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IMPORTANT NOTICE

The transmitter section of this transceiver may only be serviced by, or under the direct supervision of a qualified technician having a valid First or Second Class FCC Radiotelephone license. This includes internal adjustments or replacement of crystals, transistors, or any other components which can affect the performance of the transmitter. Servicing should only be done by a licensed, capable technician using suitable equipment and having complete knowledge of proper CB servicing techniques.

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General Description

RCA CB Co-Pilot Citizen's Band Transceivers Models 14T300 and 14T301 are fully transistorized 23 Channel CB units designed for mobile two-way AM radio communication in the 26.965 to 27.255 MHz Class D citizen's band. They operate on 12-15 volts DC (13.8 V Nominal) with either positive or negative ground, fused in the input power cable. Operation on all 23 CB channels is provided through use of three built-in crystals operating in a PLL (phase lock loop) design. All receiver and transmitter frequencies are synthesized in the highly stable PLL circuitry.

Both units feature switchable ANL circuitry for automatic noise limiting and built-in RF gain controls to optimize receiver sensitivity. Model 14T301 also features Delta-Tune circuitry for improved reception of off-frequency signals, a Noise Blanker to minimize pulse type noise effects and a built-in RF/CAL/SWR meter for adjusting antenna SWR ratio. Both models incorporate detachable dynamic push-to-talk microphones and LED indicators. Model 14T301 also includes a LOCAL/DISTANT switch, and front panel ALC and Noise Blanker switches.

Front panel illuminated "S" meters monitor receiver input signals and transmitter output levels. Adjustable squelch is featured on both models, along with a switchable CB/PA function to permit use of the units as public address amplifiers. Separate PA and external speaker jacks are provided on the unit rear panels.

Typical Specifications

General

Frequency range	26.965 – 27.255 MHz
Channel	23 (PLL synthesized)
Frequency tolerance	0.005%
Operating temperature range	–30°C to +50°C (–22°F to +112°F)
Power source	12 to 15v dc (13.8v nominal)* Positive or negative ground
Emission	6A3

**All measurements referenced to 13.8V operation.*

Transmitter

Power output	4W (FCC maximum)
Modulation	AM – Collector modulated
Attenuation of Spurious and Harmonic Radiation	50 dB (Min.)
Antenna Input Impedance	50 Ohms

Receiver

Sensitivity	0.7 micro-volts for 10 dB $\frac{S+N}{N}$
Selectivity	
2.4 KHz	–6 dB
10 KHz	–55 dB
Adjacent channel rejection	>55 dB
Image rejection (1st IF)	>60 dB
Spurious rejection (Except images)	.1/2 x 2nd IF>35 dB 2 x 2nd IF >35 dB
Intermodulation rejection ratio	>40 dB
IF frequencies	
1st IF	10.695 MHz
2nd IF	455 KHz
ACC figure of merit (RF input change for less than 10 dB change in audio output)	75 dB
Squelch sensitivity (CH13)	1.5 uv – 100 uv
Audio output	3W min.
Current drain (Nominal)	Transmit: 1.5A Receive : Full audio 1.2A Squelch 240mA

Mechanical

14T300

Dimensions	6–3/8in. x 2–1/4in. x 7–7/8in. (162mm x 57mm x 200mm)
Weight	3 lbs, 8.2 oz. (1.45 kg)

14T301

Dimensions	7in. x 8–1/4in. x 2–5/16in. (178mm x 209mm x 59mm)
Weight	3 lbs, 13.6 oz. (1.6 kg)

Circuit Description

General

Models 14T300 and 14T301 make use of the Phase Locked Loop (PLL) system of frequency synthesization to produce the crystal controlled channel and IF signals used in the operation of the transmitter and receiver sections of the transceivers. The basic PLL system is comprised of a free running voltage controlled oscillator (VCO – Q101) a phase detector, a reference crystal oscillator (Q105) and a programmable divider (IC101), refer to block diagram figure 1.

The VCO is designed to operate in a frequency range of 37.66 MHz to 37.95 MHz, which is 10.695 MHz above the channel 1 to channel 23 frequency range of 26.965 to 27.255 MHz (note that 10.695 MHz is also the receiver first mixer IF frequency). The VCO signal is mixed with the output (third harmonic) of reference oscillator Q105, producing a difference frequency range of 2.24 MHz to 2.53 MHz. Simultaneously a second crystal controlled oscillator Q117, feeds a 10.24 MHz signal to the programmable divider in IC 101 and is divided down in 10 kHz steps in the 224 to 253 MHz range being controlled by an "N" code signal originated by the channel selector. (See Frequency Table on Page 18. The phase detector within IC 101 produces a DC output voltage derived from the phase difference in the two signals fed to it, i.e. – signal from Osc. Q117 and the 2.24 to 2.53 MHz signal from Mixer Q102 via buffer Q103. This DC output is applied to VCO Q101 through the LPF, forming the phase loop. Application of the DC voltage to the VCO causes it to shift frequency until it locks up with the count-down frequency of the divider, at which point no DC output is produced from IC 101 and the VCO remains locked on frequency. When a new channel is selected a new "N" code is sent to the programmable divider. The VCO is no longer locked and again shifts in frequency and locks up, corresponding to the new channel selected.

