DL7-35

HIGH FIDELITY POWER AMPLIFIER

Operating Instructions

BEAM-ECHO LIMITED · LONDON · ENGLAND

Introduction

The DL7-35 amplifier is capable of the highest standard of reproduction expected of only the very best high fidelity amplifiers. In addition, it has a number of unusual features which make it extremely versatile. Above all, it is built to last and to give trouble-free service.

In the following pages we have set out as clearly and as cogently as possible all the relevant facts concerning the amplifier.

TECHNICAL DESCRIPTION

The DL7-35 amplifier was designed to provide the most realistic sound reproduction in the home. To this end, every possible refinement of circuit detail has been incorporated. The considerations underlying the design of a high fidelity amplifier and the methods by which the required high standard of performance has been achieved in the DL7-35 amplifier are described in this section.

POWER AMPLIFIER

From the point of view of power output an audio amplifier must be able to cope with the dynamic range of a full symphony orchestra. In the

concert hall, this reaches a maximum of about 70 db. However, for the purposes of broadcasting or recording this is generally compressed to 60 db or less. In terms of power this represents a ratio of one million to one. If we accept that 0·05 mW of electrical power into a high sensitivity loudspeaker represents the threshold of audibility in a quiet living room, the required maximum output becomes 50 watts. Fortunately, maximum output occurs for only fractions of a second and the power required under these conditions is known as the instantaneous peak power and this is generally 1·5 times the continuous power output.

There is another aspect to be examined. To provide an agreed standard of measurement, all amplifiers are tested with a pure sine wave input signal. This never occurs in speech or music except, remotely, in the case of the flute. From the point of view of power handling capacity a pure sine wave is one of the most difficult waveforms for an amplifier to reproduce and invariably gives an inferior result. It can, therefore, be taken that an amplifier rated at 30 watts continuous sine wave output will give an instantaneous peak output of speech and music of at least double this figure.

Power output of course means nothing unless distortion is taken into account. Modern standards for high fidelity reproducers demand a harmonic distortion content of not greater than 0·1 per cent. and an intermodulation distortion level of not greater than 1 per cent.

The next consideration is frequency response. The fundamental frequency range of a symphony orchestra is from about 35 c/s (the lowest note of a harp) to about 5,000 c/s. (the highest note of a piccolo). The piano ranges from 27·5 to 4,186 c/s, but the instrument of widest range is the concert organ, 16 to 8,000 c/s. However, this is not the whole picture. All instruments produce harmonics and it is the number and strength of these that produces the characteristic sound of each instrument.

Without these it would be impossible to distinguish, say, an oboe from a violin. In order to reproduce the harmonics, the response of an amplifier must extend to about 16,000 c/s. Furthermore, the response must be linear. In other words, the relative intensity of sounds of different frequencies must be the same at the output of the amplifier as at the input. Any deviation introduces colouration of the original.

A frequency response of this magnitude brings difficulties in its wake. Great care has to be taken with hum and noise. For high fidelity reproduction, these must be at least 60 db below maximum output.

Finally, there is transient response. Transients are sound waves produced by percussion instruments including plucked strings. The waveform is of a special character very rich in harmonics and the waves are of short duration giving a shock effect to the loudspeaker. The effect of this is to cause the loudspeaker cone to continue oscillating after the transient wave has passed. To eliminate this effect the loudspeaker must be heavily damped. This can be done by causing the internal resistance of the amplifier to be very much lower than the loudspeaker impedance. This is known as damping and the damping factor is a measure of the transient response of an amplifier.

CIRCUIT DESCRIPTION

To achieve these objectives, the Mullard EL34 valve is used in the DL7-35 amplifier. This is a pentode output valve capable of a dissipation of 25 watts. A pair of these are used in the output stage under distributed load conditions. Sometimes known as " ultra linear " working, this type of circuit produces the highest output at the lowest possible distortion under conditions of the highest efficiency.

Driving these valves is a Mullard ECC83 double triode used as a cathode coupled phase splitter. The first stage of the amplifier is a Mullard EF86 low-noise pentode, d.c. coupled to the phase splitter stage to reduce the overall phase shift to a minimum. High stability resistors are used in the input stage in the interests of low noise. Overall feedback of 30 db is used.

