



*Excellence in Electronics*

The CK5902WA is a heater-cathode type beam power pentode of subminiature construction. This type is characterized by long life and stable performance. It is suitable for service where severe conditions of mechanical shock or vibration are encountered. It is designed for audio power amplifier service in equipments with low plate supply voltages, and is capable of approximately one watt output in the audio range. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.

**TYPE**  
**CK5902WA**

**MECHANICAL DATA**

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads  
Length: 1.5")

TERMINAL CONNECTIONS:

- |                         |                         |
|-------------------------|-------------------------|
| Lead 1 Grid #1          | Lead 5 Plate            |
| Lead 2 Cathode, Grid #3 | Lead 6 Heater           |
| Lead 3 Heater           | Lead 7 Grid #2          |
| Lead 4 Cathode, Grid #3 | Lead 8 Cathode, Grid #3 |

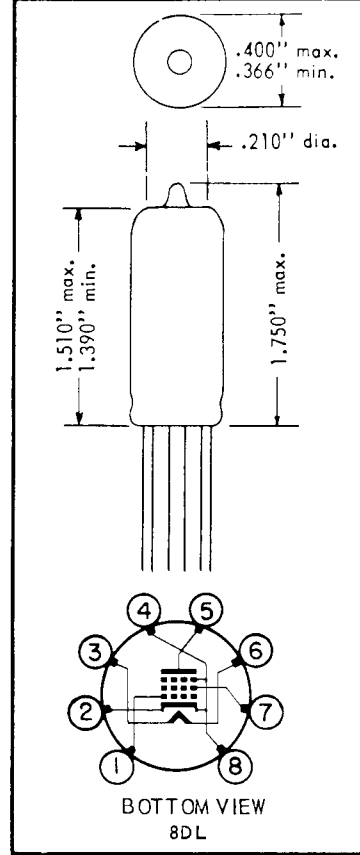
MECHANICAL RATINGS:

- |  |        |
|--|--------|
| Maximum Impact Acceleration (Shock Test—Note 3)                | 450 G  |
| Maximum Uniform Acceleration (Centrifuge Test—Note 4)          | 1000 G |
| Maximum Vibrational Acceleration (96 Hour Fatigue Test—Note 5) | 2.5 G  |
| Maximum Bulb Temperature                                       | 220 °C |

MOUNTING POSITION: Any

**ELECTRICAL DATA**

CAUTION———To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.



RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	110	110	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Grid #2 Voltage	Ec2:	----	110	110	155	Vdc
Plate Dissipation	Pp:	----	----	3.3	3.7	W
Grid #2 Dissipation	Pg2:	----	----	0.24	0.4	W
Grid #1 Circuit Resistance	Rg1:	----	----	----	0.55	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	----	+ 200	Vdc
Cathode Current	Ik:	----	----	----	50	mAdc
Cathode Resistance	Rk:	----	270	270	----	ohms
Plate Current (1):	Ib (1):	----	----	30	----	mAdc
Grid #2 Current	Ic2:	----	----	2.2	----	mAdc
Transconductance (1)	Sm(1):	----	----	4200	----	μmhos
Plate Resistance	rp:	----	----	0.015	----	Meg.

