TM 11-856A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVER R-390A/URR

DEPARTMENT OF THE ARMY – JANUARY 1956

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 240-volt power supply and circuits that are connected to it, or on the 115/230-volt ac line connections. Before connecting the receiver to an ac source, be sure that the chassis is connected to the same ground as the ac source.

Technical Manual
No. 11-856A

Department of the Army
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RADIO RECEIVER R-390A/URR

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains information for the installation, operation, maintenance, and repair of Radio Receiver R-390A/URR (fig. 1). Throughout this manual, Radio Receiver R-390A/URR is referred to as the receiver.

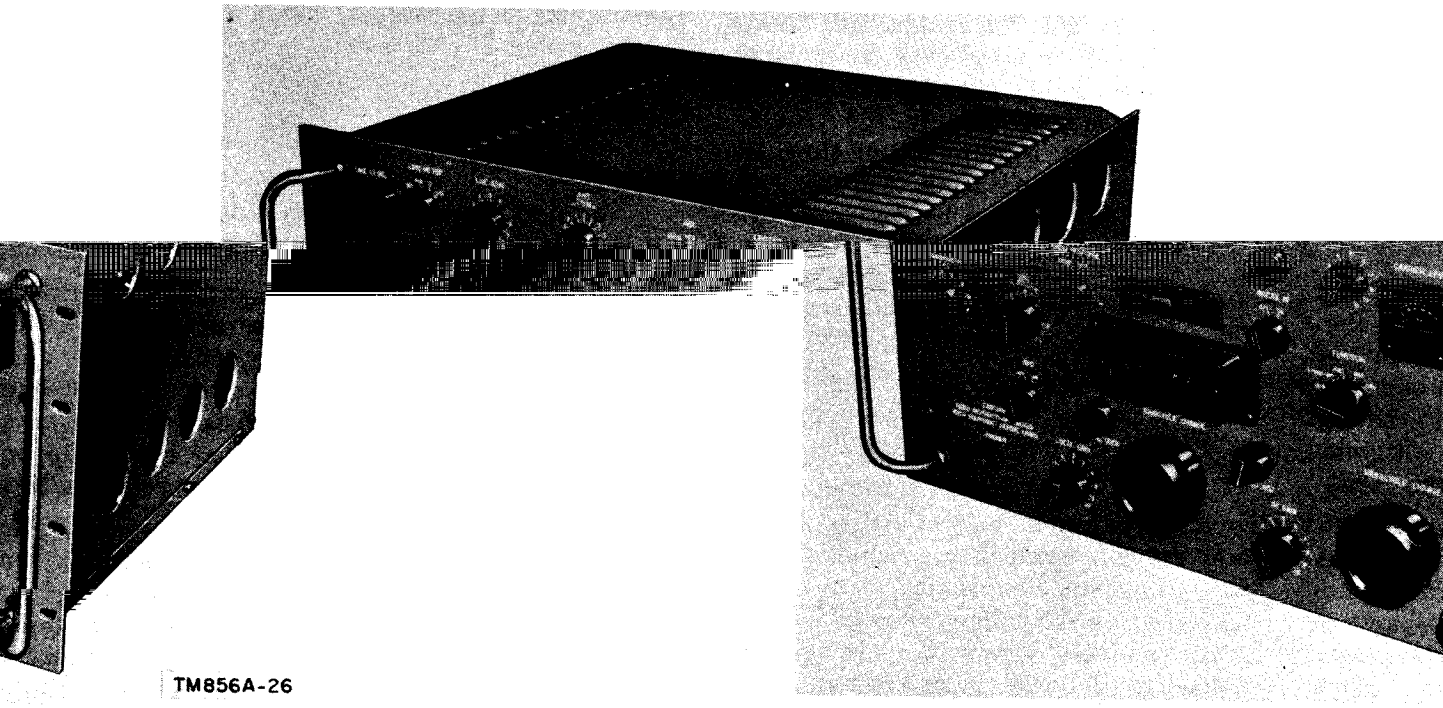
b. Forward comments on this publication directly to Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey.

2. Forms and Records

a. Unsatisfactory Equipment Reports.

(1) DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

(2) DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as pre-



URR.

Figure 1. Radio Receiver R-390A/

scribed in SR 700-45-5 and AF TO 00-35D-54.

b. Damaged or Improper Shipment. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

c. Preventive Maintenance Forms.

(1) DA Form 11-238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 13).

(2) DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 14).

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. The receiver (fig. 1) is a high-performance, exceptionally stable, general-purpose receiver for use in both fixed and mobile service. The receiver provides reception of continuous-wave (cw), modulated-continuous-wave (mcw), amplitude-modulated (am), frequency-shift keyed (fsk), and single-sideband (ssb) signals within a frequency range of .5 to 32 megacycles (mc). In this receiver, the radio-frequency (rf), intermediate-frequency (if), audio-frequency (af), oscillator and power-supply circuits are situated on individual removable subchassis (fig. 56 through 72) mounted on a front panel and main frame assembly (fig. 74). These subchassis can be removed readily for trouble shooting and repair in a minimum of time, by the use of ordinary hand tools. All the subchassis can be interchanged between any receivers bearing the same model number.

sideband reception system, an external agc circuit may be substituted for the internal control circuit. Connections are also provided for external manual rf gain control; however, when using only the receiver for single-sideband reception, manual gain control of the receiver should be used rather than automatic gain control. A break-in relay for disabling the receiver circuits is operated by grounding a terminal provided at the rear of the receiver.

d. The calibration of the receiver is accurate to within 300 cycles per second, an accuracy that permits use of the receiver as an accurate frequency meter.

4. System Application

a. Space-diversity Receiving System.

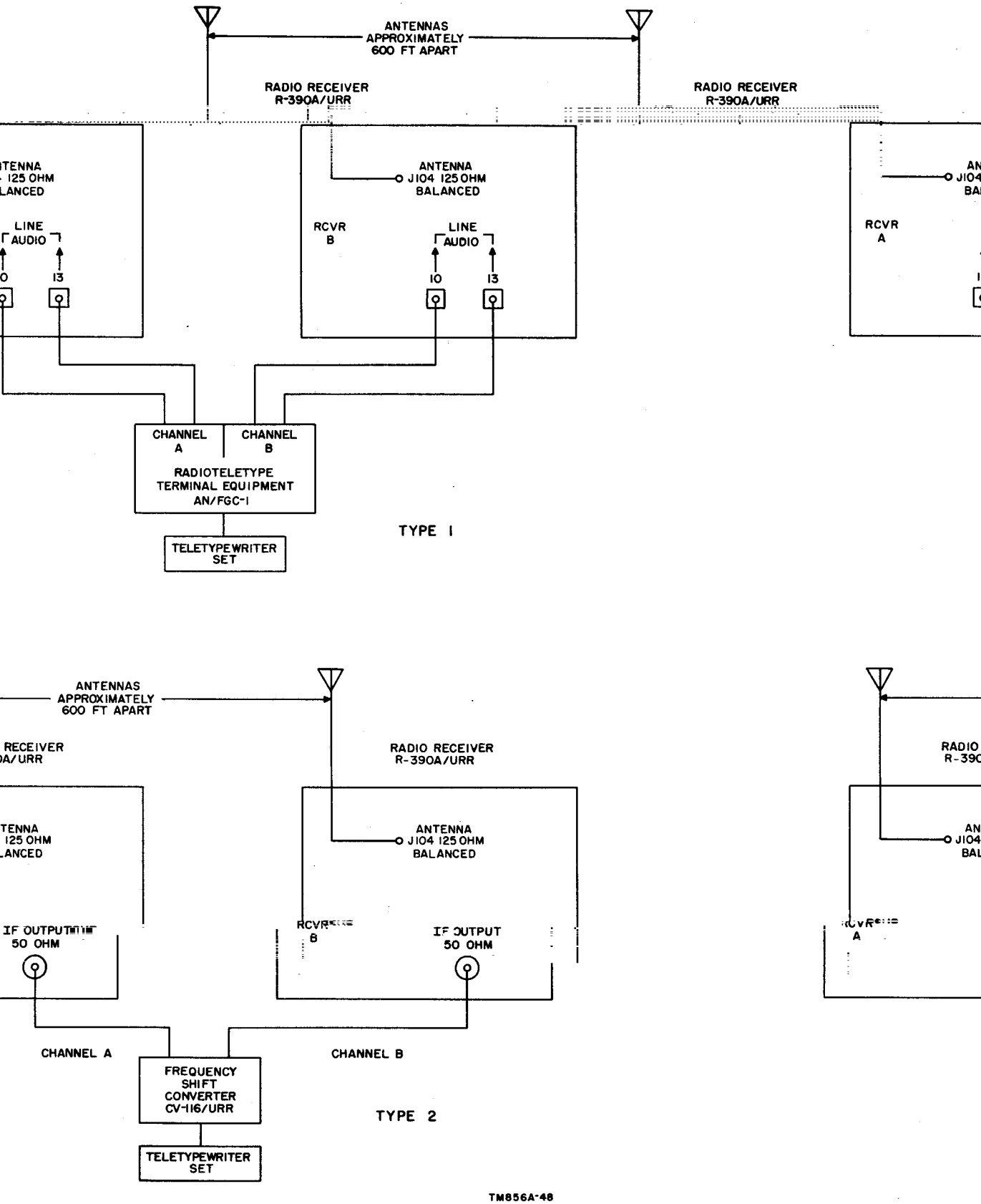
(1) Two or three receivers can be connected as a space-diversity receiving system for reception of voice signals

contacts. The outputs taken from the LINE AUDIO outputs of the receivers are applied to Radioteletype Terminal Equipment AN/FGC-1, which provides diversity combining and produces direct current (dc) signals for operation of teletypewriter equipment. The receivers are connected for operation as described in paragraph 16. Use of parallel-connected agc circuits (par. 3*c*) provides improved signal-to-noise ratio.

c. Space-diversity Radioteletype System. Type 2. Two receivers also can be used in the type of space-diversity radioteletype system shown in the lower half of figure 3. The doublet or rhombic antennas feed the incoming frequency-shift signals to the receivers, where the carrier frequency is converted to a 455-kilocycle (kc) intermediate frequency. This if signal, taken from the 50-ohm if output circuit of the receivers, then is fed to Frequency Shift Converter CV-116/URR, which provides diversity combining and produces dc pulses for operation of teletypewriter equipment. The receivers are connected for operation as described in paragraph 16. Use of parallel-connected agc circuits (par. 3*c*) provides improved signal-to-noise ratio.

d. Single-sideband Radioteletype System.

(1) A receiver and a Single Sideband Converter CV-157/URR may be connected as shown in figure 4. This system permits the reception of single-sideband signals occupying 12 kc of rf spectrum space divided into two 6-kc sidebands on both sides of a reduced carrier; or, a double-sideband signal, either amplitude-modulated or phase-modulated (pm), occupying up to a total of 12 kc of spectrum space can be received. If phase modulation is received, the deviation cannot exceed an average of 1 radian. This system is used primarily for the reception of multi-channel radioteletype transmissions. For additional information, see TM 11-649, Radio Receiving Sets AN/FRR-40 and AN/FRR-41.



. Two space-diversity radioteletype systems, block diagram.

Figure 3

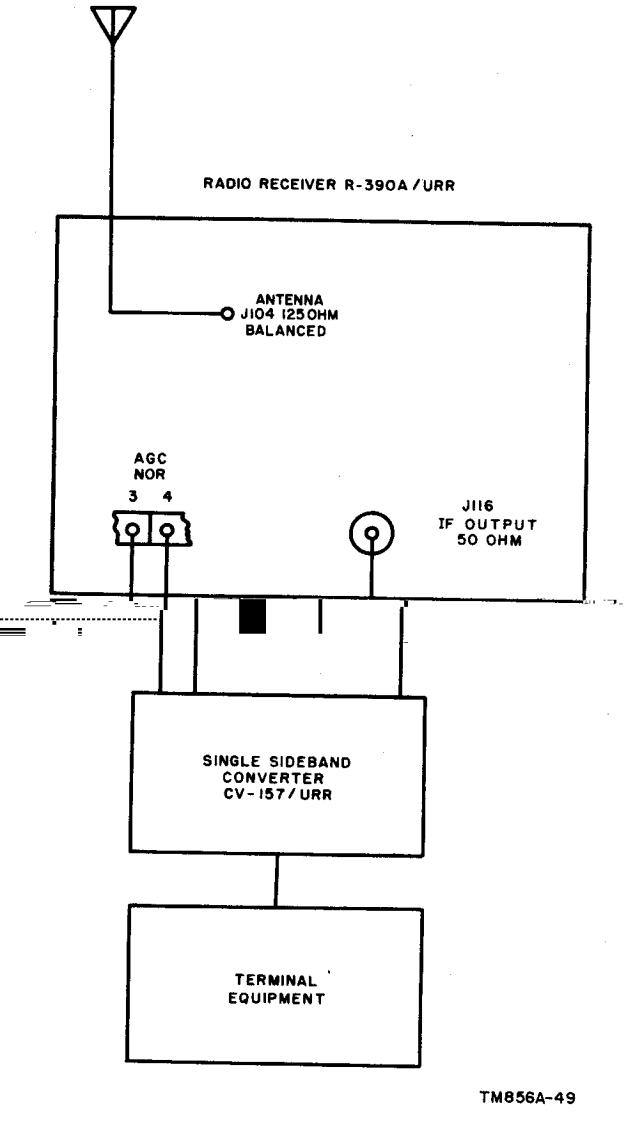


Figure 4. Single-sideband radioteletype system, block diagram.

(2) The 455-kc if output of the receiver is fed to Single Sideband Converter CV-157/URR, which heterodynes the if signal to 100 kc. The 100-kc signal is amplified and fed through highly selective filter circuits to separate the upper sideband, lower sideband, and carrier components of the original signal. The upper and lower sidebands are fed to individual detectors to recover the low-frequency (lf) intelligence that is fed to terminal equipment. The carrier component is used for automatic frequency control (afc) in the converter.

(3) The converter has provision for generating agc voltage from the carrier, upper sideband, lower sideband, or both the upper and lower sidebands, and feeding it back to the receiver. In addition, means are provided for restoring the original agc voltage of the receiver.

5. Technical Characteristics

Type of circuit	Triple-conversion superheterodyne on frequency bands; double-conversion dyne on all other bands.
Frequency range	0.5 to 32 mc.
Types of signals received	A1, cw; A2, mcw; A3, voice; A9, single frequency-shift keying.
Type of tuning	Continuous; frequency read directly on indicator.
Method of calibration	Built-in crystal-controlled.
Calibrator points	Ever
Audio power output:	
600-ohm unbalanced line	500
600-ohm balanced line	10 m
Headphones	1 mv
If selectivity	100
Intermediate frequencies:	
First variable if (used on eight lowest frequency bands)	17.5
Second variable if (used on all bands)	2.5 t ba
Third (fixed) if	455
Power source	115/
Power input:	
115/230 volts ac	225 tu
Number of tubes	26
Antennas:	
Unbalanced	Strai wi
Balanced	125- 20 by
Temperature range	-40°
Altitude	Up t
Weight	75 l
Range of vfo	3.45

eight lowest superhetero-

sideband; F1,

counter-type

v 100 kc.

mw, minimum.
w, minimum.
v, minimum.
cps to 16 kc bandwidth in six steps.

to 25 mc.
o 2 mc on lowest band; 3 to 2 mc on all other nds.
kc.
230 volts ac ±10%, 48 to 62 cps.

watts total; 140 watts with OVENS switch rned to OFF.
including current-regulator tube RT510).

ight-wire of random length or vehicular-mounted nip.
ohm terminating impedance; matches 50- to 0-ohm balanced or unbalanced transmission lines using adapters.
C (-40° F) to 65° C (149° F).
o 10,000 ft. above sea level.
.
5 to 2.455 mc.

6. Table of Components

Component	*Required No.*	*Height (in.)*	*Width (in.)*	*Depth (in.)*	*Volume (cu ft)*	*Unit wt (lb)*
Receiver	1	10–15/32	19	16–19/32	2	7
Technical manuals	2					2
Set of running spares	1					1
Total weight (lb)						80

Note. This list is for general information only. See appropriat of spare

e supply publications for information pertaining to requisition parts.

7. Description of Radio Receiver R-390A/URR

a. The receiver (fig. 1) is a 26-tube, superheterodyne receiver for reception of cw, voice, and radioteletype signals with a frequency range of .5 to 32 mc. The receiver is designed for mounting in a standard 19-inch rack, such as Electrical Equipment Cabinet CY-1119/U.

b. All operating controls are located on the front panel (fig. 11), which has a gray semigloss finish. Two handles are provided at the outer edges of the panel to aid in the removal of the receiver from the rack or case. The MEGACYCLE CHANGE and KILOCYCLE CHANGE controls are used to tune the receiver to the desired frequency. A counter-type frequency indicator shows the frequency in kilocycles. A LINE LEVEL meter is used to indicate the level in volume units (vu) of the line audio output of the receiver. The CARRIER LEVEL meter indicates the relative strength of the incoming signal. There are 15 bar knobs that control various functions of the receiver. The PHONES jack is used to connect a pair of headphones to the receiver local audio output.

c. On the rear panel of the receiver (fig. 12) are mounted special tools, antenna input connectors, an operating and a spare fuse, a power cord, an if output connector, an OVENS switch, and terminal strips for the connection of external circuits.

8. Description of Cases and Cabinets Used With Radio Receiver R-390A/URR

Two cases and two rack-type cabinets (not supplied) are available for use with the receiver. In addition, the receiver may be mounted in any standard 19-inch rack, if adequate ventilation is furnished. In mobile installations, the weight of the receiver must be supported at the rear of the main frame rather than by the front panel alone.

a. Cabinet CY-917/URR. This is a lightweight, table-top cabinet for general fixed-station use.

b. Cabinet CY-979/URR. This case is constructed more rigidly than the CY-917/URR, and has shock-absorbing mountings for mobile, table-top installations.

c. Electrical Equipment Cabinet CY-1119/U. This cabinet is a floor-mounted, rack-type installation for fixed-station use. Shelf-type angle brackets permit installation of the receiver by one man.

d. Electrical Equipment Cabinet CY-1216/U. This cabinet is of rugged construction and includes shock-absorbing mountings for mobile installations. When either electrical equipment cabinet is used with more than one receiver, always use a 1¾-inch or larger blank strip between the receivers for adequate ventilation.

Caution: When the receiver is installed in any case other than those described above, *adequate ventilation* must be provided. The receiver must be supported in the manner provided in Cabinet CY-979/URR and Electrical Equipment Cabinet CY-1216/U. For mobile applications of the receiver in cabinets other than Cabinet CY-979/URR and Electrical Equipment Cabinet CY-1216/U, support must be provided at the rear and bottom of the receiver, so that the front panel does not carry the entire weight. The recommended cabinets have dowel pins that engage holes at both rear lower corners of the receiver (fig. 12) and provide the required support.

9. Running Spares

A group of running spares is furnished with each receiver. The following is a list of running spares:

1 tube, type OA2.
1 tube, type 3TF7.
1 tube, type 6AK6.
1 tube, type 6C4.
1 tube, type 6DC6.
1 tube, type 26Z5W.
1 tube, type 5654/6AK5W.
2 tubes, type 5749/6BA6W.
2 tubes, type 5814A.
5 fuses, 3-ampere, 125-volt.
1 dial lamp, 6 volts, .2 ampere.

10. Additional Equipment Required

The following material is *not* supplied as a part of Radio Receiver R-390A/URR, but is required for its operation. The connectors required will depend on the particular installation. Also refer to paragraph 15.

Antenna:	
Balanced	Doublet or rhombic.
Unbalanced	Random-length straight-wire or whip.
Low-impedance transmission line:	
Balanced	50 to 200 ohms.
Unbalanced	70-ohm coaxial cable.
Connector	Connector Plug PL-259 or Connector Plug UG-573/U.
Headset	Headset Navy type CW-49507 or equivalent 600-ohm headset.
Cord	Headset Cord CX-1334/U, or equivalent.
Loudspeaker	600 ohms.
Adapter Connector UG-970/U	Adapts Connector Plug PL-258 on unbalanced antenna lead-in to balanced antenna input.
Adapter Connector UG-971/U	Adapts Connector Plug UG-573/U on unbalanced antenna lead-in to balanced antenna input.

Note. In adapting an unbalanced transmission line to the BALANCED ANTENNA input, use Connector Plug UG-573/U in combination with Adapter Connector UG-971/U wherever possible.

CHAPTER 2
INSTALLATION

11. Sitting Considerations

a. External Requirements.. The tactical situation and local conditions usually indicate the general area where this receiver is to be used. When locating the antenna within the general area, observe the following:

(1) Radio signals are absorbed and sometimes reflected by nearby obstructions such as hills, metal buildings and bridges, or leafy vegetation that extends above the height of the antenna. Transmitted signals have a greater range when the antenna is as high above ground as possible. Transmission and reception is best over water, or level or gently rolling ground.

(2) Enemy jamming action against the receiver is always a possibility. The effects of enemy jamming may be reduced by locating the antenna so that nearby obstructions act as a screen in the direction of probable sites of enemy jamming transmitters. This screening action may also reduce the transmitted signal strength in a direction toward the enemy, thereby making it more difficult for the enemy to intercept signals or to locate the transmitter by direction finding methods.

(3) If transmission and reception in all directions are required, place the antenna on the highest hill within the designated area.

(4) When possible, avoid locating the antenna near sources of electrical interference such as power or telephone lines, radar sets, and field hospitals.

(5) Where possible to do so, try several locations within the general area and select the one that provides the best signals from the desired stations, and for the best screening from the enemy.

b. Internal Requirements.

(1) For fixed service, mount the receiver in Electrical Equipment Cabinet CY-1119/U in Cabinet CY917/URR, or in a standard rack.

(2) For mobile use, mount the receiver in Electrical Equipment Cabinet CY-1216/U, or in Cabinet CY-979/URR. The shelter used must provide complete protection from the weather.

(3) Always provide adequate ventilation *(par. 14)*.

12. Unpacking

a. Packaging Data. When packed for shipment, the components of the receiver are placed in a water-vaporproof container and packed in a wooden crate. An exploded view of the shipping crate and its contents is shown in figure 6. The dimensions of the crate are approximately 24¼ inches high, 20½ inches wide, and 14¾ inches deep. It weighs approximately 99.76 pounds, with a volume of approximately 3.89 cubic feet.

b. Removing Contents.

(1) Place the packing case as near the operating position as is convenient.

(2) Cut and fold back the metal straps.

(3) Remove the nails with a nail puller. Remove the top and one side of the wooden case if the receiver cannot be lifted out.

(4) Remove the desiccant bags, the cardboard tray, and the plywood board.

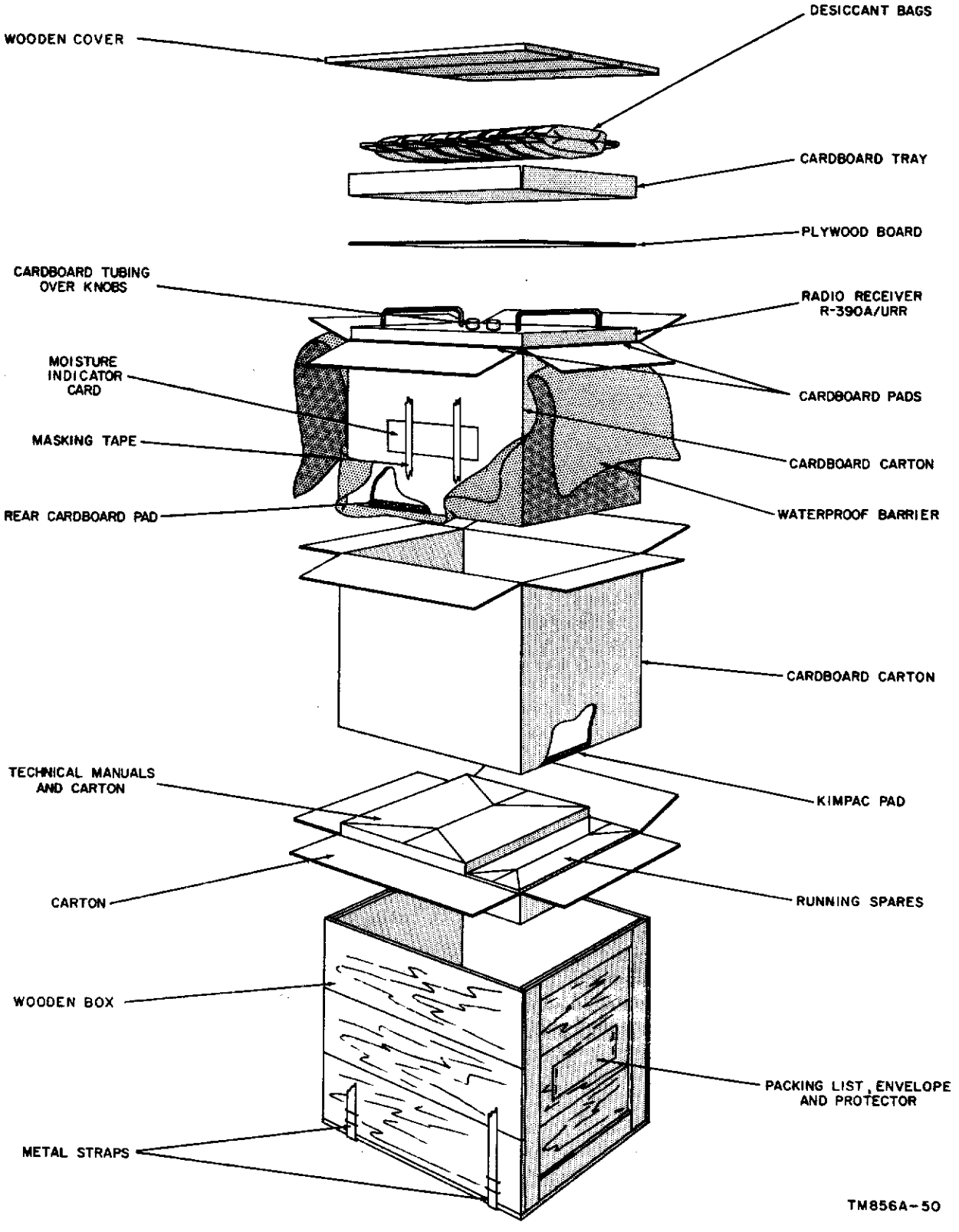


Figure 6. Packaging details.

(5) Take out the sealed cardboard carton containing the receiver.

(6) Open the carton and withdraw the inner carton that is inclosed in the moisture-vaporproof barrier.

(7) Slit open the seams of the vaporproof barrier and open the inner carton.

(8) Remove any spacers or pad the inner carton.

(9) Withdraw the receiver from the carton, and place it on a work bench or near its final location.

(10) Remove the technical manual and running spares.

g. Inspect for bent or broken connectors and terminals on the rear panel. See that the special tools are in place in their holder. See that the spare fuse is of proper rating and is tipped firmly to the rear panel.

h. Check the contents of the box that contains the running spares for damaged parts.

13. Checking

Note. For used or reconditioned equipment, refer to paragraph 17.

a. Check the contents of the cartons against the master packing slip.

b. Check the front panel of the receiver for damage to the knobs or the glass windows of the meters and the frequency indicator dial.

c. Operate the control knobs; examine them for looseness. Operate the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls throughout their range. Rough or binding indicates a damaged tuning

d. Remove the top and bottom dust covers by removing the 16 screws and lock washers that secure the covers to the main frame.

e. Inspect the subchassis on the upper and lower decks of the receiver for loose tubes and broken tubes. See that all connectors are seated firmly; loose connectors are a common cause of improper operation in radio equipment. If the receiver is to be used in a fixed installation, remove the shields from all tubes except V201, V202, V203, V204, V205, V206, and V701. Refer to figures 15 and 16 for the locations of these tubes. Unless extremely dusty conditions are expected, do not replace the dust covers. Do not replace the dust covers when the receiver is to be installed in Cabinet CY-979/URR or in Cabinet CY-917/URR.

f. Remove the fuse on the rear panel. See that it is of the proper value. If the receiver is to be operated from a 115-volt source with the OVEN switch in the OFF position, replace the AC 3 AMP fuse with a 2-ampere fuse. This provides maximum overload protection for the receiver. If the receiver is to be operated from a 230-volt power source with the OVENS switch ON, use a 1½-ampere fuse; use a 1-ampere fuse with the OVENS switch at OFF.

Caution: To avoid serious damage to the receiver, do not use any fuse other than the value specified.

14. Installation of Radio Receiver R-390A/URR

a. Antenna. The receiver is normally used with rhombic, doublet, or double-doublet antennas. For information on the rhombic and doublet antennas, refer to TM 11-666, Antennas and Radio Propagation. For information on the double-doublet antenna, refer to TM 11-2629, Antenna Kit for Double-Doublet Receiving Antenna.

b. Receiver. The receiver is shipped with all tubes, crystals, and the fuse in place. Instructions for installing the receiver for fixed and mobile use are listed in (1) through (4) below. If the radio receiver is used as part of a system, refer to the system technical manual for exact instructions on connections.

(1) *Fixed, table-top installation.* When housed in Cabinet CY-917/URR or a similar well-ventilated case for fixed operation, place the receiver on any sturdy table or bench. Install the receiver without the top and bottom dust covers and without the tube shields according to the instructions in paragraph 13*e*.

(2) *Fixed, cabinet installation.* To install the receiver in a standard cabinet, such as Electrical Equipment Cabinet

CY-1119/U, remove the top and bottom dust covers of the receiver. Remove one of the blank panels from the cabinet and install the receiver. Secure the front panel to the cabinet with the bolts removed from the blank panel. Insert them in the elongated holes located along the vertical edges of the receiver front panel (fig. 11).

(3) *Mobile, table-top installation.* When the receiver is housed in Cabinet CY-979/URR for mobile operation, securely bolt the case to a table or shelf that is fastened rigidly to the vehicle. Allow space for ventilation, for access to the connections on the back panel, and for withdrawal of the receiver from the case for servicing. To install the receiver in Cabinet CY-979/URR, first remove the top and bottom dust covers of the receiver.

(4) *Mobile, cabinet or rack installation.* When the receiver is installed in Electrical Equipment Cabinet CY-1216/U for mobile operation, securely bolt the cabinet to the vehicular body.

(5) *Ventilation.* In all types of installation, *provide as much ventilation as possible.* Do not operate the receiver with the dust covers in place unless extremely dusty or sandy conditions exist. For table-top cabinets, remove the dust covers before the receiver is installed. In fixed installations, operate the receiver with the tube shields removed (par. 13*e*). This will reduce the bulb temperature of the tubes and will prolong tube life. Wherever possible, allow space at the back of the cabinet or rack to allow for circulation of air.

(6) *Support.* For mobile installations, provide support for the lower rear of the receiver. This support is furnished in the cabinets listed in (3) and (4) above. When other cabinets are used, use the mounting holes that are provided at the rear of the receiver. Dowel pins may be inserted into them to hold the receiver securely. Figure 12 shows the dimensions required when installing the dowel pins in the cabinet.

15. Connections

Each receiver is shipped with jumpers between terminals 1 and 2, 3 and 4, 11 and 12, and 14 and 15. These four jumpers are required for normal operation.

Warning: The voltages used are high enough to endanger human life. To prevent shock hazard for personnel touching outside metallic parts of the receiver, connect GND terminal 16 (fig. 12) to the same ground as the ac power source. Do not depend on the front-panel mounting screws for a ground connection. Do not use the antenna transmission line shield for the chassis ground.

Caution: Check to see that TB801 is connected for the correct ac voltage (fig. 7). This terminal board can be reached when the power-supply subchassis is removed from the bottom of the receiver (par. 128). See figure 72 for the locations of TB801 and J811.

a. Power Input (fig. 7 and 8). For 115- or 230-volt, 48- to 62-cps operation, plug the ac power cord into the ac power source.

b. Antenna. Figure 9 shows the method of connecting coaxial connectors to the coaxial cable. The antenna is connected to either the UNBALANCED or the BALANCED ANTENNA connector (fig. 12) as follows:

(1) *UNBALANCED ANTENNA connector, J103.* When a whip antenna is to be used for vehicular installations or a random length wire is to be used in fixed installation, connect the lead-in to the UNBALANCED ANTENNA connector by means of Connector Plug UG-573/U. The whip antenna lead-in should be as short a length as possible of Radio Frequency Cable RG-8/U or RG-11/U.

(2) *BALANCED ANTENNA connector J104.* The BALANCED ANTENNA connector furnishes input to the receiver through a tuned antenna transformer. This connector is used for all balanced antennas, such as the doublet, and should be used for balanced, low-impedance transmission lines. Connect the balanced Radio Frequency Cable RG-22/U, from

50- to 200-ohm balanced antennas to J104 with Connector Plug UG-421/U, or, when Radio Frequency Cable RG-86/U transmission line is used, use Connector Plug UG-969/U. Two right-angle adapters (fig. 10) are available for connecting unbalanced coaxial cable to the BALANCED ANTENNA connector. When unbalanced coaxial lead-in is terminated in Connector Plug PL-259, use Adapter Connector UG-970/U to connect it to the BALANCED ANTENNA connector. When unbalanced coaxial lead-in is terminated in Connector Plug Connector UG-573/U, use Adapter Connector UG-971/U to connect it to the BALANCED ANTENNA connector. Adapter Connector UG-971/U and Connector Plug UG-572/U are preferred and should be used when available. Connect a whip antenna through Connector Plug UG-573/U directly to the UNBALANCED ANTENNA connector.

c. Audio Output (fig. 8).

(1) A 600-ohm headset or speaker may be connected as indicated below:

(*a*) Insert the headset plug into the PHONES jack (fig. 11) or connect the headset between PHNS terminal 8 and ground, terminal 7 (fig. 12).

(*b*) Connect the loudspeaker between LOCAL AUDIO terminals 6 and 7 on the rear panel.

(2) A 600-ohm balanced line for telephone and similar applications may be connected as follows:

(*a*) For normal balanced-line operation, connect the line between LINE AUDIO terminals 10 and 13 on the rear panel. Do not remove the jumper from terminals 11 and 12.

(*b*) If a balancing bridge is to be used for long-distance line applications, remove the jumper from terminals 11 and 12 on the rear panel and connect the bridge between these terminals. Connect the balanced line between terminals 10 and 13.

d. Auxiliary Connections (fig. 12).

(1) *Break-in relay.* Connection to the break-in relay is completed through GND terminal 16 and BRK IN terminal 9 on the rear panel. The break-in relay operates to disable the receiver when the BREAK IN switch is set at ON and terminal 9 is grounded remotely.

(2) *External diode load.* DIODE LOAD terminals 14 and 15 on the rear panel provide detector diode-load combining for diversity reception. Connect together terminals 14 and 15 for normal receiver operation.

(3) *External rf gain control.* For external rf gain control of the receiver, disconnect the internal RF GAIN control at the terminal strip on the rear panel and connect externally a 5,000-ohm potentiometer. To substitute the external control for the internal RF GAIN control, remove the jumper between RF GAIN terminals 1 and 2 on the rear panel and connect the external control between terminal 1 and terminal 7 (ground), or between terminal 1 and terminal 16 (GND).

(4) *Agc circuit.* For external agc of the receiver, remove the jumper between AGC NOR terminals 3 and 4 on the rear panel, connect the negative terminal of the source to terminal 4, and connect the other terminal of the source to terminal 7 (ground).

16. System Connections

To improve the signal-to-noise ratio for diversity use, make the common agc connections as shown in figure 2. Move the jumpers from terminals 3 and 4 on each receiver to terminals 4 and 5. Connect together the No. 4 terminals.

a. Space-diversity Reception of Voice Signals. To connect two Radio Receivers R-390A/URR for space-diversity reception of voice signals, proceed as follows:

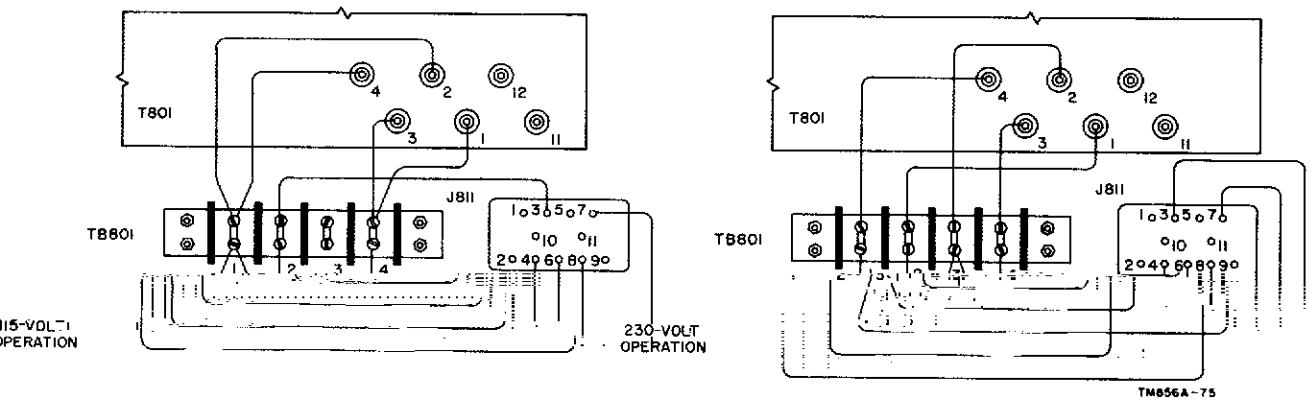


Figure 7. Connections for 115-volt or 230-volt operation.

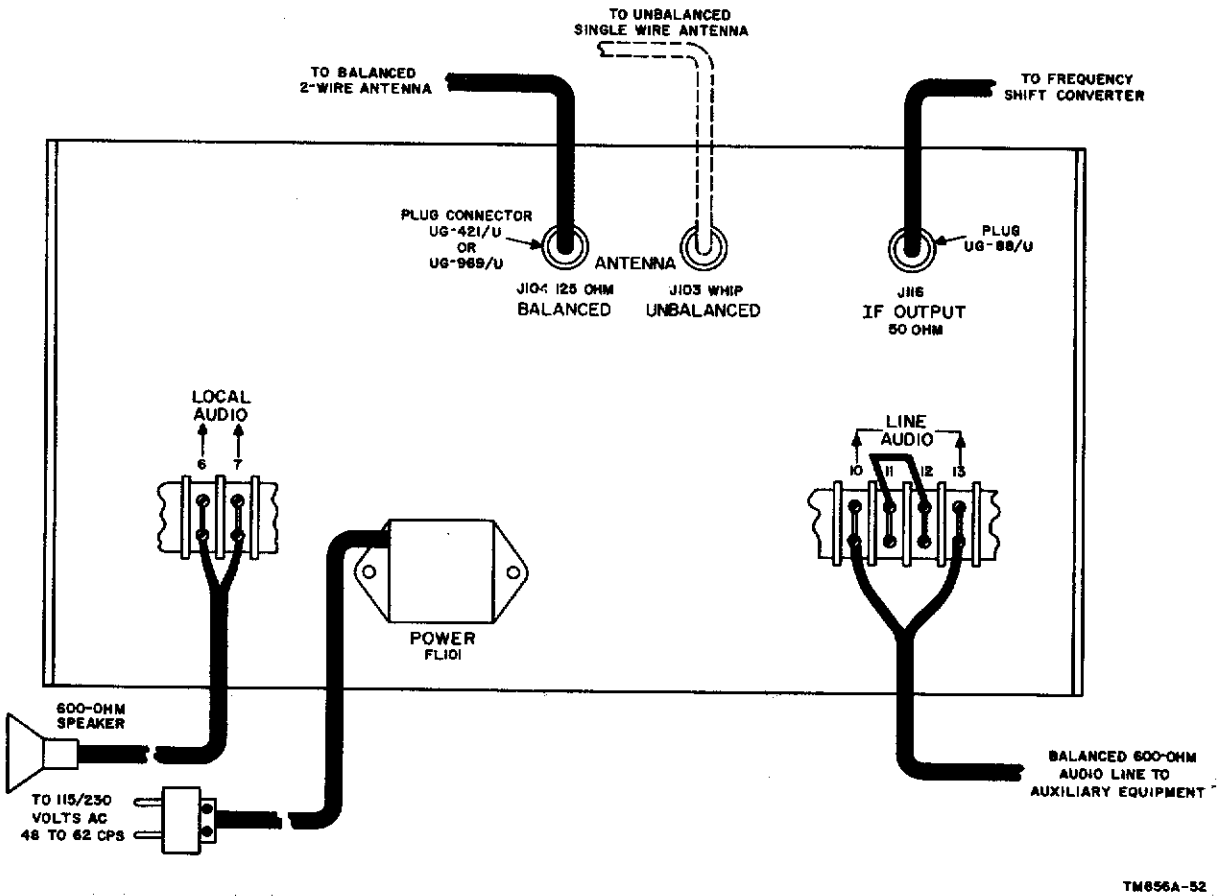


Figure 8. Radio Receiver R-390A/URR, cording diagram.

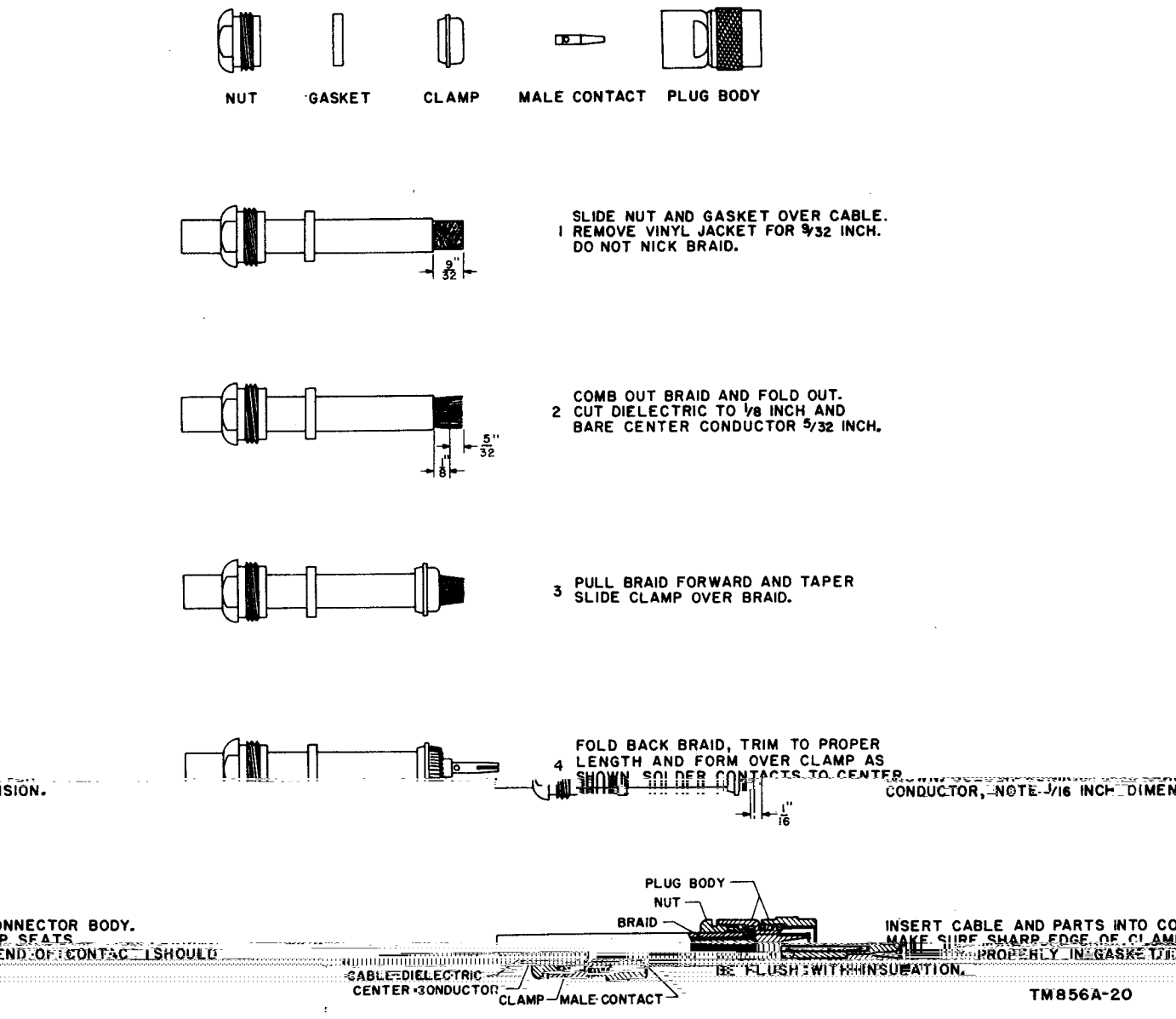


Figure 9. Assembly of Connector Plug UG-573/U to coaxial cable.

ormal on-

(1) Refer to paragraph 15 for normal on-

(1) Refer to paragraph 15 for no

al boards on the
eceivers as shown

(2) Connect LINE AUDIO terminals 10 and 13 of each receiver to the input of each channel in Radioteletype Terminal Equipment AN/FGC-1 as shown in

(2) Connect the termina
rear panels of both r
in figure 2.

re 3 as type 1.

of Radioteletype
Radio Receivers
ty recention of

c. Space-diversity Reception of Radioteletype Signals, Type 1. To connect two Radio Receivers R-390A/URR for space-diversity reception of radioteletype signals using the audio output of the receivers, proceed as follows:

the upper half of figur

c. Space-diversity Reception
Signals, Type 2. To connect two
R-390A/URR for space-diversi

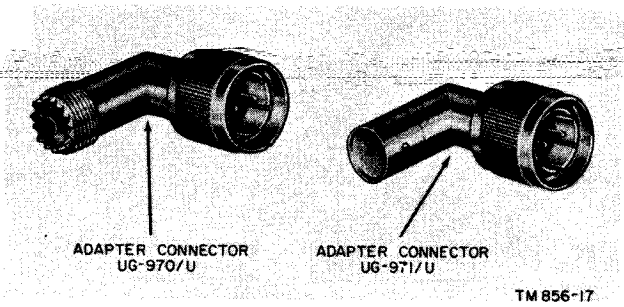


Figure 10. Adapter Connectors UG-970/U and UG-971/U.

radioteletype signals using the if outputs of the receivers, proceed as follows:

(1) Refer to paragraph 15 for normal operating and auxiliary connections for the desired mode of operation.

(2) Connect AGC NOR terminals 3 and 4 and the IF OUTPUT connector (J116) to the agc line terminals and the if input connector on Single Sideband Converter CV-157/URR as shown in figure 4. (A cable terminated in Radio Frequency Plug UG-88/U is required for connection to J116.)

17. Service Upon Receipt of Used or Reconditioned Equipment

(1) Refer to paragraph 15 for normal operating and auxiliary connections for the desired mode of operation.

(2) Connect the IF OUTPUT connector (J116) of each receiver to the input of each channel in Frequency Shift Converter CV-116/URR as shown in the lower half of figure 3. (A cable terminated in Radio Frequency Plug UG-88/U is required for connection to J116.)

d. Single-sideband Reception. To connect Radio Receiver R-390A/URR for the reception of multichannel radioteletype signals using Single Sideband Converter CV-157/URR, proceed as follows:

instructions in paragraphs 12*b*
ting, unpacking, and inspecting

ee whether the used or recon-
ent has been changed by a Modi-
er (MWO). If modified, the
appear on the front panel
e. Indicate the MWO number
iagram. (fig. 106).

EGACYCLE CHANGE and
ANGE controls for ease of
tion is required, refer to the
tions in paragraph 133.

installation and connection
paragraphs 14, 15, and 16.

a. Follow the
and 13 for uncra
new equipment.

b. Check to s
ditioned equipme
fication Work Orde
MWO number will
near the name plate
on the schematic di

c. Check the MI
KILOCYCLE CHA
rotation. If lubrica
lubrication instruct

d. Perform the
procedures given in

CHAPTER 3
OPERATION

Section I. CONTROLS AND INSTRUMENTS

18. General

Haphazard operation or improper setting of the controls can result in poor reception. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in paragraphs 20 through 28.

19. Radio Receiver R-390A/URR Controls

(fig. 11 and 12)

The following table lists the controls of the receiver and indicates their function:

Control	*Function*
LINE LEVEL meter (M101)	Indicates level of balanced-line audio output.
LINE METER switch (S105)	In OFF position, disconnects LINE LEVEL meter from balanced-line output. In +10 position, 10 vu is to be added to LINE LEVEL volume units reading; in 0 position, LINE LEVEL meter is read directly in volume units; in −10 position, 10 vu is to be subtracted from LINE LEVEL volume units reading.
LINE GAIN control (R104)	Controls level of af signal applied to balanced-line output terminals.
AGC switch (S107)	Determines rapidity of change in gain of receiver for a change of signal strength.
LIMITER switch and control (S108 and R120)	In positions 1 through 10, peak signal impulses are cut off to reduce static interference. Increased reduction of signal peaks is obtained at clockwise positions of control. In the OFF position, limiter does not operate.
CARRIER LEVEL meter (M102)	Indicates level of incoming rf signal. Indication of 0 decibel when RF GAIN control is at position 10 corresponds to an input signal of less than 2 to 5 microvolts.
BANDWIDTH switch (S501, S502, S503)	Selects width of the if pass band in KC.
BFO PITCH control (Z502)	Varies frequency of tone when receiving continuous-wave signals.
AUDIO RESPONSE switch S104	Varies response of audio amplifier. In SHARP position, an 800-cycle-per-second tone is loudest. In WIDE position, all frequencies passed by the BANDWIDTH switch are heard.
BREAK IN switch (S103)	In ON position, permits break-in operation of receiver when proper connections have been made at rear panel. In OFF position, break-in operation is not possible.
FUNCTION switch (S102)	In OFF position, receiver is turned completely off. Other positions and functions are:
	Position — *Function*
	STAND BY — Receiver inoperative, but ready for instant use.
	AGC — Receiver operative, with gain controlled automatically.
	MGC — Receiver operative, with gain controlled manually by RF GAIN control or by an external gain-trol.
	CAL — Permits calibration of the tuning system at 100-kc points.

Control	Function
ANT TRIM control (C225)	Permits peaking of received signal to maximum value.
BFO switch (S101)	In ON position, places beat-frequency oscillator in operation. In OFF position, beat-frequency oscillator is inoperative.
DIAL LOCK	In clockwise position, locks KILOCYCLE CHANGE control to prevent accidental change of setting. Unlocks in counterclockwise position.
ZERO ADJ	When turned clockwise, disengages frequency indicator from KILOCYCLE CHANGE control for calibration purposes.
LOCAL GAIN control (R105)	Controls level of af signal applied to local output terminals.
RF GAIN control (R103)	Controls gain of rf and if amplifiers.

Control	Function
KILOCYCLE CHANGE control	Tunes receiver to any frequency within a band, and changes reading of last three digits on frequency indicator. Frequency range of control slightly greater than 1 mc; when tuned to frequency higher or lower than that indicated by first two digits, plus or minus sign is displayed in space between mc and kc readings indicating, respectively, addition or subtraction of 1 mc in reading of first two digits to obtain true reading.
MEGACYCLE CHANGE control	Selects any one of 32 tuning steps; changes reading of first two digits of frequency indicator.
PHONES jack (J102)	Provides means of connecting headset to the receiver.
OVENS switch (S106, on rear panel)	Screw-driver operated. In ON position, turns on oscillator heaters for increased frequency stability.

Section II. OPERATION UNDER USUAL CONDITIONS

Warning: The voltages employed are high enough to endanger human life. Every precaution should be taken by personnel to minimize the danger of shock. Be sure that the GND terminal 16 on the rear panel (fig. 12) is connected to the same ground as the ac power source.

20. Starting Procedure

Caution: Set the ac power supply of the receiver to the correct ac input voltage. Refer to paragraph 15 and figure 7. Be sure that all of the external connections to the receiver are satisfactory for the desired type of operation outlined in paragraphs 15 and 16.

a. If the receiver is operated under low-temperature conditions, or in a location where there is considerable change in temperature, set the screw-driver-adjusted OVENS switch S106 on the rear panel to ON. When the set is operated in temperature-regulated building, set the OVENS switch to OFF. Be sure the proper fuse is used (par. 13*f*).

b. Turn the FUNCTION switch to AGC. Before operating the receiver, allow it to warm up for several minutes.

21. Voice Reception

a. Set the controls as follows:

Control	*Position*
BFO	OFF
LINE GAIN	0
RF GAIN	10
LOCAL GAIN	5
BANDWIDTH	8 KC
AUDIO RESPONSE	WIDE
AGC	MED
LIMITER	OFF
DIAL LOCK	Cou

b. Use the MEGACYC KILOCYCLE CHANGE co quency indicator to the freq station. If a plus or minus space between the megacycl ings on the dial (because KILOCYCLE CHANGE co in an unknown station, the re two digits must be increased spectively, by 1 mc to arrive a quency. To maintain maximum calibrate the frequency indica paragraph 26 each time th

nterclockwise
E CHANGE and
ntrols to set the fre-
quency of the desired
sign appears in the
e and kilocycle read-
of overtravel of the
ntrol) when tuning
ading of the first
or decreased, re-
the correct fre-
tuning accuracy,
tor as directed in
e MEGACYCLE

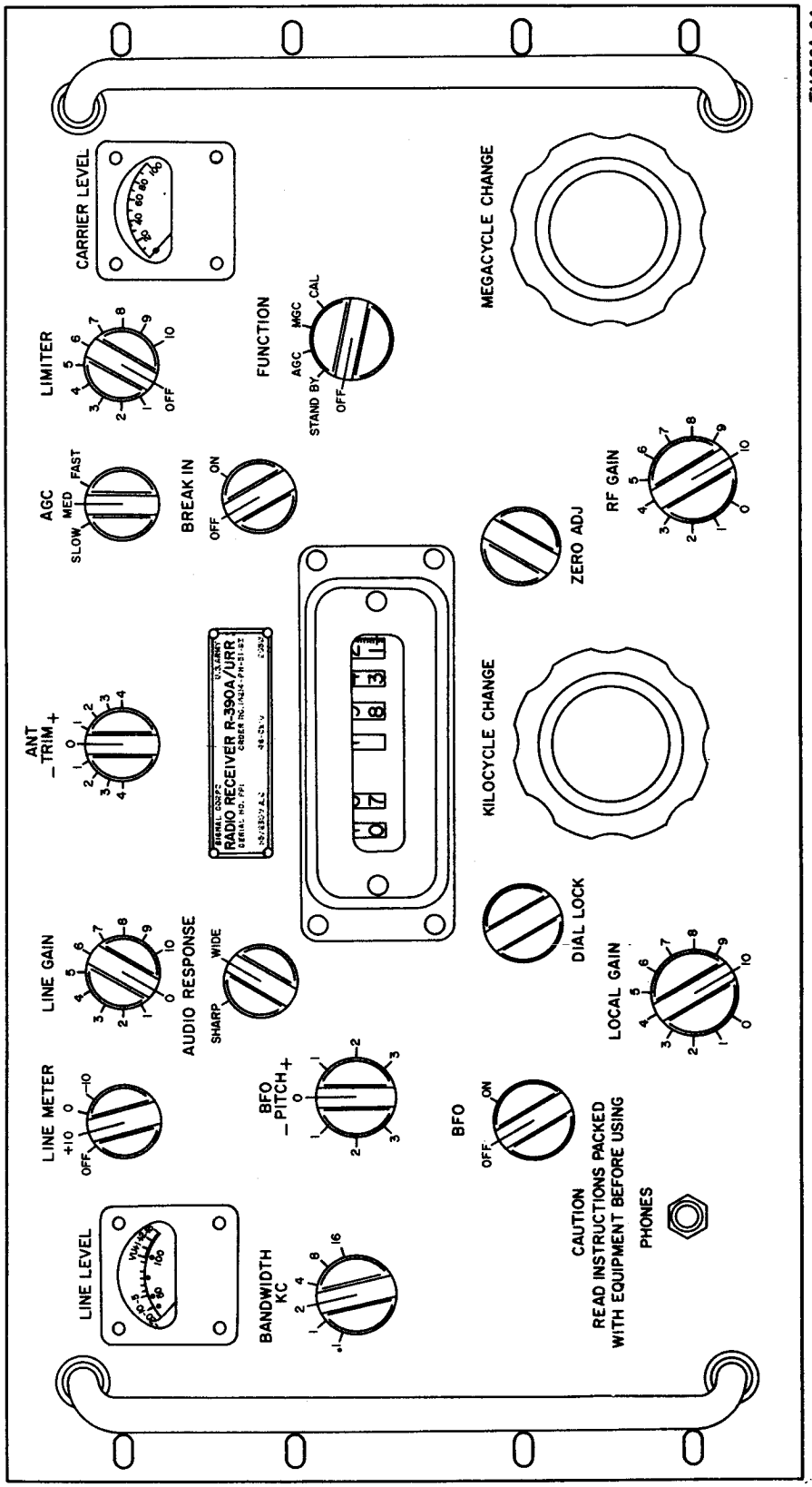


Figure 11. Radio Receiver R-390A/URR, front panel.

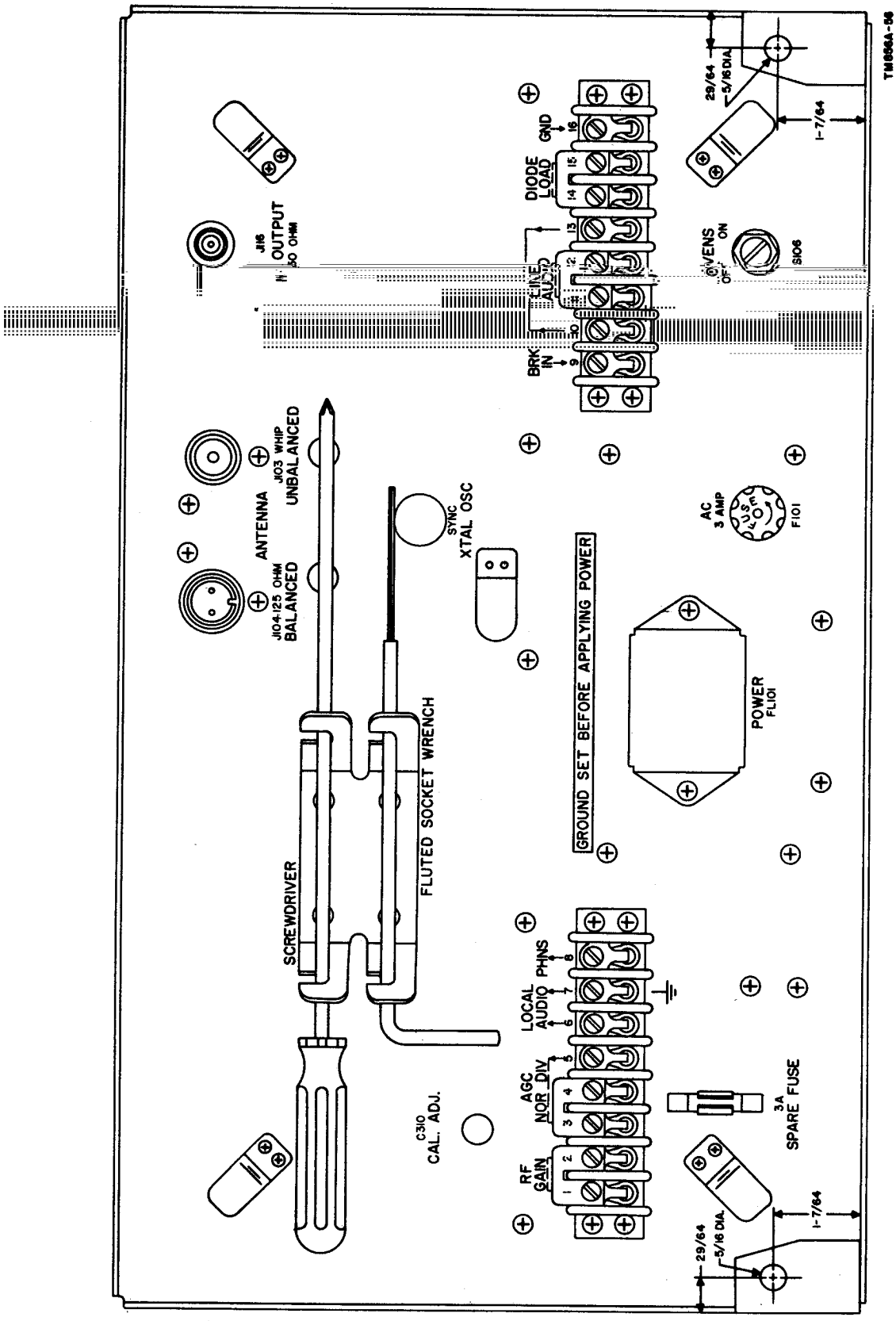


Figure 12. Radio Receiver R-390A/URR, rear panel.

CHANGE control to select another ... 23. Reception of cw Signals

Operate the receiver controls for cw signals in the same manner as for voice reception (par. 21), with the following exceptions:

a. Set the BFO switch to ON.

b. Adjust the BFO PITCH control for comfortable pitch.

c. Adjust the LOCAL GAIN control for the desired volume level.

f. If noise is excessive, rotate the LIMITER control clockwise as needed.

g. When the signal fades rapidly, set the AGC switch to FAST.

h. If interference is heard, set the BANDWIDTH switch to the 4 KC position, or, if necessary, to the 2 KC position.

i. When a balanced-line audio output circuit is used to feed telephone line or other equipment, set the LINE METER switch to the required range and adjust the LINE GAIN control for the desired reading on the LINE LEVEL meter, normally at the VU mark (O VU).

j. If the break-in relay is connected to the transmitter control circuits and the receiver is

beat. If the knob does not fall on 0, loosen the set screw, set the knob at 0, and tighten the set screw.

h. Turn the ZERO ADJ knob fully counterclockwise.

i. Set the BANDWIDTH control to 2 KC.

j. Turn the FUNCTION switch to AGC.

k. Tune the KILOCYCLE CHANGE control until mark and space signals with the same beat note are heard (with 850 cps shift this should be 425 cps).

l. Adjust the BFO PITCH control for proper operation of the radioteletype equipment.

Note. For filter-type terminal equipment, such as Radio-teletype Terminal Equipment AN/FGC-1 where audio frequencies of 2,125 cps and 2,975 cps are used, set the BFO PITCH knob between 2 and 3 (normally on the + side).

m. Turn the LINE GAIN control fully clockwise. The LINE LEVEL meter should show full deflection to the right. Adjust the LIMITER control until the reading on the LINE LEVEL meter is 0 vu. (There is no 0 marking on the meter; the 0 vu position is directly at the lettering *vu* on the meter face.)

25. Reception of Single-sideband Signals

Tuning the receiver for reception of single-sideband signals must be done accurately if this type of signal is to be received. The procedure for tuning the receiver to ssb voice signals is given below:

Note. This procedure may be used for ssb reception of am double-sideband signals. To eliminate interference and distortion caused by selective fading, use one

a. Turn the ZERO ADJ knob counterclockwise as far as it will go.

b. Calibrate the receiver at the 100-kc calibration point nearest the single-sideband signal to be received (par. 26).

c. Set the FUNCTION switch to MGC.

d. Set the RF GAIN control to 5.

e. Set the LOCAL GAIN control between 5 and 10.

f. Set the BANDWIDTH switch to 2 KC.

g. Set the BFO switch to ON.

h. Tune to the carrier frequency 1 kc if the upper sideband is used (—1 kc if the lower sideband is used).

i. If a BANDWIDTH switch setting of 4 KC is to be used, double the —1 or +1 setting in the steps in *g* and *h* above.

j. Adjust the BFO PITCH and/or KILOCYCLE CHANGE controls slightly for the most intelligible signal reception.

k. Adjust the LOCAL GAIN and RF GAIN controls for the desired audio level.

26. Frequency-indicator Calibration

To maintain maximum tuning accuracy of the receiver, calibrate the frequency indicator at the 100-kc calibration point nearest the frequency desired for reception. Calibration is accomplished by the use of the internal calibration oscillator as follows:

a. Set the BANDWIDTH switch to the .1 KC position.

b. Set the AUDIO RESPONSE switch to WIDE.

c. Set the RF GAIN control to 10.

d. Set the LOCAL GAIN control to 5.

e. Set the BFO switch to ON.

f. Turn the BFO PITCH control to 0.

g. Turn the FUNCTION switch to CAL.

h. Adjust the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a reading on the frequency indicator at the 100-kc point nearest the frequency desired for reception.

i. Turn the ZERO ADJ knob clockwise as far as it will go.

j. Rotate t

he ANT TRIM knob to obtain max-

tion on the CARRIER LEVEL

the KILOCYCLE CHANGE con-

ximum indication on the CARRIER

er.

o see that the BFO PITCH control

ero beat at the 0 position. If it does

r zero beat, loosen knob screw, and

ithout rotating the shaft. Tighten

th the fluted screw driver.

e ZERO ADJ knob counterclock-

imum indica

meter.

k. Adjust

trol for a max

LEVEL mete

l. Check t

produces a ze

not, tune it fo

adjust to 0 w

the screw wit

m. Turn th

wise until it stops. The dial now is calibrated accurately.

27. Stopping Procedure

a. When the receiver is not to be used for a short interval but is to be maintained in a state of readiness, turn the FUNCTION switch to STAND BY.

Caution: The FUNCTION switch should not be left in the STAND BY position for too long

and turn the RF GAIN control counterclockwise. The interfering signal may be reduced enough to permit part of the desired signal to come through.

(6) If these steps do not provide some degree of signal separation, request a change in frequency and call sign.

(7) Request the use of cw operation if this is permissible (*b* below).

Section III. OPERATION UNDER UNUSUAL CONDITIONS

29. General

The operation of the receiver may be difficult in regions where extreme heat, cold, humidity and moisture, sand conditions, etc. prevail. Procedures are given in paragraphs 30, 31, and 32 for minimizing the effects of these unusual operating conditions.

30. Operation in Arctic Climate

Subzero temperatures and climatic conditions associated with them affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow: when the equipment has been exposed to cold and is brought into a warm room, moisture will condense on it until the equipment reaches room temperature. This condition also can develop when the room or shelter warms up after a cold night. When the equipment has reached room temperature, dry it thoroughly. The best way to dry the receiver is to turn the receiver on and let its own heat provide the drying action. Under conditions of extreme cold allow a 45-minute warm up time to allow the oscillators to reach a stable temperature and frequency. Leave the OVENS switch in the ON position to help maintain frequency stability.

31. Operation in Tropical Climate

The receiver never should be inclosed to such an extent that adequate circulation of air is prevented. When it is exposed to humid conditions, turn the receiver on to allow it to heat up and evaporate any condensed moisture.

32. Operation in Desert Climate

a. Conditions similar to those encountered in arctic climates prevail in desert areas. Use the same measures to insure proper operation of the equipment. Leave the OVENS switch in the ON position to compensate for the great difference in the day and night temperatures common in desert areas.

b. Keep the equipment as free from dust as possible. In rack-type cabinets, leave the top [illegible] lubrication of the equipment (par. 133). D[illegible] and grease causes grit to fo[illegible] cause damage to the equipm[illegible] ...rance checks. Pay particular attention to

CHAPTER 4
ORGANIZATIONAL MAINTENANCE

Section I. TOOLS AND EQUIPMENT

33. Tools, Materials, and Test Equipment Required

The following tools, materials, and test equipment are required for organizational maintenance procedures.

a. Tools.
Tool Equipment TE-41

b. Materials.
Cheesecloth, bleached, lint-free
Sandpaper, flint #000
Cleaning Compound (Federal stock No. 7930-395-9542)

c. Test Equipment. A common usage name is indicated after each component.

Nomenclature	*Common name*
Electron Tube Test Set TV7/U	Tube tester
Multimeter TS-352/U	Multimeter

34. Special Tools Supplied

The special tools supplied with the receiver are mounted on the rear panel (fig. 12). The use of these tools is described in *a* and *b* below.

a. Phillips Screw Driver. The Phillips screw driver is used to remove the screws that secure dust covers, front panel, removable subchassis, terminal strips, etc.

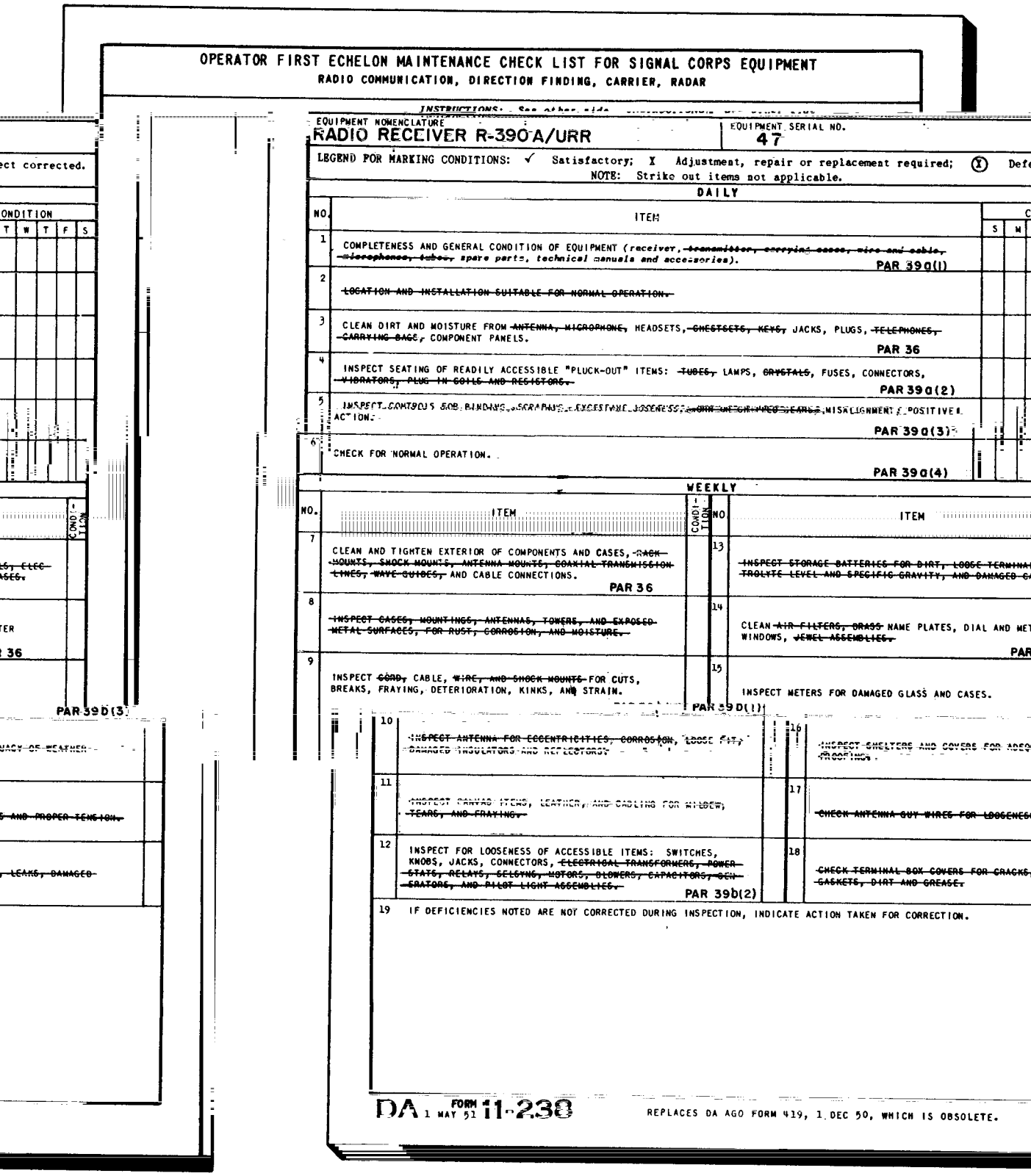
b. Bristo (Fluted) Socket Wrench. The No. 8 fluted socket wrench is used for removing the front-panel bar knobs and the MEGACYCLE CHANGE and KILOCYCLE CHANGE knobs, and for loosening the collars that secure the camshafts and gears in the mechanical tuning system.

Section II. PREVENTIVE MAINTENANCE SERVICES

35. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is

cleaning, wipe the parts dry with a cloth. Use Cleaning Compound on all parts, including electrical contacts.



OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: RADIO RECEIVER R-390A/URR
EQUIPMENT SERIAL NO.: 47

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defe
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	S	M
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, ~~transmitter, scrapping cases, wire and cable, microphones, tubes,~~ spare parts, technical manuals and accessories*). PAR 39a(1)		
2	~~LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.~~		
3	CLEAN DIRT AND MOISTURE FROM ~~ANTENNA, MICROPHONE,~~ HEADSETS, ~~CHESTSETS, KEYS,~~ JACKS, PLUGS, ~~TELEPHONES, CARRYING BAGS,~~ COMPONENT PANELS. PAR 36		
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: ~~TUBES,~~ LAMPS, ~~CRYSTALS,~~ FUSES, CONNECTORS, ~~VIBRATORS, PLUG-IN COILS AND RESISTORS.~~ PAR 39a(2)		
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~OIL OR GREASE ON GEARS,~~ MISALIGNMENT, POSITIVE ACTION. PAR 39a(3)		
6	CHECK FOR NORMAL OPERATION. PAR 39a(4)		

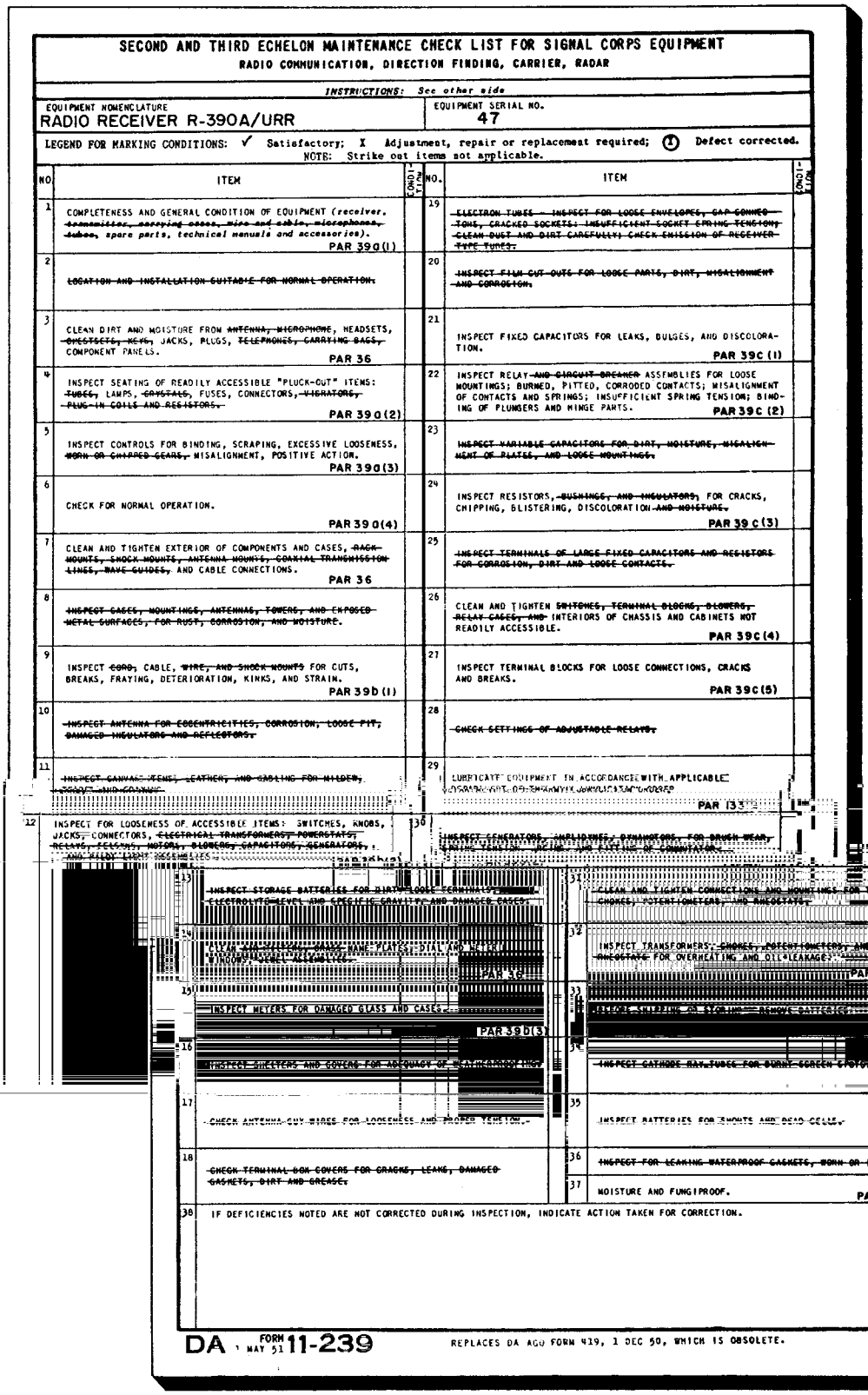
WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, ~~RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES,~~ AND CABLE CONNECTIONS. PAR 36		13	~~INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINA~~ ~~TROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CA~~
8	~~INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.~~		14	CLEAN ~~AIR FILTERS, GRASS~~ NAME PLATES, DIAL AND MET WINDOWS, ~~JEWEL ASSEMBLIES.~~ PAR
9	INSPECT ~~CORD,~~ CABLE, ~~WIRE, AND SHOCK MOUNTS~~ FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR 39b(1)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.
10	~~INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.~~		16	~~INSPECT SHELTERS AND COVERS FOR HOLES, LEAKS, DAMAGED FLOORING.~~
11	~~INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.~~		17	~~CHECK ANTENNA GUY WIRES FOR LOOSENESS~~
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ~~ELECTRICAL TRANSFORMERS, POWER STATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES.~~ PAR 39b(2)		18	~~CHECK TERMINAL BOX COVERS FOR CRACKS, GASKETS, DIRT AND GREASE.~~
19	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.			

DA FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM856A-45

Figure 13. DA Form 11-238.



SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: RADIO RECEIVER R-390A/URR
EQUIPMENT SERIAL NO.: 47

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ① Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories). PAR 39a(1)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR 36	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR 39a(2)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR 39a(3)	
6	CHECK FOR NORMAL OPERATION. PAR 39a(4)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR 36	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR 39b(1)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE PIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, ROTROT, AND CAKING.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, FELTING, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES PAR 39b(2)	
13	INSPECT STORAGE BATTERIES FOR DIRTY, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY AND DAMAGED CASES.	
14	CLEAN AND TIGHTEN PANEL, NAME PLATES, DIAL AND METER WINDOWS, KNOBS, SCALES, METERS PAR 36	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES PAR 39b(3)	
16	INSPECT METERS AND COVERS FOR ACCUMULATION OF CONDENSATION	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, GAP CONNECTIONS, CRACKED SOCKETS; INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES.	
20	INSPECT FILM CUT OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR 39c(1)	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. PAR 39c(2)	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR 39c(3)	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR 39c(4)	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. PAR 39c(5)	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE LUBRICATION CHART OR INSTRUCTIONS PAR 33	
30	INSPECT GENERATOR, VIBRATORS, DYNAMOTORS FOR BRUSH WEAR, WORN TEETH, PITTING AND FLUTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND DIELECTRIC LEAKAGE PAR 39c(6)	
33	CHECK SETTING OF STORAGE BATTERY HYDROMETER; REMOVE BATTERIES	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
37	MOISTURE AND FUNGIPROOF. PAR 41b	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA FORM 11-239 MAY 51 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM856A-46

Figure 14. DA Form 11-239.

ance check list to be used by the operator as directed.

b. Items that do not apply to the receiver are lined out on figure 13. References in the ITEM block in the figure are to paragraphs in this manual that contain additional information about the item.

38. Use of Second and Third Echelon Preventive Maintenance Form

(fig. 14)

a. DA Form 11-239 is a preventive maintenance check list to be used by second and third echelon repairmen as directed.

b. Items that do not apply to the receiver are lined out on figure 14. References in the ITEM block in the figure are to paragraphs in this manual that contain additional information about the item.

39. Performing Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Daily Items.

(1) Refer to the table of components (par. 6), the list of running spares (par. 9), and the list of additional equipment required (par. 10) when checking for completeness of the equipment.

(2) When checking the various pluck-out items, pay particular attention to the seating of the connectors on the cables that interconnect the subchassis.

If binding of the KILOCYCLE CHANGE or the MEGACYCLE CHANGE control is found, it is possible that the bushing, mounted in the front panel, has been forced out of alignment with the shaft by having been tightened in the wrong manner. Remove the knob and loosen the large hexagonal nut that holds the bushing to the front panel. If the binding is relieved, tighten the nut carefully.

(4) When checking for normal operation, use the over-all operational test given in paragraph 45. If there is any doubt about the performance of the receiver after using this test, proceed to the equipment performance check list (par. 50).

b. Weekly Items.

(1) Inspect the power cable connected to the rear panel. Check to see that no strain is placed on it. Repair or replace it if it shows signs of wear or deterioration.

(2) Check all front-panel controls and knobs for looseness. The frequency indicator wheels should not move when the ZERO ADJ knob is tightened. If they do, the ZERO ADJ mechanism requires adjustment (par. 139). Also check the PHONES jack. If any parts are found to be loose, tighten them.

(3) Inspect the LINE LEVEL and CARRIER LEVEL meters (fig. 11) for damaged glasses and cases. If such damage is found, replace the meter, when possible.

c. Monthly Items.

(1) Capacitors C603 and C606 (fig. 57) are likely to show signs of leaking and bulging. Replace them if they do.

(2) Inspect relays K101A and K101B (fig. 73). If necessary, tighten the mounting screws. If the contacts appear to be dirty, burned, or pitted, clean them with a few light strokes of a contact burnisher. Brush out any dirt in the assemblies; pay particular attention to the hinges.

(3) Inspect all fixed resistors for cracks, chipping, blistering, and discoloration. Remove each subchassis except the power-supply subchassis. If any resistors do not appear to be satisfactory, replace them.

(3)

(4) Tighten all screws that hold the subchassis to the main frame. Brush out all dirt and dust from the subchassis. Remove the dust cover from the top of the rf subchassis and carefully brush out dust and dirt.

(5) Inspect the terminal strips on the rear panel (fig. 12). Carefully tighten the screws that hold the strips to the panel. Look for cracks and breaks.

(6) Inspect transformer T801 (fig. 71) for overheating and leaking. Do this immedately after the receiver has been turned off.

Section III. LUBRICATION AND WEATHERPROOFING

40. Lubrication

Lubrication is to be performed by trained maintenance personnel. Lubrication instructions are given in paragraph 133.

41. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. The soldered connections in the receiver have been treated with a moistureproof and fungiproof varnish by the manufacturers. After repairs have been made to these connections, this type of varnish, if available, should be applied.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

42. General

a. The trouble shooting and repairs that can be performed at organizational maintenance level (operators and repairmen) are necessarily limited in scope by the tools, test equipment, and replaceable parts issued. Accordingly, trouble shooting consists of determining such troubles as burned-out tubes and fuses.

b. Paragraphs 43 through 50 will assist in determining which of the subchassis of the receiver is at fault, and in localizing the fault in that assembly to the defective stage or part, such as a tube or fuse. Repair will be limited to the replacement of those parts included in the running spares.

c. Trouble shooting at an organizational level is concerned with the localizing of defective parts that are readily replaceable at an organizational level (tubes, fuses, cables, etc.). If the fault can be determined through organizational procedures, corrective measures are indicated. If the fault cannot be determined through organizational procedures, reference is made to the necessary field maintenance instructions, which indicates the need for trouble shooting at a field maintenance level.

43. Visual Inspection

a. When the receiver fails to operate and the reason is not clear, check the items in *b* below before starting a detailed examination. If possible, obtain information from the operator of the receiver concerning performance at the time the trouble occurred.

b. Failure of the receiver to operate properly or not at all may be caused by one or more of the following faults:

(1) Improperly connected, worn, or broken power cable.

(2) Improperly connected, worn, or broken speaker or headset cord.

(3) Burned-out fuse. Be sure a fuse of proper value (par. 13) is used, especially when the receiver is operated from a 230-volt source.

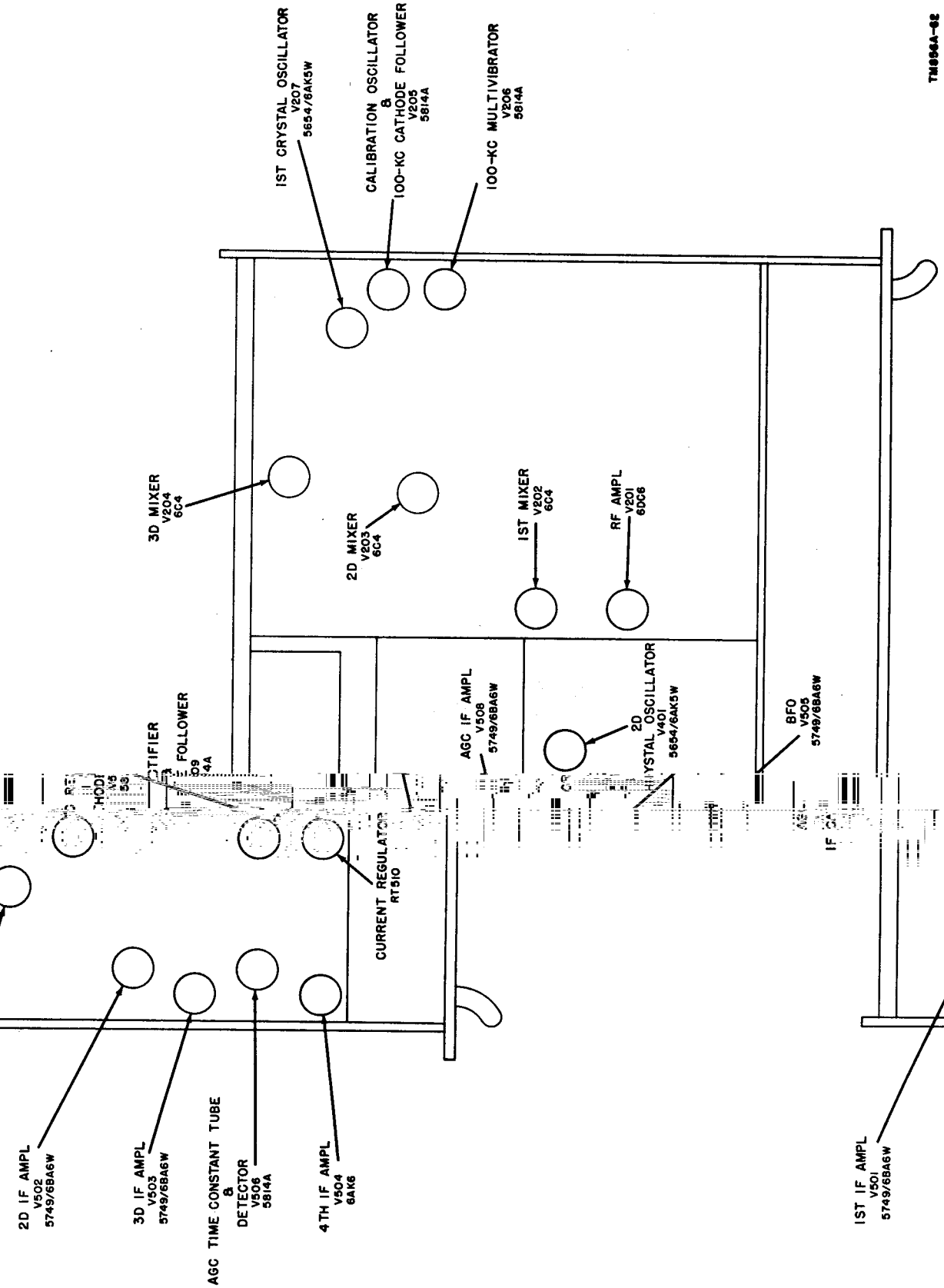
(4) Grounded or broken antenna lead-in.

(5) Improperly connected antenn

(6) Defective tube.

(7) Improperly connected or sea
nal or internal interconnecti

(8) Loose connection on termina
rear panel. Be sure to check t
connection at the rear of the



eceiver R-390A/URR, top deck, tube location.

Figure 15. Radio R

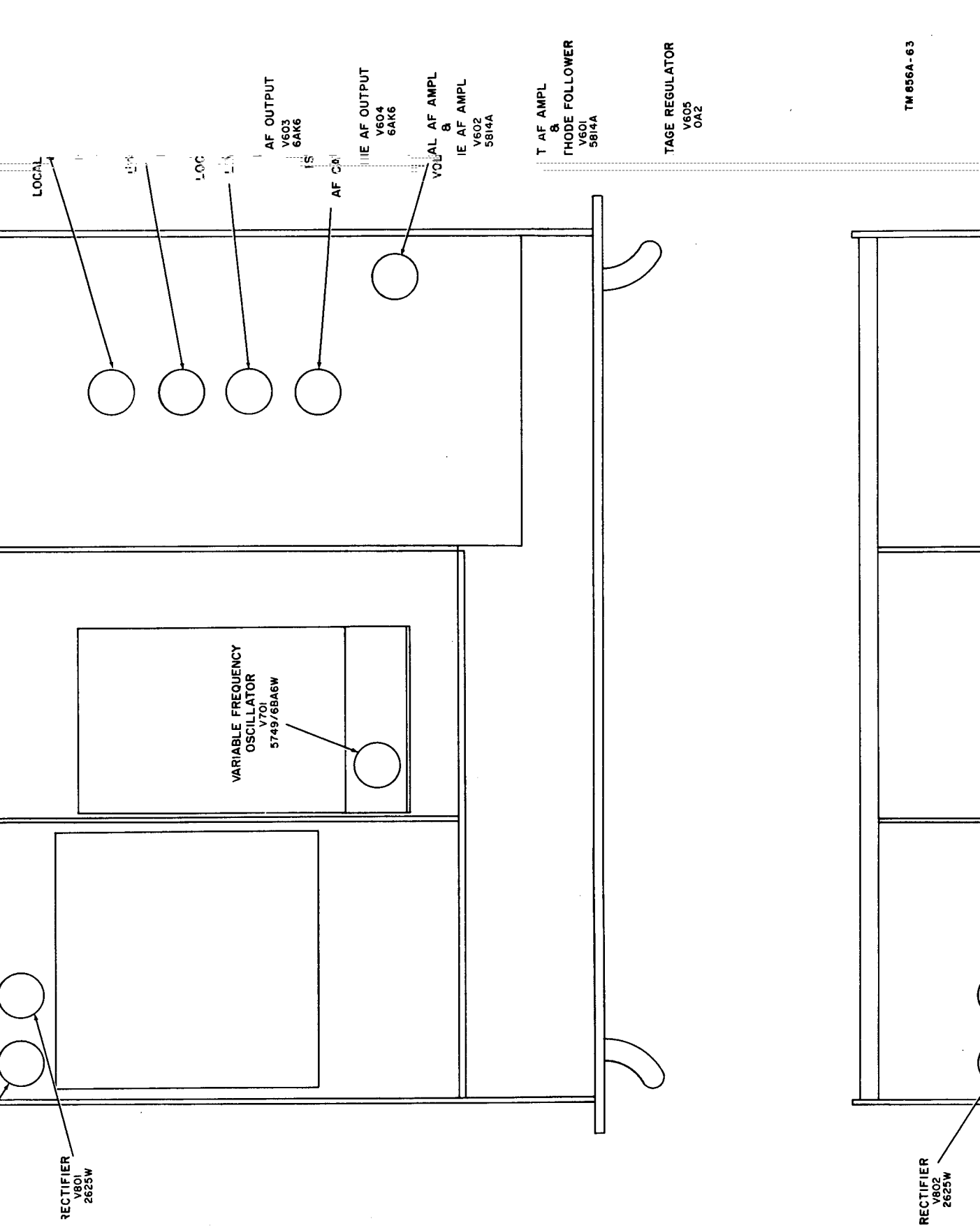


Figure 16. Radio Receiver R-390A/URR, bottom deck, tube location.

44. Checking for B Plus Shorts

a. One of the most damaging troubles in the receiver is a B plus short circuit. This trouble causes excessive current to flow through the rectifier tubes and the various B plus circuits. Such a short circuit can cause the rear panel AC 3 AMP fuse to blow, damage rectifiers tubes V801 and V802, or burn out circuit resistors. Prior to applying ac power to the receiver, check for B plus shorts as follows:

(1) Disconnect the receiver from the ac power source. Remove V801 from the power-supply subchassis.

(2) Connect the multimeter between ground and pin 3 or 8 of tube socket XV801.

(3) With the receiver still disconnected from the ac power source, turn the FUNCTION switch to each of its positions and observe the dc resistance of the B plus circuit after each position of this switch. If the dc resistance is less than 40,000 ohms a B plus short exists.

(4) With the FUNCTION switch on AGC or MGC, turn the BFO switch to ON. If the dc resistance is less than 40,000 ohms, a B plus short exists.

(5) Replace rectifier tube V801 and remove V802. Once again check the dc resistance from ground to pin 3 or 8 of XV802. This checks V801 for a short circuit.

b. If the above tests reveal a B plus short, trouble-shooting at a field maintenance level is required.

45. Over-all Operational Test

A rapid check of the receiver should be made when making frequency changes or when performing daily preventive maintenance. The procedures given in *a* through *e* below form a rapid check of the entire receiver except the primary of the antenna transformer.

a. Set the controls as follows:

Control	*Position*
RF GAIN	10
FUNCTION switch	CAL
BFO switch	ON
BFO PITCH control	+2
LINE GAIN control	5
LOCAL GAIN control	10
BANDWIDTH switch	4 KC
AUDIO RESPONSE switch	WIDE
AGC switch	
LIMITER control	
LINE METER switch	

b. Disconnect the antenna. Tune CYCLE CHANGE control to any for maximum indication on the LEVEL meter.

c. Starting at 00, turn the MI CHANGE control to each of the ba the ANT TRIM control for maxir tion on the CARRIER LEVEL me band. Listen to the signal produced bration oscillator. It should be ap the same level on all bands. The minimum indication on the LINE LEVEL meter should be 0 vu on all bands.

d. This test will indicate which bands may be inoperative. Alignment of these bands or circuit repair is normally required to return them to normal sensitivity. These operations will be done at a field maintenance level.

e. Turn the BFO switch to OFF and listen for hum in the headset or loudspeaker. A slight hum is normal, but excessive hum indicates the need for trouble shooting in the power-supply circuits at a field maintenance level.

46. Checking Receiver Performance With Noise

An effective method of checking receiver performance and determining in which subchassis possible causes of trouble exist is to perform certain operations while listening to the noise produced by the receiver. Perform the operations in *a* through *e* below with the antenna disconnected from the receiver. Adjust the controls to produce audible noise in the loudspeaker or headset. Set the FUNCTION switch at MGC, the BANDWIDTH switch at 16 KC, and the BFO switch at OFF.

a. Af Noise Test. While listening to the noise, ground the DIODE LOAD terminal on the rear panel (terminal 14). Terminal 16 is a convenient ground connection. The noise should be greatly reduced. Make the same check while listening to the remote audio output or while watching the LINE LEVEL meter. If the noise at both audio outputs almost disappears when the DIODE LOAD terminal is grounded, the audio circuits may be considered to be operating properly. If only the local output is reduced, check tubes V602 and V604 and the seating of connector P120 (fig. 57). If only the remote output is affected, check tubes V602 and V603 and the seating of connector P119 (fig. 57). If neither output is affected, check tubes V507 and V601. If tube replacement is not effective, it will be necessary to trouble shoot the af subchassis at a field maintenance level.

b. If Noise Persists. Set the BANDWIDTH switch at 16 KC. With the other controls set for audible noise, set the BANDWIDTH switch successively at each lower position, listening to the noise. The noise should decrease at each position, until it can hardly be heard in the .1 KC position. If there is little or no change in noise output as the switch is rotated, check tubes V501 through V504. If the tubes are not defective, further trouble shooting of the if subchassis at a field maintenance level will be necessary.

c. Noise at Grid Test Points. Set the multimeter to the highest resistance range. Connect one multimeter lead to the chassis and, in turn, touch the prod on the other lead to grid test points E211, E210, E209, and E208, in that order (fig. 58). A click should be heard each time the prod touches the test point. If no click is heard, check the tube closest to the check point. Be sure that all connectors are seated firmly in their receptacles.

d. Rf Tuner Noise Test. Starting with the megacycle frequency indicator at 92, turn the MEGACYCLE CHANGE control through its range to the highest frequency, listening to the noise in the headset or loudspeaker. There should be a sharp and pronounced increase in noise as the control is seated in each detent position. Across the tuning range, some adjustment of the ANT TRIM control will be necessary to produce maximum noise. Between detent settings, the noise should show a pronounced drop in level. From one detent setting to the next (except between the settings where rf coil ranges are to be switched), the noise level should be almost constant. Rf coils are switched between the following settings: 03 and 04, 07 and 08, 15 and 16. If noise at any point across the range is not maximum with the knob in the detent position, mistracking at that point is possible. Adjustment at a field maintenance level is required. The rf and variable if alignment should be checked (par. 142, 143, and 144). If the noise does not drop between detent settings, check for excessive if gain (par. 95). If noise is less at one detent setting, check the over-all gain (par. 94) and the adjustment of the crystal-oscillator trimmer capacitors (par. 140*e*).

e. Antenna Circuit Noise Tests. Rotate the ANT TRIM control. The noise should peak at one particular point. Ground the center contact of the ANTENNA UNBALANCED co (J103). A click should be heard and th should drop sharply. Ground both of the ANTENNA BALANCED co (J104). A click should be heard and th should drop sharply. If the receiver d pass these tests, check the antenna re connectors on the antenna relay box, sections of the rf band change switch t nect to transformers T201 through T2

47. Electron Tube Testing Technique

a. Inspect all interior cables, connecti the general condition of the equipmen removing the electron tubes.

b. Isolate the trouble to a particular sis of the receiver (par. 46).

c. If Electron Tube Test Set TV- equivalent is available, remove and test at a time. Substitute new tubes only f that are defective. Tubes that are sh contain heater-to-cathode leakage shoul can upset the automatic gain control circuit, as well as other receiver functions, and produce misleading test results.

d. If a tube tester is not available, trouble shoot by the tube substitution method.

(1) Substitute a new tube for an original tube. If no change occurs in the operation of the receiver, replace the new tube with the original. Similarly, check

each original tube, in turn, until the equipment becomes operative or until all suspected tubes have been tested and the need for further trouble shooting is indicated.

(2) Some circuits, for example oscillator circuits, (V206, V207, V401, V505, and V701) may function with one tube and not another, even though both tubes are new.

(3) *Do not leave a new tube in a socket if the receiver operates properly with the original tube.*

(4) If a replacement tube soon becomes defective, further trouble shooting is necessary. The section containing the tube should be tested for defective component parts.

(5) If tube substitution does not correct the trouble, *reinsert the original tubes in the original sockets before forwarding the defective equipment for higher echelon repair.*

(6) If another receiver of the same type is available, refer to the instructions given in *g* below.

e. As a general rule, discard tubes only in the cases given in (1) and (2) below. Do not discard them merely because they fall on or slightly above the lowest acceptable value when tested in a tube tester. Do not discard tubes merely because they have been used for some time. Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new tube.

(1) Discard tubes when a test in a tube tester or other instrument shows that the tube is defective.

(2) Discard tubes when the defect can be plainly seen, such as a broken glass envelope or a broken connecting prong.

f. Be careful when withdrawing a miniature tube from its socket. Do not rock or turn it; pull it straight out. The variable-frequency ocsillator (vfo) tube shield (V701) is held in place by a special clamp. Be sure that the metal insert is in place when replacing the shield. Straighten the pins with the proper pin straightener, if one is available, before replacing tubes in the receiver.

g. Tune a similar receiver, which is in good operating condition, to a voice signal that is not subject to fading; a signal on one of the lower frequency bands is preferred. Turn the FUNCTION switch to AGC and the RF GAIN control to 10. Make the substitutions from the faulty receiver to a corresponding position in the good receiver, one tube at a time; gently tap the tube under test; and, if noise or abnormal change in volume is observed, replace the tube. A considerable decrease in indication on the CARRIER LEVEL meter or a noticeable decrease in volume or quality of the signal emitted from the speaker or headset indicates a weak or otherwise defective tube; however, different test results for the following tubes must be observed.

(1) When tubes V508 and V509A (agc circuit) are weak, a decreased indication on the CARRIER LEVEL meter with an increase in volume may be noted. A weak V506A (agc time constant circuit) will cause an increase in indication on the CARRIER LEVEL meter without any change in volume. A weak V509B (if cathode follower) will produce a weak signal at the IF OUTPUT connector (J116). After testing tube V507 (noise limiter) in the usual manner, tune the receiver away from the test signal, and, if noise is received, rotate the LIMITER control clockwise; the tubes under test and tubes that are known to be good should be equally effective in reducing noise. After testing these tubes, return the LIMITER control to OFF, and retune the receiver to the test signal. To test V505, turn the BFO switch to ON, and, while turning the BFO PITCH control through its entire range, listen for the beat note.

(2) Test tube V801 and V802 of the power-supply subchassis and V701 of the vfo subchassis by listening to the audio output and observing the indication on the CARRIER LEVEL meter (*g* above). Visually inspect V605; if it does not glow properly, it will cause abnormal voltage on the +150-volt regulated line. When testing tubes V205 and V206, turn the FUNCTION switch to CAL, tune through several

100-kc points, and observe the indication on the CARRIER LEVEL meter.

(3) Test tubes in the af circuits by listening to the volume and quality of the output signal of the af channels. When testing tubes V602A and V603 (local af amplifier), listen to the output signal of the local audio channel. When testing tube V602B (line af amplifier) and V604, listen to the output signal from the balanced-line circuit and observe the indication on the LINE LEVEL meter. Tube V601 is common to both the local and line af channels. Generally, small changes in LINE LEVEL meter indication may be expected because of certain differences among tubes.

48. Interchangeable Tubes

Do not substitute a type 6C4W tube for a 6C4 tube. The differences in characteristics are such that the type 6C4W will not operate properly in the receiver.

49. Trouble Shooting by Using Equipment Performance Check List

a. General. The equipment performance check list (below) will help the repairman to locate trouble in the receiver. The list gives the items to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures to be taken. To use this list, follow the items in numerical sequence.

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of a switch and control settings with which the items are to be chec For other items, it represents an action must be taken to check the normal indica given in the *Normal indications* column.

c. Normal Indications. The normal ind tions listed include the visible and audible s that the repairman should observe when checks the items. If the indications are not mal, the operator or repairman should apply th recommended corrective measures.

d. Corrective Measures. The corrective meas ures listed are those that the operator or repai man can make without turning in the equipmer for repairs. A reference in the table to a para graph relating to field maintenance indicate that the trouble cannot be corrected durin operation and that trouble shooting by an ex perienced repairman is necessary. If the recom mended corrective measures do not produce re sults, further trouble shooting is necessary.

50. Equipment Performance Check List

	Item No.	*Item*	*Action or condition*	*Normal indications*	*Corrective measures*
PREPARATORY	1	Antenna	Lead-in wire connected.		
	2	Loudspeaker or headset	Loudspeaker connected to LOCAL AUDIO terminals 6 and 7 or headset connected to PHONES jack.		
	3	600-ohm line	Connected to terminals 10 and 13. If 600-ohm line is not available, connect headset to terminals for test purposes.		
	4	Power cord	Connected to ac power source.		
	5	AUDIO RESPONSE switch	Set at WIDE.		
	6	BANDWIDTH switch	Set at 8 KC.		
	7	RF GAIN	Set at 10.		
	8	LOCAL GAIN control	Set at 5.		

50. Equipment Performance Check List (cont.)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	9	FUNCTION switch	Turn to AGC.	Dial lamps light.	Check power cord. Check dial lamps and AC 3 AMP fuse. Refer to paragraph 43.
				Rushing noise or signal heard in speaker or headset.	Test tubes. Check connectors between subchassis. Refer to paragraphs 45 through 47.
	10	MEGACYCLE CHANGE control	Set to each band, in turn	Normal signal output on each band.	Rotate control several times to clean switch contacts. Refer to paragraphs 96 and 97.
	11	KILOCYCLE CHANGE control	Tune across a band.	Signals received. CARRIER LEVEL meter indicates strength of received signals.	Refer to paragraphs 96 and 97.
	12	ANT TRIM	Rotate control.	Obtain peak indication on CARRIER LEVEL meter for each band.	Refer to paragraphs 96 and 152.
	13	LOCAL GAIN control	Rotate control in either direction.	Volume at loudspeaker or headset increases or decreases.	Refer to paragraph 99.
	14	LINE GAIN control	Rotate control.	Output level to 600-ohm line or headset and LINE LEVEL meter increases or decreases.	If headset level varies and pointer of meter is sticking, tap meter lightly.
					If local output is satisfactory, but line output weak, check tubes V602 and V604. Refer to paragraph 100.
	15	RF GAIN control	Rotate control.	Audio output and CARRIER LEVEL meter indication increases or decreases.	Refer to paragraph 96.

