



# SERVICE MANUAL



## MODELS "ROYAL D7000, ROYAL D7000-1 AND ROYAL D7000-2"

"TRANSOCEANIC"<sup>®</sup>  
CHASSIS 500MDR70  
SOLID STATE AC/BATTERY PORTABLE  
LW/AM/FM/SW/WB RADIO

**ZENITH RADIO CORPORATION**

1900 N. AUSTIN AVENUE

CHICAGO, ILLINOIS 60639

## PRODUCT SAFETY SERVICING GUIDELINES FOR ALL AUDIO AMPLIFIERS AND RADIO RECEIVERS

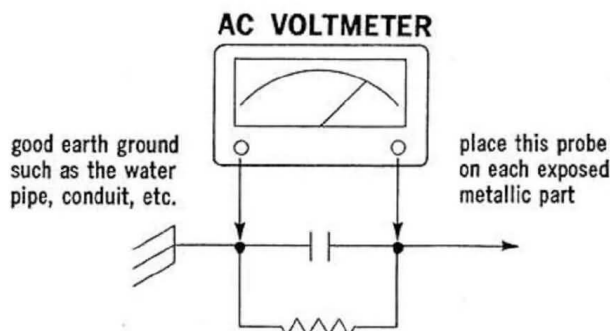
**CAUTION: No modification of any circuit should be attempted. Service work should be performed only after you are thoroughly familiar with all of the following safety checks and servicing guidelines. To do otherwise increases the risk of potential hazards and injury to the user.**

### SAFETY CHECKS

#### SUBJECT: Fire & Shock Hazard

1. Be sure that all components are positioned in such a way to avoid possibility of adjacent components shorts. This is especially important on those chassis which are transported to and from the repair shop.
2. Always replace all protective devices such as insulators and barriers after working on a receiver.
3. Check for frayed insulation on wires including the AC cord. Also check across-the-line components for damage and replace if necessary.
4. All fuses and certain resistors and capacitors which are of the flameproof type (shaded on the schematic diagrams and parts lists) must be replaced with exact Zenith types to prevent potential fire hazard.
5. After re-assembly of the set always perform an AC leakage test on the exposed metallic parts of the cabinet such as the knobs, antenna terminals, etc. to be sure the set is safe to operate without danger of electrical shock.

Do not use a line isolation transformer during this test. Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner: Connect a 1500 ohm 10 watt resistor, (63-10401-76) paralleled by a .15 mfd, AC type capacitor (22-4384) between a known good earth ground (water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination 1500 ohm resistor and .15 mfd. capacitor. Reverse the AC plug on the set and repeat AC voltage measurements for each exposed metallic part. Voltage measured must not exceed .3 volts RMS. This corresponds to 0.2 milliamp AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.



### SPECIFICATIONS

Power  
Supply ----- AC ----- 115/230V, 50/60 Hertz  
Battery --- 9, Type Z4NL, 1½ V, "D" Cells  
(1 cell powers dial and chart lights).

Current Drain—No signal condition with volume control at min.  
Approximately 27 milliamperes

Frequency Ranges	Band	Meters	Megahertz
VHF		1.83 to 1.86	161 to 164
FM		3.4 to 2.8	88 to 108
LW		2000 to 750	.15 to .4
BC		555 to 188	.54 to 1.6
SW 1		188 to 85	1.6 to 3.5
SW 2		85 to 33	3.5 to 9.0
31	31		9.4 to 10.1
25	25		11.4 to 12.3
19	19		14.6 to 15.8
16	16		17.1 to 18.5
13	13		20.6 to 22.4

Intermediate Frequency -- FM ----- 10.7 MHz  
AM ----- 455 KHz

Sensitivity (Approx.) --- Referenced to .05 watt output above noise. All bands measured with tone control at maximum and Normal/Sharp switch in NORMAL, and Manual Gain in NORMAL position.

VHF (16.0 KHz deviation)	3.0	microvolts
FM (22.5 KHz deviation)	3.0	microvolts
LW	175	microvolts/m
BC	50	microvolts/m
SW1	3.0	microvolts
SW2	4.0	microvolts

31	2.0	microvolts
25	2.0	microvolts
19	2.0	microvolts
16	3.0	microvolts
13	3.0	microvolts
Antennas	Waverod (in top of cabinet back) — all except BC&LW BC/LW Wavemagnet® (in cabinet)—BC/LW only External ----- All except VHF	

Power Output @ 10% THD ----- 500 milliwatts  
Outputs ----- Speaker ----- 4x6 inch 22 ohms at 400 Hertz  
Headphone (39-34, optional) 8 ohms at 400 "  
Earphone (39-75) 8 ohms at 400 "

### CAUTION:

1. When adjustments are made on these chassis, a line isolation transformer (120-V input to 120-V output) is recommended in order to avoid a shock hazard. If an isolation transformer is not available, check the AC voltage between chassis and bench ground; and if there is any indication of line voltage, reverse the plug before handling the set.
2. Do not operate without proper speaker load.
3. Do not short out the audio output when power is connected.
4. If the receiver is not to be operated on batteries for several weeks, the batteries should be removed.
5. Matched transistors are used in the output stage. Should one transistor fail, both transistors must be replaced, since they will not perform properly unless matched.
6. If a power transistor fails be certain to replace the emitter resistors. Also be certain to check the condition of the rectifiers, and related components.