Tentative Data



## RELIABLE SUBMINIATURE PENTODE

## ELECTRICAL DATA (cont'd.)

## CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
<b>MEASUREMENTS ACCEPTANCE TESTS PART 1</b>		Combined AQL=1.0% excluding Mechanical and Inoperatives								
Heater Current:		0.4	If:	427	----	----	----	473	----	mA
Heater-Cathode Leakage:	Ehk= + 100 Vdc Ehk= -100Vdc	0.4	Ihk: Ihk:	----	----	----	----	10 10	----	$\mu$ Adc $\mu$ Adc
Grid Current:	Rg1= 1.0 Meg.	0.4	Ic (1):	----	----	----	----	-1.0	----	$\mu$ Adc
Plate Current (1):		0.4	Ib (1):	24.0	27.0	30.0	33.0	36.0	8.0	mA
Plate Current (2):	Ec1= -40Vdc	0.4	Ib (2):	----	----	----	----	100	----	$\mu$ Adc
Power Output (1):	Esig= 6.4 Vac; Rp= 3000 ohms.	0.4	Po(1):	0.75	----	----	----	----	----	W
Continuity and Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-4) (Note 10)	----	----	----	----	----	----	----	----	----
<b>MEASUREMENTS ACCEPTANCE TESTS PART 2</b>										
Insulation of Electrodes:	Ef= 6.3 V Eg1-all= -100 Vdc Ep-all= -300 Vdc	2.5	Rg1-all: Rp-all:	250 250	----	----	----	----	----	Meg. Meg.
Screen Current:		2.5	Ic2:	0	----	2.2	----	4.0	----	mA
Transconductance (1):		2.5	Sm(1):	3500	3850	4200	4550	4900	950	$\mu$ mhos
Grid Emission:	Eb= 250Vdc; Ec2= 150Vdc; Rk= 1350 ohms; Ef= 7.5 V; Rg= 1.0 Meg. Preheat 5 minutes at Ec1= 0Vdc; Test at Ec1= -40Vdc.	6.5	Isc1:	----	----	----	----	-2.0	----	$\mu$ Adc
Power Output (2):	Ef= 5.7V; Esig= 6.4 Vac; Rp= 3000 ohms. (Note 9)	2.5	$\Delta_{EfPo(2)}$ :	----	----	----	----	15	----	%
AF Noise:	Esig= 150mVac; Ecc2= 110 Vdc; Ec1= -8.7 Vdc; Rg1= 0.5Meg.; Rg2=0.01Meg.; Rp= 2000 ohms; Rk=0; Cg2= 4 $\mu$ f	2.5	EB:	----	----	----	----	17	----	VU
Plate Resistance:		6.5	rp:	0.01	----	----	----	----	----	Meg.
Capacitance:			Cgp:	----	----	----	----	0.20	----	$\mu$ f
Capacitance:	(Note 2)	6.5	Cin:	5.5	----	6.5	----	7.5	----	$\mu$ f
Capacitance:			Cout:	6.5	----	7.5	----	8.5	----	$\mu$ f
Low Pressure Voltage Breakdown::	Pressure= 21 $\pm$ 3 mm Hg; Voltage= 300 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	F= 40 cps; G= 15; Rp= 2000 ohms.	2.5	Ep:	----	----	----	----	30	----	mVac
Vibration (3):	F= 70-2000 cps; G= 15; T= 3 minutes; Rp= 2000 ohms; Positions X1 and X2 only	6.5	ep:	----	----	----	----	200 peak to peak	----	mv
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
<b>DEGRADATION RATE ACCEPTANCE TESTS</b>										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk= + 100 Vdc; Rg= 0.1 Meg.; Hammer Angle= 30° (Note 3)	20	----	----	----	----	----	----	----	----

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RELIABLE SUBMINIATURE PENTODE

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic
							1st Sample Combined Samples
<b>DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)</b>							
Fatigue (1):	96 Hours; G= 2.5; Fixed frequency; F= 25 min., 60 max. (Note 5)	6.5	----	----	----	----	
Shock (2):	Ehk= + 100 Vdc; Rg= 0.1 Meg.; Hammer Angle= 120°+ Rubber Pad; G= 75; t= 10 Milliseconds (Note 14)	20	----	----	----	----	
Fatigue (2):	6 Hours; G= 10; F= 130-2000- 130 cps. (Note 13)	6.5	----	----	----	----	
Post Shock (1) & (2) and Fatigue (1) & (2) Test End Points:							
Vibration (2):	F= 40 cps; G= 15; Rp= 2000 ohms	----	Ep:	----	60	mVac	
Heater-Cathode Leakage:	Ehk= + 100 Vdc Ehk= -100 Vdc	----	Ihk: Ihk:	----	20 20	$\mu$ Adc $\mu$ Adc	
Change in Power Output (1) of individual tubes:		----	$\Delta_t$ Po(1):	----	20	%	
Grid Current (1):		----	Ic1	----	-3.0	$\mu$ Adc	
Glass Strain (Thermal Shock):		6.5	----	----	----	----	
<b>ACCEPTANCE LIFE TESTS</b>							
Heater Cycling Life Test:	Ef= 7.0V; Eb= Ec1= Ec2= 0V; 1 min. on, 4 min. off; Ehk= 140Vac	1.0	----	2000	----	cycles	
Heater Cycling Life Test End Points:							
Heater-Cathode Leakage:	Ehk= + 100 Vdc Ehk= -100 Vdc	----	Ihk: Ihk:	----	20 20	$\mu$ Adc $\mu$ Adc	
2 & 20 Hour Stability Life Test:	TA= Room; Eb= 250Vdc; Ec2= 150Vdc; Ehk= + 200 Vdc; Rg= 0.47 Meg; Rk= 1350 ohms	----	----	----	----	----	
2 & 20 Hour Stability Life Test End Points:							
Change in Power Output (1) of individual Tubes:	(Typical Sample Size= 50 tubes)	1.0	$\Delta_t$ Po(1):	----	15	%	
100 Hour Survival Rate Life Test:	TA= Room; Eb= 250Vdc; Ec2= 150Vdc; Ehk= + 200 Vdc; Rg= 0.47 Meg.; Rk= 1350 ohms	----	----	----	----	----	
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size= 200 tubes)	----	----	----	----	----	
Inoperatives:		0.65	----	----	----	----	
Power Output (1):		1.0	Po(1):	0.65	----	W	
200 Hour Intermittent Life Test (1):	Eb= 250Vdc; Ec2= 150Vdc; Rk= 1350 ohms; TA= Room; Ehk= + 200Vdc; Rg 1= 0.47 meg.	----	----	----	----	----	