In summary, it will be seen that a range of stable frequency outputs from the VCO will be produced over the band 37.66 to 37.95 MHz, each specific

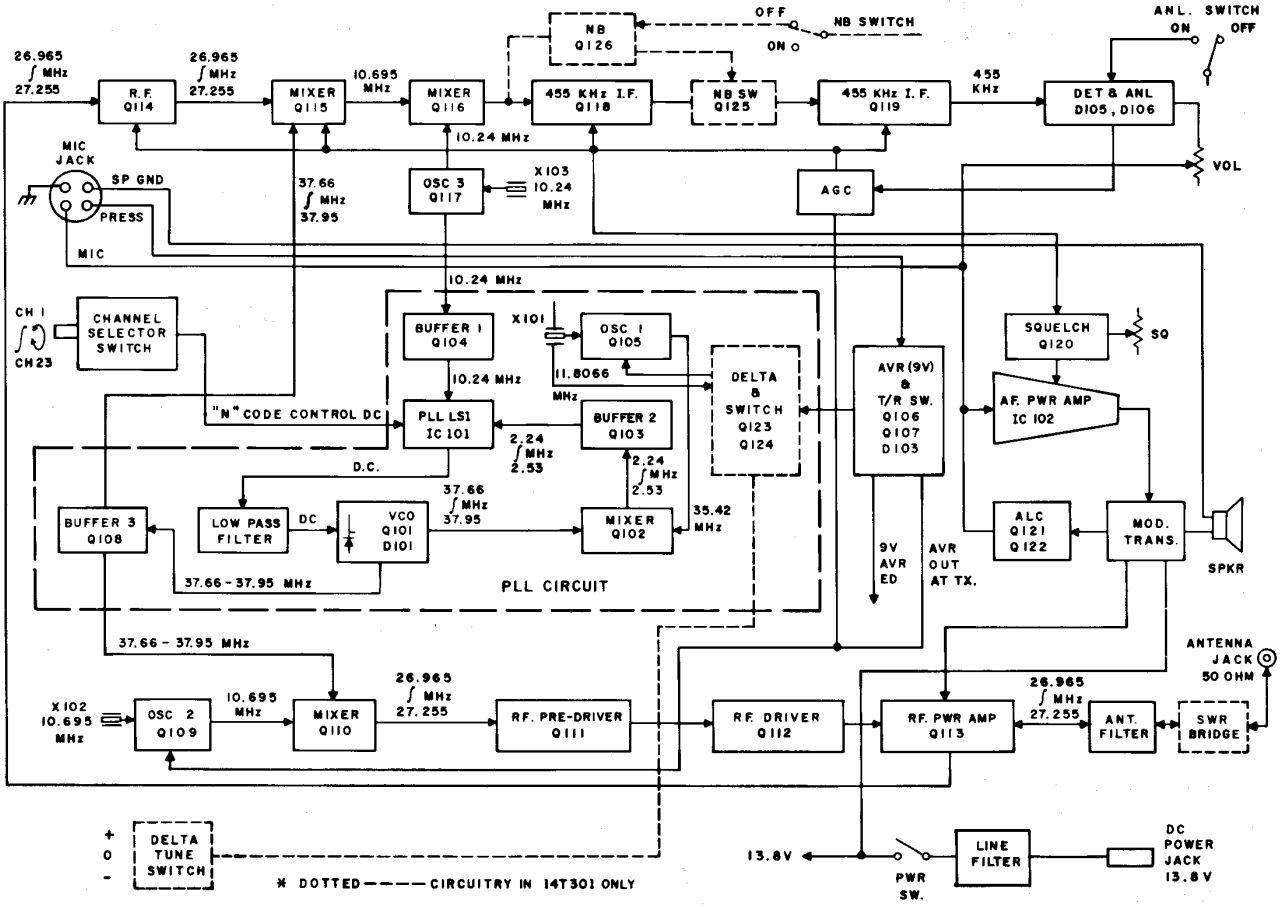

Figure 1 – Block Diagram

frequency being determined by the "N" code from the channel selector. The VCO output is used in both the transmitter and receiver sections of the transceiver as described in the separate sections which follow.

