

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

CONTENTS	PAGE
1. GENERAL	1
2. OPERATING INSTRUCTIONS	4
3. ADJUSTMENT AND MAINTENANCE	10

1. GENERAL

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.

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 C-message filter which was supplied with the 6F and 6FR sets has been replaced with a C-notched filter. An additional network for measurements on 50-kilobit wideband facilities is available.

1.03 The 6F and 6FR sets provide a means for measuring impulse noise distribution and the rms value of message circuit noise in the frequency range of 50 Hz to 25 kHz. 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.

1.04 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.

1.05 A timer provides for measuring impulse counts over a preset time interval while the set 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.

1.06 The 6F portable set (see 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.

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

1.08 Plug-in weighting networks provide a means for selecting the passband of frequencies to be measured. One network, having C-notched weighting on one side and flat weighting on the other, is supplied with each set. C-message or 50-kilobit/second networks (with flat weighting on the other side) are also available for measurements. These networks have about 5 dB of flat loss and variations of this flat loss are compensated for in the calibration of the sets.

1.09 An internal calibration oscillator generates a standard signal for checking the sensitivity



Fig. 1—6F Portable Set

of the meter circuit amplifier and for adjusting the threshold levels of the counter circuits. Once it is adjusted, it provides a stable calibration source for several months without readjustment regardless of dc supply voltage and ambient temperature variations.

1.10 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.

1.11 A pushbutton switch (CTR STOP) provides for disconnecting signals from the trigger circuits while the counters are being reset.

1.12 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).



Fig. 2—6FR Rack-Mounted Set

1.13 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 are itemized in Tables A and B, 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. When using filters other than the flat filter, the measurement accuracies listed in Tables A and B must be modified to include the frequency characteristic of the particular filter being used. Figure 3 shows the ideal frequency characteristic for the C-message (497D) weighting network.

SECTION 103-626-100

Figure 4 shows the typical frequency characteristics for the C-notched weighting network (497G). The C-notched weighting network has a frequency characteristic similar to that of the C-message filter but indicates a band rejection filter centered about 2800 Hz to permit measurements on compandored or mixed compandored-noncompandored circuits. Figure 5 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.

1.14 Table C shows the electrical specifications for the 6F and 6FR sets.

TABLE A

MEASUREMENT ACCURACY FOR IMPULSE NOISE MEASUREMENTS

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

2. OPERATING INSTRUCTIONS

2.01 Calibration of Set: 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 calibration procedure is simple and requires no external equipment. It is as follows.

- (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. Verify that the meter indicates in the BAT GOOD area. If it does not, replace the batteries in a 6F set per 3.03 and 3.04 or check the office battery connection for a 6FR set.
- (4) Adjust the COUNTER 1 CAL control until the associated counter just counts (the count will be erratic when properly adjusted).
- (5) Adjust the COUNTER 2, 3, and 4 CAL controls by depressing the associated pushbutton switch and adjusting the associated

TABLE B

MEASUREMENT ACCURACY FOR MESSAGE CIRCUIT NOISE MEASUREMENTS

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

CAL control until the counter just counts, as in (4).

Note: During this calibration procedure only inter will operate at a time. For

TABLE C
ELECTRICAL 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 1.13).

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.

- (6) Set the FUNCTION switch to CAL-MTR and adjust the meter CAL control for a meter indication at the CAL marking.
- (7) 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 3.02.

2.02 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. 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. Multiplied jacks and binding posts on the front panel

