SYLVANIA

engineering data service 6788

MECHANICAL DATA

Bulb	T-3
Base	E8-10, Subminiature Button Flexible Leads
Outline	(See Drawing)
Basing	8DL
Cathode	Coated Unipotential
Mounting Position	Any

RATINGS[1] (Absolute Maximum)

Impact Acceleration	100 G
Uniform Acceleration	1000 G
Fatigue (Vibrational Acceleration for Extended Periods)	10 G
Bulb Temperature	250° C
Altitude[2]	80000 Ft.

ELECTRICAL DATA

HEATER CHARACTERISTICS

	Min.	Bogey	Max.
Heater Voltage[3]	5.7	6.3	6.9 V
Heater Current		175	mA

DIRECT INTERELECTRODE CAPACITANCES (Shielded)[4]

Grid No. 1 to Plate	0.032 μμf Max.
Input	2.5 μμf
Output	3.2 μμf

RATINGS[1 & 5] (Absolute Maximum)

Plate Voltage	250 Vdc
Peak Plate Forward Voltage[6]	500 v
Grid No. 2 Voltage	150 Vdc
Plate Dissipation	0.5 W
Grid No. 2 Dissipation	0.15 W
Grid No. 1 Voltage	
Positive Value	0 Vdc
Negative Value	55 Vdc
Grid No. 1 Circuit Resistance	4.0 Meg

CHARACTERISTICS

Plate Voltage	100 Vdc
Grid No. 2 Voltage	100 Vdc
Cathode Resistor	1500 Ohms
Plate Current	0.8 mAdc
Grid No. 2 Current	0.09 mAdc
Transconductance	1150 μmhos
Plate Resistance	1.2 Meg
Grid No. 1 Voltage for Ib = 10 μAdc	—2.8 Vdc
White Noise Vibration Output Voltage[7]	
Peak to Peak	50 mv Max.
RMS	5 mVac Max.

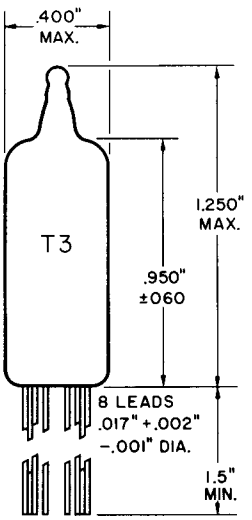
NOTES:

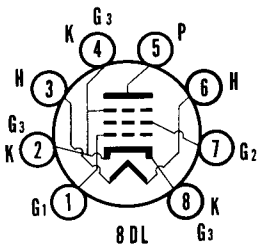
1. *Limitations beyond which normal tube performance and tube life may be impaired.*
2. *If altitude rating is exceeded, reduction of instantaneous voltages (Ef excluded) may be required.*
3. *Tube life and reliability of performance are directly related to the degree of regulation of the heater voltage to its center rated value of 6.3 volts.*
4. *External shield of 0.405 inch diameter connected to cathode.*
5. *Values shown are as registered with RETMA.*
6. *Per MIL-E-1C, Par. 6.5 and General Section of this Sylvania Subminiature Tube Manual titled Specifications and Ratings.*
7. *White Noise Output Voltage is measured across a plate resistor of 10,000 ohms, with applied vibrational force such that the instantaneous values of acceleration form a "White Noise" spectrum from 100 cps to 5000 cps. Energy within the spectrum is so distributed that in each octave of bandwidth the tube experiences 2.3 G's rms acceleration, and the degree of clipping is such that the peak value of acceleration is 15 G's maximum.*

QUICK REFERENCE DATA

The Premium Subminiature Type 6788 is a sharp cutoff pentode designed primarily for use as a high gain audio amplifier or regulator amplifier where high plate loads are desired at low plate currents. The 6788 is characterized by extra-ordinary freedom from interelement shorts of short duration, by high resistance to interelement leakage.

The 6788 is designed to provide dependable service under conditions of severe mechanical shock, vibration, high temperature and high altitude, and is manufactured and inspected to meet the applicable specification for reliable operation.





SYLVANIA ELECTRIC PRODUCTS INC.

RADIO TUBE DIVISION
EMPORIUM, PA.

