J94003C NOISE MEASURING SET (3C)

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1. GENERAL

1.01 This section describes the J94003C (3C) noise measuring set which is used to measure noise on various circuits in the telephone plant.

1.02 The 3C noise measuring (NM) set is a portable instrument contained in a metal case and cover. It is normally powered by a self-contained 45-volt battery; however, an arrangement is provided whereby the set can be powered from 120 volts 60 Hz by means of an external J87281A power supply. The principal differences between the 3C set and the 3A noise measuring set are (1) the dialing and holding features and (2) an input jack which accommodates a 310 plug.

1.03 The 3C NM set may be used to measure weighted or unweighted noise metallic (bridging and terminating) referred to 0 dBrn (10^{-12} watt of 1000-Hz power dissipated at the point of measurement) and to measure noise to ground referred to +40 dBrn. In the latter case, 40 is added to the attenuator plus the meter readings to reference the result to 0 dBrn.

1.04 The input impedance (terminating) is 735 ohms which is the geometric mean between 600 and 900 ohms, as described in Part 4.

1.05 Dialing and holding features permit a distant termination to be dialed while the set is connected to the circuit under test and to hold the connection during the noise measurement. A jack and clip-on posts are provided for connecting to a dial telephone hand test set or equivalent.

1.06 The use of the 3C NM set with external meters and recorders is described in Part 9 of this section. The 3C set may be used with the 106A current and 107A voltage TIF coupling units for measurements of KV·T and I·T product from which the telephone interference factor is determined.

1.07 The 3C set has been designed to characterize quantitatively the effects of noise on the listener, so that noises which are judged equally interfering are assigned the same numerical magnitude. To accomplish this, the 3C noise measuring set performs the following functions:

(a) Weights the components of a given noise voltage in proportion to their interfering effect.

(b) Adds the weighted voltage components on an rms (power) basis.

(c) Indicates the result on a meter with suitable dynamic characteristics.

The 3C noise measuring set weighs approximately 14 pounds and is 11 inches long, 7 inches wide, and 8 inches deep. Figure 1 is a photograph of the set with the cover removed.

2. DESCRIPTION OF APPARATUS

A. External Arrangement

2.01 In Fig. 1 two input arrangements are provided: (1) a jack which accepts a 310-type plug and (2) binding posts marked T, R, and S which are connected to the tip, ring and sleeve terminals of the input jack. The binding posts will accept cords having banana plugs, bare wire, 35-type cord tips, or a number of standard clips or spade terminals. The two inputs are electrically identical.

2.02 Directly below the input connectors are two possible means of connecting dialing apparatus. The jack accepts a 310-type plug. The connectors marked T and R accept test-type clips such as those provided on a W2EY cord.

2.03 Adjacent to the clip connectors is the GRD binding post which is equipped with a sliding strap. Normally, this strap is inserted under the S binding post and a ground wire is attached to the GRD post. However, if the test connection is such that no ground should be present on the sleeve, the strap is disconnected from the S binding post.

2.04 Below the connectors is a 2-position slide switch marked DAMP-NORM. Ordinarily, noise measurements are made with this switch in the normal (NORM) position. When measuring rapidly fluctuating noise, the switch may be operated to the DAMP position. Additional information on the effect of this switch is contained in 7.01 (i).

2.05 Situated below the damping switch is the FUNCTION switch, which selects the proper input circuitry and provides a means for dialing and holding, checking the battery, and calibrating the set.

2.06 To the right of the FUNCTION switch is a meter calibrated in dBrn. A red line and a shaded area provided on the meter scale are used for calibration and checking the battery.

2.07 To the right of the meter is the DBRN switch which controls the attenuator in the set. Attenuation is provided in 5-dB steps from 0 to 85 dB.

2.08 Above the DBRN switch is the WTG receptacle which accommodates the various weighting networks. Two separate plug-in units, each containing two networks, are available. The proper weighting network to be used for a specific application is discussed in Part 3 of this section. When a unit is plugged into the set, the upright lettering indicates which of the two networks is connected. The other network of that unit may by used by simply removing the plug-in unit, rotating it 180°, and reinserting it. The 1-kHz insertion loss of each of the networks is the same; therefore, the set does not require a new primary calibration when the network is changed.

2.09 To the left of the WTG receptacle are two monitoring jacks, one marked DC MON and the other AC MON. The DC MON jack provides a dc output suitable for driving external recorders or other dc measurement equipment. Insertion of a type 347 or equivalent plug into this jack

Fig. 1—J94003C Noise Measuring Set

disconnects the indicating meter. The AC MON jack provides a means for high-impedance monitoring with a 723A receiver equipped with a W2FS cord. ***It should be noted that this receiver and cord assembly cannot be used with the 3A noise measuring set or vice versa (see 2.22).*** A type 347A, 347B, or equivalent plug may be used to connect the monitoring output to an external ac meter. The indicating meter is not disconnected in this case.

2.10 To the left of the monitoring jacks is a screwdriver-operated calibration potentiometer marked CAL. This potentiometer provides for adjustment of the sensitivity of the set when calibrated with a reference milliwatt source or the internal reference oscillator. The procedure for making this check is described in Part 5.

2.11 The four captive screwdriver-slotted latch screws on the rear of the case may be unscrewed, but not removed, to permit removal of the panel for internal calibration and other maintenance. All apparatus except the battery is mounted on the panel.

2.12 Access to the battery is gained through an opening in the side of the set as shown in Fig. 10.

2.13 If desired, an external power supply (J87281A) may be connected to the 3C NM set. Access to the power connector is through a compartment door on the opposite side of the case from the battery opening. Opening the door switches the circuitry from the battery to the power connector. This arrangement is shown in Fig. 11.

2.14 Inside the cover of the set are compartments for storing the 723A receiver with its cord and the additional weighting network. Operating instructions are inscribed on the inside of the cover. The cover also provides a protruding guide which fits over the knob of the function switch. This guide prevents the cover from properly fitting

on the set unless the function switch is in the OFF position.

B. Electrical Features

2.15 Figure 2 is a simplified block diagram of the 3C NM set.

FUNCTION Switch

2.16 The FUNCTION switch changes the circuit to provide the nine functions required of the set.

(a) The OFF position shorts the meter (M1) and disconnects the battery.

(b) The BAT position arranges the meter as a voltmeter to indicate the battery voltage under normal load.

(c) The CAL position applies battery to the internal oscillator. A 1000-Hz tone from the oscillator is connected directly to the attenuator for calibration purposes, as shown in Fig. 3.

(d) The BRDG position is used to measure noise on circuits without removing them from service.

(e) The N_G position is used to measure noise voltages between a circuit and ground, such as those resulting from longitudinal induction.

(f) The N_M 600/900 position is used as a termination when a metallic measurement at either 600 or 900 is specified.

(g) The N_G HOLD position has the same function as the N_G position and in addition, connects a holding network with a dc resistance of 700 ohms across the input circuit.

(h) The N_M 600/900 HOLD position has the same function as the N_M 600/900 position and provides in addition, for connecting a holding network with a dc resistance of 700 ohms across the input circuit. The holding network used in this and the previous case permits holding the connection after it is dialed, while making the noise measurement.

