OPERATING INSTRUCTIONS

1021-AU
1021-AV

TYPE 1021-AU AND TYPE 1021-AV STANDARD-SIGNAL GENERATOR

. . . . SINCE 1915
manufacturers of
electronic apparatus
for science and industry

GENERAL RADIO COMPANY
CAMBRIDGE 39, MASSACHUSETTS, USA

OPERATING AND MAINTENANCE
INSTRUCTIONS

for

TYPE 1021-AU AND TYPE 1021-AV STANDARD-SIGNAL GENERATOR

Form 728-D
May, 1957

GENERAL RADIO COMPANY
275 MASSACHUSETTS AVENUE
CAMBRIDGE 39 MASSACHUSETTS

SALES ENGINEERING OFFICES

NEW YORK: Broad Avenue at Linden
Ridgefield, New Jersey

CHICAGO: 920 South Michigan Avenue
Chicago 5, Illinois

PHILADELPHIA: 1150 York Road
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WASHINGTON: 8055 13th Street
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LOS ANGELES: 1000 North Seward Street
Los Angeles 38, California

SAN FRANCISCO: 1182 Los Altos Avenue
Los Altos, California

REPAIR SERVICES

WEST COAST
Western Instrument Company
826 North Victory Boulevard
Burbank, California

EAST COAST
General Radio Company
Service Department
275 Massachusetts Avenue
Cambridge 39, Massachusetts

CANADA
Bayly Engineering, Ltd.
First Street
Ajax, Ontario

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SPECIFICATIONS

TYPE 1021-AU U-H-F STANDARD-SIGNAL GENERATOR

CARRIER FREQUENCY RANGE	250 to 920 Mc in one band.
FREQUENCY CALIBRATION	Direct reading to ±1%.
OUTPUT VOLTAGE	Continuously adjustable from 0.5 μv to 1.0 v, open circuit.
OUTPUT IMPEDANCE	50 ohms ±10%.
OUTPUT-VOLTAGE ACCURACY	Over-all, better than ±20%. Accuracy of output-voltmeter calibration between 0.5 and 1 v is better than ±10%. Accuracy of attenuator dial calibration for voltages between 1.0 μv and 0.1 v is better than ±5%; from 0.1 to 0.5 v, better than ±10%. At 920 Mc, resonance error in voltmeter is +6%.
AMPLITUDE MODULATION	Adjustable from 0 to 50%. Internal, 1000 cps ±5%. External, flat within 3 db from 30 cps to 15 kc. For 50% modulation, external audio oscillator must supply 18 v across a 100-k load.
ENVELOPE DISTORTION	Less than 5% at 50% modulation.
NOISE LEVEL	Carrier noise level corresponds to about 0.2% modulation.
INCIDENTAL FREQUENCY MODULATION	For 50% amplitude modulation, incidental fm is about 100 parts per million up to 400 Mc, and is about 1000 ppm at 920 Mc. For lower incidental fm, Type 1000-P6 Crystal Modulator is recommended.
LEAKAGE	Stray fields and residual output voltage will not affect tests with a receiver having 2- to 3-μv sensitivity.
TERMINALS	Type 874 Coaxial Terminals provided for output connection.
POWER SUPPLY	115 or 230 v, 50 to 60 cps. Power input about 50 w.
TUBES	One each: Sylvania RT-434 Oscillator, 6X5-GT, 6K6-GT, Amperite 6-4; two OC3.
ACCESSORIES SUPPLIED	CAP-35 Power Cord, 874-R22 Patch Cord, 874-PB58 Panel Connector, 874-C58 Cable Connector.
ACCESSORIES RECOMMENDED	Type 1000-P6 Crystal Diode Modulator, for amplitude modulation with low incidental fm at modulation frequencies from 0 to 5 Mc. Type 1000-P7 Balanced Modulator for linear 100% amplitude modulation and for pulses with a high degree of carrier suppression. Modulation frequency range is 0 to 20 Mc. Type 874-G20 20-db Fixed Attenuator is recommended for use with both modulators.
MOUNTING	Aluminum cabinet, with black wrinkle finish.
DIMENSIONS	Height 14-3/8 in., width 20-1/4 in., depth 10-9/16 in., over-all.
WEIGHT	37-1/2 lb.

SPECIFICATIONS

TYPE 1021-AV V-H-F STANDARD-SIGNAL GENERATOR

Specifications same as for Type 1021-AU except as follows:

CARRIER-FREQUENCY RANGE	50 to 250 Mc in one band and 40 to 50 Mc in an additional range.
INCIDENTAL FREQUENCY MODULATION	For 50% amplitude modulation, incidental fm is about 100 parts per million up to 100 Mc, and is about 500 ppm at 250 Mc. For lower incidental fm, Type 1000-P6 Crystal Modulator or Type 1000-P7 Balanced Modulator is recommended.
TUBES	One 12AT7 Oscillator, others as listed above.

U.S. Patent Nos. 2,548,457 and 2,367,681

THE GENERAL RADIO EXPERIMENTER reference: Vol XXIV, No. 10, March 1950 and Vol XXIX, No. 10, March 1955.

NOTE: A third unit, the Type 1021-AW U-H-F Standard-Signal Generator, for 900 to 2000 Mc, has recently been made available. This instrument, similar in appearance and performance to the lower-frequency generators described in this book, uses a Type 5675 pencil tube as the oscillator and is tuned by shorting elements in the transmission-line section. To avoid incidental frequency modulation, square-wave modulation from an external source is used. The Type 1021-AW Standard-Signal Generator consists of the Type 1021-P1 Power Supply and the Type 1021-P4 U-H-F Unit, mounted in the same cabinet as shown in Figure 1.

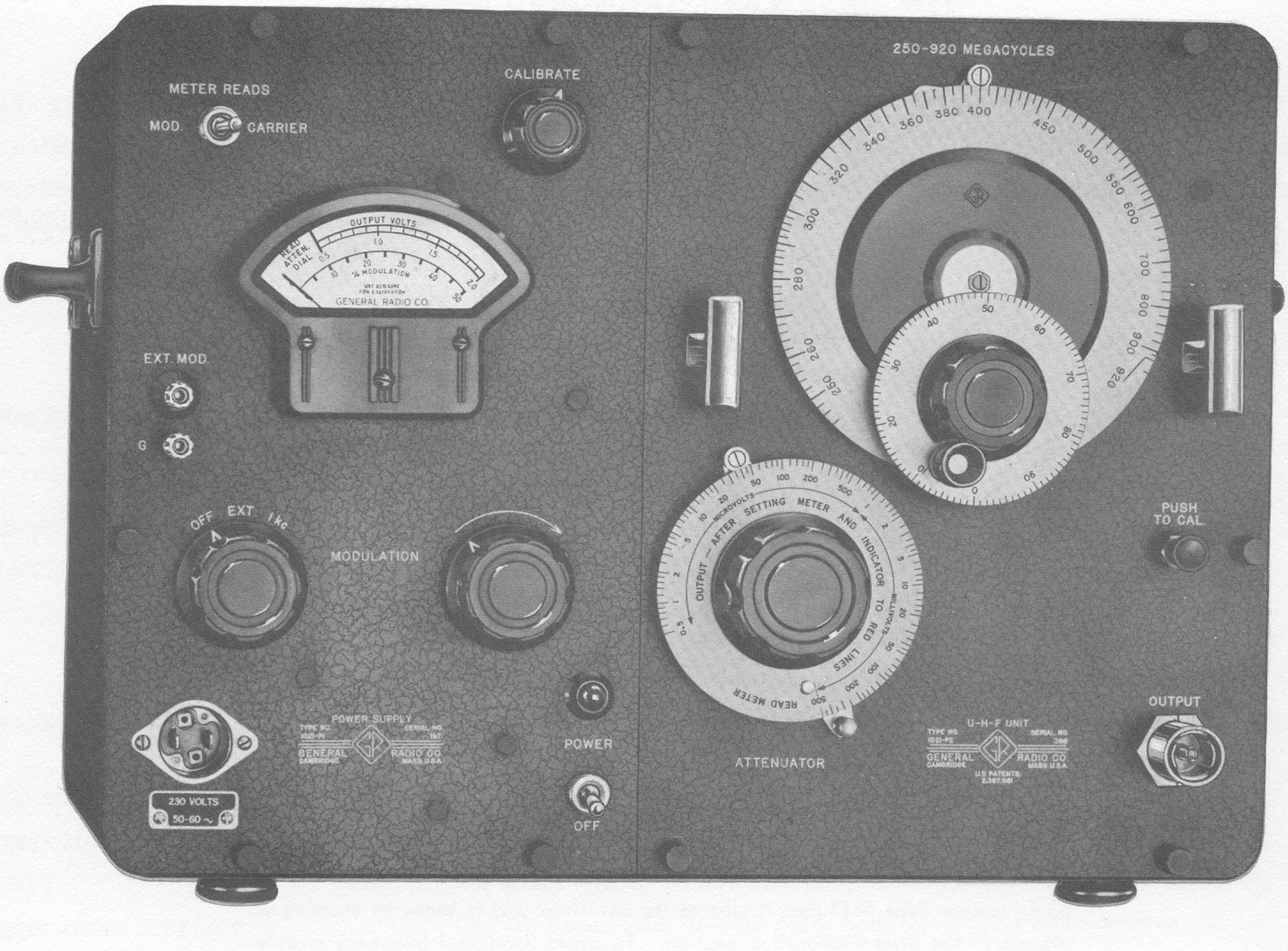

Figure 1. Type 1021-AU Standard-Signal Generator.

TYPE 1021-AU AND TYPE 1021-AV STANDARD-SIGNAL GENERATOR

Section 1
INTRODUCTION

1.1 GENERAL. The Type 1021-AU Standard-Signal Generator (Figure 1) consists of a Type 1021-P2 R-F Unit and a Type 1021-P1 Power Supply, combined in a single aluminum cabinet. Its frequency range of 250 to 920 Mc is covered in a single band.

The Type 1021-AV Standard-Signal Generator uses the same power supply and cabinet as the Type 1021-AU, but uses the Type 1021-P3B R-F Unit, which covers the frequency range of 40 to 250 Mc in two bands: 40 to 50 Mc and 50 to 250 Mc. Hence, the total range of the Type 1021-A Standard-Signal Generator, with the two interchangeable r-f units, is from 40 to 920 Mc.

If only one cabinet and power supply are available with the two r-f sections, one r-f section can be substituted for the other easily. The only connection between power supply and r-f section is a multiconductor cable and plug attached permanently to the power supply.

1.2 DESCRIPTION.

1.2.1 CONTROLS. The following controls are on the panel of the Type 1021-AU (or 1021-AV) Standard-Signal Generator:

NAME	TYPE	FUNCTION
Frequency Dial	Direct-reading 6-in. dial. Drive knob has 100-division dial and covers the range in about 11 turns.	Selects frequency.
ATTENUATOR	Dial calibrated from 0.5 μv to 0.5 v, is set by adjustable index. Index is moved by small knob below dial and is set when reference level is established.	Drives mutual-inductance-type attenuator through a rack and pinion.
RANGE (Type 1021-AV only)	2-position selector switch	Selects either 40-50 Mc or 50-250-Mc range.
PUSH TO CAL	Push-button switch	Applies 0.5 v, 60 cps across carrier voltmeter-rectifier and simultaneously turns off plate supply of carrier oscillator.
CALIBRATE	Rotary knob	Adjusts meter sensitivity to read 0.5 v when PUSH TO CAL is depressed.

