X

GALAXY FM-210

INSTRUCTION MANUAL

GALAXY ELECTRONICS

"Pacesetter in Amateur/Commercial Equipment Design"

10 South 34th Street • Council Bluffs, Iowa 51501

GALAXY
FM-210

(100669)

Manual 183-90
Price $ 1.50

The new Galaxy FM-210 is a top quality 2 Meter FM transceiver designed to offer no compromise performance for direct or repeater communications. This fully solid state transceiver maintains the same high standard of performance and rugged reliability that has become a trademark at Galaxy Electronics. Backed by a full year warranty and the best service policy ever, we are proud to add the FM-210 to the growing list of communications equipment by Galaxy Electronics, "THE PACESETTER IN AMATEUR DESIGN."

CONTENTS

Deviation Fig 9

LIST OF ILLUSTRATIONS

SECTION I

UNPACKING

1.1 Removing From Carton:

Carefully remove the Galaxy FM-210 from the packing carton. Examine it closely for signs of shipping damage. Remove the 4 screws on the bottom of the cabinet and slide the transceiver out of the cabinet. Remove all hold-down tape and check to insure that all transistors and crystals are properly seated in their sockets. Inspect closely for any signs of internal damage.

Should any shipping damage be apparent -- NOTIFY THE DELIVERING CARRIER IMMEDIATELY! State to the carrier the full extent of the damage and file a claim IMMEDIATELY!

1.2 Warranty Registration:

Fill out the enclosed WARRANTY REGISTRATION CARD and mail it TODAY to insure that your warranty will be on file.

1.3 Shipping Carton:

Save the packing material and the shipping carton. You may need it at a later date for shipment or storage of the transceiver.

1.4 Re-Assembly:

After you are satisfied that no damage has resulted from shipment, and have removed all tape and insured that all crystals and transistors are properly seated in their sockets, replace the cabinet.

SECTION II

INSTALLATION

2.1 General:

Do not attempt to operate your FM-210 or make any connections until you have read this entire section carefully and understand its content.

2.2 Antenna:

The FM-210 is designed to work with any of the common antenna systems for use on the 2 Meter amateur band with a nominal impedance of unbalanced 50 ohms resistive. Any antenna system should be adjusted so that SWR is kept to a minimum, preferably less than 2:1. The antenna connection provided on the rear panel of the FM-210 is an SO-239. To connect your antenna transmission line, you will need to provide a PL-259 connector.

NOTE: The output of the FM-210 is Unbalanced. If the transceiver is to be operated into a balanced antenna, a matching device, such as a Balun Coil, should be used. If your balanced antenna is Gamma or Beta matched the Balun Coil will not be required.

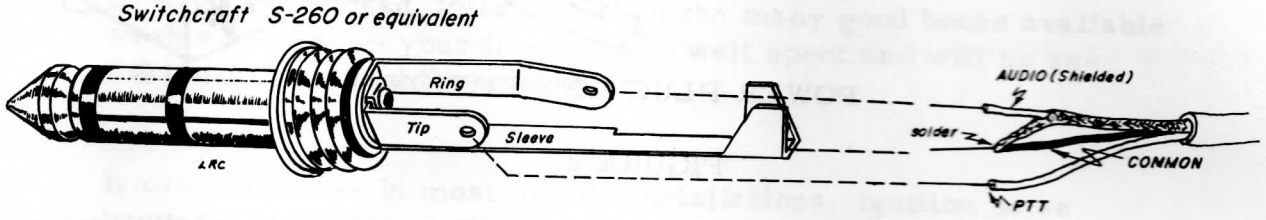
In VHF operation, remember that the most efficient transmitter is useless without a good antenna and transmission line. These two items are often overlooked by the amateur who is in a hurry to get on the air. A few moments here to make sure that you have a good grade of RG-8/U coax cable and a good antenna installation will make a great deal of difference in the performance of your new FM-210.

2.3 Microphone:

The best performance from your FM-210 will result when using a wideband, flat frequency response microphone. Microphones with limited low or high frequency response with peaks in the voice range, commonly used for SSB communications will work satisfactorily, but at somewhat less than maximum performance. Audio shaping is accomplished in the FM-210 and is not required in the microphone.

The microphone input is a HIGH IMPEDANCE input.

A three conductor (3-circuit) microphone plug is required for the jack provided on the front panel of the FM-210. A plug such as Switchcrafts S-260 or equivalent should be used. The plug and microphone are connected as shown in the illustration below --



MICROPHONE CONNECTION

FIGURE 1

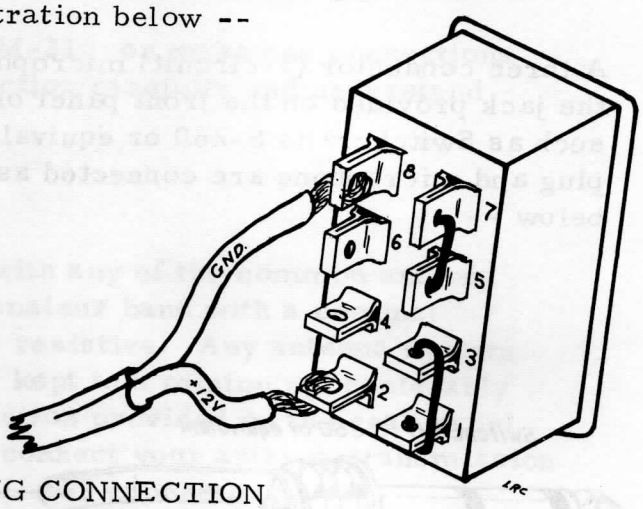
NOTE

It is necessary to utilize a PTT microphone with the FM-210 as there is no alternate means to switch into transmit mode.

2.4 Power:

The main power Jack on the rear of the FM-210 requires a Cinch-Jones type S-308 CCT connector. This connector is included with the 12 VDC power cord supplied with the FM-210 and is also a part of the AC-210 Power Booster. The power plug pins are connected as shown in the illustration below --

Pin 1 --- AC/DC control
Pin 2 --- AC/DC control
Pin 3 --- 14 - 16 VDC
Pin 4 --- spare
Pin 5 --- 14 - 16 VDC (transmit)
Pin 6 --- spare
Pin 7 --- 14 - 28 VDC
Pin 8 --- Ground



POWER PLUG CONNECTION

FIGURE 2

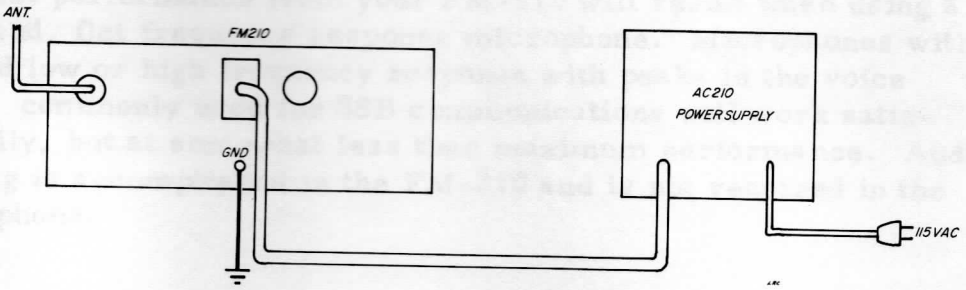
WARNING: Double-check your power cable. Incorrect polarity of the power source will cause permanent damage to the FM-210.

2.5 Location:

The location of the FM-210, fixed or mobile is not critical.

Due to transistor limitations, however, the FM-210 has an operating range of 32-140 degrees Fahrenheit.

2.5.1 Fixed installation -- the Galaxy Model AC-210 Power Booster is required for fixed station operation. Figure 3 shows the proper connections between the FM-210, AC-210, Antenna, and Ground.



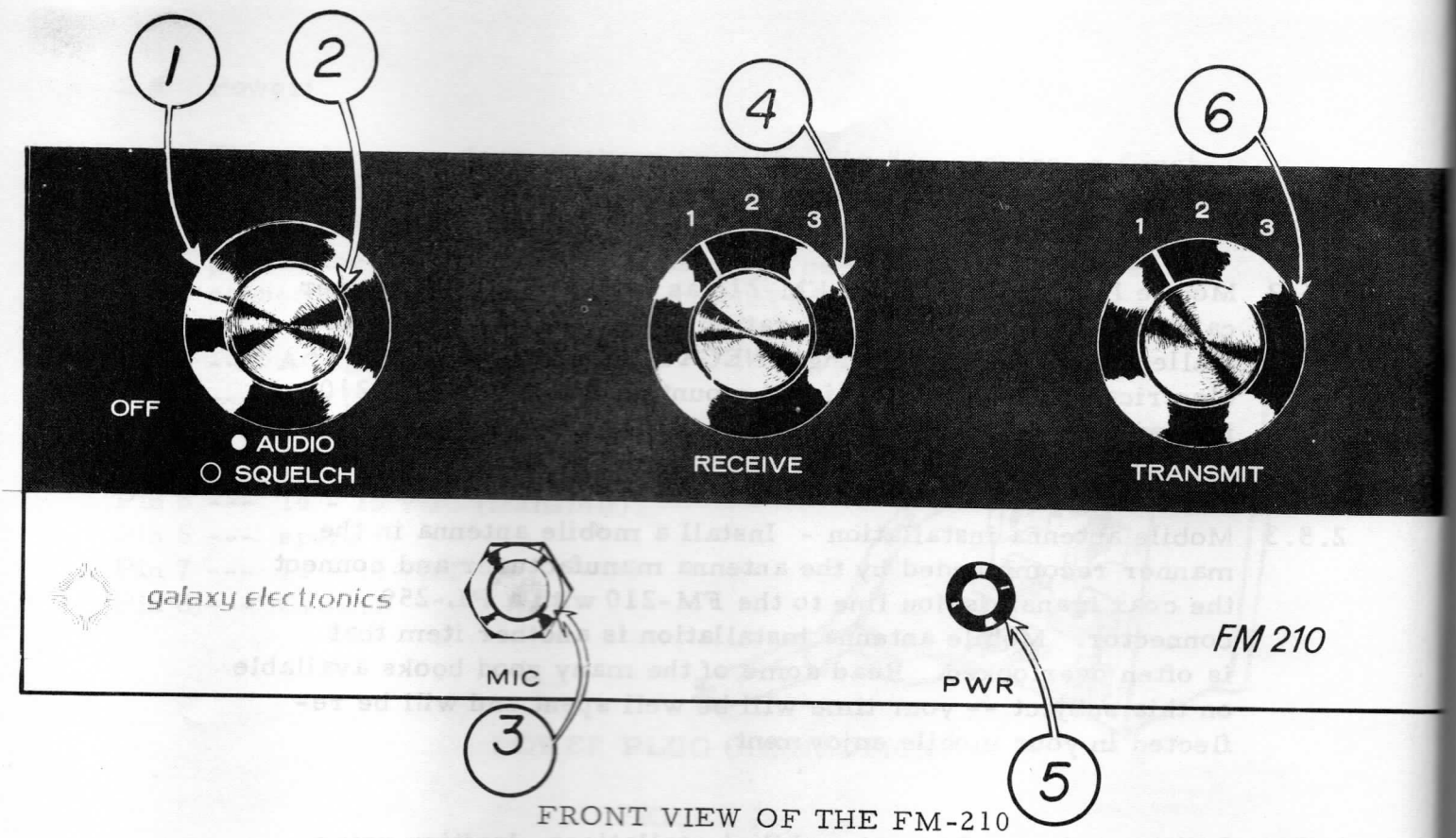
FIXED STATION CABLE CONNECTIONS

FIGURE 3

2.5.2 Mobile Installation -- The FM-210 as supplied with the power cable is ready for mobile operation. The FM-210 can be installed in any vehicle having a NEGATIVE ground 12 VDC/ electrical system. An optional mounting bracket (MMB-210) is available to mount the FM-210 under the dash.

2.5.3 Mobile antenna installation - Install a mobile antenna in the manner recommended by the antenna manufacturer and connect the coax transmission line to the FM-210 with a PL-259 connector. Mobile antenna installation is another item that is often overlooked. Read some of the many good books available on this subject -- your time will be well spent and will be reflected in your mobile enjoyment.

2.5.4 Ignition noise -- In most mobile installations, ignition noise becomes a problem. Contrary to popular opinion, FM operation is not an automatic cure-all for ignition noise. Analization of ignition noise indicates an FM component that can appear as annoying interference in mobile FM operation. When troubled with ignition noise, it is recommended that you install resistor type spark plugs and insert a 10,000 ohm suppressor resistor in the center tower of the distributor cap. In addition, a 5000 ohm suppressor resistor is suggested for each spark plug tower on the distributor cap. A coaxial capacitor at the ignition coil primary, mounted as close to the coil terminal as possible is another MUST. If noise is still present, again we suggest that you consult the many articles and books written on the subject. There are also several good commercial noise suppression kits available.



FRONT VIEW OF THE FM-210

FIGURE 4

2.6 Control Functions:

1 -- SQUELCH CONTROL
This control is located behind the AUDIO Gain control and is used to set the level of the squelch threshold.

2 -- ON-OFF SWITCH/AUDIO GAIN CONTROL
When the AUDIO Gain control knob is in the maximum counter-clockwise position, the power to the FM-210 is turned OFF. Advancing the control clockwise turns the power ON. Once the power is ON, the control governs the audio output (volume).