Transmitter

The transmitter oscillator Q109, oscillator # 2, is a Pierce type oscillator circuit operating at a frequency of 10.695 MHz. The oscillator output is coupled to the transmitter mixer Q110. The mixer is also fed a signal in the 37 MHz range from the VCO Q101. These two signals beat in the mixer and result in a 27 MHz output difference frequency which is the channel frequency of the channel chosen. See Channel Frequency Chart on page 18.

The 27 MHz mixer output is coupled to RF predriver transistor Q111 through high pass filter L/103/L104/T102 and C139/C140. The predriver serves to isolate the oscillator and mixer stages from the output, and at the same time provide a certain amount of power gain. Q111 output is applied to the base input of Q112, the RF Driver stage and in turn to Q113 the RF output stage of the transmitter. These stages amplify the 27 MHz RF signal resulting in an output at L110 of 4 watts.

In the transmit mode, the microphone feeds audio through IC102 to the output transformer T110 and to the collectors of Q112 and Q113 which serve as the modulator for the transmitter. This modulating audio is applied to both the driver and output stages to provide carrier modulation up to 100%. An ALC voltage derived from this modulating signal at L110 is fed back to Q122 to control the output of IC102 and prevent over modulation. Factory adjustment of 90% modulation is achieved by adjustment of RV102.

The low pass filter between the antenna and receiver and transmitter inputs serves to pass the 27 MHz signals, attenuating higher frequency signals. It also serves to match the antenna impedance to the output impedance of the transmitter output transistor stage Q113.

Receiver

The rf signal, at a frequency between 26.965 and 27.255 MHz, feeds from the antenna through L110 and L109 to the 27 MHz Neutralized RF Amp Q114. Then the amplified output signal from Q114 is coupled through T105 to Mixer Q115, where it is beat with an injection signal from VCO Q101 via buffer Q108. (This oscillator serves as a master in the PLL crystal synthesization of the required receiver and transmitter signals). The frequency of the injection signal depends on the channel being received, as a signal in the 37 MHz range is programmed by channel selector switch SW101. The output of Mixer Q115 is therefore 10.695 MHz, the result of the RF input and mixing of VCO signals. (see Frequency Chart on Page 18).

This 10.6-MHz range IF signal is then fed to Q116, the second mixer. Also fed to the 2nd Mixer is a second signal from Q117, Oscillator No. 3. This oscillator signal is at 10.24 MHz. Mixing of these two signals results in a signal in the T107 circuit from the 2nd Mixer of 455 kHz, the second IF frequency.

The 455 kHz second IF signal passes through the ceramic bandpass filter CF101, and feeds the 455 kHz signal to IF amplifiers Q118 and Q119 which include IF transformers T108 and T109. The output of Q119 is applied to D110 the diode detector.

The rectified audio signal from the detector is passed through the volume control VR1 to the input of the audio circuit IC102. The audio output is transformer coupled to the internal speaker, and to an external speaker if used.

Q120 is the squelch amplifier transistor. At low or no signal levels Q120 conducts heavily and its output, connected to pin 7 of IC102 results in no signal output from the audio section. As the incoming RF signal increases it results in a decreasing output from Q102. This results in opening up the AF amplifier and output is achieved. The point at which Q102 cuts off is determined by setting the SQUELCH control VR2.

Delta Tune (14T301 only)

Delta tune circuitry is employed in the oscillator # 1 Q105 crystal stage. The "Delta-Tune" switch on the front panel acts to connect SW2 (Q124) or SW1 (Q123) in the Q105 oscillator. Depending upon whether the + position of switch or – position of switch is chosen the crystal frequency is "pulled" slightly above or below its normal operating frequency. By being able to control this slight change in crystal frequency, clearer reception of an incoming signal may be achieved, when the received signal is slightly above or below the nominal frequency of the channel crystal frequency.

Public Address

Switching provision is made in the audio input circuit of the transceiver to provide a PA function by switching the microphone output. The audio output is also switched to an external PA speaker jack. This switch-

ing occurs when the CB/PA switch is set to the PA position.

In the PA mode, the transceiver serves as a public address amplifier providing 3 watts output to an external PA speaker. The other functions of the transceiver are deactivated in the PA mode per FCC Rules & Regulations).

Servicing

General

RCA 14T300 and 14T301 Co–Pilot Citizen's Band Transceivers performance depends upon the high quality of components employed and proper servicing techniques performed by licensed fully qualified technical personnel. Only use of replacement parts as outlined in the parts list on pages 16, 17, 22 & 23 should be employed.

