

2 METER BAND

KW TUBE TYPE LINEAR AMPLIFIER

MODEL SAGRA-600

C O N T E N T S

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[ 1 ] PREFACE

- ° Before setting and operating this amplifier, read this instruction manual carefully to keep your SAGRA-600 in the best condition for a long time.
  
- ° The high voltage of over 2000V is applied in the internal part of the device.

Don't touch the internal part carelessly, or you may get an electric shock and it can be lethal for you.

- ° The internal electrodes of vacuum tube 4CX250B may be damaged when they get a strong physical shock.

In case of transporting over the long distance, please pull off the vacuum tubes from the device and pack them carefully to be free from a strong shock.

[ 2 ] FEATURES

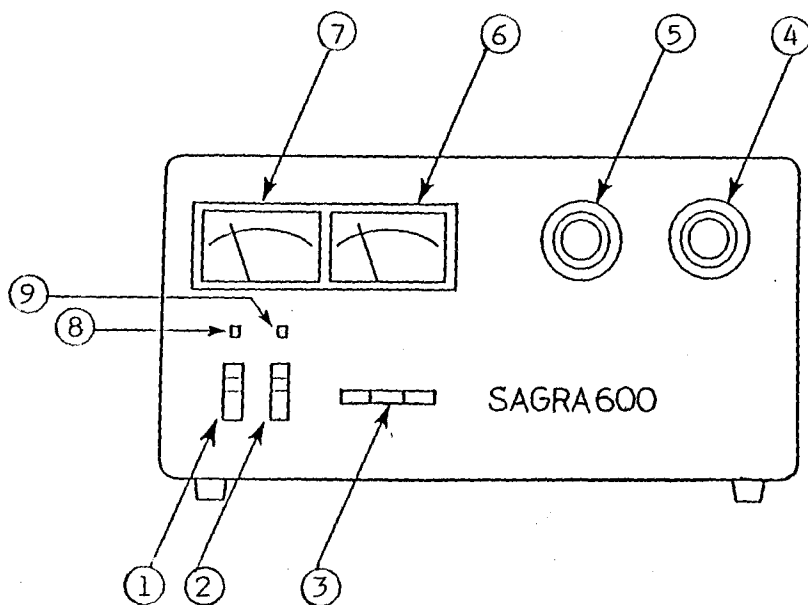
- SAGRA-600 is a compact and light weight 2 meter band tube type linear amplifier with maximum input of 1KW.
- Two vacuum tubes 4CX250B made by EIMAC are used in push-pull to get the stable and highest possible output. It boasts of maximum continuous output of 600W in SSB and FM modes.
- A large sirocco fan is used for cooling the vacuum tubes. Enhancing the reliability, tube performance can be fully achieved.
- To protect the vacuum tubes, the heater warm-up time is set for a period of 60 seconds with time delay circuit using transistors.
- Plate current can be monitored all the time with the plate current meter(IP). And plate voltage(EP), control grid current(IG) and relative output power level(PO) can be monitored with multi-meter. Every operating condition can be checked easily with these meters on the front panel.
- The high-gain design which enables the maximum input operation of the tubes, when driven with 25W output class(20-30W) transceiver. The operation at FM mode driving with 50W transceiver is possible with some adjustment of the bias voltage(See page 12).
- The broadband input circuit which enables a tuning-free operation at the RF input side, over the entire 142-150MHz.

[ 3 ] SPECIFICATIONS

Frequency band	: 2 meter band(144 - 148MHz)*
	* 142-150MHz operation is possible with a slight decrease of output power, when tuning and loading are carefully made.
Mode	: SSB, CW, (RTTY/SSTV/AM/FM)
Output power	: 600W max.
Driving power	: 30W max.(25W nominal)
Plate voltage	: DC 2KV(DC2.4KV with no RF excitation)
Plate current	: 500mA max.
Spurious output level	: - 50dB or better
Input impedance	: 50 $\Omega$ (unbalanced)
Output impedance	: 50 $\Omega$ (unbalanced)
Vacuum tubes	: EIMAC 4CX250B
Semiconductors	: Transistor x 3 Unijunction transistor x 1 Thyristor x 1 Diode x 33 LED x 2
Class of operation	: Class AB 1, Grounded cathode (with grid tuned circuit)
AC supply voltage	: AC 220V/8A max.(50/60Hz)
Built-in meters	: Plate current meter = IP 1A (full scale) (240V) Multi-meter = IG 3mA( " ) PO 1KW( " ) EP 3KV( " )
Input connector	: M type(S0-239)
Output connector	: N type
Dimensions	: 405(W) x 200(H) x 390(D) mm
Weight	: approx. 30 Kg
Cooling method	: Forced air cooling by a large sirocco fan
Power consumption	: 150VA at stand-by 1600VA at max. input
Accessories	: Fuses(8A) M-M jumper cable