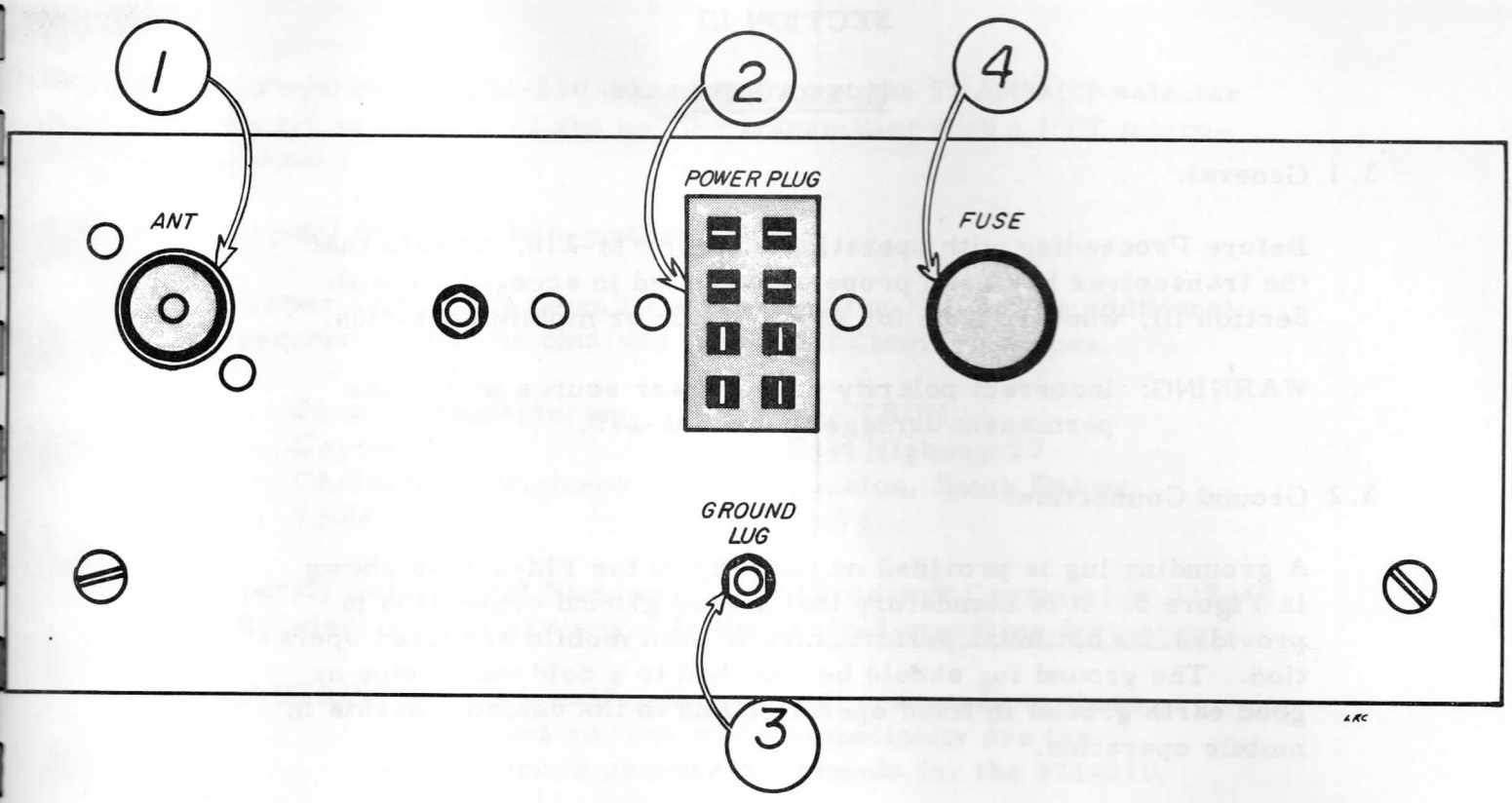
3 -- MIC (Input Jack)

The microphone jack requires a small 3-circuit plug such as Switchcraft S-260. The tip is PTT, the ring is AUDIO and the sleeve or barrel is GROUND. (See Fig. 1)

4 -- RECEIVE Crystal Selector Switch
A three position selector switch that selects one of three crystals that will determine the receiver frequency.

5 -- Indicator Light
A pilot light that will activate whenever the FM-210 is ON.

6 -- TRANSMIT Crystal Selector Switch
A three position selector switch that selects one of three crystals that will determine the transmitter frequency.



REAR VIEW OF THE FM-210

FIGURE 5

2.7 Rear Panel Jacks:

1 -- Antenna -- An SO-239 connector which is the 50 ohm antenna input. It requires a PL-259 plug on your antenna coax feed line.

2 -- Power -- Main power connector requiring a Cinch-Jones S-308 CCT mating connector. This connector is included with the 12 VDC power cord supplied with the FM-210 and is also a part of the AC-210 Power Booster.

3 -- GROUND LUG -- Grounding connection for external ground. Should be connected to cold-water pipe or good outside ground for fixed station use, or to the body chassis for mobile installations.

4 -- FUSE -- The fuse is in series with the ON-OFF switch and protects both the FM-210 and the AC-210, when used. Use ONLY 3 amp FAST-BLOW (type 3 AGC) fuse. Any other type or value fuse will not provide the necessary transistor protection.

SECTION III

OPERATION

3.1 General:

Before Proceeding with operation of your FM-210, be sure that the transceiver has been properly installed in accordance with Section III, whether it be for fixed station or mobile operation.

WARNING: Incorrect polarity of the power source will cause permanent damage to the FM-210.

3.2 Ground Connection:

A grounding lug is provided on the rear of the FM-210 as shown in Figure 5. It is mandatory that a good ground connection is provided for optimum performance in both mobile and fixed operation. The ground lug should be attached to a cold water pipe or good earth ground in fixed operation and to the vehicle chassis in mobile operation.

3.3 Receiver Operation:

The FM-210, as shipped from the Galaxy factory, includes the proper crystal in position #1 for operation on 146.940 MHZ. The receiver has been pre-tuned to accept wideband FM signals at that frequency. To operate the FM-210 receiver, first set the RECEIVE selector switch to channel #1; turn the SQUELCH control to maximum clockwise and turn the AUDIO control clockwise until unsquelched noise is heard in the speaker. Adjust the AUDIO control for a comfortable listening level and rotate the SQUELCH control counter-clockwise until the noise just disappears. This is the most sensitive setting of the SQUELCH control. Further adjustment of the SQUELCH control will reduce the sensitivity of the receiver whereby weak signals will not be heard. For maximum sensitivity, the SQUELCH control may be returned "off" (maximum clockwise). Note: To order crystals and align the FM-210 receiver for operation on additional frequencies, refer to paragraph 3.5 and Section IV.

3.4 Transmitter Operation:

The FM-210 as shipped from the Galaxy factory, includes the proper crystal in position #1 for operation on 146.940 MHZ. The transmitter has been pre-tuned to transmit wideband FM signals at that frequency into a 50 ohm NON-REACTIVE load. Any antenna presenting other than a 50 ohm resistive load should be avoided.

For optimum matching to the antenna, perform the Power Amplifier alignment outlined in paragraph 5.3.6. There are holes in the bottom of the FM-210 case to permit easy access to the proper controls.

To operate the FM-210 transmitter, set the TRANSMIT selector switch to channel #1 and key the transmitter with a PTT microphone.

3.5 Crystal Ordering Information:

Proper crystals to permit operation of the FM-210 on additional frequencies may be obtained from the following sources.

Sentry Manufacturing Crystal Park Chickasha, Oklahoma 73018	M - TRON East Highway 50 Yankton, South Dakota 57078

Specify Galaxy Part Number 117-39 (Transmit Crystals) or 117-40 (Receiver Crystals) along with the desired operating frequency.

CAUTION: Do not specify exact crystal frequency to these suppliers as they will automatically use the appropriate conversion formula for the FM-210.

When ordering crystals from suppliers other than Sentry or M-TRON, the following additional specifications must be included:

RECEIVE Crystal:

$$\text{Desired Crystal} = \frac{\text{Operating Frequency} - 10.7\ \text{MHZ}}{3} + 5\ \text{KHZ}$$

HC - 6 Holder Type

$\pm$ .002% Temperature Tolerance from 0° - 40° Centigrade

$\pm$ .002% Grinding Tolerance @ 25° Centigrade

3rd Overtone - Series Resonant

TRANSMIT Crystal:

$$\text{Desired Crystal} = \frac{\text{Operating Frequency}}{8} + 1.3\ \text{KHZ}$$

HC-6 Holder Type

$\pm$ .005% Temperature Tolerance from 0° - 40° Centigrade

$\pm$ .005% Grinding Tolerance @ 25° Centigrade

Fundamental - Parallel Resonant calibrated into a 32 pf load

SECTION IV

THEORY OF OPERATION

4.1 General Circuit Analysis for Transmitting:

Refer to the block diagram (Figure 7) and the schematic diagram. The voice signal from the microphone is passed to transistors Q401 and Q402 configured to form a high gain amplifier used to drive Q403. Q403 clips the extreme positive and negative peaks from the voice signal, thereby enhancing the average modulation characteristics. When clipping, some undesireable harmonic distortion is produced. Q404 and Q405, part of an ACTIVE FILTER NETWORK, suppress these higher order products. This ACTIVE FILTER NETWORK also "tilts" the transmitter audio response characteristics by 6 db per octave to further enhance the effectiveness of the voice characteristics. The "shaped audio" signal is then applied to the Varicap Modulator where frequency modulation of the crystal oscillator Q406 is accomplished by varying the crystal frequency in direct response to the wave form. Q406 also acts as the first frequency doubler. The signal is then presented to the second frequency doubler Q407 which feeds Q1, the third frequency doubler. The signal, now at operating frequency, is fed to Q2, the amplifier driver stage for Q3. Q3, the power amplifier feeds the output networks which couple the RF power through the antenna relay to the antenna.

4.2 General Circuit Analysis for Receiving:

Again, refer to the block diagram (Figure 7) and the schematic diagram. The incoming signal is switched through the antenna relay and coupled to the RF Amplifier stage Q101, a Field Effect Transistor (FET). The amplified signal is now fed to First Mixer stage, Q102, another FET. Here the signal is mixed with the third harmonic of the First Oscillator Q103, as delivered by the "times three" multiplier Q104. The mixed signal is then fed to the First IF Amplifier Q201 and its associated selective networks. These selective networks allow the difference mixed signal at 10.7 MHZ to pass into the Second Mixer stage Q202 where the signal is mixed with the Second Oscillator Q203 output to produce a difference mixed signal at 450 KHZ. This 450 KHZ signal is then fed into a 4 pole Chebishev filter adjusted for optimum FM reception. The signal is then fed to Intermediate Amplifiers Q204 and Q205 which amplify the signal sufficiently to produce limiting in the next two stage Q206 and Q207. The limited signal is then presented to the fixed tuned discriminator TF201, where the signal is converted to audio. The audio signal is then routed to the First and Second Audio Amplifiers, Q301 and Q302 respectively. The signal then passes to the Squelch Gate Q306. Providing the signal presented to the Squelch Rectifiers D201 and D202, is strong enough to "turn off" the Squelch Gate Q306, the signal is passed to the Audio Driver Q303 and on to the Audio Output stages Q304 and Q305 which drive the speaker.

SECTION V

TEST AND ALIGNMENT

5.1 General:

For this alignment, it is assumed that the FM-210 transceiver is in good electrical condition and that alignment is necessary due to component replacement or frequency changes greater than plus or minus 1 MHZ from factory aligned frequencies.

5.1.1 Test Equipment Required:

1. Vacuum Tube Voltmeter, Hewlett Packard 410B or equivalent.
5. 50 ohm Non-Reactive Dummy Load, minimum 10 watts (100 MHZ to 250 MHZ
3. Accurate Signal Source on operating frequency. (CW no modulation req'd)
4. Tuning Tool GC#5009 or equivalent.
5. Tuning Tool GC#8606 or equivalent.
6. Tuning Tool GC#8609 or equivalent.
7. Frequency Meter or other means of determining output frequency.
   NOTE: An accurate Communications Receiver may be used to receive harmonics of the transmitter crystal oscillator.
   Output frequency can then be determined by direct frequency multiplication.
8. Deviation Meter capable of measuring 15 KHZ deviation.
9. Audio Frequency Generator capable of generating .05 volts RMS at 600 ohms.

5.2 Receiver Alignment:

5.2.1 450 KHZ Filter Alignment:

CAUTION: Unless a component change in the 450 KHZ filter Section or T208 is necessary, it is recommended that alignment of the filter section not be attempted in the field. If filter section alignment is contemplated, the following additional test equipment is required:

1. Calibrated RF Signal Generator covering 450 KHZ.
2. Oscilloscope with bandwidth capability of 5 MHZ minimum and 10 pf/10 megohm maximum loading.

Apply power to the unit and remove the 2nd Oscillator crystal (X201) from its socket. Attach the Signal Generator to the IF board as shown in Figure 8. Adjust the Signal Generator output so that the voltage at the collector of Q202 (TP-F) Fig. 9 never exceeds .5 volts Peak to Peak. This should be accomplished several times during the filter alignment process. Attach the probe of the oscilloscope to

the collector of Q202 and adjust the frequency of the signal generator for O v at the top of R224. In performing the following, temporarily short the winding of T205 to ground (see Fig. 8).

CAUTION: Insure that T-205, T-206 and T-207 are never inadvertently shorted to any DC voltage.

Tune the slug of T204 for MAXIMUM indication on the oscilloscope.

CAUTION: The primary of T204 has 12 VDC present. Do not short to ground.