Illustrations to aid in servicing and adjustment; such as top and bottom views, exploded views and superimposed printed board views, are provided to assist in proper and competent servicing. A block diagram is shown in Figure 1. The schematic diagrams are shown in Figures 16 and 17.

Figure 10 of the printed circuit board incorporate map grid coordinates at the sides of the illustration. These coordinates are keyed to corresponding key numbers in the replacement parts list, for instant location of smaller parts. Major components, not shown in Figure 10 are shown in views Figures 8 and 9. Exploded views identify all mechanical parts by means of balloon callouts. These balloons key to corresponding balloons shown in the mechanical parts list section.

Simple removal of the four Phillips screws at each side of the transceiver case permits removal of both halves of the case.

Servicing the two models is fundamentally the same due to the similarity of the two units.

Electronic switching is used in both units making them inoperable when the microphone is disconnected from the front of the unit. In order to activate the set only for receiver service, a dummy plug must be used in place of the microphone plug. Use of this plug is HIGHLY RECOMMENDED TO ACTIVATE THE RECEIVER WHEN PERFORMING SERVICE. IF THE MICROPHONE IS USED, ACCIDENTAL DEPRESSION OF THE TRANSMIT BUTTON COULD RESULT IN DAMAGE TO VALUABLE TEST EQUIPMENT. See Figure 3B for view and information on dummy plug.

***Note** – Crystals appear to be plug-in units. What appear to be sockets are spacers for thermal isolation, crystals are soldered to board.*

Test Equipment

The following test equipment is required and recommended for servicing the 14T300 and/or 14T301 Transceiver.

1. A 50 ohm resistive antenna load with a power capability of 5 watts or more, such as Bird Model 43 "thru line" wattmeter with a 5A Element and a Model 8053 RF Coaxial Load Resistor, or equivalent.
2. A frequency counter operable in the required CB range, such as Hewlett-Packard Model HP 5283A or suitable equivalent.
3. A HF Signal Generator which operates in the 50 kHz to 65 MHz frequency range with +1% accuracy, such as Hewlett-Packard HP-606B, Wavetek Model 3000 or equivalent.
4. An oscilloscope capable of accurate monitoring of 27 MHz range AM signals.
5. High Input impedance Electronic Voltmeter such as a WV-500B or equivalent.
6. Dummy plug to activate transmitter without using microphone, see Figure 3A.
7. Dummy mike plug for receiver servicing, with jumper between pins 2 and 3 as seen in Figure 3B.
8. An 8 ohm 5 watt resistive dummy speaker load.
9. An Audio Signal Generator.
10. An RF Voltmeter. (WV-500B with WG-301A Probe)
11. A regulated bench DC power supply capable of supplying 0 – 20 v DC @ at least 2 amperes.
12. DC Ammeter with 0 – 2 amp. scale.

Tune Up and Alignment

Before performing any adjustments, check visually all jacks, plugs and solder joints for good connection. Shown in the schematics are nominal test voltage values for the transceiver transistors. In addition, certain other pertinent voltages are shown on the schematics. For tune-up and servicing identical procedures may be employed for both Model 14T300 and 14T301.

Transmitter Alignment

Connect test equipment to the transceiver as shown

in the block diagram below, Figure 2. To activate the transmitter without using the microphone, use

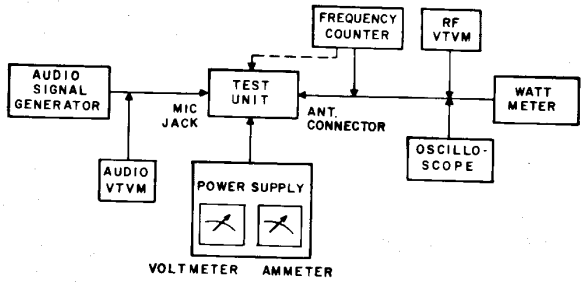

Figure 2 – Test Equipment Hook-Up

the dummy microphone plug wired as shown in Figure 3A. This plug is also used to introduce a modulating audio signal to the microphone input circuit as described in the following procedure.

