DISK REPRODUCING AMPLIFIERS AM16/1 AND AM16/1A

Introduction

The AM16/1 is a two-stage amplifier, employing a pentode and one section of a double-triode. The remaining section of the double-triode forms a third stage for pre-fade listening purposes only. Equalisation for coarse- and fine-groove records is provided in the form of frequency-discriminating negative feedback networks; the appropriate network is selected by means of relay switching. There is an optional top cut circuit, the effect of which is indicated by dotted curves in Fig. 1. The extent of the bass response is intentionally restricted to minimise rumble, but measures are taken to maintain the response to as low a frequency as possible consistent with this limitation. Two pre-set *Set Level* controls are fitted, one for coarse- and the other for fine-groove records; the appropriate control is selected automatically by means of relay switching. A remotely operated volume control facility is incorporated in the pre-fade listening stage.

The AM16/1A is identical to the AM16/1 except that, by the introduction of a minor circuit modification, the bass response is less restricted.

General Specification

Voltage Gain (fine and coarse groove)

Programme chain	About −9 dB at 1 kHz, when set for maximum level, with 600-ohm load. Reduced by 6 to 7 dB when preset level control at minimum.
Prefade chain	About +56 dB maximum, at 1 kHz, with 30-kilohm load. Reduced by about 21 dB by changing external volume control circuit from short-circuit to open-circuit.

Input Impedance

AM16/1	100 kilohms in series with 0·033 μF.
AM16/1A	100 kilohms in series with 0·133 μF.

Output Impedance

Programme chain	From about 23 to 31 kilohms, depending on preset level adjustment.
Prefade chain	From about 20 to 100 kilohms, depending on external volume control.

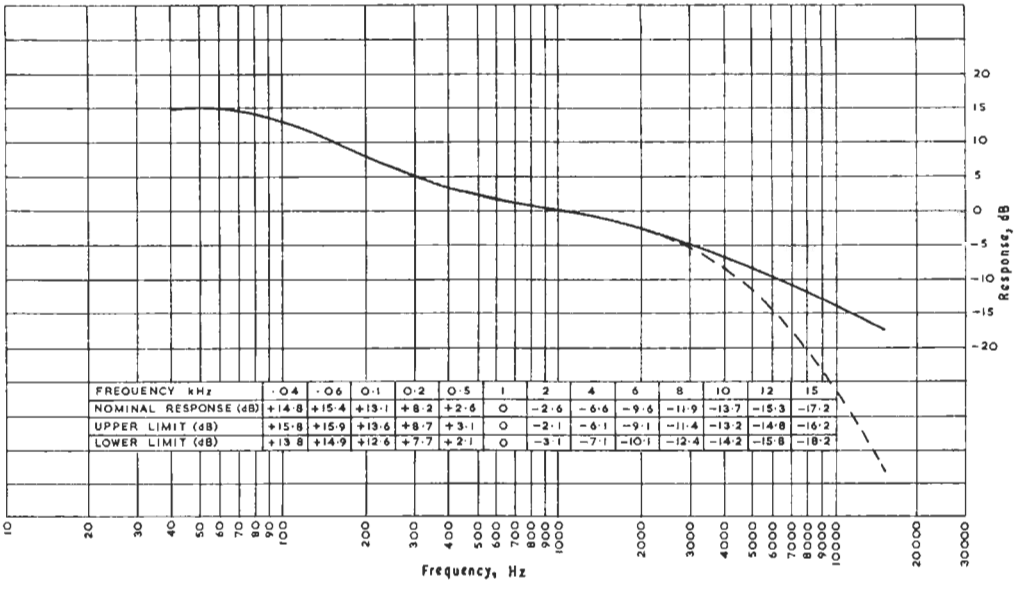
Noise Output	Not more than −110 dB measured across a 600-ohm load with amplifier input short-circuited. (Fine or coarse-groove mode.)
Frequency Response	As shown in Fig. 1 for AM16/1. Low-frequency response greater on AM16/1A.