50. Equipment Performance Check List (cont.)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	16	FUNCTION switch	Turn to MGC.	With no signal input, noise level should increase slightly and CARRIER LEVEL does not indicate.	Refer to paragraph 96.
			Turn to AGC, and tune through several different signals.	Output volume nearly constant	Refer to paragraph 96.
			Turn to CAL, and then operate KILOCYCLE CHANGE control.	Deflection on CARRIER LEVEL meter at each 100-kc reading.	Reset ANT TRIM control. Refer to paragraphs 96, 97, and 120.
	17	LIMITER control	Turn clockwise.	Noise peaks are reduced in amplitude.	Refer to paragraph 96.
	18	BREAK IN relay switch	Turn to ON. Short BRK IN terminal 9 on rear panel to ground momentarily.	LINE LEVEL Meter is disabled and break-in relay functions to silence receiver.	Refer to paragraph 96.
	19	LINE METER switch	Turn to +10.	Line level is 10 vu above LINE METER indication.	Refer to paragraph 116.
			Turn to 0.	LINE METER indicates the line level controlled by the LINE GAIN control.	
			Turn to -10.	Line level is 10 vu below LINE METER indication.	
			Turn to OFF.	LINE LEVEL meter is disconnected. Line audio output is still connected.	
	20	BFO control and BFO PITCH control	Turn BFO control to ON. Tune in a cw signal, and vary the BFO PITCH control.	Tone of signal varies.	Refer to paragraphs 96 and 97.
	21	BANDWIDTH switch	Turn from 16 kc to 1 KC.	Selectivity becomes sharper and noise decreases. Only low-frequency audio tones are heard in the counterclockwise positions.	Refer to paragraphs 96 and 110.

50. Equipment Performance Check List (cont.)

	Item No.	*Item*	*Action or condition*	*Normal indications*	*Corrective measures*
EQUIP.	22	AUDIO RESPONSE switch	Operate through both positions.	Permits amplification of nearly full af range in WIDE position, and 800 cps in SHARP position.	Refer to paragraphs 96 and 111.
PERF.	23	OVENS switch	Turn to OFF.	Oscillator ovens are turned off.	
	24	FUNCTION switch	Turn to STAND BY	Receiver is silent. Filament circuits and oscillator circuits are kept on for immediate reception.	
STOP	25	FUNCTION switch	Turn to OFF.	Turns off all receiver circuits.	

CHAPTER 5
THEORY

Section I. THEORY OF RADIO RECEIVER R-390A/URR

51. General

a. Radio Receiver R-390A/URR provides reception of cw, mcw, and am (including single-sideband) signals over a continuous frequency range of .5 to 32 mc. The receiver is a superheterodyne type with multiple frequency conversion. Double conversion is used when the receiver operates from 8 to 32 mc and triple conversion from .5 to 8 mc.

b. Tuning is linear, thus allowing constant frequency spread throughout the range. This tuning is accomplished by the insertion of powdered-iron cores into the rf and variable if coils at a rate controlled by a complex mechanical arrangement of gears, shafts and cams. The frequency is indicated by a counter-type indicator, allowing a frequency reading accuracy of 300 cps or better over the entire range of the receiver.

c. The calibration circuit, consisting of 200-kc crystal calibration oscillator V205A, 100-kc multivibrator V206, and 100-kc cathode follower V205B, injects 100-kc markers into the input circuit of rf amplifier V201. When the FUNCTION switch is in the CAL position, B+ is connected to the calibration circuit.

d. Rf amplifier V201 amplifies the signals from the antenna before they are fed to first

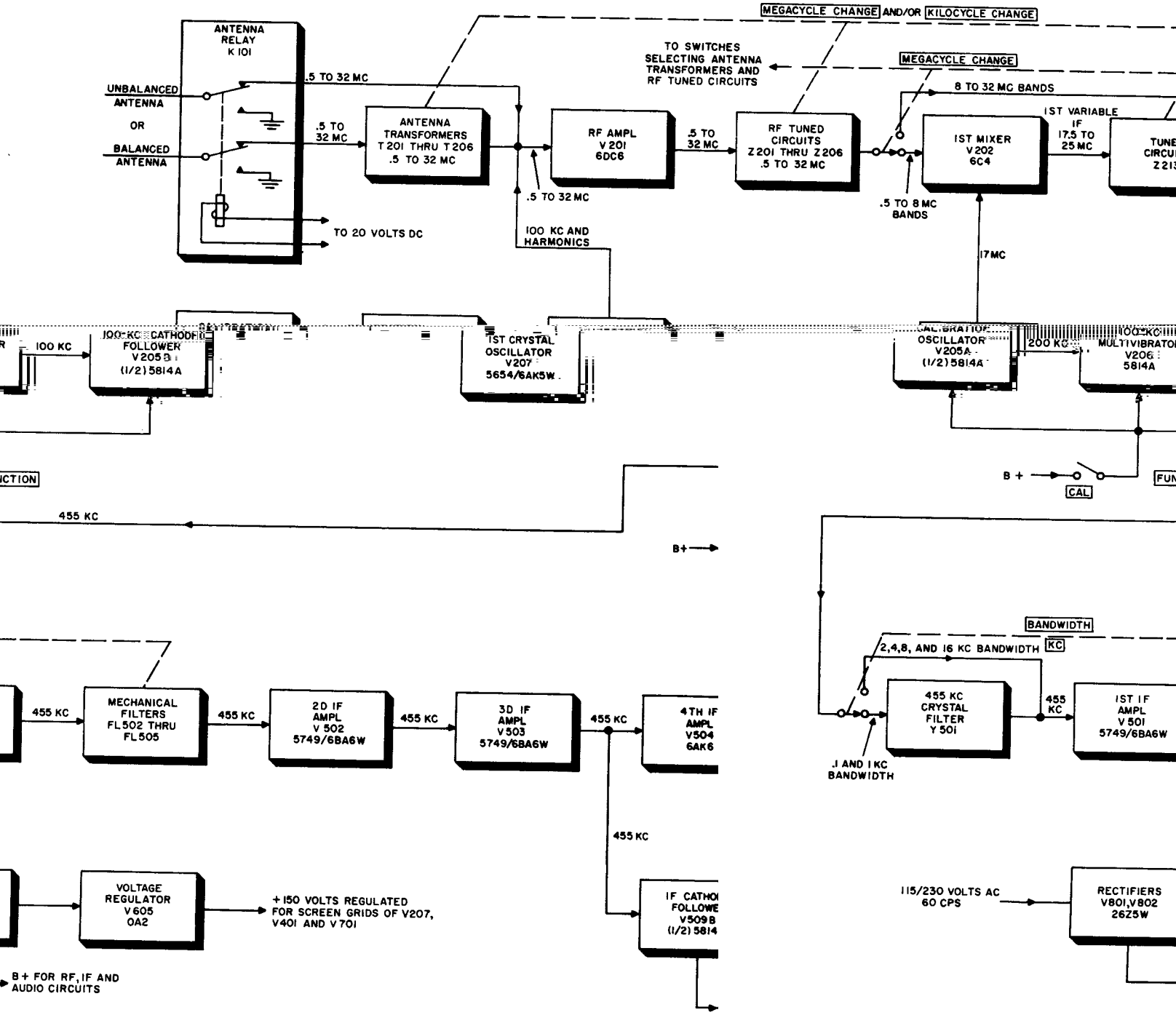
52. Block Diagram of Radio Receiver R-390A/URR

a. Figure 17 shows the path of the receiver signals from the antenna input to the audio output and if output. Figure 106 is a complete schematic diagram of the receiver.

b. Rf signals are fed into the receiver by either a balanced two-wire antenna such as a doublet, or an unbalanced antenna such as a whip or random-length wire antenna. Antenna relay K101 disconnects and grounds the antenna during standby, calibration, or break-in operation. When K101 is not energized, the balanced antenna is connected to the input of one of the antenna transformers, T201 through T206, which is selected by the MEGACYCLE CHANGE switch. The transformers are tuned by the KILOCYCLE CHANGE and/or the MEGACYCLE CHANGE tuning dials. The output of these tuned circuits is fed into rf amplifier V201. The signal from the unbalanced antenna is fed directly to the grid circuit of the rf amplifier.

d. Rf amplifier V201 amplifies the signals from the antenna before they are fed to first

e. Signals from .5 to 8 mc are coupled fr amplifier V201 and fed into the input circ first mixer V202. The 8- to 32-mc signals V201 are switched around the first mixe fed directly into second mixer V203. Wh receiver is operated between .5 and 8 m first mixer mixes the rf signals with a signal from first crystal oscillator V207 output (sum) frequency is the first varia signal, and its frequency varies from 1 25 mc. Tuned circuit Z213 is a triple-tun vice that is permeability tuned as the M CYCLE CHANGE and the KILOC CHANGE controls are operated.


MEGACYCLE CHANGE AND/OR KILOCYCLE CHANGE
TO SWITCHES SELECTING ANTENNA TRANSFORMERS AND RF TUNED CIRCUITS
MEGACYCLE CHANGE
8 TO 32 MC BANDS
ANTENNA RELAY K 101
UNBALANCED ANTENNA
OR
BALANCED ANTENNA
.5 TO 32 MC
.5 TO 32 MC
ANTENNA TRANSFORMERS T 201 THRU T 206 .5 TO 32 MC
RF AMPL V 201 6DC6
.5 TO 32 MC
RF TUNED CIRCUITS Z 201 THRU Z 206 .5 TO 32 MC
1ST MIXER V 202 6C4
1ST VARIABLE IF 17.5 TO 25 MC
.5 TO 8 MC BANDS
TO 20 VOLTS DC
100 KC AND HARMONICS
17 MC
100 KC
100 KC CATHODE FOLLOWER V 205 B (1/2) 5814A
1ST CRYSTAL OSCILLATOR V 207 5654/6AK5W
CALIBRATOR OSCILLATOR V 205 A (1/2) 5814A
200 KC
100 KC MULTIVIBRATOR V 206 5814A
B +
CAL
455 KC
B+
BANDWIDTH
2, 4, 8, AND 16 KC BANDWIDTH
KC
455 KC
MECHANICAL FILTERS FL 502 THRU FL 505
455 KC
2D IF AMPL V 502 5749/6BA6W
455 KC
3D IF AMPL V 503 5749/6BA6W
455 KC
4TH IF AMPL V 504 6AK6
455 KC CRYSTAL FILTER Y 501
455 KC
1ST IF AMPL V 501 5749/6BA6W
.1 AND 1 KC BANDWIDTH
455 KC
VOLTAGE REGULATOR V 605 0A2
+150 VOLTS REGULATED FOR SCREEN GRIDS OF V207, V401 AND V701
IF CATHODE FOLLOWER V 509 B (1/2) 5814
115/230 VOLTS AC 60 CPS
RECTIFIERS V801, V802 26Z5W
B+ FOR RF, IF AND AUDIO CIRCUITS

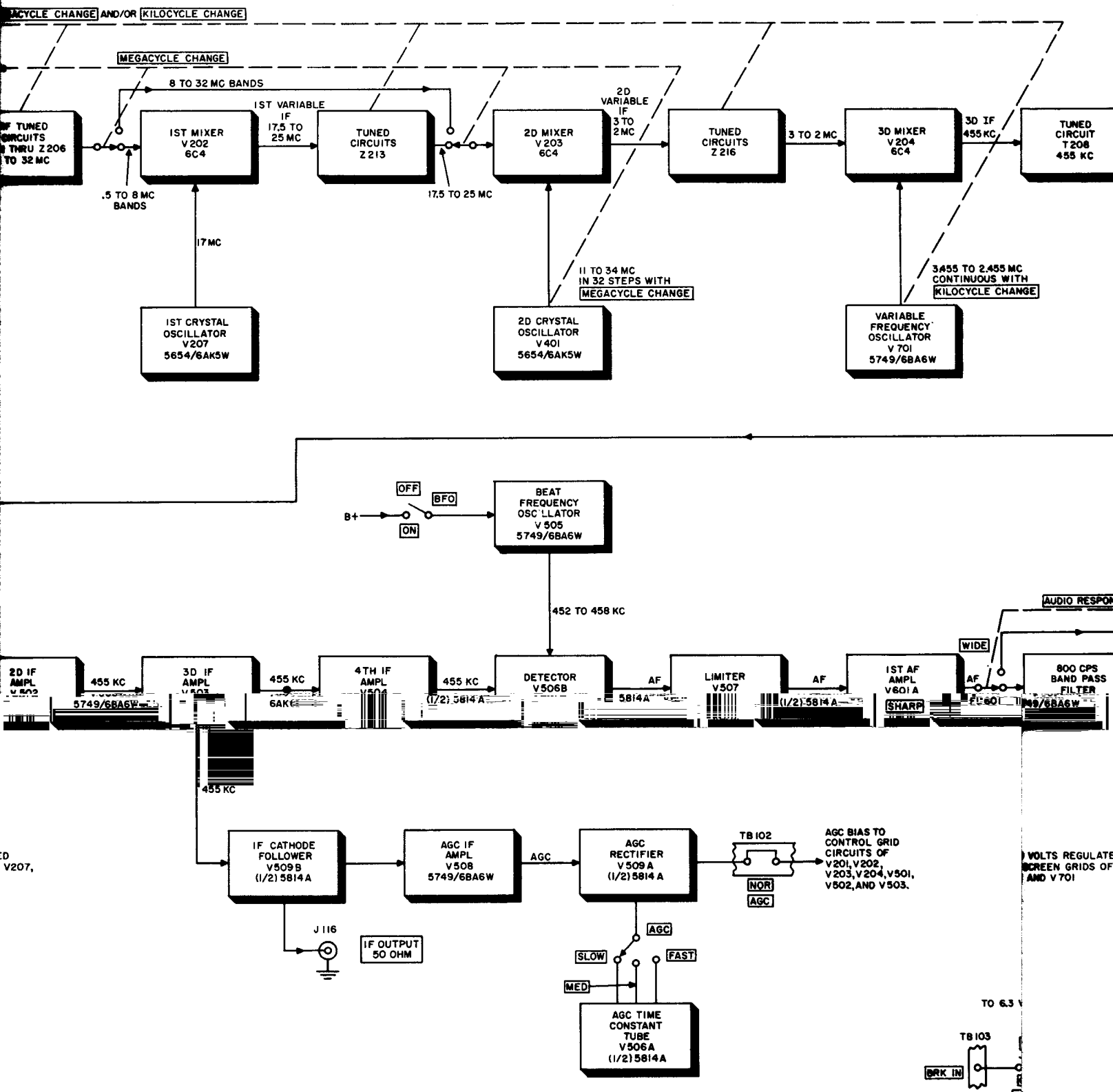
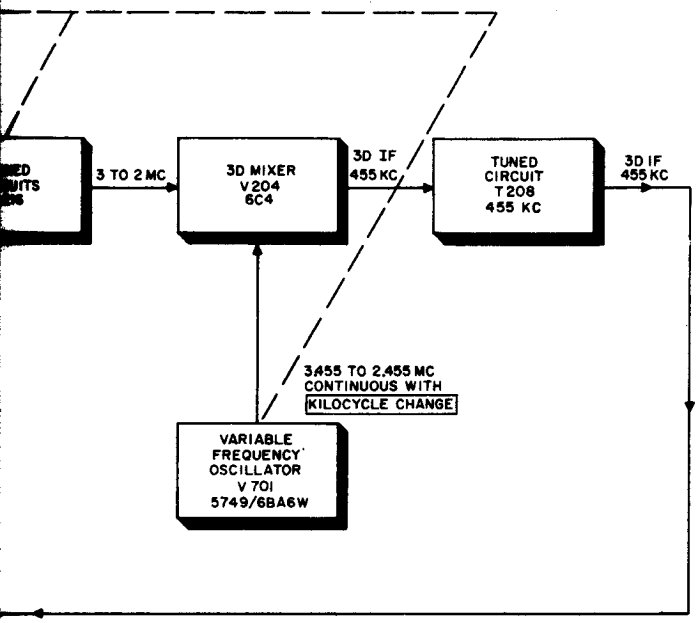
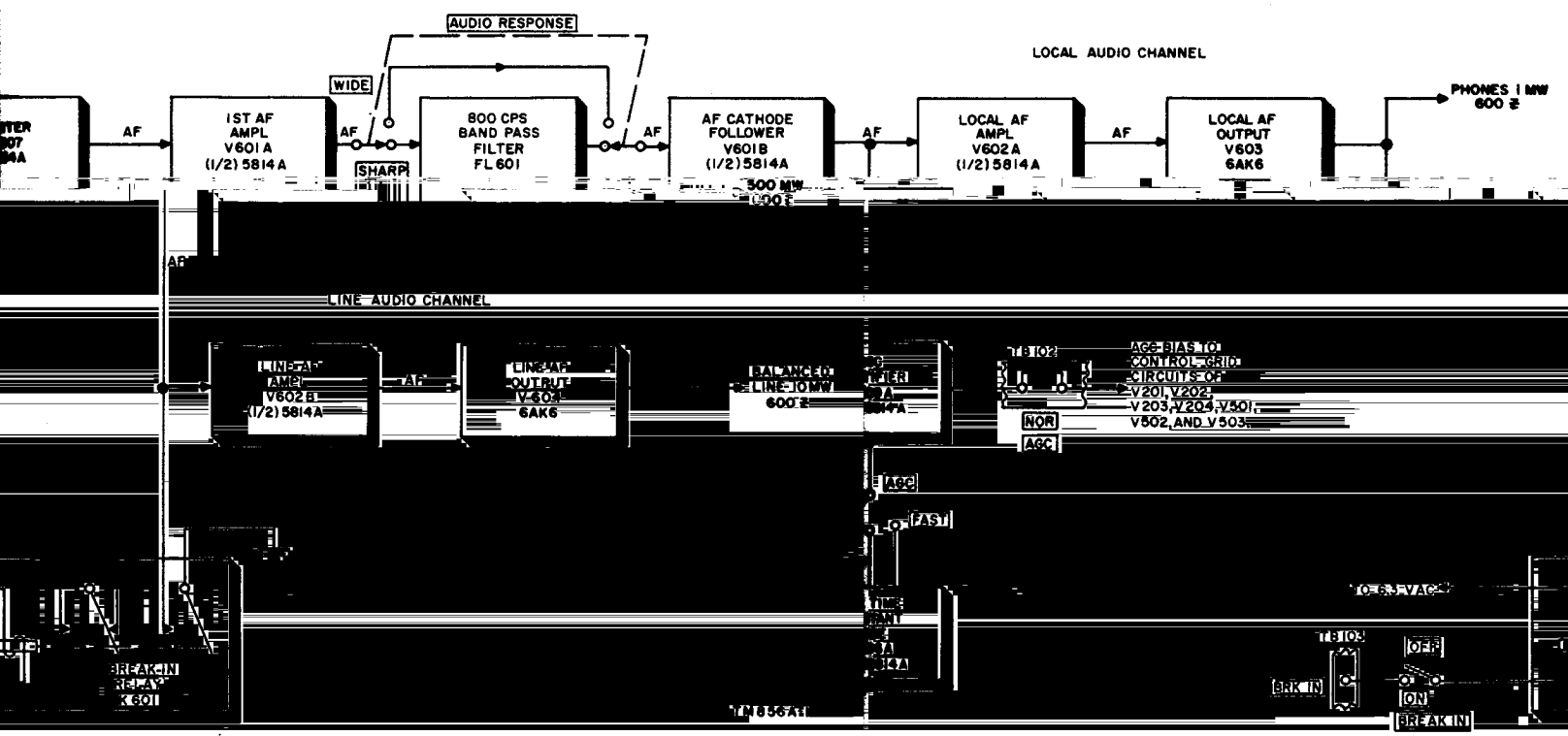


Figure 17. Radio Receiver R-390A/URR, block diagram.



NOTE:

REFERENCE SYMBOLS DENOTE:
101-200: MAIN FRAME
201-400: RF SUBCHASSIS
401-500: CRYSTAL OSCILLATOR SUBCHASSIS
501-600: IF SUBCHASSIS
701-800: VFO SUBCHASSIS
801-900: POWER SUPPLY SUBCHASSIS



block diagram.

f. The 17.5- to 25-mc output of the first mixer stage (when the receiver is tuned from .5 to 8 mc) or the 8- to 32-mc output from rf amplifier V201 (when the receiver is tuned from 8 to 32 mc) is selected by the operation of the MEGACYCLE CHANGE control and fed into second mixer V203. Also fed into V203 is a signal from second crystal oscillator V401. The output frequency of V401 is changed as the MEGACYCLE CHANGE control is operated so that the difference between these frequencies and the output frequency is always between 2 and 3 mc. When the frequency reading on the receiver dial is between 15 and .999 mc, V401 feeds a 20-mc signal into V203. When the frequency is between 1 mc and 1.999 mc, V401 feeds a 21-mc signal into V203. The output frequency of V203 thus varies downward from 3 to 2 mc, except on the .5- and 1-mc band, where the output frequency of V203 varies between 2.5 and 2 mc.

l. If signals (455 kc) present at the input to fourth if amplifier V504 are also fed to the input of if cathode follower V509B. This stage provides a 50-ohm source of 455-kc signals for use with a frequency-shift converter for teletypewriter operation. The IF OUTPUT connector for this type of service is located on the rear panel of the receiver. Tube V509B also feeds 455-kc signals into the agc circuit. The first tube of this circuit is agc if amplifier V508. This stage amplifies the 455-kc signal and feeds it to agc rectifier V509A. The rectifier stage rectifies the if signal into dc with amplitude in proportion to the average amplitude of the if signal. This agc bias is fed to the control grid circuits of V201 through V204 and V501 through V503. Tube V506A provides agc time constants of various durations when the AGC switch is set to various positions.

m. The B+ supply for the receiver is powered by a source of 115 or 230 volts alternating current (ac) at 60 cps. This ac power is changed into dc by rectifiers V801 and V802. A source of regulated 150 volts is provided by voltage regulator V605. This regulated voltage is used as a screen grid supply for V207, V401, and V701.

clips off noise peaks that might render reception difficult.

j. Beat-frequency oscillator V505 generates and feeds signals variable in frequency from 452 to 458 kc to detector stage V506B. The resultant beat frequency is adjustable continuously from 0 to 8,000 cps whether the bfo is above or below the carrier signal. Setting the BFO switch to the ON position turns on the bfo.

k. The audio output from limiter V503 is fed to first af amplifier V601A. This stage amplifies the audio signal and passes it through or around 800-cps band-pass filter FL601, depending upon the setting of the AUDIO RESPONSE switch. The audio signal is then fed to af cathode follower V601B. This stage feeds the audio signals to the local and line audio channels. The local audio channel consists of local af amplifier V602A and local af output tube V603. This audio source is used for 600-ohm headsets, loudspeakers, or special uses. The line audio channel is similar to the local audio channel, consisting of line af amplifier V602B and line af output tube V604. The output provided matches a balanced 600-ohm line.

ıal. Another
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NGE control

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CHANGE
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filter Y501,
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and V504,

ifier, V504,
V506B and
d. This af
507, which

This is the second variable if sign
set of triple-tuned coils, Z215, tune
of V203 as the KILOCYCLE CHA
is operated.

g. The 3- to 2-mc output of the s
and its tuned output circuit Z216 is
input circuit of third mixer V204.
beats the 3- to 2-mc signal with a
variable signal from variable-freq
lator V701. This precision oscillato
racy comparable with a frequency s
is controlled by the KILOCYCLE
control. The output of V204 is a fixe
of 455 kc. This is the third if.

h. The 455-kc signal is fed into
455-kc crystal filter Y501, as determ
setting of the BANDWIDTH con
this control is in the .1 KC or 1 KC
455-kc signal is fed through crystal
and in any other position it is bypa
the filter directly to first if amplifie
output of V501 is fed into one of fo
ca. limiters. The output from the sel
fed successively through the second,
fourth if amplifiers (V502, V503,
respectively).

i. The output of the fourth if ampli
is fed into half-wave diode detector
audio-frequency voltage is produce
signal is fed to the limiter stage V5

Section II. CIRCUIT ANALYSIS

53. General

Radio Receiver R-390A/URR consists of a main frame and six subchassis. These are the rf subchassis, variable-frequency oscillator (vfo) subchassis, crystal-oscillator subchassis, if subchassis, af subchassis, and the power-supply subchassis. The receiver is constructed on this basis for easier repair and replacement.

54. Antenna Circuit

(fig. 18 and 19)

The antenna circuit provides an efficient means of matching antennas of various characteristics to rf amplifier V201.

a. The BALANCED ANTENNA connector, J104, has a characteristic impedance of 125 ohms. It can accommodate two-wire antenna systems such as doublets with either twisted pair or coaxial transmission lines in the range from 50 ohms to twin-lead transmissions lines in the vicinity of 200 ohms without serious mismatch. It is also suitable for long wire antennas when one side of J104 is connected to ground. UNBALANCED ANTENNA connector, J103, is provided for whip antennas, long-wire antennas and random-length, single-wire antennas.

b. Antenna relay K101 is actually two relays operated as a single unit. During conditions of standby, calibration, or break-in operation, both sections of K101 are energized. Relay K101A opens the antenna coil primary circuit and grounds both of the wires of a two-wire antenna system. This opening and grounding of the antenna circuit attenuates the antenna signal input well over 40 decibels (db). Relay K101B accomplishes the opening and shorting for ure for a single-wire antenna system and the esulting attenuation is also well above 40 db. Resistor R121 drains static charges that may accumulate on a single-wire antenna because of mobile operation. Neon lamp I103 ignites and shorts to ground momentarily whenever the radio frequency potential at J103 exceeds 80 to 90 volts. The source of relay power is approximately 20 volts dc from CR102, a bridge rectifier located in the rear section of the main frame of the receiver. The antenna signals that pass through the antenna relay circuit feed through miniature coaxial connectors J105 through J107, and P205 through P207 to MEGACYCLE CHANGE switch section S205, S202, and S201 respectively.

c. Figure 19 shows rf band switches S201 through S205 in the .5- to 1-mc. positions. This corresponds to the MEGACYCLE CHANGE dial setting of 00. The two-wire antenna signals are fed through S201 and S202 to the proper coil corresponding to the MEGACYCLE CHANGE dial setting. The two-wire antenna is balanced across the primary of antenna transformer T201 by series-connected capacitors C201A and C202. The lower capacitor is fixed and the upper is adjustable, which allows for optimum adjustment of the balance. When a whip or random-length single-wire antenna is used, connection is made to the appropriate coil through S205. Capacitor coupling through C204 provides good signal transfer between the antenna and coil for a wide variety of antennas. The secondary windings of the antenna transformers are permeability tuned by powdered-iron cores that are inserted into the coils by the mechanical tuning system.

d. Capacitor C201B is placed across the secondary of T201 for alignment purposes. It is aligned when ANT TRIM capacitor C225 is set at 0, its midposition. Generally, antennas contain a reactive component as well as a resistive component; ANT TRIM capacitor C225 is used for cancelling this reactive component to obtain maximum signal transfer from the antenna to the input of the receiver. The tuning effect of this control is more pronounced with an antenna connected through the UNBALANCED ANTENNA connector (fig. 19) because of the capacitor coupling (C204), which presents a capacitive reactance. Capacitor C203 is also connected across L213 in parallel with C201B and C225. This provides the balance of capacitance necessary to tune L213 to resonance at the correct frequency. Because a given amount of capacitance change will cause an ever increasing change in frequency as the resonant frequency increases, both sections of C225 are

connected across L213 (par. 80*e*). This is done to maintain the range of C225 consistent on all frequency bands.

e. The rotor of the rear section of switch S204 shorts adjacent secondary winding T203. This prevents transformer interaction that would otherwise occur. The front section of S204 selects the proper antenna transformer and connects it to the control grid of rf amplifier V201 through the grid-leak network of

R233 and C255. Resistor R233 and capacitor C255 add to the negative bias from the agc line at the control grid of V201 when extremely strong signals cause grid current to flow. This short time-constant network improves the cross-modulation and blocking characteristics of the receiver when the interfering signal is strong enough to cause grid current in the V201

Test point E208 is located on the rf subassem-

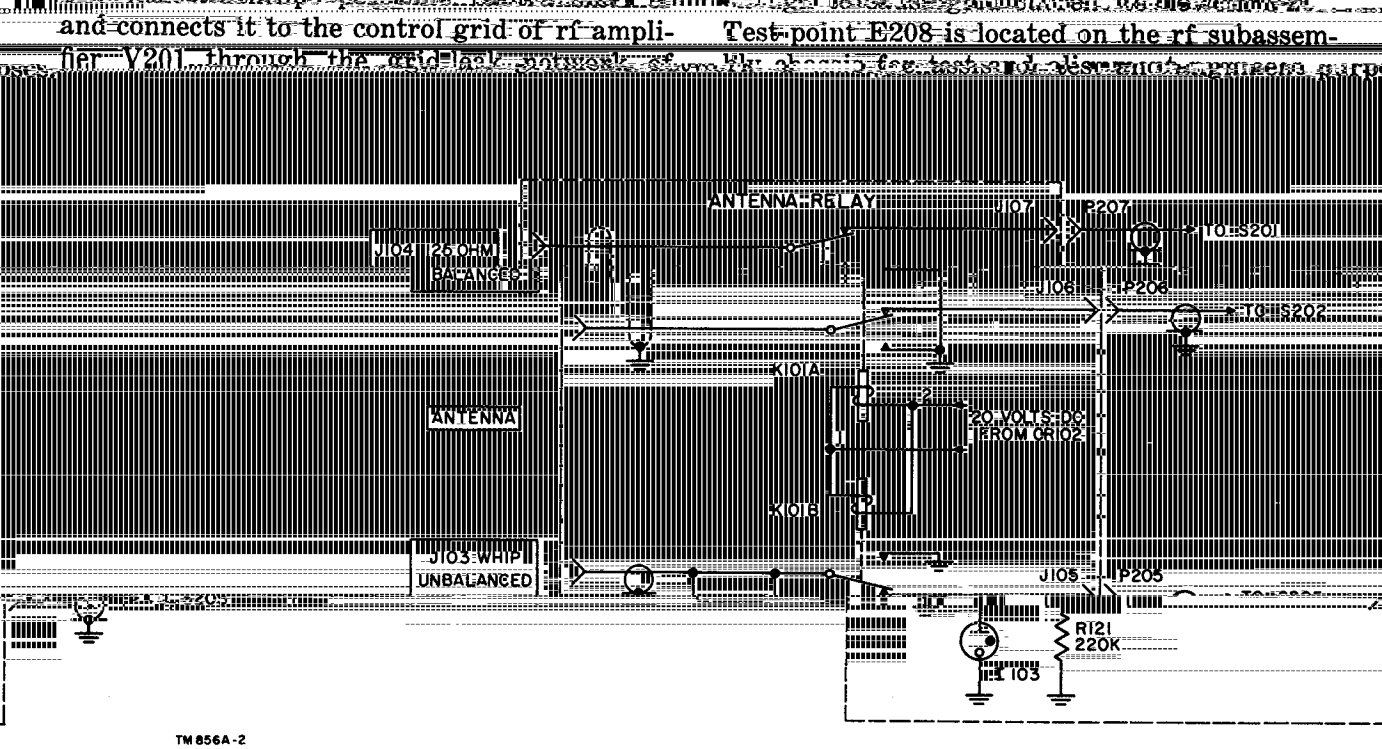


Figure 18. Antenna circuit, schematic diagra

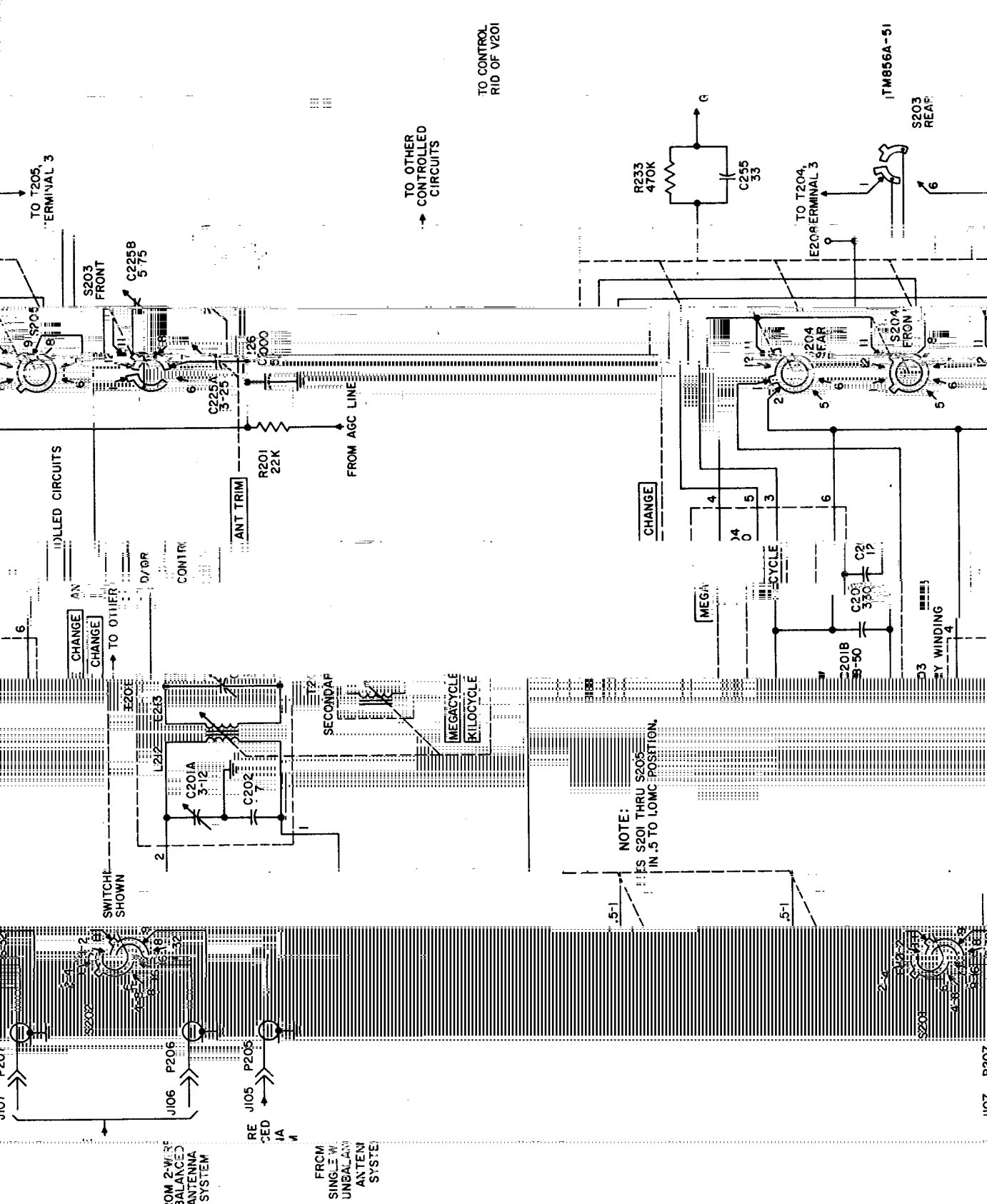
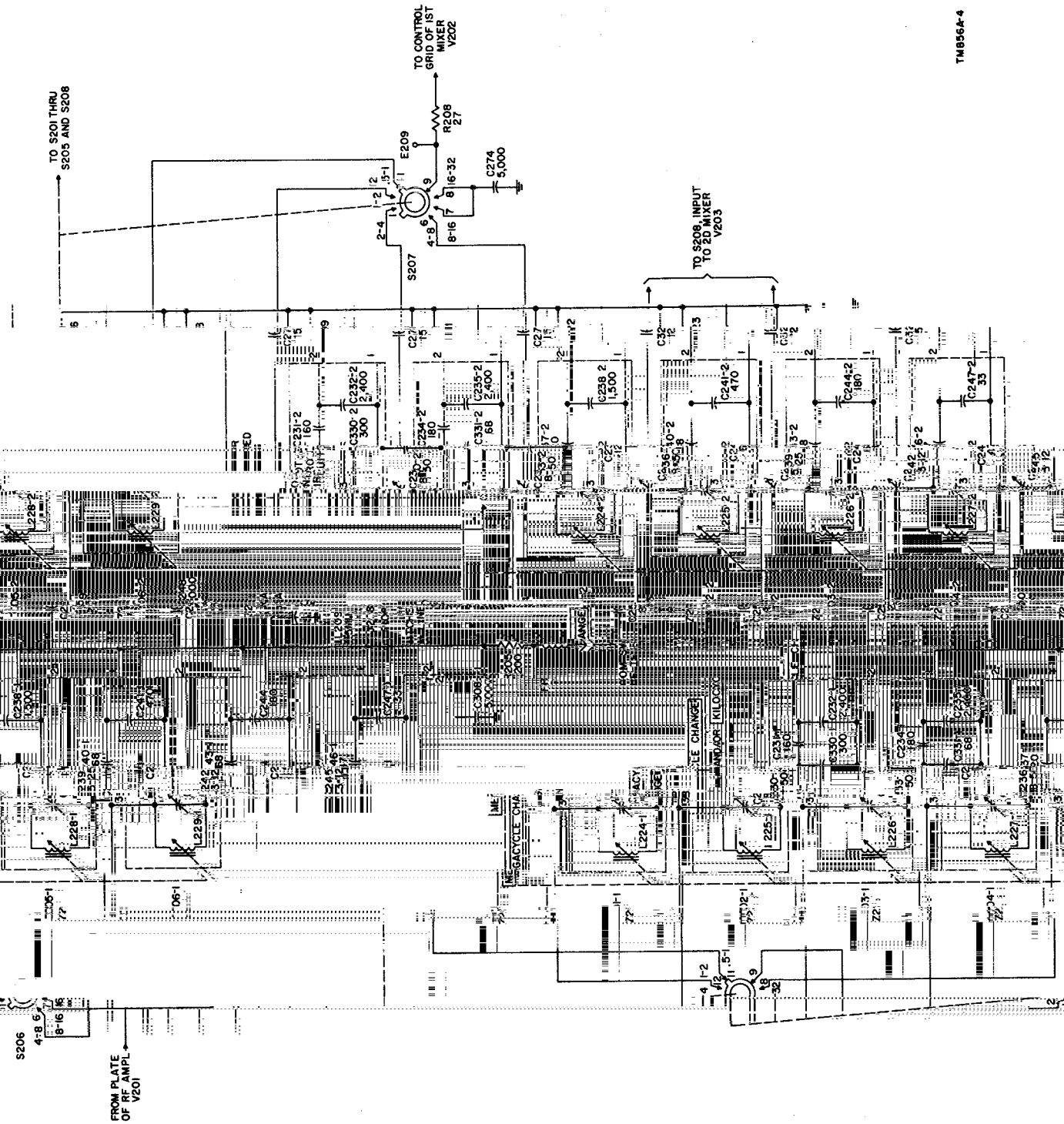


Figure 19, Switches S201 through S205, schematic diagram.

tor to ground. Plate voltage for V201 is obtained from the switched rf-if B+ line through the decoupling network of R205 and C248. Rf choke L200 and capacitor C208 provide additional isolation at the junction of R204 and R205. From the R205 point, the voltage is connected to the number 1 terminals of Z201-1 through Z206-1 (fig. 21 and 106, over-all receiver schematic diagram) and then through the No. 3 terminal of the tuned circuit selected by switch S206. Parasitic suppressor E212 is a small carbon resistor with a few turns of wire wound in



ches S206 and S207, schematic diagram.

Figure 21. Swit

parallel with the resistor. This device presents a high impedance to parasitic oscillations in the multimegacycle range.

d. Switch section S206 of the MEGACYCLE CHANGE switch selects one of the six tuned circuits Z201-1 through Z206-1 (fig. 21 and 106), depending upon the setting of the MEGACYCLE CHANGE control. The coils are permeability tuned by the KILOCYCLE CHANGE and/or the MEGACYCLE CHANGE controls. A ferrite slug is used in each coil. The variable capacitors and the fixed capacitors in Z201-1 and Z201-2 resonate the coils at the high-frequency point of the range. The antenna coupling capacitor C231 couples the signal from Z201-1 to Z201-2. The value of this capacitor is such that the coupling is fed from the antenna is slightly less than critical. Tuned circuit Z201-2 is similar to Z201-1 except that capacitor C276 is connected across L234-2 (by way of switch section S206-1) to compensate for the plate capacitance of previous stage V201. The control grid grounds through the decoupling network of R222 and capacitors C232 and C284; and rf choke L208, and then through the agc circuit when the FUNCTION switch is on AGC, and directly to ground when the FUNCTION switch is on MGC (fig. 104). Resistor R208 is a parasitic-suppressing resistor, and test point E209 is provided for testing and alignment. The cathode of V202 is returned to ground through the bias resistor R209, bypassed by C277, through connectors P221 and J221, which are miniature coaxial types and mate to form the base connection of the rf output transformer of first crystal oscillator V207. The cathode is the point at which the 17-mc signal is injected into the mixer stage. The screen grid of V202 is fed from the switched rf-if B+ line through the decoupling network of R212 and C280, and is bypassed to ground through rf choke coil L209 and bypass capacitor C308, and L232-1 of Z213-1. The control grid grounds through series-connected capacitors C231-2 and C232-2, to minimize the loading of Z201-2 by first mixer V202, and permit the Q of the circuit to remain high enough for good selectivity. By use of this tapping down across the tuned circuit, the rf amplifier gain on each of the six bands is approximately 14 db. The desired tuned circuit is selected by MEGACYCLE CHANGE switch section S207 through parasitic-suppressing resistor R208 to the mixer control grid. E209 is a test point for testing and alignment.

e. Figure 21 shows the complete switching system of switches S206 and S207. The outputs of Z205-2 and Z206-2 (fig. 106) are routed around first mixer V202 and fed directly to second mixer V203. Double conversion, rather than triple conversion, is used on the 8- to 16-mc and 16- to 32-mc bands to keep the second variable intermediate frequency between 3 and 2 mc.

56. First Mixer V202 (fig. 22)

a. The grid circuit of V202 is re
ground through grid resistor R231, t

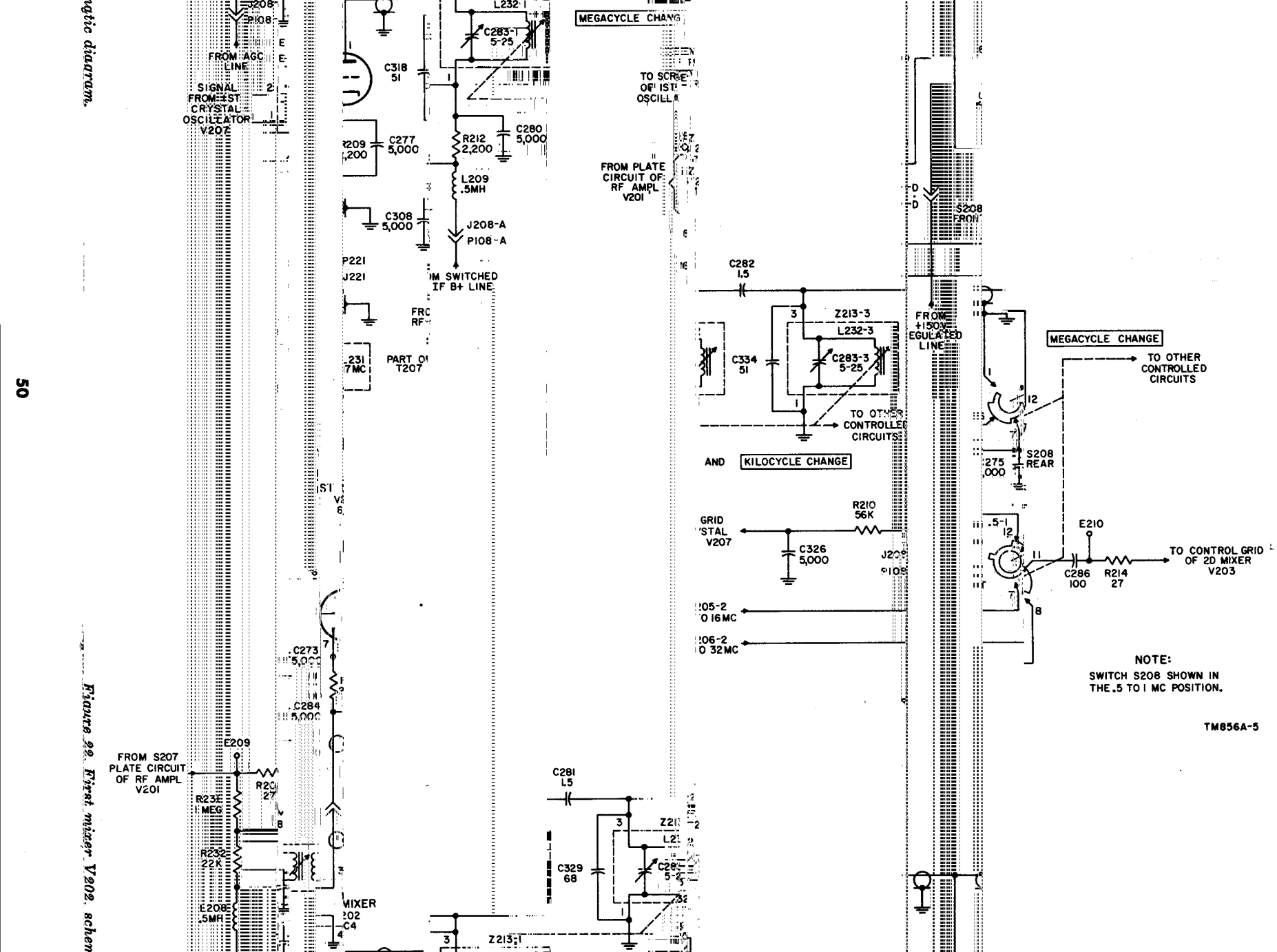


Figure 22. First mixer V202, schematic diagram.

tuned circuit Z205-2 is connected to the control grid of second mixer V203. When the 16- to 32-mc range is being used, terminal 2 of Z206-2 is connected to the control grid of V203.

57. First Crystal Oscillator V207

(fig. 23)

A miniature-type 5654/6AK5W tube is used to generate a stable 17-mc crystal-controlled signal for cathode injection into first mixer V202. This stage is operative on the .5- to 1-mc, 1- to 2-mc, 2- to 4-mc, and 4- to 8-mc ranges as controlled by the MEGACYCLE RANGE control on the front panel of the receiver.

a. Crystal Y201, 17 mc, in the grid circuit of V207-1 is contained in crystal holder HD200 and is heated and maintained at a temperature between 72° and 78° centigrade (162° to 172° fahrenheit). Resistor R207 is the grid resistor. Capacitors C324 and C325 form an approximately ten-to-one voltage divider for feed-back voltage for maintaining oscillation. Coil L201 isolates the 17-mc voltage from ground while maintaining the cathode of V207 near dc ground potential. This circuit is a modification of an electron-coupled Colpitts oscillator, as evidenced by the cathode choke, the voltage-dividing capacitors across the grid circuit, and the tap back to the cathode. The screen grid is held at rf ground potential by feed-back capacitor C326.

b. Plate voltage is applied through connectors P108-K and J208-K, through the decoupling network of R211 and C328, and through the subchassis. Plate voltage for second mixer V203 is obtained from the switched rf +B line through connectors P108-A and J208-A, choke coil L209, the plate decoupling network of R216, C308, C288, and coil L233-1 in Z21

b. Triple-tuned circuits Z216-1, Z216-2, Z216-3 tune to the difference frequency of incoming control grid and cathode sign These three tuned circuits are coupled by C and C290, and provide an essentially flat ba pass. Test point E211 is for testing and ali ment, and R230 is a parasitic-suppressing re tor. The signals from the second crystal osci tor are of such frequency that the differe between the signal on second mixer grid V and the oscillator signal injected at its cath lies between 2 and 3 mc. This difference quency is the second variable if. Because

58. Second Mixer V203

(fig. 24)

The second mixer stage uses a min 6C4 triode. Second mixer V203 co the signal on the control gric mixer V202 when the receiver is tu 5 to 8 mc, and 8 to 32 mc from the rf V201 when the receiver front section of S208 (fig. 22).

a. The grid circuit is retur through parasitic-suppressing grid resistor R213, and the dec connection continues through connecto and P108-E and to the agc circuit Agc bias is fed to the control grid FUNCTION switch is on the AGC po the agc line is grounded when the F switch is set to MGC. The cathode i to ground through the cathode-biasi pass network consisting of R215 and coaxial line, connectors P215 and finally through the secondary windin Transformer T401 is in the crysta netw

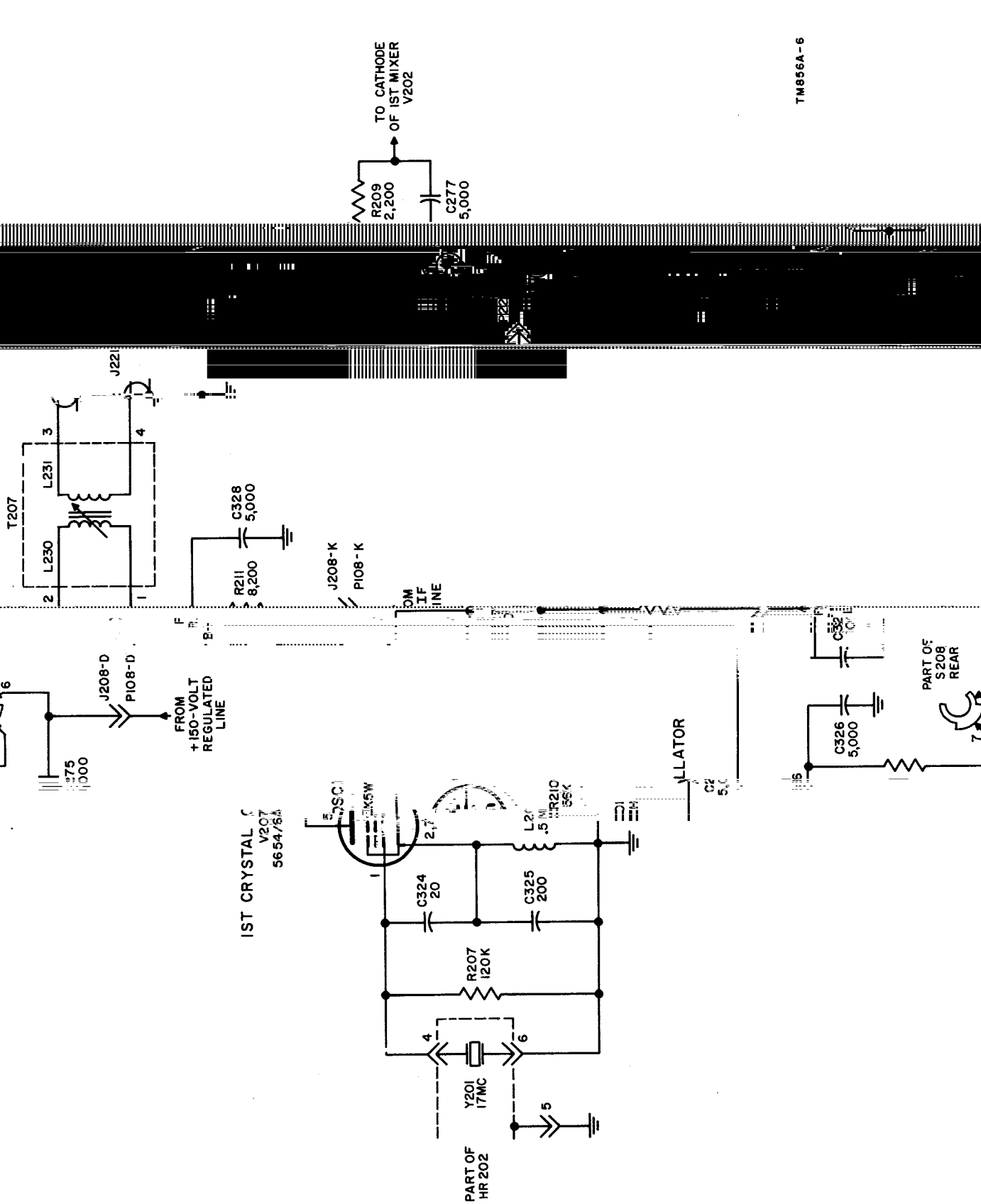


Figure 23. First crystal oscillator V207, schematic diagram.

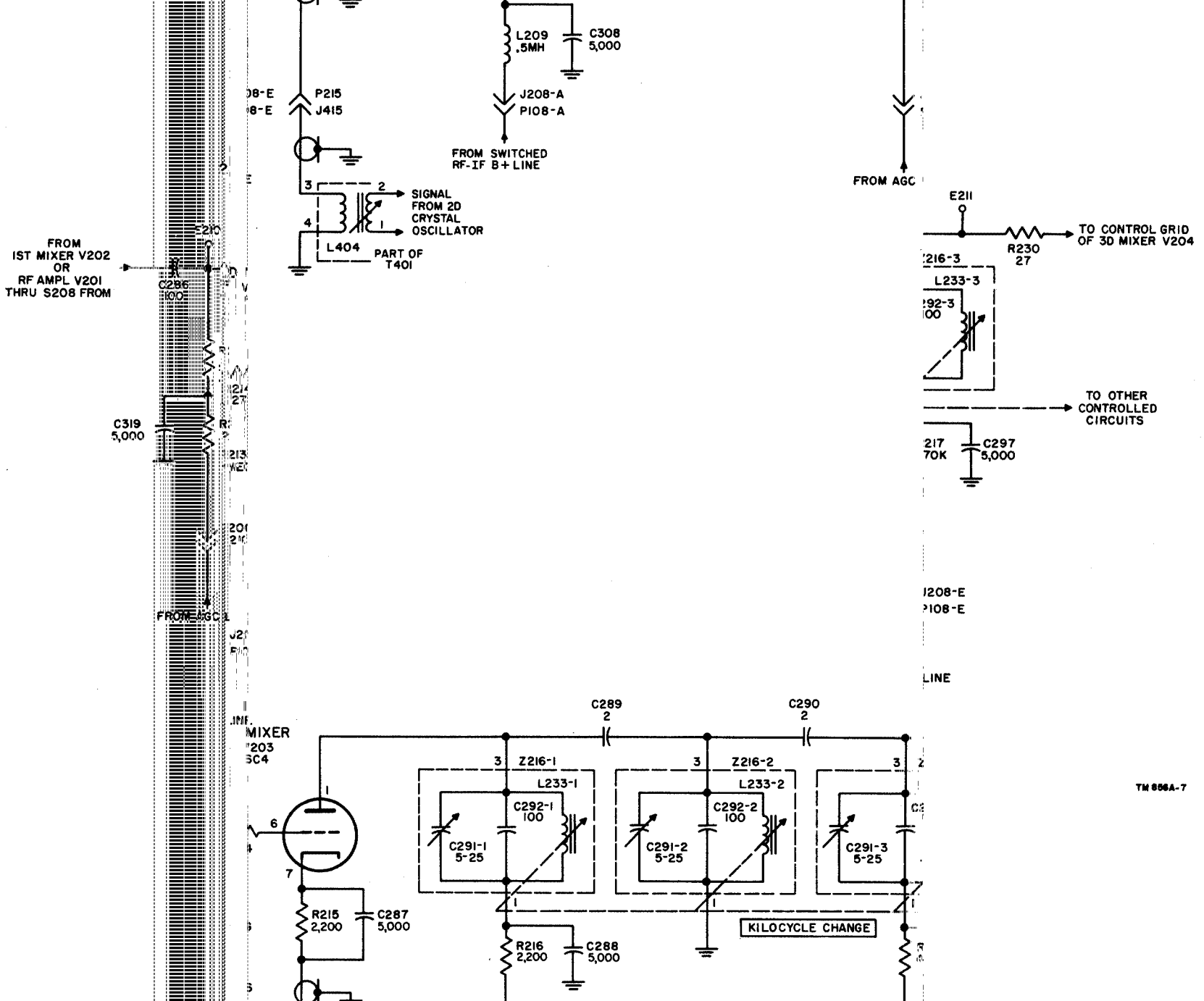


Figure 24. Second mixer V203, schematic diagram.

second crystal oscillator frequency from V401 always is above the signal frequency, an increase of the signal frequency results in a decrease of frequency for the second variable if. When the receiver is tuned to 5 mc, the second crystal oscillator feeds a 20-mc signal to the cathode circuit of second mixer V203. This beats with a 17.5-mc signal from first mixer V202. The resultant difference frequency is 2.5 mc.

26) the selection depending upon the operating frequency of the receiver. Resistor R404 (fig. 25) is the dc return to ground for the control grid, and uses capacitors C408 and C409 in an approximately ten-to-one voltage divider across the grid circuit. The cathode is connected at the junction of these two capacitors, and is maintained above rf ground by rf choke coil L401. This oscillator is a modified electron-coupled circuit, as distinguished by the cathode

rotary switches (fig. 25), which select certain crystals and resonant plate circuits for the oscillator. A total of 15 crystals is used to produce 24 different output frequencies and 32 frequency selections. This is done by operating the

harmonic.

Each crystal V401

the second crystal oscillator feeds

signal into the cathode of the second

mc.

59. Second Crystal Oscillator V
(fig. 25 and 26)

Second crystal oscillator V401

generates and feeds

of the series-connected capacitors and the cath-

tions ranging

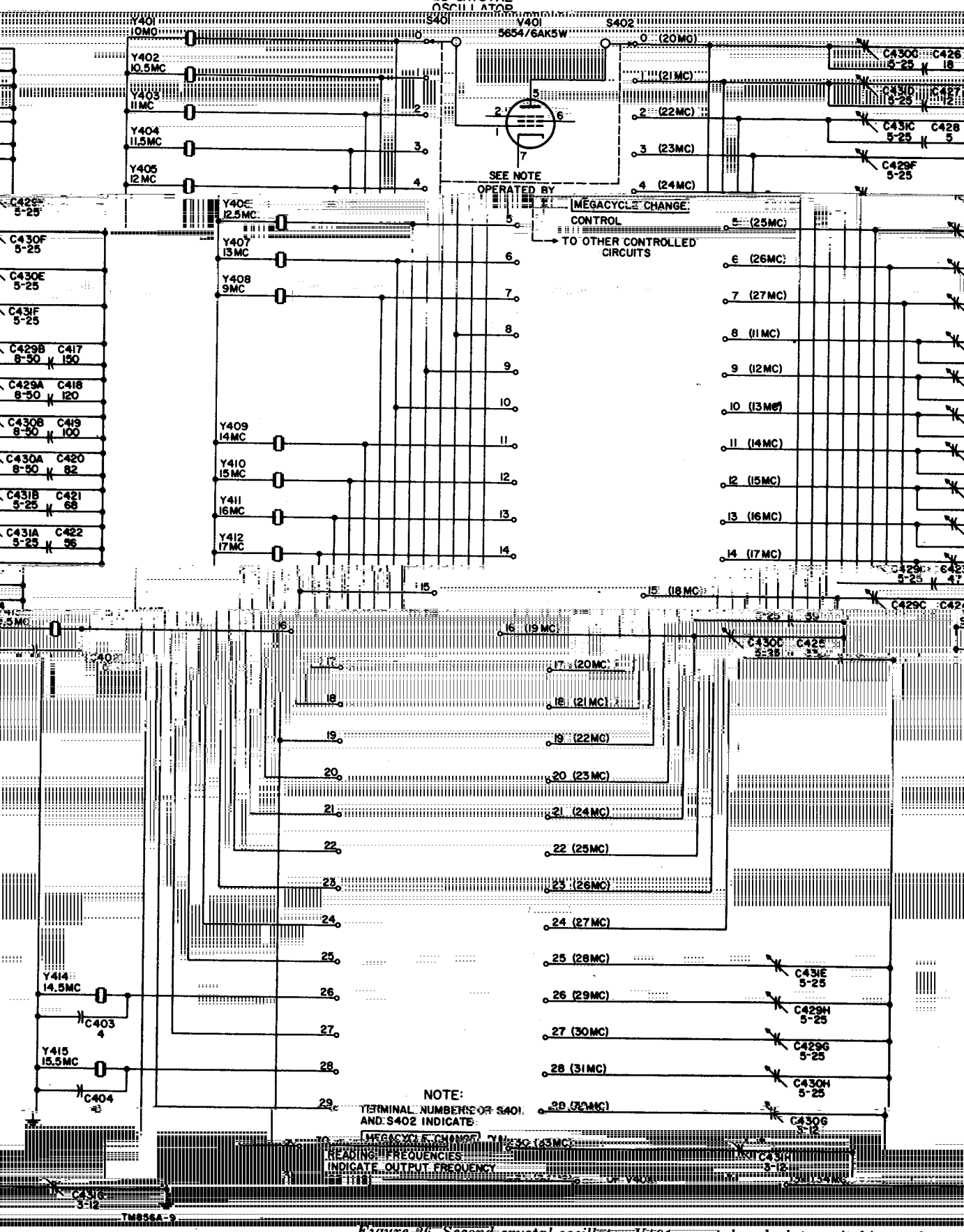


Figure 26. Second crystal oscillator V401, crystal and plate switching, schemat

ic diagram.

at the control grid of V401 and provides a convenient test point for checking the oscillator stage. This point is normally between 4 and 11 volts negative with respect to ground.

b. The plate voltage is supplied from the rf-if B+ line through connectors P110-A and J410-A, two stage-decoupling networks consisting of R407, R406, C413, C412, and C411, and finally through the primary of T401, coil L403. The screen grid is fed from the +150-volt regulated line through connector P110-A and C410C, and decoupling network R405 and capacitor C401.

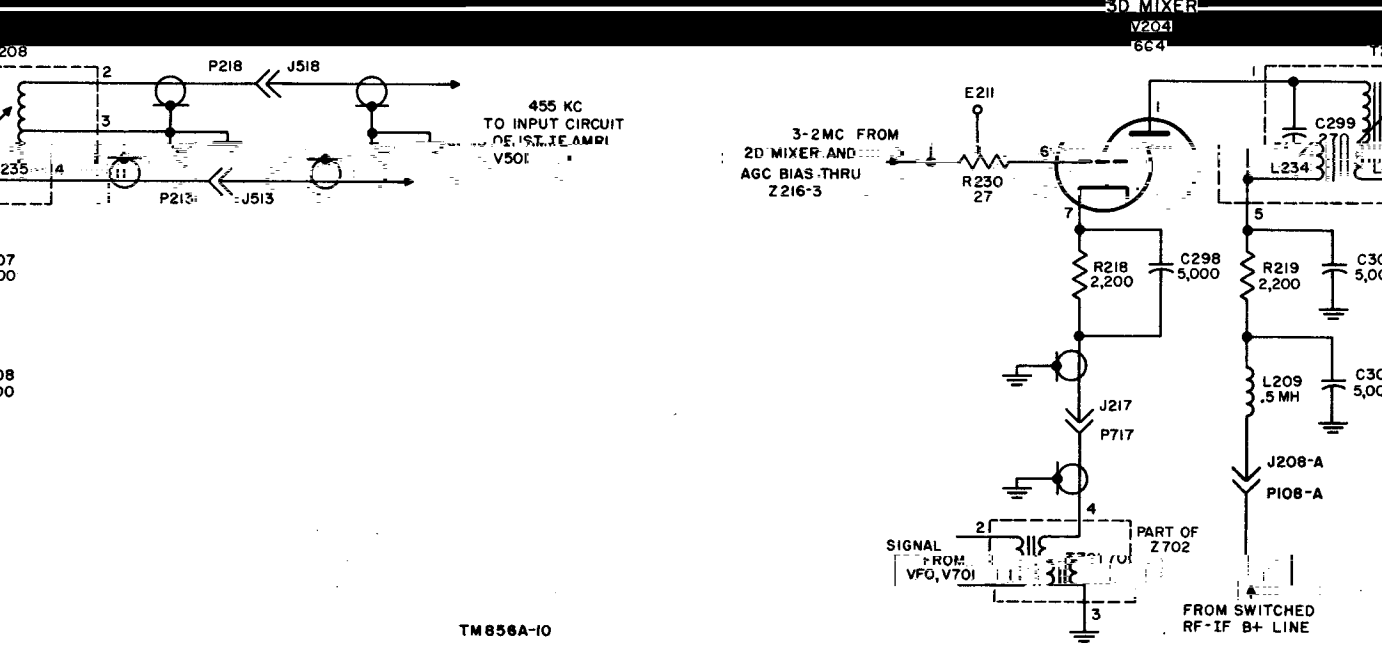
c. The output circuit is tuned to one of 32 various frequency selections by the use of one crystal and the use of one of 24 resonant circuit selections. The latter is accomplished by the setting of S402 which connects one of the 24 capacitor selections across the circuit. The actual output frequency of the oscillator is 11 mc (position 8) to 24 mc (position 31). At the 12 lowest oscillator frequencies, the oscillator inductance is increased by additional fixed capacitance (fig. 26). The rf choke L209, voltage dropping and decoupling network R219 and capacitors C308 and C306, and primary coil L234 of T205 [illegible] testing and alignment. The cathode of V204 is fed with variable frequency oscillator signals through the secondary winding of T701 in tuned circuit Z702, through coaxial cable, miniature connectors P717 and J217, coaxial cable, and the cathode biasing resistor and bypass combination of R218 and C298. Plate voltage for the circuit is furnished from the switched rf-if B+ line through connectors P108-A and J208-A. This is done to tune L403 to resonance at these lower frequency ranges.

60. Third Mixer V204

(fig. 27)

Third mixer V204 uses a miniature-type 6C4 tube to heterodyne the 3- to 2-mc output signals from second mixer V203 with the continuously variable signals from variable frequency oscillator V701. The frequency range of V701 is precisely 3.455 mc to 2.455 mc. The resultant fixed third intermediate frequency is the differ-

a. Ground return and age bias for the grid of V204 is fed through tuned circuit Z216-3 of the second mixer stage (fig. 24). Resistor R230 is the grid circuit parasitic suppressor and E211 is [illegible]



204, schematic diagram.

Figure 27. Third mixer V

b. As the receiver frequency increases, the second variable intermediate frequency at the grid of V804 decreases and the cathode signal likewise decreases. The rate of change of these two signal sources is such that the plate circuit at all times is tuned to a constant difference frequency of 455 kc. Coil L234 is tuned by adjusting the powdered-iron slug in the coil. The secondary coil of T208, L235, is center-tapped. The two signals are 180° out of phase with each other and are fed through P218 and J518, and P213 and J513 to the input circuit of first if amplifier stage V501 in the if subchassis. The first if amplifier stage is discussed in paragraphs 62 and 63.

and variable capacitor C706. The secondary coil of T701 and ... C706 are shunted by R704, a 150-ohm resistor. This resistor ... ens the response over the rang... 2.455 kc so that the output volta... the cathode of the third mixer is... stant in amplitude with freq... pedance match from the plate ... to the cathode circuit of V204 i...

d. The sealed tuning unit is ... vice comparable in accuracy ... laboratory frequency standard ... and not intended to be repaired ... L701 is tunable, and is the ... This adjustment ... vide the co... vfo tuning shaft. ... be used to restore ...

... *end point* adjustment ... made at the factory to pro... complete frequency range of precisely ... The adjustment of L701 can ... the 3.455- to 2.455-mc 10-turn ... ft travel if circuit ... (fig. 28)

Variable-frequency oscillator V701 uses a ... miniature-type 6AQ7/6BA6W tube, which gen... erates the signals fed to the cathode circuit of ... frequency coverage to change appreciably ... the third mixer. The frequency range of V701 is precisely 3.455 mc to 2.455 mc. The frequency-determining elements of this circuit are con... the OVENS switch on the rear panel is in the ON position (fig. 102).

a. The variable-frequency oscillator is an electron-coupled Hartley oscillator. The screen grid acts as the plate of an equivalent triode oscillator circuit. A powdered-iron slug in coil L702 is moved in the coil by the operation of the KILOCYCLE CHANGE control. Coils L701 and L702 with capacitors C701, C702, and C703 form the frequency-determining circuit. Capacitor C704 and resistor R701 develop grid leak bias on the control grid of this tube.

b. The screen grid voltage for V701 is obtained from the +150-volt regulated line and is connected through connectors J709-B and P109-B ... work consisting of R702 and C714. Capacitor ... circuit. The plate voltage for V701 is supplied ... A and J709-A, through the plate decoupling ... network consisting of R709, C707, and C708. ... adjustment, neutralizes the crystal holder and stray circuit capacitance. When this capacitor is properly adjusted, extremely narrow and ... of T701 ... symmetrical band-pass with steep sides is pro...

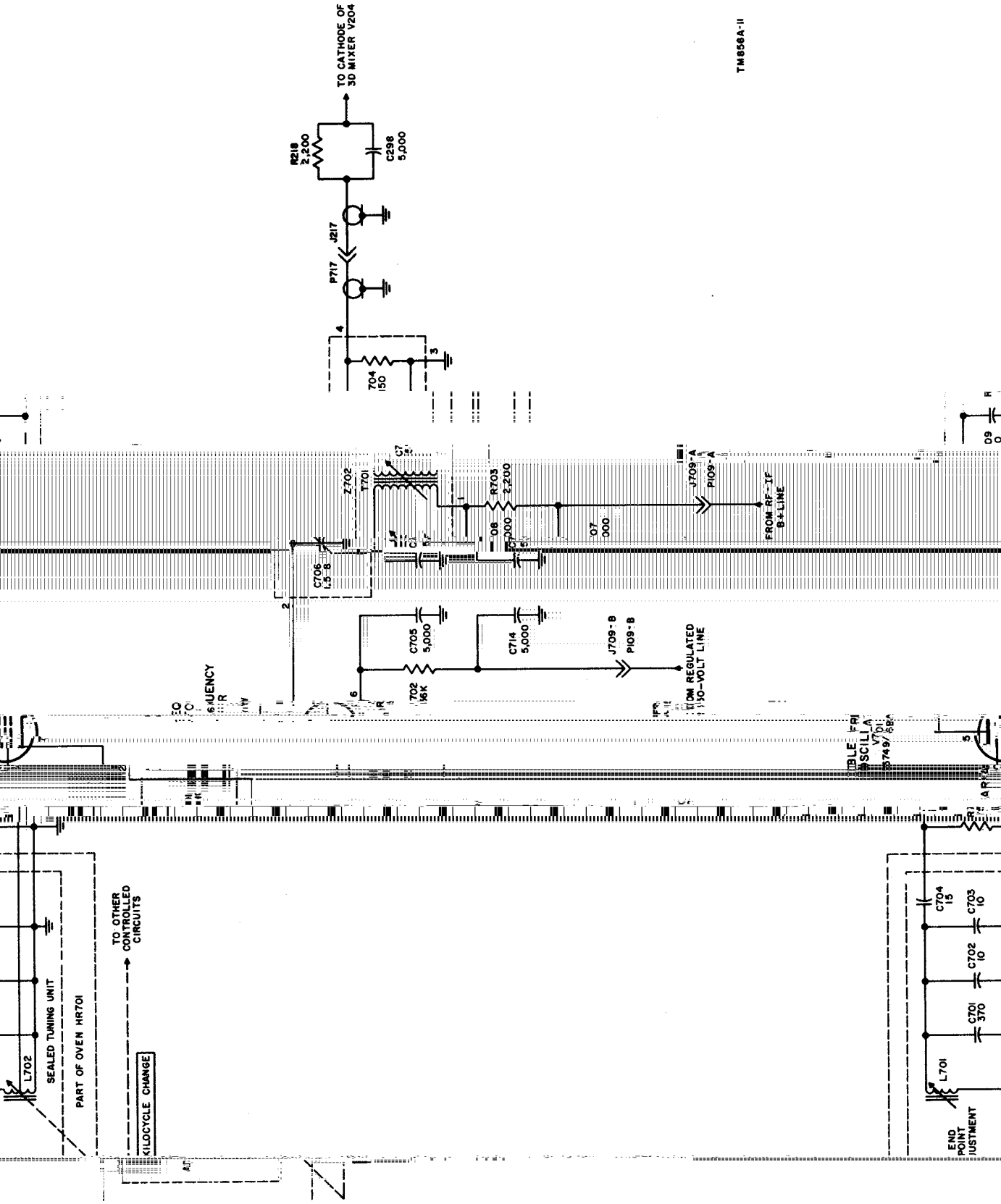
62. Crystal Filter

(fig. 29)

... filter, contains the properties ... nant circuit consisting of ca... tance, and resistance. To ob... bandwidth, a crystal filter, co... circuit Z501 with 455-kc crys... preceding the first if amplifie...

a. The 455-kc output signal from thi... V204 is coupled to the if subchassis ... transformer T208. The secondary wi... this transformer has its center tap g... thus placing the ends of the coil 180 ... phase with each other. This coil is ... through coaxial cables and connecto... and J518, and P213 and J513 into cry... Z501. Because of its high Q, crystal Y5... only those signals at or very close t... Because of crystal holder capacitance and stray ... circuit capacitance, the circuit would be unbal... anced. A neutralizing capacitor, C520, were no... also connected to the control grid of V501. This ... capacitance introduces a signal 180° out of ... phase at terminal 1 of Z501, and with proper ... and the primary winding of T701.

b. The plate circuit of V701 consists of ... circuit Z702, which includes the primary ...



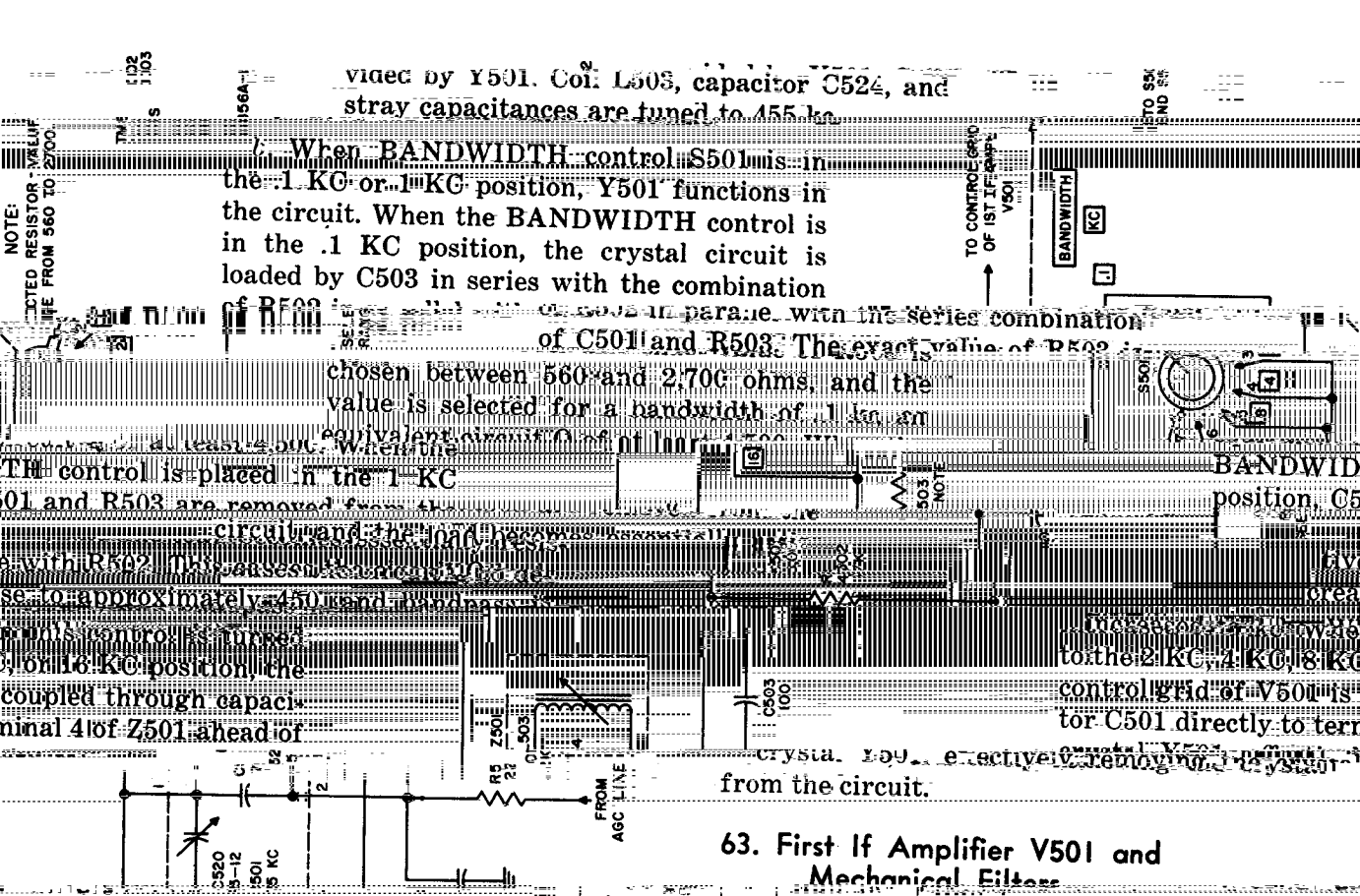
re 28. Variable-frequency oscillator V701, schematic diagram.

Figu

vided by Y501. Coil L503, capacitor C524, and stray capacitances are tuned to 455 kc.

When BANDWIDTH control S501 is in the 1 KC or 1 KC position, Y501 functions in the circuit. When the BANDWIDTH control is in the .1 KC position, the crystal circuit is loaded by C503 in series with the combination of R503 in parallel with the series combination of C501 and R503. The exact value of R503 is chosen between 560 and 2,700 ohms, and the value is selected for a bandwidth of 1 kc at least 50% when the equivalent circuit Q of the inductor

TH control is placed in the 1 KC
501 and R503 are removed from the
circuit and the input
e with R502. This causes
se to approximately 450
ol is tuned
or 16 KC position, the
coupled through capaci-
minal 4 of Z501 ahead of



crystal Y501 effectively removing the crystal from the circuit.

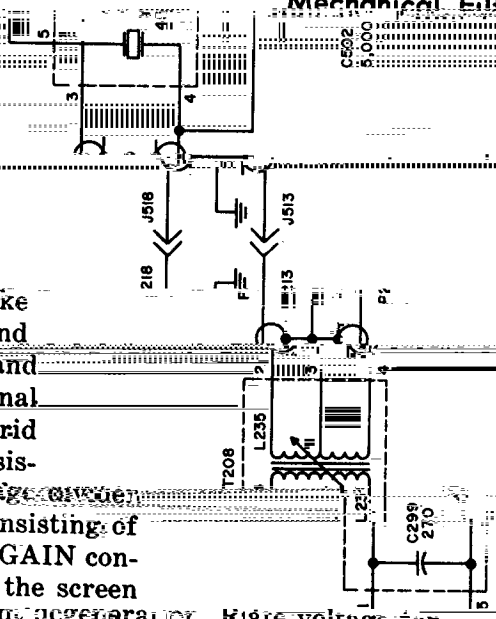
BANDWID
position, C5
increases the bandwidth to the 2 KC, 4 KC, 8 KC
control grid of V501 is
tor C501 directly to ter

63. First If Amplifier V501 and Mechanical Filters

(fig. 30)

First if amplifie
5749/6BA6W pent
the 455-kc if sign

er V501 uses a miniature-type
tode tube. This stage amplifies
ntrol grid of V501 is returned to the
rough the crystal filter circuit (fig.
cathode circuit returns to ground
L501, connectors J512-16 and P112-16, and
GAIN control R108. Capacitors C505 and
04 prevent degeneration and add additional
passing for if signals to ground. Screen grid
tage is obtained from the junction of resis-
R506 and R505, part of a voltage divider
across the switched rf if B+ line consisting of
resistors R506, R505, R504, and RF GAIN con-
trol R503. Capacitor C506 bypasses the screen
grid to prevent degeneration. Plate voltage for
V501 is obtained through
oupling filter consisting of R508 and
ate voltage for the plate and screen grid
circuits is obtained through
from the switched rf if B+ line.



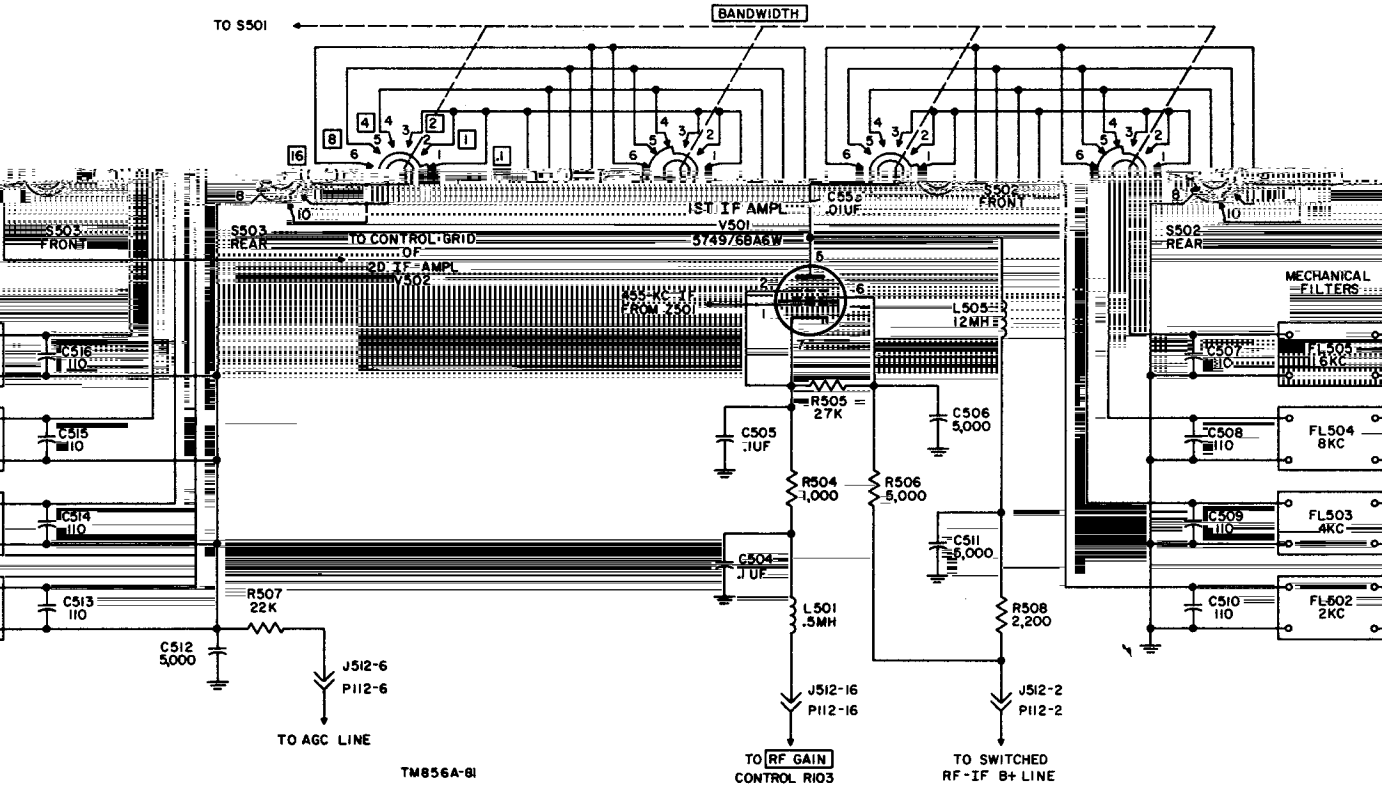
a. The co
agc line th
29). The
through
coil
C50
byp
volt
tor

b. Four mechanical filters are coupled to the
shunt-fed plate circuit of V501 through coupling

tne deco
C511. Pl

stal filter, schematic diagram.

Figure 29. Cr



natic diagram.

Figure 30. First if amplifier V501, scher

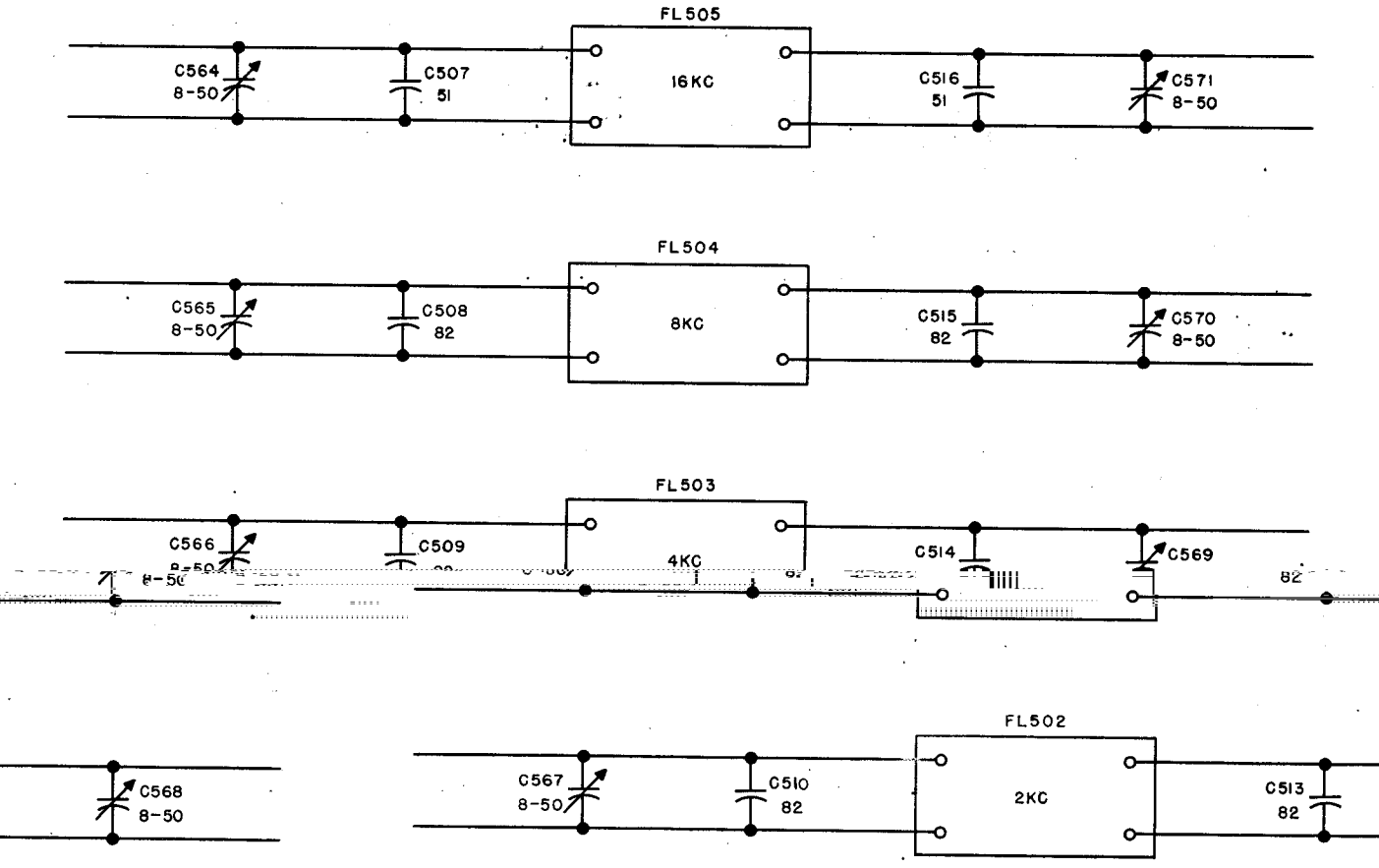
Capacitors C507 through C510 and rough C516 are used to resonate the d output coils in the filters to achieve optimum gain and band pass. Resistor R507 and apacitor C512 are an agc line decoupling filter. Agc bias for V502 is fed through P112-6, J512-, and the functioning mechanical filter.

4. Mechanical If Filters

General. A receiver with perfect band-pass ...ractoristics would be one whose band pass ...that the curve would ...ers would be ...plate circuit of V501 to the input of the appro- ...priate mechanical filter, and S503 (front) con- ...nects the output of the filter to the control grid circuit of second if amplifier V502. Switches S502 (rear) and S503 (rear) short-circuit the input and output terminals of the unused mechanical filters. This is done to prevent stray coupling to the if circuits of the unused mechan-

...lectivity of ...iscriminate ...e band pass ...mpossible to ...ed circuits. ...io Receiver ...nt. The ex- ...capacitor C553 and BANDWIDTH switches S502 and S503. When this BANDWIDTH switch is in the .1 KC, 1 KC, or 2 KC position, 2-kc mechanical filter FL502 is switched into the circuit. The 4 KC, 8 KC, and 16 KC positions of the BANDWIDTH control use FL503 through FL505, respectively. The band pass of the if amplifiers, and ultimately the entire receiver, is determined by the selection of one of the six switch positions of the BANDWIDTH cont...ol. The very narrow bandwidth .1 KC and 1 KC positions of this switch also incorporate ...the crystal filter (par. 62) into the first if ampli... ...fier circuit. Switch S502 (front) connects the ...plate circuit of V501 to the input of the appro- ...priate mechanical filter, and S503 (front) con- ...nects the output of the filter to the control grid circuit of second if amplifier V502. Switches S502 (rear) and S503 (rear) short-circuit the input and output terminals of the unused mechanical filters. This is done to prevent stray coupling to the if circuits of the unused mechan-

...characteristics were such ...be as near the ideal as ...vertical to a horizontal plane. The se... ...this receiver would be such as to d... ...against interfering signals not in the ...of the receiver. This is practically im... ...accomplish with conventional tune... The use of mechanical filters in Rad... R-390A/URR approaches this concep...

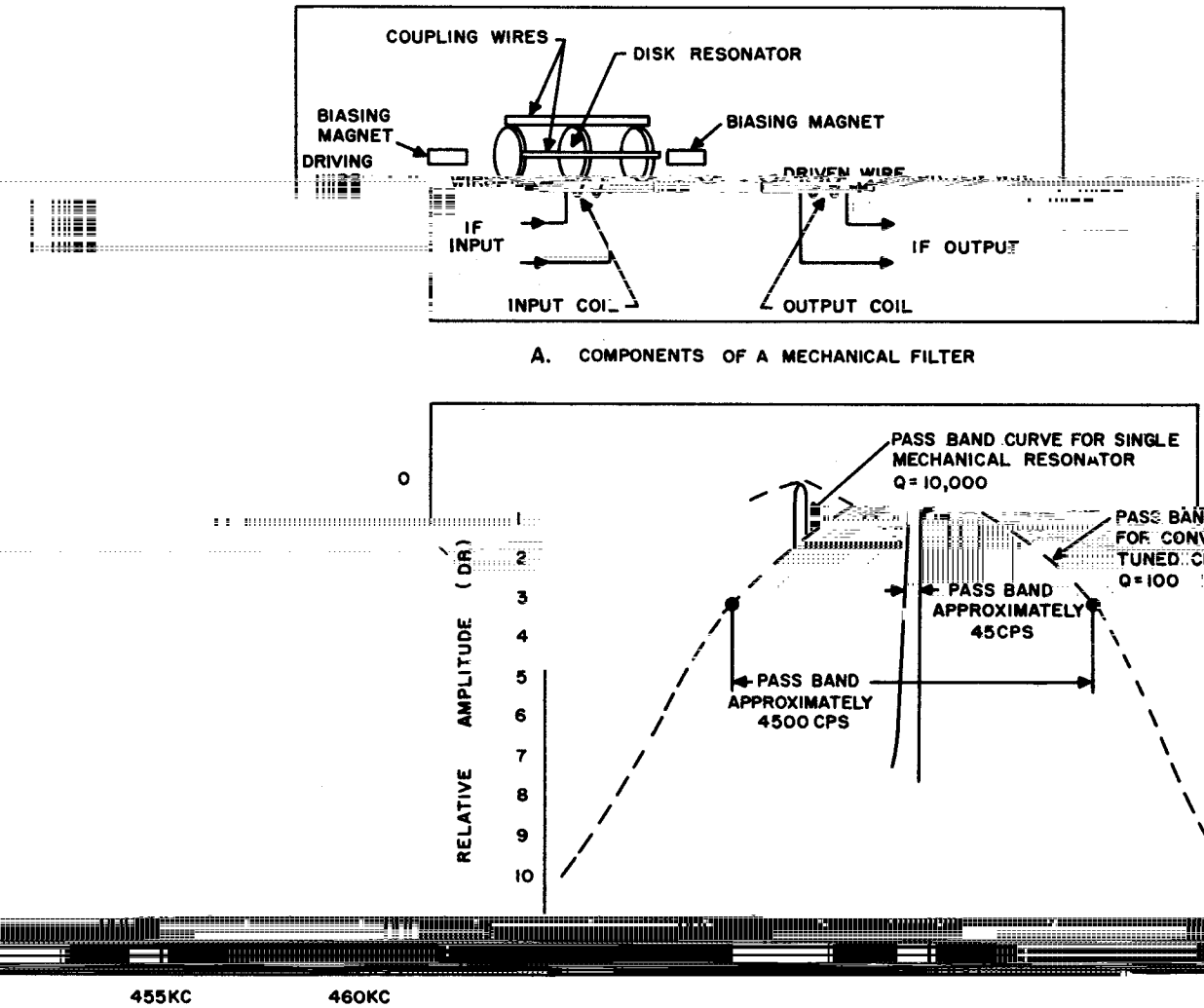


NOTES:

1. ALTERNATE TYPE FILTERS USED ONLY ON ORDER NO. 363-PHILA-54, MOD. NO.1 AND ABOVE, AND ALL ON ORDER NO. 14-PHILA-56.
2. WHEN ALTERNATE TYPE FILTERS FL504 AND FL505 ARE INSTALLED, CAPACITORS C507, C508, C515, AND C516 ARE REMOVED FROM THE CIRCUIT. THE ALTERNATE TYPE FILTERS ARE IDENTIFIED BY RED DECALS ON THEIR CASES THAT READ "WHEN USING THIS FILTER, DISCONNECT C508 AND C515 (82UUF)" OR "WHEN USING THIS FILTER, DISCONNECT C507 AND C516 (51UUF)".

TM5820-358-35-15

Figure 15. Modified mechanical if. filters.



gure 31. Typical mechanical filters.

Fi

f mechanical . . . Each disk resonator is sharply resonant to the . . . graph gives a general description of
ally with intermediate frequency, and several such disks, filters, and paragraph 65 deals specifica
synchronously tuned, are used to accomplish the those used in the receiver.
lustrates required band pass. The last disk resonator is *b. Typical Construction.* Figure 31 il
filter. A tied to the driven wire, which induces the out- typical construction of a mechanical
o r signa into the output transducer coil. signa current is passed through the input pi
c. Characteristics. Mechanical filters have transducer coil, which causes the driving wire th
ree distinctive advantages over conventional to expand and contract due to magnetostriction
ed band pass filters. The first of these lies This mechanical motion is transmitted to the tun
the fact that in the low if range, 100 to 500 disk resonators through the coupling wires. in t

kc, the dimensions of the mechanical filters are very small and lend themselves to compact design of communication equipment. (The filters used in Radio Receiver R-390A/URR are approximately ¾ inches and less in diameter.) These dimensions compare favorably with the most compact tuned circuits. The second advantage of mechanical filters is the extremely high Q they possess. Circuit Q's in excess of 2,000 are obtainable. The third advantage mechanical filters offer is the permanence of tuning of the filter. Once tuned and adjusted to the desired band pass, no further adjustments are required, even under conditions of widely varying temperatures. This feature is important because the initial design and adjustment are complex.

55. Typical Characteristics of Mechanical Filters Used in Radio Receiver R-390A/URR

(fig. 32)

a. General. Figure 32 illustrates typical band-pass characteristics of the 2-, 4-, 8-, and 16-kc mechanical filters used in Radio Receiver R-390A/URR. The general characteristics of these four filters are summarized in *b* through *g* below and hold true except for the band pass of the individual filters.

b. Center Frequencies and Bandwidth. The center frequency for each of the four filters is selected at 455 kc, and the nominal band pass is selected in the vicinity of 3- to 6-db attenuation. The bandwidth at 60 db down is less than [illegible] the bandwidth at the 6-db points, which [illegible] a perpendicular with the x-axis of the curve.

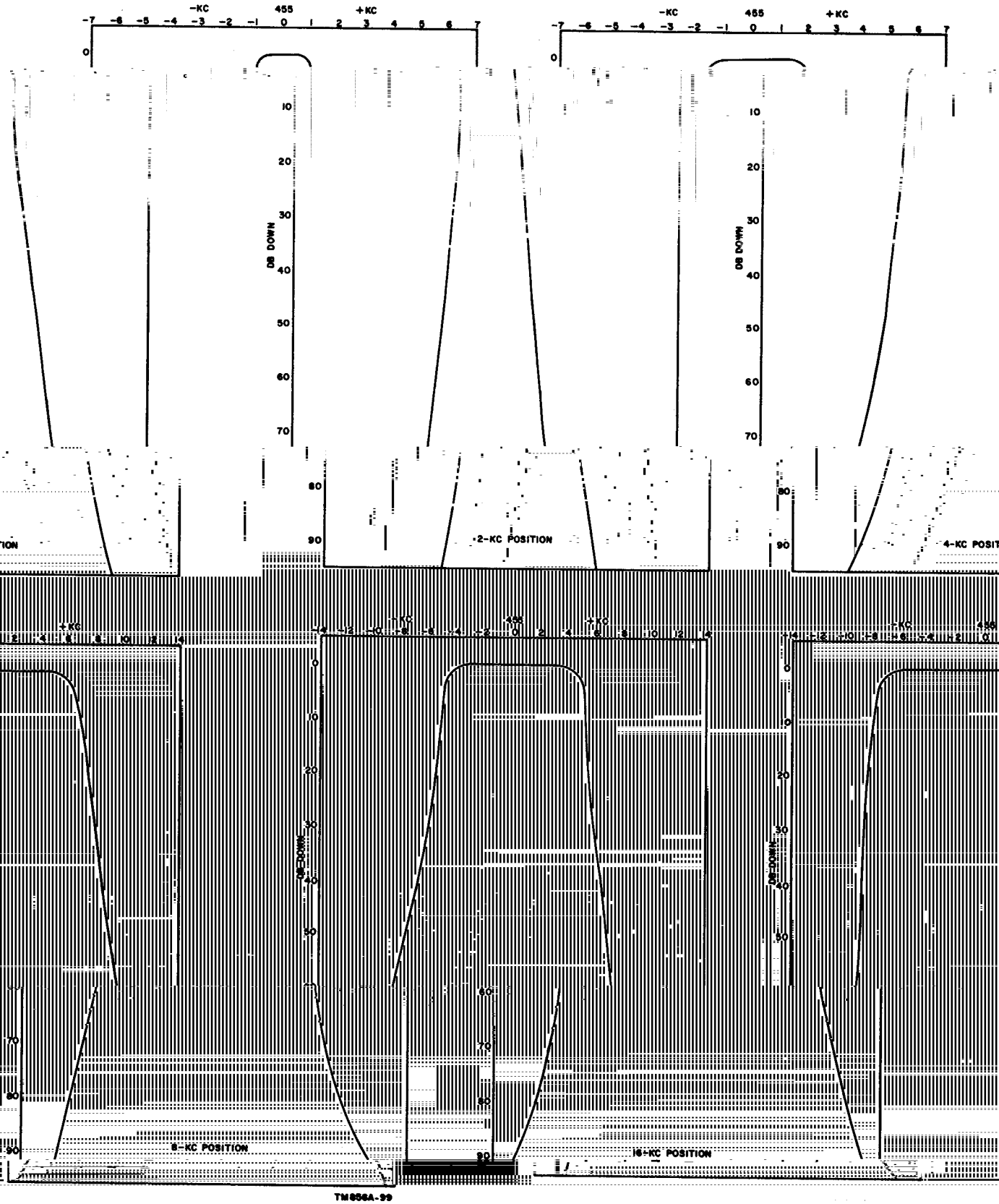
c. Transfer Impedance. Transfer impedance is defined as the ratio of the signal voltage across the output terminals terminated only with resonating capacity, to the input signal current, measured at frequencies of maximum [illegible].

d. Performance. Figure 31 also illustrates a typical mechanical filter band pass and a conventional band-pass curve for a tuned circuit. The band-pass curve for the single mechanical resonator has a Q of 10,000 and possesses a 3-db band pass of approximately 45 cps, compared with 4 kc. The conventional tuned circuit with a Q of 100 has a 3-db band pass approximately 4,500-cps wide at the 3-db point. The attainable circuit Q resulting from the use of mechanical filters permits their application to highly selective band-pass circuits that are essentially flat across the top with very steep [illegible] response. The mechanical filter is symmetrical with respect to terminal characteristics permitting an arbitrary designation of input and output terminals. This transfer impedance is approximately 7,000 ohms.

e. Spurious Responses. Mechanical filters have spurious responses that occur at various points removed from the desired band pass, and necessitate correct design in order to keep these spurious responses as far removed from the center frequency as possible. These spurious responses must be attenuated sufficiently to prevent false band-pass characteristics. This disadvantage can be minimized by designing an if circuit that has sufficient attenuation at these [illegible] frequencies. One way of accomplishing this is with the use of additional conventional tuned circuits.

f. Voltage and Current Considerations. Either series or shunt feed can be used with these mechanical filters; however, shunt feed operation is used to prevent the flow of dc through the transducer coil. With series feed, satisfactory performance is obtainable with dc [illegible] from dc to 5 milliamperes, but in excess of this [illegible] the maximum dc current [illegible] across the coils must be below 300 volts, or voltage breakdown might occur.

g. Applications. The use of mechanical filters in if circuits makes it possible to eliminate some of the conventional tuned if circuits normally found in such applications. The circuit thus can be designed with a minimum number of tuned circuits; the necessary amplification can be obtained with simple untuned [illegible] and the [illegible] band



chanical filters.

Figure 32. Band pass of me

includes the input and output capacitance of the circuit tubes plus stray circuit capacitance. Capacitors C507 through C510 and C512 through C516 (fig. 30) are selected for optimum operation of the mechanical filters.

n. GAIN ADJ control R519 and 18 are the cathode-biasing resistors ew-driver-adjusted GAIN ADJ l is adjusted during screen-co lifiers will yield sufficient ampli duce —7 volts potential at the terminals on the rear panel of en an unmodulated 150-micro- d into the if subchassis at con- is adjustment compensates for ube gain, and the loss of tube aging. The cathode circuit of 24 in series with the parallel R537 and screw-driver-adjusted ADJ control R523. The setting

f. Input and Output Impedances. The input and output impedances of the filters is in excess of 20,000 ohms and provides for satisfactory impedance matching to the input and output circuits of the preceding and following if stages.

g. Temperature Range. The mechanical filters operates satisfactorily from —40° C to +85° C (—40°F to +185°F). Under conditions of widely varying temperatures the maximum shift of the reference frequency of 455 kc is less than 10 parts per million per degree centigrade. The band-pass response variation is less than 1 db. The maximum change in bandwidth at the temperature extremes is 5 per cent or less.

found in the cathode circuits of V502, V503, and V504. RF GAIN control R103 (5K) and resistor R513 provide cathode bias for V502. The RF GAIN control also adjusts the bias of rf amplifier V201 (par. 55*b*) and first if amplifier V501 (par. 63*a*). Capacitor C517 prevents cathode degeneration resistor R51 for V503. Se control R558 that the if amp fication to pro DIODE LOAD the receiver wh volt signal is fe nector J513. Th the variation in tu gain as a result of V504 contains R52 combination of CARR-METER of this adjustment has been explained in paragraph 66. Second, Third, and Fourth I Amplifiers (fig. 33)

s use miniature-type pen- V502 and V503 each use a transformers T501 ly not included in the assembly, and djustment. The s is sufficiently within the band hanical filter than 8 kc attenuate l filters. or an explanation s response. Neutraliz- uster inductance ad- ing of T502 also feeds 455-kc cathode follower V509B, which 455-kc signals to external cir- ig. 37). The output signal de- the secondary winding of T509 530 bypasses if signals to

of V504 as it varies the cathode resistance of V504 between 680 and 698 ohms. Tube V504 is used as one leg of a bridge circuit containing CARRIER LEVEL meter M102 (par. 70*d*). type 5749/6BA6W, and V504 uses a type 6AK6. The 455-kc signals from the first if amplifier T502 and T503 is norma amplified by V502, V503, and V504.

a. The control grids of V502 and V503 are connected to the agc line, and the control grid of V504 is returned to ground through secondary winding L511 of T502. The screen grids of these tubes obtain voltage from the switched rf-if B+ line through P112-2 and J512-2. The V502 and V503 screen grids are tied to the junctions of ing of R515 and R514, and R520 and R550, respectively. The screen grid of V504 is connected to the B+ voltage in order to obtain maximum output and gain from this stage. Bypass capacitors for the V502 and V503 screen grids are C518 and C522, respectively. The B+ voltage for the plate circuits of V502, V503, and V504 is series fed through the primary coils of T501, T502, and T503, respectively. Plate circuit decoupling for these three stages is accomplished with the combinations of R551 and C552, R551 and C523, and R526 and C523.

b. Figure 33 shows that variable resistors are

c. Adjustment of if T502 and T503 is norma initially tuned during receiver should require no subsequent ad bandwidth of these transformer wide to have negligible effect w pass of even the 16-kc mec The most important function is tha viding attenuation to if signals more removed from 455 kc. This is done to spurious responses of the mechanica Refer to paragraph 64*e* mechanical filter spurious ing capacitor C526 is adj frequency oscillator signals trap V506 from the secondary wind signals to the if supplies 50-ohm, cuits (par. 69, f veloped across connected

L502. Capacitor C5 ground.

