

CONSTANT-VOLUME SPEECH AMPLIFIERS: AM1/6 SERIES

See also PA1/60

Introduction

The constant-volume speech amplifier AM1/6 is intended for use on calls over the public telephone network which it is desired to broadcast. Often there is a great difference in the levels of speech from the two ends of the circuit, and the AM1/6 is designed to balance automatically the volume received from each end to make it satisfactory for broadcasting. (By agreement with the Post Office, live or recorded telephone calls may be broadcast, subject to certain precautions which are enumerated in a 'Code of Practice for the Use of the Telephone in Programmes' issued by Communications Department.)

The equipment is designed specifically for use in the Radio Broadcasting Services and the speech of both near and distant end speakers is restricted to the internationally agreed bandwidth of 300 Hz to 3,400 Hz. It has sometimes been found desirable, when the local speaker is in a studio, to maintain high quality at the near end. In such cases the constant volume amplifier, with a minor modification, is used in conjunction with a PA1M/60 or PA1M/60P (portable) microphone amplifier and mixer panel. The effect of this is that the studio microphone is made to serve in place of the local telephone transmitter. The modified version of the AM1/6 used in this way is known as the AM1/6A, and all future constant volume speech amplifier equipment will be produced as Type AM1/6A.

The apparatus is bridged across the telephone line and does not in any way affect the performance of the line interconnecting the two speakers. The AM1/6 is designed to hold the speech volumes received from the two ends to within ± 1 dB as

measured on a peak programme meter and under the conditions specified later.

Provision is made for an attendant engineer to speak to both ends in the testing period, to monitor them and to arrange for the best sound quality to be obtained.

Mechanical Details

The AM1/6 or AM1/6A consists of a number of individual units placed in a bay-mounting chassis Type PN3/23, which is 19 in wide and $5\frac{1}{4}$ in high. With the units in position there is an overall projection of $10\frac{7}{8}$ in to the rear and 1 in to the front.

Each unit, with the exception of the power supply, is built into a standard chassis CH1/18C. The power supply, however, makes use of a double-size unit CH1/18D. Each unit is mechanically coded in the standard manner by means of pins projecting at the rear so that it can be inserted only into the correct position of the PN3/23 chassis. The units are shown in Fig. 1.

An operator's headset, S.T.C. Type 4409A, is provided; this plugs into the telephone switch unit UN9/7.

Fig. 2 shows the front of the AM1/6A equipment with all the units in position, and shows also how it is disposed in relation to the PA1M/60 microphone amplifier and mixer panel with which it is used.

Post Office Approval of Equipment

The British Post Office has given approval for the AM1/6 to be used for connection to a telephone line at BBC premises anywhere in the United Kingdom. When it is desired to make such a connection the local Post Office authority must be

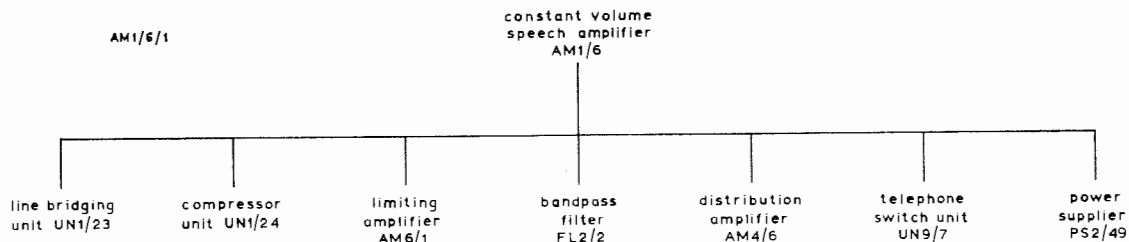


Fig. 1. AM1/6 Subunits

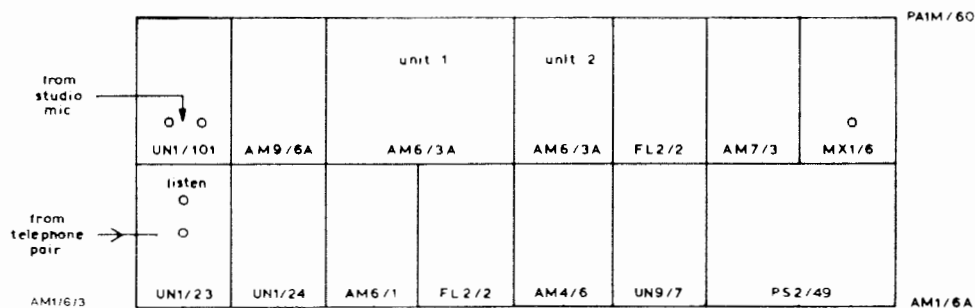


Fig. 2. Layout of AM1/6A and PAIM/60

informed and before the telephone conversation is broadcast it must be checked for quality and noise. It is important that the noise should not be either so excessive or of such a type as to give the public a bad impression of the performance of the public telephone service. It is also very important that the line noise should not contain intelligible speech from any conversation not intended for broadcasting. If the circuit is noisy, and time is not pressing, it is often possible to get a re-connection over a less noisy circuit.