Remove the short from T205 and temporarily short T206 to ground. Tune T205 for MINIMUM indication on the oscilloscope. Remove the short from T206 and temporarily short T207 to ground. Tune T206 for MAXIMUM indication.

Remove the short from T207 and tune T207 for MINIMUM indication. Move the oscilloscope probe from Q202 to the top of R219. (TP-C Fig. 9). Tune T208 for MAXIMUM indication. Remove the oscilloscope probe, disconnect the RF Signal Generator and re-insert the 2nd Oscillator crystal.

5.2.2 1st Oscillator and "Times Three" Multiplier Alignment:

Attach the DC probe of the VTVM to Q104 source. (TP-A Fig 9). Tighten trimmer capacitor C113, C114 or C115 (depending on channel in use) finger tight. Turn C113, C114 or C115 counter-clockwise until the VTVM peaks upscale. This adjustment is somewhat critical and care should be used to insure that the meter actually peaks. Remove the VTVM from Q104 (TP-A) and attach to the top of R104. (TP-B Fig. 9). Tune the slug of L103 for maximum on the VTVM. Disconnect the VTVM from R104.

5.2.3 10.7 MHZ Intermediate Frequency Alignment:

Attach the signal source (operating frequency) to the Antenna Jack and adjust the signal to approximately 50 microvolts. Attach the AC probe of the VTVM to the top of R219 (TP-C Fig. 9). Tune the slugs in T203, T202 and T201 for maximum indication.

5.2.4 Converter Board Alignment:

With the signal source attached to the Antenna Jack and the AC probe of the VTVM on the top of R219 (TP-C) tune C103 and C106 for maximum indication. NOTE: As the various stages are tuned, it may be necessary to reduce the signal level to prevent limiting of the signal. Limiting is indicated when the adjustments no longer result in a sharp "peak" indication on the VTVM. Disconnect the VTVM but leave the signal source connected.

5.2.5 Channel Frequency Alignment:

Attach the DC probe of the VTVM to the top of R224 (TP-D Fig 9). Adjust C113, C114, or C115 for 0 volts on the VTVM. Disconnect the VTVM probe, alignment of the receiver section is completed.

NOTE: The exact crystal frequency (receiver only) is computed as follows:

$$\frac{\text{Operating Frequency - 10.7 MHZ}}{3} + \text{5 KHZ} = \text{Desired Crystal Frequency}$$

To order crystals for additional operating frequencies, see paragraph 3.5.

5.3 Transmitter Alignment:

5.3.1 Frequency Adjustment:

Attach a dummy Load to the Antenna output jack on the FM-210, set the TRANSMIT frequency selector switch to the desired position, and apply power to the unit. If a Frequency Counter on the operating frequency is available, this should be coupled at the Antenna Jack. An alternate method is to use an accurate receiver to monitor the crystal frequency. When utilizing this method, calibrate the receiver at the checkpoint nearest the crystal frequency. Attach a 6 inch length of insulated wire to the center conductor of enough coaxial cable to reach from the receiver antenna jack to the FM-210. Place the insulated wire near the FM-210 crystal oscillator circuit and adjust the receiver frequency to the desire crystal operating frequency according to this formula:

$$\frac{\text{Operating Frequency}}{8} = \text{Desired Crystal Freq.}$$

Key the transmitter with the microphone or special test fixture (Figure 6). Adjust the frequency trimmer for the channel desired (C410 - CH1, C411 - CH2, C412 - CH3, see Fig. 9) until "zero beat" is accomplished in the receiver. If this cannot be accomplished and the oscillator circuit is known to be working properly, any of the following may be at fault:

a. Receiver calibration is inaccurate.
b. The crystal frequency was incorrectly calculated.
c. Defective crystal - incorrect type of tolerance.
d. Any combination of the above.

Disconnect the receiver or frequency counter cable.

5.3.2 First Frequency Doubler Alignment:

Attach the DC probe of the VTVM to the top of R425 (TP-E Fig. 9) and adjust the slugs of L401 and L402 for maximum indication. Remove the probe.

5.3.3 Second Frequency Doubler Alignment:

Attach the DC probe of the VTVM to Test Point 1 (TP-1 Fig 9). Alternately tune L403 and C423 for maximum indication. As there is some interaction, this process should be repeated several times until there is no further improvement. Remove the probe.

5.3.4 Third Frequency Doubler Alignment:

Attach the DC probe of the VTVM to TP-2 (Fig. 9) and adjust C3 (Fig. 8) for maximum indication. Remove the probe.

5.3.5 Amplifier Driver Alignment:

Attach the DC probe of the VTVM to TP-3 (Fig. 9) and adjust C8 (Fig. 8) for maximum indication. Remove the probe.

5.3.6 Power Amplifier Alignment:

Attach the AC probe of the VTVM to the antenna jack (use a Tee-Connector if necessary). The Dummy Load must also remain connected to the Antenna Jack. Alternately adjust C12 and C13 for maximum indication. Readjust L403, C423, C3, C12 and C13 several times for maximum indication. Remove the probe.
NOTE: When connecting the FM-210 to any antenna, C12 and C13 should be "peaked" using a field strength meter or a SWR Meter designed for VHF use. This insures correct matching and optimum transfer of RF to the antenna.

5.3.7 Audio Deviation Adjustment

Set up a Deviation Meter according to the manufacturer's recommendations. In the FM-210, adjust R403 (Fig. 9) maximum counter-clockwise (CCW), and R409 (Fig 9) maximum clockwise. Insert a audio signal (.05 Volt RMS at 1,000 HZ into the MIC jack (Figure 6). Adjust R409 for 12-15 KHZ on the Deviation Meter. Remove the audio signal.

5.3.8 Audio Clipping Adjustment:

The adjustment of R402 controls the clipping level and should be set for individual operator preference. Maximum counter-clockwise is maximum clipping (about 10 db) while maximum clock-wise turns the audio off. Setting the notch on the control to approximately 2 o'clock is a normal 3 db clipping level with most microphones. A minimum of experimenting will yield the setting that is optimum for individual voice characteristics and microphones.

PARTS LIST

MAIN CHASSIS ASSY

C1	.005 mfd	20-3
C2	.005 mfd	"
C3	1.5 - 20 PF Trimmer	26-18
C4	10	20-27
C5	.001 mfd	20-24
C6	7.0 PF N330	20-21
C7	.005 mfd	20-3
C8	4-40 PF Trimmer	26-19
C9	.001 mfd	20-24
C10	.02 mfd	20-49
C11	.005 mfd	20-3
C12	4-40 PF Trimmer	26-19
C13	4-40 PF Trimmer	26-19
C15	.005 mfd	20-3
C15	1000 mfd	24-28
C16	.001 mfd	20-24
C17	.005 mfd	20-3
C18	.005 mfd	20-3
C19	.005 mfd	20-3
C20	.005 mfd	20-3
C21	.005 mfd	20-3
RFC1	RF Choke	30-40
RFC2	RF Choke	30-41
RFC3	RF Choke	30-40
D1	12.0 V Zener	112-14
D2	B5E5 Diode	112-3
Q1	2N4427	111-34
Q2	2N4427	111-34
Q3	2N5641	111-35
Q4	D40D1	111-36
L1	3rd Doub Coll. Coil	40-25
L2	Driver Tank Coil	40-24
L3	Output Coil	40-23
L4	Loading Coil	40-22
J1	Antenna Connector	101-1
P1	Power Connector	104-16
J2	Microphone Jack	103-3
F1	Fuse 3A. F.B.	114-21

PARTS LIST

MAIN CHASSIS ASSY

K1	12V Relay	116-8
S1	ON-OFF Sw. P/O R9A & R9B Assy	13-18
R9A	Complete Assy.	13-18
R9B	Complete Assy.	13-18
S2	Receive Crystal Sw.	53-48
S3	Transmit Crystal Sw.	53-39
L1	Indicator Lamp	113-12
TP1	Test Point	102-3
TP2	Test Point	102-3
TP3	Test Point	102-3
Spkr	3.2 Ohm Speaker	118-11
R1	10K	10-56
R2	100 Ohm	10-7
R3	10 K	10-56
R4	100 Ohm	10-7
R5	10 K	10-56
R6	18 Ohm	10-93
R7	2.7 Ohm W.W.	12-39
R8	12 K	10-84
R9A	10 K P/O OF	13-18
R9B	59K P/O OF	13-18
R10	120 Ohm	10-77
FH1	Fuse Holder	66-1
	Knob	130-14-19
	Knob	130-14-20
	Knob	13-14-21
	Cabinet	140-38
	Front Panel Overlay	141-46
	Sub Panel (Front)	142-55
	Rear Panel	142-56
	Manual	183-90

PARTS LIST

200-59 BOARD

R401	47K	10-13
R402	50K P.C.M. Control	13-48
R403	120 K	10-76
R404	100K	10-32
R405	2.7K	10-66
R406	2.2K	10-31
R407	----	----
R408	10K	10-56
R409	10K P.C.M. Control	13-47
R410	100K	10-32
R411	100K	10-32
R412	100K	10-32
R413	100K	10-32
R414	10K	10-56
R415	100K	10-32
R416	10K	10-56
R417	10K	10-56
R418	330K	10-69
R419	6.8K	10-21
R420	150-Ohm	10-43
R421	27 K	10-14
R422	470-Ohm	10-53
R423	220-Ohm	10-4
R424	560-Ohm	10-67
R425	47-Ohm	10-29
C401	.05 mfd	20-87
C402	35 mfd	29-7
C403	30 mfd	29-3
C404	10 mfd	29-14
C405	.001 mfd	20-24
C406	.05 mfd	20-87
C407	.0015 mfd	20-52
C408	270 PF	20-86
C409	.1 mfd	20-88
C410	4-40 PF Trimmer	26-17
C411	4-40 PF Trimmer	26-17
C412	4-40 PF Trimmer	26-17
C413	150 PF N2200	20-81
C414	150 PF N2200	20-81
C415	82 PF	20-83
C416	.001 mfd	20-24
C417	.05 mfd	20-87
C418	20 PF	20-70

PARTS LIST

200-59 BOARD

C419	.01 mfd	20-5
C420	.005	20-3
C421	47 PF	20-19
C422	Factory Select	20-27
C423	1.5-20 PF Trimmer	26-16
Q401	2N2926Y	111-6Y
Q402	2N2926Y	111-6Y
Q403	2N4916	111-32
Q404	2N2926Y	111-6Y
Q405	2N4916	111-32
Q406	2N3563	111-15
Q407	2N3904	111-30
D401	2N2926Y	111-6Y
DV401	MV1628	112-19
RFC401	2.2 Microhenry	30-22
RFC402	3.3 Microhenry	30-32
RFC403	39 Microhenry	30-21
X401	T 146.9430 Crystal	117-39
X402	Special Order	117-39
X403	Special Order	117-39
L401	1st Doub Coll. Coil	73 -
L402	2nd Doub Base Coil	73 -
L403	2nd Doub Coll. Coil	73 -
Y401	Crystal Socket	64-2
Y402	Crystal Socket	64-2
Y403	Crystal Socket	64-2
PCB400	Printed Circuit Board	200-59

PARTS LIST

200-60 BOARD

C101	4.7 PF	20-25
2	10 PF	20-92
3	1.5-20 PF Trimmer	26-16
4	.001 MFD	20-24
5	15 PF	20-71
6	1.5-20 PF Trimmer	20-16
7	.001 mfd	20-24
8	.001 mfd	20-24
9	.001 mfd	20-24
10	50 PF N330	20-96
11	.005 mfd 10%	20-89
12	.001 mfd	20-24
13	1.5-20 PF Trimmer	26-16
14	1.5-20 PF Trimmer	26.-16
15	1.5-20 PF Trimmer	26-16
16	.001 mfd	20-24
17	100 PF	20-90
18	6.8 PF	20-64
Q101	2N5485	111-31
Q102	2N5485	111-31
Q103	2N5485	111-31
Q104	2N5485	111-31
RFC101	.56 Microhenry	30-42
RFC102	2.2 Microhenry	30-22
X101	R 146.940 Crystal	117-40
2	Special Order	117-40
3	Special Order	117-40
Y101	Crystal Socket	64-2
2	Crystal Socket	64-2
3	Crystal Socket	64-2
SC101	Transistor Socket	61-27
L101	Air Wound Coil	———
2	Air Wound Coil	———
3	Slug Tuned Coil	———
T101	10.7 Mhz IF Transformer	73-35
PCB100	Printed Circuit Board	200-60

200-60 BOARD

R101	180 Ohm	10-71
2	330 Ohm	10-28
3	100 K	10-32
4	5.6 K	10-83
5	220 Ohm	10-58
6	330 Ohm	10-28
7	330 Ohm	10-28
8	4.7 K	10-36
9	330 Ohm	10-28

PARTS LIST
200-61 BOARD

C201	50 PF N330	20-96
2	.01 mfd	20-5
3	.01 mfd	20-5
4	50 PF N330	20-96
5	50 PF N330	20-96
6	.005 mfd 10%	20-89
7	.01 mfd	20-5
8	.1 mfd	20-88
9	.1 mfd	20-88
10	.01 mfd	20-5
11	150 PF	20-91
12	150 PF	20-91
13	10 PF	20-92
14	47 PF	20-19
15	Part of T204	-----
16	10 PF	20-92
17	Part of T205	-----
18	8 PF	20-94
19	Part of T206	-----
20	15 PF	20-71
21	Part of T207	-----
22	.1 mfd	20-88
23	.1 mfd	20-88
24	Part of T208	-----
25	.1 mfd	20-88
26	.05 mfd	20-87
27	.05 mfd	20-87
28	470 PF 10%	20-93
29	.01 mfd	20-5
30	470 PF 10%	20-93
31	.02 mfd	20-49
32	.1 mfd	20-88
33	.01 mfd	20-5
34	470 PF	20-93
35	.05 mfd	20-87
R201	270 K	10-12
2	3.9 K	10-16
3	2.7 K	10-66
4	1.0 K	10-42
5	10 K	10-56
6	1.0 K	10-42
7	2.2 K	10-31