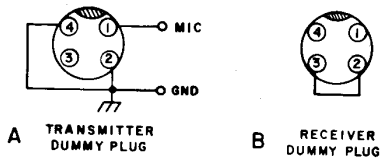

Figure 3 – Dummy Microphone Plugs

A. PLL CIRCUIT ALIGNMENT

Before proceeding with the PLL Alignment check the operating frequencies at points a, b and c on the frequency counter. (Use a 1000 pf capacitor in series with counter probe). See a,b,c below.

a. A signal frequency of 10.239 200 MHz ±0.13 MHz should be read at the collector of Q104 the 10.24 MHz Buffer # 1. (Point a)

b. A signal frequency of 37.6592 MHz ±0.38 MHz should be read at the base of Q101 the VCO. (Point b)

c. A signal frequency of 10.694200 MHz ±0.12 MHz should be read at the emitter of Q109 the 10.695 MHz Osc # 2. (Point c)

d. Delta Tune Adjustment (14T301 only)

Set "Delta Tune" switch to "0" position. Connect counter to base of Buffer Q108. A reading of 37.659200 MHz should be read with channel selector in the channel 1 position. If necessary, adjust CT101 to obtain this reading on the counter.

e. VCO Alignment

To more readily follow the frequencies involved during the alignment, refer to partial block diagram, Figure 4.

1. Set channel selector to channel 1.

2. Connect DC Voltmeter, set to 5 V range, between ground and R114 high side at TP8, see Figure 8. (Meter input impedance should be 20k ohm/volt or higher).

3. Adjust T101 core clockwise to obtain 1.5 volts ±0.1 volt on meter.

4. Set channel selector to open position between channels 1 and 23. A reading between 5.1 and 5.4 volts should be obtained. Then set selector to channel 23, a reading of 2.7 ±0.6 volts should be obtained.

B. ALIGNMENT OF MIXER Q110, PREDRIVER Q111 AND DRIVER Q112

a. Set channel selector in channel 13 position.

b. Adjust power supply for a supply voltage at 8.0 volts.

c. Connect oscilloscope to base side of T102, between C141 and ground.

d. Adjust L103, L104 and T102 for maximum amplitude on the scope (27.115 MHz – channel 13 output)

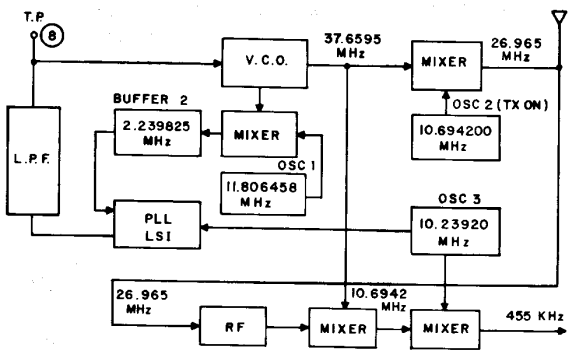

Figure 4 – Partial Block Diagram

e. Move oscilloscope to the base of Q112, RF driver, and readjust T102, then T103 for maximum amplitude.

C. ALIGNMENT OF RF POWER AMPLIFIER

a. Set channel selector to channel 13.

b. Adjust L106 for maximum reading on the RF wattmeter. See Figure 2.

c. Adjust L109 for maximum RF output.

d. Adjust L110 for maximum RF output.

e. Readjust L109 for maximum.

f. Turn L106 clockwise for an output of 4.4 watts on the meter.

g. Turn L110 counter-clockwise to obtain a reading of 3.8 watts on the meter.

h. Connect the DC ammeter in series with the power input and check the current reading. A reading of 900 milliamperes or less should be obtained. (Unmodulated)
(Note: — May be read on bench supply ammeter if used, see Figure 2)

D. TRANSMITTER FREQUENCY CHECK

a. Connect the frequency counter to the ANT connector and check the frequency on each channel with no modulation. The frequency should be within ± 800 Hz of the center frequency for each channel. Refer to the frequency table on page 18.

E. MODULATION SENSITIVITY ALIGNMENT

a. Connect the transmit dummy plug to the microphone jack.

b. Apply a 1 kHz, 20 MV signal to the microphone input circuit, between pin 1 and ground.

c. Adjust RV-102 to obtain 90% modulation, as observed on the scope, see Figure 2.

d. Decrease the signal input to 6 mV and observe that modulation ratio is maintained at 80% or higher.

F. RF METER ADJUSTMENT

a. Adjust RV104 so that the meter pointer is in the center of the red zone on meter scale. (This will indicate 3.8 watts output, the same as the wattmeter in step C.g.)

G. SWR BRIDGE ADJUSTMENT (14T301 ONLY)

a. Connect 100 ohm non-inductive resistor across antenna jack. Set RF/CAL/SWR switch to "CAL", Adjust VR4 to put meter pointer exactly on "SET" mark.

b. Set RF/CAL/SWR switch to "SWR". Adjust RV502 so that meter pointer reads "2" on meter scale.

Receiver Alignment

Connect test equipment to the transceiver as shown in Figure 5. Unless noted otherwise, keep Delta Tune switch at "0" and ANL switch to "ON" positions for Model 14T301.

