SECTION 2

MICROPHONE AMPLIFIER AMC/2

General Description

This amplifier is part of the standard Type-A studio equipment. It was designed to raise the output level from the Type-A ribbon microphone previous to mixing. There are three particular advantages in placing the AMC/2 between microphone and mixer :

(i) Potentiometer noise is much lower relative to programme volume.

(ii) Constant-impedance mixing, which inevitably introduces some loss, can be employed, thereby ensuring constant volume from any one microphone, whether other microphones connected to the same mixer are faded up or down.

(iii) Microphone-correction units, which also introduce definite loss, may be inserted between the AMC/2 and the mixer, still leaving the programme volume from the mixer high enough to retain the advantages outlined above.

Mechanically, the AMC/2 differs from normal BBC amplifiers in that it is not designed for rack mounting, but is shaped like a deep drawer.

A modified version of this amplifier, known as the AMC/2A, is used in the Type-D recorder ; this amplifier is described in Instruction R1.

Electrical Design Considerations

The maximum gain required from the amplifier is about 50 **dB**, and simple arrangements are provided to enable the gain to be reduced in 10-**dB** steps, to permit rough lining up of the output levels from various microphones. A single AC/SP3 valve is used to give the required gain and three values of current negative feedback can be selected, giving a choice of 30, 40 or 50-**dB** gain.

To make valve hiss and hum as innocuous as possible the input transformer has a large step-up ratio (the turns ratio is approximately 1 : 30) and special switching arrangements are used to ensure that the alterations in the amount of feedback do not upset the loading of the secondary winding. The secondary load should be maintained at 250,000 ohms to obtain the correct frequency characteristic and to keep the input impedance of the amplifier constant at 300 ohms.

The anode of the valve is resistance-capacitance coupled to the output transformer, the component values and transformer ratio being calculated to give an output impedance of 600 ohms.

A low noise and hum level is assured in the amplifier by using generous smoothing, earthing the cathode of the valve by means of a large capacitance (100 μF), and by adequate screening.

Mechanical Design Considerations

As these amplifiers are required in large numbers, simplicity of construction, cheapness and ease of replacement are essential. Accordingly, a drawer type of construction is adopted, an end view of which is shown in Fig. 2.1 . The chassis is of

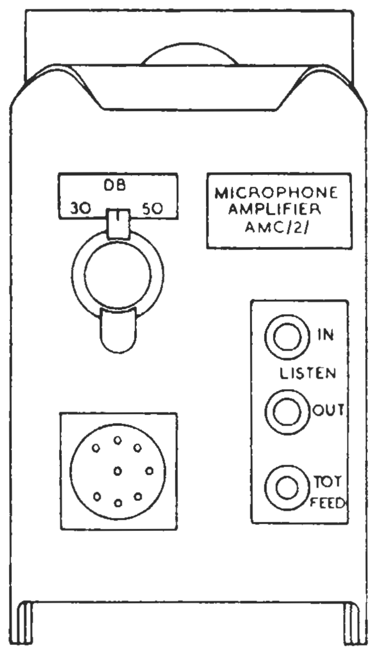


Fig. 2.1. End View of AMC/2 Chassis

folded construction and is turned up at one end to form a front panel which carries the gain control, listen jacks, supply jack and a feed measuring jack. A vertical screen in the centre of the drawer carries the valve holder and serves as a screen between input and output circuits.

In spite of the difference between the input and output levels and the low absolute value of the former, it is practicable to make both connections and also introduce both l.t. and h.t. feeds by means of a single multi-contact plug and socket.

These amplifiers are mounted in threes on trays which are attached to the studio cubicle apparatus cabinet by rubber suspensions. The high mass-to-stiffness ratio thus obtained gives good insulation from mechanical shock.

