6414GE00

6414
TWIN TRIODE
Five-Star Tube
★★★★★
FOR COMPUTER APPLICATIONS

Electronic TUBES

HIGH PERVEANCE
SHARP CUTOFF

SHOCK, VIBRATION RATINGS
HEATER-CYCLING RATING

MEDIUM MU

DESCRIPTION AND RATING

The 6414 is a miniature, medium-mu twin triode designed especially for service in computer applications in which extremely long life is essential. The tube features a high zero-bias plate current, a sharp cutoff characteristic, and separate cathode connections for the two sections.

Intended for use in critical applications in industrial and military ground equipment where operational dependability is of primary importance, the 6414 exhibits a high degree of mechanical strength and incorporates a heater-cathode construction capable of withstanding many-thousand cycles of intermittent operation. When used in on-off control applications, the tube will maintain its emission capabilities after long periods of operation under cutoff conditions.

GENERAL

ELECTRICAL

	Series	Parallel	
Cathode—Coated Unipotential			
Heater Voltage, AC or DC	12.6±5%	6.3±5%	Volts
Heater Current	0.225	0.45	Amperes

Direct Interelectrode Capacitances*

Grid to Plate, Each Section	3.0 μμf
Input, Each Section	4.0 μμf
Output, Section 1	0.47 μμf
Output, Section 2	0.38 μμf
Heater to Cathode, Each Section	4.0 μμf
Grid to Grid, maximum	0.03 μμf
Plate to Plate, maximum	0.9 μμf

* Without external shield.

MECHANICAL

Mounting Position

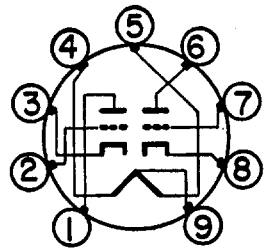
Preferred Orientation—Upright or with Plate Majors in Vertical Position

Permissible Orientation—Any

Envelope—T-6½, Glass

Base—E9-1, Small Button 9-Pin

BASING DIAGRAM

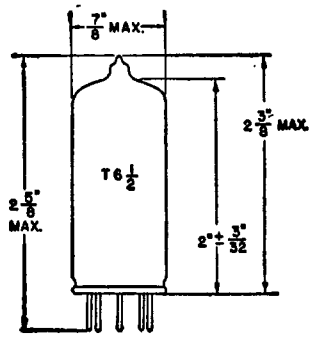


RETMA 9A

TERMINAL CONNECTIONS

Pin 1—Plate (Section 2)
Pin 2—Grid (Section 2)
Pin 3—Cathode (Section 2)
Pin 4—Heater
Pin 5—Heater
Pin 6—Plate (Section 1)
Pin 7—Grid (Section 1)
Pin 8—Cathode (Section 1)
Pin 9—Heater Center Tap

PHYSICAL DIMENSIONS



RETMA 6-3

GENERAL ELECTRIC

MAXIMUM RATINGS

DESIGN-MAXIMUM VALUES, EACH SECTION†

Ratings Are Design-Maximum Values Unless Otherwise Indicated

DC Plate Voltage		200	Volts
Peak Positive Pulse Plate Voltage‡		500	Volts
Positive DC Grid Voltage		1.0	Volts
Negative DC Grid Voltage		50	Volts
Peak Positive Grid Voltage§		10	Volts
Peak Negative Grid Voltage		100	Volts
Plate Dissipation, Each Plate	2.2♣	2.0	Watts
Total Plate Dissipation, Both Plates	4.0♣	3.6	Watts
DC Grid Current	...	1.0	Milliamperes
Peak Grid Current§	...	50	Milliamperes
DC Cathode Current	20♣	17	Milliamperes
Peak Cathode Current§	200♣	160	Milliamperes
Heater-Cathode Voltage			
Heater Positive with Respect to Cathode▲		100	Volts
Heater Negative with Respect to Cathode▲		100	Volts
Grid Circuit Resistance			
With Fixed Bias		0.1	Megohms
With Cathode Bias		0.5	Megohms
Bulb Temperature at Hottest Point		100	C

† Design-Maximum Ratings are the limiting values expressed with respect to bogie tubes at which satisfactory tube life can be expected to occur for the types of service for which the tube is rated. Therefore, the equipment designer must establish the circuit design so that initially and throughout equipment life no design-maximum value is exceeded with a bogie tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, and environmental conditions.

