

OPERATING INSTRUCTIONS FOR TYPE 605-B STANDARD-SIGNAL GENERATOR

1.0 DESCRIPTION

1.1 PURPOSE

The Type 605-B Standard-Signal Generator is a device for producing radio-frequency oscillations over a wide frequency band and is so arranged and shielded that a continuously-variable calibrated output voltage is obtainable across its output terminals. It is designed and intended primarily for testing radio receivers.

1.2 FREQUENCY RANGE

The frequency range is 9.5 kc to 30 Mc. This range is covered by seven steps which can be chosen by a band change switch on the front of the panel. Within each range the frequency is varied by means of a straight-line-logarithmic condenser. Percentage frequency change, therefore, is proportional to tuning condenser dial rotation. The dial is direct-reading in frequency over the entire range and can be set with an accuracy better than 1 per cent without calibration.

An additional oscillator coil covering a range from 30 to 50 Mc is also provided. These frequencies are outside the design range of the instrument and no guarantee of accuracy is made for either frequency or output voltage.

A frequency calibration for this coil is given on page 11.

1.3 OUTPUT

The output is continuously variable from 0.5 microvolt to 0.1 volt and is determined by the settings of two attenuator dials and the reading of a vacuum-tube voltmeter. In addition to this variable output a constant output of 1 volt can be obtained directly across the vacuum-tube voltmeter. The output may be obtained either unmodulated or modulated. Modulation is adjustable between 0 and 80 per

cent. An internal source for modulation at 400 cycles per second is provided. Provision is also made for the use of external modulation. Provision is also made for connecting an external frequency modulator.

1.4 POWER SUPPLY

1.41 A-C Operation

The Type 605-B Standard-Signal Generator is designed to be used in connection with the Type 605-P1 Power Supply Unit operated from the mains. This unit, built on a separate panel, is mounted in the signal generator cabinet. All necessary connections are made inside. The power transformer is of the flux-regulated type and will deliver constant plate and filament voltages independent of ordinary line voltage fluctuations. Since the flux density of the transformer depends on the a-c line frequency, power supplies are built for 60-, 50-, and 42-cycle lines.

1.42 Battery Operation

For battery operation the power supply can be replaced by the Type 605-P10 Control Panel, which has the necessary meters and rheostats to maintain the correct operating voltages.

1.43 Operating Voltages

For proper operation and to obtain the rated accuracy it is important that plate and filament voltages be kept constant at the specified values. Plate supply voltage is 200 volts. Of these 25 volts are used as bias and 175 as plate voltage. Filament voltage is 6 volts. No connection can exist between plate and filament supply outside the instrument.

2.0 PRINCIPLES OF OPERATION

2.1 FUNCTIONAL CIRCUIT

The block diagram of Figure 5 shows the functional arrangement of the genera-

tor. Voltage from the carrier oscillator is impressed on the attenuator through an isolating tube, the separator. The attenuator supplies its calibrated output volt-

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age when the carrier amplitude has been adjusted to a specified value as measured on the radio-frequency vacuum-tube voltmeter. The audio-frequency modulating voltage is impressed on the grid of the separator and is measured by means of the audio-frequency vacuum-tube voltmeter. This modulating voltage is either generated internally in the modulating oscillator or impressed from an external source at the EXTERNAL MOD. terminals.

2.2 CIRCUIT

The complete circuit diagram of the Type 605-B Standard-Signal Generator is shown in Figure 4. The circuits of the Type 605-P1 Power-Supply Unit and the Type 605-P10 Battery-Control Panel are shown in Figure 6 and Figure 7. Figure 8 to Figure 13 show, with omission of all the non-essential parts, the basic elements of the carrier oscillator, the separator, the modulation oscillator, the radio-frequency vacuum-tube voltmeter, the audio-frequency vacuum-tube voltmeter, and the attenuator. A brief discussion of these basic circuits will best explain the operating principle of the Type 605-B Standard-Signal Generator.

2.21 Carrier Oscillator

The carrier oscillator shown in Figure 8 is a conventional tuned plate circuit delivering about 3 volts of the carrier frequency to the grid of the separator tube. This circuit is completely enclosed in a shield on top of the instrument with the exception of R_{17} and R_{18} . R_{17} is a tapered 10,000-ohm potentiometer and is connected to the +175-volt B supply. It is actuated by the CARRIER knob on the front panel. The 20,000-ohm shunt resistor R_{18} equalizes the load on the power supply. The 76-type oscillator tube T_1 has a 500-ohm drop resistor R_1 in its cathode circuit, bypassed by a 0.005-microfarad condenser C_2 . Permanently connected to the plate of T_1 is the 1400- μ f straight-line-logarithmic tuning condenser, C_4 , by means of which the frequency for any coil selected by the FREQUENCY RANGE switch can be varied by a factor of $\sqrt{10}$. Seven trimming condensers, accessible from the front panel, and 7 adjustable cores in the 7 coils, are used to adjust the maximum and minimum frequencies of each coil in accordance with the tuning condenser calibration. The unusually large capacitance of the tuning condenser improves considerably the stability of the oscillator and almost entirely eliminates the effect of changes in

tube characteristics on carrier frequency. The condenser C_{14} connects the grid of the separator tube to the carrier oscillator. Since about 3 volts carrier amplitude must be maintained on the grid of the separator tube, it is necessary to adjust the carrier control to make up for the varying losses in the carrier oscillator circuit at different frequencies.

A jack is provided across the tuning condenser for access to the carrier oscillator tuned circuit. This jack is located on the panel between the FREQ. RANGE switch and the tuning dial. CAUTION: The jack is at a high d-c potential above ground. When not in use, the jack should always be covered by the snap button provided with the instrument to eliminate leakage.

2.22 Separator

The separator circuit shown in Figure 9 is an amplifier inserted between the carrier oscillator and the attenuator. Its function is to prevent attenuator and load changes from reacting on the carrier frequency and to provide a means of modulation. With a carrier frequency voltage of approximately 3 volts at the control grid of the Type 89 Separator Tube, T_2 , the voltage produced in the plate circuit and measured by the radio-frequency vacuum-tube voltmeter is 1 volt. The resistance of the plate circuit is 500 ohms. The drop resistor R_6 is 450 ohms and the resistance of the slide wire combination R_7 and R_8 is 50 ohms, independent of the MICROVOLTS dial setting. Another 500-ohm resistor, R_{34} , connects the 1-volt output jack on the front panel directly with the plate circuit of the separator tube. Modulation is accomplished by introducing an audio-frequency voltage into the grid circuit of the separator tube in series with the carrier frequency voltage. In this way, frequency modulation is reduced to a minimum. The modulation voltage applied across the 10,000-ohm modulation potentiometer R_{29} and measured by the audio-frequency vacuum-tube voltmeter is connected to the grid of the separator tube T_2 by the 50,000-ohm resistor R_4 and the 1-microfarad condenser C_{22} . In addition, the separator tube has a d-c grid bias of -25 volts. The screen of the separator tube is connected to the +175-volt B supply. It is bypassed for radio frequency by the 0.02-microfarad condenser C_{17} and for audio frequency by the 0.25-microfarad condenser C_{33} . The plate of the separator tube is connected to the same d-c voltage supply by the 2000-ohm resistor R_5 . Condenser C_{18} of 500 μ f is permanently connected between the plate of the separator tube T_2 and the attenuator. Condenser C_{19}

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of 0.005 μ f is connected only in the NORMAL position of switch S_4 . This normal position is intended for unmodulated carrier output and can be used for modulation frequencies up to about 1 kilocycle. Higher modulation frequencies can be applied but a relatively large amount of audio-frequency voltage would appear at the output terminals of the attenuator. By setting switch S_4 to the EXTERNAL MOD. position, the impedance of the coupling condenser is increased 10 to 1 and the amount of audio frequency present in the output is reduced in about the same ratio.

Because of this increased coupling impedance, carrier frequencies below 300 kilocycles cannot be produced in the EXTERNAL MOD. position of switch S_4 .

2.23 Radio-Frequency Vacuum-Tube Voltmeter

The radio-frequency voltage produced across R_6 , R_7 and R_8 in the plate circuit of the separator tube is measured by the vacuum-tube voltmeter shown in Figure 10. The #955 Acorn Type Tube, T_3 , is used because of its short leads. At zero grid voltage, the current through the 200- μ a meter is balanced out by that through the 10,000-ohm resistor R_{28} . With grid voltage applied, the plate current will change by an amount proportional to the average voltage applied and the meter will read. Two adjustments are provided. R_{24} , a 1000-ohm potentiometer located on the front panel, produces the bias required for proper balance and must be adjusted from time to time to compensate for changes in the characteristic of the #955 Rectifier Tube, T_3 . The second adjustment is the 1000-ohm rheostat R_{23} shunting the meter, which is set to give exactly half-scale deflection of the meter when 1 volt appears across the attenuator input. This point on the meter is marked SET CARRIER. The rheostat is located inside the instrument and does not have to be adjusted unless the voltmeter tube is replaced. R_{25} (100,000 ohms), R_{26} (20,000 ohms) and R_{27} (500 ohms) form a voltage divider which delivers about 30 volts to the plate of the tube, T_3 , when 175 volts are applied. The usual drift in vacuum-tube voltmeter circuits due to line voltage fluctuations is eliminated by the regulated power supply, and the indications of the voltmeter are correct for all line voltages within the rating given on the front panel of the power supply.