A. RECEIVER SENSITIVITY ALIGNMENT

To activate the receiver without using the microphone, connect the dummy microphone plug shown in Figure 3B in place of the microphone (jumper on plug between pins 2 and 3). VOLUME control fully clockwise.

a. Set the signal generator output to 27.115 MHz with 1 kHz 30% modulation.

b. Set the transceiver on channel 13.

c. Refer to Figure 8 and adjust T111 (Buffer 3, Q108 output) and T104, T105, L112, T106, T108 and T109, in this order, for maximum audio output across the 8 ohm dummy speaker load. Keep reducing the generator input signal as adjustment is made to avoid inaccuracy due to AGC action. Make final adjustments at low input level. Repeat adjustment to achieve maximum alignment accuracy at low level, signal level at 1 uV or less.

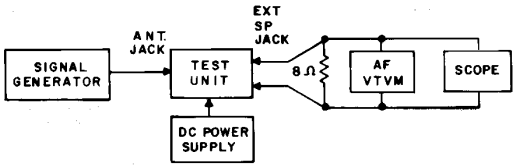

Figure 5 — Receiver Alignment Test Set-Up

B. SQUELCH CIRCUIT ADJUSTMENT

a. With signal generator and transceiver set to channel 13, 27.115 MHz, feed a 100 mV, 1 kHz signal modulated 30% into the RF input jack.

b. Rotate the SQUELCH control fully clockwise.

c. Adjust RV-101, see Figure 8, for maximum audio output on VTVM and scope connected across 8 ohm dummy speaker load. Note the output level. Slowly turn RV101 to decrease the output level by 60 dB, this will be indicated by a rapid cut-off of the audio output signal.

C. S-METER ADJUSTMENT

a. Set signal generator to produce a 100 uV signal to the RF input. (Set RF/CAL/SWR switch to "RF." — 14T301)

b. Adjust RV103, see Figure 8, so that RF meter pointer reads "9" on the meter.

