

**6F AND 6FR VOICEBAND NOISE MEASURING SET
(J94006F AND J94006FR)
DESCRIPTION, OPERATION, AND MAINTENANCE**

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G. Full-Wave Rectifier	8	1.01 This section covers the description, operation, and maintenance of the 6F and 6FR voiceband noise measuring sets (J94006F and J94006FR). The 6F set is portable and the 6FR set is arranged for rack mounting. These sets are receiving instruments which are primarily intended for making noise measurements on voiceband circuits. Specifications for the 6F and 6FR sets are shown in Table A.	
H. Counter Separation Attenuators	8	1.02 This section is reissued to change information regarding the plug-in weighting networks used in the 6F and 6FR voiceband noise measuring sets. The 497G network (C-notched at 2800 Hz) has been replaced with the KS-21567, L2 network (C-notched at 1010 Hz). The KS-21567, L2 network consisting of C-notched and flat weighting will be provided in future 6F and 6FR noise measuring set shipments. This revision does not affect the Equipment Test List. Since this is a general	
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NOTICE

Not for use or disclosure outside the
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TABLE A
6F AND 6FR NMS SPECIFICATIONS

ITEM	SPECIFICATION
Sensitivity	(a) 0 to 99 dBrn for metallic message circuit noise. (b) 30 to 129 dBrn for longitudinal message circuit noise. (c) 30 to 127 dBrn for metallic impulse noise. (d) 60 to 157 dBrn for longitudinal impulse noise.
Bandwidth	50 Hz to 25 kHz with flat weighting or as determined by other plug-in weighting network, for all inputs.
Input Impedance	(a) 735 ohms balanced for metallic noise measurements normally made at 600 and 900 ohms on a terminating basis. (b) 50,000 ohms balanced for metallic noise measurements on a bridging basis. (c) 50,000 ohms longitudinal for longitudinal noise measurements.
Balance	(a) Greater than 70 dB at 1 kHz. (b) Greater than 45 dB at 25 kHz.
Maximum Counting Rate	7 counts per second.
Maximum Counting Capacity	9999 counts per register relay.
DC Supply Voltage Range	(a) 7.5 to 11.5 volts for a 6F set. (b) 44 to 52 volts for a 6FR set.
Temperature Range	0° to 50° C.
Accuracy	±0.5 dB at calibrating frequency (see Part 4C).

revision, no revision arrows have been used to denote significant changes.

1.03 The 6F and 6FR noise measuring sets (NMS) provide a means for measuring impulse noise distribution and the root mean square (rms) value of circuit noise in the frequency range of 50 Hz to 25 kHz. Plug-in weighting networks provide a means for selecting the frequency weighting used for measurements.

1.04 The KS-21567, L2 plug-in weighting network, which replaces the 497G network, introduces a method of measuring impulse noise on compandored or compandored-noncompandored mixed circuits with the holding tone filtered out (C-notched) at around 1000 Hz as opposed to 2800 Hz for the 497G network. Filtering the holding tone at 1000 Hz allows impulse noise to be measured on the 6F

and 6FR NMS at the same frequency as gain hits and phase hits are measured. Also, 1000 Hz is the frequency that the various links in a facility are aligned, permitting a more accurate prediction of holding tone level at intermediate points.

2. EQUIPMENT DESCRIPTION

2.01 The 6F portable set (Fig. 1) is self-contained and operates from seven D-type, 1.5-volt flashlight batteries in series. In normal use (combined count on four counters of less than 1000 counts per hour), the batteries should provide a minimum of 250 hours of operation. The condition of the batteries can be observed on the meter when the FUNCTION switch is in the CAL-CTR-BAT position and the POWER switch is turned on.



Fig. 1—6F Portable Set

2.02 The 6FR rack-mounted set (Fig. 2) can be mounted in a rack ranging in size from 19 inches up. It operates from the -48 volt office battery.

2.03 The plug-in weighting network used with the 6F and 6FR NMS is shipped separately from the NMS. Each plug-in network consists of two weighting networks used separately for test applications. Insertion of the plug-in unit activates the weighting network which is in the upright position indicated by the network label. Reinsertion of the plug-in unit, after disengaging and rotating 180°, will activate the other network.

2.04 The following plug-in weighting networks were supplied in previous 6F and 6FR NMS

shipments. They are still available at most locations. (The KS-21567, L2 network C-notched at 1010 Hz and flat weighting networks will be supplied with future 6F and 6FR NMS shipments.)

- 497D for C-message and flat weighting
- 497F for 50-kilobit/second and flat weighting
- 497G for C-notched at 2800 Hz and flat weighting.

2.05 An internal calibration oscillator generates a standard signal of approximately 1000 Hz for checking the sensitivity of the meter circuit amplifier and for adjusting the threshold levels of the counter circuits. Once it is adjusted, it provides

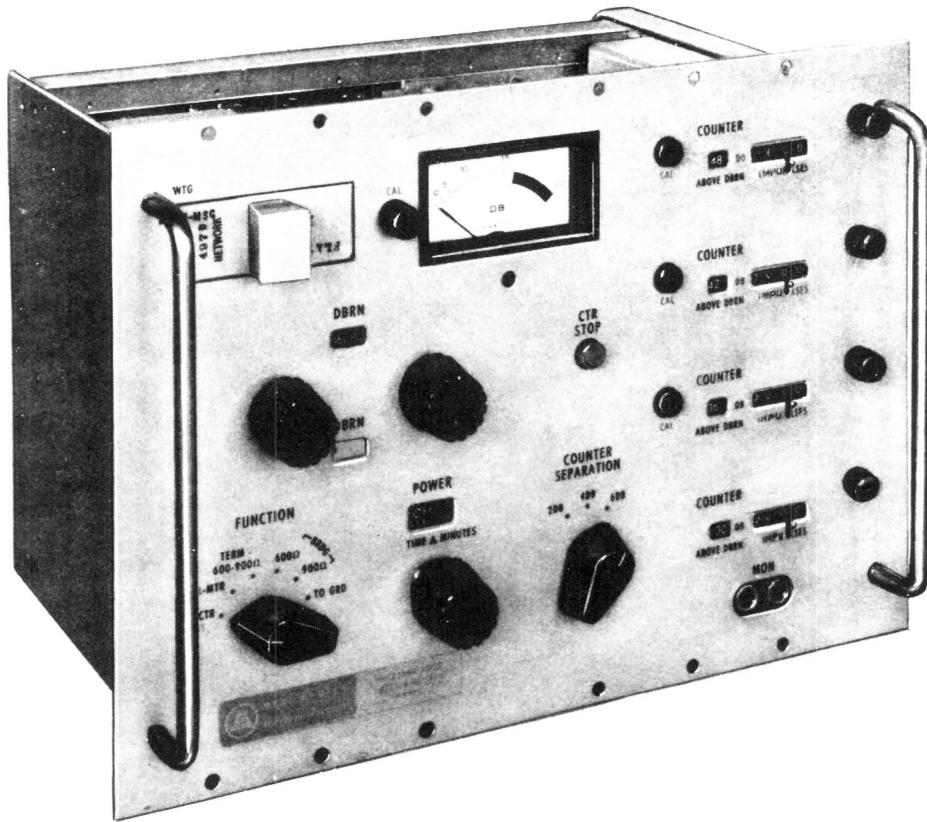


Fig. 2—6FR Rack-Mounted Set

a stable calibration source for several months without readjustment regardless of dc supply voltage and ambient temperature variations.

