

NUMERICAL INDICATOR TUBES

ZM1230
ZM1232

QUICK REFERENCE DATA

Cold cathode, neon filled, side viewing indicator tubes with long life expectancy. The ZM1230 is coated with a red filter to improve contrast of display. These tubes are similar to ZM1170, ZM1172 but are inverted with leads mounted at the top.

Numeral height	15.5	mm
	0.6	in
Minimum distance between mounting centres	19	mm
	0.75	in
Numerals	1 2 3 4 5 6 7 8 9 0	
Cathode current	2.5	mA
Minimum supply voltage	170	V

CHARACTERISTICS AND OPERATING CONDITIONS (Measured at 20 to 50°C)

Minimum anode-to-cathode voltage necessary for ignition	170	V
Ignition delay time	See page 4	
Anode-to-cathode maintaining voltage	See page 5	
Anode-to-cathode voltage below which all tubes will extinguish	115	
Cathode current		
Maximum peak	12	mA
Maximum average (averaged over any 10ms) (see note 1)	3.5	mA
Minimum average (averaged over any 10ms) (see note 1)	0.8	mA
Minimum average (averaged over any conduction period) (see note 1)	1.5	mA
Recommended average (during any d.c. conduction period)	2.5	mA
Probe current		
Probe current to individual non-conducting cathodes (I_{kk})	See pages 6 and 11	
Probe current to combined non-conducting cathodes (ΣI_{kk})	See pages 7, 11 and 12	

D.C. operation

See pages 5 to 10

Pulse operation

Minimum pulse duration	100	μ s
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See pages 5, 11, 12 and 13

LIFE EXPECTANCY at recommended operating conditions and room temperature (see note 2)

Continuous display of one numeral	> 5000	h
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Sequentially changing the display from one numeral to another, every 100 hours or less	> 30 000	h
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RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Cathode current (each digit)

Maximum average (averaged over any 10ms)	3.5	mA
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Maximum peak	12	mA
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Minimum average (averaged over any conduction period)	1.5	mA
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Bulb temperature

Maximum	+70	$^{\circ}$ C
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Minimum (see note 2)	-50	$^{\circ}$ C
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MOUNTING POSITION

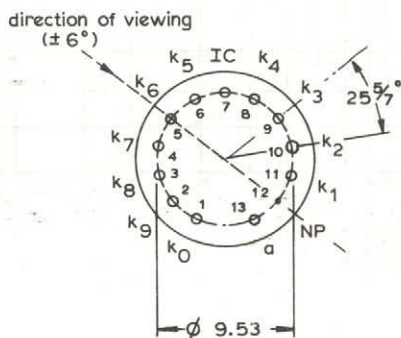
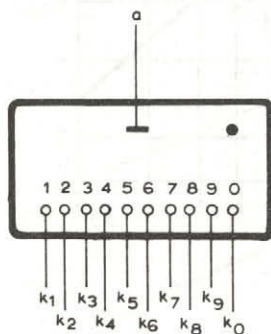
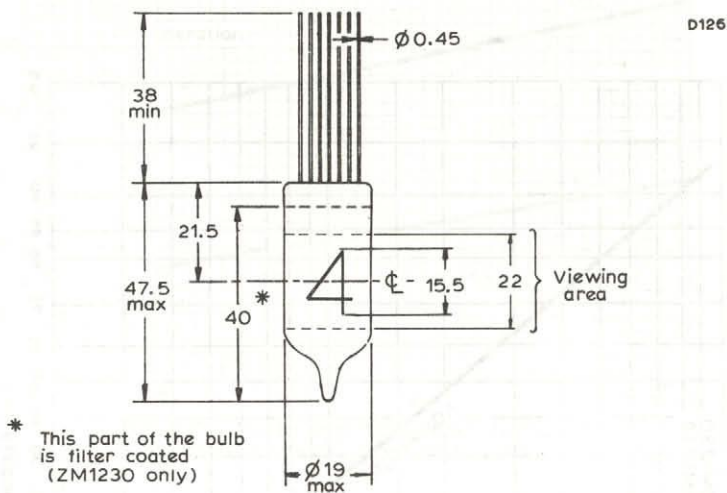
Any. The numerals are viewed through the side of the envelope. The numerals will appear upright (within $\pm 3^{\circ}$) when the tube is mounted vertically, base up.

