w/954 sheets

RADIO SET ANALYZING (VOM)

The Series 954 Super-Sensitive Dynamic Electronometer, in addition to complete tube analyzing, also incorporates a ROTARY RANGE SELECTOR system providing for the following:

1. A.C. voltage measurements at 1000 ohms per volt from 0 to 6000 volts.
2. D.C. voltage measurements at 20,000 ohms per volt from 0 to 6000 volts.
3. D.C. current measurements up to 12 Amperes.
4. Resistance measurements up to 60 megohms.
5. Output meter indications from 0 to 6000 volts.
6. Decibel readings in 6 ranges from -12 to +70 DB.
7. D.C. current measurements of leakage in electrolytic condensers.

The ranges employed and the method of selection in order to obtain these measurements and tests will be considered as if operating individual instruments.

FOR RADIO SET ANALYZING, IT IS IMPORTANT THAT CONTROL "A" BE FIRST SET TO THE "A.C." OR "D.C." POSITION BEFORE ATTEMPTING TO EMPLOY "MASTER RANGE SELECTOR" switch "F".

As a safety factor, it is advisable to disconnect instrument "fused plug" from A.C. line source before making measurements except when employing the 0-60 Megohm Range as noted on the following page.

A.C. VOLTAGE MEASUREMENTS:-1000 ohms per volt.

SET CONTROL "A" TO THE "A.C." POSITION FOR ALL A.C. VOLTAGE MEASUREMENTS. For A.C. voltage measurements up to 600 volts, select desired range on rotary MASTER RANGE SELECTOR. Insert test leads into polarized "EXT.TEST" tip jacks and read on proper RED A.C.CORRECTION SCALES as follows:

0-3v read directly on separate 3v A.C. CORRECTION SCALE
0-12v read on 120 scale, divide by 10
0-60v read directly
0-300v read on 30 scale, multiply by 10
0-600v read on 60 scale, multiply by 10

For A.C. VOLTAGE MEASUREMENTS ABOVE 600v. and to 6000v., set rotary MASTER RANGE SELECTOR to the 600v. position. Insert one test lead into the negative (-) "EXT.TEST" tip jack, and the other test lead into the appropriate 1200v. or 6000v. A.C. tip jacks and read on A.C. CORRECTION SCALE as follows:

0-1200v. read on 120 scale, multiply by 10
0-6000v. read on 60 scale, multiply by 100

CAUTION:-WHEN EMPLOYING THE 1200v. and 6000v. RANGES FOR MEASUREMENTS IN EXTRA HIGH VOLTAGE CIRCUITS, EXTREME CARE MUST BE OBSERVED IN THE MANNER OF HANDLING TEST PRODS, TIP JACKS AND HIGH VOLTAGE CIRCUIT UNDER ANALYSIS.

The "PRECISION" extra high voltage super-flex test leads (supplied with this instrument) have been designed for full safety of operation up to 6000 volts A.C. at 60 cycles and 6000 volts D.C.

D.C. VOLTAGE MEASUREMENTS:-20,000 ohms per volt.

SET CONTROL "A" TO THE "D.C." POSITION FOR ALL D.C. VOLTAGE MEASUREMENTS. For D.C. voltage measurements up to 600 volts, select desired range on rotary MASTER RANGE SELECTOR. Insert test leads into polarized "EXT.TEST" tip jacks and read on D.C. scale as follows:

0-3v. read on 30 scale, divide by 10
0-12v. read on 120 scale, divide by 10
0-60v. read directly
0-300v. read on 30 scale, multiply by 10
0-600v. read on 60 scale, multiply by 10

For D.C. VOLTAGE MEASUREMENTS ABOVE 600v. and to 6000v., set rotary MASTER RANGE SELECTOR to the 600v. position. Insert one test lead into the negative (-) "EXT.TEST" tip jack and the other lead into the appropriate 1200v. or 6000v. D.C. tip jacks and read on D.C. scale as follows:

0-1200v. read on 120 scale, multiply by 10
0-6000v. read on 60 scale, multiply by 100

CAUTION: WHEN EMPLOYING THE 1200v. and 6000v. RANGES FOR MEASUREMENTS IN EXTRA HIGH VOLTAGE CIRCUITS, EXTREME CARE MUST BE OBSERVED IN THE MANNER OF HANDLING TEST PRODS, TIP JACKS AND HIGH VOLTAGE CIRCUITS UNDER ANALYSIS.