Prepared and Released By The
TECHNICAL PUBLICATIONS SECTION
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ACCEPTANCE CRITERIA

Test Conditions

Heater Voltage	6.3 V	Grid No. 2 Voltage	100 Vdc
Plate Voltage	100 Vdc	Heater-Cathode Voltage	0 V
Grid No. 1 Voltage	0 V	Cathode Resistor MIL-E-1 Par. 3.2.2.1	1500 Ohms

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.

MIL-E-1 Ref.	Test	AQL (%)	Limits					Units
			Min.	LAL	Bogey	UAL	Max.	
	Measurements Acceptance Tests, Part 1, Note 1							
4.10.8	Heater Current:	0.65	161	—	—	—	189	mA
4.10.15	Heater-Cathode Leakage:	0.65	—	—	—	—	—	
	Ehk = +100 Vdc	—	—	—	—	—	5.0	μAdc
	Ehk = −100 Vdc	—	—	—	—	—	5.0	μAdc
4.10.6.1	Grid Current: Ic1							
	Rg1 = 1.0 Meg	0.65	0	—	—	—	−0.1	μAdc
4.1.1.7	(Method A)							
4.10.4.1	Plate Current (1): ALD = 0.20 Ib	—	—	0.73	0.8	0.87	—	mAdc
4.10.4.1	Plate Current (1): Ib	0.65	0.6	—	—	—	1.0	mAdc
4.10.4.1	Plate Current (2): Ib							
	Ec1 = −4.0 Vdc; Rk = 0 Ohms	0.65	—	—	—	—	10	μAdc
4.10.4.3	Screen Grid Current: Ic2	0.65	—	—	—	—	0.20	mAdc
4.1.1.7	(Method A)							
4.10.9	Transconductance (1): ALD = 190 Sm	—	—	1085	1150	1215	—	μmhos
4.10.9	Transconductance (1): Sm	0.65	950	—	—	—	1350	μmhos
- - - -	Continuity and Shorts (Inoperatives): Note 2	1.0	—	—	—	—	—	
4.9.1	Mechanical:							
	Envelope (As Per Outline)	—	—	—	—	—	—	
	Measurements Acceptance Tests, Part 2							
4.8.2	Insulation of Electrodes:	2.5	—	—	—	—	—	
	g1-all = 100 V	—	250	—	—	—	—	Meg
	p-all = 300 V	—	250	—	—	—	—	Meg
	g2-all = 200 V	—	250	—	—	—	—	Meg
4.10.4.1	Plate Current (3): △ Ib							
	Ef = 5.5 V	2.5	—	—	—	—	15	%
4.10.6.2	Grid Emission: Note 7 Ic1							
	Ef = 7.5 V; Rg1 = 4.0 Meg; Rk = 0 Ohms; Ec1 = −4.0 Vdc	2.5	0	—	—	—	−0.5	μAdc
4.10.3.2	AF Noise:							
	Esig = 70 mVac; Ec2 = 19 Vdc; Rg1 = 0.1 Meg; Rg2 = 1000 Ohms; Rp = 0.2 Meg; Ck = 1000 μf	2.5	—	—	—	—	17	VU
- - - -	Hum: Note 8							
	Ef = 6.3 at 400 cps; Rg1 = 0 Ohms; Rg2 = 0.03 Meg; RL = 0.01 Meg	2.5	—	—	—	—	10	mv pk-pk
- - - -	Operation Time: Note 9	6.5	—	—	—	—	20	secs
4.10.10	Plate Resistance:	6.5	1.0	—	—	—	—	Meg
4.10.14	Capacitance:	6.5	—	—	—	—	—	
	0.405 In. Dia. Shield Cg1p	—	—	—	—	—	0.032	μμf
	0.405 In. Dia. Shield Cin	—	1.9	—	—	—	3.1	μμf
	0.405 In. Dia. Shield Cout	—	2.4	—	—	—	4.0	μμf

ACCEPTANCE CRITERIA (Continued)

