

LINEAR AMPLIFIER

Model TL-91

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meter ① indicates output. Meter sensitivity can be adjusted with the knob ⑩. To observe antenna SWR on the meter, set this knob to FWD, adjust output with the knob ④ and ⑤, then adjust the meter pointer to the set point using the knob ⑩ and return the meter switch ⑨ to REF.

⑩ **SWR SEN control**

Meter sensitivity can be adjusted with this knob.

1-2 REAR PANEL

⑪ **Cooling fan**

This fan cools the final amplifier tubes.

⑫ **ALC control**

This controls the ALC voltage to an appropriate level.

⑬ **ANT connector**

Accepts an antenna impedance of from 50 to 75Ω.

⑭ **REMOTE connector**

The ALC and stand-by circuits are accessible through this connector. Hook up this connector to the exciter.

⑮ **INPUT jack (for coaxial cable)**

Connect to the exciter.

⑯ **PRO TIME control**

Used to adjust the operating time of the protector.

⑰ **SG control**

Used to adjust the screen grid voltage to a correct level.

⑱ **GND terminal**

Grounding terminal. Be sure to connect to a good ground to avoid danger.

⑲ **FUSE**

Contains a 15A fuse.

⑳ **Power cord**

Connect to 220 – 240V AC 50/60Hz power.

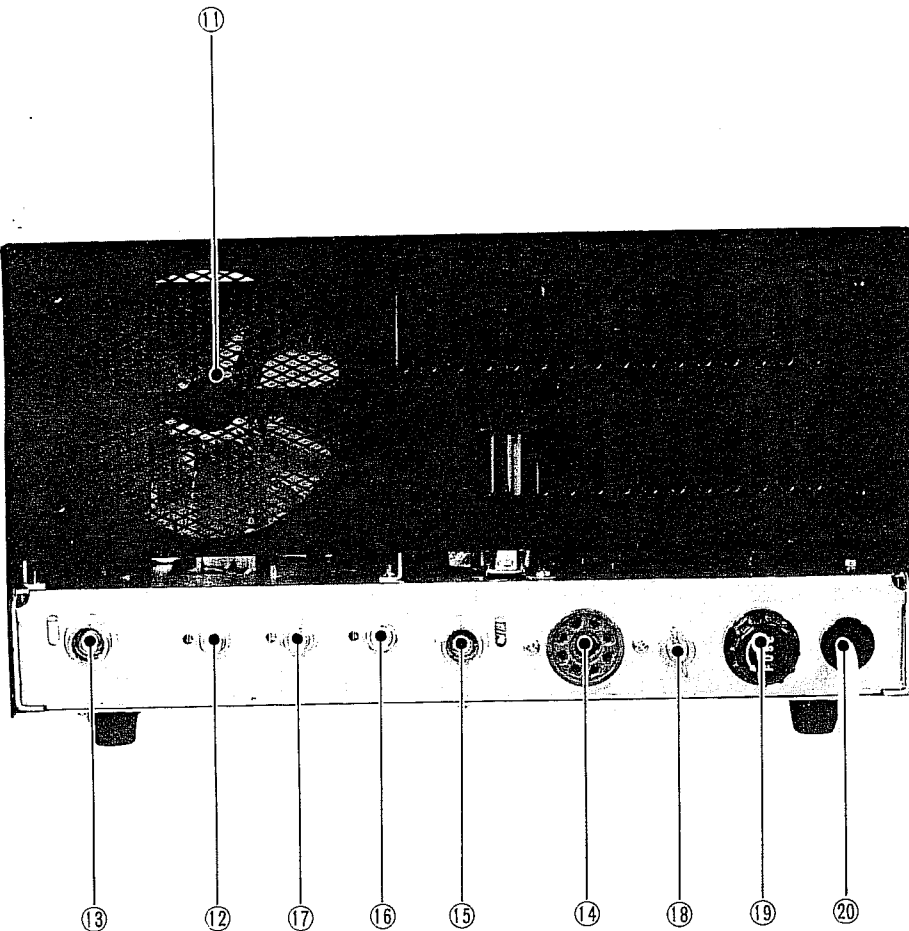


Fig. 2. Rear Panel Controls

SECTION 2. PREPARATIONS

2-1 ACCESSORIES

The following accessories are supplied with this set. Please check to see that all are provided.

Remote cable (with US plugs)	1
Exciter connection cable (with coaxial connectors)	1 set
Fuse (15A)	1

2-2 CONNECTIONS

TL-911 may be used in conjunction with a transmitter or transceiver. Connections with the 515 series are illustrated in Fig. 3 as a representative combination.

For use of TL-911 with a different model, refer to the remote connector connections and remote cable connections given in Fig. 4.

For TX-599, remove one of the US plugs from the remote cable and connect the cable to the connector supplied with the transmitter.