## CIRCUIT DESCRIPTION

Model RD7000-1 is basically identical to RD7000 except for the addition of a thermal circuit breaker which will provide protection should the receiver be connected to an incorrect power source, or for any other condition which could possibly damage the power supply. When the circuit breaker "opens", it will cut off all power to the receiver for approximately 15 minutes. After this time it will automatically reset, restoring power to the receiver. If the circuit breaker cuts out again within a few minutes, check the voltage selector switch (See Figure 4, Item 29, in the Operating Guide) to be certain that it is set to the correct voltage position. In the event this fails to correct the condition, contact a qualified service technician.

Separate tuners are used on the FM (88-108 MHz) and the VHF Weather Band (161-164 MHz). The FM tuner consists of a RF amplifier and an Autodyne Converter operating in common base circuits. CR1 is the AFC diode. On the VHF Band the RF and Oscillator stages operate in common base circuits, while the Mixer is a common emitter circuit. The VHF VFO operates 10.7 MHz below the reception frequency. AFC is not applied to the VHF tuner. AGC for both tuners is obtained from the collector of the 2nd IF, via a small value capacitor, to diode CR201, and then to the base of the RF transistor as reverse bias. Two matched diodes located in T208 form part of the Ratio Detector circuit.

On AM the RF stage is common base for LW and BC, but is common emitter for all other bands (SW1 thru 31M). The Oscillator uses a common base circuit, while the Mixer and IF stages are in common emitter circuits. AM AGC is obtained from the AM Detector diode and supplied to the base of the RF transistor. AGC is then taken from the emitter of the RF transistor and fed to the base of the mixer and 1st IF transistors.

Audio circuitry is common to all bands and consists of 1st Audio, Pre-Driver, Driver, and diode biased class "B" push-pull complementary symmetry Output stage consisting of one NPN and one PNP transistor. An output jack, located on the upper part of the cabinet back, connected to the output of the 1st audio stage, permits this unit to be connected to external amplifiers. Gain of the Pre-Driver is increased when on the VHF band to compensate for the lower recovered audio, due to the reduced deviation of VHF Band transmissions.

This set can be operated from either 115 or 230 Volt AC sources. A switch, provided inside the set must be set to the desired voltage. In addition this set can be operated on 9, 1½ Volt "D" Cells (one cell only powers the Dial and Chart Lights, and must be installed if it is desired to use these lights while on AC operation). Automatic switching between AC and Battery operation is achieved by inserting the AC Cable into a socket located on the cabinet back.

## TROUBLE SHOOTING AND SIGNAL TRACING

The old technique of "screwdriver testing" is definitely not recommended while trouble shooting any solid state product. In that method various circuit points were touched or shorted to ground to cause a hum or click in the speaker. This must be avoided because a solid state component can be destroyed if excessive voltage or if wrong polarity is applied.

Only standard point to point signal tracing with the proper RF, IF, and Audio Signal Sources should be used.

## AM OSCILLATOR BIAS ADJUSTMENT

Stability of the AM Oscillator may be maintained over a wide range of battery supply voltage's. If a variable DC voltage supply is available adjustment may be made as follows:

1. Set Manual Gain Control to maximum clockwise position.
2. Rotate Band Switch to 13 meter position.
3. Connect the positive end of a 4½ volt battery to Test Point 3 while the negative end is connected in series with a volt meter. The other end of the meter is connected to Test Point 6. There should be a meter reading of approximately 0.5 to 1.0 volt.
4. Adjust Bias Control R118 for minimum voltage change on the meter while varying the DC supply between 8 and 12 volts.
5. Return Manual Gain Control to the Normal position.

## BATTERY LEVEL METER ADJUSTMENT

This receiver is equipped with a combination Tuning and Battery Level Meter which will indicate the condition of the batteries being used. A meter reading in the blue section indicates good batteries. Under normal conditions no adjustment should be necessary. If the meter has been replaced or other repairs made which affect the meter circuit, adjustment may be made as follows. Use a supply of 9 volts and while holding the "Dial Light/Battery Level" switch in the BATTERY LEVEL position adjust control R507 so that the meter pointer lines up with the left edge of the blue section of the meter.

## ALIGNMENT

Alignment wrenches, Zenith part number 68-32, 68-35, and 68-45 may be used for aligning this receiver. Charts for proper alignment are included in this service manual.