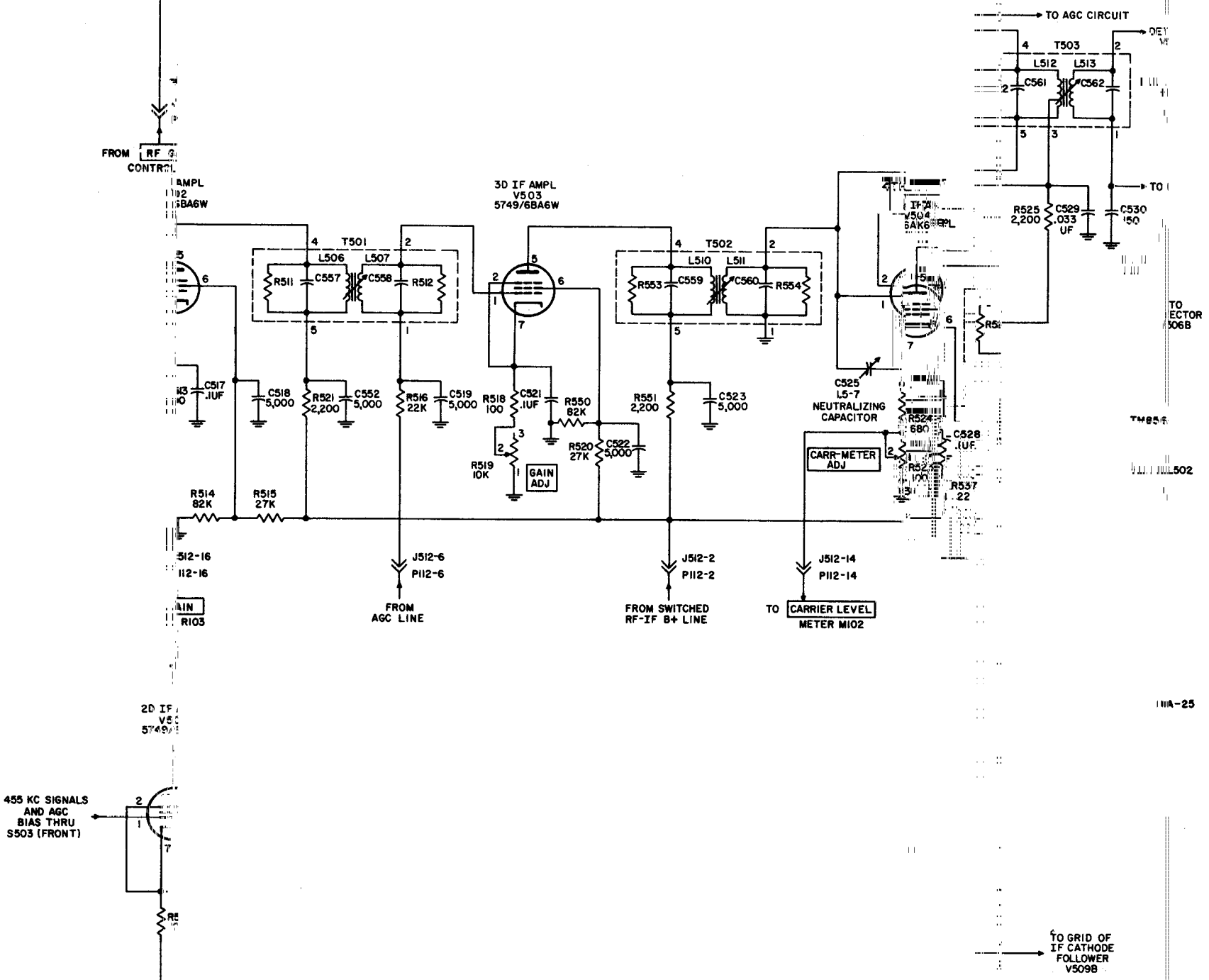


Figure 35. Second, third, and fourth if amplifiers V502 through V504, schematic diagram.

(fig. 34 and 35)

The detector demodulates the 455-kc if signal to recover the intelligence from the modulated signals. The limiter removes noise pulses that exceed the amplitude of the modulation.

The output of the detector grou[illegible] limiter stage before it is fed to the audio channels.

a. Detector. This stage, V506B, uses one half a miniature twin triode tube type 5814A.

(1) Detector V506B is connected as a half-wave diode by connecting the control grid and plate together. The secondary winding of T503 feeds the if signal to the detector. The diode load consists of resistors R527 and R526. To connect these load resistors to the stage, [illegible] terminals or TB108 must be in place. Capacitor C530 and choke coil L502 are an if filter used to remove if signals from the detected audio.

(2) When the 455-kc if signals developed across the secondary winding of T503 are negative, the diode is an open circuit to the signal. When the polarity reverses and the positive peaks are applied to pins 6 and 7 of V506B, the tube will conduct and current will flow from ground, through the diode, through L502, through J512-5 and P112-5, the DIODE LOAD terminals 14 and 15 on J108 at the rear of the receiver, P112-3 and J512-3, R527, and R526, and back to ground. The polarity at the DIODE LOAD terminals with respect to ground is nega-

[illegible] and P112-7 to the [illegible] first a-f amplifier V601A.

[illegible] clockwise, switch S108 removes the [illegible] ground from the bottom of R535 and [illegible] short-circuits B+ to ground at the [illegible] junction of R532 and R533. The entire B+ voltage is dropped across resistor R534. The cathodes of V507 assume a [illegible] condition, the level of which [illegible] and is adjusted to minimize the bfo [illegible] signal to the 50-ohm if output of the [illegible] receiver. The 50-ohm if output circuit [illegible] as explained in paragraph 69. The [illegible] audio signals are taken from the junc[illegible] of R507 and R508 and coupled [illegible] through C531 to limiter tube V507.

Limiter V507 is a series-type [illegible] which couples the audio signals from the detector to the audio channels. When LIMITER switch S108 is in the OFF position audio signals pass through stage V507 without any limiting action. When this switch is turned on, the amount of limiting applied is controlled by LIMITER control R120.

(1) The limiter uses both sections of twin triode tubes type 5814A. The B-section of the tube is the negative peak limiter, and the A-section is the positive peak limiter. The limiter effectively removes noise peaks above the level of the modulation. When the LIMITER control is set at the OFF position switch S108 grounds cathode resistor R535 through J512-9 and P112-9. At the same time, B+ voltage from the switched rf-if B+ line is applied to the diode plates through their plate resistors R532 and R533, common resistor R534, and connectors J512-2 and P112-2. Audio signals from the detector diode load pass to the plate of V507B and superimpose the audio on the B+ voltage at the plate. This audio signal causes the cathode of V507B to follow the audio signal without any limiting. Since the cathodes of both sections of the tubes are tied together, the cathode of V507A modulates the plate current of this section of the tube. The audio signal is then coupled through C549 and connectors J512-7 [illegible] grid circuit of [illegible]

(3) Neutralizing capacitor C525 is [illegible] and [illegible] signal [illegible] is [illegible] audio [illegible] through

b. Limiter. [illegible] diode limiter, [illegible]

Resistor R119 and capacitor C101 remove the audio component from the threshold voltage, leaving the threshold voltage at the average dc level, dependent on the setting of the LIMITER control, signal strength, and modulation percentage. Depending on the modulation percentage, the total dc limiter threshold voltage available is

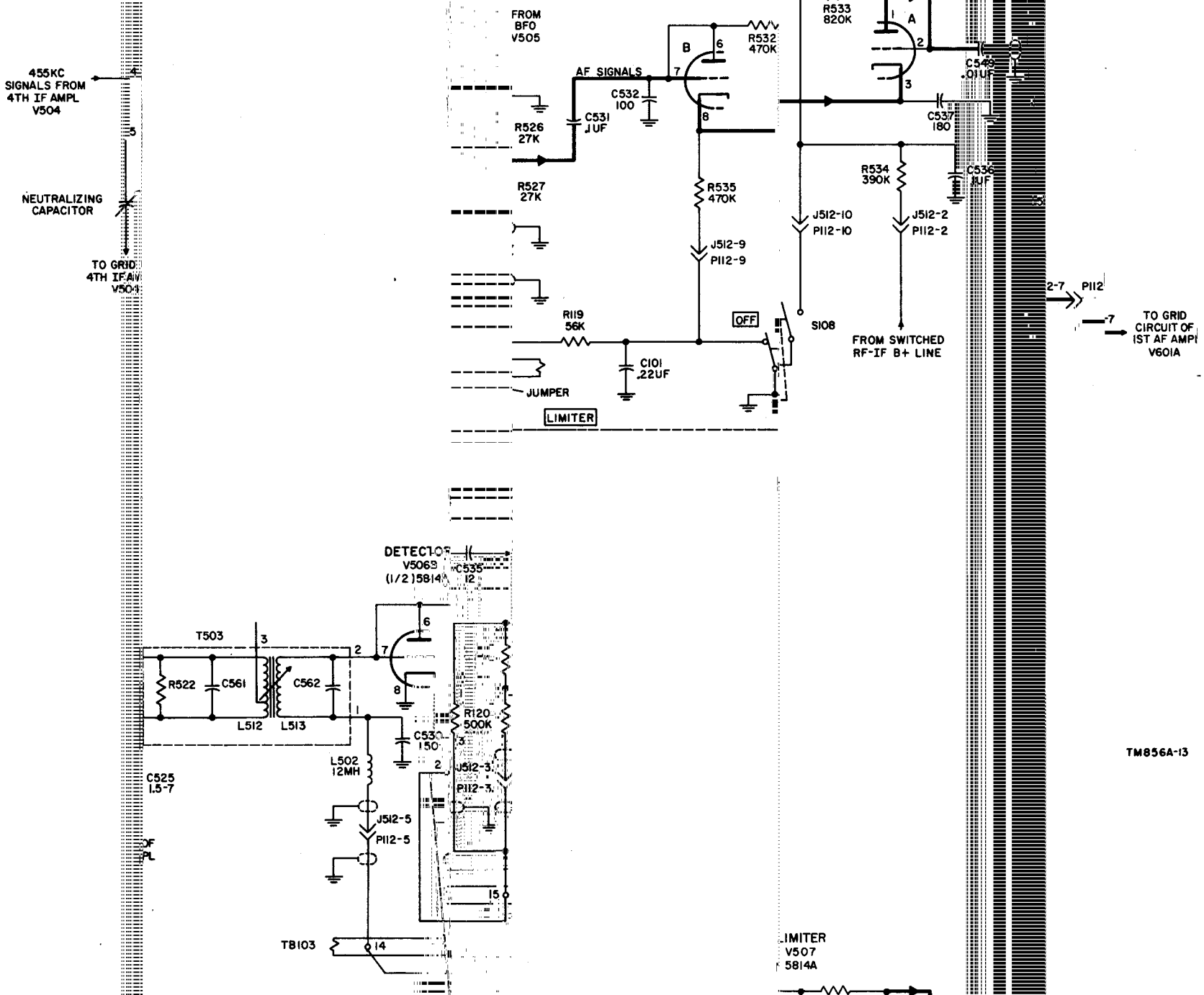


Figure 3-4. Detector V506B and limiter V507, schematic diagram.

equal to or greater than the peak-to-peak level of the audio signal at the junction of R527 and R526. When the plate voltage (audio peaks) is higher than the threshold voltage, current will flow through the diode sections. Negative peaks at the plate (pins 6 and 7) of V507B that exceed the negative threshold level at the cathode (pin 8) will be clipped because V507B will not conduct when the plate is more negative than the cathode. Simultaneously, the audio signal appears on the common cathodes, and is fed to section A of V507. This common connection is at the same negative level with respect to ground (as determined by the setting of R120), and any positive peaks that are positive enough to cut off the current flow through V507A will be clipped. As the LIMITER control is turned clockwise towards 10, the threshold voltage approaches ground and more severe clipping results. Figure 35 shows that the audio signal, as well as the noise, will be clipped if the LIMITER control is turned too far clockwise. Because the amplitude of the threshold voltage, as well as the audio signal, is a function of the signal strength and modulation percentage, the circuit automatically adjusts to any level of signal input and modulation percentage.

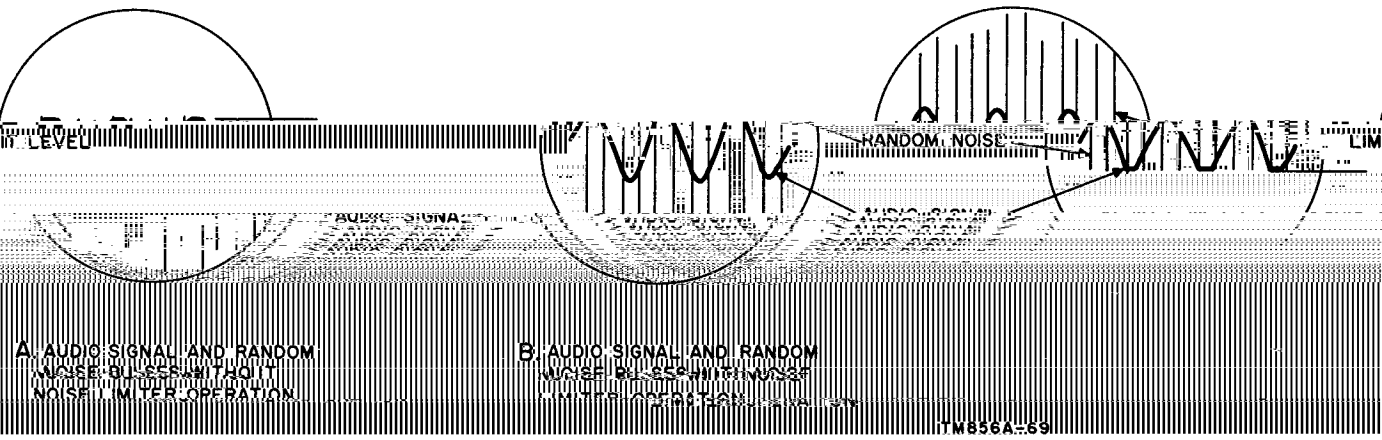


Figure 35. Typical oscilloscope presentation of limiter operation.

(fig. 36)

from 0 to 3,000 cycles.

a. The oscillator circuit is an electron-coupled Hartley-type oscillator similar to that described in paragraph 61. Coils L508 and L509 with capacitors C554, C555, and C556, with the addition of input capacity and compensation

circuit. Resistor R531 with capacitor forms a plate decoupling circuit. The volt the plate and screen grid is obtained fr switched rf-if B+ line, and is com through REC switch S301 when the swi the ON position.

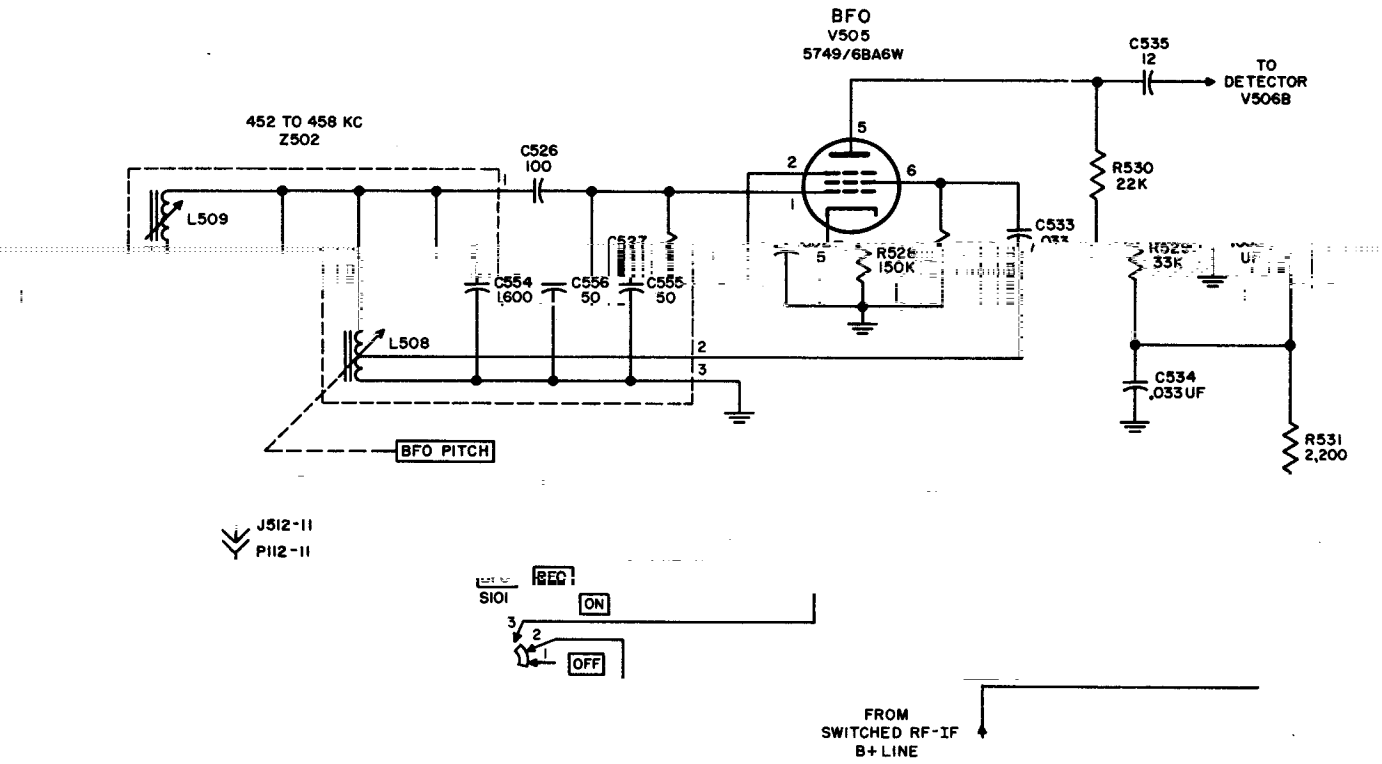


Figure 36. Beat-frequency oscillator V505, schematic diagram.

tor at the rear panel of
to the junction of C539
or R552, providing an

ge provides a
or use with a
teletypewriter

input cir-
trans-
fourth

ils cathode follower
ondary winding of
(fig. 38 and 39)

When the FUNCTION switch on the front panel of the receiver is set on the AGC position,

le at

il L504
d C540.

69. If Cathode Follower V509B (fig. 37)

This stage uses one half of a miniature twin-triode tube type 5814A. This sta

output impedance to match a 50-ohm load. Resistor R538 develops dc cathode bias which maintains the tube operating current at a safe level. A second 455-kc if signal is taken directly from the cathode through capacitor C542 to the grid of agc if amplifier V508. The cathode-follower stage isolates the agc if amplifier from fourth if amplifier V504, preventing interaction between the two stages.

50-ohm 455-kc if output signal f
frequency-shift converter in a
system. This stage
reflects a very high impedance at its
cuit, having negligible loading effect on
former T502, which also feeds the grid of f
if amplifier V504.

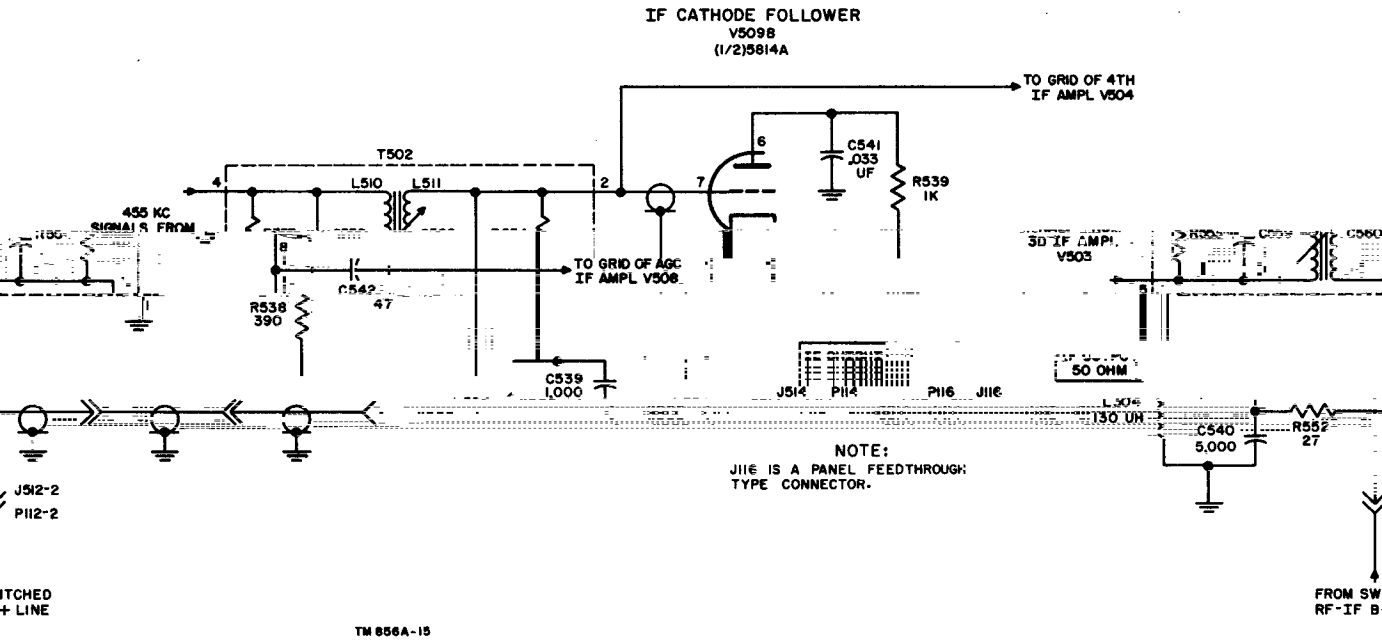
The IF OUTPUT connec
the receiver is connected
and C540 through resist

a. The input circuit of t
is connected across the sec
T502. The plate circuit of this tube is decoupled and bypassed to ground with resistor R539 and capacitor C541, and its plate voltage is obtained from the switched rf-if
nectors P112-2 and J512-2.

b. Two signal output connections are mad
the low-impedance cathode of this stage.
first output is developed across the tuned
resonant to 455 kc which consists of co
and series-connected capacitors C539 an

70. Automatic Gain Control Circuit (fig. 38 and 39)

agc bias is fed to the control grid circuits of tubes V201 through V204 in the rf subchassis and to tubes V501, V502, and V503 in the if subchassis. This agc bias controls the gain of the tubes in the rf and if subchassis in proportion to the average level of the incoming rf signal. This circuit extends the useful signal



c diagram.

Figure 37. If cathode follower V509B, schematic

40 is the grid return resistor to n grid voltage is dropped and de-

line developed agc bias from the junction of R546 and R547 is connected to the suppressor of V504 and V508 to use them as positive ons to prevent the agc line from going more few volts positive. Plate voltage for the amplifier is fed from the switched rf i through connectors P112-2 and J512-2, network of R552 and C540, into Z503. The amplified if output of coupled to the agc rectifier through 46.

4 agc. The purpose of delaying the

strength range of the receiver from a few microvolts to more than 1 volt. Signals appear to have a relatively constant signal strength

The agc circuit operates only for signals in excess of approximately 5 microvolts, in order not to reduce the gain of extremely weak signals. The AGC switch on the front panel of the receiver allows the operator to select one of three agc time constant characteristics. These positions are SLOW, MED, and FAST, and are approximately 5 seconds, 2 second, and .015 second, respectively. This feature extends the usefulness of the agc circuit by enabling the operator to choose an agc time constant which most effectively compensates for fading rf sig-

C542, and R5 ground. Scree

than a agc if B+ line the decoup in tuned circuit V508 is then c capacitor C54

b. Delayed

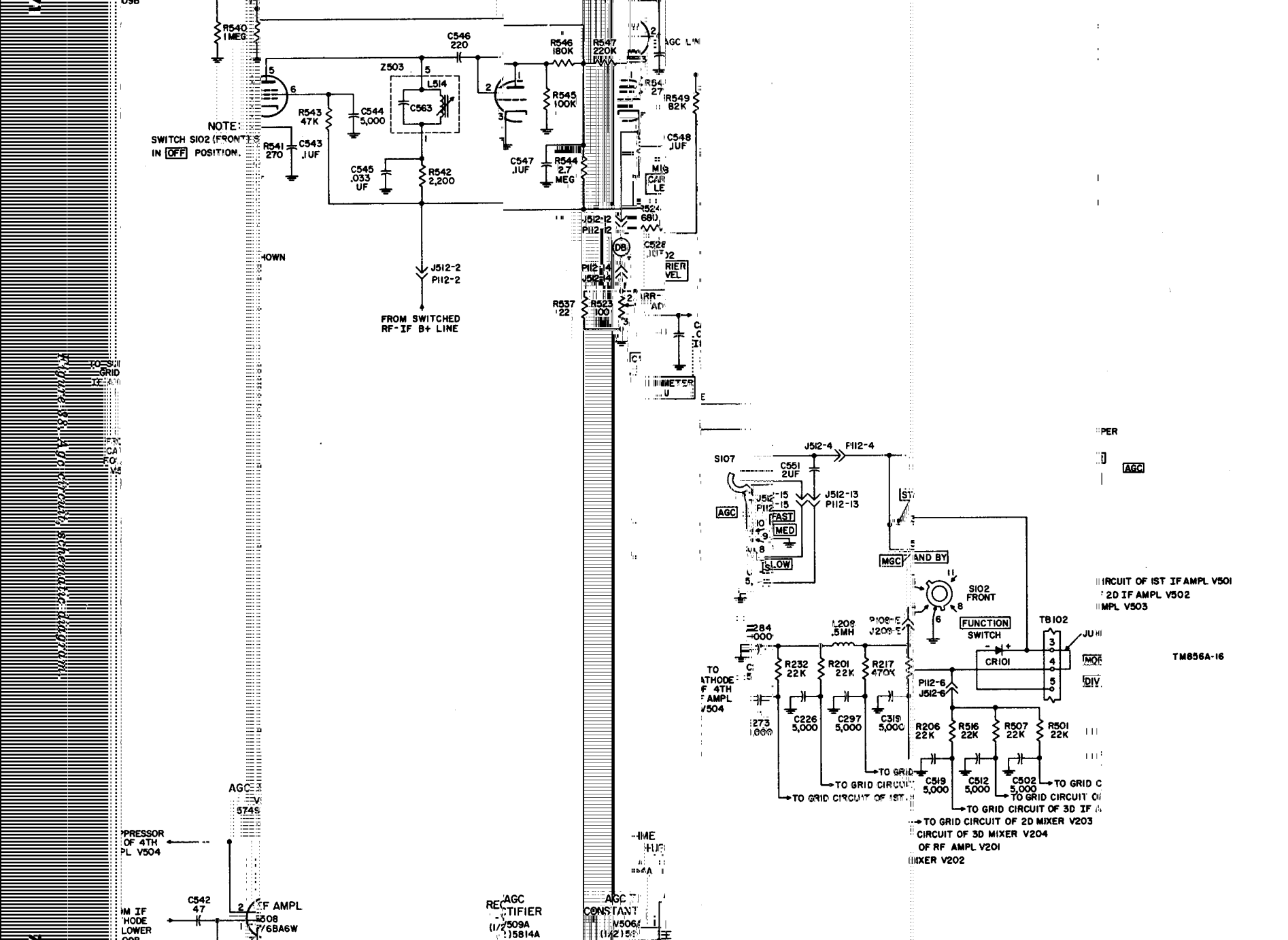


Figure 8. AGC circuit, schematic diagram.

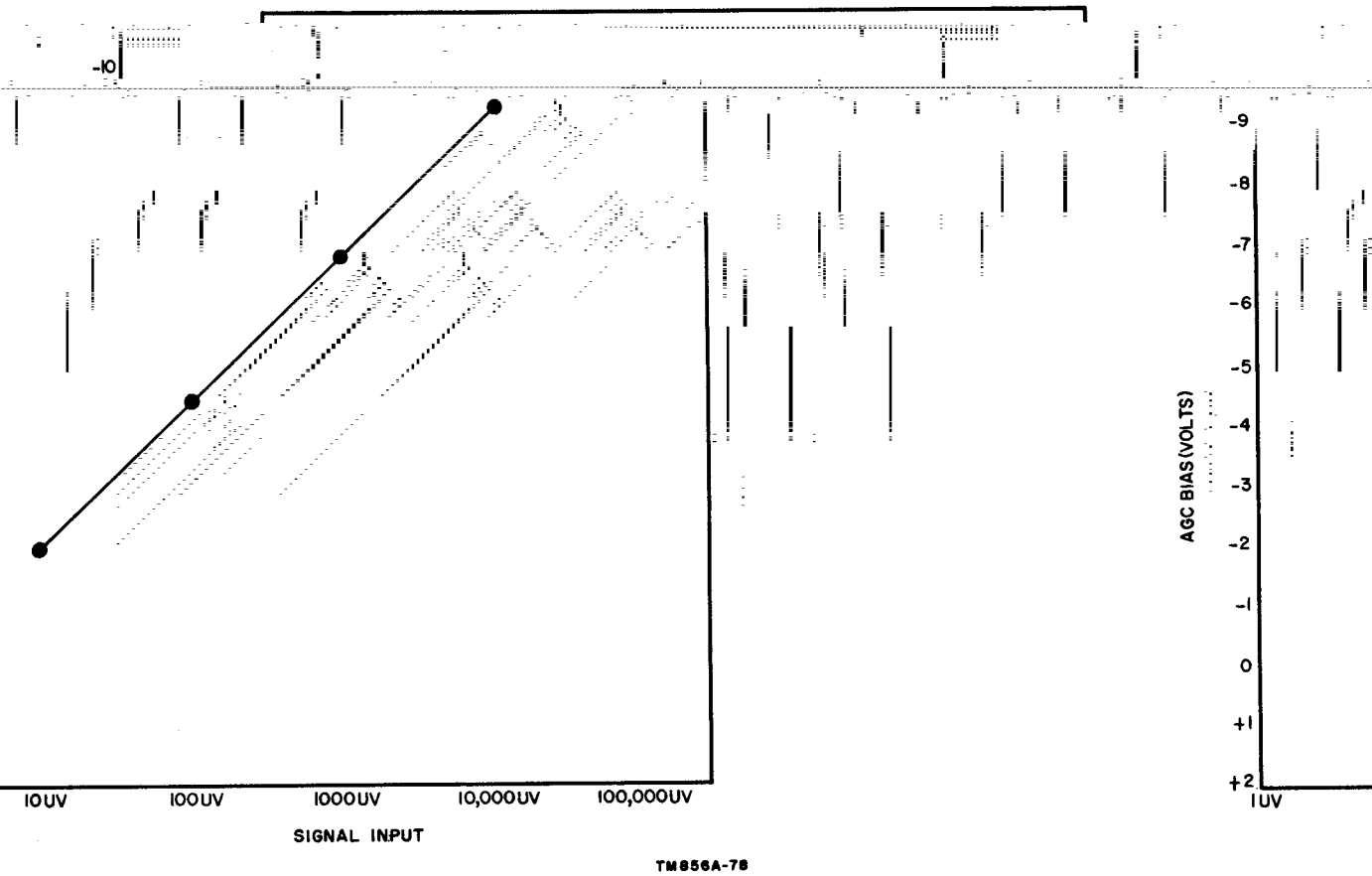


Figure 39. Imput signal versus developed agc bias.

t slightly negative
age and condition of
sitive delay voltage
vol of agc bias that

ed at the junction of R546
due to weak signals
positive peaks of the 455-kc
applied to the agc rectifier,
will conduct and effectively
ow impedance to ground at
ting a negative charge on it.
xt half-cycle, when the 455-
swing is downward, V509A
onduct and current will flow
6 through R545 to ground,
he junction of R545 and R546
with respect to ground. The
of this negative voltage
ds on the positive voltage which
ng developed simultaneously at

this junction by the B+ voltage divider action. If the developed agc voltage is larger, a negative voltage will appear at both ends of isolation resistor R546 and also on the agc line at J512-4. Capacitor C547 bypasses to ground any audio or 455-kc signals appearing at the junction of R546 and R547, leaving only dc bias at this point.

(3) Strong 455-kc signals (depending on the strength of the incoming rf signals) cause larger currents to flow through R545, and thereby charge C547. Substantial agc bias will be developed and fed through connectors J512-4 and P112-4, through the AGC NOR terminals 3 and 4 of TB102, and through the mating pairs of connectors P112-6 and J512-6 to the first

and may make i
depending on the a
the tube. This po
effects on low le
and R547
(2) When the
signal are
the tube
place a lo
C546, put
On the ne
kc signal
will not c
from C54
making th
negative
depend
is bein

three if amplifiers (V501, V502, and V503) in the if subchassis. Connectors P108-E and J208-E feed the same agc bias to the rf amplifier and the three mixer stages (V201 through V204) in the rf subchassis.

(4) When the FUNCTION switch is in the AGC position, the agc bias is applied to the controlled stages. However, when the FUNCTION switch is in the MGC position, the agc line and the grids of the controlled stage are grounded and no agc bias is allowed to get the controlled tubes. Under this condition the only control of the receiver rf and if gain is through the use of the front-panel RF GAIN control of the receiver (fig. 20, 30, and 33).

c. Time-constant System. The time constant

when the signal producing the agc voltage is

and SLOW. The time constants are approximately .015 second, .3 second, and 5 seconds, respectively.

(1) *FAST.* In the FAST position, the ability of the agc circuits to follow fast-fading rf signals is maximum. With the AGC switch in this position the time constant depends upon the resistance-capacitance (RC) combination of R546 and C547, and R547 and C548, as well as each of the agc decoupling circuits for the individual controlled stages.

(2) *MED.* In the MED (medium) position, the agc time is influenced by the

same RC combinations as in the FAST position, plus the additional capacitance of C551 in parallel to C548

signal is minimum. This is often useful for holding the receiver gain constant with on-off keying. It is more desirable than a rapid agc discharge which would raise the noise level between characters. In the SLOW

position, the
the FAST pos
effective time
capacitor C551
of agc time co
er than to g
position. The
SLOW
times th
tion. Th
Miller e
the agc
V506A
drop ac
creases
of V506

pacitor C551 begins to charge to the level of the agc voltage, as referenced to the B+ level at the plate of V506A. As this charging advances, the voltage of V506A continues to ris and C551 continue hunting for a ne voltage level as a reference charging rate. This bootstra continues until the grid of V506A reaches the level of v the junction R546 and R547. discharges its rate of discharg retarded since the plate of V506 the switch side of C551 gradual less positive.

d. CARRIER LEVEL Meter Circuit (f and 41). CARRIER LEVEL meter M102 cates the relative strength of the incomi

consists of [illegible]

potentiometer R523 and R537 in parallel. The remainder of the CARRIER LEVEL meter circuit is so arranged to form a bridge circuit with the meter connected to read the bridge unbalance. In the absence of an incoming rf signal and with the RF GAIN control fully

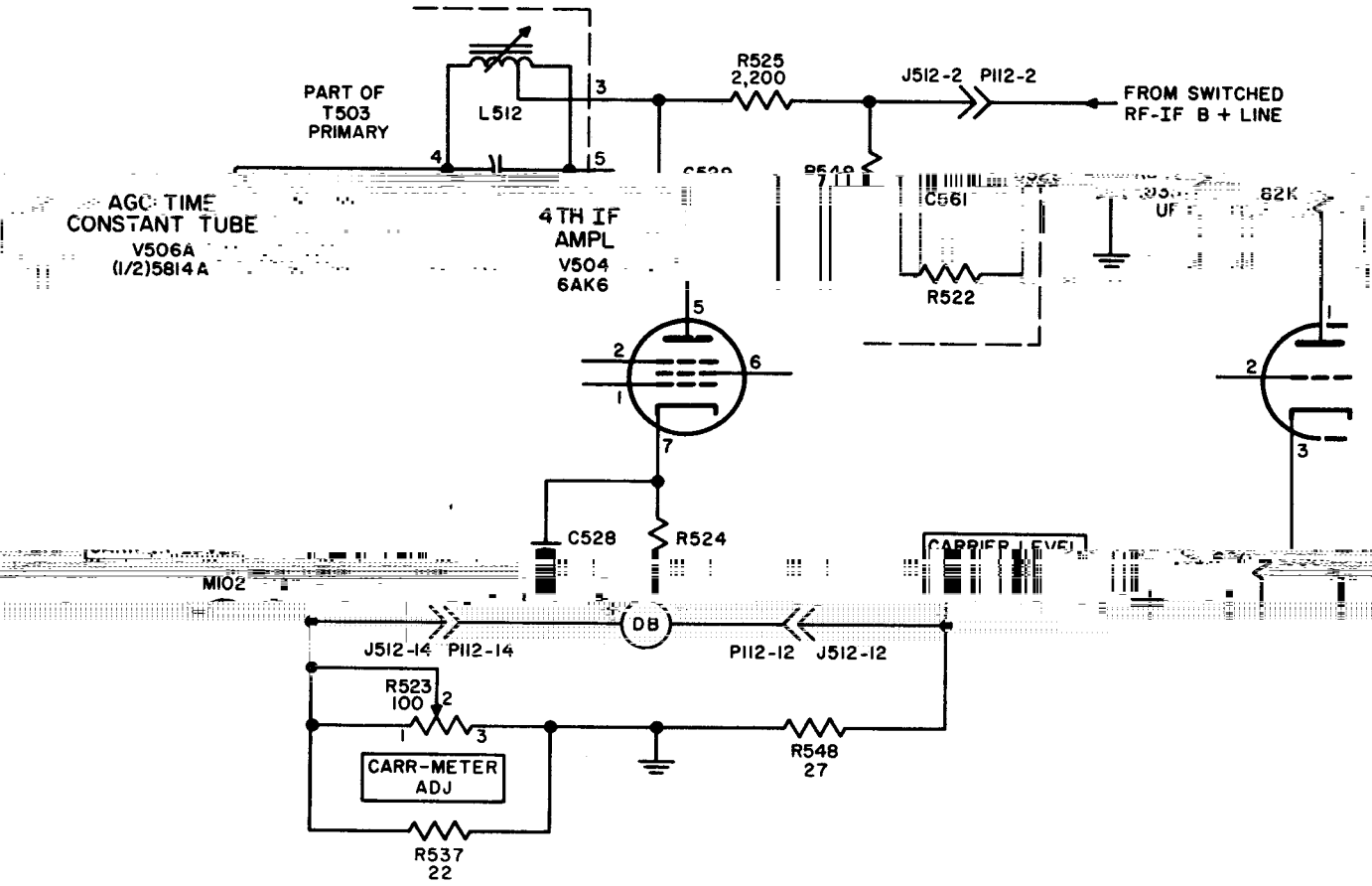


Figure 40. CARRIER LEVEL meter circuit, simplified schematic diagram.

counterclockwise, the current through V504 and [illegible] Figure 40 shows how CARRIER [illegible] is adjusted with the CARR-METER [illegible] LEVEL meter M102 will indicate with various [illegible] V506 [illegible] control [illegible] [illegible] switch [illegible] position [illegible] this time the [illegible] reads zero. [illegible] through V504 and V506A [illegible] of V506A [illegible] this time the [illegible]

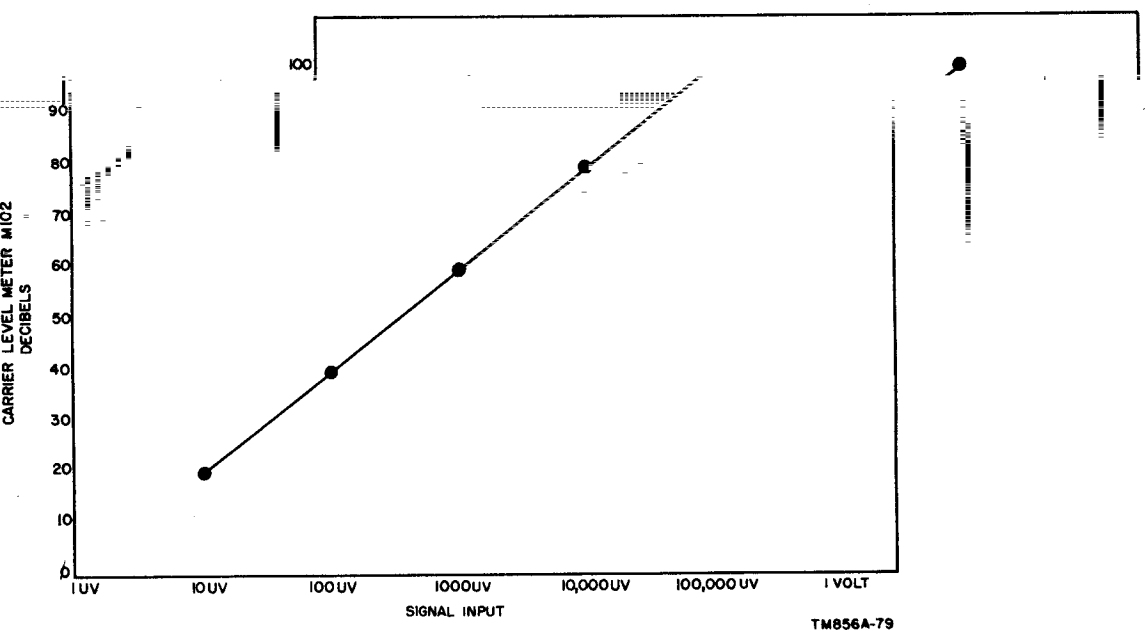


Figure 41. CARRIER LEVEL meter reading versus signal input.

Amplifier and Af

Cathode ... follows

g. 42)

purpose of these two stages is to amplify
ie signals and provide a circuit that will
te the audio signals to the local and line-
annels. The gain of V601A is less than

the parallel-connected potentiometers R104 and
R105. These are respectively the LINE GAIN
and the LOCAL GAIN controls on the front
panel of the receiver. The line audio signals are
taken from the arm of potentiometer R104
through connectors P120-3 and J620-3 and coup-
ling capacitor C607 to the control grid of line af

71. First Af

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The
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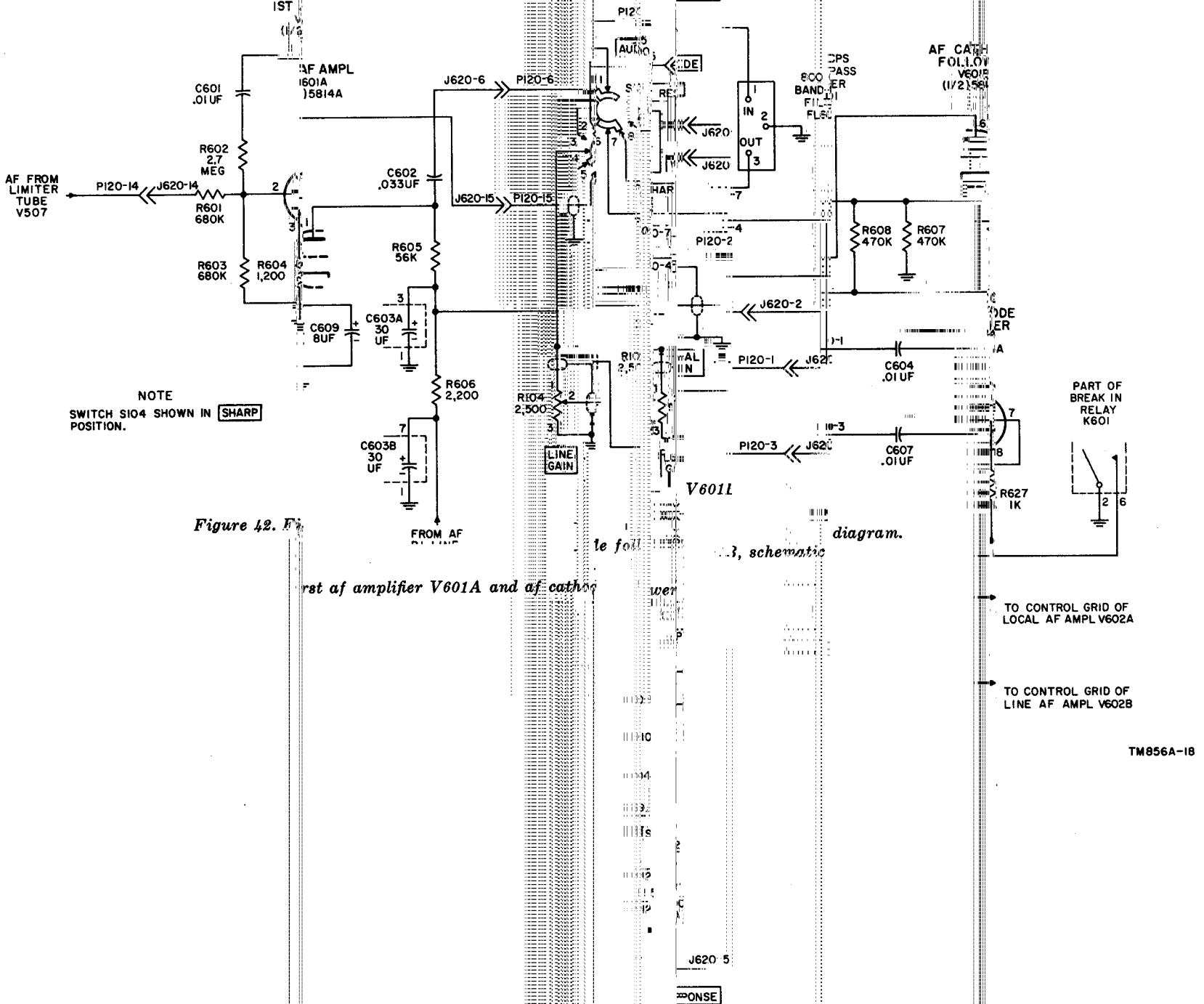


Figure 42. F… …le foll… …3, schematic diagram.

…rst af amplifier V601A and af cath… …wer…

72. Local Audio Channel

(fig. 43)

Local af amplifier stage V602A, which is one half of a miniature twin-triode type 5814A, amplifies the audio signal from LOCAL GAIN control R105 and drives local af output tube V603, a 6AK6 miniature pentode power amplifier

de bias by the
610. The plate
and plate volt-
line. Resistor
nd. The grid
cathode bias
4 and R615,
stor for
voltages
of B+

IN con-
P120-1
C604 to
ed audio
control
mary of

and
uced in
600-ohm
5 and
als 11
ver
ures
connectors J620-10 and P120-10 and

R111 through R115, are the circuit elements of this H-type attenuator. A 600-ohm load is main-
The
ough
the
uit,

pedance, and is available for teletypewriter operation.

a. Cathode biasing for V602B and V604 is accomplished with resistors R621 and R625, respectively, and common bias resistor R623. Resistors R620 and R624 are the grid return resistors for their respective tubes. Plate voltage for V602B is fed from the af B+ line to the plate of V602B through its plate-load resistor R622. Plate and screen grid voltage for V604 is obtained from the same source.

b. Audio signals from LINE GAIN control R104 are fed through connectors P120-3 and J620-3 and coupling capacitor C607 to the control grid of line af amplifier V602B, one half of a miniature twin triode type 5814A. The signal is amplified and coupled through C608 to the control grid of line af output tube V604, a miniature pentode power amplifier type 6AK5. The audio signal developed across the primary of
fed from terminal 3 through connectors J619-9 and P119-9 to TB102. Terminals 6 and 7 are 600-ohm LOCAL AUDIO connectors for this channel. The maximum audio output is at least
through an attenuator, which consists of R103
and R102 to terminal 8, the PHNS terminal of
audio channel to improve impedance matching

c. Three feed-back loops, similar to those used on the local audio channel, are employed. Regenerative feedback is accomplished by common cathode resistor R623, and degenerative feedback is accomplished by the connection of resistor R626 between the plate of V604 and the

73. Line Audio Channel

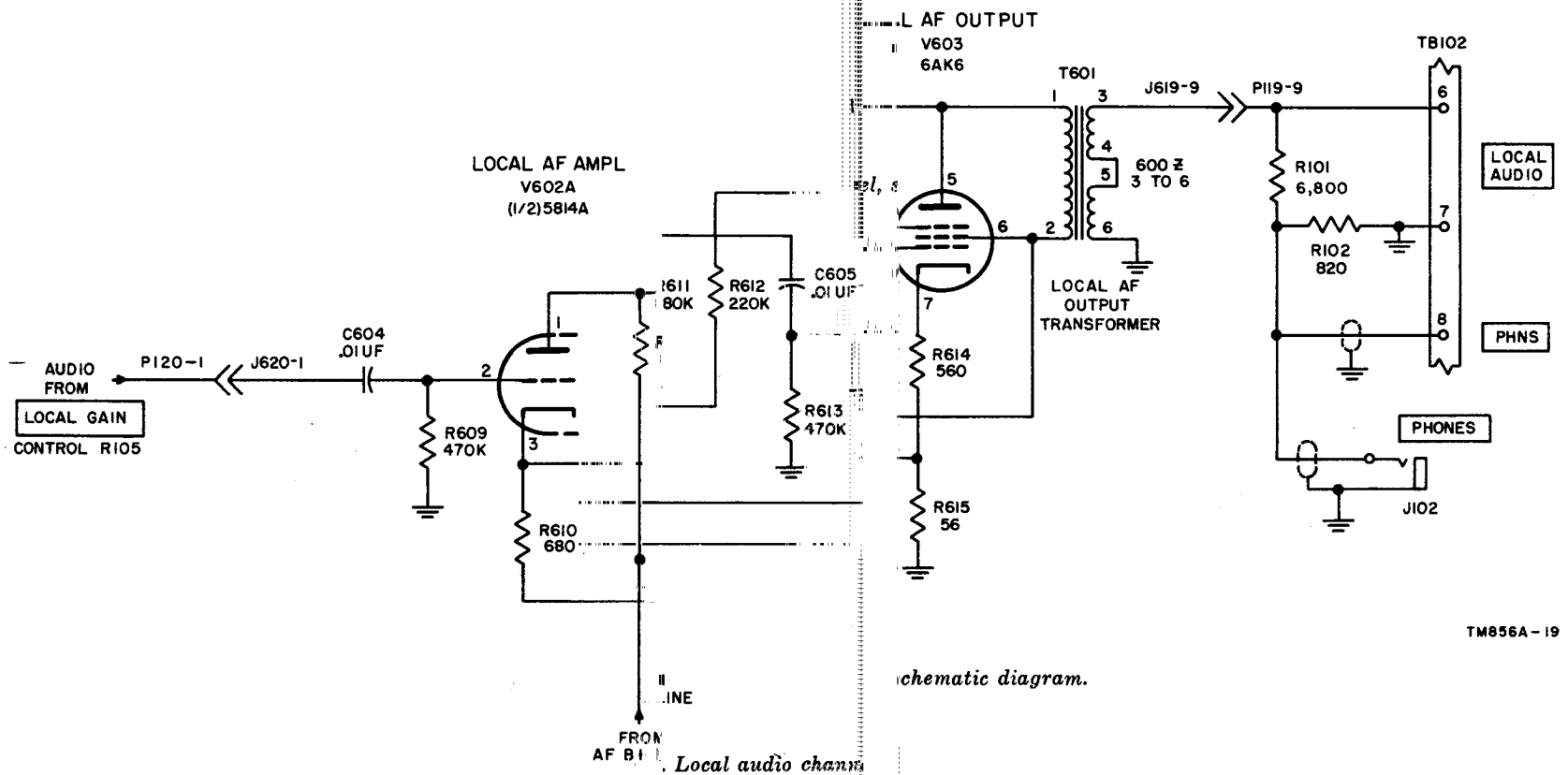
(fig. 44)

The line audio channel, which is similar to the local audio channel, includes a LINE LEVEL meter and a LINE METER switch for measuring and calibrating the LINE LEVEL meter. The maximum output of this circuit exceeds 10 milliwatts when matched into a 600-ohm im-

a. Tube V602A develops cathode current flow through R615 and R load resistor for V602A is R611, a age is supplied from the af B+ R609 is the grid return to grou resistor for tube V603 is R613, and is developed across resistors R61 R615 is a common cathode-biasing resi V602A and V603. Plate and screen grid for this tube are also supplied from the line.

b. Audio signals from LOCAL GA trol R105 are fed through connectors and J620-1 through coupling capacitor the control grid of V602A. The amplifi output of this stage is coupled to the grid of V603 through C605. The pri for V603. Line audio signals are induced series-connected secondary windings audio output transformer T602 are ind to the secondary windings of T602. A 6 output impedance exists across terminals 6 of T602 when the LINE AUDIO termina and 12 on TB103 are connected with a This connection is made through the two p of mating

and stabilize the gain of this channel. The first feed-back circuit is regenerative and is accom-
cathode resistor for V602A and V603. second feed-back path is degenerative thro resistor R612, from the plate of V603 to cathode of V602A. The third feed-back circu also degenerative, is accomplished by passing the cathodes of V602A and V603.



chematic diagram.

Local audio chann

Figure 43

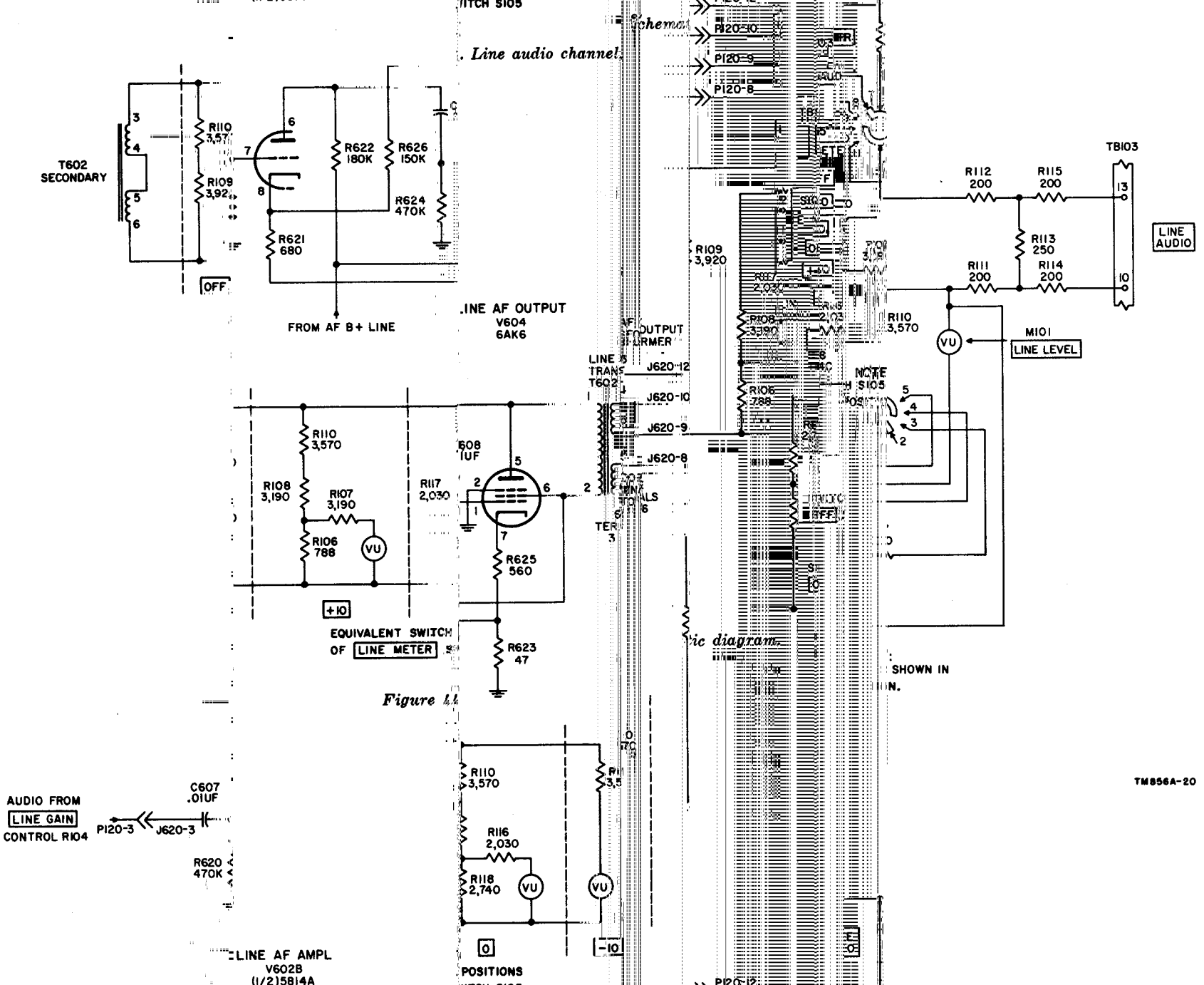

T602 SECONDARY
R110 3,570
R109 3,920
R622 180K
R626 150K
R624 470K
R621 680
OFF
FROM AF B+ LINE
LINE AF OUTPUT V604 6AK6
R108 3,190
R107 3,190
R106 788
R117 2,030
R625 560
R623 47
+10
EQUIVALENT SWITCH OF LINE METER
VU
R112 200
R115 200
R113 250
R111 200
R114 200
TB103
LINE AUDIO
M101 LINE LEVEL
NOTE S105
J620-12
J620-10
J620-9
J620-8
P120-10
P120-9
P120-8
AUDIO FROM LINE GAIN CONTROL R104
C607 .01UF
P120-3
J620-3
R620 470K
R116 2,030
R118 2,740
-10
POSITIONS
LINE AF AMPL V602B
TM856A-20

Figure 4

cathode of V602B. The unbypassed cathodes of these two stages supply additional degenerative cathode feedback.

d. The audio signal at the junction of P120-12 and R112 is fed to one of the two movable sections of LINE METER switch S105 through resistor R110. This switch has four positions: OFF, —10, 0, and +10. Simplified basic equivalents of the four switch positions are shown in figure 44. When in the OFF position, R109 and R110 load the secondary of T602, and LINE LEVEL meter M101 is silent in the circuit. In the —10 position, resistors R106, R108, and R110 are placed across the T602 secondary, and M101 in series with R107 measures the voltage across R106. In the 0 position, a similar circuit combination is used except that R110, R117, and R118 are in series across T602, and M101, in series with R116, measures the voltage across R118. In the +10 position, LINE LEVEL meter M101 and series-connected resistor R110 are placed directly across the secondary winding of T602.

e. LINE LEVEL meter M101 is calibrated in volume units (vu), which are based on a zero reference level pure sine wave of 1 mw into 600 ohms, or 0 dbm. For example, a reading on the LINE LEVEL meter of —10 vu is equal to —10 dbm. A reading of +5 vu is equal to +5 dbm. When LINE METER switch S105 is set at the 0 position the LINE LEVEL meter is read directly. When it is set at the —10 position subtract 10 vu from the meter reading, and similarly, add +10 vu to the meter reading when S105 is set at the +10 position.

74. Break-in Circuit (fig. 45)

The break-in circuit is used for disconnecting and grounding the antenna from the receiver and also grounding the audio in the receiver when the receiver and a radio transmitter are operated as a radio set.

a. When BRK IN terminal 9 on TB103 at the rear of the receiver is grounded through the

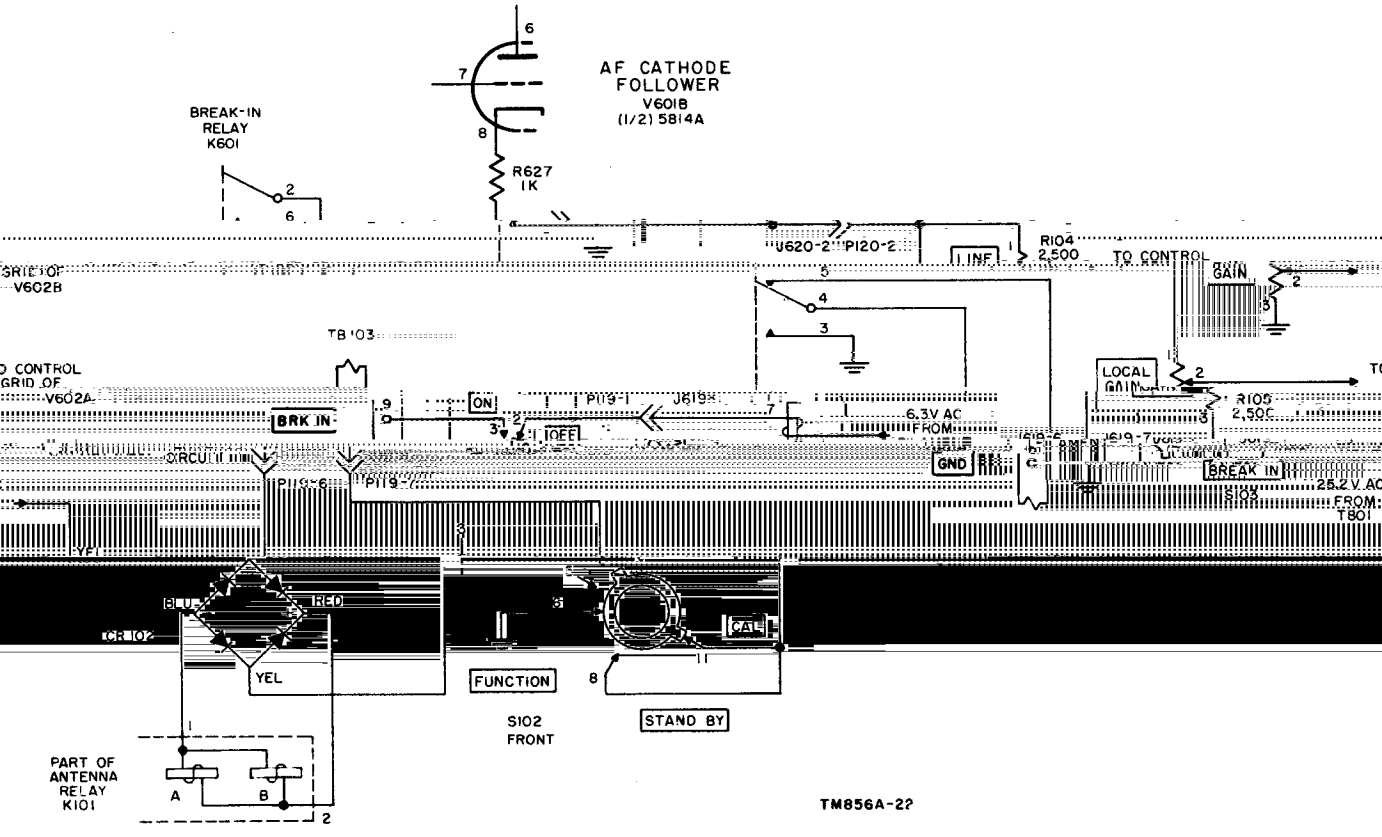


Figure 45. Break-in circuit, schematic diagram.

GND terminal 16, and BREAK IN switch S103 is in the ON position, current will flow through the coil of break-in relay K601 from the 6.3-volt ac filament circuit to ground.

b. When the break-in circuit is actuated and break-in relay K601 is operated, terminals 2 and 6 and terminals 3 and 4 make contact. Terminals 2 and 6 ground out the audio signal input to the local and line af amplifier stages, silencing the receiver. Terminals 3 and 4 complete a ground circuit through connectors J619-6 and P119-6, to CR102, energizing antenna relay K101. When the break-in relay K601 is de-energized, antenna relay K101 will be energized by the FUNCTION switch in the CAL or STAND BY position. This ground is applied through the CAL or STAND BY position of the FUNCTION switch, connectors P119-7 and J619-7, contacts 3 and 4 of K601, and J619-6 and P119-6, to the same connection of CR102.

75. Calibration Markers, 100-kc (fig. 46)

In order to calibrate the receiver at 100-kc intervals over its entire range, a calibration circuit consisting of the calibration oscillator V205A, the 100-kc multivibrator V206 and the 100-kc cathode follower V205B are used. Both of these tubes are minature twin triode types 5814A. A crystal oscillator generates a 200-kc signal which synchronizes a 100-kc multivibrator. The output from this multivibrator consists of rectangular waves containing many 100-kc harmonics. This stage drives a cathode follower which, in turn, feeds this source of 100-kc markers to rf amplifier V201.

a. Calibration oscillator V205A is essentially a Pierce crystal oscillator. Resistor R220 is a dc grid return and resistor R221 is the plate load resistor. Capacitor C312 at the plate of the calibration oscillator provides a feedback path to sustain oscillation. The 200-kc crystal Y201 is connected between the control grid and the plate of V205A. The crystal is kept at a constant temperature by crystal oven HR202. Trimmer capacitor C310 provides a means of making very small frequency adjustments. The calibration circuit harmonics can be checked against a secondary frequency standard ac voltage (570 volts, terminals 5 to 7) and feed or one of the test signals from station WWV. Capacitor C313 couples the 200-kc signal into the grid circuits of 100-kc multivibrator V206 at the junction of grid resistors R225 and R222 and the common grid resistor R223.

b. Tube V206 is a conventional multivibrator with the plates of each section coupled back to grid circuits of the other section to sustain oscillation. The frequency of oscillation is chiefly determined by the time constants determined by the values of grid resistors R222 and R225 and coupling capacitors C314 and C315. Resistors R224 and R226 are the plate load resistors for the plates of this dual triode. Capacitor C316 couples 100-kc harmonics to the grid of V205B, placing a high grid circuit impedance across V206. The output of V205B is developed across load resistor R227 and resonates with circuit and output capacitance above 32 mc, and provides high-frequency compensation to the 100-kc harmonics in order to maintain all of the 100-kc markers at approximately the same amplitude at the control grid of rf amplifier V201. Resistor R229 provides the load for the lower frequency harmonics and also prevents the stage from drawing excessive cathode current. The 100-kc harmonics are fed through coaxial cable and the small 1-uuf coupling capacitor C228 to the control grid of rf amplifier V201. The plate of V205B is kept at rf ground potential through the decoupling network consisting of R228 and C320. Plate voltage for all the tubes in Radio Receiver R-390A/URR is supplied by the power supply subchassis. This subchassis (fig. 57) consists of power transformer T801 on which is mounted a small chassis which accommodates rectifier tubes V801 and V802 and terminal boards TB801 and TB802. The rectifier tubes are connected in parallel and each tube functions as a half-wave rectifier across the ends of the center-tapped high-voltage winding (terminals 5, 6, and 7) of power transformer T801. Capacitors C801 and C802 filter the rectified output of V801 and V802. Resistor R801 is a bleeder resistor which discharges the filter capacitors when the receiver is turned off. Resistor R802 is a voltage dropping resistor which reduces the voltage applied to the plates of the rectifier tubes. Capacitor C803 bypasses any rf voltages that may appear on the plates of the rectifier tubes to ground.

76. Power Circuits (fig. 47, 102, and 103)

a. Power Supply. Plate and screen-grid voltage for all the tubes in Radio Receiver R-390A/URR is supplied by the power supply subchassis. This subchassis (fig. 57) consists of power transformer T801 on which is mounted a small chassis which accommodates rectifier tubes V801 and V802 and terminal boards TB801 and TB802. The rectifier tubes are connected in parallel and each tube functions as a half-wave rectifier across the ends of the center-tapped high-voltage winding (terminals 5, 6, and 7) of power transformer T801. Capacitors C801 and C802 filter the rectified output of V801 and V802. Resistor R801 is a bleeder resistor which discharges the filter capacitors when the receiver is turned off. Resistor R802 is a voltage dropping resistor which reduces the voltage applied to the plates of the rectifier tubes. Capacitor C803 bypasses any rf voltages that may appear on the plates of the rectifier tubes to ground.

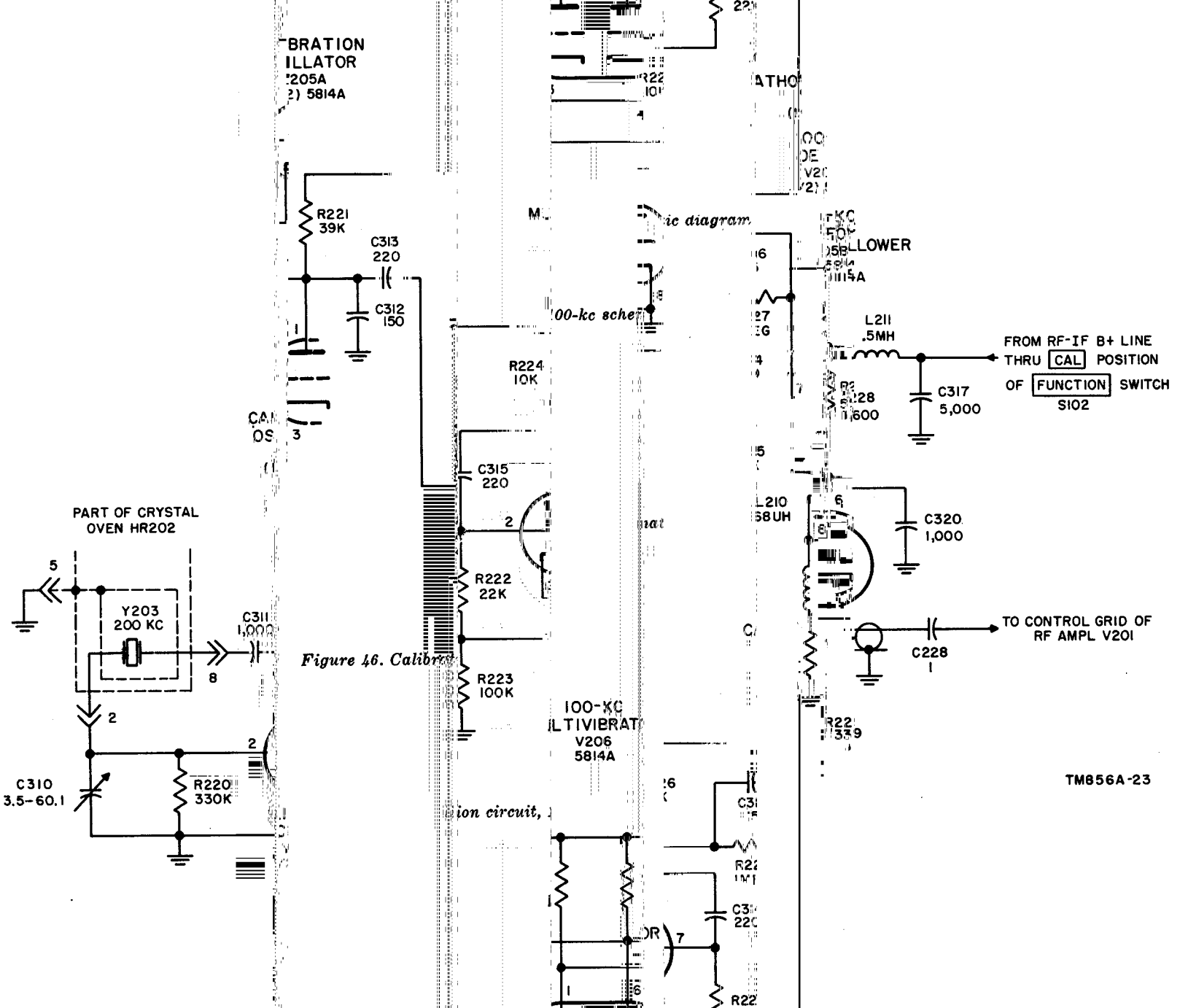


Figure 46. Calibr

this unfiltered dc voltage from the cathodes through connectors J311-5 and P111-5, and through connectors P119-5 and J619-5 (fig. 103) to terminal 1 of swinging filter choke L601. The B+ distribution divides at terminal 2 of L601 and follows three separate paths. The af B+ path is through filter choke L603 to the af subchassis. The rf-if B+ line through filter choke L602 and connectors J619-2 and P119-2 supplies the plate circuits of first and second crystal oscillators V207 and V401 and variable-frequency oscillator V701. Terminal 6 of FUNCTION switch S102 is also connected to the rf-if B+ line and through it terminal 7 feeds this B+ voltage to all the plate and screen circuits in the rf subchassis (except the calibration oscillator and the 100-kc multivibrator) and if subchassis (except the bfo stage). BFO switch S101 also connects to this point. This B+ line is called the switched rf-if B+ line and is energized when FUNCTION switch S102 is on the AGC, MGC or CAL position. The screen grids of both crystal oscillators V207 and V401 and the variable-frequency oscillator V701 require a source of regulated B+ voltage. This is supplied by V605 which maintains a constant positive 150 volts across its terminals under conditions of varying loads. The voltage is regulated of course by the amount of current drawn by V605, and fed through connectors J619-4 and P119-4 to the screen-grid circuits of V207, V401 and V701. This B+ line is called the 150 volt regulated line. Resistor R619 when not shorted out by the STAND BY position of FUNCTION switch S102 adds additional resistance into the voltage-dropping circuit which includes resistors R617 and R618. These resistors drop the voltage between terminal 2 of L601 and the constant 150 volt drop of V605. When FUNCTION switch S102 is in the STAND BY position, plate and screen voltage for most of the tubes in the rf subchassis is removed and the voltage at terminal 2 of L601 tends to rise. This would increase excessive current through V605. The 30 milliamperes which is the rating of the tube. Resistor R619 is shorted in this voltage dropping circuit when FUNCTION switch S102 is in the STAND BY position, protecting V605. When the FUNCTION switch is turned to the AGC, MGC or CAL position resistor R619 is shorted out of the circuit.

h. Filament and Oven Circuits (fig. 102). Filament voltage for all the tubes in the receiver except V505, V701, V801, and V802 are obtained from the 6.3-volt ac line, which is obtained from the filament (terminals 11 and 12) secondary winding of power transformer T801. Filament voltage for tubes V201 through V204 and V206 and V207 in the rf subchassis are made through connectors P108-B and J208-B. Rf choke coils L202 through L207 and capacitors C300 through C305 decouple rf and prevent rf currents from entering or leaving the filament circuits. Tubes V501 through V504 and V506 through V509 obtain 6.3-volt filament power through connectors P112-20 and J512-20. Resistor R536, 3.4 ohm resistor reduces the filament current to limiter tube V507 to approximately 5.3 volts. This does not impair operation of the stage but does reduce the filament hum generated by this stage. Connectors P119-10 and J619-10 connect all the 6.3 volts ac directly to the filaments of the tubes in the af subchassis. Tube V401 in the crystal oscillator subchassis receives 6.3 volts through connectors P110-B and J410-B, filament choke L402 and capacitors C402 and C415 bypass rf signals to ground at the filament. Tube V605 receives 6.3 volts through connectors P119-9 and J619-9 and P111-9 and J311-9. Tube V801 in the power supply receives 6.3 volts through connectors P119-9 and J619-9 and P111-9 and J311-9. Tube V802 receives 6.3 volts through connectors P119-9 and J619-9 and P111-9 and J311-9. Power transformer T801 supplies 25.2 volts ac to the heaters of rectifiers V801 and V802. This 25.2 volts ac source is also fed through connectors P111-11 and J311-11 to bridge rectifier CR102. The rectified voltage, approximately 20 volts dc, is used to energize antenna relay K101 when the yellow lead at the output side of the bridge is grounded through the closed contacts 4 and 5 or 4 and 5 of break-in relay K601 (fig. 45). The 25.2 volts ac is further used to supply filament voltage to tube V505 and tube V701 in series with each other and with current regulator RT510. This circuit maintains the filament current of these critical frequency-determining circuits constant under conditions of varying line voltage. Capacitors C704 and C705 and choke L706 decouple rf from the filament circuit. Crystal oven HR202 is operated by 6.3 volts ac through connectors P108-F and J208-F, and is in operation at all times that power is applied to transformer T801. Ovens HR701 and HR401 are energized when OVENS switch S106 is in the ON position. This switch should be operated only when the receiver is operated in low temperature surroundings or when the ultimate in frequency stability is necessary.

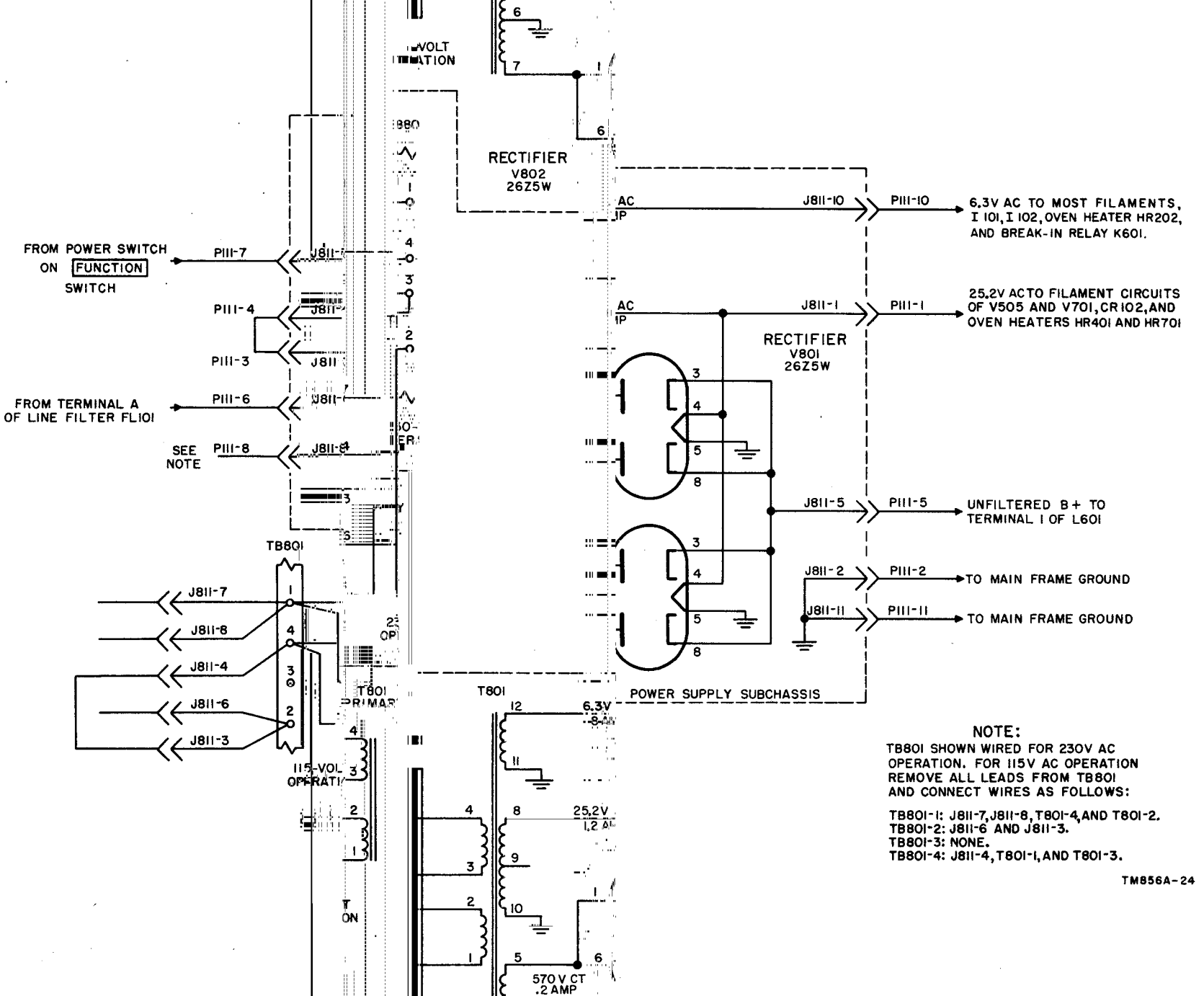
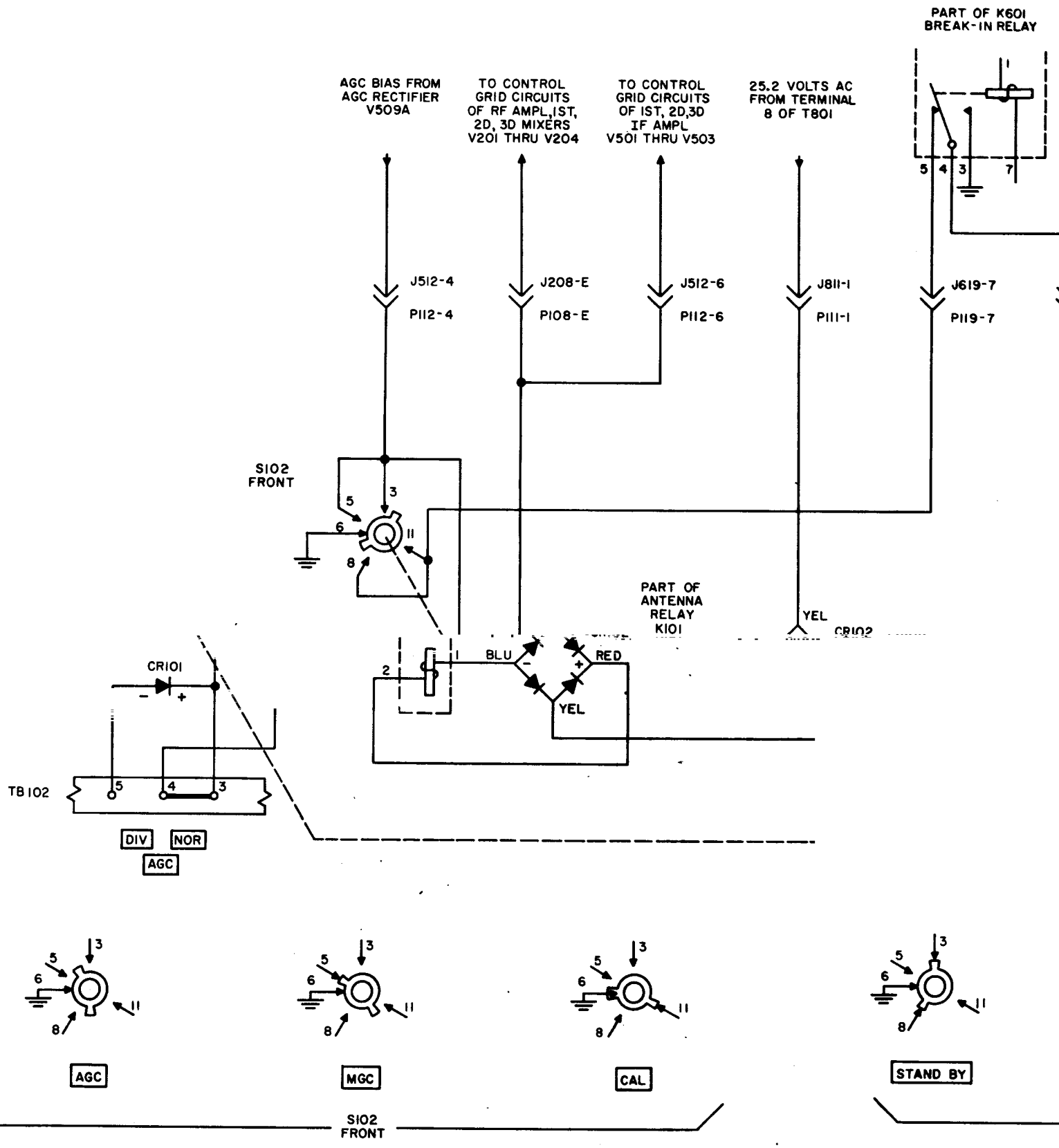


Figure 47. Power supply subchassis, schematic diagram.


PART OF K601
BREAK-IN RELAY
AGC BIAS FROM
AGC RECTIFIER
V509A
TO CONTROL
GRID CIRCUITS
OF RF AMPL, IST,
2D, 3D MIXERS
V201 THRU V204
TO CONTROL
GRID CIRCUITS
OF IST, 2D, 3D
IF AMPL
V501 THRU V503
25.2 VOLTS AC
FROM TERMINAL
8 OF T801
J512-4
P112-4
J208-E
P108-E
J512-6
P112-6
J811-1
P111-1
J619-7
P119-7
S102
FRONT
PART OF
ANTENNA
RELAY
K101
YEL
CR102
BLU
RED
YEL
CR101
TB102
DIV
NOR
AGC
AGC
MGC
CAL
STAND BY
S102
FRONT

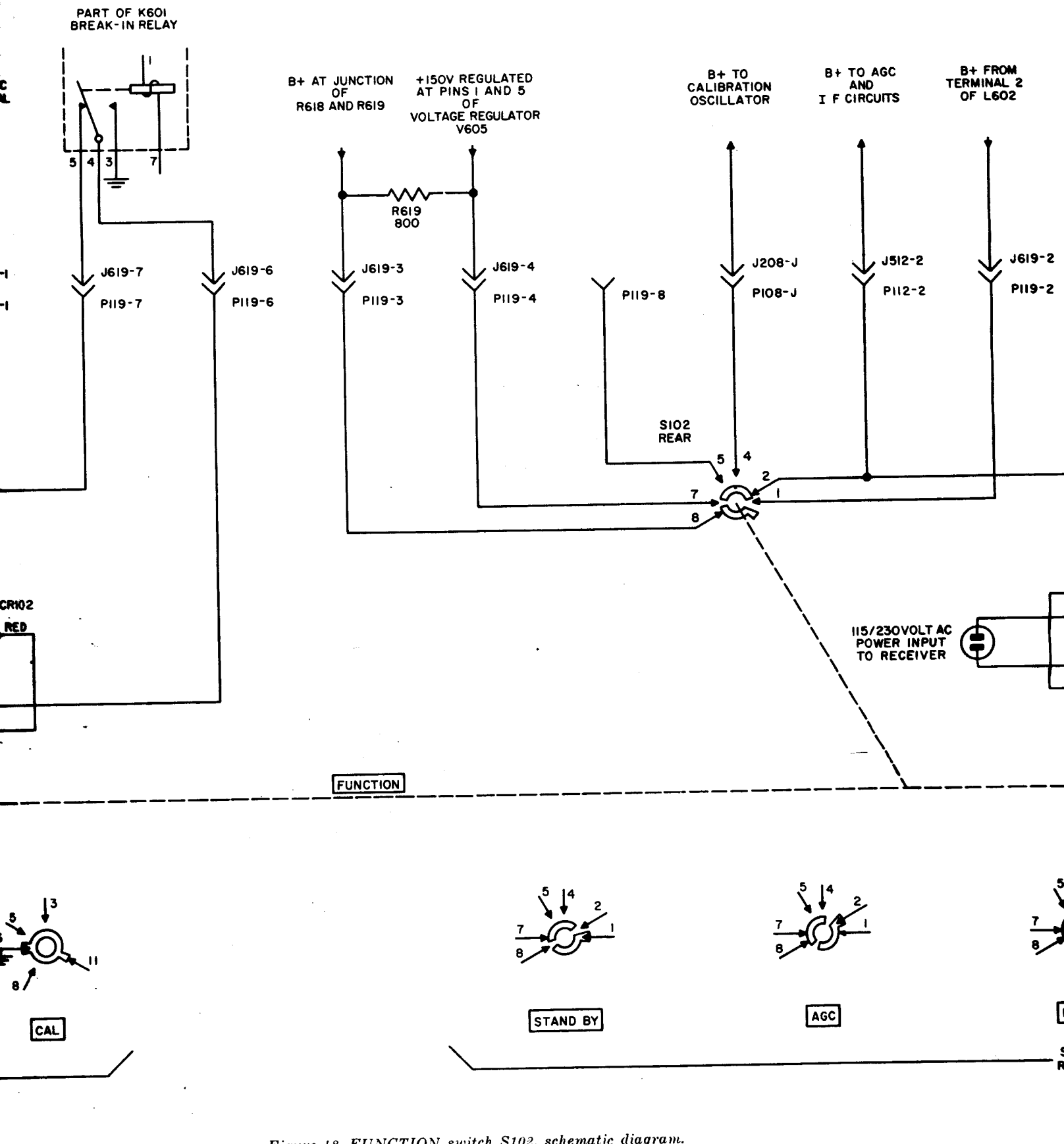
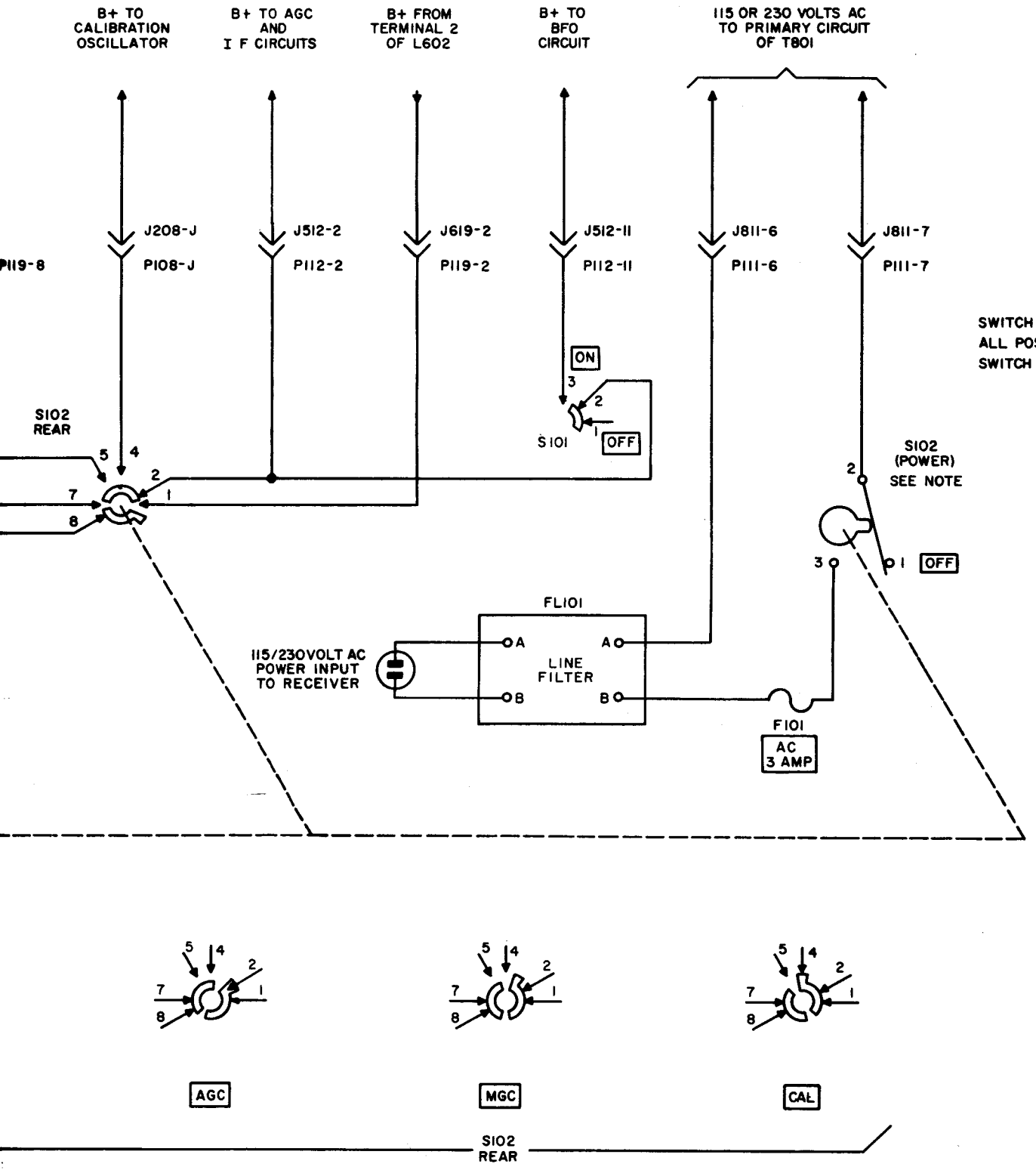


Figure 48. FUNCTION switch S102, schematic diagram.



TM856A-74

gram.

77. FUNCTION Switch

(fig. 48)

FUNCTION switch S102 selects the various types of operation of the receiver.

a. OFF. When the FUNCTION switch is in the OFF position, the power switch is open and line voltage is disconnected from the primary circuit of power transformer T801.

b. STAND BY. When in the STAND BY position, ac power is applied to the primary circuit of T801, and ground is connected through terminal 2 of the front section of this switch through terminals 5 and 4 of K601 which grounds the yellow terminal of K101. This applies 20 volts dc to energize the antenna relay K101, opening and grounding the antenna circuit of the receiver. Resistor R619 is placed in the +150 volt regulated B+ circuit by the rear section of S102 to protect V605 (par. 76*a*).

c. AGC. In the AGC position, ac power is also applied to the primary of T801. The rear section of this switch connects plate voltage from the rf-if B+ line to the rf and if subchassis. Resistor R619, part of the voltage regulator dropping resistor circuit, is short-circuited to maintain proper operating conditions for the voltage regulator. The agc line, at the AGC terminal 4 of TB102 is ungrounded, allowing the agc bias to control the receiver gain.

d. MGC. In the MGC position, ac power to T801 and plate and screen grid voltage to the rf and if subchassis are applied, but the agc line is short-circuited to ground. Under this condition, the only control of receiver sensitivity is maintained by RF GAIN control R103.

e. CAL. In this position, ac power to T801 and plate and screen grid voltage to the rf and if subchassis are supplied. In addition, plate voltage for the calibration oscillator circuit is applied from the rf-if B+ line through connectors P108-J and J208-J. At the same time, antenna relay K101 is operated and the antenna disconnected from the receiver and grounded. This allows only calibration markers at 100-kc intervals to pass through the receiver circuits.

78. External Control Circuits

a. General. The receiver alone is capable of furnishing reception when it is connected to an ac power source, a suitable antenna, and a headset or a loudspeaker. In many installations, the receiver will be used as part of a complex system. Under such conditions external control and use of the receiver functions is necessary.

b. Break-in Connection. When the receiver is operated in conjunction with a transmitter, and receiver disabling is desired during transmitting periods, BRK IN terminal 9 on the rear panel of the receiver must be grounded at the transmitter. In addition, the BREAK IN switch on the front panel of the receiver must be set at the ON position. During transmitting periods the antenna input and the audio circuits are grounded. Refer to paragraph 74. Receiver disabling may be removed for netting by setting the BRK IN switch at OFF.

c. DIODE LOAD Connection. Under conditions of diversity reception of voice signals, diode-load combining of the output of two or more receivers may be used. The jumper between terminals 14 and 15 of one receiver is removed and terminals 14 of both receivers are then connected together. With this connection, the diode detectors of both receivers are connected to the diode load resistor of the receiver with the connection between terminals 14 and 15. As the signal fades alternately in the two receivers, the diode detector having the larger signal develops a voltage across the load that cuts off the diode. Thus the receiver with the larger signal always develops the signal in the audio output. The audio signal is taken from the receiver with the connection between terminals 14 and 15.

d. AGC Connection. Under some conditions of diversity reception, an improvement in signal-to-noise ratio may be had by common connection of the agc systems of the two receivers. The jumpers of the two receivers between terminals 3 and 4 are moved to 4 and 5 and terminals 4 of the two receivers are connected together. Normally, when a receiver goes into a deep fade, the agc system increases receiver gain and noise output is increased. With the common connections, agc voltage from the receiver having the larger signal develops an agc voltage that lowers the gain of the noisy receiver.

e. External RF GAIN Control Connection. In some applications it is necessary to control the gain of the receiver at a remote location. This is accomplished by connecting an rf gain control to the RF GAIN terminal on the rear

par. 55, 63, and 66)

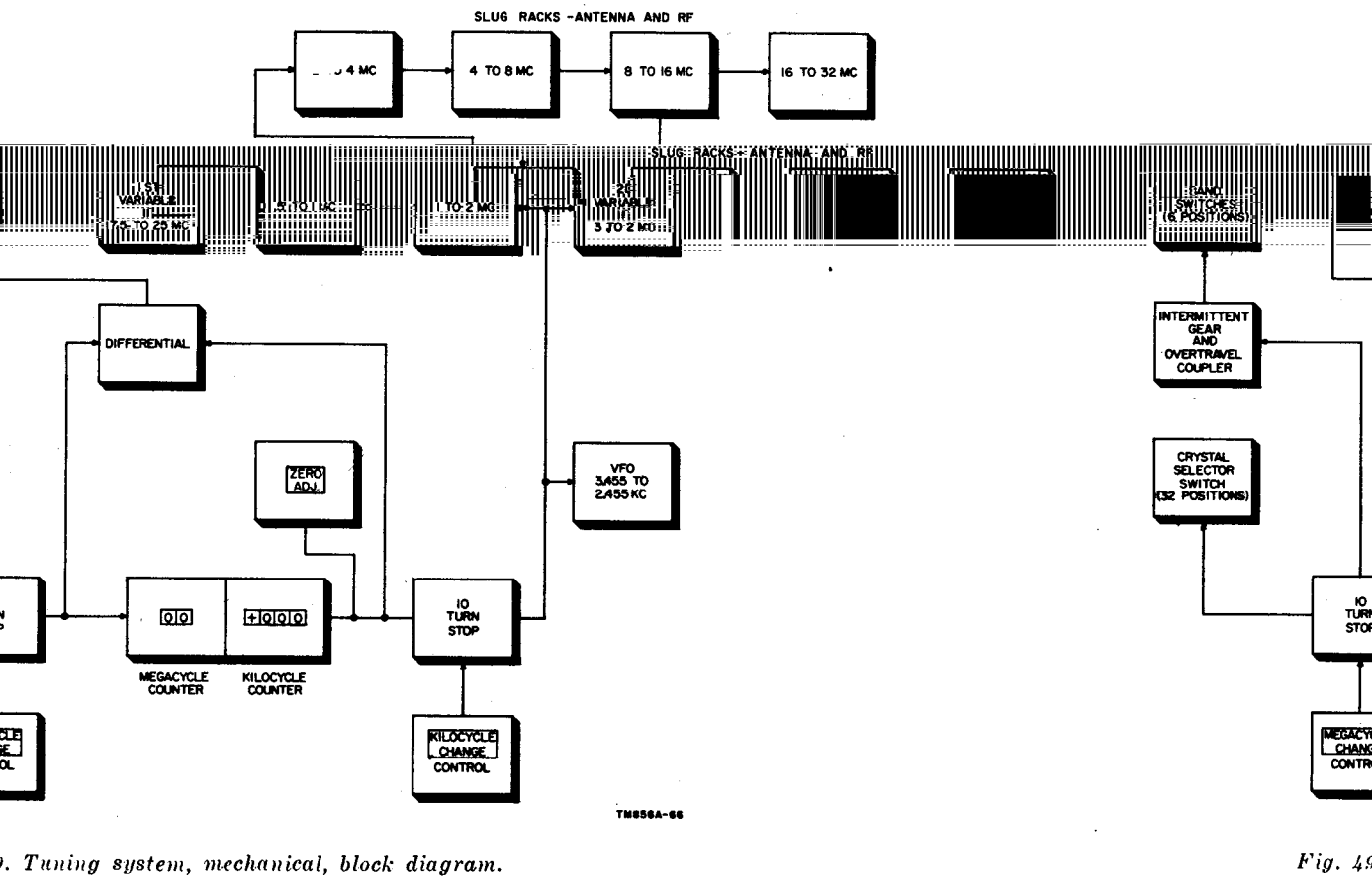
Section III. ANALYSIS OF MECHANICAL TUNING SYSTEM

79. General Principles of Operation (fig. 49)

a. General. The mechanical tuning system of Radio Receiver R-390A/URR controls the permeability tuning and switching to provide continuous linear tuning over a range of .5 to 32 mc in 32 steps. Each step, or band of the MEGACYCLE CHANGE control (except the first band), is tuned linearly over a range of 1 mc. The first band is tuned from .5 to 1 mc. Although the counter can be set between 00 000 and 00 500, no signal reception is possible. The frequency to which the receiver is tuned is indicated on a counter-type dial, which indicates the frequency in kilocycles. Figure 49 is a simplified block diagram of the mechanical tuning system.

b. MEGACYCLE CHANGE Control. Operation of the MEGACYCLE CHANGE control is limited to 10 turns by a progressive mechanical stop. As the control is turned, the first two number wheels on the counter-type dial are rotated, and the numbers coincide with the frequency of reception in thousands of kilocycles (megacycles) from 0 through 31. At the same time, the 32-position crystal selector switch is switched to one of 32 positions. The rf band switches are also operated by this control through the intermittent gear and overtravel coupler. This system operates the band switches at precisely the correct time as the MEGACYCLE CHANGE control is continuously turned. The MEGACYCLE CHANGE control also controls the positioning of all slug racks except the .5- to 1-mc, 1-2 mc antenna and rf slug racks, and second variable if slug racks through the differential.

c. KILOCYCLE CHANGE Control. The KILOCYCLE CHANGE control is connected directly through a 10-turn stop to the vfo, the second variable if, and the slug racks of the .5- to 1-mc and 1- to 2-mc antenna and rf slug



9. Tuning system, mechanical, block diagram.

Fig. 49

racks. The KILOCYCLE CHANGE knob is also connected through the same differential as the MEGACYCLE CHANGE knob. The KILOCYCLE CHANGE knob provides the movement for the 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, and the 16- to 22-mc antenna and rf slug racks and the first variable if slug racks from the starting point established by the MEGACYCLE CHANGE knob. A ZERO ADJ knob on the front panel of the receiver allows frequency dial correction over a small range in order to align the receiver frequency with the frequency-counter reading.

80. Functional Analysis
(fig. 50)

a. General. Figure 50 gives a more detailed description of the operation of the mechanical tuning system. A detailed study of the mechanical alignment, disassembly, and reassembly of the tuning assembly should be made in connection with the following analysis. In order to tune continuously from .5 to 32 mc at a linear rate, it is necessary that the correct antenna transformers be selected but the slugs must be moved at the proper rate to tune numerous coils and rf tranformers simultaneously. For example, to cover the .5 to 1-mc band, the slugs in coils T201 and Z201 move over their entire range, a distance of approximately eight-tenths of an inch. At the same time the slugs in the coils of Z213 move approximately five-hundredths of an inch in covering this range. This tuning is controlled with a single knob by means of numerous gears and cams.

b. KILOCYCLE CHANGE Knob. Starting with the right-hand side of figure 50, it will be seen that the KILOCYCLE CHANGE knob tunes the vfo directly through the 10-turn progressive stop. Also connected to this control (dotted lines) are the second variable if slug rack (3 to 2 mc) and the antenna and rf slug racks for the coils covering the .5- to 1-mc and the 1- to 2-mc bands.

c. MEGACYCLE CHANGE Knob. This knob controls the selection of the proper crystal and tuned circuit in the crystal oscillator subchassis. This is done through 32 positions of switches S401 and S402 as the MEGACYCLE CHANGE knob is turned from end to end through the 10-turn progressive stop. The antenna, rf, and variable if band switches are rotated through six positions as the MEGACYCLE CHANGE knob is turned from stop to stop. This motion is intermittent and occurs at precisely the correct time. Switches S201 through S208 in the rf subchassis are operated with this intermittent motion. This is accomplished through the intermittent gear and over-travel coupler. An intermittent gear turns its mating gear only when one of the few teeth of the driving gear mesh with teeth of the driven gear. The MEGACYCLE CHANGE control also positions (through the differential) the starting point for the slug racks of the first variable if (17.5 to 25 mc) and the antenna and rf coils for the 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, and 16- to 32-mc bands. From this starting point, the KILOCYCLE CHANGE control moves (through the same differential) the slug racks to cover the frequency range of this control.

d. Shorting Adjacent Coils. The rear section of switch S204 short-circuits the secondary windings of the adjacent antenna transformers. This is necessary to prevent interaction with the secondary winding of the antenna transformer that has been selected by the front section of switch S204. The chart below indicates the band, frequency range, secondary winding in use, and the secondary winding shorted by the rear section of S204.

Band switch and position	*Secondary winding in use*	*Secondary winding shorted*
1 (.5-1)	L213	L217
2 (1-2)	L215	L213
3 (2-4)	L217	L215
4 (4-8)	L219	L217
5 (8-16)	L221	L219
6 (16-32)	L223	L221

e. Selection of ANT TRIM Capacitors. Either or both of ANT TRIM capacitors C225A and C225B are used for peaking the tuning of the secondary windings of antenna transformers T201 through T206 (par. 54*d*). The chart below indicates the band, frequency range, the selection of C225A and/or C225B, and the use of parallel or series connection with a fixed capacitor across the selected antenna transformer secondary winding.