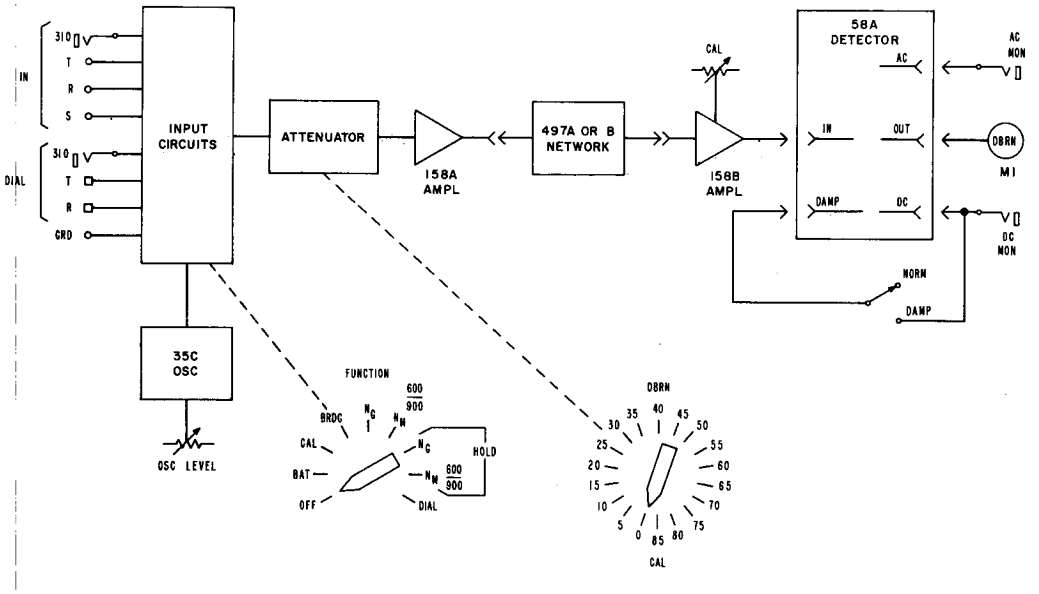

Fig. 2—J94003C Noise Measuring Set, Block Diagram

(i) The DIAL position connects the input T and R connectors to the dial T and R connectors and disconnects the input connectors from the input circuit of the set. This position is used for dialing the far end test termination over the line under test when required for making the noise measurement.

Attenuator

2.17 The attenuator consists of π and L resistive pads combined by the switching arrangement to introduce the proper loss at each step of the DBRN dial. It has a range of 85 dB in 5-dB steps.

158A AMPLIFIER

2.18 The 158A amplifier is the input amplifier for the set and provides about 23 dB of voltage gain. The input impedance (about 15,000 ohms) serves as a termination for the attenuator. The output impedance of 600 ohms serves as the driving point impedance for the plug-in networks.

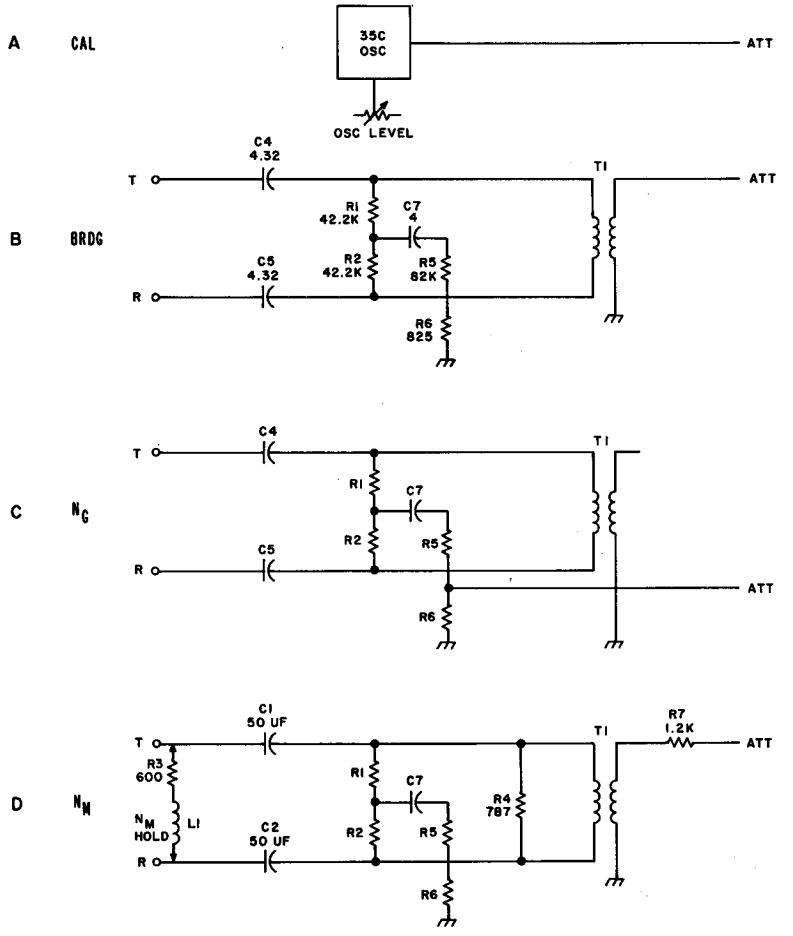

Fig. 3—Input Circuits, Simplified Schematic

497A and 497B Networks

2.19 The 497A and 497B networks, in conjunction with the characteristics of the set, provide C-message, 3-kHz flat, program, and 15-kHz flat weighting.

158B Amplifier

2.20 The 158B amplifier is the power amplifier for the noise measuring set and provides from 67 to 71 dB of voltage gain, depending on the setting of the CAL control. The input impedance is 600 ohms and serves to properly terminate the weighting network. The output impedance of the amplifier is approximately 50 ohms.

58A Detector

2.21 The 58A detector provides quasi-rms rectification of the input signal. Normally, the rectified signal is fed to the indicating meter. When the DC MON jack is used, the meter is disconnected and the rectified signal is fed to the DC MON jack.

2.22 The 58A detector also supplies the ac monitoring output. The output impedance of the AC MON jack is approximately 15,000 ohms. ***It is important to note that this output impedance is different from that of the AC MON jack of the 3A noise measuring set, which is only 600 ohms. The 3A set thus requires a 723 receiver with a special cord assembly (2W46A) which has a built-in 15,000-ohm resistor to reduce the bridging effect of the receiver on the meter indications. The cord (W2FS) used with the 723 receiver for the 3C set has no built-in resistor. Care should, therefore, be exercised to avoid the association of the wrong receiver and cord assembly with the 3A and 3C sets. Use of the receiver and cord of the 3C set with the 3A set will result in erroneous indications. Use of the receiver and cord of the 3A set with the 3C set will result in low receiver output.***

3. FREQUENCY WEIGHTING

A. C-Message Weighting

3.01 The C-message weighting characteristic, ▶including manufacturing tolerances,◀ is shown in Fig. 4. This weighting is used for the measurement of noise on circuits where C-message weighting is specified. The shape of the C-message characteristic was determined by subjective tests on the relative interfering effects of single frequencies, as heard over a 500-type telephone set. It may also be used for the measurement of noise with respect to the 300-type telephone set. The C-message weighting ▶(C MESSAGE)◀ network, associated with this characteristic, is part of the plug-in 497A network package.

B. 3-kHz Flat Weighting

3.02 The 3-kHz flat weighting frequency characteristic, including manufacturing tolerances, is shown in Fig. 5. The 3-kHz flat ▶(3KC FLAT)◀ network, associated with this characteristic, is included in the package of the 497A network and is used when it is desired to weight all frequencies in the band equally. This is often useful for detecting the presence of low-frequency noise (20-Hz ringing current or 60-, 120-, and 180-Hz energy from power induction).

