

# 8122

## Power Tube

### Linear Beam Power Tube

Coaxial-Electrode Structure

Ceramic Metal Seals

Full Ratings up to 500 MHz

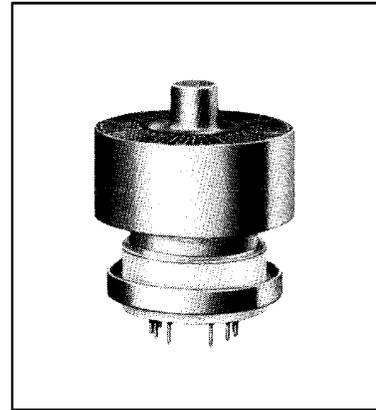
Forced-Air Cooled

380 Watts PEP Output at 30 MHz AB<sub>1</sub>

570 Watts PEP Output at 30 MHz AB<sub>2</sub>

300 Watts CW Output at 470 MHz

Matched Pair Available



BURLE-8122 is a very small, low-cost, forced-air-cooled beam power tube designed for use as an RF power amplifier, oscillator, regulator, distributed amplifier, or linear RF power amplifier in mobile or fixed equipment.

The 8122 features a light-weight, cantilever-supported cylindrical electrode structure within a ceramic-metal envelope. This construction provides a very sturdy tube and permits high-temperature operation.

The terminal arrangement of the 8122 facilitates use of the tube with tank circuits of the coaxial or stripline type. Effective isolation of the output circuit from the input circuit is provided at the higher frequencies by the low-inductance ring terminal for grid-No. 2. A base-pin termination for grid-No. 2 is also available for operation of the 8122 at the lower frequencies.

The tripod arrangement of both the cathode and the grid-No. 1 leads not only simplifies construction, but enhances electrical characteristics. The three cathode leads reduce the inductance path to RF ground and reduce the input admittance at high frequencies.

**This data sheet gives application information unique to the BURLE 8122. It is to be used in conjunction with the publication, "Application Guide for BURLE Power Tubes, TP-105", for general application information.**

The three grid-No.1 leads to separate pins accommodate a split-input circuit for distributed amplifier service.

The BURLE 8122/V1 is the designation for a matched pair of Type 8122 Beam Power Tubes for use in equipments not having individual bias adjustment. This pair is matched to assure balanced operation within a bias range of 28 to 40 volts, so that each tube will have an approximately equal anode current during zero-signal and signal operation. Such matching also assures efficient, full system operation and gives optimum life expectancy.

### General Data

#### Electrical:

Heater, for Unipotential Cathode:

Voltage (AC or DC) <sup>1</sup>	13.5 ± 10% volts
Current at 13.5 volts	1.3 A
Minimum heating time	60 s

Mu-Factor, Grid No. 2 to Grid No. 1

for Anode Volts = 450, Grid-No. 2

Volts = 325, and Anode Amperes = 1.2 12

Direct Interelectrode Capacitances:<sup>2</sup>

Grid No. to anode.....	0.15	max.	pF
Grid No. 1 to cathode.....	16.3		pF
Anode to cathode.....	0.01		pF
Grid No. 1 to grid No 2.....	23.3		pF
Grid No. 2 to anode.....	7.0		pF
Grid No. 2 to cathode.....	2.7		pF
Cathode to heater.....	3.3		pF



**Mechanical:**

Operating Position.....	Any
Maximum Overall Length.....	2.26"
Seated Length.....	1.920" ± 0.065"
Greatest Diameter.....	1.625" ± 0.015"
Base.....	Large-Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)
Socket.....	Jettron <sup>c</sup> No. CD77-030, Johnson <sup>a</sup> No. 124-311-100, Erie <sup>b</sup> No. 9813-000, or equivalent
Grid No.2 Bypass Capacitor.....	Johnson <sup>a</sup> No. 124-0113-001, Erie <sup>b</sup> No. 9812-000, or equivalent
Weight (Approx.).....	3.5 oz

**Thermal:**

Terminal Temperature (All terminals).....	250	max	°C
Radiator Core Temperature (See Dimensional Outline).....	250	max	°C
Air Flow:			

See **Figure 1** - Typical Cooling Requirements

**Linear RF Power Amplifier**

**Single-Sideband Suppressed-Carrier Service**

Peak envelope conditions for a signal having a minimum peak-to-average power ratio of 2

**Maximum CCS Ratings, Absolute-Maximum Values:**

DC Anode Voltage			
Up to 30 MHz.....	3000 <sup>4</sup>	volts	
Up to 500 MHz.....	2200	volts	
	<b>Up to 500 MHz</b>		
DC Grid-No. 2 Voltage.....	400	volts	
DC Grid-No. 1 Voltage.....	-100	volts	
DC Anode Current at Peak Of Envelope.....	450 <sup>5</sup>	mA	
DC Grid-No. 1 Current.....	100	mA	
Anode Dissipation.....	400	watts	
Grid-No. 2 Dissipation.....	8	watts	
Peak Heater-Cathode Voltage			
Heater negative with respect to cathode.....	150	volts	
Heater positive with respect to cathode.....	150	volts	

**Maximum Circuit Values:**

Grid No. 1 Circuit Resistance Under Any Condition: <sup>9</sup>			
With fixed bias.....	25,000	ohms	
With fixed bias (In Class AB <sub>1</sub> operation With cathode bias.....)	100,000	ohms	Not recommended
Grid-No. 2 Circuit Impedance <sup>8</sup> .....	10,000	ohms	
Anode Circuit Impedance.....	See Notes 4 and 6		

Typical CCS Operation at 30 MHz with "Two-Tone Modulation":

	AB <sub>1</sub>	AB <sub>2</sub>	
DC Anode Voltage.....	2000	2500	volts
DC Grid-No. 2 Voltage.....	400	400	volts
DC Grid-No. 1 Voltage.....	-35	-35	volts
Zero-Signal DC Anode Current	100	115	mA
Effective RE Load Resistance..	3050	3500	ohms

a. E. F. Johnson Co., 299 Johnson Ave., Waseca, MN 56093.  
b. Erie Specialty Products, 645W. 11th St., Erie, PA 16512.  
c. Jettron Products, Inc., 56 Route 10, Hanover, NJ 07936

DC Anode Current at Peak of Envelope.....	335	400	mA
Average DC Anode Current.....	250	275	mA
DC Grid-No. 2 Current at Peak of Envelope.....	10	6	mA
Average DC Grid-No 2 Current.....	7	4	mA
DC Grid-No. 1 Current at Peak of Envelope.....	0.05 <sup>7</sup>	3	mA
Peak-Envelope Driver Power Output (Approx.).....	0.3	0.5	watt
Output-Circuit Efficiency (Approx.)..	90	90	%
Distortion Products Level:			
Third order.....	29 <sup>10</sup>	28	db
Fifth order.....	32	32	db
Useful Power Output (Approx.)			
Average.....	190	285	watts
Peak envelope.....	380	570	watts

**RF Power Amplifier & Oscillator - Class C  
Telegraphy and RF Power Amplifier -  
Class C FM Telephony**

**Maximum CCS Ratings, Absolute-Maximum Values:  
Up to 500 MHz**

DC Anode Voltage.....	2200	volts
DC Grid-No. 2 Voltage.....	400	volts
DC Grid-No. 1 Voltage.....	-100	volts
DC Anode Current.....	300	mA
DC Grid-No. 1 Current.....	100	mA
Grid-No. 2 Dissipation.....	8	watts
Anode Dissipation.....	400	watts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode.....	150	volts
Heater positive with respect to cathode.....	150	volts

**Maximum Circuit Values:**

Grid-No. 1 Circuit Resistance Under Any Condition:		
With fixed bias.....	25,000	ohms
Grid-No. 2 Circuit Impedance.....	10,000	ohms
Anode Circuit Impedance.....	See Note 6	

**Typical CCS Operation:**

In Grid-Drive Circuit at 50 MHz					
DC Anode Voltage	700	1000	1500	1200	volts
DC Grid-No. 2 Voltage	175	200	200	200	volts
DC Grid-No. 1 Voltage	-10	-30	-30	-30	volts
DC Anode Current	300	300	300	300	mA
DC Grid-No. 2 Current	25	20	20	20	mA
DC Grid-No. 1 Current	50	40	40	30	mA
Driver Power Output (Approx)	1.2	2	2	2	watts
Useful Power Output	120	175	275	375	watts

In Grid-Drive Circuit at 470 MHz

DC Anode Voltage	700	1000	1500	2000	volts
DC Grid-No. 2 Voltage	200	200	200	200	volts
DC Grid-No. 1 Voltage	-30	-30	-30	-30	mA
DC Anode Current	300	300	300	300	mA
DC Grid-No. 2 Current	10	10	5	5	mA
DC Grid No. 1 Current	30	30	30	30	mA
Driver Power Output Approx.)	5	5	5	5	watts
Useful Power Output	100	165	235	300	watts

**Plate-Modulated RF Power Amplifier**

**Class C Telephony**

Carrier conditions per tube for use with a max. modulation factor of 1.0

**Maximum CCS Ratings, Absolute-Maximum Values:  
Up to 500 MHz**

DC Anode Voltage.....	1800	volts
DC Grid-No. 2 Voltage.....	400	volts
DC Grid-No. 1 Voltage.....	-100	volts
DC Anode Current.....	250	mA
DC Grid-No.1 Current.....	100	mA
Grid-No. 2 Input.....	5	watts
Anode Dissipation.....	280	watts

**Characteristics Range Values**

	<b>Min.</b>	<b>Max.</b>	
Heater Current <sup>11</sup> .....	1.15	1.45	A
Direct Interelectrode Capacitances			
Grid-No.1 to plate <sup>2</sup> .....	-	0.15	pF
Grid-No. 1 to cathode <sup>2</sup> .....	14.6	18.0	pF
Plate to cathode <sup>2</sup> .....	0.004	0.016	pF
Grid-No. 1 to grid-No. 2 <sup>2</sup> .....	20.0	26.5	pF
Grid-No. 2 to plate <sup>2</sup> .....	6.3	7.7	pF
Grid-No. 2 to cathode <sup>2</sup> .....	2.1	3.3	pF
Cathode to heater <sup>2</sup> .....	2.5	4.1	pF
Grid-No. 1 Voltage <sup>11, 12</sup> .....	-8	-19	volts
Reverse Grid-No. 1 Current <sup>11, 12</sup> .....	-	-25	mA
Grid-No. 2 Current <sup>11, 12</sup> .....	-5	+6	mA
Peak Emission <sup>11, 12</sup> .....	13	-	peak A
Interelectrode Leakage			
Resistance <sup>14</sup> .....	50	-	megohm
Zero Bias Anode Current <sup>11, 15</sup> .....	1.0	1.8	A

1. Because the cathode is subjected to back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should, for optimum life, be reduced to a value such that at the heater voltage obtained at minimum supply voltage conditions (all other voltages constant) the tube performance just starts to show some degradation; e.g., at 470 MHz heater volts = 12.5 (approx.)
2. Measured with special shield adapter.
3. See TP-105
4. For operation above 2200 anode volts, the tube shall see an effective anode-supply impedance of no less than 750 ohms. A fault current limiting resistor of no less than 15 ohms is to be used between the output filter capacitance and the tube anode. The anode-supply-output-filter capacitance is to be no greater than 10 microfarads.
5. The maximum rating for a signal having a minimum peak-to-average power ratio less than 2, such as is obtained in "Single-Tone" operation, is 300 mA. During

short periods of circuit adjustment under "Single-Tone" conditions, the average anode current may be as high as 450 mA.

6. The tube should see an effective anode supply impedance which limits the peak current through the tube under surge conditions to 15 amperes.
7. This value represents the approximate grid-No. 1 current obtained due to initial electron velocities and contact-potential effects when grid-No. 1 is driven to zero volts at maximum signal.
8. A fault current limiting resistor of no less than 320 ohms is to be used between the screen output filter capacitance and the tube screen. The screen supply output filter capacitance is to be no greater than 80 microfarads.
9. A fault current limiting resistor of no less than 20 ohms is to be used between the bias supply output filter capacitance and the tube grid-No. 1. The bias supply output filter capacitance is to be no greater than 150 microfarads.
10. The value of third order distortion product level shown may be improved by approximately 5dB by utilizing an unbypassed, noninductive 20-ohm resistor between the cathode and ground; a slight increase in drive power will be required.
11. With 13.5 volts ac or dc on heater.
12. With dc plate voltage at 700 volts, dc grid-No. 2 voltage of 250 volts, and dc grid-No. 1 voltage adjusted to give a dc anode current of 185 mA.
13. For conditions with grid-No. 1, grid No. 2, and anode tied together; and pulse voltage source connected between anode and cathode. Pulse duration is 2.5 microseconds and pulse repetition frequency is 60 pps. The voltage-pulse amplitude is 200 volts peak. After 1 minute at this value, the current-pulse amplitude will not be less than the value specified.
14. Under conditions with tube at 20° to 30 °C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Meggertype ohmmeter having an internal impedance of 1 .0 megohm, will be no less than the value specified.
15. With dc anode voltage of 450 volts, dc grid-No. 2 voltage of 400 volts, dc grid-No. 1 voltage of -100 volts, grid drive voltage to zero. With pulse duration of 4500 to 5000 microseconds and pulse repetition frequency of 10 to 12 pps.

## Operating Considerations for Type 8122/V1-Matched Pair

Follow all of the recommendations and instructions outlined by the equipment manufacturers with special emphasis on the following precautions:

1. Always allow at least three minutes for the tube heaters to warm up before any other voltages are applied or before any current is drawn.
2. During CW tune-up procedure, the total screen current for both tubes should never exceed 15 milliamperes.
3. During CW tune-up procedure the total anode current for both tubes should never exceed 550 milliamperes.
4. In the SSB mode, the total anode current for both tubes should not exceed 400 milliamperes during voice peaks. A sustained tone like a whistle should not be permitted.
5. Check the socket wiring to assure that each of the three pins provided for the cathode, grid and screen electrodes are interconnected rather than using one pin for each electrode. (See basing diagram of tube bulletin.)
6. Use only 8122/V1 for "matched pair" performance.

If an unmatched pair is used in a parallel circuit not having individual bias adjustment for each tube, one tube will carry most of the load current and, consequently, will be operated out of ratings.

7. Never rap a tube or equipment. Each tube of the 8122/V1 set has closely spaced electrodes which control the tube's electrical characteristics. Bumping or rapping the tubes or the equipment may change the spacings, thereby destroying the matched characteristics of the tubes.
8. The operating voltages applied to these devices presents an electrical shock hazard. The tubes and associated apparatus should be housed in a protective enclosure to keep all personnel from coming in contact with high voltage. The protective enclosure should be designed with interlocks to break the primary circuit of the high-voltage supplies, discharging high-voltage capacitors when any door or gate on the protective housing is opened, and should prevent the closing of the primary circuit until the door or gate is again closed.

9. DO NOT use the remaining tube of a matched pair with any other remaining or new tube. The tubes will be unbalanced and will fail prematurely.

### References

1. Application Guide for BURLE Power Tubes, TP-105.
2. Screen-Grid Current Loading and Bleeder Considerations, TP-122
3. Application Guide for Forced Air Cooling of BURLE Power Tubes TP-118

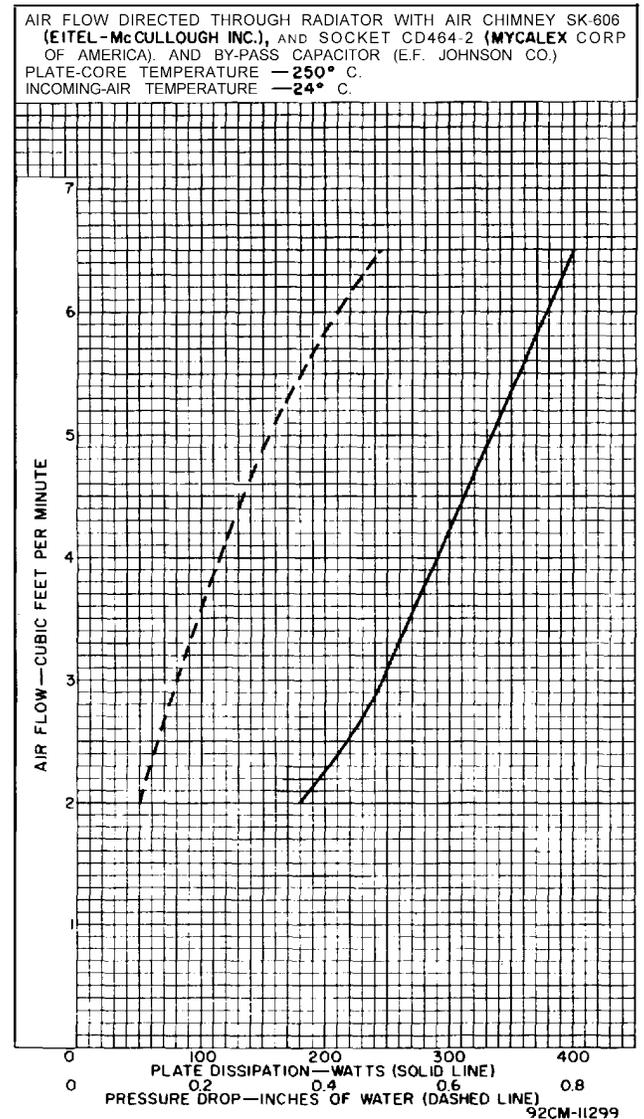


Figure 1 – Typical Cooling Requirements

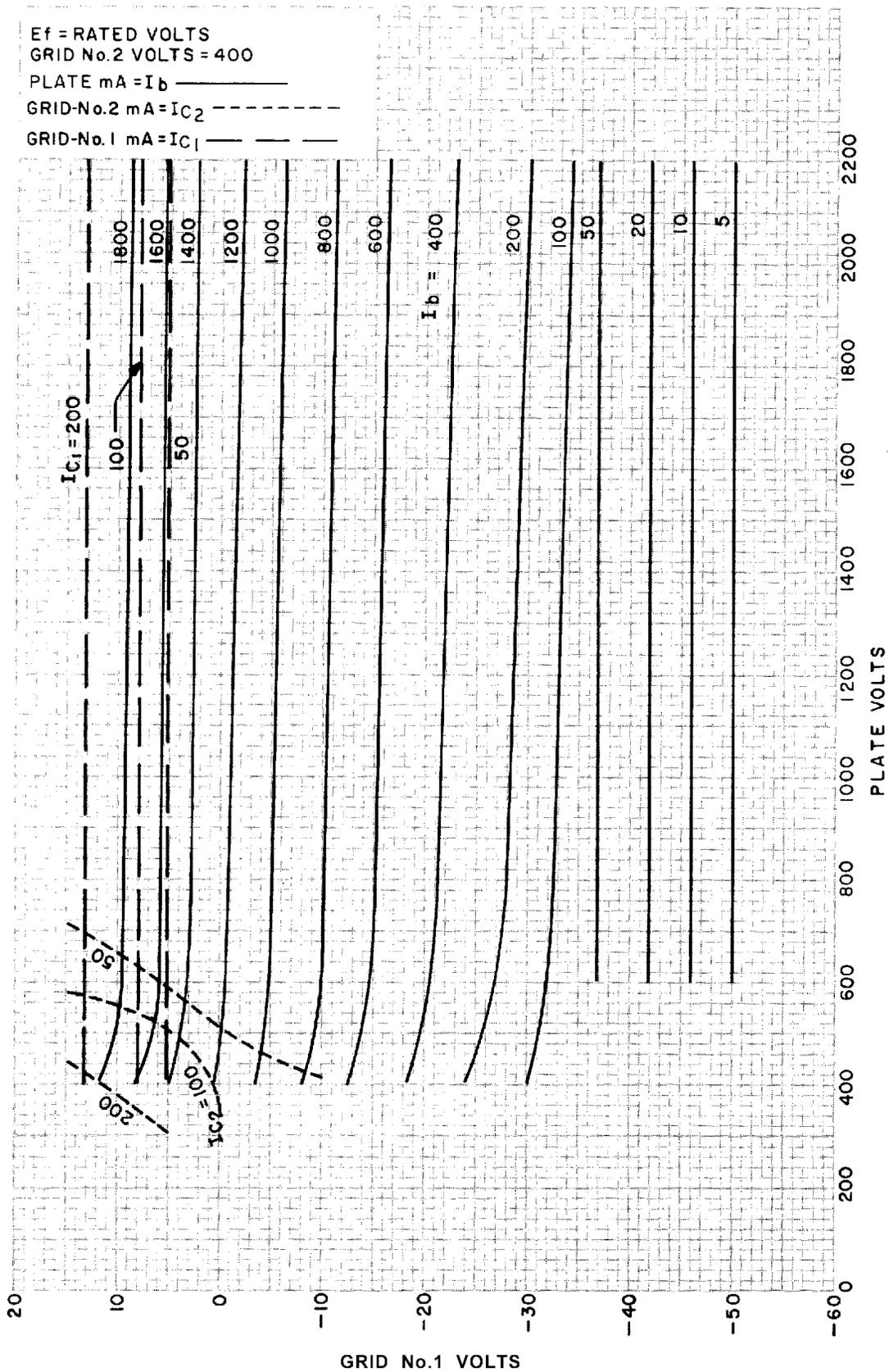


Figure 2 - Typical Constant-Current Characteristics For Grid-No. 2 Voltage = 400 Volts