Band switch and position (mc)	C225A	C225B	*Connection to fixed capacitor in antenna transformer*
1 (.5-1)	In	In	Parallel
2 (1-2)	In	In	Parallel
3 (2-4)	Out	In	Parallel
4 (4-8)	In	Out	Series
5 (8-16)	Out	In	Parallel
6 (16-32)	Out	Out	Series

(3) Also operated by the MEGACYCLE CHANGE control is the 32-position crystal oscillator switch. This is accomplished through gears (A), (B), (C), (D), (E), (L), (M), (N), and (P).

(4) The 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, and 16- to 32-mc rf slug racks are moved by both the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls through a differential gear system consisting of gears (NN), (B), (VV), (WW), and (U).

(*a*) The 2- to 4-mc rf slug rack is operated by the MEGACYCLE CHANGE control through gears (A), (B), (U), (V), (W), and (X).

(*b*) The 4- to 8-mc rf slug rack is operated by the MEGACYCLE CHANGE control through gears (A), (B), (U), (V), (W), (X), (Y), and (Z).

(*c*) The 8- to 16-mc rf slug rack is operated by the MEGACYCLE CHANGE control through gears (A), (B), (U), (V), (W), (X), (Y), (Z), (AA), and (BB).

(*d*) The 16- to 32-mc rf slug rack is operated by the MEGACYCLE CHANGE control through gears (A), (B), (U), (V), (W), (X), (Y), (Z), (AA), (BB), (CC), and (DD).

(5) In each of the steps (bands .5-1 mc through 16-32 mc) of frequency coverage it is necessary to have an exact stopping point or reference for the circuit elements controlled by the MEGACYCLE CHANGE control. This is done by the mc change detent. A disk with three equally spaced notches around its edge touches the mc change detent and locks the disk when the mc change detent falls into one of the three notches. This mc change detent is made of spring material, and constantly maintains pressure against the three-notch disk. As the MEGACYCLE CHANGE knob is rotated through each band, the action

chanical Analysis

acilitate an understanding of
e mechanical gearing system
g system, the gears in figure
gned letter designations, as
r of teeth in each gear. The
veen mating gears thus can
cams that furnish motion to
shown as single units; actu-
has a roller at both ends and
ounted on each end of the
done to provide stable and

E CHANGE Control.
EGACYCLE CHANGE con-
ned, it is limited to 10 turns
ressive stop. The mc counter
ow the frequency band or
cted by the MEGACYCLE
control. As this control is
ne counter wheels are driven
gears (A), (B), (C), (D),
, (M), (R), (S), and (T).

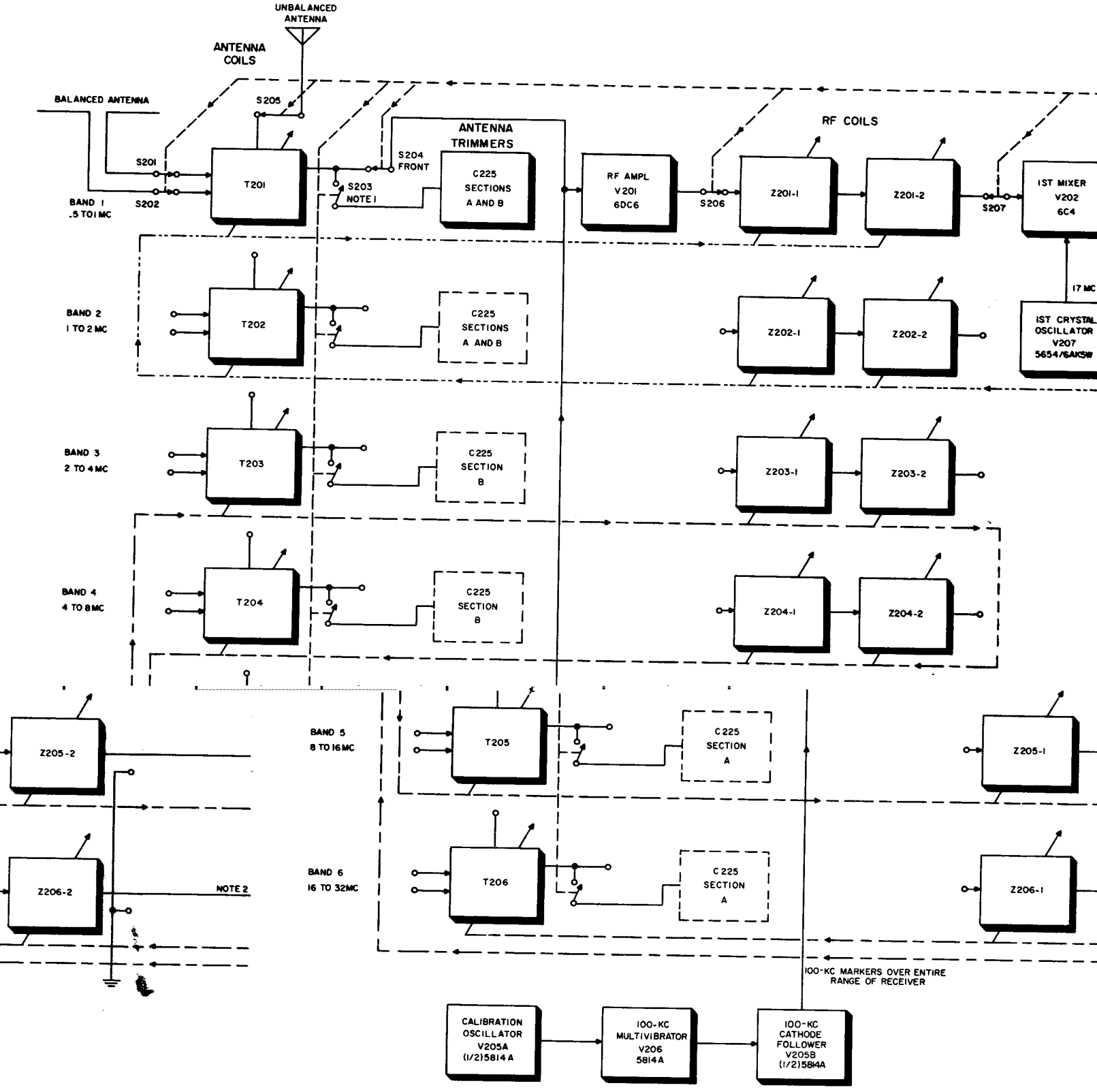
ACYCLE CHANGE control
ates the six-position rf band
rough gears (A), (B), (C),
, (F), (G), intermittent gear
gears (J) and (K). The in-
t gear and overtravel coupler
an intermittent rotary mo-
nat the switch is turned to
of its six positions at exactly
time. The gear (G) rotates
V as the MEGACYCLE
knob is turned. However,
J) and (K) are driven only
part of the rotation of the
when the teeth of the inter-
ar (H) engage the teeth of
J).

81. Detailed Mec
(fig. 51)

a. General. To fa
the function of the
and electrical tunin
51 have been assi
well as the numbe
turning ratio betw
be calculated. The
the slug racks are
ally, each slug rack
identical cams mo
cam shaft. This is
accurate operation.

b. MEGACYCL
(1) As the M
trol is tur
by a prog
wheels sh
step selec
CHANGE
rotated, t
through g
(E), (L)

(2) The MEG
also opera
switch th
(D), (E)
(H), and
termitten
provides
tion so t
only one
the right
continuous
CHANGE
the gears
during the
gear (G)
mittent ge
the gear (


UNBALANCED ANTENNA
ANTENNA COILS
BALANCED ANTENNA
S205
S201
S202
BAND 1 .5 TO 1 MC
T201
S204 FRONT
S203 NOTE 1
ANTENNA TRIMMERS
C225 SECTIONS A AND B
RF AMPL V201 6DC6
RF COILS
S206
Z201-1
Z201-2
S207
1ST MIXER V202 6C4
17 MC
BAND 2 1 TO 2 MC
T202
C225 SECTIONS A AND B
Z202-1
Z202-2
1ST CRYSTAL OSCILLATOR V207 5654/6AK5W
BAND 3 2 TO 4 MC
T203
C225 SECTION B
Z203-1
Z203-2
BAND 4 4 TO 8 MC
T204
C225 SECTION B
Z204-1
Z204-2
Z205-2
BAND 5 8 TO 16 MC
T205
C225 SECTION A
Z205-1
Z206-2
NOTE 2
BAND 6 16 TO 32 MC
T206
C225 SECTION A
Z206-1
100-KC MARKERS OVER ENTIRE RANGE OF RECEIVER
CALIBRATION OSCILLATOR V205A (1/2)5814A
100-KC MULTIVIBRATOR V206 5814A
100-KC CATHODE FOLLOWER V205B (1/2)5814A

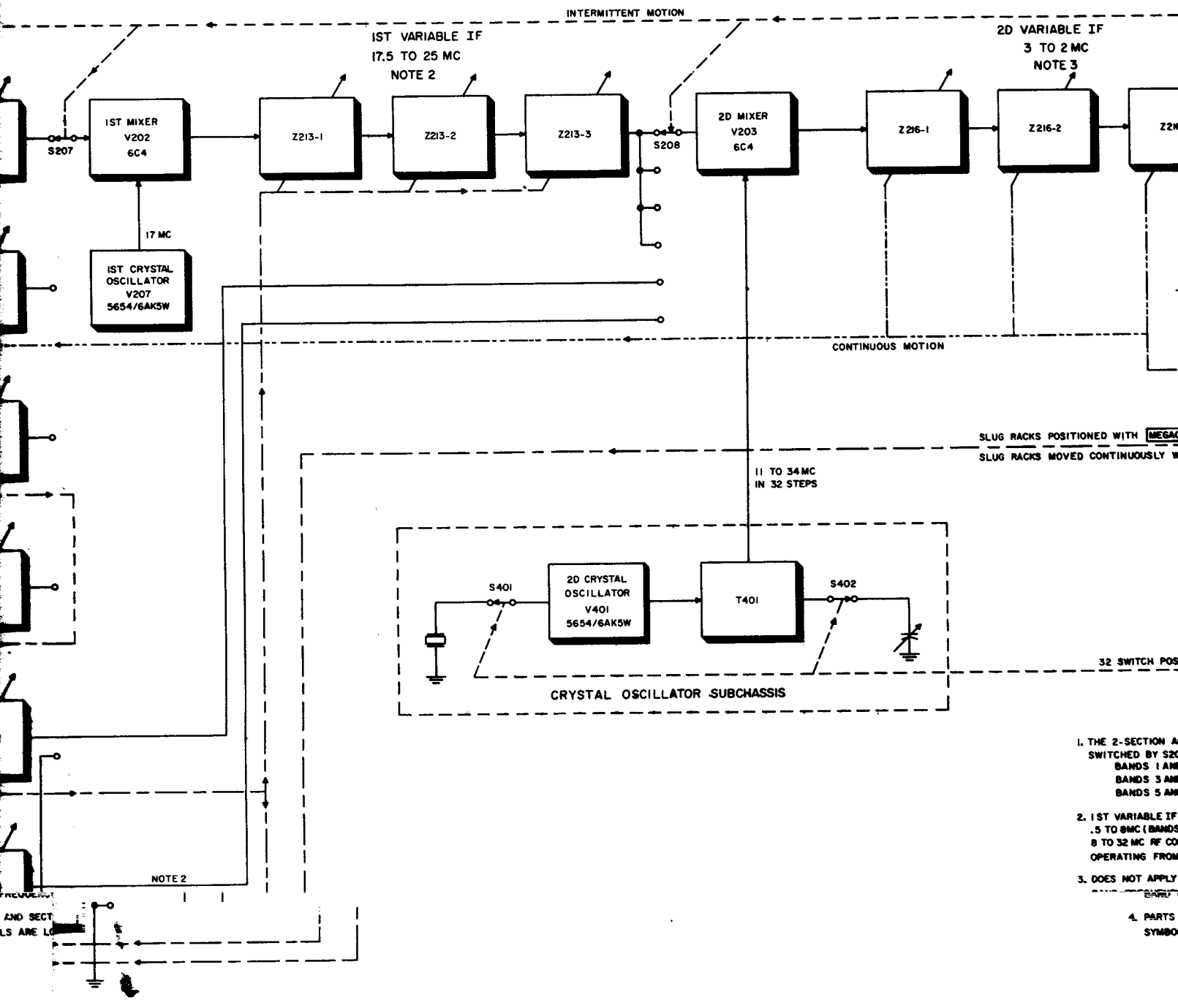
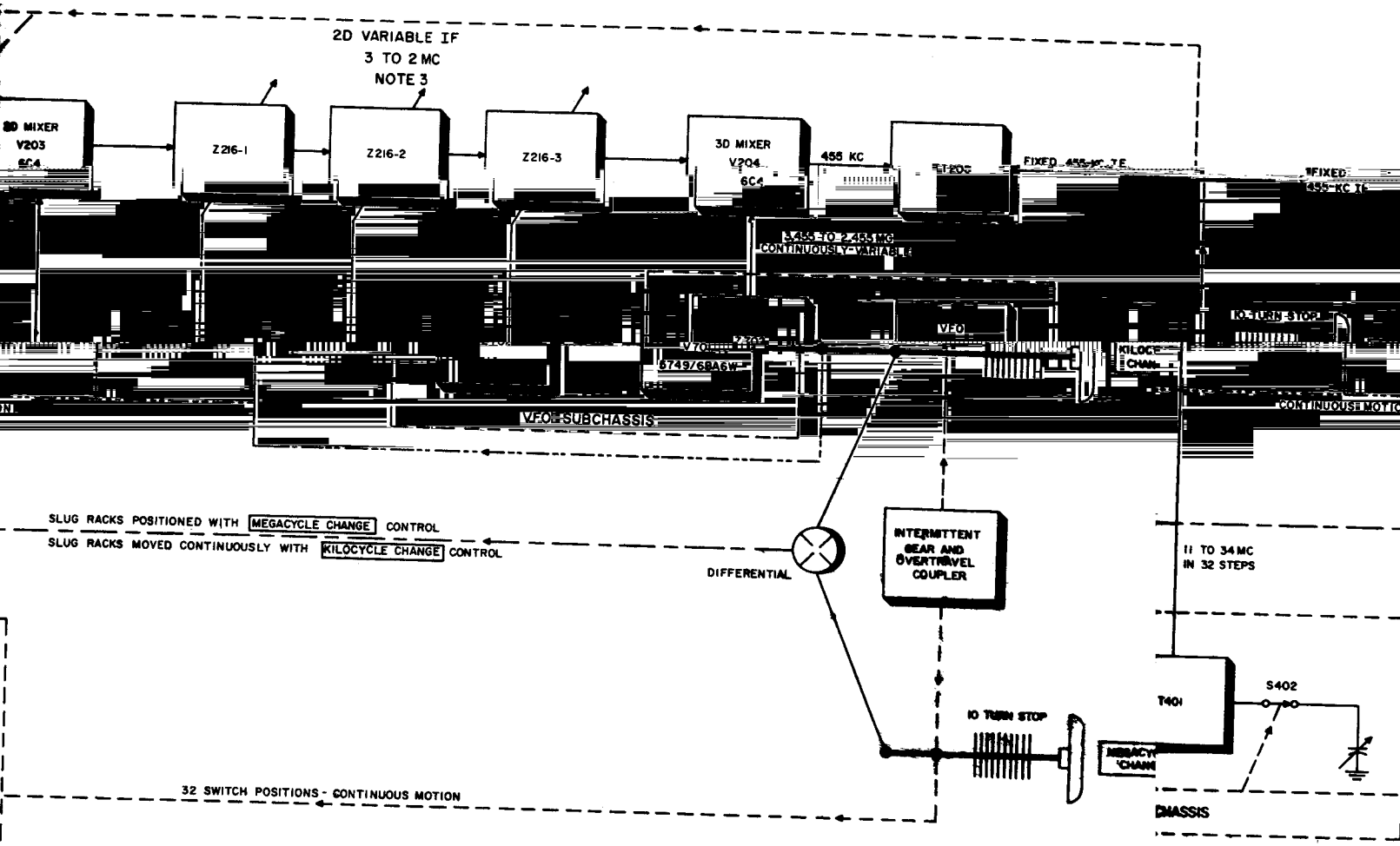


Figure 50. Tuning system, showing relationship of stages, block diagram.



NOTES:

1. THE 2-SECTION ANTENNA TRIMMER CAPACITOR C225 SWITCHED BY S203 AS FOLLOWS:
   BANDS 1 AND 2 - SECTIONS A AND B
   BANDS 3 AND 4 - SECTION B
   BANDS 5 AND 6 - SECTION A
2. 1ST VARIABLE IF (V202 AND V207) USED ONLY FROM .5 TO 8MC (BANDS 1 THROUGH 4). OUTPUT OF V201 AND 8 TO 32 MC RF COILS FED DIRECTLY INTO V203 WHEN OPERATING FROM 8 TO 32MC.
3. DOES NOT APPLY TO .5 TO 1MC BAND. ON .5 TO 1MC BAND FREQUENCY RANGE IS 2.5 TO 2MC.
4. PARTS AND SECTIONS WITH 200 SERIES REFERENCE SYMBOLS ARE LOCATED IN THE RF SUBCHASSIS.

ock diagram.

of the mc change detent can be felt. Increasing the hand torque applied to the MEGACYCLE CHANGE knob at this point will cause the three-notch disk to turn past the mc change detent, but it will fall into the adjacent notch when the detent meets the adjacent notch.

(6) The first variable if slug rack (17.5 to 25 mc) is driven by the MEGACYCLE CHANGE knob in the same manner and on the same shaft as the 8- to 16-mc rf slug rack. The gearing is through gears (A), (B), (U), (V), (W), (X), (Y), (Z), (AA), and (BB).

c. KILOCYCLE CHANGE Control.

(1) The KILOCYCLE CHANGE control is limited to 10 turns by a progressive stop. The kc counter wheels show the frequency selected by the KILOCYCLE CHANGE control. To permit overlapping of each band selected, the frequency range of this control is slightly greater than 1 mc. As the KILOCYCLE CHANGE control is rotated, the kilocycle counter wheels are driven through gears (EE), (FF), (GG), (HH), (JJ), and (KK).

(2) The vfo tuning unit is connected directly to the KILOCYCLE CHANGE control through the 10 turn stop and the Oldham coupler. The Oldham coupler is a coupling device for correcting slight misalignment of two shafts. It consists of three disks, the first and third have a tongue or ridge, running through the center of the inner faces. These two tongues are 90° displaced from each other. The second, or inner disk, has two grooves running through the center of the faces, each likewise displaced 90° from the other. Fitting the three disks together and using the first disk to drive the third disk through the second disk, transfers rotary motion between two shafts which can be slightly out of line with each other. This is possible because the mating tongues and grooves slide slightly to correct the out-of-line condition.

(3) The .5 to 1-mc rf slug rack cam is operated by the KILOCYCLE CHANGE knob through gears (EE), (FF), (LL), (MM), (NN), (PP), (RR), and (SS). The 1- to 2-mc rf slug rack cam is operated through gears (EE), (FF), (LL), (MM), (NN), (PP), (RR), (SS), (TT), and (UU).

(4) The second variable if slug rack (3 to 2 mc) is operated by the KILOCYCLE CHANGE control through the same gears and same shaft as the 1- to 2-mc rf slug rack cam.

(5) The 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, 16- to 32-mc rf slug rack cams are moved by the KILOCYCLE CHANGE control through a differential gear system. These rf slug rack cams are operated through the same gears as in *b*(4)(*a*) through (*d*) above, except for gears (A) and (B). These two gears are replaced by gears (EE), (FF), (LL), (MM), (NN), (VV), and (WW).

d. ZERO ADJ Control. The ZERO ADJ control provides a means of correcting errors in calibration. A locking screw operated by the knob releases the clutch and locks the gear (GG). Tuning over a range of approximately 10 kc is possible with the KILOCYCLE CHANGE control without moving the setting on the three kilocycle counter wheels on the frequency indicator. Operation of the ZERO ADJ knob in a counterclockwise direction engages the clutch and unlocks gear (GG).

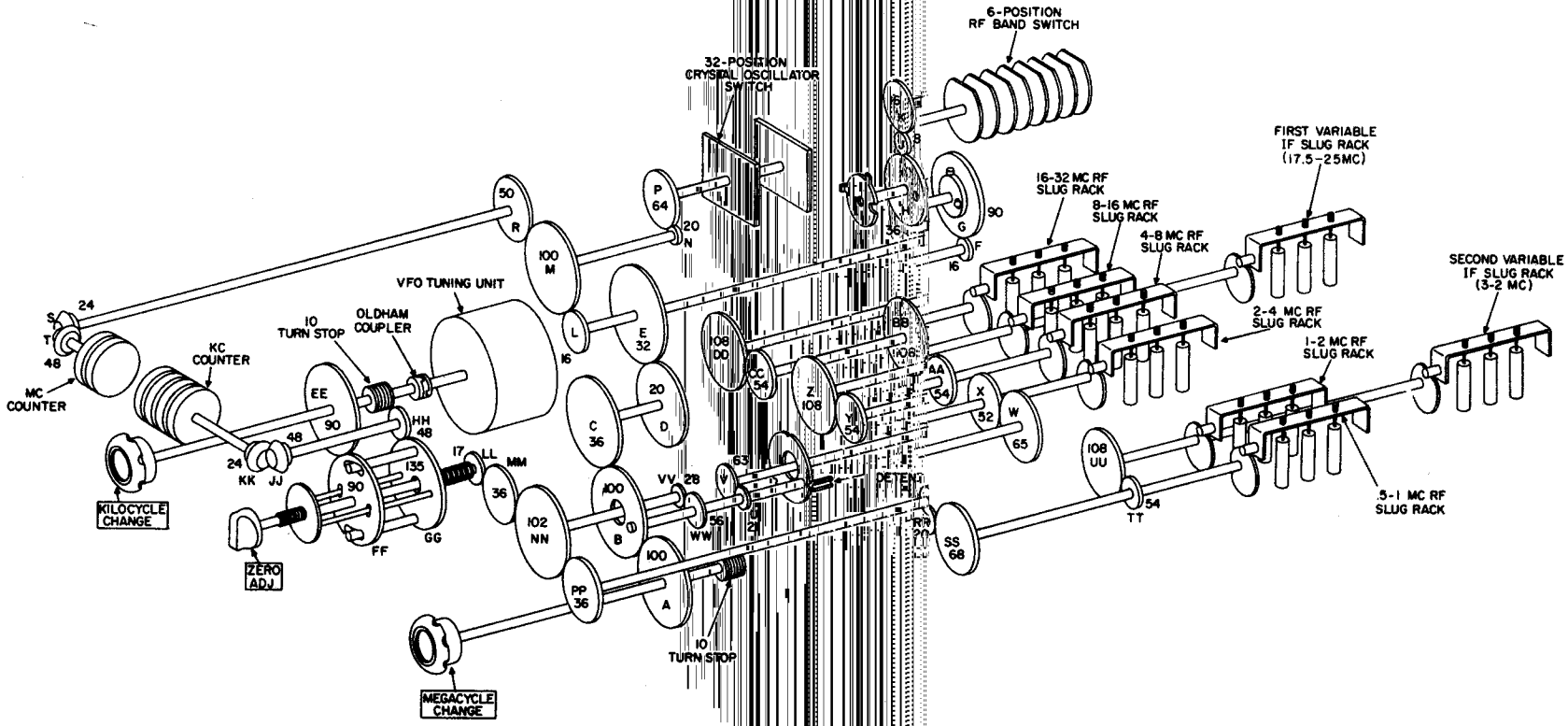


Figure 51. Tuning system, simplified diagram.

CHAPTER 6
FIELD MAINTENANCE

Section I. GENERAL TROUBLE-SHOOTING TECHNIQUES

Warning: When servicing the receiver, avoid contact with the power supply and plate circuits. The high voltages present in these circuits can cause serious injury or death. Connect GND terminal 16 to the same ground as the ac power source before applying power to the receiver.

82. Test Equipment and Tools Required for Trouble Shooting

The test equipment required for trouble shooting Radio Receiver R-390A/URR is listed below. A common usage name is given after

chassis or to the parts and wiring of
anel and main frame. Finally, isolate
ve part by voltage, resistance, and
measurements. Some faults, such as
resistors, shorted transformers, and
ections often can be located by sight,
hearing. The majority of faults, how-
be located by checking tubes, voltage,
ance.

led Procedure. The tests listed below
sed as a guide in isolating the source

ond step is to localize the fault. Localization means tracing the fault to the defective circuit

on the sub
the front p
the defecti
continuity
burned-out
loose conne
smell, and
ever, must
and resista

b. Detai
are to be u

first to be applied in the trouble-shooting procedure. This inspection is also valuable because additional damage to the receiver that might occur through improper servicing methods possibly can be avoided.

(2) *Checking B+ and heater circuits for shorts.* These measurements (par. 90 and 91) prevent further damage to the

y electron tubes. Tapping each tube
ently with a pencil may give an in-

ping or jarring the subchassis or parts under test. It is possible that the trouble is not in the receiver itself, but in the installation (mounting, antenna, ground, auxiliary equipment, or vehicle), or the trouble may be caused by external conditions. In this event, test the installation, if possible. Intermittent noise conditions may be caused

receiver from possible short circuits.
This test gives an indication of the

Fig. No.	Par. No.	Description
	121 through 132	Removals and replacements
100		Resistor color code.
101		Capacitor color code.
102		Filament and oven circuits, schematic diagram.
103		B+ circuits, schematic diagrams.
104		Agc distribution, schematic diagram.
105		Main frame wiring diagram.
106		Receiver schematic diagram.

ticular procedure order different control settings.

LINE METER	OFF
LINE GAIN	0
AGC	MED
LIMITER	OFF
AUDIO RESPONSE	WIDE
BANDWIDTH	8 KC
BFO PITCH	0
BREAK IN	OFF
FUNCTION	AGC
ANT TRIM	0, or maximum output
BFO	OFF
DIAL LOCK	Unlocked fully counterclockwise
ZERO ADJ	Disengaged, fully counterclockwise
LOCAL GAIN	5, or desired volume
OVENS	ON
MEGACYCLE CHANGE	01, or as specified
KILOCYCLE CHANGE	510, or as specified
RF GAIN	10

Use control settings given below prior to test or trouble-shooting procedure. Many of tests that follow repeat some of the settings others refer back to this paragraph, to str the importance of using the proper control s tings. Observe these control settings, a change them *only when instructions in a p*

NG RADIO RECEIVER R-390A/URR

Section II. TROUBLE SHOOTI

b. Be sure the receiver is disconnected from the power source or is turned off before touching high-voltage circuits or changing connections.

c. After disconnecting auxiliary equipment and before testing the receiver, connect pairs of terminals on the rear panel terminal strips as shown in figure 12.

d. After disconnecting tuning shafts for re... val of a subchassis, avoid turning the shafts ... tuning controls unless necessary for trouble ... oting or adjustment. Careful handling may ... minate the need for mechanical synchroni... ion. Make a note of the positions of the front... el controls indicated in the removal proced... when removing a subchassis, because a con... may be accidentally disturbed during serv... g.

. Careless replacement of parts often makes ... faults.

(1) Before unsoldering a part, note the position of the leads. If the part has a number of connections, tag each of its leads, or make a sketch of the proper connections.

86. Bench Testing

a. When testing or trouble shooting the ... ceiver, do not remove a subchassis unless ... solutely necessary. The patch cords (fig. 52 a... 53) are required for operating the subchas... out of the receiver. When making these iten... be sure to make several of the coaxial type (f... 52), because the rf and if subchassis have mo... than one coaxial connection.

b. To prepare a subchassis for testing or trouble shooting outside the receiver main frame, follow the instructions given in paragraph 121. *Avoid disturbing the synchronization of the rf gear train assembly with the rf, crystal oscillator, or vfo subchassis.*

87. General Precautions

When servicing a receiver, observe the precautions given in *a* through *f* below.

a. When the receiver is removed from the case, cabinet, or rack for servicing, connect a suitable ground to the main frame and to any subchassis operated outside the main frame before connecting the power cord.

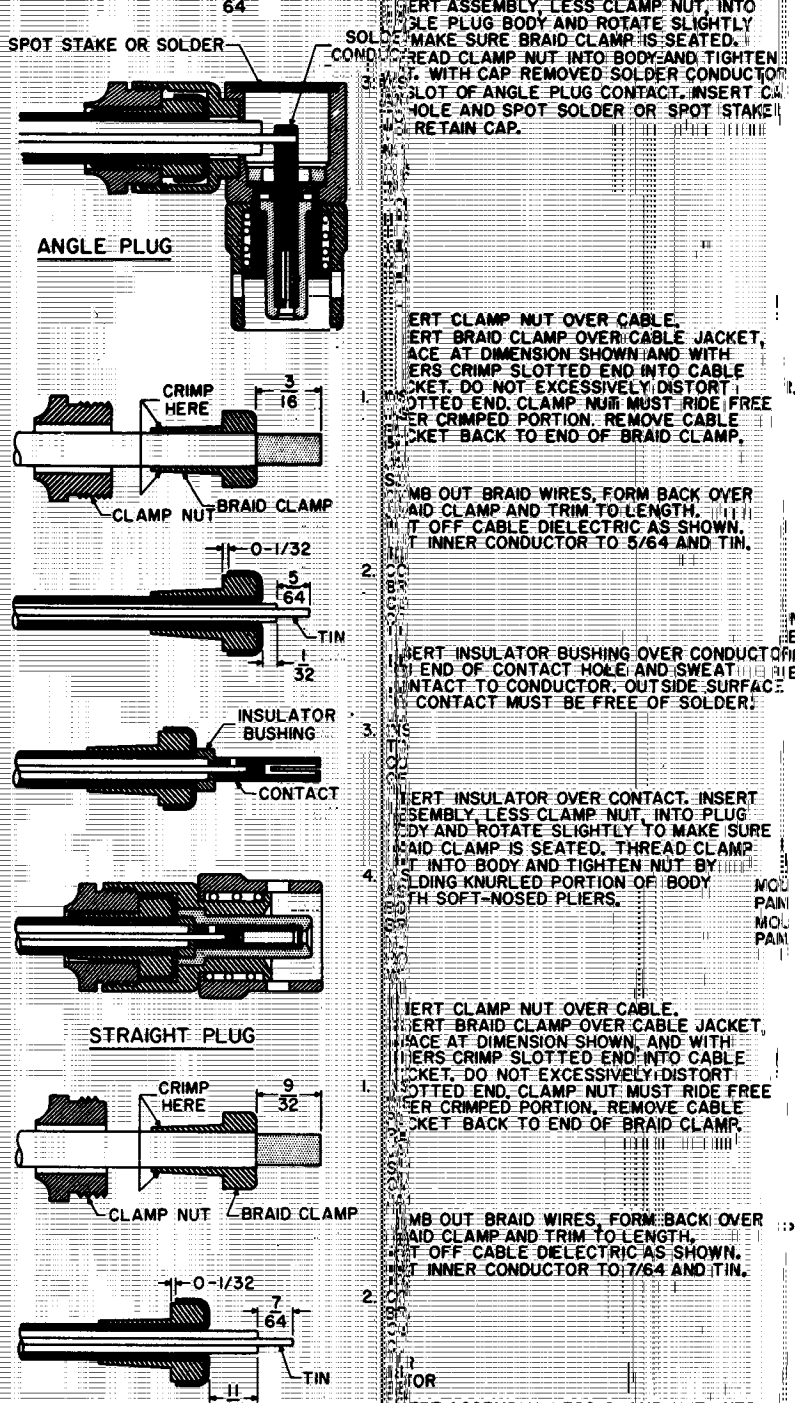


Figure 52. Coaxial test cables.

ERT ASSEMBLY, LESS CLAMP NUT, INTO
GLE PLUG BODY AND ROTATE SLIGHTLY
MAKE SURE BRAID CLAMP IS SEATED.
READ CLAMP NUT INTO BODY AND TIGHTEN
T. WITH CAP REMOVED SOLDER CONDUCTOR
SLOT OF ANGLE PLUG CONTACT. INSERT CA
HOLE AND SPOT SOLDER OR SPOT STAKE
RETAIN CAP.

ERT CLAMP NUT OVER CABLE.
ERT BRAID CLAMP OVER CABLE JACKET,
ACE AT DIMENSION SHOWN AND WITH
ERS CRIMP SLOTTED END INTO CABLE
CKET. DO NOT EXCESSIVELY DISTORT
OTTED END. CLAMP NUT MUST RIDE FREE
ER CRIMPED PORTION. REMOVE CABLE
CKET BACK TO END OF BRAID CLAMP.

MB OUT BRAID WIRES, FORM BACK OVER
AID CLAMP AND TRIM TO LENGTH.
T OFF CABLE DIELECTRIC AS SHOWN.
T INNER CONDUCTOR TO 5/64 AND TIN.

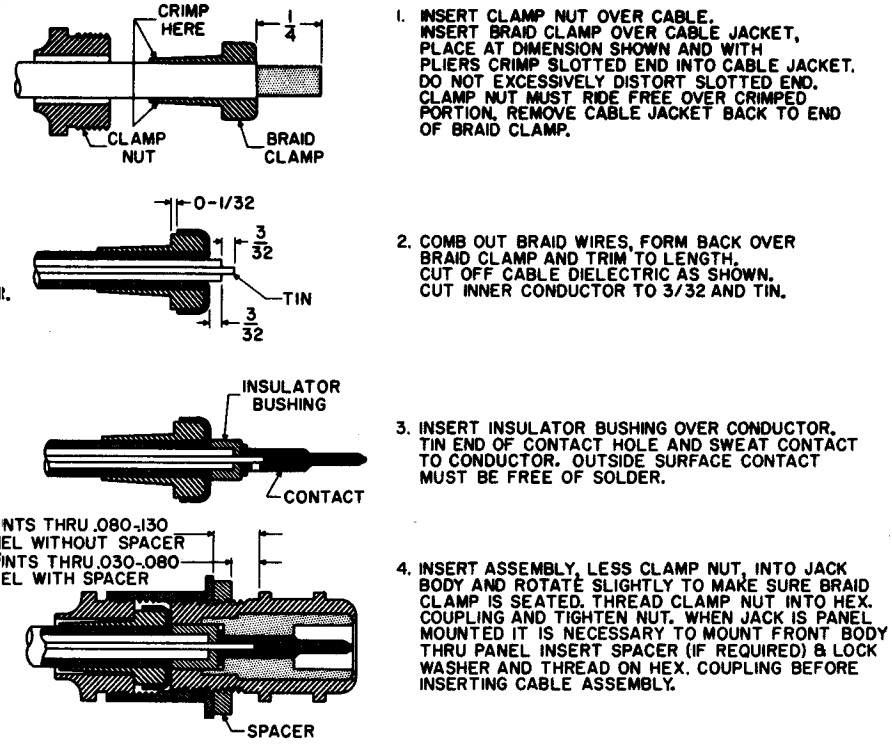
ERT INSULATOR BUSHING OVER CONDUCTOR
END OF CONTACT HOLE AND SWEAT
NTACT TO CONDUCTOR. OUTSIDE SURFACE
CONTACT MUST BE FREE OF SOLDER.

ERT INSULATOR OVER CONTACT. INSERT
SEMBLY, LESS CLAMP NUT, INTO PLUG
DY AND ROTATE SLIGHTLY TO MAKE SURE
AID CLAMP IS SEATED. THREAD CLAMP
T INTO BODY AND TIGHTEN NUT BY
LDING KNURLED PORTION OF BODY
TH SOFT-NOSED PLIERS.

ERT CLAMP NUT OVER CABLE.
ERT BRAID CLAMP OVER CABLE JACKET,
ACE AT DIMENSION SHOWN, AND WITH
ERS CRIMP SLOTTED END INTO CABLE
CKET. DO NOT EXCESSIVELY DISTORT
OTTED END. CLAMP NUT MUST RIDE FREE
ER CRIMPED PORTION. REMOVE CABLE
CKET BACK TO END OF BRAID CLAMP.

MB OUT BRAID WIRES, FORM BACK OVER
AID CLAMP AND TRIM TO LENGTH.
T OFF CABLE DIELECTRIC AS SHOWN.
T INNER CONDUCTOR TO 7/64 AND TIN.

OR



JACK

1. INSERT CLAMP NUT OVER CABLE. INSERT BRAID CLAMP OVER CABLE JACKET, PLACE AT DIMENSION SHOWN AND WITH PLIERS CRIMP SLOTTED END INTO CABLE JACKET. DO NOT EXCESSIVELY DISTORT SLOTTED END. CLAMP NUT MUST RIDE FREE OVER CRIMPED PORTION. REMOVE CABLE JACKET BACK TO END OF BRAID CLAMP.

2. COMB OUT BRAID WIRES, FORM BACK OVER BRAID CLAMP AND TRIM TO LENGTH. CUT OFF CABLE DIELECTRIC AS SHOWN. CUT INNER CONDUCTOR TO 3/32 AND TIN.

3. INSERT INSULATOR BUSHING OVER CONDUCTOR. TIN END OF CONTACT HOLE AND SWEAT CONTACT TO CONDUCTOR. OUTSIDE SURFACE CONTACT MUST BE FREE OF SOLDER.

4. INSERT ASSEMBLY, LESS CLAMP NUT, INTO JACK BODY AND ROTATE SLIGHTLY TO MAKE SURE BRAID CLAMP IS SEATED. THREAD CLAMP NUT INTO HEX. COUPLING AND TIGHTEN NUT. WHEN JACK IS PANEL MOUNTED IT IS NECESSARY TO MOUNT FRONT BODY THRU PANEL INSERT SPACER (IF REQUIRED) & LOCK WASHER AND THREAD ON HEX. COUPLING BEFORE INSERTING CABLE ASSEMBLY.

CABLE TERMINATION

ASSEMBLY INSTRUCTIONS FOR CABLE TERMINATIONS ARE IDENTICAL WITH THOSE GIVEN IN STEPS 1 AND 2 FOR STRAIGHT PLUGS EXCEPT DIMENSIONS FOR CUTTING CABLE DIELECTRIC AND CENTER CONDUCTOR ARE OPTIONAL.

TM 856A-76

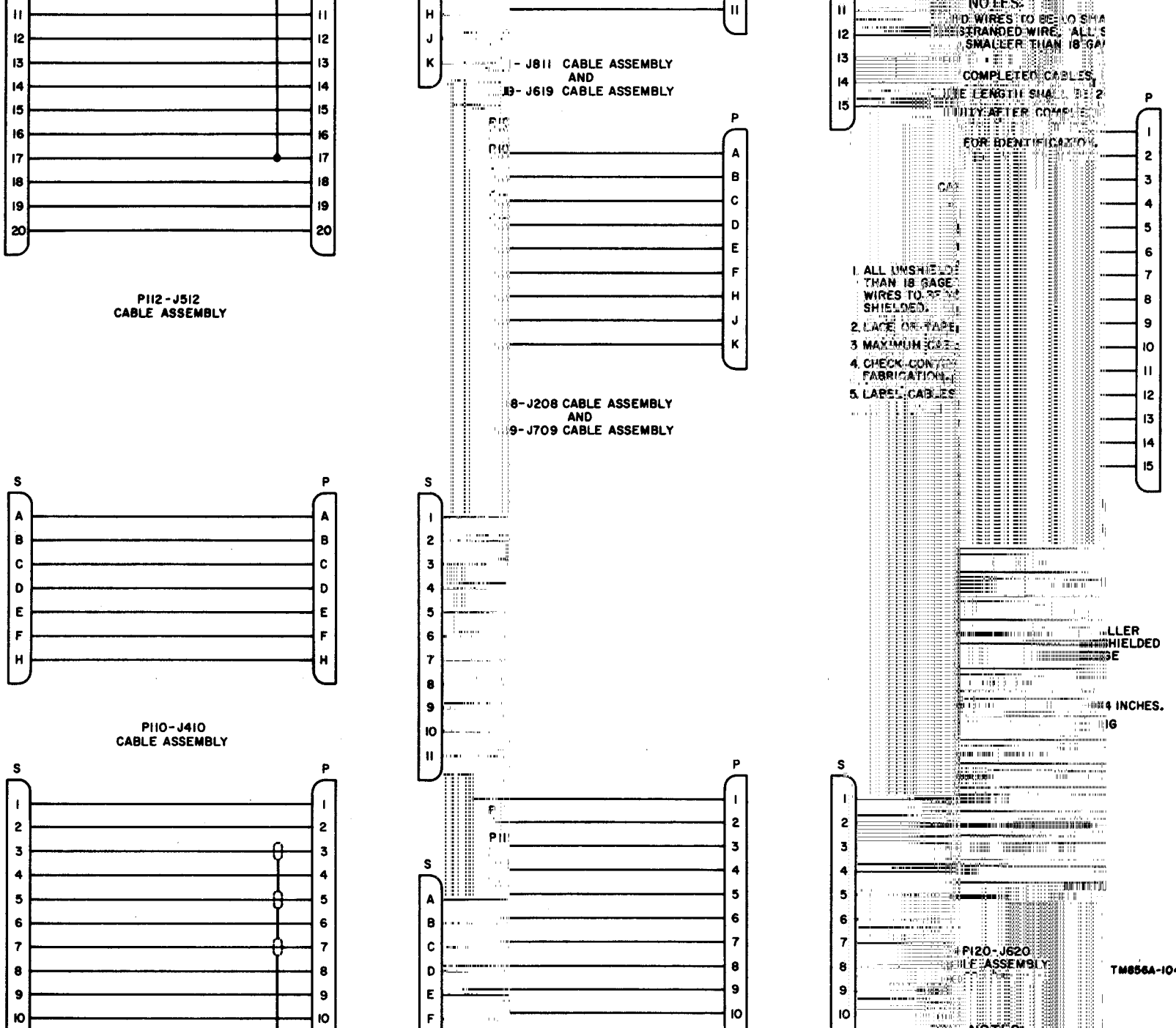


Figure 53. Multiconductor test cables.

(2) Be careful not to damage leads while pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the receiver; they may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is important to make well-soldered joints; a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced in the rf or if circuit, place it in the exact position of the original part. A part that has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground connection as in the original wiring. Failure to observe these precautions may result in decreased gain or, possibly, in oscillation of the circuit.

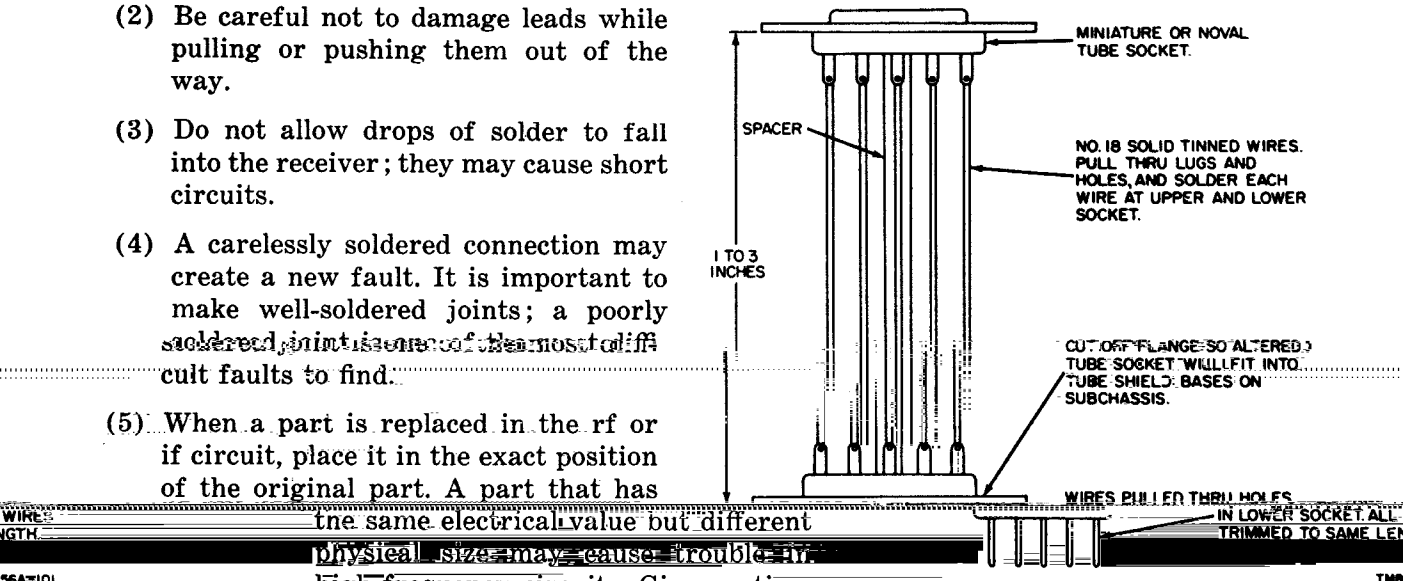


Figure 54. Fabrication of tube test point adap

f. Before taking voltage measurements or performing signal tracing, always check the value of the regulated dc voltage, unregulated dc voltage, and ac line voltage. Approximately +150 volts dc should be obtained at the +150 V dc jack, E607 (fig. 69), located on the af subchassis. This jack is accessible through the main frame of the receiver at the left side. Check the

c. A test-speaker assembly, such as the device shown in figure 55, is useful when testing or trouble shooting the receiver. The spade lugs should be connected to the LOCAL AUDIO or LINE AUDIO terminals on the rear panel of the receiver. The three-position, two-section rotary switch can be adjusted to an OFF position, a SPEAKER position, or a 600 OHM LOAD position. The external terminal board provides tie points for an audio output meter. The test-speaker assembly can be made from general-purpose parts. The only critical item is the 600-ohm, noninductive resistor. This resistor should be selected to be sure the resistance is as close to 600 ohms as possible.

d. Receiver noise can be an extremely useful aid in trouble shooting. A properly operating receiver will produce considerable noise when

can be removed readily, if necessary, to p measurement of voltage or resistance a socket contacts, or measurement of the tinuity of the coils. Instructions for the re of the coils and transformers are contain paragraph 130.

b. If trouble is suspected in the rf subch perform as much detailed trouble shooti possible to be sure that the trouble is in th chassis before removing it, because remov replacement of the rf subchassis is a tim suming procedure.

unregulated dc voltage at pin 6 of XV604. Do this by removing tube V6 from its tube socket on the af subch voltage should be between 200 and positive with respect to chassis gr the receiver is operating.

88. Trouble-shooting Notes

a. To avoid the necessity for remo chassis when voltage is to be meas signal is to be injected at a tube-sock does not have a test point, remove wrap a short length of thin insulate ing both ends bared, around the d pin. A more convenient method is t tube adapter with test points. Const formation is shown in figure 54. Th coils and transformers on the rf

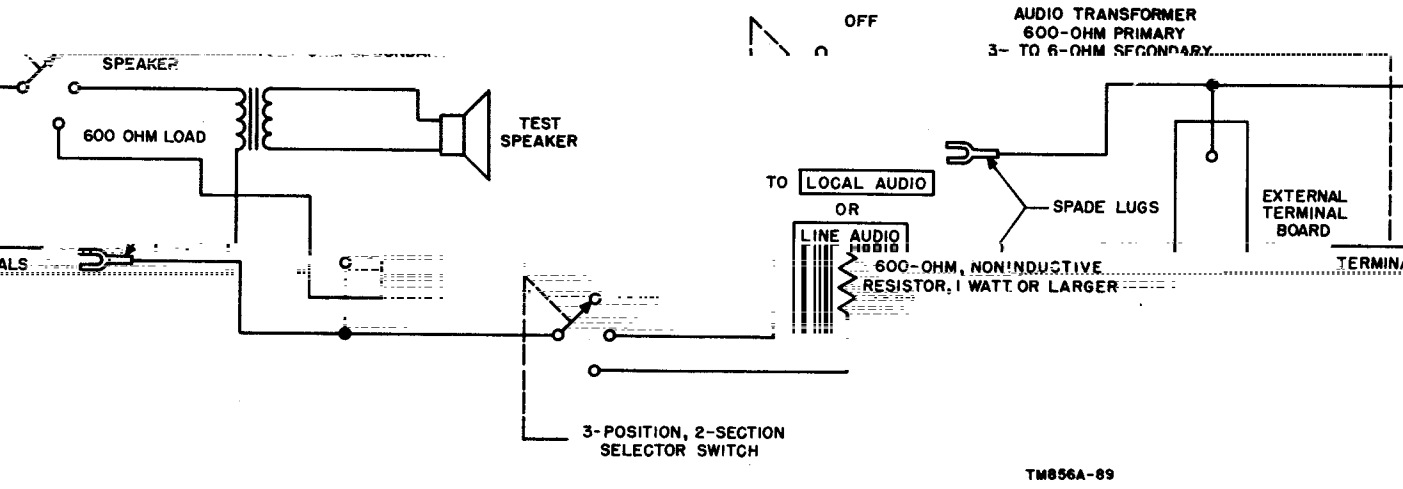


Figure 55. Test-speaker assembly fabrication.

af gain controls are advanced fully
use of receiver noise
follows:
ise should decrease
as the MEGACY-
nob is turned from
46*d*).
se should change as
ntrol is adjusted and
s the antenna ter-
(par. 46*e*).
e should decrease as
control is turned
width to a narrower
6*b*).
se will decrease as
terminals on the
unded (par. 46*a*).
EL meter and the
Radio Receiver R-
ruments for testing
CARRIER LEVEL
signal strength of
als. Indications on
at the AGC
over a 40-db range.

ght in from the field
the top and bottom

dust covers, and inspect according to the in-
structions in *a* through *g* below. Observe the precautions described in paragraph 87.

a. Inspect all cables, plugs, and receptacles. Check to see that all connectors are seated properly. This is important because improperly seated connectors are a frequent cause of abnormal operation in equipment. Repair or replace any connectors or cables that are broken or otherwise defective.

b. Inspect for burned insulation and resistors that show signs of overheating. Look for wax leakage and any discoloration of parts and wires.

c. Inspect for broken connections to tube sockets, plugs, and other apparatus, as well as for defective soldered connections. Examine for bare wires touching the chassis or adjoining wires.

d. Be sure that all tubes are in their correct positions (fig. 15 and 16). Replace or interchange any tubes that are not of the type called for in the illustrations. Replace broken tubes. Inspect for poor socket contacts.

e. Inspect the AC 3 AMP fuse and replace, if necessary, with a fuse of correct rating and type (par. 13*f*). Check carefully for short circuits (par. 90 and 91) whenever a blown fuse is found.

f. Be sure the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls turn freely. Rough operation or binding indicates a damaged tuning system or need for cleaning and lubrication (par. 39*a*(3) and 133).

the rf and
clockwise. Examples of the
for trouble shooting are as
(1) Rf subchassis noi
and then increase
CLE CHANGE k
band to band (par
(2) Rf subchassis nois
the ANT TRIM co
should decrease a
minals are shorted
(3) If subchassis noise
the BANDWIDTH
from a wider band
bandwidth (par. 4
(4) Af subchassis noi
the DIODE LOAD
rear panel are grou

e. The CARRIER LEVEL and LINE LEVEL meter on
390A/URR are useful instr
and trouble shooting. The
meter measures the relative
the incoming rf or test sign
this meter are proportional to those
LINE LEVEL meter readings can be translated into audio output or power ratio readings. The LINE METER switch extends the range
of the LINE LEVEL meter

89. Initial Inspection

When a receiver is brou
for check or repair, remove

g. Check all switches and controls for ease of operation.

90. Checking B+ Circuits for Shorts

a. To prevent damage to a receiver sent in for repair, always check the plate voltage circuits for shorts before applying ac power. A B+ circuit short is not detected, fuse F101, damage rectifiers V801 and V802, ON switch through three items. Before applying ceiver, check to see that the transformer T801 is connect line voltage (par. 15). rior to applying ac power:

(1) Remove the ac power plug from the ource of ac power.

(2) Adjust the front-panel controls as instructed in paragraph 85.

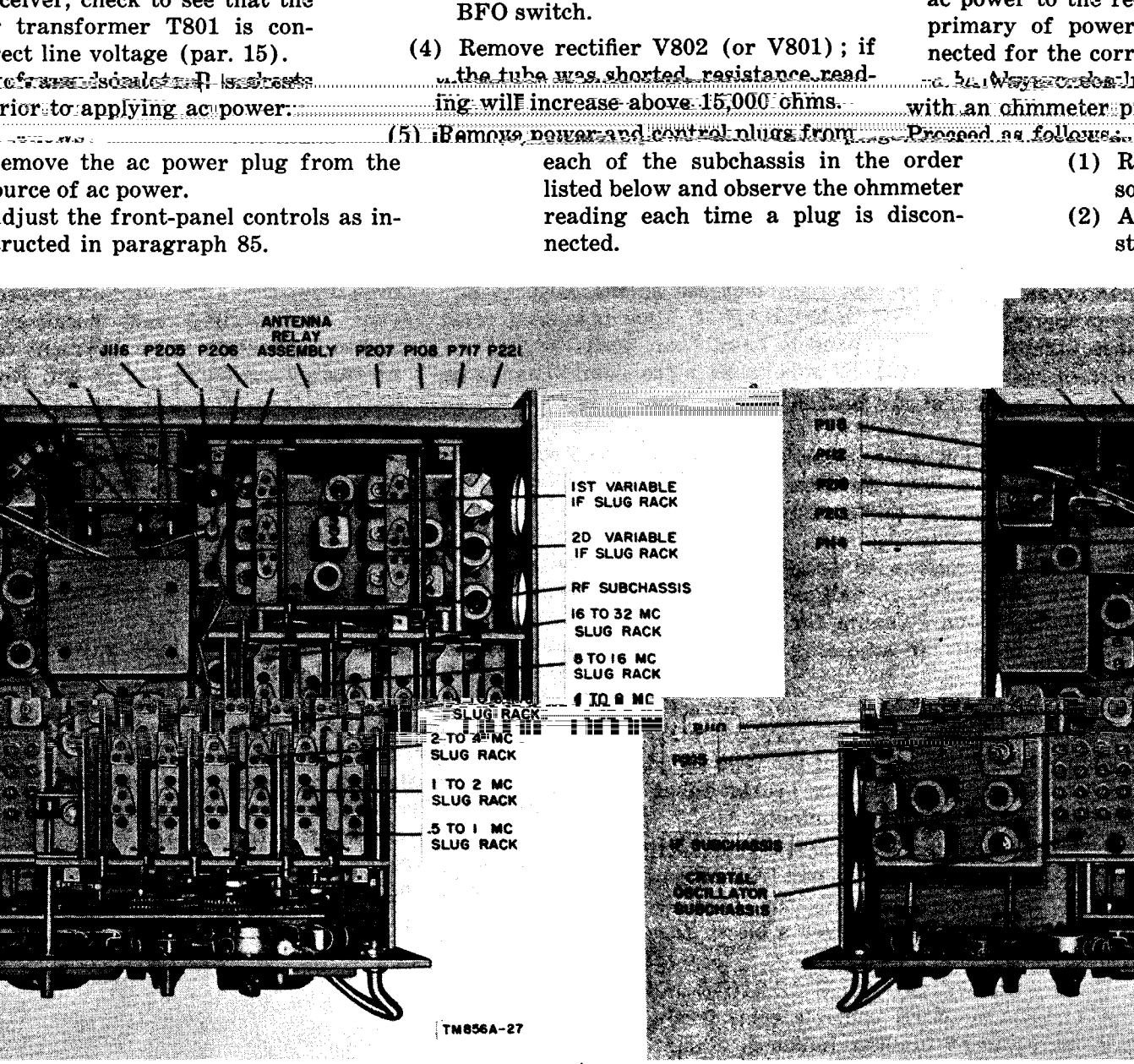
(3) Remove rectifier V801 (or V802) and connect the ohmmeter between ground and pin 3 or 8 of XV801. Set the receiver frequency below 8 mc. The resistance reading should not be lower than 15,000 ohms. If the reading is lower than 15,000 ohms, a B+ circuit short exists. If a s turn the FUNCTI bination of these t ac power to the re primary of power nected for the corr with an ohmmeter p Proceed as follows:

(1) R so

(2) A st

(4) Remove rectifier V802 (or V801); if the tube was shorted, resistance reading will increase above 15,000 ohms.

(5) Remove power and control plugs from each of the subchassis in the order listed below and observe the ohmmeter reading each time a plug is disconnected.



ceiver R-390A/URR, top view.

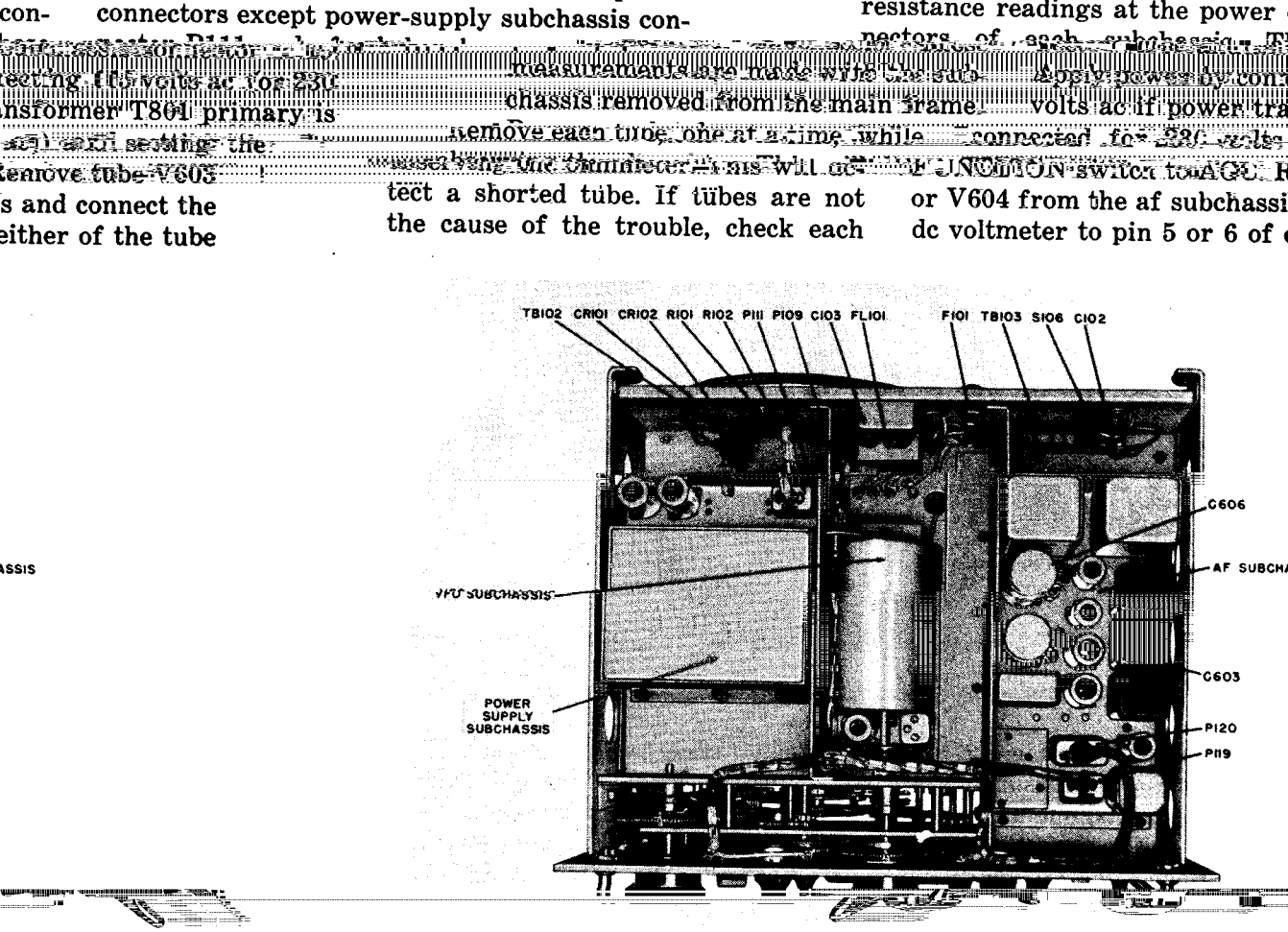
Figure 56. Radio Rec

(*a*) Af subchassis (P119 and P120).
(*b*) If subchassis (P112).
(*c*) Rf subchassis (P108).
(*d*) Vfo subchassis (P109).
(*e*) Crystal-oscillator subchassis (P110).
(*f*) Power-supply subchassis (P111).

(6) After disconnecting each of the plugs [(*a*) through (*f*) above] observe the reading on the ohmmeter. If one of the subchassis contains a B+ short, the [illegible] when its power plug is disconnected, the B+ short is traced to an individual [illegible].

c. In some cases, B+ shorts will be intermittent or will appear only when B+ voltage is present. If this is the case, disconnect all power connectors except power-supply subchassis connector P111 [illegible] measurements are made with the subchassis removed from the main frame. [illegible] remove each tube, one at a time, while observing the ohmmeter. This will detect a shorted tube. If tubes are not the cause of the trouble, check each subchassis bypass capacitor for a short circuit.

(8) If the short circuit persists after all the subchassis are disconnected, the short circuit is in the main frame wiring. If this is the case, continue tracing the B+ short with all the subchassis plugs disconnected. Check the ohmmeter readings from the chassis ground to each of the following connections: P119-2, P119-3, P119-4 and P119-5. Use the lowest ohmmeter scale that will give a usable reading. Trace through the various B+ lines with the aid of the B+ distribution diagram [illegible]. (7) If a B [illegible] subchassis, remove the subchas[illegible] and connect the ohmmeter to the [illegible] line for that subchassis. The ch[illegible] given in paragraph 119 give the [illegible] resistance readings at the power [illegible] nectors of each subchassis. T[illegible] [illegible] volts ac if power tra[illegible] [illegible] connected for 230 volts [illegible] FUNCTION switch to AGC. R[illegible] or V604 from the af subchassi[illegible] dc voltmeter to pin 5 or 6 of [illegible]



ottom view.

Figure 57. Radio Receiver R-390A/URR, b

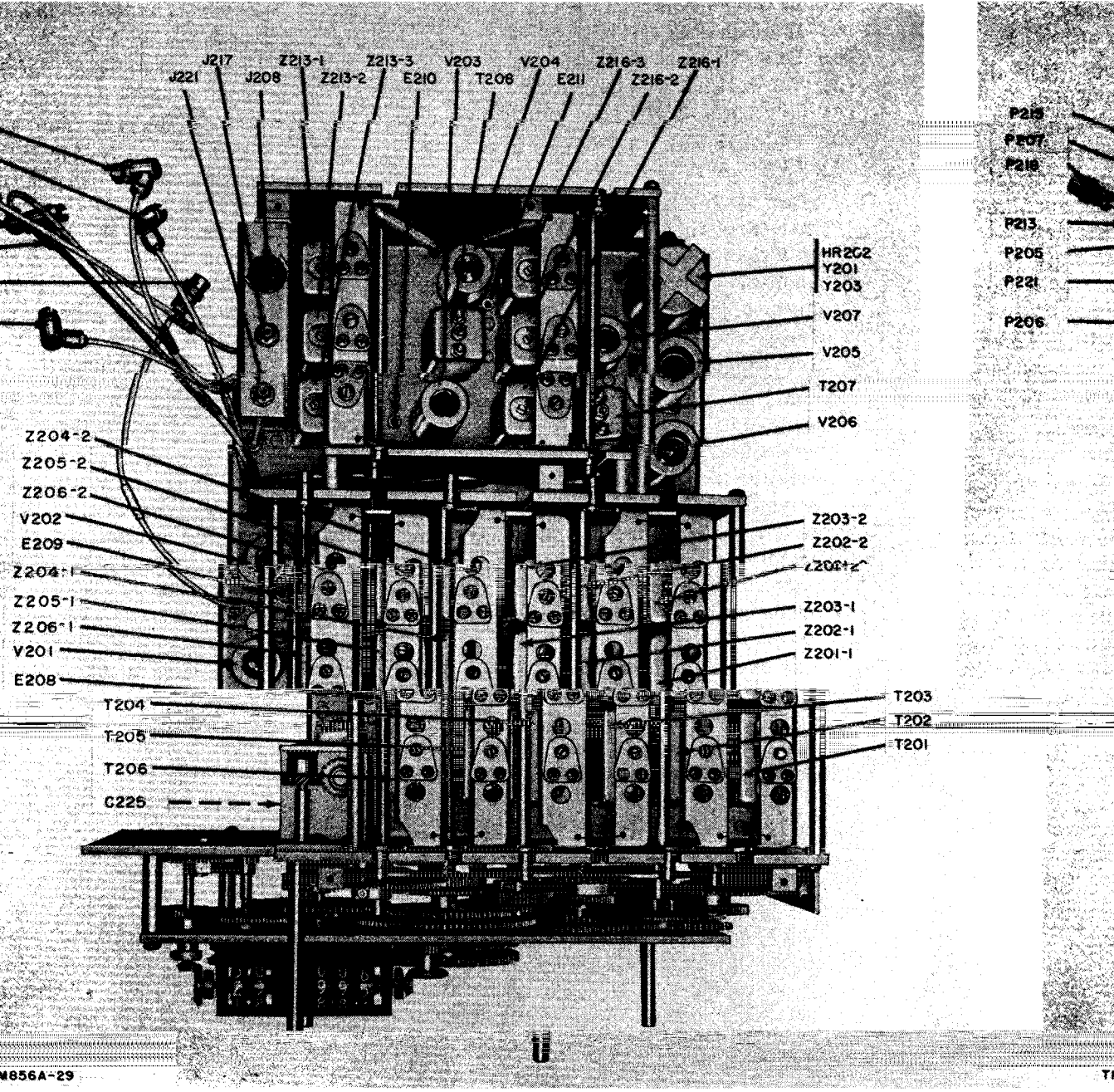


Figure 58. Rf subchassis, top view.

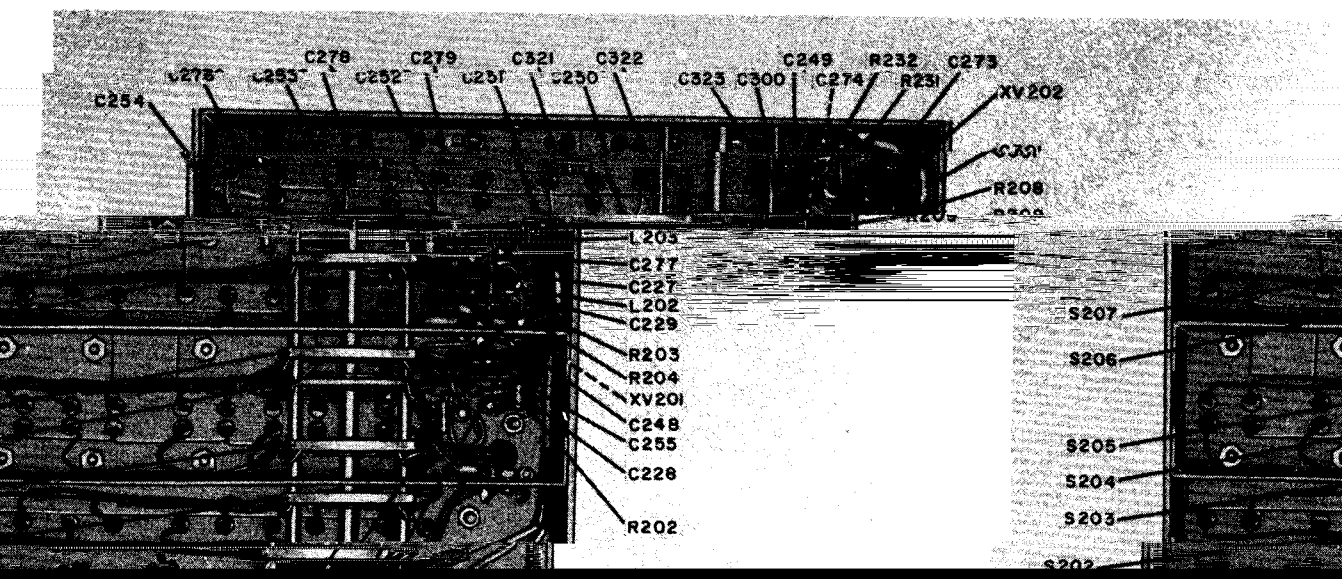
O switch to
3+ shorts.
ted, momen-
time, note the B+ voltage at pins 5 or 6 of V603 or XV604. Each time an additional
hassis is reconnected, B+ voltage will drop
7.
reconnecting the crystal-oscillator
sockets. If the voltage is approximately 215 to 240 volts, the B+ short is not in this subchassis.

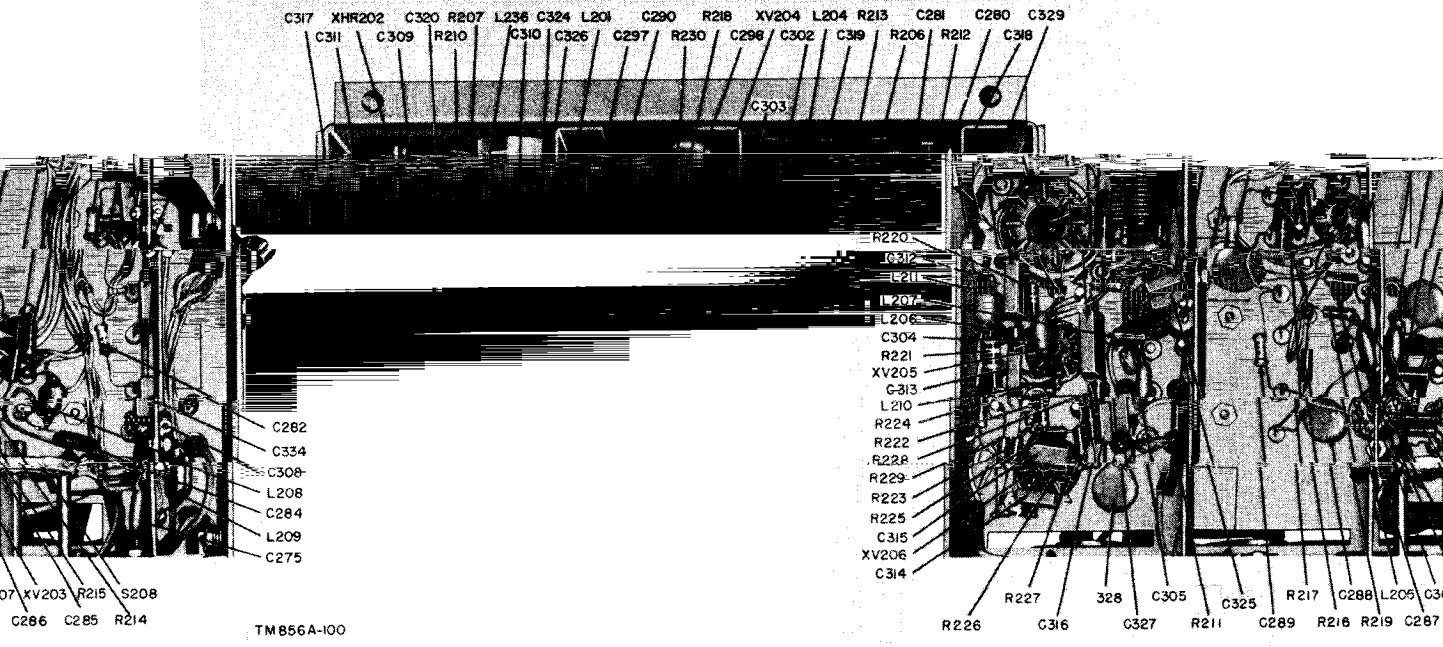
d. Reconnect each subchassis, one at a time;
regulated +150 volts to the screen a few volts after the tubes warm up. This is
normal, because of the additional load.

e. When the if subchassis is tested in this
manner, momentarily turn the BF
ON, and check the bfo circuit for B

f. When the rf subchassis is test
early check the calibration oscillator by setting
the FUNCTION switch to CAL. Tune the re-
ceiver to a frequency between .5 mc and 8 mc.
this appre
grid of V20

g. When


C254
C278
C279
C321
C322
C249
R232
C273
C275
C253
C252
C251
C250
C325
C300
C274
R231
XV202
C231
R208
L205
C277
C227
L202
C229
R203
R204
XV201
C248
C255
C228
R202
S207
S206
S205
S204
S203



v, rear section.

Figure 60. Rf subchassis, bottom view

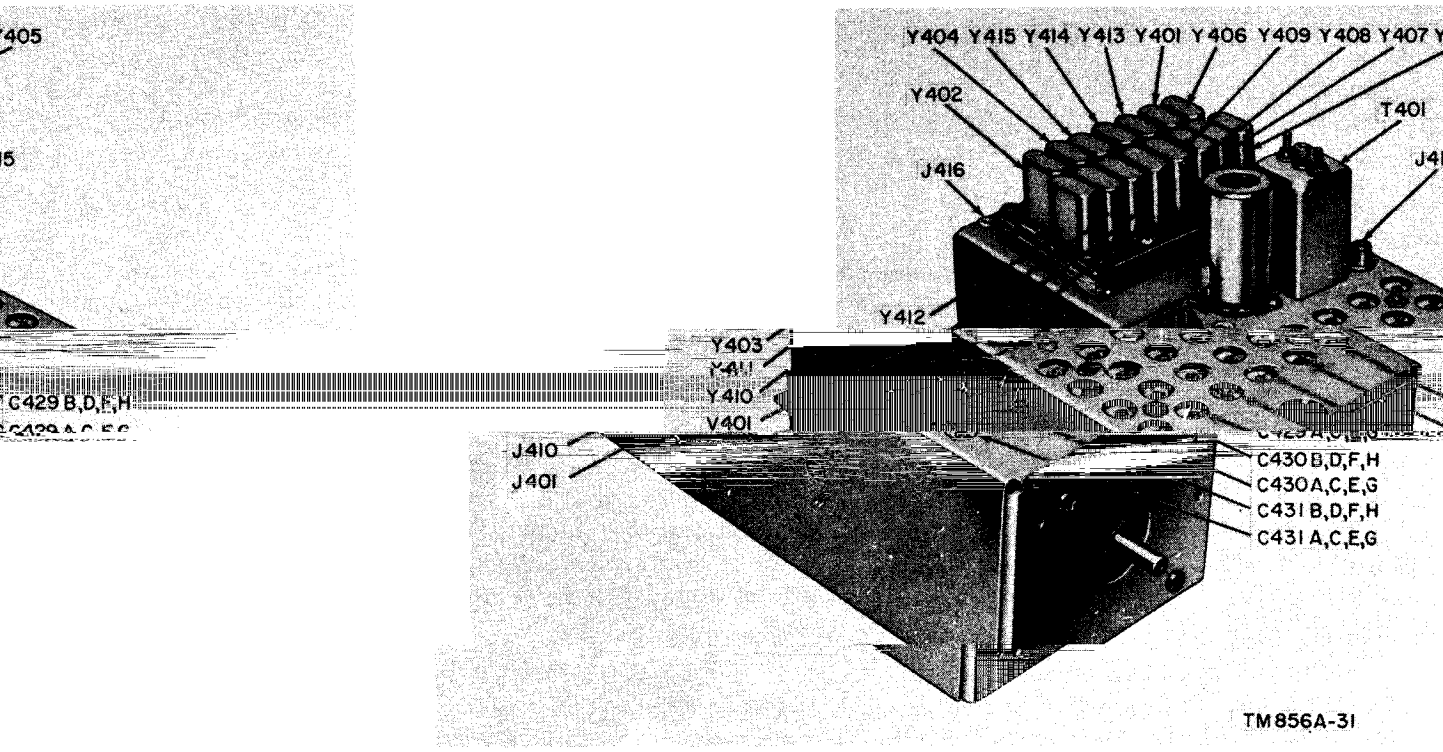


Figure 61. Crystal-oscillator subchassis, top view.

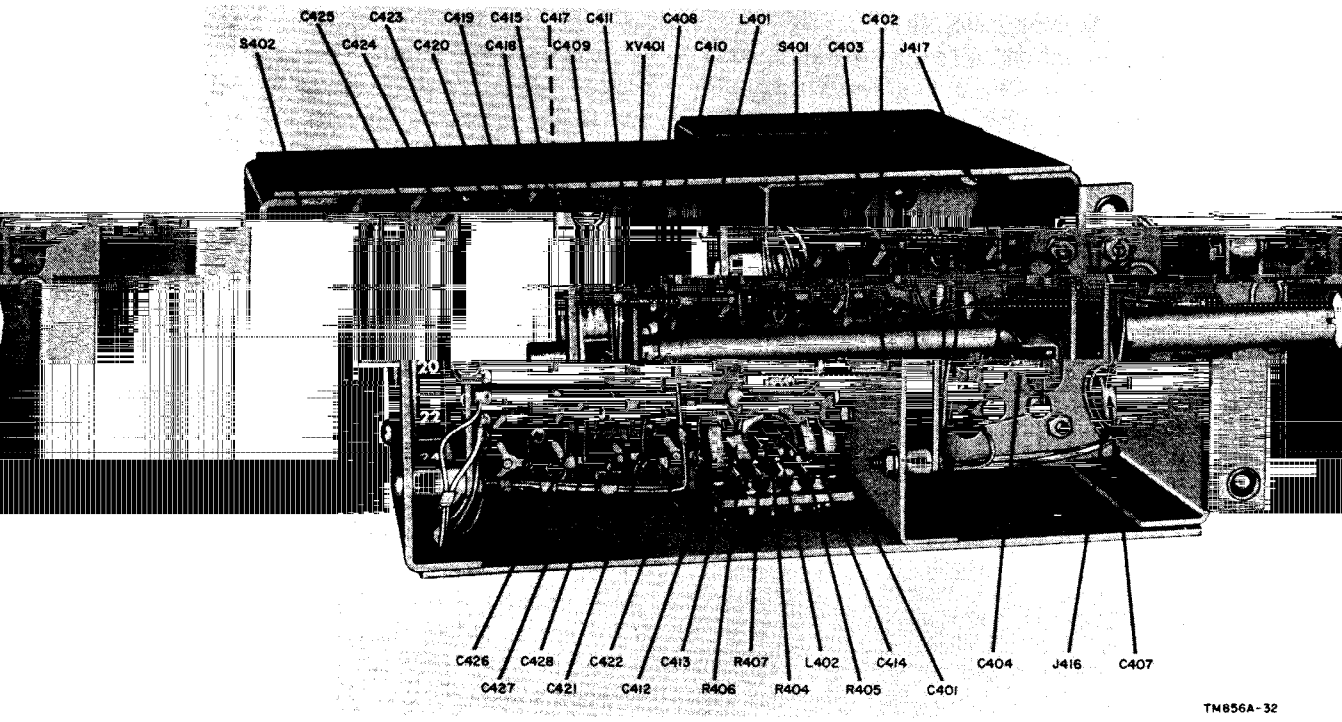


Figure 62. Crystal-oscillator subchassis, bottom view.

HR202 on the rf sub-
is connected to the A3
is with the tubes, an open 25.2-volt ac filament winding on power transformer T801 or in the wiring
thermostat switch, the heater winding, or the wiring to it is defective. For the vfo oven HR701, or crystal-oscillator oven HR401 to operate, OVENS switch S106 must be in the ON position. Trouble in these circuits must be detected by checking the individual parts in each one. Use figure 102 when checking these circuits.

(3) Crystal oven
chassis is
volt ac line

b. Shorted Circuits.

(1) Short circuits in the tube heater and/or open resistor R801 blow the 1.5-AMP fuse on the rear panel on the receiver. Disconnect all power plugs except P111 from the power-supply subchassis and apply power to the receiver. Set the FUNCTION switch to STAND BY. If tubes V401 and V402 in the power-supply subchassis light and fuse F101 does not blow, the trouble is in one of the other subchassis. If the fuse blows the trouble is in the power-supply subchassis or main frame wiring. Follow the procedure in (2) below for locating the

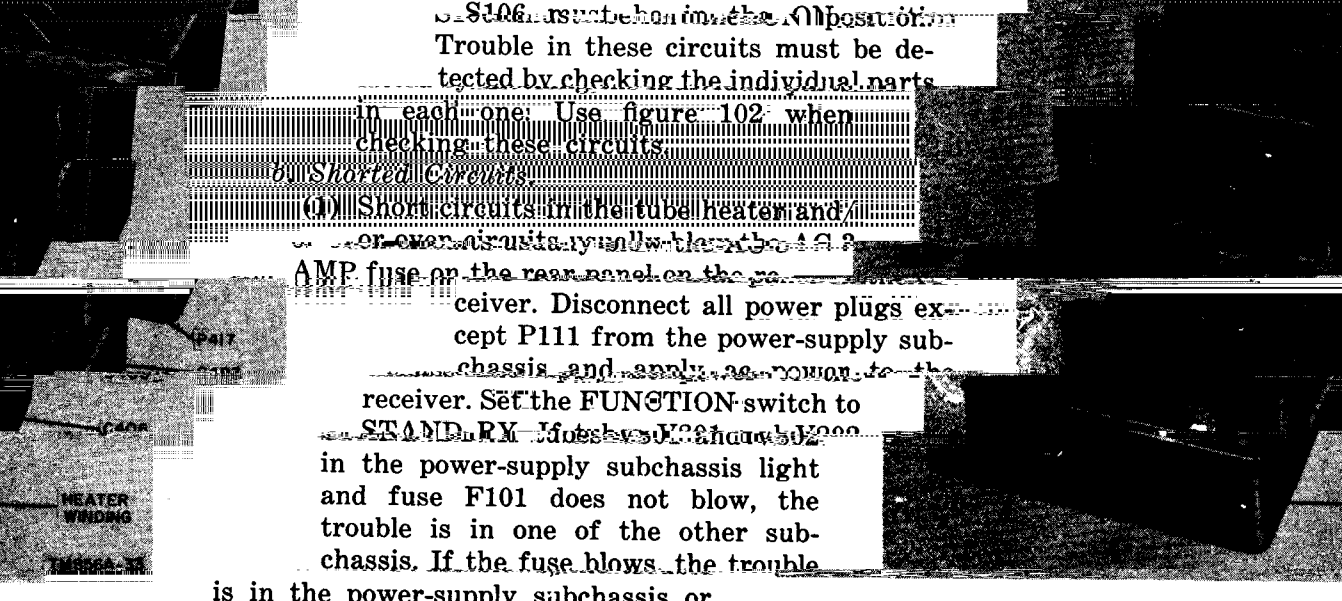


Figure 63. Crystal-oscillator subchassis, interior view of crystal oven.

tube heater or oven short.

(2) Remove each tube from the subchassis to be tested and check the terminals listed below with an ohmmeter. If the reading is below that specified, a filament bypass capacitor or an oven heater winding is short-circuited.

Subchassis	Points of ohmmeter check	Resistance not less than
ubchassis	J208-B to ground	Infinity
	J208-F to ground	100 ohms
	J512-8 to ground	Infinity
hassis	J512-12 to ground	Infinity
	J512-20 to ground	Infinity
ubchassis	C619-10	Infinity
l osc subchassis	J410-E to ground	13 ohms
	J410-F to ground	13 ohms
	J410-B to ground	Infinity
	J709-D to J709-J	13 ohms
assis	J709-E to J709-K	13 ohms
	J709-H to ground	Infinity

quently aids in sectionalizing the trouble without the need for further testing. Check for overheated parts, faulty controls, and intermittent operation. Observe closely the readings of the CARRIER LEVEL and LINE LEVEL meters. A normal reading on the CARRIER LEVEL meter usually indicates satisfactory operation of the agc circuit and all stages up to and including fourth if amplifier V504. If the LINE LEVEL meter reading is normal, satisfactory operation of the remaining stages, except for the local audio channel, consisting of V602A and V603, is indicated. These latter stages can be checked by listening to the LOCAL AUDIO output at terminals 6 and 7 on the rear panel with a 600-ohm headset or speaker.

b. To check the local audio and if stages quickly, connect a 600-ohm headset to the PHONES jack on the front panel. Turn the FUNCTION switch to AGC. Starting at the 16 KC position of the BANDWIDTH switch, set the switch in turn to each lower position. If the volume of the noise heard in the headset de-

erational Test

92. Op

inment as described in the ... appears noticeably with each lower setting, the ... *a.* Operate the equ
heck list (par. 50). If and local audio stages are operating. This test ... equipment performance c
ant because it ... does not necessarily indicate normal operation. This check list is import

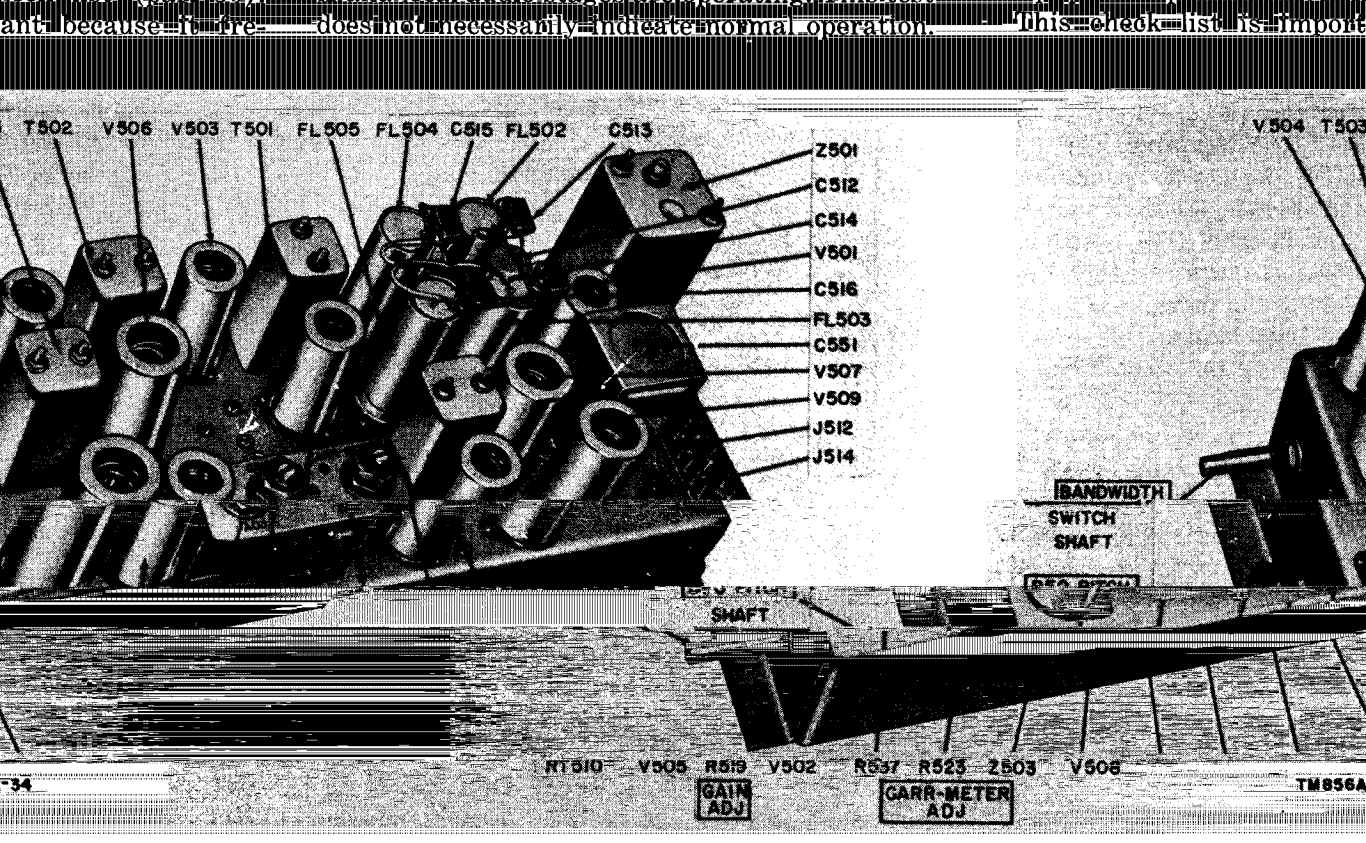


Figure 64. If subchassis, top view.

c. The calibration-oscillator signal can be used as a convenient means of quickly localizing trouble in the receiver. Typical methods are described in (1) and (2) below.

(1) To check the contacts of the rf band switches (S201 through S206, fig. 59) and crystal-oscillator band switches (S401 and S402, fig. 62), connect a 600-ohm headset to the PHONES jack on front panel. Set the FUNCTION switch to CAL. Set the KILOCYCLE CHANGE control to any 100-kc position, and turn the BFO switch to ON. Starting with the lowest detent position of the MEGACYCLE CHANGE control, turn the control to each detent position in succession. Adjust the BFO control as necessary to obtain a signal in the headset. If no audible signal is heard in a detent position, trouble with contacts of the rf band switch or crystal-oscillator band switch is indicated.

(2) Check the LINE LEVEL meter, LINE METER switch, and LINE GAIN control as follows: Connect a headset to the PHONES jack on the front panel and adjust the KILOCYCLE CHANGE control for an even 100-kc reading on the dial. Set the FUNCTION switch to CAL and turn the BFO switch to ON; an audible tone should be heard in the headset. Set the LINE METER switch to [illegible] and adjust the LINE GAIN control to obtain a LINE LEVEL meter reads 0 vu (upper

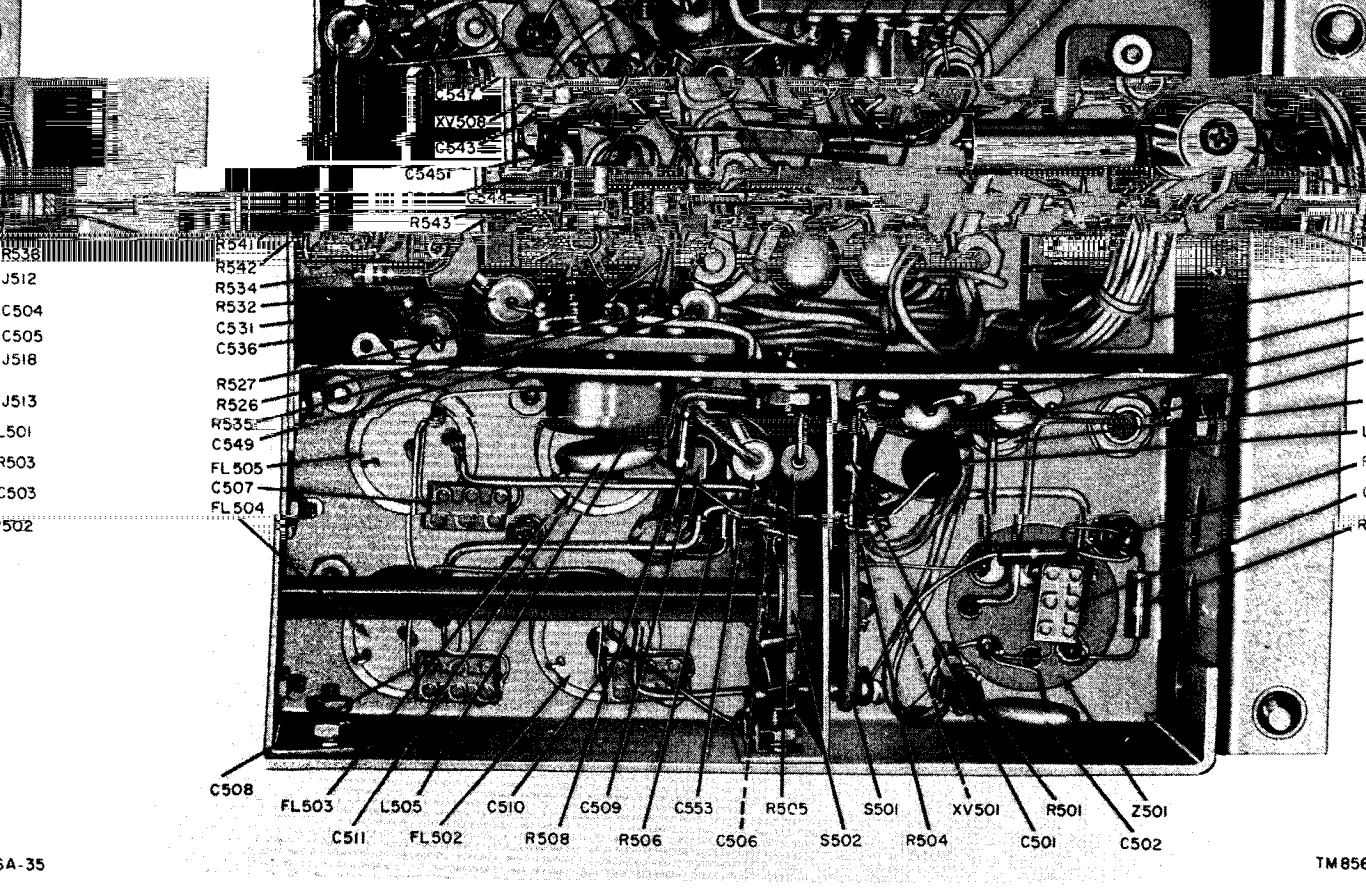
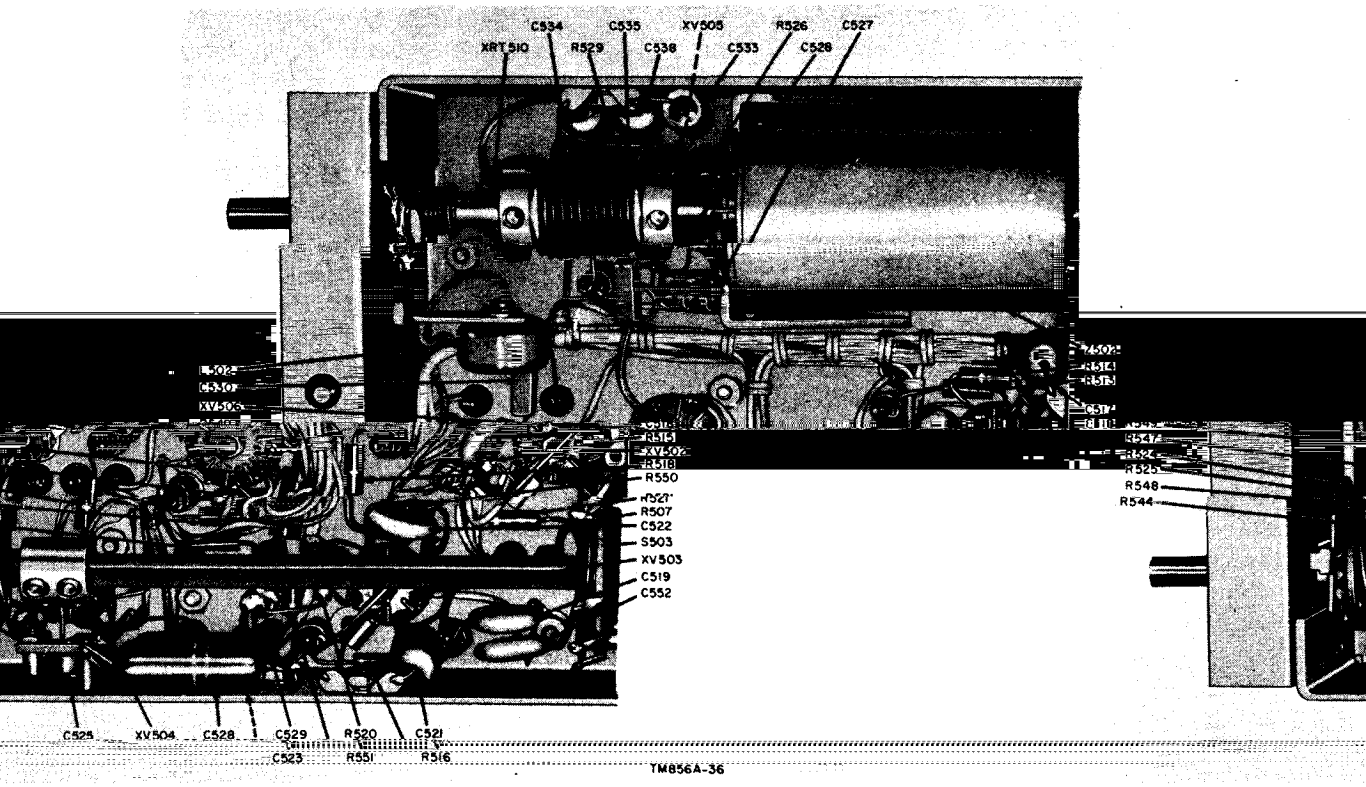


Figure 65. If subchassis, bottom view, rear section.



ure 66. If subchassis, bottom view, front section.

Fig

E METER switch TBJ01 (fig. 74), the LINE METER scale). Turn the LIN

o 0. Reading on LINE LEVEL meter switch, and the LINE GAIN control.

hould drop to —10 vu. Readjust the *d.* The synchronization of the tuning shafts

NE GAIN control for a 0-vu reading can be quickly checked as follows:

LINE LEVEL meter. Turn the

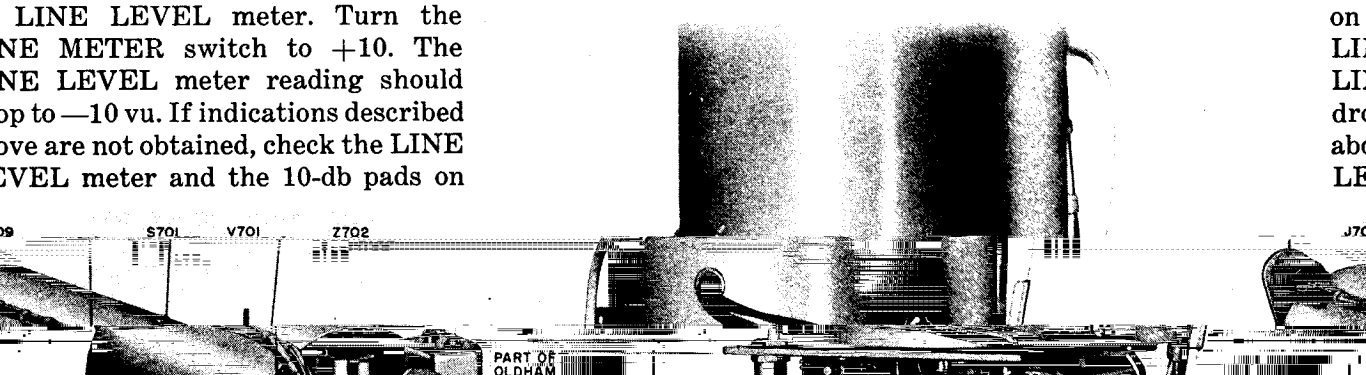
NE METER switch to +10. The

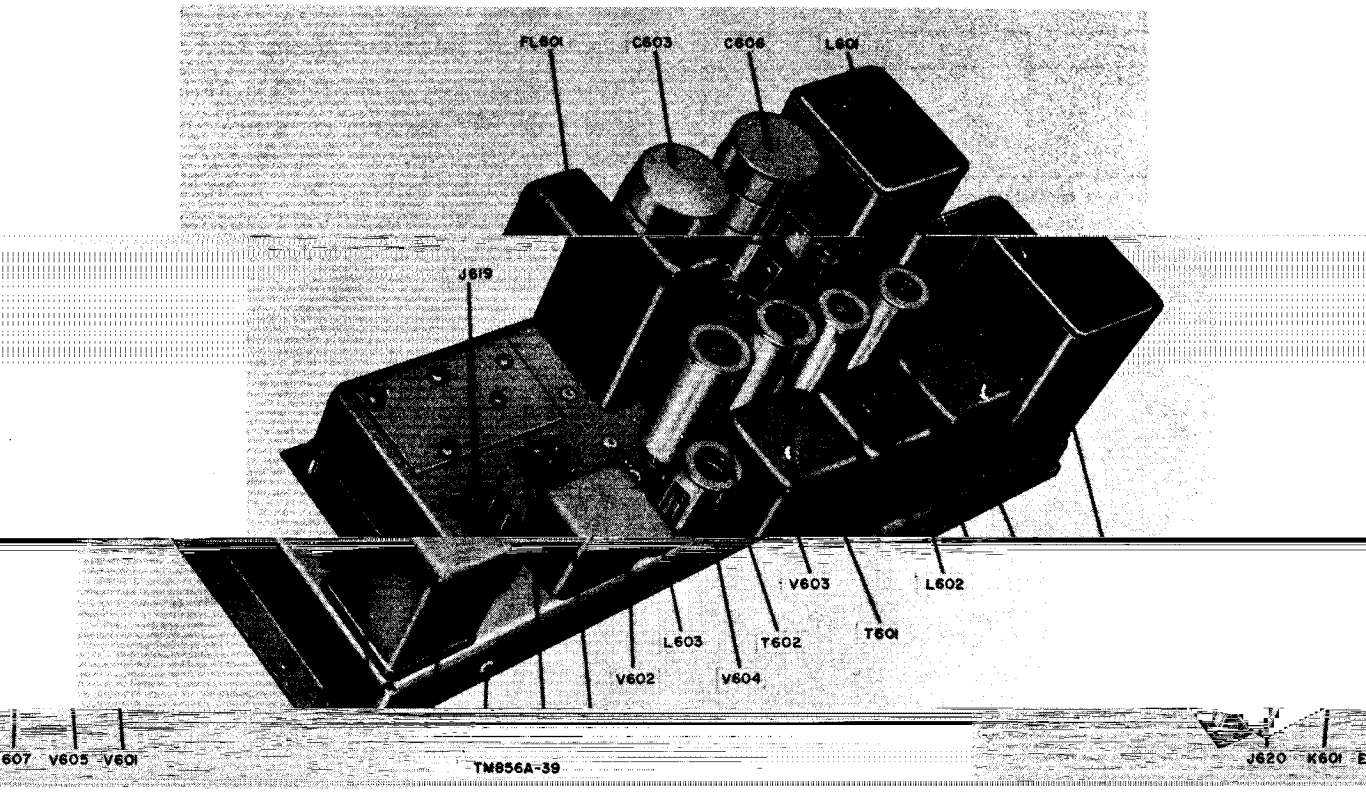
NE LEVEL meter reading should

op to —10 vu. If indications described

ove are not obtained, check the LINE

EVEL meter and the 10-db pads on





. Af subchassis, top view.

Figure 69

ng so (fig. 56), setting the megacycle num-
and bers on the frequency-indicator dial at
100 a reading within the band covered by
00 the slug rack being checked
and 1900.

(2) Set the FUNCTION switch to CAL.

(3) Advance the RF GAIN control until a reading is obtained on the CARRIER LEVEL meter.

(4) Raise the .5- to 1-mc slug rack (fig. 56) slightly with the hand; the CARRIER LEVEL meter reading should decrease.

(5) Press down lightly on the .5- to 1-mc slug rack (fig. 56) slightly with the hand; the meter reading should decrease. If the reading increases when the slug rack is either raised or depressed, the camshaft is out of synchronization or electrical alignment is required.

Caution: To prevent damage, do not depress the slug rack too vigorously.

6) Repeat the procedures described in (1) through (5) above for each slug rack

(1) Set the frequency-indicator readi
that the first two digits are zeros
the last three digits read an even
kc or a multiple thereof between 5

e. If an increase in CARRIER LEVEL meter reading is obtained, check mechanical and electrical alignment (par. 138 through 144).

93. High-frequency Oscillator Injection Voltage Tests

A simple check to determine whether the conversion oscillators (V207, V401, and V701) are oscillating can be made as follows:

a. Turn the FUNCTION switch to STAND BY. This removes B+ from all tubes except the conversion oscillators. The cathodes and control grids of the mixers act as rectifiers of the oscillator voltage at test points E209, E210, and E211 (fig. 58). The voltage at test point E402 (fig. 58) is the rectified grid leak bias at the control grid of V401.

b. Check the dc voltage at test points E209, E210, and E211 with a vtvm. The voltages should be as follows:

(6

Test point	*Voltage*
E209	−6.8 (approx.)
E210	−3.5 to −8
E211	−2.8 to −4.3
E402	−4 to −11

Note. To obtain a meter reading at test point E209, the receiver must be tuned below 8 mc.