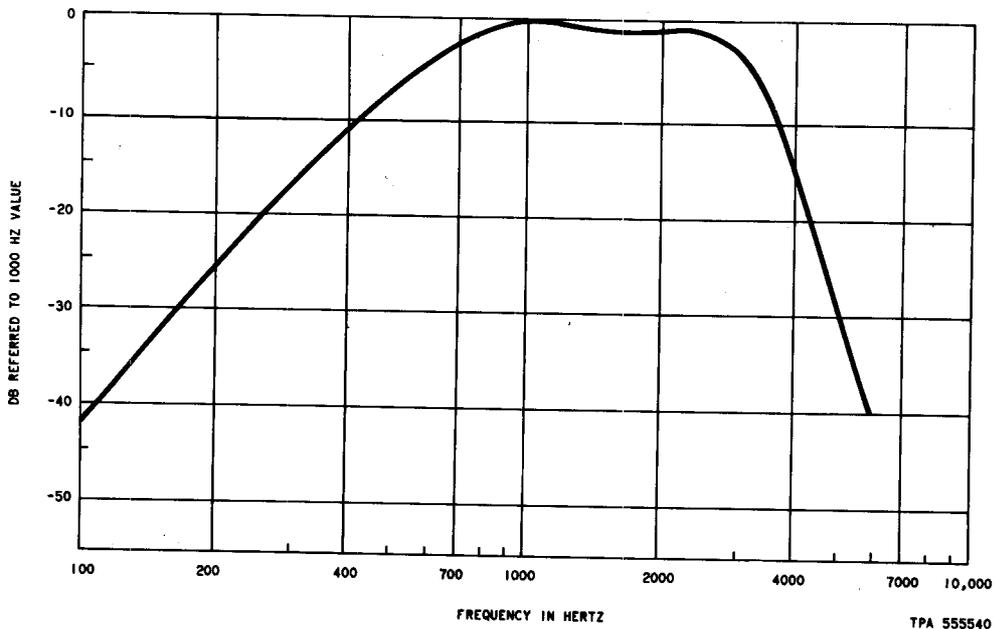


Fig. 3—Ideal Frequency Characteristic of C-Message Weighting Network

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. 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.

2.03 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. 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. 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. 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

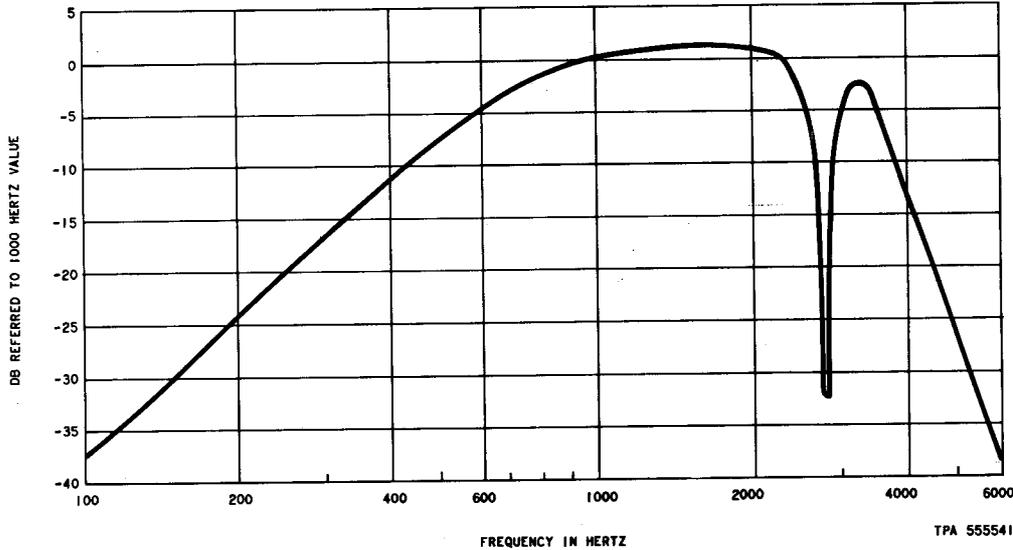


Fig. 4—Typical Frequency Characteristic With C-Notched Weighting

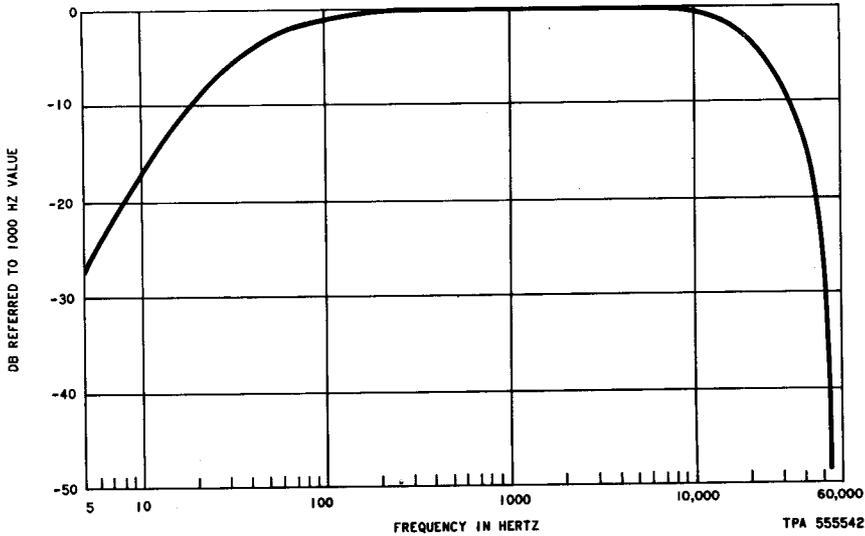


Fig.5—Typical Frequency Characteristic of Impulse Noise Circuits with 50-Kilobit/Second Weighting

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.

2.04 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. 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.

2.05 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.

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.

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.

2.06 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.

2.07 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. 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.

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.

2.08 Figures 6 and 7 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. Both curves are very similar and have 3-dB points at about 50 Hz and 25 kHz.