All voltage measurements are made with test leads applied across load. Observe proper polarity at tip jacks.

IMPORTANT PRECAUTIONS
When Testing High Voltage Circuits

Whenever making voltage measurements in any circuits wherein the potentials exceed 1200 volts, it is advisable for the operator to connect the instrument panel to a good ground. The cold water pipe is usually sufficient. Connection should be made from ground source to under one of the etched instrument panel border mounting screws.

This practice will protect the operator at all times from electrostatic charges which may readily accumulate on instrument panel, or in the case of metal cased units, on both case and panel.

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BEFORE making ANY MEASUREMENTS in a Television Receiver or in any other device wherein the POSITIVE (+) side of the high voltage power supply is connected to chassis, it is absolutely IMPERATIVE that all external ground connections be removed. This includes the following:

1. DISCONNECT ANY external grounding leads (such as from radiators, cold water pipes or power line neutrals) which may be connected (directly or through a condenser) to the receiver or device upon which measurements are to be made.
2. COMPLETELY DISCONNECT ALL power line by-pass condensers from their connection to the A.C. line cord or power transformer primaries.

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NEVER attempt adjustment or test of any circuits (such as television receivers) wherein exceedingly dangerously high voltages are present unless a complete circuit diagram is available to identify the location of all high potential terminals. Always employ well insulated test leads, such as the Precision Extra High Voltage Super-Flex Test Leads, which accompany this instrument.

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Make sure hands and shoes are DRY when performing tests wherein high voltages are involved.

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D.C. CURRENT MEASUREMENTS:

SET CONTROL "A" TO THE D.C. POSITION FOR ALL D.C. CURRENT MEASUREMENTS. For D.C. CURRENT RANGES OF 3 MA TO 600 MA INCLUSIVE, select desired range on rotary MASTER RANGE SELECTOR. Insert test leads into polarized "EXT.TEST" tip jacks and read on D.C. scale as follows:

0-3 MA read on 30 scale, divide by 10
0-30 MA read directly
0-120 MA read directly
0-600 MA read on 60 scale, multiply by 10

FOR THE 60 AND 300 MICROAMPERE RANGES, set rotary MASTER RANGE SELECTOR to the 30 MA position. Insert negative test lead into the negative (-) "TEST" tip jack and the positive lead into the appropriate 60 microamp or 300 microamp positive (+) tip jacks and read on D.C. scale as follows:

0-60 microamps read directly
0-300 microamps read on 30 scale, multiply by 10

FOR THE 12 AMPERE RANGE, set rotary MASTER RANGE SELECTOR to the 600 MA position. Insert test leads into the polarized "12 AMP" tip jacks located at lower right hand corner of instrument panel, and read on D.C. scale as follows:

0-12 AMPS read on 120 scale, divide by 10

NOTE:-When using the 12 Ampere D.C. range, never remove tip jacks while current is flowing through the circuit. Failure to observe this would result in arcing at the tip jack being removed and though it would not injure the meter, the jack would gradually char.

All current measurements are made with test leads in series with load. Observe proper polarity at tip jacks.

CAUTION:-

When voltage or current of unknown value is to be measured, it is advisable to employ the highest range first. If meter indication is slight, then select next lower range, etc. Adhere closely to the above to prevent slamming of meter pointer and meter overloading.

RESISTANCE MEASUREMENTS:

ALL RESISTANCE MEASUREMENTS ARE MADE WITH CONTROL "A" IN D.C. POSITION.

0-6000 OHMS RANGE.

Set RANGE SELECTOR to the 6000 ohms range and with test leads SHORTED, rotate (ADJUST OHMS) CONTROL "C" to obtain full scale deflection. Then proceed with measurements.

Resistance measurements for this range are read directly on the 6000 ohms scale.

0-600M OHMS RANGE.

Set RANGE SELECTOR to the 600M ohms range and with test leads SHORTED, rotate (ADJUST OHMS) CONTROL "C" to obtain full scale deflection. Then proceed with measurements.

Resistance measurements for this range are read on the 0-6000 ohms scale multiplied by 100.

