EF 5 Variable MU R.F. pentode

The EF 5 is a variable-mu R. F. or I.F. pentode. Special care has been devoted in the design of this valve to the greatest possible reduction in cross-modulation and modulation hum. At a screen-grid voltage of 100 V the anode current of the EF 5 is 8 mA, when the mutual conductance is 1.7 mA/V, the control range being from —3 to —46.5 V. The control range is capable of modification by means of the screen voltage; at lower screen potentials, for the same grid bias, the mutual conductance drops sharply, but the cross-modulation conditions are then not so very good. With a screen voltage of 85 V the control range extends from —2 to —39 V only. Obviously, a lower screen potential will result in a lower screen current as well as a lower anode current and it is thus possible to reduce the bias at the working point from —3 to —2 V to increase the slope; the working value of the mutual conductance is then 1.85 mA/V.

With 60 V screen potential the conductance is still further reduced, to —2/—29 V.

The very greatly diminished modulation hum in this valve is of first importance in A.C./D.C. receivers, where alternating voltages at mains frequency can easily occur between heater and grid. The EF 5 is notable for its low inter-electrode capacitances and high internal resistance; excellent results are obtained on the short-wave range. Although on short waves the circuit magnification is usually only fair, the excellent properties of the EF 5 make it possible to achieve extremely good amplification in this range. On short waves, too, the mutual conductance is the same as on the other ranges (e.g. 200 m). The high impedance of anode and grid with respect to earth in the 12 to 60 metre band, as compared with the impedance values of practical tuned circuits, enables the EF 5 to produce in that range amplification values equal to the product of mutual conductance and impedance. On the short-wave bands the (feed-back) impedance, which takes the place of the anode-to-grid capacitance on the long waves, is unusually high and there is therefore no risk of parasitic oscillation, even with the maximum permissible amount of gain.

A factor contributing in no small degree towards the high properties of this valve is the use of side contacts (P-type

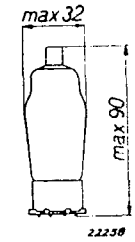


Fig. 1
Dimensions in mm.

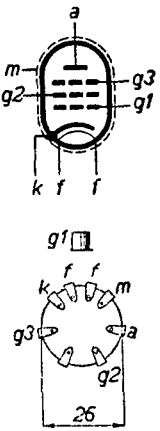


Fig. 2
Arrangement of electrodes and base connections.

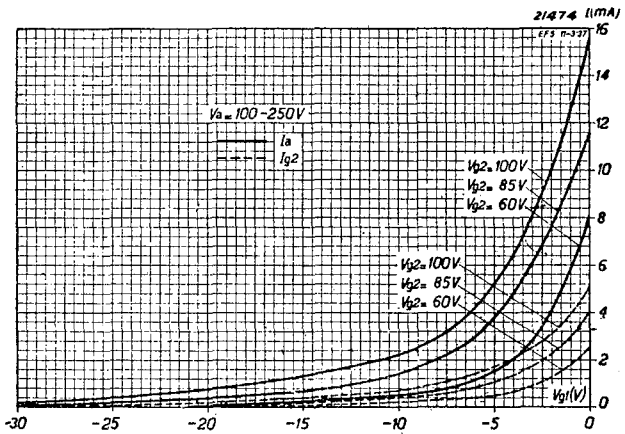
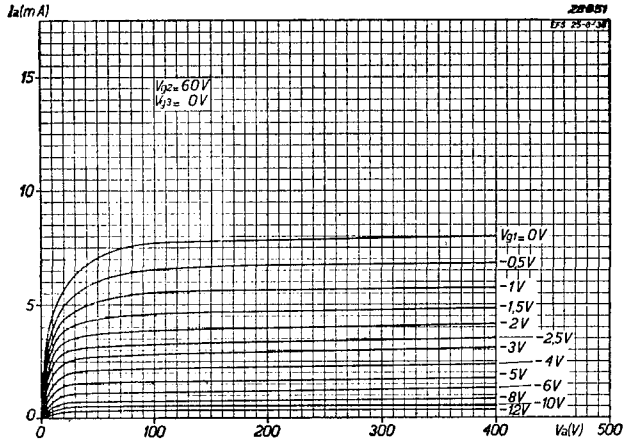
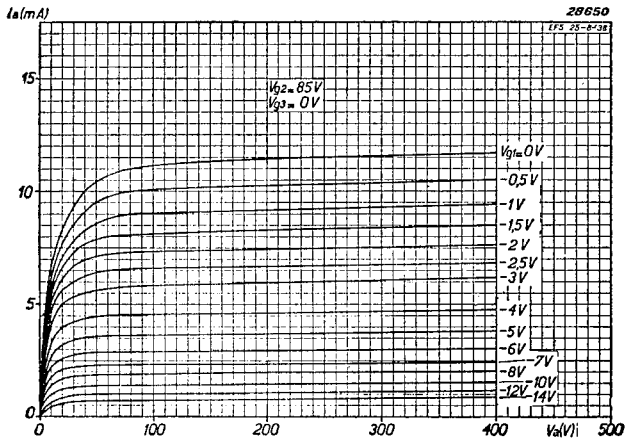