[ 4 ] EXPLANATION OF FEATURES

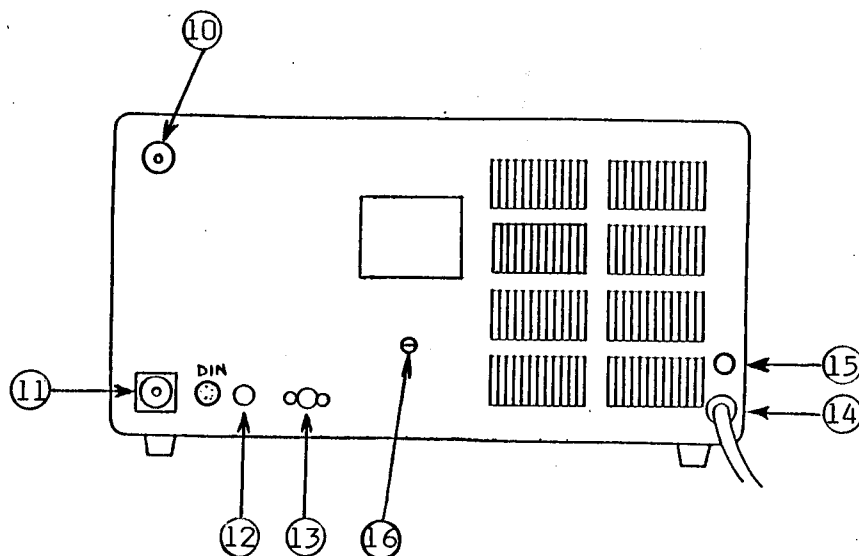
\* Front panel



- ① POWER OFF/ON : Power switch on/off  
At power switch off position, the amp is made "THRU" state. At power on position, various voltages are applied to internal parts.
- ② STBY OPER : Operation select switch  
At STBY position, the amp is made "THRU" state, and output power of transceiver will bypass the internal part and reach antenna.  
At OPER position, the amp can be ON AIR.
- ③ METER : Multimeter select switch. Select IG/PO/EP indication.
- ④ PLATE : Knob for adjusting variable capacitor of PLATE to the most proper tuning point. 36:1 vernier mechanism is furnished for an easy tuning.
- ⑤ LOAD : Knob for adjusting variable capacitor of LOAD. 6:1 vernier mechanism is furnished for an easy tuning. By adjusting this knob, effective RF power is supplied to the load.
- ⑥ IG, PO, EP : Multi-meter. By selecting METER switch, you can read IG(Control Grid Current), PO(RF Output Power) and EP(Plate Voltage) respectively.
- ⑦ IP : Plate current meter. Indicates plate current of the vacuum tubes. Full scale is 1A.

- ⑧ WARM UP pilot lamp : Turning Power Switch ① on, this lamp lights when warming up of heater is completed.(It takes approx. 60 seconds.)  
(LED : GREEN)
- ⑨ ON AIR pilot lamp : This lamp lights when the amp is ON AIR.  
(LED : RED)

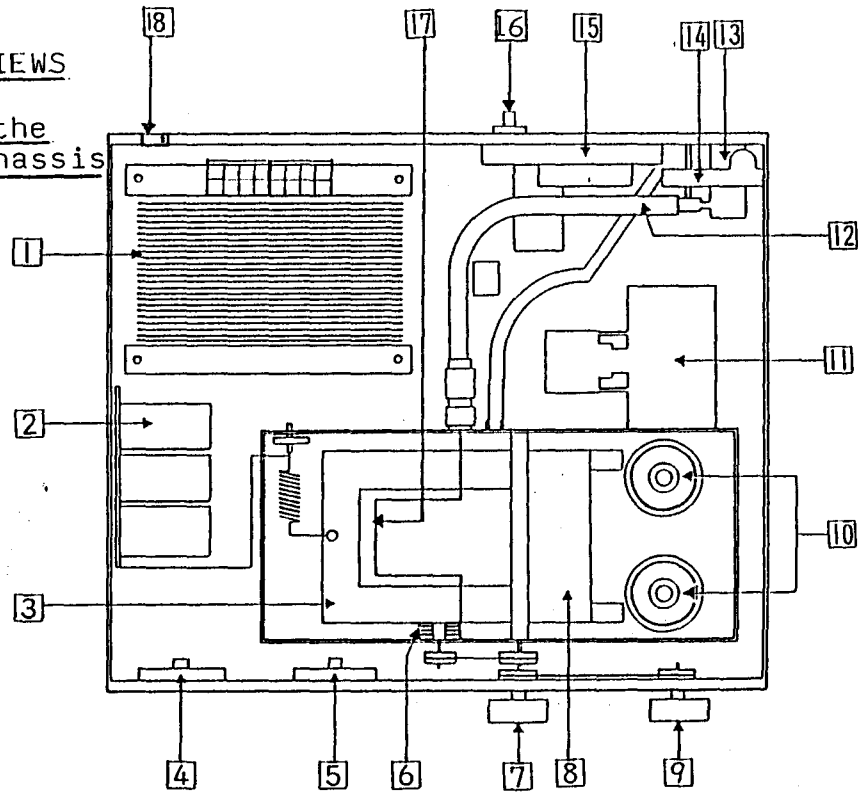
\* Rear panel



- ⑩ OUTPUT(ANT) : Output terminal of linear amp.  
Connect load(antenna or dummy load).
- ⑪ INPUT(TX) : Input terminal of linear amp.  
Connect cable from antenna terminal of transceiver or transmitter.
- ⑫ CONTROL : Terminal for remote control of RX to TX.  
By connecting cables between control terminals of transceiver or transmitter and the amp, change-over from RX to TX can be made automatically.  
Two cables(Vinyl coated wire etc.) for STBY/EARTH are required to connect with transceiver.  
(at only SSB/CW operations.)
- ⑬ GND : Ground terminal
- ⑭ AC POWER : AC power cord
- ⑮ FUSE : 8A(at AC220V)/(240V)
- ⑯ CONTROL GRID BIAS VARIABLE RESISTOR : This variable resistor sets the control grid bias voltage of the each tube.  
Usually, the idling plate current(IP) should run 0.2A at transmitting without any driving signal. The control grid bias voltage has already been adjusted at the time of shipment from factory.  
So, do not touch this potentiometer carelessly.

