SECTION 5

GENERAL PURPOSE AMPLIFIERS: AM5 SERIES

AMPLIFIERS AM5/4 AND AM5/4A

General Description

The AM5/4 and AM5/4A are mains-operated audio-frequency transistor amplifiers which will give a maximum output power of 2 watts from a low impedance for an input voltage level of −11 dB. Two gain controls enable the gain to be varied in steps of 2 dB over a range of 46 dB, and the input impedance is high.

The two amplifiers are identical except for the output transformer, which, by parallel or series connection of the secondary windings, is designed for a load impedance of either 3 ohms or 12 ohms for the AM5/4, and of either 50 ohms or 200 ohms for the AM5/4A.

The AM5/4 is used primarily for feeding low-impedance loudspeakers, and the AM5/4A is used for feeding ring-main circuits and for sending programme to line when an output higher than normal is required. For the latter purpose the output impedance may be built out externally to give either of the standard sending impedances of 75 ohms or 600 ohms.

Printed wiring is used and each amplifier with its mains unit is constructed on a double-width chassis CH1/18D for plugging into a PN3/23 panel.

General Description (Fig. 10)

Four push-pull stages are used, the second stage being direct-coupled to the third which is connected as an emitter-follower to the output stage. Feedback from the primary winding of the output transformer is applied to the emitter circuit of the second stage. Internal feedback also is employed in each of the first two stages, that in the first stage being made variable to enable the gain to be adjusted in eight steps of 2 dB each. A second gain control covering 30 dB in 10-dB steps is provided by an attenuator connected across the secondary winding of the input transformer.

The two variable resistors RV1 and RV2 in the bias circuit of TR6 and TR7 are adjusted on initial test to give equal collector currents for the output transistors TR10 and TR11 to avoid magnetisation of the output transformer.

A bridge rectifier circuit provides the 14-volt d.c. supply which is stabilised against mains voltage variations. Any mains input voltage in the range 195—255 volts at 50 c/s may be used. The stabiliser circuit is adjusted on initial test but may require re-adjustment if the Zener diode D5 is changed. (See under *Maintenance*.)

General Data

Supply Voltage

200—250 V 50 c/s a.c.

Impedances

Input impedance 23 kΩ at 1 kc/s.

Output impedance See Table 1.

Gain and Maximum Output

Input voltage level −11 dB with gain controls set for maximum output.

Output voltage level See Table 1.

Output power 2 watts.

Input gain control 3 steps of 10 ±1 dB.

Feedback gain control 8 steps of 2 ±0·5 dB.

TABLE 1

Amplifier	Transformer Secondary Winding	Load Resistance (ohms)	Max. Output Level* (ref. 0·775 V)	Output Impedance (ohms)
AM5/4	Parallel	3	+11 dB	0·3
	Series	12	+17 dB	1·3
AM5/4A	Parallel	50	+23 dB	4·6
	Series	200	+29 dB	18

*Overloading begins at approximately these values, which correspond to a load dissipation of about 2½ watts.

Frequency Response

With a source resistance of 300 ohms and the appropriate load resistances and operating conditions, the frequency response relative to 1 kc/s should be within 0 and −0·25 dB in the range between 40 c/s and 15 kc/s.

Harmonic Distortion

At an output voltage level of 2 dB below the maximum values given in Table 1, the harmonic distortion should be less than 0·2 per cent at 1 kc/s and less than 0·35 per cent at 60 c/s.

Noise

The total noise output should not exceed −80 dB relative to maximum voltage output.

D.C. Conditions

With a mains supply of 225 volts typical d.c. measurements made on an Avometer No. 8 are given in Table 2.

TABLE 2

Transistor	*Voltage*		*Collector Current (mA)*
	Point of Measurement	*Volts*	
—	Amplifier Supply	14	
—	Across C1/C2	23	
—	Across D5	6·4	
TR1	Collector/Emitter	8·4	
TR3	Collector/Emitter	4·0	
TR4, TR5	Emitter/Earth	2·6	
TR6, TR7	Emitter/Earth	3·6	
TR8, TR9	Emitter/Earth	8·8	
TR10, TR11	Emitter/Earth	1·8	275

Operation and Maintenance

Output Conditions

The load resistances given in Table 1 are those into which the amplifiers will deliver maximum power; it is not intended that these values should necessarily be used. For a given input level the amplifier performance is not appreciably affected when the values of load resistance are varied between half those given in Table 1 and open circuit.

The amplifier AM5/4A with series-connected secondary windings may be padded out with two series resistors to give the standard value of output impedance of 75 ohms or 600 ohms for sending to line; the maximum output voltage levels under such conditions across a 600-ohm load are given in Table 3.

TABLE 3

Built-out Output Impedance	*Series R Required*	*Maximum Voltage across 600-Ω Load*
75 Ω	2 × 28·5 Ω	+29 dB
600 Ω	2 × 290 Ω	+23·5 dB

All the maximum output levels given in Tables 1 and 3 are absolute maxima. When an amplifier is used in the programme chain or for high-quality monitoring a safety margin of at least 2·5 dB should be allowed for programme peaks. With this allowance, the maximum normal output of, for example, the AM5/4A has a programme volume of +18 dB when padded out to 75 ohms and of +13 dB when padded out to 600 ohms.

Output Transistors

It is important that the collector currents of the two output transistors TR10 and TR11 should be equal to avoid magnetisation of the output transformer. The necessary adjustment is made on initial test by means of the trimmer resistors RV1 and RV2, which should subsequently not normally be disturbed. Re-adjustment will be necessary, however, if any of the transistors VT6 to VT11 or either of the Zener diodes D6 or D7 is replaced. The procedure is as follows:

Disconnect the blue primary lead of the output transformer leading to the collector of TR10 and insert a d.c. milliammeter in the circuit. Adjust the trimmer RV1 to make the current 275 mA. Remove the meter, reconnect the blue lead to its tag and repeat the operation with the meter connected in the other (yellow) primary lead leading to TR11, adjusting RV2. Equality of the two currents is more important than great accuracy in absolute value.

Stabiliser Circuit

If the Zener diode D5 in the stabiliser circuit is

changed it may be necessary to alter the value of the resistor R9 which was fitted on initial test. To determine the new value, remove R9 and temporarily connect a 0—100-kilohm resistance box or a 100-kilohm variable resistor, set at a high resistance, in its place. Connect the mains supply through a Variac transformer, adjust to 225 volts r.m.s. and measure the d.c. supply with a high-grade voltmeter. This d.c. voltage should be a little below 14 volts. Reduce the value of the box resistance or variable resistor to make the d.c. supply accurately 14 volts. Substitute for this resistance an Erie Type N1 ± 2 per cent fixed resistor of the nearest 5 per cent preferred value as the replacement for R9. Check that the d.c. voltage remains within the limits of 14 $\pm 0{\cdot}5$ volts when the mains voltage is varied between 195 and 255 volts.

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