94. Over-all Receiver Gain Test

The procedures given in this paragraph and paragraph 95, provide a quick method for measuring the over-all gain and if gain of the receiver. These tests, when carried properly, render accurate information regarding the over-

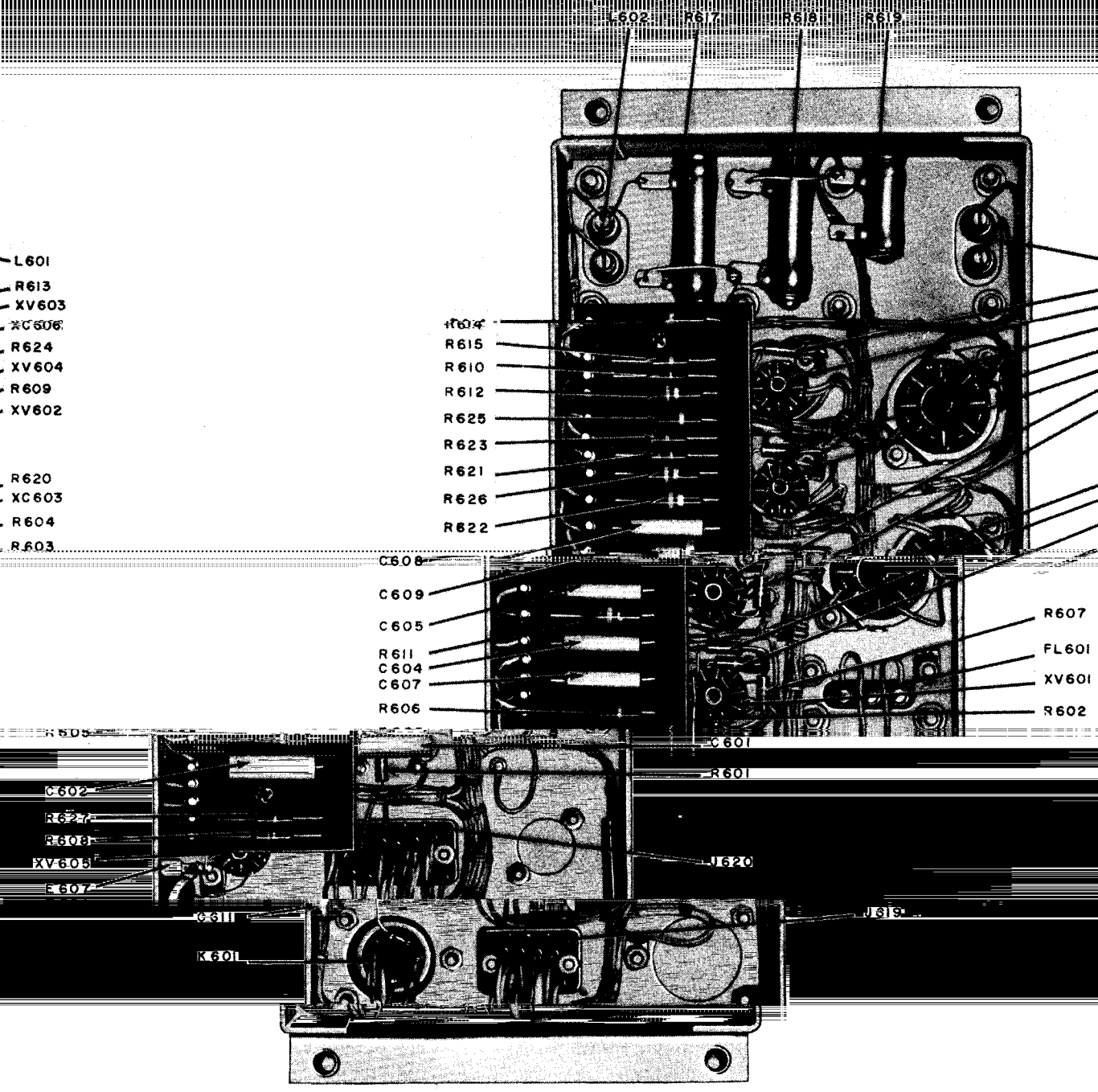


Figure 70. Af subchassis, bottom view.

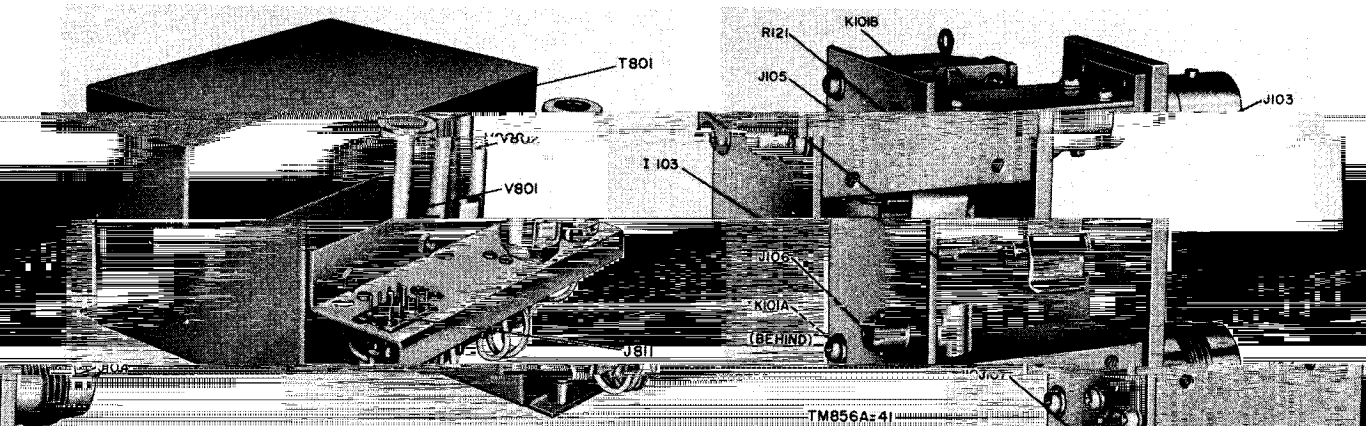
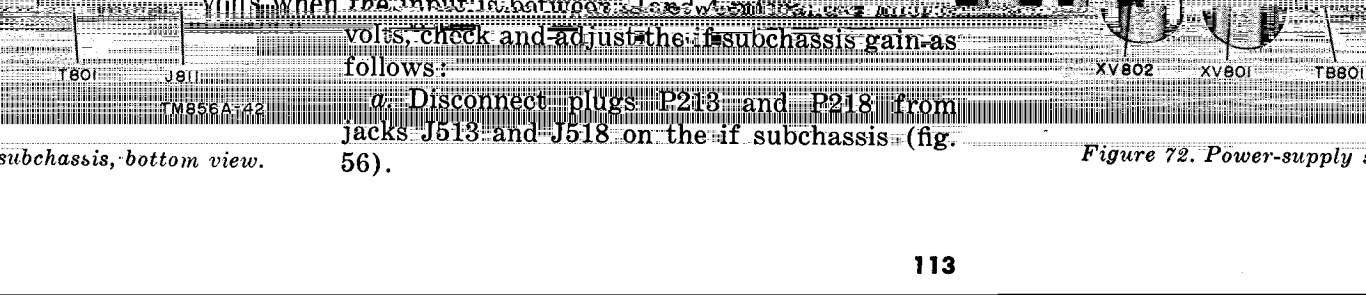


Figure 71. Power-supply subchassis, top view.

internal view.



subchassis, bottom view.

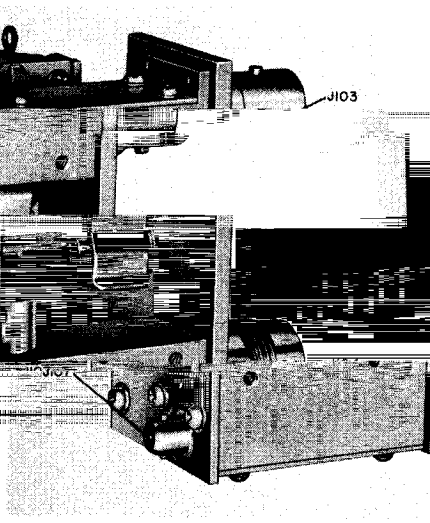


Figure 73. Antenna relay assembly,

Figure 72. Power-supply

all performance of the receiver. Correct use of these tests and procedures will eliminate the possibility of discarding tubes which still meet tube tester emission tests, but are not quite as good as new tubes. These instructions also outline the method for adjusting GAIN ADJ. control R519 on the if subchassis.

a. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to M.O.

b. Connect the vtvm between the DIODE LOAD terminal and ground.

c. Connect the signal generator through a 0.1-microfarad capacitor, to the BALANCED ANTENNA connector on the rear panel of the receiver.

d. Tune the receiver and the signal generator to the same frequency.

e. Adjust the signal generator attenuator to produce a —7-volt reading at the DIODE LOAD terminal of the receiver under test with another similar receiver known to be in good condition. Read the amplitude of the input voltage required to produce —7 volts between the DIODE LOAD terminal and ground. If the results of this test show that more than twice the input voltage is required compared to the last recorded input voltage, make the if-gain test according to the instructions in paragraph 95.

f. If the attenuator setting on the signal generator is between 1 and 4 microvolts, the over-all gain of the receiver is satisfactory. If the over-all gain of the receiver is below (or above) this limit, proceed with the instructions in paragraph 95.

g. To make this test successfully, use an accurately calibrated signal generator. If an accurately calibrated signal generator is not

h. Each time this test is made, rec

95. If Subchassis Gain Test and Adjustment

Note. This test and adjustment procedure should be done each time tubes are replaced in the if subchassis.

If the over-all gain of the receiver is not sufficient to yield a diode load voltage of —7 volts when the input is between [illegible] volts, check and adjust the if subchassis gain as follows:

a. Disconnect plugs P213 and P218 from jacks J513 and J518 on the if subchassis (fig. 56).

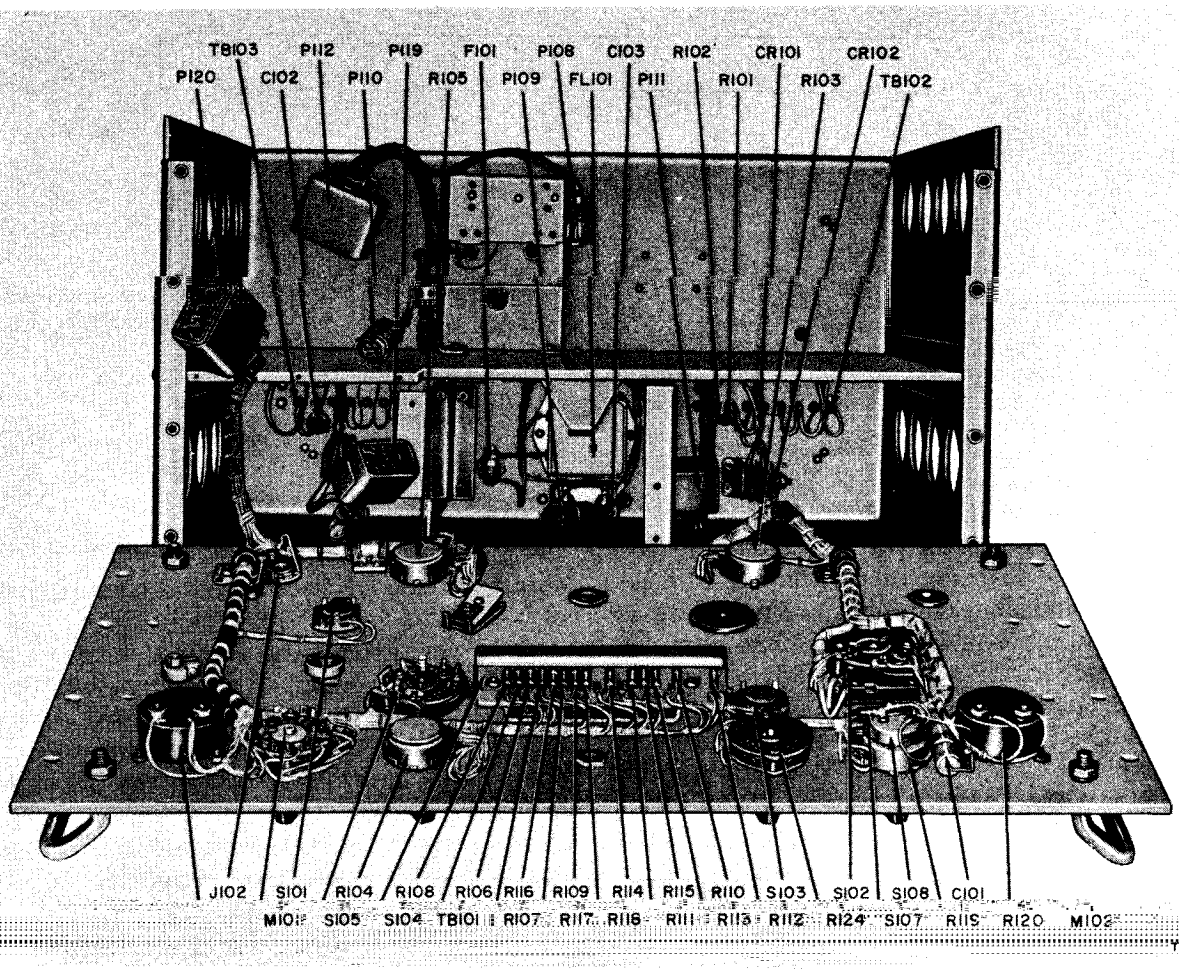


Figure 74. Radio Receiver R-390A/URR, front panel and interior of main frame.

b. Connect the signal generator through Impedance Adapter MX-1487 to the IF OUTPUT receptacle. Disconnect P114 from J514 and connect it to J513.

c. Connect the vtvm between the DIODE LOAD terminal 14 and ground.

d. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to MGC. Be sure the RF GAIN control is fully clockwise.

e. Turn the signal generator modulation off.

f. Tune the signal generator to exactly 455 kc, by peaking the response with the BANDWIDTH control set at .1 KC.

g. Adjust the signal generator attenuator for an output of 150 microvolts and set the BAND[illegible] to 8 KC.

h. If the reading on the vtvm is less than .7 volts, loosen the hexagonal lock nut and adjust GAIN ADJ control R519 located on the if subchassis (fig. 64) to obtain a reading of —7 volts. A reading of greater than —7 volts or any reading indicates low gain in the rf subchassis.

i. If a —7 volts reading cannot be obtained with a signal input level of 150 microvolts ±50 microvolts, defective tubes, misalignment, or circuit trouble is indicated.

j. Disconnect the signal generator and vtvm from the receiver, reconnect P114 to J514, P213 to J513, and P112 to J516, and tighten the hexagonal lock nut on R519.

96. Trouble-shooting Chart

a. The tests given in paragraph 46 will prove [illegible] tests should be the first step in trouble shooting.

b. The following chart is supplied as a further

aid in locating trouble in the receiver. This chart

which part is at fault. For example, if a 100,000-
oct reading is indicated at a given
pin on a diagram and the actual
0,000 ohms on the meter, the cir-
n of the subchassis should be ex-
the presence of a resistor or capaci-
circuit under test that could, if
int for the incorrect reading.
ld then be suspected and should
re are many ways of using the
stance diagrams, depending on
the resourcefulness of the repairman. Set the
reference controls as instructed in paragraph
and change them only if indicated in the par-
ticular voltage and resistance diagram.
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98. Signal Substitution Notes

Note. The noise tests described in paragraph 46 should be used to localize the trouble to a subchassis or group of stages within a subchassis prior to attempting signal substitution. These tests are simple to conduct and, in most cases, are as effective as signal substitution.

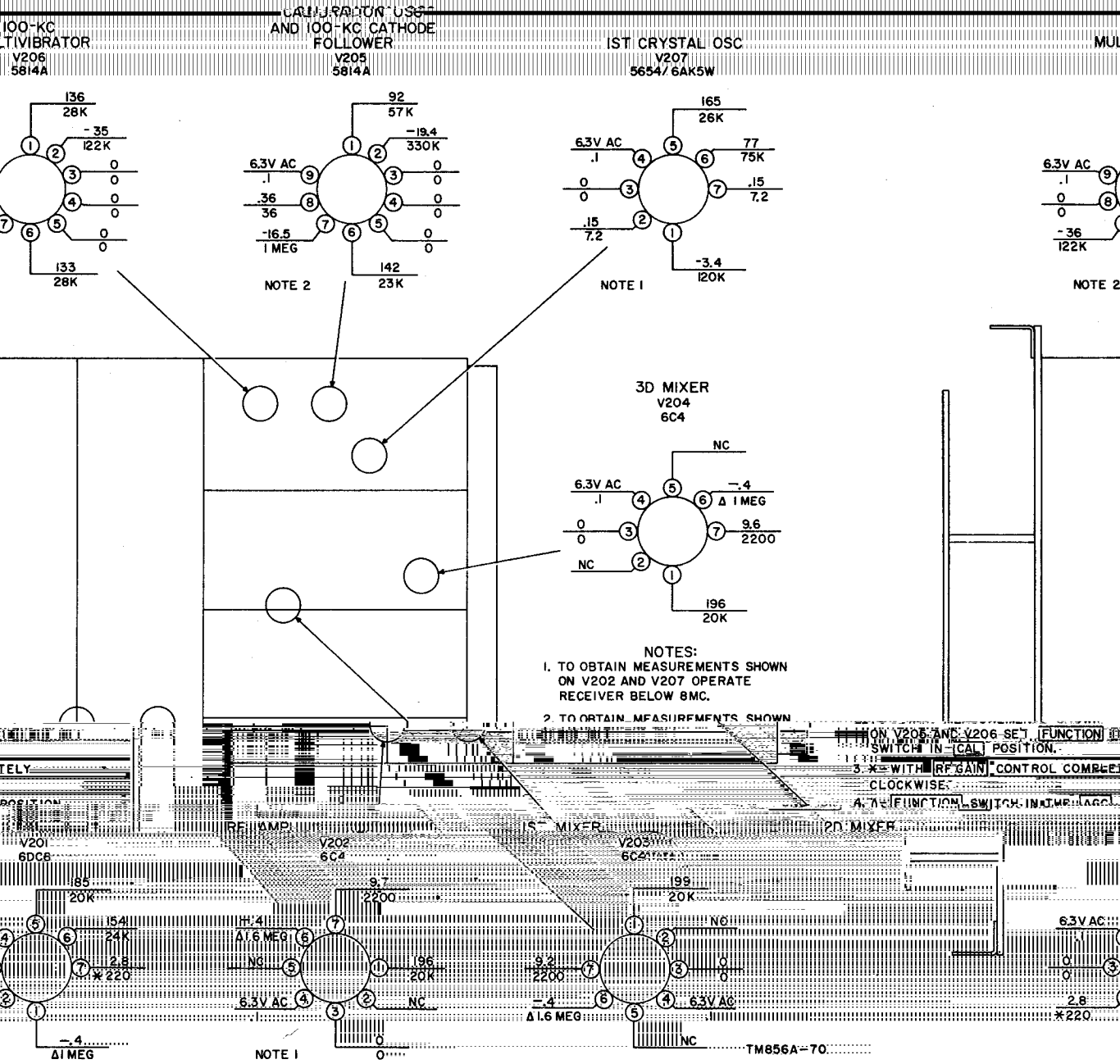


Figure 75. Rf subchassis, voltage and resistance diagram.

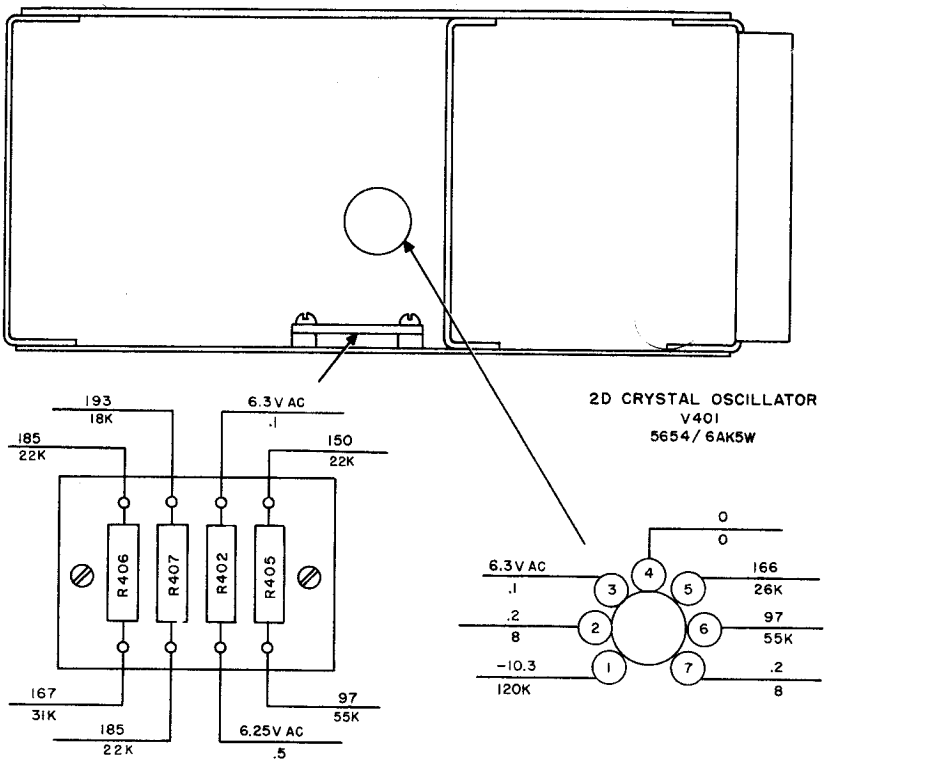


Figure 76. Crystal-oscillator subchassis, voltage and resistance diagram.

a. Signal substitution for Radio Receiver R-390A/URR requires an audio oscillator, such as Oscillator TS-382/U, or equivalent, king the audio circuits. An rf signal r, such as RF Signal Generator Set M-25, or equivalent, is required for the antenna, rf, and if circuits. This enerator must be able to supply un- ed and modulated signals from 400 kc . The signal output level of this genera- t be continuously adjustable and ac- calibrated from one microvolt to 100,- ovolts.

multimeter (such as Multimeter TS- r equivalent) and a tube tester (such as Tube Test Set TV-2/U, or equivalent) ired to isolate troubles in the various nd tubes.

the tests described in paragraphs 99 103, connect the ground lead of the cillator or signal generator to the re- assis, and connect the hot lead to the point through a capacitor (approxi- 5 uf). When using RF Signal Generator URM-25, use Test Lead CX-1363/U in place of the .05-uf blocking capacitor. The test- ing information in paragraphs 86 and 87 should be followed.

d. When performing the signal substitution tests, be sure that the amplitude of the signal from the signal generator or the audio oscillator is sufficient to produce an audio output; however, when working from the output of the receiver towards the antenna, reduce the signal generator or audio oscillator output as required to prevent overloading. Turn the amplitude of the generator all the way down and then raise it to an audible level. This insures that an extremely strong signal is not overloading the receiver, or that the signal is not being forced through a defective stage.

e. Listen to the audio signal in the headset or in the speaker, and determine whether the signal is being distorted. Be sure that the LIMITER control is in the OFF position, otherwise limiter action might distort the audio signal. If another similar receiver is available and in proper operating condition, compare the results between the two receivers.

as Audi for chec generato AN/URI checking signal g modulate to 32 mc tor mus curately 000 micr

b. A 352/U, o Electron are requ stages a

c. For through audio os ceiver ch specified mately .0 Set AN/

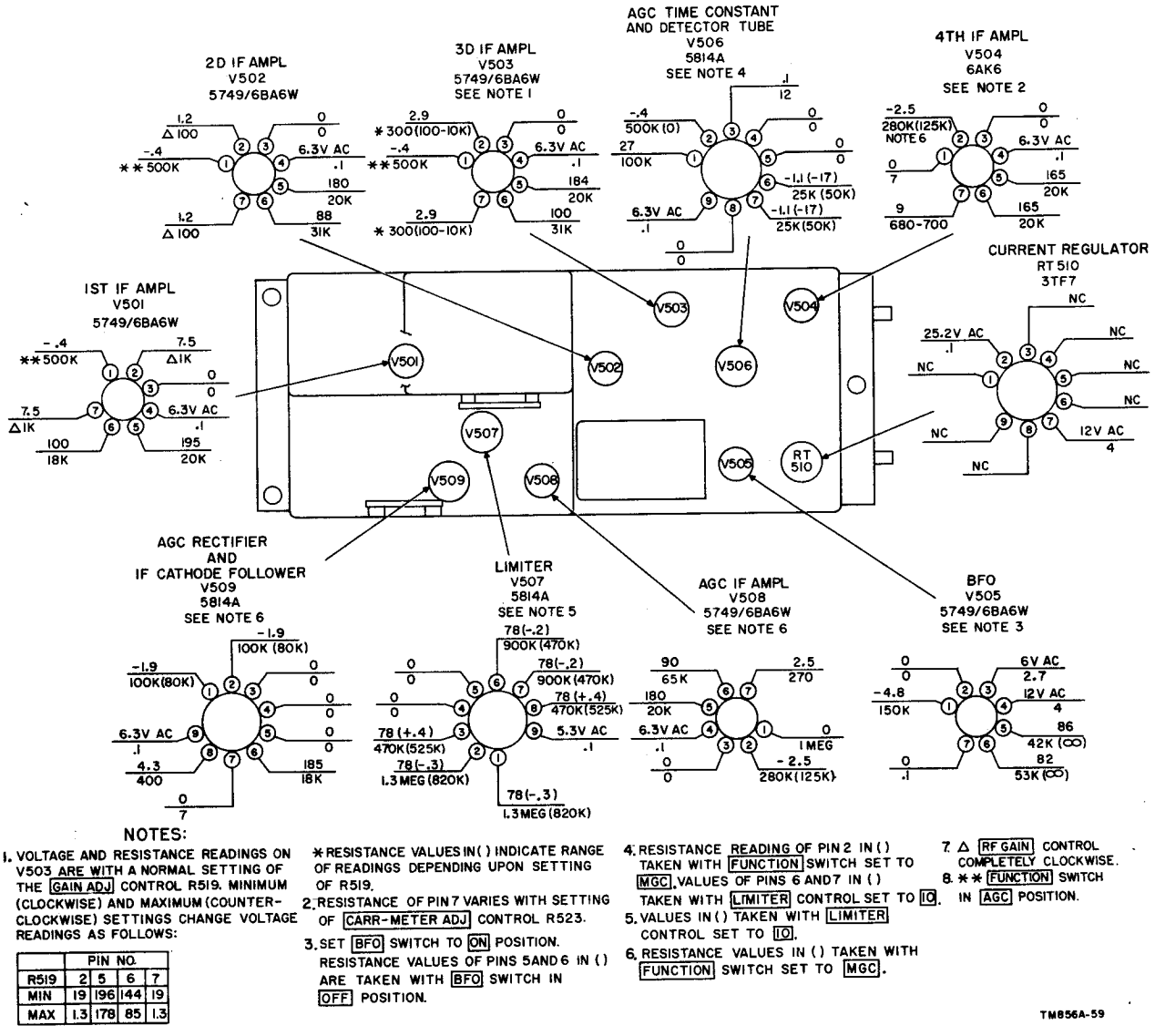


Figure 77. If subchassis, voltage and resistance diagram.

f. While performing the signal substitution tests, carefully examine the wiring and the physical condition of the receiver. Sometimes trouble is caused by loose solder or wire chips caused by previous repair or handling. Always be sure that the front-panel controls are set as specified in paragraph 85, or as instructed for the particular procedure.

g. Aligning a circuit that is out of synchronization or a coil slug or trimmer capacitor that is misaligned will cause reduced output, or even no output at all. Synchronization of the shafts and cams (par. 138) should be checked, and the proper positioning of the rf, if, and crystal-oscillator band switches should be checked before adjustment of the individual tuned circuits is attempted.

h. When the trouble is isolated to a particular stage, check the most probable cause of trouble first, and then proceed to the other probable causes. Tubes and control settings should be the first items checked. If this fails to reveal the trouble proceed with voltage and resistance tests.

i. Trouble in a particular stage does not always upset the normal voltage and resistance readings. This is especially true of open capacitors. Open capacitors often can be detected by

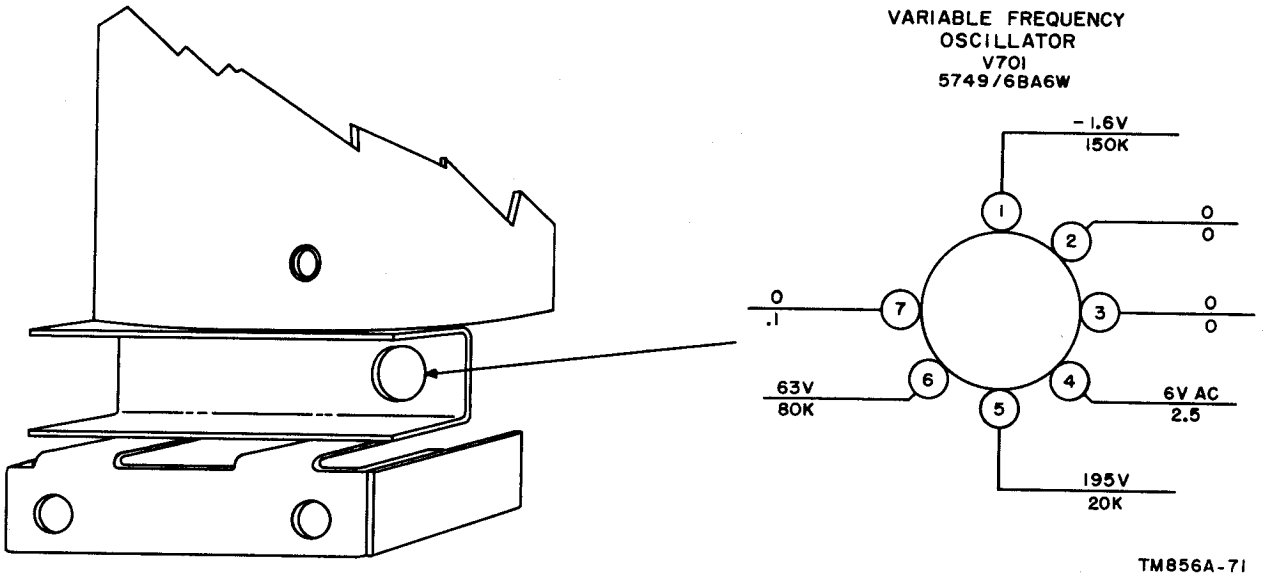


Figure 78. Vfo subchassis, voltage and resistance diagram.

bridging the suspected one with a similar capacitor. This practice is limited by the frequency at which the circuit functions, as serious detuning of rf and if stages might result. The application of this practice and its success depends largely upon the skill and experience of the repairman.

j. When testing tubes, remove one tube at a time. Observe the tube type and check it by substituting it with a tube known to be in good condition; if a tube tester is available, the tube can be checked on it. When inserting tubes into the receiver, be sure their pins are straight and that none of the pins is missing. Be sure to use the proper type tube. A wrong tube installed in the receiver might result in no operation at all, and in certain instances, cause damage to the receiver.

k. Each succeeding step of the signal substitution tests assumes that the preceding steps were made, and that the previously tested stages are functioning properly.

99. Local Audio Channel Tests

Note. Prior to attempting the audio tests, connect the output of the audio oscillator to DIODE LOAD terminal 14 and chassis ground to determine conclusively whether the local and/or line audio channels are functioning. If a clear strong signal is heard at the local and line audio outputs, the audio channels may be assumed to be operating properly.

a. Pin 5 of V603 (Plate of Local AF Output Tube). Apply an af signal to pin 5 of tube socket XV603. Use the full output of the audio oscillator. The audio signal heard in the headphones or speaker will be low. If no signal is heard, check the connections to audio output transformer T601, and also check the dc resistance of the transformer (par. 106).

b. Pin 1 of V603 (Grid of Local Af Output Tube). Apply the audio signal to the grid (pin 1) of tube socket XV603. The audio signal should be loud as compared with the previous step. It may be necessary to reduce the output of the audio oscillator. If there is little or no increase in gain, or the signal sounds distorted, or both, replace tube V603. If this does not improve the condition, check coupling capacitor C605 for leakage and check voltages on this tube.

c. Pin 1 of V602 (plate of Local Af Amplifier Tube). Apply the same level of audio signal to pin 1 of XV602 as that used in *b* above. The audio output level should be approximately the same. If the audio signal is noticeably weaker, or does not exist at all, check capacitor C605 by bridging it with a similar capacitor and repeating the test.

d. Pin 2 of V602 (Grid of Local Af Amplifier). Turn the LOCAL GAIN control on the front panel of the receiver fully clockwise. Ap-

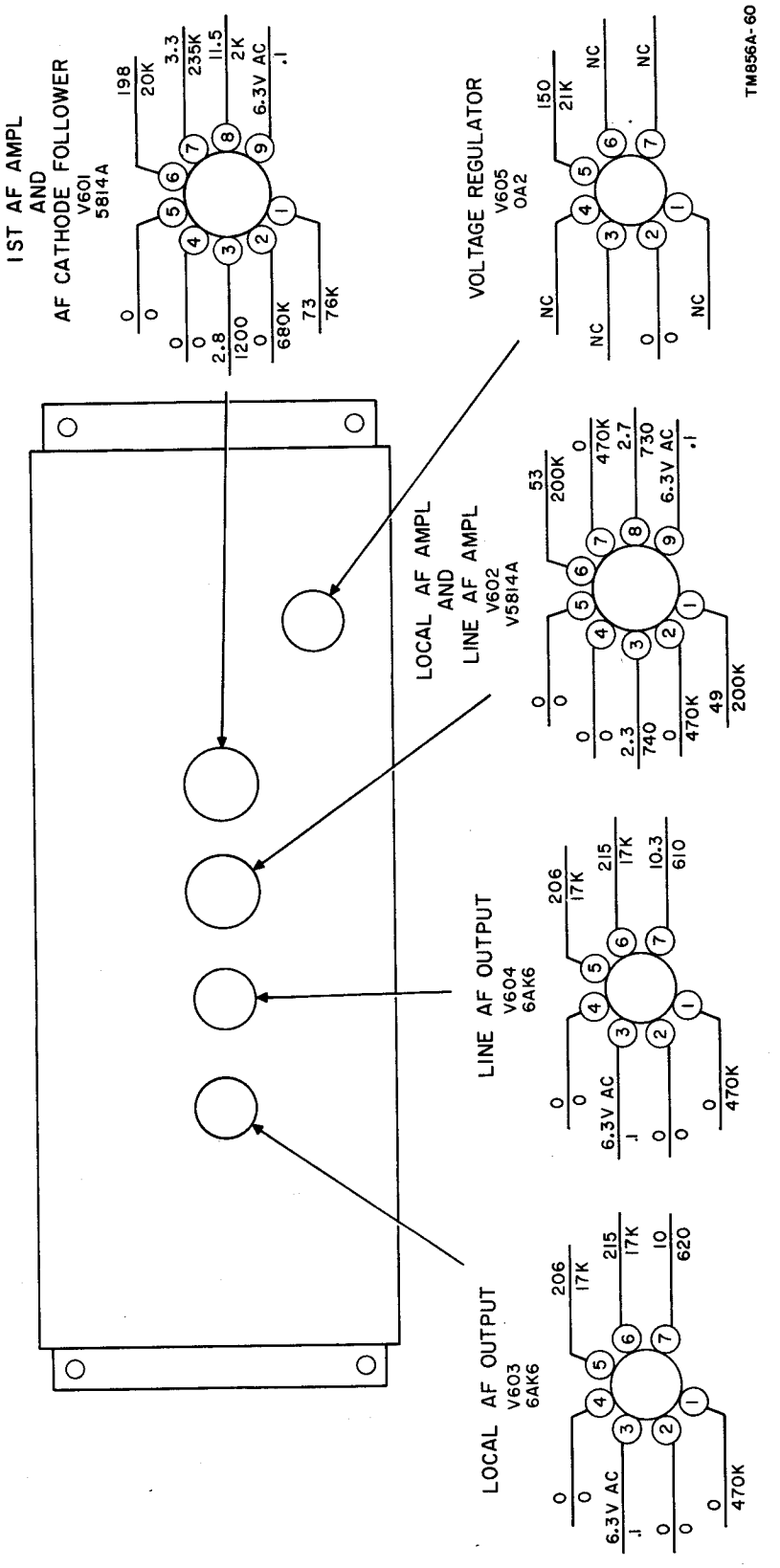


Figure 79. Af subchassis, voltage and resistance diagram.

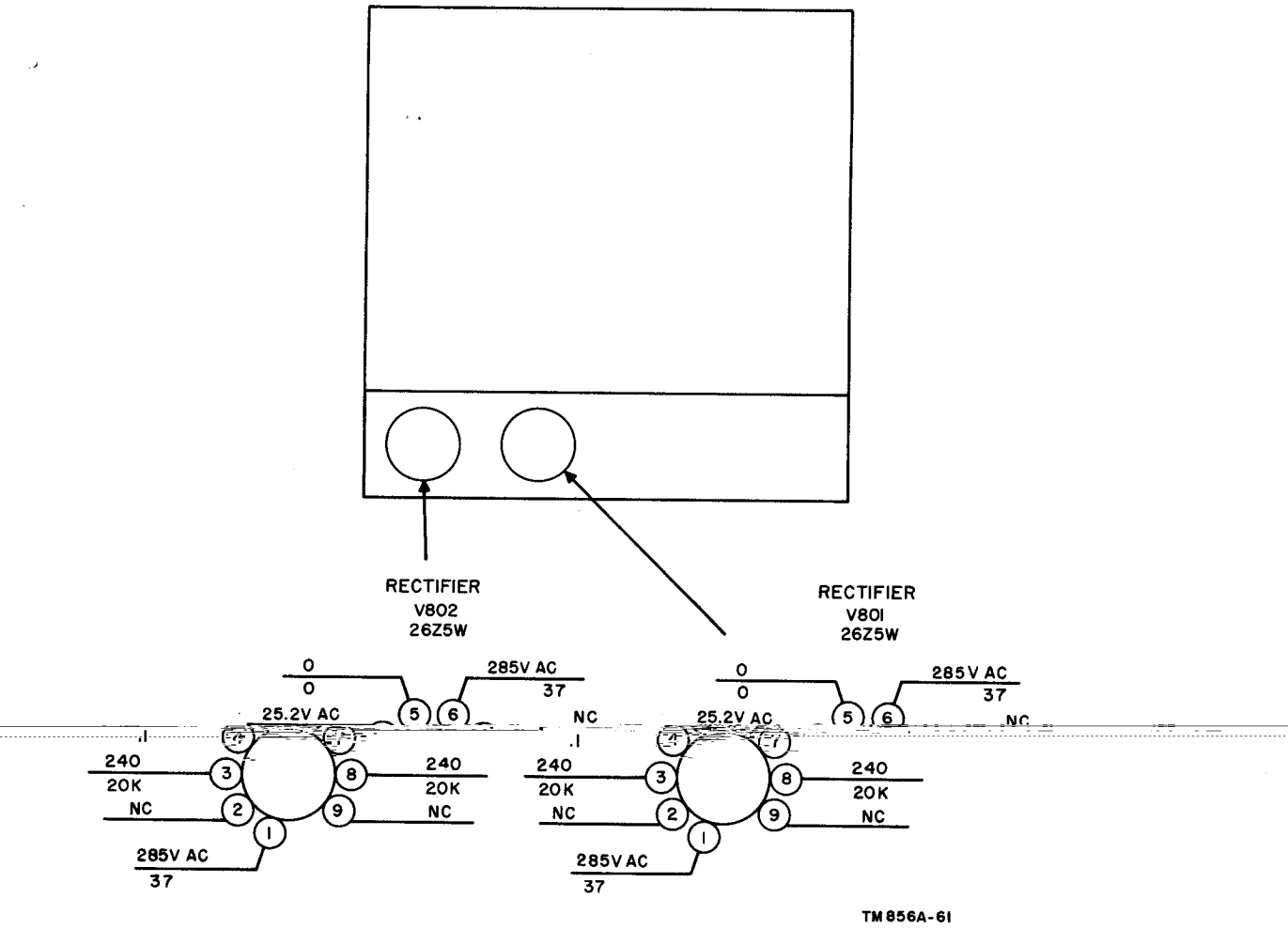


Figure 80. Power-supply subchassis, voltage and resistance diagram.

af signal to pin 2 of XV602. The signal be much louder than that of the previous ...ut will be necessary to reduce the af om the audio oscillator. If the signal is ified as it should be, or the signal istorted, or both, check tube V602 by it. If this does not correct the trouble, tages, resistance, and parts in the local er circuit.

e Audio Channel Tests

t a headset across the LINE AUDIO on the rear panel of the receiver. The VEL meter may also be used to check t of the line audio channel; however, set must be used to detect distortion .

5 of V604 (Plate of Line Af Output pply the full output of the audio oscillator to pin 5 of XV604. A weak af signal should be heard in the headset. In no signal is heard ... check the leads to af output transformer T602, the dc resistance of T602 (par. 106), the attenuator (R111 through R115), and the wiring in the output circuit of the line audio channel. Terminals 11 and 12 on the rear panel of the receiver must be tied together for this test.

b. Pin 1 of V604 (Grid of the Line Af Output Tube). Apply the af signal to the grid (pin 1) of XV604 of the line af output tube. The af signal should be louder than that in the previous step. If it is not, check tube V604 (by substitution) and coupling capacitor C608 for a short or leaky condition. Check the other voltages on V604 and the associated circuit parts. Check the operation of the LINE LEVEL meter by turning LINE METER switch S105 to each of its positions. Meter deflection should be minimum

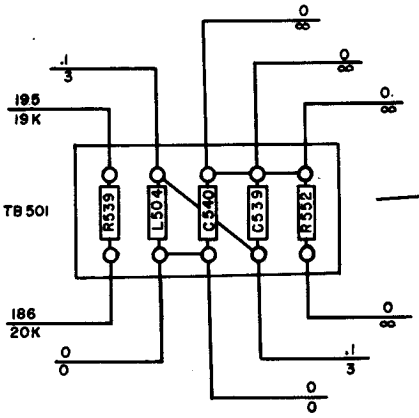
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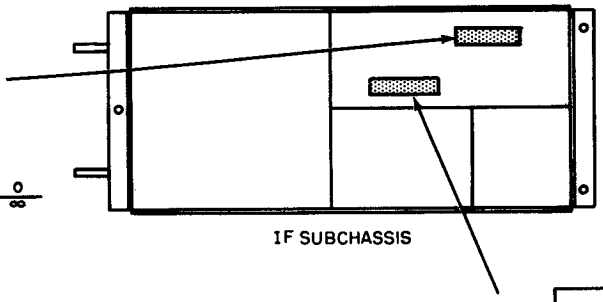
100. Line

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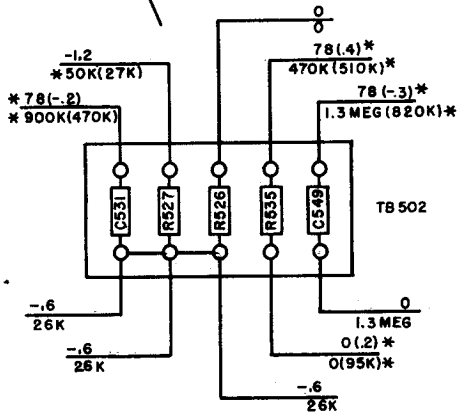
a. Pin Tube). A

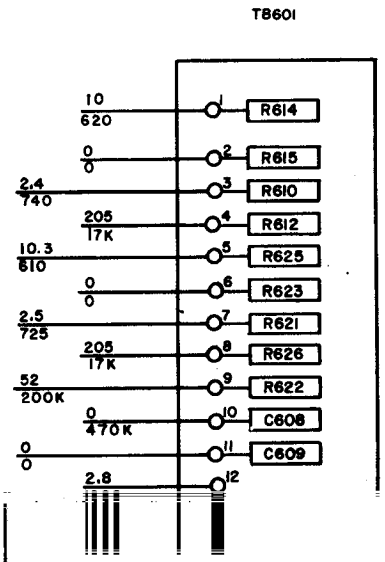
on the +10 setting and maximum on the —10 position. If the output from the audio oscillator is extremely high, the LINE LEVEL meter needle may be forced off scale.

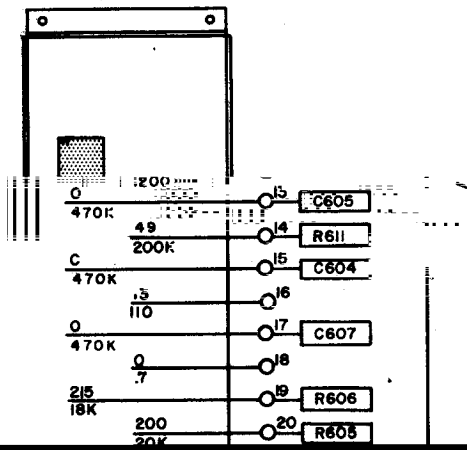




NOTE:
LIMITER CONTROL SET AT OFF,
VALUES IN ( ) WITH LIMITER SET AT 10.







c. Pin 6 of V602 (Plate of Line Af Amplifier). Apply the audio oscillator signal to pin 6 of XV602. The signal should be of approximately the same amplitude as that of the previous step. If it is not, check coupling capacitor C608 for an open by bridging it with a similar capacitor. If this does not correct the trouble, check the circuit voltages and resistances.

d. Pin 7 of V602 (Grid of Line Af Amplifier). Turn the LINE GAIN control fully clockwise. Apply the af signal to pin 7 of XV602. The audio output should be much louder than in the two previous steps. It will be necessary to reduce the output of the audio oscillator. If the signal is not amplified as required, check tube V602 by substitution, check voltages and resistances.

101. Af Amplifier Test

a. Pin 8 of V601. Apply the audio signal to XV601. Be sure the AUDIO RESPONSE switch is set to WIDE. The audio signal output should be considerably weaker than that obtained when the signal was applied to pin 2 of V601 because of low impedance at the cathode of V601B. If no signal is heard, check tube V601B by substitution. If this fails to correct the trouble, check the voltages, resistances, and parts in the af cathode-follower circuit.

b. Pin 7 of V601. Apply the audio signal to pin 7 of XV601. The audio output should be stronger than that obtained from the previous step. If no audio signal is heard or it is weak and/or distorted, check tube V601B by substitution. If this test fails, check resistors R607 and R608.

c. Pin 1 of V601. Apply the audio signal to pin 1 of XV601. The audio signal output should be the same or weaker than that obtained in the previous step. If no audio output is heard, and the audio signal is weak or distorted, check tube V601 by substitution. If this test fails, check circuit voltages, resistances, and parts.

d. Pin 2 of V601. Apply the audio signal to pin 2 of XV601. The audio signal output heard should be considerably stronger than that obtained in the previous test. If this is not the case, check V601 by substitution and check circuit voltages, resistances, and parts.

e. Pin 14 of J620. Apply the audio signal to pin 14 of J620. The signal should be weaker than that obtained in *d* above.

102. If Subchassis Tests

a. Pin 1 or 2 of V507 (Output Plate of Limiter V507). The LIMITER switch should be in the OFF position for this test. Feed an audio signal to pin 1 of XV507. The audio output should be of similar amplitude as that obtained when the audio signal is fed to pin 14 of J620. If this is not the case, check capacitor C549 for an open by bridging it with a similar capacitor. If this test fails, check the wiring from the limiter V507 to the first af amplifier V601.

b. Pins 3 and 8 of V507 (Cathodes of Limiter V507). Apply the audio signal to pins 3 and 8 of XV507. The audio output should be of similar amplitude as the previous step. If this test fails, or the audio signal is weak or distorted, V507 or R535 may be defective.

c. Pin 6 or 7 of V507 (Input Plate of Limiter V507). Apply the audio signal to pin 6 or 7 of XV507. The audio output should be similar in amplitude to that of the previous step. If this test fails, V507 may be defective. Replace by substitution. If tube V507 checks satisfactorily, capacitor V532 may be shorted.

d. Pin 6 or 7 of V506 (Plate of Detector V506B). Apply a modulated 455-kc signal to pins 6 and 7 of XV506 through Test Lead CX-1363/U. Use sufficient 455-kc signal to obtain usable audio output. If this test fails to pass any signal through the detector V506B, the tube may be defective. Test by substitution. If no signal output can be obtained, check to see that there is a jumper between the DIODE LOAD terminals 14 and 15 on the rear panel of the receiver. If the trouble persists, trace the signal path from the detector V506B to the input of limiter V507.

e. Pin 5 of V504 (Plate of Fourth If Amplifier). Apply the modulated 455-kc signal to pin 5 of XV504. The audio output level should be of approximately the same amplitude as the previous test. If this test fails, check tube V504 by substitution. If trouble persists, check circuit voltages, resistances, and individual parts.

f. Pin 1 of V504 (Control Grid of Fourth If Amplifier). Apply the modulated 455-kc signal to pin 1 of XV504. The audio output observed in the headset or loudspeaker should be considerably louder than that obtained in the previous setup. If this is not the case, check

tube V504 by substitution. If trouble persists, check circuit voltages, resistances, and parts.

g. Pins 5 and 1 of First Three If Amplifiers. Set the FUNCTION switch to MGC. Turn the RF GAIN control fully clockwise, and set the BANDWIDTH switch to the 4 KC position. Apply the modulated 455-kc signal to each of the plates and control grids in succession, working from pin 5 of XV503 and finishing on pin 1 of XV501. Each time the modulated 455-kc signal is applied to the grid of the next if amplifier, a noticeable increase in output should be observed. If this is not the case, trouble shoot the particular stage that fails to give the required amplification.

103. Rf Subchassis Tests

Note. Refer to the rf and variable if conversion scheme (par. 107) if alternate test frequencies are attempted.

a. Pin 1 of V204 (Plate of Third Mixer). Apply the modulated 455-kc signal to pin 1 of XV204. The amplitude of the audio output should be approximately the same as that obtained when applying the test signal to pin 1 of V501. If this test fails, check T208 and the connections between the rf subchassis and the if subchassis.

b. Pins 6 and 7 of V204 (Control Grid and Cathode of Third Mixer). Set the frequency indicator to 01 +000, and apply a 2-mc modulated signal to test point E211 (fig. 58). If no output signal is heard, connect an antenna or a 2-mc signal source to test point E211, and at the same time, apply a strong 2455-kc unmodulated rf signal to pin 7 of XV204. The reception of noise or signals indicates a defective vfo. To check the injection voltage of the vfo, turn the FUNCTION switch to STAND BY, and check the dc voltage at test point E211. This voltage is rectified by the cathode and control grid of V204 during the absence of plate voltage on V204. This voltage should be between —2.8 and —4.3 volts dc. If the voltage is not within these limits, check the rf voltage from the vfo. Measure the amount of rf voltage from the vfo by connecting the probe of the ac vtvm to pin 7 of V204. The voltage should measure at least 1.8 volts rms for normal operation. When the trouble is in the vfo, check tube V701; check tube-socket voltages and resistances. If no signal is heard when 2455-kc unmodulated

signal is applied to pin 6 of V204, check third mixer V204 and its tube-socket voltages and resistances.

c. Pin 1 of V203 (Plate or Second Mixer). Apply a modulated 2-mc signal to pin 1 of XV203. A weak output signal may indicate that plate circuits Z216-1 through Z216-3 are not tuned or not properly aligned mechanically.

d. Pins 6 and 7 of V203 (Control Grid and Cathode of Second Mixer). Set the MEGACYCLE CHANGE control to 00, and apply a 17.5-mc modulated rf signal to test point E210, and turn the KILOCYCLE CHANGE knob to 500. If no signal is heard, either the second mixer stage or the second crystal-oscillator stage is defective. To determine which stage is at fault, apply a strong 20-mc unmodulated rf signal to pin 7 of XV203 while test point E210 is connected to an antenna or a 17.5-mc signal source. The reception of static or rf signals indicates a defective second crystal-oscillator stage. Turn the FUNCTION switch to STAND BY. Measure the rectified injection voltage at test point E210. A reading of —3.5 to —8 indicates that injection voltage is available from the second crystal oscillator and that tube V203 has cathode emission. The amount of injection voltage available from the second crystal oscillator is measured by connecting the ac probe of the vtvm to pin 7 of V203. A reading of approximately 1.8 volts ac or higher indicates normal output from the second crystal oscillator. If normal output is not obtained, check tube V401 by substitution. Also check the crystal-oscillator subchassis dial indicator. It should read 0. If the trouble persists, check the crystal, or crystals, in the second crystal-oscillator subchassis associated with this test. This can be done by substituting a similar crystal of the same frequency. If the trouble is not caused by a tube or crystal, check the circuit voltages and resistances, and all parts associated with that circuit. If no output is heard when the proper crystal oscillator signal is applied to pin 7, check second mixer tube V203 by substitution. If this test fails, check tube-socket voltage and resistance measure-

tube socket XV202. If no signal is heard or it is weak, check the tuning and mechanical alignment of tuned circuits Z213-1 through Z213-3.

f. Pins 6 and 7 of V202 (Control Grid and Cathode of First Mixer). Apply a .5-mc modulated signal to test point E209. If no signal is heard, apply a strong unmodulated 17-mc signal to pin 7 of XV202 while test point E209 is connected to an antenna or a .5-mc signal source. If static or signals are audible, the trouble is in the first crystal oscillator. Turn the FUNCTION switch to STAND BY and check the injection voltage at test point E209. A dc reading of more than 4.5 volts indicates injection voltage is obtained from first crystal oscillator V207. Measure the ac voltage at pin 7 of V202 with the ac probe of the vtvm. Normal output should be at least 3 volts ac. If the output is not as specified, check tube V207 by substitution, check crystal Y201 by substitution with another 17-mc crystal, and measure the tube-socket voltage and resistances. If the operation of first crystal oscillator V207 is normal, check tube V202 by

a. The first method is to remove the suspected crystal and replace it with a similar crystal of the same frequency. This comparison method depends on the availability of spare crystals.

b. The second method requires the use of a vtvm, such as Electronic Multimeter TS-505/U, or equivalent. A crystal oscillator rectifies grid leak bias when it is oscillating. To determine whether the circuit is operating, measure the control grid voltage for a negative reading. This test determines to some extent the activity of the crystal, as well as the condition of the rest of the circuit. While reading the negative voltage at the control grid of the particular oscillator, remove the crystal and observe the vtvm reading. It should drop to nearly zero. This test however, will not indicate whether the crystal is operating on the correct frequency. It is possible that the crystal may be operating on another mode, possibly far removed from the correct frequency. First crystal oscillator V207

105. Stage Gain Charts

The stage gain charts in *a*, *b*, and *c* below list the minimum and maximum voltages required to produce a voltage of —7 volts at the DIODE LOAD terminal 14 at the rear panel of the receiver for if and rf tests. For af tests, the signal input to the af subchassis to produce 500 milliwatts (local af channel) and 10 milliwatts (line af channel) is measured. Use this information to check the gain of the individual stages, as well as the over-all gain of a particular subchassis, or the entire receiver. Before attempting these tests, be sure the trouble is not caused by weak or defective tubes, improper alignment, or misadjustment of GAIN ADJ control R519 on the if subchassis. To obtain the rf or if stage gain readings, connect a vtvm such as Electronic Multimeter TS-505/U, or equivalent, between DIODE LOAD terminal 14 at the rear panel of the receiver and chassis ground. Connect the ground lead of the signal generator or audio oscillator to the receiver chassis ground, and the hot lead to the specified point of signal injection through a .05-uf capacitor. When RF Signal Generator Set AN/URM-25 is used, use Test Lead CX-1363/U in place of the .05-uf blocking capacitor. When checking the if subchassis, access to the tube sockets must be made by connecting the subchassis under test to the main frame with patch cords. Another method necessitates wrapping a small piece of wire around the tube pin, or using tube adapters that are sometimes available (fig. 54). These tube adapters are placed between the tube and tube socket; each pin of the tube is accessible for connection to the test probe. Tune the signal generator to the frequency of test, and adjust the output for a reading of —7 volts. Compare the output of the signal generator with the charts listed below. Readings that are outside these limits do not necessarily indicate improper functioning of the receiver. The gain of individual stages from one receiver to another over a period of time will vary. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to MGC, and change them only when the particular check or test orders different control settings. (See chart at bottom of page.)

a. Rf Subchassis Stages.

Note. Set FUNCTION switch to MGC.

Signal generator output connection	*Balanced Antenna connector*	*Test point E208 grid V201*	*Test point E209*		*Test point E210*			*Test point E211*	
			V202		*V203*			*V204*	
Frequency (mc)	5–32	5–32	5–8	17.5–25	17.5 to 25	3–2	8–32	3–2	455[a]
Signal generator output (microvolts)	less than 4	4 to 16	15 to 60	15 to 60	20 to 60	3 to 40	20 to 65	50 to 125	20 to 40

[a] Remove the 3- to 2-mc variable if slug rack and tuned circuit Z216-3 before attempting this test [par. 130*a*(1) and (4)].

b. If Subchassis Stages. Set the FUNCTION switch to MGC and set the BANDWIDTH switch to 2 KC, 4 KC, 8 KC, and 16 KC positions for all tests. The variation from the BANDWIDTH switch position of maximum gain to the switch position of minimum gain must not exceed a ratio of two-to-one.

Signal generator output connection	*Signal generator output (microvolts)*
1st if ampl grid (V501)	100 to 200
2d if ampl grid (V502)	250 to 500
3d if ampl grid (V503)	10,000 to 20,000
4th if ampl grid (V504)	300,000 to 400,000

c. Af Subchassis Stages.

(1) Connect the output of the audio oscillator to the DIODE LOAD terminal 14 and chassis ground through a .05-uf capacitor, and adjust it for 400 cps output.

(2) Connect the ac vtvm in parallel with a 600-ohm, noninductive resistor across the LOCAL AUDIO terminals 6 and 7 on the rear panel of the receiver.

(3) Turn the RF GAIN control fully counterclockwise. Turn the LOCAL GAIN control fully clockwise. Set the AUDIO RESPONSE switch at WIDE. Check to see that the LIMITER switch is in the OFF position.

(4) Increase the output of the audio oscillator until 500 milliwatts (17.3 volts rms across 600 ohms) is indicated on the ac vtvm.

(5) Check the output of the audio oscillator. It should be approximately 1 volt.

(6) Transfer the ac vtvm and 600-ohm resistor to LINE AUDIO terminals 10 and 13.

(7) Turn the LINE GAIN control fully clockwise.

(8) Adjust the output of the audio oscillator for an output of 10 milliwatts (2.45 volts rms across 600 ohms).

(9) Check the output of the audio oscillator. It should be less than 1 volt.

106. Dc Resistances of Transformers and Coils

The dc resistances of the windings of the transformers and coils in Radio Receiver R-390A/URR as measured with an ohmmeter, such as Multimeter TS-352/U, or equivalent, are listed below:

a. Main Frame.

Transformer or coil	*Terminals*	*Ohms*
FL101	A–A	less than .1
	B–B	less than .1
K101	1–2	200

b. Rf Subchassis.

Transformer or coil	*Terminals*	*Ohms*
	3–4	less than .1

Subchassis.

Transformer or coil	*Terminals*	*Ohms*
L502	1–2	40
	3–4	40
L503	1–2	40
	3–4	40
L504	1–2	40
	3–4	40

Transformer or coil	*Terminals*	*Ohms*
L208		7
L210		.15
L211		7
L236		.3
T201	1–2	less than .2
	4–6	2.7
T202	1–2	less than .2
	4–6	1.2
T204	1–2	less than .2
	4–6	.4
T205	1–2	less than .2
	4–6	less than .2
T206	1–2	less than .2
	4–6	less than .2
T207	1–2	less than .2
	3–4	less than .2
T208	1–5	2.5
	2–3	2
	3–4	2
	2–4	4
Z201–1	1–3	2.8
Z202–1	1–3	1.8
Z203–1	1–3	1.2
Z204–1	1–3	.5
Z205–1	1–3	.2
Z206–1	1–3	less than .2
Z201–2	1–3	2.8
Z202–2	1–3	1.8
Z203–2	1–3	1.2
Z204–2	1–3	.5
Z205–2	1–3	.2
Z206–2	1–3	less than .2
Z213–1	1–3	less than .2
Z213–2	1–3	less than .2
Z213–3	1–3	less than .2
Z216–1	1–3	1.1
Z216–2	1–3	1.1
Z216–3	1–3	1.1

c. Crystal-oscillator Subchassis.

Transformer or coil	*Terminals*	*Ohms*
HR401	gnd J410–E	11
L401		7
L402		.6
T401	1–2	less than .1

Transformer or coil	*Terminals*	*Ohms*
HR202	1–3	5
L201		7
L202		.6
L203		.6
L204		.6
L205		.6
L206		.6
L207		.6
L208		7

d. If

Tran or
F
F
F

Transformer or coil	*Terminals*	*Ohms*
FL505	1–2	40
	3–4	40
L501		7
L502		90
L504		3
L505		90
RT510	2–7	8
T501	1–2	6
	4–5	6
T502	1–2	6
	4–5	6
T503	1–2	6
	3–4	6.1
	4–5	6.3
	3–5	.2
Z501	1–2	4.8
Z502	1–2	.2
	1–3	1.8
	2–3	1.6
Z503	1–5	18

e. Af Subchassis.

Transformer or coil	*Terminals*	*Ohms*
FL601	1–2	230
	2–3	250
	1–3	480
K601	1–7	2.8
L601	1–2	130
L602	1–2	125
L603	1–2	110
T601	1–2	580
	3–4	28
	5–6	30
T602	1–2	580
	3–4	28
	5–6	30

f. Vfo Subchassis.

Transformer or coil	*Terminals*	*Ohms*
L706		.6
Z702	1–2	4
	3–4	.5

107. Rf and Variable If Conversion Scheme

a. Use the chart in *e* below to understand and check the frequency conversion scheme. The output of third mixer V204 is fixed at 455 kc, and the first crystal oscillator is 17 mc. The following is an example of the use of the frequency conversion chart.

Frequency of received signal .... 7145 kc
Frequency indicator reading 07 145
Band (mc) 7
Position of switch S201 and range of antenna and rf coils (mc) 4-8
Position of switch S401 7
First variable if (mc) 24.145
Second crystal-oscillator crystal frequency (mc) 9
Second crystal-oscillator output frequency (mc) 27
Second variable if (mc) 2.855
Vfo frequency (mc) 3.310

b. The first variable if equals the first crystal-oscillator frequency (17 mc) plus the frequency being received when the received frequency is between .5 and 8 mc. When receiving signals above 8 mc, first mixer V202 and first crystal oscillator V207 are disabled.

c. The second variable if equals the difference between second crystal-oscillator V401 output frequency and the first variable if. The second variable if range is from 3 to 2 mc on all bands except the .5- to 1-mc band. On this band, the range is 2.5 to 2.0 mc.

d. The vfo frequency equals the second variable if plus the fixed if output of third mixer V204 (455 kc). The vfo frequency range is from 3.455 mc to 2.455 mc on all bands except the .5- to 1-mc band. On this band, the range is from 2.955 mc to 2.455 mc.

107. *e.*

Band (mc)	*Position of switch S201 and range of antenna and rf coils (mc)*	*Position of switch S401*	*1st variable if range (mc)*	*2d xtal osc crystal freq (mc)*	*2d xtal osc output freq (mc)*
5–1	.5–1	.5	17.5–18	10.0	20.0
1–2	1–2	1	18–19	10.5	21.0
2–3	2–4	2	19–20	11.0	22.0

voltmeter with an input resistance of less than several megohms. With the vtvm connected between chassis ground and AGC NOR terminal 4, vary the output of the signal generator, or detune the receiver slightly. The vtvm indication should rise and fall as this is done. Adjust the receiver so that a reference agc voltage is established at the AGC NOR terminal, and then proceed to check the agc voltage at test points E208 through E211 on the rf subchassis and at the control grids of the controlled tubes in the if subchassis. If the agc voltage established at the AGC NOR terminal 4 is absent, or considerably lower, at any of these check points, replace the particular tube with one known to be good. The questionable tube may be gassy.

c. Tube Substitution. Once it has been determined that agc trouble exists, substitute the tubes controlled by the agc bias. More than one such tube may be causing the trouble; temporarily replace all questionable tubes. Be sure to replace all the original tubes that are in good condition when the check is concluded.

d. Fixed Bias Source. A means of furnishing

conform properly, the particular filter is probably defective. The db loss in each filter should be approximately 8 db. This attenuation can be checked by using the CARRIER LEVEL meter and a signal from a signal generator or reliable signal from a radio station by comparing the signal level through the other mechanical filters. Both band pass and db losses can be caused by a failure of the small mica capacitors connected to the input and output windings of the mechanical filters. When replacing these items, be sure to replace them with exactly the same value capacitor, because the resonance and band pass of each filter depend on the correct capacitance. The input and output coil resistances are given in paragraph 106.

111. Band-pass Filter Test, 800-cps

The attenuation of this filter can be checked by comparing the audio level with the AUDIO RESPONSE switch in the WIDE position and then in the SHARP position. The resulting audio levels should be approximately the same. The LINE LEVEL meter, LINE METER

(4) Reconnect P108 and J208, and turn the receiver on; set the FUNCTION switch to AGC or MGC. Allow the receiver to operate for approximately 10 minutes. Note that the ac voltmeter reading changes as the oven is turned on and off, indicating that the thermostat is operating.

b. Ovens HR401 and HR701.

(1) Connect a 0- to 5-ampere ac ammeter across OVENS switch S106. This closes the oven circuits.

(2) With the receiver operating, the ac ammeter will indicate zero when both thermostats are open, and approximately 2 amperes for each oven when the ovens operate.

(4) Connect a 0 to 1 milliammeter between the arm on the potentiometer and AGC NOR terminal 3.

(5) Increase the voltage output of the supply until 10 volts is read on the meter.

(6) The reverse current should not exceed .075 milliampere.

(7) Turn the potentiometer back to 0 volt output, and reverse the terminal 3 and 5 connections.

(8) Replace the 0 to 1 milliammeter with a 0 to 10 milliammeter.

(9) Adjust the potentiometer for a 1-volt reading.

(10) The forward current through CR101 should be at least 4 milliamperes.

b. Selenium Rectifier CR102. Turn FUNCTION switch to CAL, turn the OVENS switch to ON, and measure the dc voltage between the red and blue terminals on CR102 (fig. 57). It should be at least 19 volts dc with full load applied. If the voltage is considerably less than this, check the ac voltage between chassis ground and the yellow terminal on CR102. This voltage should be approximately 25.2 volts ac. If the dc voltage output of the rectifier is considerably less than 19 volts dc, replace CR102, and recheck the dc voltage between the red and blue terminals.

113. Checking Relays K101 and K601

If the operating condition of relay K101 or K601 is doubtful, check it by disconnecting the relay from the receiver and actually checking its operation and the condition of its contacts. The dc resistance of the relays is given in paragraph 106. Relay K601 should operate when the voltage across its winding is raised from 0 volt to 5.6 volts ac. The contacts should be checked with an ohmmeter for continuity when the relay is operated and not operated. Use the receiver schematic diagram (fig. 106) for identifying the terminals. Relay K101 should operate when the voltage across its winding is raised from 0 volt to 16 volts (rectified, but not filtered ac).

114. Checking Rectifiers CR101 and CR102

a. Crystal Rectifier CR101. Crystal rectifier CR101 can be checked by measuring the forward and reverse current through it.

Caution: Always begin the test with the arm of the potentiometer adjusted to deliver 0 volt, otherwise the rectifier or the milliammeter will be damaged. Proceed as follows:

(1) Connect a 50,000-ohm potentiometer across a 22½-volt battery.

(2) Connect the negative side of this variable voltage supply to AGC DIV terminal 5 on the rear panel.

(3) Connect a 0- to 15-volt voltmeter across the variable voltage supply.

115. Checking Current-regulator Tube RT510

Remove the current-regulator tube RT510 from the tube socket, and measure the dc resistance between pins 2 and 7. The dc resistance should be approximately 8 ohms. Also check the voltages on the heaters of the tubes that are connected in series with RT510 across the 25.2-volt winding of the power transformer (fig. 77, 78, and 102).

116. Checking LINE LEVEL and CARRIER LEVEL Meters

a. LINE LEVEL Meter. The accuracy of this meter can be checked by comparing its readings with those obtained when performing the audio [illegible] (par. 155). When readings on the LINE LEVEL meter are not as they should be, check the resistors on front-panel terminal board TB101 (fig. 74). These resistors are in

the line audio circuit, and the failure of one of them will affect the readings, and possibly, the audio output level at LINE AUDIO terminals 10 through 13 on the rear panel of the receiver.

b. CARRIER LEVEL Meter. This meter is most easily checked by comparing its readings with those of a similar meter known to be in good operating condition, using [illegible]

117. Checking Lamp I 103

This lamp can be checked by applying 90 volts dc or 65 volts ac across its terminals. This is the minimum voltage required to ionize the gas in it.

118. Main Frame Resistance and Continuity Chart

This chart can be used as a trouble-shooting aid when tracing wires in the main frame of the receiver. The *From* and *To* columns indicate the wire continuity, and the *Notes* column gives additional information, such as wire color, ground connections etc. This chart should be used with the main frame wiring diagram (fig. 105).

From	*To*	*Notes*
S101-3	P112-11	White - green
S101-2	S102-2B	White - red
S102-B	F101-2	White - orange
S102-A	P111-7	White - orange
S102-8B	P119-3	White - red - blue
S102-1B	P119-2	White - red - green
S102-2B	P112-2	White - red
S102-4B	P108J	White - black - green
S102-5B	P119-8	White - black - red
S102-7B	P119-4	White - brown - red
S102-8F	P119-7	White - red - orange - blue
S102-5F	TB102-3	White - orange
S102-6F	R103-1	White
S103-3	TB103-9	White - brown - red - orange
S103-2	P119-1	White - black - red - orange
S104-1	P120-6	Shielded wire, black
S104-2	P120-5	Shielded wire, red
S104-4	R104-?	White - black
S104-6	P120-1[illegible]	Shielded wire, yellow
S104-7	P120-4	Shielded wire, green
S104-8	P120-7	Shielded wire, brown
S105-8	TB101-7	White - green - blue
S105-7	TB101-3	White - blue
S105-4	TB101-9	White - brown - blue
S105-3	TB101-11	White - black - blue
S105-10	TB101-10	White - black - red - green
S105-9	TB101-12	White - black - red - blue
S107-9	S108-6	White
S107-8	P112-15	White - orange - green
S107-7	P112-13	White - red - orange - green
J102-2	TB102-8	Shielded wire, white - blue
J102-1	TB102-7	Shield, white
S108-7	P112-10	White - orange - blue
S108-5	P112-9	White - red - orange
R120-3	TB103-15	Shielded wire, orange
R120-1	TB103-16	Shield
R104-1	R105-1	Shielded wire, white - black
R104-3	R105-3	Shield
R104-2	P120-3	Shielded wire, white - orange
R104-3	P120-13	Shield
R105-1	P120-2	Shielded wire,
R105-3	P120-13	Shield
R105-2	P120-1	Shielded wire,
R105-3	P120-13	Shield
R103-1	MF gnd-34	Main frame gr
R103-2	TB102-2	White - brown
M101 (+)	TB101-8	White - black
M102 (+)	P112-14	White - black
M102 (—)	P112-12	White - brown
TB101-1	P119-10	White - black
I 101-C	MF gnd-32	Main frame g
P119-2	P109-A	White - red
P119-2	P110-A	White - red
P119-2	P108-K	White - red -
P119-4	P109-B	White - brown
P119-4	P108-D	White - brown
P119-4	P110-C	White - brown
P119-5	P111-5	White - red
P119-6	CR102-Y2	White - brown
P119-9	TB102-6	White - green
P119-10	P111-10	White - black
P119-11	MF gnd-34	Main frame g
P120-8	M101 (+)	White - black
P120-9	TB103-11	White - black
P120-10	TB103-12	White - brown
P120-11	TB103-14	Shielded wire
P120-13	TB103-16	Shield
P120-12	TB101-4	White - green
P120-13	MF gnd-34	Main frame g
P120-14	P112-7	Shielded wire
P120-13	P112-17	Shield
P109-D	S106-ON	White - brown
P109-E	S106-ON	White - brown
P109-F	MF gnd-34	Main frame g
P109-H	P112-19	White - black
P109-J	MF gnd-34	Main frame g
P109-K	MF gnd-34	Main frame g
P111-1	P112-8	White - brown
P111-1	S106-OFF	White - brown
P111-2	MF gnd-33	Main frame gro
P111-6	FL101-A	White - orange
P111-10	P112-20	White - black
P111-11	MF gnd-33	Main frame gro
TB103-10	TB101-6	White - red - b
TB103-13	TB101-5	White - black -
TB103-14	P112-5	Shielded wire,
TB103-16	P112-17	Shield
TB103-15	P112-3	Shielded wire,
TB103-16	P112-17	Shield
TB103-16	MF gnd-33	Main frame gro
C103 (+)	P112-16	White - blue
C103 (—)	MF gnd-32	Main frame gro

From	*To*	*Notes*
P108-H	MF gnd-33	Main frame ground, white
TB102-1	C103 (+)	White - blue
TB102-3	P112-4	White - orange
TB102-4	P112-6	White - black - red
TB102-7	MF gnd-33	Main frame ground, white
P112-2	P108-A	White - red
P112-16	P108-C	White - blue
S106-0N	P110-E	White - brown
S106-0N	P110-F	White - brown
P112-17	MF gnd-32	Main frame ground, white
P112-18	MF gnd-32	Main frame ground, white
P112-20	P110-B	White - black
P112-20	P108-B	White-black
P112-6	P108-E	White - black - red
P112-20	P108-F	White - brown
P110-D	MF gnd-32	Main frame ground, white
P110-H	MF gnd-32	Main frame ground, white
CR102-Y1	S106-0FF	White - brown
CR102 (—)	K101-1	White - black - red - green
CR102 (+)	K101-2	White - black - red - blue
P111-3	P111-4	Jumper
M101	S105	White - red

119. Resistance Measurements at Subchassis Connectors

Shorts and opens sometimes can be localized by measuring the resistance to ground of the terminals on the subchassis power connectors. The charts below indicate what the resistance readings should be on properly functioning subchassis.

a. Rf Subchassis.

Terminal of receptacle J208	*Resistance to ground (ohms)*
A[a]	110K
B	.8
C	Inf
D[a]	Inf
E	Inf
F	100
H	0
J[a]	Inf
K[a]	Inf

b. Crystal-oscillator Subchassis.

Terminal of receptacle J410	*Resistance to ground (ohms)*
A[a]	Inf
B	10
C[a]	Inf
D	0
E	11
F	11
H	0

[a]B+ terminal.

c. If Subchassis.

Terminal of receptacle J512	*Resistance to ground (ohms)*
1	Inf
2[a]	54K
3	53K
4	500K
5	Inf
6	Inf
7	Inf
8	Inf
9	Inf
10	420K
11[a]	Inf
12	25
13	2 meg
14	0 to 20
15	140K
16	105K
17	0
18	0
19	Inf
20	.5

d. Af Subchassis.

Terminal of receptacle J619	*Resistance to ground (ohms)*
1	3.6
2	90K
3	90K
4	90K
5[a]	90K
6	Inf
7	Inf
8[a]	Inf
9	80
10	Less than .1
11	0

Terminal of receptacle J620	*Resistance to ground (ohms)*
1	Inf
2	1 meg
3	Inf
4	500K
5	200
6	Inf
7	200
8	Inf
9	Inf
10	Inf
11	Inf
12	Inf
13	0
14	1.4 meg
15	Inf

[a]B+ terminal.

e. Vfo Subchassis.

Terminal of receptacle J709	*Resistance to ground (ohms)*
A[a]	Inf
B[a]	Inf
C	Inf
D	Inf
E	Inf
F	0
H	3.5
J	Inf
K	Inf

120. Calibration Oscillator Circuit Wave Forms

Checking the shape and amplitude of the wave forms is sometimes useful when trouble shooting the calibration oscillator circuit. To perform this check, turn the FUNCTION switch to CAL, and check the wave forms with an oscilloscope. They should conform with the data given in the chart below. Values varying 20 per cent above or below those specified are normally acceptable.

f. Power Supply Subchassis.

Terminal of receptacle J811	*Resistance to ground (ohms)*
1	Less than .1
2	0
3	Inf
4	Inf
5[a]	Inf
6	Inf
7	Inf
8	Inf
9	0
10	Less than .1
11	0

[a]B+ terminal.

Amplitude, volts peak to peak
20 volts
.75 volt
85 volts
65 volts
85 volts
65 volts

V205-1	Sine wave, 200
V205-8	Square wave, 1
V206-1	Nonsinusoidal
V206-2	Nonsinusoidal
V206-6	Nonsinusoidal
V206-7	Nonsinusoidal

Section III. REPAIRS

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subassemblies in the
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of the receiver
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121. General Notes on Removals and Replacements

a. General. Instructions for the removal and replacement of subassemblies and detail parts in Radio Receiver R-390A/URR are given in paragraphs 122 through 131. All the subchassis
loosened and removed with the Fn [illegible]ps screw
driver supplied with the receiver. All knobs,
shaft couplers, gears and cams are loosened
and removed with the No. 8 Bristo (Autoa
wrench also supplied with the receiver.

c. Connectors. All rf and power connectors
CYCLE CHANGE control when the rf, [illegible] and
vfo subchassis are operated out o
[illegible] These controls are
them to their previous settings.

b. Captive and Mounting Screws. All the
threaded fasteners that secure the subassem
blies to the main frame of the receiver are
color-coded with green screw heads. Loosen
and remove only these screws unless otherwise
instructed. The only exceptions to the use
the green-headed screws are the front-pa
screws that secure the front panel of the

ceiver. Some of the se
conventional threaded t
are captive screws. Captive sc
tached to the subassembly th
the subassembly is removed
frame. All captive and moun
except the rf subchassis can be
of the front panel or other
KILOCYCLE CHANGE contr
switches or shafts operated

their mating connector. The coaxial rf-type connectors also must be rotated counterclockwise before removing them from their mating connectors. In several cases, the removal of an rf connector can be made easier by the use of long-nosed pliers or a long, narrow, plier-

type tool that will readily grip the connector.

Replacement of the connectors is the reverse of removal. Be careful when aligning the pins on the connectors otherwise they might be bent. Examine the pins on the connectors for proper alignment with the mating connectors. This will indicate the proper pin alignment and reveal damaged pins.

(6) Loosen the BANDWIDTH shaft coupler by [illegible] and pull the knob and shaft outward from the front panel. This will separate the shaft and coupler.

(7) Remove the four 7/16-inch by 8-32 Phillips screws on the left side of the [illegible] and the four similar screws on the right side of the front panel. Remove the five 7/16-inch by 6-32 flat Phillips screws and external tooth lock washers on the front panel. All screws to be removed are shown in figure 82.

Caution: Be sure the DIAL LOCK mechanism does not bind on the riveted locking plate (fig. 86) mounted on the KILOCYCLE CHANGE shaft.

(8) Grasp the front-panel handles and pull forward with a slight vertical rocking motion. The front panel will separate from the main frame, while riding on the shafts of the KILOCYCLE CHANGE, MEGACYCLE CHANGE, and ANT TRIM controls.

c. Replacement.

(1) Carefully lower the front panel to the bench top, resting on the handles. Be sure that the main frame is resting securely on the wooden blocks.

(2) Grasp the front-panel handles and slide it forward on the KILOCYCLE CHANGE, MEGACYCLE CHANGE, and ANT TRIM shafts with a slight vertical rocking motion while pushing forward.

(3) Check to see that the DIAL LOCK mechanism is in a vertical position and that the ZERO ADJ knob is fully counterclockwise.

(4) Grasp the DIAL LOCK shaft and rotate the mechanism so that its jaws loosely clutch the riveted locking plate on the KILOCYCLE CHANGE shaft. Set the mechanism in the position that allows the raised surface on the mechanism to fall into the aligning dimple on the rear side of the front panel.

(4) Replace the eight 5/8-inch by 8-32 screws and the five 7/16-inch by 6-32 screws with their flat washers and five [illegible] that secure the front panel.

(6) Loosen the BANDWIDTH shaft coupler by [illegible] and pull the knob and shaft outward from the front panel. This will separate the shaft and coupler.

(7) Remove the four 7/16-inch by 8-32 Phillips screws on the [illegible] and the four similar screws on the right side of the front panel. Remove the five 7/16-inch by 6-32 flat Phillips screws and external tooth lock washers on the front panel. All screws to be removed are shown in figure 82.

Caution: Be sure the DIAL LOCK mechanism does not bind on the riveted locking plate (fig. 86) mounted on the KILOCYCLE CHANGE shaft.

(8) Grasp the front-panel handles and pull forward with a slight vertical rocking motion. The front panel will separate from the main frame, while riding on the shafts of the KILOCYCLE CHANGE, MEGACYCLE CHANGE, and ANT TRIM controls.

c. Replacement.

(1) Carefully lower the front panel to the bench top, resting on the handles. Be sure that the main frame is resting securely on the wooden blocks.

(2) Grasp the front-panel handles and slide it forward on the KILOCYCLE CHANGE, MEGACYCLE CHANGE, and ANT TRIM shafts with a slight vertical rocking motion while pushing forward.

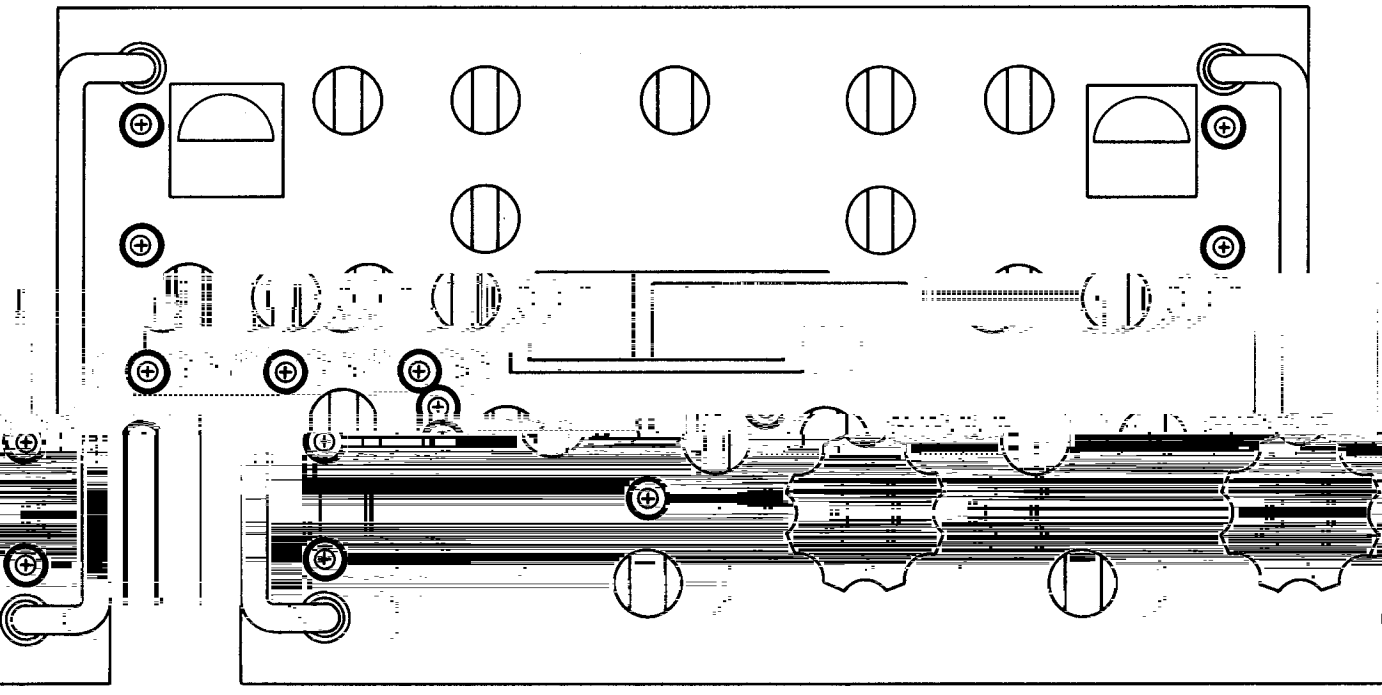
(2) Check to see that the DIAL LOCK mechanism is in a vertical position and that the ZERO ADJ knob is fully counterclockwise.

(3) Grasp the DIAL LOCK shaft and rotate the mechanism so that its jaws loosely clutch the riveted locking plate on the KILOCYCLE CHANGE shaft. Set the mechanism in the position that allows the raised surface on the mechanism to fall into the aligning dimple on the rear side of the front panel.

(4) Replace the eight 5/8-inch by 8-32 screws and the five 7/16-inch by 6-32 screws with their flat washers and five [illegible] that secure the front panel.

(6) Loosen the BANDWIDTH shaft coupler by [illegible] and pull the knob and shaft outward from the front panel. This will separate the shaft and coupler.

(7) Remove the four 7/16-inch by 8-32 Phillips screws on the left side of



TM856A-87

Figure 82. Front-panel removal, location of screws.

subassem-
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placement

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(5) Turn the DIAL LOCK hexagonal nut fully clockwise with the fingers, and tighten the hexagonal nut with a suitable ½-inch socket wrench. Replace the knob, allowing for a ⅛-inch clearance between the knob and the front panel. This prevents the knob from binding on the front panel when the DIAL LOCK is turned fully clockwise.

(6) Replace the remaining knobs on their respective shafts. The MEGACYCLE CHANGE and KILOCYCLE CHANGE knobs should have a ⅛-inch clearance from the front panel to avoid binding.

(7) Engage and tighten the shaft couplings on the BANDWIDTH and BFO PITCH controls. Be sure that the BANDWIDTH control is tightened on the 10 position and that the BFO PITCH control is tightened on 0.

(8) Turn all the knobs previously removed through their entire range, and check for smoothness of operation and freedom from binding. Also check them for correct position on their respective shafts.

(9) If the Oldham coupler and its anti-backlash spring on the vfo bly were removed in a prev ation, replace them.

123. Rf Subchassis Removal and Rep

a. General. Removal and replacem rf subchassis is the most complicat subchassis removals and replaceme erally, the crystal-oscillator subchas moved with the rf subchassis becau

removing the rf subchassis sepa- emove the crystal-oscillator sub- rf subchassis when both are main frame, follow the in- aph i

o remove the rf subchassis and subchassis, proceed as follows: the antibacklash spring from am coupler (fig. 67 and 89) o subassembly and place it in r container to prevent losing ging it.

par. 122).

P805, P806, P218, and P108

simpler than rately. To re chassis from the removed from the structure if pa

b. Removal. T crystal-oscillator

(1) Remove the Oldh on the vf a tray o or damag

(2) Remove the front panel

(3) Disconnect plugs P207, P717, P213, (fig. 56).

(4) Remove the two 5/16-inch by 6-32 Phillips green-headed screws and lock washers just below and beyond the front auxiliary gear plate. One of the screws is accessible through an access hole in the front auxiliary gear plate and is just below the clutch gear (fig. 86).

(5) Remove the two ⅝-inch by 6-32 Phil- 5⅛-inch spacers and place it into the main frame. Retain the rf subchassis in place by starting, but not tightening, one or two of the Phillips green-headed machine screws and their lock washers. These screws are located behind the LOCAL GAIN control when the front

Caution: Be careful not to damage the metal grounding strips that contact the bottom edges of the rf and crystal-oscillator subchassis. To prevent damage to the parts on the front panel, temporarily slide the front panel onto the KILOCYCLE CHANGE and MEGACYCLE CHANGE shafts prior to setting the receiver on its side.

(3) Set the receiver on its left side with two wooden blocks under it and check the fitting of the Oldham coupler on the vfo subchassis. The center disk of the Oldham coupler should join the two end disks with about 1/32-inch play in the coupler (fig. 89).

(4) Engage the two green-headed captive screws at the rear of the crystal-oscillator subassembly, but do not turn them down all the way. Also, engage, but do not turn down, the two green-headed captive screws at the rear of the rf subassembly.

(5) Engage the three Phillips green-headed screws and their lock washers at the right side of the main frame and the two Phillips green-headed screws at the left side of the main frame. Retain the rf subchassis in place by starting, but not tightening, one or two of the Phillips green-headed machine screws and their lock washers. These screws are located behind the LOCAL GAIN control when the front panel is in place.

Caution: Be careful not to damage the metal grounding strips that contact the bottom edges of the rf and crystal-oscillator subchassis. To prevent damage to the parts on the front panel, temporarily slide the front panel onto the KILOCYCLE CHANGE and MEGACYCLE CHANGE shafts prior to setting the receiver on its side.

(6) Remove the three Phillips green-headed screws and lock washers that are at the left side of the main frame.

(7) Loosen the two green-headed captive screws at the rear of the crystal-oscillator subchassis, and the two green-headed captive screws at the rear of the rf subchassis.

Caution: Once again, be sure that the cables listed in (3) above are disconnected.

(8) Turn the KILOCYCLE CHANGE shaft fully counterclockwise against the stop.

Caution: During the performance of the next step, the Oldham coupler on the vfo subassembly will fall apart and the center disk will fall to the bench. Pick up the center disk and place it with the Oldham coupler antibacklash spring for safekeeping.

(9) Grasp the rf subassembly by the 5⅛-inch spacers and lift it carefully upward out of the main frame. Place the rf subchassis on the bench. Remove the crystal-oscillator subassembly when necessary (par. 124).

c. Replacement. Instructions for replacement of the rf subchassis with the crystal-oscillator subchassis attached follow: If the crystal-oscillator subchassis has been removed from the rf subchassis, secure it to the rf subchassis (par. 124).

Caution: Before reinstalling the subchassis, be sure the KILOCYCLE CHANGE shaft is fully counterclockwise.

(1) If the center disk of the Oldham coupler has been removed, smear some grease on it and place it on the end disk attached to the vfo subchassis shaft.

(2) Grasp the rf subchassis by the two green-headed screws and lock washers from the left side of the rf subchassis deck, through the access hole in the main frame. Leaving these screws loose allows shifting of the subchassis when the panel is in place.

(3) Remove the three Phillips green-headed screws and lock washers that are at the left side of the main frame.

(4) Loosen the two green-headed captive screws at the rear of the crystal-oscillator subchassis, and the two green-headed captive screws at the rear of the rf subchassis.

Caution: Once again, be sure that the cables listed in (3) above are disconnected.

(5) Turn the KILOCYCLE CHANGE shaft fully counterclockwise against the stop.

Caution: During the performance of the next step, the Oldham coupler on the vfo subassembly will fall apart and the center disk will fall to the bench. Pick up the center disk and place it with the Oldham coupler antibacklash spring for safekeeping.

(6) Grasp the rf subassembly by the 5⅛-inch spacers and lift it carefully upward out of the main frame. Place the rf subchassis on the bench. Remove the crystal-oscillator subassembly when necessary (par. 124).

c. Replacement. Instructions for replacement of the rf subchassis with the crystal-oscillator subchassis attached follow:

(*a*) Th

nch, slide the sub-
nd lift it out of the

205, P206, and P207.

indicator should read the same num-
ber as the first two digits of the fre-
quency indicator on the front panel
of the receiver. If this is not the case,
turn the switch shaft with a screw
driver through the access hole pro-

procedure is for the removal of the crystal-
lator subchassis when the rf subchassis is
retained in the main frame of the receiver.
procedure described in (2) through (8)
v is for the removal of the crystal-oscil-
r subchassis from the rf subchassis when
rf and crystal-oscillator subchassis have

main frame.

) Temporarily disconnect plugs P205

Caution: Be careful not to damage

ge the

he two
at the

amp set screw on the crystal-oscilla-
r drive shaft.

ainst the oilite
ssis.
Phillips green-

stal-oscillator
oliers may be
while starting

-headed cap-
of the sub-

(b) Four captive screws at the rear
of both subchassis.
(c) Two at the left side.
(d) Two below the clutch gear.

(7) Reconnect plugs P110, P717, P205,

(8) Raise the rear end of the subchassis
approximately ¼ i
chassis backward a
main frame.

(9) Reconnect plugs P2

124. Crystal-oscillator Subchassis Removal and Replacement When Rf Subchassis is Retained in Main Frame

a. General. Two methods for the removal of
the crystal-oscillator subchassis are possible.

Turn over the subchassis and inspect
the positioning of the rotor and its
fixed mating contact on each of the two
sections of the switch. Adjust the shaft

satisfactorily.

Note. The crystal-oscillator shaft may be

b. Removal:

(1) Remove the front panel (par. 122).

(2) Disconnect plugs P110 and P215 (fig.
56).

(3) Temporarily replace the MEGACY-

that the gears are positioned with

the metal grounding strip that con-
tacts the bottom edges of the rf and
crystal-oscillator subchassis.

(3) Place the subchassis in position on
the dock of the main frame and care-
fully slide it forward and engag
drive shaft.

(4) Engage, but do not tighten, t
green-headed captive screws
rear of the subchassis.

(5) Tighten the set screw in the shaft
coupler on the crystal-oscillator drive
shaft and be sure that the collar and
gear are pushed aga
bearing on the subcha

(6) Replace the three
at the front of the crys
subchassis. Long-nosed
used to hold the screws
them.

(7) Tighten the two green
tive screws at the rear
chassis.

(6) Loosen the two green-headed captive
screws at the rear of the crystal-oscil-
lator subchassis.

(7) Temporarily disconnect plugs P205,
P206, and P207 (fig. 56) to provide
enough clearance for subchassis re-
moval.

Caution: Be careful not to damage
the metal grounding strip that con-
tacts the bottom edges of the rf and
crystal-oscillator subchassis.

(8) Reconnect plugs P205, P206, P207, P110, and P215.

(9) Replace the front panel (par. 122).

125. If Subchassis Removal and Replacement

nectors that connect directly to the

nnect plugs P119 and P120 (fig.

n the four green-headed cap-

(1) Disconnect plugs P112, P113, P214, and P218 (fig. 56).

(2) Set the BANDWIDTH switch to the 16 KC and the BFO PITCH control to 0.

(3) Loosen the shaft couplers on the BANDWIDTH and BFO PITCH controls. Slide the knobs and shafts outward.

(4) Loosen the three green-headed captive screws that secure the if subchassis to the main frame.

(5) Lift the if subchassis out of the main frame.

Note. Do not change the settings on the BANDWIDTH and BFO PITCH shafts unless absolutely necessary. If they are moved, it will be necessary to reset them when replacing the if subchassis in the main frame.

c. Replacement. Replace the if subchassis

KILOCYCLE CHANGE shaft on

be misaligned. If the KILOCYCLE

GE shaft must be turned, record the

and be sure to return it to the same

before replacing the vfo. Do not dis-

he Oldham coupler shaft clamps.

ouplers, set the

and then

114, P213,

headed cap-

126. Af Subchassis Removal and Replacement

a. General. The af subchassis can be removed from the main frame without removing other

a. General. Removal of this subchassis does not require the removal of other subchassis or parts except for those connectors that connect to the subchassis.

b. Removal. The if subchassis is removed as follows:

(1) Discon

57).

(2) Loose

tive screws that secure the af subchassis to the main frame.

(3) Lift the af subchassis from the main frame.

c. Replacement.

(1) Place the af subchassis into the main frame.

headed captive screws.

(3) Reconnect plugs P119 and P120.

127. Vfo Subchassis Removal and Replacement

a. General. Removal of this subchassis does not require the previous removal of any other subchassis, but does require careful handling, otherwise damage or misalignment of the vfo subchassis may result.

(1) Set the if subchassis into the main

(2) Engage, but do not tighten, the three green-headed captive screws.

(3) Slide the shafts and couplers of the BANDWIDTH and BFO PITCH controls forward so they engage the shafts

on the if subchassis.

(4) Before tightening the co

BANDWIDTH knob to K

BFO PITCH knob to 0,

tighten the couplers.

(5) Reconnect plugs P112, P

and P218.

(6) Tighten the three green-h

horizontal

shaft or the K

will

CHAN

setting

setting

turb t

b. Removal.

(1) Remove the Oldham coupler antibacklash spring on the vfo subchassis drive shaft and place it in a tray for safekeeping.

(2) Turn the KILOCYCLE CHANGE control so that one slot in the Old

tive screws.

(3) Loosen the three green-headed captive screws that secure the subchassis

(4) Loosen but do not remove the two Phillips screws that secure the triangular-shaped bracket

provide

(2) Loosen the six green-headed captive screws that secure the subchassis to the main frame of the receiver.

57) and

(3) Carefully withdraw the subassembly from the receiver. Be careful not to drop it; it is heavy.

arefully remove the vfo subchassis

om the main frame. The center disk

of the Oldham coupler will fall free.

careful

Place it in a tray with the antibacklash

nto the

spring for safekeeping until the vfo subchassis is to be replaced.

captive

c. Replacement. Replace the vfo subchassis

supply

as follows:

ighten

(1) Smear some grease on the center disk of the Oldham coupler and stick it in place against the first disk of the vfo drive shaft of the rf gear train tuning

assembly.

2) Lower the vfo subchassis into position in the main frame and engage the Oldham coupler; at the same time, engage but do not tighten the three green-headed captive screws. Replace the Oldham coupler antibacklash

ng.

ote. The act of remating the Oldham pler will accurately and correctly reposi- the vfo shaft.

hten the two Phillips screws that re the triangular-shaped bracket he rear of the vfo subchassis.

hten the three green-headed cap- screws.

onnect plugs P109 and P717.

eck the frequency of the vfo (par.) if the shaft on the vfo was turned n its original setting.

supply Subchassis Removal

ement. Replace the antenna relay

al. Removal and replacement of the

oval or replacement of other subchassis or parts in the receiver, except for connector P111, which connects to the subchassis.

(1) Disconnect plug P111 (fig. 57)

[illegible] bracket at the rear of the subchassis. This is done to extra clearance for the removal subchassis.

(5) Disconnect plugs P109 (fig. P717 (fig. 56).

(6) Ca

fr

(1) Co carefully lower the power-supp chassis into the receiver. Be not to drop it on the bench or i receiver.

(2) Engage the six green-headed screws that secure the power-s subchassis into the receiver. Ti each of the six captive screws.

(3) Reconnect plug P111.

129. Antenna Relay Assembly Removal and Replacement

a. General. Removal of the antenna relay assembly is necessary whenever a relay, resistor R121, neon lamp I103, or a connector must be replaced.

b. Removal. Remove the antenna relay assembly as follows:

(1) Disconnect plugs P205, P206, and P207 (fig. 56).

(2) Loosen and remove the four Phillips screws that secure the antenna relay assembly to the rear panel of the receiver.

(3) Turn over the antenna relay assembly so that the soldered wires can be reached and unsolder the wires. Tag the wires, or make a note of the connections, and keep this information for reference when replacing the assembly.

(4) Remove the antenna relay assembly

128. Power-

and Replacemen

c. Replac

b. Remov

power-supply subchassis does not re

assembly as follows:

(1) Place the antenna relay assembly into

remo

(2

spri

N

coup

tion

(3) Tig

secu

at t

(4) Tig

tive

(5) Rec

(6) Che

139

fro

the main frame, and turn it over so that the solder terminals on the relays can be reached. Solder the wires to the

(4) *Coils and transformers tuned by mechanical tuning system.* Remove these coils and transformers by first removing the slug racks and springs, and then inserting a Phillips screw driver into the slug hole, and proceeding to loosen the Phillips nut that fastens the coil or transformer to the chassis. These coils and transformers are plugged into small jacks fastened to the chassis and can be removed by pulling them upward away from the chassis.

however, the location of crystals with respect to the octal base will be the same. Solder the wires to the terminals as indicated by the tags on the wires, or with reference to the notes made at the time of removal.

(2) Hold the antenna relay assembly in its proper position against the rear panel of the receiver and engage and tighten the four Phillips mounting screws.

(3) Reconnect plugs P205, P206, and P207.

Subchassis

sis Parts.

cks and springs. Remove the cks by disengaging the retain- ings and lifting the slug racks the coils and away from the a paper clip or short piece of re can be fashioned into a disengaging the springs. Use ps for securing the springs to ond arm slot while the slug removed from the coils and ers.

The covers on these coils and transformers are removed by pressing the tabs on the sides of the cans inward, and lifting the cover off the coil or transformer.

(5) *Coaxial connectors.* Remove these connectors by unsoldering the wires and loosening the hexagonal nuts that secure them to the chassis or panel to which they are fastened.

(6) *If transformers.* The if transformers that are not slug-tuned are secured to the chassis by two hexagonal nuts and lock washers. Unsolder the leads and remove the nuts and lock washers.

Within S

a. Rf Subchass

(1) *Slug ra* slug rac ing spri out of t chassis. solid wi hook for paper cli the gear racks are r transforme

(2) *Band switch shaft.* The band switch shaft can be removed from the eight ops of the covers must be Two hexagonal nuts and lock washers on the t Remove the cover. Continue the removal by sliding the shaft towards the rear of the chassis, but be sure not to disturb the setting of the rotors in each wafer switch. When replacing the shaft, be careful not to damage or turn the rotors on these wafer switches.

wafer switches by loosening its drive gear and removing the retaining screw.

b. Crystal-oscillator Subchassis.

(1) *Oven cover.* The oven cover is removed by loosening and removing a Phillips screw and lock washer on the top of the chassis and two similar screws and lock washers at the rear end of the chassis. Lift the cover straight off the chassis; two small plugs (P416 and P417) connect with two jacks (J416 and J417) on the chassis. Do not loosen or remove the four Phillips screws and lock washers on the top of the cover unless it is necessary to remove the heater winding and insulation from the oven.

(3) *Crystal oven HR202* (fig. 58). The crystal oven is removed from its octal socket by first removing the retaining spring and plate and then pulling it upward out of the socket. Disassembly of the oven is shown in figure 83 and should be used as a guide in replacing the crystal. The internal construction of certain crystal ovens may require auxiliary

(2) The capacitor screwdriver adjusted trimmer capacitors are

secured to the chassis with 6 Phillips screws and lock washers that must be removed before the capacitor board assemblies can be dropped out of place. The individual capacitors cannot be replaced individually, and to replace a defective capacitor of this type, the entire board assembly must be replaced. If this becomes necessary, be sure to identify each lead before it is unsoldered so that it will be reconnected correctly.

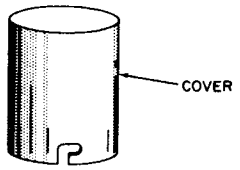
screw and its lock washer at the top of the cover. The mechanical filters below the cover are each removed by unsoldering the wires attached to them, and loosening the two Phillips screws and lock washers that secure them to the chassis.

(2) Bfo assembly. To remove the bfo assembly (7503; fig. 66) from the underside of the chassis, first loosen the Bristo screws on the bellows type

by removing the two Phillips screws and lock washers to reach certain other parts.

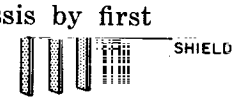
e. Vfo Subchassis.

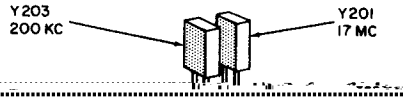
(1) *External cover.* Remove the external cover on the vfo subchassis by first





er connector J709 (fig. ree Phillips screws and spaced 120° around the the cover. Remove this check or remove the

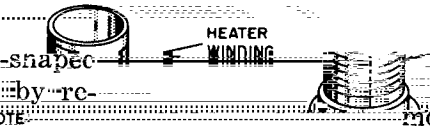




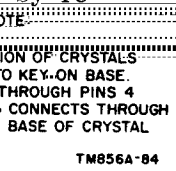
removing pow 67) and the th lock washers lower edge of cover only to thermostat an

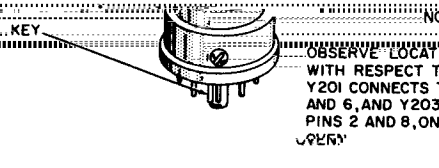
not remove the inner cover of the vfo

(2) *Chassis cover.* The sma chassis cover can be removed



-shape by re- moving the three sma Phillips screws and lock washers.





and Y203.

Figure 83. Location of crystals Y201

(3) *Thermostat.* Thermostat S701 is a separate unit and can be removed from the heater winding cover assembly. The external vfo cover should first be removed as instructed in (1) above, and then the

and sealed inner cover should be removed. *Do not remove the sealed inner cover, as this will break the seal of the vfo tuning unit.* Unsolder the thermo-

(fig. 84)

a. General. Under certain circumstances, such as extensive damage it may be necessary

stat lead wires and remove the

upward. Now rf gear train assembly. The instructions given heater winding cove

e slid downward in this paragraph should be used as a guide the thermostat can be

al compartment. when the method of removal and arrangement out of the cylindric

When replacing the of parts is not obvious. The numbers used in that holds it. W

the instructions refer to those that identify thermostat scr

ndrical compartment, take parts in figure 84. When disassembling the into the cylin

rain assembly, place parts in trays or ing note on the positioning of the com- gear

partment slot and the adjacent parts in will simplify reassem

bly the thermostat. Be sure that the cylin- *b. Disassembly*

drical portion is not damaged or dented, as this will impair the opera-

cam racks and 16 ten- tion of the thermostat. Replace the three screws, and resolder the thermostat lead wires.

(1) Remove the 8 sion springs.

ront panel (par. 122).

(2) Remove the fr

f subchassis (par. 122).

(3) Remove the r

(4) Set the frequency indicator to 07 parts in the antenna relay assembly are removed by unsoldering Most of the

ion to this is resistor ticular parts. The exce

I 103. These parts are (5) Loosen gear clamp (1) by loosening R121 and neon lamp the 4-40 by 9/16-inch socket head simply unsoldered.

screw (2) and the 4-40 square nut (3).