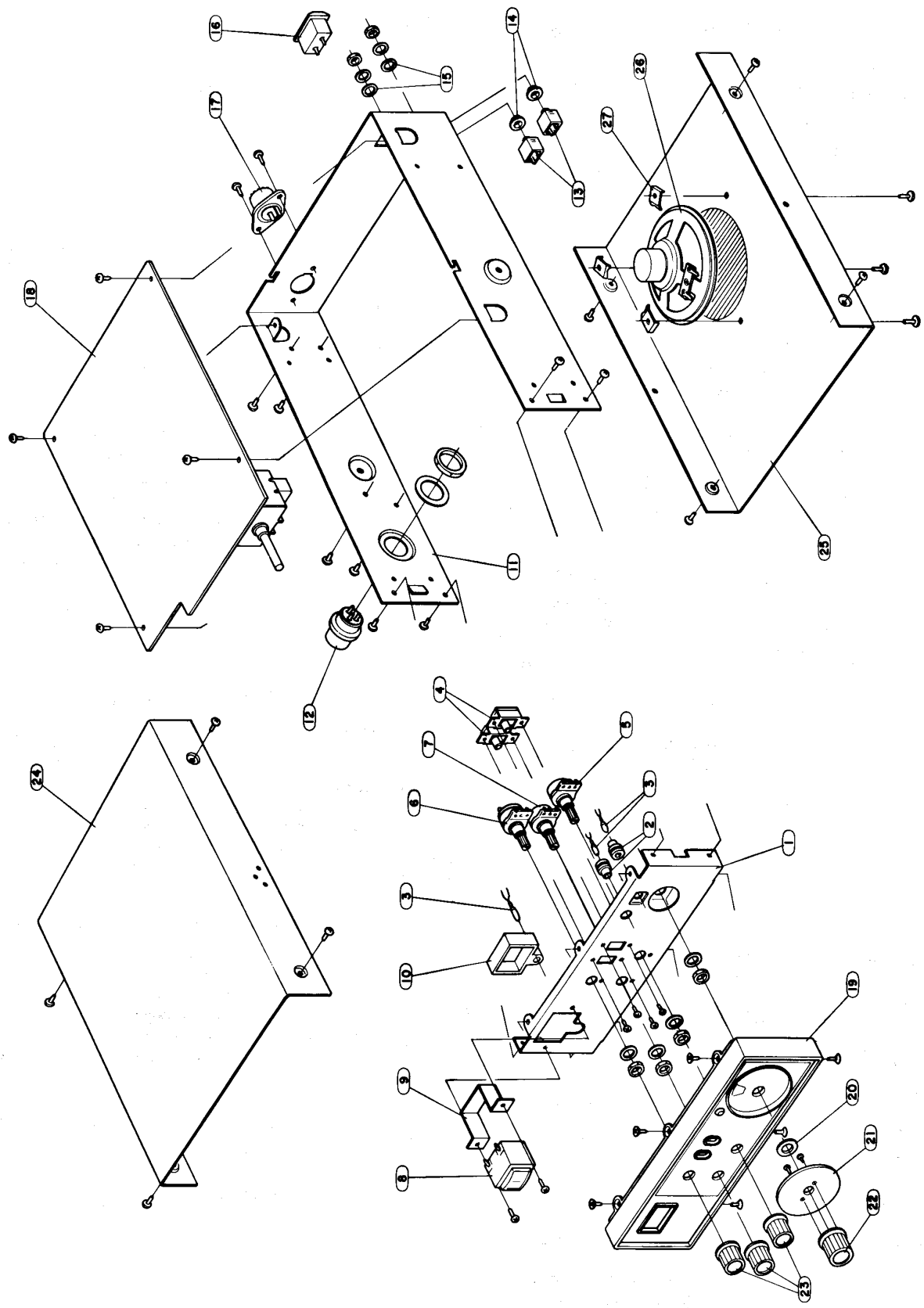

Figure 6 – Exploded View of Model 14T300

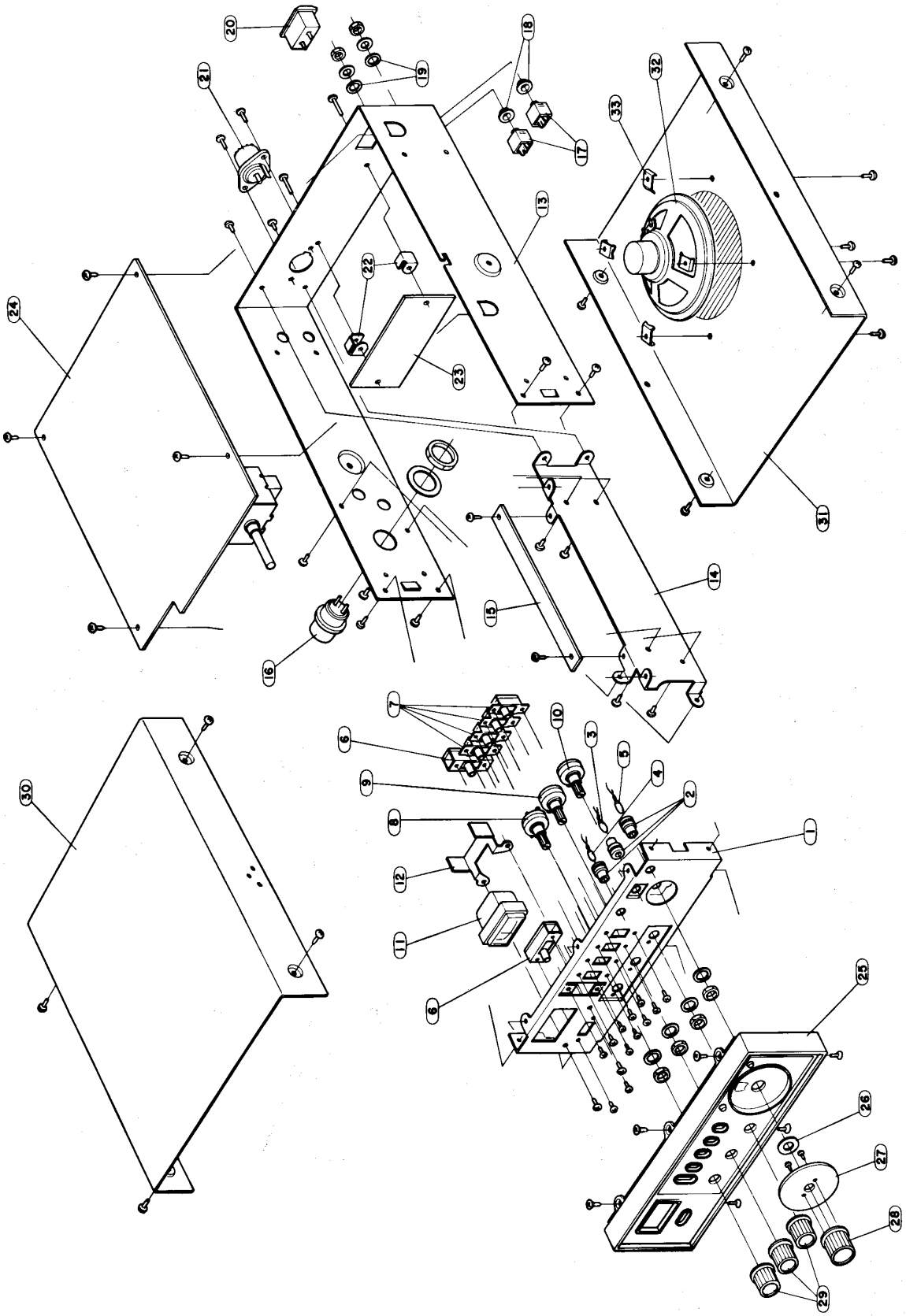

