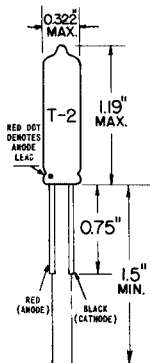


**TUNG-SOL**

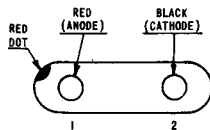
VOLTAGE REGULATOR



**GLASS BULB**

COLD CATHODE

ANY MOUNTING POSITION



**BOTTOM VIEW**

FLAT PRESS WITH 2 FLYING LEADS

THE 7099 IS A LOW CURRENT, TWO ELEMENT, INERT-GAS-FILLED, COLD CATHODE, VOLTAGE REGULATOR TUBE. THE TUBE COVERS A RANGE NOT ADEQUATELY HANDLED BY OTHER VR TUBES OR BY ZENER DIODES. IT HAS A MAINTAINING VOLTAGE OF APPROXIMATELY 155 VOLTS OVER A CURRENT RANGE FROM 0.075 TO 0.300 MILLI-AMPERES.

THE 7099 PROVIDES A HIGH DEGREE OF STABILITY AND VOLTAGE REPEATABILITY OVER ITS OPERATING TEMPERATURE RANGE. IT IS ESPECIALLY SUITED FOR SERVICE IN APPLICATIONS WHICH REQUIRE LONG LIFE, AND MINIMUM SIZE AND WEIGHT. ITS FLYING LEADS CAN BE SOLDERED DIRECTLY INTO A CIRCUIT OR CAN BE CLIPPED TO ONE-QUARTER INCH FOR INSERTION IN A STANDARD SUBMINIATURE SOCKET.

**ELECTRICAL DATA**

CATHODE

COLD

**MECHANICAL DATA**

MOUNTING POSITION	ANY	
LENGTH - OVERALL	SEE OUTLINE DRAWING	
DIAMETER (MAX.)	0.322	INCH
WEIGHT - APPROXIMATE	0.16	OUNCE
BULB	T-2	
BASE	FLAT PRESS WITH 2 FLYING LEADS	

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**TUNG-SOL**

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**RATINGS**  
ABSOLUTE VALUES

MAXIMUM DC CATHODE CURRENT	0.300	MA.
MINIMUM DC CATHODE CURRENT	0.075	MA.
BULB TEMPERATURE (MAX.)	100	°C
AMBIENT TEMPERATURE (MIN.)	-55	°C
ALTITUDE (MAX.)	60 000	FEET

**CIRCUIT VALUES**

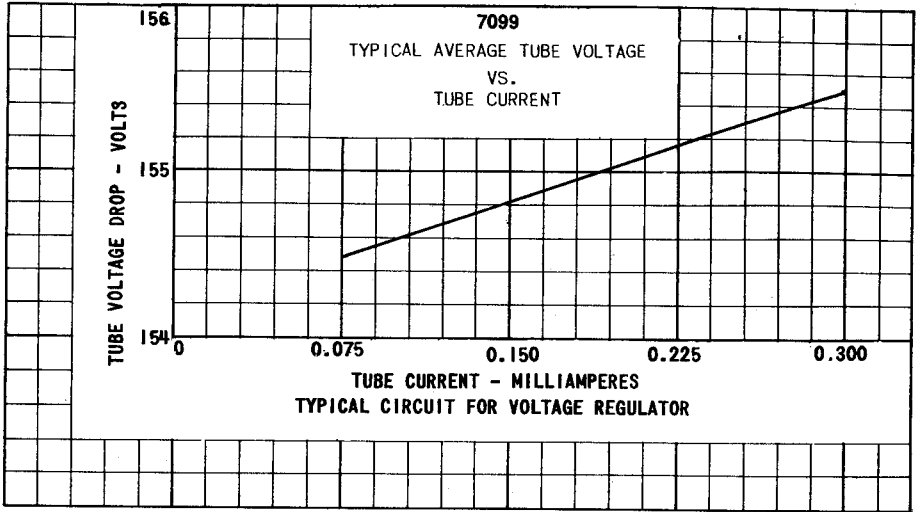
SHUNT CAPACITOR (MAX.)	0.1	μf
SERIES RESISTOR	SEE APPLICATION NOTES	

**EQUIPMENT DESIGN AND RANGE VALUES**

	MIN.	BOGEY	MAX.	
DC ANODE SUPPLY VOLTAGE	225 <sup>A</sup>	---	---	VOLTS
ANODE BREAKDOWN VOLTAGE	---	180	200	VOLTS
TUBE VOLTAGE DROP AT 0.075 MA.	152	155.0	---	VOLTS
TUBE VOLTAGE DROP AT 0.3 MA.	---	155.5	162	VOLTS
REGULATION - 0.075 THROUGH 0.150 MA.	---	0.4	2.5	VOLTS
REGULATION - 0.150 THROUGH 0.300 MA.	---	0.6	4.0	VOLTS
LEAKAGE CURRENT AT - 100 VOLTS	---	---	2	μAMP.

