EL 42 Low-consumption output pentode

Fig. 1
Normal and X-ray photographs of the EL 42 (approximately actual size).

The EL 42 is an indirectly heated output valve intended primarily for use in receivers in cases where low current consumption is important. Every effort has been made to ensure the lowest possible consumption of heater current, which is, in effect, only 200 mA, the power required by the heater being 1.26 W. Notwithstanding the low consumption, the slope of this valve is quite good, viz. 3.2 mA/V, with adequate sensitivity (approx. 0.8 V_{RMS} A.C. grid voltage to produce an output of 50 mW).

As the EL 42 is employed mainly for car radio and vibrator-driven sets, the voltage source will usually be an accumulator, of which the voltage, in practice, is subject to considerable fluctuation; it is advisable, therefore, to arrange for a working point that will give, in absence of an input voltage, an average anode dissipation of 6 W when the supply voltage is 7 V. Variations in the voltage between 5.5 and 8 V will then be permissible without risk of under-running or overloading the valve. Further, the maximum permissible anode dissipation may then be allowed to exceed its limit by as much as 15% as a result of tolerances of the components in the circuit and in consequence of the automatic gain control. (see page 2).

The maximum output power of the individual EL 42 is 2.8 W with 225 V on anode and screen grid, at which level the grid input is 8 V_{RMS}. The EL 42 is also suitable for use in push-pull output stages; a Class A amplifier with anode and screen grid operating at 250 V, and with automatic bias, will deliver an output of 7 W with a distortion of 5.5%.
In class B, the maximum output for the same anode potential is 6.5 W with 5% distortion, and, in this connection, the ECC 40 as phase inverter will be found very advantageous; one of the triode systems of this valve is then used for that purpose, whilst the other can serve as rectifier to provide bias for the output valves.

As the amount of space in car-radio sets is usually restricted, the dimensions of the EL 42 have been kept at a minimum; this valve is no larger than the pre-amplifier valves.

**TECHNICAL DATA OF THE OUTPUT PENTODE EL 42**

**Heater data**

Heating: indirect, A.C. or D.C., parallel feed  
Heater voltage . . . . . . \( V_f \) = 6.3 V  
Heater current . . . . . . \( I_f \) = 0.2 A

![Electrode Arrangement](image)

*Fig. 2*  
Electrode arrangement, electrode connections and maximum dimensions in mm of the EL 42.

**Capacitances** (cold valve)

Input capacitance . . . . . . \( C_{g1} \) = 4.3 pF  
Output capacitance . . . . . . \( C_a \) = 6.2 pF  
Anode - control grid . . . . . . \( C_{ag1} \) \& 0.2 pF  
Control grid - heater . . . . . . \( C_{gf} \) = 0.2 pF
Operating characteristics of the EL 42 used as Class A output amplifier
(see Figs. 6 and 7)

Anode voltage \( V_a \) = 200 225 V
Screen grid voltage \( V_{gs} \) = 200 225 V
Cathode resistor \( R_k \) = 360 360 Ω
Anode current \( I_a \) = 22.5 26 mA
Screen grid current \( I_{gs} \) = 3.5 4.1 mA
Mutual conductance \( S \) = 3.2 3.2 mA/V
Internal resistance \( R_i \) = 90 90 kΩ
Amplification factor, screen grid
with respect to control grid \( \mu_{gs} \) = 11 11
Matching resistance \( R_a \) = 9 9 kΩ
Output power \( W_o \) = 2.1 2.8 W
Total distortion \( d_{tot} \) = 11 12 %
A.C. grid voltage \( V_i(W_o=\text{max.}) \) = 6.8 8.0 \( V_{RMS} \)
Sensitivity \( V_i(W_o=50 \text{ mW}) \) = 0.8 0.75 \( V_{RMS} \)

Operating characteristics of two valves EL 42 as Class A push-pull amplifier
(see Figs. 8 and 9)

Anode voltage \( V_a \) = 200 V
Screen grid voltage \( V_{gs} \) = 200 V
Common cathode resistor \( R_k \) = 310 Ω
Matching resistance \( R_{aa} \) = 15 kΩ
A.C. grid voltage \( V_i \) = 0 0.75 9.6 \( V_{RMS} \)
Anode current \( I_a \) = \( 2 \times 16 \) \( 2 \times 17 \) mA
Screen grid current \( I_{gs} \) = \( 2 \times 2.6 \) \( 2 \times 5.6 \) mA
Output power \( W_o \) = 0 0.05 4.1 W
Total distortion \( d_{tot} \) = 5.5 %