NOTE:- The above two ohmmeter ranges are powered by a self-contained standard 1½ volt flashlight battery located on the inside of carrying case. This battery should be replaced when full scale deflection can no longer be obtained. RED lead should connect to 1½ volts plus (+), and BLACK lead to 1½ volts minus (-).

0-60 MEGOHM RANGE.

The 0-60 MEGOHM RANGE is made possible through the use of the tester power supply and it is therefore necessary to connect the instrument plug into any 50-60 cycle 110-125 volt A.C. source and instrument turned on.

Set CONTROL "A" to D.C. position and RANGE SELECTOR to 60 MEGS; rotate CONTROL "C" to its full-on "50" position and with test leads shorted, rotate "LINE ADJUSTMENT" CONTROL to obtain full scale ohmmeter deflection, before taking resistance measurements for this high range

Resistance measurements for this range are read on the 0-6000scale multiplied by 10,000.

CAUTION:-Any resistance measurements to be taken should be free from ground and live voltage source. Always first disengage one end of resistance from the circuit before making resistance measurements, or else an indication of the true resistance value may not be obtained due to the possibility of the circuit therein involved effectively shunting the resistance to be measured, thus reducing the true reading by an amount proportionate to the resistance of the included shunt network.

OUTPUT METER INDICATIONS.

The A.C. voltage measurements at a high sensitivity of 1000 ohms per volt makes this instrument ideally suitable for use as an output meter.

There are two methods that can be used for obtaining output meter indications as listed below:

In the firt method, make connections from the voice coil of speaker or secondary of output transformer to "EXT. TEST" tip jacks. In the event that easy access to the voice coil or secondary of transformer cannot be had, then refer to method outlined below.

In the second method, make connections from plate of output tube and ground or chassis of radio receiver to "EXT. TEST" tip jacks with a good quality .25 mfd. paper condenser in series with one of the leads in order to block the D.C. component. The voltage rating of this condenser should be comparable to the D.C. voltage appearing at the points across which the output measurements are taken.

PROCEDURE:

With the use of either method noted above, set CONTROL "A" to the A.C. position and rotary RANGE SELECTOR to highest voltage range. An output meter indication will be had when signal generator and radio receiver are put into operation. If the meter indication is slight, then use the next lower A.C. voltage range, etc.

Any gain or loss by reason of balancing or trimming will be accordingly noted by corresponding meter pointer deflection.

NOTE:-The output meter can also be used to great advantage for obtaining comparisons in tube performance by noting the difference in meter indications when any or all of the tubes are substituted in the radio receiver under test.

DECIBEL METER.

The Series 954 Super-Sensitive Dynamic Electronometer incorporates a direct reading and calibrated decibel scale enabling readings from -12 to +70 DB in six ranges.

The initial meter scale, reading -12 to +16 DB, is based upon a zero level of 6 milliwatts or 1.73 volts across a 500 ohm load, 500 ohms being that most commonly employed

in audio work. The most common use of a decibel meter is that of a power level indicator across known impedances. Because of calibration at one definite impedance, conversions must be made to the new impedance when used at other than 500 ohms. Such tables may be found in a multiplicity of text books and technical magazines. (See last page of this booklet for Decibel Conversion Table.)

Caution must be observed in the use of the DB ranges that the circuit across which the meter is placed is isolated from all D.C., else the meter may be damaged or at least erroneous readings obtained, depending upon whether the D.C. voltage is greater or less than the voltage scale to which the decibel scale corresponds.

PROCEDURE:

Make connections across 500 ohm load to "EXT.TEST" tip jacks. Set CONTROL "A" to the A.C. position for all DECIBEL READINGS. Select suitable DB range on RANGE SELECTOR CONTROL "F" in the same order as the A.C. voltage ranges to which the Decibel Ranges correspond. For example: The initial DB range, as noted on the meter scale plate, (-12 to +16 DB), corresponds to the voltage range of 12 volts AC. The second DB range corresponds to the voltage range of 60 volts, etc.

