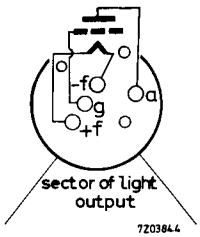
S.Q. INDICATOR TUBE

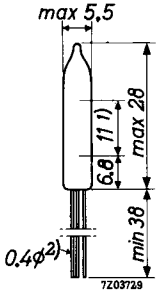
High-input impedance, special-quality indicator tube for indication of the output level of flip flops in computer circuits etc.

QUICK REFERENCE DATA			
Life test	10 000 hours		
Mechanical quality	Shock and vibration resistant		
Base	Subminiature		
Heating	Direct		
	A.C. or D.C.; parallel supply		
Filament voltage	V_f	1.0	V
Filament current	I_f	30	mA
"On"-"off" control voltage	ΔV	min. 1.4	V

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Connections should not be soldered nearer than 5 mm from the seal.
Leads should not be bent nearer than 1.5 mm from the seal.

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1) Length of the light bar.

2) Leads without letter indication are cut at the outer surface of the seal.

CHARACTERISTICS

Column I Nominal value or setting of the tube
II Range values for equipment design: Initial spread
III Range values for equipment design: End of life

		I	II	III	
Filament voltage	V_f	1.0			V
Filament current	I_f	30	24-36		mA
Anode voltage	V_a	50			V
Grid resistor	R_g	100			kΩ
Grid supply voltage [1] (maximum light output)	V_{bg}	0			V
Anode current	I_a	585	430-740	min. 250	μA
Zero light output is ensured when grid supply voltage [1] [2] is below	V_{bg}	−3	−3	−3	V
Anode current at V_{bg} = −3 V [2]	I_a		max. 5	max. 5	μA
Insulation resistance between two electrodes Voltage between two electrodes = 50 V	R_{ins}		min.100		MΩ

SHOCK RESISTANCE

The tube has been subjected 5 times in each of 4 positions to an acceleration of 500 g in an NRL shock machine with the hammer lifted over an angle of 30°.
These test conditions should not be considered as normal operating conditions.

LIFE

Production samples are checked for the end of life values (column III) under the following conditions during 10 000 hours:

Filament voltage	V_f	1.0	V_{RMS}
Anode voltage	V_a	50	V
Grid supply voltage	V_{bg}	0	V [1]
Grid resistor	R_g	100	kΩ

1) Voltage with respect to the midtap of the filament transformer.
2) The residual electron current may be concentrated on one spot which then may be visible in dark surroundings. This effect cannot be mistaken for the indicator being in the "on" condition.

LIMITING VALUES (Absolute max. rating system)

Anode voltage	V_{a_o}	max.	100	V
	V_a	max.	65	V
Anode current	I_a	max.	850	μA
Grid supply voltage, R_g = 100 kΩ ±10%	V_{b_g}	max.	0	V
R_g = 1 MΩ ±10%	V_{b_g}	max.	6	V
Grid voltage	$-V_g$	max.	50	V
Grid resistor	R_g	max.	1.1	MΩ
		min.	0.09	MΩ

Filament voltage: The average filament voltage should be 1.0 V. Variations exceeding 0 or - 10 % from nominal will shorten tube life.

APPLICATION NOTE

The visibility of the phosphorescent light produced by the anode when the indicator tube is "on" depends on the grid voltage prevailing in that condition and the illumination level of the surroundings. With V_g = -3 V for zero light output ("off" condition of the tube), the visibility is best when ΔV = 3 V (ΔV is the difference between the "high" and "low" voltages of the flip-flop) but an unambiguous indication is still obtained at ΔV = 1.4 V under nominal conditions and a low level of ambient light. With still smaller values of drive voltage a pre-amplifier is required.
Figs. 1 and 2 show typical arrangements for negative and positive logic, respectively.

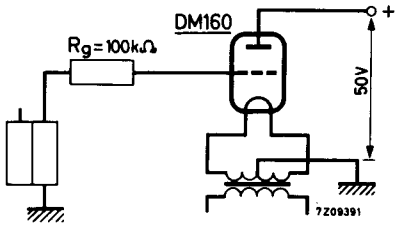


Fig. 1 Digital read-out circuit with DM160 connected to negative logic circuit which uses flip-flops equipped with p-n-p transistors. This circuit can be used for all types of flip-flops with p-n-p transistors with the "high" level near zero volt and a "low" level below -3 volt.

