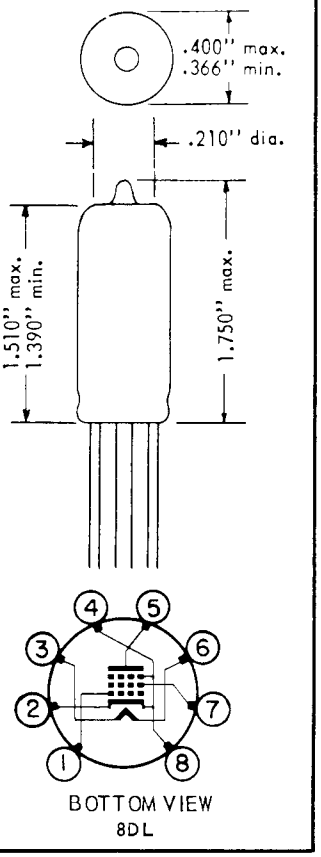
# TYPE CK5902WA

*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.



BOTTOM VIEW
8DL

## 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

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **MEASUREMENTS ACCEPTANCE TESTS PART 1** | | | Combined AQL = 1.0% excluding Mechanical and Inoperatives | | | | | | | |
| Heater Current: | | 0.4 | If: | 427 | ---- | ---- | ---- | 473 | ---- | mA |
| Heater-Cathode Leakage: | Ehk = +100 Vdc | 0.4 | Ihk: | ---- | ---- | ---- | ---- | 10 | ---- | μAdc |
| | Ehk = -100 Vdc | | Ihk: | ---- | ---- | ---- | ---- | 10 | ---- | μAdc |
| Grid Current: | Rg1 = 1.0 Meg. | 0.4 | Ic (1): | ---- | ---- | ---- | ---- | -1.0 | ---- | μAdc |
| Plate Current (1): | | 0.4 | Ib (1): | 24.0 | 27.0 | 30.0 | 33.0 | 36.0 | 8.0 | mAdc |
| Plate Current (2): | Ec1 = -40 Vdc | 0.4 | Ib (2): | ---- | ---- | ---- | ---- | 100 | ---- | μAdc |
| 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) | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| **MEASUREMENTS ACCEPTANCE TESTS PART 2** | | | | | | | | | | |
| Insulation of Electrodes: | Ef = 6.3 V<br>Eg1-all = -100 Vdc<br>Ep-all = -300 Vdc | 2.5 | Rg1-all:<br>Rp-all: | 250<br>250 | ---- | ---- | ---- | ---- | ---- | Meg.<br>Meg. |
| Screen Current: | | 2.5 | Ic2: | 0 | ---- | 2.2 | ---- | 4.0 | ---- | mAdc |
| Transconductance (1): | | 2.5 | Sm(1): | 3500 | 3850 | 4200 | 4550 | 4900 | 950 | μmhos |
| Grid Emission: | Eb = 250 Vdc; Ec2 = 150 Vdc; Rk = 1350 ohms; Ef = 7.5 V; Rg = 1.0 Meg. Preheat 5 minutes at Ec1 = 0 Vdc; Test at Ec1 = -40 Vdc. | 6.5 | Isc1: | ---- | ---- | ---- | ---- | -2.0 | ---- | μAdc |
| Power Output (2): | Ef = 5.7 V; Esig = 6.4 Vac; Rp = 3000 ohms. (Note 9) | 2.5 | $\Delta_{Ef}$Po(2): | ---- | ---- | ---- | ---- | 15 | ---- | % |
| AF Noise: | Esig = 150 mVac; Ecc2 = 110 Vdc; Ec1 = -8.7 Vdc; Rg1 = 0.5Meg.; Rg2 = 0.01Meg.; Rp = 2000 ohms; Rk = 0; Cg2 = 4μf | 2.5 | EB: | ---- | ---- | ---- | ---- | 17 | ---- | VU |
| Plate Resistance: | | 6.5 | rp: | 0.01 | ---- | ---- | ---- | ---- | ---- | Meg. |
| Capacitance: | | | Cgp: | ---- | ---- | ---- | ---- | 0.20 | ---- | μμf |
| Capacitance: | (Note 2) | 6.5 | Cin: | 5.5 | ---- | 6.5 | ---- | 7.5 | ---- | μμf |
| Capacitance: | | | Cout: | 6.5 | ---- | 7.5 | ---- | 8.5 | ---- | μμf |
| Low Pressure Voltage Breakdown:: | Pressure = 21 ± 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 $X_1$ and $X_2$ only | 6.5 | ep: | ---- | ---- | ---- | ---- | 200 peak to peak | ---- | mv |
| Operation Time: | (Note 11) | 4.0 | t: | ---- | ---- | ---- | ---- | 20 | ---- | sec. |
| **DEGRADATION RATE ACCEPTANCE TESTS** | | | | | | | | | | |
| Subminiature Lead Fatigue: | | 2.5 | ---- | 4.0 | ---- | ---- | ---- | ---- | ---- | arcs |
| Shock (1): | Ehk = +100 Vdc; Rg = 0.1 Meg.; Hammer Angle = 30° (Note 3) | 20 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