The decibel scales read in order as follows:

0 DB range: (12 volts A.C.) read directly on initial DB scale (-12 to +16 DB).
+14 DB range: (60 volts A.C.) read on initial DB scale and add +14 DB. This makes the range (+4 to +30 DB).
+28 DB range: (300 volts A.C.) read on initial DB scale and add +28 DB. This makes the range (+18 to +44 DB).
+34 DB range: (600 volts A.C.) read on initial DB scale and add +34 DB. This makes the range (+24 to +50 DB).
+40 DB range: (1200 volts A.C.) read on initial DB scale and add +40 DB. This makes the range (+30 to +56 DB).
+54 DB range: (6000 volts A.C.) read on initial DB scale and add +54 DB. This makes the range (+42 to +70 DB).

CURRENT MEASUREMENTS OF LEAKAGE IN ELECTROLYTIC CONDENSERS:

The leakage in an electrolytic condenser is measured in terms of D.C. current (per microfarad) flowing through the condenser when rated D.C. voltage is applied.

All electrolytic condensers contain an inherent current leakage. However, if leakage above an allowable amount is present, it can then be termed as poor. An allowable current leakage is dependent upon such factors as age and manufacturers' specifications of a condenser, design of power unit, filter system and rectifier tube of the radio receiver in which the condenser is incorporated. In general, considering an 8 mfd. condenser that has been in use (rated at 450 volts), the maximum allowable leakage is approximately .5 MA per microfarad or 4 MA total.

The following will serve as a basis for computing approximate maximum allowable leakages:

(a) For condensers rated at 300 volts or more, leakage of approximately .5 MA per microfarad is permissible.
(b) For condensers rated between 100 to 275 volts, permissible leakages are approximately .2 MA per microfarad.
(c) For condensers rated below 100 volts, permissible leakages are approximately .1 MA per microfarad.

CAUTION:-WHEN OBTAINING ELECTROLYTIC LEAKAGE MEASUREMENTS, HIGH VOLTAGE IS EMPLOYED. IT IS THEREFORE EXTREMELY IMPORTANT THAT THE FOLLOWING INSTRUCTIONS BE ADHERED TO IMPLICITLY TO PREVENT DAMAGE TO METER.

PROCEDURE:

With condenser disconnected from radio receiver circuit, CHECK CONDENSER FOR SHORT with ohmmeter, using the 0-600,000 OHMS RANGE. POLARITIES MUST BE OBSERVED. The positive "TEST" tip jack is connected to outside can or negative terminal of condenser and the negative "TEST" tip jack is connected to the anode (positive) terminal of condenser. A decided low resistance reading or constant full scale deflection of ohmmeter pointer indicates that the condenser is shorted and should be rejected WITHOUT FURTHER TESTING.

When an electrolytic incorporated in a radio receiver is to be tested, the necessary rated voltage is automatically applied and the following connections are made for "forming" and measuring the current leakage, after being (ohmmeter) tested for short.

(1) Set CONTROL "A" to the D.C. position and rotate master RANGE SELECTOR to the 120 MA position.

(2) Remove lead from (positive) anode terminal of condenser and connect this lead to the positive "TEST" tip jack with A PROPER LIMITING RESISTOR IN SERIES.

(Where voltage applied to condenser is above 100 volts, the limiting resistor should be approximately 4000 ohms. When the applied voltage is below 100 volts, the value of the limiting resistor should be approximately 900 ohms. This limiting resistor is very important and should not be omitted.

(3) Connect the negative "TEST" tip jack to the (positive) anode terminal of condenser. (From the above connections, it can be seen that the "TEST" tip jacks, limiting resistor, condenser terminals and voltage source are in series connection.)

(4) After series connections are made, turn on switch of radio set. The meter pointer will now deflect to near full scale and then gradually recede to the zero mark or near zero, after the expiration of about three minutes. THIS PROCEDURE IS KNOWN AS "FORMING" THE CONDENSER.

NOTE:-A steady meter pointer indication without receding to or near zero (after forming process) indicates a shorted or leaky electrolytic and the condenser should be rejected WITHOUT FURTHER TESTING.

(5) After "forming", short out the limiting resistor and read current leakage of condenser under test, directly on the 120 MA scale. If meter indication is under 30 MA, set RANGE SELECTOR to the 30 MA position for a better meter indication and read on 30 MA scale, etc. (For computation of permissible condenser leakage, refer to basis noted previously.)

