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

The RCA CB Co - Pilot Citizen's Band Transceivers Models 14T100 and 14T200, 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 (13.8v nominal) with positive or negative ground, and are fused in the input power cable. Operation on all 23 CB channels is provided through use of 14 built-in crystals, which produce stabilized crystal synthesized signals for transmission and reception on all channels. A 24 position rotary channel selector switch provides for rapid selection of any of the 23 channels, and the PA function on Model 14T100.

The transmitter produces an output power of 4 watts, and is designed to prevent spurious radiations, instability and harmonic distortion in conformance with FCC Regulations. An automatic level control (ALC) circuit prevents over-modulation of the transmitter. An LED modulation indicator on 14T200, (a transmit indicator light on 14T100) and an RF output meter located on the front panel are incorporated to monitor the transmitter output. The dynamic-type push-to-talk microphone connects to a jack on the face of the transceiver unit. Removal of the microphone disables the transceiver, preventing unauthorized use when the equipment is unattended.

Receiver circuits include a dual conversion system, automatic noise limiter (ANL) active at all times on 14T100, controllable on 14T200 by a front panel switch, and a public address (PA) function using the microphone and audio circuits as a PA system, with a jack provided for use of an external PA speaker. On Model 14T100, the PA function is selected by the channel switch (between Channel 22 and 23). On Model 14T200 a separate toggle switch on the front panel selects the PA function. An external CB spaker jack is also provided for use of a speaker away from the transceiver unit.

An illuminated signal strength ("S") meter monitors receiver input signals giving relative signal strength of the received signals. Model 14T200 incorporates a Delta-Tune circuit, with a front panel switch provided to select optimum reception of a signal which is slightly off-frequency. Selectable Automatic Noise Limiting is also provided on Model 14T200 by a front panel switch. Adjustable squelch on both models is controlled by operation of a front panel control.

Typical Specifications

General

Frequency range	26.965 to 27.255 MHz (FCC Rule Part 95.41)
Channels	23
Channel composition	Crystal synthesizer type
Frequency tolerance	+ 0.005%
Polarity of power supply	Negative or positive ground DC (13.8 V nominal)

Transmitter

RF power output	4W
Modulation capability	100%
Output impedance	50 ohms
Spurious and Harmonics Attenuation	–50 dB

Receiver

Sensitivity	0.7 μV for 10 dB S+N/N
Selectivity	–6 dB Bandwidth 6 KHz –50dB Bandwidth 20KHz
Adjacent channel Rejection	50 dB
Image rejection	at least 60 dB (S.F. +2 X 10.7 MHz)
Spurious response (Except images)	–50 dB
IF frequency	1st IF 10.595 to 10.635 MHz 2nd IF 455 KHz
Squelch Sensitivity	0.5 μV to 100μV
AGC figure of merit	more than 75 dB
Audio output	3 Watts minimum
Current Drain (Nominal)	Transmit: 1.4A Receive: Full audio - 1.1A Squelch - 240 mA

Mechanical

Dimensions	6.5 in. x 2.4 in. x 7.75 in. (165 mm x 61 mm x 197 mm)
Weight	3 lbs, 5 oz. (1.5 kg)

Circuit Description

Transmit/Receive Switching

Transmit/Receive Switching in the CB Co–Pilot transceivers is achieved with the "push-to-talk" microphone switch.

Receive

When the microphone switch is not actuated ("receive" position), a ground return for the secondary of audio transformer T2 is provided through the microphone switch, activating the internal speaker. The microphone switch in the "receiver" position also produces an open circuit from the microphone. It also biases off the transmitter.

Transmit

Activating the microphone switch to the "transmit" position, removes the ground return for the audio speaker circuit, cutting off receiver output. Simultaneously the switch connects the microphone to the input of TR41, the microphone preamplifier transistor. The receiver is biased off when the transceiver is in transmit mode.

Receiver

The rf signal, at a frequency between 26.965 and 27.255 MHz, feeds from the antenna through L111 to the 27 MHz Neutralized RF Amp TR11 to the double diode input protection circuit D111/D113 then the amplified output signal from TR11 is coupled through L112 to 1st Mixer TR12, where it is beat with an injection signal from Oscillator No. 1, TR31. (This oscillator serves as a master for the crystal synthesization of the required receiver and transmitter signals). The frequency of the injection signal depends on the channel being received, as one of six crystals of oscillator No. 1 in the 37 MHz range is selected by channel selector switch S1. The output of 1st Mixer TR12 is therefore one of four frequencies – i.e., 10.635 MHz, 10.625 MHz, 10.615 MHz or 10.595 MHz, the result of the RF input and mixing of 1st oscillator signals. (see Crystal Frequency Chart on Page 12).

