OPERATING AND MAINTENANCE

INSTRUCTIONS

for

TYPE 1181-A FREQUENCY-DEVIATION MONITOR

F. C. C. APPROVAL NO. 1467

GENERAL RADIO COMPANY

CAMBRIDGE 39 MASSACHUSETTS

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FORM 643-E
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SPECIFICATIONS

Frequency Range: ±30 cycles.

Accuracy: When received, ±10 parts in 10^8; adjustments are provided to bring the reading into agreement with monitoring station measurements.

Vacuum Tubes: The following tubes are required and are supplied with the instrument:

3 — Type 6SJ7	1 — Type 6V6-GT
2 — Type 6AC7	1 — Type 5V4-G
2 — Type 6H6	1 — Type 6B4-G
2 — Type 6SQ7-GT	1 — Type OC3

1 — Type 2050

Frequency Stability: ±1 part in one million.

R-F Sensitivity: 100 millivolts at INPUT terminals.

R-F Input: May be modulated or unmodulated.

Input Circuit: High-impedance input circuit. Short, single-wire antenna is adequate for most installations.

Accessories Supplied: Type 376-L Quartz Plate; power-connecting cord; spare fuses and pilot lights; spare fusible links; thermostat and thermometer (60°C); plug for remote meter.

Power Supply: 105 to 125 or 210 to 250 volts, 50 to 60 cycles.

Power Input: 125 watts, maximum.

Mounting: Standard 19-inch relay-rack mounting.

Dimensions: 19" wide x 15¾" high x 12⅞" deep.

Net Weight: 65 pounds.

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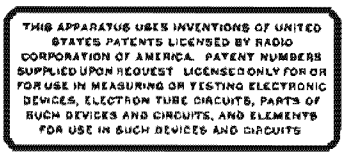
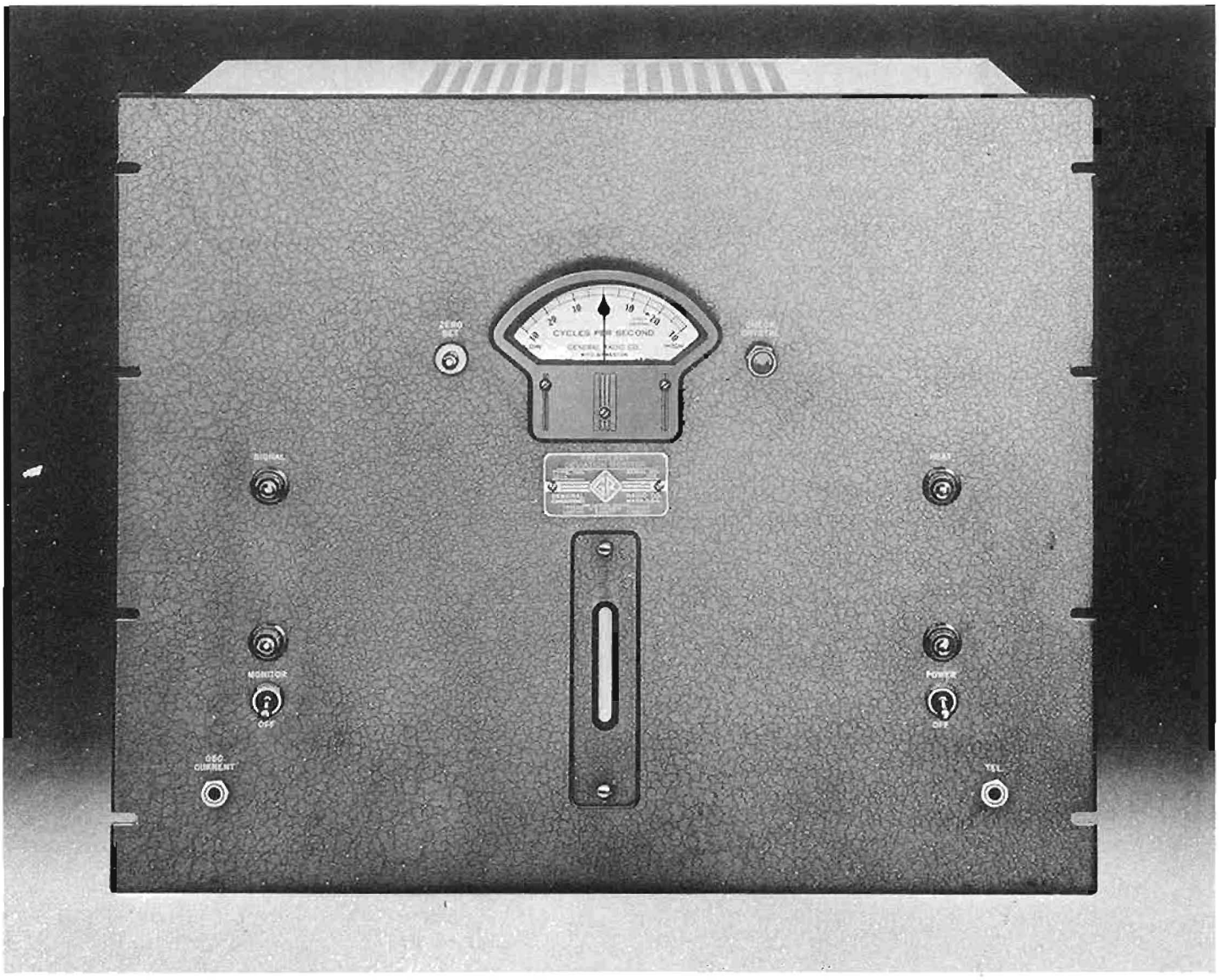
This instrument is manufactured and sold under the following United States Patents:

1,944,315 1,967,185

2,012,497 2,362,503

all patents and patent applications of Dr. G. W. Pierce pertaining to piezo-electric crystals and their associated circuits.





Panel view of Type 1181-A Frequency-Deviation Monitor

OPERATING INSTRUCTIONS
FOR
TYPE 1181-A
FREQUENCY-DEVIATION MONITOR

The General Radio Type 1181-A Frequency Deviation Monitor has been designed for use by broadcasting stations operating in the 500- to 2000-kilocycle frequency band to enable them to comply with the frequency tolerance specification of the Federal Communications Commission and of similar commissions in other countries. This monitor reads frequency deviations directly in cycles and meets the specifications of the F.C.C. for broadcast frequency monitors.

SECTION 1.0
INSTALLATION

1.1 MOUNTING

The Type 1181-A Frequency-Deviation Monitor is designed for mounting in a standard 19-inch relay rack. The relay rack should be grounded; if no rack is used, the monitor case should be grounded. The "G" binding post of the R-F INPUT can be used for grounding the instrument.

Do not mount the monitor in relay racks or cabinet racks above power rectifiers or other equipment generating large amounts of heat. Improper functioning of the temperature-control system will result.

The General Radio Company will assume no responsibility for improper operation of the monitor or of the temperature control system if the installation is made so that the temperature of the air surrounding the monitor is more than 120°F.

1.2 QUARTZ PLATE

The quartz plate is shipped in place in the temperature-controlled heater box and should be ready for operation when the instrument is received. To check whether the quartz plate is properly plugged into the jack mountings in the heater box, remove the wooden cover of the heater box at the rear of the instrument. Then open the cover of the inner aluminum case which is held by two slotted thumb screws, one on each side.

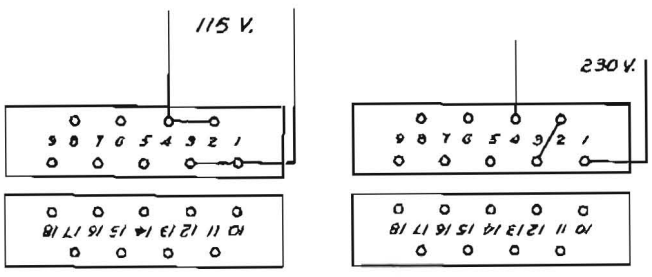


Figure 1. Power transformer connections for 115-volt and 230-volt supply. Terminal numbers are the same for round terminal plates.

1.3 THERMOMETER, THERMOSTAT, AND TUBES

The thermometer is packed separately in the rear compartment of the instrument and should be unpacked carefully and placed in the thermometer hole behind the window on the front panel.

All tubes and the thermostat are shipped in place, so it is only necessary to check that they are properly seated in their sockets.

1.4 COUPLING TO TRANSMITTER

Coupling to the transmitter need not be very close. A very short single-wire antenna in the room should pick up sufficient signal with which to operate the monitor. About 100 millivolts is required. The antenna is connected to the ungrounded R-F INPUT terminal at the left rear of the instrument. The standard RMA monitoring-output connection can be used on transmitters so equipped. A 10:1 attenuator should be inserted when this connection is used.

1.5 POWER SUPPLY

A power cord is supplied with the instrument for connecting it to the a-c power source. The instrument is designed for operation on 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles. The power source for which the instrument is wired is indicated on a nameplate located

beside the power input receptacle at the rear of the instrument.