C. Program Weighting

3.03 For measurements of noise on program circuits of bandwidths up to approximately 8,000 Hz, the characteristic of the weighting used ▶including manufacturing tolerances,◀ is shown in Fig. 6. The program weighting ▶(PROGRAM)◀ network, associated with this characteristic, is part of the 497B network package. Program weighting differs from the C- message weighting in that the design of the weighting takes into account the relative interfering effects of the various frequencies on program transmission.

D. 15-kHz Flat Weighting

3.04 The typical 15-kHz flat weighting frequency characteristic, including manufacturing tolerances, is given in Fig. 7, which shows the nominal frequency response of the overall set, exclusive of any frequency shaping as determined by the weighting networks. This 15-kHz flat weighting ▶(15 KC FLAT)◀ network is packaged in the 497B plug-in unit. This network provides a loss equal to the insertion loss at 1 kHz of the other networks without introducing additional shaping. The 15-kHz flat weighting is used to measure noise in program circuits having a bandwidth of 15 kHz.

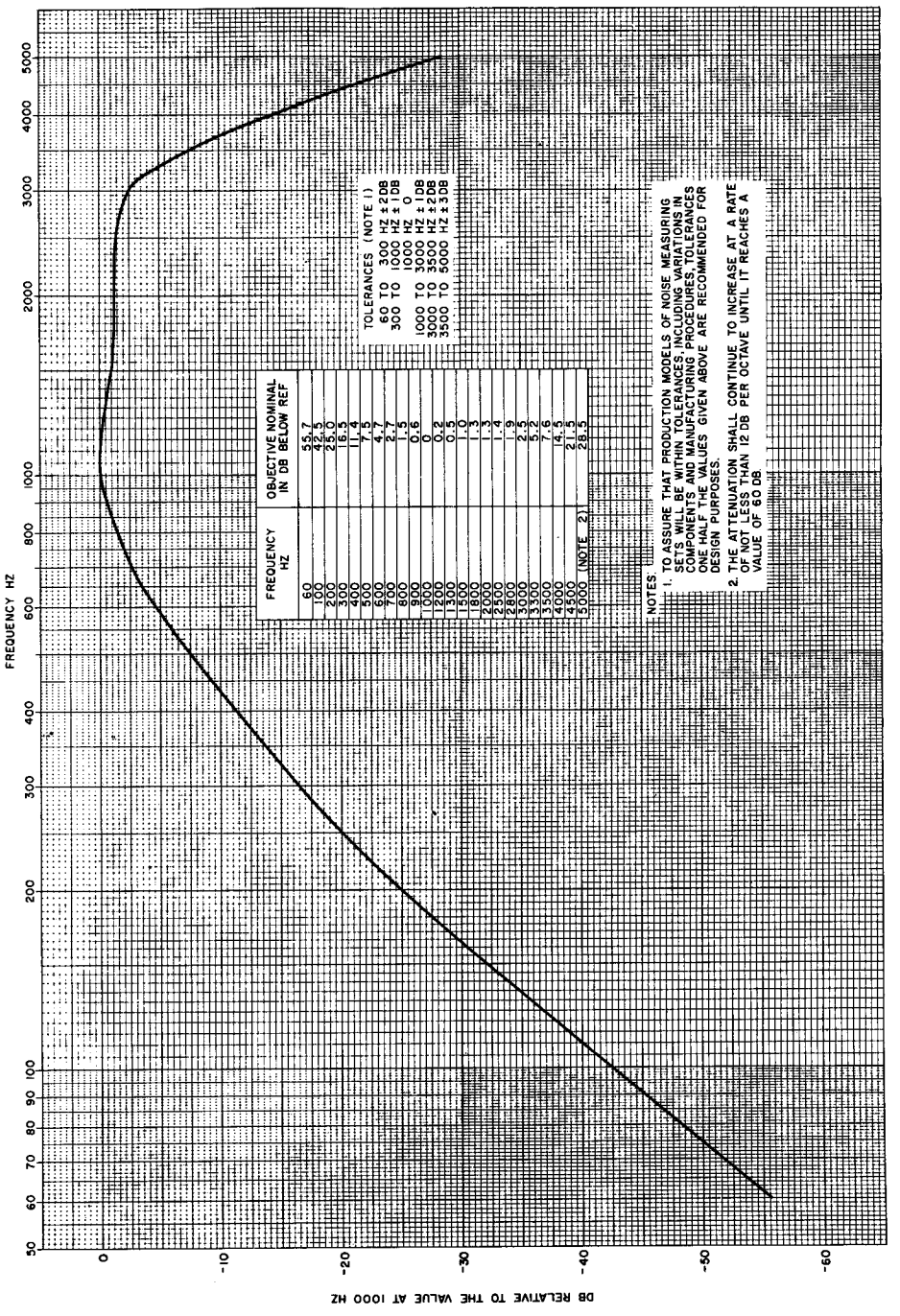

Fig. 4—C-Message Characteristic Curve

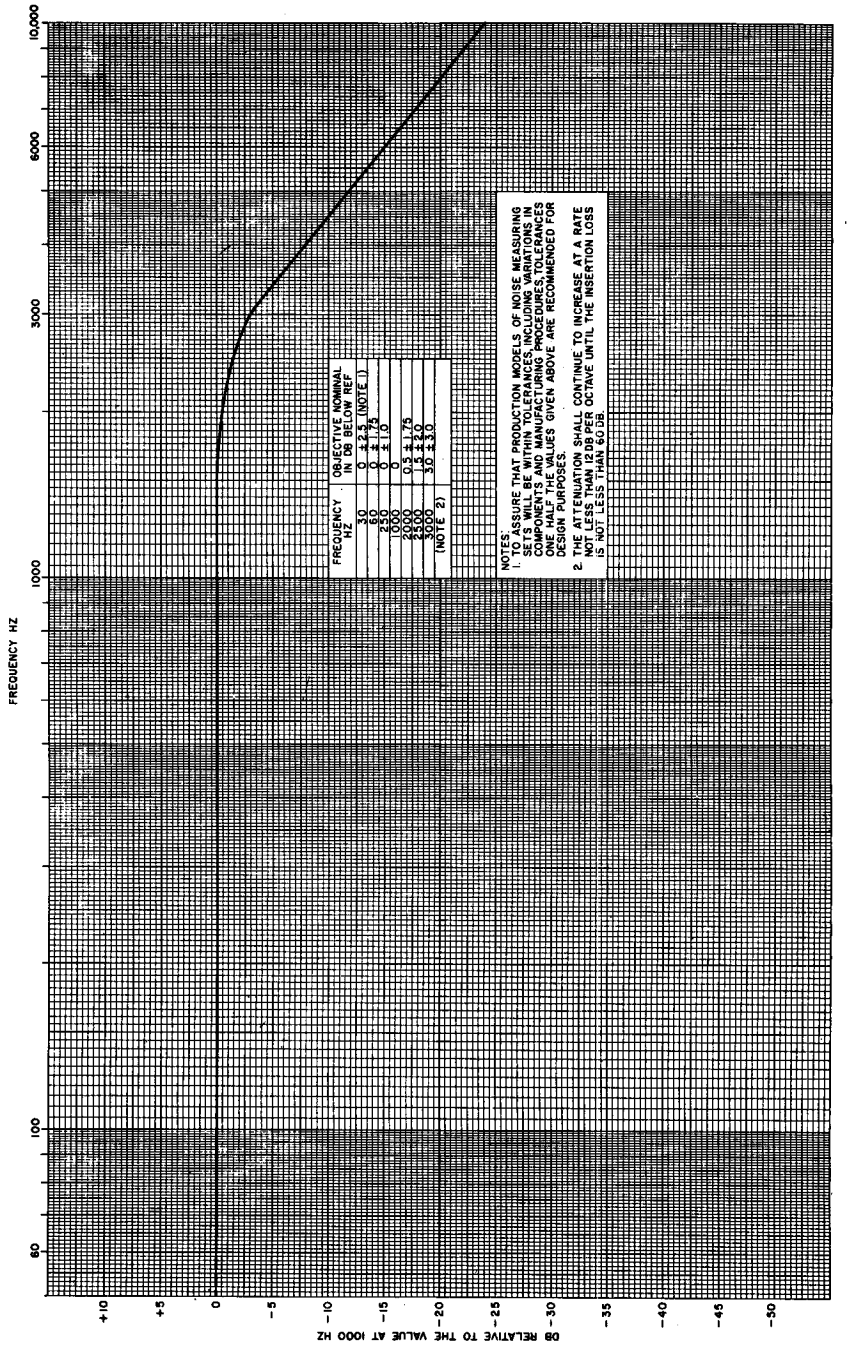

Fig. 5–3-KHz Flat Weighting Characteristic Curve

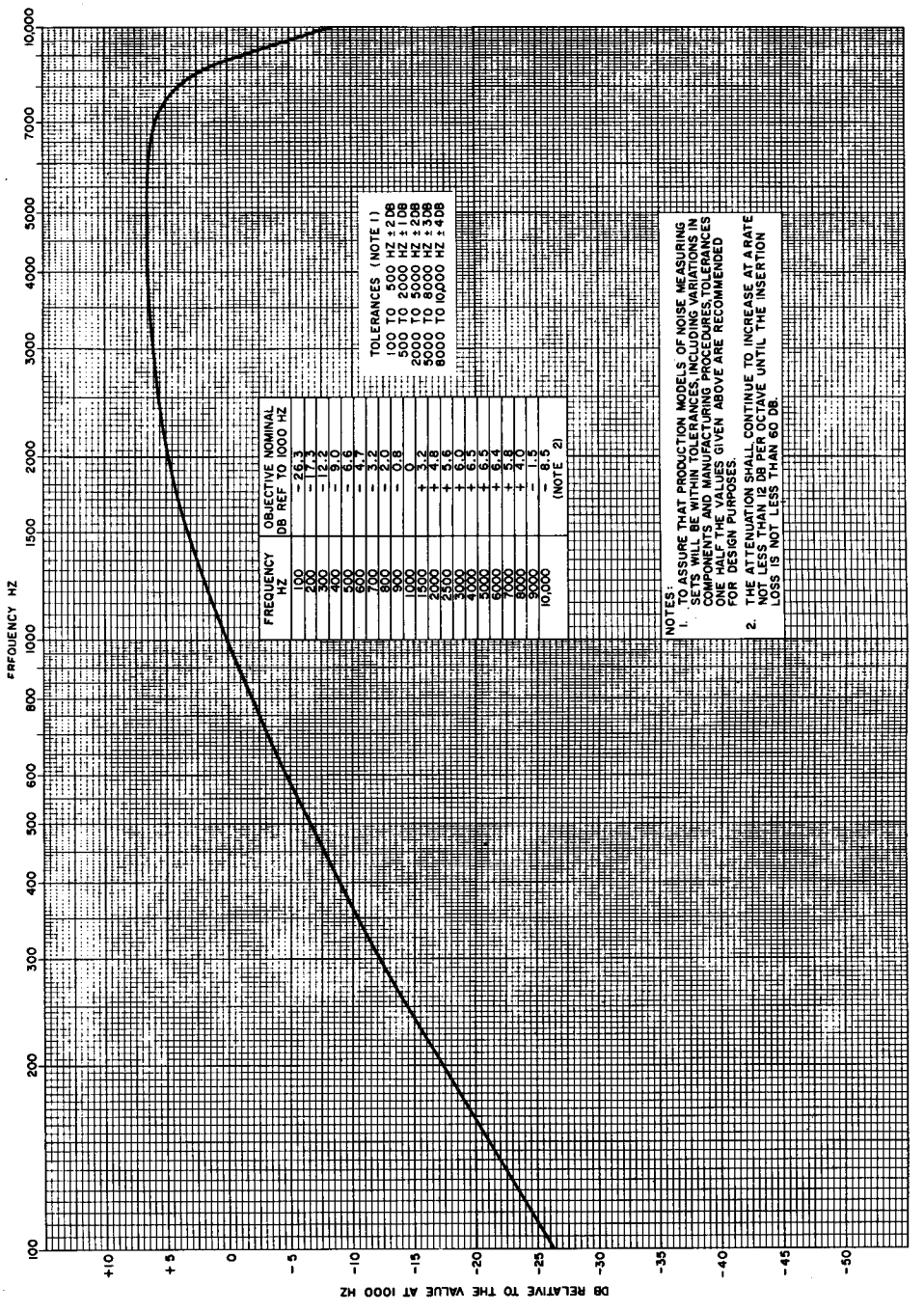

Fig. 6—Program Weighting Characteristic Curve

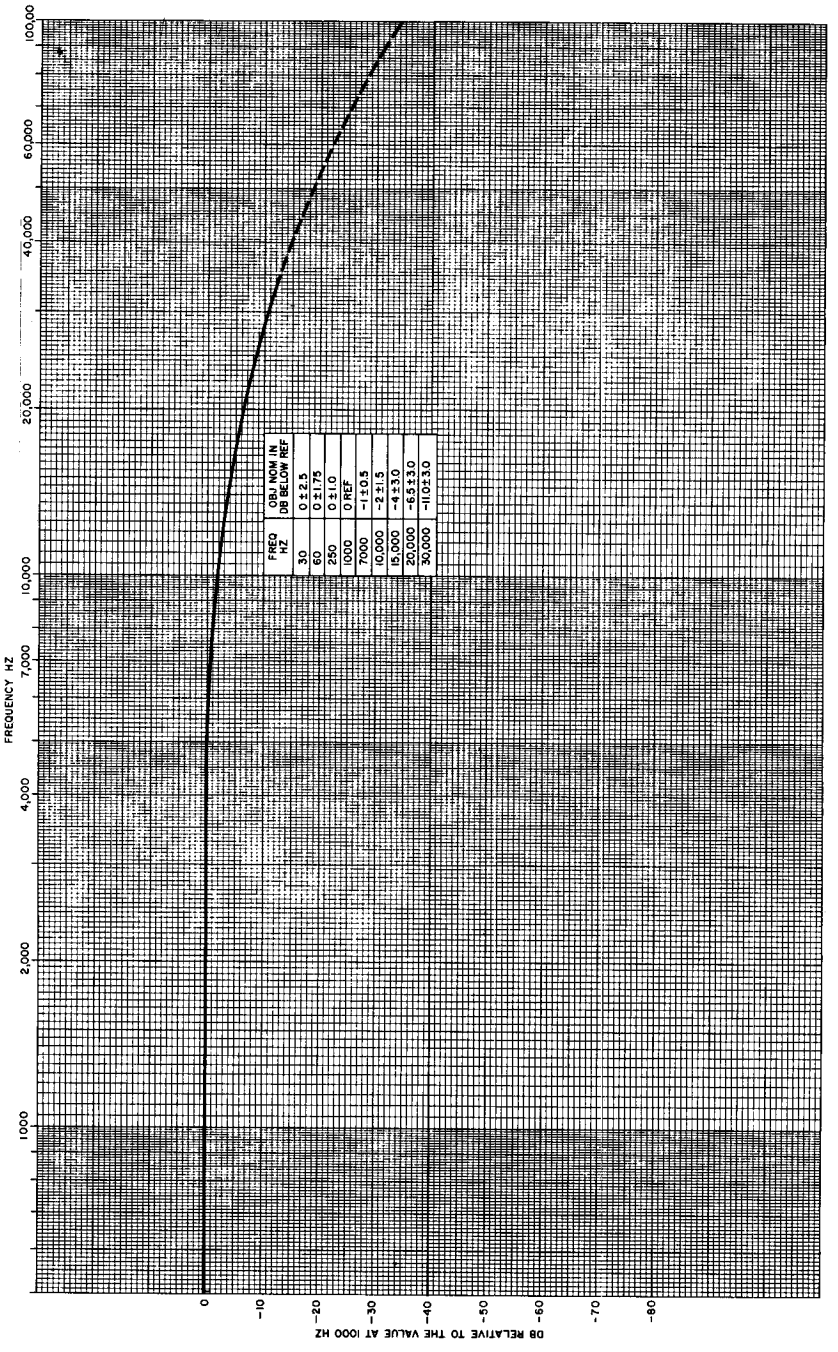

Fig. 7—15-KHz Weighting Characteristic Curve

4. CHARACTERISTICS

A. Input Circuits

4.01 The BRDG input circuit (Fig. 3B) provides an input impedance of approximately 10,000 ohms. Input blocking capacitors, C4 and C5, are chosen to have the smallest value consistent with the transmission requirements of the set. This is done so as to prevent interference to dial pulses on a working line. Results of bridging measurements made across lines of 600-ohm impedance need no correction. Table A gives corrections to be applied to the readings of the set when bridging measurements are made across circuits having impedances other than 600 ohms.

