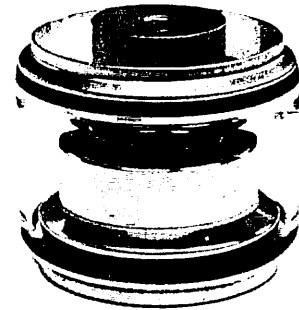




T E N T A T I V E

The YU-113 planar triode has been specifically designed for high voltage series regulator or switch tube (modulator) service. The compact, rugged design has very low internal inductance and capacitance to improve rise and fall times for very short pulse applications. The tube can be mounted in various operating positions and is capable of enduring substantial vibration and shock.



GENERAL CHARACTERISTICS<sup>1</sup>

ELECTRICAL

Cathode: Dispenser

Heater Voltage . . . . .	6.3 ± 2% Volts
Heater Current . . . . .	8.4 Amperes
Cathode Heating Time . . . . .	300 Sec
Amplification Factor (Average) . . . . .	750
(Cut-off) <sup>2</sup> . . . . .	450

Direct Interelectrode Capacitance<sup>3</sup> (Grounded Cathode):

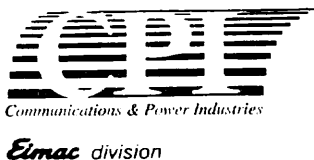
Cin . . . . .	22 pF
Cout . . . . .	0.03 pF
Cgp . . . . .	5.5 pF

<sup>1</sup>Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian Power Grid and X-Ray Tube Products should be consulted before using this information in final equipment design.

<sup>2</sup>Measured with one milliamp plate current and 1 kVdc plate voltage.

<sup>3</sup>Capacitance values are for a cold tube. When the cathode is heated to the proper temperature, the grid/cathode capacitance will increase from the cold value by approximately 4 pF due to thermal expansion of the cathode.

(Effective October 28, 1991)



301 Industrial Way  
San Carlos, CA 94070-2582  
(650) 592-1221



**RANGE VALUES FOR EQUIPMENT DESIGN**

	<u>Min.</u>	<u>Max.</u>	
Heater Current at 6.3 Volts . . . . .	7.5	9.0	Amperes
Heater Surge Current . . . . .		15	Amperes
Cathode Warm-up Time . . . . .	300	---	Sec

Interelectrode Capacitance<sup>1</sup> (Grounded Cathode Connection):

Cin . . . . .	---	28	pF
Cout . . . . .	---	0.05	pF
Cgp . . . . .	---	8.0	pF

**ENVIRONMENTAL:**

Shock, 11 ms, non-operating . . . . .	60	G
Vibration, operating, all axes, 55 to 500 Hz . . . . .	10	G

**PULSE MODULATOR & PULSE AMPLIFIER SERVICE**

ABSOLUTE MAXIMUM RATINGS (Refer to notes on next page):

DC Plate Voltage . . . . .	55	kV <sup>2</sup>
Peak Plate Voltage . . . . .	60	kV <sup>2</sup>
DC Control Grid Voltage . . . . .	-150	Volts
Pulse Duration <sup>4</sup> . . . . .	100.0	us
Duty <sup>4</sup> . . . . .	0.01	

**INSTANTANEOUS GRID TO CATHODE VOLTAGE:**

Control Grid Negative . . . . .	- 500	Volts
Control Grid Positive . . . . .	150	Volts
Pulse Cathode Current . . . . .	15	Amperes
DC Plate Current . . . . .	600	Milliamperes
DC Control Grid Current . . . . .	45	Milliamperes

**AVERAGE DISSIPATION:**

Plate Dissipation:		
(with Conduction & Convection Cooling) . . . . .	250	Watts <sup>3</sup>
Control Grid Dissipation . . . . .	2.0	Watts

**MECHANICAL**

**Maximum Overall Dimensions:**

Length . . . . .	2.685 in; 68.20 mm
Diameter . . . . .	3.050 in; 77.47 mm
Net Weight . . . . .	20 oz; 567 gms
Operating Position . . . . .	Any <sup>5</sup>

**Maximum Operating Temperature:**

Ceramic/Metal Seals . . . . .	90°C <sup>6</sup>
Anode Core . . . . .	90°C
Cooling . . . . .	Conduction & convection, in dielectric fluid, with appropriate heat sink.

