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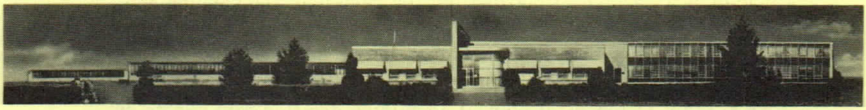

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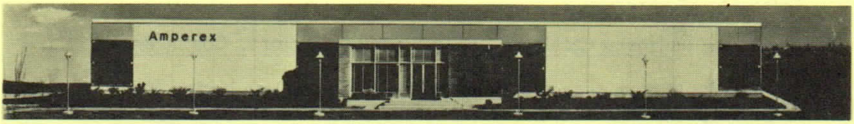

Amperex Semiconductor and Receiving Tube Division
Slatersville, Rhode Island 02876

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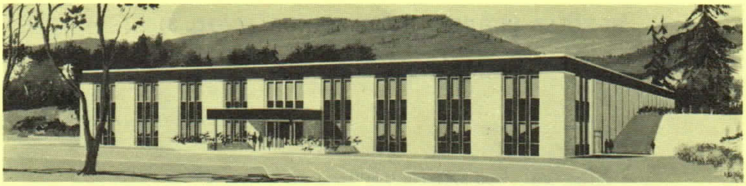

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NOTE

The data presented in this manual supersedes all previous data published for these products.

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For information on the Amperex library reference manuals see reverse side.

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Slatersville, Rhode Island 02876

SPECIAL PURPOSE TUBE MANUAL (VOL. 3)

PRICE $12.00 PREPAID

Printed in U.S.A. 8/67

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DM71	1N3	ECF202	6AJ9
DM160	6977	ECF801	6GJ7
DY51	1BG2	ECF802	6JW8
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E1T	6370	ECL82	6BM8
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E81L	6686	EF184	6EJ7
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E83F	6689	EL34	6CA7
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E91H	6687	EL505	6KG6
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EC80	6Q4	LC900	3HA5
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EC88	6DL4	LCF80	6LN8
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ECF86	6HG8	M8223	OA2
ECF200	6X9	M8224	OB2
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CROSS REFERENCE LIST

PHILIPS NO.	AMPEREX/EIA NO.	PHILIPS NO.	AMPEREX/EIA NO.
N22LL	19KF6	YF183	4EH7
N30EL	6LF6	YF184	4EJ7
PC900	4HA5	Z900T	5823
PD500	9ED4	Z550M	8453
PL84	15CW5	Z803U	Z803U
PL500	27GB5	ZA1004	ZA1004
PL505	40KG6	ZC1030	Z1030
PL508	17KW6	ZC1031	ZC1031
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AMPEREX

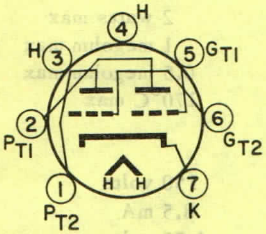
SPECIAL PURPOSE TUBES

SPECIAL PURPOSE TUBES

AMPEREX TUBE TYPE E92CC

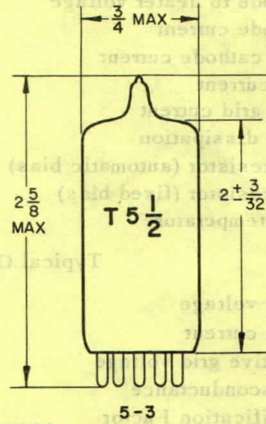
The Amperex E92CC is a reliable miniature twin triode designed for use in computer circuits which are not critical as to hum, microphonics and noise. Operatior of the tube for long periods of time under cut-off conditions will not cause deterioration of the emission surface.

The E92CC is one of the Amperex "Premium Quality, 10,000 Hour" tubes.



PIN CONNECTIONS

1-PLATE, TRIODE NO. 2
2-PLATE, TRIODE NO. 1
3-HEATER
4-HEATER
5-GRID, TRIODE NO. 1
6-GRID, TRIODE NO. 2
7-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL	
Cathode	coated, unipotential
Outline	T 5½
Bulb	5-3
Base	E 7-1
Bulb temperature	170°C max
ELECTRICAL	
Heater voltage	6.3 volts
Heater current	400 mA
Direct Interelectrode Capacitances	
Triode No. 1	
Input	3.1 $\mu\mu f$
Output	0.38 $\mu\mu f$
Plate to grid	2.1 $\mu\mu f$
Triode No. 2	
Input	3.1 $\mu\mu f$
Output	0.32 $\mu\mu f$
Plate to grid	2.2 $\mu\mu f$
Between sections	
Grid to grid	0.29 $\mu\mu f$ max
Plate to plate	2.0 $\mu\mu f$ max

E92CC

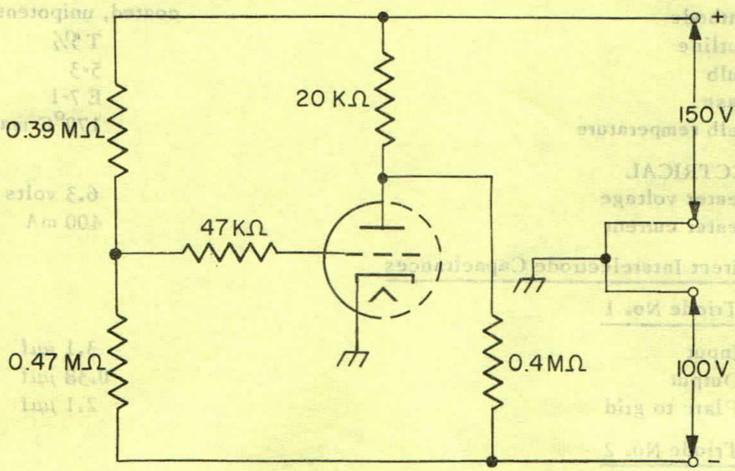
Maximum Ratings, Absolute Values

Plate supply voltage	600 volts max
Plate voltage	300 volts max
Negative grid voltage	100 volts max
Peak Negative grid voltage	200 volts max
Grid voltage	.5 volts max
Cathode to heater voltage	100 volts max
Cathode current	15 mA max
Peak cathode current	75 mA max
Grid current	250 μA max
Peak grid current	1000 μA max
Plate dissipation	2 watts max
Grid resistor (automatic bias)	1 megohm max
Grid resistor (fixed bias)	0.5 megohm max
Bulb temperature	170^{o}C max

Typical Operation, (Each Section)

Plate voltage	150 volts
Plate current	8.5 mA
Negative grid voltage	1.75 volts
Transconductance	6000 micromhos
Amplification Factor	45

Computer Service



CIRCUIT FOR COMPUTER SERVICE

Plate current	0.1 mA max
Cut-off balance ($E_{c1} - E_{c2}$)	2 volts

Characteristic Range Values for Equipment Design

	Initial Life Min	Initial Life Max	End of Life [1] Min	End of Life [1] Max	
Heater current ($E_h = 6.3$ V)	380	420	380	420	mA
Plate current ($E_b = 150$ V, $E_c = -1.7$ V)	4.5	12.5	-	-	mA
Plate current ($E_{bb} = 150$ V, $E_c = -10$ V, $R_p = 20$ kΩ, $R_g = 47$kΩ)	-	0.1	-	0.1	mA
Negative grid current ($E_b = 150$ V, $E_c = -1.7$ V)	-	0.2	-	1	μA
Cut-off balance ($E_{c1} - E_{c2}$) ($E_{bb} = E_{bb}' = 150$ V, $R_q = R_q' = 47$kΩ, $R_p = R_p' = 20$kΩ, $I_a = I_a' = 0.1$ mA)	-	2	-	2	volts
Cathode to Heater current (cathode positive, $R_{series} = 1$ meg, $V_{hk} = 100$ V)	-	15	-	30	μA
Plate resistor current (see Fig. 1)	5.1	5.9	4.75	-	mA
Transconductance ($E_b = 150$ V, $R_k = 200\ \Omega$)	4500	7500	-	-	micromhos
Insulation Resistance (between two arbitrary electrodes)	20	-	20	-	megohms

Direct Interelectrode Capacitances

	Min	Max
Triode No. 1		
Input	2.2	4.0 $\mu\mu$f
Output	0.28	0.48 $\mu\mu$f
Plate to grid	1.7	2.5 $\mu\mu$f
Triode No. 2		
Input	2.2	4.0 $\mu\mu$f
Output	0.22	0.42 $\mu\mu$f
Plate to grid	1.8	2.6 $\mu\mu$f
Between Sections		
Grid to grid	-	0.29 $\mu\mu$f
Plate to plate	-	2.0 $\mu\mu$f

[1] Conditions of life test (see Figure 1)

Heater voltage	6.3 volts	Heater-cathode voltage (cathode negative)	100 volts
Plate supply voltage	165 volts	Input voltage at frequency ca. 300 c/s	
Plate voltage	100 volts		

S = 1 : 10

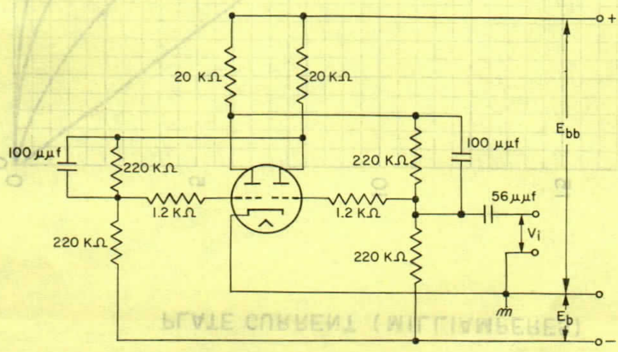
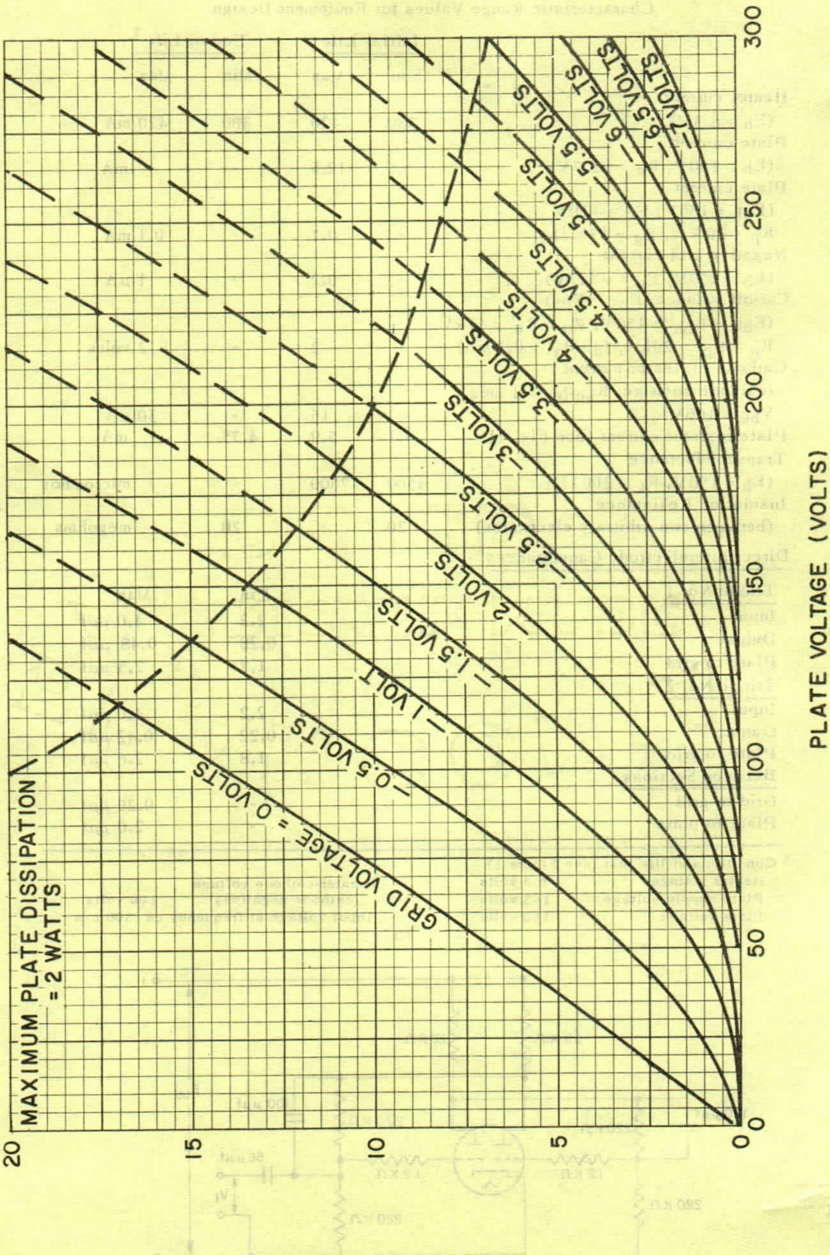


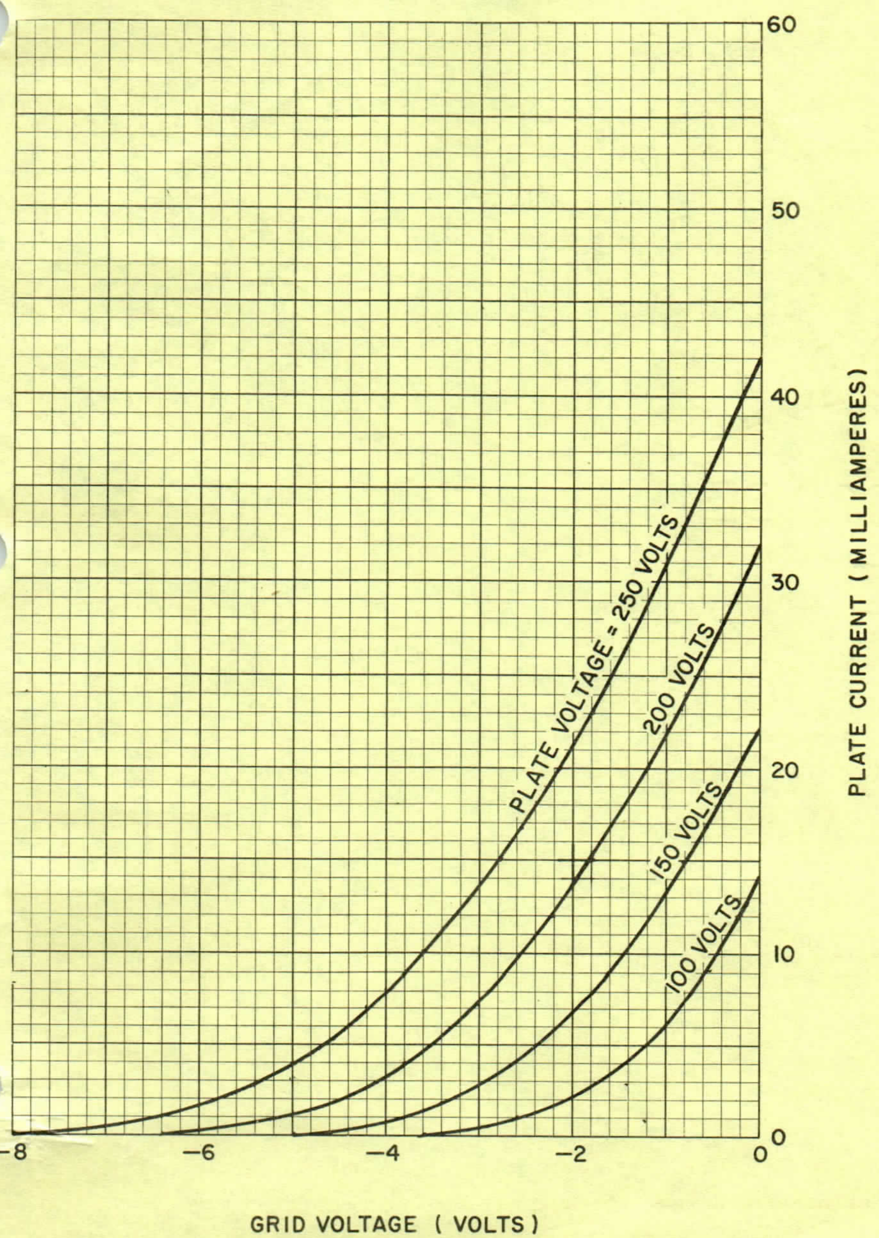
FIG. I

E92CC

PLATE CURRENT CHARACTERISTICS



TRANSFER CHARACTERISTICS

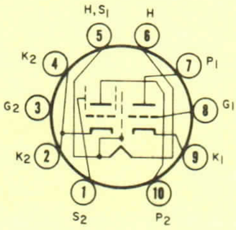


AMPEREX TUBE TYPE ECC2000

TENTATIVE DATA

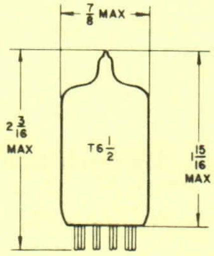
The Amperex ECC2000 is a premium quality, long-life, shock and vibration resistant dual triode for use as a VHF amplifier for frequencies up to 300 Mc in cascode circuits without external neutralization. It is also intended for use as a frequency multiplier.

The tube is provided with a neutralization screen and with gold-plated pins. The tube is interface free and has a low microphonic sensibility.



PIN CONNECTIONS

1- SCREEN NO.2
2- CATHODE NO.2
3- GRID NO.2
4- CATHODE NO.2
5- HEATER, SCREEN NO.1
6- HEATER
7- PLATE NO.1
8- GRID NO.1
9- CATHODE NO.1
10- PLATE NO.2



6-2

GENERAL CHARACTERISTICS

MECHANICAL

Base	miniature 10-pin; gold plated pins
Bulb	T 6-1/2
Dimensions	see outline drawing

ELECTRICAL

Heating	indirect, AC or DC, parallel supply
Heater Voltage	6.3 volts
Heater Current	325 ma
Interelectrode Capacitances (without shield)	

Section 1

Grid to Cathode Heater and Neutralization Screen	5.5 pf
Grid to Neutralization Screen	1.5 pf
Plate to Cathode, Heater and Neutralization Screen	5.0 pf
Plate to Grid	0.45 pf
Plate to Neutralization Screen	3.3 pf

ELECTRICAL (Cont.)

Interelectrode Capacitances (without shield) (Cont.)

Section 2

Cathode to Grid and Filament	7.0 pf
Plate to Grid and Filament	3.3 pf
Plate to Cathode	0.2 pf
Plate to Grid	1.5 pf

Between Sections

Plate to Plate (max.)	0.045 pf

ABSOLUTE MAXIMUM RATINGS (Both Sections)

Plate Voltage (Zero Current)	450 volts
Plate Voltage	250 volts
Plate Dissipation	2.7 watts
Negative Grid Voltage	50 volts
Peak Negative Grid Voltage[1]	150 volts
Grid Circuit Resistance (automatic bias)	1 megohm
Cathode to Heater Voltage	
Cathode Positive	150 volts
Cathode Negative	50 volts
Cathode Current	40 ma
Peak Cathode Current[2]	400 ma
Bulb Temperature	225°C

TYPICAL CHARACTERISTICS

Triode Section 1 (Input System)

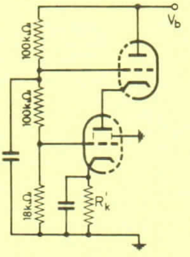
Plate Voltage	90	90 volts
Neutralization Screen Voltage	0	0 volt
Negative Grid Voltage	2.1	1.4 volts
Plate Current	15	27 ma
Transconductance	13,000	17,500 μmhos
Amplification Factor	27	27
Equivalent Noise Resistance	250	200 ohms

Triode Section 2 (Output System)

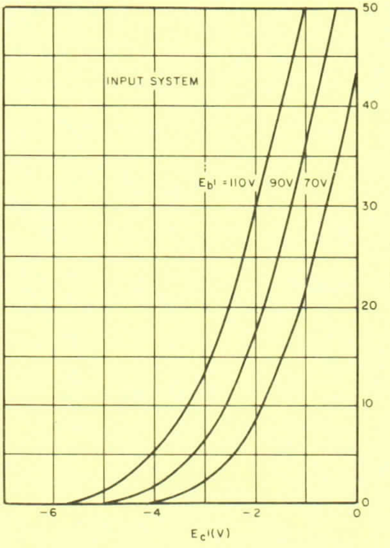
Plate Voltage	90	90 volts
Negative Grid Voltage	2.0	1.4 volts
Plate Current	15	27 ma
Transconductance	17,000	22,000 μmhos
Amplification Factor	28	28
Equivalent Noise Resistance	200	150 ohms

[1] Duty factor maximum 1%, pulse duration maximum 10 μsec.
[2] Duty factor maximum 10%, pulse duration maximum 200 μsec.

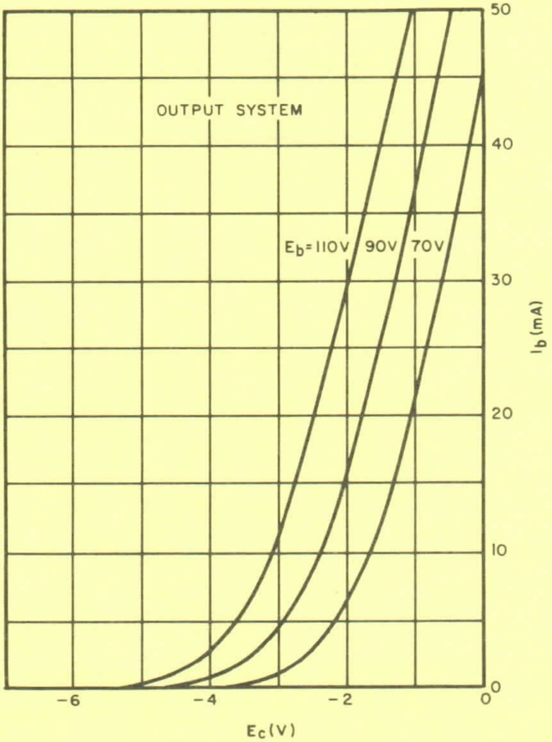
RECOMMENDED OPERATING CONDITIONS AND CORRESPONDING CHARACTERISTICS AS CASCODE AMPLIFIER AT 200 Mc



Supply Voltage	200	200 volts
Cathode Resistor	1200	680 ohms
Plate Current	15.5	26.5 ma
Input Resistance	910	670 ohms
Input Capacitance	11	12 pf
Noise Factor	4	4 db[3]



[3] Source impedance adapted to minimum noise.


OUTPUT SYSTEM
E_b=110V 90V 70V
I_b (mA)
E_c (V)
50
40
30
20
10
0
−6
−4
−2
0

AMPEREX TUBE TYPE 0A2

The OA2 is a two electrode, inert gas filled, cold cathode tube for use in voltage regulator applications.

ELECTRICAL DATA

Operating voltage (nominal)	150 volts
Anode breakdown voltage with illumination of 50 - 500 ft. candles	180 volts max.
Anode breakdown in complete darkness	225 volts max.
Regulation (Plt. Current = 5 - 30 ma)	6 volts max.

MECHANICAL DATA

Mounting position	any
Base (JETEC base designation)	5BO, 7 pin miniature
Max. overall length	2 5/8 inches
Max. diameter	3/4 inch

MAXIMUM RATINGS (absolute values)

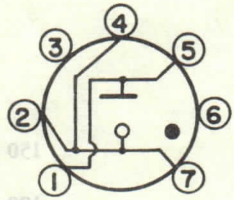
Minimum D.C. anode supply voltage [1]	185 volts
Maximum average starting current	75 ma
Maximum averaging time	10 seconds
Maximum D.C. Cathode current	30 ma
Minimum D.C. Cathode current	5 ma
Maximum frequency [2]	0 cycles/sec.
Max. shunt capacitor [3]	0.1 uf
Ambient temperature limits	-55° to $+90^{\circ}$C

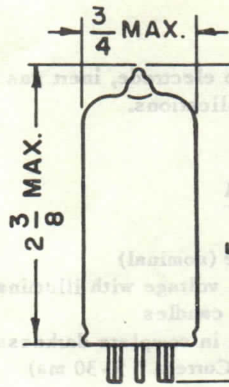
1 **Supply voltage necessary to insure starting throughout tube life with an illumination of 50 - 500 foot candles.**

2 **Tube used so that cathode cannot become positive and anode negative.**

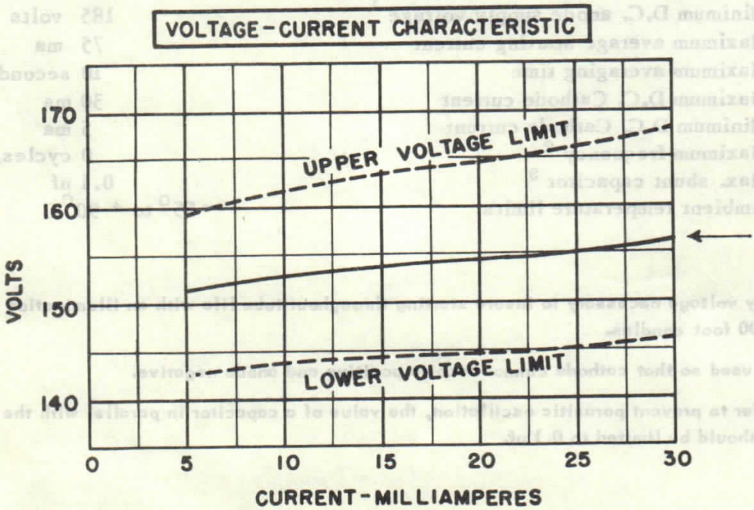
3 **In order to prevent parasitic oscillation, the value of a capacitor in parallel with the tube should be limited to 0.1 uf.**

0A2





PIN NO. 1 = ANODE
PIN NO. 2 = CATHODE
PIN NO. 3 = INTERNALLY CONNECTED
PIN NO. 4 = CATHODE
PIN NO. 5 = ANODE
PIN NO. 6 = INTERNALLY CONNECTED
PIN NO. 7 = CATHODE



AMPEREX TUBE TYPE 0B2

The OB2 is a two electrode, inert gas filled, cold cathode tube for use in voltage regulator applications.

ELECTRICAL DATA

	Min.	Nom.	Max.
Operating voltage (Plt. current = 17.5 ma)	106	108	111 volts
Anode breakdown voltage with illumination of 50 - 500 ft. candles.			127 volts max.
Anode breakdown voltage in complete darkness			210 volts max.
Regulation (Plt. current = 5 - 30 ma)			3.5 volts max.
Voltage variation during 500 hrs. operation			4 volts

MECHANICAL DATA

Mounting Position	any
Base (JETEC base designation)	5BO, 7 pin miniature
Max. overall length	2 5/8 inches
Max. diameter	3/4 inch

MAXIMUM RATINGS (absolute values)

Minimum D.C. anode supply voltage [1]	133 volts
Maximum average anode starting current	75 ma
Maximum averaging time	10 seconds
Maximum D.C. cathode current	30 ma
Minimum D.C. cathode current	5 ma
Maximum frequency [2]	0 cycles/sec.
Max. shunt capacitor [3]	0.1 uf
Ambient temperature limits	-55° to $+90^{\circ}$C

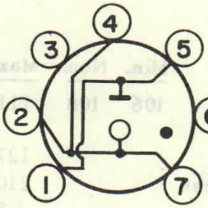
1 **Supply voltage necessary to insure starting throughout tube life with an illumination of 50 - 500 foot candles.**

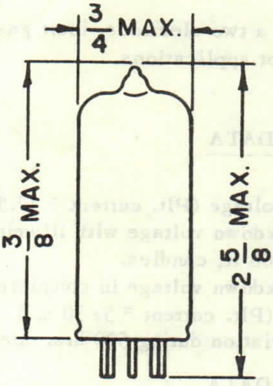
2 **Tube used so that cathode cannot become positive and anode negative.**

3 **In order to prevent parasitic oscillation, the value of a capacitor in parallel with the tube should be limited to 0.1 uf.**

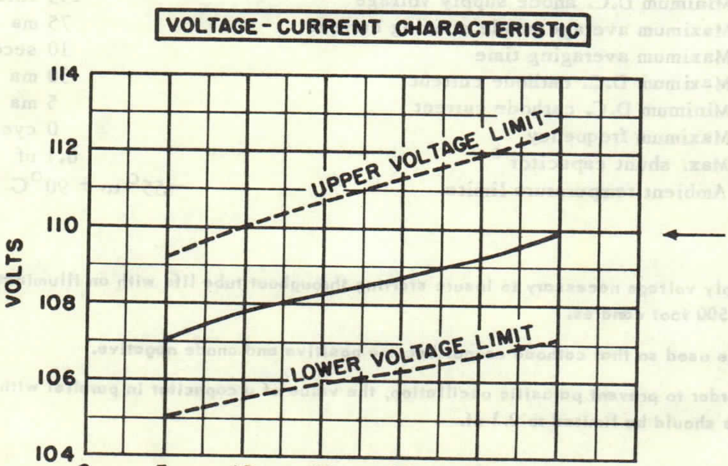
Revised 7/55

0B2





PIN NO. 1 = ANODE
PIN NO. 2 = CATHODE
PIN NO. 3 = INTERNALLY CONNECTED
PIN NO. 4 = CATHODE
PIN NO. 5 = ANODE
PIN NO. 6 = INTERNALLY CONNECTED
PIN NO. 7 = CATHODE



AMPEREX TUBE TYPE OE3/85A1

The OE3/85A1 is a lock-in voltage reference tube of the cold cathode glow discharge type designed for extremely constant voltage stability. It maintains a D.C. operating voltage of 85 volts; the operating current ranges from 1 to 8 milliamperes and its operating characteristic is independent of ambient temperature.

The OE3/85A1 is particularly distinguished from other types of regulator tubes by the small change in the operating voltage during the life of the tube. Furthermore there is very little difference in the tolerance of the operating voltage as between one tube and another. Due to these properties, the tube is particularly suitable for applications where a constant regulated voltage is required.

This excellent performance is the result of a judicious choice ot the materials used and a special manufacturing process. The cathode is made of molybdenum. Changes in the surface of the cathode due to gas from impurities in the glass bulb have been avoided by coating the inner side of the bulb with a layer of molybdenum. In addition, this layer acts as a screen for outer influences while it also acts as a getter.

Because of its extreme stability throughout life time, the OE3/85A1 is especially useful as a voltage reference tube in the D.C. supply voltage source of electronic tubes and in measuring circuits.

DATA

GENERAL

Cathode	cold
Maximum overall length	3-11/16"
Maximum seated height	2-1/2"
Maximum diameter	1-1/8"
Bulb	tubular
Base	lock-in, 3-pin
Mounting position	any

MAXIMUM RATINGS (absolute values)

D.C. operating current (continuous)	8 ma. max.
Ambient temperature range	−55 to + 90 °C

CHARACTERISTICS AND OPERATING RANGE VALUES

	Min.	Average	Max.	
D.C. starting voltage	-	110	120 [1]	volts
D.C. operating voltage	83	85	87	volts
D.C. operating current	1	4	8	ma
Regulation (1 ma to 8 ma)	-	-	3.15	volts
Stability	-	0.1	0.85 [2]	volt

INSTALLATION AND APPLICATION

The base of the OE3/85A1 fits the loctal 8-pin socket. The socket may be mounted to hold the tube in any position.

A warm-up period of 3 minutes should be allowed each time the equipment is turned on in order to insure minimum voltage drift of the tube.

NOTES

1 Not less than this value should be provided to insure ignition throughout tube life.

2 Defined as the maximum voltage fluctuation in the operating voltage throughout 5000 hours.

OE3/85A1

APPLICATION INFORMATION

A minimum D.C. anode supply voltage of 120 volts should always be provided in the equipment design to insure ignition throughout tube life.

A series resistor must always be used with the OE3/85A1. The resistance value must be s chosen that the maximum current ranting (8 ma) of the OE3/85A1 is not exceeded at the highes anode supply voltage applied, so that the minimum current rating (1 ma) is always exceeded at the lowest anode-supply voltage.

Shielding of the OE3/85A1 to insure maximum stability should be utilized when the tube is operated in the presence of strong R.F. or magnetic fields.

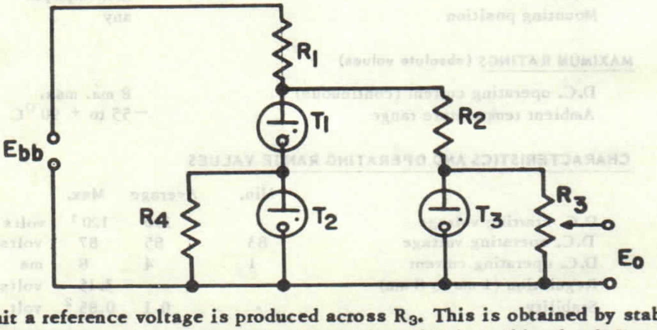
To retain the maximum constancy of the operating voltage it is desirable to mount the tube where it does not get heated too much by other tubes, resistors, etc.

The nature of a gas discharge always gives rise to noise. With a current of 4 ma flowing through the tube and a series resistor of 10,000 ohms the R.M.S. value of the noise voltage in the frequency range 30 - 10,000 c/s amounts to 80 microvolts. This noise voltage increases according to the square root of the series resistance and also increases slightly as the current is reduced. The noise energy is distributed fairly uniformly over the above mentioned-frequency range.

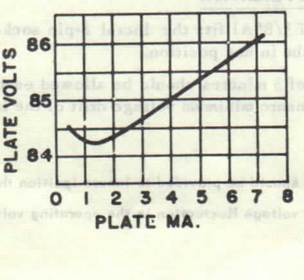
For carrying out accurate electric measurements it is often necessary to have available an extremely constant reference voltage, particularly if relatively small voltage variations are to be measured.

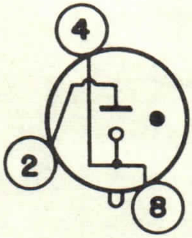
Such a constant voltage supply using the OE3/85A1 as a voltage reference is given in fig. 1. The tubes T_1, T_2 and T_3 are OE3/85A1 tubes. The current flowing through T_3 is stabilized by the tubes T_1 and T_2, as shown in the circuit.

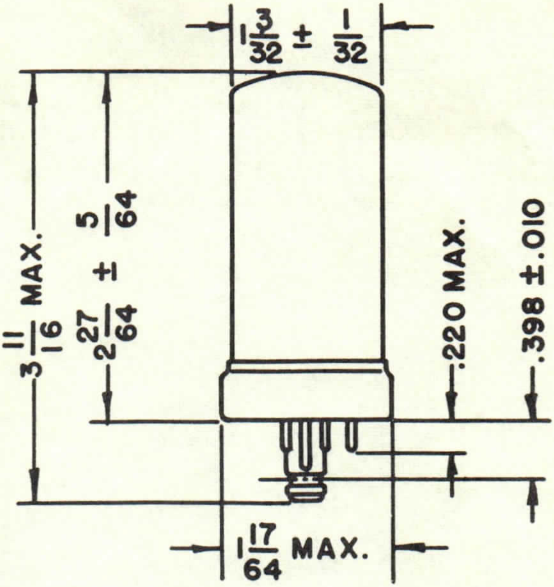
With supply voltage variations from - 10% to + 10% (Ebb = 275 volts) the maximum voltage fluctuation across T_3 does not exceed 40 millivolts (0.05%) whereas the average fluctuation is approx. 15 millivolts.



In this circuit a reference voltage is produced across R_3. This is obtained by stabilizing the current through T_3 by means of two other tubes 85A1 (T_1 and T_2). In this circuit R_1 = 0.1 megohm; R_4 = 1 megohm; Ebb = 275 volts.







CAUTION

Should the OE3/85A1 tube be run with reverse polarity for even a few seconds, its stability will be seriously impaired and it may require some hundreds of hours of operation running in the normal direction before the tube returns to its original performance. Care should be taken, therefore, to test the circuit polarity before the tube is inserted in the socket. This is particularly important in the mass production of equipment where a wiring fault may rapidly ruin a large number of tubes before the effect is noted.

AMPEREX TUBE TYPE 0G3/85A2

The OG3/85A2 is a miniature voltage reference tube of the cold cathode discharge type, for use in D.C. Amplifiers, stable regulated power supplies, oscilloscope calibrators and similar applications. Among its features are: (1) better regulation (2) larger allowable operating current range (3) reproducibility between tubes with 5 volt tolerance.

GENERAL CHARACTERISTICS

ELECTRICAL

Maximum ratings, absolute values

D.C. Starting Voltage (max.)	125 volts
D.C. Operating Current (max.)	10 ma
D.C. Operating Current (min.)	1 ma
Ambient Temperature Limits	−55 to + 90 °C

Typical Operation

Recommended D.C. Operating Current	6 ma
A.C. Resistance at 6 ma (average value)	300 ohms
A.C. Resistance at 6 ma (max. value)	450 ohms
D.C. Operating Voltage at 6 ma, Variation From Tube to Tube	83 to 87 volts
Temp. Coefficient of Operating Voltage	−2.7 mv/°C
Percentage Variation of Operating Voltage During First 300 hrs. of Life (max.)	0.3 %
Percentage Variation of Operating Voltage During Subsequent 1000 hrs. of Life (max.)	0.2 %
Short-term (100 hrs. max.) Variation of Operating Voltage After First 300 hrs. of Life (max.)	0.1 %

MECHANICAL

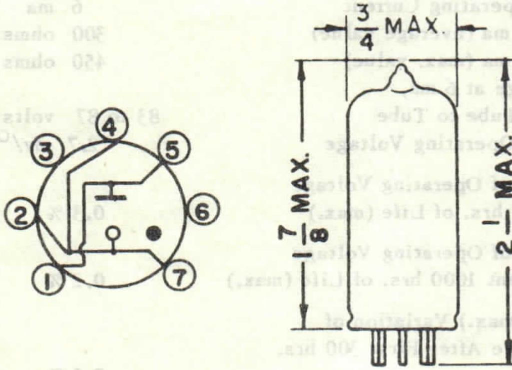
Cathode	Cold Cathode
Base	Miniature Button-7 Pin
Bulb	T 5½
Max. Overall Height	2 1/8"
Max. Seated Height	1 7/8"
Max. Diameter	3/4"
Mounting Position	any

0G3/85A2

NOTES:

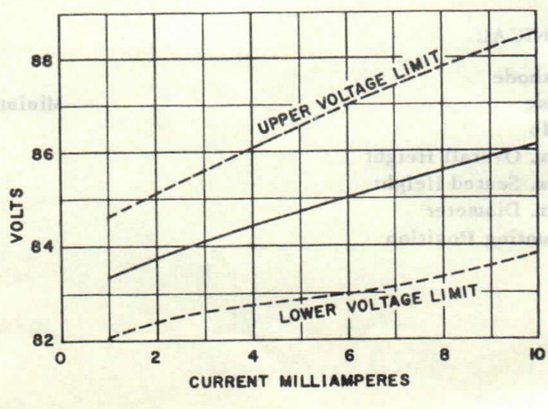
1. The tube should be operated only with the cathode negative and the anode positive.
2. Equilibrium conditions are normally reached after 3 minutes of operation.

   During life the AC resistance will remain essentially constant, but the temperature coefficient of the operating voltage can be expected to decrease slightly.
3. The greatest constancy of the operating voltage is obtained when the tube is operated at one value of current.
4. The noise of the tube over a frequency band of 30 to 10,000 cycles/sec. is of the order of 60 μV (equivalent noise resistance 22 megohms), and is evenly distributed over the frequency range.
5. The tube should not be subjected to severe shock or continuous vibration.



Basing Connections

Pin 1 - Plate
Pin 2 - Cathode
Pin 3 - Internally Connected
Pin 4 - Cathode
Pin 5 - Plate
Pin 6 - Internally Connected
Pin 7 - Cathode



OG3/85A2

APPLICATION NOTES

Basically, the OG3 is similar in construction and operation to common voltage regulator tubes such as the OA3 for example. The OA3 is intended to provide a resonably constant D.C. voltage across itself, for varying loads and line voltage, by drawing a compensating current through a voltage dropping resistor. The OG3 is intended as a voltage reference tube and is designed for operating voltage stability over long periods of time.

Especially after a "run-in" period of 300 hours, the voltage across the OG3 remains very constant for a constant current flowing through the tube and compares well with a standard cell in this respect. Instability, such a voltage jumps and oscillations are greatly reduced in this tube. However, this improvement is accompanied by a higher A.C. resistance. The detriment is of little consequence for the application intended since a constant D.C. current is drawn by the tube.

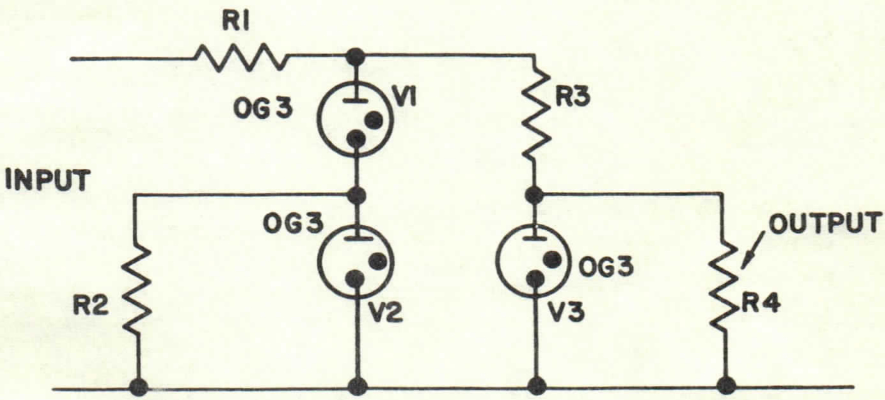


FIGURE 1

ACCURATE D.C. VOLTAGE SOURCE

Fig. 1 shows two OG3's used as regulator tubes, in controlling the input to the OG3 used as a voltage reference tube. This arrangement provides a constant current through the voltage reference tube, thereby providing a very constant 85 volts. This may be tapped off by an accurate voltage dividing network. The resistor R_2 is required to insure firing of V_1 first, followed by the firing of V_2. Parallel operation of the OG3 is not recommended because the tube with the lower striking voltage will take all the load.

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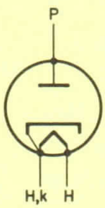
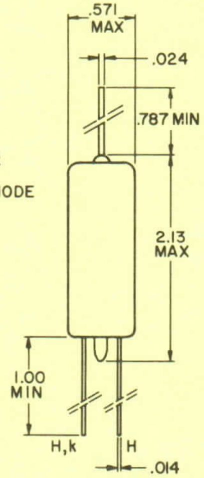
AMPEREX TUBE TYPE 1BG2

The 1BG2 is a half-wave rectifier intended for use for high voltage supplies in portable TV receivers.



PIN CONNECTIONS
P – PLATE
H,k – HEATER, CATHODE
H – HEATER



GENERAL CHARACTERISTICS

MECHANICAL

The tube is provided with flexible leads (see outline).

ELECTRICAL

Heating	indirect
Heater Voltage	1.4 volts
Heater Current	575 ma
Capacitance, Cathode to Heater	0.8 pf

ABSOLUTE MAXIMUM RATINGS

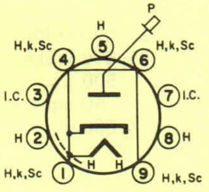
Peak Negative Plate to Cathode Voltage	18 kv
Plate Current Average	350 µa
Peak Plate Current	40 ma
Filter Capacitance	2000 µf
Heater Voltage	
Average Current <200 µa	1.6 volts
Average Current >200 µa	1.3 volts

DIODE CHARACTERISTICS

Diode Voltage	100 volts
Diode Current	13 ma

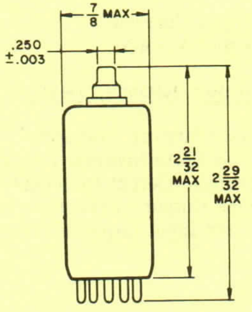
AMPEREX TUBE TYPE 1BQ2

This tube is a high-vacuum single-anode rectifier for high tension in television receivers (EHT supply from the line time base). It has a chemically treated envelope which avoids flash-over under conditions of high humidity and low atmospheric pressure.



PIN CONNECTIONS[1,2,3]

1 - HEATER, CATHODE, SCREEN
2 - HEATER
3 - INTERNAL CONNECTION
4 - HEATER, CATHODE, SCREEN
5 - HEATER
6 - HEATER, CATHODE, SCREEN
7 - INTERNAL CONNECTION
8 - HEATER
9 - HEATER, CATHODE, SCREEN
P - PLATE (TOP CAP)



GENERAL CHARACTERISTICS

Mechanical

Dimensions	see outline drawing
Bulb	T 6-1/2, glass
Base	E9-1, noval
Cap	C1-2
Mounting Position	any

Electrical

Heater Characteristics	
Heater Arrangement	parallel supply
Heater Voltage (AC or DC)[4]	1.4 volts ±10%
Heater Current	0.6 amps
Direct Interelectrode Capacitance	
Plate to All	1.0 pf

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[1] Pins 1, 4, 6 and 9 can be used for fixing an anti-corona ring.

[2] Circuit elements having the same potential as the heater (e.g. a series resistor) may be connected to pins 3 and 7. These pins must never be grounded.