PARTS LIST
200-61 BOARD

R208	330 K	10-69
9	1.8 K	10-17
10	180 Ohm	10-71
11	2.7 K	10-66
12	1.0 K	10-42
13	10 K	10-56
14	33 K	10-65
15	100 Ohm	10-7
16	150 Ohm	10-43
17	4.7 K	10-36
18	270 Ohm	10-12
19	1.8 K	10-17
20	1.0 K	10-42
21	330 Ohm	10-28
22	390 Ohm	10-85
23	220 Ohm	10-58
24	10 K	10-56
25	10 K	10-56
26	10 K	10-56
27	4.7 K	10-36
Q201	2N3855	111-11
2	2N3855	111-11
3	2N2926Y	111-6Y
4	"	"
5	"	"
6	"	"
7	"	"
D201	1N270	112-10
2	"	"
3	"	"
4	"	"
RFC201	220 Microhenry	
2	1.0 Millihenry	
T201	10.7 MHZ I.F. Transformer	73-35
2	" "	"
3	" "	"
4	450 KHZ (nominal) I.F. Transformer	73-36
5	" "	"
6	" "	"
7	" "	"
8	" "	"

PARTS LIST
200-61 BOARD

TF201	Ceramic Resonator	117-42
X201	2nd Osc Xtal (WB)	117-41
Y201	Crystal Socket	64-2
PCB201	Printed Circuit Board	200-61

PARTS LIST

200-62 BOARD

C301	.01 mfd	20-5
2	.1 mfd	20-88
3	.1 mfd	20-88
5	100 mfd	29-13
R301	68 K 10%	10-33
2	1 MEG	10-10
3	10K	10-56
4	22K 5%	10-37
5	150 Ohm	10-43
6	2.2K	10-31
7	220K 5%	10-30
8	12 Ohm	10-26
9	270 Ohm	10-68
10	1.0 Ohm 1W	11-23
11	220K 5%	10-30
12	10K	10-56
Q301	2N2926Y	111-6Y
Q302	"	111-6Y
Q303	2N3638	111-10E
Q304	D42C1 (Red)	111-37
Q305	D43C1 (Green)	111-38
Q306	2N2926Y	111-6Y
D301	B5E5	112-3
2	B5E5	112-3
PCB300	Printed Circuit Board	200-62

SECTION VII

SERVICE INFORMATION

7.1 Returning Equipment for Service:

DO NOT ship equipment to Galaxy Electronics without prior written permission. We prefer to send special shipping labels and this will often avoid delay of unexpected shipments.

If time is extremely important it is better to wire or call us for approval and we will rush shipping labels to you. When a shipment is expected, even the time of sending you the labels is less than that lost when an unexpected shipment is received.

It is VERY IMPORTANT that the shipment be well packed and fully insured. Damage claims must be settled between you and the carrier and will greatly delay any returns. Proper packing normally avoids this trouble.

ALL SHIPMENTS MUST BE SENT TO US PREPAID. All returns should be made in our standard cartons only -- so save your carton when unpacking the unit. When shipments are returned it may be handled in three ways . . .

Where all service is in warranty the shipment will be returned with transportation costs collected by the carrier on arrival.

1 - If there are any charges not covered by warranty we can hold the shipment and advise you of costs, which you can then send and shipment will arrive with only transportation costs collected by the carrier on arrival.

2 - Or if there are charges not covered by warranty you may send a blank check payable to us, which we will make out for the charges or our service and you then pay the transportation charges on arrival.

3 - Or we will ship C.O.D. for any charges not covered by warranty, then the carrier will collect these charges and the transporation costs on arrival.

SECTION VIII

WARRANTY

GALAXY ELECTRONICS guarantees to remedy any defect in material or workmanship existing in the FM-210 at no cost to the owner, exclusive of shipping charges, provided:

- That the defect is not caused by improper installation or use contrary to our instructions.
- That the unit serial number has been registered with us by the original purchaser.
- That the equipment or part that appears defective is delivered to us or the authorized repair station we may designate for examination.
- That examination does, in our judgement, disclose a defective part or workmanship.

This warranty applies to labor for a period of 90 days, and for other parts for a period of one year from the date of purchase by the original owner.

The warranty applies to only the original purchaser and is not transfereable.

This warranty does not cover any transportation costs that may be incurred, and our sole liability is repair of any defect, for the period stated above.

No person is authorized to assume for us any other liability in connection with the sale of this or other of our products.

GALAXY ELECTRONICS reserves the right to make any changes deemed necessary or desirable by us to improve the product, without advance notice, or incurring any obligation to make like changes or improvements in units previously manufactured or sold.

All warranties expressed here are void and terminated one year after the last FM-210 has been manufactured by us.

All correspondence relating to warranty service or other service requirements should be direct to:

Galaxy Electronics
Attn: Customer Service Department
10 South 34th St.
Council Bluffs, Iowa 51501

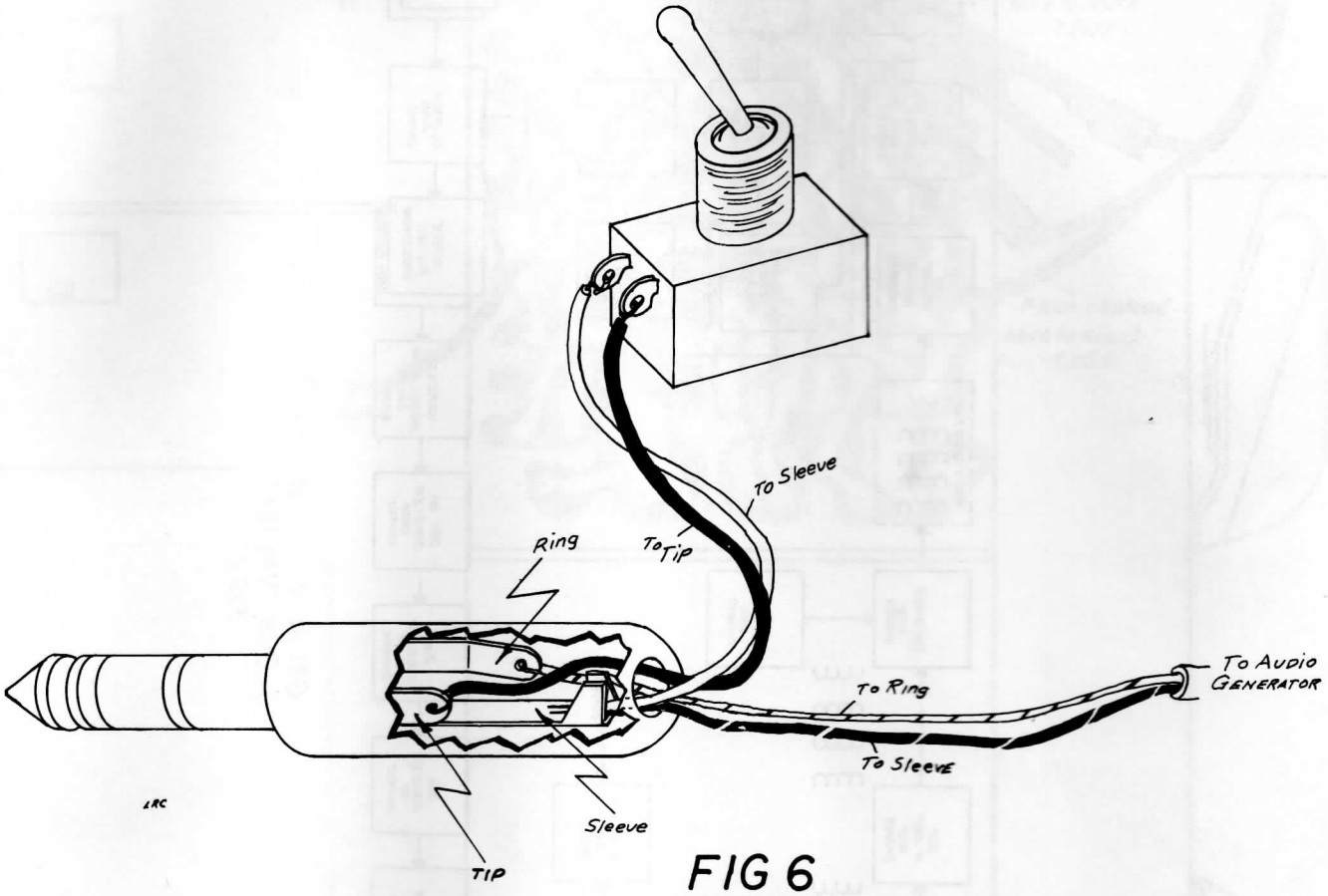
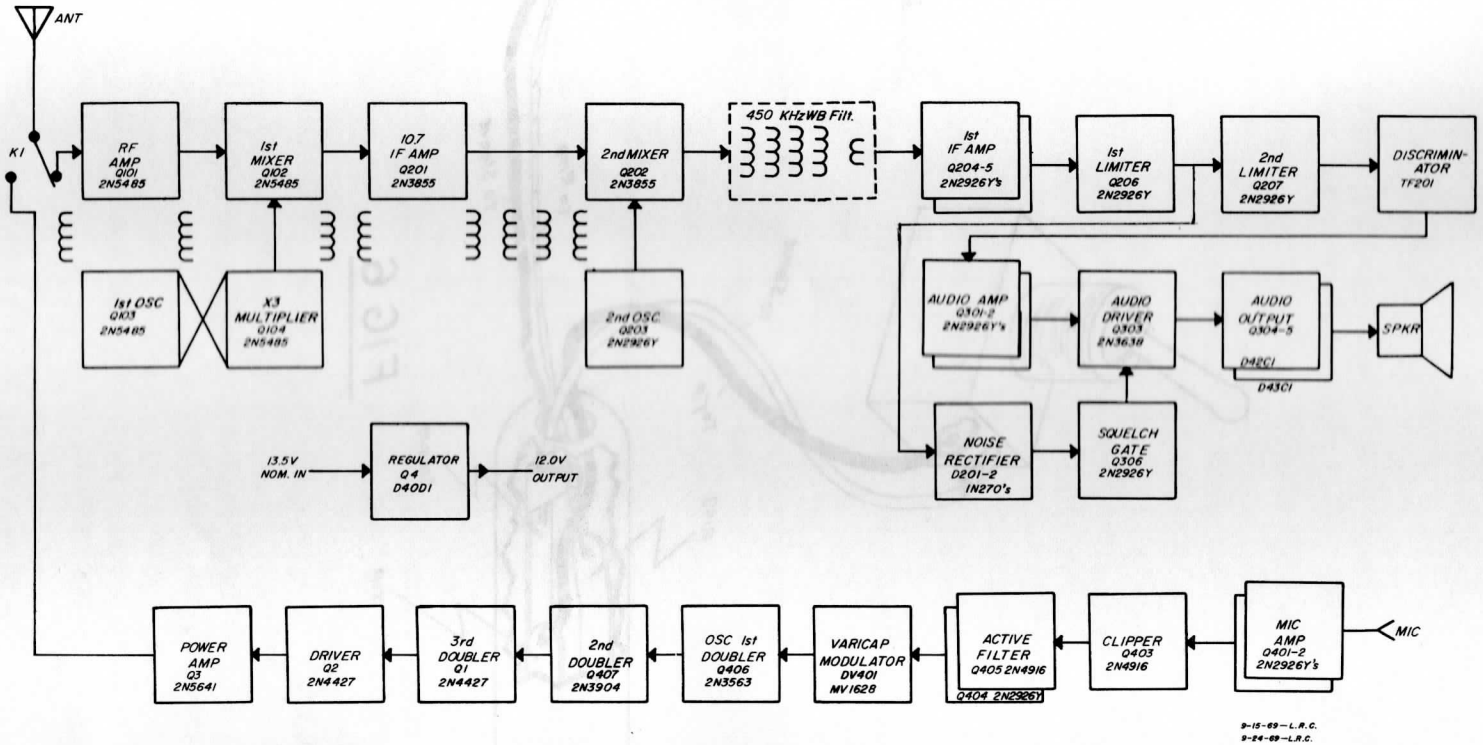