YU-113

<sup>1</sup>Capacitance values are for a cold tube.

<sup>2</sup>The plate voltage ratings are in oil.

<sup>3</sup>Using the tube with special heat sink or cooling arrangement, the anode dissipation with forced oil is 1000 W max.; radiator part number 171324.

<sup>4</sup>For applications requiring longer pulse duration and/or higher duty cycle, consult Varian Power Grid and X-Ray Tube Products, 1678 South Pioneer Road, Salt Lake City, Utah, (801) 972-5000.

<sup>5</sup>With anode up, forced liquid cooling on the cathode is necessary. Preferred mounting position in liquid is horizontal or anode down. Depending on plate dissipation experienced and the cooling media used, liquid cooling and/or a preferred mounting position is required.

<sup>6</sup>The maximum operating temperature is for standard transformer oil. If another insulating media with higher boiling temperatures or air cooling is used where voltage requirements permit, higher temperatures are possible to a maximum of 200°C.

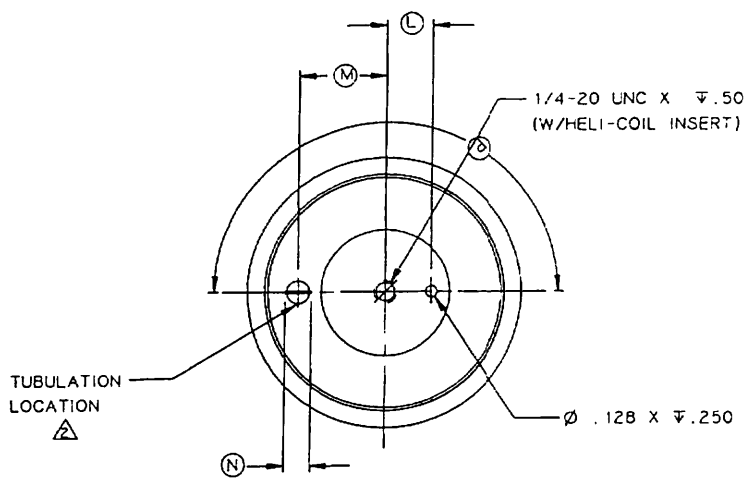
## APPLICATION

### MECHANICAL

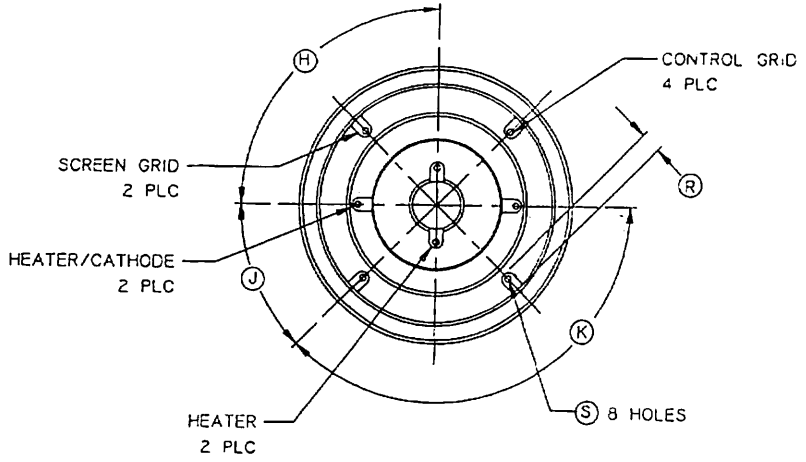
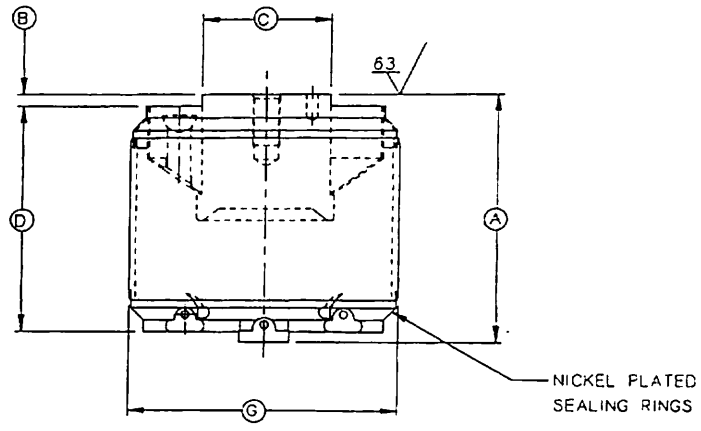
**MOUNTING** - This tube can be mounted in any position. However, in some applications certain mounting positions may be preferred. Usually, the best mounting position is horizontal. This orientation provides the optimal natural convective cooling of both the cathode and the anode.

