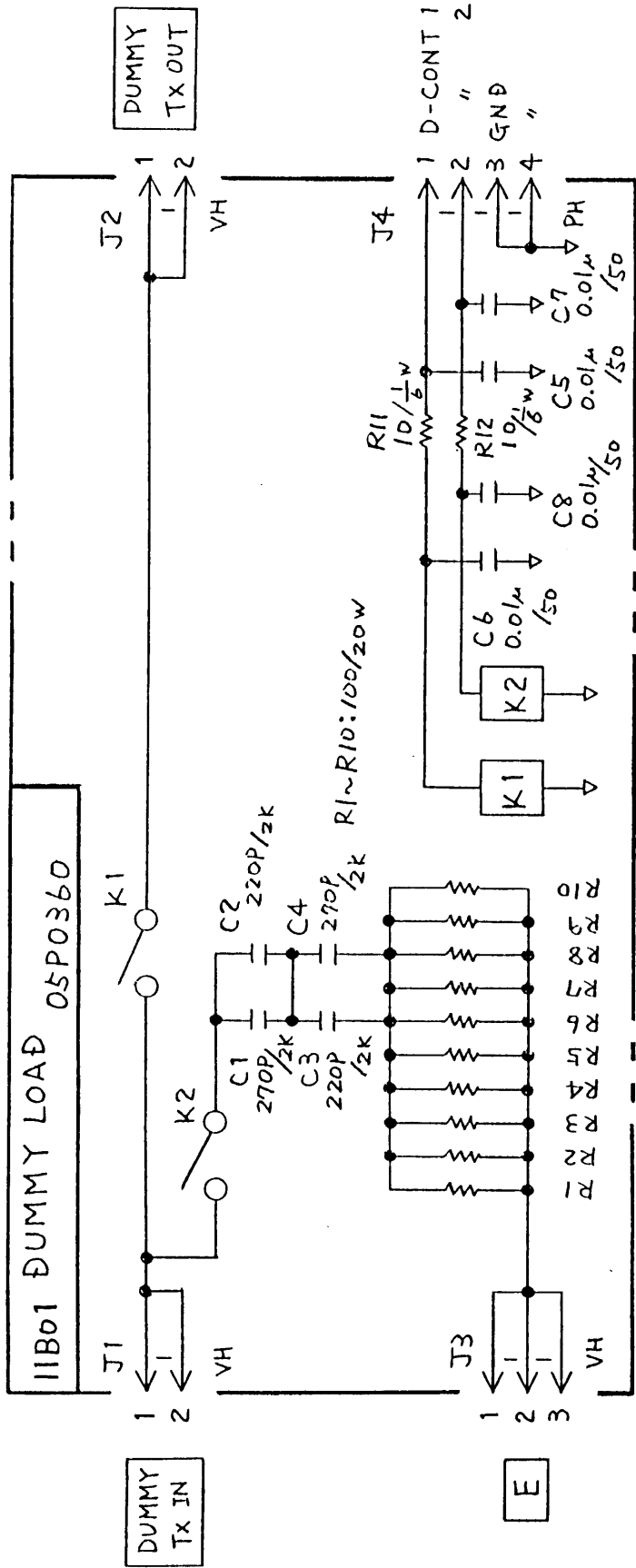
Note. 1) Marks O are 1000 pF 50WV Capacitors.  
 2) Marks Δ are 0.01 μF 50WV Capacitors.  
 3) Resistors are in Ω (0.1W), Capacitors are in F, Inductors are in H, unless otherwise noted.

CONTROLLER 1

CONTROLLER 2

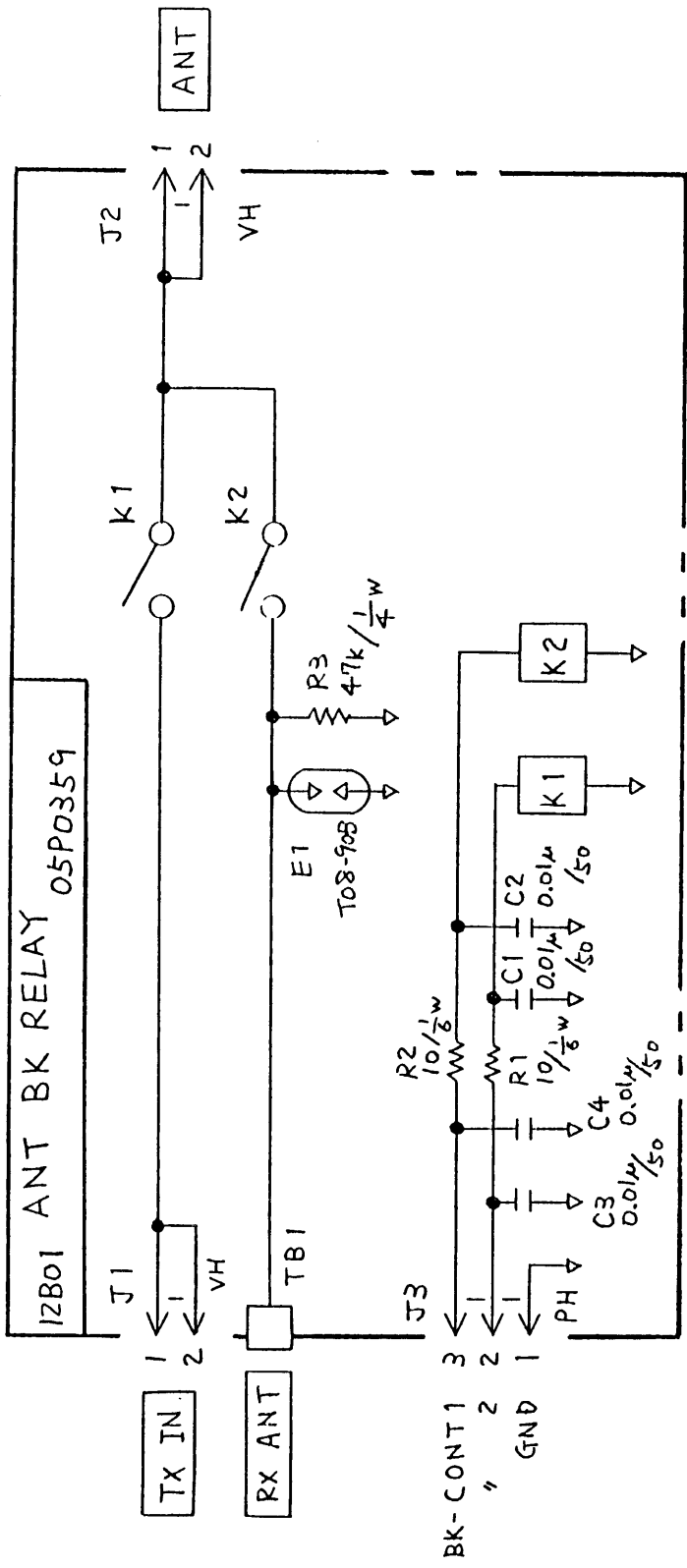
10B03 CONTROLLER SW  
OSP0368

主機種	FS-1600	コード														SHEET NO.	1/1
課長	FS-5000	型名															
検図		設計															
製図		製図															
10B03 CONTROLLER SW (OPTION) (TRANSCIVER UNIT)																	
C 5 5 1 9 - K 0 1 - B																	



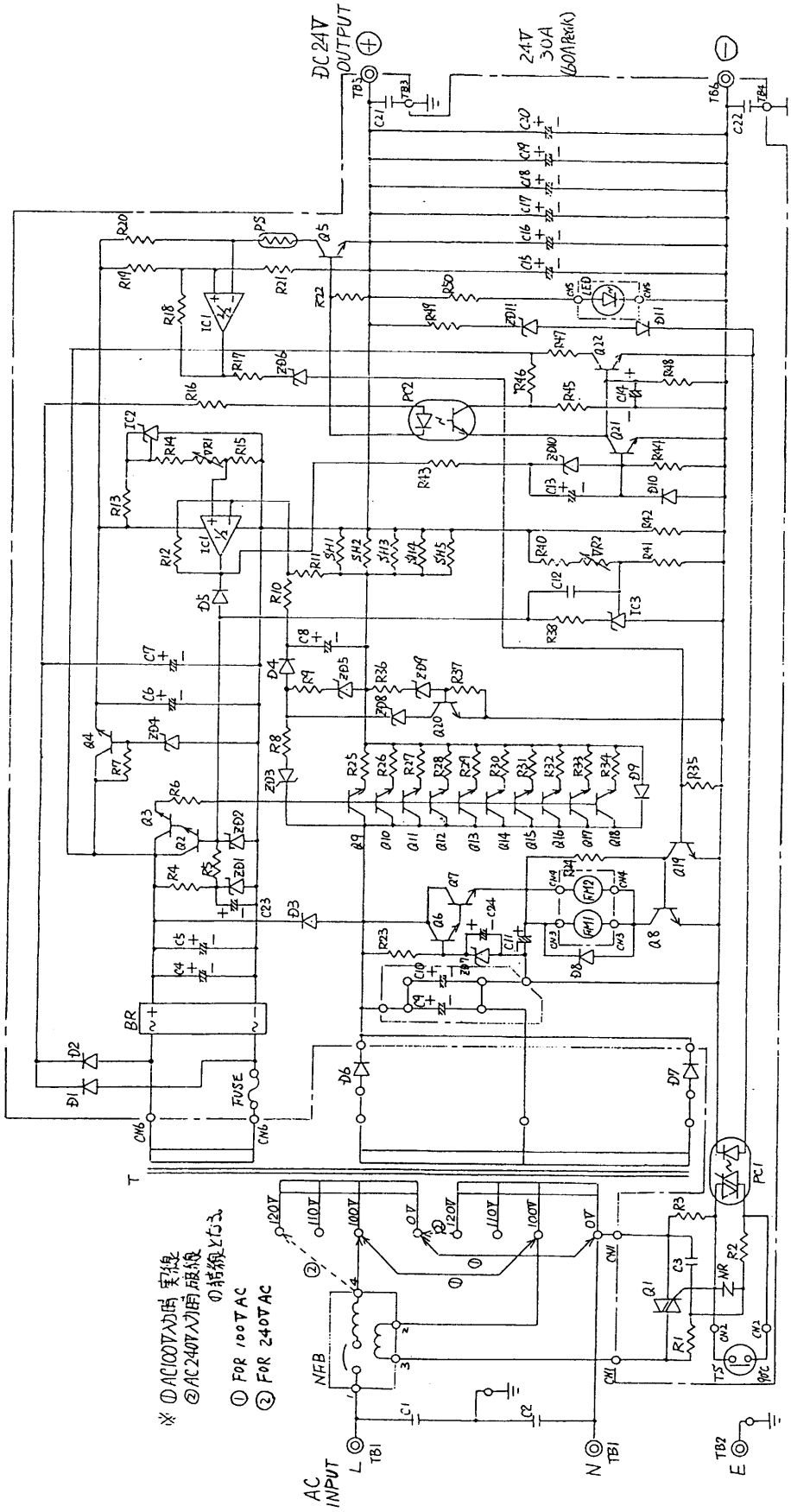
NOTE) Resistors are in  $\Omega$ , Capacitors are in F.

主機種	FS-1600	コード		SHEET	1
	FS-2500	型名		NO.	1
課長	FS-5000	設計		11B01 DUMMY LOAD (OPTION) (COUPLER UNIT)	
検閲		製		TITLE	
		裂		PWg. No. C5519-K16-B	



NOTE) Resistors are in  $\Omega$ , Capacitors are in F.

主機種		FS-1600 FS-2500 FS-5000		コード											SHEET	1
課長		検図		設計											NO.	1
製図		図		製図											12B01 ANT BK RELAY (OPTION) (COUPLER UNIT)	
															TITLE	
															DWG. No.	C5519-K17-B



※ ① AC100V用実線  
 ② AC240V用虚線  
 ① 配線方式

- ① FOR 100V AC
- ② FOR 240V AC

承認 APPROVED	品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q.TY	図番 DWG.NO.	備考 REMARKS
検 CHECKED	品名 TITLE	AC電源ユニット				
製 DRAWN	三 THIRD ANGLE PROJECTION	PR-850 AC POWER UNIT				
	R SCALE					
	重 WEIGHT	kg	C5519-K20-A			

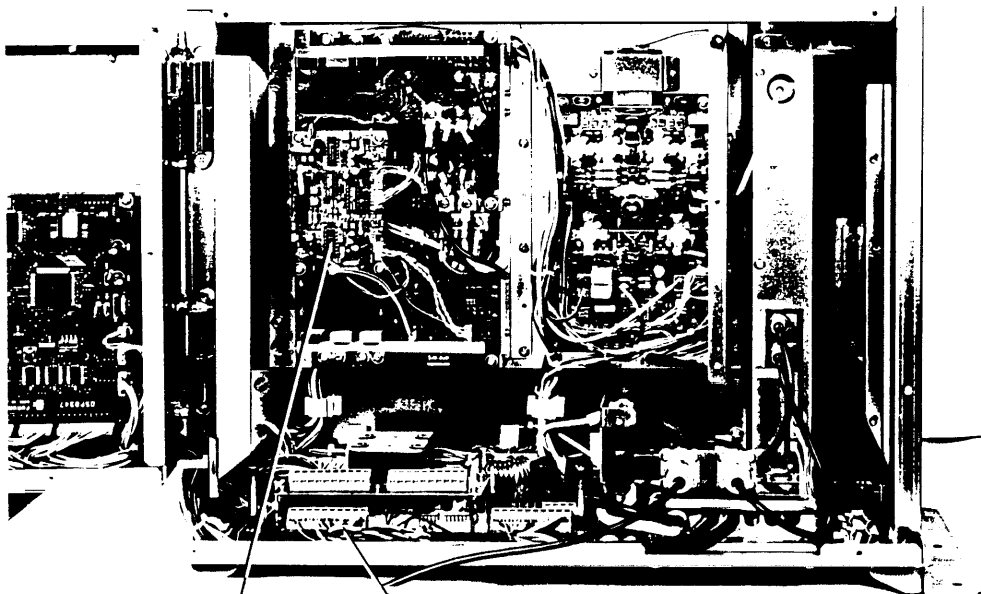
FS-1600  
 2500  
 5000  
 8000

# APPENDIX 1

## ALTERATION OF SHIP'S MAINS

Change the jumper wire on the REG CONT Board and INTERFACE Board according to ship's mains (24 or 32 VDC).

### ① Modification of REG CONT Board

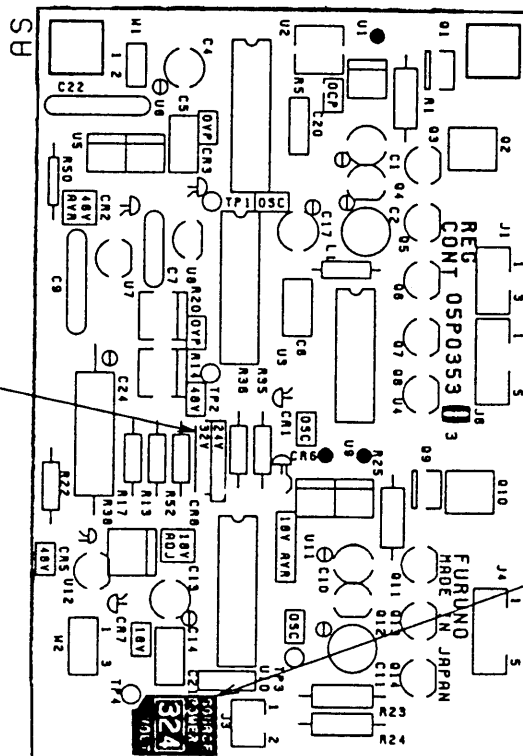


T Photo No.1107

INTERFACE Board

REG CONT Board

Jumper Wire  
 { 24 VDC: open  
 { 32 VDC: short



Input power displayed here.