NAME	TYPE	FUNCTION
METER READS	2-position toggle switch	In CARRIER position, meter indicates voltage across crystal rectifier just ahead of output terminating resistor. Voltages of 0.5 v and over are read directly. In MOD position, meter indicates audio-frequency voltage appearing at carrier oscillator plate in terms of percent modulation. Full scale corresponds to about 50 v and to 50% modulation.
MODULATION	Rotary knobs (2)	Left-hand knob turns modulation off, selects external modulation, or internal modulation at 1 kc. Right-hand knob controls amplitude of modulating voltage.
POWER-OFF	2-position toggle switch	Energizes instrument.

1.2.2 CONNECTIONS. The connections listed below are on the panel of the Type 1021-AU (or 1021-AV) Standard-Signal Generator.

NAME	TYPE	FUNCTION
OUTPUT	Coaxial connector	Output terminal.
EXT MOD	Binding posts (2)	Connection to external modulating source.

1.2.3 FUSES. Power fuses, located in the power supply on the power transformer, are two 1-amp Slo-Blo Type 3AG for 115-v operation, two 0.5-amp Type 3AG for 230-v operation.

Section 2

PRINCIPLES OF OPERATION

2.1 GENERAL. The functional arrangement of the instrument is shown in Figure 2. The upper part of the diagram represents the r-f section and the lower part the power supply. The operating frequency is set by the main six-inch dial of the carrier oscillator. The output voltage is controlled by the ATTENUATOR control. High output voltages are read directly on the carrier meter, which is energized by the carrier voltmeter-rectifier in the r-f section. Low output voltages are set by the ATTENUATOR after a reference level is established at 0.5 volt by means of the meter.

The output impedance is determined by the cylindrical 50-ohm resistor between the carrier voltmeter-rectifier and the output terminal on the panel.

Amplitude modulation is produced in the plate supply of the oscillator by an internal 1000-cycle oscillator or modulation amplifier, depending on the position of the MODULATION switch. The depth of modulation is indicated by the panel voltmeter when the METER READS switch is set to MOD.

2.2 RADIO-FREQUENCY OSCILLATOR.

2.2.1 TYPE 1021-P2 (250-920 MC). (For schematic diagrams, see Figures 9 and 10.) The Type 1021-P2 R-F Unit is housed within two concentric shields on a cylindrical aluminum casting. The tuning unit is a 2-1/2-inch-diameter butterfly circuit (Figure 3) in which both inductance and capacitance are varied without the use of sliding contacts. The wide frequency range is covered by a rotation of about 80 degrees of the rotor.

The oscillator tube (V200) is a Sylvania Type RT-434 Rocket-Type Co-planar Triode. Connections to the electrodes are made with flexible clamps designed to provide low-impedance paths to the tuned circuit and to conduct heat from the tube terminals to the mass of the tuned circuit for cooling. The oscillator uses a Colpitts circuit in which oscillation conditions are determined mainly by the tube grid-to-cathode and plate-to-cathode capacitances. Additional plate-to-cathode capacitance is provided by means of two small soft-copper tabs, C207A and

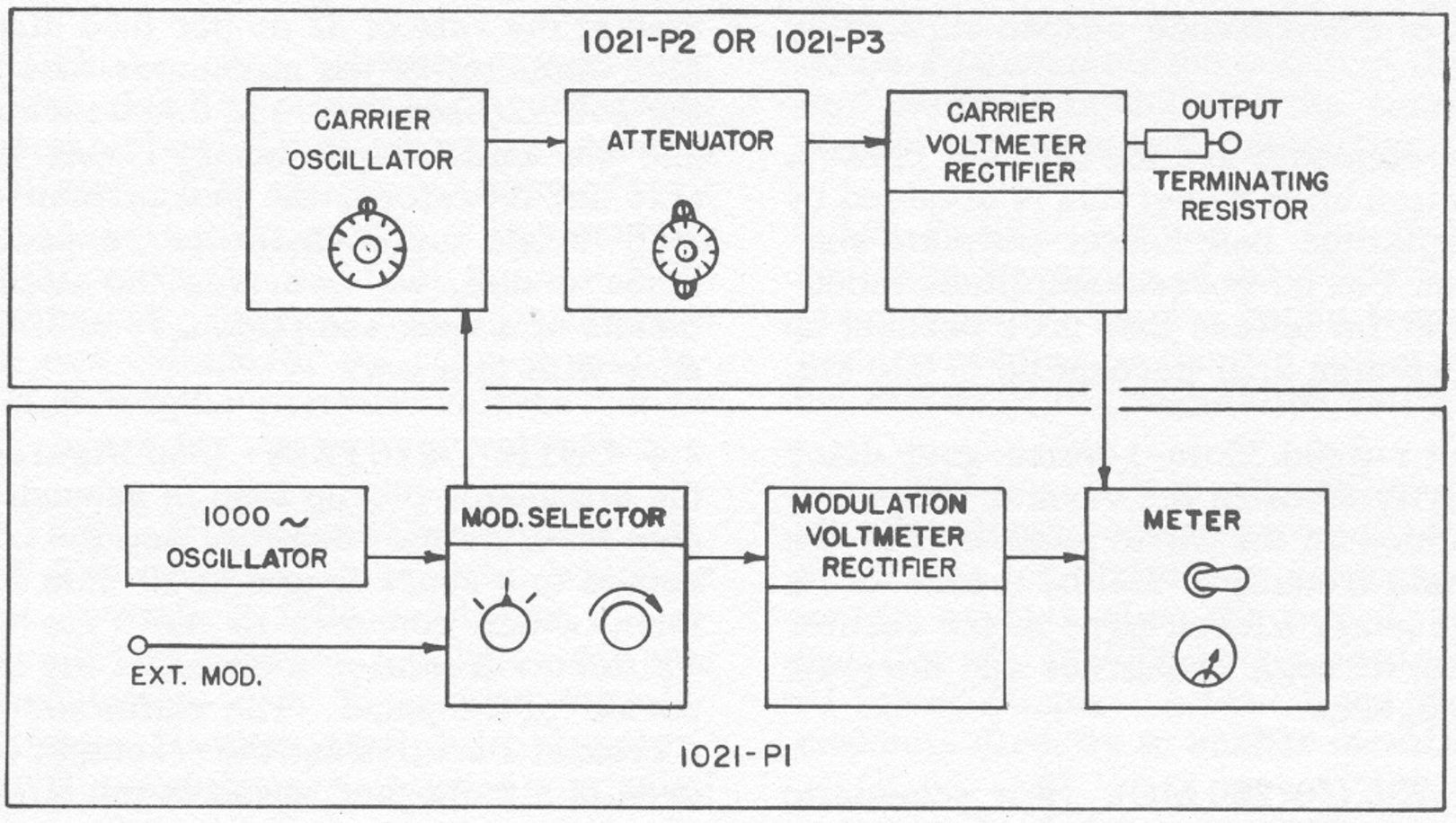

Figure 2. Functional Block Diagram.

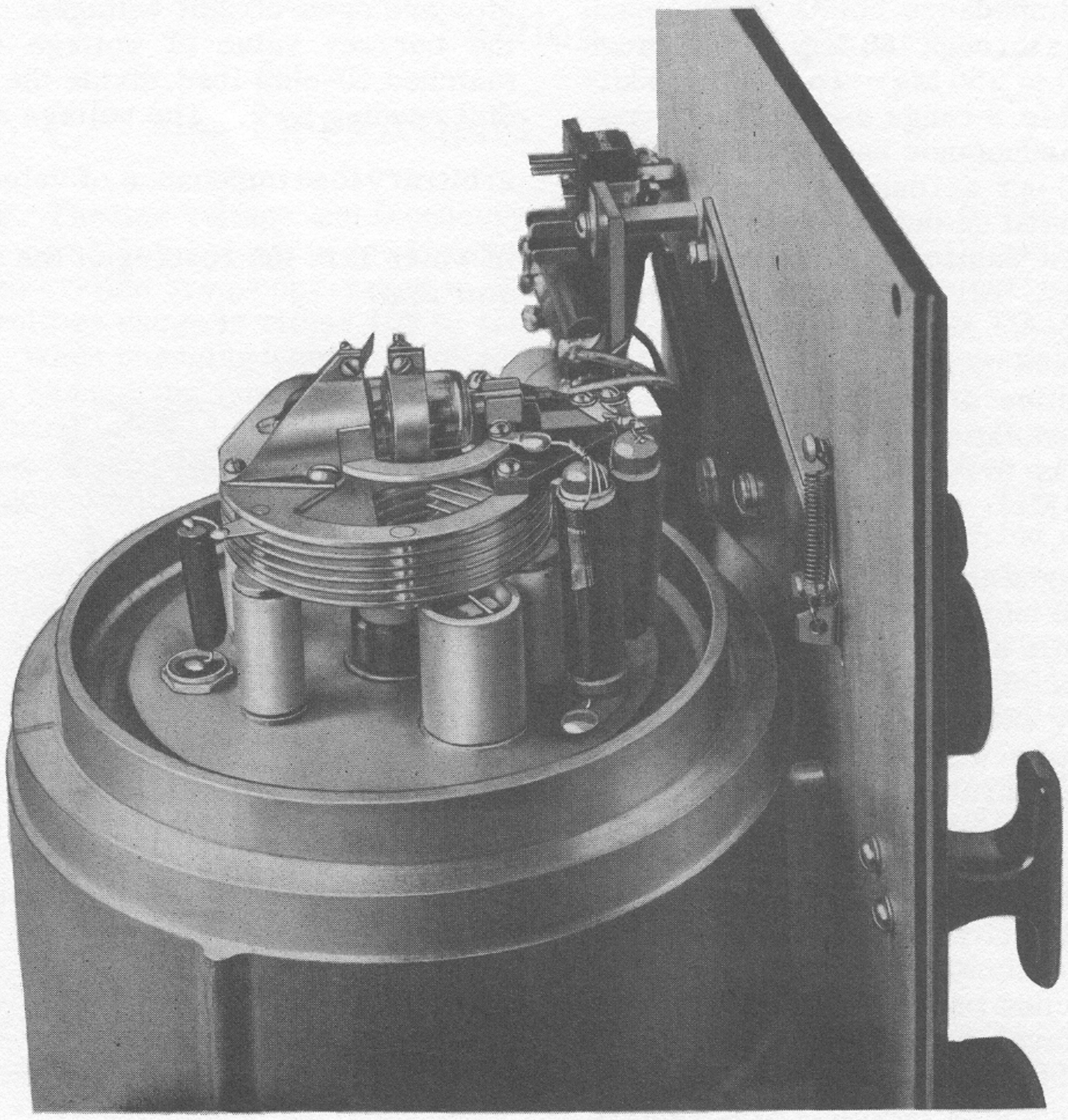

Figure 3. Type 1021-P2 U-H-F Unit, Cover Removed to Show Tube and Butterfly Circuit.

C207B, held close to the plate and connected to the cathode by means of a horseshoe-shaped supporting member.

All the tube elements are fed through chokes. Amplitude modulation up to 50 percent is obtained by plate-voltage modulation. Both heater and plate supplies are regulated. For 50-percent amplitude modulation the incidental fm is less than 0.01 percent up to 400 Mc, and less than 0.10 percent up to 920 Mc.

A simple but rugged 50-to-1 worm-gear drive connects the butterfly rotor to the vernier frequency control, while a pinion on the worm shaft drives the direct-reading main frequency dial by means of its internally cut spur gear. Eleven turns of the vernier dial rotate the rotor through 81 degrees and the main dial through 270 degrees.

