PEARL Inc.
Web: http://www.pearl-hifi.com 86008, 2106 33 Ave. SW, Calgary, AB; CAN T2T 1Z6
E-mail: custserv@pearl-hifi.com Ph: +.1.403.244.4434 Fx: +.1.403.245.4456
Perkins Electro-Acoustic Research Lab, Inc. ❦ Engineering and Intuition Serving the Soul of Music

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Electronic TUBES

6021
TWIN TRIODE
Five-Star Tube
★ ★ ★ ★ ★

FOR GENERAL-PURPOSE AMPLIFIER APPLICATIONS

8-LEAD SUBMINIATURE
MEDIUM MU

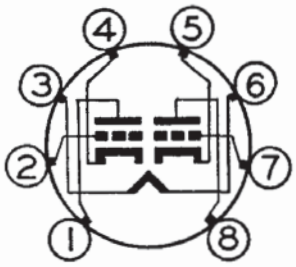
SHOCK, VIBRATION RATINGS
HEATER-CYCLING RATING

DESCRIPTION AND RATING

The 6021 is a subminiature medium-mu twin triode for use in general-purpose amplifier applications. Each section has an individual cathode and is electrically independent.

The 6021 is a special-quality tube for use in critical industrial and military applications in which operational dependability is of primary importance. Features of the tube include a high degree of mechanical strength and 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.

BASING DIAGRAM



RETMA 8DG

TERMINAL CONNECTIONS

Lead 1—Plate (Section 2)
Lead 2—Grid (Section 2)
Lead 3—Heater
Lead 4—Cathode (Section 2)
Lead 5—Cathode (Section 1)
Lead 6—Heater
Lead 7—Grid (Section 1)
Lead 8—Plate (Section 1)

GENERAL

ELECTRICAL

Cathode—Coated Unipotential

Heater Voltage, AC or DC	6.3 ± 5%	Volts
Heater Current	0.3	Amperes

Direct Interelectrode Capacitances

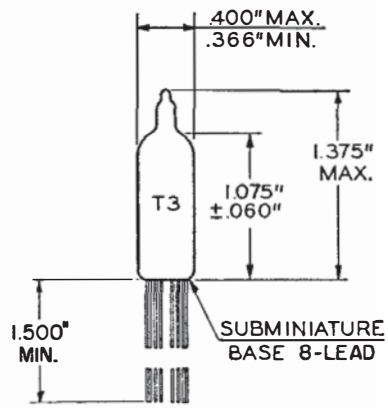
	With Shield*	Without Shield	
Grid to Plate, Each Section	1.4	1.5	μμf
Input, Each Section	2.1	2.4	μμf
Output, Section 1	1.3	0.28	μμf
Output, Section 2	1.4	0.32	μμf
Grid to Grid, maximum	0.011	0.013	μμf
Plate to Plate, maximum	0.33	0.52	μμf

*With external shield of 0.405-inch inside diameter connected to cathode of section under test.

MECHANICAL

Mounting Position—Any
Envelope—T-3, Glass
Base—E8-10, Subminiature Button 8-Lead

PHYSICAL DIMENSIONS



RETMA 3-1

GENERAL ELECTRIC

Supersedes ET-T1101 dated 8-54

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES, EACH SECTION

Plate Voltage	165	Volts
Negative DC Grid Voltage	55	Volts
Plate Dissipation	0.7	Watts
DC Plate Current	22	Milliamperes
DC Grid Current	5.5	Milliamperes
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode	200	Volts
Heater Negative with Respect to Cathode	200	Volts
Grid Circuit Resistance	1.1	Megohms
Bulb Temperature at Hottest Point	220	C

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A_1 AMPLIFIER, EACH SECTION

Plate Voltage	100	Volts
Cathode-Bias Resistor	150	Ohms
Amplification Factor	35	
Plate Resistance, approximate	6500	Ohms
Transconductance	5400	Micromhos
Plate Current	6.5	Milliamperes
Grid Voltage, approximate		
Ib = 10 Microamperes	−6.5	Volts

CLASS A RESISTANCE-COUPLED AMPLIFIER

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

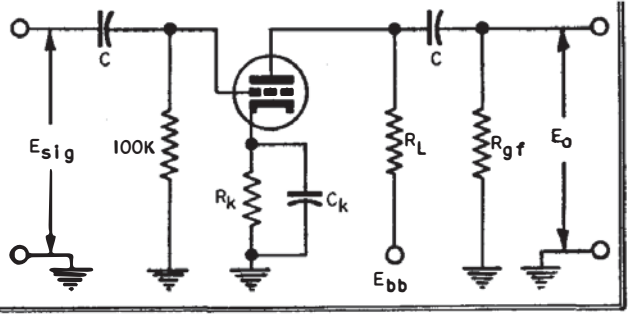
R_L	R_{gf}	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	1900	7.3	18	1400	14	20	1300	22	22
0.10	0.24	2300	11	20	1800	19	22	1600	30	22
0.24	0.24	4700	9.6	19	3800	18	20	3400	27	22
0.24	0.51	5600	13	19	4700	23	21	4300	35	22
0.51	0.51	10000	11	18	9000	20	20	8300	31	21
0.51	1.0	13000	14	19	11000	25	20	10000	39	21

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)

R_L	R_{gf}	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	2500	9.8	17	1800	18	20	1400	29	22
0.10	0.24	3100	13	18	2300	25	21	1900	39	22
0.24	0.24	6200	12	18	4800	22	20	4000	34	21
0.24	0.51	7500	15	18	6000	27	20	5200	43	21
0.51	0.51	13000	13	18	10000	24	20	9000	37	21
0.51	1.0	16000	16	18	13000	30	19	12000	46	21

Notes:

1. E_o is maximum RMS voltage output for approximately five percent total harmonic distortion.
2. Gain is measured for an output voltage of two volts RMS.
3. R_k is in ohms; R_L and R_{gf} are in megohms.
4. Coupling capacitors (C) should be selected to give desired frequency response. R_k should be adequately by-passed.



CHARACTERISTICS LIMITS

		Minimum	Maximum	
Heater Current				
Ef = 6.3 volts	Initial	280	320	Milliamperes
	500-Hr	276	328	Milliamperes
Plate Current, Each Section				
Ef = 6.3 volts, Eb = 100 volts, Rk = 150 ohms (by-passed)	Initial	4.5	8.5	Milliamperes
Plate Current Difference between Sections				
Difference between plate currents for each section at Ef = 6.3 volts, Eb = 100 volts, Rk = 150 ohms (by-passed)	Initial	....	1.6	Milliamperes
Transconductance (1), Each Section				
Ef = 6.3 volts, Eb = 100 volts, Rk = 150 ohms (by-passed)	Initial	4450	6350	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
	500-Hr	....	15	Percent
Transconductance Change with Operation, Each Section				
Difference between Transconductance (1) initially and after operation expressed as a percentage of initial value	500-Hr	....	25	Percent
Average Transconductance Change with Operation, Each Section				
Average of values for "Transconductance Change with Operation"	500-Hr	....	15	Percent
Amplification Factor, Each Section				
Ef = 6.3 volts, Eb = 100 volts, Rk = 150 ohms (by-passed)	Initial	30	40	
Plate Current Cutoff, Each Section				
Ef = 6.3 volts, Eb = 100 volts, Ec = −6.5 volts	Initial	....	100	Microamperes
Interelectrode Capacitances				
Grid to Plate (g to p), Each Section	Initial	1.2	1.8	μμf
Input (g to k+h), Each Section	Initial	1.8	3.0	μμf
Output (p to k+h), Section 1	Initial	0.20	0.36	μμf
Output (p to k+h), Section 2	Initial	0.22	0.42	μμf
Grid to Grid (g to g)	Initial	....	0.013	μμf
Plate to Plate (p to p)	Initial	....	0.52	μμf
Measured without external shield				
Negative Grid Current, Each Section				
Ef = 6.3 volts, Eb = 150 volts, Rk = 300 ohms (by-passed), Rg = 1.0 meg	Initial	....	0.3	Microamperes
	500-Hr	....	0.9	Microamperes
Heater-Cathode Leakage Current				
Ef = 6.3 volts, Ehk = 100 volts				
Heater Positive with Respect to Cathode	Initial	....	5.0	Microamperes
	500-Hr	....	10	Microamperes
Heater Negative with Respect to Cathode	Initial	....	5.0	Microamperes
	500-Hr	....	10	Microamperes
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 DC	Initial	100	....	Megohms
	500-Hr	50	....	Megohms
Plate (Each Section) to All at 300 Volts DC	Initial	100	....	Megohms
	500-Hr	50	....	Megohms
Vibrational Noise Output Voltage, RMS				
Ef = 6.3 volts, Ebb = 100 volts, Rk = 150 ohms (by-passed), R_L = 10,000 ohms, Vibrational acceleration = 15 G at 40 cps	Initial	....	50	Millivolts

CHARACTERISTICS LIMITS CONTINUED ON PAGE 4

CHARACTERISTICS LIMITS (Cont'd)

		Minimum	Maximum	
Grid Emission Current, Each Section Ef = 7.5 volts, Eb = 150 volts, Ecc = −7.5 volts, Rg = 1.0 meg	Initial	....	0.5	Microamperes
Pulse Cathode Current Ef = 6.0 volts. Pulse of 25 microseconds duration, 200-cycle repetition rate, and 50 volt amplitude is applied to plate and grid tied together. Pulse cathode current is measured for each section with opposite section floating	Initial	300	....	Milliamperes

The indicated 500-hour values are life-test end points for the following conditions of operation for each section: Ef = 6.3 volts, Eb = 100 volts, Rk = 150 ohms, Rg = 1.0 meg, Ehk = 200 volts with heater positive with respect to cathode, and bulb temperature = 220 C minimum.

SPECIAL TESTS AND RATINGS

Stability Life Test
Statistical sample operated for one hour to evaluate and control initial variations in transconductance.

Survival Rate Life Test
Statistical sample operated for one hundred hours to evaluate and control early-life electrical and mechanical inoperatives.

Heater-Cycling Life Test
Statistical sample operated for 2000 cycles to evaluate and control heater-cathode defects. Conditions of test include Ef = 7.0 volts cycled for one minute on and four minutes off, Eb = Ec = 0 volts, and Ehk = 140 volts RMS.

Shock Rating—450 G
Statistical sample subjected to five impact accelerations of 450 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 in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

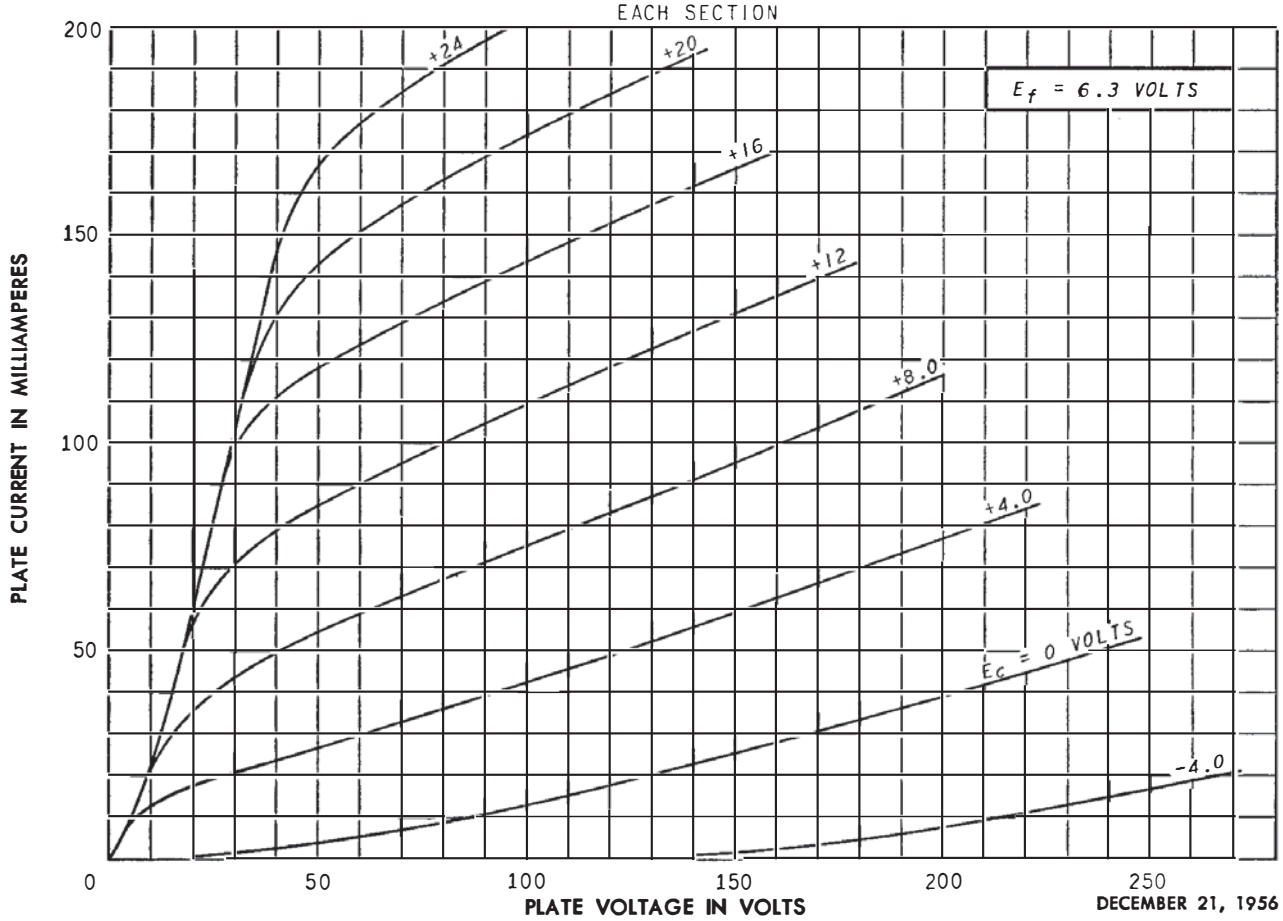
Altitude Rating—60,000 Feet
Statistical sample subjected to pressure of 55 millimeters of mercury to evaluate and control arcing and corona.