4.02 The noise-to-ground (N_G) input circuit (Fig. 3C) provides an impedance of approximately 80,000 ohms between the input terminals and 100,000 ohms between the input terminals and ground. Except for a change in the point where the signal is sampled within the set, the circuitry is the same as for BRDG. Noise-to-ground measurements are made by bridging the input terminals of the measuring set across the metallic circuit on which the noise to ground is to be measured and connecting the GRD binding post to ground.

TABLE A

CORRECTIONS FOR BRIDGING MEASUREMENTS	
CIRCUIT IMPEDANCE	ADD TO NOISE METER INDICATION
200	+5
400	+2
600	0
900	—1
1200	—2
2000	—4

4.03 The N_M 600/900 input circuit (Fig. 3D) provides an input impedance of 735 ohms, which is the geometric mean of 600 and 900 ohms. The input capacitors, C1 and C2, are changed in value to be consistent with the termination. Resistor R7 is inserted between the input circuit and the attenuator to provide a change in signal level that is required because of the 735-ohm termination.

4.04 A 735-ohm termination dissipates the same power when connected to either a 600- or a 900-ohm source. When calibrated with test power from a 600- or 900-ohm source, the 3C test set indicates correctly on either 600- or 900-ohm circuits.

4.05 When circuits being measured depart from 600 or 900 ohms, measurements with the 3C NM set differ slightly from measurements with a set whose input impedance is 600 or 900 ohms. Figure 8 shows the errors encountered when measuring such circuits by comparing the differences in indications of a 3C NM set and a set such as the 3A, having discrete 600- or 900-ohm terminations. The 735-ohm input impedance is satisfactory for the applications for which the 3-type noise measuring sets are intended. However, the 3C set should not be used in the terminated condition in critical applications, such as return-loss measurements, that require more precise termination. In such applications, the BRDG input should be used with a 600- or 900- ohm resistor bridged across the input terminals.