2.06 Amplified outputs of the received noise are provided at jacks for monitoring purposes. A 723A receiver with a W2FS cord is supplied with each 6F set for listening to the measured noise. The 6FR set has jacks for connecting a 52S telephone headset (must be supplied locally). It also has provision for wiring the monitor output to a separate jack field if desired.

2.07 The 6F set weighs 19-3/4 pounds and measures 14-1/4 inches wide, 10-3/4 inches

high, and 10-1/2 inches deep (including cover, hinges, feet, and carrying handle). Space is provided inside the cover of this set for storing the 723A receiver and W2FS cord when not in use. The 6FR set weighs 15-1/2 pounds and measures 12 inches wide, 10 inches high, and 9-1/8 inches deep (including case, jack on rear of set, and forward projections on front panel).

2.08 An internal timer of the 6F and 6FR NMS provides for measuring impulse counts over a preset time interval while the NMS is unattended. The timer is adjustable from 0 to 60 minutes. It also may be locked out (HOLD position) for continuous test intervals of greater than 60 minutes.

3. CIRCUIT DESCRIPTION

A. General

3.01 The 6F and 6FR sets are identical electrically except for their input and power supply circuits. Figure 3 shows a block diagram for these sets. The diagram may be categorized into the following circuits:

- (a) Input Circuit
- (b) Attenuators
- (c) Buffer Amplifier
- (d) Weighting Network
- (e) 60-dB Amplifier
- (f) Full-Wave Rectifier
- (g) Counter Separation Attenuators
- (h) Standard Trigger Circuits
- (i) Trigger and Register Circuits
- (j) Meter Circuit
- (k) Monitor Circuit
- (l) Calibration Oscillator
- (m) Power Circuit.

B. Input Circuit

3.02 The input circuit consists of input connections, a holding and terminating resistor, dc blocking capacitors, and a transformer to provide a balanced input. The input circuit of the 6F set provides for connecting 309- and 310-type plugs, banana-type plugs, spade tips, or wires at the front panel of the set. SLV and GRD binding posts are also provided for grounding the sleeve connection on the input cable if required by the test conditions. A link, which is permanently connected to the GRD binding post, is used for this purpose.

3.03 The 6FR set has provision for wiring the input connections to a jack at the rear of the set. A plug and jack arrangement allows for removing the set from its case without disconnecting

the wires at the jack. Transformer T1 provides a high input impedance, in the order of 50,000 ohms, for making bridging measurements. Resistor R1 is connected across the input, to shunt down the impedance to 735 ohms, when making terminating measurements. This impedance is the geometric mean of 600 and 900 ohms and is used for making measurements that are normally made at 600 or 900 ohms. R1 also provides a dc path for the circuit under test for holding purposes. Capacitors C1, C2, and C3 provide dc isolation and some low-frequency shaping.

3.04 Resistors R2, R3, and R4 provide a high input impedance for measuring longitudinal (FUNCTION switch set to TO GRD) noise. They introduce a 30-dB insertion loss which is automatically corrected on the DBRN dial when the FUNCTION switch is operated to the TO GRD position. Resistors R36 and R37 equalize the insertion loss in the terminating and bridging input circuits. Both metallic and longitudinal noise are directed to the common 2000-ohm circuit by the FUNCTION switch.

C. Attenuators

3.05 The attenuators consist of a 10-dB and a 1-dB step attenuator. They are 2000-ohm pads and provide a total of 79 dB of attenuation in 1-dB steps for setting the desired threshold for measurements of impulse noise or the desired meter reading for measurements of message circuit noise.

D. Buffer Amplifier

3.06 The buffer amplifier is a 2-stage feedback amplifier which provides a gain of about 12 dB to make up for losses in the input circuit. It provides an input impedance of about 750,000 ohms and therefore has very little shunting effect on the 1-dB attenuator. It also isolates the weighting network from the input circuits and provides an output impedance of 600 ohms for matching to the 600-ohm networks. Some temperature compensation is included in the buffer amplifier to make up for temperature effects in the amplifier, meter, and trigger circuits.

E. Weighting Networks

3.07 The KS-21567, L2 plug-in weighting network contains two passive weighting networks: a resistive pad and a C-message weighting network with a sharp notch centered at 1010 Hz. Each

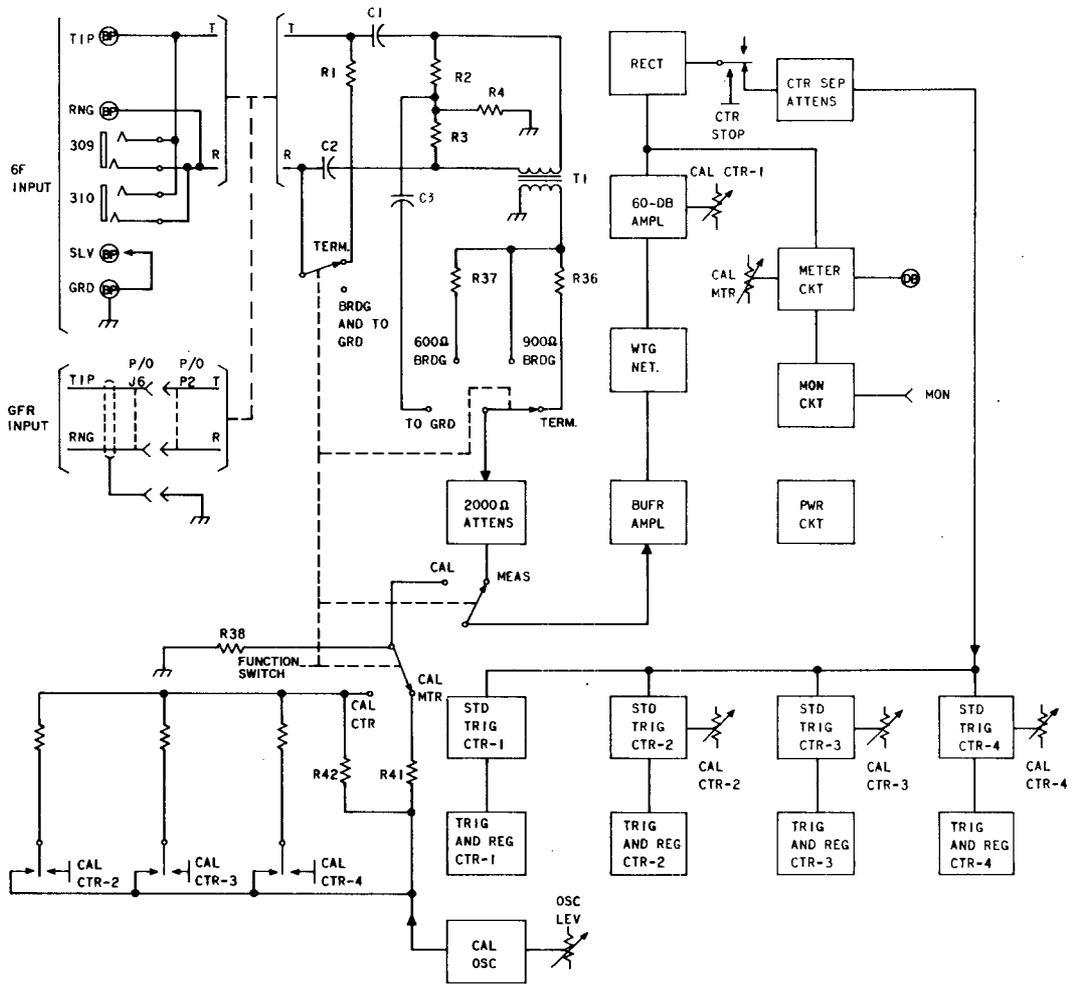


Fig. 3—6F and 6FR Voiceband Noise Measuring Sets—Block Diagram

weighting network has 600-ohm impedance with a voltage input level of 0.15 volts rms \pm 0.05 volts. (Voltage may be 0.8 volts \pm 0.2 volts when specified attenuation for the network exceeds 50 dB.) Insertion of the KS-21567, L2 plug-in network with the C-notch label upright provides C-message weighting with a 50-dB band-reject notch (see Fig. 4) and a 4-dB flat insertion loss. Reinsertion of the plug-in with the FLAT label upright provides 5-dB flat attenuation.