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

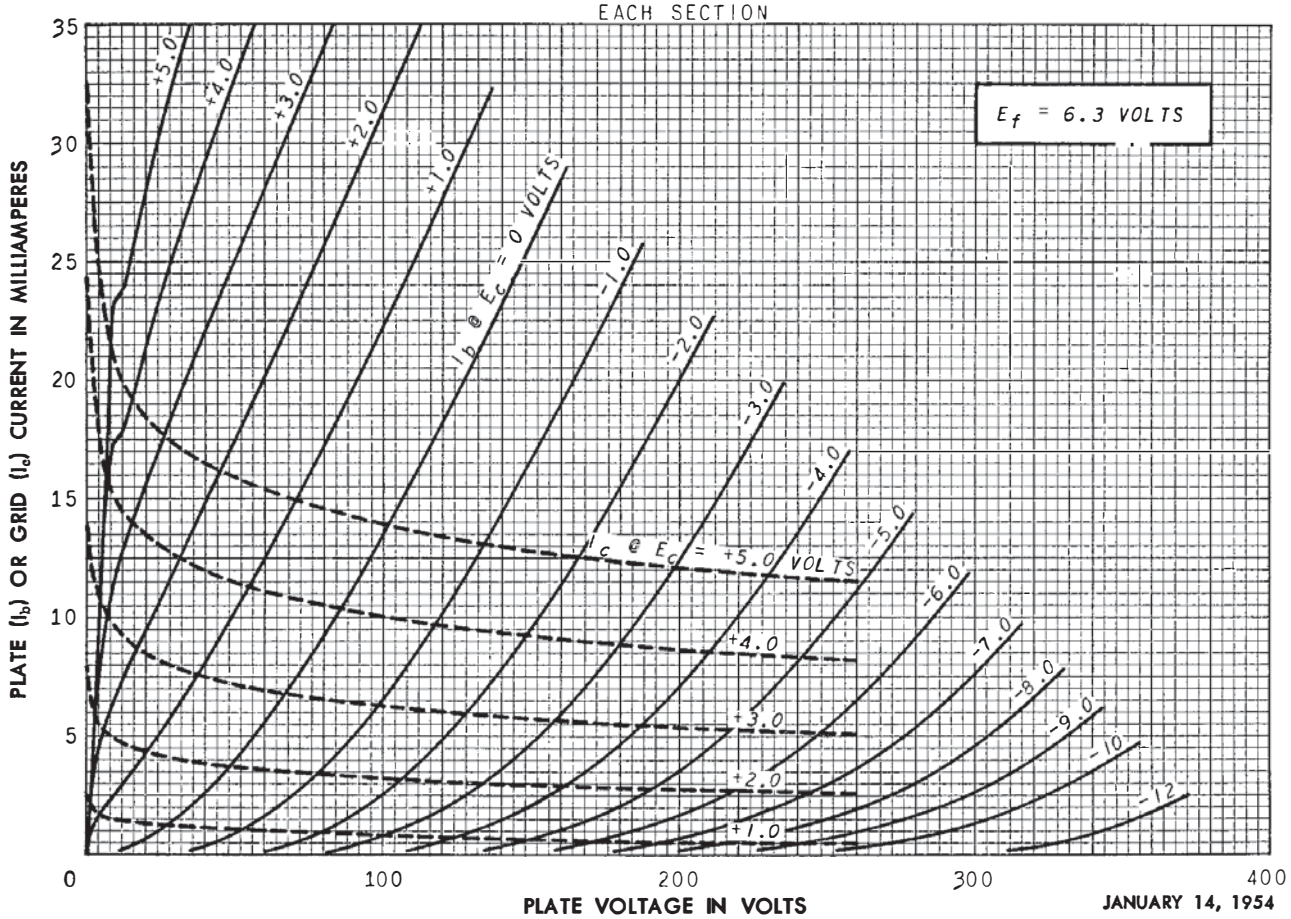
EACH SECTION



DECEMBER 21, 1956

AVERAGE PLATE CHARACTERISTICS

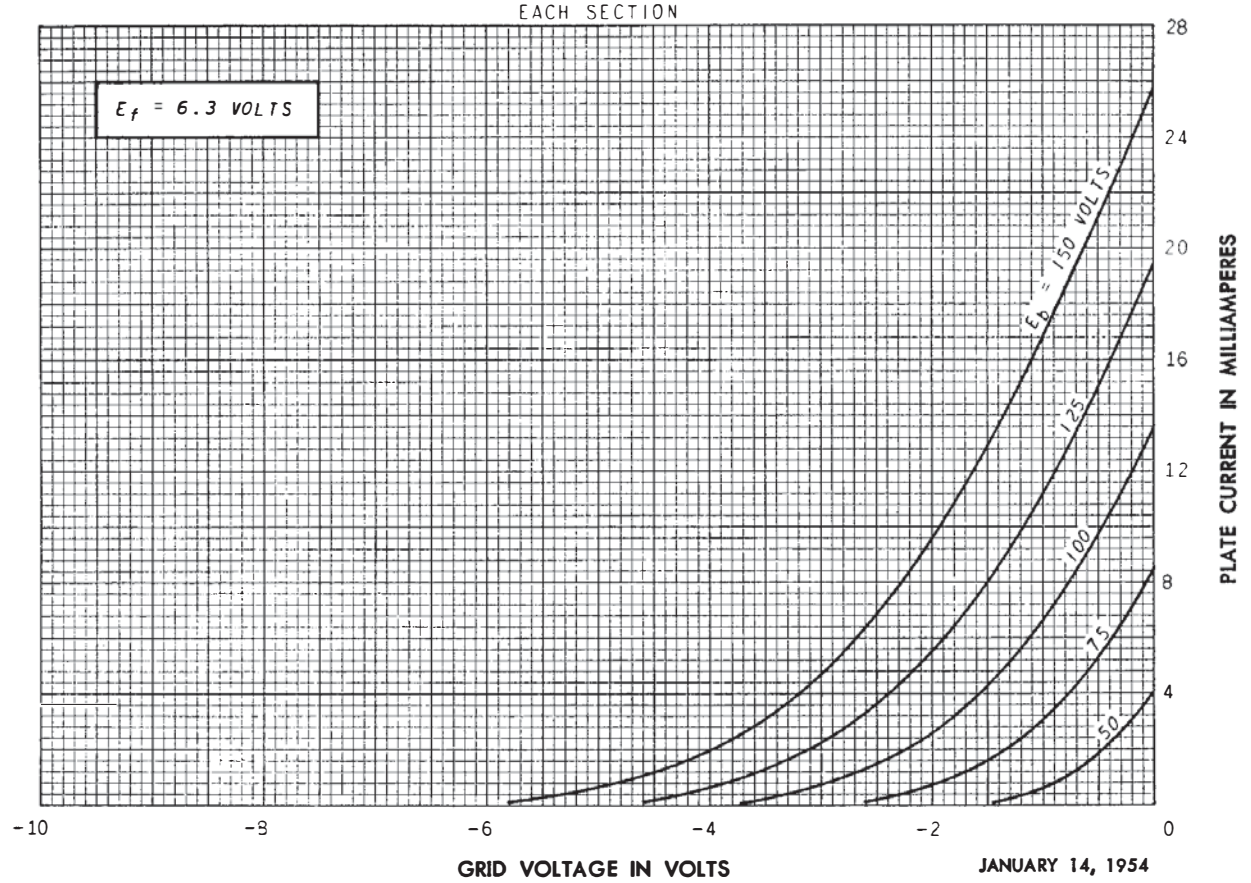
EACH SECTION



JANUARY 14, 1954

AVERAGE TRANSFER CHARACTERISTICS

EACH SECTION



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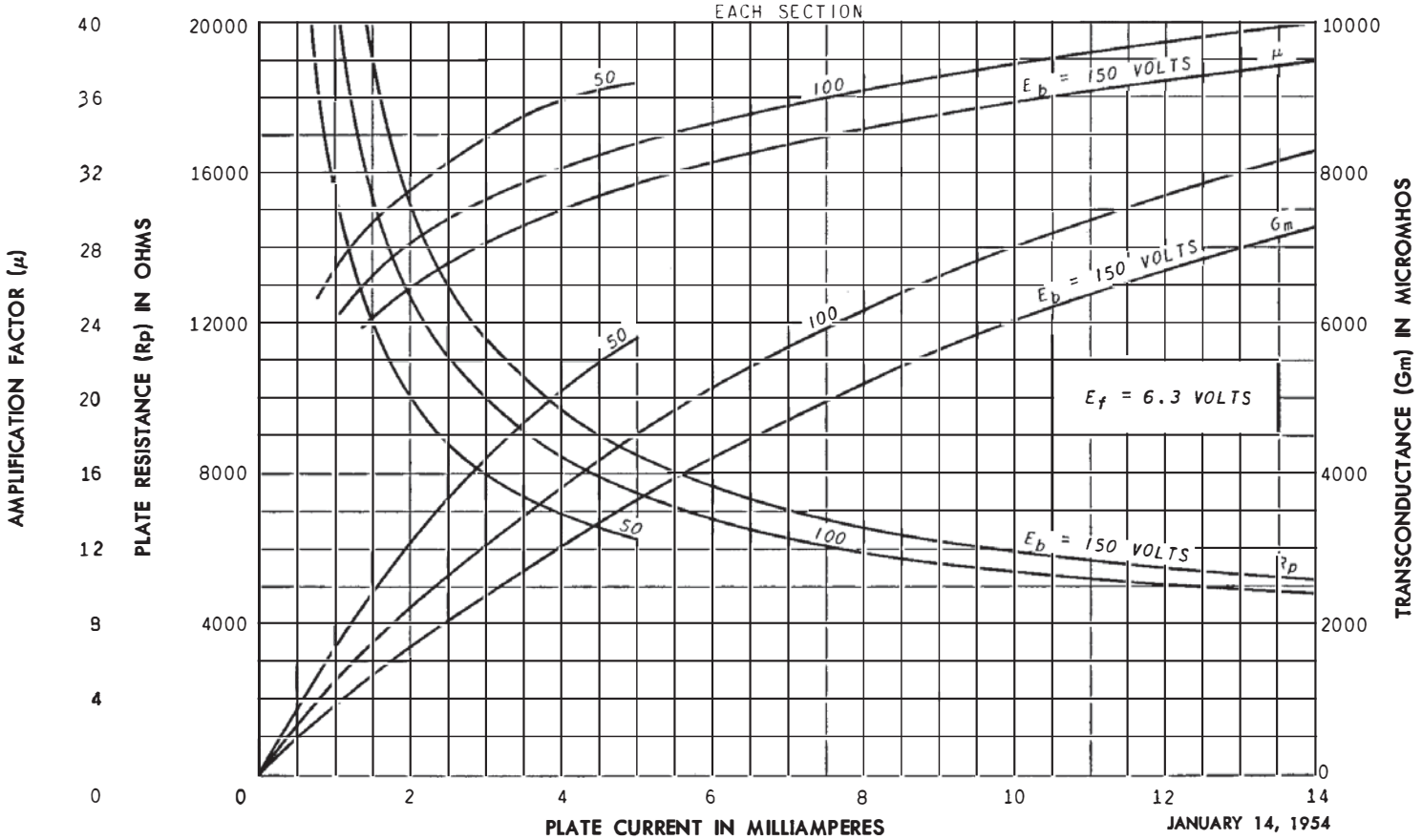
AVERAGE CHARACTERISTICS

EACH SECTION



JANUARY 14, 1954

ELECTRONIC COMPONENTS DIVISION

GENERAL ELECTRIC

Schenectady 5, N. Y.

PRINTED IN U.S.A.

6021

MEDIUM-MU TWIN TRIODE

"Premium" Subminiature Type
For Operation At Altitudes Up To 60000 Feet

TENTATIVE DATA

RCA-6021 is a subminiature medium-mu twin triode of the heater-cathode type having flexible leads. It is intended for use in oscillator and amplifier applications at frequencies up to 400 Mc. Constructed to give dependable performance under conditions of shock and vibration, this "premium" tube is especially suited for use in mobile and aircraft equipment and is rated for service at altitudes up to 60000 feet without the use of pressurized chambers.

Actual Size

The design of the 6021 incorporates a compact structure in which special attention has been given to the following features: (1) "U" frame construction to keep the mount rigid and prevent distortion of plates, (2) precisely made and accurately fitted tube parts, including new mica design, to lock the parts firmly in place, (3) grid side rods having high heat conductivity to provide cool operation of the grids, (4) pure-tungsten heater having high mechanical strength, (5) getter shield to prevent deposit of getter flash on tube elements, and (6) pure nickel plate to minimize evolution of gas.

As a result of its structural design, this tube is characterized by: (1) small spread in electrical characteristics, (2) reduced microphonic effects, (3) reduced grid emission, (4) long life under frequent on-off switching, and (5) low leakage currents and high leakage resistance between the elements. In addition, this tube utilizes separate terminals for each cathode to permit flexibility of circuit arrangement.

Manufactured under rigid controls, the 6021 undergoes rigorous tests during manufacture to insure its "premium" quality as follows: test readings at the end of 1 hour, 100 hours, and 500 hours to insure that tubes fall within the established tight characteristics limits and that early failures are held to a low percentage.

GENERAL DATA

Electrical:

Heater for Unipotential Cathodes:			
Voltage (AC or DC)	6.3 ± 5%		volts
Current	0.3		amp
Direct Interelectrode Capacitances:	*With External Shield**	*Without External Shield*	
Grid to plate (Each unit)	1.4	1.5	μμf
Grid to cathode and heater (Each unit)	2.1	2.4	μμf
Plate to cathode and heater (Unit No.1)	1.3	0.28	μμf
Plate to cathode and heater (Unit No.2)	1.4	0.32	μμf
Grid to grid	0.011 max.	0.013 max.	μμf
Plate to plate	0.33 max.	0.52 max.	μμf

Mechanical:

Operating Position	Any
Maximum Bulb Length	1-3/8"
Length from Button Seal to Bulb Top (Excluding tip)	1.075" ± 0.060"
Diameter	0.366" − 0.400"
Bulb	T3
Leads, Flexible	8
Minimum Length	1.5"
Orientation and Diameter	See Dimensional Outline

AMPLIFIER -- Class A_1

Values are for Each Unit

Maximum Ratings, *Absolute Values:*

For Operation At Altitudes Up To 60000 Feet

PLATE VOLTAGE	165 max.	volts
GRID VOLTAGE:		
Positive bias value	0 max.	volts
Negative bias value	-55 max.	volts
PLATE CURRENT	22 max.	ma
GRID CURRENT	5.5 max.	ma
PLATE DISSIPATION	1.1 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	200 max.	volts
Heater positive with respect to cathode	200 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	°C

Characteristics:

Plate Supply Voltage	100	volts
Cathode Resistor	150	ohms
Plate Current	6.5	ma

TMK ®, Marca Registrada
Printed in U.S.A

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Amplification Factor	35	
Plate Resistance (Approx.)	6500	ohms
Transconductance	5400	μmhos
Grid Voltage (Approx.) for plate current of 10 μa	-6.5	volts

Maximum Circuit Values:

Grid-Circuit Resistance:		
For cathode-bias operation	1.1 max.	megohm

* With 0.405" internal diameter shield connected to cathode of unit under test.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Values Are For Each Unit (Other unit grounded) and are Initial, Unless Otherwise Indicated.

	Note	Min.	Max.	
Heater Current	1	0.280	0.320	amp
Heater Current at 500 Hours	1	0.276	0.328	amp
Direct Interelectrode Capacitances:				
Grid to plate	2	1.2	1.8	μμf
Grid to cathode and heater	2	1.8	3.0	μμf
Plate to cathode and heater (Unit No.1)	2	0.20	0.36	μμf
Plate to cathode and heater (Unit No.2)	2	0.22	0.42	μμf
Grid to grid	3	-	0.013	μμf
Plate to plate	3	-	0.52	μμf
Amplification Factor	1,4	30	40	
Plate Current (1)	1,4	4.5	8.5	ma
Plate-Current Difference Between Units	1,4	-	1.6	ma
Plate Current (2)	1,5	-	100	μa
Transconductance (1)	1,4	4450	6350	μmhos
Transconductance(1)Change:				
With heater voltage reduced to 5.7 volts	4	-	15	per cent
Individual at 500 Hours	1,4	-	25	per cent
Average at 500 Hours	1,4	-	15	per cent
Average at 500 Hours: With heater voltage reduced to 5.7 volts	4	-	15	per cent
Reverse Grid Current	1,6	-	0.3	μa
Reverse Grid Current at 500 Hours	1,6	-	0.9	μa
Grid Emission Current	7	-	-0.5	μa
Heater-Cathode Leakage Current:				
Heater negative with respect to cathode	1	-	5	μa
Heater positive with respect to cathode	1	-	5	μa
Heater-Cathode Leakage Current at 500 Hours:				
Heater 100 volts negative with respect to cathode	1	-	10	μa
Heater 100 volts positive with respect to cathode	1	-	10	μa
Leakage Resistance:				
Between grid and all other electrodes tied together	1,3,8	100	-	megohms
Between plate and all other electrodes tied together	1,3,9	100	-	megohms
Leakage Resistance at 500 Hours:				
Between grid and all other electrodes tied together	1,3,8	50	-	megohms
Between plate and all other electrodes tied together	1,3,9	50	-	megohms

Note 1: With 6.3 volts ac or dc on heater.

Note 2: Without external shield.

Note 3: Other electrodes grounded.

Note 4: With dc plate supply voltage of 100 volts, cathode resistor of 150 ohms, and cathode-resistor bypass capacitor of 1000 μf.

Note 5: With dc plate voltage of 100 volts and grid voltage of -6.5 volts.

Note 6: With dc plate supply voltage of 150 volts, cathode resistor of 300 ohms, and grid resistor of 1 megohm.

Note 7: With ac or dc heater voltage of 7.5 volts, dc plate voltage of 150 volts, grid voltage of -7.5 volts, and grid resistor of 1 megohm.

Note 8: With grid voltage of -100 volts.

Note 9: With dc plate voltage of -300 volts.

SPECIAL RATINGS AND PERFORMANCE DATA

Shock Rating:

Impact Acceleration . . . . . 450 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are tested in four different positions. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Fatigue Rating:

Vibrational Acceleration . . . . . 2.5 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected in each of three positions to 2.5 g vibrational acceleration at 60 cycles per second for 32 hours. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Variable-Frequency Vibration Performance:

This test is performed on a sample lot from each production run. Tubes are vibrated over the frequency range of 5 to 50 cps at a total excursion of 0.08" for 3 minutes. At the end of this test, tubes are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Low-Frequency Vibration Performance:

RMS Output Voltage . . . . . 50 max. mv

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, plate supply voltage of 100 volts, cathode resistor of 150 ohms, plate load resistor of 10000 ohms and vibrational acceleration of 15 g at 40 cps.

