4654 Pentode

The 4654 is an indirectly-heated steep-slope 18 W output valve for a maximum anode voltage of 600 and maximum screen-grid voltage of 425. In view of the high anode voltage involved and the relatively small dimensions of the valve, the anode connection is located at the top of the envelope; high voltages in the pinch are thus avoided. The suppressor grid is connected to a separate contact on the base, making the valve also suitable for amateur transmission work; with the screen and suppressor grids joined, the valve can be employed as an electron-coupled master oscillator, in which case the top cap ensures a conveniently short connection between the anode and oscillator circuits.

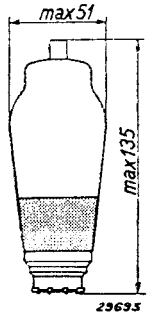
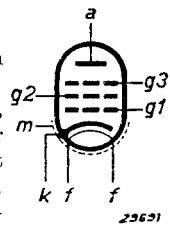


Fig. 1
Dimensions in mm.

The 4654 lends itself well to the following purposes in amateur transmitters:

1) modulator in Class A, AB or B circuits,
2) electron-coupled master oscillator,
3) R.F. amplifier or frequency-multiplier in intermediate stages (Class C),
4) class C output amplifier in telegraphy transmitters,
5) output valve for telephony (Class C), with modulation on both anode and screen grid.

It can be used as transmitter valve at all wavelengths from 50 m, for which purpose a single valve, in a Class C amplifier, will deliver a carrier-wave output power of 36 W, at 67 % efficiency, excluding circuit losses (anode voltage 600 V, screen voltage 200 V, and grid bias —60 V).



The valve is eminently suitable for simultaneous modulation of both anode and screen, in which case it should once more operate on an anode voltage of 600 V, a screen voltage of 200 V and a grid bias of —60 V, the output then being 24 W (less circuit losses). Complete details will gladly be furnished on request.

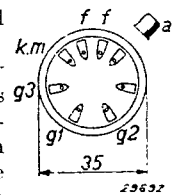


Fig. 2
Arrangement of electrodes and base connections.

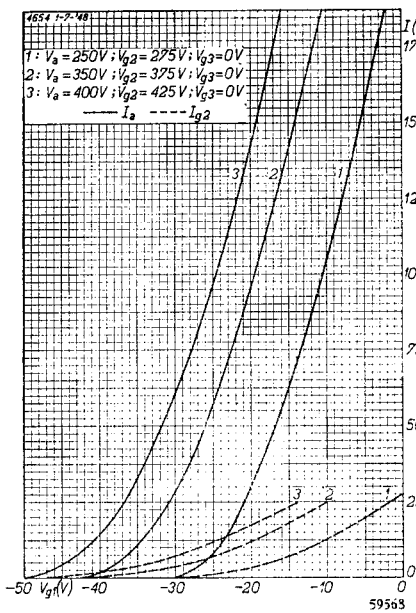


Fig. 3
Anode and screen current of the 4654 as functions of the grid bias, for various values of anode and screen potential.

As an amplifier valve the 4654 has various possibilities, both in amplifiers and modulator stages.

With a fixed bias, a supply voltage of $V_b = 425$ V, an anode voltage of $V_a = 400$ V and a common screen series resistor of $R_{g2} = 500$ ohms, an output of 48 W can be obtained without exceeding the maximum anode dissipation of 18 W.

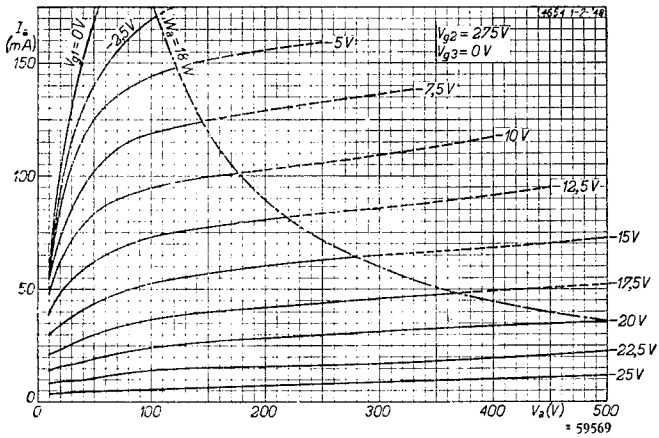


Fig. 4
Anode current as a function of the anode voltage for various values of grid bias. Vg_2 = 275 V.