F. 60-dB Amplifier

3.08 The 60-dB amplifier provides sufficient gain to the received signals to drive the rectifier and trigger circuits. It consists of a 3-transistor stage, feedback amplifier. The COUNTER 1 CAL control provides about 6 dB of adjustment on the amplifier gain for calibrating the threshold level of the COUNTER 1 circuits.

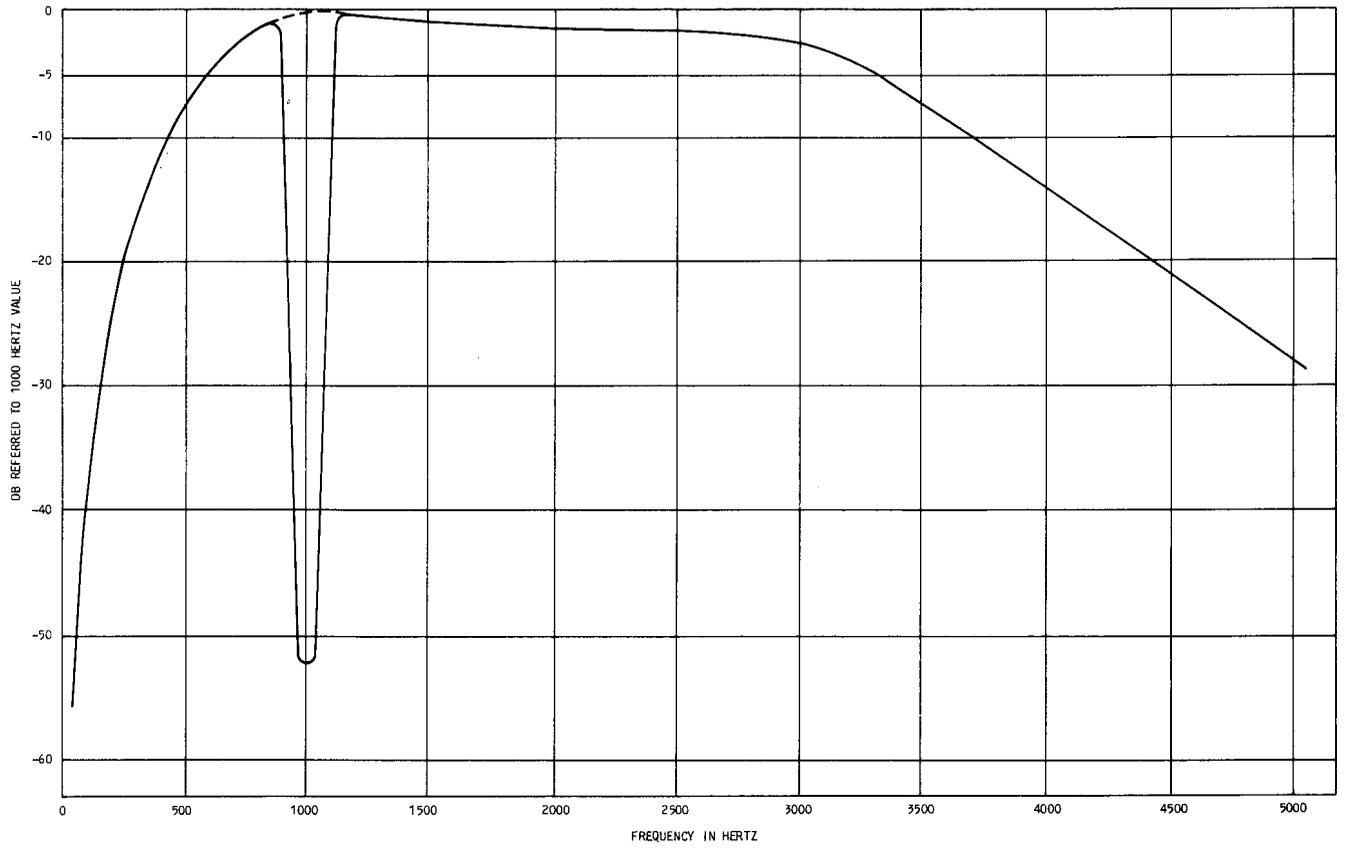


Fig. 4—Typical Frequency Characteristic With C-Notched Weighting at 1010 Hz of the KS-21567 L2 Plug In Network

G. Full-Wave Rectifier

3.09 Full-wave rectification is employed in order to detect both positive and negative impulse noise peaks. This is accomplished by a transformer-coupled diode rectifier. An emitter-follower provides a high-impedance load for the rectifier and a low source impedance for the standard trigger circuits. The rectified signals are coupled through the normally closed contacts of the CTR STOP switch. This is a pushbutton-type switch which provides for disconnecting signals to the standard trigger circuit inputs while the register relays are being reset.

H. Counter Separation Attenuators

3.10 The rectified signals are coupled through voltage divider networks to four separate standard trigger circuits. The COUNTER SEPARATION switch selects the proper voltage division to each input to provide separations of either 2, 4, or 6 dB between the thresholds of successive trigger circuits.

I. Standard Trigger Circuits

3.11 The four standard trigger circuits operate identically. They each consist of a single-transistor, blocking oscillator circuit. When a positive signal from the rectifier exceeds the threshold voltage of a blocking oscillator, the transistor is drawn into saturation and hence develops a large negative pulse at its collector for operating the trigger and register circuit. The regenerative action of the blocking oscillator causes the transistor to saturate quickly and provides a sharp threshold. The COUNTER 2, 3, and 4 standard trigger circuits have provision for adjusting their threshold levels. These adjustments are used for calibration purposes.

J. Trigger and Register Circuits

3.12 The four trigger and register circuits are identical and all operate the same. The trigger circuit consists of a 2-transistor, monostable multivibrator circuit. Normally one transistor is turned on while the other is off. When a negative pulse from the standard trigger circuit is applied, the multivibrator changes state, causing the "on" transistor to turn off and the "off" transistor to turn on.

3.13 The register relay is in the collector circuit of the normally off transistor so that when the circuit changes state, current flows through the register relay and causes it to register a count. A timing capacitor is included to prevent the multivibrator from going back to its normal state, to accept another impulse, until the register relay has had enough time to reset. This limits the speed of the register relay to about 7 counts, per second.