2.2.2 TYPE 1021-P3B (40-250 MC). (For schematic diagrams, see Figures 7 and 8.) For the lower-frequency range, a 4-1/2-inch-diameter semibutterfly tuning circuit is used since it can be made smaller than a true butterfly circuit. A standard miniature twin triode, Type 12AT7, is used as the oscillator tube (V100). The two triodes are connected in push-pull across the high-impedance points of the tuned circuit. The rotor turns through 180 degrees to change the frequency from 50 to 250 Mc. To give an additional range of 40-50 Mc, a range switch (S101) connects a low-loss, low-inductance capacitance (C114A and C114B) of about 80 μμf across the tuned circuit. The oscillator is mounted on the top of the cylindrically shaped aluminum casting, and is enclosed by two concentric shields. All leads to the oscillator circuit are well filtered. Amplitude modulation up to 50 percent is obtained by plate modulation. Both heater and plate supplies are regulated. For 50-percent amplitude modulation the incidental fm is less than 0.01 percent up to 100 Mc and approximately 0.05 percent at 250 Mc.

A simple but rugged and smooth 22-to-1 worm-gear drive connects the butterfly rotor to the vernier frequency control, while a pinion on the worm shaft drives the direct-reading main frequency dial by means of its internally cut spur gear. Eleven turns of the vernier dial rotate the rotor through 180 degrees and the main dial through 264 degrees.

2.3 ATTENUATOR. The pickup or output coupling loop on the piston of the mutual-inductance-type attenuator is coupled directly to the r-f field of the butterfly oscillator as shown in Figures 8 and 10. The attenuator tube is just below the oscillator tuned circuit, and extends through the casting base to the rear compartment, which houses the frequency and attenuator drive mechanisms. A simple electrostatic shield (or mode suppressor) is mounted at the input end of the attenuator tube, so that, except for a short distance near the input end, the r-f energy is attenuated at the rate of 32 db per tube diameter. The inside diameter of the attenuator tube is 0.600 inch in the 250-920 Mc Unit and 0.880 inch in the Type 40-250 Mc Unit. To attenuate 1 volt to 0.5 microvolt (126 db) therefore, the pickup loop must be moved 2.36 inches and 3.46 inches respectively. The attenuator dial, which drives the attenuator piston by means of a rack and pinion, is calibrated in accordance with this law.

2.4 OUTPUT SYSTEM. (See Figure 4.) One end of the attenuator pickup loop is grounded through a 50-ohm terminating resistor, and the other end is connected to a short length of 50-ohm flexible shielded lead, which connects to the Type 874-VR Crystal Voltmeter Rectifier mounted at the lower right-hand corner of the panel. The voltmeter unit is built into a coaxial T section and the r-f output voltage is measured at a point just ahead of the 50-ohm cylindrical terminating resistor in the center conductor of the output connector. The rectified output of the crystal drives the output voltmeter located on the power supply panel.

The voltage readings on the meter and attenuator are open-circuit voltages. Thus, to determine the correct value of voltage appearing across a matched 50-ohm load, divide the meter or attenuator dial reading by 2. The voltage appearing across an arbitrary load impedance of value Z_L is $E\left(\frac{Z_L}{Z_L + 50}\right)$, in which E is the reading of the meter or the attenuator dial.

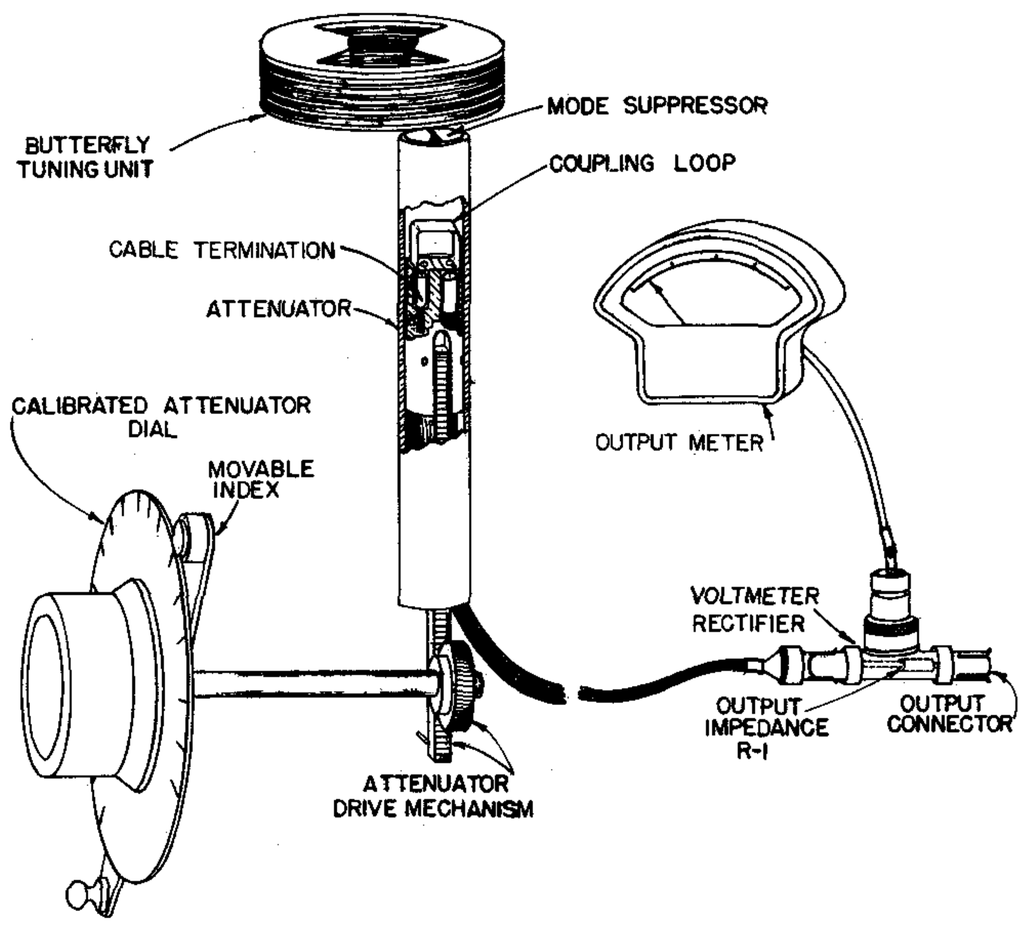

Figure 4. Functional Diagram of Output System.

2.5 POWER SUPPLY UNIT.

2.5.1 POWER SUPPLY. (For schematic diagrams, see Figures 13 and 14.) The power supply furnishes essentially constant plate and filament voltages to the carrier oscillator. The simple VR tube circuit (V3, V4) regulates plate voltage over a line-voltage range of 105 to 125 volts or 210 to 250 volts at 50 to 60 cycles. The Amperite current regulator tube (V1) maintains the heater voltage for the carrier oscillator. A portion of the regulated heater voltage is used as a calibrating source for the carrier voltmeter.

2.5.2 MODULATION. The modulator circuit consists of a single Type 6K6-GT tube (V5), which is connected either as an L-C 1-kc oscillator for internal modulation or as a power amplifier for use with external modulation. For 50-percent modulation it supplies about 50 volts rms to the carrier-oscillator plate. The modulating voltage is controlled by the 100-kilohm rheostat R10 on the right-hand side of the power supply panel. For internal modulation, R10 controls the output of the audio oscillator. For external modulation the control is switched to control the input to the amplifier.

2.5.3 PANEL METER. The panel meter can be switched, by means of the METER READS switch, to indicate either the d-c output from the carrier voltmeter rectifier or the d-c output from the germanium diodes of the modulation voltmeter.

Rheostat R19 is adjusted so that its resistance plus the meter resistance equals 1000 ohms. This is important for frequency compensation of the voltmeter crystal when the new Type 1021-P4 U-H-F Unit (for 900 to 2000 Mc) is used with the Type 1021-P1 Power Supply. A lead from the new r-f section connects directly to anchor terminal No. 4.

Section 3

OPERATING PROCEDURE

3.1 POWER SUPPLY. The line voltage and frequency are indicated on the nameplate below the power input receptacle. The power-line frequency range is 50 to 60 cycles. The voltage range is either 105 to 125 or 210 to 250 volts. When changing from one voltage range to the other, change the power-transformer connections as shown in Figure 13, reverse the nameplate to indicate the appropriate line voltage, and replace the fuses as indicated in paragraph 1.2.3.

The power supply will not operate unless one of the two r-f oscillators is connected by means of the interconnecting cable.

3.2 FREQUENCY CONTROL. The only frequency control of the 250-920 Mc Unit is the vernier knob on the main frequency dial. The frequency range is covered in 270 degrees of rotation of the dial and 11 turns of the vernier knob. The 40-250 Mc Unit has a range switch in addition (refer to paragraph 2.2.2).

3.3 METER ZERO. With the power off, the meter should indicate zero. If it does not, it can be adjusted to zero by means of the screw-driver adjustment on the meter (mechanical zero adjustment). This is the only meter zeroing required, since the panel meter indicates on dc from crystal rectifiers for either modulation or carrier voltage.

3.4 CARRIER VOLTMETER STANDARDIZATION. With the METER READS switch in the CARRIER position, standardize the carrier voltmeter at 0.5 volt by depressing the PUSH TO CAL switch and adjusting the CALIBRATE knob until the meter pointer indicates the red line at 0.5 volt. Depressing the PUSH TO CAL switch removes plate voltage from the carrier oscillator and applies 0.5 volt, 60 cycles across the voltmeter rectifier. The attenuator setting does not affect this procedure, but a load that generates an appreciable terminal voltage will cause the meter to deflect and hence upset the meter calibration. Such a load (for instance, a heterodyne receiver with a strong local oscillator) should have its voltage source shut off during standardization.

The effect of the 60-cycle impedance of the load on the standardizing voltage can usually be disregarded. The standardizing-voltage rheostat (R103 or R203) has been set for a 50-ohm load, and the error for open or shorted conditions is ±1 percent.

Standardization of the carrier voltmeter should be repeated from time to time to compensate for changes in the Type 1N21-B crystal detector, which may be caused by aging, by overloads, or by changes in temperature and humidity.

3.5 SETTING OF OUTPUT VOLTAGES BETWEEN 0.5 AND 2 VOLTS. After the carrier voltmeter has been standardized, output voltages between 0.5 and 2 volts can be set directly. Adjust the ATTENUATOR control until the output meter indicates the desired value with the load connected. The voltage indicated on the meter is the voltage across the load and the internal 50-ohm terminating resistor. A load that generates an appreciable terminal voltage should have its voltage source shut off when the meter is read. Two volts may not be available at all frequencies.

Changes in carrier frequency and load impedance will change the output voltage and the carrier voltmeter reading. After every change, the desired meter reading may have to be restored. To restore the reading, reset the ATTENUATOR dial.

3.6 ATTENUATOR STANDARDIZATION. With the signal generator operating at the desired frequency, and with the load connected and the meter reading carrier output voltage, adjust the carrier output level by means of the ATTENUATOR knob until the meter indicates 0.5 volt. Then move the adjustable attenuator index until it lines up with the red line at 0.5 volt on the attenuator dial. Meter and attenuator dial now read alike at 0.5 volt, and the attenuator is standardized for the particular frequency and load. A load that generates an appreciable terminal voltage should have its voltage source shut off when the meter is read.