‡ Rating based on a half-sinusoidal pulse of 10-millisecond duration and 10-percent duty cycle.

§ Rating based on a pulse of 10-microsecond duration, 1-percent duty cycle, and 1000-cycle repetition rate.

♣ Absolute-Maximum Value.

▲For pulse voltages of less than 1-percent duty cycle, the peak voltage may be 150 volts maximum.

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS, EACH SECTION

Plate Voltage	100	150	180	Volts
Grid Voltage	♦	−4.8	−2	Volts
Amplification Factor	...	...	42.5	
Plate Resistance, approximate	...	...	7650	Ohms
Transconductance	...	...	5550	Micromhos
Plate Current	17	0.15	8.0	Milliamperes

♦ With grid current adjusted for approximately 200 microamperes.

CHARACTERISTICS LIMITS

		Minimum	Maximum	
Heater Current				
Ef = 6.3 volts	Initial	425	475	Milliamperes
	1000 Hrϕ	425	495	Milliamperes
Zero-Bias Plate Current, Each Section				
Ef = 6.3 volts, Eb = 100 volts, Ic = 200 μa (Rg = 0.5 meg to +100 volts)	Initial	13.6	20.4	Milliamperes
	1000 Hr**	11.5	21.0	Milliamperes
	1000 Hr††	11.5	21.0	Milliamperes
Plate Current, Each Section				
Ef = 6.3 volts, Eb = 180 volts, Ec = −2.0 volts	Initial	5.0	11.5	Milliamperes
	1000 Hrϕ	4.0	....	Milliamperes
Transconductance (1), Each Section				
Ef = 6.3 volts, Eb = 180 volts, Ec = −2.0 volts	Initial	4000	7250	Micromhos
	1000 Hrϕ	3500	....	Micromhos
Transconductance Change with Heater Voltage, Each Section				
Difference between Transconductance (1) and Transconductance at Ef = 5.7 volts (other conditions the same) expressed as a percentage of Transconductance (1)	Initial	....	15	Percent
Amplification Factor, Each Section				
Ef = 6.3 volts, Eb = 180 volts, Ec = −2.0 volts	Initial	37	48	
Grid Voltage Cutoff, Each Section				
Ef = 6.3 volts, Eb = 150 volts, Ib = 150 μa	Initial	....	−7.5	Volts
Grid Voltage Cutoff Difference between Sections				
Difference between cutoff voltages for each section at Ef = 6.3 volts, Eb = 150 volts, Ib = 150 μa	Initial	....	1.5	Volts
Interelectrode Capacitances				
Grid to Plate (g to p), Each Section	Initial	2.4	3.6	μμf
Input (g to k+h), Each Section	Initial	3.0	5.0	μμf
Output (p to k+h), Section 1	Initial	0.37	0.57	μμf
Output (p to k+h), Section 2	Initial	0.30	0.46	μμf
Heater to Cathode (h to k), Each Section	Initial	3.0	5.0	μμf
Grid to Grid (g to g)	Initial	....	0.03	μμf
Plate to Plate (p to p)	Initial	....	0.9	μμf
Measured without external shield				
Negative Grid Current, Each Section				
Ef = 6.3 volts, Eb = 180 volts, Ec = −2.0 volts, Rg = 0.5 meg.	Initial	....	0.3	Microamperes
	1000 Hr**	....	0.5	Microamperes
	1000 Hrϕ	....	0.5	Microamperes
	1000 Hr§§	....	0.5	Microamperes
Heater-Cathode Leakage Current, Each Section				
Ef = 6.3 volts, Ehk = 100 volts				
Heater Positive with Respect to Cathode	Initial	....	7	Microamperes
	1000 Hrϕ	....	15	Microamperes
Heater Negative with Respect to Cathode	Initial	....	7	Microamperes
	1000 Hrϕ	....	15	Microamperes