K. Meter Circuit

3.14 Signals from the output of the 60-dB amplifier are applied to the meter circuit. This circuit consists of two transistor stages which provide gain for driving the meter and also provide isolation between the meter circuit and the 60-dB amplifier. The meter CAL potentiometer provides about 5 dB of adjustment on the gain of the meter circuit for calibration purposes.

3.15 Output signals from the meter amplifier are full-wave rectified with a bridge rectifier before being applied to the meter. The meter is connected to the output of the rectifier for all positions of the FUNCTION switch except the CAL-CTR-BAT position. For this position, the meter measures the battery voltage for a 6F set and the dc supply voltage applied to the buffer amplifier, calibration oscillator, and 60-dB amplifier for a 6FR set.

L. Monitor Circuit

3.16 The monitor circuit consists of a single-transistor stage. It provides about 12 dB of gain and also isolates any monitoring device from the meter circuit. The 6F set is equipped with a single MON jack on the front panel assembly. A 723A receiver and W2FS cord, which can be plugged into this jack, are provided with each 6F set. The 6FR set is equipped with a double-jack arrangement on the front panel assembly to accept a 52S telephone headset (supplied locally). In addition, the monitor output appears at the jack at the rear of the 6FR set for wiring to a separate jack field, if desired.

M. Calibration Oscillator

3.17 The calibration oscillator provides a standard signal at 1000 Hz for adjusting the sensitivity of the meter circuit and for adjusting the threshold

levels of the counter circuits. The oscillator is compensated for dc supply voltage and ambient temperature variations. Once its output level is adjusted, it provides a stable calibration source for long periods of time without readjustment.

3.18 Calibration signals are directed through L-type attenuator networks which determine the proper signal level applied to the buffer amplifier input during calibration of the meter and counter circuits. Resistor R38 provides the shunt arm for all networks. Resistor R41 provides the series arm of the network during calibration of the meter circuit. Resistor R42 and the resistor in parallel with it provide the series arm for the attenuation network when calibrating the counter circuits. The parallel resistor is determined by the combination of the COUNTER SEPARATION switch setting and the position of the counter CAL pushbutton switches.

N. Power Circuit

3.19 Power for the 6F set is provided by seven 1.5-volt, type D flashlight cells connected in series. Power for the 6FR set is provided by the -48 volt office battery.

3.20 Three separate zener voltage regulating circuits divide the office battery voltage down to approximately 9 volts for the buffer amplifier, 60-dB amplifier, and calibration oscillator circuits, for the standard trigger and register circuits, and for the meter and monitor circuits. This arrangement filters out noise on the office battery and reduces the effects of interaction between the various circuits in the 6FR set. Power to the 6F and 6FR circuits is controlled by a switch which is part of the timer unit.

4. OPERATION

A. Description

4.01 The 6F and 6FR sets are primarily intended for making noise measurements on voiceband circuits. In general, the receiving end of the circuit to be tested will be connected directly to the 6F or 6FR set (through a test pad when specified), and the far end will be terminated in the office impedance. These sets provide for measuring both metallic (FUNCTION switch to TERM or BRDG) and longitudinal (FUNCTION switch to TO GRD) noise.

4.02 A 735-ohm balanced input impedance is provided for measurements normally made at 600 or 900 ohms. This impedance is the geometric mean of 600 and 900 ohms which makes the mismatch identical for 600- and 900-ohm measurements. The effects of this mismatch are corrected for in the calibration of the set. A 50,000-ohm balanced input impedance is provided for making bridging measurements and a 50,000-ohm longitudinal impedance is provided for making longitudinal noise measurements.

4.03 Multiplied jacks and binding posts on the front panel of the 6F set provide for connecting 309- and 310-type plugs, banana-type plugs, spade tips, or wires. SLV and GRD binding posts are also provided on the 6F set for grounding the sleeve of the circuit under test if required by the test conditions. A shorting link is permanently attached to the GRD binding post for this purpose.

4.04 The 6FR set has no input jacks on its front panel but has provision for wiring the input circuit to a separate jack field. A plug and jack arrangement at the rear of the 6FR set provides for making the input connection as well as the monitor output and office battery connections, and also provides for removing the set from its case without disconnecting any wiring.

4.05 The 6F and 6FR sets can measure the cumulative distribution of impulse noise by simultaneously counting impulses having a *peak* value exceeding one or more of four threshold levels. The thresholds of the four counter circuits can be separated by either 2, 4, or 6 dB as selected by the COUNTER SEPARATION switch.

4.06 Adjacent to each counter is a window (ABOVE DBRN). The value indicated in the window is the threshold level at which the counter will operate when noise impulses exceed the combined value set in the DBRN window and the ABOVE DBRN window. The threshold level of the first counter circuit is a fixed 30 dB above the DBRN dial setting regardless of the position of the COUNTER SEPARATION switch. The threshold levels of the remaining three counter circuits are determined by the COUNTER SEPARATION switch setting. The numbers in the ABOVE DBRN windows near these counter circuits are automatically corrected when this switch setting is changed.

4.07 The threshold level of each counter circuit is determined simply by adding the DBRN dial setting to the number in the ABOVE DBRN window near the associated counter. This applies for longitudinal as well as metallic noise measurements.

4.08 The upper DBRN window is open and the lower DBRN window is closed when the FUNCTION switch is in any position other than TO GRD. When the switch is in the TO GRD position, the window operation is reversed. A 30-dB insertion loss in the longitudinal noise input circuit is automatically corrected on the lower DBRN dial reading. The dial setting is added to the ABOVE DBRN readings to determine the threshold levels at which the counters operate.

Example: It is desired to measure the distribution of impulse noise in the range of 65 to 77 dBrn. Since this is a range of 12 dB, the COUNTER SEPARATION switch should be set to 4 dB. This provides for measuring over a 12-dB range with the four counters. The threshold level of each counter is the number of decibels indicated in the window near the associated counter, above the DBRN dial setting. To achieve the DBRN dial setting for any counter, the desired threshold level must be subtracted from the number in the associated window. Since the first counter is a constant 30 dB above the DBRN dial setting, for all positions of the COUNTER SEPARATION switch, it provides a good reference for setting up the DBRN dial. The procedure is then: **DBRN dial setting = (lowest threshold to be measured) - (30)**. For this example, the lowest threshold to be measured is 65 dBrn. Therefore, the DBRN dial should be set to $65 - 30 = 35$. This example applies for either metallic or longitudinal noise measurements.

4.09 The *rms* value of message circuit noise or transmission levels can be measured on the meter. The meter has a 20-dB range. Metallic noise can be measured over a range from 0 to 99 dBrn and longitudinal noise can be measured over a range from 30 to 129 dBrn when the meter reading is combined with the DBRN dial setting.

4.10 A measurement is made simply by stepping the DBRN dial until an indication is observed on the meter. For best accuracy, the upper half of the meter scale should be used whenever possible.

The level in dBrn is then the sum of the DBRN dial setting and the meter reading. This applies for both metallic and longitudinal noise measurements since the DBRN dial window arrangement automatically corrects for differences of insertion loss in the two circuits.

4.11 The timer provides for measuring impulse counts for a preset time interval while the set is unattended. The timer, having dial markings at 1-minute intervals, is adjustable from 0 to 60 minutes. At the end of the preset interval, the timer will disable the counting circuits by removing power from all circuits in the 6F and 6FR sets.

