INSTRUCTION BOOK
FOR
TYPE SM-9310A SIGNAL MONITOR

Communication Electronics, Inc.
4900 HAMPDEN LANE
BETHESDA 14, MARYLAND

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

T-1 To Instruction Manual SM-9310A October 15, 1962

Temporary Correction

Page	Action
Figure 6-1.	At C105 and C105 change value from "0.1 μf" to read "1.0 μf". Change rating from "50V" to read "35V". Change polarity so that "-" termination is connected to T102.
Figure 6-1.	At R126 change connection of arm of R126 from junction of R114 and R126 to junction of R126 and R115. Reverse the direction of the arrow on arm of R126 to indicate clockwise rotation.

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TUBE, TRANSISTOR, AND DIODE COMPLEMENT, SM-9310A

Symbol	Type	Function
V101	3XP1	CRT
V201	7587	Shaping Amplifier
V202	7587	Shaping Amplifier
V203	7587	1st Mixer
V204	6CW4	Sweep Oscillator
V205	6CW4	2nd Mixer
V206	6CW4	5.25-mc Oscillator
V207	7587	1st 950-kc IF Amplifier
V208	7587	2nd 950-kc IF Amplifier
Q301	2N489	Pulse Generator
Q302	2N697	Sawtooth Generator
Q303 Q304	2N335	Sawtooth Module Output
CR101 CR102	1N2360	Rectifier
CR103 through CR106	1N2613	Rectifier
CR107	1N979A	Voltage Regulator
CR108	1N972A	Voltage Regulator
CR201 CR202 CR203	1N462	Sweep Linearity
CR204	1N746	Sweep Linearity
CR205	1N749	Sweep Linearity
CR206 CR207	1N198A	Push-Pull Detector

SECTION I

SPECIFICATIONS

Input Center Frequency	21.4 mc
Bandwidth	3 mc, 2-db maximum ripple when used with receiver of 1-mc bandwidth at SM output
Resolution	6-db valley between signals 20 kc apart
Sweep Oscillator	
Center Frequency	25.7 mc
Sweep Width	0-3 mc (continuously adjustable)
Sweep Rate	30 cps
1st IF Frequency	4.3 mc
2nd IF Frequency	950 kc
Sensitivity	10 microvolts input to SM produces one inch vertical deflection on screen
Linearity	Within 5% of sweep width
Dimensions	3-1/2" high x 19" wide x 15" deep (front panel to rearmost extension)
Power Input	115 vac, 50-400 cps, 17 watts, approximately
Weight	9.5 pounds

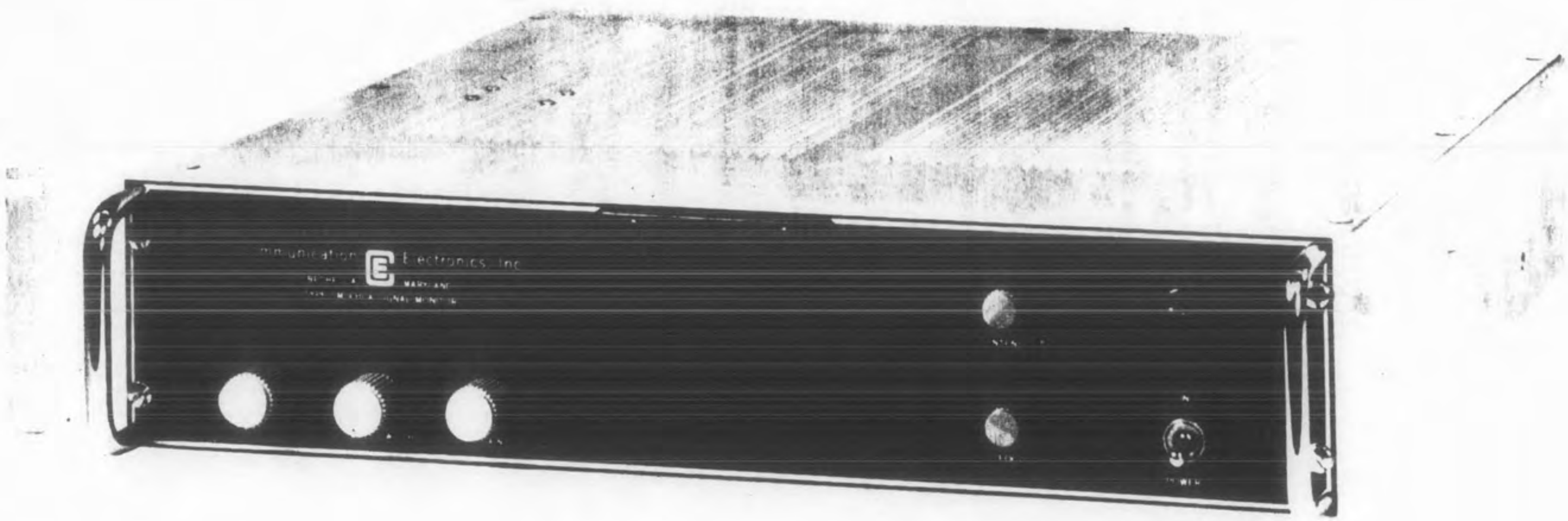

Figure 2-1. Type SM-9310A Signal Monitor

SECTION II

GENERAL DESCRIPTION

1. ELECTRICAL CHARACTERISTICS.

The CEI Type SM-9310A Signal Monitor is designed for use in conjunction with a receiver to provide a visual display of all signals present within a frequency range adjustable from zero to three megacycles per second, with a center frequency of 21.4 mc. Such displays are an aid in analyzing signals intercepted by the receiver and can be used in studying the amplitude, type of modulation, etc., of the signals. The sensitivity is such that 10 microvolts at the signal monitor input produces at least full deflection. Resolution is such that any two signals 20 kc apart show on the screen as separate traces with a 6-db valley between them.

The SM-9310A is especially designed for use with any of the CEI receivers. However, it may be used with other equipments having the correct signal output (see subsection 4 of this section).

2. MECHANICAL CHARACTERISTICS.

The front panel (see fig. 2-1) mounts the cathode-ray tube (CRT) screen; the CENTER FREQ. control; the SWEEP WIDTH control; the GAIN control; the INTENSITY control; the FOCUS control; and the POWER switch, with ON position marked.

The chassis rear apron (see fig. 2-2) mounts a type BNC receptacle marked SIGNAL INPUT J101; and a fuseholder marked F101 3/16 AMP. The power cord is permanently connected through the rear of the signal monitor.

The panel and main chassis are constructed of aluminum. The main chassis top and bottom are covered with aluminum dust covers. The panel is overlaid with a black-anodized etched plate. Within the main chassis are four separate subassemblies. One of these is a silver-plated brass chassis which has been gold flashed to prevent tarnishing and is wired into the main chassis. It mounts the 21.4-mc shaping amplifier, the first mixer, the sweep oscillator, the second mixer, the 5.25-mc oscillator, the 950-kc IF amplifier, and the signal detector. The other three subassemblies are all etched circuit board modules. One of these, the sweep linearity network module, is wired on the underside of the brass chassis subassembly. Another etched circuit board, the sawtooth generator module, is mounted plug-in fashion on the main chassis. The remaining etched circuit board, a module mounting power supply components and most of the components not included in any other subassembly, is wired to the main chassis underside. The remaining components are on a printed board located on the rear of the front panel with the INTENSITY and FOCUS controls.

3. EQUIPMENT SUPPLIED.

The signal monitor is shipped complete with an instruction book, a mating connector for the SIGNAL INPUT receptacle, and a three-pin to two-pin power cord plug adapter.

4. ADDITIONAL EQUIPMENT REQUIRED FOR OPERATION.

The SM-9310A may be used with CEI receivers or any other equipments having a signal output of 50-ohm impedance and a 21.4-mc center frequency IF signal with a one-megacycle bandwidth at the 3-db points.