CHARACTERISTICS LIMITS CONTINUED ON PAGE 4

CHARACTERISTICS LIMITS (Cont'd)

		Minimum	Maximum	
Interelectrode Leakage Resistance				
Ef = 6.3 volts. Polarity of applied d-c interelectrode voltage is such that no cathode emission results.				
Grid (Each Section) to All at 100 volts d-c	Initial	1000	....	Megohms
	1000 Hrφ	100	....	Megohms
Plate (Each Section) to All at 300 volts d-c	Initial	1000	....	Megohms
	1000 Hrφ	100	....	Megohms
Vibrational Noise Output Voltage, RMS, Each Section				
Ef = 6.3 volts, Ebb = 180 volts, Ec = −2.0 volts, R_L = 2000 ohms. Vibration acceleration = 2.5 G at 25 cps	Initial	....	300	Millivolts
Grid Emission Current, Each Section				
Ef = 6.7 volts, Eb = 180 volts, Ec = −30 volts, Rg = 0.5 meg	Initial	....	0.5	Microamperes
	1000 Hrφ	....	1.0	Microamperes
Pulse Cathode Current				
Ef = 6.3 volts, Eb = 150 volts, Ecc = −20 volts. Grid is driven 10 volts positive with a pulse of 1% duty cycle and 1000-cycle repetition rate. Pulse cathode current is measured for each section with both sections operating under pulse conditions	Initial	160	....	Milliamperes
	1000 Hr††	150	....	Milliamperes
	1000 Hr§§	150	....	Milliamperes
Contact Potential, Each Section				
Ef = 6.3 volts, Eb = 0 volts, Ec adjusted for Ic = 0.1 microamperes, Rg = 0.1 meg	Initial	....	−1.5	Volts
	1000 Hrφ	....	−1.5	Volts

φ REGULAR INTERMITTENT LIFE TEST: Conditions of operation for each section are Ef = 6.3 volts, Eb = 180 volts, Rk = 140 ohms, Rg = 0.1 meg, Ehk = 180 volts with the heater positive with respect to cathode, and bulb temperature = 130 C minimum.

**ZERO-BIAS LIFE TEST: Conditions of operation for each section are Ef = 6.3 volts, Ebb = 180 volts, R_L = 3900 ohms, Ic = 46 μa (Rg = 3.9 meg to +180 volts), and bulb temperature = 130 C minimum.

††CUTOFF LIFE TEST: Conditions of operation for each section are Ef = 6.3 volts, Eb = 180 volts, and Ec = −50 volts.

§§PULSE LIFE TEST: Conditions of operation for each section are Ef = 6.3 volts, Ebb = 180 volts, Ecc = −20 volts, R_L = 200 ohms, and Rg = 50 ohms. Grid is driven with a 11.5-volt positive-going pulse (measured on driver side of Rg) of 1% duty cycle and 1000-cycle repetition rate.

SPECIAL TESTS AND RATINGS

Stability Life Test

Statistical sample operated for one hundred hours to evaluate and control variations in zero-bias plate current.

Survival Rate Life Test

Large statistical sample operated for five hundred hours to evaluate and control early-life electrical and mechanical inoperatives.

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 (parallel-heater connection) cycled for one minute on and one minute off, Eb = Ec = 0 volts, and Ehk = 135 volts with heater positive with respect to cathode.

Shock Rating—300 G

Statistical sample subjected to five impact accelerations of 300 G in each of four different positions. The accelerating forces are applied by the Navy-type, High Impact (flyweight) Shock Machine for Electronic Devices or its equivalent.