Note: To insure accurate timing when setting the timer for 5 minutes or less, first adjust the timer to 10 minutes or greater and then return it to the desired value.

4.12 The register relays will not be reset so that the total impulses received in a preset interval can be read from the registers. The registers must be reset for additional testing. The timer may be locked out (HOLD position) for continuous test intervals of greater than 60 minutes.

4.13 The trigger and register circuit response times are limited electrically so that impulses separated by approximately 140 ms (about 7 counts per second) or more will be recorded on the register relays. This insures that the register relays, after counting, will have sufficient time to reset properly before accepting another count.

4.14 The MON jacks provide amplified outputs of the received noise for listening with a headset or other monitoring device or for observation with an oscilloscope. This may be useful in identifying the type of noise or the location of the source.

4.15 A 723A receiver with a W2FS cord is supplied with each 6F set. It can be connected to a single jack on the front panel of the set. The 6FR set has a double jack on the front panel for connecting a 52S telephone headset (must be supplied locally). This set also has provision for wiring the monitor output, at the jack at the rear of the set, to a separate jack field if desired.

4.16 Impulse noise measurement on a compandored facility (T- or N-Carrier or No.4 ESS) is accomplished using a holding tone of 1000 Hz to

simulate active data or voice transmission. The C-notched network of the KS-21567, L2 network allows measurements with tone based on C-message weighting by filtering out or attenuating the holding tone 50 dB between 995 Hz and 1025 Hz. This 30-Hz band-reject is shown as a 50-dB notch in the C-message curve shown in Fig.4. The resultant noise reading on the 6F or 6FR set, by eliminating the holding tone, is the summation of background or quantizing noise, amplitude and phase jitter above 120 Hz, and harmonic distortion.

4.17 Figures 5 and 6 show typical frequency characteristics with flat weighting for the impulse and message circuit noise for the 6F and 6FR sets, respectively. These curves apply for terminating, bridging, or longitudinal measurements concerning white noise. Both curves are similar and have 3-dB points at about 50 Hz and 25 kHz.

B. Calibration Procedure

4.18 The 6F and 6FR sets are calibrated through the weighting networks, and any variation in flat loss between the networks can be calibrated out. The desired weighting is obtained by proper orientation of the network when plugging it into the set.

4.19 The 6F and 6FR sets employ a nominal 1000-Hz internal oscillator for calibration. The KS-21567, L2 C-notched network centered at 1010 Hz, used in the CAL function, would cause the meter reading to be off-scale on the low side. However, inverting the plug-in network to the FLAT weighting will permit calibration in the normal manner.

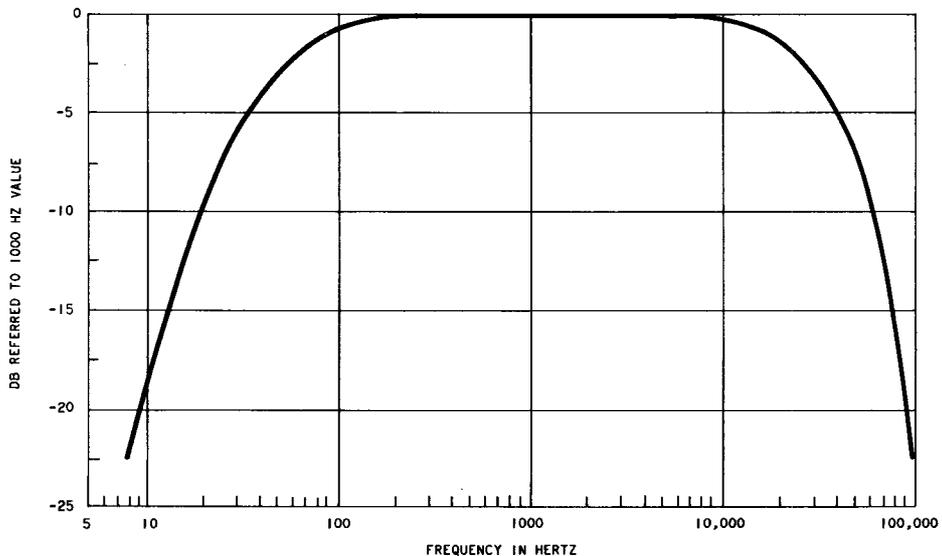


Fig. 5—Typical Frequency Characteristic of Impulse Noise Circuits With Flat Weighting

4.20 To insure good measurement accuracy, the 6F and 6FR sets should be calibrated frequently, preferably every time they are used. Calibration of the sets compensates for battery

decay and ambient temperature change effects. The following calibration procedure is simple and requires no external equipment.

STEP	PROCEDURE
1	Plug the desired weighting network into the set and make sure that it is oriented for the proper weighting.
2	Set the COUNTER SEPARATION switch to the desired position.
3	Set the FUNCTION switch to CAL-CTR-BAT and turn the POWER switch on.
4	Verify that the meter indicates in the BAT GOOD area. If it does not, replace the batteries in a 6F set per Part 5C or check the office battery connection for a 6FR set.
5	Adjust the COUNTER 1 CAL control until the associated counter just counts (the count will be erratic when properly adjusted).
6	Adjust the COUNTER 2, 3, and 4 CAL controls by depressing the associated pushbutton switch and adjusting the associated CAL control until the counter just counts, as in Step 5.
	Note: During this calibration procedure, only one counter will operate at a time. For example, if COUNTER 4 is being calibrated, COUNTERs 1, 2, and 3 will not operate even though the calibration signal would normally be large enough to cause all four counters to count; COUNTERs 1, 2, and 3 have been disconnected for this part of the calibration procedure.
7	Set the FUNCTION switch to CAL-MTR and adjust the meter CAL control for a meter indication at the CAL marking.
8	Repeat the above procedure when changing the weighting network or when changing the COUNTER SEPARATION switch setting.
	Note: If it is suspected that the internal calibration oscillator is out of adjustment or if more than 6 months have elapsed since it was adjusted, it should be readjusted per Part 5B.

