Western Electric

J68312C AMPLIFIER

INSTRUCTION BULLETIN No. 1121, ISSUE No. 2

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

NOTE: The following drawings are furnished with each order and should be kept on the premises for the use of the maintenance force:

Title	*Schematic*	*Wiring*
Amplifier	SD-59193-01	T-59193-80

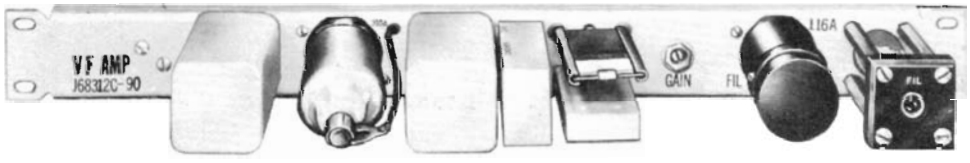

Figure 1 — J68312C Amplifier-Circuit

Western Electric

J68312C AMPLIFIER

Instructions For Use

SECTION 1

DESCRIPTION AND OPERATING PRINCIPLES

1—1. General

1—101. The J68312C Amplifier is a 600-ohm single tube, feedback amplifier for use in radio telephone control terminals and other applications where such a unit is required. It has an adjustable gain range between approximately 5 and 35 db and the frequency range is between 100 and 6000 cycles. The gain is continuously adjustable by the combined use of soldered taps in 4-db steps and a 5.5-db potentiometer covering the intervals. The nominal output capacity is +17 dbm of single frequency tone and +12 vu for speech.

1—102. The amplifier requires .32 amperes at 10 volts A-C or D-C for the vacuum tube heater and a battery or filtered plate supply with a nominal voltage between 130 and 150 volts, regulated within ±5 volts.

1—103. The amplifier is assembled on a 1¾-inch panel for mounting on a standard 19-inch relay rack. It is assembled, wired, and tested in the shop (see Fig. 1).

1—2. Circuit Description

1—201. The circuit of the amplifier is shown in Fig. 2. Across the primary of the input transformer IN is a 600-ohm bridge consisting of resistances E and F, giving a nominal input impedance of 600 ohms. The impedance ratio of the input transformer is 300:357,000, and the secondary winding has six taps which provide a gain adjustment in 4-db steps with lead N on terminal 7. Terminal 10 of this transformer is not connected internally to either winding and is provided as a permanent connection for the grid lead from the vacuum tube. The gain is normally adjusted by strapping terminal 10 to terminals 1 to 6 required.

1—202. The output transformer OUT has four windings. Windings 7-8 and 1-2 are the usual plate and line output windings, respectively; winding 9-10 is the feedback winding, and 3-4 is the monitoring winding. Because of the nature of the network connected across the feedback winding, the application of feedback through it produces an output impedance which approximates 600 ohms. The monitoring winding is low impedance and its output into a 600-ohm termination is approximately 11 db below the output of the 1-2 winding similarly terminated.

1—203. A pentode vacuum tube is the amplifying element. Grid bias potential is obtained from the voltage drop in resistances B and C and the potentiometer GAIN, through which the total cathode current flows. The potentiometer GAIN serves as a supplementary gain control with a range of about 5.5 db.

1—204. The amplifier employs negative feedback which reduces gain fluctuations with changes in potentials applied to the vacuum tube. The application of feedback also makes the output impedance of the amplifier substantially independent of the setting of the potentiometer. The feedback voltage is the resultant of the voltage induced in winding 9-10 of the output transformer plus the drop across resistance A and condenser B, and the a-c voltage across resistances B and C and the used portion of the potentiometer. The amount of effective feedback, therefore, depends upon the setting of the potentiometer. The gain change resulting from a movement of the potentiometer contact arm is due to the combined effects of a change in feedback voltage and a change in the amplification of the vacuum tube resulting from the change in grid bias.

1—205. With the potentiometer resistance all in the circuit, the cathode current and amplifier gain are minimum. With the potentiometer resistance entirely out of the circuit, the cathode current and amplifier gain are maximum. Cathode current is measured as a voltage drop across resistance B.