To Sleeve
Ring
To Tip
To Audio Generator
To Ring
To Sleeve
LRC
Sleeve
TIP

FIG 6



GALAXY FM 210
BLOCK DIAGRAM
FIG 7

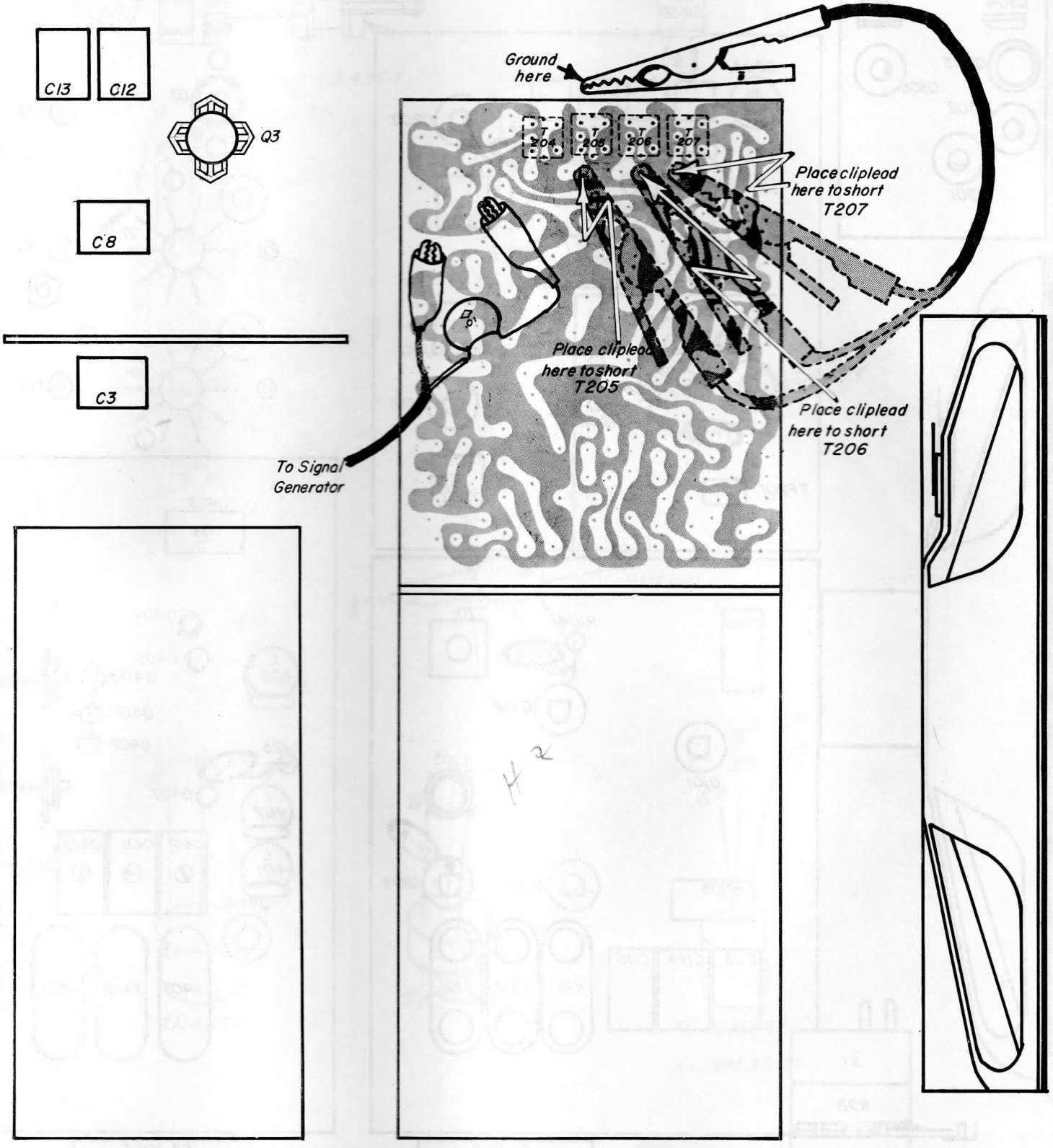

C13
C12
Q3
C8
C3
Ground here
T204
T205
T206
T207
Place cliplead here to short T207
Place cliplead here to short T205
Place cliplead here to short T206
To Signal Generator
LRC

FIG 8

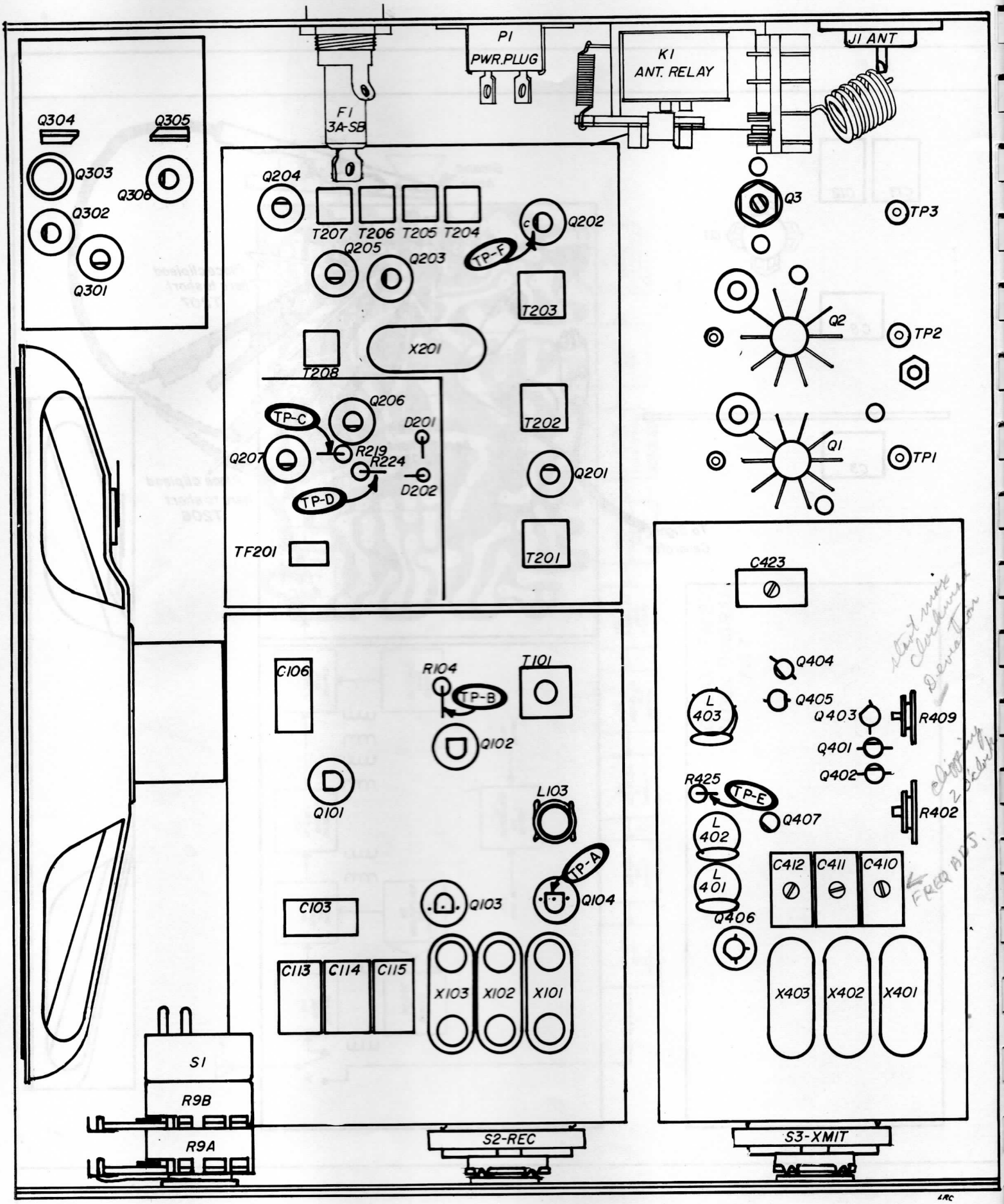
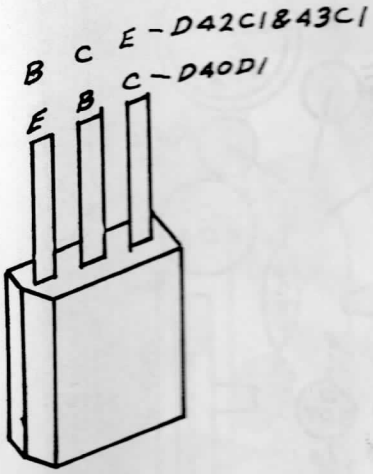
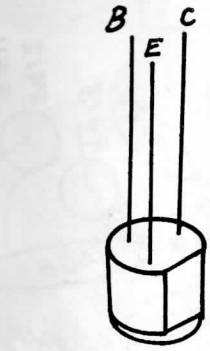

P1
PWR.PLUG
K1
ANT. RELAY
J1 ANT
F1
3A-SB
Q304
Q305
Q303
Q306
Q302
Q301
Q204
T207
T206
T205
T204
Q202
Q205
Q203
TP-F
T203
X201
T208
Q206
TP-C
D201
Q207
R219
R224
D202
TP-D
Q201
T202
TF201
T201
Q3
TP3
Q2
TP2
Q1
TP1
C423
C106
R104
T101
TP-B
Q102
Q101
L103
TP-A
Q104
Q103
C103
C113
C114
C115
X103
X102
X101
Q404
Q405
Q403
R409
L 403
Q401
Q402
R425
TP-E
Q407
R402
L 402
L 401
C412
C411
C410
Q406
X403
X402
X401
S1
R9B
R9A
S2-REC
S3-XMIT