Figure 7 – Exploded View of Model 14T301

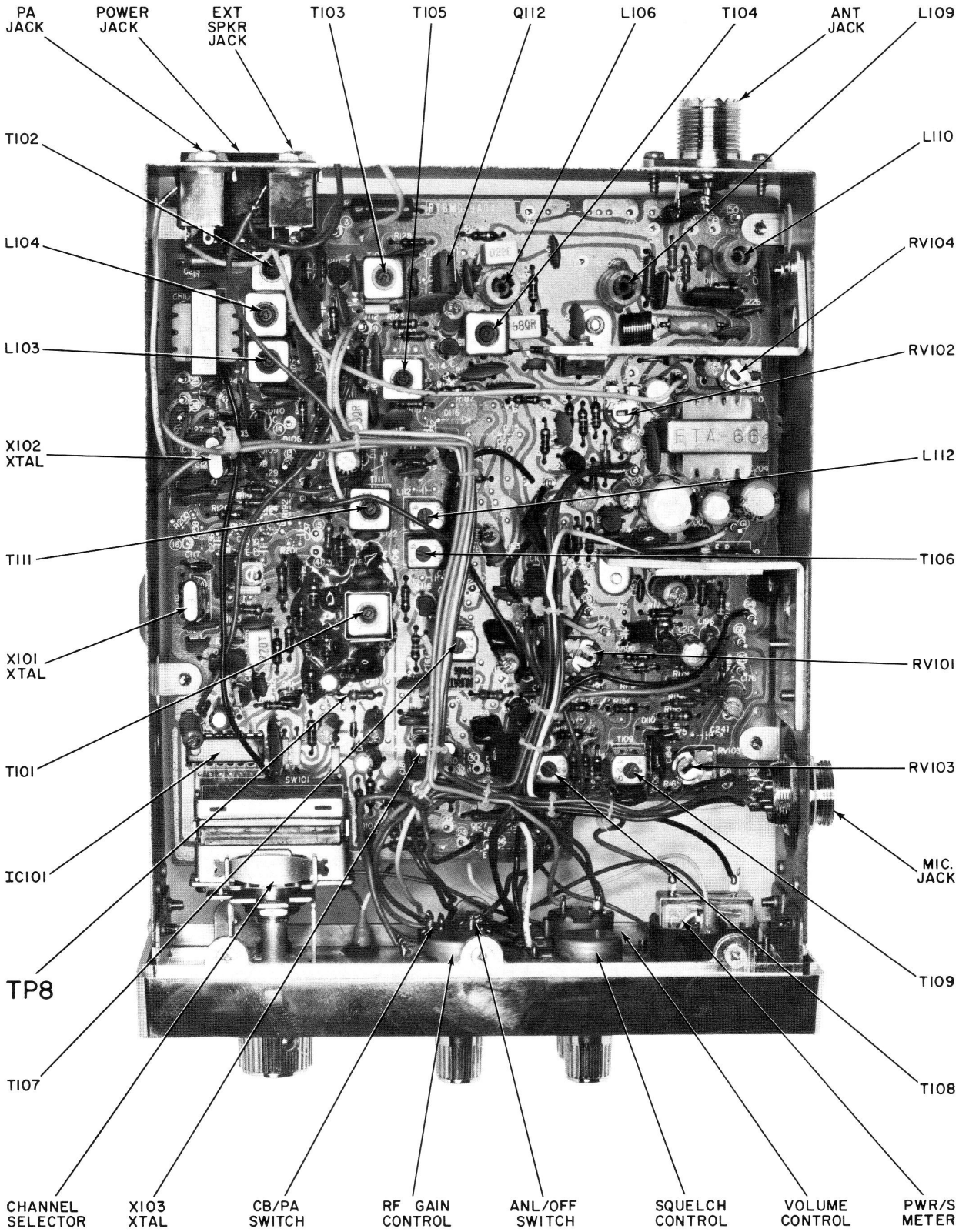

Figure 8 — Bottom (Component) View of Model 14T300