Depending on the plate dissipation, another mounting position may be selected. For example, with a plate dissipation of less than 250 watts the tube can be mounted with the anode down. With a plate dissipation of between 250 to 500 watts, the radiator (part number 171324) can be used with natural convection in a vertical orientation. With the anode up, forced liquid cooling of the cathode and heater flanges is required. For plate dissipation between 500 and 1000 watts, forced cooling is necessary so horizontal mounting is again the preferred orientation. When the tube is used in an application where high shock and vibration are encountered, the tube must be securely mounted by the anode. Clamping to any other tube surface may break the seals between the insulator and the metal envelope.

DIMENSIONAL DATA						
INCHES				MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
QUALITY CONFORMANCE INSPECTION: PART 2						
A	2.385	2.585		60.58	68.20	
B	.110	.190		.79	4.83	
C	1.350	1.450		34.29	36.83	
D	2.335	2.535		59.31	64.39	
G	2.970	3.030		75.44	76.96	
H	80°	100°		80°	100°	
J	35°	55°		35°	55°	
K	125°	145°		125°	145°	
L	.450	.550		11.43	13.97	
M	.900	1.110		22.86	28.19	
N	.300	.400		7.62	10.16	
P	90°	270°		90°	270°	
R	.075	.150		1.91	3.81	
S	.075	.100		1.91	2.54	



- NOTES:
1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
  2. TUBULATION MAY NOT EXTEND BEYOND ANODE AFTER NIP-OFF.



YU113

LT#	DESCRIPTION OF CHANGE	SCO	DATE	BY	PART NO.	DATE
E	REDRAWN ON CAD \ DIFFERENTIATE DIMENSIONS INTO PART 2		248909/03/98	SM/JH	YU113	
F	2% QUALITY CHANGE LOCATION OF TABS ON SIDE VIEW TO MATCH BOTTOM VIEW AND CHANGE TOP VIEW TO MATCH SIDE VIEW		250428/01/98	SM/CB	YU113	

DRAWN S SINGH 09/03/98 CHECKED J HEROLD 02/04/28 ENGR APPR SUPERSEDES	SCALE: NONE FILE PATH: OUTLINE\YU113	This Document is the Property of Eimac and shall not be drawn, reproduced, used in the manufacture or sale of equipment or equipment components without written permission. DIV of CPI <b>ELECTRON TUBE</b> <b>YU113</b>
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This tube is supplied with the pinch-off tubulation exposed. Even though no problems occur during normal handling, care should be taken to prevent damage to the pinch-off during tube installation. For example, surfaces or set screws should never press against the knife edge, nor should other undue force be applied to the pinch-off.

**COOLING** - This tube was designed to permit high envelope temperatures, up to 200 degrees C. However, lower temperatures are required when operating in most liquids. If the tube is operated in a liquid all envelope surfaces must remain below the liquid's maximum operating temperature. As is the case with all components, long term reliability is enhanced when the tube is kept as cool as possible. In all new applications, the envelope temperature close to the ceramic/glass to metal seals should be monitored.

Temperature sensing paint or stickers are recommended. Monitoring heater and cathode flanges is important, especially when no auxiliary cooling, such as forced liquid cooling is used. Anode temperature measurements are also important, particularly when the tube is operated close to the maximum plate dissipation limit. Care in locating and attaching the sensors is important to get proper results.

Cooling can be achieved by conduction, forced air, natural liquid convection, forced liquid or a combination of these methods. When forced air cooling is used, air flow should be provided to the heater and cathode flanges as well as to the anode. With natural convection in liquid, sufficient space around the tube should be allowed to ensure adequate room for circulation. To cool the anode in liquid a radiator such as part number 171324 is recommended. With the anode up, forced liquid cooling of the cathode and heater flanges is required.