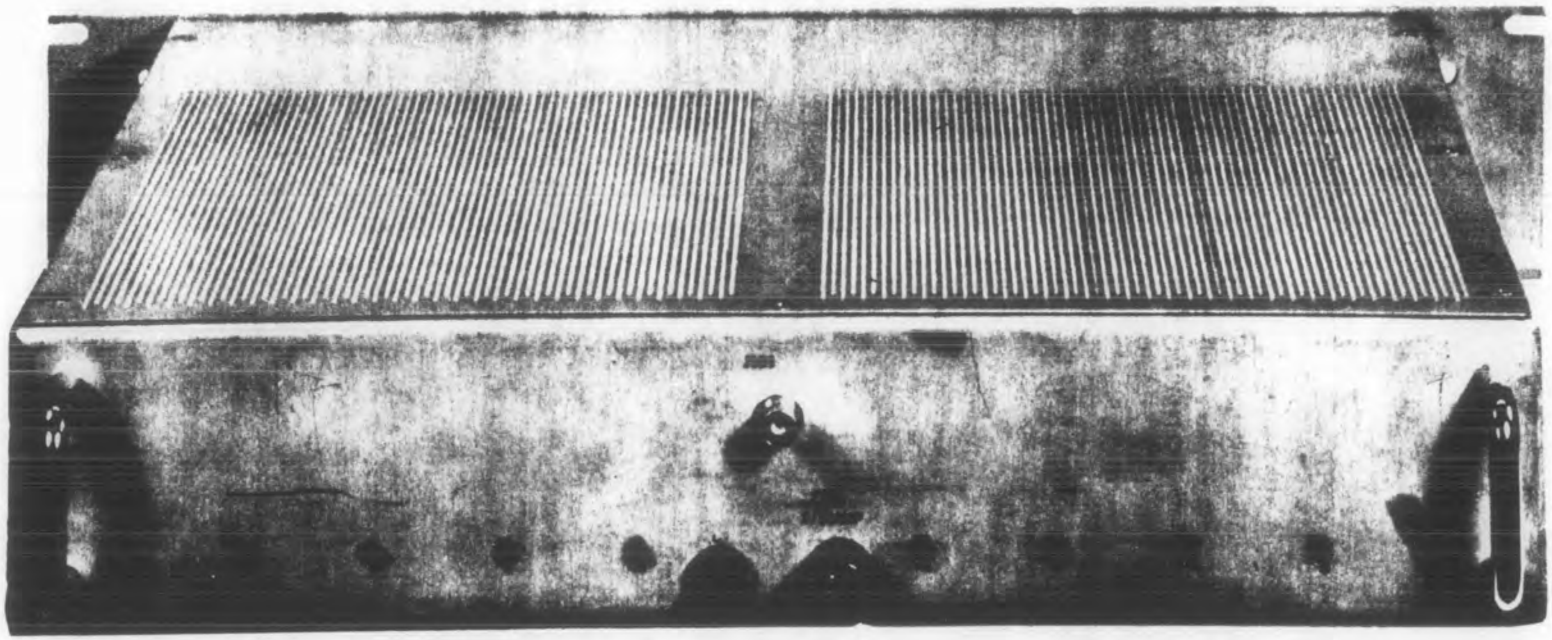

Figure 2-2. SM-9310A, Rear View

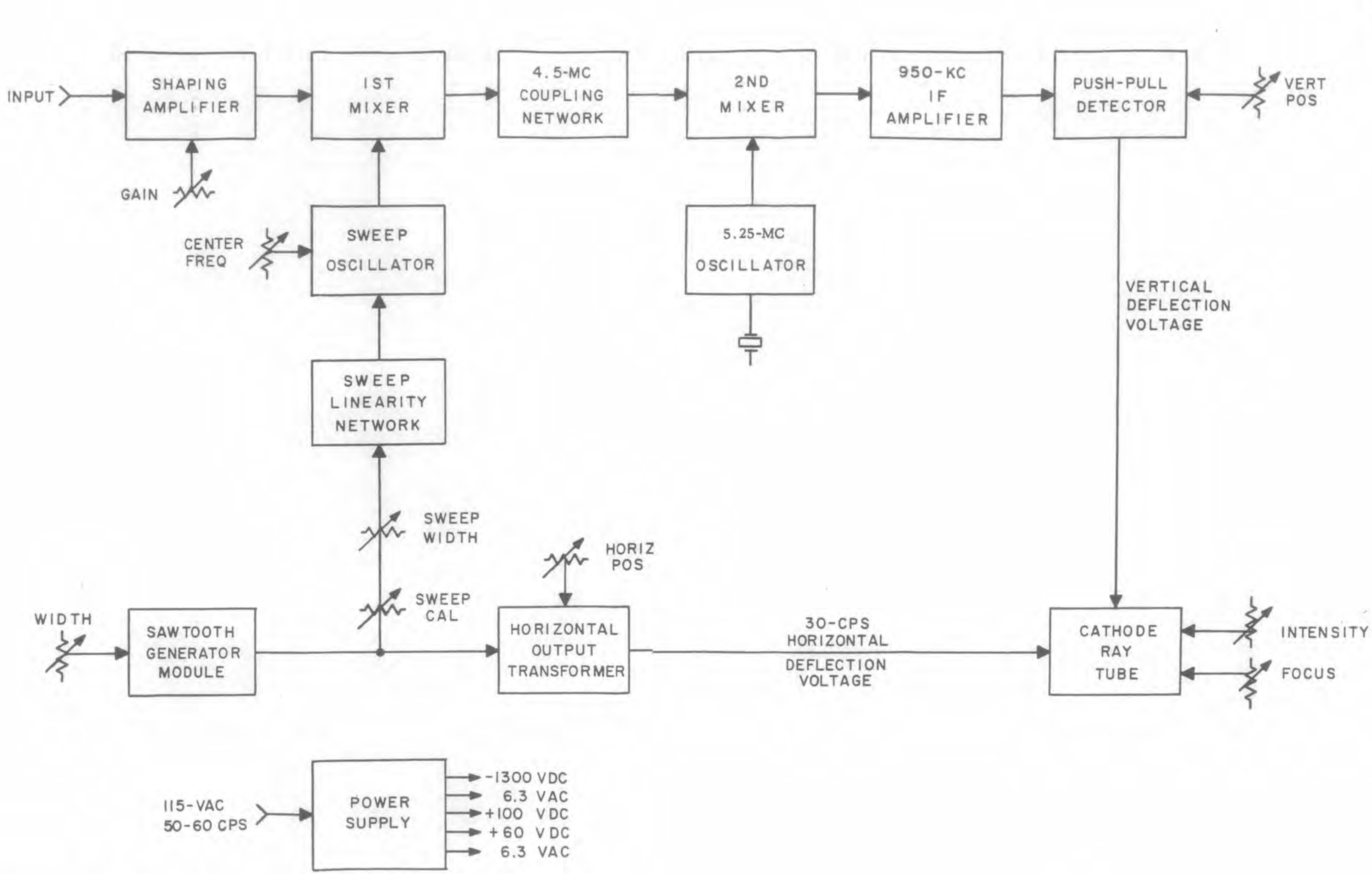

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Figure 3-1. SM-9310A, Functional Block Diagram

SECTION III

CIRCUIT DESCRIPTION

1. FUNCTIONAL ANALYSIS.

The SM-9310A is operated with an appropriate receiver to provide a panoramic visual display of the IF signal from the receiver's signal monitor output. The frequency range under view at one time may be continuously adjusted from zero to three megacycles. The sensitivity of the SM-9310A is such that 10 microvolts at the signal monitor input will give one inch deflection. Its resolution is such that signals 20 kc apart will appear as separate traces with a 6-db valley between them.

The signal monitor is depicted by a functional block diagram in Figure 3-1. The 21.4-mc center frequency IF signal from the receiver is fed through the input to a shaping amplifier. The shaping amplifier response curve combines with the receiver's response curve to give an over-all amplitude vs frequency response curve which has no greater than 2-db ripple over a 3-mc bandwidth. The GAIN control functions by controlling the gain of the shaping amplifier. From the shaping amplifier the signal is passed to the first mixer. Within the first mixer the signal is mixed with a signal from the sweep oscillator to provide a 4.3-mc IF signal which is then fed to the second mixer through a 4.3-mc coupling network.

The sweep oscillator frequency varies above and below its center frequency 30 times each second. The amount of sweep is set by the SWEEP WIDTH control, and the center frequency location is adjusted by the CENTER FREQ. control. Since the output from the first mixer passes through a coupling network tuned to 4.3 mc, only a frequency of 4.3 mc is accepted from the first mixer (with due allowance for the coupling network bandwidth). Thus, a signal passes through the signal monitor only at those times when the beat frequency produced in the first mixer is a 4.3-mc IF signal. All other beat frequencies are rejected from the first mixer.

In the second mixer the 4.3-mc IF signal is mixed with the output of a 5.25-mc crystal-controlled oscillator and a 950-kc IF signal is developed. The 950-kc IF signal is amplified in a 950-kc IF amplifier and applied to a push-pull detector. The push-pull detector output is applied directly to the vertical deflection plates of the CRT. Vertical positioning is accomplished with the VERT POS control, connected to the push-pull detector.

The horizontal deflection plates of the CRT receive a push-pull, 30-cps horizontal deflection signal which is developed by a sawtooth generator and applied to the horizontal plates through the horizontal output transformer. Horizontal centering is accomplished by a control present in the horizontal output transformer circuit.

The sawtooth wave from the sawtooth generator is also applied to the sweep oscillator. Application to the sweep oscillator is through the SWEEP CAL. control, the SWEEP WIDTH control, and the sweep linearity network. The sawtooth signal to the sweep oscillator synchronizes the sweep oscillator frequency variations from below center frequency to above center frequency with the left-to-right horizontal deflection of the trace on the CRT screen. This synchronization is of fundamental importance in producing the vertical traces on the screen.

An understanding of exactly how a signal at the receiver produces a trace on the screen is most easily gained by considering a case in which the receiver is tuned to a CW signal. When the receiver is tuned to a steady CW carrier, the receiver produces a steady 21.4-mc IF signal. The signal monitor receives the 21.4-mc IF from the receiver's signal monitor output. During that instant of each sweep when the sweeping oscillator is at its exact center frequency (normally 25.7 mc), the incoming 21.4-mc signal from the receiver mixes with the sweep oscillator signal to produce a 4.3-mc beat frequency. In all other regions of the sweep oscillator's output frequency range, no signal passes through the 4.3-mc coupling network because the beat produced in the first mixer is either above or below 4.3 mc.

From the 4.3-mc coupling network the signal goes on through the signal monitor until it produces a trace on the screen. Assuming a constant setting of the GAIN control, the height of that vertical trace depends on the amplitude of the incoming signal. Also, since the sweep oscillator's frequency changes are synchronized with the horizontal movements of the CRT beam, the moment at which the sweep oscillator's heterodyning action causes a signal to leave the first mixer will always occur at the same point in the left-to-right movement of the CRT beam. Thus a CW carrier coming into the receiver will produce a vertical trace at a fixed position on the screen and of a height varying with the strength of the received carrier (assuming that the GAIN setting is constant).

2. SHAPING AMPLIFIER

The function of the shaping amplifier is to provide a response curve of such a shape that, when added to the response curve present at a receiver signal monitor output, the sum of the two will be a virtually flat amplitude vs frequency response. The shaping amplifier consists of two Nuvistor tetrodes, V201 and V202. Input to the shaping amplifier is through a broadband transformer, T201.

Both stages are neutralized by a capacitive pi-network between the plate and screen grid circuits. These capacitors are C202, C203, and C204 for V201, and C213, C214, and C215 for V202. Such neutralization avoids response curve distortion.

In the plate circuit of the first stage, capacitor C206 and inductor L201 form a rejection filter. This filter helps establish a 3-mc input bandwidth and also reduces the center portion of the receiver's signal monitor output response curve.

Double-tuned coupling is used between the first and second stages, with the bandwidth controlled by trimmer capacitor C208. The output from the shaping amplifier to the first mixer is also through a double-tuned coupling. It is the functioning of the four tuned circuits (from the two double-tuned couplings) plus the action of the rejection filter which brings about the shaping amplifier's over-all response. This response, as seen at the input to the first mixer, is a frequency vs amplitude curve flat within a 2-db ripple across a 3-mc bandwidth.

Control of the shaping amplifier's gain is by means of the GAIN potentiometer, R121, which varies the cathode-to-ground voltages of V201 and V202.

3. SWEEP OSCILLATOR.

The sweep oscillator, V204, is a type 6CW4 Nuvistor triode connected in a Clapp circuit with its output frequency swept across a maximum range of at least 3 mc by means of a voltage-variable capacitor, C266. The voltage-variable capacitor is a semiconductor device whose effective capacitance varies with the dc voltage applied across it. It is connected in series with the oscillator tank circuit and controls the oscillator's frequency by varying the tank circuit's series capacitance.

Two voltages are used to control the effective capacitance of C266, and they are applied to it from two sources. One source, through feedthrough capacitor C271, comes from potentiometer R124, the CENTER FREQ control. Potentiometer R124 is part of a voltage-divider-to-ground across which a +30 vdc source, regulated by Zener diode CR108, is applied. This fixed bias to C266 can be adjusted over a range of voltages which vary the sweep oscillator center frequency $\pm$ 250 kc from 25.7 mc. The use of a regulated +30 vdc as the source of the CENTER FREQ control bias is to keep the sweep oscillator frequency stable at the center frequency to which it is adjusted.

The second voltage applied to the voltage variable capacitor is a 30-cps sawtooth wave. This sawtooth wave originates in the sawtooth generator module and reaches C266 through inductor L215 after passing through other circuit components.

Two of the components through which the sawtooth voltage passes on its way to C266 are the SWEEP CAL potentiometer, R122, and the SWEEP WIDTH potentiometer, R125. They are both used to control the sweep oscillator frequency variations by controlling the amplitude of the sawtooth voltage as it is applied to C266.

Additional components through which the sawtooth voltage passes on its way to C266 are diodes CR201 through CR205 and resistors R214 through R219, all of which make up the sweep linearity network. This network varies the shape of the sawtooth wave so as to compensate for the nonlinearity of the capacitance vs voltage characteristic of C266. The result is to give the sweep oscillator a linear frequency vs time characteristic at the sweep oscillator output.

The sweep linearity network's configuration is that of two voltage dividers, each divider having two stages and conducting in only one direction. The two dividers are arranged so that they come into action in turn each time the sawtooth wave goes more and more positive, bending the wave to the desired form. While the sawtooth is below ground potential, first CR204 conducts and later CR205 conducts. Thus the negative portion of the upward rising sawtooth wave is altered by the shunting effect of these diodes across resistor R219. When the voltage is above ground potential, first CR202 conducts and later CR201 conducts, providing additional shunts which modify the shape of those portions of the sawtooth's upward rising wave which are above ground potential. Diode CR201 is kept from conducting until after CR202 has conducted by a bias CR201 receives from the junction of resistors R106 and R107, two components in the divider from which the center frequency control voltage is derived.