Fig. 3
Anode current and screen current as a function of the grid bias, for different values of screen potential, at 250 V anode. The curves also apply as an approximation to anode voltages of 100–250 V.

base). The suppressor grid and metallizing, each with their own individual contacts, can be connected direct to earth to give the best possible results with short-wave reception.





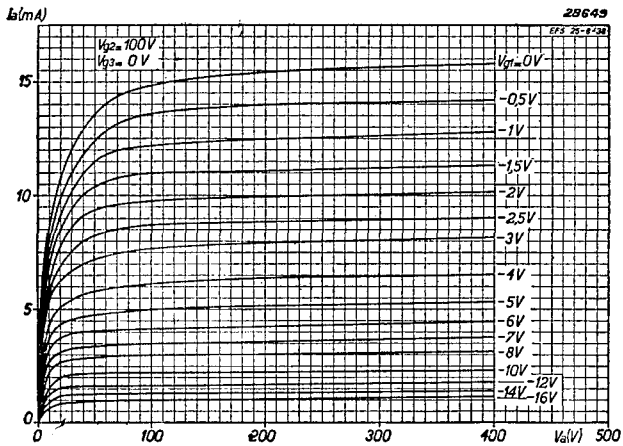


Fig. 4
Anode current as a function of the anode voltage, for different values of screen potential and grid bias.

HEATER RATINGS

Heating: indirect, A.C. or D.C., series or parallel supply

Heater voltage . . . . . V_f = 6.3 V

Heater current . . . . . I_f = 0.200 A

CAPACITANCES

C_{ag1} < 0.003 $\mu\mu$F

C_{g1} = 5.4 $\mu\mu$F

C_a = 6.9 $\mu\mu$F

OPERATING DATA: valve employed as R.F. or I.F. amplifier

Anode voltage									
V_a (V)		100			200			250	
Screen-grid voltage									
V_{g2} (V)		100			100			100	
Suppressor-grid voltage									
V_{g3} (V)		0			0			0	
Cathode resistor									
R_k (ohms)		170			180			180	
Grid bias									
V_{g1} (V)	-2.85[1])	-34[2])	-46.5[3])	-2.95[1])	-34[2])	-46.5[3])	-3[1])	-34[2])	-46.5[3])
Anode current									
I_a (A)	8	—	—	8	—	—	8	—	—
Screen current									
I_{g2} (mA)	2.6	—	—	2.6	—	—	2.6	—	—
Mutual conductance									
S (μA/V)	1700	17	2	1700	17	2	1700	17	2
Amplification factor									
μ	500	—	—	1600	—	—	2000	—	—
Internal resistance									
R_i (M ohms)	0.3	> 10	> 10	0.95	> 10	> 10	1.2	> 10	> 10

Anode voltage									
V_a (V)		100			200			250	
Screen-grid voltage									
V_{g2} (V)		85			85			85	
Suppressor-grid voltage									
V_{g3} (V)		0			0			0	
Cathode resistor									
R_k (ohms)		190			195			200	
Grid bias									
V_{g1} (V)	-1.9[1])	-29[2])	-39[3])	-1.95[1])	-29[2])	-39[3])	-2[1])	-29[2])	-39[3])
Anode current									
I_a (mA)	7.5	—	—	7.5	—	—	7.5	—	—
Screen current									
I_{g2} (mA)	2.45	—	—	2.45	—	—	2.45	—	—
Mutual conductance									
S (μA/V)	1850	18	2	1850	18	2	1850	18	2
Amplification factor									
μ	550	—	—	1750	—	—	2200	—	—
Internal resistance									
R_i (M ohms)	0.3	> 10	> 10	0.95	> 10	> 10	1.2	> 10	> 10

