TECHNICAL DATA

HIGH-MU WATER COOLED POWER TRIODE YU-191A

The EIMAC YU-191A is a ceramic/metal, water cooled, high-mu triode intended for use as an amplifier, oscillator, or modulator, or in voltage regulator applications. Its maximum rated anode dissipation is 7000 watts.

Operation with zero grid bias in many applications offers circuit simplicity by eliminating the bias supply. Grounded grid operation is attractive since a power gain of over 20 times can be obtained.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten
- Voltage ..... 7.5 ± 0.37 V
- Current @ 7.5 volts ..... 51.5 A

Amplification Factor, Average 160

Direct Interelectrode Capacitances (Grounded Filament)[2]
- Cin ..... 38.0 pF
- Cout ..... 0.6 pF
- Cgp ..... 24.0 pF

Direct Interelectrode Capacitances (Grounded Grid)[2]
- Cin ..... 38.0 pF
- Cout ..... 24.0 pF
- Cpk ..... 0.6 pF

Frequency of Maximum Ratings (CW) ..... 110 MHz

MECHANICAL

Maximum Overall Dimensions:
- Length ..... 10.4 in; 264 mm
- Width ..... 7.1 in; 180 mm

Net Weight ..... 5.5 lb; 2.5 kg

Operating Position ..... Vertical, Base Up or Down

Maximum Operating Temperature:
- Envelope and Ceramic/Metal Seals ..... 250°C

Cooling ..... Water

Base ..... Special Coaxial

[1] Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. CPI Eimac Division should be consulted before using this information for final equipment design.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE..... 5000 Volts
DC PLATE CURRENT. .....2.5 Amperes
PLATE DISSIPATION .....7000 Watts
GRID DISSIPATION . ..... 225 Watts

TYPICAL OPERATION:

Plate Voltage	4800	4800	4900	Vdc
Zero-Signal Plate Current[1]	0.35	0.35	0.36	Adc
Single -Tone Plate Current	1.68	2.00	2.25	Adc
Single-Tone Grid Current[2]	0.46	0.60	0.65	Adc
Driving Power[2]	293	410	535	Watts
Plate Dissipation	2275	2275	2275	Watts
Single-Tone Plate Output Power	6000	7266	8250	Watts
Resonant Load Impedance	1720	1425	1308	Ω
Driving Impedance	50.0	46.3	49.2	Ω

1. Bias voltage may be required.

2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE..... 5000 Volts
DC PLATE CURRENT..... 2.5 Amperes
PLATE DISSIPATION ..... 7000 Watts
GRID DISSIPATION .....225 Watts

TYPICAL OPERATION

Plate Voltage	4000	4900	Vdc
Zero-Signal Plate Current[1]	0.25	0.36	Adc
DC Plate Current	0.74	1.23	Adc
DC Grid Current[1]	0.13	0.17	Adc
Peak RF Grid Voltage[2]	85.0	125	Volts
Driving Power[2]	11.5	21.2	Watts
Plate Dissipation	1830	3840	Watts
Carrier Plate Output Power	1130	2200	Watts
Resonant Load Impedance	1750	1100	Ω

1. Bias voltage may be required.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER CATHODE DRIVEN

Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE.....5000 Volts
DC PLATE CURRENT..... 2.5 Amperes
PLATE DISSIPATION ..... 7000 Watts
GRID DISSIPATION..... 225 Watts

TYPICAL OPERATION

Plate Voltage	4900	Vdc
Grid Voltage	-50	Vdc
Plate Current	2.16	Adc
Grid Current[1]	0.61	Adc
Peak RF Cathode Voltage[1]	300	Volts
Calculated Driving Power[1]	691	Watts
Plate Dissipation	2315	Watts
Useful Output Power[2]	7500	Watts