OPERATING NOTES

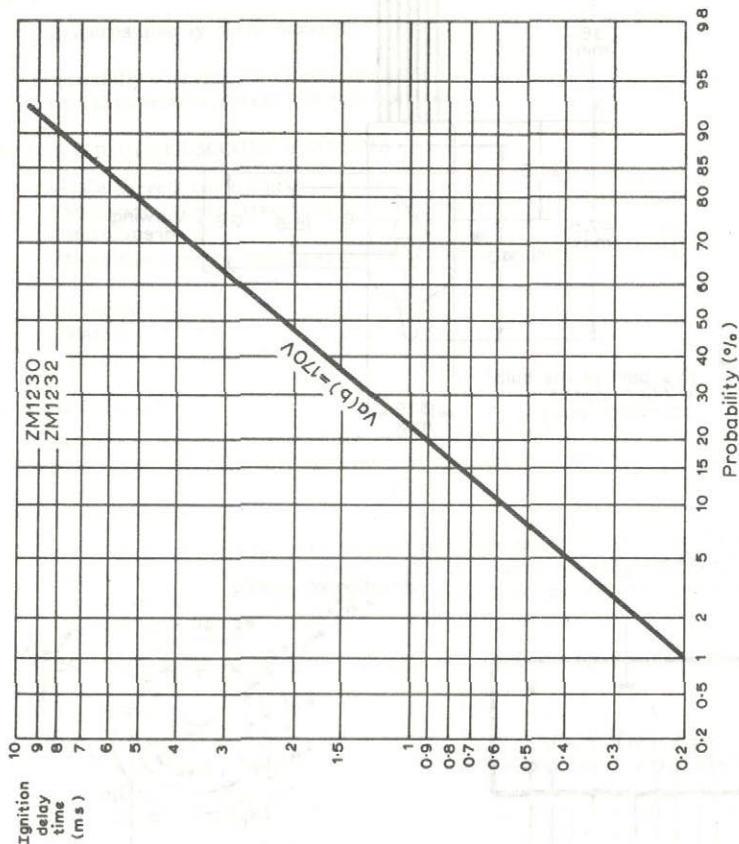
1. The minimum average current (averaged over any 10ms) of 0.8mA is necessary for adequate light output without flicker in applications other than d.c. The minimum average current (averaged over any conduction period) of 1.5mA is necessary to ensure complete cathode coverage initially and throughout life.
2. For bulb temperatures below 0° C the life expectancy of the tube is substantially reduced.
3. The tube may be soldered directly into the circuit, but heat conduction to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt.
4. The leads are tinned and may be dip-soldered to a minimum of 5mm from the seals at a solder temperature of 240° C for a maximum of 10 seconds.
5. Care should be taken not to bend the leads nearer than 1.5mm from the seals.



OUTLINE AND DIMENSIONS



All dimensions in mm



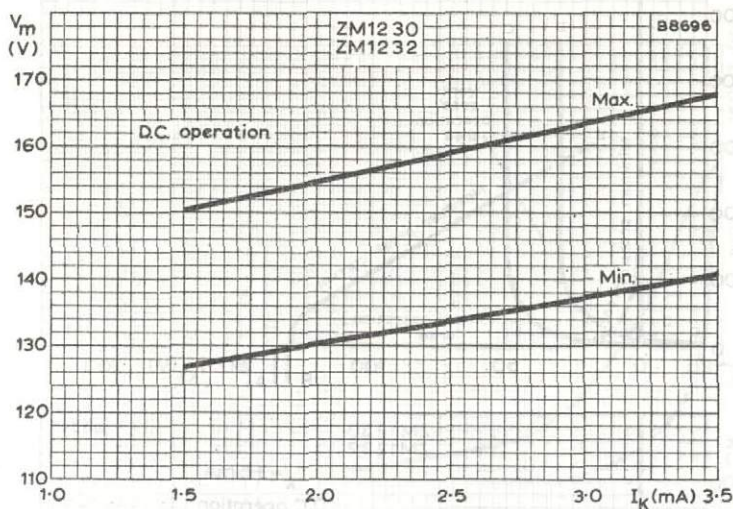
CUMULATIVE DISTRIBUTION OF IGNITION DELAY TIME

This curve shows the probability that a tube will ignite in less than the time shown after a non-conduction period of a few seconds. The ignition delay time will be appreciably reduced when the interval between conduction periods is less than 100 milliseconds. In general, an increase in the supply voltage will reduce the ignition delay time.