4. SAWTOOTH GENERATOR.

The sawtooth generator is a four-transistor module which develops a sawtooth wave for control of the sweep generator and to control the horizontal deflection in the CRT. The first stage, Q301, is a silicon unijunction transistor operated as a pulse generator. A +30 vdc, regulated by Zener diode CR301, charges capacitor C303 through resistor R301. When the charge reaches a sufficiently high level, the unijunction transistor conducts, discharging C303 through resistor R306. The rate of discharge is relatively rapid, and a sudden pulse of voltage is developed across R306. This pulse is conducted to the second stage, Q302, through capacitor C304 and resistor R305.

The sawtooth wave is generated across capacitor C306, which is alternately permitted to charge from a dc voltage source and then to quickly discharge during the momentary periods in which the pulses from Q301 cause Q302 to conduct. The voltage used to charge C306 is from a +100 vdc source. It is applied through the WIDTH control, potentiometer R12Ω the resistance of which varies the amplitude of the sawtooth waves, thereby controlling the amount of the horizontal deflection of the CRT beam. The use of resistor R309 keeps C306 at a dc bias above ground, thereby preventing the sawtooth module output transistors, Q303 and Q304, from being cut off. It is necessary that current flow through them during all parts of the sweep cycle in order that a horizontal deflection voltage be constantly present at the output of the horizontal output transformer. Those two transistors form a cascaded emitter follower used to provide the proper impedance to the horizontal output transformer.

5. HORIZONTAL OUTPUT TRANSFORMER.

The horizontal output transformer, T102, transforms the sawtooth wave to a voltage suitable for use as a horizontal deflection voltage for application to the horizontal plates of the CRT. In effect it operates as an autotransformer with a single input and two outputs. Thus, with the sawtooth wave passing through the primary, a push-pull voltage appears at each end of the winding for application through capacitors C104 and C105, respectively, to each of the horizontal deflection plates.

To provide for horizontal centering of the CRT beam a dc component is applied to each horizontal plate. To one plate a constant voltage of approximately +10 vdc is applied, being developed at the junction resistors R108 and R109, which are in series from +100 vdc to ground through a portion of the T102 winding. To the other horizontal plate a voltage adjustable from zero to approximately +20 vdc is applied through isolation resistor R110 from the HORIZ POS potentiometer, R123, which is also connected between + 100 vdc and ground. Thus the no-signal dc potential between the two horizontal plates can be adjusted to center the CRT beam.

6. FIRST MIXER.

The first mixer, V203, is a Nuvistor tetrode which receives both the signal from the shaping amplifier and the 25.7-mc center frequency sweep signal on its grid. The plate of the first mixer tube is tuned to 4.3 mc and loosely coupled to the second mixer through a quadruple-tuned circuit in which the tuning is accomplished by inductors L206 through L209.

7. SECOND MIXER.

The second mixer, V205, is a Nuvistor tetrode. From the second mixer the 950-kc IF signal is coupled to the first of two stages of 950-kc amplification through capacitor C246.

8. 5.25-MC OSCILLATOR.

The 5.25-mc crystal-controlled oscillator uses a Nuvistor triode, V206. Design is such that the oscillator uses very little current. The oscillator signal is coupled to the grid of the second mixer by capacitor C239.

9. 950-KC IF AMPLIFIER.

The 950-kc IF amplifier uses two Nuvistor tetrodes, V207 and V208. Coupling between the two stages is through a double-tuned network and output from the second 950-kc amplifier stage is through a double-tuned circuit. The two 950-kc IF amplifiers function to produce the required 8-kc bandwidth so that a 20-kc resolution is obtained.

The extent of the bandwidth of any given carrier as it appears within a single trace on the screen is determined by the 8-kc bandwidth of the 950-kc IF amplifier. In effect, each individual trace on the screen is a picture of the 950-kc IF amplifier's response to the particular signal producing the trace.

10. PUSH-PULL DETECTOR.

The push-pull detector rectifies the 950-kc IF signal, obtaining a dc voltage which varies according to the average IF signal amplitude. The detector applies this voltage directly to the vertical deflection plates of the CRT, with the result that the vertical height of a signal trace varies directly with the input signal amplitude (subject, however, to GAIN control settings).

The circuit (see fig. 3-2) is effectively two shunt diode detectors, CR206 and CR207, with opposite polarities and their outputs filtered through two identical RC networks. The load for CR206 is resistor R236; the load for CR207 is resistor R237. The filter for CR206 is resistor R238 plus stray capacity at the deflection plate to which it is connected. The filter for CR237 is resistor R240 plus stray capacity at the deflection plate to which it is connected. The two filters keep the 950-kc IF signal from reaching the vertical deflection plates.

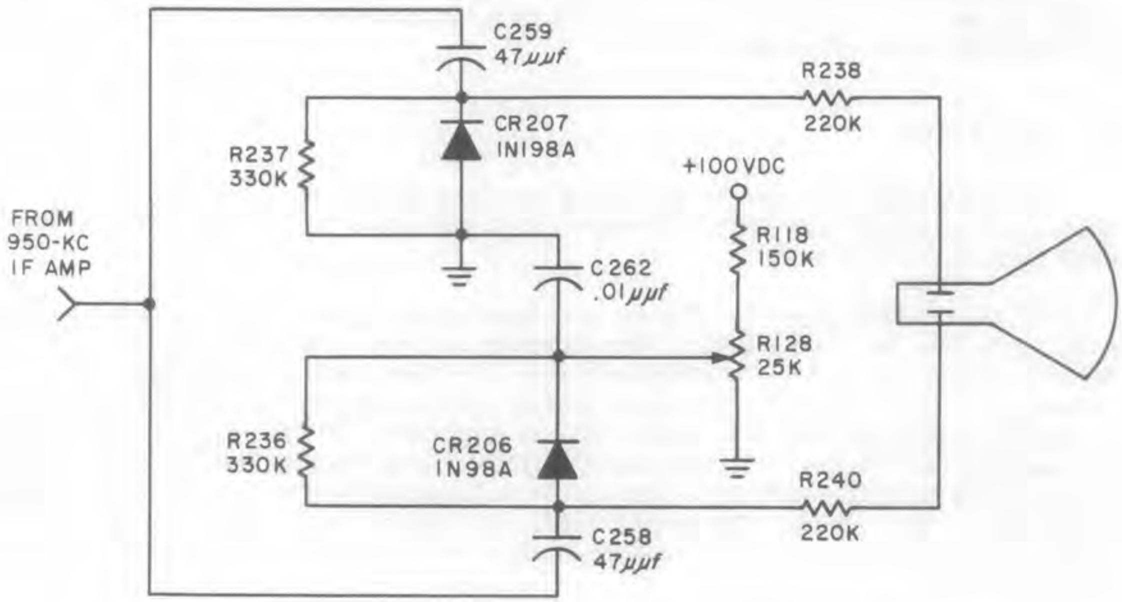

Figure 3-2. SM-9310A, Push-Pull Detector, Simplified Schematic Diagram

As a 950-kc IF signal is applied to the circuit, a dc voltage is set up across the two load resistors. In each load resistor the dc voltage varies as the average amplitude of the IF signal and is applied to one of the vertical deflection plates. The result is a deflection of the CRT beam up from the base line.

The trace is positioned on the base line by a positive dc bias applied to the lower deflection plate from the VERT POS potentiometer, R128, which is in series with resistor R118 to ground from + 100 vdc. The bias reaches the plate through R236. Capacitor C262 is a dc blocking capacitor present to make it possible to use the vertical positioning bias.

11. CATHODE RAY TUBE.

The CRT, V101, has a rectangular face measuring 2-3/4 x 1-1/4 inches and overlaid with green Plexiglas. The Plexiglas is inscribed with a horizontal base line, a vertical center marker, and six vertical markers each side of center. The markers are for relative reference only and are not calibrated to read in specific units.

The CRT uses a -1300 vdc acceleration voltage. From the power supply this source is connected across a voltage-divider-to-ground composed of resistor R114, potentiometer R126, resistor R115, potentiometer R127, resistor R116, and resistor R117. Potentiometer R126 functions as the INTENSITY control by controlling the voltage to the control grid. Potentiometer R127 functions as the FOCUS control by controlling the voltage to the first anode.

Horizontal positioning of the trace is accomplished by means of potentiometer R123 (see subsection 5 of this section). Vertical positioning of the trace is accomplished by potentiometer R128 (see subsection 10 of this section).

12. POWER SUPPLY.

The power supply furnishes all the power requirements of the signal monitor. The 115 vac, 60 cps, input is controlled by the POWER switch, S101, and passes through a single fuse, F101, which protects the entire device.

The power transformer, T101, has an electrostatic shield between the primary and secondary sides. It has four secondary windings. One of these is a 6.3-volt winding used for the filament of the CRT. Another is a 6.3-volt winding used to power the filaments of all other tubes. A third secondary is a 214-volt, rms, center-tapped winding powering a bridge rectifier, the output of which is passed through a conventional RC filter to give an unregulated +100 vdc. From the center tap on this same winding a +60 vdc is taken off and filtered by capacitor C102C. This +60 vdc is available because CR103 and CR104 are used to form a full-wave center-tapped rectifier while also functioning as part of the bridge rectifier. The fourth secondary winding is a 490-volt, rms, winding which powers a full-wave voltage-doubler circuit producing -1300 vdc. This circuit uses CR101 and CR102, two silicon diodes.

SECTION IV

INSTALLATION AND OPERATION

1. INSTALLATION.

The SM9310A is designed for mounting in a standard 19-inch rack. It requires 3-1/2 inches of vertical space and will extend 15 inches back into the rack. The rack should be adequately ventilated.

The power cord is permanently connected to the signal monitor and is equipped with a three-pin plug. When used with an appropriate receptacle, the third pin grounds the chassis. For use with a two-pin receptacle, use the adapter supplied with the device.

Using the mating plug supplied, connect a 50-ohm coaxial cable to the SIGNAL INPUT receptacle (see fig. 2-2) and connect the other end of the cable to the signal monitor output from the receiver.

2. OPERATION.

A. Panel Controls. The panel controls (see fig. 2-1) should be used as follows:

(1) The POWER switch applies ac to the equipment and should be turned on several minutes prior to using the equipment in order to allow a thorough warm up.

(2) The GAIN control governs the height of the signal traces and should be set to give the trace sufficient height.

(3) The CENTER FREQ. control can be used to move the trace left or right a certain amount so that the center frequency of the bandwidth to which the receiver is tuned will correspond exactly to the center of the CRT screen. The best way to adjust it is to tune in a signal of known frequency, preferably one with a simple display such as a CW signal, and turn the CENTER FREQ. control until the center of the display falls exactly on the center marker of the screen. If the signal does not stay at the center marker for all positions of the SWEEP WIDTH control, the HORIZ POS control needs readjustment. (See Section V, Subsection 3, paragraph E.)

(4) The SWEEP WIDTH control governs the width of the frequency spectrum which is being viewed on the screen. When searching for signals it is best to leave it at maximum clockwise, which will give maximum width (3 megacycles). Then, as it is desired to narrow down the width to inspect certain signals more closely, this control may be adjusted as desired.

(5) The INTENSITY control should be set to give the trace the desired brightness.

(6) The FOCUS control should be set to give the trace maximum sharpness.

B. Chassis Controls. The chassis controls, which are the SWEEP CAL. WIDTH, HORIZ POS, and VERT POS controls, should not need adjustment during normal use of the device. (For adjustment of these controls see alignment instructions in Section V.) However, the VERT POS and HORIZ POS can be easily checked during normal operation and such should occasionally be done. The procedure is as follows:

(1) Using a very narrow sweep width, tune in a signal and position its pip to the exact center of the base line.

(2) The pip should rest slightly above the base line or the VERT POS control needs adjustment.

