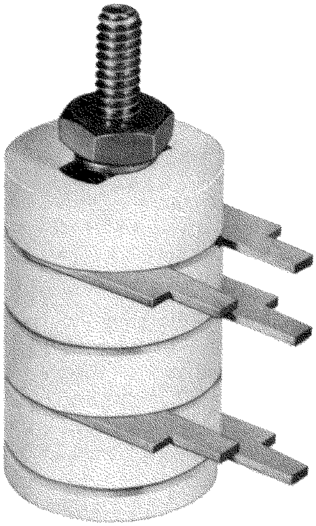
7296
METAL-CERAMIC TRIODE



DESCRIPTION AND RATING

FOR VHF OSCILLATOR AND AMPLIFIER APPLICATIONS

The 7296 is a high-mu triode of ceramic-and-metal planar construction primarily intended for use as an oscillator, broadband radio-frequency amplifier, or VHF power amplifier. The 7296 is especially suited for use where unfavorable conditions of mechanical shock, mechanical vibration, and nuclear radiation are encountered.

GENERAL

ELECTRICAL

Cathode—Coated Unipotential

Heater Voltage, AC or DC *	6.3±0.3	Volts
Heater Current +	0.4	Amperes
Direct Interelectrode Capacitances ‡		
Grid to Plate: (g to p)	2.2	pf
Input: g to (h + k)	5.0	pf
Output: p to (h + k)	0.075	pf
Heater to Cathode: (h to k)	2.8	pf

MECHANICAL

Mounting Position—Any §

MAXIMUM RATINGS

ABSOLUTE-MAXIMUM VALUES

Plate Voltage	330	Volts
Positive DC Grid Voltage	0	Volts
Negative DC Grid Voltage	50	Volts
Plate Dissipation	5.5	Watts
DC Grid Current	10	Milliamperes
DC Cathode Current	30	Milliamperes
Peak Cathode Current	120	Milliamperes
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode	50	Volts
Heater Negative with Respect to Cathode	50	Volts
Grid Circuit Resistance		
With Fixed Bias	0.1	Megohms
With Cathode Bias	0.18	Megohms
Envelope Temperature at Hottest Point ※		
Plate Dissipation not over 3.3 Watts	300	C
Plate Dissipation up to 5.5 Watts	250	C

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron tube of a specified type as defined by its published data and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, making no allowance for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the tube under consideration and of all other electron devices in the equipment.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of the tube under consideration and of all other electron devices in the equipment.

Supersedes ET-T1538A dated 2-60

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS

Plate Voltage	200	Volts
Cathode-Bias Resistor	68	Ohms
Amplification Factor	90	
Plate Resistance, approximate	5450	Ohms
Transconductance	16500	Micromhos
Plate Current	17	Milliamperes
Grid Voltage, approximate Ib = 10 Microamperes	−5.5	Volts

* The equipment designer should design the equipment so that the heater voltage is centered at the specified bogey value, with heater supply variations restricted to maintain heater voltage within the specified tolerance.

† Heater current of a bogey tube at Ef = 6.3 volts.

‡ Without external shield.

§ One method of mounting the 7296 is to use a stainless-steel "T" bolt (see drawing) to attach the mounting base of the tube to a chassis or circuit board. The "T" bolt should be inserted in the slot in the base of the tube, turned 90 degrees, and attached to the chassis or circuit board with a 4-40 nut and lock washer. Torque used to tighten the nut should not exceed 3 inch-pounds.

Operation below the rated maximum envelope temperatures is recommended for applications requiring the longest possible tube life. The 7296 is also capable of operation at envelope temperatures much higher than the rated maximum values. For specific recommendations concerning higher temperature operation, contact your General Electric tube sales representative.