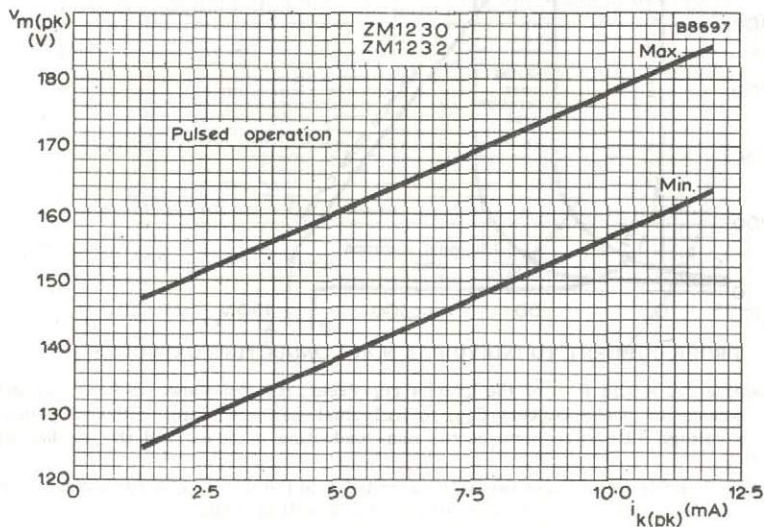


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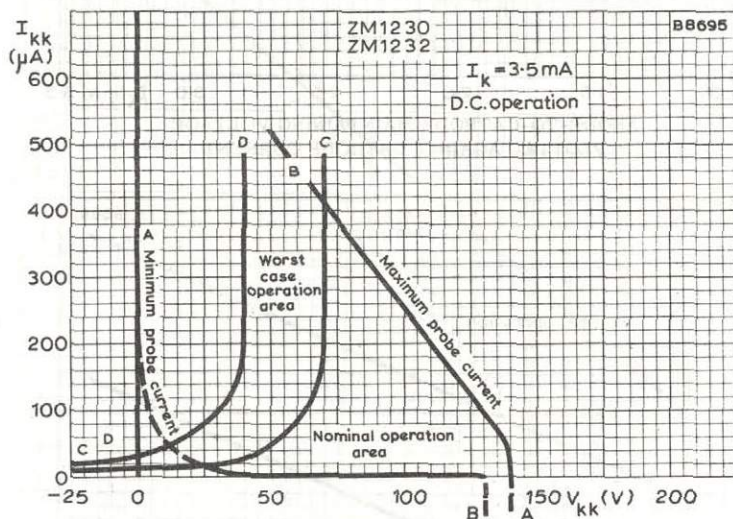
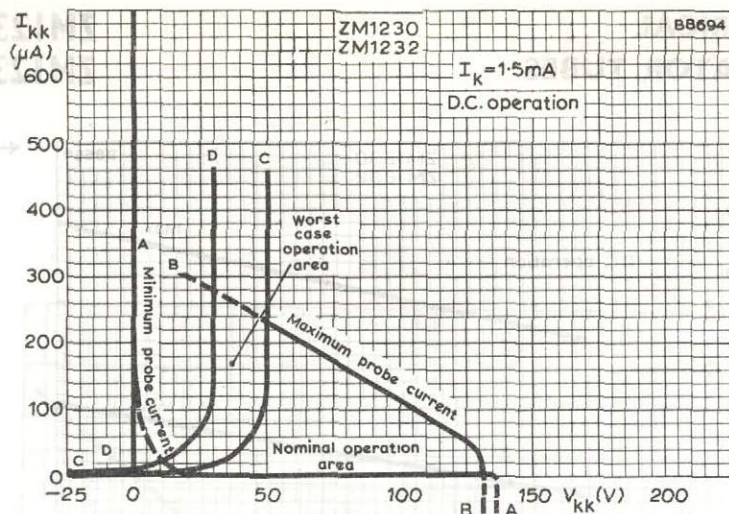