(6) Remove the riveted locking plate (4) and spur gear (5). To separate 4 and 5, remove the two rack gear springs (6) and the 7/16-inch retaining ring (7).

(7) Remove the four 4-40 by 5/16-inch machine screws (8) and four No. 4 split lock washers (9) to remove the mechanical counter (10).

(8) The bevel gear (11) can be removed by loosening the gear clamp (12) and the 3/56 by ¼-inch socket-nead screw (13).

[illegible] washers (48) and two No. 6-32 washers (49).

(20) Pull off the final differential gear assembly (50).

(21) Pull off the pinned gear (51).

(22) Remove the No. 8 riveted gear (52) by first removing the ¼-inch retaining ring (53).

(23) Pull out the pinned spur gear (54) with the spur gear (55), .312-inch hole gear clamp (56), 4-40 by ½-inch socket-head screw (57), 4-40 square nut (58), and gear bushing (59).

(24) Remove the loaded rack gear assembly (60), .312-inch hole gear clamp (61), 4-40 by ½-inch socket-head screw (62), and 4-40 square nut (63) by loosening screw (62).

(25) Remove the No. 4 gear assembly (64), .312-inch hole gear clamp (65), 4-40 by ½-inch socket-head screw (66), and 4-40 square nut (67) by loosening screw (66).

(26) Remove the soldered rack gear (68).

[illegible] loosening and [illegible] by 3/4-inch [illegible] binder-head screws (33), six No. 8 [illegible] one speed screw (35), and one No. 8 split lock washer (36). Pull the pressed auxiliary gear plate assembly (32) forward and remove

[illegible] sisting [illegible] 76)), gear [illegible] ch socket- [illegible] nut (79),

(16) Remove the staked gear post (39) and two 6-32 by 3/16-inch machine screws (40).

(17) Remove the pinned gear assembly (41), gear bushing (42), and washers (43) from the riveted front gear plate (155).

(18) Remove the pinned gear assembly (44) and washers (45).

(19) Loosen or remove the detent spring (46) by loosening or removing the two 6-32 by ¼-inch binder-head machine screws (47), two No. [illegible] split

(9) The bevel gear (14) can be removed by loosening the gear clamp (15) and the 3/56 by ¼-inch socket-head screw (16).

(10) Remove the locked clutch gear assembly (17) and the pressed bevel gear (18) by loosening and removing the spur gear (19), .312-inch hole gear clamp (20), 4-40 by ½-inch socket-head screw (21), 4-40 square nut (22), and two washers (23).

(11) Remove the bevel gear (24), gear clamp (25), gear bushing (26), and 4-40 by 9/16-inch socket-head screw (27).

(12) Disassemble the clutch assembly between the vio subassembly and rf gear train assembly if this has not been done previous[illegible]

(13) Remove the ¼-inch retaining ring (28) from the pinned stop assembly (29), and remove stop assembly (29) and the washers (30 and 31). These washers are used to shim the stop assembly (29).

(14) [illegible] plate assembly (32) by removing the six [illegible] of the retaining ring (72), solder [illegible] gear (73), spur gear (74), and [illegible] gear rack springs (75) by loosening screw (70) and removing retaining ring (72).

(15) Remove the pressed gear (37) by removing the ¼-inch E-type retaining ring (38).

(27) Remove the gear assembly consisting [illegible] of the soldered rack gear ([illegible] clamp (77), 4-40 by 9/16-inch head screw (78), 4-40 square

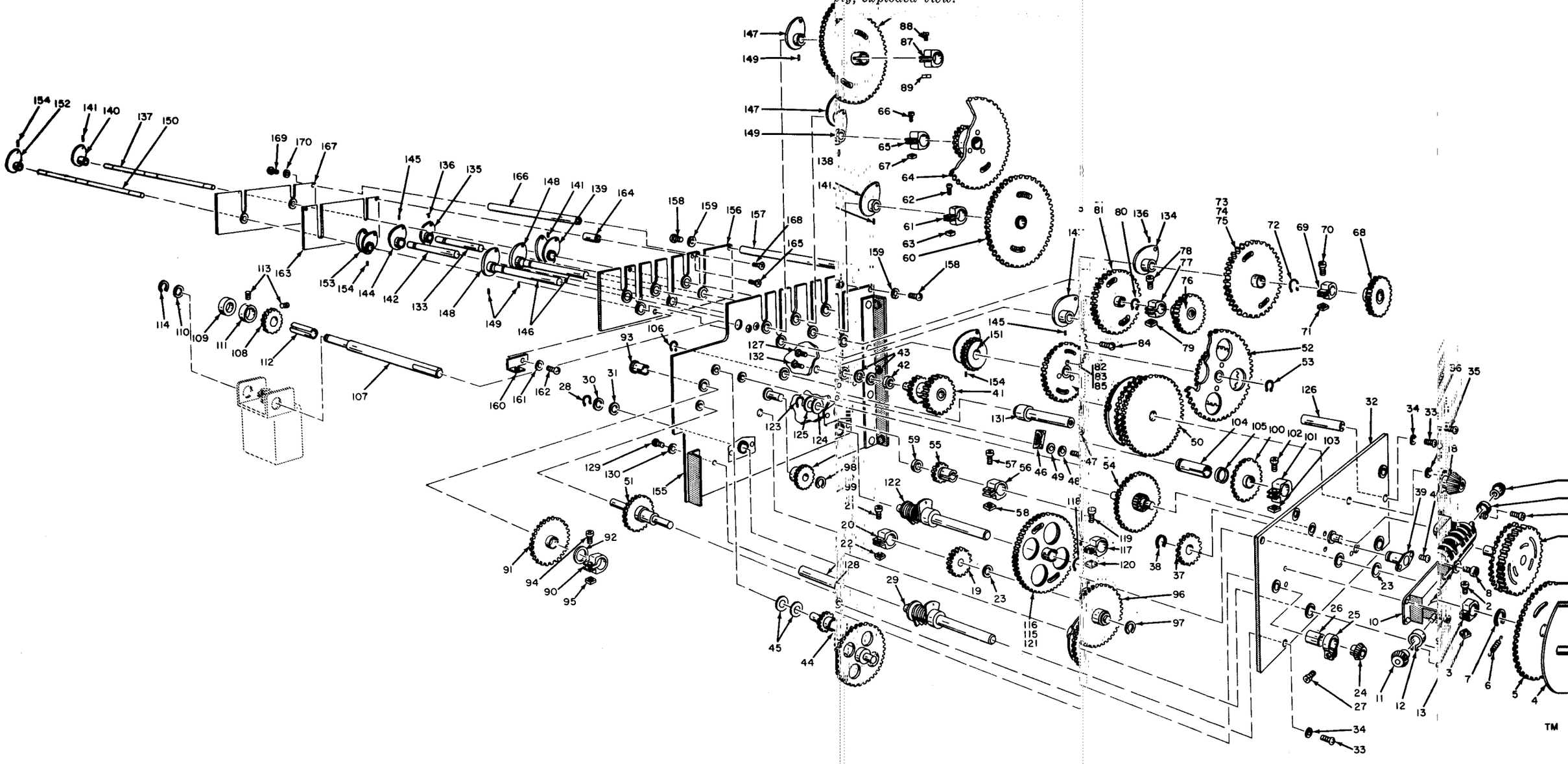
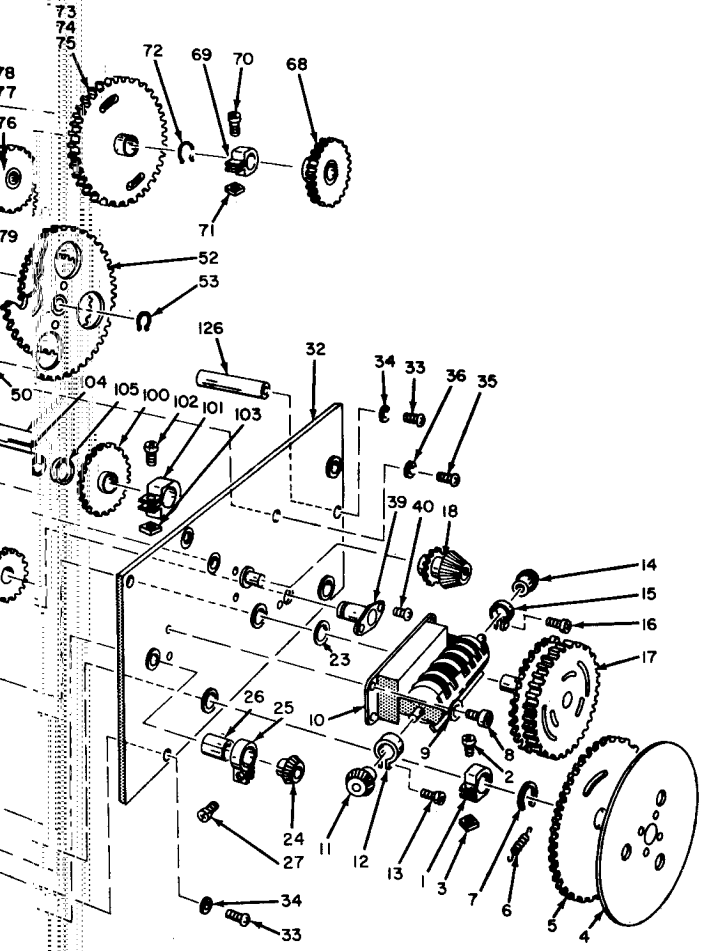


Figure 84. Rf gear train assem

bly, exploded view.


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TM856A-65

retaining ring (80), and No. 2 gear assembly (81) by loosening screw (79) and removing retaining ring (80).

(28) Remove the 8- to 16-mc gear (82), the 8- to 16-mc loading gear (83) by removing the three 4-40 by 1/4-inch machine screws (84) and two gear rack springs (85).

(29) Remove the loaded rack gear assembly (86), by loosening the .312-inch hole gear clamp (87), 4-40 by 1/4-inch socket-head screw (88), and 4-40 square nut (89).

(30) Loosen and remove the gear clamp (90), oscillator spur gear (91), 5/16-inch flat washer (92), and oscillator dial hub (93) by loosening the 4-40 by 9/16-inch socket-head screw (94) and 4-40 square nut (95).

(31) Remove the switch gear assembly (96) by removing the screw at the rear of the riveted front gear plate assembly (155).

Caution: To disassemble the switch

(35) Remove the megacycle gear (115) and the soldered megacycle gear (116) by loosening the gear clamp (117). To separate items 115 and 116, remove the retaining ring (118). The 4-40 by 9/16-inch socket-head screw (119) and 4-40 square nut (120) secure the gear clamp (117). To separate items (115) and (116), remove the two

(36)

(37)

(38) Remove the four panel spacing posts (128) by removing eight 8-32 by 3/8-inch machine screws (129) and eight No. 8 split lock washers (130).

(39) Remove the differential shaft (131) by removing the 8-32 by 5/16-inch

(40) Remove the 5- to 1-mc camshaft assembly that consists of the camshaft (133), soldered rf cam (134), soldered rf cam (135), and two No. 6/0 taper pins (136). This is done by removing the taper pins (136).

(41) The 1- to 2-mc camshaft assembly

(82) Remove the locking gear (98) by first removing the 1/8-inch E-type retaining ring (99).

(83) Remove the idler gear (100) by loosening the .312-inch hole gear clamp (101), 4-40 by 1/2-inch socket-head screw (102), 4-40 square nut (103), shaft sleeve (104), [illegible] bushing (105), and 1/4-inch retaining ring

(42) The

(43) The 4- to 8-mc camsha

the 16- to 32-mc cam

are identical; each co

shafts (146), soldered

and soldered rf cam (148) can be taken apart by removing the two

(44) The 8- to 16-mc camshaft assembly consists of the shaft (1 150), pressed doved rf cam rf cam (153) ble by removing three No. pins (154). ted front gear plate (155) pressed rear plate (156) are four posts (157), n machine screws 6 split lock wash- on, two cam plate fastened to the 56) with two 6-32 nd screws (161) lock washers (162) d auxiliary cam plate (163) ened to the pressed cam plate shoulder posts (164) and ¾-inch flat head ma-

(47) Two long posts (166) separate the pressed rear plate (156) and the riv- 6-32 by ⅜-inch flat head machine screws (168), two 6-32 by ⅜-inch machine screws (169), and two No. 6 split lock washers (170).

c. Reassembly. Reassemble the rf gear train assembly in the reverse order of disassembly. The reverse order of the index numbers in figure 84 should be used as a guide. During and after reassembly the mechanical and electrical synchronization of the rf gear train assembly must be followed (par. 138). Each step of the disassembly procedure (para 13[illegible]) contains an item or items removed and the attaching parts, such as screws, retaining rings, etc. Inspect the parts for each step and reassemble in a systematic manner.

chine screws (165).

consists of the shaft (1 gear assembly (151), sol (152), and soldered Disassemb 670 taper

(45) The rivet are the pressed cam fastened together by eight 6-32 by ⅜-inch (158), and eight No. ers (159). In additio brackets (160) are pressed cam plate (1 by 7/16-inch machi and two No. 6 split

(46) The pressed is fast with four eight 6-32 by ⅜

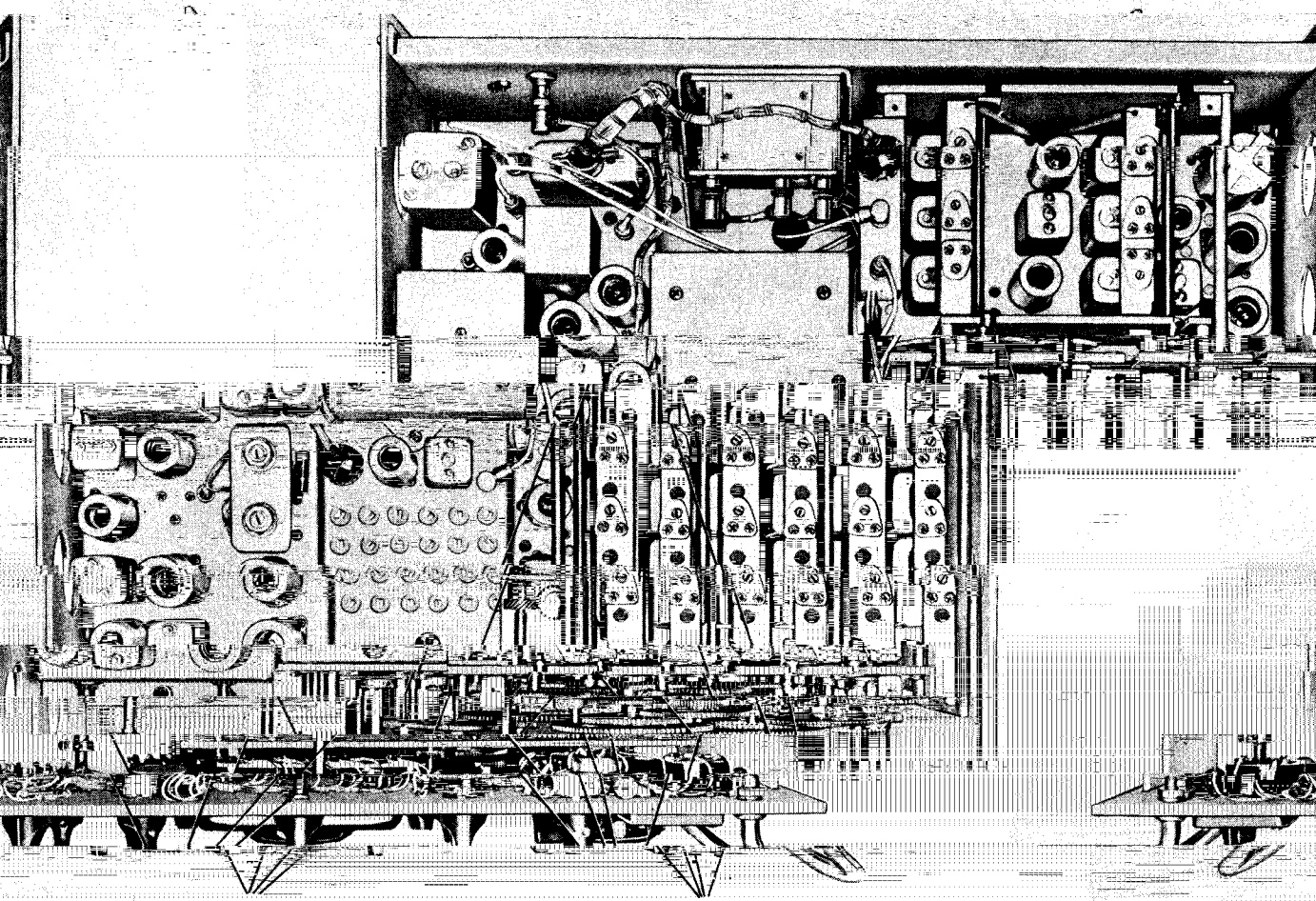
f Gear Train Assembly Parts Legend

132. R

Index No.	Reference symbol	Description
1		8-32 by 3/8-inch binder-head screws
2		No. 6 split lock washers
3		10-32 by 5/16-inch flat head machine screws
4	A 216	Riveted locking plate
5	O 223	Spur gear
6		Gear springs
7		1/4-inch type E retaining ring
8		6-32 by 3/16-inch machine screws
9		Pinned gear assembly
10		Gear bushing
11		Washers
12		Pinned gear assembly
13		Washers
14		Detent spring
15		6-32 by 1/4-inch binder head screws
16		No. 6 split lock washers
17		No. 6 flat washers
18		Final differential gear assembly
19		Pinned gear
20		312-inch hole gear clamp
21		6-32 by 1/4-inch socket-head screw
22		4-40 square nut
23		Washer
24		Bevel gear
25		Gear clamp
26		4-40 by 9/16-inch socket-head screw
27		Gear bushing
28		1/4-inch retaining ring
29		Loaded rack gear assembly
30		Pinned stop assembly
31		Washer
32		Pressed auxiliary gear plate assembly
33		10-32 by 1/4-inch flat head machine screws
34		No. 6 split lock washers
35		10-32 by 5/16-inch flat head machine screws
36		No. 6 split lock washer
37		Pressed gear
38		Staked gear post
41		Pinned gear assembly
42		Gear bushing
43		Washers
44		Pinned gear assembly
45		Washers
46		Detent spring
47		6-32 by 1/4-inch binder head screws
48		No. 6 split lock washers
49		No. 6 flat washers
50		Final differential gear assembly
51		Pinned gear
52		No. 8 ri
53		1/4-inch
54		Pinned spur gear
55		Spur gear
56		312-inch hole gear clamp
57		4-40 by 1/2-inch socket-head screw
58		4-40 square nut
59		Gear bushing
60		Loaded rack gear assembly
61		312-inch hole gear clamp
62		6-32 by 1/2-inch socket-head screw
63		4-40 square nut
64		Gear assembly No. 4

Reference symbol	Description
O 207	Gear clamp
H202	No. 4 split lock washers
M201	Mechanical counter
O 202	Bevel gear
H231	Gear clamp
H217	3/56 by 1/4-inch socket-head screw
O 295	Socket clutch gear assembly
O 296	Pressed bevel gear
O 245	Spur gear
O 890	Pinned spur gear
O 243	Spur gear
H233	312-inch hole gear clamp
H215	4-40 by 1/2-inch socket-head screw
H219	4-40 square nut
O 222	Gear bushing
H224	1/4-inch retaining ring
O 316	Pinned stop assembly
H253	Washer
A 201	Pressed auxiliary gear plate assembly
H230	8-32 by 3/8-inch binder-head screws
H212	No. 6 split lock washer
O 253	Pressed gear
O 252	Staked gear post
H228	6-32 by 3/16-inch machine screws
O 261	Pinned gear assembly
O 222	Gear bushing
H254	Washers
O 246	Pinned gear assembly
H254	Washers
O 244	Detent spring
H216	6-32 by 1/4-inch binder head screws
H202	No. 6 split lock washers
H218	No. 6 flat washers
O 219	Final differential gear assembly
O 283	Pinned gear
O 205	No. 8 ri
H221	1/4-inch
H219	4-40 square nut
H253	Washer
O 213	Bevel gear
H233	Gear clamp
H219	4-40 square nut
O 222	Gear bushing
	Loaded rack gear assembly
H233	312-inch hole gear clamp
H215	6-32 by 1/2-inch socket-head screw
H219	4-40 square nut
	Gear assembly No. 4

Index No.	Reference symbol	Description
	124	H251 Washers
	125	H253 Washers
	126	H236 Gear panel-spacing posts
	65	H233 .312-inch hole gear clamp
	66	H215 4-40 by 1/2-inch socket-head sc
	67	H219 4-40 square nut



5. Radio Receiver R-390A/URR, Lubrication points.

Figure 85

cal

ver that require
l tuning system,
in assembly and
H control shaft
ed at the factory
6 months there-
re need for more
e receiver is used

under abnormal conditions, shorten the lubrication interval accordingly. When the receiver is used in a hot, dry climate, the bearings may require lubrication at least every 3 months. Over-lubrication sometimes causes more trouble than a lack of lubrication and should be avoided. Check the condition of the mechanical tuning system every time the receiver is withdrawn from its cabinet or case. Turn the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls throughout their ranges, and observe the

133. Lubrication of Mechani Tuning System

The only parts of the recei lubrication are the mechanica which includes the rf gear trai cam racks, and the BFO PITC bearing. The receiver is lubricat and should be lubricated every
frequent lubrication, or if the

136. Standard Test Conditions

Unless specified otherwise, conduct all alignment and test procedures under the following conditions:

a. Temperature—normal room or shelter.

b. Humidity—normal room or shelter.

c. Line voltage and frequency—115 volts ac ±1 per cent at 60 cps.

d. Warm-up period—at least 5 minutes.

e. Dummy antenna balanced. Electrical equivalent of Dummy Antenna Simulator OA-2/GR (part of Test Equipment Kit MK-288/URR) connected between terminal 1 on the rear panel of the receiver and chassis ground. Terminal 2 connected to terminal 9 on the rear panel of the receiver. This should actuate the antenna relay and short out the audio output when the FUNCTION switch is in the AGC or MGC position.

n. Set the FUNCTION switch to AGC and the RF GAIN control fully counterclosewise. Adjust CARR-METER ADJ control R523 (fig. 64) on the af subchassis for a 0 reading on the CARRIER LEVEL meter.

138. Mechanical and Electrical Synchronization

(fig. 86 through 89)

The receiver tuning elements, consisting of

chassis ground. It should be between +148 volts and +158 volts.

j. Check to see that all tube filaments are lighted.

k. Check to see that the CARRIER LEVEL and LINE LEVEL meters are illuminated.

l. Check to see that the antenna relay is actuated when the FUNCTION switch is placed in the STAND BY and CAL positions.

m. Set the BREAK IN switch to the ON position. Connect Antenna Dummy Load DA-121/U (part of Accessory Kit MK-288/URR).

f. Standard modulation—30 per c 400 cps.

g. Audio load impedance—600 oh reactive.

137. Preliminary Checks

Before aligning the receiver and power, check the following items and the instructions:

a. All the controls should operate f the knobs should be securely attache shafts.

...rrupted locking slots (fc, 8f) the corner ... the peak at 07"+000. The cam follower reads 07"+000. If the index lines do not bisect ...

trol shaft fully counterclockwise; then

oscillator band
ed correctly when
sis (par. 123).

itch clamp (fig.
t by hand until

shaft exactly on the eighth detent position.

the reading on the indicator wheel agrees with the reading on the first two digits of the frequency indicator.

Note. Only even numbers appear on the in-

numbers appear as straigh

c. Second Crystal Oscillator Band Switch.

The second crystal oscillator band switch should

(1) The second crystal
switch is synchronize

(4) Remove the rf subchass

(5) Loosen the rf band sw
88) and turn the shaft

second receiver a few kc nearer 3.455 mc, and turn the vfo shaft to make its signal heard on the second receiver.

(6) Once the correct direction of rotation of the vfo shaft has been established, tune the second receiver to precisely 3.455 mc, and turn the vfo shaft until the 3.455-mc signal from the vfo is set at zero beat with the second receiver.

Caution: The vfo will be permanently damaged if the shaft is turned too far in either direction. The end of the vfo shaft travel can be felt while turning the shaft with the fingers. Do not force the shaft, or damage will result.

(7) Tighten the clamp on the vfo shaft and replace the antibacklash spring.

(8) Disconnect the extension coaxial cable cord from P717, and reconnect P717 to J217.

(9) Set the FUNCTION switch on the receiver under test to CAL, turn the BFO switch to ON, and the BFO PITCH control to 0. Connect a headset or a loudspeaker to the receiver.

(10) With the first two dig
quency indicator set t
check the receiver calib
of the 100-kc calibratio

(11) The receiver should be
a frequency-checking
that from WWV, or
cast station of known

gits of the fre-
o any position,
bration on each
on markers.

checked against
signal, such as
any local broad-
frequency.

ADJ Control

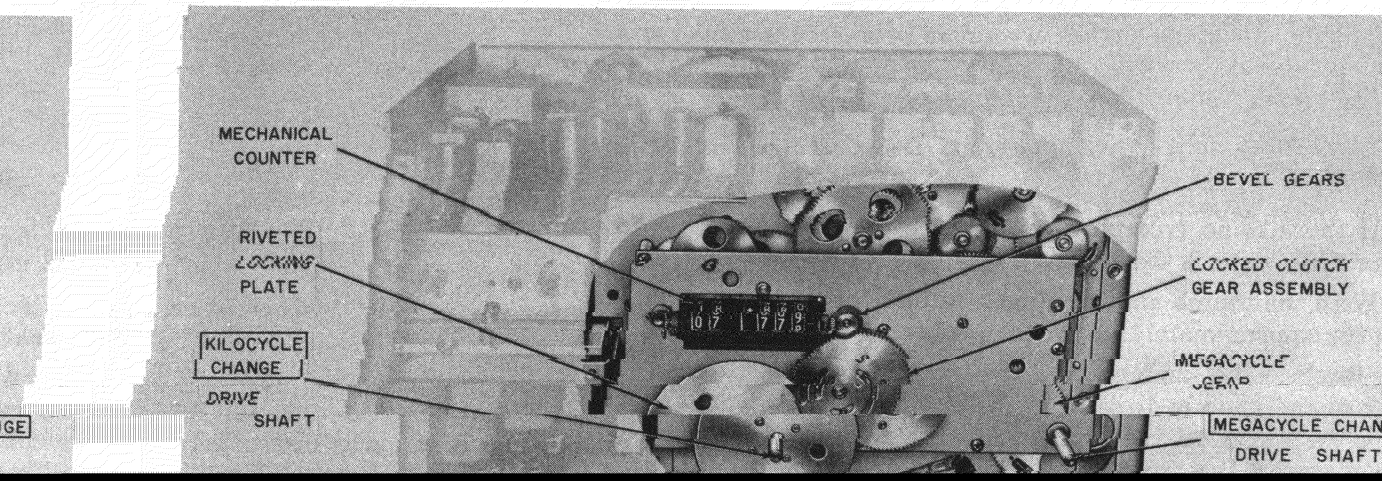
check and adjust-
rol as follows:

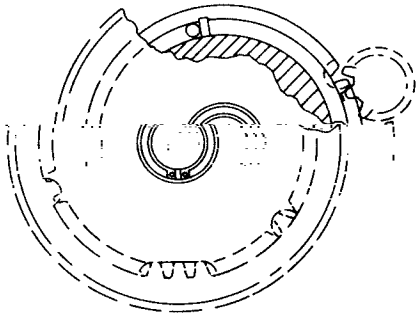
nob fully counter-
vly turn the knob
e play in the knob.
ximately ⅛ turn

139. Adjusting the ZERO

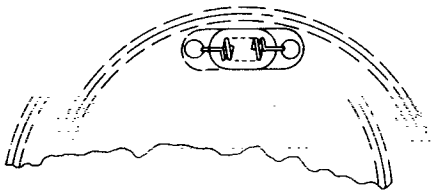
Perform the operational c
ment of the ZERO ADJ cont

a. Turn the ZERO ADJ k
clockwise. Carefully and slow
clockwise, and observe the fre
The free play should be appro

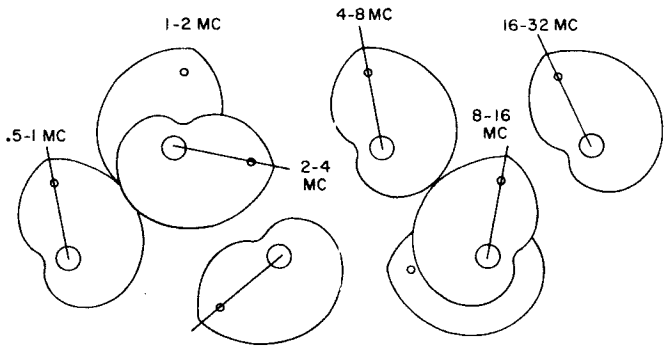




INTERMITTENT SWITCH DRIVE
VIEWED FROM FRONT IN 7+000MC
POSITION



GEARS SHOWN IN
LOADED POSITION



CAM POSITIONS VIEWED FROM REAR WITH 2 REAR
PLATES REMOVED IN 7+000MC POSITION

TM856A-83

Figure 87. Mechanical alignment details.

b. If there is no free play, or the free play is excessive, remove the knob.

c. With the thumb and forefinger, adjust the ft for approximately ⅛-turn free play.

. Replace the knob so that the stop on the r of the knob is directly to the right of and ching the finger on the ZERO ADJ control ging plate on the front panel. Tighten the

e. Turn the ZERO ADJ control fully clock- se to the stop and check that the clutch is isengaged. Do this by rocking the KILO CYCLE CHANGE control back and forth, and o digits of the frequency indicator. serve the band switch indicator on the crystal-oscillator subchassis. It should agree with the setting.

Note. The band switch indicator on the crystal-oscillator subchassis registers even-numbered bands. Band 7 is the white line halfway between bands 6 and 8.

140. Crystal-oscillator Switch Alignment

(fig. 90)

Two methods for performing this operation are given below.

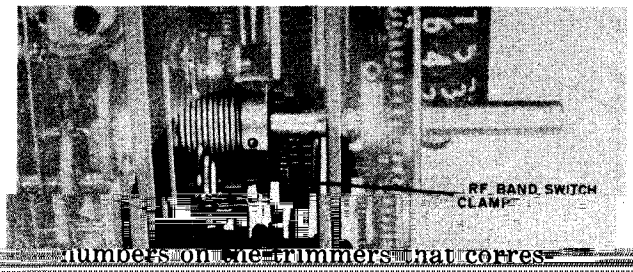
a. First Method.

(1) Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to STAND-BY and connect a vtvm to test point E210 (fig. 58) on the rf subchassis.

(2) Set the MEGACYCLE CHANGE control for a reading of 07 on the first indicator does not change.

(3) Turn the ZERO ADJ control fully counterclockwise to the stop and recheck for approximately ⅛-turn free play.

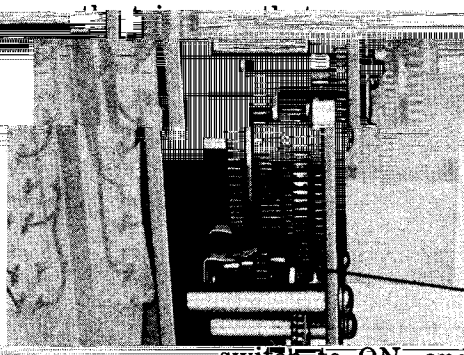
(4) Repeat the procedures in *b* above if the free play and clutch disengagement is not as specified.



numbers on the trimmers that correspond to 00 through 07 only indicate that the same trimmers are used on the higher frequency bands as indicated.

b. Second Method.

(1) Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to CAL, the BFO



switch to ON, and control to 0.

(2) Set the MEGACYCL trol for a reading c two digits of the fre Observe the band crystal-oscillator sub agree with this setti

(3) If adjustment is nec shaft clamp on the subchassis band sw the shaft with a lo through the SYNC XT at the rear panel of the 12).

(4) Rock the MEGACYCLE control back and forth over and listen for the calibratio signal. The calibration osc on the detent. The crystal-oscillator band switch should be centered with respect to the detent position.

(4) If adjustment is necessary, loosen the shaft clamp on the crystal-oscillator band switch shaft, and adjust the shaft with a long screw driver through the SYNC XTAL OSC hole on the rear panel of the receiver (fig. 12).

(5) Set the MEGACYCLE control to each of the ba 31 (first two digits o indicator) and adjust

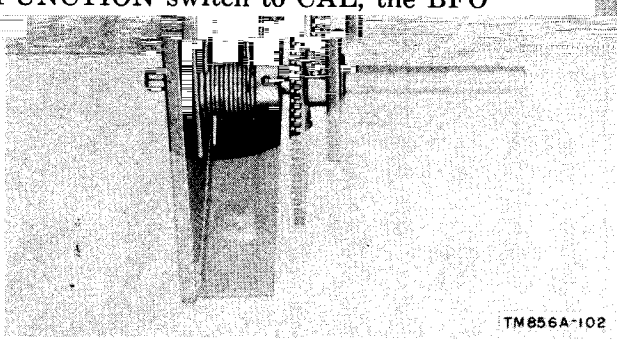
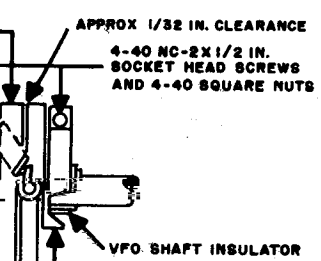


Figure 88. Location of rf band switch shaft clamp and detent spring.

(3) Rock the MEGACYCLE CHANGE control back and forth over the detent, and observe the reading on the vtvm. The reading on the vtvm should be between —3.5 and —8 volts when the MEGACYCLE CHANGE control knob is on the detent.



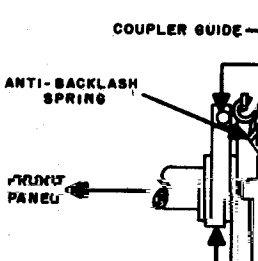




Figure 89. Oldham coupler details.

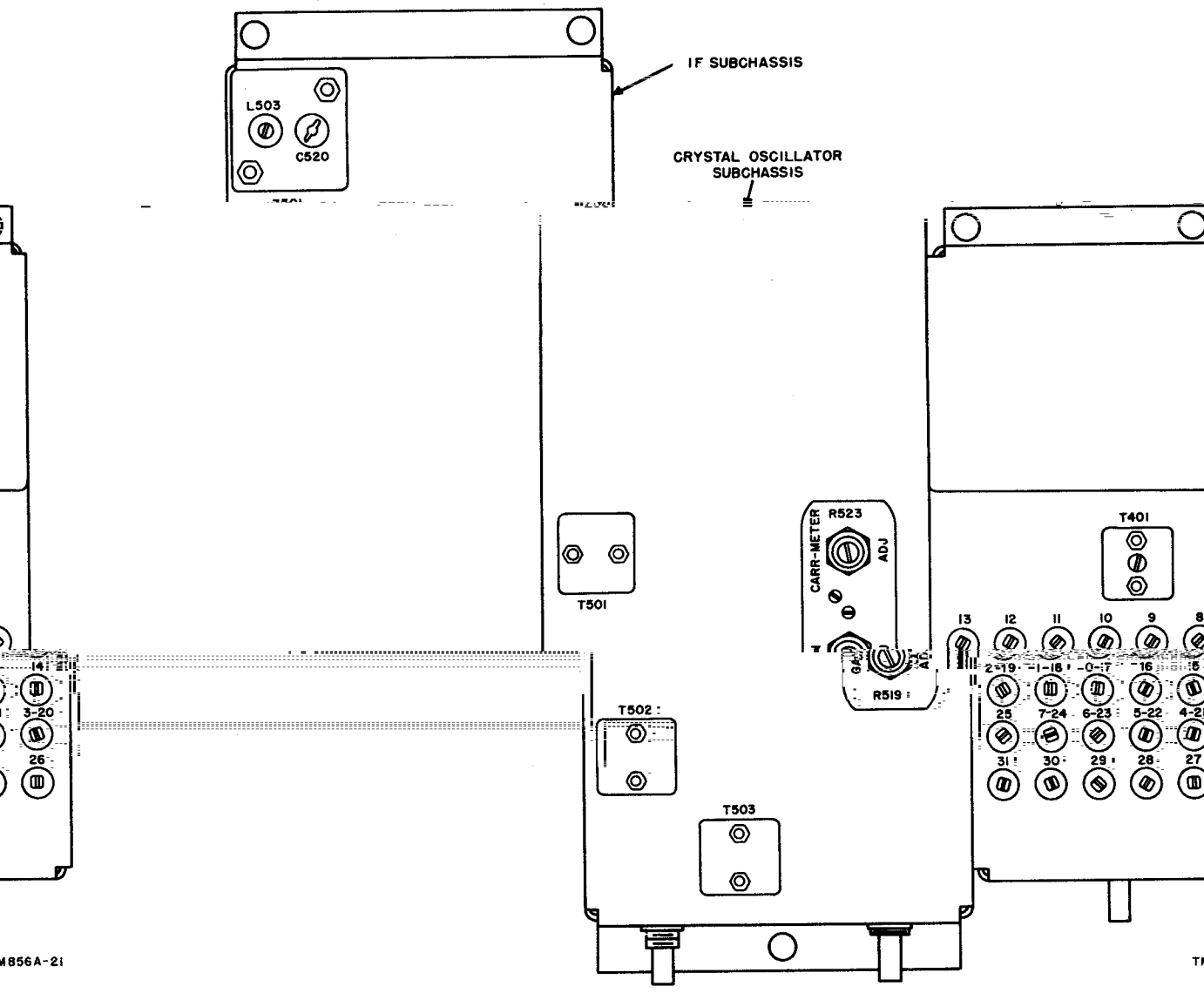


Figure 90. Crystal-oscillator and if subchassis alignment po

ints.

Oscillator Alignment

e given

the detent.

(5) Set the MEGACYCLE CHANGE control to each of the bands from 08 to

3] (first two digits of the frequency indicator) and adjust the corresponding trimmer on the crystal oscillator subchassis (fig. 90) for maximum output, as indicated on the CARRIER LEVEL meter.

(6) Check audio for output on bands 00

ugh 07. There are no adjustments these bands (*a*(6) above).

should drop out on either side of 14] Beat frequency

Two methods for aligning the bfo ar below.

First Method

(1) Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to MGC and connect a vtvm to the DIODE LOAD terminal 14 GND terminal 16 on the rear panel of the receiver.

(2) Set the BANDWIDTH control to .1 KC and feed a strong 455-kc signal

thro

for t

with the signal generator into the grid of V204 through test point E211 (fig. 58) on the top of the rf subchassis.

a. Set the receiver controls as instructed in paragraph 85, except set the frequency indicator to 01 000 and the FUNCTION switch to

nect the vtvm to the DIODE LOAD
14 and GND terminal 16.
nect the signal generator to the control
t test point E210. Adjust the sig-
o 2.1 mc.

(3) Adjust the signal generator frequency for maximum diode load voltage. This adjusts the signal generator to the exact resultant frequency of the crysta filter.

(4) Turn the BFO switch to ON, and

MGC
b. Co
terminal
Co
grid of V202 a
nal generator t

he specified frequency, tune the signal generator to that frequency. Slowly rock the frequency control on the signal generator back and forth and set it at the point that gives zero beat when the BFO switch is at ON and the BFO PITCH is at 0 (correctly calibrated). Do not depend on the reading on the signal generator frequency dial. During the alignment procedure, readjust the signal generator attenuator as necessary to keep the voltage on the vtvm from exceeding a −7-volt reading, otherwise detector overloading and inaccurate alignment will result.

adjust the BFO PITCH control for zero beat, as indicated by a slow oscillat of the needle on the do vtvm. If z beat does not occur at 0 on the fro dial, loosen the BFO PITCH knob and reset it to zero. It may be necessary to remove the BFO knob to gain access to the BFO PITCH knob set screw.

Note. After setting the receiver to t

d. Adjust the slugs in Z216-1, Z216-2, and Z216-3 (L233-1 through L233-3) for maximum diode load voltage.

b. Second Method.

(1) Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to CAL, and tune the receiver to some 100-kc

point above tune the signal generator to 2.9 mc.
00 500.

f. Adjust the trimmer capacitors in Z216-1,

ne LINE METER switch and
AIN control for an indication
INE LEVEL meter. Set the
IDTH control to 1 KC.

Z216-2, and Z216-3 (C291-1 through C291-3) for maximum diode load voltage.

g. Repeat the procedures in *b* through *f* above until no further increase in diode load voltage is obtainable.

(2) Adjust th
LINE GA
on the L
BANDW

ment

(3) Adjust the KILOCYCLE CHANGE control for maximum output, as indicated on the CARRIER LEVEL meter.

143. First Variable If Align

O switch to ON, and ad-
O PITCH control to exact
indicated by a slow oscil-
ne needle on the LINE
er.

does not occur with the
knob at zero, loosen the
set it at zero. It may be
remove the BFO knob to
to the BFO PITCH knob

(fig. 91)

a. Set the receiver controls as instructed in paragraph 85, except set the frequency indicator to 01 250.

b. Connect the signal generator to the grid of V202 at test point E209 (fig. 58). Tune the signal generator to 18.25 mc.

c. Connect the vtvm to the DIODE LOAD terminal 14 and GND terminal 16.

d. Adjust the slugs in Z213-1, Z213-2, and Z213-3 (L232-1 through L232-3) for maximum diode load voltage.

e. Set the frequency indicator to 07 250. Tune the signal generator to 24.25 mc.

f. Adjust the trimmer capacitors in Z213-1, Z213-2, and Z213-3 (C283-1 through C283-3) for maximum output, as indicated on the

(4) Turn the BF
just the BFO
zero beat, as
lation of th
LEVEL mete

(5) If zero beat
BFO PITCH
knob, and re
necessary to
gain access t
set screw.

e If Alignment

of the printing on the top
mounted over the rf

emove this cover and
ating the alignment

g. Repeat the procedures in *b* through *f* above until no further increase in diode load voltage is obtainable.

142. Second Variabl

(fig. 91)

Figure 91 is a copy
protective cover that
chassis alignment points. Re
use it, as figure 91, for loc
points.

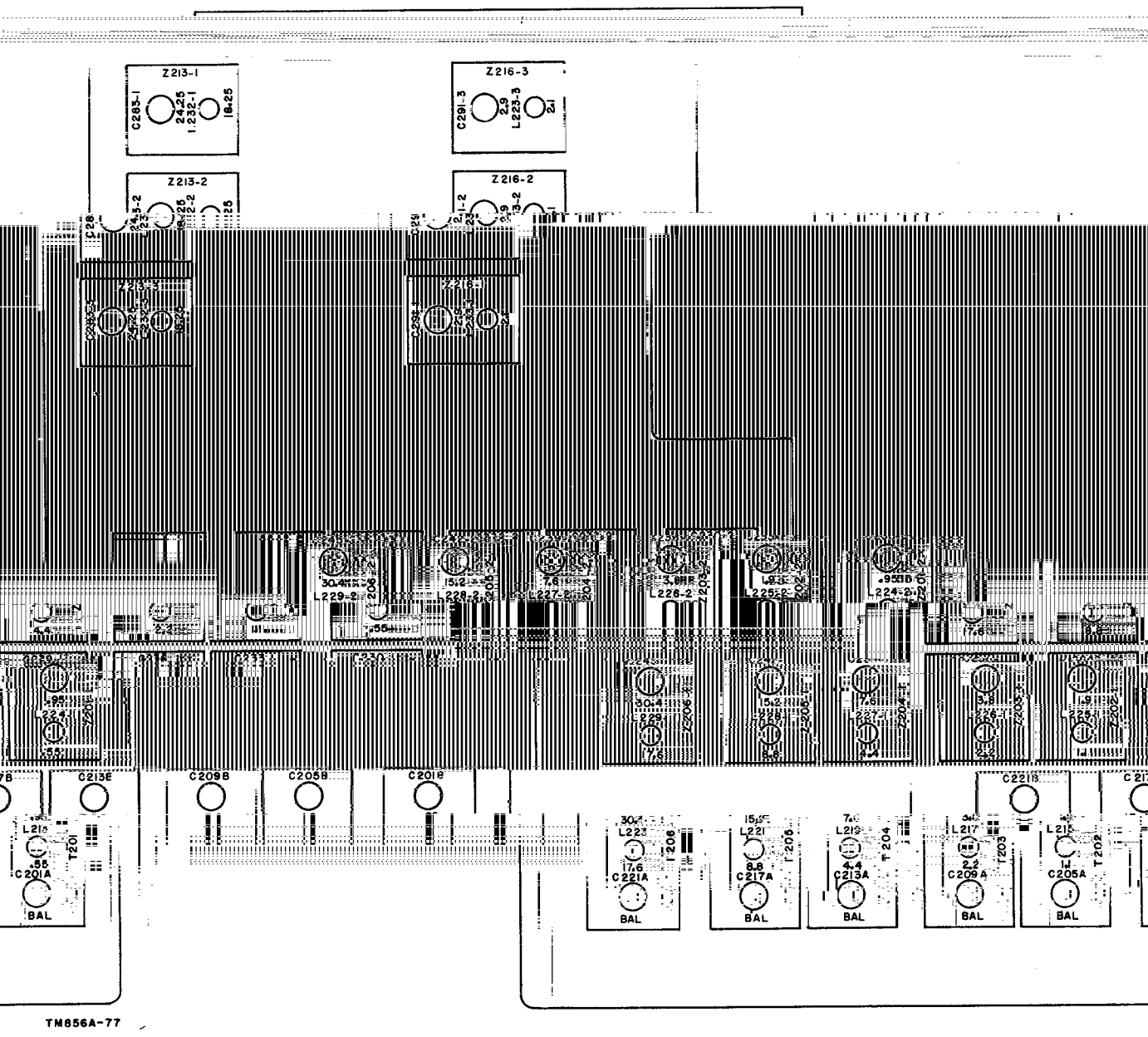


Figure 91. Rf and variable if alignment points.

vtvm to DIODE LOAD
) terminal 16 on the rear
panel of the receiver.

144. Rf Coil Alignment

(fig. 91)

b. Connect the dc
terminal 14 and CNI

ANTENNA receptacle on the rear panel of the receiver.

d. If preliminary adjustments are ne
because of extreme misalignment of
ceiver, connect the output of the signa
ator through Test Lead CX-1363/U
points listed in the last column of the al
ment chart in *i* below instead of connecti
to the BALANCED ANTENNA recepta
ontinue with the procedures through
below. After completing the preliminary align-
ment, repeat all the steps in the chart with the
output of the signal generator connected to the
BALANCED ANTENNA.

e. Use the MEGACYCLE CHANGE and
FINE TUNING controls to tune the re-
ceiver to the frequency indicated by the

Set of rf coils	Mc reading	Kc reading	Sig gen freq (kc)	Adjust slugs for peak	Adjust trimmer capacitors for peak	Sig gen connection (preliminary alignment only)
5-1 mc	00	550	550	L213		J104
			L224-1		E208	
			L224-2		E208	
					C201	J104
					C23c-1	E208
					C30c-2	E208
						J104
						E208
						J104
						E208
						J104
						E208
						J104
						E208
						J104
						E208
					C205	J104
						E208

c. Turn the BFO switch to ON, and turn the BFO PITCH control to the point where it is

access hole (fig. 12) for exact zero beat, as indicated on the LINE LEVEL meter. Make this

(8) Adjust the primary and secondary windings of the transformer for maximum diode load voltage. Reduce the output of the signal generator if necessary to keep the diode load voltage less than —7 volts.

[illegible] completed, disconnect P114 [illegible] from J518, disconnect the signal generator from the IF OUTPUT jack and reconnect P114 to J514, P113 to J513, and P218 to J518. Install the new cover on the replacement part.

[illegible] potentiometer. This is done by setting the gain of one receiver, and then matching the other to it.

b. Procedure for Adjustment.

(1) Disconnect P114 from J514, P213 from J513, and P218 from J518. Connect P114 to J513.

(2) Connect the signal generator through Impedance Adapter MX-1487 to the IF OUTPUT jack on the rear panel of the receiver.

(3) Tune the signal generator to 455 kc, and adjust the attenuator to an output level of 150 microvolts. Be sure the modulation is turned [illegible]

(4) Connect the vtvm to the DIODE LOAD terminal 14 and chassis ground.

(5) Set the receiver controls as instructed in paragraph 85 except set the FUNCTION switch to MGC, the GAIN [illegible] for a diode load voltage of —7 volts.

(7) Disconnect the signal generator and the vtvm, disconnect P114 from J513, and reconnect P213 to J513, and P218 to J518, and P114 to J514.

Adjustment for Diversity Operation. When [illegible] are used for diversity operation, proceed as follows:

(1) Adjust one receiver according to the instructions in *b* above.

[illegible] vtvm and signal generator [illegible]

148. Adjustment of GAIN ADJ Potentiometer R519

(fig. 64)

a. General. The correct adjustment of this control is very important. If it is set too low, the receiver sensitivity will be below that required. (9) If it is set too high, the receiver noise will be excessive. This adjustment should be checked monthly, and whenever any tubes are replaced in the r-f or if subchassis. When two receivers are operated in diversity operation, the if outputs should be balanced with the GAIN ADJ [illegible]

b. Alignment of Z503.

(1) Perform the procedures in *a* (1) through (3) above.

(2) Replace Z503 if necessary. Remove the cover from Z503, and punch a hole in the top of it. Replace the cover on the coil.

(3) Connect the vtvm to the AGC terminal 4 and chassis ground on the rear panel of the receiver.

(4) Tune the signal generator to 455 kc, and adjust the attenuator for an agc voltage of 1 volt. Be sure the modulation is turned [illegible]

(5) Adjust the slug core in Z503 for maximum agc voltage.

(6) When completed, perform the procedure in *a* (9) above.

c. Alignment of T208 (fig. 58). (1) Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to MGC, and the BANDWIDTH switch to 2 KC.

(2) Feed the output of the signal generator to test point E211 (fig. 58). Connect the vtvm to DIODE LOAD terminal 14 and chassis ground.

(3) Adjust the signal generator to 455 kc, and adjust the attenuator to give a diode load voltage reading of less than —7 volts.

(4) Adjust T208 for maximum diode load voltage. The adjustment of T208 will be broad, so be sure to attain maximum output.

(5) Disconnect the signal generator. Connect the signal generator to the UNBALANCED ANTENNA receptacle; tune it and the receiver.

(3) Adjust the output level of the signal generator to produce 7 volts between the DIODE LOAD terminal and chassis ground.

(4) Measure the output voltage at the IF OUTPUT jack with the ac vtvm.

(5) Without changing the settings of the signal generator in any way, connect it to the UNBALANCED ANTENNA receptacle of the receiver, and tune the receiver to the frequency that was used in (2) above. Adjust the output voltage of the signal generator to produce the same reading on the vtvm connected to the receiver IF OUTPUT jack. Adjust the GAIN ADJ control until the voltage is the same as that measured in (4) above.

c. Replace the vfo subchassis (par. 127).

d. Remove the front panel of the receiver (par. 122).

e. Turn the riveted locking plate (fig. 86) by hand until the frequency indicator reads exactly +000.

f. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to CAL, the BFO switch to ON, and the BFO PITCH control to zero beat. Allow the receiver to warm up for at least 1 hour. Adjust for zero beat by adjusting the LINE METER switch and the LINE GAIN control for a reading on the LINE LEVEL meter, and then carefully adjusting the BFO PITCH control for a zero reading, or a slowly fluctuating needle on the LINE LEVEL meter.

g. Turn the riveted locking plate until the frequency indicator reads exactly 000.

149. Adjustment of CARR-METER ADJ

h. With a small screw driver, adjust the potentiometer R623 (fig. 64) for a zero reading on the CARRIER LEVEL meter on the front panel of the receiver.

i. Set the FUNCTION switch to AGC and turn the RF GAIN control full counterclockwise. Reset the frequency indicator so that the LINE LEVEL meter reads zero, if necessary, by adjusting the BFO PITCH control to zero beat on the if subchassis for a zero reading on the CARRIER LEVEL meter on the front panel of the receiver.

j. Repeat the procedures in *g* and *h* above until no further improvement can be made.

k. When the job is completed, replace the front panel (par. 122), replace the vfo (par. 127), replace the end point adjustment plug, and replace the vfo.

150. Variable-frequency Oscillator End Point Adjustment

(fig. 92)

After the receiver has been in service for about a year, a frequency check of the variable-frequency oscillator may reveal that its range may not be exactly 5.455 to 2.455 mc. This condition, in most cases, is caused by aging of the frequency-determining components in the sealed vfo subchassis, and can be compensated for by adjusting end point adjustment L701. Access to this adjustment is made by removing the screw on the front of the sealed vfo unit.

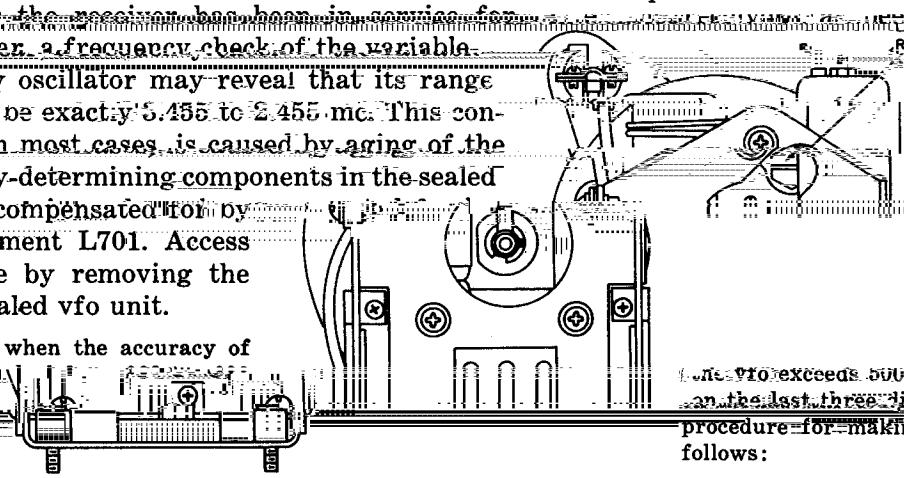


Figure 92. Variable-frequency oscillator end point adjustment.

Note. Make this adjustment when the accuracy of the vfo exceeds 500 cps when checked from 000 to +000 on the last three digits of the frequency indicator. The procedure for making the end point adjustment follows:

a. Remove the vfo subchassis (par. 127).

b. Remove the plug which covers the end point adjustment L701 (fig. 92).

151. Crystal Filter Neutralizing

Capacitor C520 in tuned circuit Z501 (fig. 90) usually is not adjusted at the time of general receiver alignment; however, if any part of Z501 or the entire tuned circuit is replaced, C520 in Z501 until the peak frequency and bandwidth is the same as the peak frequency for .1-kc bandwidth.

Note. This may require several operations of adjusting C503.

152. Antenna Trimmer Capacitor Adjustment (fig. 93)

The ANT TRIM control is adjusted properly when the red dot on the helical gear that drives C225 is positioned as shown in figure 93, and the ANT TRIM knob is set at 0. If adjustment is necessary, loosen the helical driving gear, position the helical gears as shown, and reset the knob if necessary to point to 0.

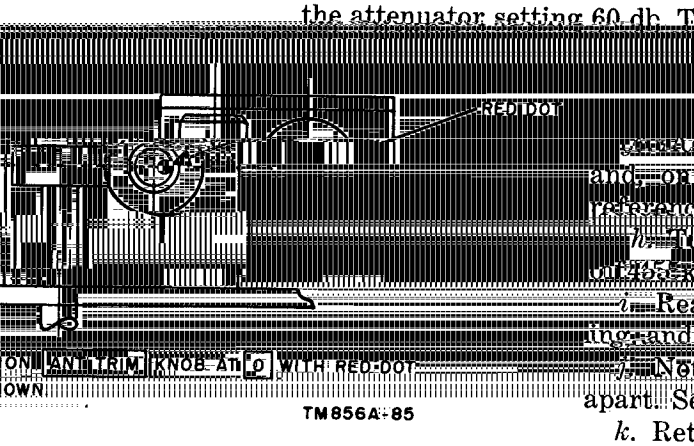


Figure 93. ANT TRIM control adjustment.

Section V. FINAL TEST

153. Purpose

Equipment that has been repaired must meet definite minimum performance standards before it is returned to service. The tests outlined in paragraphs 154 through 168 are designed to measure the performance capability of a repaired Radio Receiver R-390A/URR. Receivers that meet the minimum standards stated in the tests will give satisfactory operation

154. Test Equipment Required for Final Testing

The test equipment required for final testing is listed below as a common usage name is listed after each component.

Nomenclature	Common name
Multimeter TS-505/U	Vtvm
RF Signal Generator Set AN/URM-25	Signal generator
Accessory Kit MX-288/URM (for the signal generator)	Accessory kit
Audio Oscillator TS-382/U	Audio oscillator
Oscilloscope OS-8A/U	Oscilloscope
Electronic Multimeter ME-30A/U	Ac vtvm

b. The following noninductive resistors are required:

Quantity	*Value (ohms)*
2	600
	60
	68

Note. Power (watts) equals voltage squared divided by 600 ohms.

h. Connect the 600-ohm resistor and the ac vtvm to the PHNS terminal and GND on the rear panel of the receiver. With the LOCAL GAIN control turned fully clockwise, the minimum power output at the PHNS terminal should be greater than 1 milliwatt (.78 volts rms across 600 ohms).

d. Connect the signal generator to the BALANCED ANTENNA connector on the rear panel. Connect the ac vtvm across LINE AUDIO terminals 6 and 7. Turn the LINE GAIN control fully clockwise. Turn the LINE METER switch to OFF. Read the ac power on the ac vtvm. The minimum power output should be 10 milliwatts (2.45 volts rms across 600 ohms).

BFO switch to ON, and the BFO PITCH control to 0. Adjust the signal generator for zero beat. This can be done accurately by turning the LINE METER switch to 0 and turning the LINE GAIN control clockwise for a meter indication on the LINE LEVEL meter. When the signal generator is tuned to zero beat, the reading on the LINE LEVEL meter will drop to zero. T

c. To connect the signal generator to the BALANCED ANTENNA connector, connect it through Electrical Dummy Load DA-121/U (part of the accessory kit), Adapter Connector UG-274/U, and Adapter Connector UG-573/U to the BALANCED ANTENNA connector (fig. 94).

g. T

a. Set the receiver controls as instru paragraph 85.

b. Connect a 600-ohm 1-watt noninductive resistor across LOCAL AUDI terminals 6 and 7 on the rear panel of the re

c. Connect the ac vtvm across the LO AUDIO terminals (600 ohms).

d. Connect the 600-ohm resistor a of the receiver (par. 4a4c).

e. Set the receiver freq generator frequency to signal generator for an u volt output.

f. On the f

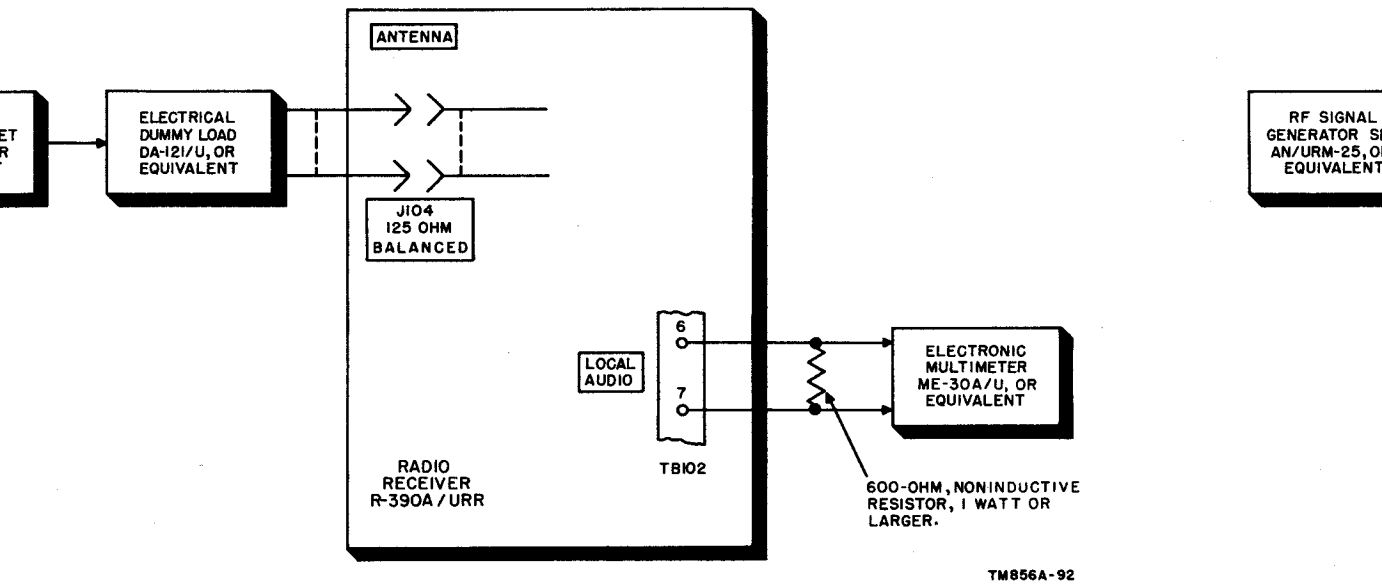


Figure 94. Receiver audio test setup.


800-CPS
FILTER
2KC
4KC
8KC
16 KC
20

158. LINE LEVEL Meter Operation

Set the FUNCTION switch to CAL and set the KILOCYCLE CHANGE control to any 100-kc point. With the BFO switch at ON, adjust the BFO PITCH control for an audible tone at the loudspeaker. Set the LINE METER switch to 10, and adjust the LINE GAIN control for an indication of -10 on the LINE LEVEL meter. Set the LINE METER switch to 0. The LINE LEVEL meter should indicate 0 db. Adjust the LINE GAIN control for an indication of -10 on the LINE LEVEL meter. Set the LINE METER switch to 10. The meter should indicate 0 db.

ing Level

f the limiter can be checked
ds. The first method
perating position
ugh 10

a. Connect the output of the signal generator to the BALANCED ANTENNA connector (par. 154*c*), and tune the receiver and signal generator to the same frequency. Adjust the attenuator on the signal generator for an output of 1,000 microvolts.

b. Adjust the modulating audio frequency to 400 cps.

c. Connect the oscilloscope to pin 1 or 2 of limiter tube V507, and adjust the oscilloscope for two or three complete sine waves. This can be done with a jube test point adapter.

d. Increase the percentage of modulation on the signal generator to 50 per cent. Use the LINE LEVEL meter. Set the LINE METER switch to 0. Adjust the LINE GAIN control for an indication of -10 on the LINE LEVEL meter. Set the LINE METER switch to 10. The meter should indicate 0 db. Adjust the LINE GAIN control for an indication of -10 on the LINE LEVEL meter.

serving the smooth variation of limiting.

Note. The output may drop approximately 1 db when the LIMITER control is turned clockwise from OFF position, return to 0 db, then drop again as the control is advanced.

1, and note the amount of clipping. Continue turning the LIMITER control clockwise to 10; note that the amount of clipping is smooth and gradual as the control is advanced clockwise.

159. Limiter Clipp

(fig. 96)

The operation o
by one of two met
sists of tuning in an am signal, and o
the LIMITER control from the OFF
fully clockwise through settings 1 thro
and listening to the degree of clipping that results as the LIMITER control is turned clockwise. The second method requires the use of an oscilloscope and an rf signal generator that can be modulated up to a high level. The procedure is as follows:

160. Bfo Calibration and If Output (fig. 97)

To check the 455-kc if output of the receiver, the bfo leakage into this signal source, and the

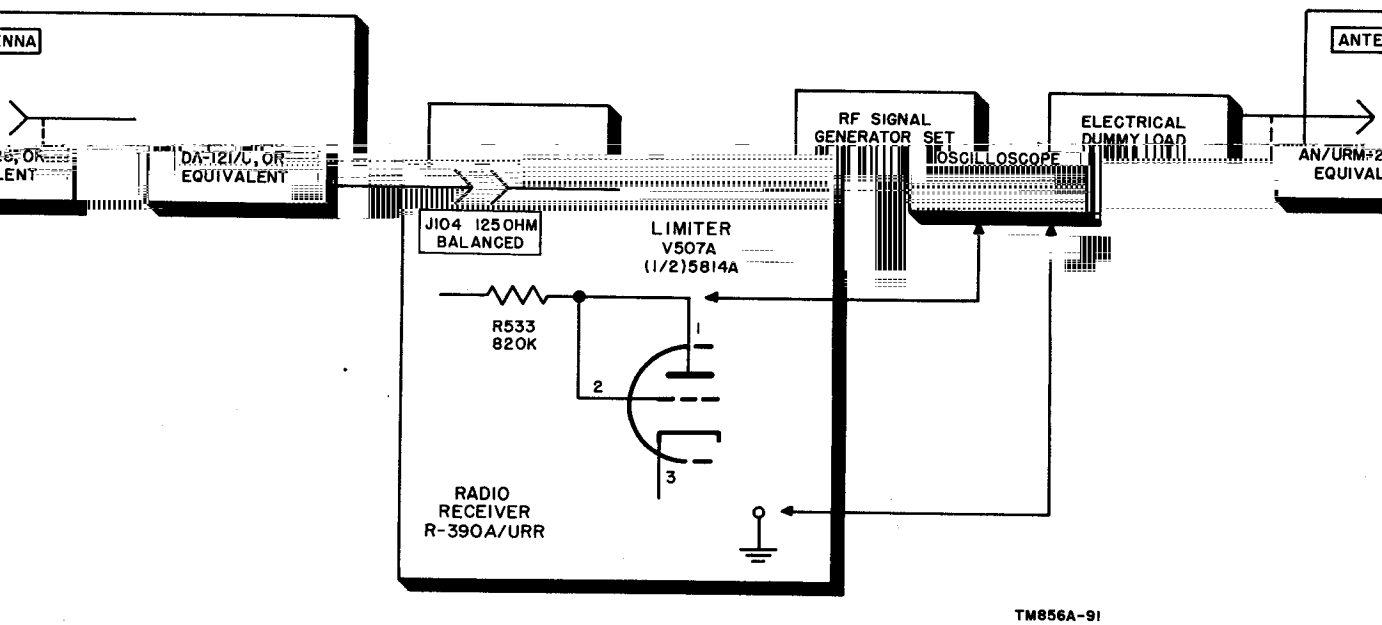


Figure 96. Limiter clipping level test setup.

calibration accuracy of the beat-frequency oscillator, proceed as instructed below.

a. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to MGC and the receiver frequency to 1.510 mc.

b. Connect the output of the signal generator to the BALANCED ANTENNA connector on the rear panel of the receiver (par. 154*c*).

c. Connect the ac vtvm in parallel with a 60-ohm, noninductive resistor to the IF OUTPUT jack on the rear panel of the receiver, and connect the vtvm to DIODE LOAD terminal 14 and GND terminal 16.

d. Connect the vertical input of the oscillo-

PITCH control setting of 0.

l. Set the BANDWIDTH switch on the receiver to 2 KC, turn the BFO switch to ON, and adjust the BFO PITCH control slightly to one side of 0 until a null is indicated on the ac vtvm connected to the IF OUTPUT jack.

m. Note this reading and record it as bfo leakage. The bfo leakage should be less than 750 microvolts.

g. Adjust the RF GAIN control on the receiver for a reading of 20 millivolts on the ac vtvm connected to the IF OUTPUT jack.

h. Increase the output of the rf signal generator to 30 microvolts, and record the reading on the ac vtvm. The if output should be between 180 and 220 millivolts.

i. Turn the BFO switch to ON, set the BFO PITCH control to 0, and adjust the KILOCY-

j. Set the BFO PIT
adjust the oscilloscope
for a one-to-one lissajou
scope. Read the output
oscillator. It should be
cps.

k. Repeat the procedure

AUDIO terminals
the receiver.

e. Connect the
to the horizontal

f. Adjust the o
to 3 microvolts, a
tor frequency f

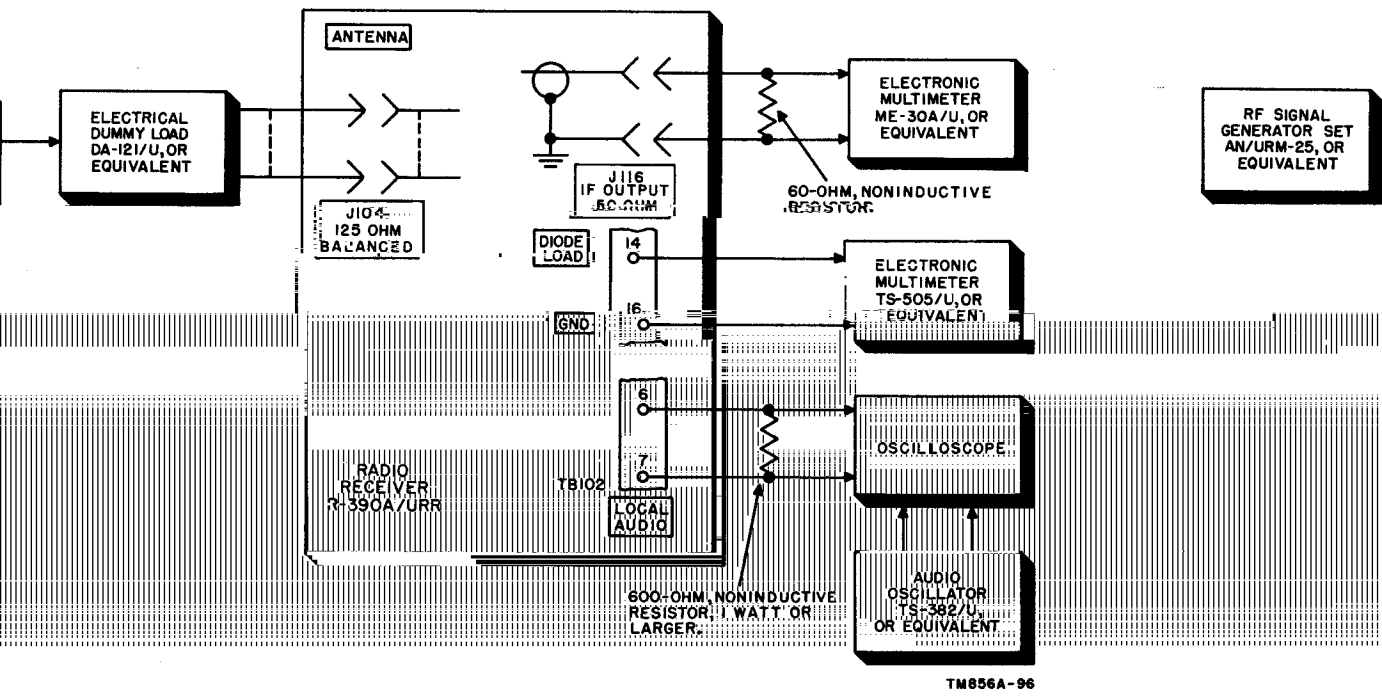


Figure 97. Bfo calibration and if output test setup.

161. Over-all Receiver Selectivity

this above and below the 10-kc dial reference

frequency.

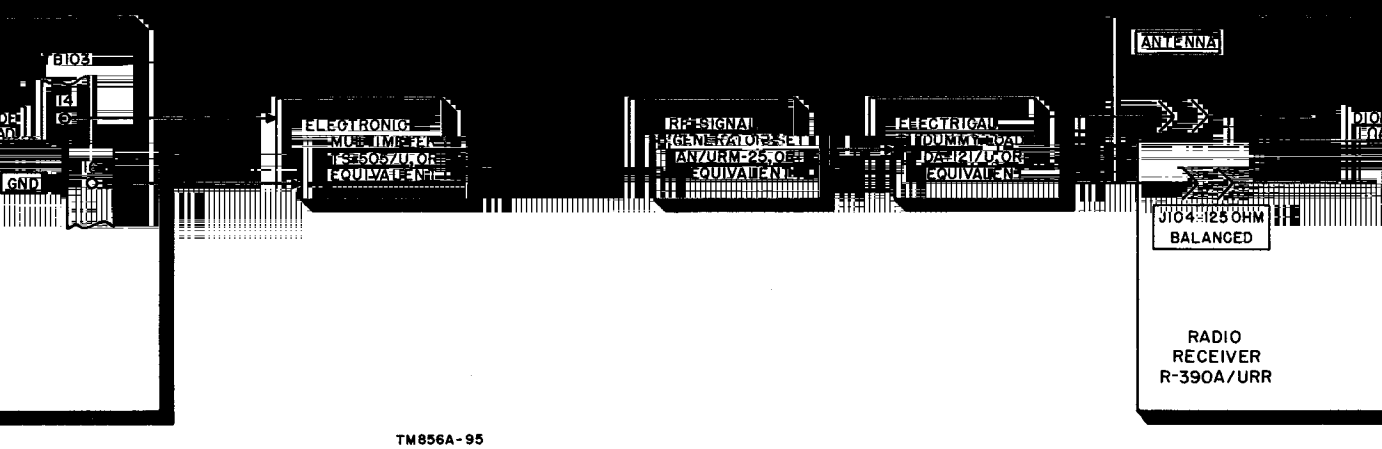
8 KC, and 16 KC. Record the results and compare the receiver bandwidth with the figures given in the chart below:

BAND WIDTH control setting	DIODE LOAD voltage	
	-3.5 (3 db)	-7 (6 db)
1 KC		8 to 11 kc
2 KC		1.9 to 3 kc
5 KC		3.6 to 4.4 kc
8 KC	Not less than 7.5 kc	
16 KC		

Tune the signal generator to the same frequency.

Note. The bandwidth on the .5- to 1-mc band when the BANDWIDTH switch is in the 16 KC position may be somewhat less than 16 kc because of the bandpass of the .5- to 1-mc antenna and rf coils. This condition is permissible.

2-kc band pass. Record this reading. It should be not less than 3 db (—3.5 volts). This is the



TM856A-95

test setup.

Figure 98. Over-all selectivity

162. Agc Characteristics

(fig. 99)

To check the operation of the agc circuit and the accuracy of the CARRIER LEVEL meter, proceed as instructed below. Select at least three frequencies over the range of the receiver for making these tests.

Step	Input from signal generator	CARRIER LEVEL meter reading
1	Reference setting (see *h* above)	20 (reference)
2	10 times step 1	40 (typical)
3	100 times step 1	58 (typical)
4	1,000 times step 1	78 (typical)
5	10,000 times step 1	Approxi (typica
6	1/10 times step 1	0 (typica

a. Set the receiver controls as instructed in paragraph 85.

b. Connect the signal generator to the BALANCED ANTENNA jack on the rear panel of the receiver (par. 154*c*).

c. Connect a 600-ohm, 1-watt or larger, resistor in parallel with the ac vtvm across LOCAL AUDIO terminals 6 and 7 on the rear panel of the receiver.

d. Connect the vtvm across DIODE LOAD terminal 14 and GND terminal 16 on the rear panel of the receiver.

e. Adjust the attenuator on the rf signal generator for an output of 5 microvolts, and modulate the signal generator with a 400-cps signal modulated 30 percent.

f. Adjust the LOCAL GAIN control for a 5-milliwatt (.173 volts rms across 600 ohms) output on the ac vtvm.

g. Increase the setting on the rf signal generator and note the rise in the audio output.

h. Reduce the signal generator attenuator setting to obtain a CARRIER LEVEL meter reading of 20 db. Record the output of the signal generator.

i. Decrease the signal input from the signal generator by 20 db (1/10 of the level established in the procedure in *h* above) and record the results under step 6 in the chart above. The reading on the CARRIER LEVEL meter should be from 0 to 6 db.

j. Transfer the connection of the vtvm from LOCAL AUDIO terminals 6 and 7 to the ACC terminal 4 and chassis ground.

k. Set the AGC switch on the receiver to SLOW, and adjust the attenuator on the signal generator until the dc vtvm indicates —10 volts agc bias. Abruptly remove the signal input to the receiver, and record the time for the indication on the CARRIER LEVEL meter to decrease from —10 V to —3.5 V. This decrease in meter reading should occur in 4 to 8 seconds.

l. Repeat the procedure in *k* above for setting the AGC switch on the receiver to FAST. Since the discharge time constants for these two settings are different, the time for the meter reading to decrease from —10 V to —3.5 V should be 1 to 2 seconds. If the discharge time constants for these two settings are too fast (.005 to .025 second and 1 to 2 seconds, respectively), or if the agc voltage does not decrease from —10 V to —3.5 V in the time specified, compare the performance of the receiver with that of a known good receiver of the same model. If the receiver is equipped with a CARRIER LEVEL meter, check for a rapid decrease in the agc voltage reading when the rf signal is removed.

m. Adjust the rf signal generator for a 1-volt output on the dc vtvm. Transfer the vtvm connection to DIODE LOAD terminal 14 and measure the voltage at DIODE LOAD terminal 14 and GND terminal 16. It should be between negative-5 and 10 volts.

Input level (microvolts)	Audio increase (db)	Audio output (volts)
5	0 (reference)	.775 (reference)
50	20	7.75
500	40	77.5
5,000	60	775
50,000	80	7750

i. Increase the signal generator output in 20-db steps, and each time record the CARRIER LEVEL meter reading.

Note. A 20-db increase in signal generator output is the equivalent of multiplying the previous setting by a factor of 10. Use a chart similar to the one below for recording the results. For every change in input level [illegible] the CARRIER LEVEL meter reading should increase from 10 db to 80 db.

30,050 mc.

163. Antenna Grounding Relay

a. Set the receiver controls as instructed in paragraph 85.

b. Connect the signal generator to the BALANCED ANTENNA jack (par. 154*c*).

d. Set the BFO PITCH control to 0, and turn the BFO switch to ON.

e. Tune the signal generator to zero beat, ...tch to OFF, and adjust the ... or maximum reading at ...al 14.

...uator on the signal gen... ...ad voltage of —5 volts. ...the signal generator.

Dial reading	Transformer	Trimmer	Ratio (minimum db)
00 +000	T201	C205A	40
01 +300	T202	C205A	40
03 +000	T203	C209A	4000
07 +000	T204	C213A	35
15 +000	T205	C217A	30
31 +000	T206	C221A	20

...turn the BFO swi... ANT TRIM control ... DIODE LOAD termin...

f. Adjust the atten... erator for a diode lo... Record the output of ...

...y antenna trans- ...erator to ... ...ts. Record ... least 40 db, ...

...(*g* above) ...(*f* above)

...nstructed in ...EGACYCLE ...KILOCYCLE ...the FUNC- ...

...al generator ...two 68-ohm ...ree ends of ...ects on the ... the rear ...mal which gave produces the weak ... markers, adjust the KILOCYCLE ... control to each 100-kc point within ... and determine which 100-kc point ... the weakest marker signal.

...BFO control to 0. ...e BFO switch to ON. ...the KILOCYCLE CHANGE ...for zero beat. ...the BFO PITCH control for ...ndication on the LINE ...ter.

...LINE LEVEL control and ...METER switch for an in... ...0 vu on the meter.

...ILOCYCLE CHANGE con... ...c away from zero beat.

...LEVEL meter indication

g. Turn the FUNCTION switch to CAL, and just the balance trimmer (fig. 91) for a minimum with the signal generator connected as instructed in *b* above.

Note. Be sure a true balance is obtained, and not a maximum or minimum trimmer capacity condition.

h. If the balance ratio for any ... increase the output of the signal gen... obtain a diode load voltage of —5 vol... the output of the signal generator.

h. The attenuation should be at ... as calculated from the formula:

$$\text{Db} = 20 \text{ times log } \frac{\text{microvolts}}{\text{microvolts}}$$

165. Calibration Signal

a. Set the receiver controls as instructed in paragraph 85, except set the FUNCTION switch to CAL.

b. Tune the KILOCYCLE CHANGE control to 500, set the MEGACYCLE CHANGE control successively to each band, and observe the strength of the 100-kc calibration markers on the CARRIER LEVEL meter. Be sure to pack the ANT TRIM control for each setting of the MEGACYCLE CHANGE control.

164. Antenna Balance Ratio

a. Set the receiver controls as i... paragraph 85, except set the MI... CHANGE control to 00, the K... CHANGE control to +000, and ... TION switch to MGC.

b. Connect the output of the sign... between ground and the junction of ... composition resistors. Connect the f... each 68-ohm resistor to the two cont... BALANCED ANTENNA connector on ... panel of the receiver.

c. Connect the vtvm to DIODE LOAD ter... minal 14 and chassis ground.

d. Tune the signal generator to the receiver ... frequency and set the attenuator to the lowe... that gives —7 volts indication on the vtvm. Note the output of the signal generator.

e. Disconnect the 68-ohm resistors and ... connect the signal generator to the ANTENNA ... ANTENNA jack (par. 154*c*). Repeat the pro... cedure in *d* and note the output of the signal generator.

f. Calculate the db ratio according to the following formula:

$$\text{Db} = 20 \log \frac{\text{microvolts } (d \text{ above})}{\text{microvolts } (e \text{ above})}$$

g. Compare the results with the data in the chart below. Perform the same test for all the other frequencies listed in the chart.

(1) Set the ...

(2) Set the ...

(2) Adjust ... control ...

(4) Adjust ... maximum ... LEVEL me...

(5) Adjust the ... the LINE M... dication of ...

(6) Tune the KI... trol to 10 k...

(7) The LINE ...

should decrease at least 10 vu when the KILOCYCLE CHANGE control is tuned 10 kc away from the zero beat position.

Frequency (mc)	Maximum input (microvolts)	
	BALANCED ANTENNA	UNBALANCED ANTENNA
.500	8	
1.510	3.3	
2.000		5.5
3.000	3.3	
5.000		5.5
6.000	3.3	
18.000		4.4
20.000		4.4
21.000		4.4
22.000		4.4
26.000		4.4
27.000		4.4
28.000		4.4
29.000		4.4
30.000		4.4

166. Am Sensitivity (fig. 99)

a. The am sensitivity is measured for a signal plus noise-to-noise ratio of 10 to 1 at 10 millivolts power output.

b. Connect the signal generator to the BALANCED ANTENNA connector (par. 154c). Connect the ac vtvm to LOCAL AUDIO terminals 6 and 7 on the rear panel of the receiver.

c. Tune the receiver and the signal generator to .75 mc.

d. Set the BFO PITCH control to 0 and turn the BFO switch to ON.

e. With modulation off, tune the signal generator for zero beat. Turn the BFO switch to OFF.

f. Adjust the LOCAL GAIN control for a .8-volt noise indication on the ac vtvm.

g. Set the signal generator modulation to 30 per cent and adjust it for an audio output of 1,000 cps. Tune the receiver to measure the signal plus noise. Peak the ANT TRIM control.

h. Adjust the output of the signal generator for a 2.5-volt signal-plus-noise indication on the ac vtvm.

i. Repeat *g* and *h* above as necessary until no further readjustment is necessary. The signal generator output in microvolts for this condition is the sensitivity figure for the receiver. It should meet the test limits shown in *m* below.

j. Repeat the procedures in *c* through *i* above for all the other frequencies listed in the chart in *m* below for BALANCED ANTENNA connection.

k. Connect the output of the signal generator to the UNBALANCED ANTENNA jack (par. 154c) through Electric adapter UG-636A/U.

l. Using the same procedures given in *c* through *i* above, determine the am sensitivity for all the frequencies specified for an unbalanced antenna connection in the chart *m* below.

m.

Frequency (mc)	Maximum input (microvolts)	
	BALANCED ANTENNA	UNBALANCED ANTENNA
.500	8	
1.510	3.3	
2.000		5.5
3.000	3.3	
5.000		5.5
6.000	3.3	
18.000		4.4
20.000		4.4
21.000		4.4
22.000		4.4
26.000		4.4
27.000		4.4
28.000		4.4
29.000		4.4
30.000		4.4

167. Cw Sensitivity

Cw sensitivity is measured in the same manner as am sensitivity except that the unmodulated carrier output of the signal generator is measured. Set the BFO PITCH control to 0 and adjust the signal generator for a 1,000-cps audio output of about 10 times the noise output, the sensitivity figure measured for cw sensitivity is approximately one-third of that for am sensitivity.

168. Over-all Gain

a. Adjust the receiver controls as indicated in paragraph 85. Current set the FUNCTION switch to MGC.

b. Connect the signal generator to the BALANCED ANTENNA jack (par. 154c). Connect the ac vtvm to DIODE LOAD terminal 14 and GND terminal 16.

c. Tune the signal generator and receiver to 500 kc.

d. Turn the BFO PITCH control to 0 and turn the BFO switch to ON.

e. Tune the signal generator to zero beat, and turn the BFO switch to OFF.

f. Adjust the ANT TRIM control for maximum indication at DIODE LOAD terminal 14.

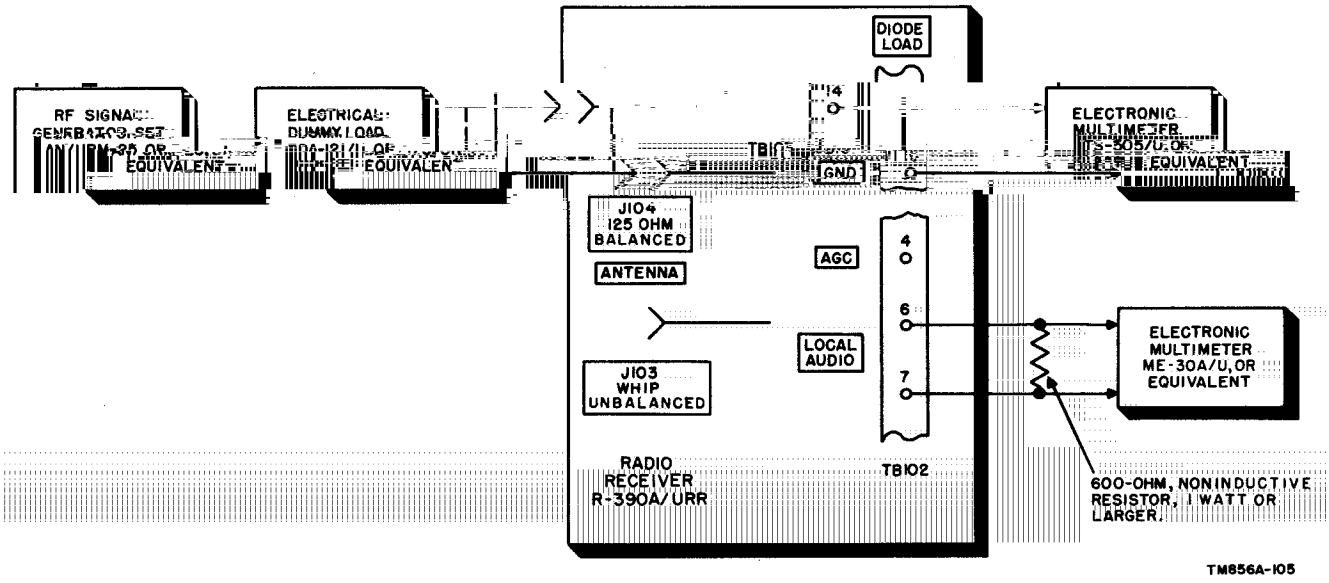


Figure 99. Sensitivity and over-all gain, test setup.

g. Adjust the attenuator on the signal generator for a reading of —7 volts at DIODE LOAD terminal 14. Record the output of the signal generator.

h. Compare this reading with the value in the chart (*i* below) and repeat the procedure in *d* through *g* above for all the other frequencies shown in the chart.

Frequency (mc)	*Maximum input (microvolts)*	
	BALANCED ANTENNA	*UNBALANCED ANTENNA*
.500	4	10
.750	4	—
.900	4	—
1.000	4	8
1.510	4	—
1.990	4	—
2.000	4	6
3.000	4	—
3.999	4	—
4.000	4	6
5.000	4	—
7.999	4	—
8.000	4	6
9.000	4	—
12.000	4	—
15.000	4	—
16.000	4	6
17.000	4	—
24.000	4	—
31.990	4	—

i. Remove the signal generator connection from the receiver antenna terminals. Connect the ANT ANGLED ANTENNA jack through Electrical Dummy Load AB-131/U and adapter UG-636A/U.

j. Repeat the procedure in *d* through *h* above for all the test frequencies and sensitivity limits shown in the chart below.

Note. The gain variation of gain within any coil range should not exceed four to one.

CHAPTER 7
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

b. Packaging.

...se each manual in a close-fitting ... made of waterproof barrier ma... Seal the seams with water- ... bag. Wrap the manuals with ... surfaces. ... aced cor... to absorb ... by han... the cush... ape.

d. Disconnect the power cable from the ac outlet and wind the cable around the clips provided for it on the rear panel of the receiver.

169. Disassembly

The following instructions are prepared as a guide for preparing the receiver for transportation and storage.

a. Disconnect the antenna lead-in cable. ... cess...

b. Remove all connectors or ... cess... strips on the rear panel of the receiver.

c. Unplug the headphone cord from the PHONES jack on the front panel.

(2) Cushion the receiver on all ... with pads made of single-fa... rugated fiberboard, in order ... shocks that might be caused ... dling and shipping. Secure t... ioning with gummed paper t...

c. Packing.

(1) Line the nailed wooden b... waterproof barri... enough material ... sealed over the r... placed in the box.

(2) Place the package ... packaged manuals ...

(3) Seal the waterpro... with the water-resi... sitive tape.

(4) Nail the top on th...

(5) On intertheatre sh...

170. Repacking for Shipment or Limited Storage

...er with ... er material—leave ... so that it may be ... receiver when it is ...

...ed receiver and the ... in the box.

...of barrier material ...istant, pressure-sen...

...e wooden box.

...ipments only, apply ...

The exact procedure for repacking depends on the material available and the conditions under which the receiver is to be shipped or stored. Use the procedures outlined in *a* through *c* below whenever possible. The information concerning the original packaging (par. 12 and fig. 6) will also be helpful.

a. Material Requirements.

Material	*Quantity*
Waterproof barrier material	22 sq ft
Fiberboard, corrugated, single-faced	40 sq ft
Tape, gummed, paper	...

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

171. Authority for Demolition

The receiver and its accessories will be demolished only upon the order of the commander. The demolition procedures outlined in paragraph 172 will be used to prevent the enemy from using or salvaging the equipment.

172. Methods of Destruction

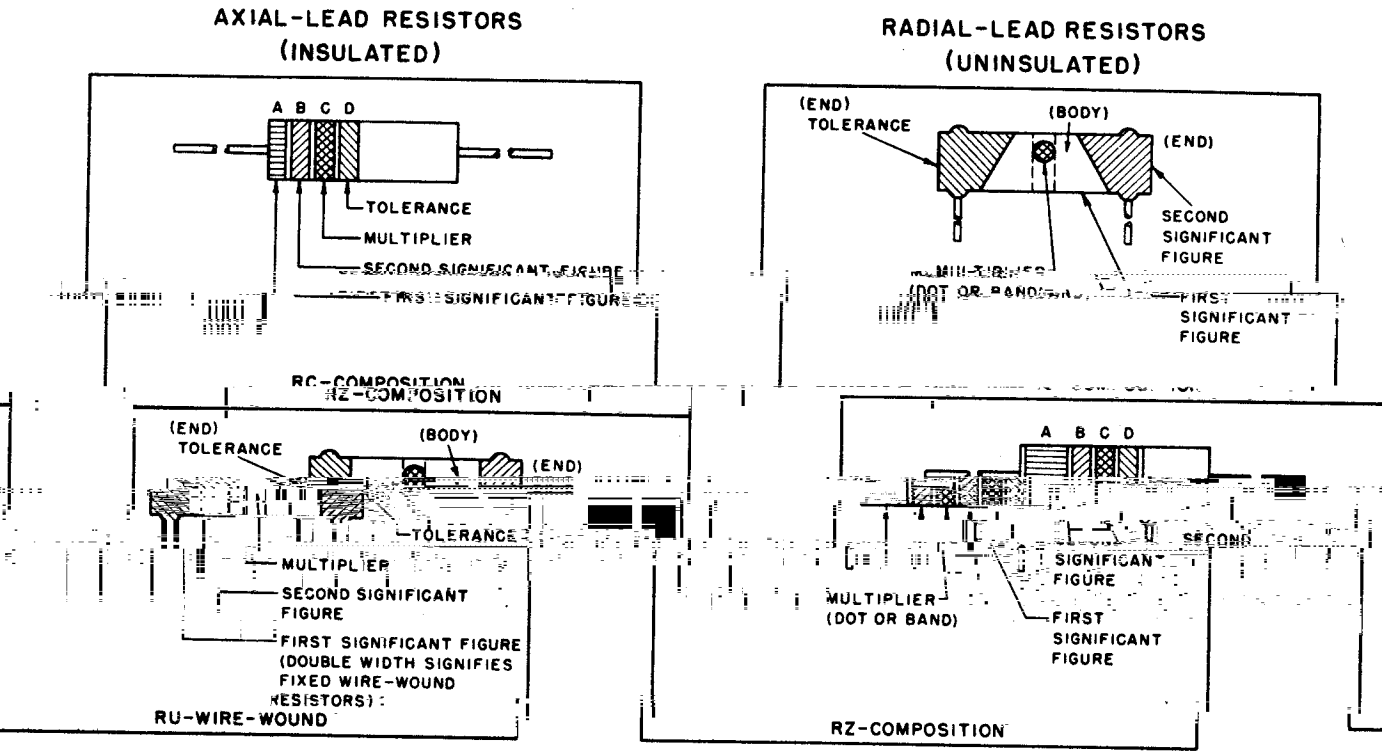
power cord, the antenna lead-
headset cord; use an axe, a
hete.
cords, cables, and manuals;
osene, oil, flamethrowers, or
es.

handaxes, pickaxes, hammers, crowbars, or

b. Cut. Cut the
in cable, and the
handaxe, or a mac

c. Burn. Burn
use gasoline; kero
incendiary grenad

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*		BAND E
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESIS TOLE (PER
BLACK	0	BLACK	0	BLACK	1	BODY	±
BROWN	1	BROWN	1	BROWN	10	SILVER	±
RED	2	RED	2	RED	100	GOLD	±
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

STANCE RANCE RCENT)
20
10
5

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

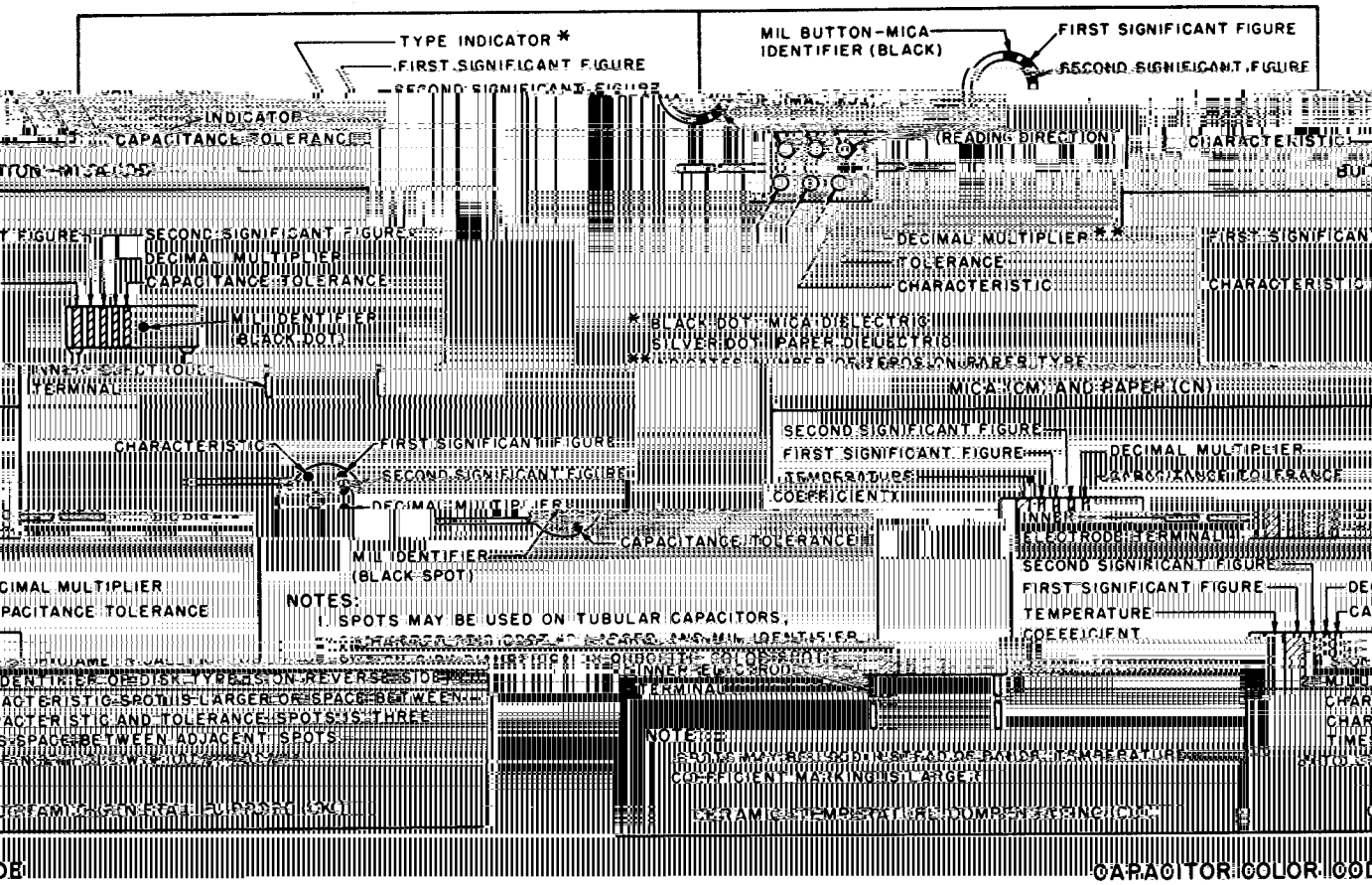
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
3,000 OHMS ±10 PERCENT: ORANGE BODY, BLACK END, RED DOT OR BAND, SILVER END.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BL
GOLD BAND C; GOLD

STD-RI

Figure 100. Resistor color code.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



TOLERANCE 2					TEMPERATURE COEFFICIENT (UUF/UF/°C)
M	CN	CB	CC		
			OVER 10UUF	10UUF OR LESS	CC
)	20	20	20	2	ZERO
			1		-30
		2	2		-80
	30				-150
					-220
			5	0.5	-330
					-470
					-750
				0.25	+30
		10	1		-330(±500) 3
	5				+100
10	10				

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC 1				
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CI
BLACK	0	1	NONE		A			20
BROWN	1	10	1	B	E	B	W	
RED	2	100	2	C	H		X	2
ORANGE	3	1,000	3	D	J	D		
YELLOW	4	10,000	4	E	P			
GREEN	5		5	F	R			
BLUE	6		6		S			
PURPLE (VIOLET)	7		7		W			
GRAY	8		8		X			
WHITE	9		9					
GOLD		0.1					5	
SILVER		0.01					10	

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C-[illegible] SPECIFICATIONS
2. IN PERCENT, EXCEPT IN UUF FOR CC TYPE CAPACITORS OF 10UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-01

Figure 101. Capacitor color code.