MIL-E-1 Test	Test	AQL (%)	Limits Min.	LAL	Bogey	UAL	Max.	Units
Measurements Acceptance Tests, Part 2 (Continued)								
4.9.12.1	Low Pressure Voltage Breakdown: Pressure = 20 ±5 mm Hg.; Voltage = 300 Vac	6.5	—	—	—	—	—	
4.9.19.1	White Noise: Note 3							
	Rp = 10,000 Ohms; Ck = 1000 μf;	2.5	—	—	—	—	50	mv pk-pk
	Peak Acceleration = 15 G	2.5	—	—	—	—	5	mVac
Degradation Rate Acceptance Tests, Note 4								
4.9.5.3	Subminiature Lead Fatigue:	2.5	2	—	—	—	—	arcs
4.9.20.5	Shock: Hammer Angle = 10.5°	20	—	—	—	—	—	
4.9.20.6	Fatigue: Note 6.. G = 10; Variable Frequency	6.5	—	—	—	—	—	
- - - -	Post Shock and Fatigue Test End Points:							
	White Noise	—	—	—	—	—	50.0	mv pk-pk
		—	—	—	—	—	5.0	mVac
	Heater-Cathode Leakage							
	Ehk = +100 Vdc	—	—	—	—	—	5.0	μAdc
	Ehk = -100 Vdc	—	—	—	—	—	5.0	μAdc
	Change in Plate Current (1) of Individual Tubes △ Ib	—	—	—	—	—	20	%
4.9.6.3	Glass Strain:	6.5	—	—	—	—	—	

MIL-E-1 Ref.	Test	AQL (%)	Allowable Defectives per Characteristic 1st Sample	Combined Samples	Limits Min.	Max.	Units
Acceptance Life Tests, Note 4							
4.11.3.1	Stability Life Test: (1 Hour) Eb = 250 Vdc; Ec2 = 150 Vdc; Rk = 680 Ohms; Ehk = +200 Vdc; Rg1 = 4.0 Meg; TA = Room	1.0	—	—	—	—	
4.11.4	Stability Life Test End Points: Change in Plate Current (1) of Individual Tubes △ Ib	—	—	—	—	15	%
4.11.3.1 4.11.3.1.1	Survival Rate Life Test: (100 Hours) Stability Life Test Conditions or Equivalent; TA = Room	—	—	—	—	—	
4.11.4	Survival Rate Life Test End Points:						
	Continuity and Shorts (Inoperatives)	1.5	—	—	—	—	
	Change in Plate Current (1) of Individual Tubes △ Ib	1.0	—	—	—	15	%
4.11.7	Heater Cycling Life Test: Ef = 7.0 V; 1 min. on, 4 min. off; Ehk = 140 Vac; Ec1 = Ec2 = Eb = O V	2.5	—	—	—	—	
4.11.5 4.11.3.1	Intermittent Life Test: Note 5 Stability Life Test Conditions; T Envelope = +250°C min.; 1000 Hour Requirements Do Not Apply	—	—	—	—	—	

ACCEPTANCE CRITERIA (Continued)

MIL-E-1 Ref.	Test	AQL (%)	Allowable Defectives per Characteristic		Limits		Units
			1st Sample	Combined Samples	Min.	Max.	
Acceptance Life Tests, Note 4 (Continued)							
4.11.3.1 4.11.4	Intermittent Life Test End Points: (500 Hours)						
	Inoperatives	—	1	3	—	—	
	Grid Current Ic1	—	1	3	0	-0.5	μAdc
	Heater Current	—	2	5	161	194	mA
	Change in Plate Current (1) of Individual Tubes △ Ib	—	1	3	—	20	%
	Plate Current (3) △ Ib	—	2	5	—	20	%
	Heater-Cathode Leakage	—	2	5	—	—	
	Ehk = +100 Vdc	—	—	—	—	5.0	μAdc
	Ehk = -100 Vdc	—	—	—	—	5.0	μAdc
	Insulation of Electrodes	—	2	5	—	—	
	g1-all	—	—	—	100	—	Meg
	p-all	—	—	—	100	—	Meg
	g2-all	—	—	—	75	—	Meg
	Total Defectives	—	4	8	—	—	

ACCEPTANCE CRITERIA NOTES:

1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding inoperatives and mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective.

2: All tubes shall be tested for continuity of all circuits, including duplicate pin connections to the same electrode; for shorts between any of the tube elements or between the elements and the no-connection base pins; and for air leaks.

Testing for shorts shall be performed using the Sylvania Automatic Tapper, B5-1379-A6. Each tube shall be tapped a total of six taps, three in each of two planes 90° apart. The tapper shall be adjusted so that the peak acceleration level delivered to the tube is 75 G's as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a dc device capable of detecting as shorts the following interelement resistances of the given time durations.

Interelement Resistance	*Time Duration*
4.5 megohms or less	80 μsec or greater
2.2 megohms or less	27 μsec or greater
1.0 megohm or less	14 μsec or greater
0.1 megohm or less	4.5 μsec or greater
10,000 ohms or less	2.5 μsec or greater

Continuity testing shall be performed with tapping of the tube as specified in MIL-E-1 Par. 4.7.5.

Tubes which give indication of one or more of the following shall be rejected without retesting.

(a) Any short during tapping
(b) Any open circuit
(c) Air leaks (as defined in MIL-E-1 Par.3.2.4.3)

3: The tube shall be rigidly mounted on a table vibrating such that the instantaneous values of acceleration shall constitute approximately a "White Noise" spectrum which is free from discontinuities from 100 cps to 5000 cps. The spectrum of instantaneous acceleration shall be such that each octave of bandwidth delivers 2.3 G's rms acceleration. With this the case, the rms value of acceleration for any bandwidth within the specified spectrum is equal to

$$G\ rms = 2.3\ G \sqrt{3.32 \log_{10} (f2/f1)}$$

f2 and f1 are the upper and lower frequencies respectively of the band under consideration. The degree of clipping of the peak accelerations shall be such that the peak value of acceleration is at least 15 G's.

The voltage (ep) produced across the resistor (Rp) as a result of vibration shall be coupled through a compensating amplifier to a low pass filter. The compensating amplifier shall have a high input impedance of (0.25 megohm or more) and shall be adjusted to compensate for any insertion losses in the filter. The combined frequency response of amplifier and filter shall be flat within ±0.5 db from 50 cps to 8000 cps, shall be down no more than 5 db at 10,000 cps and at 20 cps, and down at least 40 db at 13,000 cps. For reading the peak to peak value of output voltage the filter output shall be fed directly to the input of a Ballantine Model 305 peak to peak electronic voltmeter or equal, while the rms value shall be measured with a Hewlett-Packard Model 400C or equal.

4: Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.5.3	Subminiature lead fatigue
4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.7	Heater cycling life test
4.11.5	Intermittent life test

5: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze placed in contact with the bulb. Envelope temperature requirement will be satisfied if a tube, having bogey Ib (±5%) under normal test conditions, is determined to operate at maximum specified temperature at any position on the life test rack.

6: The tubes shall be rigidly mounted on a table vibrating at a constant acceleration level of 10 G. The frequency of vibration shall be varied from 30 cps to 3000 cps and back to 30 cps with three minutes being the time required to sweep the range in each direction. The rate of change of frequency with time shall be such that the frequency various logarithmically with time. The tubes shall be vibrated for a total of six hours, that is two hours in each of the three positions X1, X2 and Y1. All general test voltages shall be applied to the tube under test.

ACCEPTANCE CRITERIA NOTES (Continued)

7: Prior to this test, tubes shall be preheated five (5) minutes at conditions indicated below. Test within three (3) seconds after preheating. Three-minute test is not permitted. Grid Emission shall be the last test performed on the sample selected for the Grid Emission Test.

Ef	Eb	Ec1	Ec2	Rk	Rg1
V	Vdc	Vdc	Vdc	Ohms	Meg
7.5	250	0	150	680	4.0

8: Maximum total distortion of the filament supply voltage shall be 5%. The frequency response of the peak to peak measuring device from 20 cps to 5000 cps must be within 0.5 db of its response at 400 cps.

9: Insert a cold tube into the test socket having all Plate Current (1) conditions applied and record Ib continuously for three (3) minutes. Plate Current must reach 90% of the three (3) minute figure within the time indicated.

APPLICATION DATA

The Type 6788 is a Premium Subminiature sharp cut-off pentode designed for audio amplifier service. It has particular advantage as a high gain audio amplifier or regulator amplifier where high plate loads are desired at low plate current.

