

## 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.

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.

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.

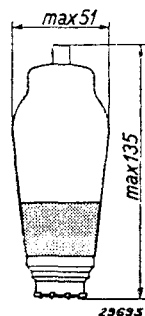


Fig. 1  
Dimensions in mm.

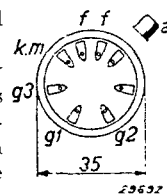
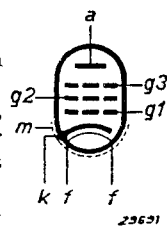


Fig. 2  
Arrangement of electrodes and base connections.

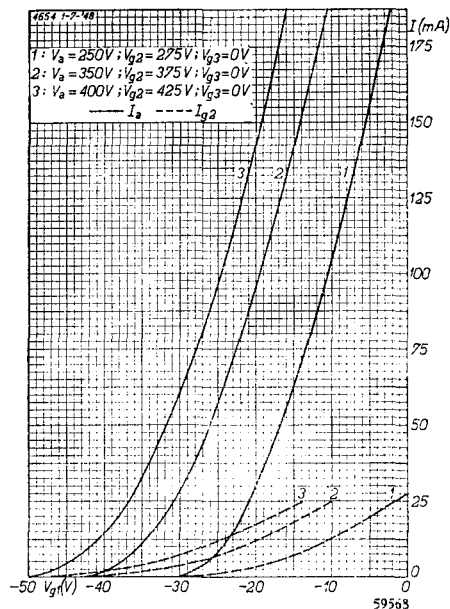


Fig. 3  
Anode and screen current of the 4654 as functions of the grid bias, for various values of anode and screen potential.

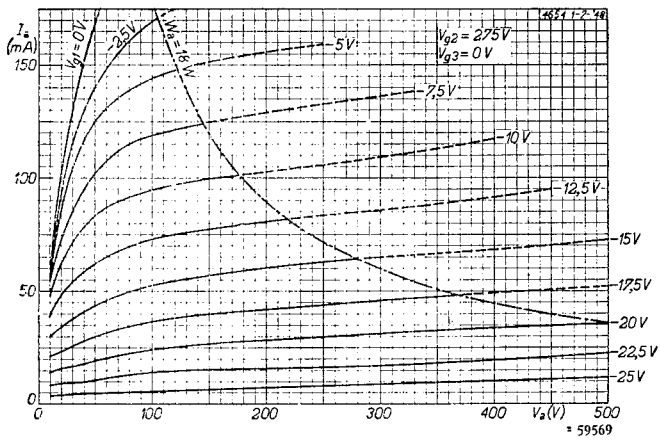


Fig. 4  
Anode current as a function of the anode voltage for various values of grid bias.  $V_{g2} = 275$  V.

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

$C_{ag1} < 0.8$   $\mu$ 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. . . . . | $\mu_{g2g1} = 11$ —           |
| Internal resistance. . . . .                                       | $R_i = 22,000$ ohms           |
| Load resistor. . . . .                                             | $R_a = 3,500$ ohms            |
| Alternating input voltage ( $I_{g1} = + 0.3$ $\mu$ A). . . . .     | $V_i = 11.5$ V <sub>eff</sub> |
| Power output ( $I_{g1} = + 0.3$ $\mu$ A). . . . .                  | $W_o = 9.2$ W                 |
| Total distortion ( $I_{g1} = + 0.3$ $\mu$ A). . . . .              | $d_{tot} = 11.4$ %            |
| Alternating input voltage ( $W_o = 50$ mW). . . . .                | $V_i = 0.5$ V <sub>eff</sub>  |

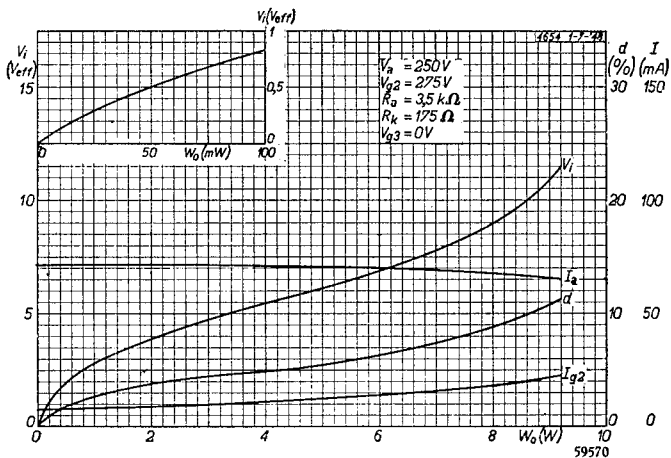


Fig. 5  
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; the 4654 used as single output valve class A with  $V_a = 250$  V and  $V_{g2} = 275$  V.