HEATER RATINGS

Heating: indirect by A.C., parallel supply.

Heater voltage
V_f = 6.3 V

Heater current
I_f = 1.35 A

CAPACITANCES

Anode-grid
$C_{ag1} < 0.8\ \mu\mu F$

OPERATING DATA

The 4654 used as single output valve in class A

Anode voltage	V_a	=	250 V
Suppressor-grid voltage	V_{g3}	=	0 V
Screen-grid voltage	V_{g2}	=	275 V
Cathode resistor	R_k	=	175 ohms
Anode current	I_a	=	72 mA
Screen-grid current	I_{g2}	=	8 mA
Mutual conductance	S	=	8.5 mA/V
Amplification factor; screen with respect to control grid	$\mu_{fg}{}^{g1}$	=	11 —
Internal resistance	R_i	=	22,000 ohms
Load resistor	R_a	=	3,500 ohms
Alternating input voltage (I_{g1} = + 0.3 μA)	V_i	=	11.5 V_{eff}
Power output (I_{g1} = + 0.3 μA)	W_o	=	9.2 W
Total distortion (I_{g1} = + 0.3 μA)	d_{tot}	=	11.4 %
Alternating input voltage (W_o = 50 mW)	V_i	=	0.5 V_{eff}

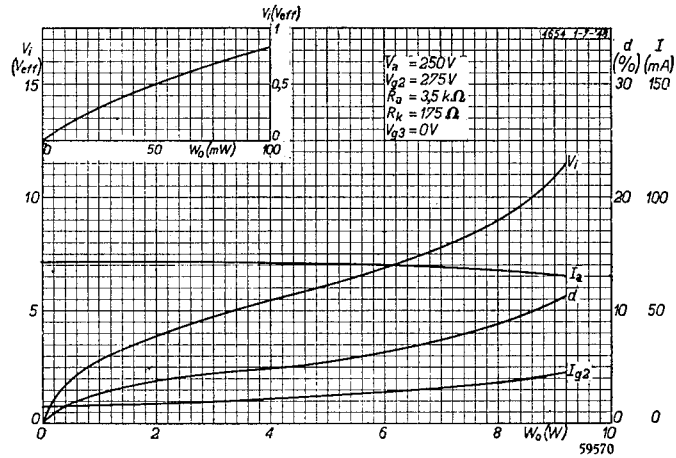


Fig. 5
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; the 4654 used as single output valve class A with Va = 250 V and Vg_2 = 275 V.

The 4654 used in class B output stage with fixed grid bias (two valves)

Load resistor between anodes	R_{aa} =	5,000				5,000		ohms
Common screen-grid series resistor	R_{g2} =	500				500		ohms
Grid bias	V_{g1} =	—38				—32		V
Suppressor-grid voltage	V_{g3} =	0				0		V
Alternating input voltage	V_i =	0	26.5	26.5	0	22.4	22.4	V_{eff}
Supply voltage	V_b =	425	425	400	375	375	350	V
Anode voltage	V_a =	420	400	375	370	350	325	V
Anode current	I_a =	2 × 20	2 × 93	2×81.5	2 × 20	2 × 79	2 × 70	mA
Screed-grid current	I_{g2} =	2 × 2,2	2 × 21	2×18	2 × 2.2	2 × 17	2 × 15	mA
Power output	W_o =	0	48	39	0	35	29	W
Total distortion	d_{tot} =	—	2.5	4.2	—	2.5	4.0	%

The 4654 used in class AB output stage with auto. grid bias (two valves)

Supply voltage	V_b =	425		375		V
Load resistor between anodes	R_{aa} =	6,500		5,000		ohms
Common screen-grid series resistor	R_{g2} =	2,000		500		ohms
Common cathode resistor	R_k =	265		195		ohms
Suppressor-grid voltage	V_{g3} =	0		0		V
Alternating input voltage	V_i =	0	27	0	22.5	V_{eff}
Anode voltage	$V_a + V_{Rk}$ =	405	400	355	350	V
Anode current	I_a =	2×46.5	2×60	2× 53	2×66.5	mA
Screen-grid current	I_{g2} =	2× 5.4	2×13	2×6.5	2×15.5	mA
Power output	W_o =	0	27.5	0	26	W
Total distortion	d_{tot} =	—	5	—	3.5	%