3.7 SETTING OF OUTPUT VOLTAGES BELOW 0.5 VOLT. To set output voltages below 0.5 volt, turn the ATTENUATOR dial until the desired value appears under the attenuator index. The voltage indicated by the attenuator index is the voltage across the load and the internal 50-ohm terminating resistor. As the output level is decreased, the reading of the output meter is gradually decreased to zero.

Changes in carrier frequency and load impedance will change the output voltage, but, at low levels, this change cannot be observed on the output meter. After every change the attenuator must be restandardized at 0.5 volt.

Sometimes, particularly in circuits employing tubes and rectifier crystals, the load impedance changes with the voltage applied. This change occurs at higher voltage levels, and may make it impossible to standardize the attenuator at 0.5 volt as long as the voltage on the load is equally high. If this condition is suspected, the attenuator can still be standardized at 0.5 volt if additional attenuation is inserted between the signal generator output terminal and the load. The Type 874-G20 20-db Attenuator is recommended for this purpose.

3.8 OUTPUT IMPEDANCE. As long as the attenuator is standardized for each frequency and load change, the effective output impedance of the Standard-Signal Generator is 50 ohms. Maintaining a constant voltage level at the reference point produces an effective impedance of zero at the output voltmeter. The output impedance of the Standard-Signal Generator is then determined by the terminating resistor at the output terminal. (See Figure 2.)

3.9 MODULATION.

3.9.1 AMPLITUDE MODULATION. Select either internal amplitude modulation at 1000 cycles, external amplitude modulation (30 cps-15kc), or no modulation by means of the MODULATION switch. With the METER READS switch at MOD, the modulation level is indicated on the meter, and can be adjusted by means of the MODULATION control for any degree of modulation up to 50 percent. For more accurate modulation-level settings, depress the PUSH TO CAL switch while reading the modulation meter.

About 12 volts across 100 kilohms is required from the external modulating oscillator for 50-percent modulation.

The Standard-Signal Generator is normally amplitude-modulated by modulating voltages superimposed on the plate supply of the oscillator tubes. Incidental fm inherent in such a system is relatively small, but may be excessive for some applications. Amplitude modulation free of incidental fm can be obtained by the use of auxiliary equipment at the output of the signal generator. A Type 874-G20 20-db Fixed Attenuator is recommended to separate the d-c circuits of the modulators from the carrier meter of the Standard-Signal Generator.

3.9.2 TELEVISION MODULATION. (See Figure 5.) In the Type 1000-P6 Crystal Diode Modulator[1], modulating-frequency voltages are used to vary the resistance of a Type 1N21-B crystal. Therefore, the r-f output of the Standard-Signal Generator can be amplitude-modulated with no incidental fm if the Crystal Diode Modulator is inserted ahead of the load. The modulating-frequency characteristic is flat from zero to several megacycles, and down only 2 db at 5 Mc. A convenient source of video modulation voltages is a television receiver tuned to a local channel. The Type 1000-P6 Modulator is fitted with Type 874 coaxial terminals for the input and output connections and for the modulation circuit. The modulation range is from zero to about 50 percent. The modulator is designed to operate from a 50-ohm source into a 50-ohm load. To avoid distortion, the r-f input to the crystal modulator must be limited to 50 millivolts. The insertion loss is about 12 db over the r-f range of from 20 to 1000 Mc.

[1]Byers, W.F., "An Amplitude Modulator for Video Frequencies", General Radio Experimenter, March, 1950.

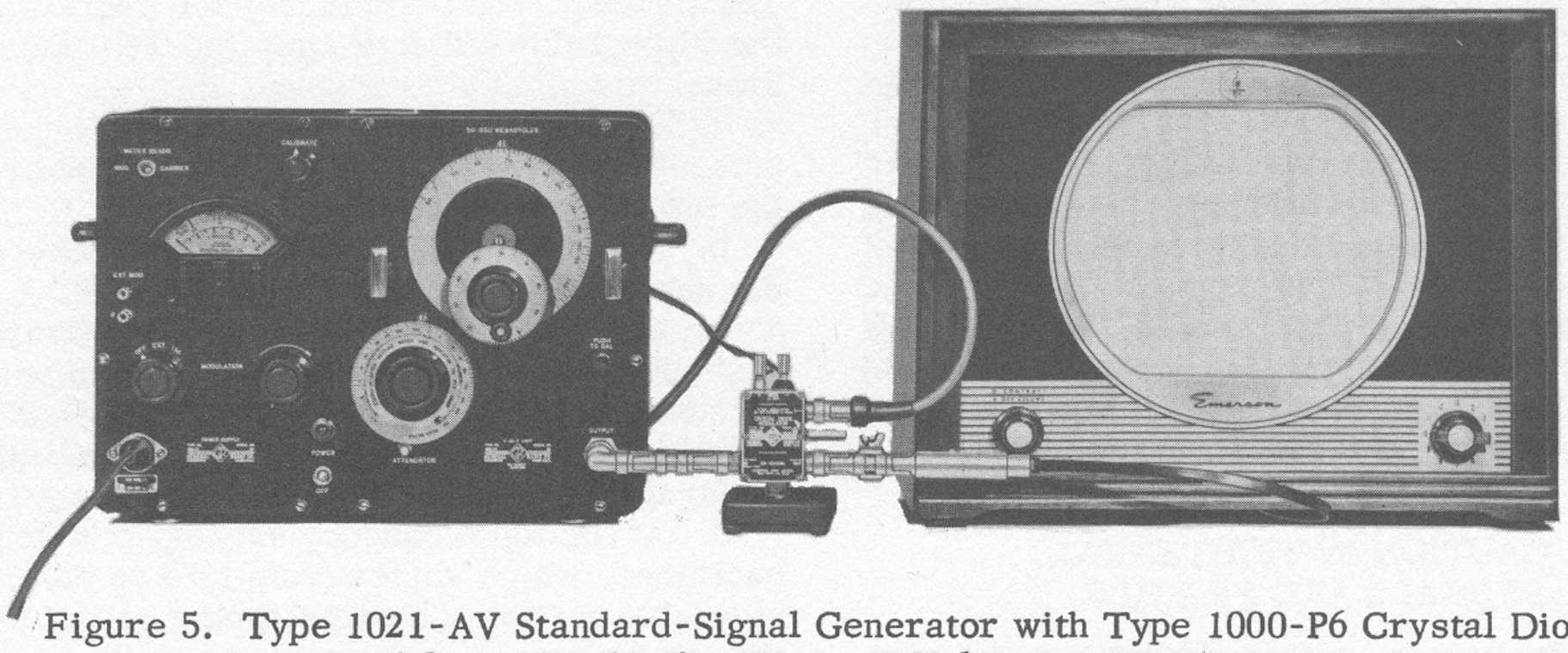

Figure 5. Type 1021-AV Standard-Signal Generator with Type 1000-P6 Crystal Diode Modulator, Set Up for Tests on Television Receiver.

3.9.3 BALANCED MODULATOR. For linear 100-percent amplitude modulation, and for pulse modulation with fast rise times and a high degree of carrier suppression, the Type 1000-P7 Balanced Modulator[2] should be used. This modulator, with a modulation frequency range of from 0 to 20 Mc, can be used at carrier frequencies from 60 to 2500 Mc. Crystal diodes are used in two separate signal paths between input and output. A coaxial phasing line, set to an odd multiple of one-half wavelength at the carrier frequency, is inserted in one of the signal paths. By adjustment of the bias of the two diodes the carrier can be balanced out.

[2]Byers, W.F. "A Balanced Modulator for Pulse Applications", General Radio Experimenter, April, 1954.

Section 4

SERVICE AND MAINTENANCE

4.1 GENERAL. This service information, together with the information given in other sections, should enable the user to locate and correct ordinary difficulties resulting from normal use. Major service problems should be referred to our Service Department, which will cooperate as much as possible by furnishing information and instructions, as well as by supplying any replacement parts needed. When notifying our Service Department of any difficulties in operation or service, specify the serial and type numbers of the instrument. Also give a complete report of the trouble encountered and steps taken to eliminate the trouble.

Before returning an instrument or part for repair, please write to our Service Department, requesting a Returned Material Tag, which includes shipping instructions. Use of this tag will insure proper handling and identification. A purchase order covering repair of material returned should also be forwarded to avoid any unnecessary delay.

4.2 LOCATION OF COMPONENTS. The table on page 9 indicates the location of tubes, pilot lights, and fuses in the instrument.

4.3 REPLACEMENT OF OSCILLATOR TUBE.

4.3.1 GENERAL. If the maximum obtainable output of the r-f oscillator is no longer sufficient to standardize the attenuator at 0.5 volt, the r-f oscillator tube must be replaced. After the tube is replaced, several readjustments may be necessary to restore the frequency calibration and to insure that the new tube is operating properly.

4.3.2 TUBE REPLACEMENT IN 250-920-MC UNIT. The procedure for replacing the oscillator tube in the

Type 1021-P2-R-F Unit (250-920 Mc) is as follows (see Figure 6):

a. Remove the two concentric shield cans from the top of the casting.

b. Remove entirely screw holding plate clamp.

c. Loosen grid clamp screw until tube can be slid into position. Place cathode connection just short of filament clip.

d. Carefully tighten grid clamp, holding tube flange ring in position. Tighten only enough to hold tube firmly.

e. Replace plate screw and carefully tighten plate clamp.

USE CAUTION IN TIGHTENING,
GLASS SEALS ARE FRAGILE.

f. Check the heater voltage directly at the tube terminals. It should be 6.3 volts ±5%. For this measurement, turn off the plate voltage by pushing the PUSH TO CAL switch. If heater voltage is not within limits, refer to paragraph 4.5.

g. At the top frequency setting, grid-to-plate capacitance, which varies slightly from tube to tube, is a considerable portion of the total tuning capacitance. Thus the top frequency obtained varies with tube changes. Adjust the trimmer capacitance, C208 (soft-copper tab on the plate connector), so that the oscillator frequency (as determined by frequency-measuring equipment) agrees with the dial at a setting of 920 Mc. The inner shield can should be in place when frequency is measured.

h. With a milliammeter in series with the oscillator plate-supply lead, adjust plate series resistor R210 (screw-driver control on the main casting near the output cable) so that plate current is 30 ma or less as the oscillator is tuned through its range.

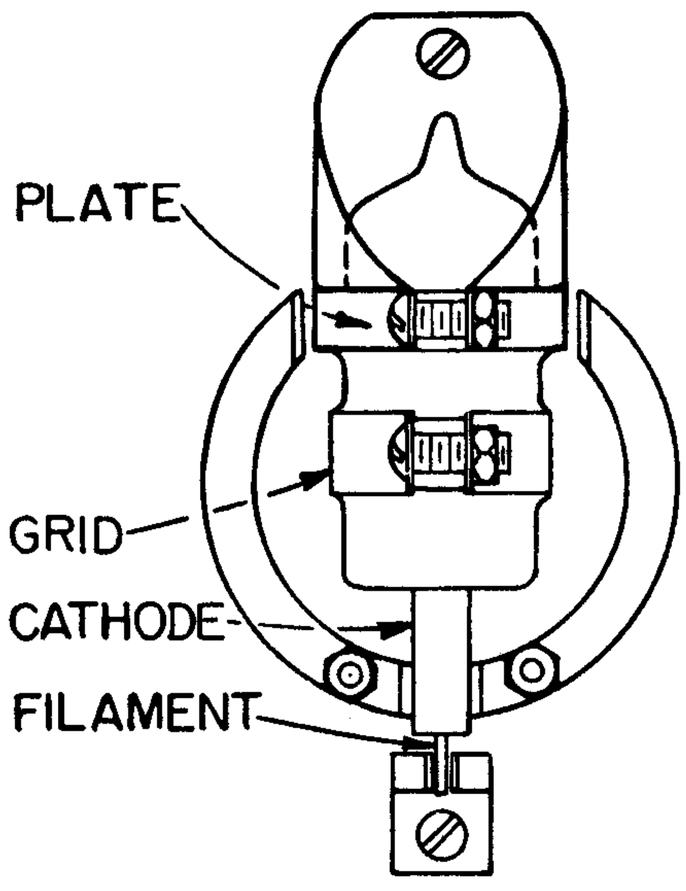

Figure 6. Installation Detail, Type RT-434 Oscillator Tube.