Heater-Cycling Life Performance:

Cycles of Intermittent Operation . . 2000 min. cycles

Under the following conditions: Heater voltage of 7.0 volts cycled one minute on four minutes off, heater 140 volts rms with respect to both cathodes tied together.

Audio-Frequency Noise and Microphonic Performance:

Output Voltage . . . . . 65 max. mv

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, plate supply voltage of 100 volts, cathode resistor of 75 ohms, grid-No.1 resistor of 0.1 megohm, plate load resistor of 0.01 megohm, and cathode-bypass capacitor of 1000 μf. Units are connected in parallel. The output voltage of a tube, when tapped, will not cause a reading on a vu meter greater than that produced when a calibrating signal of 65 millivolts rms is applied to the plates of the tube.

Shorts and Continuity Test:

This test is performed on a sample lot of tubes from each production run. In this test a tube is considered inoperative it it shows a permanent or temporary

short or open circuit, or a value of reverse grid current in excess of 1.0 microampere under the conditions specified in the Characteristics Range Values for reverse grid current.

1-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that the tubes have been properly stabilized. Conditions of life testing are specified under 500-Hour Intermittent Life Performance, except test run at room temperature. Tubes are initially read for Transconductance (1). At the end of 1 hour, the value of transconductance (1) is read. The variation in transconductance (1) from the 0-hour reading will not exceed 15 per cent under the conditions specified in Characteristics Range Values.

100-Hour Survival Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Conditions of life testing are specified under 500-Hour Intermittent Life Performance, except test run at room temperature. At the end of 100 hours, a tube is considered inoperative if it shows a permanent or temporary short or open circuit, reverse grid current in excess of 1.0 microampere, or a transconductance (1) of less than 4000 micromhos under the conditions specified in Characteristics Range Values.

500-Hour Intermittent Life Performance:

This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures of any of the characteristics indicated below. Life testing is conducted under the following conditions: Heater voltage of 6.3 volts, plate supply voltage of 100 volts, heater-cathode voltage of 200 volts (heater positive with respect to cathode), cathode resistor of 150 ohms, grid resistor of 1 megohm and bulb temperature of 220° C. At the end of 500 hours, tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to pass established initial limits of heater current, individual, average, and 5.7 heater voltage transconductance change, reverse grid current and heater-cathode leakage current shown under Characteristics Range Values.

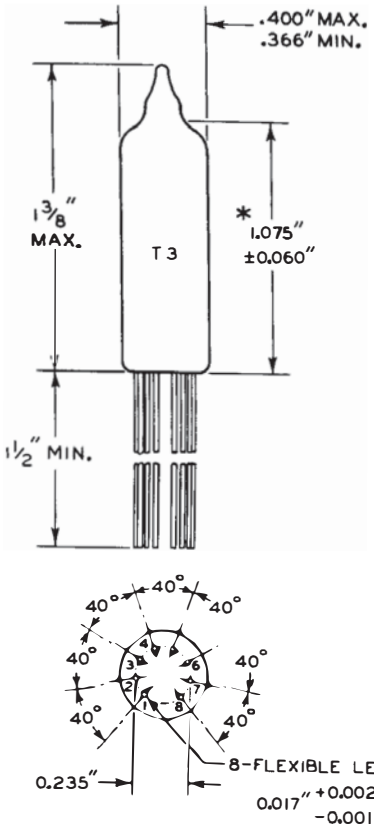
OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the 6021 are limiting values above which the serviceability of the 6021 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value below each absolute rating by an amount such that the absolute values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The *heater supply* should be well regulated because life and reliability of the 6021 are adversely affected by departures from the 6.3-volt value. The extent to which life is affected is a function of the amount of these departures and their durations.

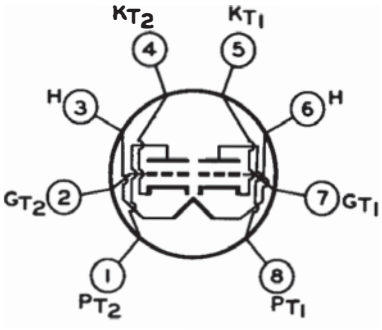
The *flexible leads* of the 6021 are usually soldered to the circuit elements. Soldering of the connections should be made as far as possible from the glass button. If this precaution is not followed, the heat of the soldering may crack the glass seals of the leads and damage the tube.

DIMENSIONAL OUTLINE



* MEASURED FROM BULB SEAT TO BULB-TOP LINE AS DETERMINED BY A RING GAUGE OF 0.210" ± 0.001" I.D.

LEAD CONNECTIONS
Bottom View



LEAD No.1: PLATE OF TRIODE No.2
LEAD No.2: GRID OF TRIODE No.2
LEAD No.3: HEATER
LEAD No.4: CATHODE OF TRIODE No.2
LEAD No.5: CATHODE OF TRIODE No.1
LEAD No.6: HEATER
LEAD No.7: GRID OF TRIODE No.1
LEAD No.8: PLATE OF TRIODE No.1

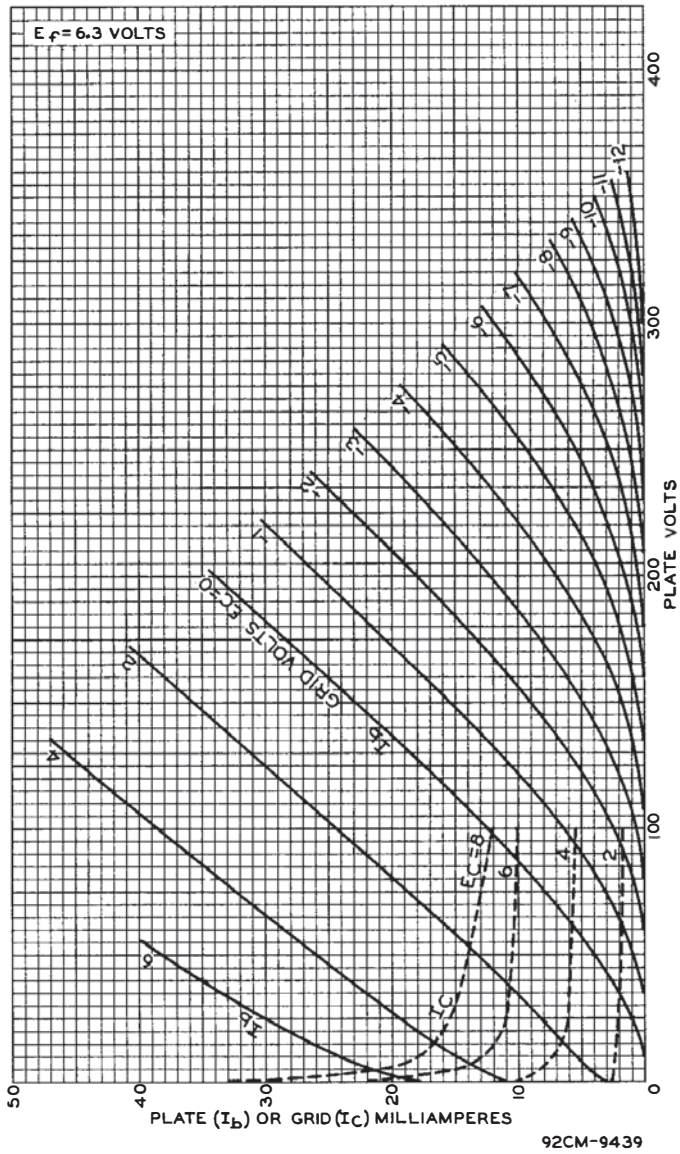


Fig. 1 - Average Characteristics for Each Unit of Type 6021.

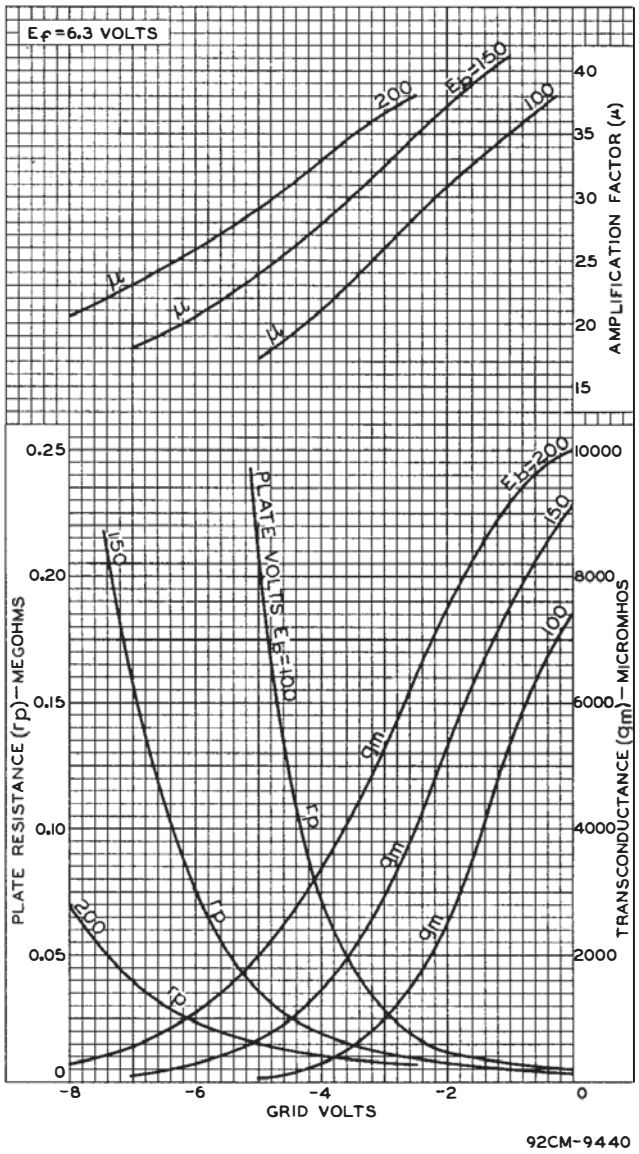


Fig. 2 - Average Characteristics for Each Unit of Type 6021.

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.

SYLVANIA

engineering data service 6021

MECHANICAL DATA

Bulb	T-3
Base	E8-10, Subminiature Button Flexible Leads
Outline	JETEC 3-1
Basing	8DG
Cathode	Coated Unipotential
Mounting Position	Any

RATINGS[1] (Absolute Maximum)

Impact Acceleration	450 G
Uniform Acceleration	1000 G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5 G
Bulb Temperature	220° C
Altitude[2]	80000 Ft.

ELECTRICAL DATA

HEATER CHARACTERISTICS

	Min.	Bogey	Max.
Heater Voltage[3]	6.0	6.3	6.6 V
Heater Current		300	mA

DIRECT INTERELECTRODE CAPACITANCES

	Shielded[4]	Unshielded
Grid to Plate (Each Section)	1.4	1.5 μμf
Input (Each Section)	2.1	2.4 μμf
Output		
Section No. 1	1.3	0.28 μμf
Section No. 2	1.4	0.32 μμf
Grid to Grid	0.011	0.013 μμf Max.
Plate to Plate	0.33	0.52 μμf Max.

RATINGS[1 & 5] (Absolute Maximum)

Plate Voltage	165 Vdc
Peak Plate Forward Voltage[6]	330 v
Plate Dissipation (Each Section)	1.1 W
Plate Current (Each Section)	22 mAdc
DC Grid Voltage	
Positive Value	0 Vdc
Negative Value	55 Vdc
Grid Current	5.5 mAdc
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	200 v
Heater Negative with Respect to Cathode	200 v
Grid Circuit Resistance	1.1 Meg

CHARACTERISTICS (Each Section)

Plate Voltage	100 Vdc
Cathode Resistor	150 Ohms
Plate Current	6.5 mAdc
Transconductance	5400 μmhos
Amplification Factor	35
Grid Voltage for Ib = 100 μAdc Max.	-6.5 Vdc

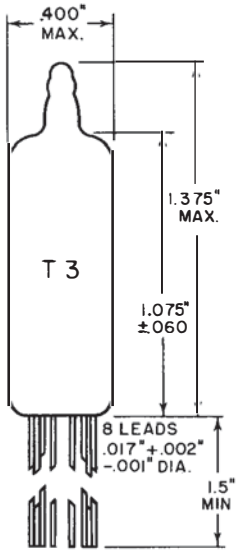
NOTES:

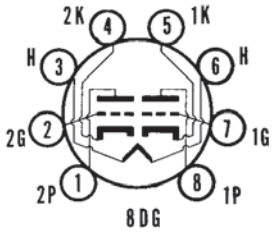
1. *Limitations beyond which normal tube performance and tube life may be impaired.*
2. *If altitude rating is exceeded, reduction of instantaneous voltages (Ef excluded) may be required.*
3. *Tube life and reliability of performance are directly related to the degree of regulation of the heater voltage 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.*

QUICK REFERENCE DATA

The Premium Subminiature Type 6021 is a general purpose, medium mu, double triode having separate cathode connections for each section. It is particularly useful in oscillator and amplifier applications where power requirements permit the use of two tubes in one envelope.

The 6021 is designed to provide dependable operation under conditions of severe shock, vibration, high temperature and high altitude and is manufactured and inspected to meet the applicable MIL-E-1 specification for reliability.





SYLVANIA ELECTRIC PRODUCTS INC.

RADIO TUBE DIVISION
EMPORIUM, PA.

Prepared and Released By The
TECHNICAL PUBLICATIONS SECTION
EMPORIUM, PENNSYLVANIA
FEBRUARY 1957

ACCEPTANCE CRITERIA

Test Conditions

Heater Voltage	6.3 V	Heater-Cathode Voltage MIL-E-1 Par. 3.2.2.1	0 V
Plate Voltage	100 Vdc	Cathode Resistance Per Cathode MIL-E-1 Par. 3.2.2.1	150 Ohms
Grid Voltage	0 V		

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								
4.1.1.7 4.10.8	(Method A) Heater Current: ALD = 24	—	—	288	300	312	—	mA
4.10.8	Heater Current:	0.65	280	—	—	—	320	mA
4.10.15	Heater-Cathode Leakage: Note 4	0.65	—	—	—	—	—	
	Ehk = +100 Vdc	—	—	—	—	—	5.0	μAdc
	Ehk = −100 Vdc	—	—	—	—	—	5.0	μAdc
4.10.6.1	Grid Current: Note 4 Eb = 150 Vdc; Rk = 300 Ohms; Rg = 1.0 Meg	0.65	0	—	—	—	−0.3	μAdc
4.1.1.7 4.10.4.1	(Method A) Plate Current (1): Note 4 ALD = 2.3	—	—	5.6	6.5	7.3	—	mAdc
4.10.4.1	Plate Current (1):	0.65	4.5	—	—	—	8.5	mAdc
4.10.4.1	Plate Current (2): Note 4 Ec = −6.5 Vdc; Rk = 0 Ohms	0.65	—	—	—	—	100	μAdc
4.1.1.7 4.10.9	Transconductance (1): Note 4 ALD = 1100 Sm	—	—	5000	5400	5800	—	μmhos
4.10.9	Transconductance (1): Sm	0.65	4450	—	—	—	6350	μmhos
4.7.5	Continuity and Shorts: (Inoperatives)	0.4	—	—	—	—	—	
4.9.1	Mechanical: Envelope (8-1)	—	—	—	—	—	—	
Measurements Acceptance Tests, Part 2								
4.8.2	Insulation of Electrodes: Note 4	2.5	—	—	—	—	—	
	g-all	—	100	—	—	—	—	Meg
	p-all	—	100	—	—	—	—	Meg
4.10.4.1	Plate Current (1) Difference Between Sections:	2.5	—	—	—	—	1.6	mAdc
4.10.9	Transconductance (2): Note 4 $\triangle$ Sm Ef = 5.7 V $\triangle$ Ef	2.5	—	—	—	—	15	%
4.10.6.2	Grid Emission: Notes 4 and 5 Ef = 7.5 V; Ec = −7.5 Vdc; Eb = 150 Vdc; Rk = 0 Ohms; Rg = 1.0 Meg	2.5	0	—	—	—	−0.5	μAdc
4.10.3.2	AF Noise: Note 7 Esig = 65 mVac; Rg = 0.1 Meg; Rp = 0.01 Meg; Rk = 75 Ohms; Ck = 1000 μf	2.5	—	—	—	—	17	UV
- - - -	Pulse Emission: Notes 4 and 6 Ef = 6.0 V; e pulse = 50 v; tp = 25 μsec; prr = 200 pps	6.5	300	—	—	—	—	ma
4.10.11.1	Amplification Factor: Note 4	6.5	30	—	35	—	40	
4.10.14	Capacitance:	6.5	—	—	—	—	—	
	No Shield; Note 4 Cgp	—	1.2	—	—	—	1.8	μμf
	No Shield; Note 4 Cin	—	1.8	—	—	—	3.0	μμf
	No Shield; Section 1 Cout	—	0.20	—	—	—	0.36	μμf
	No Shield; Section 2 Cout	—	0.22	—	—	—	0.42	μμf
	No Shield Cgg	—	—	—	—	—	0.013	μμf
	No Shield Cpp	—	—	—	—	—	0.52	μμf