Supplies Required

H.T.	+310 volts max. About 8 mA.
L.T.	6·3 volts a.c., balanced to earth. 0·5 amp.
Fine/Coarse Relay	24 volts d.c., smoothed. 34 mA.

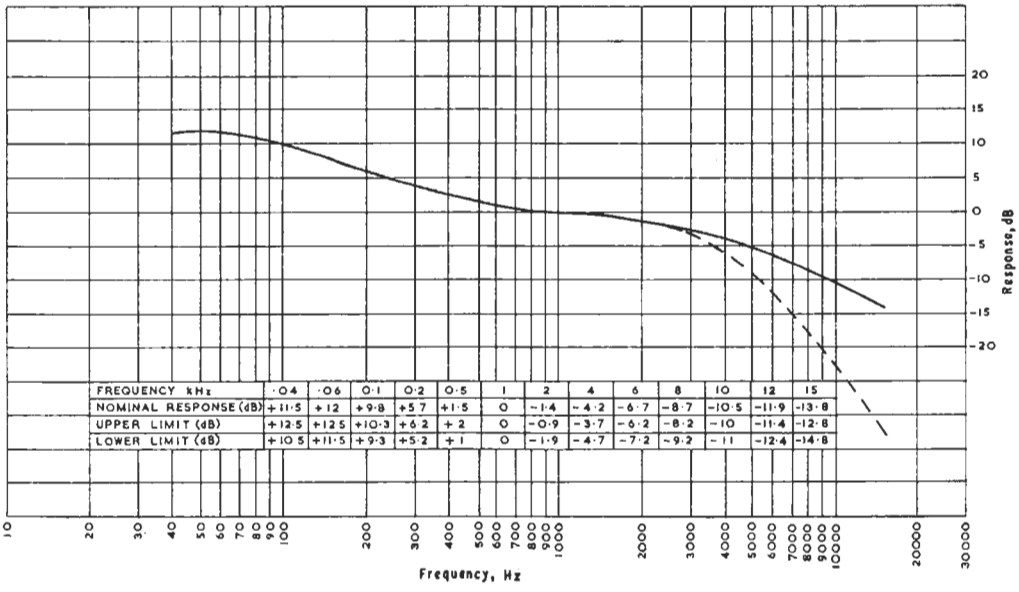
Construction

The chassis of the amplifier forms a framework in which a sub-chassis carrying the circuit components is supported resiliently. This arrangement avoids the risk of valve noise due to mechanical



FREQUENCY kHz	·04	·06	0·1	0·2	0·5	1	2	4	6	8	10	12	15
NOMINAL RESPONSE (dB)	+14·8	+15·4	+13·1	+8·2	+2·6	0	−2·6	−6·6	−9·6	−11·9	−13·7	−15·3	−17·2
UPPER LIMIT (dB)	+15·8	+15·9	+13·6	+8·7	+3·1	0	−2·1	−6·1	−9·1	−11·4	−13·2	−14·8	−16·2
LOWER LIMIT (dB)	+13·8	+14·9	+12·6	+7·7	+2·1	0	−3·1	−7·1	−10·1	−12·4	−14·2	−15·8	−18·2