## 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 1 st Sample | Allowable Defects per Characteristic Combined Samples |
|---|---|---|---|---|---|---|---|---|
| **DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)** | | | | | | | | |
| 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 | ---- | Ihk: | ---- | 20 | μAdc | | |
| | Ehk= -100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| Change in Power Output (1) of individual tubes: | | ---- | $\Delta_t$ Po(1): | ---- | 20 | % | | |
| Grid Current (1): | | ---- | $I_{c1}$ | ---- | -3.0 | μAdc | | |
| Glass Strain (Thermal Shock): | | 6.5 | ---- | ---- | ---- | ---- | | |
| **ACCEPTANCE LIFE TESTS** | | | | | | | | |
| 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 | ---- | Ihk: | ---- | 20 | μAdc | | |
| | Ehk= -100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| 2 & 20 Hour Stability Life Test: | TA= Room; Eb= 250Vdc; Ec2= 150Vdc; Ehk= + 200 Vdc; Rg= 0.47Meg; 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. | ---- | ---- | ---- | ---- | ---- | | |

## 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 | Allowable Defects per Characteristic Combined Samples |
|---|---|---|---|---|---|---|---|---|
| **ACCEPTANCE LIFE TESTS (cont'd.)** | | | | | | | | |
| 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): | | ---- | Ic (1): | 0 | -2.0 | μAdc | 1 | 3 |
| Heater Current: | | ---- | If: | 414 | 492 | mA | 1 | 3 |
| Change in Power Output (1) of individual tubes: | | ---- | $\Delta_t$ Po (1): | ---- | 20 | % | 1 | 3 |
| Power Output (2): | (Note 9) | ---- | $\Delta_{Ef}$ Po (2): | ---- | 15 | % | 1 | 3 |
| Heater Cathode Leakage: | | | | | | | | |
| Ehk=+100 Vdc | | ---- | Ihk: | ---- | 20 | μAdc | 1 | 3 |
| Ehk=-100 Vdc | | ---- | Ihk: | ---- | 20 | μAdc | | |
| 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= 100 Vdc; Ehk= +200 Vdc; 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): | | ---- | Ic(1): | 0 | -2.0 | μAdc | 1 | 3 |
| Heater Current: | | ---- | If: | 414 | 492 | mA | 1 | 3 |
| Power Output (1) Change of individual tubes from initial: | | ---- | $\Delta_t$ Po (1): | ---- | 20 | % | 1 | 3 |
| Power Output (2): | (Note 9) | ---- | $\Delta_{Ef}$ Po (2): | ---- | 15 | % | 1 | 3 |
| Heater-Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | 1 | 3 |
| | Ehk=-100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| Insulation of Electrodes: | | | | | | | | |
| g-all | | ---- | Rg-all: | 25 | ---- | Meg. | 1 | 3 |
| p-all | | ---- | Rp-all: | 25 | ---- | Meg. | | |
| Power Output (1) Average Change: | | ---- | Avg. $\Delta_t$ Po (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: | | ---- | Ic1: | ---- | -2.0 | μAdc | 1 | 3 |