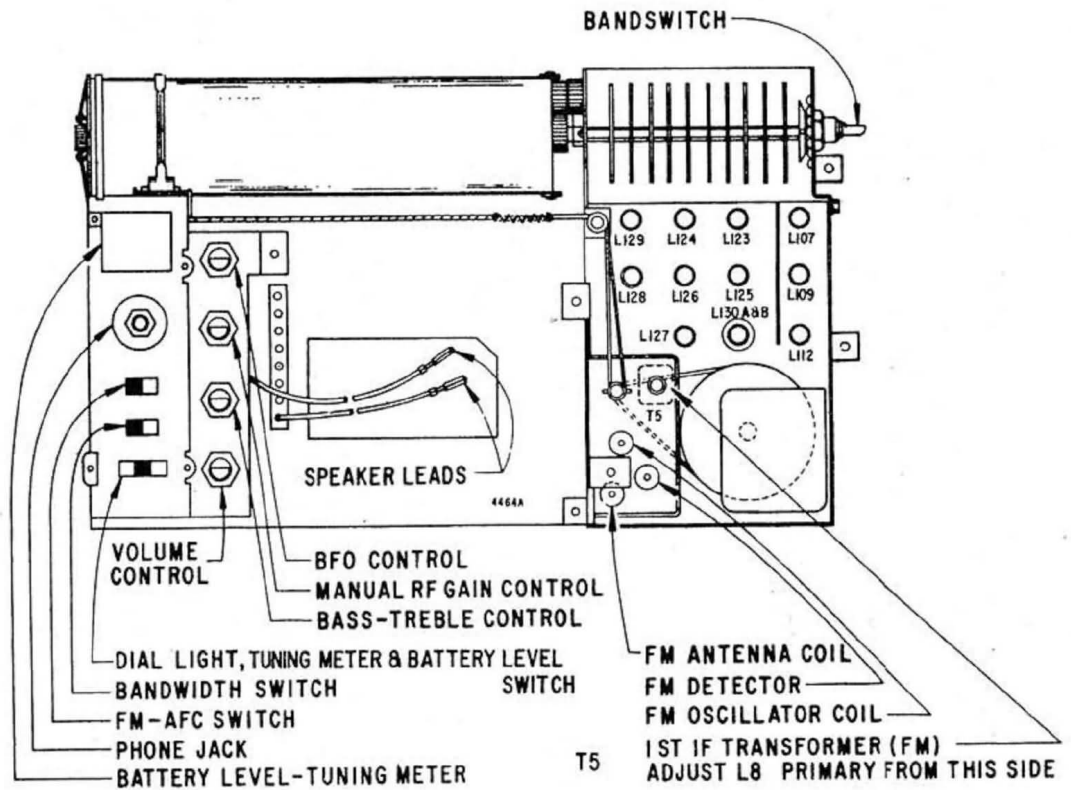
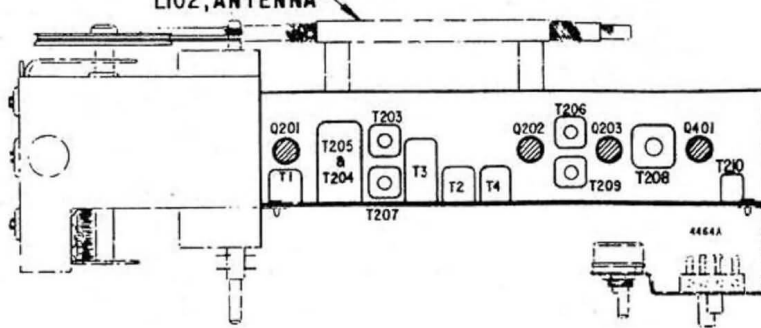
## CHASSIS REMOVAL INSTRUCTIONS

To remove this chassis it will first be necessary to remove the B.F.O., Manual Gain, Tone, Volume and Tuning Knobs from the front panel. A set screw holds the Band Selector knob in place, and will be visible, from the rear, when in the 19M position. Loosen screw and remove knob. The chassis is mounted by five (5) screws. (See chassis layout drawing for location). Remove the screws and also the bracket secured by the three (3) right hand screws. Disconnect the speaker and chart light leads. The chassis is now free to be removed. *Note* — be certain to replace the bracket and screws when replacing chassis.

## DIAL LIGHT REPLACEMENT

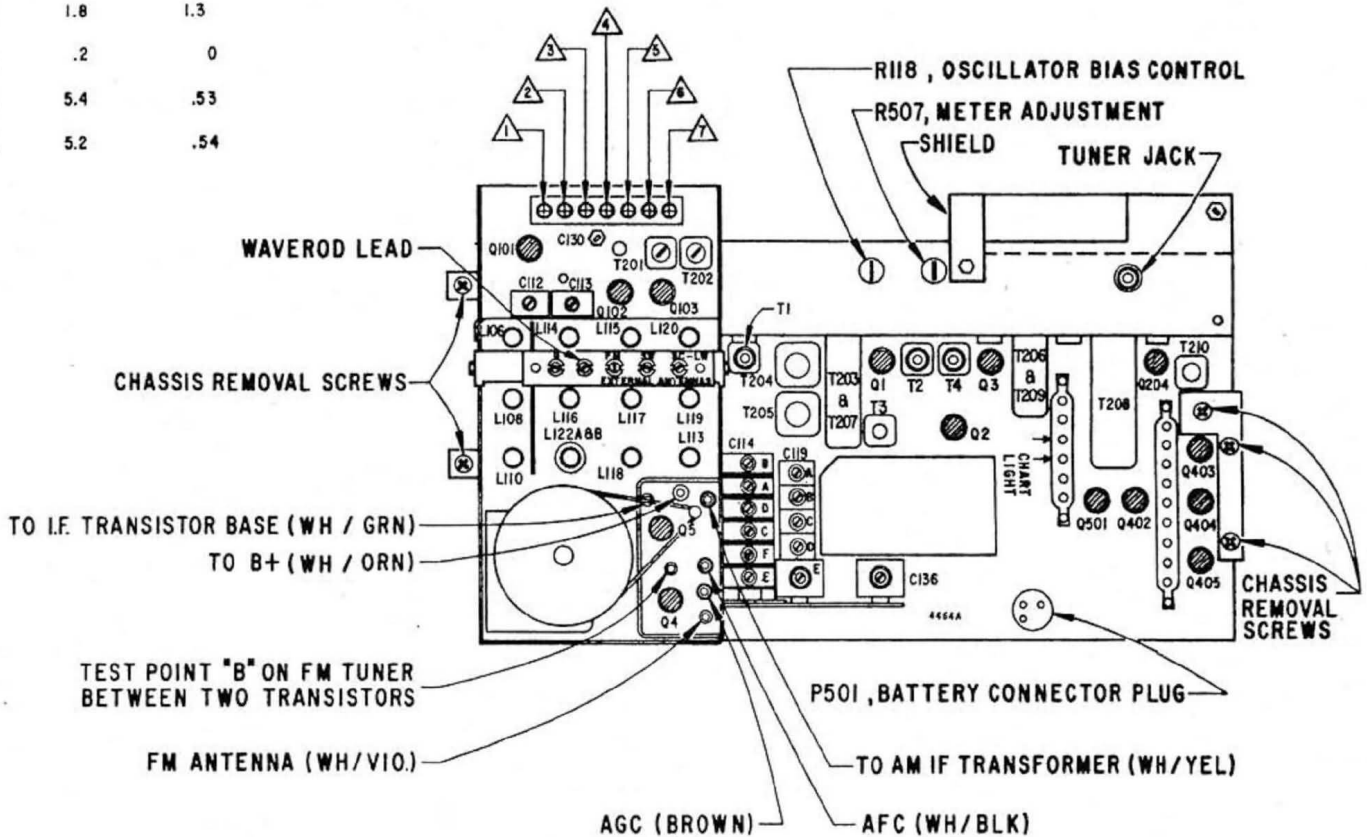
The dial light assembly is mounted to the dial scale drum by two screws. Lights may be replaced in the following manner. Remove cabinet back. Rotate Band Selector to BC position. Remove shield by *loosening* right hand screw (long) and remove the left hand screw. Lift shield out noting proper position. The dial drum will now be visible through a rectangular cut out at the top of the chassis. Remove the two screws (one at each end of the dial light assembly). Lift plate. These lights are Part Number 100-218.

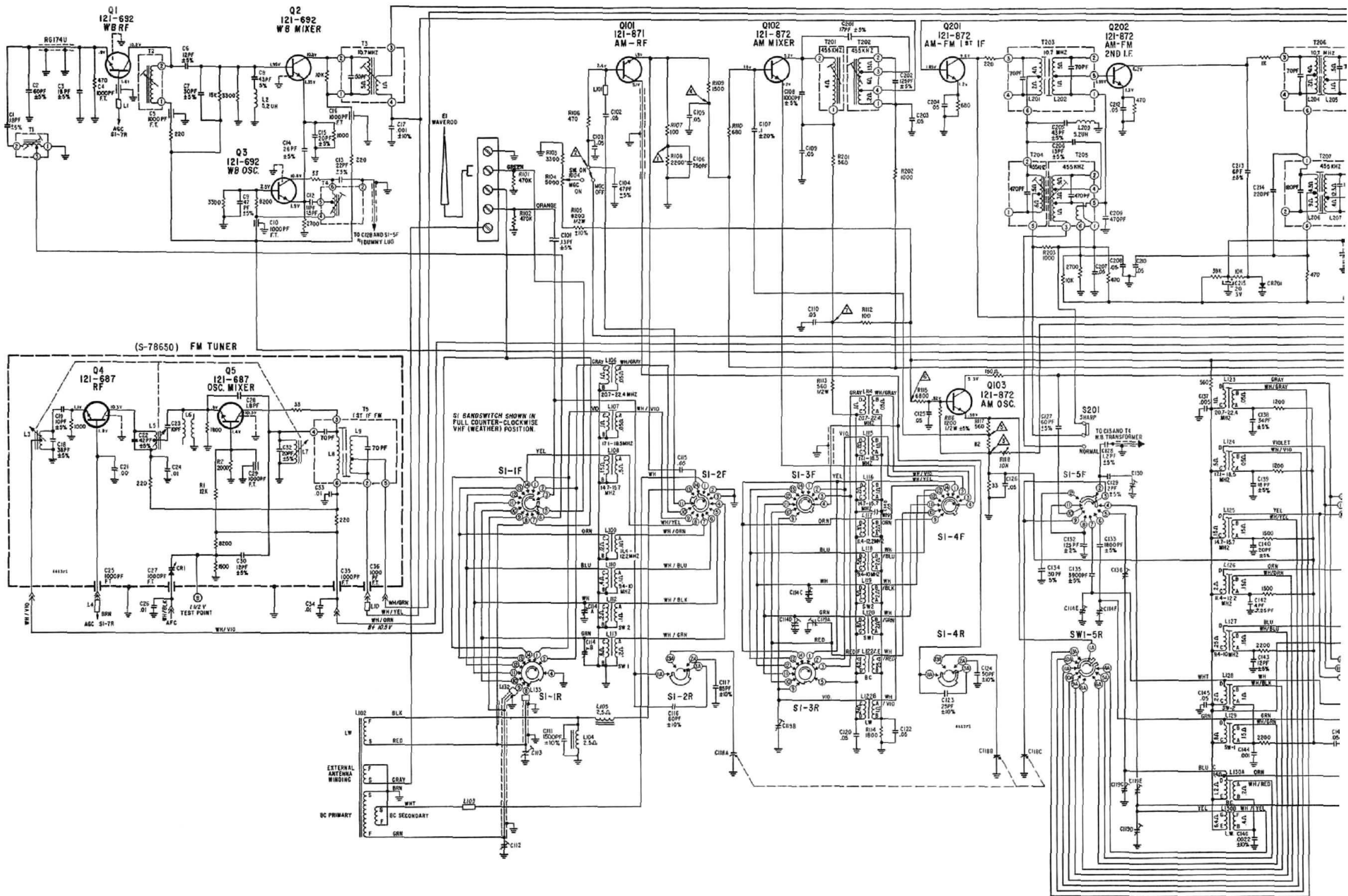
Replace shield by inserting end tab in to ¼" hole in end of chassis and the folded tab over chassis. Replace left screw and tighten right hand screw.

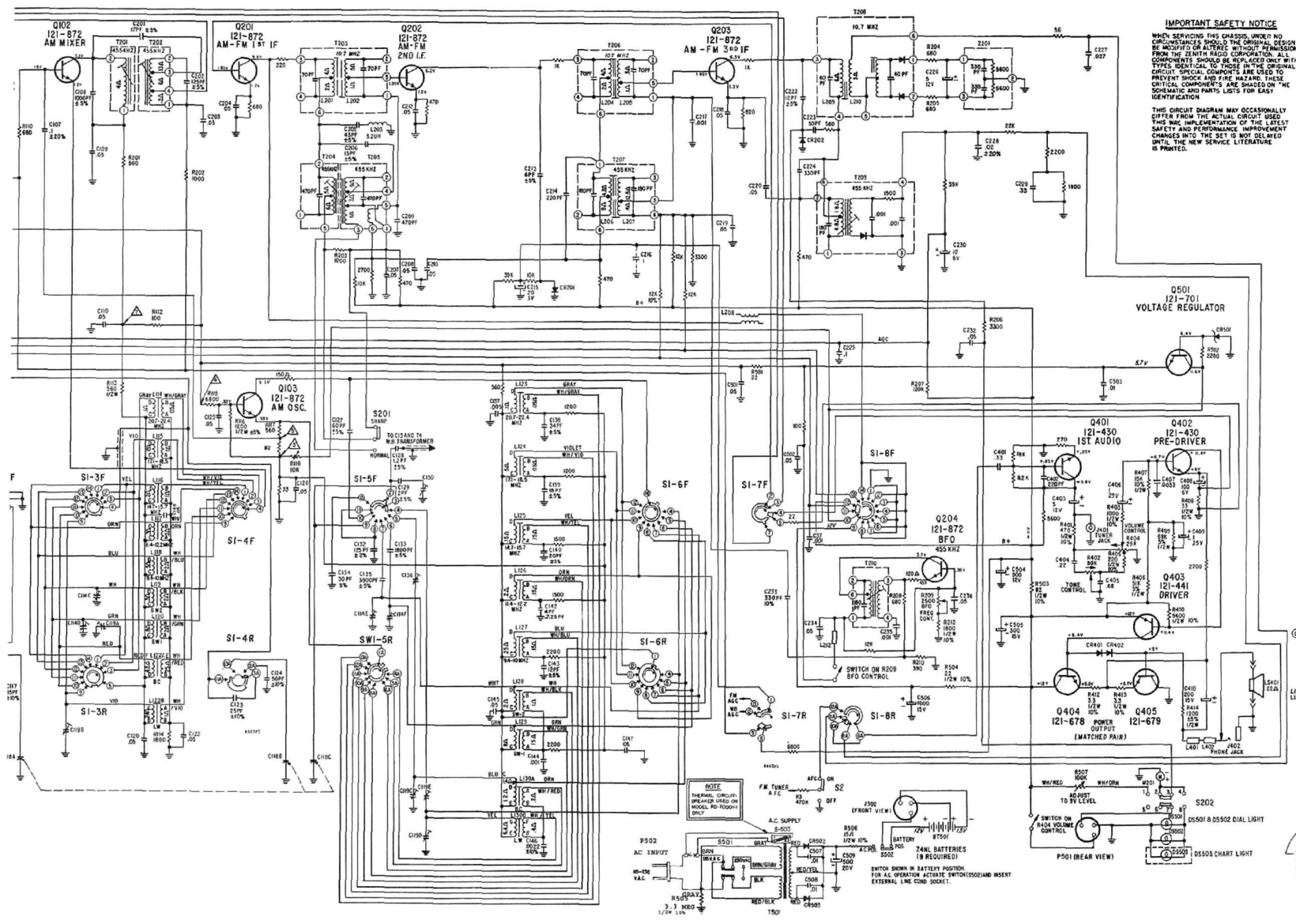


**TEST POINT VOLTAGES**  
(NO SIGNAL)

	AM	FM
1	1.75	.85
2	2.5	1.5
3	.03	0
4	1.8	1.3
5	.2	0
6	5.4	.53
7	5.2	.54



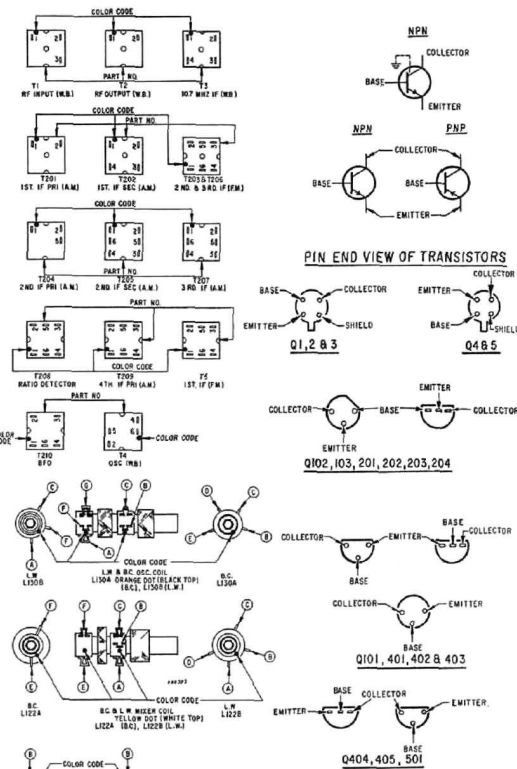




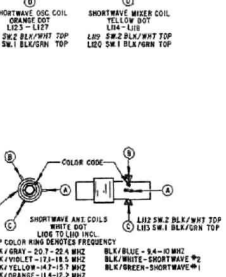
**IMPORTANT SAFETY NOTICE**

WHEN SERVICING THIS CHASSIS UNDER NO CIRCUMSTANCES SHOULD THE ORIGINAL DESIGN BE MODIFIED OR ALTERED WITHOUT PERMISSION FROM THE DESIGNER. ALL COMPONENTS SHOULD BE REPLACED ONLY WITH PARTS IDENTICAL TO THOSE IN THE ORIGINAL CIRCUIT. SPECIAL COMPONENTS ARE USED TO PREVENT SHOCK AND FIRE HAZARD. THESE CRITICAL COMPONENTS ARE SHADDED ON THE SCHEMATIC AND PARTS LISTS FOR EASY IDENTIFICATION.

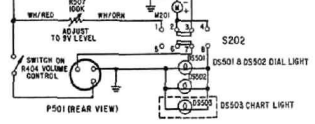
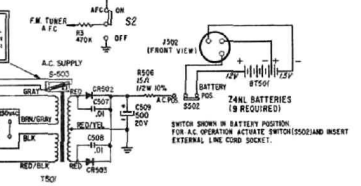
THIS CIRCUIT DIAGRAM MAY OCCASIONALLY DIFFER FROM THE ACTUAL CIRCUIT USED. THIS WAS IMPLEMENTATION OF THE LATEST SAFETY AND PERFORMANCE IMPROVEMENT CHANGES INTO THE SET IS NOT DELAYED UNTIL THE NEW SERVICE LITERATURE IS PRINTED.