This type is characterized by extra-ordinary freedom from interelement short circuits of short term duration, by high resistance to interelement leakage, and by stable performance. In addition, vibrational output when the tube is subjected to wide band (White Noise) vibration is held to a very low value. It is designed for service at high altitudes and where severe conditions of mechanical shock, vibration and high temperature are encountered. These characteristics give the type special value in guided missile applications.

To insure correlation with actual field conditions and thereby enhance equipment reliability, vibrational noise output is controlled by the "white noise test" as shown in the acceptance criteria. Briefly, this test consists of subjecting the tube to a white noise vibration spectrum covering the frequency band of 100 to 5000 cps at a rms level of 2.3 g's per octave and a peak level of 15 g's. Limits are shown for both peak and rms output. A further discussion of the white noise vibrational test is included in the frontal section of this manual.

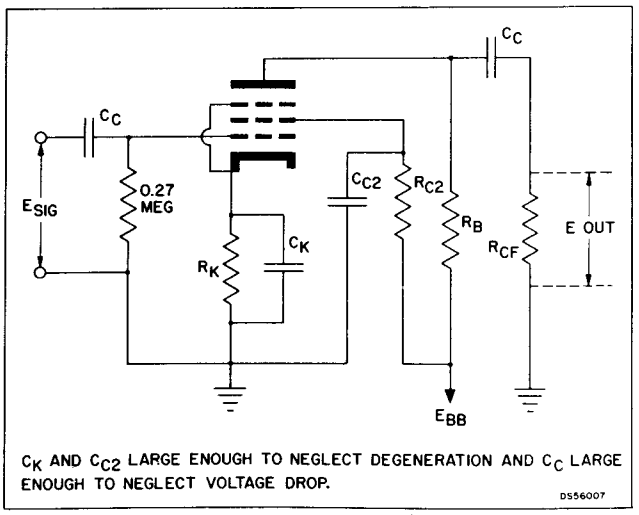
The 6788 is manufactured and inspected to meet the applicable specification for reliability. Life expectancy is described by the life tests, specified on the attached pages. The actual life expectancy of the tubes in an operating circuit is affected by both the operating and environmental conditions involved. Likewise, the life tests specified indicate performance under certain operating criteria to a set of specified end points. Performance at conditions other than those specified can usually be estimated only roughly as giving better or poorer life expectancy. For further discussion of life expectancy, reference should be made to the frontal section of this manual.

When operated under conditions common to on-off control applications, the tube exhibits freedom from the development of interface resistance. The heater-cathode construction is designed to withstand intermittent operation.