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 . . . . .       | $I_a =$     | $2 \times 20$  | $2 \times 93$ | $2 \times 81.5$ | $2 \times 20$  | $2 \times 79$ | $2 \times 70$ | mA        |
| Screen-grid current . . . . . | $I_{g2} =$  | $2 \times 2.2$ | $2 \times 21$ | $2 \times 18$   | $2 \times 2.2$ | $2 \times 17$ | $2 \times 15$ | 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 . . . . .             | $I_a =$          | $2 \times 46.5$ | $2 \times 60$ | $2 \times 53$  | $2 \times 66.5$ | mA        |
| Screen-grid current . . . . .       | $I_{g2} =$       | $2 \times 5.4$  | $2 \times 13$ | $2 \times 6.5$ | $2 \times 15.5$ | 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 . . . . .                | $I_a =$     | $2 \times 50$ | $2 \times 56$ 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   | $V_{g1} (I_{g1} = + 0.3 \mu A)$ | = 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 |
| $W_{g2} (W_o = \text{max.})$ | = 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.  $V_b = 425$  V.

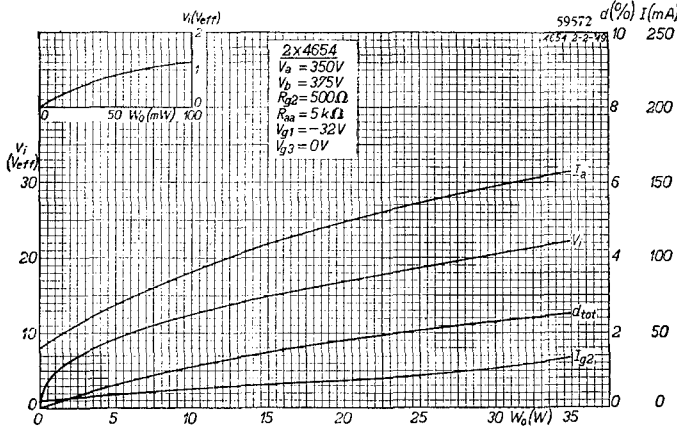
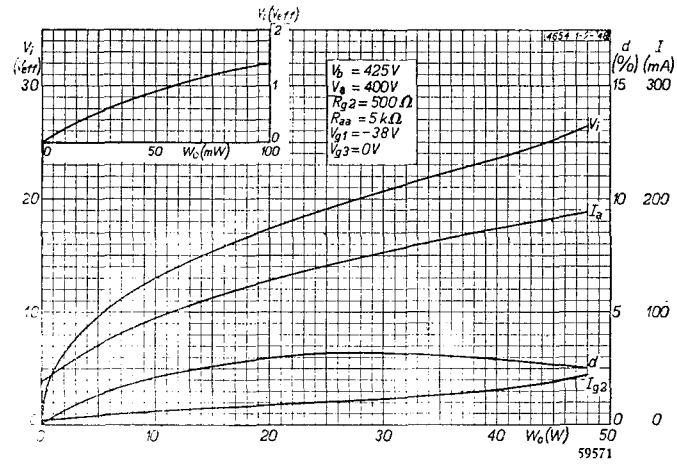


Fig. 7  
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class B output stage with fixed grid bias.  $V_b = 375$  V.

