Instruction Book

For

Model 1306

Special Purpose Receiver

Vitro ELECTRONICS
A DIVISION OF VITRO CORPORATION OF AMERICA
PRODUCERS OF NEMS-CLARKE EQUIPMENT
919 JESUP-BLAIR DRIVE / SILVER SPRING, MARYLAND

JSW 5501101361

ERRATA

MODEL 1306 SPECIAL PURPOSE RECEIVER

Make the following changes in Section 5, Replacement Parts List:

Add C130 with description, "Same as C123"

Add C331 with description, "Same as C305"

Change the description of C504 to read, "Same as C123"

Change the description of R168 to read, "Not Used"

Change the description of R621 to read, "Part of T601"

Make the following changes to Figure 5-1, schematic diagram:

The value of C104 should read, ".047"

Add C752, a 0.01 uf capacitor at the junction of R725 and S104C (AM)

Add plug P503 and jack J110 between J503 and "SDU OUTPUT". Connect the plug and jack which were added with a line

The resistor marked "R22" located near R202 should read "R220"

Jack J201 is a UG-1098/U connector instead of a UG-290/U connector.

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Table 1-1. Model 1306 Receiver, Performance Specifications

Types of Reception	AM, FM, CW
Tuning Ranges	30 to 60 mc 60 to 260 mc
Input Impedance	50 ohms (nominal)
Noise Figure	6 db (max.)
Image Rejection	45 db on low band (min.) 58 db on high band (min.)
IF Rejection	45 db on low band (min.) 70 db on high band (min.)
Signal-to-Noise Ratio	4 μv produces at least 23 db S/N with 100-kc deviation, 1-kc modulation frequency, on 300-kc FM IF strip 4 μv produces at least 20-db S/N on 10-kc AM IF strip with 50% modulation at 1 kc
IF Frequency	21.4 mc
IF Bandwidths	10 kc, 300 kc, 500 kc, 1 mc
Outputs Provided	1. Four simultaneous low level video 2. One high level video 3. Panel speaker, headphones, or 600-ohm balanced audio output
High Level FM Output	Approximately 0.10 volt-per-kc signal deviation
High Level AM Output	Approximately 10 volts peak-to-peak for 500-μv input modulated 50% at 1 kc
FM Output Stability	Varies less than 2 db for input above 10 μv on low band and above 25 μv on high band
AM Output Stability	7-db maximum variation for 40-db variation in input
Video Response	150 cps to 500 kc
Video Bandwidth Control	6 positions: 1, 3, 10, 30, 100, and 500 kc cut-off frequencies
Power Input	115 or 230 vac, 50 to 60 cps, single phase
Power Consumption	150 watts
Weight	46 pounds

Table 1-2. Model 1306 Receiver, Semiconductor and Tube Complement

Symbol	Type	Function
CR-101, 102, 103, 104	1N1695	Power Rectifiers
CR-105, 106	1N34A	Pulse Rectifiers
CR-107	10M150Z5	Zener Diode Voltage Regulator
CR-401	1N34A	AGC Detector
CR-402	1N34A	Video Detector
CR-403	1N458	AGC Delay
CR-501	1N34A	AGC Detector
CR-502	1N34A	Video Detector
CR-503	1N458	AGC Delay
CR-601	1N458	AGC Delay
CR-602	1N34A	AGC Detector
CR-603	1N34A	Audio Detector
CR-701	1N34A	Video Detector
CR-702	1N458	AGC Delay
V-102	12AU7	Low Level 500-kc and 1-mc Bandwidth Outputs
V-103	12AU7	Low Level 10-kc and 100-kc Bandwidth Outputs
V-104	12AU7	Balanced DC Amplifier (tuning meter circuit)
V-105	12AU7	Video Amplifier
V-106	12AU7	High Level Video Output
V-107	12AU7	1st Audio Amplifier and Squelch
V-108	12AU7	Audio Output Amplifier
V-201	416B	1st High Band RF Amplifier
V-202	6J4	2nd High Band RF Amplifier
V-203	6AK5	High Band Mixer
V-204	6AF4A	High Band Local Oscillator
V-301	6688	Low Band RF Amplifier
V-302	6AK5	Low Band Mixer
V-303	6AF4A	Low Band Local Oscillator
V-401	6DC6	1st IF Amplifier (500-kc bandwidth)
V-402	6DC6	2nd IF Amplifier (500-kc bandwidth)
V-403	6CB6	3rd IF Amplifier (500-kc bandwidth)
V-501	6DC6	1st IF Amplifier (1-mc bandwidth)
V-502	6DC6	2nd IF Amplifier (1-mc bandwidth)
V-503	6CB6	3rd IF Amplifier (1-mc bandwidth)
V-601	6DC6	1st IF Amplifier (10-kc bandwidth

Table 1-2. (Cont'd.) Model 1306 Receiver, Semiconductor and Tube Complement

Symbol	Type	Function
V-602	6DC6	2nd IF Amplifier (10-kc bandwidth)
V-603	6CB6	3rd IF Amplifier (10-kc bandwidth)
V-701	6DC6	1st IF Amplifier (300-kc bandwidth)
V-702	6DC6	2nd IF Amplifier (300-kc bandwidth)
V-703	6CB6	3rd AM IF Amplifier and 1st FM Limiter (300-kc bandwidth)
V-704	6AK5	2nd FM Limiter
V-705	6AL5	Discriminator
V-801	6CB6	Beat Frequency Oscillator

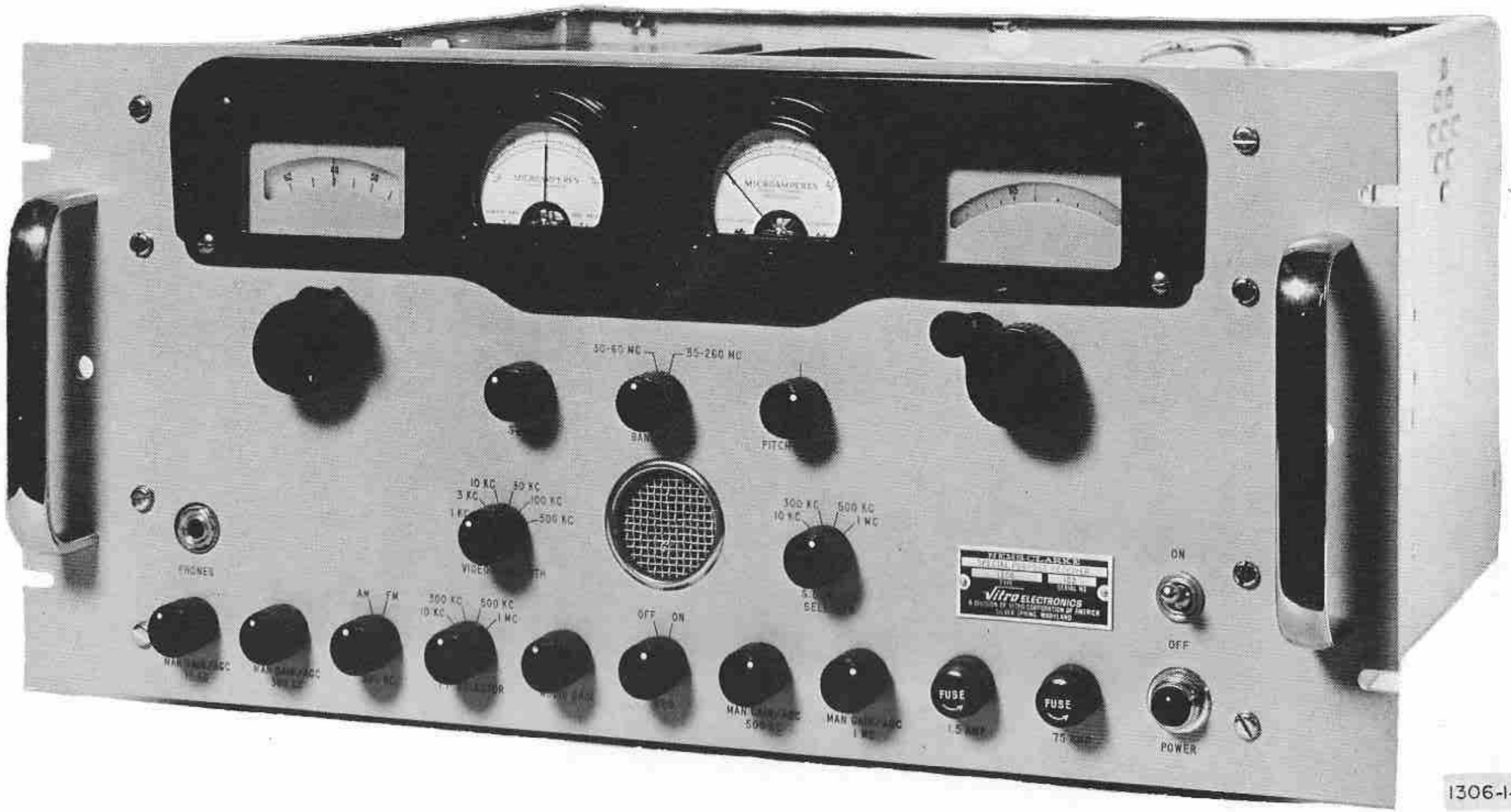

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Figure 1-1. Model 1306 Special Purpose Receiver, Front View

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE OF RECEIVER

The Nems-Clarke Model 1306 Special Purpose Receiver has been designed to meet the requirements for an extremely sensitive, highly stable AM-FM-CW receiver for critical application in the 30 to 260 megacycle range.

Among the special features of the Model 1306 receiver are two RF tuners to cover the frequency range, and four IF strips operating simultaneously. The low band tuner covers 30 to 60 mc; the high band tuner covers 55 to 260 mc. By using separate tuners, maximum sensitivity is achieved with a low receiver noise figure over the entire tuning range.

Each IF strip has a different bandwidth. The IF strip with the 10-kc bandwidth is suitable for AM or CW reception; the 300-kc strip can be used for FM, CW and pulsed AM; and the 500-kc and 1-mc strips are suitable for CW and pulsed AM reception. Low level video outputs from the four IF strips are available simultaneously. A high level video output is available from any one of the IF strips. The high level output is equipped with a variable low pass video filter so that the maximum signal-to-noise (S/N) ratio can be obtained when the full video bandwidth is not needed.

Other features include tuning and signal strength meters, an audio squelch with adjustable threshold, a panel speaker for monitoring purposes, and a high-quality 600-ohm audio output. AGC voltage from each IF strip is available at a connector on the back of the receiver so that a recorder may be attached to make a continuous record of received signal strengths. Provision is also made for attaching a Spectrum Display Unit.

The receiver has a self-contained power supply which operates from 115 or 230 volts, 50 to 60 cps, single phase, alternating current. Power consumption is 150 watts. Selection of the primary voltage is made by a toggle switch located at the rear of the receiver. The switch is equipped with a locking device which prevents accidental switching from one position to the other once the proper voltage is selected. Further performance details are presented in Table 1-1, Performance Specifications.

2. PHYSICAL DESCRIPTION

The Model 1306 Receiver is 10-1/2 inches high by 19 inches wide by 16-7/8 inches deep, occupies approximately 1.95 cubic feet, and weighs 46 pounds.

The receiver is designed for mounting in a standard 19-inch relay rack; however, the unit is equipped with dust covers and louvered side panels and may be operated on a table or shelf. Panel and chassis are constructed of aluminum. The RF tuners and IF amplifiers are self-contained, completely shielded subassemblies. Most of the audio and video components are mounted on the underside of the main chassis.

The front of the receiver and its operating controls are shown in Figure 1-1. The tube and semiconductor complement are listed in Table 1-2.

SECTION 2

OPERATION

1 INTRODUCTION

Location of controls on the front panel of the Model 1306 Receiver is shown in Figure 1-1. Power, antenna, and output connections are made at the rear of the receiver. The power cable is connected to K-101, the antenna for the 30-60 mc tuner to J-107, the antenna for the 55-260 mc tuner to J-106. Output to drive a Spectrum Display Unit is available at J-503.

2. CONTROLS

a. Line Voltage Selector. - Switch S-102, located at the rear of the receiver, is set in either 115 or 230 volt ac position depending on the line voltage which is used to operate the receiver. Once the proper voltage is selected, the locking device on the switch should be tightened to prevent accidental switching from one voltage to the other.

b. Power. - The receiver is turned on and off by switch S-101 located on the front panel. If the 55-260 mc band is to be used initially, the receiver remains inoperative for approximately two minutes after power is applied. To improve tube life, a time delay relay (K-201) is included in the high band tuner to delay application of plate voltage to the 416B tube for approximately 120 seconds.

c. Tuning. - Band-change switch S-105 selects the proper tuner for the frequency to be received. The tuning dial window of the band in use is lighted. An external device can be connected to pins A, B, and C of J-112 at the rear of the receiver to remotely indicate the band in use. The large knobs directly below each dial window are used for tuning. As an aid in tuning, the Model 1306 Receiver is equipped with a zero-center tuning meter (M-101) and a signal strength meter (M-102). Proper tuning is indicated by a zero reading at the center of the meter scale of M-101 The tuning meter should center on zero with no signal input; if not, R-126, located at the rear of the chassis, should be readjusted. The signal strength meter is not calibrated but gives a relative indication of the strength of the signal being received. The meter is switched to each of the four IF strips by the signal strength selector switch (S-107) located on the front panel.

d. IF Bandwidth Selection. - A high level, low impedance output from any one of the four IF strips is chosen by the IF selector switch (S-106). The high level output is available at J-108 at the rear of the receiver. The audio signal monitored by the panel speaker is from the IF strip supplying the high level output. Low level, low impedance outputs from all four IF strips are available simultaneously at jacks on the rear of the receiver. These jacks and their associated IF strips can be readily identified by referring to Figure 2-1, the block diagram of the receiver. Each IF strip has an individual Manual-AGC gain control on the front panel. With the control turned fully clockwise, a switch activates the AGC circuit for that particular IF strip and its gain is automatically controlled. However, when the AM-FM switch is in the FM position, gain of the 300-kc IF strip is AGC controlled regardless of the position of the Manual-AGC switch. The Manual-AGC control should always be in the AGC position except when monitoring CW signals. Care should be exercised in tuning when monitoring the 10-kc IF strip to avoid "missing" the station.

e. AM Reception. - The AM-FM switch (S-104) must be in the AM position, the BFO switch (S-103) off, and the Manual-AGC control should be in the AGC position.

f. FM Reception. - The AM-FM switch must be in the FM position, the IF selector switch in the 300 KC position, and the BFO switch OFF. Reception of FM signals is possible only through the 300-kc bandwidth IF strip. With the AM-FM switch in the FM position, the Manual-AGC control is inoperative and IF gain is AGC controlled.

g. CW Reception. - The AM-FM switch must be in the AM position and the BFO switch turned on to supply a beat note. Tone of the beat note can be varied by the pitch control on the front panel. IF gain may be manually adjusted to give a beat note of the desired strength, when the MAN/AGC control is in the MAN position.

h. Video Bandwidth. - The video bandwidth switch (S-112) has six positions: 500 KC, 100 KC, 30 KC, 10 KC, 3 KC, and 1 KC. The position which gives the best S/N ratio may be used when the loss of higher frequencies can be tolerated.

i. Squelch. - The squelch circuit is inoperative when the squelch control, R-135, is turned completely counter-clockwise. With no signal input, rotate R-135 clockwise until the background noise just becomes inaudible. Any usable signal then disables the squelch circuit and allows the audio circuits to operate.

j. Audio Gain. - Adjust as desired. Inserting headphones in the phone jack (J-109) automatically disconnects the panel speaker.

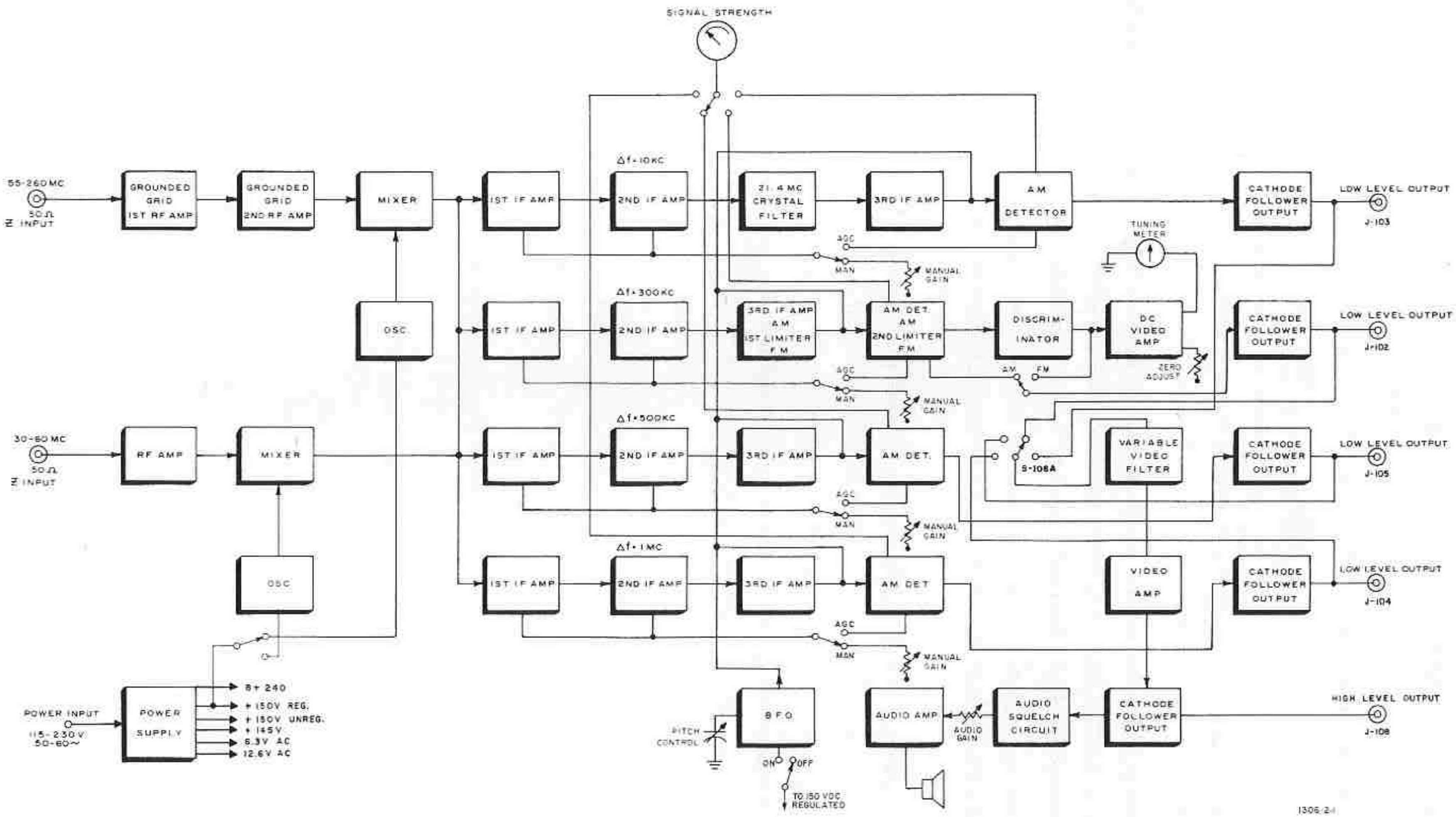

Figure 2-1. Model 1306 Special Purpose Receiver, Block Diagram

SECTION 3

THEORY OF OPERATION

1. GENERAL

A block diagram of the Model 1306 Special Purpose Receiver is shown in Figure 2-1. The receiver is a single-conversion superheterodyne covering the 30- to 260-mc frequency range in two overlapping bands. Separate RF tuners are used for each band. The low band tuner covers 30 to 60 mc, the high band tuner 55 to 260 mc. Both tuners have been designed to give the maximum sensitivity with the lowest possible noise figure. The receiver has four IF strips of different bandwidths but with a common IF frequency of 21.4 mc. All operate simultaneously. The three-db bandwidths are 10 kc, 300 kc, 500 kc, and 1 mc. The 300-kc, 500-kc, and 1-mc IF strips are suitable for CW and pulse reception; the 10-kc IF strip is used for AM and CW reception. FM reception is possible only through use of the 300-kc IF strip. Low level video outputs from all four IF strips are available simultaneously.

