



Excellence in Electronics

**TYPE
CK6021WA**

The CK6021WA is a heater-cathode type medium-mu double triode of subminiature construction capable of operation in the UHF region. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. 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.

MECHANICAL DATA

ENVELOPE: T-3 Glass

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

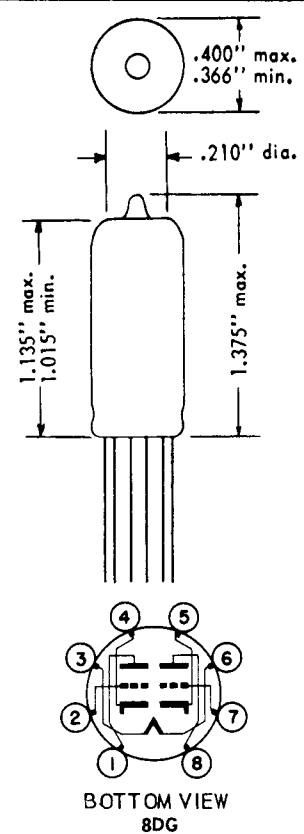
TERMINAL CONNECTIONS

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

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 design 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:	----	100	100	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid Voltage	Ec1:	-55	0	0	----	Vdc
Plate Dissipation (per plate)	Pp/p:	----	----	0.65	0.7	W
Grid #1 Circuit Resistance	Rg/g:	----	----	1.0	1.1	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	Vdc
Plate Current (per plate)	Ib/p:	0.5	----	6.5	22	mA _{dc}
Grid Current (per grid)	Ic/c:	----	----	----	5.5	mA _{dc}
Cathode Resistance (per unit)	Rk:	----	150	150	----	ohms
Transconductance (per plate)	Sm/p:	----	----	5400	----	μmhos
Amplification Factor	Mu/p:	----	----	35	----	----

Tentative Data

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.



RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)
In the following tests, each unit is tested separately

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:	285	----	----	----	315	----	mA
Heater-cathode Leakage (1):	Ehk = +100 Vdc Ehk = -100 Vdc	0.4	lhk (1): lhk (1):	----	----	----	----	3.5 3.5	----	μ Adc μ Adc
Grid Current:	Eb = 150 Vdc; Rk/k = 300 ohms; Rg = 1.0 Meg.	0.4	lc (1):	----	----	----	----	-0.3	----	μ Adc
Plate Current (1):		0.4	lb (1):	4.5	5.6	6.5	7.3	8.5	2.3	mAdc
Plate Current (2):	Ec1 = -6.5 Vdc	0.4	lb (2):	----	----	----	----	100	----	μ Adc
Transconductance (1):		0.4	Sm (1):	4450	5000	5400	5800	6350	1100	μ mhos
Continuity to Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3V Eg-all = -100Vdc Ep-all = -300Vdc	2.5	Rg1-all: Rp-all:	250 250	----	----	----	----	----	Meg. Meg.
Plate Current (1) Difference between Sections:		2.5	lb:	----	----	----	----	1.5	----	mAdc
Transconductance (2):	Ef = 5.7V; (Note 9)	2.5	$\Delta_{Ef} S_m (2)$:	----	----	----	----	10	----	%
Grid Emission:	Eb = 250 Vdc; Rg/g = 1.0 Meg.; Rk/k = 2200 ohms; Ef = 7.5V; Preheat 5 minutes at Ec = 0; Test at Ec = -9.0 Vdc	6.5	lsc1:	----	----	----	----	-0.5	----	μ Adc
AF Noise:	Esig = 65 mVac; Rg = 0.1 Meg; Rp = 0.01 Meg.; Rk = 75 ohms; Ck = 1000 μ f; Units connected in parallel	2.5	EB:	----	----	----	----	17	----	VU
Pulse Emission (1):	Eb = 150 Vdc; Ec1 = -25 Vdc; Egk = +30V; Rk/k = 1.0 ohm; duty cycle = 1%; tp = 10 μ sec. (Note 13)	2.5	$\left\{ \begin{array}{l} ik: \\ \Delta_{tp} ik: \end{array} \right.$	320 ----	----	----	----	----	10	ma. %
Pulse Emission (2):	Ef = 5.9V; Eb = 150 Vdc; Ec1 = -25 Vdc; tp = 10 μ sec, duty cycle = 1%; egk = +30v; Rk/k = 1.0 ohms; (Note 13)	6.5	ik:	300	----	----	----	----	----	ma
Heater-Cathode Leakage (2):	Ef = -6.7V (Pin 6 negative); Ehk = +100 Vdc (cathode neg.); t = 16 seconds (Note 14)	6.5	lhk (2):	----	----	----	----	1.0	----	μ Adc
Amplification Factor:		6.5	mu:	30	----	35	----	40	----	----
Capacitance:			Cgp:	1.2	----	1.5	----	1.8	----	μ f
Capacitance:			Cin:	1.8	----	2.4	----	3.0	----	μ f
Capacitance:	(Note 2)	6.5	Cout (Unit #1):	0.20	----	0.28	----	0.36	----	μ f
Capacitance:			Cout (Unit #2):	0.22	----	0.32	----	0.42	----	μ f
Capacitance:			Cgg:	----	----	----	----	0.013	----	μ f
Capacitance:			Cpp:	----	----	----	----	0.52	----	μ f
Operation Time:	Note 11	4.0	t:	----	----	----	----	20	----	sec.
Low Pressure Voltage Breakdown:	Pressure = 21 \pm 3 mmHg; Voltage = 300 Vac.	6.5	----	----	----	----	----	----	----	----