If, for any reason, the alternate voltage supply is to be used, the connections to *two* transformers will have to be changed. The terminal plates of the two transformers are shown at the upper left of Figure 8. For 105- to 125-volt operation, terminals 1 and 3 as well as 2 and 4 should be connected together *on each transformer*, and for 210- to 250-volt operation only terminals 2 and 3 should be connected together. These connections are shown in Figure 1. Connections of cabled wires should not be altered in any way. The fuses should be changed in accordance with Figure 2, and the power supply nameplate which is reversible, should be turned over.

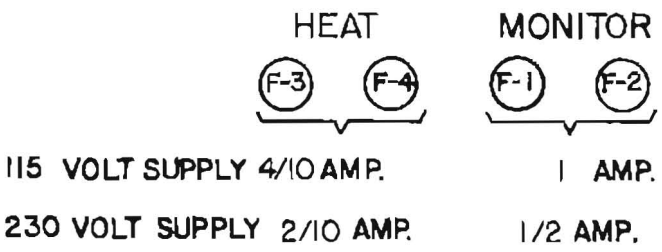


Figure 2 Fuse ratings for 115-volt and 230-volt supply.

1.6 EXTERNAL METER

An external meter can be connected in series with the panel meter by means of the multipoint connector at the rear of the monitor. The jumper should be removed from terminals 2 and 3 of the plug supplied and the external meter connected to terminals 1 and 3. Any d-c meter having a sensitivity of 100-0-100 microamperes can be used. The standard type mounted on the instrument panel is available separately from the factory.

SECTION 2.0
OPERATION

2.1 TEMPERATURE CONTROL

Throw the POWER switch ON and the MONITOR switch to OFF. The red HEAT bull's-eye should light immediately, as well as the red one at the lower right of the panel.

To test the operation of the heat-control circuit, short-circuit the thermostat temporarily. The relay should open and the red HEAT lamp go out. A fusible link is provided which melts at 72°C. and opens the heater circuit if the temperature becomes excessively high due to relay or thermostat failure.

The heat will remain on for about a half an hour before the thermostat begins to operate. After about an hour, the thermostat will cycle so that the heat is on (indicator lamp lighted) about 50 seconds and heat off (indicator lamp out) about 160 seconds at ordinary room temperatures (70° to 80° F). A period of about four hours is required before the inner temperature reaches its final value. When proper operating temperature has been reached, the thermometer should read 60.0 ± 0.3°C.

2.2 CRYSTAL OSCILLATOR

Adjust the screw on meter case until the meter reads zero. Throw the MONITOR switch ON and allow about a minute for the tubes to stabilize. Depress the CHECK CRYSTAL button to the right of the meter on the panel. A deflection of the meter to the right indicates that the crystal is oscillating. This deflection should be at least to the red line at 15 on the meter. If the meter reads less than 15, see Section 7.0 in the Service and Maintenance Notes.

A jack, engraved OSC. CURRENT, is provided at the lower left-hand corner of the panel. A 0-25 ma d-c meter plugged into this jack will indicate the cathode current of the crystal oscillator. The meter will read between 1 and 3 milliamperes when the crystal is oscillating and approximately 5 milliamperes when the crystal is not oscillating.

2.3 INPUT SIGNAL LEVEL

The red SIGNAL pilot lamp and the meter lamps are connected in the same circuit and the meter should be at full brilliance. If they are very dim or flicker badly, insufficient signal is being picked up from the transmitter, the transmitter is more than 300 cycles off frequency, or the crystal has not reached normal operating temperature. About 100 millivolts at the input terminals will be sufficient for proper operation. The instrument will operate properly over a range of 0.25 to 2.0 volts carrier input. If single-frequency modulation at multiples of 60 cycles is used, the lamps may flicker at a low frequency because the modulation frequency is beating with the power-line frequency. Normal program modulation will not cause the lamps to flicker, unless the carrier input signal is too low.

2.4 METER READING AND TRANSMITTER DEVIATION

If the transmitter frequency is within ±30 cycles of its assigned value, the meter will indicate the frequency deviation in cycles per second. Should the transmitter be more than ±30 cycles and less than about ±360 cycles off

frequency, the meter pointer will be off scale. If the station is more than ±360 cycles off the assigned frequency, the meter may read on scale, but the indication will be false. *The station should be adjusted as closely as possible before using the deviation meter.* Should there be any doubt as to whether or not the station is approximately correct, i.e. within 30 cycles, plug a pair of phones into the jack marked TEL. on the right of the panel. The tone heard should be 1000 ± 30 cycles. This may be checked against a 1000-cycle tuning fork or a calibrated audio oscillator.

A ZERO SET adjustment is provided under a snap button on the panel located near the meter. By means of this adjustment the point of zero frequency deviation, as indicated by the meter, can be changed. Slight differences between operating and calibrating temperatures, rough handling in shipment, or slight aging effects may shift the operating frequency of the quartz crystal in the monitoring oscillator. The ZERO SET permits the operator to bring the indication into exact agreement with measurements made by government or commercial monitoring stations.*

2.5 STAND BY

When the transmitter is not operating, the frequency monitor should be turned off by throwing the MONITOR switch to OFF. This will allow the tube circuits to be shut off without disturbing the operation of the heat-control system on the crystal oscillator. The switch marked POWER controls the entire instrument and should not be used unless the unit is to be taken out of operation for an extended period.

* *Example:* Suppose the average of a number of measurements indicates that the station frequency is 10 cycles high. The ZERO SET is adjusted until the meter reads 10 cycles high, which makes the monitor agree exactly with the measurements. If the monitor is then left alone, and the station frequency adjusted until the deviation meter reads zero, the station will be exactly on frequency as determined by the agency making the measurements.

SECTION 3.0
CIRCUIT DESCRIPTION

3.1 PRINCIPLE OF OPERATION

A functional block diagram of the Type 1181-A Frequency-Deviation Monitor is shown in Figure 3. The standard of frequency against which the transmitter is monitored is a piezo-electric oscillator whose frequency differs from the assigned channel frequency of the transmitter by exactly 1000 cycles per second. A voltage derived from this oscillator and a voltage of the transmitter carrier frequency are applied to a vacuum-tube detector where the difference frequency (1000 cycles plus or minus the deviation of the transmitter) is produced. This audio frequency is then amplified and passed through a clipper stage to produce a square wave of constant peak-to-peak amplitude.

The square wave is then fed to a frequency meter which reads zero (mid-scale) when the beat frequency is exactly 1000 cycles. It indicates the deviation from 1000 cycles over a range of ±30 cycles. It is calibrated to read directly in cycles deviation.

The voltage from the transmitter can be either modulated or unmodulated, since modulation will have no effect upon the operation of the instrument.

The monitor uses a Type 376-L Quartz Plate to control the frequency of the monitoring oscillator.

3.2 CIRCUIT DETAILS

An elementary schematic diagram of the Type 1181-A Frequency-Deviation Monitor is shown in Figure 4 and a complete circuit diagram in Figure 5.

The crystal used in this monitor has a low temperature coefficient of frequency (less than 3 parts per million per degree Centigrade over the normal operating range). The plate is mounted in a dust-proof, air-gap type holder which imposes very little restraint upon its vibration. This assembly is mounted in a temperature-controlled chamber operating at 60°C and is thermostatically controlled.

The crystal-controlled oscillator* is of a type developed in the General Radio laboratories specifically for use in standard frequency oscillators where a high degree of stability and reliability are required. It differs from older types

* U. S. Patent No. 2,013,497.

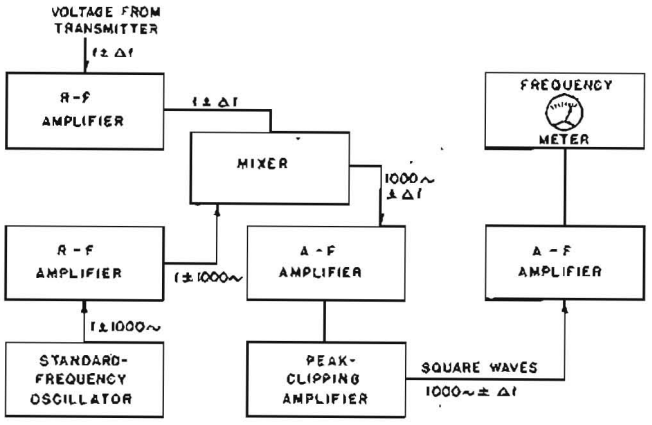


Figure 3. Functional block diagram of the monitor.

