

**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.

**GENERAL**

**ELECTRICAL**

Cathode—Coated Unipotential

Heater Voltage, AC or DC.....  $6.3 \pm 5\%$  Volts

Heater Current..... 0.3 Amperes

Direct Interelectrode Capacitances

	With Shield*	Without Shield
Grid to Plate, Each Section.....	1.4	1.5 $\mu\text{f}$
Input, Each Section.....	2.1	2.4 $\mu\text{f}$
Output, Section 1.....	1.3	0.28 $\mu\text{f}$
Output, Section 2.....	1.4	0.32 $\mu\text{f}$
Grid to Grid, maximum.....	0.011	0.013 $\mu\text{f}$
Plate to Plate, maximum.....	0.33	0.52 $\mu\text{f}$

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

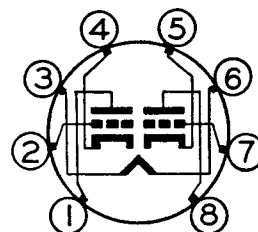
**MECHANICAL**

Mounting Position—Any

Envelope—T-3, Glass

Base—E8-10, Subminiature Button 8-Lead

**BASING DIAGRAM**

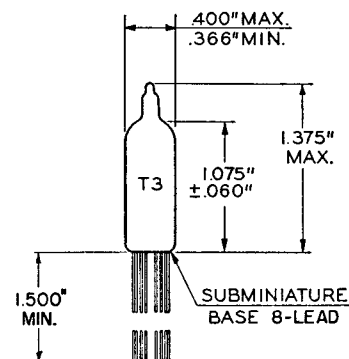


RETMA 8DG

**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)

**PHYSICAL DIMENSIONS**



RETMA 3-1

**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
<b>Heater-Cathode Voltage</b>	
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<sub>1</sub> 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
<b>Grid Voltage, approximate</b>	
I <sub>b</sub> = 10 Microamperes .....	-6.5 Volts

**CLASS A RESISTANCE-COUPLED AMPLIFIER**

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)										
R <sub>L</sub>	R <sub>gf</sub>	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R <sub>k</sub>	E <sub>o</sub>	Gain	R <sub>k</sub>	E <sub>o</sub>	Gain	R <sub>k</sub>	E <sub>o</sub>	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 <sub>L</sub>	R <sub>gf</sub>	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R <sub>k</sub>	E <sub>o</sub>	Gain	R <sub>k</sub>	E <sub>o</sub>	Gain	R <sub>k</sub>	E <sub>o</sub>	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:**

- E<sub>o</sub> is maximum RMS voltage output for approximately five percent total harmonic distortion.
- Gain is measured for an output voltage of two volts RMS.
- R<sub>k</sub> is in ohms; R<sub>L</sub> and R<sub>gf</sub> are in megohms.
- Coupling capacitors (C) should be selected to give desired frequency response. R<sub>k</sub> should be adequately by-passed.

## CHARACTERISTICS LIMITS

		Minimum	Maximum	
Heater Current				
E <sub>f</sub> = 6.3 volts . . . . .	Initial	280	320	Milliamperes
	500-Hr	276	328	Milliamperes
Plate Current, Each Section				
E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 100 volts, R <sub>k</sub> = 150 ohms (by-passed) . . . . .	Initial	4.5	8.5	Milliamperes
Plate Current Difference between Sections				
Difference between plate currents for each section at E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 100 volts, R <sub>k</sub> = 150 ohms (by-passed) . . . . .	Initial	. . . .	1.6	Milliamperes
Transconductance (1), Each Section				
E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 100 volts, R <sub>k</sub> = 150 ohms (by-passed) . . . . .	Initial	4450	6350	Micromhos
Transconductance Change with Heater Voltage, Each Section				
Difference between Transconductance (1) and Transconductance at E <sub>f</sub> = 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				
E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 100 volts, R <sub>k</sub> = 150 ohms (by-passed) . . . . .	Initial	30	40	
Plate Current Cutoff, Each Section				
E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 100 volts, E <sub>c</sub> = -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				
E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 150 volts, R <sub>k</sub> = 300 ohms (by-passed), R <sub>g</sub> = 1.0 meg . . . . .	Initial	. . . .	0.3	Microamperes
	500-Hr	. . . .	0.9	Microamperes
Heater-Cathode Leakage Current				
E <sub>f</sub> = 6.3 volts, E <sub>hk</sub> = 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				
E <sub>f</sub> = 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				
E <sub>f</sub> = 6.3 volts, E <sub>bb</sub> = 100 volts, R <sub>k</sub> = 150 ohms (by-passed), R <sub>L</sub> = 10,000 ohms, Vibrational acceleration = 15 G at 40 cps . . . . .	Initial	. . . .	50	Millivolts

**CHARACTERISTICS LIMITS (Cont'd)**

	<b>Minimum</b>	<b>Maximum</b>	
Grid Emission Current, Each Section $E_f = 7.5$ volts, $E_b = 150$ volts, $E_{cc} = -7.5$ volts, $R_g = 1.0$ meg . . . . . Initial	. . . .	0.5	Microamperes
Pulse Cathode Current $E_f = 6.0$ 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:  $E_f = 6.3$  volts,  $E_b = 100$  volts,  $R_k = 150$  ohms,  $R_g = 1.0$  meg,  $E_{hk} = 200$  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 in-operatives.