A high level video output from any one of the four IF strips is obtained by feeding its low level output signal through a two-stage video amplifier and then to a cathode follower output. The video amplifier is preceded by a variable low pass filter to obtain the maximum S/N ratio when the full video bandwidth is not needed. A portion of the high level output drives a four-stage squelch-audio amplifier circuit. A two-inch panel speaker is provided for aural monitoring, with provision for using headphones or feeding a 600-ohm audio line.

2. 30- to 60-mc RF TUNER

a. Antenna. - The antenna signal is applied through J-107, an N-type coaxial receptacle located at the rear of the receiver. Input impedance is approximately 50-ohms over the tuner frequency range. The input signal is applied directly to the grid of the RF amplifier through C-301 and C-302.

b. RF Amplifier. - A type 6688 (V-301) high transconductance pentode in a grounded-cathode circuit is used as the RF amplifier. The 50-ohm antenna input is matched to the high impedance grid circuit by a network made up of C-300 and C-301. The stage is tuned by L-300A and L-300B, two sections of a three-section Inductuner, in the grid and plate circuits. A capacity "T" network is used to couple the plate to the mixer grid. The shunt element of the "T", C-311, is adjustable to provide a control over the interstage bandwidth. To produce the maximum S/N ratio, the RF amplifier is operated at maximum gain at all times. When the high band tuner is in use, plate voltage is removed from V-301 by the band switch, S-105.

c. Mixer. - The mixer, V-302, is a 6AK5 sharp-cutoff pentode. The oscillator signal is injected into the grid through C-320 and develops a self-bias proportional to the amplitude of the oscillator signal. This feature minimizes the effect on receiver performance of variations in oscillator signal level. Mixer plate voltage is obtained through the primary winding of the IF input transformer, T-501, located on the IF amplifier subassembly. When the tuner is not in use, band switch S-105 removes screen voltage from the mixer. A decoupled test point, TP-301, at the junction of the mixer grid resistors, R-306 and R-307, provides a convenient means for observing the response of the RF circuits.

d. Local Oscillator. - The local oscillator, V-303, is a high frequency 6AF4A triode in a Colpitts circuit. The oscillator frequency is 21.4 mc higher than that of the received signal. The oscillator is tuned by L-300C, the third section of the Inductuner. The oscillator signal is fed to the mixer grid through C-320. Capacitor C-325 places the plate of V-303 at RF ground. Trimmer capacitor C-321 is used to align the oscillator at the low frequency end of the band. No adjustment is necessary at the high end. Plate voltage is removed from the oscillator by band switch S-105 when the tuner is not in use.

3. 55- to 260-mc RF TUNER

a. Antenna. - The antenna signal is applied through J-106, an N-type coaxial receptacle located at the rear of the receiver. Input impedance is approximately 50 ohms over the tuner frequency range. The input signal is applied directly to the cathode of the first RF amplifier through C-239.

b. First RF Amplifier. - The first RF amplifier, V-201, is a 416B low noise planar triode in a grounded-grid circuit. Input resistance of the 416B is approximately $2/G_m$ when $R_L = R_p$, and in this case is 40 ohms. This 40-ohm shunt load and the low cathode-to-ground capacity produce an extremely broad input bandwidth, making it unnecessary to tune the cathode circuit. To prevent losing part of the input signal due to cathode-to-filament capacitance, the filaments are kept above RF ground by broadband chokes L-202 and L-203. Relatively large bypassed cathode resistors are used to obtain a considerable amount of dc degeneration. This degeneration has a stabalizing effect on the 416B and also minimizes performance variations between tubes if replacement is ever necessary. A positive grid bias of 8 volts is applied to the grid of the tube from the 150-volt regulated supply through a voltage divider made up of R-203, R-204, and R-219. This positive bias is necessary to cancel most of the 8.2 volts self-bias developed across the cathode resistors so that the tube operates with approximately 0.2 volt bias. If the grid bias is removed or shorted, plate current is reduced and damage to the tube cannot result. Both the first and second RF amplifiers are operated at maximum gain at all times to help produce the maximum S/N ratio. The high impedance plate circuit of the 416B is coupled to the low impedance grounded-grid 6J4 second RF amplifier by a modified pi network tuned by L-205A. The plate current of the 416B can be conveniently measured at TP-201, the junction of R-201 and R-202, the cathode bias resistors. A VTVM at TP-201 reads the voltage drop across 100-ohms. Thus, for example, 2 volts indicates a current flow of 20 ma. A time delay relay, K-201, is used to delay the application of plate voltage to the first RF amplifier for approximately 120 seconds after the receiver is first turned on. This delay is included to insure that the cathode of the 416B is emitting before plate voltage is applied, and thus improve tube life. If the high band is to be used initially, the receiver remains inoperative for approximately two minutes after power is first applied. The filament of the 416B is operated from a 12.6 volt winding on the power transformer, T-101, through a 5.1-ohm series dropping resistor, R-220. This provision produces a self-regulating effect which helps extend tube life. A blower mounted on the tuner assembly is used to cool the 416B. The blower motor is connected to the main chassis by P-111. A jumper between pins E and F of P-111 removes plate voltage from the tube when the motor is disconnected, thus protecting the tube. When the low band tuner is in use, plate voltage is removed by band switch S-105.

c. Second RF Amplifier. - The second RF amplifier, V-202, is a 6J4 triode in a grounded-grid circuit. The noise figure of this stage is extremely low, so that the tuner noise figure is essentially that of the first RF amplifier. The plate of the 6J4 is coupled to the mixer grid by a double-tuned, over-coupled band-pass filter. A capacity "T" network made up of C-219, C-220, and C-221 is used to provide coupling between the primary and secondary tuned circuits. The shunt element of the "T", C-220, is adjustable to provide a control over the interstage bandwidth. A small iron-core inductor, L-208, across C-220 approaches parallel resonance with the capacitor at 55 mc. This feature increases coupling at the low end of the band and helps provide more uniform coupling over the entire tuning range. The single-tuned high Q plate circuit of the first RF amplifier is used to "fill in" the dip caused by the over-coupling of the second RF amplifier plate circuit. The over-all tuner RF response is essentially flat over the entire band when viewed at the mixer grid test point, TP-202. Plate voltage is removed from the 6J4 by band switch S-105 when the low band tuner is in use.

d. Mixer. - The mixer, V-203, is a 6AK5 sharp-cutoff pentode. The oscillator signal is injected into the grid through C-233 and develops a self-bias proportional to the amplitude of the oscillator signal, thus minimizing the effect on receiver performance of variations in oscillator signal level. Mixer plate voltage is obtained through the primary winding of the IF input transformer, T-501, located on the IF amplifier subassembly. Band switch S-105 removes screen voltage from the mixer when the low band tuner is in use. A decoupled test point, TP-202, at the junction of the mixer grid resistors, R-209 and R-210, provides a convenient means for observing the response of the RF circuits.

e. Local Oscillator. - The local oscillator, V-204, is a high frequency 6AF4A triode in a modified Colpitts circuit. The oscillator frequency is 21.4 mc higher than that of the received signal. A high degree of stability is obtained by using a heavy strap for the end inductor and a high G_m tube loosely coupled to a high Q tank circuit. The oscillator is tuned by L-205D, a section of the Inductuner. Capacitor C-233 feeds the oscillator signal to the mixer grid. Trimmer capacitor C-229 is used to align the oscillator at the low frequency end of the band. The location of the ungrounded lead from C-230 on the end inductor, L-210, controls the high frequency end of the band. Plate voltage is removed from the 6AF4A by band switch S-105 when the low band tuner is in use.

4. IF AMPLIFIERS

a. General. - The Model 1306 Receiver contains four IF strips with a common IF frequency of 21.4 mc built as a single subassembly. The strips differ mainly in bandwidth, AGC time constants, and the inclusion of an FM discriminator in the 300-kc bandwidth strip. Inputs from the two RF tuners are fed in parallel through short lengths of RG-71/A coaxial cable to the wideband IF transformer, T-501, the common input transformer for all four strips. The transformer is capacitively coupled to the grid of the first IF amplifier tube in each IF strip.

b. 500-kc Bandwidth IF Strip. - The IF amplifier consists of two high gain stages using 6DC6 tubes (V-401 and V-402) followed by a 6CB6 (V-403) sharp cut-off pentode in the third stage. The tuned circuits use conventional double-tuned transformers designed for optimum performance at 21.4 mc with a bandwidth of 500 kc. A combination of inductance and capacitance is used for interstage coupling. The IF signal is detected by a 1N34A diode, CR-402, passes through a filtering and compensation network made up of C-435, L-407, and R-421, and drives the low level cathode follower output tube, V-102A. The BFO signal, when used, is injected into the detector through C-433. The gain of the first two IF stages is controlled either manually or by AGC depending on the position of the Manual AGC switch S-109. When manually controlled, the AGC voltage is shorted to ground and the cathode voltage of V-401 and V-402 is varied by R-154. With S-109 in the AGC position, R-154 is shorted to ground and the AGC circuit controls the gain of V-401 and V-402 by varying the grid bias. A simplified schematic of the AGC circuit is shown in Figure 3-1. CR-401 is the AGC rectifier and CR-403, a 1N458 silicon diode, delays application of the AGC voltage to V-401 and V-402 until the incoming signal reaches a predetermined level. Delaying AGC action permits the first two IF stages to operate at maximum gain on weak signals. CR-401 conducts on the negative peaks of incoming IF signals and develops a negative voltage at point A proportional to the strength of the incoming signal. With no signal input, point B is approximately 0.5 volt positive as a result of the forward current characteristics of CR-403 and the voltage drop from the high voltage supply across R-420, a 20-megohm resistor. The negative AGC voltage developed by CR-401 across R-419 has no effect on receiver gain until the incoming signal is strong enough to overcome the positive 0.5 volt at point B. Thus, AGC action is delayed and V-401 and V-402 operate at maximum gain. Once the signal strength is great enough to develop -0.5 volt at point B, IF gain is controlled by AGC. The AGC time constant is 0.005 second, determined largely by the parallel comination of C-434, C-444, and C-446. C-445 is a filter for the AGC line. The cathode resistors of the 6DC6 tubes are only partially bypassed in order to obtain a degree of cathode degeneration, which is necessary to eliminate detuning due to changes in tube input capacitances resulting from changes in bias voltage. There is always a negative voltage at point A directly proportional to signal strength, regardless of the position of the Manual-AGC control. Aside from providing AGC, voltage from this point operates the signal strength meter (after passing through voltage divider R-418 and R-424), keys the squelch circuit when the 500-kc IF strip is being monitored, and is made available through isolating resistors R-423 and R-112 at pin H of J-112 for the recording of signal strength.

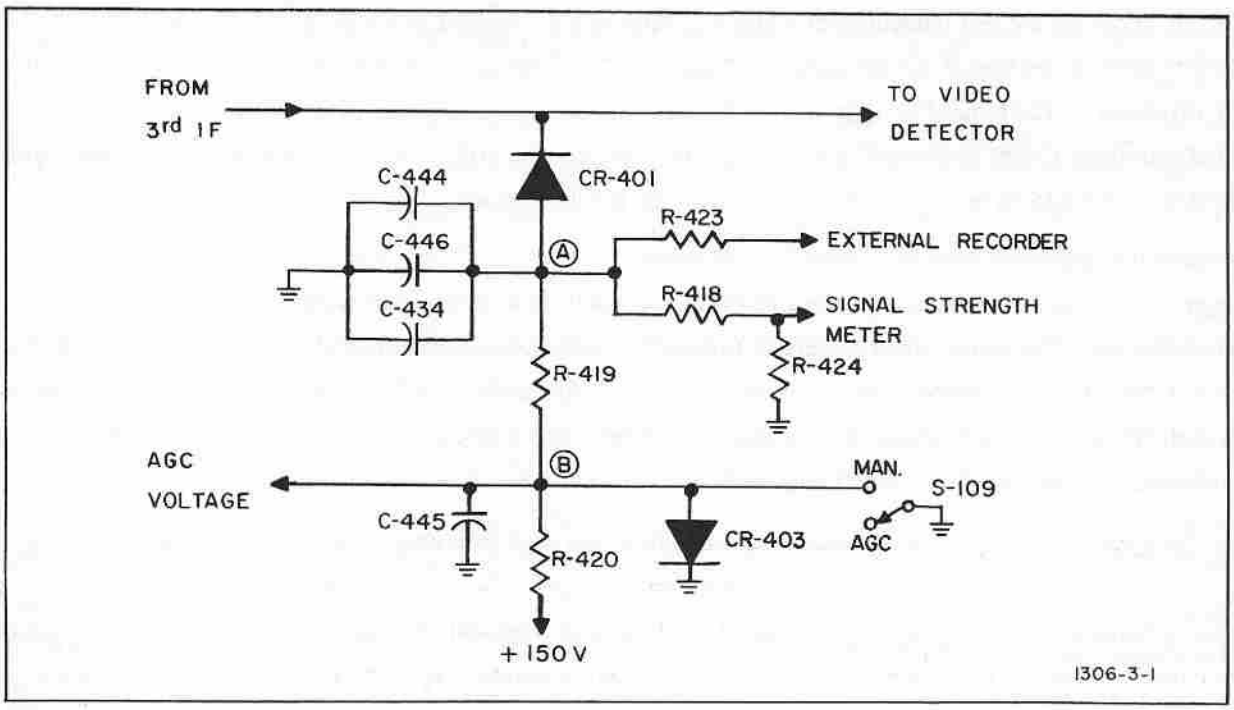

Figure 3-1. 500-kc IF Bandwidth AGC Circuit, Simplified Schematic

c. <u>1-mc Bandwidth IF Strip.</u> - The circuit configuration of the 1-mc bandwidth IF strip is identical to that of the 500-kc bandwidth strip. Only the values of components necessary to achieve the greater bandwidth are different. Output from the video detector, CR-502, is fed to the low level cathode follower output tube V-102B.

d. 10-kc Bandwidth IF Strip. - The 10-kc bandwidth IF strip closely resembles the 500-kc strip except for a crystal filter installed between the second and third IF amplifiers. The crystal filter, FL-601 and its associated matching network, T-602 and T-603, is used to attain the narrow bandwidth at the 21.4-mc IF frequency without using additional IF stages. Output from the audio detector, CR-603, passes through a filter network made up of C-635 and R-623, and then drives the low level output tube, V-103A. The AGC circuit is essentially that used in the 500-kc IF strip except for a 0.1-second time constant to make the strip suitable for AM reception. AGC voltage is made available at pin E of J-112 to operate an external recorder.

e. 300-kc Bandwidth IF Strip. - The 300-kc bandwidth IF strip is used for FM reception as well as CW and pulsed AM. Its signal handling capability is increased by operating the screen of the second IF amplifier from the 240-volt supply and its plate from the 150 volt supply (unregulated). The first and second IF amplifier are gain controlled and have their cathode resistors only partially bypassed to obtain a degree of cathode degeneration, which is necessary to eliminate detuning due to changes in tube input capacitance resulting from changes in bias voltage. The third stage serves as an IF amplifier on AM and as the first limiter on FM.

(1) Function Switch in FM Position. - Two high gain stages using 6DC6 tubes (V-701 and V-702) are followed by a 6CB6 (V-703) first limiter and a 6AK5 (V-704) second limiter. A 6AL5 (V-705) in a modified Foster-Seeley circuit is used as the FM discriminator. The detected signal is applied through L-712 to the grid of low level output tube, V-103B, and to the balanced dc amplifier in the tuning meter circuit. V-703 is made suitable for limiting action on FM by lowering its screen voltage when section D of the AM-FM switch (S-104) functions to ground R-718, causing it to serve with R-719, as a voltage divider network. When used for FM reception, the gain of the IF strip is controlled by AGC action regardless of the position of the Manual-AGC control. AGC voltage is obtained by grid rectification at the grid of the first limiter and applied through R-714 to the AGC delay diode, CR-702. The delayed AGC voltage is then applied to the grids of V-701 and V-702. This voltage also operates the signal strength meter after passing through a voltage divider made up of R-715, R-716, R-163 and R-165. An AGC voltage to operate the squelch circuit and monitor signal strength is obtained by grid rectification at the second limiter grid. The voltage is applied to the squelch circuit through R-734 and made available at pin F of J-112 for external use.