## 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 | Allowable Defects per Characteristic Combined Samples |
|---|---|---|---|---|---|---|---|---|
| **ACCEPTANCE LIFE TESTS (cont'd.)** | | | | | | | | |
| Heater Current: | | ---- | If: | 414 | 496 | mA | 1 | 3 |
| Power Output (1) change of individual tubes from initial: | | ---- | $\Delta_t$ Po (1): | ---- | 25 | % | 1 | 3 |
| Power Output (2): | (Note 9) | ---- | $\Delta_{Ef}$ Po (2): | ---- | 20 | % | 1 | 3 |
| Heater Cathode Leakage: | | | | | | | | |
| Ehk= +100 Vdc | | ---- | Ihk: | ---- | 20 | μAdc | 1 | 3 |
| Ehk= -100 Vdc | | ---- | Ihk: | ---- | 20 | μAdc | | |
| Electrode Insulation: | | | | | | | | |
| g1 - all | | ---- | Rg1 - all: | 25 | ---- | Meg. | 2 | 5 |
| p - all | | ---- | Rp - 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 ± 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 Ef= 6.3V to that value measured at Ef= 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 ± 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± 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

## ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

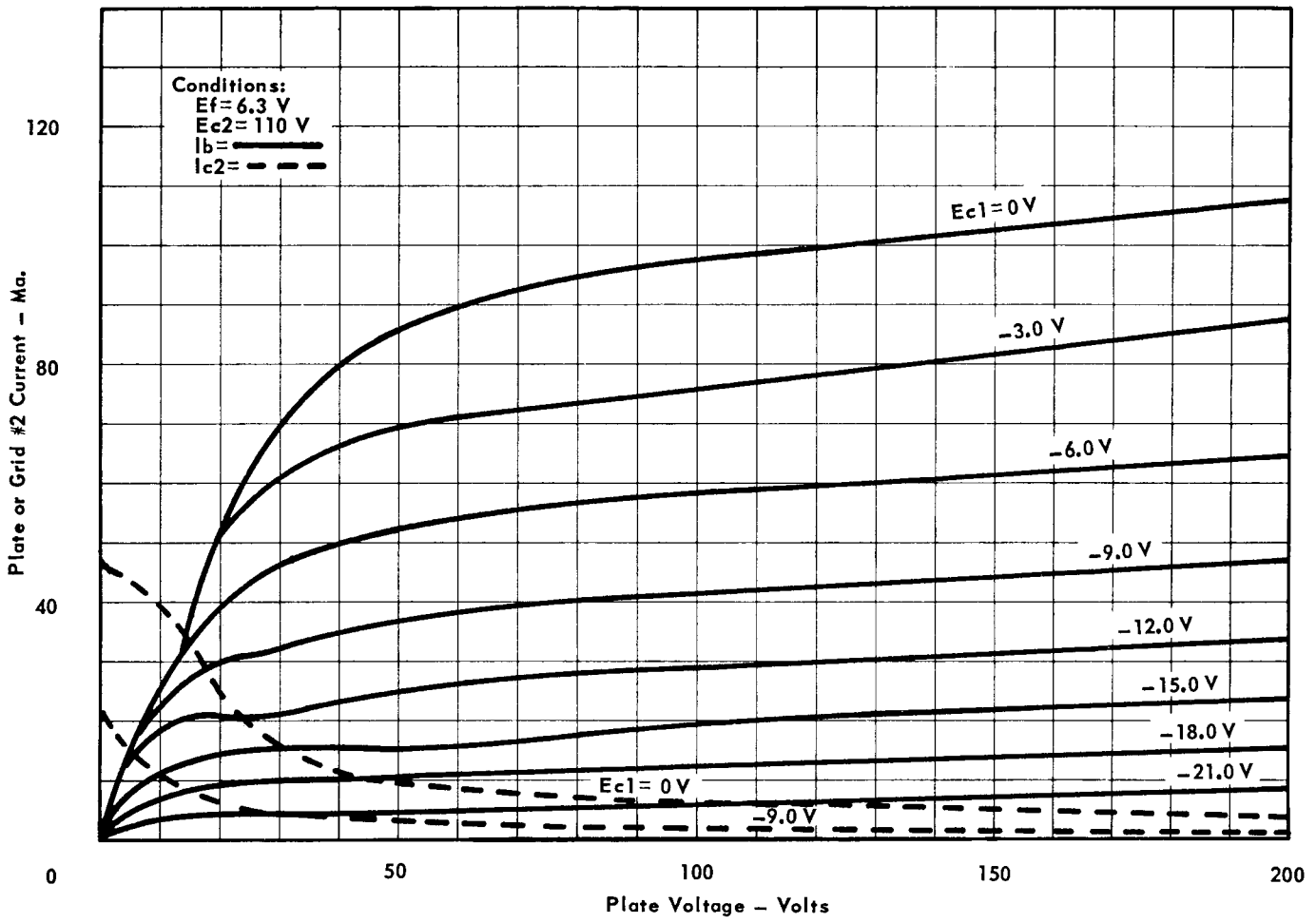
Note 13: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one more of the following defects shall be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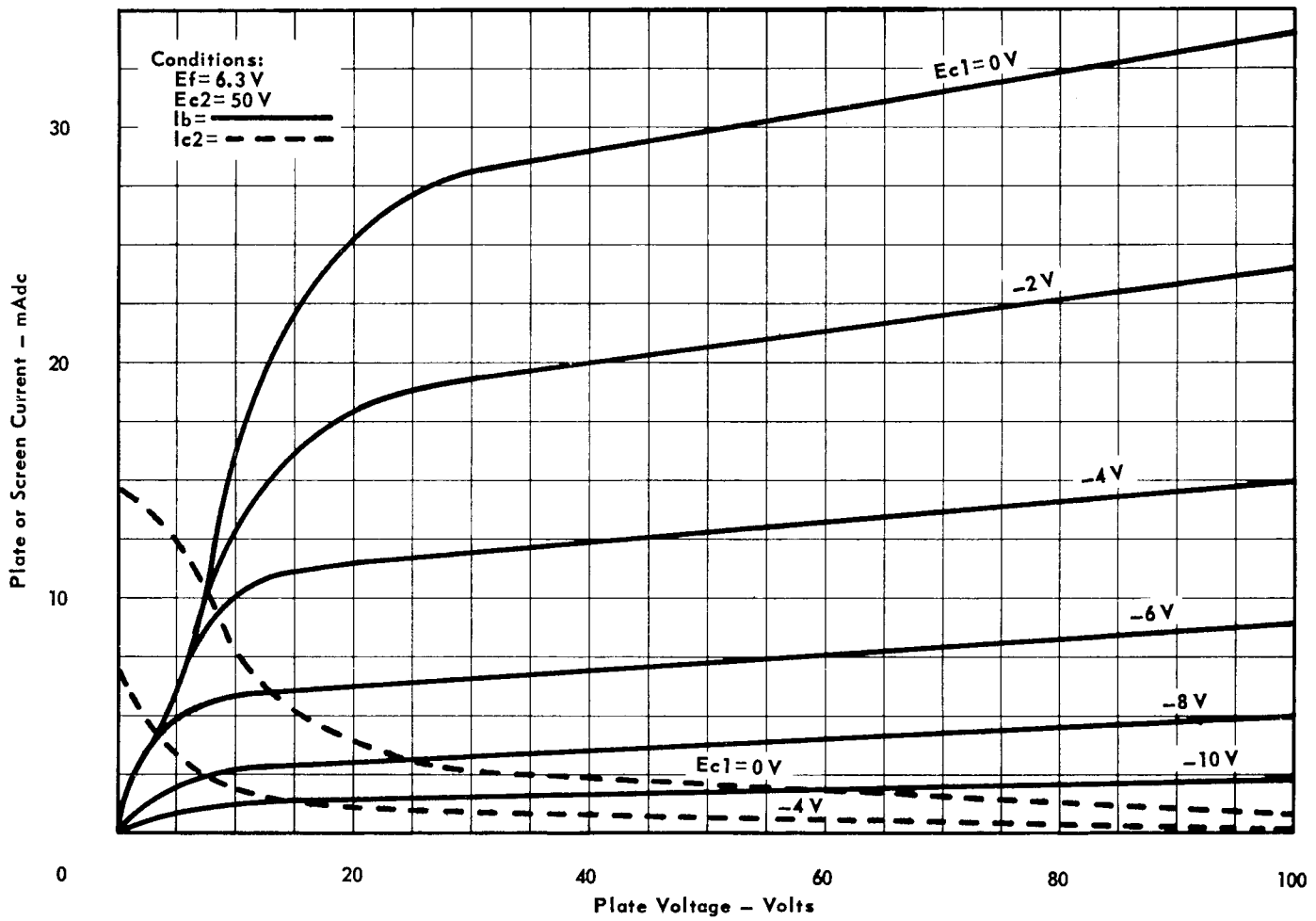
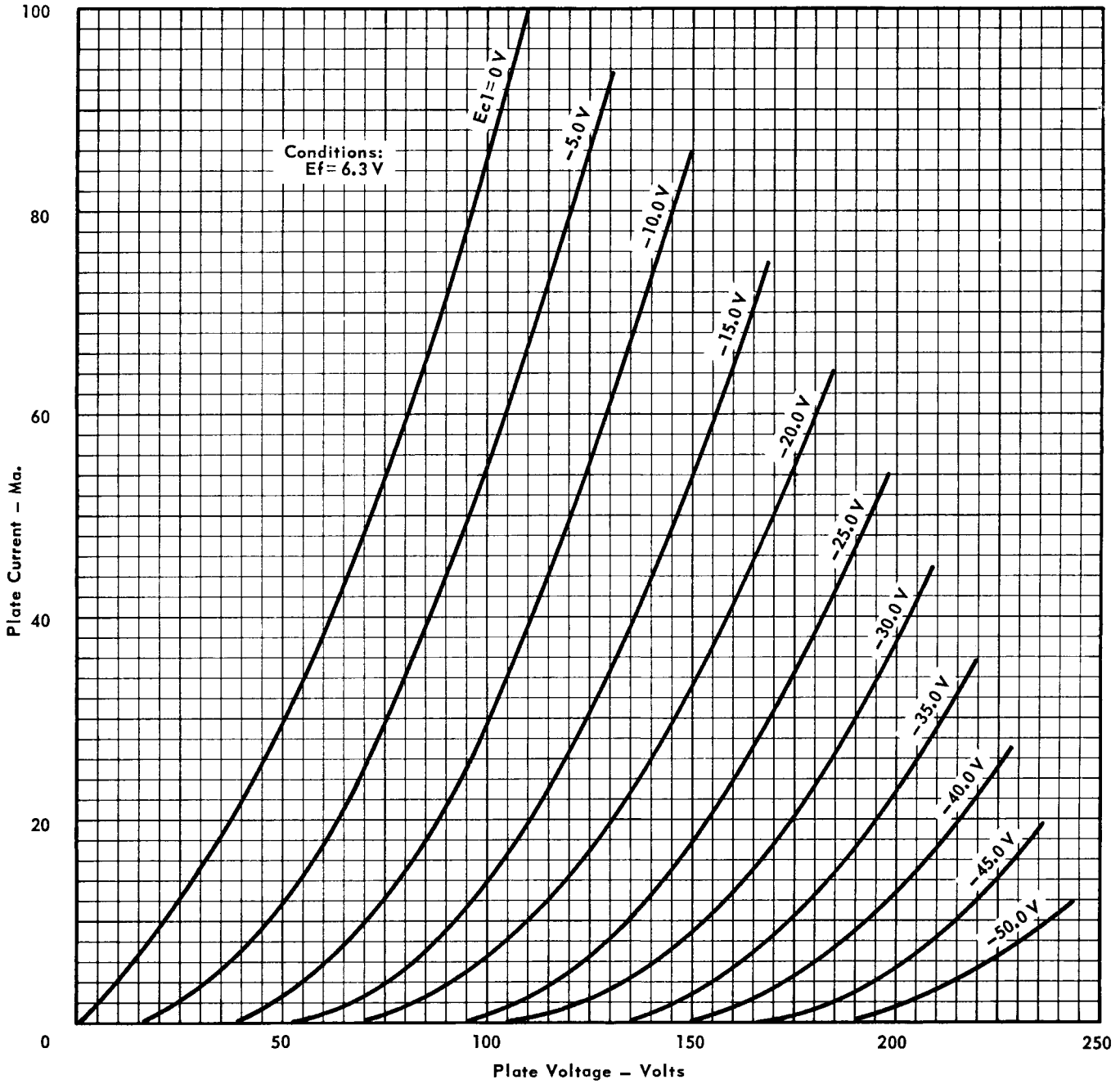
**RELIABLE SUBMINIATURE PENTODE**

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



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## RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS