INSTRUCTION MANUAL FOR

EICO

EICO ELECTRONIC INSTRUMENT CO., Inc.

283 MALTA STREET, BROOKLYN, N. Y. 11207

EICO

Laboratory Precision at lowest cost

INSTRUCTION MANUAL

Model 324

ELECTRONIC INSTRUMENT CO., Inc. 33-00 Northern Blvd. • Long Island City 1, N. Y.

GENERAL DESCRIPTION

The EICO Model 324 RF Signal Generator is intended for general radio and television servicing and for other applications requiring a modulated or unmodulated r-f signal of sine waveform from 175 kc to 420 mc.

The r-f output from the Model 324 may be modulated internally by a 400 cps audio oscillator or may be modulated externally by an audio signal fed into a connector on the front panel. The internal 400 cps modulating signal is also available separately at a front-panel connector. Selection of external modulation rearranges the audio oscillator stage as an amplifier operating on the external modulation signal. As a result, up to 30% modulation is possible when the output of the external a-f source is as low as 3.0 volt. Percentage modulation by either an internal or external a-f source, as well as a-f output voltage, is adjustable by a single panel control.

Six tuning bands are employed to cover the fundamental frequency range from 150 kc to 145 mc. Calibration of the third harmonic of the highest fundamental band (F1) 37 mc to 145 mc is also given on the tuning dial to provide a seventh tuning band (F2) from 111 mc to 435 mc. The particular band desired is selected by the band selector switch which acts, therefore, as a coarse output frequency selector; the 6 to 1 vernier tuning dial control is for fine tuning and permits exact setting of the output frequency.

Construction of the dial and tuning assembly is unusually fine. A heavy gauge, deep-etched, aluminum tuning dial is fastened to the shaft of the tuning capacitor behind the panel and rotates with the tuning knob. The dial is viewed through twin plexiglass windows, four complete scales appearing in one window and four in the other, so that, despite the large number of scales, they are well-spaced and not easily confused. The plexiglass not only affords protection for the tuning dial, but, due to its unique light-conducting property, permits the use of an illuminated hairline, which is engraved in the plexiglass and edge-lit by a panel lamp to permit maximum ease of reading. The illuminated hairline also serve as a pilot. Other important construction points include the use of turret mounted, slug-tuned coils for maximum accuracy, copper-plated chassis for minimized interference, line filters, shielded r-f output cable and jack-top binding posts for audio in/out.

The Model 324 incorporates both coarse and fine r-f attenuators for smooth, efficient control of the r-f output signal. The coarse attenuator provides two steps of coarse attenuation of approximately 20 db each.

The Model 324 employs a Colpitts-type r-f oscillator and a Colpitts-type audio oscillator of proven design for efficient and trouble-free operation. The r-f oscillator is plate modulated by a cathode follower for improved modulation. Maintenance is simplified by an uncrowded chassis and easy access to all internal alignment adjustments for the six fundamental r-f bands.

The characteristics of the Model 324 render it extremely flexible. It may be used in the radio and television service shop or in the field for such applications as alignment and signal tracing of am and fm radio receivers, alignment of both high and low frequency i-f amplifiers in television receivers, and signal tracing and troubleshooting almost all sections of tv receivers. The Model 324 is equally suitable to bench or portable applications, being provided with an uncluttered, professional satin aluminum panel that will add to the appearance of any test bench and a rugged steel case that will withstand "car trunk" abuse.

SPECIFICATIONS

RF CHARACTERISTICS:

RF Output Frequency Range .... 150kc to 145mc on fundamentals in 6 bands
111mc to 435mc on calibrated harmonics.

Accuracy of Tuning Dial Calibration. .±1.5%

RF Coarse Attenuation .... in two steps, each approximately 20db

RF Fine Attenuation .... continuous 0 to max.

AF CHARACTERISTICS:

Internal AF Modulating Frequency... approx. 400cps

AF Output Voltage .... adjustable 0 to 10 volts across 100KΩ load; adjustable 0 to 5 volts across 10K ohm load.

AF In Impedance .... approx. 70KΩ

AF Out Impedance .... approx. 10KΩ

MODULATION CHARACTERISTICS:

Percentage Modulation by Internal 400cps signal ..... adjustable 0 to 50%

External Modulation Frequency Range .... 20 - 15,000 cps

External AF Voltage Required for 30% Modulation at 1 mc RF Setting (1000 cps signal) .... approx. 3.0 volts.

TUBE COMPLEMENT: 1-12AU7, 1-12AV7, 1 selenium rectifier.

POWER REQUIREMENTS: 105-125 volts AC, 50/60 cps; drain 15 watts.

DIMENSIONS: 8" high, 10" wide, 4 3/4" deep.

WEIGHT: 10 lbs.

FUNCTIONS OF CONTROLS AND TERMINALS

SIGNAL SEL. - Turns power off in "OFF" position. In "INT. MOD./AF OUT" position, modulated r-f output is available at the RF OUT connector and 400 cycle audio signal is available at the AUDIO IN/OUT connectors. In "RF/ EXT. MOD" position, pure or externally modulated r-f output is available at the RF OUT connector depending on whether or not any external modulating signal is fed to the AUDIO IN/OUT connectors.

BAND SEL. - Used to select desired tuning band. Frequencies in lower three bands (from 150 kc to 3.5 mc) as well as the linear reference scale are read in the upper window. Frequencies in higher four bands (3.5 mc to 435 mc) are read in the lower window. Note that position F is used when tuning frequencies in either band F1 or F2.

TUNING (knob between windows): - Permits adjustment of RF output frequency to exact value. The RF output frequency is the setting directly under the illuminated hairline on the scale for the band selected with the BAND SEL.

RF OUT - The output cable supplied with the Model 324 should be connected to the RF OUT connector. The amount of output voltage is controlled by the RF COARSE and RF FINE attenuators.

RF COARSE - Permits adjustment of the RF output in coarse steps of approximately 20db each. This is a primary rather than a secondary adjustment.

RF FINE - Continuous control permits exact adjustment of the RF output voltage. This is a secondary rather than a primary adjustment.

AUDIO IN/OUT - Has a double function. When the SIGNAL SEL. switch is set to "INT. MOD./AF OUT", a 400 cps audio signal from the internal audio oscillator is fed to this connector. The audio output voltage is adjustable from zero to a maximum depending upon the load by the AF/MOD. OUTPUT control. When the switch is turned to "RF/EXT. MOD." an external modulating signal up to 15kc may be injected at AF IN/OUT to modulate the r-f output taken from the RF OUT connector.

NOTE: When using external modulation, the AF MOD./OUTPUT control should be turned clockwise in order to prevent short-circuiting the modulating signal to ground. In use, this control may be used as an attenuator to adjust the amount of injected modulating signal. As the Model 324 provides a stage of amplification for the external modulating signal, a signal of only 3.0 volts approximately is required to modulate the r-f oscillator to 30% at 1000 cps (at 1 mc RF setting).

AF MOD/OUTPUT - Has three functions. 1) Adjusts the percentage of internal modulation when the SIGNAL SEL. is set at "INT. MOD./AF OUT. 2) Adjusts the amount of audio signal available at the AUDIO IN/OUT connectors when the SIGNAL SEL. is set at "INT. MOD./AF OUT". 3) Adjusts the percentage of external modulation when the SIGNAL SEL. is set at "RF/EXT. MOD." and an external modulating signal is injected at the AUDIO IN/OUT connectors.

APPLICATIONS

NOTE: Agc troubles may cause r-f or i-f amplifiers to appear weak, dead, or intermittent. Where doubtful, eliminate agc for the test and use fixed bias as shown in Fig. 1.

WARNING: Do not connect the 324 to test circuit points having operating voltages exceeding the maximums listed below:

RF OUT Connector - 500 dc volts max.
AF IN/OUT Connector - 400 dc volts max.

TV SERVICING:

General: If a tv set being serviced has picture or raster trouble, first check the ion trap magnet, brightness control, focusing magnet, and drive control in order to see whether a normal raster with normal brightness is obtainable. The picture tube, the high voltage section, and the vertical and horizontal deflection circuits are o.k. if a normal raster is obtained. If you have a poor raster or no raster, check these sections and correct the trouble. When you have a normal raster, apply picture signal with the contrast control set for max. contrast. If you get a weak picture or no picture, it indicates that there is probably trouble in the r-f, i-f, or video sections.

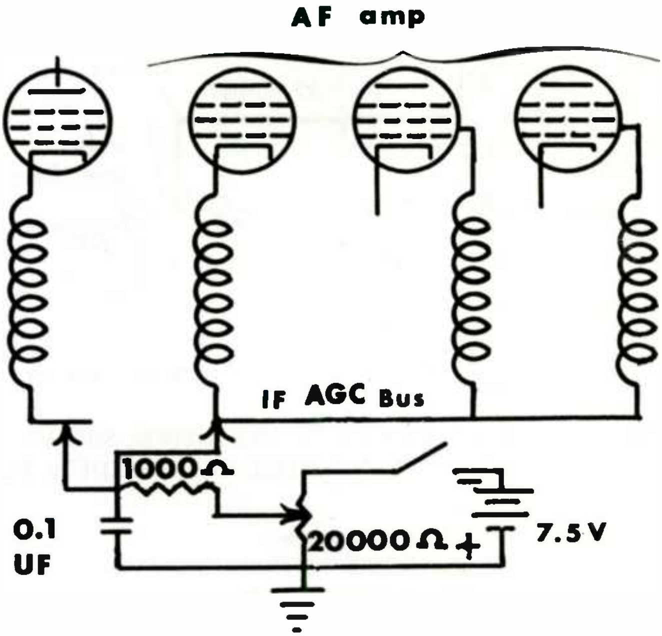


FIG. 1. ELIMINATING AGC AND USING FIXED BIAS

Dead Stage Location in video amplifiers: Check the video section by applying a few volts of audio to the input of the video section (point 1 Fig. 2). As a result, about 6 horizontal bars (the frequency of the a-f output, 400 cps, is about 6 times the normal vertical oscillator operating rate, 60 cps) should appear on the raster as shown in Fig. 3. Adjust the vertical hold control to keep the bars stationary. If the bars do not appear, check out the video section point-by-point starting at the picture tube input and working back toward the 2nd detector. The gain provided by each stage should result in darkening of the bars when the 324 audio lead is moved from the plate to the grid of the same stage if the stage is operating. Distinct lightening of the bars when the 324 audio lead is moved from the grid of one stage to the plate of the preceeding stage indicates a faulty coupling capacitor. Reduce the audio voltage applied to avoid overloading as required.

Dead stage location in picture i-f amplifiers: If the video amplifier is o.k., check the picture i-f section as follows. Tune the 324 to the center of the picture i-f pass band. Apply a modulated r-f signal at the input of the picture

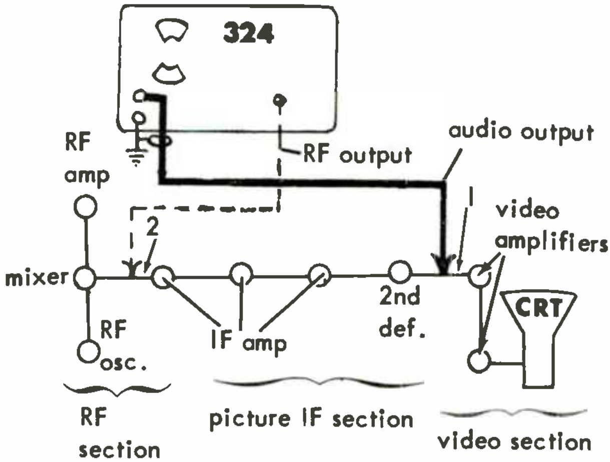


FIG. 2. BLOCK DIAGRAM OF TV RECEIVER SHOWN WITH OUTPUT OF 324 APPLIED TO KEY CHECK POINTS

FIG. 3. HORIZONTAL BARS PRODUCED BY 400 CPS MODULATION ON SCREEN OF TV RECEIVER

i-f amplifier (point 2, Fig. 2). If horizontal bars do not appear on the raster, check the agc voltage according to the manufacturer's service notes. A shorted i-f tube or agc bus may result in clipping. If the agc circuit seems o.k., check out the picture i-f section point-by-point starting at the grid circuit of the last picture i-f amplifier and working back toward the first i-f amplifier. The gain provided by each stage should result in darkening of the bars when the 324 r-f lead is moved from the grid of the following stage to the grid of the stage under test if the stage is operating. Reduce the 324 output voltage with the output cable connected to the plate of a stage to obtain light bars so that the stage gain will be observable as darkening of the bars when the output cable is moved to the grid of the stage.

If the picture i-f stages are functioning properly, check the mixer stage by applying r-f signal to the grid. If the receiver is designed so that the r-f tuned circuits act as a partial i-f short across the converter grid, temporarily eliminate the short during this procedure by a) removing a mixer coil strip in tuner of the turret type and turning the turret to the blank position, or b) using a spare mixer tube, carefully bending out the grid pin for connection to the signal generator. In step b and sometimes in a, you will need to use a 10KΩ or larger resistor to ground to supply a dc-return path for the grid current.

Locating a dead r-f amplifier or r-f oscillator stage: If the mixer stage, picture i-f section and video sections are ok, determine whether the r-f oscillator is operating by measuring the negative grid bias developed in the oscillator circuit. It is important to use a vtvm such as the EICO 221,214,232, or 249 for this measurement. The correct value of the bias voltage should be obtained from the service notes for the particular set. As the range of value for this voltage is usually from -2 to -6 volts, a measurement of a few tenths of a volt or less indicates the r-f oscillator is not functioning and the supply voltages, tube, and other parts of the circuit should be checked. If the r-f oscillator is functioning properly, tune the receiver to any desired vhf channel and the 324 to the picture carrier frequency of that channel. Apply the modulated r-f signal to the mixer tube grid and adjust the r-f output so the bars are clearly visible on the picture tube screen.

Note: Tuners employing triode mixers and some employing pentode mixers may require that a capacitor of about 5 uuf or less be connected in series with the r-f lead to minimize circuit loading and avoid detuning of the high impedance circuits.

Move the output cable to the plate of the r-f amplifier. The bars may turn lighter in shade. If the bars become very faint of disappear entirely, look for trouble in the r-f tuned circuits between the r-f amplifier plate and the converter grid. Without moving the cable, reduce the 324 r-f output until the bars are light grey and then shift it to the grid of the r-f amplifier. Darker bars should result, indicating that the r-f amplifier is functioning. Finally, shift the cable to the antenna input terminals of the receiver, which should result in bars of about the same intensity as before. Faint bars or disappearance of the bars indicates trouble in the circuits ahead of the r-f amplifier.

Locating a dead stage in the sound i-f amplifier: Normal picture but no sound indicates that the trouble is probably in the sound circuits following the sound i-f take-off circuit. If the audio section of the receiver tests o.k. (use method described in later section), check the f-m sound detector. In either the ratio detector or discriminator type detectors, set your vtvm up to use the zero-center scale and connect it across the output load resistor of the detector. Connect the r-f output cable of the 324 to the grid of the last sound i-f stage and tune the generator to the center frequency of the sound i-f amplifier. Tune the 324 back and forth through the sound i-f setting. If the detector is aligned and operating properly, the vtvm meter pointer will swing above and below center scale as the 324 is tuned. If the last stage or detector is defective, however, performance may be impaired.

Next, set up your vtvm to measure dc volts and connect it to the grid of the last sound i-f stage. Normally, grid current flowing through the grid resistor of this stage when a sound i-f signal is applied will produce a negative dc voltage varying from -1.0 volt on weak signals to -30 volts or more on strong signals. At no signal, contact potential in the tube will produce a negative voltage of a few tenths of a volt. Tune the 324 to the center frequency of the sound i-f amplifier and apply the full r-f output, unmodulated, to the input of the sound i-f amplifier. If no reading is obtained, check out the sound i-f amplifier point-by-point by shifting the 324 i-f output cable first to the plate of the next-to-last sound i-f stage, then to the grid, and so on to the input.

Localizing intermittent picture troubles where raster is not affected: Tune the tv receiver to an unused channel at the high end of the band. Tune the 324 to the center of the picture i-f pass band and apply it with modulation to the input of the picture i-f amplifier. Adjust the 324 output and receiver contrast control until the horizontal bars are clearly visible. Set your vtvm to a low d-c voltage range and connect it across the second detector load resistor where it should read several volts of rectified signal. If, when the intermittent occurs, the bars disappear but the vtvm reading remains unaltered, you know the trouble is in the video section or the picture tube. If the intermittent does not occur, the trouble is probably in the r-f section. Intermittents due to voltage breakdown, such as in capacitors or other components may be speeded up by operation at higher than normal line voltage. Intermittent r-f oscillator action due to low line voltage (possibly due to weak or defective oscillator or power rectifier, or dirty tuner contacts) may be induced by operating the receiver at lower than normal line voltage. Intermittent contacts may be found by inspection or tapping and prodding suspected components, whereas intermittents due to contraction and expansion as a result of temperature changes may be induced by heating the components in the suspected section with an infra-red lamp or an ordinary electric lamp.

Localizing intermittent sound trouble: Intermittent sound but normal picture indicates that the trouble is probably in the sound i-f or audio section of the receiver. (Similar symptoms may result from r-f oscillator frequency shift in receivers having a separate a sound channel.) To determine whether the trouble is in the sound i-f or audio section, set your vtvm at the 50 volt d-c range or thereabouts and connect it to the output of the sound i-f detector. Set the 324 for modulated r-f output and connect the output cable to the input of the sound i-f amplifier. Tune the 324 to a frequency a little above the frequency resulting in maximum positive or negative swing on the vtvm scale. Turn up the receiver volume control and then reduce the 324 output so that the i-f signal is slightly below the limiting level. Reset the volume control for desired sound level. If, when the sound disappears, the meter reading drops to a low value, then the trouble is in the sound i-f amplifier. If the meter reading remains unaffected, look for trouble in the audio section. The occurence of the intermittent may be speeded up here also by the methods described previously.

Locating a weak or faulty stage by gain measurements: The procedures already described are applicable only to finding a dead, extremely weak, or intermittent stage. Where the fault is a definitely weak but not dead stage, it can be located by stage gain measurements. To make stage gain measurements on i-f and r-f amplifiers in receivers employing agc, disable agc and use fixed bias as shown in Fig. 1. A low bias voltage such as -1.5 volts will usually be satisfactory and provide nearly maximum gain, whereas -3 volts may be necessary to decrease the gain of high gain amplifiers or in noisy locations. A bias of -4.5 or -7.5 volts may be required if oscillation occurs at lower bias voltage.

To check stage gain in the video or audio amplifier sections, connect the audio output terminals of the 324 to the grid of the output tube and adjust the audio voltage at that point (as measured on your vtvm) to 1.0 volt. Now shift the vtvm lead to the plate of the tube and measure the signal voltage there. As the voltage gain of the stage is equal to the signal voltage at the plate divided by the signal voltage at the grid, the numerical value of the signal voltage measured at the plate is the gain of the stage. Repeat this procedure for the first stage. In ac/dc receivers and some small ac receivers a hum voltage up to 10 or 15 volts may be present at the plate of the output tube. Measure this voltage with no signal applied and subtract it from the value obtained with signal before calculating the stage gain.

To check stage gain in the picture i-f amplifier, replace agc by fixed bias. Then connect the r-f output cable of the 324 to the grid of the last picture i-f tube and adjust the r-f output without modulation to produce 0.5 volt across the second detector load resistor, as measured with your vtvm. Next, shift the output cable of the 324 to the grid of the next-to-last i-f tube and read the vtvm again. Divide this reading by the first reading (0.5 volt) to obtain the gain of the next-to-last stage. Now reduce the 324 r-f output to again produce 0.5 volt across the load resistor and shift the cable to the grid of the second from last stage. Read the new voltage across the load resistor. This reading divided by 0.5 volt is the gain of the second from last stage. Any other stages may be checked in the same manner.

RADIO SERVICING:

Locating a dead section in an a-m receiver: (Unless stated otherwise, the indication of normal functioning in all cases is a loud 400 cps tone.) Check the audio section by applying 0.1 volt audio signal from the 324 to the input of the audio amplifier (point 1 Fig. 4) with the volume control of the receiver set for full volume. Check the i-f section by tuning the 324 to the i-f frequency (usually 455 kc) and applying a very low modulated i-f signal to the input of the i-f amplifier (point 2, Fig.4). If both audio and i-f sections are functioning, it may be assumed that the trouble is in the r-f section.

Locating a dead stage in the audio amplifier section of a radio or tv receiver: Check the speaker and output transformer by applying the full audio output to the primary of the output transformer. Check the audio-output stage by applying almost the full audio output to the grid of the output stage.

Turn up the receiver volume control to maximum and shift the 324 audio lead from the grid of the output stage to the plate of the 1st audio stage. The sound level should remain unchanged if the intervening coupling capacitor is o.k. Now reduce the audio output of the 324 until the 400 cps tone is weak and shift the audio lead to the grid of the 1st audio stage. Proper functioning of this stage is indicated by greatly increased volume. Check the volume control by applying 0.1 volt across it and turning it through its complete range. Noise may be caused by a defective control or d-c leakage in the associated blocking capacitors. To check the input coupling capacitor, shift the audio lead ahead of it. There should be practically no change in volume.

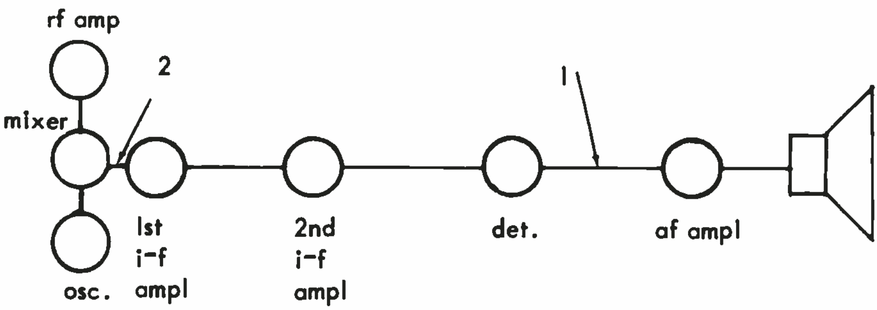


FIG. 4. BLOCK DIAGRAM OF A-M RECEIVER

Locating a dead stage in the i-f amplifier section of an a-m broadcast receiver: If the audio section is functioning, the i-f stages may be checked in the same way the picture i-f stages of a tv receiver were checked, except that the indication here is the 400 cycle tone. Start by setting up the 324 for modulated r-f output, tune it to the receiver i-f frequency, and apply a very low level signal to the grid of the second i-f amplifier. Retune the generator for peak sound output. With the receiver volume control turned all the way up, a loud 400 cycle tone should result, indicating proper functioning of the second i-f amplifier and second detector circuits. Check the first i-f stage in the same manner. Check the converter stage by shifting the 324 output cable to the grid of the converter tube. Where the r-f tuned circuits form a partial i-f short across the converter grid circuit, connect a 10KΩ resistor between the converter grid and the r-f tuned circuit when checking the converter stage and remove after completing the test.

Checking i-f transformers and i-f coupling capacitors: To check an i-f coupling transformer, apply a modulated i-f signal to the grid circuit side of the transformer and then to the plate circuit side. While the 400 cycle tone may be somewhat reduced on the plate circuit side, a drastic reduction in sound level or disappearance of the tone indicates a faulty coupling transformer. Coupling capacitors may be checked in the same way.

Locating a dead r-f stage or r-f oscillator in an a-m broadcast receiver: Operation of the r-f oscillator is checked by the same method used to check the r-f oscillator in a tv receiver as described previously, that is measuring the negative grid bias developed. In a-m receivers, the value of this voltage ranges from -5 to -15 volts.

If the r-f oscillator is functioning, check the r-f amplifier as follows. Apply a low level, modulated 600 kc signal from the 324 with a 5 uuf (approx.) capacitor in series with the output cable to the signal grid of the mixer tube. Tune the receiver for peak intensity of the 400 cycle tone and adjust the volume to a comfortable level. Now shift the 324 cable to the plate of the r-f amplifier. A considerable reduction or disappearance of the 400 cycle tone indicates trouble in the coupling circuit between the r-f amplifier and the converter stage. Check the r-f amplifier by shifting the 324 output cable to the grid of the r-f stage and retune the receiver slightly, if necessary, for the greatest sound intensity. While the output may increase slightly when shifting the cable from plate to grid, a considerable reduction or weakening of the sound indicates trouble in the r-f amplifier circuit. Finally, shift the output cable to the antenna coil input. A slight increase or decrease in output is normal, but considerable weakening or disappearance of the sound indicates a defect in the antenna coil.

Checking i-f amplifier gain in an a-m broadcast receiver: Tune the 324 to the i-f frequency and feed the unmodulated output to the grid of the first i-f amplifier. Adjust the r-f output to develop 10 volts across the second detector load resistor as measured with a vtvm. Now using your vtvm with an RF probe (such as an EICO PRF-11 or PRF-25), measure the generator output voltage at the i-f amplifier grid. The gain is equal to 10 volts divided by the measured generator output voltage.

Correcting contact potential effect: If the second detector of the receiver is a vacuum-tube diode, in making gain checks you may need to correct for the dc voltage across the second detector load resistor due to contact potential, particularly when the signal at the second detector is weak. You may do this by first eliminating any input signal to the second detector by temporarily removing an i-f tube and then measuring the dc voltage across the second detector load resistor with your vtvm. This value which may range from 0.1 volt to 0.5 volt must be subtracted from all subsequent measurements of voltage across the second detector load resistor for the purpose of gain calculations.

Peak Alignment of a-m and f-m broadcast receivers: I-f alignment is basically the same for both a-m and f-m receivers. Manufacturer's instructions in any case should be followed as closely as possible. In general, the following procedure may be used.

Set up your vtvm to read d-c voltages. In a-m receivers, connect it across the second detector load resistor. In f-m receivers employing a standard Foster-Seeley discriminator preceded by a limiter stage (Fig.5), connect it across the limiter stage grid resistor R1. In f-m receivers employing a ratio detector (Fig.6), connect it across the load resistor R2 in the ratio detector circuit. Disable the agc circuit of the receiver and use battery bias, if necessary (described previously). Set an a-m receiver at a quiet point near 1600 kc and f-m receiver at a point near the low frequency end of the dial. Tune the 324 to the receiver's i-f frequency (usually 455 kc in a-m and 10.7 mc in f-m receivers) and apply the modulated output to the grid of the last i-f stage, using only enough output to produce a usable meter reading. With a proper alignment tool, adjust the output i-f transformer secondary and primary trimmers (in that order) for peak indication of the vtvm. Then move the 324 output cable to the grid of the next-to-last i-f stage and adjust the next-to-last i-f transformer secondary and primary trimmers (in that order for peak indication of the vtvm. Finally shift the 324 output cable to the grid of the converter stage and adjust the first i-f transformer secondary and primary trimmers (in that order) for peak indication of the vtvm.

Receivers employing over-coupled i-f transformers ordinarily require that a sweep generator be used for alignment. It is possible to use the peak alignment method just described if the degree of coupling is reduced by shunting a resistor of 1000 ohms or less across the transformer winding opposite to that being tuned. That is to say, when the secondary of the transformer is being tuned, the shunt resistor is placed across the primary, and when the primary is being tuned, the shunt resistor is placed across the secondary.

F-m receivers, particularly the detector sections, are most conveniently and rapidly aligned by the visual method, using a tv-fm sweep generator such as the EICO Model 360 and an oscilloscope (any model EICO oscilloscope is suitable for this purpose). Where such equipment is not available, a careful, experienced person may do a fairly accurate alignment job with an a-m generator and a vtvm. F-m i-f alignment by the a-m generator and vtvm method is described above. F-M detector alignment by this method depends of the type of detector circuit employed in the particular receiver. Two common F-M detector circuits are diagrammed below together with the alignment instructions appropriate to each.

Fig. 4. is the basic Foster-Seeley ("phase") discriminator and preceeding limiter stage. With the 324 set up and connected as per instructions for the last step of the i-f alignment shift the vtvm to measure the d-c voltage across either

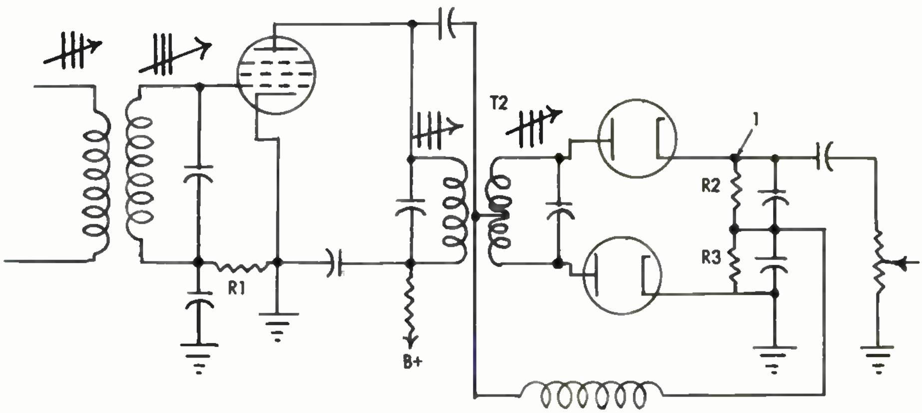


FIG. 5. BASIC FOSTER-SEELEY DISCRIMINATOR CIRCUIT

resistor R2 or R3 and adjust the primary of T2 for a maximum reading. As it is the rectified i-f frequency voltage that is being measured here, the 324 a-f modulation can be turned off for this step although it can do no harm to leave it on as some a-f modulation will filter through to the a-f section and serve to identify the signal by the loudspeaker output. Then shift the vtvm leads to measure the dc voltage across R2 and R3 in series (i.e. from point 1 to ground) and adjust the secondary of T2 until a zero reading is obtained. When using this method, set the generator to 10.7 mc as accurately as possible and what is even more important, maintain the same i-f frequency setting during all adjustments of the i-f amplifier and discriminator. (If the generator setting is slightly inaccurate it will be compensated by a slight variation in the dial setting, but a drift of only a few kc during the time between the i-f and the discriminator alignment will result in a poor job. Therefore make sure that the generator is thoroughly warmed up before doing alignment work.)

Fig. 5 is a basic ratio detector circuit. The primary circuit of T2 is realigned with an unmodulated i-f signal from the 324 connected to the same point used in the last step of the i-f alignment. Adjust the primary of T2 for peak d-c voltage reading across R2 (point 1 to ground). To align the secondary of T2 for the most usual case where R2 is a single resistor (in some receivers R2 is replaced by two equal resistors, the midpoint of which is connected to point 2 through a resistor or to ground) temporarily connect two equal resistances in series across R2 to produce artifically the condition in which the load resistance is split.

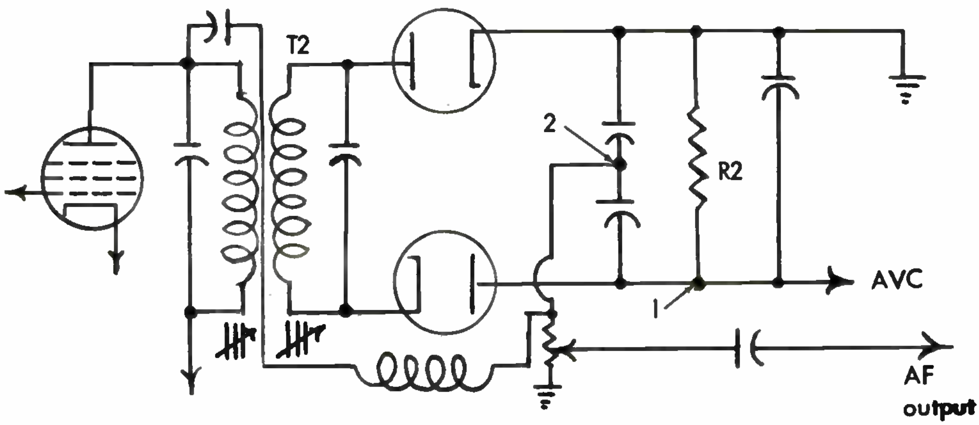


FIG. 6. BASIC RATIO DETECTOR CIRCUIT

Turn on the 324 a-f amplitude modulation and connect a vtvm from the mid-point of the equal resistances, added as described, to point 2 or some point in the a-f signal amplifier circuit (if larger signal amplitude is required for convenient readings) and adjust the secondary of T2 for zero a-f (ac) voltage. Note that the a-f voltage minimum is critical and care must be taken so that the minimum will not be missed.

Alignment of the oscillator section of a-m and f-m receivers should be done after alignment of the i-f section (and detector circuit in f-m receivers). To align an a-m receiver oscillator, connect your vtvm across the second detector load resistor and set it to read d-c voltage. Connect the receiver antenna to the receiver and set the 324 output cable sufficiently near the antenna so that the radiated signal will be picked up. Tune the receiver to its highest frequency, approximately 1600 kc for most types, and set the 324 to the same frequency. Using an insulated screwdriver, adjust the trimmer capacitor on the receiver oscillator for peak reading on the vtvm and then the antenna trimmer for peak indication. Retune the receiver and the 324 to 600 kc, rock the tuning gang slightly, and adjust the trimmer for the low frequency end of the receiver oscillator to obtain a peak reading on the meter.

The adjustment procedure for f-m receivers is the same as for a-m receivers, except that the high and low frequency check points are between 88 and 108 mc (the f-m broadcast band). If particular alignment frequencies are not given for the particular receiver, use the ends of the band (namely 88 and 108 mc).

For all alignment work, always obtain if possible and follow closely the receiver manufacturer's instructions which of course take precedence over any instructions given here. Note that some type of receivers such as those which are stagger-tuned, can not be aligned without specific information as to the specific tuning frequencies.

CALIBRATION

General: Instruments purchased in kit form must be calibrated before use as described below. Factory-wired instruments have been calibrated and tested at the factory. If a change occurs in the accuracy of the instrument after a long period of use, it is probably due to aging of the components. The accuracy of the instrument may readily be restored by repeating this calibration procedure. Recalibration will also be necessary, whenever parts (tubes, etc.) are replaced.

Tuning Dial Adjustments: With the instrument out of the cabinet, insert the line cord into a 115 VAC, 50-60 cycle outlet and turn the power on. Tighten the tuning dial set screw and turn the tuning knob counter-clockwise until the tuning capacitor is fully meshed, i.e. to the point at which further counter-clockwise rotation of the tuning knob causes no further rotation of the tuning dial. Loosen the tuning dial set screw and turn the dial until zero (0) on the LINEAR REFERENCE scale appears directly under the edge-lit hairline in the upper window. Retighten the tuning dial set screw.

Individual band calibration: For each of the five lowest bands there is a coil with an adjustable tuning slug mounted on the BAND SELECTOR switch. The inductance for the highest fundamental band F1 and the harmonic band F2 is simply a straight piece of heavy bus wire which provides the proper inductance at the high frequencies covered by these bands.

The coil corresponding to each band can be identified by the stock number printed on the coil form which is reproduced in the parts list with the proper identification. To facilitate calibration for the kit builder, the tuning slug in each coil has been preset at the factory so that the distance it protrudes from the coil is correct to within one-sixteenth of an inch of the value for the correct calibration.

The method of calibration is to couple the output of the signal generator to an a-m broadcast and/or short-wave receiver sufficiently to provide a strong signal of about the same strength as the broadcast stations signals to be checked against. Depending on what is expedient, the signal generator is set to read either the broadcast station carrier frequency or half the broadcast station carrier frequency (in the case of band A which is entirely below the a-m band). Then the tuning coil slug for the particular band is adjusted with a proper alignment tool until the fundamental frequency output or the second harmonic of this frequency (in the case of band A) is "zero beating" against the broadcast station carrier frequency. Approach of the "zero beat" point is indicated by a squeal heard from the radio receiver which progressively drops in pitch. The procedure is to adjust for the lowest pitched squeal or preferably, a point where there is slow popping with a rising squeal on either side of the setting. The point at which there is slow popping or complete silence is the "zero beat" point, which means that the signal generator frequency (or a harmonic thereof) is the same as or very close to the broadcast station carrier frequency. The set-up for calibration is diagrammed in Fig. 7 below.

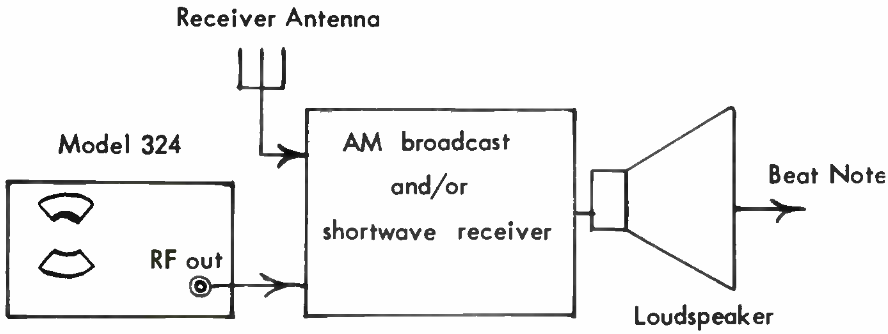


FIG. 7. SET-UP FOR 324 CALIBRATION

It is recommended that wherever possible the coil for each band be adjusted at a frequency approximately two-thirds of the frequency range up from the low end of the band.

Band A Calibration: Tune the receiver to a station of known frequency from 600 to 700 kc. Then set the 324 band selector switch at band A and the tuning knob to read exactly half the known broadcast station frequency. Adjust the coil A tuning slug for "zero beat". Check the calibration by setting the receiver at another station of known frequency under 800 kc and tuning the 324 through a short arc about half the known station frequency on band A to again obtain "zero beat".

Band B Calibration: Tune the receiver to a station of known frequency from 900 to 1000 kc. Then set the 324 band selector at band B and the tuning knob at exactly the known station frequency. Adjust the coil B tuning slug for "zero beat". Check the calibration as above.

Band C Calibration: If a short wave receiver is available, use can be made of the extremely accurate signals transmitted by the Bureau of Standards station WWV. This station transmits frequencies of 2.5, 5, 10, 15, 20, 25, 30, and 35 mc modulated by standard audio frequencies of 440 cps and 660 cps as well as timing signals. Transmissions on 5, 10, 15, and 20 mc are more readily received because of the high transmitting powers used. If the 2.5 mc WWV signal can be received, band C can be calibrated by setting the receiver to receive the 2.5 mc signal, setting the 324 to band C and exactly 2.5 mc on the tuning dial, and then adjusting coil C for "zero beat". If a short wave receiver is not available, calibrate band C making use of an a-m broadcast station of known frequency around 1600 kc.

Bands D and E Calibration: Coils D and E for bands D and E respectively can be adjusted by either zero beating against a WWV transmitted signal (5 or 10 mc for band D; 15,20,25,30, or 35 mc for band E) or against a standard signal generator.

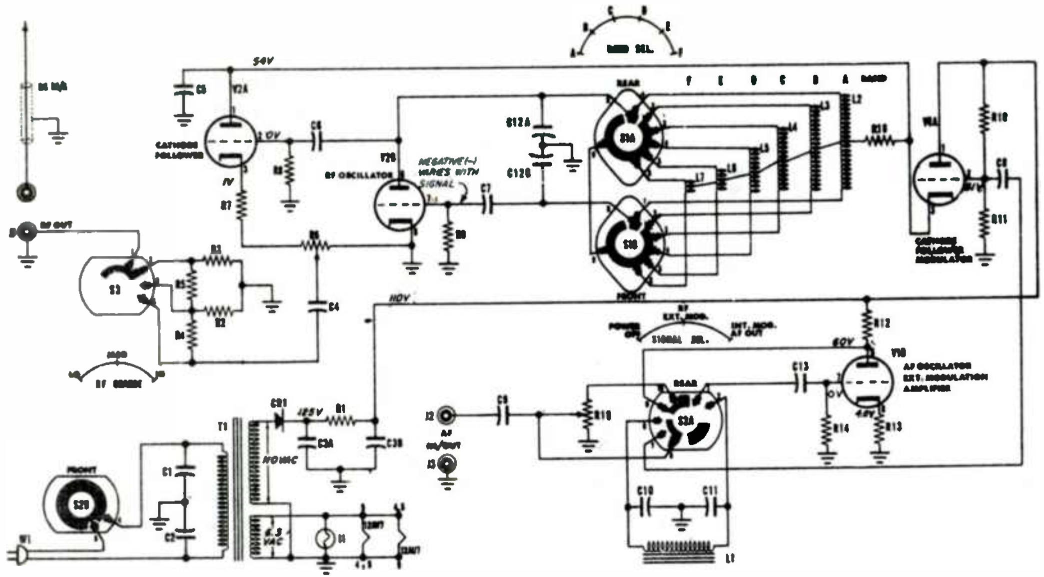
There is no calibration required for band F.

SERVICE

If your instrument fails to function properly and the cause of the trouble can not be found, you may return it to the EICO repair department where it will be repaired at a charge of $5.00 plus the cost of parts. (If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book.) Pack carefully and ship by prepaid Railway Express if possible. Return shipment will be made by express collect.

REPLACEMENT PARTS LIST

STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION
20000	C1,2,13	cap., paper, .01 mf - 400V	51000	P1	amphenol, female
23009	C3	cap., elec., 2 X 20mf - 150V	10041	R1	res., 2.2KΩ, 1/2W, 20%
22500	C4,5	cap., disc., 1000mmf	10002	R2,3	res., 47Ω, 1/2W, 20%
22008	C6	cap., cer., 5mmf	10005	R4,5	res., 470Ω, 1/2W, 20%
22007	C7	cap., cer., 47mmf	16013	R6	pot., 200Ω (RF FINE)
20006	C8,9	cap., paper, .1mf - 400V	10040	R7	res., 68Ω, 1/2W, 20%
20001	C10	cap., paper, .05mf - 400V	10018	R8,9	res., 22KΩ, 1/2W, 20%
20008	C11	cap., paper, .02mf - 400V	10028	R10	res., 470KΩ, 1/2W, 20%
29004	C12	cap., tuning	10419	R11	res., 270KΩ, 1/2W, 10%
93003	CR1	rect., 50 ma	10424	R12	res., 22KΩ, 1/2W, 10%
92000	I1	bulb, #47	10432	R13	res., 1KΩ, 1/2W, 10%
50002	J1	amphenol, male	10410	R14	res., 100KΩ, 1/2W, 10%
52001	J2,3	binding post, 5 way	16002	R15	pot., 250KΩ (AF MOD/OUTPUT)
34501	L1	choke o.f. resonant	10012	R16	res., 4.7KΩ, 1/2W, 20%
36003	L2	coil "A"	60032	S1	switch, BAND SEL., 6 pos.
36004	L3	coil "B"	60033	S2	switch, SIGNAL SEL., 3 pos.
36005	L4	coil "C"	60034	S3	switch, RF COARSE, 3 pos.
36006	L5	coil "D"	30013	T1	transformer, power
36007	L6	coil "E"	90013	V1	12AU7 tube
36008	L7	coil "F" (straight bare wire)	90022	V2	12AV7 tube



STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION
20000	C1,2,13	cap., paper, .01 mf-400V	36003	L2	coil "A"	10028	R10	res., 470KΩ, 1/2W, 20%
23009	C3	cap., elec., 2 X 20mf-150V	36004	L3	coil "B"	10419	R11	res., 270KΩ, 1/2W, 10%
22500	C4,5	cap., disc., 1000mmf	36005	L4	coil "C"	10424	R12	res., 22KΩ 1/2W 10%
22008	C6	cap., cer., 5mmf	36006	L5	coil "D"	10432	R13	res.. 1KΩ 1/2W. 10%
22007	C7	cap., cer., 47mmf	36007	L6	coil "E"	10410	R14	res., 100KΩ, 1/2W, 10%
20006	C8,9	cap., paper, .1mf-400V	36008	L7	coil "F" (straight bare wire)	16002	R15	pot., 250KΩ
20001	C10	cap., paper, .05mf-400V	51000	P1	amphenol, female	10012	R16	res., 4.7KΩ, 1/2W, 20%
20008	C11	cap., paper, .02 mf-400V	10041	R1	res., 2.2KΩ, 1/2W, 20%	60032	S1	switch, BAND SEL., 6 pos.
29004	C12	cap., tuning	10002	R2,3	res., 47Ω, 1/2W, 20%	60033	S2	switch, SIGNAL SEL., 3 pos.
93003	CR1	rect., 50ma	10005	R4,5	res., 470Ω, 1/2W, 20%	60034	S3	switch, RF COARSE, 3 pos.
92000	I1	bulb, #47	16013	R6	pot., 200Ω,	30013	T1	transformer, power
50002	J1	amphenol, male	10040	R7	res., 68Ω, 1/2W, 20%	90013	V1	12AU7 tube
52001	J2,3	binding post, 5 way	10018	R8,9	res., 22KΩ, 1/2W, 20%	90022	V2	12AV7 tube
34501	L1	choke						

INSTRUCTION MANUAL

FOR

Model 221

Vacuum Tube Volt-Ohm-Meter

EICO

ELECTRONIC INSTRUMENT CO.
276 NEWPORT STREET
BROOKLYN 12, N. Y.

INSTRUCTION MANUAL

FOR

Model 221

Vacuum Tube Volt-Ohm-Meter

EICO

ELECTRONIC INSTRUMENT CO.