Anode voltage									
V_a (V)		100			200			250	
Screen-grid voltage									
V_{g2} (V)		60			60			60	
Supressor-grid voltage									
V_{g3} (V)		0			0			0	
Cathode resistor									
R_k (ohms)		360			370			380	
Grid bias									
V_{g1} (V)	-1.9[1])	-22[2])	-29[3])	-2.95[1])	-22[2])	-29[3])	-2[1])	-22[2])	29[3])
Anode current									
I_a (mA)	4	—	—	4	—	—	4	—	—
Screen-grid current									
I_{g2} (mA)	1.3	—	—	1.3	—	—	1.3	—	—
Mutual conductance									
S (μA/V)	1400	14	2	1400	14	2	1400	14	2
Amplification factor									
μ	1200	—	—	1900	—	—	2000	—	—
Internal resistance									
R_i (M ohms)	0.85	> 10	> 10	1.35	> 10	> 10	1.4	> 10	> 10

[1]) Without control
[2]) Mutual conductance reduced to one-hundredth of uncontrolled value.
[3]) Extreme limit of control.

MAXIMUM RATINGS

V_{ao}	= max. 550 V
V_a	= max. 250 V
W_a	= max. 2 W
V_{g20}	= max. 400 V
V_{g2}	= max. 125 V
W_{g2}	= max. 0.4 W
I_k	= max. 15 mA
V_{g1} (I_{g1} = +0.3 μA)	= max. —1.3 V
R_{g1}	= max. 2.5 M ohms
R_{fk}	max. 20,000 ohms
V_{fk}	= max. 100 V [1])

[1]) Direct voltage or effective value of alternating voltage.

Due to the curvature of the characteristic, the uses of the EF 5 are restricted to R.F. and I.F. amplification. It can be employed as amplifier with either automatic or manual control. It is preferable to feed the screen through a potential divider; in many cases it would be found when using a series resistor that the screen voltage would become too high on full control and that the amplification control would be far too tardy.

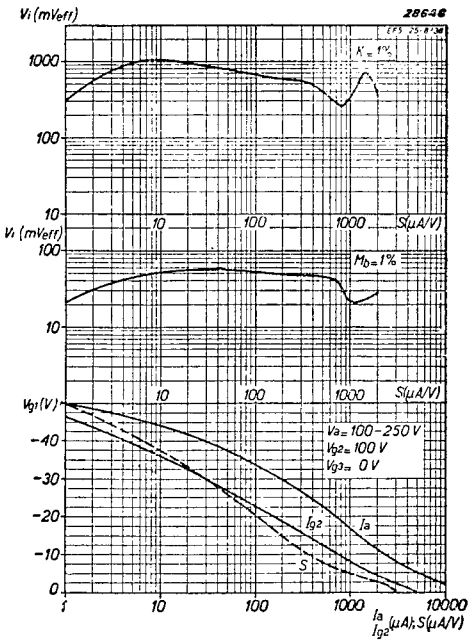


Fig. 5
At 100–250 V anode and 100 V screen;
Upper diagram. Alternating grid voltage as a function of the mutual conductance, with 1 % cross modulation.
Centre diagram. Alternating grid voltage as a function of the mutual conductance, with 1 % modulation hum.
Lower diagram. Mutual conductance S, anode current Ia and screen current Ig_2 as a function of the voltage on the first grid.