[3] If the tube operates at high inverse plate voltages and/or under conditions of high relative humidity or low pressure the metal cap should get an insulating cover to avoid corona phenomena.

[4] For use as EHT rectifier in television receivers the heater voltage should be adjusted to its nominal value at a D.C. output current of 200 μa. At an increase of the D.C. output current to 400 - 800 μa which may occur during operation, the decrease of the heater voltage may amount to 15% maximum.

These requirements hold for nominal voltage and full horizontal scanning of the picture tube. If the picture width control is such that also the heater voltage of the E.H.T. diode is influenced, the influence of this control must be kept within the 15% limit indicated above.

Operating Characteristics

Output Current	I_o	200 μA
Output Voltage	V_o	20 KV

Maximum Ratings, Design Center Values

Plate Inverse Voltage[5]	20,000 volts
Peak Plate Inverse Voltage[6]	25,000 volts
Average Output Current[7]	500 μa
Peak Output Current	50 ma
Filter Input Capacitance	3,000 pf

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[5] D.C. component

[6] **Max. pulse duration 22% of a cycle, but max. 18 microseconds. The absolute maximum value = 30,000 volts.**

[7] **During short periods as in TV operation I_b = max. 800 microamps.**

AMPEREX TUBE TYPE 1M3/DM70

The 1M3/DM70 is a subminiature tuning indicator tube specially designed for use in FM tuners where the demand for high-fidelity sound reproduction makes highly accurate tuning very desirable. This visual tuning tube is also suitable for application in wire and tape recorders where it simplifies proper recording by indicating the depth of modulation.

The 1M3/DM70 features extreme sensitivity, clear visual indication, low filament consumption, small size and "on-off" signal indication. The filament is directly heated.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater	directly heated, A.C. or D.C., series or parallel connection.

MECHANICAL

Maximum overall length (excluding pins)	1 3/4 inches
Maximum diameter	0.4 inches
Base	miniature, 8 pin.
Socket	Amperex #S-19883

HEATER CIRCUIT

A. <u>In Battery Receivers</u>

Heater Voltage	1.4 volts
Heater Current	25 mA

Either pin 4 or 5 must be connected to the grounded point of the detector circuit.

B. <u>In A.C. Receivers</u>

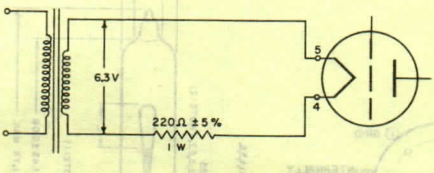


FIG. 1
With 6.3 volt transformer winding

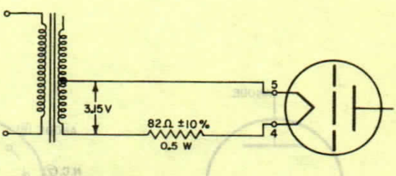


FIG. 2
With 6.3 volt winding with center tap

C. <u>In A.C./D.C. Receivers</u>

The heater, together with a suitable shunt resistor, can be connected in series with other tube heaters providing a negative temperature coefficient resistor is incorporated in the circuit.

Pin 5 must be connected to the grounded point of the detector circuit.

1M3/DM70

GRID CIRCUIT
(A.C. Filament Supply)

In order to minimize hum, a filter is recommended in the grid circuit according to the diagram below. R_1 is the detector resistor. R_2 and C_1 are already a part of the grid circuit in the case of non-delayed A.G.C.

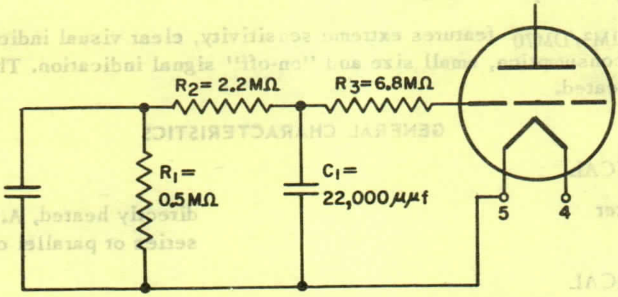


FIG. 3

PLATE CIRCUIT
(A.C. Filament Supply)

In order to minimize hum, an external plate resistar is recommended according to the table below.

Plate Voltage	Plate Resistor
250 volts	1.8 megohms
170 volts	1.0 megohms
110 volts	0.47 megohm

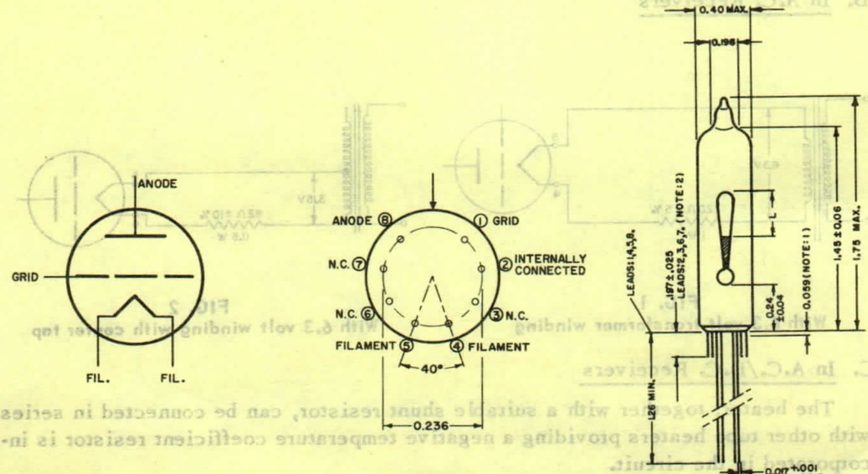


FIG. 4
L = Length of light bar

1M3/DM70

Maximum Ratings, Design Center Values

Supply Voltage (Plate Current = 0)	450 volts
Supply Voltage	300 volts
Plate Voltage [3]	90 volts
Plate Voltage	45 volts
Plate Dissipation (Plate Voltage $\leq$ 90 volts) [4]	45 mW
Plate Dissipation (Plate Voltage = 200 volts) [4]	10 mW
Cathode Current	0.3 mA
External Resistance Between Grid & Negative Filament	10 megohms

Typical Operating Conditions - Battery Supply

D.C. Filament Voltage	1.4 [3]	1.4 [5]	volts
Supply Voltage	67.5	90	volts
Plate Voltage [6]	60	85	volts
Grid Voltage	0	0	volts
Plate Current	105	170	μA
L (Length of light bar)	10	11	mm
Grid Voltage (L = 0)	−7	−10	volts

Typical Operating Conditions - A.C. Supply

Filament Voltage [7]	1.4	1.4	1.4	volts
Supply Voltage	110	170	250	volts
Plate Resistor	0.47	1.0	1.8	megohms
Grid Voltage	0	0	0	volts
Plate Current	105	110	105	μA
L (Length of light bar)	10	10	10	mW
Grid Voltage (L = 0)	−15	−23	−34	volts

1 **This part of the lead should not be bent.**

2 **This part of the lead should not be soldered.**

3 **Pin 5 grounded.**

4 **At other values of plate voltage, the maximum plate dissipation can be found by linear interpolation.**

5 **Pin 4 grounded.**

6 **Plate voltage is equal to the supply voltage reduced by the bias for the output tube.**

7 **Pin 5 grounded. When the filament voltage is adjusted according to FIG. 1 and FIG. 2, the plate current will be 1 to 2 microamps lower. All other operating conditions remain the same.**

1M3/DM70

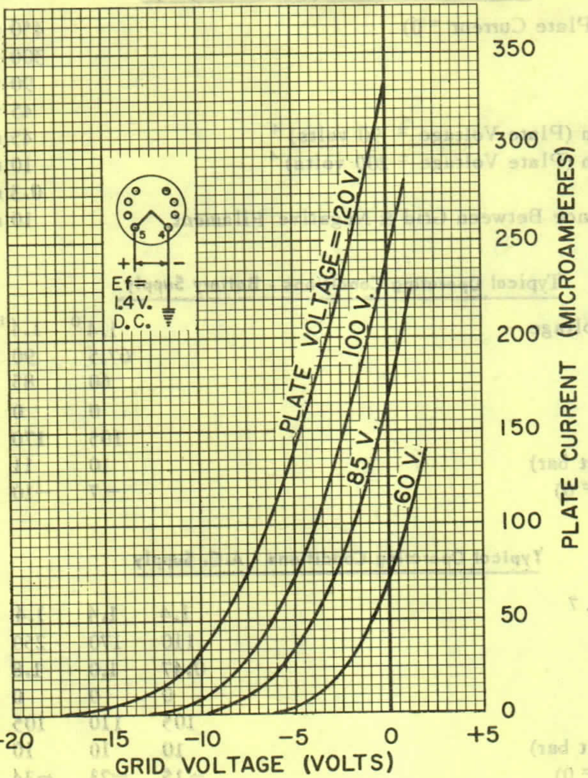


FIG. 5

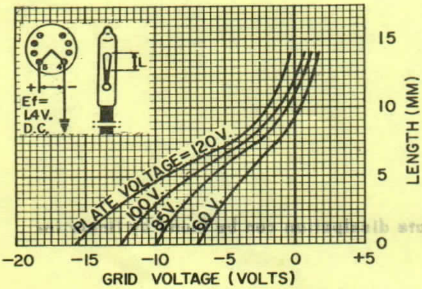


FIG. 6

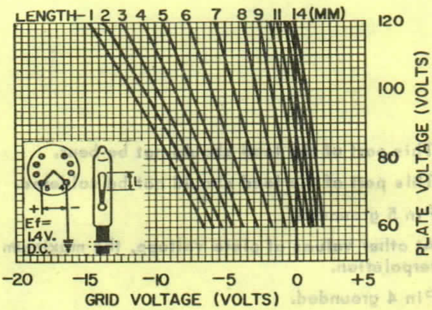


FIG. 7

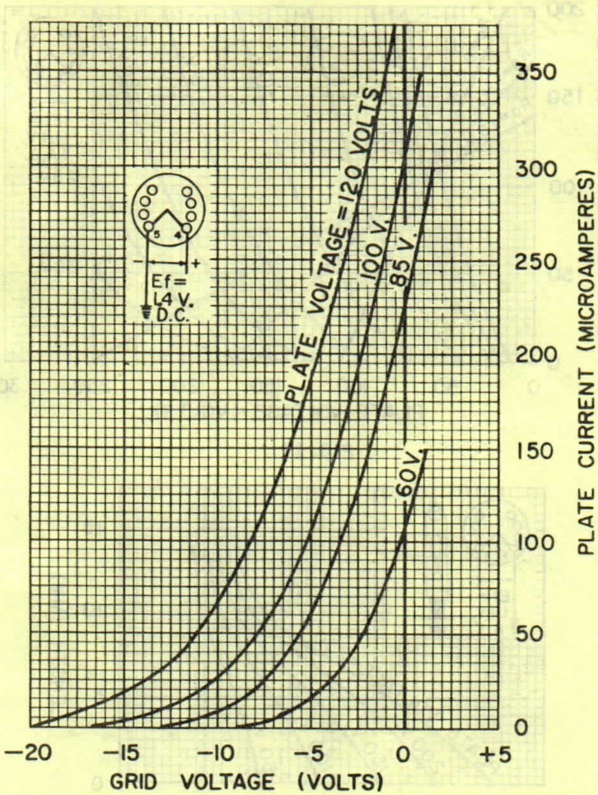


FIG. 8

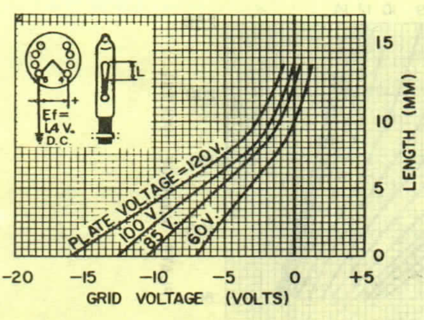


FIG. 9

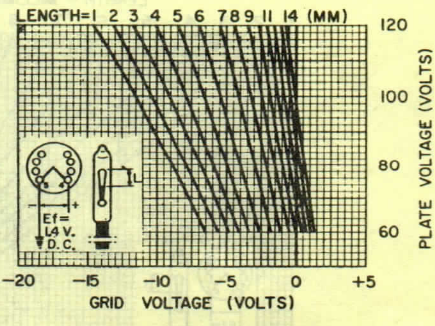


FIG. 10

1M3/DM70

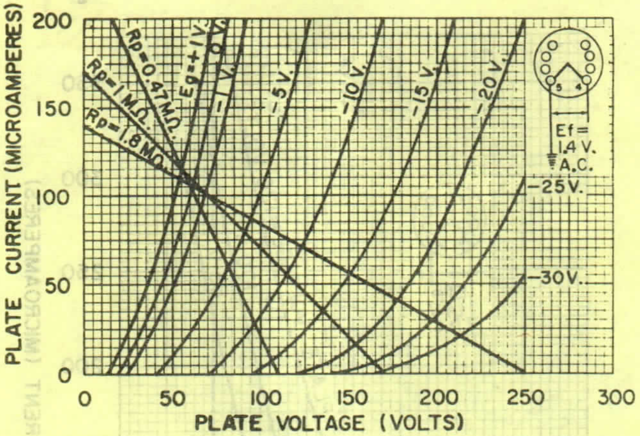


FIG. 11

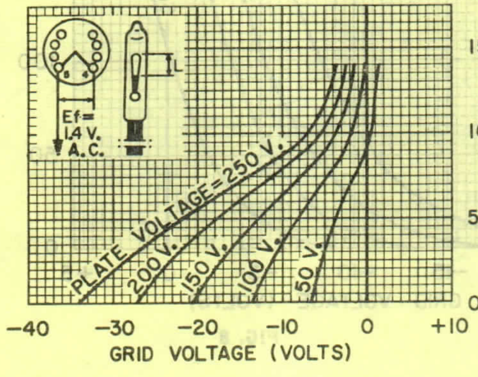


FIG. 12

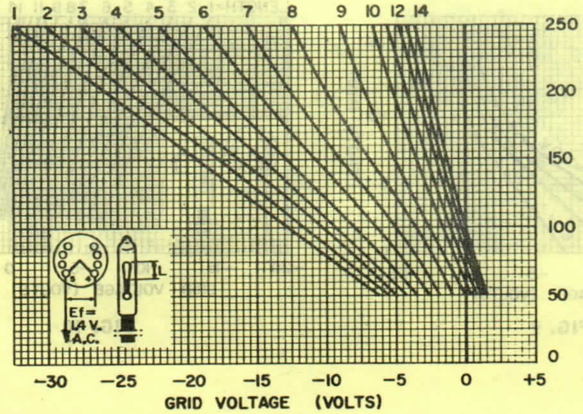
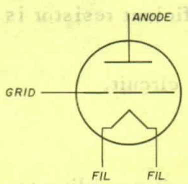


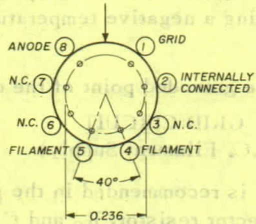
FIG. 13

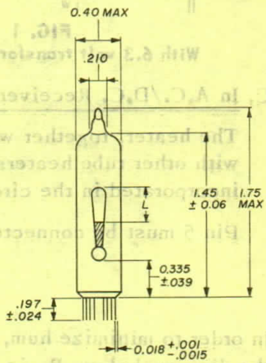
AMPEREX TUBE TYPE 1N3/DM71

The 1N3/DM71 is a subminiature tuning indicator tube specially designed for use in FM tuners where the demand for high-fidelity sound reproduction makes highly accurate tuning very desirable. This visual tuning tube is also suitable for application in wire and tape recorders where it simplifies proper recording by indicating the depth of modulation.

The 1N3/DM71 features extreme sensitivity, clear visual indication, low filament consumption, small size and "on-off" signal indication. The filament is directly heated.







GENERAL CHARACTERISTICS

MECHANICAL

Maximum overall length (excluding pins)	1¾ inches
Maximum Diameter	0.4 inches
Base	Miniature, 8 pin

Accessories

Socket	Amperex #S-19883

ELECTRICAL

Heater	directly heated AC or DC series or parallel connection

1N3/DM71

HEATER CIRCUIT

A. In Battery Receivers

Heater Voltage 1.4 volts
Heater Current 25 mA
Either pin 4 or 5 must be connected to the grounded point of the detector circuit.

B. In A.C. Receivers

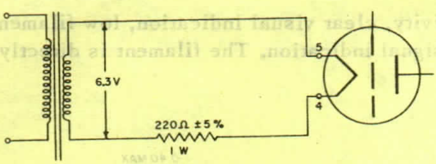


FIG. 1
With 6.3 volt transformer winding

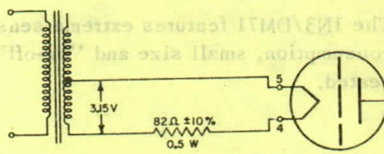


FIG. 2
With 6.3 volt winding with center tap

C. In A.C./D.C. Receivers

The heater, together with a suitable shunt resistor, can be connected in series with other tube heaters providing a negative temperature coefficient resistor is incorporated in the circuit.

Pin 5 must be connected to the grounded point of the detector circuit.

GRID CIRCUIT
(A.C. Filament Supply)

In order to minimize hum, a filter is recommended in the grid circuit according to the diagram below. R_1 is the detector resistor. R_2 and C_1 are already a part of the grid circuit in the case of non-delayed A.G.C.

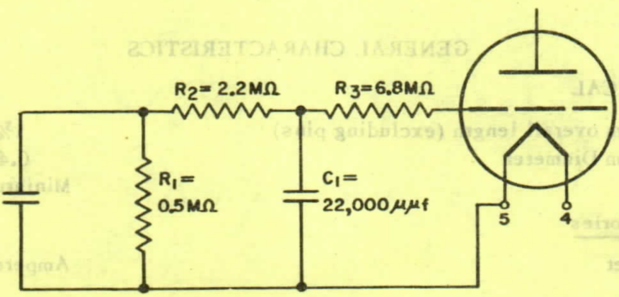


FIG. 3

PLATE CIRCUIT
(A.C. Filament Supply)

In order to minimize hum, an external plate resistor is recommended according to the table below.

Plate Voltage	Plate Resistor
250 volts	1.8 megohms
170 volts	1.0 megohms
110 volts	0.47 megohms

Maximum Ratings, Design Center Values

Supply Voltage (Plate Current = 0)	450 volts
Supply Voltage	300 volts
Plate Voltage [1]	90 volts
Plate Voltage	45 volts
Plate Dissipation (Plate Voltage $\leq$ 90 volts) [2]	45 mW
Plate Dissipation (Plate Voltage = 200 volts) [2]	10 mW
Cathode Current	0.3 mA
External Resistance Between Grid & Negative Filament	10 megohms

Typical Operating Conditions - Battery Supply

D.C. Filament Voltage	1.4[1]	1.4[3] volts
Supply Voltage	67.5	90 volts
Plate Voltage [4]	60	85 volts
Grid Voltage	0	0 volts
Plate Current	105	170 μA
L (Length of light bar)	0.4	0.43 inches
Grid Voltage (L = 0)	−7	−10 volts

Typical Operating Conditions - A.C. Supply

Filament Voltage [5]	1.4	1.4	1.4 volts
Supply Voltage	110	170	250 volts
Plate Resistance	0.47	1.0	1.8 megohms
Grid Voltage	0	0	0 volts
Plate Current	105	110	105 μA
L (Length of light bar)	0.4	0.4	0.4 inches
Grid Voltage (L = 0)	−15	−23	−34 volts

---

1 Pin 5 grounded.

2 At other values of plate voltage, the maximum plate dissipation can be found by linear interpolation.

3 Pin 4 grounded.

4 Plate voltage is equal to the supply voltage reduced by the bias for the output tube.

5 Pin 5 grounded. When the filament voltage is adjusted according to Fig. 1 and Fig. 2, the plate current will be 1 to 2 microamps lower. All other operating conditions remain the same.

1N3/DM71

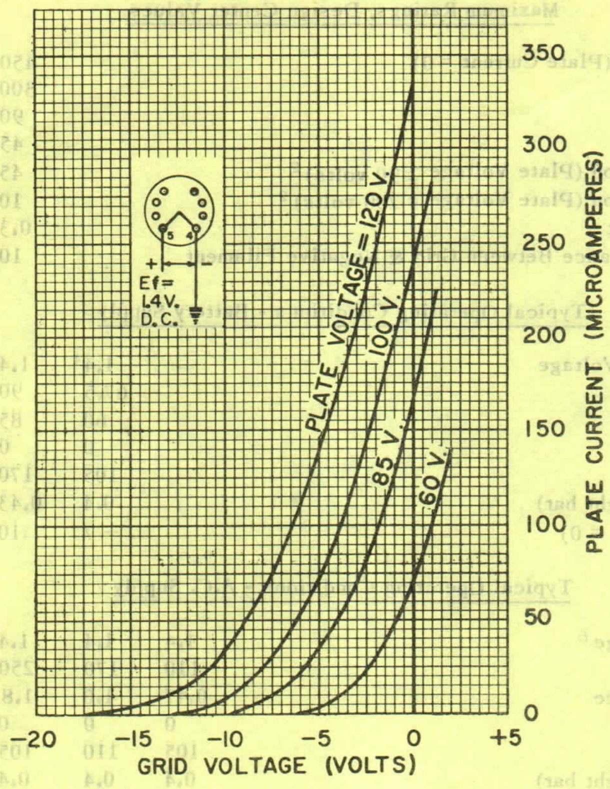


FIG. 5

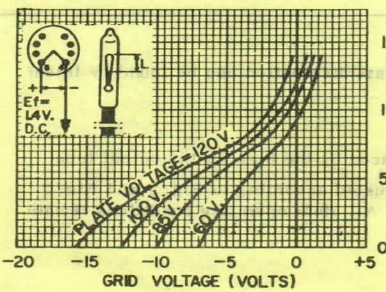


FIG. 6

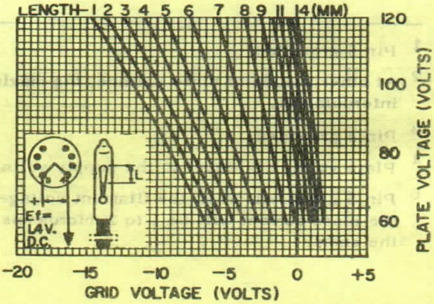


FIG. 7

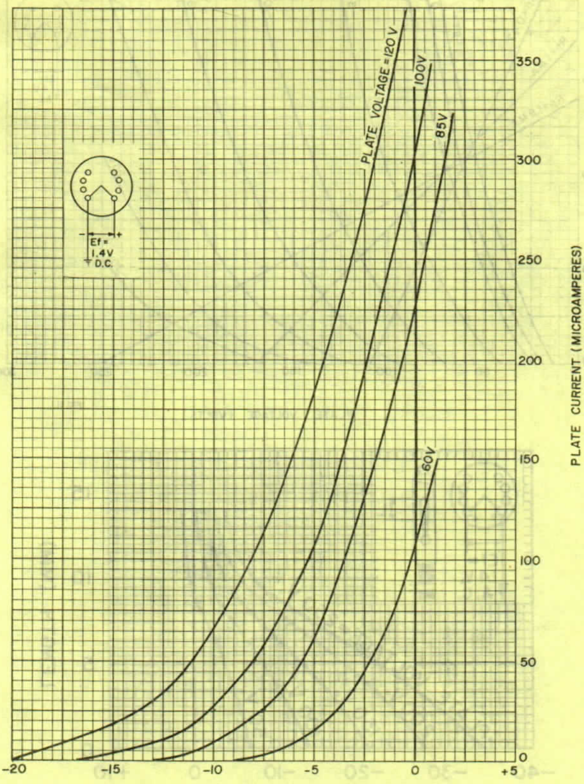


FIG. 8

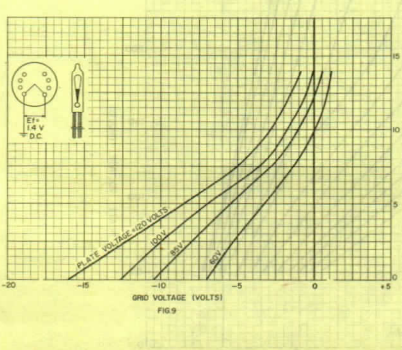


FIG. 9

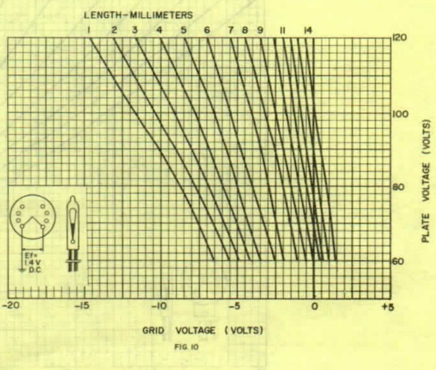


FIG. 10

1N3/DM71

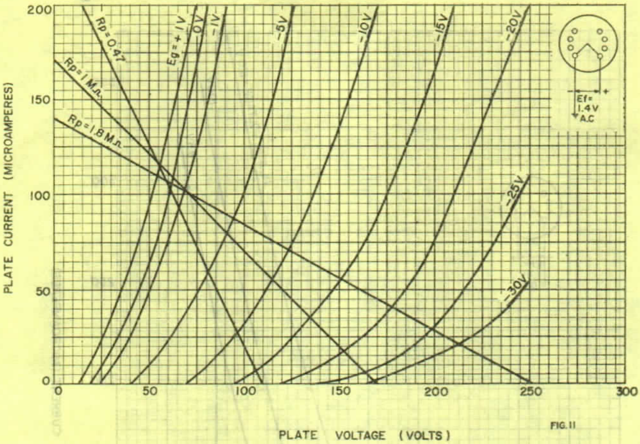


FIG. 11

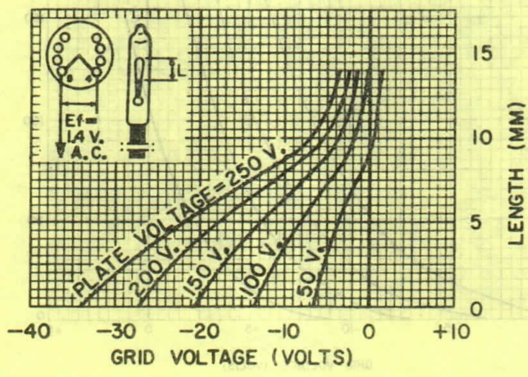


FIG. 12

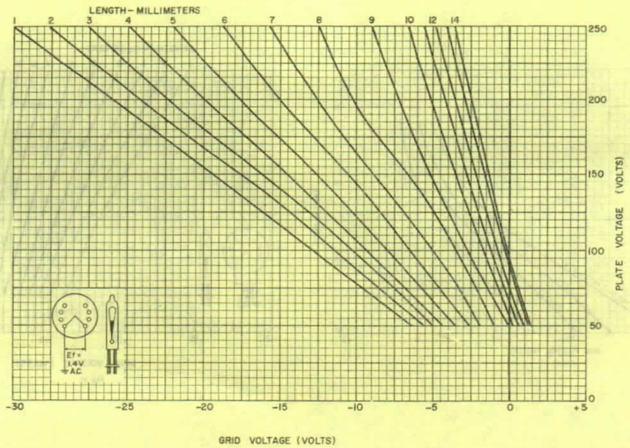
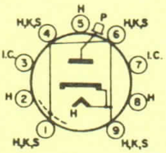


FIG. 13

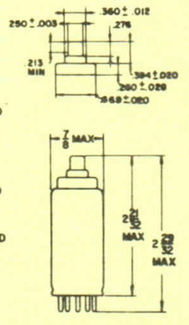
AMPEREX TUBE TYPE 1S2A

The 1S2A is a half wave vacuum rectifier especially designed for use in high voltage, low current applications in television scanning systems. The envelope of this tube is chemically treated to insure that no flash-over will occur under conditions of high humidity and low atmospheric pressure.



PIN CONNECTIONS

1 - HEATER, CATHODE AND SHIELD
2 - HEATER
3 - INTERNALLY CONNECTED
4 - HEATER, CATHODE AND SHIELD
5 - HEATER
6 - HEATER, CATHODE AND SHIELD
7 - INTERNALLY CONNECTED
8 - HEATER
9 - HEATER, CATHODE AND SHIELD



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Plate Cap[1]	see plate cap drawing
Base[2]	E 9-1

ELECTRICAL

Heater Characteristics	
Heater Arrangement	parallel supply
Heater Voltage (AC or DC)[3,4]	1.4 volts
Heater Current	0.55 amps
Output Capacitance (without external shield)	1.55 pf

[1] If the tube is operated at high values of peak inverse plate voltage and/or under conditions of high relative humidity or low pressure, an insulating cover should be applied to the plate cap to avoid corona effects.

[2] Pins 1, 4, 6 and 9 can be connected together to form an anti-corona ring.

[3] Circuit elements having the same potential as the heater may be connected to pins 3 and 7.

[4] When the heater is to be operated on RF or flyback pulses, the heater voltage can be adjusted to its nominal value of 1.4 volts at a DC output current of 200 μa by measurement with a thermocouple. When the DC output is increased to 400 - 600 μa, the decrease in heater voltage must be kept within a 15% limit.

1S2A

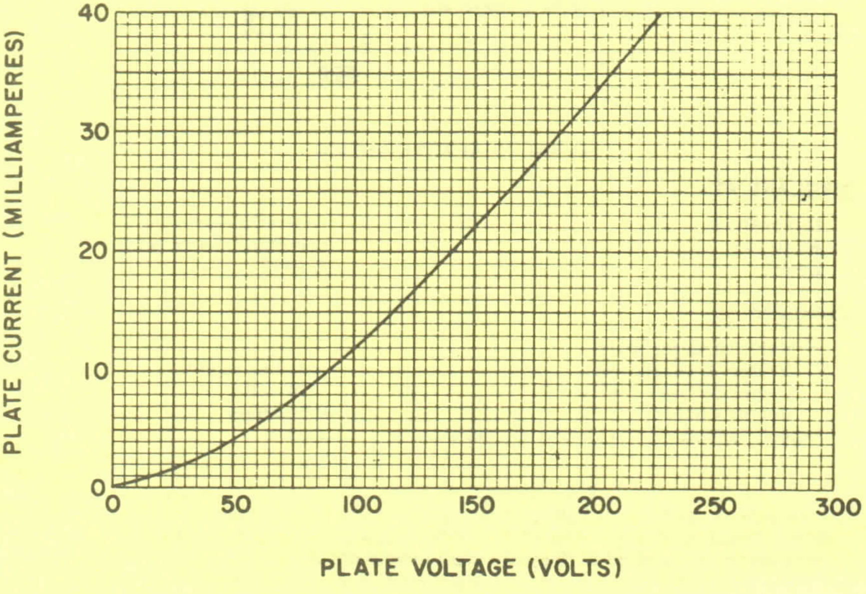
MAXIMUM RATINGS, DESIGN CENTER VALUES

Peak Plate Inverse Voltage[5,6]	22,000 volts
Peak Plate Inverse Voltage (Absolute Limits)[5]	27,000 volts
Output Current	0.8 ma max.
Peak Plate Current[7]	40 ma
Filter Input Capacitor	2,000 pf

TYPICAL CHARACTERISTICS

Output Voltage	18,000 volts
Output Current	0.15 ma

PLATE CHARACTERISTICS



[5] The ratio of the negative peak plate voltage due to ringing in the circuit to the positive DC voltage can be about 1:4.5. This voltage may be 24,000 volts at $I_O = 0$.

[6] Maximum duration is 22% of a line scanning cycle but no more than 18 μsec.

[7] Maximum duration is 10% of a line scanning cycle but no more than 10 μsec.

AMPEREX TUBE TYPE 2FY5

TENTATIVE DATA

The Amperex type 2FY5 is a miniature frame grid shielded triode with remote cut-off. It is especially designed for service in VHF tuners for television receivers, and is controlled for low noise figure at 220 Mc/s and operation at low supply voltages.

A high transconductance and input impedance give the 2FY5 a very high gain bandwidth factor, and the remote cut-off insures low intermodulation distortion. The two cathode pins serve the purpose of insuring low lead inductance and a separately connected shield reduces direct grid to plate capacitance to simplify neutralization.

The 2FY5 is electrically identical to the Amperex 6FY5 except it is intended for series supply and the heater ratings are as follows:

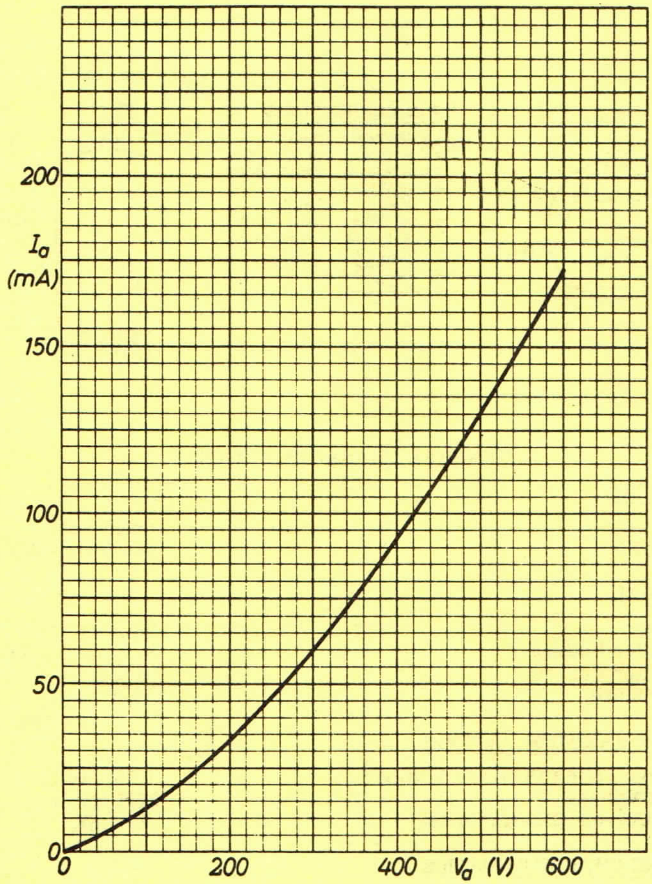
Heater Voltage	2.4 volts
Heater Current	600 ma

AMPEREX TUBE TYPE 2HA5

The Amperex 2HA5 is an Ampliframe shielded triode for use for 600 ma series string operation as an RF amplifier in VHF television tuners. This tube is designed to have high input impedance at high frequencies, which, in conjunction with its extremely low interelectrode capacitances ensures high stage gain; yet its very low input grid resistance assures a low noise figure.

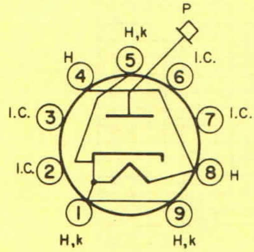
The 2HA5 is electrically equivalent to the 6HA5 with the exception of the following ratings.

Heater Arrangement	series supply
Heater Voltage	2.2 volts
Heater Current	600 ma


200
I_a (mA)
150
100
50
0
0
200
400
V_a (V)
600

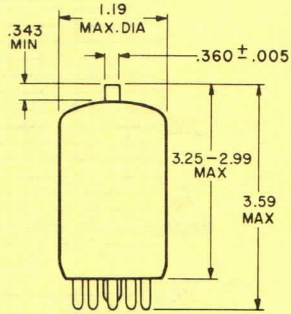
AMPEREX TUBE TYPE 3BH2

The 3BH2 is a high voltage rectifier diode intended for use in color TV receivers.



PIN CONNECTIONS

1 – HEATER, CATHODE
2 – INTERNAL CONNECTION
3 – INTERNAL CONNECTION
4 – HEATER
5 – HEATER, CATHODE
6 – INTERNAL CONNECTION
7 – INTERNAL CONNECTION
8 – HEATER
9 – HEATER, CATHODE
P – PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Dimensions	see outline drawing

ELECTRICAL

Heating	Indirect, AC or DC
Heater Voltage	3.15 volts ± 15%
Heater Current	370 ma
Capacitance	1.5 pf, Plate to Cathode

ABSOLUTE MAXIMUM RATINGS

Negative Plate to Cathode Voltage[1]	35 k volts
Output Voltage	27.5 k volts
Plate Current (Design Center)	1.7 ma

OPERATING CHARACTERISTICS

Output Voltage	25 k volts
Plate Current	1.5 ma

OPERATING NOTES

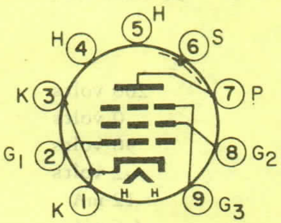
A. Pins 1, 5 and 9, may be used to connect an anti-corona ring.
B. X-ray shielding may be required for protection against excessive radiation

1. Negative peak due to ringing in output transformer should be taken into account. Maximum pulse duration 22% of a cycle and 18 μsec.

AMPEREX TUBE TYPE 3EH7/XF183

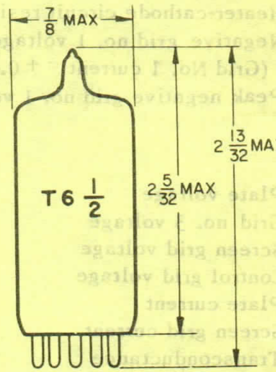
TENTATIVE DATA

The Amperex 3EH7/XF183 is a frame grid remote cut-off pentode designed for use as an IF amplifier in television receivers. Its high variable transconductance, with low interelectrode and low feed back capacitance, enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip. The 3EH7/XF183 is designed for 600 mA controlled warm-up series string operation.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO. 2
9 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E 9-1
Dimensions	see outline drawing

ELECTRICAL

Cathode	coated, unipotential
Heater current	600 mA
Heater voltage	3.4 volts

Direct Interelectrode Capacitances

Input	9.5 $\mu\mu f$
Output	3 $\mu\mu f$
Plate to grid No. 1	0.005 $\mu\mu f$ max

3EH7/XF183

Maximum Ratings, Design Center

→ Plate voltage, cut-off condition	550 volts max
Plate voltage	250 volts max
Plate dissipation	2.5 watts max
→ Screen grid voltage, cut-off condition	550 volts max
Screen grid voltage	250 volts max
Screen grid dissipation	0.65 watts max
Cathode current	20 mA max
Control grid series resistance	1 megohm max
Heater-cathode voltage	150 volts max
Heater-cathode circuit resistance	20,000 ohms max
Negative grid no. 1 voltage (Grid No. 1 current = + 0.3 μA)	1.3 volts max
Peak negative grid no. 1 voltage	50 volts max

Typical Characteristics

Plate voltage	200 volts
Grid no. 3 voltage	0 volts
Screen grid voltage	90 volts
Control grid voltage	−2 volts
Plate current	12 mA
Screen grid current	4.5 mA
Transconductance	12,500 micromhos
Plate resistance	0.5 megohms
→ Input resistance (f = 40 Mc/s)	10,000 ohms

Typical Operation [1]

Plate voltage				200 volts
Screen grid supply voltage				200 volts
Grid No. 3 voltage				0 volts
→ Screen grid series resistance				24,000 ohms
Negative control grid voltage	2	6.5	9.5	19.5 volts
Transconductance	12,500	1250	625	125 micromhos
Input voltage for cross-modulation = 1%		100	160	450 millivolts

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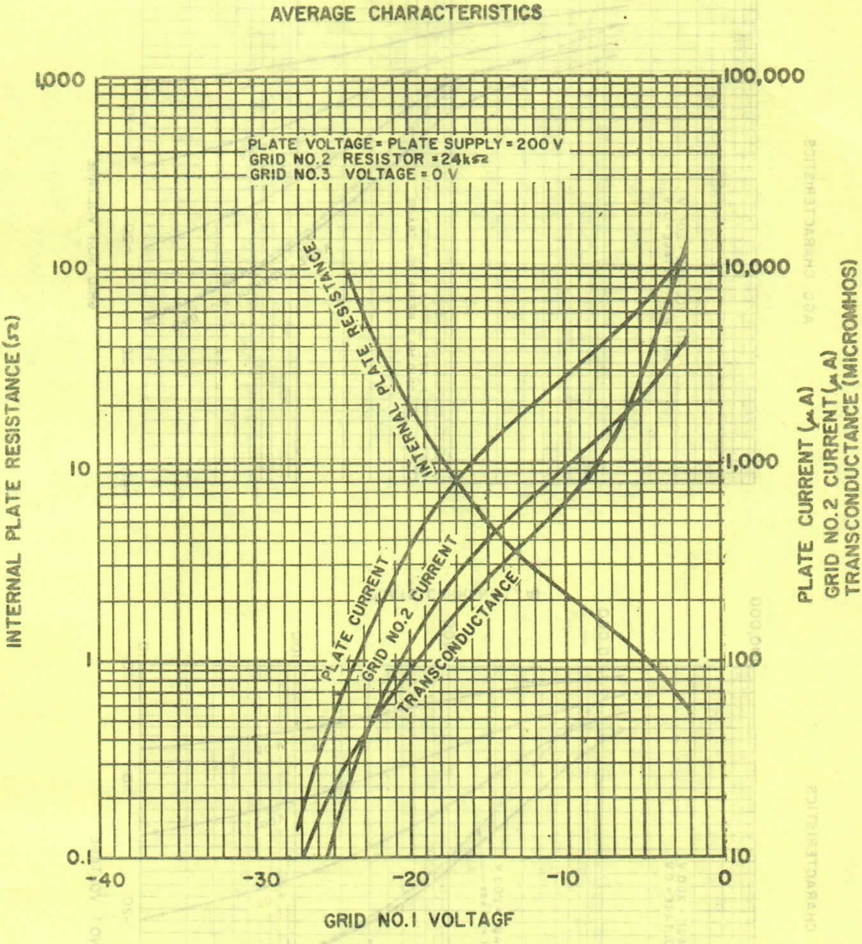
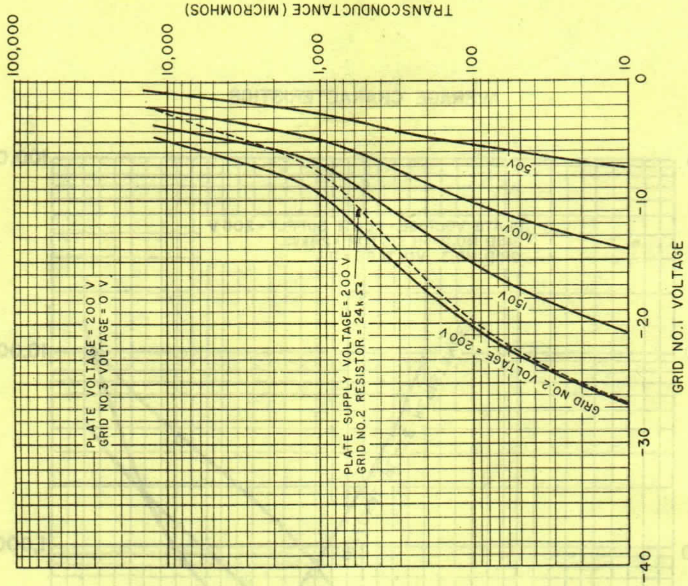
[1] Operation with cathode bias resistor and/or screen grid resistor is recommended.