VACUUM TUBE VOLTMETER

Model 221

SPECIFICATIONS

Overall Dimensions:

Height 9-7/16" Width 6"
Depth 5" Weight 10 lbs.

External Finish:

CABINET: Blue-gray wrinkle laquer on steel

PANEL: Pale Blue-Red trim-Reverse etched

Power Supply:

115 volts, 50-60 cycle (specifications based on 117 volts, 60 cycles).

Power consumption: 10 watts

D-C Voltmeter:

RANGES: 0 to 5, 10, 100, 500, 1,000 volts.

Input resistance: 25 megohmss.

A-C Voltmeter:

RANGES: 0 to 5, 10, 100, 500, 1,000 volts r.m.s.
Input Impedance 3 Megohms

Electronic Ohmeter:

Measures from 0.2 ohms to 1,000 megohms (one billion ohms).

RANGES:
- 0 to 1,000 ohms with 9.5 ohms C.S.
- 0 to 10,000 ohms with 95 ohms C.S.
- 0 to 1 Meg. ohm with 9500 ohm C.S.
- 0 to 10 Meg. ohms with 95,000 ohm C.S.
- 0 to 1,000 megohms with 9.5 megohm C.S.

Battery:

1½ Volt Standard Flashlight Dry Cell.
(For Ohms Range Only)

Tube Complement: 1 6H6, 1 6X5, 1 6SN7

ACCURACY: 2% all ranges of AC & DC.

GENERAL DESCRIPTION

Model 221 combines in one compact convenient instrument an adequate laboratory for rapid radio servicing. The instrument consists of an AC-DC completely *electronic volt-ohm meter* High input impedance is available on both DC and AC voltmeter ranges, since both functions are true vacuum tube voltmeter circuits. Complete electronic overload protection is provided on all AC-DC and Ohmeter ranges. Instantaneous polarity reversal is provided by a flip of a switch on all

DC Voltmeter Ranges. (This instrument will measure DC voltages that are either positive or negative with respect to ground without switching leads). Patented Bridge Circuit provides constant accuracy despite line variations. Visual and audible indications are provided for receiver alignment by use of Db scale of the meter The electronic ohmmeter takes advantage of the high input impedance of the DC Voltmeter to facilitate measurement of resistances up to 1,000 megohms using only 1½ volts. *This feature protects delicate apparatus being measured from the high voltages* normally encountered in high resistance measuring circuits.

The DC electronic voltmeter uses a grounded grid bridge circuit, combining a dual triode tube (6SN7GT) and an extremely rugged meter. The ranges are so chosen as to best fill the needs of practical radio service. Only two calibrations of the arc are required for all AC and DC ranges, eliminating complex and hard to read scales.

The AC electronic voltmeter uses a dual diode 6H6 tube to rectify the voltage to be read, and apply the rectified portion of the applied voltage to the DC voltmeter section. Two simple adjustments of potentiometers on the chassis inside the instrument, calibrate the AC voltmeter, and balance out the unwanted contact potential. (It may be of interest to technical laboratories to note that while the instrument is calibrated during manufacture to read RMS or regular AC, it is a simple matter to re-calibrate it to read peak values). Decibel functions are available at all ranges when function switch is set to AC volts.

The ohmmeter section uses a number of standard matched resistors of 1% tolerance, a 1½ volt "C" battery, and the DC electronic voltmeter bridge to "read" the resistance of any resistor or circuit element from 0.2 ohm to 1,000 megohms.

OPERATING INSTRUCTIONS

INITIAL ADJUSTMENT

Plug the power cord into 60 cycle 117 volt AC Supply, turn on the line switch (associated with the Ohms Adjust Knob) and allow normal warm-up time. Plug the Red test lead intc the DC jack. Plug the AC-Ohms Probe into the recepticle marked AC-Ohms.

Plug the Common (Ground) lead into the Banana Jack. THIS IS THE COMMON LEAD FOR ALL THE FUNCTIONS.

Check the mechanical zero adjustment of the needle with the set off. To adjust, rotate screw on Bakelite case with screwdriver.

D-C VOLTAGE MEASUREMENTS

The desired range is set on the RANGE switch and read direct from one of the two voltage scales of the meter.

Operation:

Function........................	to + volts or - volts
Range...........................	to the desired voltage range
Zero Adj.	set voltmeter pointer to Zero.
Common (GND)....................	black lead clip always to grounded or low side of source to be measured
D-C.............................	probe to high side of source to be measured.

Caution Note:

When working with HIGH VOLTAGES: avoid contact with or close proximity to high voltage points. If possible work with the power off in the circuit to be measured.

DO NOT CONNECT ground lead to high voltage point since the Model 221 case is connected directly to ground terminal.

AC VOLTAGE MEASUREMENTS

AC Voltage measurements are read direct from AC meter scale

Operation:

Function........................	to A.C. volts
Range...........................	to desired voltage range.
Zero Adjust.....................	Set voltmeter pointer to zero
Common..........................	Clip to ground or low side of source to be measured.
Probe (AC)......................	to high side of source to be measured.

OHMMETER RESISTANCE MEASUREMENTS

Operation:

Function........................	to ohms
Range...........................	to desired ohms range
Zero Adj........................	Adjust meter pointer to Zero with ohms lead (black) shorted to common lead.
Ohms Adj........................	adjust voltmeter for full scale deflection.

NOTE: The slight reading noted on the lowest range is the resistance of the leads.

DECIBEL MEASUREMENTS

Operation:

Function........................	to A.C. volts.
Range...........................	To desired decibel (A.C.) range.
Zero Adjust.....................	Set voltmeter pointer to zero with A.C. lead (Black) shorted to common lead.
Common..........................	Clip to ground or low side of source to be measured.
Probe (Black)...................	to high side of source to be measured.

USING THE DB SCALE FOR RECEIVER ALIGNMENT

The DB scale can be used during receiver alignment:

(1) Connect the RF cable probe and the black ground lead across the voice coil.

(2) Set SELECTOR to A-C VOLTS. RANGE at 5V.

(3) Feed a 400-cycle modulated R-F or I-F signal into the receiver.

Keep receiver volume control at maximum, and adjust signal-generator output to produce a small deflection on DB scale.

As alignment adjustments are made thus increasing the sensitivity, the DB scale will show the improvement directly in decibels.

The effective attenuation of wave traps, in decibels, can be determined by noting the decrease in decibels as the trap is tuned through resonance.

ZERO-CENTER APPLICATIONS

In some applications, for example in aligning the discriminator in FM or AFC circuits, it is convenient to use a zero-center D-C voltmeter, because the D-C output of the discriminator changes from + to - to + as the secondary of the discriminator transformer is tuned or as the input frequency is varied above and below resonance.

This zero-center feature can be obtained as follows:

(1) SELECTOR at either + VOLTS or - VOLTS.

(2) RANGE at 5 V. (higher if necessary).

(3) Turn ZERO ADJ. knob to bring the meter pointer to the zero DB mark on the decibel scale.

(4) Connect the common lead to low side of the discriminator load.

(5) Connect the DC probe to the high side of the discriminator load.

(6) Refer to the decibel scale: when the secondary of a conventional discriminator is correctly tuned, there is zero D-C output, and the meter will indicate zero db.

TO MEASURE POWER OUTPUT IN WATTS

Use formula: $\text{Watts} = \frac{\text{Output Voltage Squared}}{\text{Load Impedance}}$

EXAMPLE:

The maximum undistorted output voltage across a 2-ohm load is 5 volts:

$\text{Watts} = \frac{5 \times 5}{2} = \frac{25}{2} = 12.5 \text{ Watts}$

OUTPUT METER

When the RANGE switch is set at "5V", with Selector knob at "A-C Volts," the power level in a 600-ohm circuit can be read directly in decibels on the DB scale, which is calibrated from -20 to + 16 db, based on a reference level of 1.0 milliwatt and 600 ohms.

To measure higher levels, turn the RANGE switch to the required higher setting, read decibels on the DB scale, and add to this reading the range factor given below:

Range Switch: Position	Range Factors
10V	6db
100V	26db
500V	40db
1000V	46db

MODEL 221 APPLICATIONS
As applied to Radio Equipment

OSCILLATOR STRENGTH: the negative D-C voltage developed on the oscilator grid is always directly proportional to the strength of oscillation. This voltage can be measured very readily at the oscillator grid while the band switch is changed to the various bands and in each of its positions the main tuning condenser rotated from minimum to maximum capacity. This will give an indication of the strength of oscillation at all frequencies within the oscillator's range.

AVC VOLTAGE: The automatic volume control voltage developed by the incoming signal can be measured at a number of places in the receiver. This negative voltage first appears across the diode load resistor. It may also be measured along the AVC bus and at the grids of the R-F tubes being controlled. THIS D-C VOLTAGE MEASURED AT THE DIODE LOAD RESISTOR IS A VERY CONVENIENT OUTPUT INDICATION DURING RECEIVER ALIGNMENT.

Owing to the high input resistance of the Model 221, it is possible to measure bias (AVC) voltage on the grid of R-F and I-F amplifier tubes without disrupting the signal.

D-C SUPPLY VOLTAGES: The power supply D-C voltage can be measured at the rectifier filaments and in the filter circuit; plate voltages at the plates of the various tubes; screen voltages at the screen voltages dropping resistor; and cathode voltages at the tube cathodes.

BIAS CELL VOLTAGE: The Model 221 will accurately measure the voltage delivered by a bias cell. Most voltmeters are not capable of making this measurement and in many cases will damage the cell if it is attempted. This voltage should be measured across the cell.

AFC DISCRIMINATOR VOLTAGE: The discriminator voltage developed in radio receivers employing automatic frequency control can be measured directly at the discriminator and also at the grid of the oscillator control tube.

F.M. DISCRIMINATOR VOLTAGE: The D.C. Voltage developed by the discriminator in a frequency modulation receiver can be measured right at the discriminator. For convenience in this application, the ZERO ADJ. knob should be set so the pointer is on the ZERO DB mark of the decibel Scale so the pointer can swing positive or negative without changing the polarity switch.

TELEVISION RECEIVER ADJUSTMENTS: The Model 221 is very useful for measuring the D-C voltage developed in the picture channel of a television receiver across the second-detector load resistor. This measurement is most useful when adjusting antenna orientation and position as well as when adjusting antenna-matching sections.

GASSY TUBES: One effect of a gassy tube is to reduce the normal negative grid bias, or even make the grid positive. The Model 221 is ideal for measuring the voltage directly at the control grid of any tube in order to determine whether or not this effect is present. Excessive gas will cause the tube to cease operating normally and in an audio amplifier, will usually cause the volume control to become noisy. This amount of gas will not always produce a noticeable change in the operation of the radio receiver. Consequently if repeated difficulty is experienced with volume controls becoming noisy, in this type of circuit, the Model 221 should be used to check for incorrect bias.

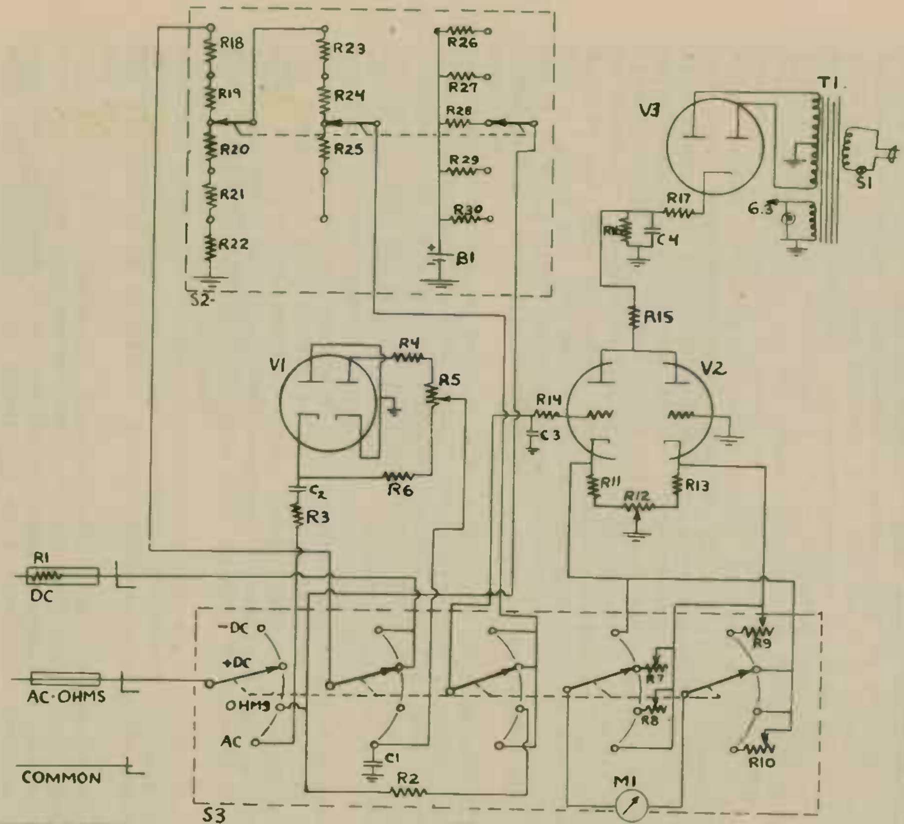
A-C VOLTAGES: The A-C voltmeter within the Model 221 is extremely useful in measuring all A-C voltages encountered in the average radio receiver. The measurements include all voltages from power transformer secondaries, and audio voltages developed across the output transformer or voice coil as an indication of output during receiver alignment. When making such measurements all readings should be taken with respect to ground, and other cautions under A-C voltage measurements should be observed.

The MODEL 221 can be used to check for presence of audio signals at grids and plates of audio amplifiers, etc.

§

GUARANTEE

This instrument is guaranteed to be free from defects in material and workmanship in accordance with the terms of the Standard RMA Warranty.



ITEM	PART	SPECIFICATION
R1	41	15 MEG. RES.
R2	42	12 MEG. RES.
R3	46	500,000Ω
R4	44	1.5 MEGOHM
R5	53	2 MEG AC ZERO POT
R6	44	1.5 MEGOHM
R7	51	1K +D.C. CAL. POT
R8	52	1K OHMS ADJ. POT
R9	51	1K -DC CAL. POT
R10	51	1K AC CAL. POT
R11	50	1,000Ω BTS
R12	52	1K ZERO ADJ. POT
R13	50	1,000Ω BTS
R14	45	1 MEGΩ BTS
R15	49	20,000Ω
R16	47	33,000Ω 2W
R17	48	10,000Ω 2W
R18	32	5 MEGΩ 1%
R19	33	4.5 MEGΩ 1%
R20	34	400,000Ω 1%
R21	35	50,000Ω 1%
R22	35	50,000Ω 1%
R23	43	5 MEGΩ BTS
R24	57	4.7 MEGΩ BTS
R25	46	500,000Ω BTS
R26	36	9.5Ω 1%
R27	37	95Ω 1%
R28	38	9500Ω 1%
R29	39	95,000 1%
R30	40	9.5 MEGΩ 1%
C1	55	.01 CONDENSER
C2	55	.01 CONO.
C3	54	.002 COND.
C4	56	2 MFD COND.
V1	25	6H6 TUBE
V2	24	6SN7 TUBE
V3	23	6X5 TUBE
T1	22	TRANSFORMER
M1	3	0-1 MA. METER
B1	28	1.5 VOLT BATTERY
S1	9	ON-OFF SWITCH
S2	4	RANGE SWITCH
S3	5	FUNCTION SWITCH

EICO MODEL 221-CIRCUIT DIAGRAM

VACUUM TUBE VOLTMETER ASSEMBLY AND CALIBRATION INSTRUCTIONS

The assembly of the vacuum tube voltmeter is not difficult, and if care if used, no trouble should be encountered. First unpack all the parts, checking them against the parts list, identifying each one to make sure no parts are thrown away with the packing. Standard manufacturers values may be interchangeable etc. We are forced to order from several sources in order to assure the supply of these kits. You may therefore find that a value may vary within the permissable circuit tolerance, e.g., a resistance of 470,000 may be substituted or may measure 510,000 etc. All parts supplied will work just as well as the part for which it is substituted. Most parts have a tolerance rating of 20% and the circuit is designed to take these variations into account.

The tools needed for the work are a cleaned and tinned soldering iron, screwdrivers, pliers, and side cutters. Use a good grade of <u>rosin cored</u> solder. <u>Do not</u> use acid core solder or flux. When making connections, wrap the wire securely around the joint and then solder, making sure solder flows into the joint.

Before starting the actual construction, study the schematic and pictorial wiring diagrams thoroughly, getting all the steps clear in your mind. Do not rush the assembly. Care will pay dividends. When this kit is completed, it will represent a fine piece of laboratory test equipment. Most troubles in building kits can be traced to wrong connections or reversed parts and poor soldering.

Mount the parts of the chassis first, using lock washers under all potentiometers. The calibration potentiometers have screwdriver slots in the shafts, while the adjust potentiometers going on the panel do not. Mount the transformer on the top of the chassis after mounting terminal strip 58. Wire as shown. Be sure to solder grounding lug #75 to center arm of potentiometer 52.

Now assemble the function and range switches. Many troubles encountered in the assembly have occured in wiring these switches. Some difficulties are the result of poor soldering connections. Use care to prevent rosin from running on to the contacts as this will result in erratic operation. Trace out the wiring with a colored pencil to make sure you have left out no connections. When mounting the ground lug on the function switch, make sure it does not touch the wafer terminals. Matched (or single) 1% Precision resistors are supplied in the VTVM for all multipliers. These will be found in a paper sleeve with the value indicated on the sleeve. Do not separate these resistors. They are to be soldered together either in series (parts #32 to 35 and 37 to 40) or parallel (part #36) as per assembly print #2. All paired resistors are matched to within 1% accuracy and care should be taken not to over heat them. Carbofilm single 1% resistors may be used insted of the matched pairs and are equally good. Use each carbofilm resistor instead of a pair. After building the switches, they should be carefully cleaned with generous amounts of carbon tetrachloride.

Mount the panel as shown on assembly print 3. Tighten the banana jack well, as it is a ground connection. Mount the panel flush to the chassis by fastening it with the nuts. Put flat washers under the nuts to keep from marring the panel. Wire the unit as shown in assembly print 4. Watch the polarity of the electrolytic condenser. When the instrument is completed, the wiring should be carefully checked. In this way, any connections overlooked or incorrect, will be disclosed.

Plug the line cord into 110 volt 60 cycle AC current. Set selector switch to +DC volts, and turn instrument on. To insure maximum accuracy, the tubes should be aged. Preliminary calibration can be made after a warm up period of approximately 30 minutes. However, final calibration should be made after aging the tubes. This can be done by leaving the instrument on for 48 hours or by using it for several weeks. After final calibration is made against known accurate voltages (described below), apply glue to the base of the calibration potentiometer to prevent jarring them out of place. The instrument should then not vary from calibration unless tubes are changed.

In switching ranges, a change in the zero setting of the meter pointer will be observed. A small amount of this (not more than two fractional divisions on the voltage scales) is normal and will decrease as the tubes are aged. Some 6SN7 and 6H6 tubes however, are sufficiently unbalanced to cause a great deal more change. If possible, these should be exchanged for other tubes locally, as they are entirely satisfactory for radio use, but not for VTVM use. These tubes should not be returned, as they are guaranteed only as good for radio use.

Before turning the instrument on to calibrate, set meter needle to zero with the set screw on bakelite meter case. In this way, the needle will stay on zero when switching from plus to minus DC. Be sure (R1) isolation resistor is in DC (red) probe.

To calibrate DC, use two flashlight cells in series. This adds up to a total of 3.10 volts when fresh. Put the function switch on -DC and the range switch on 5v. Short the DC lead to ground and adjust zero control until meter reads exactly zero (ignore any change after test leads are disconnected). Put batteries between the ground clip and DC test lead with the ground clip touching the positive side of the battery. Adjust the -DC calibration potentiometer to read 3.10 volts on the 5 volt scale. To calibrate the +DC, repeat the above steps with the function on +DC and the battery positive touching the DC lead. Adjust the +DC potentiometer. The electrostatic pick up which appears when the AC or DC lead is held or touched is normal in sensitive VTVM, and is due to the extreme sensitivity of the instrument. When the lead is grounded, and zero adjusted, the actual zero will remain correct for meter readings. No error is introduced because of this pick up.

To calibrate AC, set function switch to AC and range switch to 1000 volts. Short AC test lead to ground or to common test lead. Set meter needle on zero with zero adjust knob. Turn range switch to 5 volt position. Turn the AC zero shift balance potentiometer until the needle returns to zero. Turn the range switch to 500 volts.

The needle should move very little, usually no movement at all. Connect the common and AC test leads to the 115 volt AC line and adjust the AC calibration potentiometer until the scale reads 115 volts. This is usually within 5% and sufficient for service work. If greater accuracy is desired, the instrument should be calibrated against a known AC standard voltage.

To check the ohms scale, set the function switch on ohms and adjust the zero adjust potentiometer with the leads shorted. Unshort the leads and set the needle on the last line past the 1000 mark on the ohms scale with the ohms adjust potentiometer. The ohmmeter is ready for use. If the ohms adjust potentiometer will not bring the needle past the last mark on the scale, try a higher gain 6SN7 or a new battery. If neither of the above will do, put two batteries in series.

To use meter scales: Because of the linearity of AC diode rectification, the same scale is used for both AC and DC reading. The top half of the AC-DC scale is used for 5 volt readings and the lower half for 10 volt readings. To use the 500 volt scale, use the top scale and add two zero's to the reading. Thus read 5 and add two zero's to make it 500. To use the 100 volt scale, use the 10 volt scale and add one zero. To use the 1000 volt scale use the 10 volt scale and add two zero's to the reading.

To use the ohmmeter, read the top scale directly and multiply by the number of zero's (e.g. Rx1, Rx100, etc.) shown on the range switch.

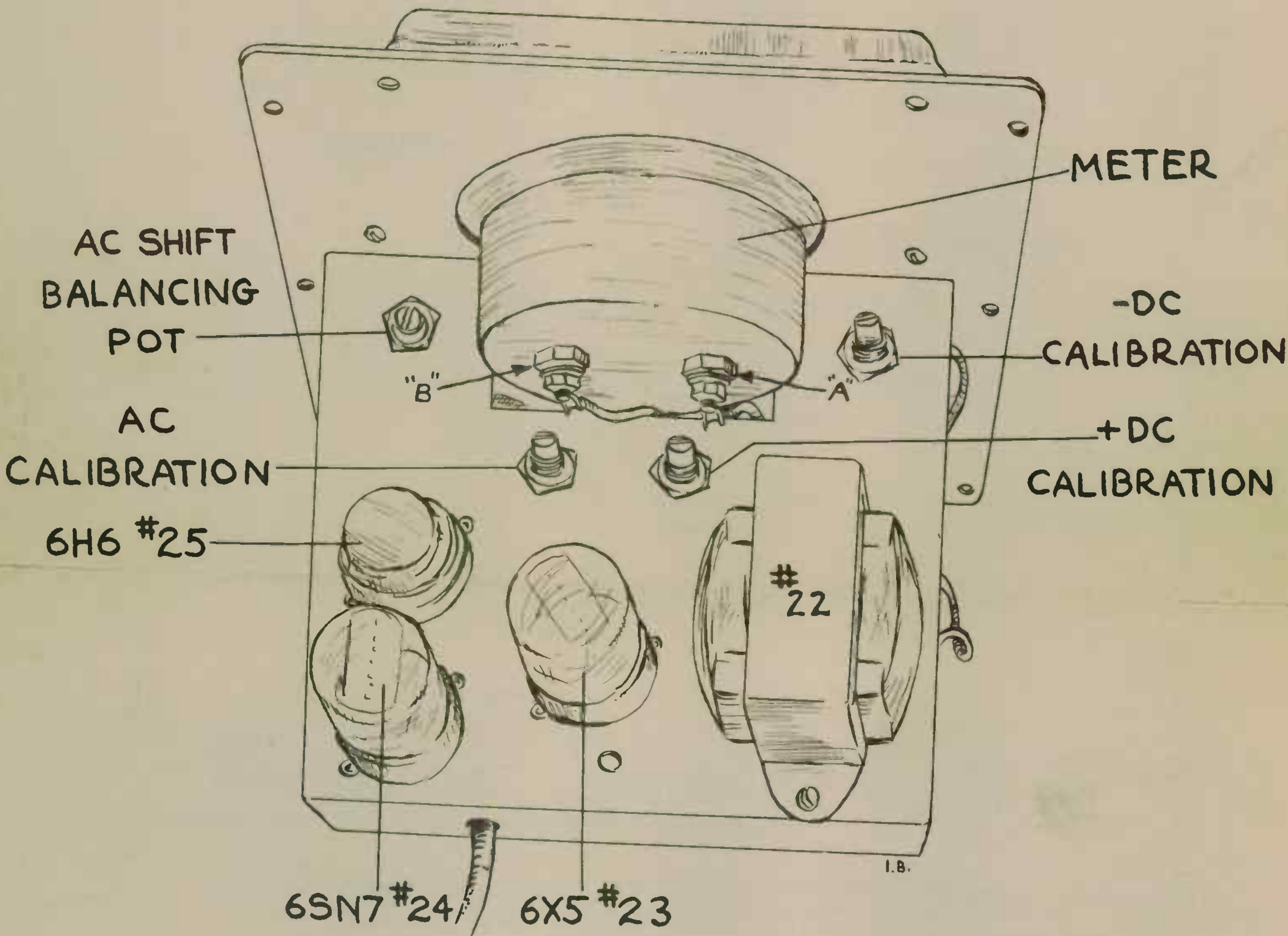
The db meter is calibrated for a 600 ohm load with a reference level of 1.0 multiwatt. To use, set the function switch to AC and the range switch to 5 volts. Read decibels directly on DB scale. To measure higher levels, turn the range switch to a higher setting, read decibels on scale and add to this reading the factor listed below.

10 V Range add -/ 6db, 100 V Range add -/ 26 db, 500 V add -/ 40 db, 1000V add-/ 46 db

If you have trouble

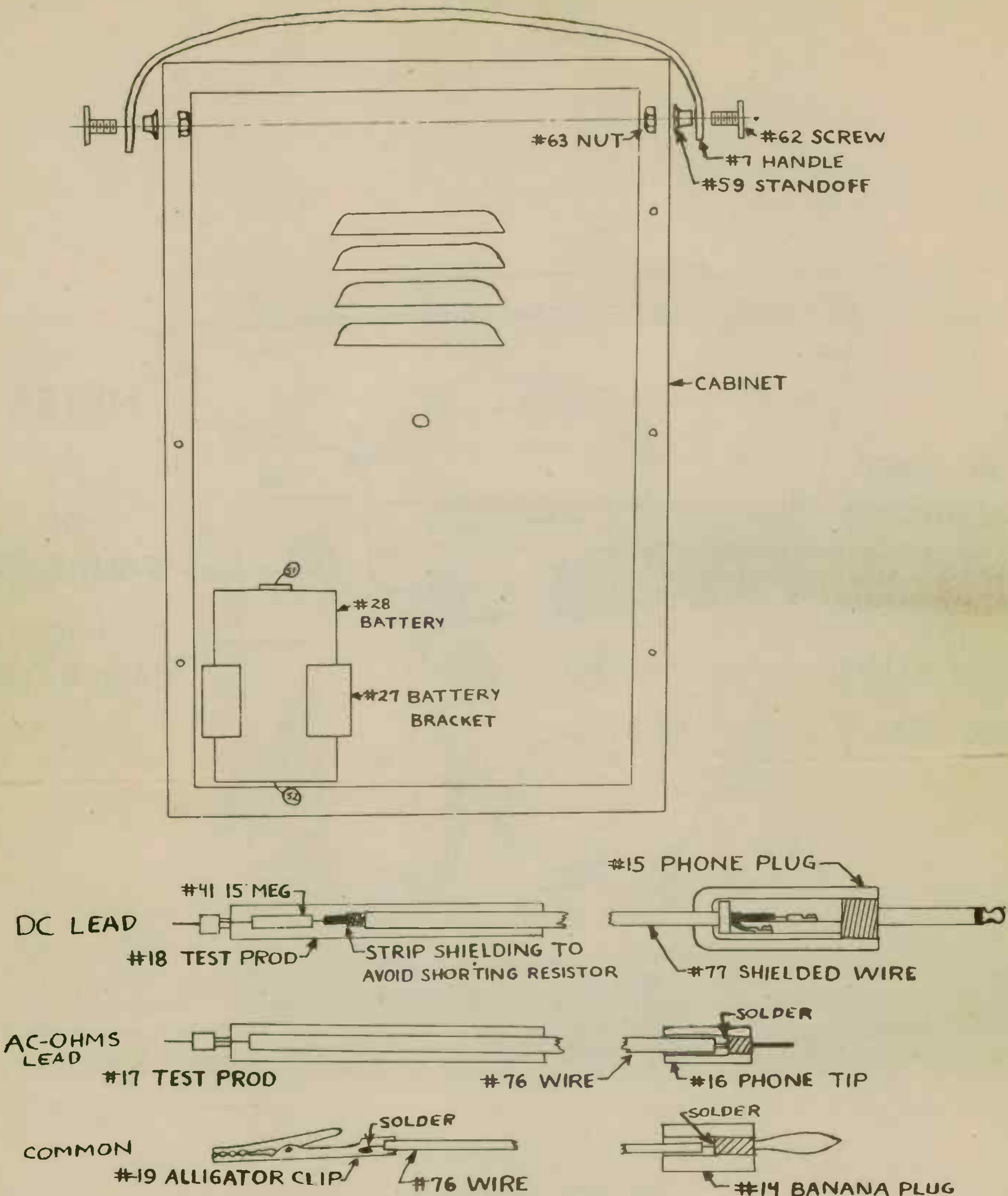
1. Check wiring carefully. Most cases of trouble result from wrong or reversed wiring.
2. Check tubes and battery. (See that DC isolation resistor (R1) is in DC Probe).
3. If pointer swings to right on /DC and cannot be brought back, the grid circuit ingluding the range switch may be open.
4. Check voltages on tubes. The 6SN7 plate voltage should be about 85 volts and the cathode voltage about 3.5 volts. 82V + 3Volt
5. Check DC probe carefully to make sure shielding is not shorting the wire. Check jacks for shorting to ground
6. If you are unable to obtain satisfactory results, write the engineering department, giving all information possible, voltages obtained, any indications on meter, etc., which will help diagnosing the trouble.

7. If desired, your instrument may be returned to the factory. It will be put in operating condition for a charge of $4.00 plus any parts or alterations required due to damaged or improper construction. Pack well and mark fragile. Ship prepaid. Instrument will be returned as soon as possible.



TOP VIEW

ASSEMBLY PRINT #6



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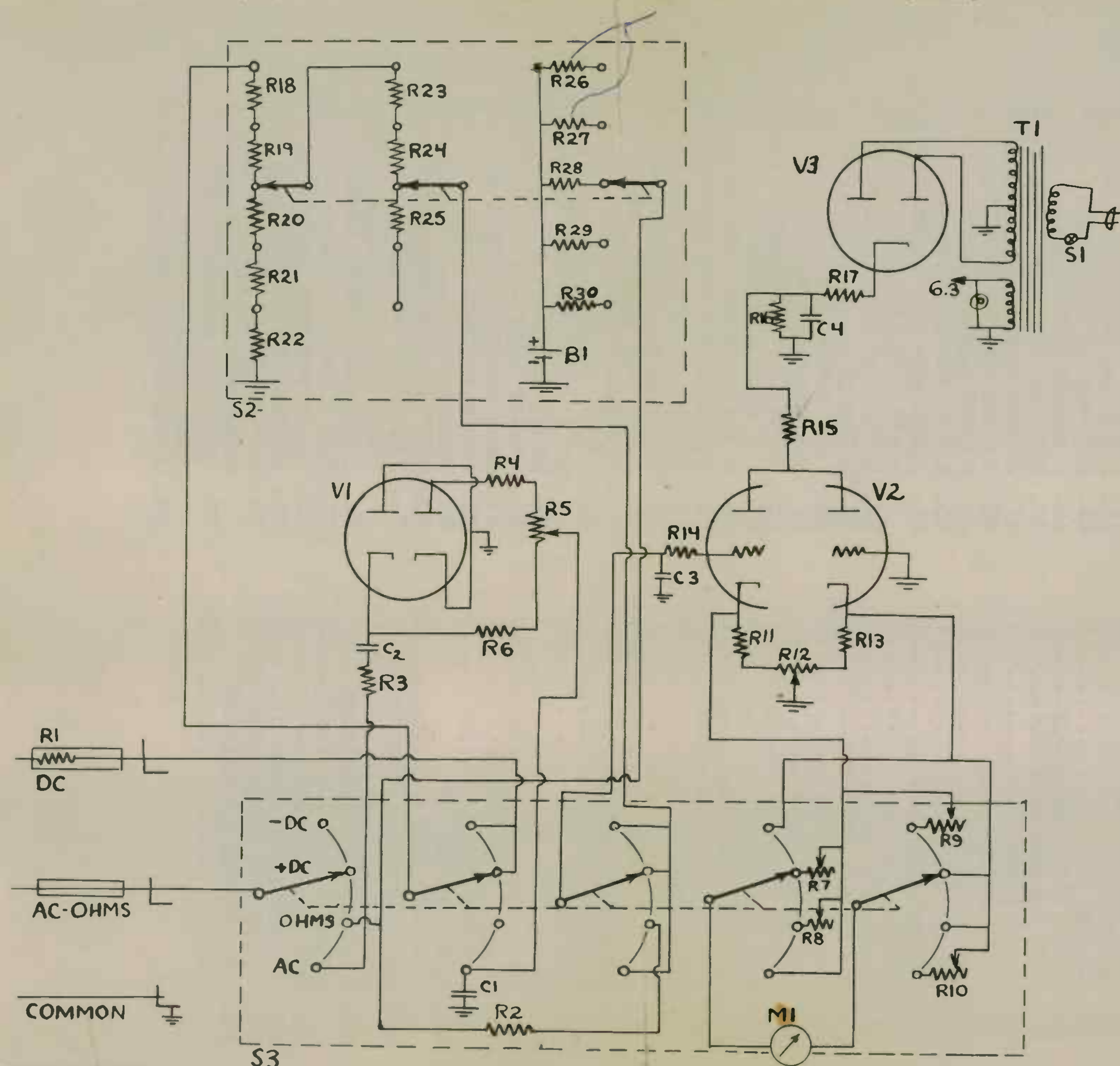


MODEL 221-CIRCUIT DIAGRAM

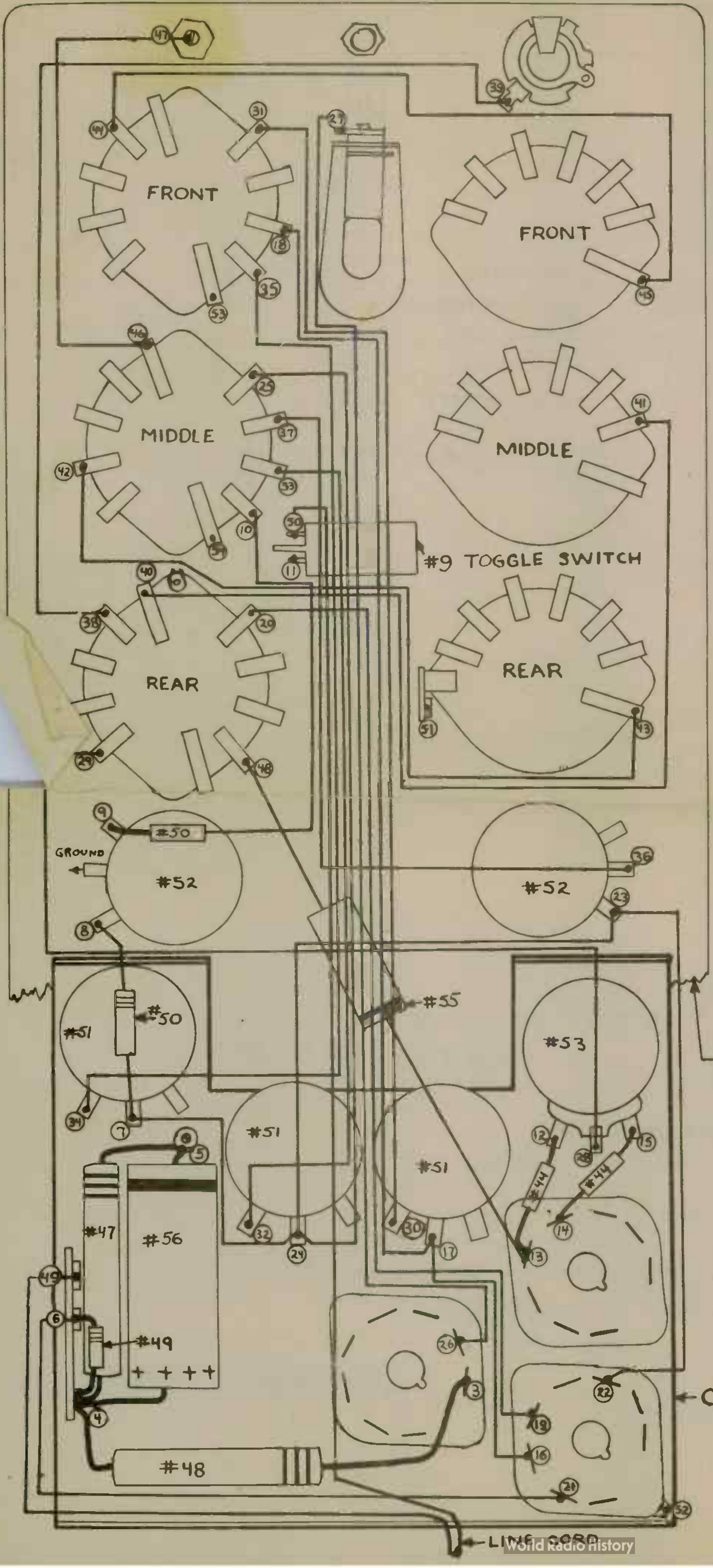
11-48
REV. 1

ITEM	PART	SPECIFICATION
R1	41	15 MEG. RES.
R2	42	12 MEG. RES.
R3	46	500,000Ω
R4	44	1.5 MEGOHM
R5	53	2 MEG AC ZERO POT
R6	44	1.5 MEGOHM
R7	51	1K +D.C. CAL. POT
R8	52	1K OHMS ADJ. POT
R9	51	1K -DC CAL. POT
R10	51	1K AC CAL. POT
R11	50	1,000Ω BTS
R12	52	1K ZERO ADJ. POT
R13	50	1,000Ω BTS
R14	45	1 MEGΩ BTS
R15	49	20,000Ω
R16	47	33,000Ω 2W
R17	48	10,000Ω 2W
R18	32	5 MEGΩ 1%
R19	33	4.5 MEGΩ 1%
R20	34	400,000Ω 1%
R21	35	50,000Ω 1%
R22	35	50,000Ω 1%
R23	43	5 MEGΩ BTS
R24	57	4.7 MEGΩ BTS
R25	46	500,000Ω BTS
R26	36	5.5Ω 1%
R27	37	95Ω 1%
R28	38	9500Ω 1%
R29	39	95,000 1%
R30	40	9.5 MEGΩ 1%
C1	55	.01 CONDENSER
C2	55	.01 COND.
C3	54	.002 COND.
C4	56	2MFD COND.
V1	25	6H6 TUBE
V2	24	6SN7 TUBE
V3	23	6X5 TUBE
T1	22	TRANSFORMER
M1	3	0-1 MA. METER
B1	28	1.5 VOLT BATTERY
S1	9	ON-OFF SWITCH
S2	4	RANGE SWITCH
S3	5	FUNCTION SWITCH

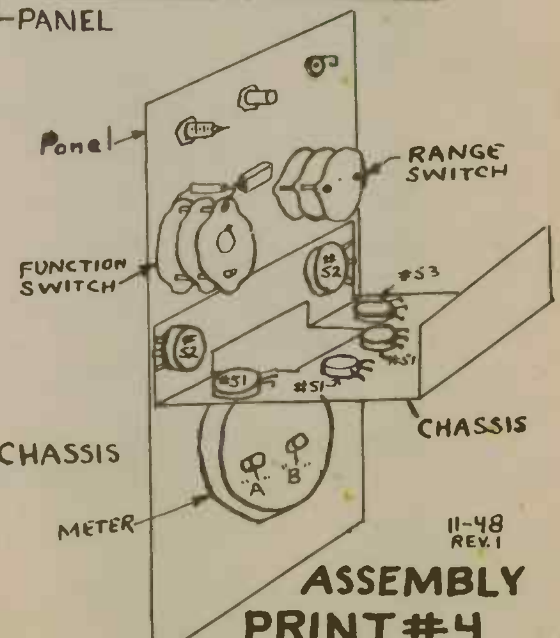
PARTS LIST

1. Panel........................1
*2. Chassis assembly..........1
3. Meter.........................1
4. Range switch...............1
5. Function switch...........1
6. Cabinet......................1
7. Handle........................1
8. Pilot light assembly......1
9. SPST toggle switch........1
10. Pilot light...................1
11. Phone jack...................1
12. Banana jack.................1
13. Pin jack......................1
14. Banana plug.................1
15. Phone plug...................1
16. Phone tip.....................1
17. Test prod (black).........1
18. Test prod (red)............1
19. Alligator clip..............1
20. 1 lug terminal strip.....1
*21. Wafer sockets..............3
22. Transformer..................1
23. 6X5 tube.....................1
24. 6SN7 tube....................1
25. 6H6 tube.....................1
26. Rubber grommet.............1
27. Battery bracket.............1
28. 1.5v battery.................1
29. Bar knobs.....................2
30. Round knobs..................2
31. Line cord.....................1
32. 5 meg 1% resistor matched pair..............1
33. 4.5 meg ohm 1% matched pair..............1
34. 400,000 ohm 1% matched pair......................1
35. 50,000 ohm 1% matched pair......................2
36. 9.5 ohm 1% matched pr....1
37. 95 ohm 1% matched pr.....1
38. 9,500 ohm 1% matched pr..1
39. 95,000 ohm 1% matched pair......................1
40. 9.5 meg ohm 1% matched pair......................1
41. 15 meg ohm BTS resistor..1
42. 11 meg or 12 megohm resistor.....................1
43. 5 megohm resistor.........1
44. 1.5 megohm resistor......2
45. 1 megohm resistor.........1
46. 510,000 ohm resistor.....2
47. 33,000 ohm 2w resistor...1
48. 10,000 ohm 2w resistor...1
49. 20,000 ohm resistor......1
50. 1,000 ohm resistor.......2
51. 1,000 ohm pot screwdriver shaft (calibrate)........3
52. 1,000 ohm pot (adjust)...2
53. 2 meg pot..................1
54. .002 condenser............1
55. .01 condensers............2
56. 2mfd. 250v condenser.....1
57. 4.7 megohm resistor......1
58. 3 lug terminal strip.....1
59. standoff ½" for handle...2
60. 6/32-¼ screws.............6
61. 6/32 nuts..................4
62. 10/24-3/8 button head screw.....................2
63. 10/24 nuts.................2
64. #6-¼" "A" PK screws.....7
65. Meter lugs.................2
*66. Ground lugs................5
67. Lock washers, small #6...5
68. Fibre washers.............2
69. Roll wire..................1
70. 3/8" lock washer, lge....8
71. 3/8" flat washer , panel......................4
72. 10/32 nut brass (meter)..2
73. 3/8 nuts..................10
74. Brass washers (meter)....4
75. Control grounding lug....1
76. AC & common test lead wire 48" strip...........2
77. Shielded wire 48" (DC test lead)...............1
78. Instruction book.........1

WIRING			
PART	DESCRIPTION	FROM	TO
48	10K (2W)	3	4
47	33K (2W)	4	5
56	2 MFD COND	4	5
49	20KΩ	4	6
50	1KΩ	7	8
50	1KΩ	9	10
	BLACK WIRE	TRANS.	11
44	1.5 MEG	12	13
44	1.5 MEG	14	15
	WIRE	16	17
	WIRE	17	18
	WIRE	19	20
	WIRE	6	21
	WIRE	22	23
	WIRE	23	24
	WIRE	7	24
	WIRE	24	25
	WIRE	26	27
	WIRE	28	29
	WIRE	30	31
	WIRE	32	33
	WIRE	34	35
	WIRE	36	37
	WIRE	38	39
	WIRE	40	41
	WIRE	42	43
	WIRE	44	45
	BARE WIRE	46	47
55	.01 COND	13	48
	LINE CORD		49
	LINE CORD		50
	WIRE	BATTERY +	51
	WIRE	BAT. −	52
	WIRE	53	METER LUG "A"
	WIRE	54	METER LUG "B"