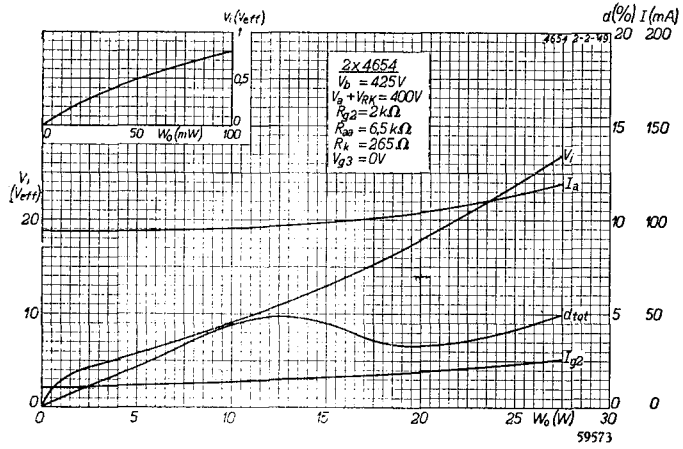


Fig. 8  
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class AB output stage with auto. grid bias.  $V_b = 425$  V.

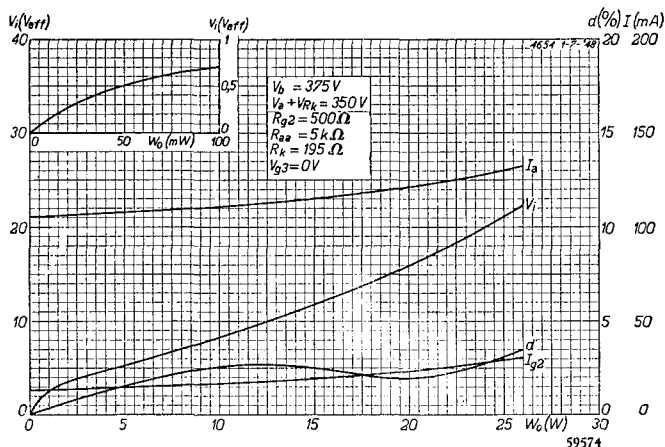


Fig. 9  
Total distortion, anode and screen-grid current and alternating input voltage as functions of the output power; 2 valves 4654 used in class AB output stage with auto. grid bias,  $V_b = 375 V$

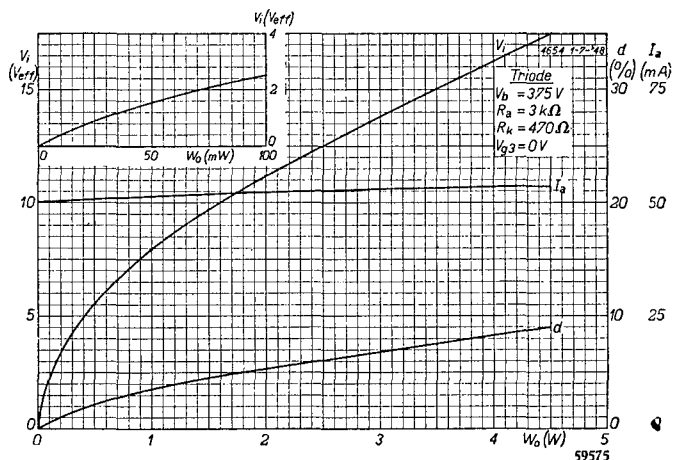


Fig. 10  
Total distortion, anode current and alternating input voltage as functions of the output power; the 4654 used as single output valve in triode connection (screen-grid connected to anode) class A with  $V_b = 375 V$ .

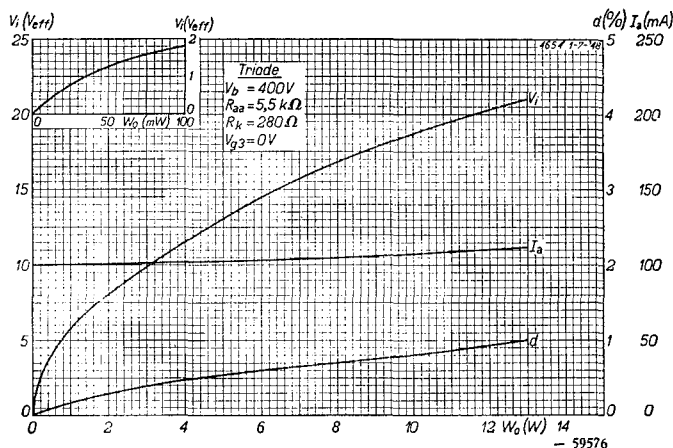


Fig. 11  
Total distortion, anode current and alternating input voltage as functions of the output power; 2 valves 4654 in triode connection (screen-grid connected to anode) used in class AB output stage with  $V_b = 400 V$