ACCEPTANCE CRITERIA (Continued)

MIL-E-1 Ref.	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	—	—	—	—	—	
4.9.20.3	Vibration (1): No Voltages; Post Shock and Fatigue Test End Points Apply	10.0	—	—	—	—	—	
4.9.19.1	Vibration (2): Note 4 Rp = 10,000 Ohms; Ck = 1000 μf; F = 40 cps; G = 15	2.5	—	—	—	—	50	mVac
4.9.19.1	White Noise: (Each Section); Note 8 Rp = 10,000 Ohms; Ck = 1000 μf;	2.5	—	—	—	—	250	mv pk-pk
	Peak Acceleration = 15 G	2.5	—	—	—	—	50	mVac
	Degradation Rate Acceptance Tests, Note 2							
4.9.5.3	Subminiature Lead Fatigue:	2.5	4	—	—	—	—	arcs
4.9.20.5	Shock: Hammer Angle = 30°; Ehk = +100 Vdc; Rg = 0.1 Meg	20	—	—	—	—	—	
4.9.20.6	Fatigue: G = 2.5; Fixed Frequency; F = 25 min., 60 max.	6.5	—	—	—	—	—	
- - - - -	Post Shock and Fatigue Test End Points: Vibration (2)	—	—	—	—	—	200	mVac
	Heater-Cathode Leakage Ehk = +100 Vdc	—	—	—	—	—	20	μAdc
	Ehk = −100 Vdc	—	—	—	—	—	20	μAdc
	Change in Transconductance (1) of Individual Tubes Δ_t Sm	—	—	—	—	—	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 2						
4.11.7	Heater Cycling Life Test: Ef = 7.0 V; 1 min. on, 4 min. off; Ehk = 140 Vac; Ec = Eb = O V	2.5	—	—	—	—	
4.11.3.1	Stability Life Test: (1 Hour) Note 7 Ehk = +200 Vdc; Rg/g = 1.0 Meg; TA = Room	1.0	—	—	—	—	
4.11.4	Stability Life Test End Points: Change in Transconductance (1) of Individual Tubes Δ_t Sm	—	—	—	—	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)	0.65	—	—	—	—	
	Transconductance (1) Sm	1.0	—	—	40000	—	μmhos
4.11.5 4.11.3.1	Intermittent Life Test: Note 3 Stability Life Test Conditions; T Envelope = +220°C min.; 1000 Hour Requirements Do Not Apply	—	—	—	—	—	

ACCEPTANCE CRITERIA (Continued)

MIL-E-1 Ref.	Test	AQL (%)	Allowable Defectives per Characteristic: 1st Sample	Allowable Defectives per Characteristic: Combined Samples	Limits: Min.	Limits: Max.	Units
Acceptance Life Tests, Note 2 (Continued)							
4.11.3.1 4.11.4	Intermittent Life Test End Points: (500 Hours)						
	Inoperatives	—	1	3	—	—	
	Grid Current	—	1	3	0	−0.9	μAdc
	Heater Current	—	2	5	276	328	mA
	Change in Transconductance (1) of Individual Tubes $\triangle \frac{Sm}{t}$	—	1	3	—	25	%
	Transconductance (2) $\triangle \frac{Sm}{Ef}$	—	2	5	—	15	%
	Heater-Cathode Leakage	—	2	5	—	—	
	Ehk = +100 Vdc	—	—	—	—	10	μAdc
	Ehk = −100 Vdc	—	—	—	—	10	μAdc
	Insulation of Electrodes	—	2	5	—	—	
	g-all	—	—	—	50	—	Meg
	p-all	—	—	—	50	—	Meg
	Transconductance (1) Average Change, Avg $\triangle \frac{Sm}{t}$	—	—	—	—	15	%
	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: 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

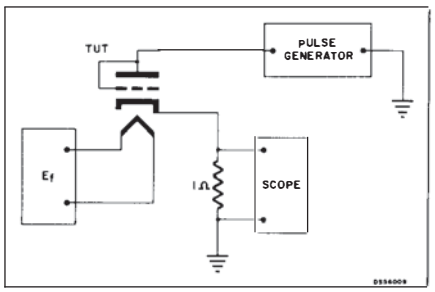
3: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze placed in contact with the envelope. Envelope temperature requirement will be satisfied if a tube, having bogey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

4: Test each section separately.

5: Prior to this test tubes shall be preheated five (5) minutes with each section operating separately 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	Ec	Eb	Rk	Rg
V	Vdc	Vdc	Ohms	Meg
7.5	0	150	500	1.0

6: The pulse is essentially a square wave with 1.0 μsec rise time and 0.8 μsec fall. The pulse shall be applied to plate and grid tied together. Pulse emission shall be measured in terms of voltage developed across a 1.0 ohm resistor in the cathode circuit. Test limit as measured by the leading edge of a calibrated trace, the amplitude of the trailing edge of which shall not vary by more than 20 percent from the value of the leading edge. Test each unit separately.



7: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

8: 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 (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.

APPLICATION DATA

The Sylvania Premium Subminiature Type 6021 is a medium mu double triode having separate cathode connections for each section. It is intended as a general purpose tube and is particularly useful in applications where power requirements are such that the 6021 may be employed rather than two high power single triodes. Among the many uses for this type are a number of low frequency amplifier and oscillator configurations. To insure optimum performance in pulse applications this type is subjected to a pulse emission test as shown in the accompanying data. The tube must, under the specified pulse operating conditions, deliver a minimum specified current. A further discussion of this test is included in the general section of this manual.

Resistance coupled amplifier data is shown in the accompanying table.

The Type 6021 may also be used as uhf amplifier. Instability, however, may be noted with cascode arrangements at frequencies above approximately 100 mc. Input resistance is plotted as a function of frequency in Figure 1.

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 tubes 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.

Life expectancy is described by the life tests, specified on the attached pages and/or individual MIL-E-1 specifications. 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.

The Type 6021 is manufactured and inspected to meet the applicable MIL-E-1 specification and is intended for operation under severe conditions of vibration, shock, high temperature and high altitude.

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.

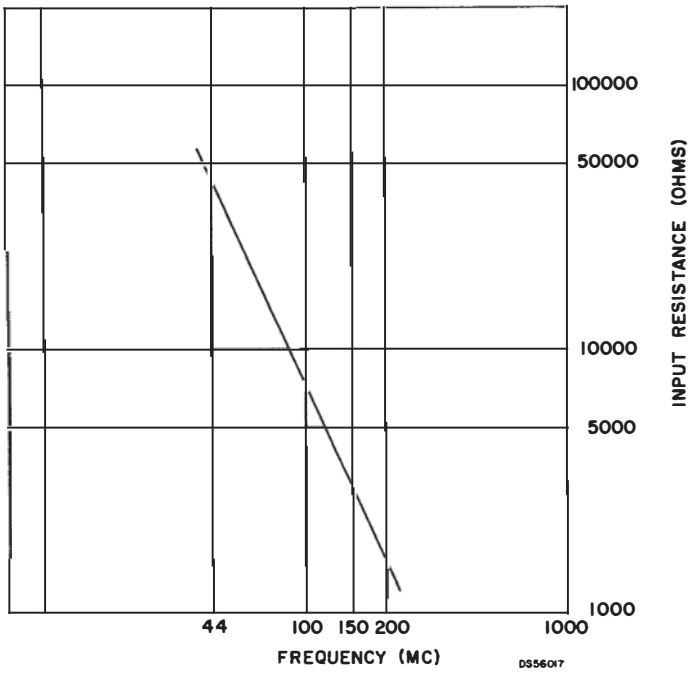


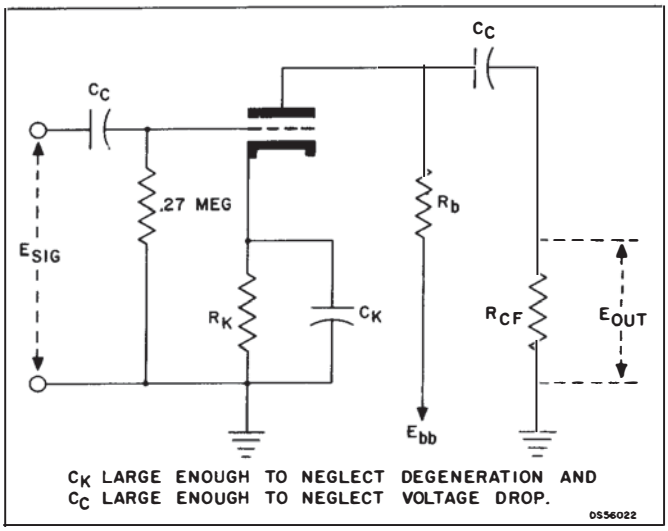
Figure 1—Input resistance vs frequency

The information presented on this data sheet is furnished without assuming any obligation.

RESISTANCE COUPLED AMPLIFIER DATA
SELF-BIAS OPERATION

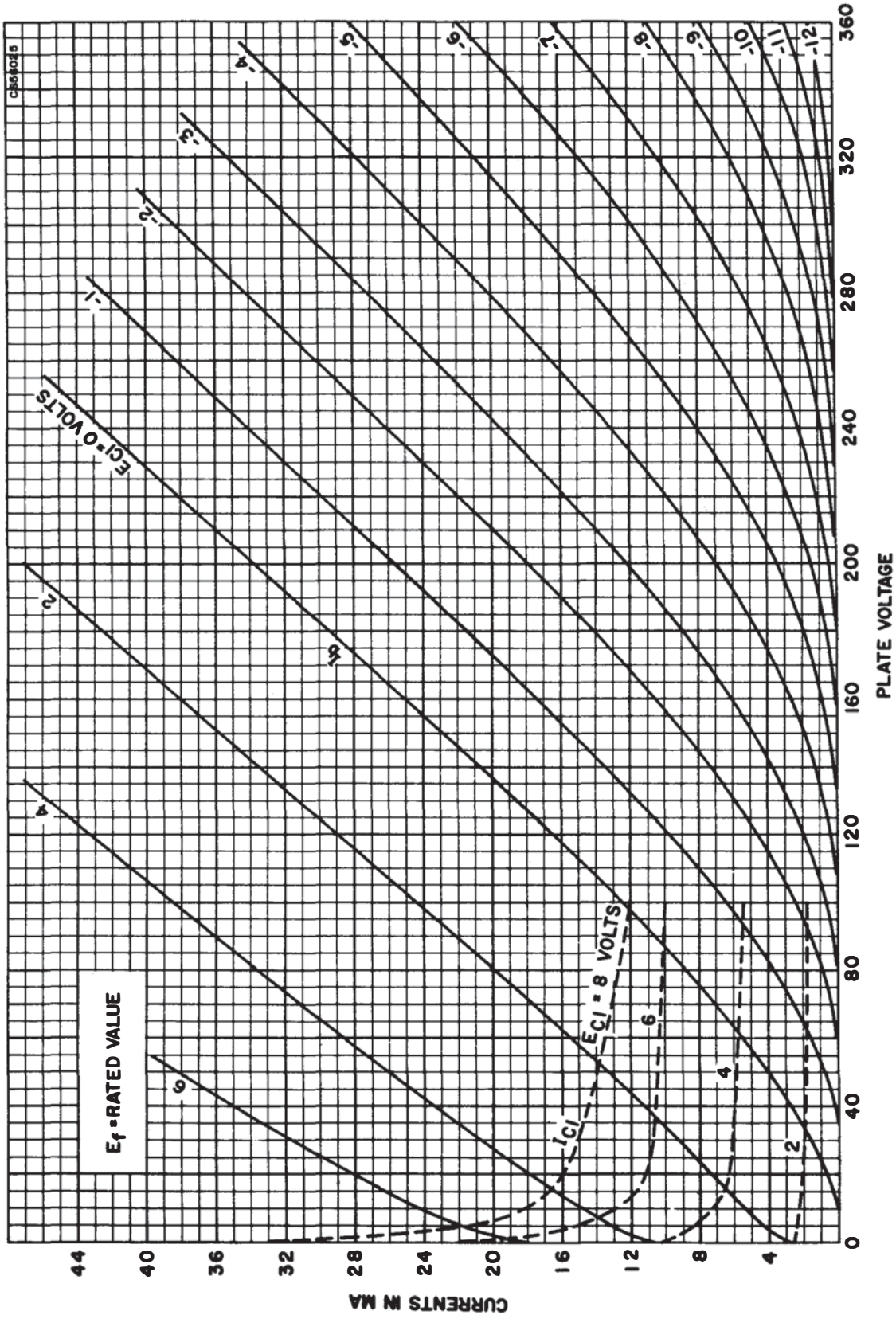
	Ebb = 100 Volts								Ebb = 200 Volts							
Rb (megohms)	.047		0.10		0.27		.47		.047		.10		.27		.47	
Rcf (megohms)	.10	.27	.10	.47	.27	.47	.47	1.0	.10	.27	.10	.47	.27	.47	.47	1.0
Rk (ohms)	1500	1500	2200	3300	6800	8200	12000	16000	1000	1200	1500	2700	4700	5600	9100	12000
Ib (ma)	.85	.86	.51	.44	.19	.18	.115	.10	2.05	1.95	1.20	.98	.45	.43	.26	.24
Ec (volts)	−1.27	−1.29	−1.12	−1.45	−1.29	−1.48	−1.38	−1.60	−2.05	−2.34	−1.80	−2.65	−2.12	−2.40	−2.36	−2.88
Eb (volts)	58.8	58.2	47.9	54.5	47.4	49.8	44.6	51.4	101.6	106.2	78.2	99.4	76.9	81.6	75.6	84.1
Esig (volts, rms)	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
Eout (volts, rms)	2.01	2.14	2.04	2.18	2.05	2.1	2.04	2.14	2.34	2.42	2.36	2.4	2.3	2.36	2.28	2.29
Gain	20.1	21.4	20.4	21.8	20.5	21.0	20.4	21.4	23.4	24.2	23.6	24.0	23.0	23.6	22.8	22.9
% Distortion	1.4	1.4	1.4	2.4	1.4	2.3	2.4	1.5	1.20	1.3	1.3	1.4	1.3	1.3	1.3	1.4
Esig* (volts, rms)	.47	.57	.42	.63	.55	.62	.58	.78	1.15	1.35	.97	1.41	1.15	1.35	1.2	1.6
Eout (volts, rms)	9.4	12.1	8.5	13.5	11.0	12.8	11.7	16.0	26.8	32.1	22.8	33.5	26.5	31.5	27.2	36.0
Gain	20.0	21.2	20.2	21.4	20.0	20.5	20.2	20.5	23.3	23.8	23.5	23.8	23.0	23.3	22.6	22.6
% Distortion	5.0	5.0	4.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.8	5.0

*Maximum signal for 5% distortion or 1/8 microampere grid current.