External services provided by the octal socket on the amplifier chassis are as follows:—

Pins 1 and 8	For switching mains externally.
Pins 2 and 3	6·3 V. A supply (Heaters).
Pin 4	410 V. D.C. Decoupled B Supply (H.T.).
Pin 5	440 V. D.C. B Supply (H.T.).
Pins 6 and 7	6·3 V., 2·5 A, A Supply (Heaters).

The two, two-pin sockets are mains outlets.

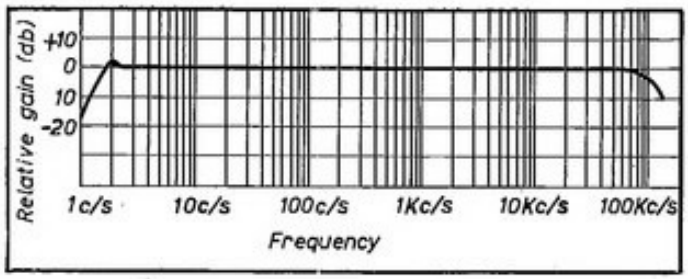

Fig. 1—Frequency response of power amplifier

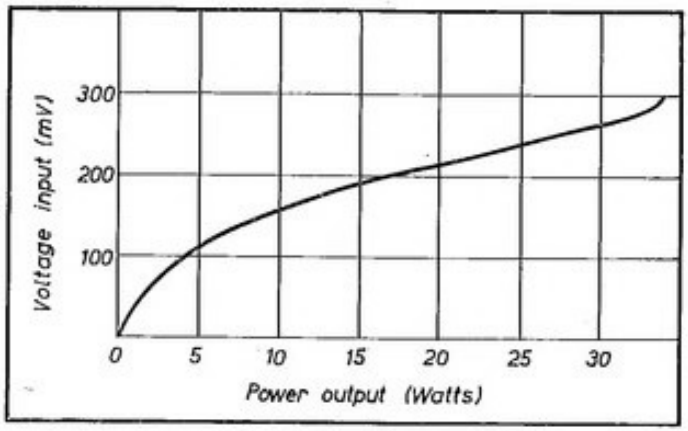

Fig. 2—Sensitivity of power amplifier

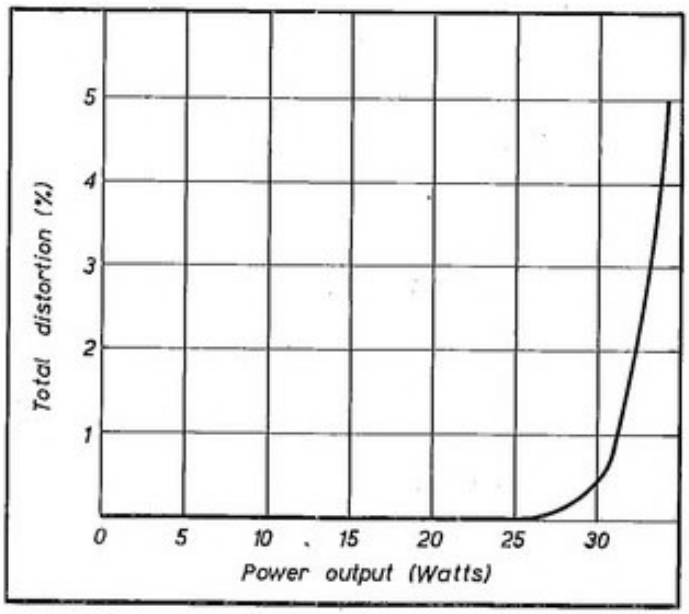

Fig. 3—Output power/distortion curve of power amplifier

The performance is graphically illustrated. Figure 1 shows the frequency response; figure 2, the sensitivity and figure 3, distortion plotted against power output.

SUMMARY OF PERFORMANCE:

Power Output:

20 watts at less than 0·05% total distortion.
27 watts at 0·1% total distortion.

Instantaneous peak power output: 45/60 watts.