4.06 The N_M 600/900 HOLD input circuit connects resistor R3 and inductor L1 to the T and R input connectors and provides a dc holding resistance of approximately 700 ohms. The ac impedance, however, is high enough so that it has only a neglible effect on the measurements. This input permits a noise measurement to be made on a line or trunk while holding the connection to a far end test termination which has previously been dialed over the line or trunk.

B. Sensitivity, Accuracy and Internal Noise

4.07 The sensitivity (unweighted) is such that the 3C NM set detects -90 dBm. The internal noise is approximately -110 dBm. The accuracy of noise measurements is about ±1 dB over a temperature range of 0° to 122° F.

C. Noise Reference Level DBRN

4.08 The reference level for noise measurement with the 3C set is 10^{-12} watt of 1000-Hz power. The measured unit is called DBRN (dB above reference noise). When a value of noise is

given, the weighting used is always shown (e.g., 30 dBrnc, 40 dBrn 3 kHz, 15 dBrn PROG, or 10 dBrn 15 kHz).

D. Measurements on Circuits Equipped With E-Type Signaling Units

4.09 The path to ground of the input circuit of the 3C NM set includes a 4-uf capacitor, C7, as shown on Fig. 3D, to prevent false keying of certain types of E-type signaling units.

5. CALIBRATION

A. Primary Calibration

5.01 The purpose of primary calibration is to check the internal calibration of the 3C NM set. Primary calibration should be performed every 6 months. Primary calibration is performed in the following manner.

(a) With the FUNCTION switch at OFF, set the meter pointer over the base line at the left end of the scale. Turn the FUNCTION switch to BAT, and make sure the meter indicates in the shaded area.

(b) Use a 1000-Hz oscillator or calibrated milliwatt outlet having an output impedance of 600 or 900 ohms and an output level of 0 dBm to supply a calibration signal. When an oscillator is used, measure its output with a 22A milliwatt reference meter to be sure it is 1 milliwatt (0 dBm).