Circuit Description (Fig. 2)

General

A complete circuit diagram of the amplifier is given in Fig. 2. The anode of the AC/SP3A is fed via two RC smoothing circuits R11, C1 and R8, C4, and its d.c. anode load of 20,000 ohms is made up of two resistors, R9 and R14 in parallel with the preferred values of 22,000 and 220,000 ohms respectively. The anode load of the valve is coupled to the output transformer T2 by the capacitor C5, and is, in effect, the generator resistance for T2. Accordingly the ratio of T2 (5·9 : 1) matches 20,000 ohms to 600 ohms. Parallel-feeding the output transformer has the merit of preserving the correct value of output impedance if the amount of feedback is varied or if the valve fails. The screen h.t. supply is smoothed by the two filters R11, C1 and R7, C3. The automatic bias resistor R6 is shunted by the 100-μF capacitor C2.

The input transformer T1, which has a turns ratio of 1 : 28·8, is shunted on its primary side by the capacitor C7, and on its secondary side by the network R1-R5, which is designed to have an effective value of 250,000 ohms at all three positions of the gain selector switch S1. This loading ensures that the transformer has a substantially level response over the required frequency range.

Feedback Circuit (Fig. 2.2)

The anode load of the AC/SP3A and the apparent resistance of the primary of T2 are both equal to 20,000 ohms and the a.c. component of the anode current of the valve divides equally between them. As C4 and the primary winding of T2 are both returned to R10, practically the whole of the a.c. component passes through this resistor. The p.d. developed across R10 is introduced into the grid circuit via the switch S1. This is an example of current negative feedback.

The sliders A and B, together with the apparent 250,000-ohms resistance of the input transformer secondary (shown dotted in Fig. 2.2), form a potential divider across R10, which applies a certain fraction of the p.d. developed across R10 to the grid of the valve. As A and B move upwards, this fraction increases, giving increased feedback and, therefore, decreased gain. In practice, as indicated in Fig. 2, A and B are not sliders but a two-pole three-way switch, S1, giving three degrees of negative feedback. A single slider, A,

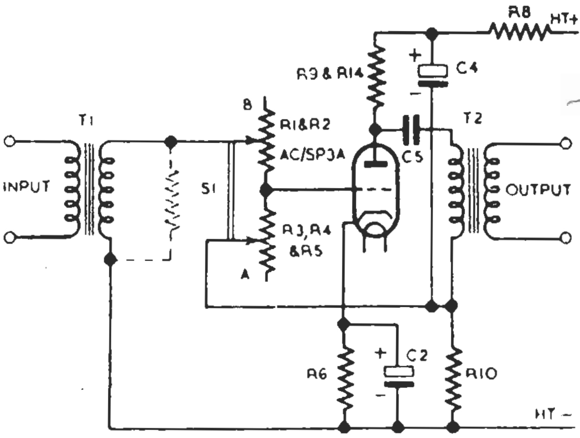


Fig. 2.2. AMC/2 Feedback Circuit Simplified

could be used to give the required degrees of feedback but this would alter the loading on the secondary winding of T1. The slider, B, and the resistors R1 and R2 are therefore necessary in order to keep the secondary loading constant at 250,000 ohms. As A and B move upwards the effective resistance of R3, R4 and R5 becomes progressively less, due to the increasing feedback, but additional padding resistance is inserted into the secondary circuit by the slider B. The way in which the effective value of the grid circuit resistance is decreased by the application of feedback is explained in the instruction on the GPA/1 amplifier, which uses a somewhat similar circuit. (Page 8.1)

The network R17, C8 in parallel with R10 (Fig. 2) reduces the feedback voltage at high audio-frequencies and has the effect of compensating for a slight loss in the output transformer. This correction is common to all gain settings. The capacitor C6 is inserted to correct for high-frequency loss caused by the shunting effect of the secondary winding of T1 by the input capacitance of the valve. This loss is negligible when the gain is set for 30 or 40 dB, due to the large amount of feedback and the "padding-out" effect of R1, R2 at those positions, but in the 50-dB gain position some correction is necessary; accordingly C6 is connected in such a way that it is only effective in the 50-dB position; in other positions one or two resistors totalling more than 1 megohm (R4 and R5) are connected in series with it, so rendering it ineffective. On the 40-dB and 30-dB gain positions, the amplifier will deliver zero volume with distortion on 8-dB peaks of less than 1 per cent at 1,000 c/s and less than 1·5 per cent at 50 c/s. *It will not give this performance with 50-dB gain* owing to the smaller amount of feedback.