(3) Increase the sweep width to maximum. If the signal pip does not remain at center, the HORIZ POS control needs adjustment.

C. <u>Interpretation of Signals</u>. The following are some guides to interpreting the signal patterns:

(1) A constant carrier appears as a deflection of fixed height.

(2) An amplitude-modulated signal appears as a deflection of variable height. For example, an MCW signal appears like a CW signal of periodically varying height. If the modulation rate is high, sidebands may appear.

(3) A single-tone-modulated FM signal will appear as a group of spikes corresponding to the center frequency and the sidebands.

(4) Transient disturbances which are periodic, such as automobile ignitions, vibrators, or buzzers, appear as signals moving along the base line; random transients appear as irregular deflections and flashes.

(5) Noise appears as varying irregularities or "grass" along the base line and may sometimes be eliminated by gain reduction.

(6) Image signals, if passed through the receiver, are distinguishable because they move in the opposite direction with respect to normal signals on the screen when the receiver is tuned.

SECTION V

MAINTENANCE

1. GENERAL.

The SM-9310A will give comparatively trouble-free performance. However, should trouble occur, it is important that maintenance be performed by trained technicians familiar with Section III, in which the circuits are described. In addition, they should use Figures 5-1 through 5-6, which show the locations of components; Figure 6-1, the schematic diagram; and Table 2, in which the tube socket voltages are listed.

The SM-9310A presents no special maintenance problems and normally requires no care beyond being kept clean. This is best accomplished by the use of compressed air at not more than 60 psi.

To remove the CRT, first remove the bezel by taking out the four front panel screws. After this the tube can be drawn out of the equipment. If this seems difficult, apply a slight pressure against the center pin of the tube by pushing with a blunt instrument through the center hole of the CRT socket.

The plug-in module can be easily removed by pulling it out of the receptacle into which it is fitted. The numbers on the pins coming out of the module correspond to the numbers indicated on the complete schematic diagram at the points where the connecting leads pass through the dashed lines outlining each module on the schematic.

Field maintenance should be confined to cleaning and replacement of the fuse, tube, or plug-in module. All other maintenance and repair work should be carried on in a well-equipped shop and performed only by trained and experienced personnel.

2. TROUBLESHOOTING.

The greatest percentage of troubles will be caused by failures of the fuse, the tubes, or the diodes. The proper functioning of all these parts should be assured either by test or by replacement with parts known to be good before any further troubleshooting is carried out.

After the above measure has been carried out, initial troubleshooting should be directed toward localizing the problem to a specific portion of the signal monitor. The power supply should always be one of the first circuits suspected, and voltage measurements should be taken to assure its proper functioning before other circuits are suspected.

Once the power supply is known to be operating properly the best means to locate the faulty circuit is to feed in a signal at the input and, using an oscilloscope, trace the signal from point to point through the device. The plug-in module can be easily replaced with a spare known to be good, thus quickly checking the entire sweep generator circuit.

Finally, it is recommended that, even though realignment is not necessary, the procedures for doing so be studied by maintenance personnel. The alignment procedures provide insight into the operation of the device as well as methods for checking its performance.

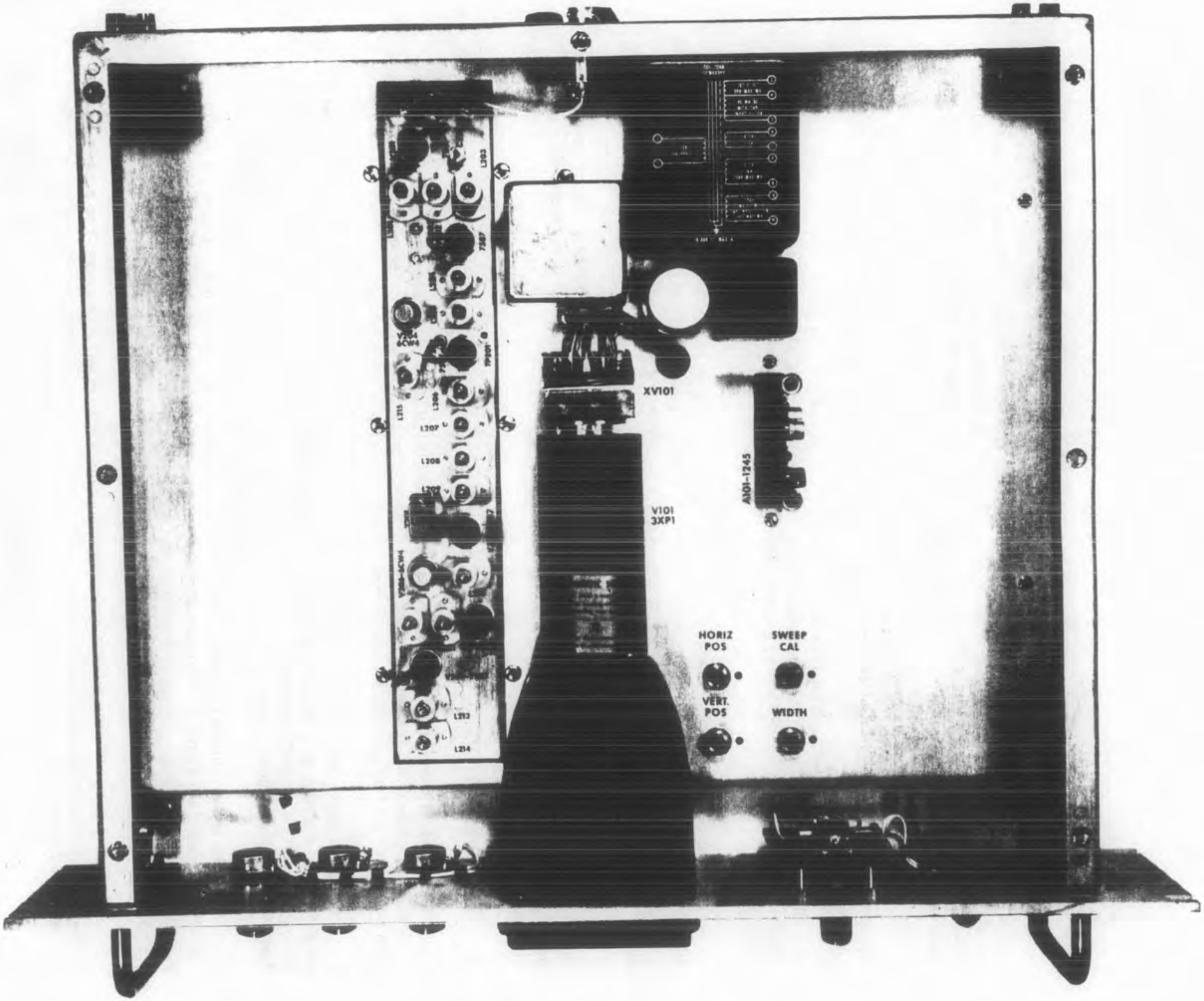

Figure 5-1. SM-9310A, Chassis Top

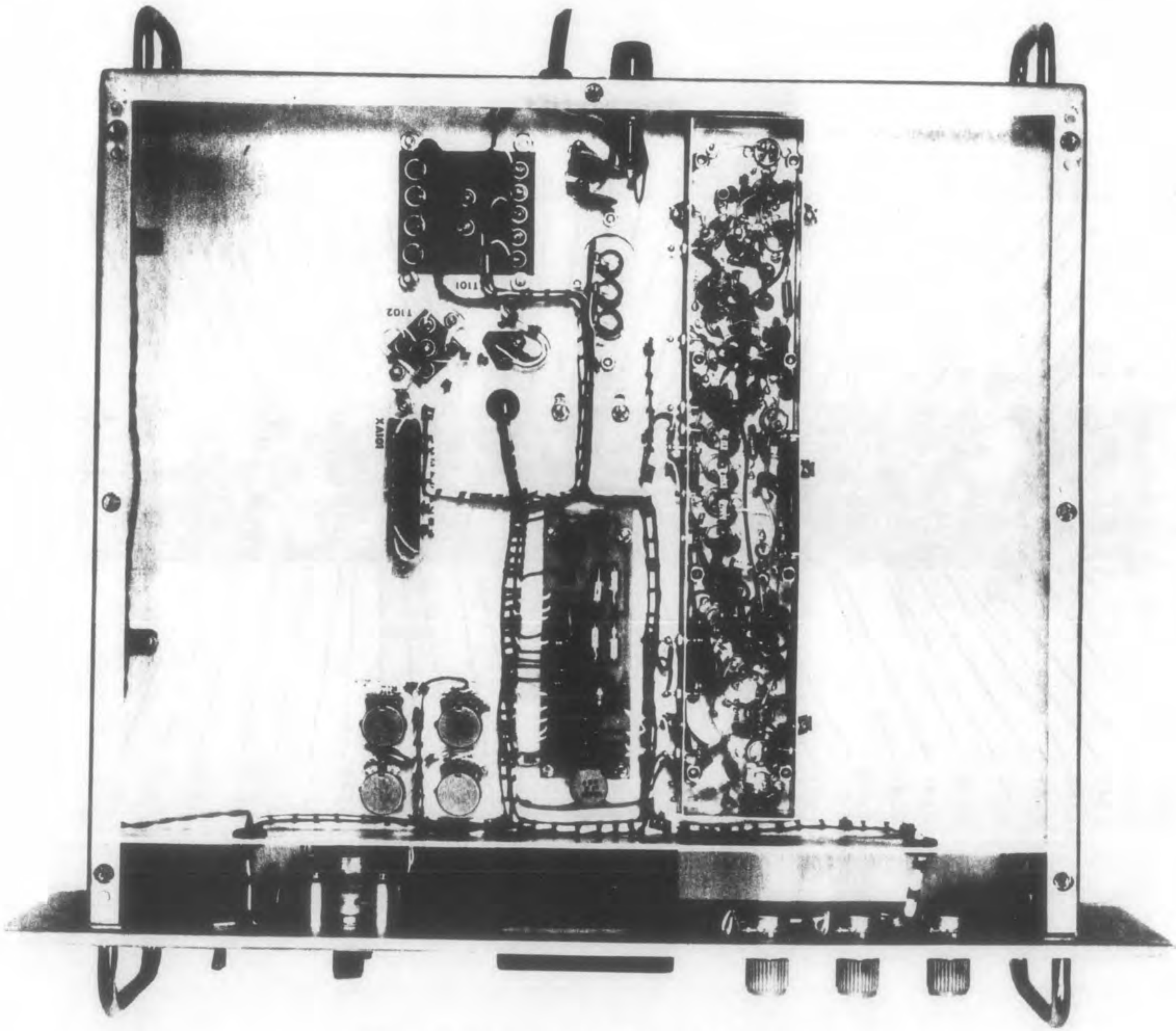

Figure 5-2. SM-9310A, Chassis Bottom

C242 and R229, not used in equipments bearing serial numbers above 140. (See fig. 5-3 and fig. 5-4.)