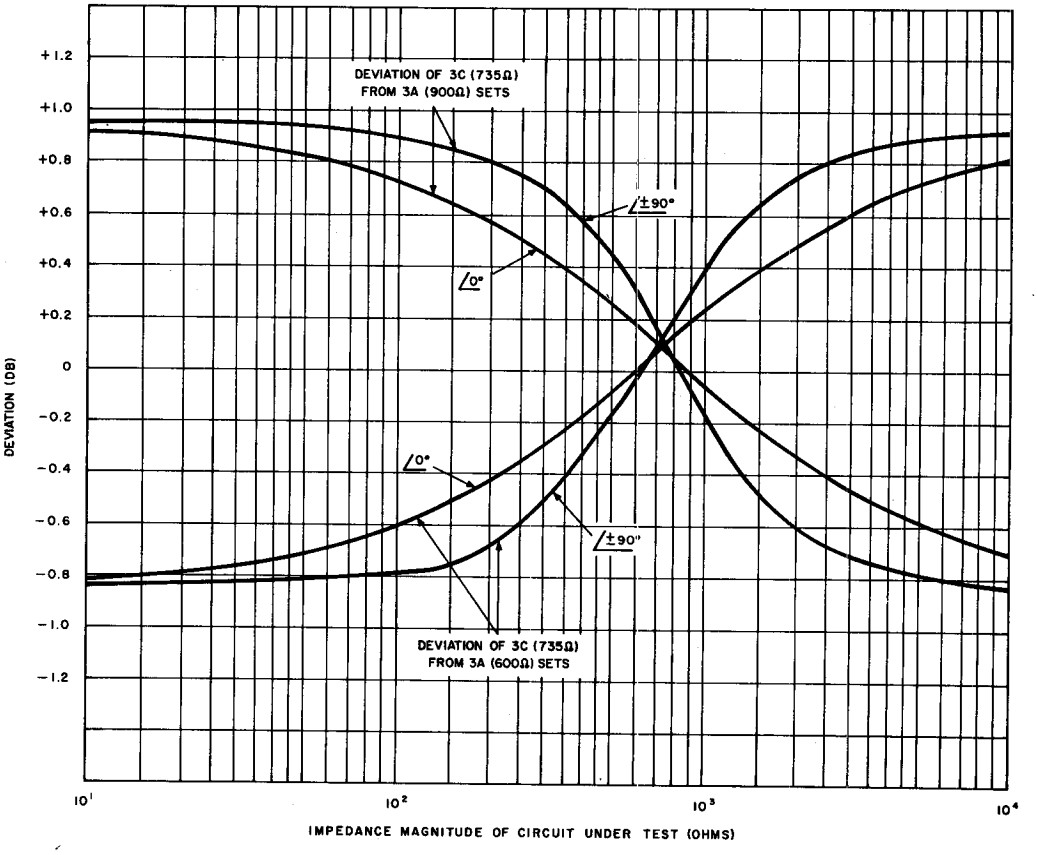

Fig. 8—Measurement Comparison Between 3C and 3A Noise Measuring Sets

(c) Insert any of the weighting networks.

(d) Adjust the DBRN dial to 85.

(e) Turn the FUNCTION switch to N_M 600/900. Connect the GRD binding post to ground.

(f) Connect the input terminals of the set to the 0-dBm 1000-Hz output which was measured as discussed in (b).

(g) Adjust the CAL control on the face of the panel for a meter indication of +5. Insert a screwdriver through the front panel hole for this adjustment. (85 + 5 = 90 dBrn = 0 dBm).

(h) Turn the FUNCTION switch to OFF.

(i) Remove the set from its case. This may be done by simply unscrewing the captive screws on the back of the set.

(j) Turn the FUNCTION switch to CAL.

(k) Adjust the OSC LEVEL potentiometer (Fig. 9) until the 3C set meter indicates on the red line of the scale.

(l) Turn the FUNCTION switch to OFF, replace the 3C set in its case, and tighten down the captive screws. The set is now accurately calibrated and may be relied upon to retain its internal calibration for 6 months.

B. Field Calibration

5.02 The 3C noise measuring set should be calibrated in the field at each test location before any measurements are made. If the battery is fresh, and the temperature is constant, the initial calibration will remain within ±0.1 dB for a period of at least 2 hours.

(a) Turn the FUNCTION switch to OFF and see that the meter pointer is properly adjusted [See 5.01(a).] The meter pointer adjustment is on the meter case.

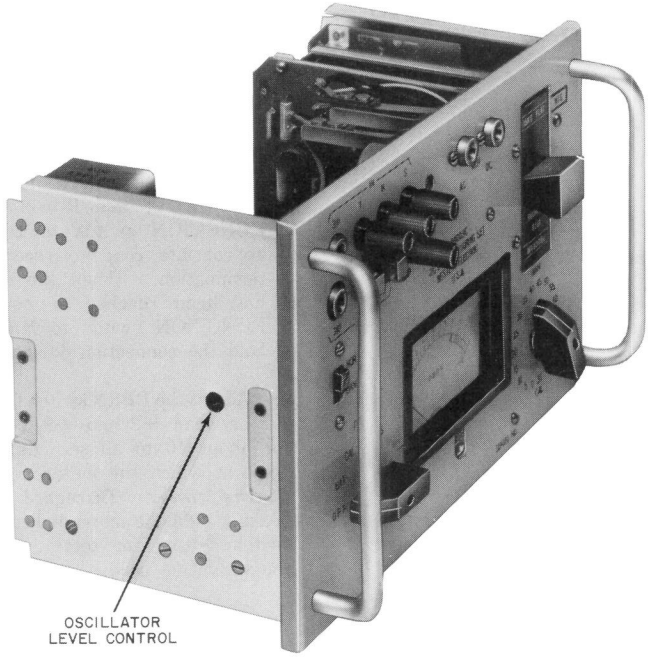

Fig. 9—Location of Oscillator Level Control

(b) Insert the proper weighting network, with the appropriate orientation.

(c) Turn the DBRN switch to 85.

(d) Turn the FUNCTION switch to BAT. If the meter fails to indicate in the shaded area marked BAT, turn the FUNCTION switch to OFF and replace the battery (see 6.01). If the external J87281A power supply is being used, check the ac voltage or rectifier in accordance with Section 167-256-301.

(e) Turn the FUNCTION switch to CAL. Adjust the CAL control for a meter indication on the red line of the scale.

6. BATTERY INSTALLATION AND POWER SUPPLY CONNECTION

6.01 To remove the battery in the 3C NM set, unscrew the captive screws and remove the cover plate as shown in Fig. 10. Slide the battery out of the compartment and remove the battery plug from the old battery. Replace the battery with a new equivalent battery listed below:

Eveready	484
Burgess	B30
Bright Star	30-03
Mallory	M207
Marathon	4207
Montgomery Ward	49
Philco	P305
Ray-o-Vac	207
RCA	VS012
Sears Roebuck	6462
Usalite	624
Zenith	Z550

6.02 When the set is to be operated from the external power supply, open the door near the handle by unscrewing the captive screw. Insert the plug from a J87281A power supply into the receptacle on the 3C set (see Fig. 11).

6.03 A switch located beneath the door disconnects the battery and connects the set circuitry to the power connector when the door is opened. ***This door must be securely fastened when operating from the internal battery.***

7. MEASURING PROCEDURE

7.01 The measuring procedure is given below.

(a) Select the proper weighting network for the measurement to be made as discussed in Part 3 and plug it into position, with appropriate orientation.

(b) Calibrate the set as described in 5.02.

(c) Turn the FUNCTION switch to the position which will be used for the measurement.

(d) Check for pickup from external magnetic and electrostatic fields. With no input connected to the set, adjust the DBRN dial to 0. If there is a deflection on the meter, orient or position the set to minimize the deflection. ***Make sure the GRD post of the 3C set is connected to a ground.***

(e) Restore the DBRN dial to 85.

(f) Connect the circuit to be tested to the input of the set, using the appropriate cord.

Note: If the measurement requires that a distant test termination be dialed over the circuit to be tested, connect a 1011-type hand test set or equivalent to the DIAL jack or the DIAL T and R connectors. Turn the FUNCTION switch to DIAL and dial the appropriate code to reach the distant test termination. When the distant termination has been reached or connected, turn the FUNCTION switch to N_M 600/900 HOLD to hold the connection during the measurement.

(g) Adjust the DBRN switch for a meter indication between +2 and +9. Observe the meter for about 10 to 30 seconds, and establish the point at which the meter needle appears ***most of the time.*** (Disregard highest occasional peaks.) Add the meter indication and the DBRN switch setting for total dBrn with respect to the weighting used.

(h) Always use the monitoring receiver provided with the set in the course of measurements to aid in identifying the noise. The character of the noise heard in the monitoring receiver should be recorded along with the noise indication.

(i) Rapidly fluctuating noise (i.e., atmospheric static or switching-type noise) can be more conveniently read on the meter by operating the DAMP-NORM switch to the DAMP position. When the switch is in the DAMP position, the meter should be read to include the maximum of the most frequently occurring peaks. Note, however, that this type of measurement does not provide an indication of the actual noise peaks.

8. PRECAUTIONS

8.01 Always set the DBRN switch to 85 before connecting the 3C NM set to an external circuit or when changing from circuit to circuit. This will prevent possible damage to the meter movement.