<sup>A</sup> IN ORDER TO ASSURE STARTING THROUGHOUT LIFE OF TUBE, NOT LESS THAN THE SPECIFIED SUPPLY VOLTAGE SHOULD BE PROVIDED.

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**OPERATING NOTES**

IN THE OPERATION OF A GLOW TUBE THERE ARE SEVERAL REQUIREMENTS WHICH MUST ALWAYS BE MET. THE FIRST IS THAT THE SUPPLY VOLTAGE MUST ALWAYS BE GREATER THAN THE ANODE BREAKDOWN VOLTAGE AND THE SECOND IS THAT SUFFICIENT RESISTANCE MUST ALWAYS BE PUT IN SERIES WITH THE TUBE IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM AND MAXIMUM VALUES GIVEN IN THE RATINGS.

IN ORDER TO ILLUSTRATE HOW TO CALCULATE THE VALUE OF THE SERIES RESISTANCE A TYPICAL REGULATOR CIRCUIT IS SHOWN IN FIGURE 1.

FROM FIGURE 1 WE SEE THAT  $E_{BB}$  IS THE UNREGULATED SUPPLY VOLTAGE,  $E_L$  IS THE TUBE VOLTAGE DROP OR THE REGULATED VOLTAGE SUPPLIED TO THE LOAD,  $R$  IS THE SERIES LIMITING RESISTOR,  $R_L$  IS THE VARIABLE LOAD,  $I_T$  IS THE TUBE CURRENT AND  $I_L$  IS THE LOAD CURRENT.

WE SEE THAT THE TUBE CURRENT WILL BE A MAXIMUM WHEN THE SUPPLY VOLTAGE IS A MAXIMUM ( $E_{BB \text{ MAX.}}$ ); WHEN THE LOAD CURRENT IS A MINIMUM ( $I_L \text{ MIN.}$ ); AND WHEN THE TUBE VOLTAGE DROP IS A MINIMUM ( $E_L \text{ MIN.}$ ). THEREFORE THE CONDITIONS WHICH DETERMINE THE LOWER LIMIT FOR THE SERIES RESISTANCE  $R_1$  ARE THAT

$$R > \frac{E_{BB \text{ MAX.}} - E_L \text{ MIN.}}{I_T \text{ MAX.} + I_L \text{ MIN.}}$$

IN A LIKE MANNER IT CAN BE SHOWN THAT THE VALUE OF  $R$  IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM VALUE REQUIRES THAT

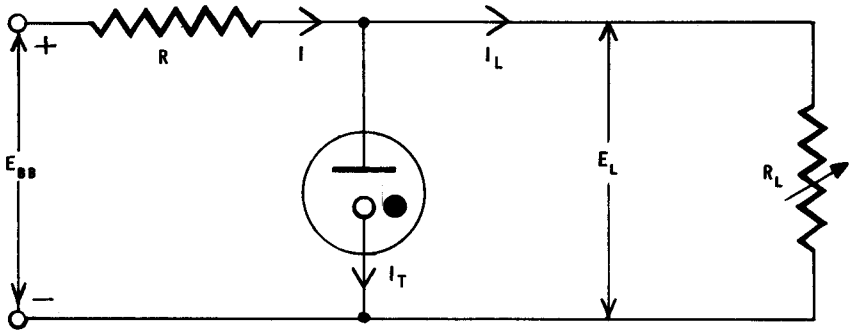
$$R < \frac{E_{BB \text{ MIN.}} - E_L \text{ MAX.}}{I_T \text{ MIN.} + I_L \text{ MAX.}}$$

WHEN THESE VALUES HAVE BEEN COMPUTED, ONE SHOULD CHECK TO SEE IF THERE IS SUFFICIENT STARTING VOLTAGE BY THE FOLLOWING RELATION

$$E_{BB \text{ MIN.}} \frac{R_L}{R + R_L} > E \text{ STARTING}$$

## TUNG-SOL

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TYPICAL CIRCUIT FOR VOLTAGE REGULATOR

FIGURE 1

WHEN THESE CALCULATIONS HAVE BEEN MADE AND THERE IS INSUFFICIENT STARTING VOLTAGE, A NEW LOAD CURRENT OF LOWER VALUE MUST BE USED AND THE CALCULATIONS REPEATED.