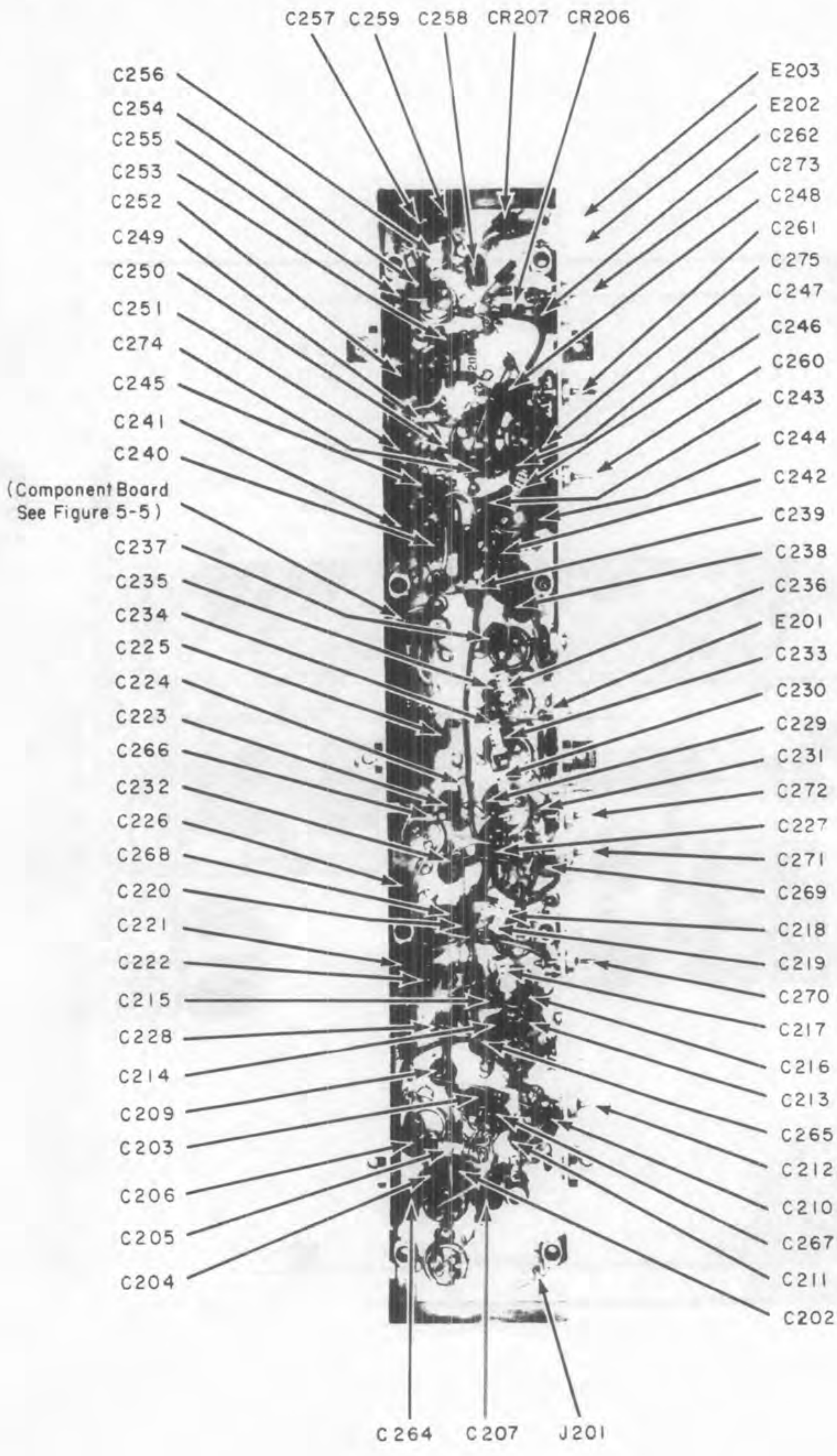

Figure 5-3. SM-9310A, Subassembly Chassis, Capacitor Location

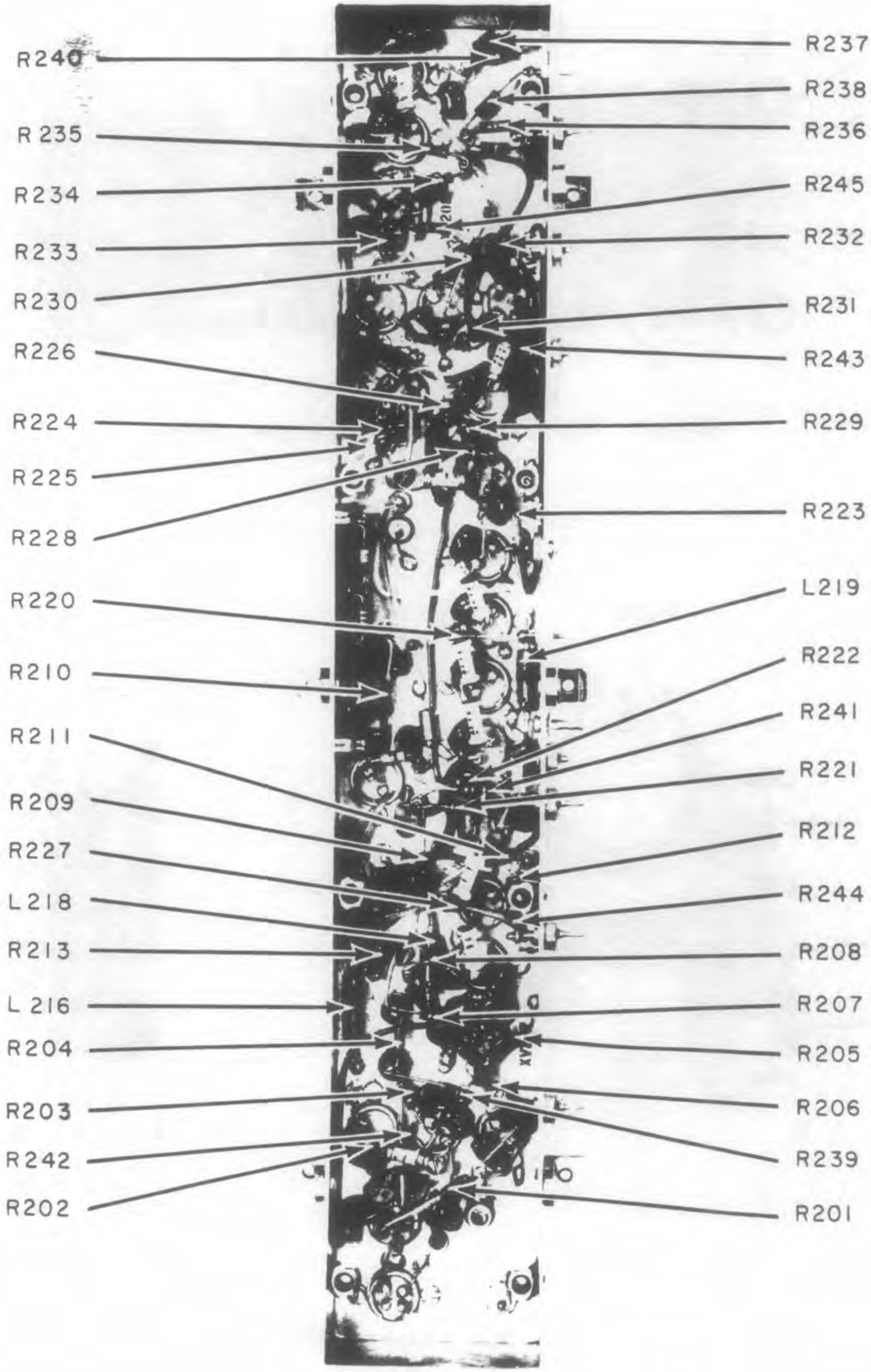

Figure 5-4. SM-9310A, Subassembly Chassis, Resistor and Inductor Location

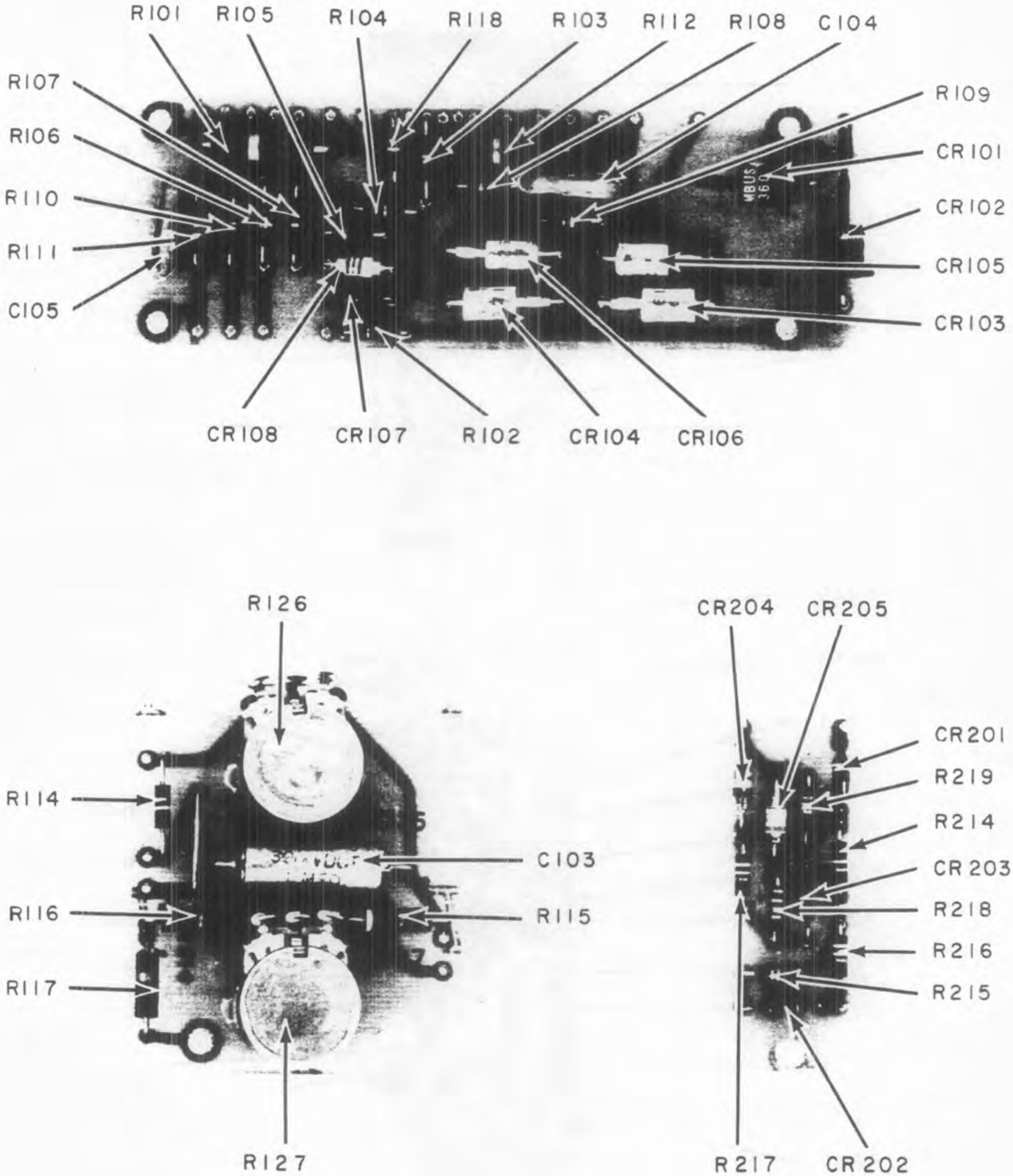

Figure 5-5. SM-9310A, Sweep Linearity Module and Component Boards

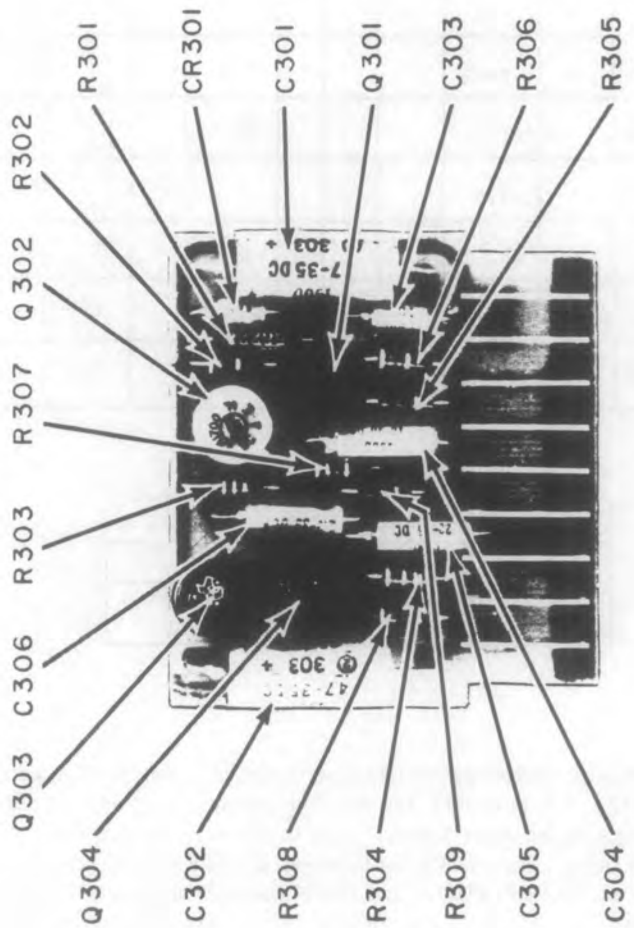

Figure 5-6. SM-9310A, Sawtooth Generator Module

TABLE 2

TUBE SOCKET AND MODULE PIN VOLTAGES, SM-9310A

Symbol	Type	Tube Socket Pin Numbers												Anode	Plate
		1	2	3	4	5	6	7	8	9	10	11	12		
V101	3XP1	8.5	8.2	-1230	-1180	-620	7.0	0	-1240					0	
V201	7587		15.5		0				0.58		0		6.3 vac		82.0
V202	7587		16.0		0				0.58		0		6.3 vac		83.0
V203	7587		17.0		-2.05				0		6.3 vac		0		93.0
V204	6CW4		58.0		*-1.1				0		6.3 vac		0		
V205	7587		13.0		-1.5				0		6.3 vac		0		94.0
V206	6CW4		66.0		*15.0				*28.0		0		6.3 vac		
V207	7587		16.5		-0.47				0.38		0		6.3 vac		92
V208	7587		19.0		0				0.69		0		6.3 vac		87.0

Sawtooth Generator Module Pin Numbers			
1	5	8	9
30.0	0	97.0	6.8 vac

Note: All readings taken with reference to ground, using RCA VoltOhmyst WV-98B. All readings are positive dc unless otherwise noted. All readings taken with signal monitor powered by 115 vac, 60 cps; no signal input; controls set as follows: CENTER FREQ control at mid-position; SWEEP WIDTH and GAIN controls at maximum clockwise; INTENSITY, FOCUS, and HORIZ POS controls as necessary; VERT POS control as needed to position trace on base line.

*Voltages taken with 1 megohm resistor in series with probe.

WARNING

Due to the extremely high voltage present across capacitors C101A and C101B, especial care should always be taken to discharge them prior to carrying out any work on the chassis underside. Do not rely on the bleeder circuit to discharge them. An open circuit may have occurred which leaves these capacitors charged with a lethal voltage.

3. ALIGNMENT.

A. Equipment Required. The following equipments, or their equivalents, are required to perform the complete alignment:

(1) Hewlett-Packard Signal Generator, Type 606A.
(2) Tektronix Oscilloscope, Type 503.
(3) RCA Sweep Generator, Type 59B.
(4) RCA Senior VoltOhmyst, Type WV98B.
(5) Assorted leads and connectors.

B. Control Settings. Begin the alignment by adjusting the controls as follows:

(1) CENTER FREQ. control at midrange.
(2) SWEEP WIDTH control fully counterclockwise.
(3) GAIN control fully clockwise.
(4) INTENSITY control at midrange.
(5) FOCUS control at midrange.
(6) HORIZ POS control at midrange.
(7) VERT POS control fully counterclockwise.
(8) SWEEP CAL control at midrange.
(9) WIDTH control at midrange.

C. 950-kc and 4.3-mc IF Alignments. The alignment of the 950-kc and 4.3-mc IF portions of the equipment is best accomplished by repeating some adjustments for maximum output. This will be done if the following steps are carried out in the order given:

(1) Connect VTVM, set to +15 vdc range, positive lead to E202, negative lead to E203.

(2) Turn on signal monitor power and allow 15-minute warm up.

(3) Adjust VERT POS control for zero dc volts on VTVM.

(4) Remove V206.

(5) Connect signal generator output to pin 4 of V205, frequency adjusted to exactly 950 kc.

(6) Reducing signal generator output as necessary for 10 vdc maximum VTVM reading, adjust, in the order given, L214, L213, L212, L211, and L210 for maximum output.

(7) Replace V206.

(8) Remove V204.

(9) Adjust signal generator output to exactly 4.3 mc.

(10) Connect signal generator output to pin 4 of V203.

(11) Reducing signal generator output as necessary for 10 vdc maximum output reading on VTVM, adjust, in the order given, L209, L208, L207, and L206 for maximum output.

(12) With VTVM and signal generator as in previous step, carefully readjust, in the order given, L214 through L206, for maximum output, continuing process until further adjustments do not increase output.

(13) Disconnect signal generator and VTVM and replace V204.

D. First and Second 21.4-mc Shaping Amplifier Stages Alignment. In order to properly align the 21.4-mc shaping amplifier stages, V201 and V202, it is necessary that the sweep signal appear to the stages with a response shape the same as the signals from the receiver. Thus the sweep generator must be coupled through a receiver with which the signal monitor is normally used. It is strongly recommended that no alignment of this stage be attempted unless considered absolutely necessary, such as after replacement of a component. The procedure is as follows:

(1) Connect vertical input of oscilloscope to TP201.

(2) Connect sweep generator output to pin 4 of V202, using a small capacitor to make the connection.

(3) Remove V204.

(4) Adjust sweep generator to a 5-mc sweep, centered at 21.4-mc, using sufficient output to obtain a good response on oscilloscope.

(5) Adjust L204 and L205 to obtain an overcoupled response with center at 21.4 mc.