Anode voltage \( V_a \) = 250 V
Screen grid voltage \( V_{gs} \) = 250 V
Common cathode resistor \( R_k \) = 310 Ω
Matching resistance \( R_{aa} \) = 15 kΩ
A.C. grid voltage \( V_i \) = 0 0.7 12.5 \( V_{RMS} \)
Anode current \( I_a \) = \( 2 \times 20 \) \( 2 \times 21.5 \) mA
Screen grid current \( I_{gs} \) = \( 2 \times 3.2 \) \( 2 \times 6.7 \) mA
Output power \( W_o \) = 0 0.05 7.0 W
Total distortion \( d_{tot} \) = 5.5 %
Operating characteristics of two valves EL 42 as Class B push-pull amplifier (see Figs. 10 and 11)

Anode voltage \( V_a \) = 200 V
Screen grid voltage \( V_{g2} \) = 200 V
Control grid voltage \( V_{g1} \) = -17 V
Matching resistance \( R_{aa} \) = 16 kΩ
A.C. grid voltage \( V_i \) = 0 1.5 12 V_{RMS}
Anode current \( I_a \) = \( 2 \times 5 \) \( 2 \times 16 \) mA
Screen grid current \( I_{g2} \) = \( 2 \times 0.8 \) \( 2 \times 4.6 \) mA
Output power \( W_o \) = 0 0.05 4.0 W
Total distortion \( d_{tot} \) = -- -- 3.5 %

Anode voltage \( V_a \) = 250 V
Screen grid voltage \( V_{g2} \) = 250 V
Control grid voltage \( V_{g1} \) = -22.5 V
Matching resistance \( R_{aa} \) = 16 kΩ
A.C. grid voltage \( V_i \) = 0 1.7 16 V_{RMS}
Anode current \( I_a \) = \( 2 \times 5 \) \( 2 \times 20 \) mA
Screen grid current \( I_{g2} \) = \( 2 \times 0.8 \) \( 2 \times 6.5 \) mA
Output power \( W_o \) = 0 0.05 6.5 W
Total distortion \( d_{tot} \) = -- -- 5 %

Limiting values

Anode voltage when biased to cut-off
Anode voltage
Anode dissipation
Screen grid voltage, biased to cut-off
Screen grid voltage
Screen grid dissipation without input signal
Screen grid dissipation on full load
Cathode current
Grid current starting point
External resistance between control grid and cathode
External resistance between cathode and heater
Voltage between cathode and heater

\( V_{a_o} \) = max. 550 V
\( V_a \) = max. 300 V
\( W_a \) = max. 6 W
\( V_{g2o} \) = max. 550 V
\( V_{g2} \) = max. 300 V
\( W_{g2}(V_i=0) \) = max. 1 W
\( W_{g2}(W_o=\text{max.}) \) = max. 2 W
\( I_c \) = max. 35 mA
\( V_{g1}(I_{g1}=+0.3\mu A) \) = max. -1.3 V
\( R_{g1} \) = max. 2 MΩ
\( R_{fk} \) = max. 20 kΩ
\( V_{fk} \) = max. 100 V
Fig. 3
Anode current $I_a$ and screen grid current $I_{g2}$ as a function of the grid bias $V_{g1}$. 
Anode current $I_a$ as a function of the anode voltage $V_a$ with grid bias $V_{g1}$ as parameter. The dot-dash line represents the maximum anode dissipation ($W_a = 6$ W). In Fig. 4 the screen grid voltage $V_{g2} = 200$ V; in Fig. 5 $V_{g2} = 250$ V.
Anode current $I_a$, screen grid current $I_{g2}$, distortion $d$ and required A.C. grid voltage $V_i$, as functions of the output power $W_o$. Anode-load resistance $R_a = 0$ kΩ; cathode resistor $R_k = 360$ Ω. In Fig. 6 both anode and screen grid voltage are 200 V; in Fig. 7, 225 V. In the inset the required A.C. grid voltage $V_i$ is shown as a function of the output power $W_o$ at low values of the latter.
As Fig. 6, but for 2 valves EL 42 in Class A push-pull, with $V_a = V_{a2} = 200$ V (Fig. 8) and $V_a = V_{a2} = 250$ V (Fig. 9). In both cases the load resistance between the two anodes is 15 kΩ and the common bias resistor 310 Ω.
As Fig. 6, but for 2 valves EL 42 in Class B push-pull, with \( V_a = V_{es} = 200 \text{ V} \) (Fig. 10) and \( V_a = V_{es} = 250 \text{ V} \) (Fig. 11). In both cases the load resistance between the two anodes is 10 kΩ. In Fig. 10 the grid bias is \( V_{gs} = -17 \text{ V} \), whilst in Fig. 11 \( V_{gs} = -22.5 \text{ V} \).