4.3.3 TUBE REPLACEMENT IN 40-250-MC UNIT. The procedure for replacing the oscillator tube in the Type 1021-P3B R-F Unit (40-250 Mc) is as follows:

a. Remove the two concentric shield cans from the top of the casting.

b. Remove the old tube from the socket and insert the new tube.

c. Check the heater voltage at the tube terminals. It should be 6.3 volts ±10%. For this measurement, turn off the plate voltage by pushing the PUSH TO CAL switch. If heater voltage is not within limits, refer to paragraph 4.5.

d. At the top frequency setting, grid-to-plate capacitance, which varies from tube to tube, is a considerable portion of the total tuning capacitance. Thus the top frequency obtained varies with tube changes. Adjust the trimmer capacitance, C110 (small, slotted rectangular plate spanning the gap in the top stator plate), so that the oscillator frequency (as determined by frequency-measuring equipment) agrees with the dial at a setting of 250 Mc. The inner shield can should be in place when frequency is measured.

e. With a milliammeter in series with the oscillator plate-supply lead, adjust grid resistor R108 (screw-driver control in bottom of lower casting well) so that plate current is 25 ma or less as the oscillator is tuned through its range. The inner shield should be in place for this adjustment.

4.4 REPLACEMENT OF RECTIFIER CRYSTAL. If the carrier output meter cannot be standardized according to the procedure outlined in paragraph 3.4, the 60-cycle calibration voltage may not be correct (refer to paragraph 4.5), or the voltmeter crystal may be damaged and need replacement. Remove the crystal from the output voltmeter as follows:

a. After removing the small screw, disconnect the voltmeter output lead, located in back of the panel, just below the PUSH TO CAL switch. (The screw is omitted on some instruments. On these instruments, merely pull the lead from the voltmeter terminal.)

b. Unscrew and remove the voltmeter cap on which the output terminal is located.

c. Loosen the small spring clamp that holds the crystal cartridge in place, and remove the cartridge.

Any Type 1N21-B replacement crystal will yield accurate results if used in accordance with instructions in paragraphs 3.4, 3.6, and 3.7 for output voltages below 0.5 volt. For accurate output voltages between 0.5 and 2 volts (paragraph 3.5), the crystal characteristic must match the meter scale. Selected crystals that conform to the original accuracy specifications of the instrument can be obtained from General Radio Company. Any Type 1N21-B crystal can be checked between 0.5 and 2 volts by the following procedure: Disconnect the long shielded lead from the oscillator circuit by unplugging the con-

nector at the rear of the output voltage-rectifier unit. At this same point, feed into the voltage-rectifier unit an external 60-cycle calibrating voltage in parallel with an accurate vacuum-tube voltmeter, such as the General Radio Type 1800-B. For this calibration, the power supply must be turned off and the PUSH TO CAL button depressed.

4.5 REPLACEMENT OF REGULATOR TUBE V1. If the heater voltage is not as specified in paragraph 4.3.2f or 4.3.3c, the regulator tube V1 may be defective. However, before replacing V1, verify the resistance values of the series resistors (R102 and R103 in Type 1021-P3B; R202 and R203 in Type 1021-P2).

If either the Amperite regulator tube (V1) or the r-f oscillator tube is changed, heater currents may change enough to affect the 0.5-volt voltmeter calibrating voltage. Check this by pushing the PUSH TO CAL switch and measuring the 60-cycle voltage between the exposed terminal of the Type 874-VR Voltmeter Rectifier (in back of the panel just below the PUSH TO CAL switch) and ground. Use a reliable vacuum-tube voltmeter, such as the General Radio Type 1800-B. If the voltage must be reset, adjust the screw-driver control (R103 or R203) mounted on the resistor strip just above the PUSH TO CAL switch.

LOCATION CHART

Reference Designation	Description	Function	Location
Type 1021-P2 R-F Unit (250-920 Mc):			
V200	TUBE, Sylvania RT-434	Oscillator	On tuned circuit on upper side of oscillator casting within two cylindrical shields.
RX201	DIODE, 1N21-B	Rectifier crystal for rf	In output voltmeter unit in back of output terminal.
Type 1021-P3B R-F Unit (40-250 Mc):			
V100	TUBE, 12AT7	Oscillator	On tuned circuit on upper side of oscillator casting within two cylindrical shields.
RX101	DIODE, 1N21-B	Rectifier crystal for rf	In output voltmeter unit in back of output terminal.
Type 1021-P1 Power Supply:			
V1	TUBE, Amperite 6-4	Heater Regulator	On power-supply shelf. See Figure 15.
V2	TUBE, 6X5-GT/G	Rectifier	See Figure 15.
V3	TUBE, OC3/VR-105	Regulator	See Figure 15.
V4	TUBE, OC3/VR-105	Regulator	See Figure 15.
V5	TUBE, 6K6-GT/G	Modulator	See Figure 15.
RX1	DIODE, 1N34	Rectifier crystal for modulation	On resistor strip.
RX2	DIODE, 1N34	Rectifier crystal for modulation	On resistor strip.
P1	LAMP, 6-8 v	Pilot light	Mounted on panel.
F1	FUSE, Slo-Blo 3AG	Power fuse	On power-transformer terminal plate.
F2	FUSE, Slo-Blo 3AG	Power fuse	On power-transformer terminal plate.

Section 5

PARTS LIST

			GR NO. (NOTE A)
	TYPE 1021-P3B V-H-F UNIT		
RESISTORS (NOTE B)	R100	5.1 k ± 5%, 2 w	REW-6C
	R101	5.1 k ± 5%, 2 w	REW-6C
	R102	10 ± 5%, 2 w	REW-6C
	R103	10 ±10%	POSW-3
	R104	5.1 k ± 5%, 1/2 w	REC-20BF
	R105	10 ± 5%, 1/2 w	REC-20BF
	R106	10 ± 5%, 1/2 w	REC-20BF
	R107	5.1 k ± 5%, 1/2 w	REC-20BF
	R108	1 k ±10%	POSC-11
	R109	150 ± 5%, 1/2 w	REC-20BF
	R110	39 ± 5%, 1/2 w	REC-20BF
	R111	50 ± 1% (part of RX100)	REU-10
	R112	5.1 ±10%, 1/2 w	REW-3C
	R113	47 k ±10%, 2 w	REC-41BF
CAPACITORS (NOTE D)	C100	16 µf +100% -10%, 150 dcwv	COE-4
	C101	100 ±10%, 500 dcwv	COU-8-2
	C102	2000	COU-10
	C103	200 ±10%, 500 dcwv	COU-8-2
	C104	200 ±10%, 500 dcwv	COU-8-2
	C105	2000	COU-10-2
	C106	2000	COU-10-2
	C107	1000 ±20%	GP, CN-1
	C108	4.7 ±0.5 µµf	CC-20CG-050D
	C109	4.7 ±0.5 µµf	CC-20CG-050D
	C110	Built-in trimmer	
	C111	1000 (part of LC101)	1021-214
	C112	1000 (part of LC101)	COU-25
	C113	300-400 (part of RX100)	
	C114A	43 ± 5%	COM-20E
	C114B	43 ± 5%	COM-20E
MISCELLANEOUS	L100	Choke, 185 µh	ZCHA-30
	L101	Choke, 185 µh	ZCHA-30
	L102	Choke, 20 µh	ZCHA-29
	L103	Choke, 20 µh	ZCHA-48
	L104	Attenuator Loop (part of attenuator)	
	L105	Choke, 2 µh (part of LC101)	ZCHA-37
	L106	Choke, 185 µh	ZCHA-30
	LC100	Butterfly, 44-250 Mc	Built-in
	LC101	Filter	1021-302
	PL100	Plug	CDMP-1264-8
	RX100	Voltmeter Rectifier	874-309
	RX101	Rectifier (part of RX100)	1N21B
	S100	Switch, tpdt	SWP-3
	S101	Switch, spst	Built-in

NOTES

(A) Type designations for resistors and capacitors:

COE - Capacitor, electrolytic
COEB - Capacitor, electrolytic block
COL - Capacitor, oil
COM - Capacitor, mica
COU - Capacitor, unclassified
POSC - Potentiometer, composition
POSW - Potentiometer, wire-wound
REC - Resistor, composition
REF - Resistor, film
REPO - Resistor, power
REU - Resistor, unclassified
REW - Resistor, wire-wound

(B) All resistances are in ohms, except as otherwise indicated by k (kilohms) or M (megohms).

(C) Capacitances in microfarads.

(D) Capacitances in micro-microfarads unless otherwise indicated by µf (microfarads).