(6) Now change the sweep oscillator output (still set for 5-mc sweep centered at 21.4 mc) to the grid of the mixer in the receiver and connect the coaxial lead from the SM output on the receiver to the SIGNAL INPUT of the SM-9310A.

(7) Loosely couple in a 21.4-mc marker signal to the sweep generator output lead.

(8) By alternately adjusting L203, L202, C208, and L201, work until the output from entire shaping amplifier has a response with less than 2-db ripple, 3 mc wide. Some readjustment of L204 and L205 may be needed to obtain the required response.

(9) Remove all equipment.

(10) Replace V204.

(11) Replace all covers on signal monitor.

E. Chassis Top Controls Adjustments. The WIDTH, VERT POS, HORIZ POS, and SWEEP CAL controls should be adjusted with the INTENSITY and FOCUS controls set to give a fine definition of the CRT horizontal trace. The procedure for checking their adjustment and correcting any misadjustment is as follows:

(1) With no signal tuned in, observe the CRT horizontal trace. It should reach across the full width of the screen but at least one end of the trace should be barely visible. If not, adjust the WIDTH control until the trace appears as described. Adjustment of the WIDTH control may necessitate readjustment of the HORIZ POS control.

(2) With no signal tuned in, observe the CRT horizontal trace position relative to the black base line on the screen. The trace should rest slightly above the base line. If not, adjust the VERT POS control until it does.

(3) Using a very narrow sweep width (SWEEP WIDTH control near maximum counterclockwise position) tune in a CW signal and position it accurately at the center of the base line. Then turn the SWEEP WIDTH control to the maximum clockwise position. The signal pip should remain at center. If not, repeat the procedure, adjusting the HORIZ POS control until the pip remains at center.

(4) Apply a CW signal to the input of the unit and position the signal pip accurately at the center of the base line. Adjust for maximum sweep width. Then reduce the frequency of the applied signal precisely 1.50 megacycles. The signal pip should move over to the vertical marker at the right end of the black base line. If not, adjust the SWEEP CAL control until it does. The adjustment should then be checked by increasing the frequency of the applied signal precisely 1.50 megacycles, above the original frequency, in which case the signal pip should fall at the vertical marker at the left end of the base line. If the test signal is applied through a receiver, the pip moves to the right with an increase in frequency and vice versa.

F. Sweep Oscillator Alignment. The alignment of the sweep oscillator is as follows:

(1) Adjust the INTENSITY and FOCUS controls for a fine definition of the trace and check that all chassis top controls are properly adjusted.

(2) Set the SWEEP WIDTH control fully clockwise.

(3) Apply a 21.4-mc calibrated CW signal to the unit, with a signal strength sufficient to give a signal pip which can be easily seen.

(4) While constantly adjusting L215 to keep the signal pip exactly at the center of the base line, slowly decrease the sweep width until the SWEEP WIDTH control has been turned to maximum counterclockwise position.

(5) Leaving the SWEEP WIDTH control at maximum counterclockwise position, adjust L215 for maximum vertical deflection of the trace.

(6) Remove all test equipment.

SECTION VI

PARTS LIST

No JAN or Military Specifications designations are applicable to this list.

Symbol Number	Description and Manufacturer	Units Per Assembly
	MAIN CHASSIS	
A101	ASSEMBLY, SAWTOOTH GENERATOR MODULE: CEI 1245	1
C101A,B	CAPACITOR, DUAL BATHTUB: 0.5 µf-0.5 µf, 1000-1000V, Sprague 90P228	1
C102A,B, C	CAPACITOR, ELECTROLYTIC: 20 µf, 150V; 30 µf, 150V; 40 µf 150V, GE 43F2356B	1
C103	CAPACITOR, CERAMIC DISC: 0.1 µf +80% -20% 100 wvdc, RMC BT	1
C104	CAPACITOR, TANTALUM: 1.0 µf ±20%, Sprague 150D105X0035A0	2
C105	Same as C104	
C106	CAPACITOR, CERAMIC DISC: 0.01 µf 1400 wvdc, RMC Discap	2
C107	Same as C106	
CR101	DIODE, HIGH VOLTAGE RECTIFIER: Columbus 1N2360	2
CR102	Same as CR101	
CR103	DIODE RECTIFIER: Motorola 1N2613	4
CR104	Same as CR103	
CR105	Same as CR103	
CR106	Same as CR103	
CR107	DIODE, ZENER: 56V, Motorola 1N979A	1
CR108	DIODE, ZENER: 30V, 1N972A, P.S.I.	2
DS101	LAMP: 6V, 0.04 amp, T-1-3/4 bulb, mid screw, Chilco 345	1
F101	FUSE: 3/16 amp, Slow-Blow, Littelfuse	1
J101	RECEPTACLE, RECESSED PLUG: Hubbell 7486	1
J102	RECEPTACLE, JACK, BNC: Amphenol UG-1094/U	1
R101	RESISTOR, FIXED, COMPOSITION: 2.7K Ω ±5% 1W, AB GB2725	1
R102	RESISTOR, FIXED, COMPOSITION: 47 Ω ±5% 1/4W, AB CB4705	1
R103	RESISTOR, FIXED, COMPOSITION: 5.1K Ω ±5% 1/2W AB EB5125	1
R104	RESISTOR, FIXED, COMPOSITION: 15K Ω ±5% 1/4W AB EB1535	2
R105	RESISTOR, FIXED, COMPOSITION: 7.5K Ω ±5% 1/4W AB CB7525	1
R106	Same as R104	
R107	RESISTOR, FIXED, COMPOSITION: 5.1K Ω ±5% 1/4W AB CB5125	1
R108	RESISTOR, FIXED, COMPOSITION: 2.2 megohms ±5% 1/4W AB CB2255	1
R109	RESISTOR, FIXED, COMPOSITION: 220K Ω ±5% 1/4W AB CB2245	4