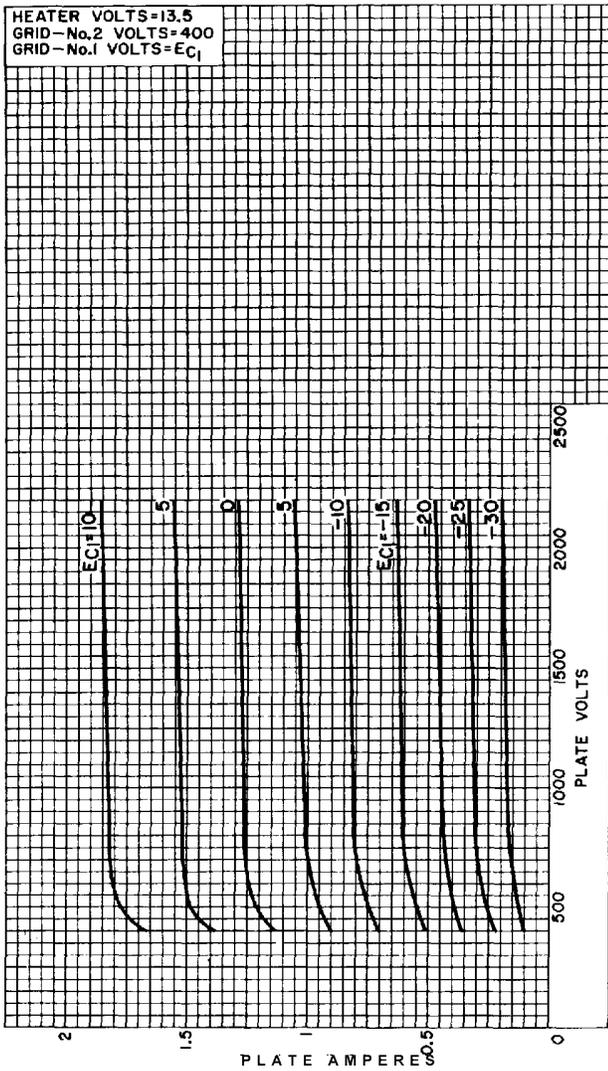


Figure 3 - Typical Anode characteristics - For Grid-No. 2 Voltage = 400 Volts

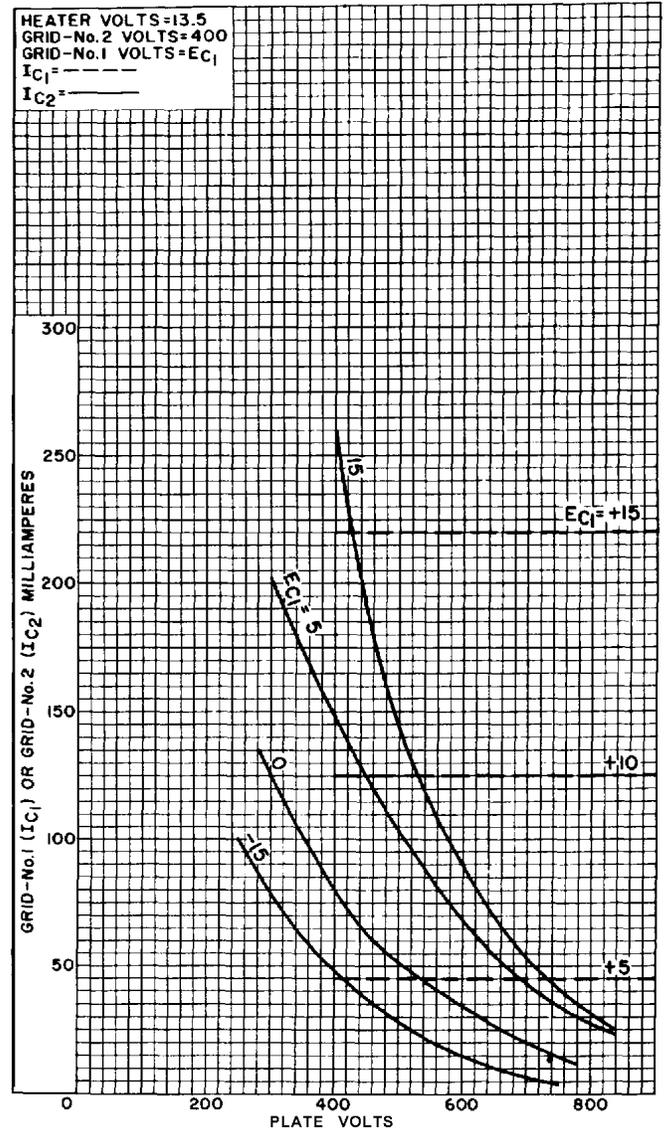


Figure 4 - Typical Characteristics - For Grid-No. 2 Voltage = 400 Volts

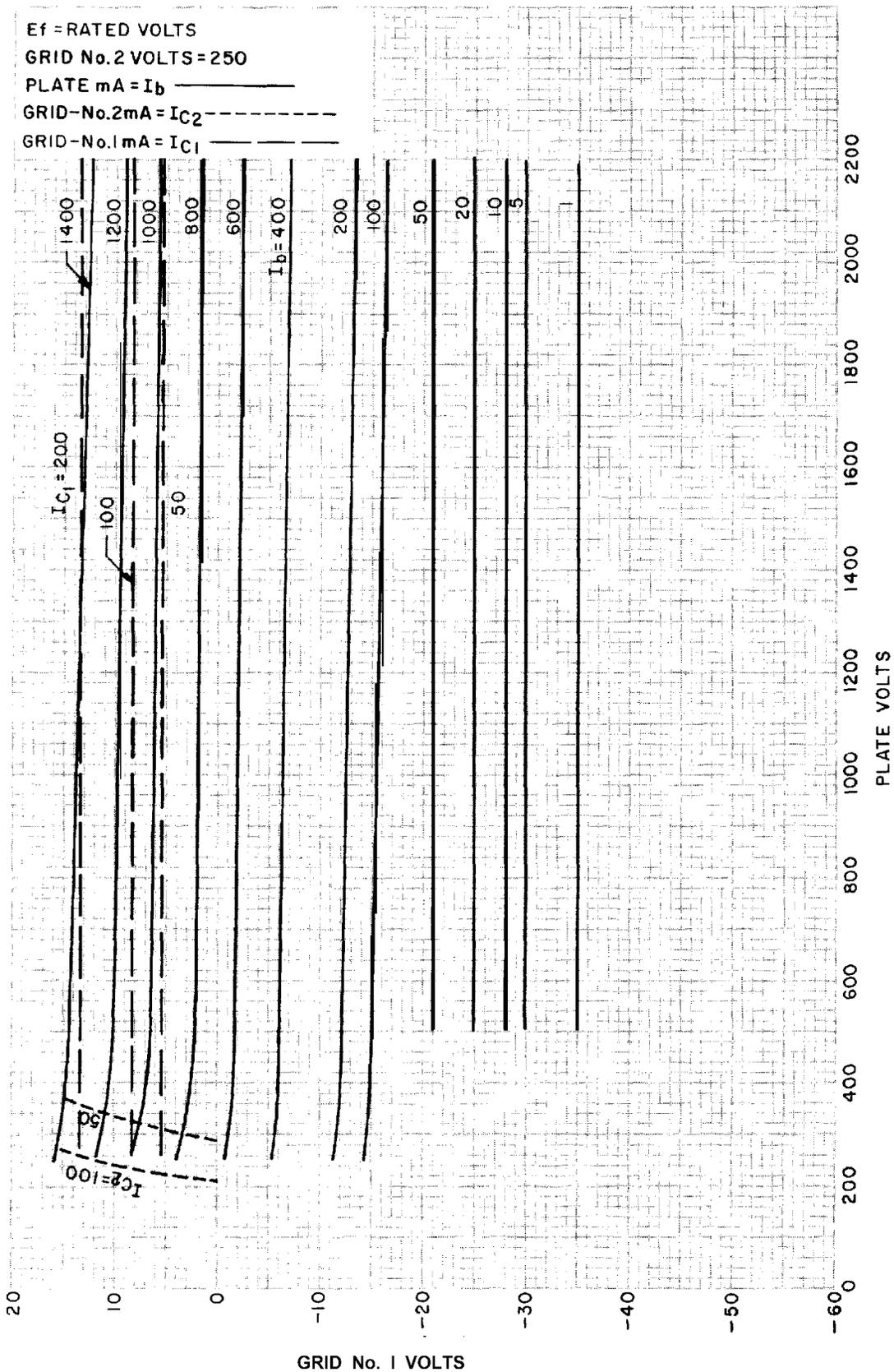
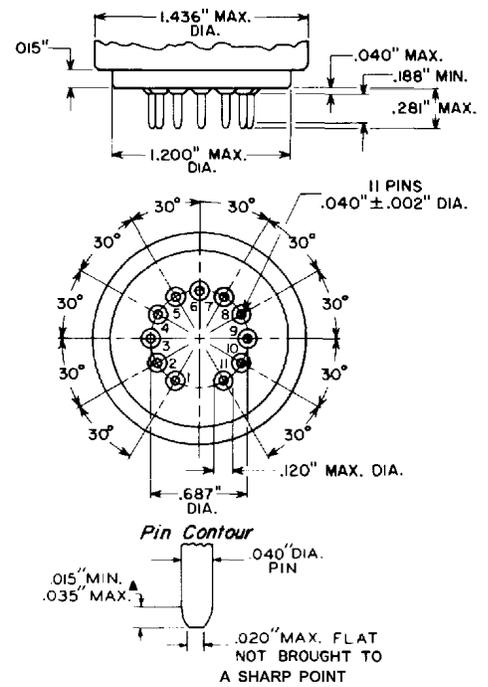
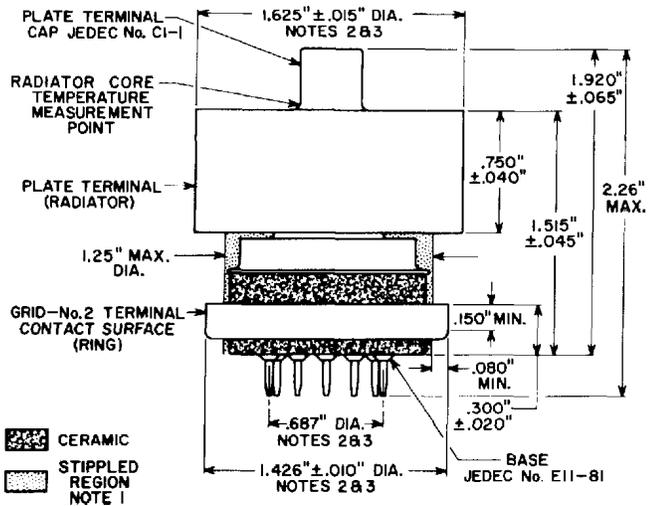


Figure 5 - Typical constant-current characteristics For Grid-No. 2 Voltage = 250 Volts



**Note 1:** Keep all stippled regions clear. Do not allow contacts or circuit components to protrude into these annular volumes.

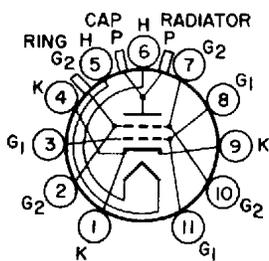
**Note 2:** The diameters of the radiator, grid-No. 2 terminal contact surface, and pin circle to be concentric within the following values of maximum full indicator reading:

Radiator to Grid-No. 2 Terminal Contact Surface.....	0.030" max.
Radiator to Pin Circle.....	0.040" max.
Grid-No. 2 Terminal Contact Surface to Pin Circle.....	0.030" max.

**Note 3:** The full indicator reading is the maximum deviation in radial

position of a surface when the tube is completely rotated about the center of the reference surface. It is a measure of the total effect of run-out and ellipticity.

**Figure 6 - Dimensional Outline**

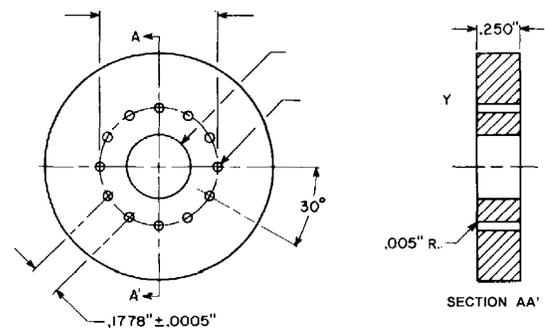


- |                 |   |
|-----------------|---|
| Pin1: Cathode   | Pin 9: Cathode  |
| Pin2: Grid-No.2 | Pin 10: Grid-No.2   |
| Pin3: Grid-No.1 | Pin 11: Grid-No.1   |
| Pin4: Cathode   | Cap: Anode Terminal   |
| Pin5: Heater    | Radiator: Anode Terminal  |
| Pin6: Heater    | Ring: Grid-No. 2 Terminal Contact Surface (For use at higher frequencies) |
| Pin7: Grid-No.2 |   |
| Pin8: Grid-No.1 |   |

**Figure 8 - Basing Diagram - Bottom View**

\* This dimension around the periphery of any individual pin may vary within the limits shown.

**Figure 7 - Base Drawing Large-Wafer Elevenar 11-Pin With Ring JEDEC No. E11-81**



**Figure 9 - Gauge Drawing JEDEC No. GE11-1**

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# 1. GENERAL

*The model NSD-51 is telegraph and SSB telephone transmitter of synthesizer type.*

## **Features**

1. It is used to set the frequency of Morse telegraph (A1, A2H), SSB telephone (A3J, A3A, A3H) and printing telegraph (F1) in steps of 100 Hz of all the band assigned to a ship station in a frequency range of from 0.4 MHz to 26 MHz.
2. All solid states (except power amplifier tube) improve reliability and stability of the unit.
3. Easy maintenance is assured by using unit type section.
4. Selective calling unit, LINCOMPEX unit and printing telegraph unit can easily be connected.
5. Applied for Radio regulations, 1976 Geneva and Safety of Life at Sea Conference (SOLAS, London in 1974).

## 2. SPECIFICATIONS

Frequency range	MF band	MF	405-	535 kHz
	IF band	IF1	1,605-	2,000 kHz
		IF2	2,000-	3,000 kHz
		IF3	3,000-	4,000 kHz
	HF band	4 MHz	4,063-	4,219 kHz
		6 MHz	6,200-	6,325.4 kHz
		8 MHz	8,195-	8,435.4 kHz
		12 MHz	12,230-	12,652.3 kHz
		16 MHz	16,460-	16,859.3 kHz
22 MHz		22,000-	22,310.5 kHz	
	25 MHz	25,070-	25,110 kHz	
Frequency control	Synthesizer system (in steps of 100 Hz)			
Frequency stability	Within 1 PPM ( $\pm 1 \times 10^{-6}$ , 0 – 40°C)			
	Within $\pm 5$ Hz for a short time (15 min.)			
Aerial power	MF band	400 W PP		
	IF band	400 W PEP		
	HF band	1,200 W PEP		
Aerial impedance	MF band	2-ohm, 600 pF		
	IF band	10-ohm, 400 pF		
	HF band	50-ohm		
Type of emission	Turnable to all normal ship aerial.			
	MF band	A1, A2H		
	IF band	A1, A3J, A3A, A3H, F1		
Power reduction	HF band	A1, A3J, A3H, A3A, F1		
	4 stages, 1/1, 1/4, 1/16 and 1/64 of rated power.			
Modulation freq. and modulation degree	1,500 Hz (for test tone), 800 Hz (for A2H) Modulation degree of A3H, more than 80%			
Spurious suppression	More than 45 dB			
Carrier suppression	A3J, better than 44 dB			
	A3A, 18dB $\pm$ 2 dB			
	A3H, 6 dB $\pm$ 1 dB			
Intermodulation products (out of band)	1.5 kHz $< \Delta \leq$ 4.5 kHz 31 dB			
	4.5 kHz $< \Delta \leq$ 7.5 kHz 38 dB			
	7.5 kHz $< \Delta$ 43 dB			
Audio response	Within 6 dB deviation at 350 – 2,700 Hz			
Microphone	40-ohm carbon microphone			
Two-tone alarm	Built-in			
Ambient temperature	Temperature, –10°C ~ +55°C			
	Humidity, 95% max. (+40°C)			
	Voltage fluctuation, $\pm 10\%$			
Power consumption	Max. 3.5 kVA			
Power requirement	AC440 V, 50/60 Hz, three-phase			

## Dimensions and weight

	Equipment proper
Height (incl. aerial)	1,580 mm
Width	570 mm
Depth	560 mm
Weight	200 kg

### 3. CONTROL SWITCHES

Before the description of the operation procedures, how to use the switches and dials on each panel of the transmitter is explained.

#### 3.1 Power Amplifier Panel (NAF-501A, POWER AMPLIFIER)

Adjusting devices	Application																																		
1. Meter <b>ANT CURR</b>	IF. HF band; Antenna current meter																																		
2. Meter <b>TEST/TUNE</b>	This meter indicates a matching condition of voltage, current and aerial at each point of drive amplifier (DA) and power amplifier (PA). Read after changing the switch to TEST (in general, set the switch in TUNE position.).																																		
3. Switch <b>TEST</b>	Indicates a standard value. However, *marks are values at the rated power A1.																																		
	<table border="1"> <thead> <tr> <th rowspan="2">Switch</th> <th colspan="2">At space</th> <th colspan="2">At mark</th> </tr> <tr> <th><b>VOLT</b></th> <th><b>CURR</b></th> <th><b>VOLT</b></th> <th><b>CURR</b></th> </tr> </thead> <tbody> <tr> <td><b>DA</b></td> <td>28 V</td> <td>—</td> <td>28 V</td> <td>—</td> </tr> <tr> <td><b>PAG1</b></td> <td>—34 V</td> <td>0</td> <td>—34 V</td> <td>0</td> </tr> <tr> <td><b>PAG2</b></td> <td>400 V</td> <td>0</td> <td>400 V</td> <td>*10 — 30 mA</td> </tr> <tr> <td><b>PAP</b></td> <td>2,300 V</td> <td>300 mA</td> <td>2,200 V</td> <td>*0.75 — 0.9 A</td> </tr> <tr> <td><b>TUNE</b></td> <td colspan="4">(0)</td> </tr> </tbody> </table>	Switch	At space		At mark		<b>VOLT</b>	<b>CURR</b>	<b>VOLT</b>	<b>CURR</b>	<b>DA</b>	28 V	—	28 V	—	<b>PAG1</b>	—34 V	0	—34 V	0	<b>PAG2</b>	400 V	0	400 V	*10 — 30 mA	<b>PAP</b>	2,300 V	300 mA	2,200 V	*0.75 — 0.9 A	<b>TUNE</b>	(0)			
Switch	At space		At mark																																
	<b>VOLT</b>	<b>CURR</b>	<b>VOLT</b>	<b>CURR</b>																															
<b>DA</b>	28 V	—	28 V	—																															
<b>PAG1</b>	—34 V	0	—34 V	0																															
<b>PAG2</b>	400 V	0	400 V	*10 — 30 mA																															
<b>PAP</b>	2,300 V	300 mA	2,200 V	*0.75 — 0.9 A																															
<b>TUNE</b>	(0)																																		

#### 3.2 IF. HF TUNING Panel (NFF-501)

Adjusting devices	Application
1. Dial <b>TUNE</b>	This dial varies the rotary coil of tuning circuit and the scale is indicated in the counter. Turning the switch, <b>TUNE</b> to the right or to the left, the rotary coil can be rotated by motor drive. A fine adjustment is made manually. This dial is used along with the dial, <b>LOAD</b> for tuning adjustment. (Refer to the article 4, Transmitter adjustment.)
2. Dial <b>LOAD</b>	This dial varies the rotary coil of coupled circuit, and the scale zero indicates the maximum inductance and the scale 100 indicates the minimum inductance (This is driven by motor the same as the dial <b>TUNE</b> .) When move toward to the small value (0 direction), the coupling becomes loose and the swing of pointer on the meter <b>TUNE</b> is increased. When moved toward to the higher scale (100 direction), the coupling is close, the swing of pointer of the meter, <b>TUNE</b> is decreased. (Refer to article 4, Transmitter adjustment.)

### 3.3 MF TUNING PANEL (NFG-501)

Adjustment devices	Application
1. Meter <b>ANT CURR</b>	Antenna current meter for MF band.
2. Dial <b>TUNE</b>	Variometer for tuning. The scale zero indicates the maximum inductance and the scale 100 indicates the minimum inductance. Turn the dial <b>TUNE</b> so that the meter <b>ANT CURR</b> indicates the maximum oscillation.

### 3.4 Exciter, NNE-510

Switch	Position	Operation
1. Pushbutton switch. <b>SUPPLY</b>	<b>OFF</b>	Cuts off all power for transmitter.
	<b>ST-BY</b>	Transmitter ST-BY, supplies power to the exciter, drive amplifier, filaments and bias of power amplifier and cooling fan for power tubes.
	<b>ON</b>	Transmitter operates. Power is supplied to the screen grid and plate for the power amplifier and the transmitter is set in operating mode. However, it is necessary to wait for one minute (for preheating of the power amplifier tube) before the <b>ON</b> button becomes effective. The <b>ON</b> button does not effect the high tensions if the preheating is insufficient. Push the <b>ON</b> button again, the transmitter goes back to <b>ST-BY</b> condition.
2. Pushbutton switch <b>EMISSION</b>	<b>A1</b>	Morse telegraph (CW), All frequency bands.
	<b>A2H</b>	Morse telegraph (MCW), only MF band.
	<b>A3J</b>	SSB telephony (Suppressed carrier). IF and HF bands.
	<b>A3A</b>	SSB telephony (Reduced carrier). IF and HF bands.
	<b>A3H</b>	SSB telephony (Full carrier). IF and HF bands.
	<b>F1</b>	Printing telegraph (FSK). IF and HF bands.
3. Pushbutton switch <b>TELEPHONY</b>	<b>SIMP</b>	SIMPLEX, SSB Telephony presstalk communication system.
	<b>DUP</b>	DUPLEX, SSB telephony simultaneous transmission-reception system
	<b>STONE</b>	For test, Emission of modulated wave of 1,500 Hz.