EICO



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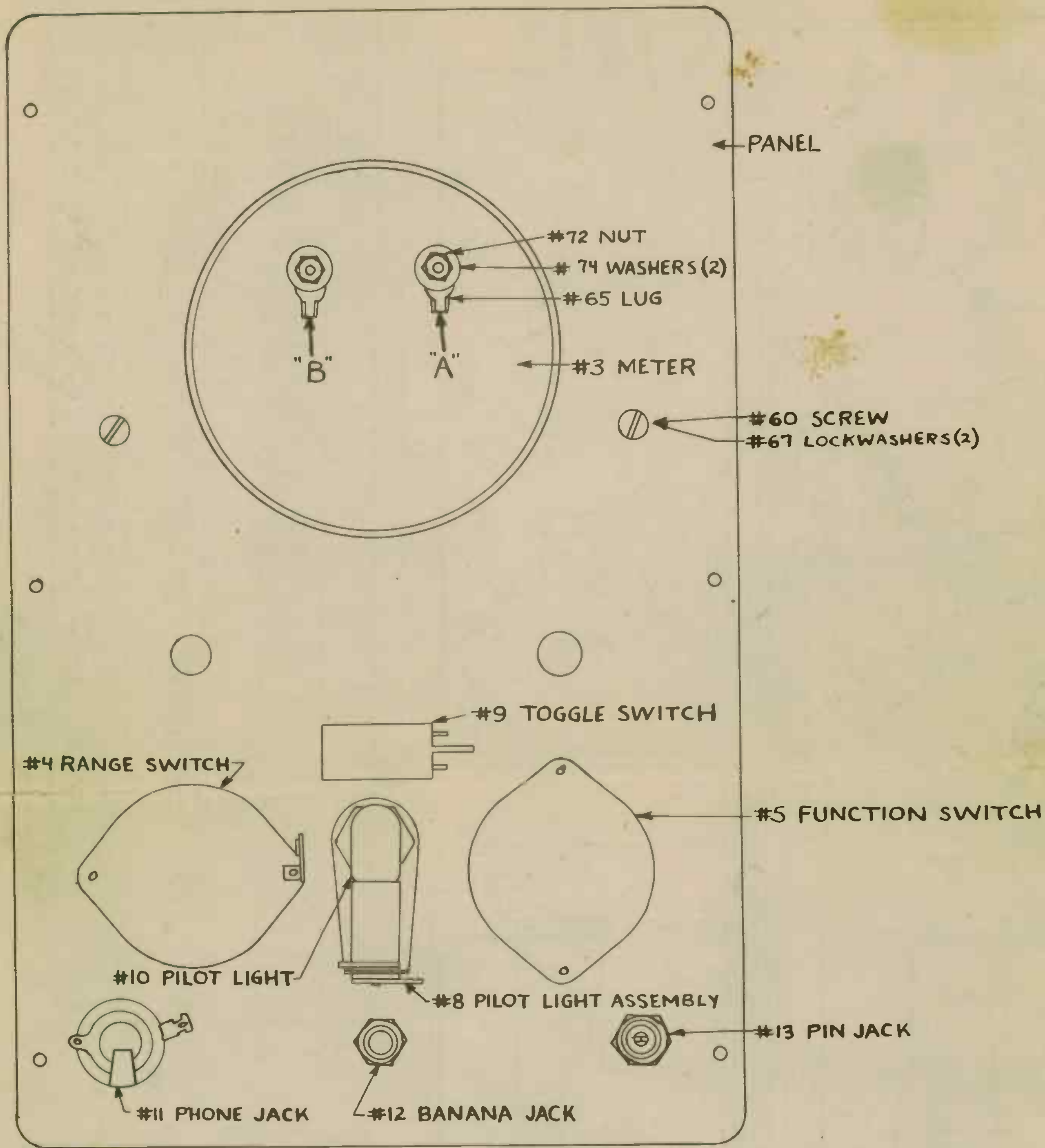
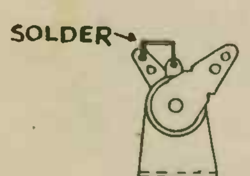
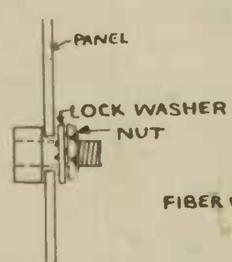
REV. 1

ASSEMBLY PRINT #4

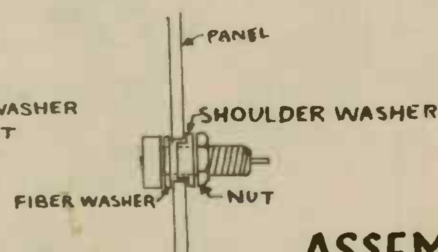




PILOT LIGHT ASSEMBLY



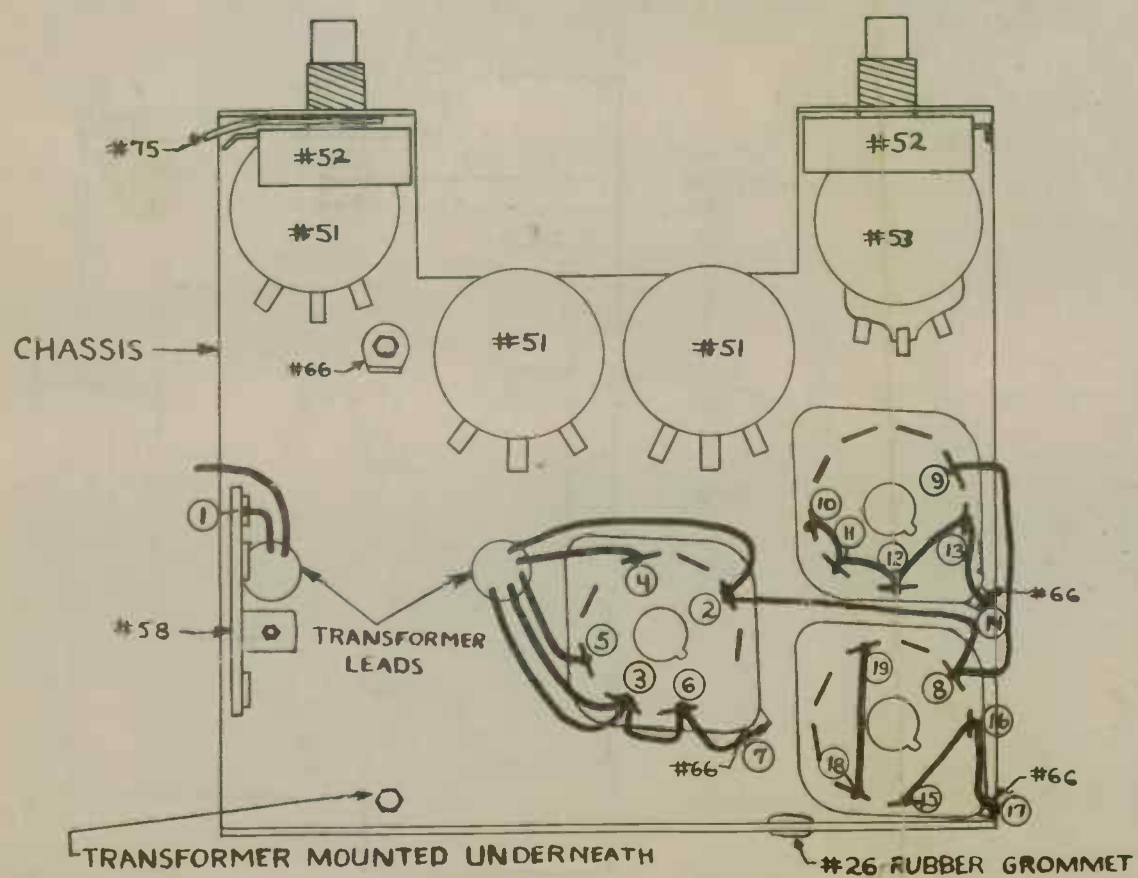
BANANA JACK



PIN JACK

ASSEMBLY PRINT #3

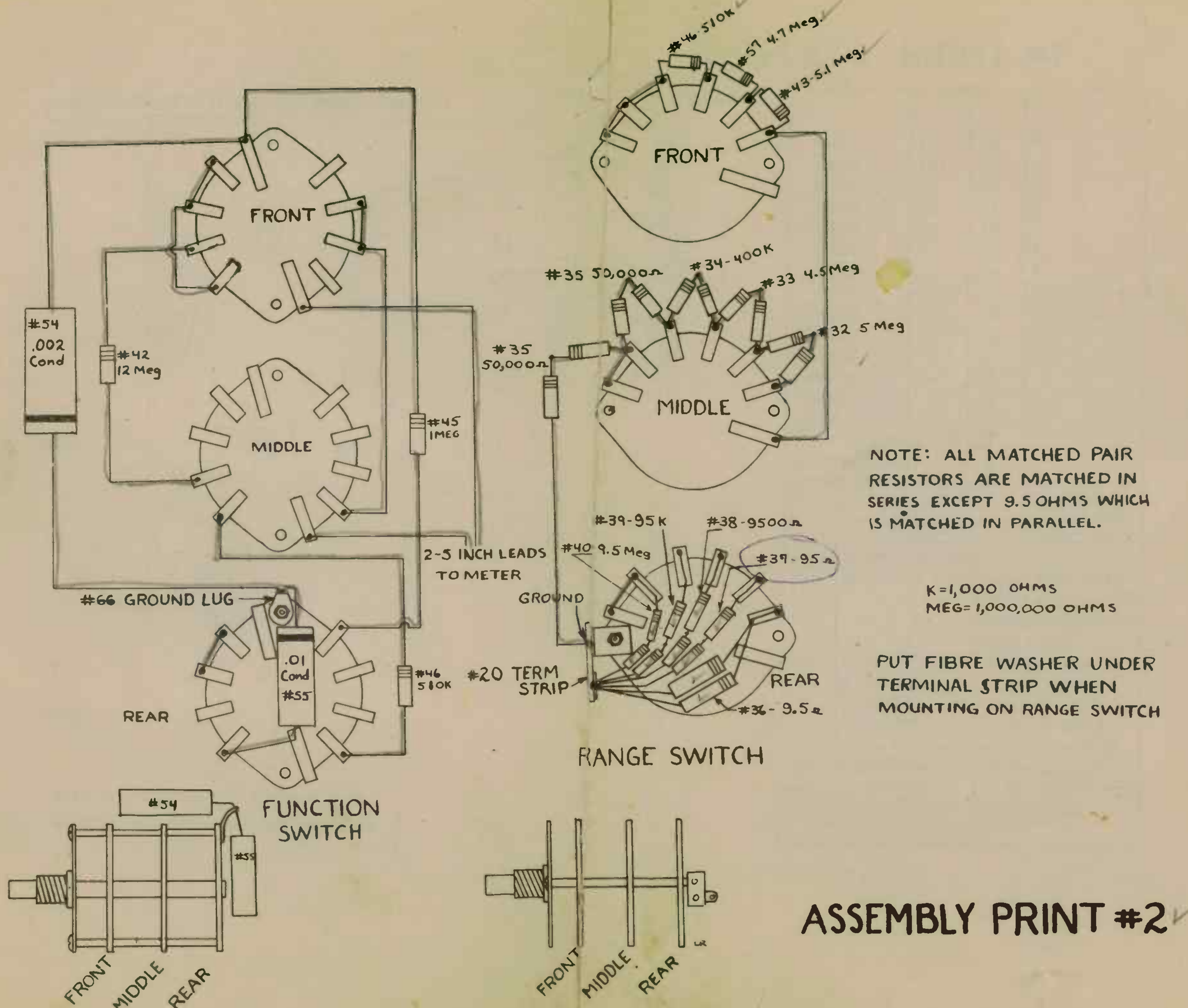
NOTE: SOLDER GROUNDING LUG #75 TO CENTER LUG OF POT #52



MOUNTING		
PART NO.	DESCRIPTION	HARDWARE
52	1,000 Ω pot	1 #70 LOCKWASHER
52	1,000 Ω pot	1 #70, 1 #75 LUG
51	1,000 Ω pot SCREW SHAFT	1 #70, 1 #73 NUT
51	1,000 Ω pot " "	1 #70, 1 #73
51	1,000 Ω pot " "	1 #70, 1 #73
53	2 MEG POT	1 #70, 1 #73
22	TRANSFORMER	2 #60 SCREWS 2 #61 NUTS 2 #67 LOCKWASHERS 1 # 66 GROUND LUG
58	TERMINAL STRIP	1 #60, 1 #61, 1 #67
26	RUBBER GROMMET	

WIRING			
WIRE	FROM	TO	REMARKS
TRANS. BLACK	TRANS	1	
TRANS. YELLOW	"	2	
TRANS. YELLOW	"	3	
TRANS. RED	"	4	
TRANS. RED	"	5	
TRANS. RED-YEL.	"	3	
BARE	3	6	
BARE	6	7	
BARE	2	8	SPAGETTI
BARE	8	9	SPAGETTI
BARE	10	11	
BARE	11	12	
BARE	12	13	
BARE	13	14	
BARE	15	16	
BARE	16	17	
BARE	18	19	

ASSEMBLY PRINT #1



ASSEMBLY PRINT #2

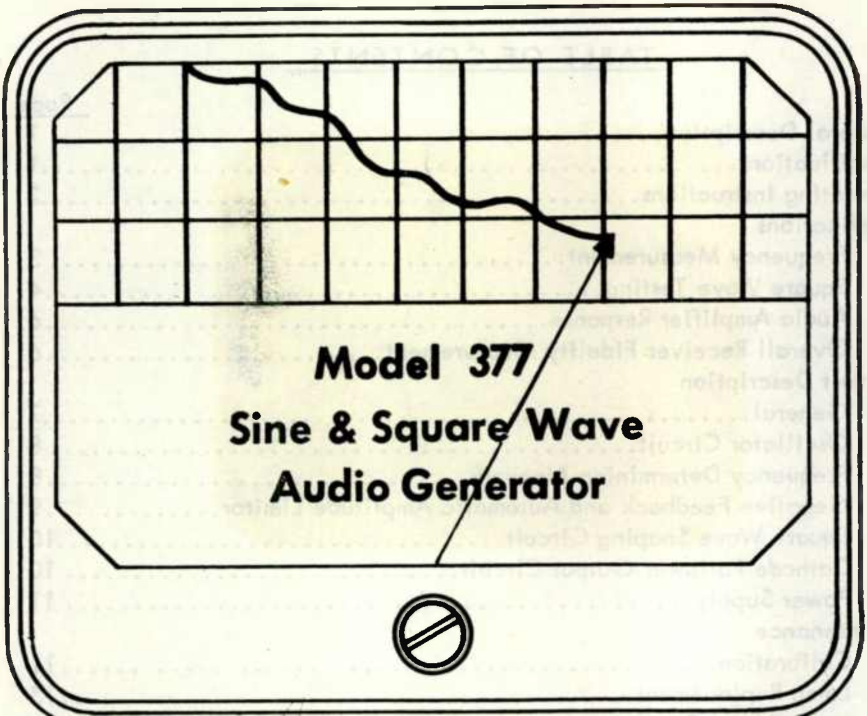
INSTRUCTION MANUAL FOR

EICO

EICO ELECTRONIC INSTRUMENT CO., Inc.

131-01 39th AVENUE, FLUSHING 54, N. Y.

INSTRUCTION MANUAL FOR



EICO

ELECTRONIC INSTRUMENT CO., Inc.

TABLE OF CONTENTS

GENERAL DESCRIPTION

The EICO Model 377 is an audia sine and square wave generator providing sine wave voltages throughout the frequency range of 20 to 200,000 c.p.s. and useful square wave voltages throughout the frequency range of 60 to 30,000 c.p.s. The entire frequency spectrum is covered in four ranges, providing a long effective scale length for maximum accuracy and readability. A linear 0 to 100 scale is also provided for reference purposes.

The 377 is an adjustable vacuum-tube oscillator utilizing the widely-accepted resistance-capacitance tuning circuit that has been used for years in the finest laboratory generators. The frequency of oscillation is controlled with a capacitance-resistance filter (Wien Bridge) in a circuit which is highly degenerative except at the pass frequency of the filter; the circuit oscillates at this frequency. The Wien Bridge is composed of 1% precision resistors and a large 2 gang tuning condenser for accurate frequency determination and wide-band coverage. This generator possesses a high degree of frequency stability and requires a very short warm-up time to attain stable operation. The harmonic distortion in the output is less than 0.5%, giving a purity of waveform equalled only by the finest power generating stations. Although this instrument provides only sine and square waves, any desired waveform can be produced with an external R-C circuit (inserted between the generator and the load).

A cathode follower output circuit enables the instrument to deliver at least 10 volts across a 1000 ohm load (100 milliwatts) and to maintain high output without appreciable distortion when feeding into larger loads. The frequency response is flat ± 1.5 db from 60 c.p.s. to 150 Kc. The hum is kept down to less than 0.4% of the rated output by a full wave rectifier and a pi type LC filter, plus additional RC filtering.

This instrument will prove itself extremely useful in determining radio receiver fidelity and loudspeaker response, audio amplifier testing and design, and for square wave testing of television receivers.

SPECIFICATIONS

Sine Wave Range: 20 - 200,000 c.p.s. in 4 bands; the dial can be read directly on all ranges.

Band A: 20 - 200 c.p.s.
Band B: 200 - 2000 c.p.s.
Band C: 2000 - 20,000 c.p.s.
Band D: 20,000 - 200,000 c.p.s.

Square Wave Range: 60 - 30,000 c.p.s. (5% tilt at 60 c.p.s., 5% rounding at 30 Kc). Read on same scales as sine waves.

Calibration Accuracy: ± 3% or 1 c.p.s., whichever is greater

Frequency Response: ± 1.5 db, 60 c.p.s. - 150 Kc

Output Voltage: The output circuit employed is of the cathode follower type. The table below gives the minimum output voltages that can be expected when the generator is feeding into different load impedances.

1000 ohms	-	10 volts	-	1% max. distortion
10,000 ohms and higher	-	14 volts	-	1% max. distortion
500 ohms	-	8 volts	-	1.5% max. distortion

These voltages are given for sine wave output and are unvarying with frequency; on square wave, the output voltages (r.m.s. values) are somewhat higher.

Rated Load: 1000 ohms (resistive)

Rated Output Power: 100 milliwatts into rated load (10 volts across a 1000 ohm resistive load).

Distortion: Less than 1% of rated output

Hum: Less than 0.4% of rated output

Power Requirements: 105 - 125 volts, 50 - 60 c.p.s., 50 watts

Tube Complement: 1 - 6X5, 1 - 6SJ7, 1 - 6SN7, 2 - 6K6 and 1 - 3S6 3 watt lamp (G.E. lamp designation)

Overall Dimensions: 11 1/8" long, 7 1/8" high, 7 5/8" deep

Weight: 20 pounds

Cabinet: Blue grey wrinkle lacquer on steel

Panel: 3 color, deep-etched, rub-proof

OPERATING INSTRUCTIONS

1. PRELIMINARY STEPS: Insert the plug on the line cord into the a-c supply. Snap on the power switch (the pilot lamp should light), and allow a few minutes for the unit to warm up and begin to oscillate. If very accurate work is to be done, allow a ten minute warm-up for the unit to reach complete stability.

2. WAVEFORM SELECTION: Set the WAVEFORM selector switch to "SINE" or "SQUARE" as desired.

3. FREQUENCY SELECTION: Set the BAND selector switch to the desired frequency band. Each position on the BAND switch corresponds to a direct reading scale on the dial, as follows:

Band A: 20 - 200 c.p.s. Band C: 2 Kc - 20 Kc
Band B: 200 - 2000 c.p.s. Band D: 20 Kc - 200 Kc

Turn the frequency dial knob until the hairline on the indicator lines up with desired frequency (on the scale corresponding to the band selected). The linear 0-100 scale on the frequency dial is useful when it is required to repeat a given setting.

4. OUTPUT: The output voltage is obtained from the two terminal posts at the right hand side of the front panel. The lower of the two posts is grounded to the chassis.

Output power is varied by means of the attenuator control (marked AMPLitude) on the front panel. Clockwise rotation of the control knob increases the output power to its maximum value.

If a small signal voltage having a high signal-to-noise ratio is required, it is advisable to obtain it from a large signal voltage and an external voltage dividing network. This method is preferable because the noise in the generator output is constant (0.4% of rated output), and therefore a larger output has a higher signal-to-noise ratio which carries over to the small voltage taken from the dividing network. The voltage divider network shown below is suitable for most applications.

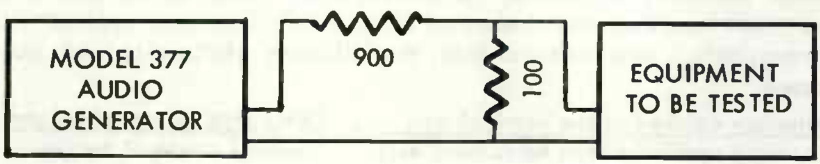


FIG. 1

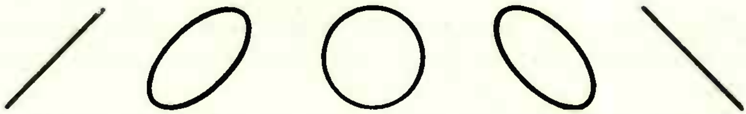
Different sets of resistors may be used in the dividing network to obtain other voltage divisions. In all cases, however, the total of the two resistances should be at least 1000 ohms.

APPLICATIONS

FREQUENCY MEASUREMENT: The Model 377 Audio Generator can be used to measure frequency by comparison.

WITH HEADPHONES: Connect the output of the Audio Generator to one of a pair of headphones. The signal of unknown frequency is fed to the other headphone. Put the headphones on and tune the generator for "zero beat". The reading on the tuning dial of the generator is the unknown frequency.

WITH AN OSCILLOSCOPE: Connect the Audio Generator to the horizontal axis of the 'scope. Then apply the unknown frequency to the vertical axis The 'scope controls (or the input voltages) are now adjusted for roughly equal deflections on each axis. Vary the frequency of the Audio Generator until the 'scope pattern is a stationary ellipse, a circle, or a diagonal line of fixed length. The shape of the pattern depends on the phase relationship between the known and unknown signals (See Fig. 2). The unknown frequency is now equal to the frequency of the Audio Generator as read on the tuning dial. Non-sinusoidal waves will produce distorted forms of a single loop pattern or a diagonal line of uneven brightness.



0° 45° 90° 135° 180°

FIG. 2

Frequencies out of the Audio Generator's range can be measured by means of Lissajous figures. Lissajous figures are stationary closed-loop patterns that appear on the screen when the frequency applied to one set of plates is a whole number of times larger than the frequency applied to the other set of plates, or if one frequency is a simple fraction of the other. To determine frequency ratio from the Lissajous figure, count the number of points of tangency to horizontal and vertical lines, drawn or imagined (See Figures 3a, 3b, 3c, 3d, 3e, and 3f). Points of tangency at the top of the figures result from the unknown frequency applied to the vertical axis. Those at the side of the figure result from the known frequency of the Audio Generator applied to the horizontal axis. As a matter of fact, the following relationship holds true in all cases:

$$\frac{\text{Frequency applied to the vertical axis}}{\text{Frequency applied to the horizontal axis}} = \frac{\text{Horizontal points of tangency}}{\text{Vertical points of tangency}}$$

As an example, take Fig. 3c, which shows four points of tangency at the top and one point at the side. This indicates that the unknown frequency applied to the vertical axis is four times the known frequency. In Fig. 3f, one point of tangency at the top and four at the side indicate that the unknown frequency is one fourth the known frequency.

2:1 3:1 4:1 1:2 1:3 1:4

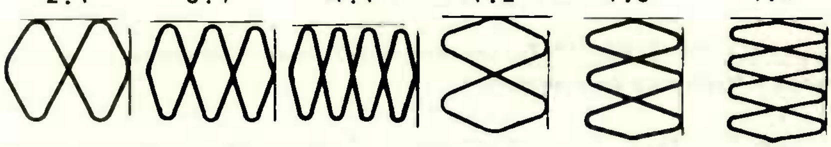


FIG. 3a 3b 3c 3d 3e 3f

SQUARE WAVE TESTING: The square wave signal provided by the Model 377 Audio Generator can be used to check amplifiers as to frequency response, phase shift, transient response, deficient design, or faulty components. In addition to the generator, an oscilloscope with sufficiently wide frequency response is needed to carry out the tests. The equipment is set up as shown in Fig. 4.

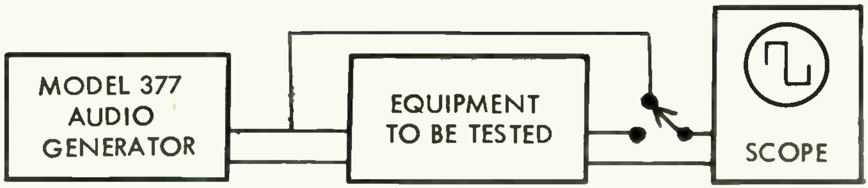


FIG.4

First, as a means of comparison, the square wave output from the Audio Generator is viewed on the 'scope. The horizontal sweep of the 'scope should be adjusted so that at least two full cycles can be seen on the screen. (Fig. 5a shows one full cycle of a perfect square wave). The 'scope is then connected to the output of the amplifier under test so that the modified square wave can be viewed on the screen. Possible output wave shapes are shown in Fig. 5b to 5i, and the significance of each wave shape is explained below.

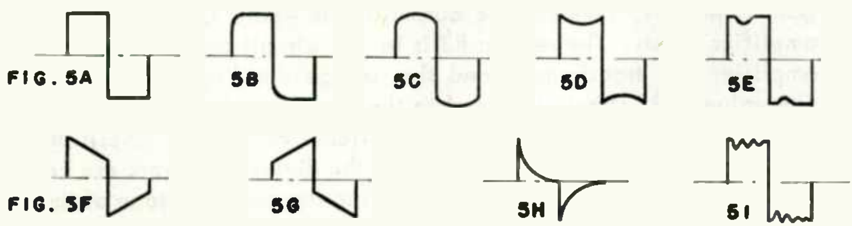


Fig. 5b shows "rounding" of the leading edge of the square wave. This indicates a drop off in gain at high frequencies. "Rounding" will generally be observable when there is a substantial drop in the gain by the tenth harmonic (or less). Therefore, if a 2 Kc square wave fed to the amplifier is reproduced on the 'scope without "rounding", the amplifier is flat to 10 X 2 Kc = 20 Kc.

Fig. 5c shows the effect of increased gain and Fig. 5d shows the effect of decreased gain at the square wave frequency. Fig. 5e indicates lowered gain at a narrow frequency band. If the square wave frequency is brought into this narrow frequency band, Fig. 5d will result.

The effect of phase shift in the amplifier is shown in Figs. 5f and 5g. If, at low frequencies, there is phase shift in the leading direction, the square wave will be tilted as in Fig. 5f. If there is phase shift in the lagging direction, the top of the square wave will be tilted as in Fig. 5g. The steepness of the tilt is proportional to the amount of phase shift. Phase shift is not important in audio amplifiers, although the ear is not entirely insensitive to it. In television and 'scope amplifiers, however, phase shift should not be tolerated.

Fig. 5h shows the pulse output from the amplifier that results when the square wave has undergone differentiation. This will happen when the grid resistor or the coupling condenser is too low in value or if the coupling condenser is partially open. Lastly, Fig. 5i, shows a square wave with damped oscillations following the leading edge. This results when a high frequency square wave is fed to an amplifier in which distributed capacities and lead inductances resonate at low frequencies. In television and 'scope amplifiers it may result from an undamped peaking coil.

AUDIO AMPLIFIER RESPONSE: The set up for determining the frequency response of an audio amplifier is shown in Fig. 6.

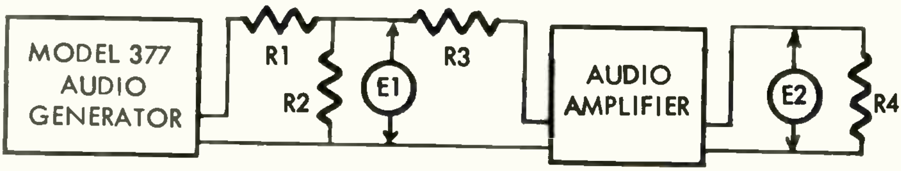


FIG.6

The voltage dividing network R1 and R2, is necessary when testing high gain amplifiers (see "OUTPUT" in OPERATING INSTRUCTIONS). For testing low gain amplifiers, connect the output of the Audio Generator directly to the amplifier input. The resistor R3 is in the circuit only when the input of the amplifier is a transformer, and the voltage dividing network is being used. The value of R3 should be equal to the input impedance of the amplifier.

The input voltage to the amplifier is E1. If the amplifier has a high input impedance and the resistances in the dividing network are known accurately, E1 may be determined by measuring the output voltage of the generator and multiplying it by R2/(R1 + R2). This may be necessary when testing high gain amplifiers where the input voltages to the amplifier are very low and therefore difficult to measure.

The output of the amplifier should be fed to a load resistor of proper value, or to the speaker or other suitable apparatus. The output voltage is measured across the load resistor R4 or other suitable load.

The amplifier gain at any frequency is equal to the output voltage, E2, divided by the input voltage, E1. To obtain the data for a frequency response curve, measure the gain of the amplifier throughout the audio frequency range.

OVERALL RECEIVER FIDELITY MEASUREMENT: The set up for determining the overall fidelity of a radio receiver is shown in Fig. 7.

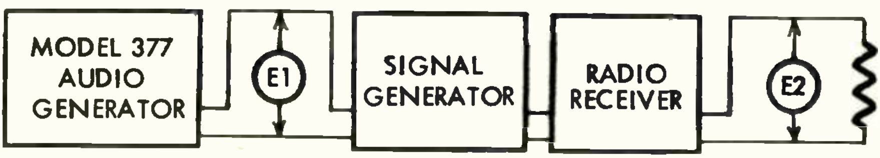


FIG.7

The Model 377 Audio Generator is used to modulate the output of an R-F Signal Generator that is connected to the antenna and ground terminals of the radio receiver under test. The output voltage of the Audio Generator should be adjusted to produce about 30% modulation of the r-f signal.

Connect a voltmeter across the voice coil of the speaker. Set the R-F Signal Generator at 1000 Kc or to the desired frequency in the broadcast band, and then carefully tune the receiver to this frequency. Make sure that the receiver is exactly on resonance with the R-F Signal Generator frequency and not on one of the sideband peaks. Note that the output meter will show a maximum reading when the receiver is tuned to either of the sideband peaks on both sides of exact resonance. The receiver is tuned correctly when it is set at the point between the two sideband peaks where the output meter reading is a minimum. Data for an overall fidelity curve is obtained by recording the output voltage, E2, as the frequency of the Audio Generator is varied throughout the audio range (voltage E1 is kept constant).

CIRCUIT DESCRIPTION

GENERAL: (See Fig. 8) The Model 377 Audio Sine and Square Wave Generator is a vacuum-tube oscillator of the resistance-capacitance type. It consists of a two tube oscillator that oscillates at the resonant frequency of the Wien Bridge frequency determining network inserted in the feed-back path. The oscillator is coupled to a cathode follower amplifier that acts as an isolation stage and as a power amplifier. The square wave is formed by a dual-triode clipping circuit that is inserted between the oscillator and the cathode follower stage when square wave output is desired.

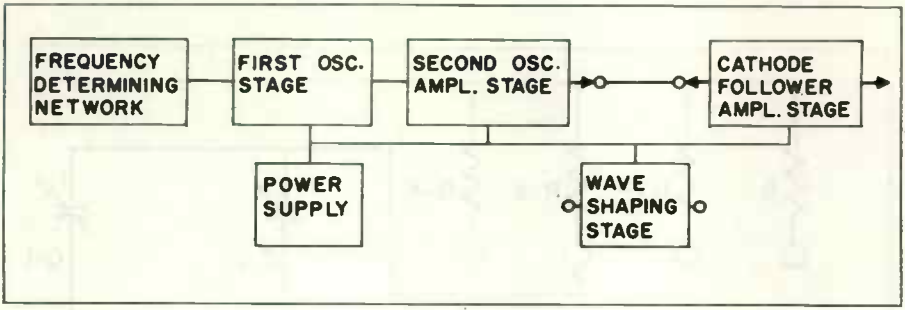


FIG. 8

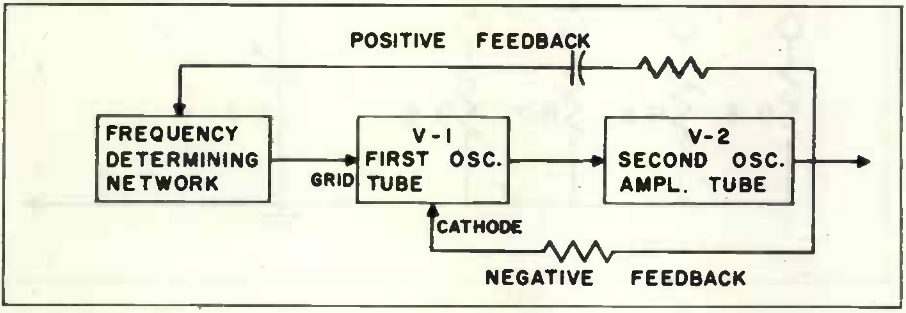


FIG. 9

THE OSCILLATOR CIRCUIT: (See Fig. 9) The oscillator section is basically a two tube amplifier with a Wien Bridge inserted in the feed-back path. It oscillates as a result of part of the output voltage being fed back to the input with the correct phase relation. This type of feed-back is known as positive feed-back. Negative feed-back is also employed to stabilize the oscillator operation and to maintain constant output over a wide frequency range.

THE FREQUENCY DETERMINING NETWORK: (See Figs. 10 and 11) The frequency determining network consists of two groups of variable capacitors and two groups of resistors wired to the band switch. Designating the resistor group R1-4 as R-S (in series with the associated variable capacitor) and R5-8 as R-P (in parallel with the associated variable capacitor), the values of R-S and R-P are fixed for each band. R-S and R-P are always equal in value, as are C-S and C-P.

The circuit design is such that the voltage applied to the first oscillator control grid is in phase with the voltage applied to the whole frequency determining network. In addition, the grid voltage is always one third of the voltage applied to the whole network. This is a characteristic of the Wien Bridge at resonance.

The resonant frequency of the network is inversely proportional to the product of resistance and capacity (R-S and C-S, or R-P and C-P). Large changes in resonant frequency are possible with each set of components. A frequency change of more than ten to one is achieved with each set of resistors, and the audio and supersonic spectrum is covered in only four bands.

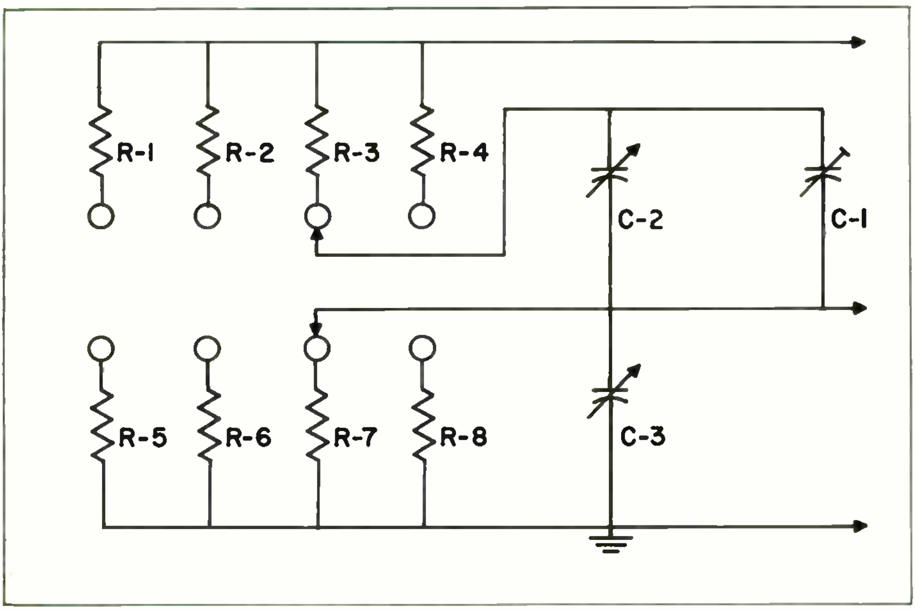


FIG. 10

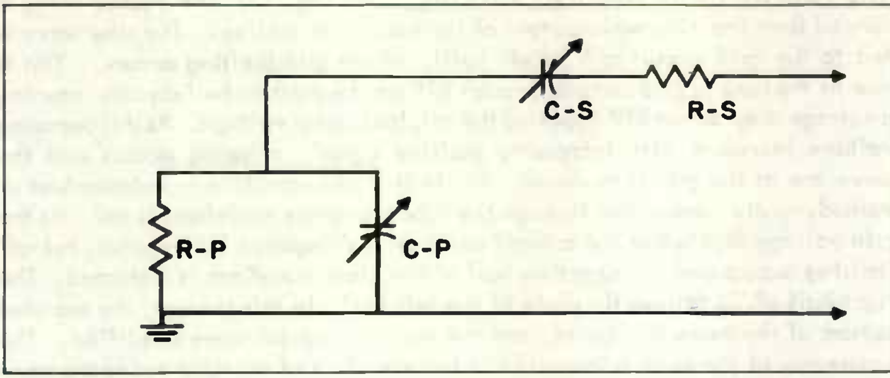


FIG. 11

NEGATIVE FEED-BACK AND AUTOMATIC AMPLITUDE LIMITOR: As may be seen in Fig. 12, the negative feed-back voltage used in the oscillator section is derived from the output of the second oscillator tube, V2, and is fed back to the cathode of the first oscillator tube, V1. The magnitude of the negative feed-back is determined by a resistor network, one element of which is the incandescent lamp, 3S6. A property of this lamp is that it has a positive temperature coefficient; however it possesses sufficient thermal inertia so that its temperature is substantially constant at all audio frequencies. Because of the lamp's positive temperature coefficient, the oscillations can not build up to a value in excess of the tube's handling capacity. This is so because the resistance of the lamp increases with increased current. As a result the degeneration in the cathode circuit of V1 increases, causing less amplification in the oscillator section. Thus, the lamp serves as an automatic amplitude limitor. Pot R9 is set at calibration for the proper negative feed-back.

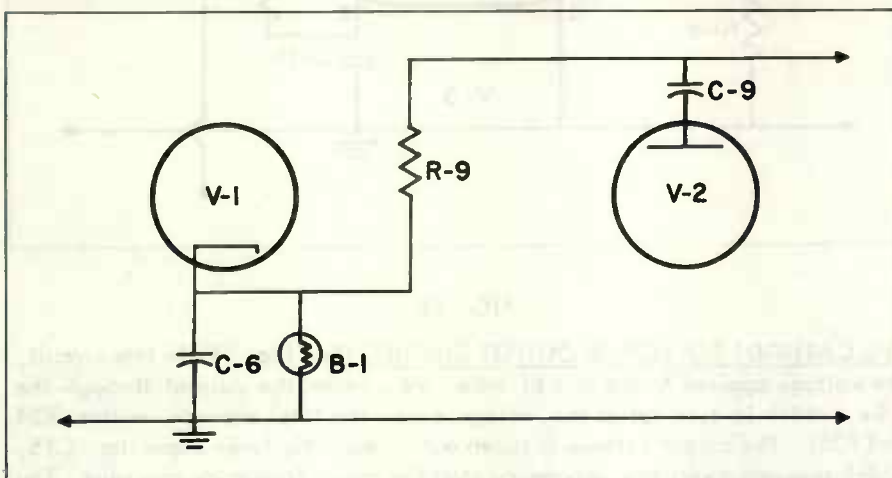


FIG. 12

THE SQUARE WAVE SHAPING CIRCUIT: (See Fig. 13) The square wave is formed from the sine wave output of the oscillator section. The sine wave is fed to the grid circuit of V3 (left-half), where grid limiting occurs. This is due to the flow of grid current through R19 on the positive half-cycles, causing a voltage drop across R19 opposing the original signal voltage. As this opposing voltage increases with increasing positive signal, clipping occurs and the waveform at the grid is as shown. While the grid waveform is independent of cathode-plate conduction through the tube, the plate waveform is not. As the grid voltage dips below the cut-off point on the negative half-cycles, cut-off limiting occurs and the negative half of the plate waveform is flattened. The right half of V3 follows the plate of the left half. In this section, the rounded bottom of the wave is clipped, and the resulting square wave amplified. The squareness of the wave is increased in both sections of the tube due to the non-linear tube characteristic.

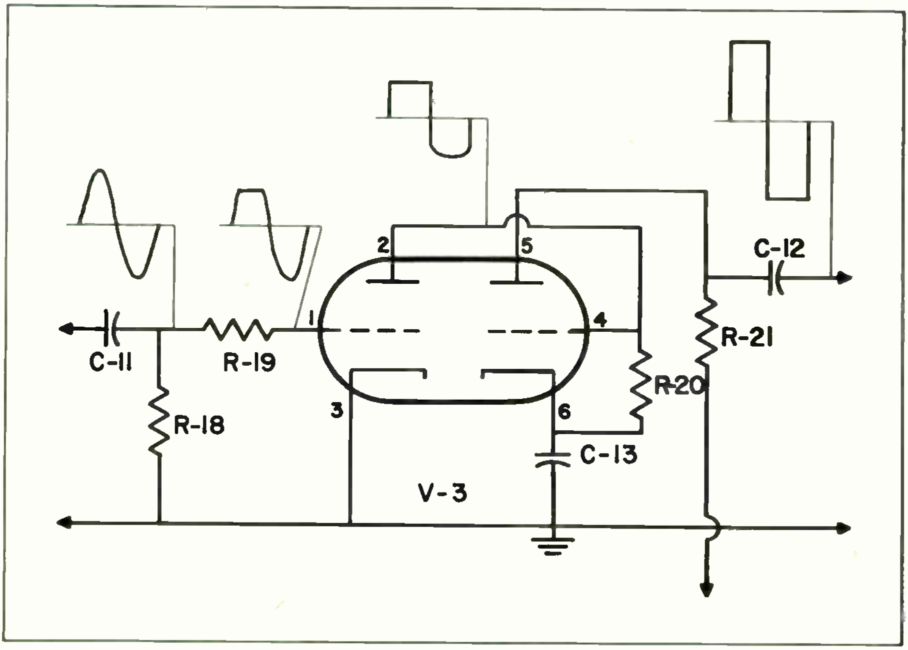


FIG. 13

THE CATHODE FOLLOWER OUTPUT CIRCUIT: (See Fig. 14) In this circuit, the voltage applied to the grid of tube, V4, varies the current through the tube, which in turn varies the voltage across the total cathode resistor (R24 and R25). The output voltage is taken out through the large capacitor, C15, which presents a very low impedance over the entire frequency spectrum. The cathode resistance is split into R24 and R25 to provide the proper bias.

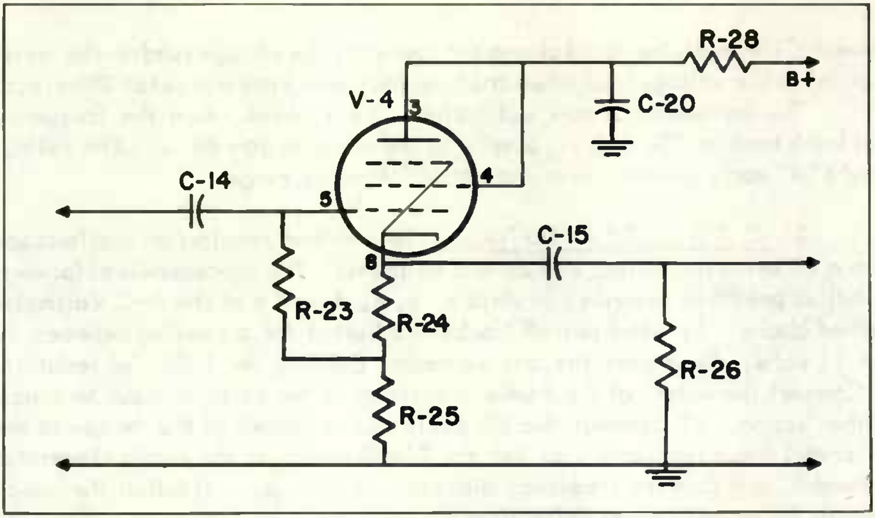


FIG. 14

THE POWER SUPPLY: The power supply is a conventional full wave rectifier circuit, employing a 6X5 tube (V5) and a pi filter consisting of a choke, L1, and two electrolytic capacitors, C16 and C17. This LC network effectively filters the d-c voltage output of the rectifier. The +B voltages for the first oscillator tube, V1, and the cathode follower tube, V4, are additionally filtered by RC circuits. R27 and C18 form an RC filter for V1, and R28 and C19 form an RC filter for V4.

MAINTENANCE

CALIBRATION: The Model 377 is extremely stable. However, after a long period of use, it may require re-calibration due to aging of the components. The accuracy may be readily restored by using one of the methods below. Re-calibration will also be necessary whenever tubes or other components are replaced. Fig. 15 shows the locations of trimmer C1, pot R9, and the tubes.

The A-C Voltmeter method is satisfactory for general use of the instrument. The Oscilloscope method is preferable, however, as it gives better accuracy. The Frequency Standard method is necessary for work that requires very accurate knowledge of the frequency.