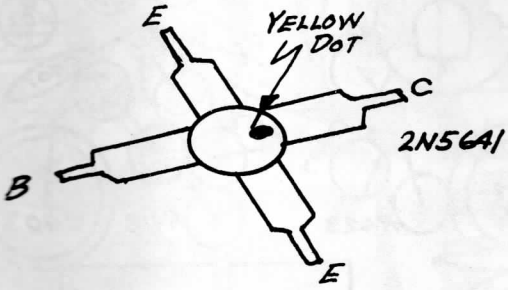
FIG 9



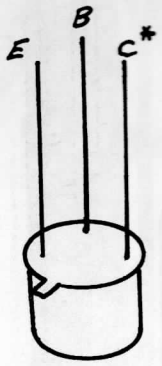


2N3563

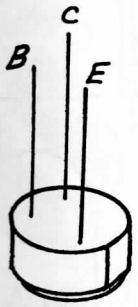
2N2926Y
2N3855



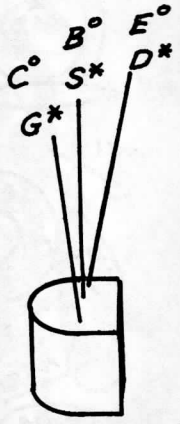
2N5641



2N4427



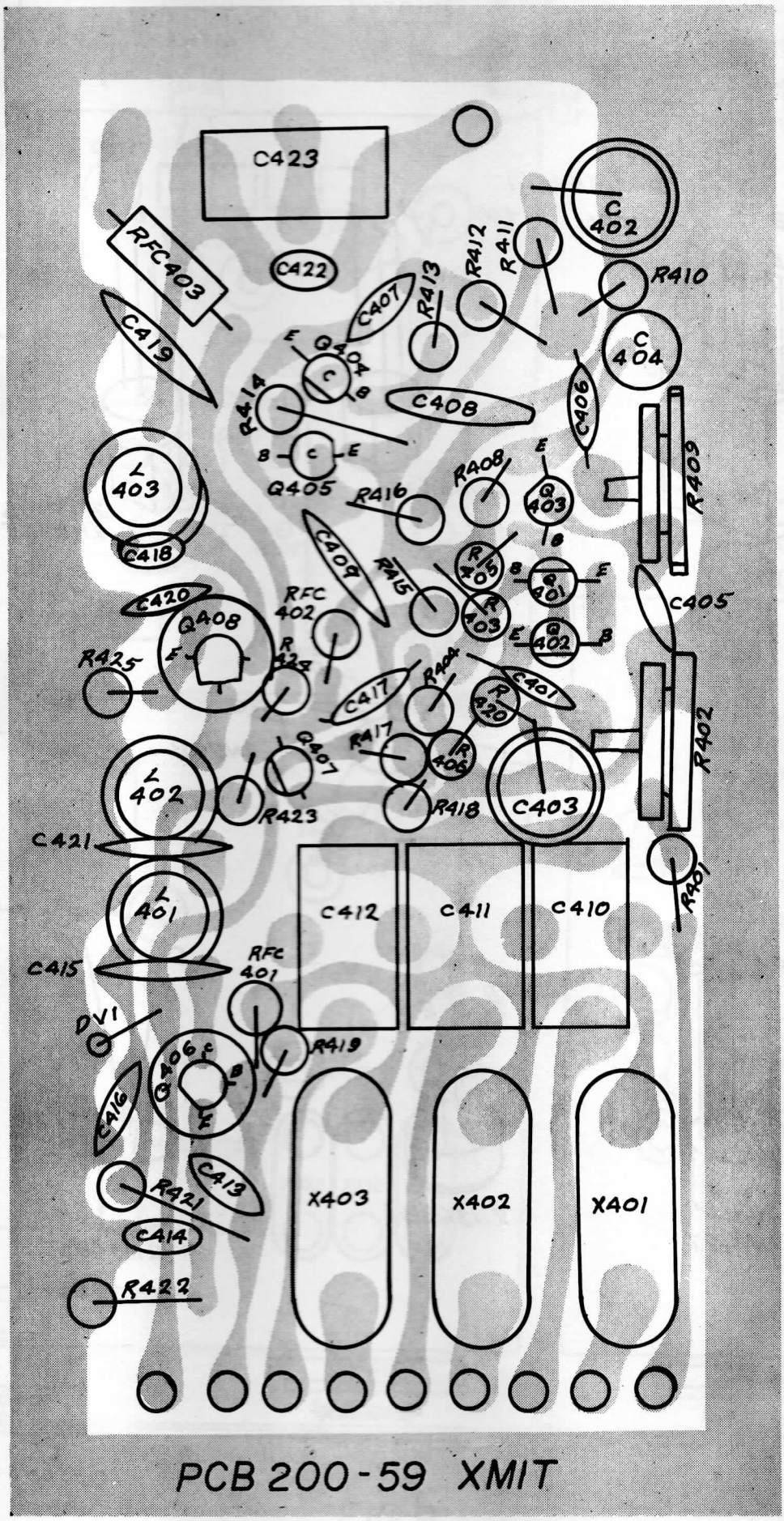
2N3638

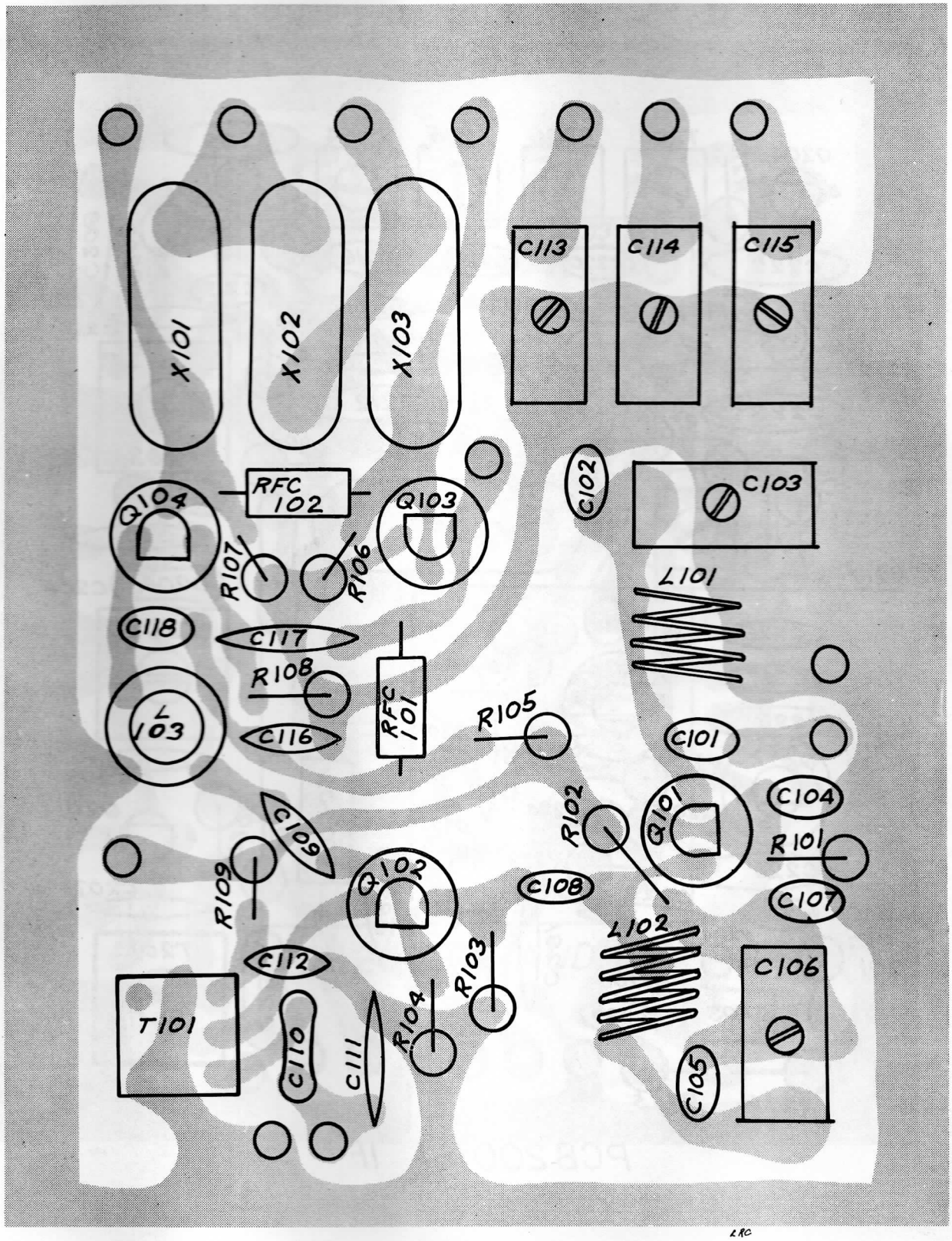


* 2N5485

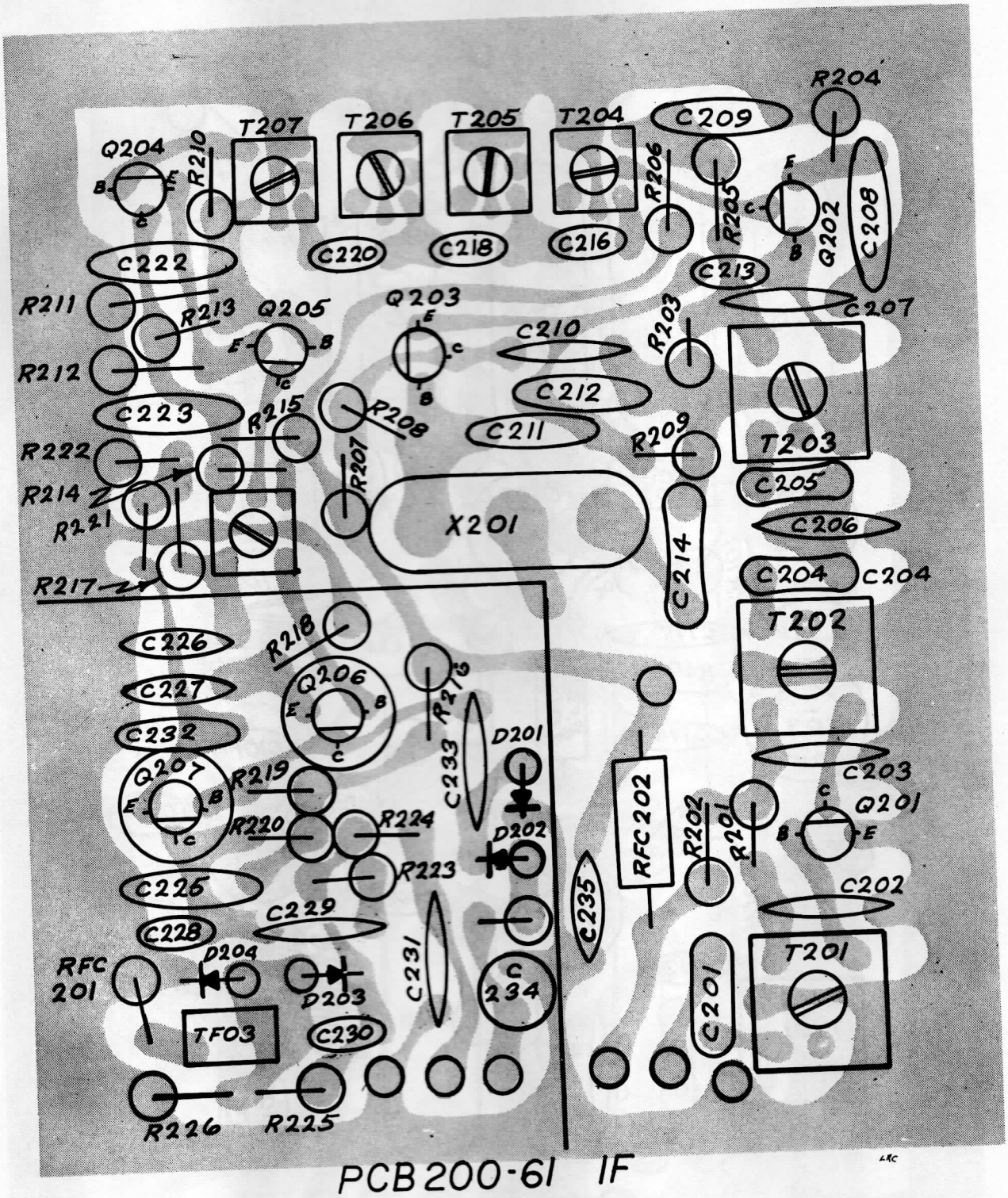
o = 2N3904

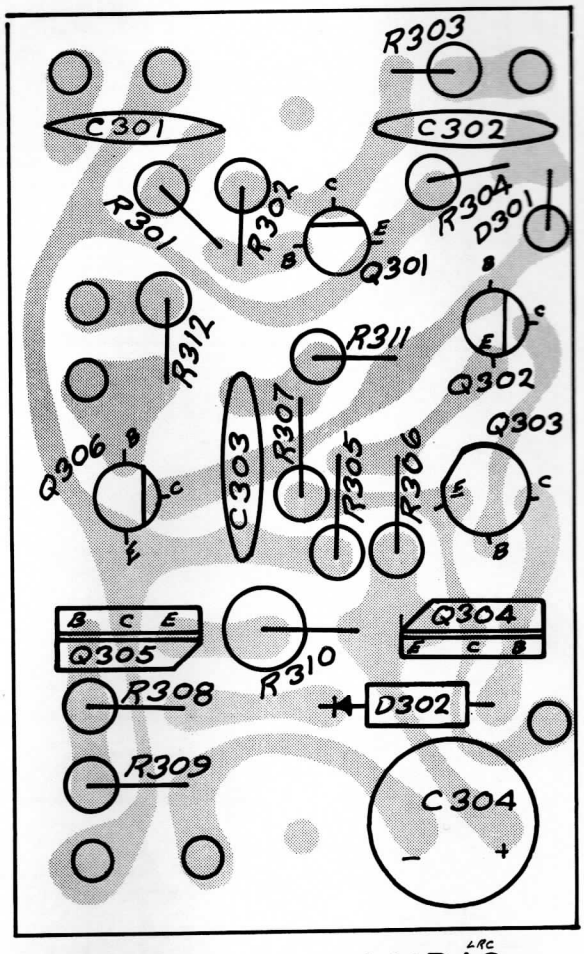
* - COLLECTOR - BODY


C423
RFC403
C422
C419
C407
R413
R412
R411
C402
R410
C404
R414
C408
C406
R409
L403
C418
Q405
R416
R408
Q403
C409
R415
R405
Q401
C405
C420
RFC402
Q408
R403
Q402
R425
R404
C417
R420
C401
R402
R417
Q407
R406
L402
R423
R418
C403
C421
L401
C412
C411
C410
R401
C415
RFC401
DV1
R419
Q406
C416
C413
X403
X402
X401
R421
C414
R422
PCB 200-59 XMIT

