V4 TELEPHONE REPEATER

227-TYPE AMPLIFIERS—TESTS AND ADJUSTMENTS

This section covers the methods of testing and adjusting the 227-type amplifiers as shown in Fig. 1 and includes the requirements and limits for each test.

This section is reissued to include information for the 227 C-, D-, E-, and F-type amplifiers.

The 227-type amplifier is a plug-in transistorized amplifier using a 15-pin connector. Pin jacks on the amplifier are provided for monitoring with a high-impedance receiver. So that the amplifier can be measured in its working location, 518AM jacks are provided in all standard layouts at the input and output of the amplifier. The amplifier gain is measured by plugging the measuring equipment into the AMPL IN and AMPL OUT part of the jacks. The MON IN and MON OUT part of the 518AM jacks permits monitoring to be conducted on the circuit with a high-impedance receiver without interrupting transmission. These jacks may also be used for transmission measurements on the incoming or outgoing line, but in this case an open plug must be inserted in the AMPL IN or AMPL OUT jack, respectively, to prevent the amplifier from acting as a bridging impedance.

After a circuit release has been obtained from the control office, the high-impedance monitoring receiver should be used to monitor the output of the 227-type amplifier to insure that the circuit is idle before the circuit is interrupted by any patching into the AMPL IN and AMPL OUT jacks.

It is very important to identify accurately the correct location of the 227-type amplifier wanted before working on an amplifier or before a monitoring receiver is connected to the pin jacks of the amplifier. The repeater numbers for rows of units are designated on the vertical uprights, but within a given row of units the proper location of a pair of amplifiers associated with a given circuit is determined only by counting. ***It is very important to make certain that the correct units are selected before performing any operations that might interfere with service on working circuits, and it is very important to identify the units removed with respect to their 1 and 2 sockets so that no error will be made when they are inserted again.***

APPARATUS:

1—602C Tool (For removing amplifier from socket)

1—KS-14418 High Impedance Headset equipped with 354A Plug

1—21A Transmission Measuring Set or

40B Transmission Measuring Set or

4TTS Transmission Measuring Set (Manufactured by Northeast Electronics Corp.)

1—3A Noise Measuring Set

MONITORING ON THE AMPLIFIER

To monitor on the 227-type amplifier, insert the 354A plug of the KS-14418 headset into the pin jacks on the front plate of the 227-type amplifier. The transmission loss caused by the insertion of the headset is negligible.

REMOVING AND REPLACING THE AMPLIFIER UNIT

Before removing an amplifier unit or a pair of amplifier units from their sockets, positive identification of the units wanted is very important, as discussed. Also, before removing an amplifier unit from its socket, it is important to make sure that no adverse service reactions will result, especially in the case of circuits employing single-frequency signaling.

To facilitate removing the 227-type amplifier from the bay, two ears extending 7/16 inch beyond the front plate have been provided. The 602C tool should be used for pulling the amplifier out of the 15-pin shelf-mounted socket. ***In replacing the 227-type amplifier units in their sockets (where a pair of units have been removed), it is very important to make certain that each unit is inserted into the correct socket 1 or 2.*** Care should be taken that the pins are properly aligned with the socket holes and that the unit is straight in line. It should then be seated by pushing with the thumbs, taking care that the potentiometer setting is not changed. The fingers should be kept away from the roughened surface in the lower right-hand corner of the amplifier unit to avoid smudging any penciled data. The amplifier should then be carefully pushed home into the socket.

GAIN MEASUREMENTS AND ADJUSTMENTS

The 227-type amplifier may be arranged for either 600- or 1200-ohm input and output impedances in accordance with the following strapping of the connector block.

INPUT IMPEDANCE	600 OHMS	1200 OHMS
Strap Terminals	11-13	9-13
Connect to Terminals	1-5	1-5

OUTPUT IMPEDANCE	600 OHMS	1200 OHMS
Connect to Terminals	4-8	2-10

For measuring gain and output level, a 600-ohm transmission measuring set is used and corrections to the readings applied as shown in Table A.