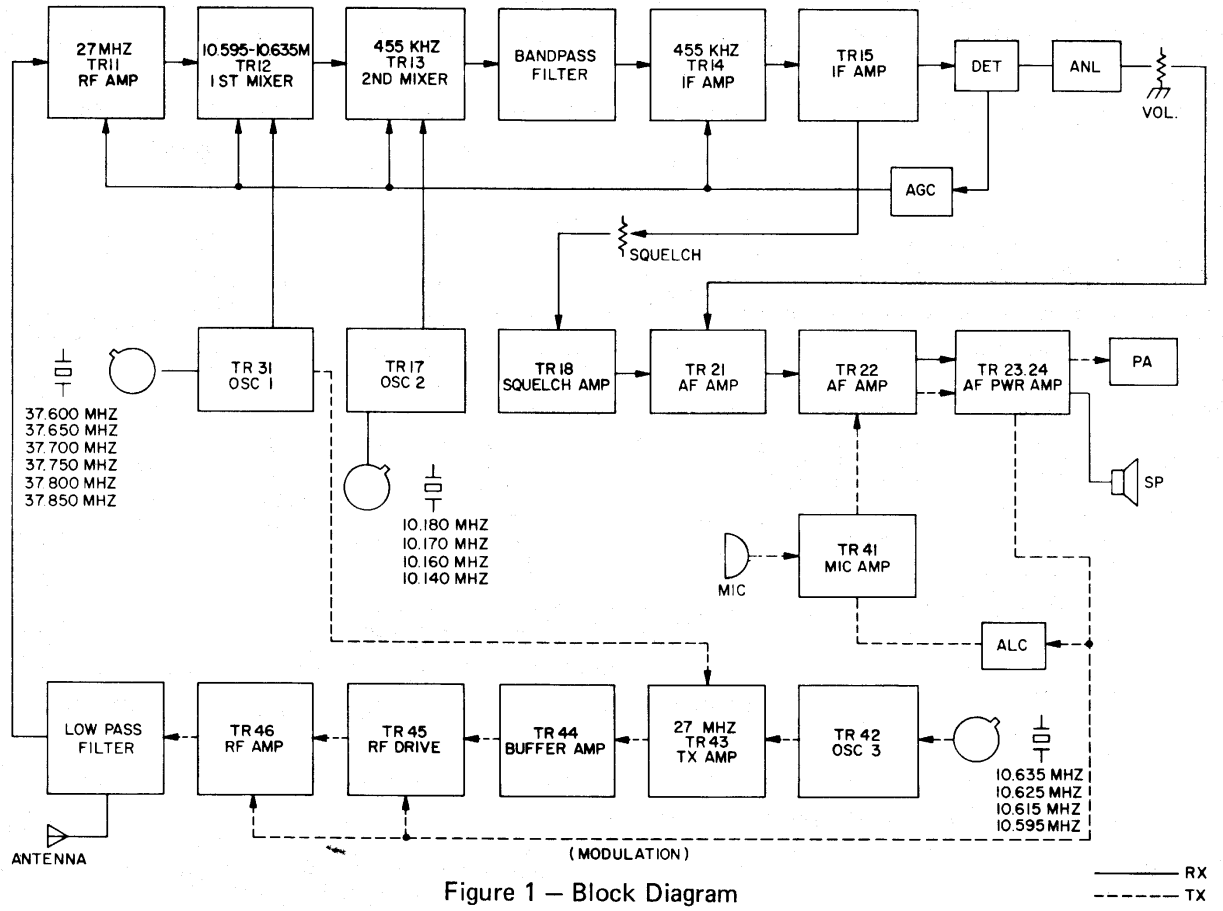

Figure 1 – Block Diagram

This 10.6-MHz range IF signal is then fed to TR13, the second mixer. Also fed to the 2nd Mixer is a second signal from TR17, Oscillator No. 2. This oscillator signal is at one of four frequencies, depending, as in the case of the 1st Mixer, on the particular channel selected, and is determined by switch S1B. Mixing of these two signals results in a signal in the L121/L122 circuit from the 2nd Mixer of 455 MHz, the second IF frequency.

The 455 kHz second IF signal passes through the ceramic bandpass filter F131, and feeds the 455 kHz signal to IF amplifiers TR14 and TR15 which include L141 and L151. The output of TR15 is applied to D151/D152 a voltage doubler type detector.

The output of the detector provides a DC component across C157 proportional to the received signal. This DC AGC signal is used to establish the base bias on transistors TR11, TR12, TR13, and TR14, causing a reduction in bias with an increase in input signal strength.

Diode D153 circuit is a series noise limiter, which limits ignition and other man-made noise induced into the receiver and is in the circuit at all times except that in model 14T200, the noise limiter may be shunted by the ANL switch S4, provided on the front panel. enabling reception of weaker signals.

The rectified audio signal from the detector is passed through the volume control VR153 to the base of the 1st audio amplifier TR21, then through 2nd audio amplifier TR22 to the push-pull audio power amplifiers TR23/TR24. The audio output is transformer coupled to the internal speaker, and to an external speaker if used.

TR18 is the squelch amplifier transistor. At low or no signal levels TR18 conducts heavily and its output, connected to the base of AF amplifier TR22, cuts off TR22 resulting in no signal output from the audio section. As the Incoming RF signal increases it results in a decreasing output from TR18, until TR18 is cut-off. This results in opening up the AF amplifier TR22 and output is achieved. The point at which TR18 cuts off is determined by the setting of SQUELCH control VR182.

Delta Tune

Model 14T200 employes a delta tune circuit in the oscillator # 2 crystal stage. The "Delta-Tune" switch on the front panel acts to connect an inductance L171 or capacitance C171 in series with the oscillator # 2 crystal. Depending upon whether the inductance (+ position of switch) or capacitance (– 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.