1. Approximate value.
2. Output circuit and filter loss of 10% assumed.

NOTE: The equipment designer and user must assure that rated dissipation values are not exceeded. In continuous opertion (Class A) element dissipation is simply the product of voltage and current at the operating conditions. In pulsed operation the element dissipation is basically the product of voltage, current, and duty factor, though pulse shape and circuit conditions may effect actual dissipation values.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min	Max	
Filament Current @ 7.5 volts	48.0	54.0	A
Interelectrode Capacitances[1] (grounded filament connection)			
Cin	30.0	45.0	pF
Cout	---	1.0	pF
Cgp	20.0	28.0	pF
Interelectrode Capacitances[1] (grounded grid connection			
Cin	30.0	45.0	pF
Cout	20.0	28.0	pF
Cpk	---	1.0	pF
Zero Bias Plate Current (Eb = 5000 Volts)	0.36	0.52	A
Cut-off Bias (Eb = 5000 Volts, Ib = 1.0 mAdc	---	-45.0	V

[1]Capacitance values are for a cold tube as mounted in a shielded fixture.

APPLICATION

MECHANICAL

MOUNTING – The YU-191A must be mounted vertically, base down or up at the convenience of the circuit designer.

COOLING - The cooling data indicates the minimum flow and pressure drop across the tube required for varous levels of anode dissipation. The cooling water outlet temperature should not exceed 70°C.

Anode Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
2	0.9	1.3
4	1.3	2.5
6	2.0	4.7
7	2.4	5.9

The filament stem structure also requires forced air cooling. A minimum of 6 cfm should be directed into the space between the inner and outer filament contacting surfaces.

A major factor effecting long life of water cooled tubes is the condition of the cooling water. High purity water must be used to minimize power loss, corrosion of metal fittings, and loss of anode dissipation capability. Water resistivity must be maintained at 1 megohm/cm (at 25°C) or better for long term operation. EIMAC Application Bulletin #16 should be consulted for details on maintenance of water quality standards and use of a water purification loop in the installation. Since the anode is normally at high potential to ground, water connections to the anode are made through insulating tubing, with long enough sections that column resistance is above 4 megohms per 1000 plate supply volts, or 10 megohms total, whichever is less.

Both air and water flow must be supplied before or simultaneously with the application of electrode voltages, including the filament, and may be removed simultaneously with them. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

ELECTRICAL

FILAMENT OPERATION – The filament voltage, as measured at the filament terminals, should be 7.5 volts, with maximum allowable variations due to the line fluctuations of from 7.12 to 7.87 volts.

INTERLOCKS – An interlock device should be provided to ensure that cooling water and air flow is established before application of electrical power, including the heater. The circuit should be so arranged that RF drive cannot be applied in the absence of normal plate voltage.

INPUT CIRCUIT – When operated as a ground grid RF amplifier, the use of a matching network in the cathode circuit is recommended. For best results with a single ended amplifier, and depending on the application, it is suggested the cathode tuned circuit operate with a "Q" of 5 or more.

RADIO FREQUENCY RADIATION – Avoid exposure to strong RF fields even at relatively low frequency. Absorption of RF energy by human tissue is dependent on frequency. Under 30 MHz most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as these, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong RF field in the general proximity of the power tube and its associated circuitry – the more power involved the stronger the RF field. Proper enclosure design and efficient coupling of RF energy to the load will minimize the RF field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION – In addition to normal cooling flow interlock and plate over-current interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high plate voltage

In all cases some protective resistance, at least 10 ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