**GLASS IMPLOSION** - When handling a glass tube remember that glass is a relatively fragile material. Breaking the glass can cause an implosion, which will result in an explosive scattering of glass particles. Handle glass tubes carefully. Use of safety glasses, heavy clothing and leather gloves is recommended for protection.

#### ELECTRICAL

**X-RAY RADIATION HAZARD** - High vacuum tubes operating at voltages higher than 15 kV produce progressively more dangerous x-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential x-ray hazard. Only limited shielding is afforded by the tube envelope.

Moreover, the x-ray radiation level may increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of a tube operating at these voltages to provide adequate protection throughout the tube's life. The amount of shielding required will vary with tube usage and therefore is beyond Varian's control.

Periodic checks on the x-ray level should be made and the tube should never be operated without adequate shielding in place. Lead glass attenuates x-rays and is available for viewing windows. If there is any doubt as to the adequacy of shielding, an expert in this field should be contacted to perform an x-ray survey of the equipment.

Useful information on this subject can be found in Reports 33 and 39 of the National Council on Radiation Protection, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814; telephone (301) 657-2652.

Operation of high voltage equipment with interlock switches rendered inoperative and cabinet doors open in order to better locate an equipment malfunction can result in serious x-ray exposure.

The amount of x-ray radiation is dependent upon the particular tube operating conditions. When the YU-113 is tested per EIA TEPAC Publication #181, the maximum radiation measured 12 inches from the tube surface is 51.4 R/Min.

**ABSOLUTE MAXIMUM RATINGS** - The values for each type of service are based on the "absolute" system and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so the absolute values will never be exceeded under any conditions of supply voltage variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

**HIGH VOLTAGE** - Normal operating voltages used with this tube can be hazardous. The equipment must be designed properly and operating precautions followed. Design all equipment so no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or cheated to allow operation with access doors open. Always remember that **HIGH VOLTAGE CAN KILL**.

YU-113

**FAULT PROTECTION** - It is good practice to protect the tube from internal damage caused by an internal arc which may occur at high anode voltage. An electronic crowbar, which will discharge power supply capacitors in a few microseconds after initiation of an anode arc, is recommended.

**HEATER VOLTAGE** - One of the most important factors affecting tube life and ultimate performance is the heater voltage. The heater voltage value indicated under GENERAL CHARACTERISTICS/ELECTRICAL is the nominal value used when evaluating the tube during the manufacturing process.

Optimum heater voltage for a specific use may, or may not be, the same value. Due to the many possible applications, no general definition of optimum heater voltage can be given. Many applications require low heater voltage to assure the longest possible tube life.

When the heater of a planar triode is energized by a dc source, its useful life is always shorter than with equivalent ac operation. Heater life under dc conditions is extended by connecting the common heater/cathode terminal to the positive side of the heater supply.

The tube's initial cold heater resistance is such that damaging filament current in excess of 40 amps can occur without current limiting. When operated after the 300-second warm-up period, the heater current is within the noted range values. To eliminate possible damage to the tube, a maximum of 15 amps peak for 500 milliseconds is recommended. A commercial soft-start thermistor or equivalent current limiting device is recommended.

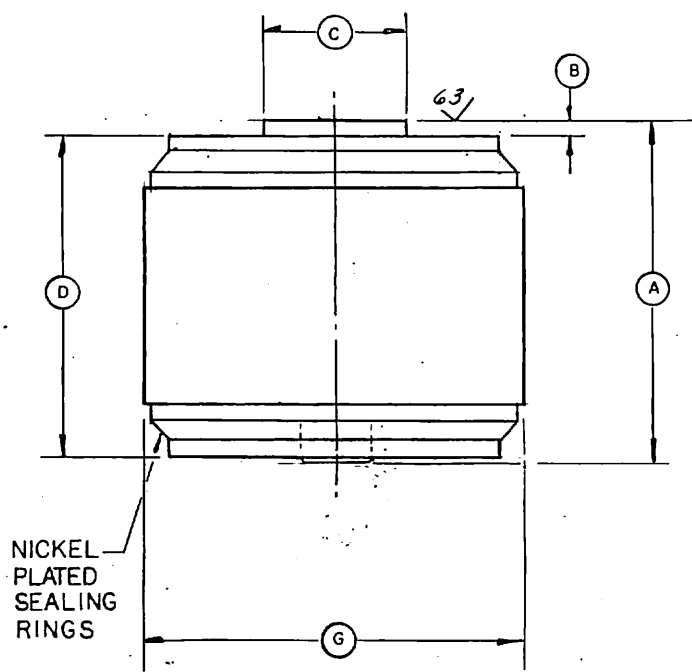
**HOT SURFACES** - When the tube is used in air and air cooled, external surfaces of the tube may reach temperatures up to 200 degrees C and higher. In addition to the anode, the cathode insulator and cathode/heater surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns, take care to avoid any bodily contact with these surfaces both during and for a reasonable cool down period after tube operation.