Transmitter

The transmitter oscillator TR41, oscillator # 3, is a Pierce type oscillator circuit using one of four 10 MHz range crystals – i.e., 10.635, 10.625, 10.615 or 10.595 MHz. Depending on the channel of operation, one of the above four frequencies is selected by channel selector switch S1C. (See Channel Frequency Chart on page 12).

The oscillator output is capacitively coupled to the transmitter mixer TR43. The mixer is also fed a signal in the 37 MHz range from oscillator # 1. One of six frequencies is selected by channel switch S1A, depending on the channel selected. (See Channel Frequency Chart on page 12). 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.

The 27 MHz mixer output is coupled to buffer amplifier transistor TR44 through high pass filter L431/L432/L433/C433 and C434. The buffer serves to isolate the oscillator and mixer stages from the output, and at the same time provide a small amount of power gain. TR44 output is applied to the base input of TR45, the RF Driver stage and in turn to TR46 the RF output stage of the transmitter. These stages amplify the 27 MHz RF signal resulting in an output from TR46 of 4 watts.

In the transmit mode, the microphone feeds audio through TR41 and TR22 to the push-pull audio output TR23/TR24 which serves as the modulator for the transmitter. This modulating audio is applied to both the driver and output stages TR45 and TR46, to provide carrier modulation up to 100%. An ALC voltage derived from this modulating signal is fed back to TR23/TR24

via the microphone amplifier TR41 to control its output and prevent over modulation. Factory adjustment of 100% modulation is achieved by adjustment of VR481.

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 TR46.

Public Address

Switching provision is made in the audio output circuit of the transceiver to provide a PA function by switching the audio output to an external PA speaker jack. On Model 14T100 this switching occurs when the channel selector S1 is set between channels 22 and 23. On Model 14T200 a separate front panel toggle switch is provided for PA function selection.

In the PA mode, the microphone, the microphone amplifier TR41, AF amplifier TR22 and Audio power Amplifiers TR23 and TR24 serve as a public address amplifier providing 5 watts output to an external PA speaker.

Servicing

General

Performance of the RCA 14T100 and 14T200 Co–Pilot Citizen's Band Transceivers 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 18, 22, 23 should be employed.

Illustrations to aid in servicing and adjustment; such as top and bottom views, exploded views and a superimposed printed board view, are provided to assist in proper and competent servicing. A block diagram is shown in Figure 1. The schematic diagram Figure 9 is combined for the both models with the small differences for the 14T200 shown in dotted lines on the schematic, plus a small section at the extreme right which shows the difference in the audio output circuitry for the 14T200.

Figure 6 of the printed circuit board incorporates a map grid coordinate scale 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 6 are shown in chassis views Figures 2 and 3. 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 two Phillips screws at the rear of the transceiver case permits the entire unit to slide out of the case. Loosening the two screws on the slotted speaker bracket permits the speaker and bracket to be rotated 90° to an upright position revealing all components on both top and bottom of the unit.

Servicing the two models is fundamentally the same due to the similarity of the two units. As mentioned earlier, the only variations between the units are readily discerned from the few dotted lines on the schematic diagram and the slightly different circuitry in the audio output circuit of Model 14T200.

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 8 for view and information on dummy plug.

Test Equipment

The following test equipment is required and recommended for servicing the 14T100 and/or 14T200 Transceiver.

1. A 50 ohm resistive antenna load with a power capa-

bility 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 mike plug for receiver servicing, with jumper between pins 2 and 3 as seen in photo in Figure 8.

7. An 8 ohm 5 watt resistive dummy speaker load.

8. An Audio Signal Generator.

9. An RF Voltmeter. (WV-500B with WG-301A Probe)

10. A bench DC power supply capable of supplying 13.8 V DC @ at least 2 amperes.

11. A VHF radio receiver capable of tuning in the 54.3 MHz range, or a TV set if available (for adjustment of the TV interference trap L465).

Tune Up and Alignment

Shown in the table on Page 10 are nominal test voltage values for the transceiver transistors. In addition, certain other pertinent voltages are shown on the schematic Figure 9. For tune-up and servicing identical procedures may be employed for both Model 14T100 and 14T200.

A. Audio Frequency Adjustment

Unless otherwise specified, the input signal level is adjusted for an audio output of 1 watt across 8 ohms with volume control at maximum. Connect the dummy microphone plug to activate the receiver.

1. Connect an 8 ohm resistive dummy load across the EXT SPKR jack.

2. Connect an AC voltmeter across the load.

3. Connect the Audio Oscillator Output to the center lead (arm) of VR153 volume control. Set VR153 maximum clockwise.

4. The amplitude gain from VR153 to the dummy load should be approximately .5 volts RMS with 1 watt output at the load.

5. Check resistor voltages, table 1, if condition in step 4 is not obtained.

NOTE:

Iron core adjusting slugs are secured in place at the factory to prevent movement from excessive vibration as may be encountered in mobile service. Before attempting to readjust these cores, carefully soften the wax by inserting a pencil tipped iron in the coil form. After the wax is softened the core may be easily adjusted.