ANODE-TO-CATHODE MAINTAINING VOLTAGE
PLOTTED AGAINST CATHODE CURRENT



PEAK ANODE-TO-CATHODE MAINTAINING VOLTAGE
PLOTTED AGAINST PEAK CATHODE CURRENT



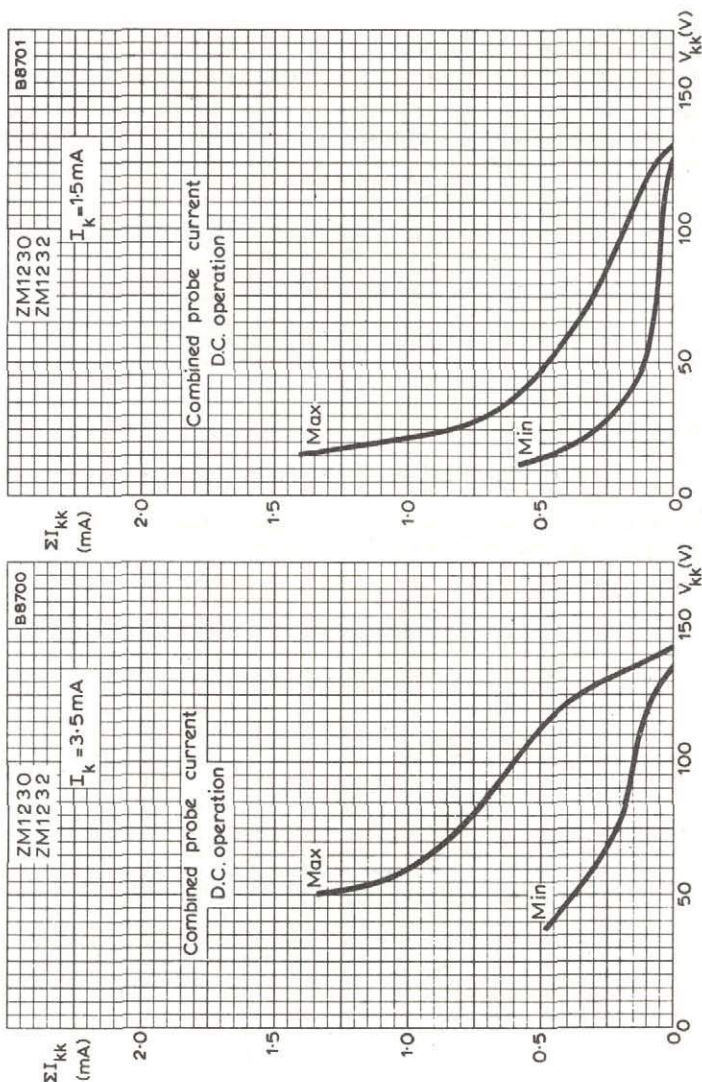


PROBE CURRENT TO INDIVIDUAL NON-CONDUCTING CATHODES

The boundaries A-A and B-B of the graphs represent, for the shown cathode current range, the range of probe current (I_{kk}) to individual non-conducting cathodes plotted against the voltage difference between the non-conducting cathodes and the conducting cathode (V_{kk}).

For low cathode selecting voltages (V_{kk}) the current I_{kk} to the non-conducting cathode will increase, and the readability of the conducting cathode will be affected.

It is therefore recommended to use a nominal operating point to the right of line C-C. Under the worst operating conditions the operating point should never reach the area left of the line D-D.



COMBINED PROBE CURRENT TO ALL NON-CONDUCTING CATHODES

Sum of the probe currents to the non-conducting cathodes (ΣI_{kk}) plotted against the voltage difference between the non-conducting cathodes and the conducting cathode (V_{kk}), showing the minimum and maximum values of probe current for a particular cathode current (I_k).

SUPPLY VOLTAGE/LOAD RESISTOR

The graphs on pages 9, 10 and 13 give the relationship between the anode supply voltage and the required anode load resistor for fixed values of V_{kk} (voltage difference between conducting cathode and non-conducting cathodes).

Each graph is plotted on log-log graph paper; therefore a given tolerance expressed as a percentage can be represented as a fixed length at any point on the x and y axes. This is shown on the first graph by taking points on each axis with a fixed tolerance.