24 VDC: 

3	2	4
---	---	---

  
 32 VDC: 

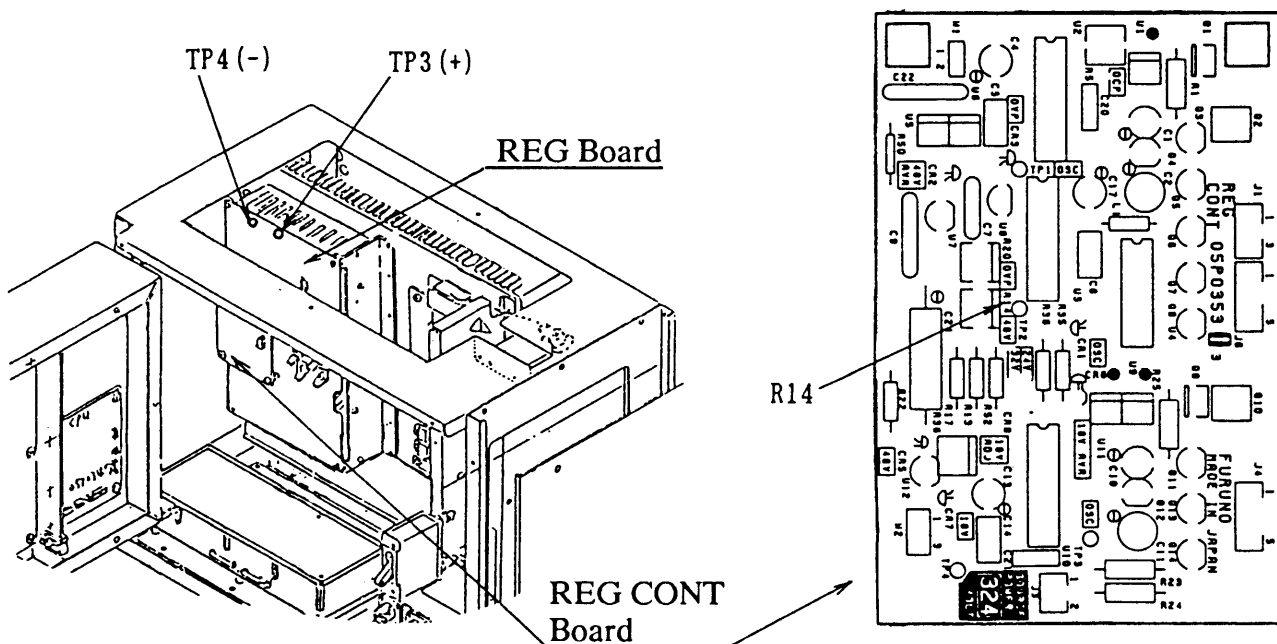
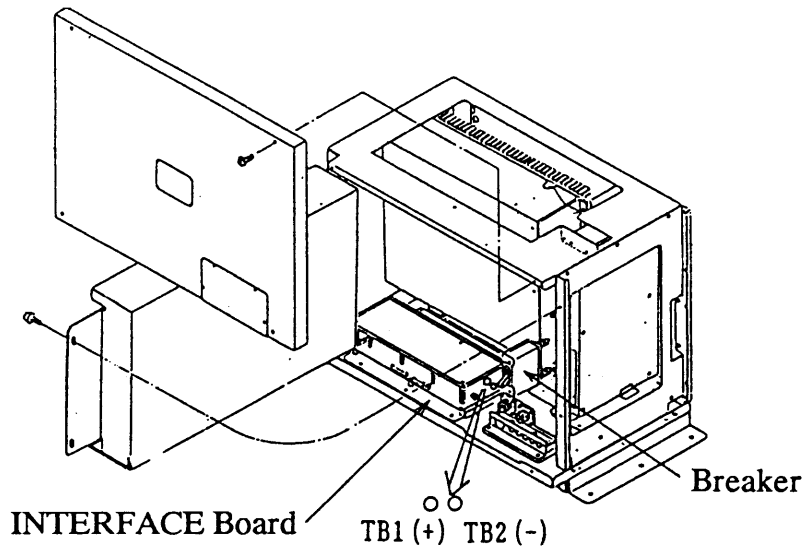
3	2	4
---	---	---

Black out a digit to show voltage.

## Checking Voltage

Measure input voltage and the 48 V line under receiving condition. If the voltage of 48 V line is not within the rating shown in the table below, adjust it with R14 on the REG CONT Board.

Ship's Mains	Input Voltage		48 V Line Voltage		
	Measuring Point	Rating	Measuring Point	Rating	Adjuster
24VDC	INTERFACE Board	21.6 – 31.2 V	REG Board	45 ± 0.1V (at 24V supply)	REG CONT Board
32VDC	TB1 (+) TB2 (-)	28.8 – 41.6 V	TP3 (+) TP4 (-)	44 ± 0.1V (at 32V supply)	R14



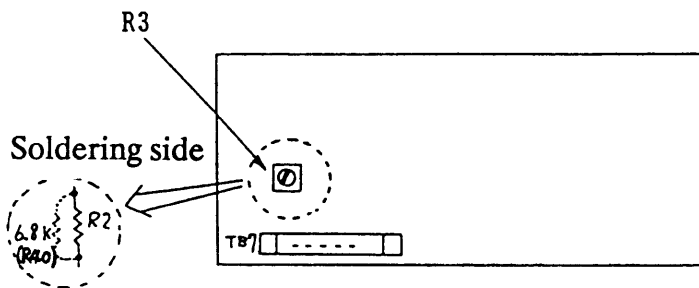
② **Modification of  
INTERFACE Board**  
(Overvoltage Setting)

**Jumper pattern on the board.** ----- (In the future, a jumper pattern will be provided around R3.)

Ship's Mains	Jumper Setting
24 VDC	Short
32 VDC	Open

**No jumper pattern on the board.**

Ship's Mains	Addition of 6.8 k ohm resistor in parallel with R2 (soldering side)
24 VDC	Necessary
32 VDC	Not necessary



**INTERFACE Board**

After modification, overvoltage value is automatically set as follows.

Ship's Mains	Overvoltage value
24 VDC	34 VDC
32 VDC	44 VDC

# **APPENDIX 2 SYSTEM SETTINGS & POWER ADJUSTMENT**

(ROM Version No. 06)

**(Including modification of DUMMY LOAD PCB for  
adding shortening capacitor)**

## **IMPORTANT:**

**After installation, if necessary, change  
system settings and adjust output power.**

# 1. System Setting

Changeable specifications are shown in Table-1 and Table-2. If necessary, change the specifications with the following key sequence.

Item	Key Sequence
Calling up screen for specification change	STO (CH No.) ENT ↑ 9900 to 9999
Selecting setting No.	(setting No.) ENT ↑ 0 to 3

(EX) When only the frequencies stored in the user channel are authorized for transmitting.

STO 9 9 0 1 ENT 2 ENT

Note: The setting in the tables 1 and 2 are applicable to the two ROMs having version No. 06.

Table-1 Changeable Specifications

Shading shows factory setting.

Channel No.	Function	Setting No.			
		0	1	2	3
9900	Model (*1)	FS-5000	FS-2500	FS-1600	FS-8000
9901	TX freq. selection (*2)	Free (USA)	Limited (Other than USA)	ROM	—
9903	Output power of transceiver unit on MF band (adjustable)	400 (Other than USA)	150 (USA)	50	—
9904	Class of emission on 2182kHz	AM	SSB (USA)	—	—
9905	TX TUNE (TX TUNE key)	Enable	Disable	Auto (Tuning is done when setting TX freq.)	—
9906	Scan of TX channel	Enable	Disable	—	—
9911	Test alarm	Disable	Enable(*3)	—	—
9912	Test alarm frequency	2191 kHz (Enter another freq. if 2191kHz is inadequate.)			

Continued

Channel No.	Function	Setting No.			
		0	1	2	3
9913	TX delay time	30 ms (Selectable: 10 to 99ms)			
9914	Alarm sending time	45 sec. (1 to 9999 sec.)			
9917	50 ohm BK relay	ON/OFF	ON (Fixed) (*4)	—	—
9926	Test tone	Enable	Disable (Europe)	—	—
9927	Power reduction on 2182/2187.5 kHz	Enable	Disable	—	—
9928	Minimum output power (*5)	Less than 60W	60W or more	—	—
9930	Data to "REM1" terminal	MIF (*6)	TBUS (*7)	CIF	NMEA
9931	Data to "REM2" terminal	MIF	TBUS	CIF	NMEA
9932	Data to "REM3" terminal	MIF	TBUS	CIF	NMEA
9933	Data to "CIF/NMEA" terminal	MIF	TBUS	CIF	NMEA
9934	Class of emission of TX/RX, when unit connected to "REM1" is once keyed.	No change (*8)	SSB	AM	TLX
9935	Class of emission of TX/RX, when unit connected to "REM2" is once keyed.	No change	SSB	AM	TLX
9936	Class of emission of TX/RX, when unit connected to "REM3" is once keyed.	No change	SSB	AM	TLX
9937	Class of emission of TX only while unit connected to "REM1" is keyed.	No change	SSB	AM	TLX
9938	Class of emission of TX only while unit connected to "REM2" is keyed.	No change	SSB	AM	TLX
9939	Class of emission of TX only while unit connected to "REM3" is keyed.	No change	SSB	AM	TLX
9953	Operation on AM mode	T/Rx	RX only	No	2182 (*9) (Europe)
9954	Operation on R3E mode	T/Rx (USA)	RX only (other than USA)	No	—
9955	Operation on weather FAX mode	T/Rx (USA)	RX only (other than USA)	No	—

9956	Operation on LSB mode	T/Rx (USA)	RX only (other than USA)	No	—
9960	Recall of 27 MHz SSB/DSB frequencies (for Japanese vessels)	Disable	Enable	—	—
9998	System Lock (Important system settings are not changeable.)	[ OFF /ON]: Enter "present time" to change setting. (*10)			
9999	System Initialization (Default)	Disable	Enable	—	—

Table-2 User Changeable Specifications

Shading shows factory setting.

Channel No.	Function	Setting No.			
		0	1	2	3
9902	ITU frequency	CURRENT	FUTURE	—	—
9907	Time display format	JAPAN	USA	EUROPE	—
9908	Second unit display	ON	OFF	—	—
9909	Display of class of emission	NOR(SSB)	ITU(J3E)	—	—
9910	Numerical display of check meter data	OFF	ON	—	—
9915	Check meter items	FULL	SHORT (*11)	—	—
9916	Keyboard lock (controlled by [*] key)	OFF	ON (*12)	—	—
9918	Time adj. (Clock)	Auto	Man	—	—
9919	Control unit priority (*13)	No	#1	#2	—
9920	Beep sound	ON/OFF	OFF	ON	—
9921		Level	6 (0 to 10)		
9922		Freq.	2000 Hz (100 to 3000 Hz)		

9923	Dummy (*14)		Enable	Disable	Shortening capacitor	—
9924	Freq. range in which shortening capacitor turns on. (9923 should be set at "2".)	Lower limit	2500.0 kHz			
9925		Upper limit	3999.9 kHz			
9940	Receiver bandwidth in kHz (Changeable thru keyboard)	SSB	6 k	3 k	0.3 k	—
9941		CW	6 k	3 k	0.3 k	—
9942		TELEX	6 k	3 k	0.3 k	—
9943		AM	6 k	3 k	0.3 k	—
9944		R3E	6 k	3 k	0.3 k	—
9945		FAX	6 k	3 k	0.3 k	—
9946		LSB	6 k	3 k	0.3 k	—
9997	All user CH clear		—	ON	—	—

(\*1): Output power of ITU/DSC channels and direct key-in frequencies are preset as shown below.

Table-3 Model vs Max. Output Power

(\*): for Japanese vessels only.

	FS-5000	FS-2500 (*)	FS-1600 (*)	FS-8000
Output Power	400W	250W	150W	800W

(\*2): Free ----- Any frequencies (1.6065 to 29.9999 MHz) can be transmitted by direct key-in.

Limited--- The frequencies in the ITU/DSC and user channels can be transmitted.

ROM ----- Only the frequencies stored in the user channel can be transmitted.

(\*3): To test the transmitter press **TEST** and **START** keys in this order. The dummy load (if equipped) is connected automatically and the test signal of 2191kHz, modulated by two-tone alarm, is sent to the dummy load.

(\*4) Selective if installation contains a specialty receiving antenna or ANT BK RELAY board (in antenna coupler). For high speed switching between receiving and transmitting (for example, telex) set to "1." Then, TX delay time (system setting 9913) is shortened to "10ms." (In actual practice, data is transmitted with 14 ms delay.)

(\*5): For 1988 SOLAS Convention ships (GMDSS) set to "1." Then, minimum output power is automatically set at 60W (power data: 100), except for minimum power data already stored into user channel.

(\*6): MIF ----- Furuno Multi Interface for Radio communication  
Select MIF when DP-5, DSC-5, selcall or intership FAX is connected.

(\*7): TBUS ----- For equipment made by "Thrane & Thrane A/S" of Denmark.  
If TBUS data is used, it is not necessary to connect TXD/RXD lines.

(\*8): Ex. ----- Selcall is connected to "REM1".  
If you wish to change the class of emission only while the selcall is transmitted and to restore it automatically to previous status after transmission, set the channel Nos. 9934 and 9937 to "0" (No change) and "2" (AM), respectively.

(\*9): Transmission ----- 2182 kHz, Reception ----- all frequencies

(\*10): Ex. ----- Preset time is 12 : 35.  
Press **1 2 3 5 ENT** in this order to turn on or off the system lock function. The following system settings are not changeable when you turn on the system lock function.

- **STO FULL** (or **LOW**) ----- Power Adjustment
- **STO** {
  - 9900 ----- Model
  - 9901 ----- Tx freq. selection
  - 9903 ----- Output power of SSB on MF band
  - 9914 ----- Alarm sending time
  - 9960 ----- Recall 27MHz freq.
  - 9999 ----- System initialization

(\*11): If you select "1" (short), only check data for Ia, Vc, Ic and Pi are displayed repeatedly every pressing of the **CHECK METER** key.

(\*12): To enable to lock the keys except for **SEND, START, 2182,** and **2187.5** keys, select "1" (ON). Then press the \* key to turn on the key lock function. First press of the \* key make the keys inactive. ("Keyboard Lock [ON]" will be displayed.)

(\*13) For control unit priority, select the same setting numbers for both control units.

No. 1 Control Unit priority

Control Unit	Setting No.
No. 1	"1"
No. 2	"1"

No. 2 Control Unit priority

Control Unit	Setting No.
No. 1	"2"
No. 2	"2"

(\*14)

<b>Setting No.</b>	<b>Contents</b>	<b>LCD Indication</b>	<b>Remarks</b>
"0" (Enable)	Dummy load can be switched by <b>DUMMY</b> key.	DUMMY	With DUMMY LOAD PCB.
"1" (Disable)	<b>DUMMY</b> key is not operative.	—	Without DUMMY LOAD PCB.
"2" (Short Cap.)	Shortening capacitor automatically turns on in the range set by 9924/9925. Further, <b>DUMMY</b> key is allowed to turn on/off shortening capacitor.	S. CAP (Shortening Capacitor)	With modified DUMMY LOAD PCB. (Ref. to page AP2-12.)

### **CONFIRMATION OF SETTING**

To confirm settings, press **RCL, 9, 9, 9** and **ENT** in this order. Then press **ENT** key successively.

---

## 2. How to Store Frequencies to the User (Preset) Channel

---

### For USA Flag Vessels

The "TX freq. selection" (9901) for the sets distributed thru Furuno USA is factory-set to "0" (Free), so you may store frequencies by recalling the ITU/DSC channels or by keying in a frequency through the keyboard.

Select class of emission, bandwidth and frequency then press the following keys to store the frequencies (class of emission & BW as well) into the user channel.

STO (CH No.) ENT ENT  
↑  
1 to 8999 CH (storage capacity: 400 CH)

### Non-USA Flag Vessels

The "TX freq. selection" (9901) is factory-set to "1" (Limited), so only the frequencies in the ITU/DSC channels can be used.

Execute the following key sequence to store ITU/DSC frequencies (class of emission & BW as well) into the user channel.

{ ITU } (CH No.) ENT STO (CH No.) ENT ENT  
{ DSC } ↑ ↑  
DSC: 1 to 79 CH 1 to 8999 CH  
ITU: (Storage capacity: 400 CH)  
(ex) Recalling of 401 CH  
41, 401 or 4001

*Note:* 1. Current ITU/DSC frequencies can be changed to future ITU/DSC frequencies (from July 1991) by changing the system setting.

STO 9 9 0 2 ENT 1 ENT

*However, since ITU/DSC frequencies stored into the user channel are not changed automatically, it is recommended to store both current and future ITU/DSC frequencies into the user channel after installation.*

2. To see stored user channels, press the following keys.

RCL 9 9 9 8 ENT

### 3. Power Adjustment

When precise power adjustment is required, adjust the "power data" referring to the procedure below.