(2) Function Switch in AM Position. - The IF amplifier consists of two high gain stages using 6DC6 tubes followed by a 6CB6 sharp cut-off pentode in the third stage. The IF signal is detected by diode CR-701 and applied to the grid of the low level output tube, V-103B, after passing through a filter network composed of L-708 and R-735. The gain of V-701 and V-702 is controlled either manually or by AGC depending on the position of S-110. When the switch is in the manual position, the AGC voltage is shorted to ground and the cathode voltage of V-701 and V-702 is varied by R-155. When S-110 is in the AGC position, R-155 is shorted to ground and AGC bias is applied to the grids of the first two IF amplifiers. An AGC voltage proportional to signal strength is developed by grid rectification at the grid of the second limiter, V-704, and applied to the AGC delay diode, CR-702, through R-725. Voltage to operate the signal strength meter is dropped by a voltage divider made up of R-724 and R-726. AGC voltage to operate the squelch circuit and an external signal strength recorder is fed through isolating resistor R-734 to V-107B and pin F of J-112.

5. VIDEO

Video and audio outputs from the four IF strips are fed to low level cathode follower output tubes V-102 and

V-103. The low level outputs are available at J-102 through J-105. The low level output from one of the cathode followers is selected by S-106A, passed through a variable low-pass video bandwidth filter, and on to a two-stage video amplifier (V-105). The high level video output from V-105 feeds cathode follower tube V-106. High level video output is available at J-108. To increase the distortionless signal-handling ability of the cathode followers, relatively large cathode resistors are used. To counteract part of the self-bias developed in the cathode resistors, a positive grid bias is applied from the 145-volt supply through 4.7-megohm resistors. The video bandwidth filter has six positions: 500KC, 100KC, 30KC, 10KC, 3KC, and 1KC. When the full bandwidth is not needed, the filter permits selecting the bandwidth which gives the best S/N ratio.

6. SQUELCH

A simplified schematic diagram of the squelch circuit is shown in Figure 3-2. V-107A is a gated audio amplifier while V-107B serves as a dc amplifier and gate generator. The audio signal to drive V-107A is supplied by the high level cathode follower output so that the monitored audio signal is from the IF strip which provides the high level video output. The squelch circuit is connected so that V-107B has zero grid bias when no signal is being received, and with signal input, a negative voltage from the AGC circuit. The audio stage passes signals when the dc amplifier is non-conducting, and is cut off when the dc amplifier conducts. In this manner, the audio section is disabled when no signal is being received. The signal strength necessary to make the audio section operative is adjusted by the threshold (squelch) control, R-135.

In detail, the squelch circuit works as follows: The dc amplifier, V-107B, is connected between the 150-volt supply and ground. The fixed bias on this stage is adjusted by R-135. The audio amplifier, V-107A, is connected between the 240-volt supply and the 150-volt supply. The bias on this stage is the voltage drop across the cathode

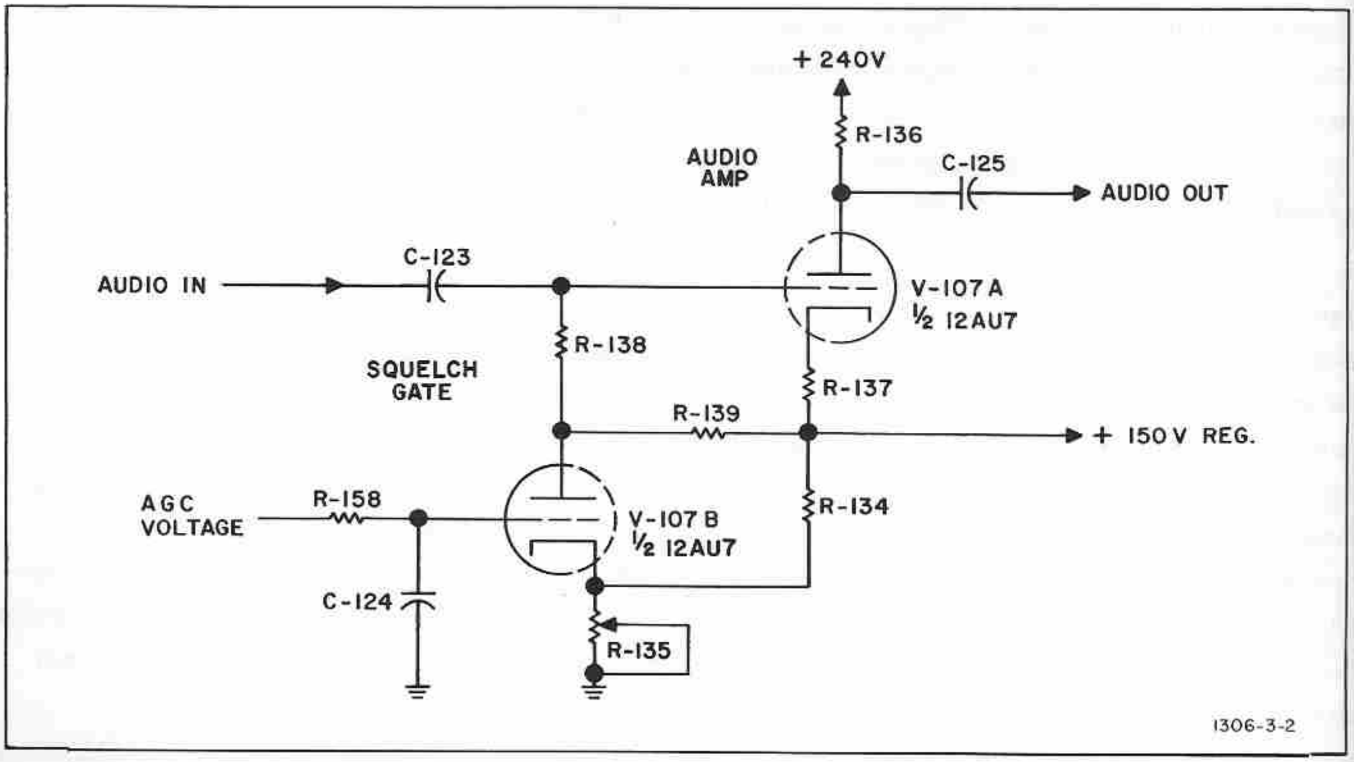

Figure 3-2. Receiver Squelch Circuit, Simplified Schematic

resistor, R-137, plus the voltage drop, if any, across R-139, the plate load resistor for V-107B. Assuming no signal is being received, the grid of the dc amplifier tube has zero bias, or, at most, a very small negative voltage. Control R-135 is adjusted until the noise just desappears from the speaker output. In this condition, V-107B is drawing plate current and the voltage drop across its plate load resistor, R-139, appears as a bias to the audio amplifier. This voltage drop is sufficient to cut off V-107A and disable the audio output. When a signal is received, AGC bias from the IF strip supplying the high level video output is supplied to the grid of the dc amplifier through resistor, R-158. This voltage is sufficient to cut off the tube, causing the voltage drop across its plate load resistor, R-139, to fall to zero. V-107A then receives only the normal cathode bias developed in its cathode resistor, R-137, and audio signals are passed through to the output. When receiving AM signals with a high percentage of modulation, the squelch circuit may cut off on negative modulation peaks when the envelope amplitude becomes zero. To prevent this, a filter consisting of R-158 and C-124 has been placed between S-106B and the grid of the dc amplifier. This filter has a time constant long enough to prevent the squelch circuit from cutting off but of insufficient duration to noticeably delay its operation.

7. AUDIO OUTPUT

The audio signal from V-107A is coupled to V-108A and V-108B, a two stage resistnace-coupled amplifier, through C-125. The audio volume control, R-141, is in the grid circuit of V-108A. The cathode resistors of both sections of V-108 are not bypassed in order to obtain cathode degeneration, thus reducing distortion and extending the frequency response of the stage. The output from V-108B drives a two-inch panel speaker. Headphones may be plugged into J-109. Using headphones automatically disconnects the panel speaker. The output from J-109 can also be used to feed a 600-ohm audio line.

8. BEAT FREQUENCY OSCILLATOR

The BFO is located on the IF subassembly. A 6CB6 tube (V-801) is employed in an electron-coupled, modified Hartley circuit. The basic BFO frequency is 21.4 mc. A small trimmer capacitor, C-801, is the BFO pitch control and it permits the oscillator frequency to be varied slightly on either side of 21.4 mc in order to change the beat note. The BFO output is capacitively coupled to the video detectors of the four IF strips. The parallel combination of L-803 and R-803 acts as the load for the untuned plate circuit of V-801. Switch S-103 is the BFO on-off switch. Resistor R-162 is connected between the "off" contact of the switch and ground to maintain a constant load on the regulated power supply when the BFO is not drawing current.

9. TUNING METER CIRCUIT

The tuning meter circuit uses a 12AU7 (V-104) as a balanced dc amplifier. Signal voltage to operate the meter is obtained from the output of the discriminator (V-705). A rectifier circuit using 1N34A diodes (CR-105 and CR-106) is incorporated so that the meter responds to pulse type signals. C-114 and R-123 comprises the filter circuit for CR-105, C-115 and R-124 for CR-106. With no signal input, the tuning meter should center on zero; if not, R-126, located on the rear apron of the chassis, is used to make the adjustment.

10. SPECTRUM DISPLAY UNIT OUTPUT CONNECTION

Output is available from the two RF tuners to operate a spectrum display unit at J-503 on the rear of the receiver. This output is obtained from the mixer of the tuner being used through a capacitive voltage divider made up of C-501 and C-505 at the primary of the IF input transformer, T-501. (A special SDU for use with the Model 1306

Receiver is available from Vitro Electronics, 919 Jesup Blair Drive, Silver Spring, Maryland.)

11. POWER SUPPLY

The receiver power supply operates on 115 or 230 volts, 50 to 60 cycles, single phase, ac. Power consumption is 150 watts. Selection of the primary voltage is made by S-102. As shown on the schematic, S-102 is in the 115-volt position and the two primary windings of T-101 are in parallel. With S-102 in the 230-volt position, the windings are in series and fuse F-102 is added to the primary circuit.

A full-wave bridge rectifier circuit using four 1N1695 silicon diodes with a two-section capacitance input filter supplies 240 volts dc. A 10M150Z5 Zener diode and dropping resistor R-166 are used to provide 150 volts regulated from this source. Two of the diodes in the bridge circuit, CR-101 and CR-103, work in conjunction with the high voltage winding center tap of T-101 as a conventional full-wave rectifier circuit. A two-section capacitance input filter is used with this circuit to supply 150 volts unregulated, and, after a 5-volt drop through R-167, 145 volts dc. A 6.3-volt winding supplies the filaments of all tubes except V-201 which is energized from a separate 12.6-volt winding with a series dropping resistor, R-220.

SECTION 4

MAINTENANCE

1. GENERAL

The Model 1306 Receiver has been designed to give trouble-free performance for long periods with a minimum of routine maintenance. Should trouble occur, however, a thorough knowledge of the theory of operation given in Section 3 and familiarity with the schematic diagram are essential for rapid troubleshooting. Experience has shown that tube failures are the most frequent causes of equipment malfunction. Often a simple visual inspection will reveal such faults as improperly seated connectors and plugs, burned components, arcing, and breaks in wiring. If more extensive testing is required, signal tracing or signal substitution, using the alignment instructions given in this section as the basis, are recommended as methods of rapidly localizing the fault. The defective part can then be found by voltage and resistance measurements. In Table 4-1, the voltage chart, are presented the approximate voltages at the pins of the tube sockets when the receiver is operating properly. Any significant deviation from these readings indicates a source of trouble.

In time, the blower for the 416B tube (V-201) may become clogged with dust collected from the atmosphere. Since impairment of blower efficiency may result in the loss of a very expensive tube, the blower should be inspected at regular intervals, and disassembled and cleaned when necessary. The locations of all major components of the receiver, and of many small parts which cannot be readily identified from adjacent stencils on the chassis, are shown in Figures 4-2 through 4-14.

CAUTION

All maintenance work within the RF tuners in this receiver should be kept to a minimum and performed only by trained and experienced personnel. The placement of components and the dress of the leads within the tuners has been carefully engineered to give maximum performance. In making any replacements of tuner components great care should be ecercised to duplicate the exact physical layout or the original assembly. In particular, the high band noise figure may be increased if the components in the high band RF tuner are disturbed and changes in the dress of the low band RF tuner B+ leads are apt to cause excessive oscillator radiation.

2. ALIGNMENT PROCEDURE (Sweep Method)

a. General Instructions. - In order to effectively utilize the oscilloscope presentations for visual alignment, the sweep generator sweep width should be no greater than required to produce the desired response curve for the circuit being aligned. When the marker generator is being used, insure that the response shape is not upset by disconnecting the marker from the sweep generator and observing whether there is any change in the shape of the pattern. The marker signal can be introduced by connecting to one or two turns of insulated wire wrapped around the sweep generator lead near the circuit under test, or by coupling to the sweep generator lead through a small capaitor. To avoid extraneous coupling or regeneration, the sweep and marker generator leads should be dressed away from the stages already tuned. A low capacity shielded test lead such as RG-62/U coaxial cable should be used for the oscilloscope connection. The cable capacity plus the oscilloscope input capacity should be no greater than 100 $\mu\mu$f. The direct-coupled (DC) vertical amplifier of the oscilloscope should be used.

Table 4-1. Tube Voltage Chart

Symbol	Type	Pin Number								
		1	2	3	4	5	6	7	8	9
V-102	12AU7	163	21	52	Gnd.	Gnd.	163	20.2	52	6.2AC
V-103	12AU7	163	22	55	Gnd.	Gnd.	163	21.5	56	6.2AC
V-104	12AU7	170	0	6.5	Gnd.	Gnd.	170	0	6.5	6.2AC
V-105	12AU7	126	0	4.2	Gnd.	Gnd.	126	0	4.0	6.2AC
V-106	12AU7	163	0	55	Gnd.	Gnd.	163	0	4.0	6.2AC
V-107	12AU7	213	125	160	Gnd.	Gnd.	150	0	28	6.4AC
V-108	12AU7	75	0	4.4	Gnd.	Gnd.	165	0	5.6	6.4AC
V-201	416B	Cathode	5.1	Filament	6.2AC	Plate	200	Grid	5	
V-202	6J4	Gnd.	1.18	Gnd.	6.2AC	Gnd.	Gnd.	117		
V-203	6AK5	-2.1	Gnd.	6.2AC	Gnd.	168	61	Gnd.		
V-204	6AF4A	44	1.6	Gnd.	6.2AC	1.85	1.6	44		
V-301	6688	1.75	0	1.72	6.3AC	Gnd.	NC	210	1.75	177
V-302	6AK5	-2.1	Gnd.	6.2AC	Gnd.	168	64	Gnd.		
V-303	6AF4A	97	-0.45	Gnd.	6.2AC	0	-0.45	97		
V-401	6DC6	0	9.2	6.0AC	Gnd.	165	163	Gnd.		
V-402	6DC6	0	9.4	6.0AC	Gnd.	164	159	Gnd.		
V-403	6CB6	0	0.57	6.0AC	Gnd.	158	76	Gnd.		
V-501	6DC6	0	11	6.0AC	Gnd.	166	161	Gnd.		
V-502	6DC6	0	11	6.0AC	Gnd.	166	159	Gnd.		
V-503	6CB6	0	0.62	6.1AC	Gnd.	175	73	Gnd.		
V-601	6DC6	0	8.8	6.0AC	Gnd.	165	163	Gnd.		
V-602	6DC6	0	8.8	6.0AC	Gnd.	165	157	Gnd.		
V-603	6CB6	0	0.65	6.1AC	Gnd.	157	66	Gnd.		
V-701	6DC6	0	4.4	6.0AC	Gnd.	165	150	Gnd.		
V-702	6DC6	0	4.6	6.0AC	Gnd.	165	150	Gnd.		
V-703	6CB6	0	0.43	6.1AC	Gnd.	152	70	Gnd.		
V-704	6AK5	-0.25	Gnd.	6.0AC	Gnd.	12	65	Gnd.		
V-705	6AL5	0	-0.5	6.0AC	Gnd.	Gnd.	Gnd.	-0.2		
V-801*	6CB6	-1.97	0	6.2AC	Gnd.	144	129	Gnd.		

NOTES:

1. Line voltage 117 vac, 60 cps, single phase.
2. All switches in CCW position, except bandswitch is in position to apply B+ to RF tuner under test. No signal input.
3. DC voltages taken with 20,000 ohms-per-volt DC meter.
4. AC voltages taken with 5,000 ohms-per-volt AC meter.
5. All voltages measured with respect to ground.

* BFO switch "on" for measurement of V-801.

Allow the receiver 30 minutes warm-up time to stabilize operation before beginning the alignment. The procedure given here should be carefully followed, making the adjustments in the order given.

b. Test Equipment Required.

(1) Sweep Generator, RCA WR-59C or equivalent

(2) Oscilloscope, Dumont 304-A or equivalent

(3) Signal Generator, Hewlett-Packard 606A or equivalent (for use as a marker)

(4) Signal Generator, Boonton 202-B

(5) Univerter, Boonton 207-B

(6) Audio Generator, Hewlett-Packard 200CD or equivalent

(7) One 10-ohm, 1/2 watt, resistor

(8) One 200-ohm, 1/2 watt, resistor

(9) Assorted leads and connectors as indicated in the text.

c. Control Settings. - During the entire alignment procedure, the receiver controls must be set as follows, unless otherwise indicated:

(1)	Squelch	Maximum CCW
(2)	Pitch Control	Aligned at reference mark
(3)	BFO	Off
(4)	Video Bandwidth	500-kc position
(5)	Audio Gain	Maximum CCW
(6)	AM-FM	AM position
(7)	Band Switch	55- to 260-mc range
(8)	IF Selector	300-kc position
(9)	10 kc MAN/AGC	Maximum CCW
(10)	300 kc MAN/AGC	Maximum CCW
(11)	500 kc MAN/AGC	Maximum CCW
(12)	1 mc MAN/AGC	Maximum CCW

Set the 55- to 260-mc tuning dial to 55 mc. Remove the local oscillator tube, V-204, to prevent its signal from causing interference.

d. Alignment of 300-kc IF Strip. - For alignment of the 300-kc IF strip, set the AM-FM switch to the FM position.

(1) Second Limiter, Adjustment of T-703. - Proceed as follows:

(a) Remove second IF amplifier tube (V-702).

(b) Connect the oscilloscope to TP-702.

(c) Connect the sweep generator between pin 1 of V-703 and ground on the tube socket mounting strap.