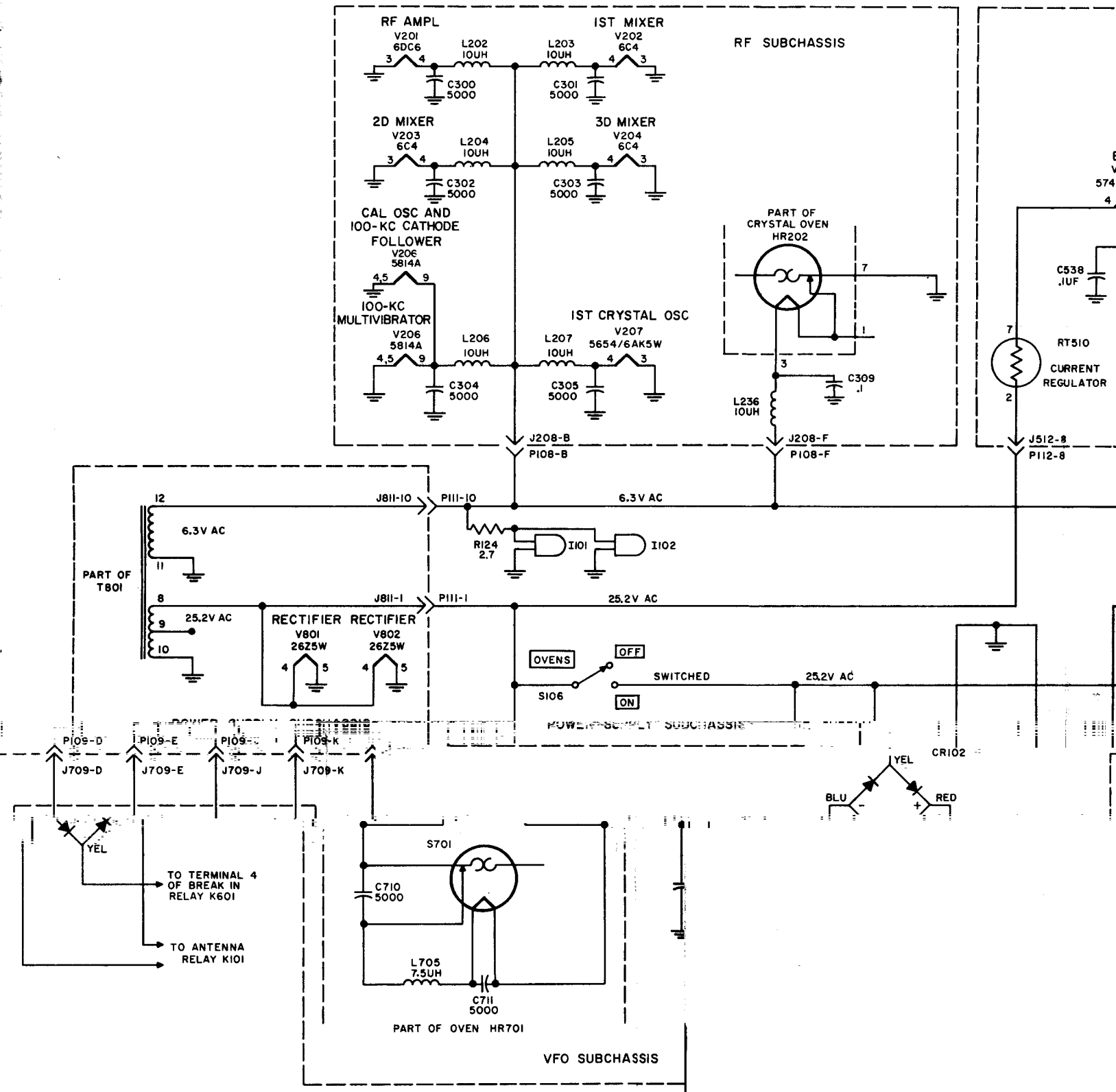
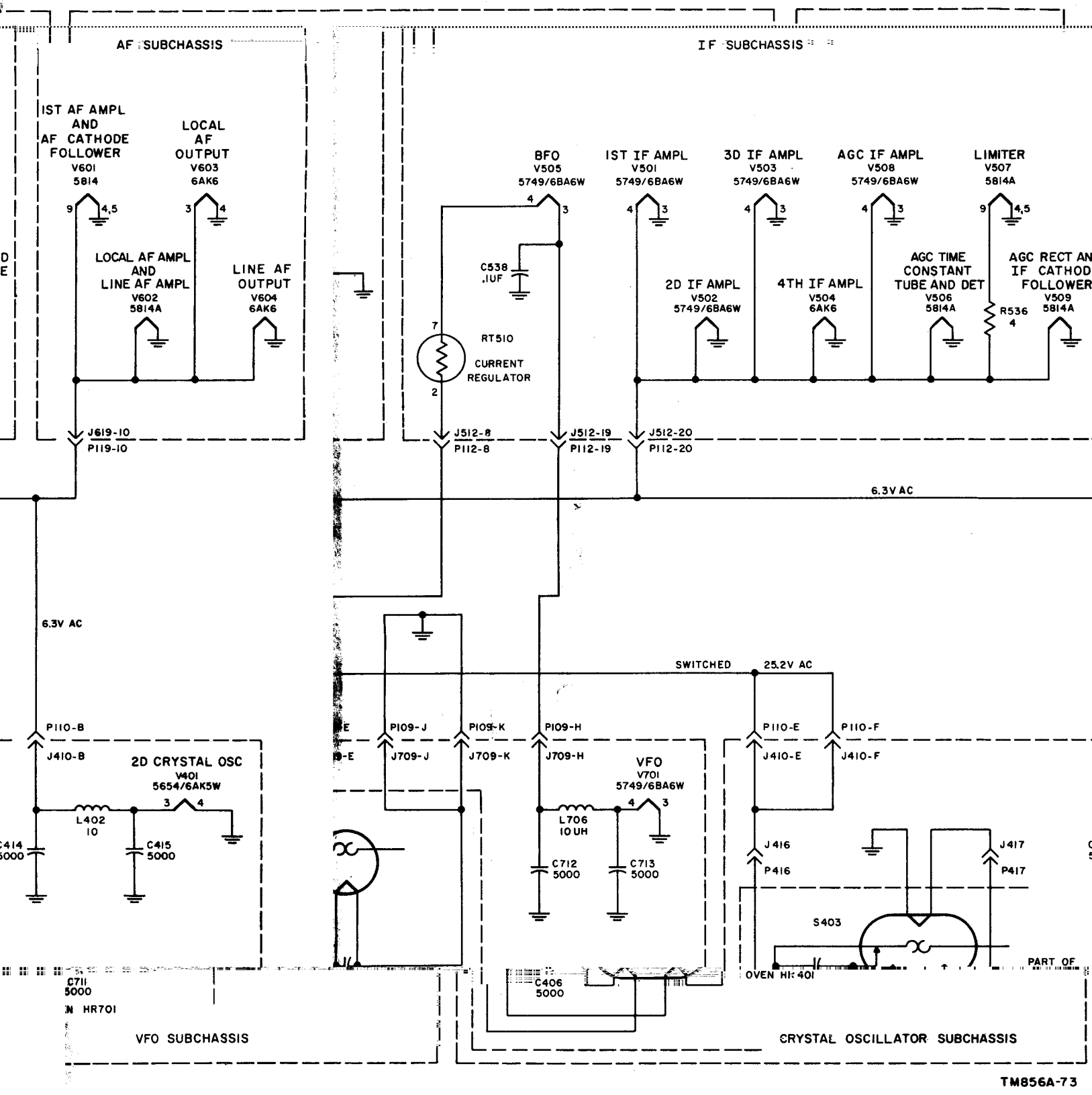
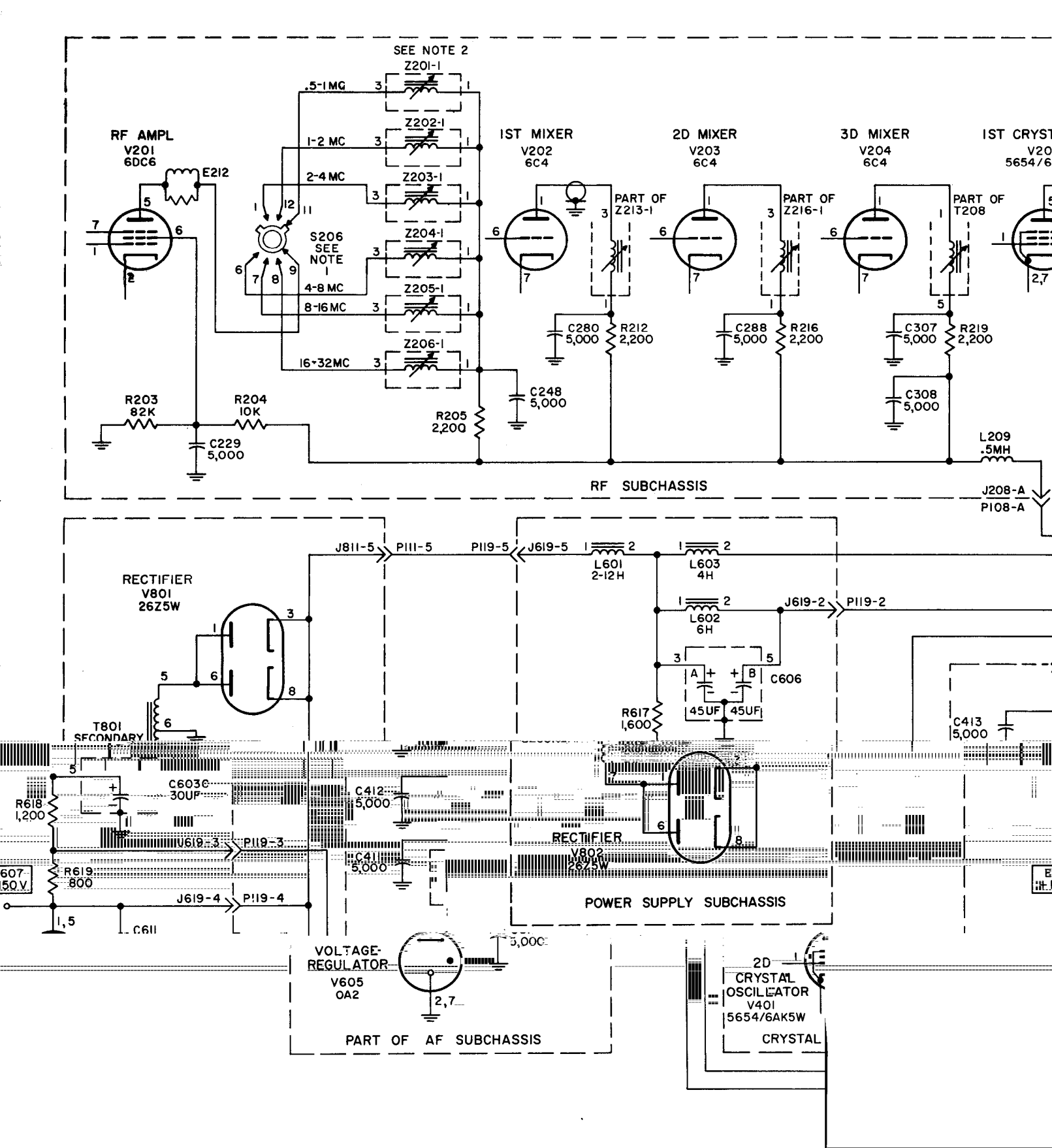
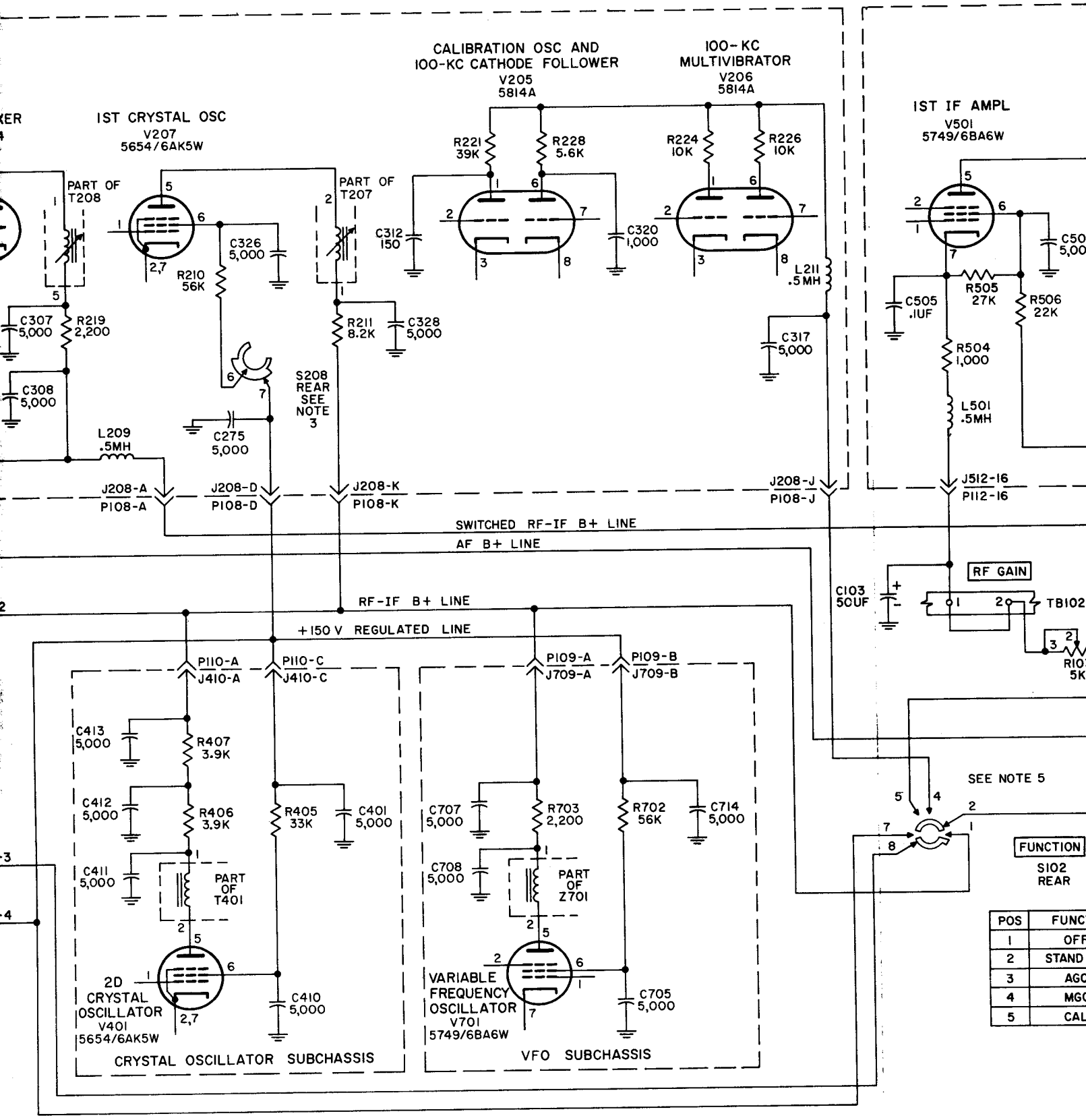


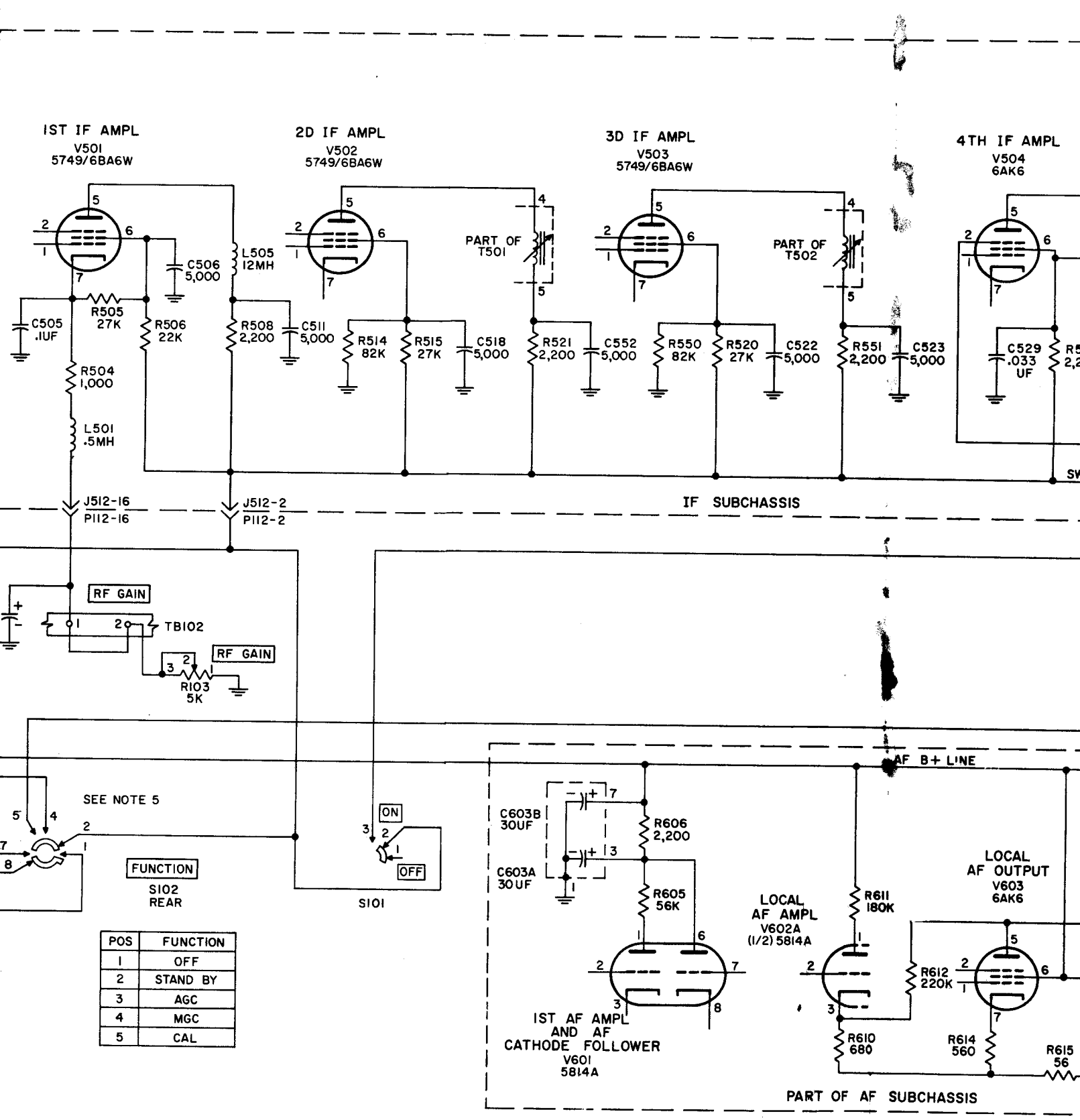
Figure 102. Filament and oven circuits, s



Filament and oven circuits, schematic diagram.

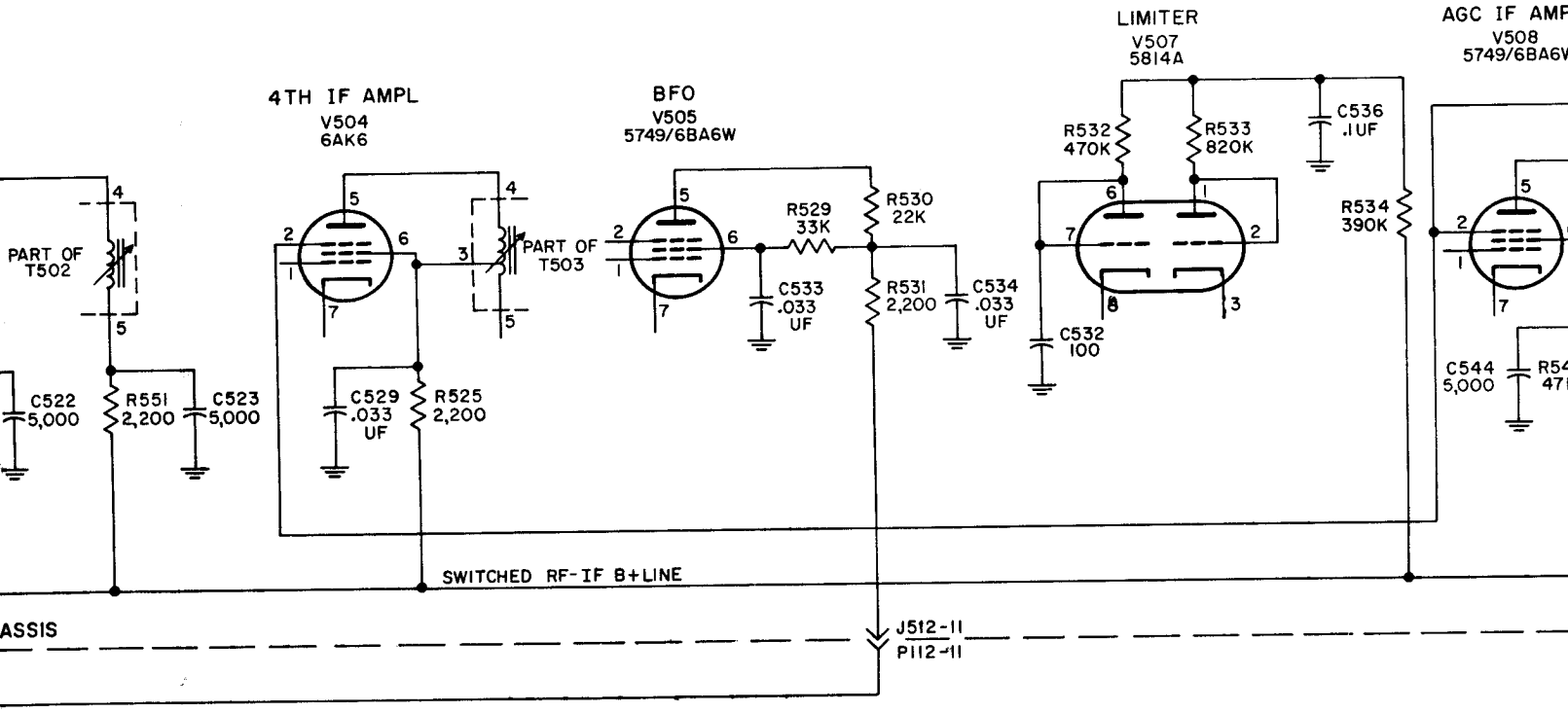

SEE NOTE 2
Z201-1
.5-1 MC
Z202-1
1-2 MC
Z203-1
2-4 MC
Z204-1
4-8 MC
Z205-1
8-16 MC
Z206-1
16-32 MC
RF AMPL
V201
6DC6
E212
S206
SEE
NOTE
1ST MIXER
V202
6C4
2D MIXER
V203
6C4
3D MIXER
V204
6C4
1ST CRYST
V20
5654/6
PART OF
Z213-1
PART OF
Z216-1
PART OF
T208
C280
5,000
R212
2,200
C288
5,000
R216
2,200
C307
5,000
R219
2,200
C308
5,000
C248
5,000
R205
2,200
R203
82K
R204
10K
C229
5,000
L209
.5MH
RF SUBCHASSIS
J208-A
P108-A
J811-5
P111-5
P119-5
J619-5
L601
2-12H
L603
4H
L602
6H
J619-2
P119-2
RECTIFIER
V801
26Z5W
T801
SECONDARY
C606
45UF
45UF
R617
1,600
C413
5,000
C603
30UF
C412
5,000
C411
5,000
R618
1,200
R619
800
J619-3
P119-3
J619-4
P119-4
RECTIFIER
V802
26Z5W
POWER SUPPLY SUBCHASSIS
VOLTAGE-
REGULATOR
V605
0A2
PART OF AF SUBCHASSIS
2D
CRYSTAL
OSCILLATOR
V401
5654/6AK5W
CRYSTAL

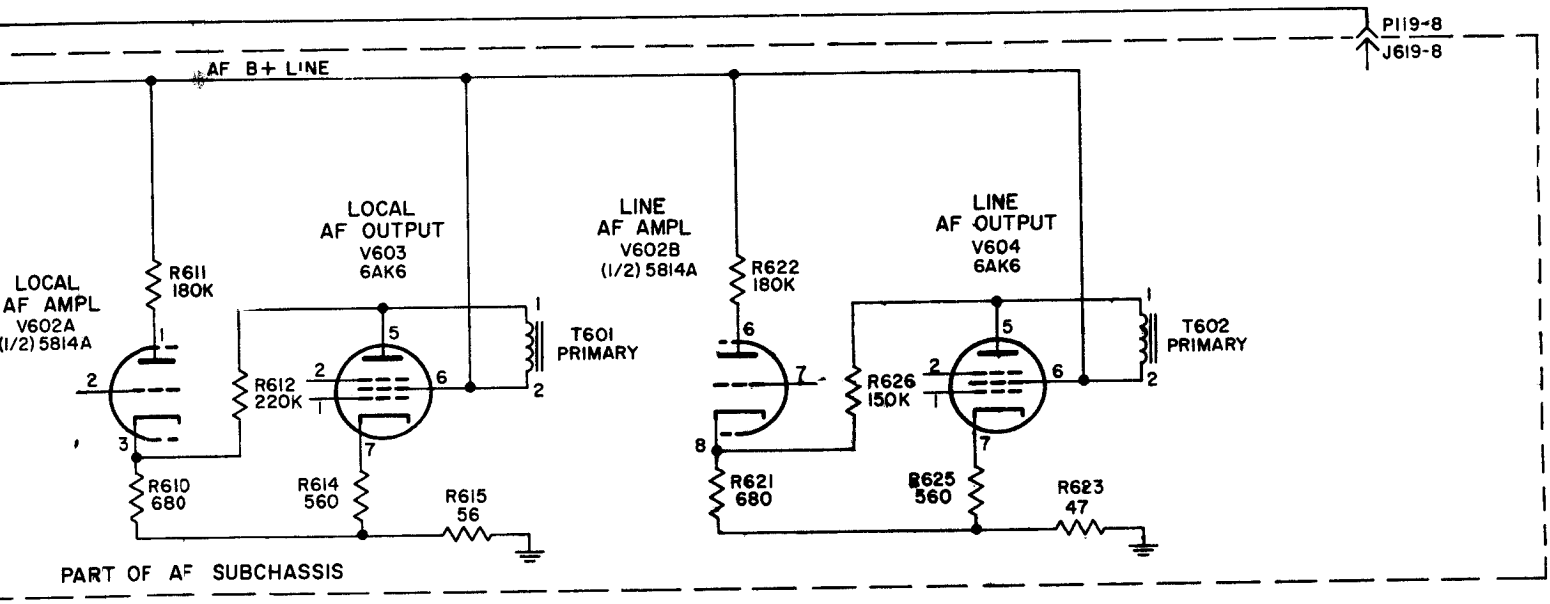

CALIBRATION OSC AND
100-KC CATHODE FOLLOWER
V205
5814A
100-KC
MULTIVIBRATOR
V206
5814A
1ST CRYSTAL OSC
V207
5654/6AK5W
1ST IF AMPL
V501
5749/6BA6W
PART OF T208
PART OF T207
R221 39K
R228 5.6K
R224 10K
R226 10K
C312 150
C320 1,000
L211 .5MH
C317 5,000
C326 5,000
R210 56K
R211 8.2K
C328 5,000
C307 5,000
R219 2,200
C308 5,000
L209 .5MH
C275 5,000
S208 REAR SEE NOTE 3
C505 .1UF
R505 27K
R506 22K
R504 1,000
L501 .5MH
J208-A P108-A
J208-D P108-D
J208-K P108-K
J208-J P108-J
J512-16 P112-16
SWITCHED RF-IF B+ LINE
AF B+ LINE
RF-IF B+ LINE
+150 V REGULATED LINE
RF GAIN
C103 50UF
TB102
P110-A J410-A
P110-C J410-C
P109-A J709-A
P109-B J709-B
C413 5,000
R407 3.9K
C412 5,000
R406 3.9K
R405 33K
C401 5,000
C411 5,000
PART OF T401
C410 5,000
2D CRYSTAL OSCILLATOR V401 5654/6AK5W
CRYSTAL OSCILLATOR SUBCHASSIS
C707 5,000
R703 2,200
R702 56K
C714 5,000
C708 5,000
PART OF Z701
VARIABLE FREQUENCY OSCILLATOR V701 5749/6BA6W
C705 5,000
VFO SUBCHASSIS
SEE NOTE 5
FUNCTION S102 REAR
POS FUNC
1 OFF
2 STAND
3 AGC
4 MG
5 CAL

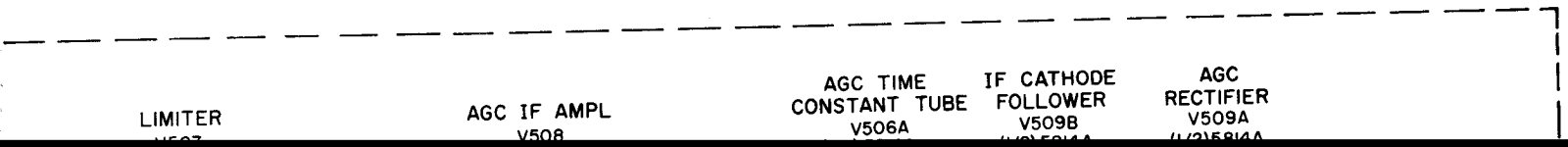


POS	FUNCTION
1	OFF
2	STAND BY
3	AGC
4	MGC
5	CAL

Figure 103. B+ circuits, schematic diagram.


4TH IF AMPL
V504
6AK6
BFO
V505
5749/6BA6W
LIMITER
V507
5814A
AGC IF AMP
V508
5749/6BA6W
PART OF T502
PART OF T503
C522 5,000
R551 2,200
C523 5,000
C529 .033 UF
R525 2,200
R529 33K
R530 22K
C533 .033 UF
R531 2,200
C534 .033 UF
R532 470K
R533 820K
C536 .1UF
R534 390K
C532 100
C544 5,000
SWITCHED RF-IF B+LINE
J512-11
P112-11


P119-8
J619-8
AF B+ LINE
LOCAL AF AMPL V602A (1/2) 5814A
R611 180K
R610 680
LOCAL AF OUTPUT V603 6AK6
R612 220K
R614 560
R615 56
T601 PRIMARY
LINE AF AMPL V602B (1/2) 5814A
R622 180K
R621 680
LINE AF OUTPUT V604 6AK6
R626 150K
R625 560
R623 47
T602 PRIMARY
PART OF AF SUBCHASSIS


LIMITER
AGC IF AMPL
V508
AGC TIME
CONSTANT TUBE
V506A
IF CATHODE
FOLLOWER
V509B
AGC
RECTIFIER
V509A

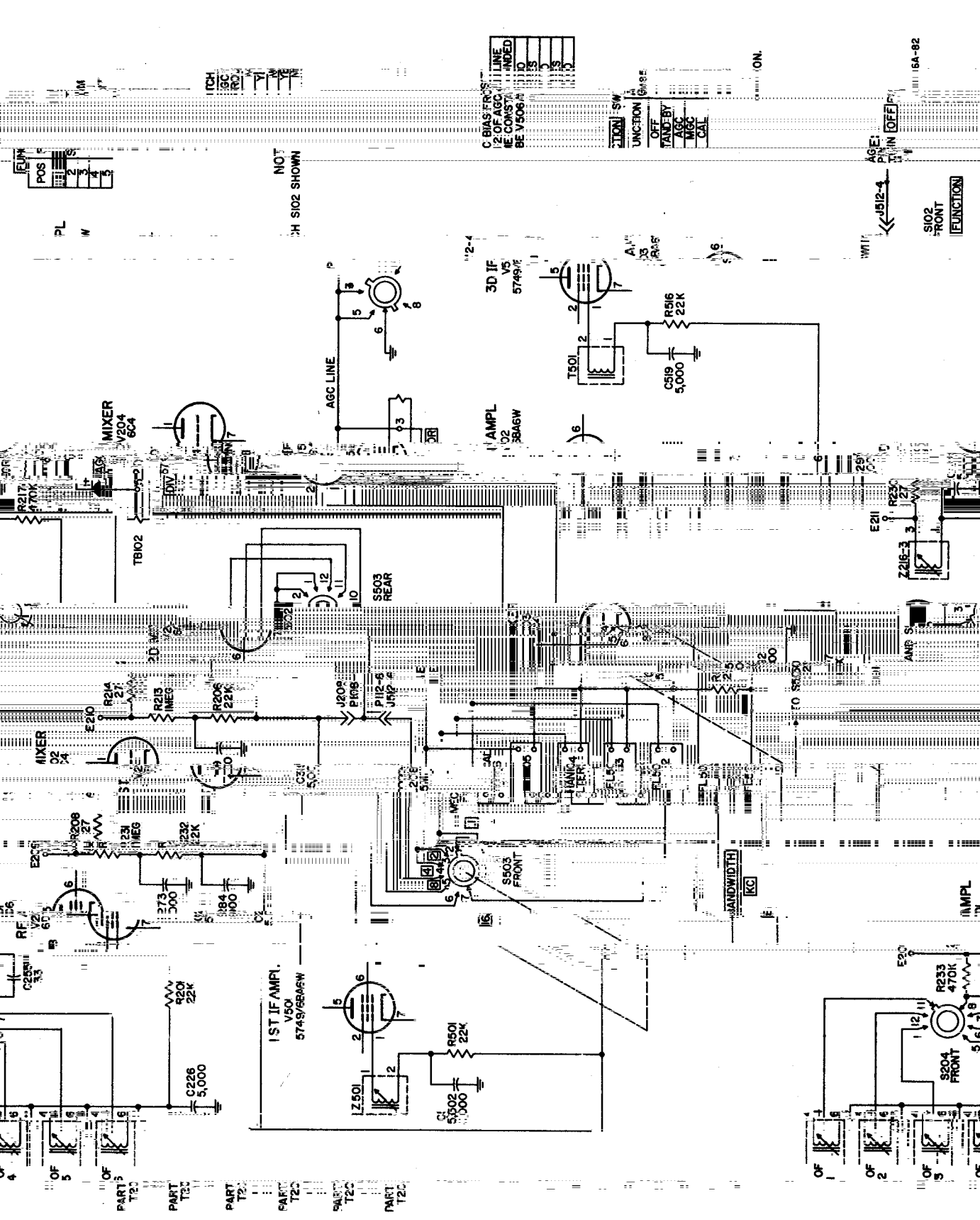


Figure 104. Agc bias distribution, schematic diagram.

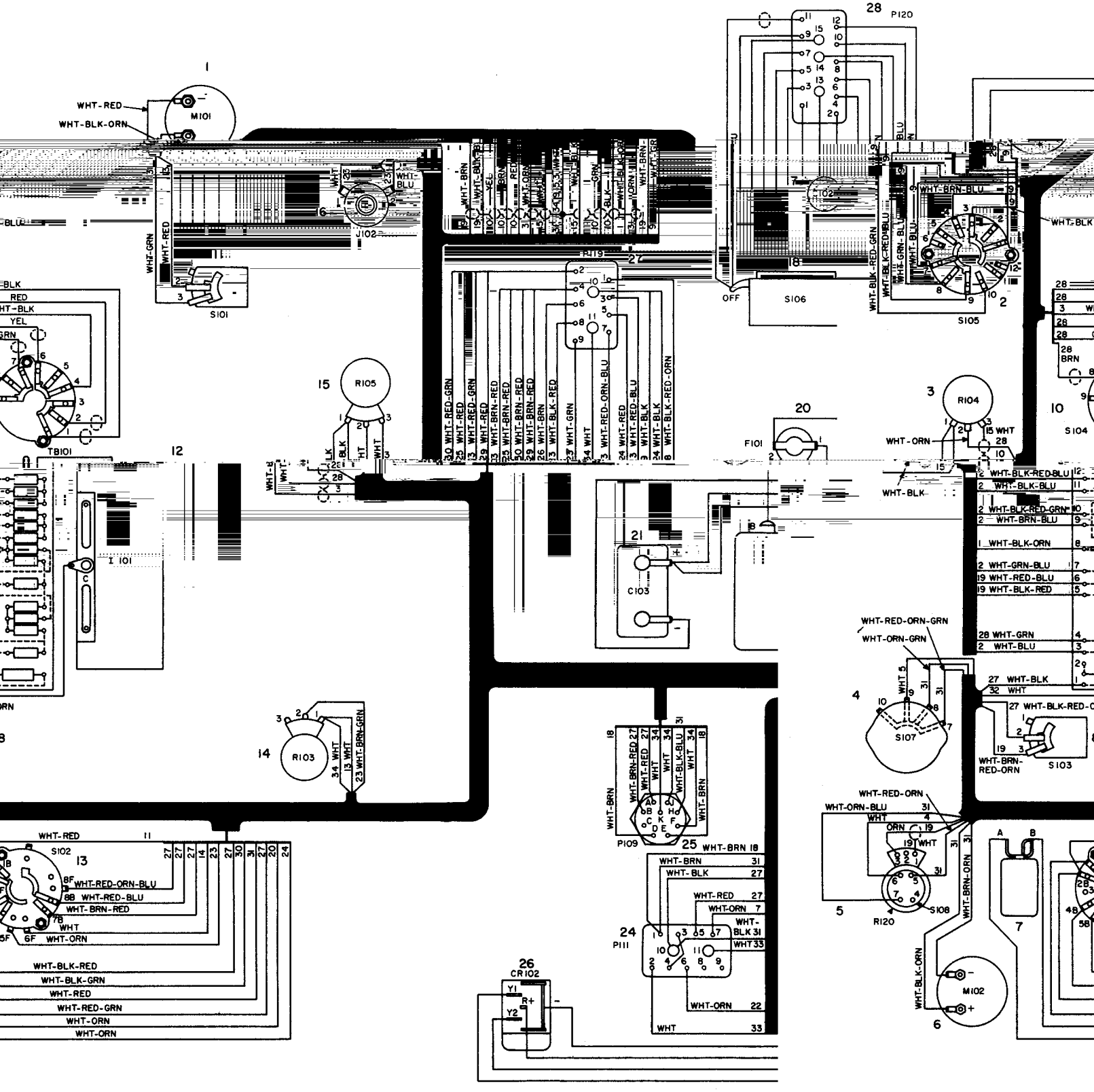
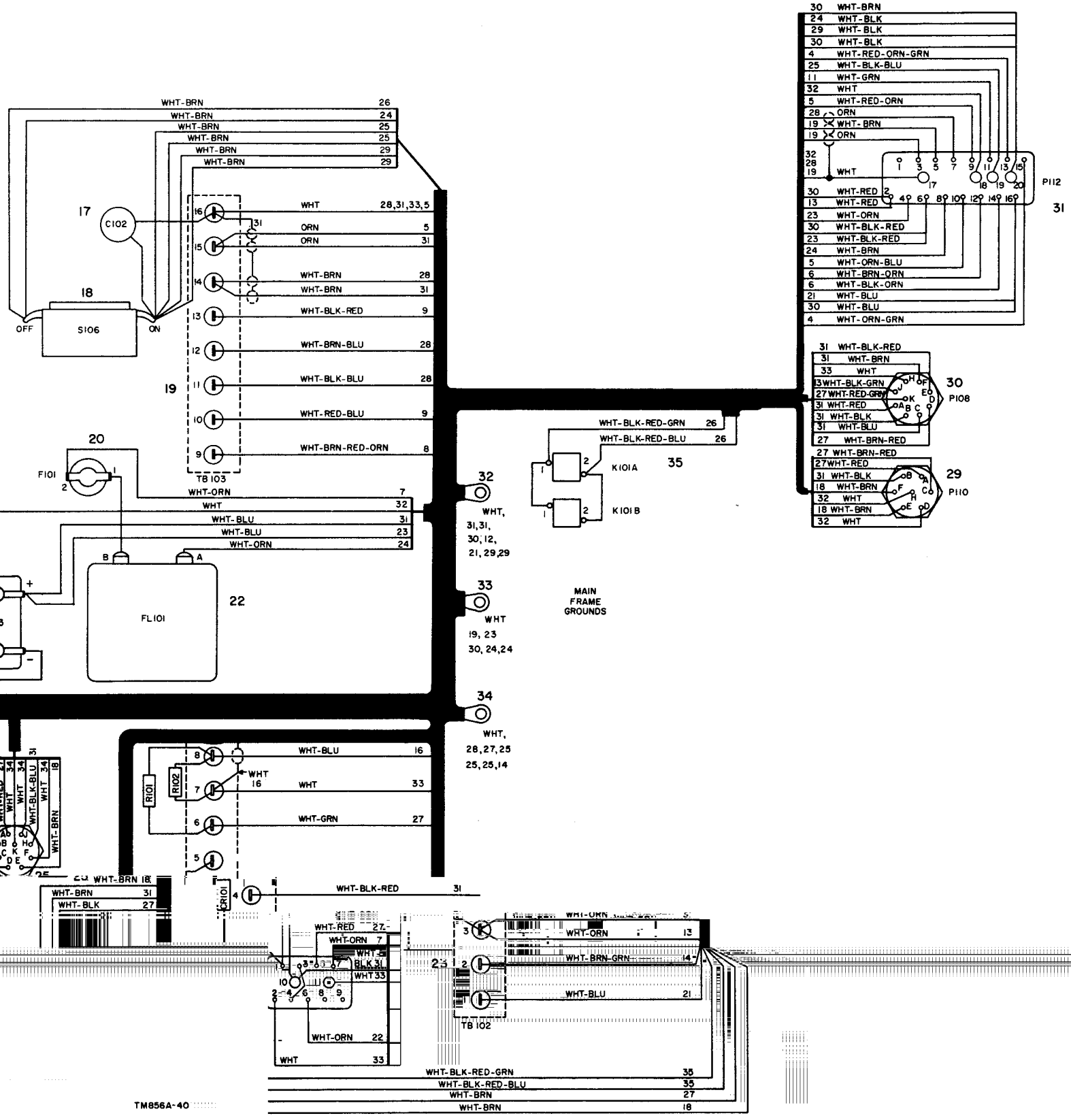


Figure 105. Main fr



igure 105. Main frame, wiring diagram.

ZONING FOR SCHEMATIC DIAGRAM FIGURE 5-13 (SHEET 1 of 4) (Cont)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
R228	9C	S205	12C	V201	9E	Z203-1	7D
R229	9B	S206	8D	V202	4E	Z203-2	6D
R231	3E	S207	5D	V205A	10B	Z204-1	7C
R232	3C	S208 (front)	2D	V205B	9B	Z204-2	6C
R233	9D	S208 (rear)	2E	V206	10B	Z205-1	7C
R234	12B	T201	13E	V207	4D	Z205-2	6C
R235	11C	T202	13D	Y201	5D	Z206-1	7B
S201	14D	T203	13D	Y203	11C	Z206-2	6B
S202	14C	T204	13C	Z201-1	7E	Z213-1	2E
S203 (front)	12B	T205	13C	Z201-2	6E	Z213-2	2D
S203 (rear)	12C	T206	13B	Z202-1	7D	Z213-3	2D
S204	12D	T207	4D	Z202-2	6D		

GENERAL NOTES:

A. UNLESS OTHERWISE INDICATED, ELECTRICAL VALUES ARE EXPRESSED IN PICOFARADS, MICROHENRIES, AND OHMS.

B. [ ] INDICATES EQUIPMENT MARKING.

SPECIFIC NOTES:

1. ANTENNA, RF, AND VARIABLE IF COILS ARE TUNED AS FOLLOWS:

   CONTINUOUSLY WITH [KILOCYCLE CHANGE] , ALL COILS.

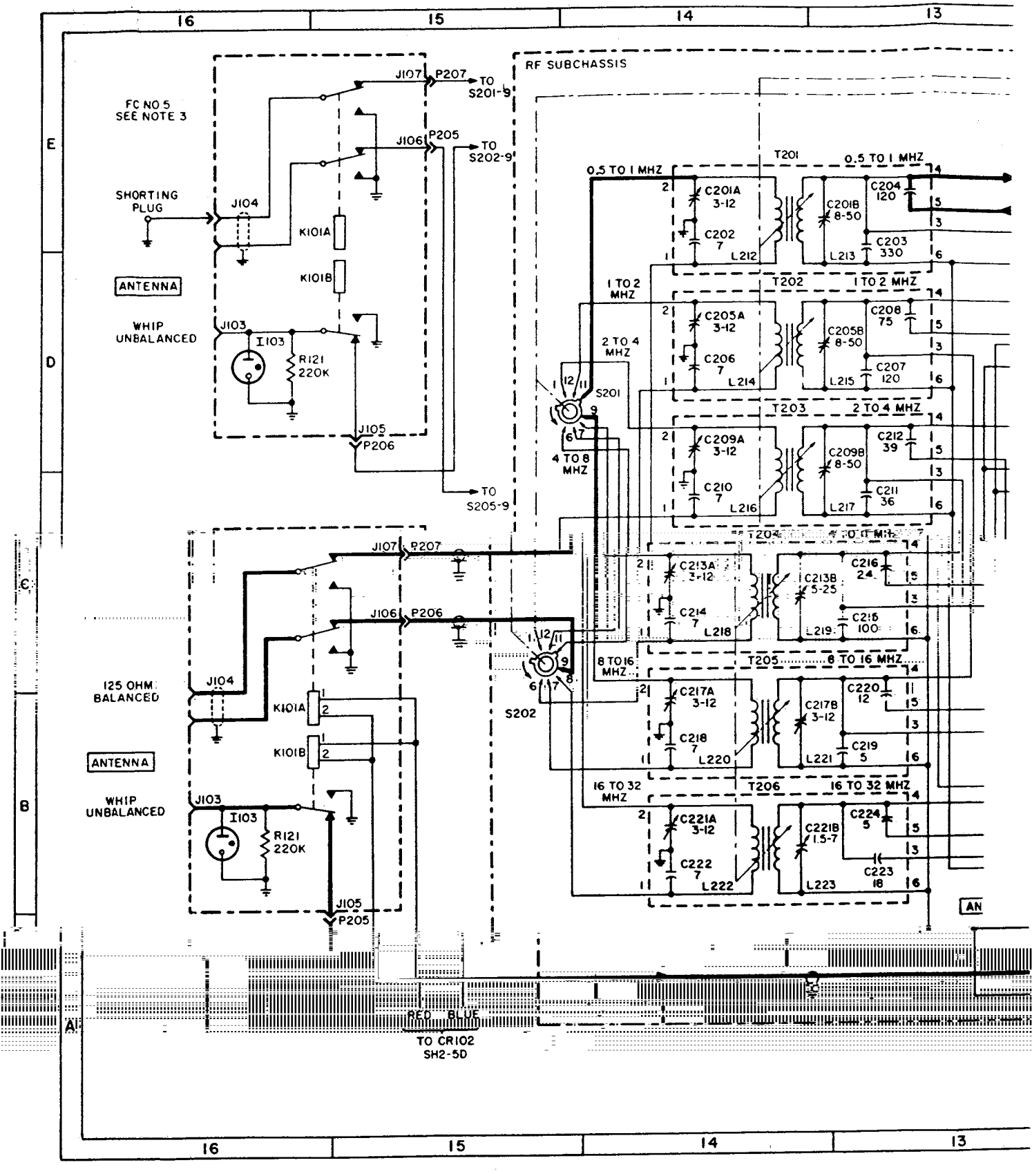
   INTERMITTENTLY WITH [MEGACYCLE CHANGE] . T203 THRU T206, Z203-1 THRU Z206-1, Z203-2 THRUZ206-2, AND Z213-1 THRU Z213-3.

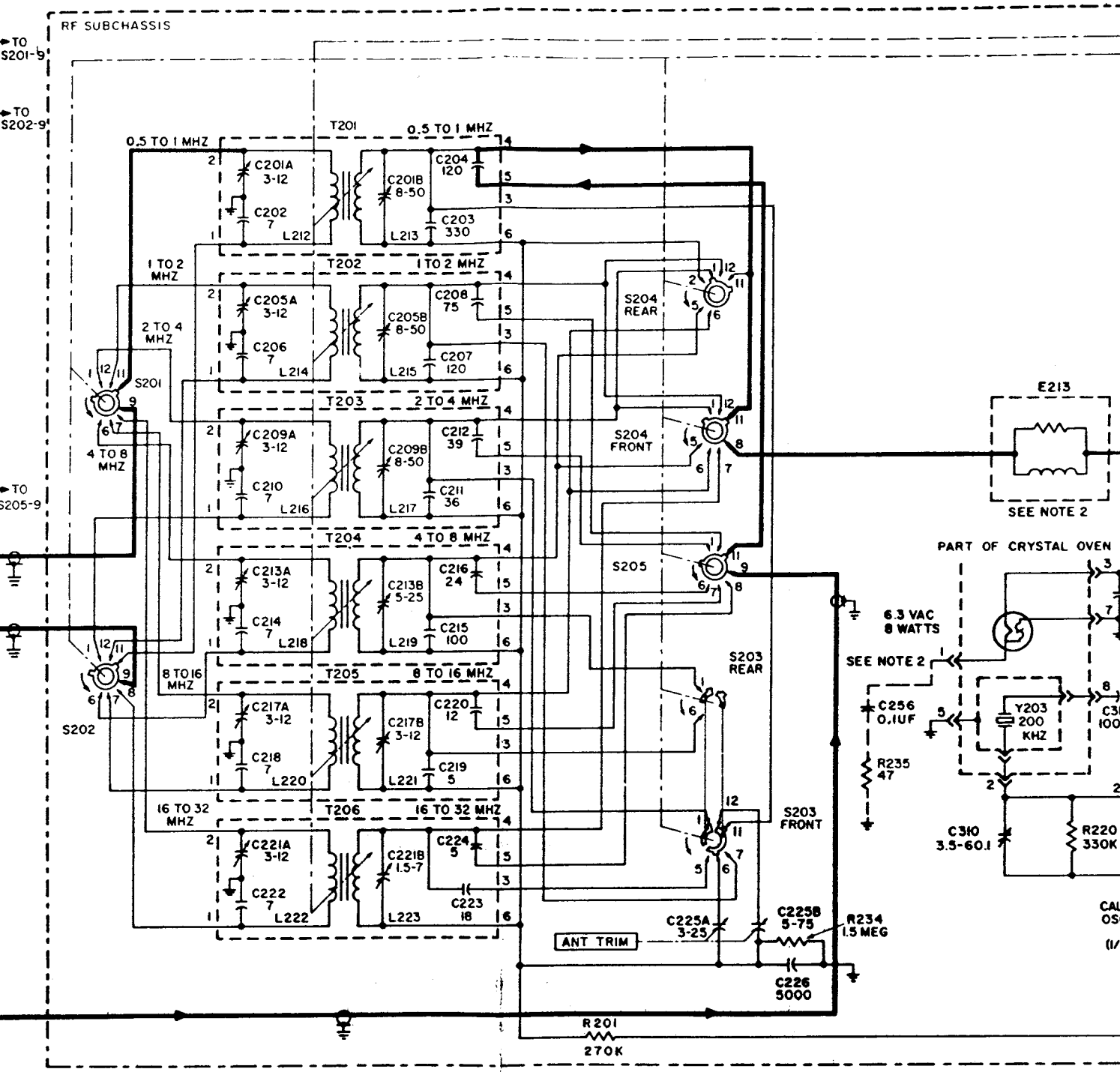
2. REFER TO TABLE 1-9, PRODUCTION MODIFICATIONS.

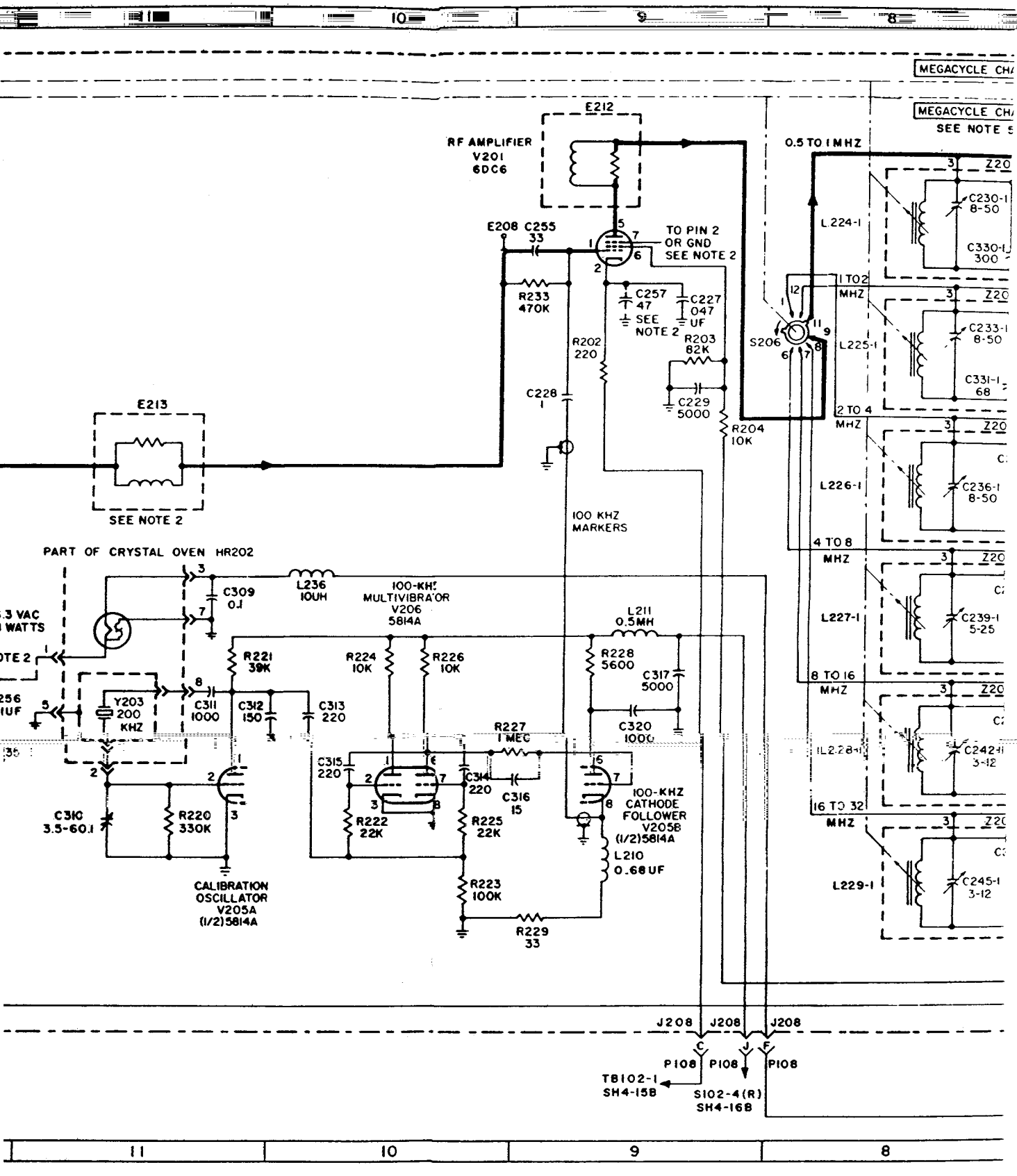
3. REFER TO TABLE 1-8, FIELD CHANGE DATA, AND FIGURE 5-15.

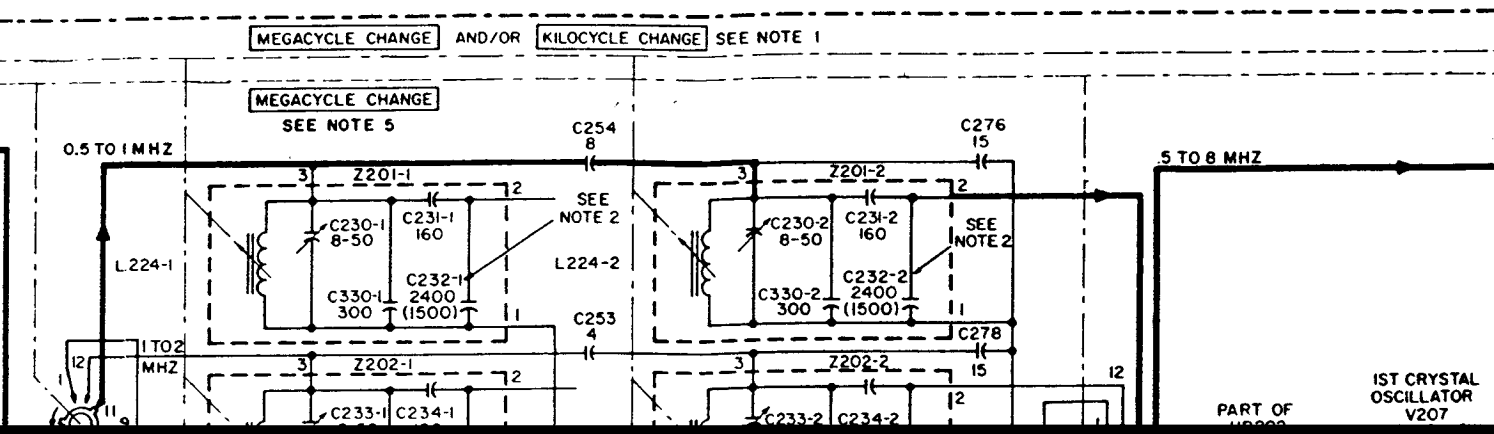
4. REFER TO FIGURE 5-4, VOLTAGE AND RESISTANCE DIAGRAM.

5. SCHEMATIC SHOWN WITH [MEGACYCLE CHANGE] SET FOR THE .5 TO 1 MC BAND.


16
15
14
13
RF SUBCHASSIS
FC NO 5
SEE NOTE 3
SHORTING
PLUG
ANTENNA
WHIP
UNBALANCED
125 OHM
BALANCED
J104
J103
J105
J106
J107
P205
P206
P207
I103
R121
220K
K101A
K101B
TO
S201-9
TO
S202-9
TO
S205-9
S201
S202
T201
T202
T203
T204
T205
T206
0.5 TO 1 MHZ
1 TO 2
MHZ
2 TO 4
MHZ
4 TO 8
MHZ
8 TO 16
MHZ
16 TO 32
MHZ
C201A
3-12
C201B
8-50
C202
7
C203
330
C204
120
L212
L213
C205A
3-12
C205B
8-50
C206
7
C207
120
C208
75
L214
L215
C209A
3-12
C209B
8-50
C210
7
C211
36
C212
39
L216
L217
C213A
3-12
C213B
5-25
C214
7
C215
100
C216
24
L218
L219
C217A
3-12
C217B
3-12
C218
7
C219
5
C220
12
L220
L221
C221A
3-12
C221B
1.5-7
C222
7
C223
18
C224
5
L222
L223
RED
BLUE
TO CR102
SH2-5D
AN


RF SUBCHASSIS
TO S201-9
TO S202-9
TO S205-9
T201
0.5 TO 1 MHZ
C201A 3-12
C202 7
L212
C201B 8-50
L213
C204 120
C203 330
T202
1 TO 2 MHZ
C205A 3-12
C206 7
L214
C205B 8-50
L215
C208 75
C207 120
T203
2 TO 4 MHZ
C209A 3-12
C210 7
L216
C209B 8-50
L217
C212 39
C211 36
T204
4 TO 8 MHZ
C213A 3-12
C214 7
L218
C213B 5-25
L219
C216 24
C215 100
T205
8 TO 16 MHZ
C217A 3-12
C218 7
L220
C217B 3-12
L221
C220 12
C219 5
T206
16 TO 32 MHZ
C221A 3-12
C222 7
L222
C221B 1.5-7
L223
C224 5
C223 18
S201
S202
S203 REAR
S203 FRONT
S204 REAR
S204 FRONT
S205
ANT TRIM
C225A 3-25
C225B 5-75
R234 1.5 MEG
C226 5000
R201 270K
E213
SEE NOTE 2
PART OF CRYSTAL OVEN
6.3 VAC 8 WATTS
SEE NOTE 2
C256 0.1UF
Y203 200 KHZ
R235 47
C310 3.5-60.1
R220 330K


MEGACYCLE CH
MEGACYCLE CH
SEE NOTE 5
E212
RF AMPLIFIER
V201
6DC6
E208 C255
33
TO PIN 2
OR GND
SEE NOTE 2
R233
470K
C257
47
SEE
NOTE 2
C227
047
UF
R202
220
R203
82K
C228
1
C229
5000
R204
10K
0.5 TO 1 MHZ
L224-1
C230-1
8-50
C330-1
300
1 TO 2
MHZ
L225-1
C233-1
8-50
C331-1
68
S206
2 TO 4
MHZ
L226-1
C236-1
8-50
4 TO 8
MHZ
L227-1
C239-1
5-25
8 TO 16
MHZ
C242-1
3-12
16 TO 32
MHZ
L229-1
C245-1
3-12
E213
SEE NOTE 2
100 KHZ
MARKERS
PART OF CRYSTAL OVEN HR202
C309
0.1
L236
10UH
100-KHZ
MULTIVIBRATOR
V206
5814A
L211
0.5MH
R221
39K
R224
10K
R226
10K
R228
5600
C317
5000
C320
1000
Y203
200
KHZ
C311
1000
C312
150
C313
220
R227
1 MEG
C315
220
C314
220
C316
15
C310
3.5-60.1
R220
330K
R222
22K
R225
22K
R223
100K
R229
33
100-KHZ
CATHODE
FOLLOWER
V205B
(1/2)5814A
L210
0.68 UF
CALIBRATION
OSCILLATOR
V205A
(1/2)5814A
J208
J208
J208
P108
P108
P108
TB102-1
SH4-15B
S102-4(R)
SH4-16B


MEGACYCLE CHANGE AND/OR KILOCYCLE CHANGE SEE NOTE 1
MEGACYCLE CHANGE
SEE NOTE 5
0.5 TO 1 MHZ
C254
8
C276
15
.5 TO 8 MHZ
Z201-1
Z201-2
SEE NOTE 2
C230-1
8-50
C231-1
160
C232-1
2400
(1500)
C330-1
300
L224-1
L224-2
C230-2
8-50
C231-2
160
C232-2
2400
(1500)
C330-2
300
C253
4
C278
1 TO 2 MHZ
Z202-1
Z202-2
C233-1
C234-1
C233-2
C234-2
PART OF
IST CRYSTAL OSCILLATOR V207

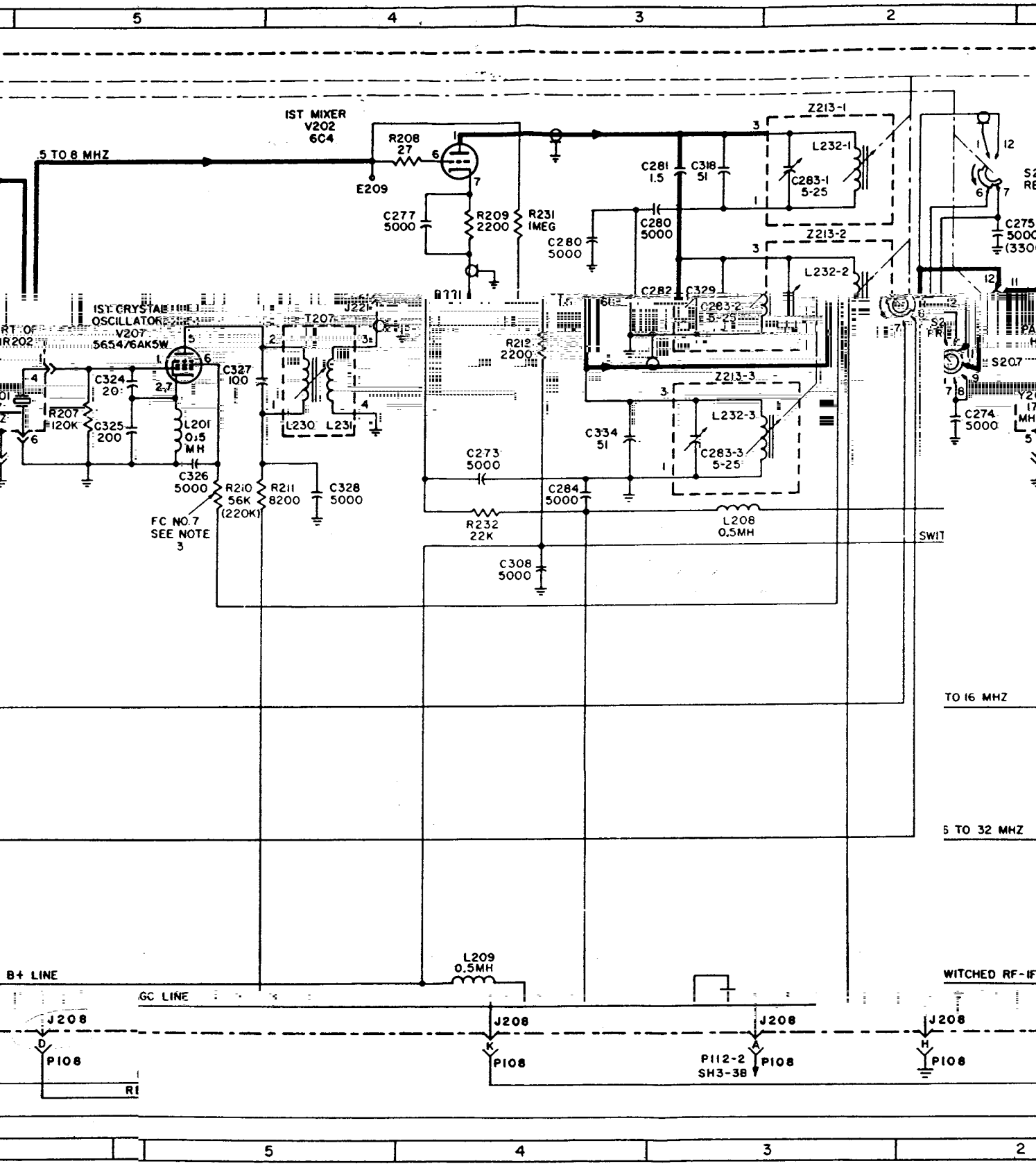
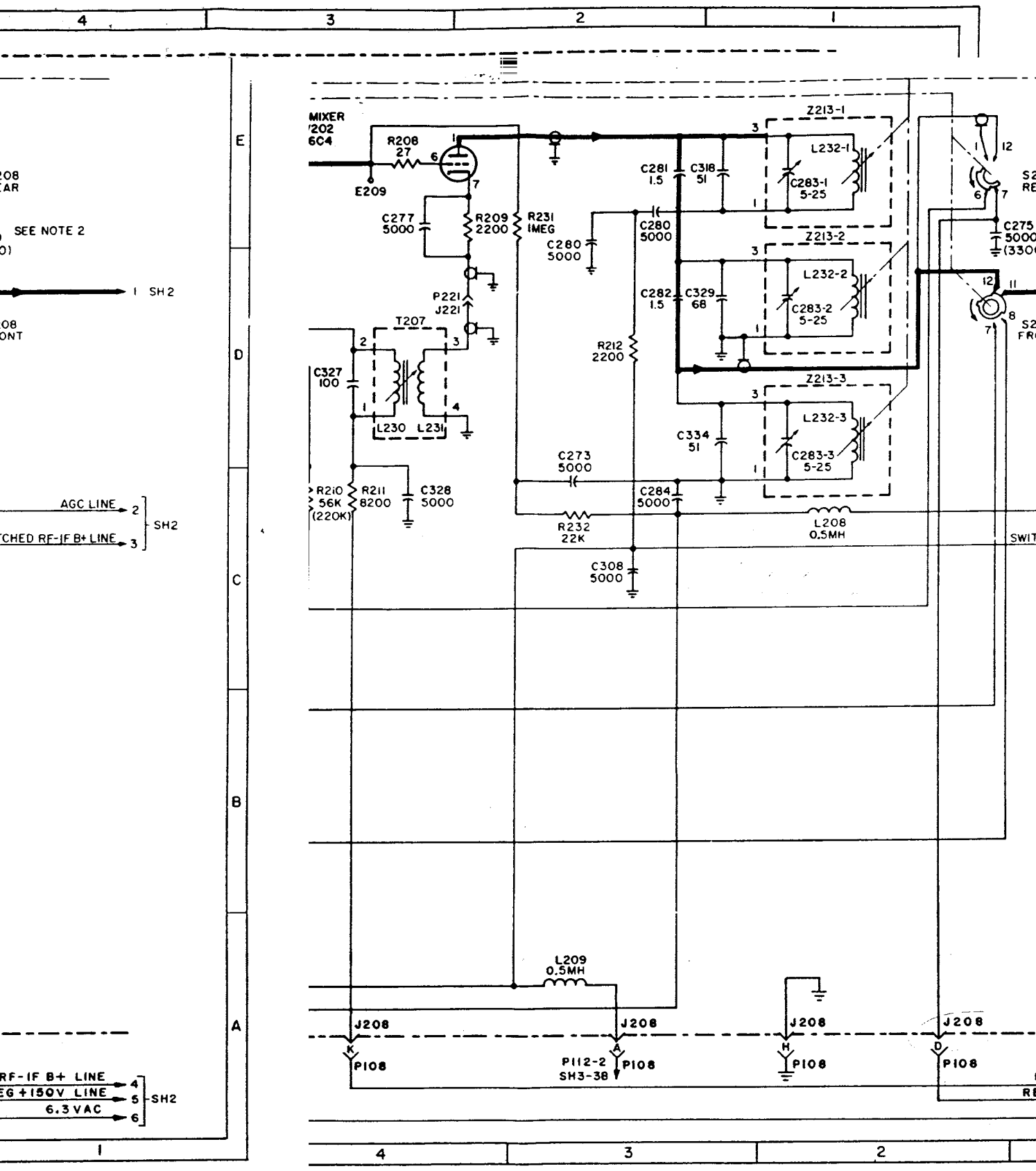


Figure 5-13. Sc
(Sheet



chematic Diagram
1 of 4)

Figure 5-13. Sc
(Sheet

ZONING FOR SCHEMATIC DIAGRAM FIGURE 5-13 (SHEET 2 of 4) (Cont)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
Y405	2C	Y409	2D	Y413	1C	Z216-2	13D, 14D
Y406	1C	Y410	2D	Y414	1D	Z216-3	13D, 14D
Y407	2C	Y411	2D	Y415	1D	Y702	11C, 12C
Y408	1C	Y412	2D	Z216-1	13E, 14E		

GENERAL NOTES:

A. UNLESS OTHERWISE INDICATED, ELECTRICAL VALUES ARE EXPRESSED IN PICOFARADS, MICROHENRIES, AND OHMS.

B. [ ] INDICATES EQUIPMENT MARKING.

SPECIFIC NOTES:

1. ANTENNA, RF, AND VARIABLE IF COILS ARE TUNED AS FOLLOWS:

   CONTINUOUSLY WITH [KILOCYCLE CHANGE] , ALL COILS.

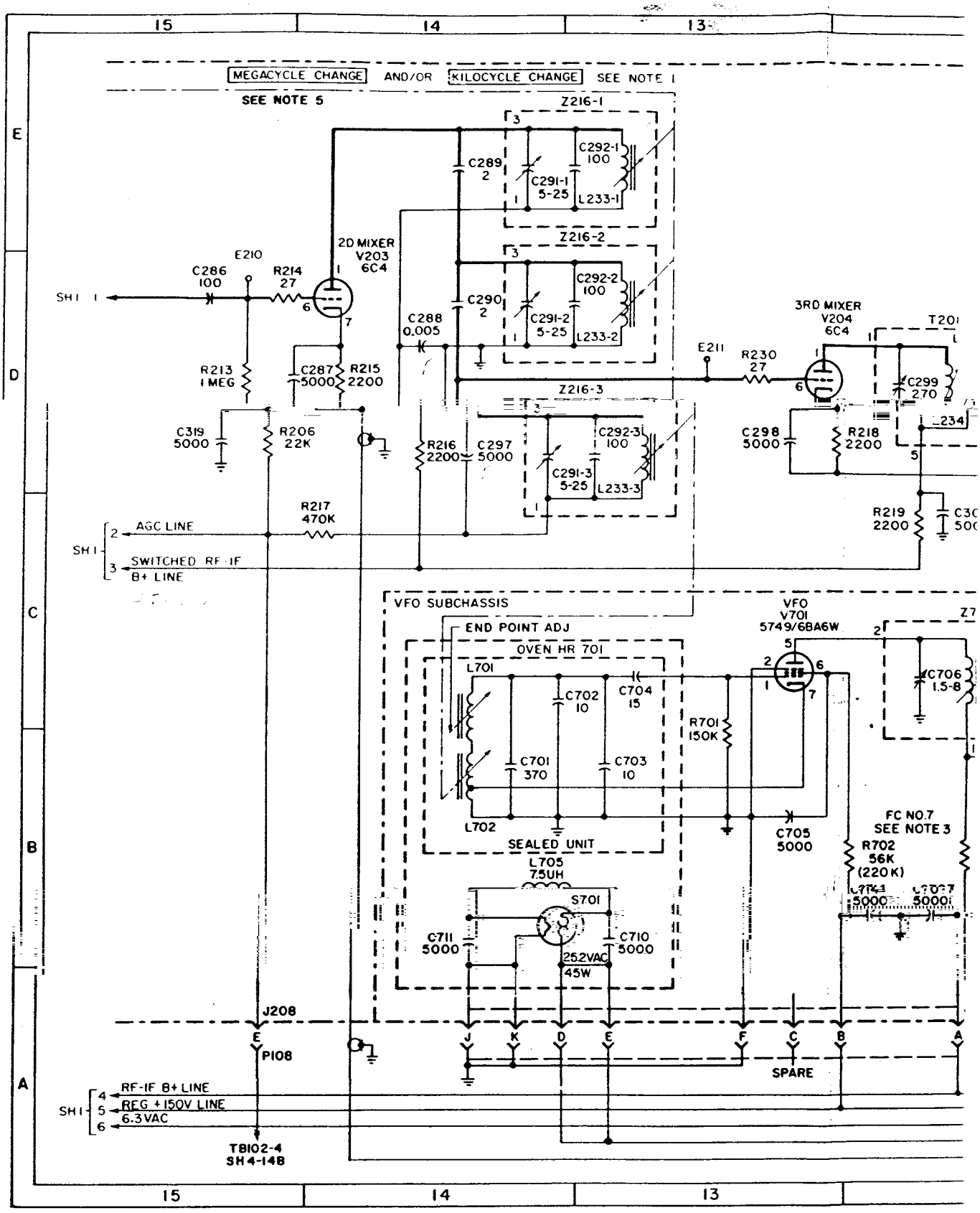
   INTERMITTENTLY WITH [MEGACYCLE CHANGE] , T203 THRU T206, Z203-1 THRU Z206-1, Z203-2 THRU Z206-2, AND Z213-1 THRU Z213-3.

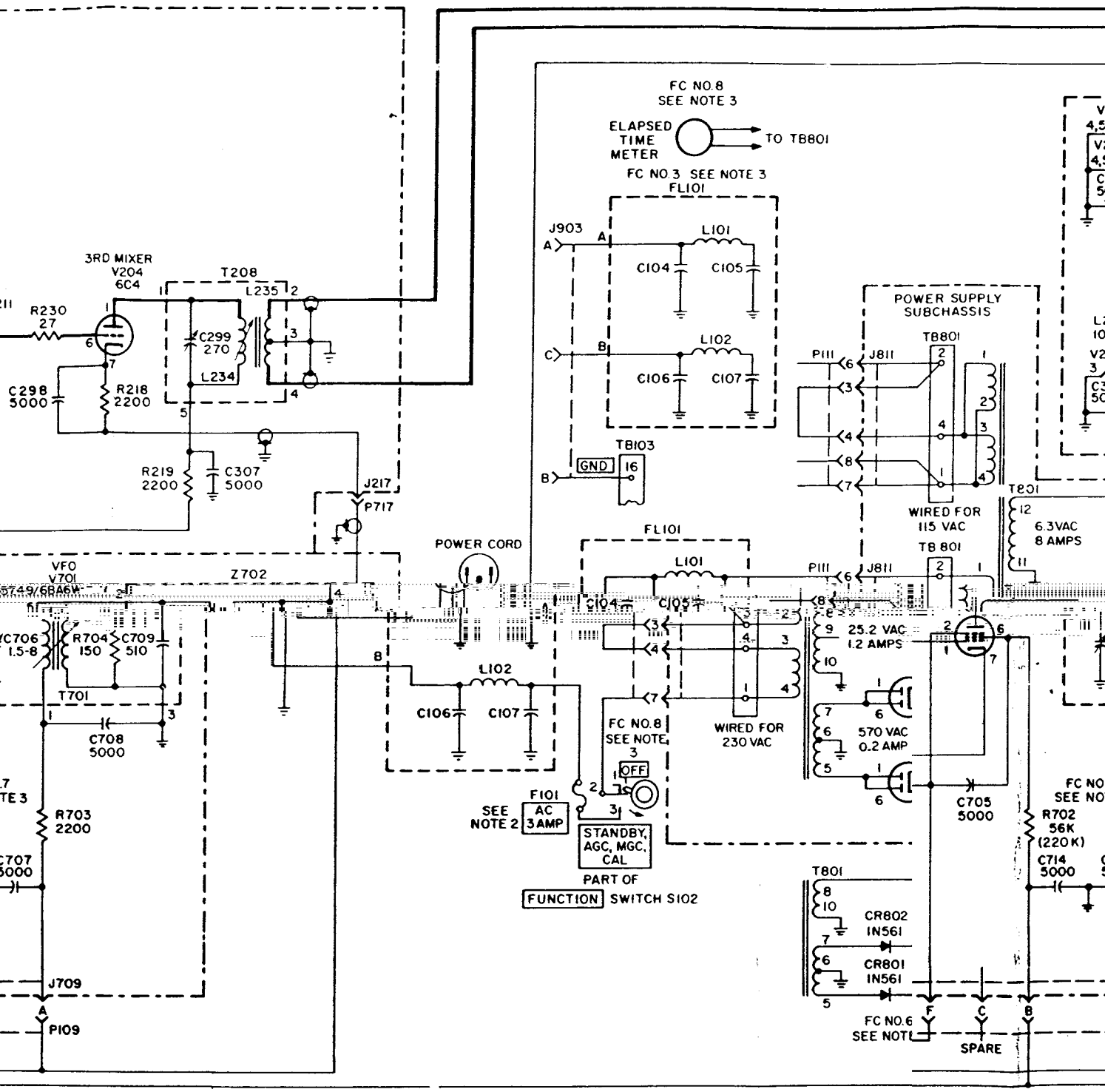
2. REFER TO TABLE 2-3 FOR FUSE VALUES.

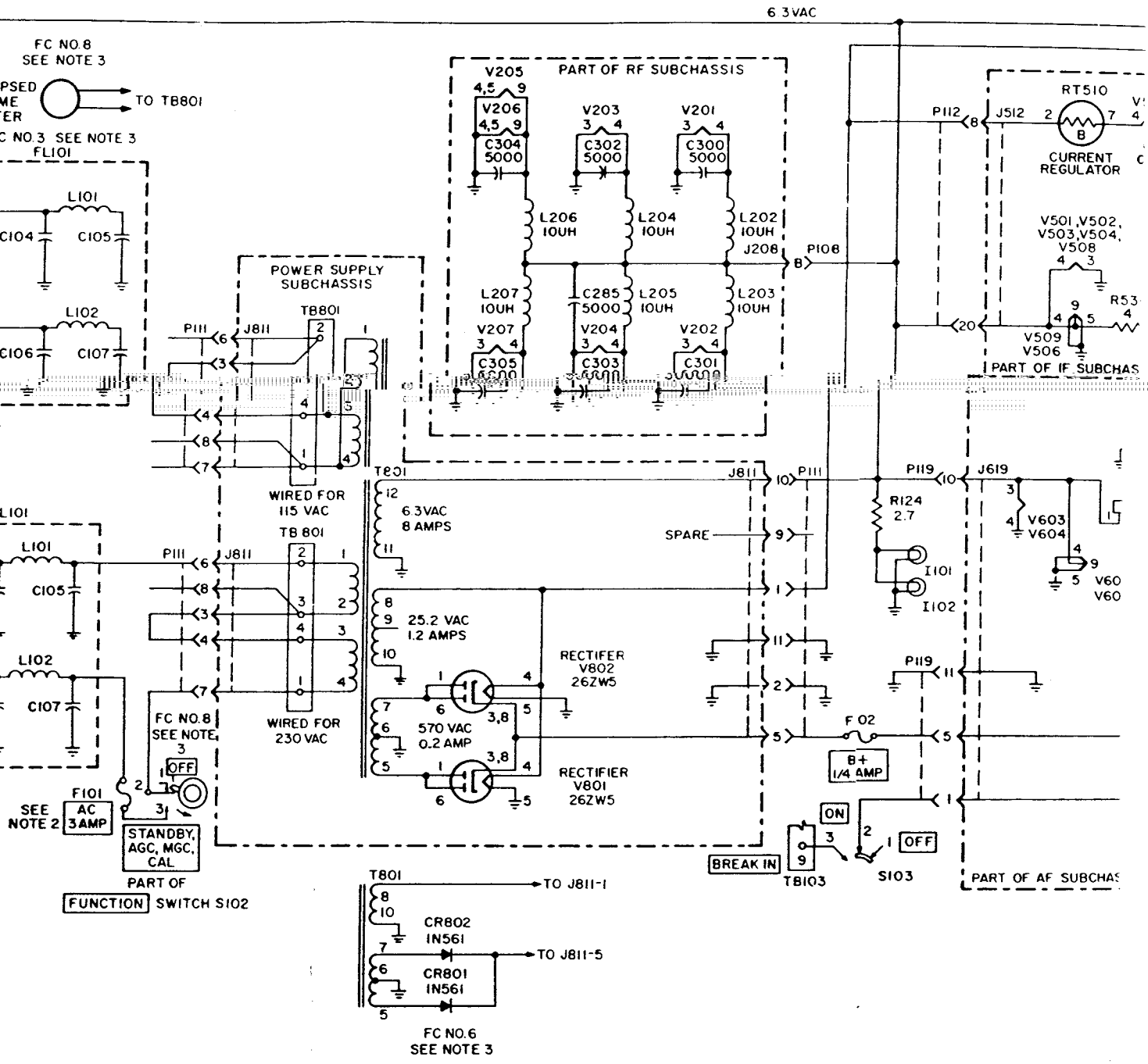
3. REFER TO TABLE 1-8, FIELD CHANGE DATA.

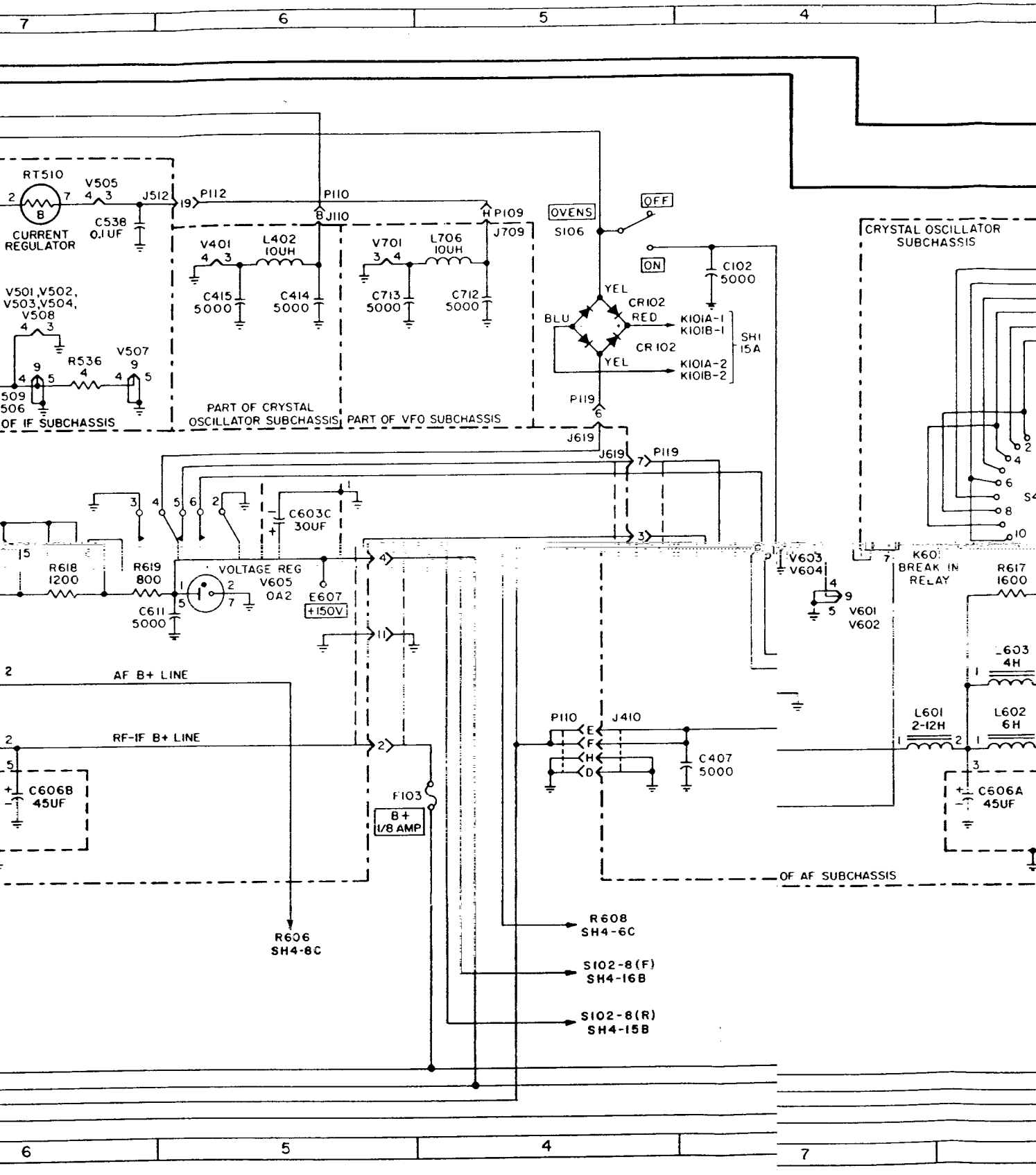
4. REFER TO FIGURES 5-4, 5-5, 5-7, 5-8, AND 5-9 VOLTAGE AND RESISTANCE DIAGRAMS.

5. SCHEMATIC SHOWN WITH [MEGACYCLE CHANGE] SET FOR THE .5 TO 1 MC BAND.


15
14
13
MEGACYCLE CHANGE
AND/OR
KILOCYCLE CHANGE
SEE NOTE 1
SEE NOTE 5
Z216-1
C289 2
C291-1 5-25
C292-1 100
L233-1
Z216-2
C290 2
C291-2 5-25
C292-2 100
L233-2
Z216-3
C291-3 5-25
C292-3 100
L233-3
2D MIXER V203 6C4
E210
C286 100
R214 27
SH1 1
C288 0.005
R213 1 MEG
C287 5000
R215 2200
C319 5000
R206 22K
R216 2200
C297 5000
E211
R230 27
3RD MIXER V204 6C4
T201
C299 270
C298 5000
R218 2200
L234
R219 2200
R217 470K
SH1 2 AGC LINE
SH1 3 SWITCHED RF-IF B+ LINE
VFO SUBCHASSIS
END POINT ADJ
OVEN HR 701
VFO V701 5749/6BA6W
L701
C702 10
C704 15
C701 370
C703 10
L702
SEALED UNIT
R701 150K
C705 5000
C706 1.5-8
FC NO.7 SEE NOTE 3
R702 56K (220K)
L705 75UH
S701
C711 5000
C710 5000
252VAC 45W
J208
E
P108
J
K
D
E
F
C
B
A
SPARE
SH1 4 RF-IF B+ LINE
SH1 5 REG +150V LINE
SH1 6 6.3VAC
TB102-4 SH4-14B
14D
14D
12C


12
11
10
9
FC NO.8
SEE NOTE 3
ELAPSED
TIME
METER
TO TB801
FC NO.3 SEE NOTE 3
FL101
J903
A
L101
C104
C105
C
B
L102
C106
C107
TB103
GND
16
B
3RD MIXER
V204
6C4
T208
L235
L234
C299
270
R230
27
C298
5000
R218
2200
R219
2200
C307
5000
J217
P717
POWER CORD
POWER SUPPLY
SUBCHASSIS
TB801
P111
J811
WIRED FOR
115 VAC
T801
6.3VAC
8 AMPS
TB 801
25.2 VAC
1.2 AMPS
570 VAC
0.2 AMP
WIRED FOR
230 VAC
FC NO.8
SEE NOTE
3
OFF
F101
SEE
NOTE 2
AC
3AMP
STANDBY,
AGC, MGC,
CAL
PART OF
FUNCTION SWITCH S102
VFO
V701
Z702
T701
C706
1.5-8
R704
150
C709
510
C708
5000
R703
2200
J709
P109
C705
5000
R702
56K
(220K)
C714
5000
CR802
IN561
CR801
IN561
FC NO.6
SEE NOTE
SPARE


6.3VAC
FC NO.8
SEE NOTE 3
TO TB801
C NO.3 SEE NOTE 3
FL101
L101
C104
C105
L102
C106
C107
POWER SUPPLY
SUBCHASSIS
TB801
P111
J811
WIRED FOR
115 VAC
WIRED FOR
230 VAC
V205
PART OF RF SUBCHASSIS
V206
V203
V201
C304
5000
C302
5000
C300
5000
L206
10UH
L204
10UH
L202
10UH
J208
P108
L207
10UH
C285
5000
L205
10UH
L203
10UH
V207
V204
V202
C305
C303
C301
RT510
P112
J512
CURRENT
REGULATOR
V501,V502,
V503,V504,
V508
R53
V509
V506
PART OF IF SUBCHAS
T801
6.3VAC
8 AMPS
SPARE
25.2 VAC
1.2 AMPS
RECTIFER
V802
26ZW5
570 VAC
0.2 AMP
RECTIFIER
V801
26ZW5
P119
J619
R124
2.7
I101
I102
V603
V604
V60
V60
F 02
B+
1/4 AMP
FC NO.8
SEE NOTE
3
OFF
F101
SEE
NOTE 2
AC
3AMP
STANDBY,
AGC, MGC,
CAL
PART OF
FUNCTION SWITCH S102
BREAK IN
TB103
ON
OFF
S103
PART OF AF SUBCHAS
T801
TO J811-1
CR802
IN561
TO J811-5
CR801
IN561
FC NO.6
SEE NOTE 3


RT510
V505
J512
P112
P110
J110
P109
J709
C538
0.1 UF
CURRENT REGULATOR
V401
L402
10UH
C415
5000
C414
5000
V701
L706
10UH
C713
5000
C712
5000
OVENS
S106
OFF
ON
C102
5000
CR102
YEL
BLU
RED
K101A-1
K101B-1
SH1
15A
K101A-2
K101B-2
V501,V502,
V503,V504,
V508
R536
V507
P119
J619
PART OF IF SUBCHASSIS
PART OF CRYSTAL OSCILLATOR SUBCHASSIS
PART OF VFO SUBCHASSIS
CRYSTAL OSCILLATOR SUBCHASSIS
C603C
30UF
R618
1200
R619
800
VOLTAGE REG
V605
0A2
E607
+150V
C611
5000
V603
V604
V601
V602
K601
BREAK IN RELAY
R617
1600
L603
4H
L601
2-12H
L602
6H
C606A
45UF
AF B+ LINE
RF-IF B+ LINE
C606B
45UF
F103
B+
1/8 AMP
P110
J410
E
F
H
D
C407
5000
OF AF SUBCHASSIS
R606
SH4-8C
R608
SH4-6C
S102-8(F)
SH4-16B
S102-8(R)
SH4-15B

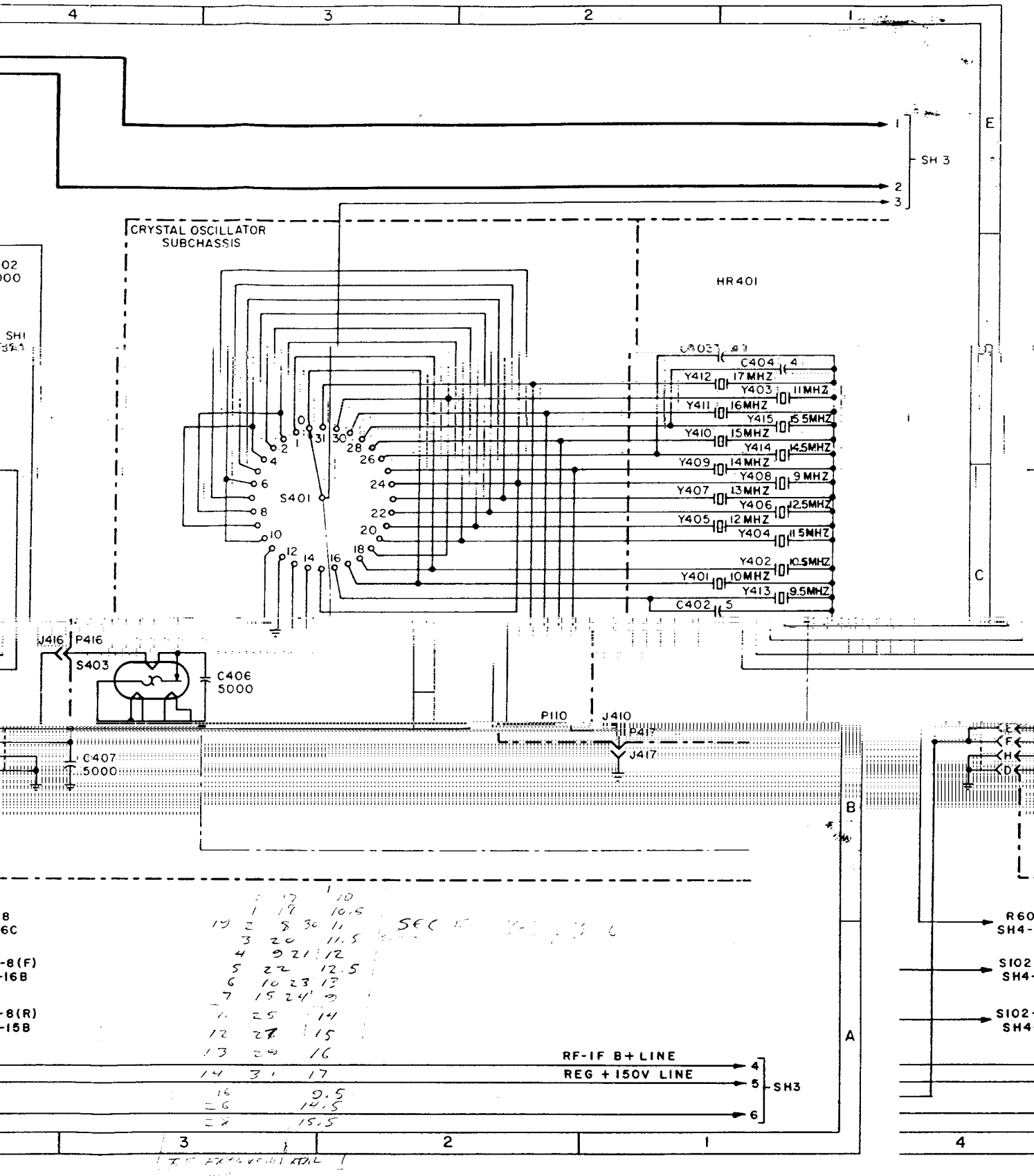


Figure 5-13. Schematic Diagram
(Sheet 2 of 4)

GENERAL NOTES:

A. UNLESS OTHERWISE INDICATED, ELECTRICAL VALUES ARE EXPRESSED IN PICOFARADS, MICROHENRIES, AND OHMS.

B. [ ] INDICATES EQUIPMENT MARKING.

SPECIFIC NOTES:

1. RESISTORS R502 AND R503 SELECTED FOR OPTIMUM BANDPASS.

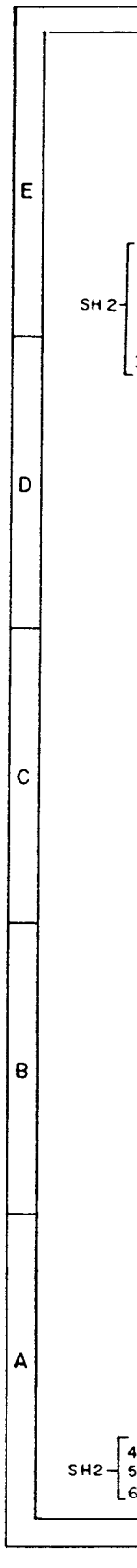
   R502 SELECTED WITHIN RANGE OF 33K TO 68K.

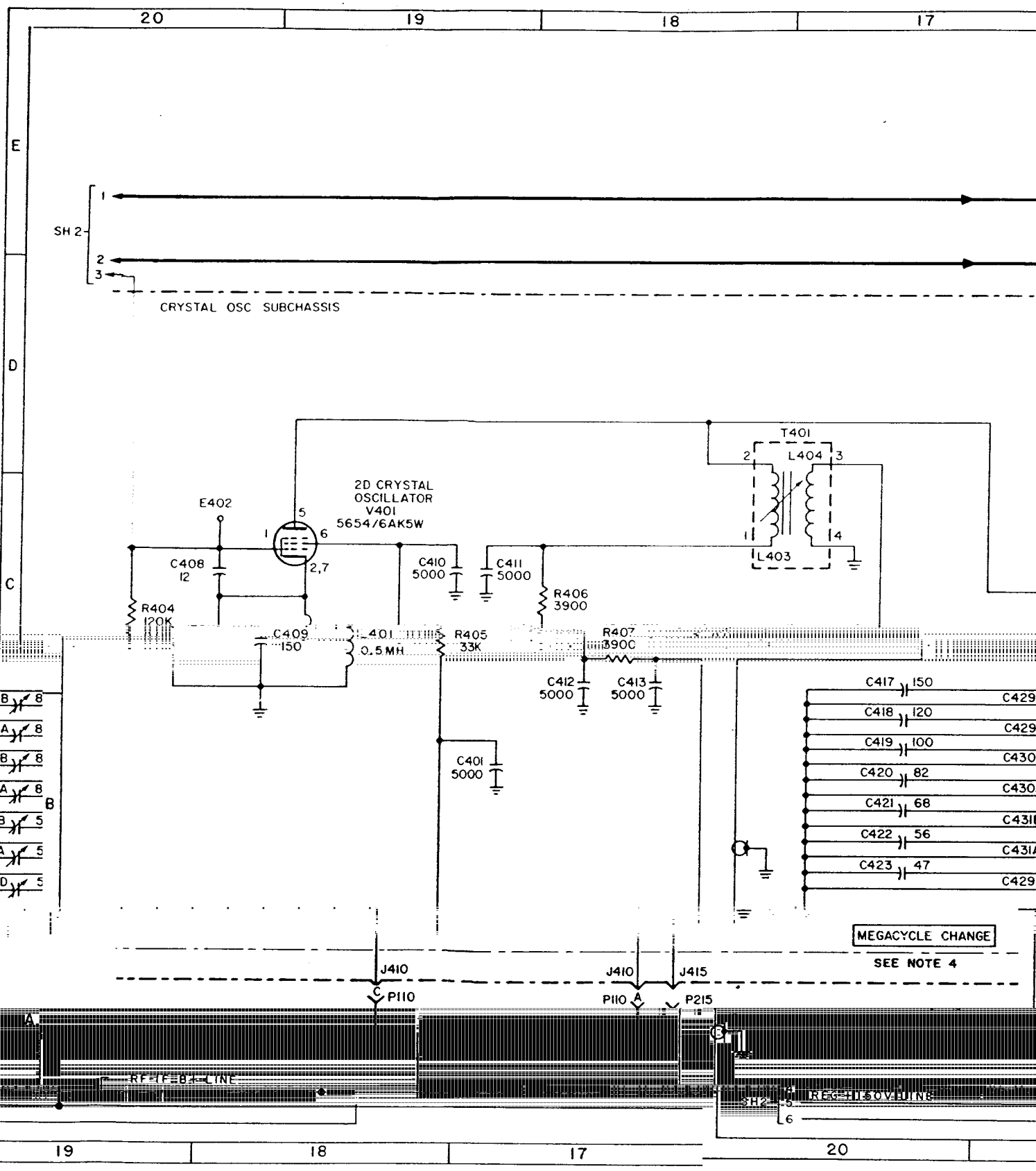
   R503 SELECTED WITHIN RANGE OF 560 TO 2700.

2. REFER TO TABLE 1-9, PRODUCTION MODIFICATIONS, AND FIGURE 3-6.

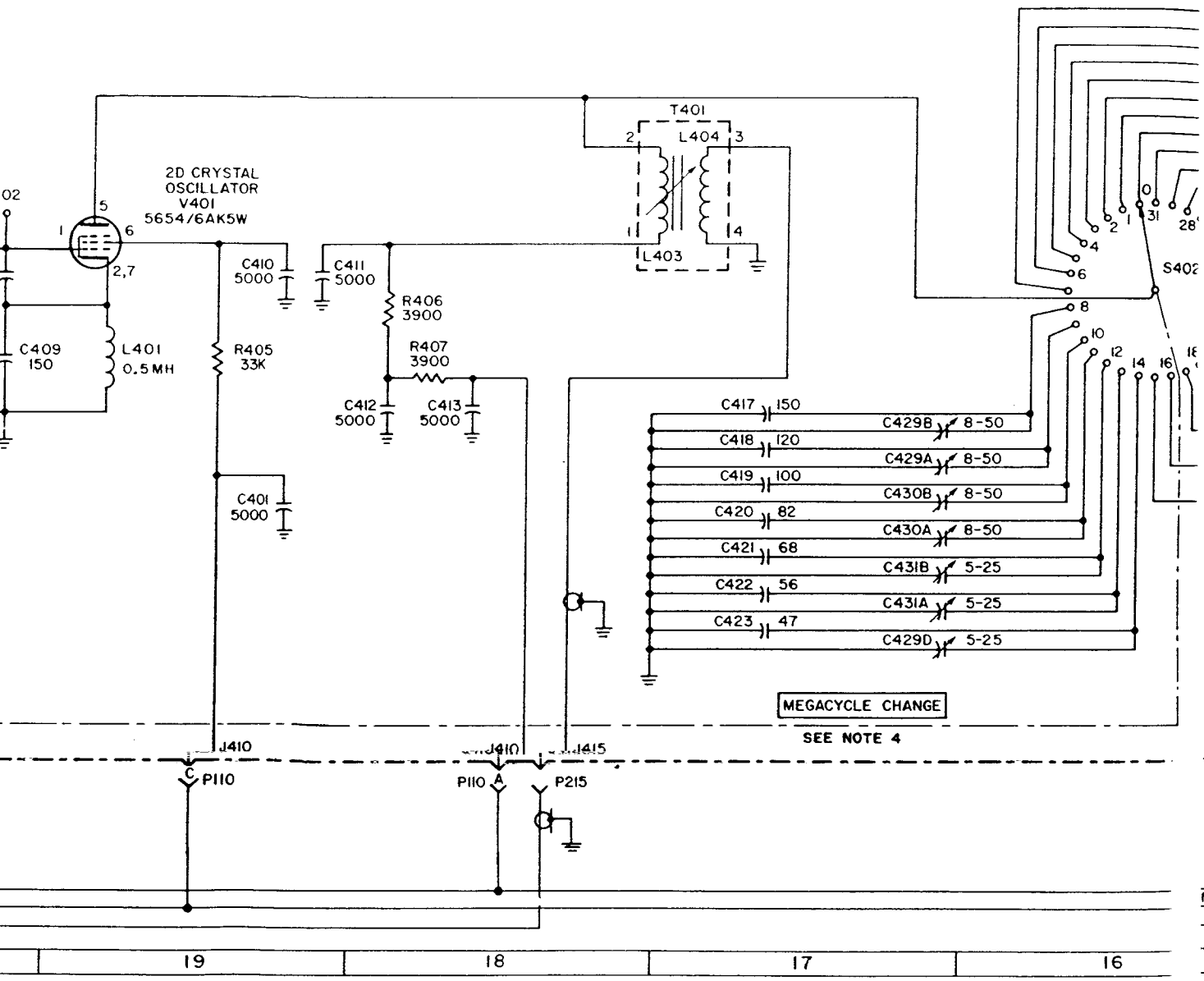
3. REFER TO FIGURES 5-5 AND 5-6, VOLTAGE AND RESISTANCE DIAGRAMS.

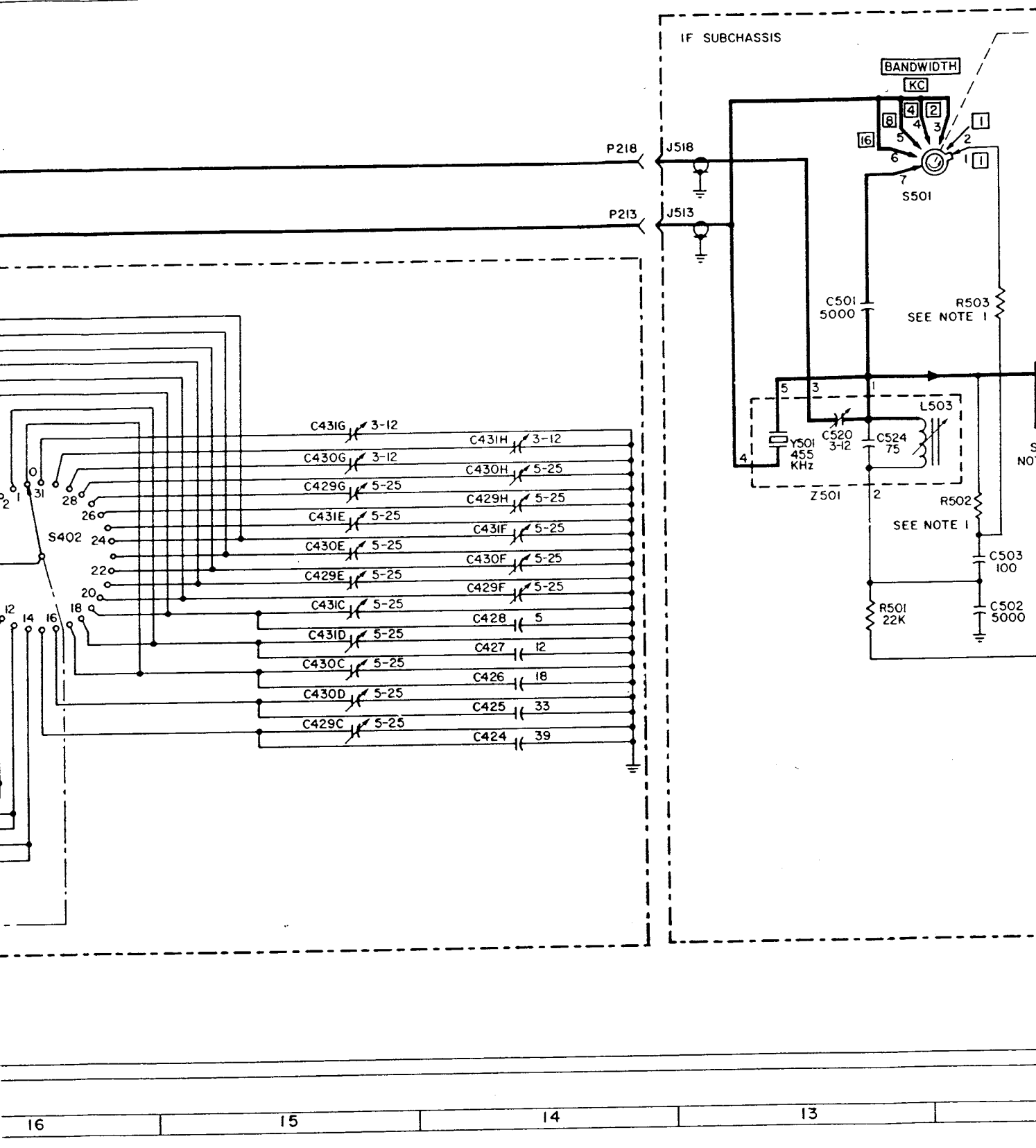
4. SCHEMATIC SHOWN WITH [MEGACYCLE CHANGE] SET FOR THE .5 TO 1 MC BAND.