1. A-C VOLTMETER METHOD: This method requires only an a-c voltmeter, preferably one with 1000 ohms/volt sensitivity or more. The procedure is as follows: a) Connect a 1000 ohm resistor across the output terminals of the Audio Generator. b) Connect the a-c voltmeter across the resistor. c) Set the BAND switch at band B and the frequency dial at 200 c.p.s. d) Turn the AMPL. control to the maximum clockwise position. e) Adjust pot R9 for a reading between 10.5 and 11 volts(r.m.s.) on the meter. f) Turn the frequency dial knob to 2 Kc. g) Loosen or tighten the adjustment screw on

trimmer C1 with an insulated alignment tool until the voltage read on the meter is equal to the voltage read when the frequency dial knob was set at 200 c.p.s.

The instrument is now calibrated. As a check, turn the frequency dial knob back to 200 c.p.s., observing the meter as you do so. The voltage should be nearly constant over the entire frequency range.

2. OSCILLOSCOPE METHOD: This method requires an oscilloscope with a 60 cycle test output and an a-c voltmeter. The procedure is as follows: a) Adjust pot R9 as described in steps a, b, c, d, and e of the A-C Voltmeter method above. b) After pot R9 has been adjusted for a reading between 10 and 11 volts, disconnect the a-c voltmeter (leaving the 1000 ohm resistor). c) Connect the output of the Audio Generator to the vertical input terminals of the 'scope. d) Connect the 60 cycle test terminals of the 'scope to the horizontal input terminals. e) Set the BAND switch of the Audio Generator at band A, and turn the frequency dial knob to 180 c.p.s. f) Adjust the 'scope controls for roughly equal deflections on each axis. g) Loosen or tighten the adjustment screw on trimmer C1 with an insulated alignment tool until the Lissajous figure shown in Fig. 3b (for 3:1 ratio) appears stationary on the screen.

The instrument is now calibrated. As a check, turn the frequency dial knob to 20 c.p.s. The Lissajous pattern shown in Fig. 3e should appear on the screen. Turn the frequency dial knob to 60 c.p.s. One of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) should be obtained.

3. FREQUENCY STANDARD METHOD: This method requires either a standard audio generator with known accuracy or a fixed frequency standard. Before calibration, allow the Model 377 to heat up for at least thirty minutes. The calibration procedure is the same as described in the OSCILLOSCOPE method above. Instead of the 60 cycle test signal, however, the standard is connected to the horizontal plates of the 'scope.

If a standard generator is used, set it at a frequency of 2 Kc. Set the BAND switch of the Model 377 at band B, and the frequency dial knob at 2 Kc. Adjust the trimmer, C1, until one of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) appears stationary on the screen. The Model 377 is now calibrated. As a check, adjust the standard generator and the Model 377 to equal frequencies on their respective dials at two other points in band B and three points in each of the remaining bands. One of the Lissajous figures for 1:1 ratio should appear on the screen at each point, allowing for the specified accuracy of Model 377.

If a fixed frequency standard is used, set the Model 377 at a nominal frequency near the high end of band B that is in the ratio of a whole number or a simple fraction to the fixed standard frequency. Adjust the trimmer, C1, until the appropriate Lissajous figure appears stationary on the screen. The instrument is now calibrated. Check at least two other points on band B and three other points on each of the remaining bands by means of the appropriate Lissajous figures.

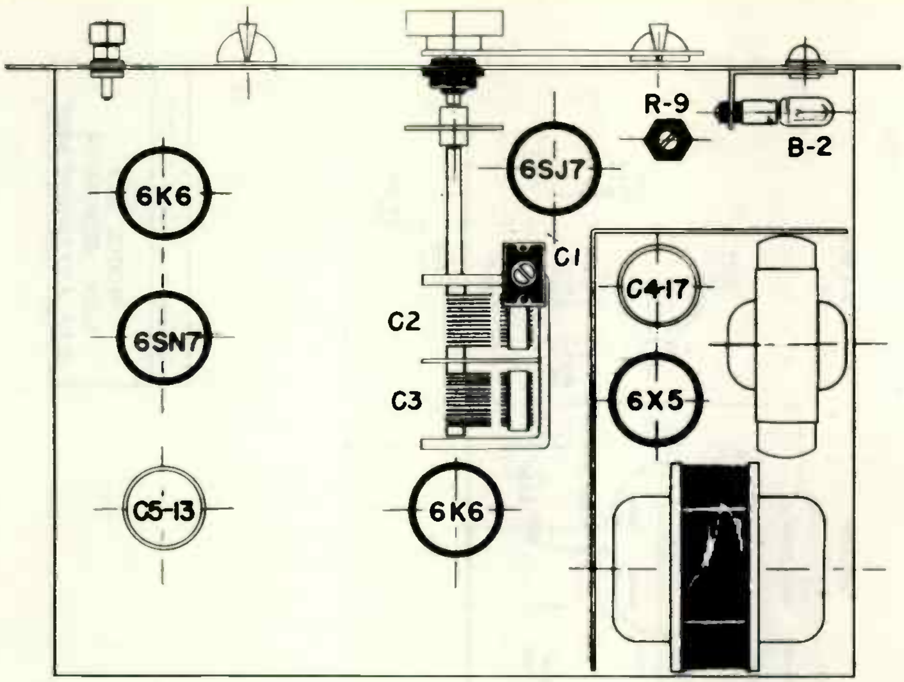


FIG. 15

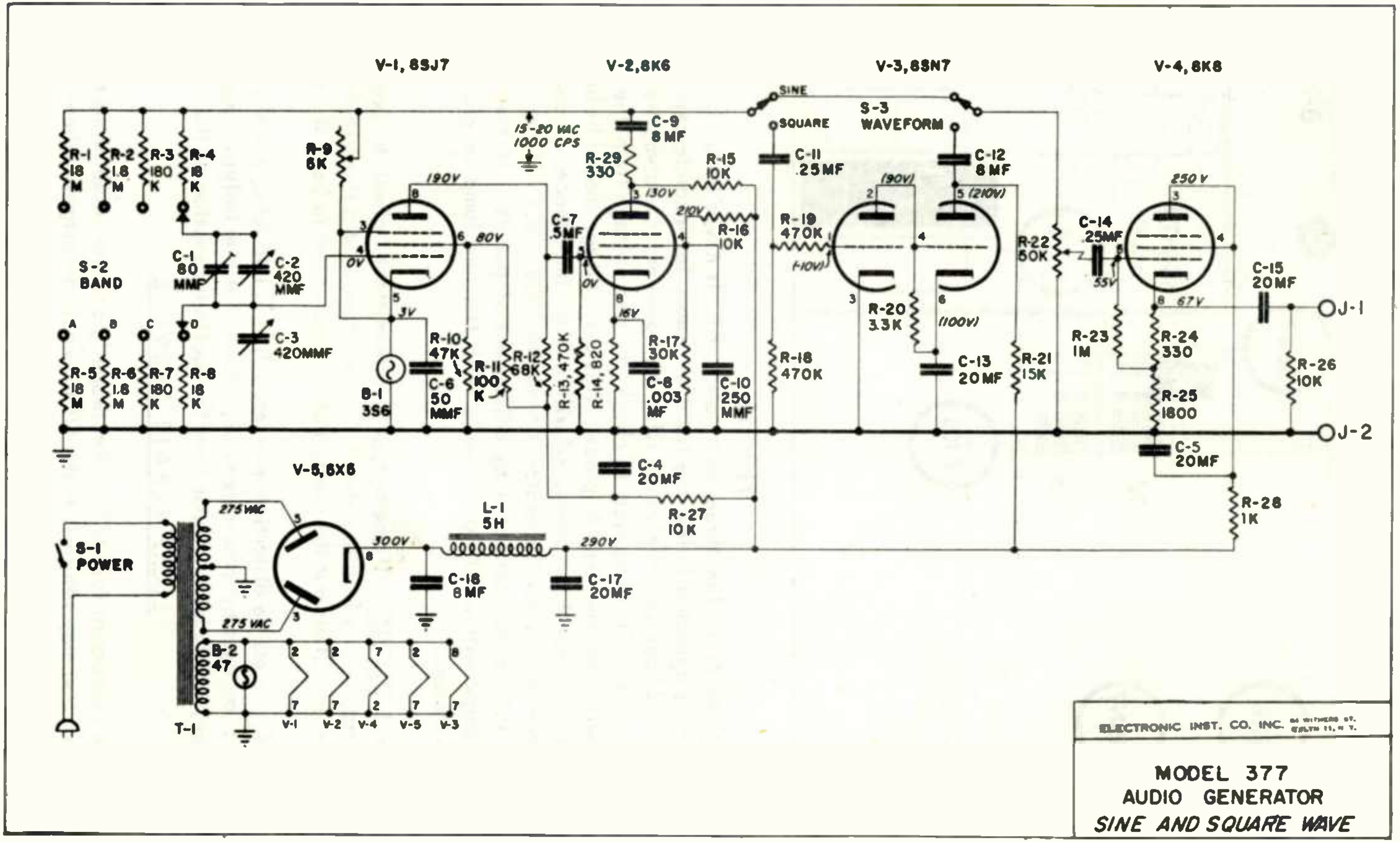
LAMP REPLACEMENT: The three watt lamp, B1, is never lit up in normal operation as it is operated below the level necessary for incandescence. As a result, it should have extremely long life. If, however, it becomes necessary to replace the lamp, it is required to check the a-c voltage from the arm of R9 to ground with the new lamp in place. This a-c voltage should be between 15 and 20 volts (r.m.s.), as measured with a high impedance vacuum-tube voltmeter, when the Audio Generator is tuned to 1000 c.p.s. If the voltage is not within this range, correct it by adjustment of pot R9. If the voltage cannot be brought within 15 to 20 volts with the new lamp in place, try another lamp instead.

INTERMITTENT OUTPUT: If the output is intermittent, check to see if the three watt lamp, B1, is flashing also. If it is, check for a short in the main tuning condenser. Clear out the short, but be careful not to bend the plates.

DISTORTION: Excessive distortion may result from a bad tube, a leaky coupling capacitor, an open by-pass capacitor, a defective electrolytic capacitor, low +B voltage, or too much output from the oscillator section of the circuit.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble is not apparent, you may return it to the EICO repair department where it will be repaired for a nominal charge.



V-1, 6SJ7
V-2, 6K6
V-3, 6SN7
V-4, 6K6
V-5, 6X6
SINE
SQUARE
S-3 WAVEFORM
15-20 VAC 1000 CPS
R-1 18 M
R-2 1.8 M
R-3 180 K
R-4 18 K
R-5 18 M
R-6 1.8 M
R-7 180 K
R-8 18 K
A B C D
S-2 BAND
C-1 80 MMF
C-2 420 MMF
C-3 420MMF
R-9 5K
190V
80V
0V
3V
R-10 47K
R-11 100 K
R-12 68K
R-13, 470K
R-14, 820
B-1 3S6
C-6 50 MMF
C-7 .5MF
C-9 8 MF
R-29 330
130V
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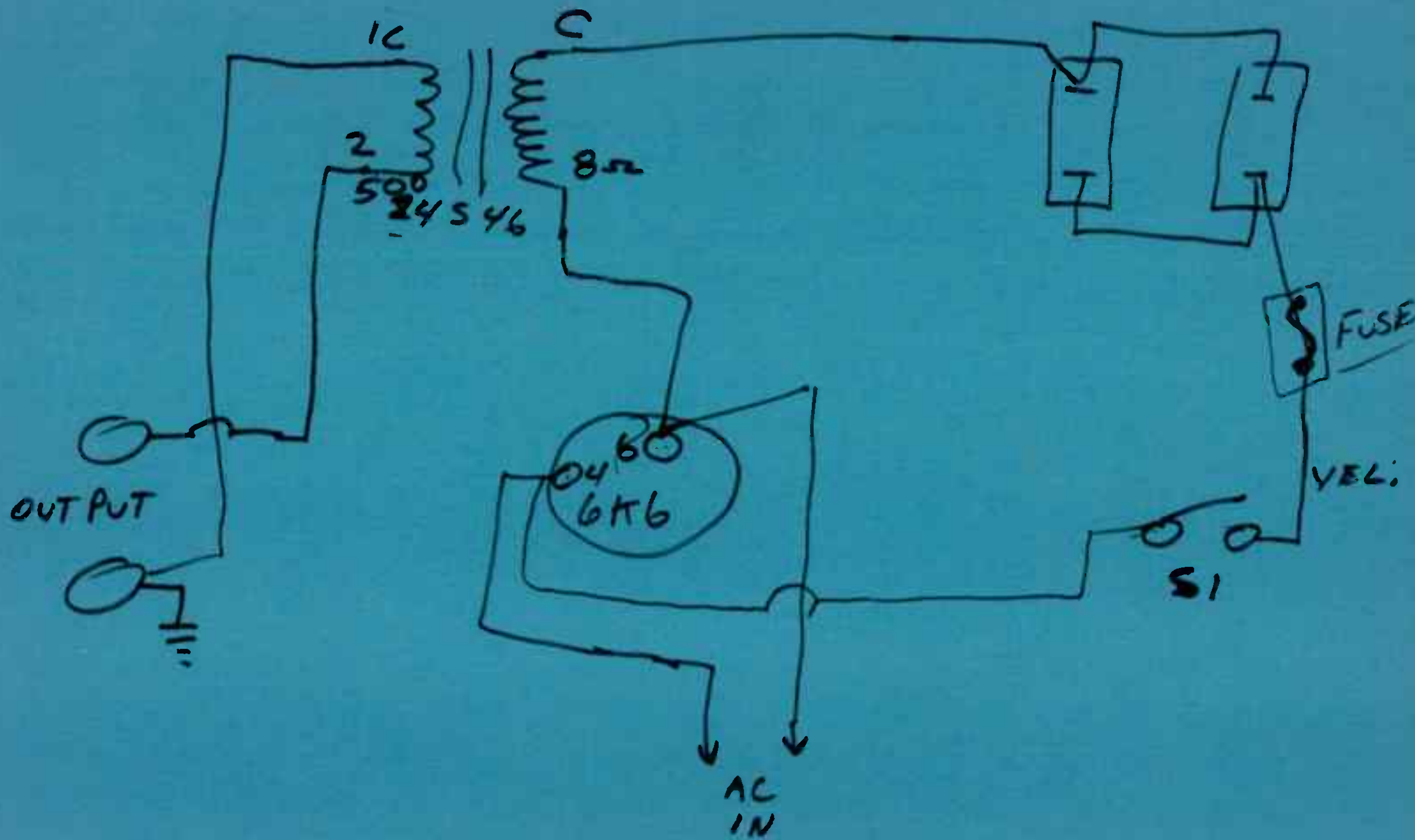
16V
R-15 10K
R-16 10K
R-17 30K
C-8 .003 MF
C-10 250 MMF
C-11 .25MF
R-18 470K
R-19 470K
(-10V)
(90V)
(210V)
(100V)
C-12 8 MF
R-20 3.3K
C-13 20MF
R-21 15K
R-22 50K
C-14 .25MF
55V
250 V
67V
R-23 1M
R-24 330
R-25 1800
C-15 20MF
R-26 10K
J-1
J-2
C-4 20MF
R-27 10 K
C-5 20MF
R-28 1K
S-1 POWER
275 VAC
275 VAC
300V
L-1 5H
290V
C-16 8 MF
C-17 20MF
B-2 47
T-1
V-1 V-2 V-4 V-5 V-3
ELECTRONIC INST. CO. INC.
MODEL 377
AUDIO GENERATOR
SINE AND SQUARE WAVE



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INSTRUCTION MANUAL FOR

EICO

EICO ELECTRONIC INSTRUMENT CO., Inc.

131-01 39th AVENUE, FLUSHING 54, N. Y.

EICO
Laboratory Precision at lowest cost

INSTRUCTION MANUAL

Model 324

ELECTRONIC INSTRUMENT CO., Inc. 33-00 Northern Blvd. • Long Island City 1, N. Y.

GENERAL DESCRIPTION

The EICO Model 324 RF Signal Generator is intended for general radio and television servicing and for other applications requiring a modulated or unmodulated r-f signal of sine waveform from 175kc to 420mc.

The r-f output from the Model 324 may be modulated internally by a 400 cps audio oscillator or may be modulated externally by an audio signal fed into a connector on the front panel. The internal 400 cps modulating signal is also available separately at a front-panel connector. Selection of external modulation rearranges the audio oscillator stage as an amplifier operating on the external modulation signal. As a result, up to 30% modulation is possible when the output of the external a-f source is as low as 3.0 volt. Percentage modulation by either an internal or external a-f source, as well as a-f output voltage, is adjustable by a single panel control.

Six tuning bands are employed to cover the fundamental frequency range from 150kc to 145mc. Calibration of the third harmonic of the highest fundamental band (F1) 37 mc to 145 mc is also given on the tuning dial to provide a seventh tuning band (F2) from 111 mc to 435mc. The particular band desired is selected by the band selector switch which acts, therefore, as a coarse output frequency selector; the 6 to 1 vernier tuning dial control is for fine tuning and permits exact setting of the output frequency.

Construction of the dial and tuning assembly is unusually fine. A heavy gauge, deep-etched, aluminum tuning dial is fastened to the shaft of the tuning capacitor behind the panel and rotates with the tuning knob. The dial is viewed through twin plexiglass windows, four complete scales appearing in one window and four in the other, so that, despite the large number of scales, they are well-spaced and not easily confused. The plexiglass not only affords protection for the tuning dial, but, due to its unique light-conducting property, permits the use of an illuminated hairline, which is engraved in the plexiglass and edge-lit by a panel lamp to permit maximum ease of reading. The illuminated hairline also serve as a pilot. Other important construction points include the use of turret mounted, slug-tuned coils for maximum accuracy, copper-plated chassis for minimized interference, line filters, shielded r-f output cable and jack-top binding posts for audio in/out.

The Model 324 incorporates both coarse and fine r-f attenuators for smooth, efficient control of the r-f output signal. The coarse attenuator provides two steps of coarse attenuation of approximately 20 db each.

The Model 324 employs a Colpitts-type r-f oscillator and a Colpitts-type audio oscillator of proven design for efficient and trouble-free operation. The r-f oscillator is plate modulated by a cathode follower for improved modulation. Maintenance is simplified by an uncrowded chassis and easy access to all internal alignment adjustments for the six fundamental r-f bands.

The characteristics of the Model 324 render it extremely flexible. It may be used in the radio and television service shop or in the field for such applications as alignment and signal tracing of am and fm radio receivers, alignment of both high and low frequency i-f amplifiers in television receivers, and signal tracing and troubleshooting almost all sections of tv receivers. The Model 324 is equally suitable to bench or portable applications, being provided with an uncluttered, professional satin aluminum panel that will add to the appearance of any test bench and a rugged steel case that will withstand "car trunk" abuse.

SPECIFICATIONS

RF CHARACTERISTICS:

RF Output Frequency Range .... 150kc to 145mc on fundamentals in 6 bands
111 mc to 435mc on calibrated harmonics.

Accuracy of Tuning Dial Calibration. .±1.5%

RF Coarse Attenuation .... in two steps, each approximately 20db

RF Fine Attenuation .... continuous 0 to max.

AF CHARACTERISTICS:

Internal AF Modulating Frequency... approx. 400 cps

AF Output Voltage .... adjustable 0 to 10 volts across 100KΩ load; adjustable 0 to 5 volts across 10K ohm load.

AF In Impedance .... approx. 70KΩ

AF Out Impedance .... approx. 10KΩ

MODULATION CHARACTERISTICS:

Percentage Modulation by Internal 400 cps signal ..... adjustable 0 to 50%

External Modulation Frequency Range .... 20 - 15,000 cps

External AF Voltage Required for 30% Modulation at 1 mc RF Setting (1000 cps signal) .... approx. 3.0 volts.

TUBE COMPLEMENT: 1-12AU7, 1-12AV7, 1 selenium rectifier.

POWER REQUIREMENTS: 105-125 volts AC, 50/60 cps; drain 15 watts.

DIMENSIONS: 8" high, 10" wide, 4 3/4" deep.

WEIGHT: 10 lbs.

FUNCTIONS OF CONTROLS AND TERMINALS

SIGNAL SEL. - Turns power off in "OFF" position. In "INT. MOD./AF OUT" position, modulated r-f output is available at the RF OUT connector and 400 cycle audio signal is available at the AUDIO IN/OUT connectors. In "RF/EXT. MOD" position, pure or externally modulated r-f output is available at the RF OUT connector depending on whether or not any external modulating signal is fed to the AUDIO IN/OUT connectors.

BAND SEL. - Used to select desired tuning band. Frequencies in lower three bands (from 150 kc to 3.5 mc) as well as the linear reference scale are read in the upper window. Frequencies in higher four bands (3.5 mc to 435 mc) are read in the lower window. Note that position F is used when tuning frequencies in either band F1 or F2.

TUNING (knob between windows): - Permits adjustment of RF output frequency to exact value. The RF output frequency is the setting directly under the illuminated hairline on the scale for the band selected with the BAND SEL.

RF OUT - The output cable supplied with the Model 324 should be connected to the RF OUT connector. The amount of output voltage is controlled by the RF COARSE and RF FINE attenuators.

RF COARSE - Permits adjustment of the RF output in coarse steps of approximately 20db each. This is a primary rather than a secondary adjustment.

RF FINE - Continuous control permits exact adjustment of the RF output voltage. This is a secondary rather than a primary adjustment.

AUDIO IN/OUT - Has a double function. When the SIGNAL SEL. switch is set to "INT. MOD./AF OUT", a 400 cps audio signal from the internal audio oscillator is fed to this connector. The audio output voltage is adjustable from zero to a maximum depending upon the load by the AF/MOD. OUTPUT control. When the switch is turned to "RF/EXT. MOD." an external modulating signal up to 15kc may be injected at AF IN/OUT to modulate the r-f output taken from the RF OUT connector.

NOTE: When using external modulation, the AF MOD./OUTPUT control should be turned clockwise in order to prevent short-circuiting the modulating signal to ground. In use, this control may be used as an attenuator to adjust the amount of injected modulating signal. As the Model 324 provides a stage of amplification for the external modulating signal, a signal of only 3.0 volts approximately is required to modulate the r-f oscillator to 30% at 1000 cps (at 1 mc RF setting).

AF MOD/OUTPUT - Has three functions. 1) Adjusts the percentage of internal modulation when the SIGNAL SEL. is set at "INT. MOD./AF OUT. 2) Adjusts the amount of audio signal available at the AUDIO IN/OUT connectors when the SIGNAL SEL. is set at "INT. MOD./AF OUT". 3) Adjusts the percentage of external modulation when the SIGNAL SEL. is set at "RF/EXT. MOD." and an external modulating signal is injected at the AUDIO IN/OUT connectors.

APPLICATIONS

NOTE: Agc troubles may cause r-f or i-f amplifiers to appear weak, dead, or intermittent. Where doubtful, eliminate agc for the test and use fixed bias as shown in Fig. 1.

WARNING: Do not connect the 324 to test circuit points having operating voltages exceeding the maximums listed below:

RF OUT Connector - 500 dc volts max.
AF IN/OUT Connector - 400 dc volts max.

TV SERVICING:

General: If a tv set being serviced has picture or raster trouble, first check the ion trap magnet, brightness control, focusing magnet, and drive control in order to see whether a normal raster with normal brightness is obtainable. The picture tube, the high voltage section, and the vertical and horizontal deflection circuits are o.k. if a normal raster is obtained. If you have a poor raster or no raster, check these sections and correct the trouble. When you have a normal raster, apply picture signal with the contrast control set for max. contrast. If you get a weak picture or no picture, it indicates that there is probably trouble in the r-f, i-f, or video sections.

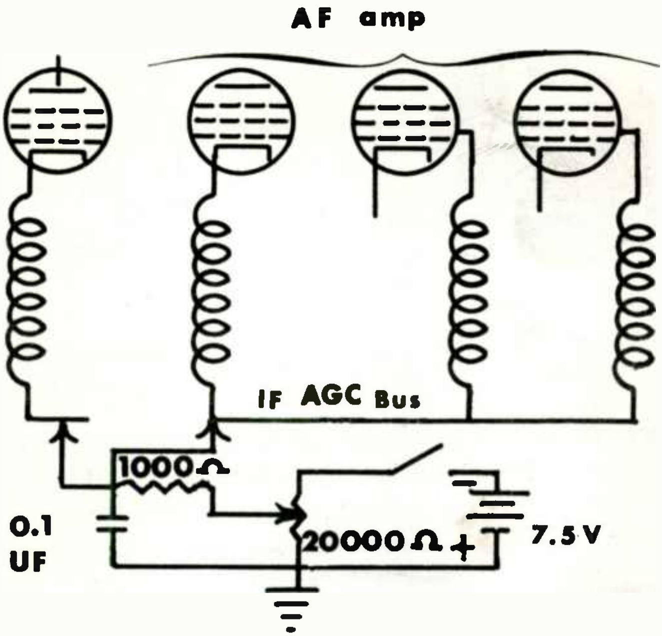


FIG. 1. ELIMINATING AGC AND USING FIXED BIAS

Dead Stage Location in video amplifiers: Check the video section by applying a few volts of audio to the input of the video section (point 1 Fig. 2). As a result, about 6 horizontal bars (the frequency of the a-f output, 400 cps, is about 6 times the normal vertical oscillator operating rate, 60 cps) should appear on the raster as shown in Fig. 3. Adjust the vertical hold control to keep the bars stationary. If the bars do not appear, check out the video section point-by-point starting at the picture tube input and working back toward the 2nd detector. The gain provided by each stage should result in darkening of the bars when the 324 audio lead is moved from the plate to the grid of the same stage if the stage is operating. Distinct lightening of the bars when the 324 audio lead is moved from the grid of one stage to the plate of the preceeding stage indicates a faulty coupling capacitor. Reduce the audio voltage applied to avoid overloading as required.

Dead stage location in picture i-f amplifiers: If the video amplifier is o.k., check the picture i-f section as follows. Tune the 324 to the center of the picture i-f pass band. Apply a modulated r-f signal at the input af the picture

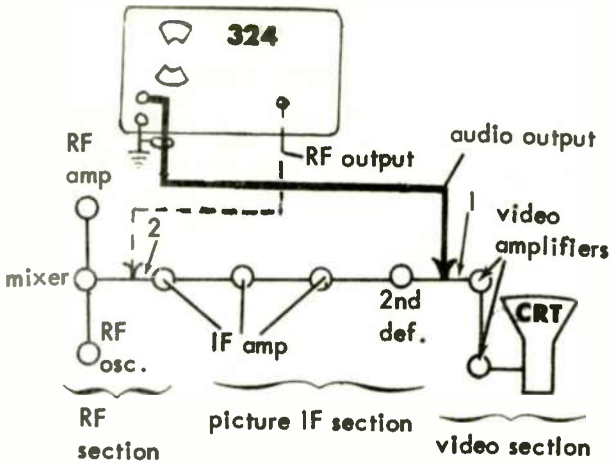


FIG. 2. BLOCK DIAGRAM OF TV RECEIVER SHOWN WITH OUTPUT OF 324 APPLIED TO KEY CHECK POINTS

FIG. 3. HORIZONTAL BARS PRODUCED BY 400CPS MODULATION ON SCREEN OF TV RECEIVER

i-f amplifier (point 2, Fig. 2). If horizontal bars do not appear on the raster, check the agc voltage according to the manufacturer's service notes. A shorted i-f tube or agc bus may result in clipping. If the agc circuit seems o.k., check out the picture i-f section point-by-point starting at the grid circuit of the last picture i-f amplifier and working back toward the first i-f amplifier. The gain provided by each stage should result in darkening of the bars when the 324 r-f lead is moved from the grid of the following stage to the grid of the stage under test if the stage is operating. Reduce the 324 output voltage with the output cable connected to the plate of a stage to obtain light bars so that the stage gain will be observable as darkening of the bars when the output cable is moved to the grid of the stage.

If the picture i-f stages are functioning properly, check the mixer stage by applying r-f signal to the grid. If the receiver is designed so that the r-f tuned circuits act as a partial i-f short across the converter grid, temporarily eliminate the short during this procedure by a) removing a mixer coil strip in tuner of the turret type and turning the turret to the blank position, or b) using a spare mixer tube, carefully bending out the grid pin for connection to the signal generator. In step b and sometimes in a, you will need to use a 10KΩ or larger resistor to ground to supply a dc-return path for the grid current.

Locating a dead r-f amplifier or r-f oscillator stage: If the mixer stage, picture i-f section and video sections are ok, determine whether the r-f oscillator is operating by measuring the negative grid bias developed in the oscillator circuit. It is important to use a vtvm such as the EICO 221, 214, 232, or 249 for this measurement. The correct value of the bias voltage should be obtained from the service notes for the particular set. As the range of value for this voltage is usually from −2 to −6 volts, a measurement of a few tenths of a volt or less indicates the r-f oscillator is not functioning and the supply voltages, tube, and other parts of the circuit should be checked. If the r-f oscillator is functioning properly, tune the receiver to any desired vhf channel and the 324 to the picture carrier frequency of that channel. Apply the modulated r-f signal to the mixer tube grid and adjust the r-f output so the bars are clearly visible on the picture tube screen.

Note: Tuners employing triode mixers and some employing pentode mixers may require that a capacitor of about 5 uuf or less be connected in series with the r-f lead to minimize circuit loading and avoid detuning of the high impedance circuits.

Move the output cable to the plate of the r-f amplifier. The bars may turn lighter in shade. If the bars become very faint of disappear entirely, look for trouble in the r-f tuned circuits between the r-f amplifier plate and the converter grid. Without moving the cable, reduce the 324 r-f output until the bars are light grey and then shift it to the grid of the r-f amplifier. Darker bars should result, indicating that the r-f amplifier is functioning. Finally, shift the cable to the antenna input terminals of the receiver, which should result in bars of about the same intensity as before. Faint bars or disappearance of the bars indicates trouble in the circuits ahead of the r-f amplifier.

Locating a dead stage in the sound i-f amplifier: Normal picture but no sound indicates that the trouble is probably in the sound circuits following the sound i-f take-off circuit. If the audio section of the receiver tests o.k. (use method described in later section), check the f-m sound detector. In either the ratio detector or discriminator type detectors, set your vtvm up to use the zero-center scale and connect it across the output load resistor of the detector. Connect the r-f output cable of the 324 to the grid of the last sound i-f stage and tune the generator to the center frequency of the sound i-f amplifier. Tune the 324 back and forth through the sound i-f setting. If the detector is aligned and operating properly, the vtvm meter pointer will swing above and below center scale as the 324 is tuned. If the last stage or detector is defective, however, performance may be impaired.

Next, set up your vtvm to measure dc volts and connect it to the grid of the last sound i-f stage. Normally, grid current flowing through the grid resistor of this stage when a sound i-f signal is applied will produce a negative dc voltage varying from -1.0 volt on weak signals to -30 volts or more on strong signals. At no signal, contact potential in the tube will produce a negative voltage of a few tenths of a volt. Tune the 324 to the center frequency of the sound i-f amplifier and apply the full r-f output, unmodulated, to the input of the sound i-f amplifier. If no reading is obtained, check out the sound i-f amplifier point-by-point by shifting the 324 i-f output cable first to the plate of the next-to-last sound i-f stage, then to the grid, and so on to the input.

Localizing intermittent picture troubles where raster is not affected: Tune the tv receiver to an unused channel at the high end of the band. Tune the 324 to the center of the picture i-f pass band and apply it with modulation to the input of the picture i-f amplifier. Adjust the 324 output and receiver contrast control until the horizontal bars are clearly visible. Set your vtvm to a low d-c voltage range and connect it across the second detector load resistor where it should read several volts of rectified signol. If, when the intermittent occurs, the bars disoppear but the vtvm reading remains unaltered, you know the trouble is in the video section or the picture tube. If the intermittent does not occur, the trouble is probably in the r-f section. Intermittents due to voltage breakdown, such as in capacitors or other components may be speeded up by operotion at higher than normal line voltage. Intermittent r-f oscillator action due to low line voltage (possibly due to weak or defective oscillator or power rectifier, or dirty tuner contacts) may be induced by operating the receiver at lower than normal line voltage. Intermittent contacts may be found by inspection or tapping and prodding suspected components, whereas intermittents due to contraction and expansion as a result of temperature changes may be induced by heating the components in the suspected section with an infra-red lamp or an ordinary electric lamp.

Localizing intermittent sound trouble: Intermittent sound but normal picture indicates that the trouble is probably in the sound i-f or audio section of the receiver. (Similar symptoms may result from r-f oscillator frequency shift in receivers having a separate a sound channel.) To determine whether the trouble is in the sound i-f or audio section, set your vtvm at the 50 volt d-c range or thereabouts and connect it to the output of the sound i-f detector. Set the 324 for modulated r-f output and connect the output cable to the input of the sound i-f amplifier. Tune the 324 to a frequency a little above the frequency resulting in maximum positive or negative swing on the vtvm scale. Turn up the receiver volume control and then reduce the 324 output so that the i-f signal is slightly below the limiting level. Reset the volume control for desired sound level. If, when the sound disappears, the meter reading drops to a low value, then the trouble is in the sound i-f amplifier. If the meter reading remains unaffected, look for trouble in the audio section. The occurence of the intermittent may be speeded up here also by the methods described previously.

Locating a weak or faulty stage by gain measurements: The procedures already described are applicable only to finding a dead, extremely weak, or intermittent stage. Where the fault is a definitely weak but not dead stage, it can be located by stage gain measurements. To make stage gain measurements on i-f and r-f amplifiers in receivers employing agc, disable agc and use fixed bias as shown in Fig. 1. A low bias voltage such as -1.5 volts will usually be satisfactory and provide nearly maximum gain, whereas -3 volts may be necessary to decrease the gain of high gain amplifiers or in noisy locations. A bias of -4.5 or -7.5 volts may be required if oscillation occurs at lower bias voltage.

To check stage gain in the video or audio amplifier sections, connect the audio output terminals of the 324 to the grid of the output tube and adjust the audio voltage at that point (as measured on your vtvm) to 1.0 volt. Now shift the vtvm lead to the plate of the tube and measure the signal voltage there. As the voltage gain of the stage is equal to the signal voltage at the plate divided by the signal voltage at the grid, the numerical value of the signal voltage measured at the plate is the gain of the stage. Repeat this procedure for the first stage. In ac/dc receivers and some small ac receivers a hum voltage up to 10 or 15 volts may be present at the plate of the output tube. Measure this voltage with no signal applied and subtract it from the value obtained with signal before calculating the stage gain.

To check stage gain in the picture i-f amplifier, replace agc by fixed bias. Then connect the r-f output cable of the 324 to the grid of the last picture i-f tube and adjust the r-f output without modulation to produce 0.5 volt across the second detector load resistor, as measured with your vtvm. Next, shift the output cable of the 324 to the grid of the next-to-last i-f tube and read the vtvm again. Divide this reading by the first reading (0.5 volt) to obtain the gain of the next-to-last stage. Now reduce the 324 r-f output to again produce 0.5 volt across the load resistor and shift the cable to the grid of the second from last stage. Read the new voltage across the load resistor. This reading divided by 0.5 volt is the gain of the second from last stage. Any other stages may be checked in the same manner.

RADIO SERVICING:

Locating a dead section in an a-m receiver: (Unless stated otherwise, the indication of normal functioning in all cases is a loud 400 cps tone.) Check the audio section by applying 0.1 volt audio signal from the 324 to the input of the audio amplifier (point 1 Fig. 4) with the volume control of the receiver set for full volume. Check the i-f section by tuning the 324 to the i-f frequency (usually 455 kc) and applying a very low modulated i-f signal to the input of the i-f amplifier (point 2, Fig. 4). If both audio and i-f sections are functioning, it may be assumed that the trouble is in the r-f section.

Locating a dead stage in the audio amplifier section of a radio or tv receiver: Check the speaker and output transformer by applying the full audio output to the primary of the output transformer. Check the audio-output stage by applying almost the full audio output to the grid of the output stage.

Turn up the receiver volume control to maximum and shift the 324 audio lead from the grid of the output stage to the plate of the 1st audio stage. The sound level should remain unchanged if the intervening coupling capacitor is o.k. Now reduce the audio output of the 324 until the 400 cps tone is weak and shift the audio lead to the grid of the 1st audio stage. Proper functioning of this stage is indicated by greatly increased volume. Check the volume control by applying 0.1 volt across it and turning it through its complete range. Noise may be caused by a defective control or d-c leakage in the associated blocking capacitors. To check the input coupling capacitor, shift the audio lead ahead of it. There should be practically no change in volume.

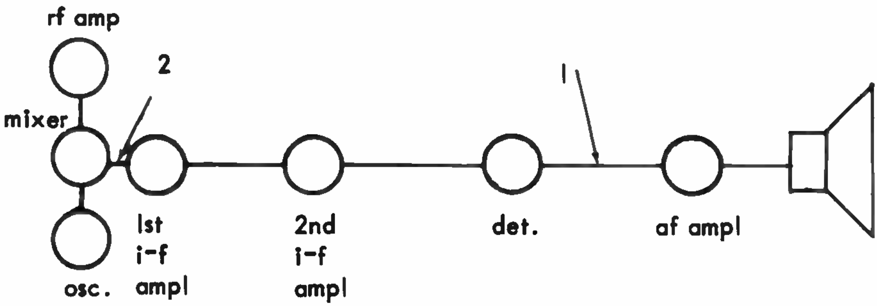


FIG. 4. BLOCK DIAGRAM OF A-M RECEIVER

Locating a dead stage in the i-f amplifier section of an a-m broadcast receiver: If the audio section is functioning, the i-f stages may be checked in the same way the picture i-f stages of a tv receiver were checked, except that the indication here is the 400 cycle tone. Start by setting up the 324 for modulated r-f output, tune it to the receiver i-f frequency, and apply a very low level signal to the grid of the second i-f amplifier. Retune the generator for peak sound output. With the receiver volume control turned all the way up, a loud 400 cycle tone should result, indicating proper functioning of the second i-f amplifier and second detector circuits. Check the first i-f stage in the same manner. Check the converter stage by shifting the 324 output cable to the grid of the converter tube. Where the r-f tuned circuits form a partial i-f short across the converter grid circuit, connect a 10KΩ resistor between the converter grid and the r-f tuned circuit when checking the converter stage and remove after completing the test.

Checking i-f transformers and i-f coupling capacitors: To check an i-f coupling transformer, apply a modulated i-f signal to the grid circuit side of the transformer and then to the plate circuit side. While the 400 cycle tone may be somewhat reduced on the plate circuit side, a drastic reduction in sound level or disappearance of the tone indicates a faulty coupling transformer. Coupling capacitors may be checked in the same way.

Locating a dead r-f stage or r-f oscillator in an a-m broadcast receiver: Operation of the r-f oscillator is checked by the same method used to check the r-f oscillator in a tv receiver as described previously, that is measuring the negative grid bias developed. In a-m receivers, the value of this voltage ranges from -5 to -15 volts.

If the r-f oscillator is functioning, check the r-f amplifier as follows. Apply a low level, modulated 600 kc signal from the 324 with a 5 uuf (approx.) capacitor in series with the output cable to the signal grid of the mixer tube. Tune the receiver for peak intensity of the 400 cycle tone and adjust the volume to a comfortable level. Now shift the 324 cable to the plate of the r-f amplifier. A considerable reduction or disappearance of the 400 cycle tone indicates trouble in the coupling circuit between the r-f amplifier and the converter stage. Check the r-f amplifier by shifting the 324 output cable to the grid of the r-f stage and retune the receiver slightly, if necessary, for the greatest sound intensity. While the output may increase slightly when shifting the cable from plate to grid, a considerable reduction or weakening of the sound indicates trouble in the r-f amplifier circuit. Finally, shift the output cable to the antenna coil input. A slight increase or decrease in output is normal, but considerable weakening or disappearance of the sound indicates a defect in the antenna coil.

Checking i-f amplifier gain in an a-m broadcast receiver: Tune the 324 to the i-f frequency and feed the unmodulated output to the grid of the first i-f amplifier. Adjust the r-f output to develop 10 volts across the second detector load resistor as measured with a vtvm. Now using your vtvm with an RF probe (such as an EICO PRF-11 or PRF-25), measure the generator output voltage at the i-f amplifier grid. The gain is equal to 10 volts divided by the measured generator output voltage.

Correcting contact potential effect: If the second detector of the receiver is a vacuum-tube diode, in making gain checks you may need to correct for the dc voltage across the second detector load resistor due to contact potential, particularly when the signal at the second detector is weak. You may do this by first eliminating any input signal to the second detector by temporarily removing an i-f tube and then measuring the dc voltage across the second detector load resistor with your vtvm. This value which may range from 0.1 volt to 0.5 volt must be subtracted from all subsequent measurements of voltage across the second detector load resistor for the purpose of gain calculations.

Peak Alignment of a-m and f-m broadcast receivers: I-f alignment is basically the same for both a-m and f-m receivers. Manufacturer's instructions in any case should be followed as closely as possible. In general, the following procedure may be used.

Set up your vtvm to read d-c voltages. In a-m receivers, connect it across the second detector load resistor. In f-m receivers employing a standard Foster-Seeley discriminator preceded by a limiter stage (Fig.5), connect it across the limiter stage grid resistor R1. In f-m receivers employing a ratio detector (Fig.6), connect it across the load resistor R2 in the ratio detector circuit. Disable the agc circuit of the receiver and use battery bias, if necessary (described previously). Set an a-m receiver at a quiet point near 1600 kc and f-m receiver at a point near the low frequency end of the dial. Tune the 324 to the receiver's i-f frequency (usually 455 kc in a-m and 10.7 mc in f-m receivers) and apply the modulated output to the grid of the last i-f stage, using only enough output to produce a usable meter reading. With a proper alignment tool, adjust the output i-f transformer secondary and primary trimmers (in that order) for peak indication of the vtvm. Then move the 324 output cable to the grid of the next-to-last i-f stage and adjust the next-to-last i-f transformer secondary and primary trimmers (in that order for peak indication of the vtvm. Finally shift the 324 output cable to the grid of the converter stage and adjust the first i-f transformer secondary and primary trimmers (in that order) for peak indication of the vtvm.

Receivers employing over-coupled i-f transformers ordinarily require that a sweep generator be used for alignment. It is possible to use the peak alignment method just described if the degree of coupling is reduced by shunting a resistor of 1000 ohms or less across the transformer winding opposite to that being tuned. That is to say, when the secondary of the transformer is being tuned, the shunt resistor is placed across the primary, and when the primary is being tuned, the shunt resistor is placed across the secondary.

F-m receivers, particularly the detector sections, are most conveniently and rapidly aligned by the visual method, using a tv-fm sweep generator such as the EICO Model 360 and an oscilloscope (any model EICO oscilloscope is suitable for this purpose). Where such equipment is not available, a careful, experienced person may do a fairly accurate alignment job with an a-m generator and a vtvm. F-m i-f alignment by the a-m generator and vtvm method is described above. F-M detector alignment by this method depends of the type of detector circuit employed in the particular receiver. Two common F-M detector circuits are diagrammed below together with the alignment instructions appropriate to each.

Fig. 4. is the basic Foster-Seeley ("phase") discriminator and preceeding limiter stage. With the 324 set up and connected as per instructions for the last step of the i-f alignment shift the vtvm to measure the d-c voltage across either

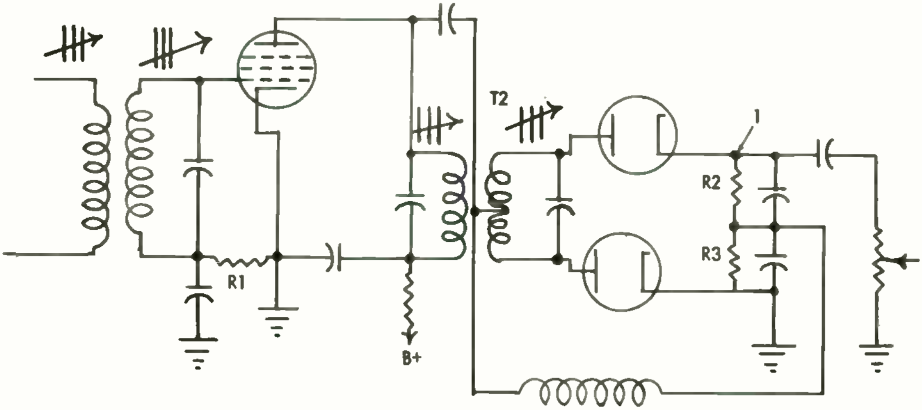


FIG. 5. BASIC FOSTER-SEELEY DISCRIMINATOR CIRCUIT

resistor R2 or R3 and adjust the primary of T2 for a maximum reading. As it is the rectified i-f frequency voltage that is being measured here, the 324 a-f modulation can be turned off for this step although it can do no harm to leave it on as some a-f modulation will filter through to the a-f section and serve to identify the signal by the loudspeaker output. Then shift the vtvm leads to measure the dc voltage across R2 and R3 in series (i.e. from point 1 to ground) and adjust the secondary of T2 until a zero reading is obtained. When using this method, set the generator to 10.7 mc as accurately as possible and what is even more important, maintain the same i-f frequency setting during all adjustments of the i-f amplifier and discriminator. (If the generator setting is slightly inaccurate it will be compensated by a slight variation in the dial setting, but a drift of only a few kc during the time between the i-f and the discriminator alignment will result in a poor job. Therefore make sure that the generator is thoroughly warmed up before doing alignment work.)