Valve Data

Valve	*Anode Potential*	*Anode Current*	*Screen Potential*	*Screen Current*	*Fil. Potential*	*Fil. Current*
AC/SP3A RH	100V.	7·0 mA	115V.	2·1mA	4V. a.c.	1 A

Total Feed 9 mA.
Total h.t. Supply 300 V.

General Data

Gain Control

Three-position switch giving nominal gains of 30, 40 or 50 dB.

Combined Input, Output and Supply Connector (8-way)

Plug: Films and Equipment, Type EP/C6/8/15 (light pressure).

Socket: Films and Equipment, Type EP/8/14s (light pressure).

Impedances

Normal source 300 Ω (balanced).
Normal input 300 Ω (balanced).
Normal output 600 Ω (balanced).
Normal output load 600 Ω (balanced).

Normal Working Input Level
– 60 dB to – 90 dB
Normal Working Output Level
– 10 dB to – 40 dB
} approximately, depending on programme.

Maximum Gain. 49 dB at 1,000 c/s.

Gain and Feedback Details

Gain Setting	*Normal Voltage Gain*	**Amount of Current Feedback*
50	49 dB	4.7 dB
40	39 dB	11·5 dB
30	28 dB	15·6 dB

*With normal source impedance.

Test Data

600-ohm Test Gain

Gain Setting	*600-ohm Test Gain*
50 dB	45·5 dB
40 dB	35·5 dB
30 dB	24·5 dB

Frequency Response

Within ± 0·1 dB from 100 to 5,000 c/s.
±0·5 dB from 50 to 10,000 c/s.
± 1·5 dB from 30 to 15,000 c/s.

Total Percentage Harmonic Content

Frequency	*At normal input and output levels*	*8 dB above normal input and output levels*
50 c/s	< 0·1	< 0·6
1,000 c/s	< 0·1	< 0·5