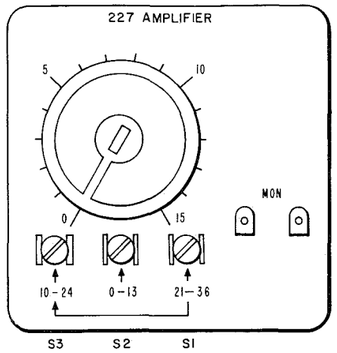
TABLE A

AMPLIFIER IMPEDANCE		CORRECTION TO BE ADDED TO TRANSMISSION MEASURING SET READING	
INPUT	OUTPUT	GAIN (dB)	OUTPUT POWER (dB)
600	600	0	0
1200	600	+0.5	0
600	1200	+0.5	+0.5
1200	1200	+1.0	+0.5

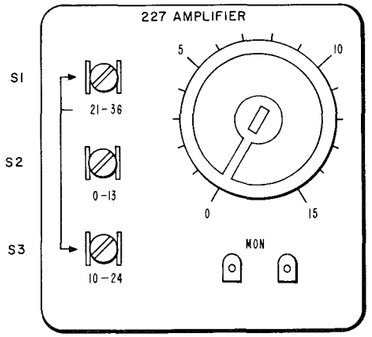
GAIN RANGE IN DB	SCREW-TYPE SWITCH POSITIONS		
	S1	S2	S3
21–36	CLOSED	OPEN	CLOSED
10–24	OPEN	OPEN	CLOSED
0–13	OPEN	CLOSED	OPEN

NOTES:

1. RV1, CR1, CR2 USED FOR 227B, C, D, F ONLY.
2. AMPLIFIERS MADE BEFORE 9/64 HAD C6, R15 AND OMITTED C4, C7, AND R12.



FACEPLATE OF PRESENT PRODUCTION AMPLIFIER



FACEPLATE OF EARLY PRODUCTION AMPLIFIER

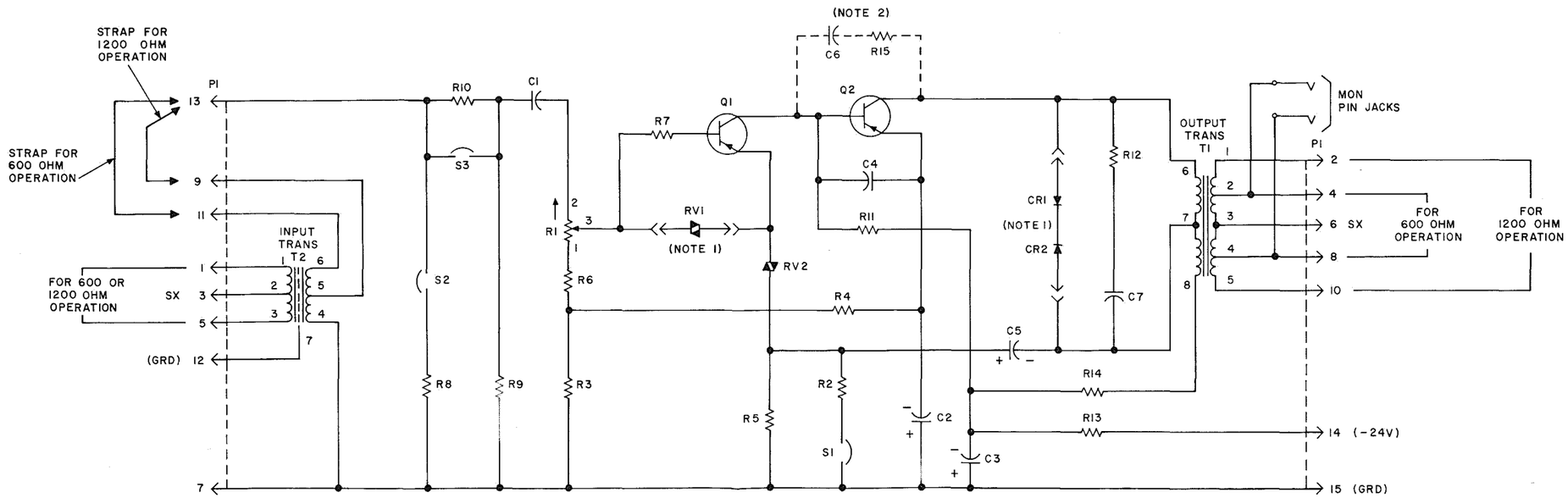


Fig. 1— 227 - Type Amplifier — Schematic and Faceplate Arrangement

FOR DIRECT GAIN MEASUREMENT AND FOR ADJUSTING THE GAIN

STEP	PROCEDURE
1	Set up the testing arrangement as shown in Fig. 2 using a 21A transmission measuring set, or equivalent.
2	Adjust the oscillator output so that the testing power at the AMPL OUT jack is not greater than +10 dBm.
3	The gain of the amplifier is the difference between the detector reading obtained at the AMPL OUT jack and the measured output of the oscillator connected to the AMPL IN jack. For example: AMPL OUT measurement 2.3 dBm Oscillator output -10.0 dBm Gain of amplifier = 2.3 - (-10) = 12.3 dB

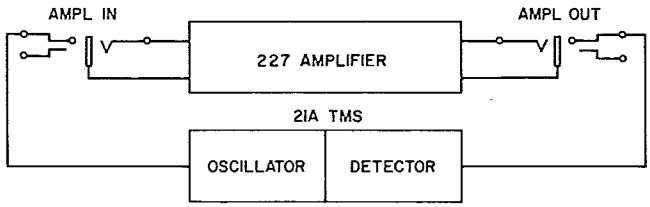


Fig. 2—Gain and Gain-Frequency Testing Arrangement

Requirement: The measured gain for the working adjustment should not differ from the authorized gain by more than 0.3 dB, and when readjusted, should be set as nearly as practicable to the authorized value. (It is considered practicable to adjust to an accuracy of better than 0.1 dB.)

4	The gain is adjusted by means of two fixed steps, one in the feedback circuit which decreases the basic gain of the amplifier by 11.4 ±0.8 dB, and the other, an input pad of 11.0 ±0.7 dB. The potentiometer has a continuous gain range of 15 dB (min. 12.5, max. 20). The fixed steps are controlled by three screws on the front plate of the amplifier. With the S1 and S3 screws turned in to make contact with the respective side rails, a gain of about 21 to 36 dB may be obtained depending upon the setting of the potentiometer. With only the S3 screw turned in, the nominal gain is from about 10 to 24 dB, while with only the middle screw (S2) turned in, the nominal gain is from about 0 to 13 dB. The feedback step should be used wherever possible (screw S1 open) to obtain the maximum gain stability of the amplifier. See Fig. 1 for reference to S1, S2, and S3 screw designations.
5	The potentiometer knob is recessed to avoid inadvertent changes in gain. It is slotted for a screwdriver adjustment.

GAIN-FREQUENCY CHARACTERISTICS

The gain-frequency requirements for the 600-ohm impedance amplifier ***set for maximum gain*** are given in Table B. Typical frequency characteristics of three gain ranges of the amplifier are shown in Fig. 3. These characteristics over the voice-frequency band are essentially the same for any potentiometer setting in the two low gain-frequency ranges. Some shape variations can be expected as the potentiometer is varied in the high-gain range.

TABLE B

FREQUENCY IN Hz	DEVIATION FROM 1000-Hz GAIN, DB	
	227A, B, E, F	227C, D
100	−2.8 ± 2.5	0.4 ± 1.0
200	0.2 ± 0.8*	0.1 ± 0.7
3000	0 ± 0.8*	0 ± 0.8

* −1.1 ± 0.8 for 227A, B amplifiers dated Feb. 1966 or earlier.

The maximum 1000-Hz gain of the amplifier should be 36.3 ±2.0 dB whether the amplifier is strapped for 600- or 1200-ohm impedances. The gain-frequency characteristic of the 1200-ohm amplifier is essentially the same as that of the 600-ohm amplifier at high frequencies. At frequencies below 500 Hz, the gain characteristic of the 1200-ohm amplifier falls off slightly, being about 0.3 dB lower at 200 Hz.

NOISE AND CROSSTALK TESTS

BATTERY SUPPLY NOISE

The susceptiveness of the 227-type amplifier to battery noise on the 48-volt battery should be satisfactorily low because of the 1400-ohm resistor in series with the battery. In 24-volt offices sufficient filtering should be accomplished by the decentralized filter specified for large offices and by the inductor-capacitor filter arrangement specified for use with 1 to 12 amplifiers in small offices.