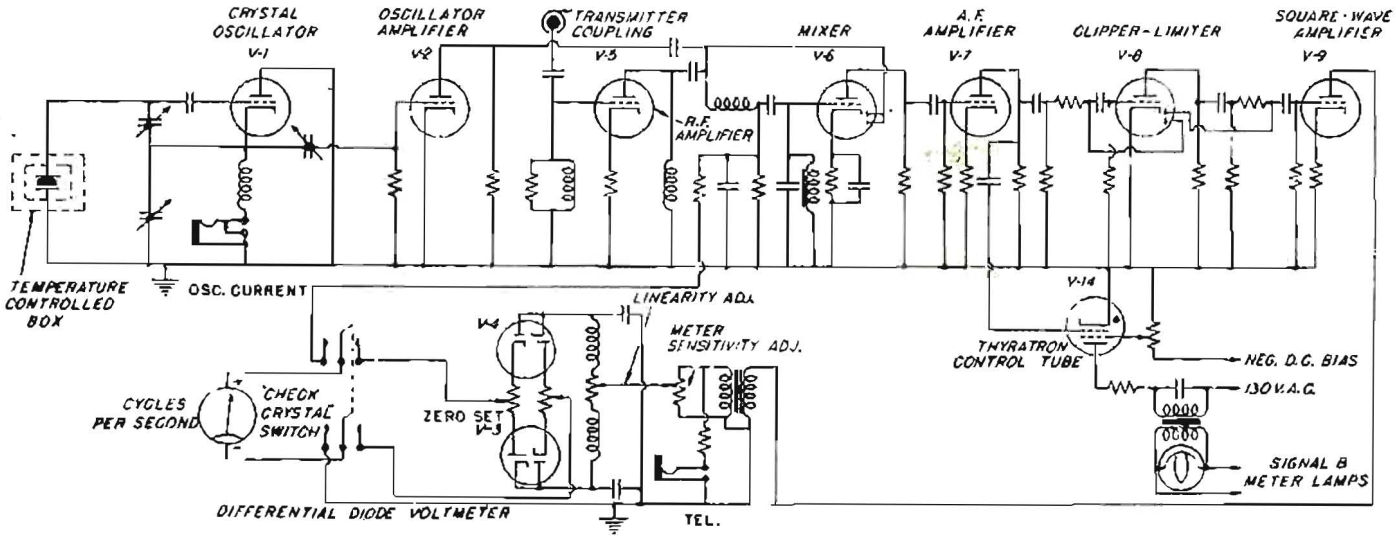


Figure 4. Elementary schematic diagram.

of crystal oscillators in that no inductance coil is used in the frequency-determining system. The crystal operates much nearer to its true resonant frequency than is possible in older circuits, and consequently much better stability is obtained.

A jack, J-1, is mounted on the panel to provide a means of inserting a milliammeter to check the plate current of the oscillator tube.

An r-f amplifier which increases the input sensitivity couples the transmitter input to the mixer and detector and also acts as a buffer amplifier.

The diode detector followed by a stage of audio-frequency amplification is used to produce a beat note resulting from the difference in frequency between the motoring oscillator frequency and the transmitter frequency. The operating conditions are given in Table I.

TABLE I

Crystal Frequency	*Transmitter Deviation*	*Audio Beat Produced*	*Meter Reads*†
Low Side*	−30	970	−30
of Carrier	−20	980	−20
or	0	1000	0
$f_0 - 1000$	+20	1020	+20
	+30	1030	+30
High Side	−30	1030	−30
of Carrier	−20	1020	−20
or	0	1000	0
$f_0 + 1000$	+20	980	+20
	+30	970	+30

* This is the general case.

† Polarity of d-c indicating meter arranged at factory to give proper direction to meter reading.

To check the amplitude of the monitoring-oscillator output voltage, the diode detector current is indicated on the panel meter when the CRYSTAL CHECK switch is depressed. A reading above the red line on the meter scale indicates normal operation. The plate circuit of the carrier-frequency buffer amplifier is opened by the action of this switch.

A duplex diode-triode is used as a clipper and limiting amplifier to produce a square wave of constant peak-to-peak amplitude from the audio-frequency signal.

The presence of an audio signal is indicated by a SIGNAL pilot lamp on the panel, and also by the illumination of the meter. A thyratron tube is used for control, and will cause these lamps to glow at normal brillance when a signal is present and exceeds a predetermined minimum amplitude. When no signal is present, but the circuit is otherwise operating properly, the lamps will glow very dimly.

The square-wave voltage is applied to a power amplifier, the output of which is coupled to the meter circuit by a transformer.

The meter circuit consists of a full-wave differential diode voltmeter, which indicates the potential difference between the midpoints of two series resonant circuits. Circuit constants are such as to cause equal potentials to exist at exactly 1000 cycles, since the two circuits are resonant, one above, and the other below, this frequency. Any deviation from this frequency will cause the current through the meter to assume a direction and amplitude directly proportional to the direction and magnitude of the frequency change, over the normal range of ±30 cycles deviation.

Internal voltage regulators permit stable operation over a wide range in supply-line voltages, and remove effects due to voltage transients.

GENERAL RADIO
TYPE 1181-A

SERVICE AND MAINTENANCE NOTES FOR THE TYPE 1181-A FREQUENCY-DEVIATION MONITOR

1.0 FOREWORD

1.1 This Service Information together with the information given in the Operating Instructions should enable the user to locate and correct ordinary difficulties resulting from normal usage.

1.2 Most of the components mentioned in these notes can be located by referring to the photographs.

1.3 Major service problems should be referred to the Service Department which will cooperate as far as possible by furnishing information and instructions, as well as by shipping any replacement parts which may be required. If the instrument is more than one year old, a reasonable charge may be expected for replacement parts or for complete reconditioning and recalibration if the monitor is returned.

1.4 Detailed facts giving type and serial numbers of the instrument and parts, as well as operating conditions, should always be included in your report to the Service Department.

2.0 GENERAL

If the monitor becomes inoperative, a few simple checks should be made before removing the instrument from the rack.

2.1 Check power line source.

2.2 Test power supply cord for open circuit or poor contact in power outlet.

2.3 Check fuses mounted at back of the monitor for open circuits and be sure they are tight in their clips.

3.0 MONITOR INOPERATIVE

3.1 See that all tube filaments are lighted. Test also the r-f line filter for short circuit. This comprises Capacitors C-40 and C-41 located at the power input receptacle.

3.2 If POWER lamp does not light, see Section 4.0.

3.3 If HEAT lamp does not light, see Section 5.0.

3.4 If MONITOR lamp does not light, see Section 6.0.

3.5 If SIGNAL lamp does not light, see Section 8.0.

3.6 If lamps in CYCLE PER SECOND meter do not light, see Section 8.0.

3.7 If crystal oscillator cannot be tested by CRYSTAL CHECK push switch, see Section 7.0.

3.8 If the thermometer does not indicate correct operating temperature, see Section 5.0.

3.9 Vacuum-tube replacements, see Sections 11.0 and 12.0

4.0 POWER AND THERMOMETER LAMPS DO NOT LIGHT

4.1 Check lamps P-2 and P-3, also R-15.

4.2 Check fuses F-3 and F-4.

4.3 Check connections to the primary of power transformer T-3.

5.0 HEAT LAMP DOES NOT OPERATE NORMALLY

5.1 Check lamp P-4.

5.2 Check fusible link F-5 located inside oven.

5.21 Due to cold flowing of the soft metal used, the mounting screws should be tightened occasionally.

5.22 *CAUTION* Do not replace the fusible link with a substitute. Serious damage to the oven, crystal, thermometer, and thermostat will result. Always keep a few spare fusible links on hand. Replacement links can be shipped promptly from the factory when those supplied with the instrument are exhausted.

5.3 Check fuses F-3 and F-4.

5.4 Check rectifier RX-1. The output should measure 8 volts dc.

5.5 Check operation of thermostat S-4.

5.51 Breaks in the mercury column can be cor-

rected by cooling the bulb so that all the mercury is drawn down into it. The column will be intact when the mercury again rises in the column.

5.52 To check for proper operation remove the thermostat and connect an ohmmeter across the contacts and heat the bulb by hot water. When the mercury column comes in contact with both internal electrodes, there should be an indication of a closed circuit by the ohmmeter.

5.6 Check relay S-5 for proper operation.

5.61 Check coil for open circuit. The resistance of the coil is 1000 ohms.

5.62 Check operation of armature. About 3.0 volts dc is required to close the contacts against normal spring tension.

5.63 Contacts should be cleaned by using fine sandpaper or a thin flat file.

5.7 Check R-16, R-54, R-88, R-89, and R-90. Also C-51.

6.0 MONITOR LAMP DOES NOT LIGHT

6.1 Check lamp P-1.

6.2 Check R-14.

6.3 Check fuses F-1 and F-2.

6.31 V-10 defective, see Section 6.6.

6.32 Line surges sometimes will cause the fuses to blow because of the inrush of current to either transformer T-2 or T-3.

6.4 Check operation and contacts of MONITOR switch S-2.

6.5 Check connections to primary of power transformer T-2.

6.6 Observe V-10 to be sure that flash-over is not occurring when switch S-2 is ON.

7.0 CYCLES PER SECOND METER DOES NOT INDICATE TO RED LINE WHEN CHECK CRYSTAL SWITCH IS PRESSED

7.1 Defective meter M-1.

7.12 Change in sensitivity. Full-scale reading should be ±100 microamperes dc from 0. Internal resistance is 450 ohms ±20%.

7.13 If the meter is defective, a replacement should be ordered from the Service Department. The General Radio Company cannot assume responsibility for any local repairs to the meter, although such repairs might be necessary in an emergency.

7.2 See that the crystal Q-1 is plugged into its jacks in the oven.

7.3 Check crystal oscillator current by connecting a d-c milliammeter to the OSC CURRENT jack J-1 on panel. If the crystal is operating properly, the reading should be between 1 and 3 ma.