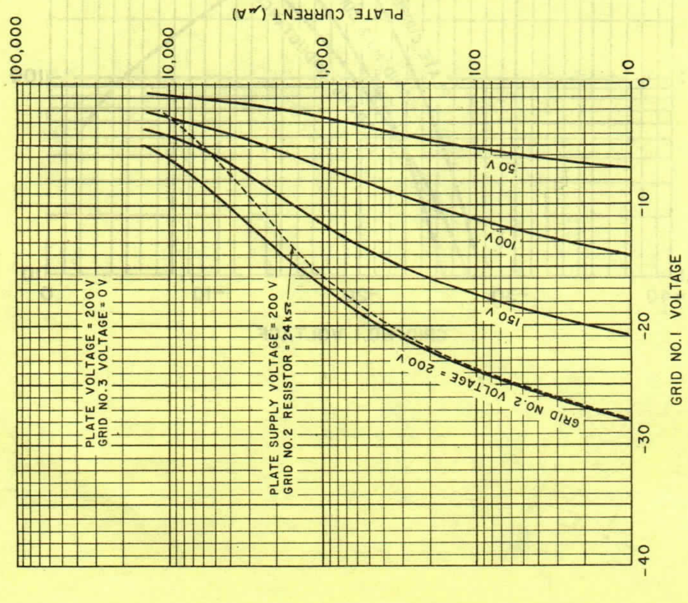

AVERAGE CHARACTERISTICS
PLATE VOLTAGE = PLATE SUPPLY = 200 V
GRID NO.2 RESISTOR = 24kΩ
GRID NO.3 VOLTAGE = 0 V
INTERNAL PLATE RESISTANCE
PLATE CURRENT
GRID NO.2 CURRENT
TRANSCONDUCTANCE
INTERNAL PLATE RESISTANCE (Ω)
1,000
100
10
1
0.1
100,000
10,000
1,000
100
10
PLATE CURRENT (μA)
GRID NO.2 CURRENT (μA)
TRANSCONDUCTANCE (MICROMHOS)
-40
-30
-20
-10
0
GRID NO.1 VOLTAGF

3EH7/XF183

AGC CHARACTERISTICS



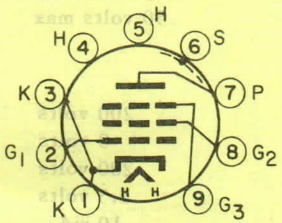
TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 3EJ7/XF184

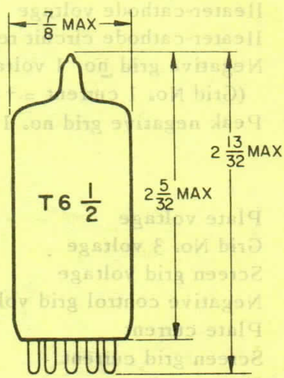
TENTATIVE DATA

The Amperex 3EJ7/XF184 is a frame grid sharp cut-off pentode designed for use as an IF amplifier in television receivers. Its high transconductance with low interelectrode and feed-back capacitance, enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip. The 3EJ7/XF184 is designed for 600 mA controlled warm-up series string operation.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO. 2
9 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E 9-1
Dimensions	see outline drawing

ELECTRICAL

Cathode	coated, unipotential
Heater current	600 mA
Heater voltage	3.4 volts

Direct Interelectrode Capacitances

Input	10 $\mu\mu$f
Output	3 $\mu\mu$f
→ Plate to grid No. 1	0.005 $\mu\mu$f max

3EJ7/XF184

Maximum Ratings, Design Center Values

→ Plate voltage, cut-off condition	550 volts max
Plate voltage	250 volts max
Plate dissipation	2.5 watts max
→ Screen grid voltage, cut-off condition	550 volts max
Screen grid voltage	250 volts max
Screen grid dissipation	0.9 watts max
Cathode current	25 mA max
Control grid series resistance	1 megohm max
Heater-cathode voltage	150 volts max
Heater-cathode circuit resistance	20,000 ohms max
Negative grid no. 1 voltage (Grid No. 1 current = + 0.3 μA)	1.3 volts max
Peak negative grid no. 1 voltage	50 volts max

Typical Operation [1,2]

Plate voltage	200 volts
Grid No. 3 voltage	0 volts
Screen grid voltage	200 volts
Negative control grid voltage	2.5 volts
Plate current	10 mA
Screen grid current	4.1 mA
Transconductance	15,000 micromhos
Plate resistance	350,000 ohms
Amplification factor of grid No. 2 with respect to grid no. 1	60
→ Input resistance (f = 40 Mc/s)	10,000 ohms

1 Operation with cathode bias resistor is recommended.

2 In order to ensure good performance with respect to cross modulation and microphonics, the 3EJ7/XF184 should not be used in circuits with automatic gain control. For such applications a tube with a variable amplification factor is recommended.

3EJ7/XF184

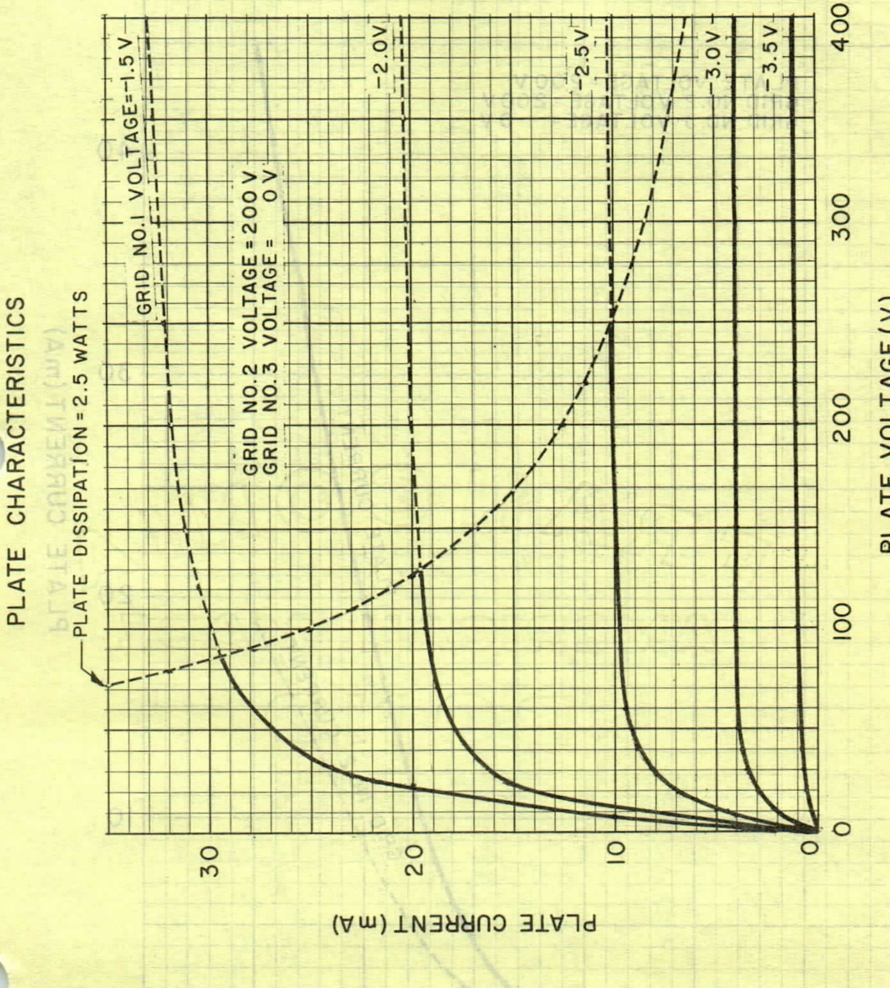
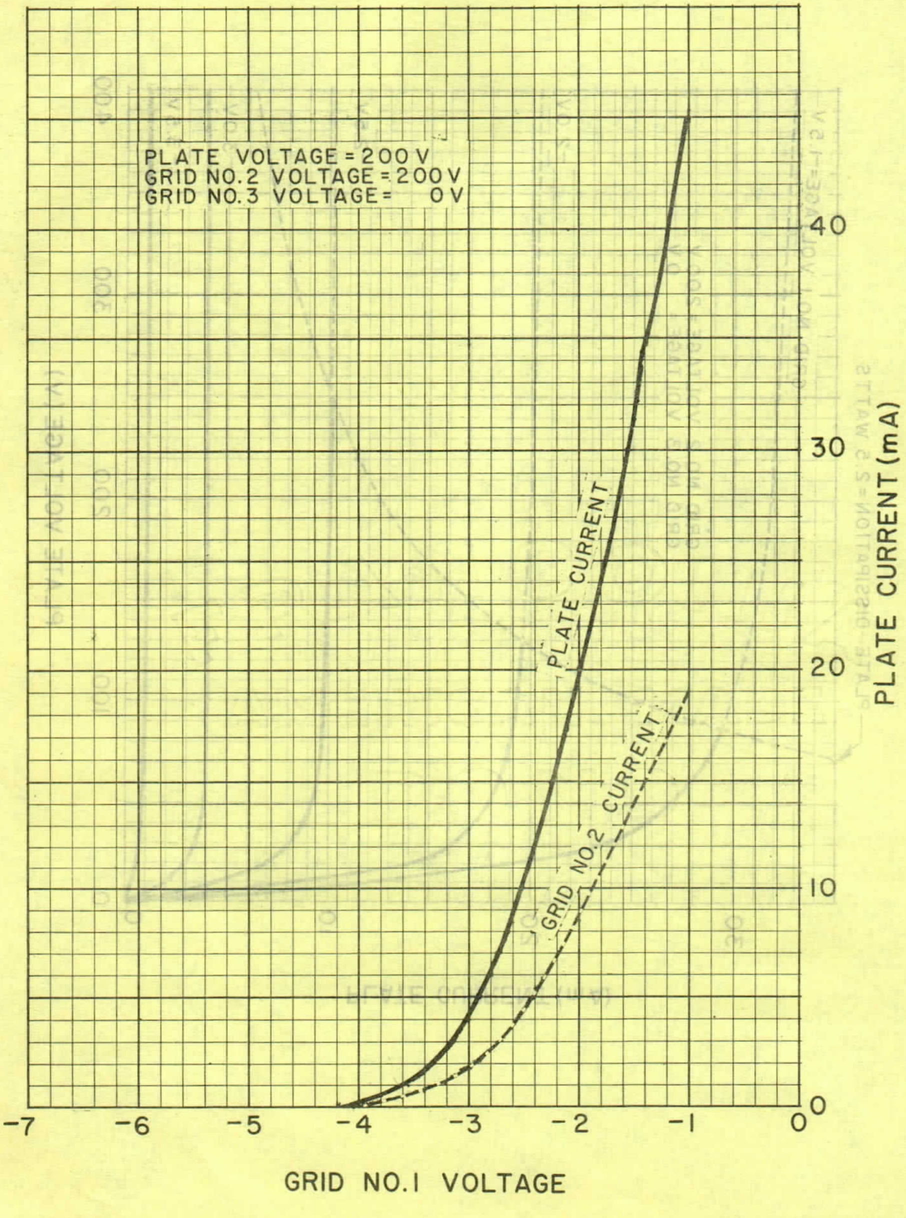


PLATE CHARACTERISTICS
PLATE DISSIPATION = 2.5 WATTS
GRID NO.1 VOLTAGE = −1.5 V
−2.0 V
−2.5 V
−3.0 V
−3.5 V
GRID NO.2 VOLTAGE = 200 V
GRID NO.3 VOLTAGE = 0 V
PLATE CURRENT (mA)
30
20
10
0
PLATE VOLTAGE (V)
0
100
200
300
400

3EJ7/XF184

TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 3FY5

TENTATIVE DATA

The Amperex 3FY5 is a miniature frame grid shielded triode with remote cut-off. It is especially designed for service in VHF tuners for television receivers and is controlled for low noise figure at 220 Mc/s and operation at low supply voltages.

A high transconductance and input impedance give the 3FY5 a very high gain bandwidth factor, and the remote cut-off insures low intermodulation distortion. The two cathode pins serve the purpose of insuring low lead inductance and a separately connected shield reduces direct grid to plate capacitance to simplify neutralization.

The 3FY5 is electrically identical to the Amperex 6FY5 except it is intended for series supply and the heater ratings are as follows:

Heater Voltage	3.1 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 3HA5

The Amperex 3HA5 is an Ampliframe shielded triode for use for 450 ma series string operation as an RF amplifier in VHF television tuners. This tube is designed to have high input impedance at high frequencies, which, in conjunction with its extremely low interelectrode capacitances ensures high stage gain; yet its very low input grid resistance assures a low noise figure.

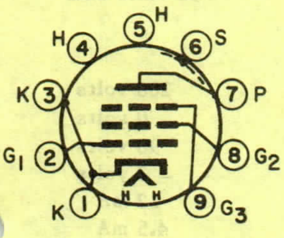
The 3HA5 is electrically equivalent to the 6HA5 with the exception of the following ratings.

Heater Arrangement	series supply
Heater Voltage	2.7 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 4EH7/YF183

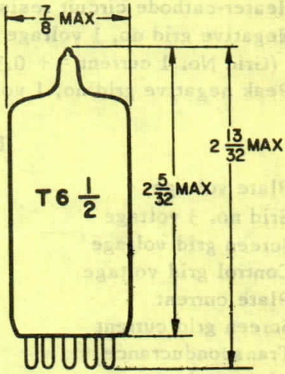
TENTATIVE DATA

The Amperex 4EH7/YF183 is a frame grid remote cut-off pentode designed for use as an IF amplifier in television receivers. Its high variable transconductance, with low interelectrode and low feed back capacitance, enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip. The 4EH7/YF183 is designed for 450 mA controlled warm-up series string operation.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO. 2
9 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E 9-1
Dimensions	see outline drawing

ELECTRICAL

Cathode	coated, unipotential
Heater current	450 mA
Heater voltage	4.4 volts

Direct Interelectrode Capacitances

Input	9.5 $\mu\mu$f
Output	3 $\mu\mu$f
Plate to grid No. 1	0.005 $\mu\mu$f

4EH7/YF183

Maximum Ratings, Design Center

Plate voltage, cut-off condition	550 volts max
Plate voltage	250 volts max
Plate dissipation	2.5 watts max
Screen grid voltage, cut-off condition	550 volts max
Screen grid voltage	250 volts max
Screen grid dissipation	0.65 watts max
Cathode current	20 mA max
Control grid series resistance	1 megohm max
Heater-cathode voltage	150 volts max
Heater-cathode circuit resistance	20,000 ohms max
Negative grid no. 1 voltage (Grid No. 1 current = + 0.3 μA	1.3 volts max
Peak negative grid no. 1 voltage	50 volts max

Typical Characteristics

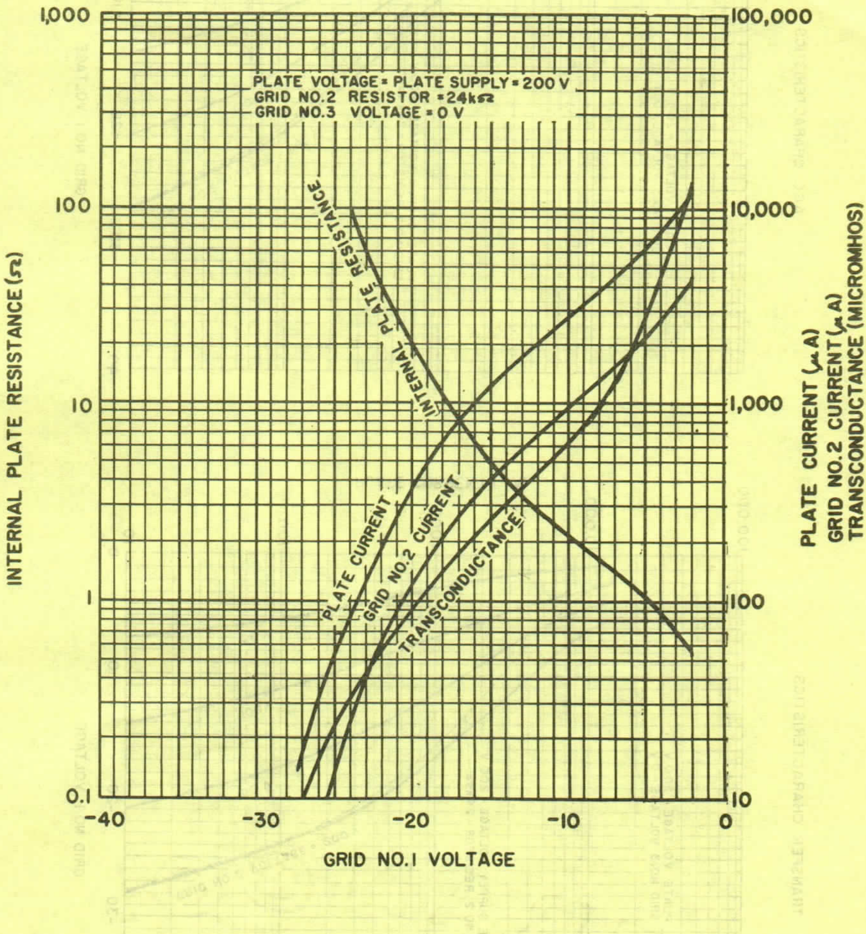
Plate voltage	200 volts
Grid no. 3 voltage	0 volts
Screen grid voltage	90 volts
Control grid voltage	– 2 volts
Plate current	12 mA
Screen grid current	4.5 mA
Transconductance	12,500 micromhos
Plate resistance	0.5 megohms
Input resistance (f = 40 Mc/s)	10,000 ohms

Typical Operation [1]

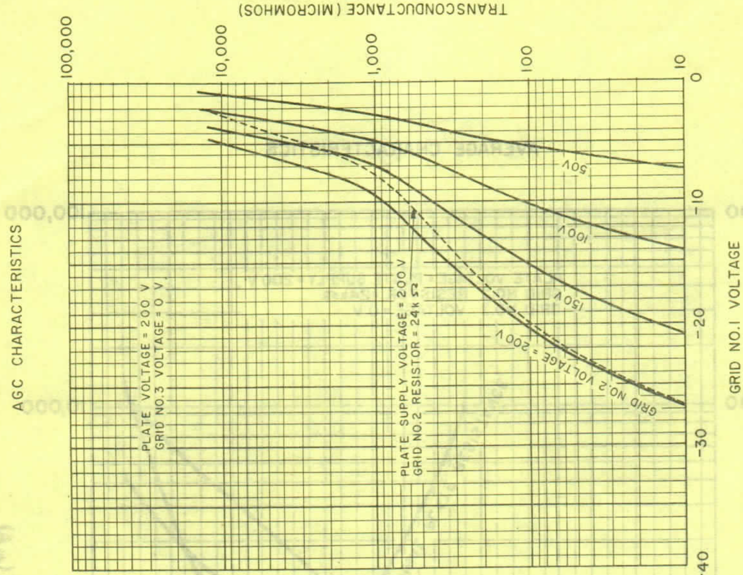
Plate voltage				200 volts
Screen grid supply voltage				200 volts
Grid No. 3 voltage				0 volts
Screen grid series resistance				24,000 ohms
Negative control grid voltage	2	6.5	9.5	19.5 volts
Transconductance	12,500	1250	625	125 micromhos
Input voltage for cross-modulation = 1%		100	160	450 millivolts

[1] Operation with cathode bias resistor and/or screen grid resistor is recommended.

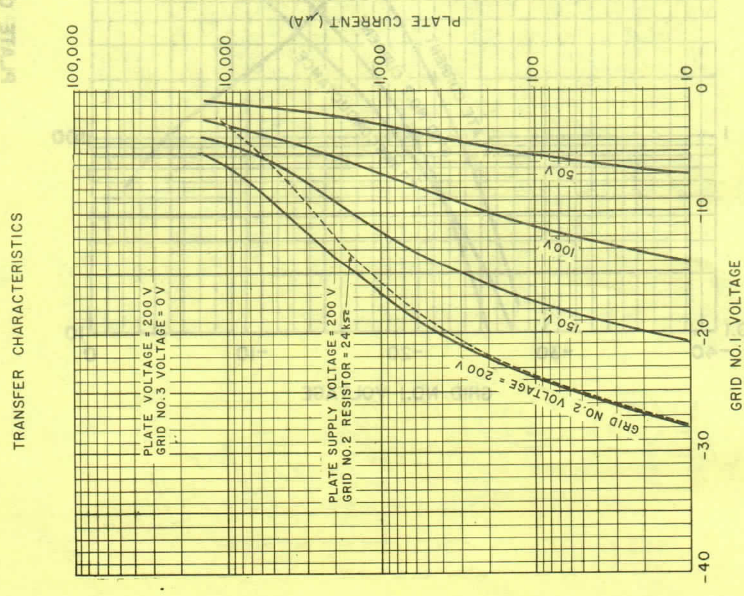
AVERAGE CHARACTERISTICS



4EH7/YF183



AGC CHARACTERISTICS
TRANSCONDUCTANCE (MICROMHOS)
100,000
10,000
1,000
100
10
0
-10
-20
-30
-40
GRID NO.1 VOLTAGE
PLATE VOLTAGE = 200 V
GRID NO.3 VOLTAGE = 0 V
PLATE SUPPLY VOLTAGE = 200 V
GRID NO.2 RESISTOR = 24k Ω
50V
100V
150V
GRID NO.2 VOLTAGE = 200 V

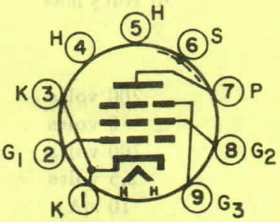


TRANSFER CHARACTERISTICS
PLATE CURRENT (μA)
100,000
10,000
1,000
100
10
0
-10
-20
-30
-40
GRID NO.1 VOLTAGE
PLATE VOLTAGE = 200 V
GRID NO.3 VOLTAGE = 0 V
PLATE SUPPLY VOLTAGE = 200 V
GRID NO.2 RESISTOR = 24kΩ
50 V
100V
150 V
GRID NO.2 VOLTAGE = 200 V

AMPEREX TUBE TYPE 4EJ7/YF184

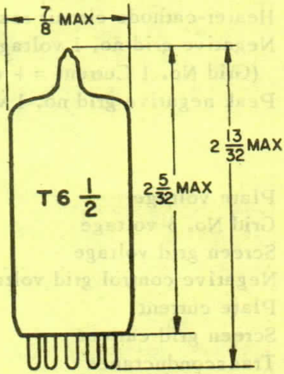
TENTATIVE DATA

The Amperex 4EJ7/YF184 is a frame grid sharp cut-off pentode designed for use as an IF amplifier in television receivers. Its high transconductance, with low interelectrode and feed-back capacitance, enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip. The 4EJ7/YF184 is designed for 450 mA controlled warm-up series string operation.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO. 2
9 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E 9-1
Dimensions	see outline drawing

ELECTRICAL

Cathode	coated, unipotential
Heater current	450 mA
Heater voltage	4.4 volts

Direct Interelectrode Capacitances

Input	10 $\mu\mu$f
Output	3 $\mu\mu$f
Plate to grid No. 1	0.005 $\mu\mu$f max

4EJ7/YF184

Maximum Ratings, Design Center Values

Plate voltage, cut-off conditon	550 volts max
Plate voltage	250 volts max
Plate dissipation	2.5 watts max
Screen grid voltage, cut-off condition	550 volts max
Screen grid voltage	250 volts max
Screen grid dissipation	0.9 watts max
Cathode current	25 mA max
Control grid series resistance	1 megohm max
Heater-cathode voltage	150 volts max
Heater-cathode circuit resistance	20,000 ohms max
Negative grid no. 1 voltage (Grid No. 1 Current = + 0.3 μA)	1.3 volts max
Peak negative grid no. 1 voltage	50 volts max

Typical Operation [1,2]

Plate voltage	200 volts
Grid No. 3 voltage	0 volts
Screen grid voltage	200 volts
Negative control grid voltage	2.5 volts
Plate current	10 mA
Screen grid current	4.1 mA
Transconductance	15,000 micromhos
Plate resistance	350,000 ohms
Amplification factor of grid no. 2 with respect to grid no. 1	60
Input resistance (f = 40 Mc/s)	10,000 ohms

---

1 Operation with cathode bias resistor is recommended.

2 In order to ensure good performance with respect to cross modulation and microphonics, the 4EJ7/YF184 should not be used in circuits with automatic gain control. For such applications a tube with a variable amplification factor is recommended.

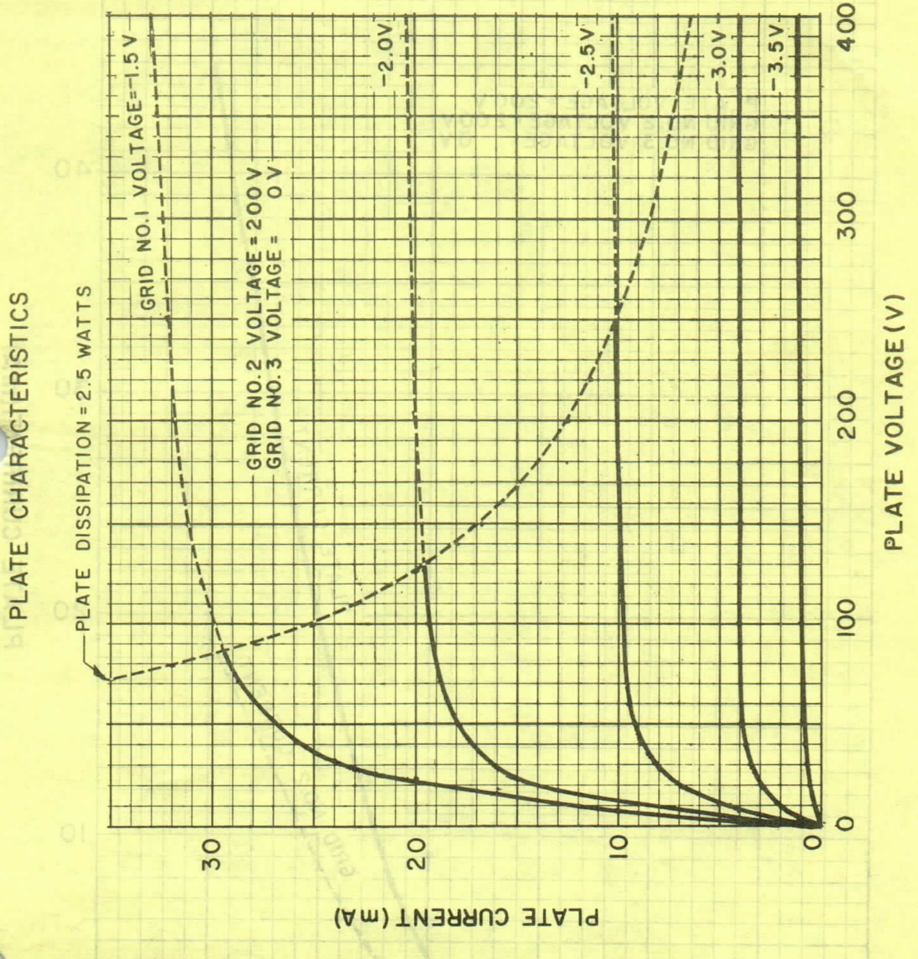
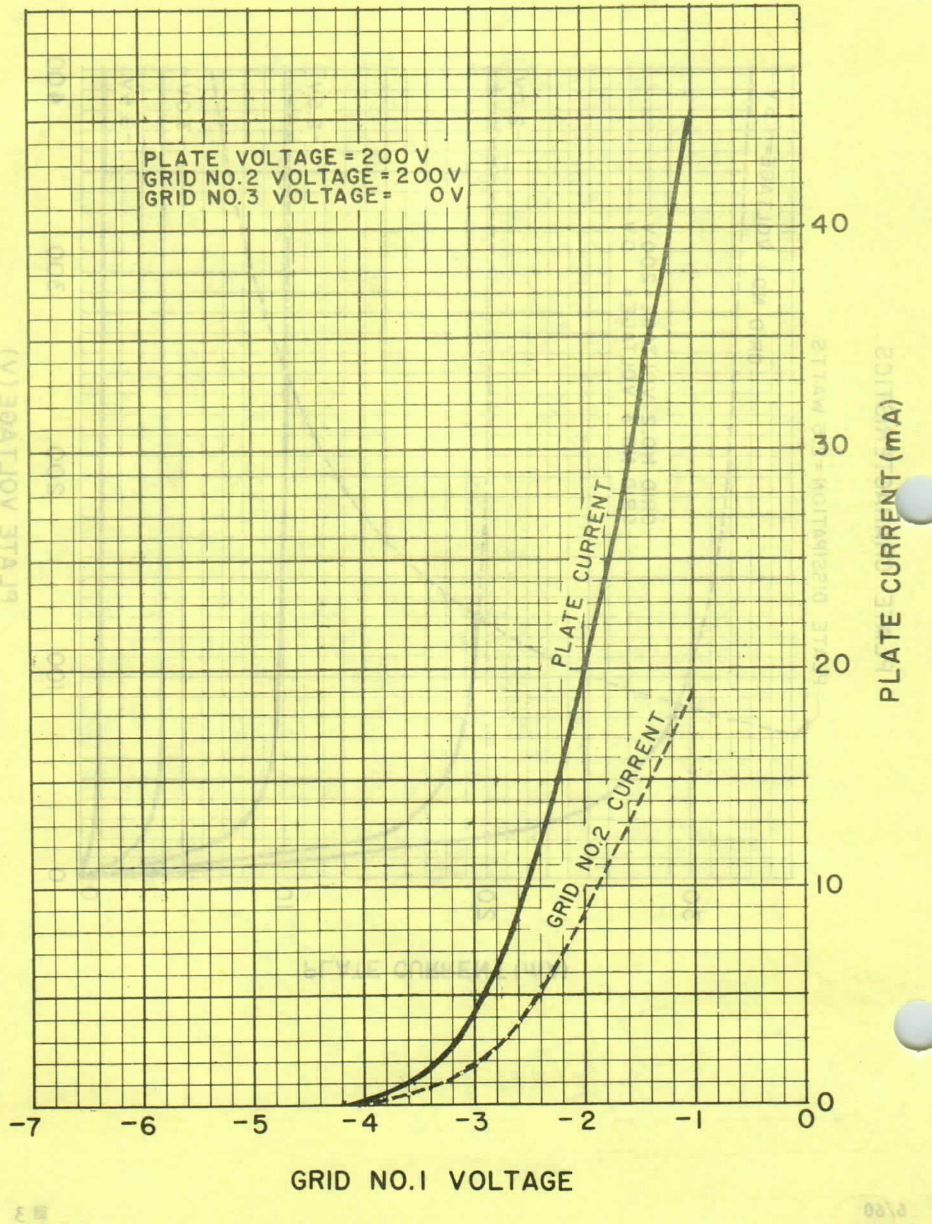


PLATE CHARACTERISTICS
PLATE DISSIPATION = 2.5 WATTS
GRID NO.1 VOLTAGE = -1.5 V
-2.0 V
-2.5 V
-3.0 V
-3.5 V
GRID NO.2 VOLTAGE = 200 V
GRID NO.3 VOLTAGE = 0 V
PLATE CURRENT (mA)
0
10
20
30
PLATE VOLTAGE (V)
0
100
200
300
400

4EJ7/YF184

TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 4ES8

The Amperex 4ES8 is a high performance frame grid twin triode with remote cut-off characteristics. It is designed for use as a low noise cascode tube for 600 mA series string operation in premium television tuners. The remote cut-off feature has been designed so as to reduce intermodulation under strong signal oonditions while allowing extremely sensitive performance of the tuner in weak signal areas.

The 4ES8 is electrically identical to the Amperex 6ES8 except for the following ratings:

Heater Arrangement	series supply
Heater Voltage	4.2 volts
Heater Current	600 mA

Revised 6/60

AMPEREX TUBE TYPE 4HA5

The Amperex 4HA5 is an Ampliframe shielded triode for use for 300 ma series string operation as an RF amplifier in VHF television tuners. This tube is designed to have high input impedance at high frequencies, which, in conjunction with its extremely low interelectrode capacitances ensures high stage gain; yet its very low input grid resistance assures a low noise figure.

The 4HA5 is electrically equivalent to the 6HA5 with the exception of the following ratings.

Heater Arrangement	series supply
Heater Voltage	3.9 volts
Heater Current	300 ma

AMPEREX TUBE TYPE 5AR4/GZ34

The 5AR4/GZ34 is a high vacuum, full-wave rectifier capable of output currents up to 250 milliamperes. The indirectly heated cathode is connected directly to the heater. Its small size and generous ratings make it particularly suitable for application in new, compact Hi-Fi component designs.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater	Indirectly heated cathode, coated unipotential
Heater Voltage (A.C.)	5.0 volts
Heater Current	1.9 amps

MECHANICAL

Base	Octal, 5 pin
Maximum Overall Length	3 25/64 inches
Maximum Diameter	1½ inches

MAXIMUM RATINGS (DESIGN CENTER VALUES)

Maximum Peak Inverse Voltage	1500 volts
Maximum Peak Current (per plate)	750 Ma
A.C. Supply (plate-to-plate) Voltage (rms)	1100 volts
Maximum D.C. Output Current	250 Ma
Maximum Capacity (condenser input filter)	60 μf

Typical Operating Conditions
Condenser Input Filter

A.C. Supply Voltage (plate to plate) (rms)	2x300	2x350	2x400	2x450	2x500	2x550 volts
Limiting Resistor [2] (minimum)	75	100	125	150	175	200 ohms ←
D.C. Output Current	250	250	250	250	200	160 Ma
D.C. Output Voltage [3]	330	380	430	480	560	640 volts ←

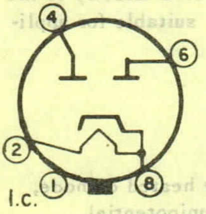
Choke Input Filter

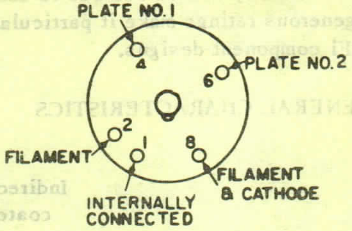
A.C. Supply Voltage (plate to plate) (rms)	2x300	2x350	2x400	2x450	2x500	2x550 volts
Inductance	10	10	10	10	10	10 henries
Limiting Resistor	0	0	0	0	0	0 ohms
D.C. Output Current	250	250	250	250	250	225 mA
D.C. Output Voltage [3]	250	290	330	375	420	465 volts ←

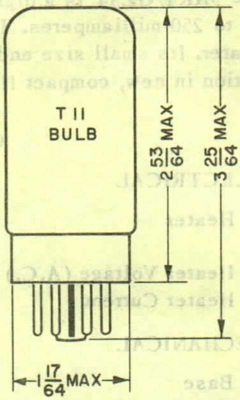
[2] Per Plate

[3] At maximum values

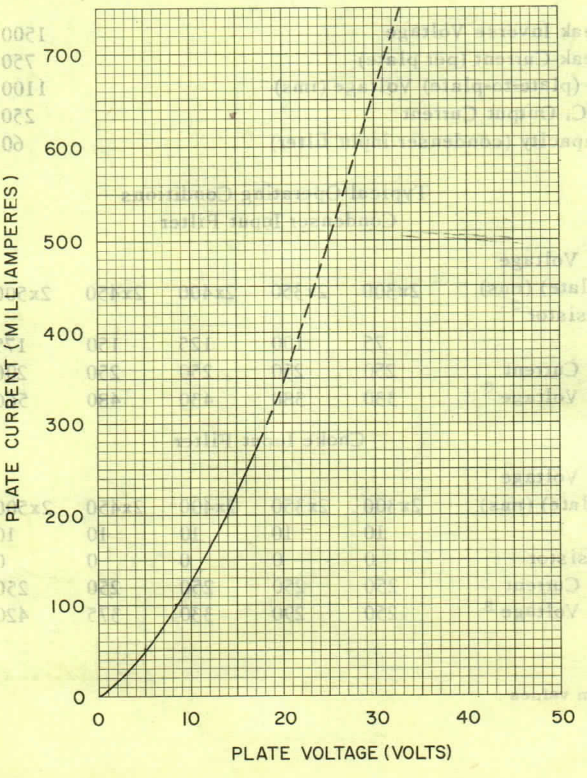
5AR4/GZ34



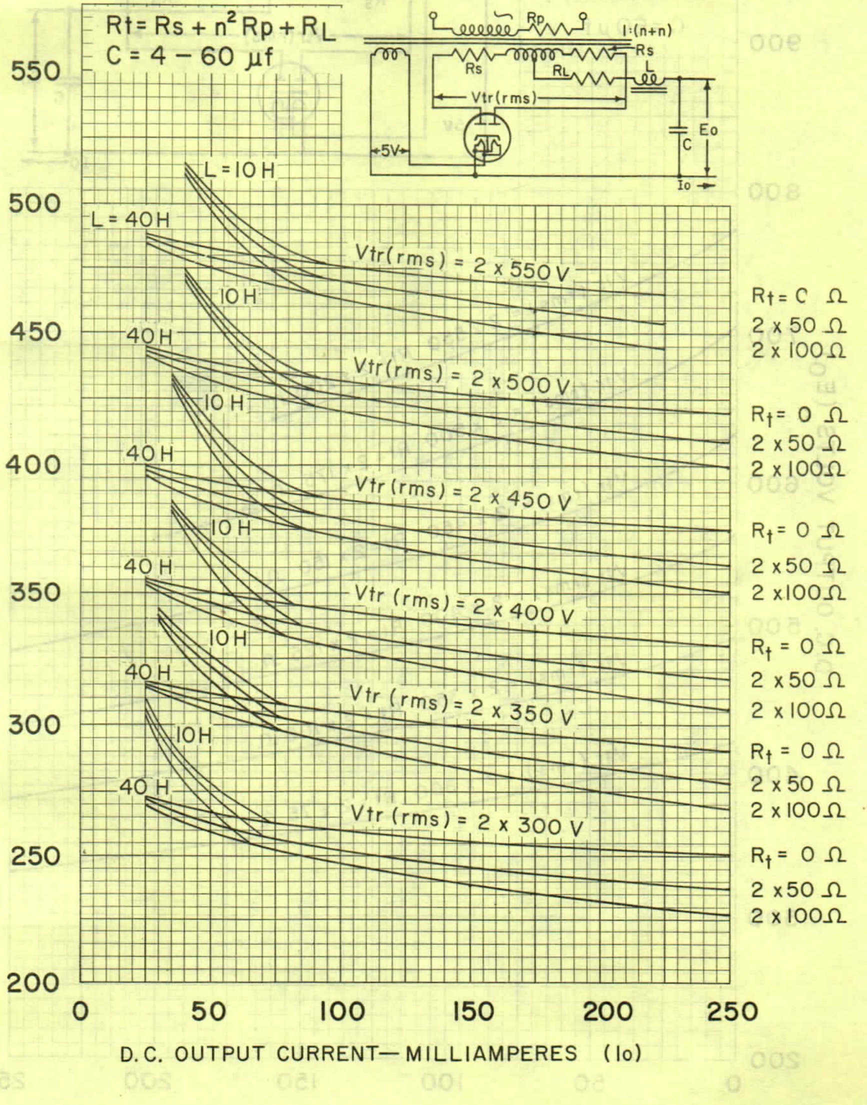




AVERAGE DIODE CHARACTERISTICS (EACH DIODE)

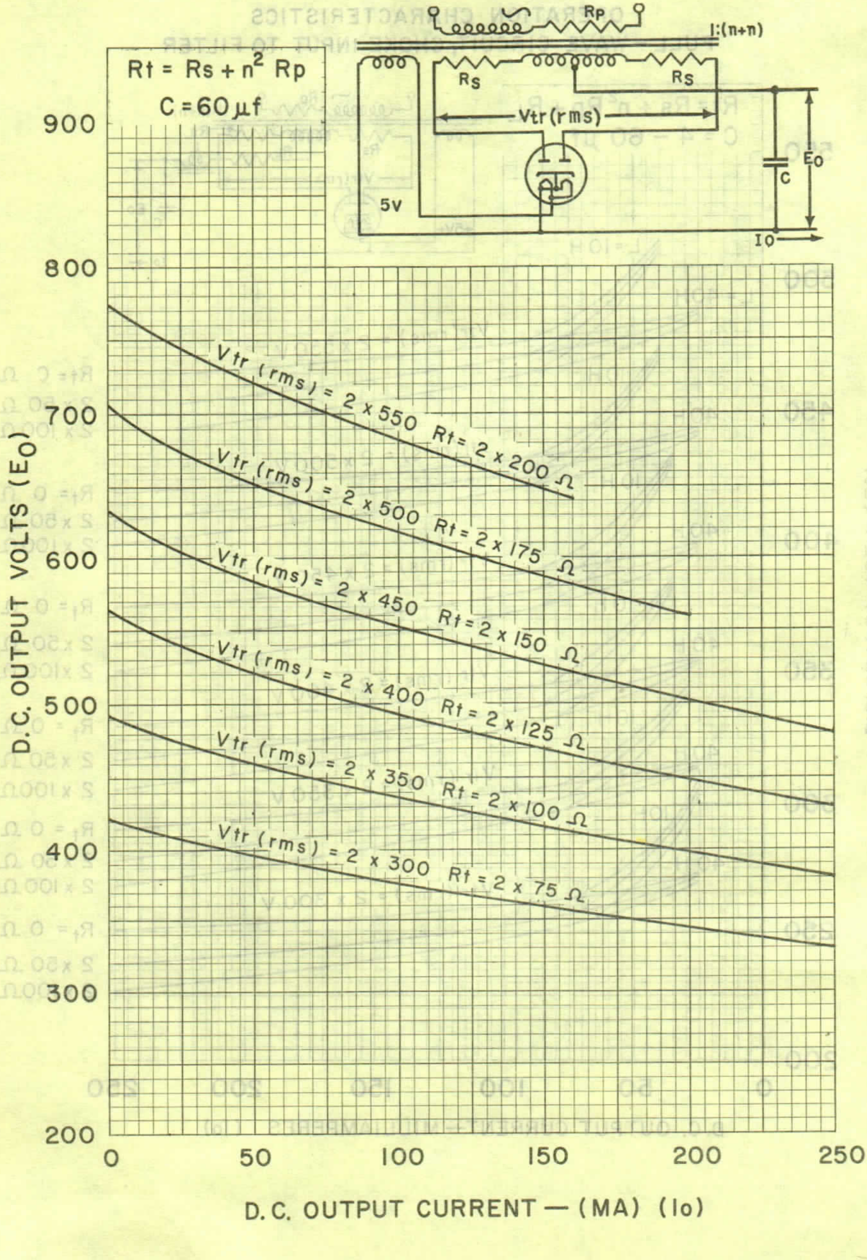


OPERATION CHARACTERISTICS
FULL-WAVE CIRCUIT, CHOKE INPUT TO FILTER

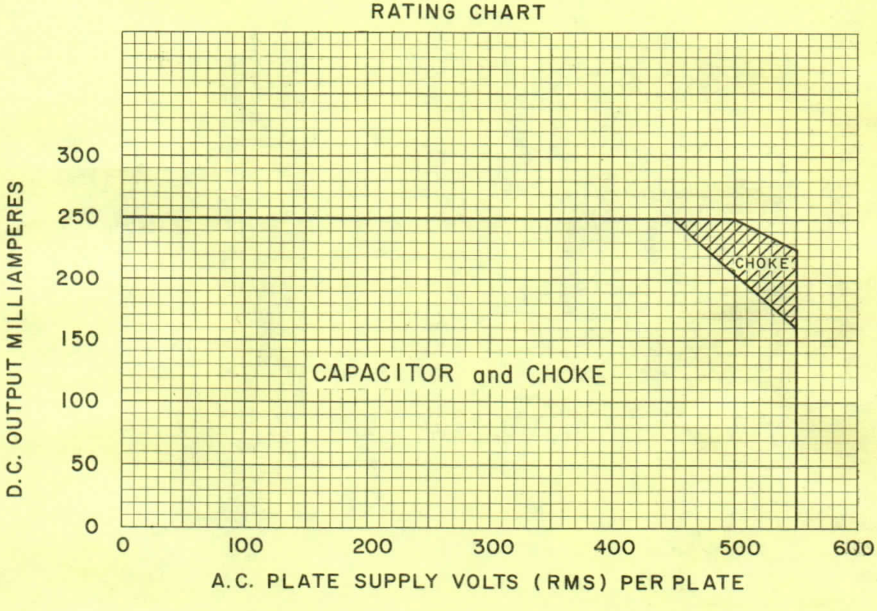


5AR4/GZ34

OPERATION CHARACTERISTICS
FULL-WAVE CIRCUIT, CAPACITOR INPUT TO FILTER



5AR4/GZ34


RATING CHART
D.C. OUTPUT MILLIAMPERES
300
250
200
150
100
50
0
CHOKE
CAPACITOR and CHOKE
0
100
200
300
400
500
600
A.C. PLATE SUPPLY VOLTS (RMS) PER PLATE

AMPEREX TUBE TYPE 5ES8

TENTATIVE DATA

The Amperex 5ES8 is a high frequency, frame grid twin triode with a variable transconductance and remote cut-off characteristics. It is designed for use as a low noise cascode tube in premium television tuners. The remote cut-off feature has been designed so as to reduce intermodulation under strong signal conditions, while allowing extremely sensitive performance of the tuner in weak signal areas.

The 5ES8 is electrically identical to the Amperex 6ES8 except for the following ratings:

Heater Voltage	5.6 volts
Heater Current	450 mA

AMPEREX TUBE TYPE 5GJ7

The Amperex 5GJ7 is an Ampliframe triode-pentode for 450 ma series string operation as an oscillator mixer in television applications. The high gm Ampliframe triode insures stable oscillator performance even at low line voltages. The Ampliframe pentode section has an extremely high conversion transconductance of 4700 μmhos.

The varying pitch control grid makes possible the application of automatic gain control of the mixer, when the tube is used as an IF amplifier in integrated UHF - VHF tuners.

The 5GJ7 is electrically equivalent to the 6GJ7, except for the following ratings.

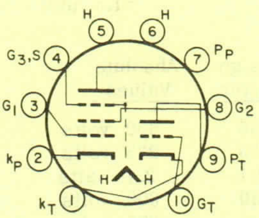
Heater Arrangement	series supply
Heater Voltage	5.7 volts
Heater Current	450 ma

AMPEREX TUBE TYPES 5U9, 6U9, 8U9

TENTATIVE DATA

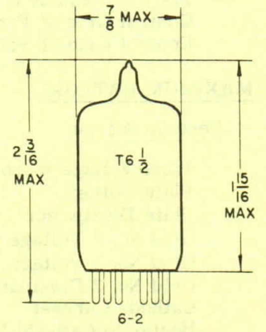
The Amperex 5U9, 6U9 and 8U9 are triode-pentodes with Decal bases. They are intended for use in IF amplifiers and general purpose sound and sync applications in TV receivers. The triode section has a low amplification factor and is capable of supplying a high plate current. To avoid hum in blocking oscillators or multi-vibrators circuits, the cathode of the triode section must be directly grounded.

The pentode section is of frame grid construction and is similar in performance to type 6EH7.