INITIAL CHARACTERISTICS LIMITS

	Min.	Bogey	Max.	
Heater Current				
Ef = 6.3 volts	370	400	430	Milliamperes
Plate Current				
Ef = 6.3 volts, Eb = 200 volts, Rk = 68 ohms (bypassed)	10	17	24	Milliamperes
Transconductance				
Ef = 6.3 volts, Eb = 200 volts, Rk = 68 ohms (bypassed)	13000	16500	20000	Micromhos
Amplification Factor				
Ef = 6.3 volts, Eb = 100 volts, Rk = 68 ohms (bypassed)	65	90	115	
Zero-Bias Transconductance				
Ef = 6.3 volts, Eb = 100 volts, Ec = 0 volts	13000	20000	.....	Micromhos
Grid Voltage Cutoff				
Ef = 6.3 volts, Eb = 200 volts, Ib = 10 μa	.....	−5.5	−9.5	Volts
Interelectrode Capacitances				
Grid to Plate (g to p)	1.9	2.2	2.5	pf
Input: g to (h + k)	3.7	5.0	6.3	pf
Output: p to (h + k)	0.05	0.075	0.1	pf
Heater to Cathode: (h to k)	2.1	2.8	3.5	pf
Negative Grid Current				
Ef = 6.3 volts, Eb = 200 volts, Ecc = −1.0 volts, Rk = 68 ohms (bypassed), Rg = 0.18 meg	.....	.....	0.5	Microamperes
Heater-Cathode Leakage Current				
Ef = 6.3 volts, Ehk = 100 volts				
Heater Positive with Respect to Cathode	.....	.....	20	Microamperes
Heater Negative with Respect to Cathode	.....	.....	20	Microamperes
Interelectrode Leakage Resistance				
Ef = 6.3 volts. Polarity of applied d-c interelectrode voltage is such that no cathode emission results.				
Grid to All at 100 volts d-c	100	.....	.....	Megohms
Plate to All at 300 volts d-c	100	.....	.....	Megohms
Grid Emission Current				
Ef = 7.0 volts, Eb = 200 volts, Ecc = −15 volts, Rg = 0.18 meg	.....	.....	2.0	Microamperes

SPECIAL PERFORMANCE TESTS

	Min.	Bogey	Max.	
400 Megacycle Oscillator Power Output	1.6	2.0	.....	Watts
Pulse Emission	320	.....	.....	Milliamperes
Grid Recovery . . . . . Change in Average Plate Current	.....	.....	1.0	Milliamperes
Peak Plate Current Backswing	.....	.....	2.0	Milliamperes
Low Frequency Vibrational Output	.....	.....	15	Millivolts RMS

400 Megacycle Oscillator Power Output

Tubes are tested for power output as an oscillator under the following conditions: F = 400 mc, Ef = 6.3 volts, Eb = 300 volts, Rg = 1400 ohms, Ib = 20 ma maximum, Ic = 6.0–9.0 ma.

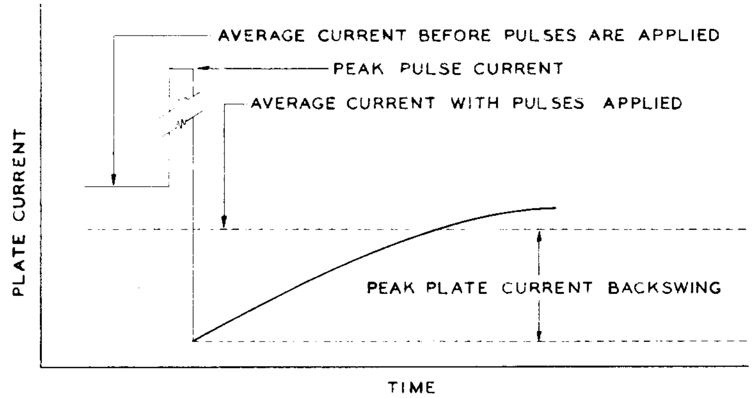
Pulse Emission

Tubes are tested for pulse emission under the following conditions: Ef = 6.3 volts, Eb = 200 volts, Ec = −20 volts, egk = +12 volts, prr = 1000 pps, duty cycle 1%. Pulse cathode current is measured.