\*INTERNAL VIEWS

°Upside of the chassis

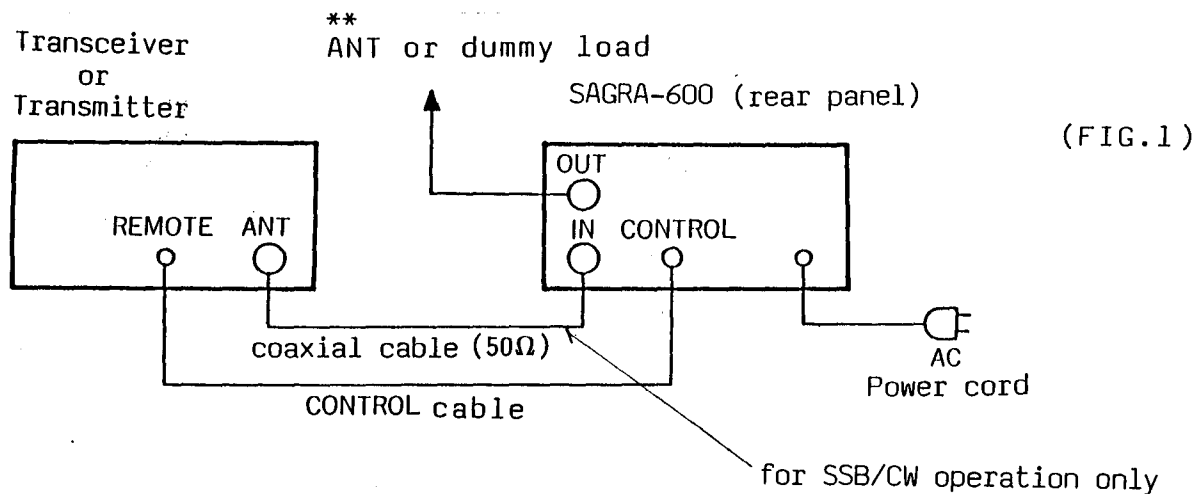


- 1 POWER TRANSFORMER
- 2 HIGH VOLTAGE RECTIFIER UNIT
- 3 PLATE TANK CIRCUIT COIL
- 4 PLATE CURRENT METER.
- 5 MULTI-METER
- 6 LOADING VARIABLE CAPACITR
- 7 KNOB OF VARIABLE CAPACITOR FOR LOAD
- 8 PLATE VARIABLE CAPACITOR FIN
- 9 KNOB OF VARIABLE CAPACITOR FOR PLATE
- 10 VACUUM TUBE (EIMAC 4CX250Bx2)
- 11 BLOWER
- 12 COAXIAL CABLE (OUTPUT SECTION)
- 13 COAXIAL RELAY (OUTPUT SECTION)
- 14 RF DETECTOR CIRCUIT
- 15 CONTROL UNIT
- 16 VARIABLE RESISTOR (CONTROL GRID BIAS)
- 17 OUTPUT COUPLING COIL
- 18 INTERLOCK SWITCH (AC SOURCE SIDE)



[ 5 ] OPERATION

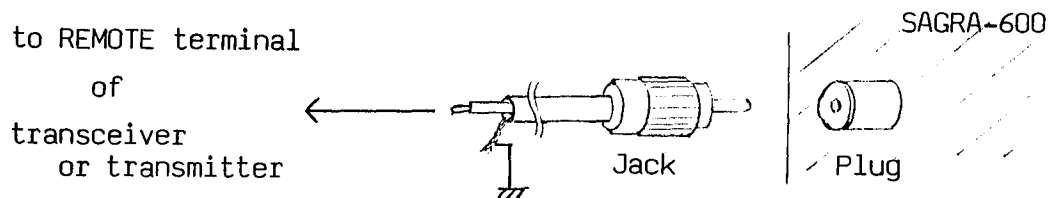
- 1) Connect RF jumper cables and power cord according to FIG. 1. The SAGRA-600 has a built-in carrier operated automatic send-receive control circuit. So the simple connection shown below is just enough to start to operate.



\*\* ANT : Be sure to use the suitable antenna for this model whose maximum handling power is at least 600W.

- 2) Connection of control terminal, when the direct send-receive control is desired by your transceiver.

\*Control socket viewed from outside of the chassis



By grounding the center pin of RCA phono plug (or DIN plug), the amp is made "transmitting" state.

- ° Set the cable from STBY terminal to the remote control terminal of transceiver or transmitter which gets grounded at transmitting.
- ° "Power amplification state" can not be made without connecting STBY terminal.