7.4 If crystal check indicates low output, try replacing V-1, V-2, or V-6. V-11

7.5 To set the level of the crystal oscillator, wait until the crystal has been brought fully up to temperature. Set coupling capacitor C-4 to maximum. Adjust R-49 with CHECK CRYSTAL button depressed until the meter reading is 20 divisions to the right. This is five divisions above the red line and corresponds to about 5 volts across the crystal terminals.

8.0 SIGNAL AND CYCLES PER SECOND METER LAMPS DO NOT LIGHT WITH R-F SIGNAL APPLIED

8.1 Check lamps P-5 and P-6.

8.2 Check resistors R-17 and R-18.

8.3 Check C-52.

8.4 Check thyratron tube V-14 and operating voltages.

8.41 To check operation, ground terminal 6 temporarily, and lamps will light if V-14 is normal.

8.42 To check circuit operation, ground terminal No. 3 temporarily

8.43 Check that the ground connection at Anchor Terminal No. 2 is tight and making good contact.

8.5 Measure voltages across primary and secondary of transformer T-4 with V-14 removed.

8.51 Between terminals 1 and 2, 30 volts ac.

8.52 Between terminals 3 and 4, 2.6 volts ac.

8.6 Check V-1, V-2, V-5, V-6 and V-7 and operating voltages.

8.7 *CAUTION* R-93 is properly adjusted in our laboratory and its setting determines the amount of signal necessary to trigger V-14. This should not be changed unless a source of 1000 cycles audio frequency with an output of at least 54 volts is available. The audio voltage should be applied across R-35 and R-93 adjusted until the lamps just go out when a 54-volt signal is applied.

9.0 FAILURE OF CYCLES PER SECOND METER TO INDICATE CORRECT TRANSMITTER FREQUENCY DEVIATIONS (WITH MONITOR OPERATING PROPERLY, PER PRECEDING

SECTIONS AND TRANSMITTER FREQUENCY CORRECT)

9.1 Defective meter (see Section 7.1).

9.2 See that screws holding connections on the METER terminal strip are tight.

9.3 See that the Jones plug, PL-2, is in its socket on the rear of the monitor and making proper contact.

9.4 See that there is a connecting wire between terminals 2 and 3 in PL-2 unless an external meter is used.

9.5 Check ZERO SET to see if it changes readings in both directions.

9.6 Plug phones in TEL jack J-2 to determine whether a 1000 cycle beat note is present.

9.61 This can be checked using an accurately calibrated beat frequency oscillator or other source of 1000 cycles which is available from telephone companies.

9.7 If the beat note (Section 9.6) is not approximately 1000 cycles or is not present, proceed as follows:

9.71 Check V-8, V-9, and operating voltages.

9.72 Check T-1 for open circuit.

9.73 Readjustment of both C-1 and C-2 may be necessary if the crystal has developed a slight shift in frequency or is replaced by a new one.

9.731 C-1 and C-2 are set identically, but if readjustment is necessary, turn C-1 and C-2 *slightly* the same amount and in the same direction.

9.74 Check C-5, C-6, C-7, C-8, C-9, C-21, C-22 and C-23.

9.75 Try replacing V-5.

9.8 If beat note of 1000 cycles is present and meter does not indicate correctly, proceed as follows:

9.81 Check contacts of CRYSTAL CHECK switch S-1.

9.82 If meter indicates off scale, check V-3 and/or V-4. See Section 11.24.

9.83 Check C-11 and C-16. Also check L-3 and L-4 for continuity.

9.84 Check components in V-3 and V-4 circuits including R-10, R-11 and R-12. (Refer to Section 11.2)

9.85 Located under the name plate on the panel are two adjustments marked SENSITIVITY AND LINEARITY. *CAUTION* These adjustments should not be disturbed unless there is a source of voltage adjustable over the frequency range of 970 to 1030 cycles with means for determining the absolute value of the frequency within ±1 cycle. A signal level of 3 volts should be applied to the grid of V-7, and the controls are adjusted as follows, to obtain the results shown in Table 1, Columns 3 and 4.

9.851 The SENSITIVITY adjustment, R-48, controls the effective scale length of the meter by changing the input level to the vacuum-tube voltmeter circuit. It is set so that the meter reads exactly 60 cycles from one end of the meter scale to the other end.

9.852 The LINEARITY adjustment, R-13, controls the meter scale linearity so that it is uniform over the entire range from +30 through 0 to —30 cycles.

9.86 R-10 is an auxiliary control to the ZERO SET adjustment on the panel. It is used in the laboratory at the factory to make initial adjustments and assures the user of a maximum range of adjustment on the panel control in either direction.

9.87 Make certain that transformer T-1 is securely fastened to the instrument chassis and that mounting screws are drawn tight.

9.9 If meter indication is erratic or jumps suddenly when monitor is rapped or jarred, proceed as follows:

9.91 Monitors having serial numbers under 250 should be examined to make sure that a black fibre insulator is fastened to the left side dust cover. If this insulator is not present, the Service Department will be pleased to forward one upon request.

9.92 Check plate voltage on V-1. (Refer to Sections 10.4 and 12.0).

9.921 If voltage is high or erratic, check R-62, R-63, R-64 and R-65.

9.93 Try replacing V-1 and/or V-5 as these tubes may be oscillating, producing spurious beats in the output circuit.

9.94 The quartz crystal, Type 376-L, may be defective. Such a condition should be reported to the Service Department immediately as it may be necessary to repair or replace this unit.

9.941 Under no circumstances should the crystal holder be opened or the seals broken by the user unless authorized by the Service Department, as this procedure will void the guarantee. The General Radio Company will not be responsible for the proper operation of the monitor if the crystal seals have been broken.

10.0 POWER SUPPLY

10.1 Check V-10, V-11, V-12, and operating voltages.

10.2 Check V-13 and operating voltage. This should glow steadily if operating properly.

10.3 Check C-42, C-43, C-44, and C-45

10.4 The plate voltage on V-1 should be approximately 250 ± 20 volts. R-68 may be adjusted to correct this voltage.

10.5 If the plate circuit develops shorted elements, resistors R-56, R-57, R-58, and R-59 may become defective.

11.0 TUBE REPLACEMENTS

11.1 The following tubes may be replaced without affecting the over-all performance of the instrument in any way.

V-1 RCA Type 6SJ7
V-2 RCA Type 6AC7
V-5 RCA Type 6AC7
V-6 RCA Type 6SQ7-GT
V-7 RCA Type 6SJ7
V-10 RCA Type 5V4-G
V-11 RCA Type 6B4-G
V-12 RCA Type 6SJ7
V-13 RCA Type OC3

11.2 V-3 and V-4 can be replaced without producing a serious error, but some selection is desirable for the best results, as follows:

11.21 Remove the rear Jones plug, PL-2, from the EXT. METER receptacle at the rear of the monitor.

11.22 Set the mechanical zero adjustment on the meter.

11.23 Remove the connections of the r-f input and short circuit these terminals.

11.24 Place a new 6H6 in one of the sockets. Replace the Jones Plug and note the meter reading. Remove the tube and select a second tube which gives the same reading in the same socket. Use these tubes as the replacements. Readjust the ZERO SET control to make the meter read zero. If the ZERO SET control has previously been used to compensate for a drift in the crystal frequency, note the original reading before replacing the tubes, and then set to the same value when resetting the ZERO SET control.

11.3 If the following tubes are replaced, the electrical meter circuits may be affected somewhat.

V-8 RCA Type 6SQ7-GT
V-9 RCA Type 6V6-GT

The maximum errors encountered by direct tube substitution will not exceed ±8% of the indicated reading, or ±6% of the indicated reading, respectively. These are *maximum* possible variations. It is good practice to replace the tubes with tubes of the same manufacturer as are originally supplied with the instrument. This will minimize possibilities of introducing errors.

11.4 When replacing the following tube, the operation of the SIGNAL lamp circuits should be checked.

V-14 RCA Type 2050

11.41 Refer to Section 8.7.

11.42 If the apparatus required under Section 8.7 is not available, the circuit can be made to operate temporarily by performing the following operations: remove the r-f input and short the INPUT terminals. Adjust R-93 *clockwise* until the SIGNAL pilot lamp attains full brilliance; then *slowly rotate R-93 counter-clockwise* until it appears to go out. Leave the potentiometer set at this position.

12.0 VACUUM-TUBE DATA (MONITOR OPERATING NORMALLY WITH NO R-F SIGNAL APPLIED). LINE VOLTAGE 115 VOLTS, 60 CYCLES.

Table of tube socket voltages measured from socket pin to ground using a 20,000 ohm-per-volt meter (Weston 772 Analyzer). D-C voltages except as noted may vary ±20%.