Examples are shown on the first graph of the supply voltages and load resistors with tolerances expressed as a percentage so as to remain within the recommended operating region.

The curves are derived from:-

$$V_s = I_a \cdot R_a + V_m$$

$$I_a = I_k + \Sigma I_{kk}$$

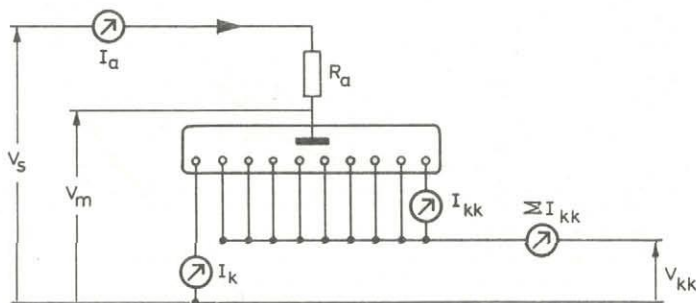
$$V_s = (I_k + \Sigma I_{kk}) R_a + V_m$$

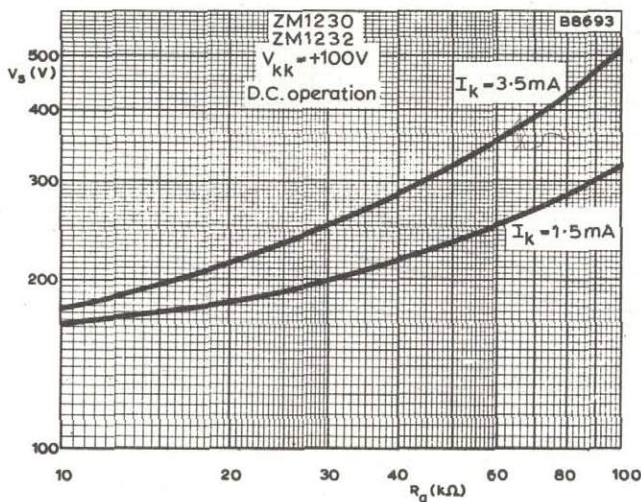
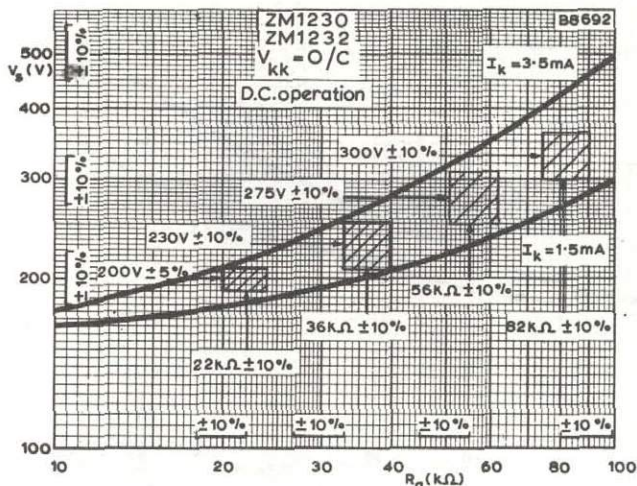
For a given value of R_a , the minimum supply voltage limit to ensure that the cathode current exceeds I_k min. is given by:

$$V_s \text{ min.} = \left[I_k \text{ min.} + \Sigma I_{kk} \text{ max. (at } I_k \text{ min.)} \right] R_a + V_m \text{ max. (at } I_k \text{ min.)}$$