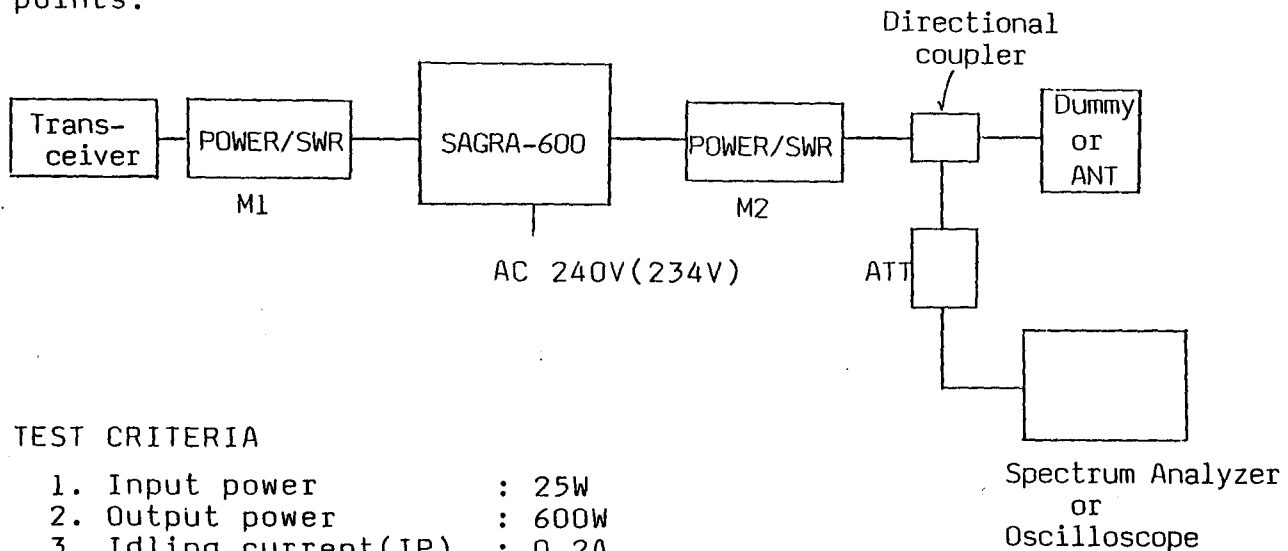
A simple transmitting test without wiring Send/Receive remote control can be made because of a built-in carrier control circuit.

- 3) Set the knobs of variable capacitors for Plate and Load to each center position beforehand (at 50Ω load).

- 4) Turn the POWER switch on and wait for approx. 60 seconds until WARM-UP pilot lamp lights. Then, turn the STBY/OPER switch to OPER position and make your transceiver or transmitter on air. ON AIR pilot lamp lights and idling plate current(IP) should run approx. 200mA.
- 5) Always adjust Plate variable capacitor to make output power meter (PO) indication to increase and IP to dip.
- 6) Adjust Load Variable capacitor to maximize PO meter indication.
- 7) Now increase carrier output power level of transceiver or transmitter to get IP of 500mA.  
At this time, adjust each Load knob and Plate knob alternately to maximize the output power.  
To achieve a clean output wave form, turn Load knob clockwise slightly to decrease PO(output power) by 5-10% from the maximum point, and set the Plate knob always to get IP(plate current) dipped.
  - \* Try to finish this adjustment within a minute.  
If it takes longer, please let the device idle for a minute.

[ 6 ] HOW TO CHECK SAGRA-600

If your SAGRA-600 is not working properly, please set up test instruments and SAGRA-600 as follows, and check the following points.



\* TEST CRITERIA

1. Input power : 25W
2. Output power : 600W
3. Idling current(IP) : 0.2A
4. Spurious response : less than -50dB

\* TEST INSTRUMENT

1. Transceiver : 144MHz band, 25W output
2. Directional power meter : 50Ω, 25W(or 50W) = M1 and 1,000W = M2 with the reflection power reading(M1)
3. Directional coupler
4. Attenuator
5. Dummy or antenna
6. Spectrum Analyzer or oscilloscope

1) Reading the deflection of the needles on directional power meters, check whether or not the amp gets 600W output at 25W input.

- a. Reading the deflection on directional power meter(M1), if the reflected power is too high, check the jumper cables, or if operating frequency is off the designed frequency band.
- b. Reading the fundamental and spurious level on the spectrum analyzer, check whether or not the amp is self-oscillated.

2) How to adjust idling current(IP)

Ground the center pin of RCA phono plug( ⑫ ), and make the amp "Transmitting" state.

At this time, check whether or not the idling current runs 0.2A. If it does not run 0.2A. adjust the variable resistor( ⑬ ) to get IP of 0.2A.

3) How to adjust PO meter

At 600W output, turn the variable resistor(VR2 : near the relay RL2) so that the needle indicates 70-80% of the full scale of the meter( ⑭ ).

## [ 7 ] AN OUTLINE OF MAJOR CIRCUITS

### 1) RF Input Circuit

RF power sent from transmitter or transceiver to input terminal goes through relay contact and is resonated with input network circuit. Drive signal passes impedance-transformer(1:4) then reaches control grid of the vacuum tube 4CX250B.