Grid Recovery

Tubes with poor grid recovery affect circuit operation, when the grid is driven positive by a pulse of signal or noise, somewhat as if a parallel RC circuit were in series with the grid. This effect may occur in tubes of any type, but is unimportant in many applications. In the majority of 7296 tubes the effect is negligible, but to eliminate the few in which it may be excessive, tubes are tested under the following conditions: Ef = 6.3 volts, Ebb = 250 volts, R_L = 0.01 meg. Ec is adjusted for Ib = 10 ma.

Upon application to the grid of a pulse driving it 3 volts positive with respect to cathode (prr = 60 pps, duty cycle = 0.12%) the change in average plate current is noted, and the peak plate current backswing is measured. The following diagram shows qualitatively the plate current—time relationship for a tube (with poor grid recovery) subjected to this test:



Low Frequency Vibrational Output

Statistical sample is subjected to vibration in each of two planes at 40 cps, with peak acceleration 15 G. Tube is operated with Ef = 6.3 volts, Ebb = 200 volts, Rk = 68 ohms (bypassed), R_L = 2000 ohms.

Variable Frequency Vibrational Output

The tube is designed to be free of vibrational outputs in excess of 100 mv RMS at any frequency within the range 100–2000 cps, when vibrated in either of two planes at 10 G peak acceleration. Electrical conditions for this test are the same as for Low Frequency Vibrational Output.

Low Pressure Voltage Breakdown Test

Statistical sample tested for voltage breakdown at a pressure of 8 mm Hg, to simulate an altitude of 100,000 feet. Tubes shall not give visual evidence of flashover or corona when 300 volts RMS, 60 cps, is applied between the plate and grid terminals.

DEGRADATION RATE TESTS

Fatigue

Statistical sample vibrated for a total of six hours, three hours in each of two planes, at a peak acceleration of 10 G. Frequency is continuously varied from 30 cps to 2000 cps and back to 30 cps, with a period of ten minutes. Tubes are operated during the test with Ef = 6.3 volts, Eb = 200 volts, and Rk = 68 ohms. Following the test, tubes are evaluated for low frequency vibrational output, heater-cathode leakage, heater current, and transconductance.

Shock

Statistical sample subjected to 5 impact accelerations of approximately 600 G in each of four positions. The accelerating forces are applied by the Navy-type, High Impact (flyweight) Shock Machine using a 42° hammer angle. Tubes are mounted by T-bolt with 3 inch-pounds torque, and operated during the test with Ef = 6.3 volts, Eb = 200 volts, Ehk = +100 volts, Rg = 0.1 Meg, and Rk = 68 ohms. Following the test, tubes are evaluated for low frequency vibrational output, heater-cathode leakage, heater current, and transconductance.

Stability Life Test

The statistical sample subjected to the Dynamic Life Test is evaluated for percent change in zero-bias transconductance of individual tubes, from the initial reading to readings following 2 hours and 20 hours of the life test.

Survival Rate Life Test

The combined statistical samples subjected to the Dynamic and Pulse Life Tests are evaluated for shorted and open elements following approximately 100 hours of life test.

Dynamic Life Test

Statistical sample operated, with a 60 cps grid signal, at maximum rated DC grid current and cathode current for a period of 1000 hours. Heater voltage is cycled (on 1¾ hours, off ¼ hour). Tubes are evaluated, following 500 and 1000 hours of life test, for shorted or open elements, heater current, zero-bias transconductance, oscillator power output, and heater-cathode leakage.

Pulse Life Test

Statistical sample operated with 400 ma peak cathode current, 1% duty cycle, for 1000 hours. Heater voltage is cycled (on 1¾ hours, off ¼ hour). Tubes are evaluated, following 500 and 1000 hours of life test, for shorted or open elements, heater current, pulse emission, and heater-cathode leakage.