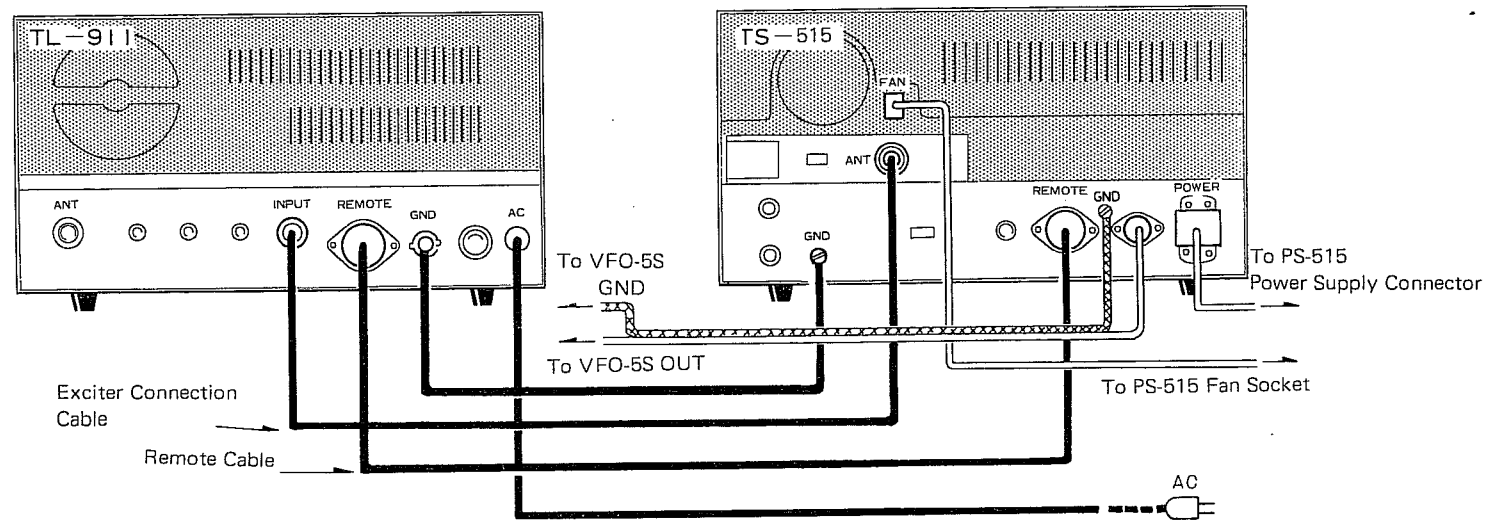
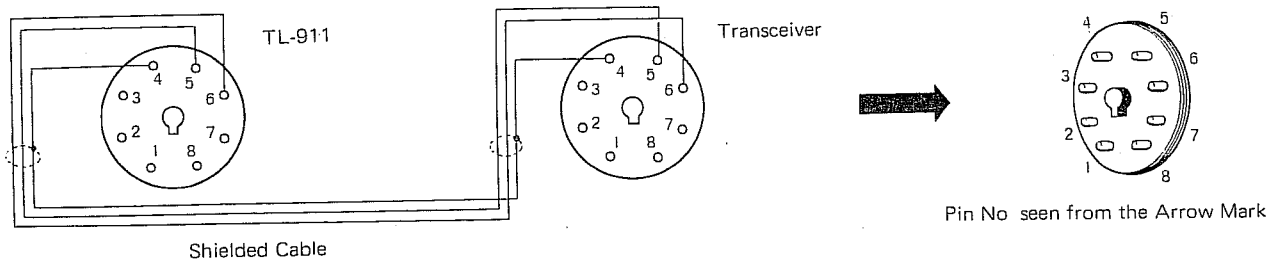
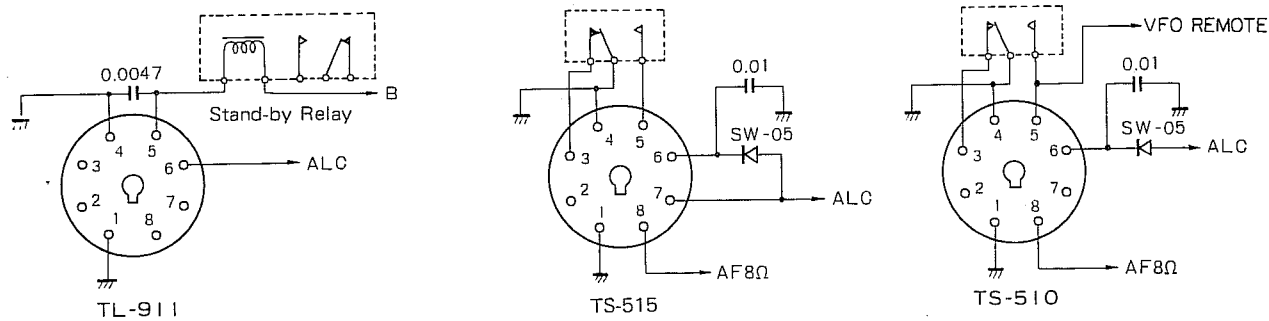