Symbol Number	Description and Manufacturer	Units Per Assembly
R110	RESISTOR, FIXED, COMPOSITION: 1 megohm ±5% 1/4W AB CB1055	2
R111	RESISTOR, FIXED, COMPOSITION: 330K Ω ±5% 1/4W AB CB3345	1
R112	RESISTOR, FIXED, COMPOSITION: 1K Ω 1W ±5%, AB GB1025	1
R113	NOT USED	
R114	RESISTOR, FIXED, COMPOSITION: 100K Ω ±5% 1/4W AB CB1045	6
R115	RESISTOR, FIXED, COMPOSITION: 4.7 meg ohms ±5% 1/2W AB EB4755	1
R116	RESISTOR, FIXED, COMPOSITION: 6.8 megohms ±5% 1/2W AB EB6855	2
R117	Same as R116	
R118	RESISTOR, FIXED, COMPOSITION: 150K Ω ±5% 1/4W AB CB1545	1
R119	NOT USED	
R120	RESISTOR, VARIABLE, COMPOSITION: 50K Ω ±10% 1/2W, CTS RV5LAYSB503A	1
R121	RESISTOR, VARIABLE, COMPOSITION: 10K Ω ±10% 1/2W, CTS KW23043	1
R122	RESISTOR, VARIABLE, COMPOSITION: 100K Ω ±10% 1/2W, CTS RV5LAYSB104A	1
R123	RESISTOR, VARIABLE, COMPOSITION: 500K Ω ±10% 1/2W, CTS RV5LAYSB504A	1
R124	RESISTOR, VARIABLE, COMPOSITION: 2.5K Ω ±10% 1/2W, CTS KW23045	1
R125	RESISTOR, VARIABLE, COMPOSITION: 100K Ω ±10% 1/2W, CTS KW23047	1
R126	RESISTOR, VARIABLE, COMPOSITION: 500K Ω ±10% 1/2W, CTS KW23044	1
R127	RESISTOR, VARIABLE, COMPOSITION: 2.5 megohms ±20% 1/2W, CTS KW23046	1
R128	RESISTOR, VARIABLE, COMPOSITION: 25K Ω ±10% 1/2W, CTS RV5LAYSB253A	1
S101	SWITCH, TOGGLE, SPST: Cutler-Hammer 8280-K16	1
T101	TRANSFORMER, POWER: CEI 1248	1
T102	TRANSFORMER, HORIZONTAL DEFLECTION: CEI 1247	1
V101	TUBE, ELECTRON, CRT: Waterman 3XP1	1
	SUBCHASSIS	
C201	NOT USED	
C202	CAPACITOR, CERAMIC, DISC: 1000 μμf ±20%, Sprague 40C214A	12
C203	Same as C202	
C204	CAPACITOR, CERAMIC, DISC: 470 μμf ±20% 1000 wvdc, Sprague 40C209A	1
C205	CAPACITOR, CERAMIC TUBULAR: 1.0 μμf ±0.1 μμf, Erie NPOA	2
C206	CAPACITOR, DIPPED MICA: 18 μμf ±5% 500 wvdc, Arco DM10-180J	4
C207	CAPACITOR, CERAMIC TUBULAR: 12 μμf ±5%, Arco DM10-120J	3
C208	CAPACITOR, CERAMIC, VARIABLE: 2-12 μμf, CTC CST-50	1
C209	CAPACITOR, CERAMIC, STANDOFF: 1000 μμf, AB SS5A-102W	3

Symbol Number	Description and Manufacturer	Units Per Assembly
C210	Same as C207	
C211	Same as C207	
C212	CAPACITOR, CERAMIC, FEEDTHRU: 1000 μμf GMV, AB FA5C-102W	7
C213	Same as C202	
C214	Same as C202	
C215	Same as C202	
C216	CAPACITOR, DIPPED MICA: 15 μμf ±5% 500 vdc, Arco DM10-150J	3
C217	CAPACITOR, CERAMIC, TUBULAR: 5.6 μμf ±0.25 μμf, Erie NPOA	1
C218	Same as C216	
C219	CAPACITOR, CERAMIC, TUBULAR: 4.7 μμf, Erie NPOA	2
C220	CAPACITOR, DIPPED MICA: 10 μμf ±5%, Arco DM10-100J	1
C221	CAPACITOR, DIPPED MICA: 68 μμf ±5%, Arco DM10-680J	1
C222	CAPACITOR, DIPPED MICA: 33 μμf ±5%, Arco DM10-330J	2
C223	CAPACITOR, CERAMIC DISC: 0.01 μf ±20% 200 wvdc, Sprague 19C233	10
C224	CAPACITOR, TANTALUM: 0.47 μf ±20% 20V, Sprague 150D474X0020A2	1
C225	Same as C216	
C226	Same as C222	
C227	Same as C202	
C228	Same as C209	
C229	CAPACITOR, DIPPED MICA: 82 μμf ±5% 500 wvdc, Arco DM10-820J	4
C230	CAPACITOR, CERAMIC TUBULAR: 0.68 μμf ±0.1 μμf, Erie NPOA	3
C231	Same as C223	
C232	Same as C209	
C233	Same as C229	
C234	Same as C230	
C235	Same as C229	
C236	Same as C230	
C237	Same as C229	
C238	Same as C206	
C239	CAPACITOR, CERAMIC TUBULAR: 1 μμf ±0.1 μμf, Erie NPOA	1
C240	CAPACITOR, DIPPED MICA: 22 μμf ±5%, Arco DM10-22[illegible]	2
C241	Same as C240	
C242	NOT USED	

Symbol Number	Description and Manufacturer	Units Per Assembly
C243	CAPACITOR, DIPPED MICA: 220 $\mu\mu f$ ±5%, Arco DM10-221J	5
C244	Same as C223	
C245	Same as C202	
C246	Same as C206	
C247	Same as C223	
C248	Same as C223	
C249	CAPACITOR, CERAMIC TUBULAR: 2 $\mu\mu f$ ±0.25 $\mu\mu f$, Erie NPOA	1
C250	Same as C243	
C251	Same as C243	
C252	Same as C223	
C253	Same as C223	
C254	Same as C243	
C255	Same as C223	
C256	Same as C219	
C257	Same as C243	
C258	CAPACITOR, DIPPED MICA: 47 $\mu\mu f$ ±5%, Arco DM10-470J	2
C259	Same as C258	
C260	Same as C212	
C261	Same as C212	
C262	Same as C223	
C263	NOT USED	
C264	Same as C202	
C265	Same as C202	
C266	CAPACITOR, VARICAP: PSI V27E	1
C267	Same as C216	
C268	Same as C202	
C269	Same as C202	
C270	Same as C212	
C271	Same as C212	
C272	Same as C212	
C273	Same as C212	
C274	Same as C223	
C275	Same as C202	

Symbol Number	Description and Manufacturer	Units Per Assembly
CR201	DIODE: Texas Inst. 1N462	3
CR202	Same as CR201	
CR203	Same as CR201	
CR204	DIODE: PSI 1N746	1
CR205	DIODE: PSI 1N749	1
CR206	DIODE, GERMANIUM: Raytheon 1N198A	2
CR207	Same as CR206	
J201	RECEPTACLE, JACK: Amphenol 27-3	1
L201	COIL, VARIABLE: CEI 1472-3	5
L202	Same as L201	
L203	Same as L201	
L204	Same as L201	
L205	Same as L201	
L206	COIL, VARIABLE: CEI 1472-5	4
L207	Same as L206	
L208	Same as L206	
L209	Same as L206	
L210	COIL, VARIABLE: CEI 1472-8	5
L211	Same as L210	
L212	Same as L210	
L213	Same as L210	
L214	Same as L210	
L215	COIL, VARIABLE: CEI 1472-4	1
L216	COIL, FIXED: 9.5 μf, CEI 1131-18	1
L217	NOT USED	
L218	COIL, FIXED: 2.7 μh, CEI 1131-16	2
L219	Same as L218	
P201	PLUG, CABLE: Amphenol 27-1	1
R201	RESISTOR, FIXED, COMPOSITION: 30 Ω ±5% 1/4W, AB CB3005	2
R202	Same as R114	
R203	RESISTOR, FIXED, COMPOSITION: 4.7K Ω ±5% 1/4W, AB CB4725	6
R204	RESISTOR, FIXED, COMPOSITION: 100 Ω, ±5% 1/4W, AB CB1015	2
R205	RESISTOR, FIXED, COMPOSITION: 2K Ω ±5% 1/4W, AB CB2025	1

Symbol Number	Description and Manufacturer	Units Per Assembly
R206	Same as R201	
R207	Same as R114	
R208	Same as R203	
R209	Same as R204	
R210	RESISTOR, FIXED, COMPOSITION: 27K Ω ±5% 1/4W, AB CB2735	1
R211	RESISTOR, FIXED, COMPOSITION: 47K Ω 1/4W ±5%, AB CB4735	3
R212	Same as R211	
R213	RESISTOR, FIXED, COMPOSITION: 47K Ω ±5% 1/4W, AB CB4735	5
R214*	RESISTOR, FIXED, COMPOSITION: 150K Ω ±5% 1/4W, AB CB1545	1
R215	RESISTOR, FIXED, COMPOSITION: 680K Ω ±5% 1/4W, AB CB6845	1
R216	RESISTOR, FIXED, COMPOSITION: 240K Ω ±5% 1/4W, AB CB2445	2
R217	Same as R216	
R218	RESISTOR, FIXED, COMPOSITION: 33K Ω ±5% 1/4W, AB CB3335	1
R219	RESISTOR, FIXED, COMPOSITION: 130K Ω ±5% 1/4W, AB CB1345	1
R220	RESISTOR, FIXED, COMPOSITION: 1K Ω ±5% 1/4W, AB CB1025	2
R221	RESISTOR, FIXED, COMPOSITION: 270K Ω ±5% 1/4W, AB CB2745	1
R222	Same as R203	
R223	Same as R110	
R224	Same as R114	
R225	Same as R213	
R226	Same as R213	
R227	Same as R220	
R228	Same as R211	
R229	NOT USED	
R230	Same as R203	
R231	RESISTOR, FIXED, COMPOSITION: 220 Ω ±5% 1/4W, AB CB2215	2
R232	Same as R109	
R233	Same as R231	
R234	Same as R114	
R235	Same as R203	
R236	RESISTOR, FIXED, COMPOSITION: 330K Ω ±5% 1/4W, AB CB3345	3
R237	Same as R236	
R238	Same as R109	

* Value listed is nominal and is subject to variation from unit to unit.

