PHILIPS "Miniwatt"

BEAM DEFLECTION TUBE

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E80T

"PREMIUM QUALITY" BEAM DEFLECTION TUBE with ribbon-shaped beam

- for impulse phase discriminators in impulse governed oscillators in:
- communication equipment which is to operate at various frequencies
- carrier telephone systems in which a large number of carrier frequencies are to be produced
- frequency standards producing from one reference frequency any frequency with great accuracy

The tube is shock resistant up to 500 g.

HEATING

Indirect, parallel supply. V_f = 6.3 V ± 10 % , I_f = 150 mA.

DIMENSIONS in mm

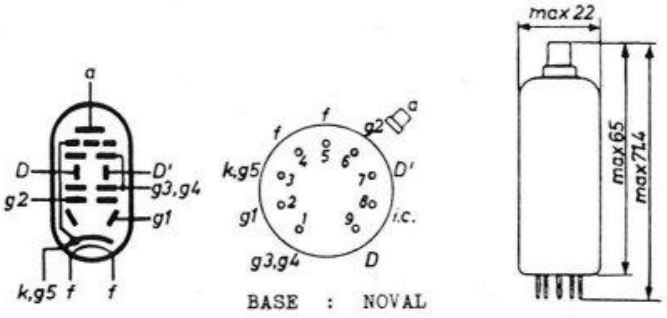

Fig. 1. Dimensions in mm and base connections of the E80T.

MOUNTING

The tube may be mounted in any position but must not be subjected to a magnetic field strength exceeding 1 Gauss.

CAPACITANCES

C_{g1}	=	2.2	pF	max.	3.5	pF	1)
C_D	=	3.0	pF	max.	4.5	pF	1)
$C_{D'}$	=	3.0	pF	max.	4.5	pF	1)
C_a	=			max.	2.0	pF	1)
C_{Dg1}	=			max.	0.1	pF	
$C_{D'g1}$	=			max.	0.1	pF	
C_{g1g2}	=			max.	0.9	pF	
C_{Da}	=			max.	0.02	pF	
$C_{D'a}$	=			max.	0.02	pF	

1) To all electrodes.

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TYPICAL CHARACTERISTICS

Plate voltage	V_a	=	100	V
Grid voltage (grids 3 and 4)	$V_{(g3 + g4)}$	=	250	V
Screen grid voltage	V_{g2}	=	70	V
Control grid voltage	V_{g1}	=	0	V
Deflection plate voltage	V_D	=	120	V
Deflection plate voltage	$V_{D'}$	=	120	V 2)
Plate current	I_a	=	1.35 ± 0.45	mA
Cathode current	I_k	=	2.0 (approx.)	mA
Plate current $\lvert V_D - V_{D'} \rvert$ = 7.5 V	I_a	=	0.25 (defl.)	mA
Control grid voltage ($I_a \leqslant 50$ µA)	V_{g1}	=	-20	V

LIMITING VALUES

Plate voltage (cut-off condition)	V_{a0}	=	max.	500	V
Plate voltage	V_a	=	max.	330	V
Grid voltage (grids 3 and 4, cut-off condition)	$V_{(g3 + g4)0}$	=	max.	600	V
Grid voltage (grids 3 and 4)	$V_{(g3 + g4)}$	=	max.	330	V
Screen grid voltage (cut-off condition)	V_{g20}	=	max.	600	V
Screen grid supply voltage	V_{bg2}	=	max.	330	V
Screen grid voltage	V_{g2}	=	max.	100	V
Deflection plate voltage	V_D	=	max.	170	V
Peak deflection plate voltage	V_{Dp}	=	max.	970	V
Negative peak deflection plate voltage	$-V_{Dp}$	=	max.	800	V
Deflection plate voltage	$V_{D'}$	=	max.	170	V
Peak deflection plate voltage	$V_{D'p}$	=	max.	670	V
Negative peak deflection plate voltage	$-V_{D'p}$	=	max.	500	V
Voltage between cathode and heater	V_{kf}	=	max.	50	V
Cathode current	I_k	=	max.	5.5	mA

SHOCK RATINGS

The tube is proof against the impact acceleration obtained with the N.R.L. impact machine for electronic devices. lifting the hammer over an angle of 30°

2) Adjusted for max. plate current I_a.

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OPERATION

The electrode system of the E80T (see fig. 2) consists of an electron gun (space between k and g_3), the deflection space (between g_3 and g_4) and the anode space (between g_4 and a), which will be discussed in succession.

ELECTRON GUN

Since the electron beam in this tube need be deflected in one plane only, the obvious solution is to use a ribbon-shaped beam. The most important dimension of the cross-section of the beam is that in the direction in which it is deflected. Moreover, the current flowing through the tube should be as large as possible when the beam passes through the slot in g_4, while the electrode voltages should be as low as practicable. At a given current the current density of a flat, ribbon-shaped beam will be very much smaller than that of a beam with a circular cross-section. This smaller current density results in a greatly reduced space charge, so that lower electrode voltages suffice.