Fig. 3. Connections with TS-515

■ Connecting Remote Cable to TS-515



■ Connections of Remote Connector



■ Connecting Remote Cable

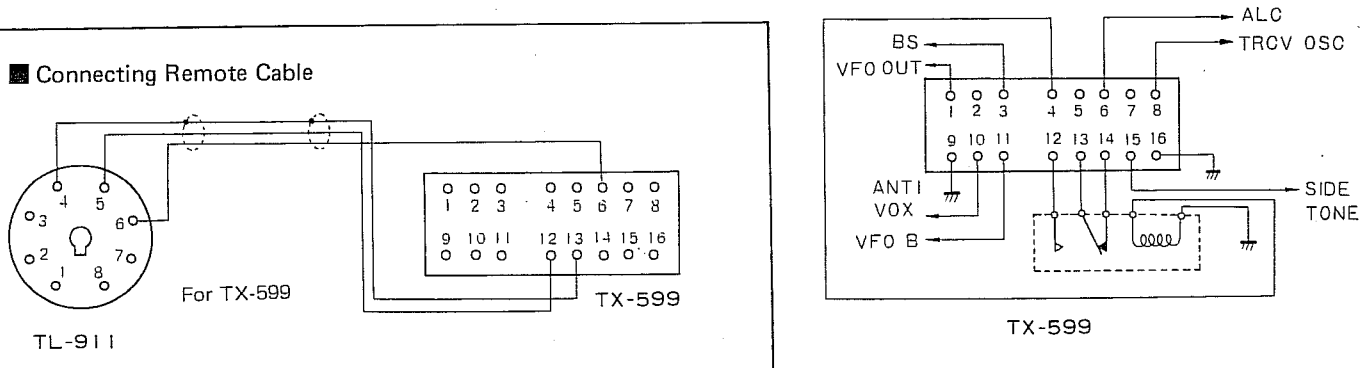


Fig. 4. Connecting Remote Cable

4 = black
5 = red
6 = white

SECTION 3. OPERATION

3-1 SSB OPERATION

Set the exciter to CW mode, LINEAR ON switch to OFF, and accurately tune the exciter to a dummy antenna or actual antenna used. Then, set the LINEAR ON switch to SSB, the LOAD knob ④ to the fully counterclockwise position, the PLATE knob ⑤ to the desired band and tune the PLATE and LOAD variable capacitors to the band. The overcurrent protection circuit will function if the above adjustment prolongs more than 20 seconds. Therefore, tuning should be as quick as possible.

The protection circuit enables the tuning control to be made even under full swing conditions of SSB, to obtain perfect linearity of SSB.

The built-in SWR meter permits observing matching to the load. Plate currents I_p on individual tubes are checked to see how uniformly the individual tubes share the load. (The base current for each tube is set to approximately 15mA.)

When SSB tuning is made, the overcurrent protector effectively operates to interrupt circuit operation if the maximum level of plate current is maintained for an excessive long period of time or when the BAND switch is erroneously used, thus protecting the 6LQ6 tubes from damage. Operation of the protector will be indicated by the protection lamp.

The protector will not operate under normal SSB transmission. However, if it frequently operates, it indicates there is a defective tube or the tubes are overdriven. If this occurs, check I_p on individual tube, or reduce the input.

If the exciter used can deliver an output of more than 100W and the input level to the linear amplifier must be reduced, it is recommended to bias the ALC line by connecting the negative (–) supply to it through a variable resistor.

Use of VOX will require that several relays are connected in cascade. This will somewhat lower the switching speed, causing the first part of voice to drop out.

3-2 CW OPERATION

Tuning can be accomplished in the same way as for SSB operation after setting the exciter to the CW mode and the LINEAR ON switch to CW. The 6LQ6 tubes will however receive a grid bias deeper than that in SSB so that they operate in class C. Therefore, I_p with the same exciting level is lesser to permit keying over extended periods of time.

In CW mode, the duty cycle is greater and the overcurrent protector will operate more quickly due to an average current. Reduce the exciting level so that

the linear amplifier can operate without actuation of the protector.

If the exciting level is too high and the protector operates, the linear amplifier can readily be reset to operation either by once returning the stand-by switch to reception or by setting the LINEAR ON switch to OFF. However, frequent tripping (more than five times in sequence) may result in power tube damage due to overheat in the 6LQ6 tubes. If this occurs, reduce the exciting level to an appropriate value.

In general, to use the linear amplifier under overdrive (an input level greater than rated input level) will reduce the life of tubes and relays. So, please observe the rated input level.

SPECIFICATIONS

FREQUENCY RANGE	3.5 ~ 29.7 MHz (In 5 bands)
MODE	SSB (A3j), CW (A1)
POWER AMPLIFIER STAGE CIRCUITRY	SSB (Class AB) Grounded-grid amplifier CW (Class C)
INPUT POWER	2.0 KW PEP max.
PLATE VOLTAGE	1350V ±10% (With no input signal)
SCREEN GRID VOLTAGE	70V ±5%
CONTROL GRID VOLTAGE	-35V ±10% (SSB) -75V ±20% (CW)
INPUT IMPEDANCE	50Ω
OUTPUT IMPEDANCE	50 ~ 75Ω
EXCITING POWER	100W
PROTECTION CIRCUIT	Operates in 20 seconds at a cathode current of 240mA per tube and instantaneously at 400mA.
VACUUM TUBES AND SEMI-CONDUCTORS	Vacuum tubes 6 Transistors 3 Diodes 27 Thyristor 1
DIMENSIONS	13-1/16" wide, 13-9/16" deep, 6-11/16" high
WEIGHT	40.7 lbs.
POWER REQUIREMENT	220 – 240V AC, 50/60Hz, less than 10A at the rated input.