SYMBOL	TYPE	SOCKET PIN NUMBER						DESCRIPTION
		2	3	4	5	6	8	
V-1	6SJ7	6.5(AC)				80	250	Crystal Oscillator
V-2	6AC7	6.5(AC)			2.2	165	280	Oscillator Amplifier
V-3*	6H6	6.5(AC)						Voltmeter Diode
V-4*	6H6	6.5(AC)						Voltmeter Diode
V-5	6AC7	6.4(AC)			1.6	55	300	R-F Amplifier
V-6	6SQ7-GT					195	6.4(AC)	Mixer
V-7	6SJ7	6.4(AC)	0.3	0.10 (+gnd)	0.3	47 58	185 230	A-F Amplifier
V-8**	6SQ7-GT					165	6.4(AC)	Clipper-Limiter
V-9	6V6-GT	6.5(AC)	250	230		250	16.0	Square-Wave Amplifier
V-10	5V4G	2 to 8 5 (AC)		370(AC)		370(AC)	415	Rectifier
V-11	6B4G 6W6 GT	2 to 7 6.3(AC) 255	420		222			Regulator
V-12	6SJ7	2 to 7 5.3(AC)	106	105	106	125	222	Regulator
V-13	OC3				106			Regulator
V-14	2050	6.0(AC)	95(AC)			6.9		Thyratron Control Tube

* When the meter reads zero with the monitor operating and regardless of whether or not a signal is applied, there are no voltage readings obtainable except those of the filaments. However a continuity and resistance check between some of the socket terminals of V-3 and V-4 will ordinarily indicate defective components in that part of the circuit.

** The small values of voltages indicated are difficult to measure accurately. The following table lists the resistance from some of the socket terminals of V-8 to ground.

From Terminal	Tube	To Terminal	Tube	Ohms
3	V-3	4	V-4	330
5	V-3	8	V-4	0.1 Meg
3	V-3	6	V-3	47
6	V-4	4	V-4	74
4	V-3	3	V-4	0.1 Meg

Terminal	Ohms
2	2 Meg
3	0
4	0.12 Meg
5	0.3 Meg
6	0.5 Meg

GENERAL RADIO COMPANY

PARTS LIST

Symbol	Rating and Tolerance		Mfr.	Mfr.'s Type No.
	RESISTORS			
R-1	2.7 MΩ	±10%	IRC	Type BT-1/2
R-2	100 kΩ	±10%	IRC	Type BT-1/2
R-3	10 kΩ	±10%	IRC	Type BT-1/2
R-4	220 Ω	±10%	IRC	Type BW-1/2
R-5	68 kΩ	±10%	IRC	Type BT-1/2
R-6	40 kΩ	± 1%	IRC	Type WW-3
R-7	20 kΩ		GR	301-430
R-8	40 kΩ	± 1%	IRC	Type WW-3
R-9	560 Ω	± 5%		REW-3C
R-10	20 kΩ		GR	301-430
R-11	40 kΩ	± 1%	IRC	Type WW-3
R-12	40 kΩ	± 1%	IRC	Type WW-3
R-13	250 Ω	±10%	GR	POSW-3
*R-14	15 Ω	±10%	IRC	Type BW-1/2
△R-15	15 Ω	±10%	IRC	Type BW-1/2
□R-16	15 Ω	±10%	IRC	Type BW-1/2
**R-17	15 Ω	±10%	IRC	Type BW-1/2
R-18	3.3 Ω	±10%	IRC	Type BW-1
R-19	4.7 kΩ	±10%	IRC	Type BT-1
R-20	560 Ω	±10%	IRC	Type BT-1/2
R-21	27 kΩ	±10%	IRC	Type BT-1/2
R-22	220 Ω	±10%	IRC	Type BW-1/2
R-23	470 kΩ	±10%	IRC	Type BT-1/2
R-24	8200 Ω	±10%	IRC	Type BT-1
R-25	200 kΩ	± 5%	IRC	Type BT-1/2
R-26	33 kΩ	±10%	IRC	Type BT-1/2
R-27	10 kΩ	±10%	IRC	Type BT-1/2
R-28	560 Ω	±10%	IRC	Type BT-1/2
R-29	100 kΩ	±10%	IRC	Type BT-1/2
R-30	470 kΩ	±10%	IRC	Type BT-1/2
R-31	1.8 MΩ	±10%	IRC	Type BT-1/2
R-32	100 Ω	±10%	IRC	Type BW-1/2
R-33	470 kΩ	±10%	IRC	Type BT-1/2
R-34	56 kΩ	±10%	IRC	Type BT-1/2
R-35	150 kΩ	±10%	IRC	Type BT-1/2
R-36	470 kΩ	±10%	IRC	Type BT-1/2
R-37	150 kΩ	±10%	IRC	Type BT-1/2
R-38	1 MΩ	±10%	IRC	Type BT-1/2
R-39	1 MΩ	±10%	IRC	Type BT-1/2
R-40	22 kΩ	±10%	IRC	Type BT-1/2
R-41	47 kΩ	±10%	IRC	Type BT-1/2
R-42	180 kΩ	±10%	IRC	Type BT-1/2
R-43	100 kΩ	±10%	IRC	Type BT-1/2
R-44	1 MΩ	±10%	IRC	Type BT-1/2
R-45	620 Ω	± 5%	IRC	Type BW-1
R-46	15 kΩ	±10%	IRC	Type BT-2
R-47	7500 Ω	±10%	IRC	REPO-22-2
R-48	200 Ω	±10%	GR	POSW-3
R-49	100 Ω	±10%	GR	POSC-11

Symbol	Rating and Tolerance		Mfr.	Mfr.'s Type No.
	RESISTORS			
R-54	1 kΩ	±10%	IRC	Type BT-1/2
R-55	1 kΩ	±10%	IRC	Type BT-1
R-56	1.5 kΩ	± 5%	IRC	REPO-1043
R-57	1.5 kΩ	± 5%	IRC	REPO-1043
R-58	1.5 kΩ	± 5%	IRC	REPO-1043
R-59	1.5 kΩ	± 5%	IRC	REPO-1043
R-60	1 MΩ	±10%	IRC	Type BT-1/2
R-62	470 kΩ	±10%	IRC	Type BT-1/2
R-63	820 kΩ	±10%	IRC	Type BT-2
R-64	560 kΩ	±10%	IRC	Type BT-1
R-65	22 kΩ	±10%	IRC	Type BT-2
R-66	470 kΩ	±10%	IRC	Type BT-1/2
R-67	270 kΩ	±10%	IRC	Type BT-1/2
R-68	50 kΩ	±20%	GR	POSC-11
R-69	180 kΩ	±10%	IRC	Type BT-1/2
R-75	300 Ω	± 5%	IRC	Type BW-1
R-76	35 Ω	±10%	GR	REPO-4
R-77	35 Ω	±10%	GR	REPO-4
R-78	35 Ω	±10%	GR	REPO-4
R-79	35 Ω	±10%	GR	REPO-4
R-80	35 Ω	±10%	GR	REPO-4
R-81	35 Ω	±10%	GR	REPO-4
R-82	35 Ω	±10%	GR	REPO-4
R-83	35 Ω	±10%	GR	REPO-4
R-84	35 Ω	±10%	GR	REPO-4
R-85	35 Ω	±10%	GR	REPO-4
R-86	35 Ω	±10%	GR	REPO-4
R-87	35 Ω	±10%	GR	REPO-4
R-88	41 Ω	±10%	GR	REPO-4
R-89	27 Ω	±10%	IRC	Type BT-1/2
R-90	1000 Ω	±10%	IRC	Type BT-1/2
R-91	400 Ω	±10%	GR	REPO-4
R-92	2000 Ω	±10%	GR	REPO-6
R-93	5 kΩ	±10%	GR	POSW-862
R-94	10 kΩ	±10%	IRC	Type BT-1/2
R-95	1 MΩ	±10%	IRC	Type BT-1/2
R-96	5600 Ω	±10%	IRC	Type BT-1/2

*Part of P-1 Socket
△Part of P-2 Socket
□Part of P-4 Socket
**Part of P-5 Socket

TUBES

V-1	6SJ7
V-2	6AC7
V-3	6H6
V-4	6H6
V-5	6AC7
V-6	6SQ7-GT
V-7	6SJ7
V-8	6SQ7-GT
V-9	6V6-GT
V-10	5Y4-G
V-11	6B4-G
V-12	6SJ7
V-13	OC3
V-14	2050

INDOCTORS

L-1	2.5 mh		CHA-597
L-3	200 mh		681-42
L-4	295 mh		681-43
L-5	1.27 h	±2.5%	746-409
L-8	2.5 mh		CHA-597
L-9	2.5 mh		CHA-597
L-10	25 mh		CHA-1226

FUSES

For 115 volts			
F-1	1 amp.	Slow Blow	Type 3AG
F-2	1 amp.	Slow Blow	Type 3AG
F-3	0.4 amp.	Slow Blow	Type 3AG
F-4	0.4 amp.	Slow Blow	Type 3AG
For 230 volts			
F-1	0.5 amp.	Slow Blow	Type 3AG
F-2	0.5 amp.	Slow Blow	Type 3AG
F-3	0.2 amp.	Slow Blow	Type 3AG
F-4	0.2 amp.	Slow Blow	Type 3AG
F-5	547-50		