RESISTANCE COUPLED AMPLIFIER DATA

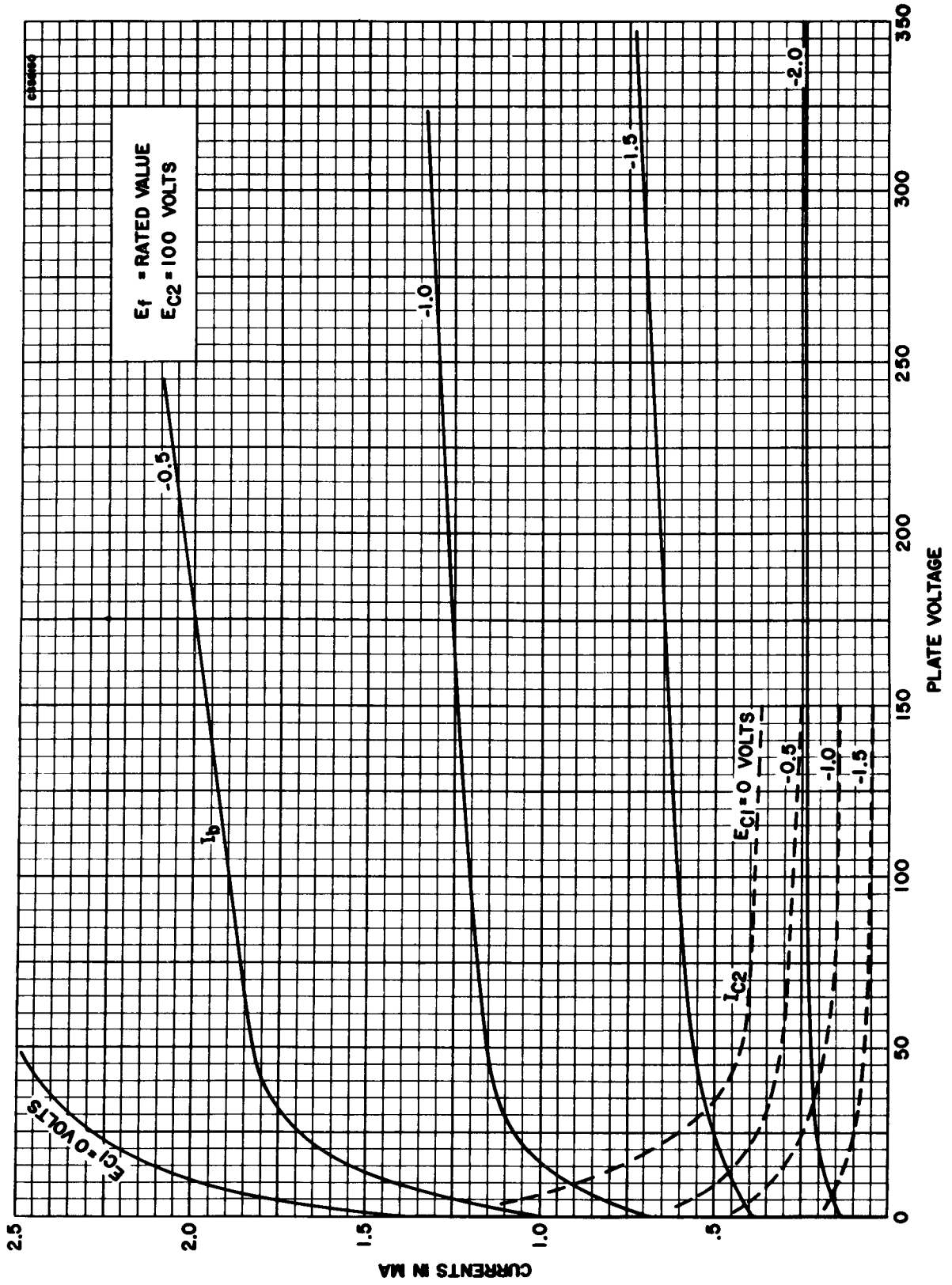
	Ebb = 100 Volts						Ebb = 250 Volts					
Rb (megohms)	0.1		0.27		0.47		0.1		0.27		0.47	
Rc2 (megohms)	0.82		2.2		3.9		0.82		2.2		3.9	
Rcf (megohms)	0.27	0.47	0.47	1.0	0.47	1.0	0.27	0.47	0.47	1.0	0.47	1.0
Rk (ohms)	1800	1800	4700	3900	6800	6800	560	1000	1500	1200	2200	2200
Ib (ma)	.400	.400	.177	.187	.118	.116	1.36	1.16	.575	.61	.365	.367
Ic2 (ma)	.055	.054	.024	.026	.016	.016	.19	.17	.082	.083	.050	.050
Ec1 (volts)	-.82	-.82	-.95	-.83	-.91	-.89	-.87.	-1.36	-1.02	-.83	-.92	-.92
Ec2 (volts)	54.1	55.0	46.2	46.4	38.7	38.7	96.	113	72.	66.	56	56
Eb (volts)	59.2	59.2	51.2	49.1	44.6	44.6	113.	129	87.	85.	76	76
Esig (volts, rms)	0.05	0.05	0.05	0.05	0.05	0.05	0.10	0.10	0.10	0.10	0.10	0.10
Eout (volts, rms)	3.3	3.65	4.5	5.9	4.7	6.2	9.3	10.1	16.2	19.8	18.2	23.6
Gain	66.	73.	90.	118.	94.	124.	93.	101.	162.	198.	182.	236.
% Distortion	2.0	2.0	3.9	3.75	4.6	4.25	0.9	1.0	1.8	1.15	3.7	3.2
Esig* (volts, rms)	0.09	0.10	0.07	0.07	0.06	0.06	0.18	0.47	0.25	0.13	0.14	0.17
Eout (volts, rms)	5.9	7.28	6.3	8.2	5.6	7.35	16.6	45.	39.	25.7	25.3	38.
Gain	65.5	72.8	90.	117.	93.	122.	92.	96.	156.	198.	181.	224.
% Distortion	3.4	3.8	5.0	5.0	5.0	5.0	1.4	5.0	4.8	1.70	5.0	5.0

*Maximum signal for 5% distortion or $\frac{1}{8}$ microampere grid current.