Fatigue Rating—2.5 G

Statistical sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Cathode-Interface Impedance Life Test

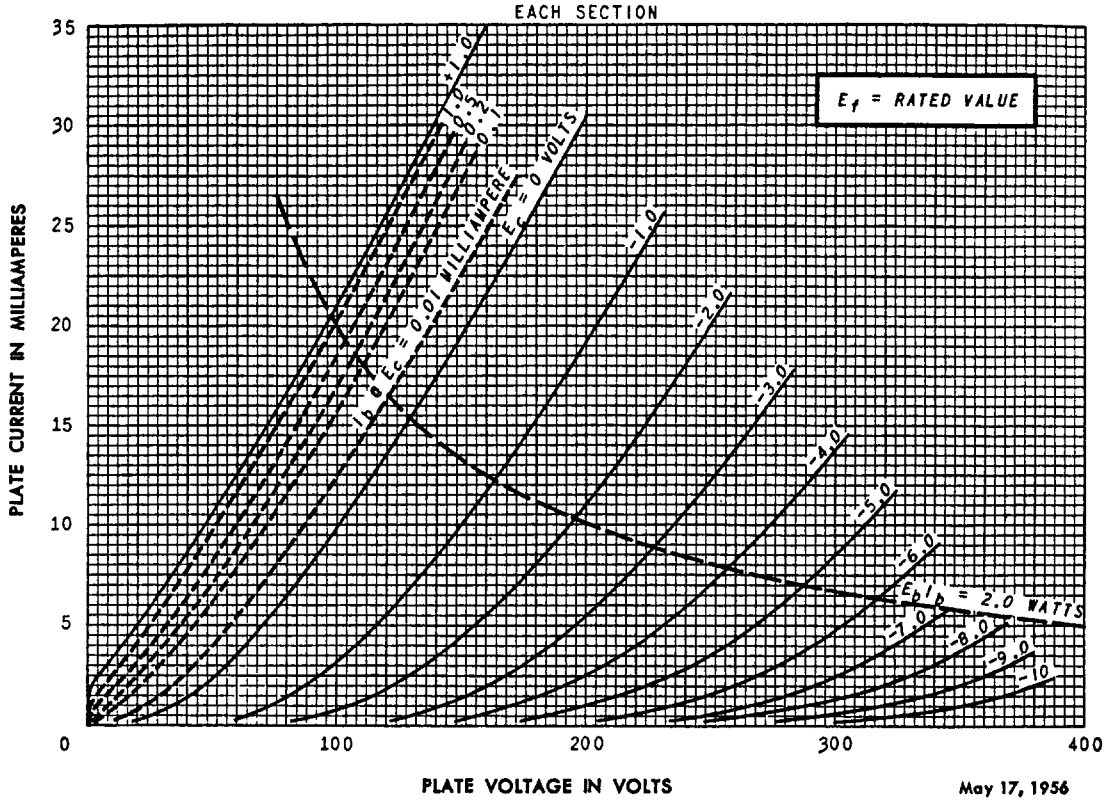
Statistical sample operated without cathode current to evaluate and control the development of cathode interface impedance.

Note: The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

In the design of military equipment employing this tube, reference should be made to the appropriate MIL-E-1 specification.