The 4654 used in triode connection as single output valve class A (screen-grid connected to anode)

Supply voltage	V_b =	375 V	Anode current	I_a =	50 mA
Suppressor-grid voltage	V_{g3} =	0 V	Alternating input voltage	V_i =	17.5 V_{eff}
Cathode resistor	R_k =	470 ohms	Power output	W_o =	4.5 W
Load resistor	R_a =	3,000 ohms	Total distortion	d_{tot} =	9 %

The 4654 used in triode connection in class AB output stage with auto. grid bias (two valves)

Supply voltage	V_b =	400		V
Load resistor between anodes	R_{aa} =	5,500		ohms
Suppressor-grid voltage	V_{g3} =	0		V
Common cathode resistor	R_k =	280		ohms
Alternating input voltage	V_i =	0	21	V_{eff}
Anode current	I_a =	2 × 50	2 × 56	ohms
Power output	W_o =	0	13	W
Total distortion	d_{tot} =	—	1	%

MAXIMUM RATINGS

V_{ao}	= max. 1,200 V	I_k	= max. 120 mA
V_a	= max. 600 V	V_{g1} (I_{g1} = + 0.3 μA)	= max. —1.3 V
W_a	= max. 18 W	R_{g1} *(auto. bias)*	= max. 0.7 M ohm
V_{g20}	= max. 1,000 V	R_{g1} *(fixed bias)*	= max. 0.5 M ohm
V_{g2}	= max. 425 V	V_{fk}	= max. 50 V
W_{g2} (V_i = 0)	= max. 3 W	R_{fk}	= max. 20,000 ohms
W_{g2} (W_o = max.)	= max. 10 W		

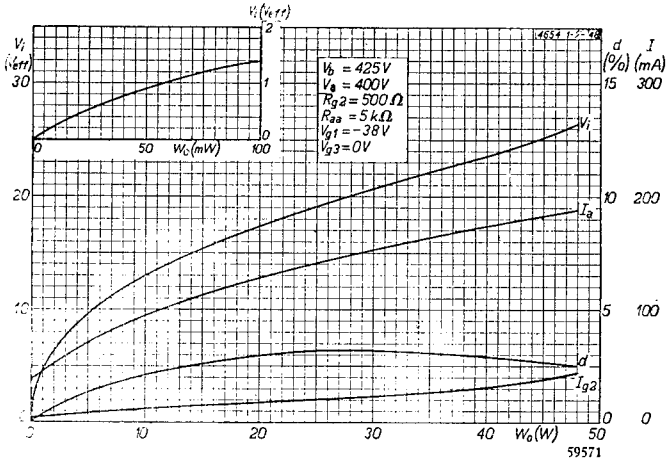


Fig. 6
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class B output stage with fixed grid bias, Vb = 425 V.

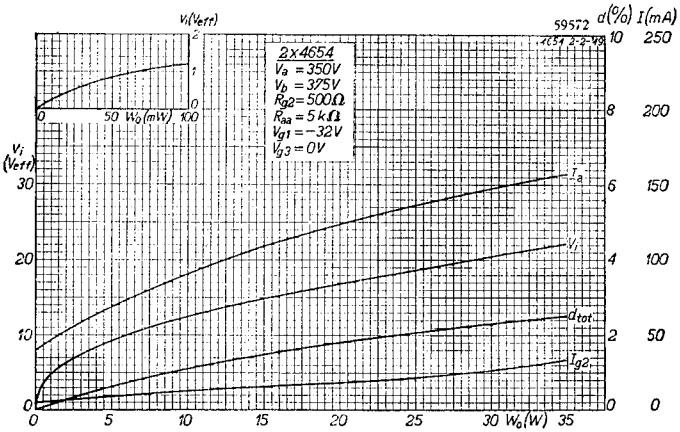


Fig. 7
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class B output stage with fixed grid bias, Vb = 375 V.