PIN CONNECTIONS

1 - CATHODE, TRIODE SECTION
2 - CATHODE
3 - GRID NO. 1
4 - GRID NO. 3 SHIELD
(2–4: PENTODE SECTION)
5 - HEATER
6 - HEATER
7 - PLATE
8 - GRID NO. 2
(7–8: PENTODE SECTION)
9 - PLATE
10 - GRID
(9–10: TRIODE SECTION)



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Decal

ELECTRICAL

Heater Supply	indirect, AC or DC series or parallel			
	5U9	6U9	8U9	
Heater Voltage	5.9	6.3	8.0	volts
Heater Current	450	410	300	ma

Direct Interelectrode Capacitances

Pentode Section

Plate to All Other Elements (except grid No. 1)	3.5 pf
Grid No. 1 to All Other Elements (except plate)	6.5 pf

Direct Interelectrode Capacitances (Cont.)

Pentode Section (Cont.)

Grid No. 1 to Cathode	4.0 pf
Plate to Grid No. 1	<6.5 mpf
Grid No. 1 to Grid No. 2	1.8 pf

Triode Section

Plate to All Other Elements (except grid)	3.0 pf
Grid to All Other Elements (except plate)	2.5 pf
Plate to Grid	2.0 pf

Between Pentode and Triode Section

Plate of Pentode to Plate of Triode	<15 mpf
Control Grid of Pentode to Plate of Triode	<1.2 mpf
Control Grid of Pentode to Grid of Triode	<1.5 mpf

MAXIMUM RATINGS

Pentode Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Plate Dissipation	2.1	2.4	watts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Grid No. 2 Dissipation	0.7	0.8	watts
Cathode Current	18	20	ma
Heater to Cathode Voltage	150	165	volts
Grid No. 1 Resistor	1	1	megohm

Triode Section

Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Plate Dissipation	1.5	1.75	watts
Cathode Current	18	20	ma
Peak Cathode Current[1]	50	55	ma
Grid Resistor	1	1	megohm
Heater Cathode Voltage (6U9, 8U9)	150	165	volts
Heater Cathode Voltage (5U9)	100	110	volts

[1] T_{max} = 10 μsec.; 10% of one cycle.

TYPICAL CHARACTERISTICS

Pentode Section

Plate Voltage	160	volts
Grid No. 2 Voltage	110	volts
Grid No. 3 Voltage	0	volts
Grid No. 1 Voltage	-1.4	volts
Plate Current	13	ma
Grid No. 2 Current	5	ma
Transconductance	12,000	μmhos
Amplification Factor (Grid No. 1 to Grid No. 2)	45	

Triode Section

Plate Voltage	100	volts
Grid Voltage	-2	volts
Plate Current	14	ma
Transconductance	5000	μmhos
Amplification Factor	17	

OPERATING CHARACTERISTICS

Pentode Section - Video IF Amplifier

Supply Voltage	135	230	250	volts
Grid No. 3 Voltage	0	0	0	volts
Plate Resistance	0	5.6	6.8	k ohms
Grid No. 2 Resistor	5.1	24	27	k ohms
Cathode Resistor	78	78	74	ohms
Plate Current	13	13	13.5	ma
Grid No. 2 Current	5	5	5.2	ma
Transconductance	12,000	12,000	12,300	μmhos
Grid No. 1 Circuit Resistance (40 Mc)	7.4	7.4	7.4	k ohms

Triode Section - Line Blocking Oscillator

Plate Voltage	30	volts
Grid Voltage	1.5	volts
Peak Cathode Current	40	ma
Peak Plate Current	25	ma
Peak Grid Current	15	ma

Triode Section - Sync Separator

Plate Voltage	130-150	volts
Plate Resistance	33	k ohms
Grid Current	1	μa
Plate Current	72	ma

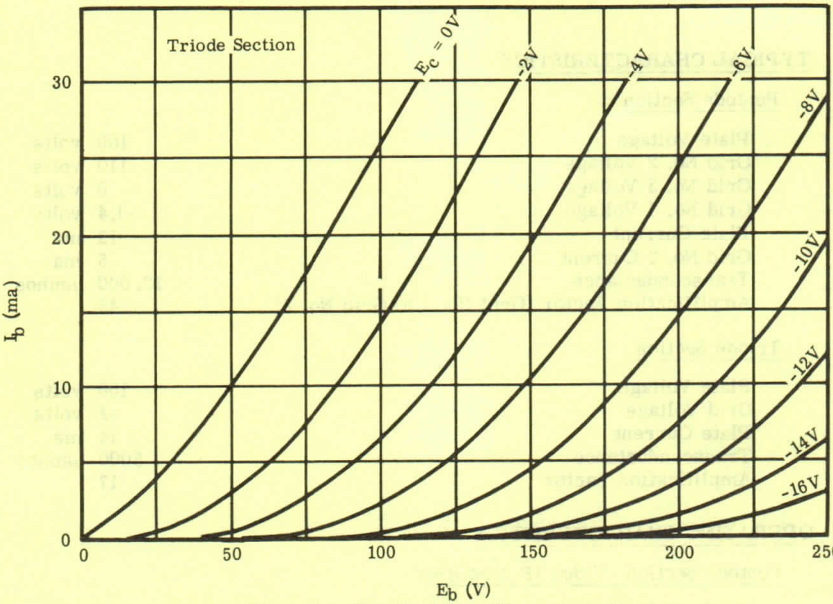


Figure 1. Triode Plate Characteristics

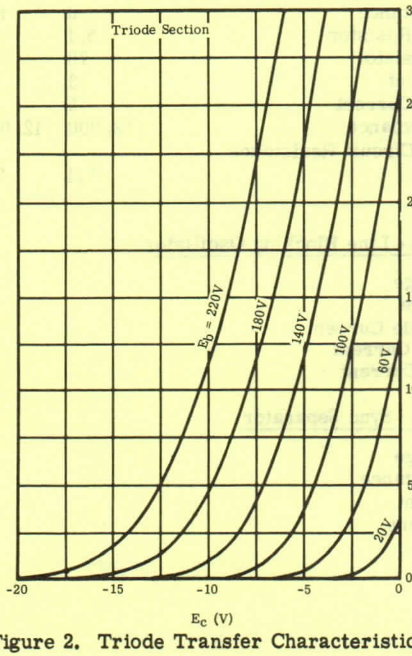


Figure 2. Triode Transfer Characteristics

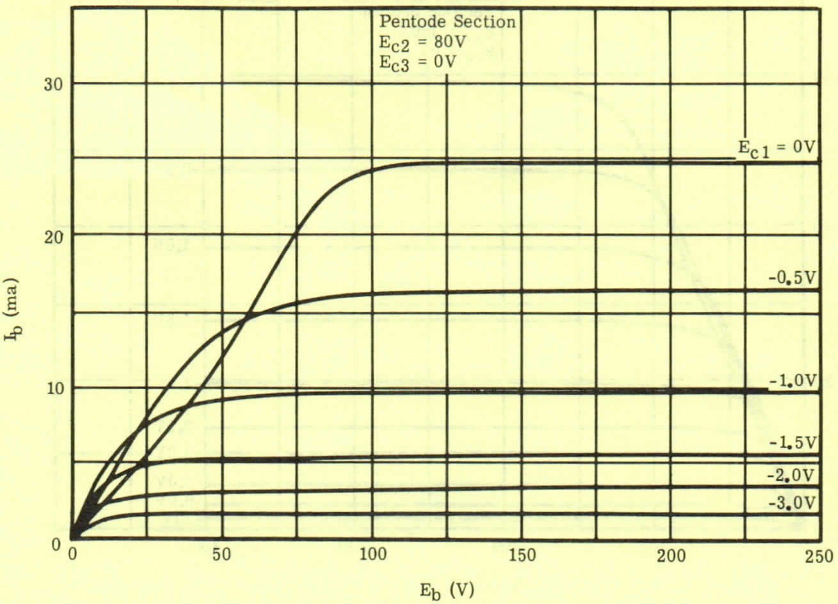


Figure 3. Pentode Plate Characteristics

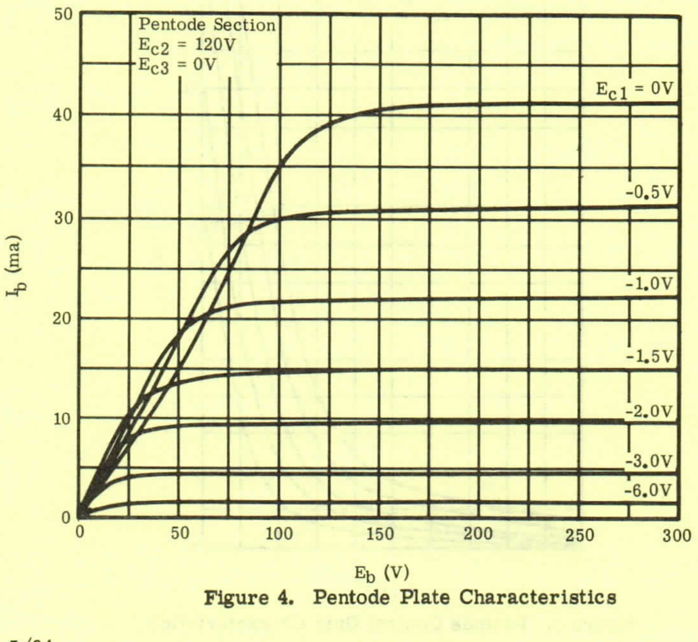


Figure 4. Pentode Plate Characteristics

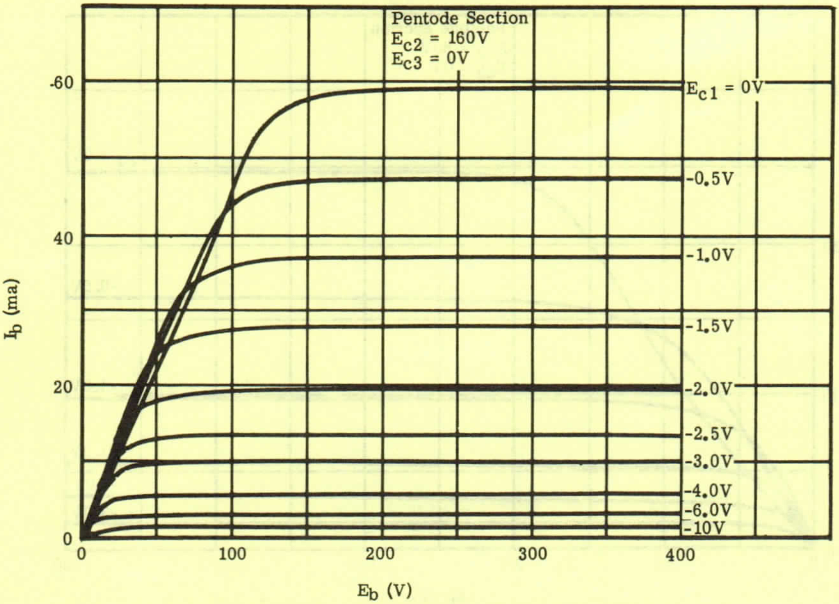


Figure 5. Pentode Plate Characteristics

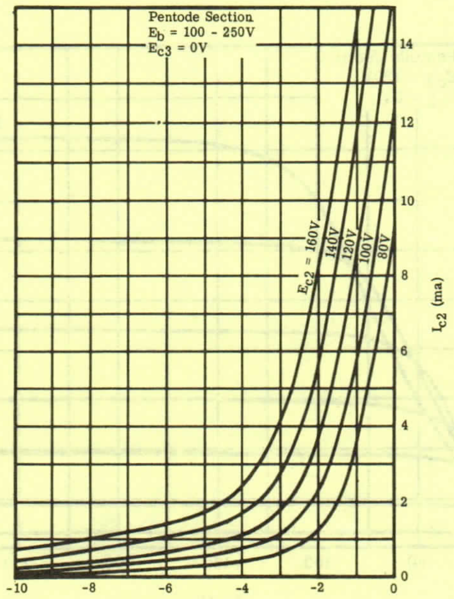


Figure 6. Pentode Control Grid Characteristics

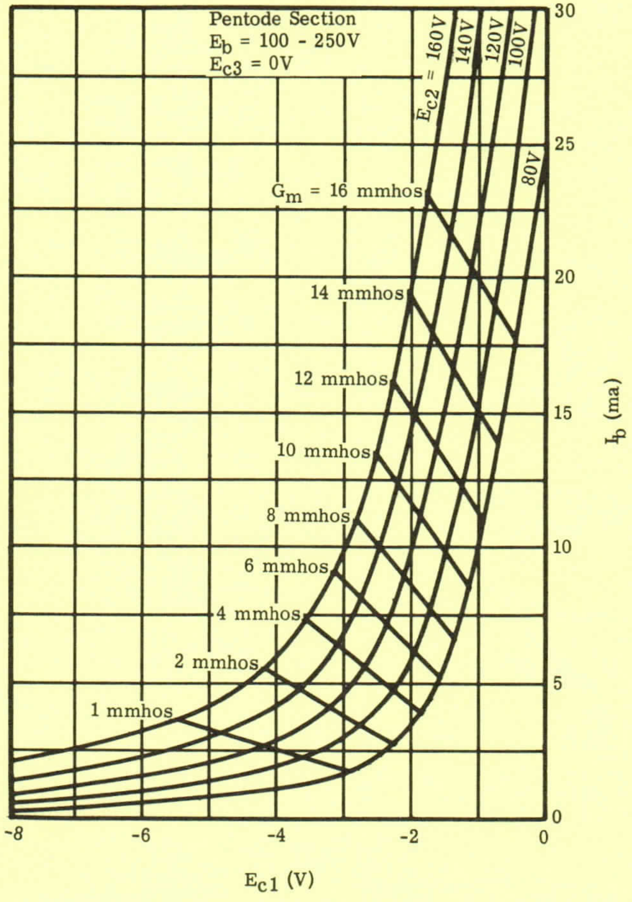
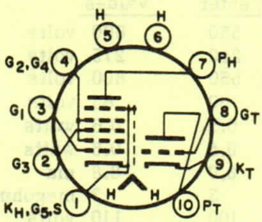


Figure 7. Pentode Average Characteristics

AMPEREX TUBE TYPES 5V9, 6V9, 9V9

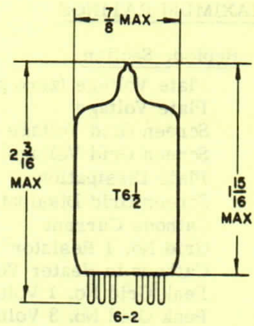
TENTATIVE DATA

The Amperex 5V9, 6V9 and 9V9 are triode-heptodes with Decal bases. They are designed for use in sync separator and sync amplifier stages of television receivers. Triode and heptode sections are separated. The triode can supply sufficient plate current to drive phase discriminator circuits. The heptode section is similar to that of the 6JX8.



PIN CONNECTIONS

1 - CATHODE, GRID NO. 5, SHIELD		HEPTODE SECTION
2 - GRID NO. 3		
3 - GRID NO. 1		
4 - GRID NO. 2, GRID NO. 4		
5 - HEATER		
6 - HEATER		
7 - PLATE, HEPTODE SECTION		
8 - GRID		TRIODE SECTION
9 CATHODE		
10 - PLATE		



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Decal

ELECTRICAL

Heater Supply	indirect, AC or DC series or parallel			
	5V9	6V9	9V9	
Heater Voltage	5.0	6.3	9.2	volts
Heater Current	450	435	300	ma

Direct Interelectrode Capacitances

Heptode Section

Grid No. 1 to All Other Elements (except plate)	4.3	pf
Plate to All Other Elements (except grid No. 1)	5.3	pf
Plate to Grid No. 1	<0.1	pf
Plate to Grid No. 3	<0.25	pf
Grid No. 1 to Grid No. 3	0.3	pf

5V9, 6V9, 9V9

Direct Interelectrode Capacitances (Cont.)

Triode Section

Grid to All Other Elements (except plate)	3.1 pf
Plate to All Other Elements (except grid)	1.7 pf
Plate to Grid	1.0 pf

Between Heptode and Triode Section

Grid No. 1 of Heptode to Grid of Triode	<5 mpf
Grid No. 1 of Heptode to Plate of Triode	<10 mpf
Grid No. 3 of Heptode to Plate of Triode	<20 mpf
Plate of Heptode to Plate of Triode	<150 mpf

MAXIMUM RATINGS

Heptode Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Screen Grid Voltage (zero grid current)	550	600	volts
Screen Grid Voltage[1]	50	65	volts
Plate Dissipation	0.5	0.6	watts
Screen Grid Dissipation	0.5	0.6	watts
Cathode Current	8.0	8.8	ma
Grid No. 1 Resistor[3]	3	3	megohms
Cathode to Heater Voltage	100	110	volts
Peak Grid No. 1 Voltage	-100	-110	volts
Peak Grid No. 3 Voltage	-150	-165	volts

Triode Section

Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Plate Dissipation	1.5	1.75	watts
Cathode Current	20	22	ma
Grid Resistor[3]	2	2	megohms
Peak Grid Voltage	-200	-220	volts
Cathode to Heater Voltage (9V9) Cathode Positive	70+100V RMS	77+110V RMS	
Cathode to Heater Voltage (6V9)	100	110	volts

TYPICAL CHARACTERISTICS

Heptode Section

Plate Voltage	14	14	14	14	14	volts
Screen Grid Voltage	14	14	14	14	14	volts
Plate Current	1500	20	20	20	20	μa
Screen Grid Current	1300	--	--	--	--	μa
Grid No. 1 Current	--	--	--	--	100	μa
Grid No. 1 Voltage	0	-1.8	0	-2	--	volts
Grid No. 3 Voltage	0	0	-1.8 (<22)	+25	-1.9 (<2.3)	volts

[1] The minimum screen grid voltage is 6 volts under absolute values conditions.
[2] Only for sync separator circuits.
[3] In circuits with cathode biasing, R_g = 3 megohms max.

OPERATING CHARACTERISTICS AS SYNC SEPARATOR

Heptode Section

Screen Grid Voltage		14	volts
Grid No. 1 Current		100	μa
Grid No. 3 Current		1	μa
Plate Voltage	14	1	volts
Plate Current	750	300	μa

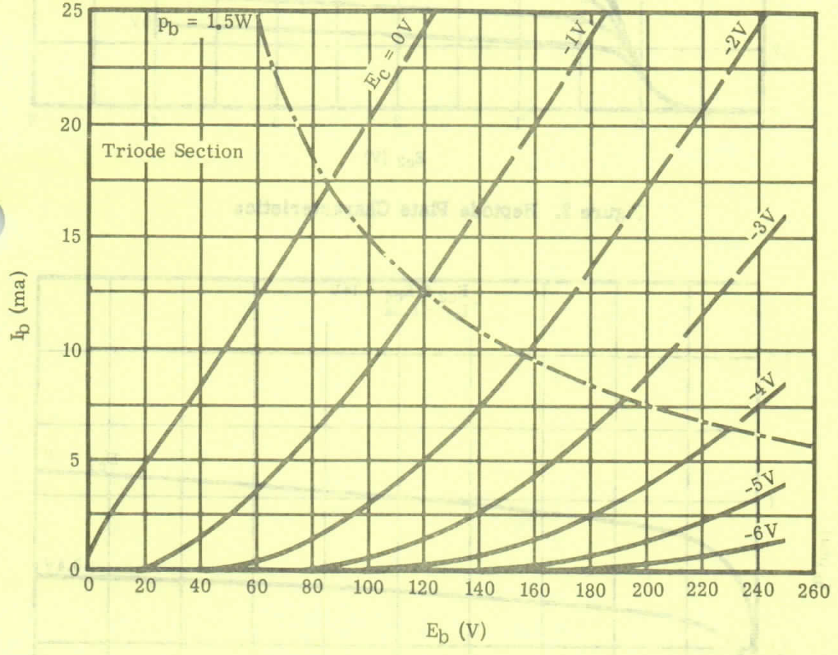


Figure 1. Triode Plate Characteristics

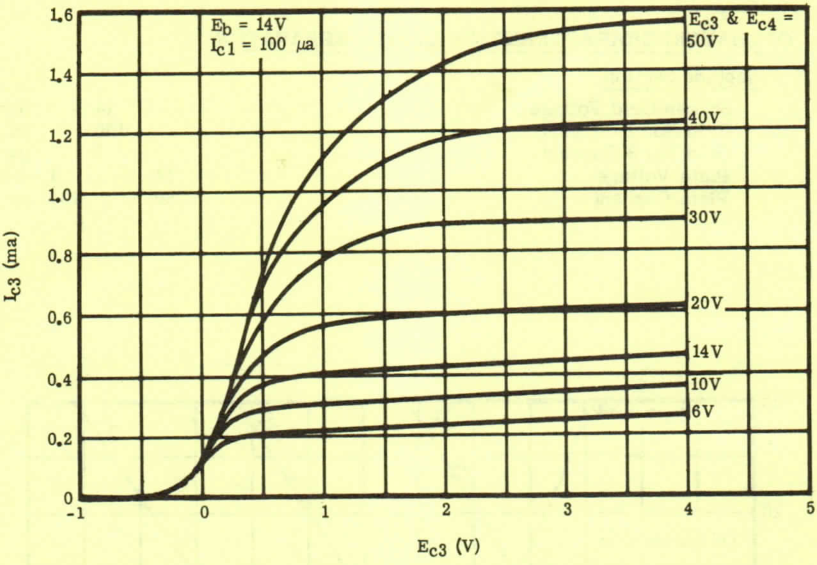


Figure 2. Heptode Plate Characteristics

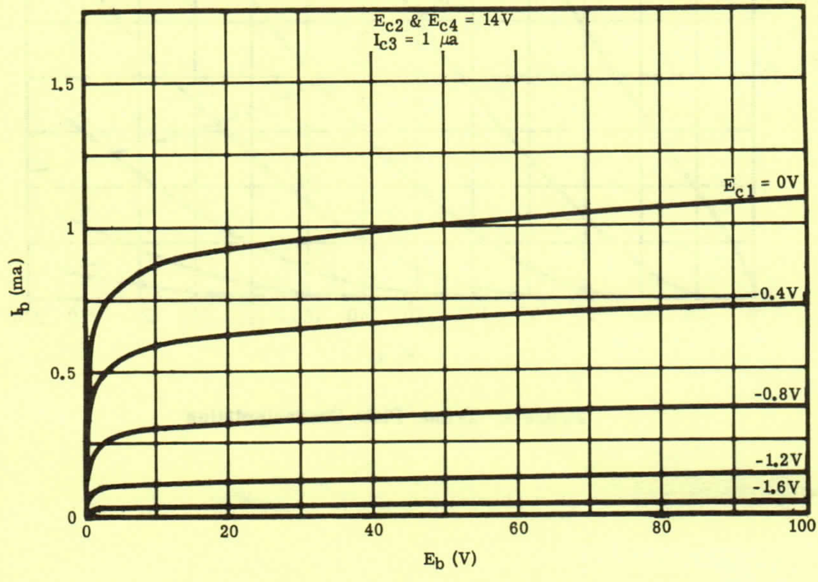


Figure 3. Heptode Plate Characteristics

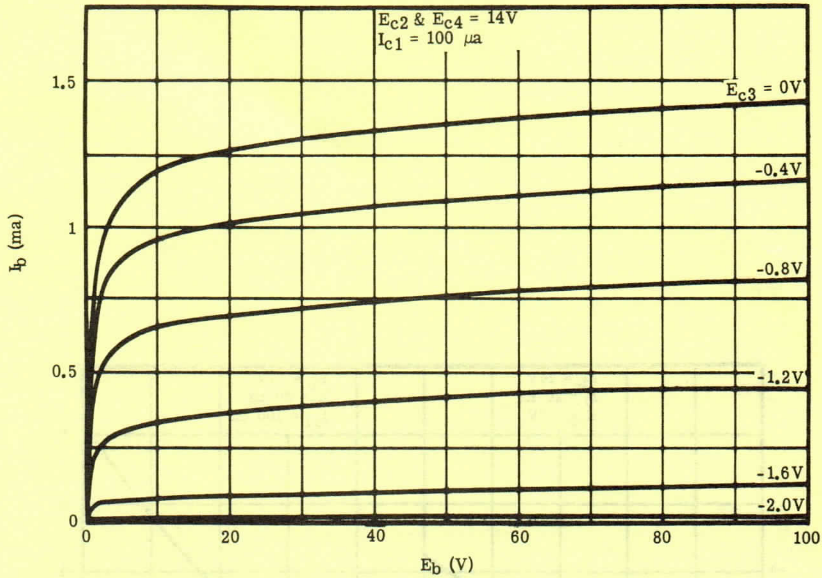


Figure 4. Heptode Grid No. 3 Characteristics

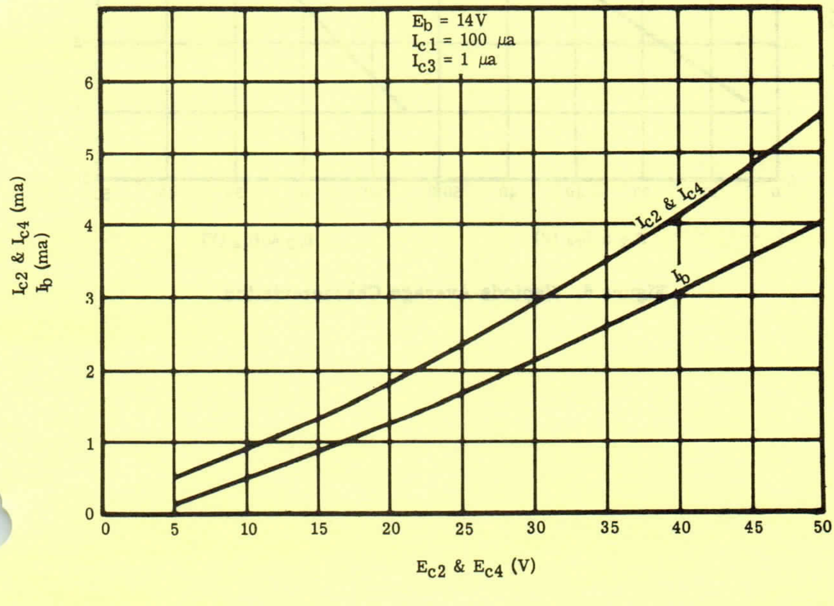


Figure 5. Heptode Average Characteristics

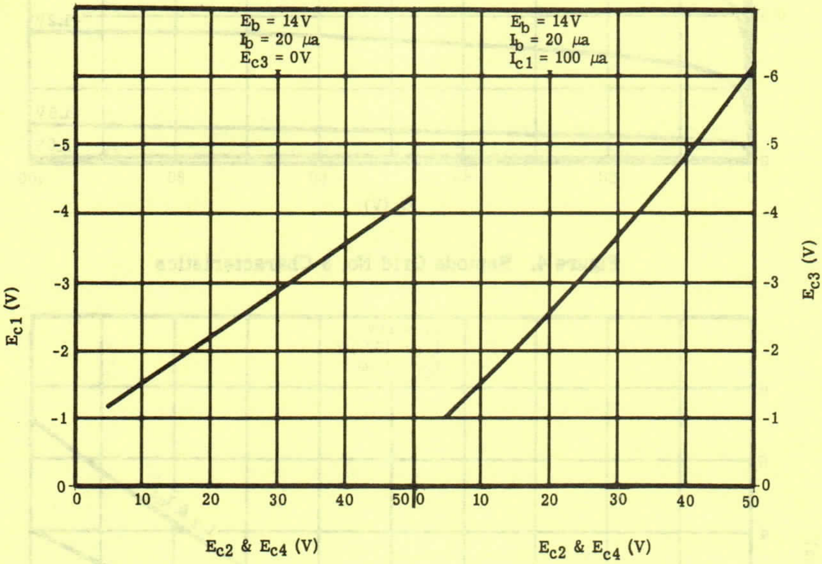


Figure 6. Heptode Average Characteristics

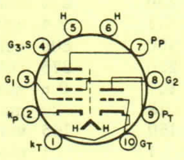
AMPEREX TUBE TYPES 5X9, 6X9, 8X9

TENTATIVE DATA

The Amperex 5X9, 6X9 and 8X9 are triode-pentodes with Decal bases. They are designed for use in television receivers. Some of the applications in which these tubes may be used are shown below.

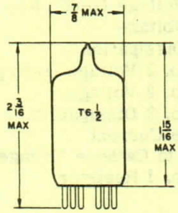
Pentode Section		Triode Section
Sound IF Amplifier	+	Sound IF Amplifier
Video IF Amplifier	+	Noise Detector
Video IF Amplifier	+	AGC Amplifier
Video IF Amplifier	+	Sync Separator
Video IF Amplifier	+	Pulse Amplifier

The pentode section is of frame grid construction and is similar in performance to type 6EJ7.



PIN CONNECTIONS

1 - CATHODE, TRIODE SECTION
2 - CATHODE
3 - GRID NO. 1
4 - GRID NO. 3 SHIELD
(pins 2–4: PENTODE SECTION)
5 - HEATER
6 - HEATER
7 - PLATE
8 - GRID NO. 2
(pins 7–8: PENTODE SECTION)
9 - PLATE
10 - GRID
(pins 9–10: TRIODE SECTION)



6-2

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Decal

ELECTRICAL

Heater Supply	indirect, AC or DC series or parallel			
	5X9	6X9	8X9	
Heater Voltage	5.9	6.3	8.0	volts
Heater Current	450	410	300	ma

Direct Interelectrode Capacitances (without external shield)

Pentode Section

Plate to All Other Elements (except grid No. 1)	3.5 pf
Grid No. 1 to All Other Elements (except plate)	6.5 pf
Grid No. 1 to Cathode	4.0 pf
Plate to Grid No. 1	<6.5 mpf
Grid No. 1 to Grid No. 2	1.8 pf

Triode Section

Plate to All Other Elements (except grid)	3.0 pf
Grid to All Other Elements (except plate)	2.5 pf
Plate to Grid	2.0 pf

Between Pentode and Triode Section

Plate of Pentode to Plate of Triode	<15 mpf
Control Grid of Pentode to Plate of Triode	<1.2 mpf
Control Grid of Pentode to Grid of Triode	<1.5 mpf

MAXIMUM RATINGS

Pentode Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Plate Dissipation	2.1	2.4	watts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Grid No. 2 Dissipation	0.7	0.8	watts
Cathode Current	18	20	ma
Heater to Cathode Voltage	150	165	volts
Grid No. 1 Resistor	1	1	megohm

Triode Section

Peak Plate Voltage (I_b = 0.1 ma)[1]	600	660	volts
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Plate Dissipation	1.5	1.75	watts
Cathode Current	18	20	ma
Grid Resistor	1	1	megohm
Heater to Cathode Voltage			
Cathode Negative (6X9, 8X9)	150	165	volts
Cathode Positive (6X9, 8X9)	200+150V RMS	220+165V RMS	
Cathode Negative (5X9)	100	110	volts
Cathode Positive (5X9)	200+100V RMS	220+110V RMS	

[1] T_{max} = 18 μsec.; 18% of one cycle.

TYPICAL CHARACTERISTICS

Pentode Section

Plate Voltage	160	volts
Grid No. 2 Voltage	135	volts
Grid No. 1 Voltage	-1.7	volts
Grid No. 3 Voltage	0	volts
Plate Current	13	ma
Grid No. 2 Current	5	ma
Transconductance	14,000	μmhos
Amplification Factor (Grid No. 1 to Grid No. 2)	55	

Triode Section

Plate Voltage	170	volts
Grid Voltage	-1.0	volts
Plate Current	8.5	ma
Transconductance	4800	μmhos
Amplification Factor	55	

TYPICAL OPERATING CHARACTERISTICS

Pentode Section - Sound or Video Amplifier

Supply Voltage	135	230	250	volts
Grid No. 3 Voltage	0	0	0	volts
Plate Resistance	0	5.6	6.8	k ohms
Grid No. 2 Resistor	0	18	22	k ohms
Cathode Resistor	95	100	100	ohms
Plate Current	13	13.3	13.3	ma
Grid No. 2 Current	4.8	4.9	4.9	ma
Transconductance	14,000	14,000	14,000	μmhos
Grid No. 1 Resistance (40 Mc)	6.6	6.6	6.6	k ohms

Triode Section - Sync Separator

Plate Voltage	130-150	volts
Plate Resistance	33	k ohms
Grid No. 1 Current	1	μa
Plate Current	>2	ma

5X9, 6X9, 8X9

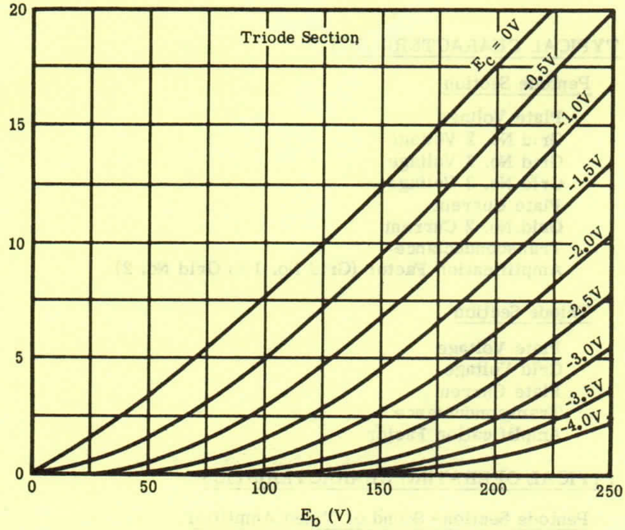


Figure 1. Triode Plate Characteristics

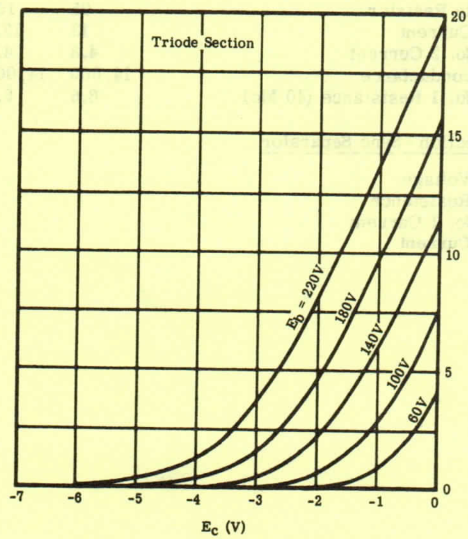


Figure 2. Triode Transfer Characteristics

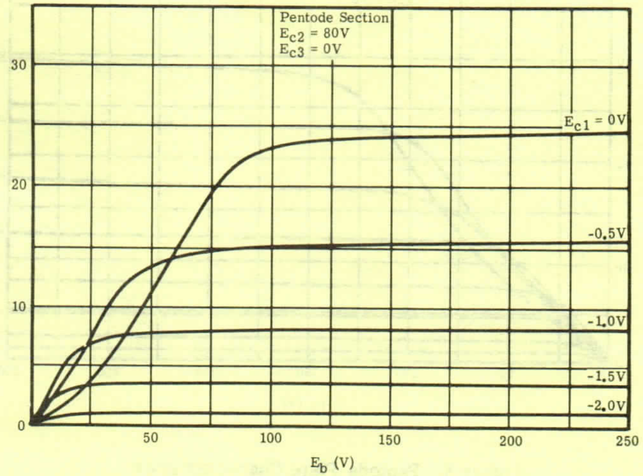


Figure 3. Pentode Plate Characteristics

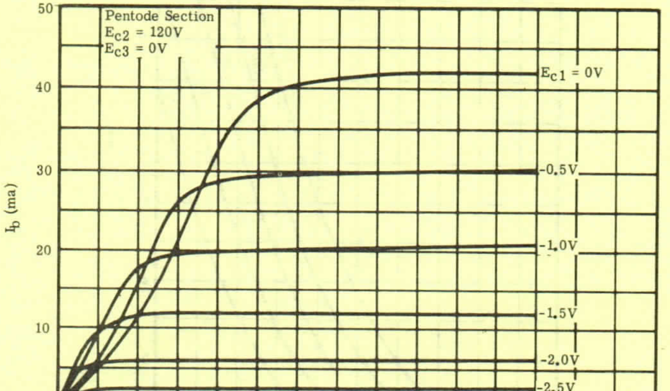


Figure 4. Pentode Plate Characteristics

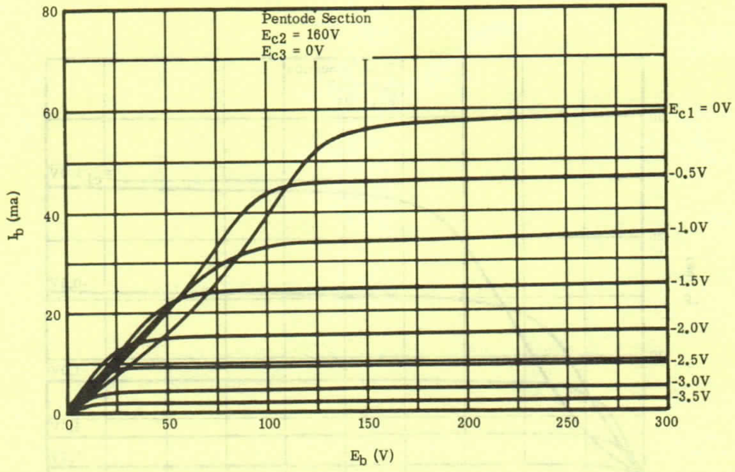


Figure 5. Pentode Plate Characteristics

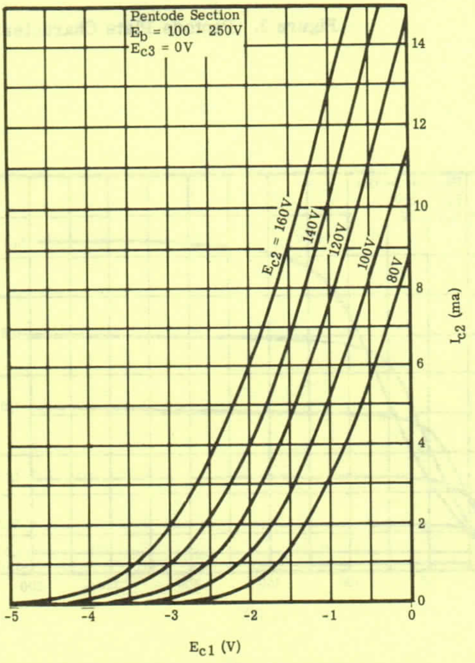


Figure 6. Pentode Transfer Characteristics

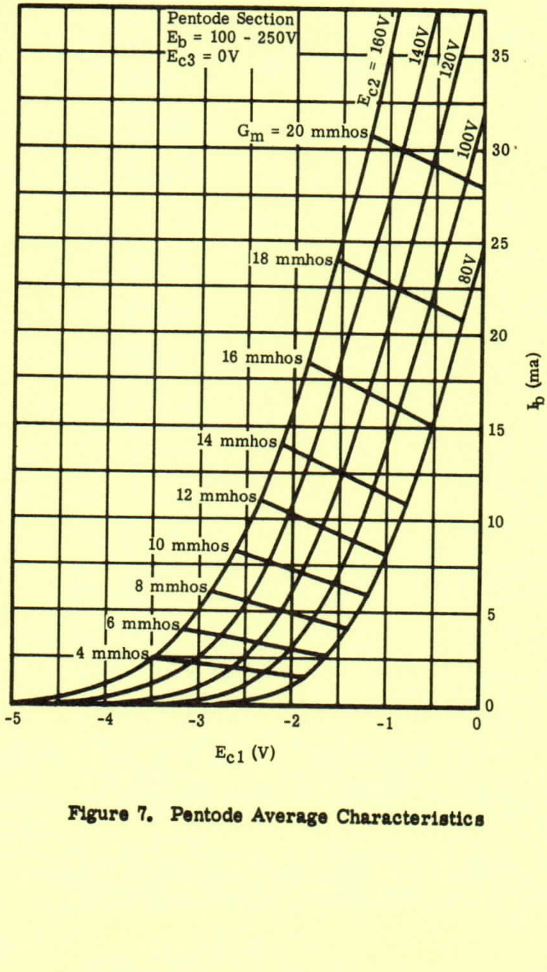
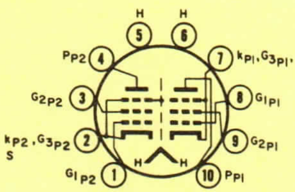


Figure 7. Pentode Average Characteristics

AMPEREX TUBE TYPE 6AF9

TENTATIVE DATA

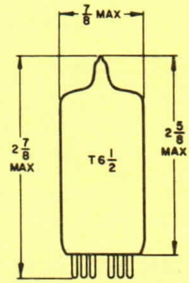
The Amperex 6AF9 is a dual-pentode tube with a Decal base designed for use in television receivers: Pentode No. 1 as a video output pentode and Pentode No. 2 as a sound IF amplifier, AGC amplifier or sync separator. The extremely low capacitances between sections prevent interference and make it possible to use both sections as a cascade amplifier.



PIN CONNECTIONS

1- GRID NO.1
2- CATHODE, GRID NO.3 SHIELD
3- GRID NO.2
4- PLATE
5- HEATER
6- HEATER
7- CATHODE, GRID NO.3
8- GRID NO.1
9- GRID NO.2
10- PLATE

(Pins 1–4: PENTODE NO.2 SECTION; pins 7–10: PENTODE NO.1 SECTION)



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Decal

ELECTRICAL

Heater Supply	indirect, AC or DC series or parallel
Heater Voltage	6.3 volts
Heater Current	850 ma

6AF9

Direct Interelectrode Capacitances (without external shield)

Pentode No. 1

Plate to All Other Elements (except grid No. 1)	7 pf
Grid No. 1 to All Other Elements (except plate)	12 pf
Plate to Grid No. 1	105 mpf

Pentode No. 2

Plate to All Other Elements (except grid No. 1)	11 pf
Grid No. 1 to All Other Elements (except plate)	10 pf
Plate to Grid No. 1	140 mpf
Grid No. 1 to Heater	<100 mpf

Between Pentode No. 1 and Pentode No. 2

Plate to Plate	<150 mpf
Grid to Grid	<10 mpf
Plate of Pentode No. 1 to Control Grid of Pentode No. 2	<100 mpf
Plate of Pentode No. 2 to Control Grid of Pentode No. 1	<5 mpf

MAXIMUM RATINGS

Pentode No. 1 Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Plate Dissipation	5.1	5.8	watts
Grid No. 2 Dissipation	2.5[1]	2.9[3]	watts
Cathode Current	60[2]	66[4]	ma
Grid No. 1 Resistance	1	1	megohms
Heater to Cathode Voltage	200	220	volts

Pentode No. 2 Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Plate Dissipation	1.5	1.75	watts
Grid No. 2 Dissipation	0.5	0.6	watts
Cathode Current	15	16.5	ma
Grid No. 1 Resistance	1	1	megohms
Heater to Cathode Voltage	200	200	volts

---

[1] For short periods, screen dissipation = 3.2 watts (max.).
[2] For short periods, cathode current = 85 ma (max.).
[3] For short periods, screen dissipation = 3.5 watts (max.).
[4] For short periods, cathode current = 93 ma (max.).

TYPICAL CHARACTERISTICS

	Pentode No. 1	Pentode No. 2	
Plate Voltage	170	150	volts
Grid No. 2 Voltage	170	150	volts
Grid No. 1 Voltage	-2.6	-2.1	volts
Plate Current	30	10	ma
Grid No. 2 Current	7.2	3.0	ma
Transconductance	22,000	8500	µmhos
Amplification Factor (grid No. 1 to grid No. 2)	38	38	
Internal Resistance	32	160	k ohms

TYPICAL OPERATING CHARACTERISTICS

Pentode No. 1 - Video Output (Figure 1)

Supply Voltage	135		230	250	250	volts
Supply Series Resistor (RV)[5]	0		820	1200	0	ohms
Voltage at $E_{bb'}$	--		190	190	0	volts
Plate Resistance	2.2	4.7	2	3.9	3.3	k ohms
Grid No. 2 Resistor	0	0	1	1	3.9	k ohms
Cathode Resistor	6.8	6.8	6.8	6.8	15	ohms
Peak to Peak Input Signal	2.5	1.4	3.6	1.8	5.5	volts
Peak to Peak Output Signal	90	90	100	100	160	volts

Pentode No. 2 - Sync Separator

Supply Voltage	100-140	200-250	volts
Plate Resistance	50	50	k ohms
Grid No. 2 Voltage	75	75	volts
Grid No. 1 Resistor	1	1	megohm
Grid No. 1 Voltage	-2.6	-2.7	volts
Plate Current	0.1	0.1	ma
Transconductance	250	200	µmhos

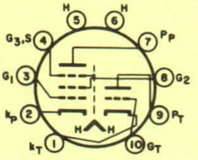
Pentode No. 2

	AGC Amplifier	IF Amplifier		
Plate Voltage	100-150	135	150	volts
Grid No. 2 Voltage	60	135	150	volts
Grid No. 1 Voltage	-1.5	-1.7	-2.1	volts
Plate Current	1.0	10	10	ma
Transconductance	2000	8700	8700	µmhos

[5] RV given to avoid excessive plate dissipation.