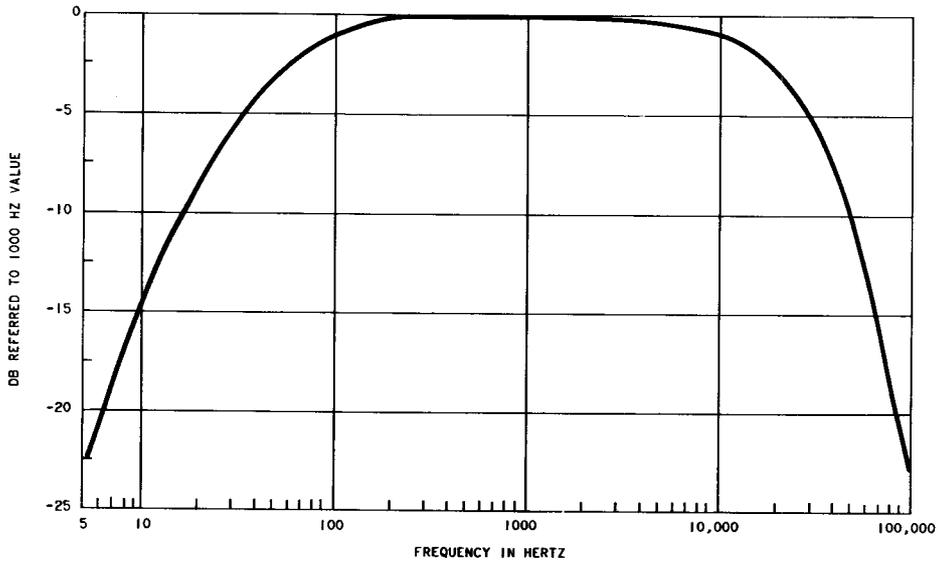


Fig. 6—Typical Frequency Characteristic of Message Circuits With Flat Weighting

C. Measurement—Description and Procedure

4.21 The measurement accuracy of the 6F and 6FR sets is dependent on the frequency of the signals being measured. For message circuit noise measurements, it is also dependent on what part of the meter scale is used. The set has its best accuracy when measuring noise having principal component frequencies close to the calibrating frequency (1000 Hz). The measurement accuracy is proportionately poorer for noise component frequencies further away from this frequency. When the set is properly calibrated, the measurement accuracy near the calibrating frequency is within ± 0.5 dB for both impulse and message circuit noise measurements. This assumes that message circuit measurements are made on the upper half of the meter scale and that the weighting network is oriented for flat weighting. For other frequencies and other conditions, the measurement accuracies for impulse and message circuit noise measurements with FLAT weighting are itemized in Tables B and C, respectively. These accuracies apply for battery voltages of 7.5 to 11.5 volts for a 6F set

and 44 to 52 volts for a 6FR set and for ambient temperatures of 0° to 50°C , assuming that the set is properly calibrated and that flat weighting is used. They also apply for measurement of both metallic and longitudinal noise.

TABLE B
MEASUREMENT ACCURACY FOR IMPULSE
NOISE MEASUREMENTS
USING FLAT FILTER WEIGHTING

FREQUENCY (Hz)	ACCURACY (dB)
50	-2.8 ± 1.6
200	-0.2 ± 0.7
1,000	0 ± 0.5
10,000	-0.2 ± 0.8
25,000	-2.2 ± 1.8

TABLE C
MEASUREMENT ACCURACY FOR MESSAGE CIRCUIT NOISE MEASUREMENTS
USING FLAT FILTER WEIGHTING

FREQUENCY (Hz)	METER READING (dB)			
	0-5	5-10	10-14	14-20
	ACCURACY (dB)			
50	-2.8 ±2.6	-2.8 ±1.9	-2.8 ±1.7	-2.8 ±1.6
200	-0.2 ±2.1	-0.2 ±1.2	-0.2 ±0.9	-0.2 ±0.7
1,000	0 ±2.0	0 ±1.1	0 ±0.8	0 ±0.5
10,000	-0.6 ±2.2	-0.6 ±1.3	-0.6 ±1.0	-0.6 ±0.8
25,000	-3.8 ±2.7	-3.8 ±2.0	-3.8 ±1.9	-3.8 ±1.8

4.22 When using filters other than the flat filter, the measurement accuracies listed in Tables B and C must be modified to include the frequency characteristic of the particular filter being used. Figure 7 shows the ideal frequency characteristic for the C-message (497D) weighting network. Figure 8 shows the typical frequency characteristic for the C-notched weighting network (497G). The 497G C-notched weighting network has a frequency characteristic similar to that of the C-message filter with a band-rejection filter centered about 2800 Hz to permit measurements on compandored or mixed compandored-noncompandored circuits. The KS-21567, L2 network (Fig. 4) also has a frequency characteristic similar to the C-message filter with a band-rejection filter centered about 1010 Hz which permits measurements on compandored or mixed compandored-noncompandored circuits. Figure 9 shows the typical frequency characteristic for the 50-kilobit/second weighting network. This network provides for making measurements on 50-kilobit wideband facilities. The 3-dB points are approximately at 45 Hz and 28 kHz.

4.23 Impulse noise distribution measurements are made by simultaneously counting impulse noise peaks exceeding any of four threshold levels. The thresholds of the four counter circuits can be separated by either 2, 4, or 6 dB as selected by the COUNTER SEPARATION switch. The rms value of message circuit noise is indicated on the meter. At the beginning of a measurement period, counters should be reset for the new count. A pushbutton switch (CTR STOP) provides for disconnecting signals from the trigger circuits while the counters are being reset.

4.24 A bridging input impedance is provided for both metallic and longitudinal noise measurements. A terminating input impedance is also provided for metallic noise measurements. Holding is provided when measurements are made on a terminating basis.

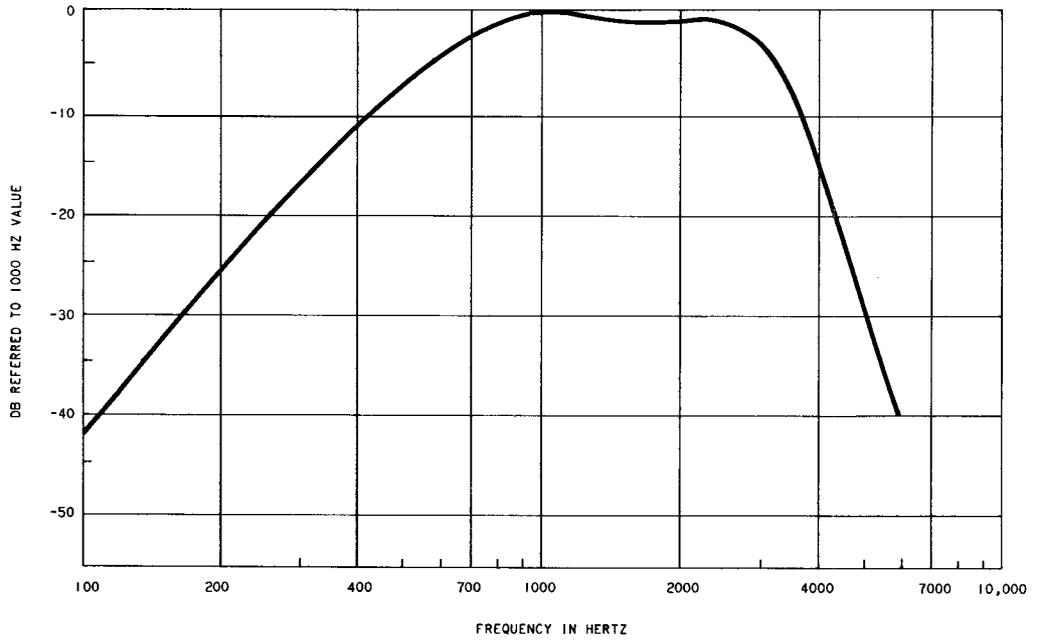


Fig. 7—Ideal Frequency Characteristic of C-Message Weighting Network of the 497D Plug-In Network