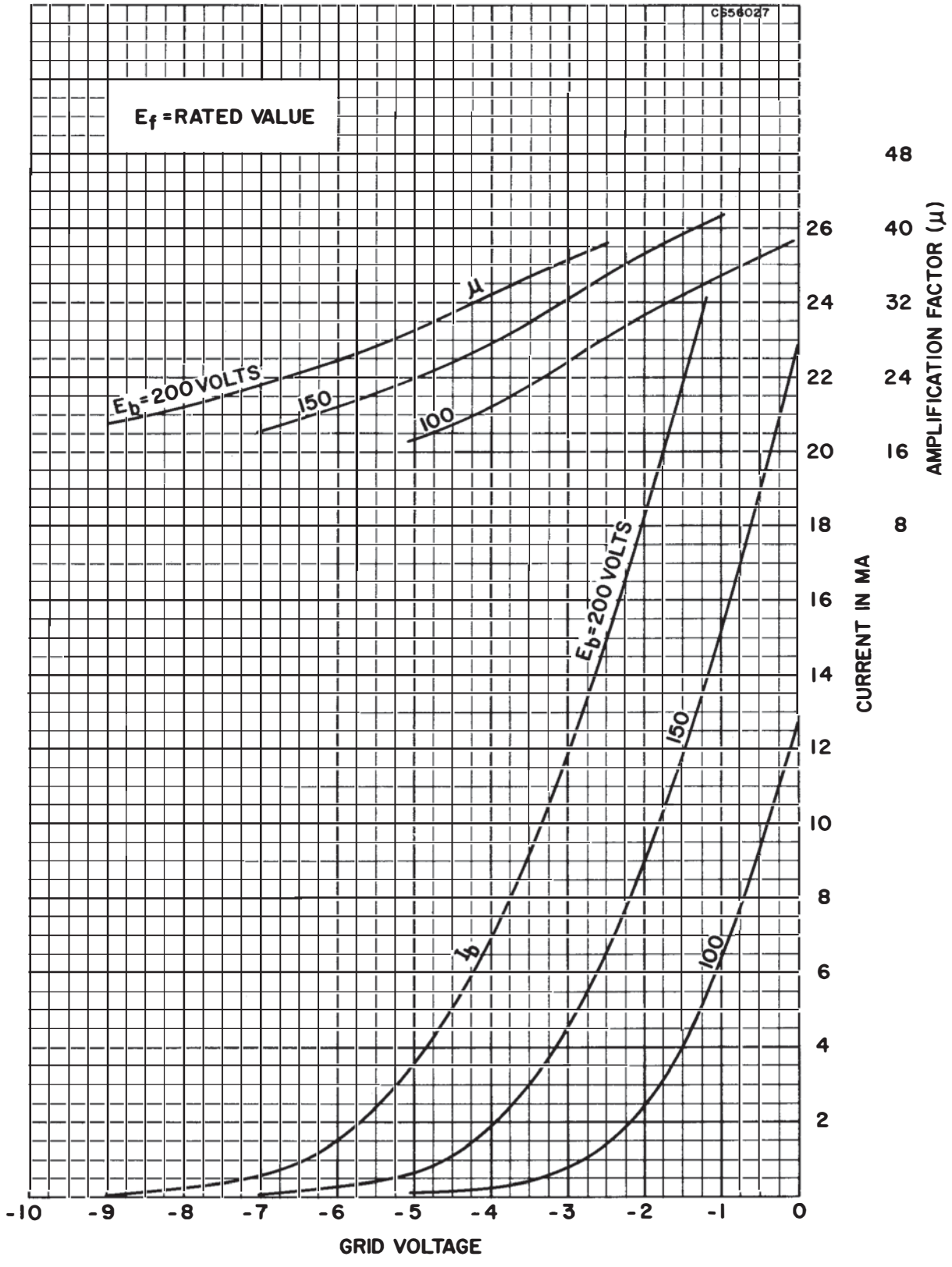


Resistance coupled amplifier circuit (Self-Bias)

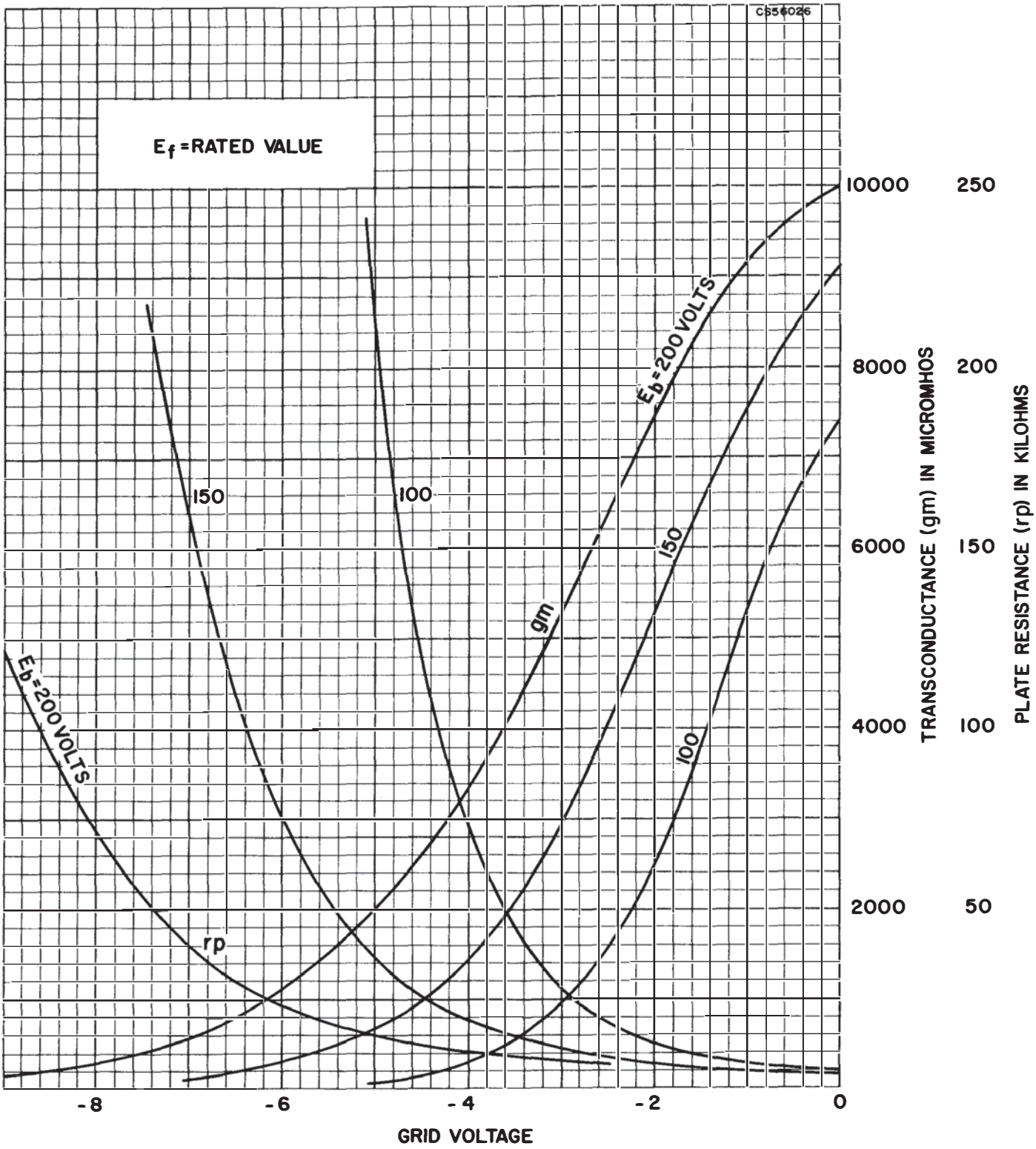
AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

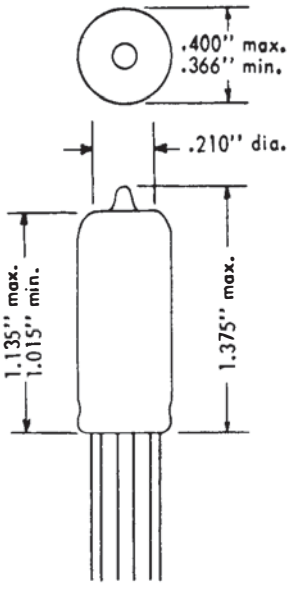


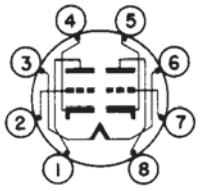
AVERAGE TRANSFER CHARACTERISTICS



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.





BOTTOM VIEW
8DG

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	mAdc
Grid Current (per grid)	Ic/c:	----	----	----	5.5	mAdc
Cathode Resistance (per unit)	Rk:	----	150	150	----	ohms
Transconductance (per plate)	Sm/p:	----	----	5400	----	μmhos
Amplification Factor	Mu/p:	----	----	35	----	----

Tentative Data

Printed in U.S.A.

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	Ihk (1): Ihk (1):	---- ----	---- ----	---- ----	---- ----	3.5 3.5	---- ----	μAdc μAdc
Grid Current:	Eb = 150 Vdc; Rk/k = 300 ohms; Rg = 1.0 Meg.	0.4	Ic (1):	----	----	----	----	-0.3	----	μAdc
Plate Current (1):		0.4	Ib (1):	4.5	5.6	6.5	7.3	8.5	2.3	mAdc
Plate Current (2):	Ec1 = -6.5 Vdc	0.4	Ib (2):	----	----	----	----	100	----	μAdc
Transconductance (1):		0.4	Sm (1):	4450	5000	5400	5800	6350	1100	μmhos
Continuity to Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg-all = -100 Vdc Ep-all = -300 Vdc	2.5	Rg1-all: Rp-all:	250 250	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (1) Difference between Sections:		2.5	Ib:	----	----	----	----	1.5	----	mAdc
Transconductance (2):	Ef = 5.7V; (Note 9)	2.5	Δ Ef Sm (2):	----	----	----	----	10	----	%
Grid Emission:	Eb = 250 Vdc; Rg/g = 1.0 Meg; Rk/k = 22 Preheat 5 minutes at Ec = 0; Test at Ec = -9.0 Vdc	6.5	Isc1:	----	----	----	----	-0.5	----	μAdc
AF Noise:	Esig = 65 mVac; Rg = 0.1 Meg; Rp = 0.01 Meg., Rk = 75 ohms; Ck = 1000 μf; 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 μsec. (Note 13)	2.5	ik: Δ_{tp} ik:	320 ----	---- ----	---- ----	---- ----	---- 10	---- ----	ma. %
Pulse Emission (2):	Ef = 5.9V; Eb = 150 Vdc; Ec1 = -25 Vdc; tp = 10 μsec, 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	Ihk (2):	----	----	----	----	1.0	----	μAdc
Amplification Factor:		6.5	mu:	30	----	35	----	40	----	----
Capacitance:			Cgp:	1.2	----	1.5	----	1.8	----	μμf
Capacitance:			Cin:	1.8	----	2.4	----	3.0	----	μμf
Capacitance:	(Note 2)	6.5	Cout (Unit #1):	0.20	----	0.28	----	0.36	----	μμf
Capacitance:			Cout (Unit #2):	0.22	----	0.32	----	0.42	----	μμf
Capacitance:			Cgg:	----	----	----	----	0.013	----	μμf
Capacitance:			Cpp:	----	----	----	----	0.52	----	μμf
Operation Time:	Note 11	4.0	t:	----	----	----	----	20	----	sec.
Low Pressure Voltage Breakdown:	Pressure = 21 ± 3 mmHg; Voltage = 300 Vac.	6.5	----	----	----	----	----	----	----	----

RAYTHEON

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	Allowable Defects per characteristic 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	---- ----	Ihk (1): Ihk (1):	---- ----	7.0 7.0	μAdc μAdc		
Change in Trans-conductance (1) of individual tubes:	Ef= 6.3V	----	Δ_t Sm (1):	----	15	%		
Grid Current (1):		----	Ic1:	----	–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	---- ----	Ihk (1): Ihk (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_t 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:	(Typical Sample Size= 200 tubes)							
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	4000	----	μmhos		

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	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd.)								
200 Hour Intermittent Life Test (1):	Eb= 250 Vdc; Ehk= + 200 Vdc; 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):		----	Ic (1):	----	−0.9	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	20	%	1	3
Heater–Cathode Leakage (1):	Ehk= + 100 Vdc Ehk= −100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Electrode Insulation:								
g–all: p–all:		---- ----	Rg1–all: Rp–all:	100 100	---- ----	Meg. Meg.	1	3
Total Defectives:		----	----	----	----	----	3	6
500 Hour Intermittent Pulse Life Test:	Eb= 250 Vdc; Ec1= −25 Vdc; Rk/k= 0; RL/p= 330 ohms; tp= 10 μsec; duty cycle= 1.0%; egk= + 30± 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:		---- ----	Δik: Δik:	---- ----	−35 +50	% %	1	3
Total Defectives:		----	----	----	----	----	2	5
Intermittent High Temperature Life Test (2):	T Bulb= 220°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):		----	Ic (1):	----	−0.7	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) change of individual tubes from initial:		----	Δ_t Sm (1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	15	%	1	3
Heater–Cathode Leakage (1):	Ehk= + 100 Vdc Ehk= −100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Insulation of Electrodes:								
g–all: p–all:		---- ----	Rg1–all: Rp–all:	50 50	---- ----	Meg. Meg.	1	3

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	Allowable Defects per characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
Transconductance (1) Average change:		----	Avg. Δ_t Sm	----	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 (1):		----	Ic (1):	----	–1.0	μAdc	1	3
Heater–Current:		----	If:	276	328	mA	1	3
Transconductance (1) Change of individual tubes:		----	Δ_t Sm (1):	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	20	%	1	3
Heater–Cathode Leakage (1):	Ehk= +100 Vdc	----	Ihk (1):	----	10	μAdc	1	3
	Ehk= –100 Vdc	----	Ihk (1):	----	10	μAdc		
Electrode Insulation:								
g–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, 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 ± 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 Ef= 6.3 V to the value measured at Ef= 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 ± 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

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± 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 Ef= 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.

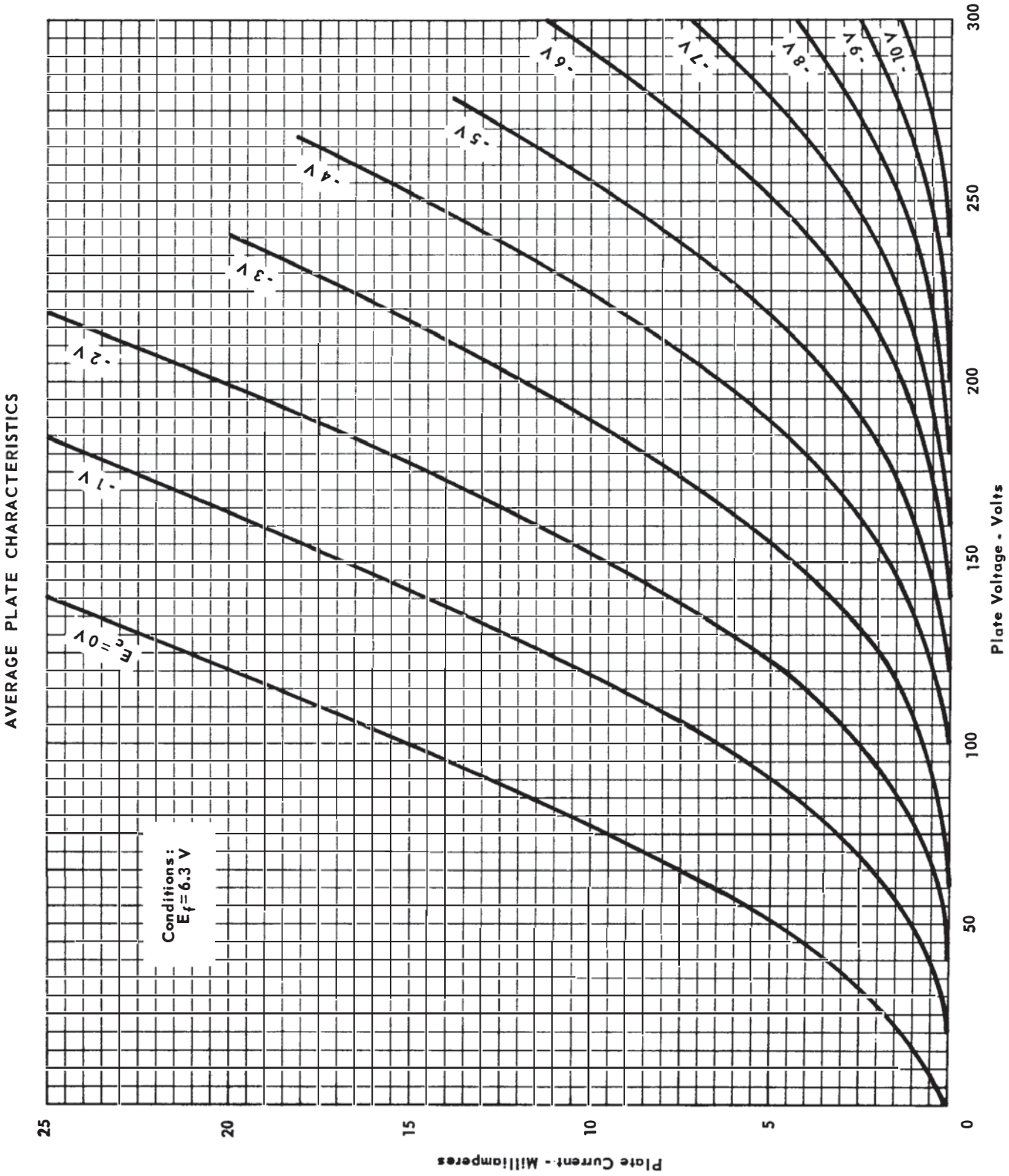
A) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

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).