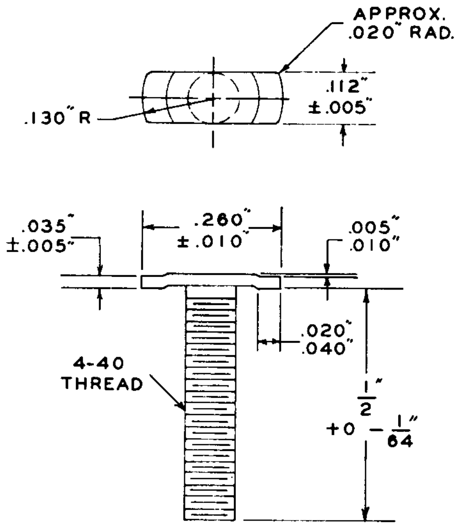
Interface Life Test

Statistical sample operated for 1000 hours with Ef = 6.6 volts, no other voltages applied, and evaluated for cathode interface resistance following the life test.

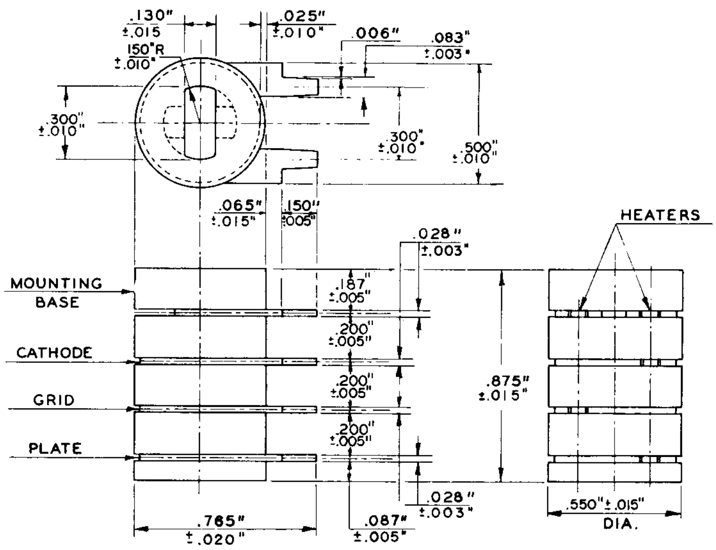
Heater-Cycling Life Test

Statistical sample operated for 2000 cycles minimum to evaluate and control heater-cathode defects. Conditions of test include Ef = 7.5 volts cycled for one minute on and one minute off, Eb = Ec = 0 volts, and Ehk = 70 volts with heater positive with respect to cathode. Following this test tubes are evaluated for open heaters, heater-cathode shorts, and heater-cathode leakage current.