### 2) Power Amplification Unit(P.A.Unit)

P.A.Unit is a grounded cathode linear amplifier consisting of two vacuum tubes of 4CX250B connected in push-pull. -55V is applied to the control grid to run approx. 200mA of IP as idling current for two tubes when no driving. Approx. +350V voltage is applied to the screen grid. At receiving state, control grid voltage becomes -140V to cut off the tube operation.

### 3) Output Circuit

The output power of vacuum tubes goes into plate output tuning circuit. Power from output tuning circuit goes through relay RL2 and, then reaches output terminal J2.

### 4) Heater Warming-up Unit

Time constant by capacitors and resistors of this circuit is set approx. 60 seconds to enough warm up vacuum tubes 4CX250B beforehand. Relay(RL1) is driven by 1 pc. each of uni-junction transistor and thyristor.

### 5) Power Supply Circuit

High voltage of AC850V at secondary winding of power transformer is rectified by voltage doubler circuit of eight rectifying diodes to get the DC voltage of 2400V(at stand-by condition), which is then supplied to plate of the vacuum tubes. Two heaters are connected in series to accept 12V line of power transformer and this AC voltage of 12V is shared with heater warm-up circuit(used after being rectified). Besides, DC power supplies for screen grid of 390V and for control grid bias of -55V to -140V stabilized by zener diode are built in the unit.

[ 8 ] CAUTION

1) Impedance

When you operate the device, please always connect, as a load, a well-adjusted antenna or a dummy load of 50Ω. In case that the antenna impedance is extremely off from 50Ω, please use the impedance matching circuit such as an antenna coupler etc. If you transmit under the no load or mis-matching condition, the expensive vacuum tubes may be deteriorated in a short time, and also output tuning circuit may get a damage.

2) Place of Installation

Install the device at well-ventilated and dry places where is not exposed to the direct rays of the sun, as the device radiates plenty of heat and uses a high voltage.

3) AC Power Source

The device is designed to operate from AC 240V(234V).

4) When you open the cover,

a) to check the internal part of the device, please pull the AC power plug off and check if high voltage has been discharged to prevent from getting electric shock. (Be sure to check the EP 0(zero)V on the multi-meter.)

b) Don't touch or trim the power indicator and control grid bias adjustable resistor VRI as they have been already adjusted.

5) Driving Power

SAGRA-600 can get maximum output power with the driving power of 25W. Please be careful not to exceed 30W output. In case that IG meter is driven extremely, it may be overdriving or mis-matching.

As long as you operate the amp at only FM mode, this amp can be operated at 50W input. Please refer to [ 9 ] on page 12.

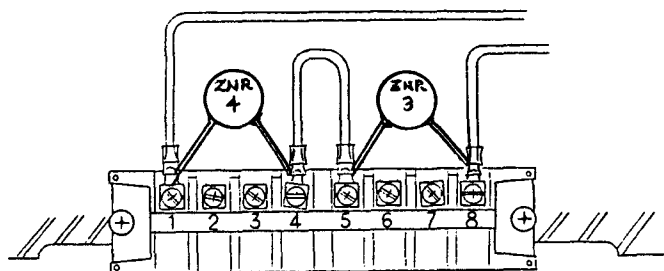
6) Please clear dust in the internal part of the device at least once a year, or cooling fan will not work effectively, and it may be the cause of leak.

7) Reverse deflection of the IG Meter

This phenomenon will be caused on the multianodes such as the tetrode at higher frequency.

Please note that this is not a trouble of the amp.

\* THE CONNECTION OF AC SOURCE TERMINAL BOARD FOR AC 240V(234V)



[ 9 ] HOW TO OPERATE SAGRA-600 WITH 50W TRANSCEIVER AT FM MODE

This model is designed for producing maximum output power with 25W transceiver.

If you want to use the amp with 50W transceiver, the following adjustment enables the amp to be operated with 50W transceiver.

If you use the amp at SSB mode, you have to reduce the output level to 25W because the distortion may increase compared to FM mode.

- 1) Turn the POWER switch on and wait until WARM-UP pilot lamp lights. And then, turn STBY/OPER switch to OPER position.
- 2) Ground the center terminal of RCA phono plug( 12 CONTROL) on rear panel.
- 3) At this time, the needle of IP meter indicates approx. 200mA. And adjust variable resistor ( 16 ) to indicate the needle to approx. 50mA.
- 4) In case that the output level of transceiver is from 25W through 50W. Set the Plate current according to the following diagram.

Transceiver's rated output(W)	Plate Idling Current IP(mA) at transmitting without a driving signal
25	200
30	180
35	150
40	100
45	70
50	50

- 5) Even if the output level of transceiver can be varied, we recommend you to use the amp at 25W drive, if possible.