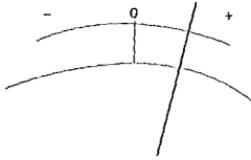
Switch	Position	Operation
4. Pushbutton switch <b>POWER</b>	<b>TUNE</b>	This is used for the matching adjustment of aerial. Make sure to turn OFF this button under normal condition as keys are down when this switch turns ON.
	<b>FULL</b>	The aerial power is the rated power.
	<b>MED1</b>	The aerial power is reduced to 1/4 of the rated power.
	<b>MED2</b>	The aerial power is reduced to 1/16 of the rated power.
	<b>LOW</b>	The aerial power is reduced to 1/64 of the rated power.
5. Six freq. selection switches	<b>10 M</b>	The setting of transmission frequency is accomplished at each digit.  The transmission frequency is displayed in six numerical display diodes (LED).
	<b>1 M</b>	
	<b>100 K</b>	
	<b>10 K</b>	
	<b>1 K</b>	
6. Pushbutton switch <b>2182 kHz</b>		Setting frequency is set to A3H of 2182 kHz having no connection with six frequency selection switches and <b>EMISSION</b> . (SIMPLEX).
7. Switch	<b>NORMAL</b>	At the normal position, transmission can be made by using the microphone.
	<b>ALARM</b>	Push the <b>START</b> button to emit the alarm signal. The alarm signal continues for 45 seconds.
	<b>TEST</b>	Push the <b>STRT</b> button to hear the alarm signal through the external speaker. . . . for test.
8. Meter		Radio frequency output of the exciter can be read. (It is normal if the meter indicates green mark when <b>AI</b> mark is used.)

## 4. TRANSMITTER ADJUSTMENT

A normal ship's antenna varies greatly its constant by frequencies and is affected by a weather condition and cargo amount.

In order to operate the transmitter and emit radio waves from the antenna, an adjustment is necessary to attain "impedance matching" of the transmitter (power amplifier) and antenna. In this article, the adjustment procedures (antenna matching TUNE and LOAD) are picked out before describing the operating procedure (Article 5, procedures of daily operation) of the transmitter and the procedures and guide are fully explained. An inadequate adjustment not only results in low efficiency of the transmitter, but also causes malfunctions of the transmitter.

### Adjustment procedure

Switch, dial	Position	Operation
1. Switch <b>TEST</b>  Note 1	<b>TUNE</b>	<p>When the <b>TUNE</b> button of the exciter is pressed, the meter pointer swings towards positive (+) side.</p> <p style="text-align: center;"><b>TUNE TO DIP</b></p>  <p>Turn the dial <b>TUNE</b> to obtain the minimum deflection of the meter pointer (DIP). When the pointer at DIP is on the + side or - side, adjust by the following procedures.</p> <p><u>When the meter pointer indicates +.</u></p> <p>Turn the dial <b>LOAD</b> to a direction of the scale where the numbers on the scale become larger and obtain again DIP point by using the <b>TUNE</b> dial. The pointer should have moved to - side. However, when the pointer is not indicating the center (0), repeat the above process until the pointer indicates the center (0).</p> <p><u>When the meter pointer indicates -.</u></p> <p>Turn the dial <b>LOAD</b> to a direction where the numbers on the scale become smaller, obtain DIP by using the dial <b>TUNE</b>.</p> <p>Repeat the above process until the meter pointer indicates the center (0).</p>

Switch, dial	Position	• Operation
2. Switch <input type="checkbox"/> POWER	<input type="checkbox"/> FULL  <input type="checkbox"/> MED 1  <input type="checkbox"/> MED 2  <input type="checkbox"/> LOW	This selects the desired value of the antenna power.   <input type="checkbox"/> FULL      rated power <input type="checkbox"/> MED 1      1/4 of full power <input type="checkbox"/> MED 2      1/16 of full power <input type="checkbox"/> LOW         1/64 of full power
3. Switch <input type="checkbox"/> TEST	<input type="checkbox"/> PAP <input type="checkbox"/> CURR  <input type="checkbox"/> PAG2 <input type="checkbox"/> CURR	<input type="checkbox"/> FULL power. It is advisable to check so as not to overload the following values.  <input type="checkbox"/> PAP CURR      Less than 0.9 A <input type="checkbox"/> PAG2 CURR     Less than 30 mA

NOTE 1. As to the MF band (405 – 535 kHz), proceed the steps described in item 3.3.

## 5. PROCEDURES FOR DAILY OPERATION

The following are the procedures for daily operation of the transmitter. The control switches, dials and meters to be used have been explained in the previous sections. Operate the transmitter correctly by proceeding the following steps.

1. Switch ① Push the **ST-BY** button of the **SUPPLY** .
2. Switch ② Select the emission type among the **EMISSION** pushbutton switches.
3. Switch ③ Push the **SIMP** button of the **TELEPHONY** . (Note 1)
4. Switch ⑤ Set the six frequency selection switches to the transmission frequency.
5. Switch ⑦ Set to the **NORMAL** . (In general, set this in **NORMAL** .)
6. Dial ⑧ ⑪ Adjust the **TUNE** to the scale of the TUNING CHART TABLE. (IF. HF band ⑧ , MF band ⑪ .)
7. Dial ⑨ (only in IF. HF bands) Adjust the **LOAD** to the scale of the TUNING CHART TABLE.
8. Switch ⑩ (only in IF. HF bands), Turn the **TEST** to the **TUNE** .
9. Switch ① Push the **HT** button of the **SUPPLY** .
10. Switch ④ Push the **TUNE** of the **POWER** .
11. Meter ⑩ ⑫ IF. HF bands: Confirm that the meter pointer indicates the center (0 display). (In case the pointer is not placed in the center (0) position, turn the dial ⑧ **TUNE** slightly clockwise or counter-clockwise so that the pointer indicates the minimum point.  
MF band: Set the dial ⑪ to obtain the maximum deflection of the meter **ANT CURR** .
12. Switch ④ Push the **FULL** button of the **POWER** . (Note 2)
13. Push the telegraph key or the button of the handset to talk.
14. When the transmission is completed, release the **HT** button of the switch ① **SUPPLY** .  
(The equipment is set in ST-BY mode.)  
Then, push the **OFF** button.

NOTE 1. To use the equipment in **DUPLEX** , pair frequencies for DUPLEX communication should be set for transmission and receiving frequency. In case of the antenna is not adequate for DUPLEX communication, noise obstacle may occur.

NOTE 2. Reduce the antenna power in case of a short distance communication.

## 6. PRECAUTIONS IN TRANSMITTER HANDLING

In order to achieve smooth daily communication, it is vitally important to prevent troubles of transmitter before happening, and also to obtain the highest efficiency from it. This article describes the general precautions in the daily handling of the transmitter.

### 6.1 Daily operation

As explained before, the characteristics of the antenna used on ships are varied depending on frequency, draft adjacent buildings and other factors. Therefore, adjustment of the transmitter is required every time it is used. Faulty adjustment of the transmitter not only causes a reduction in communication efficiency with lower transmission power, but also reduces the life of the final stage tube. Especially, the **TUNE** dial and the **LOAD** dial are inter-related so that when the **LOAD** dial is adjusted, the tuning of tune circuit is detuned. In this case, therefore, make sure to retune by adjusting the **TUNE** dial.

In addition, the tuning characteristics are sharper for higher frequencies (16 – 25 MHz) and a small deviation of the **TUNE** dial causes a DETUNE condition. Then, adjust the meter pointer strictly to obtain the minimum vibration. To transmit the short wave band (4 – 25 MHz) in the rated power (FULL, A1), check without fail that the plate and screen-grid currents are less than 0.9 A and 30 mA respectively.

Do not operate the switches while keys are down. If switches are operated while keys are down, it may cause a trouble in the transmitter. (Pay attention especially to the position of the **POWER** switch. It should not be in **TUNE** position.) Furthermore, if the frequency selection switch is changed over at DUPLEX, and if it matches the receiving band in change-over of switch, it may cause a trouble in the receiver.

### 6.2 Maintenance

It is important to detect a trouble in the transmitter at an early stage, namely, to perform the daily inspection work, to prevent a minor fault developing into a serious one. In performing the most suitable maintenance, it is required to know the full details of the instrument, and to be well familiarized with each part. In the daily inspection, check the voltage and current of each part by the check meters on the power amplifier and the exciter panel to ensure that those values conform to the standard values. (Article 3.1 and article 3.4).

Cleaning, if there is a dust or corrosion in the instrument, it will shorten the life and will cause a trouble. Clean the inside of the transmitter periodically with a soft cloth and a dry brush. Especially, if a dust is accumulated in a high voltage part, it may cause a spark or a poor contact (relays and contacts), resulting in trouble in the transmitter.

Visual inspection. Check carefully for loose set screws, damage, dirt or discoloration of parts.

It is necessary to inspect periodically the antenna circuit and the power amplifier where the high tension is impressed. Especially the rotary coil, which is used in the antenna

matching part, is an important part. Inspect carefully for a rough surface of roller or abnormal condition by sliding the coil.

### 6.3 HOW to use the TUNING CHART TABLE

If the approximate scale position of the **TUNE** and **LOAD** dials are known at the daily transmitter adjustment, this makes carrying out adjustment of antenna matching, simple and quick. Especially when the scale of the **TUNE** dial is considerably away from the suitable value, the adjustment of the tuning circuit sometimes causes emission of double or other higher harmonics against the required transmission frequency.

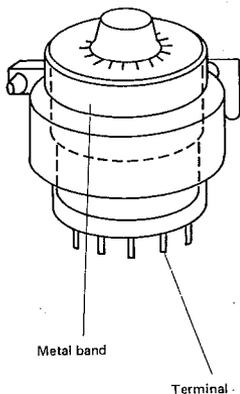
To prevent such failure operation, the use of the TUNING CHART TABLE helps in acquiring the right operation method faster. However, make sure to perform the correction or the adjustment.

TUNING CHART TABLE		
FREQUENCY	TUNE	COUP
4183	73	30

### 6.4 Removal and insertion of the power tube (8122)

Removal: Remove the metal band holding the anode and pull out the tube by your hand.

Insertion: Insert the tube by adjusting the terminals to the socket. If it is forced into the socket, the socket may be broken.



### 6.5 Interface with Telex (TTY)

When printing telegraph communication is performed by connecting a teleprinter equipment to the transmitter, it is only necessary to connect the signal output (FSK) of the teleprinter (TTY) and the key operation line (-BK) to the transmitter. (but, the receiver output should be connected separately.)

The signal output (FSK) of TTY usually has a center frequency of about 1,500 Hz or 1,700 Hz and varies within the range of  $\pm 85$  Hz.

The FSK signal is connected to the microphone circuit as the input signal of the transmitter, therefore, the output frequency (emission) of the transmitter is higher than the carrier wave by the FSK signal frequency. However, as it has been standardized to call the assigned frequency for the purpose of printing telegraphy by the carrier wave frequency, it is necessary to set the transmission frequency by subtracting the frequency equivalent to the center frequency of the FSK signal.

Example (When the center frequency of the FSK signal is 1,500 Hz.)

TTY assigned frequency	Set frequency on exciter panel
4175.0 kHz	4173.5 kHz

#### 6.6 When Overload Circuit Operates.

When the overload circuit is operated, the high tension power circuit (HT) of the transmitter is cut out and the lamp (OVERLOAD display) located on the power amplifier, model NAF-501 will light.

To reset the overload circuit, turn **OFF** the **SUPPLY** switch again and turn ON the **ST-BY** and **HT** switches. If the overload circuit operates after resetting the overload circuit, do not operate the transmitter until the cause of abnormal condition of the transmitter is removed. (Fault of vacuum tube, detune of antenna adjustment, etc.)

#### 6.7 When dummy antenna is used.

A dummy antenna is mounted on the antenna selector NKH-201 and can be used for test of the transmitter.

Dummy antenna constant

for MF and IF band      Series connection of 500 pF and 2-ohm  
(maximum power: 400W)

NOTE: When the transmitter is checked by using the dummy antenna, reduce the transmission power less than **MED 1**.

In case it is checked with the maximum power **FULL** mark time for quick reading should be within 10 sec.

## 7. CIRCUIT INFORMATION

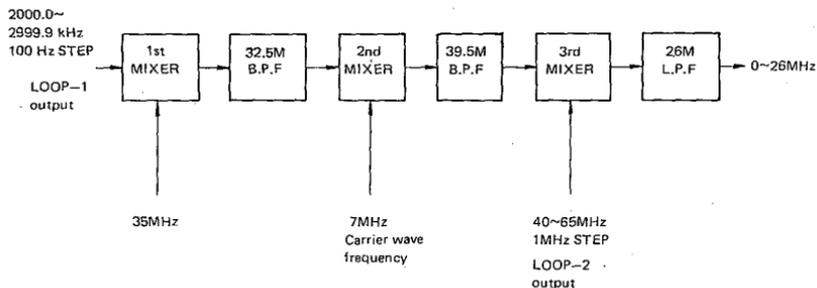
### 7.1 Exciter, Model NNE-510

The exciter is assembled in an independent cabinet of 19-inch standard panel dimension. The exciter consists of the control panel (control switches, frequency indicator and check meters), and 9 circuit units and line filter for external connection located inside the cabinet.

The output signal of the exciter contains all necessary informations for the transmitting radio wave, which are given to the main transmitter to amplify linearly to the desired power.

#### Frequency and signal formation

First, the method of frequency formation is shown in the frequency synthesis diagram and the frequency synthesis table shown below.



Frequency synthesis diagram

LOOP-1 output	1st MIXER output	Carrier wave frequency	2nd MIXER output	LOOP-2 output	3rd MIXER output
2000.0 – 2999.9 kHz	33,000.0 – 32,000.1 kHz	7 MHz	40,000.0 – 39,000.1 kHz	40 – 65 MHz	0 – 25,999.9 kHz

The 1st MIXER synthesizes the LOOP-1 unit frequency of 20000.0 – 2999.9 kHz and the REFERENCE unit output of 35 MHz, and picks up from the output only the component of 33,000.0 – 32,000.1 kHz by passing through the filter (32.5 MHz B.P.F.) with a center frequency of 32.5 MHz and a pass band of 1 MHz.

The 2nd MIXER synthesizes 33,000 – 32,000.1 kHz from the 1st MIXER and the 7 MHz carrier wave of modulator output, and picks up from the output only the component of 40,000.0 – 39,000.1 kHz by passing through the filter (39.5 MHz B.P.F.) with a center frequency of 39.5 MHz and a pass band of 1 MHz.

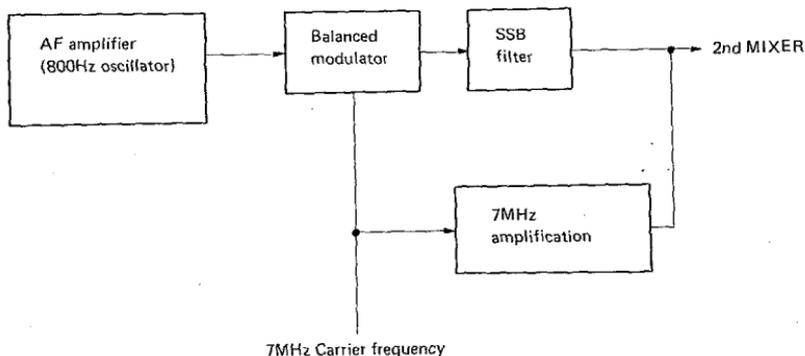
The 3rd MIXER synthesizes 40,000.1 – 39,000.1 kHz from the 2nd MIXER and 40 – 65 MHz of the LOOP-2 unit output, picks up from the output only the component of

0 – 26 MHz by passing through the filter (26 MHz L.P.F.) with a pass band of 26 MHz and less to remove the unnecessary components of more than 26 MHz, and amplifies the filtered component to an appropriate level as the exciter output. The frequency accuracy of the exciter output signal depends on the accuracy of the reference frequency oscillator (10 MHz, TCXO).

The frequency outputs of LOOP-1, LOOP-2, the 35 MHz reference wave, and the 7 MHz carrier wave are related to the frequency accuracy. These frequency outputs are made from the output of 10 MHz, TCXO.

The reference frequency oscillator uses a very high accuracy, very high stability, and temperature compensated crystal oscillator which has accuracy of 1 PPM ( $1 \times 10^{-6}$ ) in ambient temperatures of 0 – 50°C. LOOP-1 and LOOP-2 are frequency oscillators in which PLL (PHASE LOCKED LOOP) circuit is used. The LOOP-1 output changes 2000.0 – 2999.9 kHz in a step of 100 Hz, and determines the emission frequency of 100 kHz digit or less, that corresponds to the channel frequency. The LOOP-2 output changes 40 – 60 MHz in a step of 1 MHz and determines more than MHz digit, that corresponds to the band frequency of the transmission frequency. The 1st MIXER stage is related only to the frequency synthesis, and does not include any signal components. Therefore, if high enough output voltage for the MIXER circuit to work efficiently is obtained, and if the unwanted waves are adequately attenuated, there is no problem of linearity and level fluctuation. However, the signal wave formation system shown below and output stages from the 2nd MIXER employ the signal waves, good linearity and little level fluctuation are required.

Signal wave formation diagram



The microphone output or the FSK signal (TTY) is amplified to an appropriate level by the AF amplifier and fed to the balanced modulator. (1,500 Hz oscillation output is appeared in TEST TONE.)

On the other hand, when the 7 MHz carrier wave frequency is fed to the balanced modulator, the upper and lower side bands are obtained as an output. Only this lower side band is picked up by passing the output through the SSB filter. (It is converted to the upper side band at the exciter output.) The output signal of the SSB filter is a complete single side band wave (SSB) and corresponds to the radio wave type of A3J. For the radio wave type of A3A and A3H, 7 MHz carrier wave of an appropriate level made at the 7 MHz amplifier circuit, is superposed with the SSB filter output to obtain a signal of appropriated

level ratio (carrier wave vs. single side band). In a case of A1, the side band wave components are not required, only 7 MHz carrier wave components are added to the next stage of the 2nd MIXER by suppressing the function of the balanced modulator.

### 7.1.1 Function Control Circuit

All control information obtained from switches on the exciter control panel is treated on the function control circuit and is supplied to each circuit unit, the main body of transmitter and the associated instrument (receiver).

#### 7.1.1.1 Frequency information

The frequency information (binary system, H level) from the frequency selection switches is applied to the LOOP-1 and LOOP-2 units to control a division ratio of the variable frequency divider. At the same time, it gives the information to the drive circuit for 7 segment numerical display diodes to display the set frequency.

Frequency information	Control	Location to be supplied and its application
10 MHz B.C.D (1. 2. 4. 8)	Corresponds to the 10 MHz digit of the frequency selection switch.	LOOP-2 unit. Frequency divided ratio control of 10 MHz digit programmable counter.
1 MHz B.C.D (1. 2. 4. 8)	Corresponds to the 1 MHz digit of the frequency selection switch.	LOOP-2 unit. Frequency divided ratio control of 10 MHz digit programmable counter.
100 kHz B.C.D (1. 2. 4. 8)	Corresponds to the 100 kHz digit of the frequency selection switch.	LOOP-1 unit. Frequency divided ratio control of 100 kHz digit programmable counter.
10 kHz B.C.D (1. 2. 4. 8)	Corresponds to the 10 kHz digit of the frequency selection switch.	LOOP-1 unit. Frequency divided ratio control of 10 kHz digit programmable counter.
1 kHz B.C.D (1. 2. 4. 8)	Corresponds to the 1 kHz digit of the frequency selection switch.	LOOP-1 unit. Frequency divided ratio control of 1 kHz digit programmable counter.
0.1 kHz B.C.D (1. 2. 4. 8)	Corresponds to the 0.1 kHz digit of the frequency selection switch.	LOOP-1 unit. Frequency divided ratio control of 0.1 kHz digit programmable counter.

#### 7.1.1.2 Band and channel information

The frequency range is discriminated from the frequency information by the frequency selection switch from 10 MHz to 10 kHz, and the band and channel information (L level) is formed.

Band and channel information	Control	Location to be supplied and its application
MF	When the 10 M and 1 M of the freq. selection switch is set to 0.0.	Power amplifier section Relay control
IF	When the freq. selection switch is set to either one of 1 M, 2 M or 3 MHz.	Power amplifier, Relay control, W.B.A. unit, signal level setting.
IF. HF	When the freq. selection switch is set to 1 – 25 MHz.	Power amplifier, Relay control
1 M (1ch), 2 M (2ch), 3 M (3ch), 4 M (4ch), 6 M (5ch), 12 M (7ch), 16 M (8ch), 22 M. 25 M.	When the freq. selection switch is set to the frequency corresponding to 1 – 25 MHz, and when it is set to 410 k – 512 kHz in MF band. (When it is set to the intermediate freq., low band or channel information is appeared. –5 M is 4 MH.	IF. HF TUNING MF TUNING, Selection information of the band selector and relay control. Set the NOISE SUPPRESSOR unit and filter circuit to the personal band.
MF-1 MF-2 MF-3	410. 425. 432 kHz – MF-1 454. 468. 480 kHz – MF-2 500. 512 kHz – MF-3	W.B.A unit, Signal level setting.
HF-1 HF-2 HF-3	HF band 4.16 MHz – HF-1 6.8.12 MHz – HF-2 22.25MHz– HF-3	W.B.A unit, Signal level setting

### 7.1.1.3 EMISSION information

The EMISSION control information is made from the control information of the EMISSION control switch, **TUNE** information (when the **POWER** switch is set to the TUNE position) and 2,182 kHz information. (All L level).