INDUSTRIAL TUBE DIVISION

RAYTHEON MANUFACTURING COMPANY



RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

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

In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL - E - 1 SYMBOL	MIN	MAX	MIL - E - 1 UNITS	Allowable Defects per characteristic 1st Sample	Combined Samples
MEASUREMENTS ACCEPTANCE TESTS PART 2 (cont'd.)								
Vibration (2):	F= 40 cps; G= 15; Rp= 10,000 ohms	2.5	Ep:	----	20	mVac		
Vibration (3):	F= 70-2000; t= 3 minutes; G= 15; Rp= 10,000 ohms. Positions X ₁ and X ₂ only.	6.5	ep:	----	125 peak to peak	mv		
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	----	----	----	----		
Fatigue (1):	96 hours; G= 2.5; Fixed frequency; F= 25 min., 60 max. (Note 5)	6.5	----	----	----	----		
Shock (2):	Ehk= 100Vdc; Rg= 0.1 Meg; Hammer Angle= 120°+ Rubber Pad; t= 10 milliseconds; G= 75; (Note 16)	20	----	----	----	----		
Fatigue (2):	6 hours; G= 10; F= 130-2000-130 cps (Note 15)	6.5	----	----	----	----		
Post Shock (1) & (2) and Fatigue (1) & (2) Test End Points:								
Vibration (2):	F= 40 cps; G= 15; Rp= 10,000 ohms	----	Ep:	----	80	mVac		
Heater - Cathode Leakage (1):	Ehk= + 100 Vdc Ehk= -100 Vdc	----	lhk (1): lhk (1):	----	7.0 7.0	μAdc μAdc		
Change in Trans-conductance (1) of individual tubes:	Ef= 6.3V	----	Δ _f Sm (1):	----	15	%		
Grid Current (1):		----	lc1:	----	-1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef= 7.0V; Eb= Ec1= 0V; Ehk= 140Vac; 1 min on, 4 min off	1.0	----	2000	----	cycles		
Heater Cycle Life Test End Point:								
Heater-Cathode Leakage (1):	Ehk= + 100 Vdc Ehk= -100 Vdc	----	lhk (1): lhk (1):	----	7.0 7.0	μAdc μAdc		
2 & 20 Hour Stability Life Test:	TA= Room; Ehk= + 200 Vdc; Rg/g= 1.0 Meg.	----	----	----	----	----		
2 & 20 Hour Stability Life Test End Points:								
Change in Trans-conductance (1) of individual tubes:	(Typical Sample Size= 50 tubes)	1.0	Δ _f Sm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA= Room; Ehk= + 200 Vdc; Rg/g= 1.0 meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:								
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	4000	----	μmhos		