[ 10 ]  TROUBLESHOOTING

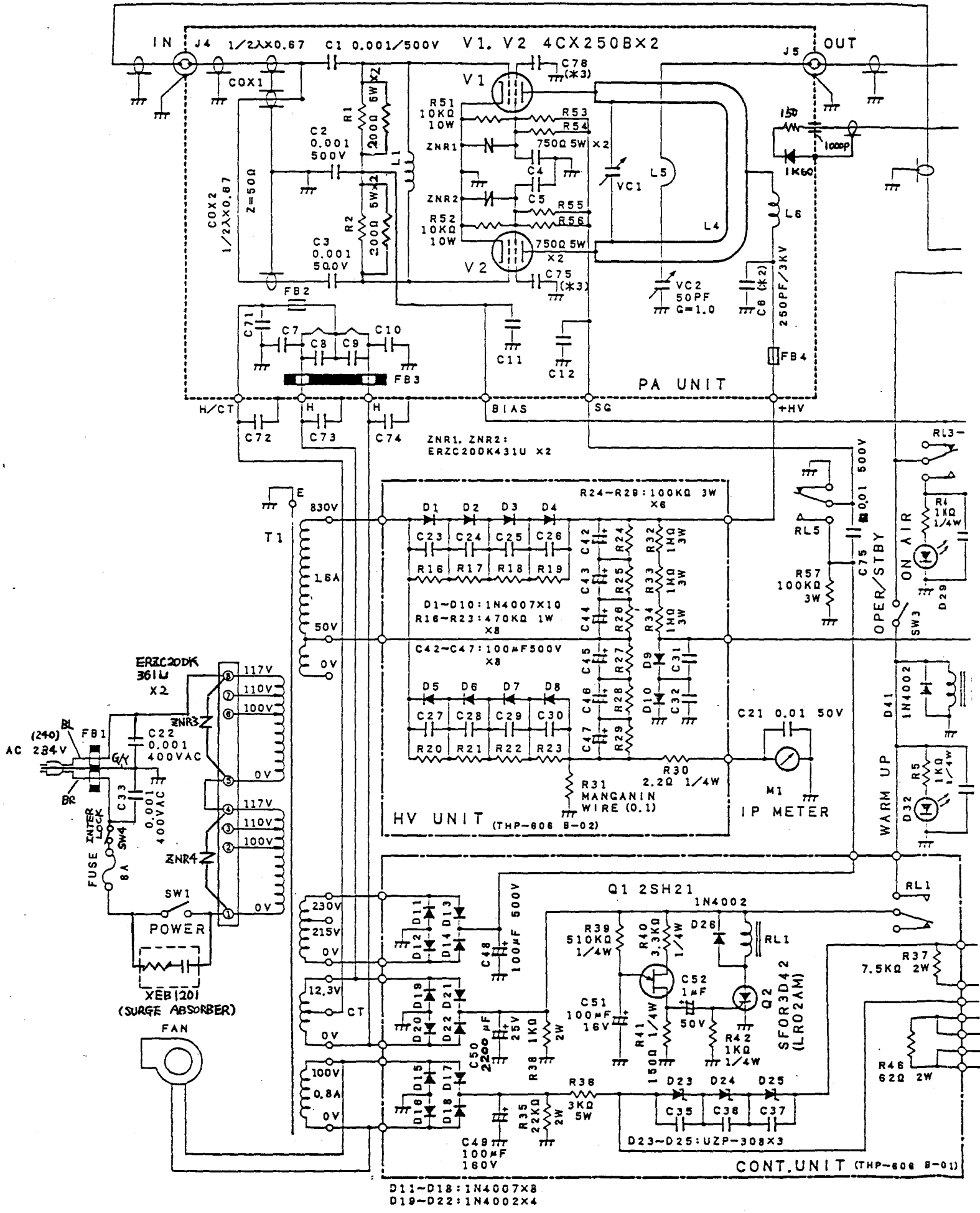
The following symptoms are minor troubles, which can be solved rather easily.

Please check each cause carefully.

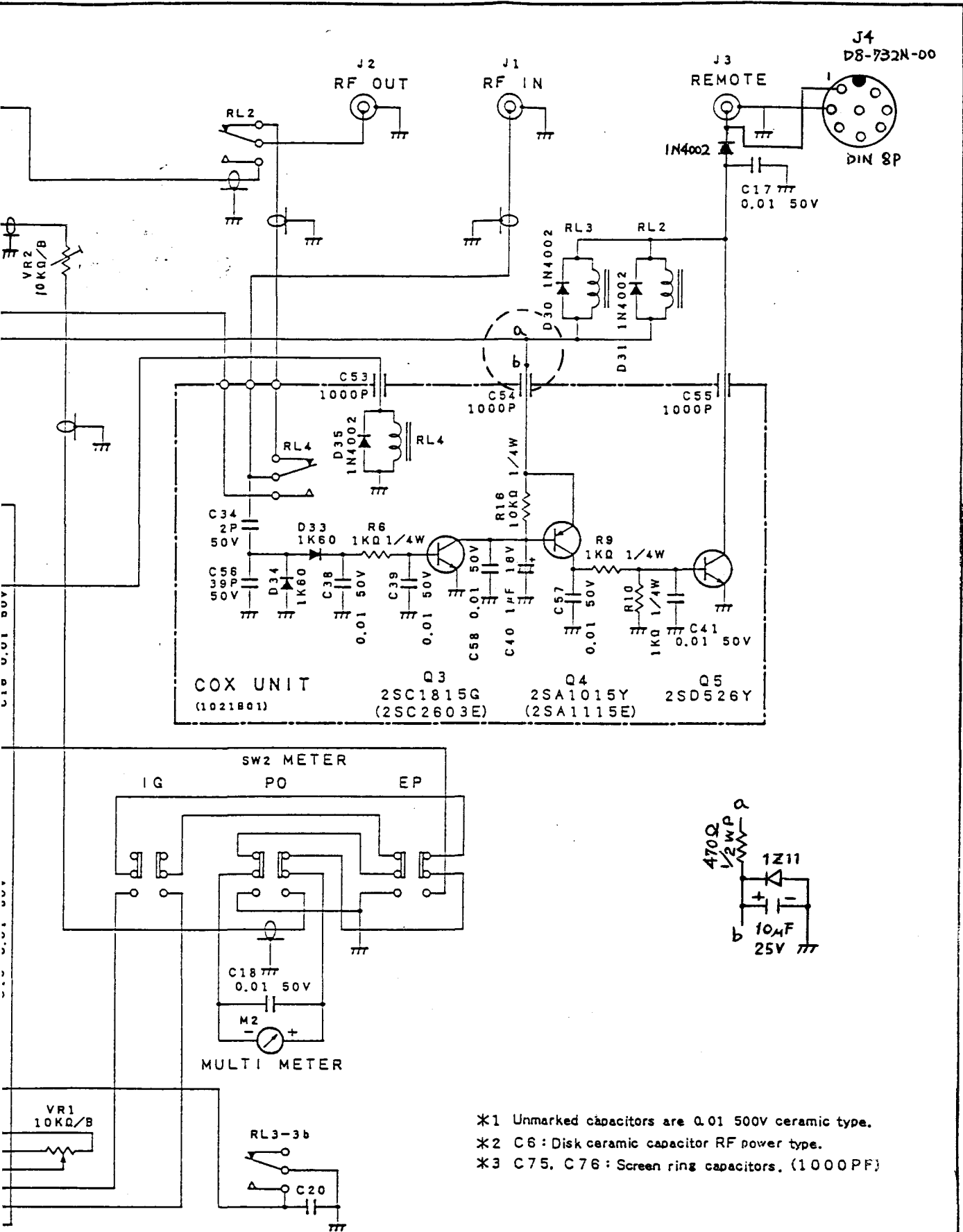
Symptoms	Cause	Treatment
Can not turn on AC power.	1.AC fuse blown. 2.AC power cord isn't connected.	1.Replace fuse(8A at 220V). If fuse blows again, it should be a trouble. 2.Plug it firmly(surely).
Fuse blown soon.	1.Capacity of fuse is not proper. 2.Plate band touches other parts(chassis, VC, for example). 3.As tubes were not set, plate band touched chassis and high-voltage circuitry became short-circuit state.	1.Install correct fuse(8A at 220V). 2.Keep space from other parts. 3.Set the tubes correctly.
Fan doesn't turn round. (or turns round slowly)	1.Some foreign substance are in the fan.	1.Remove the substance.
IP(Plate Current) at transmission is extremely low or zero.	1.Tubes are not set correctly. 2.Deterioration of vacuum tubes. 3.It's not a transmitting state. 4.Control Grid bias variable resistor is turned off erroneously.	1.Set the tubes into the sockets firmly. 2.Replace tubes. 3.Be sure to check coaxial jumper cable. 4.Turn CG bias variable resistor to set IP for 200mA.
PO(output power) is low or zero.	1.Deterioration of the vacuum tubes. 2.Antenna terminal is open or short stage. 3.Mis-tuning. 4.Driving power from transceiver or transmitter is less than the rated level.	1.Replace the tubes. 2.Repair the open or short stage. 3.Tune correctly according to instruction manual. 4.Adjust output level of transceiver or transmitter to reach SAGRA-600's rated level, so that enough RF output can be achieved.

Symptoms	Cause	Treatment
	5.Connectors of coaxial cable between transceiver or transmitter and SAGRA-600 are short or open. 6.Vacuum tubes haven't been set. 7.Input and output connectors are connected in a wrong way.	5.Replace coaxial cable or repair bad place. 6.Set the tubes correctly. 7.Set the connectors at the right position again.
"ON AIR" state cannot be made.	1.Coaxial jumper cable is bad or not connected. 2.Warm-up time(approx. 60 sec.) has not passed. 3.STBY/OPER select switch is not at OPER position	1.Connect coaxial jumper cable correctly. 2.Wait until warm-up has been completed and "WARM-UP" pilot lamp(red) lights. 3.Set this switch to OPER position.
Receiving signal cannot be received when STBY/OPER switch is at "OPER" position.	1.Short-circuit at remote cable.	1.Repair short-circuit.





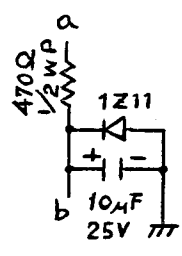
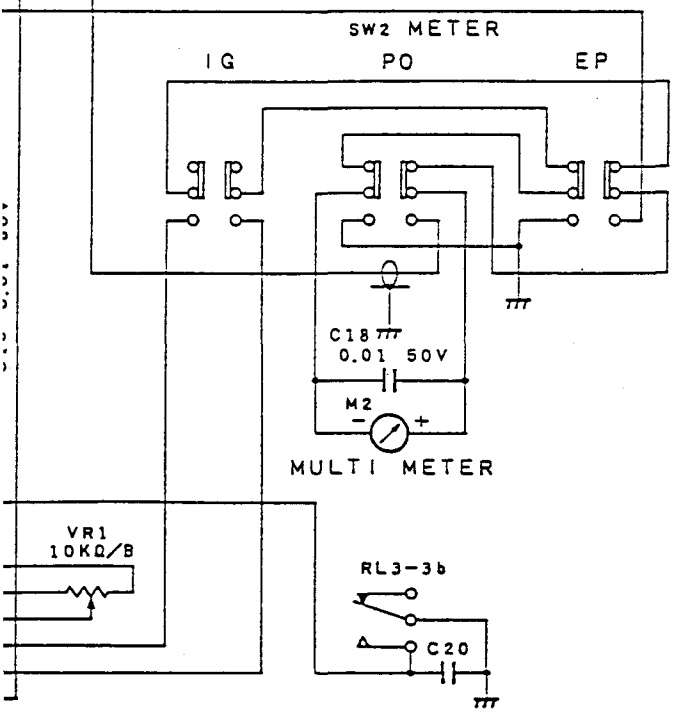
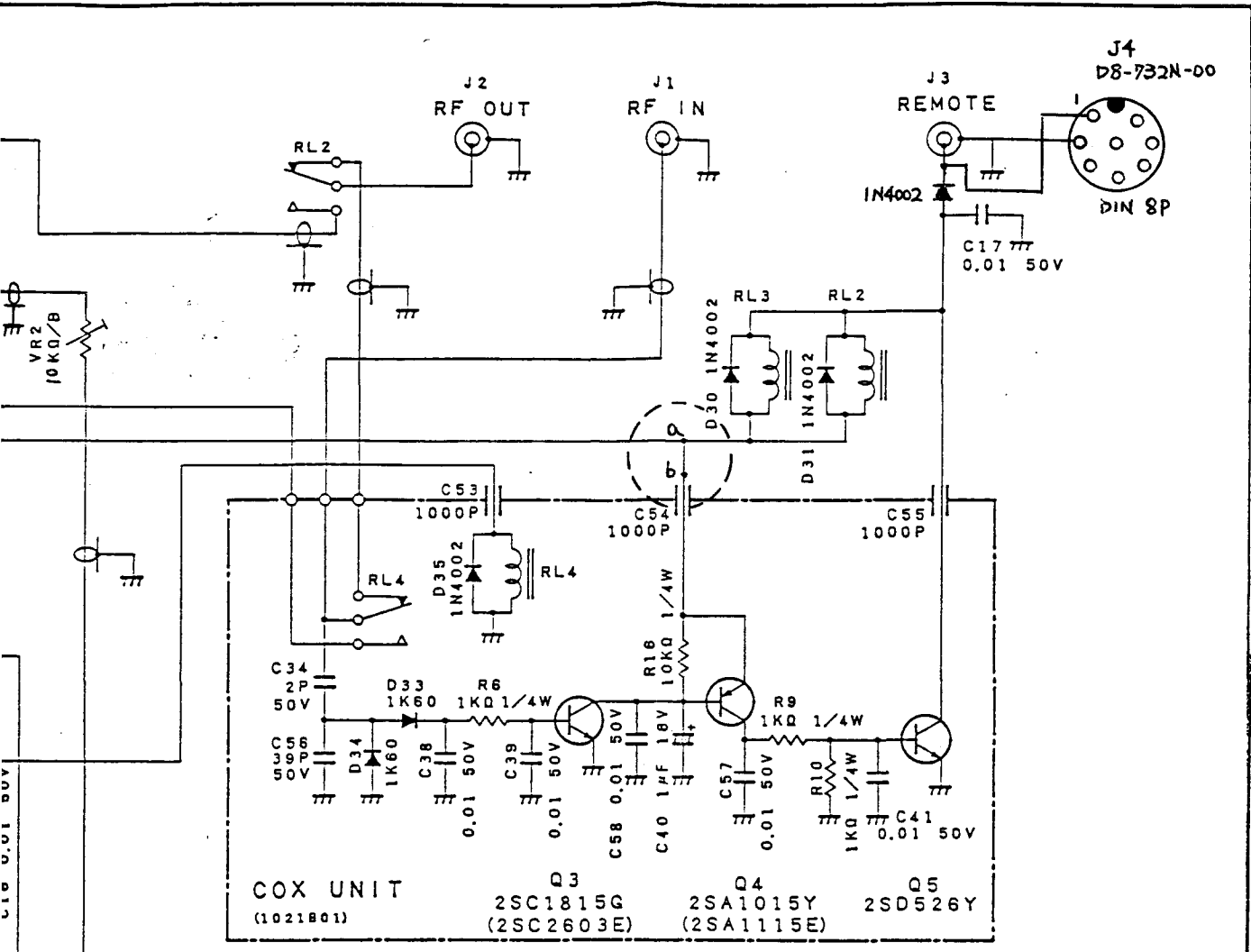
D11-D18: 1N4007X8  
 D19-D22: 1N4002X4



- \*1 Unmarked capacitors are 0.01 500V ceramic type.
- \*2 C6 : Disk ceramic capacitor RF power type.
- \*3 C75, C76 : Screen ring capacitors. (1000PF)

This diagram is subject to change without notice.

APPROVED BY	CHECKED BY	DRAWING BY	DESIGNED BY	<b>CIRCUIT DIAGRAM</b>	(Improve)	
					REVISION	BY
				<b>TOKYO HY-POWER</b>	D/FILE NO.	MODEL NAME
						S-600



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