**Heater-Cycling Life Test**

Statistical sample operated for 2000 cycles to evaluate and control heater-cathode defects. Conditions of test include  $E_f = 7.0$  volts cycled for one minute on and four minutes off,  $E_b = E_c = 0$  volts, and  $E_{hk} = 140$  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**

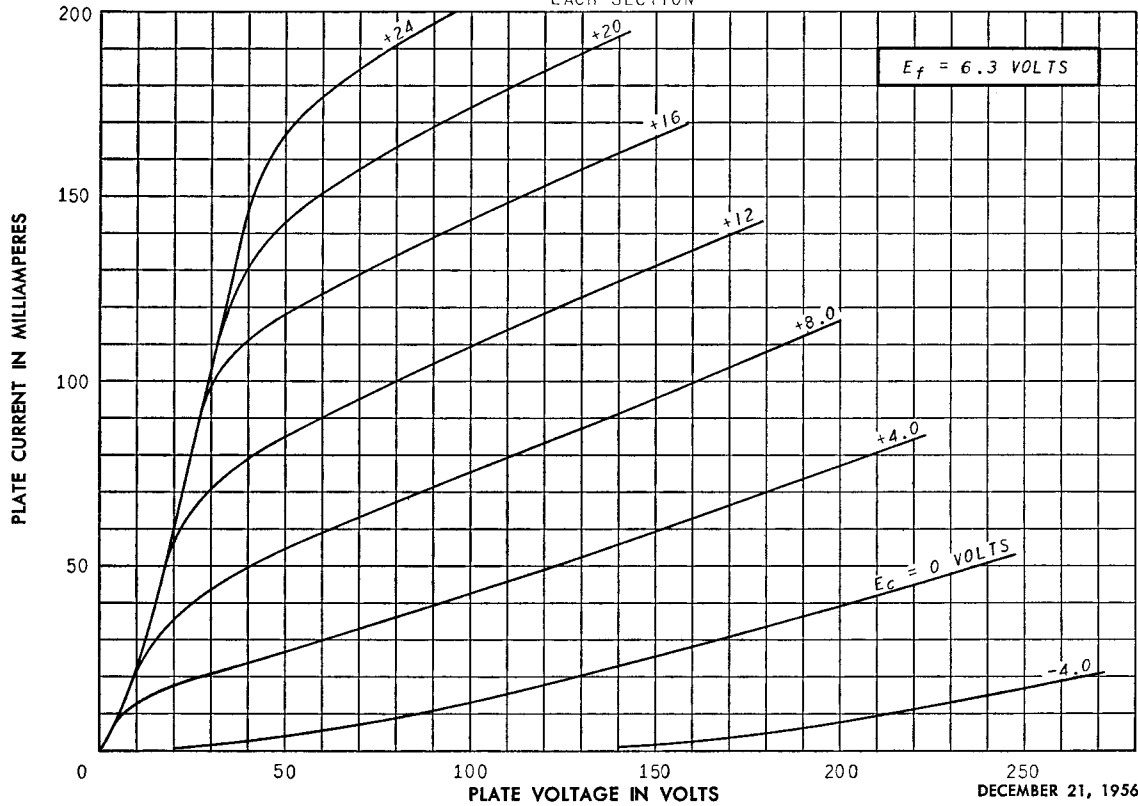
Statistical sample subjected to pressure of 55 millimeters of mercury to evaluate and control arcing and corona.