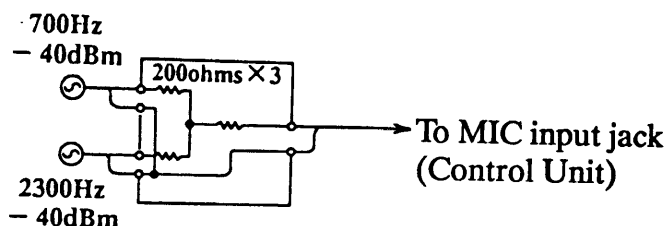
Table-4 Channel & Resolution of Memory

Channel	Resolution of Memory
User channel	<u>Each channel</u>
Free direct key-in ITU Channel DSC Channel	MF --- <u>500 kHz steps</u> HF --- <u>1 MHz steps</u>

- Note**
1. If the "Model name setting (9900)" is correctly made, maximum power data will be "255" (MAX).
  2. If the error message "Excessive Ic on PA." (when Ic exceeds 25A) appears during transmission, output power is reduced automatically from "FULL" to "LOW1" → "LOW2 ---." In this case, reduce the output power to prevent overcurrent from flowing into the power amp, by following the steps from 6 to 9 shown below.

#### Procedure

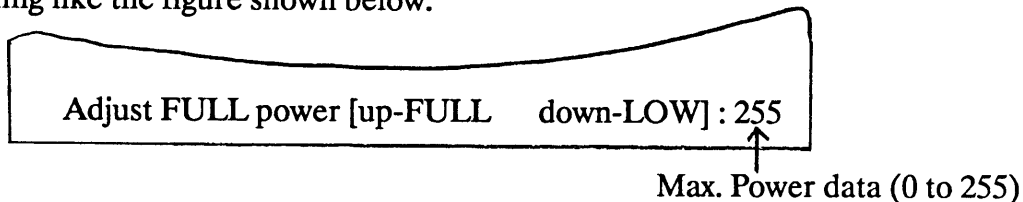
1. Connect a power meter (input impedance 50 ohms, measurable range 500 W ave. for FS-5000, 800 W ave. for FS-8000.) to the TX ANT jack on the transceiver unit.
2. To display the numeral check meter data on the screen, press **STO 9 9 1 0 ENT 1 ENT** in this order.
3. Press the **CHECK METER** key successively until the "Collector Current (A)" can be monitored.
4. Connect two AF oscillators to the MIC input jack as below, and then press PTT switch.



5. Read the meter indication.

<u>Model</u>	<u>Meter ind.</u>	<u>(Output power)</u>
FS-5000	200 W	(400 W pep)
FS-8000	400 W	(800 W pep)

6. Stop transmission and press the **STO** key followed by the **FULL** key. The screen should look something like the figure shown below.



7. To decrease the output power, decrease the "power data" by pressing and holding the **LOW** key.

8. Transmit again and check that the output power is as desired and **Ic** on the LCD is lower than 24.5A (the indication "FULL" remains).

9. If the power is decreased excessively, increase the power by pressing and holding the **FULL** key.

10. Repeat steps 6 to 9 until desired power is obtained.

The relationship between power data and output power of the transceiver unit is as follows. Refer to pages AP2-11 and AP2-11a.

Table-5 Power Data & Output Power

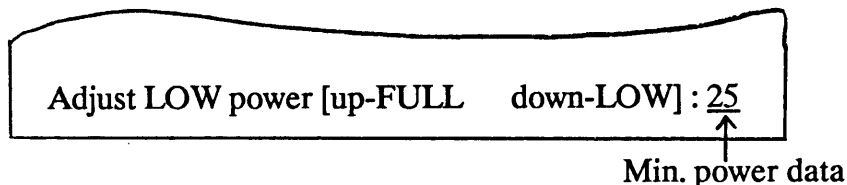
Power data	Output power (approx.)	
	FS-5000	FS-8000
255	400W	800W
200	250W	500W
175	200W	370W
150	150W	280W
80	50W	110W
25	10W	30W
0	5W	10W

## MINIMUM POWER SET

If necessary, you may change the minimum output power.

### Procedure

1. Press the **STO** key followed by the **LOW** key. The screen should look something like the figure shown below.



2. Press and hold the **FULL** or **LOW** key to increase or decrease power data, respectively.
3. To memorize power data, press the **ENT** key.

## POWER DATA FOR POWER REDUCTION

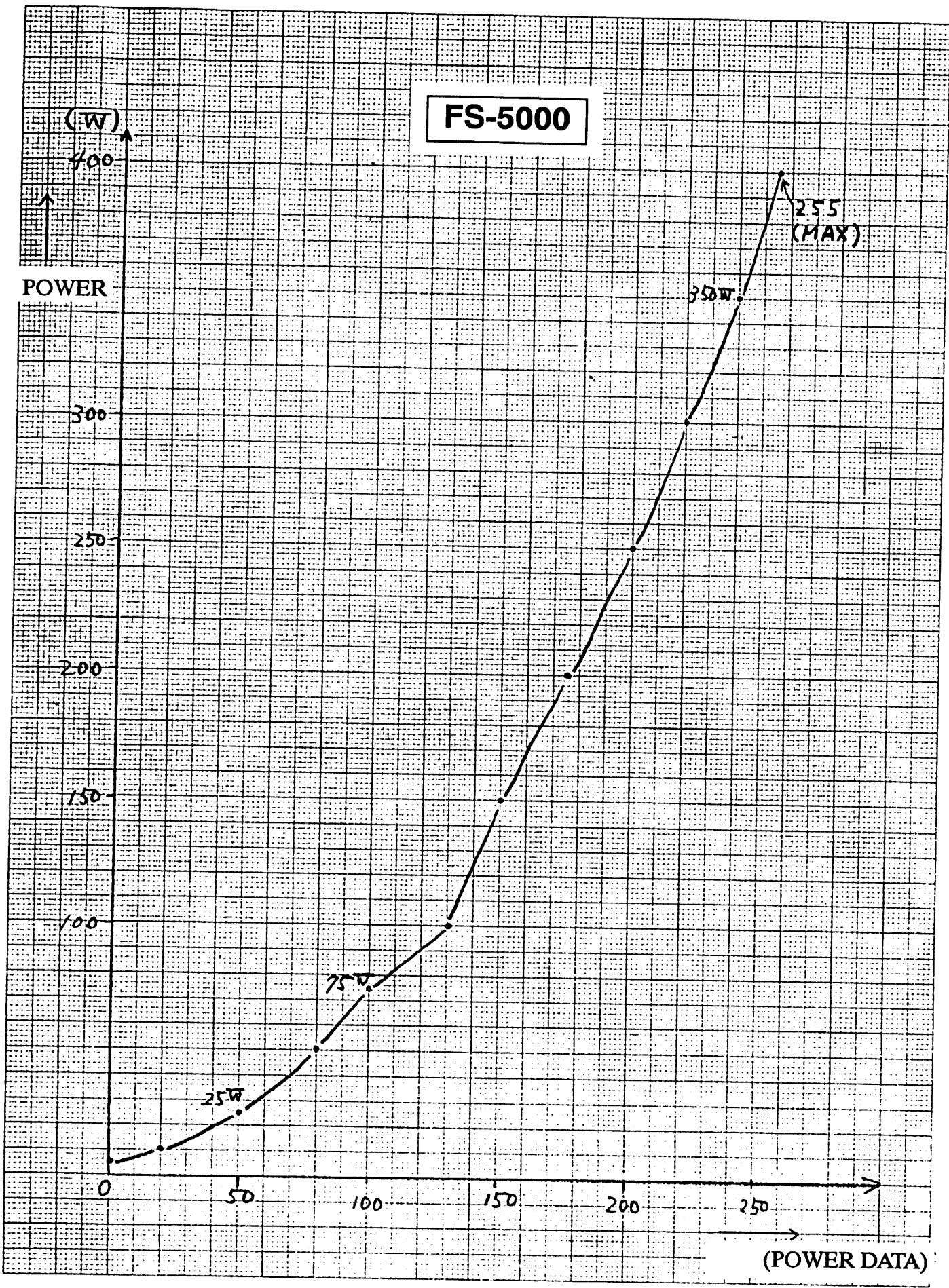
For every press of the **LOW** key in normal operation, the power indication on the screen changes from "FULL" to "LOW1" → "LOW2" --- "LOW5." The relationship between power indication and "power data" is as follows.

Table-6 Power Indication & Power Data

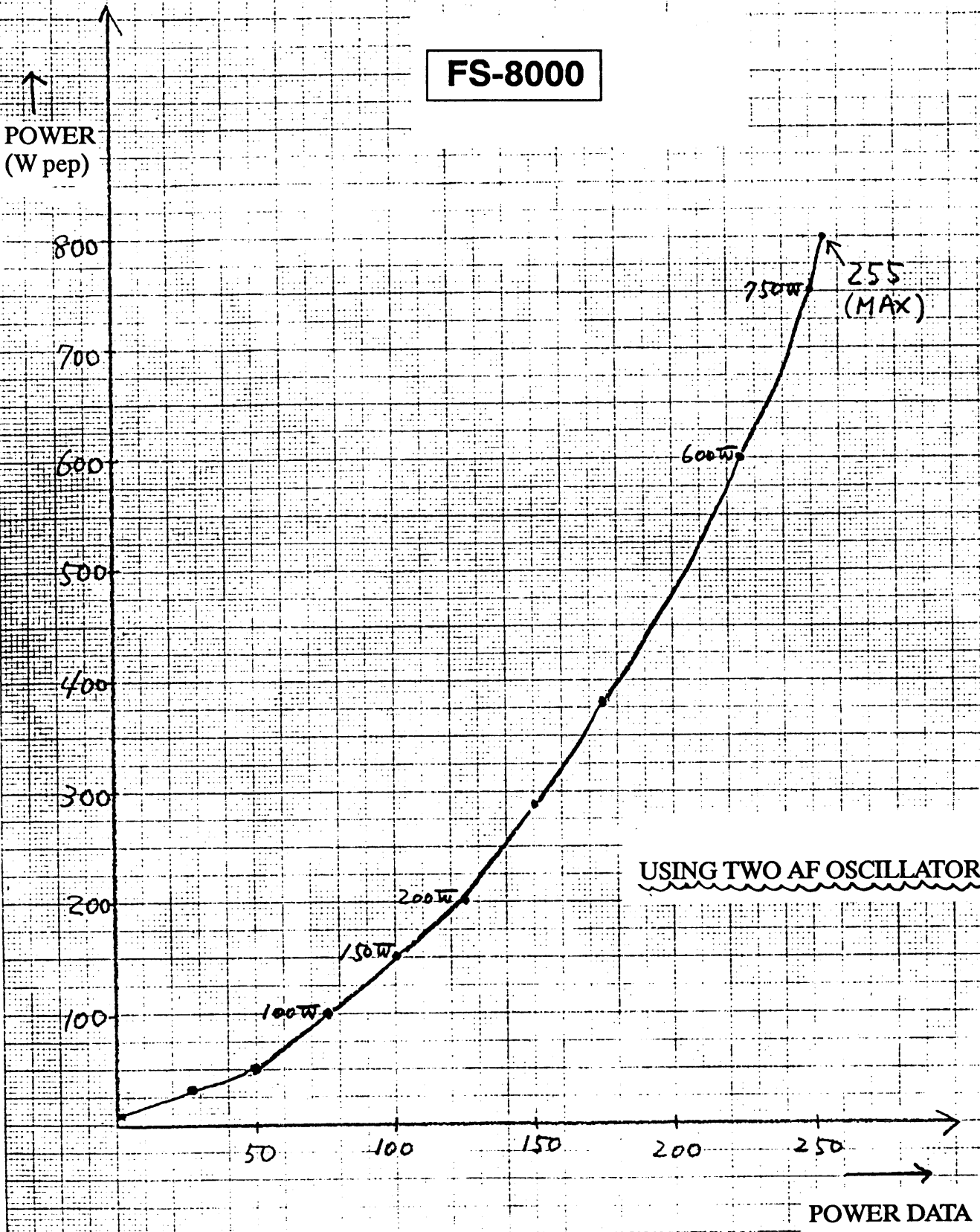
Power Indication	Power data	Output power (approx.)	
		FS-5000	FS-8000
"FULL"	255	400W	800W (400W)
"LOW1"	205	260W	520W (200W)
"LOW2"	155	160W	310W (80W)
"LOW3"	105	80W	150W (25W)
"LOW4"	55	30W	50W
"LOW5"	Minimum power data		

*Note: Number in parentheses is output power on frequencies below 4 MHz.*

# FS-5000



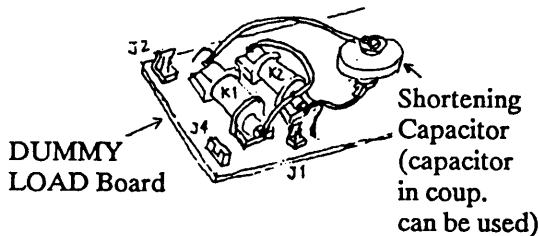
# FS-8000



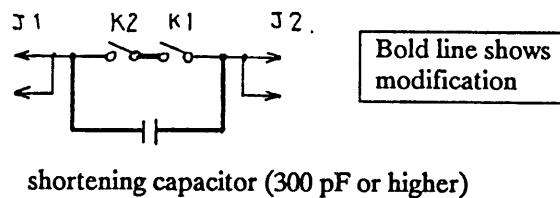
## 4. Modification of DUMMY LOAD PCB

When a certain MF frequency cannot be tuned, due to improper length of antenna, a shortening capacitor can be inserted only to tune that frequency. Control of the shortening capacitor is assigned to system settings 9923 – 9925. *This modification requires the optional DUMMY LOAD Board, (type: OP05-34, code no.: 005-925-830) and nullifies the dummy load function. If the dummy load is required, install an external dummy load.*

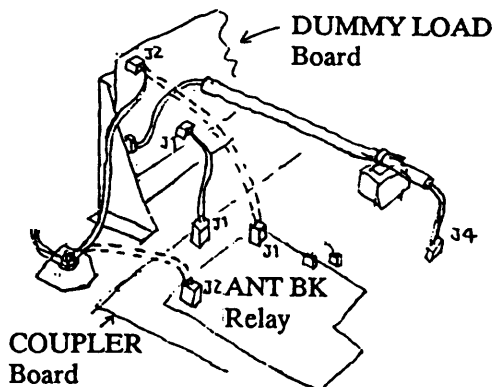
DUMMY LOAD Board with shortening capacitor



Signal flow with addition of shortening capacitor



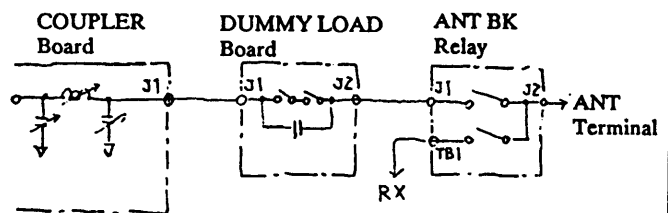
DUMMY LOAD Board with ANT BK relay



Dotted lines show wiring for ANT BK relay.