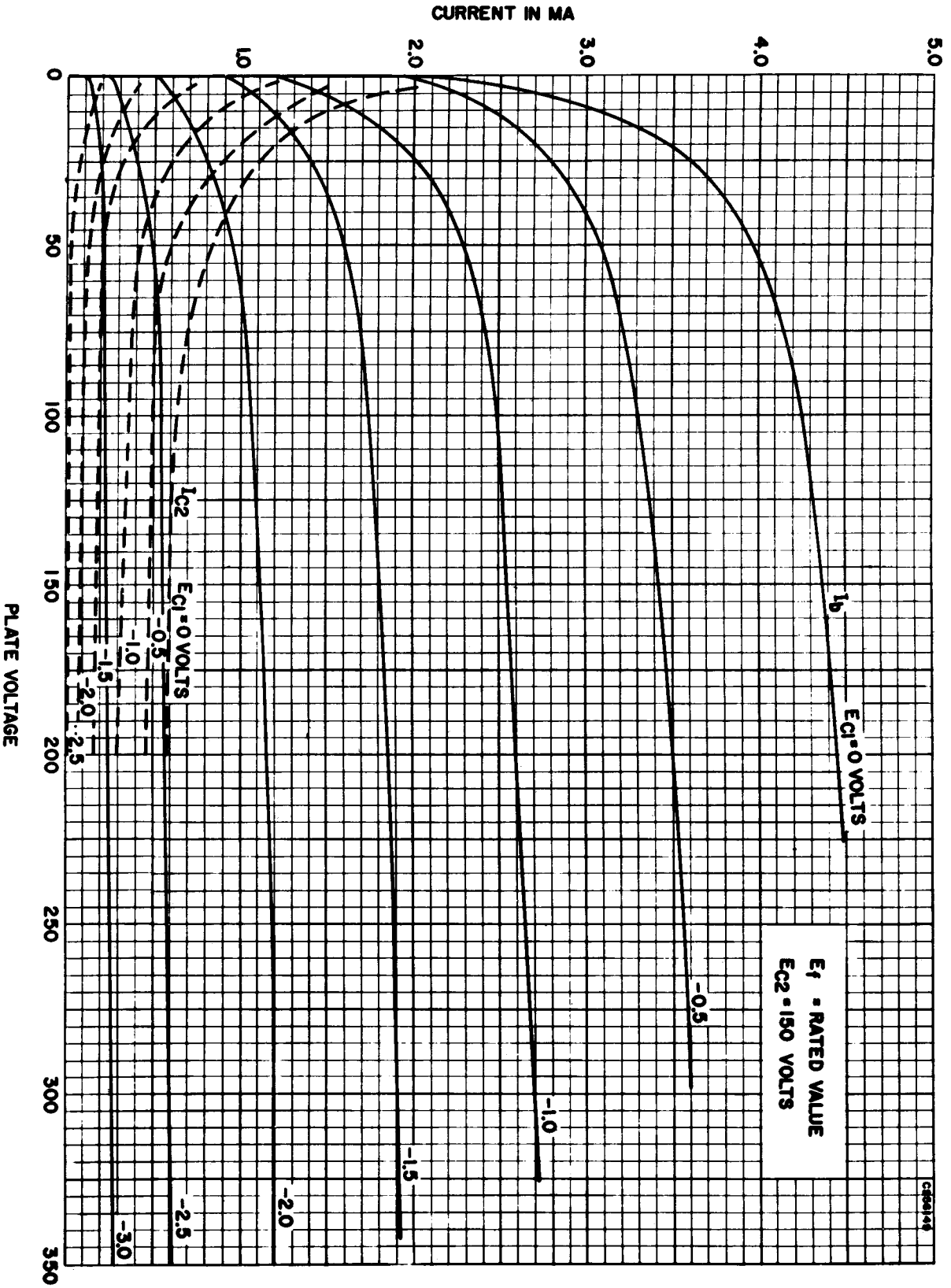


Resistance coupled amplifier circuit

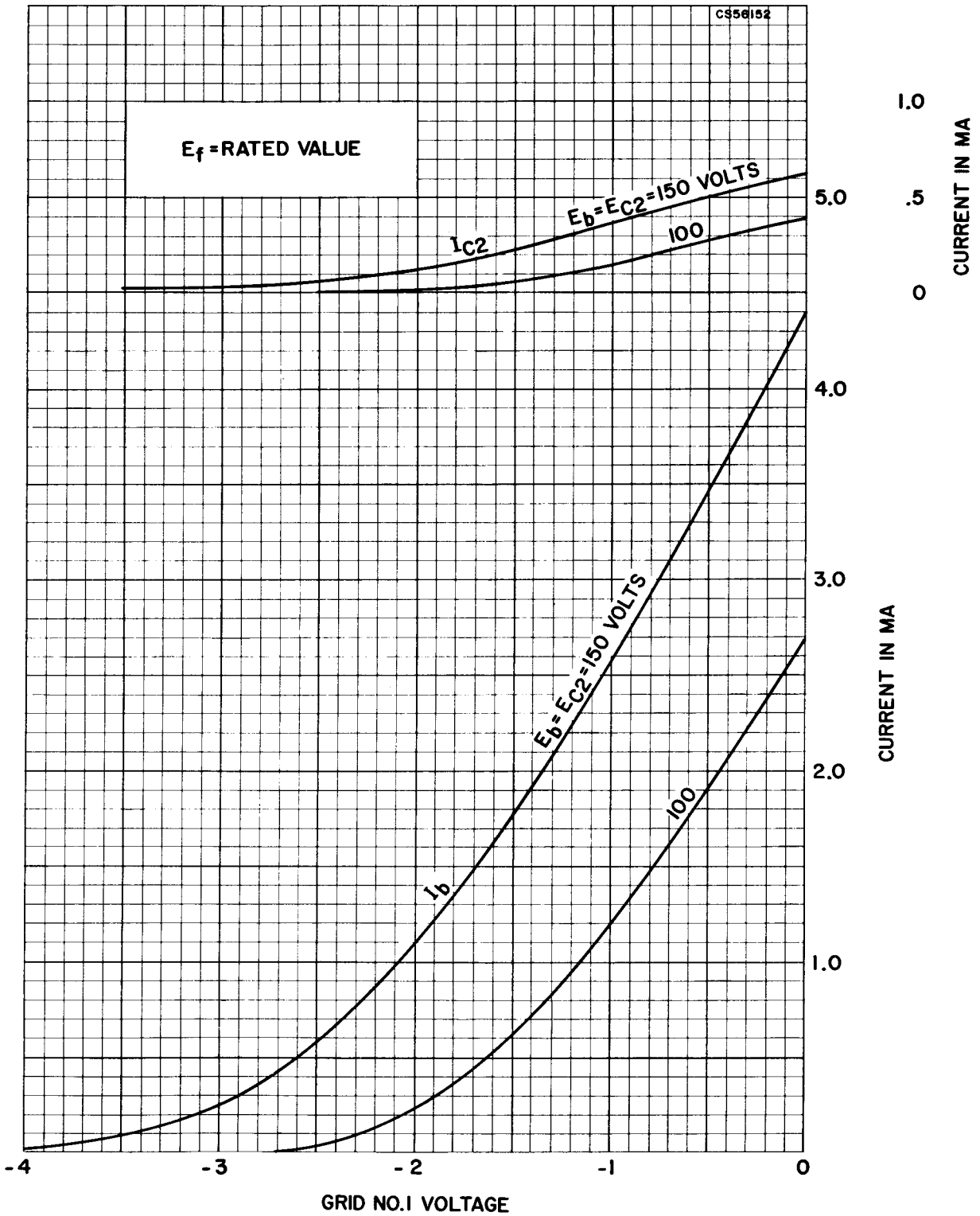
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS
(PENTODE CONNECTED)



AVERAGE TRANSFER CHARACTERISTICS
(PENTODE CONNECTED)