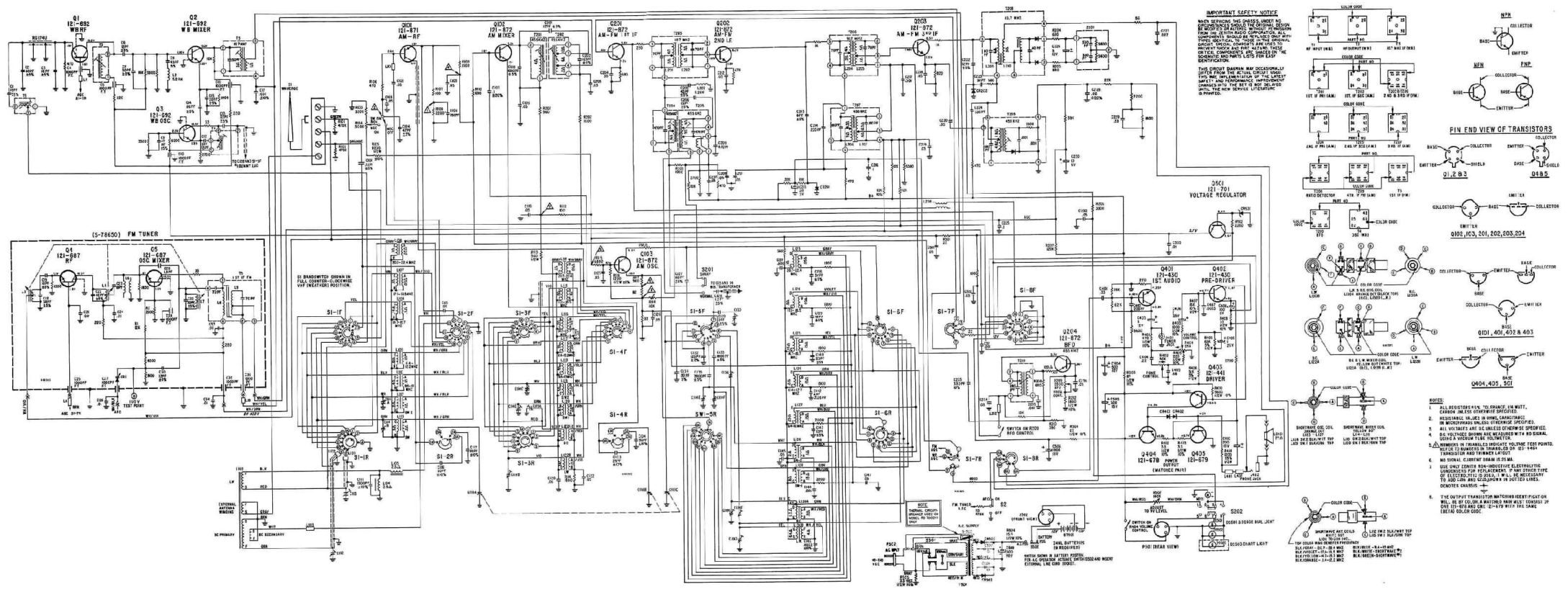


- NOTES:**
- ALL RESISTORS 5% TOLERANCE, 1/4 WATT, CARBON UNLESS OTHERWISE SPECIFIED.
  - RESISTANCE VALUES IN OHMS, CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
  - ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.
  - DC VOLTAGES SHOWN ARE MEASURED WITH NO SIGNAL USING A VACUUM TUBE VOLTMETER.
  - NUMBERS IN TRIANGLES INDICATE VOLTAGE TEST POINTS. REFER TO NUMBERS IN TRIANGLES ON T50-4454 TRANSISTOR AND TRIMMER LAYOUT.
  - NO SIGNAL CURRENT DRAIN IS 25 MA.
  - USE ONLY ZENITH NON-INDUCTIVE ELECTROLYTIC CONDENSERS FOR REPLACEMENT. IF ANY OTHER TYPE OF ELECTROLYTIC IS USED, IT WILL BE NECESSARY TO ADD C28 AND C29 SHOWN IN DOTTED LINES. DENOTES CHASSIS.
  - THE OUTPUT TRANSISTOR MATCHING IDENTIFICATION WILL BE BY COLOR. A MATCHED PAIR MUST CONSIST OF ONE 121-678 AND ONE 121-679 WITH THE SAME (BETAL) COLOR CODE.