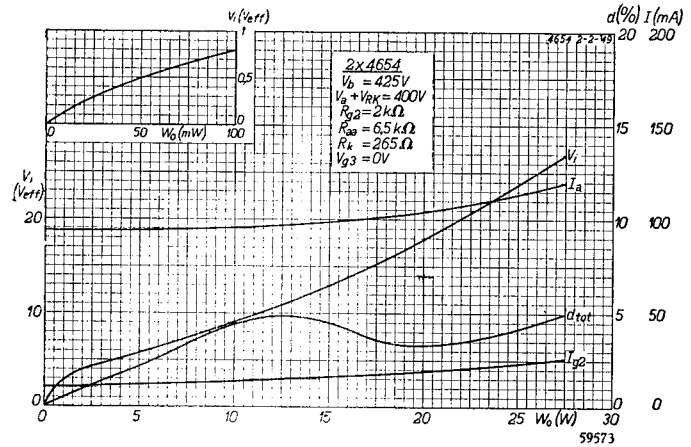


Fig. 8
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class AB output stage with auto. grid bias, Vb = 425 V.

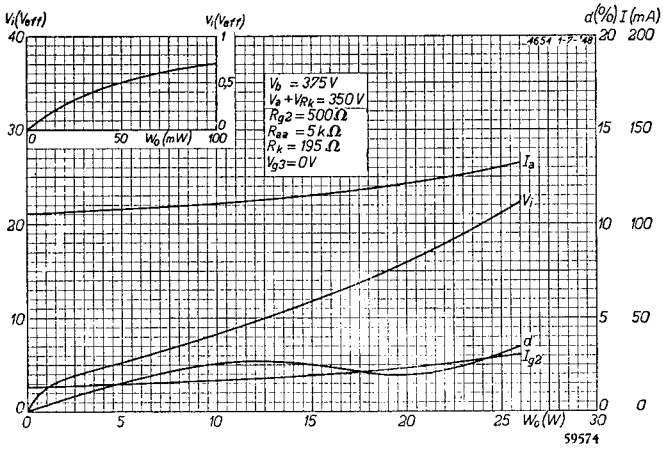


Fig. 9
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class AB output stage with auto. grid bias, $Vb = 375$ V

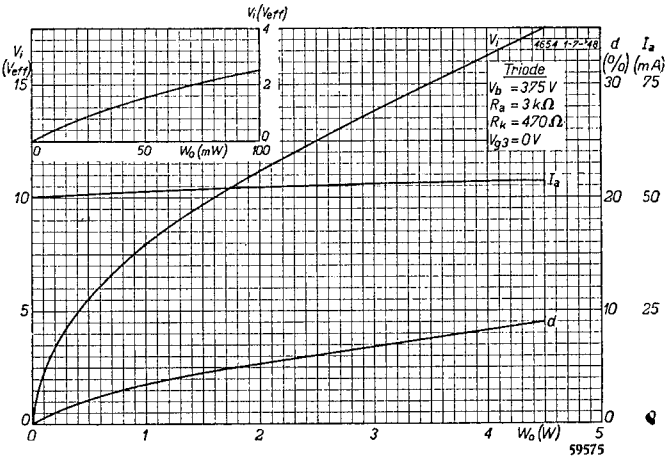


Fig. 10
Total distortion, anode current and alternating input voltage as functions of the output power; the 4654 used as single output valve in triode connection (screen-grid connected to anode) class A with $Vb = 375$ V.

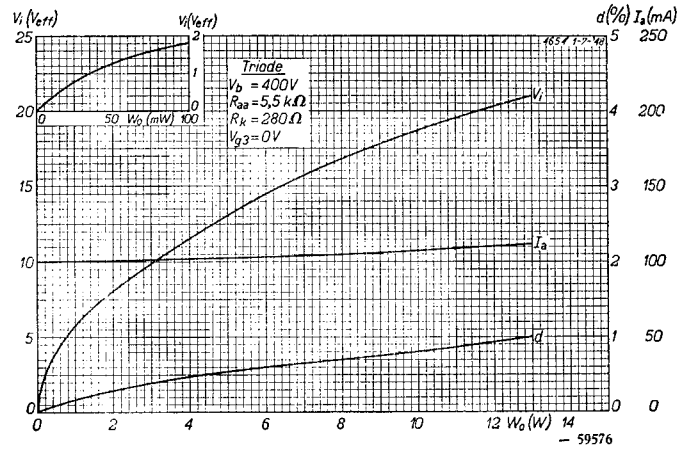


Fig. 11
Total distortion, anode current and alternating input voltage as functions of the output power; 2 valves 4654 in triode connection (screen-grid connected to anode) used in class AB output stage with $Vb = 400$ V