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RELIABLE SUBMINIATURE PENTODE

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic	
							1st Sample	Combined Samples
<b>ACCEPTANCE LIFE TESTS (cont'd.)</b>								
200 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size= 20 Tubes 1st sample, 40 Tubes 2nd sample)	....	....	....	....	....	...	...
Inoperatives:		....	....	....	....	....	1	3
Grid Current (1):		....	lc(1):	0	-2.0	$\mu\text{A}_{dc}$	1	3
Heater Current:		....	If:	414	492	mA	1	3
Change in Power Output (1) of individual tubes:		....	$\Delta_{\uparrow} P_o(1)$ :	....	20	%	1	3
Power Output (2):	(Note 9)	....	$\Delta_{E_f} P_o(2)$ :	....	15	%	1	3
Heater Cathode Leakage:								
Ehk=+100 Vdc		....	lhk:	....	20	$\mu\text{A}_{dc}$	1	3
Ehk=-100 Vdc		....	lhk:	....	20	$\mu\text{A}_{dc}$		
Electrode Insulation								
g1-all		....	Rg1-all:	50	....	Meg. }	1	3
p-all		....	Rp-all:	50	....	Meg. }		
Total Defectives :		....	....	....	....	....	3	6
Intermittent High Temperature Life Test (2):	T Bulb= 220°C, Eb= Ec2= 100Vdc; Ehk= +200Vdc; Rg= 0.47 Meg.; Rk= 220 ohms	....	....	....	....	....	...	...
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	....	....	....	....	....	...	...
Inoperatives:		....	....	....	....	....	1	3
Grid Current (1):		....	lc(1):	0	-2.0	$\mu\text{A}_{dc}$	1	3
Heater Current:		....	If:	414	492	mA	1	3
Power Output (1) Change of individual tubes from initial:		....	$\Delta_{\uparrow} P_o(1)$ :	....	20	%	1	3
Power Output (2):	(Note 9)	....	$\Delta_{E_f} P_o(2)$ :	....	15	%	1	3
Heater-Cathode Leakage:	Ehk=+100Vdc	....	lhk:	....	20	$\mu\text{A}_{dc}$	1	3
	Ehk=-100Vdc	....	lhk:	....	20	$\mu\text{A}_{dc}$		
Insulation of Electrodes:								
g-all		....	Rg-all:	25	....	Meg. }	1	3
p-all		....	Rp-all:	25	....	Meg. }		
Power Output (1) Average Change:		....	Avg. $\Delta_{\uparrow} P_o(1)$ :	....	15	%	...	...
Total Defectives:		....	....	....	....	....	3	6
1000 Hour High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	....	....	....	....	....	...	...
Inoperatives:		....	....	....	....	....	1	3
Grid Current:		....	lc1:	....	-2.0	$\mu\text{A}_{dc}$	1	3

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RELIABLE SUBMINIATURE PENTODE

ELECTRICAL DATA (cont'd.)