Fig. 5 is a basic ratio detector circuit. The primary circuit of T2 is realigned with an unmodulated i-f signal from the 324 connected to the same point used in the last step of the i-f alignment. Adjust the primary of T2 for peak d-c voltage reading across R2 (point 1 to ground). To align the secondary of T2 for the most usual case where R2 is a single resistor (in some receivers R2 is replaced by two equal resistors, the midpoint of which is connected to point 2 through a resistor or to ground) temporarily connect two equal resistances in series across R2 to produce artifically the condition in which the load resistance is split.

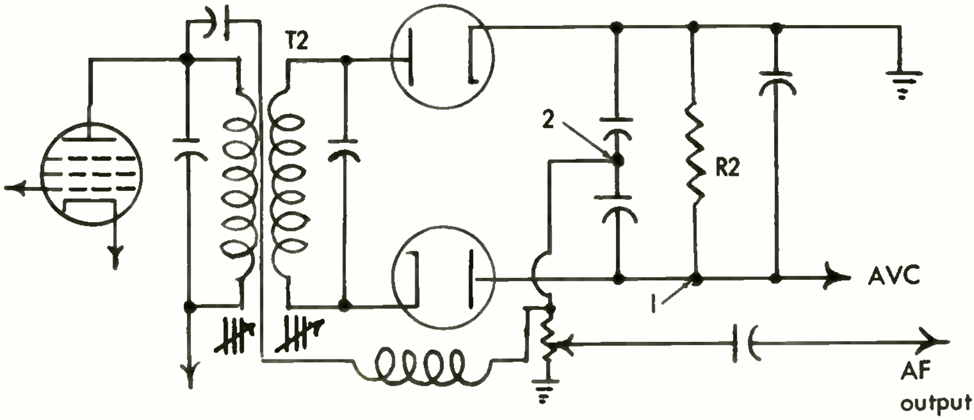


FIG. 6. BASIC RATIO DETECTOR CIRCUIT

Turn on the 324 a-f amplitude modulation and connect a vtvm from the mid-point of the equal resistances, added as described, to point 2 or some point in the a-f signal amplifier circuit (if larger signal amplitude is required for convenient readings) and adjust the secondary of T2 for zero a-f (ac) voltage. Note that the a-f voltage minimum is critical and care must be taken so that the minimum will not be missed.

Alignment of the oscillator section of a-m and f-m receivers should be done after alignment of the i-f section (and detector circuit in f-m receivers). To align an a-m receiver oscillator, connect your vtvm across the second detector load resistor and set it to read d-c voltage. Connect the receiver antenna to the receiver and set the 324 output cable sufficiently near the antenna so that the radiated signal will be picked up. Tune the receiver to its highest frequency, approximately 1600 kc for most types, and set the 324 to the same frequency. Using an insulated screwdriver, adjust the trimmer capacitor on the receiver oscillator for peak reading on the vtvm and then the antenna trimmer for peak indication. Retune the receiver and the 324 to 600 kc, rock the tuning gang slightly, and adjust the trimmer for the low frequency end of the receiver oscillator to obtain a peak reading on the meter.

The adjustment procedure for f-m receivers is the same as for a-m receivers, except that the high and low frequency check points are between 88 and 108 mc (the f-m broadcast band). If particular alignment frequencies are not given for the particular receiver, use the ends of the band (namely 88 and 108 mc).

For all alignment work, always obtain if possible and follow closely the receiver manufacturer's instructions which of course take precedence over any instructions given here. Note that some type of receivers such as those which are stagger-tuned, can not be aligned without specific information as to the specific tuning frequencies.

CALIBRATION

General: Instruments purchased in kit form must be calibrated before use as described below. Factory-wired instruments have been calibrated and tested at the factory. If a change occurs in the accuracy of the instrument after a long period of use, it is probably due to aging of the components. The accuracy of the instrument may readily be restored by repeating this calibration procedure. Recalibration will also be necessary, whenever parts (tubes, etc.) are replaced.

Tuning Dial Adjustments: With the instrument out of the cabinet, insert the line cord into a 115 VAC, 50-60 cycle outlet and turn the power on. Tighten the tuning dial set screw and turn the tuning knob counter-clockwise until the tuning capacitor is fully meshed, i.e. to the point at which further counter-clockwise rotation of the tuning knob causes no further rotation of the tuning dial. Loosen the tuning dial set screw and turn the dial until zero (0) on the LINEAR REFERENCE scale appears directly under the edge-lit hairline in the upper window. Retighten the tuning dial set screw.

Individual band calibration: For each of the five lowest bands there is a coil with an adjustable tuning slug mounted on the BAND SELECTOR switch. The inductance for the highest fundamental band F1 and the harmonic band F2 is simply a straight piece of heavy bus wire which provides the proper inductance at the high frequencies covered by these bands.

The coil corresponding to each band can be identified by the stock number printed on the coil form which is reproduced in the parts list with the proper identification. To facilitate calibration for the kit builder, the tuning slug in each coil has been preset at the factory so that the distance it protrudes from the coil is correct to within one-sixteenth of an inch of the value for the correct calibration.

The method of calibration is to couple the output of the signal generator to an a-m broadcast and/or short-wave receiver sufficiently to provide a strong signal of about the same strength as the broadcast stations signals to be checked against. Depending on what is expedient, the signal generator is set to read either the broadcast station carrier frequency or half the broadcast station carrier frequency (in the case of band A which is entirely below the a-m band). Then the tuning coil slug for the particular band is adjusted with a proper alignment tool until the fundamental frequency output or the second harmonic of this frequency (in the case of band A) is "zero beating" against the broadcast station carrier frequency. Approach of the "zero beat" point is indicated by a squeal heard from the radio receiver which progressively drops in pitch. The procedure is to adjust for the lowest pitched squeal or preferably, a point where there is slow popping with a rising squeal on either side of the setting. The point at which there is slow popping or complete silence is the "zero beat" point, which means that the signal generator frequency (or a harmonic thereof) is the same as or very close to the broadcast station carrier frequency. The set-up for calibration is diagrammed in Fig. 7 below.

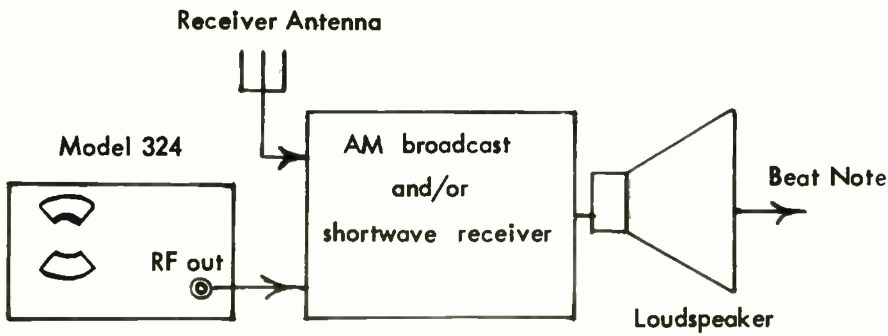


FIG. 7. SET-UP FOR 324 CALIBRATION

It is recommended that wherever possible the coil for each band be adjusted at a frequency approximately two-thirds of the frequency range up from the low end of the band.

Band A Calibration: Tune the receiver to a station of known frequency from 600 to 700 kc. Then set the 324 band selector switch at band A and the tuning knob to read exactly half the known broadcast station frequency. Adjust the coil A tuning slug for "zero beat". Check the calibration by setting the receiver at another station of known frequency under 800 kc and tuning the 324 through a short arc about half the known station frequency on band A to again obtain "zero beat".

Band B Calibration: Tune the receiver to a station of known frequency from 900 to 1000 kc. Then set the 324 band selector at band B and the tuning knob at exactly the known station frequency. Adjust the coil B tuning slug for "zero beat". Check the calibration as above.

Band C Calibration: If a short wave receiver is available, use can be made of the extremely accurate signals transmitted by the Bureau of Standards station WWV. This station transmits frequencies of 2.5, 5, 10, 15, 20, 25, 30, and 35 mc modulated by standard audio frequencies of 440 cps and 660 cps as well as timing signals. Transmissions on 5, 10, 15, and 20 mc are more readily received because of the high transmitting powers used. If the 2.5 mc WWV signal can be received, band C can be calibrated by setting the receiver to receive the 2.5 mc signal, setting the 324 to band C and exactly 2.5 mc on the tuning dial, and then adjusting coil C for "zero beat". If a short wave receiver is not available, calibrate band C making use of an a-m broadcast station of known frequency around 1600 kc.

Bands D and E Calibration: Coils D and E for bands D and E respectively can be adjusted by either zero beating against a WWV transmitted signal (5 or 10 mc for band D; 15,20,25,30, or 35 mc for band E) or against a standard signal generator.

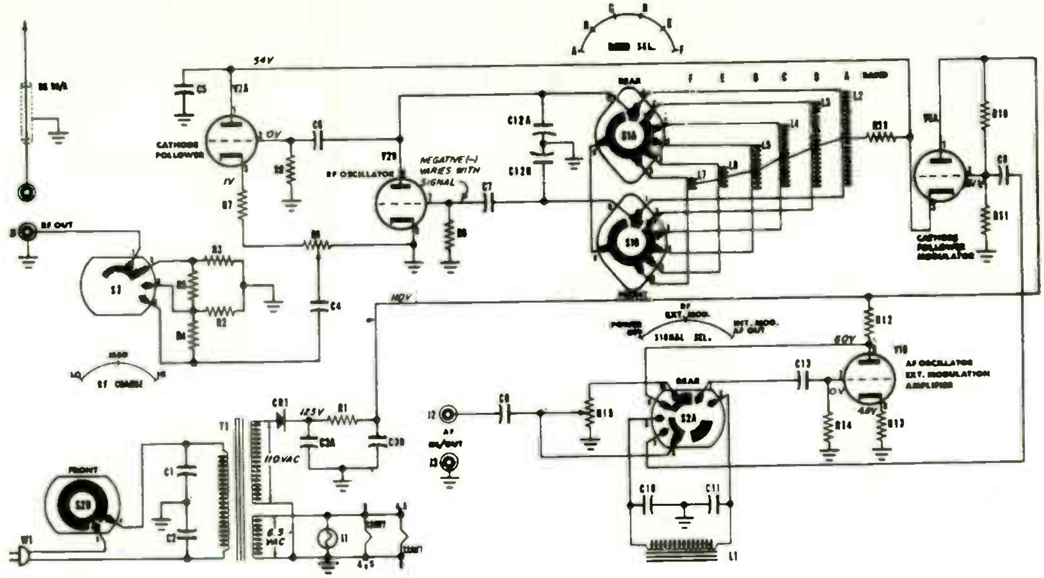
There is no calibration required for band F.

SERVICE

If your instrument fails to function properly and the cause of the trouble can not be found, you may return it to the EICO repair department where it will be repaired at a charge of $5.00 plus the cost of parts. (If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book.) Pack carefully and ship by prepaid Railway Express if possible. Return shipment will be made by express collect.

REPLACEMENT PARTS LIST

STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION
20000	C1,2,13	cap., paper, .01 mf - 400V	51000	P1	amphenol, female
23009	C3	cap., elec., 2 X 20mf - 150V	10041	R1	res., 2.2KΩ, 1/2W, 20%
22500	C4,5	cap., disc., 1000mmf	10002	R2,3	res., 47Ω, 1/2W, 20%
22008	C6	cap., cer., 5mmf	10005	R4,5	res., 470Ω, 1/2W, 20%
22007	C7	cap., cer., 47mmf	16013	R6	pot., 200Ω (RF FINE)
20006	C8,9	cap., paper, .1mf - 400V	10040	R7	res., 68Ω, 1/2W, 20%
20001	C10	cap., paper, .05mf - 400V	10018	R8,9	res., 22KΩ, 1/2W, 20%
20008	C11	cap., paper, .02mf - 400V	10028	R10	res., 470KΩ, 1/2W, 20%
29004	C12	cap., tuning	10419	R11	res., 270KΩ, 1/2W, 10%
73003	CR1	rect., 50 ma	10424	R12	res., 22KΩ, 1/2W, 10%
92000	I1	bulb, #47	10432	R13	res., 1KΩ, 1/2W, 10%
50002	J1	amphenol, male	10410	R14	res., 100KΩ, 1/2W, 10%
2001	J2,3	binding post, 5 way	16002	R15	pot., 250KΩ (AF MOD/OUTPUT)
4501	L1	choke a.f. resonant	10012	R16	res., 4.7KΩ, 1/2W, 20%
5003	L2	coil "A"	60032	S1	switch, BAND SEL., 6 pos.
5004	L3	coil "B"	60033	S2	switch, SIGNAL SEL., 3 pos.
5005	L4	coil "C"	60034	S3	switch, RF COARSE, 3 pos.
006	L5	coil "D"	30013	T1	transformer, power
007	L6	coil "E"	90013	V1	12AU7 tube
008	L7	coil "F" (straight bare wire)	90022	V2	12AV7 tube



STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION	STOCK#	SYM.	DESCRIPTION
20000	C1,2,13	cap., paper, .01mf-400V	36003	L2	coil "A"	10028	R10	res., 470KΩ, 1/2W, 20%
23009	C3	cap., elec., 2X20mf-150V	36004	L3	coil "B"	10419	R11	res., 270KΩ, 1/2W, 10%
22500	C4,5	cap., disc., 1000mmf	36005	L4	coil "C"	10424	R12	res., 22KΩ 1/2W 10%
22008	C6	cap., cer., 5mmf	36006	L5	coil "D"	10432	R13	res., 1KΩ 1/2W, 10%
22007	C7	cap., cer., 47mmf	36007	L6	coil "E"	10410	R14	res., 100KΩ, 1/2W, 10%
20006	C8,9	cap., paper, .1mf-400V	36008	L7	coil "F" (straight bare wire)	16002	R15	pot., 250KΩ
20001	C10	cap.,paper,.05mf-400V	51000	P1	amphenol, female	10012	R16	res., 4.7KΩ, 1/2W, 20%
20008	C11	cap., paper, .02mf-400V	10041	R1	res., 2.2KΩ, 1/2W, 20%	60032	S1	switch, BAND SEL., 6 pos.
29004	C12	cap., tuning	10002	R2,3	res., 47Ω, 1/2W, 20%	60033	S2	switch, SIGNAL SEL., 3 pos.
93003	CR1	rect., 50ma	10005	R4,5	res., 470Ω, 1/2W, 20%	60034	S3	switch, RF COARSE, 3 pos.
92000	I1	bulb, #47	16013	R6	pot., 200Ω,	30013	T1	transformer, power
50002	J1	amphenol, male	10040	R7	res., 68Ω, 1/2W, 20%	90013	V1	12AU7 tube
52001	J2,3	binding post, 5 way	10018	R8,9	res., 22KΩ, 1/2W, 20%	90022	V2	12AV7 tube
34501	L1	choke						

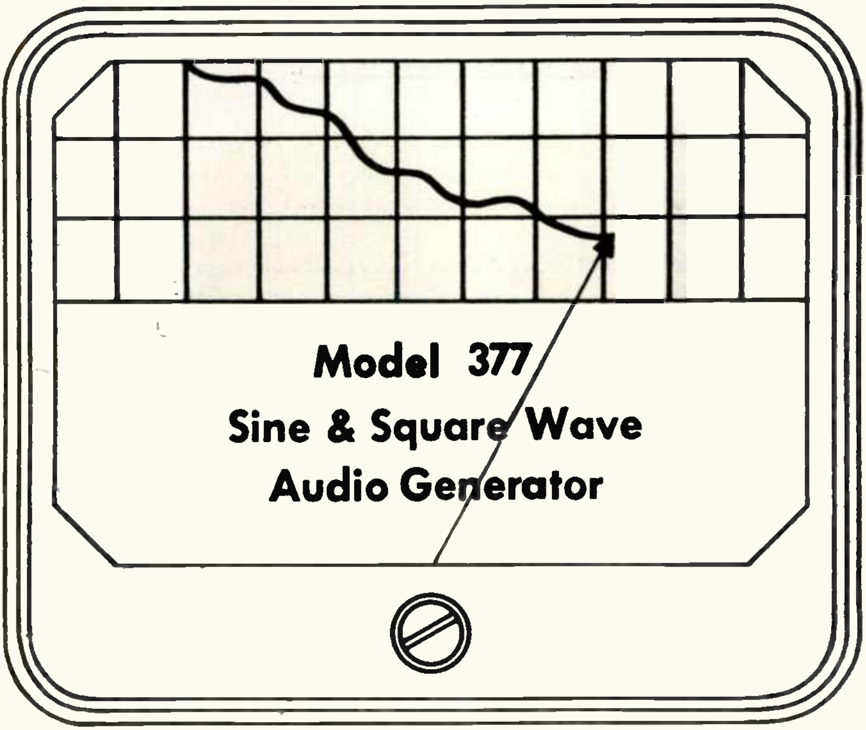
INSTRUCTION MANUAL FOR

EICO

ELECTRONIC INSTRUMENT CO., Inc.

33-00 NORTHERN BLVD. LONG ISLAND CITY 1, N. Y.

INSTRUCTION MANUAL FOR



EICO

ELECTRONIC INSTRUMENT CO., Inc.

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GENERAL DESCRIPTION

The EICO Model 377 is an audio sine and square wave generator providing sine wave voltages throughout the frequency range of 20 to 200,000 c.p.s. and useful square wave voltages throughout the frequency range of 60 to 30,000 c.p.s. The entire frequency spectrum is covered in four ranges, providing a long effective scale length for maximum accuracy and readability. A linear 0 to 100 scale is also provided for reference purposes.

The 377 is an adjustable vacuum-tube oscillator utilizing the widely-accepted resistance-capacitance tuning circuit that has been used for years in the finest laboratory generators. The frequency of oscillation is controlled with a capacitance-resistance filter (Wien Bridge) in a circuit which is highly degenerative except at the pass frequency of the filter; the circuit oscillates at this frequency. The Wien Bridge is composed of 1% precision resistors and a large 2 gang tuning condenser for accurate frequency determination and wide-band coverage. This generator possesses a high degree of frequency stability and requires a very short warm-up time to attain stable operation. The harmonic distortion in the output is less than 0.5%, giving a purity of waveform equalled only by the finest power generating stations. Although this instrument provides only sine and square waves, any desired waveform can be produced with an external R-C circuit (inserted between the generator and the load).

A cathode follower output circuit enables the instrument to deliver at least 10 volts across a 1000 ohm load (100 milliwatts) and to maintain high output without appreciable distortion when feeding into larger loads. The frequency response is flat ± 1.5 db from 60 c.p.s. to 150 Kc. The hum is kept down to less than 0.4% of the rated output by a full wave rectifier and a pi type LC filter, plus additional RC filtering.

This instrument will prove itself extremely useful in determining radio receiver fidelity and loudspeaker response, audio amplifier testing and design, and for square wave testing of television receivers.

SPECIFICATIONS

Sine Wave Range: 20 - 200,000 c.p.s. in 4 bands; the dial can be read directly on all ranges.

Band A: 20 - 200 c.p.s.
Band B: 200 - 2000 c.p.s.
Band C: 2000 - 20,000 c.p.s.
Band D: 20,000 - 200,000 c.p.s.

Square Wave Range: 60 - 30,000 c.p.s. (5% tilt at 60 c.p.s., 5% rounding at 30 Kc). Read on same scales as sine waves.

Calibration Accuracy: ± 3% or 1 c.p.s., whichever is greater

Frequency Response: ± 1.5 db, 60 c.p.s. - 150 Kc

Output Voltage: The output circuit employed is of the cathode follower type. The table below gives the minimum output voltages that can be expected when the generator is feeding into different load impedances.

1000 ohms	-	10 volts	-	1% max. distortion
10,000 ohms and higher	-	14 volts	-	1% max. distortion
500 ohms	-	8 volts	-	1.5% max. distortion

These voltages are given for sine wave output and are unvarying with frequency; on square wave, the output voltages (r.m.s. values) are somewhat higher.

Rated Load: 1000 ohms (resistive)

Rated Output Power: 100 milliwatts into rated load (10 volts across a 1000 ohm resistive load).

Distortion: Less than 1% of rated output

Hum: Less than 0.4% of rated output

Power Requirements: 105 - 125 volts, 50 - 60 c.p.s., 50 watts

Tube Complement: 1 - 6X5, 1 - 6SJ7, 1 - 6SN7, 2 - 6K6 and 1 - 3S6 3 watt lamp (G.E. lamp designation)

Overall Dimensions: 11 1/8" long, 7 1/8" high, 7 5/8" deep

Weight: 20 pounds

Cabinet: Blue grey wrinkle lacquer on steel

Panel: 3 color, deep-etched, rub-proof

OPERATING INSTRUCTIONS

1. PRELIMINARY STEPS: Insert the plug on the line cord into the a-c supply. Snap on the power switch (the pilot lamp should light), and allow a few minutes for the unit to warm up and begin to oscillate. If very accurate work is to be done, allow a ten minute warm-up for the unit to reach complete stability.

2. WAVEFORM SELECTION: Set the WAVEFORM selector switch to "SINE" or "SQUARE" as desired.

3. FREQUENCY SELECTION: Set the BAND selector switch to the desired frequency band. Each position on the BAND switch corresponds to a direct reading scale on the dial, as follows:

Band A: 20 - 200 c.p.s.
Band B: 200 - 2000 c.p.s.
Band C: 2 Kc - 20 Kc
Band D: 20 Kc - 200 Kc

Turn the frequency dial knob until the hairline on the indicator lines up with desired frequency (on the scale corresponding to the band selected). The linear 0-100 scale on the frequency dial is useful when it is required to repeat a given setting.

4. OUTPUT: The output voltage is obtained from the two terminal posts at the right hand side of the front panel. The lower of the two posts is grounded to the chassis.

Output power is varied by means of the attenuator control (marked AMPLitude) on the front panel. Clockwise rotation of the control knob increases the output power to its maximum value.

If a small signal voltage having a high signal-to-noise ratio is required, it is advisable to obtain it from a large signal voltage and an external voltage dividing network. This method is preferable because the noise in the generator output is constant (0.4% of rated output), and therefore a larger output has a higher signal-to-noise ratio which carries over to the small voltage taken from the dividing network. The voltage divider network shown below is suitable for most applications.

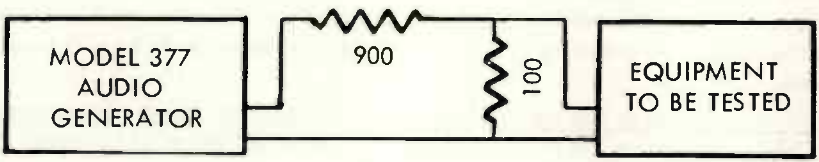


FIG. 1

Different sets of resistors may be used in the dividing network to obtain other voltage divisions. In all cases, however, the total of the two resistances should be at least 1000 ohms.

APPLICATIONS

FREQUENCY MEASUREMENT: The Model 377 Audio Generator can be used to measure frequency by comparison.

WITH HEADPHONES: Connect the output of the Audio Generator to one of a pair of headphones. The signal of unknown frequency is fed to the other headphone. Put the headphones on and tune the generator for "zero beat". The reading on the tuning dial of the generator is the unknown frequency.

WITH AN OSCILLOSCOPE: Connect the Audio Generator to the horizontal axis of the 'scope. Then apply the unknown frequency to the vertical axis. The 'scope controls (or the input voltages) are now adjusted for roughly equal deflections on each axis. Vary the frequency of the Audio Generator until the 'scope pattern is a stationary ellipse, a circle, or a diagonal line of fixed length. The shape of the pattern depends on the phase relationship between the known and unknown signals (See Fig. 2). The unknown frequency is now equal to the frequency of the Audio Generator as read on the tuning dial. Non-sinusoidal waves will produce distorted forms of a single loop pattern or a diagonal line of uneven brightness.

0° 45° 90° 135° 180°

FIG. 2

Frequencies out of the Audio Generator's range can be measured by means of Lissajous figures. Lissajous figures are stationary closed-loop patterns that appear on the screen when the frequency applied to one set of plates is a whole number of times larger than the frequency applied to the other set of plates, or if one frequency is a simple fraction of the other. To determine frequency ratio from the Lissajous figure, count the number of points of tangency to horizontal and vertical lines, drawn or imagined (See Figures 3a, 3b, 3c, 3d, 3e, and 3f). Points of tangency at the top of the figures result from the unknown frequency applied to the vertical axis. Those at the side of the figure result from the known frequency of the Audio Generator applied to the horizontal axis. As a matter of fact, the following relationship holds true in all cases:

$$\frac{\text{Frequency applied to the vertical axis}}{\text{Frequency applied to the horizontal axis}} = \frac{\text{Horizontal points of tangency}}{\text{Vertical points of tangency}}$$

As an example, take Fig. 3c, which shows four points of tangency at the top and one point at the side. This indicates that the unknown frequency applied to the vertical axis is four times the known frequency. In Fig. 3f, one point of tangency at the top and four at the side indicate that the unknown frequency is one fourth the known frequency.

2:1 3:1 4:1 1:2 1:3 1:4

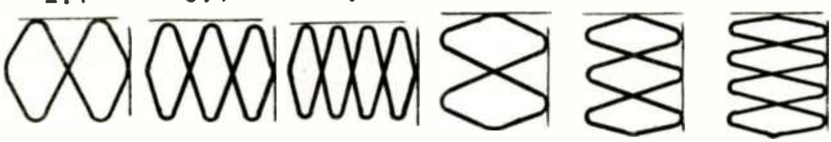


FIG. 3a 3b 3c 3d 3e 3f

SQUARE WAVE TESTING: The square wave signal provided by the Model 377 Audio Generator can be used to check amplifiers as to frequency response, phase shift, transient response, deficient design, or faulty components. In addition to the generator, an oscilloscope with sufficiently wide frequency response is needed to carry out the tests. The equipment is set up as shown in Fig. 4.

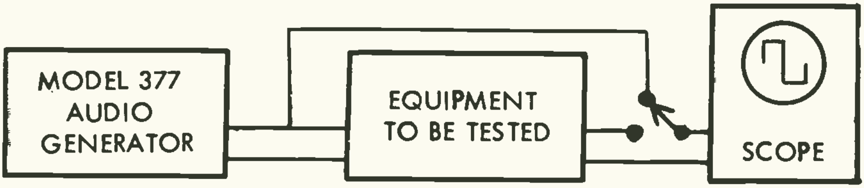


FIG.4

First, as a means of comparison, the square wave output from the Audio Generator is viewed on the 'scope. The horizontal sweep of the 'scope should be adjusted so that at least two full cycles can be seen on the screen. (Fig. 5a shows one full cycle of a perfect square wave). The 'scope is then connected to the output of the amplifier under test so that the modified square wave can be viewed on the screen. Possible output wave shapes are shown in Fig. 5b to 5i, and the significance of each wave shape is explained below.

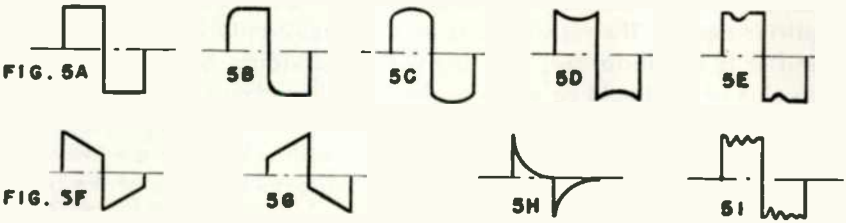


Fig. 5b shows "rounding" of the leading edge of the square wave. This indicates a drop off in gain at high frequencies. "Rounding" will generally be observable when there is a substantial drop in the gain by the tenth harmonic (or less). Therefore, if a 2 Kc square wave fed to the amplifier is reproduced on the 'scope without "rounding", the amplifier is flat to 10 X 2 Kc = 20 Kc.

Fig. 5c shows the effect of increased gain and Fig. 5d shows the effect of decreased gain at the square wave frequency. Fig. 5e indicates lowered gain at a narrow frequency band. If the square wave frequency is brought into this narrow frequency band, Fig. 5d will result.

The effect of phase shift in the amplifier is shown in Figs. 5f and 5g. If, at low frequencies, there is phase shift in the leading direction, the square wave will be tilted as in Fig. 5f. If there is phase shift in the lagging direction, the top of the square wave will be tilted as in Fig. 5g. The steepness of the tilt is proportional to the amount of phase shift. Phase shift is not important in audio amplifiers, although the ear is not entirely insensitive to it. In television and 'scope amplifiers, however, phase shift should not be tolerated.

Fig. 5h shows the pulse output from the amplifier that results when the square wave has undergone differentiation. This will happen when the grid resistor or the coupling condenser is too low in value or if the coupling condenser is partially open. Lastly, Fig. 5i, shows a square wave with damped oscillations following the leading edge. This results when a high frequency square wave is fed to an amplifier in which distributed capacities and lead inductances resonate at low frequencies. In television and 'scope amplifiers it may result from an undamped peaking coil.

AUDIO AMPLIFIER RESPONSE: The set up for determining the frequency response of an audio amplifier is shown in Fig. 6.

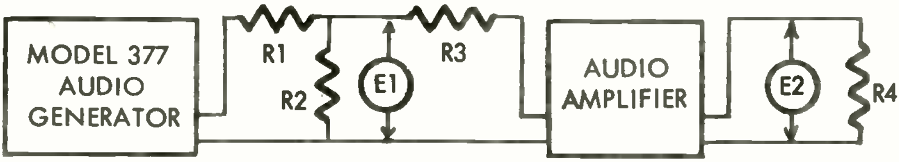


FIG. 6

The voltage dividing network R1 and R2, is necessary when testing high gain amplifiers (see "OUTPUT" in OPERATING INSTRUCTIONS). For testing low gain amplifiers, connect the output of the Audio Generator directly to the amplifier input. The resistor R3 is in the circuit only when the input of the amplifier is a transformer, and the voltage dividing network is being used. The value of R3 should be equal to the input impedance of the amplifier.

The input voltage to the amplifier is E1. If the amplifier has a high input impedance and the resistances in the dividing network are known accurately, E1 may be determined by measuring the output voltage of the generator and multiplying it by R2/(R1 + R2). This may be necessary when testing high gain amplifiers where the input voltages to the amplifier are very low and therefore difficult to measure.

The output of the amplifier should be fed to a load resistor of proper value, or to the speaker or other suitable apparatus. The output voltage is measured across the load resistor R4 or other suitable load.

The amplifier gain at any frequency is equal to the output voltage, E2, divided by the input voltage, E1. To obtain the data for a frequency response curve, measure the gain of the amplifier throughout the audio frequency range.

OVERALL RECEIVER FIDELITY MEASUREMENT: The set up for determining the overall fidelity of a radio receiver is shown in Fig. 7.

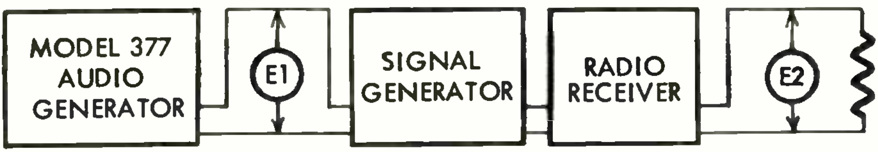


FIG. 7

The Model 377 Audio Generator is used to modulate the output of an R-F Signal Generator that is connected to the antenna and ground terminals of the radio receiver under test. The output voltage of the Audio Generator should be adjusted to produce about 30% modulation of the r-f signal.

Connect a voltmeter across the voice coil of the speaker. Set the R-F Signal Generator at 1000 Kc or to the desired frequency in the broadcast band, and then carefully tune the receiver to this frequency. Make sure that the receiver is exactly on resonance with the R-F Signal Generator frequency and not on one of the sideband peaks. Note that the output meter will show a maximum reading when the receiver is tuned to either of the sideband peaks on both sides of exact resonance. The receiver is tuned correctly when it is set at the point between the two sideband peaks where the output meter reading is a minimum. Data for an overall fidelity curve is obtained by recording the output voltage, E2, as the frequency of the Audio Generator is varied throughout the audio range (voltage E1 is kept constant).

CIRCUIT DESCRIPTION

GENERAL: (See Fig. 8) The Model 377 Audio Sine and Square Wave Generator is a vacuum-tube oscillator of the resistance-capacitance type. It consists of a two tube oscillator that oscillates at the resonant frequency of the Wien Bridge frequency determining network inserted in the feed-back path. The oscillator is coupled to a cathode follower amplifier that acts as an isolation stage and as a power amplifier. The square wave is formed by a dual-triode clipping circuit that is inserted between the oscillator and the cathode follower stage when square wave output is desired.

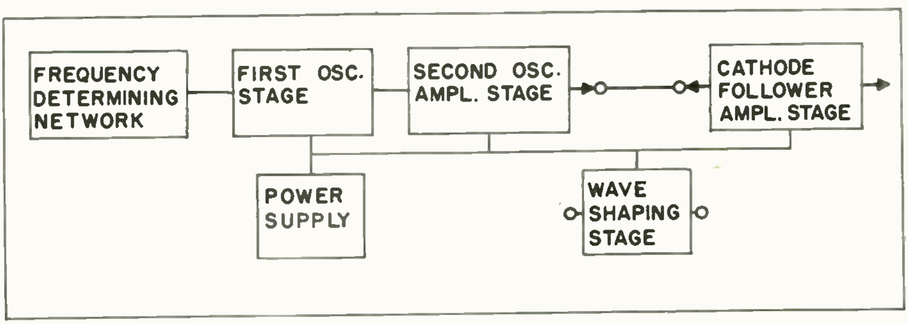


FIG. 8

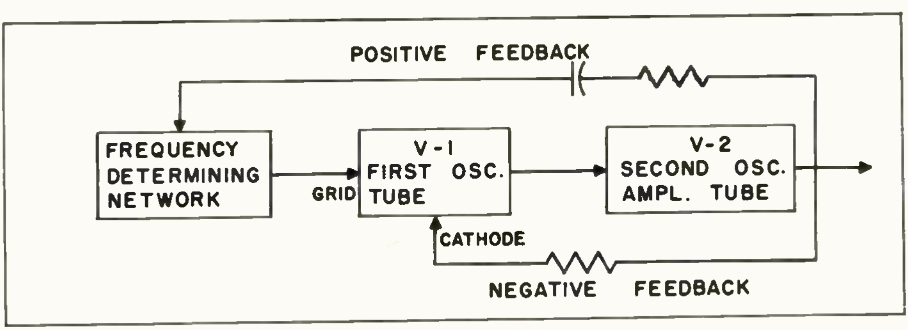


FIG. 9

THE OSCILLATOR CIRCUIT: (See Fig. 9) The oscillator section is basically a two tube amplifier with a Wien Bridge inserted in the feed-back path. It oscillates as a result of part of the output voltage being fed back to the input with the correct phase relation. This type of feed-back is known as positive feed-back. Negative feed-back is also employed to stabilize the oscillator operation and to maintain constant output over a wide frequency range.

THE FREQUENCY DETERMINING NETWORK: (See Figs. 10 and 11) The frequency determining network consists of two groups of variable capacitors and two groups of resistors wired to the band switch. Designating the resistor group R1-4 as R-S (in series with the associated variable capacitor) and R5-8 as R-P (in parallel with the associated variable capacitor), the values of R-S and R-P are fixed for each band. R-S and R-P are always equal in value, as are C-S and C-P.

The circuit design is such that the voltage applied to the first oscillator control grid is in phase with the voltage applied to the whole frequency determining network. In addition, the grid voltage is always one third of the voltage applied to the whole network. This is a characteristic of the Wien Bridge at resonance.

The resonant frequency of the network is inversely proportional to the product of resistance and capacity (R-S and C-S, or R-P and C-P). Large changes in resonant frequency are possible with each set of components. A frequency change of more than ten to one is achieved with each set of resistors, and the audio and supersonic spectrum is covered in only four bands.

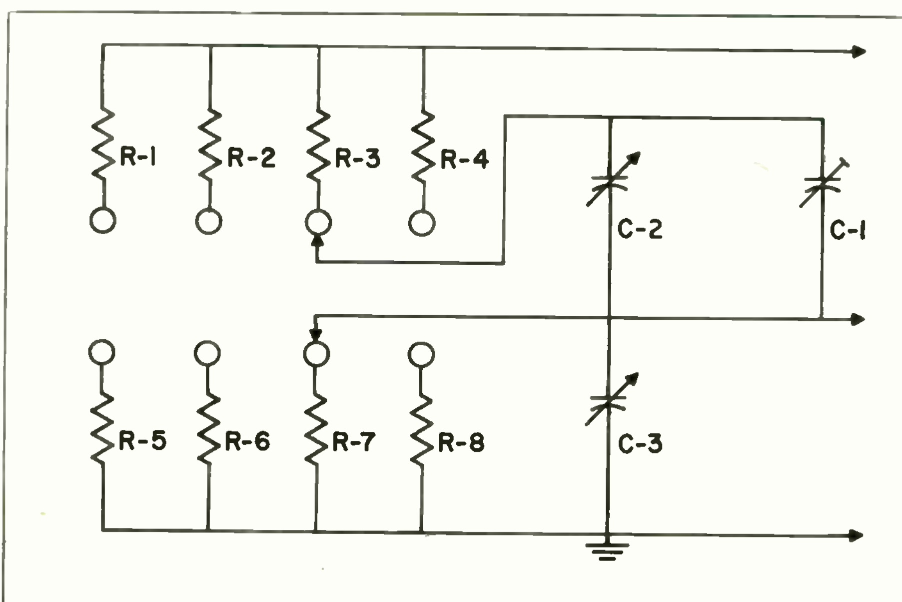


FIG. 10

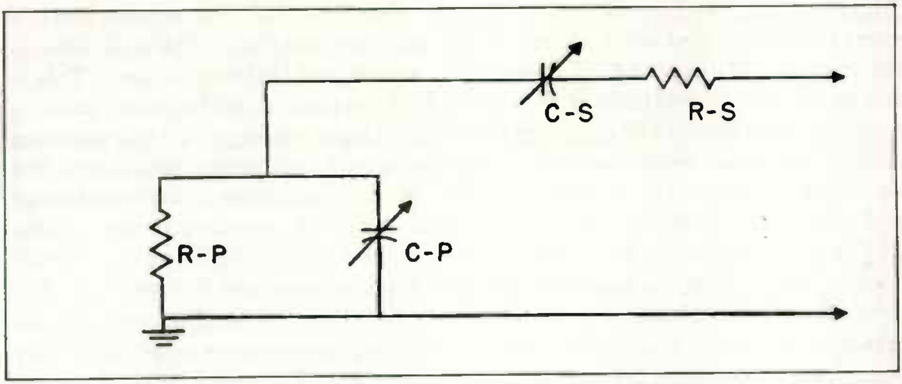


FIG. 11

NEGATIVE FEED-BACK AND AUTOMATIC AMPLITUDE LIMITOR: As may be seen in Fig. 12, the negative feed-back voltage used in the oscillator section is derived from the output of the second oscillator tube, V2, and is fed back to the cathode of the first oscillator tube, V1. The magnitude of the negative feed-back is determined by a resistor network, one element of which is the incandescent lamp, 3S6. A property of this lamp is that it has a positive temperature coefficient; however it possesses sufficient thermal inertia so that its temperature is substantially constant at all audio frequencies. Because of the lamp's positive temperature coefficient, the oscillations can not build up to a value in excess of the tube's handling capacity. This is so because the resistance of the lamp increases with increased current. As a result the degeneration in the cathode circuit of V1 increases, causing less amplification in the oscillator section. Thus, the lamp serves as an automatic amplitude limitor. Pot R9 is set at calibration for the proper negative feed-back.

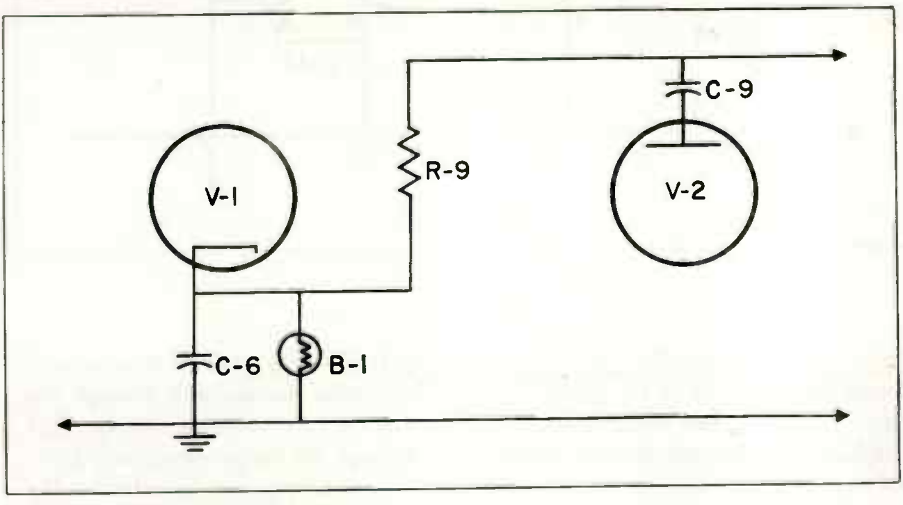


FIG. 12

THE SQUARE WAVE SHAPING CIRCUIT: (See Fig. 13) The square wave is formed from the sine wave output of the oscillator section. The sine wave is fed to the grid circuit of V3 (left-half), where grid limiting occurs. This is due to the flow of grid current through R19 on the positive half-cycles, causing a voltage drop across R19 opposing the original signal voltage. As this opposing voltage increases with increasing positive signal, clipping occurs and the waveform at the grid is as shown. While the grid waveform is independent of cathode-plate conduction through the tube, the plate waveform is not. As the grid voltage dips below the cut-off point on the negative half-cycles, cut-off limiting occurs and the negative half of the plate waveform is flattened. The right half of V3 follows the plate of the left half. In this section, the rounded bottom of the wave is clipped, and the resulting square wave amplified. The squareness of the wave is increased in both sections of the tube due to the non-linear tube characteristic.

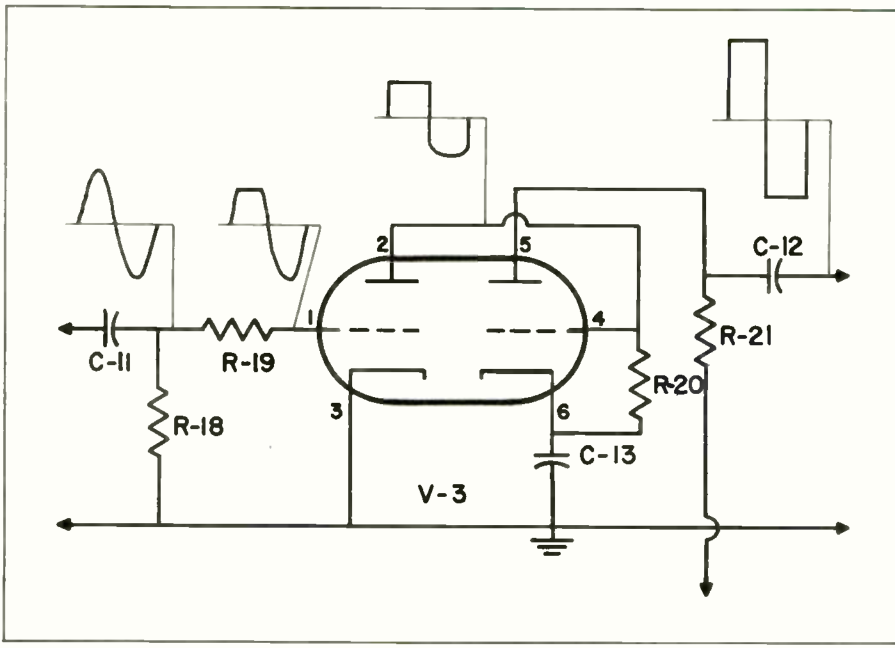


FIG. 13

THE CATHODE FOLLOWER OUTPUT CIRCUIT: (See Fig. 14) In this circuit, the voltage applied to the grid of tube, V4, varies the current through the tube, which in turn varies the voltage across the total cathode resistor (R24 and R25). The output voltage is taken out through the large capacitor, C15, which presents a very low impedance over the entire frequency spectrum. The cathode resistance is split into R24 and R25 to provide the proper bias.