AVERAGE PLATE CHARACTERISTICS

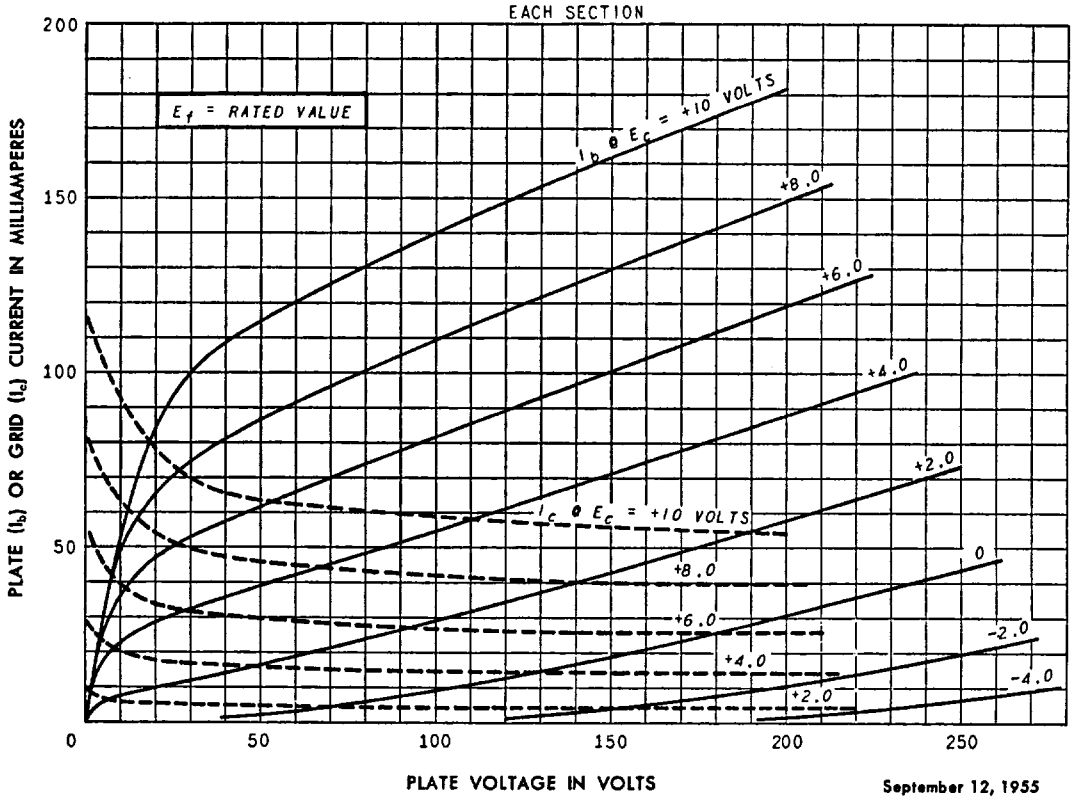
EACH SECTION



May 17, 1956

AVERAGE PLATE CHARACTERISTICS

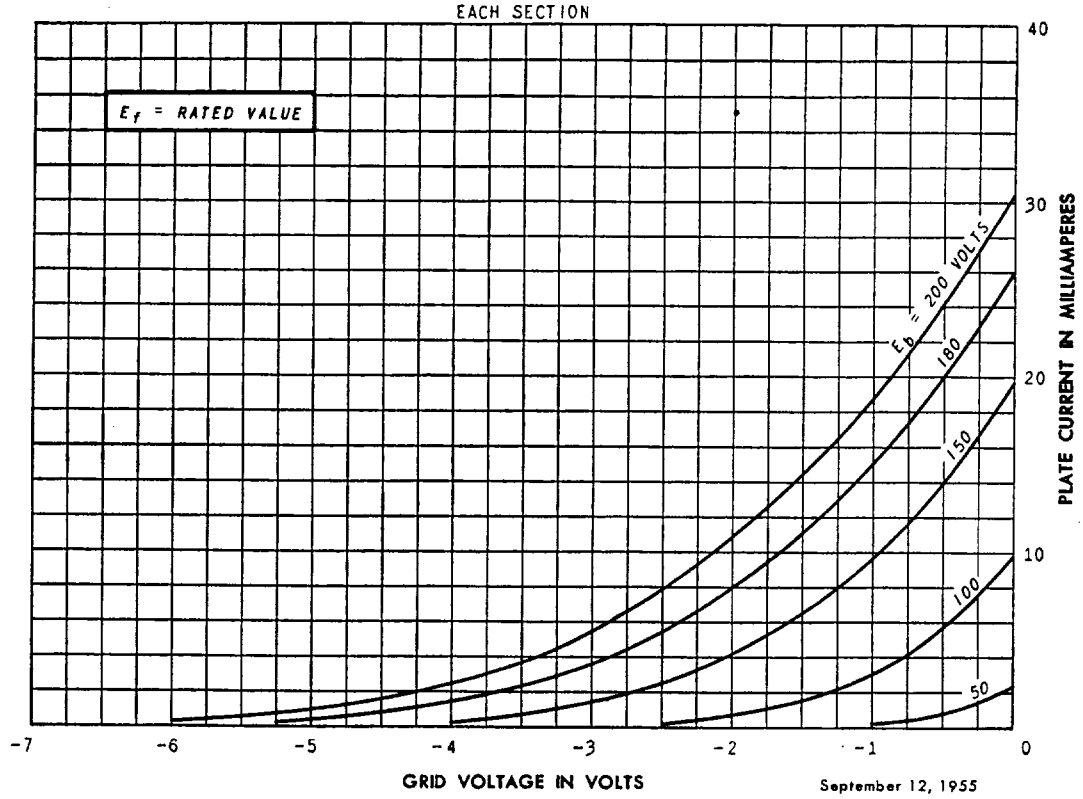
EACH SECTION