The focusing electrode g_1 consists of two small, rectangular plates mounted at an angle of 90° with respect to each other, instead of 135° as in the case of conventional electron guns, because g_1 not only acts as a focusing electrode but also controls the current flowing through the tube.

DEFLECTION SPACE

In order to obtain high sensitivity, the deflection plates D and D' are placed very close together at the cathode end, diverging towards the anode to prevent the beam from impinging on the plates. Deflection sensitivity is at a maximum when the mean value of the voltage applied to these plates is fairly low, namely 120 V. At a lower voltage focusing deteriorates.

The width of the slot in the electrode g_4 is determined by the following considerations:

1) The current flowing through the slot towards the anode should be as high as possible.
2) The duration of the anode current impulses should be as short as possible.
3) The focusing action should have little effect on the maximum value of the anode current.

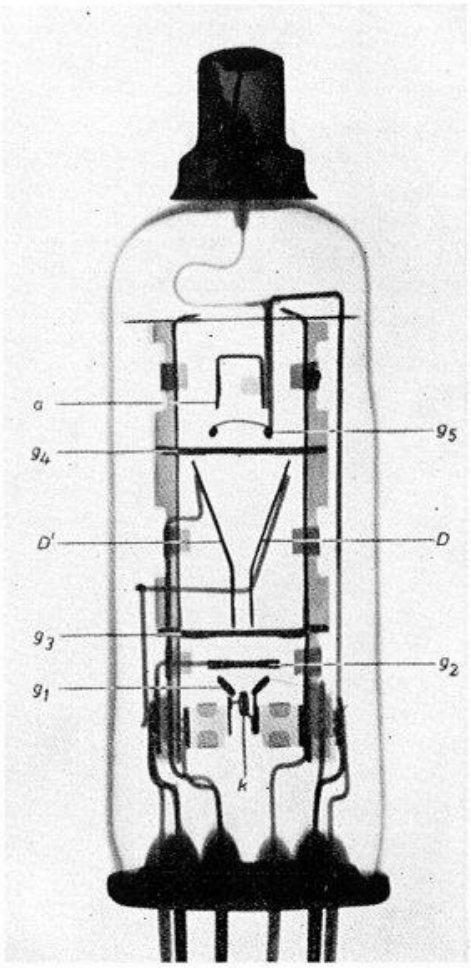

Fig. 2. Radiograph of an E80T tube.

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Conditions (1) and (3) imply that the slot must be wider than the width of the beam, but in order to satisfy condition (2), it should only slightly exceed this width.

ANODE SPACE

A suppressor grid g_5 is located between g_4 and the anode a. This suppressor grid is connected to the cathode and is given such a form that the risk of electrons being unable to pass the plane of g_5 is minimized, notwithstanding the fact that the beam enters a diverging field after having passed the slot of g_4. The anode is, moreover, made so wide that all electrons of the beam passing through the slot of g_4 must impinge on this electrode, and it is U-shaped so that secondary electrons released by the anode are nevertheless captured.

CONSTRUCTION

The E80T is constructed in the Noval technique and the tube is able to withstand mechanical shocks up to 500 g. The cathode is therefore mounted in the lower part of the envelope perpendicular to its axis. A ruggedized construction has been obtained by clamping the mica insulators between the vertically mounted plates, which also serve for the screening. The system is mounted on the stem by means of four rigid connectors and, moreover, it is supported in the envelope by an additional mica plate.

Since the cathode and g_1 are located near the base, their connections can be kept extremely short, which is of importance, since the signal applied to g_1 is usually of very high frequency.

Various requirements in regard to the interelectrode capacitances, and the fairly high voltages that must be applied to the deflection plates, have also been taken into account. These requirements are:

1) The capacitance of g_1 to all other elements should be small, so that the voltage generated by a controlled oscillator, which may have a very high frequency, can be applied to this electrode.
2) The interelectrode capacitance C_{g1g2} should be small to avoid harmonics of a high gating voltage applied to g_2 being induced on g_1.
3) The restriction of the interelectrode capacitance between the deflection plates and g_1 is also important. The deflection plates are very effectively screened, and by suitable choice of the connections (g_1 to pin 2 and the deflection plates to pins 7 and 9 - see fig. 1), this capacitance has been kept extremely small.
4) It would be very harmful if voltages were induced from the deflection plates on the anode, because a high impedance is often included in the anode circuit. For this reason the anode is connected to a terminal at the top of the envelope, so that the capacitance of the deflection plates to the anode is minimized. Neutralization is greatly facilitated in the case of symmetrical deflection by the fact that the capacitances of the two deflection plates to the anode are almost equal.
5) The duration of the anode current impulse should as a rule be extremely short. This is achieved by applying a fairly high deflection voltage. To avoid flashovers even under unfavourable atmospheric conditions, pin 8 is left unconnected, the deflection plate D being connected to the last pin, 9.

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