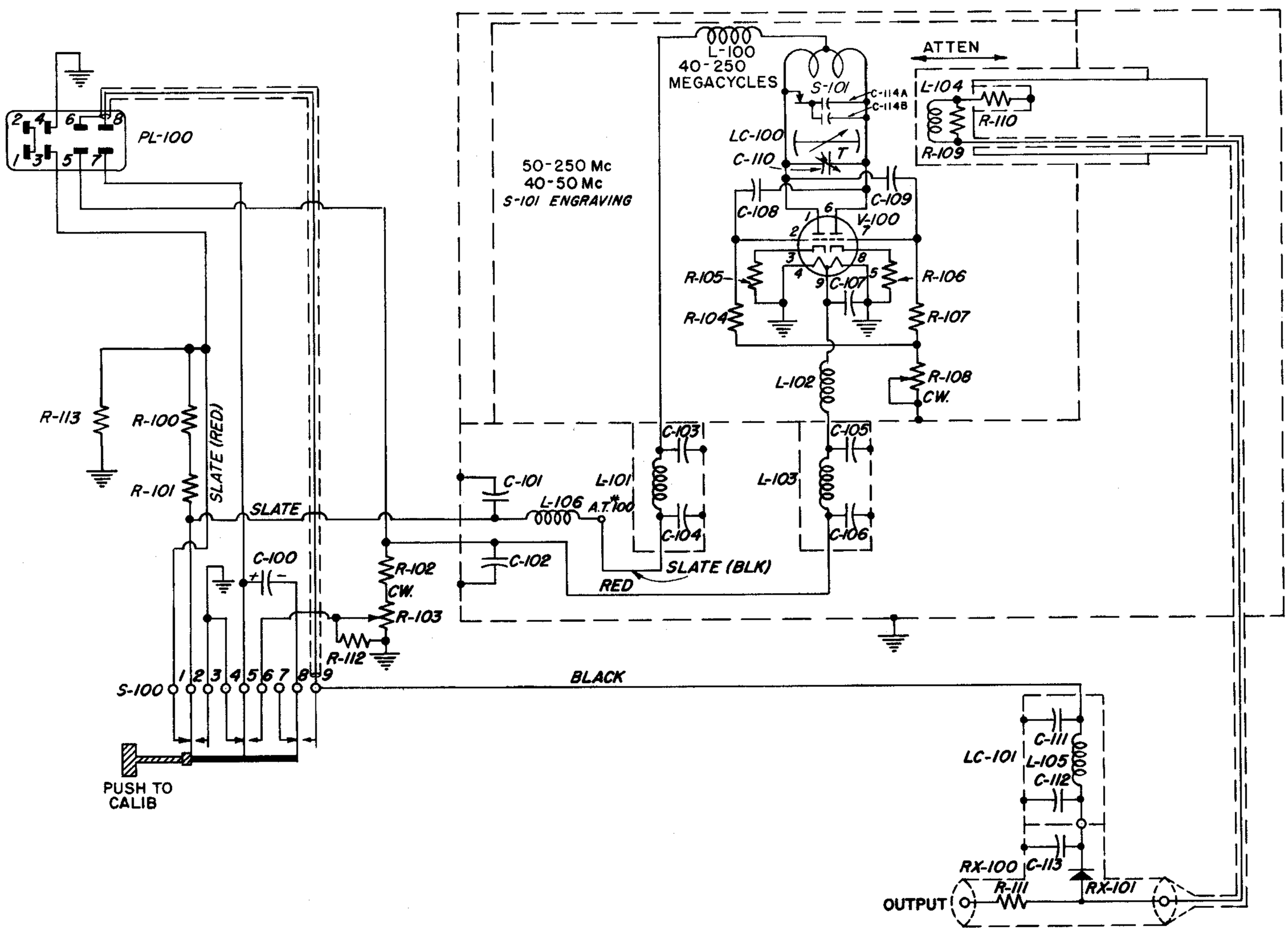

Figure 7. Schematic Diagram, Type 1021-P3B V-H-F Unit.

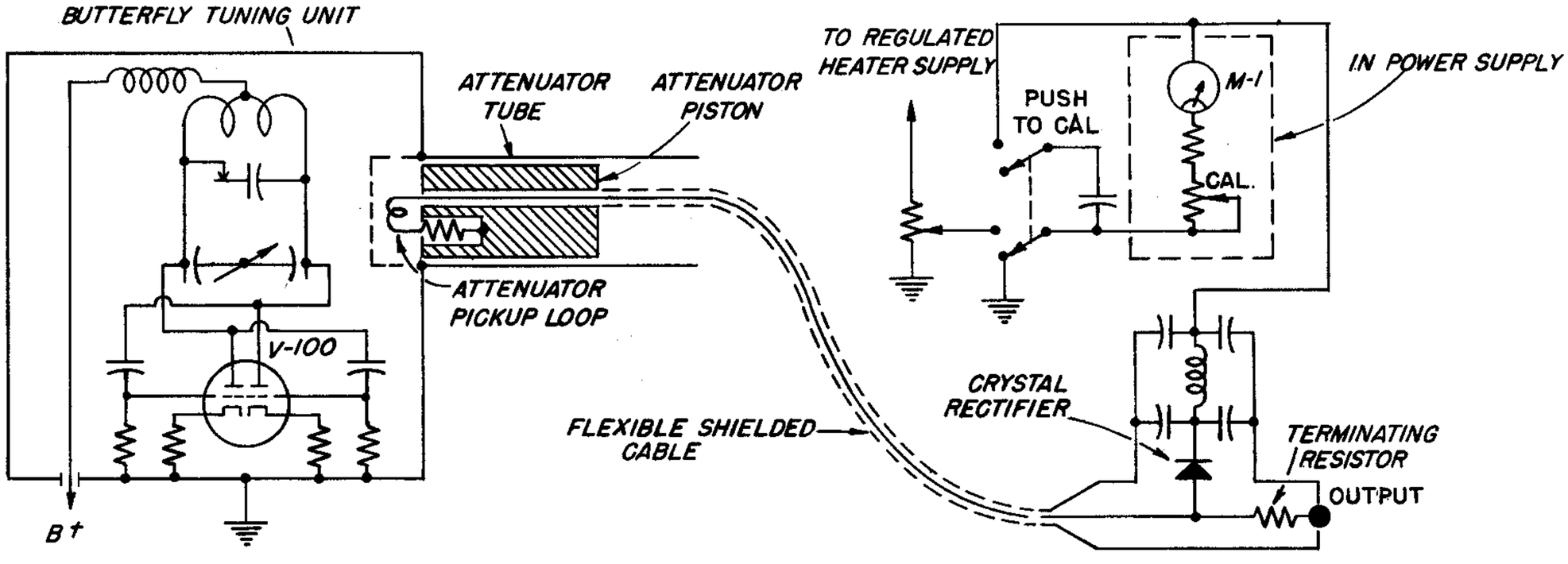

Figure 8. Elementary Schematic Diagram, Type 1021-P3B V-H-F Unit.

PARTS LIST (Cont)

			GR NO. (NOTE A)
	TYPE 1021-P2 U-H-F UNIT		
RESISTORS (NOTE B)	R200	5.1 k ±10%, 2 w	REW-6C
	R201	5.1 k ±10%, 2 w	REW-6C
	R202	24 ± 5%, 2 w	REW-6C
	R203	10 ±10%	POSW-3
	R205	1.0 k ±10%, 1/2 w	REC-20BF
	R206	51 ± 5%, 1/2 w	REC-20BF
	R207	50 ± 1% (part of RX200)	REU-10
	R208	5 k ±10%	POSW-3
	R209	5.1 ±10%, 1/2 w	REW-3C
	R210	2.5 k ±10%	POSC-11
	R211	1 k ±10%, 2 w	REW-6C
CAPACITORS (NOTE D)	C200	16 µf +100% -10%, 150 dcwv	COE-4
	C201	100 ±10%, 500 dcwv	COU-8-2
	C202	500 ±10%, 500 dcwv	COU-8-2
	C203	200 ±10%, 500 dcwv	COU-8-2
	C204	200 ±10%, 500 dcwv	COU-8-2
	C205	500 ±10%, 500 dcwv	COU-8-2
	C206	500 ±10%, 500 dcwv	COU-8-2
	C207A	Built-in air adjustment	
	C207B	Built-in air adjustment	
	C208	Built-in air adjustment	
	C209	10, Built-in mica	
	C210	1000 (part of LC201)	1021-214
	C211	1000 (part of LC201)	COU-25
	C212	300-400, built-in mica (part of RX200)	
MISCELLANEOUS	L200	Choke, 45 µh	ZCHA-9
	L201	Choke, 45 µh	ZCHA-9
	L204	Choke, 20 µh	ZCHA-48
	L205	Choke, 45 µh	ZCHA-9
	L206	Attenuator Loop (part of attenuator)	
	L207	Choke, 2 µh (part of LC201)	ZCHA-37
	L208	Choke, 45 µh	ZCHA-39
	LC200	Butterfly, 250-920 Mc	Built-in
	LC201	Filter	1021-302
	LR1	Heater Filter	1021-216
	PL200	Plug	CDMP-1264-8
	RX200	Voltmeter Rectifier	874-309
	RX201	Rectifier (part of RX200)	1N21-B
	S200	Switch, tpdt	SWP-3

NOTES

(A) Type designations for resistors and capacitors:

COE - Capacitor, electrolytic
COEB - Capacitor, electrolytic block
COL - Capacitor, oil
COM - Capacitor, mica
COU - Capacitor, unclassified
POSC - Potentiometer, composition
POSW - Potentiometer, wire-wound
REC - Resistor, composition
REF - Resistor, film
REPO - Resistor, power
REU - Resistor, unclassified
REW - Resistor, wire-wound

(B) All resistances are in ohms, except as otherwise indicated by k (kilohms) or M (megohms).

(C) Capacitances in microfarads.

(D) Capacitances in micro-microfarads unless otherwise indicated by µf (microfarads).

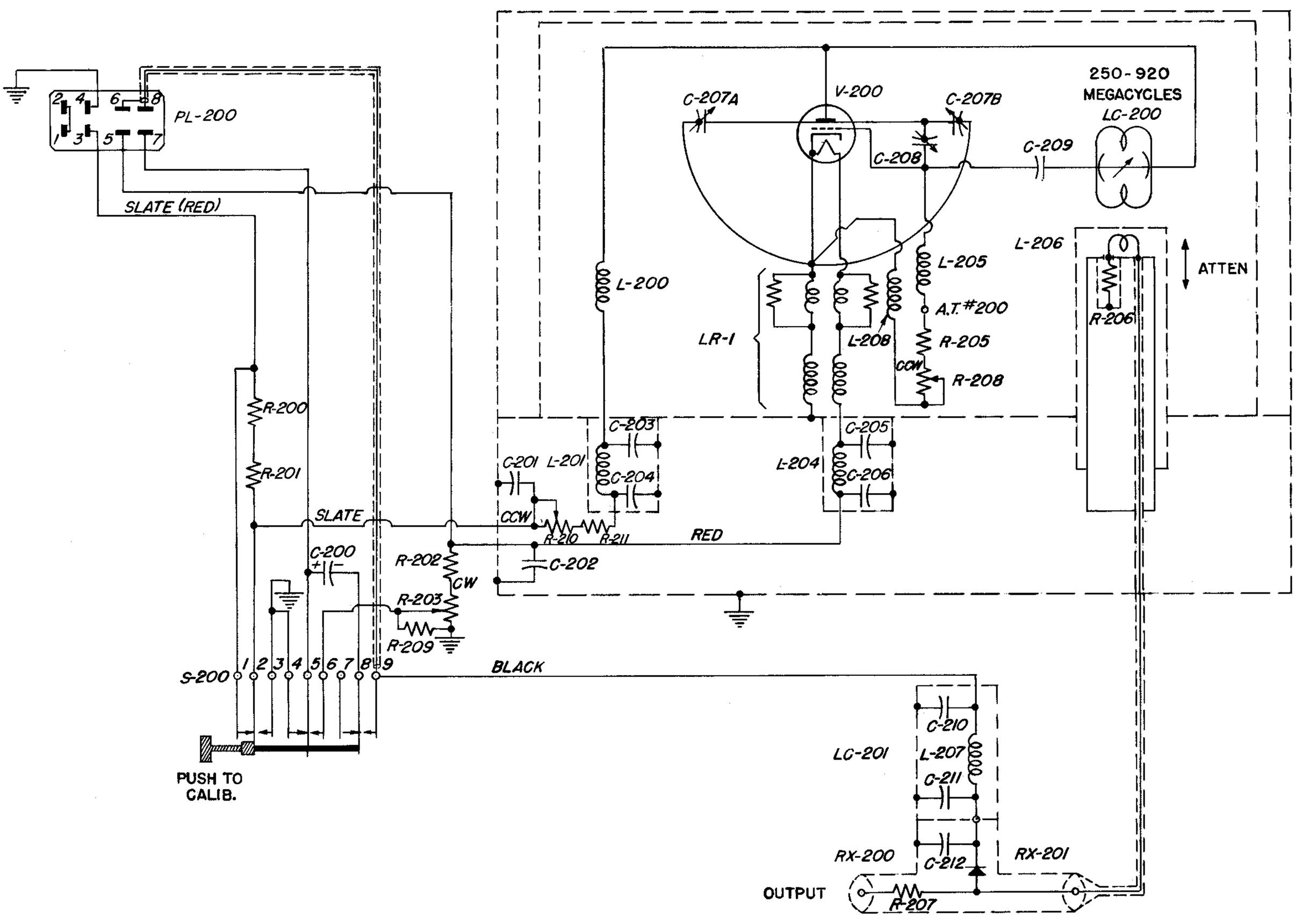

Figure 9. Schematic Diagram, Type 1021-P2 U-H-F Unit.