EMISSION information	Control	Location to be supplied and its application
A1	When the <b>A1</b> button of the <b>EMISSION</b> switch is pushed or when TUNE information is obtained.	MODULATOR unit Signal level setting.
A2H	When <b>A2H</b> button of the <b>EMISSION</b> switch is pushed and MF band information is obtained.	AF AMP and MODULATOR units, Signal level setting.
A3J	When <b>A3J</b> button of the <b>EMISSION</b> switch is pushed.	AF AMP unit Signal level setting.
A3A	When <b>A3A</b> button of the <b>EMISSION</b> switch is pushed.	AF AMP and MODULATOR units, Signal level setting.

EMISSION information	Control	Location to be supplied and its application
A3H	When [A3H] button of the [EMISSION] switch is pushed. (in the case of 2,128 kHz, it is at [A3H] with no relation to the [EMISSION] switch)	AF AMP and MODULATOR units, Signal level setting.

#### 7.1.1.4 TELEPHONY information

The TELEPHONY information is made by selecting the adequate telephony type from the operating information of the TELEPHONY switches and each information of band and EMISSION.

(L level)

TELEPHONY information	Control	Location to be supplied and its application
TONE	When the [TONE] button of the [TELEPHONY] control switch, and either [A3J], [A3A] or [A3H] button of the [EMISSION] control switch are pushed, and furthermore, IF. HF information is obtained.	AF AMP unit, Transmission of 1,500 Hz signal and signal level setting.
SIMP	When [SIMP] button of the [TELEPHONY] switch is pushed.	MOISE SUPPRESSOR unit, Set to the SIMPLEX circuit.
DUP	When [DUP] button of the [TELEPHONY] switch and either one of [A3J], [A3A] or [A3H] button of the [EMISSION] switch are pushed.	NOISE SUPPRESSOR unit, Set to the DUPLEX circuit.
DUP BK	ditto.	To external receiver. Open the BK relay control line of the receiver at DUPLEX.

#### 7.1.1.5 POWER information

(L level)

POWER information	Control	Location to be supplied and its application
FULL	When the [FULL] button of the [POWER] switch is pushed.	W.B.A. unit, FULL level setting.
MED 1	When the [MED 1] button of the [POWER] switch is pushed.	W.B.A. unit, MEDIUM 1 level setting.
MED 2	When the [MED 2] button of the [POWER] switch is pushed.	W.B.A. unit, MEDIUM 2 level setting.
LOW	When the [LOW] button of the [POWER] switch is pushed.	W.B.A. unit, LOW level setting.

## 7.1.1.6 Other informations

(L level)

Other information	Control	Location to be supplied and its application
TUNE	When the <b>TUNE</b> button of the <b>POWER</b> switch is depressed.	Inside the function control circuit. The A1 and MED2 are set having no relation to the <b>EMISSION</b> and <b>POWER</b> control switches. Further, Keys are DOWN.
2,182 kHz	When <b>2182 kHz</b> button is pushed.	Inside the function control circuit. The A3H or 2,182 kHz is set having no relation with the frequency selection switch, and it is automatically set to SIMPLEX.
P. CONT	When frequency is changed in MF band, when MF band and IF. HF band is selected and when the <b>RESERVE ANT</b> switch is changed to <b>MAIN MF</b> .	PS $\pm 5$ V, +12 V unit, When P.CONT information is obtained, open the KEY circuit.
-BK.CONT	When TUNE information is obtained and when alarm information is appeared.	PS $\pm 5$ V, +12 V unit, When TUNE information and ALARM information are appeared, down the key.
ALARM	When the ALARM switch is set to ALARM and the START button is pushed, and further either A3J, A3A or A3H of the EMISSION information is appeared.	AF AMP unit, Transmission of 2-tone alarm signal and signal level setting.
ALARM TEST	Set the ALARM switch to TEST and push the START button. Further, either A3J, A3A or A3H of the EMISSION information is appeared.	To external speaker. 2-tone alarm signal can be monitored through external speaker.

### 7.1.2 POWER SUPPLY $\pm 5$ V/ $+12$ V Unit, CBD-700

This unit stabilizes the voltage of the three kinds of DC power supply for the exciter.

#### 7.1.2.1 +5 V Voltage stabilizer circuit

The supplied AC 10 V from the power supply unit is rectified by the single phase full wave rectifiers (CD1), and the output voltage is stabilized by the voltage stabilizer circuits (IC1, TR1 and the external transistor TR2). (RV1, labeled "+5 V", is the resistor for the output voltage adjustment). The overcurrent protective circuit is provided to prevent a faulty short-circuiting in its load.

#### 7.1.2.2 -5 V Voltage stabilizer circuit

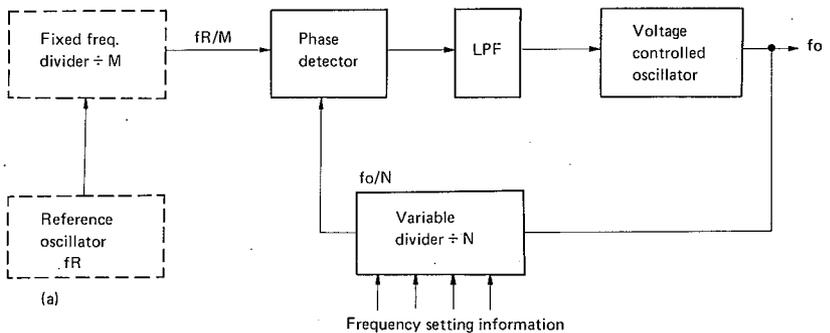
The output of the +5 V voltage stabilizer circuit is applied to the AC/DC converter (PS1) to convert to -5 V.

#### 7.1.2.3 +12 V Voltage stabilizer circuit

The supplied AC 16 V from the power supply unit is rectified by the single phase full wave rectifiers (CD1 and CD2), and the output voltage is stabilized by the voltage stabilizer circuits (IC2, TR2 and the external transistor TR2). (RV2, labeled "+12 V" is the resistor for the output voltage adjustment.) The overcurrent protective circuit is provided to prevent a faulty short-circuiting in its load.

### 7.1.4 LOOP-1 unit, CCF-703

This unit is a frequency generator which enables the setting of the four frequency digits of 100 kHz or less (100 kHz, 10 kHz, 1 kHz and 0.1 kHz) corresponding to the channel frequency of the transmitter. The output frequency is between 2000.0 and 2999.9 kHz, and it can be changed in steps of 100 Hz. The frequencies on the basis of a stable frequency as a standard. The basic block of phase locked loop is shown in the figure 5-1.



Basic block diagram of phase locked loop

The voltage-controlled oscillator changes the bias voltage of variable capacity diodes and varies its frequency.

The reference oscillator is the frequency standard of the synthesizer, and is composed of an extremely stable crystal oscillator. The output  $fR$  is divided by  $M$  by the fixed frequency divider to become the reference frequency  $fR/M$ , which is supplied to the phase detector. The variable divider divides VCO frequency  $f_0$  by  $N$  and outputs a frequency which is nearly equal to  $fR/M$ . The division ratio  $N$  is varied by the frequency setting information.

The phase detector outputs a frequency which is nearly equal to the variable divider output  $f_0/N$  and the reference frequency  $fR/M$ . The filter output voltage is supplied to the variable capacity diodes of VCO, and controls its frequency. When two input frequencies to the phase detector become equal, the loop (VCO -  $N$  freq. divider - phase detector - LPF - VCO) is called to be phase locked at the reference frequency. In this case, the output frequency  $f_0$  of VCO can be shown as follows.

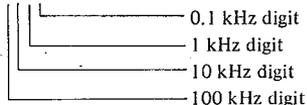
$$f_0 = N \cdot fR/M$$

As the division ratio  $N$  is varied by the frequency setting information, a frequency,  $N$  fold of  $fR/M$ , can be obtained from VCO output. The channel distance of  $f_0$  is  $fR/M$ . The frequency stability of  $f_0$  is the same as the stability of the reference oscillator.

The numerical relation for this unit is as shown below.

$fR/M = 100$  Hz, supplied from REFERENCE OSC unit.  
(Refer to 7.1.5)

$N = 20000 - 29999$



It is set at an arbitrary number from 0 to 9 by each digit by the frequency setting information sent from SWITCHING CIRCUIT.

$$f_0 = 2000.0 - 2999.9 \text{ kHz, } 100 \text{ Hz step}$$

#### 7.1.5 REFERENCE OSC unit, CGD-704

This unit is to make 4 types of reference frequencies from the output of a highly stable crystal oscillator, and supplies to each unit as shown below.

Reference frequency	Location to be supplied and its application
1. 100 Hz	LOOP-1 unit Reference frequency of phase locked loop.
2. 125 kHz	LOOP-2 unit, Reference frequency of phase locked loop.
3. 35 MHz	MIXER unit, For frequency conversion in the 1st MIXER circuit.
4. 7 MHz	MODULATOR unit, Frequency for carrier.

The reference oscillator is a temperature-compensated, at 10 MHz, crystal oscillator (10 MHz, TCXO), and its frequency stability is  $1 \times 10^{-6}$  (1 PPM) deviation at ambient temperature of 0 – 50°C. 100 Hz and 125 kHz are made by dividing the output (TTL level) of the oscillator (XU-1). It also makes each reference frequency, 7 MHz by multiplying a 1/10 divider output 1 MHz by 7 and, 35 MHz by multiplying 7 MHz by 5.

#### 7.1.6 MIXER and AF AMP Unit, CHE-705

The MIXER circuit converts the frequency of 2000.0 – 2999.9 kHz output frequency of LOOP-1 to the frequency of 33,000.0 – 32,000.1 kHz by using the reference frequency of 35 MHz.

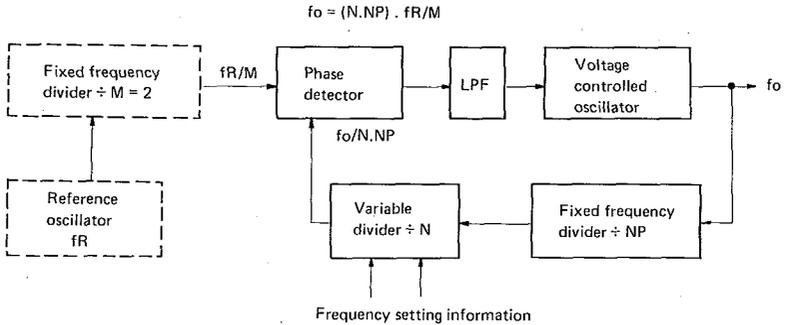
The 2 – 3 MHz output of the LOOP-1 is passed through the low-pass filter to remove the components of more than 3 MHz, and then, and fed to the 1st MIXER (IC1). Similarly, the 35 MHz reference frequency is fed to IC1 to convert the frequency. The output is passed through the band-pass filter (32.5 MHz B.P.F) of 32 – 33 MHz to remove unnecessary wave components. The filter output is amplified by two stages and the output is formed by the emitter follower. The AF AMP circuit consists of the compressor circuit (IC3), the analog switch (IC5, IC6), the level adjustment device (RV1 – RV4) and the voice amplifier (IC7). The microphone output (and TTY signal) is fed to the compressor circuit to be limited to the level in which overmodulation is not occurred even though over-amplitude is made.

As to the output (SIG LINE) of the FUNCTION CONTROL circuit, 1,500 Hz (for TONE), 800 Hz (for A2H) and mutual signals (for alarm signal) of 2,200 Hz 1,300 Hz are selected and a suitable signal is selected to transmit. The analog switch switches the selection of the compressor output and the SIG LINE, and the selection of the level setting device. Signals are amplified by the voice amplifier and are fed to the next stage (MODULATOR) at the required level.

#### 7.1.7 LOOP-2 Unit, CCF-706

This unit is a frequency generator to enable the setting of the 10 MHz digit and 1 MHz digit corresponding to the band frequency of the transmitter. The output frequency of 40 – 65 MHz is changeable in steps of 1 MHz. The operating theory is the same as that of the LOOP-1 unit except that there is a fixed frequency divider in the LOOP-2 unit.

Therefore, the output frequency  $f_o$  is shown as follows. \*



The numerical relation of this unit.

$f_R = 125$  kHz, supplied from the REFERENCE OSC unit.

$NP = 16$

$N = 40 - 65$

└── 1 MHz digit  
└── 10 MHz digit

By the frequency setting information from the FUNCTION CONTROL CIR, the 1 MHz digit is set at a value from 4 – 6.

$f_o = 40 - 65$  MHz, 1 MHz step

### 7.1.8 MODULATOR Unit, CME-708

This unit contains the following four kinds of circuits.

#### 7.1.8.1 Balanced modulator

When an AF signal (or 800 Hz signal) is applied to the 7 MHz balanced modulator (ICS), the upper and the lower side band waves are obtained at the output. (The 7 MHz component attenuates extremely when it is balanced by RV1, labeled "BALANCE ADJ".) The output of the balanced modulator is applied to the SSB filter which provides the following characteristics.

Characteristics of the SSB filter

- (1) Center frequency 6,998.5 kHz
- (2) Pass-band width 7,000 kHz  $-350 \sim -2,700$  Hz
- (3) Band width hump Within 3 dB
- (4) Attenuation characteristics
  - More than 25 dB at +1.5 kHz
  - More than 66 dB within +10 kHz
  - More than 60 dB within +100 kHz

Therefore, the upper side band is fully attenuated, and only the lower side band wave, so called the single side band wave (SSB signal) is obtained.

NOTE: In this case, this SSB signal is the lower side band wave, but it is eventually inverted in the 3rd MIXER and is emitted as an upper side band wave at the exciter output.

#### 7.1.8.2 7 MHz amplifier circuit

The output signal of the SSB filter (FL1) is a genuine single side band wave, which corresponds to the radio emission type A3J. For the radio emission types of A3A and A3H, the carrier wave is required in addition to the single side band wave signal. Then, a 7 MHz component of the required level is made and is overlapped with the single side band wave signal at the output of the SSB filter. For the radio emission type A1, the single side band wave is unnecessary, and only 7 MHz is amplified and fed to the next stage. 7 MHz amplifier is impressed with the power supply voltage (by the operation of TR1) only in the cases of the radio emission types of A1, A3A and A3H to amplify the 7 MHz. RV2, labeled "A1", RV3, labeled "A2H", RV4, labeled "A3H" and RV5, labeled "A3A" are the resistors to set the 7 MHz level, and to adjust the ratio of the 7 MHz and the single side band wave component at an appropriate level.

#### 7.1.8.3 2nd MIXER

The 7 MHz carrier wave signal, which is synthesized at the SSB filter output, and the 33,000.0 – 32,000.1 kHz at the MIXER unit output are applied to the MIXER circuit (IC1 and IC2) for frequency conversion. The output is passed through the band filter (39.5 MHz B.P.F) of 40 – 39 MHz to take out 40,000.0 – 39,000.1 kHz, and are amplified by the amplifier (IC3) to an appropriate level.

#### 7.1.8.4 KEY control

When the key is operated at key-down (mark condition), transistor TR2 operates as the base of TR2 is grounded, and +12 V appears at the emitter of the transistor. As the emitter output of the transistor TR2 is supplied to each MIXER circuit (1st MIXER, 2nd MIXER and 3rd MIXER) as a power voltage, each MIXER circuit actuates normally only under the mark condition (no emitted under space condition).

#### 7.1.9 WIDE BAND AMP Unit, CAF-708

In this unit, the 40,000.0 and 39,000.1 kHz signals from the MODULATOR unit, corresponding to the channel frequency, are converted by a frequency of 40 – 65 MHz, corresponding to the band frequency and to obtain agreed frequency with the transmission frequency in a range of from medium wave band to 25 MHz band. Furthermore, signals in this frequency range are almost uniformly amplified.

#### 7.1.9.1 3rd MIXER

The 2nd MIXER output frequency of 40,000.0 – 39,000.1 kHz of the MODULATOR unit and the LOOP-2 unit frequency of 40 – 65 MHz (1 MHz step) are fed to the MIXER circuits (IC1 and IC2). The unnecessary components of over 26 MHz of the output are sufficiently attenuated by a low-pass filter (26 MHz L.P.F), and only the required frequency components in the range of less than

26 MHz are picked up.

#### 7.1.9.2 WIDE BAND AMP

This is a three-stage transistor amplifier, and the required frequency signals in a range of 0.4 – 26 MHz are almost uniformly amplified. The output voltage is approx. 1.1 V RMS (50-ohm).

#### 7.1.9.3 Power setting attenuator

The WIDE BAND AMP output is set at the required power by changing over 4 attenuator circuits by the specified power.

FULL:	0 dB
MED1:	-6 dB
MED2:	-12 dB
LOW:	-18 dB

#### 7.1.9.4 Level selector for band

This selector is provided to set to the most suitable signal level when changing the band and channel.

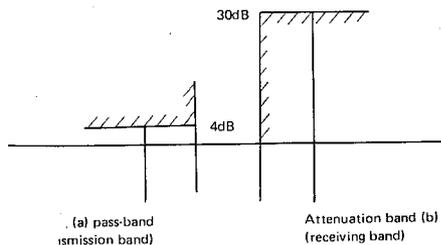
for MF	Three (MF-1, MF-2, MF-3)
for IF	One (IF)
for HF	Three (HF-1, HF-2, HF-3)

#### 7.1.10 NOISE SUPPRESSOR FILTER Unit, CFJ-709

Some kinds of noise generated in the solid state circuit of the exciter sometimes interfere with the receiver in simultaneous communication (DUPLEX) of the SSB telephony. This unit removes this noise and ensures smooth operations of the simultaneous communication. The filter circuit is provided to ensure smooth simultaneous communication. The low-pass filter (L.P.F) prepared exclusively for each band is provided as a noise filter and the transmission frequency band is sent through the filter. The frequency components of the receiving frequency band are attenuated approx. 30 dB.

In the communication of telegraphy and the SSB telephony (SIMPLEX), the signals do not pass the filter, and the resistance attenuator is inserted for the appropriate level adjustment.

Characteristics of noise filter



Band	Pass band (kHz)	Attenuation band (kHz)
4 MHz	4063 – 4143.6	4357.4 – 4438
6 MHz	6200 – 6218.6	6506.4 – 6525
8 MHz	8191 – 8291.1	9718.9 – 8815
12 MHz	12330 – 1242.9.2	13100.8 – 13200
16 MHz	16460 – 16587.1	17232.9 – 17360
22 MHz	22000 – 22124	22596 – 22720

## 7.2 Power Amplifier, NAF-501A

The power amplifier consists of two linear amplifiers of drive and power amplifier, their peripheral circuits, tuning condition and power detection circuits, overload detection circuit, voltage and current measurement circuits, and the antenna matching circuit. The cooling fan for the power amplifier and the antenna ammeter are installed in one cabinet.

### 7.2.1 Drive amplifier, CAF-501

This is a transistor amplifier. The initial stage (TR1 and TR2) are class "A" amplifiers. The final stage (TR3 and TR4) are class "AB" amplifier. The input and output, and the coupling of stages are all transformer couplings to obtain appropriate impedance matching. The collector power for each stage is supplied by a separate +28 V DC voltage stabilizer circuit. In the space condition, by the use of KEY control (TR7 and TR8), the base voltage of each stage approaches 0 V, and none of these stages performs amplification.

Characteristics of the drive amplifier

Input impedance	50-ohm
Output impedance	50-ohm
Frequency characteristics	0.4 – 26 MHz $\pm$ 1.5 dB
Amplification	Approx. 30 dB

### 7.2.2 Power amplifier

A forced-air cooled ceramic type tetrode (RCA, 8122  $\times$  3) is operated at class "AB1".

Voltage and current for each electrode (designed value, indicates the sum of four tubes.)

Plate voltage	2,200 V
Plate current	0.9 A
Screen grid voltage	400 V
Screen grid current	30 mA maximum
Control grid voltage	-34 V (typical)
Control grid current	0

As the screen grid current changes greatly depending on the magnitude of the load impedance, the appropriateness of the load impedance can be judged from this value. In addition, it is an effective indicator of tuning detection of load tuning circuit. (This value is maximum at the tuning point.) The plate current is 300 mA at no signal, and

0.9 A (max.) at the rated power. (This should be used within a range not exceeding 0.9 A.)

The signals sent from the drive amplifier is fed to the control grid of the power amplifier is fed to the control grid of the power amplifier V1 after its high harmony wave components have been removed by the low band filter (26 MHz L.P.F) of the input circuit.

### 7.2.3 Tuning condition and power value detection circuit.

This circuit consists of the control grid input voltage of the power amplifier and the detection circuit of the plate output voltage.

The voltage obtained by condensers (C2 and C27) is detected by diodes (CD1 and CD3), and the detected current is coupled with the inverse phase and measured by the meter (M1).

As the plate output voltage is maximum at the maximum point of the load side tuning circuit, the meter shows the minimum deflection. (Detection of **TUNE** .)

As the magnitudes of indicated values (plate output voltage) at the minimum deflection of meter are in proportion to the magnitudes of load resistance, it indicates the optimum load condition in the tuning point under the constant input voltage. (Detection of **LOAD** .)

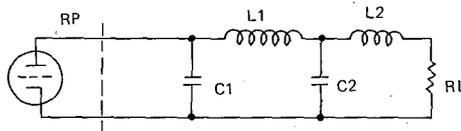
### 7.2.4 Overload Detection Circuit

In a **DETUNE** condition of the load tuning circuit for the power amplifier, the load resistance for the power amplification is extremely low. As a result, the plate current increases, and the plate input increases greatly, while the output power is low. This results in the excess plate loss and the deterioration of the vacuum tubes. The temperature sensor (R9) reacts at approx. 150°C of the plate temperature of the vacuum tubes (indicates a high resistance value), and the overload control circuit on the power supply unit operates to cut off the screen grid and the plate power source.