INDUSTRIAL TUBE DIVISION





RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

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

In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL - E - 1 SYMBOL	MIN	MAX	MIL - E - 1 UNITS	Allowable Defects per Characteristic	1st Sample	Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd.)									
200 Hour Intermittent Life Test (1):	Eb= 250Vdc; Ehk=+ 200Vdc; Rg/g= 1.0 meg; Rk/k= 2200 ohms; TA= Room	----	----	----	----	----	---	---	---
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):	----	-0.9	μ Adc	1	3	
Heater Current:		----	If:	276	328	mA	1	3	
Change in Trans-conductance (1) of individual tubes:		----	$\Delta_{\dagger} S_m (1):$	----	25	%	1	3	
Transconductance (2):	(Note 9)	----	$\Delta_{E_f} S_m (2):$	----	20	%	1	3	
Heater-Cathode Leakage (1):	Ehk=+ 100 Vdc Ehk= -100 Vdc	----	Ihk (1): Ihk (1):	----	10 10	μ Adc μ Adc	1	3	
Electrode Insulation:									
g-all:		----	Rg1-all:	100	----	Meg. }	1	3	
p-all:		----	Rp-all:	100	----	Meg. }	1	3	
Total Defectives:		----	----	----	----	----	3	6	
500 Hour Intermittent Pulse Life Test:	Eb= 250Vdc; Ec1= -25 Vdc; Rk/k= 0; RL/p= 330 ohms; tp= 10 μ sec; duty cycle= 1.0%; egk= + 30 \pm 1 v; TA= Room.	----	----	----	----	----	---	---	---
500 Hour Intermittent Pulse Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---	---
Inoperatives:		----	----	----	----	----	1	3	
Pulse Emission (1):		----	ik:	300	----	ma	1	3	
Change in Pulse Emission (1) of individual tubes from initial:		----	$\Delta_{ik};$ $\Delta_{ik};$	----	-35 + 50	% } % }	1	3	
Total Defectives:		----	----	----	----	----	2	5	
Intermittent High Temperature Life Test (2):	T Bulb= 220 $^{\circ}$ C; Ehk=+ 200 Vdc; Rg/g= 1.0 Meg.	----	----	----	----	----	---	---	---
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):	----	-0.7	μ Adc	1	3	
Heater Current:		----	If:	276	328	mA	1	3	
Transconductance (1) change of individual tubes from initial:		----	$\Delta_{\dagger} S_m (1):$	----	20	%	1	3	
Transconductance (2):	(Note 9)	----	$\Delta_{E_f} S_m (2):$	----	15	%	1	3	
Heater-Cathode Leakage (1):	Ehk=+ 100 Vdc Ehk= -100 Vdc	----	Ihk (1): Ihk (1):	----	10 10	μ Adc μ Adc	1	3	
Insulation of Electrodes:									
g-all:		----	Rg1-all:	50	----	Meg. }	1	3	
p-all:		----	Rp-all:	50	----	Meg. }	1	3	

INDUSTRIAL TUBE DIVISION

RAYTHEON MANUFACTURING COMPANY



RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)
In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic	1st Sample	Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)									
Transconductance (1) Average change:		----	Avg. $\Delta_f S_m$	----	15	%	---	---	---
Total Defectives:		----	----	----	----	----	3	6	6
1000 Hour High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---	---
Inoperatives:		----	----	----	----	----	1	3	3
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	1	3	3
Heater-Current:		----	If:	276	328	mA	1	3	3
Transconductance (1) Change of individual tubes:		----	$\Delta_f S_m$ (1):	----	25	%	1	3	3
Transconductance (2):	(Note 9)	----	$\Delta_{Ef} S_m$ (2):	----	20	%	1	3	3
Heater-Cathode Leakage (1):	Ehk= +100 Vdc Ehk= -100 Vdc	----	Ihk (1): Ihk (1):	----	10 10	μAdc μAdc	1	3	3
Electrode Insulation:									
g-all:		----	Rg1-all:	25	----	Meg. }	2	5	5
p-all:		----	Rp-all:	25	----	Meg. }			
Total Defectives :		----	----	----	----	----	4	8	8

- Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, and MIL-STD-105A.
- Note 2: Without shield.
- 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 transconductance for individual tubes from that value measured at $E_f = 6.3V$ to the value measured at $E_f = 5.7V$.
- Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in the 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 $\pm 10\%$ 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 micro seconds 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

INDUSTRIAL TUBE DIVISION

RAYTHEON MANUFACTURING COMPANY



RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

Note 12: (cont'd.) 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

Note 13: Peak cathode current shall be measured by means of a high impedance oscilloscope or equivalent device connected across a $1.0 \pm 1\%$ cathode resistor. The specified limit refers to the maximum of the pulse amplitude. The variation of the output pulse amplitude between 20% tp and 80% tp shall not exceed the specified limit.