FEATURES

Ample 2KW PEP input provides high power operation in SSB.

A class AB grounded-grid configuration with the regulated screen grid voltage is employed to assure stable, distortion-free SSB transmission. The linear switch can be set to CW for additional safety in CW (A1) operation.

An overcurrent detection type protection circuit is added to prevent heat trouble caused by abnormal operations and to assure safe tuning, which would be difficult with the TV-application tubes.

The plate currents in the power amplifier tubes can be monitored individually to facilitate determining which tube is defective when they develop flashing, low emission trouble, etc.

A dynamic balance circuit is employed to make power sharing uniform among the power amplifier tubes. This enables all power tubes to serve with full efficiency and safety.

The ALC circuit is a dual type which controls both I_{g1} and I_{g2} for quality transmission over an extended dynamic range.

An SWR meter is provided for quick matching to the antenna.

A final tube box with efficient heat radiation and a large, powerful cooling fan (with a 6-vane) are employed to double the life of power tubes.

TL-911 is designed as a desk top type, the same construction as TS-515 transceiver so that they can be put together on a space-limited table.

Switching between exciter and linear amplifier operations is simple and accomplished by switching an antenna-through relay by means of the linear switch.

SECTION 1. CONTROLS

1-1 FRONT PANEL

① Meter

This meter indicates plate current I_p and SWR (standing wave ratio).

② PROTECT LAMP

This lamp lights up when an overcurrent flows in the amplifier and the overcurrent protection circuit operates.

③ POWER ON switch

The upper position of this switch makes the set ON.

④ LOAD

Used in conjunction with the PLATE knob ⑤.

⑤ PLATE

Used in conjunction with the LOAD knob ④. Adjust them alternately for a maximum output.

⑥ LINEAR ON switch

When set to central position, LINEAR OFF, this switch passes the exciter output directly to the antenna. For operation with the linear amplifier, set this switch to SSB for SSB operation or to CW for CW operation.

⑦ BAND switch

Used to select band. (3.5 ~ 28MHz bands).

⑧ IP switch

In the IPA position, the meter indicates the sum of all power tube plate currents. To read I_p of individual power tubes, set this switch to the desired tube, V1, V2, V3, V4 or V5. This I_p reading must be taken with the knob ⑨ set to IP.

⑨ Meter switch

In the IP position, meter ① indicates plate current I_p . In the FWD position,

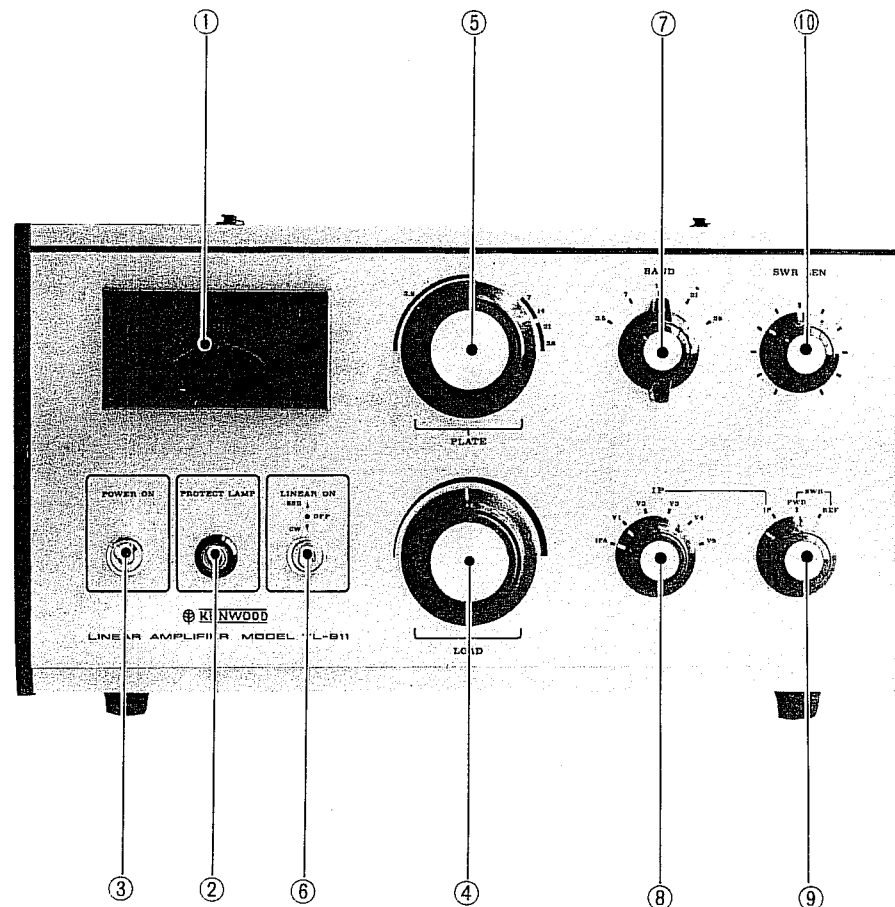


Fig. 1. Front Panel Controls

SECTION 4. CIRCUIT DESCRIPTION

4-1 BLOCK DIAGRAM

TL-911 linear amplifier circuitry are shown in Fig. 5, block diagram. It is a hybrid type amplifier employing 6 vacuum tubes, 3 transistors, 27 diodes and 1 thyristor. The final amplifier section is completely shielded; the rectifier and control units are mounted on the printed circuit boards. Thus, this amplifier is functionally sectionalized.

4-2 FINAL POWER AMPLIFIER SECTION

The five 6LQ6 tubes are enclosed in a shielded box containing the powerful cooling fan. They operate in Class AB for SSB and in Class C for CW in a grounded-grid configuration. Necessary bias switching is accomplished by means of the LINEAR ON switch. Since the screen grid receives its voltage from a regulated voltage supply, free from distortion is assured. In addition, a dynamic balance circuit which makes the dynamic characteristics uniform among the power tubes, a dual type ALC circuit which improves linearity, and an SWR meter circuit are included.

4-3 POWER SUPPLY SECTION

The individual supply voltages from a large power transformer having a current capacity more than actually required is rectified by the rectifier unit X43-1010-00. The high voltage for the tube plates is obtained from a bridge rectifier composed of 8 diodes (10D10); voltage for the screen grids, bias circuit and relays are supplied by 10D4 and 10D1.

4-4 CONTROL UNIT

The overcurrent protection circuit which is one of the special features of this amplifier is included in the control unit X53-1000-00. This protection circuit uses 2SC374 and 2SA495 transistors as main components for switching, and CR02A-2 for relay control. The screen grid voltage regulator, ALC discriminator and bias circuit are also contained in this unit.

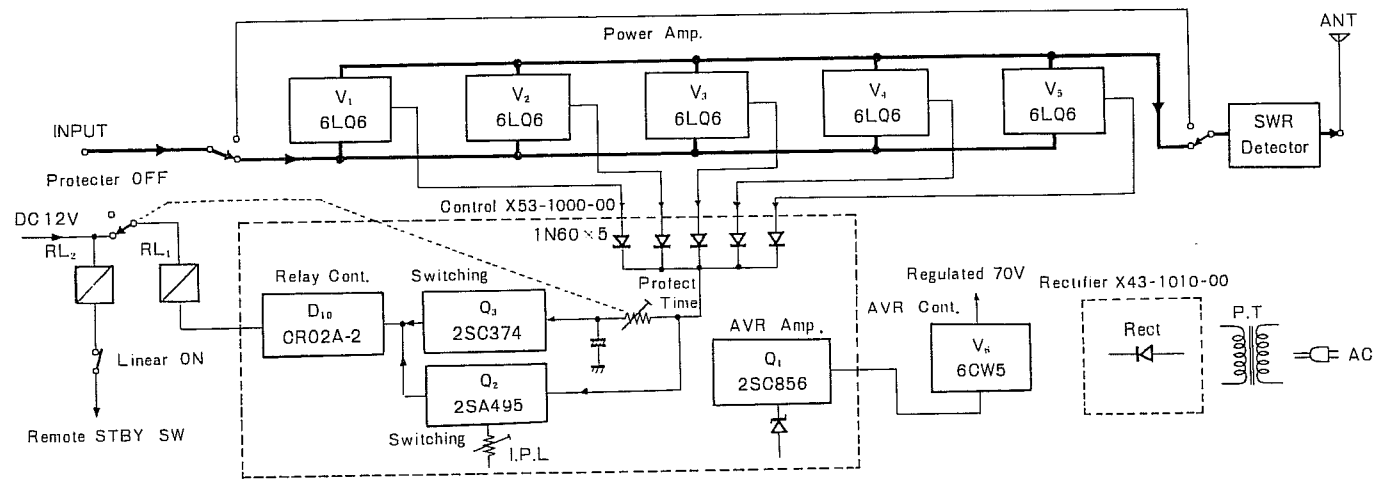


Fig. 5. Block Diagram of TL-911

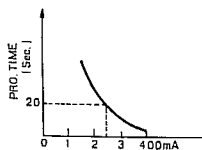
SECTION 5. ALIGNMENTS

NOTE: Never touch the high voltage circuit during adjustments.
Also wear rubber gloves to avoid electric shock.

Adjustment point	Adjustment parts	Adjusting condition	Adjusting method	Measuring instruments and adjusting tools
(1) Screen grid voltage E_{sg} (V)	VR5 (5k Ω)	Exciter is in transmit condition. LINEAR ON switch ⑥ at SSB.	Adjust VR5 until voltage at pin 1 or 7 of one of tubes V1 thru V5 becomes 70V DC.	Multimeter, vacuum tube voltmeter
(2) Base current I_p (static balance)	VR1 thru VR5 (10k Ω)	Exciter is in transmit condition in SSB mode. LINEAR ON switch ⑥ at SSB.	Switch the I_p meter switch of the linear amplifier from V1 thru V5, and adjust so that the I_p meter reads 15mA on each tube. NOTE: If meter indications are difficult to read, this adjustment may be made in terms of cathode voltage across cathode resistors (10 Ω) of V1 thru V5. Adjust them to 0.15V using a multimeter.	Meter ① (V1 ~ V5) Insulated screwdriver with a flat blade.
(3) Plate current with input signal (dynamic balance)	TC1 thru TC5 VC1, VC2.	Exciter is in transmit condition in CW mode. LINEAR ON switch ⑥ at SSB. NOTE: An exciter to be used must be of a rated output of 80 to 100W. If it exceeds 100W in CW mode, the ALC circuit must be biased to reduce the input.	Adjust VC1 (plate tuning capacitor) and VC2 (loading capacitor) so that a maximum output in SSB mode is obtained in 7MHz band. Measure I_p and check for its variations among the individual 6LQ6 while switching the Meter ① V1 thru V5, and adjust TC1 thru TC5 so that each tube flows equal 240mA of I_p . This current, however, may deviate ± 30 mA since all cannot be perfectly the same due to thermal drift or other causes.	Meter ① (IPA, I_p , V1 ~ V5) Meter switch ⑨ I_p switch ⑧ Dummy or RF power meter. Insulated screwdriver with a flat blade.
(4) (I. P. L.) Instantaneous protection level adjustment.	X53-1000-00 VR6, (Refer to the name plate on the final box.)	Exciter is off. Linear amplifier POWER switch ③ at ON, and LINEAR ON switch at OFF. NOTE: Voltage across the cathode resistor (10 Ω) should be 4V.	Obtain a 4V DC stabilized source voltage from a battery or an AVR (Automatic voltage regulator). Connect this 4V DC source across one of the 10 Ω cathode resistors of V1 thru V5. Since this 4V is equivalent to 400mA of the cathode current of each tube, adjust VR6 so that the IPL circuit operates with this voltage applied and the protection lamp lights.	Multimeter and vacuum tube voltmeter. Insulated screwdriver with a flat blade.
(5) Protection time adjustment	VR4, (100k Ω) (Rear panel)	Same as (a)	Apply 2.4V DC to the 10 Ω cathode resistor of one of the tubes V1 thru V5, using the above voltage source. (This voltage is equivalent to 240mA of the 6LQ6 cathode current.) Therefore, adjust VR4 (100k Ω) so that the protection circuit operates and protection lamp lights approximately 20 seconds after application of the voltage.	Multimeter or vacuum tube voltmeter. Insulated screwdriver with a flat blade.
(6) Calibration of Meter (a) V1 thru V5 (b) IPA	X53-1000-00 VR7 (10k Ω) VR8 (10k Ω) (Refer to the name plate on the final box.)	Exciter is off. Linear amplifier POWER switch ③ at OFF.	Adjust VR7 (10k Ω) so that the meter ① reads 240mA under the same condition as above. Apply 7.5V DC across R9 and R10 inserted into the return line to the high voltage rectifier diodes in rectifier unit X43-1010-00. Adjust VR8, (10k Ω) so that the meter ① swings to full scale with this voltage applied. However, since this adjustment has been made before shipment, no further adjustment is normally necessary and should not be attempted unless a qualified voltage source (AVR capable of 2A) is available.	Meter ① Multimeter or vacuum tube voltmeter.

SECTION 6. TROUBLE SHOOTING

Trouble	Cause and corrective action
(1) Linear amplifier does not operate when switched to transmission.	<p>(a) Check that the remote cable is connected to the exciter. TL-911 inserts the LINEAR ON switch in series with the external stand-by circuit and, therefore, merely turning on the LINEAR ON switch will not actuate the linear amplifier. To operate the linear amplifier for transmission, it is necessary to connect the remote cable to the exciter, and to turn on both the LINEAR ON switch and stand-by switch of the exciter.</p> <p>(b) Is the remote cable correctly wired between the exciter and linear amplifier? (The accessory remote cable is prepared for use with TS-515 or TS-510.)</p>
(2) Output meter does not deflect.	<p>(a) Is not the SWR SEN control located at the front panel set to its minimum sensitivity? Is the meter switch ⑨ at FWD? (The SWR meter increases its sensitivity as the SWR SEN control ⑩ is turned clockwise.)</p>
(3) Overcurrent protection circuit does not operate.	<p>(a) The protection circuit does not operate if the PRO TIME control ⑪ located on the rear panel is at the fully counterclockwise position. NOTE: Do not touch this control during normal operation since the power tubes may be damaged if transmission is continued with the protection circuit off.</p>
(4) Overcurrent protection circuit operates frequently.	<p>(a) Check the PRO TIME control ⑪ located at the rear. (Adjust operating time by referring to "ALIGNMENT".)</p> <p>(b) Exciting power input to this linear amplifier should be 100W. If driven with more power, the protector will function more quickly by the amount of I_p increased. (See the figure at left.) If transmission is continued with I_p being near 300mA, the protector will operate quickly. Such use, however, will reduce the life of power tubes, and requires reduction of input.</p> <p>(c) If the tank circuit of the linear amplifier is out of adjustment, the plate dissipation is larger than it should be with the given plate current. If with so large a plate dissipation as to heat the plates red, I_p increases due to temperature rise in the tubes, quickening protector actuation. This state of use imposes an overload upon the power tubes, causing them to flash over. Therefore, the tank</p>



- circuit must be adjusted for a correct, maximum output.
- (5) Protection circuit trips immediately when whistled or driven with loud voice in SSB mode.
- (6) Peak does not appear for SWR-FWD during adjustment of linear amplifier output.
- (7) Any of tubes has a considerable difference in plate current with no input signal.
- (8) Input cannot be adjusted with dynamic balance trimmers.
- (a) This is also due to overdriving, and occurs when I_p swings to above 400mA instantaneously with whistling etc. Even if instantaneous, such an excessive input can consume the life of the cathodes and should be avoided by reducing the microphone gain of the exciter amplifier.
- (a) Check that the meter switch ⑨ is in the SWR-FWD position. If the output adjustment is made with the meter in the I_p position, the plate dissipation increases as meter deflection increases. This is a dangerous condition and calls for special caution.
- (b) Is the BAND switch ⑦ set to the operating band? There are two band switches to be controlled; one on the exciter and the other on the linear amplifier.
NOTE: If the band switches are in a wrong position, the plate VC cannot be tuned and all power input to the plates becomes a loss.
If this is the case, allow more than 10 seconds for the tubes to cool after the protection circuit has tripped and before resetting the protector.
- (a) The bias adjust potentiometer is not properly adjusted and calls for readjustment as explained in "ALIGNMENT".
- (a) Power tubes are defective. Replace them with good ones and adjust the bias potentiometer and trimmers of the dynamic balance circuit as explained in "ALIGNMENT".