B. Oscillator #1 (TR31) Adjustment (37 MHz)

1. Connect the RF voltmeter between TP31 (top of L311 in TR31 output see Figures 2 and 3) and ground. Set channel selector to channel 21 or 23. Turn L311 fully clockwise.

2. Turn L311 counterclockwise slowly for a peak reading on the meter. Then turn clockwise approximately 1/4 turn (90%). This will result in setting the oscillator to a stable oscillation point.

3. Refer to the crystal frequency table and check the six oscillator 37 MHz output frequencies on the frequency counter. When adjustment is proper voltages should be approximate to TR31 voltages in table 1.

C. Oscillator #2 Check (TR17 10.1 MHz RX Oscillator)

1. Connect the RF voltmeter between the emitter of TR17 and ground.

2. A reading of approx. .52 volts should be obtained.

3. Refer to the crystal frequency table on Page 12 and check the four oscillator output frequencies on the frequency counter.

4. Check oscillator # 2 DC voltages. Should approximate those in table 1.

Voltage Table

Transistor	Function	Emitter	Base	Collector
TR11	RF AMP	0.47v	1.18v	3.6v
TR12	1ST MIXER	0.54v	1.2v	7.8v
TR13	2ND MIXER	0.5v	1.2v	7.4v
TR14	IF AMP	0.55v	1.2v	8.0v
TR15	IF AMP	0.17v	.82v	8.0v
TR17	OSC #2	0.68v	1.2v	4.6v
TR18	SQ. AMP	*0 **(0.v)	*0.45v **(0.6-0.65v)	*4.0v **(0v)
TR21	AF AMP	*0.2v **(0v)	*0.8v **(0v)	*9.5v **(11.5v)
TR22	AF AMP	1.3v	2.0v	11.0v
TR23	AF OUTPUT	0.05	0.64	13.6v
TR24	AF OUTPUT	0.05v	0.64v	13.6v
TR31	OSC #1	†1.7v ††1.7v	†1.5v ††1.5v	†12.5v ††12.5v
TR41	MIC AMP	†4.5v ††1.0v	†1.7v ††1.7v	†11.6v ††7.6v
TR43	27 MHZ AMP	†4.6v †† .38v	†0.5v ††0v	†13.8v ††13.8v
TR44	BUFFER AMP	†3.2v ††1.7v	†3.7v ††2.1v	†13.8v ††13.8v
TR45	RF DRIVER	†.015v ††.06v	†0v ††–.9v	†13.6v ††13.6v
TR46	RF OUTPUT	†0v ††0v	†0v ††–.62v	†13.8v ††12.0v

* Indicates unsequelched condition.
** Indicates squelched condition.
† Receive condition.
†† Transmit condition.

All voltages measured with RCA Volt Ohmyst WV-98C and may vary ±20% – Voltages marked †† may vary ± 40%.

D. Oscillator #3 Check (TR42 10.6 MHz TX Oscillator)

1. Open up the jumper between "a" and "b" of TP47 (Located next to L463 and L462 in TR46 output) See Figures 2 and 3.

2. Connect the RF voltmeter between the emitter of TR42 Oscillator # 3 and ground.

3. An oscillator voltage of approx. 1.8 volts should be read on the meter.

4. Refer to the crystal frequency table on Page 12 and check the four oscillator output frequencies on the frequency counter. Reconnect TP47 jumper.

5. Voltages measured on Oscillator #3 should approximate TR42 voltages in table 1.

E. Receiver Adjustment

1. Connect 8 ohm dummy load across EXT. SPKR jack. Connect Output Meter across load. On 14T200 set ANL switch to OFF.

2. Set the Signal Generator to 455 kHz and connect between the base of TR13 2nd IF Amplifier and ground.

NOTE:

Iron core adjusting slugs are secured in place at the factory to prevent movement from excessive vibration as may be encountered in mobile service. Before attempting to readjust these cores, carefully soften the wax by inserting a pencil tipped iron in the coil form. After the wax is softened the core may be easily adjusted.

3. Adjust L151, L141 and L131 (in this order) for maximum output on the meter at the EXT SPKR load. Gradually decrease input from generator to obtain maximum adjustment sensitivity when making adjustments.

4. Move the signal generator output to the "Antenna" jack and set the receiver to channel 13 or 14.

5. Set generator to only a high enough output to obtain a reading on audio output meter.

6. Tune L121, L122, L112 and L111 in RF and mixer stages for maximum output meter reading. Keep decreasing generator output so that final adjustment is made at low level for maximum sensitivity.

7. Check on channel 1 and channel 23. The sensitivity should be within −3dB. If not, readjust L111 and L112 to obtain this condition between the two frequency extremes.

8. Input signal generator levels to obtain 1 watt audio output should read as follows with volume fully clockwise:

   *TR11 base: .7 uV (27 MHz)

   *TR12 base: 5.5 uV (27 MHz)

   *TR13 base: 40 uV (10.6 MHz)

   *TR14 base: 250 uV (455 kHz)

   *TR15 base: 9000 uv (455 kHz)

F. Squelch Control Circuit Adjustment

1. Use same test equipment as in section E, signal generator connected to "ANTENNA".

2. Set signal generator input for 100 uV level.

3. Set "SQUELCH" control fully clockwise.

4. Adjust VR181 in TR18 input for an output of

5. The voltages on the squelch amplifier should be close to VR18 readings shown in table, page 10, in the squelched and unsquelched conditions.

G. Receiver "S" Meter Adjustment

1. Set VR151 for a reading of S9 with a signal generator input level of 100 uV. (See 2, section F)

2. Remove all test equipment.

H. Transmitter Adjustment

Remove power from unit

1. Open up jumper between "a" and "b" at TP47 (see step 1 under "D").

2. Connect the RF Voltmeter between TR45 base and ground.

3. Remove dummy microphone plug, and connect the microphone to the transceiver. Reconnect power to unit.

4. Depress microphone switch and adjust L431, L432, L433 and L441 for maximum meter reading.

5. Connect a DC Ammeter across "a" and "b" of TP47, see step 1.

6. Connect the in-line wattmeter and 50 ohm dummy load to the Antenna.

7. Adjust L451, L463 and L464 for maximum reading on wattmeter.

8. Adjust the output power to 4 watts, readjusting L463 to achieve correct output.

9. Whistle or speak into microphone. Modulation "TX" indicator light should increase in intensity indicating upward modulation.

I. ALC Adjustment

1. Connect the oscilloscope to the antenna – Loosely couple with a 10 pf capacitor.

2. In the transmitter mode, provide a 1000 Hz audio signal from the Audio Oscillator to produce a 50% modulation indication on the oscilloscope. Adjust oscilloscope for 1" deflection.

3. Increase the audio signal by 16 dB, and while observing the oscilloscope, set VR481 for 100% modulation.

J. Transmitter RF Power Meter Adjustment

1. Four watts output from the transmitter is represented by a point on the "S" meter of +10 dB. This corresponds to a point just below the red line on the lower RF-P scale.

2. With full four watt output adjust the meter trim pot VR491 to achieve this reading.

K. Transmitter Frequency Check

1. Loosely couple the frequency counter to the antenna.

2. Check the transmitter output frequency of all channels 1 through 23. They should fall within + .005% of the FCC assigned channel frequency (see table below).

3. If outside this tolerance, touch-up slightly, L311 in the output of TR31 Oscillator # 1 until this tolerance is achieved. No more the +45° rotation should be required to do so.

L. TV Interference Trap

1. Loosely couple the transmitter output to the 54 MHz receiver or a TV receiver.

2. Adjust receiver to 54.23 MHz, or set the TV receiver to channel 2.

3. Adjust L465 trap for minimum signal output on receiver, or minimum interference pattern on TV receiver.

Crystal Frequency Chart

	RECEIVER					TRANSMITTER		
CHAN	CHAN FREQ	OSC # 1 XTAL FREQ	1ST MIXER FREQ	OSC # 2 XTAL FREQ	2ND MIXER OUTPUT FREQ	OSC # 1 XTAL FREQ	OSC # 3 XTAL FREQ	TX AMP (CHAN) FREQ
1	26.965	37.600	10.635	10.180	455 kHz	37.600	10.635	(1) 26.965
2	26.975	"	10.625	10.170	455 kHz	"	10.625	(2) 26.975
3	26.985	"	10.615	10.160	455 kHz	"	10.615	(3) 26.985
4	27.005	"	10.595	10.140	455 kHz	"	10.595	(4) 27.005
5	27.015	37.650	10.635	10.180	455 kHz	37.650	10.635	(5) 27.015
6	27.025	"	10.625	10.170	455 kHz	"	10.625	(6) 27.025
7	27.035	"	10.615	10.160	455 kHz	"	10.615	(7) 27.035
8	27.055	"	10.595	10.140	455 kHz	"	10.595	(8) 27.055
9	27.065	37.700	10.635	10.180	455 kHz	37.700	10.635	(9) 27.065
10	27.075	"	10.625	10.170	455 kHz	"	10.625	(10) 27.075
11	27.085	"	10.615	10.160	455 kHz	"	10.615	(11) 27.085
12	27.105	"	10.595	10.140	455 kHz	"	10.595	(12) 27.105
13	27.115	37.750	10.635	10.180	455 kHz	37.750	10.635	(13) 27.115
14	27.125	"	10.625	10.170	455 kHz	"	10.625	(14) 27.125
15	27.135	"	10.615	10.160	455 kHz	"	10.615	(15) 27.135
16	27.155	"	10.595	10.140	455 kHz	"	10.595	(16) 27.155
17	27.165	37.800	10.635	10.180	455 kHz	37.800	10.635	(17) 27.165
18	27.175	"	10.625	10.170	455 kHz	"	10.625	(18) 27.175
19	27.185	"	10.615	10.160	455 kHz	"	10.615	(19) 27.185
20	27.205	"	10.595	10.140	455 kHz	"	10.595	(20) 27.205
21	27.215	37.850	10.635	10.180	455 kHz	37.850	10.635	(21) 27.215
22	27.225	"	10.625	10.160	455 kHz	"	10.625	(22) 27.225
23	27.255	"	10.595	10.140	455 kHz	"	10.595	(23) 27.255

All frequencies in MHz except 2nd Mixer Output.

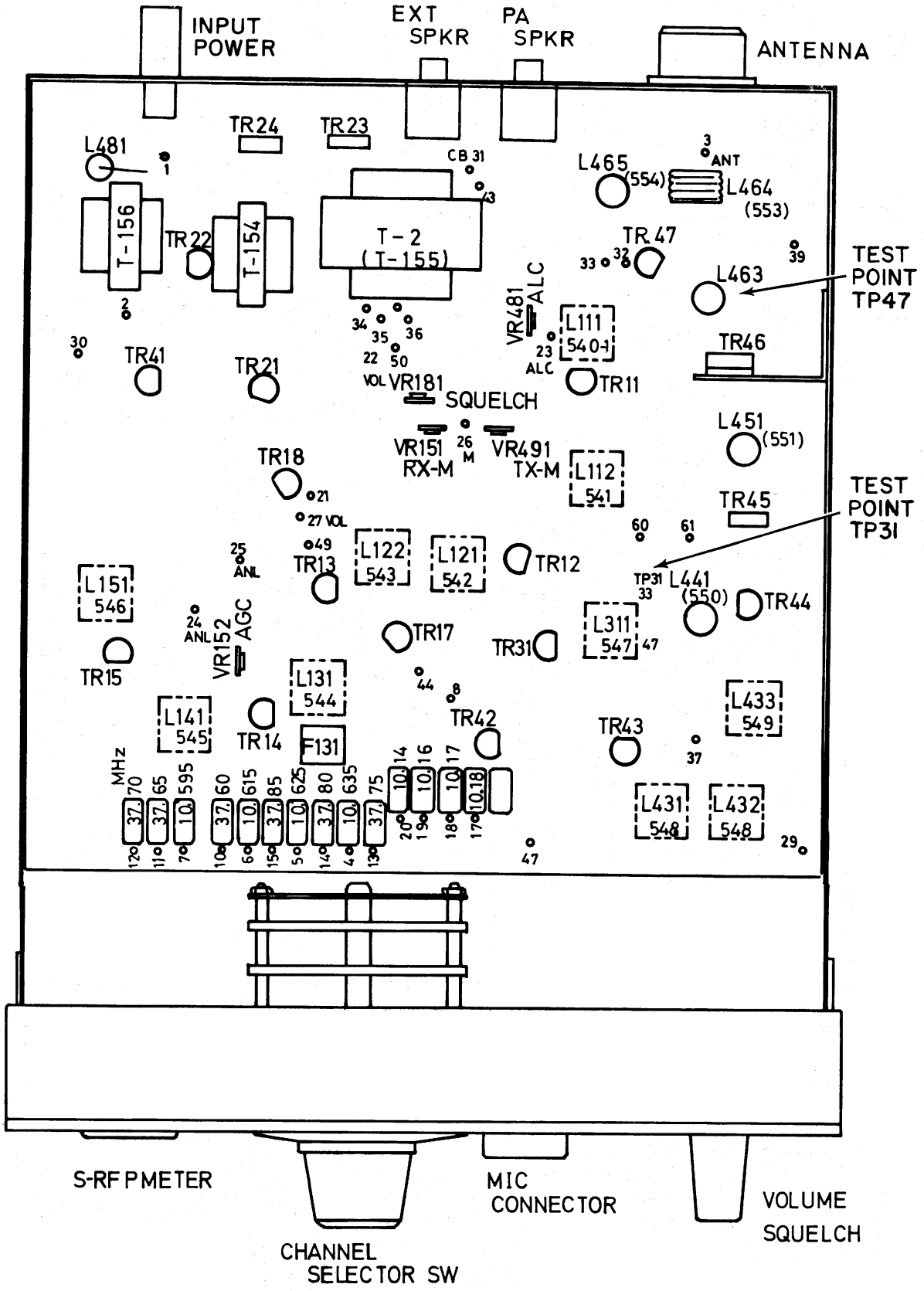

Figure 2 — Top View of 14T100

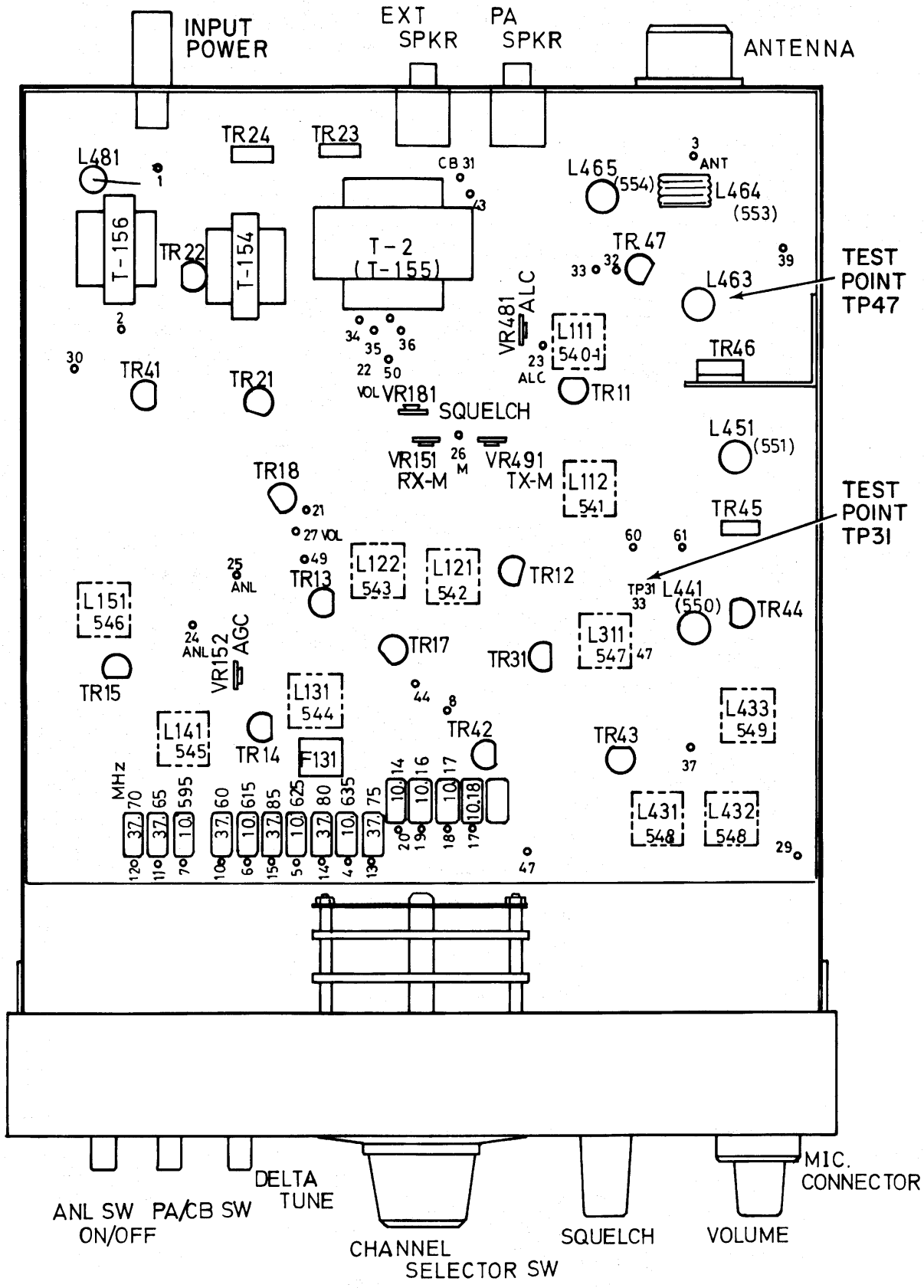