Performance

Range of Operation on Speech

The AM1/6 is designed to operate on a speech signal received from a telephone circuit or direct from the telephone transmitter and to balance the volumes of two speakers at the ends of a telephone line to within ± 1 dB, provided that the received volumes do not differ by more than 40 dB. In practice, however, greater volume differences may well be encountered. The two main reasons for excessive differences are the large attenuation of some circuits and the loudness of articulation of certain speakers. Some speakers also use the telephone inefficiently by not holding the transmitter close to the mouth, and there are variations in efficiency between various types of telephone transmitter. Whatever the reason for excessive differences, the signal-to-noise ratio will in all probability be bad if the received volume is worse than about 40 to 50 dB below zero volume, and for this reason, apart from any other, the received speech will then be unacceptable for broadcasting.

Though the volumes of the two speakers as measured on a peak programme meter at the output of the AM1/6 may be kept to within ± 1 dB, the distant speaker actually sounds about 4 dB lower in volume than the near-end speaker, an effect due to the action of the UN1/24 compressor unit.

Quality of Transmission

Because of the process of automatic volume equalisation employed to keep the near- and far-end speech volumes balanced, momentary speech distortion occurs due to a short-duration high-level breakthrough of near-end speech either after a weak signal from the distant end or when there has been no signal at all. The greater the range of gain employed in this operation, the greater the distortion; such breakthrough peaks have a duration of 5 ms when the apparatus is set to work at its maximum range of 40 dB. It is therefore clearly desirable to set the range to fit the conditions under which the AM1/6 is to be used and not to employ a greater range than necessary. The effects of this high-level breakthrough of speech are reduced by a limiter followed by a bandpass filter. (See Fig. 3.)

Another reason for using the range switch with caution is that if it is set at its maximum and both speakers remain quiet, the line noise is amplified to an undesirable extent.

A practical point to remember is that the speech quality from many telephone transmitters may be poor, especially if the speaker shouts, and an improvement may sometimes be effected by tapping the transmitter lightly a few times.

Noise

Excessive noise may adversely affect the transmission in the following ways, apart from those mentioned above in connection with Post Office approval.

(a) Noise at the Near End

Excessive background noise accompanying the near-end speaker, whether it is due to, say, traffic outside an office or to applause or to an orchestra in a studio, will probably seriously affect the performance of the AM1/6. Loud ambient noise

of this sort will take control of the amount of gain made available by the AM1/6 and will prevent a correct balance of the near- and distant-end speakers being obtained. For instance, if ambient noise at the near end were received at the input of the AM1/6 at a level of -25 dB, the gain would be set automatically, and if the distant-end speech were received at a level lower than -25 dB no further gain adjustment would be made by the equipment while the ambient noise at -25 dB was still present.

It is therefore essential to provide a quiet background for the near-end talker if the equipment is to be used to full advantage.

(b) Output Signal

Provided the volume range is not greater than the setting of the range switch, the volume of all speakers is -3 ± 1 dB at the output terminals of the AM1/6.

The frequency response, for input levels over the range corresponding to the setting of the range switch, is as follows:

Frequency	Output Level
300 Hz	-5.5 ± 2.0 dB
1000 Hz	-3.0 ± 0.5 dB
3000 Hz	-3.0 ± 1.0 dB
3500 Hz	-33.0 ± 5.0 dB

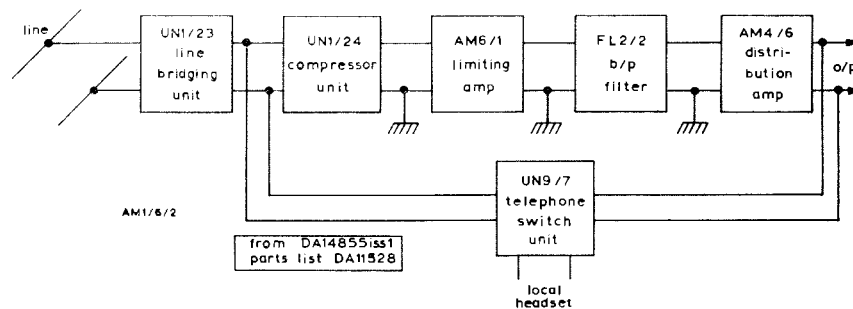


Fig. 3. Block Diagram of AM1/6

(b) Noise at the Far End

Ambient noise at the far end is unlikely to be of sufficient volume to affect the operation of the AM1/6. It could, however, be sufficiently annoying to make a broadcast not worth while.

Quantitative Performance

(a) Volume Range

The maximum speech volume that may be received is 0 dB, and the range switch is calibrated with reference to this value to give a range of 40 dB in steps marked -10 , -20 , -30 and -40 dB. The range switch should be set to match as closely as possible the range of volumes encountered.

(c) Harmonic Distortion

With a zero-level 1-kHz input to the equipment, the total harmonic distortion measured with a harmonic routine tester FHP/3 should not exceed 2 per cent (-37 dB), the output of the fundamental having been lined up to -3 dB.

(d) Impedances

Over the frequency band 300-3000 Hz the input and output impedances are of the order of 3500 ohms and 30 ohms respectively, and no current should flow when 50 volts d.c. is applied across the input terminals of the equipment.

(e) Noise

With the input terminated by a 600-ohm resistor and the range switch set to 40 dB, the noise should be below -53 dB.

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