Symbol Number	Description and Manufacturer	Units Per Assembly
R239	RESISTOR, FIXED, COMPOSITION: 110K Ω ±5% 1/4W, AB CB1145	1
R240	Same as R109	
R241	Same as R213	
R242	Same as R114	
R243	Same as R110	
R244	RESISTOR, FIXED, COMPOSITION: 3.9K Ω ±5% 1/4W, AB CB3925	1
R245	Same as R213	
T201	TRANSFORMER, INPUT: CEI 1126	1
TP201	TEST POINT: Taurus TI-6	1
V201	TUBE, ELECTRON: Nuvistor, tetrode, RCA 7587	5
V202	Same as V201	
V203	Same as V201	
V204	TUBE, ELECTRON: Nuvistor, triode, RCA 6CW4	3
V205	Same as V204	
V206	Same as V204	
V207	Same as V201	
V208	Same as V201	
Y201	CRYSTAL, QUARTZ: 5.25 mc, Piezo CR-18/U	1
	SAWTOOTH GENERATOR MODULE	
C301	CAPACITOR, TANTALUM: 47 µf ±20% 35V, Sprague 150D476X0035S0	2
C302	Same as C301	
C303	CAPACITOR, TANTALUM: 1 µf ±10% 35V, Sprague 150D105X9035A0	1
C304	CAPACITOR, TANTALUM: 10 µf ±20% 20V, Sprague 150D106X0020B0	1
C305	CAPACITOR, TANTALUM: 22 µf ±20% 15V, Sprague 150D226X0015B0	1
C306	CAPACITOR, TANTALUM: 2.2 µf ±10% 35V, Sprague 150D225X9035B0	1
CR301	Same as CR108	
Q301	TRANSISTOR, SILICON, UNIJUNCTION: GE 2N489	1
Q302	TRANSISTOR, SILICON: RCA 2N697	1
Q303	TRANSISTOR, SILICON: Texas Inst. 2N335	2
Q304	Same as Q303	
R301	RESISTOR, FIXED CARBON FILM: 61.9K ±1% 1/8W, Texas Inst. CDM 1/8	1
R302	RESISTOR, FIXED, COMPOSITION: 470 Ω ±5% 1/4W, AB CB4715	2
R303	RESISTOR, FIXED, COMPOSITION: 24K ±5% 1/4W, AB CB2435	1

Symbol Number	Description and Manufacturer	Units Per Assembly
R304	RESISTOR, FIXED, COMPOSITION: 56K ±5% 1/4W, AB CB5635	1
R305	RESISTOR, FIXED, COMPOSITION: 10 Ω ±5% 1/4W, AB CB1005	1
R306	Same as R302	
R307	RESISTOR, FIXED, COMPOSITION: 330 Ω ±5% 1/4W, AB CB3315	1
R308	Same as R203	
R309	RESISTOR, FIXED, COMPOSITION: 2.2K ±5% 1/4W, AB CB2225	1

4. LIST OF MANUFACTURERS.

Abbreviation	Name and Address
AB	Allen Bradley Company 136 W. Greenfield Ave. Milwaukee, Wisconsin
Aerovox	Aerovox Corp. 740 Belleville Ave. New Bedford, Mass.
Amphenol	Amphenol-Borg Electronics Corp. 1830 South 54th Avenue Chicago, Illinois
Arco	Arco Electronics, Inc. Community Drive Great Neck, New York
CEI	Communication Electronics, Inc. 4900 Hampden Lane Bethesda 14, Maryland
Columbus	Columbus Electronics Corp. 1000 Saw Mill River Road Yonkers, New York
Cornish	Cornish Wire Company 50 Church Street New York, New York
CTC	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, Massachusetts
CTS	Chicago Telephone Supply Corp. 1142 W. Beardsley Ave. Elkhart, Indiana
Cutler-Hammer	Cutler-Hammer, Inc. 321 North 12th Street Milwaukee, Wisconsin
Erie	Erie Resistor Corporation Erie, Pennsylvania

Abbreviation	Name and Address
GE	General Electric Company 777 14th Street, N.W. Washington, D.C.
Littelfuse	Littelfuse, Inc. 1865 Miner Street Des Plaines, Illinois
Microdot	Microdot, Inc. 220 Pasadena Avenue South Pasadena, California
Motorola	Motorola Semiconductor Products, Inc. 5005 East McDowell Road Phoenix, Arizona
Piezo	Piezo Crystal Company Carlisle, Pennsylvania
P.S.I	Pacific Semiconductors, Inc. 10451 W. Jefferson Boulevard Culver City, California
Radio Materials Company	Radio Materials Company 4242 West Bryn Mawr Ave. Chicago 46, Illinois
Raytheon	Raytheon Company 100 Roesler Road Glen Bernie, Md.
RCA	Radio Corporation of America Electron Tube Division 415 South Fifth Street Harrison, New Jersey
Sprague	Sprague Electric Company 91 Marshall Street North Adams, Mass.
Taurus	Taurus Corp. Academy Hill Lambertville, New Jersey

Abbreviation	Name and Address
TI	Texas Instruments, Inc. 6000 Lemmon Ave. Dallas, Texas
Waterman	Waterman Products Co. 2445-63 Emerald Street Philadelphia, Pa.
Chilco	Chicago Miniature Lamp Works 1510 N. Ogden Avenue, Chicago, Illinois

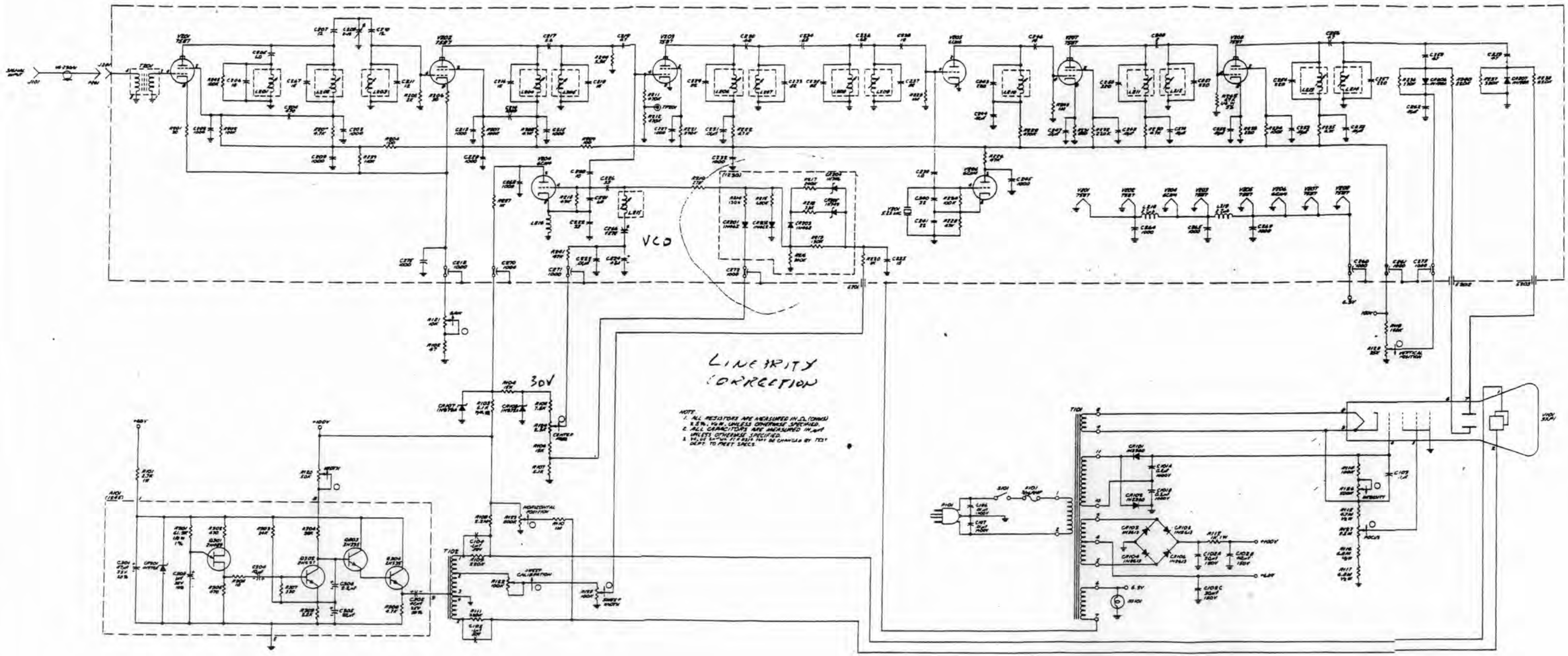

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Figure 6-1. Type SM-9310A Signal Monitor, Schematic Diagram

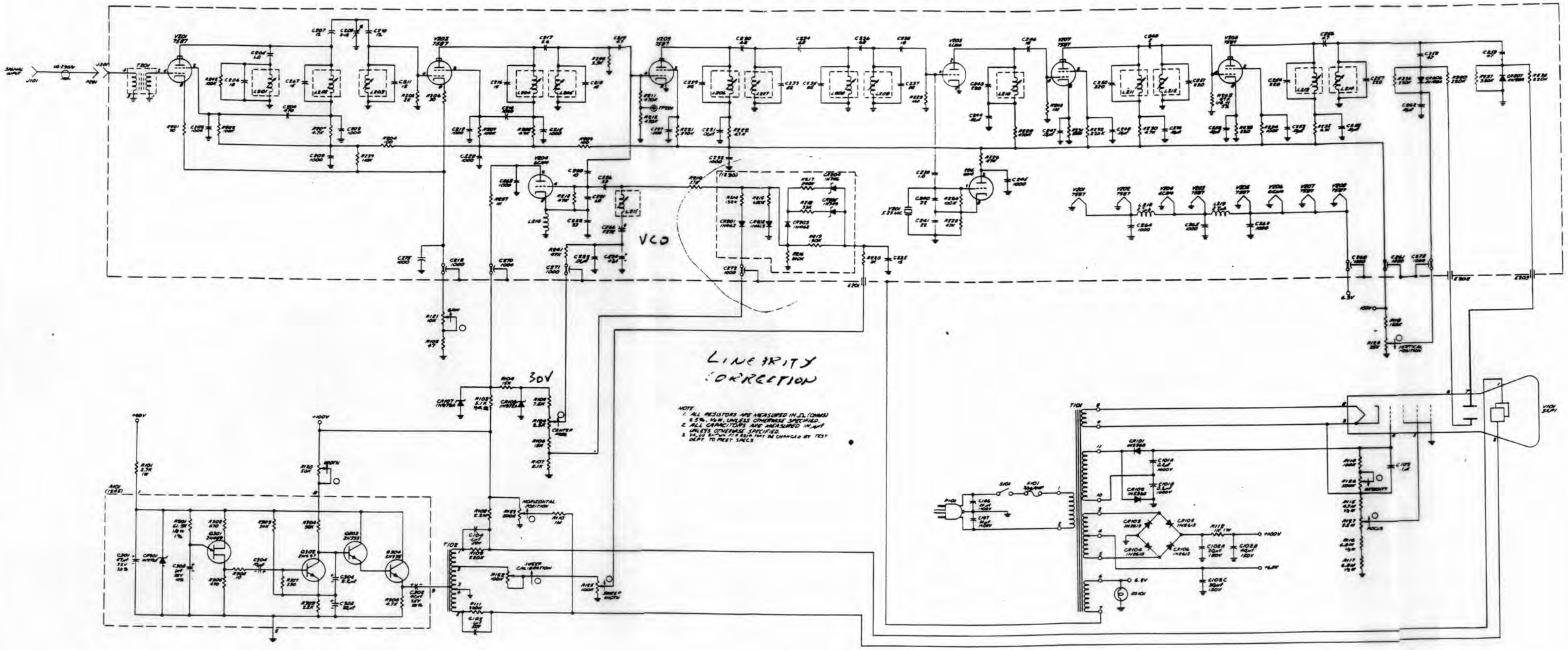

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Figure 6-1. Type SM-9310A Signal Monitor, Schematic Diagram