Intermodulation distortion measured with a carrier frequency of 10 Kc/s. and a modulating frequency of 40 c/s in the ratio of 1:4:—
0·7% at 20 watts output.
1% at 29 watts output.

Frequency response:

± O db from 5 c/s to 30 Kc/s.
± 1db from 2 c/s to 100 Kc/s.
(Reference level 1 Kc/s.)

Hum and Noise:

—89 db relative to 20 watts output with 10KΩ source resistance.

Input/Output voltage characteristic linear to 35 watts output.

Damping factor:

50—equivalent to an internal resistance of 0·3Ω with a loudspeaker impedance of 15Ω.

Sensitivity:

220 mV for 20 watts output.
240 mV for 25 watts output.
270 mV for 30 watts output.

Output impedances of 4Ω, 8Ω and 16Ω may be selected by a switch which automatically adjusts the negative feedback to the output impedance.

COMPONENTS LIST

RESISTORS

R1	4·7KΩ
R2	390KΩ, High Stability, ½ W
R3	100KΩ, High Stability, ½ W.
R4	4·7KΩ
R5	2·2KΩ
R6	100Ω, High Stability, ½ W.
R7	1·0MΩ
R8	82KΩ
R9	270KΩ
R10	15KΩ, ±20%, 2 W.
R11	180KΩ, ±2%
R12	180KΩ, ±2%
R13	3·9KΩ, High Stability
R14	8·2KΩ, High Stability, ½ W.
R15	470KΩ, ±2%
R16	470KΩ, ±2%
R17	2·2KΩ
R18	470Ω, Wire Wound 10 W.
R19	470Ω, Wire Wound 10 W.
R20	2·2KΩ
R21	1KΩ
R22	1KΩ
VR1	1MΩ, Volume Control, 10% log law

CAPACITORS

C1	0·05μF, 350 V.
C2	50μF., 6 V. Electrolytic
C3	600pF, ±10%
C4	0·25μF, 350 V.
C5	10μF, 350 V. Electrolytic
C6	40μF, 500 V., Electrolytic*
C7	0·5μF, 350 V.
C8	0·5μF, 350 V.
C10	75pF, ±10%
C11	40μF, 500 V., Electrolytic *
C12	50μF, 50 V., Electrolytic
C13	50μF, 50 V., Electrolytic
C14	4μF, 600 V., Oil filled paper

*In common can

VALVES

V1	EF86: Audio Amplifier
V2	ECC83: Phase Splitter
V3	EL34: Power Output
V4	EL34: Power Output
V5	GZ34: Rectifier

Installation

A unique method of ventilation (patent pending) is used on the DL7-35 amplifier. However, this can only operate satisfactorily if adequate room is allowed for the air to circulate around it. When mounting the amplifier in a cabinet, make sure that cold air can enter the cabinet and hot air escape from it.

OPERATING INSTRUCTIONS

1. Adjust Mains Voltage Selector to correct line voltage. Make sure that the amplifier is set for the correct voltage range. This can be ascertained by examining the underside of the power amplifier. Through one of the apertures will be seen a coloured plug. According to the colour of this plug, the selection of voltages are as follows:—

Voltage Selector	*Voltage (Red Plug)*	*Voltage (Green Plug)*
1	210 V. (200—220 V.)	105 V. (100—110 V.)
2	233 V. (225—240 V.)	117 V. (110—120 V.)
3	251 V. (240—260 V.)	125 V. (120—130 V.)

2. Connect loudspeaker unit to appropriate terminals and adjust impedance matching to suit by switch provided.

3. Connect ancillary equipment to the appropriate sockets at the rear of the pre-amplifier taking care to select those that give the appropriate sensitivity.

4. Connect DL7-35 unit to mains (or Line Socket) and switch on with Volume Control Knob.

WEIGHTS AND MEASURES

Dimensions.—Power amplifier:

Length	14¼-inch (36 cm.)
Width	9-inch (23 cm.)
Height	8½-inch (22 cm.)

Weight:

Power Amplifier ..	35¾ lbs. (16·2 kg.)
Power Consumption ..	140 watts.