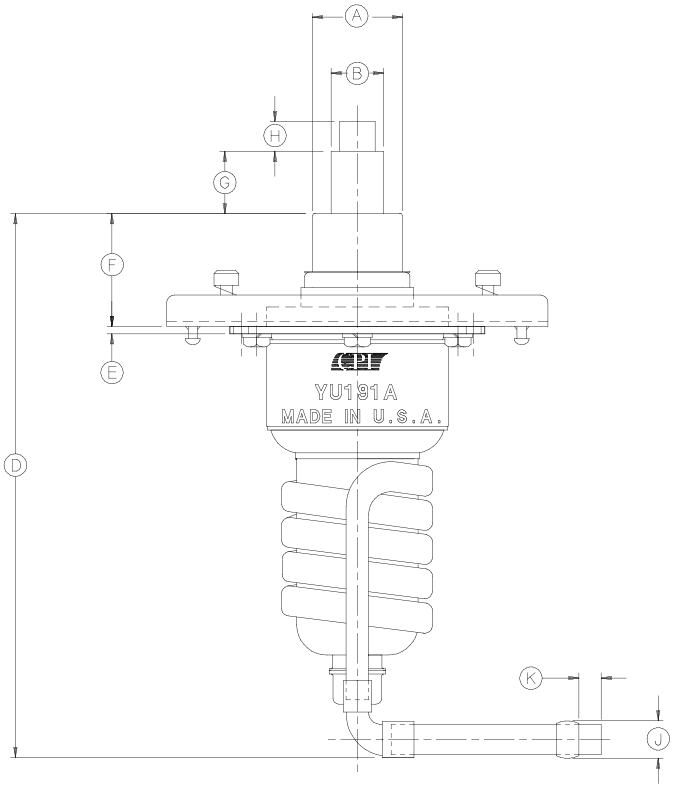
HOT SURFACES – When the tube is used in air and air cooled, external surfaces of the tube may reach temperatures up to 200°C and higher. In addition to the anode, the cathode insulator and cathode/heater surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns,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

HIGH VOLTAGE - The YU-191A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that 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 the primary circuits of the power supplies and to discharge high-voltage condensers 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.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., CPI Eimac Division, San Carlos, Calif. 94070 for information and recommendations.

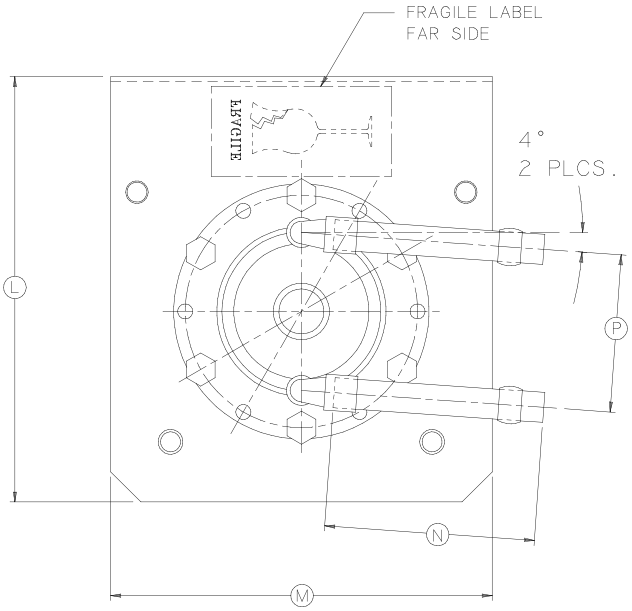
YU-191A

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.490	1.510		37.8	38.4	
B	.871	.881		22.1	22.4	
C						
D			8.985			228.22
E			.125			3.175
F	1.703	1.953		43.26	49.6	
G	.812	.938		20.62	23.82	
H	.480	.520		12.2	13.2	
J			.59			15.0
K			.38			9.65
L			7.08			179.83
M			6.35			161.29
N			3.500			88.90
P			2.625			66.68
R						
S						
T						
U						
V						
W						
X						
Y						
Z						



NOTES:

1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



YU191A

LTR	DESCRIPTION OF CHANGE	SCO	DATE	BY
A	DRAWN / ESTAB. IN ECO SYS.	252145	5/18/99	DB/KA

DRAWN: DB 5/18/99 ENGR APPR: /1/outline/yu191a SCALE: NONE
CHK'D: KA 5/24/99 SUPERSEDES: PRC-24366

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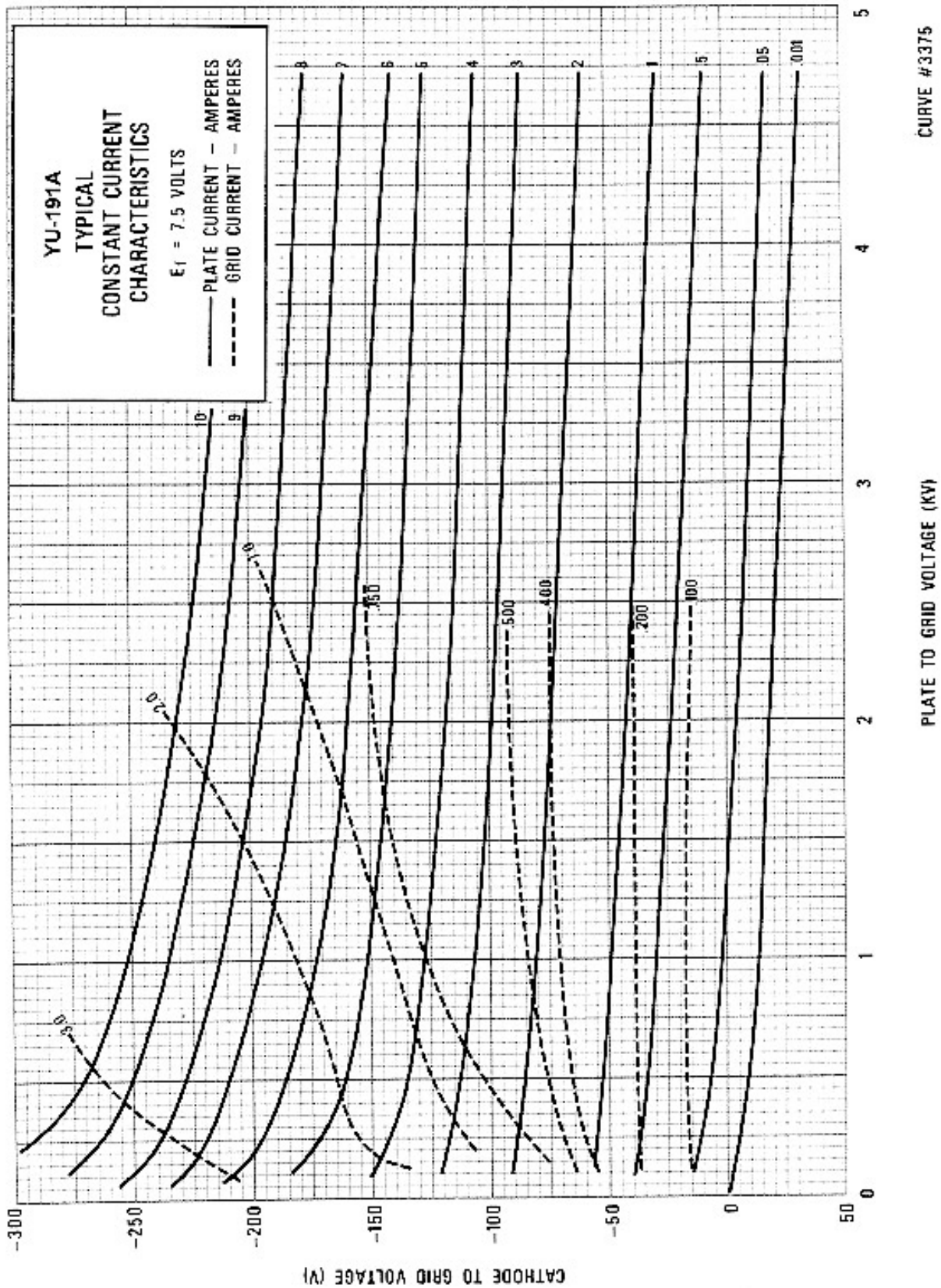
PART NO. CODE IDENT NO. 06982