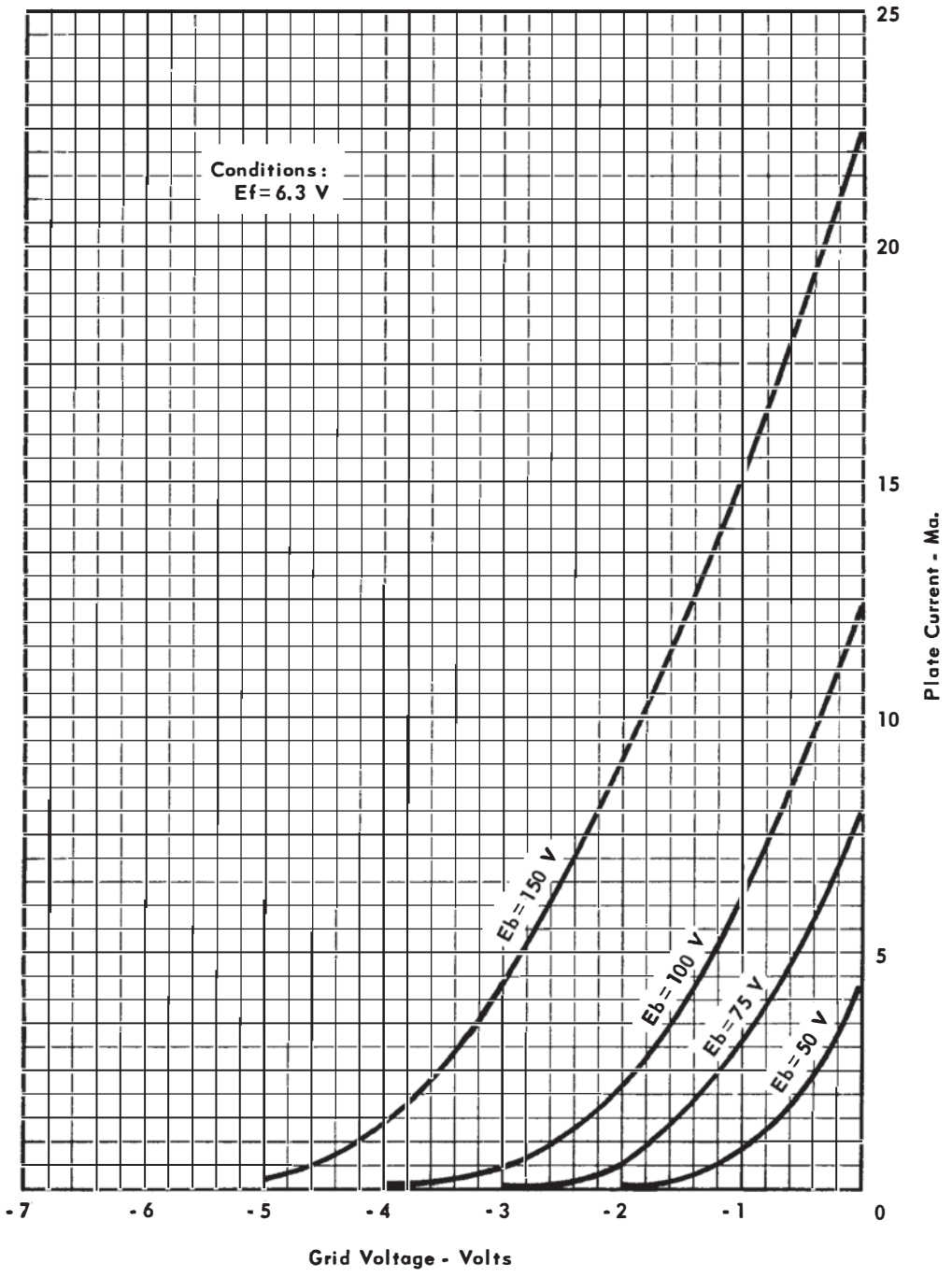
RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE



INDUSTRIAL TUBE DIVISION

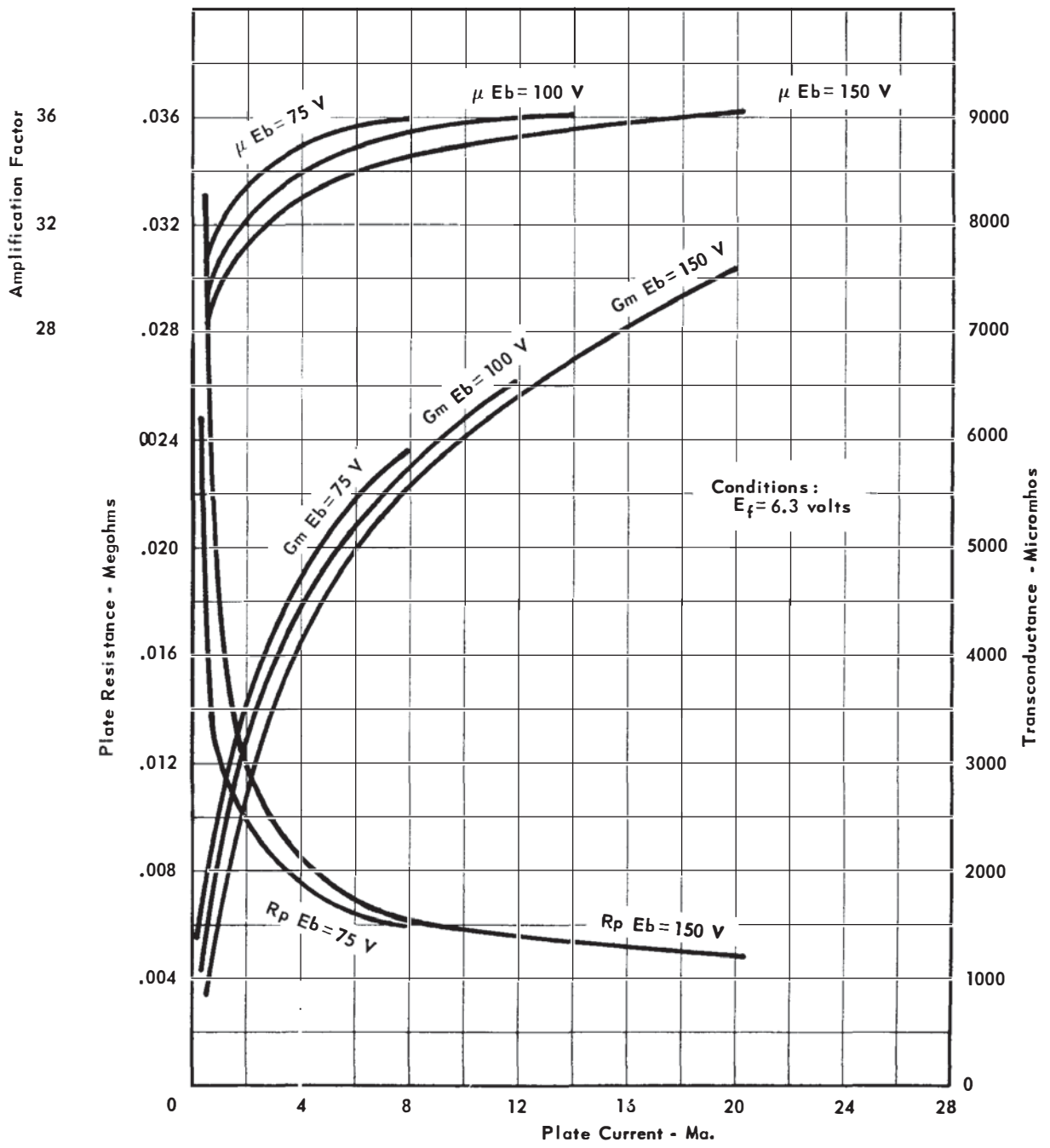
AVERAGE CHARACTERISTICS



RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

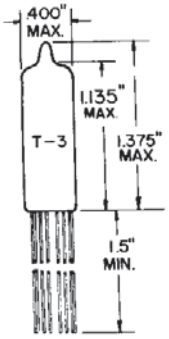
AVERAGE CHARACTERISTICS



TUNG-SOL

DOUBLE TRIODE

SUBMINIATURE TYPE



GLASS BULB

HEATER

ANY MOUNTING POSITION

BOTTOM VIEW
SUBMINIATURE BUTTON
8PIN
0.017" TINNED
FLEXIBLE LEADS

8DG

THE 6021WA IS A HEATER-CATHODE TYPE MEDIUM-MU DOUBLE TRIODE OF SUBMINIATURE CONSTRUCTION CAPABLE OF OPERATION IN THE UHF REGION. IT IS DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. THE FLEXIBLE 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.

RATINGS
MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST–NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST–NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST–NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS
AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDITIONS NOTE 7	NORM. OPERATION NOTE 6	DES. MAX.	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	mAdc
GRID CURRENT (PER GRID)	Ic/c:	---	---	---	5.5	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	150	150	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	5400	---	μMHOS
AMPLIFICATION FACTOR	Mu/p:	---	---	35	---	---

TUNG-SOL

CONTINUED FROM PRECEDING PAGE

CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1	COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES								
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA.
HEATER-CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.4	Ihk(1):	---	---	---	---	3.5	---	μAdc
Ehk=−100 Vdc		Ihk(1):	---	---	---	---	3.5	---	μAdc
GRID CURRENT:									
Eb=150 Vdc; Rk/k=300 OHMS; Rg=1.0 MEG.	0.4	Ic(1):	---	---	---	---	−0.3	---	μAdc
PLATE CURRENT (1):	0.4	Ib(1):	4.5	5.6	6.5	7.3	8.5	2.3	mAdc
PLATE CURRENT (2):									
Ec1=−6.5 Vdc	0.4	Ib(2):	---	---	---	---	100	---	μAdc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	4450	5000	5400	5800	6350	1100	μMHOS
CONTINUITY TO SHORTS (NOTE 11) (INOPERATIVES):	0.4	---	---	---	---	---	---	---	---
MECHANICAL:									
ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3 V									
Eg-all=−100 Vdc	2.5	Rg1-all:	250	---	---	---	---	---	MEG.
Ep-all=−300 Vdc		Rp-all:	250	---	---	---	---	---	MEG.
PLATE CURRENT (1) DIFFERENCE BETWEEN SECTIONS:	2.5	Ib:	---	---	---	---	1.5	---	mAdc
TRANSCONDUCTANCE (2):									
Ef=5.7 V; (NOTE 9)	2.5	Δ_{Ef}Sm(2):	---	---	---	---	10	---	PERCENT
GRID EMISSION:									
Eb=250 Vdc; Rg/g=1.0 MEG; Rk/k=2200 OHMS; Ef=7.5 V; PREHEAT 5 MINUTES AT Ec=0; TEST AT Ec=−9.0 Vdc	6.5	Isc1:	---	---	---	---	−0.5	---	μAdc
AF NOISE:									
Esig=65 mVac; Rg=0.1 MEG.; Rp=0.01 MEG., Rk=75 OHMS: Ck=1000 μf; UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
PULSE EMISSION (1):									
Eb=150 Vdc; Ec1=−25 Vdc; Egk=+30 V; Rk/k=1.0 OHM; DUTY CYCLE = 1%; tp= 10 μsec (NOTE 12)	2.5	ik:	320	---	---	---	---	---	ma.
		Δ_{tp}ik:	---	---	---	---	10	---	PERCENT

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TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]-cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 (CONT'D.)									
		COMBINED AQL=1.0% EXCLUDING MECH. AND INDPERATIVES							
PULSE EMISSION (2): Ef=5.9V; Eb=150 Vdc; Ec1=-25 Vdc; tp=10μsec, DUTY CYCLE =1%; egk=+30 V; Rk/k=1.0 OHMS; (NOTE 12)	6.5	ik:	300	---	---	---	---	---	ma.
HEATER-CATHODE LEAKAGE (2): Ef=-6.7 V (PIN 6 NEGATIVE); Ehk=+100 Vdc (CATHODE NEG.) t=16 SECONDS (NOTE 13)	6.5	Ihk(2):	---	---	---	---	1.0	---	μAdc
AMPLIFICATION FACTOR:	6.5	mu:	30	---	35	---	40	---	---
CAPACITANCE		Cgp:	1.2	---	1.5	---	1.8	---	μμf
CAPACITANCE:		Cin:	1.8	---	2.4	---	3.0	---	μμf
CAPACITANCE (NOTE 2)	6.5	Cout: (UNIT #1):	0.20	---	0.28	---	0.36	---	μμf
CAPACITANCE:		Cout (UNIT #2):	0.22	---	0.32	---	0.42	---	μμf
CAPACITANCE:		Cgg:	---	---	---	---	0.013	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.52	---	μμf
OPERATION TIME: (NOTE 10)	4.0	t:	---	---	---	---	20	---	SEC.
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE =21 ±3 mmHg; VOLTAGE = 300 Vac.	6.5	---	---	---	---	---	---	---	---
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	---	---	---	---	---	---	---	---

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TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOWABLE DEF. PER CHARACT. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
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; t=10 MILLISECONDS; G=75; (NOTE 15)			20	---	---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 14)			6.5	---	---	---	---
POST SHOCK (1) & (2) AND FATIGUE (1) & (2) TEST END POINTS:							
VIBRATION (2): F=40cps; G=15; Rp=10,000 OHMS			---	Ep:	---	80	mVac
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc			---	Ihk(1):	---	7.0	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7.0	μAdc
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:							
Ef=6.3 V			---	Δ_tSm(1):	---	15	PERCENT
GRID CURRENT (1):			---	Ic1:	---	-1.0	μAdc
GLASS STRAIN (THERMAL SHOCK):			6.5	---	---	---	---
ACCEPTANCE LIFE TEST							
HEATER CYCLING LIFE TEST: Ef=7.0 V; Eb=Ec1=0V; Ehk=140 Vac; 1 MIN ON, 4 MIN OFF			1.0	---	2000	---	CYCLES
HEATER CYCLE LIFE TEST END POINT:							
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc			---	Ihk(1):	---	7.0	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7.0	μAdc
2 & 20 HOUR STABILITY LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.			---	---	---	---	---

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TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
2 & 20 HOUR STABILITY LIFE TEST END POINTS:							
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES: (TYPICAL SAMPLE SIZE = 50 TUBES)			1.0	Δ_tSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.			---	---	---	---	---
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE=200 TUBES)							
INOPERATIVES:			0.65	---	---	---	---
TRANSCONDUCTANCE (1):			1.0	Sm(1):	4000	---	μMHOS
200 HOUR INTERMITTENT LIFE TEST (1): Eb=250 Vdc; Ehk=+200 Vdc; 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):	1	3	---	Ic(1):	---	-0.9	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:	1	3	---	Δ_tSm(1):	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	20	PERCENT
HEATER=CATHODE LEAKAGE (1): Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
ELECTRODE INSULATION: g-all:	1	3	---	Rg1-all:	100	---	MEG.
p-all:			---	Rp-all:	100	---	MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
500 HOUR INTERMITTENT PULSE LIFE TEST: Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; RL/p=330 OHMS; tp=10μsec.; DUTY CYCLE= 1.0%; egk=+30±1v; TA=ROOM.	---	---	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]-cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST ACCEPTANCE LIFE TESTS (CONT'D.)	ALLOW. DEF. PER CHAR. 1st SAMP.	ALLOW. DEF. PER CHAR. COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
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):	1	3	---	ik:	300	---	ma.
CHANGE IN PULSE EMISSION (1) OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_{ik}:	---	-35	PERCENT
			---	Δ_{ik}:	---	+50	PERCENT
TOTAL DEFECTIVES:	2	5	---	---	---	---	---
INTERMITTENT HIGH TEMPERATURE LIFE TEST (2): T BULB=220°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):	1	3	---	Ic(1):	---	-0.7	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_tSm(1):	---	20	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	15	PERCENT
HEATER=CATHODE LEAKAGE (1): Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES: g-all	1	3	---	Rg1-all:	50	---	MEG.
p-all			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	---	---	---	Avg Δ_tSm:	---	15	PERCENT
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	---	---	---	---	---

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TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TESTS [1] . cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	2nd. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
GRID CURRENT (1):	1	3	---	Ic(1):	---	-1.0	μAdc
HEATER-CURRENT	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES:	1	3	---	Δ_tSm(1):	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
ELECTRODE INSULATION:							
g-all:	2	5	---	Rg1-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES

1. CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1, AND MIL-STD-105A.

2. WITHOUT SHIELD

3. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

4. CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.

5. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

6. THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

7. THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

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.