## 7.3 IF. HF TUNING, NFF-501

There are two purposes for an antenna matching circuit. One is to adjust the antenna impedance to the optimum impedance of the power amplifier. The other is to tune the antenna to the transmitting frequency to remove unnecessary higher harmonic components. The antenna matching circuit is of the  $\pi$ -L type tuning circuit. As this circuit is a form of a low-pass filter, it is effective in attenuation of higher harmonics.

The relation between the input and output impedance for the type circuit is as follows.



RP	Load resistance of vacuum tube
RL	Antenna resistance
C1	Input capacitor
C2	Output capacitor
L1, L2	Inductance

(The actual antenna impedance is not a pure resistance. But, the reactance part can be cancelled by C2 and L2.)

$$\frac{RP}{RL'} \doteq \left(\frac{C2}{C1}\right)^2 \quad \therefore RL' \doteq \left(\frac{C1}{C2}\right)^2 \cdot RP$$

$$\therefore RL' \doteq RL (1 + S^2)$$

$$\therefore S = \frac{XL2'}{RL} \quad (XL2' \text{ indicates the rest after cancelling the reactance of the antenna.})$$

For this transmitter, C1 and C2 are fixed, and L1 and L2 are variable. Therefore, the degree of coupling is adjusted by reducing or increasing L2 depending on whether the antenna resistance is high or low.

Circuit tuning is accomplished by adjusting the inductance L1.

$$\text{Tuning frequency of circuit} = \frac{1}{2\pi\sqrt{LC}}$$

$$\therefore C = \frac{C1 \cdot C2}{C1 + C2}$$

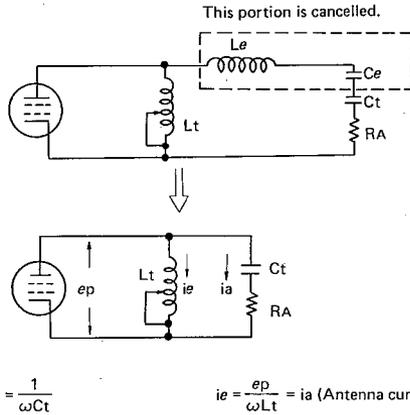
The fixed capacitors (C1 – C5) at the input side are changed over by the BAND switch (S1), and connected to the circuit.

The fixed capacitors (C7 – C11) at the output side are changed over by the BAND switch (S1-2), and connected to the circuit. (Suitable value is selected by the antenna resistance.) The variable rotary type coil of 45  $\mu$ H, maximum, is employed for inductances L1 and L2.

#### 7.4 MF TUNING, NFG-501

In normal ship's antenna, the antenna constant in MF band indicates the value connected in series, resistance of several ohms and capacity of 400 – 700pF. In MF band, as the frequency band width is narrow, and variation of antenna constant by frequency is little, a simple easy tuning circuit is employed.

This portion is cancelled.



As the antenna current is approximately equal to the current flow in the variable coil, the coupling degree can be changed by changing the  $L_t$ . In the actual circuit,  $L_t$  is engaged with  $L_1$  and the inductance can be varied. Also, the fixed capacitors ( $C_{12}$ ,  $C_3$ ) can be selected to connect to the circuit for correction of  $L_t$ . (Channel relay, K1 – K3).

## 7.5 Power Supply, Unit, NBL-501

This part includes various power supply circuits for the transmitter. DC24 V power supply, AC100 V power supply, AC10 V power supply AC16 V power supply, DC34 V power supply, DC28 V power supply, DC400 V power supply and DC2,200 V power supply, and as peripheral circuits, LT control circuit, a minute timer circuit, overload control circuit and HT control circuit are provided.

### 7.5.1 Input Voltage

AC440 V  $\pm 10\%$ , 50/60 Hz  
3.5 kVA at maximum input

### 7.5.2 Various Power Supply

Name	Output	Application
1. DC24 V power supply	DC24 V, 5.0 A	Excitation power supply for various relays.
2. AC100 V power supply	AC100 V, 0.6 A	Motors for power amplifier cooling fan and for driving rotary coils.
3. AC10 V power supply	AC10 V, 3.2 A	For $\pm 5$ V power supply of the exciter.

Name	Output	Application
4. AC15 V power supply	AC15 V, 3.2 A	For $\pm 12$ V power supply of the exciter.
5. AC 13.5 V power supply	AC13.5 V, 5.2 A	Power amplifier, for filament power supply
6. -DC34 V power supply	-DC34 V, 0.3 A	Power amplifier, for bias power supply
7. DC28 V power supply	DC28 V, 3.2 A	Power supply for drive amplifier.
8. DC400 V power supply	DC400 V, 50 mA	Power supply for screen grid of the power amplifier.
9. DC2,200 V power supply	DC2,200 V, 1.2 A	For plate power supply of the power amplifier.

### 7.5.3 LT Control Circuit (Drawing NO. DD00-NBL-501)

The [ST-BY] button of the [SUPPLY] switch located on the exciter panel is pushed. Then, the relay K1 operates and +24 V is applied to the exciting coil of the relay K2, and the relay K2 operates. +24 V power is fed to the exciting coil of the LT control relay K1 (drawing NO. DD00-NBL-501) by passing through the contact of the relay K2, and the relay K1 operates. Consequently, AC440 V is impressed to the first stage of the transformer T2, and respective LT power supply will turn ON.

### 7.5.4 One Minute Timer Circuit

As the power amplifier tube (8122) requires a minute of filament preheating time, a minute time lapse controls a relay control circuit so that the plate power is supplied one minute after the filament power is turned ON.

In the [OFF] position, the power is not supplied to the anode of the transistor TR45, but the [ST-BY] button of the [SUPPLY] switch is depressed, power is supplied to the anode of the transistor TR45. The anode gate voltage of the transistor TR45 (which is determined by the time constant of R58, R67 and C60) is decreased gradually in a curve, and approx. a minute later, the transistor TR45 will turn ON. The timer relay operates when the TR45 turns ON and closes the control line of the HT control relay.

### 7.5.5 Overload control circuit

#### A: Temperature detection of vacuum tube

The temperature sensor (R9) which is installed on the top of the power amplifier tube indicates, in general, several ohms. When the power amplifier tube is rised in temperature by overload (DETUNE), the sensor indicates high resistance (several kilo-ohm) suddenly. The R9 becomes high resistance, and the base voltage of the transistor (TR8) will rise to turn ON. Then, the relay K4 operates. The gate of the IC (IC4) for HT control is changed to H level from the L level by the contact of the relay K4, and cuts off the HT power supply.

B: +2,200 V overcurrent control

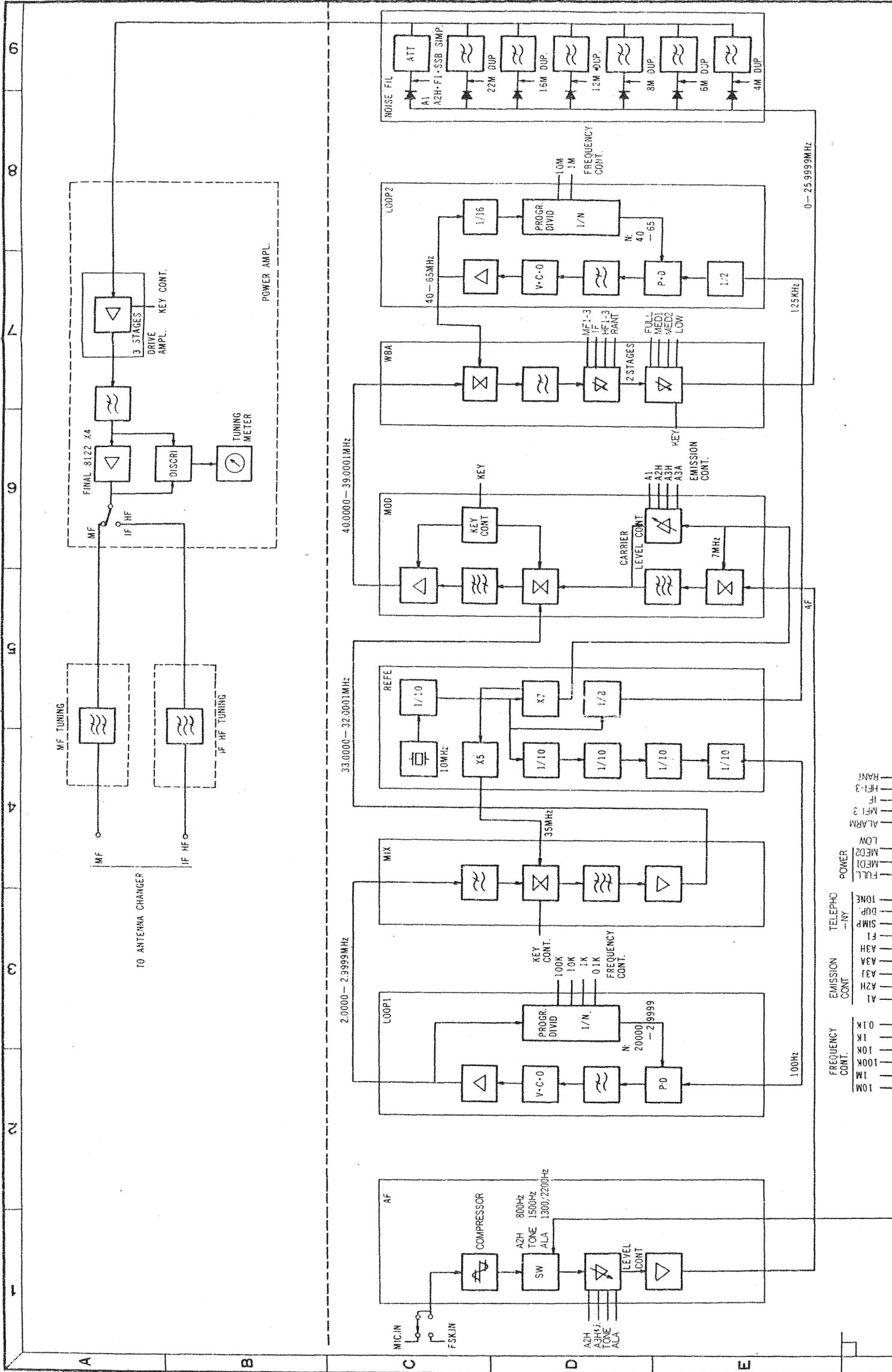
The both ends voltage of the series resistance (R103) in the +2,200 V circuit for power amplifier tube plate power supply is fed to the comparator (IC5). When it exceeds the reference voltage (set by RV4), turn ON the transistor (TR10) to operate the relay K4. (The RV4 is set when the current of the +2,200 V circuit exceeds 2 A.)

As the relay K4 keeps itself in operating condition, if the overload control circuit is required to reset, turn ON the  ST-BY and  HT buttons after turning  OFF the  SUPPLY switch once.

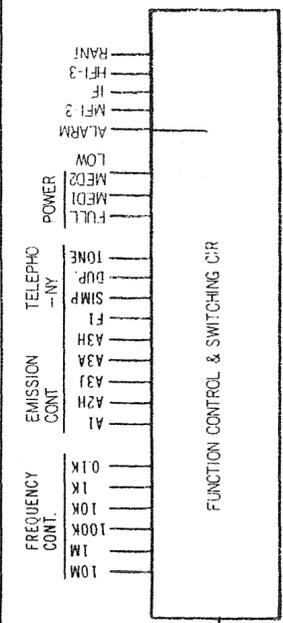
7.5.6 HT control circuit

When the  SUPPLY switch located on the excited panel turns  ON the No. 11 gate of the IC (IC4) for HT control becomes L level (in case all other gate of the IC4 are L level) and the output of the IC4 becomes H level. In this case, the base voltage of the transistor (TR7) will rise. Therefore, the transistor TR7 will turn ON, the relay K3 will operate and +24 V will be fed to the exciting coil of the HT control relay K2 (drawing No. DD00-NBL-501) (by passing through the contact of the K3). Then, the K2 will operate. Consequently, AC440 V is supplied to the first stage of the transformer T1/T101 and the HT power turns ON. The respective gates of the HT control IC (IC4) are connected to the following circuit.

No. 12 gate	OLR CONT circuit (K4)
No. 10 gate	LT CONT circuit (K1)
No. 9 gate	-34 V voltage detector circuit (K5)
No. 5 gate	One minute timer circuit (TR9)

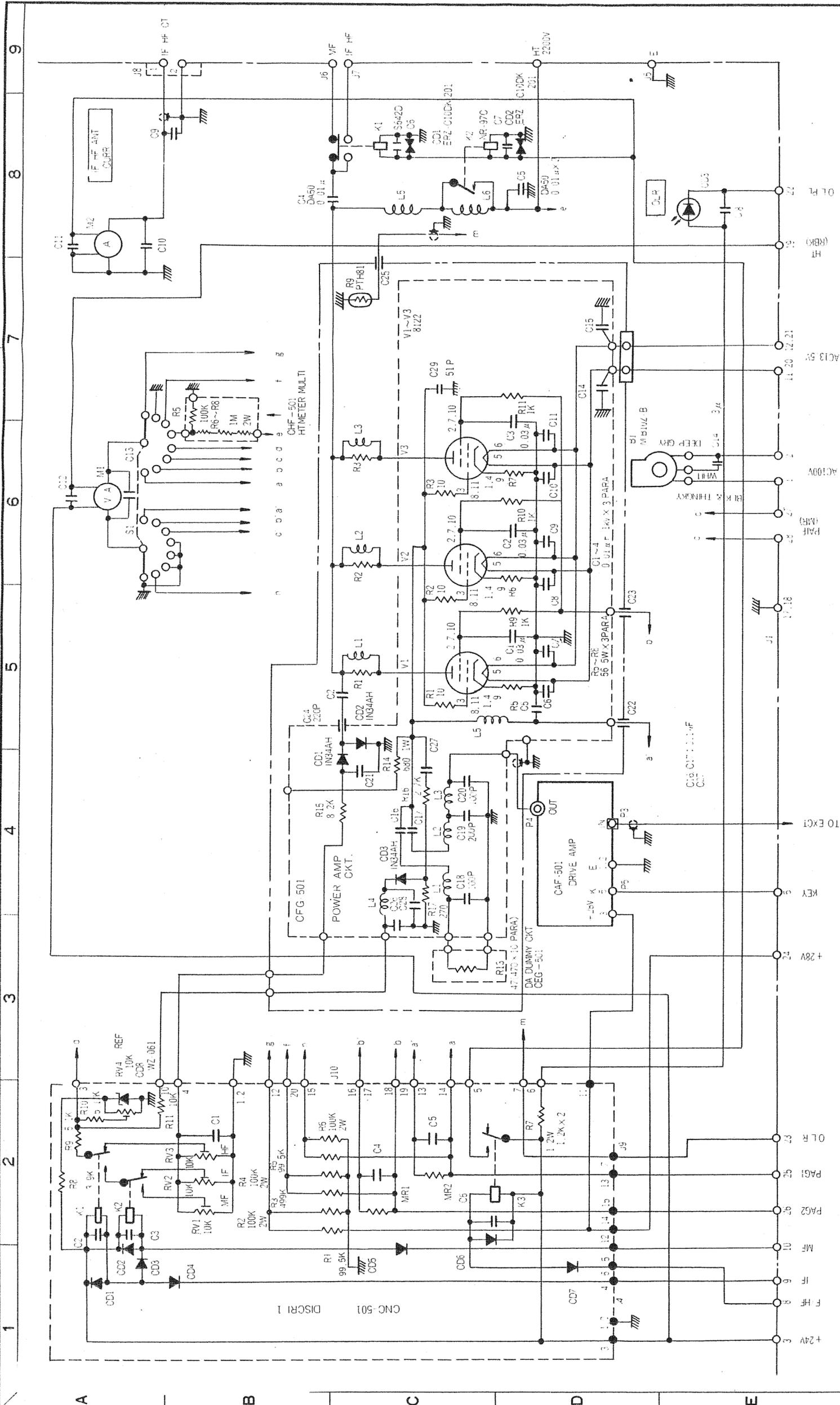


APPROVED	DATE	TITLE	SHEET NO
<i>M. Miyajima</i>		NSD-51 1.2KW TRANSMITTER	1/21
CHECKED	SCALE	BLOCK DIAGRAM	
<i>K. Tanaka</i>	A3		
DESIGNED DRAWN		DRAWING NO.	
		DA00-NSD-51	
JRC Japan Radio Co., Ltd.			

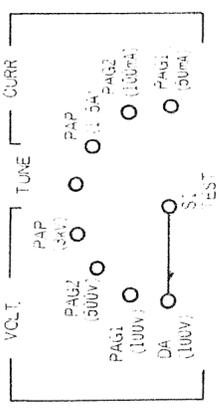


ARRANGE NO.	REVISIONS

G. 114 3rd Angle System Dimension mm

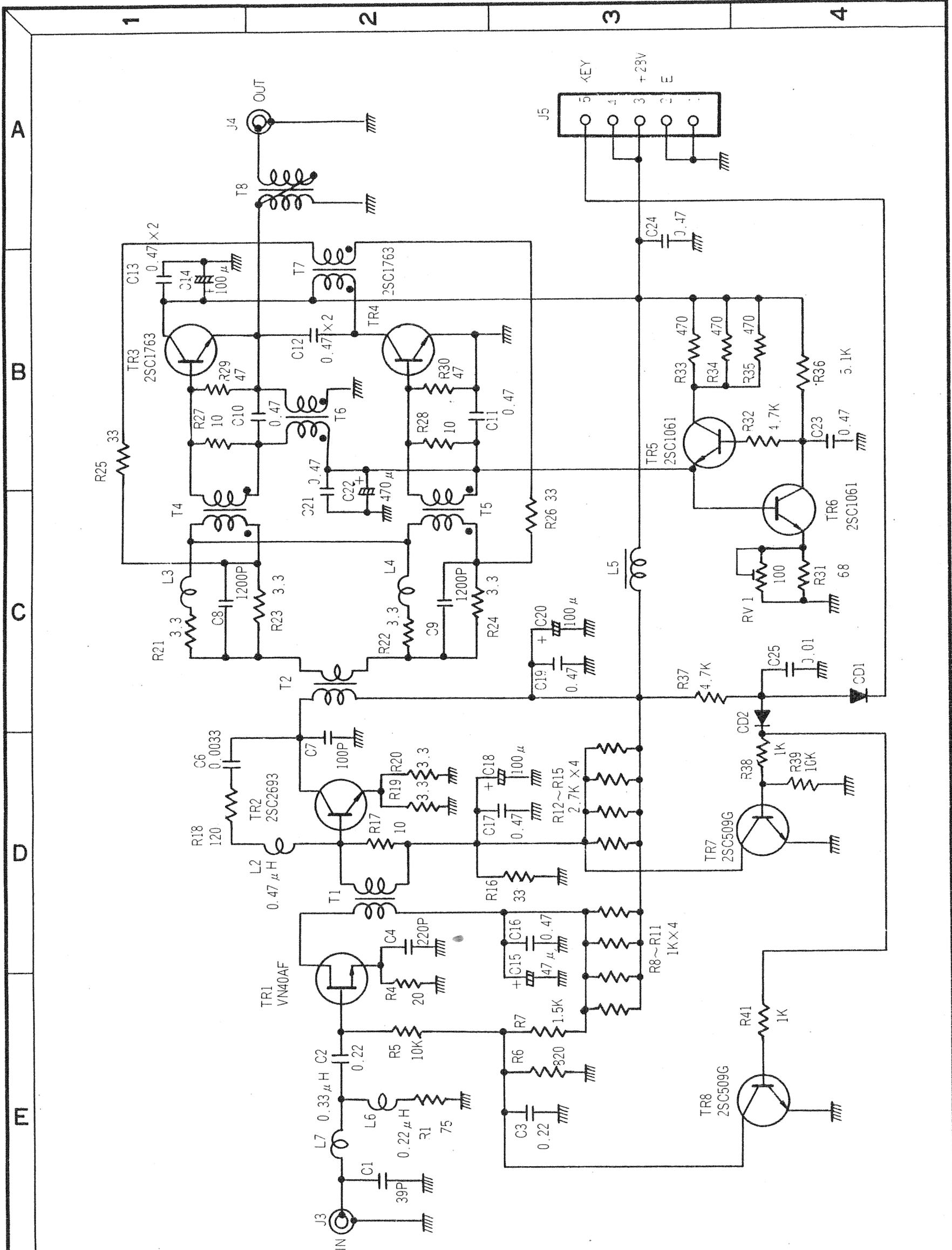


NOTES: 1 UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE 0.01 μF  
 2 RESISTANCE ARE IN OHMS : K = 1000



ARRANGE NO.	REVISIONS

APPROVED	DATE	TITLE	SHEET NO.
CHECKED	SCALE	NAF-501A	2/21
DESIGNED DRAWN	A 3	POWER AMPLIFIER	DRAWING NO.
JRC Japan Radio Co., Ltd.		DD00 - NAF - 501A	

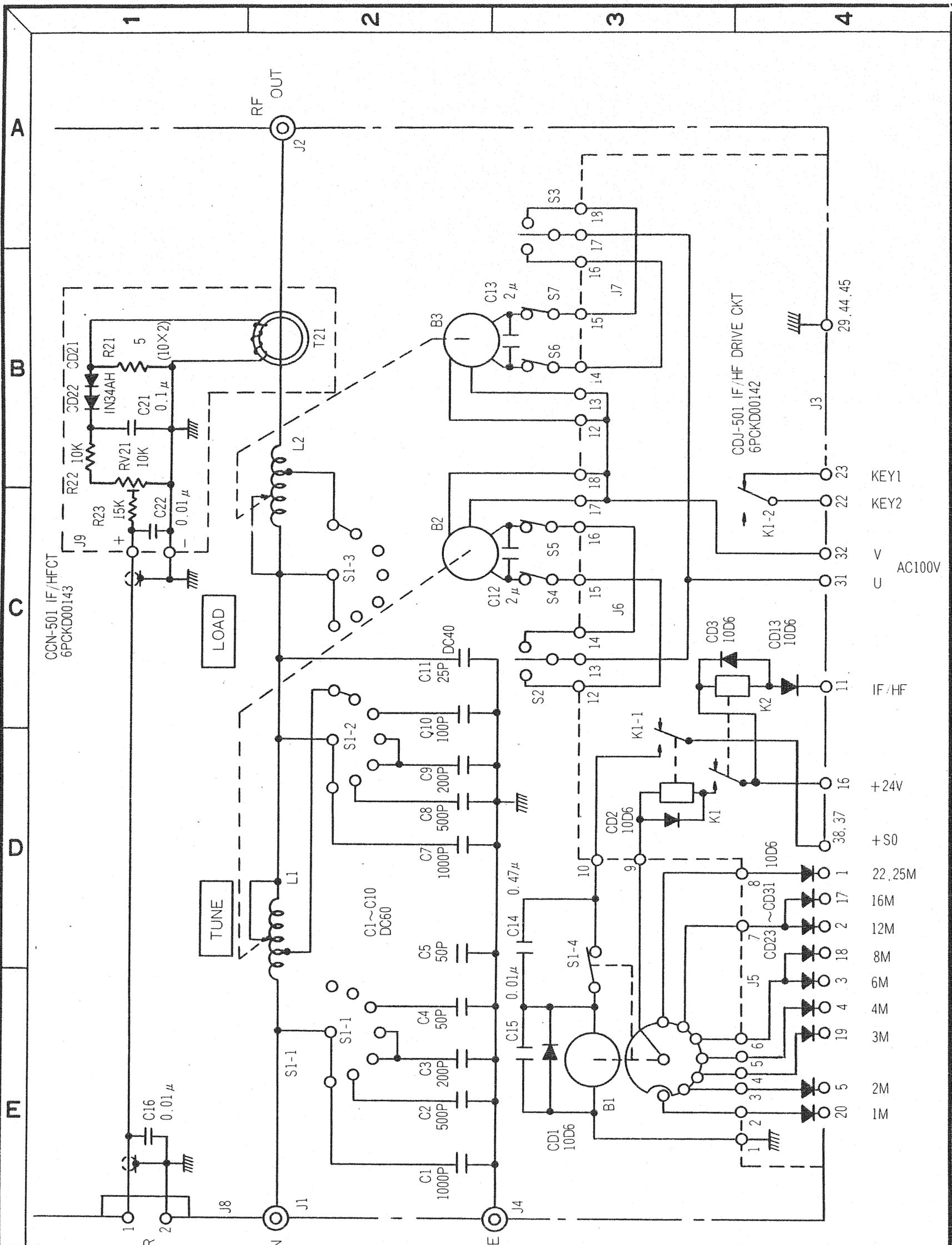


ARRANGE NO.