2.24 Attenuator

The setting of the attenuator shown in Figure 11 controls the amplitude of the carrier voltage applied to the out-

put jack. The system is resistive throughout and the attenuation is independent of frequency.* The attenuator system is strictly a ratio operating device but the two panel controls are calibrated directly in terms of microvolts. This calibration is correct only, of course, when the input voltage to the attenuator between R_6 and ground has been set to the proper value.

There are three principal elements in the attenuator. The 450-ohm drop resistor R_6 , the slide wire combination R_7 and R_8 operated by the MICROVOLTS dial, and the completely shielded MULTIPLIER with the resistors R_9 to R_{16} . R_6 reduces the voltage applied to the slide wire to 0.1 volt since the tapered 50-ohm resistor R_7 is designed to keep at exactly 50 ohms the resistance between R_6 and ground. The MICROVOLTS dial drives by a common shaft the blades on R_7 and R_8 and indicates the attenuation introduced. The narrow Ayerton-Perry-wound non-inductive resistance strip R_8 with a total of 95 ohms connects through a short tube to the multiplier. Switch S_5 and the 8 resistors R_9 to R_{16} are built in and shielded by a brass casting, the multiplier. This four-section ladder network is designed to attenuate in 4 steps with a ratio of 10 to 1 between steps. The lowest calibrated output voltage obtainable on the standard-signal generator is 0.5 microvolt. As the microvolt dial is turned further in a clockwise direction the output voltage will be still further decreased and will come to almost zero. The output impedance of the signal generator is independent of the MICROVOLTS dial setting and constant at 10 ohms with the exception of the last step from 10,000 to 100,000 microvolts (position of the MULTIPLIER=10,000), where the impedance is 50 ohms.

2.25 Modulation Oscillator

The modulation oscillator, a conventional Hartley-type circuit, is shown in Figure 12. The iron-core inductor is tuned to a frequency of 400 cycles by a 0.25-microfarad condenser C_{25} . The grid leak resistor R_{30} is 2 megohms. With a +175-volt plate voltage, the audio-frequency voltage produced across the 10,000-ohm MODULATION potentiometer R_{29} is about 14 volts. To eliminate a shift in carrier frequency between unmodulated and internally modulated signals, switch S_3 is pro-

*For a description of the method of measuring attenuation at radio frequencies see: L. B. Arguimbau, "Standardizing the Standard-Signal Generator", General Radio Experimenter Vol. XII, Nos. 3 and 4, August-September, 1937.

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vided. The plate voltage is removed from the 76-type tube, T₅, when the modulation oscillator is not in use and a dummy load of 35,000 ohms (R₃₂) is substituted for that of the tube.

2.26 Audio-Frequency Vacuum-Tube Voltmeter

The percentage modulation of the carrier frequency is determined by the modulation voltage applied to the control grid of the separator tube T₂. The voltages required for 20, 40, 60 and 80 per cent modulation are 2.3, 4.7, 7.1 and 10.4 volts approximately. This modulation voltage is taken off the 10,000-ohm MODULATION potentiometer R₂₉ and measured with the audio-frequency vacuum-tube voltmeter shown in Figure 13. According to the position of switch S₃, the MODULATION potentiometer is connected either to the internal 400-cycle modulator or to the EXTERNAL MOD. binding posts. To eliminate distortion in the measuring circuit a full-wave 84-type rectifier tube T₄ is used to measure the modulation voltage. The two 10,000-ohm resistors R₁₉ and R₂₀ provide an artificial center point. The 2500-ohm potentiometer R₂₂ determines the sensitivity of the voltmeter. The meter is the same 200-micro-ampere meter used to measure carrier amplitude and is shifted from one circuit to the other by the METER READS switch S₂. The lower scale of the meter is marked 20, 40, 60 and 80 per cent modulation.

2.27 Power Supply

The Type 605-P1 Power Supply shown in Figure 6 is a conventional full-wave rectifier circuit employing a flux-regulated transformer to compensate for

line voltage fluctuations. For different a-c line frequencies and voltages, different regulator transformers must be used. Frequency and voltage range are clearly marked on the front panel of each instrument. The regulator transformers are designed to deliver constant output for line voltage fluctuations of about ± 12 per cent from rated value when working into a constant load. The resistors R₁₈ (across the carrier potentiometer R₁₇) and R₃₂ (the dummy resistance in the modulating circuit) are used to keep the load constant. Likewise, R₃ in the power supply itself replaces the plate load of the entire signal generator in the "PLATE-OFF" position of switch S₂. Without this resistance the plate voltage of the power supply might rise to a dangerously high value and arc across filter condensers when the load is removed. This fact should be remembered when testing the power supply without the signal generator. With the proper load, the plate current will be 40 milliamperes and the voltage produced across R₁ will be 25 volts which is needed as bias for the separator tube. The hum voltage is less than 0.1%.

2.28 Control Panel

The Type 605-P10 Control Panel shown in Figure 7 is used when the signal generator is operated from batteries. Current and voltage requirements are 200 volts, 40 ma and 6 volts, 1.7 amperes. The meter M₁ and the rheostats R₁ and R₂ should be used to maintain these voltages accurately. Slight variations in the voltages will not impair the operation of the signal generator but will affect the accuracy of the absolute level of output as read on the carrier vacuum-tube voltmeter.

3.0 OPERATING INSTRUCTIONS

3.1 INSTALLATION

The Type 605-B Standard-Signal Generator is shipped with the Type 605-P1 Power Supply (or with the Type 605-P10 Control Panel) mounted together in one cabinet and ready for use. All tubes required are shipped in place and all connections between the standard-signal generator and

the power supply or control panel are made inside.

3.11 Vacuum Tubes, Pilot Lights and Fuses

All tubes required are furnished with each instrument and shipped solidly held in place inside of the instrument.

Type 605-B Standard-Signal Generator

Vacuum Tube.

Type	Function	Location
76	R-F Oscillator	Inside shielded unit at top
76	A-F Modulator	Left front corner of amplifier shelf
89	Separator	In shield at middle of amplifier shelf
84	A-F Voltmeter	Left rear corner of amplifier shelf
955	R-F Voltmeter	Ring socket accessible from bottom of amplifier shelf

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Type 605-P1 Power Supply

Function	Type or Rating
Rectifier	84
Line Fuse	2.5A Bussman #7AG
Line Fuse	2.5A Bussman #7AG
Pilot Light	6-8 Volt

Type 605-P10 Control Panel

Function	Type or Rating
Plate Fuse	0.1A Bussman #7AG
Filament Fuse	2.5A Bussman #7AG
Pilot Light	5-6 Volt

3.12 A-C Power Supply

When using Type 605-P1 Power Supply, be sure the line voltage and frequency are those engraved on its front panel. Connect to the line with the 6-foot cord supplied with the instrument.

The Type 605-P1 Power Supply for 50 cycles per second line frequency can be changed easily to work either from 100-130 volts line voltage or 200-260 volts. There are 3 terminal strips on the regulated transformer. The middle strip has 4 terminals: 9, 10, 11 and 12. For operation from 100-130 volts, terminal 9 is connected to terminal 11 and terminal 10 is connected to terminal 12. For operation from 200-260 volts, terminal 10 is connected to terminal 11. In either case terminal 9 is connected to terminal 1 and terminal 12 to terminal 2, terminals 1 and 2 being on the terminal strip on top. When a change in terminal connections is made on the transformer the engraved name plate on the front panel should be changed as well. Type 605-P1 Power Supplies for 50-cycle line frequency are furnished with 2 of these name plates, one fastened under the other. Care should be taken that the name plate on top always corresponds to the actual transformer connections. Different power supplies can be used with the same signal generator if the filament voltage is set to 5.8 volts by means of resistor R_4 whenever a change is made.

3.13 Battery Operation

External batteries are used with the Type 605-P10 Control Panel. The power requirements are as follows:

Plate: 200 volts, 40 ma
Filament: 6 volts, 1.7 a

There can be no electrical connection externally between the plate and filament batteries. A 10-foot shielded cable is supplied. Leads are well filtered, but it is advisable not to use the same batteries for the receiver under test and to place the batteries at some distance from the receiver. To realize the full accuracy of which the generator is capable, filament

and plate voltages should be checked frequently and readjusted if necessary, for 175 volts on the plate voltmeter and 5.8 volts on the filament meter.

3.2 OPERATING CONTROLS

The Type 605-B Standard-Signal Generator is simple to operate. All dials, knobs and switches are clearly marked on the front panel.