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TUNG-SOL

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NOTES - CONT'D.

9. CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef=6.3 V TO THAT VALUE MEASURED AT Ef=5.7 V.

10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN ±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.

11. 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

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

12. PEAK CATHODE CURRENT SHALL BE MEASURED BY MEANS OF A HIGH IMPEDANCE OSCILLOSCOPE OR EQUIVALENT DEVICE CONNECTED ACROSS A 1.0±1% CATHODE RESISTOR. THE SPECIFIED LIMIT REFERS TO THE MAXIMUM OF THE PULSE AMPLITUDE. THE VARIATION OF THE OUTPUT PULSE AMPLITUDE BETWEEN 20% AND 80% TP SHALL NOT EXCEED THE SPECIFIED LIMIT.

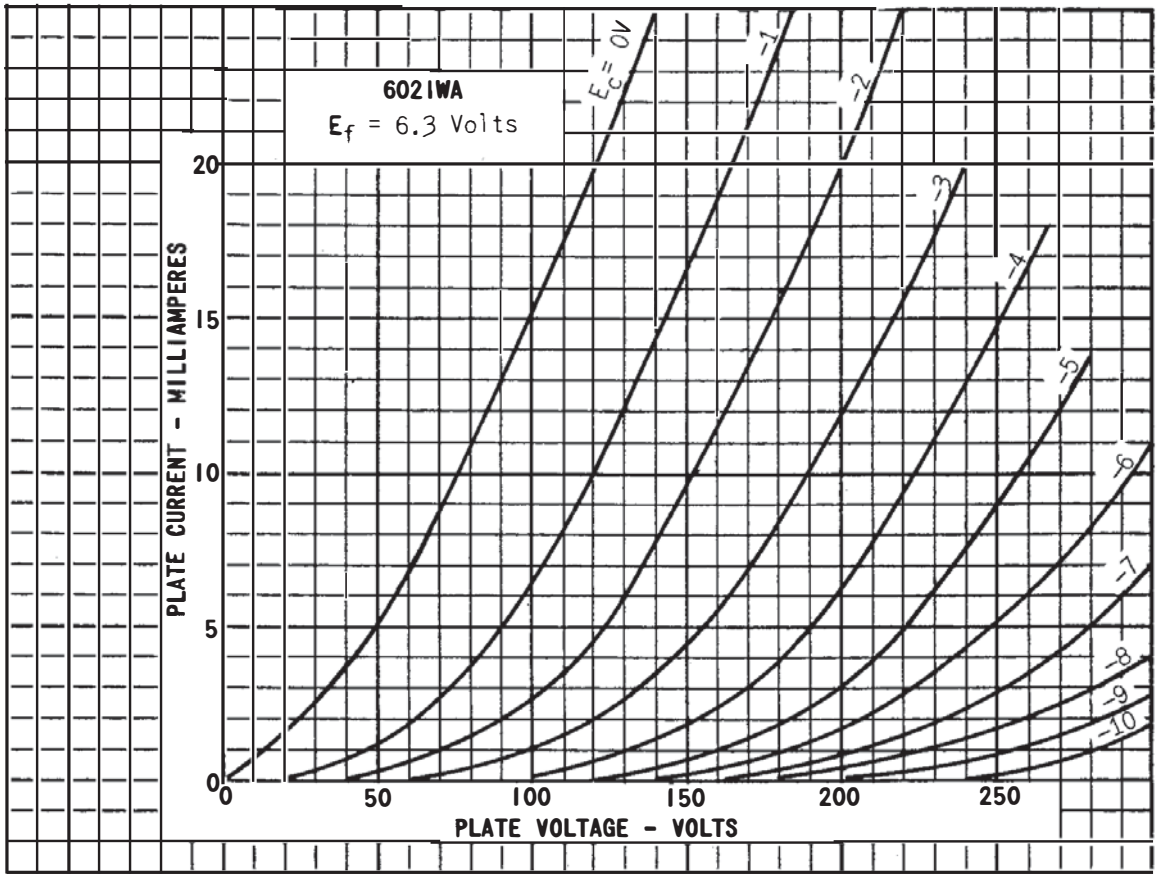
13. HEATER-CATHODE LEAKAGE (2) IS PERFORMED AS FOLLOWS:

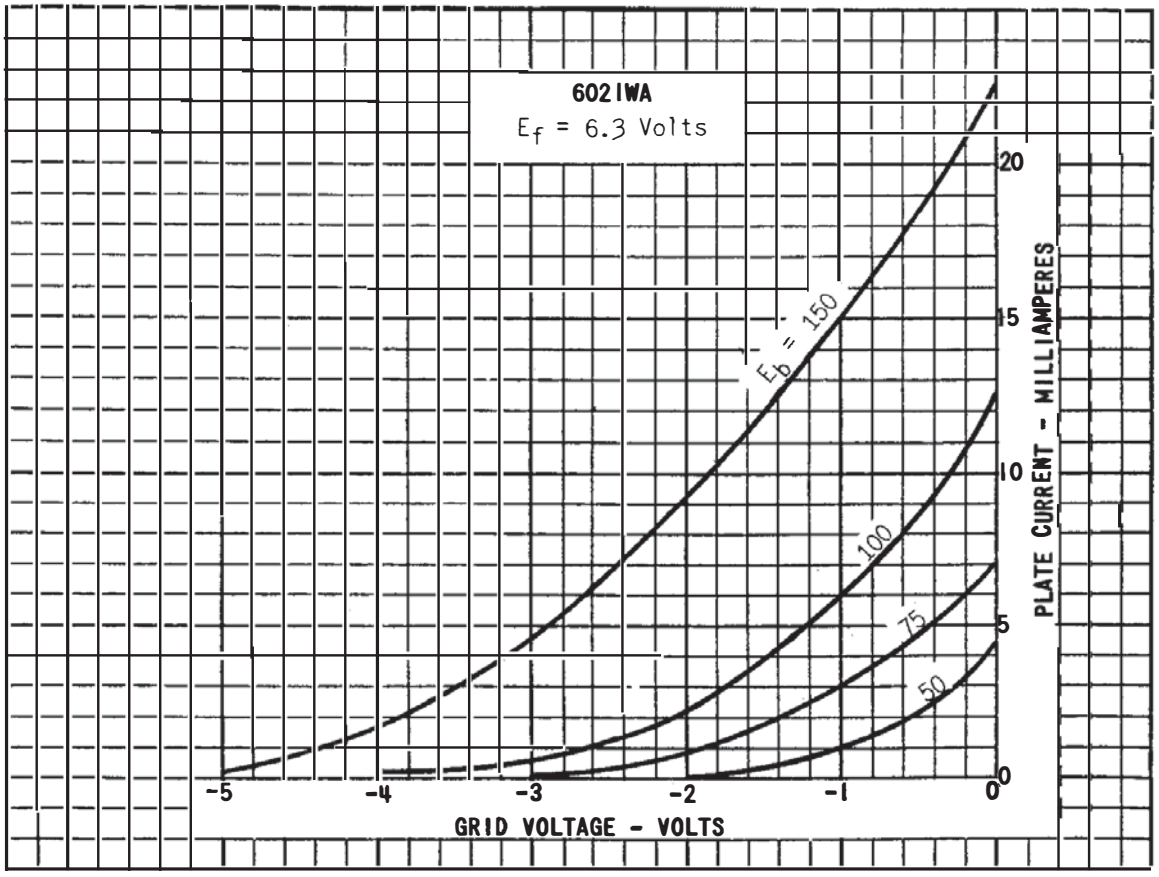
A) PREHEAT TUBES FOR 10 SECONDS WITH Ef=10.5 V.
B) TEST IMMEDIATELY BY THE APPLICATION OF THE SPECIFIED TEST CONDITIONS OF THIS TEST.
C) AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTIONS.

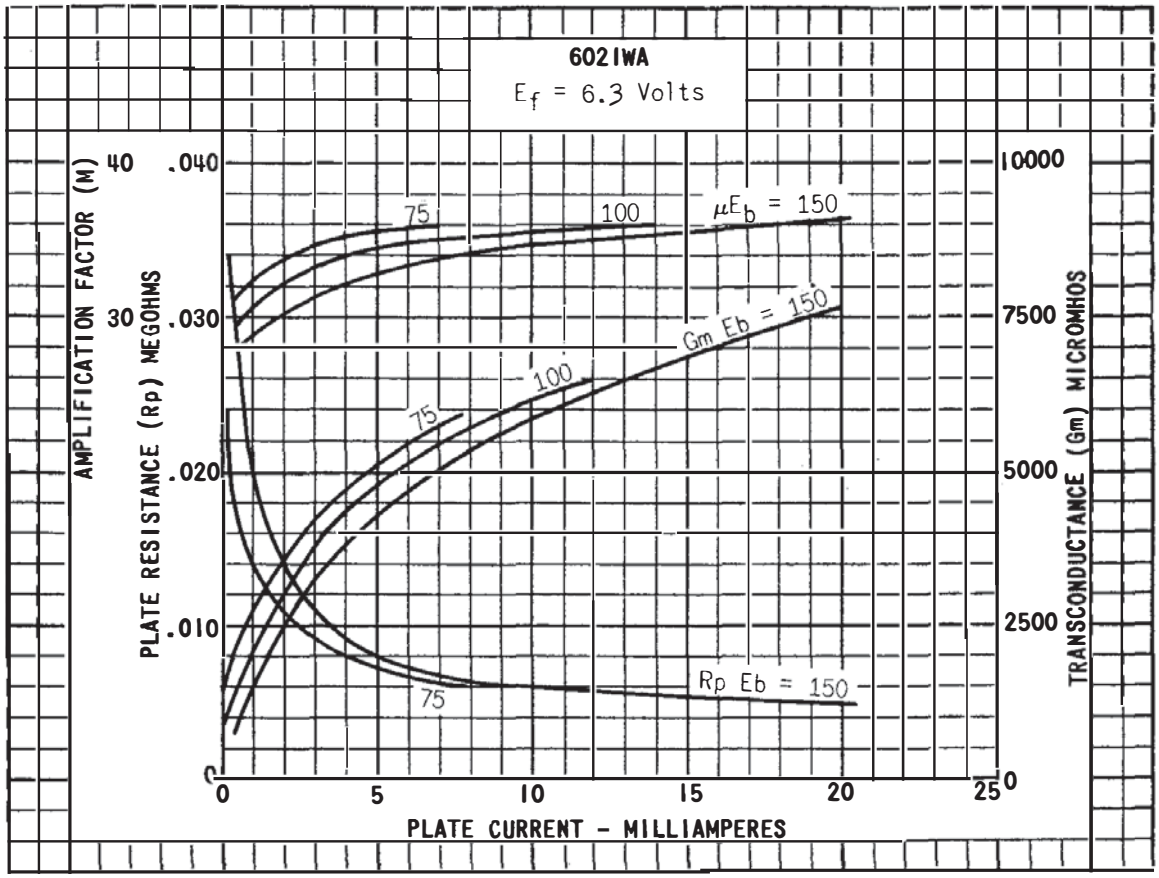
14. THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2, AND Y1. ONLY RATED HEATED VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED 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.

15. THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).


6021WA
E_f = 6.3 Volts
E_c = 0V
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
PLATE CURRENT - MILLIAMPERES
0
5
10
15
20
0
50
100
150
200
250
PLATE VOLTAGE - VOLTS


6021WA
E_f = 6.3 Volts
E_b = 150
100
75
50
PLATE CURRENT - MILLIAMPERES
0
5
10
15
20
-5
-4
-3
-2
-1
0
GRID VOLTAGE - VOLTS


6021WA
E_f = 6.3 Volts
AMPLIFICATION FACTOR (M)
PLATE RESISTANCE (Rp) MEGOHMS
TRANSCONDUCTANCE (Gm) MICROMHOS
PLATE CURRENT - MILLIAMPERES
40
30
0
.040
.030
.020
.010
0
10000
7500
5000
2500
0
0
5
10
15
20
25
75
100
μE_b = 150
Gm Eb = 150
Rp Eb = 150

SUBMINIATURE DOUBLE TRIODE

ECC70

Subminiature medium-μ double triode intended for use at v.h.f.

HEATER

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
$c_{a'-a''}$	<0.33	<0.52	pF
c_{a-g} (each section)	1.4	1.6	pF
$c_{g'\ g''}$	<0.011	<0.015	pF
c_{in} (each section)	—	2.4	pF
$c_{out'}$	1.2	0.3	pF
$c_{out''}$	1.3	0.35	pF

CHARACTERISTICS (each section)

V_a	100	V
V_g	–1.0	V
I_a	6.5	mA
g_m	5.4	mA/V
r_a	6.5	kΩ
μ	35	
V_g (I_a = 10μA)	–6.5	V

LIMITING VALUES (absolute ratings) each section

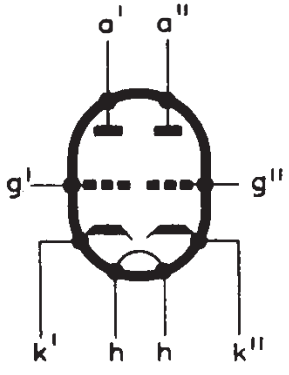
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
I_a max.	22	mA
$-V_g$ max.	55	V
I_g max.	5.5	mA
V_{h-k} max.	200	V

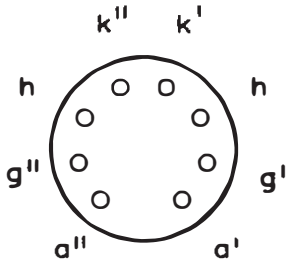
ECC70

SUBMINIATURE DOUBLE TRIODE

Subminiature medium-μ double triode intended for use at v.h.f.

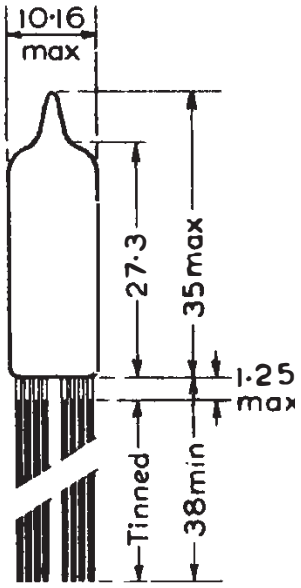
5262



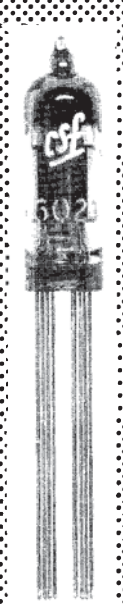


B8D/F Base

All dimensions in mm



"Subnitron" 6021



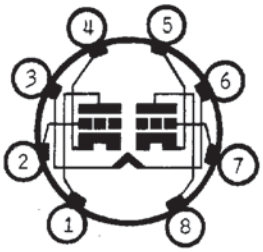
DOUBLE TRIODE HF 6021

SUBMINIATURE DE SÉCURITÉ A COEFFICIENT D'AMPLIFICATION MOYEN

La double triode 6021 convient pour divers montages amplificateurs, mais plus particulièrement dans toutes applications nécessitant deux parties triodes électriquement indépendantes.

Ce tube est spécialement destiné à l'équipement de matériels militaires et professionnels. Sa structure interne renforcée lui confère une grande robustesse mécanique et une sécurité de fonctionnement élevée.