TEST	CONDITIONS	CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)					Allowable Defects	
		AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	1st Sample	Combined Samples
<b>ACCEPTANCE LIFE TESTS (cont'd.)</b>								
Heater Current:		----	I <sub>f</sub> :	414	496	mA	1	3
Power Output (1) change of individual tubes from initial:		----	$\Delta_{\frac{1}{2}} P_o(1)$ :	----	25	%	1	3
Power Output (2):	(Note 9)	----	$\Delta_{E_f} P_o(2)$ :	----	20	%	1	3
Heater Cathode Leakage:								
E <sub>hk</sub> = +100 Vdc		----	I <sub>hk</sub> :	----	20	$\mu$ A <sub>dc</sub>	1	3
E <sub>hk</sub> = -100 Vdc		----	I <sub>hk</sub> :	----	20	$\mu$ A <sub>dc</sub>		
Electrode Insulation:								
g1-all		----	R <sub>g1</sub> -all:	25	----	Meg.	2	5
p-all		----	R <sub>p</sub> -all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D. - 1 7/8" long) connected to cathode lead.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by  $\pm 5\%$  heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of Power Output for individual tubes from that value measured at E<sub>f</sub> = 6.3V to that value measured at E<sub>f</sub> = 5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "MIL-E-1 Basic Specifications".

Note 11: Operation time is the time in seconds required for the plate current to attain a value within  $\pm 15\%$  of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed. A cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300  $\pm$  50 microseconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent short	600,000 ohms
500 microseconds	500,000 ohms
100 microseconds	100,000 ohms
60 microseconds	1,000 ohms

Tubes which give an indication of one or more of the following shall be rejected as inoperable:  
 A) either a permanent or tap short at any time during the tapping procedure  
 B) any open circuit  
 C) air leaks

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RELIABLE SUBMINIATURE PENTODE

ELECTRICAL DATA (Cont'd.)

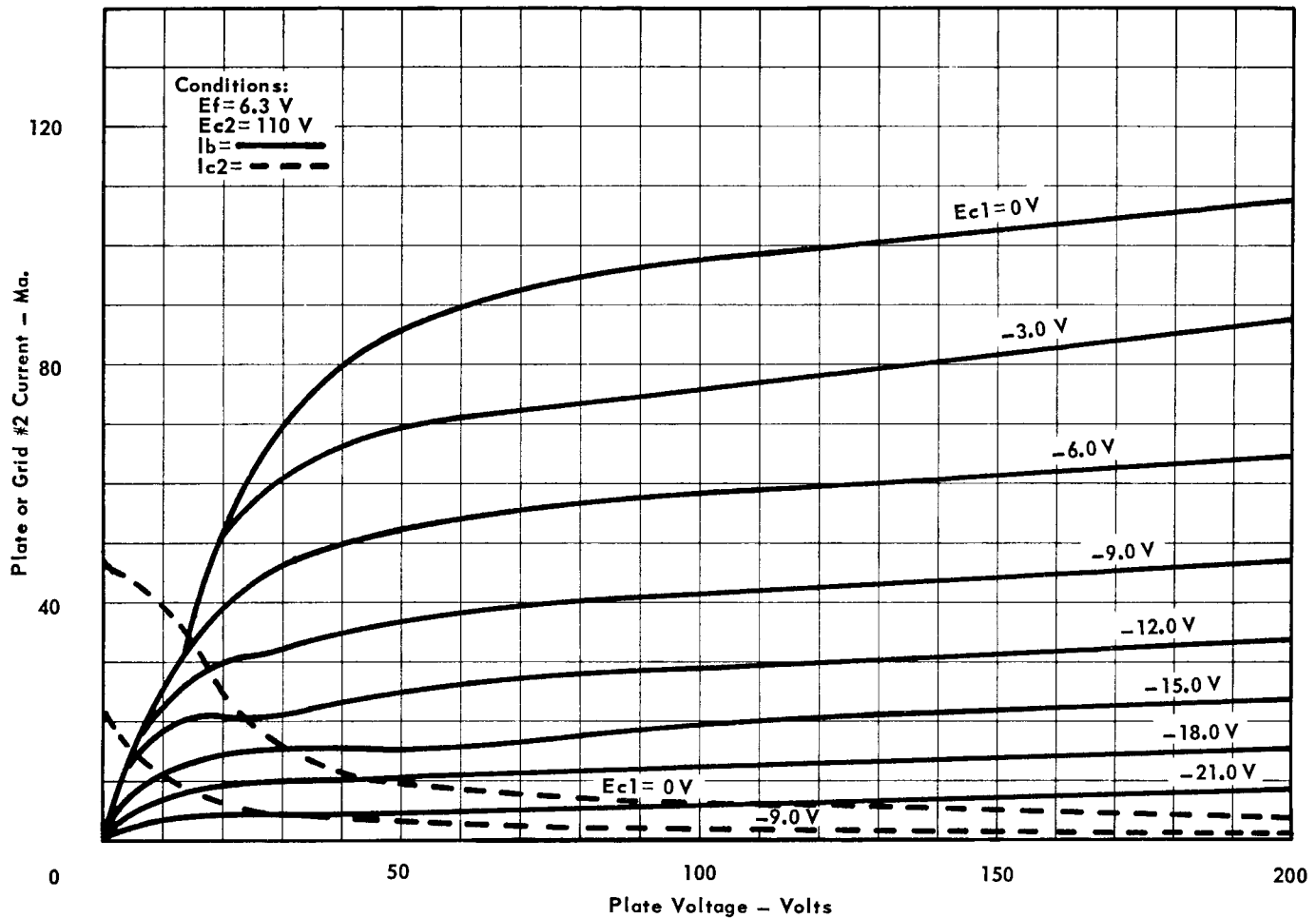
NOTES (cont'd.)