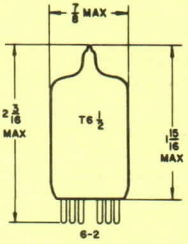
AMPEREX TUBE TYPE 6AJ9

The 6AJ9 is a triode-pentode with Decal base, designed for use in television receivers: Triode section for use as amplifier for color difference signals and Pentode section for use as video IF or sub-carrier amplifier.



PIN CONNECTIONS

1-CATHODE, TRIODE SECTION
2-CATHODE | PENTODE SECTION
3-GRID NO. 1 | PENTODE SECTION
4-GRID NO. 3 SHIELD | PENTODE SECTION
5-HEATER
6-HEATER
7-PLATE | PENTODE SECTION
8-GRID NO. 2 | PENTODE SECTION
9-PLATE | TRIODE SECTION
10-GRID | TRIODE SECTION



GENERAL CHARACTERISTICS

Mechanical

Dimensions	see outline drawing
Maximum overall length	2-3/16 inches
Maximum seated length	1-15/16 inches
Maximum diameter	7/8 inch
Bulb	T-6-1/2
Base	Decal
Basing diagram	10K

Electrical

Heating	indirect AC or DC, parallel supply
Heater Voltage	6.3 volts
Heater Current	410 ma

Direct Interelectrode Capacitances (without external shield)

Pentode Section	
Plate to all other elements (except Grid No.1)	3.3 pf
Grid No. 1 to all other elements (except plate)	6.1 pf
Grid No. 1 to cathode	3.7 pf
Plate to grid No. 1	≤ 5 mpf
Grid No. 1 to grid No. 2	1.75 pf

Triode Section	
Plate to all other elements (except grid)	3.3 pf
Grid to all other elements (except Plate)	3.0 pf
Plate to grid	1.8 pf

Between Pentode and Triode Section	
Plate of pentode to plate of triode	< 15 mpf
Control grid of pentode to plate of triode	< 1.2 mpf
Control grid of pentode to grid of triode	< 1.5 mpf

6AJ9

Maximum Ratings

Pentode Section

	Design Center	Design Max.	
Plate voltage (zero plate current)	550	--	volts
Plate voltage	250	--	volts
Plate dissipation	2.1	2.4	watts
Grid No. 2 supply voltage (zero grid current)	550	--	volts
Grid No. 2 voltage	250	--	volts
Grid No. 2 dissipation	0.7	0.8	watts
Cathode current	18	--	ma
Heater to cathode voltage	150	--	volts
Grid No. 1 Resistor	1	--	Megohms

Triode Section

	Design Center	Design Max.	
Plate voltage (zero plate current)	550	--	volts
Plate voltage	400	--	volts
Plate dissipation	1.5	1.9	watts
Cathode current	15	--	ma
Grid resistor	3	--	Megohms
Peak negative grid voltage	100	--	volts
Heater cathode voltage	150	--	volts

Typical Characteristics

Pentode Section

Plate voltage	160	volts
Grid No. 2 voltage	135	volts
Grid No. 1 voltage	-1.7	volts
Grid No. 3 voltage	0	volts
Plate current	13	ma
Grid No. 2 current	5	ma
Transconductance	14,000	μmhos
Amplification Factor (Grid No. 1 to Grid No. 2)	50	

Triode Section

Plate voltage	100	volts
Grid voltage	-1	volt
Plate current	6.5	ma
Transconductance	10,000	μmhos
Amplification Factor	58	
Grid voltage for V_a = 200V and I_a = 100 μA[1]	-5	volts

[1] $V_g = -11\ V_{max}$

Typical Operating Characteristics

Pentode Section - IF Amplifier

	Design Center	Design Max.	
Supply voltage	210	230	volts
Grid No. 3 voltage	0	0	volts
Plate Resistance	3.9	5.6	k ohms
Grid No. 2 resistor	15	22	k ohms
Cathode resistor	96	90	ohms
Plate current	13	12.5	ma
Grid No. 2 current	5	4.8	ma
Transconductance	14,000	14,000	μmhos
Grid No. 1 Resistance (40MHz)[2]	6.6	6.6	k ohms

Triode Section - Color Difference Amplifier

Plate voltage	150	volts
Grid voltage[3]	-2	volts
Plate current	6	ma
Transconductance	9,000	μmhos
Amplification factor	57	

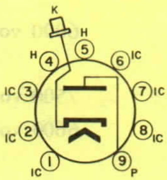
---

[2] with conventional tube socket

[3] corresponding with R_k = 330 ohms

AMPEREX TUBE TYPE 6AL3

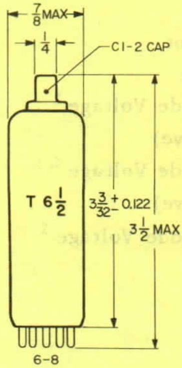
The Amperex 6AL3/EY88 is a damper diode designed for use in television receiver horizontal sweep circuits.



PIN CONNECTIONS

1. INTERNALLY CONNECTED
2. INTERNALLY CONNECTED
3. INTERNALLY CONNECTED
4. HEATER
5. HEATER
6. INTERNALLY CONNECTED
7. INTERNALLY CONNECTED
8. INTERNALLY CONNECTED
9. PLATE

CAP-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6½
Base	Noval
Outline	6 - 8

ELECTRICAL

Heating	parallel supply
Voltage	6.3 volts
Current	1.55 amps

Direct Interelectrode Capacitances

Plate to All Other Elements	8.6 pf
Cathode to Heater	2.0 pf

6AL3

Maximum Ratings, Design Center Values

Plate Voltage, Cut-Off Condition	550 volts max
Plate Voltage	250 volts max
Plate Current	220 mA max
Peak Plate Current	550 mA max
Plate Dissipation	5 watts max
Peak Plate-Cathode Voltage [1] (Cathode Positive)	6000 volts max
Peak Plate-Cathode Voltage [1, 2] (Cathode Positive)	7500 volts max
Peak Heater-Cathode Voltage [1]	6600 volts max

1 Maximum Pulse duration 22% of a cycle with a maximum of 18 μsec.

2 Absolute Maximum.

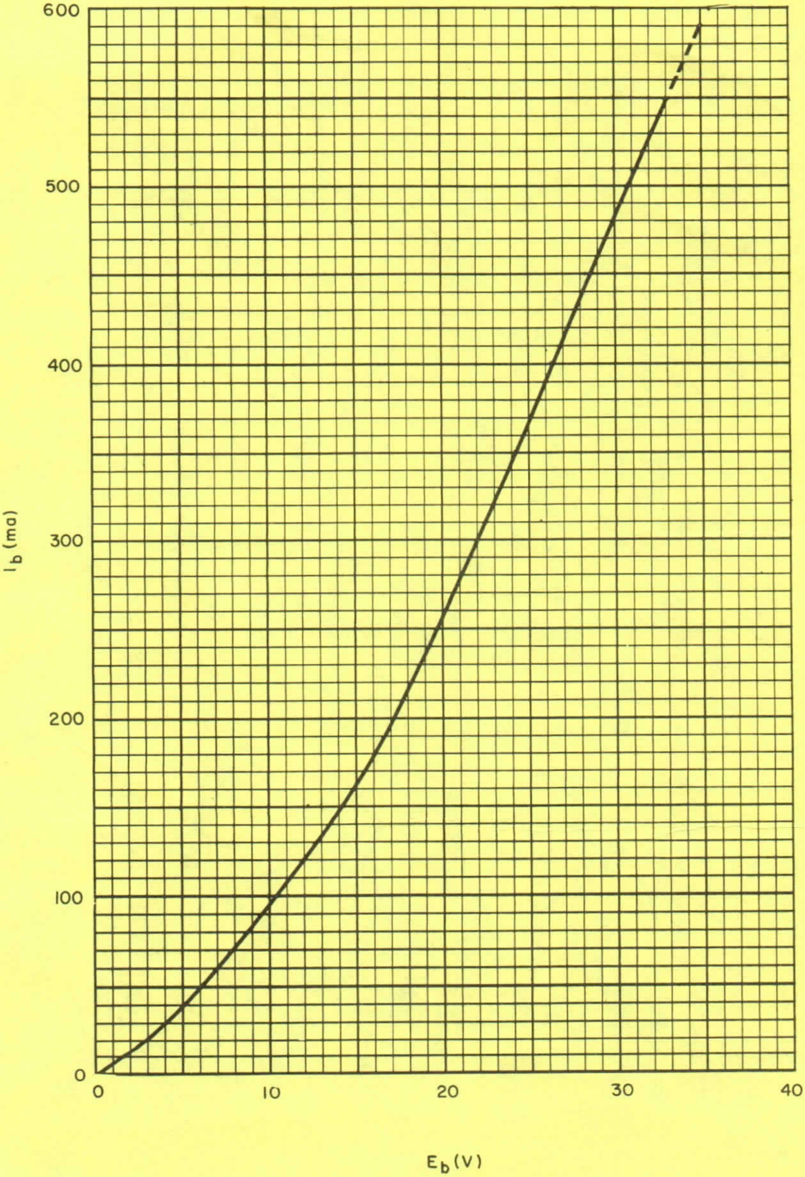
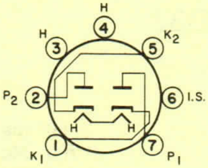


FIGURE 1- PLATE CHARACTERISTICS

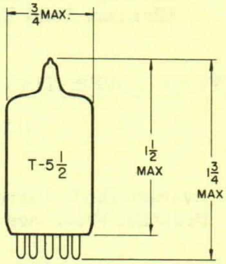
AMPEREX TUBE TYPE 6AL5

The Amperex 6AL5 combines two independent diode units in the 7 pin miniature construction. Its high perveance permits high efficiency in either FM or AM detector service.



PIN CONNECTIONS

1– CATHODE NO. 1
2– PLATE NO. 2
3– HEATER
4– HEATER
5– CATHODE NO. 2
6– INTERNAL SHIELD
7– PLATE NO. 1



5-1

GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5-1/2
Base	E 7-1
Outline	5-1
Basing Diagram	6 BT
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heater Characteristics	
Heater Arrangement	AC or DC parallel supply
Heater Voltage	6.3 ± 10% volts
Heater Current	0.3 amp

Direct Interelectrode Capacitances

	Without Shield	With Shield[1]	
Plate Input: Plate to Heater, Cathode and Internal Shield (each unit)	2.5	3.2	pf
Coupling: No. 1 Plate to No. 2 Plate (max.)	0.068	0.026	pf
Cathode Input: Cathode to Plate, Heater and Internal Shield (each unit)	3.4	3.6	pf

[1] External shield No. 316 connected to pin No. 6.

MAXIMUM RATINGS (DESIGN CENTER)

Peak Heater to Cathode Voltage:		
Heater Negative with Respect to Cathode[2]	330	volts
Heater Positive with Respect to Cathode[3]	200	volts
Peak Inverse Voltage	330	volts
AC Plate Voltage (each plate) RMS	117	volts
Steady State Peak Plate Current (each plate)	54	ma
DC Output Current (each plate)	9	ma
Minimum Total Effective Plate Supply Impedance (each plate)	300	ohms

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

HALF-WAVE RECTIFIER

Average Diode Current (each unit) at 10 volts DC	60	ma
Resonant Frequency of Each Unit (approx.)	700	Mc

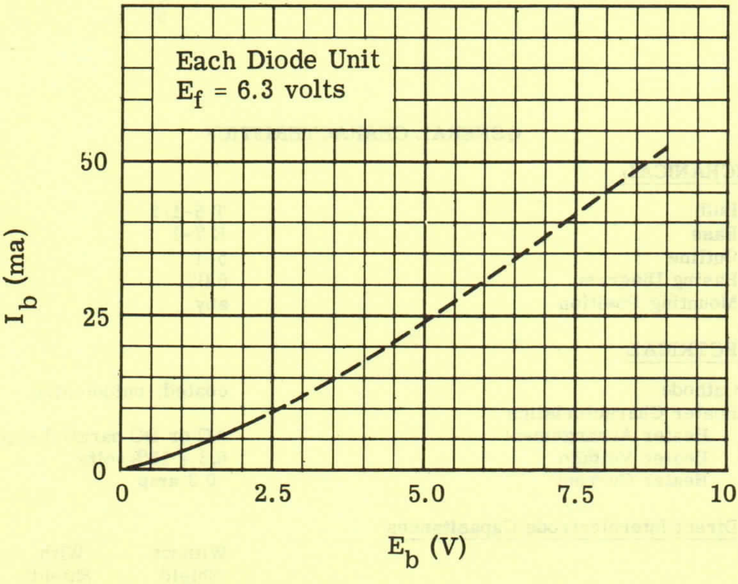


Figure 1. Typical Plate Characteristics

[2] DC component must not exceed 330 volts.
[3] DC component must not exceed 100 volts.

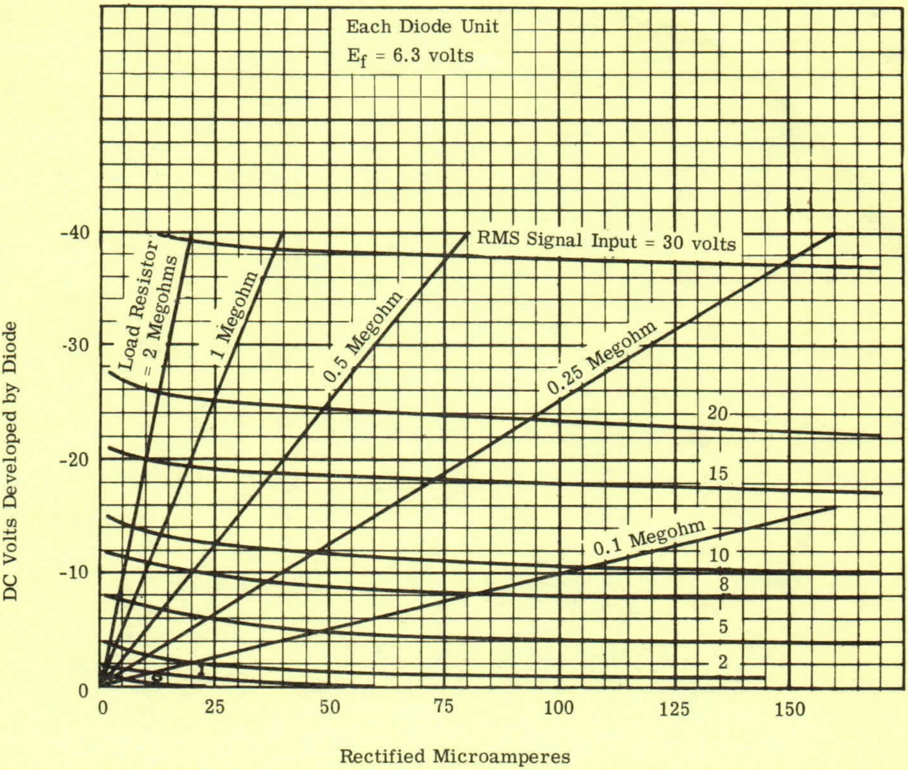


Figure 2. Rectification Characteristics

AMPERLEX TUBE TYPE 6AQ8/ECC85

The 6AQ8/ECC85 is a miniature high mu, high transconductance twin triode designed for application in AM and FM receivers as an RF amplifier in grounded-grid or grounded-cathode connection and as a self-oscillating frequency converter or cascode amplifier. In TV service it can be used as an oscillator-mixer up to 220 Mc.

An internal shield separates both triode sections which reduces oscillator radiation from the antenna of the receiver to values considerably less than with twin triodes previously available.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	oxide coated, unipotential	
Heater Voltage (AC or DC)	6.3	volts
Heater Current	0.435	amps

Direct Interelectrode Capacitances

	Section 1	Section 2	
Grid to Plate	1.5	1.5	$\mu\mu f$
Cathode to Plate	0.18	0.18	$\mu\mu f$
Input	3.0	3.0	$\mu\mu f$
Output - without external shield	1.2	1.2	$\mu\mu f$
Output - with external shield	1.9	1.9	$\mu\mu f$

Plate to Plate - without external shield	0.04 $\mu\mu f$ max.
Plate to Plate - with external shield*	0.008 $\mu\mu f$ max.
Grid to Grid	0.003 $\mu\mu f$ max.
Plate T_1 to Grid T_2	0.008 $\mu\mu f$ max.
Plate T_2 to Grid T_1	0.008 $\mu\mu f$ max.
Plate T_1 to Cathode T_2	0.008 $\mu\mu f$ max.
Plate T_2 to Cathode T_1	0.008 $\mu\mu f$ max.
Grid T_1 to Cathode T_2	0.003 $\mu\mu f$ max.
Grid T_2 to Cathode T_1	0.003 $\mu\mu f$ max.

Typical Characteristics - each section

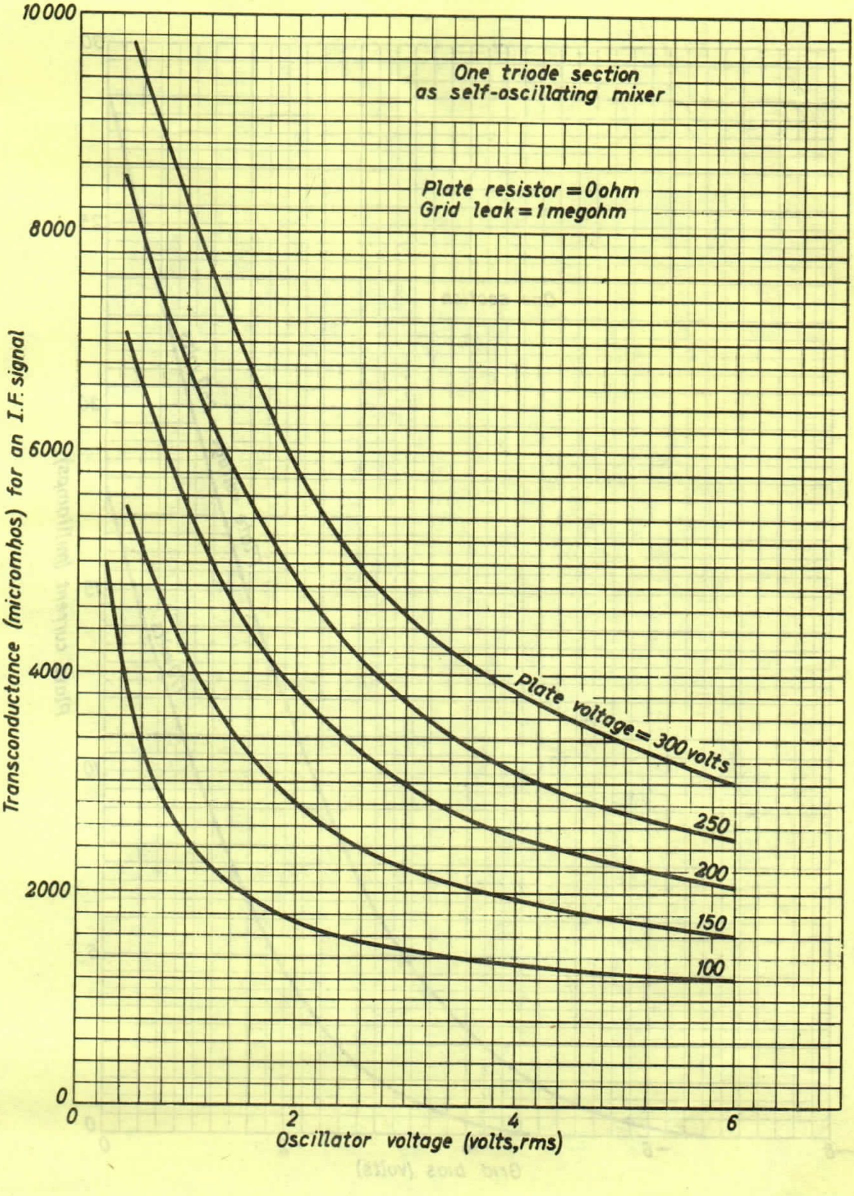
D.C. Plate Voltage	250	volts
D.C. Grid Bias	−2.3	volts
D.C. Plate Current	10	mA
Transconductance	5900	micromhos
Amplification Factor	57	

MECHANICAL

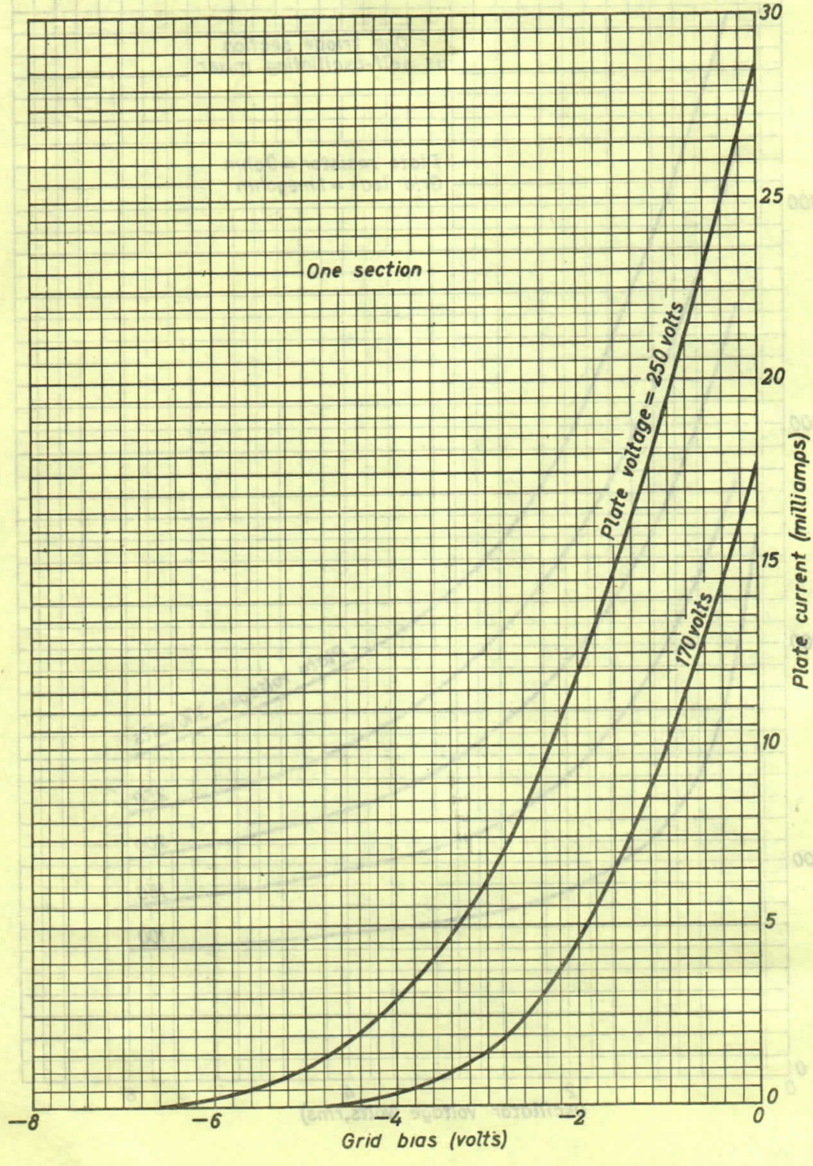
Mounting Position	any
Envelope	T 6½
Base	9 pin, B9A

* Shield can diameter = 0.886 inches

FEB. 1957

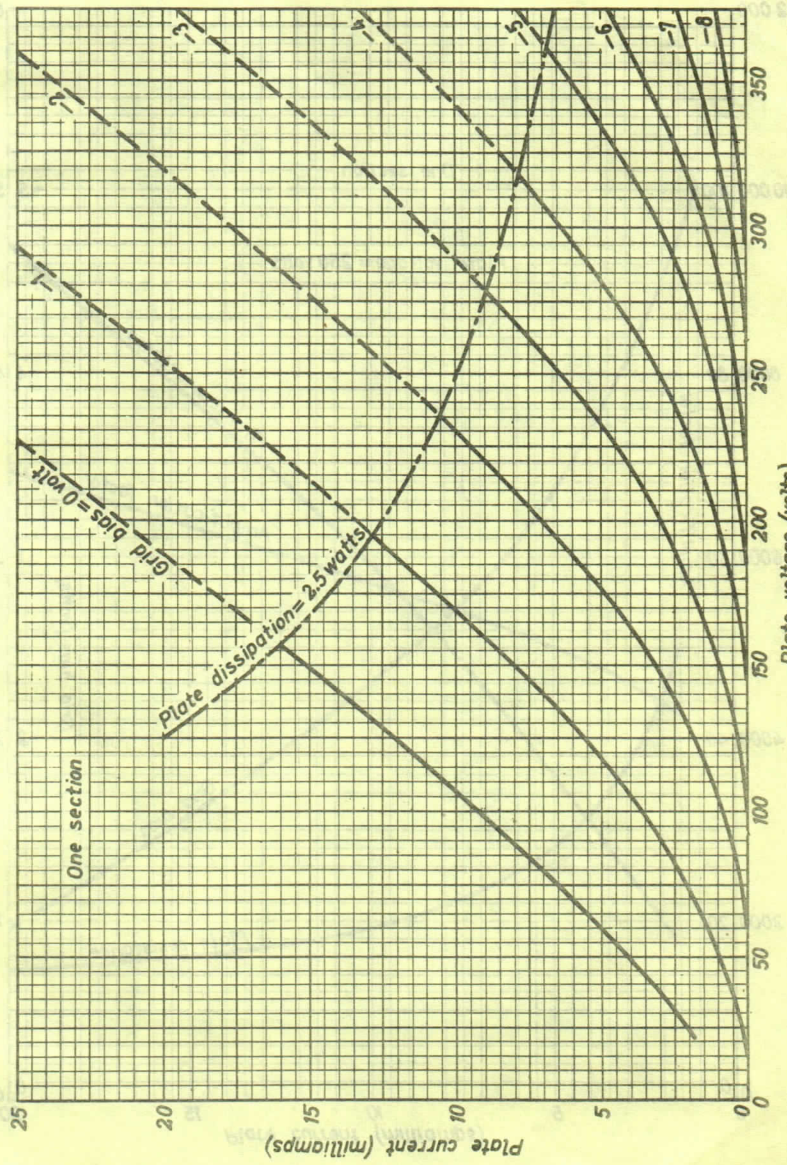

10000
8000
6000
4000
2000
0
Transconductance (micromhos) for an I.F. signal
One triode section
as self-oscillating mixer
Plate resistor = 0 ohm
Grid leak = 1 megohm
Plate voltage = 300 volts
250
200
150
100
0
2
4
6
Oscillator voltage (volts, rms)

6AQ8/ECC85

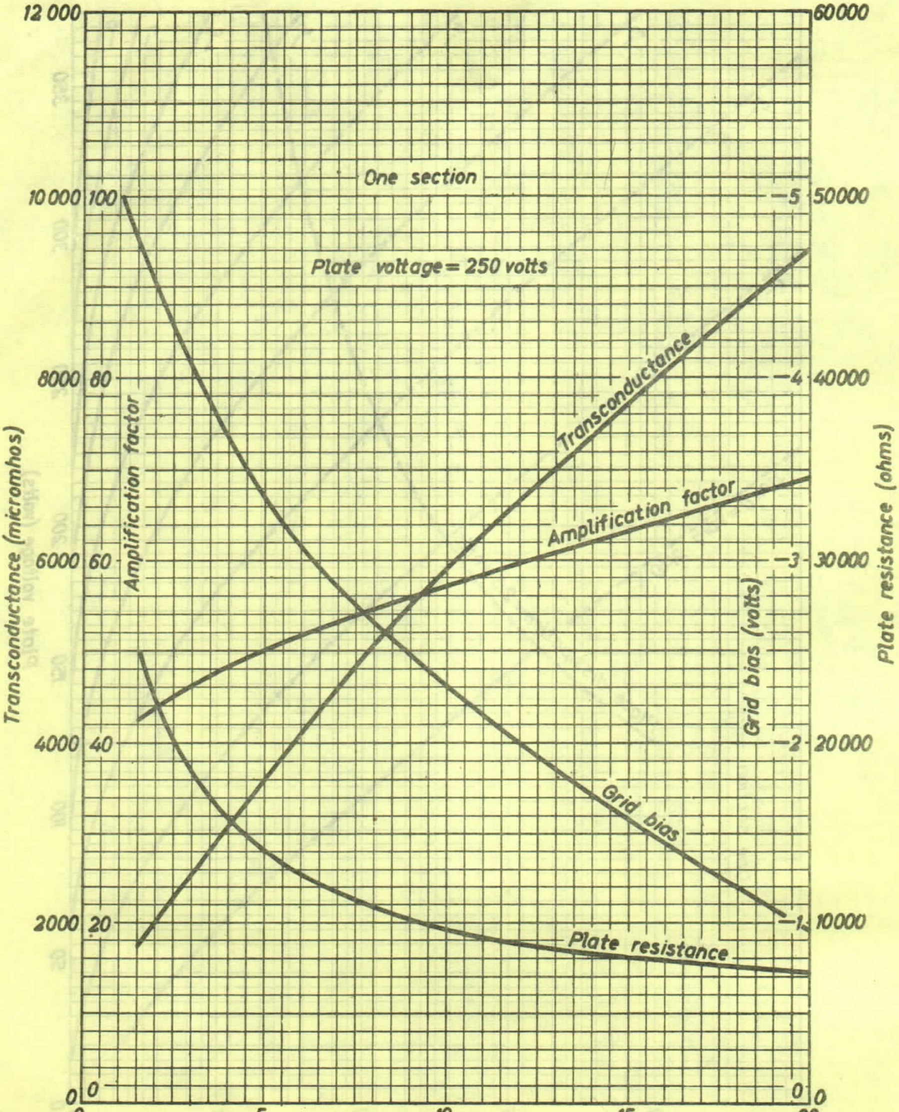


One section
Plate voltage = 250 volts
170 volts
Plate current (milliamps)
30
25
20
15
10
5
0
−8
−6
−4
−2
0
Grid bias (volts)

6AQ8/ECC85

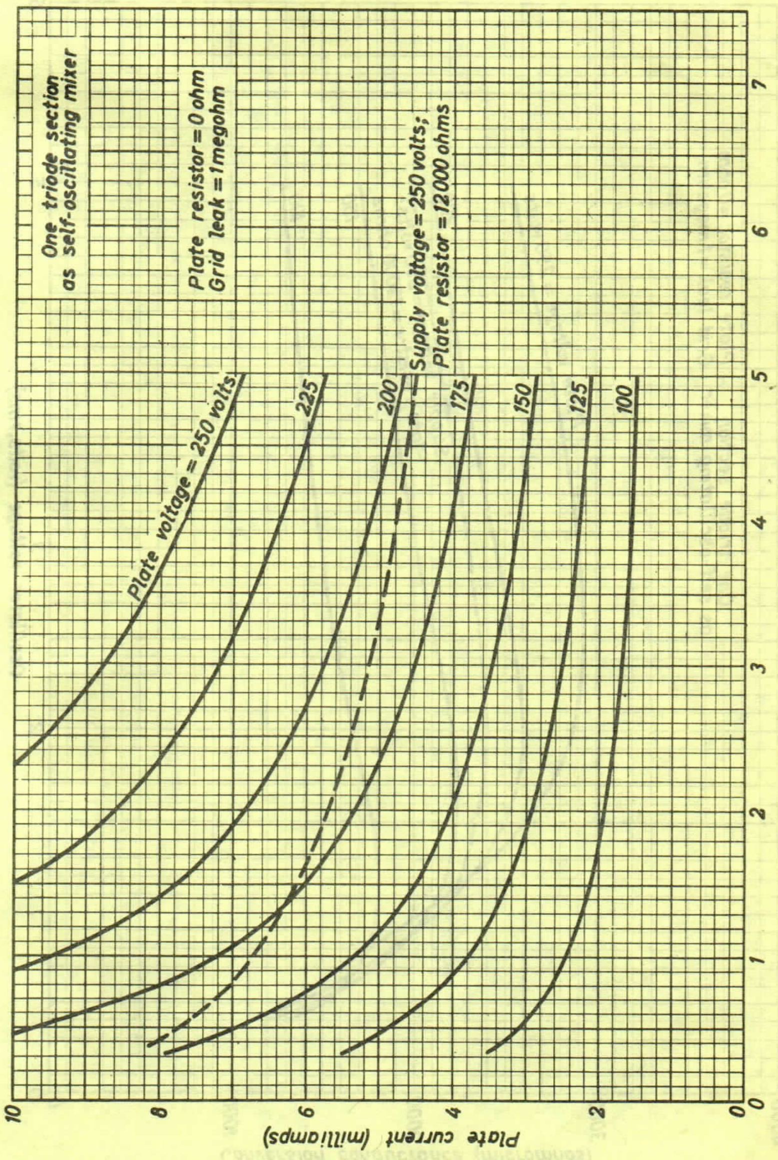

One section
Grid bias = 0 volt
-1
-2
-3
-4
-5
-6
-7
-8
Plate dissipation = 2.5 watts
Plate voltage (volts)
0
50
100
150
200
250
300
350
Plate current (milliamps)
0
5
10
15
20
25

6AQ8/ECC85

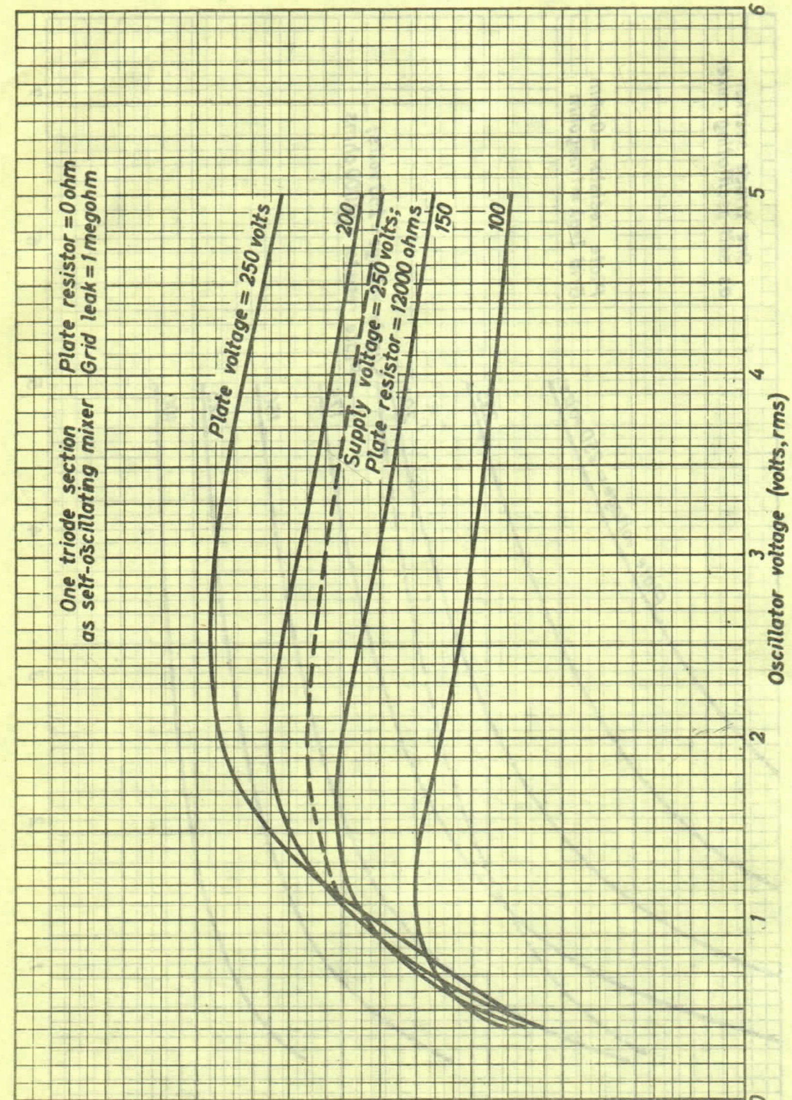


One section
Plate voltage = 250 volts
Transconductance
Amplification factor
Grid bias
Plate resistance
Transconductance (micromhos)
Amplification factor
Grid bias (volts)
Plate resistance (ohms)
Plate current (milliamps)
12 000
10 000
8000
6000
4000
2000
0
100
80
60
40
20
0
−5
−4
−3
−2
−1
0
60000
50000
40000
30000
20000
10000
0
5
10
15
20

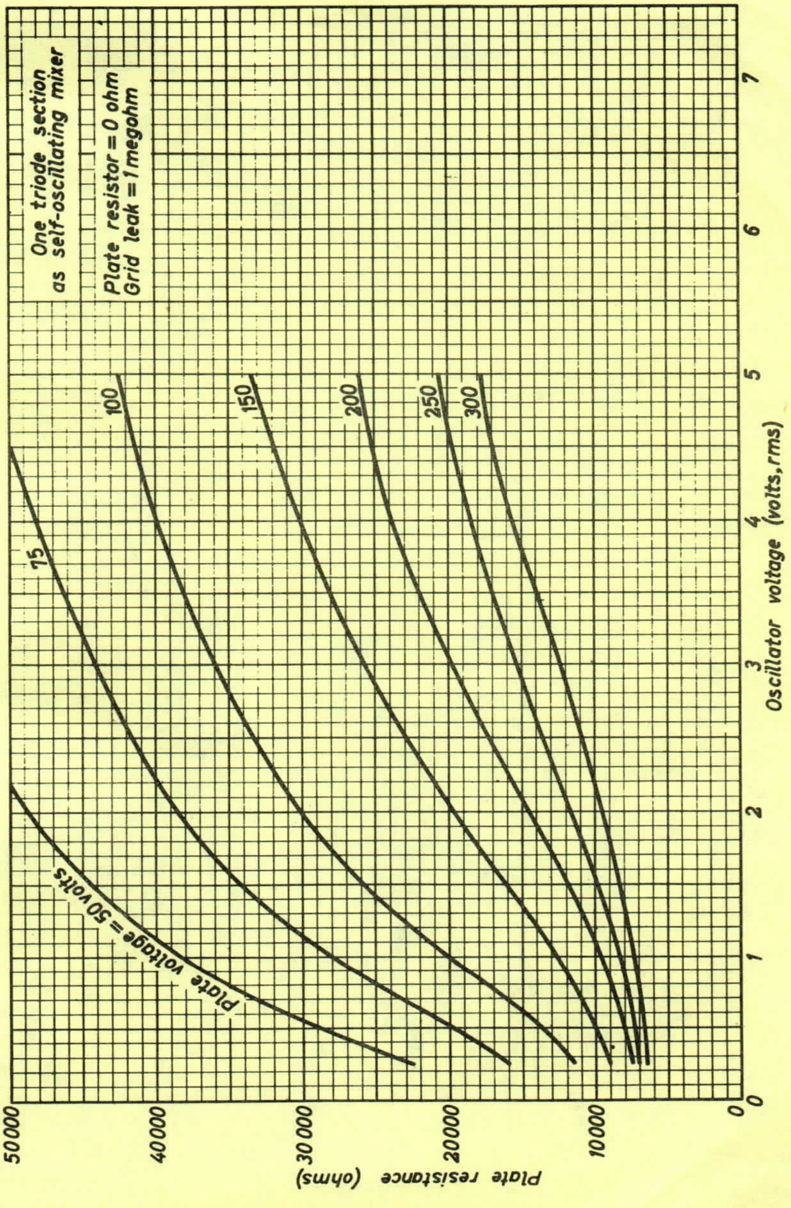
6AQ8/ECC85


One triode section
as self-oscillating mixer
Plate resistor = 0 ohm
Grid leak = 1 megohm
Supply voltage = 250 volts;
Plate resistor = 12 000 ohms
Plate voltage = 250 volts
225
200
175
150
125
100
Plate current (milliamps)
0
2
4
6
8
10
1
2
3
4
5
6
7

6AQ8/ECC85


One triode section
as self-oscillating mixer
Plate resistor = 0 ohm
Grid leak = 1 megohm
Plate voltage = 250 volts
200
Supply voltage = 250 volts;
Plate resistor = 12000 ohms
150
100
Oscillator voltage (volts, rms)
Conversion conductance (micromhos)
0
1
2
3
4
5
6
1000
2000
3000
4000

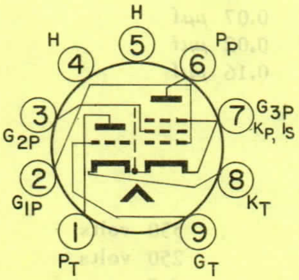
6AQ8/ECC85



One triode section
as self-oscillating mixer
Plate resistor = 0 ohm
Grid leak = 1 megohm
Plate voltage = 50 volts
75
100
150
200
250
300
Plate resistance (ohms)
50000
40000
30000
20000
10000
0
Oscillator voltage (volts, rms)
0
1
2
3
4
5
6
7

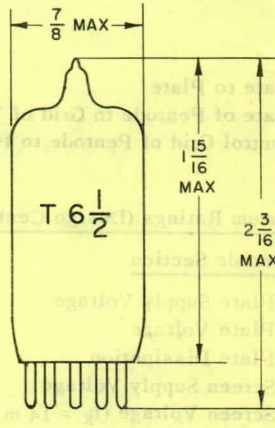
AMPEREX TUBE TYPE 6BL8/ECF80

The Amperex 6BL8/ECF80 is a miniature triode-pentode with separate cathodes which is especially designed for use as a combined oscillator and mixer in television and AM/FM receivers.



PIN CONNECTION

1 – PLATE, TRIODE
2 – GRID NO. 1 PENTODE
3 – GRID NO. 2 PENTODE
4 – HEATER
5 – HEATER
6 – PLATE, PENTODE
7 – GRID NO. 3 PENTODE
CATHODE, PENTODE
INTERNAL SHIELD
8 – CATHODE, TRIODE
9 – GRID, TRIODE



6 – 2

GENERAL CHARACTERISTICS

MECHANICAL

Base	E9-1
Bulb	T6-1/2
Outline	6-2
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential

Heater Characteristics

Heater Arrangement	parallel supply
Heater Voltage	6.3 volts
Heater Current	430 mA

6BL8/ECF80

Interelectrode Capacitances

	triode section	pentode section
Input	2.5	5.2 $\mu\mu f$
Output	1.8	3.4 $\mu\mu f$
Plate to Grid	1.5	0.025 $\mu\mu f$

	between triode and pentode sections
Plate to Plate	0.07 $\mu\mu f$
Plate of Pentode to Grid of Triode	0.02 $\mu\mu f$
Control Grid of Pentode to Plate of Triode	0.16 $\mu\mu f$

Maximum Ratings (Design Center Values)

Pentode Section

Plate Supply Voltage	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.7 watts
Screen Supply Voltage	550 volts
Screen Voltage (I_k = 14 mA)	175 volts
Screen Voltage (I_k < 10 mA)	200 volts
Screen Dissipation [1]	0.5 watts
Cathode Current	14 mA
Grid Series Resistance (Cathode Bias)	1 megohm
Grid Series Resistance (Fixed Bias)	0.5 megohm
Negative Grid Voltage ($I_{g1} = 0.3\ \mu A$) [2]	1.3 volts
Voltage between Cathode and Heater	100 volts

Triode Section

Plate Supply Voltage	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.5 watts
Cathode Current	14 mA
Grid Series Resistance	0.5 megohm
Negative Grid Voltage ($I_g = 0.3\ \mu A$) [2]	1.3 volts
Voltage between Cathode and Heater	100 volts

[1] If plate dissipation is less than 1.2 watts, the maximum value of the screen dissipation may be increased to 0.75 watts.

[2] Grid Voltage must not be more positive than this value.

6BL8/ECF80

Typical Characteristics

Pentode Section

Plate Voltage	170	volts
Screen Voltage	170	volts
Grid Voltage	–2	volts
Plate Current	10	mA
Screen Current	2.8	mA
Transconductance	6200	micromhos
Amplification Factor	47	
Plate Resistance	0.4	megohms
Input Resistance (F = 50 Mc/s)	10,000	ohms
Equivalent Noise Resistance	1500	ohms

Triode Section

Plate Voltage	100	volts
Grid Voltage	–2	volts
Plate Current	14	mA
Transconductance	5000	micromhos
Amplification Factor	20	

Typical Operation - Converter Service [3]

Plate Voltage	170	170	volts
Screen Voltage	170	170	volts
Grid Resistance	0.1	0.1	megohm
Cathode Resistor	330	820	ohms
Oscillator Voltage	3.5	3.5	volts
Plate Current	6.5	5.2	mA
Screen Current	2.0	1.5	mA
Grid Current	20	0	μA
Conversion Conductance	2200	2100	micromhos
Internal Resistance	0.8	0.87	megohm

[3] The triode should be used in a Colpitts rather than a Hartley type oscillator circuit.