Note 14: Heater-Cathode Leakage (2) is performed as follows:

- A) Preheat tubes for 10 seconds with $E_f = 10.5$ V.
- B) Test immediately by the application of the specified test conditions of this test.
- C) After 16 seconds read Heater-cathode Leakage of each section.

Note 15: 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 heated voltage shall be applied. Tubes which show one or 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.

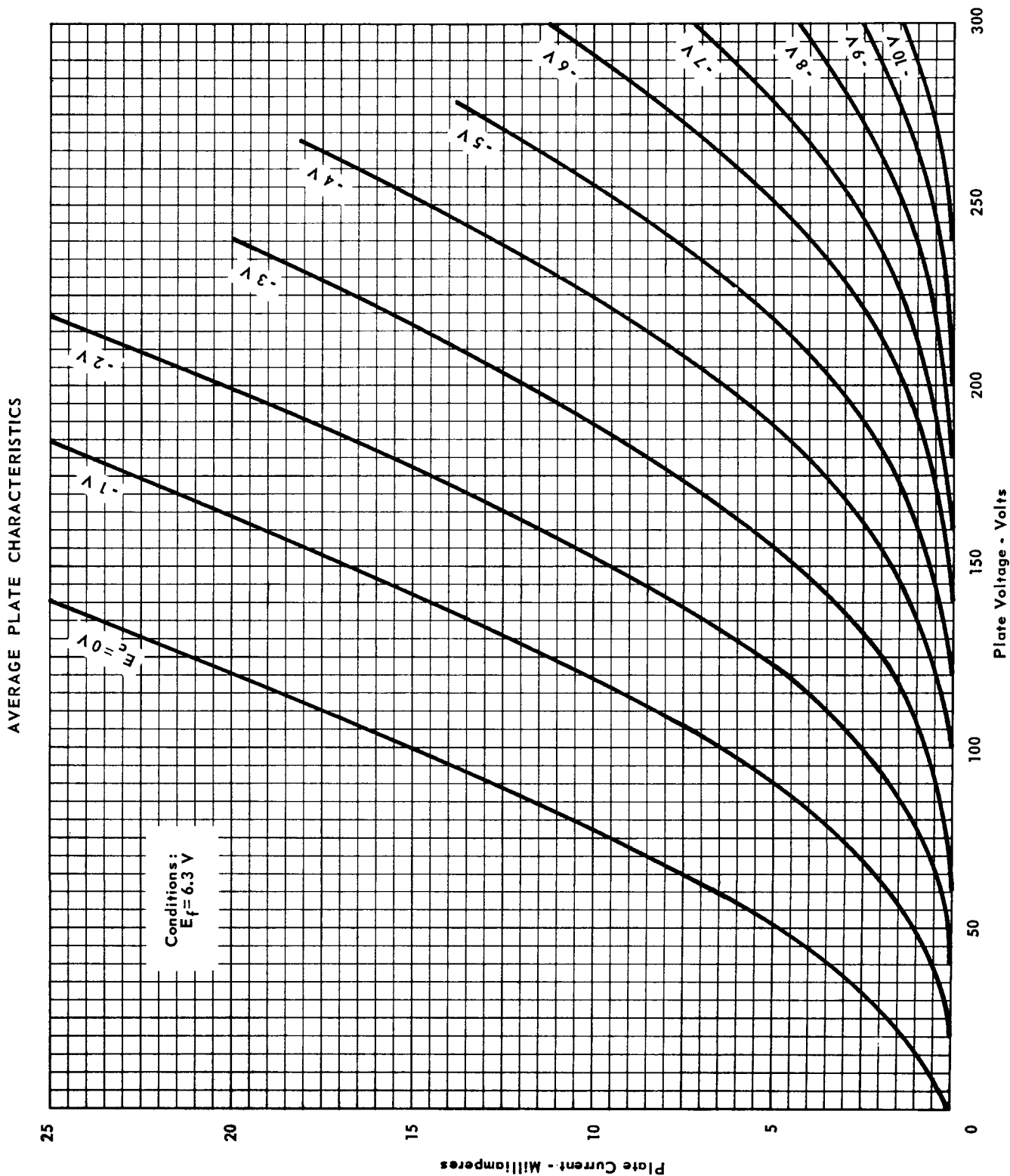
Note 16: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