(d) Set the sweep generator and marker generator to 21.4 mc. • The frequency settings of the signal generators remain the same throughout the alignment of this IF strip.

(e) Adjust T-703 for symmetrical response on both sides of the center frequency marker. See Figure 4-13(a) for a typical response curve.

(2) Discriminator, Adjustment of T-704. - Proceed as follows:

(a) Remove the first limiter tube (V-703).

(b) Connect the oscilloscope to TP-703.

(c) Connect the sweep generator between pin 1 of V-704 and ground on the tube socket mounting strap.

(d) Adjust the discriminator transformer (T-704) for a symmetrical S-shaped curve centered around

21.4 mc. See Figure 4-13(b) for a typical response curve. • The adjustments for equal amplitude should be made with the marker disconnected to prevent base line shift.

(3) First Limiter, Adjustment of T-702. - Proceed as follows:

(a) Replace V-702 and V-703.

(b) Remove the first IF amplifier tube (V-701).

(c) Connect the oscilloscope to TP-701.

(d) Connect the sweep generator to pin 1 of V-702 and ground on the tube socket mounting strap.

(e) Set the sweep generator output for a peak oscilloscope deflection of 0.25 volt.

(f) Adjust T-702 for a symmetrical response on both sides of the center frequency marker. See Figure 4-13(c) for typical response curve.

(4) Second IF Amplifier, Adjustment of T-701. - Proceed as follows:

(a) Replace V-701.

(b) Disconnect the cables to J-202 and J-302 on the RF tuners. • The oscilloscope remains at TP-701.

(c) Solder a 10-ohm resistor between pin 1 of V-701 and ground on the tube socket mounting strap.

(d) Solder a 200-ohm resistor to pin 1 of V-701.

(e) Connect the sweep generator between the free end of the 200-ohm resistor and the grounded lead of the 10-ohm resistor.

(f) Set the sweep generator output to produce a peak oscilloscope deflection of 0.25 volt.

(g) Adjust T-701 for a symmetrical response centered around the marker frequency. See Figure 4-13 (d) for a typical response curve.

e. Alignment of 10-kc IF Strip. - For alignment of the 10 kc IF strip, set the 10 kc MAN/AGC control as far CW as possible without switching to the AGC position.

(1) AM Detector, Adjustment of T-604. - Proceed as follows:

(a) Remove second IF amplifier tube (V-602).

(b) Connect the oscilloscope to TP-601. • The oscilloscope remains at TP-601 throughout the alignment of this IF strip.

(c) Set the sweep generator and marker generator to 21.4 mc.

(d) Connect the sweep generator to pin 1 of V-603 and ground on the tube socket mounting strap.

(e) Set sweep generator output for peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-604 for a symmetrical response on both sides of the center frequency marker at 21.4 mc. See Figure 4-13(e) for a typical response curve.

(2) Third IF Amplifier, Adjustment of T-602 and T-603. - Proceed as follows:

(a) Replace V-602.

(b) Remove the first IF amplifier tube (V-601).

(c) Arrange setup as shown in Figure 4-1. The low sweep rate (5 cps) makes it possible to align the crystal filter without distorting the response curve.

(d) Connect the Univerter to pin 1 of V-602 and ground on the tube socket mounting strap.

(e) Set the signal generator to produce a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-602 and T-603 for a symmetrical response. See Figure 4-13(f) for a typical response curve.

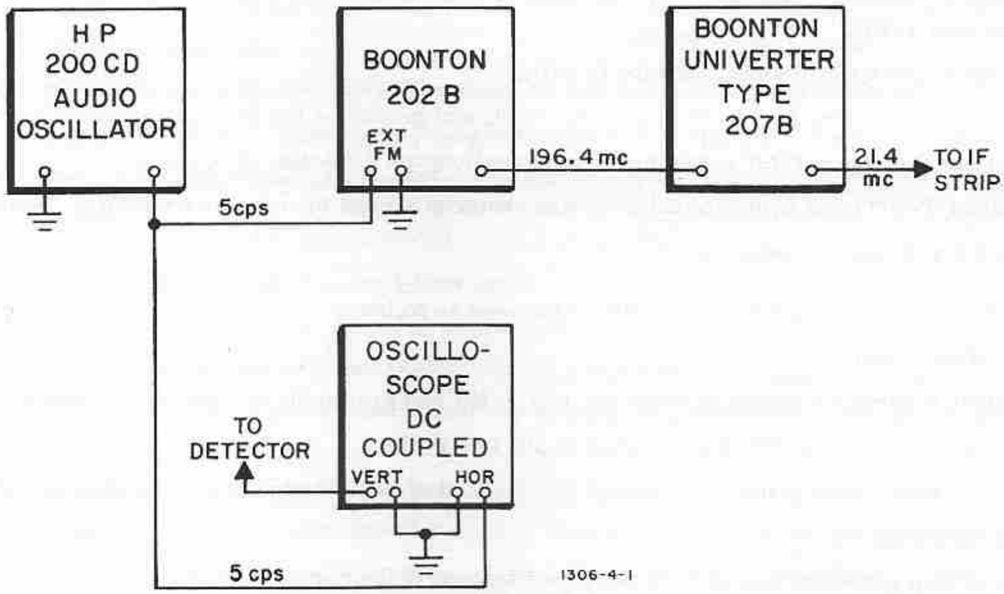

Figure 4-1. 10-kc IF Crystal Filter Alignment Set-ip

(3) Second IF Amplifier, Adjustment of T-601. - Proceed as follows

(a) Replace V-601.

(b) Solder a 10-ohm resistor betwee pin 1 of V-601 and ground on the tube socket mounting strap.

(c) Solder one end of a 200-ohm resistor to pin 1 of V-601.

(d) Connect the Univerter between the free end of the 200-ohm resistor and the grounded lead of the 10-ohm resistor.

(e) Set the signal generator to produce a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-601 for maximum symmetrical response. See Figure 4-13 (g) for a typical response curve.

f. Alignment of 500-kc IF Strip. - Set the 500-kc MAN/AGC control as far CW as possible without switching to the AGC position.

(1) Video Detector, Adjustment of T-403. - Proceed as follows:

(a) (a) Remove the second IF amplifier tube (V-402).

(b) Connect the oscilloscope to TP-401. • The oscilloscope remains here throughout the alignment of this IF strip.

(c) Set the sweep generator and marker generator at 21.4 mc. • The frequency settings of the generators remain the same throughout the alignment of this IF strip.

(d) Connect the sweep generator to pin 1 of V-403 and ground on the tube socket mounting strap.

(e) Set sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-403 for a flat-topped symmetrical response on both sides of center frequency marker. See Figure 4-13(h) for a typical response curve.

(2) Third IF Amplifier, Adjustment of T-402. - Proceed as follows:

(a) Replace V-402.

(b) Remove the first IF amplifier tube (V-401).

(c) Connect the sweep generator to pin 1 of V-402 and ground on the tube socket mounting strap.

(d) Set the sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(e) Adjust T-402 for a symmetrical response centered around the marker frequency. See Figure 4-13 (i) for a typical response curve.

(3) Second IF Amplifier, Adjustment of T-401. - Proceed as follows:

(a) Replace V-401.

(b) Solder a 10-ohm resistor between pin 1 of V-401 and ground on the tube socket mounting strap.

(c) Solder one end of a 200-ohm resistor to pin 1 of V-401.

(d) Connect the sweep generator between the free end of the 200-ohm resistor and grounded lead of the 10-ohm resistor.

(e) Set sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-401 for a flat-topped symmetrical response centered around the marker frequency. See Figure 4-13(j) for a typical response curve.

g. <u>Alignment of the 1-mc IF Strip.</u> - For alignment of the 1-mc strip, set the 1-mc MAN/AGC control as far CW as possible without switching to the AGC position.

(1) Video Detector, Adjustment of T-504. - Proceed as follows:

(a) Remove the second IF amplifier tube (V-502).

(b) Connect the oscilloscope to TP-502. • The oscilloscope remains here throughout the alignment of this IF strip.

(c) Set the sweep generator and marker generator to 21.4 mc. • The generator frequency settings remain the same throughout the alignment of this IF strip.

(d) Connect the sweep generator to pin 1 of V-503 and ground on the tube socket mounting strap.

(e) Set sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-504 for a flat-topped symmetrical response centered around the marker frequency. See Figure 4-13(k) for a typical response curve.

(2) Third IF Amplifier, Adjustment of T-503. - Proceed as follows:

(a) Replace V-502.

(b) Remove the first IF amplifier tube (V-501).

(c) Connect the sweep genrator to pin 1 of V-502 and ground on the tube socket mounting strap.

(d) Set the sweep generator for a peak oscilloscope deflection of 0.5 volt.

(e) Adjust T-503 for a flat-topped symmetrical response centered around the marker frequency. See Figure 4-13(l) for a typical response curve.

(3) Second IF Amplifier, Adjustment of T-502. - Proceed as follows:

(a) Replace V-501.

(b) Solder a 10-ohm resistor between pin 1 of V-501 and ground on the tube socket mounting strap.

(c) Solder one end of a 200-ohm resistor to pin 1 of V-501.

(d) Connect the sweep generator between the free end of the 200-ohm resistor and the grounded lead of the 10-ohm resistor.

(e) Set the sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-502 for a symmetrical response centered around the marker frequency. See Figure 4-13 (m) for a typical response curve.

(4) First IF Amplifier, Adjustment of T-501. - Proceed as follows:

(a) Remove the 10- and 200-ohm resistors.

(b) Install the bottom cover of the IF subassembly and tighten all mounting screws.

(c) Solder one end of a 200-ohm resistor to pin 1 of V-501

(d) Connect the sweep generator between the free end of the 200-ohm resistor and the grounded lead of the 10-ohm resistor

(e) Set the sweep generator output for a peak oscilloscope deflection of 0.5 volt.

(f) Adjust T-502 for a symmetrical response centered around the marker frequency. See Figure 4-13 (m) for a typical response curve.

h. BFO Alignment. - Proceed as follows:

(1) Leave the oscilloscope and signal generators connected as above.

(2) Turn the BFO switch to the "ON" position. • Make sure the BFO pitch control is lined up with the panel reference mark.

(3) Adjust T-801 until the BFO signal appears in the middle of the IF response curve and zero beats with the 21.4 mc marker. • Rotating the BFO pitch control should cause the BFO signal to move back and forth on both sides of the 21.4 mc marker.

i. Alignment of the 55- to 260- mc RF Tuner. - Proceed as follows:

(1) Local Oscillator. - The only local oscillator adjustment necessary is to make the tuning dial read correctly. If a tube is replaced and an error is noted, it can normally be corrected by trimmer capacitor C-229. This adjustment should be made using a signal generator of high accuracy at 60 mc. The high frequency end of the dial is controlled by the location of C-230 on the end inductor, L-210. The correct adjustment is made at the factory and should not require readjustment in the field.

(2) Mechanical Adjustments. - Normally, the tuning dial mechanism will not require any attention in the field. However, if the tuning dial cannot be made to read correctly by the above procedure, make the following adjustments:

(a) Loosen both stops on the tuning dial gear train. • Dial stops are shown in Figure 4-12.

(b) Rotate the dial to the extreme high frequency end until halted by the Inductuner stop. The hairline should now align with the triangle on the dial. If not, loosen the set screws on the Inductuner shaft, align the triangle, and retighten set screws.

(c) Back up just short of the Inductuner stop and tighten the set screws on the tuning drive high frequency stop.

(d) Rotate the dial to the extreme low frequency end until halted by the Inductuner stop. Back up just short of the Inductuner stop and tighten the set screws on the tuning drive low frequency stop.

(3) RF amplifier alignment. - The RF circuits are designed around a highly stable Inductuner and rigid end inducors, so that RF stages will not normally require realignment. However, should realignment be found necessary, use the following procedure:

(a) Unsolder C-248 from the Inductuner lug and solder to the BNC test jack located on the compartment divider of the tuner.

(b) Connect a sweep generator with a 50-ohm source impedance to the BNC test jack. An accurate 50-ohm source can be achieved by using a 6- or 10-db, 50-ohm pad between the sweep generator and the jack. Attach a marker generator to the sweep generator.

(c) Connect an oscilloscope to test point TP-202.

(d) Set the receiver tuning dial and both signal generators to 70 mc.

(e) Adjust C-217 and C-222 for a double-tuned symmetrical response centered at 70 mc.

(f) Adjust C-220 for a 15% dip in the response curve.

(g) Repeat step e. A typical response curve is shown in Figure 4-13(o).

(h) Set the receiver tuning dial and signal generators to 250 mc. Vend end inductors L-207 and L-209 to produce a symmetrical response centered at 250 mc. A typical response curve is shown in Figure 4-13(p)

(i) Unsolder C-248 from the BNC test jack and resolder to the Inductuner.

(j) Connect the sweep generator to antenna jack J-106 or J-201.

(k) Set the receiver tuning dial and signal generators to 70 mc. Adjust C-243 for a symmetrical response. A typical response curve is shown in Figure 4-13(q).

(l) Set the receiver tuning dial and the signal generators to 250 mc. Move the position of C-244 along the rear of end inductor L-204 to produce a symmetrical round-nosed response. A typical response curve is shown in Figure 4-13(r).

j. <u>Alignment of 30- to 60-mc RF Tuner</u>. - Proceed as follows:

(1) Local Oscillator. - The only local oscillator adjustment is to make the tuning dial read correctly. If a tube is replaced and an error is noted, it can normally be corrected by trimmer capacitor C-321. This adjustment should be made using a signal generator of high accuracy at 30 mc. No adjustment should be necessary at 60 mc.

(2) Mechanical adjustments. - Use the same procedure given in paragraph i. (2) for the 55-260 mc tuner. Dial stops are shown in Figure 4-11.

(3) RF amplifier alignment. - Realignment of the RF section should not be necessary because of the stability of the spiral Inductuner and the rigid end inductors. However, should realignment be found necessary, use the following procedure:

(a) Connect a sweep generator with a 50-ohm source to antenna jack J-107 or J-301. Attach a marker generator to the sweep generator.

(b) Connect an oscilloscope to test point TP-301.

(c) Set the receiver tuning dial and the signal generators to 30 mc.

(d) Adjust C-303 and C-311 for a symmetrical response centered around the 30 mc marker.

(e) Check the response at other frequencies between 30 and 60 mc. The loading of the IF input transformer, T-501, should cause a notch to appear in the response curve. This notch should never be more than 25% down on either side of the RF response.

3. IF ALIGNMENT (CW Method)

a. General. - Should it become necessary to align the IF strips and a suitable sweep generator and oscilloscope are not available, the following CW alignment procedure is included. The CW method should not be used on the 10-kc IF strip, however. Because of the critical adjustments to the crystal filter in this strip, use only the sweep method given in 2.e. The broad-bandwidth IF input transformer, T-501, should also be aligned by the sweep method, as it controls the response shape of the SDU output. Alignment by the sweep method is more efficient and effective than the the CW method, and more easily adaptable to troubleshooting, should the necessity arise. Therefore, if suitable equipment is available, the sweep method of alignment should be used.

b. Alignment of the 300-kc IF Strip. - Proceed as follows:

(1) Connect a VTVM set on the -1.5 volt dc range to TP-702.

(2) Connect a signal generator accurately set at 21.4 mc to pin 1 of V-703.

(3) Detune the primary of T-703 by screwing the slug all the way out.

(4) Set the signal generator output to give a -1 volt reading on the VTVM.

(5) Tune the secondary of T-703 for a maximum reading on the VTVM, reducing the generator output if necessary. Then peak the primary of T-703, reducing the generator output as necessary.

• Do not retune the secondary of T-703.

(6) Move the signal generator connection to pin 1 of V-702.

(7) Repeat the above procedure for T-702, maintaining the VTVM reading at -1 volt.

• Do not retune the secondary of T-702 after it is first peaked.

(8) Move the signal generator connection to pin 1 of V-701. Repeat the above procedure for T-701.

c. Alignment of the 500-kc and 1-mc IF Strips. - Repeat steps (1) through (8) in paragraph b., except the VTVM will be connected to TP-401 and TP-502 in the appropriate IF strip. Circuit reference numbers will, of course, be different. Do not attempt alignment of the IF input transformer, T-501, by the CW method.