Figure 3 – Top View of 14T200

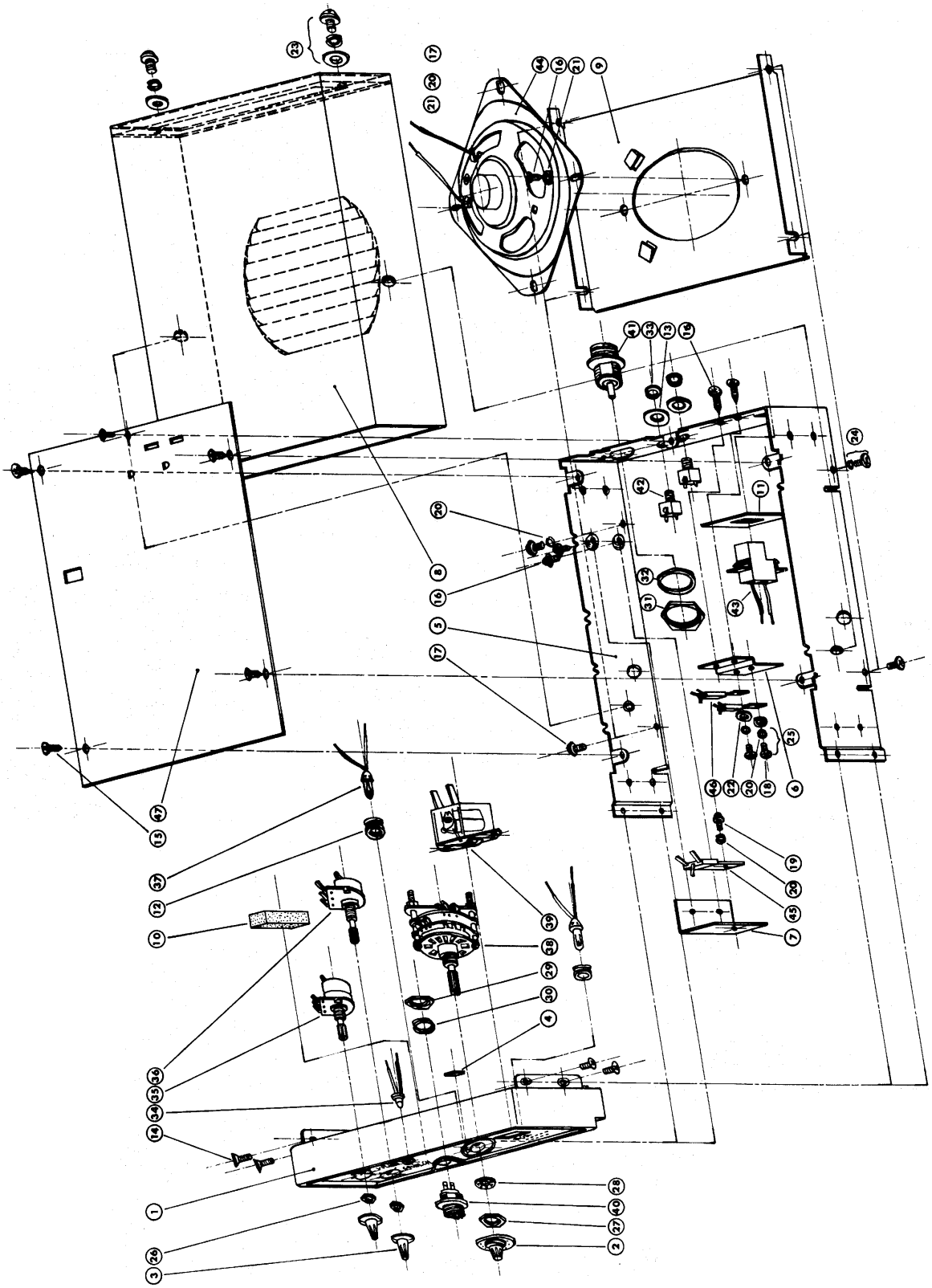