3.3 PRECAUTIONS

Always turn back the CARRIER rheostat in a counterclockwise direction when the frequency of the oscillator is to be changed, and be sure the METER READS switch is set to the CARRIER position. In addition, when using carrier frequencies below 300 kc, set the modulation switch to the NORMAL position. These precautions are necessary to prevent overloading of the oscillator tube. At 50 kilocycles, for instance, the oscillator will deliver the proper voltage and cause the meter to deflect to the SET CARRIER mark with about 30 volts plate voltage applied by the CARRIER potentiometer. With the CARRIER potentiometer turned all the way over in a clockwise direction the plate voltage will be 175 volts and the tube will be overloaded and damaged if run for a considerable time. This condition will be noticed immediately by the fact that the carrier meter is deflected off scale.

3.4 FREQUENCY

The desired frequency is set by selecting the proper coil with the band change switch and turning the direct reading frequency dial so that the desired frequency appears under the celluloid indicator for Coils A to F, and opposite the lower left disc indicator for Coil G. All frequencies in the normal range of the instrument are correct within 1%. The frequency of Coil H (30 to 50 Mc) is not direct reading. A calibration is given on page 11 together with operating instructions. Since the tuning condenser is of

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the straight-line logarithmic type, percentage frequency change is proportional to tuning condenser rotation. Small percentage changes in frequency can be set and read directly on the vernier dial. This dial has 125 uniform divisions, each division corresponding to a 0.1% change in frequency. This uniform law of frequency change does not apply, however, at the extreme ends of the tuning ranges, that is, from 0-25 and from 275-300 divisions of the main dial.

3.5 SWITCH POSITIONS

After making sure that the CARRIER control is in counterclockwise position, the METER READS switch in the CARRIER position, the MODULATION switch on OFF, and the second modulation switch in the NORMAL position, the POWER switch is put in the ON position. The pilot light will light immediately and in a short time, after the heaters of the tubes have come to temperature, the instrument will be in operating condition when the PLATE switch is in the ON position. This switch has been provided to interrupt oscillations of the standard-signal generator during receiver testing without allowing the heaters of the tubes to cool.

3.6 OUTPUT VOLTAGE

3.61 Zero Position Adjustment

With all power off, the indicating meter should read zero. A zero-adjustment is provided in the meter itself.

3.62 Electrical Zero Adjustment

With the POWER switch in the ON position and PLATE switch OFF, the meter will show a small deflection which should go back to zero after the PLATE switch is thrown to the ON position. If, after the cathode heaters have reached operating temperature, the meter does not return to zero, remove the small cap on the panel above the MODULATION switch, and readjust R₂₄ with a screw driver (see paragraph 2.23). These adjustments have been made at the factory and usually will require no attention.

3.63 Output Level Adjustment

Advance the CARRIER control until the meter is set on the SET CARRIER mark. The output voltage of the CONSTANT 1-VOLT output jack is then exactly 1 volt and the output voltage of the lower output

Jack is read directly from the two attenuator dials.

3.7 MODULATION

3.71 Internal

For internal 400-cycle modulation, set the MODULATION switch to INTERNAL and the METER READS switch to MODULATION. Adjust the MODULATION control until the meter reads the desired percentage modulation. The two dots on the meter scale beyond 80% correspond to 90% and 100% modulation, but the accuracy in that range is rather limited.

3.72 External

Set the upper MODULATION switch to EXT. and the lower switch to EXTERNAL MOD. Connect an external audio-frequency source to the EXTERNAL MOD. terminals. Adjust for desired percentage modulation by means of MODULATION control.

3.721 Power Requirements and Filtering

For modulation frequencies between 30 and 15,000 cycles per second the input impedance of the external modulation binding posts is 4000 ohms and approximately 4 volts modulation voltage is required for 30 per cent modulation. The modulation circuit is well filtered for radio frequencies and at carrier frequencies above 300 kc no special precautions need be taken to prevent pickup from the leads connecting to the external modulation binding post.

3.722 Frequency Limits

As pointed out in the discussion of the separator circuit under operating principles, carrier frequencies below 300 kilocycles cannot be produced in the EXTERNAL MOD. position of the lower modulation switch. If this switch is in the NORMAL position, carrier frequencies down to 10 kilocycles can be produced, but the external modulation frequency should be limited to values below 1000 cycles. At higher external modulation frequencies, the output of the signal generator will contain a relatively large amount of modulation frequency in addition to the modulated carrier voltage. It will be found that the meter will indicate this external modulation voltage with the METER READS switch in the CARRIER position and the CARRIER control set at zero.

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3.73 Audio-Frequency Distortion

The envelope distortion introduced by the modulation process increases rapidly with percentage modulation. The distortion is less than 3% up to 50% modulation and is between 5% and 10% at 80% modulation.

3.8 CONNECTIONS TO RECEIVER

Connection to the receiver under test is conveniently made by one of the two connectors supplied. They plug into the output jacks of the signal generator and are fitted with two clips on the other side. The plain lead is connected to ground, the lead with the green tracer to the high side of the circuit.

One connector is a concentric shielded rubber cable of 3-foot length with a characteristic impedance of 72 ohms and a capacity of 100 μf , approximately. The other connector has two separate leads of 2-foot length. The cable is intended for use in the lower output jack, the separate leads should be used in the CONSTANT 1-VOLT jack and in connection with high impedance dummy antennas.

When the lower output jack of the signal generator is used, the upper CONSTANT 1-VOLT jack always must be covered by the cap supplied to prevent any leakage.

The CONSTANT 1-VOLT output jack has an internal output resistance of 500 ohms shunted by the capacitance of the output jack. Due to the shunt capacity of the jack the actual output voltage at higher frequencies is lower than 1 volt and any load connected to this output will further decrease it. Figure 1 shows the actual output voltage at the CONSTANT 1-VOLT jack plotted against frequency. The frequency error is due to the 16 μf shunt capacitance of the output jack itself.

3.81 Caution

Care must be taken to prevent the introduction of voltages back into the attenuator from the circuit under test. The resistance of the attenuator is 10 ohms for the four first positions of the multiplier and 50 ohms for the last position. Currents greater than 50 milliamperes may burn out the resistance cards of the attenuator.

3.82 Dummy Antenna

For many receiver tests an artificial or dummy antenna should be used to simulate the characteristic of the receiver antenna. Two different dummy antennas are available at a charge of \$10.00 each. They are the Type 418-G Dummy Antenna, primarily intended for testing receivers in the frequency range above 500 kilocycles, and the Type 418-F Dummy Antenna with 1.11 ohms in parallel with the output terminals for testing receivers in connection with loop antennas in the broadcasting range and for field strength measurements. This last dummy antenna reduces the output impedance of the signal generator to 1 ohm in the four first multiplier steps and reduces the output voltage in the ratio one to ten. It cannot be used with the multiplier in its 10,000 position. The maximum voltage obtainable with the Type 418-F Dummy Antenna, therefore is 1000 microvolts.

The Type 418-G Dummy Antenna is intended for input measurements of all-wave radio receivers and is designed in accordance with the specifications recommended in the "Standards on Radio Receivers" (1938) of the Institute of Radio Engineers. Figure 2 shows the connections of the two condensers of 200 and 400 micromicrofarads, the 20-micronhenry inductor and the 400-ohm resistor.

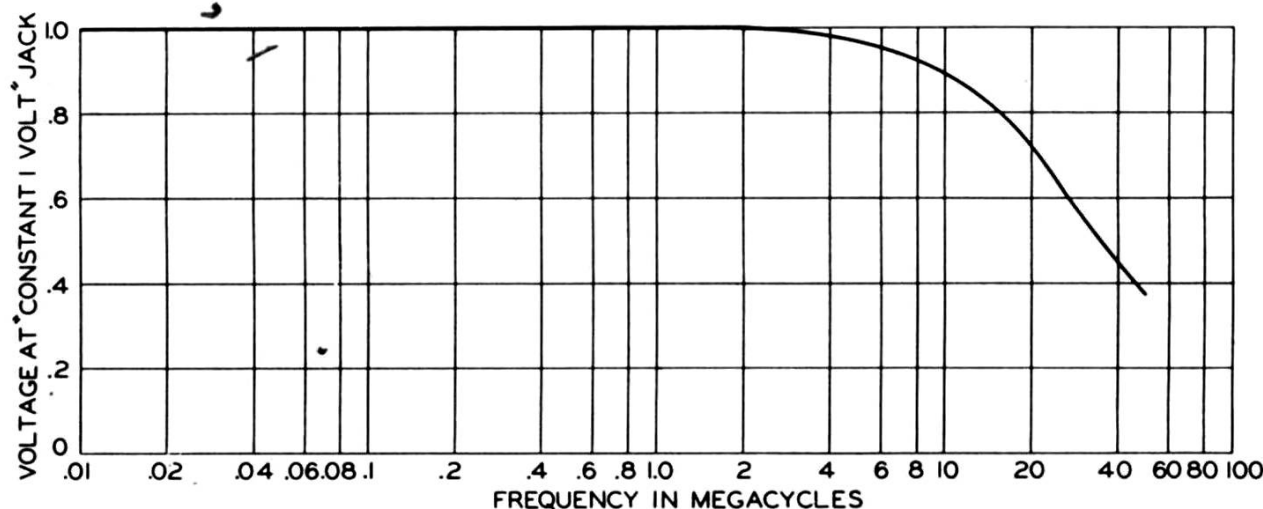


Figure 1.