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RELIABLE SUBMINIATURE DOUBLE TRIODE



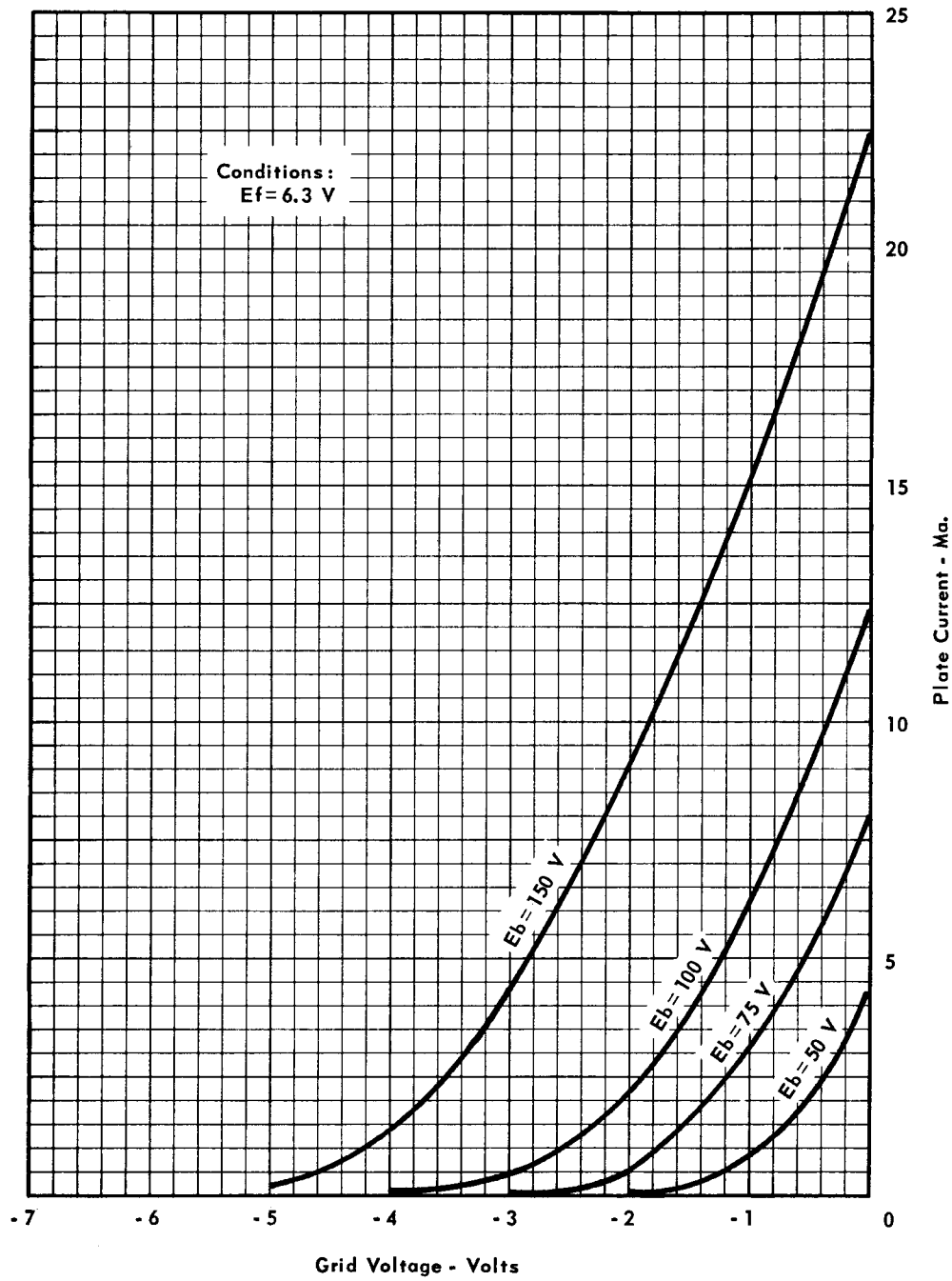
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RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS



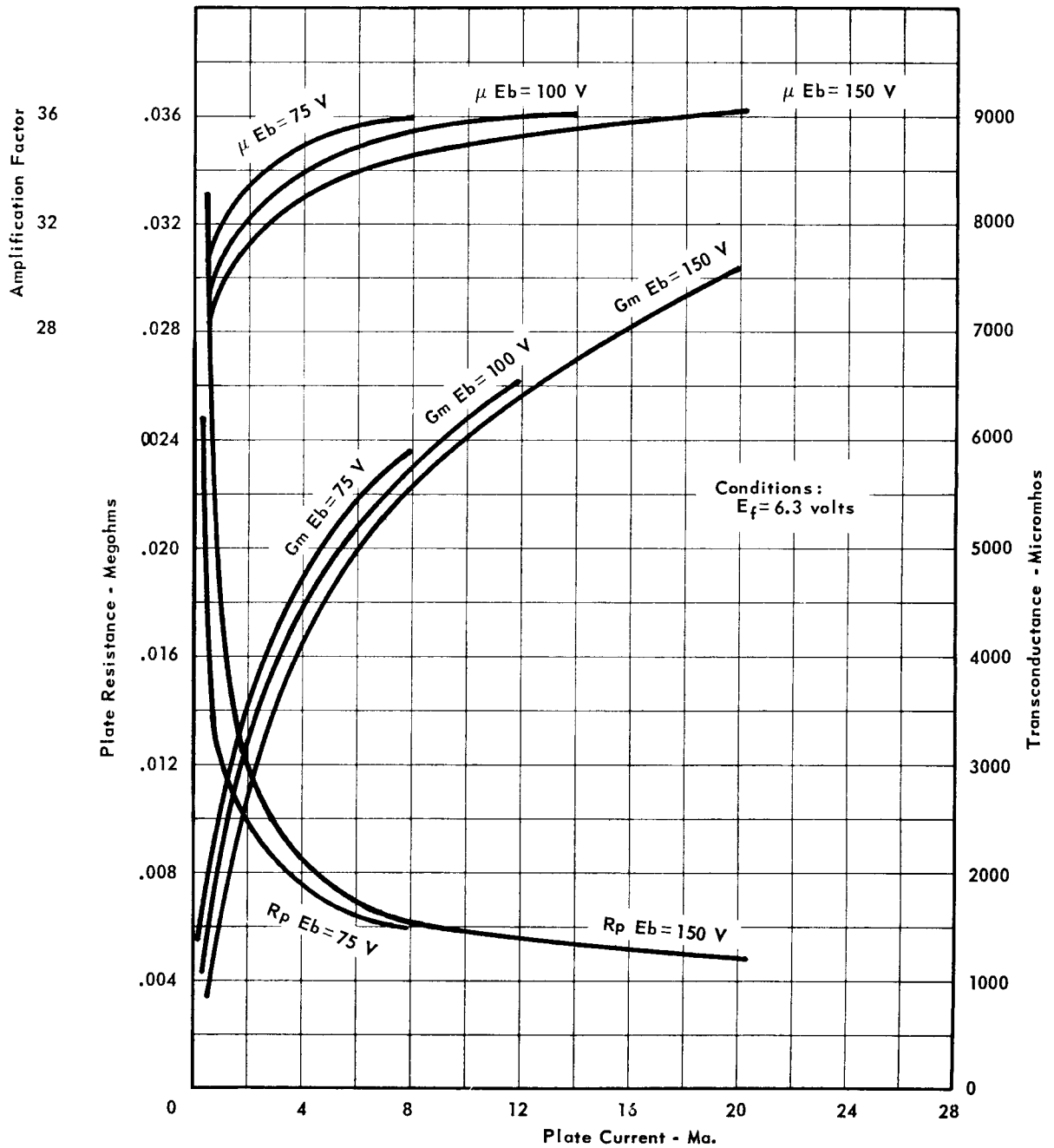
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RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS



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