WHERE THE REGULATOR TUBE IS SHUNTED BY A CAPACITOR, THE VALUE OF SUCH CAPACITOR SHOULD BE LIMITED TO  $0.1 \mu f$  AS A LARGER VALUE MIGHT CAUSE OSCILLATION.

OPERATION OF TWO TUBES IN PARALLEL TO INCREASE THE CURRENT RATING IS NOT RECOMMENDED UNLESS A RESISTANCE OF APPROXIMATELY 100 OHMS IS USED IN SERIES WITH EACH TUBE TO EQUALIZE THE DIVISION OF CURRENT. IT SHOULD BE NOTED THAT PARALLEL OPERATION REDUCES THE REGULATION THAT CAN BE OBTAINED.

HIGHER REGULATED VOLTAGES CAN BE OBTAINED BY CONNECTING TWO TUBES IN SERIES AS SHOWN IN FIGURE 2. HOWEVER, CARE SHOULD BE EXERCISED TO MAKE CERTAIN THAT SUFFICIENT SUPPLY VOLTAGE IS AVAILABLE TO START BOTH TUBES. THIS CAN BE ACCOMPLISHED BY SHUNTING THE LOWER TUBE WITH A HIGH RESISTANCE.

**TUNG-SOL**

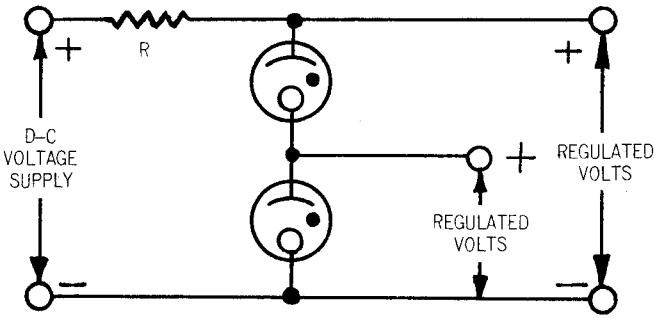
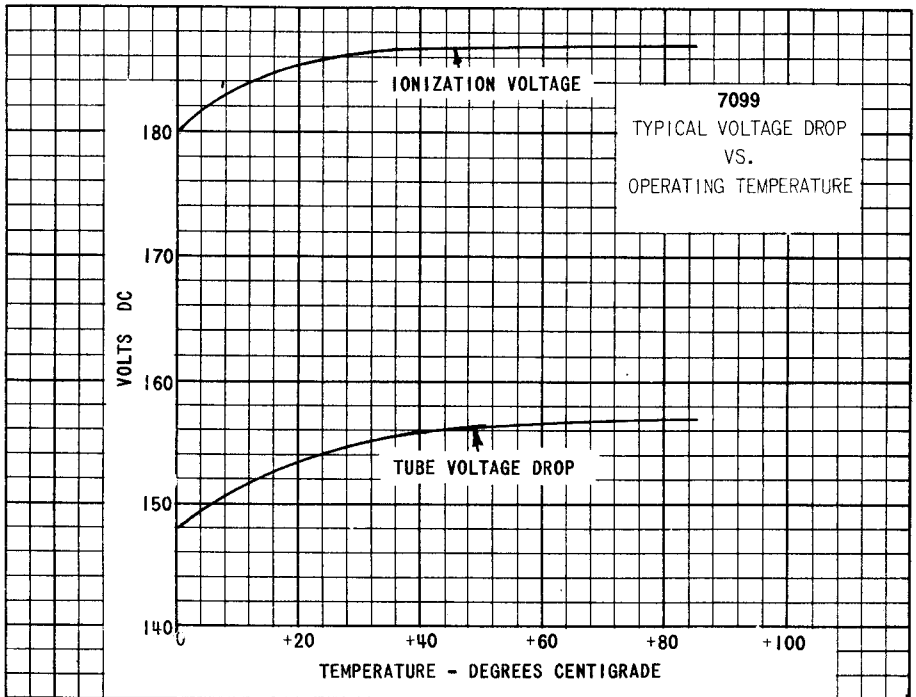


FIGURE 2. OPERATION OF REGULATOR TUBES IN SERIES



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