**NOTE:** Be sure wiring does not touch other wiring.

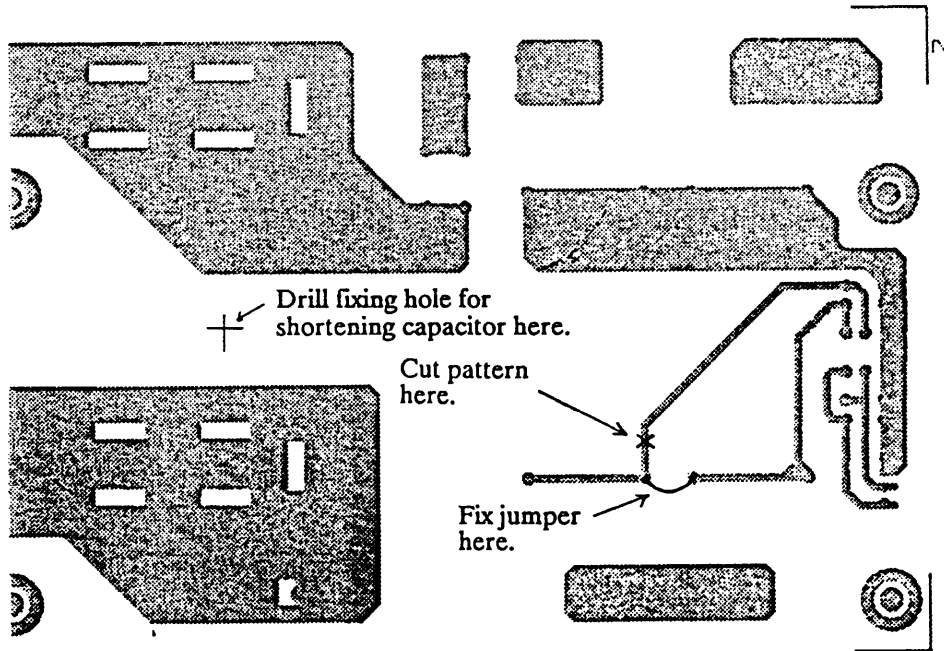
Signal flow with addition of ANT BK relay



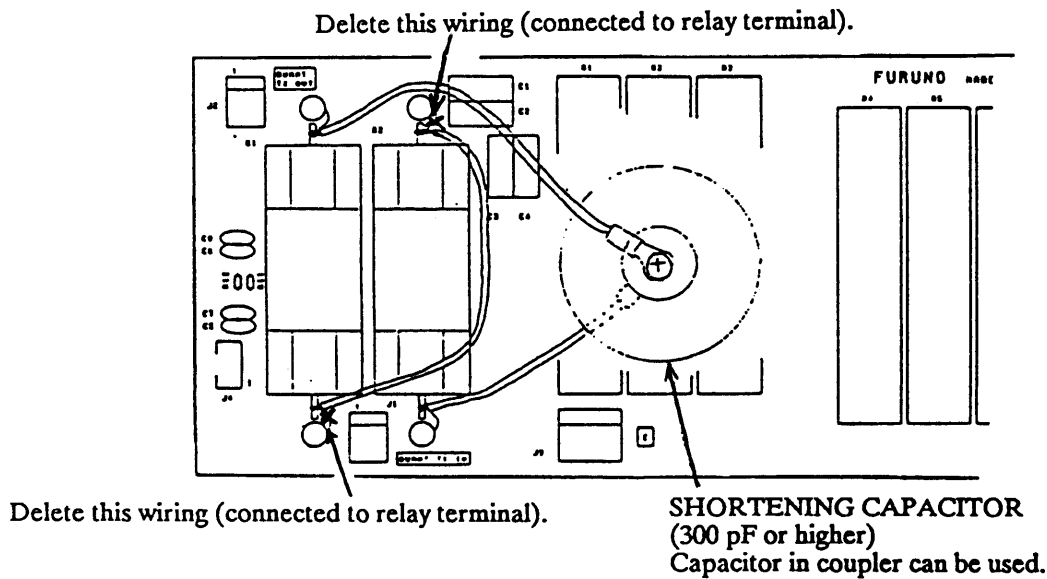
**Procedure**

1. Prepare optional DUMMY LOAD board (OP05-34, code no. 005-925-830).
2. Remove C1 – C4 and R1 – R3.

(SOLDER SIDE OF DUMMY LOAD BOARD)



3. To install the shortening capacitor, drill fixing hole under R2 in the center of where there is no pattern.
4. Cut pattern and fit a jumper wire as shown in the figure below.
5. Install and wire the shortening capacitor. Be sure wiring does not contact other wiring and parts.



## 5. Preset Frequency List

DSC & DISTRESS FREQUENCIES

(from July, '91)

CH. No.	TX	RX	Mode	ITU Ch. No.	Remarks
DSC 1	2182.0	2182.0	USB		DISTRESS
DSC 2	4125.0	4125.0	USB		DISTRESS
DSC 3	6215.0	6215.0	USB		DISTRESS
DSC 4	8291.0	8291.0	USB		DISTRESS
DSC 5	12290.0	12290.0	USB		DISTRESS
DSC 6	16420.0	16420.0	USB		DISTRESS
DSC 7	500.0	500.0	H2A		DISTRESS
DSC 11	2187.5	2187.5	TLX		DSC
DSC 12	4207.5	4207.5	TLX	4030	DSC
DSC 13	6312.0	6312.0	TLX	6058	DSC
DSC 14	8414.5	8414.5	TLX	8077	DSC
DSC 15	12577.0	12577.0	TLX	12191	DSC
DSC 16	16804.5	16804.5	TLX	16233	DSC
DSC 21	2174.5	2174.5	TLX		
DSC 22	4177.5	4177.5	TLX	4011	
DSC 23	6268.0	6268.0	TLX	6011	
DSC 24	8376.5	8376.5	TLX	8001	
DSC 25	12520.0	12520.0	TLX	12087	
DSC 26	16695.0	16695.0	TLX	16024	
DSC 30	490.0	490.0	TLX		NAV.
DSC 31	518.0	518.0	TLX		NAV.
DSC 32	4209.5	4209.5	TLX		NAV.
DSC 42	4210.0	4210.0	TLX		MSI
DSC 43	6314.0	6314.0	TLX		MSI
DSC 44	8416.5	8416.5	TLX		MSI
DSC 45	12579.0	12579.0	TLX		MSI
DSC 46	16806.5	16806.5	TLX		MSI
DSC 47	19680.5	19680.5	TLX		MSI
DSC 48	22376.0	22376.0	TLX		MSI
DSC 49	26100.5	26100.5	TLX		MSI
DSC 50	458.5	455.5	TLX		DSC
DSC 51	2177.0	2177.0	TLX		DSC
DSC 52	4208.0	4219.5	TLX	4031	DSC
DSC 53	6312.5	6331.0	TLX	6059	DSC
DSC 54	8415.0	8436.5	TLX	8078	DSC
DSC 55	12577.5	12657.0	TLX	12192	DSC
DSC 56	16805.0	16903.0	TLX	16234	DSC
DSC 57	18898.5	19703.5	TLX	18057	DSC
DSC 58	22374.5	22444.0	TLX	22181	DSC
DSC 59	25208.5	26121.0	TLX	25072	DSC
DSC 61	2189.5	2189.5	TLX		DSC
DSC 62	4208.5	4220.0	TLX	4032	DSC
DSC 63	6313.0	6331.5	TLX	6060	DSC
DSC 64	8415.5	8437.0	TLX	8079	DSC
DSC 65	12578.0	12657.5	TLX	12193	DSC
DSC 66	16805.5	16903.5	TLX	16235	DSC
DSC 67	18899.0	19704.0	TLX	18058	DSC
DSC 68	22375.0	22444.5	TLX	22182	DSC
DSC 69	25209.0	26121.5	TLX	25073	DSC
DSC 72	4209.0	4220.5	TLX	4033	DSC
DSC 73	6313.5	6332.0	TLX	6061	DSC
DSC 74	8416.0	8437.5	TLX	8080	DSC
DSC 75	12578.5	12658.0	TLX	12194	DSC
DSC 76	16806.0	16904.0	TLX	16236	DSC
DSC 77	18899.5	19704.5	TLX	18059	DSC
DSC 78	22375.5	22445.0	TLX	22183	DSC
DSC 79	25209.5	26122.0	TLX	25074	DSC

**FURUNO** ITU SSB FREQUENCY TABLE (effective till June 30, 1991. 1991年6月30日迄)

4 MHz BAND			6 MHz BAND			8 MHz BAND			12 MHz BAND			16 MHz BAND			22 MHz BAND		
No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX
401	4063.0	4357.4	601	6200.0	6506.4	801	8195.0	8718.9	1201	12330.0	13100.8	1601	16460.0	17232.9	2201	22000.0	22596.0
402	4066.1	4360.5	602	6203.1	6509.5	802	8198.1	8722.0	1202	12333.1	13103.9	1602	16463.1	17236.0	2202	22003.1	22599.1
403	4069.2	4363.6	603	6206.2	6512.6	803	8201.2	8725.1	1203	12336.2	13107.0	1603	16466.2	17239.1	2203	22006.2	22602.2
404	4072.3	4366.7	604	6209.3	6515.7	804	8204.3	8728.2	1204	12339.3	13110.1	1604	16469.3	17242.2	2204	22009.3	22605.3
405	4075.4	4369.8	605	6212.4	6518.8	805	8207.4	8731.3	1205	12342.4	13113.2	1605	16472.4	17245.3	2205	22012.4	22608.4
406	4078.5	4372.9	606	6215.5	6521.9	806	8210.5	8734.4	1206	12345.5	13116.3	1606	16475.5	17248.4	2206	22015.5	22611.5
407	4081.6	4376.0	607	6218.6	6525.0	807	8213.6	8737.5	1207	12348.6	13119.4	1607	16478.6	17251.5	2207	22018.6	22614.6
408	4084.7	4379.1	608	6221.6	6528.1	808	8216.7	8740.6	1208	12351.7	13122.5	1608	16481.7	17254.6	2208	22021.7	22617.7
409	4087.8	4382.2				809	8219.8	8743.7	1209	12354.8	13125.6	1609	16484.8	17257.7	2209	22024.8	22620.8
410	4090.9	4385.3				810	8222.9	8746.8	1210	12357.9	13128.7	1610	16487.9	17260.8	2210	22027.9	22623.9
411	4094.0	4388.4				811	8226.0	8749.9	1211	12361.0	13131.8	1611	16491.0	17263.9	2211	22031.0	22627.0
412	4097.1	4391.5				812	8229.1	8753.0	1212	12364.1	13134.9	1612	16494.1	17267.0	2212	22034.1	22630.1
413	4100.2	4394.6				813	8232.2	8756.1	1213	12367.2	13138.0	1613	16497.2	17270.1	2213	22037.2	22633.2
414	4103.3	4397.7				814	8235.3	8759.2	1214	12370.3	13141.1	1614	16500.3	17273.2	2214	22040.3	22636.3
415	4106.4	4400.8				815	8238.4	8762.3	1215	12373.4	13144.2	1615	16503.4	17276.3	2215	22043.4	22639.4
416	4109.5	4403.9				816	8241.5	8765.4	1216	12376.5	13147.3	1616	16506.5	17279.4	2216	22046.5	22642.5
417	4112.6	4407.0				817	8244.6	8768.5	1217	12379.6	13150.4	1617	16509.6	17282.5	2217	22049.6	22645.6
418	4115.7	4410.1				818	8247.7	8771.6	1218	12382.7	13153.5	1618	16512.7	17285.6	2218	22052.7	22648.7
419	4118.8	4413.2				819	8250.8	8774.7	1219	12385.8	13156.6	1619	16515.8	17288.7	2219	22055.8	22651.8
420	4121.9	4416.3				820	8253.9	8777.8	1220	12388.9	13159.7	1620	16518.9	17291.8	2220	22058.9	22654.9
421	4125.0	4419.4				821	8257.0	8780.9	1221	12392.0	13162.8	1621	16522.0	17294.9	2221	22062.0	22658.0
422	4128.1	4422.5				822	8260.1	8784.0	1222	12395.1	13165.9	1622	16525.1	17298.0	2222	22065.1	22661.1
423	4131.2	4425.6				823	8263.2	8787.1	1223	12398.2	13169.0	1623	16528.2	17301.1	2223	22068.2	22664.2
424	4134.3	4428.7				824	8266.3	8790.2	1224	12401.3	13172.1	1624	16531.3	17304.2	2224	22071.3	22667.3
425	4137.4	4431.8				825	8269.4	8793.3	1225	12404.4	13175.2	1625	16534.4	17307.3	2225	22074.4	22670.4
426	4140.5	4434.9				826	8272.5	8796.4	1226	12407.5	13178.3	1626	16537.5	17310.4	2226	22077.5	22673.5
427	4143.6	4143.6				827	8275.6	8799.5	1227	12410.6	13181.4	1627	16540.6	17313.5	2227	22080.6	22676.6
						828	8278.7	8802.6	1228	12413.7	13184.5	1628	16543.7	17316.6	2228	22083.7	22679.7
						829	8281.8	8805.7	1229	12416.8	13187.6	1629	16546.8	17319.7	2229	22086.8	22682.8
						830	8284.9	8808.8	1230	12419.9	13190.7	1630	16549.9	17322.8	2230	22089.9	22685.9
						831	8288.0	8811.9	1231	12423.0	13193.8	1631	16553.0	17325.9	2231	22093.0	22689.0
						832	8291.1	8291.1	1232	12426.1	13196.9	1632	16556.1	17329.0	2232	22096.1	22692.1
						833	8294.2	8294.2	1233	12429.2	12429.2	1633	16559.2	17332.1	2233	22099.2	22695.2
									1234	12432.3	12432.3	1634	16562.3	17335.2	2234	22102.3	22698.3
									1235	12435.4	12435.4	1635	16565.4	17338.3	2235	22105.4	22701.4
												1636	16568.5	17341.4	2236	22108.5	22704.5
												1637	16571.6	17344.5	2237	22111.6	22707.6
												1638	16574.7	17347.6	2238	22114.7	22710.7
												1639	16577.8	17350.7	2239	22117.8	22713.8
												1640	16580.9	17353.8	2240	22120.9	22716.9
												1641	16584.0	17356.9	2241	22124.0	22720.0
												1642	16587.1	16587.1	2242	22127.1	22723.1
												1643	16590.2	16590.2	2243	22130.2	22726.2
												1644	16593.3	16593.3	2244	22133.3	22729.3
															2245	22136.4	22732.4