FINE-GROOVE EQUALISER

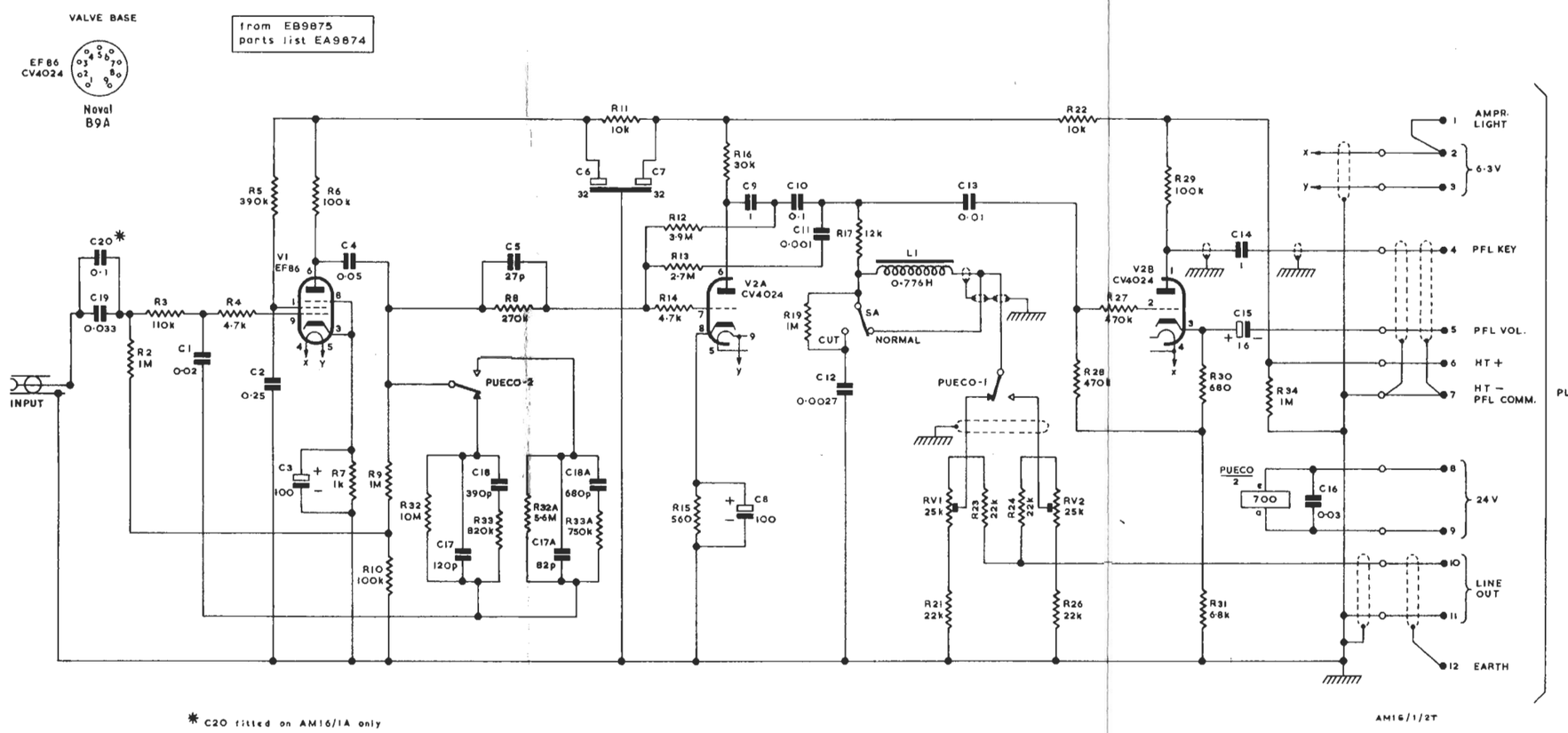


FREQUENCY kHz	·04	·06	0·1	0·2	0·5	1	2	4	6	8	10	12	15
NOMINAL RESPONSE (dB)	+11·5	+12	+9·8	+5·7	+1·5	0	−1·4	−4·2	−6·7	−8·7	−10·5	−11·9	−13·8
UPPER LIMIT (dB)	+12·5	+12·5	+10·3	+6·2	+2	0	−0·9	−3·7	−6·2	−8·2	−10	−11·4	−12·8
LOWER LIMIT (dB)	+10·5	+11·5	+9·3	+5·2	+1	0	−1·9	−4·7	−7·2	−9·2	−11	−12·4	−14·8

AM16/1/1

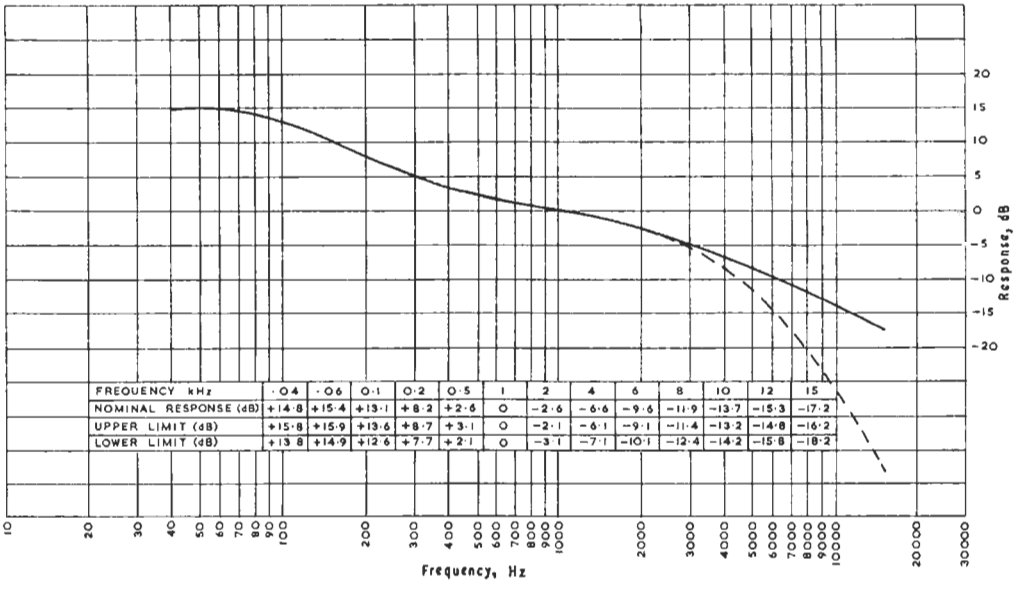
COARSE-GROOVE EQUALISER

Fig. 1. Frequency Characteristics of the AM16/1



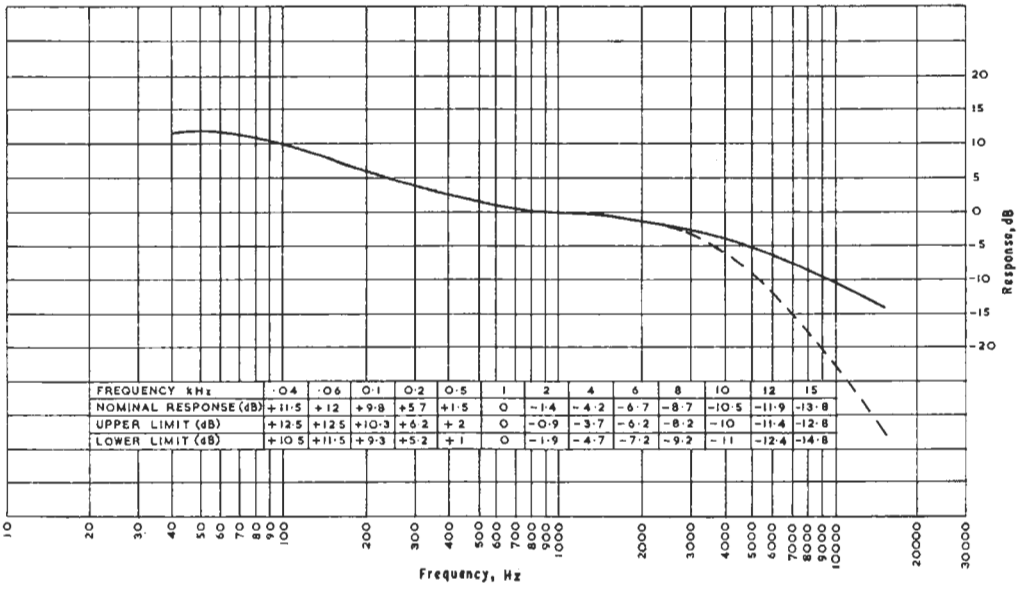
* C20 fitted on AM16/1A only

Fig. 2. Circuit of the AM16/1 and AM16/1A



FREQUENCY kHz	·04	·06	0·1	0·2	0·5	1	2	4	6	8	10	12	15
NOMINAL RESPONSE (dB)	+14·8	+15·4	+13·1	+8·2	+2·6	0	−2·6	−6·6	−9·6	−11·9	−13·7	−15·3	−17·2
UPPER LIMIT (dB)	+15·8	+15·9	+13·6	+8·7	+3·1	0	−2·1	−6·1	−9·1	−11·4	−13·2	−14·8	−16·2
LOWER LIMIT (dB)	+13·8	+14·9	+12·6	+7·7	+2·1	0	−3·1	−7·1	−10·1	−12·4	−14·2	−15·8	−18·2

FINE-GROOVE EQUALISER



FREQUENCY kHz	·04	·06	0·1	0·2	0·5	1	2	4	6	8	10	12	15
NOMINAL RESPONSE (dB)	+11·5	+12	+9·8	+5·7	+1·5	0	−1·4	−4·2	−6·7	−8·7	−10·5	−11·9	−13·8
UPPER LIMIT (dB)	+12·5	+12·5	+10·3	+6·2	+2	0	−0·9	−3·7	−6·2	−8·2	−10	−11·4	−12·8
LOWER LIMIT (dB)	+10·5	+11·5	+9·3	+5·2	+1	0	−1·9	−4·7	−7·2	−9·2	−11	−12·4	−14·8

AM16/1/1

COARSE-GROOVE EQUALISER

Fig. 1. Frequency Characteristics of the AM16/1

shock. The top cut switch is mounted so that its shaft can project through a panel to form an operational control. The pre-set *Set Level* controls are screwdriver adjustments at the rear of the sub-chassis, and are marked *F.G.* and *C.G.* (fine-groove and coarse-groove).

The components forming each of the frequency-discriminating negative feedback networks by which the replay equalisation is obtained are grouped on a tag strip which is easily removable so that a change of either replay characteristic, if required, would be a simple matter.

The input connection to the amplifier is by means of a female coaxial connector. The power supply, control and output circuits are connected via a ten-way group of flexible leads terminating in a twelve-pin Painton plug.

Circuit Description of AM16/1

A circuit diagram of the amplifier is given in Fig. 2.

The input signal is applied to the grid of V1 via the co-axial *Input* connector, C19, R3 and R4. R4 is a grid resistor; the purposes of the other components are described later.

The anode of V1 is coupled via C4, C5, R8 and R14 to the grid of V2A; R9 and R10 form a grid leak. R14 is a grid series resistor; the purpose of R8 is to raise the impedance at the grid of V2A sufficiently to enable parallel negative feedback to be applied at this point. In combination with the Miller input capacitance of the valve, R8 tends to cause some attenuation at the higher frequencies; C5 is fitted to offset this effect.

There is a second connection from the negative side of C4 via the relay contacts PUECO-2 to the alternative negative feedback networks C17, C18, R32, R33 and C17A, C18A, R32A, R33A for fine- and coarse-groove equalisation, respectively. The normally-closed pair of relay contacts bring the fine-groove equaliser into circuit. Both networks are connected via C1 to the junction of R3 and R4. As well as affecting the frequency response of the stage in the desired manner, this application of parallel voltage negative feedback to V1 via frequency-discriminating networks reduces the effective impedance of the circuit at the grid of the valve to a value which depends on the signal frequency, and can be as low as 1·6 kilohms at high frequencies. Further negative feedback is applied to the stage by connecting the earthy end of R2 to the junction of R9 and R10. This feedback path, being resistive, does not affect the frequency response of the stage but reduces the impedance at the junction of R2 and R3 by a factor depending on the stage gain. At low frequencies the gain is greatest and the impedance at the junction of R2, R3 is therefore least (approximately 100 kilohms).