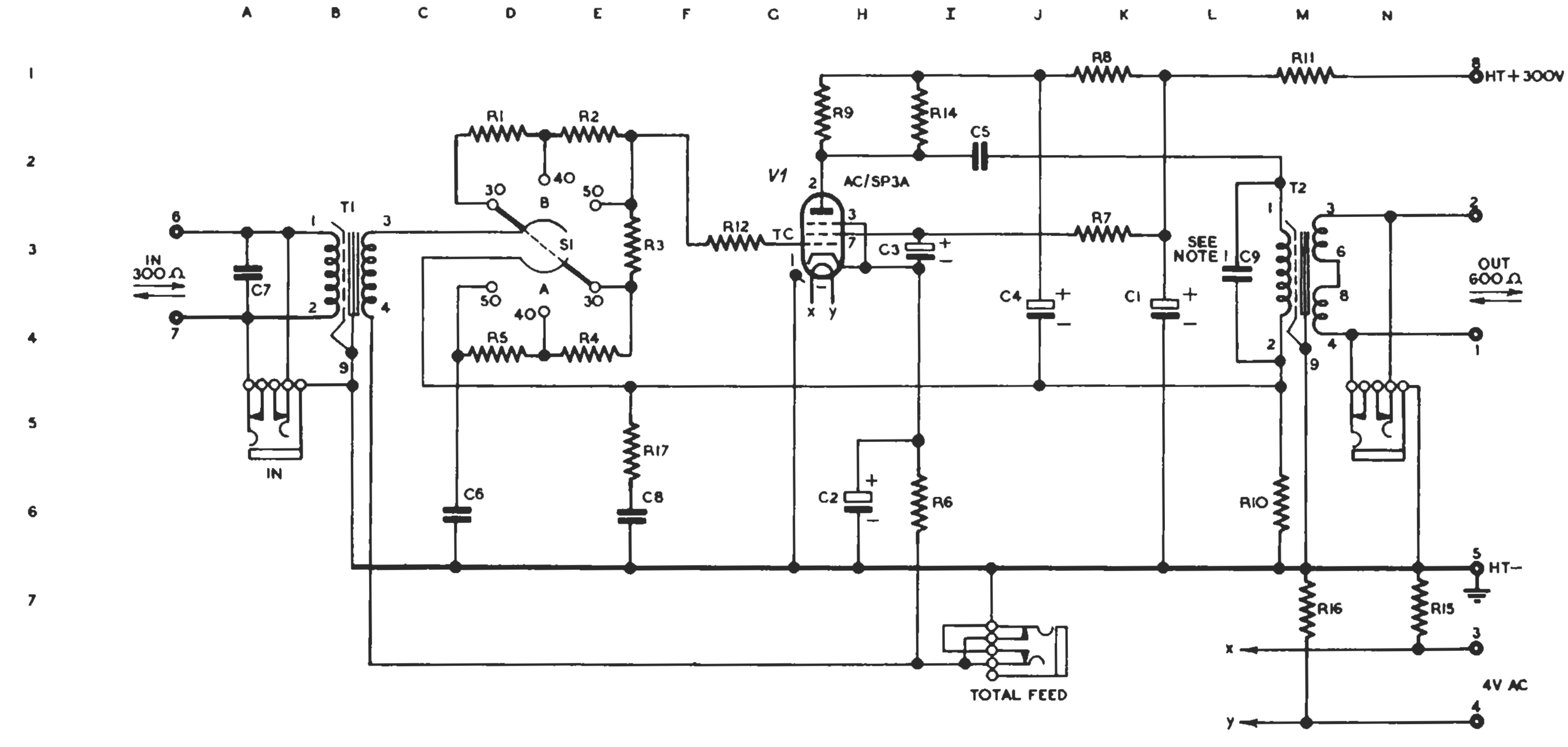
Total Percentage Harmonic Content at +8 dB Output Level

Frequency	*30-dB and 40-dB Gain Settings*	*50-dB Gain Setting*
50 c/s	1	2
1000 c/s	1	2

Noise Level

< – 77 dB total with input and output circuits loaded normally.

101B/S3/DJE
D/LF1/777



COMP.	LOCATION	VALUE	TYPE
C1	K4	16 μF	BEC CE15129
C2	H6	100 "	12V AS10697
C3	I3	2 "	TCC FW
C4	J4	16 "	BEC CE15129
C5	I2	2 "	TCC 87
C6	D6	{·002 " / ·005 "	" M2N / " M3N
C7	A3	{·02 " / ·02 "	" 545 / " "
C8	E6	·002 "	" M2N
C9	L3	200 μμF	
R1	D2	56 000 Ω ± 10%	ERIE 0·25W
R2	E2	180 000 " "	" " "
R3	E3	180 000 " "	" " "
R4	E4	470 000 " "	" " "
R5	D4	1·5 MΩ	

COMP.	LOCATION	VALUE	TYPE
R6	I6	180 Ω ± 2%	ERIE 108 ·25W
R7	K3	68 000 " 10	" 0·5W
R8	K1	4700 " "	" "
R9	H1	22000 " "	" 2W
R10	M6	1500 " "	" 0·25W
R11	M1	4700 " "	" 1W
R12	G3	3300 " "	" 0·25W
R14	I2	220000 " "	" "
R15	N7	22 " "	" "
R16	M7	22 " "	" "
R17	E5	560 " "	" "
T1	B3	1 : 28·8	LG/32R8
T2	M3	5·9 : 1	AL/20RD

MICROPHONE AMPLIFIER AMC/2

ISSUE	AMENDMENT
2	TURNS RATIO OF T2 WAS 6·9:1 C9 ADDED
3	R6 WAS 220 Ω ± 10%

FIG. 2 S3
3rd ISSUE