6BL8/ECF80

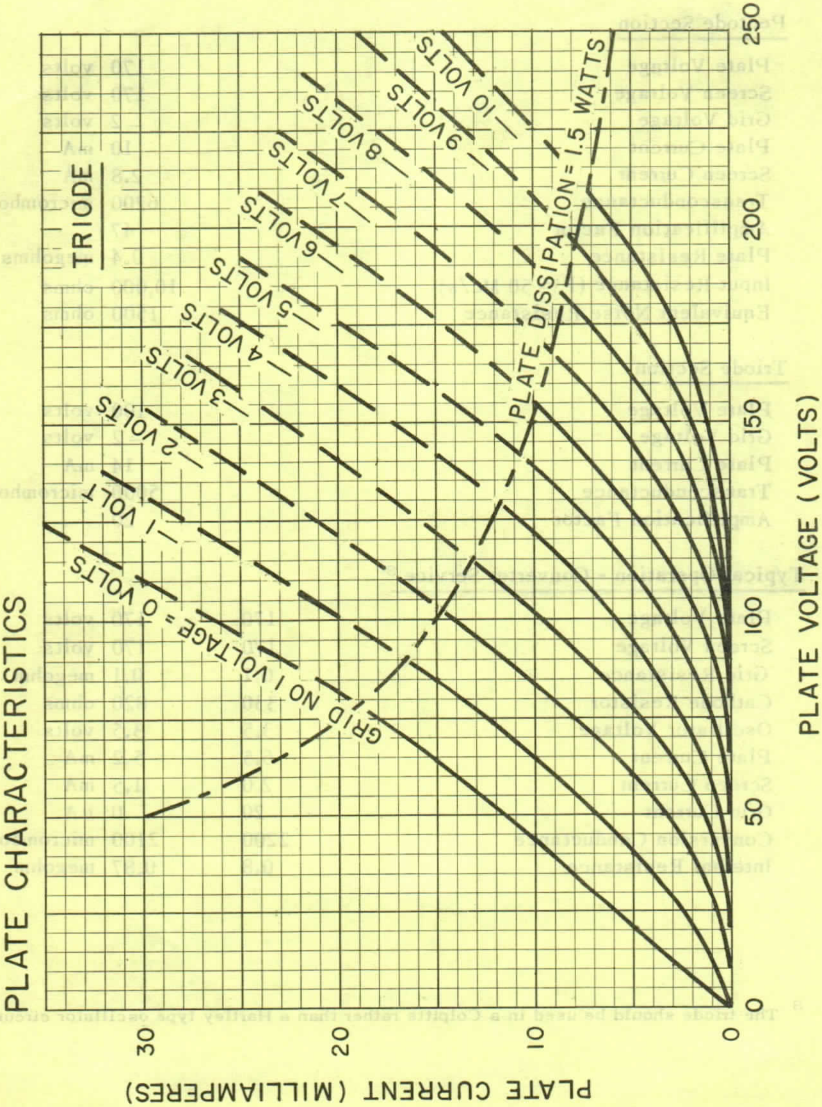


PLATE CHARACTERISTICS
TRIODE
GRID NO 1 VOLTAGE = 0 VOLTS
1 VOLT
2 VOLTS
3 VOLTS
4 VOLTS
5 VOLTS
6 VOLTS
7 VOLTS
8 VOLTS
9 VOLTS
10 VOLTS
PLATE DISSIPATION = 1.5 WATTS
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
10
20
30

6BL8/ECF80

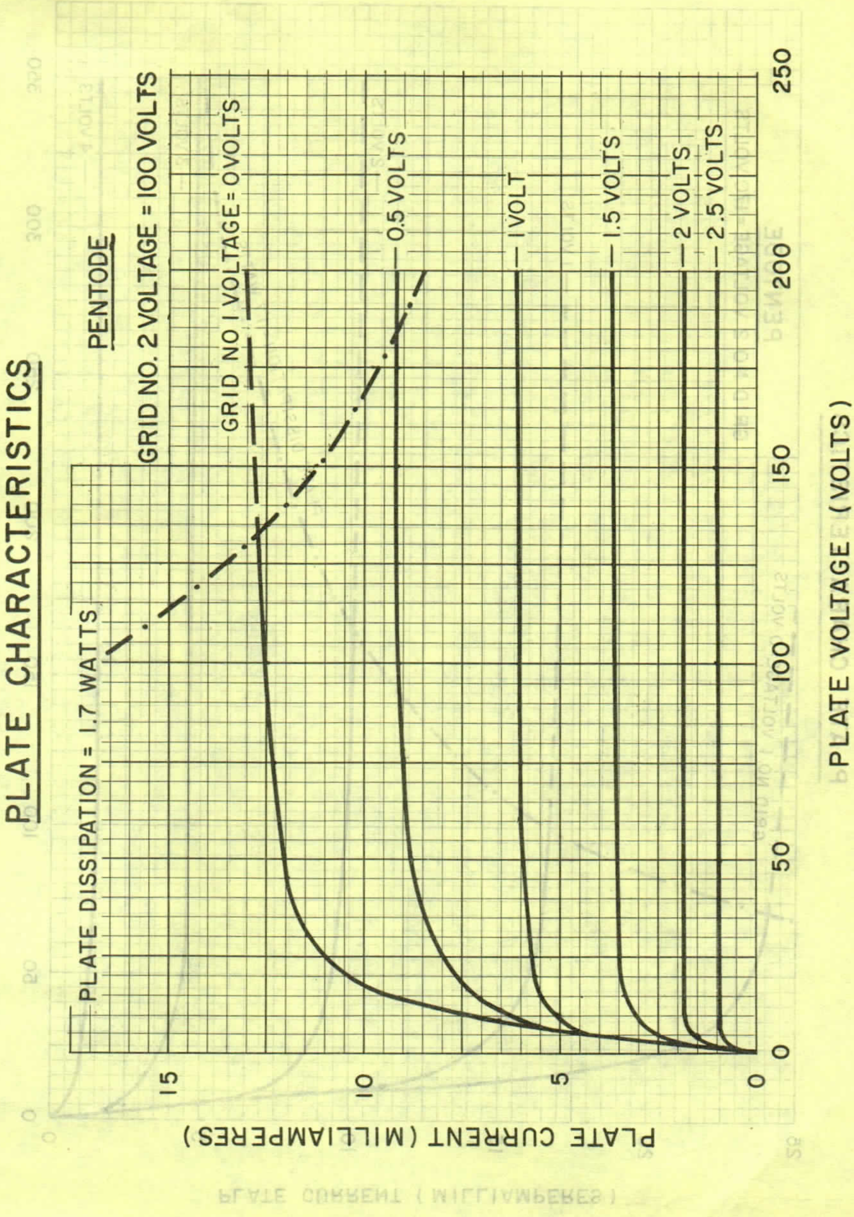


PLATE CHARACTERISTICS
PENTODE
GRID NO. 2 VOLTAGE = 100 VOLTS
GRID NO 1 VOLTAGE = 0 VOLTS
PLATE DISSIPATION = 1.7 WATTS
0.5 VOLTS
1 VOLT
1.5 VOLTS
2 VOLTS
2.5 VOLTS
0
50
100
150
200
250
PLATE VOLTAGE (VOLTS)
0
5
10
15
PLATE CURRENT (MILLIAMPERES)

6BL8/ECF80

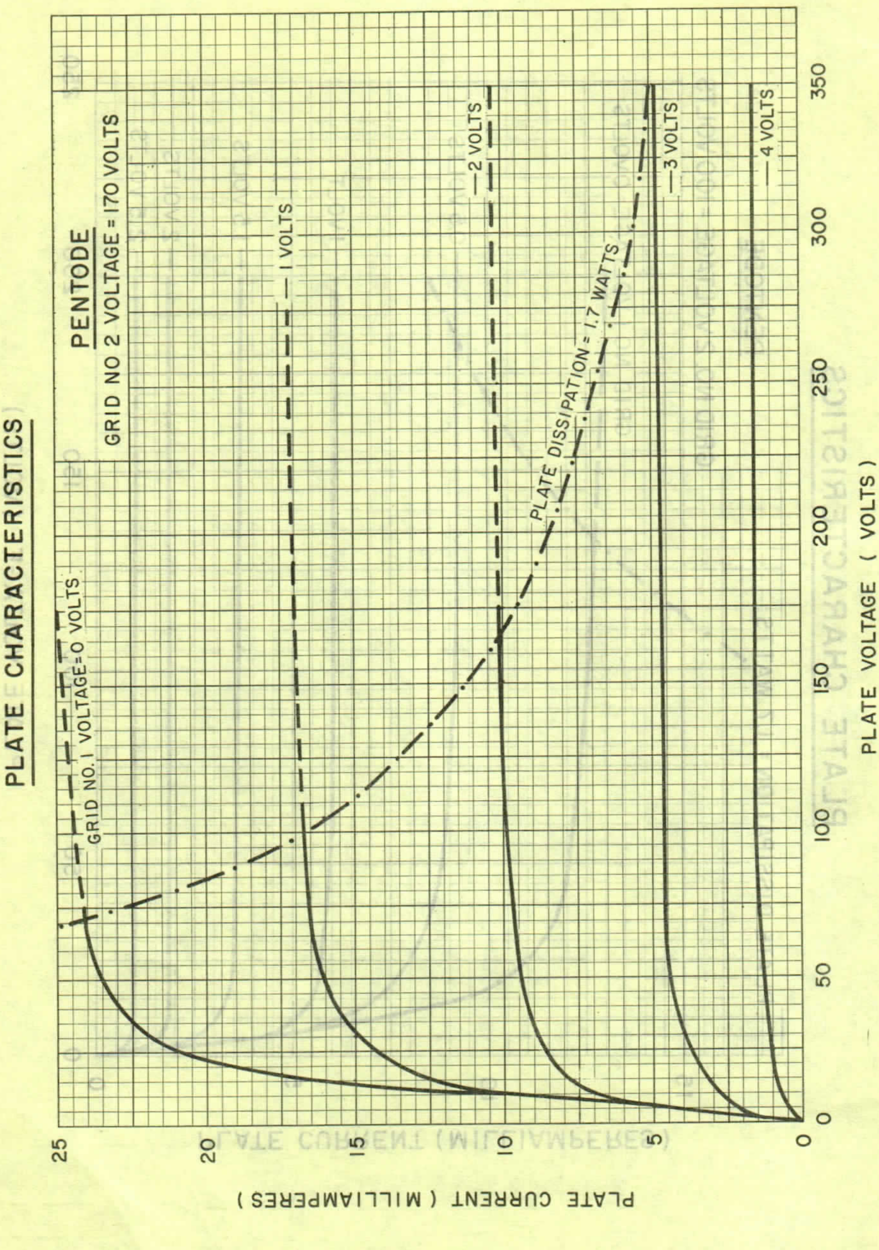
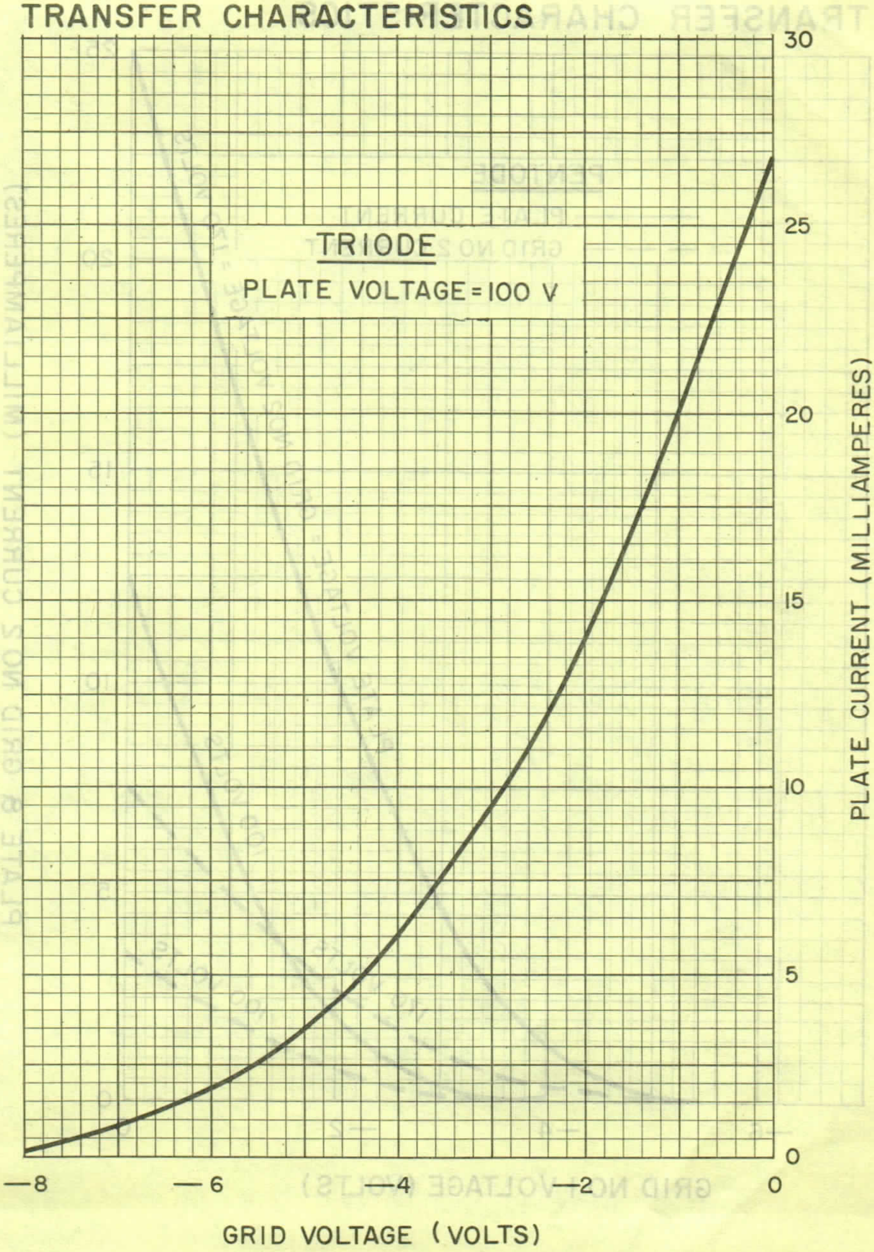


PLATE CHARACTERISTICS
PENTODE
GRID NO 2 VOLTAGE = 170 VOLTS
GRID NO. 1 VOLTAGE = 0 VOLTS
1 VOLTS
2 VOLTS
3 VOLTS
4 VOLTS
PLATE DISSIPATION = 1.7 WATTS
PLATE VOLTAGE (VOLTS)
PLATE CURRENT (MILLIAMPERES)
0
50
100
150
200
250
300
350
25
20
15
10
5
0

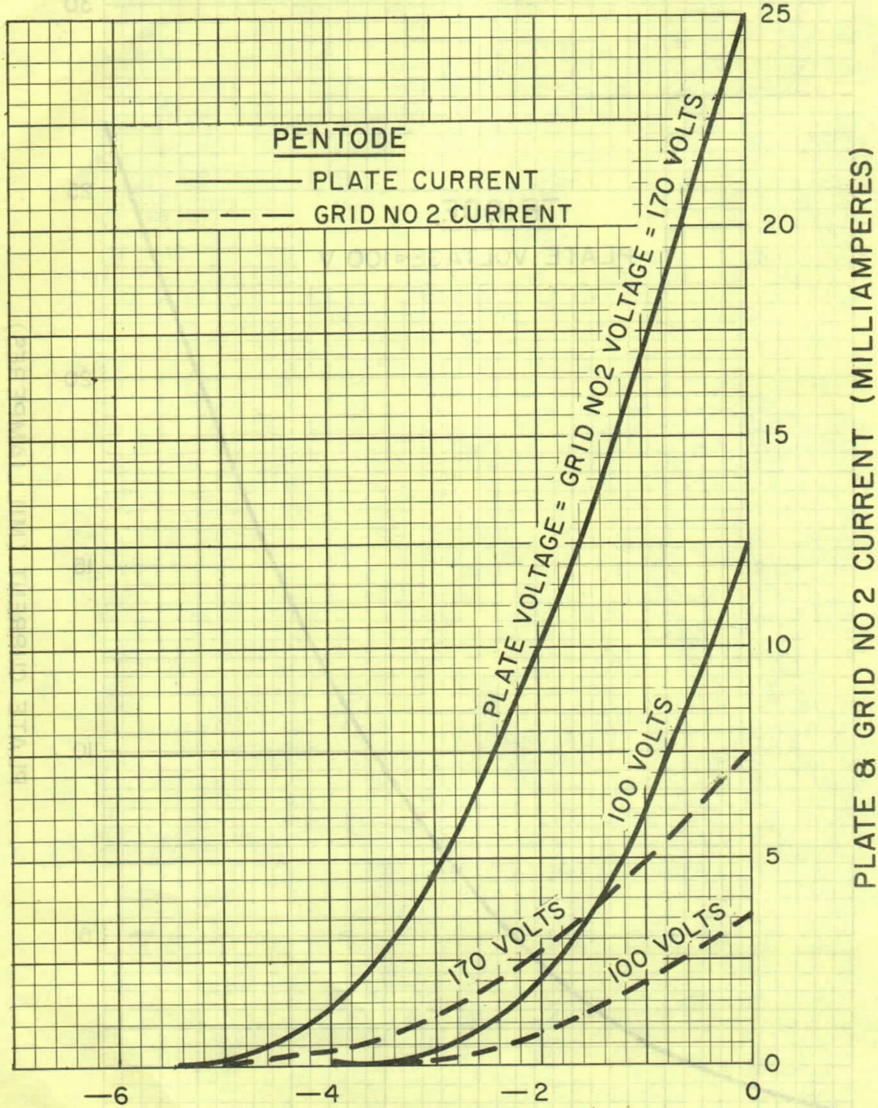
6BL8/ECF80



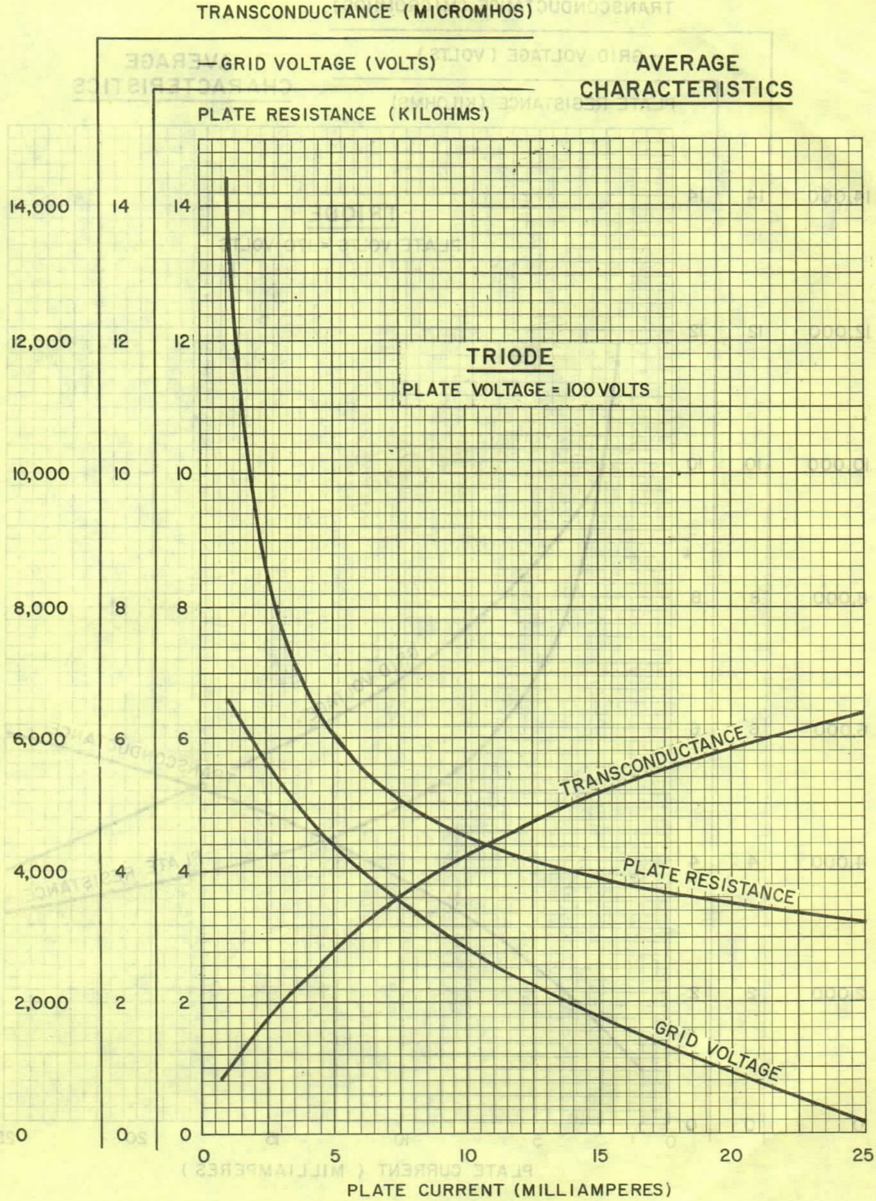
TRANSFER CHARACTERISTICS
TRIODE
PLATE VOLTAGE = 100 V
30
25
20
15
10
5
0
PLATE CURRENT (MILLIAMPERES)
—8
—6
—4
—2
0
GRID VOLTAGE (VOLTS)

6BL8/ECF80

TRANSFER CHARACTERISTICS

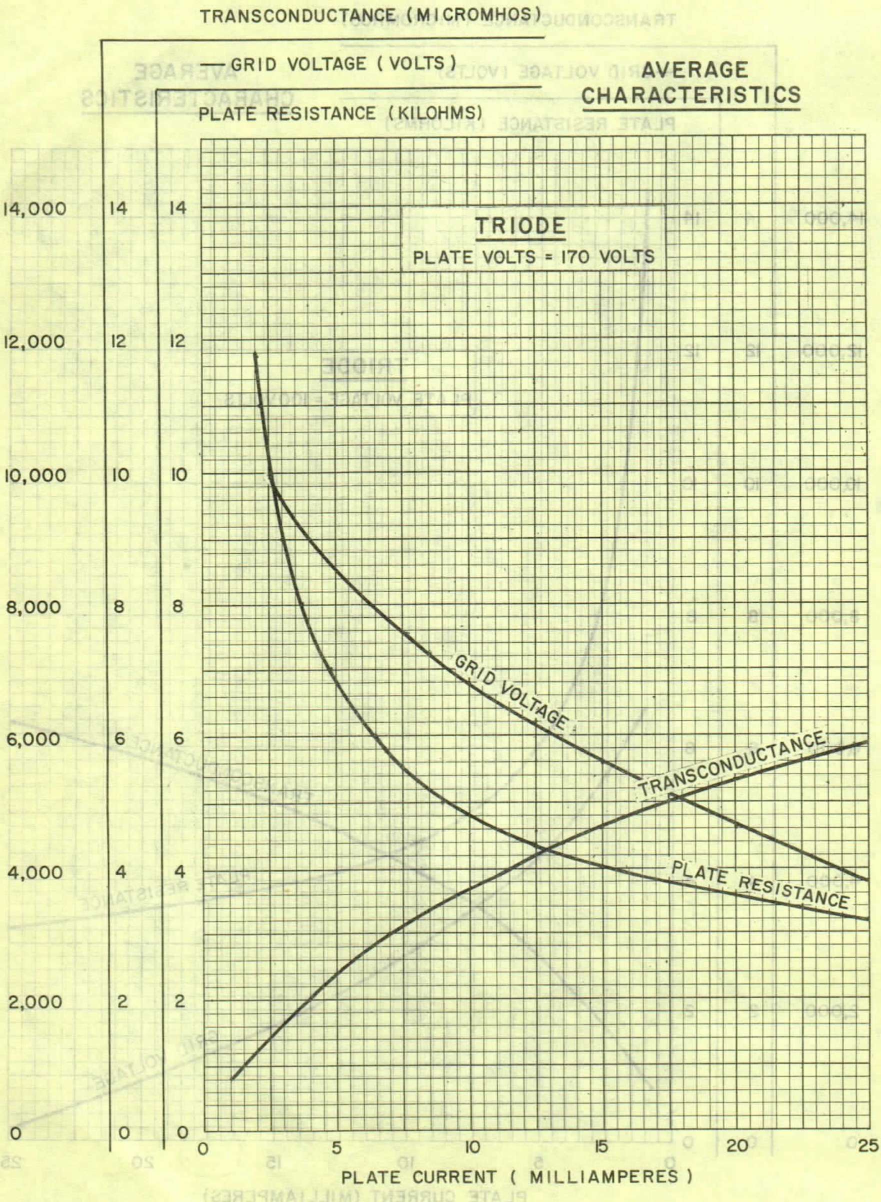


6BL8/ECF80

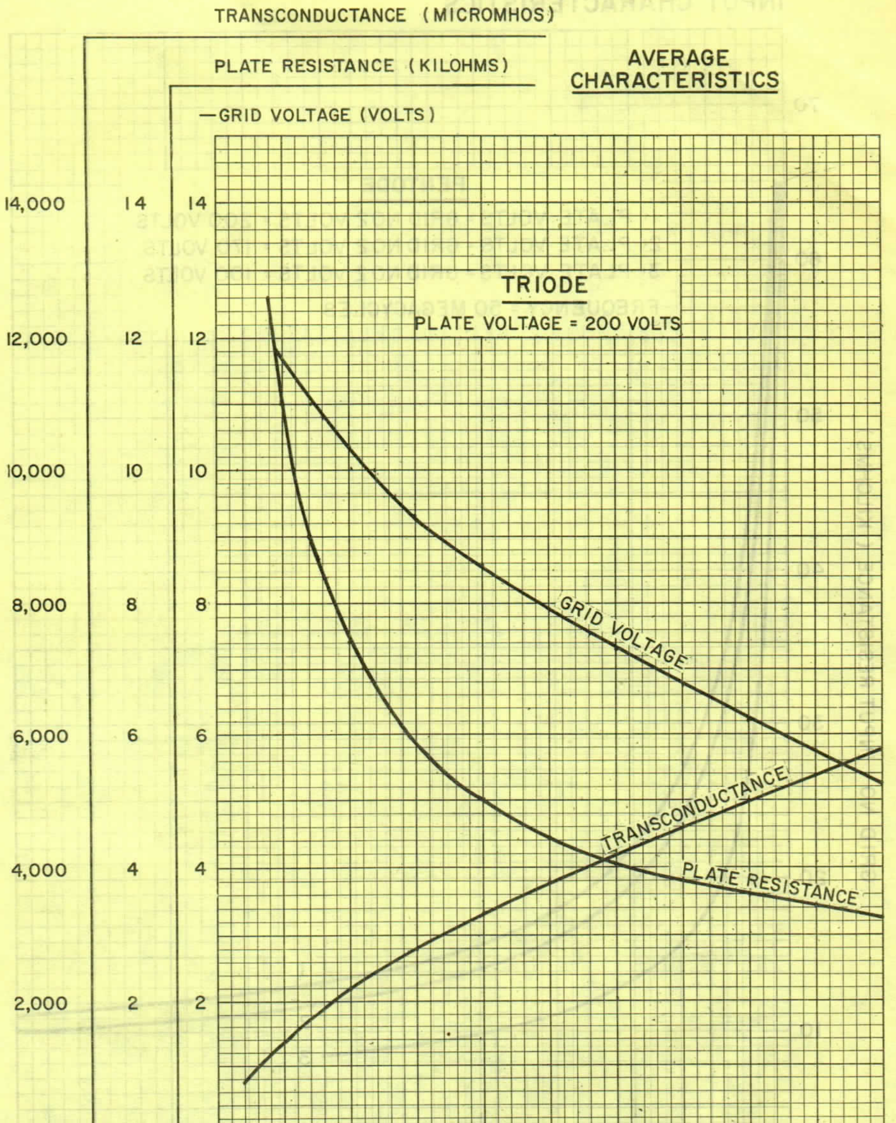


TRANSCONDUCTANCE (MICROMHOS)
—GRID VOLTAGE (VOLTS)
PLATE RESISTANCE (KILOHMS)
AVERAGE CHARACTERISTICS
TRIODE
PLATE VOLTAGE = 100 VOLTS
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
14
12
10
8
6
4
2
0
TRANSCONDUCTANCE
PLATE RESISTANCE
GRID VOLTAGE
0
5
10
15
20
25
PLATE CURRENT (MILLIAMPERES)

6BL8/ECF80

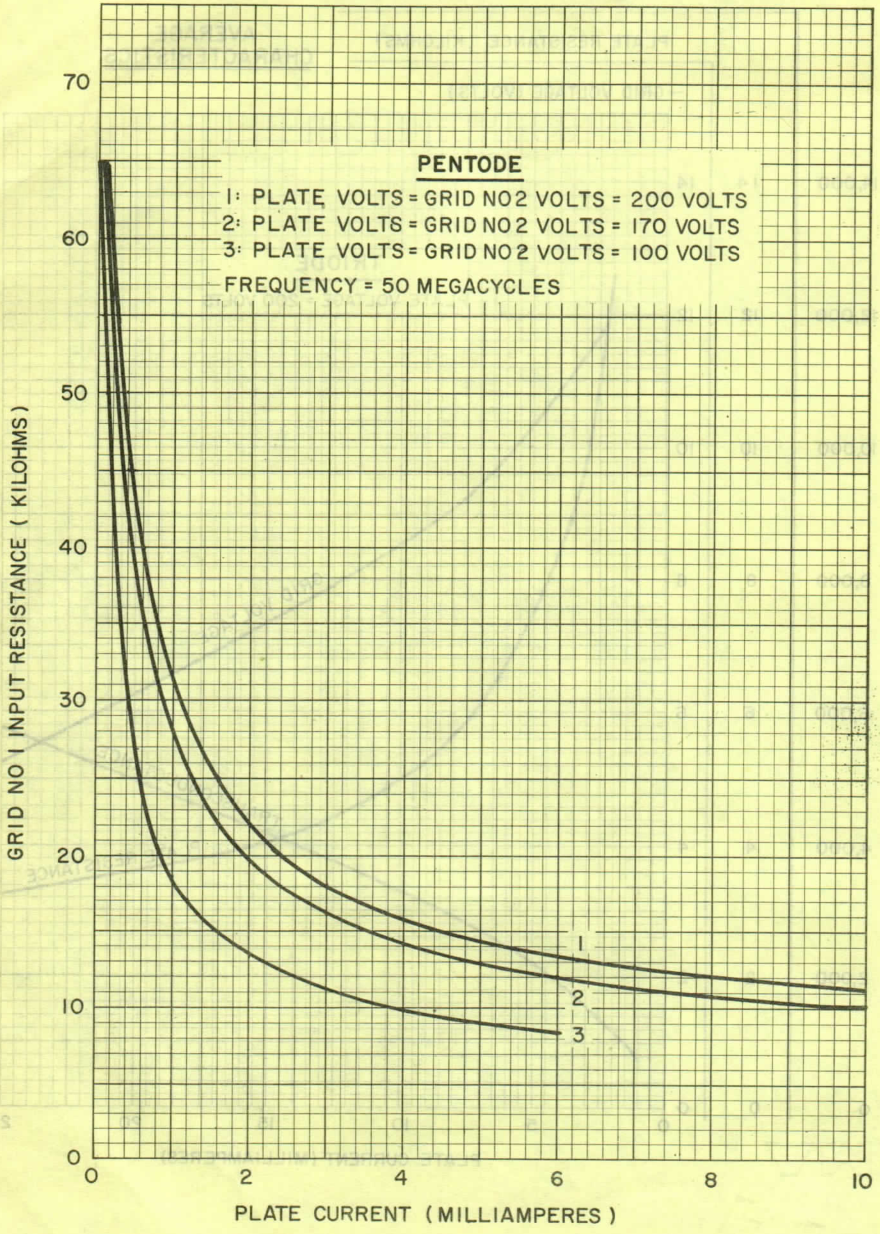


TRANSCONDUCTANCE (MICROMHOS)
— GRID VOLTAGE (VOLTS)
PLATE RESISTANCE (KILOHMS)
AVERAGE CHARACTERISTICS
TRIODE
PLATE VOLTS = 170 VOLTS
14,000 14 14
12,000 12 12
10,000 10 10
8,000 8 8
6,000 6 6
4,000 4 4
2,000 2 2
0 0 0
0 5 10 15 20 25
GRID VOLTAGE
TRANSCONDUCTANCE
PLATE RESISTANCE
PLATE CURRENT (MILLIAMPERES)

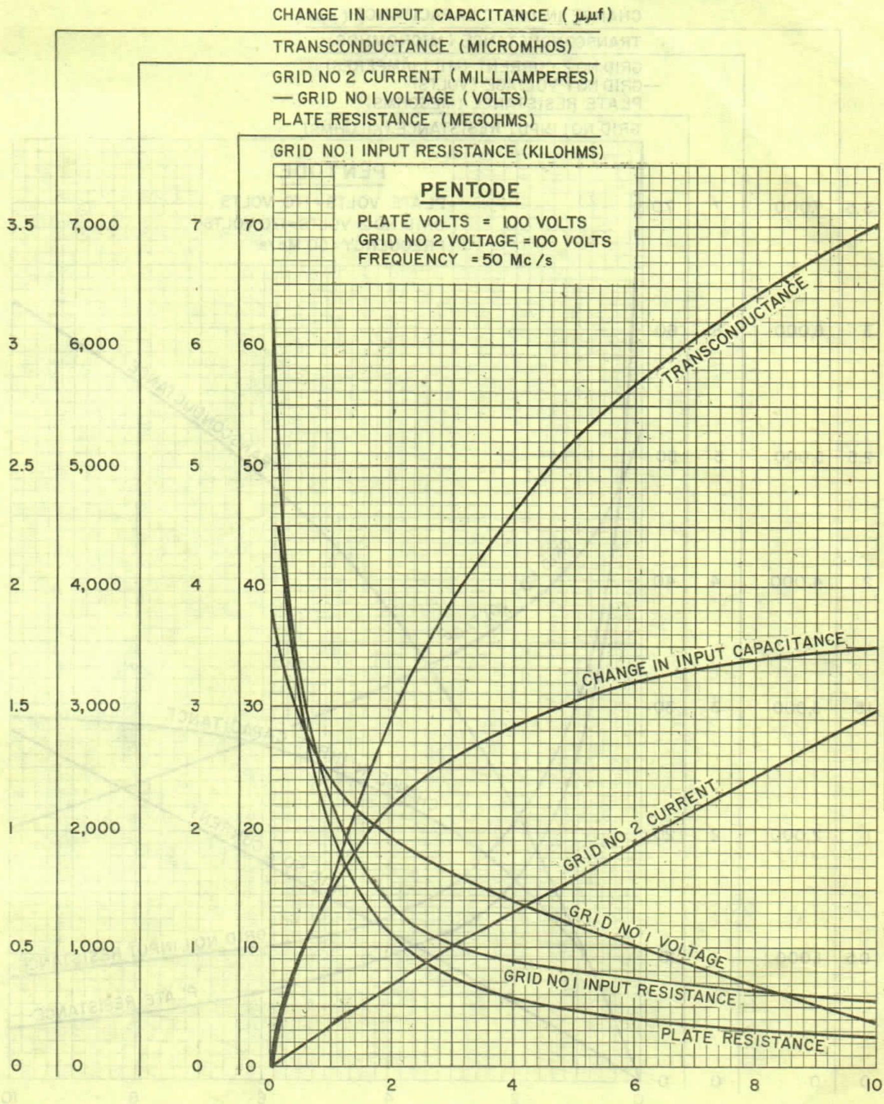

TRANSCONDUCTANCE (MICROMHOS)
PLATE RESISTANCE (KILOHMS)
AVERAGE CHARACTERISTICS
—GRID VOLTAGE (VOLTS)
TRIODE
PLATE VOLTAGE = 200 VOLTS
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
14
12
10
8
6
4
2
0
GRID VOLTAGE
TRANSCONDUCTANCE
PLATE RESISTANCE
0
5
10
15
20
25
PLATE CURRENT (MILLIAMPERES)

6BL8/ECF80

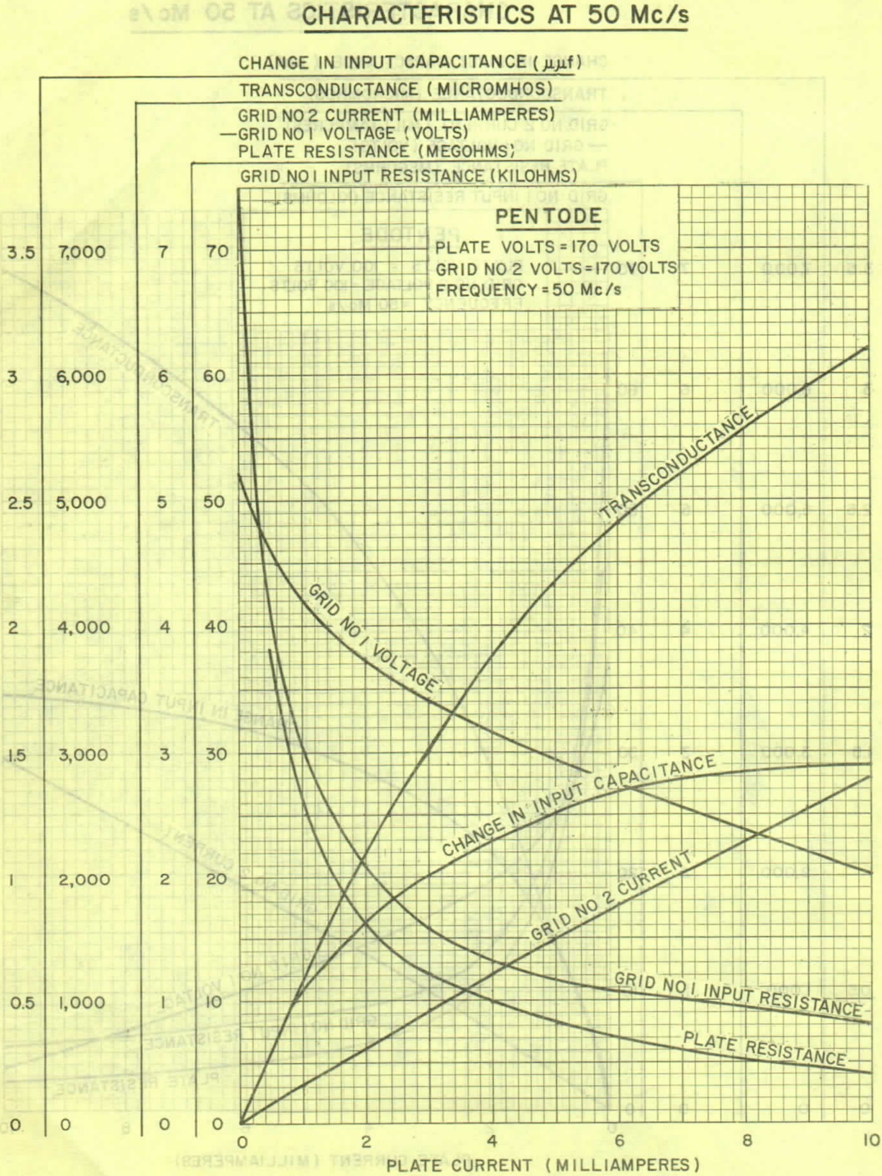
INPUT CHARACTERISTICS



CHARACTERISTICS AT 50 Mc/s

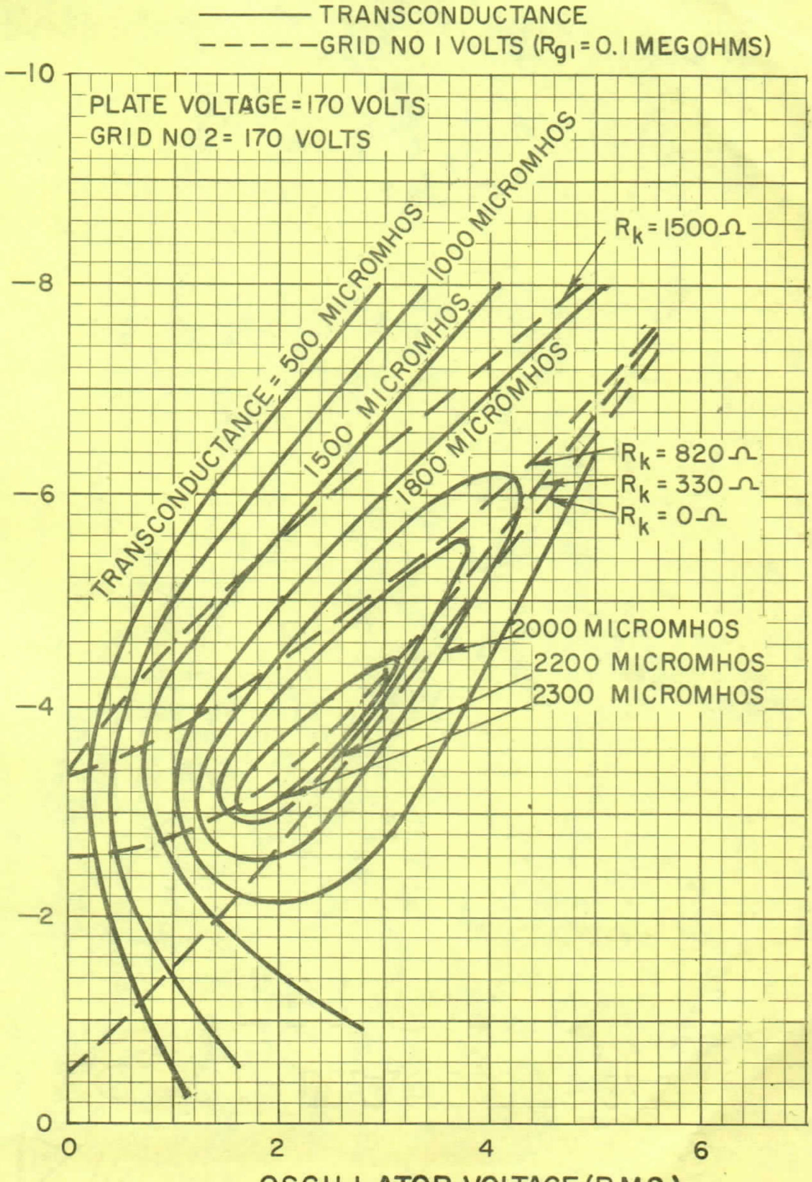


6BL8/ECF80


CHARACTERISTICS AT 50 Mc/s
CHANGE IN INPUT CAPACITANCE (μμf)
TRANSCONDUCTANCE (MICROMHOS)
GRID NO 2 CURRENT (MILLIAMPERES)
—GRID NO I VOLTAGE (VOLTS)
PLATE RESISTANCE (MEGOHMS)
GRID NO I INPUT RESISTANCE (KILOHMS)
PENTODE
PLATE VOLTS = 170 VOLTS
GRID NO 2 VOLTS = 170 VOLTS
FREQUENCY = 50 Mc/s
3.5 7,000 7 70
3 6,000 6 60
2.5 5,000 5 50
2 4,000 4 40
1.5 3,000 3 30
1 2,000 2 20
0.5 1,000 1 10
0 0 0 0
TRANSCONDUCTANCE
GRID NO I VOLTAGE
CHANGE IN INPUT CAPACITANCE
GRID NO 2 CURRENT
GRID NO I INPUT RESISTANCE
PLATE RESISTANCE
0 2 4 6 8 10
PLATE CURRENT (MILLIAMPERES)

OPERATION CHARACTERISTICS

PENTODE

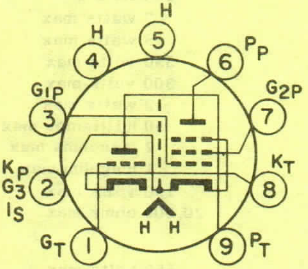


AMPEREX TUBE TYPE 6BM8/ECL82

The 6BM8/ECL82 is a one envelope triode pentode designed for application in medium power Hi Fi amplifiers.

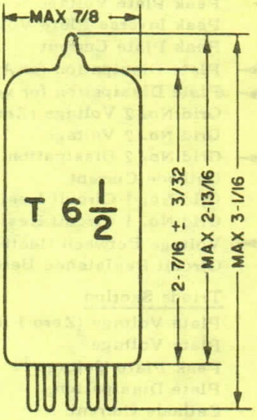
The combination of voltage amplifier and output tube in one envelope makes this tube particularly suitable for the construction of one tube phonograph amplifiers.

The 6BM8/ECL82 is also suitable for vertical deflection in TV applications.