REVISIONS

P.C.Card, 6PCKD00135

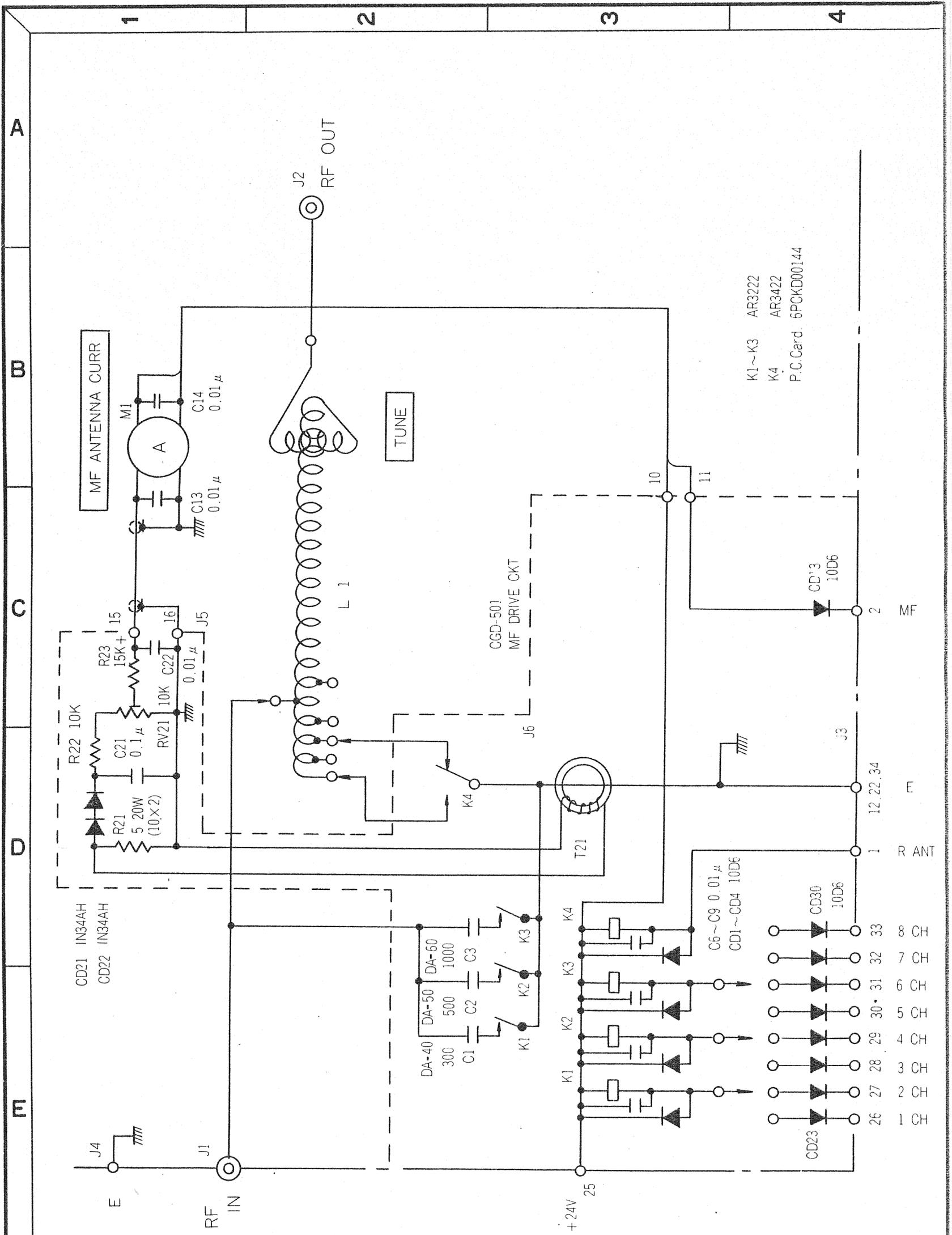
APPROVED <i>[Signature]</i>	DATE	TITLE <b>CAF-501 DRIVE AMP</b>	SHEET NO. <b>3/21</b>
	SCALE		
CHECKED <i>[Signature]</i>	DESIGNED DRAWN <i>[Signature]</i>	<b>A 4</b>	DRAWING NO. <b>DD00-CAF-501</b>
<b>JRC Japan Radio Co., Ltd.</b>			



ARRANGE NO.

REVISIONS

<p>APPROVED</p> <p><i>M. Nishizawa</i> / <i>K. M. ...</i></p>		<p>DATE</p>		<p>TITLE</p> <p>NFF-501 IF/HF ANT MATCHING UNIT</p>		<p>SHEET NO.</p> <p>4/21</p>	
<p>CHECKED</p> <p><i>K. Tamura</i></p>		<p>DESIGNED DRAWN</p>		<p>SCALE</p> <p>A 4</p>		<p>DRAWING NO.</p> <p>DD00-NFF-501</p>	
<p><b>JRC</b> Japan Radio Co., Ltd.</p>							



K1~K3 AR3222  
 K4 AR3422  
 P.C.Card. 6PCKD00144

ARRANGE NO.

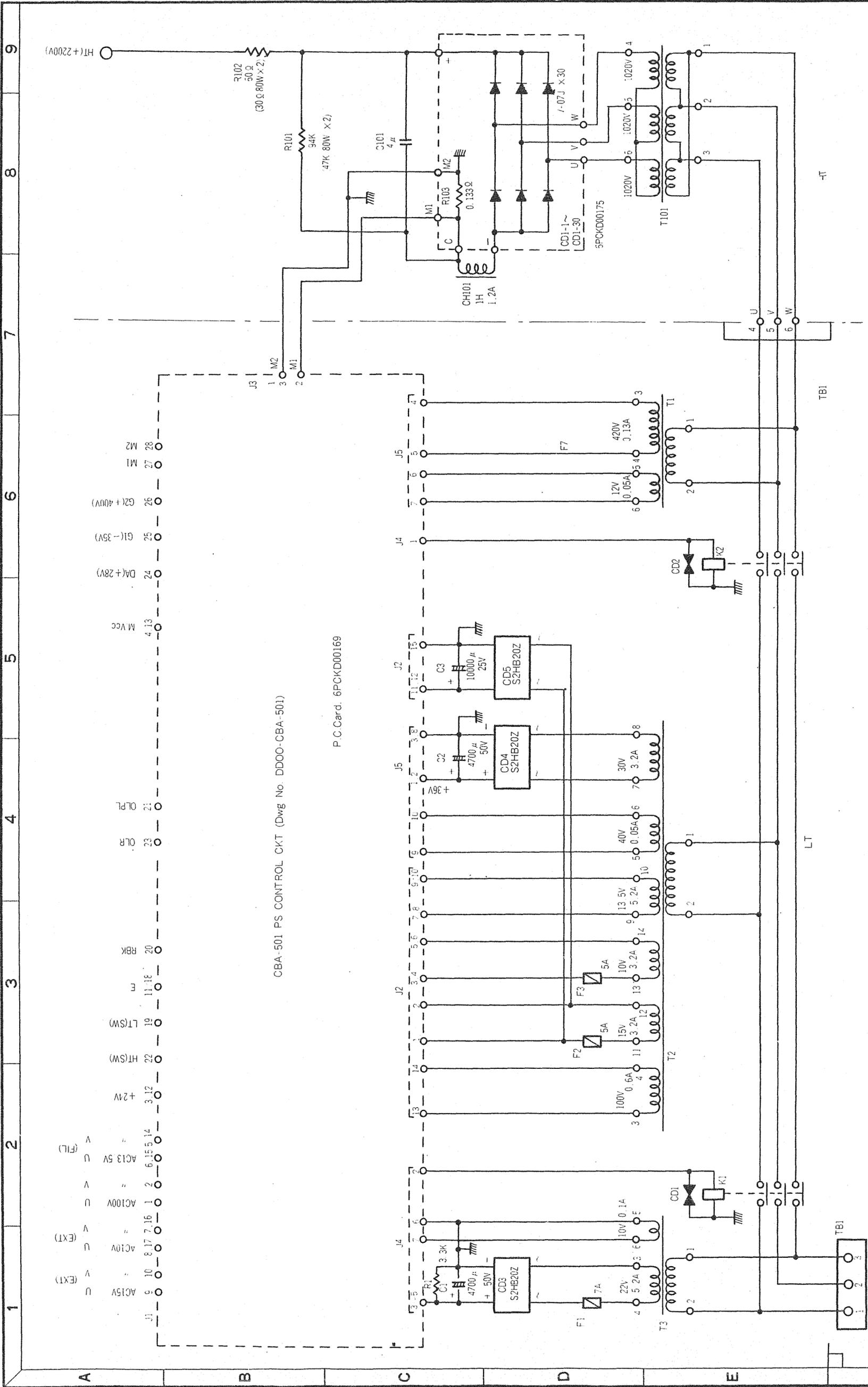
REVISIONS

APPROVED <i>[Signature]</i>	DESIGNED DRAWN	DATE	TITLE NFG-501 MF ANTENNA TUNING	SHEET NO. 5/21
		SCALE		

A 4

**JRC** Japan Radio Co., Ltd.

D D 0 0 - N F G - 5 0 1

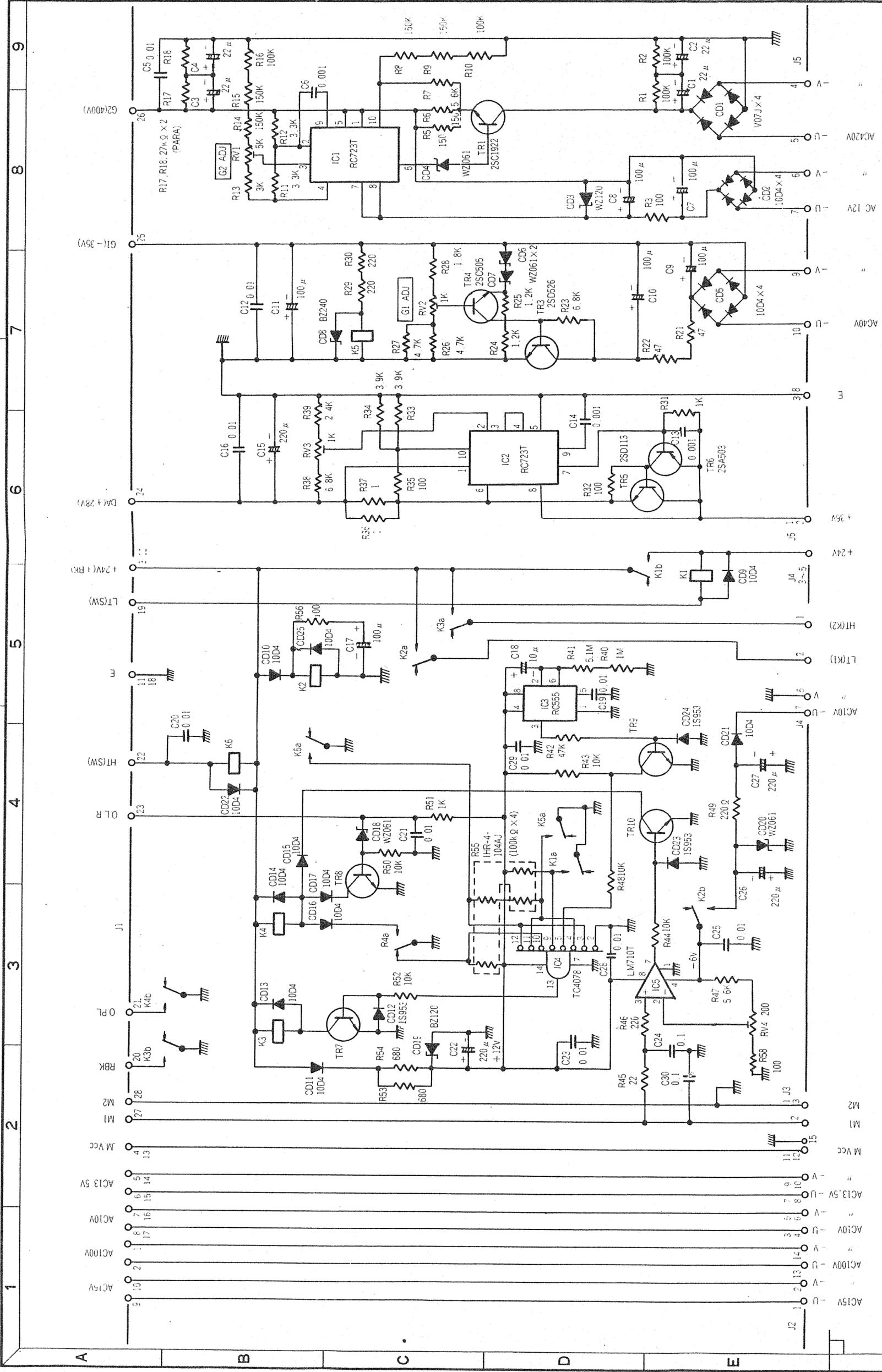


CBA-501 PS CONTROL CKT (Dwg No. DD00-CBA-501)

P.C.Card: 6PCKD00169

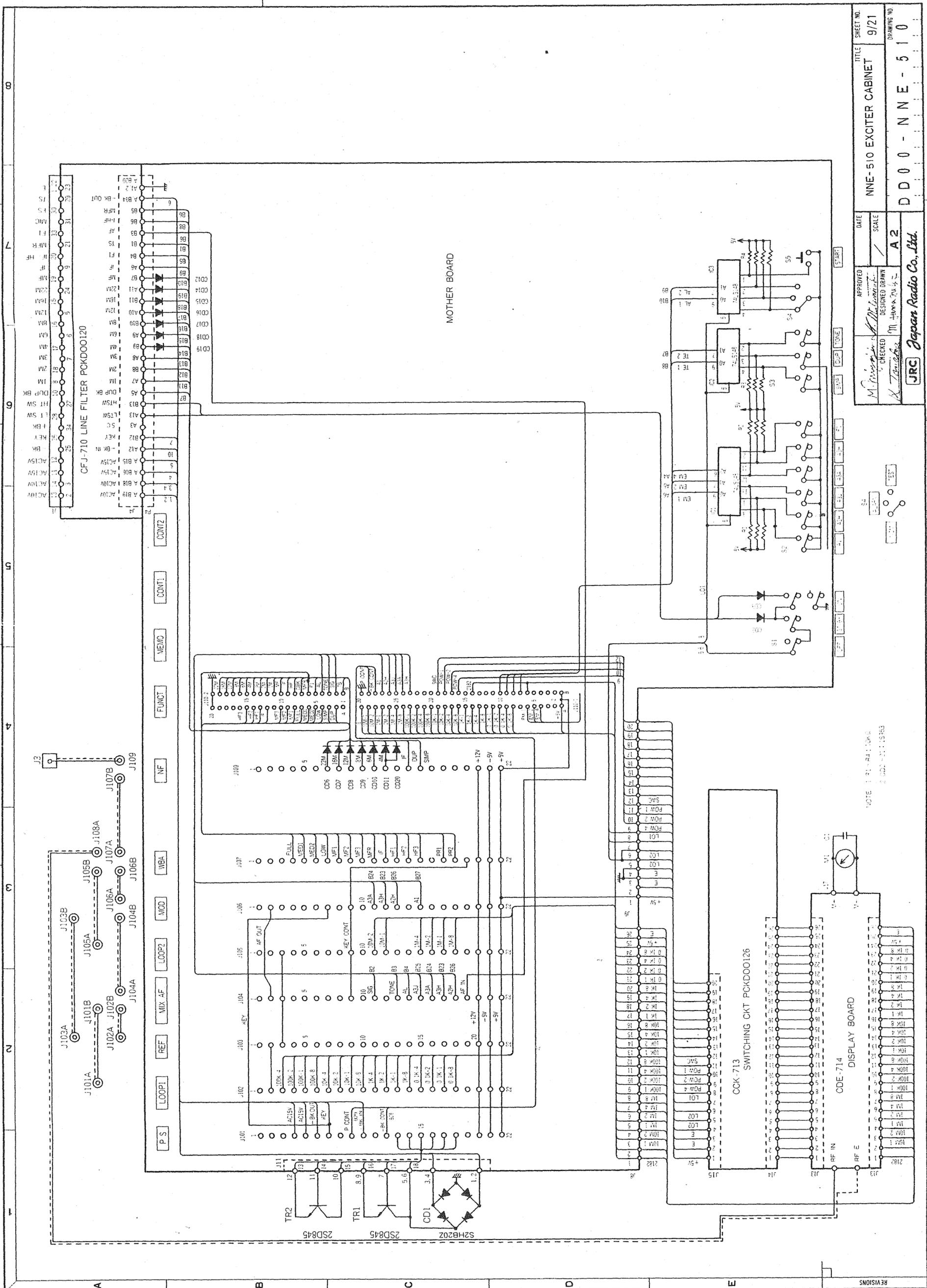
APPROVED	DATE	TITLE	SHEET NO.
DESIGNED DRAWN	SCALE	NBL-501 POWER SUPPLY	6/21
CHECKED	A 3	DRAWING NO.	
JRC Japan Radio Co., Ltd.		DD00 - NBL - 501	