MEASUREMENT OF NOISE

STEP	PROCEDURE
1	Connect the 3A noise measuring set to the AMPL OUT jacks of the amplifier under test. The 3A noise measuring set should be arranged for C message weighting and a 600-ohm termination for an amplifier output impedance of 600 ohms. It should be set for a 900-ohm termination when the amplifier output impedance is 1200 ohms. No reading correction is necessary in either case. The input of the amplifier should be terminated in a 600-ohm resistor regardless of amplifier input impedance.

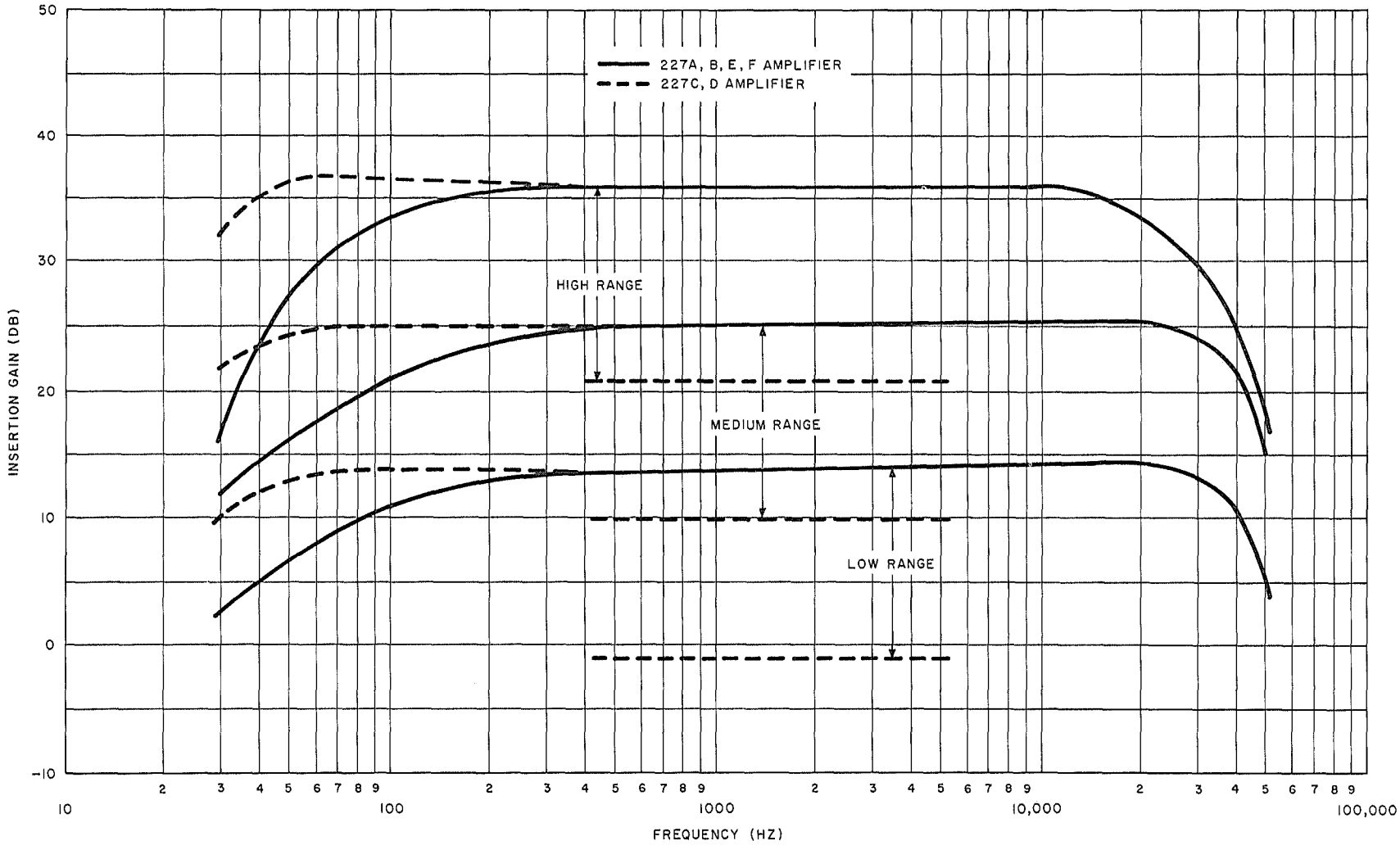


Fig. 3—Frequency Characteristics—227-Type Amplifiers (Potentiometer Set for Maximum Gain)