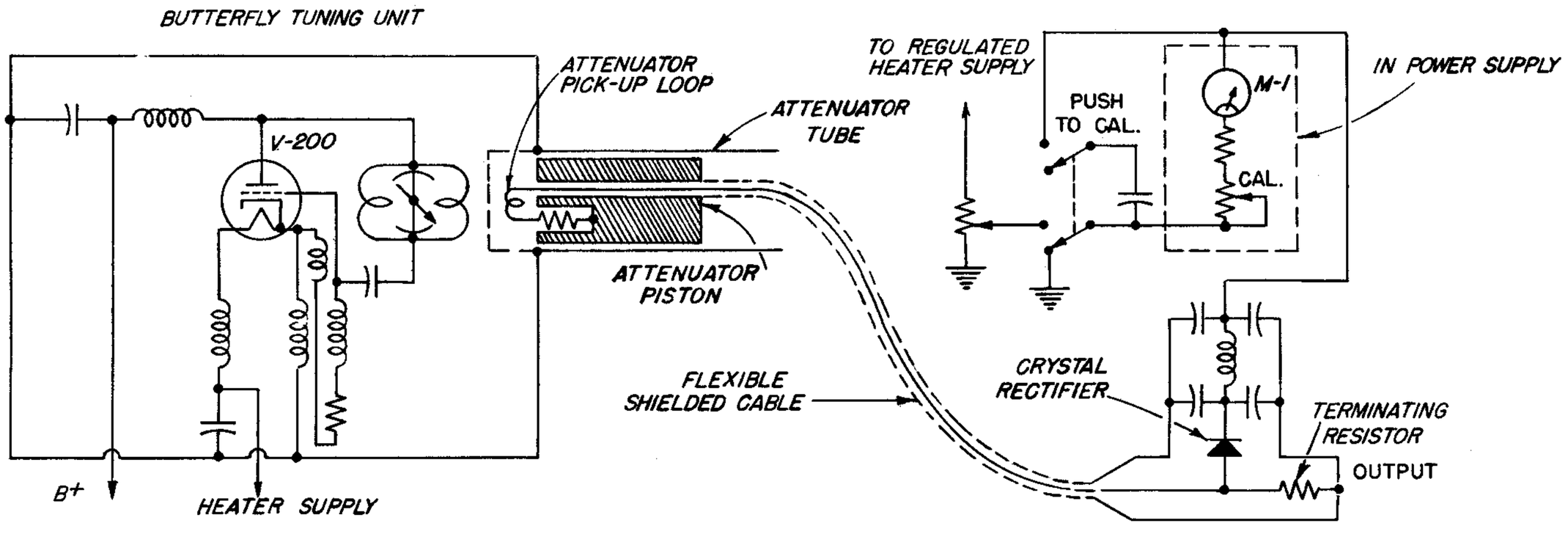

Figure 10. Elementary Schematic Diagram, Type 1021-P2 U-H-F Unit.

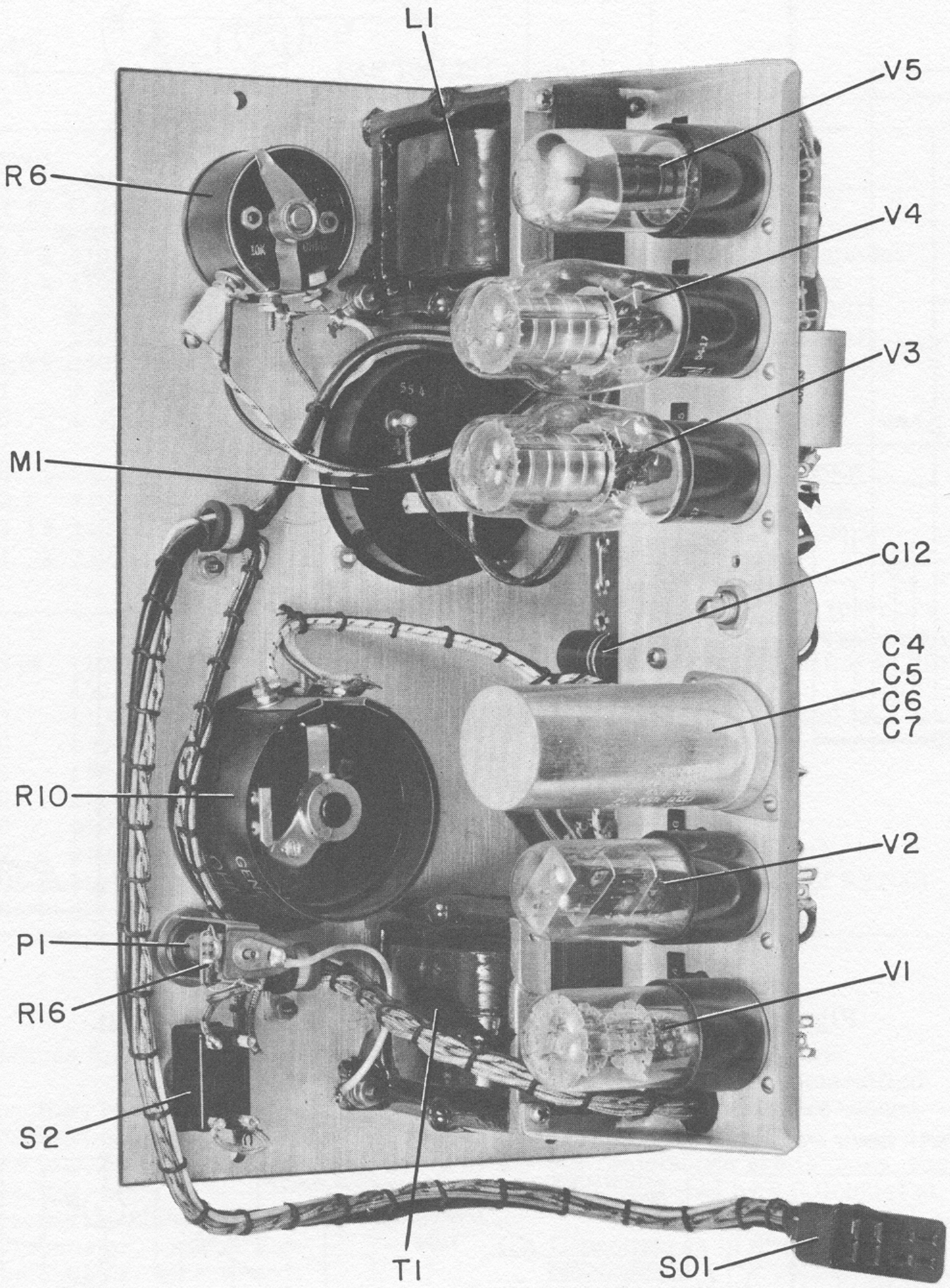

Figure 11. Interior View, Type 1021-P1 Power Supply.

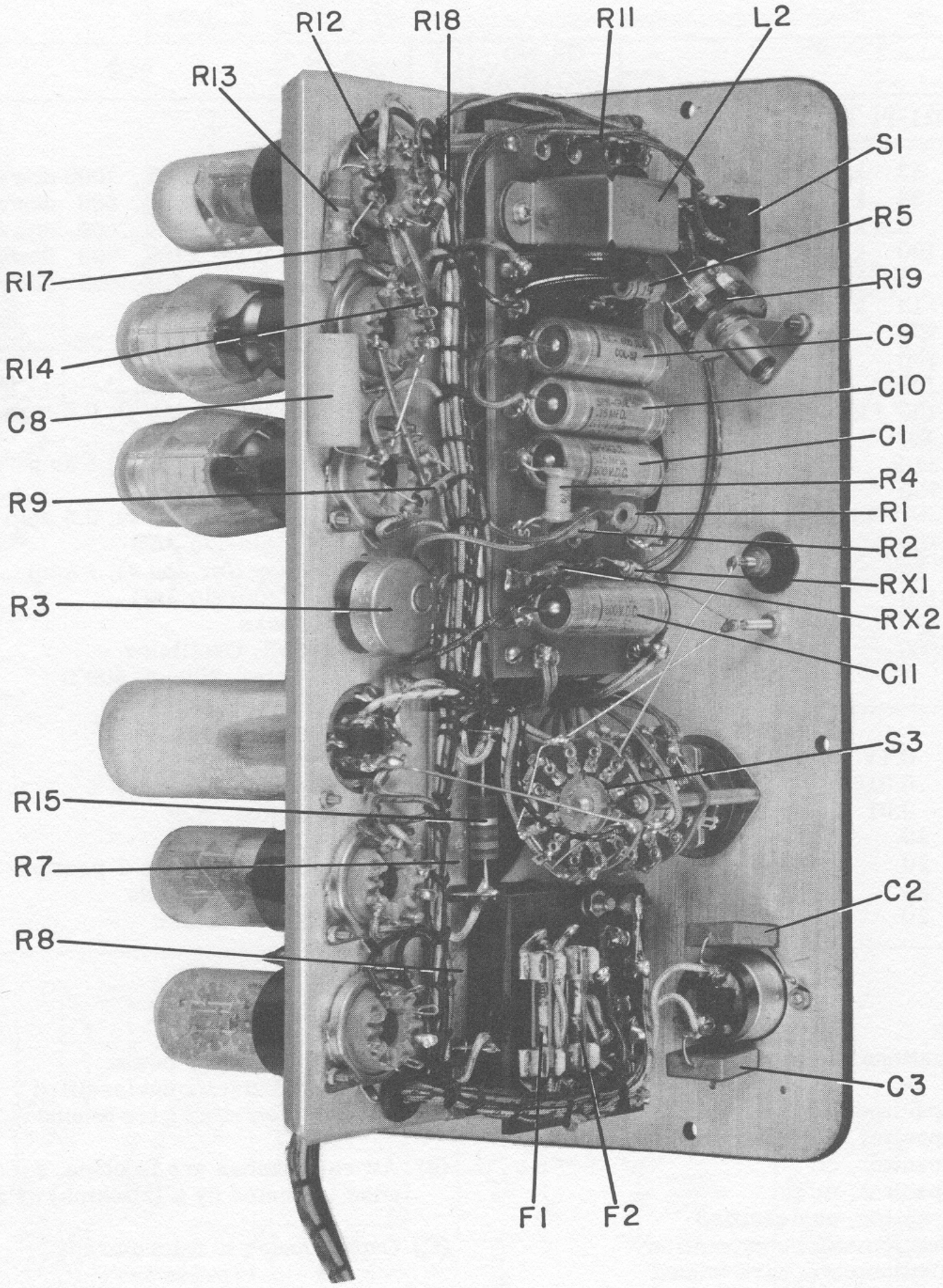

Figure 12. Interior View, Type 1021-P1 Power Supply.