**FURUNO** ITU TELEX FREQUENCY TABLE (effective till June 30, 1991, 1991年6月30日迄)

4 MHz BAND			6 MHz BAND			8 MHz BAND			12 MHz BAND			16 MHz BAND			22 MHz BAND			25 MHz BAND		
No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX
401	4170.5	4350.0	601	6256.5	6494.5	801	8344.0	8705.0	1201	12491.5	13071.5	1601	16660.5	17197.5	2201	22192.5	22561.5	2501	25076.3	25076.3
402	4171.0	4350.5	602	6257.0	6495.0	802	8344.5	8705.5	1202	12492.0	13072.0	1602	16661.0	17198.0	2202	22193.0	22562.0	2502	25076.8	25076.8
403	4171.5	4351.0	603	6257.5	6495.5	803	8345.0	8706.0	1203	12492.5	13072.5	1603	16661.5	17198.5	2203	22193.5	22562.5	2503	25077.3	25077.3
404	4172.0	4351.5	604	6258.0	6496.0	804	8345.5	8706.5	1204	12493.0	13073.0	1604	16662.0	17199.0	2204	22194.0	22563.0	2504	25077.8	25077.8
405	4172.5	4352.0	605	6258.5	6496.5	805	8346.0	8707.0	1205	12493.5	13073.5	1605	16662.5	17199.5	2205	22194.5	22563.5	2505	25078.3	25078.3
406	4173.0	4352.5	606	6259.0	6497.0	806	8346.5	8707.5	1206	12494.0	13074.0	1606	16663.0	17200.0	2206	22195.0	22564.0	2506	25078.8	25078.8
407	4173.5	4353.0	607	6259.5	6497.5	807	8347.0	8708.0	1207	12494.5	13074.5	1607	16663.5	17200.5	2207	22195.5	22564.5	2507	25079.3	25079.3
408	4174.0	4353.5	608	6260.0	6498.0	808	8347.5	8708.5	1208	12495.0	13075.0	1608	16664.0	17201.0	2208	22196.0	22565.0	2508	25079.8	25079.8
409	4174.5	4354.0	609	6260.5	6498.5	809	8348.0	8709.0	1209	12495.5	13075.5	1609	16664.5	17201.5	2209	22196.5	22565.5	2509	25080.3	25080.3
410	4175.0	4354.5	610	6261.0	6499.0	810	8348.5	8709.5	1210	12496.0	13076.0	1610	16665.0	17202.0	2210	22197.0	22566.0	2510	25080.8	25080.8
411	4175.5	4355.0	611	6261.5	6499.5	811	8349.0	8710.0	1211	12496.5	13076.5	1611	16665.5	17202.5	2211	22197.5	22566.5	2511	25081.3	25081.3
412	4176.0	4355.5	612	6262.0	6500.0	812	8349.5	8710.5	1212	12497.0	13077.0	1612	16666.0	17203.0	2212	22198.0	22567.0	2512	25081.8	25081.8
413	4176.5	4356.0	613	6262.5	6500.5	813	8350.0	8711.0	1213	12497.5	13077.5	1613	16666.5	17203.5	2213	22198.5	22567.5	2513	25082.3	25082.3
414	4177.0	4356.5	614	6263.0	6501.0	814	8350.5	8711.5	1214	12498.0	13078.0	1614	16667.0	17204.0	2214	22199.0	22568.0	2514	25082.8	25082.8
415	4177.5	4177.5	615	6263.5	6501.5	815	8351.0	8712.0	1215	12498.5	13078.5	1615	16667.5	17204.5	2215	22199.5	22568.5	2515	25083.3	25083.3
416	4178.0	4178.0	616	6264.0	6502.0	816	8351.5	8712.5	1216	12499.0	13079.0	1616	16668.0	17205.0	2216	22200.0	22569.0	2516	25083.8	25083.8
417	4178.5	4178.5	617	6264.5	6502.5	817	8352.0	8713.0	1217	12499.5	13079.5	1617	16668.5	17205.5	2217	22200.5	22569.5	2517	25084.3	25084.3
418	4179.0	4179.0	618	6265.0	6503.0	818	8352.5	8713.5	1218	12500.0	13080.0	1618	16669.0	17206.0	2218	22201.0	22570.0	2518	25084.8	25084.8
419	4179.5	4179.5	619	6265.5	6503.5	819	8353.0	8714.0	1219	12500.5	13080.5	1619	16669.5	17206.5	2219	22201.5	22570.5	2519	25085.3	25085.3
			620	6266.0	6504.0	820	8353.5	8714.5	1220	12501.0	13081.0	1620	16670.0	17207.0	2220	22202.0	22571.0	2520	25085.8	25085.8
			621	6266.5	6504.5	821	8354.0	8715.0	1221	12501.5	13081.5	1621	16670.5	17207.5	2221	22202.5	22571.5	2521	25086.3	25086.3
			622	6267.0	6505.0	822	8354.5	8715.5	1222	12502.0	13082.0	1622	16671.0	17208.0	2222	22203.0	22572.0	2522	25086.8	25086.8
			623	6267.5	6505.5	823	8355.0	8716.0	1223	12502.5	13082.5	1623	16671.5	17208.5	2223	22203.5	22572.5	2523	25087.3	25087.3
			624	6268.0	6268.0	824	8355.5	8716.5	1224	12503.0	13083.0	1624	16672.0	17209.0	2224	22204.0	22573.0	2524	25087.8	25087.8
			625	6268.5	6268.5	825	8356.0	8717.0	1225	12503.5	13083.5	1625	16672.5	17209.5	2225	22204.5	22573.5	2525	25088.3	25088.3
			626	6269.0	6269.0	826	8356.5	8717.5	1226	12504.0	13084.0	1626	16673.0	17210.0	2226	22205.0	22574.0	2526	25088.8	25088.8
			627	6269.5	6269.5	827	8357.0	8718.0	1227	12504.5	13084.5	1627	16673.5	17210.5	2227	22205.5	22574.5	2527	25089.3	25089.3
						828	8297.6	8297.6	1228	12505.0	13085.0	1628	16674.0	17211.0	2228	22206.0	22575.0	2528	25089.8	25089.8
						829	8298.1	8298.1	1229	12505.5	13085.5	1629	16674.5	17211.5	2229	22206.5	22575.5			
						830	8298.6	8298.6	1230	12506.0	13086.0	1630	16675.0	17212.0	2230	22207.0	22576.0			
						831	8299.1	8299.1	1231	12506.5	13086.5	1631	16675.5	17212.5	2231	22207.5	22576.5			
						832	8299.6	8299.6	1232	12507.0	13087.0	1632	16676.0	17213.0	2232	22208.0	22577.0			
						833	8357.5	8357.5	1233	12507.5	13087.5	1633	16676.5	17213.5	2233	22208.5	22577.5			
									1234	12508.0	13088.0	1634	16677.0	17214.0	2234	22209.0	22578.0			
									1235	12508.5	13088.5	1635	16677.5	17214.5	2235	22209.5	22578.5			
									1236	12509.0	13089.0	1636	16678.0	17215.0	2236	22210.0	22579.0			
									1237	12509.5	13089.5	1637	16678.5	17215.5	2237	22210.5	22579.5			
									1238	12510.0	13090.0	1638	16679.0	17216.0	2238	22211.0	22580.0			
									1239	12510.5	13090.5	1639	16679.5	17216.5	2239	22211.5	22580.5			
									1240	12511.0	13091.0	1640	16680.0	17217.0	2240	22212.0	22581.0			
									1241	12511.5	13091.5	1641	16680.5	17217.5	2241	22212.5	22581.5			
									1242	12512.0	13092.0	1642	16681.0	17218.0	2242	22213.0	22582.0			
									1243	12512.5	13092.5	1643	16681.5	17218.5	2243	22213.5	22582.5			
									1244	12513.0	13093.0	1644	16682.0	17219.0	2244	22214.0	22583.0			
									1245	12513.5	13093.5	1645	16682.5	17219.5	2245	22214.5	22583.5			
									1246	12514.0	13094.0	1646	16683.0	17220.0	2246	22215.0	22584.0			
									1247	12514.5	13094.5	1647	16683.5	17220.5	2247	22215.5	22584.5			
									1248	12515.0	13095.0	1648	16684.0	17221.0	2248	22216.0	22585.0			
									1249	12515.5	13095.5	1649	16684.5	17221.5	2249	22216.5	22585.5			
									1250	12516.0	13096.0	1650	16685.0	17222.0	2250	22217.0	22586.0			
									1251	12516.5	13096.5	1651	16685.5	17222.5	2251	22217.5	22586.5			
									1252	12517.0	13097.0	1652	16686.0	17223.0	2252	22218.0	22587.0			
									1253	12517.5	13097.5	1653	16686.5	17223.5	2253	22218.5	22587.5			
									1254	12518.0	13098.0	1654	16687.0	17224.0	2254	22219.0	22588.0			
									1255	12518.5	13098.5	1655	16687.5	17224.5	2255	22219.5	22588.5			

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									1256	12519.0	13099.0	1656	16688.0	17225.0	2256	22220.0	22589.0			
									1257	12519.5	13099.5	1657	16688.5	17225.5	2257	22220.5	22589.5			
									1258	12520.0	12520.0	1658	16689.0	17226.0	2258	22221.0	22590.0			
									1259	12520.5	12520.5	1659	16689.5	17226.5	2259	22221.5	22590.5			
									1260	12521.0	12521.0	1660	16690.0	17227.0	2260	22222.0	22591.0			
									1261	12521.5	12521.5	1661	16690.5	17227.5	2261	22222.5	22591.5			
									1262	12522.0	12522.0	1662	16691.0	17228.0	2262	22223.0	22592.0			
									1263	12522.5	12522.5	1663	16691.5	17228.5	2263	22223.5	22592.5			
									1264	12523.0	12523.0	1664	16692.0	17229.0	2264	22224.0	22593.0			
									1265	12523.5	12523.5	1665	16692.5	17229.5	2265	22224.5	22593.5			
									1266	12524.0	12524.0	1666	16693.0	17230.0	2266	22225.0	22594.0			
									1267	12524.5	12524.5	1667	16693.5	17230.5	2267	22225.5	22594.5			
									1268	12525.0	12525.0	1668	16694.0	17231.0	2268	22226.0	22226.0			
									1269	12525.5	12525.5	1669	16694.5	17231.5	2269	22226.5	22226.5			
									1270	12526.0	12526.0	1670	16695.0	16695.0						
									1271	12526.5	12526.5	1671	16695.5	16695.5						
												1672	16696.0	16696.0						
												1673	16696.5	16696.5						
												1674	16697.0	16697.0						
												1675	16697.5	16697.5						
												1676	16698.0	16698.0						
												1677	16698.5	16698.5						
												1678	16699.0	16699.0						
												1679	16699.5	16699.5						
												1680	16700.0	16700.0						
												1681	16700.5	16700.5						
												1682	16701.0	16701.0						
												1683	16701.5	16701.5						
												1684	16702.0	16702.0						
												1685	16702.5	16702.5						
												1686	16703.0	16703.0						
												1687	16703.5	16703.5						
												1688	16704.0	16704.0						
												1689	16704.5	16704.5						
												1690	16705.0	16705.0						
												1691	16705.5	16705.5						

**FURUNO** ITU CW FREQUENCY TABLE (effective till June 30, 1991, 1991年6月30日迄)

No.	4 MHz	No.	6 MHz	No.	8 MHz	No.	12 MHz	No.	16 MHz	No.	22 MHz	No.	25/26 MHz
4001	4188.5	6001	6282.75	8001	8377.0	12001	12565.5	16001	16754.0	22001	22250.5	25001	25091.5
4002	4189.0	6002	6283.50	8002	8377.5	12002	12566.0	16002	16754.5	22002	22251.0	25002	25092.0
4003	4189.5	6003	6284.25	8003	8378.0	12003	12566.5	16003	16755.0	22003	22251.5	25003	25092.5
4004	4190.0	6004	6285.00	8004	8378.5	12004	12567.0	16004	16755.5	22004	22252.0	25004	25093.0
4005	4190.5	6005	6285.75	8005	8379.0	12005	12567.5	16005	16756.0	22005	22252.5	25005	25093.5
4006	4191.0	6006	6286.50	8006	8379.5	12006	12568.0	16006	16756.5	22006	22253.0	25006	25094.0
4007	4191.5	6007	6287.25	8007	8380.0	12007	12568.5	16007	16757.0	22007	22253.5	25007	25094.5
4008	4192.0	6008	6288.00	8008	8380.5	12008	12569.0	16008	16757.5	22008	22254.0	25008	25095.0
4009	4192.5	6009	6288.75	8009	8381.0	12009	12569.5	16009	16758.0	22009	22254.5	25009	25095.5
4010	4193.0	6010	6289.50	8010	8381.5	12010	12570.0	16010	16758.5	22010	22255.0	25010	25096.0
4011	4193.5	6011	6290.25	8011	8382.0	12011	12570.5	16011	16759.0	22011	22255.5	25011	25096.5
4012	4194.0	6012	6291.00	8012	8382.5	12012	12571.0	16012	16759.5	22012	22256.0	25012	25097.0
4013	4194.5	6013	6291.75	8013	8383.0	12013	12571.5	16013	16760.0	22013	22256.5	25013	25097.5
4014	4195.0	6014	6292.50	8014	8383.5	12014	12572.0	16014	16760.5	22014	22257.0	25014	25098.0
4015	4195.5	6015	6293.25	8015	8384.0	12015	12572.5	16015	16761.0	22015	22257.5	25015	25098.5
4016	4196.0	6016	6294.00	8016	8384.5	12016	12573.0	16016	16761.5	22016	22258.0	25016	25099.0
4017	4196.5	6017	6294.75	8017	8385.0	12017	12573.5	16017	16762.0	22017	22258.5	25017	25099.5
4018	4197.0	6018	6295.50	8018	8385.5	12018	12574.0	16018	16762.5	22018	22259.0	25018	25100.0
4019	4197.5	6019	6296.25	8019	8386.0	12019	12574.5	16019	16763.0	22019	22259.5	25019	25100.5
4020	4198.0	6020	6297.00	8020	8386.5	12020	12575.0	16020	16763.5	22020	22260.0	25020	25101.0
4021	4198.5	6021	6297.75	8021	8387.0	12021	12575.5	16021	16764.0	22021	22260.5	25021	25101.5
4022	4199.0	6022	6298.50	8022	8387.5	12022	12576.0	16022	16764.5	22022	22261.0	25022	25102.0
4023	4199.5	6023	6299.25	8023	8388.0	12023	12576.5	16023	16765.0	22023	22261.5	25023	25102.5
4024	4200.0	6024	6300.00	8024	8388.5	12024	12577.0	16024	16765.5	22024	22262.0	25024	25103.0
4025	4200.5	6025	6300.75	8025	8389.0	12025	12577.5	16025	16766.0	22025	22262.5	25025	25103.5
4026	4201.0	6026	6301.50	8026	8389.5	12026	12578.0	16026	16766.5	22026	22263.0	25026	25104.0
4027	4201.5	6027	6302.25	8027	8390.0	12027	12578.5	16027	16767.0	22027	22263.5	25027	25104.5
4028	4202.0	6028	6303.00	8028	8390.5	12028	12579.0	16028	16767.5	22028	22264.0	25028	25105.0
4029	4202.5	6029	6303.75	8029	8391.0	12029	12579.5	16029	16768.0	22029	22264.5	25029	25105.5
4030	4203.0	6030	6304.50	8030	8391.5	12030	12580.0	16030	16768.5	22030	22265.0	25030	25106.0
4031	4203.5	6031	6305.25	8031	8392.0	12031	12580.5	16031	16769.0	22031	22265.5	25031	25106.5
4032	4204.0	6032	6306.00	8032	8392.5	12032	12581.0	16032	16769.5	22032	22266.0	25032	25107.0
4033	4204.5	6033	6306.75	8033	8393.0	12033	12581.5	16033	16770.0	22033	22266.5	25033	25107.5
4034	4205.0	6034	6307.50	8034	8393.5	12034	12582.0	16034	16770.5	22034	22267.0	25034	25108.0
4035	4205.5	6035	6308.25	8035	8394.0	12035	12582.5	16035	16771.0	22035	22267.5	25035	25108.5
4036	4206.0	6036	6309.00	8036	8394.5	12036	12583.0	16036	16771.5	22036	22268.0	25036	25071.0
4037	4206.5	6037	6309.75	8037	8395.0	12037	12583.5	16037	16772.0	22037	22268.5	25037	25073.0
4038	4207.0	6038	6310.50	8038	8395.5	12038	12584.0	16038	16772.5	22038	22269.0	25038	25075.0
4039	4207.5	6039	6311.25	8039	8396.0	12039	12584.5	16039	16773.0	22039	22269.5		
4040	4208.0	6040	6312.00	8040	8396.5	12040	12585.0	16040	16773.5	22040	22270.0		
4041	4208.5	6041	6312.75	8041	8397.0	12041	12585.5	16041	16774.0	22041	22270.5		
4042	4209.0	6042	6313.50	8042	8397.5	12042	12586.0	16042	16774.5	22042	22271.0		
4043	4209.5	6043	6314.25	8043	8398.0	12043	12586.5	16043	16775.0	22043	22271.5		
4044	4210.0	6044	6315.00	8044	8398.5	12044	12587.0	16044	16775.5	22044	22272.0		
4045	4210.5	6045	6315.75	8045	8399.0	12045	12587.5	16045	16776.0	22045	22272.5		
4046	4211.0	6046	6316.50	8046	8399.5	12046	12588.0	16046	16776.5	22046	22273.0		
4047	4211.5	6047	6317.25	8047	8400.0	12047	12588.5	16047	16777.0	22047	22273.5		
4048	4212.0	6048	6318.00	8048	8400.5	12048	12589.0	16048	16777.5	22048	22274.0		
4049	4212.5	6049	6318.75	8049	8401.0	12049	12589.5	16049	16778.0	22049	22274.5		
4050	4213.0	6050	6319.50	8050	8401.5	12050	12590.0	16050	16778.5	22050	22275.0		
4051	4213.5	6051	6320.25	8051	8402.0	12051	12590.5	16051	16779.0	22051	22275.5		
4052	4214.0	6052	6321.00	8052	8402.5	12052	12591.0	16052	16779.5	22052	22276.0		
4053	4214.5	6053	6321.75	8053	8403.0	12053	12591.5	16053	16780.0	22053	22276.5		
4054	4215.0	6054	6322.50	8054	8403.5	12054	12592.0	16054	16780.5	22054	22277.0		
4055	4215.5	6055	6323.25	8055	8404.0	12055	12592.5	16055	16781.0	22055	22277.5		
4056	4216.0	6056	6324.00	8056	8404.5	12056	12593.0	16056	16781.5	22056	22278.0		
4057	4216.5	6057	6324.75	8057	8405.0	12057	12593.5	16057	16782.0	22057	22278.5		
4058	4217.0	6058	6270.30	8058	8405.5	12058	12594.0	16058	16782.5	22058	22279.0		
4059	4217.5	6059	6270.90	8059	8406.0	12059	12594.5	16059	16783.0	22059	22279.5		
4060	4218.0	6060	6271.50	8060	8406.5	12060	12595.0	16060	16783.5	22060	22280.0		