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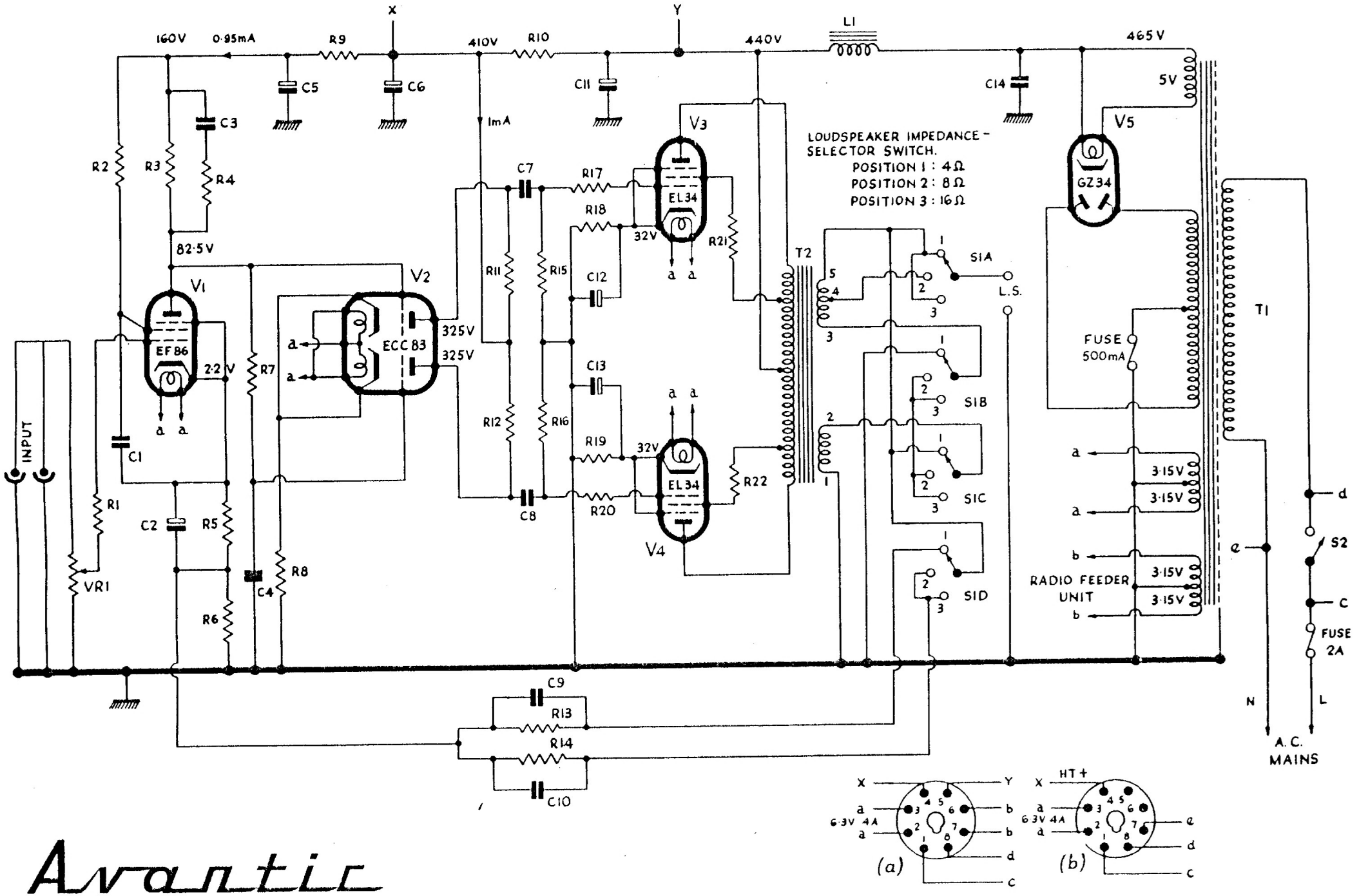

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Fig. 3. *Circuit diagram of power amplifier.* *(For component values, see page 18).*
Rear view of power output socket : *(a) standard version* *(b) American version.*