PARTS LIST (Cont)

			GR NO. (NOTE A)
	TYPE 1021-P1 POWER SUPPLY		
RESISTORS (NOTE B)	R1	33 k ± 5%, 1/2 w	REF-1
	R2	33 k ± 5%, 1/2 w	REF-1
	R3	2.5 k ±10%	POSW-3
	R4	100 k ± 5%, 1/2 w	REF-1
	R5	5.6 k ±10%, 1/2 w	REF-1
	R6	10 k ± 5%	301-A
	R7	900 ±10%	REPO-33
	R8	900 ±10%	
	R9	100 ±10%, 1/2 w	REW-3C
	R10	100 k ± 5%	314-A
	R11	330 ± 5%, 1/2 w	REW-3C
	R12	270 ± 5%, 1/2 w	REW-3C
	R13	750 ± 5%, 1 w	REW-4C
	R14	1 M ±10%, 1/2 w	REC-20BF
	R15	1800 ±10%, 2 w	REC-41BF
	R16	15 ±10%, 1/2 w	REW-3C
	R17	180 ±10%, 1/2 w	REW-3C
	R18	180 ±10%, 1/2 w	REW-3C
	R19	1000 ±10%	POSW-3
CAPACITORS (NOTE C)	C1	0.15 ±10%, 600 dcwv	COL-57
	C2	0.01 ±10%	COM-35B
	C3	0.01 ±10%	COM-35B
	C4	20 450 dcwv	COEB-25
	C5	20 450 dcwv	
	C6	20 450 dcwv	
	C7	20 450 dcwv	
	C8	0.02 ±10%, 1000 dcwv	COL-33
	C9	0.15 ± 5%, 600 dcwv	COL-57
	C10	0.15 ±10%, 600 dcwv	COL-57
	C11	0.15 ±10%, 600 dcwv	COL-57
	C12	0.1 ±10%, 600 dcwv	COL-71
MISCELLANEOUS	F1	Fuse (for 115 v), 0.5 amp Slo-Blo 3AG	FUF-1
	F1	Fuse (for 230 v), 1 amp Slo-Blo 3AG	FUF-1
	F2	Fuse (for 115 v), 0.5 amp Slo-Blo 3AG	FUF-1
	F2	Fuse (for 230 v), 1 amp Slo-Blo 3AG	FUF-1
	L1	Choke	485-458
	L2	Coil, Oscillator	746-412
	M1	Meter, 200 μa, 600 Ω	MEDS-40
	P1	Pilot Light	2LAP-939
	PL1	Plug, Power	CDPP-562A
	RX1	Rectifier	1N34-A
	RX2	Rectifier	1N34-A
	S1	Switch, dpdt	SWT-335
	S2	Switch, dpst	SWT-333
	S3	Switch, 8-pole 3-position	SWRW-50
	SO1	Socket, 8-blade	CDMS-1-8
	T1	Transformer	485-459

NOTES

(A) Type designations for resistors and capacitors:

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COEB - Capacitor, electrolytic block
COL - Capacitor, oil
COM - Capacitor, mica
COU - Capacitor, unclassified
POSC - Potentiometer, composition
POSW - Potentiometer, wire-wound
REC - Resistor, composition
REF - Resistor, film
REPO - Resistor, power
REU - Resistor, unclassified
REW - Resistor, wire-wound

(B) All resistances are in ohms, except as otherwise indicated by k (kilohms) or M (megohms).

(C) Capacitances in microfarads.

(D) Capacitances in micro-microfarads unless otherwise indicated by μf (microfarads).

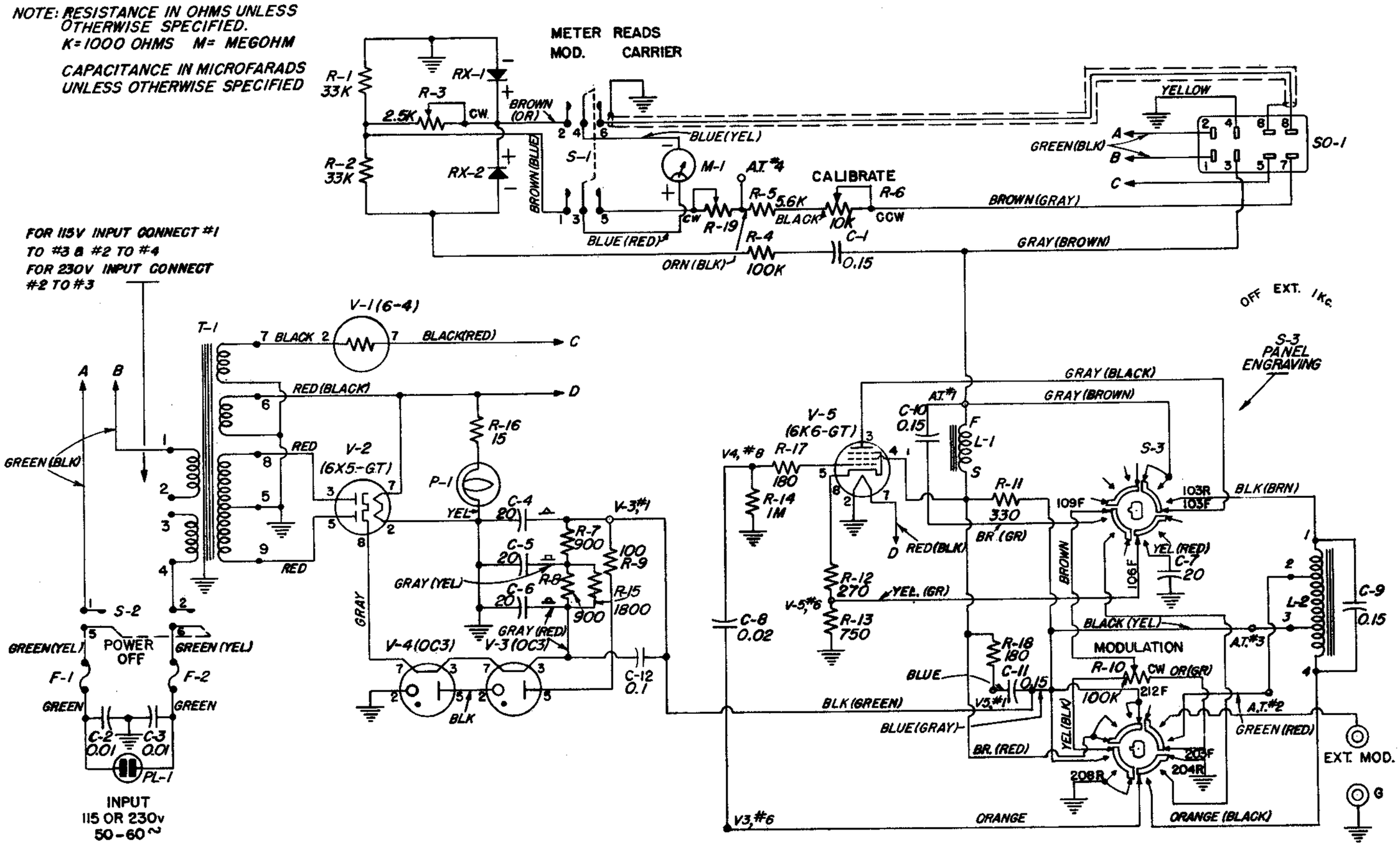

Figure 13. Schematic Diagram, Type 1021-P1 Power Supply.

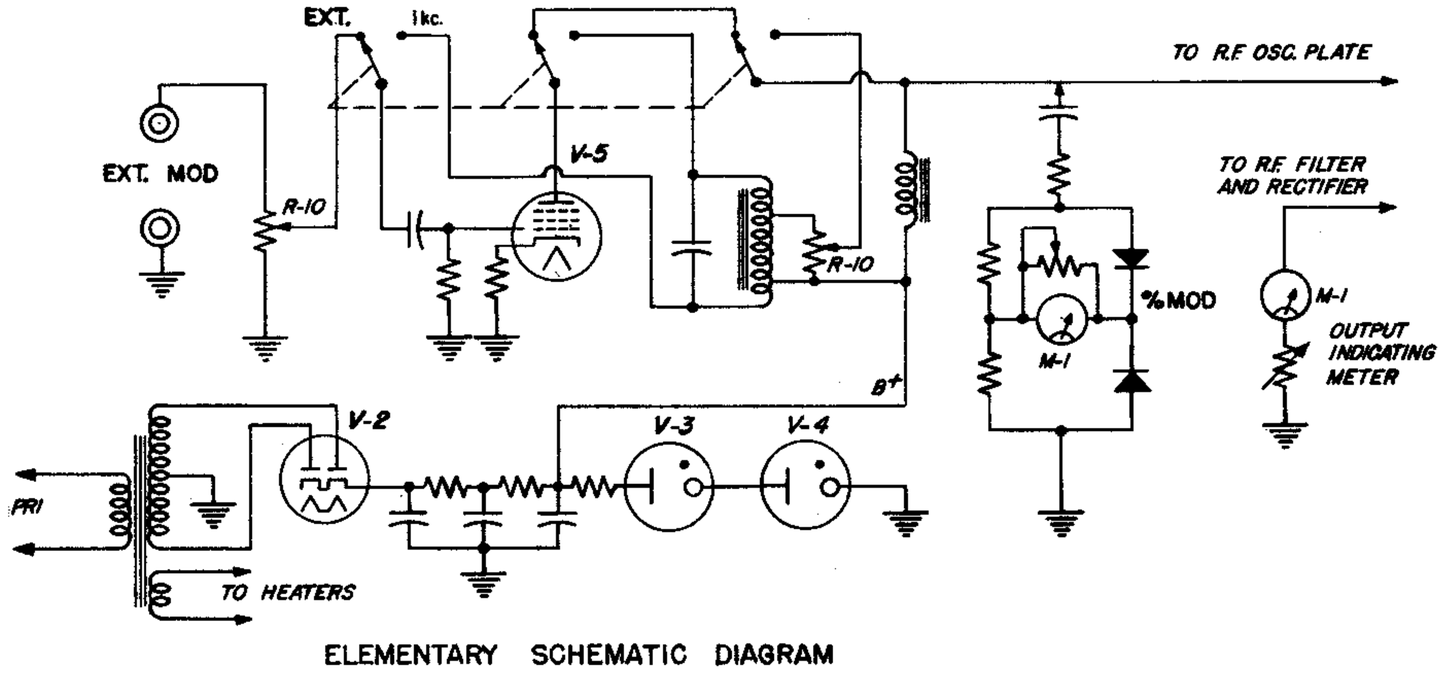

Figure 14. Elementary Schematic Diagram, Type 1021-P1 Power Supply.

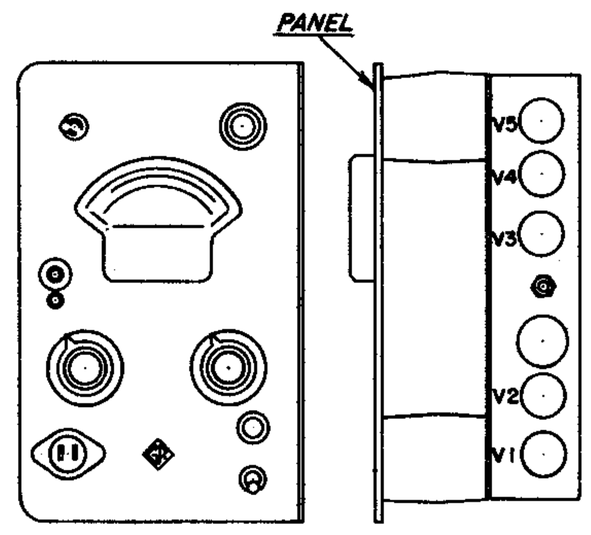

Figure 15. Tube Location Diagram, Type 1021-P1 Power Supply.