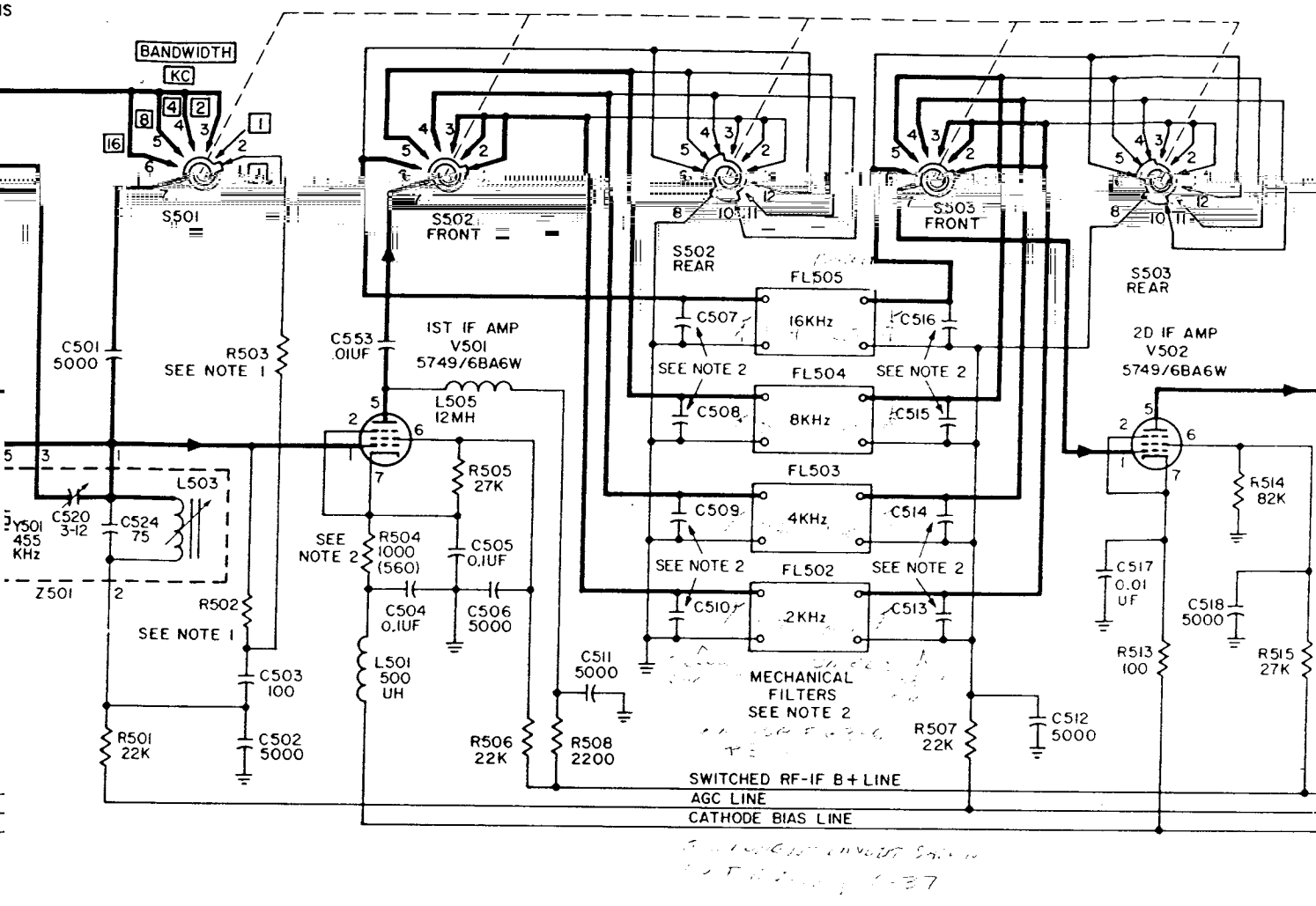


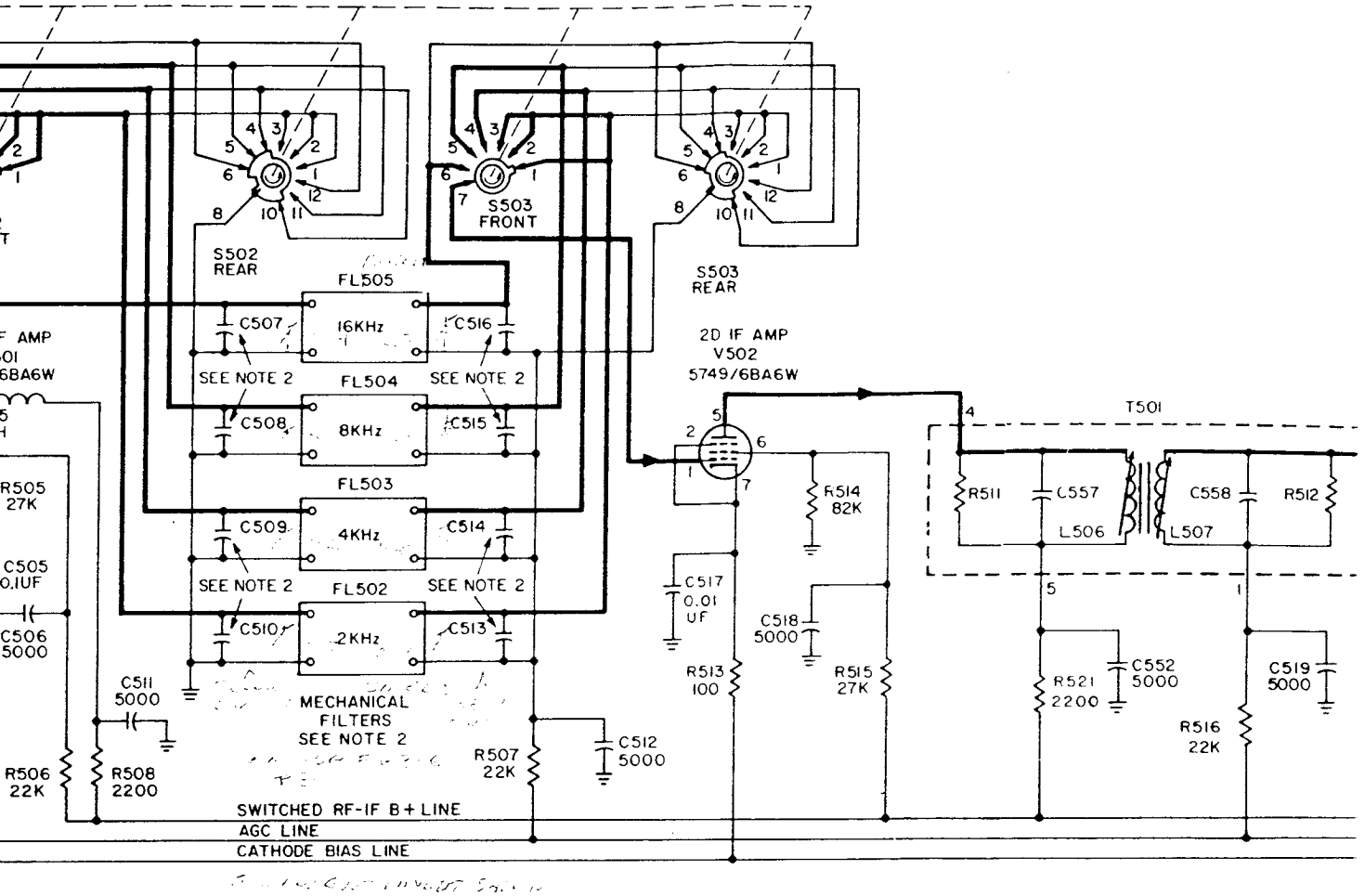

20
19
18
17
E
D
C
B
SH 2
1
2
3
CRYSTAL OSC SUBCHASSIS
T401
L404
L403
2D CRYSTAL
OSCILLATOR
V401
5654/6AK5W
E402
C408
12
C410
5000
C411
5000
R406
3900
R404
120K
C409
150
L401
0.5MH
R405
33K
R407
3900
C412
5000
C413
5000
C401
5000
C417 150
C418 120
C419 100
C420 82
C421 68
C422 56
C423 47
MEGACYCLE CHANGE
SEE NOTE 4
J410
P110
J410
J415
P110
P215
RF-IF-BU-LINE
REG-HI-SOV-LINE
SH2
19
18
17
20

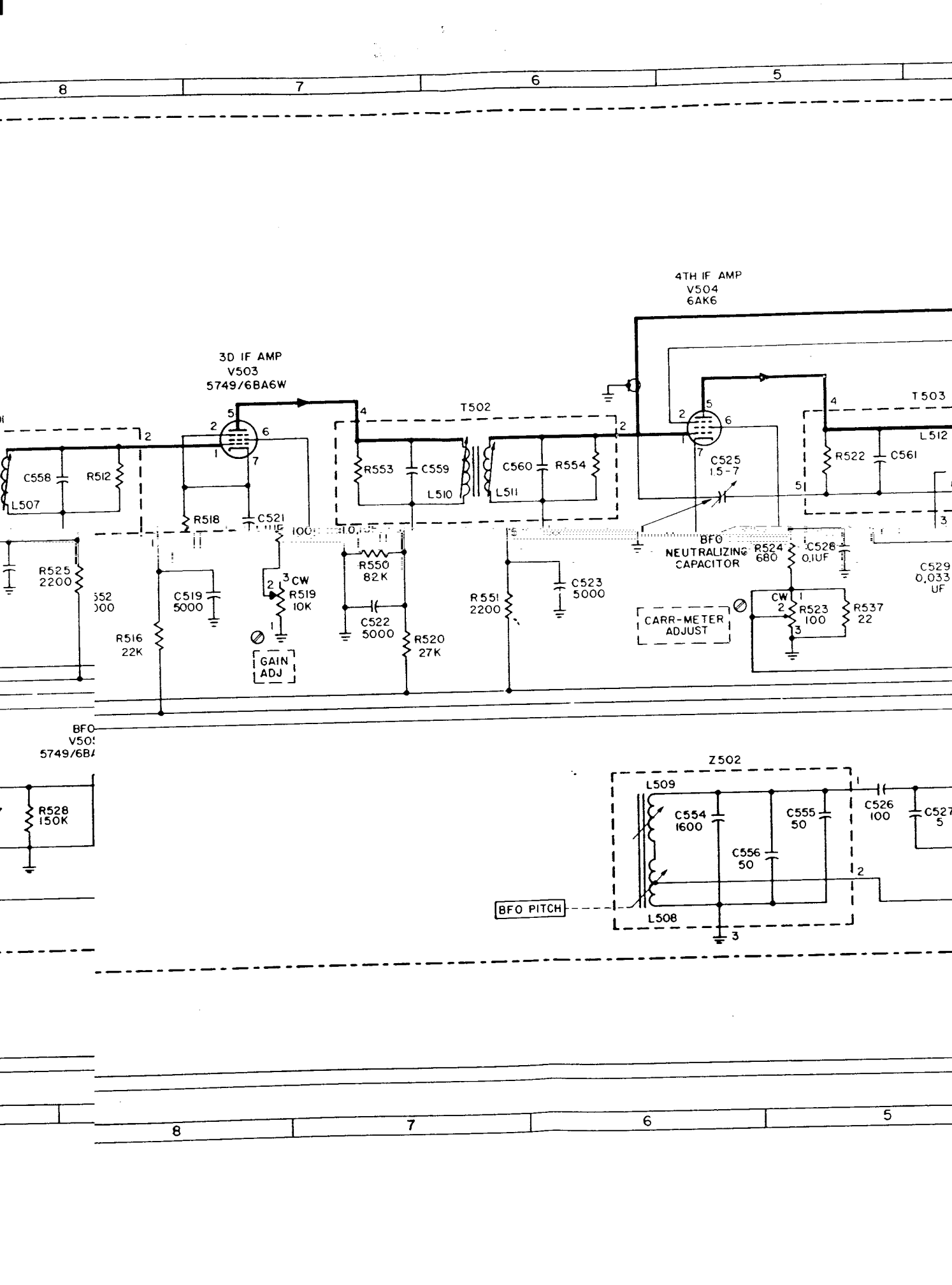
OSC SUBCHASSIS

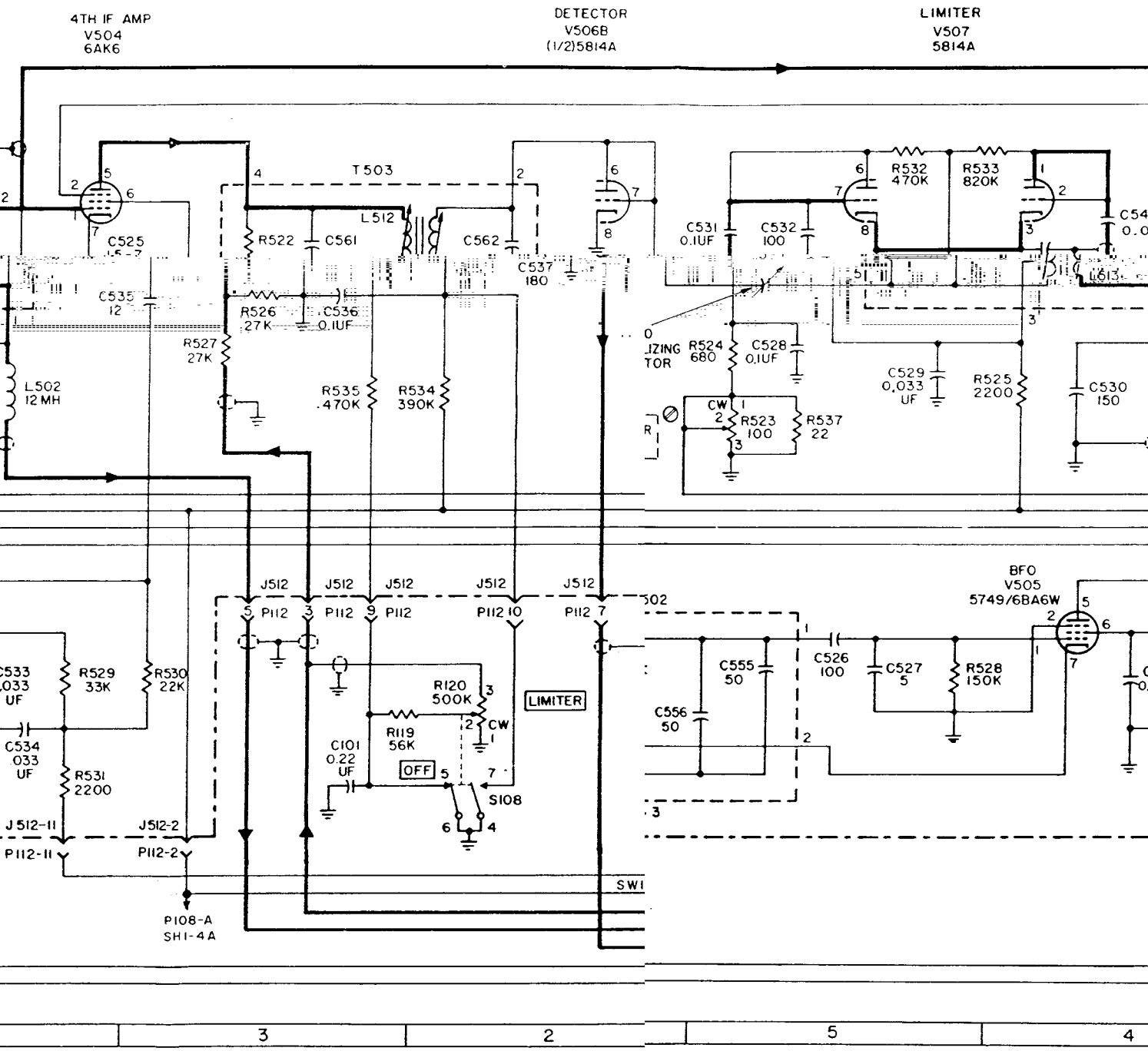



16
15
14
13
IF SUBCHASSIS
BANDWIDTH
KC
8
4
2
1
16
5
4
3
2
6
1
7
S501
P218
J518
P213
J513
C501
5000
R503
SEE NOTE 1
L503
Y501
455
KHz
C520
3-12
C524
75
Z501
R502
SEE NOTE 1
C503
100
C502
5000
R501
22K
S402
C431G 3-12
C430G 3-12
C429G 5-25
C431E 5-25
C430E 5-25
C429E 5-25
C431C 5-25
C431D 5-25
C430C 5-25
C430D 5-25
C429C 5-25
C431H 3-12
C430H 5-25
C429H 5-25
C431F 5-25
C430F 5-25
C429F 5-25
C428 5
C427 12
C426 18
C425 33
C424 39

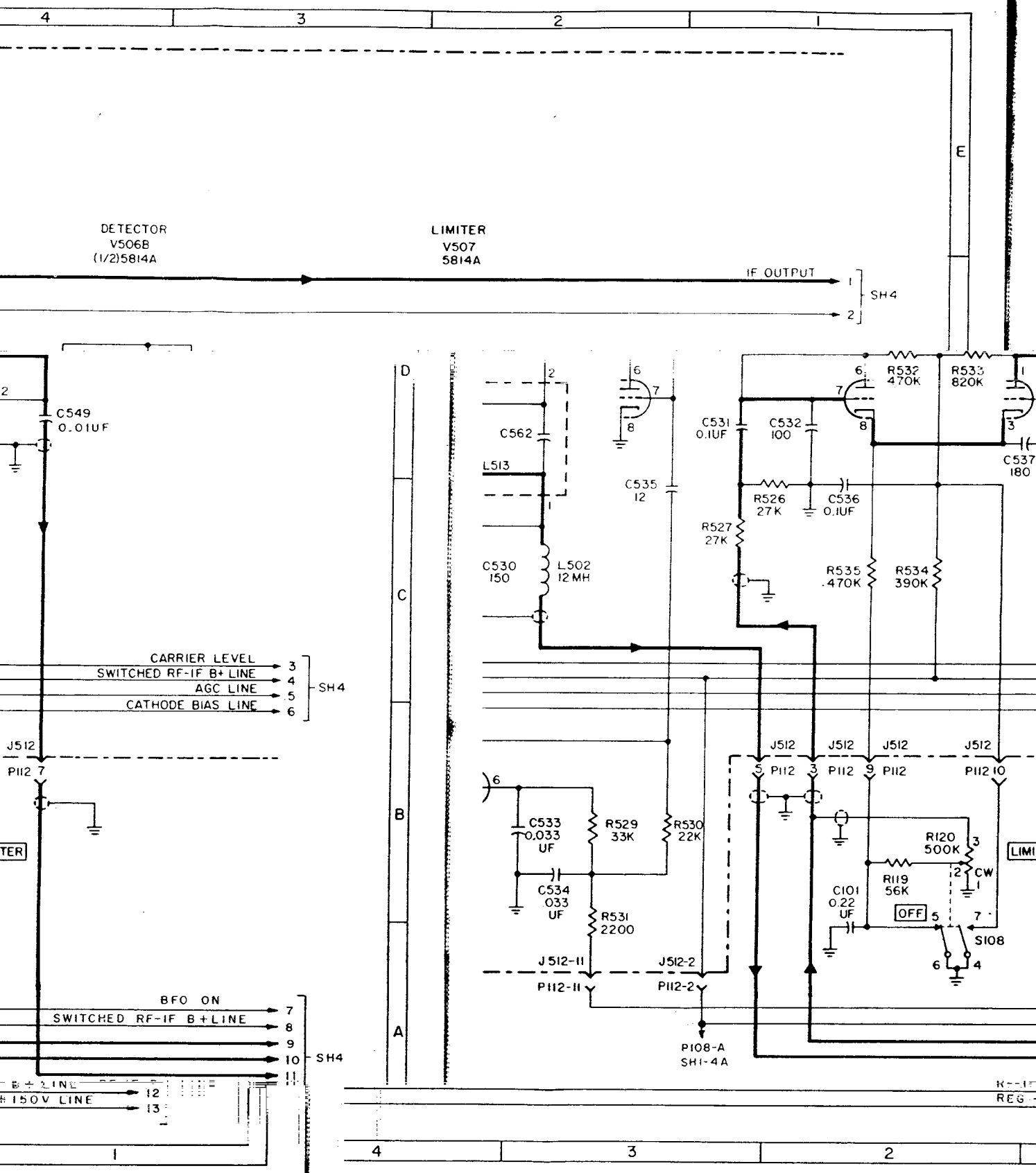

BANDWIDTH
KC
16
8
4
2
1
S501
S502
FRONT
S502
REAR
S503
FRONT
S503
REAR
FL505
16KHz
FL504
8KHz
FL503
4KHz
FL502
2KHz
C507
C508
C509
C510
C516
C515
C514
C513
SEE NOTE 2
MECHANICAL
FILTERS
SEE NOTE 2
C501
5000
R503
SEE NOTE 1
C553
.01UF
1ST IF AMP
V501
5749/6BA6W
L505
12MH
2D IF AMP
V502
5749/6BA6W
L503
Y501
455
KHz
C520
3-12
C524
75
Z501
R502
SEE NOTE 1
C503
100
R501
22K
C502
5000
SEE
NOTE 2
R504
1000
(560)
C504
0.1UF
C505
0.1UF
C506
5000
L501
500
UH
R505
27K
C511
5000
R506
22K
R508
2200
R507
22K
C512
5000
R514
82K
C517
0.01
UF
C518
5000
R513
100
R515
27K
SWITCHED RF-IF B+ LINE
AGC LINE
CATHODE BIAS LINE


S502
REAR
S503
FRONT
S503
REAR
FL505
16KHz
FL504
8KHz
FL503
4KHz
FL502
2KHz
C507
C516
C508
C515
C509
C514
C510
C513
SEE NOTE 2
MECHANICAL
FILTERS
SEE NOTE 2
2D IF AMP
V502
5749/6BA6W
T501
R514
82K
R511
C557
L506
C558
L507
R512
C517
0.01
UF
C518
5000
R513
100
R515
27K
R521
2200
C552
5000
C519
5000
R516
22K
C511
5000
R506
22K
R508
2200
R507
22K
C512
5000
SWITCHED RF-IF B+ LINE
AGC LINE
CATHODE BIAS LINE


8
7
6
5
4TH IF AMP
V504
6AK6
3D IF AMP
V503
5749/6BA6W
T502
T503
L512
C558
R512
L507
R518
C521
R553
C559
L510
C560
R554
L511
C525
1.5-7
R522
C561
R525
2200
C519
5000
R516
22K
CW
R519
10K
GAIN
ADJ
R550
82K
C522
5000
R520
27K
R551
2200
C523
5000
BFO
NEUTRALIZING
CAPACITOR
R524
680
C528
0.1UF
C529
0.033
UF
CARR-METER
ADJUST
CW
R523
100
R537
22
BFO
V50
5749/6B
R528
150K
Z502
L509
C554
1600
C556
50
C555
50
C526
100
C527
5
BFO PITCH
L508


4TH IF AMP
V504
6AK6
DETECTOR
V506B
(1/2)5814A
LIMITER
V507
5814A
T503
L512
C525
C535
12
R522
C561
C562
C537
180
R526
27K
C536
.01UF
R527
27K
L502
12 MH
R535
470K
R534
390K
C531
0.1UF
C532
100
R532
470K
R533
820K
R524
680
C528
0.1UF
R523
100
R537
22
C529
0.033
UF
R525
2200
C530
150
J512
P112
R529
33K
R530
22K
C534
.033
UF
R531
2200
J512-11
J512-2
P112-11
P112-2
P108-A
SH1-4A
R120
500K
R119
56K
C101
0.22
UF
OFF
CW
LIMITER
S108
BFO
V505
5749/6BA6W
C555
50
C556
50
C526
100
C527
5
R528
150K

Figur



Schematic Diagram
(Sheet 3 of 4)

Figure 5-13.
(Sh

ZONING FOR SCHEMATIC DIAGRAM FIGURE 5-13 (SHEET 4 of 4)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C529	4C	R620	6C	J620	6C	S116	9D, 9C
R517	3A	R621	5B	C540	12C		9B, 9D
R518	3B	R622	5B	C541	12D	J904	6B
R538	12D	R623	4A	C542	17D	L504	13C
R539	13D	R624	5B	C543	17D	L514	15D
R540	17D	R626	5B	C544	16D	M101	12B
R541	16D	R627	7C	C545	16C	M102	13B
R542	15C	S101	17B	C546	15D	P102	12D, 13C
R543	16D	S102 (front)	16B	C547	14D		14C, 15C
R544	14D	S102 (rear)	18B	C548	13D		16C, 17C
R545	15D	S104	10C	C551	13D	P114	12C
R546	15D	S105	3A	C563	16D	P116	11C
R547	14D	S107	11B	C601	8D	P119	3D, 6E
R548	13D	T601	4D	C602	8D	P120	3B, 3C
R549	13D	T602	4B	C603A	8B		6E, 9B
R552	12C	TB102	2D, 13A	C603B	8B		9D, 9E
R601	9D		13B	C604	6C	R101	3D
R602	8D	TB103	2B, 13B	C605	5D	R102	2C
R603	9C	V506A	13D	C607	6B	R103	14B
R604	8C	V508	16D	C608	5B	R104	10C
R605	8C	V509A	15D	C609	8C	R105	10C
R606	8C	V509B	12D	C612	9D	R106	2B
	7C	V601A	8C	CR101	13B	R107	2A
	7C	V601B	7C	FL601	6C	R108	2A
	6C	V602A	5C	J102	2D	R109	3B
	5C	V602B	5B	J116	11C	R110	3B
	5C	V603	4C	J512	12D, 13C	R111	2B
	5C	V604	4B		14C, 15C	R112	2B
	5C	Z503	16D		16C, 17C	R113	2C
R614	4C			J514	12C	R114	2B
R615	4C			J619	3D, 6D	R115	2B

GENERAL NOTES:

PASSES AND PARAGRAPHS.

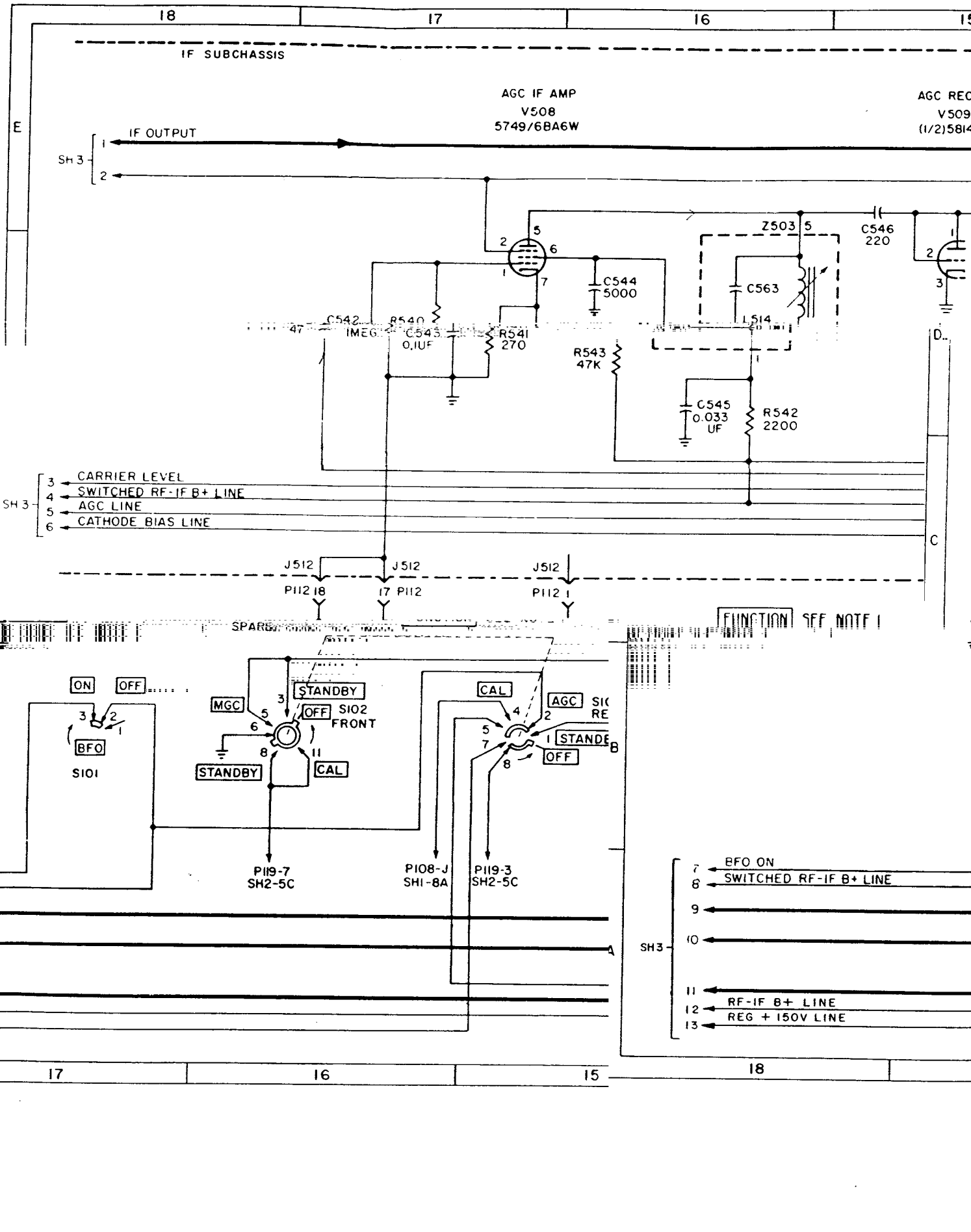
ALL INDICATIONS OTHERWISE EXPRESSED, ELECTRICAL VALUES ARE IN MICROFARADS, MICROHENRIES, AND OHMS.

B. [ ] INDICATES EQUIPMENT MARKING.

SPECIFIC NOTES:

1. [FUNCTION] SWITCH S102 SHOWN IN [OFF] POSITION
2. REFER TO TABLE 1-9, PRODUCTION MODIFICATIONS.
3. REFER TO TABLE 1-8, FIELD CHANGE DATA.
4. [AUDIO RESPONSE] SWITCH S104 SHOWN IN [WIDE] POSITION.
5. [LINE METER] SWITCH S105 SHOWN IN [OFF] POSITION.
6. REFER TO FIGURES 5-6 AND 5-8, VOLTAGE AND RESISTANCE D

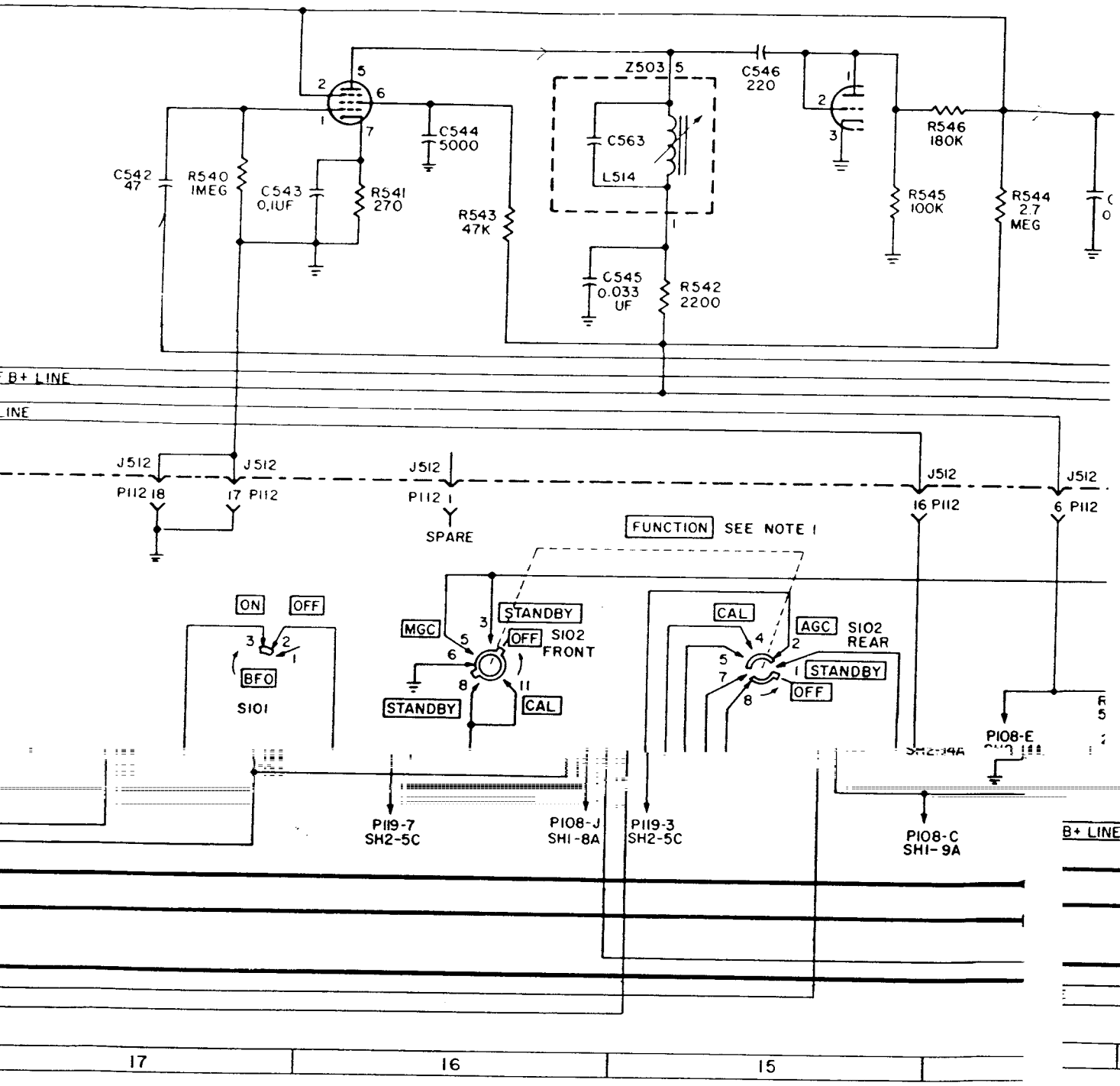
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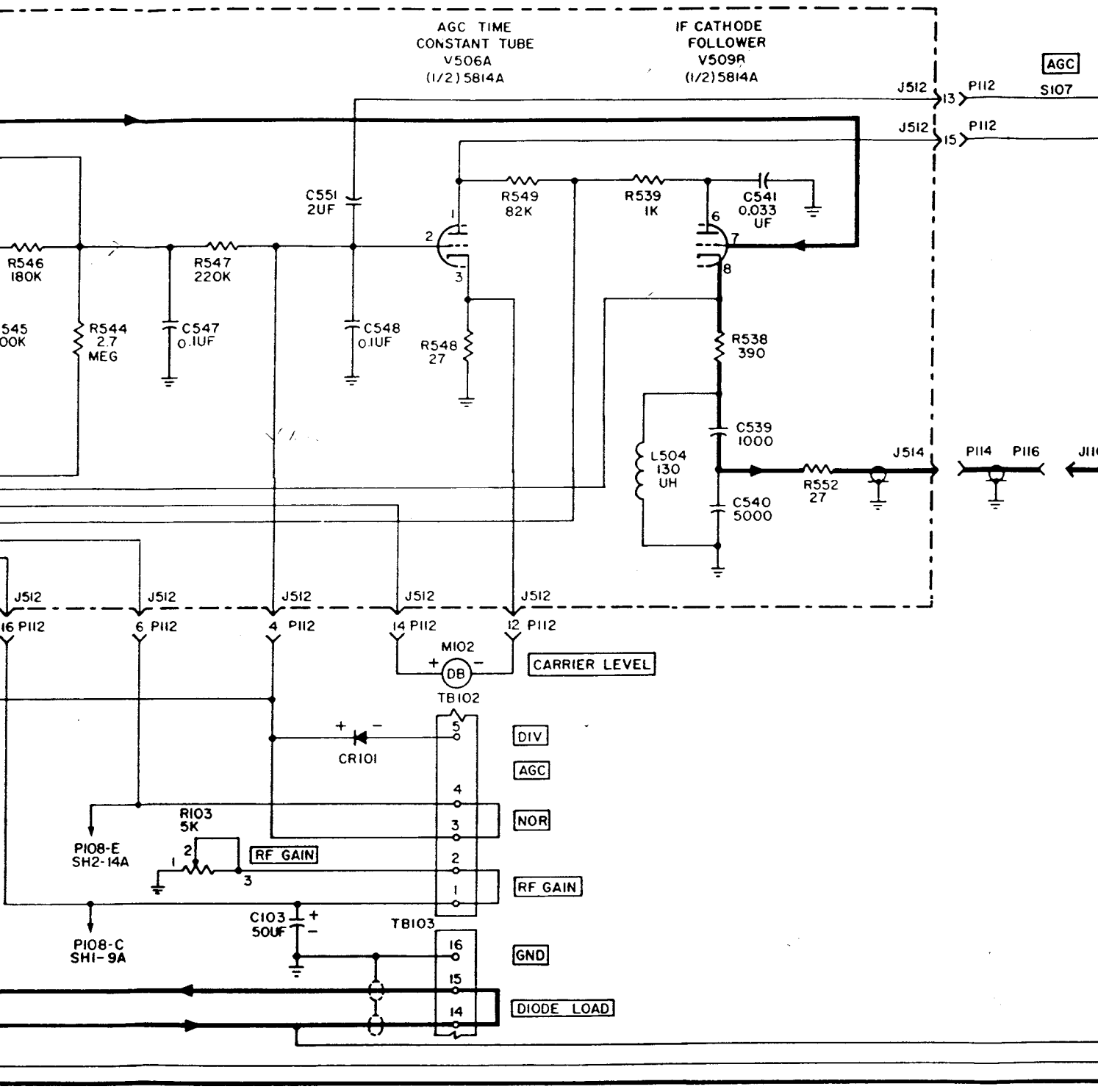

18
17
16
IF SUBCHASSIS
AGC IF AMP
V508
5749/6BA6W
AGC REC
V509
(1/2)5814
IF OUTPUT
SH 3
1
2
Z503
C546
220
C544
5000
C563
L514
C542
IMEG
R540
47
C545
0.1UF
R541
270
R543
47K
C545
0.033
UF
R542
2200
CARRIER LEVEL
SWITCHED RF-IF B+ LINE
AGC LINE
CATHODE BIAS LINE
3
4
5
6
J512
P112 18
17 P112
P112 1
SPARE
FUNCTION SEE NOTE 1
ON
OFF
BFO
S101
MGC
STANDBY
OFF
S102
FRONT
CAL
AGC
STANDBY
OFF
P119-7
SH2-5C
P108-J
SH1-8A
P119-3
SH2-5C
BFO ON
SWITCHED RF-IF B+ LINE
RF-IF B+ LINE
REG + 150V LINE
7
8
9
10
11
12
13
17
16
15
18

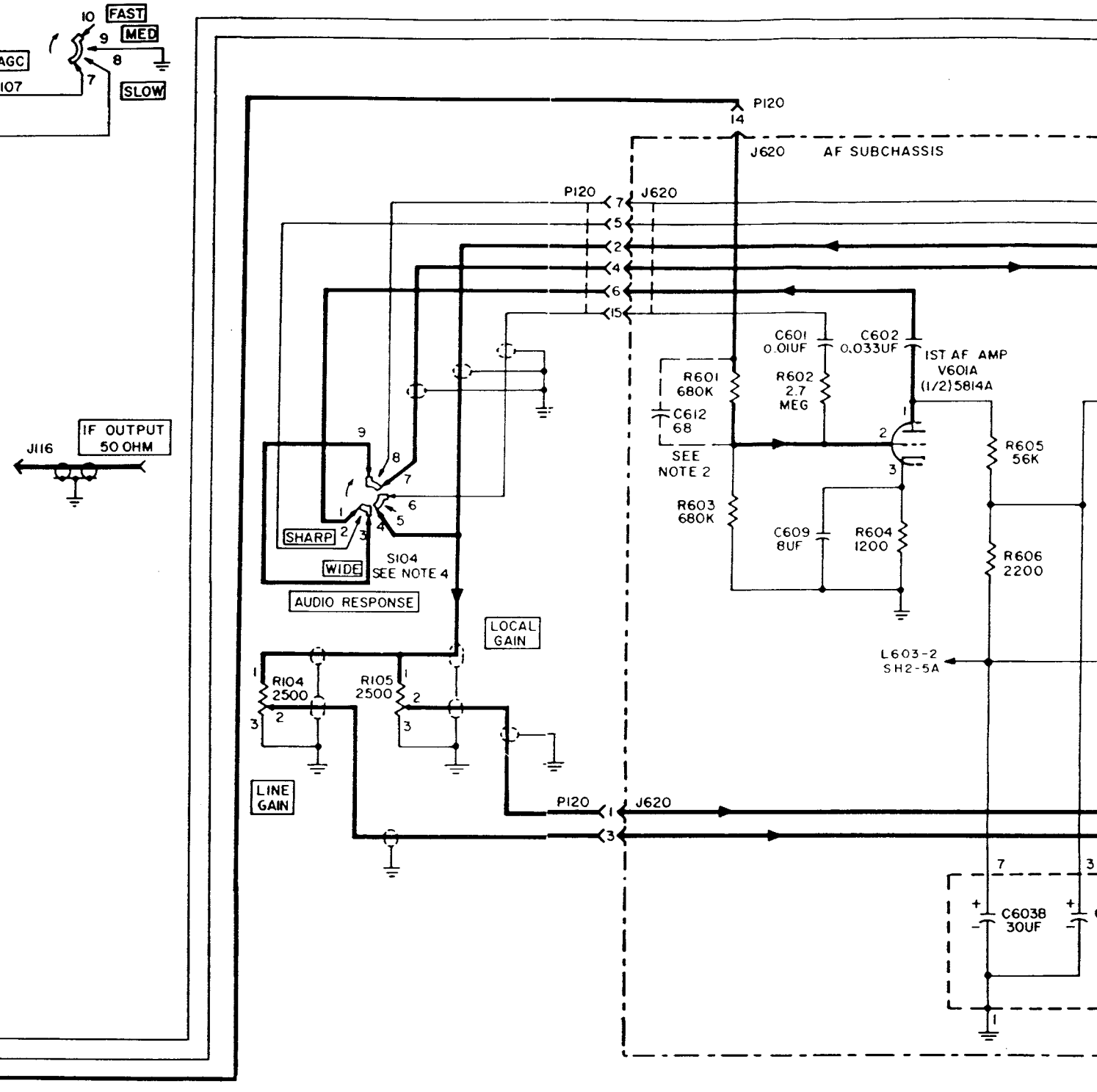
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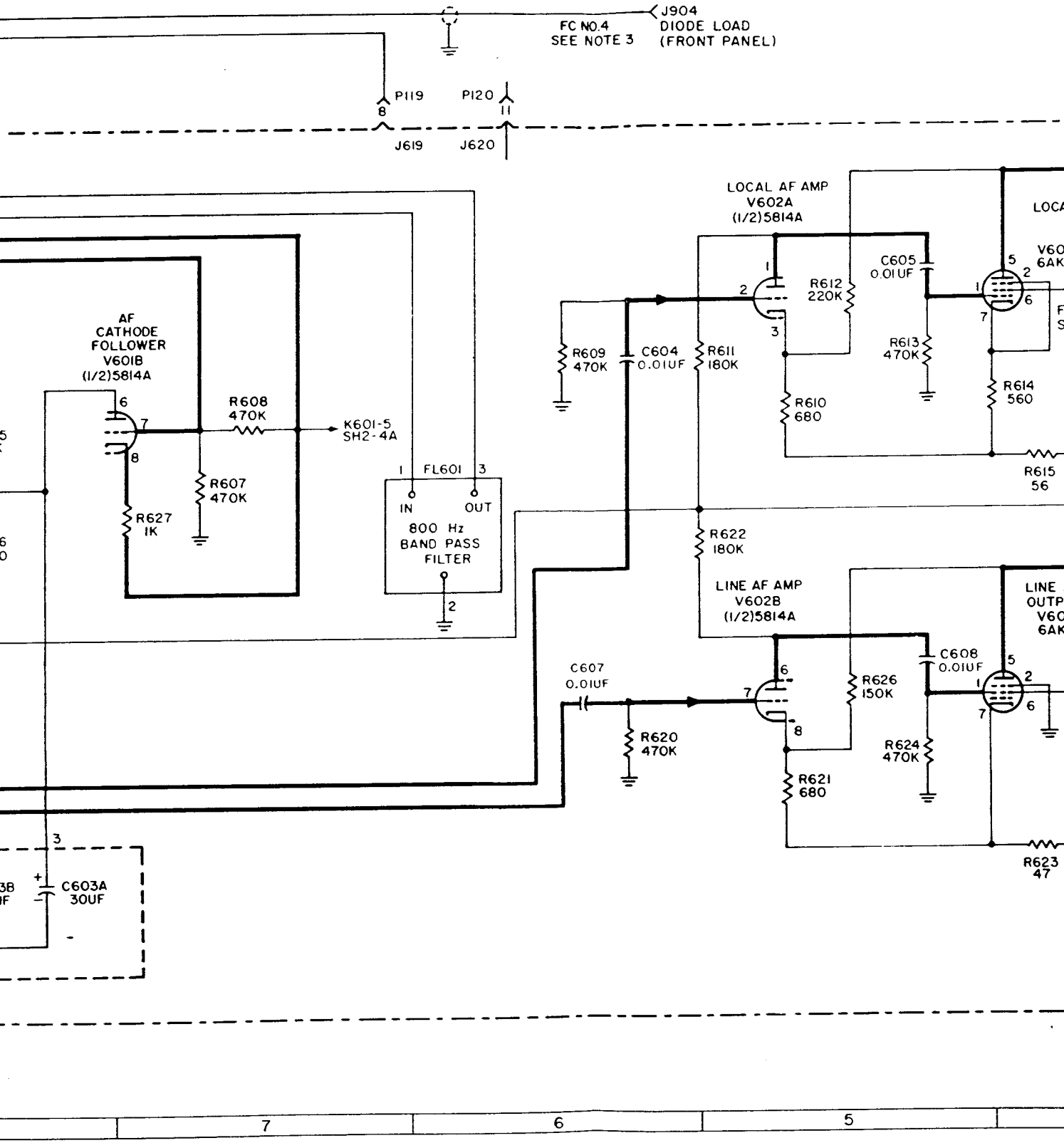
AGC IF AMP
V508
5749/6BA6W

AGC RECTIFIER
V509A
(1/2)5814A

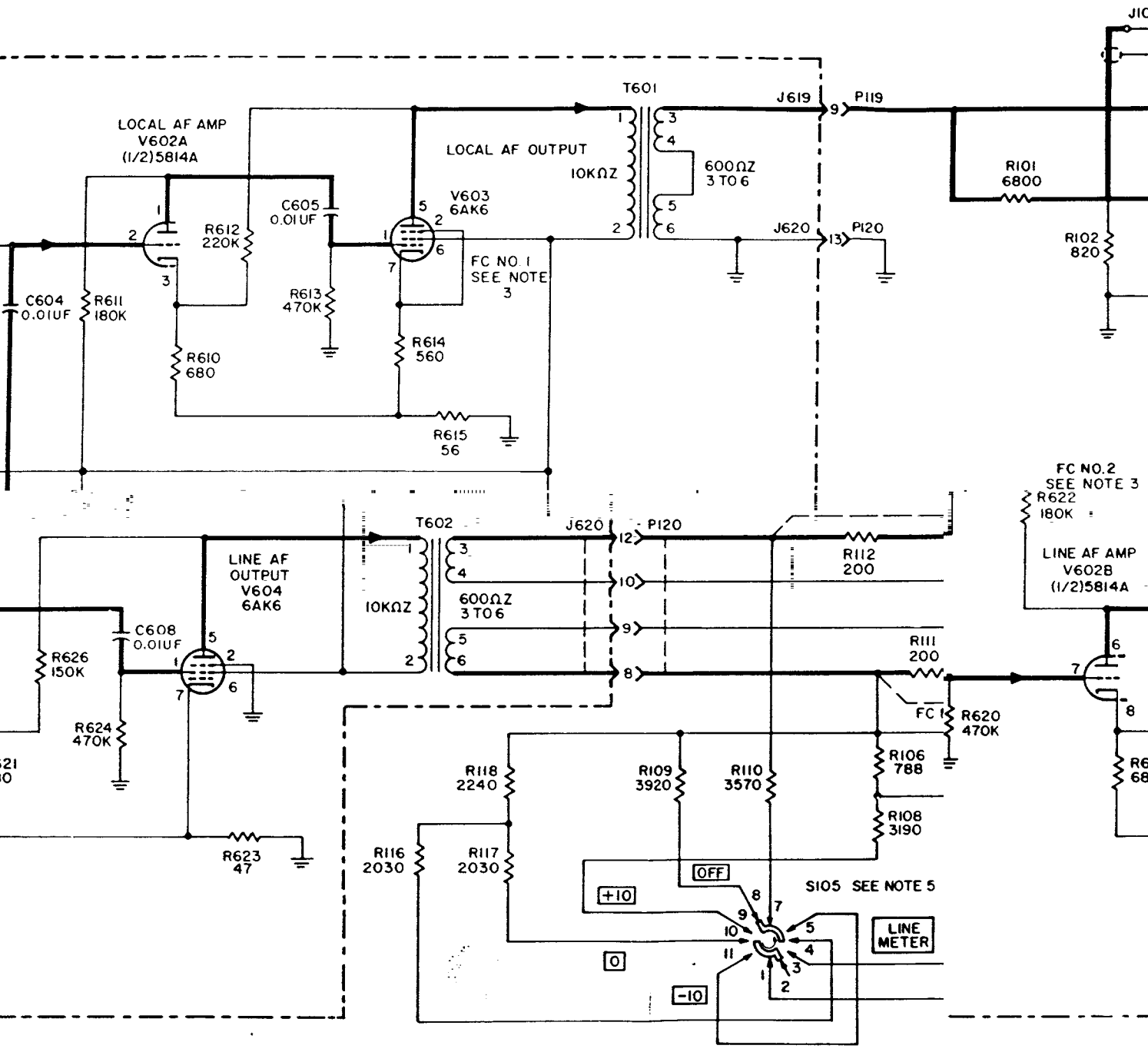



AGC TIME CONSTANT TUBE V506A (1/2) 5814A
IF CATHODE FOLLOWER V509R (1/2) 5814A
AGC
S107
J512 13 P112
J512 15 P112
C551 2UF
R549 82K
R539 1K
C541 0.033 UF
R546 180K
R547 220K
R544 2.7 MEG
C547 0.1UF
C548 0.1UF
R548 27
R538 390
C539 1000
L504 130 UH
C540 5000
R552 27
J514
P114
P116
J512 16 P112
J512 6 P112
J512 4 P112
J512 14 P112
J512 12 P112
M102
DB
CARRIER LEVEL
TB102
CR101
DIV
AGC
NOR
RF GAIN
R103 5K
P108-E SH2-14A
RF GAIN
C103 50UF
TB103
P108-C SH1-9A
GND
DIODE LOAD


10 FAST
9 MED
8
7 SLOW
AGC
107
J116
IF OUTPUT
50 OHM
P120
14
J620 AF SUBCHASSIS
P120 J620
7
5
2
4
6
15
C601
0.01UF
C602
0.033UF
1ST AF AMP
V601A
(1/2)5814A
R601
680K
C612
68
SEE
NOTE 2
R602
2.7
MEG
R603
680K
C609
8UF
R604
1200
R605
56K
R606
2200
L603-2
SH2-5A
9
8
7
6
5
4
1
2
3
SHARP
WIDE
S104
SEE NOTE 4
AUDIO RESPONSE
LOCAL
GAIN
R104
2500
R105
2500
LINE
GAIN
P120 J620
1
3
7
3
C6038
30UF


J904
DIODE LOAD
(FRONT PANEL)
FC NO.4
SEE NOTE 3
P119
8
P120
11
J619
J620
LOCAL AF AMP
V602A
(1/2)5814A
AF
CATHODE
FOLLOWER
V601B
(1/2)5814A
R608
470K
K601-5
SH2-4A
R607
470K
R627
1K
FL601
IN
OUT
800 Hz
BAND PASS
FILTER
R609
470K
C604
0.01UF
R611
180K
R612
220K
C605
0.01UF
R610
680
R613
470K
R614
560
R615
56
R622
180K
LINE AF AMP
V602B
(1/2)5814A
C607
0.01UF
R620
470K
R626
150K
C608
0.01UF
R621
680
R624
470K
R623
47
C603A
30UF

J904
DIODE LOAD
(FRONT PANEL)



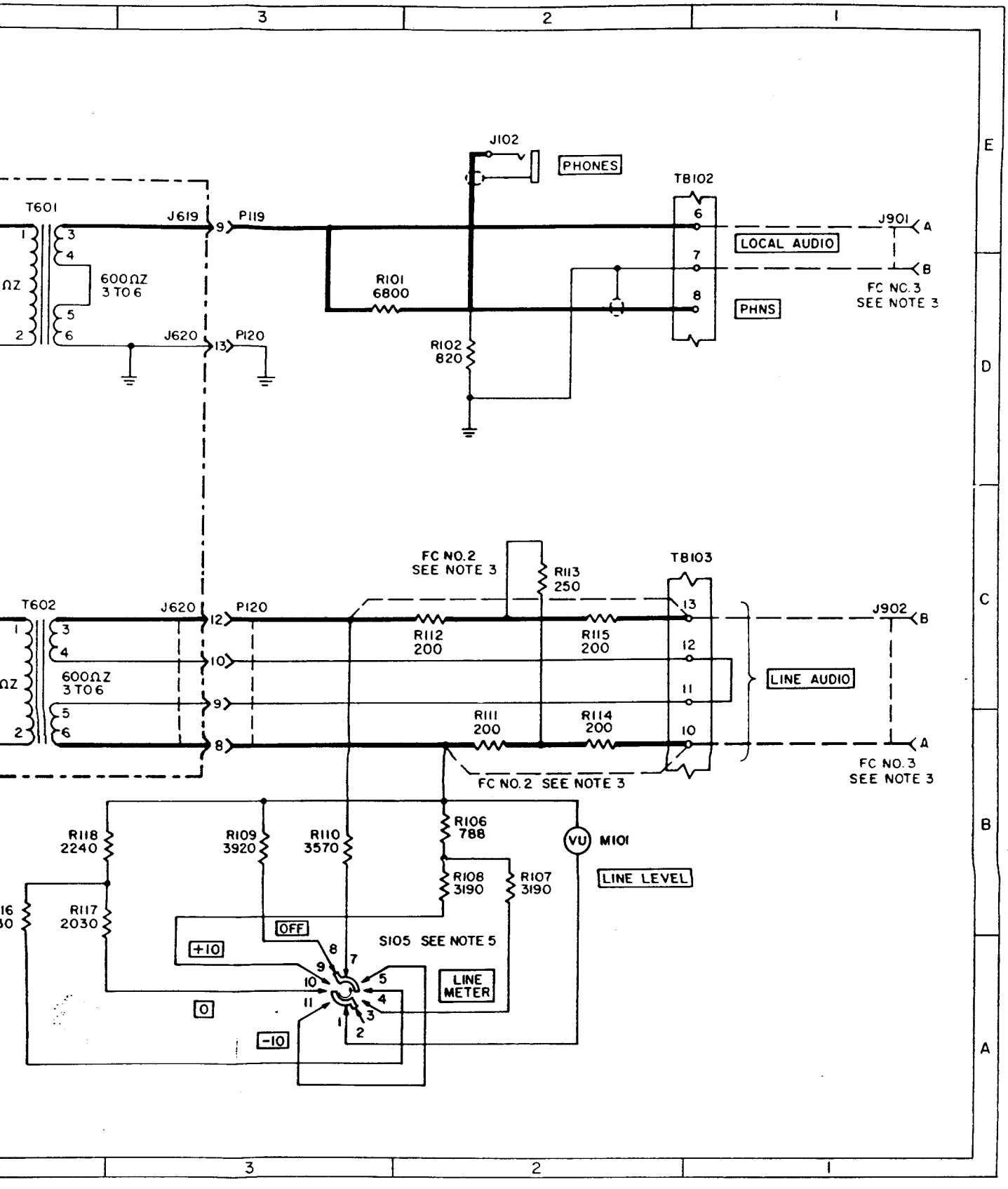


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[illegible]	[illegible]	[illegible]
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Description and data		
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Alignment
Circuit analysis
Stage gain chart
Subchassis removal
Rf and variable if conversion scheme

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[AG 413.44 (30 Dec. 55)]

BY ORDER OF THE SECRETARY OF THE ARMY

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General, United States Army,
Chief of Staff.

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JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

DISTRIUBTION:

Active Army:

CNGB (1)

Tec Svc, DA (1) except

CSIGO (30)

vc Bd (1)

ONARC (5)

ARC Bd (Incl ea Test Sec) (1)

AA Comd (2)

ai Comd (5)

Corps (3)

11-557R, Armd Sig Co (3)

md (5)

W (1)

nies (5)

ps (2)

Div (2)

& Cp (2)

& Bn Svc Schs (5) except

g Sch (25)

Depots (2) except

lanta Gen Depot (None)

Sec, Gen Depots (10)

Depots (20)

te AG (6); Units—Same as Active Army
ept allowance is one copy to each unit.

None.

anation of abbreviations used, see
50-1.

Trans Terminal Comd (2)

OS Sup Agencies (2)

Sig Fld Maint Shops (3)

Sig Lab (5)

Mil Dist (1)

Units organized under following TOE:

11-7R, Sig Co, Inf Div (2)

11-16R, Hq&Hq Co, Sig Bn, Corps or Abn

OS Base Comd (5)

11-127R, Sig Repr Co (2)

11-128R, Sig Depot Co (2)

11-500R (AA-AE), Sig Svc Org (2)

11-557C, Abn Sig Co (2)

11-587R, Sig Base Maint Co (2)

11-592R, Hq&Hq Co, Sig Base Depot (2)

11-597R, Sig Base Depot Co (2)

32-51R, Hq&Hq Co, Comm Recon Gp (2)

32-55R, Comm Recon Bn (2)

32-56R, Hq&Hq Co, Comm Recon Bn (2)

32-57R, Comm Recon Opr Co (2)

Tec S

Hq C

CONA

Army

OS M

Log Co

MD

Arm

Cor

Tng

Ft

Gen

Sig

Gen

At

Sig

Sig

NG: Sta
exc

USAR:

For expl
SR 320-5

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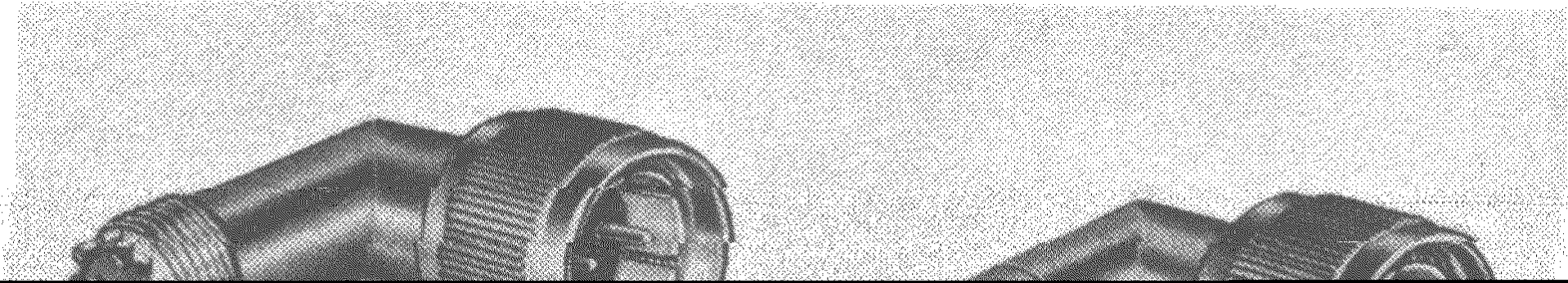
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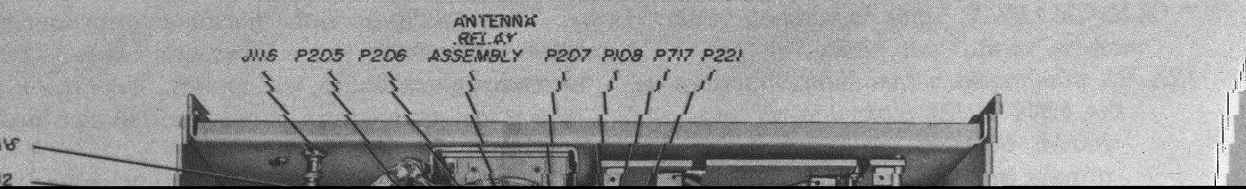
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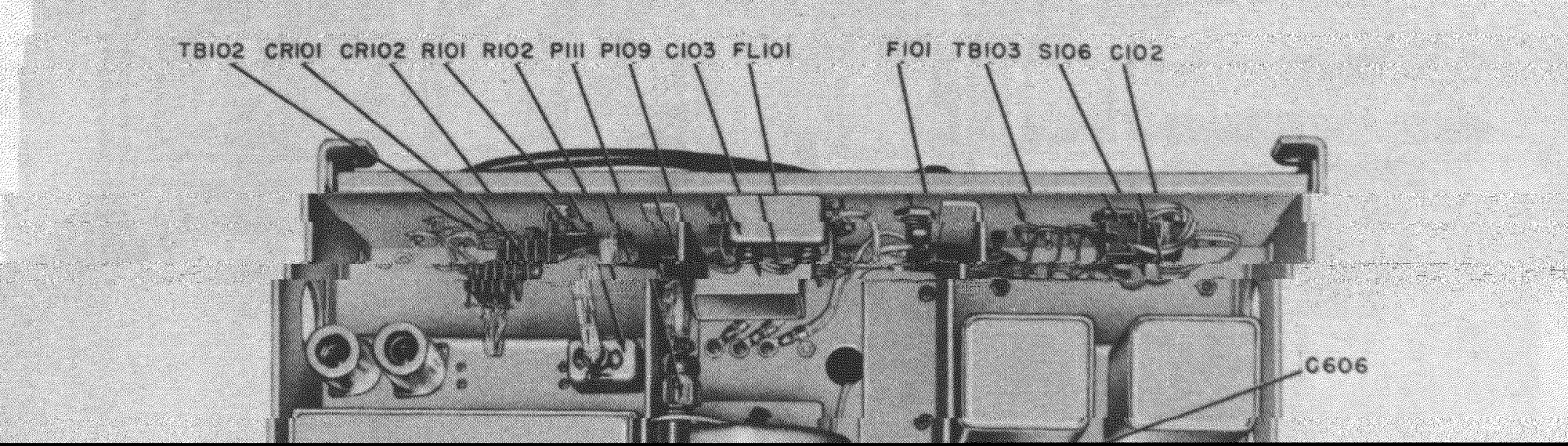
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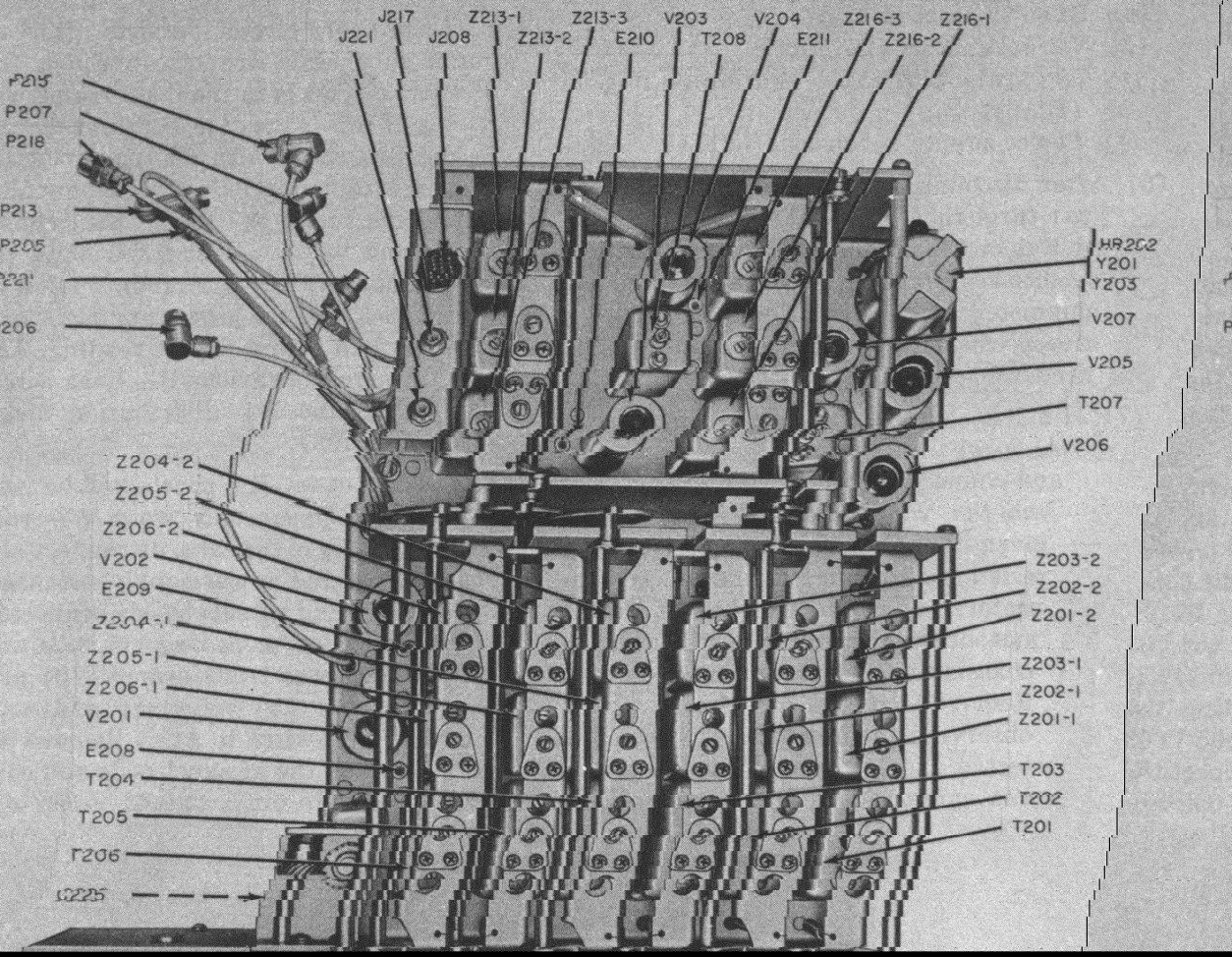
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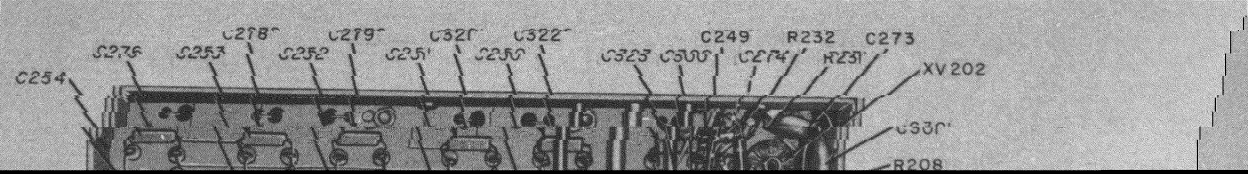





ANTENNA
RELAY
ASSEMBLY
J116
P205
P206
P207
P108
P717
P221


TB102
CR101
CR102
R101
R102
P111
P109
C103
FL101
F101
TB103
S106
C102
C606


J221
J217
J208
Z213-1
Z213-2
Z213-3
E210
V203
T208
V204
E211
Z216-3
Z216-2
Z216-1
P207
P218
P213
P205
V207
V205
T207
V206
Z204-2
Z205-2
Z206-2
V202
E209
Z204-1
Z205-1
Z206-1
V201
E208
T204
T205
T206
Z203-2
Z202-2
Z201-2
Z203-1
Z202-1
Z201-1
T203
T202
T201


C254
C273
XV202
R208

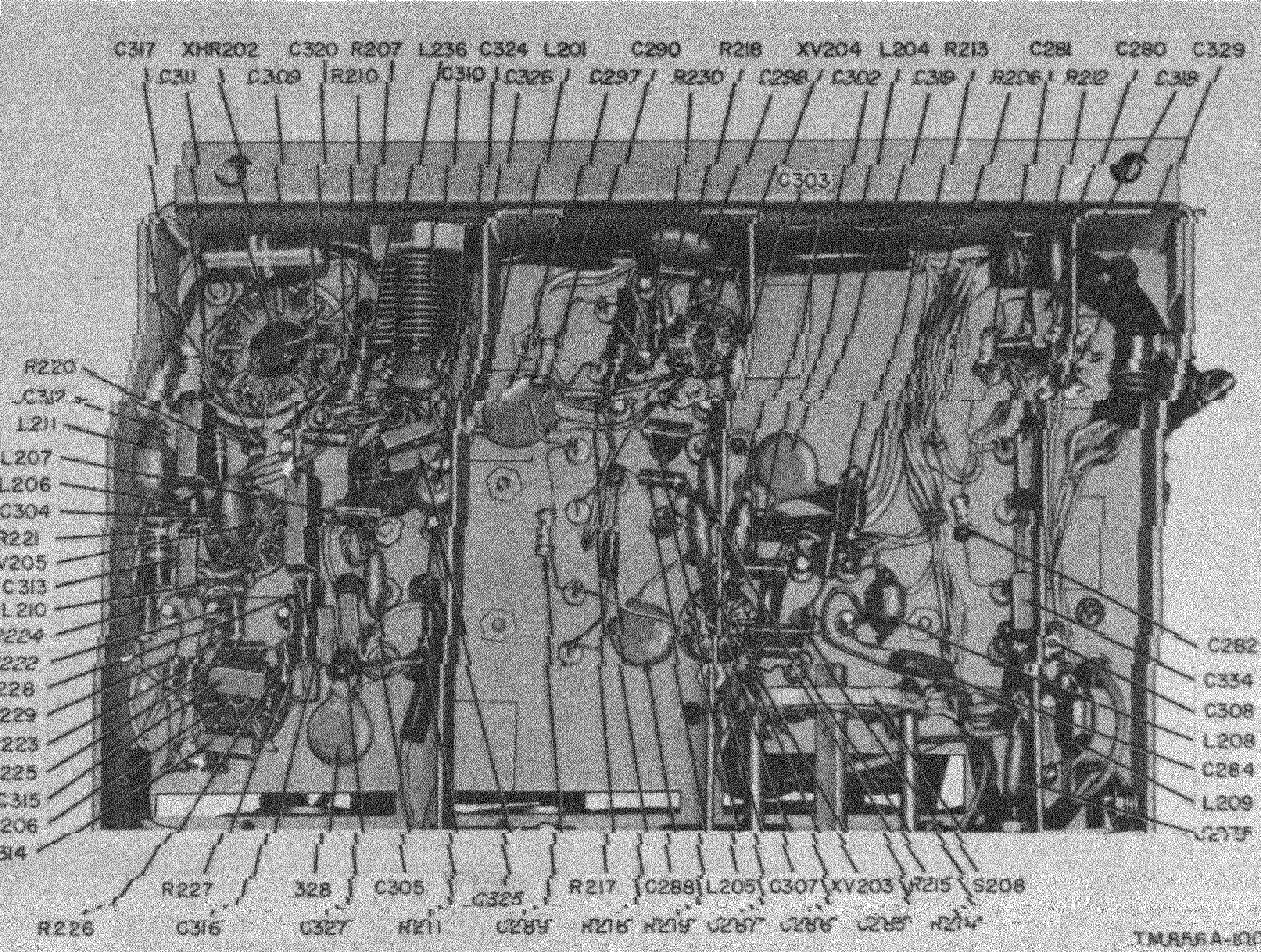


Figure 60. Rf subchassis, bottom view, rear section.

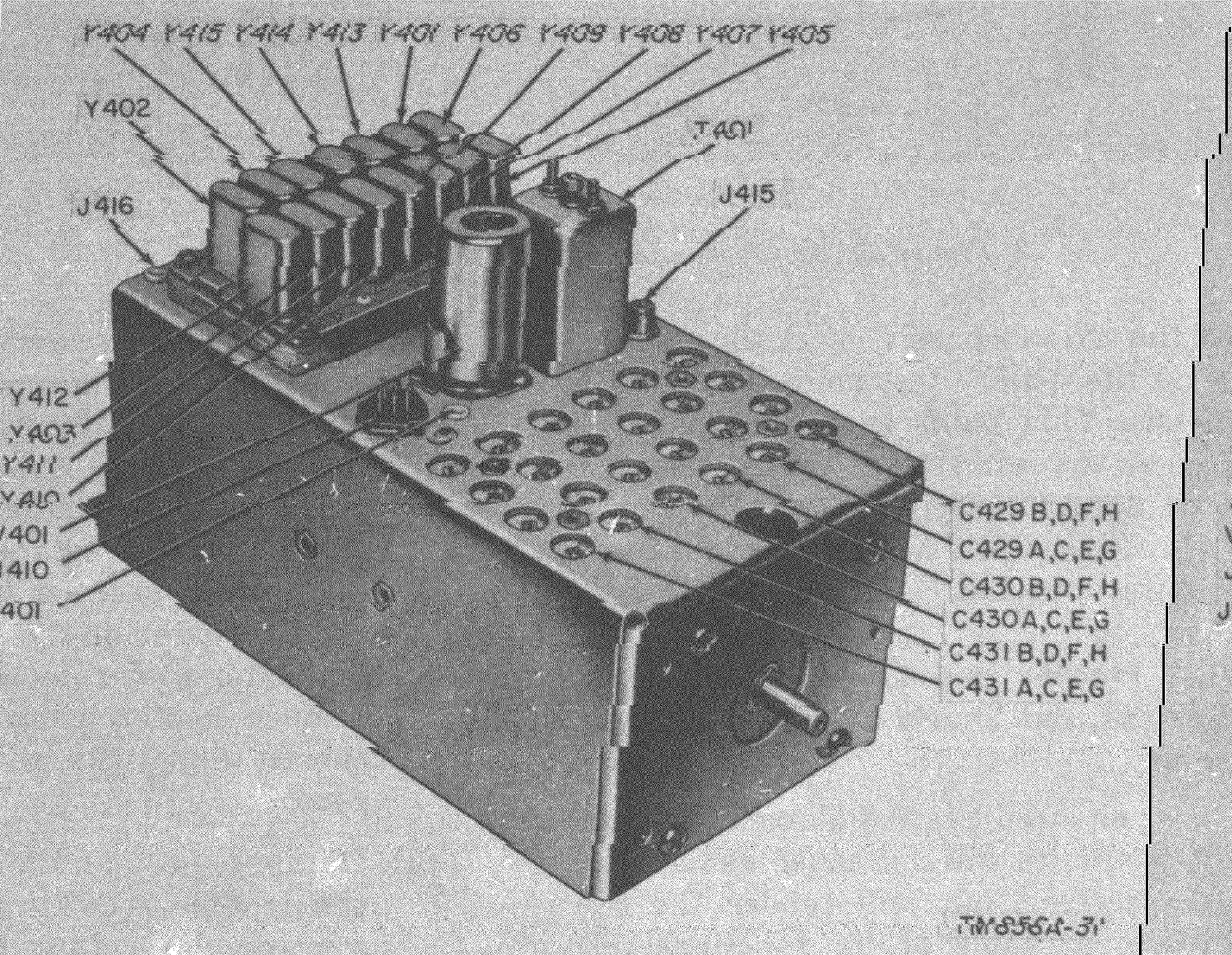
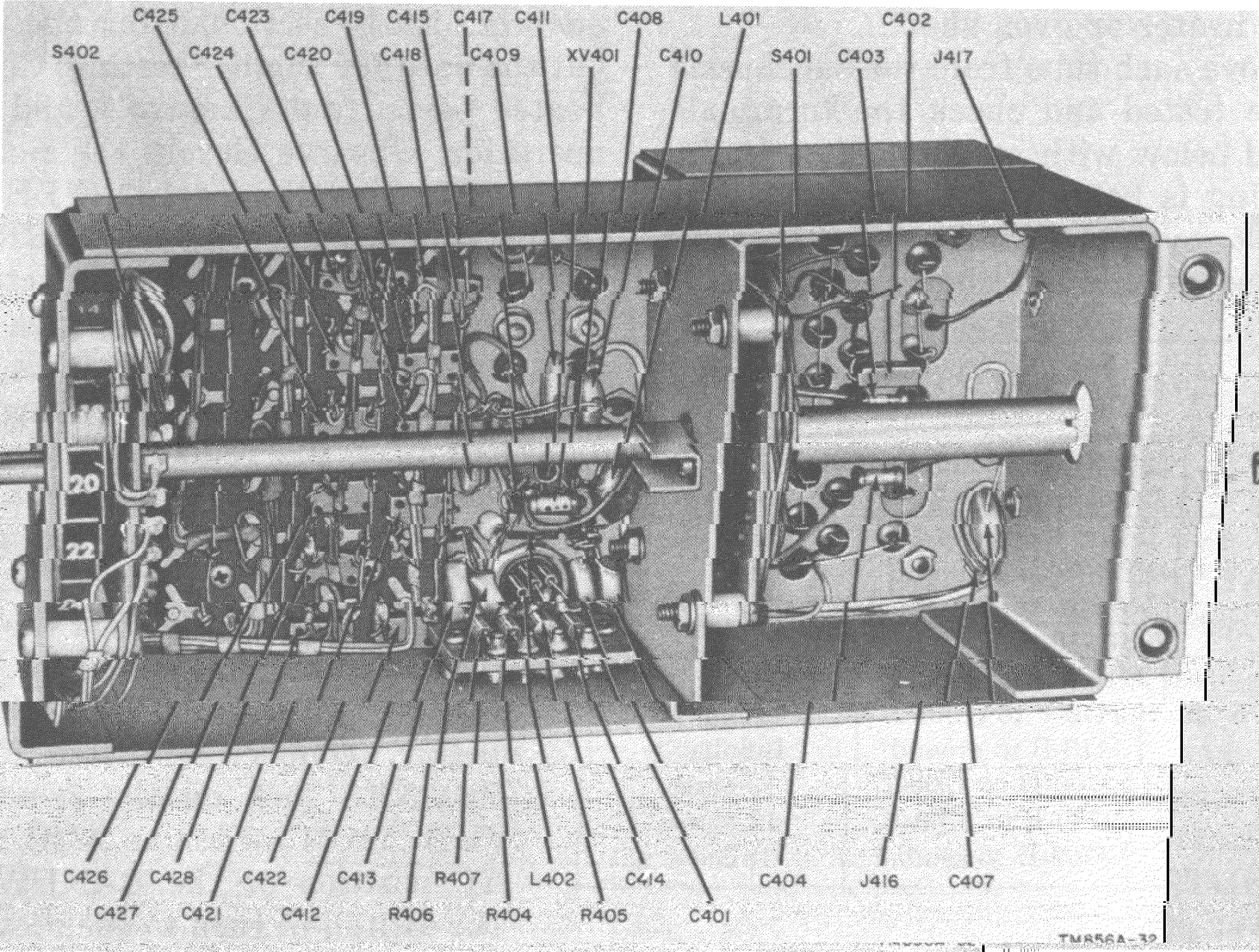
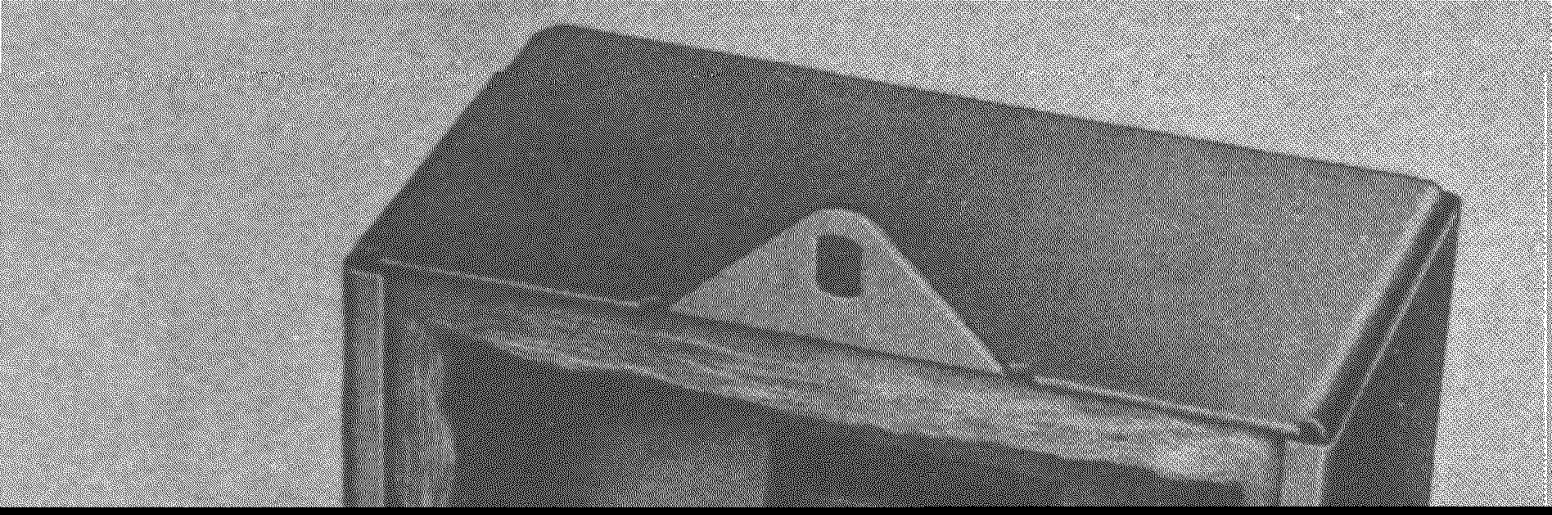


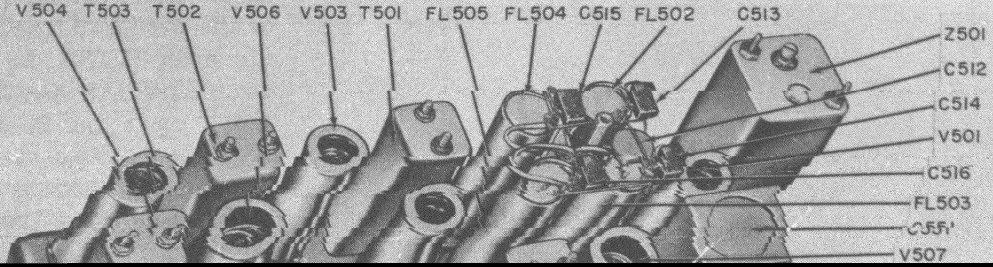
Figure 61. Crystal-oscillator subchassis, top view.



gure 62. Crystal-oscillator subchassis, bottom view.

Fi




V504
T503
T502
V506
V503
T501
FL505
FL504
C515
FL502
C513
Z501
C512
C514
V501
C516
FL503
V507


R533
XV507
C537
R546
XV509
R538
L504
C539
J514


C534
C535
XV505
R526
C527
XRT510
R529
C538
C533
C528

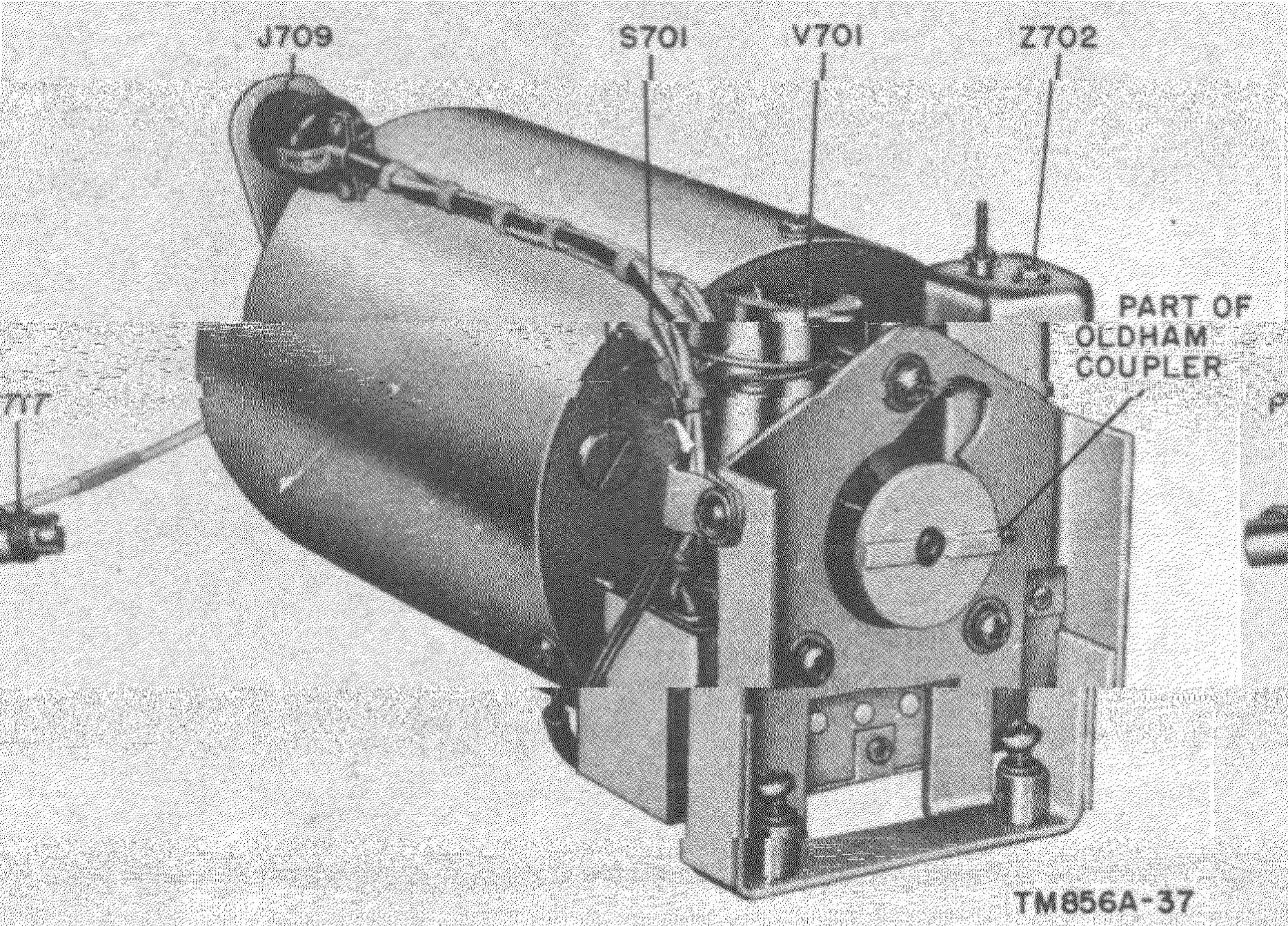


Figure 67. Wiring harness, top view.

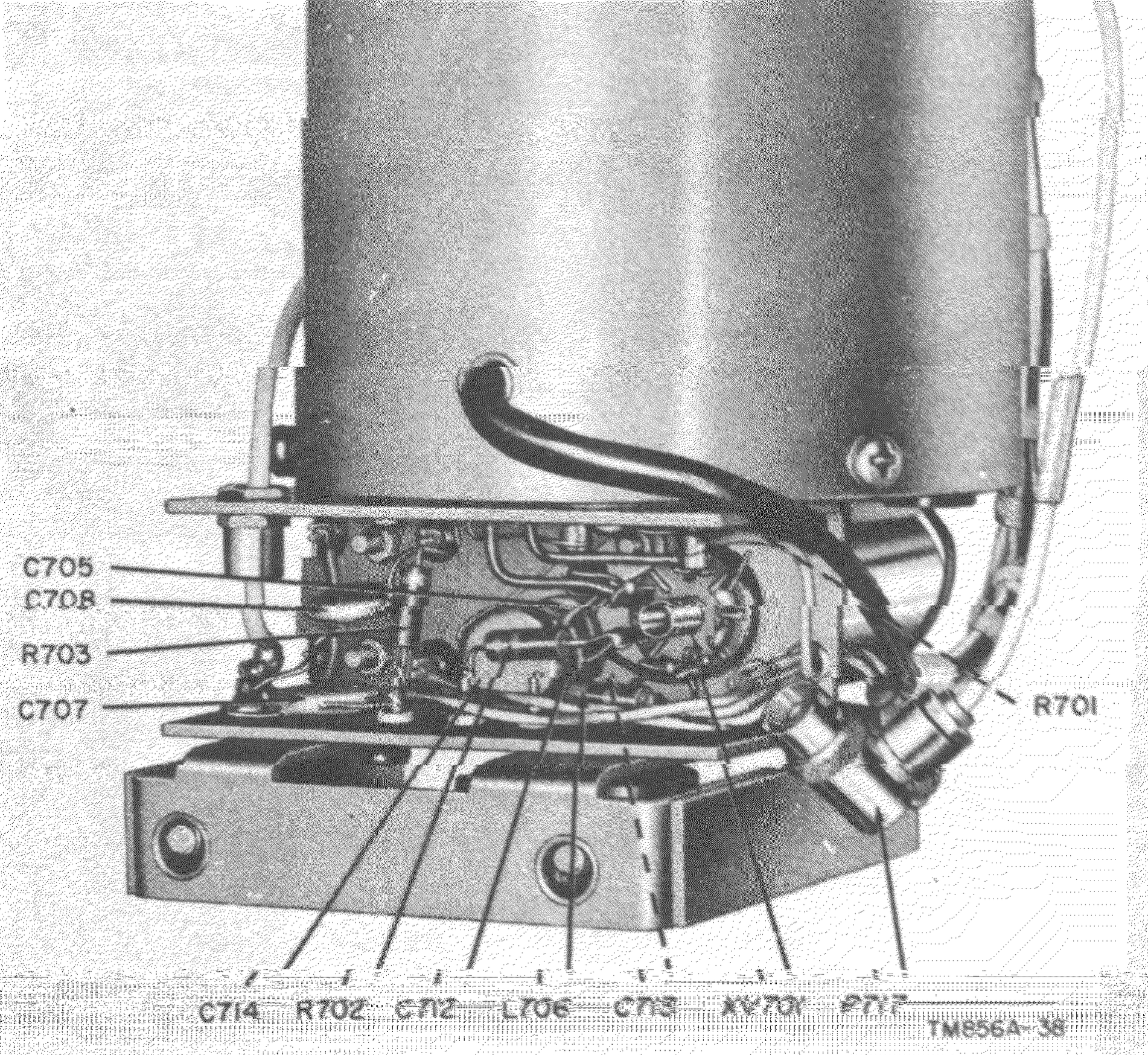
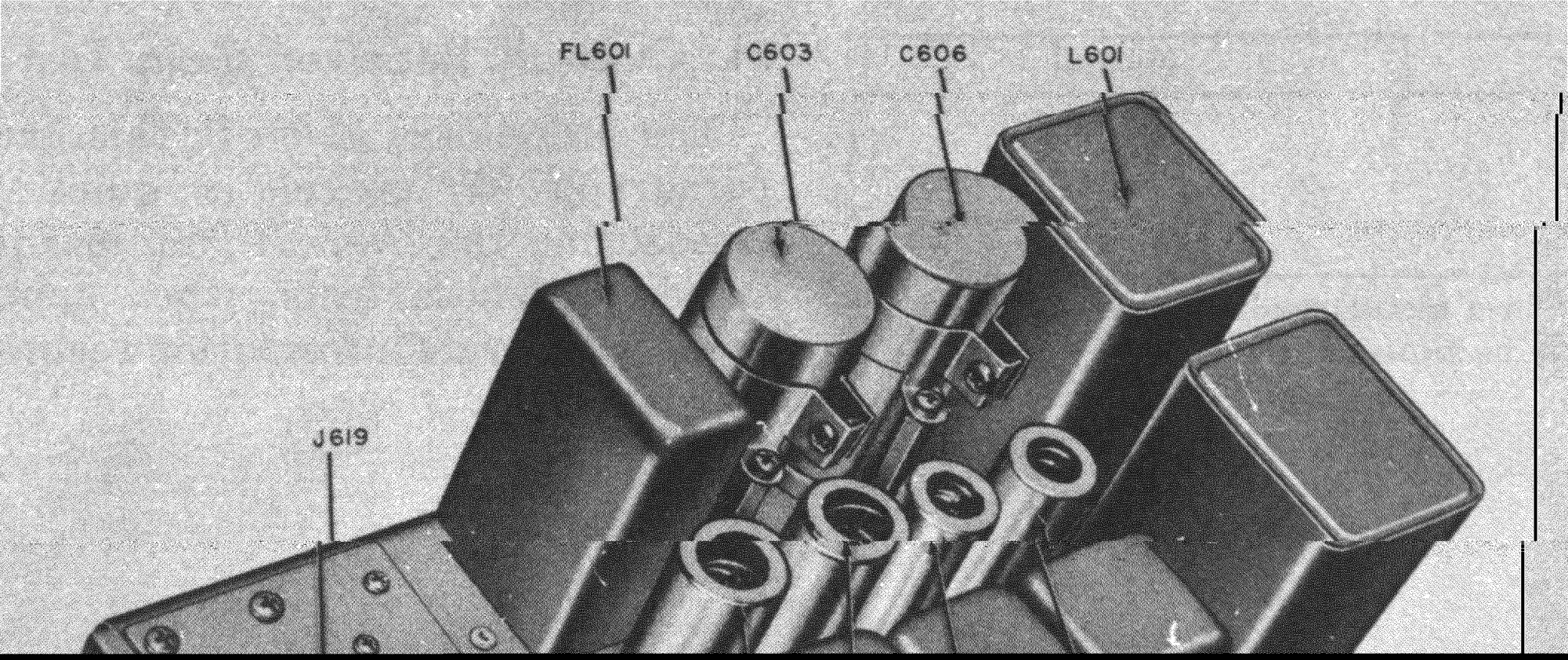
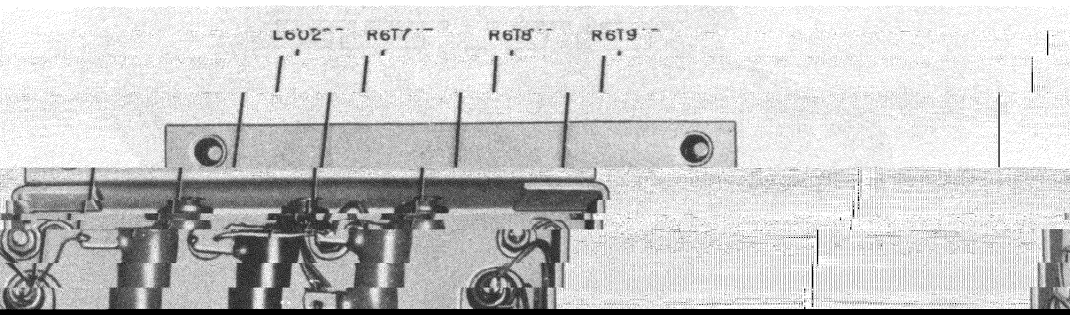
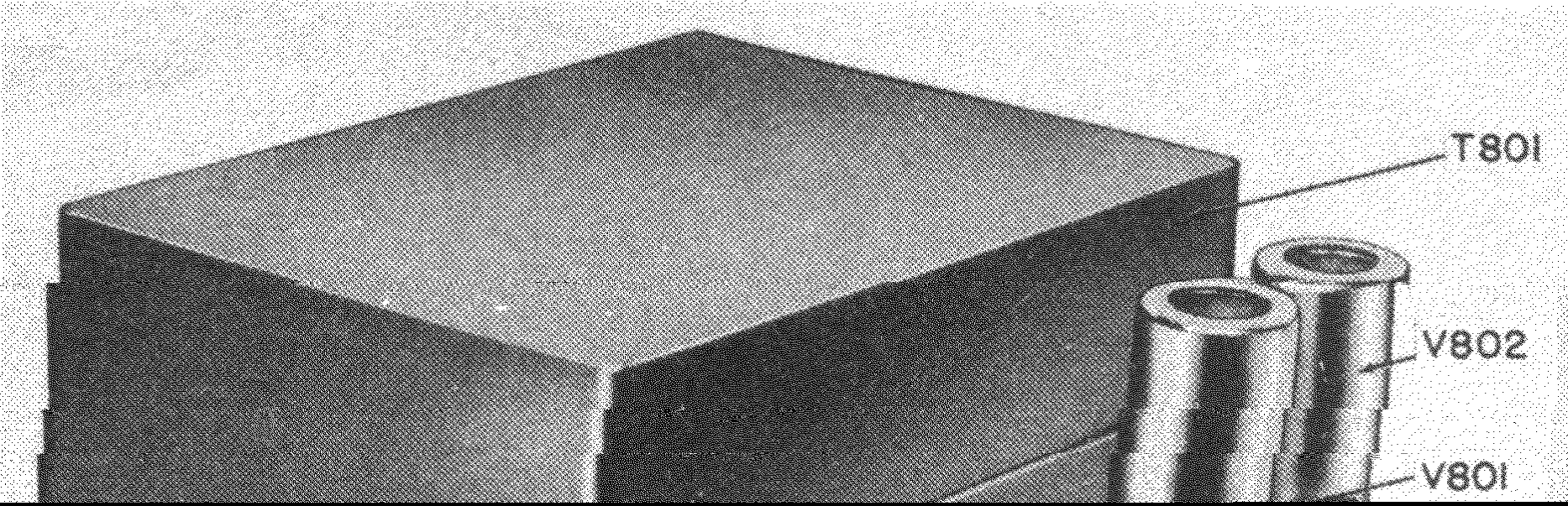


Figure 68. Vfo subchassis, bottom view.


FL601
C603
C606
L601
J619


L602
R617
R618
R619


T801
V802
V801

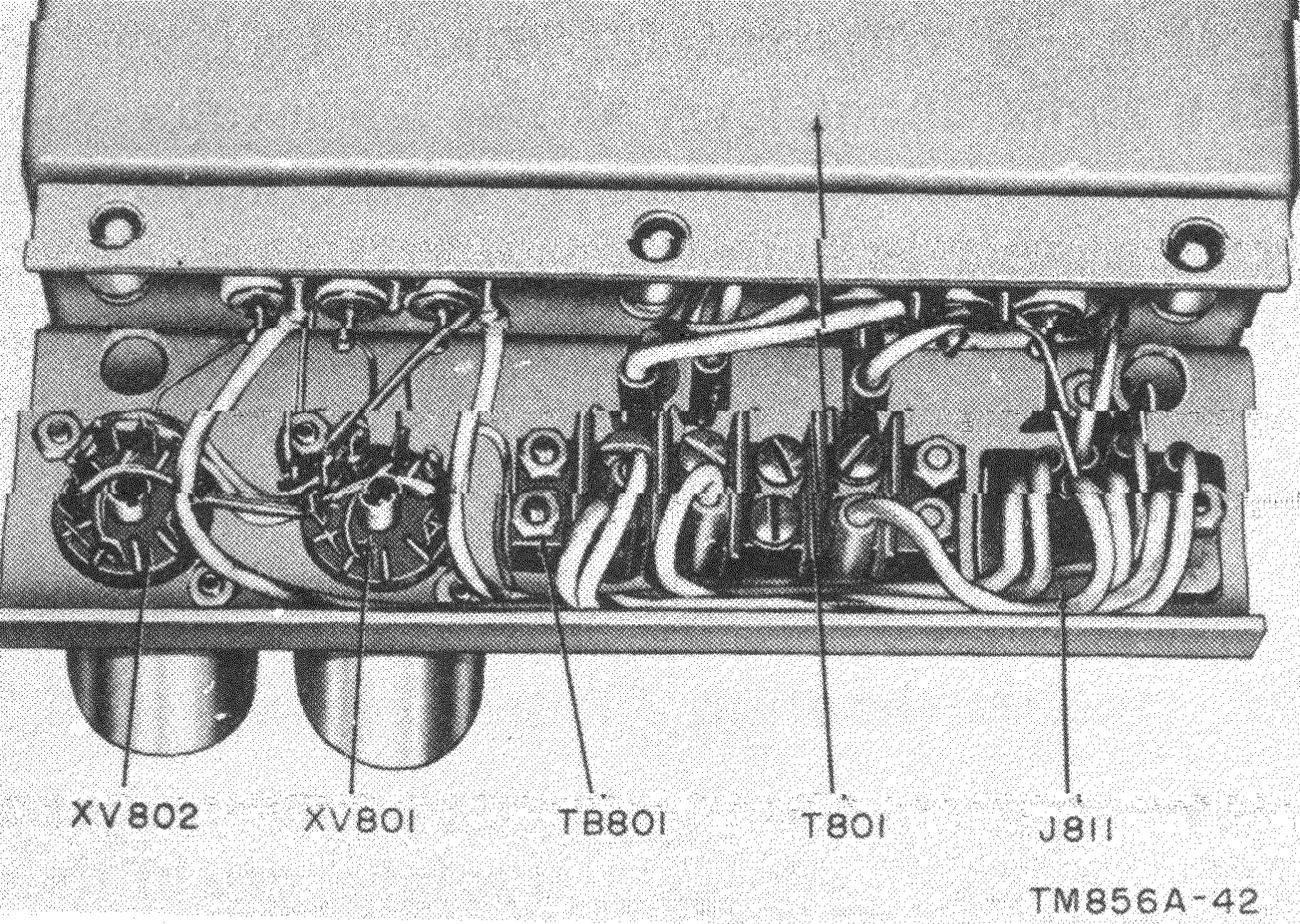


Figure 72. Power-supply subchassis, bottom view.

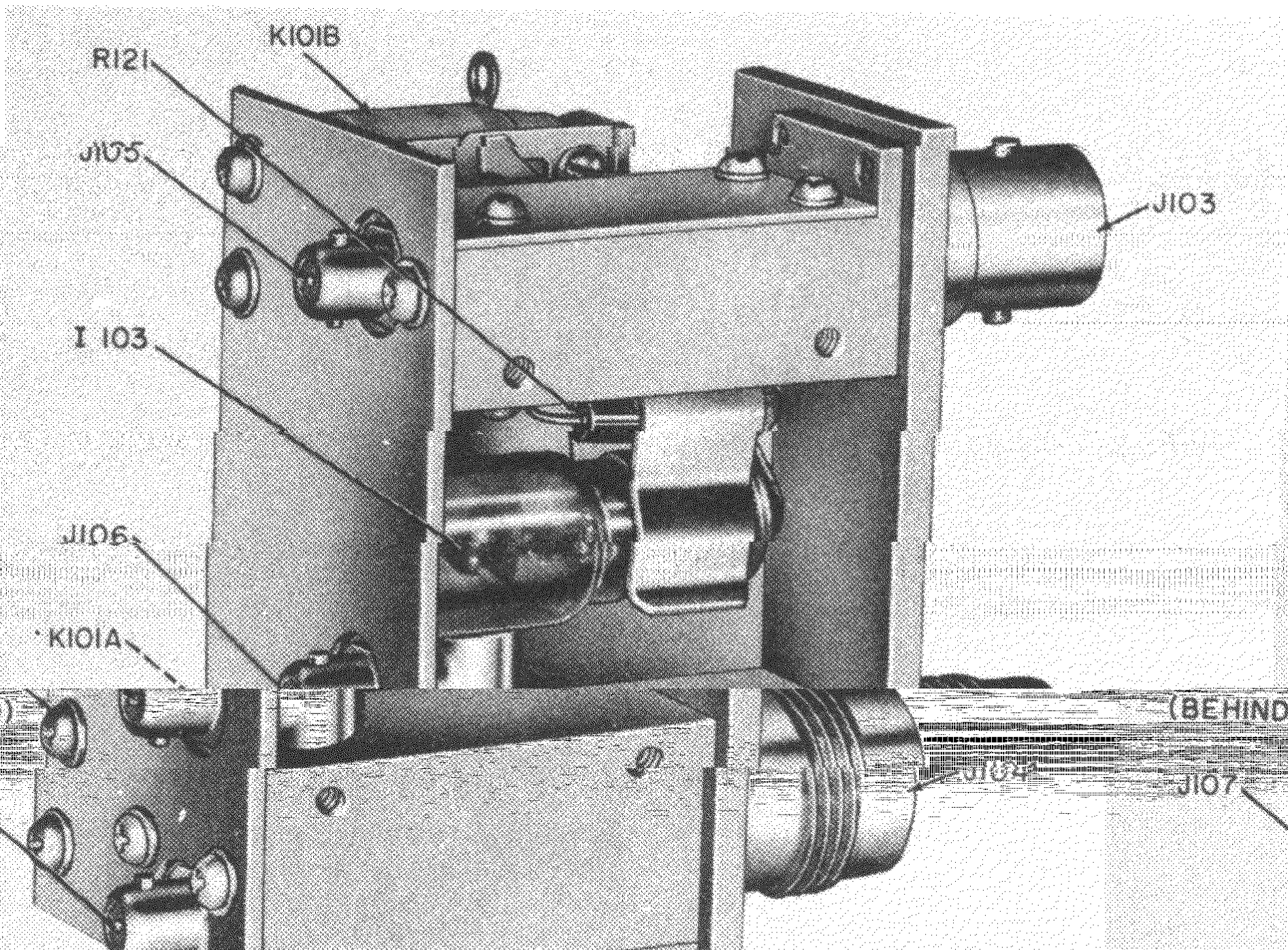
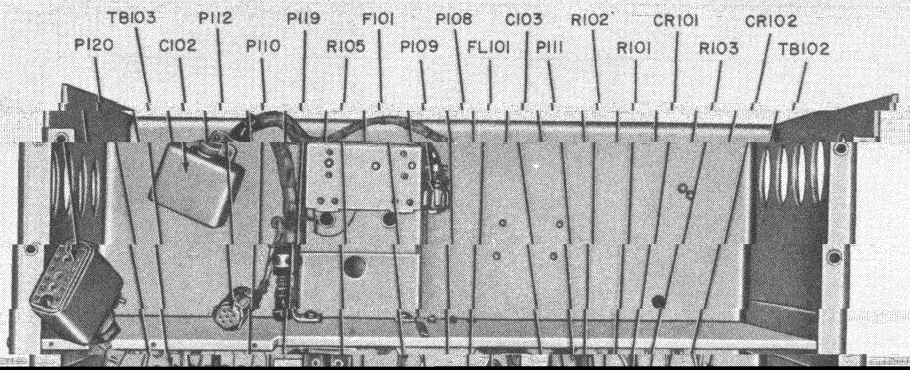


Figure 73. Antenna relay assembly, internal view.


TB103
P112
P119
F101
P108
C103
R102
CR101
CR102
P120
C102
P110
R105
P109
FL101
P111
R101
R103
TB102