8.02 ***Do not attempt to use central office battery to power the 3C NM set.*** (See Part 6 for 60-Hz operation.)

8.03 If the 3C set is used for bridging measurements on circuits having impedances that are not nominally 600 ohms, a correction factor must be applied to the dBrn indication. The correction needed is dependent upon the circuit impedance and is given in Table A.

9. OTHER USES

9.01 The 3C NM set can be used for a number of purposes in addition to those discussed above. A few of these uses are described in this part of the section. Auxiliary apparatus is required as an adjunct to the 3C set to make some of the measurements, while for other tests, the set alone will be sufficient.

A. Measurement of Open-Circuit Longitudinal Voltage

9.02 The noise-to-ground input (N_G) can be used to provide a measure of open-circuit longitudinal voltage in a telephone circuit. Such a measurement is useful in determining the longitudinal balance of the circuit. Due to the input circuit, it is necessary to add 40 dB to the measurement to

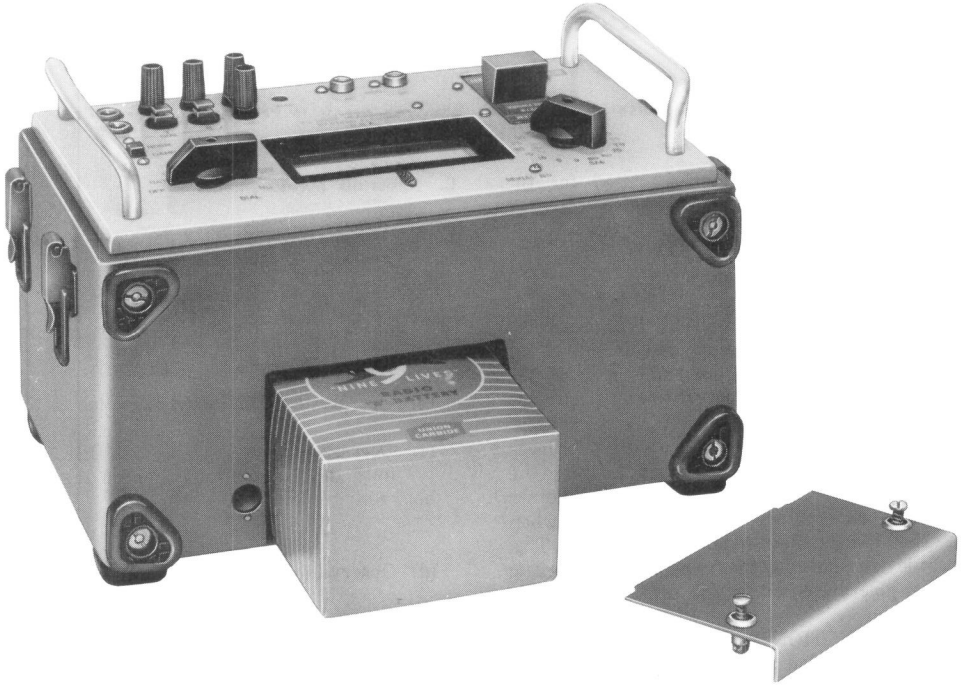

Fig. 10—J94003C Noise Measuring Set, Showing Access to Battery

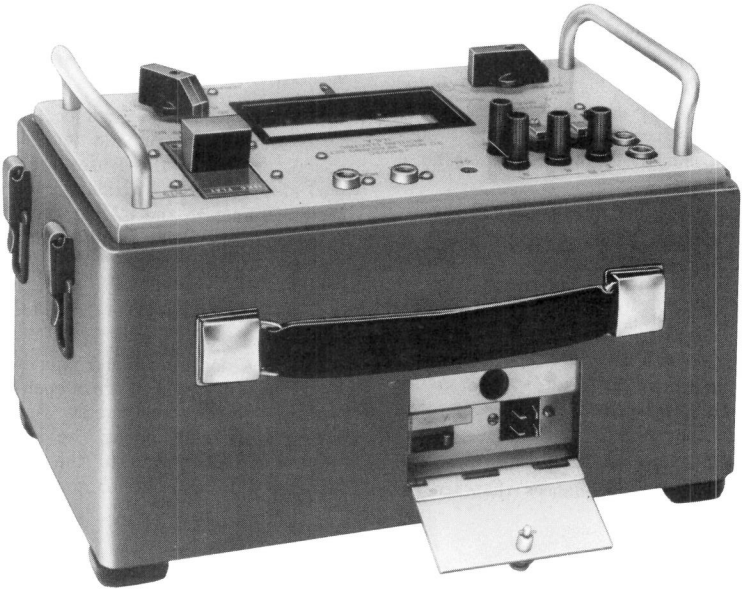

Fig. 11—J94003C Noise Measuring Set, Showing Access to Power Connector

convert it to the same reference used for the metallic noise measurement.

B. Level Measurement

9.03 Where only an approximate indication is required, the 3C set can be used for measuring power levels either on a terminated or a bridging basis. It should not be used for any of the transmission measurements covered in other sections unless its use is specifically called for or permitted. Typical frequency characteristics, with tolerances indicated, are shown on Fig. 5 and 7. Over the frequency range from 200 Hz to 7000 Hz, the set should have an accuracy of about ±1.0 dB when using the 15-kHz flat weighting network. This accuracy is determined by the frequency characteristic and other tolerances within the set.

9.04 The FUNCTION switch is operated to the proper position and, if other than 1 kHz is to be measured, the 3 KC or 15 KC FLAT WTG is used. To convert dBrn indications to equivalent dBm, subtract 90 from the dBrn indication.

C. Crosstalk Measurements

9.05 The 3C NM set may be used to obtain a measure of crosstalk volume.

(a) Using the C MESSAGE WTG and the BRDG or N_M 600/900 input circuit, adjust the DBRN dial to 85.

(b) Operate the DAMP-NORM switch to NORM.

(c) Decrease the setting of the DBRN switch until the average indication on the meter is between +2 and +9.

(d) Observe for the maximum of the frequently occurring peaks, excluding the occasional high peaks.

(e) The approximate crosstalk volume in dBm is equal to the total dBrn (dial plus meter) minus 90. (See 9.06.)

9.06 Part of the indication on the measuring set may be contributed by noise on the circuit under test. Allowance for this may be made by taking a reading when the crosstalk is absent (as determined by monitoring), in addition to a reading when both crosstalk and noise are present. Then subtract from the latter reading a correction obtained from Table B.

TABLE B

CORRECTIONS TO BE MADE WHEN MEASURING CROSSTALK IN PRESENCE OF NOISE	
DB DIFFERENCE BETWEEN READING OF CROSSTALK AND NOISE AND READING OF NOISE ALONE	DB CORRECTION — SUBTRACT FROM CROSSTALK AND NOISE READING TO GIVE CROSSTALK VOLUME
1	7
2	4
3	3
4 to 5	2
6 to 8	1
Over 8	0

D. Use As Flat-Gain Amplifier

9.07 The 3C set may be used as a flat-gain amplifier with either the BRDG or N_M 600/900 input circuits and either the 3-kHz or 15-kHz flat weighting. The maximum voltage gain is 90 dB. The signal to be amplified is inserted at the input jacks or terminals and the output is available at the AC MON jack. The output impedance of this jack is approximately 15,000 ohms.

