



VALVES, TUBES & CIRCUITS

13. OPERATION OF TYPE EL84 OUTPUT PENTODE IN AUDIO AMPLIFIERS

Recent developments in the art of recording music on disc and tape, together with improvements in the quality of sound broadcasting provided by V.H.F. transmissions such as the television service, are leading to increased demands for high fidelity in the amplifier or receiver. To meet this requirement it is desirable to increase the available audio output power and hence decrease the distortion present at a given output.

The new Mullard output pentode, type EL84, has been designed to satisfy these demands, a single valve providing an output power of 5 to 6 watts. Its rated anode dissipation is 12 watts compared with earlier valves such as types EL41 and EL33 which were rated at 9 watts. The EL84 is in the miniature all-glass range having a single-ended construction and a B9A (noval) base. Although the total cathode current under typical conditions of operation is about 55mA, the heater rating is only 6.3V, 0.76A.

With the maximum anode dissipation rating of 12W and a mutual conductance of over 11 mA/V, a signal of very small amplitude is sufficient for full drive; an output of 5 to 6 watts being obtained with a signal of less than 5V r.m.s. When adjusted for operation with an anode dissipation of 9 watts the performance of the EL84 is superior to that of the EL41. In addition this valve may be successfully employed in the output stage of medium power amplifiers, two valves in push-pull giving output powers of up to 17 watts. It is particularly suitable for use in high-fidelity amplifiers rated to deliver outputs of the order of 10 watts.

CHOICE OF OPERATING CONDITIONS. The accompanying table includes operating conditions as a single valve Class "A" amplifier. The first two columns give alternative conditions depending on the choice of anode load. The value of 5.2kΩ is the conventional choice calculated from the quotient of anode voltage to anode current at the working point for 12 watts anode dissipation. Under these conditions the third harmonic distortion at large signals represents a considerable proportion of the total distortion. The ratio of third to second harmonics in the total distortion may be reduced by choosing a lower value of anode load such as the 4.5 kΩ shown in the second column.

The remaining two columns in the table indicate the best methods of using the EL84 as a replacement for the EL41. In one case the screen-grid voltage is reduced to 210 volts compared with 250 volts on the anode. This gives a smaller screen-grid current and a slightly higher mutual conductance than the EL41 but the resulting output power is about the same for the two valves.

The other method of simulating the EL41 conditions consists of applying the same voltage (250V) to anode and screen-grid, and to increase the negative grid-bias to -8.4V by changing the cathode bias resistor. With the higher screen-grid voltage the grid base is increased. Under these conditions the efficiency may considerably exceed 50% before grid current commences to flow but the distortion will then necessarily be fairly large. This method of operation results in the available peak power being extremely high.

VALVE DATA

HEATER		CHARACTERISTICS				LIMITING VALUES			
V_h	6.3 V	V_a	250 V	V_{g2}	250 V	V_a max.	300 V	p_a max.	12 W
I_h	0.76 A	I_a	48 mA	I_{g2}	5.5 mA	V_{g2} max.	300 V	p_{g2} max.	2.0 W
CAPACITANCES		V_{g1}	-7.3 V	g_m	11.3 mA/V	I_k max.	65 mA	V_{h-k} max.	100 V
C_{out}	6 μF	r_a	38 kΩ						
C_{in}	11 μF								
C_{a-gl}	< 0.5 μF								
C_{gl-h}	< 0.25 μF								
BASE B9A	DIMENSIONS	Max. seated height	71 mm.	Max. overall length	78 mm.	Max. bulb diameter	22.2 mm.		

TYPICAL OPERATION AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	250	250	250	250	V
V_{g2}	250	250	210	250	V
R_a	5.2	4.5	7.0	7.0	kΩ
I_k	135	135	160	210	Ω
V_{g1}	-7.3	-7.3	-6.4	-8.4	V
I_a	48	48	36	36	mA
I_{g2}	5.5	5.5	3.9	4.1	mA
$V_{in}(r.m.s.)$	4.3	4.4	3.4	3.5	V
P_{out}	6.0	6.0	4.3	4.2	W
D_{tot}	10	10	10	10	%
D_3	9.5	8.0	9.3	8.7	%
D_2	2.0	5.0	1.8	1.7	%

† Measured with fixed bias.

* Operation under EL41 conditions.

TYPICAL OPERATION AS PUSH-PULL OUTPUT STAGE

V_a	250	300	V
V_{g2}	250	300	V
R_k	130	130	Ω
R_{a-a}	8.0	8.0	kΩ
$I_a(o)$	2 × 31	2 × 36	mA
I_a (max. sig.)	2 × 37.5	2 × 46	mA
$I_{g2}(o)$	2 × 3.5	2 × 4	mA
I_{g2} (max. sig.)	2 × 7.5	2 × 11	mA
$V_{in}(g-g)$ (r.m.s.)	16	20	V
P_{out}	11	17	W
D_{tot}	3	4	%

Reprints of this advertisement, together with additional data, may be obtained free of charge, from the address below.

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