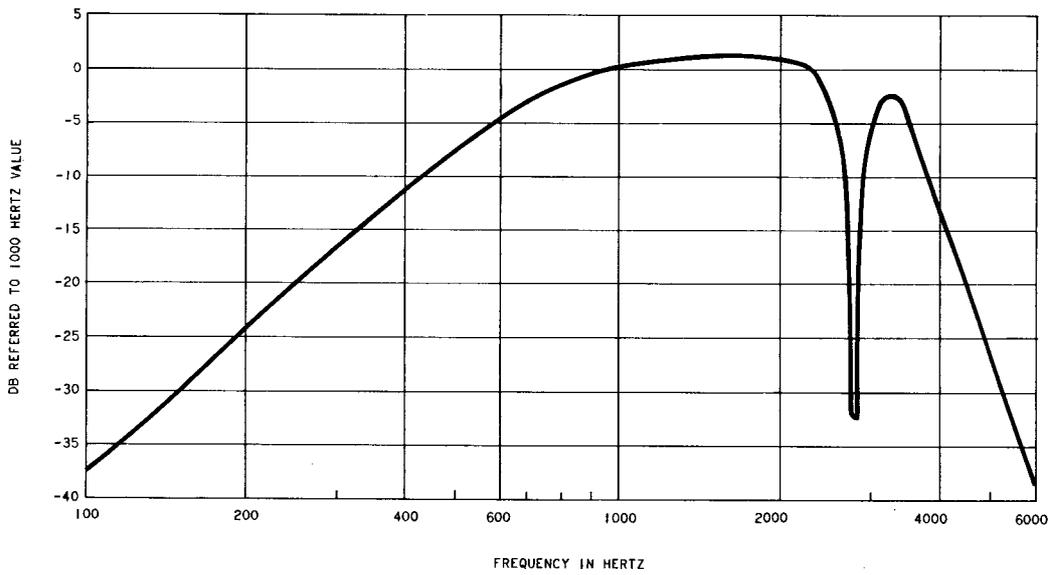


Fig. 8—Typical Frequency Characteristic With C-Notched Weighting at 2800 Hz of the 497G Plug-In Network

4.25 The following is a typical measurement procedure.

STEP	PROCEDURE
1	Calibrate the 6-type NMS per Part 4B.
2	Verify that the circuit to be tested has been turned down from service.
3	Using proper cordage, connect circuit to be tested to the input of the NMS.
4	Set the FUNCTION switch to the proper setting.
5	Measure the message circuit noise by adjusting the DBRN dial for an on-scale meter reading using the upper half of the meter scale whenever possible. Note: The message circuit noise level in dBrn will be the sum of the meter reading and the DBRN dial setting.
6	Using the following guide, set the DBRN dial for measuring impulse noise as follows: $\text{DBRN dial setting} = (\text{Lowest threshold level}) - (30)$
7	Verify that the threshold level of each counter in dBrn is the sum of the DBRN dial setting and the number in the window near the associated counter. Note: When the COUNTER SEPARATION switch is changed, the counters should be recalibrated per Part 4B to ensure the best measurement accuracy.
8	Connect a headset, oscilloscope, or other monitoring device to the MON jack for listening to or observing the measured noise. Note: To avoid possible measurement errors due to noise pickup from a monitoring device, remove any monitoring device from the MON jack before making an impulse or message circuit noise measurement unless noise sources are being investigated. To determine whether noise is being picked up by a monitoring device under these conditions, disconnect the test circuit from the input of the set, terminate the input of the set with a 600- or 900-ohm resistor, and observe the meter and counters.
9	Set the TIME-MINUTES dial to the desired time. Note: To insure accurate timing when setting the timer for 5 minutes or less, first adjust the timer to 10 minutes or greater and then return it to the desired value.
10	Depress the CTR STOP pushbutton and reset the counters to zero. Release the CTR STOP pushbutton. Note: At the end of the preset time interval, the timer switch will remove power from the set. The total number of impulses measured by each counter in this interval will be retained on the counters until they are reset for another test.

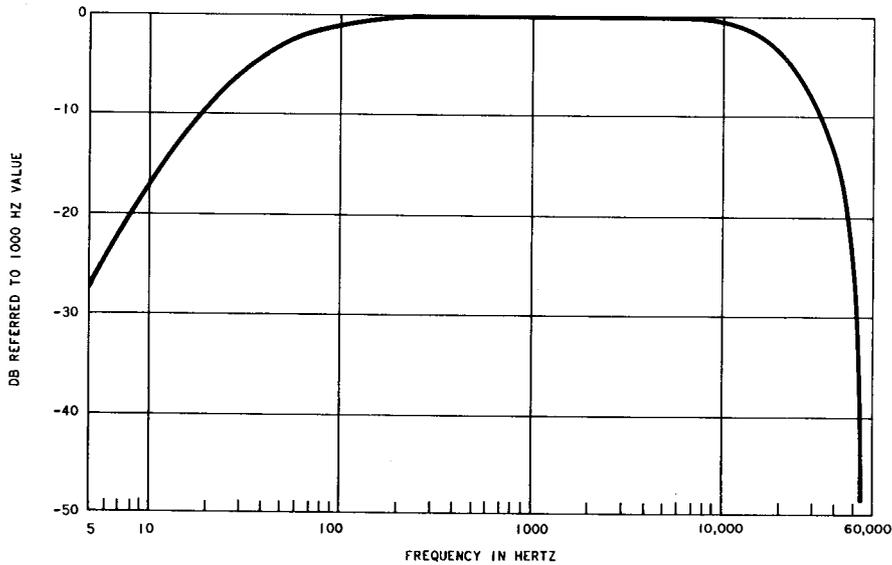


Fig. 9—Typical Frequency Characteristic of Impulse Noise Circuits With 50-Kilobit/Second Weighting of the 497F Plug-In Network

5. ADJUSTMENT AND MAINTENANCE

A. General

5.01 Adjustment and maintenance will normally consist of adjusting the internal calibration oscillator and replacing the batteries (6F set only). **The internal calibration oscillator should be adjusted at least once every 6 months.** When adjusted properly, it serves as a stable source over long periods of time for calibrating the set regardless of dc supply voltage and ambient temperature variations.

B. Internal Calibration Oscillator Adjustment

5.02 The only external equipment needed for adjusting the internal calibration oscillator is a 600- or 900-ohm, 1000-Hz generator, such as the J94071-type milliwatt generator or milliwatt outlet, having a nominal level of 0 ± 0.05 dBm. If this equipment is available, the internal calibration oscillator can be adjusted locally when it is required. If calibration requirements cannot be met or if the necessary equipment is not available locally, the set should be sent to a repair and calibration center such as a Western Electric Service Center. The adjustment procedure is as follows.

STEP	PROCEDURE
1	Remove the set from its case.
2	Plug the weighting network into the set in the position which gives flat weighting (FLAT under WTG panel stamping).
3	Set the FUNCTION switch to CAL-CTR-BAT.

STEP	PROCEDURE
4	Connect the 0 ± 0.05 dBm, 600- or 900-ohm output of the 1000-Hz generator or outlet to the input of the set.
5	Set the DBRN dial to 63. (The 6F and 6FR sets are calibrated to measure the peak value of impulse noise. Since the peak value of a sine wave is 3 dB above the rms value, the DBRN dial must be set to 63 rather than to 60.)
6	Turn the POWER switch on (see Note) and check that the meter indicates in the BAT GOOD area. If it does not, take the necessary steps to see that it does before continuing the calibration procedure (see Parts 5C and 6). Note: For a 6FR set, first connect -48 volts to the 502A plug at the rear of the set before turning the POWER switch on. Make sure that the positive voltage is connected to terminal 16 and the negative voltage is connected to terminal 20.
7	Set the FUNCTION switch to TERM and adjust the COUNTER 1 CAL control until the associated counter just counts (the count will be erratic when properly adjusted).
8	Set the FUNCTION switch to CAL-CTR-BAT and adjust the calibration oscillator potentiometer, R47 (on circuit board), until COUNTER 1 just counts, as in Step 7.
9	This completes adjustments of the interval calibration oscillator. Set the POWER switch to OFF and restore the set to its case.