1—206. The FIL socket, FIL jack and resistance G are connected in series with the vacuum tube heater when the heater current is supplied from a 20-28 volt D-C source. A variable plug-in type 116A resistance is mounted in the FIL socket to adjust the heater current which is read on a meter connected into the circuit by inserting a plug in the FIL jack. The heaters of two amplifiers may be operated in series by substituting the second heater for resistance G in the first amplifier.

1—3. Transmission Performance

1—301. The maximum 1000-cycle gain of the amplifier is 35 $\pm$ 2.0 db. These limits take into consideration manufacturing tolerances of the amplifier as well as tube variations and normal plate voltage variation (see paragraph 1—102). A reduction in heater voltage has very little effect until the voltage falls below 8.5 volts when the gain and load carrying capacity of the amplifier starts to drop off. Increasing the heater voltage above 10 volts does not affect the performance of the amplifier but decreases the life of the tube.

1—302. A continuous range of gain adjustment of about 30 db is available by means of the taps on the input transformer IN and the potentiometer GAIN. With lead N on terminal 7 the taps on the input transformer provide five gain steps of 4 db each, and with the 5.5 db range of the potentiometer GAIN a total range of 25.5 db. A further reduction of 4.5 db may be obtained by connecting lead N to terminal 6 and by strapping terminal 10 to terminal 5. Table 1 shows the nominal amplifier gain range for various connections of the input transformer. Whenever a choice in setting exists, it is desirable from the load carrying standpoint to use the lower gain input transformer taps and the higher gain potentiometer setting which will give the desired gain.

TABLE 1

Terminal 10 Strapped to Terminal	*Lead N Connected to Terminal*	*Gain Range db*
1	7	29.5 to 35
2	7	25.5 to 31
3	7	21.5 to 27
4	7	17.5 to 23
5	7	13.5 to 19
6	7	9.5 to 15
5	6	5.0 to 10.5

1—303. Figure 3 gives a typical gain-frequency characteristic of the amplifier measured between 600-ohm resistances. The curve shows the gain at various frequencies relative to that at 1000 cycles.

1—304. The power-carrying capacity of the amplifier is such that the output may be as high as +17 dbm for single frequency tone and +12 vu for speech.

SECTION 2
INSTALLATION

2—1. General

2—101. The amplifier is assembled, wired, and tested in the factory. Usually the panel will be mounted and wired with other equipment in cabinets before shipment. When it is shipped loose the installer will be required to mount the equipment on a relay rack or in a cabinet, running leads to the power supply (or battery fuse panels), line, and other connecting circuits.

2—102. *Wiring Diagrams*

The wiring diagram employs the so-called "air line" system of showing connections. In the air line system, each individual piece of apparatus (each group in some cases) is numbered, and the lines representing the individual wires from each piece of apparatus are carried a short distance and terminated at a common base line. These individual lines between apparatus and base line are called feed lines. Each feed line is numbered to correspond with the identification number of the piece of apparatus at which the other end terminates. It is not necessary to follow a connection through the base line and no provision is made for so doing. By observing the color and identification number included with the feed line, it is possible to jump directly between pieces of apparatus.

2—103. *Installation Tests*

At the completion of all installation work, the installer should make a visual inspection to insure that the connections are made to meet job conditions as specified on the circuit drawing, and to insure that no wires have been broken off in shipment.

2—104. Continuity tests to detect opens, reverses, and direct or low-resistance crosses and grounds should be made on all wire and cabling connected by the installer, using a tone buzzer or voltmeter continuity test set.

CAUTION: READ PARAGRAPH 4—104, SECTION 4.

2—105. Measure gain in accordance with paragraph 4—106. Section 4.

SECTION 3
MAINTENANCE ROUTINES

3—1. *Tests*	*For Method of Making Test See Par.*	*Initial*	*As Required*	*3 Months*
Vacuum Tube	4—105	X		X
Gain	4—106	X	X	
Gain-Frequency	4—108		X	

SECTION 4
OPERATION AND MAINTENANCE METHODS

4—1. General

4—101. In this section are described tests to be made initially in placing an amplifier in service, and tests for maintaining the equipment in good operating condition and for the location of trouble. The method of making the tests is described, the requirements to be met are given, and the testing equipment required is listed. The requirements are based on the use of this testing equipment or the equivalent.