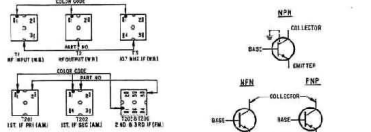


**NOTE:** THERMAL COPPER SPEAKERS USED ON MODEL NO. T5000-1 ONLY.

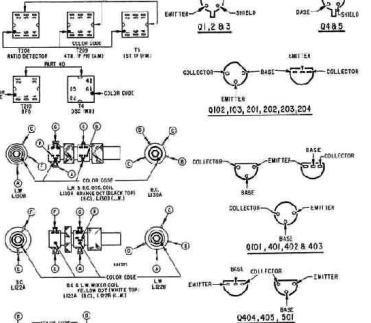




**IMPORTANT SAFETY NOTICE**  
 WHEN REPAIRING THIS PRODUCT, PLEASE READ THE SAFETY INFORMATION IN THE SERVICE MANUAL. THE SAFETY INFORMATION IS LOCATED IN THE SERVICE MANUAL UNDER THE SAFETY INFORMATION SECTION. THE SAFETY INFORMATION IS LOCATED IN THE SERVICE MANUAL UNDER THE SAFETY INFORMATION SECTION. THE SAFETY INFORMATION IS LOCATED IN THE SERVICE MANUAL UNDER THE SAFETY INFORMATION SECTION.



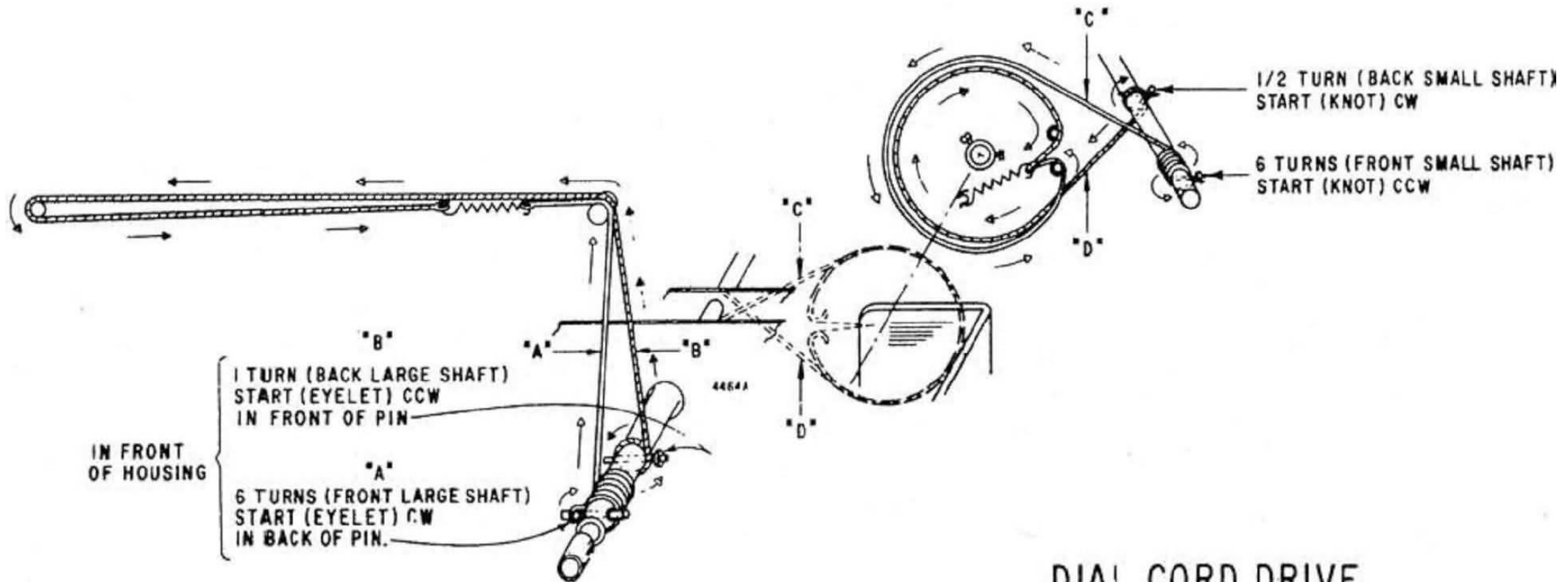
**PIN END VIEW OF TRANSISTORS**



- NOTES:**
1. ALL RESISTORS ARE TO BE PRECISION 1% TOLERANCE UNLESS OTHERWISE SPECIFIED.
  2. RESISTOR VALUES IN OHMS, CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
  3. ALL VOLTAGE AND DC MEASUREMENTS SHOULD BE MADE WITH A VOLTAGE TABLE VOLTMETER.
  4. ALL POINTS TO BE MEASURED SHOULD BE IDENTIFIED WITH A RED POINT.
  5. TRANSISTOR PART NUMBERS SHOULD BE IDENTIFIED WITH A RED POINT.
  6. USE ONLY GENUINE NON-INDUCTIVE ELECTROLYTIC CAPACITORS FOR POWER SUPPLY. FOLLOW THE TYPE OF ELECTROLYTIC CAPACITOR TO BE USED IN THE CIRCUIT AND IDENTIFY IT BY THE MARKING ON THE CAPACITOR.
  7. THE OUTPUT TRANSISTOR MATCHING IDENTIFICATION SHALL BE BY COLOR MARKING AND NOT BY PART NUMBER OR BY THE MARKING ON THE TRANSISTOR WITH THE SAME COLOR CODE.