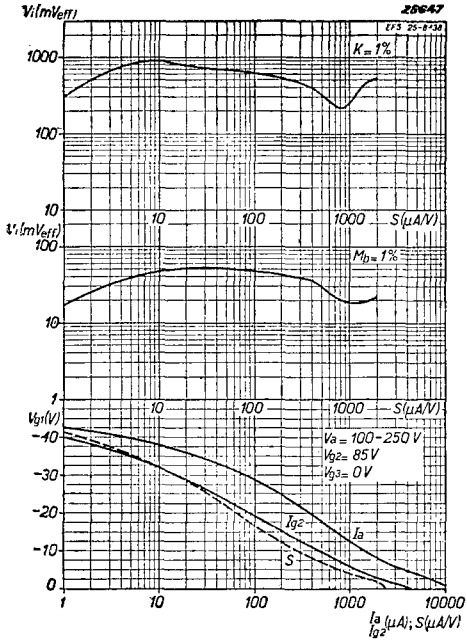


Fig. 6
At 100–250 V anode and 85 V screen;
Upper diagram. Effective alternating grid voltage as a function of the mutual conductance, with 1 % cross modulation.
Centre diagram. Effective alternating grid voltage as a function of the mutual conductance, with 1 % modulation hum.
Lower diagram. Mutual conductance S, anode current Ia and screen current Ig_2 as a function of the grid bias.

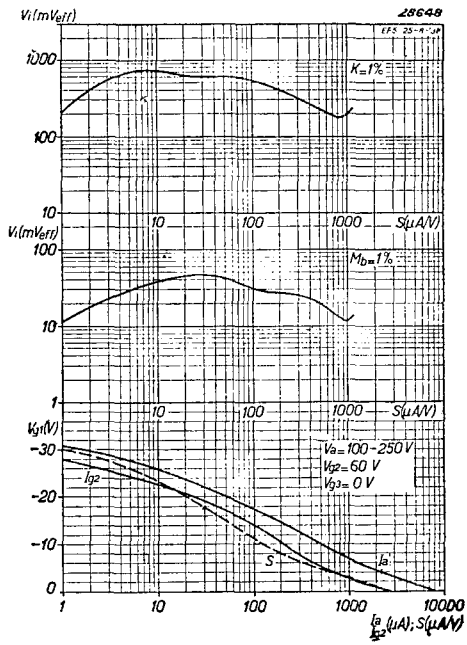


Fig. 7
At 100–250 V anode and 60 V screen:
Upper diagram. Effective alternating grid voltage as a function of the mutual conductance, with 1 % cross-modulation.
Centre diagram. Effective alternating grid voltage as a function of the mutual conductance, with 1 % modulation hum.
Lower diagram. Mutual conductance S, anode current Ia and screen current Ig_2 as a function of the grid bias.

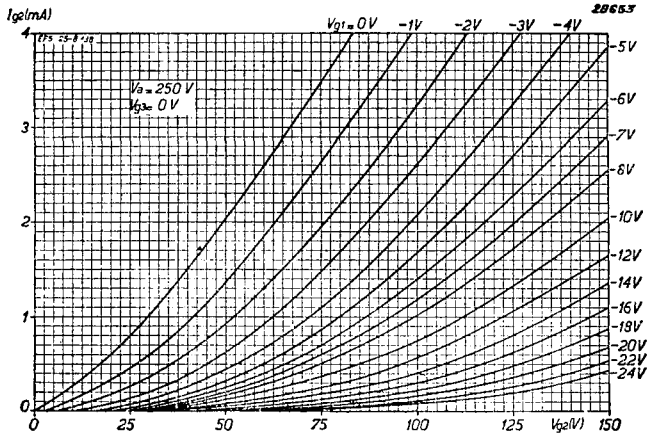


Fig. 8
Screen-grid current as a function of the screen voltage, for different values of grid bias.

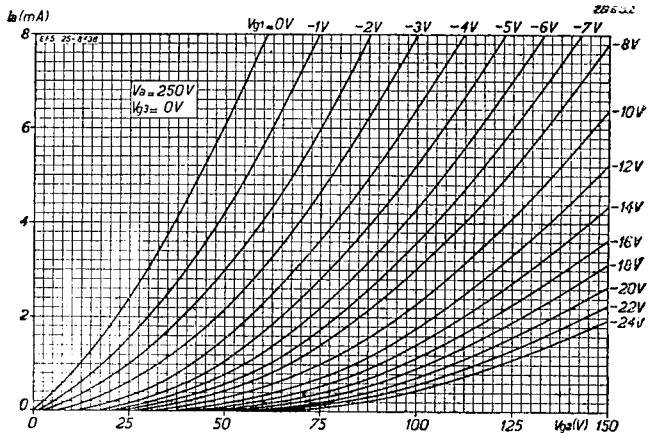


Fig. 9
Anode current as a function of the screen-grid voltage, for different values of grid bias.