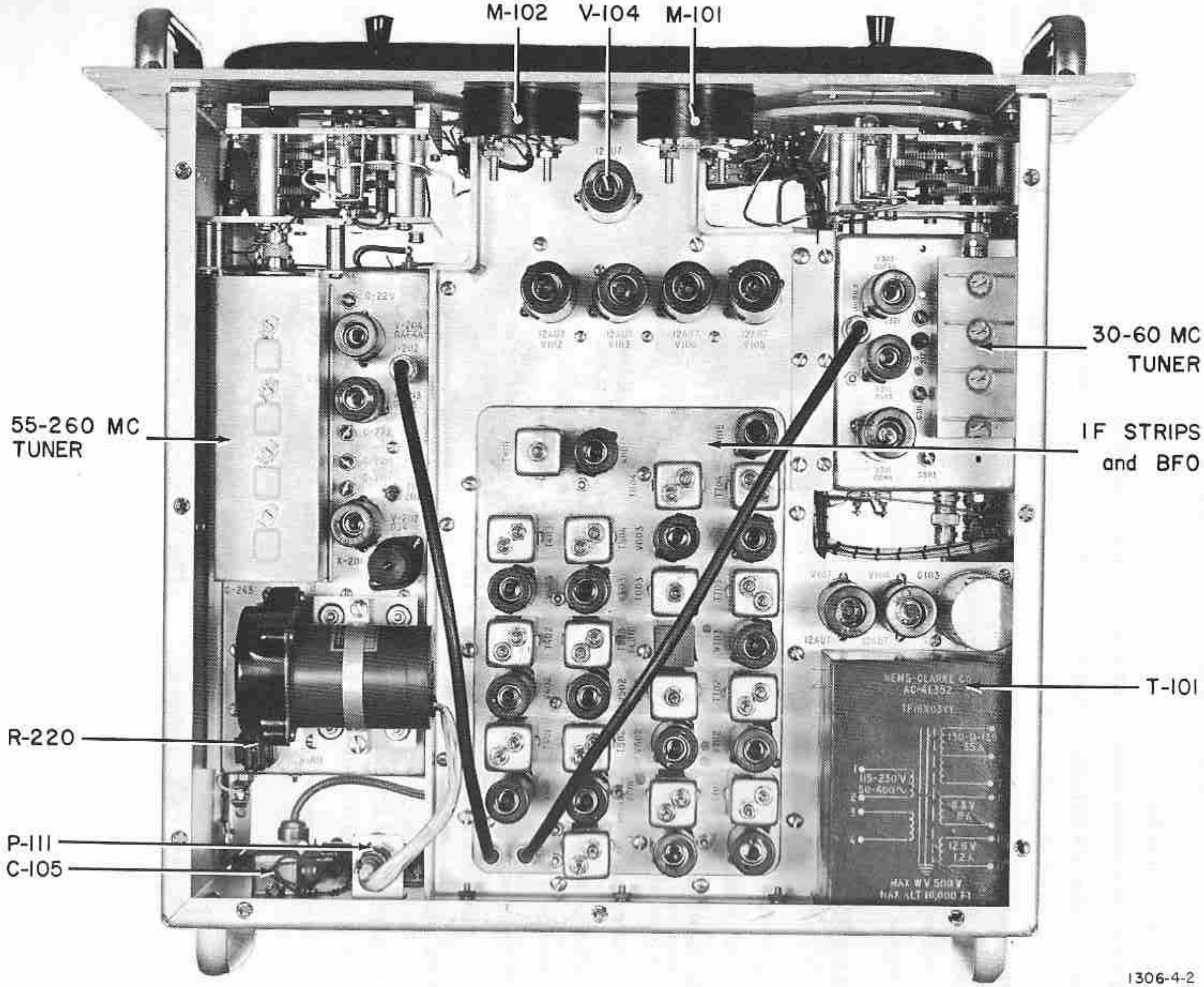

Figure 4-2. Top View of Receiver (dust cover removed)

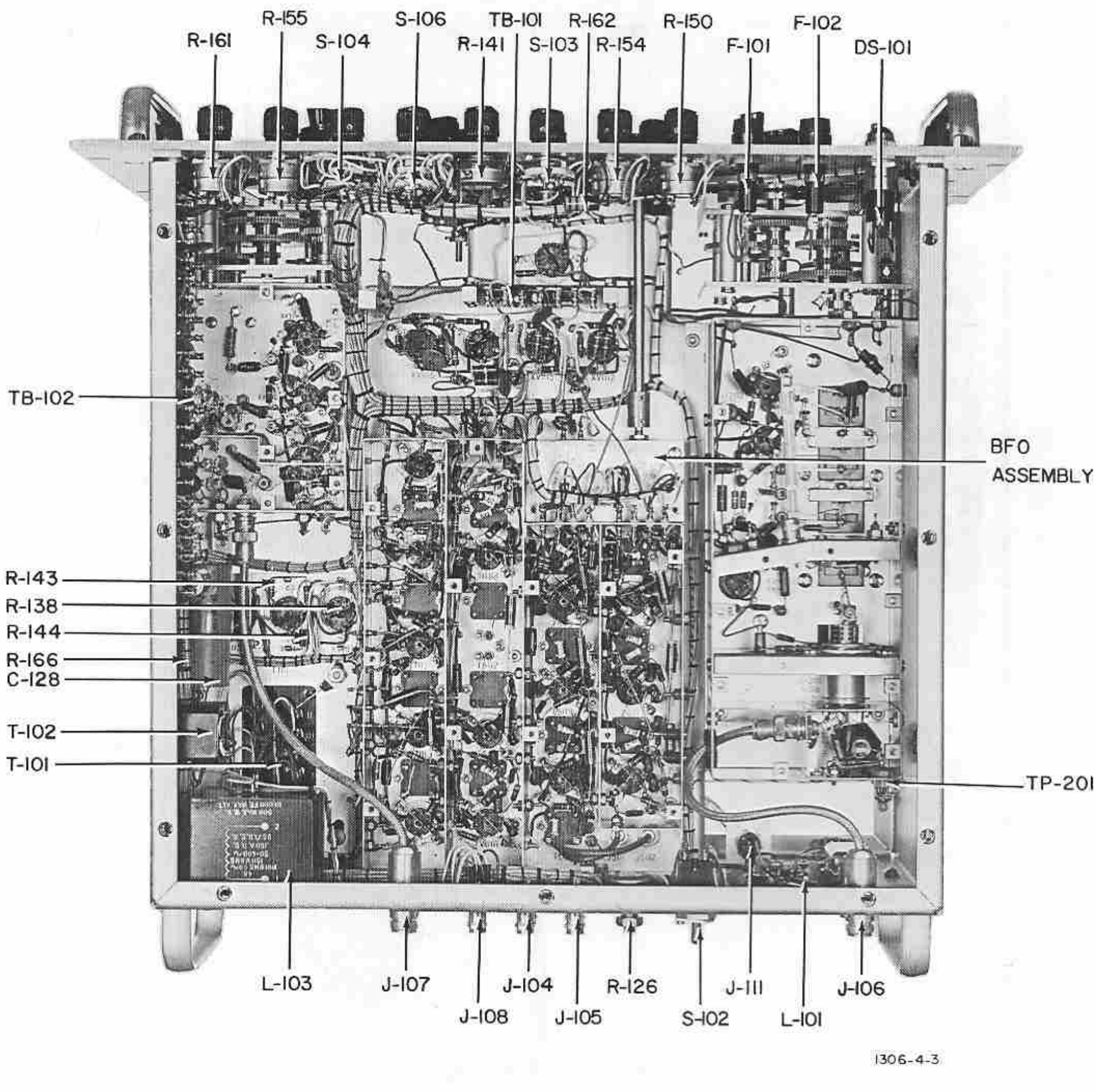

Figure 4-3. Bottom View of Receiver (dust cover removed)

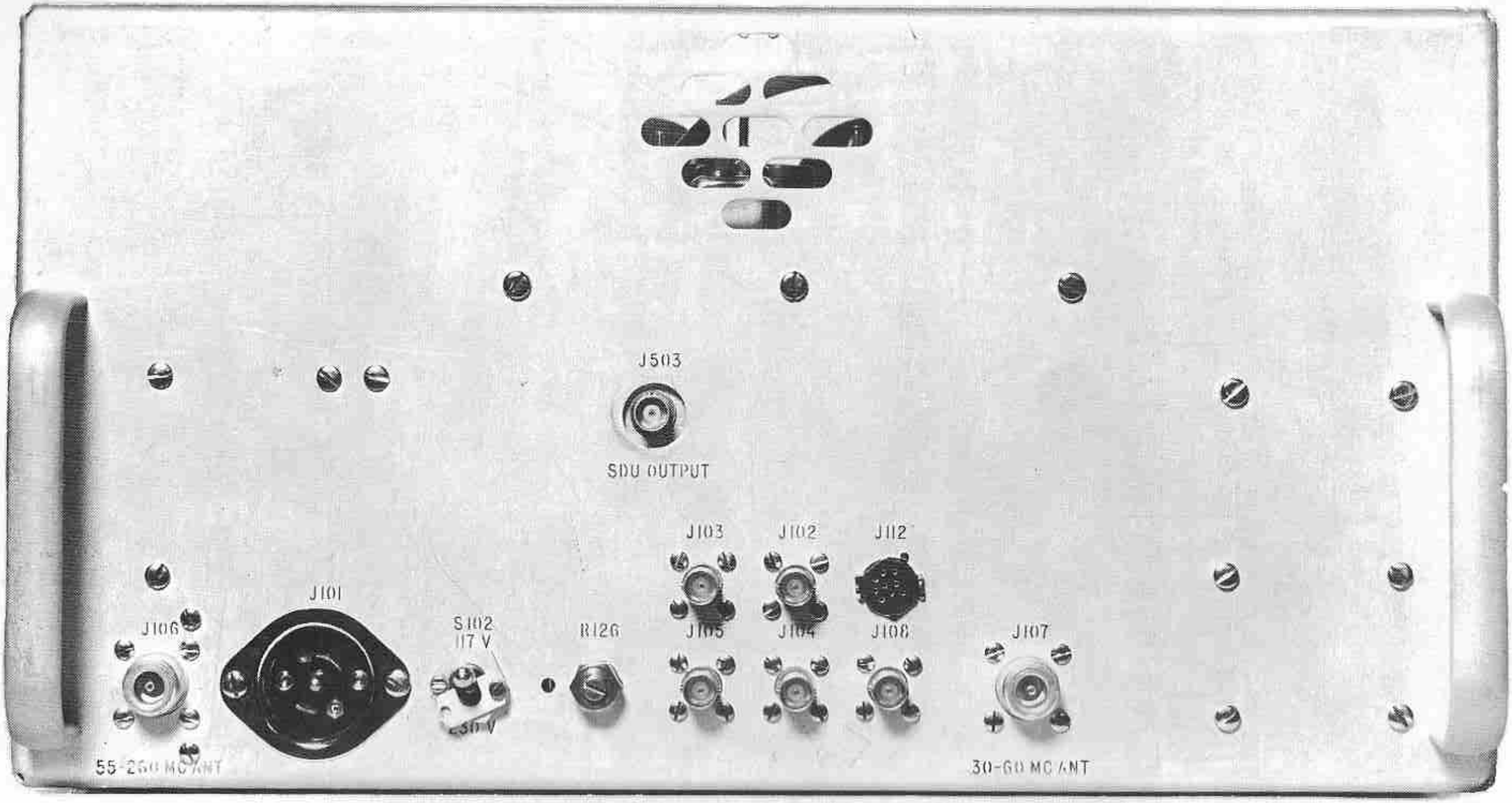

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Figure 4-4. Rear View of Receiver

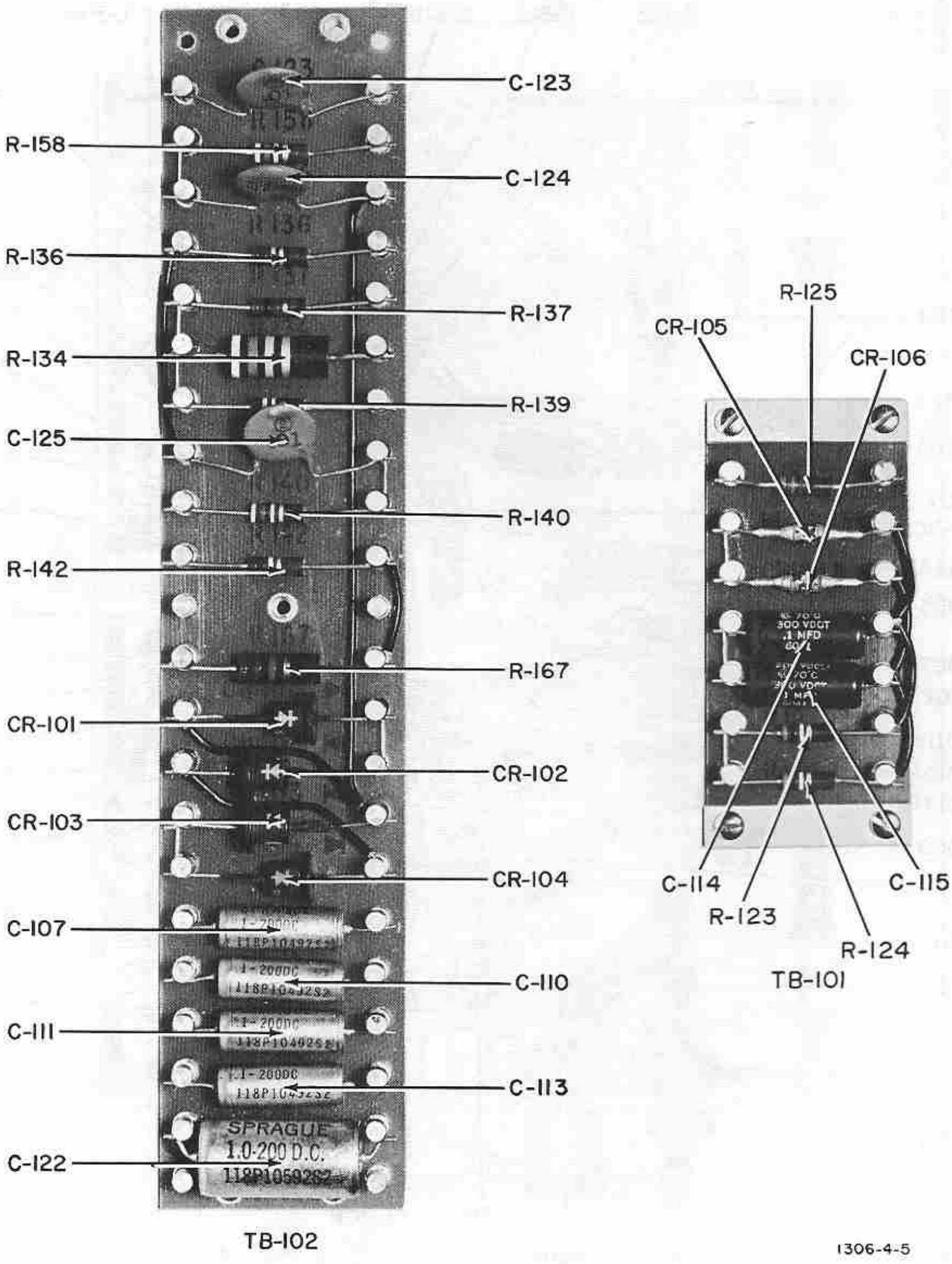

Figure 4-5. Receiver Terminal Boards

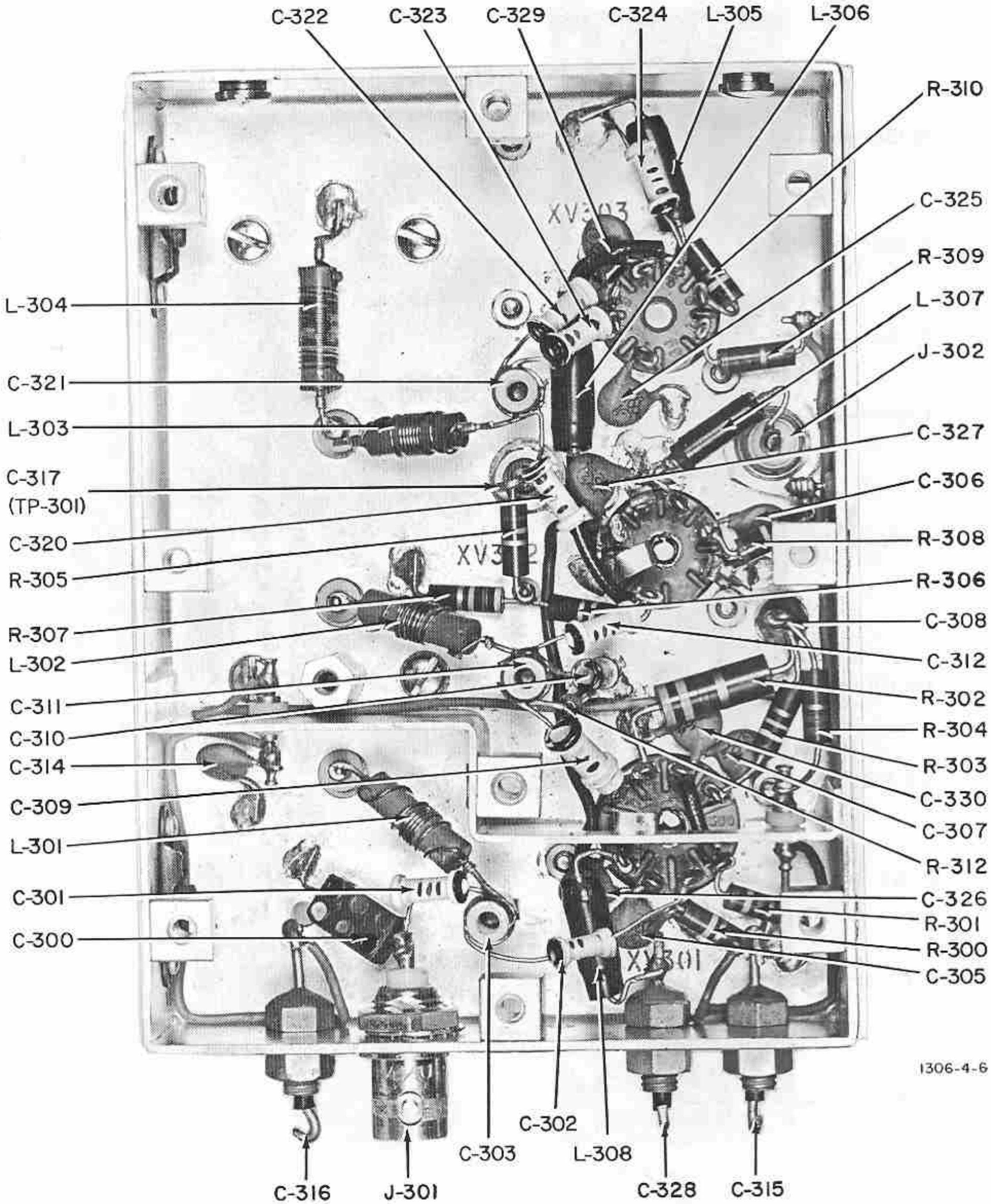

Figure 4-6. 30-60 mc RF Tuner (dust cover removed)