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The dummy antennas mentioned are well shielded and plug directly into the signal generator output jack. Connection to the receiver is made by one of the connectors supplied but, as mentioned before, the cable should not be used with the Type 418-G Dummy Antenna

3.9 HIGH FREQUENCIES

At high radio frequencies, antenna characteristics cannot easily be reproduced and considerable care must be taken in making receiver sensitivity tests. The voltage available at the signal generator output jack is always known, but not the voltage at the receiver input terminals a few feet away. This latter voltage is pro-

portional to the signal generator output voltage but it may be larger or smaller due to the characteristic and the termination of the "transmission line" between the instruments represented by the output cable.

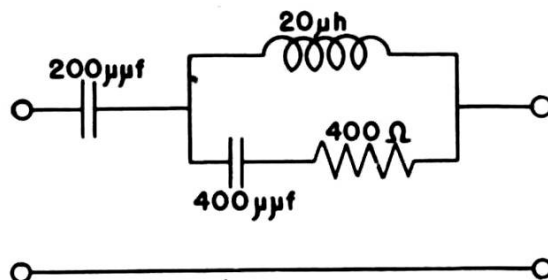


Figure 2.

4.0 MAINTENANCE

The only parts of the Type 605-B Standard-Signal Generator which are subject to wear or deterioration and which require periodical attention are the vacuum tubes, the band change switch and the slide-wire combination associated with the MICROVOLTS dial. In addition, and as a result of ageing or excessive temperature variation, the calibration of the inductors may show slight drifts.

4.1 MAJOR REPAIRS

Fuses have been provided in the instrument to prevent serious damage if parts of the circuit should be short circuited. Condenser breakdown is one example of this type of failure. In such cases repairs are usually made at the factory.

4.2 DISASSEMBLY

To remove the instrument from the cabinet, remove all panel screws and disconnect the plug-in cable between the signal generator and the power supply.

4.3 VACUUM TUBES

The locations of the five vacuum tubes are given in paragraph 3.11. Following are instructions for readjusting, if necessary, the different circuits after changing the tubes. Operating voltages are given as measured at the socket terminals. Vacuum tube symbols T_1 , T_2 etc. refer to the wiring diagram. All d-c voltages are measured with a Weston Type 772 Analyzer unless otherwise noted. Power frequency voltages must be measured with an accurate r-m-s instrument. Copper-oxide rectifier-type meters would give erroneous readings because the voltage-regulating transformer in the Type 605-P1 Power Sup-

ply produces a distorted waveform. Audio-frequency voltages may be measured with a copper-oxide meter. Radio-frequency voltage should be measured with an rms vacuum-tube voltmeter. All voltages given are approximate except the r-f voltage on the grid of T_3 and the audio-frequency voltage across the plates of T_4 .

4.31 Carrier Oscillator

The only requirement to be met by the 76-type carrier oscillator tube is that it give sufficient output for operation over the complete frequency range of the instrument. The most critical point is at a frequency of 10 megacycles on Coil G where the highest plate voltage is used. The radio-frequency carrier voltage delivered to the grid of the separator tube must be about 3 volts for coils B, C, D, E and F and somewhat more for coils A and G. Since the tuning condenser has a high zero capacitance, changing the oscillator tube ordinarily will not affect the frequency calibration. Any change will be most noticeable at the high-frequency end of each coil where compensation can be made by means of the trimming condensers. These are accessible from the front panel, after removing the short hexagonal bolts indicated in Figure 3. Under normal operation, when the CARRIER control is advanced until the meter on the panel indicates at the SET CARRIER position, the plate current for the 76-type carrier oscillator is less than 3 milliamperes d-c for ranges A-B-C-D-E and F and is less than 10 milliamperes d-c for ranges G and H.

The approximate voltages appearing at the carrier oscillator tube socket under normal operating conditions are as follows:

Heater: 5.8 volts, r-m-s or d-c.

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Plate-to-Ground:

<u>Frequency Range</u>	<u>Volts</u>
A,G,H	Less than 160
B,C,D,E,F	Less than 50

Except when checking coil continuity, it is recommended that these voltages be measured between the slider on R-17 (CARRIER control) and ground.

4.32 Separator

The 89-type separator tube with shield and grid cap can be replaced without affecting the accuracy of the frequency calibration or of the output level. This tube is working satisfactorily when one volt is produced across the 500-ohm plate output resistance.

The approximate voltages and currents appearing at the separator tube socket under normal operation are as follows:

Heater: 5.8 volts, r-m-s or d-c.

Plate-to-Ground: 155 volts d-c at about 9 milliamperes.

Screen Grid-to-Ground: 175 volts d-c at about 1.5 milliamperes.

Control Grid-to-Ground: -25 volts d-c through a high resistance. A direct measurement with a 20 k Ω per volt voltmeter of 50 volts full scale will indicate about -12 volts d-c.

4.33 Carrier Vacuum-Tube Voltmeter

The 955-type vacuum tube used in this circuit determines the accuracy of the output voltage and should be checked periodically since the emission current changes somewhat with age. Compensation for this effect can be made by readjusting the plate current balance as explained in Par. 3.62. This readjustment will not affect the accuracy of the meter indication for a considerable range but it will eventually be necessary to readjust R₂₃ which determines the sensitivity of the meter. With an old tube that has very low emission this adjustment will be impossible and the tube should be replaced. A spare 955-type vacuum tube is shipped inside the cabinet of this instrument.

4.331 Procedure

The procedure in adjusting carrier vacuum-tube voltmeter is as follows: Set meter zero with meter adjusting screw with all power off.

After both filament and plate power have been on for about 5 minutes, with METER READS switch on CARRIER and the CARRIER control set at zero, set meter zero again with screw driver through front panel.

Connect an accurate high-impedance rms voltmeter between ground and the grid of the 955-type tube (or the rear end of the mica resistance card R₆) and advance CARRIER control until this voltmeter reads exactly one volt. The frequency of the CARRIER oscillator for this measurement should be low in order to avoid errors due to the leads connecting to the external meter. The MODULATION switch must be set in the OFF position and the lower modulation switch in the NORMAL position. At 10 kilocycles a high-impedance copper-oxide rectifier-type meter can be used but it should be borne in mind that the accuracy of the signal generator output will be no better than the accuracy of the meter with which this adjustment has been made. For this adjustment a voltmeter should be used that indicates the rms or root mean square value of the voltage, since a peak voltmeter (although calibrated to read rms value of a sine wave) would read about 5% too high, due to the harmonic distortion present in the carrier voltage.

With the external meter reading one volt, the shunt resistor R₂₃ across the microammeter is adjusted to make the pointer come exactly to the SET CARRIER mark. This resistor is located at the rear center of the amplifier shelf and is locked by a flat-head screw. After resetting R₂₃, this screw should be locked again and care must be exercised to be sure the rheostat arm does not move when this is done. Under normal operation, the plate-to-ground voltage is about 30 volts d-c, with a plate current of about 70 microamperes.

The approximate voltages appearing at the carrier vacuum-tube voltmeter socket under normal operating conditions are as follows:

Heater: 5.8 volts, r-m-s or d-c.

Plate-to-Ground: 30 volts d-c.

Cathode-to-Ground: 1.5 volts d-c.

4.34 Modulation Oscillator

The 76-type tube used in the modulating oscillator should be replaced when it is no longer possible to obtain sufficient 400-cycle voltage to give 80% internal modulation with the MODULATION control set at maximum. A good tube will produce about 14 volts across the modulation potentiometer R₂₉. The plate voltage is approximately 170 volts d-c at about 5.5 milliamperes.

The approximate voltages appearing at the modulation-oscillator tube socket under normal operating conditions are as follows:

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Heater: 5.8 volts, r-m-s or d-c.
Plate-to-Ground: 170 volts d-c

4.35 Audio-Frequency Vacuum-Tube Voltmeter

If the 84-type audio-frequency voltmeter tube is replaced, readjustment of the 2500-ohm shunt rheostat R_{22} may be necessary. This rheostat is located on the right-hand side of the amplifier shelf and is set to make the indicating meter read 40% with 4.7 volts audio frequency applied between the arm of the modulation potentiometer R_{29} and ground.* An audio-frequency voltage for this test is most conveniently obtained from the internal modulation oscillator by setting the MODULATION switch to INTERNAL and reading the voltage on an accurate high-impedance voltmeter connected between the arm of R_{29} and ground. For this test the METER READS switch must be set to the MODULATION position.

The heater for this tube is operated at a low temperature. Heater voltages are approximately 5.8 volts (r-m-s or d-c) for one heater terminal to ground and approximately 2.8 volts for the other heater terminal to ground.