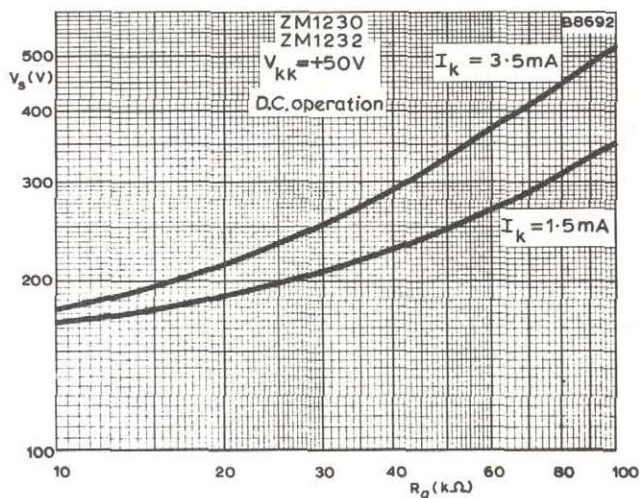
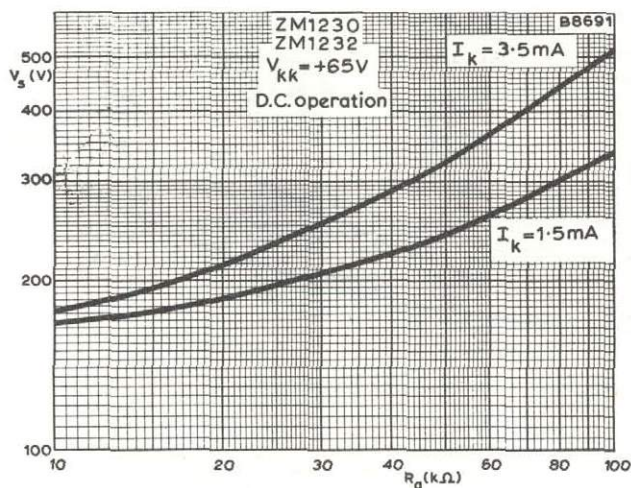
For the same value of R_a , the maximum supply voltage limit to ensure that the cathode current does not exceed I_k max. is given by:

$$V_s \text{ max.} = \left[I_k \text{ max.} + \Sigma I_{kk} \text{ min. (at } I_k \text{ max.)} \right] R_a + V_m \text{ min. (at } I_k \text{ max.)}$$