Note 13: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one more of the following defects shall be considered failures.

- (a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.
- (b) Tubes which do not comply with post fatigue limits. This is a destructive test.

Note 14: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

AVERAGE PLATE CHARACTERISTICS

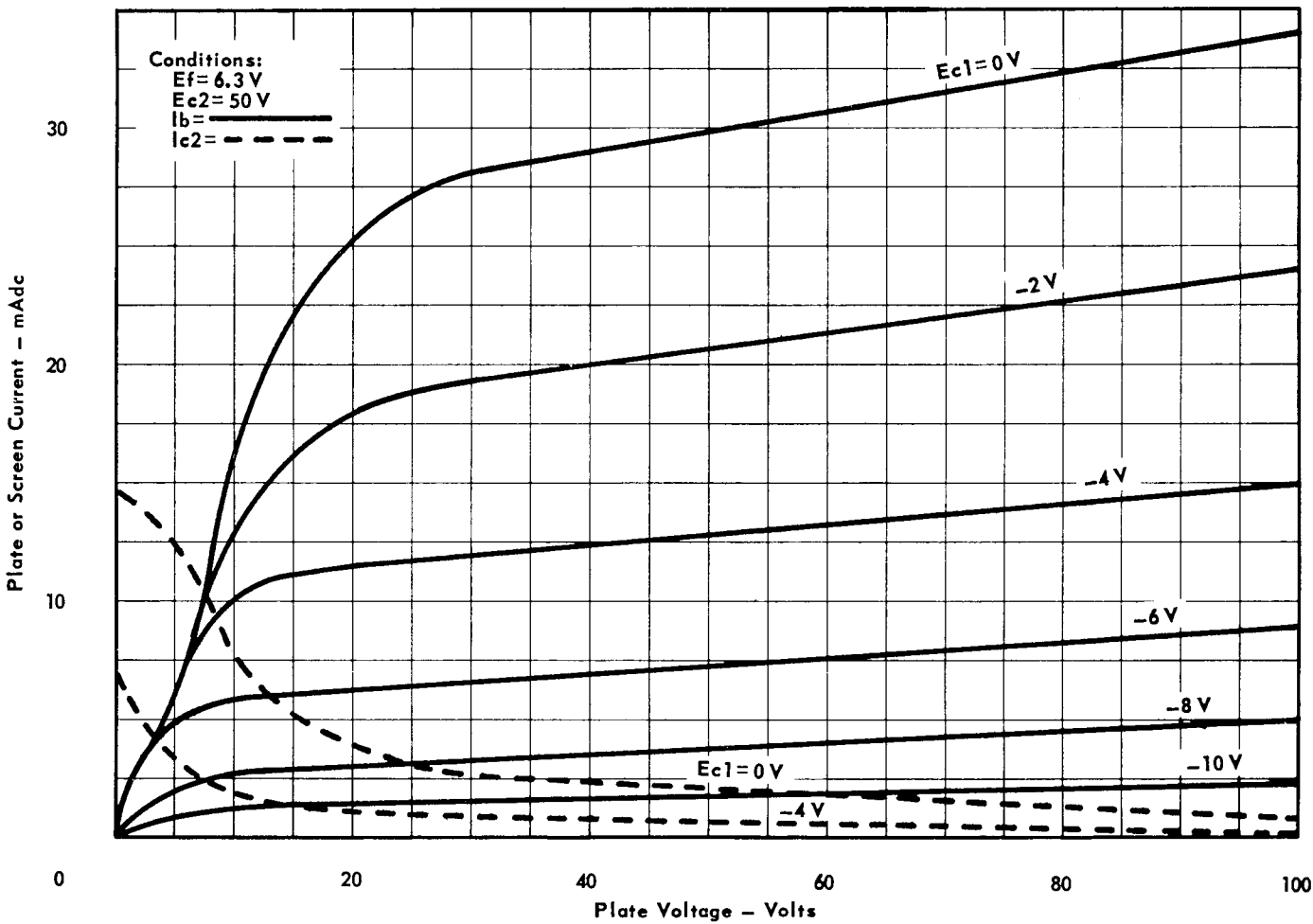


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RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



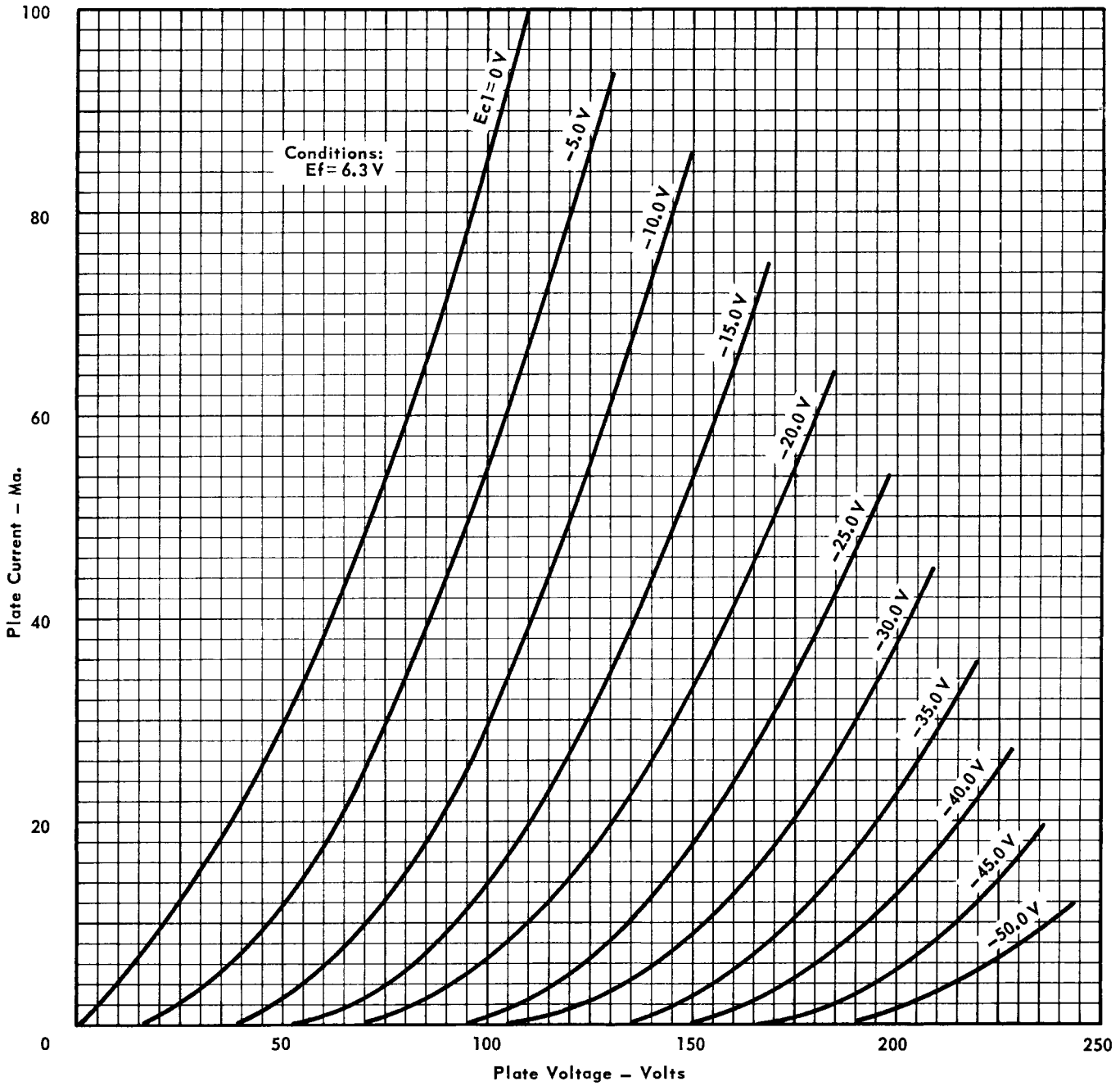
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RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS  
(Triode Connected)