**RF RADIATION** - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. **CARDIAC PACEMAKERS MAY BE AFFECTED.**

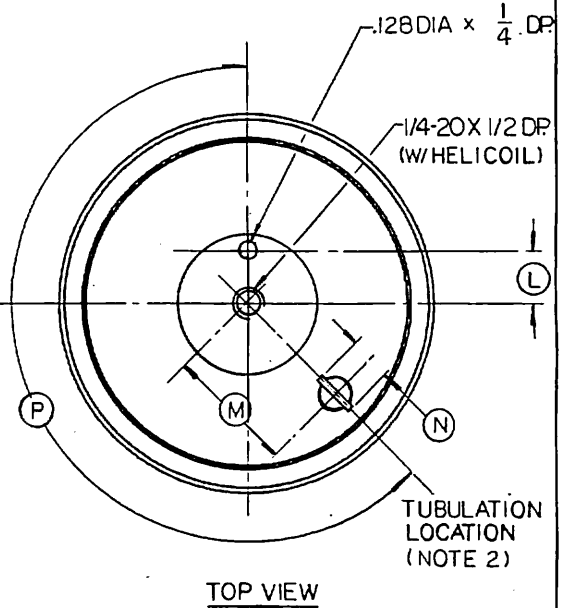
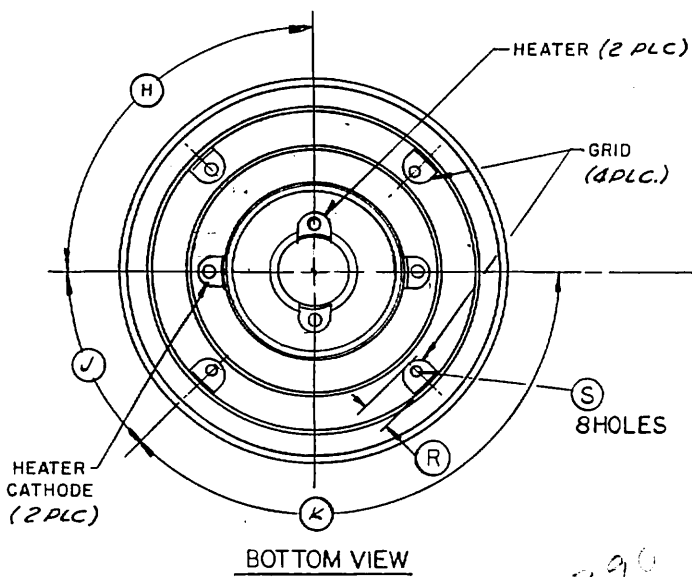
**SPECIAL APPLICATIONS** - If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, Varian, 1678 South Pioneer Road, Salt Lake City, UT 84104, telephone (801) 972-5000 for information and recommendations.



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A	2.385	2.685		60.58	68.20	
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290  
200

LTR	DESCRIPTION OF CHANGE	SCO	DATE	BY	
A	Ø.128 x 1/4 WAS 6-32 x 3/8 / X WAS 1.200 / 1.300	MR	8/5/85	BM	EIMAC, division of varian San Carlos, California CODE IDENT No. 08594 PART No. YU-113 OUTLINE ELECTRON TUBE No. YU-113
B	ADD NOTE 2 & W/HELICOIL / B' MIN. WAS .140	GH	7/3/86	BM	
C	RELOC. HTR CUP & DIM. 'A'	RS	1/28/87	BM	
D	ADD MILLIMETER DIMENSIONS	CA	10/5/90	DM/CA	
DRAWN: BM 3-16-85 ENGR APPR: Chris Artyg		SCALE: NONE			
CHK'D:		SUPERSEDES:		D	