9.08 The maximum undistorted open-circuit output voltage at the AC MON jack is about 9 volts rms. However, into a 600-ohm load, the maximum undistorted output voltage is about 0.25 volt rms. At these voltages, the meter indicates off scale, but the set is not overloaded. Pegging of the meter in this condition is not harmful.

E. Use with DC Recorders

9.09 The 3C NM set may be used to drive many different types of dc recorders. Figure 12 has been prepared to assist in determining the types which may be used.

9.10 Knowing the input impedance and full scale current of a recorder, a point may be determined on Fig. 12 which will fall within one of the areas. For instance, suppose the recorder that is available has an input impedance of 3000 ohms and a full-scale current of 500 microamperes. The point determined by these two numbers falls in region 2, which indicates that this recorder may be used with the 3C set (see Fig. 12). If the point had fallen in region 1, the set would not be able to drive the recorder to full scale. If the point had fallen in region 3, a suitable pad could be designed which would make the recorder usable. For example, suppose the recorder has an input impedance of 10,000 ohms and a full-scale sensitivity of 20 microamperes. If R2 (Fig. 13) is chosen to be 500 ohms, the apparent input impedance is essentially 500 ohms and the full-scale sensitivity is decreased by a factor of 21 (10,500/500), making the full-scale current 420 microamperes. Then choose R1 to be approximately 3500 ohms; in this case, the combination looks like a recorder with a 4000-ohm input impedance and a 420-microampere sensitivity which now falls in region 2 of Fig. 12.

9.11 To calibrate the recorder, use the equipment setup shown in Fig. 13. (Do not disturb any necessary pad arrangement.) Make no connection to the DC MON jack. Follow the procedure outlined below.

(a) Turn the FUNCTION switch of the set to N_M 600/900. Set the DBRN switch to 50 and the external attenuator loss to 40 dB. Adjust the oscillator level at 1000 Hz so that the meter on the 3C set indicates +9.

(b) Connect the dc recorder to the DC MON output on the set and decrease the attenuator loss until the recorder indicates near full scale. Note the attenuator setting and subtract that number from 49. Mark this number (49 minus the attenuator setting) on the recorder paper at the recorder indication.

(c) Add attenuator loss in 1-dB steps. Mark the recorder scale value for each step. Do this until the scale range has been covered.

Note: In this calibration procedure, do not set the attenuator loss at more than 49 dB.

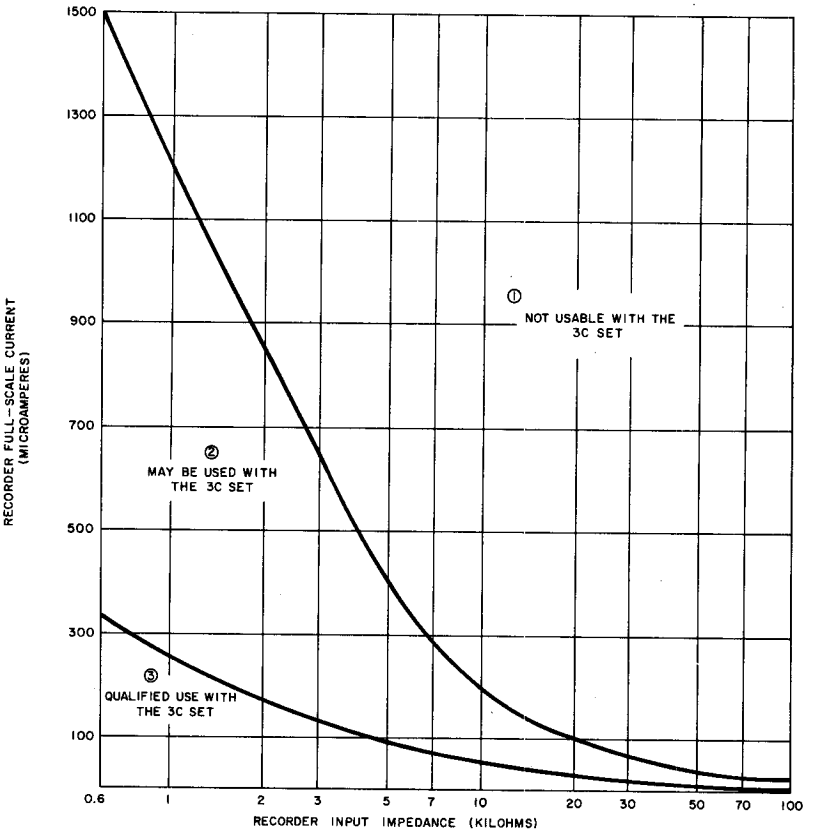

Fig. 12—Use of Recorder With 3C Noise Measuring Set

The internal noise of the set may begin to affect the indication if this is done. When the 3C set is restored to regular service it will be necessary to make a field calibration. (See 5.02.)

9.12 The measuring procedure for using the dc recorder after calibration is as follows.

(a) Turn the FUNCTION switch to CAL. Adjust the CAL control for a recorder indication of +9 (the noise measuring set meter is disconnected and will have no indication).

(b) Turn the FUNCTION switch to either BRDG or N_M 600/900 as required.

(c) Turn the DBRN switch in a counterclockwise direction until a convenient recorder deflection is obtained. The noise indication in dBrn is then the recorder indication plus the DBRN switch setting.

Note: A convenient recorder deflection should be one that anticipates any expected change in the noise. For example, if increases are expected, set the DBRN switch so that the chart indication starts at or near the low end of the scale.

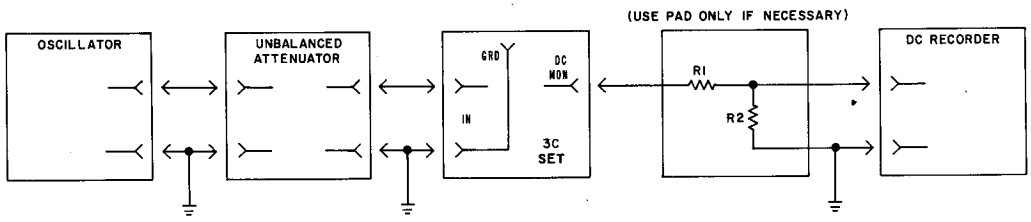

Fig. 13—Calibration Circuit for DC Recorders

9.13 The voltage at the DC MON output is negative with respect to the set case.

9.14 Continuous operation of the 3C set subjects the battery to constant drain. With continuous operation, a new battery may be expected to last for only about 48 hours. Therefore, it is preferable to use the 3C set on the external ac power supply when a recorder is used. Frequent checks of the battery should be made.

10. MAINTENANCE

10.01 The 3C NM set requires very little maintenance except for the replacement of the battery or worn mechanical parts such as knobs, jacks, rubber feet, etc.

10.02 A new battery should provide satisfactory service for approximately 100 hours if the set is used for about 2 hours each day or for approximately 48 hours if used for continuous operation. The normal shelf life of a new battery is about 12 months when the battery is stored in a cool, dry location.

10.03 Replacement of the battery is discussed in Part 6.

10.04 The 3C set should be stored in a dry location with the cover on the set. Under these conditions, there should be no battery leakage problems.

10.05 The 3C NM set should be returned to the Western Electric distributing house for ***any*** repair. This is suggested because printed-circuit boards, transistors, and diodes, along with the associated circuitry, are incompatible with ordinary techniques of repair.

10.06 The 3C set should be returned to the Western Electric distributing house at least once a year for a complete check to ensure overall accuracy of the set.

11. REFERENCE (NOT ATTACHED)

11.01 The following drawing is related to this section:

SD-95276-02—Circuit Schematic.

NOTES