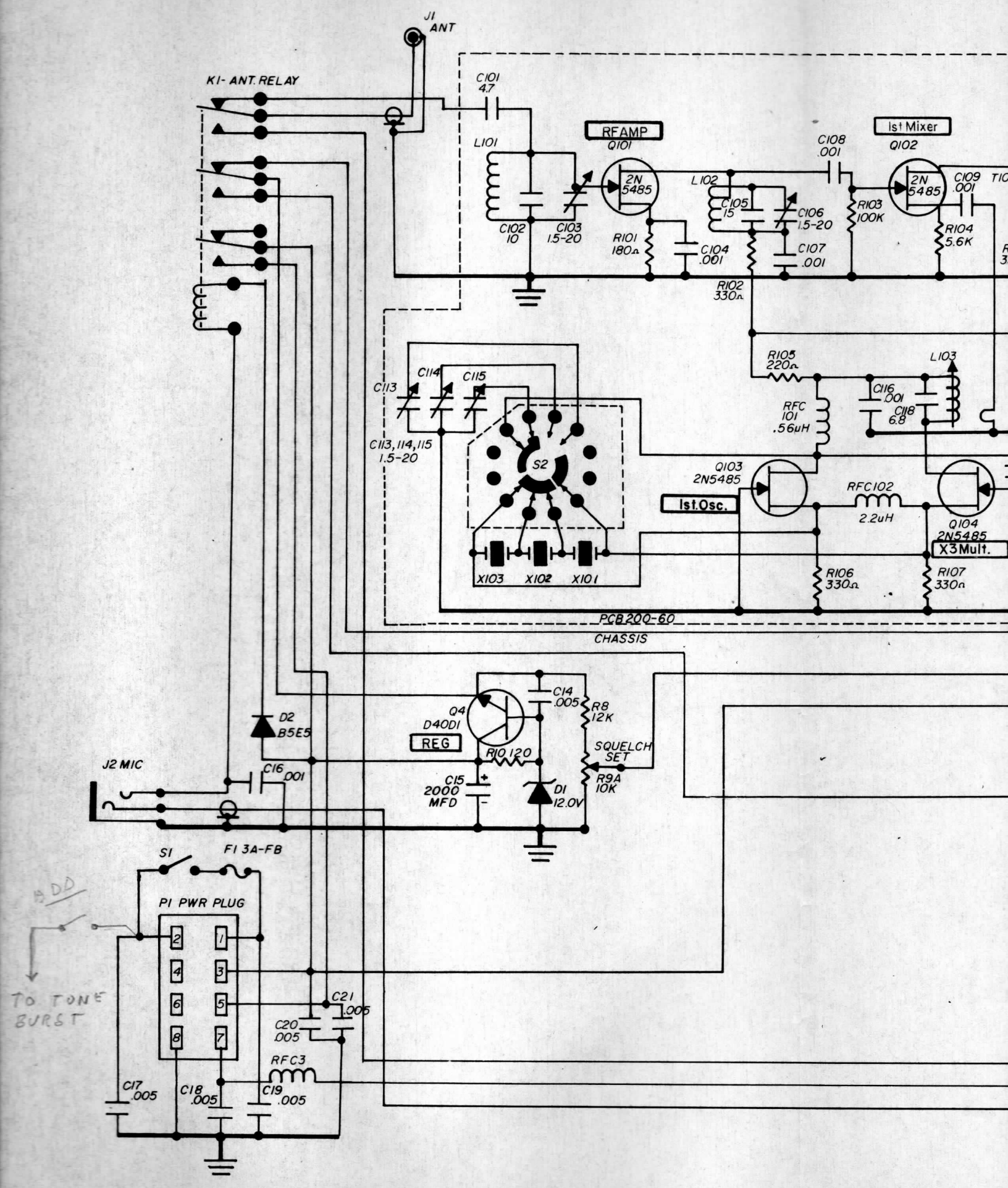


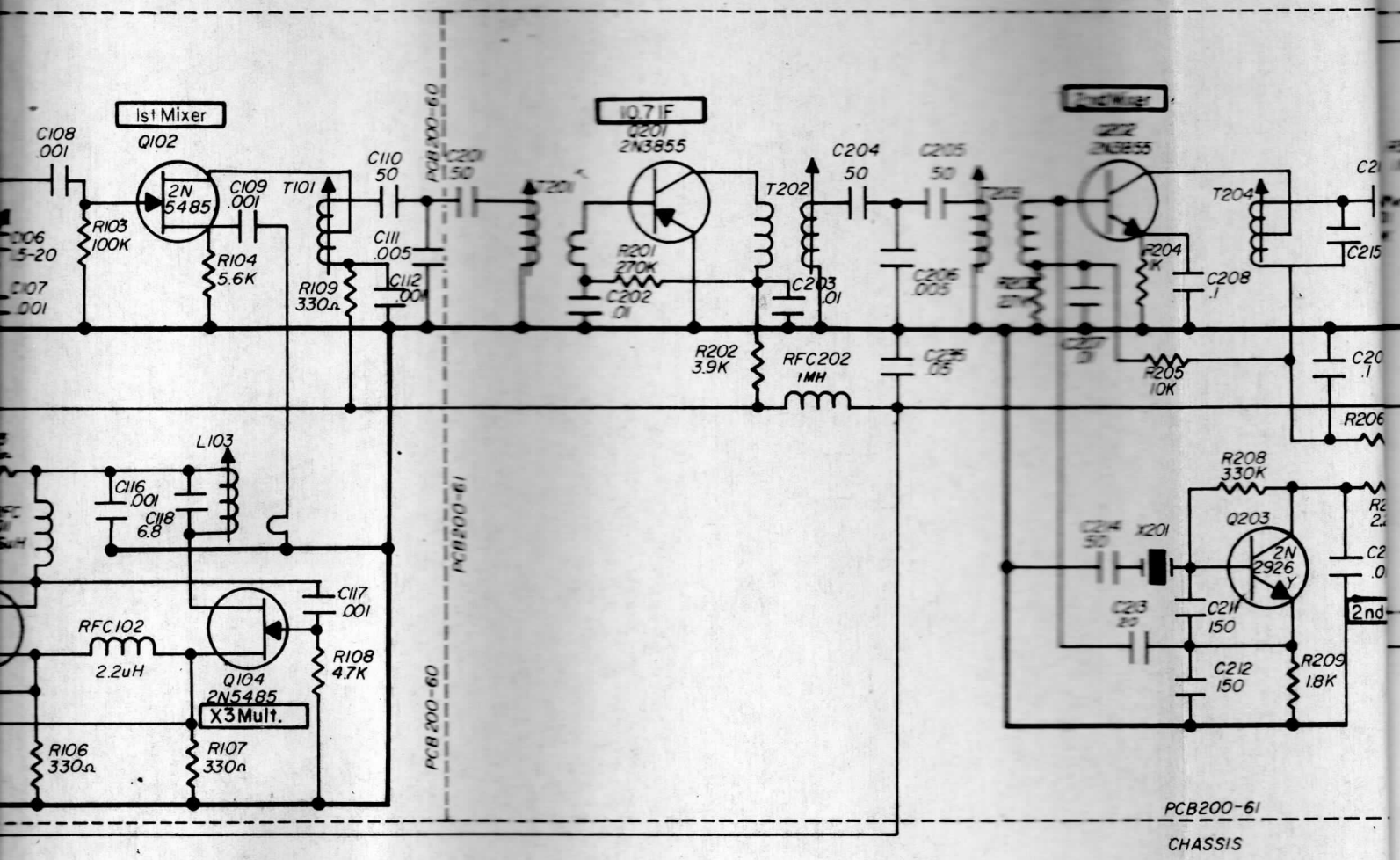
PCB 200-60 CONVERTER

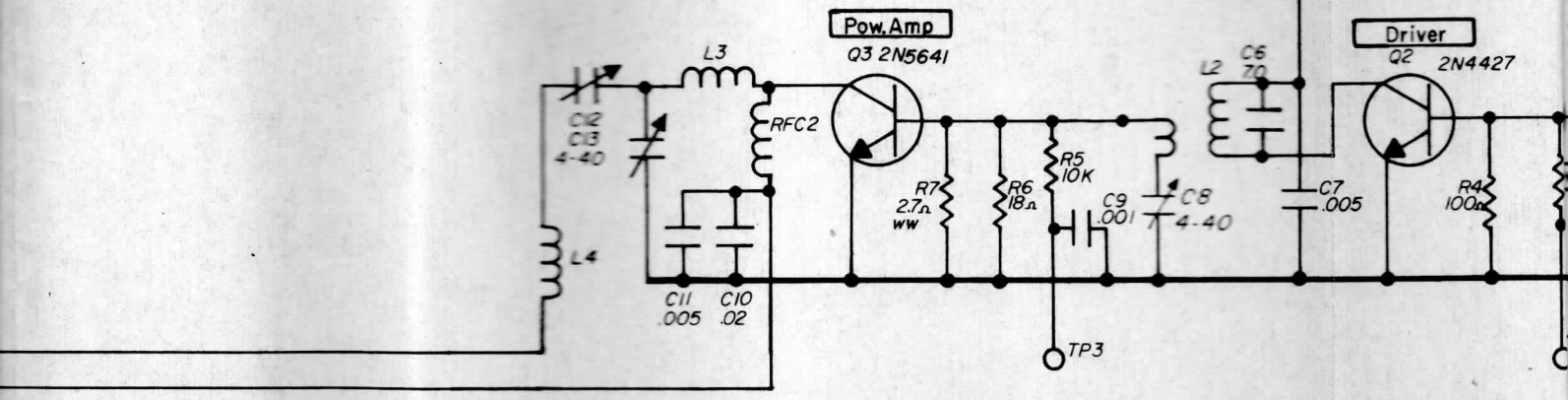

Q204
R210
T207
T206
T205
T204
C209
R204
R206
R205
Q202
C208
C222
C220
C218
C216
C213
R211
R213
Q205
Q203
C210
R203
C207
R212
C212
C223
R215
R208
C211
R209
T203
R222
R207
C205
R214
X201
C214
C206
R221
C204
C204
R217
T202
C226
R218
Q206
C227
R216
C232
C233
D201
Q207
R219
C203
Q201
R220
R224
D202
R202
R201
R223
RFC 202
C235
C225
C229
C202
C228
D204
C231
C234
T201
RFC 201
D203
C201
TF03
C230
R226
R225
PCB 200-61 IF



PCB 200-62 AUDIO LRC


J1 ANT
K1- ANT. RELAY
C101 4.7
L101
C102 10
C103 1.5-20
RFAMP Q101
2N 5485
R101 180Ω
C104 .001
L102
C105 15
C106 1.5-20
C107 .001
R102 330Ω
C108 .001
1st Mixer Q102
2N 5485
C109 .001
R103 100K
R104 5.6K
C113
C114
C115
C113, 114, 115 1.5-20
S2
X103
X102
X101
R105 220Ω
L103
C116 .001
C118 6.8
RFC 101 .56uH
Q103 2N5485
1st Osc.
RFC102 2.2uH
Q104 2N5485
X3 Mult.
R106 330Ω
R107 330Ω
PCB 200-60
CHASSIS
J2 MIC
D2 B5E5
C16 .001
Q4 D40D1
REG
C14 .005
R8 12K
R10 120
SQUELCH SET
R9A 10K
C15 2000 MFD
D1 12.0V
S1
F1 3A-FB
P1 PWR PLUG
ADD
TO TONE BURST
C21 .005
C20 .005
RFC3
C17 .005
C18 .005
C19 .005