Figure 4 – Exploded View of 14T100

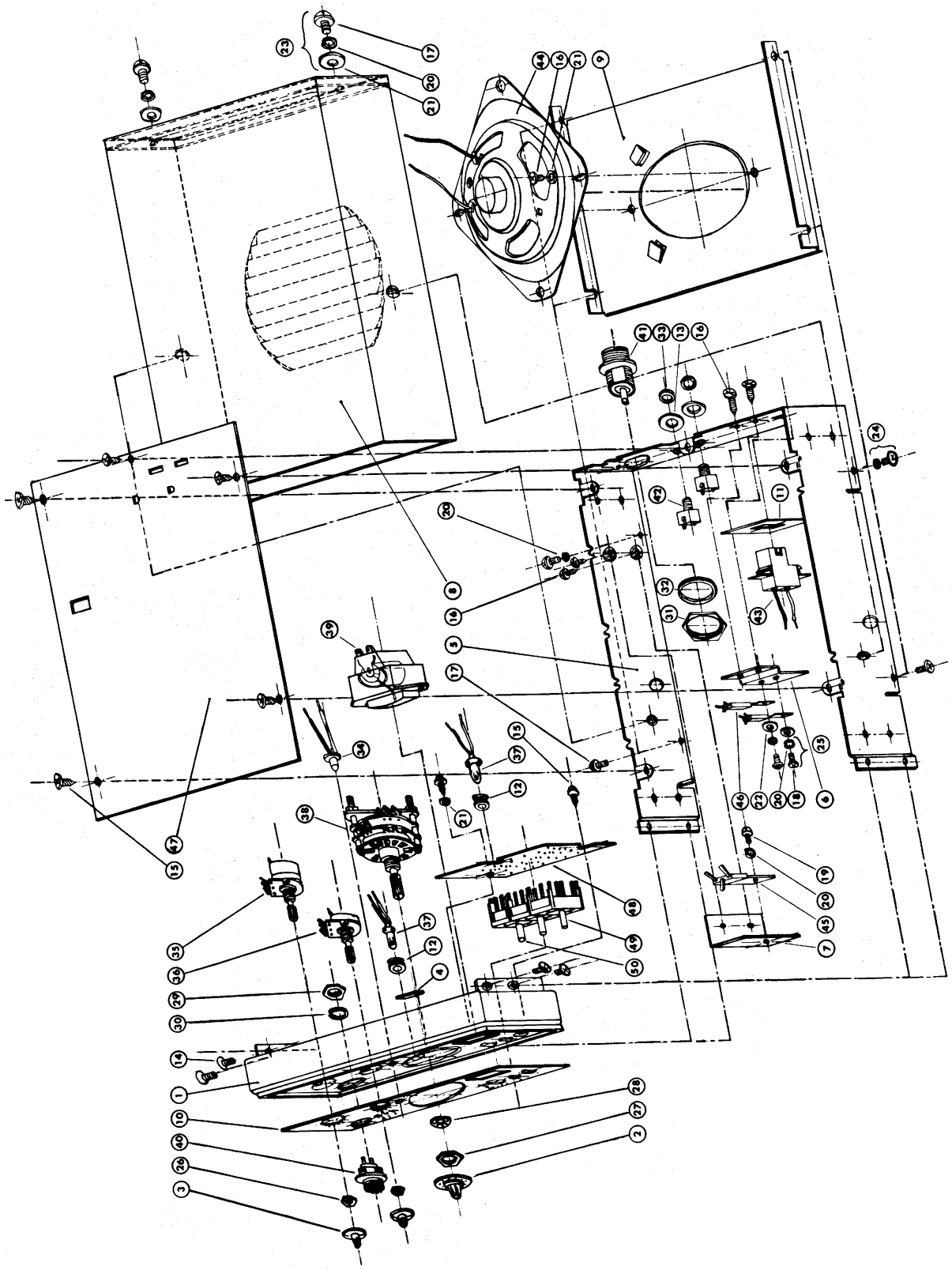

Figure 5 – Exploded View of 14T200