BROCHAGE



1 - Anode, élément 2
2 - Grille, élément 2
3 - Filament
4 - Cathode, élément 2
5 - Cathode, élément 1
6 - Filament
7 - Grille, élément 1
8 - Anode, élément 1

Montage : toutes positions

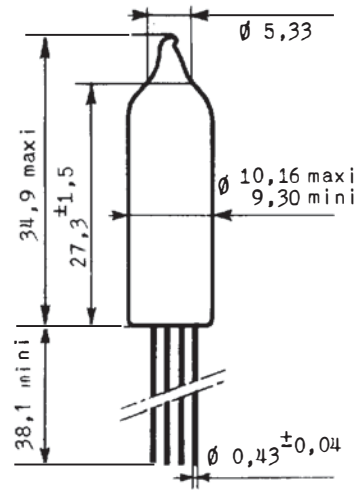
Cathode à oxydes, chauffage indirect.

Tension filament (V)	6,3 ± 5 %
Courant filament (A)	0,3

Capacités entre électrodes µµF	Avec blindage externe	Sans blindage externe
Grille à anode, chaque élément	1,4	1,5
Entrée, chaque élément	2,1	2,4
Sortie élément 1	1,3	0,28
Sortie élément 2	1,4	0,32
Grille à grille, maximum	0,011	0,013
Anode à anode, maximum	0,33	0,52

Le blindage externe d'un diamètre intérieur de 10,28 est connecté à la cathode de l'élément essayé.

A 10 - 1 UTE



Embase circulaire
8 fils 8A6 UTE
Poids net 3,4 g

Compagnie générale de télégraphie Sans Fil

Société Anonyme au Capital Porté à NF 40 608 900
Siège Social : 79, Boul. Haussmann - PARIS (8e)

DIVISION TUBES ÉLECTRONIQUES
Direction

CONDITIONS LIMITES D'UTILISATION

PAR ÉLÉMENT, VALEURS ABSOLUES

Tension d'anode (V)	165
Tension continue de grille (V)	65
Dissipation d'anode (W)	0,7
Courant d'anode (mA)	22
Courant grille (mA)	5,5
Résistance de grille (MΩ)	1,1
Tension entre cathodes et filament (V)	± 200
Température de l'ampoule (°C)	220

EXEMPLE DE FONCTIONNEMENT

AMPLIFICATRICE CLASSE A 1 (par élément)

Tension d'anode (V)	100
Résistance de cathode (Ω)	150
Coefficient d'amplification	35
Résistance interne (Ω)	6.500
Pente (mA/V)	5,4
Courant d'anode (mA)	6,5
Tension approximative de grille pour un courant d'anode de 10 µA (V)	- 6,5

VALEURS LIMITES DES CARACTÉRISTIQUES POUR PROJETS D'ÉQUIPEMENT

	Min.	Max.
Courant filament (mA)	280	320
Vf = 6,3 V		
- après 500 h de durée	276	328
- après 1000 h de durée	276	328
Courant d'anode (mA)	4,5	8,5
Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω; Ck = 1.000 µF		

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	Min.	Max.
Différence de courant d'anode entre les deux éléments (mA)	-	1,6
Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω ; Ck = 1.000 µF		
Pente de chaque élément (mA/V)	4,45	6,35
Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω ; Ck = 1.000 µF		
Variation individuelle de pente après 500 h de durée (%) *	-	20
Variation individuelle de pente après 1000 h de durée (%)		25
Coefficient d'amplification de chaque élément . .	30	40
Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω ; Ck = 1.000 µF		
Courant d'anode au blocage, par élément (µA) . .	-	100
Vf = 6,3 V ; Va = 100 V ; Vg = -6,5 V		
Courant inverse de grille pour chaque élément (µA)		0,3
Vf = 6,3 V ; Va = 150 V ; Rk = 300 Ω ; Ck = 1.000 µF ; Rg = 1 M		
- après 500 h de durée *		0,9
- après 1000 h de durée		1
Capacités interélectrodes (µµF) sans blindage externe		
Capacité entre grille et anode par élément . .	1,2	1,8
Capacité d'entrée par élément	1,8	3
Capacité de sortie élément 1	0,2	0,36
Capacité de sortie élément 2	0,22	0,42
Capacité de grille à grille	-	0,013
Capacité d'anode à anode	-	0,52
Courant filament-cathode pour chaque élément (µA)	-	5
Vf = 6,3 V ; Vfk = ± 100 V		
- après 500 h de durée *	-	10
- après 1000 h de durée	-	10
Résistance d'isolement interélectrodes (MΩ)		
Vf = 6,3 V		
- 100 V entre la grille de chaque élément et les autres électrodes	100	-
- après 500 h de durée *	50	-
- après 1000 h de durée	50	-
- 300 V entre l'anode de chaque élément et les autres électrodes	100	-
- après 500 h de durée *	50	-
- après 1000 h de durée	50	

- après 1000 h de durée	50	-
Tension vibratoire pour chaque élément (mV) . .	-	35
Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω ;		
Ck = 1.000 µF ; Ra = 10.000 Ω		
Accélération 10 g à 50 Hz.		

* Les conditions de durée sont : Vf = 6,3 V ; Va = 100 V ; Rk = 150 Ω Rg/g = 1 M ; Vfk = 200 V ; le filament étant positif par rapport à la cathode, température de l'ampoule 220° C.

ESSAIS SPÉCIAUX DE CONTROLE

FATIGUE FILAMENT

2.000 cycles : allumage une minute, extinction quatre minutes
Vf = 7 V ; Va = Vg = 0 et Vfk = 140 V eff.

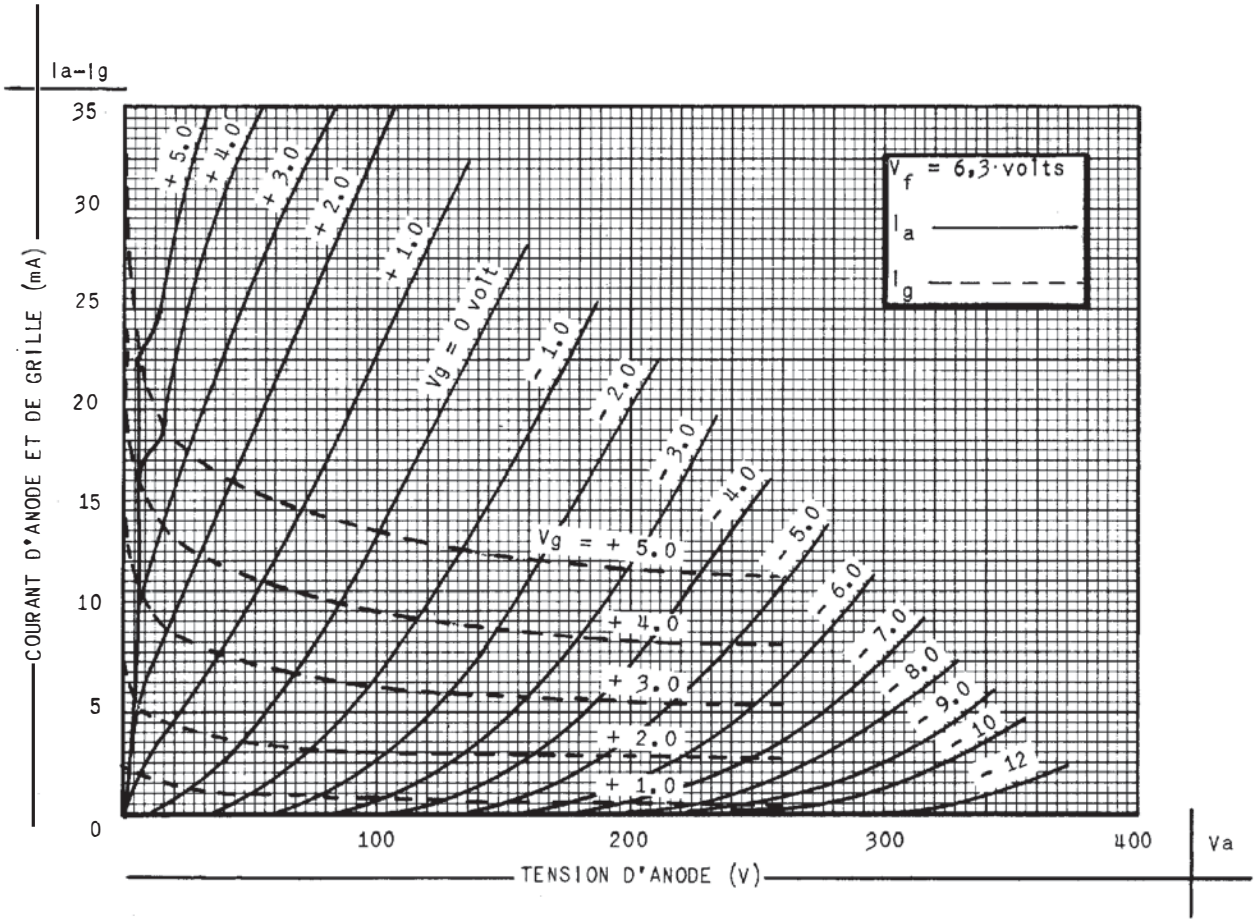
RÉSISTANCE AUX CHOCS

Cinq chocs de 450 G apliqués successivement dans quatre sens suivant trois axes perpendiculaires.

FATIGUE VIBRATIONS

Accélération de 2,5 G appliquée successivement suivant trois directions perpendiculaires (3 fois 24 heures).
Fréquence 25 Hz.

CARACTÉRISTIQUES MOYENNES Ia/Va PAR ÉLÉMENT



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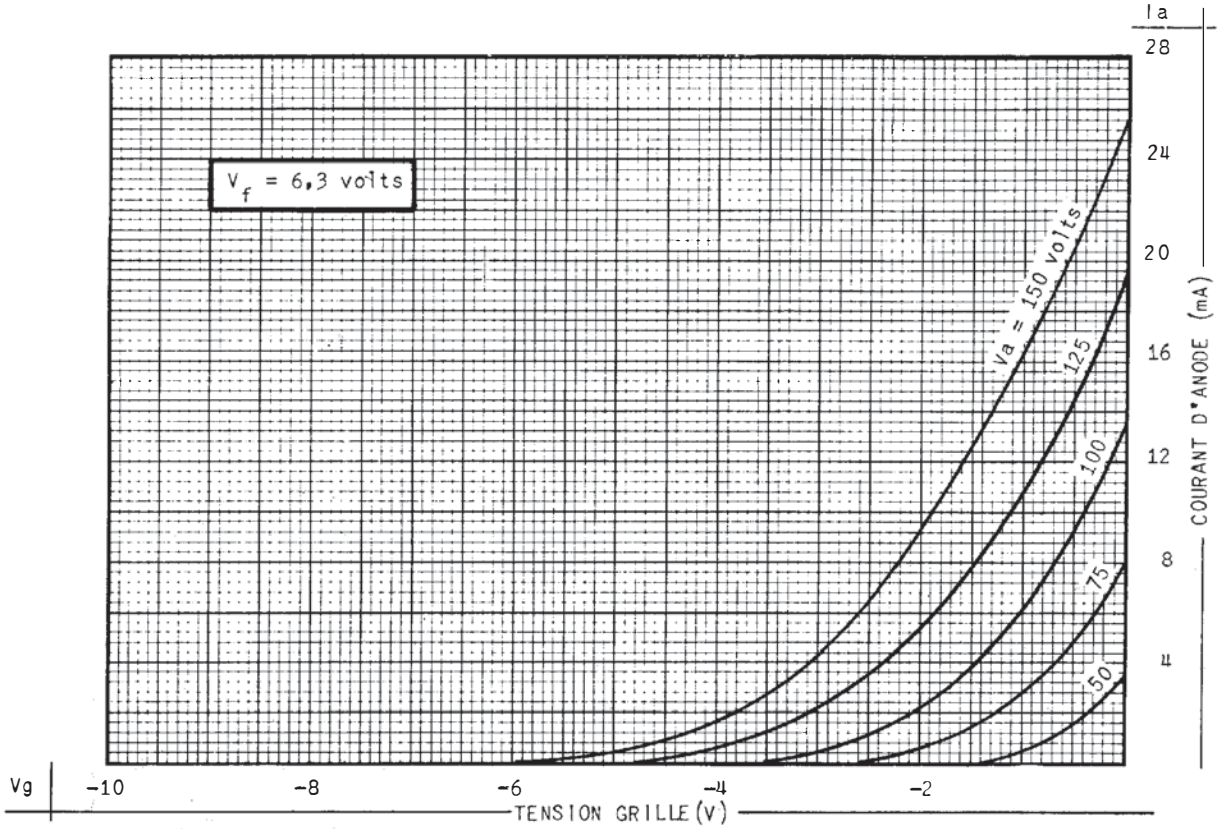
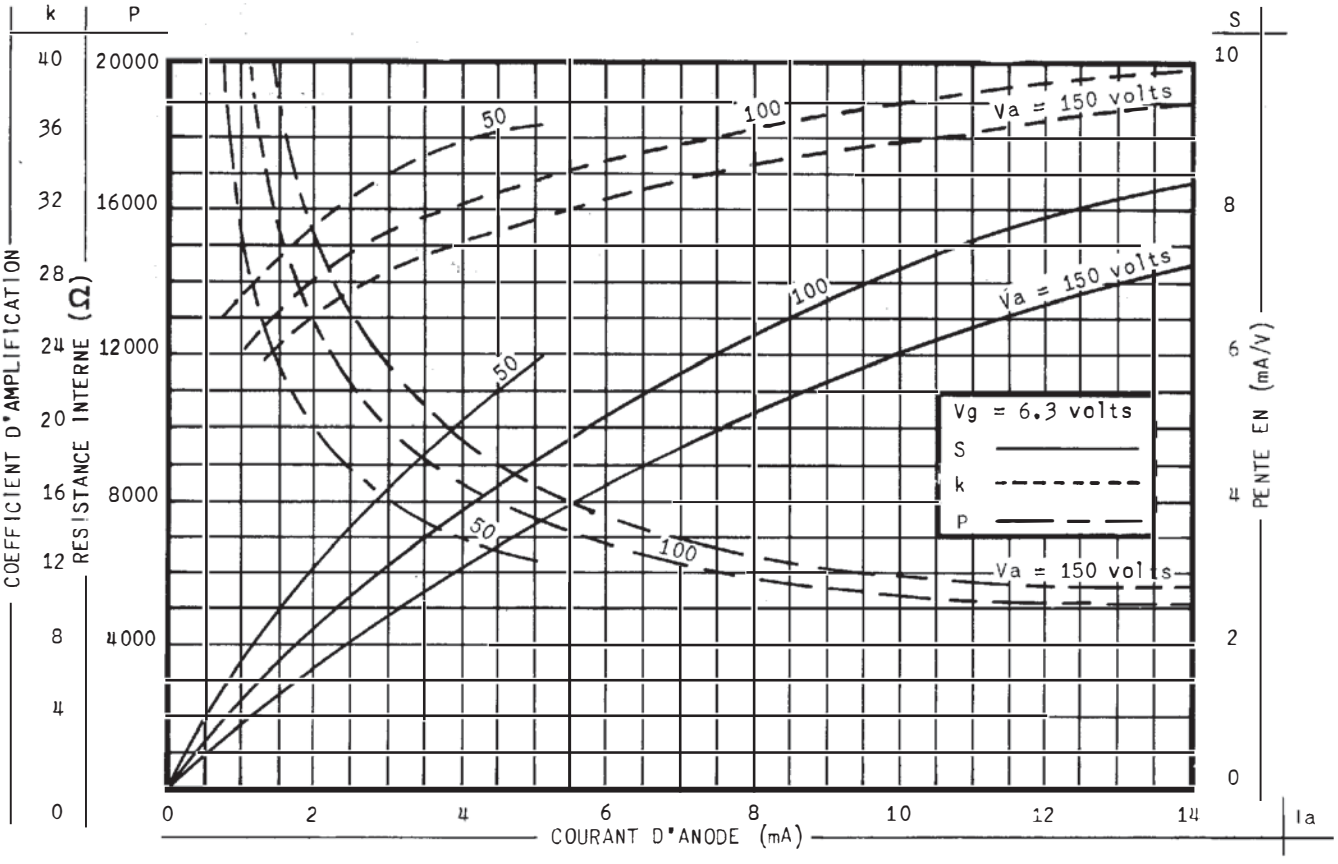
CARACTÉRISTIQUES MOYENNES Ia/Vg PAR ÉLÉMENT



CARACTÉRISTIQUES MOYENNES PAR ÉLÉMENT



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