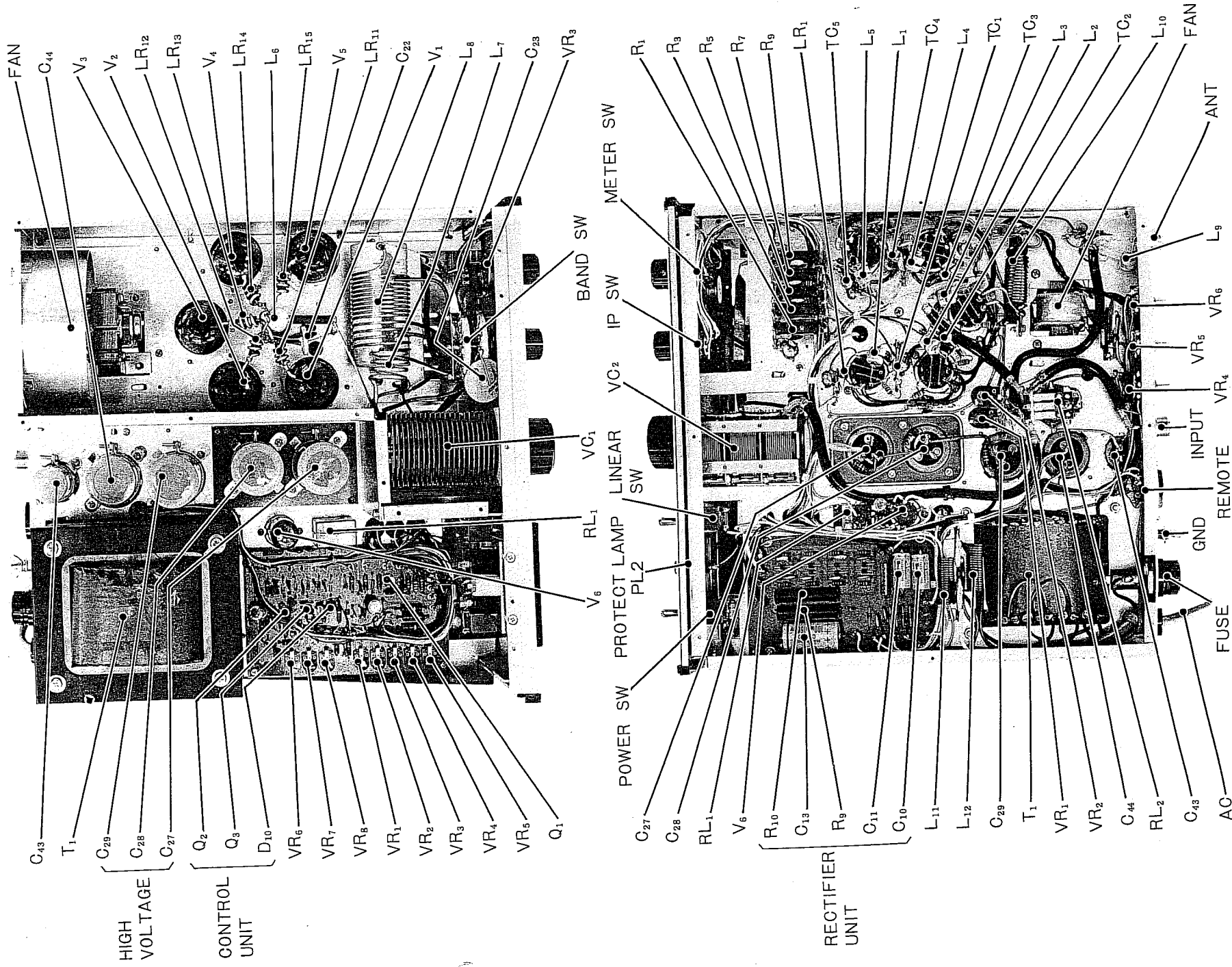
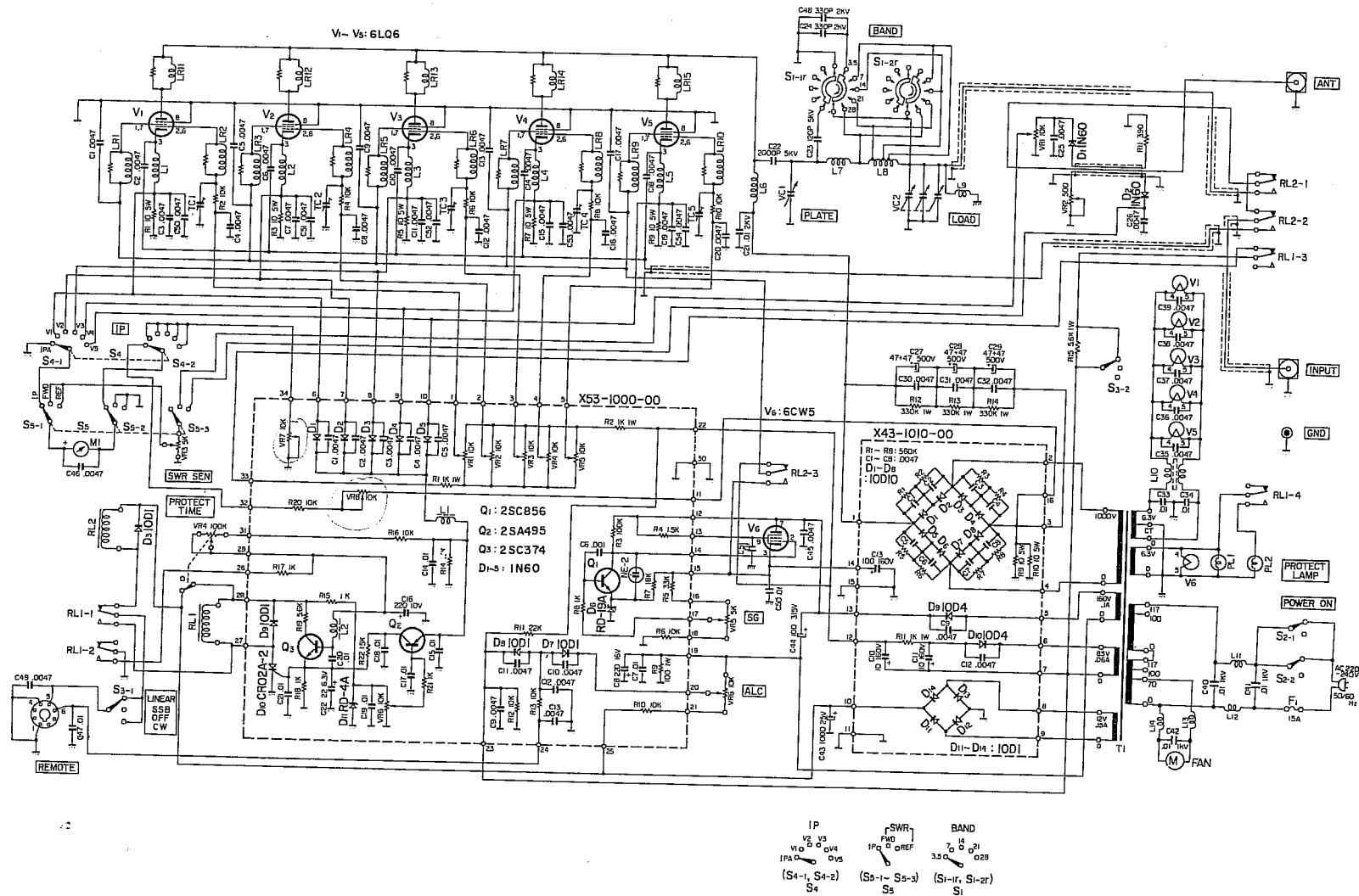


Fig. 6. Top & Bottom Chassis View

TL-911 SCHEMATIC DIAGRAM



TL-911

NOTE: We reserve the right to make modifications in this model in accordance with technical developments.