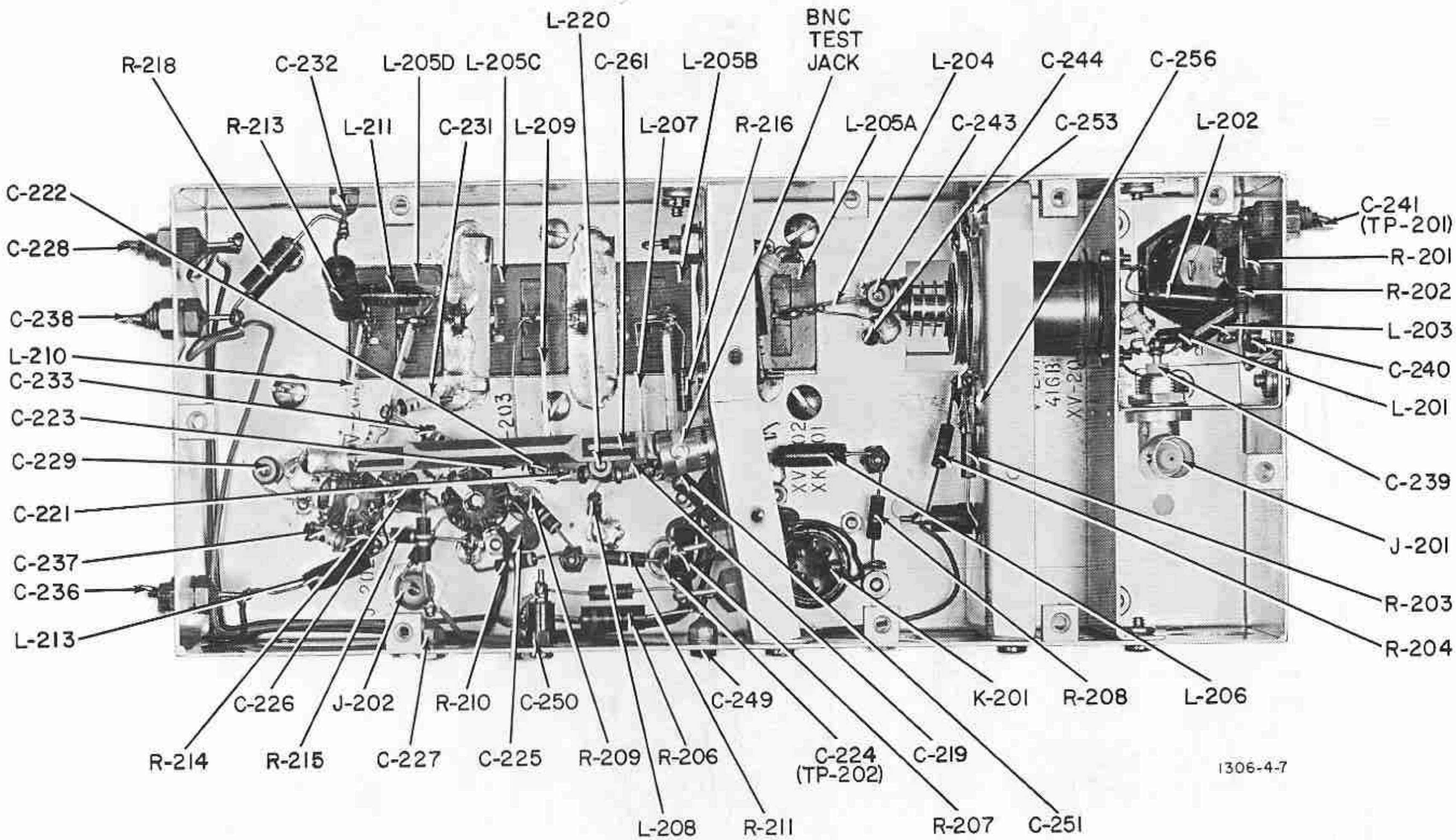

Figure 4-7. 55-260 mc RF Tuner (dust cover removed)

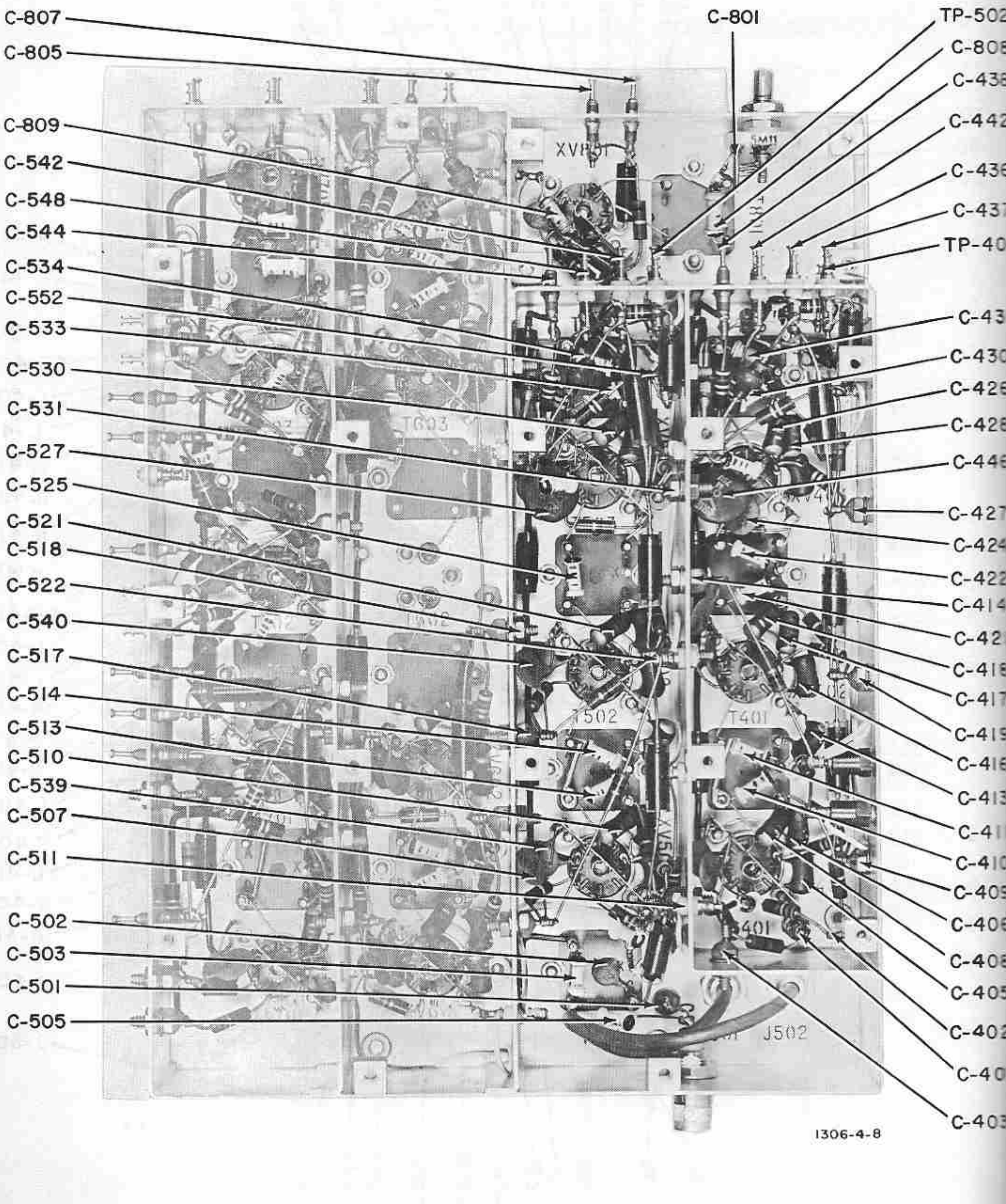

Figure 4-8. 500-kc and 1-mc IF Strips and BFO, Bottom View, Location of Capacitors and Test Points

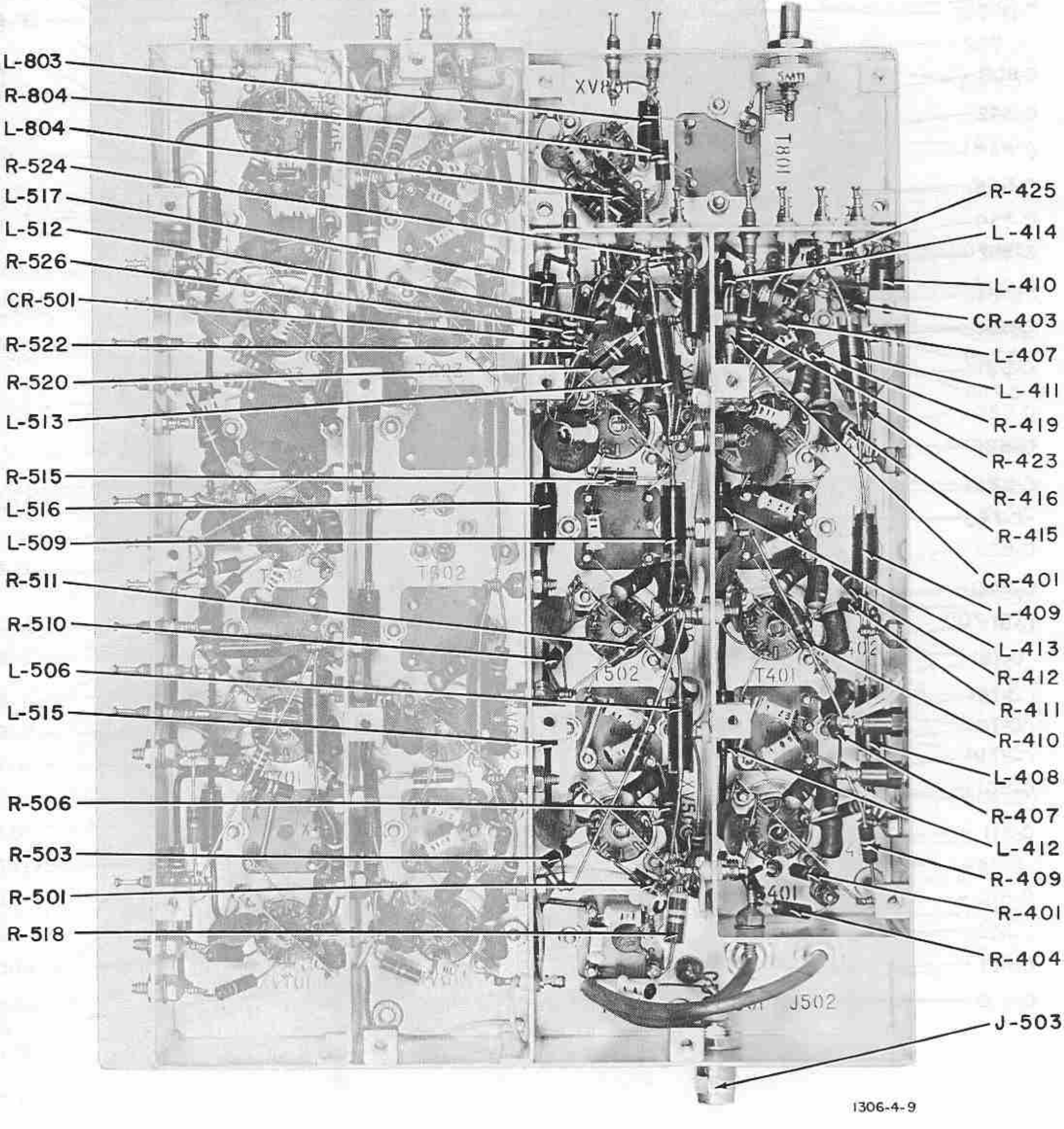

Figure 4-9. 500-kc and 1-mc IF Strips and BFO, Bottom View, Location of Resistors and Miscellaneous Items

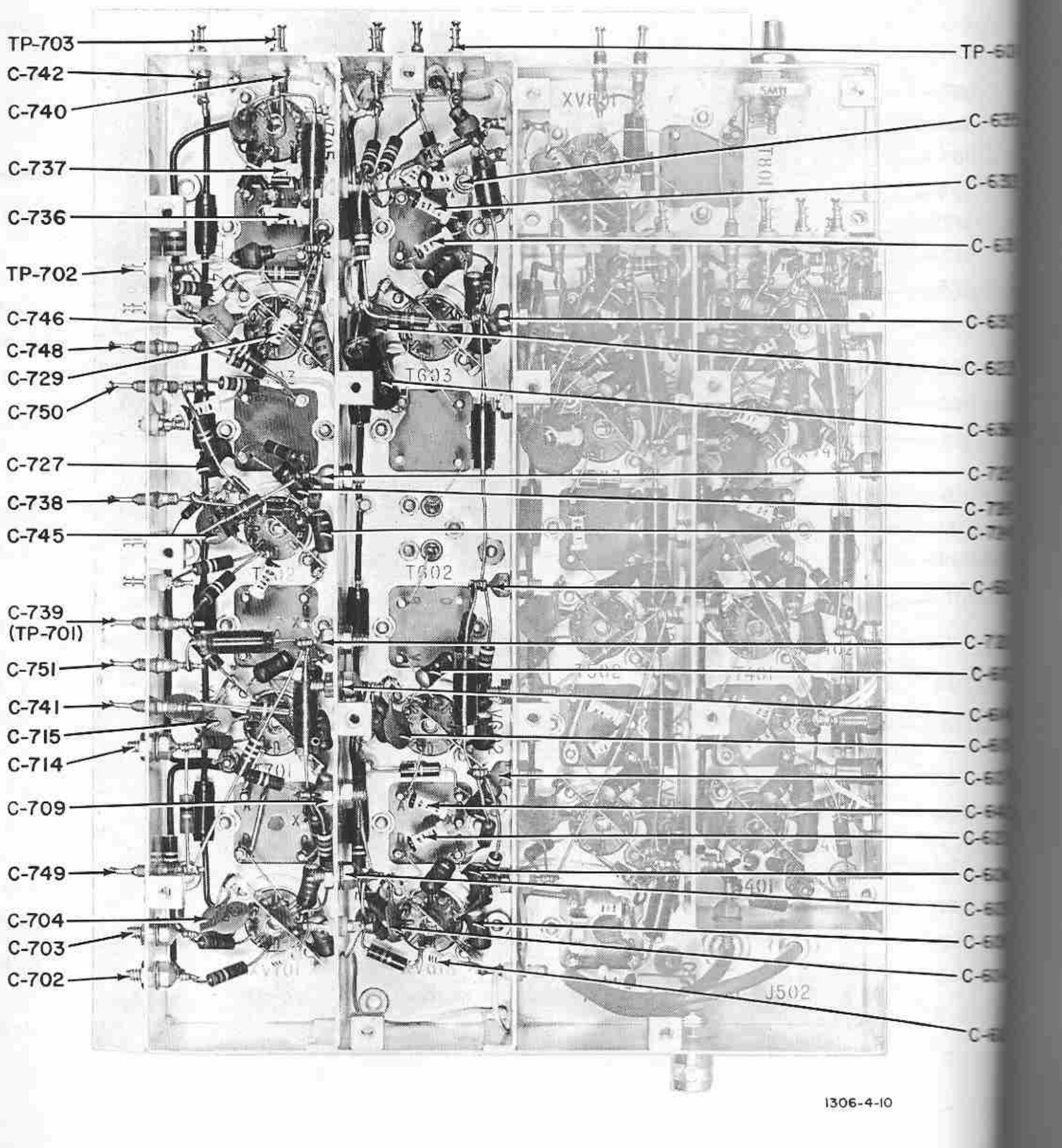

Figure 4-10. 10-kc and 300-kc IF Strips, Bottom View, Location of Capacitors and Test Points

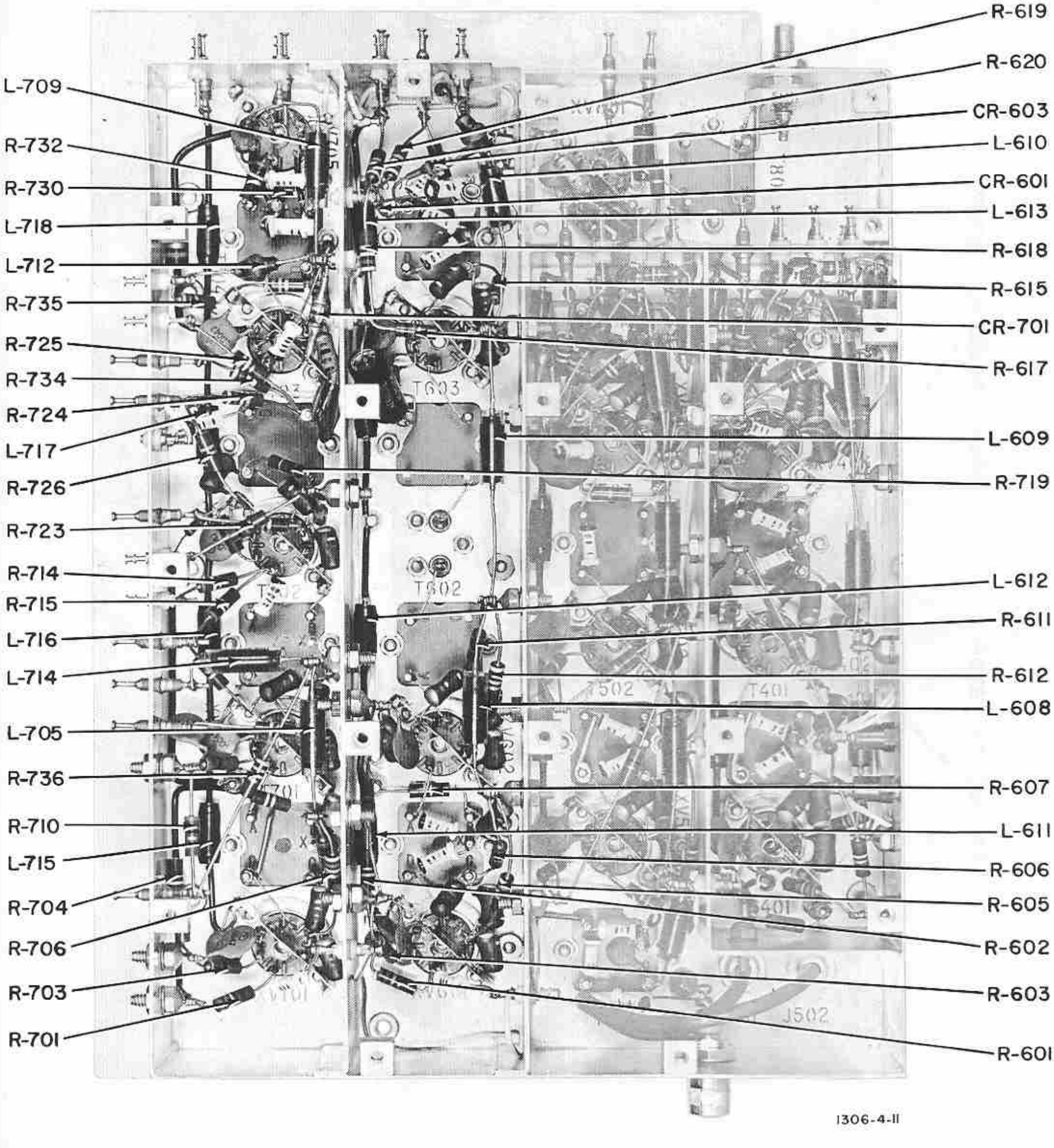

Figure 4-11. 10-kc and 300-kc IF Strips, Bottom View, Location of Resistors and Miscellaneous Items