JACKS

J-1	CDSJ-1281
J-2	CDSJ-1281

PLUGS

PL-1	CDPP-562A
PL-2	1181-21

Symbol	Rating and Tolerance	Mfr.	Mfr.'s Type No.
	CONDENSERS		
C-1	13-320 μμf	GR	COA-6
C-2	13-320 μμf	GR	COA-6
C-3	0.00025 μf ±10%	CD	Type 5W
C-4	3-25 μμf	GR	COA-1
C-5	0.02 μf ±10%	GR	COL-33
C-6	0.02 μf ±10%	GR	COL-33
C-7	0.02 μf ±10%	GR	COL-33
C-8	0.02 μf ±10%	GR	COL-33
C-9	0.02 μf ±10%	GR	COL-33
C-10	0.005 μf ±10%	CD	Type 4
C-11	0.09772 μf ±1/2%	CD	Type 4
C-12	0.1 μf ±10%	GR	COLB-10
C-13	0.1 μf ±10%	GR	
C-14	0.1 μf ±10%	GR	COLB-10
C-15	0.1 μf ±10%	GR	
C-16	0.10857 μf ±1/2%	CD	Type 4
C-20	0.001 μf ±10%	CD	Type 1W
C-21	0.02 μf ±10%	GR	COL-33
C-22	0.02 μf ±10%	GR	COL-33
C-23	0.02 μf ±10%	GR	COL-33
C-24	0.005 μf ±10%	CD	Type 4
C-25	0.001 μf ±10%	CD	Type 5W
C-26	0.01 μf ± 5%	CD	Type 4
C-27	0.003 μf ±10%	CD	Type 1W
C-28	0.001 μf ±10%	CD	Type 5W
C-29	0.0005 μf ±10%	CD	Type 4
C-30	5.0 μf +70%,-10%	GR	Part of COEB-4
C-31	0.01 μf ±10%	CD	Type 4
C-32	0.0025 μf ±10%	CD	Type 4
C-33	10 μf +50%,-10%	GR	Part of COEB-4
C-34	0.020 μf ±10%	CD	Type 4
C-35	0.020 μf ±10%	CD	Type 4
C-36	10 μf +50%,-10%	GR	Part of COEB-4
C-37	0.0005 μf ±10%	CD	Type 5W
C-38	0.000050 μf ±10%	CD	Type 5W
C-39	0.013 μf ± 5%	CD	Type 4
C-40	0.01 μf ±10%	CD	Type 3L
C-41	0.01 μf ±10%	CD	Type 3L
C-42	20 μf +50%,-10%	GR	COEB -9
C-43	20 μf +50%,-10%	GR	
C-44	20 μf +50%,-10%	GR	
C-45	20 μf +50%,-10%	GR	
C-46	4.0 μf ±10%	GR	COL-8
C-50	100 μf +50%,-10%	GR	COE-15
C-51	0.1 μf ±10%	GR	COL-11
C-52	3.0 μf ±10%	GR	COL-7
C-53	0.00025 μf ±10%	CD	Type 4
C-54	16 μf +50%,-10%	GR	COE-4

Symbol	Rating and Tolerance	Mfr.	Mfr.'s Type No.
	SWITCHES		
S-1			SWP-3
S-2		D.P.S.T.	SWT-333
S-3		D.P.S.T.	SWT-333
S-4		60° C	TH-503
S-5		Relay	Z3RE-2
	TRANSFORMERS		
T-1			485-442
T-2			365-450-2
T-3			485-441
T-4			745-406
	PILOT LAMPS		
P-1	6.3 v	Mazda 44	2LAP-939
P-2	6.3 v	Mazda 44	2LAP-939
P-3	6.3 v	Mazda 44	2LAP-939
P-4	6.3 v	Mazda 44	2LAP-939
P-5	6.3 v	Mazda 44	2LAP-939
P-6	6.3 v	Mazda 47	2LAP-939F (2 Req. in M-1)
	RECTIFIER		
RX-1			2RE-1400-6
	SOCKET		
SO-1			CDMS-1405-4
	INDICATORS		
M-1	Meter		MEDS-13
M-2	Thermometer	60° C	TH-488
	QUARTZ BAR		
Q-1			376-L

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GENERAL RADIO COMPANY,
CAMBRIDGE 39, MASS.

Symbol	Rating and Tolerance		Mfr.	Mfr.'s Type No.
	CONDENSERS			
C-1	13-320 μμf		GR	COA-6
C-2	13-320 μμf		GR	COA-6
C-3	0.00025 μf	±10%	CD	Type 5W
C-4	3-25 μμf		GR	COA-1
C-5	0.02 μf	±10%	GR	COL-33
C-6	0.02 μf	±10%	GR	COL-33
C-7	0.02 μf	±10%	GR	COL-33
C-8	0.02 μf	±10%	GR	COL-33
C-9	0.02 μf	±10%	GR	COL-33
C-10	0.005 μf	±10%	CD	Type 4
C-11	0.09772 μf	±1/2%	CD	Type 4
C-12	0.1 μf	±10%	GR	COLB-10
C-13	0.1 μf	±10%	GR	
C-14	0.1 μf	±10%	GR	COLB-10
C-15	0.1 μf	±10%	GR	
C-16	0.10857 μf	±1/2%	CD	Type 4
C-20	0.001 μf	±10%	CD	Type 1W
C-21	0.02 μf	±10%	GR	COL-33
C-22	0.02 μf	±10%	GR	COL-33
C-23	0.02 μf	±10%	GR	COL-33
C-24	0.005 μf	±10%	CD	Type 4
C-25	0.001 μf	±10%	CD	Type 5W
C-26	0.01 μf	± 5%	CD	Type 4
C-27	0.003 μf	±10%	CD	Type 1W
C-28	0.001 μf	±10%	CD	Type 5W
C-29	0.0005 μf	±10%	CD	Type 4
C-30	5.0 μf	+70%,-10%	GR	Part of COEB-4
C-31	0.01 μf	±10%	CD	Type 4
C-32	0.0025 μf	±10%	CD	Type 4
C-33	10 μf	+50%,-10%	GR	Part of COEB-4
C-34	0.020 μf	±10%	CD	Type 4
C-35	0.020 μf	±10%	CD	Type 4
C-36	10 μf	+50%,-10%	GR	Part of COEB-4
C-37	0.0005 μf	±10%	CD	Type 5W
C-38	0.000050 μf	±10%	CD	Type 5W
C-39	0.013 μf	± 5%	CD	Type 4
C-40	0.01 μf	±10%	CD	Type 3L
C-41	0.01 μf	±10%	CD	Type 3L
C-42	20 μf	+50%,-10%	GR	COEB -9
C-43	20 μf	+50%,-10%	GR	
C-44	20 μf	+50%,-10%	GR	
C-45	20 μf	+50%,-10%	GR	
C-46	4.0 μf	±10%	GR	COL-8
C-50	100 μf	+50%,-10%	GR	COE-15
C-51	0.1 μf	±10%	GR	COL-11
C-52	3.0 μf	±10%	GR	COL-7
C-53	0.00025 μf	±10%	CD	Type 4
C-54	16 μf	+50%,-10%	GR	COE-4

Symbol	Rating and Tolerance	Mfr.	Mfr.'s Type No.
	SWITCHES		
S-1			SWP-3
S-2		D.P.S.T.	SWT-333
S-3		D.P.S.T.	SWT-333
S-4		60° C	TH-503
S-5		Relay	23ME-2
	TRANSFORMERS		
T-1			485-442
T-2			365-450-2
T-3			485-441
T-4			745-406
	PILOT LAMPS		
P-1	6.3 v	Mazda 44	2LAP-939
P-2	6.3 v	Mazda 44	2LAP-939
P-3	6.3 v	Mazda 44	2LAP-939
P-4	6.3 v	Mazda 44	2LAP-939
P-5	6.3 v	Mazda 44	2LAP-939
P-6	6.3 v	Mazda 47	2LAP-939F (2 Req. in M-1)
	RECTIFIER		
RX-1			2RE-L400-6
	SOCKET		
SO-1			CDMS-1405-4
	INDICATORS		
M-1	Meter		MEDS-13
M-2	Thermometer	60° C	TH-488
	QUARTZ BAR		
Q-1			376-L

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CAMBRIDGE 39, MASS.