4.36 Power Supply Rectifier

The 84-type rectifier tube in the Type 605-P1 Power Supply should deliver 40 milliamperes at 200 volts. To test this voltage with the signal generator disconnected the plate switch should be in the OFF position. This will substitute the 5000-ohm resistor R_3 for the plate load of the signal generator. CAUTION: IF THE PLUG CONNECTED BETWEEN THE POWER SUPPLY AND THE SIGNAL GENERATOR IS REMOVED, NEVER TURN ON THE POWER SWITCH UNLESS THE PLATE SWITCH IS IN THE OFF POSITION. OTHERWISE THE POWER SUPPLY WILL BE SERIOUSLY DAMAGED BECAUSE THE VOLTAGE DELIVERED BY THE POWER TRANSFORMER REACHES A SUFFICIENTLY HIGH VALUE TO ARC ACROSS THE FILTER CONDENSERS. A 4.2-ohm external resistor should be placed between terminal 4 of the power transformer and the arm of rheostat R_4 to simulate the load of the vacuum-tube cathode heaters. The voltage between the OUT terminals of the Type 732-24 Filter Assembly and terminal 7 of the power transformer should be 200 volts and the voltage across the 650-ohm resistor R_1

*For a more accurate setting, the actual percentage modulation of the standard-signal generator should be checked by some other means, a cathode-ray tube or a modulation meter, since variations in the characteristic of the Type 89 Separator Tube may require a modulation voltage different from the average voltage given in 2.26.

should be 25 volts. Both these voltages must be measured with high-resistance voltmeters drawing less than 1 milliamperere.

The voltage appearing across the heater of the 84-type rectifier tube (and across the pilot lamp) is set to 5.8 volts rms by means of the resistor R_4 .

4.4 BAND CHANGE SWITCH

The band change switch and the two rheostats of the slide wire combination may after long use become erratic in operation as a result of dust accumulating on the contacts. When this occurs these should be carefully cleaned with a dry cloth.

4.5 FREQUENCY CALIBRATION

A drift in the frequency calibration can be corrected by changing the inductance and capacitance values in the 7 tuned circuits. Each circuit is provided with a trimming condenser and an adjustable iron core. The cores for Coils A to F are threaded on a stud which is concentric with the coil. The core for Coil G is held in place by two setscrews.

4.51 Resetting of the trimming condensers, which can be easily done from the outside without removing the instrument from the cabinet, will change the frequency at the high-frequency end of each coil much more than at the low-frequency end. Changing the inductance of a coil by moving the iron core will affect both ends of the range equally.

4.52 The cores can be readjusted only after the instrument is taken out of the cabinet and the three-sided shield of the oscillator unit has been removed. Since this shield also affects the frequency of the oscillator it should be replaced after each adjustment before measuring the frequency. It will be sufficient for this purpose to replace only one or two of the 24 screws.

4.53 The quickest way to adjust a coil is to set first the low-frequency end by moving the iron core at a setting of the tuning condenser dial of 10, for coils A, C, E, and G and 30 for coils B, D, and F. When this is done the high-frequency end of the coil should be set by means of the trimming condenser at a setting of the tuning condenser dial of 30 or 90 respectively. If the adjustment of the trimming condenser is changed appreciably, it will be advisable to recheck the low frequency end and to repeat the same procedure until the frequencies at both ends of the coils are correct.

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4.54 The frequency at an intermediate setting of the tuning condenser dial should then be well within 1 per cent. of the calibrated value. These intermediate frequencies depend on the shape of the tuning condenser plates and on the accuracy with which the condenser has been

assembled. If an intermediate frequency differs more than 1% from the calibrated value on one coil, it will be found that the same error exists on all other coils. In that case the tuning condenser has been damaged and the instrument should be returned to the factory for repair.

5.0 HIGH-FREQUENCY RANGE

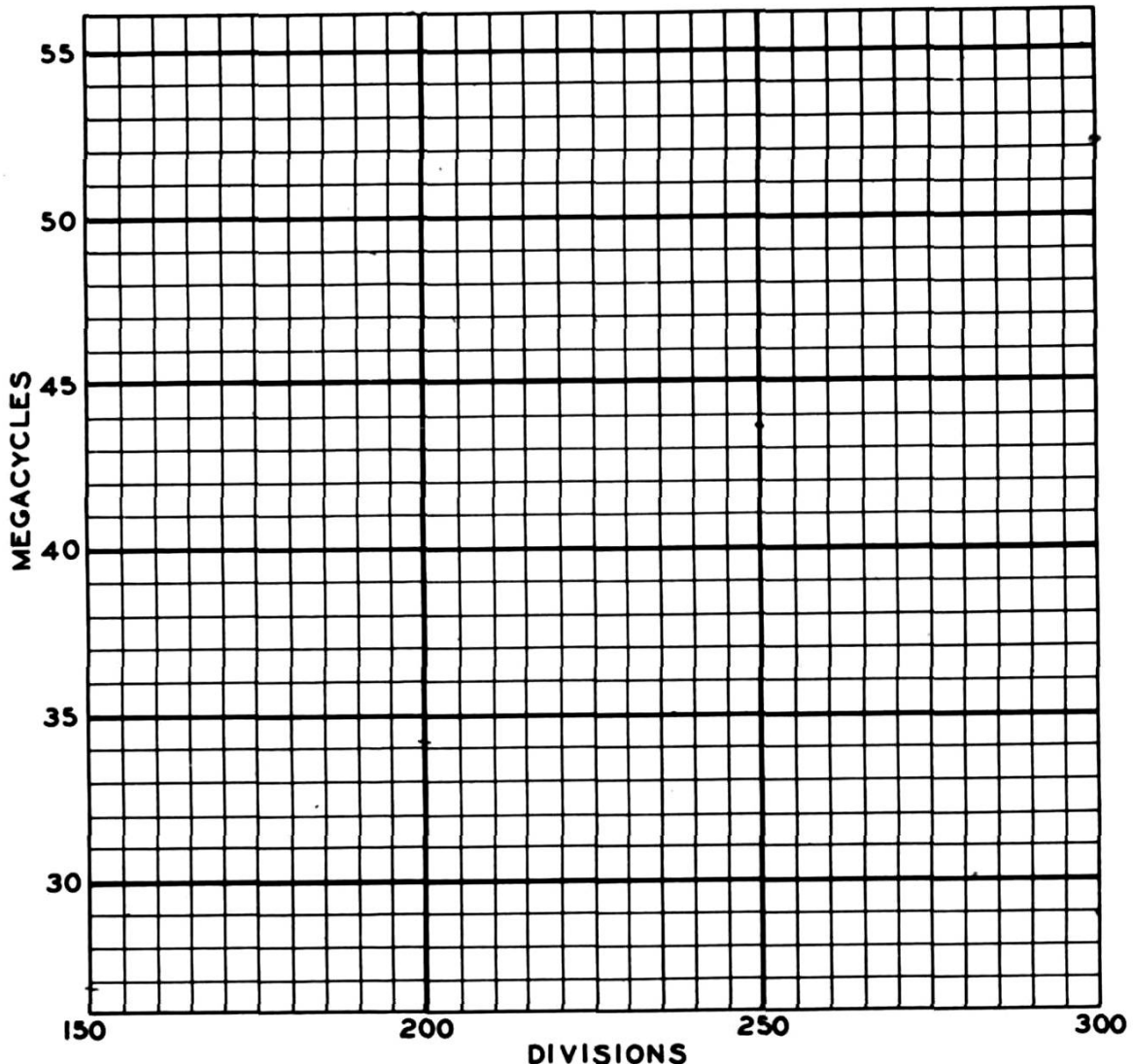
For the convenience of the user, an additional carrier frequency range covering approximately 30-50 Mc has been added to the Type 605-B Signal Generator.

The accuracy of output voltage in this range is not as high as at the lower frequencies but it is felt that the added frequency range will still be useful.

To obtain output in this additional range, turn the BAND CHANGE switch two positions beyond range G and proceed as at the lower frequencies.

The DIVISIONS in the calibration given below appear at the upper right disc index of the tuning dial.

CALIBRATION OF COIL H 605-B STANDARD SIGNAL GENERATOR SERIAL # _____



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6.0 FREQUENCY MODULATION

A concentric jack is provided on the front panel (between the main tuning condenser and the FREQ. RANGE switch) to permit the use of an external frequency modulator. The jack is covered by a snap button when not in use, in order to avoid leakage. The center lead of the jack is connected to the "high" terminal of the variable tuning condenser of the carrier oscillator, which carries high d-c potential.

CAUTION: Whenever an external frequency modulator is used, care must be taken not to ground the center lead of the jack.

A concentric plug is furnished to fit the jack. A suitable frequency modulator consists of a motor-driven variable condenser. The capacitance range of this condenser depends upon the carrier frequency and upon the frequency variation desired. This can be determined as follows:

(1) Compute the value of tuning condenser capacitance from the expression:

$$C = \left(\frac{f}{f_0}\right)^2 \quad 1465 \text{ uuf}$$

where f is the desired carrier frequency and f_0 is the lowest carrier frequency for the frequency range used.