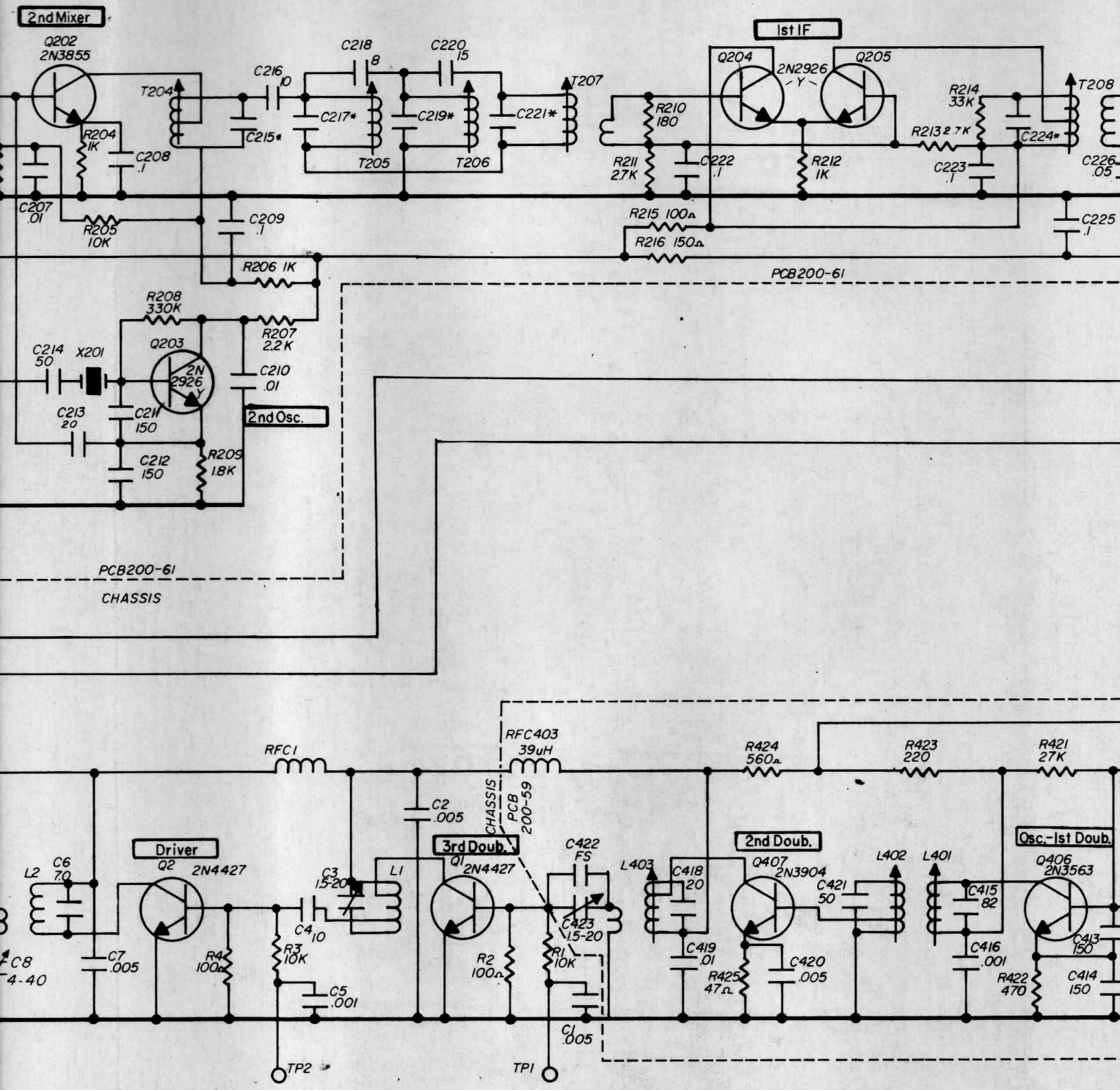




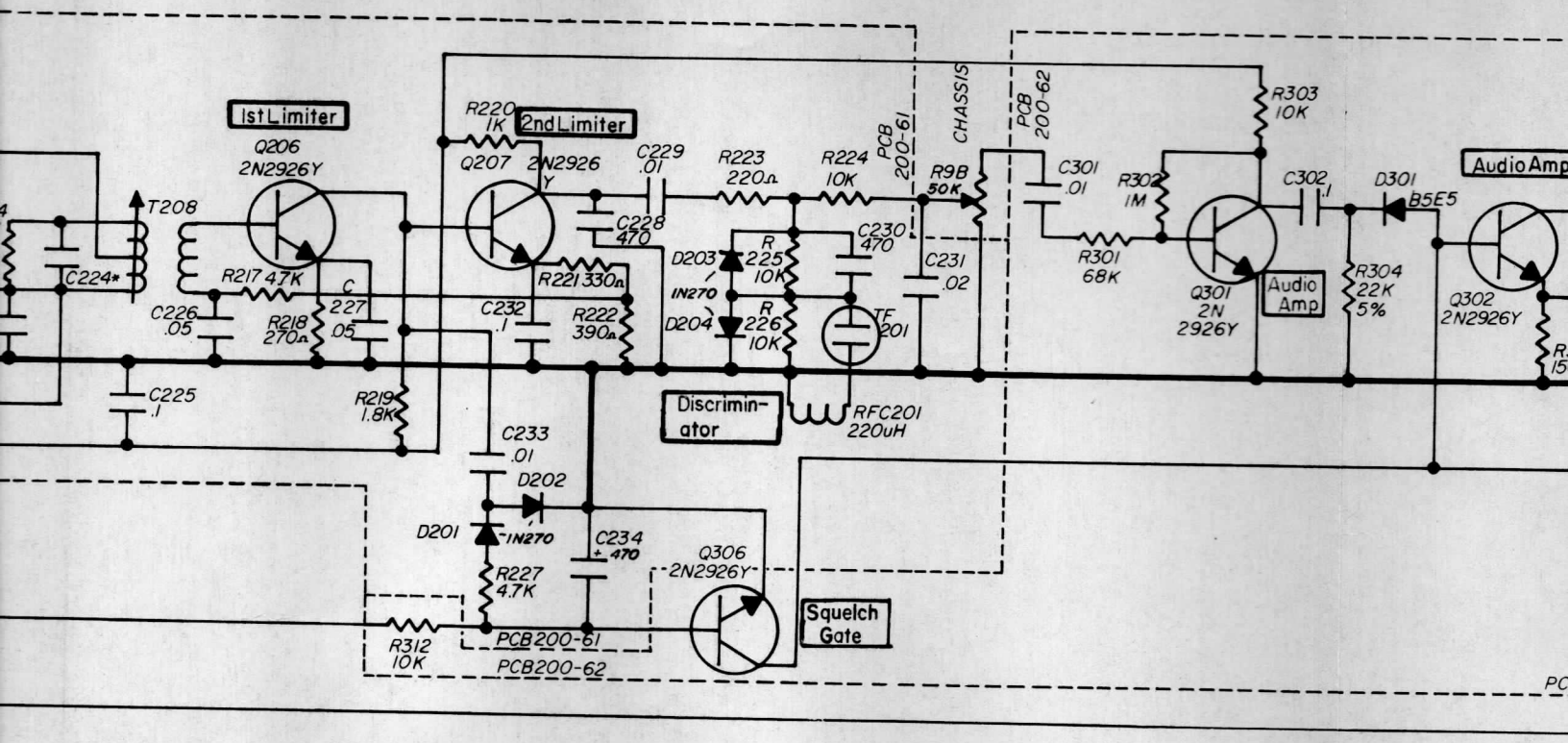
NOTES:

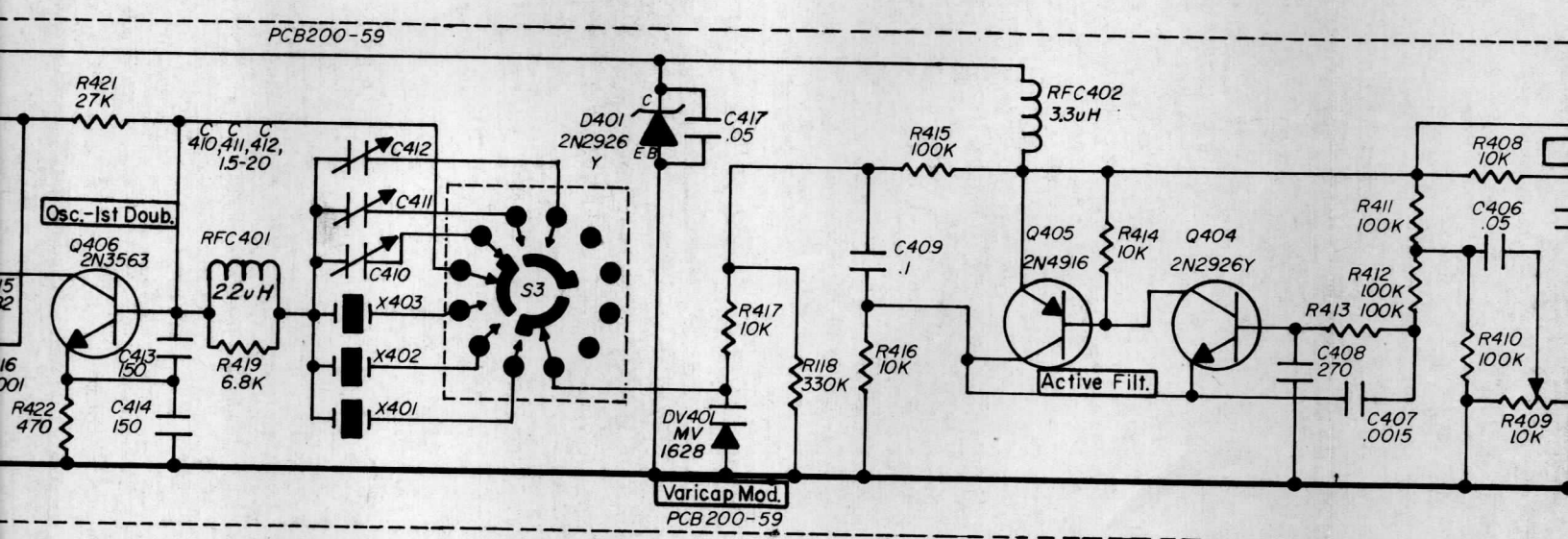
1. All switchs shown in max. CCW position
2. * - Capacitors are integral part of respective transformer assembly. Non-replaceable independently.
3. FS. - Factory Selected values

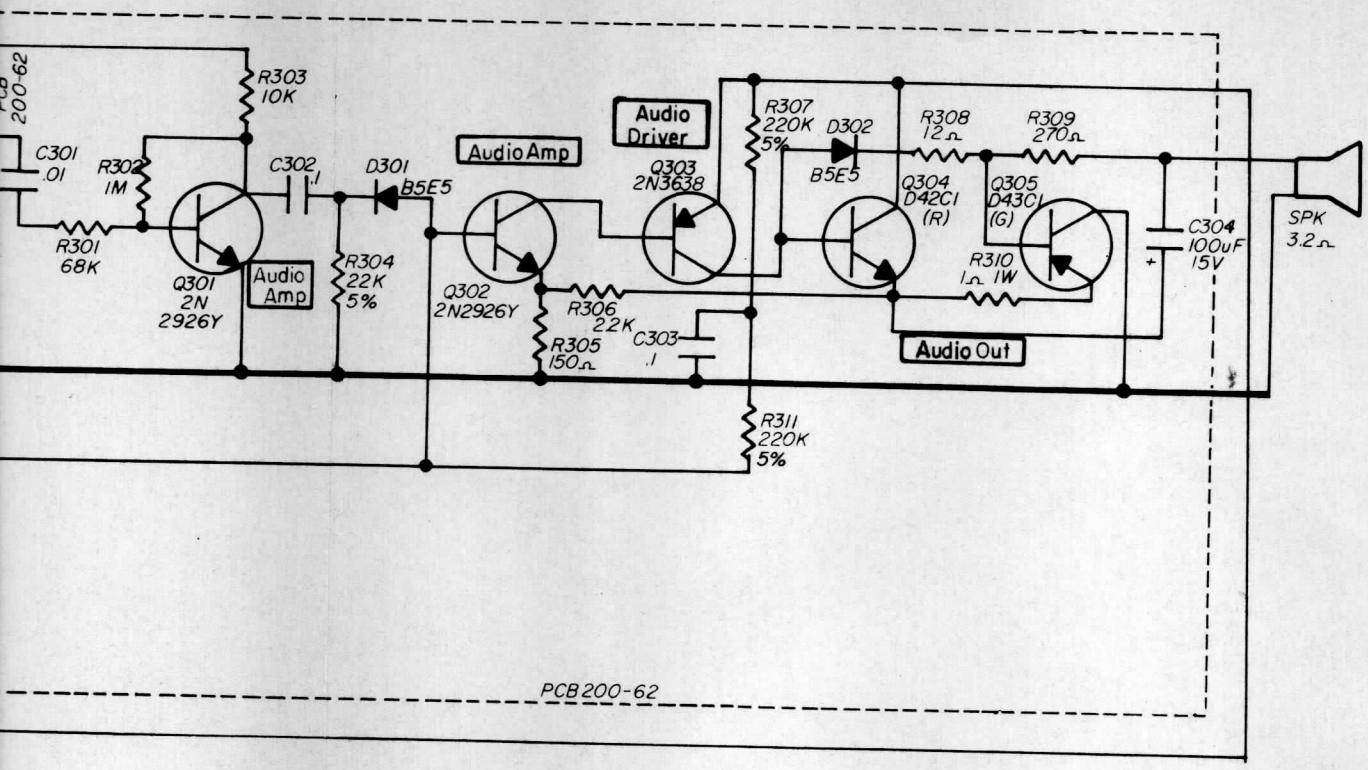
GALAXY FM 210 SCHEMATIC DIAGRAM

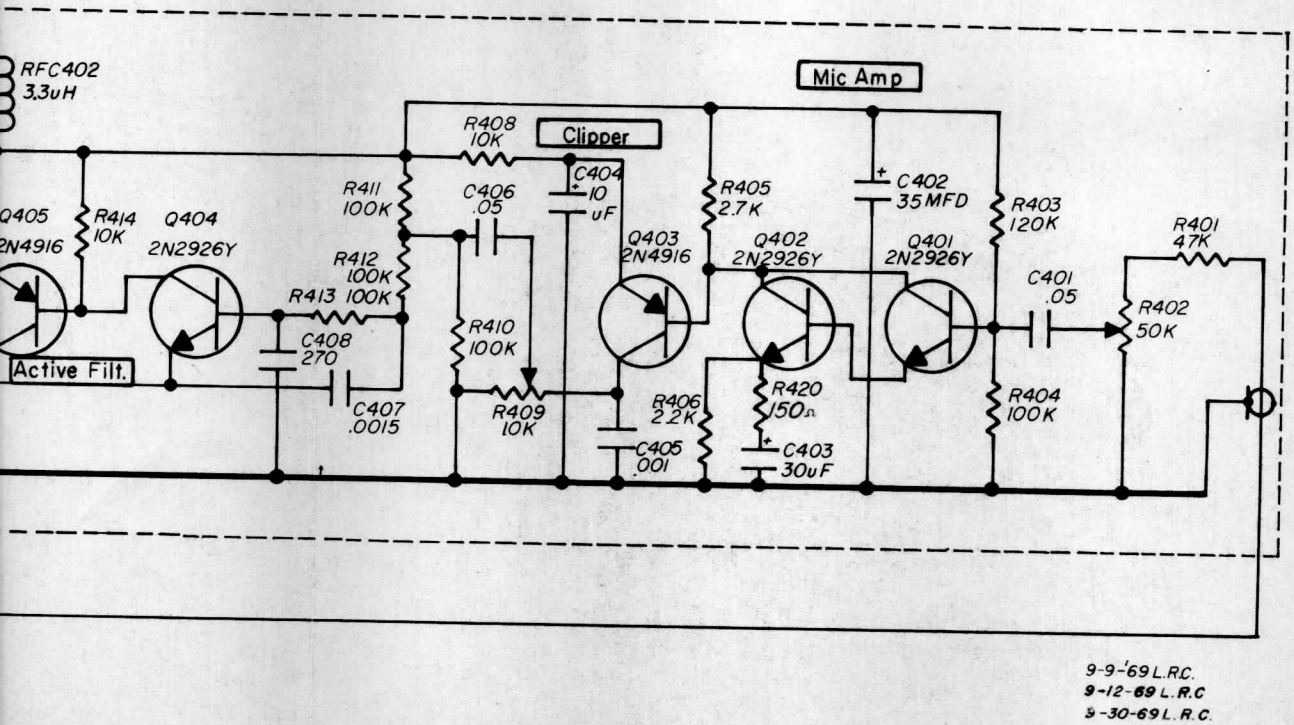


MFD. BY GALAXY ELECTRONICS
10 SO. 34 ST.
COUNCIL BLUFFS, IOWA
51501


1st Limiter
Q206 2N2926Y
T208
C224*
R217 47K
C226 .05
R218 270Ω
C 227 .05
C225 .1
R219 1.8K
R220 1K
2nd Limiter
Q207 2N2926Y
C229 .01
R223 220Ω
R224 10K
C228 470
R221 330Ω
C232 .1
R222 390Ω
D203 IN270
D204
R 225 10K
R 226 10K
C230 470
TF 201
C231 .02
R9B 50K
PCB 200-61
CHASSIS
PCB 200-62
C301 .01
R301 68K
R302 1M
R303 10K
Q301 2N 2926Y
Audio Amp
C302 .1
D301 B5E5
R304 22K 5%
Audio Amp
Q302 2N2926Y
Discrimin-ator
RFC201 220uH
C233 .01
D202
D201 IN270
C234 ± 470
R227 4.7K
Q306 2N2926Y
Squelch Gate
R312 10K
PCB200-61
PCB200-62


PCB200-59
R421 27K
C 410
C 411
C 412, 1.5-20
Osc.-1st Doub.
Q406 2N3563
RFC401 2.2uH
C413 150
R419 6.8K
R422 470
C414 150
C412
C411
C410
X403
X402
X401
S3
D401 2N2926 Y
C417 .05
R417 10K
DV401 MV 1628
Varicap Mod.
PCB200-59
R415 100K
C409 .1
R118 330K
R416 10K
RFC402 3.3uH
Q405 2N4916
R414 10K
Q404 2N2926Y
Active Filt.
R411 100K
R412 100K
R413 100K
C408 270
C407 .0015
R408 10K
C406 .05
R410 100K
R409 10K





9-9-'69 L.R.C.
9-12-69 L.R.C
9-30-69 L.R.C.