CAUTION:-AFTER THIS TEST IS COMPLETED, ALWAYS FIRST DISCONNECT THE NEGATIVE TEST LEAD FROM CIRCUIT BEFORE TURNING OFF POWER SUPPLY TO PREVENT SLAMMING OF METER POINTER DUE TO DISCHARGE OF CONDENSER UNDER TEST.

To test electrolytic condensers not incorporated in a radio set, an external D.C. power supply is necessary. Preferably one that employs various voltage taps suitable to application for the various D.C. voltage condenser ratings. In this case, adhere to the same testing procedure as noted above in paragraphs 1, 4 and 5, but making the following series connections:

(a) Select voltage tap of D.C. power supply approximating rated voltage of condenser to be tested.

(b) Connect positive potential of power supply to the positive "TEST" tip jack with a 4000 ohm limiting resistor in series if applied potential is above 100 volts. If potential is 100 volts or under, use a 900 ohm limiting resistor.

(c) Connect negative potential of power supply to outside can or negative terminal of condenser.

(d) Connect negative "TEST" tip jack to the (positive) anode terminal of condenser.

(e) Refer to paragraphs 1, 4 and 5 for obtaining current leakage measurements.

QUALITATIVE PAPER CONDENSER TESTS:-Other than the use of the 60 MEGOHM RANGE.

The insulation resistance or permissible leakages of paper and mica condensers is expressed in megohm microfarads. A good 1 mfd. condenser will have an insulation resistance of approximately 450 megohms. Furthermore, insulation resistance of paper and mica condensers of similar voltage ratings is inversely proportional to its capacity, so that a .1 mfd. condenser will have ten times the insulation resistance of a 1 mfd. condenser or 4500 megohms. It therefore can be readily seen that it is not always practical to use the ohmmeter method for measuring leakages in paper or mica condensers.

In the following method, a high D.C. potential is applied to the condenser in series with the proper D.C. VOLTS range to determine whether or not it has low insulation resistance or abnormal leakage.

The necessary D.C. potential can be obtained from an external high voltage D.C. power supply or from the power output tube socket of a radio receiver. In the latter instance, the plate prong position of that socket will be the positive high voltage lead and the negative return or ground will be the negative lead. Voltage to be applied to the condenser should be greater than its rated voltage.

PROCEDURE:

1. Measure the D.C. voltage obtainable from D.C. power supply to be used. Then select the proper voltmeter range that would indicate the greatest deflection for the voltage there available.

2. With the power supply OFF, insert the high voltage leads into the instrument tip jacks, observing correct polarities, and insert the condenser to be tested in series with one of these leads.

3. Turn ON power supply. An instantaneous deflection due to the charge of the condenser will be indicated on the D.C. meter.

(a) In the case of a good condenser, the needle pointer will recede to the zero voltage mark.

(b) If the meter pointer remains above the zero mark, then this indicates that the condenser has abnormal leakage.

(c) If the meter pointer remains at the indicated value of the voltage measurement obtained initially, then the condenser is "shorted".

(d) If no meter deflection is obtained, then this indicates that the condenser is "open" or that the capacity is too low in value to indicate an instantaneously noticeable meter deflection when charged.

CAUTION:-AFTER THIS TEST IS COMPLETED, ALWAYS FIRST DISCONNECT THE NEGATIVE TEST LEAD FROM CIRCUIT BEFORE TURNING OFF POWER SUPPLY TO PREVENT SLAMMING OF NEEDLE POINTER DUE TO DISCHARGE OF CONDENSER UNDER TEST.

GENERAL INFORMATION

NOTE:-
A slight overload will damage or change characteristics of the meter rectifier incorporated. Rectifiers are checked before instruments leave the factory. It is important to note this fact inasmuch as rectifiers are not guaranteed when overloaded.

Instructions and guarantee card are enclosed with this instrument. Mail the guarantee card at once for future information to be mailed from this record. Always give Pattern No. and Serial No. when writing for information relative to this instrument.

SERIES 954 MULTI-RANGE TESTER
ACCESSORIES INCLUDED:

1 Standard 1½ volt flashlight Battery .....$ .10
1 Set of extra high voltage super-flex test leads. (Part No. 228) 1.65

NOTE:-
Extra accessories, if required, will be sent postpaid upon receipt of money order or stamps equivalent to prices noted above. Minimum billing $.50.

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