September 12, 1955

AVERAGE TRANSFER CHARACTERISTICS

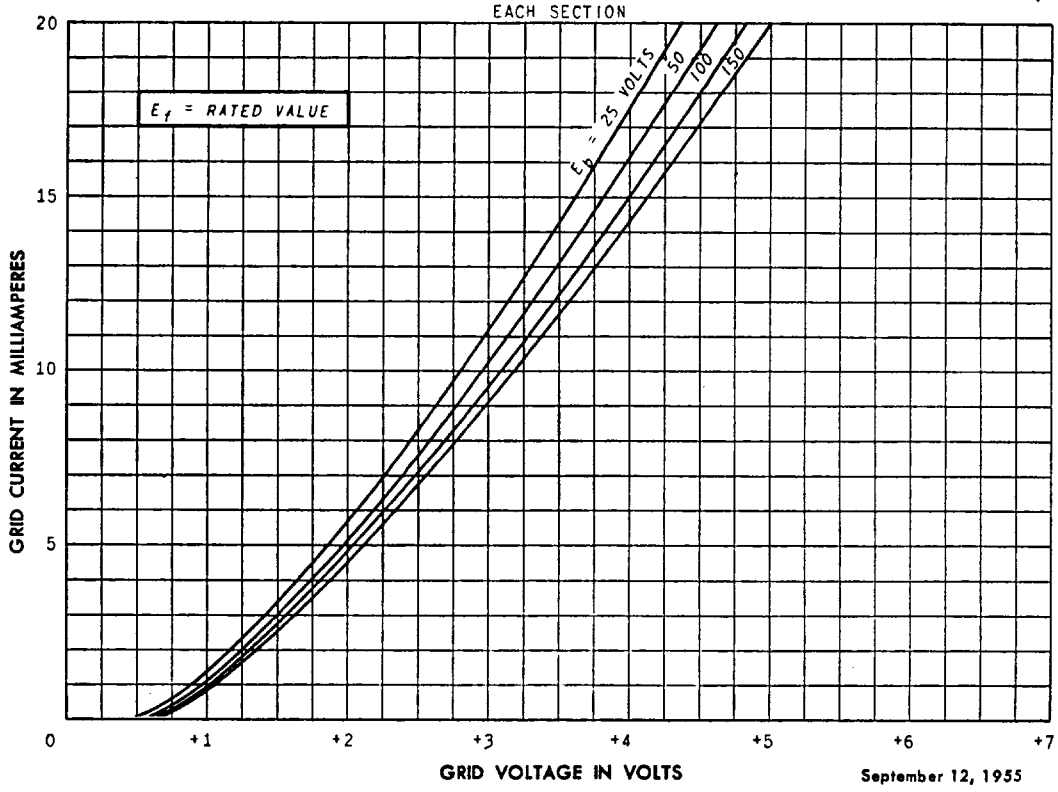
EACH SECTION



September 12, 1955

AVERAGE CHARACTERISTICS

EACH SECTION