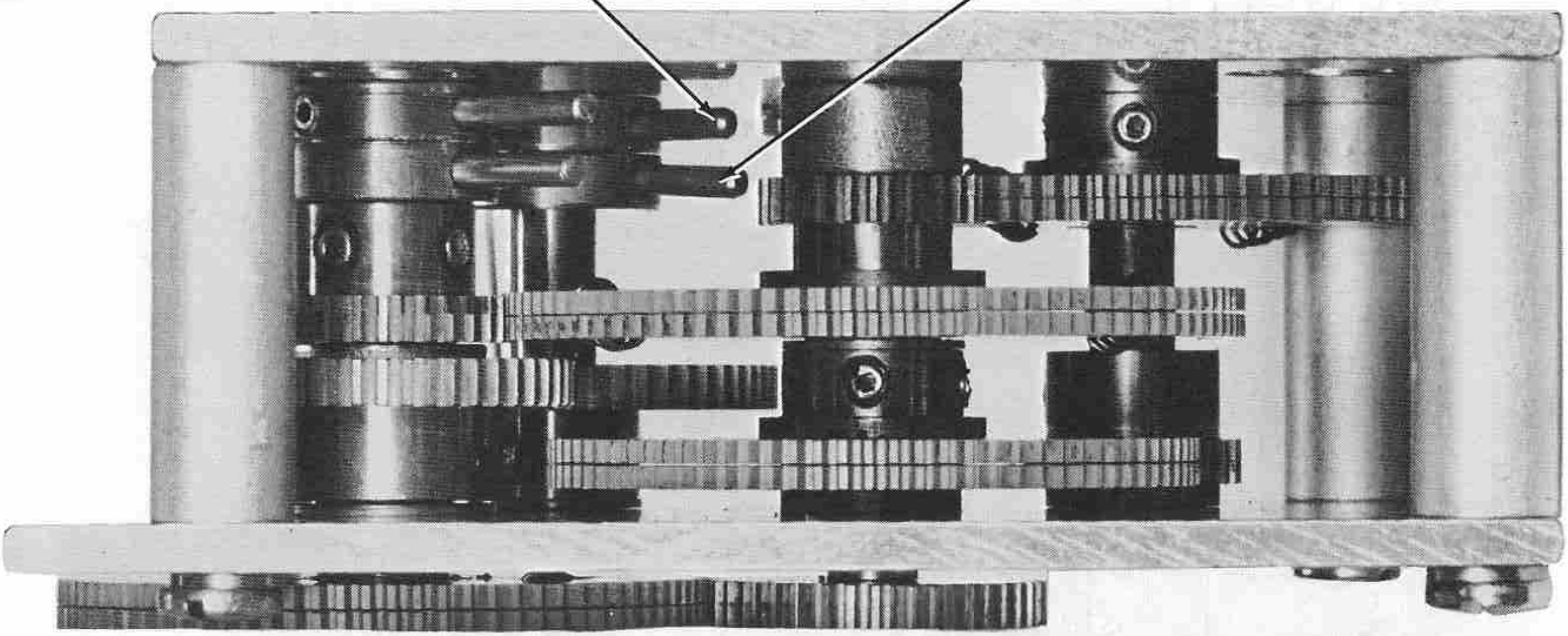

Figure 4-12. 30-60 mc RF Tuner Gear Train

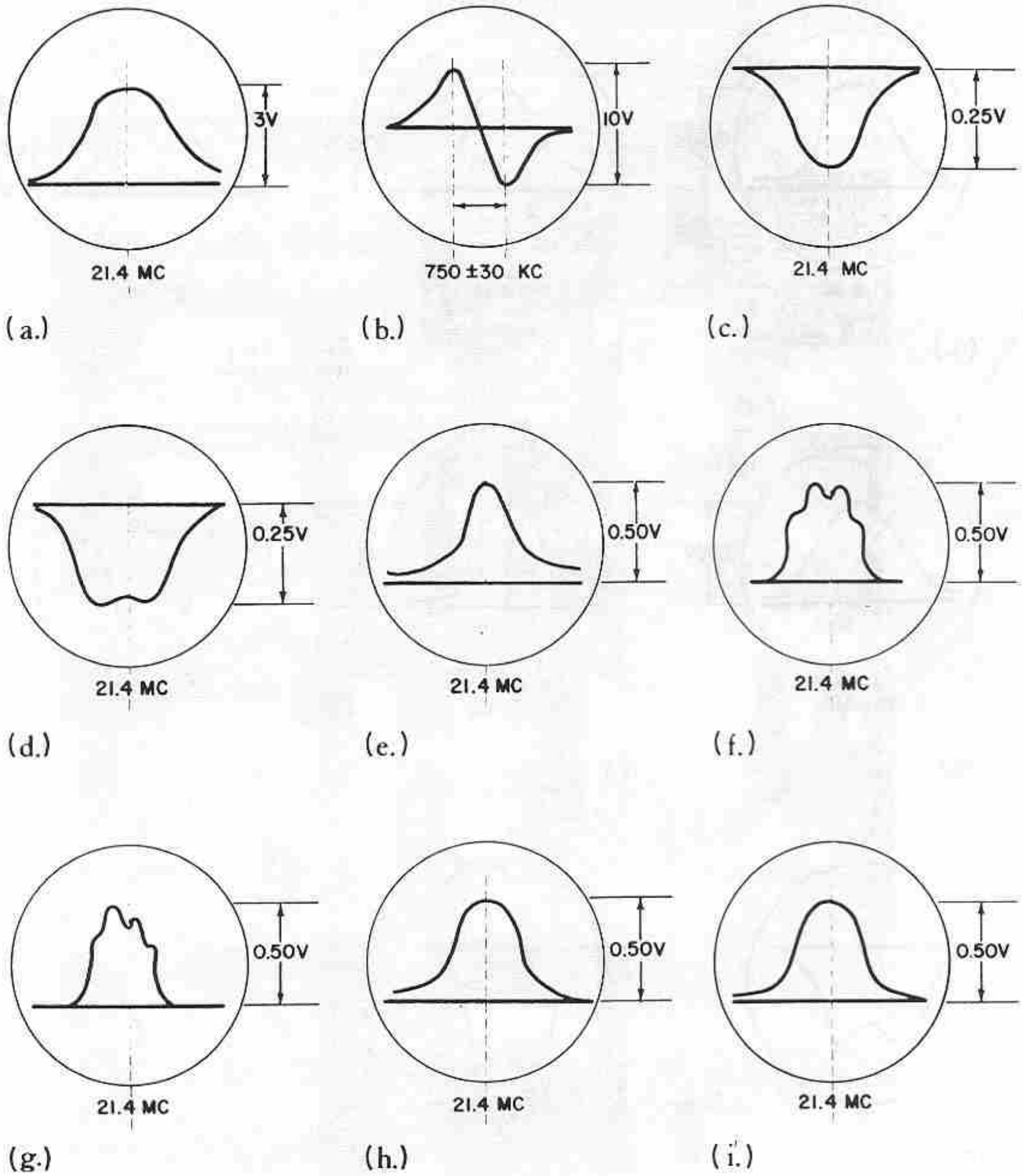

Figure 4-13. Typical IF and RF Alignment Response Curves

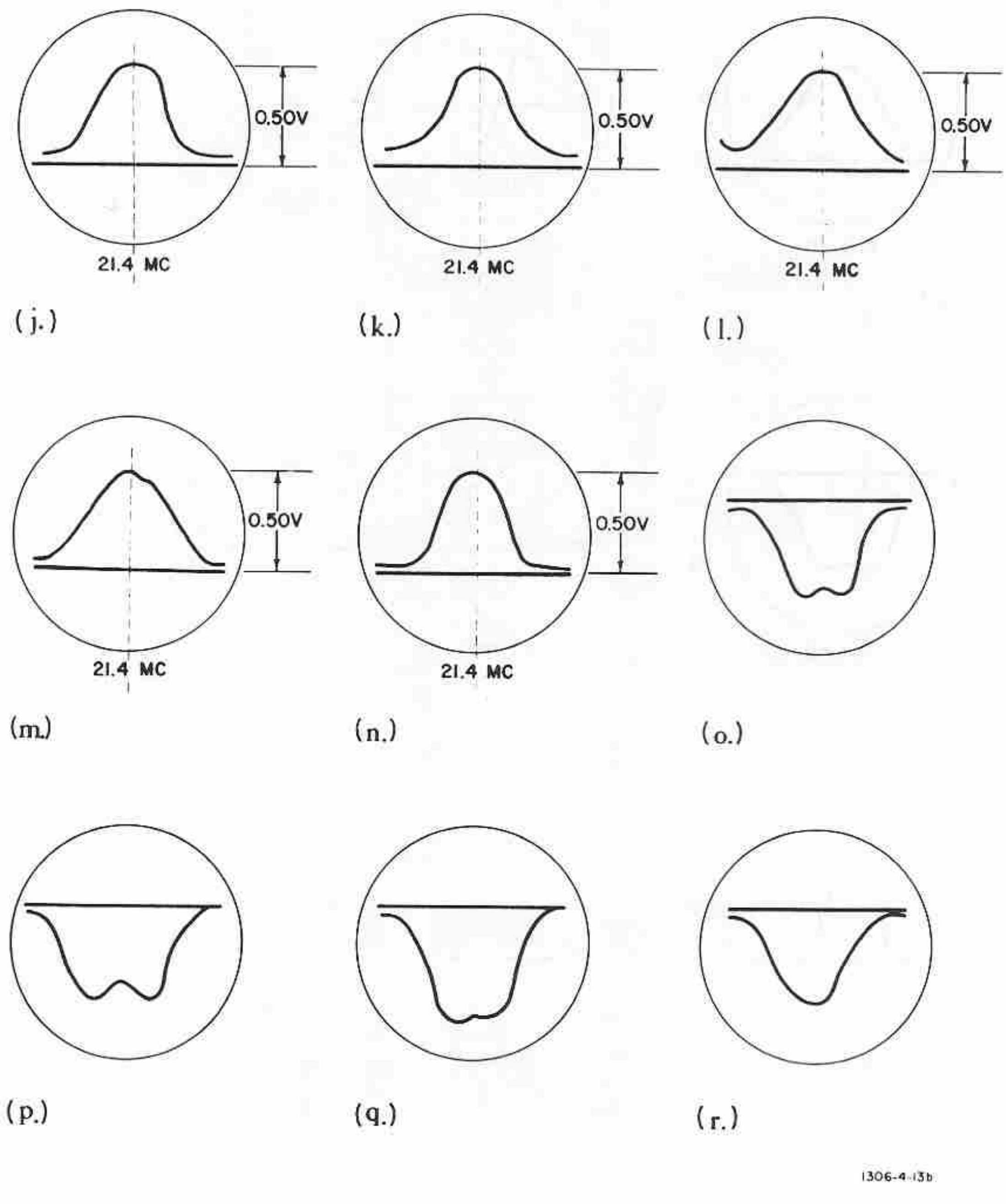

Figure 4-13. (Cont'd.) Typical IF and RF Alignment Response Curves

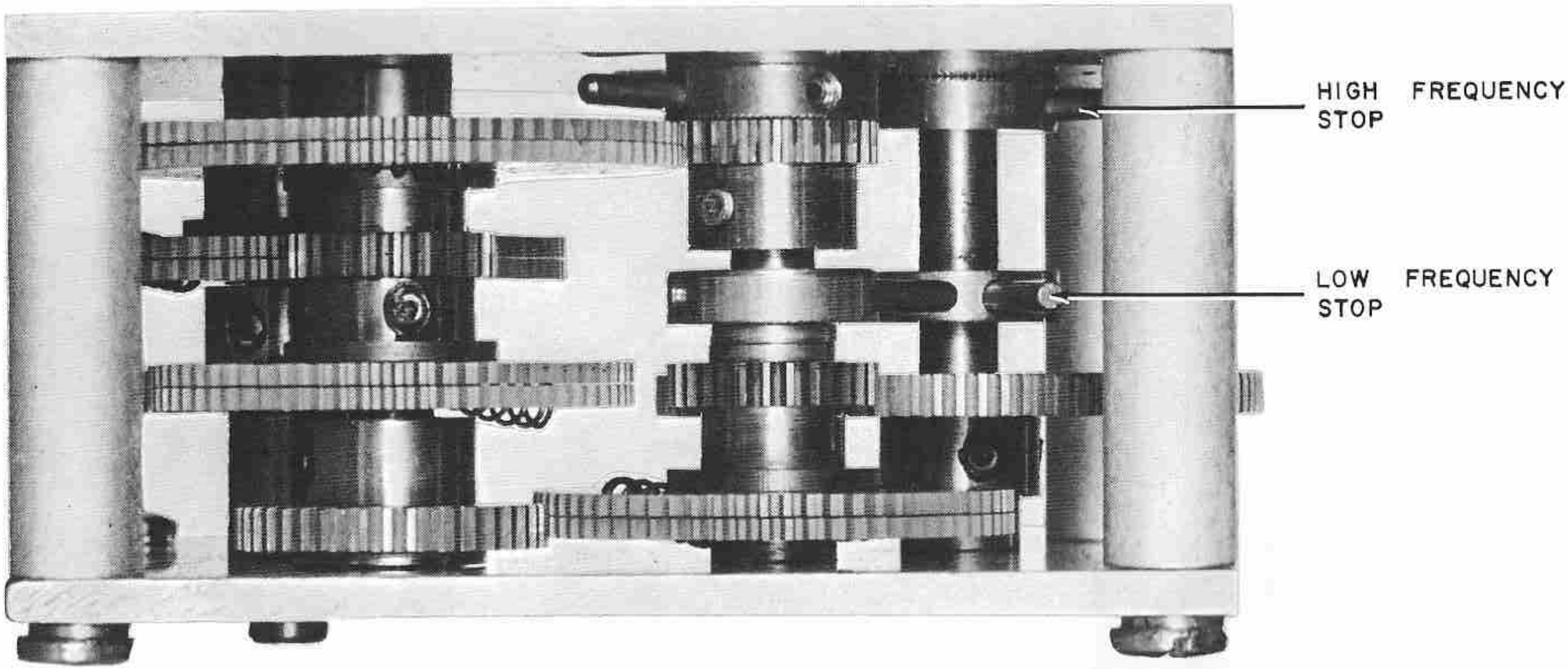

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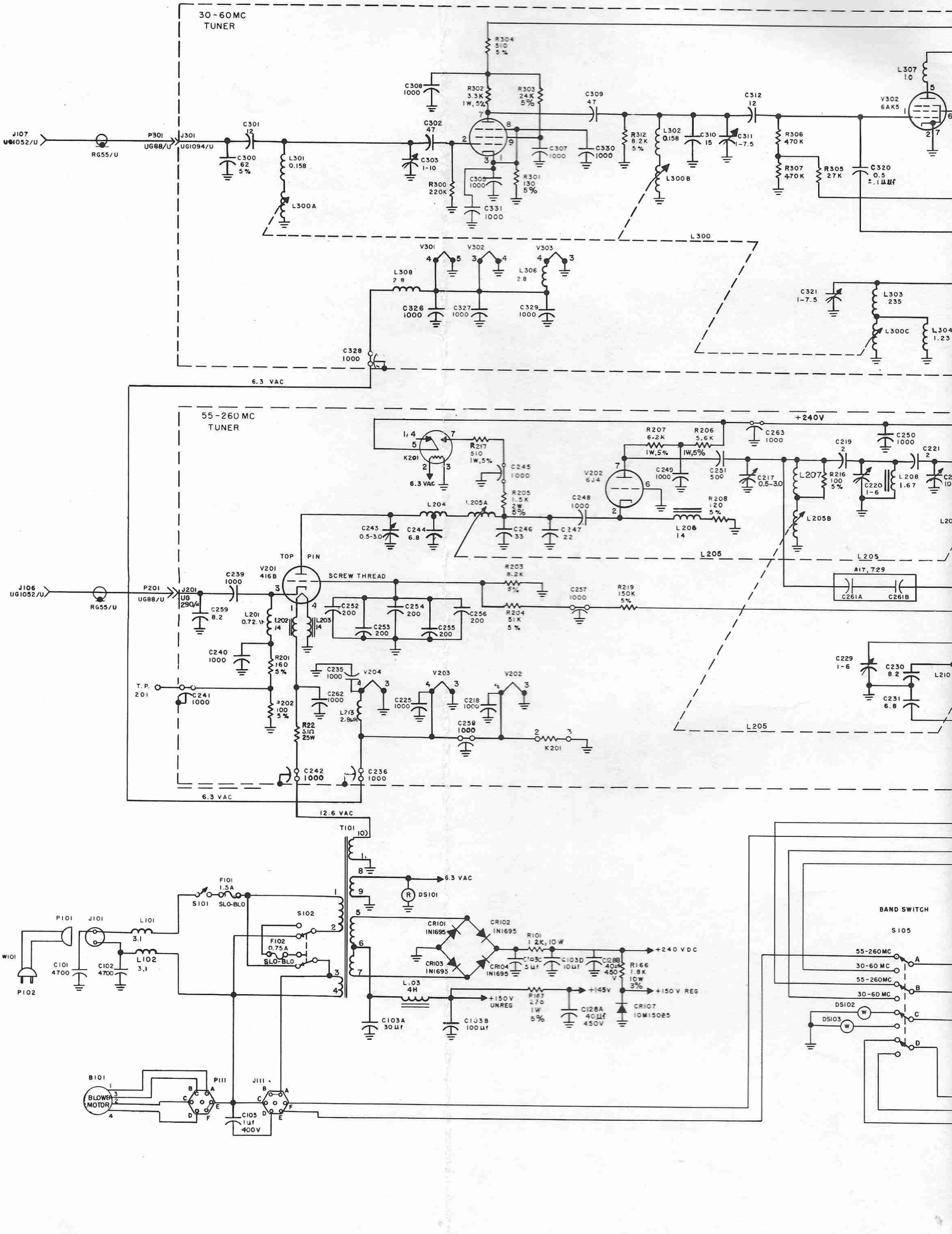
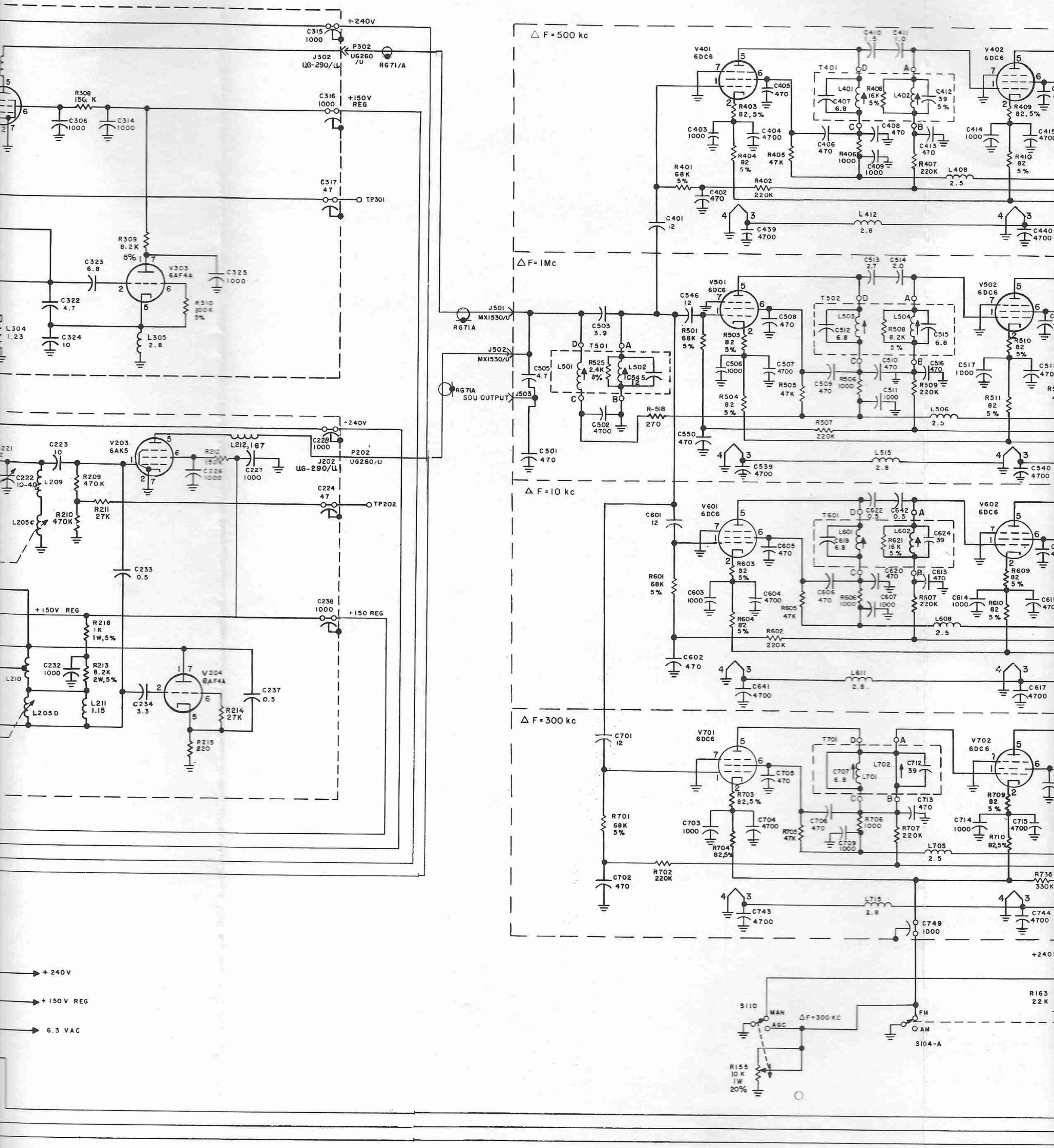
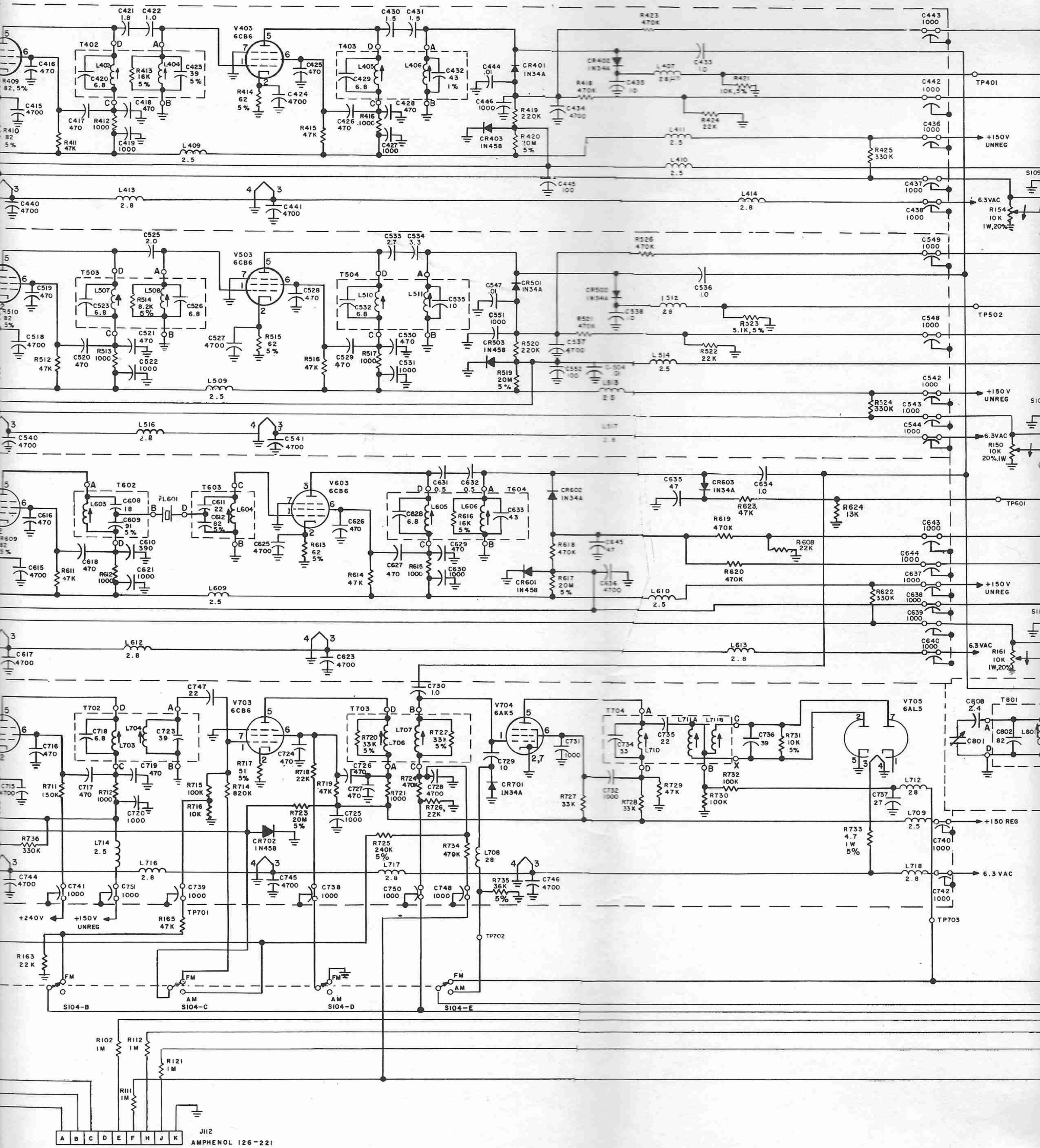
Figure 4-14. 55-260 mc RF Tuner Gear Train


30-60MC
TUNER
J107
UG1052/U
RG55/U
P301
UG88/U
J301
UG1094/U
C301
12
C300
62
5%
L301
0.158
L300A
C302
47
C303
1-10
R300
220K
C308
1000
R304
510
5%
R302
3.3K
1W, 5%
R303
24K
5%
C305
1000
C331
1000
R301
130
5%
C307
1000
C330
1000
C309
47
R312
8.2K
5%
L302
0.158
L300B
C310
15
C311
1-7.5
C312
12
R306
470K
R307
470K
R305
27K
C320
0.5
L307
1.0
V302
6AK5
L300
V301
V302
V303
L308
2.8
L306
2.8
C326
1000
C327
1000
C329
1000
C321
1-7.5
L303
.235
L300C
L304
1.23
C328
1000
6.3 VAC
55-260 MC
TUNER
+240V
K201
6.3 VAC
R217
510
1W,5%
C245
1000
R205
1.5K
2W
5%
R207
6.2K
1W,5%
R206
5.6K
1W,5%
C263
1000
C250
1000
C219
2
C221
2
V202
6J4
C249
1000
C251
500
C217
0.5-3.0
L207
R216
100
5%
C220
1-6
L208
1.67
L205B
C248
1000
R208
120
5%
L206
14
L204
L205A
C243
0.5-3.0
C244
6.8
C246
33
C247
22
L205
TOP
PIN
V201
416B
SCREW THREAD
R203
8.2K
5%
R204
51K
5%
C257
1000
R219
150K
5%
A17, 729
C261A
C261B
J106
UG1052/U
RG55/U
P201
UG88/U
J201
UG
290/U
C239
1000
C259
8.2
L201
0.72
L202
14
L203
14
C252
200
C253
200
C254
200
C255
200
C256
200
C240
1000
R201
160
5%
T.P.
201
C241
1000
R202
100
5%
C235
1000
V204
V203
V202
C262
1000
L213
2.8uh
C225
1000
C218
1000
C229
1-6
C230
8.2
L210
C231
6.8
R22
5.1Ω
25W
C258
1000
K201
C242
1000
C236
1000
6.3 VAC
12.6 VAC
T101
6.3 VAC
DS101
F101
1.5A
S101
SLO-BLO
S102
F102
0.75A
SLO-BLO
P101
J101
L101
3.1
L102
3.1
W101
C101
4700
C102
4700
P102
CR101
1N1695
CR102
1N1695
CR103
1N1695
CR104
1N1695
R101
1.2K, 10W
C103C
5uf
C103D
10uf
C128B
40uf
450V
R166
1.8K
10W
3%
+240 VDC
L103
4H
+150V
UNREG
R167
270
1W
5%
+145V
C128A
40uf
450V
CR107
10M150Z5
+150 V REG
C103A
30uf
C103B
100uf
BAND SWITCH
S105
55-260MC
30-60MC
55-260MC
30-60MC
DS102
DS103
B101
BLOWER
MOTOR
P111
J111
C105
1uf
400V



+240V
C315 1000
P302 UG260 /U
J302 UG-290/U
RG71/A
R308 150K
C306 1000
C314 1000
C316 1000
+150V REG
C317 47
TP301
R309 8.2K 5%
C323 6.8
V303 6AF4A
C325 1000
C322 4.7
R310 100K 5%
C324 10
L304 1.23
L305 2.8