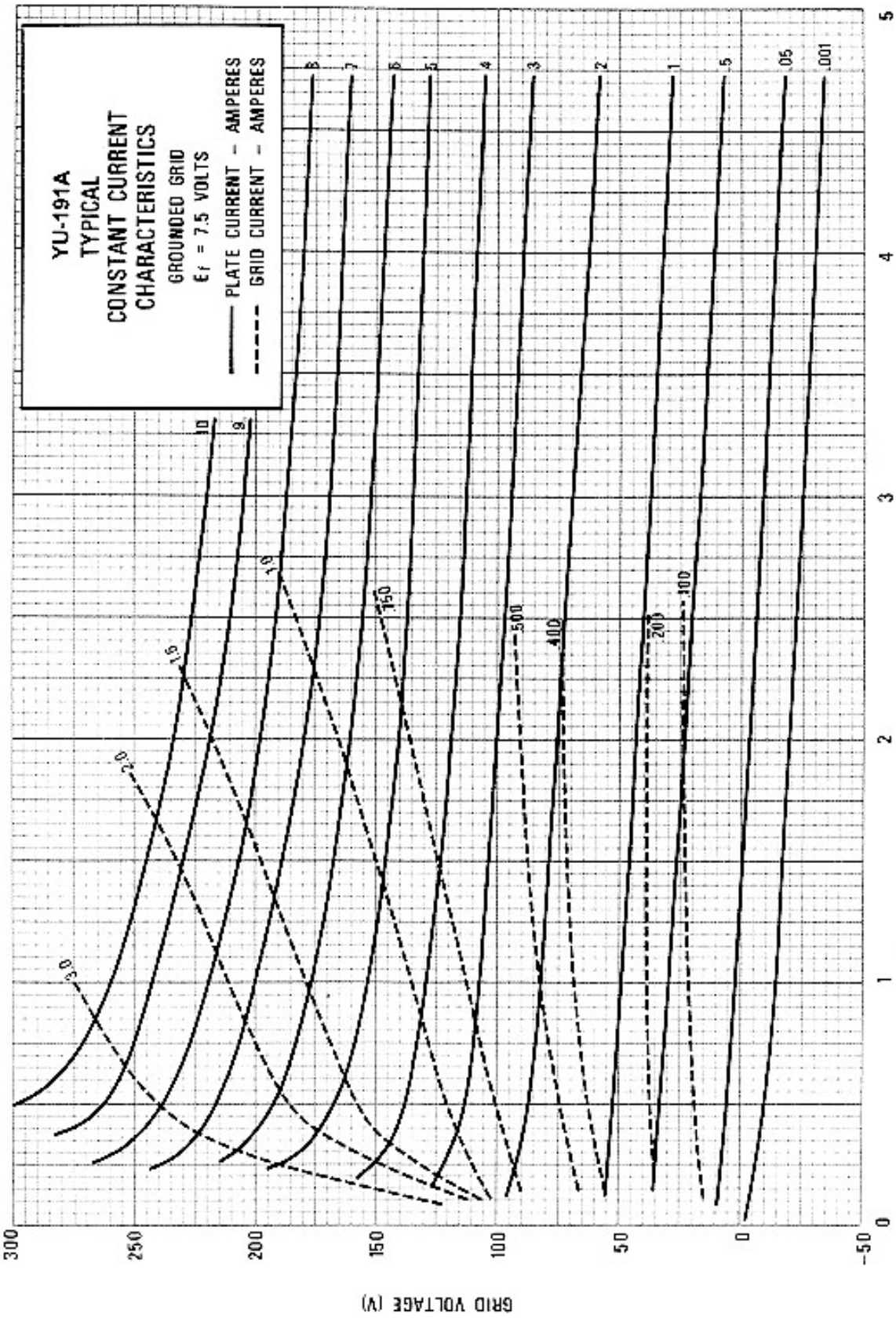
OUTLINE

ELECTRON TUBE

NO. YU191A A

MV: Z - CPL: 1 - SCL: 0.75


YU-191A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 7.5 VOLTS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (KV)
CURVE #3375


YU-191A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
Ef = 7.5 VOLTS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
300
250
200
150
100
50
0
-50
0
1
2
3
4
5
3.0
2.0
1.5
1.0
.150
.500
.400
.200
.100
10
9
8
7
6
5
4
3
2
1
.5
.05
.001