4—102. The following testing equipment or the equivalent is required:

1 19C Oscillator*
1 13A Transmission Measuring Set*
1 5A Attenuator
1 1 Vacuum Tube Tester*
1 D-166852 Volt-Ohm-Milliammeter*
2 2W15B Cords

4—103. All tests and requirements are based on the use of a vacuum tube known to be good, heated for at least five minutes.

4—104. CAUTION: This amplifier contains coils which may be permanently injured if their cores are magnetized by direct or excessive alternating current through their windings. Ordinary buzzers and similar equipment should not be used for making continuity tests. Care should be exercised during all testing operations to avoid injuring the coils through magnetization.

4—105. *Vacuum Tube Test*

In general, the only maintenance required will be the vacuum tube. This tube should be tested in a vacuum tube test set every three months. If such a test set is not available, the tube should be replaced by a new one every six months. These intervals may be shortened whenever vacuum tube trouble is known or suspected. The heater voltage measured between terminals 1 and 6 of the vacuum tube socket should be between 8½ and 11½ volts. The cathode current measured as a voltage drop across resistance B with the potentiometer GAIN in the extreme clockwise direction should be between 0.45 and 0.80 volts.

4—106. *Gain Test*

If trouble is experienced in transmission through the amplifier, its gain should be checked at a frequency of 1000 cycles at an output power not exceeding + 10 dbm. Unless the amplifier input and output both appear at jacks, which when patched into, completely disconnect other circuits from the amplifier, it will be necessary to remove the external input or output leads or both at the amplifier terminal strip. The measured gain should check the working gain of the amplifier within 0.7 db. If the gain fails to meet this requirement the most likely cause is vacuum tube failure. The tube should be checked in a vacuum tube test set or replaced by a new one. If a new tube increases the gain of the amplifier by more than 1.0 db, the indications are that the original tube was defective.

4—107. If the amplifier still appears in trouble with a good vacuum tube, measure the gain at 1000 cycles with the potentiometer GAIN in its extreme clockwise position. For this test the amplifier output should not exceed +10 dbm. Table 2 shows the nominal gain for various connections to the input transformer IN. The measured gain should be within ±2 db of these values. Measure the gain with the potentiometer GAIN in its extreme counterclockwise position. This gain should be 5.4±0.5 db less than that measured above.

TABLE 2

Terminal 10 Strapped to Terminal	*Lead N Connected to Terminal*	*Gain Db*
1	7	35
2	7	31
3	7	27
4	7	23
5	7	19
6	7	15
5	6	10.5

4—108. *Gain-Frequency Test*

The gain-frequency characteristic should be measured with the potentiometer GAIN in its extreme clockwise position. The gain at various frequencies relative to that at 1000 cycles should be as indicated in Table 3 ("—" indicates less gain).

*Information on these items is available in separate bulletins.

TABLE 3

Frequency in Cycles per Second	100	200	3000	6000
Deviation from 1000-Cycle Gain, db	0.0−6.5	+0.2 to −1.8	+0.2 to −1.4	0 to −4.0