PIN CONNECTIONS

1. GRID, TRIODE
2. CATHODE, GRID NO. 3 INTERNAL SHIELD, PENTODE
3. GRID NO. 1, PENTODE
4. HEATER
5. HEATER
6. PLATE, PENTODE
7. GRID NO. 2, PENTODE
8. CATHODE, TRIODE
9. PLATE, TRIODE



MECHANICAL DATA

Cathode	Coated, unipotential
Base	E 9-1
Bulb	T 6½
Mounting Position	any
RETMA Basing Designation	9EX

ELECTRICAL DATA

Heater Voltage	6.3 volts
Heater Current	0.78 amps

Direct Interelectrode Capacitances

Triode Section

Grid to All Other Elements Except Plate	2.7 $\mu\mu f$
→ Plate to All Other Elements Except Grid	4.3 $\mu\mu f$
→ Plate to Grid	4.4 $\mu\mu f$
Grid to Heater	0.1 $\mu\mu f$ max

Pentode Section

→ Grid No. 1 to All Other Elements Except Plate	9.3 $\mu\mu f$
→ Plate to All Other Elements Except Grid No. 1	8 $\mu\mu f$
Grid No. 1 to Plate	0.3 $\mu\mu f$ max
Grid No. 1 to Heater	0.3 $\mu\mu f$ max

NOTE

The same electrical characteristics with different heater ratings are available in the following tubes;

50BM8/UCL82

Heater Voltage	50 volts
Heater Current	100 mA

16A8/PCL82

Heater Voltage	16 volts
Heater Current	300 mA

Between Triode and Pentode Sections	
Triode Plate to Pentode Grid No. 1	0.02 μμf max
Triode Grid to Pentode Plate	0.02 μμf max
Triode Grid to Pentode Grid No. 1	0.025 μμf max
Triode Plate to Pentode Plate	0.25 μμf max

Maximum Ratings (Design Center Value)

Pentode Section	
→ Plate Voltage (Zero Plate Current)	550 volts max
→ Plate Voltage	300 volts max
Peak Plate Voltage [1]	2500 volts max
Peak Inverse Plate Voltage	500 volts max
Peak Plate Current	see note 2
→ Plate Dissipation for Audio Output Application	7 watts max
→ Plate Dissipation for vertical deflection Application	5 watts max
Grid No. 2 Voltage (Zero Grid Current)	550 volts max
Grid No. 2 Voltage	300 volts max
→ Grid No. 2 Dissipation	2 watts max
Cathode Current	50 milliamps max
Grid No. 1 Circuit Resistance With Automatic Bias	2 megohms max
Grid No. 1 Circuit Resistance With Fixed Bias	1 megohm max
→ Voltage Between Heater and Cathode	150 volts max
Circuit Resistance Between Heater and Cathode	20,000 ohms max

Triode Section	
Plate Voltage (Zero Plate Current)	550 volts max
Plate Voltage	300 volts max
Peak Plate Voltage [1]	600 volts max
Plate Dissipation	1 watt max
Cathode Current	15 milliamps max
Peak Cathode Current	see note 1
→ Grid Circuit Resistance with Automatic Bias [3]	3 megohms max
Grid Circuit Resistance with Fixed Bias	1 megohm max
Voltage Between Heater and Cathode	100 volts max
Circuit Resistance Between Heater and Cathode	20,000 ohms max
→ Grid Impedance (50 cps)	0.5 megohms max

TYPICAL CHARACTERISTICS

→ Pentode Section	
Plate Voltage	170 volts
Grid No. 2 Voltage	170 volts
Grid No. 1 Bias	−11.5 volts
Plate Current	41 milliamps
Grid No. 2 Current	9 milliamps
Transconductance	7500 micromhos
Plate Resistance	16,000 ohms
Amplification Factor of Grid No. 2 With Respect to Grid No. 1	9.5

Triode Section	
Plate Voltage	100 volts
Grid Voltage	0 volt
Plate Current	3.5 milliamps
→ Transconductance	2200 micromhos
Amplification Factor	70

Revised 6/60

Typical Operation - Class A - AF Output Tube
Pentode Section

Plate Supply Voltage		200			272		volts
Grid No. 2 Supply Voltage		200			272		volts
Grid No. 2 series resistor (not bypassed)		470			2200		ohms
Series cathode Resistor		330			650		ohms
Plate load Resistance		4500			8000		ohms
Input Voltage	0	0.66	6.7	0	0.9	9.5	volts (rms)
Plate Current	35	-	37	28	-	27	mA
Grid No. 2 Current	7.8	-	13.3	6.5	-	10.8	mA
Power Output	0	0.05	3.3	0	0.05	3.5	watts
Total Distortion	-	-	10	-	-	10	%

Typical Operation - Class AB - AF Output Tube
Two Tubes in Push-Pull
Pentode Sections

Plate Supply Voltage	200	250	volts
Grid No. 2 Supply Voltage	200	200	volts
Series Cathode Resistor (Common Cathode Resistor)	170	220	ohms
Plate to Plate Load Resistance	4500	10,000	ohms
Max Signal Input Voltage	14.2	12.5	volts (rms)
Zero Signal Plate Current	2x35	2x28	mA
Max Signal Plate Current	2x42.5	2x31	mA
Zero Signal Grid No. 2 Current	2x8	2x5.8	mA
Max Signal Grid No. 2 Current	2x16.5	2x13	mA
Max Signal Power Output	9.3	10.5	watts
Max Signal Total Distortion	6.3	4.8	%

6BM8/ECL82

Typical Operation as AF Amplifier
Triode Section

Source impedance 0.22 megohms
Grid Resistor of the following tube 0.68 megohms

E_{bb} volts	R_k ohms	R_p meg-ohms	R_g meg-ohms	I_p mA	E_o volts rms	E_o[4] / E_{sig}	Total harmonic distortion (%)
200	2200	0.22	3	0.52	26	52	1.6[5]
170	2700	0.22	3	0.43	25	51	2.3[5]
Grid resistor of the following tube							0.68 megohms
200	0	0.1	22	1.05	24	50	1.5[6]
170	0	0.1	22	0.86	19	49	1.4[6]
200	0	0.22	22	0.61	-	55	1.4[6]
170	0	0.22	22	0.50	20	53	1.4[6]

MICROPHONY AND HUM

The triode section can be used without special precautions against microphony and hum in circuits where the input voltage required for an output power of 50 milliwatts is higher than 10 millivolts. The grid circuit impedance at 50 cps should not exceed 0.5 megohm.

---

1 Maximum pulse duration 4% of one cycle with a maximum of 0.8 millisecond.

2 In vertical deflection applications the circuit should be designed so that it operates satisfactorily with a peak plate current not exceeding 85 mA at plate voltage = 50 V; grid no. 2 voltage = 170 V and heater voltage = 6.3 V.

The minimum available peak plate current at end of life and at underheating (heater voltage = 5.5 V) is:

Peak Plate Current = 70 mA at Plate Voltage = 50 V, Grid No. 2 Voltage = 170 V

Peak Plate Current = 80 mA at Plate Voltage = 50 V, Grid No. 2 Voltage = 190 V

3 With grid current biasing the maximum permissible value of the grid circuit resistance is 22 megohms.

4 Measured at small input voltage.

5 At lower output voltages the percent of distortion is proportionally lower.

6 Between E_o = 5 volts (rms) and the maximum output voltage the total harmonic distortion is about constant. At lower output voltages the total harmonic distortion is about proportional to the output voltage.

AMPEREX TUBE TYPE 6BQ5/EL84

The 6BQ5/EL84 is an output pentode designed for application in medium power Hi-Fi amplifiers. A pair of tubes in Class AB, push-pull conventional operation yields an output of up to 17 watts at 4% distortion (without feedback). In single-ended operation a power output of 5.7 watts can be obtained.

The true pentode characteristics of this tube reduce distortion at low instantaneous plate voltages which allow larger A.C. swings and increased undistorted output as compared with beam power tubes in the same power class.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	coated unipotential
Heater Voltage	6.3 volts
Heater Current	0.76 amps.

Direct Interelectrode Capacitances

Grid No. 1 to all elements except plate	10.8 $\mu\mu$f
Plate to all other elements except Grid No. 1	6.5 $\mu\mu$f
Plate to Grid No. 1	0.5 $\mu\mu$f
Grid No. 1 to heater	0.25 $\mu\mu$f

Characteristics

Plate Voltage	250 volts
Grid No. 2 Voltage	250 volts
Plate Current	48 mA
Grid No. 2 Current	5.5 mA
Grid No. 1 Voltage	− 7.3 volts
Transconductance	11,300 micromhos
Plate Resistance	40 KΩ
Amplification Factor (Grid No. 1 to Grid No. 2)	19.5

MECHANICAL

Base	Small button, 9 pin, RETMA #9CV
Max. Overall Length	3 1/16 inches
Max. Seated Height	2 13/16 inches
Max. Diameter	7/8 inches
Mounting Position	any

MAXIMUM RATINGS (Design Center Values)

Plate Voltage	300 volts
Plate Dissipation	12 watts
Grid No. 2 Voltage	300 volts
Grid No. 2 Dissipation (zero signal)	2.0 watts
Grid No. 2 Dissipation (max. signal)	4.0 watts
Cathode Current	65 mA
Grid Resistance (cathode bias)	1.0 MΩ
Grid Resistance (fixed bias)	300 KΩ
Filament to Cathode Voltage	100 volts

6BQ5/EL84

Operating Conditions - Class A - One Tube

Plate Voltage	250	250	250	250 volts
Screen Grid Voltage	250	250	250	210 volts
Plate Load Resistance	5.2	4.5	7.0	7.0 KΩ
Cathode Resistance	135	135	210	160 Ω
Grid No. 1 Voltage	−7.3	−7.3	−8.4	−6.4 volts
Plate Current (zero signal)	48	48	36	36 mA
Plate Current (max. signal)	49.5	50.6	36.8	36.6 mA
Grid No. 2 Current (zero signal)	5.5	5.5	4.1	3.9 mA
Grid No. 2 Current (max. signal)	10.8	10.0	8.5	7.3 mA
Input (rms) Signal Voltage	4.3	4.4	3.5	3.4 volts rms.
Power Output	5.7	5.7	4.2	4.3 watts
Total Distortion (measured with fixed grid bias)	10	10	10	10 %

Operating Conditions - Class AB - Two Tubes, Push-Pull

Plate Voltage	250	300 volts
Grid No. 2 Voltage	250	300 volts
Common Cathode Resistance	130	130 Ω
Plate to Plate Load Resistance	8.0	8.0 KΩ
Plate Current (zero signal)	2x31	2x36 mA
Plate Current (max. signal)	2x37.5	2x46 mA
Grid No. 2 Current (zero signal)	2x3.5	2x4.0 mA
Grid No. 2 Current (max. signal)	2x7.5	2x11 mA
Input Signal Voltage (rms)	8	10 volts
Power Output	11	17 watts
Percent Distortion	3.0	4.0 %

Operating Conditions - Class B - Two Tubes, Push-Pull

Plate Voltage	250	300 volts
Grid No. 2 Voltage	250	300 volts
Grid No. 1 Voltage	−11.6	−14.7 volts
Plate to Plate Load Resistance	8.0	8.0 KΩ
Plate Current (zero signal)	2x10	2x7.5 mA
Plate Current (max. signal)	2x37.5	2x46 mA
Grid No. 2 Current (zero signal)	2x1.1	2x0.8 mA
Grid No. 2 Current (max. signal)	2x7.5	2x11 mA
Input Signal Voltage (rms)	8	10 volts (rms)
Power Output	11	17 watts
Percent Distortion	3.0	4.0 %

6BQ5/EL84

Class A - Triode Operation

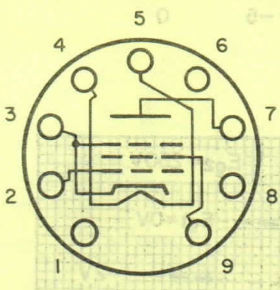
(Screen grid connected to plate)

Plate Voltage	250 volts
Common Cathode Resistance	270 Ω
Plate Load Resistance	3.5 KΩ
Plate Current (zero signal)	34 mA
Plate Current (max. signal)	36 mA
Input Signal Voltage (rms)	6.7 volts (rms)
Power Output	1.95 watts
Percent Distortion	9.0 %

Class AB - Triode Operation

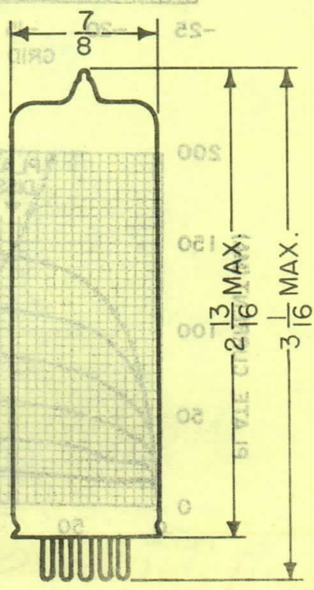
(Two tubes, push-pull. Screen grid connected to plate)

Plate Voltage	250	300 volts
Common Cathode Resistance	270	270 Ω
Plate to Plate Load Resistance	10	10 KΩ
Plate Current (zero signal)	2x20	2x24 mA
Plate Current (max. signal)	2x21.7	2x26.0 mA
Input Signal Voltage (rms)	8.3	10 volts (rms)
Power Output	3.4	5.2 watts
Percent Distortion	2.5	2.5 %

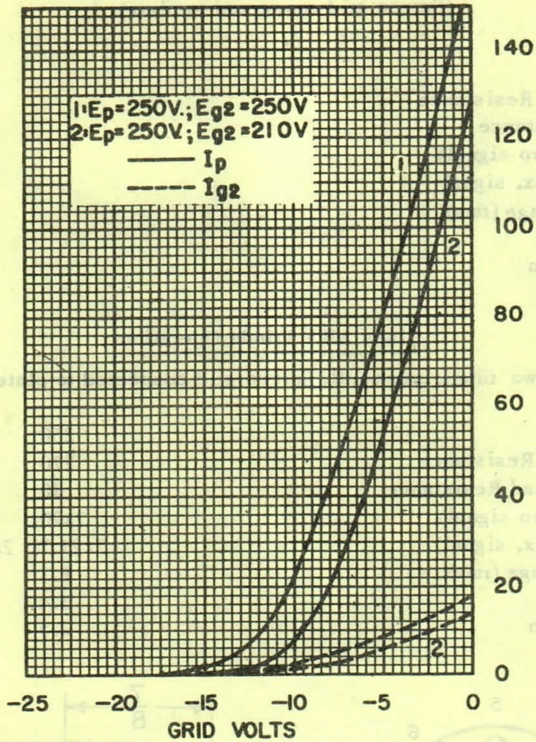


PIN CONNECTIONS

PIN. NO.	ELEMENT
1. —	INTERNALLY CONNECTED
2. —	GRID NO. 1.
3. —	CATHODE AND GRID NO. 3.
4. —	FILAMENT
5. —	FILAMENT
6. —	INTERNALLY CONNECTED
7. —	ANODE
8. —	INTERNALLY CONNECTED
9. —	GRID NO. 2.



6BQ5/EL84


1:Ep=250V.; Eg2=250V
2:Ep=250V.; Eg2=210V
Ip
Ig2
1
2
1
2
140
120
100
80
60
40
20
0
PLATE CURRENT (MA)
-25
-20
-15
-10
-5
0
GRID VOLTS

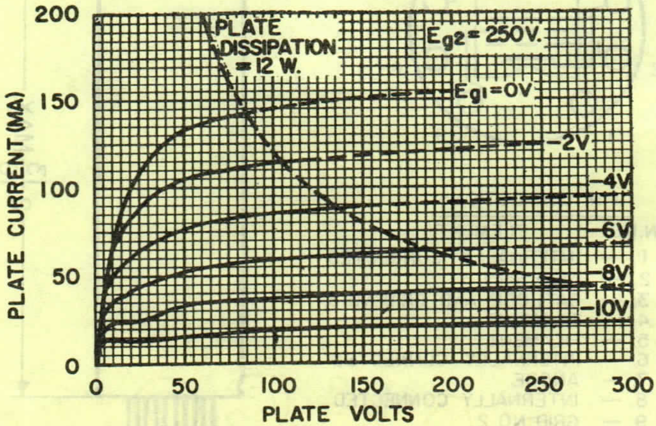


PLATE DISSIPATION =12 W.
Eg2=250V.
Eg1=0V
-2V
-4V
-6V
-8V
-10V
200
150
100
50
0
PLATE CURRENT (MA)
0
50
100
150
200
250
300
PLATE VOLTS

6BQ5/EL84

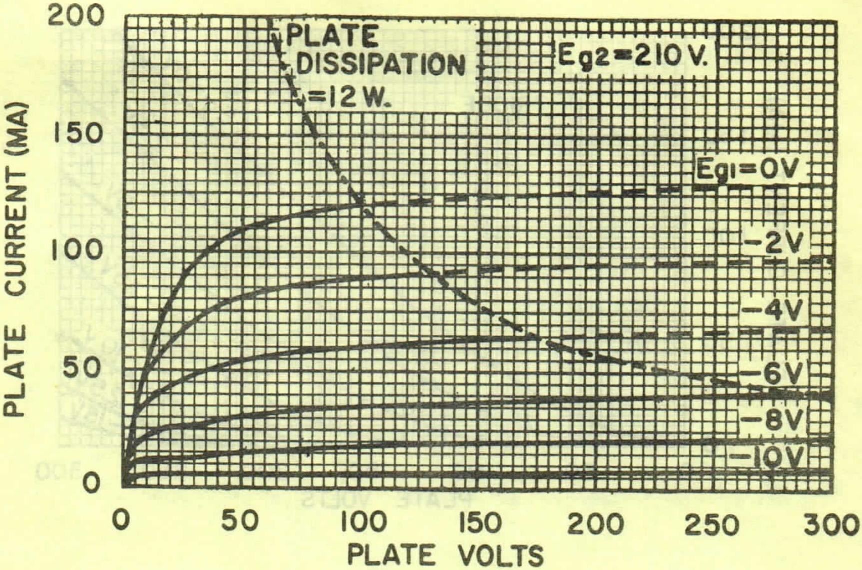
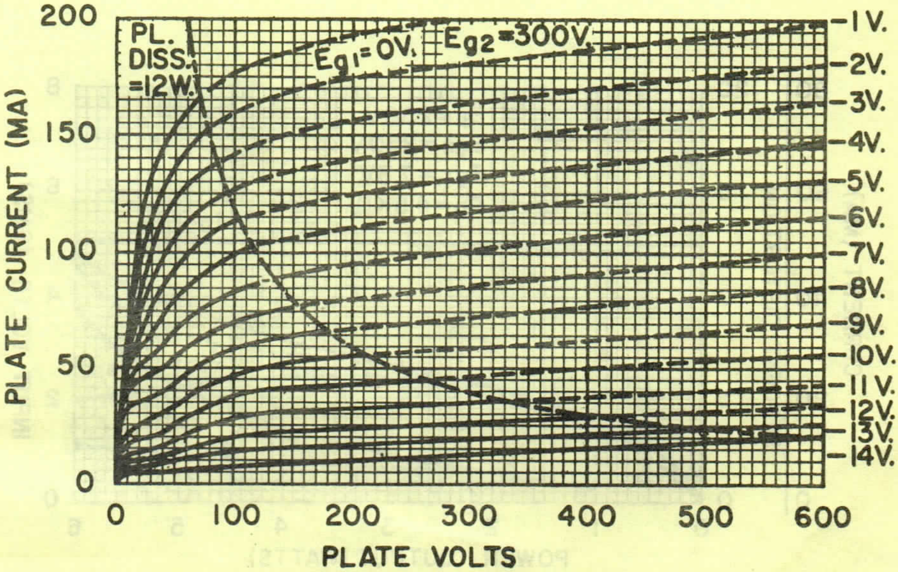
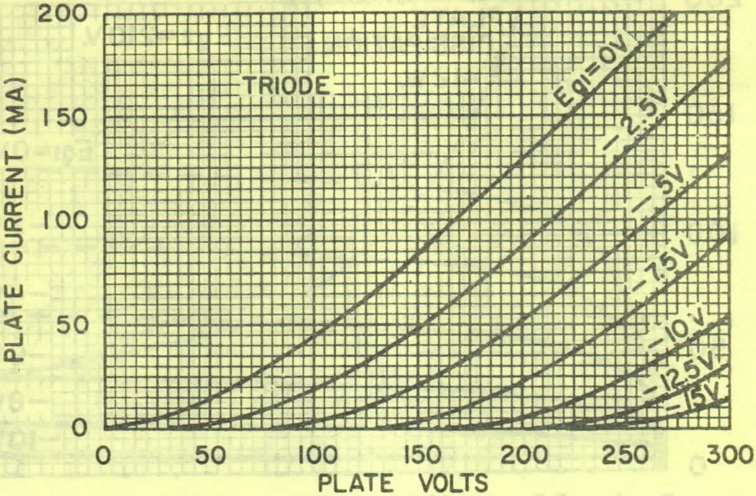
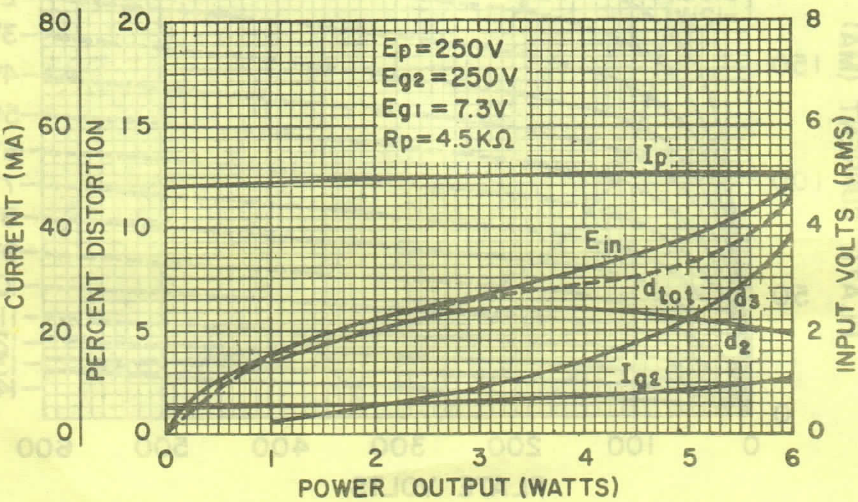


PLATE DISSIPATION =12 W.
Eg2=210 V.
Eg1=0V
-2V
-4V
-6V
-8V
-10V
PLATE CURRENT (MA)
200
150
100
50
0
0
50
100
150
200
250
300
PLATE VOLTS

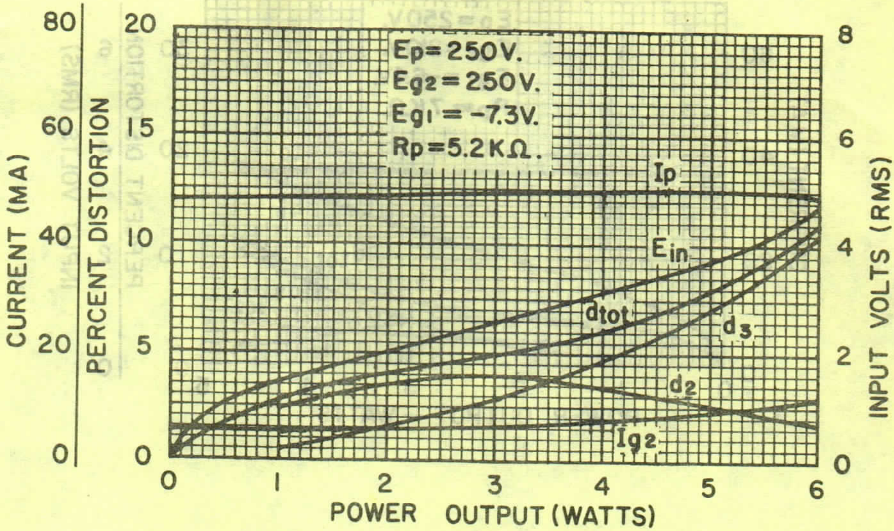

PL. DISS. =12W.
Eg1=0V.
Eg2=300V.
-1 V.
-2V.
-3V.
-4V.
-5V.
-6V.
-7V.
-8V.
-9V.
-10V.
-11 V.
-12V.
-13V.
-14V.
PLATE CURRENT (MA)
200
150
100
50
0
0
100
200
300
400
500
600
PLATE VOLTS

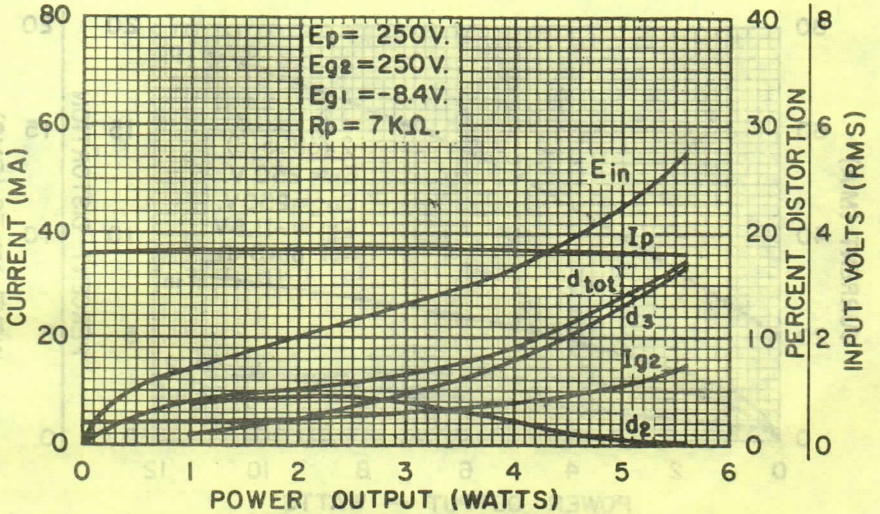
6BQ5/EL84


200
150
100
50
0
PLATE CURRENT (MA)
TRIODE
Eg1=0V
-2.5V
-5V
-7.5V
-10V
-12.5V
-15V
0
50
100
150
200
250
300
PLATE VOLTS

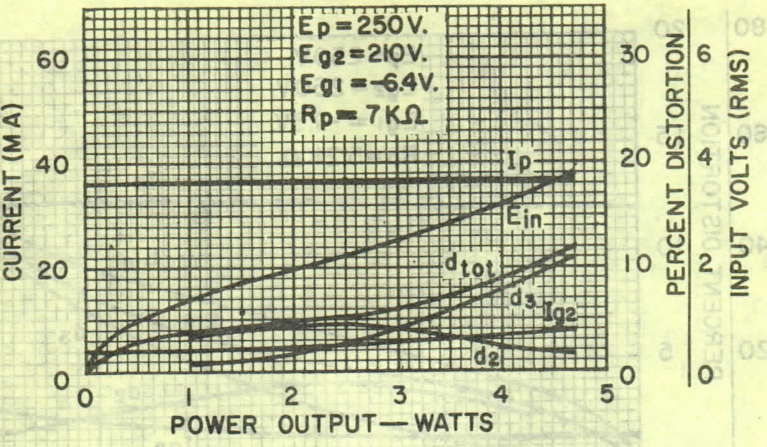

CURRENT (MA)
80
60
40
20
0
PERCENT DISTORTION
20
15
10
5
0
Ep=250V
Eg2=250V
Eg1 = 7.3V
Rp=4.5KΩ
Ip
Ein
dtot
d3
d2
Ig2
8
6
4
2
0
INPUT VOLTS (RMS)
0
1
2
3
4
5
6
POWER OUTPUT (WATTS)

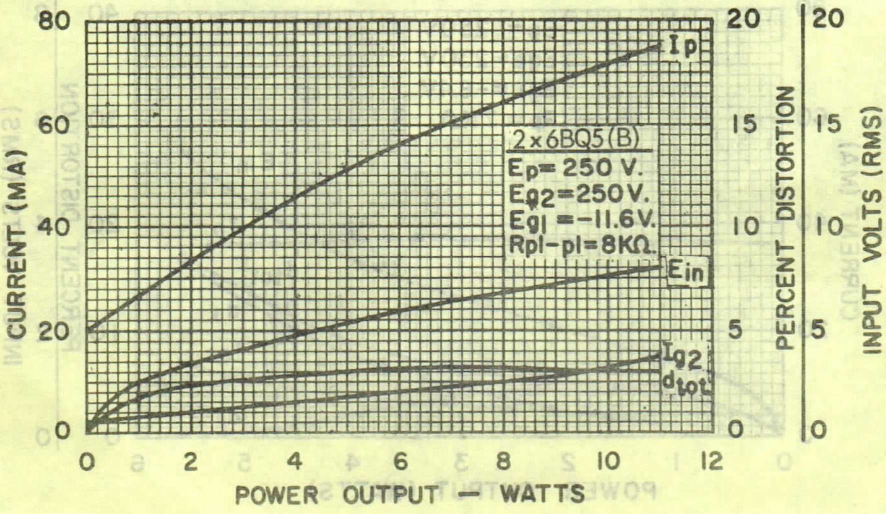
6BQ5/EL84

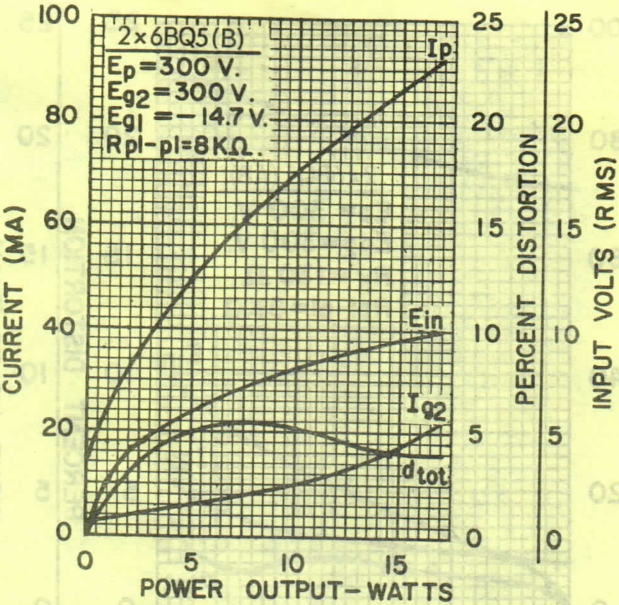

Ep=250V.
Eg2=250V.
Eg1 = -7.3V.
Rp=5.2KΩ.
Ip
Ein
dtot
d3
d2
Ig2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
80
60
40
20
0
20
15
10
5
0
8
6
4
2
0
0
1
2
3
4
5
6

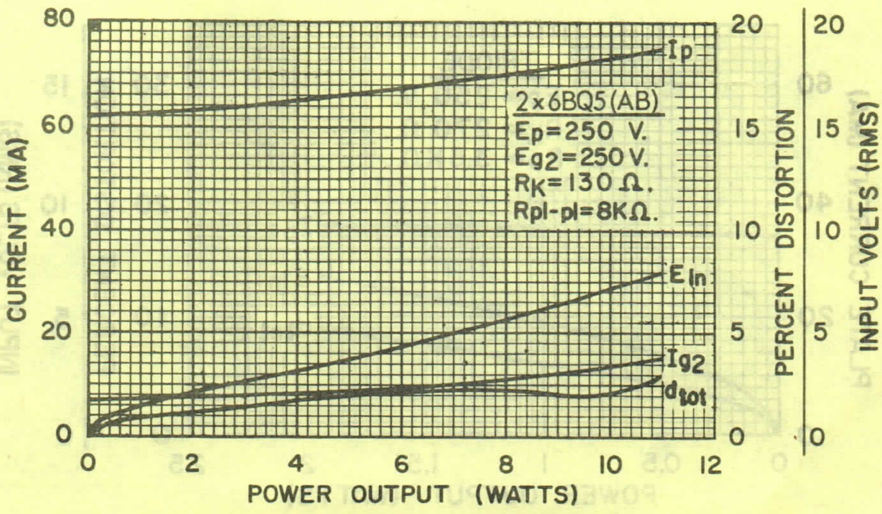

Ep= 250V.
Eg2=250V.
Eg1 =-8.4V.
Rp= 7KΩ.
Ein
Ip
dtot
d3
Ig2
d2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
80
60
40
20
0
40
30
20
10
0
8
6
4
2
0
0
1
2
3
4
5
6

6BQ5/EL84

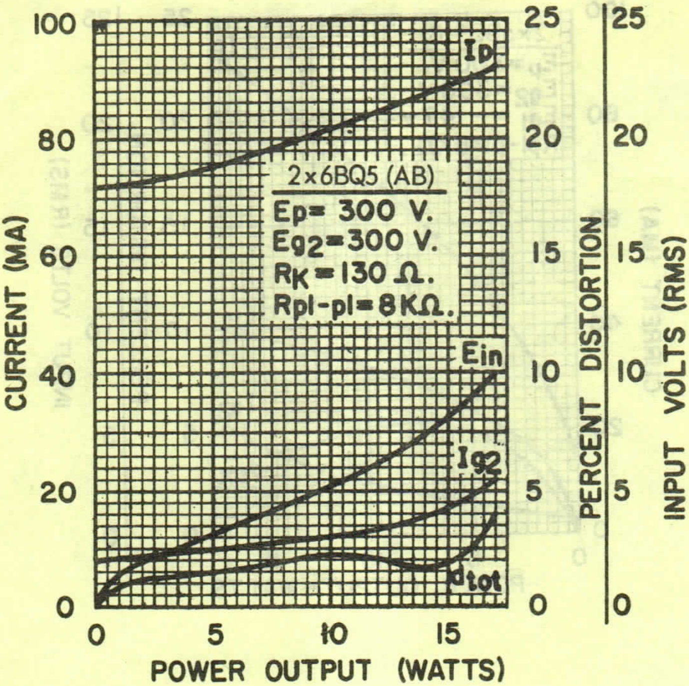

Ep = 250 V.
Eg2 = 210 V.
Eg1 = -6.4 V.
Rp = 7 KΩ
CURRENT (MA)
60
40
20
0
PERCENT DISTORTION
30
20
10
0
INPUT VOLTS (RMS)
6
4
2
0
Ip
Ein
dtot
d3
Ig2
d2
0
1
2
3
4
5
POWER OUTPUT — WATTS

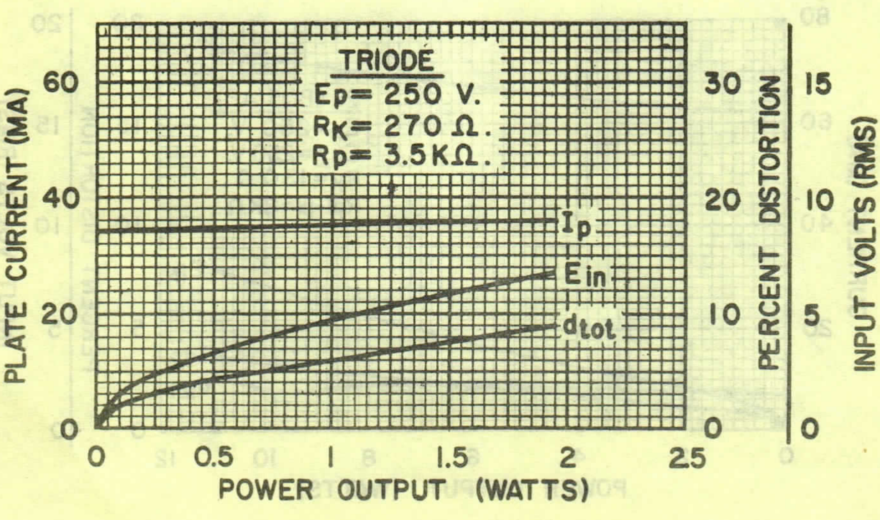

2 x 6BQ5 (B)
Ep = 250 V.
Eg2 = 250 V.
Eg1 = -11.6 V.
Rpl-pl = 8 KΩ.
CURRENT (MA)
80
60
40
20
0
PERCENT DISTORTION
20
15
10
5
0
INPUT VOLTS (RMS)
20
15
10
5
0
Ip
Ein
Ig2
dtot
0
2
4
6
8
10
12
POWER OUTPUT — WATTS

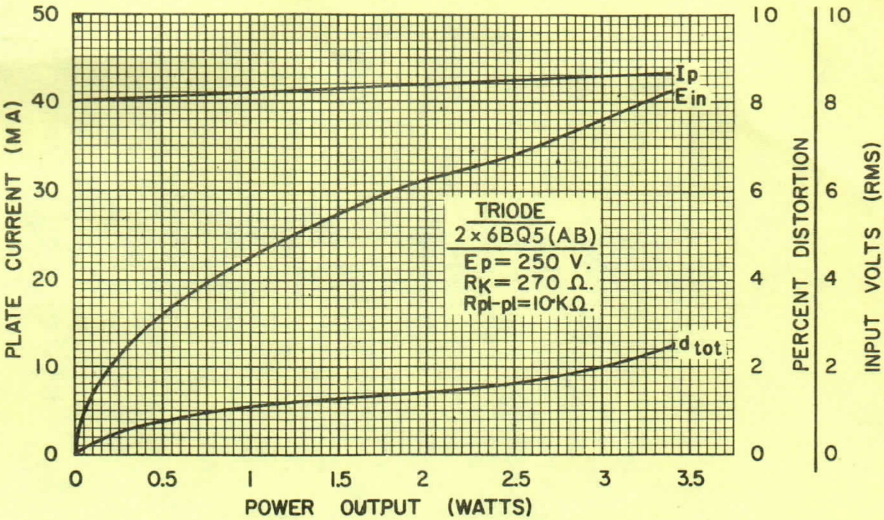

2×6BQ5(B)
Ep=300 V.
Eg2=300 V.
Eg1=−14.7 V.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT-WATTS
0
5
10
15
20
25
40
60
80
100


2×6BQ5(AB)
Ep=250 V.
Eg2=250 V.
RK=130 Ω.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
2
4
6
8
10
12
20
40
60
80
5
15

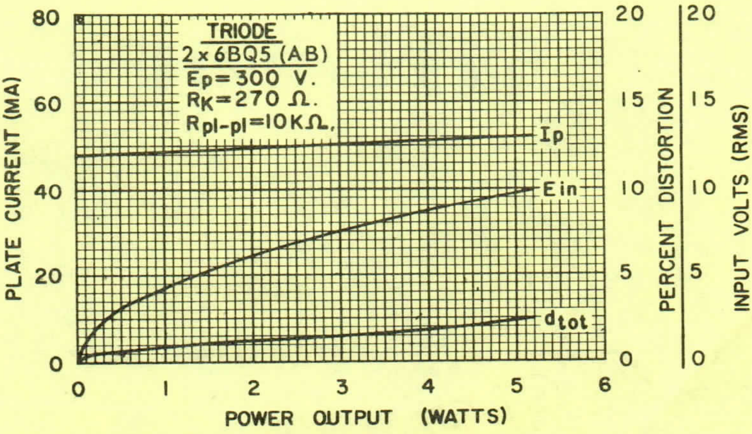
6BQ5/EL84


2×6BQ5 (AB)
Ep= 300 V.
Eg2=300 V.
RK=130 Ω.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)


TRIODE
Ep= 250 V.
RK= 270 Ω.
Rp= 3.5KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)



TRIODE
2 x 6BQ5 (AB)
Ep = 250 V.
RK = 270 Ω.
Rpl-pl = 10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)

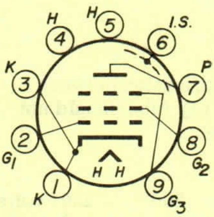


TRIODE
2 x 6BQ5 (AB)
Ep = 300 V.
RK = 270 Ω.
Rpl-pl = 10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)

AMPEREX TUBE TYPE 6BX6

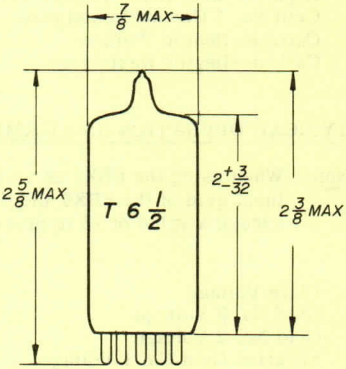
TENTATIVE DATA

The 6BX6 is a sharp cut-off pentode for use as an r-f, i-f or video amplifier in FM and television receivers. It features two cathode leads for high input impedance over the frequency range. Also, a separate suppressor-grid pin connection is brought out for added flexibility.



PIN CONNECTION

1 – CATHODE
2 – GRID NO. 1
3 – CATHODE
4 – HEATER
5 – HEATER
6 – INTERNAL SHIELD
7 – PLATE
8 – GRID NO. 2
9 – GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Noval

ELECTRICAL

Heating	series or parallel supply
Heater Voltage	6.3 volts
Heater Current	300 ma

Direct Interelectrode Capacitances

Grid No. 1 to All Other Elements	7.5 pf
Plate to All Other Elements	3.3 pf
Plate to Grid No. 1	<0.007 pf
Plate to Cathode	<0.012 pf
Grid No. 2 to All Other Elements	5.4 pf
Grid No. 1 to Grid No. 2	2.6 pf
Grid No. 1 to Heater	<0.15 pf
Cathode to Heater	5.0 pf

MAXIMUM RATINGS (DESIGN CENTER)

Plate Voltage (Zero Plate Current)	550 volts
Plate Voltage	300 volts
Plate Dissipation	2.5 watts
Grid No. 2 Voltage (Zero Grid Current)	550 volts
Grid No. 2 Voltage	300 volts
Grid No. 2 Dissipation[1]	0.7 watt
Cathode Current	15 ma
Negative Grid No. 1 Voltage (Grid No. 1 Current = 0.3 μa)	1.3 volts
Grid No. 1 Circuit Resistance	1 megohm
Cathode-Heater Voltage	150 volts
Cathode-Heater Resistance	20,000 ohms

TYPICAL OPERATION AS RF AMPLIFIER

Note: When using the 6BX6 as a video amplifier the amplification between the input grid of the 6BX6 and the input of the cathode ray tube should not exceed a value of 25 to prevent microphonic effects.

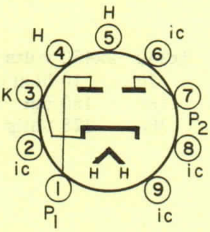
Plate Voltage	170	200	250	volts
Grid No. 3 Voltage	0	0	0	volts
Grid No. 2 Voltage	170	200	250	volts
Negative Grid No. 1 Voltage	2.0	2.55	3.5	volts
Plate Current	10	10	10	ma
Grid No. 2 Current	2.5	2.6	2.8	ma
Transconductance	7400	7100	6800	μmhos
Plate Resistance	0.5	0.55	0.65	megohm
Amplification Factor - Grid No. 2 to Grid No. 1	50	50	50	
Equivalent Noise Resistance	1000	1100	1200	ohms
Grid No. 1 Input Resistance[2]	10,000	12,000	15,000	ohms

[1] For plate dissipation ≤ 1.8 watts, maximum screen grid dissipation is 0.9 watts.
[2] Input resistance at 50 Mc; pin 1 connected to pin 3.

AMPEREX TUBE TYPE 6CA4

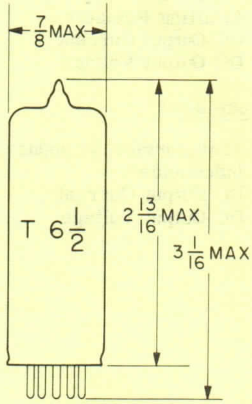
TENTATIVE DATA

The 6CA4 is a miniature, high vacuum full wave rectifier capable of output currents up to 150 milliamperes. Its high current and voltage ratings in a small T 6-1/2 envelope make it particularly suitable for application in compact Hi-Fi component designs.