SCHEMATIC

REAR VIEW OF CHASSIS



FRONT VIEW OF CHASSIS

DIAL CORD DRIVE  
SHOWN IN FULL COUNTERCLOCKWISE POSITION



## ALIGNMENT PROCEDURE

STEP NO.	CONNECT GENERATOR TO	INPUT SIGNAL FREQUENCY	BAND I	DIAL FREQUENCY	ADJUST	PURPOSE	
NOTE - Perform A.M. I.F. and B.F.O. alignment with bandwidth switch in sharp position, manual gain control off. Connect meter across speaker voice coil.							
1	Test Point "5"	455 KHz	BC	1600 KHz	T201, T202, T204 T205, T207, T209	Align A.M. I.F. for max.	
NOTE - Turn B.F.O. Control ON and set to mid rotation with bandwidth switch in sharp.							
2*	Test Point "5"	455 KHz	BC	1600 KHz	T210	Adjust BFO for zero beat.	
NOTE - Place bandwidth switch to normal and turn B.F.O. to off.							
3*	One turn loop loosely coupled to wavemagnet	1620 KHz	BC	1620 KHz Gang Open	C119C	Set B.C. oscillator to scale	
4*		600 KHz	BC	600 KHz	C136		
5		Repeat steps 3 and 4 until minimum change					
6*		1420 KHz	BC	1420 KHz	C112, C119A		Align B.C. antenna and mixer for maximum
7*		600 KHz	BC	600 KHz	L122A		
8*		Repeat steps 6 and 7 until minimum change					
9*		405 KHz	LW	405 KHz Gang Open	C119D	Set L.W. Oscillator to scale.	
10*		160 KHz	LW	160 KHz	C119E		
11		Repeat steps 9 and 10 until minimum change					
12*		375 KHz	LW	375 KHz	C113, C119B		Align L.W. Antenna and mixer for maximum
13*		160 KHz	LW	160 KHz	L122B		
14		Repeat steps 12 and 13 until minimum change					
NOTE - Align F.M. with A.F.C. switch off.							
15		Test Point "B" (**)	10.7 MHz modulated	FM	98 MHz	T5, T203, T206, and top of T208	Align F.M. I.F. and Ratio Detector Pri. Connect meter across voice coil and reduce input so output will not be greater than 0.4 volts.
16	10.7 MHz modulated		FM	98 MHz	Bottom of T208	Align FM Ratio Detector or Sec. Place meter probe on pin 6 of T208 and adjust bottom of T208 to zero after determining that there is a symmetrical swing around this zero point.	
17	Repeat steps 15 and 16 until minimum change						
18	FM Antenna Terminals (**)	98 MHz modulated	FM	98 MHz	L7	Set FM Oscillator to scale-meter across voice coil.	
19		98 MHz modulated	FM	98 MHz	L3, L5	Align FM antenna and detector for maximum	
20		164 MHz	VHF	164 MHz	T4, T1, T2, T3	Align VHF	
21		161 MHz	VHF	161 MHz	C130	Set VHF Oscillator to scale.	
22		164 MHz	VHF	164 MHz	T4		
23		Repeat steps 21 and 22 until minimum change					
24		161 MHz	VHF	161 MHz	T2	Adjust T2 for equal output at 161 MHz and 164 MHz.	
25		164 MHz	VHF	164 MHz	T2		
26	Repeat steps 24 and 25 until minimum change						
27	3 feet of wire approximately 1 foot from and parallel to Extended Waverod.	3.4 MHz	SW1	3.4 MHz	C114F	Set SW1 Oscillator to scale	
28		1.8 MHz	SW1	1.8 MHz	L129		
29		Repeat steps 27 and 28 until minimum change					
30		3.4 MHz	SW1	3.4 MHz	C114B, C114D	Align SW1 Antenna & mixer for maximum	
31		1.8 MHz	SW1	1.8 MHz	L120, L113		
32		Repeat steps 30 and 31 until minimum change					
33		8.75 MHz	SW2	8.75 MHz	C114E	Set SW2 Oscillator to scale.	
34		3.9 MHz	SW2	3.9 MHz	L128		
35		Repeat steps 33 and 34 until minimum change					
36		8.75 MHz	SW2	8.75 MHz	C114A, C114C	Align SW2 Antenna & mixer for maximum	
37		3.9 MHz	SW2	3.9 MHz	L112, L119		
38		Repeat steps 36 and 37 until minimum change					
39		9.7 MHz	31M	9.7 MHz	L110, L118, L127	Align 31M, 25M, 19M, 16M, and 13M Oscillator, Antenna and Mixer.	
40		11.8 MHz	25M	11.8 MHz	L109, L117, L126		
41		15.2 MHz	19M	15.2 MHz	L108, L116, L125		
42		17.8 MHz	16M	17.8 MHz	L107, L115, L124		
43	21.6 MHz	13M	21.6 MHz	L106, L114, L123			

\* Rock Tuning Capacitor when making adjustment.

\*\* Probe from generator should be isolated through a .05 MFD Capacitor.

\*\*\* Probe from generator should be terminated with the proper resistor to match 72 ohm line output impedance.