MOUNTING BOLT

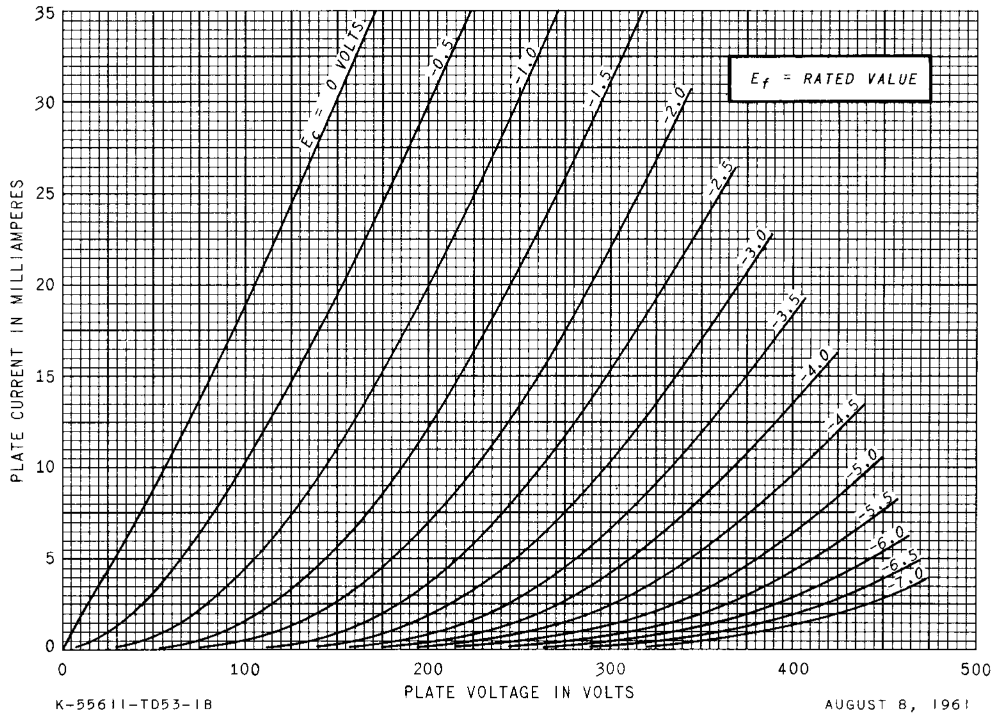


PHYSICAL DIMENSIONS

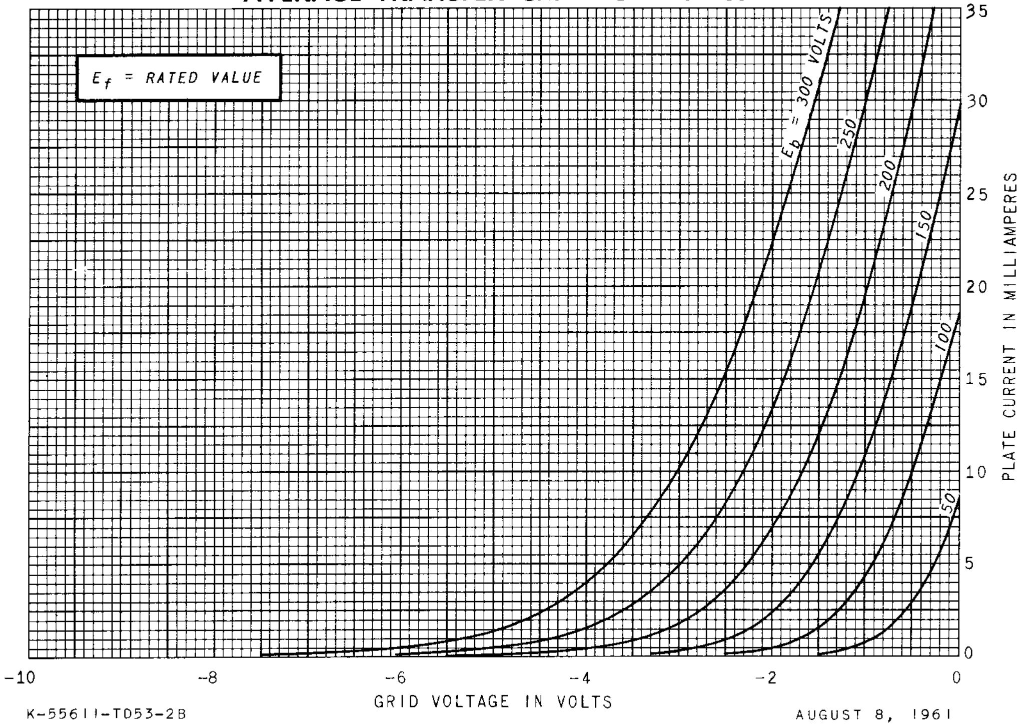


Maximum eccentricity of insulators 0.015 in. from center line.