C. Power Supply

5.03 For a 6F set, the condition of the batteries can be observed on the meter when the FUNCTION switch is placed in the CAL-CTR-BAT position after the POWER switch is turned on. In normal use, the battery life will be about 250 hours. If the meter indicates outside the BAT GOOD area due to battery failure, the batteries should be replaced. KS-6522 type flashlight batteries should be used whenever possible. If they are not obtainable, any leakproof, type D flashlight batteries can be used as substitutes.

5.04 When replacing the batteries in a 6F set, care should be taken that the batteries are inserted properly in the holders. A special clip is provided at the positive terminal of each holder. This allows the batteries to make contact at both terminals only when they are inserted properly. After inserting a new set of batteries, check that each battery fits snugly into its holder. If any does not, it may be necessary to bend the holder

slightly (with the battery removed) to insure that good electrical contact is made.

5.05 With new batteries in place, verify that the meter indicates in the BAT GOOD area when the FUNCTION switch is set to the CAL-CTR-BAT position and the POWER switch is turned on. With a new set of batteries, the meter should indicate about three-fourths of the way up in the BAT GOOD area.

5.06 For a 6FR set, the meter indicates the dc supply voltage applied to the buffer amplifier, 60-dB amplifier, and calibration oscillator circuits when the FUNCTION switch is set to the CAL-CTR-BAT position and the POWER switch is turned on. The meter should normally indicate near the lower edge of the BAT GOOD area. If it indicates outside this area, a trouble condition exists. In this case, check the office battery connections and refer to Part 6 for corrective measures.

6. TROUBLE INDICATION AND REPAIR

6.01 If any item of the set is malfunctioning or defective or if it is required that the internal calibration oscillator be adjusted and the necessary equipment is not available locally, the set should be sent to a repair and calibration center such as a Western Electric Service Center.

6.02 Most trouble conditions will become apparent during calibration of the set. The calibration procedure is simple and requires no external equipment (see Part 4B). Table D provides a guide to aid in localizing the more common trouble conditions.

7. REFERENCES

7.01 The following references provide supplementary information for this section.

NUMBER	TITLE
CD-99737-01 SD-99737-01	Common Systems—Transmission Measuring—6F and 6FR Voiceband Noise Measuring Sets
J94006— 801-250-154	Transmission Measuring— 6-Type Noise Measuring Equipment — Common Systems
DL-3265	Notes on the KS-21567 C-Notch Networks
KS-21567	C-Notch Network
314-410-500	Voice Bandwidth Tests and Requirements

TABLE D
TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTIVE MEASURES
<p>1. Meter indicates outside BAT GOOD area with FUNCTION switch in CAL-CTR-BAT position.</p>	<p>(a) Batteries in a 6F set defective.</p> <p>(b) Bad connection to office battery for a 6FR set.</p> <p>(c) Regulating circuit for a 6FR set defective.</p> <p>(d) Resistor R5 defective.</p> <p>(e) Diode CR3 defective.</p> <p>(f) Meter defective.</p>	<p>Replace batteries.</p> <p>Check office battery connections at plug P2 and jack J6.</p> <p>Check that voltage across capacitor C50 is within limits of 8.0 to 9.6 volts.</p> <p>Replace resistor.</p> <p>Replace diode.</p> <p>Replace meter.</p>
<p>2. COUNTER 1 CAL control does not have sufficient range.</p>	<p>(a) Check Item 1a for a 6F set or Items 1b and 1c for a 6FR set.</p> <p>(b) Internal calibration oscillator out of adjustment.</p> <p>(c) Internal calibration oscillator defective.</p> <p>(d) Buffer amplifier defective.</p> <p>(e) Weighting network defective.</p> <p>(f) 60-dB amplifier defective.</p> <p>(g) Rectifier defective.</p> <p>(h) Attenuation pad defective.</p> <p>(i) Standard trigger circuit defective.</p> <p>(j) Trigger and register circuit defective.</p>	<p>Adjust internal calibration oscillator per 5.02.</p> <p>Check voltages at transistor Q3 and waveform No. 1.*</p> <p>Check voltages at transistors Q1 and Q2.*</p> <p>Replace network.</p> <p>Check voltages at transistors Q4, Q5, and Q6 and waveform No. 2.*</p> <p>Check voltages at transistor Q7 and waveform No. 5.*</p> <p>Check waveform No. 6.*</p> <p>Check voltages at transistor Q8 and waveform No. 10.*</p> <p>Check voltages at transistors Q9 and Q10 and waveform No. 11.*</p>

* Voltages and waveforms are listed in CD-99737-01.

TABLE D (Cont)

TROUBLE	PROBABLE CAUSE	CORRECTIVE MEASURES
3. COUNTER 2 CAL control does not have sufficient range.	(a) Check Items 2a through 2g. (b) Attenuation pad defective. (c) Standard trigger circuit defective. (d) Trigger and register circuit defective.	Check waveform No. 7.* Check voltages at transistor Q14 and waveform No. 10.* Check voltages at transistors Q15 and Q16 and waveform No. 11.*
4. COUNTER 3 CAL control does not have sufficient range.	(a) Check Items 2a through 2g. (b) Attenuation pad defective. (c) Standard trigger circuit defective. (d) Trigger and register circuit defective.	Check waveform No. 8.* Check voltages at transistor Q17 and waveform No. 10.* Check voltages at transistors Q18 and Q19 and waveform No. 11.*
5. COUNTER 4 CAL control does not have sufficient range.	(a) Check Items 2a through 2g. (b) Attenuation pad defective. (c) Standard trigger circuit defective. (d) Trigger and register circuit defective.	Check waveform No. 9.* Check voltages at transistor Q20 and waveform No. 10.* Check voltages at transistors Q21 and Q22 and waveform No. 11.*
6. Meter CAL control does not have sufficient range.	(a) Check Items 2a through 2f. (b) Meter circuit defective. (c) Meter rectifier defective. (d) Meter defective.	Check voltages at transistors Q11 and Q12 and waveform No. 3.* Check diodes CR1, CR2, CR3, and CR4. Replace meter.
7. Counter and meter circuits can be calibrated but no input signals can be measured.	(a) Defective circuit between input and buffer amplifier.	Check input circuit, attenuators, and FUNCTION switch connections.

*Voltages and waveforms are listed in CD-99737-01.

TABLE D (Cont)

TROUBLE	PROBABLE CAUSE	CORRECTIVE MEASURES
<p>8. Counter and meter circuits can be calibrated but measurements seem to be in error.</p>	<p>(a) Internal calibration oscillator out of adjustment.</p> <p>(b) Level of external calibration source in error.</p> <p>(c) Defective attenuators.</p>	<p>Adjust internal calibration oscillator per 5.02.</p> <p>Check level of calibration source with J94022A milliwatt reference meter or equivalent and adjust internal calibration oscillator per 5.02.</p> <p>Check attenuator steps against external attenuator.</p>
<p>9. A register relay fails to operate.</p>	<p>(a) CAL control does not have sufficient range.</p> <p>(b) Register relay defective.</p>	<p>Under Trouble column, check Items 2, 3, 4, or 5 for counter circuits 1, 2, 3, and 4, respectively.</p> <p>Replace register relay.</p>

*Voltages and waveforms are listed in CD-99737-01.