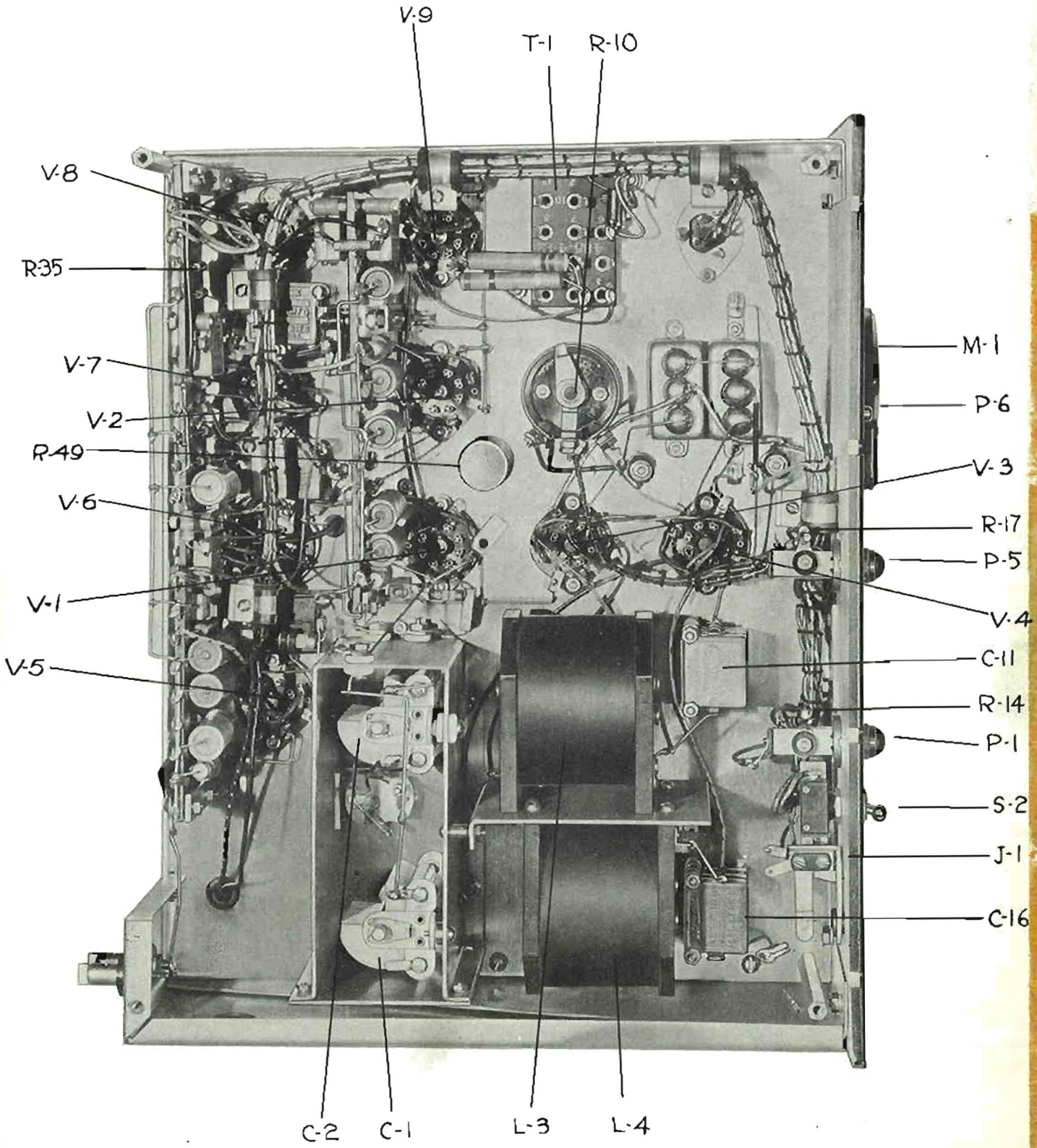


Figure 7. View of left-hand side of monitor with dust cover removed.

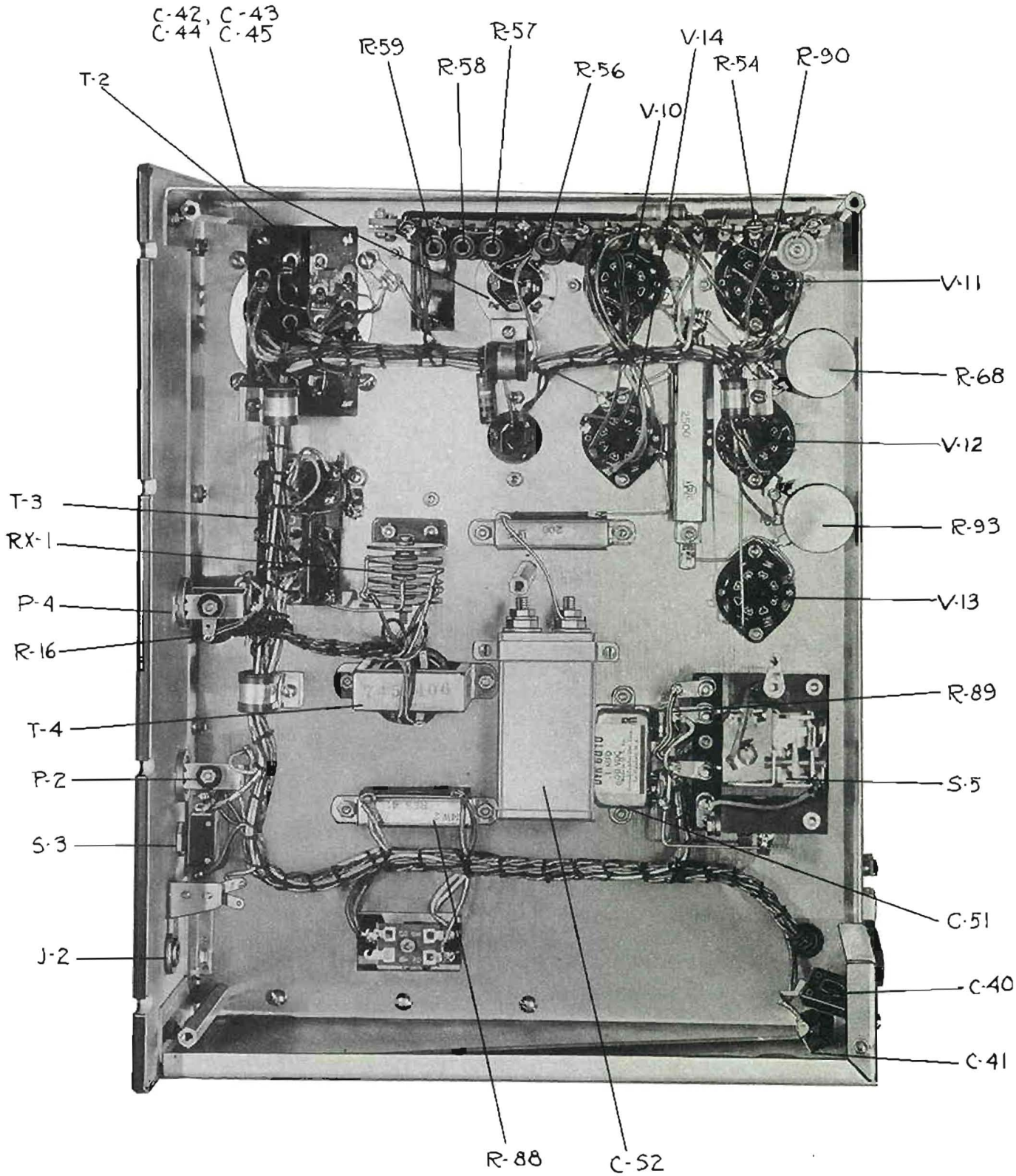


Figure 8. View of right-hand side of monitor with dust cover removed.