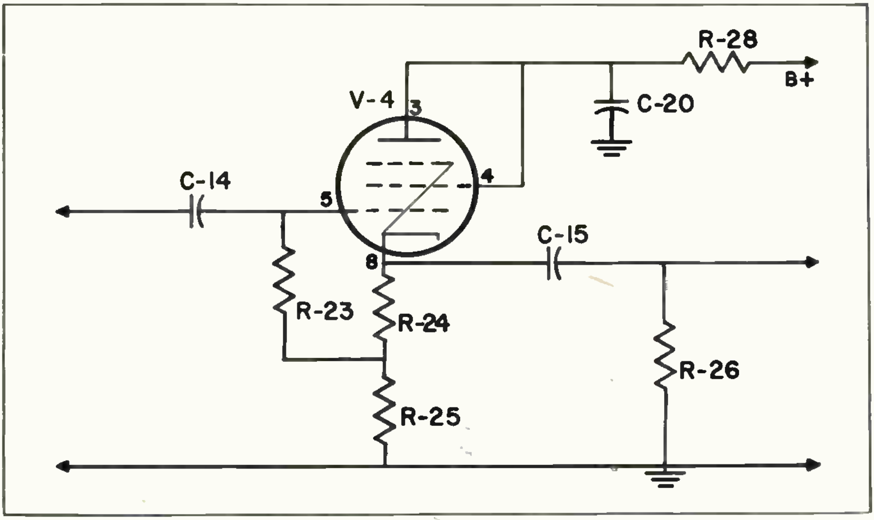


FIG. 14

THE POWER SUPPLY: The power supply is a conventional full wave rectifier circuit, employing a 6X5 tube (V5) and a pi filter consisting of a choke, L1, and two electrolytic capacitors, C16 and C17. This LC network effectively filters the d-c voltage output of the rectifier. The +B voltages for the first oscillator tube, V1, and the cathode follower tube, V4, are additionally filtered by RC circuits. R27 and C18 form an RC filter for V1, and R28 and C19 form an RC filter for V4.

MAINTENANCE

CALIBRATION: The Model 377 is extremely stable. However, after a long period of use, it may require re-calibration due to aging of the components. The accuracy may be readily restored by using one of the methods below. Re-calibration will also be necessary whenever tubes or other components are replaced. Fig. 15 shows the locations of trimmer C1, pot R9, and the tubes.

The A-C Voltmeter method is satisfactory for general use of the instrument. The Oscilloscope method is preferable, however, as it gives better accuracy. The Frequency Standard method is necessary for work that requires very accurate knowledge of the frequency.

1. A-C VOLTMETER METHOD: This method requires only an a-c voltmeter, preferably one with 1000 ohms/volt sensitivity or more. The procedure is as follows: a) Connect a 1000 ohm resistor across the output terminals of the Audio Generator. b) Connect the a-c voltmeter across the resistor. c) Set the BAND switch at band B and the frequency dial at 200 c.p.s. d) Turn the AMPL. control to the maximum clockwise position. e) Adjust pot R9 for a reading between 10.5 and 11 volts(r.m.s.) on the meter. f) Turn the frequency dial knob to 2 Kc. g) Loosen or tighten the adjustment screw on

trimmer C1 with an insulated alignment tool until the voltage read on the meter is equal to the voltage read when the frequency dial knob was set at 200 c.p.s.

The instrument is now calibrated. As a check, turn the frequency dial knob back to 200 c.p.s., observing the meter as you do so. The voltage should be nearly constant over the entire frequency range.

2. OSCILLOSCOPE METHOD: This method requires an oscilloscope with a 60 cycle test output and an a-c voltmeter. The procedure is as follows: a) Adjust pot R9 as described in steps a, b, c, d, and e of the A-C Voltmeter method above. b) After pot R9 has been adjusted for a reading between 10 and 11 volts, disconnect the a-c voltmeter (leaving the 1000 ohm resistor). c) Connect the output of the Audio Generator to the vertical input terminals of the 'scope. d) Connect the 60 cycle test terminals of the 'scope to the horizontal input terminals. e) Set the BAND switch of the Audio Generator at band A, and turn the frequency dial knob to 180 c.p.s. f) Adjust the 'scope controls for roughly equal deflections on each axis. g) Loosen or tighten the adjustment screw on trimmer C1 with an insulated alignment tool until the Lissajous figure shown in Fig. 3b (for 3:1 ratio) appears stationary on the screen.

The instrument is now calibrated. As a check, turn the frequency dial knob to 20 c.p.s. The Lissajous pattern shown in Fig. 3e should appear on the screen. Turn the frequency dial knob to 60 c.p.s. One of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) should be obtained.

3. FREQUENCY STANDARD METHOD: This method requires either a standard audio generator with known accuracy or a fixed frequency standard. Before calibration, allow the Model 377 to heat up for at least thirty minutes. The calibration procedure is the same as described in the OSCILLOSCOPE method above. Instead of the 60 cycle test signal, however, the standard is connected to the horizontal plates of the 'scope.

If a standard generator is used, set it at a frequency of 2 Kc. Set the BAND switch of the Model 377 at band B, and the frequency dial knob at 2 Kc. Adjust the trimmer, C1, until one of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) appears stationary on the screen. The Model 377 is now calibrated. As a check, adjust the standard generator and the Model 377 to equal frequencies on their respective dials at two other points in band B and three points in each of the remaining bands. One of the Lissajous figures for 1:1 ratio should appear on the screen at each point, allowing for the specified accuracy of Model 377.

If a fixed frequency standard is used, set the Model 377 at a nominal frequency near the high end of band B that is in the ratio of a whole number or a simple fraction to the fixed standard frequency. Adjust the trimmer, C1, until the appropriate Lissajous figure appears stationary on the screen. The instrument is now calibrated. Check at least two other points on band B and three other points on each of the remaining bands by means of the appropriate Lissajous figures.

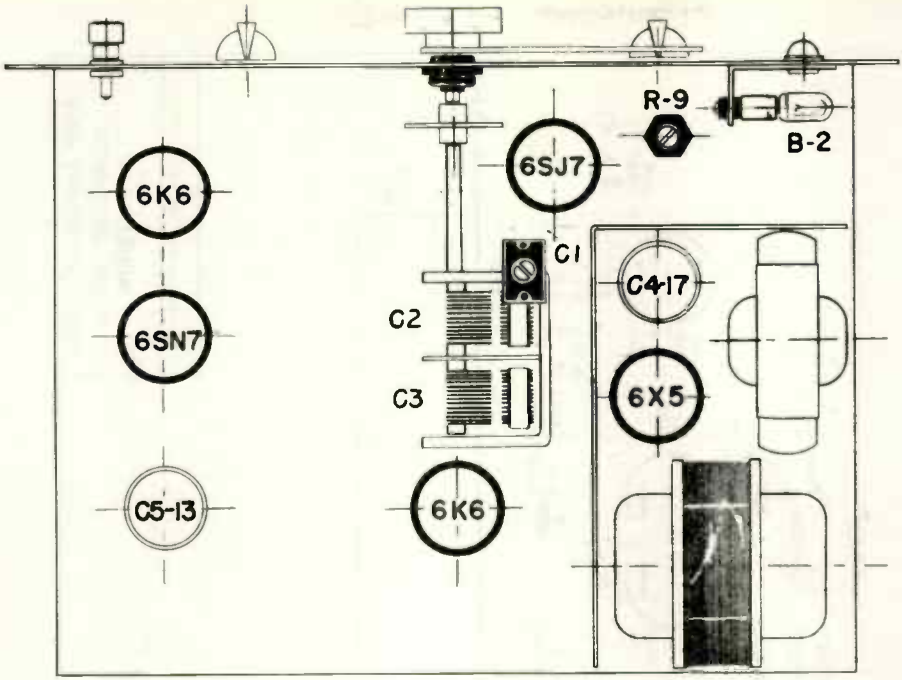


FIG. 15

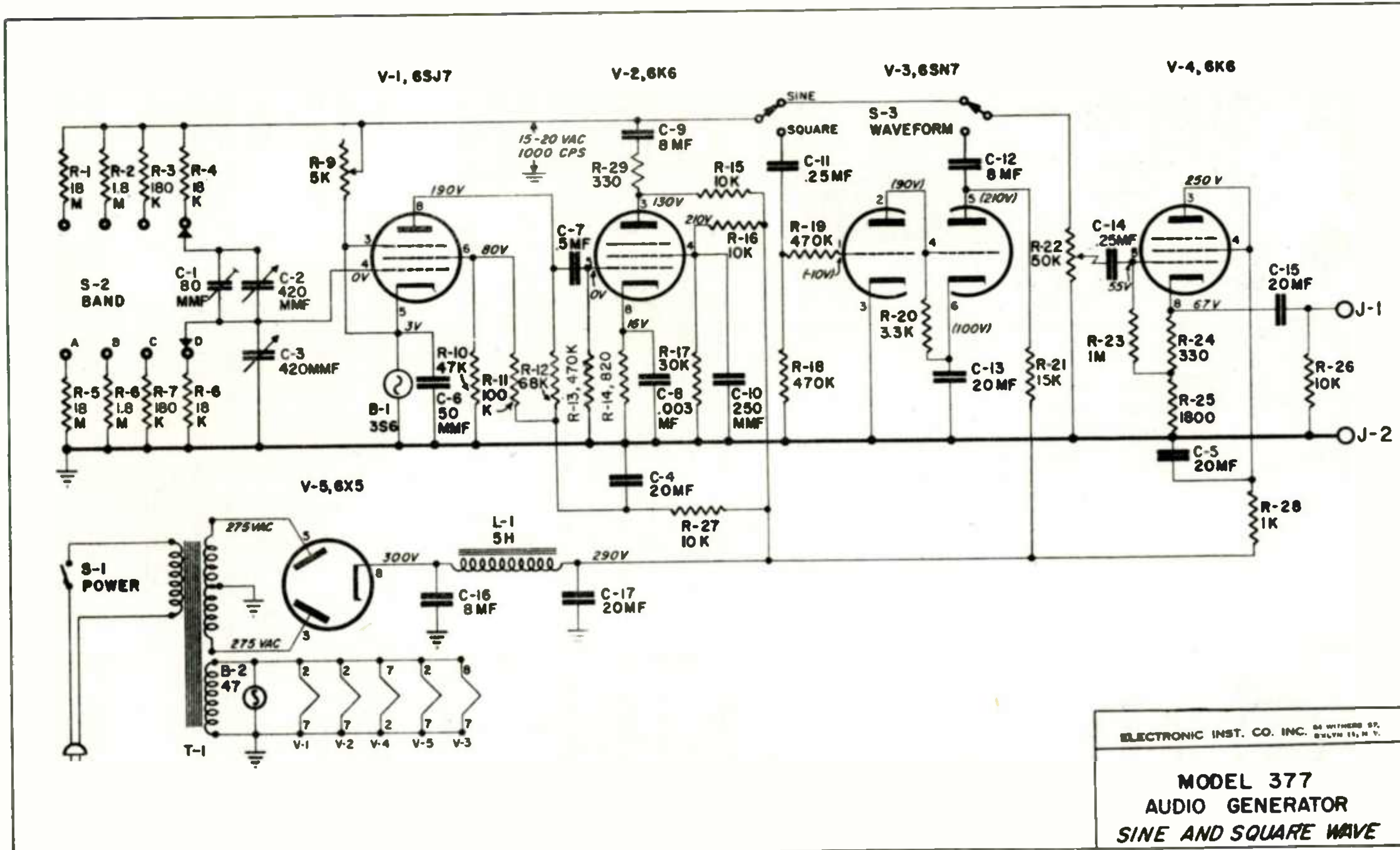
LAMP REPLACEMENT: The three watt lamp, B1, is never lit up in normal operation as it is operated below the level necessary for incandescence. As a result, it should have extremely long life. If, however, it becomes necessary to replace the lamp, it is required to check the a-c voltage from the arm of R9 to ground with the new lamp in place. This a-c voltage should be between 15 and 20 volts (r.m.s.), as measured with a high impedance vacuum-tube voltmeter, when the Audio Generator is tuned to 1000 c.p.s. If the voltage is not within this range, correct it by adjustment of pot R9. If the voltage cannot be brought within 15 to 20 volts with the new lamp in place, try another lamp instead.

INTERMITTENT OUTPUT: If the output is intermittent, check to see if the three watt lamp, B1, is flashing also. If it is, check for a short in the main tuning condenser. Clear out the short, but be careful not to bend the plates.

DISTORTION: Excessive distortion may result from a bad tube, a leaky coupling capacitor, an open by-pass capacitor, a defective electrolytic capacitor, low +B voltage, or too much output from the oscillator section of the circuit.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble is not apparent, you may return it to the EICO repair department where it will be repaired for a nominal charge.



ELECTRONIC INST. CO. INC.

MODEL 377
AUDIO GENERATOR
SINE AND SQUARE WAVE

INSTRUCTION MANUAL FOR

ELECTRONIC INSTRUMENT CO., Inc.

84 WITHERS STREET, BROOKLYN 11, N. Y.

EICO
Laboratory Precision at lowest cost

INSTRUCTION MANUAL

Model 950B

ELECTRONIC INSTRUMENT CO., Inc.   84 Withers Street, Brooklyn, N. Y.

general description

The Model 950-B is a highly flexible ac-powered bridge which measures capacitance in the range from 10 mmf to 5000 mf and resistance from 0.5 Ω to 500 MΩ on direct reading scales, employing an electron-ray ("magic eye") tube as a visual null indicator. Measurement of resistance, capacitance, and inductance by comparison with an external complementary standard is also possible, in which case a special ratio scale is read. An invaluable feature for service work is a dual-sensitivity leakage test employing a built-in source of polarizing voltage, continuously variable from 0 to 500 volts dc. The high sensitivity leakage test is used for testing paper, mica, and ceramic capacitors and the low sensitivity test for electrolytic capacitors. The electron-ray tube is the leakage indicator in both tests. In addition, this instrument provides direct power factor measurement on the higher capacity ranges in which electrolytics are measured. The Model 950-B, by the nature and accuracy of its testing and measurement facilities, will be found extremely valuable in the servicing of TV, fm-am radio, and other electronic equipment.

specifications

Capacity: 4 ranges	10 mmf - 5000 mmf
	0.001 mf - 0.5 mf
	0.1 mf - 50 mf
	50 mf - 5000 mf
Resistance: 4 ranges	0.5 Ω - 500 Ω
	50 Ω - 50,000 Ω
	5000 Ω - 5 MΩ
	5 MΩ - 500 MΩ
Comparator: 1 range	ratio from 0.05 to 20 (400 to 1)
DC Polarizing Voltage: (for leakage test)..	0-500 volts continuously variable
Power Factor: 1 range	0-80%
Tube Complement:	1-1629, 1-6X5
Power Supply:	transformer operated half-wave rect.
Power Requirements:	105-125 volts AC, 50/60 cps
Overall Dimensions:	8" high, 10" wide, 4 3/4" deep
Weight:	10 lbs.

operation

PRELIMINARY: Plug the line cord into an ac outlet supplying 105-125 volts, 50/60 cps. Rotate the POWER FACTOR control clockwise from the "AC-OFF" position. Allow a 1-minute warm-up period, during which the electron-ray tube will slowly attain its characteristic green glow.

CONNECTIONS: The component to be measured or tested, whether it be resistive, capacitive, or inductive, is always connected to the right-hand binding post. In the case of electrolytic capacitors, the positive lead must go to the plus binding post and the negative lead to the minus binding post. In comparison measurement, the standard component is connected to the left-hand binding posts, and, as usual, the unknown component is connected to the right-hand binding posts. If the component to be measured is connected in a circuit, it will be necessary to disconnect at least one side from the circuit so that the measurement will not be affected by other circuit components. To measure an extremely small capacitor, it will be necessary to remove it from the circuit entirely and connect it directly across the binding posts.

READING COMPONENT VALUES: In all component value measurements, whether made on the direct reading resistive and capacitive ranges or on the comparator range, the reading is made by setting the RANGE switch to the range including the expected value (comparator has only one range) and rotating the pointer knob to the point on the dial at which the bridge is balanced.

Balance is indicated as follows: When the bridge is far from balance, the entire target area of the electron-ray tube glows green with even a narrow, extra-bright sector resulting from "overlapping". As the pointer knob approaches the balance point, first the "overlapping disappears and is replaced by a dark shadow sector. The closer the pointer knob approaches the balance point, the wider the shadow sector grows. If the balance point is passed the shadow sector will narrow down again. The position of the pointer knob at which the shadow angle is maximum is the balance point.

On the two highest capacitance ranges the power factor potentiometer is switched into the standard capacitor arm of the bridge to permit balancing of the internal series resistance frequently present in electrolytic capacitors. The "POWER FACTOR" knob must therefore be manipulated together with the pointer knob in order to achieve perfect bridge balance. The power factor control should be set at "0" while the pointer is rotated to obtain a capacitive balance. If the internal series resistance of the capacitor being measured is appreciable, the shadow angle at capacitive balance will be less than normal. When this occurs, the power factor control is rotated clockwise until the shadow angle reaches its normal maximum. The % power factor of the capacitor may be read on the power factor dial.

NOTE: Power factor is a measure of power dissipation in a capacitor due to its effective internal series resistance. In filter applications, power factor reduces the measured capacity as follows: At 20% p.f., C effective is 98% of C measured; at 30% p.f., C effective is 95% of C measured; at 50% p.f., C effective is 87% of C measured.

If the unknown capacitance or resistance is smaller than the minimum of the range used, either balance will be obtained in the off-scale sector counter-clockwise from the lowest value marked on the dial or the shadow angle will widen to maximum only as the pointer knob approaches maximum counter-clockwise rotation (except on the expanded ranges). If the unknown capacitor is open or if the unknown resistor is shorted, the last-mentioned indication will be obtained even when the RANGE switch is set at the lowest capacitance or resistance range.

If the unknown resistance or capacitance is larger than the maximum of the range used, either balance will be obtained in the off-scale sector clockwise from the largest value marked on the dial or the shadow angle will widen to maximum only as the pointer knob approaches maximum clockwise rotation. If the unknown capacitor is shorted or if the unknown resistor is open, the last-mentioned indication will be obtained even when the RANGE switch is set at the highest capacitance or resistance range.

NOTE: To obtain the correct value of extremely small capacitors, the value of the distributed wiring capacity for your particular instrument should be subtracted from the reading obtained. This compensation is required in practically all instruments of this type. To measure the distributed wiring capacity, set the RANGE switch at the lowest capacity range ("10 mmfd - 5000 mmfd") and adjust the pointer knob carefully for exact bridge balance with nothing connected to the instrument terminals. You will have to observe the electron-ray tube very closely to determine just where the maximum shadow angle occurs. If the distributed wiring capacity readings is less than 10 mmf (off-scale) it can be safely ignored and no compensation need be made.

Interpretation of the reading on the ratio scale when the instrument is used as a comparator bridge depends upon the type of components being compared. When inductances or resistances are being compared, divide the known value of the standard by the reading on the ratio dial to obtain the value of the unknown. When capacitances are being compared, multiply the known value of the standard by the reading on the ratio dial to obtain the value of the unknown. It is unnecessary to use the comparator range for measurement of resistances and capacitances falling into the direct measurement range of the instrument. However, for resistances and capacitors outside the direct measurement range and for certain chokes, transformers, speakers, and coils, the comparator method of measurement is very useful.

LEAKAGE TESTS

To test for leakage in paper, mica, or ceramic capocitors, set the RANGE switch at the "PAPER-MICA TEST" position. To test for leakage in electrolytic capacitors set the RANGE switch at the "ELECTROLYTIC TEST" position. In both tests, start with the "VOLTAGE" control at "0". The capacitor in both tests is connected across the right-hand binding posts just as in capacitance measurements. Be certain that the positive lead of an electrolytic capacitor is connected to the binding post marked plus and the negative lead to the binding post marked minus. Otherwise, not only will the leakage test have no value, but the electrolytic may be seriously damaged. Observe the electron-ray tube and note that the shadow angle is at maximum, which is the "normal" or "no-leakage" indication in the leakage tests. Now turn the "VOLTAGE" control from "0" to the rated dc working voltage of the capacitor. The shadow angle should contract instantaneously as the capacitor charges and then slowly expand. If the shadow angle completely disappears and does not reappear, the capacitor is excessively leaky. The shadow angle need not expand to the maximum as before in order for the capacitor to check good. As these tests are very sensitive, a little leakage in capacitors with values above .1 mfd may result in only a small shadow angle reappearing. This is normal with a good capacitor and the reappearance of even a very small shadow angle means that the capacitor is good. Only complete failure of the shadow angle to reappear indicate an excessively leaky capacitor. CAUTION: Discharge the capacitor before disconnection from the instrument terminals by turning the "VOLTAGE" control down to "0".

Note on Leakage Testing of Electrolytic Capacitors: Initial leakage current in an electrolytic capacitor is a function of shelf life; it does not show the condition of the capacitor. When making the leakage test, enough time must be allowed for the leakage current to reach the normal value. The instructions of the capacitor manufacturers are to measure the leakage current of the capacitor at the rated dc voltage, after the rated dc voltage has been applied to the capacitor for five minutes plus one minute for each month of shelf storage.

circuit description

The operation of the Model 950-B may be best understood by examining the circuit formed at each position of the range switch. In each of the bridge circuits P1 varies the resistance in two arms. Capacitor C5 or C6, resistor R10, and the electron-ray tube V2 compose the null indicating circuit. The 54 volt winding is the secondary winding of the power transformer that supplys the ac power to operate the bridge. R1 is a current limiting resistor.

The B plus voltage required to power the electron-ray indicator and the negative dc voltage required for leakage testing of capacitors are obtained from the 6X5 tube (V1) connected as a half-wave rectifier, in conjunction with the high voltage secondary winding of the power transformer and the filter and voltage divider networks composed of R8, R7, P3, C1 and C9.

NOTE: The electron-ray indicator is preferable to headphone or a meter since it may be used without disturbance from external noises and is capable of withstanding substantial overloading without damage.

Simplified schematic diagrams of the Model 950-B circuit at each position of the range switch are given below.

Fig. 1. Bridge circuit for "10 mmfd - 5000 mmfd" range (C2) and ".001 mfd-.5 mfd" range (C3).
Fig. 2. Bridge circuit for ".1 mfd - 50 mfd" range. P2 is required to balance the internal series resistance frequently present in electrolytic capacitors and is calibrated in % power factor.
Fig. 3. Bridge circuit for "50 mfd - 5000 mfd" EXPanded range. R2 exponds capacitance measurement range as compared to circuit of Fig. 2.
Fig. 4. Bridge circuit for ".5Ω - 500Ω" range (R4), "50Ω - 50,000Ω" range (R5), and "5000Ω - 5MΩ" range (R6).
Fig. 5. Bridge circuit for "5MΩ - 500MΩ" EXPanded range. R2 expands resistance measurement range as compared to circuit of Fig. 4.
Fig. 6. Bridge circuit for "COMPARATOR" range.
Fig. 7. Leakage check circuit in "PAPER-MICA TEST" position. R9 slows down charging process so that electron-ray tube action will not be too fast for detection by the operator.
Fig. 8. Leakage check circuit in "ELECTROLYTIC TEST" position. Note that R11, 2.2 KΩ, provides reduced electron-ray tube sensitivity as compared to the circuit of Fig. 7.

replacement parts list

Stock#	Sym.	Description	Am't.	Stock#	Sym.	Description	Am't.
23006	C1	cap., elec 8 mfd-525 V..	1	11002	R4	res., 20Ω, 1/2 W, 1%.	1
21500	C2	cap., 200 mmf, prec. ..	1	11011	R5	res., 2KΩ, 1/2 W, 1%.	1
20500	C3	cap., .02 mf, prec. ..	1	11026	R6	res., 200KΩ, 1/2 W, 1%.	1
20501	C4	cap., 2 mf, prec.	1	10803	R7	res., 3.3KΩ, 1 W ...	1
20000	C5,6,7	cap., .01 mf, 400 V ...	3	10848	R8	res., 68KΩ, 1 W	1
20015	C8	cap., .25 mf-600 V ...	1	10027	R9	res., 270KΩ, 1/2 W ...	1
23008	C9	cap., elec 4 mfd-250 V..	1	10037	R10	res., 10MΩ, 1/2 W ...	1
17000	P1	pot., 10KΩ	1	10818	R11	res., 2.2KΩ, 1 W	1
18007	P2	pot., 1KΩ w/SPST	1	10028	R12	res., 470K, 1/2 W ...	1
19005	P3	pot., 100KΩ, 4 W	1	60030	S1	switch, range	1
10752	R1	res., 500Ω, 4 W	1	30005	PT1	transformer, power ...	1
11027	R2	res., 250K, 1/2 W, 1%.	1	90009	V1	tube, 6X5	1
10030	R3	res., 1 MΩ. 1/2 W,....	1	90015	V2	tube, 1629	1

NOTE: If your instrument fails to function properly and the cause of trouble is not apparent, you may reutrn it to the EICO repair department where it will be repaired at a charge of $3.50 plus the cost of parts. If possible, ship by Railway Express. Return shipment will be made express collect.

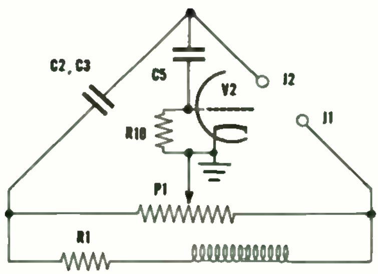


Fig. 1

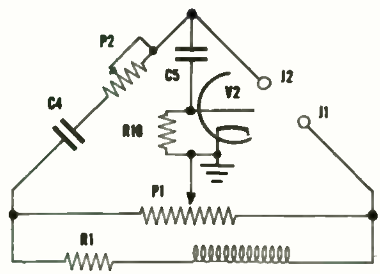


Fig. 2

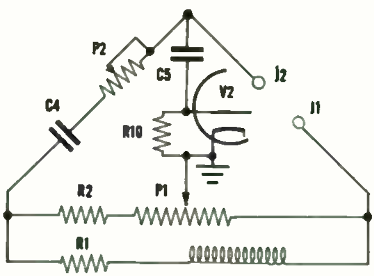


Fig. 3

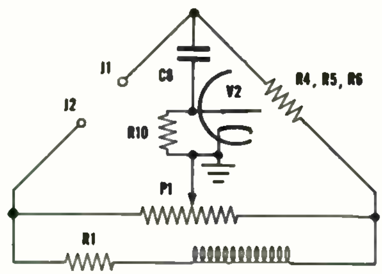


Fig. 4

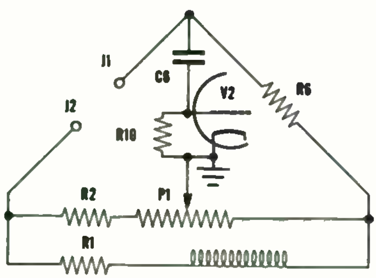


Fig. 5

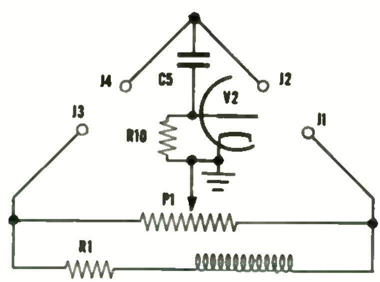


Fig. 6

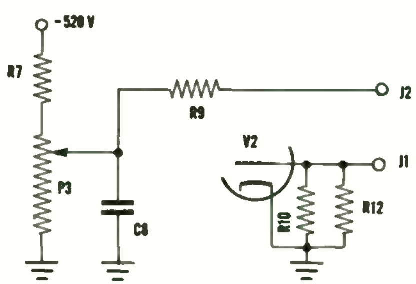


Fig. 7

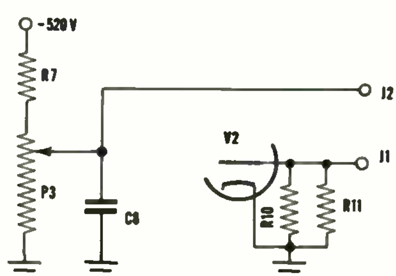
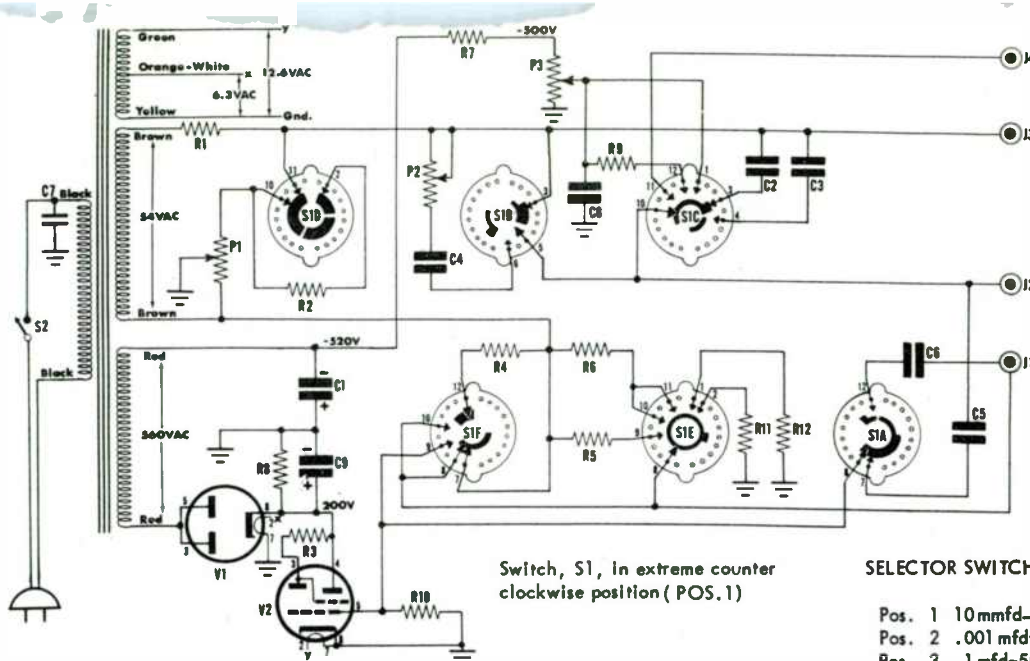


Fig. 8



Switch, S1, in extreme counter clockwise position (POS.1)

SELECTOR SWITCH POSITIONS

Pos. 1	10 mmfd–5000 mmfd
Pos. 2	.001 mfd–.5 mfd
Pos. 3	.1 mfd–50 mfd
Pos. 4	50 mfd–5000 mfd
Pos. 5	.5Ω – 500Ω
Pos. 6	50Ω – 50KΩ
Pos. 7	5KΩ – 5MΩ
Pos. 8	5MΩ – 500MΩ
Pos. 9	Comparator
Pos. 10	Paper-Mica Test
Pos. 11	Electrolytic Test

Sym.	Description	Sym.	Description	Sym.	Description
C1	cap., elec 8 mfd-525 V	P3	pot., 100KΩ, 4W	R9	res., 270KΩ, 1/2 W
C2	cap., 200 mmf, prec.	R1	res., 500Ω, 4 W	R10	res., 10 MΩ, 1/2 W
C3	cap., .02 mf, prec.	R2	res., 250K, 1/2 W, 1%	R11	res., 2.2KΩ, 1W
C4	cap., 2 mf, prec.	R3	res., 1 MΩ, 1/2 W	R12	res., 470K, 1/2 W
C5,6,7	cap., .01 mf-400V	R4	res., 20Ω, 1/2 W, 1%		
C8	cap., .25 mf-600 V	R5	res., 2KΩ, 1/2 W, 1%	S1	switch, range
C9	cap., elec 4 mfd-250 V	R6	res., 200KΩ, 1/2W, 1%	S2	switch, SPST, p/o P2
P1	pot., 10KΩ	R7	res., 3.3KΩ, 1W	V1	tube, 6X5
P2	pot., 1KΩ w/SPST	R8	res., 68KΩ, 1W	V2	tube, 1629

MODEL 950B
RESISTANCE-CAPACITANCE-COMPARATOR BRIDGE

ELECTRONIC INSTRUMENT CO., Inc.
84 Withers Street, Brooklyn, N. Y.

EICO

INSTRUCTION MANUAL FOR

EICO

EICO ELECTRONIC INSTRUMENT CO., Inc.

33-00 NORTHERN BLVD. LONG ISLAND CITY 1, N. Y.

EICO
Laboratory Precision at lowest cost

INSTRUCTION

MANUAL

Model 950B

ELECTRONIC INSTRUMENT CO., Inc.

general description

The Model 950-B is a highly flexible ac-powered bridge which measures capacitance in the range from 10 mmf to 5000 mf and resistance from 0.5 Ω to 500 MΩ on direct reading scales, employing an electron-ray ("magic eye") tube as a visual null indicator. Measurement of resistance, capacitance, and inductance by comparison with an external complementary standard is also possible, in which case a special ratio scale is read. An invaluable feature for service work is a dual-sensitivity leakage test employing a built-in source of polarizing voltage, continuously variable from 0 to 500 volts dc. The high sensitivity leakage test is used for testing paper, mica, and ceramic capacitors and the low sensitivity test for electrolytic capacitors. The electron-ray tube is the leakage indicator in both tests. In addition, this instrument provides direct power factor measurement on the higher capacity ranges in which electrolytics are measured. The Model 950-B, by the nature and accuracy of its testing and measurement facilities, will be found extremely valuable in the servicing of TV, fm-am radio, and other electronic equipment.

specifications

Capacity: 4 ranges	10 mmf - 5000 mmf
	0.001 mf - 0.5 mf
	0.1 mf - 50 mf
	50 mf - 5000 mf
Resistance: 4 ranges	0.5 Ω - 500 Ω
	50 Ω - 50,000 Ω
	5000 Ω - 5 MΩ
	5 MΩ - 500 MΩ
Comparator: 1 range	ratio from 0.05 to 20 (400 to 1)
DC Polarizing Voltage: (for leakage test)..	0-500 volts continuously variable
Power Factor: 1 range	0-80%
Tube Complement:	1-1629, 1-6X5
Power Supply:	transformer operated half-wave rect.
Power Requirements:	105-125 volts AC, 50/60 cps
Overall Dimensions:	8" high, 10" wide, 4 3/4" deep
Weight:	10 lbs.

operation

PRELIMINARY: Plug the line cord into an ac outlet supplying 105-125 volts, 50/60 cps. Rotate the POWER FACTOR control clockwise from the "AC-OFF" position. Allow a 1-minute warm-up period, during which the electron-ray tube will slowly attain its characteristic green glow.

CONNECTIONS: The component to be measured or tested, whether it be resistive, capacitive, or inductive, is always connected to the right-hand binding post. In the case of electrolytic capacitors, the positive lead must go to the plus binding post and the negative lead to the minus binding post. In comparison measurement, the standard component is connected to the left-hand binding posts, and, as usual, the unknown component is connected to the right-hand binding posts. If the component to be measured is connected in a circuit, it will be necessary to disconnect at least one side from the circuit so that the measurement will not be affected by other circuit components. To measure an extremely small capacitor, it will be necessary to remove it from the circuit entirely and connect it directly across the binding posts.

READING COMPONENT VALUES: In all component value measurements, whether made on the direct reading resistive and capacitive ranges or on the comparator range, the reading is made by setting the RANGE switch to the range including the expected value (comparator has only one range) and rotating the pointer knob to the point on the dial at which the bridge is balanced.

Balance is indicated as follows: When the bridge is far from balance, the entire target area of the electron-ray tube glows green with even a narrow, extra-bright sector resulting from "overlapping". As the pointer knob approaches the balance point, first the "overlapping disappears and is replaced by a dark shadow sector. The closer the pointer knob approaches the balance point, the wider the shadow sector grows. If the balance point is passed the shadow sector will narrow down again. The position of the pointer knob at which the shadow angle is maximum is the balance point.

On the two highest capacitance ranges the power factor potentiometer is switched into the standard capacitor arm of the bridge to permit balancing of the internal series resistance frequently present in electrolytic capacitors. The "POWER FACTOR" knob must therefore be manipulated together with the pointer knob in order to achieve perfect bridge balance. The power factor control should be set at "0" while the pointer is rotated to obtain a capacitive balance. If the internal series resistance of the capacitor being measured is appreciable, the shadow angle at capacitive balance will be less than normal. When this occurs, the power factor control is rotated clockwise until the shadow angle reaches its normal maximum. The % power factor of the capacitor may be read on the power factor dial.

NOTE: Power factor is a measure of power dissipation in a capacitor due to its effective internal series resistance. In filter applications, power factor reduces the measured capacity as follows: At 20% p.f., C effective is 98% of C measured; at 30% p.f., C effective is 95% of C measured; at 50% p.f., C effective is 87% of C measured.

If the unknown capacitance or resistance is smaller than the minimum of the range used, either balance will be obtained in the off-scale sector counterclockwise from the lowest value marked on the dial or the shadow angle will widen to maximum only as the pointer knob approaches maximum counterclockwise rotation (except on the expanded ranges). If the unknown capacitor is open or if the unknown resistor is shorted, the last-mentioned indication will be obtained even when the RANGE switch is set at the lowest capacitance or resistance range.

If the unknown resistance or capacitance is larger than the maximum of the range used, either balance will be obtained in the off-scale sector clockwise from the largest value marked on the dial or the shadow angle will widen to maximum only as the pointer knob approaches maximum clockwise rotation. If the unknown capacitor is shorted or if the unknown resistor is open, the last-mentioned indication will be obtained even when the RANGE switch is set at the highest capacitance or resistance range.

NOTE: To obtain the correct value of extremely small capacitors, the value of the distributed wiring capacity for your particular instrument should be subtracted from the reading obtained. This compensation is required in practically all instruments of this type. To measure the distributed wiring capacity, set the RANGE switch at the lowest capacity range ("10 mmfd - 5000 mmfd") and adjust the pointer knob carefully for exact bridge balance with nothing connected to the instrument terminals. You will have to observe the electron-ray tube very closely to determine just where the maximum shadow angle occurs. If the distributed wiring capacity readings is less than 10 mmf (off-scale) it can be safely ignored and no compensation need be made.

Interpretation of the reading on the ratio scale when the instrument is used as a comparator bridge depends upon the type of components being compared. When inductances or resistances are being compared, divide the known value of the standard by the reading on the ratio dial to obtain the value of the unknown. When capacitances are being compared, multiply the known value of the standard by the reading on the ratio dial to obtain the value of the unknown. It is unnecessary to use the comparator range for measurement of resistances and capacitances falling into the direct measurement range of the instrument. However, for resistances and capacitors outside the direct measurement range and for certain chokes, transformers, speakers, and coils, the comparator method of measurement is very useful.

LEAKAGE TESTS

To test for leakage in paper, mica, or ceramic capacitors, set the RANGE switch at the "PAPER-MICA TEST" position. To test for leakage in electrolytic capacitors set the RANGE switch at the "ELECTROLYTIC TEST" position. In both tests, start with the "VOLTAGE" control at "0". The capacitor in both tests is connected across the right-hand binding pasts just as in capacitance measurements. Be certain that the positive lead of an electrolytic capacitor is connected to the binding post marked plus and the negative lead to the binding post marked minus. Otherwise, not only will the leakage test have no value, but the electrolytic may be seriously damaged. Observe the electron-ray tube and note that the shadow angle is at maximum, which is the "normal" or "no-leakage" indication in the leakage tests. Now turn the "VOLTAGE" control from "0" to the rated dc working voltage of the capacitor. The shadow angle should contract instantaneously as the capacitor charges and then slowly expand. If the shadow angle completely disappears and does not reappear, the capacitor is excessively leaky. The shadow angle need not expand to the maximum as before in order for the capacitor to check good. As these tests are very sensitive, a little leakage in capacitors with values above .1 mfd may result in only a small shadow angle reappearing. This is normal with a good capacitor and the reappearance of even a very small shadow angle means that the capacitor is good. Only complete failure of the shadow angle to reappear indicate an excessively leaky capacitor. CAUTION: Discharge the capacitor before disconnection from the instrument terminals by turning the "VOLTAGE" control down to "0".

Note on Leakage Testing of Electrolytic Capacitors: Initial leakage current in an electrolytic capacitor is a function of shelf life; it does not show the condition of the capacitor. When making the leakage test, enough time must be allowed for the leakage current to reach the normal value. The instructions of the capacitor manufacturers are to measure the leakage current of the capacitor at the rated dc voltage, after the rated dc voltage has been applied to the capacitor for five minutes plus one minute for each month of shelf storage.

circuit description

The operation of the Model 950-B may be best understood by examining the circuit formed at each position of the range switch. In each of the bridge circuits P1 varies the resistance in two arms. Capacitor C5 or C6, resistor R10, and the electron-ray tube V2 compose the null indicating circuit. The 54 volt winding is the secondary winding of the power transformer that supplys the ac power to operate the bridge. R1 is a current limiting resistor.

The B plus voltage required to power the electron-ray indicator and the negative dc voltage required for leakage testing of capacitors are obtained from the 6X5 tube (V1) connected as a half-wave rectifier, in conjunction with the high voltage secondary winding of the power transformer and the filter and voltage divider networks composed of R8, R7, P3, C1 and C9.

NOTE: The electron-ray indicator is preferable to headphone or a meter since it may be used without disturbance from external noises and is capable of withstanding substantial overloading without damage.

Simplified schematic diagrams of the Model 950-B circuit at each position of the range switch are given below.

Fig. 1. Bridge circuit for "10 mmfd - 5000 mmfd" range (C2) and ".001 mfd-.5 mfd" range (C3).

Fig. 2. Bridge circuit for ".1mfd - 50 mfd" range. P2 is required to balance the internal series resistance frequently present in electrolytic capacitors and is calibrated in % power factor.

Fig. 3. Bridge circuit for "50 mfd - 5000 mfd" EXPanded range. R2 expands capacitance measurement range as compared to circuit of Fig. 2.

Fig. 4. Bridge circuit for ".5 Ω - 500 Ω" range (R4), "50 Ω - 50,000 Ω" range (R5), and "5000 Ω - 5 MΩ" range (R6).

Fig. 5. Bridge circuit for "5 MΩ - 500 MΩ" EXPanded range. R2 expands resistance measurement range as compared to circuit of Fig. 4.

Fig. 6. Bridge circuit for "COMPARATOR" range.

Fig. 7. Leakage check circuit in "PAPER-MICA TEST" position. R9 slows down charging process so that electron-ray tube action will not be too fast for detection by the operator.

Fig. 8. Leakage check circuit in "ELECTROLYTIC TEST" position. Note that R11, 2.2 KΩ, provides reduced electron-ray tube sensitivity as compared to the circuit of Fig. 7.

replacement parts list

Stock#	Sym.	Description	Am't.
23006	C1	cap., elec 8 mfd-525 V..	1
21500	C2	cap., 200 mmf, prec. ..	1
20500	C3	cap., .02 mf, prec. ..	1
20501	C4	cap., 2 mf, prec.	1
20000	C5,6,7	cap., .01 mf, 400 V ...	3
20015	C8	cap., .25 mf-600 V ...	1
23008	C9	cap., elec 4 mfd-250 V..	1
17000	P1	pot., 10KΩ	1
18007	P2	pot., 1KΩ w/SPST	1
19005	P3	pot., 100KΩ, 4 W	1
10752	R1	res., 500 Ω, 4 W	1
11027	R2	res., 250K, 1/2 W, 1%.	1
10030	R3	res., 1 MΩ. 1/2 W,....	1
11002	R4	res., 20 Ω, 1/2 W, 1%.	1
11011	R5	res., 2KΩ, 1/2 W, 1%.	1
11026	R6	res., 200KΩ, 1/2 W, 1%.	1
10803	R7	res., 3.3KΩ, 1 W ...	1
10848	R8	res., 68KΩ, 1 W	1
10027	R9	res., 270KΩ, 1/2 W ...	1
10037	R10	res., 10 MΩ, 1/2 W ...	1
10818	R11	res., 2.2KΩ, 1 W	1
10028	R12	res., 470K, 1/2 W ...	1
60030	S1	switch, range	1
30005	PT1	transformer, power ...	1
90009	V1	tube, 6X5	1
90015	V2	tube, 1629	1

NOTE: If your instrument fails to function properly and the cause of trouble is not apparent, you may reutrn it to the EICO repair department where it will be repaired at a charge of $3.50 plus the cost of parts. If possible, ship by Railway Express. Return shipment will be made express collect.

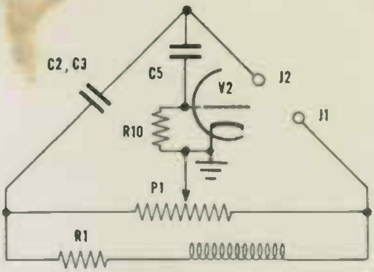


Fig. 1

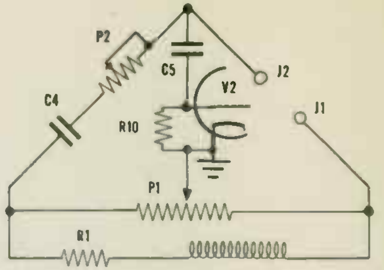


Fig. 2

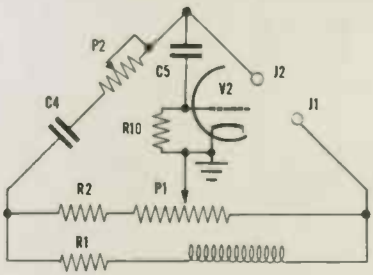


Fig. 3

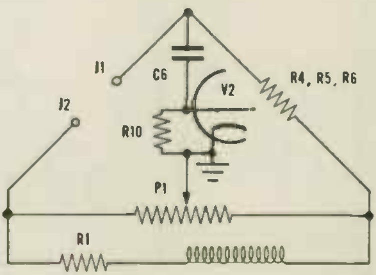


Fig. 4

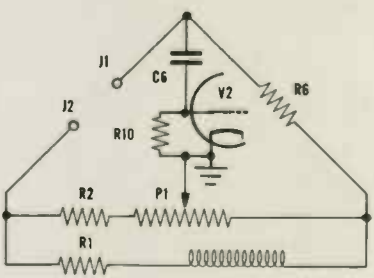


Fig. 5

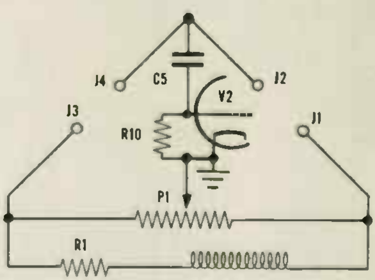


Fig. 6

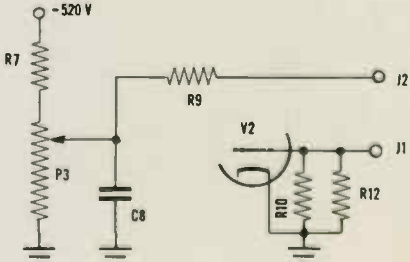


Fig. 7

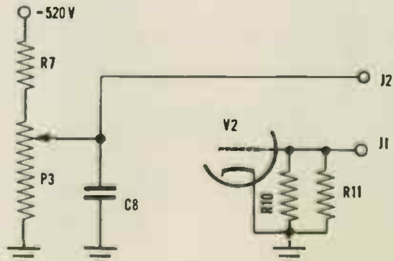
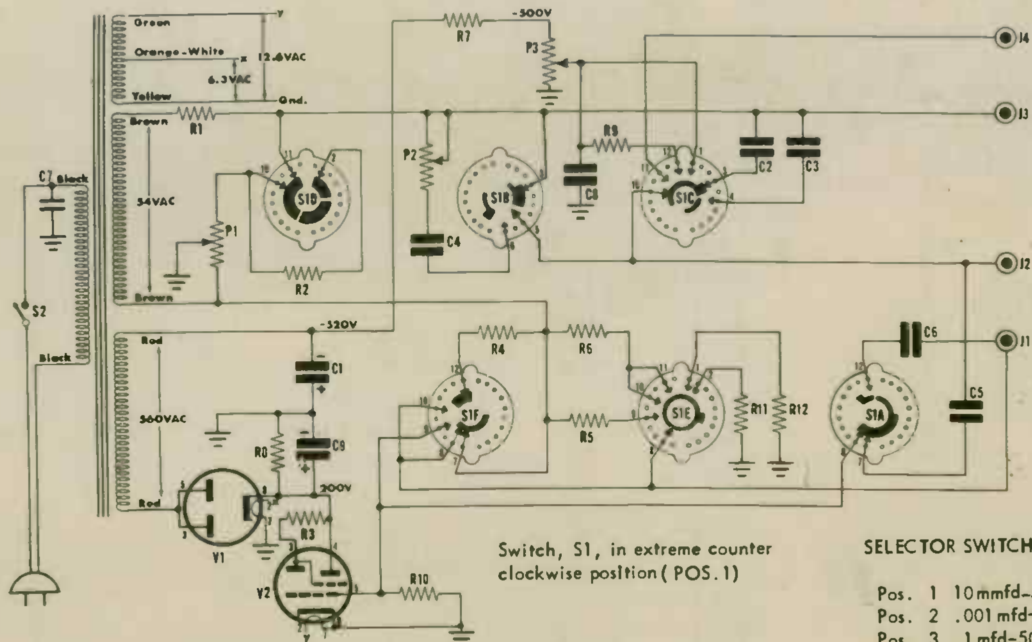


Fig. 8



Switch, S1, in extreme counter clockwise position (POS.1)

SELECTOR SWITCH POSITIONS

- Pos. 1 10 mmfd-5000 mmfd
- Pos. 2 .001 mfd-.5 mfd
- Pos. 3 .1 mfd-50 mfd
- Pos. 4 50 mfd-5000 mfd
- Pos. 5 .5 Ω - 500 Ω
- Pos. 6 50 Ω - 50KΩ
- Pos. 7 5KΩ - 5 MΩ
- Pos. 8 5 MΩ - 500 MΩ
- Pos. 9 Comparator
- Pos. 10 Paper-Mica Test
- Pos. 11 Electrolytic Test

Sym.	Description	Sym.	Description	Sym.	Description
C1	cap., elec 8 mfd-525 V	P3	pot., 100KΩ, 4W	R9	res., 270KΩ, 1/2 W
C2	cap., 200 mmf, prec.	R1	res., 500 Ω, 4 W	R10	res., 10 MΩ, 1/2 W
C3	cap., .02 mf, prec.	R2	res., 250K, 1/2 W, 1%	R11	res., 2.2KΩ, 1W
C4	cap., 2 mf, prec.	R3	res., 1 MΩ, 1/2 W	R12	res., 470K, 1/2 W
C5,6,7	cap., .01 mf-400 V	R4	res., 20 Ω, 1/2 W, 1%		
C8	cap., .25 mf-600 V	R5	res., 2KΩ, 1/2 W, 1%	S1	switch, range
C9	cap., elec 4 mfd-250 V	R6	res., 200KΩ, 1/2W, 1%	S2	switch, SPST, p/o P2
P1	pot., 10KΩ	R7	res., 3.3KΩ, 1W	V1	tube, 6X5
P2	pot., 1KΩ w/SPST	R8	res., 68KΩ, 1W	V2	tube, 1629

MODEL 950B
RESISTANCE-CAPACITANCE-COMPARATOR BRIDGE

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INSTRUCTION MANUAL FOR

ELECTRONIC INSTRUMENT CO., Inc.

84 WITHERS STREET, BROOKLYN 11, N. Y.

INSTRUCTION MANUAL FOR

ELECTRONIC INSTRUMENT CO., Inc.

33-00 NORTHERN BLVD. LONG ISLAND CITY 1, N. Y.

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Laboratory Precision at lowest cost

INSTRUCTION MANUAL

Model 944

ELECTRONIC INSTRUMENT CO., Inc. 84 Withers Street, Brooklyn, N. Y.

general description

Operating on the grid-dip meter principle, the Model 944 Flyback Transformer, & Yoke Tester provides a short test that will reveal even one shorted turn in any TV flyback transformer or yoke. As an open winding will produce the same indication as a perfect winding on the short test, a continuity test is also provided.

The need for this instrument stems from the fact that even one or two shorted turns will absorb the energy normally developed in the magnetic field of a flyback transformer or yoke and make it defective. While this is a very common reason for flyback transformer failure, it has remained a difficult trouble to detect because the slight change of winding resistance due to a few shorted turns is entirely masked by the normal commerical tolerances on winding resistance (±20%). (Ohmmeter measurements are useful only when a winding is open or more than 20% of the turns are shorted.)

As a result actually replacing the flyback transformer with a new one, has been the only reliable way of checking this part. Not only is this a very time-consuming and difficult job, but as a general servicing procedure it requires either stocking a full line of replacements or purchasing a flyback transformer or yoke for a particular receiver without being sure that the transformer or yoke you are replacing is defective and therefore the cause of the trouble.

The Model 944 is not only expressly designed to deal with this problem completely and effectively, but to provide maximum ease of operation. All readings are made on a large 4 1/2", 50 ua meter with three separate "GOOD-BAD" scales for flyback transformer, yoke, and continuity testing. In addition, separate calibration points are provided on the meter scale for air core and iron core flybacks so that all types may be tested accurately with no extra operation required (such as inserting an iron core into an air core type flyback to boost the inductance). Entirely professional in both appearance and performance, yet extremely compact for easy portability, the Model 944 is a wise and necessary addition to any TV serviceman's equipment.

specifications

Electrical Specifications:

Oscillator Frequency .... approx. 600 cps interrupted 60 times per second

Test Voltage .... 100 rms v (short test); 60 rms v (cont. test)

Tube Complement 6K6

Meter .... 4 1/2" 50 ua - 2000Ω

Power Supply .... transformer operated from 105-125 volts AC, 50-60 cps line

Mechanical Specifications

Overall Dimensions .... 8 1/2" high, 5" wide, 5" deep

Weight .... 5 pounds

Cabinet .... steel, rub-proof grey wrinkle finish

Panel .... aluminum, satin finish, 2 color deep-etched

circuit description

The heart of the Model 944 Flyback Transformer & Yoke Tester is an oscillator circuit employing a 6K6 tube. The secondary winding of transformer T2 and capacitor C1 make up the tank circuit. The primary of transformer T2 functions as a feedback coil through which power taken from the line isolation transformer T1 is delivered to the oscillator. The isolation provided by T1 permits the instrument to be used safely on transformer-less or universal TV sets.

As the oscillator operates only during the positive half-cycles of the raw ac voltage which powers it, oscillation is interrupted 60 times a second to simulate the operating condition of a flyback transformer under pulsed conditions. This is desirable also because the abrupt potential changes across the winding under test will often expose an intermittent condition which might otherwise go undetected.

The frequency of oscillation is approximately 600 cps (with nothing connected across the test terminals) as determined by the secondary of T2, C1, and the time constant of R1 and C2. When the oscillator circuit is operating, a negative voltage (bias) is developed on the grid of the tube which is measured by a 50 ua meter. The meter sensitivity can be adjusted by rheostat R3 (CALIBRATION control) in series with the meter and mounted on the front panel.

When the instrument is used for "SHORT" testing, the coil under test is connected directly across the oscillator tank circuit. Before the component is connected to the test terminals, the position of the meter pointer is adjusted with the CALIBRATION control to the appropriate "CAL" point on the scale as required by the type of component being tested. If the component under test is good, the oscillator will continue to oscillate undamped (although at a much higher frequency than 600 cps) and the meter reading will remain unaffected

or will remain within the "GOOD" section of the appropriate scale. If however, there are shorted turns in the component under test (even as few as one) the shorted section of the coil will absorb power from the oscillator and the meter pointer will dip to the "BAD" section of the scale.

When the instrument is used for "CONTINUITY" testing, the coil under test is connected directly across the meter circuit. Before the component is connected to the test terminals, the meter pointer is set with the CALIBRATION control at the "AIR CORE-CONT. CAL" point, which is used in any type of continuity testing. If the component is continuous, it will shunt the meter circuit and the meter reading will drop to the "GOOD" region on the "CONTINUITY TEST" scale.

operation

GENERAL

The two upper "GOOD-BAD" scales on the meter face, designated "XFMR SHORT TEST" and "YOKE SHORT TEST", are used when "SHORT" testing flyback transformers and yokes respectively. The lowest "GOOD-BAD" scale, designated "CONTINUITY TEST", is used when "CONTINUITY" testing either a flyback transformer or yoke.

The meter pointer must be set at the proper "CAL" point or the scale before connecting either a flyback transformer or yoke to the test terminals for either "SHORT" or "CONTINUITY" testing. The "AIR CORE-CONT. CAL." point is used for both "SHORT" and "CONTINUITY" testing of air-core flyback transformers and all yokes, but only for "CONTINUITY" testing of iron-core flyback transformers. The "IRON CORE CAL." point is used for "SHORT" testing of iron-core flyback transformers.

NOTE: The "CONTINUITY" test is useful for continuity checking of power and audio transformer windings, wiring, switches and in any other instance where an ohmmeter would normally be used for continuity testing.

The 0-100 linear reference scale is useful for comparing two identical flyback transformers or yokes, one of which is known to be in good condition and another whose condition is unknown. This is a highly reliable method and is recommended to the operator when the reading obtained is in or near the borderline region between "GOOD" and "BAD". Another use for this scale is to enable the operator to record and repeat any new calibration point that might be necessary if flyback transformers or yokes of radically different impedance are developed in the future.

OPERATING INSTRUCTIONS

Read the following instructions carefully before using the instrument

A. Flyback Transformer Testing

1. Turn the TV receiver off and disconnect it from the AC line.

2. Remove the plate caps on the High Voltage Rectifier and Horizontal Output tubes.

3. Remove the HV Rect. tube from its socket. As this instrument is sufficiently sensitive to respond to a closed filament circuit, failure to remove the HV Rect. tube will cause an unjustified "BAD" reading.

NOTE: After the tests have been completed, the HV Rect. tube may be replaced in its socket. If the meter pointer dips with the instrument set for "SHORT" testing, the filament section of this tube is o.k.

4. Unplug the deflection yoke assembly.

5. Unsolder one side of the width coil.

6. Plug the line cord of the Model 944 into a 105-125 volts AC, 50/60 cps outlet and allow the instrument to warm up for one minute.

7. Set the SELECTOR switch at "CONTINUITY" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is at the "AIR CORE-CONT. CAL." point on the scale. This calibration point is used for all "CONTINUITY" testing of flyback transformers (air core <u>or</u> iron core) and yokes.

8. Insert the test leads in the TEST binding posts on the panel and connect them in turn across each winding of the transformer. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale in each test. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the transformer is defective and disqualified from any further testing.

9. Set the SELECTOR switch at "SHORT" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is set at the "AIR CORE-CONT.CAL." position if you are testing an air core flyback transformer or at the "IRON CORE CAL". position if you are testing an iron core flyback transformer. Connect the two test leads to the two plate cap terminals coming from the transformer. (It is not necessary to

observe polarity.) The meter reading may be higher, lower, or the same as the "CAL." point, but should remain in the "GOOD" region of the "XFMR SHORT TEST" scale. If the meter pointer dips into the "BAD" region, the transformer is defective and should be replaced. The short test is now completed. A short anywhere in the flyback transformer will show up in this test. It is not necessary to perform separate "SHORT" tests on the other windings of the transformer.

B. Deflection Yoke Testing

1. Performs steps 6 and 7 above.

2. Disconnect one lead of both the Vertical and Horizontal sections of the deflection yoke from the set. In addition, always check the schematic of the TV set to determine whether or not a resistor shunts the Horizontal or Vertical coil. Any resistor shunt must be disconnected for accurate testing of deflection yokes.

3. Insert the test leads in the TEST binding posts on the panel and connect them in turn across the Vertical and Horizontal sections of the deflection yoke. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale on both tests. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the yoke is defective and disqualified from any further testing.

4. Set the SELECTOR switch at "SHORT". (There is never any need to reset the CALIBRATION control when going from "CONTINUITY" to "SHORT" testing of deflection yokes as the "AIR CORE-CONT.CAL." point is always used for both tests.) Connect the two test leads across the Vertical and Horizontal sections in turn. (It is not necessary to observe polarity.) In each test, the meter reading may be higher, lower, or the same as the "AIR CORE-CONT. CAL." point, but should remain in the "GOOD" region of the "YOKE SHORT TEST" scale. If the meter pointer dips into the "BAD" region when testing either the Vertical or Horizontal section, that section is defective.

maintenance

If you have constructed your instrument from a kit, potentiometer R1 (mounted in the center of the chassis) must be adjusted as described below before the instrument can be used. In factory-wired instruments, potentiometer R1 has already been adjusted properly for the particular 6K6 tube in your unit and a line voltage of 117 volts. If the normal line voltage in your area is substantially higher or lower, you may readjust R1 by this procedure. R1 must be re-

adjusted by this procedure also whenever aging or replacement of the tube or other components makes it necessary.

1. Set the CALIBRATION control at "0" and the SELECTOR switch at either "CONTINUITY" or "SHORT".

2. Plug the line cord into a 105-125 volts AC, 50/60 cps outlet and allow 1/2 hour for the instrument to warm up.

3. Use a screwdriver to turn the slotted shaft of potentiometer R1 to its extreme clockwise position.

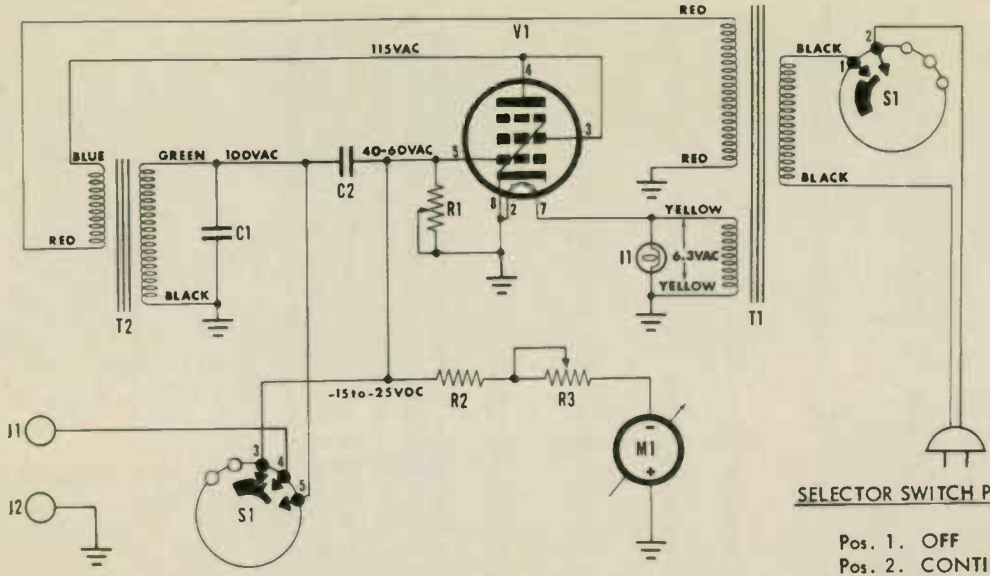
4. Set the CALIBRATION control at "10" on the dial.

5. Rotate potentiometer R1 counter-clockwise until the meter pointer reads exactly full-scale.

The adjustment of R1 is now completed and the instrument is ready for use.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble can not be found, you may return it to the EICO repair department where it will be repaired at a charge of $3.00 plus the cost of parts. (If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book.) Pack carefully and ship by prepaid Railway Express if possible. Return shipment will be made by express collect.



SELECTOR SWITCH POSITIONS

Pos. 1. OFF
Pos. 2. CONTINUITY
Pos. 3. SHORT

Stock#	Sym.	Description	Am't.
20002	C1	cap., .002 mf	1
21000	C2	cap., .001 mf	1
92000	I1	bulb #47	1
72005	M1	meter movement, 50 ua	1
18000	R1	pot., 2MΩ w/slotted shaft (Int.)	1
10027	R2	res., 270KΩ, 1/2W	1
16011	R3	pot., 2MΩ, calibration	1
60029	S1	switch, 3 pos., selector	1
30013	T1	transformer, power	1
32001	T2	transformer, osc.	1
90005	V1	tube, 6K6	1

MODEL 944 FLYBACK XFMR and YOKE TESTER

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ELECTRONIC INSTRUMENT CO., INC.
84 Withers St., Brooklyn 11, N. Y.

INSTRUCTION MANUAL FOR

EICO

ELECTRONIC INSTRUMENT CO., Inc.

84 WITHERS STREET, BROOKLYN 11, N. Y.

EICO

Laboratory Precision at lowest cost

INSTRUCTION

MANUAL

Model 944

ELECTRONIC INSTRUMENT CO., Inc. 84 Withers Street, Brooklyn, N. Y.

general description

Operating on the grid-dip meter principle, the Model 944 Flyback Transformer, & Yoke Tester provides a short test that will reveal even one shorted turn in any TV flyback transformer or yoke. As an open winding will produce the same indication as a perfect winding on the short test, a continuity test is also provided.

The need for this instrument stems from the fact that even one or two shorted turns will absorb the energy normally developed in the magnetic field of a flyback transformer or yoke and make it defective. While this is a very common reason for flyback transformer failure, it has remained a difficult trouble to detect because the slight change of winding resistance due to a few shorted turns is entirely masked by the normal commerical tolerances on winding resistance (±20%). (Ohmmeter measurements are useful only when a winding is open or more than 20% of the turns are shorted.)

As a result actually replacing the flyback transformer with a new one, has been the only reliable way of checking this part. Not only is this a very time-consuming and difficult job, but as a general servicing procedure it requires either stocking a full line of replacements or purchasing a flyback transformer or yoke for a particular receiver without being sure that the transformer or yoke you are replacing is defective and therefore the cause of the trouble.

The Model 944 is not only expressly designed to deal with this problem completely and effectively, but to provide maximum ease of operation. All readings are made on a large 4 1/2", 50 ua meter with three separate "GOOD-BAD" scales for flyback transformer, yoke, and continuity testing. In addition, separate calibration points are provided on the meter scale for air core and iron core flybacks so that all types may be tested accurately with no extra operation required (such as inserting an iron core into an air core type flyback to boost the inductance). Entirely professional in both appearance and performance, yet extremely compact for easy portability, the Model 944 is a wise and necessary addition to any TV serviceman's equipment.

specifications

Electrical Specifications:

Oscillator Frequency .... approx. 600 cps interrupted 60 times per second

Test Voltage .... 100 rms v (short test); 60 rms v (cont. test)

Tube Complement 6K6

Meter .... 4 1/2" 50 ua - 2000 Ω

Power Supply .... transformer operated from 105-125 volts AC, 50-60 cps line

Mechanical Specifications

Overall Dimensions .... 8 1/2" high, 5" wide, 5" deep

Weight .... 5 pounds

Cabinet .... steel, rub-proof grey wrinkle finish

Panel .... aluminum, satin finish, 2 color deep-etched

circuit description

The heart of the Model 944 Flyback Transformer & Yoke Tester is an oscillator circuit employing a 6K6 tube. The secondary winding of transformer T2 and capacitor C1 make up the tank circuit. The primary of transformer T2 functions as a feedback coil through which power taken from the line isolation transformer T1 is delivered to the oscillator. The isolation provided by T1 permits the instrument to be used safely on transformer-less or universal TV sets.

As the oscillator operates only during the positive half-cycles of the raw ac voltage which powers it, oscillation is interrupted 60 times a second to simulate the operating condition of a flyback transformer under pulsed conditions. This is desirable also because the abrupt potential changes across the winding under test will often expose an intermittent condition which might otherwise go undetected.

The frequency of oscillation is approximately 600 cps (with nothing connected across the test terminals) as determined by the secondary of T2, C1, and the time constant of R1 and C2. When the oscillator circuit is operating, a negative voltage (bias) is developed on the grid of the tube which is measured by a 50 ua meter. The meter sensitivity can be adjusted by rheostat R3 (CALIBRATION control) in series with the meter and mounted on the front panel.

When the instrument is used for "SHORT" testing, the coil under test is connected directly across the oscillator tank circuit. Before the component is connected to the test terminals, the position of the meter pointer is adjusted with the CALIBRATION control to the appropriate "CAL" point on the scale as required by the type of component being tested. If the component under test is good, the oscillator will continue to oscillate undamped (although at a much higher frequency than 600 cps) and the meter reading will remain unaffected

or will remain within the "GOOD" section of the appropriate scale. If however, there are shorted turns in the component under test (even as few as one) the shorted section of the coil will absorb power from the oscillator and the meter pointer will dip to the "BAD" section of the scale.

When the instrument is used for "CONTINUITY" testing, the coil under test is connected directly across the meter circuit. Before the component is connected to the test terminals, the meter pointer is set with the CALIBRATION control at the "AIR CORE-CONT. CAL" point, which is used in any type of continuity testing. If the component is continuous, it will shunt the meter circuit and the meter reading will drop to the "GOOD" region on the "CONTINUITY TEST" scale.

operation

GENERAL

The two upper "GOOD-BAD" scales on the meter face, designated "XFMR SHORT TEST" and "YOKE SHORT TEST", are used when "SHORT" testing flyback transformers and yokes respectively. The lowest "GOOD-BAD" scale, designated "CONTINUITY TEST", is used when "CONTINUITY" testing either a flyback transformer or yoke.

The meter pointer must be set at the proper "CAL" point or the scale before connecting either a flyback transformer or yoke to the test terminals for either "SHORT" or "CONTINUITY" testing. The "AIR CORE-CONT. CAL." point is used for both "SHORT" and "CONTINUITY" testing of air-core flyback transformers and all yokes, but only for "CONTINUITY" testing of iron-core flyback transformers. The "IRON CORE CAL." point is used for "SHORT" testing of iron-core flyback transformers.

NOTE: The "CONTINUITY" test is useful for continuity checking of power and audio transformer windings, wiring, switches and in any other instance where an ohmmeter would normally be used for continuity testing.

The 0-100 linear reference scale is useful for comparing two identical flyback transformers or yokes, one of which is known to be in good condition and another whose condition is unknown. This is a highly reliable method and is recommended to the operator when the reading obtained is in or near the borderline region between "GOOD" and "BAD". Another use for this scale is to enable the operator to record and repeat any new calibration point that might be necessary if flyback transformers or yokes of radically different impedance are developed in the f...

OPERATING INSTRUCTIONS

Read the following instructions carefully before using the instrument

A. Flyback Transformer Testing

1. Turn the TV receiver off and disconnect it from the AC line.

2. Remove the plate caps on the High Voltage Rectifier and Horizontal Output tubes.

3. Remove the HV Rect. tube from its socket. As this instrument is sufficiently sensitive to respond to a closed filament circuit, failure to remove the HV Rect. tube will cause an unjustified "BAD" reading.

NOTE: After the tests have been completed, the HV Rect. tube may be replaced in its socket. If the meter pointer dips with the instrument set for "SHORT" testing, the filament section of this tube is o.k.

4. Unplug the deflection yoke assembly.

5. Unsolder one side of the width coil.

6. Plug the line cord of the Model 944 into a 105-125 volts AC, 50/60 cps outlet and allow the instrument to warm up for one minute.

7. Set the SELECTOR switch at "CONTINUITY" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is at the "AIR CORE-CONT. CAL." point on the scale. This calibration point is used for all "CONTINUITY" testing of flyback transformers (air core or iron core) and yokes.

8. Insert the test leads in the TEST binding posts on the panel and connect them in turn across each winding of the transformer. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale in each test. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the transformer is defective and disqualified from any further testing.

9. Set the SELECTOR switch at "SHORT" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is set at the "AIR CORE-CONT.CAL." position if you are testing an air core flyback transformer or at the "IRON CORE CAL." position if you are testing an iron core flyback transformer. Connect the two test leads to the two plate cap terminals coming from the transformer. (It is not necessary to

observe polarity.) The meter reading may be higher, lower, or the same as the "CAL." point, but should remain in the "GOOD" region of the "XFMR SHORT TEST" scale. If the meter pointer dips into the "BAD" region, the transformer is defective and should be replaced. The short test is now completed. A short anywhere in the flyback transformer will show up in this test. It is not necessary to perform separate "SHORT" tests on the other windings of the transformer.

B. Deflection Yoke Testing

1. Performs steps 6 and 7 above.

2. Disconnect one lead of both the Vertical and Horizontal sections of the deflection yoke from the set. In addition, always check the schematic of the TV set to determine whether or not a resistor shunts the Horizontal or Vertical coil. Any resistor shunt must be disconnected for accurate testing of deflection yokes.

3. Insert the test leads in the TEST binding posts on the panel and connect them in turn across the Vertical and Horizontal sections of the deflection yoke. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale on both tests. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the yoke is defective and disqualified from any further testing.

4. Set the SELECTOR switch at "SHORT". (There is never any need to reset the CALIBRATION control when going from "CONTINUITY" to "SHORT" testing of deflection yokes as the "AIR CORE-CONT.CAL." point is always used for both tests.) Connect the two test leads across the Vertical and Horizontal sections in turn. (It is not necessary to observe polarity.) In each test, the meter reading may be higher, lower, or the same as the "AIR CORE-CONT. CAL." point, but should remain in the "GOOD" region of the "YOKE SHORT TEST" scale. If the meter pointer dips into the "BAD" region when testing either the Vertical or Horizontal section, that section is defective.

maintenance

If you have constructed your instrument from a kit, potentiometer R1 (mounted in the center of the chassis) must be adjusted as described below before the instrument can be used. In factory-wired instruments, potentiometer R1 has already been adjusted properly for the particular 6K6 tube in your unit and a line voltage of 117 volts. If the normal line voltage in your area is substantially higher or lower, you may readjust R1 by this procedure. R1 must be re-

adjusted by this procedure also whenever aging or replacement of the tube or other components makes it necessary.

1. Set the CALIBRATION control at "0" and the SELECTOR switch at either "CONTINUITY" or "SHORT".

2. Plug the line cord into a 105-125 volts AC, 50/60 cps outlet and allow 1/2 hour for the instrument to warm up.

3. Use a screwdriver to turn the slotted shaft of potentiometer R1 to its extreme clockwise position.

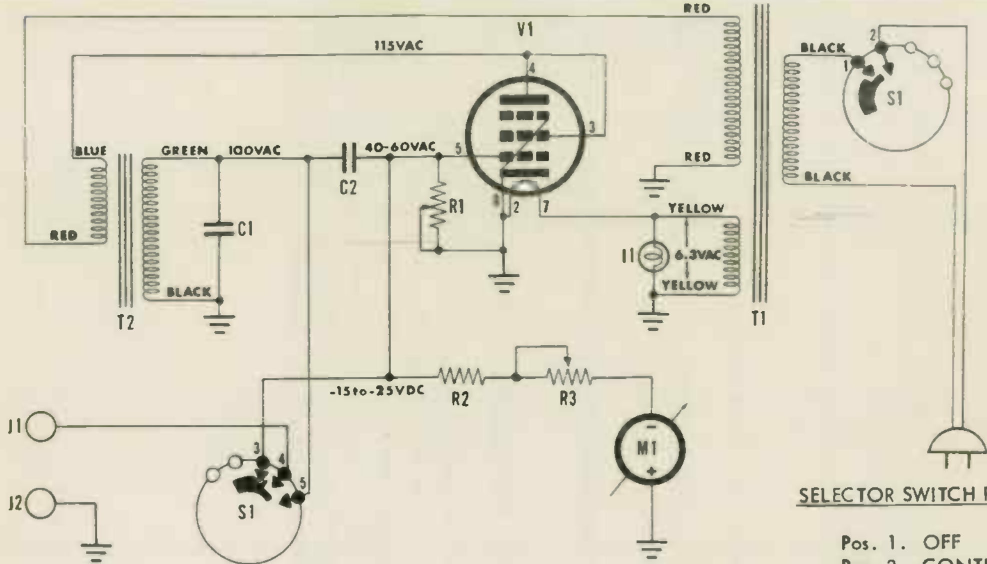
4. Set the CALIBRATION control at "10" on the dial.

5. Rotate potentiometer R1 counter-clockwise until the meter pointer reads exactly full-scale.

The adjustment of R1 is now completed and the instrument is ready for use.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble can not be found, you may return it to the EICO repair department where it will be repaired at a charge of $3.00 plus the cost of parts. (If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book.) Pack carefully and ship by prepaid Railway Express if possible. Return shipment will be made by express collect.



SELECTOR SWITCH POSITIONS

Pos. 1. OFF
Pos. 2. CONTINUITY
Pos. 3. SHORT

Stock#	Sym.	Description	Am't.
20002	C1	cap., .002 mf	1
21000	C2	cap., .001 mf	1
92000	I1	bulb #47	1
72005	M1	meter movement, 50ua	1
18000	R1	pot., 2MΩ w/slotted shaft (int.)	1
10027	R2	res., 270KΩ, 1/2W	1
16011	R3	pot., 2MΩ, calibration	1
60029	S1	switch, 3 pos., selector	1
30013	T1	transformer, power	1
32001	T2	transformer, osc.	1
90005	V1	tube, 6K6	1

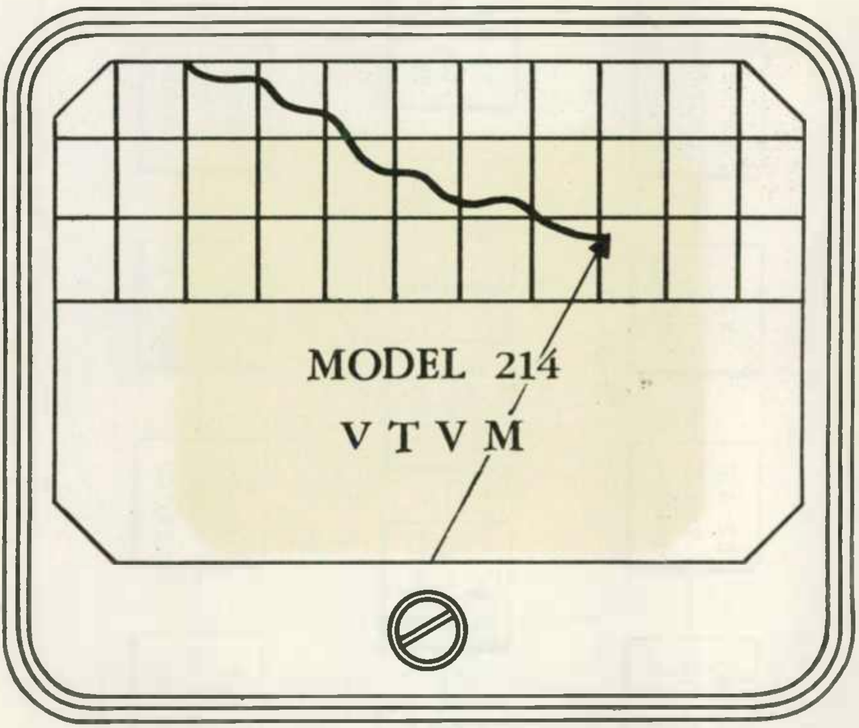
MODEL 944 FLYBACK XFMR and YOKE TESTER

EICO

ELECTRONIC INSTRUMENT CO., INC.
84 Withers St., Brooklyn 11, N. Y.

Dec. 29, 1955
Cost $ 24.55

INSTRUCTION MANUAL FOR



EICO

ELECTRONIC INSTRUMENT CO., Inc.

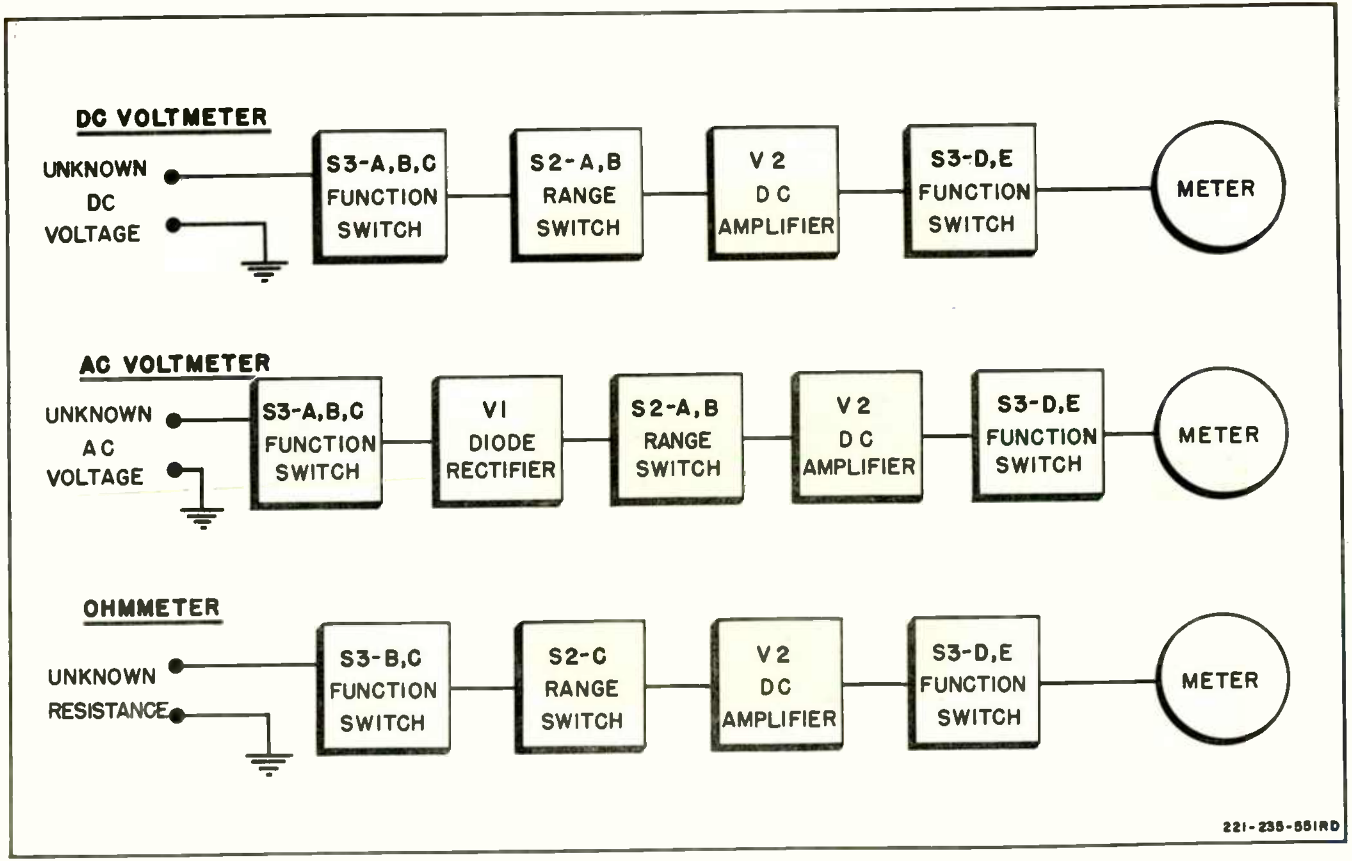


Fig. 1 - Block Diagram

GENERAL DESCRIPTION

The EICO Model 214 Electronic Volt-Ohm Meter is a high quality VTVM that is especially suited for use in television, f-m, and a-m radio servicing. Featuring a rugged and easy reading 7 1/2" meter, this instrument provides entirely electronic measurement of a-c voltage, d-c voltage, decibels and resistance.

Complete overload protection is provided electronically on all a-c voltage, d-c voltage, and ohmmeter ranges. To eliminate the need for reversing the test leads on d-c voltage measurement (when a negative d-c voltage is to be measured), positive and negative d-c positions have been provided on the function switch. A zero centering position on the meter facilitates discriminator alignment in f-m and a-f-c circuits.

This instrument allows measurement of d-c and a-c voltages up to 1000 volts in five ranges. The d-c voltage range can be extended to 30,000 volts with the EICO Model HVP-1 High Voltage Probe. Another accessory, the EICO Model P-75 RF Probe extends the frequency range of the instrument (20 - 200,000 cps) to 200 Mc.

The readings on the d-c voltage ranges are accurate within 3% and on the a-c ranges within 5% of full-scale (the multiplier resistors used are accurate within 1%). As the input impedance is 25 megohms on d-c and 3 megohms on a-c voltage ranges, the current drawn by the instrument is negligible, so there is no problem of error due to circuit loading. A balanced bridge circuit maintains constant accuracy despite variations in line voltage.

On the ohmmeter ranges, advantage is taken of the high sensitivity of the d-c amplifier to provide resistance measurements up to 1000 megohms using only the 1 1/2 volt battery. This feature avoids any danger to delicate apparatus that may be tested with the instrument, since it eliminates the high voltage normally encountered in high resistance measuring circuits.

The user of the instrument will benefit from direct reading scales, simple operation, and the dependable quality that results from high grade components, and careful engineering and testing in the field. It will prove to be an extremely valuable tool for signal tracing, alignment, for voltage and resistance measurements in television and radio receivers, and for testing many types of electrical equipment.

SPECIFICATIONS

D-C Voltage Ranges:
0 to 5, 10, 100, 500, 1000 volts
(to 30 KV with HVP-1 probe)
Input impedance: 25 Meg.

A-C Voltage Ranges:
0 to 5, 10, 100, 500, 1000 volts
(Special scale for 0 to 5 volts)
Input impedance: 3 Meg.

Electronic Ohmmeter Ranges:
0 to 1000 ohms, 10,000 ohms,
1 Meg., 10 Meg., 1000 Meg.
(Measures from 0.2 ohm to 1000 Meg.)

Decibel Ranges: -20 to + 55 db

Frequency Range: 20 - 200,000 cps
(Up to 200 Mc with P-75 probe)

Accuracy: d-c volts, ohms -- ± 3%
a-c volts -- ± 5%

Power Supply: 115 v, 50-60 cps, 10 w

Ohmmeter Battery: 1 1/2 v dry cell

Tubes: 6X5, 6H6, 6SN7

Overall Dimensions: height - 9 in., width - 13 1/4 in., depth - 6 in.

Weight: 10 pounds

Cabinet: Blue grey wrinkle lacquer on steel

Panel: 3 color, deep etched

OPERATING INSTRUCTIONS

INITIAL STEPS: Check the mechanical zero adjustment of the meter pointer when the power is off. If the pointer is off zero, turn the slotted screw directly beneath the meter face until the pointer is brought to zero.

Plug the line cord into the 60 cycle, 115 volt a-c supply, turn the power on with the "ON-OFF" switch, and allow a normal warm-up time (about one minute).

Insert the phone plug, P1 (on the DC test lead), in the DC jack, J1, on the panel. Insert the pin plug, P2 (on the AC-OHMS test lead), in the AC-OHMS jack, J2, on the panel. Insert the banana plug, P3 (on the COMMON test lead), into the COMMON (ground) jack, J3, on the panel. This is the COMMON lead for all functions.

CAUTION: Never connect the COMMON lead to a high voltage point as this will place the meter chassis and case at a high voltage above ground.

When working with high voltages, avoid contact with or close proximity to high voltage points. If possible, attach the test leads with the power off in the circuit to be measured. After the leads are attached, turn the power on and take the reading.

D-C VOLTAGE MEASUREMENT: Set the FUNCTION switch to "+DC" or "-DC VOLTS", the RANGE switch to desired voltage range, and then use the ZERO ADJ. potentiometer to bring the meter pointer to zero*. Clip the COMMON lead to ground or the low side and touch the DC probe to the high side of the source to be measured. On the 5V and 500V ranges, read the 0-5 AC-DC scale (black); on the 10V, 100V, and 1000V ranges, read the 0-10 AC-DC scale.

A-C VOLTAGE MEASUREMENT: Set the FUNCTION switch to "AC VOLTS", the RANGE switch to the desired voltage range, and then use the ZERO ADJ. potentiometer to bring the meter pointer to zero*. Clip the COMMON lead to ground or the low side and touch the AC-OHMS probe to the high side of the source to be measured. On the 5V range, read the special 5VAC scale (red); on the 500V range, read the 0-5 AC-DC scale (black); on the 10V, 100V, and 1000V ranges, read the 0-10 AC-DC scale.

RESISTANCE MEASUREMENT: Set the FUNCTION switch to "OHMS" and the RANGE switch to the desired ohms range; connect the COMMON lead to the AC-OHMS lead and then use the ZERO ADJ. to bring the meter pointer to zero; separate the COMMON lead from the AC-OHMS lead and then use the OHMS ADJ. potentiometer to set the meter pointer so that it reads exactly full-scale. Clip the COMMON lead to one terminal of the unknown resistance and touch or connect the AC-OHMS probe to the other terminal. Read the OHMS scale on the meter. On the RX1 range, read the OHMS scale directly in ohms; on RX10, RX1000, and RX10,000 ranges, multiply the scale reading by 10, 1000, and 10,000 respectively and read in ohms; on the RX1MEG range, read the scale directly in megohms. Note: The small reading noted on the lowest range is the resistance of the leads.
CAUTION: Never leave the FUNCTION switch set at the "OHMS" position as this will greatly shorten the life of the ohmmeter battery.

DECIBEL MEASUREMENT: The instructions for decibel measurement are the same as for a-c voltage measurement except that the DB scale is read. To the reading on the DB scale, add the number of db shown on the meter as corresponding to the a-c voltage range used. Correction for measuring across different impedances is included in the APPLICATIONS section under "OUTPUT METER".

ZERO-CENTER INDICATION: See APPLICATIONS section.

APPLICATIONS

OUTPUT METER: When the RANGE switch is set at 10V and the FUNCTION switch is set at AC VOLTS, the power level in a 500 ohm circuit can be read directly in decibels on the DB scale, which is calibrated from - 20 to + 15 DB, based on a reference level of 6.0 milliwatts and 500 ohms. This reference level is marked "0" decibels, and corresponds to 1.73 vac on the 0-10 volt scale. To measure higher levels, proceed as instructed in the OPERATING INSTRUCTIONS section under "DECIBEL MEASUREMENT".

The DB scale on the meter is calibrated across a 500 ohm line. If the DB measurement is being made across an impedance other than 500 ohms, use

*See note on electrostatic pickup in the MAINTENANCE section, page 9.

the correction table below to obtain the number of DB (corresponding to the actual impedance) that has to be added to or subtracted from the measured value. This correction is separate from the correction made for the a-c volts range used.

ACTUAL IMPEDANCE	CORRECTION FACTOR	ACTUAL IMPEDANCE	CORRECTION FACTOR
4 ohms	+ 21 db	200 ohms	+ 4 db
8 ohms	+ 18 db	300 ohms	+ 2.2 db
16 ohms	+ 15 db	500 ohms	0 db
50 ohms	+ 10 db	600 ohms	- 0.8 db
75 ohms	+ 8.2 db	1000 ohms	- 3 db
150 ohms	+ 5.2 db	2000 ohms	- 6 db

RECEIVER ALIGNMENT: To use the DB scale for receiver alignment: 1) connect the AC-OHMS probe and the COMMON lead across the voice coil; 2) set the FUNCTION switch at AC VOLTS and the RANGE switch at 10V; 3) feed a 400 cycle modulated r-f or i-f signal into the receiver. Keep the receiver volume control at maximum, and adjust the signal generator output to produce a small deflection on the DB scale. As alignment adjustments are made, thus increasing the sensitivity, the DB scale will show the improvement directly in decibels. The effective attenuation of wave traps, in decibels, can be determined by noting the decrease in decibels as the trap is tuned through resonance.

ZERO-CENTER APPLICATIONS: In some applications, for example in aligning the discriminator in f-m or a-f-c circuits, it is convenient to use a zero-center d-c voltmeter, because the d-c output of the discriminator changes from + to - to + as the secondary of the discriminator transformer is tuned or as the input frequency is varied above and below resonance.

Zero-center indication can be obtained as follows: 1) set the FUNCTION switch at either "+DC" or "-DC VOLTS", 2) set the RANGE switch at "5V" (higher if necessary); 3) turn the ZERO ADJ. knob to bring the meter pointer to the special zero mark (-0+) beneath the center of the DB scale; 4) connect the COMMON lead to the low side of the discriminator load; 5) connect the DC probe to the high side of the discriminator load; 6) refer to the special center scale zero mark; when the secondary of a conventional discriminator is correctly tuned, the DC output is zero and the meter will indicate zero.

POWER OUTPUT IN WATTS: Use formula: $\text{Watts} = \dfrac{\text{Output Voltage Squared}}{\text{Load Impedance}}$

EXAMPLE: The maximum undistorted output voltage across a 2 ohm load is 5 volts.

$$\text{Power Output} = \frac{5X5}{2} = \frac{25}{2} = 12.5 \text{ Watts}$$

OSCILLATOR STRENGTH: The negative d-c voltage developed on the oscillator grid is always directly proportional to the strength of oscillation. This voltage can be measured very readily at the oscillator grid while the band switch is turned to the various bands, and in each of its positions the main tuning condenser is rotated from minimum capacity. This will give an indication of the strength of oscillation at all frequencies within the oscillator's range.

A-V-C VOLTAGE: The automatic volume control voltage developed by the incoming signal can be measured at a number of places in the receiver. This negative voltage first appears across the diode load resistor. It may also be measured along the a-v-c bus and at the grids of the r-f tubes being controlled. The d-c voltage measured at the diode load resistor is a very convenient output indication during receiver alignment.

Owing to the high input resistance of this instrument, it is possible to measure bias (a-v-c) voltage on the grid of r-f and i-f amplifier tubes without disrupting the signal.

D-C SUPPLY VOLTAGES: Power supply d-c voltages can be measured at the rectifier filaments and in the filter circuits. Plate, screen, and cathode d-c voltages can be measured at the corresponding pins of the tube sockets.

BIAS CELL VOLTAGE: This instrument will accurately measure the voltage of a bias cell. Current drawing voltmeters are not capable of making this measurement and in many cases will damage the cell.

TELEVISION RECEIVER ADJUSTMENTS: This instrument will measure the d-c voltage developed across the second-detector load resistor in the picture channel of a television receiver. This measurement is most useful when adjusting antenna orientation as well as when adjusting antenna matching sections.

GASSY TUBES: One effect of a gassy tube is to reduce the normal negative grid bias, or even make the grid positive. This instrument is ideal for measuring the voltage directly at the control grid of any tube in order to determine whether or not this effect is present. Excessive gas will cause the tube to cease operating normally, and in an audio amplifier will usually cause the volume control to become noisy. This amount of gas will not always produce a noticeable change in the operation of the radio receiver. Consequently if repeated difficulty is experienced with volume controls becoming noisy, in this type of circuit, this instrument should be used to check for incorrect bias.

A-C VOLTAGES: The a-c voltmeter within the instrument is extremely useful in measuring all a-c voltages encountered in the average radio receiver. The measurements that can be made include all voltages from power transformer secondaries, audio signal voltages at grids and plates of amplifiers, and audio voltages developed across the output transformer or voice coil (as an indication of output during receiver alignment).

ACCESSORIES

R-F PROBE P-75 (K): An EICO R-F probe (P-75K - kit form, P-75 - factory wired) for use in measuring voltages up to 50 volts and to 200 Mc is available to extend the uses of the instrument. This probe is simply plugged into the D-C jack of the instrument and the r-f voltages are read on the regular D-C scales.

HIGH VOLTAGE PROBE HVP-1: An EICO High Voltage Probe HVP-1 (factory wired only) for measuring d-c voltages up to 30KV is available to extend the uses of the instrument. The probe may be supplied with a multiplier resistor of 240 Megohms to give a high voltage range of 10,000 volts or with a multiplier resistor of 750 Megohms to give a high voltage range of 30,000 volts.

CIRCUIT DESCRIPTION

GENERAL: The meter measures either d-c or a-c voltages by making use of the rectifying and amplifying characteristics of vacuum tubes. The input impedances are very high (d-c - 25 megohms, a-c - 3 megohms), and the current used to actuate the indicating meter is not taken from the circuit being measured. A bridge circuit, used to stabilize the operating voltages of the tubes, provides constant accuracy despite line variations. When used as an ohmmeter, the instrument will measure resistances between zero and 1000 megohms. Decibel measurements between - 20 and + 55 db can be made using the DB scale.

D-C AMPLIFIER CIRCUIT: (See Figures 1 and 3) A balanced bridge circuit is used in the d-c amplifier, comprising the twin triode V-2, a common plate load resistor R-3, and the balanced cathode load resistors R-10, R-11, and R-12. The meter M-1 is connected across the two cathodes of V-2. In the normal condition, a reference current flows through V-2B, which has a grounded grid. Current flow through V-2A is adjusted by means of the ZERO ADJ. control R-12 to equal the current flow in V-2B. The meter then reads zero.

OPERATION AS A D-C VOLTMETER: (See Figures 1 and 3) The circuit for operation as a d-c voltmeter is as follows: The unknown voltage is applied across the connectors J-1 and J-3 (ground). The FUNCTION switch S-3 connects the range voltage divider across J-1 and ground. A voltage, depending on the RANGE switch setting, is then applied to the grid of d-c amplifier V-2A. This grid voltage unbalances the bridge circuit, and the meter is deflected in direct proportion to the unbalanced current.

OPERATION AS AN A-C VOLTMETER: (See Figures 1 and 3) The circuit for operation as an a-c voltmeter is as follows: The unknown a-c voltage is applied across the connectors at J-2 and J-3 (ground). The FUNCTION switch applies the voltage to the diode rectifier V-1. The d-c output voltage of V1 is then applied to the voltage divider. A d-c voltage, depending on the RANGE switch setting, is then applied to the grid of d-c amplifier V-2A. The remaining portion of a-c voltmeter operation is the same as the d-c voltmeter operations. The a-c circuit is also used for decibel measurements but the readings are made on the DB scale.

OPERATION AS AN OHMMETER: (See Figures 1 and 3) The circuit for operation as an ohmmeter is as follows: The unknown resistance is connected across connectors J-2 and J-3. The FUNCTION switch connects the range voltage divider and battery B-1 across J-2 and ground. A voltage, depending on the RANGE switch setting, is then applied to the grid of the d-c amplifier V-2A. The remaining portion of the ohmmeter circuit follows the same pattern as the d-c voltmeter circuit.

POWER SUPPLY: (See Figures 1 and 3) The operating potential for the d-c amplifier V-2A is obtained from the full wave rectifier V-3. The B+ output of the rectifier is suitably filtered by R-1, R-2, and C-2. Filament voltages for all tubes are obtained from the 6.3 volt winding of the power transformer T-1.

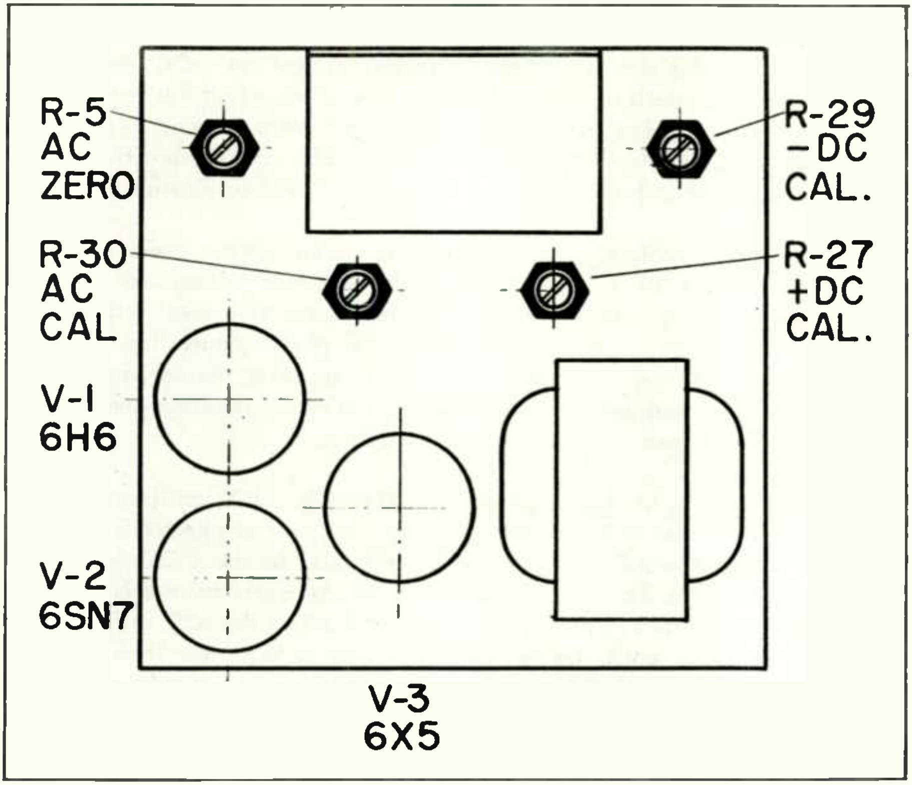


Fig. 2 - Top View of Chassis - Location of calibrating pots.

MAINTENANCE

1. CALIBRATION: After construction of the instrument is completed, it is necessary to carry out the calibration procedure described below.

If a change occurs in the accuracy of the instrument after a long period of use, it is probably due to aging of the components. The accuracy of the instrument may readily be restored by repeating this calibration procedure. Recalibration will also be necessary, whenever parts (tubes, etc.) are replaced.

A. INITIAL STEPS: Follow the procedure described in "INITIAL STEPS" in the OPERATING INSTRUCTIONS section. In addition, check to see that the isolation resistor, R-31, is properly connected within the D-C test probe.

B. D-C VOLTMETER CALIBRATION: (See Fig. 2) To calibrate the d-c voltage ranges, use two flashlight batteries connected in series. The terminal voltage will be 3.10 volts when fresh batteries are used. Set the FUNCTION switch to "-DC" and the RANGE switch to "5V". Short the D-C (red) probe to the COMMON lead (ground) and turn the ZERO ADJ. control until the meter pointer is at zero (ignore any change after the test leads are disconnected). Connect the batteries between the D-C test leads with the COMMON (ground) lead touching the positive side of the batteries. Adjust the "-DC" calibration potentiometer R-29 until a 3.10 volt reading is obtained on the meter (3.10 on the 0 to 5 D-C scale). To calibrate the "+DC" voltage ranges, repeat the above steps with the FUNCTION switch set at "+DC" and the positive end of the cells connected to the D-C probe. Adjust the "+DC" calibration potentiometer R-27.

NOTE: The electrostatic pickup which appears on the low a-c and d-c voltage ranges, when either the AC-OHMS or DC probe is held or touched is normal in a sensitive vacuum tube voltmeter, due to the extreme sensitivity of the instrument. However, if the AC-OHMS or DC probe (depending upon the function) is shorted to the COMMON (ground) lead when the zero adjustment is made, the zero obtained will result in correct meter readings and no error will be introduced because of electrostatic pcikup.

C. A-C VOLTMETER CALIBRATION: (See Fig. 2) To calibrate the a-c voltage ranges, set the FUNCTION switch at "AC" and the RANGE switch at "1000V". Short the AC-OHMS (black) test lead to the COMMON lead (ground) and turn the ZERO ADJ. control until the meter pointer is at zero. Turn the RANGE switch to the "5V" position and adjust the A-C shift balance potentiometer, R-5, until the meter pointer returns to zero. Then turn the RANGE switch to the "500V" position; the meter pointer should move very little, usually not at all. Connect the COMMON and AC-OHMS test leads to the 115 volt A-C supply and adjust the A-C calibration potentiometer, R30, until the meter reads 115 volts. Calibration with the 115 volt A-C supply will result in the instrument being accurate within 5%. If greater accuracy is desired, the instrument should be calibrated against a known, standard A-C voltage.

D. OHMMETER CALIBRATION: No separate calibration required.

2. BATTERY REPLACEMENT: When it is no longer possible to adjust the meter pointer to full-scale deflection with the OHMS ADJ. potentiometer, the battery is probably at fault. This battery is a standard 1.5 volt flashlight cell and so may be readily replaced.

NOTE: When replacing the battery, make certain that polarity is observed as shown in the schematic diagram. Recalibration is not required when the battery is replaced.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble is not apparent, you may return it to the EICO repair department where it will be repaired for a nominal charge.

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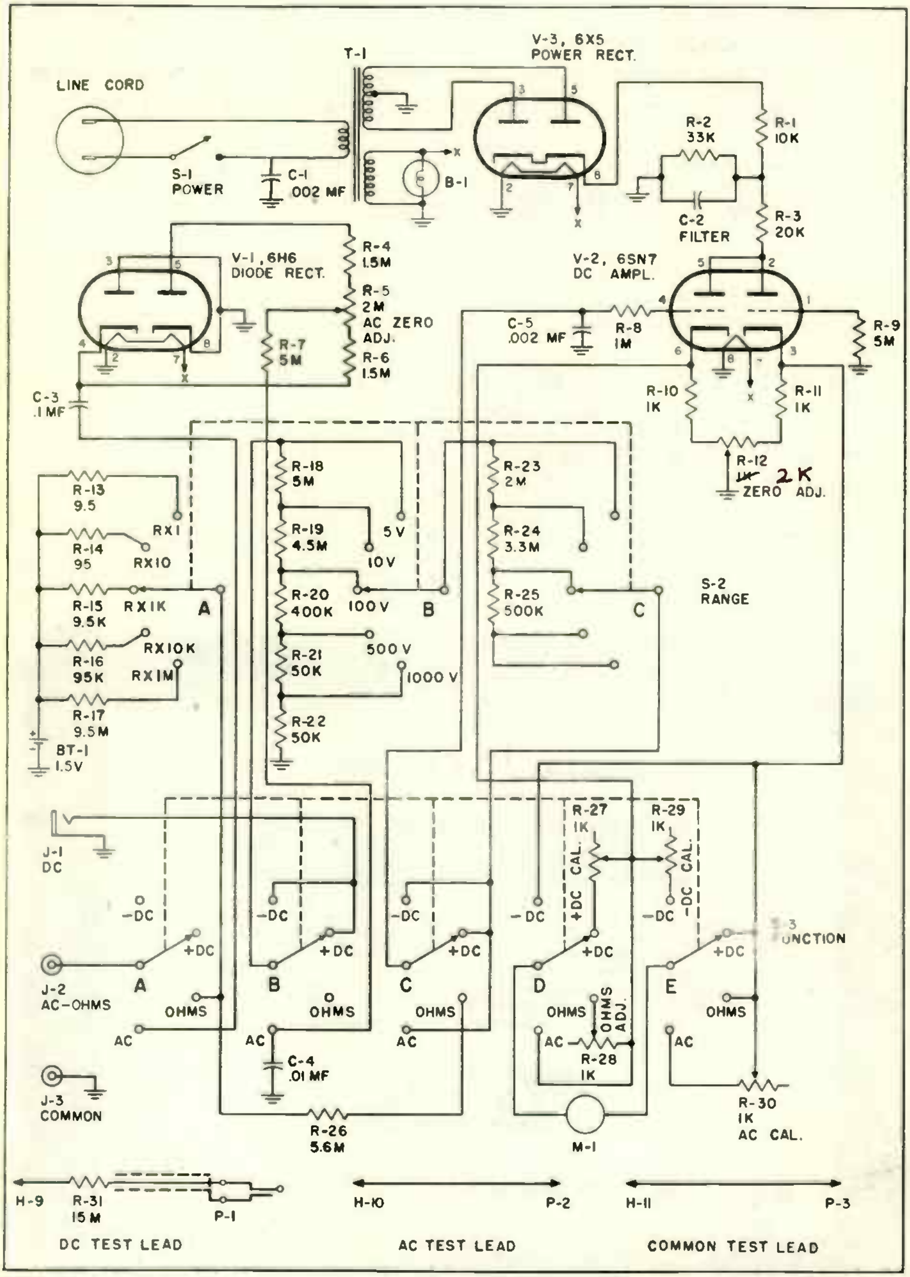

Fig. 3 – Schematic Diagram

INSTRUCTION MANUAL FOR

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Laboratory Precision at lowest cost

INSTRUCTION MANUAL

Model 944

ELECTRONIC INSTRUMENT CO., Inc. 84 Withers Street, Brooklyn, N. Y.

general description

Operating on the grid-dipmeter principle, the Model 944 Flyback Transformer, & Yoke Tester provides a short test that will reveal even one shorted turn in any TV flyback transformer or yoke. As an open winding will produce the same indication as a perfect winding on the short test, a continuity test is also provided.

The need for this instrument stems from the fact that even one or two shorted turns will absorb the energy normally developed in the magnetic field of a flyback transformer or yoke and make it defective. While this is a very common reason for flyback transformer failure, it has remained a difficult trouble to detect because the slight change of winding resistance due to a few shorted turns is entirely masked by the normal commerical tolerances on winding resistance (±20%). (Ohmmeter measurements are useful only when a winding is open or more than 20% of the turns are shorted.)

As a result actually replacing the flyback transformer with a new one, has been the only reliable way of checking this part. Not only is this a very time-consuming and difficult job, but as a general servicing procedure it requires either stocking a full line of replacements or purchasing a flyback transformer or yoke for a particular receiver without being sure that the transformer or yoke you are replacing is defective and therefore the cause of the trouble.

The Model 944 is not only expressly designed to deal with this problem completely and effectively, but to provide maximum ease of operation. All readings are made on a large 4 1/2", 50 ua meter with three separate "GOOD-BAD" scales for flyback transformer, yoke, and continuity testing. In addition, separate calibration points are provided on the meter scale for air core and iron core flybacks so that all types may be tested accurately with no extra operation required (such as inserting on iron core into on air core type flyback to boost the inductance). Entirely professional in both appearance and performance, yet extremely compact for easy portability, the Model 944 is a wise and necessary addition to any TV serviceman's equipment.

specifications

Electrical Specifications:

Oscillator Frequency .... approx. 600 cps interrupted 60 times per second

Test Voltage .... 100 rms v (short test); 60 rms v (cont. test)

Tube Complement 6K6

Meter	4 1/2" 50 ua - 2000 Ω
Power Supply	transformer operated from 105-125 volts AC, 50-60 cps line

Mechanical Specifications

Overall Dimensions	8 1/2" high, 5" wide, 5" deep
Weight	5 pounds
Cabinet	steel, rub-proof grey wrinkle finish
Panel	aluminum, satin finish, 2 color deep-etched

circuit description

The heart of the Model 944 Flyback Transformer & Yoke Tester is an oscillator circuit employing a 6K6 tube. The secondary winding of transformer T2 and capacitor C1 make up the tank circuit. The primary of transformer T2 functions as a feedback coil through which power taken from the line isolation transformer T1 is delivered to the oscillator. The isolation provided by T1 permits the instrument to be used safely on transformer-less or universal TV sets.

As the oscillator operates only during the positive half-cycles of the raw ac voltage which powers it, oscillation is interrupted 60 times a second to simulate the operating condition of a flyback transformer under pulsed conditions. This is desirable also because the abrupt potential changes across the winding under test will often expose an intermittent condition which might otherwise go undetected.

The frequency of oscillation is approximately 600 cps (with nothing connected across the test terminals) as determined by the secondary of T2, C1, and the time constant of R1 and C2. When the oscillator circuit is operating, a negative voltage (bias) is developed on the grid of the tube which is measured by a 50 ua meter. The meter sensitivity can be adjusted by rheostat R3 (CALIBRATION control) in series with the meter and mounted on the front panel.

When the instrument is used for "SHORT" testing, the coil under test is connected directly across the oscillator tank circuit. Before the component is connected to the test terminals, the position of the meter pointer is adjusted with the CALIBRATION control to the appropriate "CAL" point on the scale as required by the type of component being tested. If the component under test is good, the oscillator will continue to oscillate undamped (although at a much higher frequency than 600 cps) and the meter reading will remain unaffected

or will remain within the "GOOD" section of the appropriate scale. If however, there are shorted turns in the component under test (even as few as one) the shorted section of the coil will absorb power from the oscillator and the meter pointer will dip to the "BAD" section of the scale.

When the instrument is used for "CONTINUITY" testing, the coil under test is connected directly across the meter circuit. Before the component is connected to the test terminals, the meter pointer is set with the CALIBRATION control at the "AIR CORE-CONT. CAL" point, which is used in any type of continuity testing. If the component is continuous, it will shunt the meter circuit and the meter reading will drop to the "GOOD" region on the "CONTINUITY TEST" scale.

operation

GENERAL

The two upper "GOOD-BAD" scales on the meter face, designated "XFMR SHORT TEST" and "YOKE SHORT TEST", are used when "SHORT" testing flyback transformers and yokes respectively. The lowest "GOOD-BAD" scale, designated "CONTINUITY TEST", is used when "CONTINUITY" testing either a flyback transformer or yoke.

The meter pointer must be set at the proper "CAL" point or the scale before connecting either a flyback transformer or yoke to the test terminals for either "SHORT" or "CONTINUITY" testing. The "AIR CORE-CONT. CAL." point is used for both "SHORT" and "CONTINUITY" testing of air-core flyback transformers and all yokes, but only for "CONTINUITY" testing of iron-core flyback transformers. The "IRON CORE CAL." point is used for "SHORT" testing of iron-core flyback transformers.

NOTE: The "CONTINUITY" test is useful for continuity checking of power and audio transformer windings, wiring, switches and in any other instance where an ohmmeter would normally be used for continuity testing.

The 0-100 linear reference scale is useful for comparing two identical flyback transformers or yokes, one of which is known to be in good condition and another whose condition is unknown. This is a highly reliable method and is recommended to the operator when the reading obtained is in or near the borderline region between "GOOD" and "BAD". Another use for this scale is to enable the operator to record and repeat any new calibration point that might be necessary if flyback transformers or yokes of radically different impedance are developed in the future.

OPERATING INSTRUCTIONS

Read the following instructions carefully before using the instrument

A. Flyback Transformer Testing

1. Turn the TV receiver off and disconnect it from the AC line.

2. Remove the plate caps on the High Voltage Rectifier and Horizontal Output tubes.

3. Remove the HV Rect. tube from its socket. As this instrument is sufficiently sensitive to respond to a closed filament circuit, failure to remove the HV Rect. tube will cause an unjustified "BAD" reading.

NOTE: After the tests have been completed, the HV Rect. tube may be replaced in its socket. If the meter pointer dips with the instrument set for "SHORT" testing, the filament section of this tube is o.k.

4. Unplug the deflection yoke assembly.

5. Unsolder one side of the width coil.

6. Plug the line cord of the Model 944 into a 105-125 volts AC, 50/60 cps outlet and allow the instrument to warm up for one minute.

7. Set the SELECTOR switch at "CONTINUITY" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is at the "AIR CORE-CONT. CAL." point on the scale. This calibration point is used for all "CONTINUITY" testing of flyback transformers (air core or iron core) and yokes.

8. Insert the test leads in the TEST binding posts on the panel and connect them in turn across each winding of the transformer. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale in each test. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the transformer is defective and disqualified from any further testing.

9. Set the SELECTOR switch at "SHORT" and adjust the CALIBRATION control (with nothing connected across the TEST binding posts) until the meter pointer is set at the "AIR CORE-CONT.CAL." position if you are testing an air core flyback transformer or at the "IRON CORE CAL." position if you are testing an iron core flyback transformer. Connect the two test leads to the two plate cap terminals coming from the transformer. (It is not necessary to

observe polarity.) The meter reading may be higher, lower, or the same as the "CAL." point, but should remain in the "GOOD" region of the "XFMR SHORT TEST" scale. If the meter pointer dips into the "BAD" region, the transformer is defective and should be replaced. The short test is now completed. A short anywhere in the flyback transformer will show up in this test. It is not necessary to perform separate "SHORT" tests on the other windings of the transformer.

B. Deflection Yoke Testing

1. Performs steps 6 and 7 above.

2. Disconnect one lead of both the Vertical and Horizontal sections of the deflection yoke from the set. In addition, always check the schematic of the TV set to determine whether or not a resistor shunts the Horizontal or Vertical coil. Any resistor shunt must be disconnected for accurate testing of deflection yokes.

3. Insert the test leads in the TEST binding posts on the panel and connect them in turn across the Vertical and Horizontal sections of the deflection yoke. The meter pointer should dip into the "GOOD" region of the CONTINUITY TEST scale on both tests. If the meter pointer remains stationary or remains within the "BAD" region (indicating an open winding or a high resistance connection) on any test, the yoke is defective and disqualified from any further testing.

4. Set the SELECTOR switch at "SHORT". (There is never any need to reset the CALIBRATION control when going from "CONTINUITY" to "SHORT" testing of deflection yokes as the "AIR CORE-CONT.CAL." point is always used for both tests.) Connect the two test leads across the Vertical and Horizontal sections in turn. (It is not necessary to observe polarity.) In each test, the meter reading may be higher, lower, or the same as the "AIR CORE-CONT. CAL." point, but should remain in the "GOOD" region of the "YOKE SHORT TEST" scale. If the meter pointer dips into the "BAD" region when testing either the Vertical or Horizontal section, that section is defective.

maintenance

If you have constructed your instrument from a kit, potentiometer R1 (mounted in the center of the chassis) must be adjusted as described below before the instrument can be used. In factory-wired instruments, potentiometer R1 has already been adjusted properly for the particular 6K6 tube in your unit and a line voltage of 117 volts. If the normal line voltage in your area is substantially higher or lower, you may readjust R1 by this procedure. R1 must be re-

adjusted by this procedure also whenever aging or replacement of the tube or other components makes it necessary.

1. Set the CALIBRATION control at "0" and the SELECTOR switch at either "CONTINUITY" or "SHORT".

2. Plug the line cord into a 105-125 volts AC, 50/60 cps outlet and allow 1/2 hour for the instrument to warm up.

3. Use a screwdriver to turn the slotted shaft of potentiometer R1 to its extreme clockwise position.

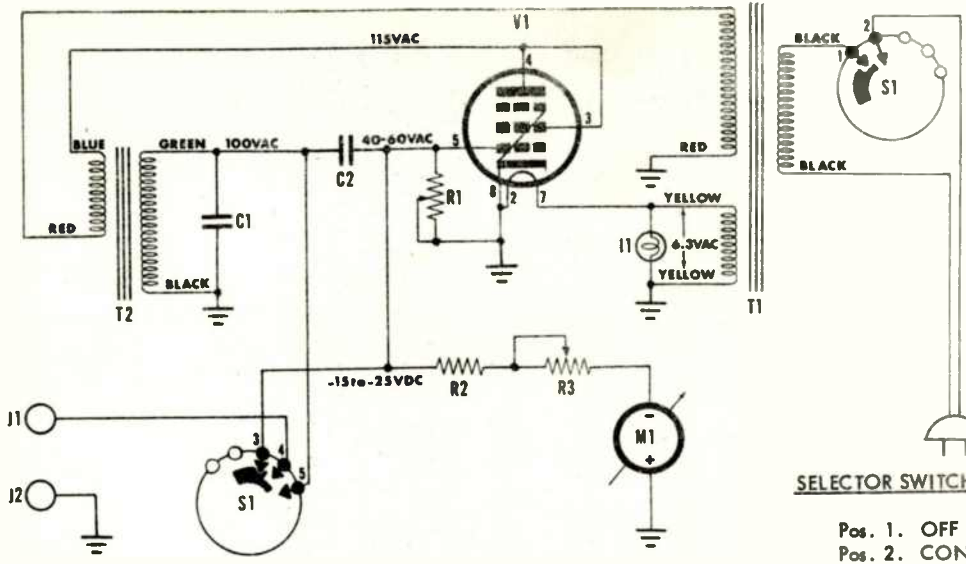
4. Set the CALIBRATION control at "10" on the dial.

5. Rotate potentiometer R1 counter-clockwise until the meter pointer reads exactly full-scale.

The adjustment of R1 is now completed and the instrument is ready for use.

EICO REPAIR SERVICE

If your instrument fails to function properly and the cause of the trouble can not be found, you may return it to the EICO repair department where it will be repaired at a charge of $3.00 plus the cost of parts. (If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book.) Pack carefully and ship by prepaid Railway Express if possible. Return shipment will be made by express collect.



SELECTOR SWITCH POSITIONS

Pos. 1. OFF
Pos. 2. CONTINUITY
Pos. 3. SHORT

Stock#	Sym.	Description	Am't.
20002	C1	cap., .002 mf	1
21000	C2	cap., .001 mf	1
92000	I1	bulb #47	1
72005	M1	meter movement, 50ua	1
18000	R1	pot., 2MΩ w/slotted shaft (int.)	1
10027	R2	res., 270KΩ, 1/2W	1
16011	R3	pot., 2MΩ, calibration	1
60029	S1	switch, 3 pos., selector	1
30013	T1	transformer, power	1
32001	T2	transformer, osc.	1
90005	V1	tube, 6K6	1

MODEL 944 FLYBACK XFMR and YOKE TESTER

ELECTRONIC INSTRUMENT CO., INC.
84 Withers St., Brooklyn 11, N. Y.

EICO

INSTRUCTION MANUAL

FOR

Model 221

Vacuum Tube Volt-Ohm-Meter

ELECTRONIC INSTRUMENT CO.
276 NEWPORT STREET
BROOKLYN 12, N. Y.

INSTRUCTION MANUAL

FOR

Model 221

Vacuum Tube Volt-Ohm-Meter

EICO

ELECTRONIC INSTRUMENT CO.

VACUUM TUBE VOLTMETER

Model 221

SPECIFICATIONS

Overall Dimensions:

Height 9-7/16" Width 6"
Depth 5" Weight 10 lbs.

External Finish:

CABINET: Blue-gray wrinkle laquer on steel

PANEL: Pale Blue-Red trim-Reverse etched

Power Supply:

115 volts, 50-60 cycle (specifications based on 117 volts, 60 cycles).

Power consumption: 10 watts

D-C Voltmeter:

RANGES: 0 to 5, 10, 100, 500, 1,000 volts.

Input resistance: 25 megohms.

A-C Voltmeter:

RANGES: 0 to 5, 10, 100, 500, 1,000 volts r.m.s.
Input Impedance 3 Megohms

Electronic Ohmeter:

Measures from 0.2 ohms to 1,000 megohms (one billion ohms).

RANGES:
- 0 to 1,000 ohms with 9.5 ohms C.S.
- 0 to 10,000 ohms with 95 ohms C.S.
- 0 to 1 Meg. ohm with 9500 ohm C.S.
- 0 to 10 Meg. ohms with 95,000 ohm C.S.
- 0 to 1,000 megohms with 9.5 megohm C.S.

Battery:

1½ Volt Standard Flashlight Dry Cell.
(For Ohms Range Only)

Tube Complement: 1 6H6, 1 6X5, 1 6SN7

ACCURACY: 2% all ranges of AC & DC.

GENERAL DESCRIPTION

Model 221 combines in one compact convenient instrument an adequate laboratory for rapid radio servicing. The instrument consists of an AC-DC completely *electronic volt-ohm meter*

High input impedance is available on both DC and AC voltmeter ranges, since both functions are true vacuum tube voltmeter circuits. Complete electronic overload protection is provided on all AC-DC and Ohmeter ranges. Instantaneous polarity reversal is provided by a flip of a switch on all

DC Voltmeter Ranges. (This instrument will measure DC voltages that are either positive or negative with respect to ground without switching leads). Patented Bridge Circuit provides constant accuracy despite line variations. Visual and audible indications are provided for receiver alignment by use of Db scale of the meter The electronic ohmmeter takes advantage of the high input impedance of the DC Voltmeter to facilitate measurement of resistances up to 1,000 megohms using only 1½ volts. *This feature protects delicate apparatus being measured from the high voltages* normally encountered in high resistance measuring circuits.

The DC electronic voltmeter uses a grounded grid bridge circuit, combining a dual triode tube (6SN7GT) and an extremely rugged meter. The ranges are so chosen as to best fill the needs of practical radio service. Only two calibrations of the arc are required for all AC and DC ranges, eliminating complex and hard to read scales.

The AC electronic voltmeter uses a dual diode 6H6 tube to rectify the voltage to be read, and apply the rectified portion of the applied voltage to the DC voltmeter section. Two simple adjustments of potentiometers on the chassis inside the instrument, calibrate the AC voltmeter, and balance out the unwanted contact potential. (It may be of interest to technical laboratories to note that while the instrument is calibrated during manufacture to read RMS or regular AC, it is a simple matter to re-calibrate it to read peak values). Decibel functions are available at all ranges when function switch is set to AC volts.

The ohmmeter section uses a number of standard matched resistors of 1% tolerance, a 1½ volt "C" battery, and the DC electronic voltmeter bridge to "read" the resistance of any resistor or circuit element from 0.2 ohm to 1,000 megohms.

OPERATING INSTRUCTIONS

INITIAL ADJUSTMENT

Plug the power cord into 60 cycle 117 volt AC Supply, turn on the line switch (associated with the Ohms Adjust Knob) and allow normal warm-up time. Plug the Red test lead into the DC jack. Plug the AC-Ohms Probe into the recepticle marked AC-Ohms.

Plug the Common (Ground) lead into the Banana Jack. THIS IS THE COMMON LEAD FOR ALL THE FUNCTIONS.

Check the mechanical zero adjustment of the needle with the set off. To adjust, rotate screw on Bakelite case with screwdriver.

D-C VOLTAGE MEASUREMENTS

The desired range is set on the RANGE switch and read direct from one of the two voltage scales of the meter.

Operation:

Function........................	to + volts or - volts
Range...........................	to the desired voltage range
Zero Adj.	set voltmeter pointer to Zero.
Common (GND)....................	black lead clip always to grounded or low side of source to be measured
D-C.............................	probe to high side of source to be measured.

Caution Note:

When working with HIGH VOLTAGES: avoid contact with or close proximity to high voltage points. If possible work with the power off in the circuit to be measured.

DO NOT CONNECT ground lead to high voltage point since the Model 221 case is connected directly to ground terminal.

AC VOLTAGE MEASUREMENTS

AC Voltage measurements are read direct from AC meter scale

Operation:

Function........................	to A.C. volts
Range...........................	to desired voltage range.
Zero Adjust.....................	Set voltmeter pointer to zero
Common..........................	Clip to ground or low side of source to be measured.
Probe (AC)......................	to high side of source to be measured.

OHMMETER RESISTANCE MEASUREMENTS

Operation:

Function........................	to ohms
Range...........................	to desired ohms range
Zero Adj........................	Adjust meter pointer to Zero with ohms lead (black) shorted to common lead.
Ohms Adj........................	adjust voltmeter for full scale deflection.

NOTE: *The slight reading noted on the lowest range is the resistance of the leads.*

DECIBEL MEASUREMENTS

Operation:

Function........................	to A.C. volts.
Range...........................	To desired decibel (A.C.) range.
Zero Adjust.....................	Set voltmeter pointer to zero with A.C. lead (Black) shorted to common lead.
Common..........................	Clip to ground or low side of source to be measured.
Probe (Black)...................	to high side of source to be measured.

USING THE DB SCALE FOR RECEIVER ALIGNMENT

The DB scale can be used during receiver alignment:

(1) Connect the RF cable probe and the black ground lead across the voice coil.

(2) Set SELECTOR to A-C VOLTS. RANGE at 5V.

(3) Feed a 400-cycle modulated R-F or I-F signal into the receiver.

Keep receiver volume control at maximum, and adjust signal-generator output to produce a small deflection on DB scale.

As alignment adjustments are made thus increasing the sensitivity, the DB scale will show the improvement directly in decibels.

The effective attenuation of wave traps, in decibels, can be determined by noting the decrease in decibels as the trap is tuned through resonance.

ZERO-CENTER APPLICATIONS

In some applications, for example in aligning the discriminator in FM or AFC circuits, it is convenient to use a zero-center D-C voltmeter, because the D-C output of the discriminator changes from + to - to + as the secondary of the discriminator transformer is tuned or as the input frequency is varied above and below resonance.

This zero-center feature can be obtained as follows:

(1) SELECTOR at either + VOLTS or - VOLTS.

(2) RANGE at 5 V. (higher if necessary).

(3) Turn ZERO ADJ. knob to bring the meter pointer to the zero DB mark on the decibel scale.

(4) Connect the common lead to low side of the discriminator load.

(5) Connect the DC probe to the high side of the discriminator load.

(6) Refer to the decibel scale: when the secondary of a conventional discriminator is correctly tuned, there is zero D-C output, and the meter will indicate zero db.

TO MEASURE POWER OUTPUT IN WATTS

Use formula: $\text{Watts} = \frac{\text{Output Voltage Squared}}{\text{Load Impedance}}$

EXAMPLE:

The maximum undistorted output voltage across a 2-ohm load is 5 volts:

$\text{Watts} = \frac{5\times5}{2} = \frac{25}{2} = 12.5 \text{ Watts}$

OUTPUT METER

When the RANGE switch is set at "5V", with Selector knob at "A-C Volts," the power level in a 600-ohm circuit can be read directly in decibels on the DB scale, which is calibrated from -20 to + 16 db, based on a reference level of 1.0 milliwatt and 600 ohms.

To measure higher levels, turn the RANGE switch to the required higher setting, read decibels on the DB scale, and add to this reading the range factor given below:

Range Switch: Position	Range Factors
10V	6db
100V	26db
500V	40db
1000V	46db

MODEL 221 APPLICATIONS
As applied to Radio Equipment

OSCILLATOR STRENGTH: the negative D-C voltage developed on the oscilator grid is always directly proportional to the strength of oscillation. This voltage can be measured very readily at the oscillator grid while the band switch is changed to the various bands and in each of its positions the main tuning condenser rotated from minimum to maximum capacity. This will give an indication of the strength of oscillation at all frequencies within the oscillator's range.

AVC VOLTAGE: The automatic volume control voltage developed by the incoming signal can be measured at a number of places in the receiver. This negative voltage first appears across the diode load resistor. It may also be measured along the AVC bus and at the grids of the R-F tubes being controlled. THIS D-C VOLTAGE MEASURED AT THE DIODE LOAD RESISTOR IS A VERY CONVENIENT OUTPUT INDICATION DURING RECEIVER ALIGNMENT.

Owing to the high input resistance of the Model 221, it is possible to measure bias (AVC) voltage on the grid of R-F and I-F amplifier tubes without disrupting the signal.

D-C SUPPLY VOLTAGES: The power supply D-C voltage can be measured at the rectifier filaments and in the filter circuit; plate voltages at the plates of the various tubes; screen voltages at the screen voltages dropping resistor; and cathode voltages at the tube cathodes.

BIAS CELL VOLTAGE: The Model 221 will accurately measure the voltage delivered by a bias cell. Most voltmeters are not capable of making this measurement and in many cases will damage the cell if it is attempted. This voltage should be measured across the cell.

AFC DISCRIMINATOR VOLTAGE: The discriminator voltage developed in radio receivers employing automatic frequency control can be measured directly at the discriminator and also at the grid of the oscillator control tube.

F.M. DISCRIMINATOR VOLTAGE: The D.C. Voltage developed by the discriminator in a frequency modulation receiver can be measured right at the discriminator. For convenience in this application, the ZERO ADJ. knob should be set so the pointer is on the ZERO DB mark of the decibel Scale so the pointer can swing positive or negative without changing the polarity switch.

TELEVISION RECEIVER ADJUSTMENTS: The Model 221 is very useful for measuring the D-C voltage developed in the picture channel of a television receiver across the second-detector load resistor. This measurement is most useful when adjusting antenna orientation and position as well as when adjusting antenna-matching sections.

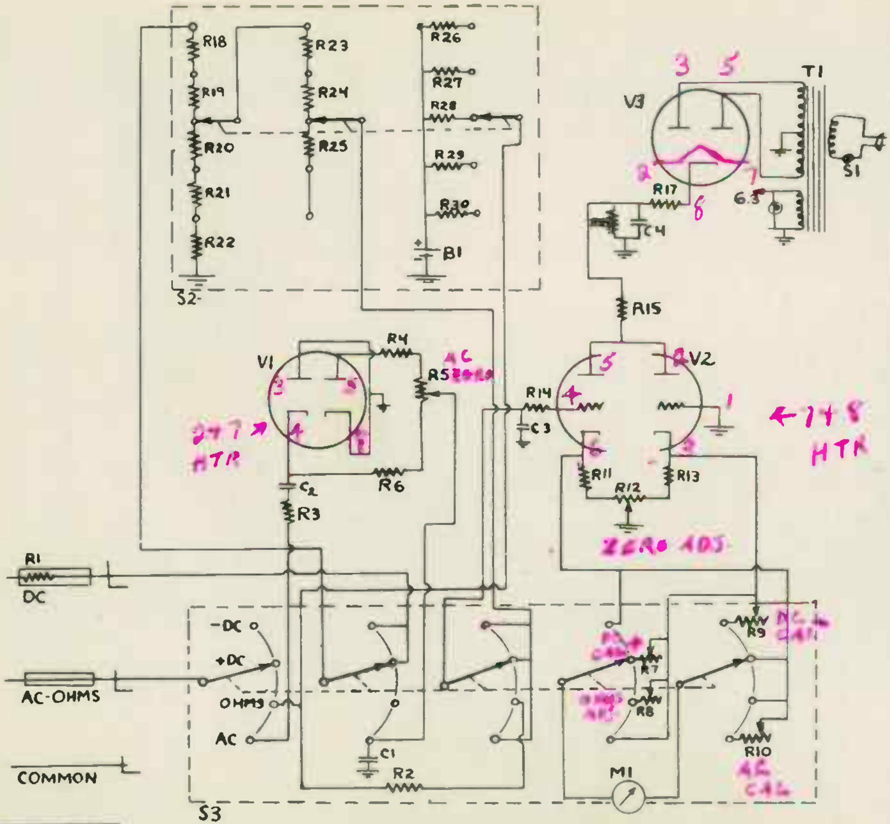
GASSY TUBES: One effect of a gassy tube is to reduce the normal negative grid bias, or even make the grid positive. The Model 221 is ideal for measuring the voltage directly at the control grid of any tube in order to determine whether or not this effect is present. Excessive gas will cause the tube to cease operating normally and in an audio amplifier, will usually cause the volume control to become noisy. This amount of gas will not always produce a noticeable change in the operation of the radio receiver. Consequently if repeated difficulty is experienced with volume controls becoming noisy, in this type of circuit, the Model 221 should be used to check for incorrect bias.

A-C VOLTAGES: The A-C voltmeter within the Model 221 is extremely useful in measuring all A-C voltages encountered in the average radio receiver. The measurements include all voltages from power transformer secondaries, and audio voltages developed across the output transformer or voice coil as an indication of output during receiver alignment. When making such measurements all readings should be taken with respect to ground, and other cautions under A-C voltage measurements should be observed.

The MODEL 221 can be used to check for presence of audio signals at grids and plates of audio amplifiers, etc.

G U A R A N T E E

This instrument is guaranteed to be free from defects in material and workmanship in accordance with the terms of the Standard RMA Warranty.



ITEM	PART	SPECIFICATION
R1	41	15 MEG. RES.
R2	42	12 MEG. RES.
R3	46	500,000Ω
R4	44	1.5 MEGOHM
R5	53	2 MEG AC ZERO POT
R6	44	1.5 MEGOHM
R7	51	1K +DC. CAL. POT
R8	52	1K OHMS ADJ POT
R9	51	1K -DC CAL. POT
R10	51	1K AC CAL. POT
R11	50	1,000Ω BTS
R12	52	1K ZERO ADJ. POT
R13	50	1,000Ω BTS
R14	45	1 MEGΩ BTS
R15	49	20,000Ω
R16	47	33,000Ω 2W
R17	48	10,000Ω 2W
R18	32	5 MEGΩ 1%
R19	33	4.5 MEGΩ 1%
R20	34	400,000Ω 1%
R21	35	50,000Ω 1%
R22	35	50,000Ω 1%
R23	43	5 MEGΩ BTS
R24	57	4.7 MEGΩ BTS
R25	46	500,000Ω BTS
R26	36	9.5Ω 1%
R27	37	95Ω 1%
R28	38	9500Ω 1%
R29	39	95.000 1%
R30	40	9.5 MEGΩ 1%
C1	55	.01 CONDENSER
C2	55	.01 COND.
C3	54	.002 COND.
C4	56	2MFD COND.
V1	25	6H6 TUBE
V2	24	6SN7 TUBE
V3	23	6X5 TUBE
T1	22	TRANSFORMER
M1	3	0-1 MA. METER
B1	28	1.5 VOLT BATTERY
S1	9	ON-OFF SWITCH
S2	4	RANGE SWITCH
S3	5	FUNCTION SWITCH

EICO

MODEL 221-CIRCUIT DIAGRAM