+240V
C223 10
V203 6AK5
L212 .167
C228 1000
P202 UG260/U
J202 UG-290/U
C222 10-40
L209
R209 470K
R212 150K
C226 1000
C227 1000
C224 47
TP202
R210 470K
R211 27K
L205C
C233 0.5
+150V REG
C238 1000
+150 REG
R218 1K 1W,5%
C232 1000
R213 8.2K 2W,5%
V204 6AF4A
C237 0.5
L210
L211 1.15
C234 3.3
R214 27K
L205D
R215 220
+240V
+150V REG
6.3 VAC
△F = 500 kc
V401 6DC6
C410 1.5
C411 1.0
V402 6DC6
T401
L401
C407 6.8
R408 16K 5%
L402
C412 39 5%
C405 470
R403 82, 5%
C403 1000
C404 4700
C406 470
C408 470
C413 470
R409 82, 5%
C414 1000
C415 4700
R404 82 5%
R405 47K
R406 1000
C409 1000
R407 220K
R410 82 5%
R401 68K 5%
C402 470
R402 220K
L408 2.5
L412 2.8
C439 4700
C440 4700
C401 12
△F = 1Mc
J501 MX1530/U
RG71A
C503 3.9
C546 12
V501 6DC6
C513 2.7
C514 2.0
V502 6DC6
T502
L503
C512 6.8
L504
R508 8.2K 5%
C515 6.8
C508 470
R501 68K 5%
R503 82 5%
J502 MX1530/U
T501
L501
R525 2.4K 5%
L502
C545 12
C505 4.7
RG71A SDU OUTPUT
J503
C502 4700
R-518 270
C506 1000
C507 4700
R505 47K
C509 470
R506 1000
C510 470
C511 1000
C516 470
R509 220K
R510 82 5%
C517 1000
R511 82 5%
R504 82 5%
R507 220K
L506 2.5
C550 470
C501 470
L515 2.8
C539 4700
C540 4700
△F = 10 kc
C601 12
V601 6DC6
C622 0.5
C642 0.5
V602 6DC6
T601
L601
C619 6.8
L602
R621 16K 5%
C624 39
C605 470
R601 68K 5%
R603 82 5%
C603 1000
C604 4700
R605 47K
C606 470
R606 1000
C620 470
C607 1000
C613 470
R607 220K
R609 82 5%
C614 1000
R610 82 5%
R604 82 5%
R602 220K
L608 2.5
C602 470
L611 2.8
C641 4700
C617 4700
△F = 300 kc
C701 12
V701 6DC6
T701
L702
C712 39
V702 6DC6
C707 6.8
L701
C705 470
R703 82,5%
C703 1000
C704 4700
C706 470
R706 1000
C713 470
R709 82 5%
C714 1000
C715 4700
R701 68K 5%
R705 47K
C709 1000
R707 220K
R710 82,5%
R704 82,5%
L705 2.5
R736 330K
C702 470
R702 220K
L715 2.8
C743 4700
C744 4700
C749 1000
+240V
S110
MAN
AGC
△F = 300 KC
FM
AM
S104-A
R163 22K
R155 10K 1W 20%


V403 6CB6
V503 6CB6
V603 6CB6
V703 6CB6
V704 6AK5
V705 6AL5
T402
T403
T503
T504
T602
T603
T604
T702
T703
T704
T801
FL601
CR401 1N34A
CR402 1N34A
CR403 1N458
CR501 1N34A
CR502 1N34A
CR503 1N458
CR601 1N458
CR602 1N34A
CR603 1N34A
CR701 1N34A
CR702 1N458
TP401
TP502
TP601
TP701
TP702
TP703
+150V UNREG
+150 REG
+240V
6.3VAC
R154 10K 1W,20%
R150 10K 20%,1W
R161 10K 1W,20%
S104-B
S104-C
S104-D
S104-E
FM
AM
R102 1M
R112 1M
R121 1M
R111 1M
R163 22K
R165 47K
J112
AMPHENOL 126-221
A B C D E F H J K

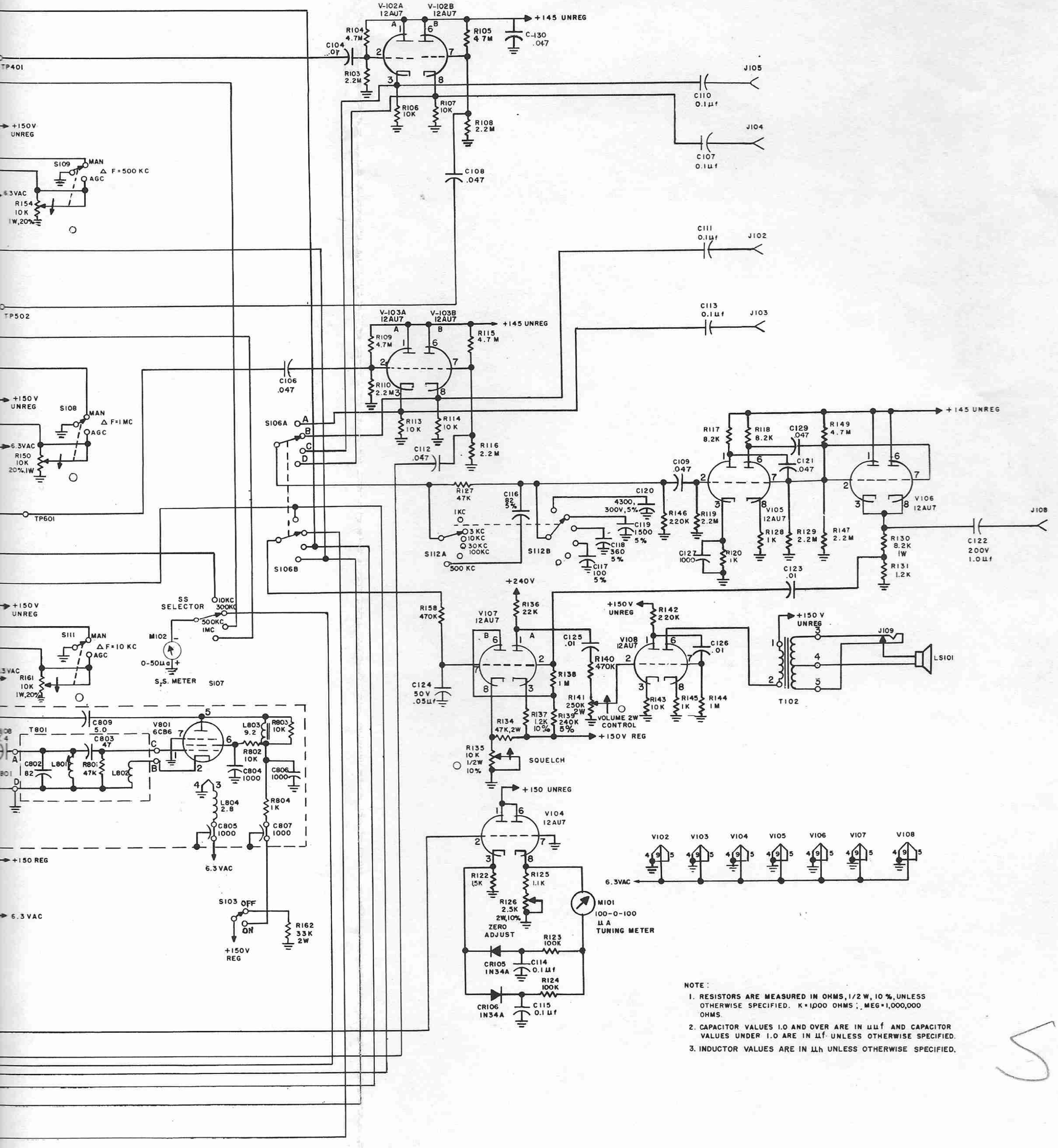


Figure 5-1. Model 1306 Receiver, Schematic Diagram

Figure 5-1. Model 1306 Receiver, Schematic Diagram