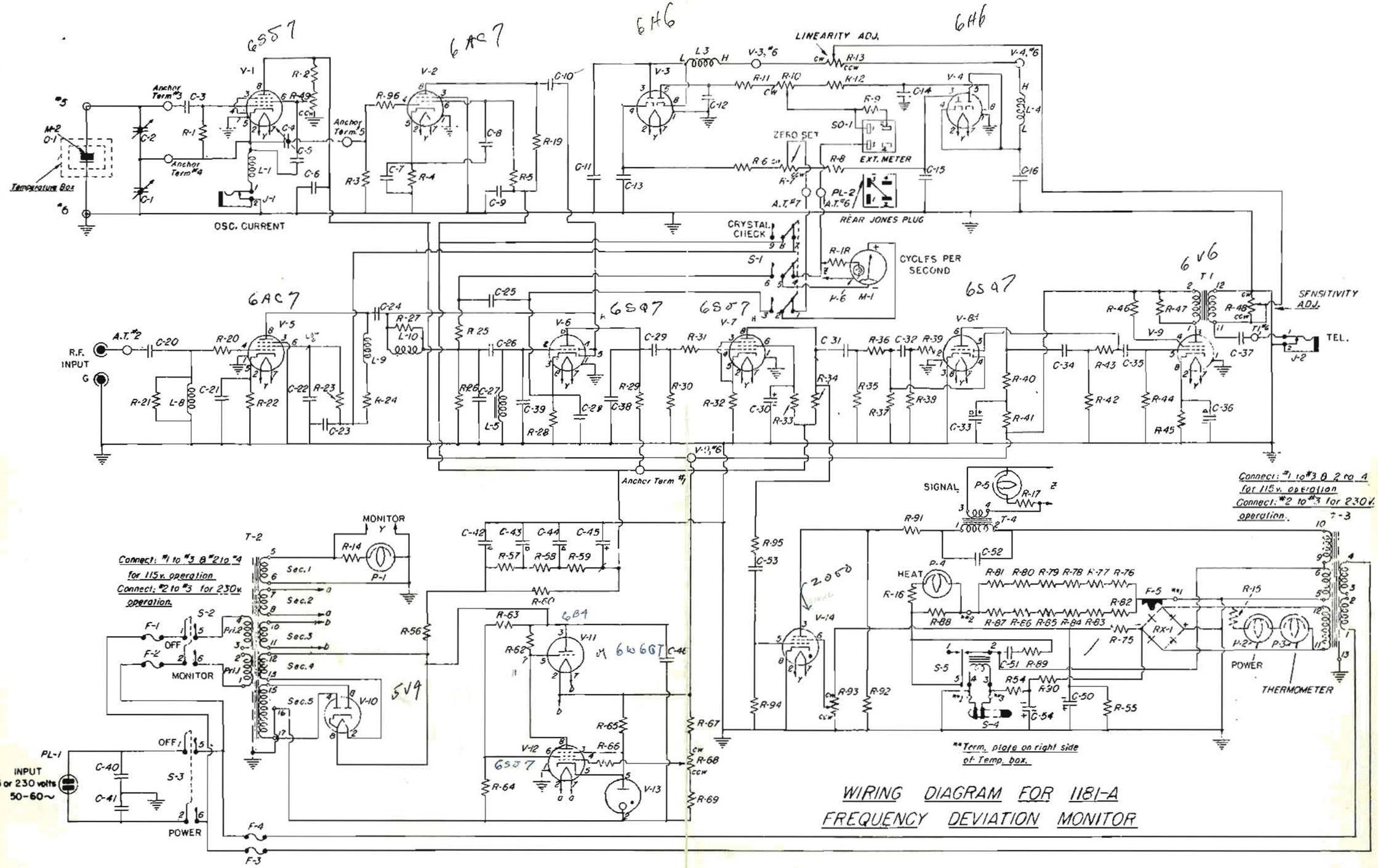
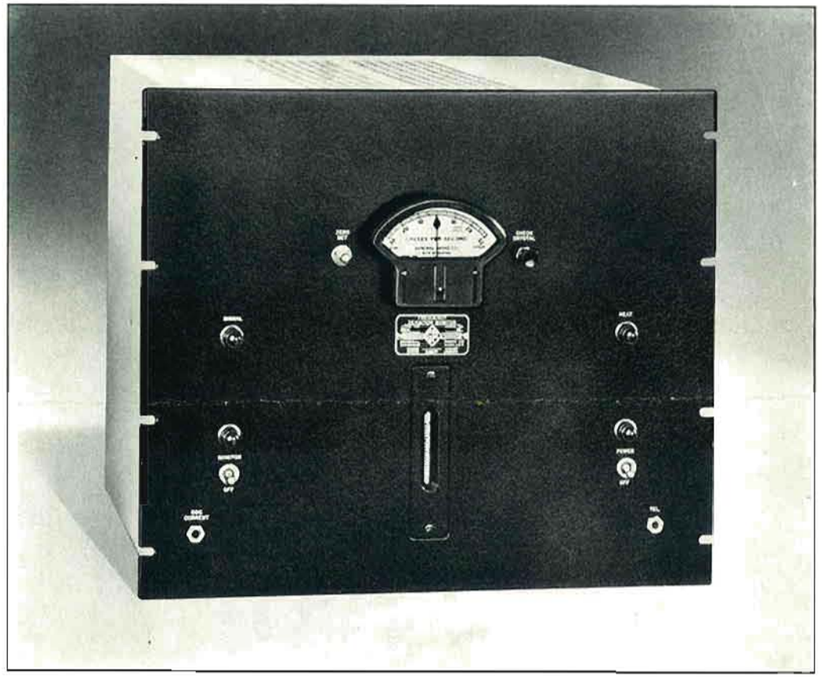


Figure 5. Complete wiring diagram.



TYPE 1181-A FREQUENCY DEVIATION MONITOR FOR A-M TRANSMITTERS

USES: The Frequency Deviation Monitor indicates directly the magnitude and direction of the frequency deviation of a broadcast transmitter from its assigned channel frequency. A monitor of this general type is required for each station by the Federal Communications Commission.

This monitor replaces the TYPE 25-A Broadcast Frequency Monitor which consisted of TYPE 475 Frequency Monitor and TYPE 681 Frequency Deviation Meter.

DESCRIPTION: The elements of the monitor are shown in the accompanying schematic block diagram. Voltages from a temperature-controlled piezo-electric oscillator (frequency $f \pm 1000$ cycles) and the transmitter to be monitored (frequency $f \pm \Delta f$) are amplified and fed to a mixer from which their difference frequency ($1000 \pm \Delta f$) is obtained. This audio frequency is amplified, its peaks are clipped to produce an essentially square waveform, and the square waves are applied to an audio-frequency meter. The indicating element of the frequency meter is calibrated to read zero when the audio beat is exactly 1000 cycles per second. Deviations from 1000 cycles (Δf) are indicated directly as frequency deviation of the transmitter in cycles per second.

The monitor is a-c operated and is mounted on a single relay rack panel. Coupling to the transmitter is obtained from a short length of wire attached to the input terminals to act as an antenna.

FEATURES: *Modulation of the transmitter does not affect the frequency indication.* Consequently, it is no longer necessary to couple the monitor to the crystal buffer stage. The monitor input is obtained from the modulated transmitter output, and the r-f power required to operate the monitor is so small that only a simple pickup antenna is needed; usually a few inches of wire is adequate.

Positive indication of failure of either transmitter carrier or monitor crystal oscillator is provided. Within wide limits the frequency indication is independent of carrier amplitude, but a signal-level pilot is extinguished if the carrier input level drops too low for proper operation of the monitor. In addition, the lamp in the frequency indicating meter is extinguished. Similarly, a push-button test indicates whether or not the monitor crystal voltage is adequate. Other lamps serve as indicators of power circuits, tube circuits, and thermostat operation. Thus a glance will determine whether or not the monitor is operating properly.

Remote monitoring is possible by connecting to a socket provided at the rear of the instrument.

These features alone constitute a vast improvement over previous models. They are achieved through a thoroughly coordinated electrical and mechanical design. The TYPE 1181-A Frequency Deviation Monitor is so designed that installation is extremely simple and that a minimum of attention is required from the station operating staff.

SPECIFICATIONS

Frequency Deviation Range: ±30 cycles, readable to one cycle.

Carrier Frequency Range: 500 to 2000 kc.

Accuracy: When received, within ±10 parts per million. An adjustment is provided to bring the reading into agreement with monitoring station measurements.

Stability: Under normal operating conditions, the frequency stability is better than one part in a million. Adjustments are provided to correct the indicated frequency in terms of standard-frequency transmissions whenever necessary.

Vacuum Tubes: The following tubes are required and supplied with the instrument:

3—type 6SJ7	1—type 5V4-G
2—type 6AC7	1—type 6B4-G
2—type 6H6	1—type 0C3/VR105
2—type 6SQ7	1—type 2050
1—type 6V6	

Coupling to Transmitters: A few inches of wire serving as an antenna is usually sufficient. A minimum of 50 millivolts pickup is required into a high-impedance grid circuit.

Accessories Supplied: Quartz plate, spare pilot lights, and spare fuses.

Power Supply: 105 to 125 or 210 to 250 volts, 50 to 60 cycles.

Power Input: 25 watts for heater circuits, 100 watts for monitor circuits.

Mounting: The instrument is relay-rack mounted.

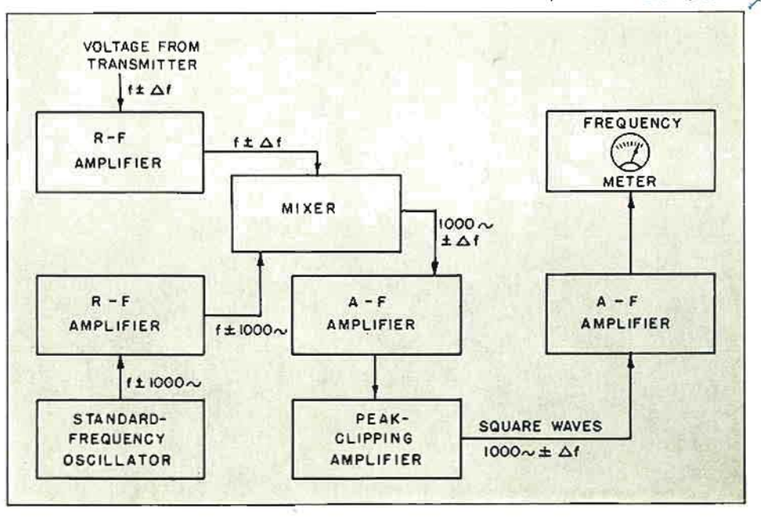
Panel Finishes: Standard General Radio black crackle. Certain standard grays which can be processed in quantity can be supplied at a price increase of $10.00.

Dimensions: Panel (length) 19 x (height) 15¾ inches. Depth behind panel, 13 inches.

Net Weight: 59½ pounds.

Type		*Code Word*	*Price*
1181-A	Frequency Deviation Monitor.....	MALAY	~~$775.00~~ ~~$705.50~~

PATENT NOTICE. See Notes 7, 8, 12, 20, 26, page vi.



Substituting The 6B4

The nearly extinct 6B4 (V11) tube in the fine old 1181-A frequency monitor can easily be replaced with the relatively modern 6W6GT. Simply leave the present leads connected to V11 socket and jumper from pin 2 to 8, also from pin 3 to 4. After this modification either a 6B4 or a 6W6GT tube may be used in V11 socket. No other changes are necessary, just check B+ regulated bus and readjust R68 if need be. One other point, **never** substitute anything else for the F5 fusible link in the oven; not even fine copper, lead or wire solder. F5 is a heat sensitive fuse, not an electrical fuse. It is the main oven protection from burnout.

Eidson Electronic Co.
Temple, Texas

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