CD1, CD2, ERZ-C14DK201  
K1, K2 SRC3651-5 1G



ARRANGE NO.	REVISIONS	G. 814 3rd Angle System Dimension mm	
		P. C. Card: 6FOK000.69	
		TR7~TR10: 2SC509②	
		TR1: 2SC1922	
		TR2: 2SD526	
		TR3: 2SD526	
		TR4: 2SC505	
		TR5: 2SD113	
		TR6: 2SA503	
		TR7: 2SC509②	
		TR8: 1HR-4-104AJ	
		TR9: 2SD526	
		TR10: 2SD113	
		TR11: 2SD113	
		TR12: 2SD113	
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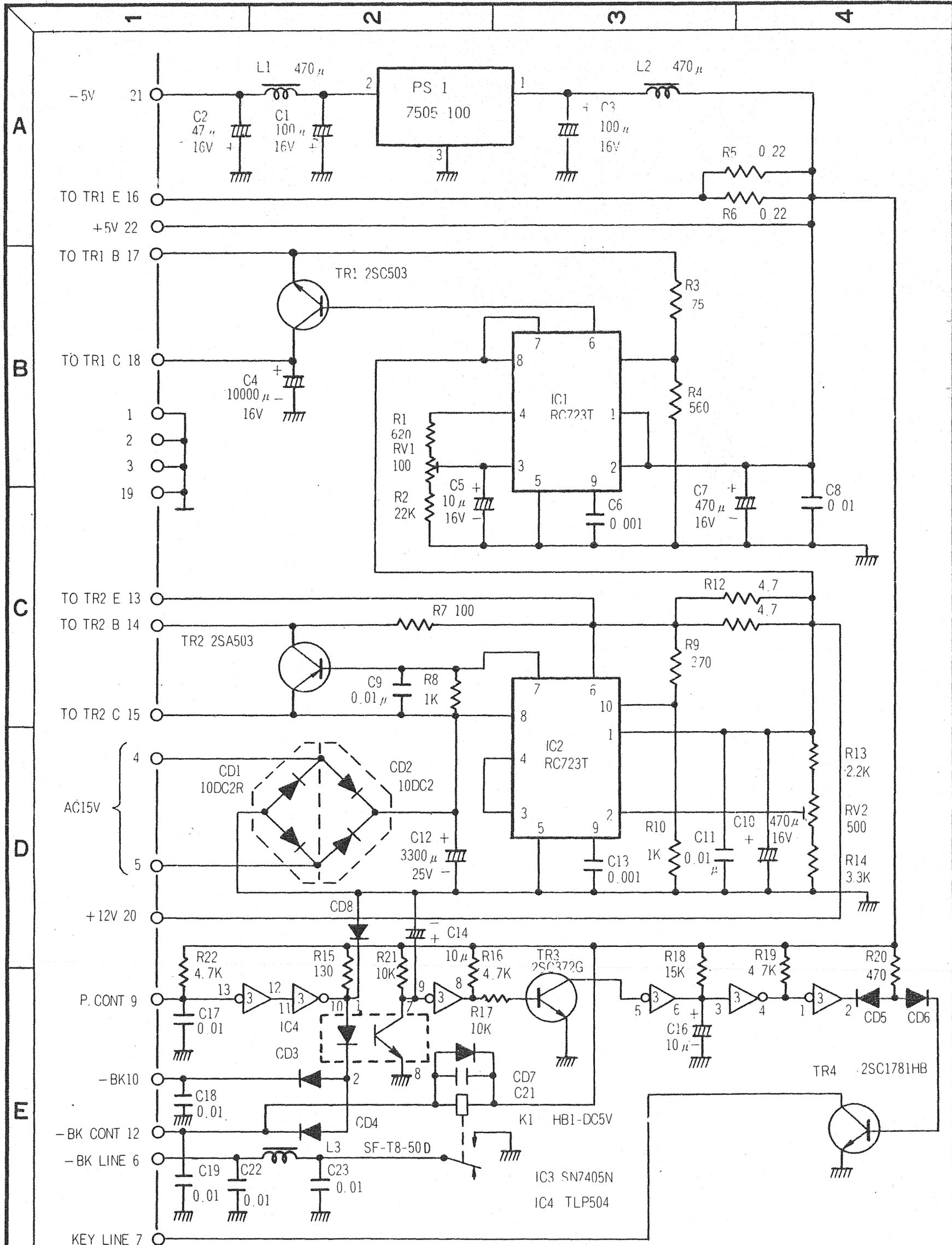


ARRANGE NO	REVISIONS	DATE	TITLE	SHEET NO.
			NNE-510 EXCITER CABINET	9/21
		SCALE	DESIGNED DRAWN	DRAWING NO
		A 2	M. Iwano M. Iwano	DD00 - NNE - 510

APPROVED: *M. Iwano*  
 CHECKED: *M. Iwano*  
 DESIGNED DRAWN: *M. Iwano*  
**JRC Japan Radio Co., Ltd.**

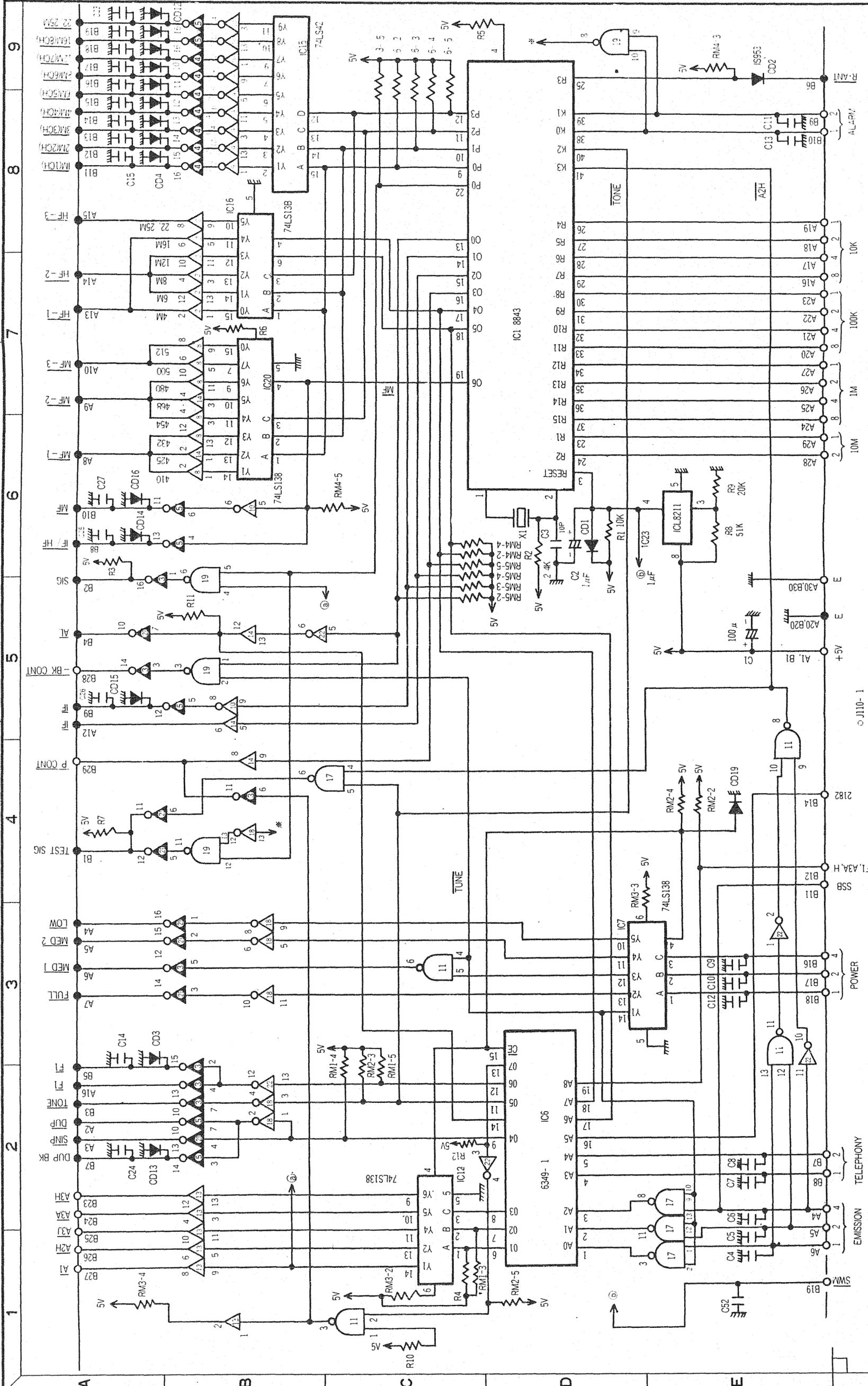
NOTE: 1. RF IN: 100V  
 2. RF OUT: 100V

3rd Angle System Dimension mm



REVISIONS

ARRANGE NO.	APPROVED	DATE	TITLE	SHEET NO.
	CHECKED	SCALE		
	DESIGNED DRAWN	A 4	DRAWING NO.	
				CBD-700 POWER SUPPLY ±5V/+12V 10/21 DD00-CBD-700



ARRANGE NO. \_\_\_\_\_

REVISIONS

A1	A2H	F1	A3J	A3A	A3H
A4	A5	A6	A7	A8	A9

B7	B8
SIMP	DUP
TONE	

B16	B17	B18
TUNE	FULL	MEDI
MEDI	MEDI	LOW

B9	B10
NORM.	ALARM
TEST	START

TELEPHONY

EMISSION

POWER

ALARM

3rd Angle System Dimension mm

51 814

APPROVED \_\_\_\_\_  
DESIGNED DRAWN \_\_\_\_\_  
CHECKED \_\_\_\_\_  
M. Yamaguchi

DATE \_\_\_\_\_

SCALE \_\_\_\_\_

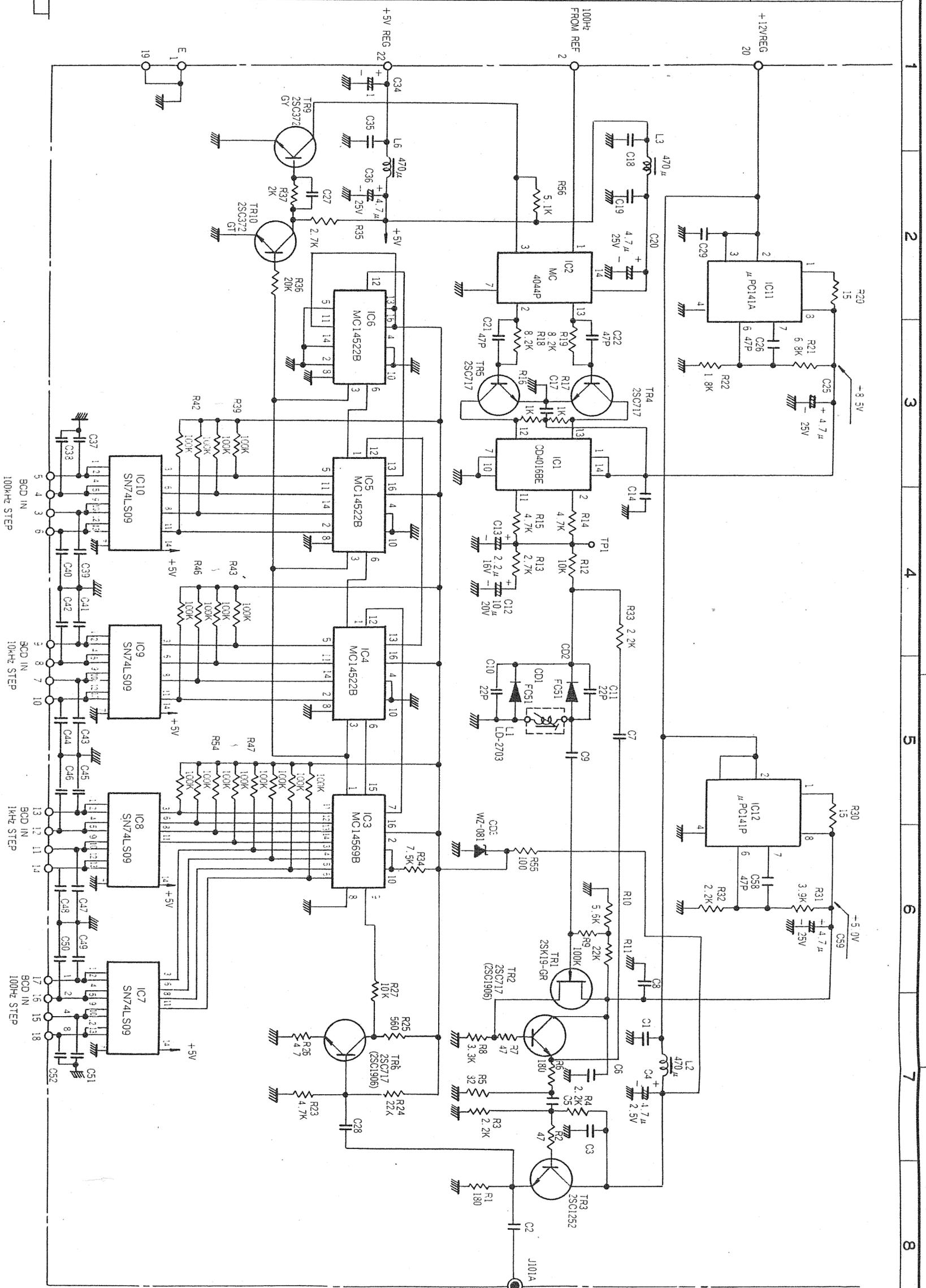
A3

JRC Japan Radio Co., Ltd.

TITLE CDJ-702-F FUNCTION CONTROL

SHEET NO. 11/21

DRAWING NO. DD00-CDJ-702-F



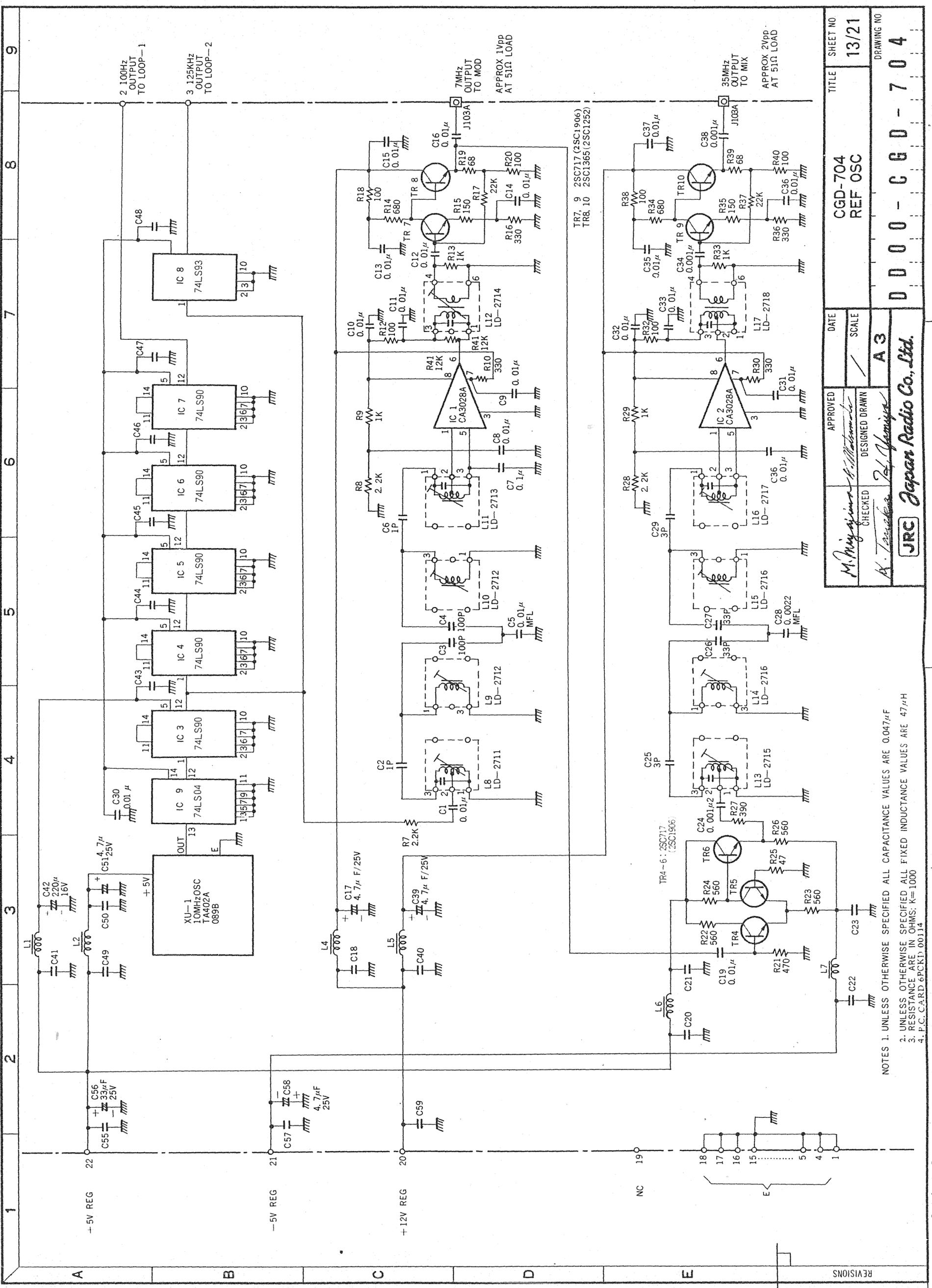
NOTE: UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE 0.047 $\mu$ F  
P.C. Card: 6PCKD00113

REVISIONS

ARRANGE NO.

3rd Angle System Dimension mm

APPROVED	DATE	TITLE	SHEET NO.
CHECKED	SCALE	CCF-703	12/21
DESIGNED DRAWN		LOOP-1	
A3		DD00-CCCF-703	DRAWING NO.
JRC Japan Radio Co., Ltd.			

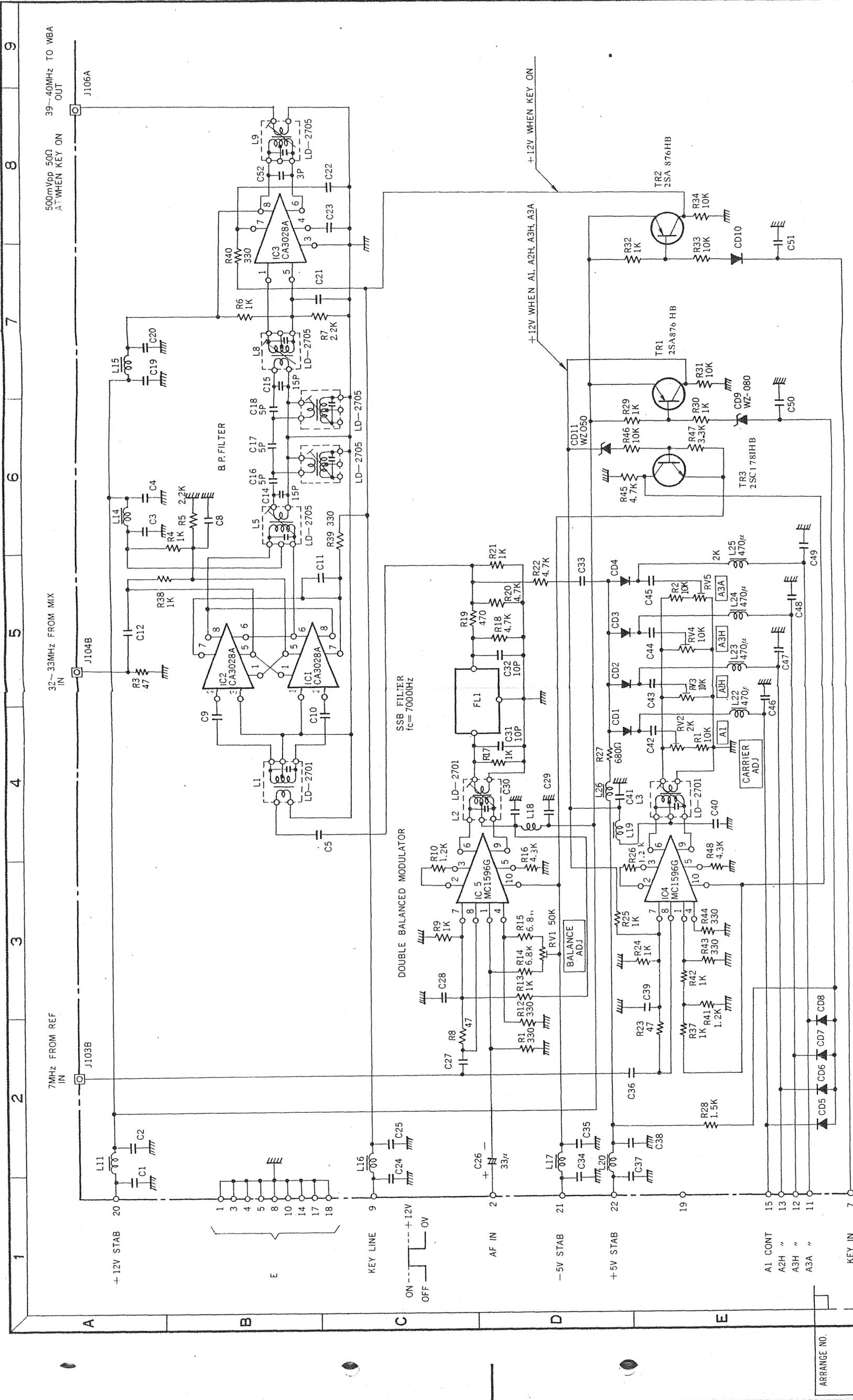


TITLE	CGD-704 REF OSC	SHEET NO	13/21
DATE		SCALE	
APPROVED	<i>M. Miyajima</i>	DESIGNED DRAWN	<i>A.3</i>
CHECKED	<i>A. Tanaka</i>		
JRC Japan Radio Co., Ltd.		D D O O - C G D - 7 0 4	
DRAWING NO		DRAWING NO	

NOTES 1. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE 0.047μF  
 2. UNLESS OTHERWISE SPECIFIED ALL FIXED INDUCTANCE VALUES ARE 47μH  
 3. RESISTANCE ARE IN OHMS; K=1000  
 4. P.C. BOARD 6PCK1, 00114

