EBF 80  Double diode-variable-mu pentode

Fig. 1
Normal and X-ray photographs of the EBF 80.

The EBF 80 comprises a pentode section with a variable-mu characteristic and two diodes operating on a common cathode. The pentode system is suitable for R.F., I.F. or A.F. amplification, the slope being 2.2 mA/V, and the internal resistance 1.4 MΩ, for a grid bias of —2 V. The two diodes can be used for detection and as a voltage source for automatic gain control.

In view of the fact that this valve has two diodes, it is particularly suitable for receivers containing no other diodes: delayed A.G.C. can thus be employed without any difficulty with all the advantages mentioned in the description of the EAF 42.

Examples of receivers in which the EBF 80 can be used with advantage as I.F. amplifier are as follows:
1. Simple receivers without an A.F. amplifying valve, employing, for example, the ECH 42 or ECH 41 as the frequency changer and the EL 41 as the output valve.
2. Push-pull receivers with the ECC 40 as an A.F. amplifier and phase inverter.
3. Sets in which the EF 40 is used as an A.F. amplifying valve, ensuring high A.F. amplification with low hum level and little risk of microphony.
4. Sets suitable for receiving A.M. as well as F.M. signals, employing the EQ 80 as F.M. detector. For A.M. reception, the EQ 80 can be used as an A.F. amplifier, with the two diodes of the EBF 80 as detector and A.G.C. diode.

In order to avoid undesirable coupling, suitable screens are fitted between the diodes and the pentode section and between the electrodes of the pentode. The whole is enclosed in a screening cage to protect the valve from external influences, thus obviating the necessity for external screening.

When used as an A.F. amplifier, the EBF 80 provides a gain of 150, which represents more amplification than is usually required, and so leaves a reserve which can be used for feedback purposes. Moreover, the gain in an amplifier or receiver is usually limited by microphony; unless special precautions are taken, the gain cannot be allowed to reach a value such that, using a loudspeaker of 5% efficiency, the input signal applied to the EBF 80 is less than 25 mV for an output of 50 mW from the output valve. The full significance of this is explained in the description of the valve EAF 42.

**TECHNICAL DATA OF THE DOUBLE DIODE-PENTODE EBF 80**

**Heater data**

Heating: indirect by A.C. or D.C.; parallel feed

Heater voltage \( V_f \) \( \equiv 6.3 \) V

Heater current \( I_f \) \( \equiv 0.3 \) A

![Electrode arrangement, electrode connections and max. dimensions in mm of the EBF 80](image-url)
Capacitances

Pentode section

Input capacitance \( C_{gt} \) = 4.2 pF
Output capacitance \( C_a \) = 4.9 pF
Control grid - anode \( C_{ag1} \) < 0.0025 pF
Control grid - heater \( C_{g1f} \) < 0.07 pF

Diode system

Diode 1 - cathode \( C_{g1} \) = 2.2 pF
Diode 2 - cathode \( C_{dz} \) = 2.35 pF
Between the diode anodes \( C_{dxdz} \) < 0.35 pF
Diode 1 - heater \( C_{d1f} \) < 0.02 pF
Diode 2 - heater \( C_{dzf} \) < 0.005 pF

Between the diodes and the pentode section

Diode 1 - control grid \( C_{d1a1} \) < 0.0008 pF
Diode 2 - control grid \( C_{d2a1} \) < 0.001 pF
Diode 1 - pentode anode \( C_{d1a} \) < 0.2 pF
Diode 2 - pentode anode \( C_{d2a} \) < 0.05 pF

Operating characteristics of the pentode section as R.F. or I.F. amplifier

Anode and supply voltage \( V_a = V_b \) = 250 V
Voltage on grid 3 \( V_{g3} \) = 0 V
Screen grid resistor \( R_{g2} \) = 95 kΩ
Cathode resistor \( R_C \) = 295 Ω

Grid bias \( V_{g1} \) = \(-2 - 41.5\) V
Screen grid voltage \( V_{g2} \) = 85 250 V
Anode current \( I_a \) = 5.0 mA
Screen grid current \( I_{g2} \) = 1.75 mA
Mutual conductance \( S \) = 2200 22 μA/V
Internal resistance \( R_i \) = 1.4 >10 MΩ

Amplification factor of grid No. 2 with respect to grid No. 1 \( \beta_{g2a1} \) = 18 18
Equivalent noise resistance \( R_{eq} \) = 6.8 kΩ
Operating characteristics of the pentode section as a resistance-capacity coupled A.F. amplifier

![Diagram of a pentode circuit](image)

**Fig. 3**

Supply voltage \( V_b \) = 250 250 250 250 V
Anode resistor \( R_a \) = 0.22 0.1 0.22 0.1 M\( \Omega \)
Screen grid resistor \( R_{g2} \) = 0.82 0.39 1.0 0.47 M\( \Omega \)
Grid leak \( R_{g1} \) = 1 1 10 10 \( \Omega \)
Cathode resistor \( R_{ck} \) = 1800 1000 0 0 \( \Omega \)
Grid leak of next valve \( R'_{g1} \) = 0.68 0.33 0.68 0.33 M\( \Omega \)
Anode current \( I_a \) = 0.75 1.5 0.75 1.5 mA
Screen grid current \( I_{g2} \) = 0.30 0.53 0.25 0.50 mA
Amplification \( V_o/V_i \) = 110 80 160 110