**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**

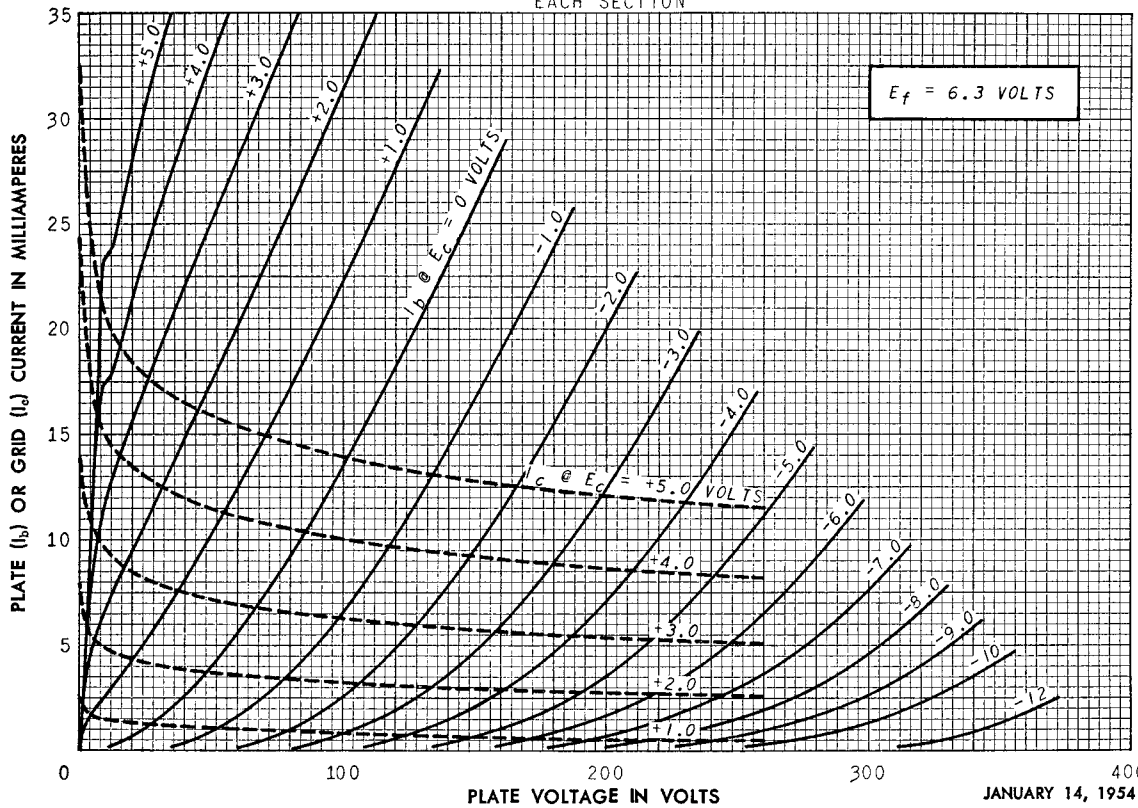
EACH SECTION



DECEMBER 21, 1956

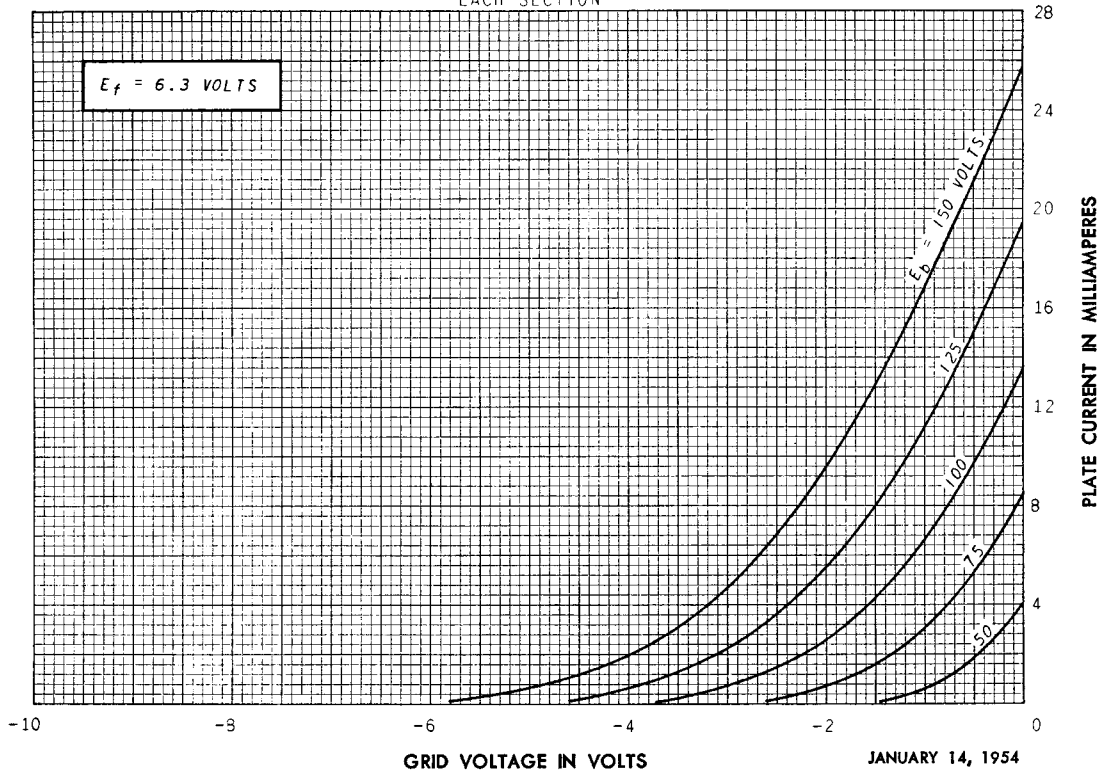
**AVERAGE PLATE CHARACTERISTICS**

EACH SECTION



JANUARY 14, 1954

**AVERAGE TRANSFER CHARACTERISTICS**  
 EACH SECTION



**AVERAGE CHARACTERISTICS**  
 EACH SECTION