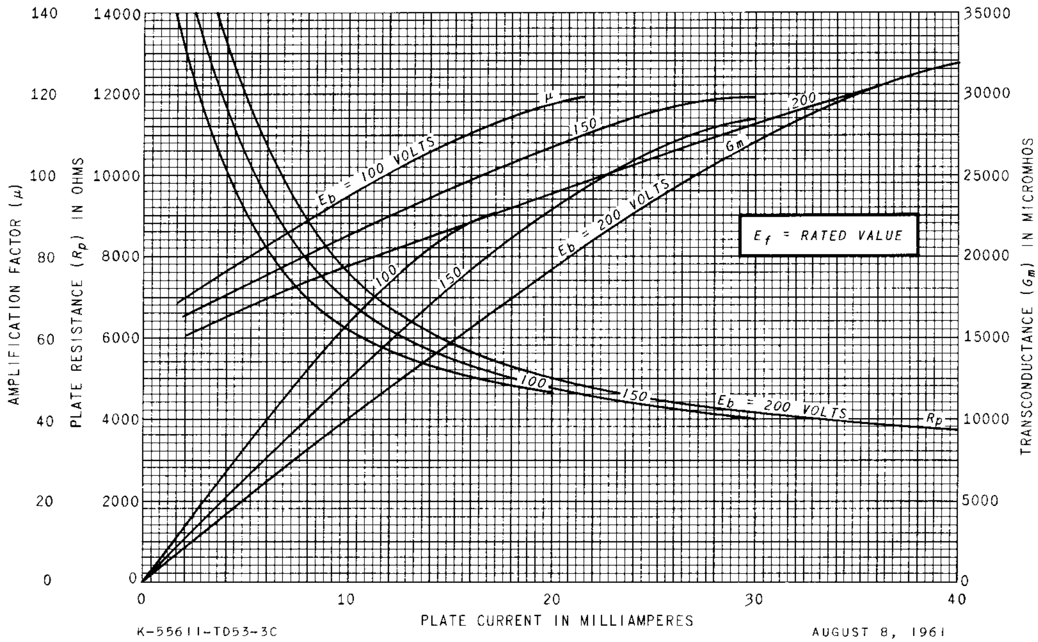
AVERAGE PLATE CHARACTERISTICS



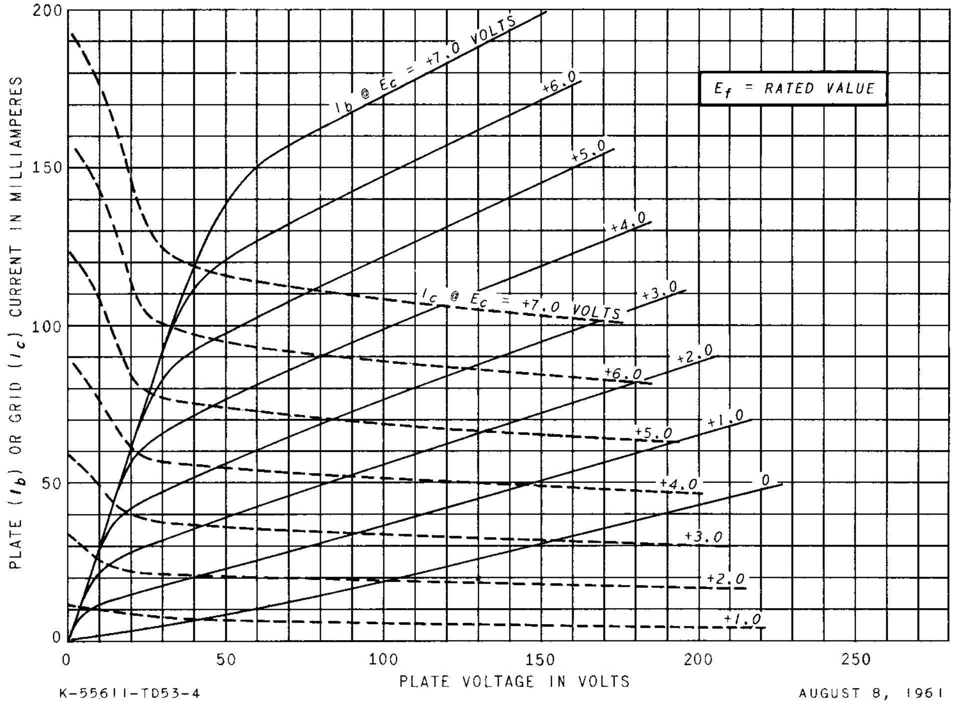
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE CONSTANT-CURRENT CHARACTERISTICS