Distortion \( d_{tot} \) at an output voltage of

3 \( V_{RMS} \) = 0.75 0.9 0.8 0.8 %
5 \( V_{RMS} \) = 1.3 1.5 1.4 1.4 %
8 \( V_{RMS} \) = 2.0 2.2 2.1 2.1 %

Operating characteristics of the pentode section as a resistance-capacity coupled A.F. amplifier, triode-connected (screen grid connected to anode)

Supply voltage \( V_b \) = 250 250 250 250 V
Anode resistor \( R_a \) = 0.1 0.047 0.1 0.047 M\( \Omega \)
Grid leak \( R_{g1} \) = 1 1 10 10 \( \Omega \)
Cathode resistor \( R_{ck} \) = 820 560 0 0 \( \Omega \)
Grid leak of next valve \( R'_{g1} \) = 0.33 0.15 0.33 0.15 M\( \Omega \)
Anode current \( I_a \) = 2.08 4.10 2.16 4.50 mA
Amplification \( V_o/V_i \) = 14 13 15 15
Distortion \( d_{tot} \) at an output voltage of

3 \( V_{RMS} \) = 1.6 1.3 2.0 1.7 %
5 \( V_{RMS} \) = 2.5 2.0 3.1 2.7 %
8 \( V_{RMS} \) = 4.3 2.9 4.8 4.1 %
Limiting values of the pentode section

Anode voltage, valve biased to cut-off \ldots \ldots \ldots \ldots \ldots V_{a_o} = \text{max.} \ 550 \ \text{V}
Anode voltage \ldots \ldots \ldots \ldots V_{a} = \text{max.} \ 300 \ \text{V}
Anode dissipation \ldots \ldots \ldots \ldots W_{a} = \text{max.} \ 1.5 \ \text{W}
Screen grid voltage, in cut-off condition \ldots \ldots \ldots \ldots V_{g1_o} = \text{max.} \ 550 \ \text{V}
Screen grid voltage, valve controlled \ldots \ldots \ldots \ldots V_{g2}(I_{a}<2.5 \ \text{mA}) = \text{max.} \ 300 \ \text{V}
Screen grid voltage, valve uncontrolled \ldots \ldots \ldots \ldots V_{g2}(I_{a}=5 \ \text{mA}) = \text{max.} \ 125 \ \text{V}
Screen grid dissipation \ldots \ldots \ldots \ldots W_{g2} = \text{max.} \ 0.3 \ \text{W}
Cathode current \ldots \ldots \ldots \ldots I_{k} = \text{max.} \ 10 \ \text{mA}
Grid current starting point \ldots \ldots \ldots \ldots V_{g1}(I_{g1}=+0.3 \ \mu\text{A}) = \text{max.} \ -1.3 \ \text{V}
External resistance between control grid and cathode \ldots \ldots \ldots \ldots R_{g1} = \text{max.} \ 3 \ \text{M\Omega}\)
External resistance between heater and cathode \ldots \ldots \ldots \ldots R_{fk} = \text{max.} \ 20 \ \text{k\Omega}
Voltage between heater and cathode \ldots \ldots \ldots \ldots V_{fk} = \text{max.} \ 100 \ \text{V}

Limiting values of the diode sections

Peak inverse voltage on diode No. 1 \ldots \ldots \ldots \ldots V_{d1\text{inv}p} = \text{max.} \ 350 \ \text{V}
Peak inverse voltage on diode No. 2 \ldots \ldots \ldots \ldots V_{d2\text{inv}p} = \text{max.} \ 350 \ \text{V}
Current to diode anode No. 1 \ldots \ldots \ldots \ldots I_{d1} = \text{max.} \ 0.8 \ \text{mA}
Current to diode anode No. 2 \ldots \ldots \ldots \ldots I_{d2} = \text{max.} \ 0.8 \ \text{mA}
Peak current to diode anode No. 1 \ldots \ldots \ldots \ldots I_{d1p} = \text{max.} \ 5 \ \text{mA}
Peak current to diode anode No. 2 \ldots \ldots \ldots \ldots I_{d2p} = \text{max.} \ 5 \ \text{mA}
External resistance between heater and cathode \ldots \ldots \ldots \ldots R_{fk} = \text{max.} \ 20 \ \text{k\Omega}
Voltage between heater and cathode \ldots \ldots \ldots \ldots V_{fk} = \text{max.} \ 100 \ \text{V}

\footnote{Applicable where grid bias is obtained from cathode resistor; if a grid leak provides the grid bias, the limiting value for $R_{g1}$ is 22 M\Omega.}
Fig. 4
Anode current ($I_a$, Fig. 4) and mutual conductance ($S$, Fig. 5) as functions of the grid bias ($V_{g1}$), with screen grid voltage ($V_{g2}$) as parameter. The broken lines represent $I_a$ and $S$ when a series resistor of 95 kΩ is included in the screen grid circuit.
Fig. 6
Anode current ($I_a$), screen grid current ($I_{g2}$), mutual conductance ($S$), internal resistance ($R_i$) and equivalent noise resistance ($R_{eq}$) as functions of the grid bias ($V_{g1}$), with $R_{g2} = 95 \, k\Omega$ in the screen grid circuit.

Fig. 7
1) Strength of an interfering signal ($V_i$) at the control grid producing 1% cross-modulation (curve $K = 1\%$), and
2) strength of a ripple voltage ($V_r$) at the control grid producing 1% modulation hum (curve $m_b = 1\%$), both as functions of the slope ($S$).
Screen grid current ($I_{gs}$) as a function of the screen grid voltage ($V_{gs}$) with grid bias ($V_{g1}$) as parameter. The broken curve indicates the maximum permissible screen grid dissipation ($W_{gs}=0.3$ W), whilst the straight line represents the load line with a series resistor of 95 kΩ.