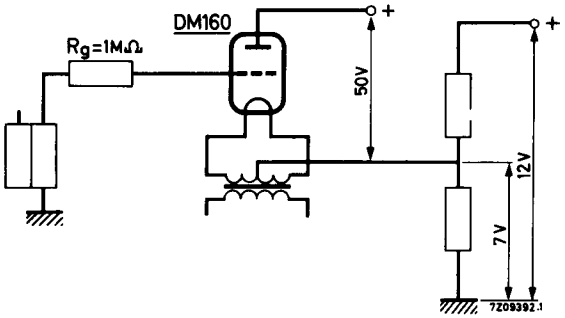


Fig.2 Digital read-out circuit with DM160 connected to positive logic circuit which uses a type of flip-flops equipped with n-p-n transistors and of which the "high" output level may be above +7.5 V and the "low" level near 0 V. R_g protects the tube against too large anode currents and too large positive grid currents when the grid supply voltage exceeds the cathode potentional.

When the minimum of ΔV lies below 3 V the spread in the "high" level of the flip-flop will give rise to an extra spread in the brightness of the phosphorescent light. When undesirable this spread may be reduced by clamping the grid voltage, see Fig.3.

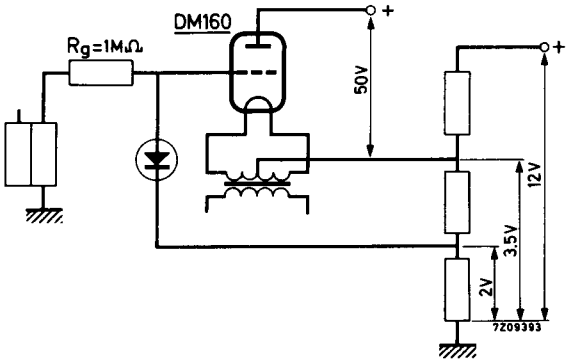
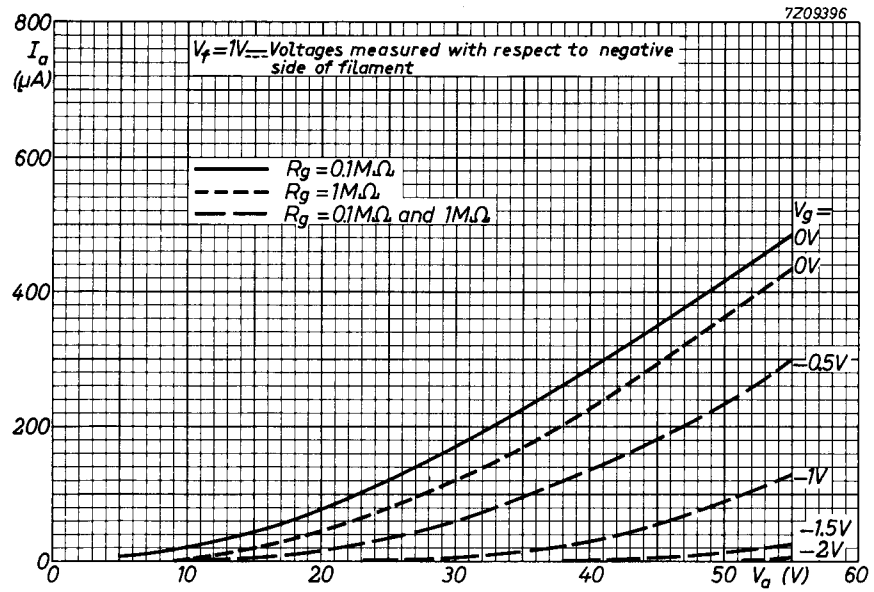
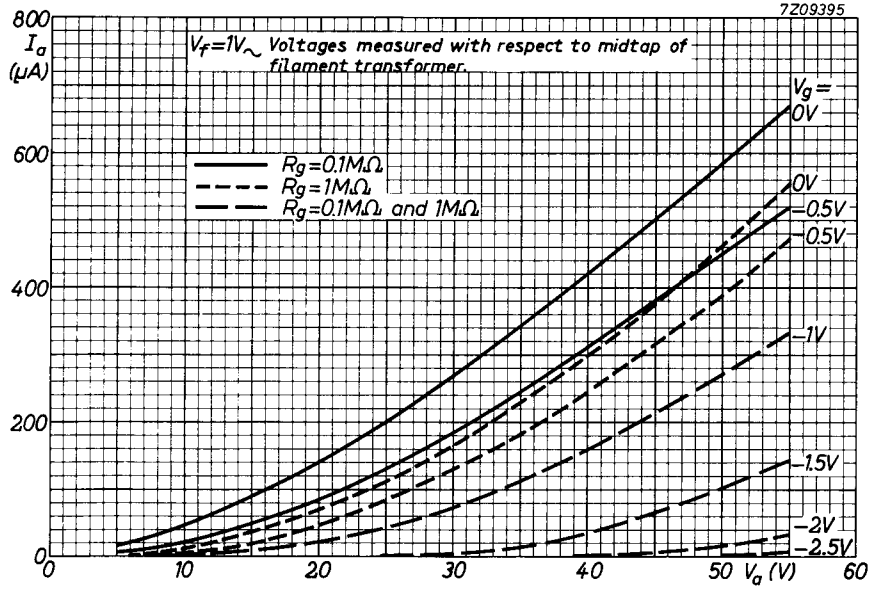
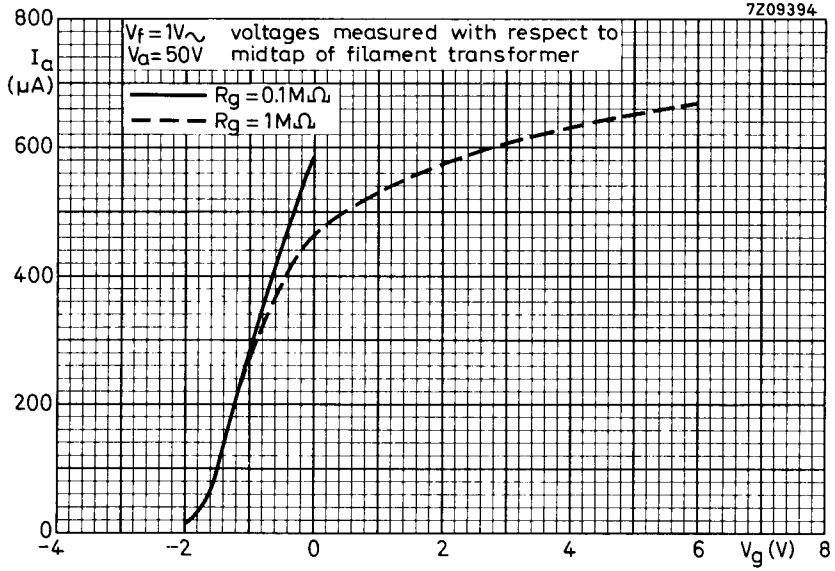
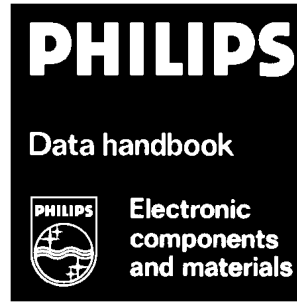


Fig.3 As Fig.2; but for a type of flip-flop with a "high" voltage level between +2.0 V and +7.0 V and "low" level between 0 V and +0.5 V; with clamping of the grid voltage.


7Z09396
800
I_a
(μA)
600
400
200
0
V_f=1V⎓ Voltages measured with respect to negative side of filament
R_g =0.1MΩ
R_g =1MΩ
R_g =0.1MΩ and 1MΩ
V_g =
0V
0V
−0.5V
−1V
−1.5V
−2V
0
10
20
30
40
50
V_a (V)
60


7Z09395
800
I_a
(μA)
600
400
200
0
V_f=1V~ Voltages measured with respect to midtap of filament transformer.
R_g=0.1MΩ
R_g=1MΩ
R_g=0.1MΩ and 1MΩ
V_g =
0V
0V
−0.5V
−0.5V
−1V
−1.5V
−2V
−2.5V
0
10
20
30
40
50
V_a (V)
60


7Z09394
800
I_a (μA)
600
400
200
0
$V_f = 1V_{\sim}$
$V_a = 50V$
voltages measured with respect to midtap of filament transformer
$R_g = 0.1M\Omega$
$R_g = 1M\Omega$
-4
-2
0
2
4
6
V_g (V)
8



DM160

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