(2) Compute the capacitance to produce the desired frequency variation Δf at carrier frequency f as follows:

$$\Delta C = C \frac{\left(\frac{f + \Delta f}{f - \Delta f}\right)^2 - 1}{\left(\frac{f + \Delta f}{f - \Delta f}\right)^2 + 1}$$

The motor-driven modulation condenser should vary by $2\Delta f$. The main dial of the signal generator should of course be set at $f + \Delta f$, so that the correct carrier frequency is obtained with the motor-driven condenser at mid scale.

PATENT NOTICE

This instrument is licensed under patents of the American Telephone and Telegraph Company, solely for utilization in research, investigation, measurement, testing, instruction, and development work in pure and applied science.

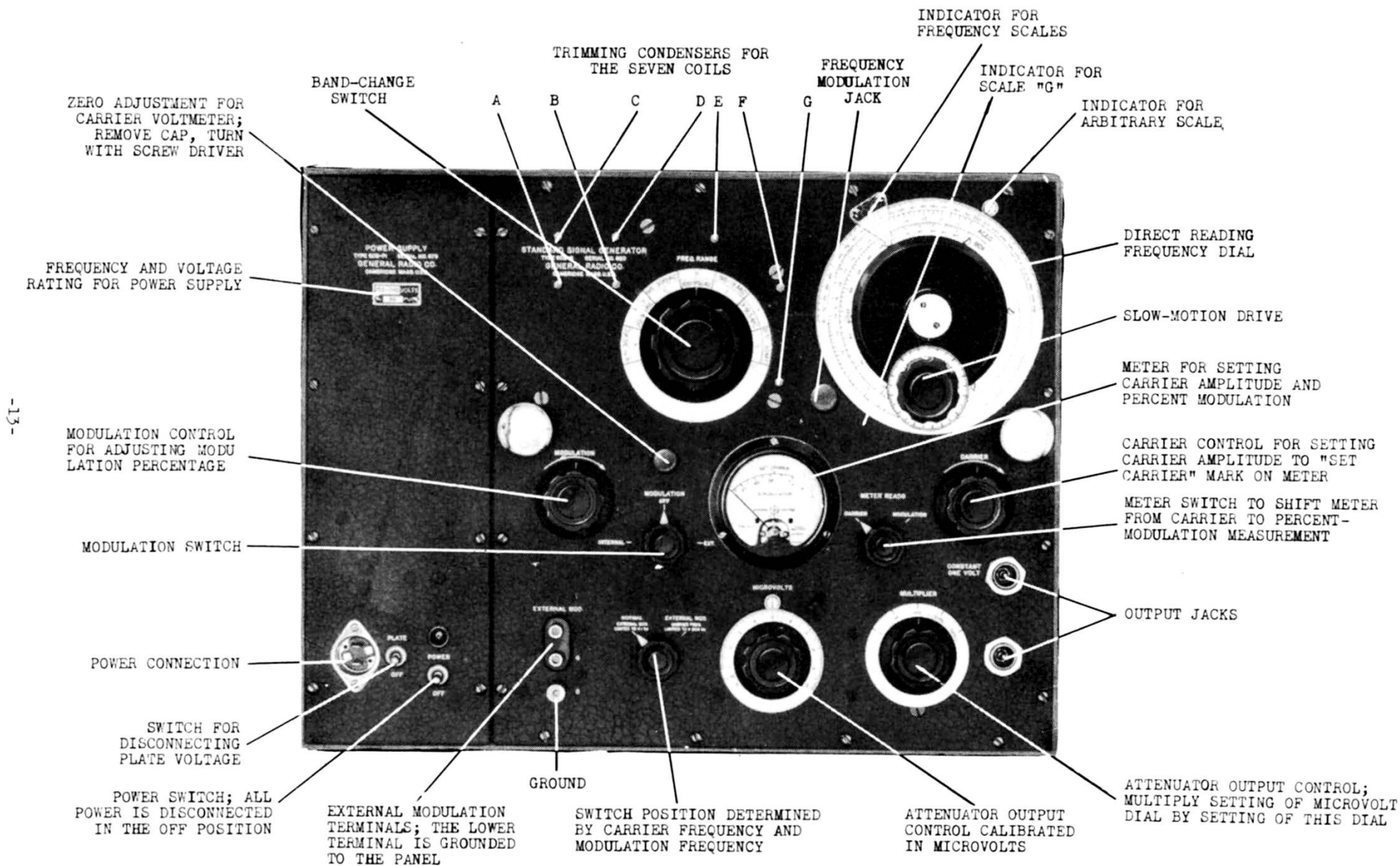


Figure 3.

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PARTS LIST

RESISTORS

R-1 = 450 Ω \pm 5%	R-19 = 10,000 Ω
R-2 = 0.1 M Ω	R-20 = 10,000 Ω
R-3 = 0.75 M Ω	R-21 = 8 Ω
R-4 = 50,000 Ω	R-22 = 2500 Ω
R-5 = 2000 Ω	R-23 = 1000 Ω
R-6 = 450 Ω	R-24 = 1000 Ω
R-7 = 50 Ω	R-25 = 0.1 M Ω
R-8 = 95 Ω	R-26 = 20,000 Ω
R-9 = 95 Ω	R-27 = 500 Ω
R-10 = 11.7 Ω	R-28 = 10,000 Ω
R-11 = 99 Ω	R-29 = 10,000 Ω
R-12 = 12.2 Ω	R-30 = 2 M Ω
R-13 = 99 Ω	R-31 = 0.5 M Ω
R-14 = 12.2 Ω	R-32 = 35,000 Ω
R-15 = 99 Ω	R-33 = 450 Ω
R-16 = 11 Ω	R-34 = 500 Ω
R-17 = 10,000 Ω	R-35 = 15,000 Ω
R-18 = 20,000 Ω	R-36 = 10,000 Ω

CONDENSERS

C-1 = 0.02 μ f	C-19 = 0.005 μ f
C-2 = 0.005 μ f	C-20 = 0.02 μ f
C-3 = 0.02 μ f	C-21 = 0.02 μ f
C-4 = 1400 μ mf	C-22 = 1.0 μ f
C-141 = 50 μ mf	C-23 = 0.00025 μ f
C-142 = 50 μ mf	C-24 = 0.00025 μ f
C-143 = 50 μ mf	C-25 = 0.25 μ f \pm 5%
C-144 = 50 μ mf	C-26 = 0.02 μ f
C-145 = 50 μ mf	C-27 = 0.001 μ f
C-146 = 50 μ mf	C-28 = 0.0005 μ f
C-147 = 25 μ mf	C-29 = 0.0005 μ f
C-12 = 0.02 μ f	C-30 = 0.1 μ f
C-13 = 0.02 μ f	C-31 = 0.1 μ f
C-14 = 0.00002 μ f	C-32 = 0.1 μ f
C-15 = 0.25 μ f	C-33 = 0.25 μ f \pm 5%
C-16 = 0.0005 μ f	C-34 = 0.0001 μ f
C-17 = 0.02 μ f	C-35 = 0.0001 μ f
C-18 = 0.0005 μ f	

SWITCHES

S1 = Band Change Switch
S2 = Meter Switch
S3 = Modulation Switch
S4 = External Modulation Switch
S5 = Multiplier Switch

TUBES

T1 = RCA-76
T2 = RCA-89
T3 = RCA-955
T4 = RCA-84
T5 = RCA-76

TYPE 605-P1 POWER SUPPLY

CONDENSERS

C-1 = 0.002 μ f
C-2 = 0.002 μ f
C-3 = 1 μ f

FUSES

F-1 = 2.5 amp.
F-2 = 2.5 amp.

RESISTORS

R-1 = 650 Ω
R-2 = 0.5 M Ω
R-3 = 5000 Ω
R-4 = 1.5 Ω

SWITCHES

S-1 = Power Switch
S-2 = Plate Switch

TUBE

T1 = RCA-84

PILOT LAMP

P1 = 5-6 volt

TYPE 605-P10 POWER SUPPLY

CONDENSERS

C-1 = 0.1 μ f
C-2 = 0.1 μ f
C-3 = 0.1 μ f
C-4 = 1 μ f
C-5 = 2 μ f

RESISTORS

R-1 = 0.75 Ω
R-2 = 1000 Ω
R-4 = 0.5 M Ω
R-5 = 650 Ω

SWITCHES

S-1 = Power Switch
S-2 = Plate Switch

FUSES

F-1 = 2.5 Amp.
F-2 = 0.1 Amp.

METER

M1 = Weston, Type 506, 200-8V

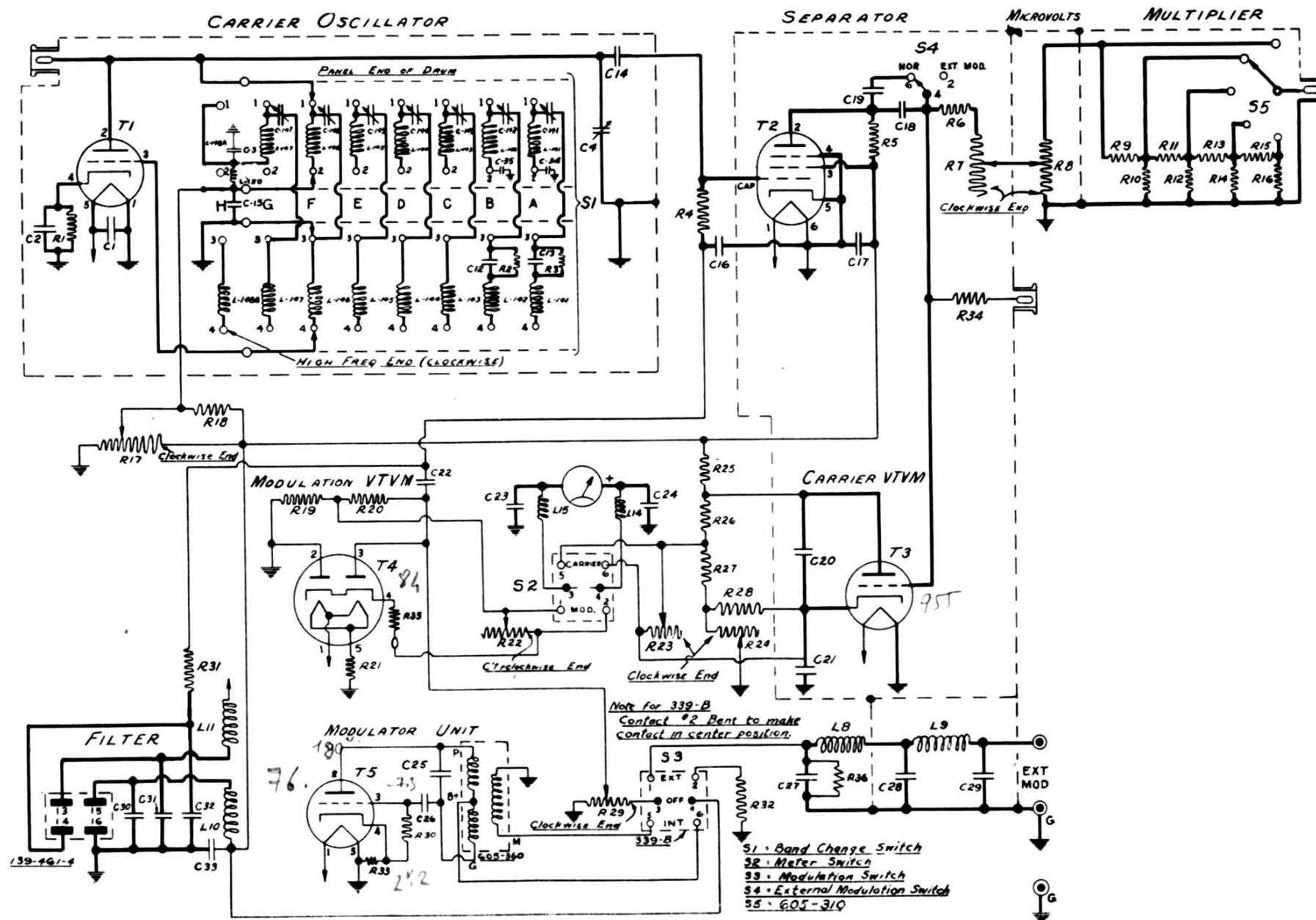


Figure 4. Wiring Diagram for Type 605-B Standard-Signal Generator

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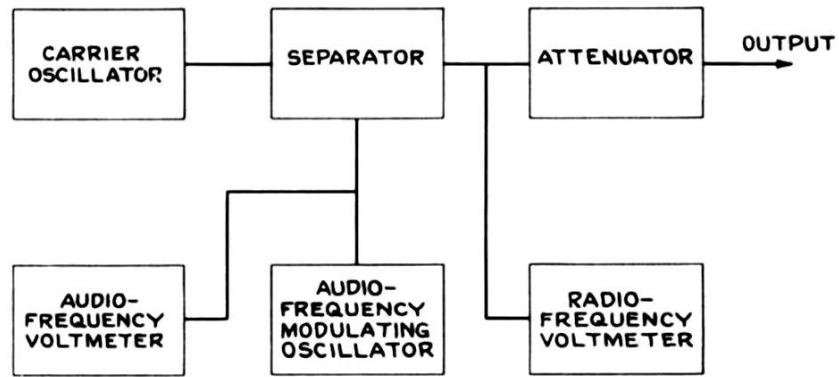


Figure 5. Functional Diagram of Type 605-B Standard-Signal Generator

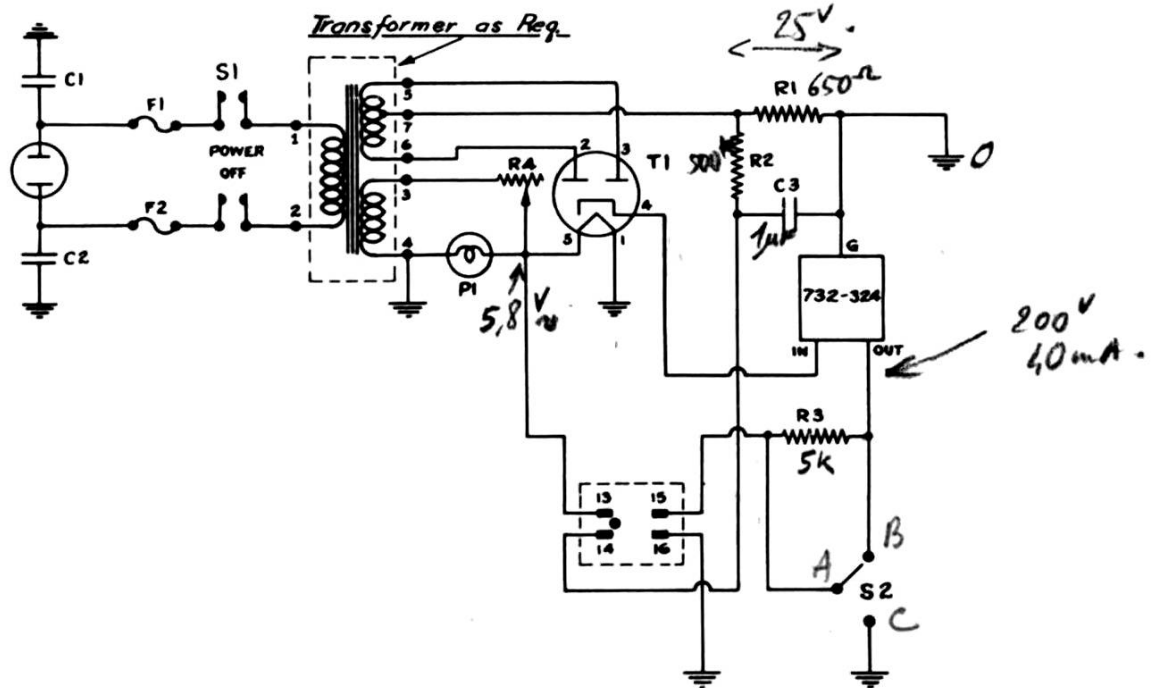


Figure 6. Wiring Diagram for Type 605-P1 Power Supply

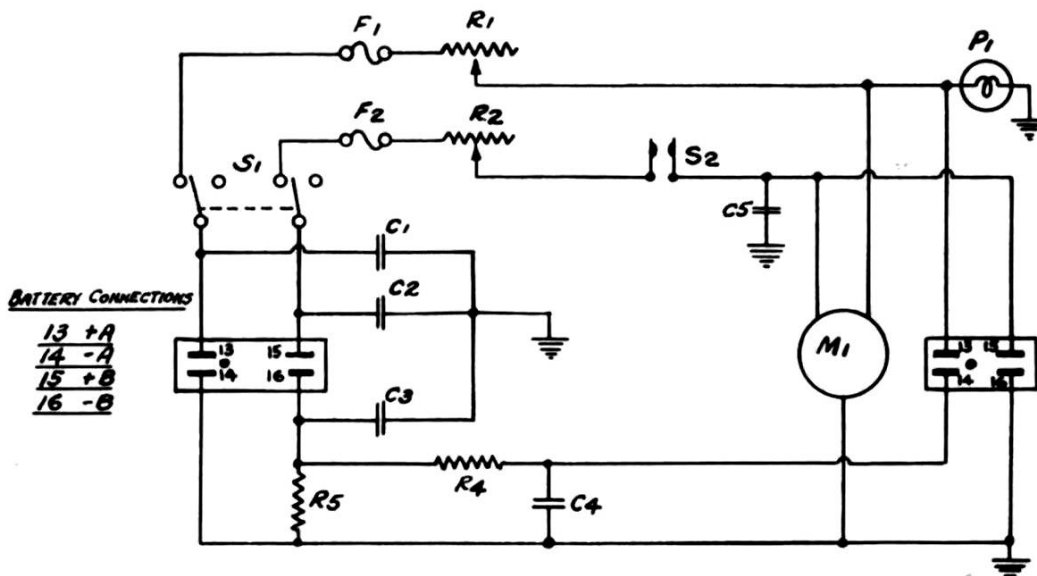


Figure 7. Wiring Diagram for Type 605-P10 Power Supply

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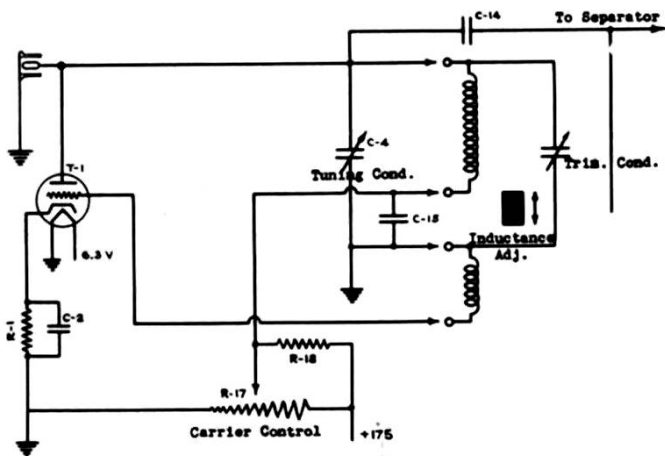