4061	4218.5	6061	6272.10	8061	8407.0	12061	12595.5	16061	16784.0	22061	22280.5
4062	4219.0	6062	6272.70	8062	8407.5	12062	12596.0	16062	16784.5	22062	22281.0
4063	4180.2	6063	6273.30	8063	8408.0	12063	12596.5	16063	16785.0	22063	22281.5
4064	4180.6	6064	6273.90	8064	8408.5	12064	12597.0	16064	16785.5	22064	22282.0
4065	4181.0	6065	6274.50	8065	8409.0	12065	12597.5	16065	16786.0	22065	22282.5
4066	4181.4	6066	6275.10	8066	8409.5	12066	12598.0	16066	16786.5	22066	22283.0
4067	4181.8	6067	6275.70	8067	8410.0	12067	12598.5	16067	16787.0	22067	22283.5
4068	4182.2	6068	6276.30	8068	8410.5	12068	12599.0	16068	16787.5	22068	22284.0
4069	4182.6	6069	6276.90	8069	8411.0	12069	12599.5	16069	16788.0	22069	22284.5
4070	4183.0	6070	6277.50	8070	8411.5	12070	12600.0	16070	16788.5	22070	22285.0
4071	4183.4	6071	6278.10	8071	8412.0	12071	12600.5	16071	16789.0	22071	22285.5
4072	4183.8	6072	6278.70	8072	8412.5	12072	12601.0	16072	16789.5	22072	22286.0
4073	4184.2	6073	6279.30	8073	8413.0	12073	12601.5	16073	16790.0	22073	22286.5
4074	4184.6	6074	6279.90	8074	8413.5	12074	12602.0	16074	16790.5	22074	22287.0
4075	4185.0	6075	6280.50	8075	8414.0	12075	12602.5	16075	16791.0	22075	22287.5
4076	4185.4			8076	8414.5	12076	12603.0	16076	16791.5	22076	22288.0
4077	4185.8			8077	8415.0	12077	12603.5	16077	16792.0	22077	22288.5
4078	4186.2			8078	8415.5	12078	12604.0	16078	16792.5	22078	22289.0
4079	4186.6			8079	8416.0	12079	12604.5	16079	16793.0	22079	22289.5
4080	4187.0			8080	8416.5	12080	12605.0	16080	16793.5	22080	22290.0
				8081	8417.0	12081	12605.5	16081	16794.0	22081	22290.5
				8082	8417.5	12082	12606.0	16082	16794.5	22082	22291.0
				8083	8418.0	12083	12606.5	16083	16795.0	22083	22291.5
				8084	8418.5	12084	12607.0	16084	16795.5	22084	22292.0
				8085	8419.0	12085	12607.5	16085	16796.0	22085	22292.5
				8086	8419.5	12086	12608.0	16086	16796.5	22086	22293.0
				8087	8420.0	12087	12608.5	16087	16797.0	22087	22293.5
				8088	8420.5	12088	12609.0	16088	16797.5	22088	22294.0
				8089	8421.0	12089	12609.5	16089	16798.0	22089	22294.5
				8090	8421.5	12090	12610.0	16090	16798.5	22090	22295.0
				8091	8422.0	12091	12610.5	16091	16799.0	22091	22295.5
				8092	8422.5	12092	12611.0	16092	16799.5	22092	22296.0
				8093	8423.0	12093	12611.5	16093	16800.0	22093	22296.5
				8094	8423.5	12094	12612.0	16094	16800.5	22094	22297.0
				8095	8424.0	12095	12612.5	16095	16801.0	22095	22297.5
				8096	8424.5	12096	12613.0	16096	16801.5	22096	22298.0
				8097	8425.0	12097	12613.5	16097	16802.0	22097	22298.5
				8098	8425.5	12098	12614.0	16098	16802.5	22098	22299.0
				8099	8426.0	12099	12614.5	16099	16803.0	22099	22299.5
				8100	8426.5	12100	12615.0	16100	16803.5	22100	22300.0
				8101	8427.0	12101	12615.5	16101	16804.0	22101	22300.5
				8102	8427.5	12102	12616.0	16102	16804.5	22102	22301.0
				8103	8428.0	12103	12616.5	16103	16805.0	22103	22301.5
				8104	8428.5	12104	12617.0	16104	16805.5	22104	22302.0
				8105	8429.0	12105	12617.5	16105	16806.0	22105	22302.5
				8106	8429.5	12106	12618.0	16106	16806.5	22106	22303.0
				8107	8430.0	12107	12618.5	16107	16807.0	22107	22303.5
				8108	8430.5	12108	12619.0	16108	16807.5	22108	22304.0
				8109	8431.0	12109	12619.5	16109	16808.0	22109	22304.5
				8110	8431.5	12110	12620.0	16110	16808.5	22110	22305.0
				8111	8432.0	12111	12620.5	16111	16809.0	22111	22305.5
				8112	8432.5	12112	12621.0	16112	16809.5	22112	22306.0
				8113	8433.0	12113	12621.5	16113	16810.0	22113	22306.5
				8114	8433.5	12114	12622.0	16114	16810.5	22114	22307.0
				8115	8434.0	12115	12622.5	16115	16811.0	22115	22307.5
				8116	8434.5	12116	12623.0	16116	16811.5	22116	22308.0
				8117	8435.0	12117	12623.5	16117	16812.0	22117	22308.5
				8118	8360.4	12118	12624.0	16118	16812.5	22118	22309.0
				8119	8361.2	12119	12624.5	16119	16813.0	22119	22228.0
				8120	8362.0	12120	12625.0	16120	16813.5	22120	22230.0

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				8121	8362.8	12121	12625.5	16121	16814.0	22121	22232.0		
				8122	8363.6	12122	12626.0	16122	16814.5	22122	22234.0		
				8123	8364.4	12123	12626.5	16123	16815.0	22123	22236.0		
				8124	8365.2	12124	12627.0	16124	16815.5	22124	22238.0		
				8125	8366.0	12125	12627.5	16125	16816.0	22125	22240.0		
				8126	8366.8	12126	12628.0	16126	16816.5	22126	22242.0		
				8127	8367.6	12127	12628.5	16127	16817.0	22127	22244.0		
				8128	8368.4	12128	12629.0	16128	16817.5	22128	22246.0		
				8129	8369.2	12129	12629.5	16129	16818.0				
				8130	8370.0	12130	12630.0	16130	16818.5				
				8131	8370.8	12131	12630.5	16131	16819.0				
				8132	8371.6	12132	12631.0	16132	16819.5				
				8133	8372.4	12133	12631.5	16133	16820.0				
				8134	8373.2	12134	12632.0	16134	16820.5				
				8135	8374.0	12135	12632.5	16135	16821.0				
						12136	12633.0	16136	16821.5				
						12137	12633.5	16137	16822.0				
						12138	12634.0	16138	16822.5				
						12139	12634.5	16139	16823.0				
						12140	12635.0	16140	16823.5				
						12141	12635.5	16141	16824.0				
						12142	12636.0	16142	16824.5				
						12143	12636.5	16143	16825.0				
						12144	12637.0	16144	16825.5				
						12145	12637.5	16145	16826.0				
						12146	12638.0	16146	16826.5				
						12147	12638.5	16147	16827.0				
						12148	12639.0	16148	16827.5				
						12149	12639.5	16149	16828.0				
						12150	12640.0	16150	16828.5				
						12151	12640.5	16151	16829.0				
						12152	12641.0	16152	16829.5				
						12153	12641.5	16153	16830.0				
						12154	12642.0	16154	16830.5				
						12155	12642.5	16155	16831.0				
						12156	12643.0	16156	16831.5				
						12157	12643.5	16157	16832.0				
						12158	12644.0	16158	16832.5				
						12159	12644.5	16159	16833.0				
						12160	12645.0	16160	16833.5				
						12161	12645.5	16161	16834.0				
						12162	12646.0	16162	16834.5				
						12163	12646.5	16163	16835.0				
						12164	12647.0	16164	16835.5				
						12165	12647.5	16165	16836.0				
						12166	12648.0	16166	16836.5				
						12167	12648.5	16167	16837.0				
						12168	12649.0	16168	16837.5				
						12169	12649.5	16169	16838.0				
						12170	12650.0	16170	16838.5				
						12171	12650.5	16171	16839.0				
						12172	12651.0	16172	16839.5				
						12173	12540.6	16173	16840.0				
						12174	12541.8	16174	16840.5				
						12175	12543.0	16175	16841.0				
						12176	12544.2	16176	16841.5				
						12177	12545.4	16177	16842.0				
						12178	12546.6	16178	16842.5				
						12179	12547.8	16179	16843.0				
						12180	12549.0	16180	16843.5				

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						12181	12550.2	16181	16844.0				
						12182	12551.4	16182	16844.5				
						12183	12552.6	16183	16845.0				
						12184	12553.8	16184	16845.5				
						12185	12555.0	16185	16846.0				
						12186	12556.2	16186	16846.5				
						12187	12557.4	16187	16847.0				
						12188	12558.6	16188	16847.5				
						12189	12559.8	16189	16848.0				
						12190	12561.0	16190	16848.5				
								16191	16849.0				
								16192	16849.5				
								16193	16850.0				
								16194	16850.5				
								16195	16851.0				
								16196	16851.5				
								16197	16852.0				
								16198	16852.5				
								16199	16853.0				
								16200	16853.5				
								16201	16854.0				
								16202	16854.5				
								16203	16855.0				
								16204	16855.5				
								16205	16856.0				
								16206	16856.5				
								16207	16857.0				
								16208	16857.5				
								16209	16858.0				
								16210	16720.8				
								16211	16722.4				
								16212	16724.0				
								16213	16725.6				
								16214	16727.2				
								16215	16728.8				
								16216	16730.4				
								16217	16732.0				
								16218	16733.6				
								16219	16735.2				
								16220	16736.8				
								16221	16738.4				
								16222	16740.0				
								16223	16741.6				
								16224	16743.2				
								16225	16744.8				
								16226	16746.4				
								16227	16748.0				



**FURUNO** ITU TELEX FREQUENCY TABLE (effective from July 1, 1991, 1991年7月1日より発効)

4 MHz BAND			6 MHz BAND			8 MHz BAND			12 MHz BAND			16 MHz BAND			18/19 MHz BAND			22 MHz BAND			25/26 MHz BAND		
No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX	No.	TX	RX
4001	4172.5	4210.5	6001	6263.0	6314.5	8001	8376.5	8376.5	12001	12477.0	12579.5	16001	16683.5	16807.0	18001	18870.5	19681.0	22001	22284.5	22376.5	25001	25173.0	26101.0
4002	4173.0	4211.0	6002	6263.5	6315.0	8002	8377.0	8417.0	12002	12477.5	12580.0	16002	16684.0	16807.5	18002	18871.0	19681.5	22002	22285.0	22377.0	25002	25173.5	26101.5
4003	4173.5	4211.5	6003	6264.0	6315.5	8003	8377.5	8417.5	12003	12478.0	12580.5	16003	16684.5	16808.0	18003	18871.5	19682.0	22003	22285.5	22377.5	25003	25174.0	26102.0
4004	4174.0	4212.0	6004	6264.5	6316.0	8004	8378.0	8418.0	12004	12478.5	12581.0	16004	16685.0	16808.5	18004	18872.0	19682.5	22004	22286.0	22378.0	25004	25174.5	26102.5
4005	4174.5	4212.5	6005	6265.0	6316.5	8005	8378.5	8418.5	12005	12479.0	12581.5	16005	16685.5	16809.0	18005	18872.5	19683.0	22005	22286.5	22378.5	25005	25175.0	26103.0
4006	4175.0	4213.0	6006	6265.5	6317.0	8006	8379.0	8419.0	12006	12479.5	12582.0	16006	16686.0	16809.5	18006	18873.0	19683.5	22006	22287.0	22379.0	25006	25175.5	26103.5
4007	4175.5	4213.5	6007	6266.0	6317.5	8007	8379.5	8419.5	12007	12480.0	12582.5	16007	16686.5	16810.0	18007	18873.5	19684.0	22007	22287.5	22379.5	25007	25176.0	26104.0
4008	4176.0	4214.0	6008	6266.5	6318.0	8008	8380.0	8420.0	12008	12480.5	12583.0	16008	16687.0	16810.5	18008	18874.0	19684.5	22008	22288.0	22380.0	25008	25176.5	26104.5
4009	4176.5	4214.5	6009	6267.0	6318.5	8009	8380.5	8420.5	12009	12481.0	12583.5	16009	16687.5	16811.0	18009	18874.5	19685.0	22009	22288.5	22380.5	25009	25177.0	26105.0
4010	4177.0	4215.0	6010	6267.5	6319.0	8010	8381.0	8421.0	12010	12481.5	12584.0	16010	16688.0	16811.5	18010	18875.0	19685.5	22010	22289.0	22381.0	25010	25177.5	26105.5
4011	4177.5	4177.5	6011	6268.0	6268.0	8011	8381.5	8421.5	12011	12482.0	12584.5	16011	16688.5	16812.0	18011	18875.5	19686.0	22011	22289.5	22381.5	25011	25178.0	26106.0
4012	4178.0	4215.5	6012	6268.5	6319.5	8012	8382.0	8422.0	12012	12482.5	12585.0	16012	16689.0	16812.5	18012	18876.0	19686.5	22012	22290.0	22382.0	25012	25178.5	26106.5
4013	4178.5	4216.0	6013	6269.0	6320.0	8013	8382.5	8422.5	12013	12483.0	12585.5	16013	16689.5	16813.0	18013	18876.5	19687.0	22013	22290.5	22382.5	25013	25179.0	26107.0
4014	4179.0	4216.5	6014	6269.5	6320.5	8014	8383.0	8423.0	12014	12483.5	12586.0	16014	16690.0	16813.5	18014	18877.0	19687.5	22014	22291.0	22383.0	25014	25179.5	26107.5
4015	4179.5	4217.0	6015	6270.0	6321.0	8015	8383.5	8423.5	12015	12484.0	12586.5	16015	16690.5	16814.0	18015	18877.5	19688.0	22015	22291.5	22383.5	25015	25180.0	26108.0
4016	4180.0	4217.5	6016	6270.5	6321.5	8016	8384.0	8424.0	12016	12484.5	12587.0	16016	16691.0	16814.5	18016	18878.0	19688.5	22016	22292.0	22384.0	25016	25180.5	26108.5
4017	4180.5	4218.0	6017	6271.0	6322.0	8017	8384.5	8424.5	12017	12485.0	12587.5	16017	16691.5	16815.0	18017	18878.5	19689.0	22017	22292.5	22384.5	25017	25181.0	26109.0
4018	4181.0	4218.5	6018	6271.5	6322.5	8018	8385.0	8425.0	12018	12485.5	12588.0	16018	16692.0	16815.5	18018	18879.0	19689.5	22018	22293.0	22385.0	25018	25181.5	26109.5
4019	4181.5	4219.0	6019	6272.0	6323.0	8019	8385.5	8425.5	12019	12486.0	12588.5	16019	16692.5	16816.0	18019	18879.5	19690.0	22019	22293.5	22385.5	25019	25182.0	26110.0
4020	4202.5	4202.5	6020	6272.5	6323.5	8020	8386.0	8426.0	12020	12486.5	12589.0	16020	16693.0	16816.5	18020	18880.0	19690.5	22020	22294.0	22386.0	25020	25182.5	26110.5
4021	4203.0	4203.0	6021	6273.0	6324.0	8021	8386.5	8426.5	12021	12487.0	12589.5	16021	16693.5	16817.0	18021	18880.5	19691.0	22021	22294.5	22386.5	25021	25183.0	26111.0
4022	4203.5	4203.5	6022	6273.5	6324.5	8022	8387.0	8427.0	12022	12487.5	12590.0	16022	16694.0	16817.5	18022	18881.0	19691.5	22022	22295.0	22387.0	25022	25183.5	26111.5
4023	4204.0	4204.0	6023	6274.0	6325.0	8023	8387.5	8427.5	12023	12488.0	12590.5	16023	16694.5	16818.0	18023	18881.5	19692.0	22023	22295.5	22387.5	25023	25184.0	26112.0
4024	4204.5	4204.5	6024	6274.5	6325.5	8024	8388.0	8428.0	12024	12488.5	12591.0	16024	16695.0	16818.5	18024	18882.0	19692.5	22024	22296.0	22388.0	25024	25184.5	26112.5
4025	4205.0	4205.0	6025	6275.0	6326.0	8025	8388.5	8428.5	12025	12489.0	12591.5	16025	16695.5	16818.5	18025	18882.5	19693.0	22025	22296.5	22388.5	25025	25185.0	26113.0
4026	4205.5	4205.5	6026	6275.5	6326.5	8026	8389.0	8429.0	12026	12489.5	12592.0	16026	16696.0	16819.0	18026	18883.0	19693.5	22026	22297.0	22389.0	25026	25185.5	26113.5
4027	4206.0	4206.0	6027	6281.0	6327.0	8027	8389.5	8429.5	12027	12490.0	12592.5	16027	16696.5	16819.5	18027	18883.5	19694.0	22027	22297.5	22389.5	25027	25186.0	26114.0
4028	4206.5	4206.5	6028	6281.5	6327.5	8028	8390.0	8430.0	12028	12490.5	12593.0	16028	16697.0	16820.0	18028	18884.0	19694.5	22028	22298.0	22390.0	25028	25186.5	26114.5
4029	4207.0	4207.0	6029	6282.0	6328.0	8029	8390.5	8430.5	12029	12491.0	12593.5	16029	16697.5	16820.5	18029	18884.5	19695.0	22029	22298.5	22390.5	25029	25187.0	26115.0
4030	4207.5	4207.5	6030	6282.5	6328.5	8030	8391.0	8431.0	12030	12491.5	12594.0	16030	16698.0	16821.0	18030	18885.0	19695.5	22030	22299.0	22391.0	25030	25187.5	26115.5
4031	4208.0	4219.5	6031	6283.0	6329.0	8031	8391.5	8431.5	12031	12492.0	12594.5	16031	16698.5	16821.5	18031	18885.5	19696.0	22031	22299.5	22391.5	25031	25188.0	26116.0
4032	4208.5	4220.0	6032	6283.5	6329.5	8032	8392.0	8432.0	12032	12492.5	12595.0	16032	16699.0	16822.0	18032	18886.0	19696.5	22032	22300.0	22392.0	25032	25188.5	26116.5
4033	4209.0	4220.5	6033	6284.0	6330.0	8033	8392.5	8432.5	12033	12493.0	12595.5	16033	16699.5	16822.5	18033	18886.5	19697.0	22033	22300.5	22392.5	25033	25189.0	26117.0
			6034	6284.5	6330.5	8034	8393.0	8433.0	12034	12493.5	12596.0	16034	16700.0	16823.0	18034	18887.0	19697.5	22034	22301.0	22393.0	25034	25189.5	26117.5
			6035	6300.5	6300.5	8035	8393.5	8433.5	12035	12494.0	12596.5	16035	16700.5	16823.5	18035	18887.5	19698.0	22035	22301.5	22393.5	25035	25190.0	26118.0
			6036	6301.0	6301.0	8036	8394.0	8434.0	12036	12494.5	12597.0	16036	16701.0	16824.0	18036	18888.0	19698.5	22036	22302.0	22394.0	25036	25190.5	26118.5
			6037	6301.5	6301.5	8037	8394.5	8434.5	12037	12495.0	12597.5	16037	16701.5	16824.5	18037	18888.5	19699.0	22037	22302.5	22394.5	25037	25191.0	26119.0
			6038	6302.0	6302.0	8038	8395.0	8435.0	12038	12495.5	12598.0	16038	16702.0	16825.0	18038	18889.0	19699.5	22038	22303.0	22395.0	25038	25191.5	26119.5
			6039	6302.5	6302.5	8039	8395.5	8435.5	12039	12496.0	12598.5	16039	16702.5	16825.5	18039	18889.5	19700.0	22039	22303.5	22395.5	25039	25192.0	26120.0
			6040	6303.0	6303.0	8040	8396.0	8436.0	12040	12496.5	12599.0	16040	16703.0	16826.0	18040	18890.0	19700.5	22040	22304.0	22396.0	25040	25192.5	26120.5
			6041	6303.5	6303.5	8041	8396.5	8396.5	12041	12497.0	12599.5	16041	16703.5	16826.5	18041	18890.5	19701.0	22041	22304.5	22396.5	25041	25193.0	26121.0
			6042	6304.0	6304.0	8042	8397.0	8397.0	12042	12497.5	12600.0	16042	16704.0	16827.0	18042	18891.0	19701.5	22042	22305.0	22397.0	25042	25193.5	26121.5
			6043	6304.5	6304.5	8043	8397.5	8397.5	12043	12498.0	12600.5	16043	16704.5	16827.5	18043	18891.5	19702.0	22043	22305.5	22397.5	25043	25194.0	26122.0
			6044	6305.0	6305.0	8044	8398.0	8398.0	12044	12498.5	12601.0	16044	16705.0	16828.0	18044	18892.0	19702.5	22044	22306.0	22398.0	25044	25194.5	26122.5
			6045	6305.5	6305.5	8045	8398.5	8398.5	12045	12499.0	12601.5	16045	16705.5	16828.5	18045	18892.5	19703.0	22045	22306.5	22398.5	25045	25195.0	26123.0
			6046	6306.0	6306.0	8046	8399.0	8399.0	12046	12499.5	12602.0	16046	16706.0	16829.0	1804								