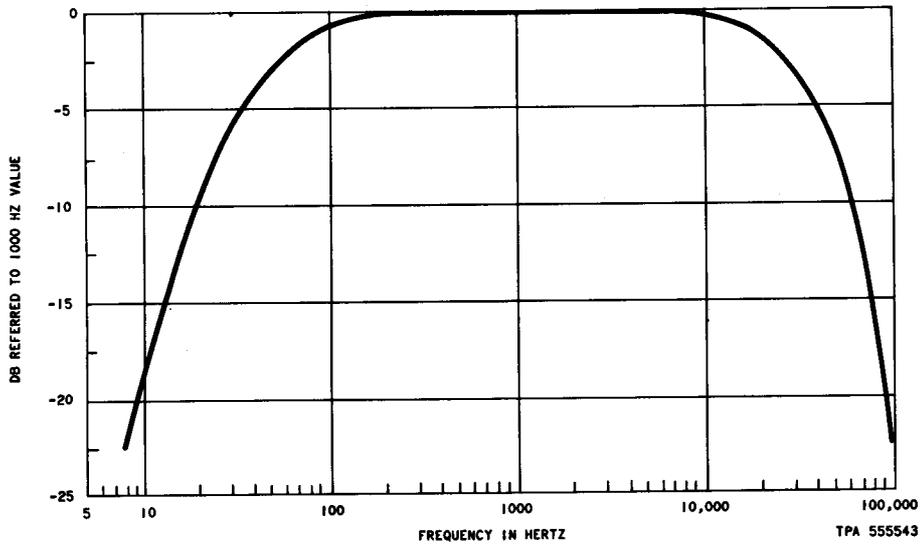


Fig. 6—Typical Frequency Characteristic of Impulse Noise Circuits With Flat Weighting

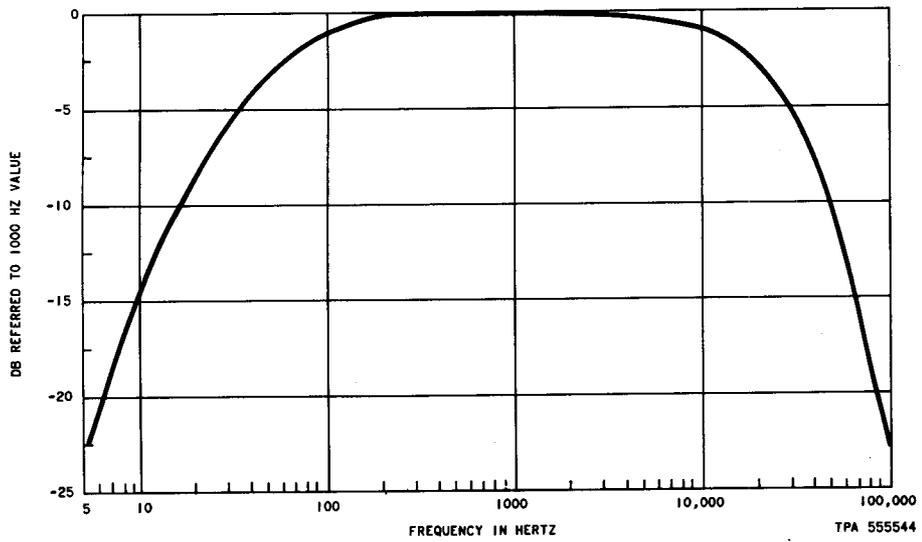


Fig. 7—Typical Frequency Characteristic of Message Circuits With Flat Weighting

SECTION 103-626-100

2.09 Following is the operating procedure for a typical measurement.

- (1) Calibrate the set per 2.01.
- (2) Connect the circuit to be measured to the input of the set.
- (3) Set the FUNCTION switch to the proper setting.
- (4) Measure the message circuit noise by adjusting the DBRN dial for an on-scale meter reading. Use the upper half of the meter scale whenever possible. The message circuit noise level in dBrn will be the sum of the meter reading and the DBRN dial setting.
- (5) Set the DBRN dial, for measuring impulse noise, as follows.

DBRN dial setting = (Lowest threshold level) - (30).

The threshold level of each counter in dBrn will be the sum of the DBRN dial setting and the number in the window near the associated counter.

Note: Whenever the COUNTER SEPARATION switch is changed, the counters should be recalibrated per 2.01 to insure the best measurement accuracy.

- (6) If desired, 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.

- (7) 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.

- (8) Depress the CTR STOP pushbutton and reset the counters to zero. Release the CTR STOP pushbutton.

- (9) 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.

3. ADJUSTMENTS AND MAINTENANCE

3.01 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.

4.09 Weighting Network: Plug-in weighting networks provide a means for selecting the passband of frequencies to be measured.

◆ Networks available are:

497D for C-message and flat weighting

497F for 50-kilobit/second and flat weighting

497G for C-notched and flat weighting.

The 497G network is supplied with each set. This network has a 600-ohm impedance and about 5 dB of flat loss.◆ The set is calibrated through the weighting network and therefore 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.