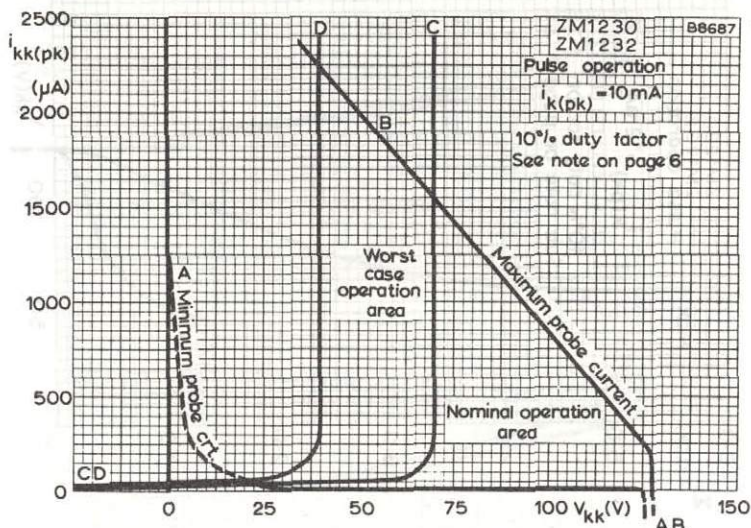


D.C. SUPPLY VOLTAGE PLOTTED AGAINST ANODE LOAD RESISTOR

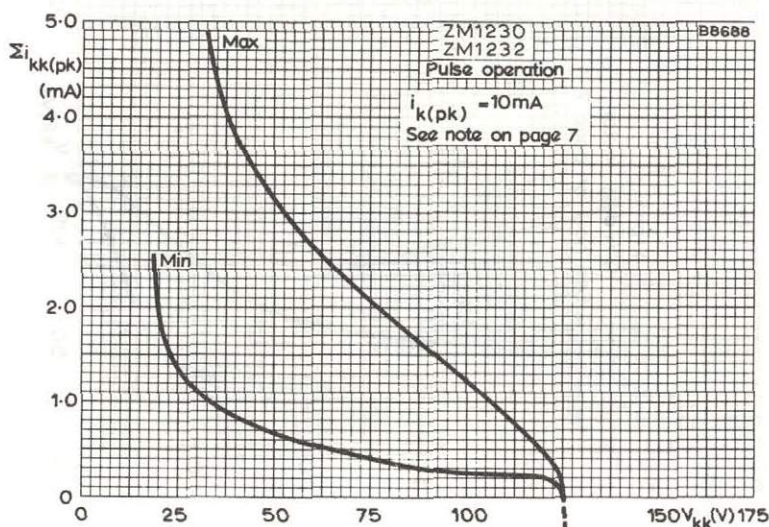


D.C. SUPPLY VOLTAGE PLOTTED AGAINST ANODE LOAD RESISTOR



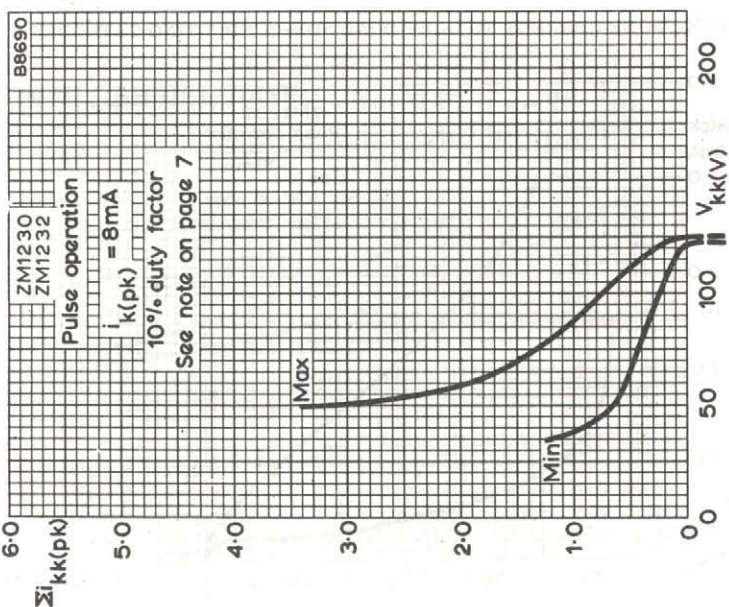


PEAK PROBE CURRENT TO INDIVIDUAL NON-CONDUCTING CATHODES



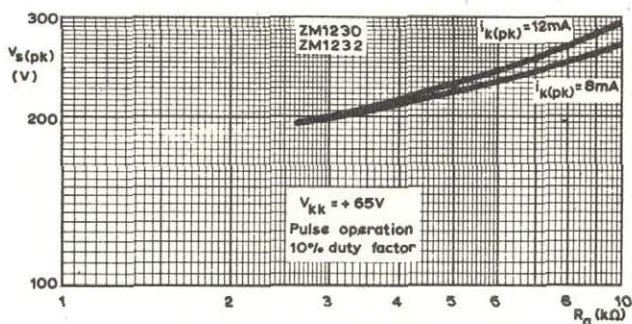
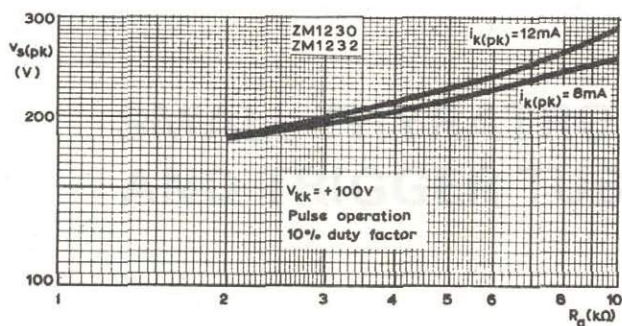
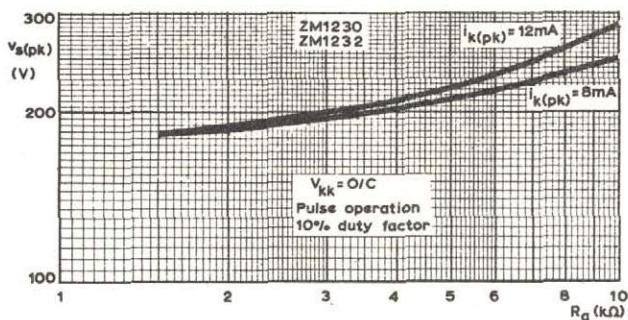
COMBINED PEAK PROBE CURRENT TO ALL NON-CONDUCTING CATHODES





COMBINED PEAK PROBE CURRENT TO ALL NON-CONDUCTING CATHODES





PEAK SUPPLY VOLTAGE PLOTTED AGAINST ANODE LOAD RESISTOR