The total effect of both negative feedback paths is to give a constant effective resistance of 100 kilohms between the junction of R2 and R3 and earth; C19 forms, with this resistance, a bass cut circuit having a 3-dB attenuation point at approximately 50 Hz. At high frequencies, the impedance at the grid of the valve is small, as already explained, and the impedance at the junction of R2 and R3 consists mainly of R3, shunted by a high resistance due to R2 and R10, giving 100 kilohms. At low frequencies, the impedance at the grid of the valve is high, and that at the junction of R2 and R3 is due to feedback via the resistive path, being 100 kilohms as explained above.

The anode of V2A is coupled by C9, C10, R17, L1 (optionally) and the relay contacts PUECO-1 to the resistor network from which the output of the amplifier is taken. C9 is a high-grade capacitor, selected for its insulation resistance. C10 forms, with R17 and the network, a second bass cut circuit similar in effect to the one mentioned above. Parallel voltage negative feedback is applied to the grid of the valve by R12, R13 and C11, forming two parallel paths, one resistive and the other containing capacitive reactance. There is a phase difference between the signals fed back via the two paths, which becomes appreciable at low frequencies, and causes partial cancellation. At still lower frequencies, C11 attenuates the phase-shifted feedback signal to an insignificant level, and the partial cancellation does not occur. The result is a tendency for the response of the amplifier to rise over a narrow band of frequencies in the region of 60 Hz, offsetting the effect of the bass cut circuits in this region and thus maintaining the frequency response of the amplifier down to 40 Hz, below which it falls off at a rate approaching 12 dB/octave; the purpose of the bass cut is to minimise rumble.

When the switch SA is set to *Normal*, the choke L1 is short-circuited and C12 has no effect because the high-value resistor R19 is in series with it. When the switch is set to *Cut* the short-circuit is removed from L1 and placed across R19; L1 and C12 then form a half-section filter giving treble attenuation, as indicated by the dotted curves in

Fig. 1. C12 is brought into action by the short-circuiting of R19 rather than by a simple switching action in order to avoid clicks due to the operation of the switch.

The output network enables the gain of the amplifier to be adjusted separately for fine- and coarse-groove operation by means of the pre-set controls RV1 and RV2. The appropriate control is selected by the relay contacts PUECO-1; the normally-closed pair of the contacts brings the fine-groove control RV1 into circuit.

There is a second connection from the junction of C10 and C11, via C13 and R27 to the grid of V2B. This valve is an additional amplifying stage for pre-fade listening purposes; the output is taken from the anode via C14. The gain of the stage is controlled by variable current negative feedback. A cathode load R31 is provided; this and the bias resistor R30 are shunted by C15 in series with an external variable resistor, which is connected in circuit through pins 5 and 7 on the multi-pole plug of the amplifier: typically this is a 10-kilohm variable resistor mounted in a convenient operating position. By adjusting such a 10-kilohm control, the impedance of the cathode circuit at signal frequencies can be varied from zero (since C15 is large) to approximately 4·3 kilohms, giving a 20-dB range of variation of the stage gain. At high settings of the *P.F.L. Volume* control, V2B may be driven into grid current; the waveform at the grid of the valve is then distorted. To prevent this distortion from affecting the programme chain, the grid resistor R27 is of unusually high value, preventing the grid-to-cathode conduction path from forming a low-impedance non-linear load on the previous stage.

Because relay PUECO is close to low-level signal carrying circuits, it is operated from a smoothed supply to avoid hum pick-up.

Circuit Description of AM16/1A

The circuit is identical with that of the AM16/1 except that an additional capacitor, C20, is fitted in parallel with C19, reducing the bass-cut effect of the input circuit.

Reference

Disk Reproducers RP2/1 and RP2/1B.

DEH 3/61
Revised DPEB 4/70