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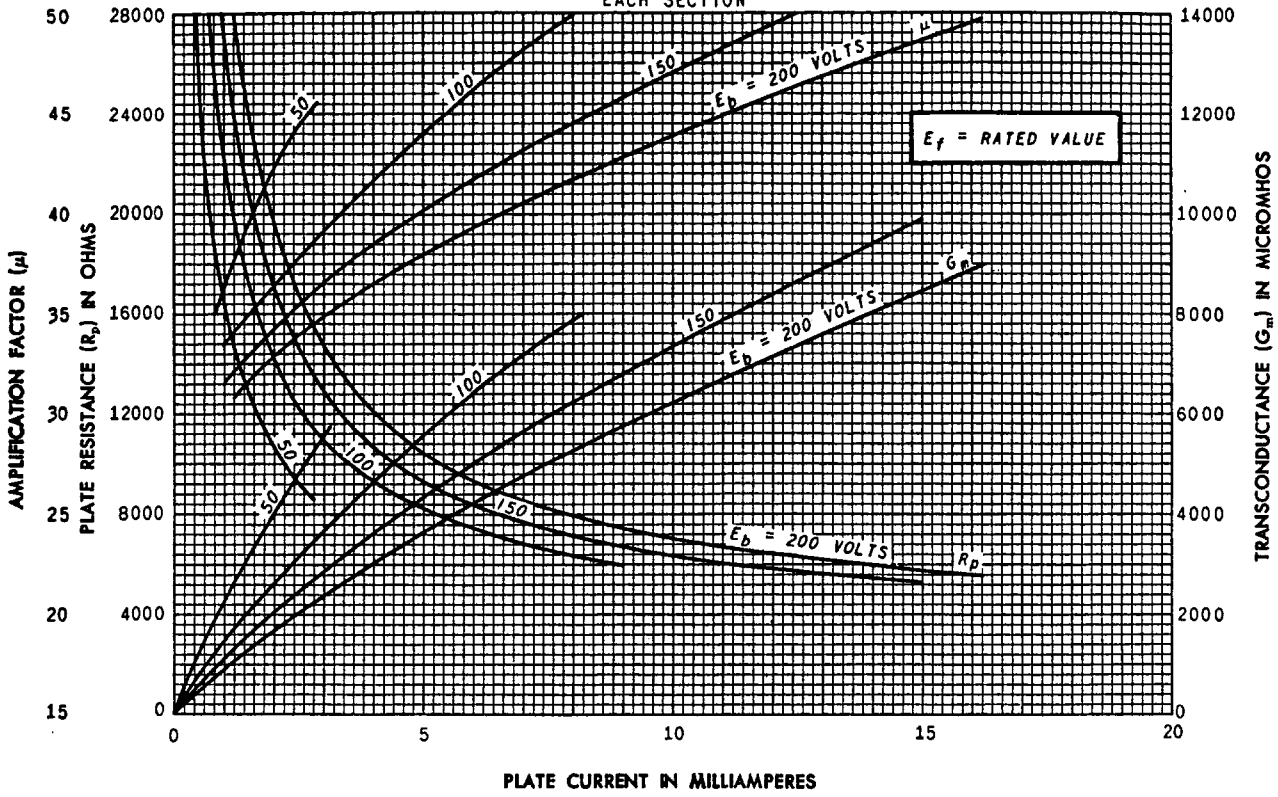
AVERAGE CHARACTERISTICS

EACH SECTION



September 12, 1955

TUBE DEPARTMENT

GENERAL ELECTRIC

Schenectady 5, N. Y.