STEP	PROCEDURE
	Requirement: The measured noise should not exceed 28 DBRN. If the measured noise is greater than 28 DBRN, another 227-type amplifier known to be in good condition may be substituted to see whether the trouble is in the amplifier. If the same noise result is obtained, the noise can be measured at the battery terminal of the 227-type amplifier. Leaving the input of the amplifier terminated, terminate the output of the amplifier in a 600-ohm resistor, regardless of output impedance. Use the bridging setting of the 3A noise measuring set, C message weighting, and make connections between the battery terminal and ground. Internal capacitors provided in the 3A noise measuring set prevent direct current from flowing in the input circuit. Measure the noise. Repeat the noise measurement at the battery bus bar on the battery side of the 1400-ohm resistor in the case of the 48-volt supply, or on the battery side of the decentralized filter or small office filter in the case of the 24-volt offices. There should be a considerable reduction in the noise at the battery terminal of the amplifier from that at the battery bus bar.

CROSSTALK MEASUREMENT

Crosstalk: The controlling crosstalk paths between 227-type amplifiers are those via the battery supply circuits. The relative location of one amplifier with respect to another is of minor importance in influencing the coupling between the two. Crosstalk measurements between 227-type amplifiers are made with both amplifiers at top gain and with the disturbing amplifier energized with 1000-Hz testing power sufficient to produce an output close to, but not exceeding, +10 dBm. Table C indicates the connections to be made and the readings to be noted during crosstalk tests between any two amplifiers A and B. These tests should be repeated with the connections to amplifiers A and B interchanged.

Compute measurement (2) minus measurement (3) of Table C; look up the corresponding correction in Table D, and subtract this correction from measurement (2) in order to obtain crosstalk alone. If measurement (3) cannot be brought on to the calibrated part of the dB scale by adjusting the dB dial, the effect of noise may be neglected and no correction need be made to measurement (2). The crosstalk coupling loss is found by subtracting the crosstalk alone from measurement (1).

TABLE C

MEASUREMENT	AMPLIFIER A		AMPLIFIER B	
	INPUT	OUTPUT	INPUT	OUTPUT
(1) Disturbing Power	Test Power	NMS*	Term.	Term.
(2) Crosstalk + Noise	Test Power	Term.	Term.	NMS*
(3) Noise Alone	Term.	Term.	Term.	NMS*

* NMS = 3A noise measuring set, C Message Weighting.

Term. = 217D plug (or 600 ±6 ohm) termination.

STEP	PROCEDURE

TABLE D

MEASUREMENT (2) MINUS MEASUREMENT (3) (dB)	CORRECTION TO BE SUBTRACTED FROM MEASUREMENT (2) (dB)
1	7
2	4
3	3
4, 5	2
6, 7,8	1
Greater than 8	0

Requirement: The corrected crosstalk coupling loss should be not less than 74 dB.

EXAMPLE: Computing The Corrected Crosstalk Coupling Loss

(1) Suppose disturbing power at output of amplifier A is +95 dBrn as read on the 3A noise measuring set.

(2) Reading on output of amplifier B is +20 dBrn. (This includes both crosstalk and noise.)

(3) Reading on output of amplifier B is +18 dBrn with no input connected to amplifier A (noise only, on amplifier B).

To compute the crosstalk coupling loss:
Measurement 2 minus Measurement 3 = 20 dBrn -18 dBrn = 2 dB.
From Table D for a difference of 2 dB the correction is 4 dB.
Therefore, the crosstalk alone is 20 dBrn -4 dB = 16 dBrn.

The crosstalk coupling loss between disturbing and disturbed circuits is therefore 95 dBrn -16 dBrn = 79 dB.