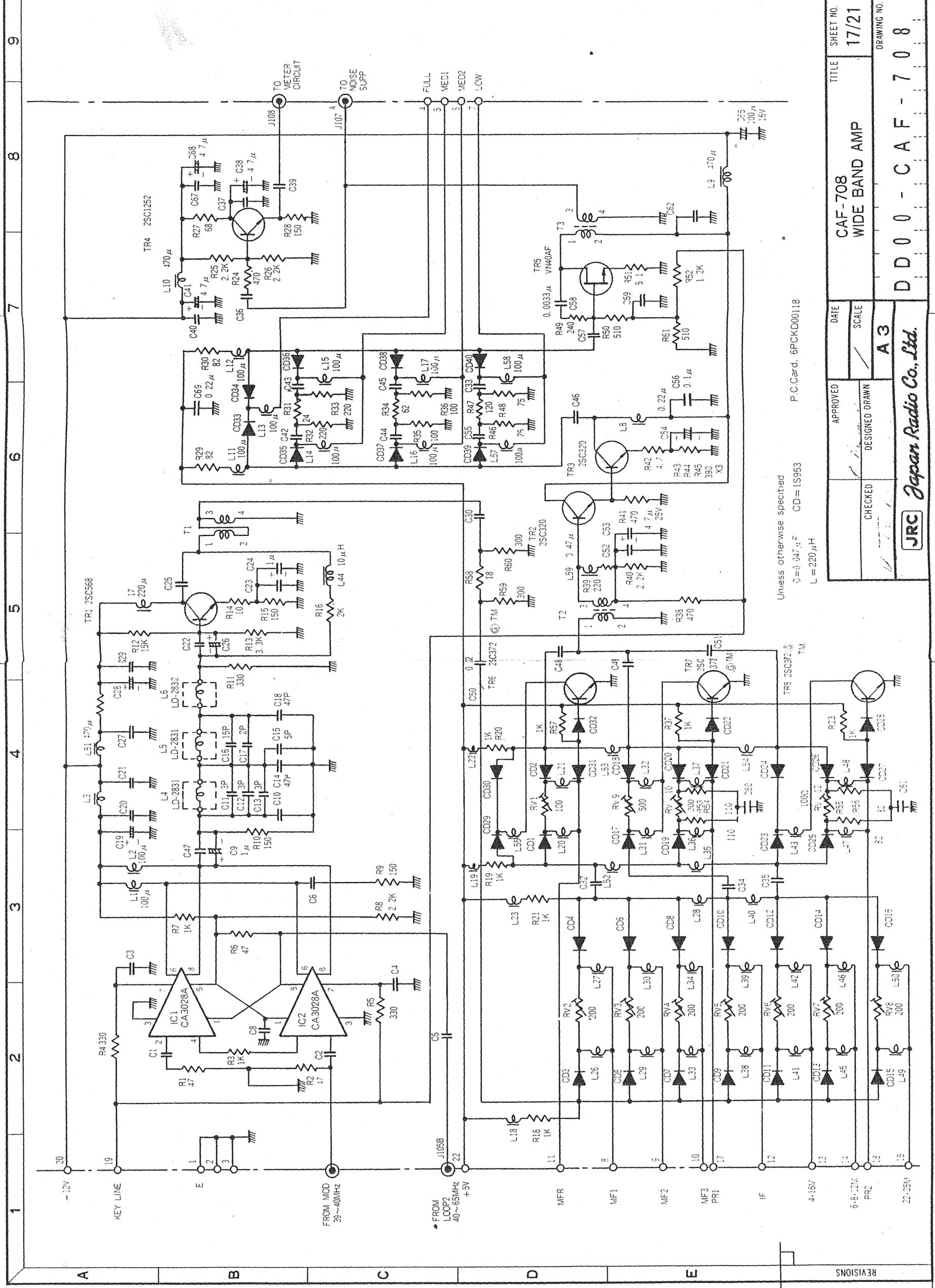






APPROVED	DESIGNED DRAWN	DATE	TITLE	SHEET NO.
CHECKED	A 3		CME-707 MODULATOR	16/21
Japan Radio Co., Ltd.			D D O O - C M E - 7 0 7	

NOTES 1. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE 0.01 $\mu$ F.  
 2. " " " ALL FIXED INDUCTANCE VALUES ARE 100 $\mu$ H.  
 3. RESISTANCES ARE IN OHMS; K=1000  
 4. UNLESS OTHERWISE SPECIFIED ALL DIODES ARE 1S963.  
 5. P.C. CARD. 6(PCKD) 00117



Unless otherwise specified  
 C = 0.047 μF CD = IS953  
 L = 220 μH

ARRANGE NO.	REVISIONS

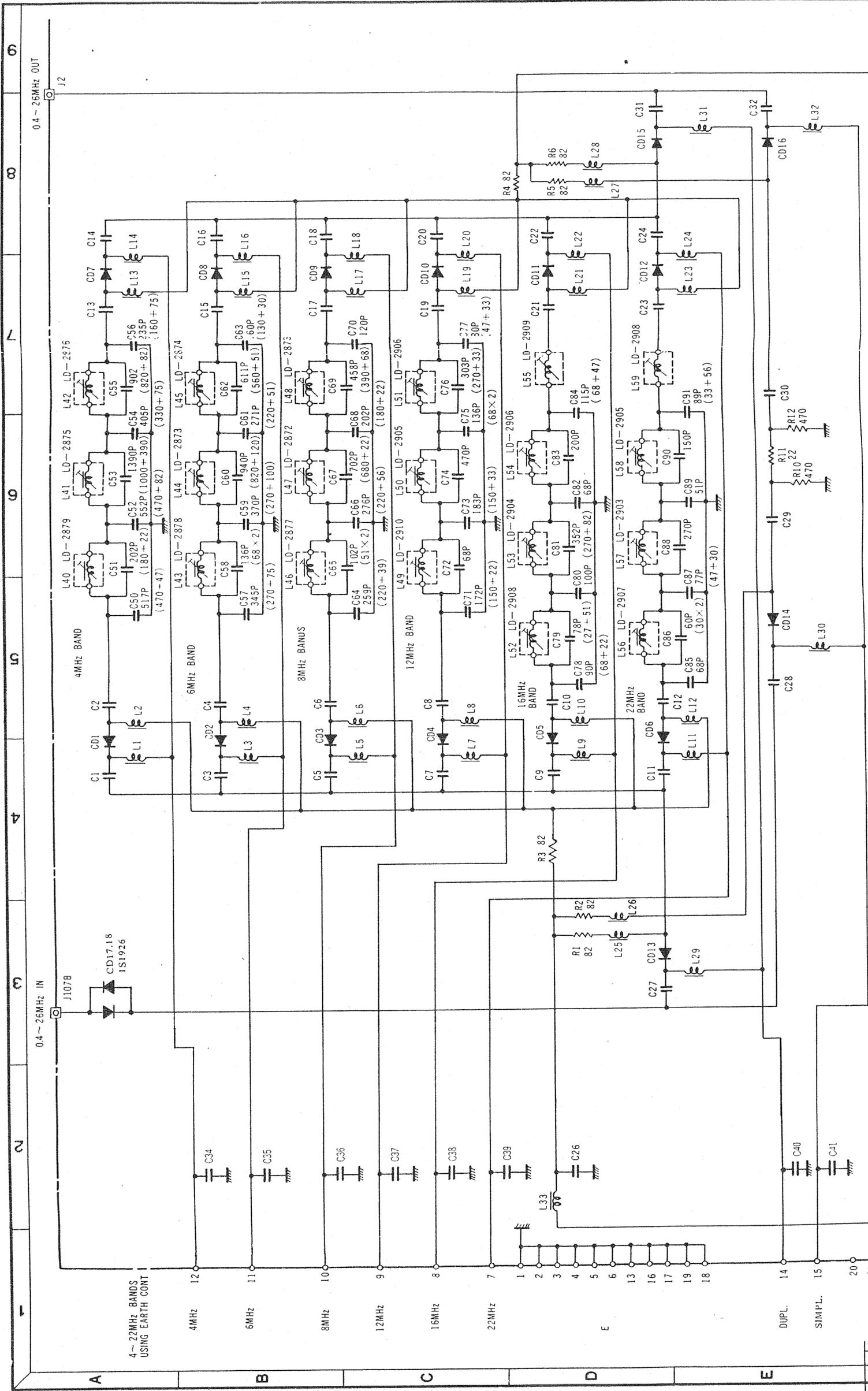
APPROVED	DATE	TITLE	SHEET NO.
DESIGNED DRAWN	SCALE	CAF-708 WIDE BAND AMP	17/21
CHECKED			DRAWING NO.
			DD00-CAF-708

**A 3**

**JRC Japan Radio Co., Ltd.**

P.C.Card. 6PCKD00118

3rd Angle System Dimension mm



ARRANGE NO. \_\_\_\_\_

REVISIONS \_\_\_\_\_

CFJ-709  
NOISE SUPPRESSOR FILTER

SHEET NO 18/21  
DRAWING NO D000-CFJ-709

DATE \_\_\_\_\_  
SCALE \_\_\_\_\_  
APPROVED \_\_\_\_\_  
DESIGNED DRAWN \_\_\_\_\_  
CHECKED \_\_\_\_\_

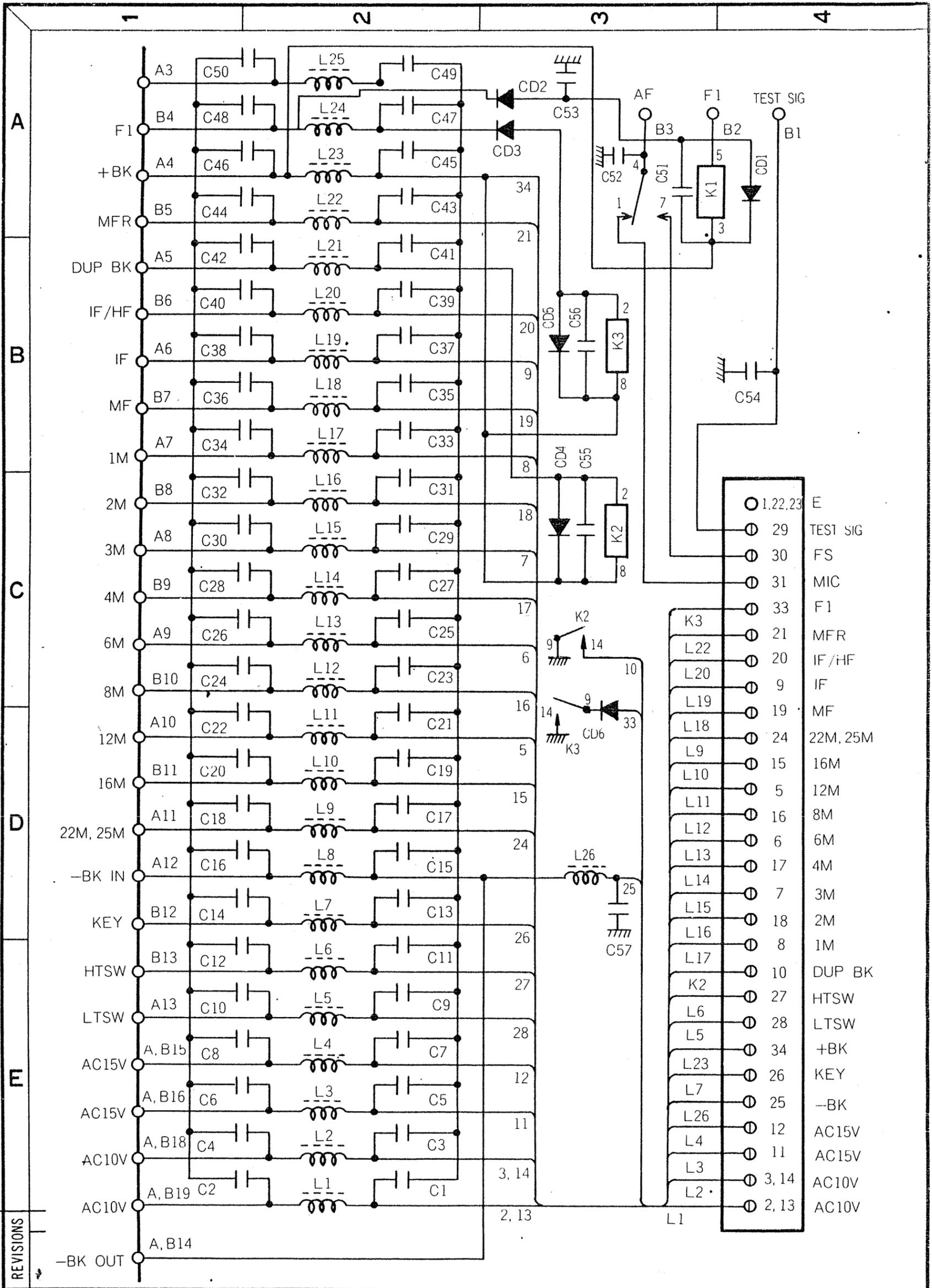
A 3

JRC Japan Radio Co., Ltd.

NOTES 1. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE 0.01 $\mu$ F.  
2. ALL FIXED INDUCTANCE VALUES ARE 100 $\mu$ H  
3. ALL DIODES ARE 1S953  
4. P.C. CARD 6PCKD00114

3rd Angle System Dimension mm

G. 814

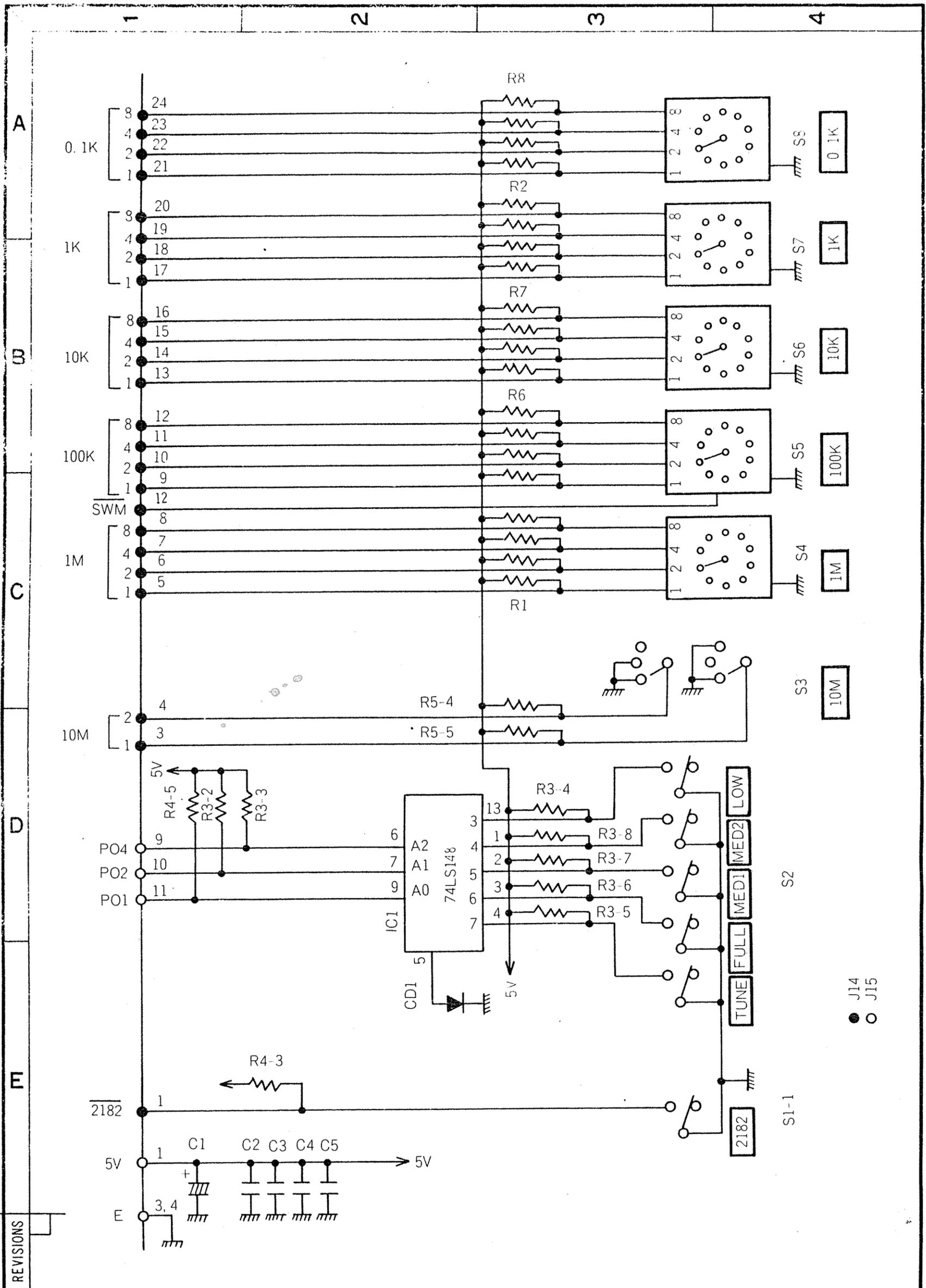


- 1, 22, 23 E
- 29 TEST SIG
- 30 FS
- 31 MIC
- 33 F1
- 21 MFR
- 20 IF/HF
- 9 IF
- 19 MF
- 24 22M, 25M
- 15 16M
- 5 12M
- 16 8M
- 6 6M
- 17 4M
- 7 3M
- 18 2M
- 8 1M
- 10 DUP BK
- 27 HTSW
- 28 LTSW
- 34 +BK
- 26 KEY
- 25 -BK
- 12 AC15V
- 11 AC15V
- 3, 14 AC10V
- 2, 13 AC10V

ARRANGE NO.

REVISIONS

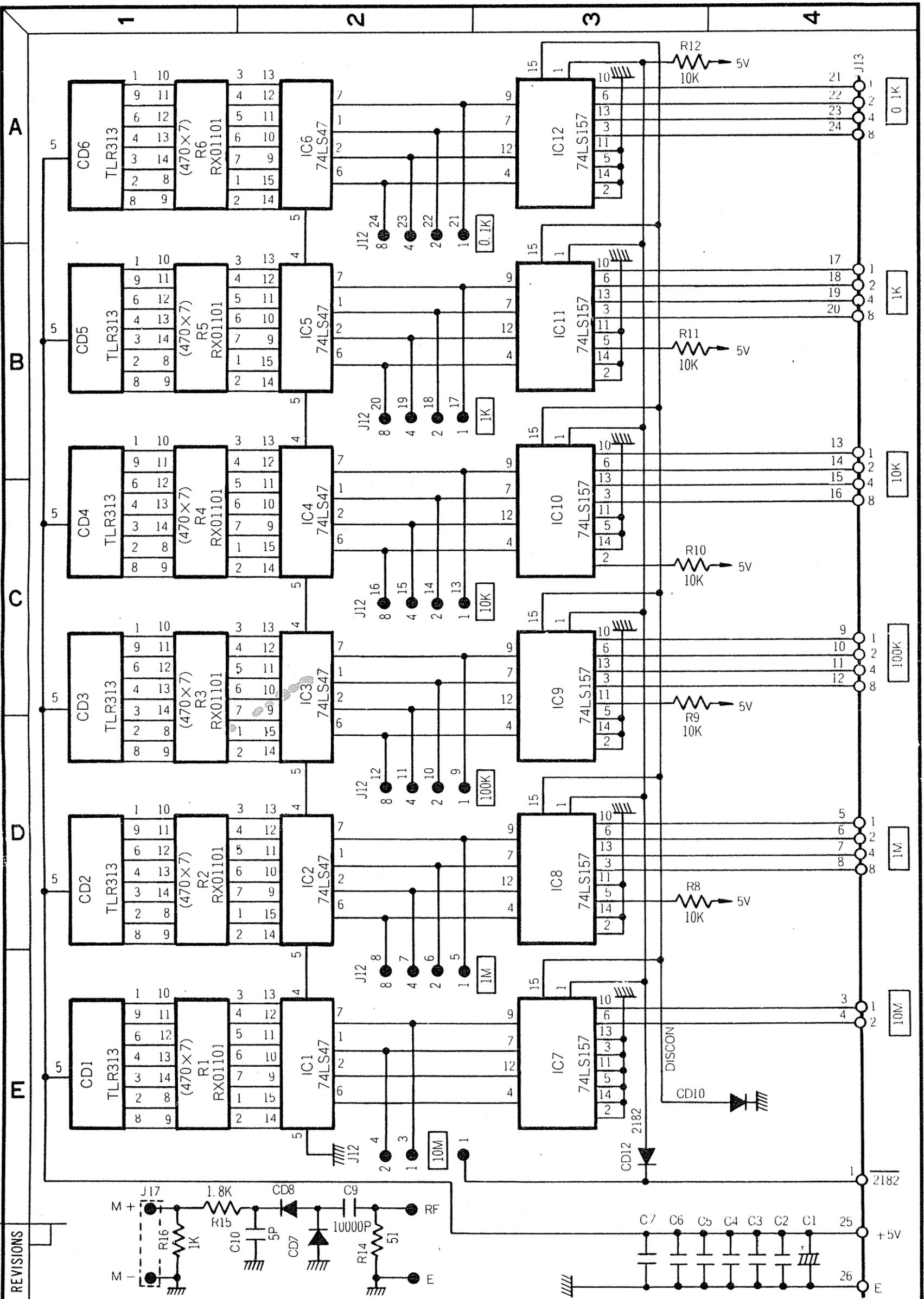
APPROVED		DATE	TITLE	SHEET NO.
CHECKED		SCALE	CFJ-710 LINE FILTER	19/21
DESIGNED DRAWN		A 4	DRAWING NO.	
JRC Japan Radio Co., Ltd.		DD00-CFJ-710		



ARRANGE NO.

REVISIONS

APPROVED		DATE	TITLE	SHEET NO.
DESIGNED DRAWN		SCALE	CCK-713-F SWITCHING CKT	20/21
A 4		DRAWING NO.		
JRC Japan Radio Co., Ltd.		D D 0 0 - C C K - 7 1 3 F		



ARRANGE NO.

REVISIONS

APPROVED	DATE
<i>M. Miyajima</i>	Dec. 4
CHECKED	SCALE
<i>K. Tanaka</i>	A 4
DESIGNED DRAWN	
<i>M. Yamaoka</i>	

CDE-714-F  
DISPLAY BOARD

TITLE SHEET NO.  
21/21

DRAWING NO.

DD00-CDE-714-F

JRC Japan Radio Co., Ltd.