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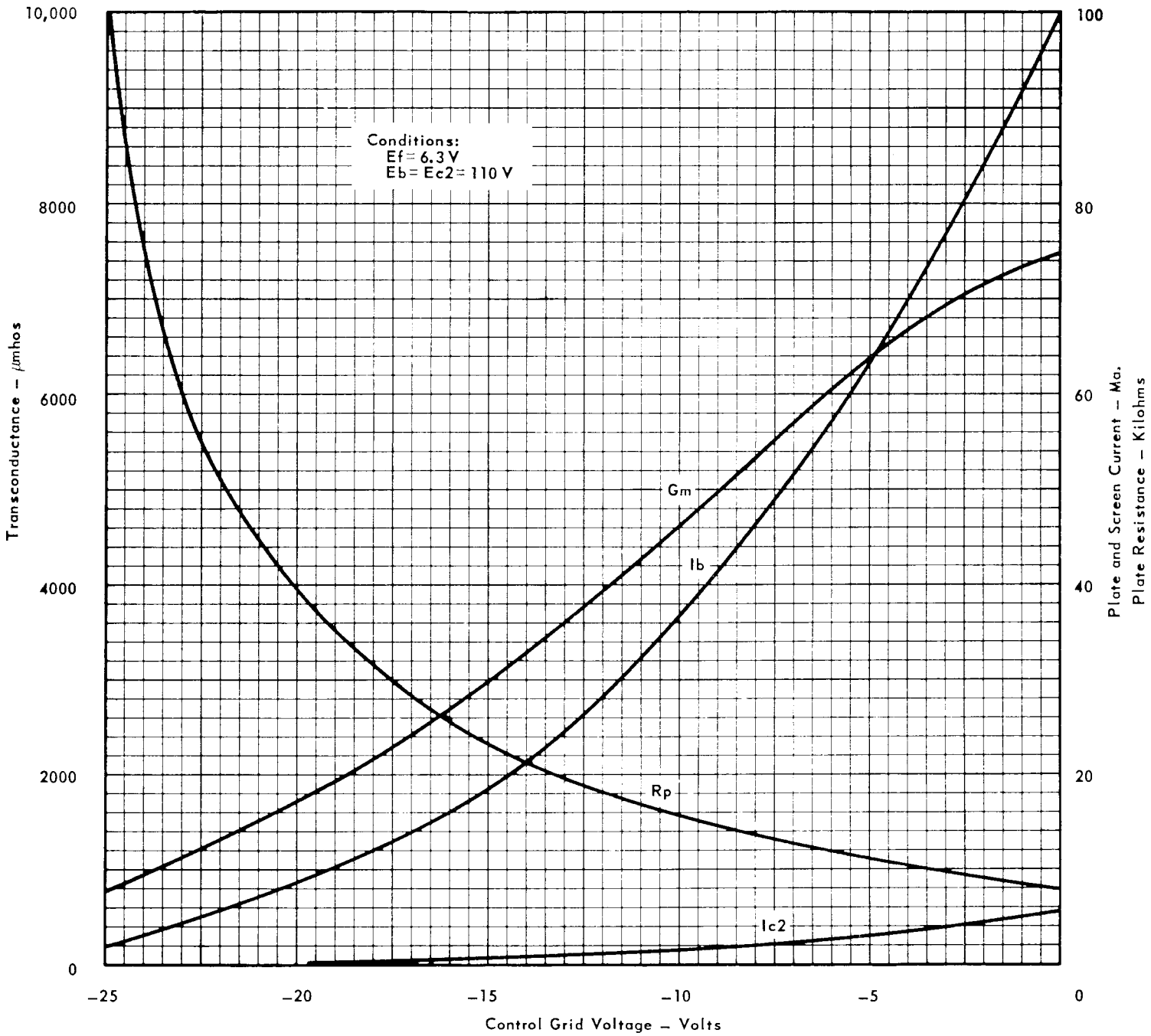
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RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



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