			6056	6311.0	6311.0	8056	8404.0	8404.0	12056	12504.5	12607.0	16056	16711.0	16834.0	18056	18898.0	18898.0	22056	22312.0	22404.0	25056	25200.5	25200.5
			6057	6311.5	6311.5	8057	8404.5	8404.5	12057	12505.0	12607.5	16057	16711.5	16834.5	18057	18898.5	19703.5	22057	22312.5	22404.5	25057	25201.0	25201.0
			6058	6312.0	6312.0	8058	8405.0	8405.0	12058	12505.5	12608.0	16058	16712.0	16835.0	18058	18899.0	19704.0	22058	22313.0	22405.0	25058	25201.5	25201.5
			6059	6312.5	6331.0	8059	8405.5	8405.5	12059	12506.0	12608.5	16059	16712.5	16835.5	18059	18899.5	19704.5	22059	22313.5	22405.5	25059	25202.0	25202.0
			6060	6313.0	6331.5	8060	8406.0	8406.0	12060	12506.5	12609.0	16060	16713.0	16836.0				22060	22314.0	22406.0	25060	25202.5	25202.5
			6061	6313.5	6332.0	8061	8406.5	8406.5	12061	12507.0	12609.5	16061	16713.5	16836.5				22061	22314.5	22406.5	25061	25203.0	25203.0
						8062	8407.0	8407.0	12062	12507.5	12610.0	16062	16714.0	16837.0				22062	22315.0	22407.0	25062	25203.5	25203.5
						8063	8407.5	8407.5	12063	12508.0	12610.5	16063	16714.5	16837.5				22063	22315.5	22407.5	25063	25204.0	25204.0
						8064	8408.0	8408.0	12064	12508.5	12611.0	16064	16715.0	16838.0				22064	22316.0	22408.0	25064	25204.5	25204.5
						8065	8408.5	8408.5	12065	12509.0	12611.5	16065	16715.5	16838.5				22065	22316.5	22408.5	25065	25205.0	25205.0
						8066	8409.0	8409.0	12066	12509.5	12612.0	16066	16716.0	16839.0				22066	22317.0	22409.0	25066	25205.5	25205.5
						8067	8409.5	8409.5	12067	12510.0	12612.5	16067	16716.5	16839.5				22067	22317.5	22409.5	25067	25206.0	25206.0
						8068	8410.0	8410.0	12068	12510.5	12613.0	16068	16717.0	16840.0				22068	22318.0	22410.0	25068	25206.5	25206.5
						8069	8410.5	8410.5	12069	12511.0	12613.5	16069	16717.5	16840.5				22069	22318.5	22410.5	25069	25207.0	25207.0
						8070	8411.0	8411.0	12070	12511.5	12614.0	16070	16718.0	16841.0				22070	22319.0	22411.0	25070	25207.5	25207.5
						8071	8411.5	8411.5	12071	12512.0	12614.5	16071	16718.5	16841.5				22071	22319.5	22411.5	25071	25208.0	25208.0
						8072	8412.0	8412.0	12072	12512.5	12615.0	16072	16719.0	16842.0				22072	22320.0	22412.0	25072	25208.5	26121.0
						8073	8412.5	8412.5	12073	12513.0	12615.5	16073	16719.5	16842.5				22073	22320.5	22412.5	25073	25209.0	26121.5
						8074	8413.0	8413.0	12074	12513.5	12616.0	16074	16720.0	16843.0				22074	22321.0	22413.0	25074	25209.5	26122.0
						8075	8413.5	8413.5	12075	12514.0	12616.5	16075	16720.5	16843.5				22075	22321.5	22413.5			
						8076	8414.0	8414.0	12076	12514.5	12617.0	16076	16721.0	16844.0				22076	22322.0	22414.0			
						8077	8414.5	8414.5	12077	12515.0	12617.5	16077	16721.5	16844.5				22077	22322.5	22414.5			
						8078	8415.0	8436.5	12078	12515.5	12618.0	16078	16722.0	16845.0				22078	22323.0	22415.0			
						8079	8415.5	8437.0	12079	12516.0	12618.5	16079	16722.5	16845.5				22079	22323.5	22415.5			
						8080	8416.0	8437.5	12080	12516.5	12619.0	16080	16723.0	16846.0				22080	22324.0	22416.0			
									12081	12517.0	12619.5	16081	16723.5	16846.5				22081	22324.5	22416.5			
									12082	12517.5	12620.0	16082	16724.0	16847.0				22082	22325.0	22417.0			
									12083	12518.0	12620.5	16083	16724.5	16847.5				22083	22325.5	22417.5			
									12084	12518.5	12621.0	16084	16725.0	16848.0				22084	22326.0	22418.0			
									12085	12519.0	12621.5	16085	16725.5	16848.5				22085	22326.5	22418.5			
									12086	12519.5	12622.0	16086	16726.0	16849.0				22086	22327.0	22419.0			
									12087	12520.0	12622.5	16087	16726.5	16849.5				22087	22327.5	22419.5			
									12088	12520.5	12623.0	16088	16727.0	16850.0				22088	22328.0	22420.0			
									12089	12521.0	12623.5	16089	16727.5	16850.5				22089	22328.5	22420.5			
									12090	12521.5	12624.0	16090	16728.0	16851.0				22090	22329.0	22421.0			
									12091	12522.0	12624.5	16091	16728.5	16851.5				22091	22329.5	22421.5			
									12092	12522.5	12625.0	16092	16729.0	16852.0				22092	22330.0	22422.0			
									12093	12523.0	12625.5	16093	16729.5	16852.5				22093	22330.5	22422.5			
									12094	12523.5	12626.0	16094	16730.0	16853.0				22094	22331.0	22423.0			
									12095	12524.0	12626.5	16095	16730.5	16853.5				22095	22331.5	22423.5			
									12096	12524.5	12627.0	16096	16731.0	16854.0				22096	22332.0	22424.0			
									12097	12525.0	12627.5	16097	16731.5	16854.5				22097	22332.5	22424.5			
									12098	12525.5	12628.0	16098	16732.0	16855.0				22098	22333.0	22425.0			
									12099	12526.0	12628.5	16099	16732.5	16855.5				22099	22333.5	22425.5			
									12100	12526.5	12629.0	16100	16733.0	16856.0				22100	22334.0	22426.0			
									12101	12527.0	12629.5	16101	16733.5	16856.5				22101	22334.5	22426.5			
									12102	12527.5	12630.0	16102	16734.0	16857.0				22102	22335.0	22427.0			
									12103	12528.0	12630.5	16103	16734.5	16857.5				22103	22335.5	22427.5			
									12104	12528.5	12631.0	16104	16735.0	16858.0				22104	22336.0	22428.0			
									12105	12529.0	12631.5	16105	16735.5	16858.5				22105	22336.5	22428.5			
									12106	12529.5	12632.0	16106	16736.0	16859.0				22106	22337.0	22429.0			
									12107	12530.0	12632.5	16107	16736.5	16859.5				22107	22337.5	22429.5			
									12108	12530.5	12633.0	16108	16737.0	16860.0				22108	22338.0	22430.0			
									12109	12531.0	12633.5	16109	16737.5	16860.5				22109	22338.5	22430.5			
									12110	12531.5	12634.0	16110	16738.0	16861.0				22110	22339.0	22431.0			
									12111	12532.0	12634.5	16111	16738.5	16861.5				22111	22339.5	22431.5			
									12112	12532.5	12635.0	16112	16739.0	16862.0				22112	22340.0	22432.0			
									12113	12533.0	12635.5	16113	16739.5	16862.5				22113	22340.5	22432.5			
									12114	12533.5	12636.0	16114	16740.0	16863.0				22114	22341.0	22433.0			
									12115	12534.0	12636.5	16115	16740.5	16863.5				22115	22341.5	22433.5			

								12116	12534.5	12636.5	16116	16746.0	16864.0				22116	22342.0	22434.0				
								12117	12535.0	12637.0	16117	16746.5	16864.5				22117	22342.5	22434.5				
								12118	12535.5	12637.5	16118	16747.0	16865.0				22118	22343.0	22435.0				
								12119	12536.0	12638.0	16119	16747.5	16865.5				22119	22343.5	22435.5				
								12120	12536.5	12638.5	16120	16748.0	16866.0				22120	22344.0	22436.0				
								12121	12537.0	12639.0	16121	16748.5	16866.5				22121	22344.5	22436.5				
								12122	12537.5	12639.5	16122	16749.0	16867.0				22122	22345.0	22437.0				
								12123	12538.0	12640.0	16123	16749.5	16867.5				22123	22345.5	22437.5				
								12124	12538.5	12640.5	16124	16750.0	16868.0				22124	22346.0	22438.0				
								12125	12539.0	12641.0	16125	16750.5	16868.5				22125	22346.5	22438.5				
								12126	12539.5	12641.5	16126	16751.0	16869.0				22126	22347.0	22439.0				
								12127	12540.0	12642.0	16127	16751.5	16869.5				22127	22347.5	22439.5				
								12128	12540.5	12642.5	16128	16752.0	16870.0				22128	22348.0	22440.0				
								12129	12541.0	12643.0	16129	16752.5	16870.5				22129	22348.5	22440.5				
								12130	12541.5	12643.5	16130	16753.0	16871.0				22130	22349.0	22441.0				
								12131	12542.0	12644.0	16131	16753.5	16871.5				22131	22349.5	22441.5				
								12132	12542.5	12644.5	16132	16754.0	16872.0				22132	22350.0	22442.0				
								12133	12543.0	12645.0	16133	16754.5	16872.5				22133	22350.5	22442.5				
								12134	12543.5	12645.5	16134	16755.0	16873.0				22134	22351.0	22443.0				
								12135	12544.0	12646.0	16135	16755.5	16873.5				22135	22351.5	22443.5				
								12136	12544.5	12646.5	16136	16756.0	16874.0				22136	22352.0	22352.0				
								12137	12545.0	12647.0	16137	16756.5	16874.5				22137	22352.5	22352.5				
								12138	12545.5	12647.5	16138	16757.0	16875.0				22138	22353.0	22353.0				
								12139	12546.0	12648.0	16139	16757.5	16875.5				22139	22353.5	22353.5				
								12140	12546.5	12648.5	16140	16758.0	16876.0				22140	22354.0	22354.0				
								12141	12547.0	12649.0	16141	16758.5	16876.5				22141	22354.5	22354.5				
								12142	12547.5	12649.5	16142	16759.0	16877.0				22142	22355.0	22355.0				
								12143	12548.0	12650.0	16143	16759.5	16877.5				22143	22355.5	22355.5				
								12144	12548.5	12650.5	16144	16760.0	16878.0				22144	22356.0	22356.0				
								12145	12549.0	12651.0	16145	16760.5	16878.5				22145	22356.5	22356.5				
								12146	12549.5	12651.5	16146	16761.0	16879.0				22146	22357.0	22357.0				
								12147	12550.0	12652.0	16147	16761.5	16879.5				22147	22357.5	22357.5				
								12148	12550.5	12652.5	16148	16762.0	16880.0				22148	22358.0	22358.0				
								12149	12551.0	12653.0	16149	16762.5	16880.5				22149	22358.5	22358.5				
								12150	12551.5	12653.5	16150	16763.0	16881.0				22150	22359.0	22359.0				
								12151	12552.0	12654.0	16151	16763.5	16881.5				22151	22359.5	22359.5				
								12152	12552.5	12654.5	16152	16764.0	16882.0				22152	22360.0	22360.0				
								12153	12553.0	12655.0	16153	16764.5	16882.5				22153	22360.5	22360.5				
								12154	12553.5	12655.5	16154	16765.0	16883.0				22154	22361.0	22361.0				
								12155	12554.0	12656.0	16155	16765.5	16883.5				22155	22361.5	22361.5				
								12156	12554.5	12656.5	16156	16766.0	16884.0				22156	22362.0	22362.0				
								12157	12555.0	12657.0	16157	16766.5	16884.5				22157	22362.5	22362.5				
								12158	12555.5	12657.5	16158	16767.0	16885.0				22158	22363.0	22363.0				
								12159	12556.0	12658.0	16159	16767.5	16885.5				22159	22363.5	22363.5				
								12160	12556.5	12658.5	16160	16768.0	16886.0				22160	22364.0	22364.0				
								12161	12557.0	12659.0	16161	16768.5	16886.5				22161	22364.5	22364.5				
								12162	12557.5	12659.5	16162	16769.0	16887.0				22162	22365.0	22365.0				
								12163	12558.0	12660.0	16163	16769.5	16887.5				22163	22365.5	22365.5				
								12164	12558.5	12660.5	16164	16770.0	16888.0				22164	22366.0	22366.0				
								12165	12559.0	12661.0	16165	16770.5	16888.5				22165	22366.5	22366.5				
								12166	12559.5	12661.5	16166	16771.0	16889.0				22166	22367.0	22367.0				
								12167	12560.0	12662.0	16167	16771.5	16889.5				22167	22367.5	22367.5				
								12168	12560.5	12662.5	16168	16772.0	16890.0				22168	22368.0	22368.0				
								12169	12561.0	12663.0	16169	16772.5	16890.5				22169	22368.5	22368.5				
								12170	12561.5	12663.5	16170	16773.0	16891.0				22170	22369.0	22369.0				
								12171	12562.0	12664.0	16171	16773.5	16891.5				22171	22369.5	22369.5				
								12172	12562.5	12664.5	16172	16774.0	16892.0				22172	22370.0	22370.0				
								12173	12563.0	12665.0	16173	16774.5	16892.5				22173	22370.5	22370.5				
								12174	12563.5	12665.5	16174	16775.0	16893.0				22174	22371.0	22371.0				
								12175	12564.0	12666.0	16175	16775.5	16893.5				22175	22371.5	22371.5				