Figure 8. Schematic Circuit Diagram of Carrier Oscillator

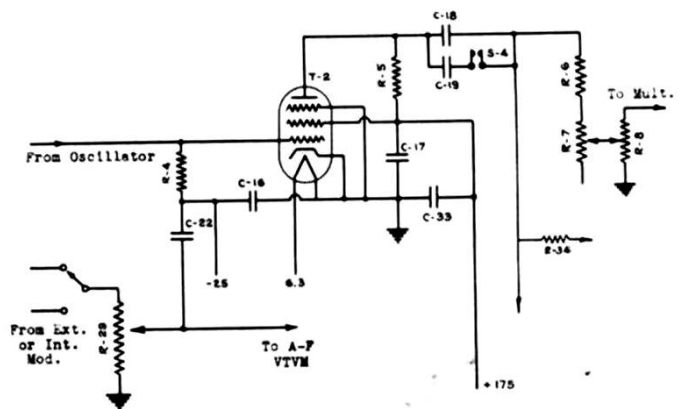


Figure 9. Schematic Circuit Diagram of Separator

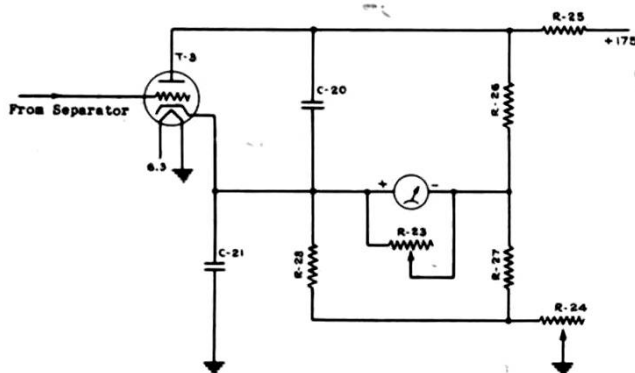


Figure 10. Schematic Circuit of Radio-Frequency Vacuum-Tube Voltmeter

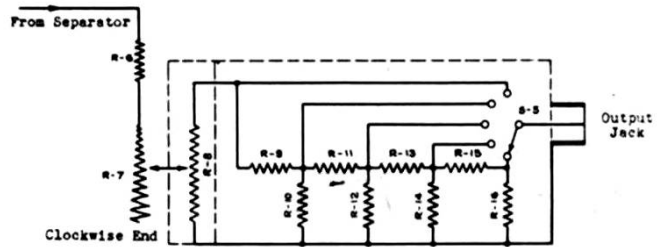


Figure 11. Circuit Diagram of Attenuator

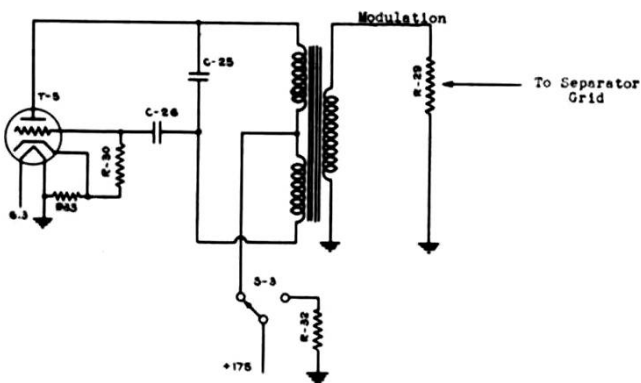


Figure 12. Circuit Diagram of Modulating Oscillator

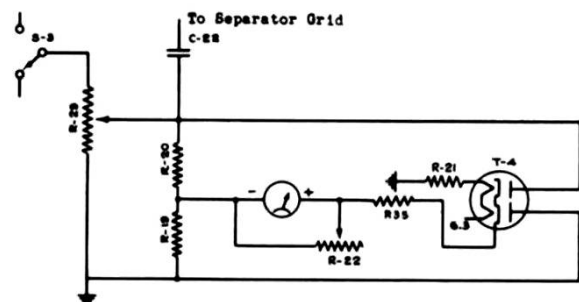
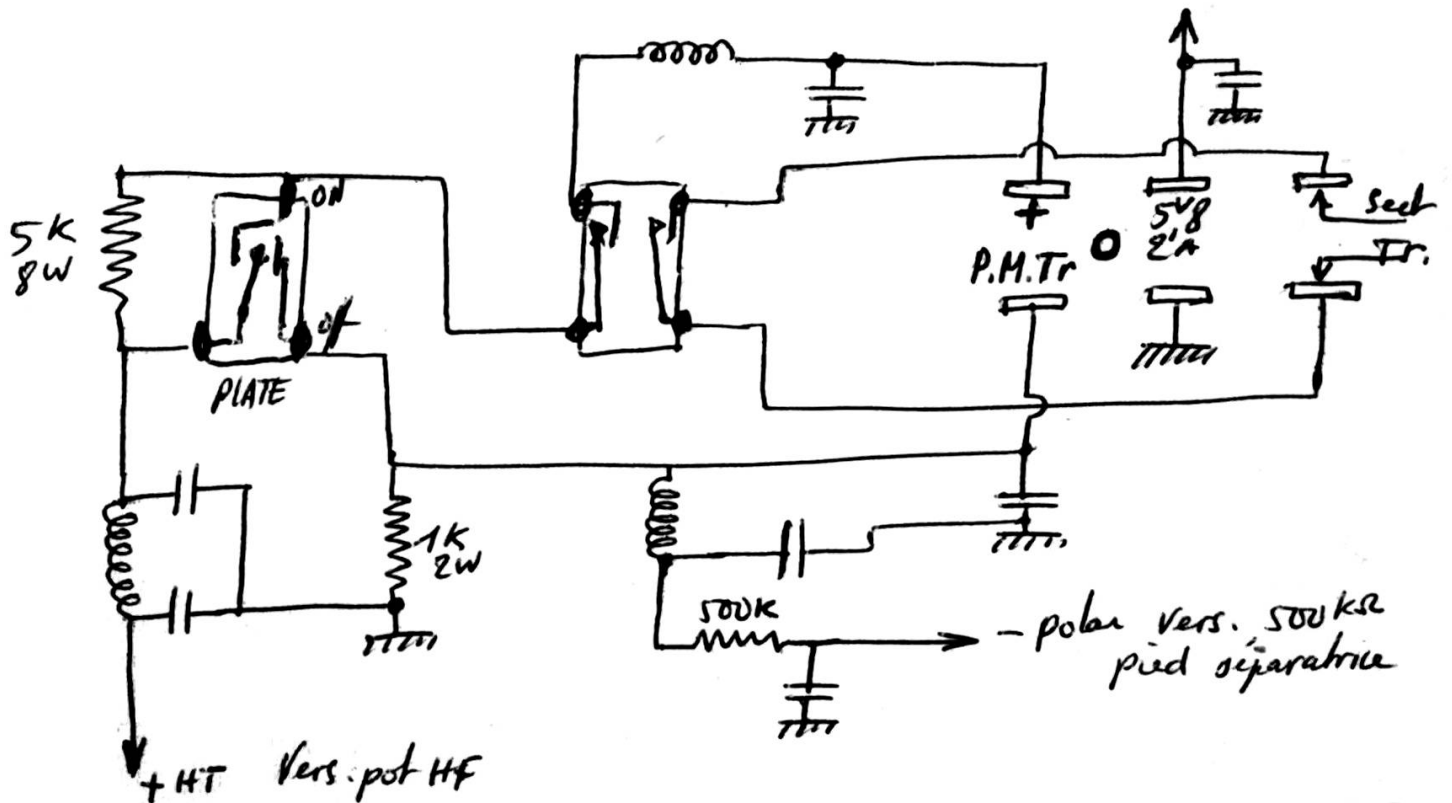


Figure 13. Circuit Diagram of Audio-Frequency Vacuum-Tube Voltmeter

Schéma de prise d'alimentation réalisé dans l'appareil militaire.



Alimentation.