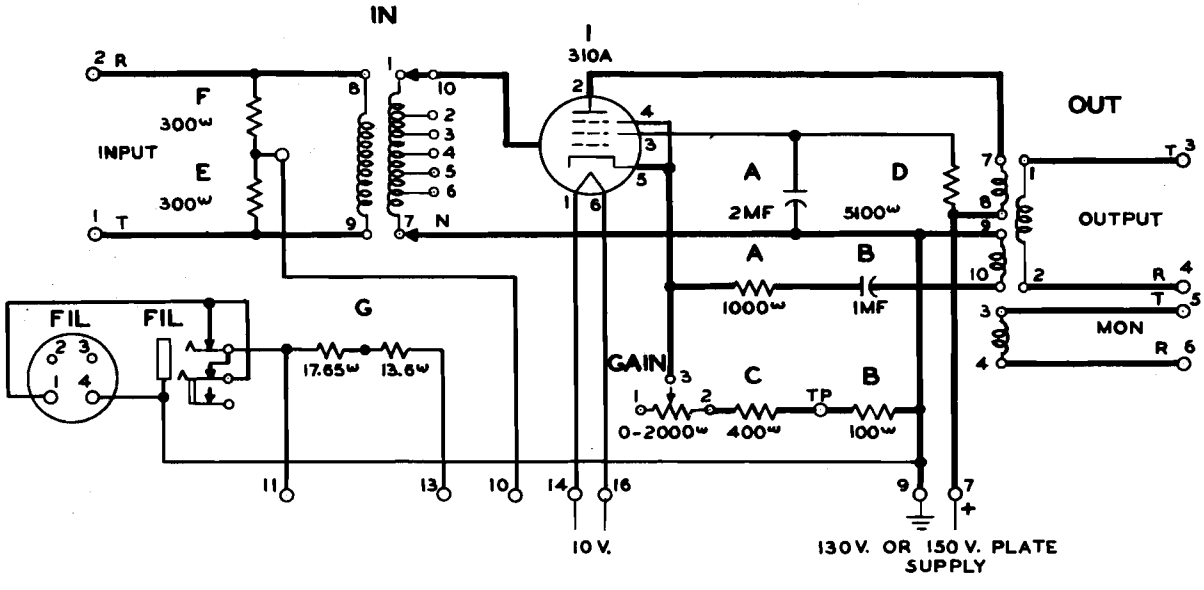

Figure 2 — Functional Schematic

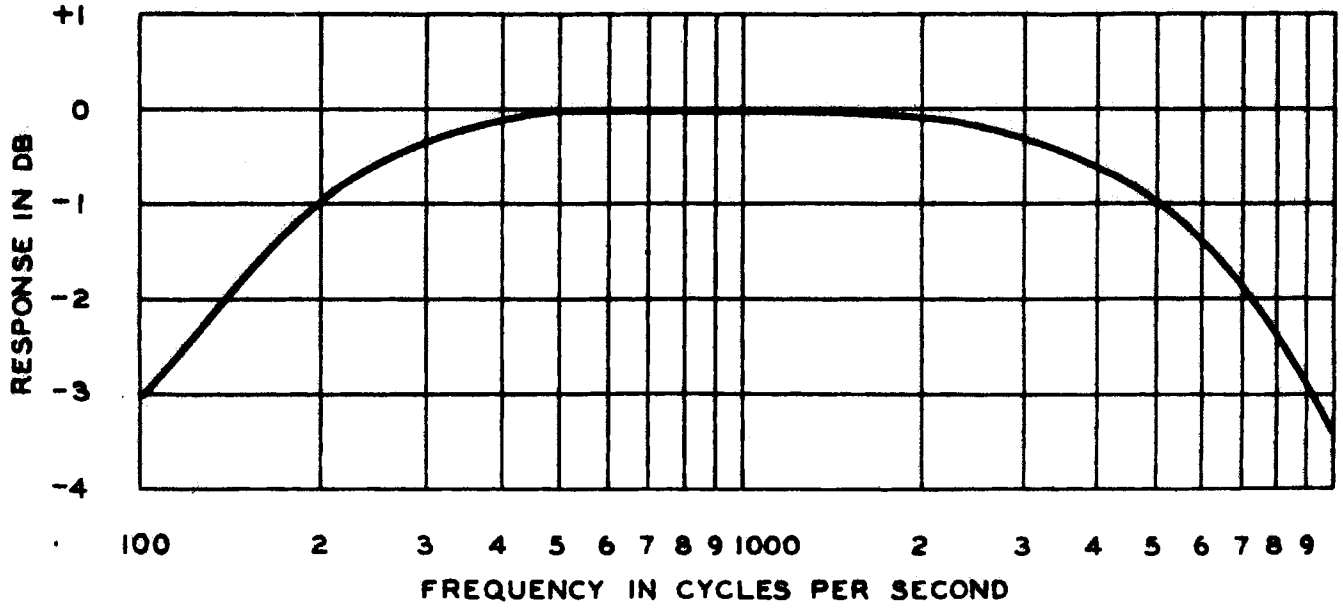

Figure 3 — J68312C Amplifier Gain Frequency Characteristic

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