									12176	12569.5	12569.5	16176	16776.0	16894.0					22176	22372.0	22372.0			
									12177	12570.0	12570.0	16177	16776.5	16894.5					22177	22372.5	22372.5			
									12178	12570.5	12570.5	16178	16777.0	16895.0					22178	22373.0	22373.0			
									12179	12571.0	12571.0	16179	16777.5	16895.5					22179	22373.5	22373.5			
									12180	12571.5	12571.5	16180	16778.0	16896.0					22180	22374.0	22374.0			
									12181	12572.0	12572.0	16181	16778.5	16896.5					22181	22374.5	22444.0			
									12182	12572.5	12572.5	16182	16779.0	16897.0					22182	22375.0	22444.5			
									12183	12573.0	12573.0	16183	16779.5	16897.5					22183	22375.5	22445.0			
									12184	12573.5	12573.5	16184	16780.0	16898.0										
									12185	12574.0	12574.0	16185	16780.5	16898.5										
									12186	12574.5	12574.5	16186	16781.0	16899.0										
									12187	12575.0	12575.0	16187	16781.5	16899.5										
									12188	12575.5	12575.5	16188	16782.0	16900.0										
									12189	12576.0	12576.0	16189	16782.5	16900.5										
									12190	12576.5	12576.5	16190	16783.0	16901.0										
									12191	12577.0	12577.0	16191	16783.5	16901.5										
									12192	12577.5	12657.0	16192	16784.0	16902.0										
									12193	12578.0	12657.5	16193	16784.5	16902.5										
									12194	12578.5	12658.0	16194	16785.0	16785.0										
												16195	16785.5	16785.5										
												16196	16786.0	16786.0										
												16197	16786.5	16786.5										
												16198	16787.0	16787.0										
												16199	16787.5	16787.5										
												16200	16788.0	16788.0										
												16201	16788.5	16788.5										
												16202	16789.0	16789.0										
												16203	16789.5	16789.5										
												16204	16790.0	16790.0										
												16205	16790.5	16790.5										
												16206	16791.0	16791.0										
												16207	16791.5	16791.5										
												16208	16792.0	16792.0										
												16209	16792.5	16792.5										
												16210	16793.0	16793.0										
												16211	16793.5	16793.5										
												16212	16794.0	16794.0										
												16213	16794.5	16794.5										
												16214	16795.0	16795.0										
												16215	16795.5	16795.5										
												16216	16796.0	16796.0										
												16217	16796.5	16796.5										
												16218	16797.0	16797.0										
												16219	16797.5	16797.5										
												16220	16798.0	16798.0										
												16221	16798.5	16798.5										
												16222	16799.0	16799.0										
												16223	16799.5	16799.5										
												16224	16800.0	16800.0										
												16225	16800.5	16800.5										
												16226	16801.0	16801.0										
												16227	16801.5	16801.5										
												16228	16802.0	16802.0										
												16229	16802.5	16802.5										
												16230	16803.0	16803.0										
												16231	16803.5	16803.5										
												16232	16804.0	16804.0										
												16233	16804.5	16804.5										
												16234	16805.0	16903.0										
												16235	16805.5	16903.5										
												16236	16806.0	16904.0										

**FURUNO** ITU CW FREQUENCY TABLE (effective from July 1, 1991, 1991年7月1日より発効)

No.	4 MHz	No.	6 MHz	No.	8 MHz	No.	12 MHz	No.	16 MHz	No.	22 MHz	No.	25/26 MHz
4001	4187.0	6001	6285.0	8001	8342.0	12001	12422.0	16001	16619.0	22001	22242.0	25001	25161.5
4002	4187.5	6002	6285.5	8002	8342.5	12002	12422.5	16002	16619.5	22002	22242.5	25002	25162.0
4003	4188.0	6003	6286.0	8003	8343.0	12003	12423.0	16003	16620.0	22003	22243.0	25003	25162.5
4004	4188.5	6004	6286.5	8004	8343.5	12004	12423.5	16004	16620.5	22004	22243.5	25004	25163.0
4005	4189.0	6005	6287.0	8005	8344.0	12005	12424.0	16005	16621.0	22005	22244.0	25005	25163.5
4006	4189.5	6006	6287.5	8006	8344.5	12006	12424.5	16006	16621.5	22006	22244.5	25006	25164.0
4007	4190.0	6007	6288.0	8007	8345.0	12007	12425.0	16007	16622.0	22007	22245.0	25007	25164.5
4008	4190.5	6008	6288.5	8008	8345.5	12008	12425.5	16008	16622.5	22008	22245.5	25008	25165.0
4009	4191.0	6009	6289.0	8009	8346.0	12009	12426.0	16009	16623.0	22009	22246.0	25009	25165.5
4010	4191.5	6010	6289.5	8010	8346.5	12010	12426.5	16010	16623.5	22010	22246.5	25010	25166.0
4011	4192.0	6011	6290.0	8011	8347.0	12011	12427.0	16011	16624.0	22011	22247.0	25011	25166.5
4012	4192.5	6012	6290.5	8012	8347.5	12012	12427.5	16012	16624.5	22012	22247.5	25012	25167.0
4013	4193.0	6013	6291.0	8013	8348.0	12013	12428.0	16013	16625.0	22013	22248.0	25013	25167.5
4014	4193.5	6014	6291.5	8014	8348.5	12014	12428.5	16014	16625.5	22014	22248.5	25014	25168.0
4015	4194.0	6015	6292.0	8015	8349.0	12015	12429.0	16015	16626.0	22015	22249.0	25015	25168.5
4016	4194.5	6016	6292.5	8016	8349.5	12016	12429.5	16016	16626.5	22016	22249.5	25016	25169.0
4017	4195.0	6017	6293.0	8017	8350.0	12017	12430.0	16017	16627.0	22017	22250.0	25017	25169.5
4018	4195.5	6018	6293.5	8018	8350.5	12018	12430.5	16018	16627.5	22018	22250.5	25018	25170.0
4019	4196.0	6019	6294.0	8019	8351.0	12019	12431.0	16019	16628.0	22019	22251.0	25019	25170.5
4020	4196.5	6020	6294.5	8020	8351.5	12020	12431.5	16020	16628.5	22020	22251.5	25020	25171.0
4021	4197.0	6021	6295.0	8021	8352.0	12021	12432.0	16021	16629.0	22021	22252.0	*25021	25171.5
4022	4197.5	6022	6295.5	8022	8352.5	12022	12432.5	16022	16629.5	22022	22252.5	*25022	25172.0
4023	4198.0	6023	6296.0	8023	8353.0	12023	12433.0	16023	16630.0	22023	22253.0	*25023	25172.5
4024	4198.5	6024	6296.5	8024	8353.5	12024	12433.5	16024	16630.5	22024	22253.5		
4025	4199.0	6025	6297.0	8025	8354.0	12025	12434.0	16025	16631.0	22025	22254.0		
4026	4199.5	6026	6297.5	8026	8354.5	12026	12434.5	16026	16631.5	22026	22254.5		
4027	4200.0	6027	6298.0	8027	8355.0	12027	12435.0	16027	16632.0	22027	22255.0		
4028	4200.5	6028	6298.5	8028	8355.5	12028	12435.5	16028	16632.5	22028	22255.5		
4029	4201.0	6029	6299.0	8029	8356.0	12029	12436.0	16029	16633.0	22029	22256.0		
4030	4201.5	6030	6299.5	8030	8356.5	12030	12436.5	16030	16633.5	22030	22256.5		
4031	4202.0	6031	6300.0	8031	8357.0	12031	12437.0	16031	16634.0	22031	22257.0		
*4032	4182.0	*6032	6276.0	8032	8357.5	12032	12437.5	16032	16634.5	22032	22257.5		
*4033	4182.5	*6033	6276.5	8033	8358.0	12033	12438.0	16033	16635.0	22033	22258.0		
*4034	4183.0	*6034	6277.0	8034	8358.5	12034	12438.5	16034	16635.5	22034	22258.5		
*4035	4183.5	*6035	6277.5	8035	8359.0	12035	12439.0	16035	16636.0	22035	22259.0		
*4036	4184.0	*6036	6278.0	8036	8359.5	12036	12439.5	16036	16636.5	22036	22259.5		
*4037	4184.5	*6037	6278.5	8037	8360.0	12037	12440.0	16037	16637.0	22037	22260.0		
*4038	4185.0	*6038	6279.0	8038	8360.5	12038	12440.5	16038	16637.5	22038	22260.5		
*4039	4185.5	*6039	6279.5	8039	8361.0	12039	12441.0	16039	16638.0	22039	22261.0		
*4040	4186.0	*6040	6280.0	8040	8361.5	12040	12441.5	16040	16638.5	22040	22261.5		
*4041	4186.5	*6041	6280.5	8041	8362.0	12041	12442.0	16041	16639.0	22041	22262.0		
				8042	8362.5	12042	12442.5	16042	16639.5	22042	22262.5		
				8043	8363.0	12043	12443.0	16043	16640.0	22043	22263.0		
				8044	8363.5	12044	12443.5	16044	16640.5	22044	22263.5		
				8045	8364.0	12045	12444.0	16045	16641.0	22045	22264.0		
				8046	8364.5	12046	12444.5	16046	16641.5	22046	22264.5		
				8047	8365.0	12047	12445.0	16047	16642.0	22047	22265.0		
				8048	8365.5	12048	12445.5	16048	16642.5	22048	22265.5		
				8049	8371.0	12049	12446.0	16049	16643.0	22049	22266.0		
				8050	8371.5	12050	12446.5	16050	16643.5	22050	22266.5		
				8051	8372.0	12051	12447.0	16051	16644.0	22051	22267.0		
				8052	8372.5	12052	12447.5	16052	16644.5	22052	22267.5		
				8053	8373.0	12053	12448.0	16053	16645.0	22053	22268.0		
				8054	8373.5	12054	12448.5	16054	16645.5	22054	22268.5		
				8055	8374.0	12055	12449.0	16055	16646.0	22055	22269.0		
				8056	8374.5	12056	12449.5	16056	16646.5	22056	22269.5		
				8057	8375.0	12057	12450.0	16057	16647.0	22057	22270.0		
				8058	8375.5	12058	12450.5	16058	16647.5	22058	22270.5		
				8059	8376.0	12059	12451.0	16059	16648.0	22059	22271.0		
				*8060	8366.0	12060	12451.5	16060	16648.5	22060	22271.5		

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				*8061	8366.5	12061	12452.0	16061	16649.0	22061	22272.0		
				*8062	8367.0	12062	12452.5	16062	16649.5	22062	22272.5		
				*8063	8367.5	12063	12453.0	16063	16650.0	22063	22273.0		
				*8064	8368.0	12064	12453.5	16064	16650.5	22064	22273.5		
				*8065	8368.5	12065	12454.0	16065	16651.0	22065	22274.0		
				*8066	8369.0	12066	12454.5	16066	16651.5	22066	22274.5		
				*8067	8369.5	12067	12455.0	16067	16652.0	22067	22275.0		
				*8068	8370.0	12068	12455.5	16068	16652.5	22068	22275.5		
				*8069	8370.5	12069	12456.0	16069	16653.0	22069	22276.0		
						12070	12456.5	16070	16653.5	22070	22276.5		
						12071	12457.0	16071	16654.0	22071	22277.0		
						12072	12457.5	16072	16654.5	22072	22277.5		
						12073	12458.0	16073	16655.0	22073	22278.0		
						12074	12458.5	16074	16655.5	22074	22278.5		
						12075	12459.0	16075	16656.0	22075	22279.0		
						12076	12459.5	16076	16656.5	*22076	22279.5		
						12077	12460.0	16077	16657.0	*22077	22280.0		
						12078	12460.5	16078	16657.5	*22078	22280.5		
						12079	12461.0	16079	16658.0	*22079	22281.0		
						12080	12461.5	16080	16658.5	*22080	22281.5		
						12081	12462.0	16081	16659.0	*22081	22282.0		
						12082	12462.5	16082	16659.5	*22082	22282.5		
						12083	12463.0	16083	16660.0	*22083	22283.0		
						12084	12463.5	16084	16660.5	*22084	22283.5		
						12085	12464.0	16085	16661.0	*22085	22284.0		
						12086	12464.5	16086	16661.5				
						12087	12465.0	16087	16662.0				
						12088	12465.5	16088	16662.5				
						12089	12466.0	16089	16663.0				
						12090	12466.5	16090	16663.5				
						12091	12467.0	16091	16664.0				
						12092	12467.5	16092	16664.5				
						12093	12468.0	16093	16665.0				
						12094	12468.5	16094	16665.5				
						12095	12469.0	16095	16666.0				
						12096	12469.5	16096	16666.5				
						12097	12470.0	16097	16667.0				
						12098	12470.5	16098	16667.5				
						12099	12471.0	16099	16668.0				
						12100	12471.5	16100	16668.5				
						12101	12472.0	16101	16669.0				
						12102	12472.5	16102	16669.5				
						12103	12473.0	16103	16670.0				
						12104	12473.5	16104	16670.5				
						12105	12474.0	16105	16671.0				
						12106	12474.5	16106	16671.5				
						12107	12475.0	16107	16672.0				
						12108	12475.5	16108	16672.5				
						12109	12476.0	16109	16673.0				
						12110	12476.5	16110	16673.5				
						*12111	12550.0	16111	16674.0				
						*12112	12550.5	16112	16674.5				
						*12113	12551.0	16113	16675.0				
						*12114	12551.5	16114	16675.5				
						*12115	12552.0	16115	16676.0				
						*12116	12552.5	16116	16676.5				
						*12117	12553.0	16117	16677.0				
						*12118	12553.5	16118	16677.5				
						*12119	12554.0	16119	16678.0				
						*12120	12554.5	16120	16678.5				

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								16121	16679.0				
								16122	16679.5				
								16123	16680.0				
								16124	16680.5				
								16125	16681.0				
								16126	16681.5				
								16127	16682.0				
								16128	16682.5				
								16129	16683.0				
								*16130	16734.0				
								*16131	16734.5				
								*16132	16735.0				
								*16133	16735.5				
								*16134	16736.0				
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								*16136	16737.0				
								*16137	16737.5				
								*16138	16738.0				
								*16139	16738.5				