PIN CONNECTIONS

1 – PLATE NO. 1
2 – INTERNAL CONNECTION
3 – CATHODE
4 – HEATER
5 – HEATER
6 – INTERNAL CONNECTION
7 – PLATE NO. 2
8 – INTERNAL CONNECTION
9 – INTERNAL CONNECTION



6-4

GENERAL CHARACTERISTICS

MECHANICAL

Outline	6-4
Base	E 9-1, small button, 9 pin
Bulb	T 6-1/2 glass
Mounting Position	any

ELECTRICAL

Heater	indirectly heated, coated unipotential
Heater Voltage	6.3 volts
Heater Current	1.0 amp

MAXIMUM VALUES (DESIGN CENTER)

Peak Inverse Voltage	1300 volts
Peak Plate Current	500 ma
Plate Current (Surge)	1.8 amps
Cathode to Filament Voltage (Cathode Positive)	500 volts

TYPICAL OPERATING CHARACTERISTICS

Capacitor Input

Transformer Secondary Voltage	2x250	2x350	2x450	volts (RMS)
Capacitance (Input Filter Capacitor)	50	50	50	μf
Limiting Resistor	2x150	2x230	2x310	ohms
DC Output Current	160	150	100	ma
DC Output Voltage	245	352	497	volts

Choke Input

Transformer Secondary Voltage	2x250	2x350	2x450	volts (RMS)
Inductance	10	10	10	henrys
DC Output Current	180	180	150	ma
DC Output Voltage	199	288	378	volts

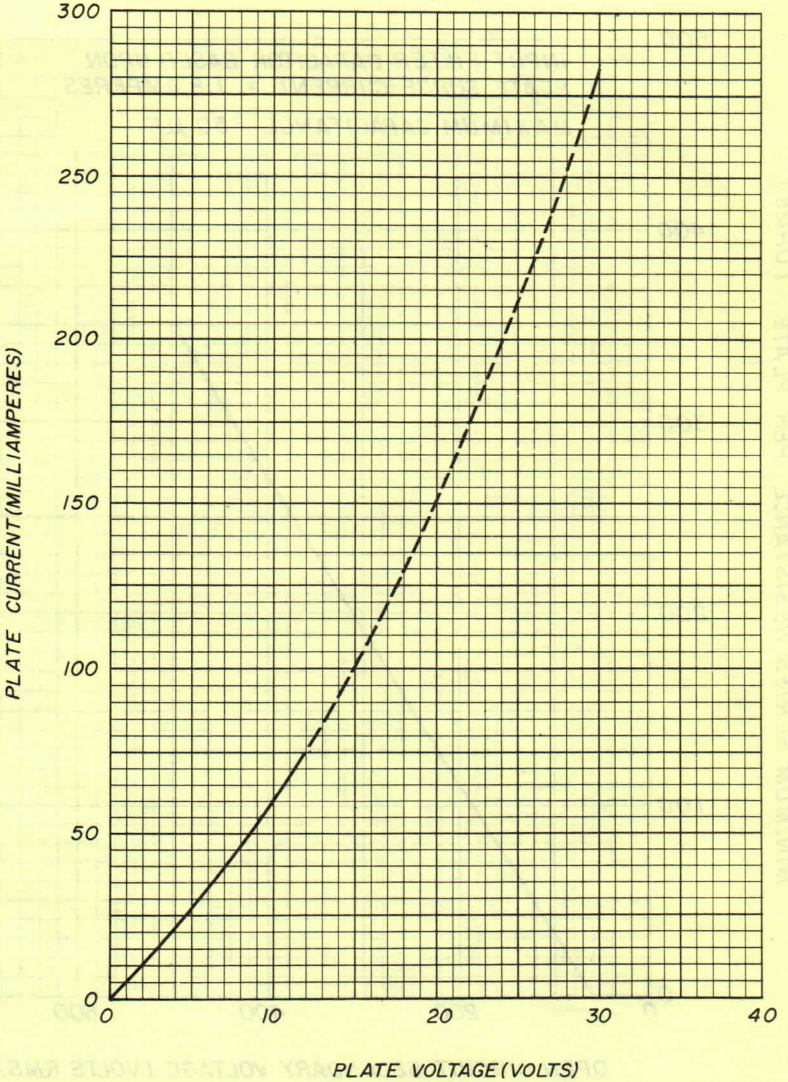


Figure 1. Rectification Characteristics

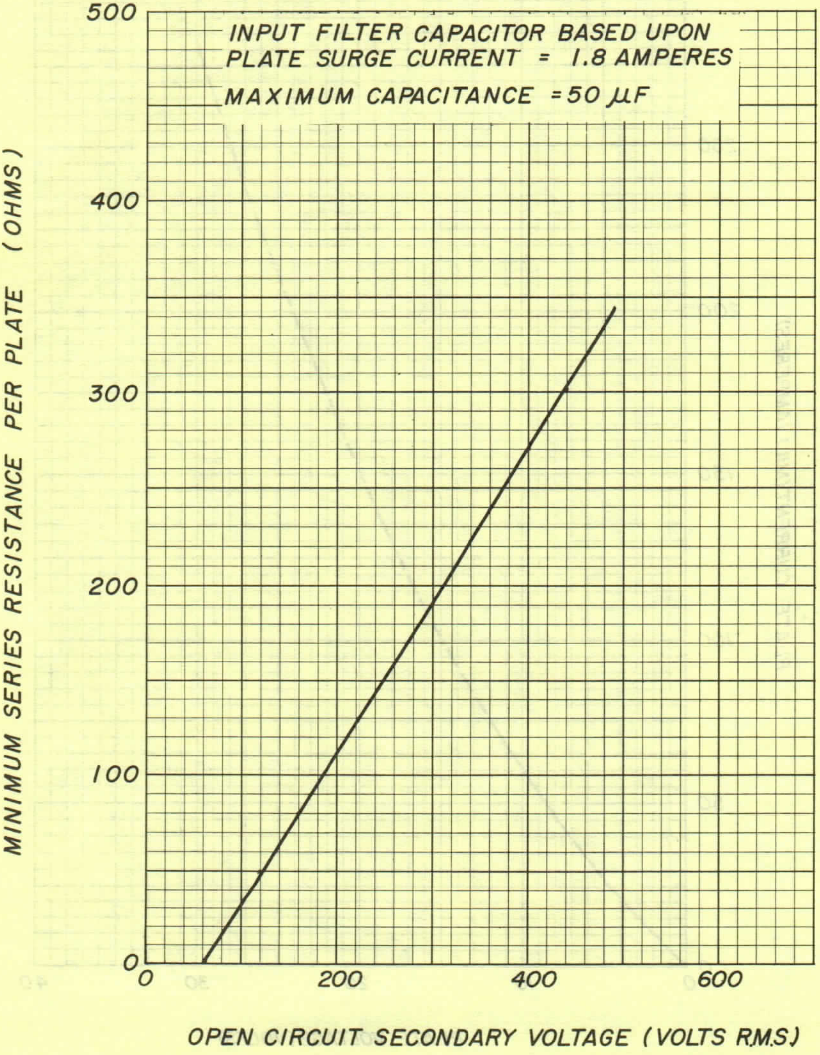


Figure 2. Limiting Resistor Requirement Curve

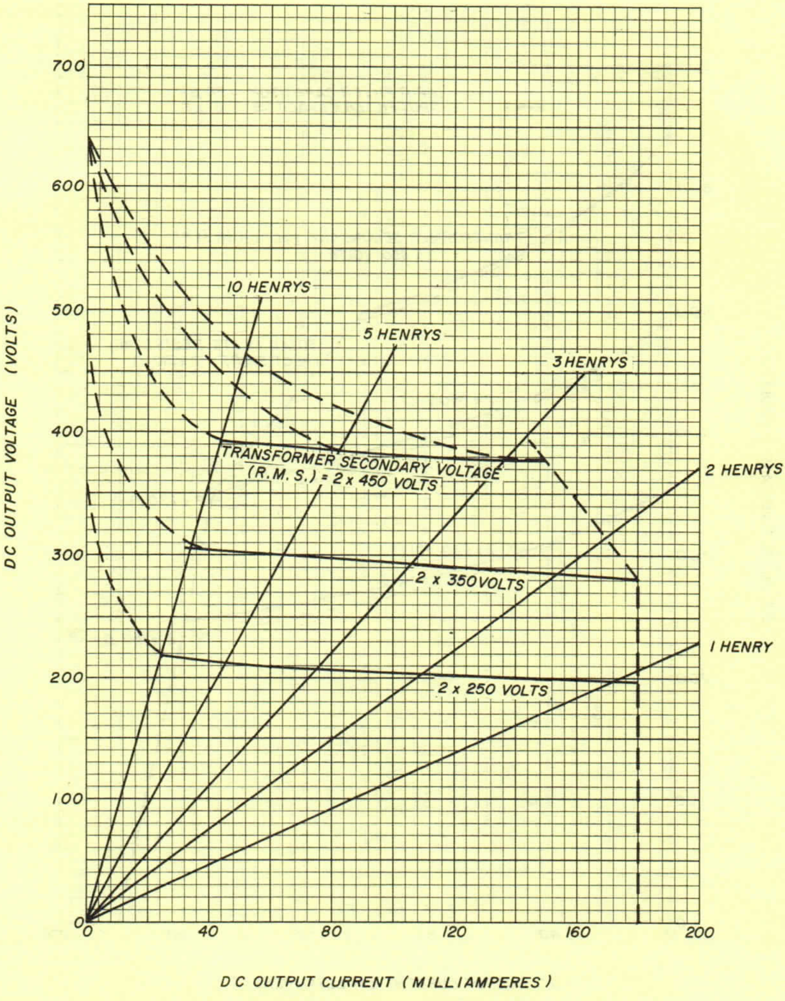


Figure 3. DC Output Voltage vs. Output Current (Choke Input Filter)

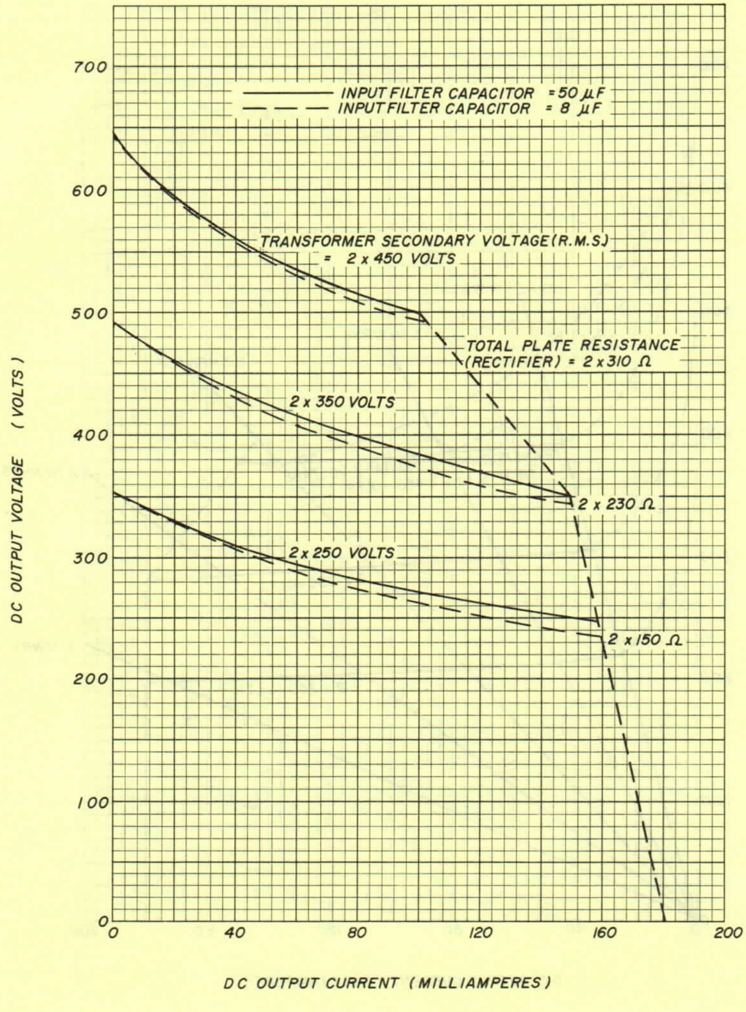


Figure 4. DC Output Voltage vs. DC Output Current (Capacitor Input Filter)

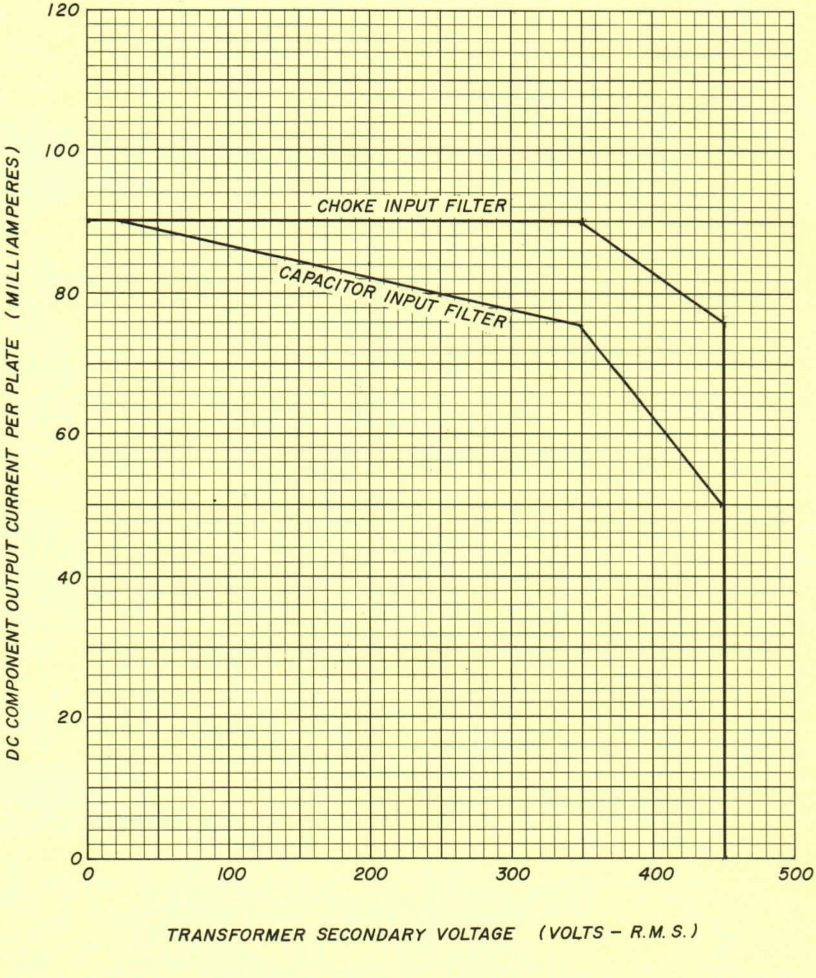


Figure 5. DC Output Current per Plate
vs. Input Voltage

AMPEREX TUBE TYPE 6CA7/EL34

The 6CA7 is a power pentode designed especially for high fidelity audio systems. It has a plate dissipation of 25 watts and delivers high power without drawing control-grid current.

The 6CA7 features high efficiency with extremely low distortion. Great care is taken in manufactuing so that there is very little spread in characteristics of individual tubes. Thus, the rated output power can be obtained with all tubes. The tube also features high sensitivity which results in low distortion introduced by driver stages.

The tube features a large plate dissipation reserve. The high allowable grid leak resistance imporves the performance of preceding stages.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	coated unipotential
Heater Voltage	6.3 volts
Heater current	1.5 amps

Direct Interelectrode Capacitances

Grid No. 1 to all other elements except plate		15.2 uuf
Plate to all other elements except grid No. 1		8.4 uuf
Plate to grid No. 1	max.	1.1 uuf
Grid No. 1 to heater	max.	1.0 uuf
Heater to cathode		10 uuf

MECHANICAL

Base	JETEC #8ET, octal, 8 pin
Bulb	Tubular, 1 5/16" max. dia.
Max. overall length	4 7/16"
Max. seated height	3 7/8"
Max. diameter	1 1/2"
Mounting position	any

6CA7/EL34

MAXIMUM RATINGS (Design Center Values)

Plate voltage	800	volts
Plate voltage without plate current	2000	volts
Plate dissipation	27.5	watts
Plate dissipation without input signal	25	watts
Grid No. 2 voltage	425	volts
Grid No. 2 voltage without plate current	800	volts
Grid No. 2 dissipation	8	watts
Cathode current	150	ma
Grid current starting point. Grid No. 1 voltage when grid No. 1 current is 0.3 u amp	1.3	volts
Grid No. 1 circuit resistance (class A and AB)	0.7	megohm
Grid No. 1 circuit resistance (class B)	0.5	megohm
External resistance between heater and cathode	20,000	ohms
Voltage between heater and cathode	100	volts

Operating Characteristics Class A, one tube

Supply voltage	265	265	volts
Plate voltage	250	250	volts
Grid No. 2 series resistor	2000	0	ohms
Grid No. 3 voltage	0	0	volt
Grid No. 1 bias	−14.5	−13.5	volts
Plate current	70	100	ma
Grid No. 2 current	10	15	ma
Transconductance	9,000	11,000	micromhos
Amplification factor of grid No. 2 with respect to grid No. 1	11	11	
Plate resistance	18,000	15,000	ohms
Plate load resistance	3,000	2,000	ohms
Input voltage	9.3	8.7	volts (rms)
Max. signal power output	8	11	watts
Total harmonic distortion	10	10	percent
Input voltage for power output of 50 m watts	0.65	0.5	volt (rms)

Operating Characteristics Class B, two tubes

Supply voltage 425 volts

Common grid No. 2 resistor (without decoupling)		1000		ohms
Grid No. 1 bias		−38		volts
Grid No. 3 voltage		0		volts
Input voltage	0	27	27	volts (rms)
Load resistance, plate to plate	——	3400	4000	ohms
Supply voltage	425	425	400	volts
Plate voltage	420	400	375	volts
Plate current	2x30	2x120	2x100	ma
Grid No. 2 current	2x4.4	2x25	2x25	ma
Max. signal power output	0	55	45	watts
Total harmonic distortion	——	5	6	percent

Operating Characteristics Class B, two tubes

Supply Voltage 375 volts

Common grid No. 2 resistor (without decoupling)		470		ohms
Grid No. 1 bias		− 32		volts
Grid No. 3 voltage		0		volt
Input voltage	0	22.7	22.7	volts (rms)
Load resistance, plate to plate	——	2800	3800	ohms
Supply voltage	375	375	350	volts
Plate voltage	370	350	325	volts
Plate current	2x35	2x120	2x93	ma
Grid No. 2 current	2x4.7	2x25	2x25	ma
Max. signal power output	0	44	36	watts
Total harmonic distortion	——	5	6	percent

Operating Characteristics Class B, two tubes

Supply voltage 500/400 volts

Common grid No. 2 resistor (without decoupling)		750		ohms
Grid No. 1 bias		−36		volts
Grid No. 3 voltage		0		volt
Input voltage	0	25.8	25.8	volts (rms)
Load resistance, plate to plate	——	4000	5000	ohms
Plate supply voltage	500	500	475	volts
Plate voltage	495	475	450	volts
Grid No. 2 supply voltage	400	400	375	volts
Plate current	2x30	2x125	2x102	ma
Grid No. 2 current	2x4	2x25	2x25	ma
Max. signal power output	0	70	58	watts
Total harmonic distortion	——	5	6	percent

Operating Characteristics Class B, two tubes

Supply voltage 800/400 volts

Common grid No. 2 resistor (without decoupling)		750		ohms
Grid No. 1 bias		−39		volts
Grid No. 3 voltage		0		volt
Input voltage	0	23.4	23.4	volts (rms)
Load resistance, plate to plate	——	11,000	11,000	ohms
Plate supply voltage	800	800	750	volts
→ Plate voltage	795	775	725	volts
Grid No. 2 supply voltage	400	400	375	volts
Plate current	2x25	2x91	2x84	ma
Grid No. 2 current	2x3	2x19	2x19	ma
Max. signal power output	0	100	90	watts
Total harmonic distortion	——	5	6	percent

Revised 9/57

6CA7/EL34

Operating Characteristics Class AB, two tubes

Supply voltage 375 volts

Load resistance, plate to plate	3400		ohms
Common grid No. 2 resistor	470		ohms
Cathode resistor	130		ohms
Grid No. 3 voltage	0		volt
Input voltage	0	21	volts (rms)
Supply voltage	375	375	volts
Plate voltage + voltage across cathode resistor	355	350	volts
Plate current	2x75	2x95	ma
Grid No. 2 current	2x11.5	2x22.5	ma
Max. signal power output	0	35	watts
Total harmonic distortion	——	5	percent

Operating Characteristics in Triode Connection

(Grid No. 2 connected to plate)

Class A, one tube, supply voltage 375 volts

Supply voltage	375	volts
Grid No. 3 voltage	0	volt
Cathode resistor	370	ohms
Load resistance	3000	ohms
Input voltage	18.9	volts (rms)
Plate current	70	ma
Max. signal power output	6	watts
Total harmonic distortion	8	percent
Input voltage for power output of 50 milliwatts	1.7	volts (rms)

Operating Characteristics in Triode Connection

(Grid No. 2 connected to plate)

Class AB, two tubes, supply voltage 400 volts

Supply voltage	400		volts
Grid No. 3 voltage	0		volt
Cathode resistor	220		ohms
Load resistance, plate to plate	5000		ohms
Input voltage	0	22	volts (rms)
Plate current	2x65	2x71	ma
Max. signal power output	0	16.5	watts
Total harmonic distortion	——	3	percent

TENTATIVE DATA

Class AB_1 Audio Amplifier
Distributed Load Connection

←

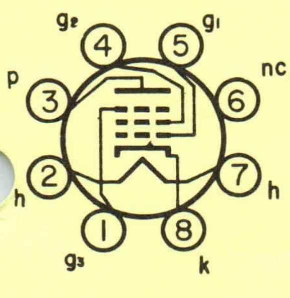
Maximum Ratings (Design Center Values)

Plate and Grid No. 2 Supply Voltage	500 V
Plate Dissipation	25 W
Grid No. 2 Dissipation	8 W
Cathode Current	150 mA
Grid Current Starting Point - Grid No. 1 Voltage when Grid No. 1 Current is 0.3 μA	−1.3 V
Grid No. 1 Circuit Resistance	500 KΩ
External Resistance Between Heater and Cathode	20 KΩ
Voltage Between Heater and Cathode	100 V

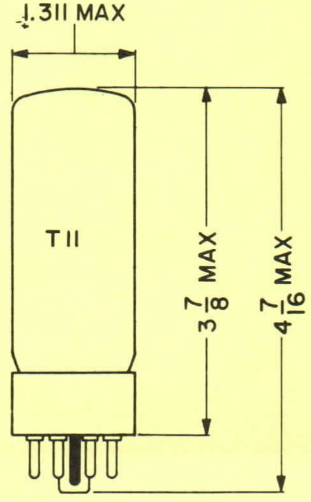
Typical Operation (Fixed Bias - Two Tubes Push Pull)

Plate Supply Voltage	500 V
Grid No. 2 Supply Voltage	(See Note 1)
Grid No. 1 Bias	(approx.) −44.5 V
Plate to Plate Load Resistance	7000 Ω
Plate and Grid No. 2 Current (Zero Signal)	2x57 mA
Plate and Grid No. 2 Current (Max Signal)	2x112 mA
Input Signal Voltage (rms)	32 V
Power Output	60 W
Harmonic Distortion	2.5 %

Note 1:
Screen voltage is obtained from taps located at 43% of the plate winding turns. An unbypassed resistor of 1 KΩ in series with each screen grid is necessary to prevent screen overload.



PIN CONNECTIONS
NO.1- GRID NO.3
NO.2- HEATER
NO.3- PLATE
NO.4- GRID NO.2
NO.5- GRID NO.1
NO.6- N.C.
NO.7- HEATER
NO.8- CATHODE

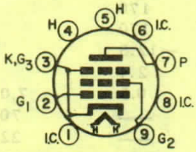


Revised 9/60

AMPEREX TUBE TYPE 6CW5/EL86

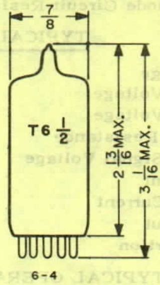
The 6CW5/EL86 is a high current, low voltage output pentode designed for application in medium power Hi-Fi amplifiers. A pair of tubes in Class AB_1 push-pull operation yields an output of up to 25 watts with only 1% distortion (without feedback).

The 6CW5/EL86 is also useful in single ended push-pull circuits because of its highly efficient operation with relatively low supply voltage. In a typical transformerless circuit, a pair of 6CW5/EL86 tubes can deliver up to 10 watts in Class AB_1.



PIN CONNECTIONS

1 – INTERNALLY CONNECTED
2 – GRID NO. 1.
3 – CATHODE & GRID NO.3.
4 – HEATER
5 – HEATER
6 – INTERNALLY CONNECTED
7 – PLATE
8 – INTERNALLY CONNECTED
9 – GRID NO. 2.



GENERAL CHARACTERISTICS

MECHANICAL

Maximum Dimensions	see outline drawing
Bulb	T-6½
Outline	6-4
Base	E9-1
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heater Voltage	6.3 volts
Heater Current	0.76 amps
Direct Interelectrode Capacitances	
Output	6.0 $\mu\mu f$
Input	12.0 $\mu\mu f$
Plate to Grid No. 1	0.6 $\mu\mu f$
Grid No. 1 to Heater	0.25 $\mu\mu f$
Characteristics	
Plate Voltage	170 volts
Grid No. 2 Voltage	170 volts
Grid No. 1 Voltage	–12.5 volts
Plate Current	70 mA
Grid No. 2 Current	5 mA
Transconductance	10,000 micromhos
Amplification Factor (Grid No. 1 to Grid No. 2)	8
Internal Plate Resistance	23 K Ω

NOTE

The tube type 45B5/UL84 has the same electrical characteristics as the Amperex type 6CW5/EL86 except that the heater ratings are as follows:

Heater Voltage	45 volts
Heater Current	100 mA

(kindly place this notice in the "Special Purpose Tube" section of your manual preceeding data for type 6CW5/EL86)

6CW5/EL86

MAXIMUM RATINGS (Design Center Values)

Plate Supply Voltage	550	volts
Plate Voltage	250	volts
Plate Dissipation	12	watts
Grid No. 2 Supply Voltage	550	volts
Grid No. 2 Voltage	200	volts
Grid No. 2 Dissipation	1.75	watts
Peak Grid No. 2 Dissipation	6	watts
Cathode Current	100	mA
Grid Resistance (with cathode bias)	1	megohm
Peak Heater-Cathode Voltage (cathode positive) [1]	300	volts
Heater-Cathode Voltage (cathode negative to heater)	100	volts
Heater-Cathode Circuit Resistance	20	KΩ

TYPICAL OPERATION, ONE TUBE, CLASS A

Plate Voltage		170		volts
Grid No. 2 Voltage		170		volts
Grid No. 1 Voltage		−12.5		volts
Plate Load Resistance		2.4		KΩ
Input (rms) Signal Voltage	0	0.5	7.0	volts
Plate Current	70	—	70	mA
Grid No. 2 Current	5	—	22	mA
Power Output	—	0.05	5.6	watts
Total Distortion	—	—	10	%

TYPICAL OPERATION, TWO TUBES, PUSH-PULL, CLASS AB_1

TENTATIVE DATA

Plate Voltage	250	volts
Grid No. 2 Voltage	200	volts
Grid No. 1 Voltage (approx.)	− 18.5	volts
Plate to Plate Load Resistance	3	KΩ
Plate Current (zero signal)	91	mA
Plate Current (max signal)	180	mA
Grid No. 2 Current (zero signal)	2x2	mA
Grid No. 2 Current (max signal)	2x11.5	mA
Input Signal (rms)	12	volts
Power Output	25	watts
Percent Distortion	1	%

TYPICAL OPERATION, SINGLE-ENDED, PUSH-PULL, CLASS A

Operating Conditions - Single Ended, Push-Pull (Single Tone)

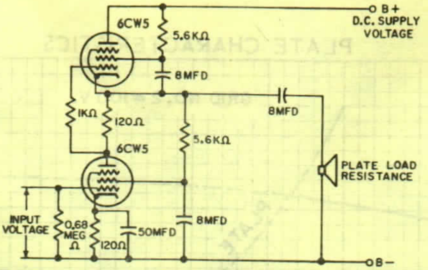
Supply Voltage		300		volts
Plate Load Resistance		1		KΩ
Input (rms) Signal Voltage	0	0.55	5.7	volts
D.C. Supply Current	69	—	67	mA
Power Output	—	0.05	4.8	watts
Total Distortion	—	—	9.3	%

Operating Conditions - Single Ended, Push-Pull (Double Tone)

Supply Voltage		300		volts
Plate Load Resistance		1		KΩ
Input (rms) Signal Voltage [2]	0	—	2.85	volts
D.C. Supply Current	69	—	67	mA
Power Output	—	—	5.9	watts
Total Distortion	—	—	8.5	%

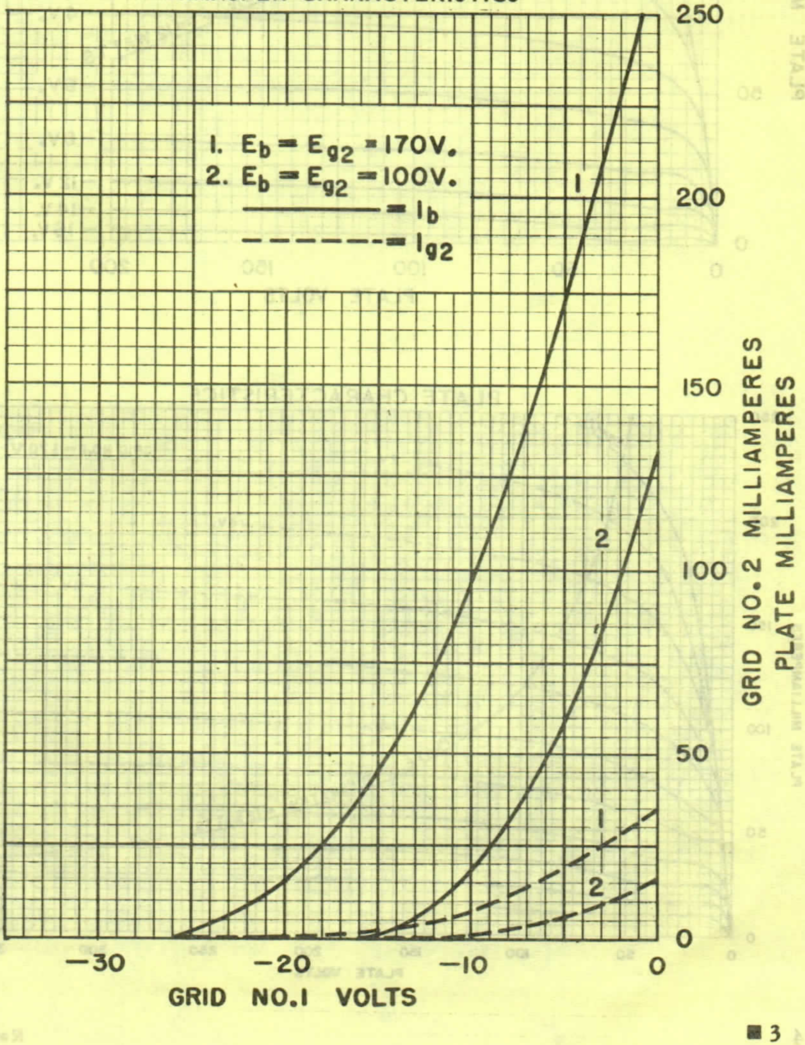
1 D.C. component max. 150 volts

2 R.M.S. value of each tone.



TYPICAL CIRCUIT; SINGLE-ENDED, PUSH-PULL; CLASS A

TRANSFER CHARACTERISTICS



6CW5/EL86

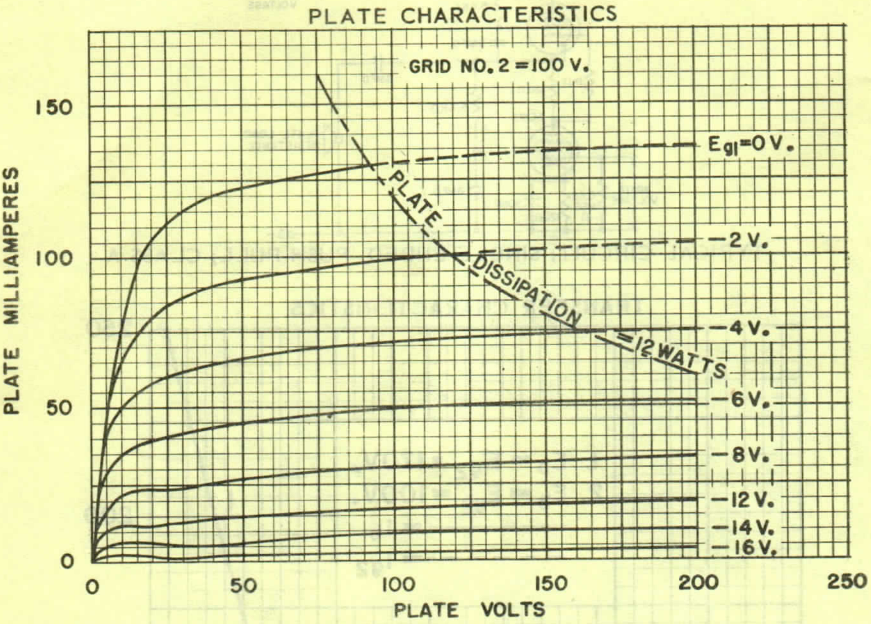


PLATE CHARACTERISTICS
GRID NO. 2 = 100 V.
E_{g1}=0 V.
-2 V.
-4 V.
-6 V.
-8 V.
-12 V.
-14 V.
-16 V.
PLATE DISSIPATION = 12 WATTS
PLATE MILLIAMPERES
PLATE VOLTS
0
50
100
150
200
250

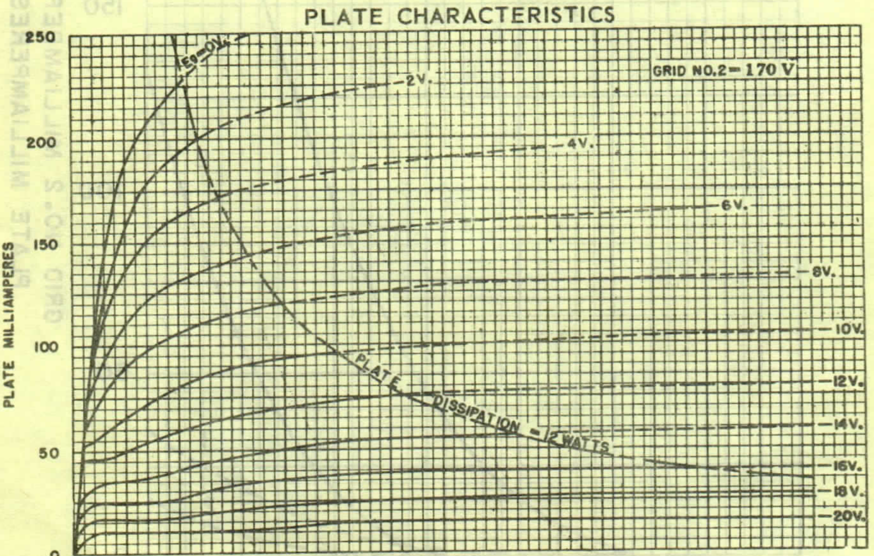
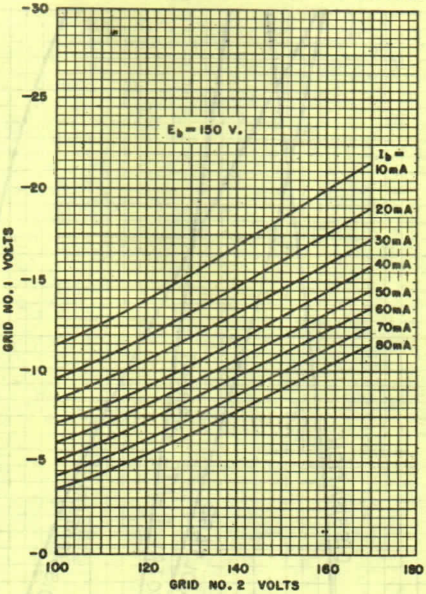
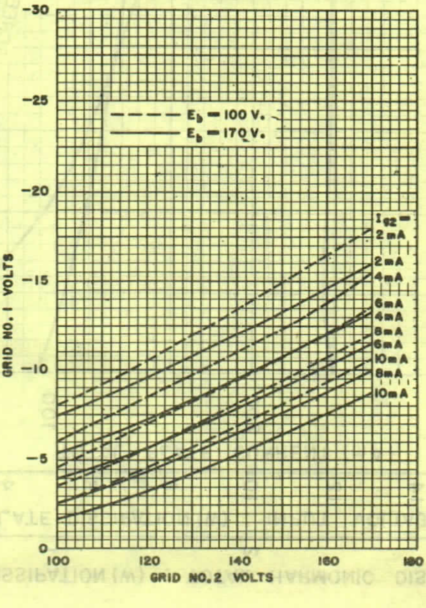


PLATE CHARACTERISTICS
GRID NO. 2 = 170 V
E_g=0V.
-2V.
-4V.
-6V.
-8V.
-10V.
-12V.
-14V.
-16V.
-18V.
-20V.
PLATE DISSIPATION = 12 WATTS
PLATE MILLIAMPERES
PLATE VOLTS
0
50
100
150
200
250
300
350

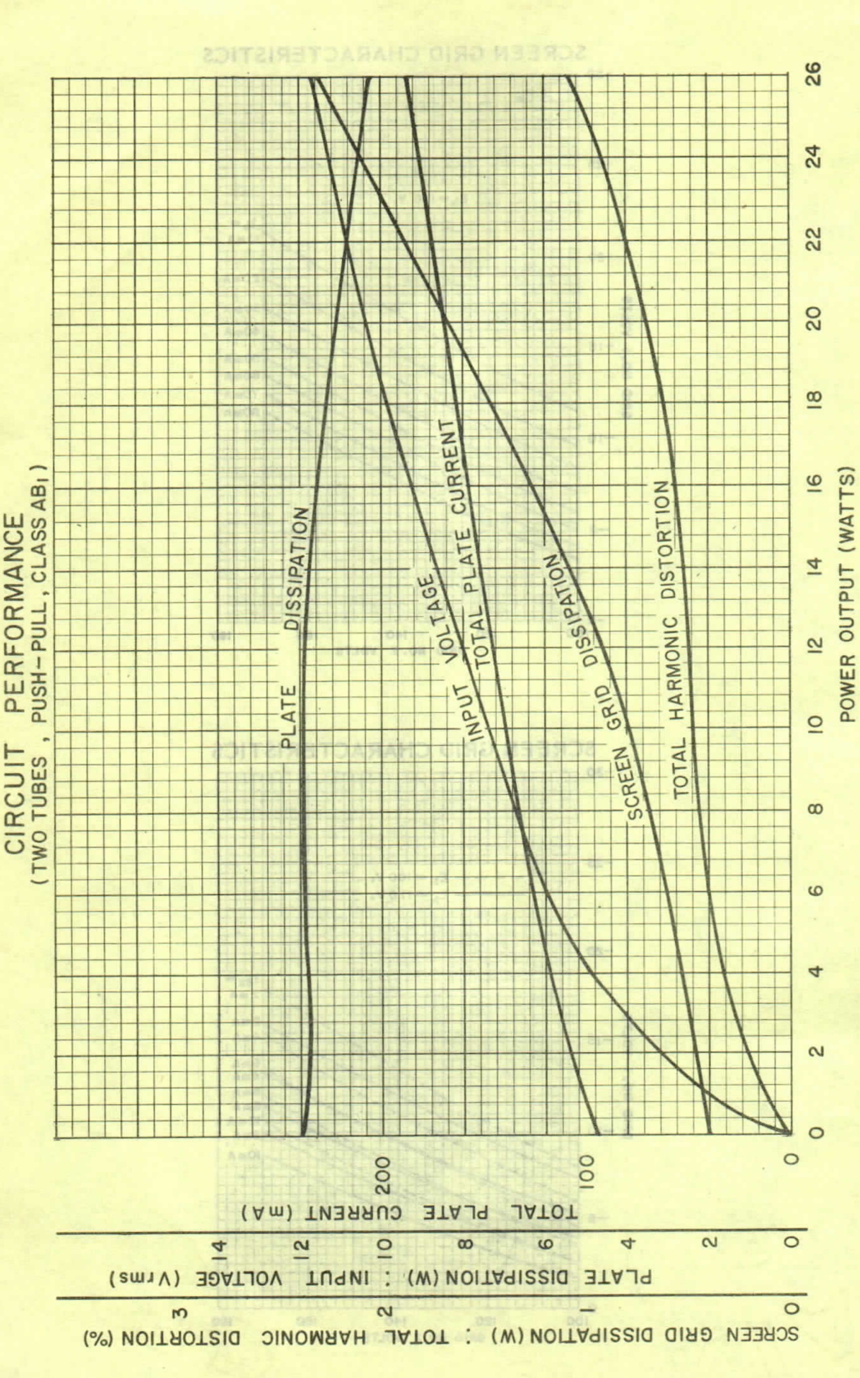
SCREEN GRID CHARACTERISTICS



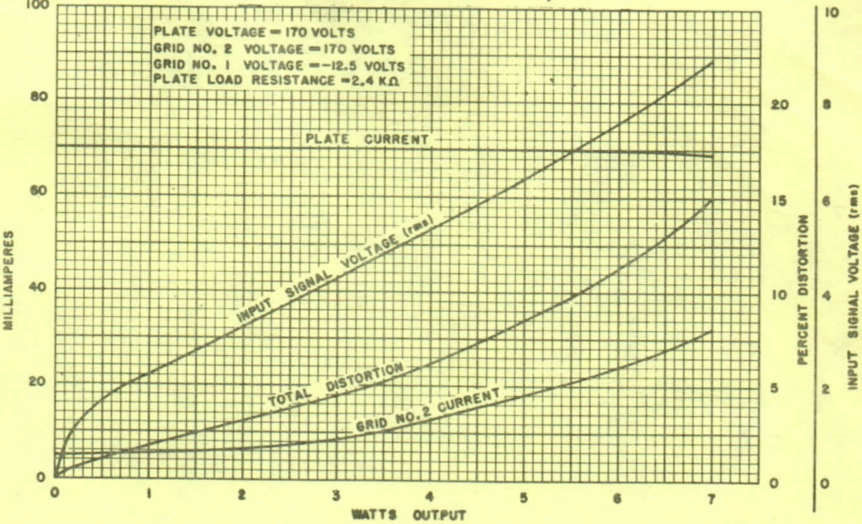
SCREEN GRID CHARACTERISTICS



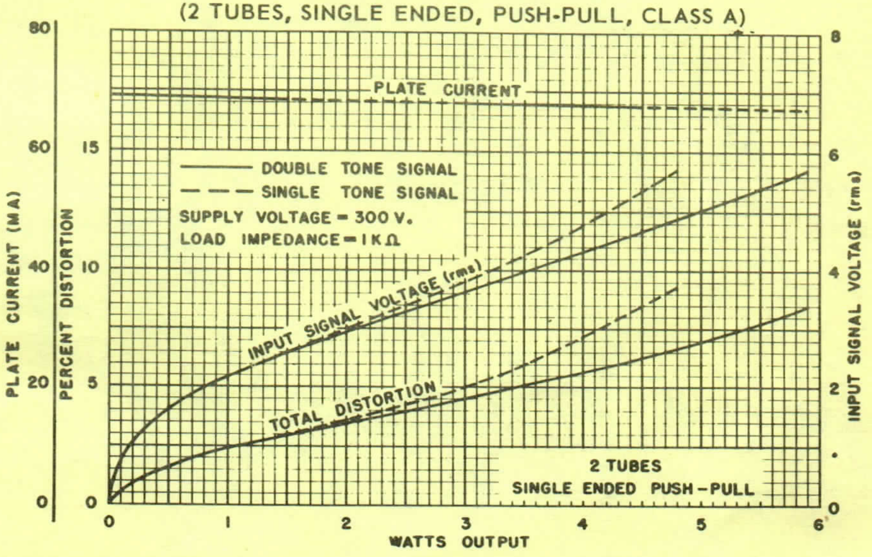
6CW5/EL86


CIRCUIT PERFORMANCE
(TWO TUBES, PUSH-PULL, CLASS AB1)
PLATE DISSIPATION
INPUT VOLTAGE
TOTAL PLATE CURRENT
SCREEN GRID DISSIPATION
TOTAL HARMONIC DISTORTION
POWER OUTPUT (WATTS)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
TOTAL PLATE CURRENT (mA)
0
100
200
PLATE DISSIPATION (W) : INPUT VOLTAGE (V rms)
0
2
4
6
8
10
12
14
SCREEN GRID DISSIPATION (W) : TOTAL HARMONIC DISTORTION (%)
0
1
2
3

CIRCUIT PERFORMANCE
(ONE TUBE, CLASS A)

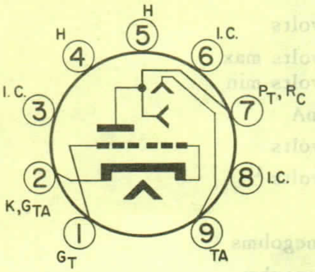


CIRCUIT PERFORMANCE
(2 TUBES, SINGLE ENDED, PUSH-PULL, CLASS A)



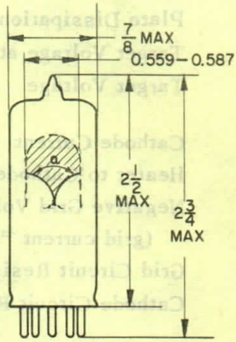
AMPEREX TUBE TYPE 6DA5/EM81

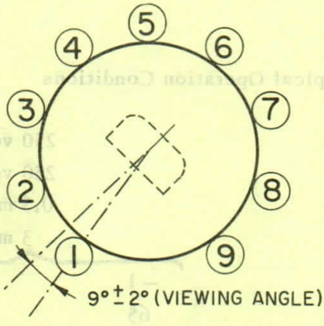
The 6DA5/EM81 is a tuning indicator having a bright and highly sensitive indicating pattern. Comprised of an amplifying triode in combination with an indicating system, the EM81 is especially designed for use in AM and FM receivers with a normal A.G.C. circuit.



PIN CONNECTIONS

1— GRID, TRIODE
2— CATHODE, TARGET GRID
3— INTERNAL CONNECTION
4— HEATER
5— HEATER
6— INTERNAL CONNECTION
7— PLATE OF TRIODE, RAY CONTROL ELECTRODE
8— INTERNAL CONNECTION
9— TARGET





GENERAL CHARACTERISTICS

MECHANICAL

Maximum Dimensions	See outline drawing
Bulb	T-6½
Outline	6-3
Base	E9-1
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heating	indirect by AC or DC, parallel supply
Heater Voltage	6.3 volts
Heater Current	300 mA

6DA5/EM81

Maximum Ratings

Plate Voltage at Zero Plate Current	550 volts
Plate Voltage	300 volts
Plate Dissipation	0.2 watts
Target Voltage at Zero Current	550 volts
Target Voltage	300 volts max 165 volts min
Cathode Current	3 mA
Heater to Cathode Voltage	100 volts
Negative Grid Voltage (grid current = 0.3 μA)	1.3 volts [1]
Grid Circuit Resistance	3 megohms
Cathode Circuit Resistance	0.02 megohm

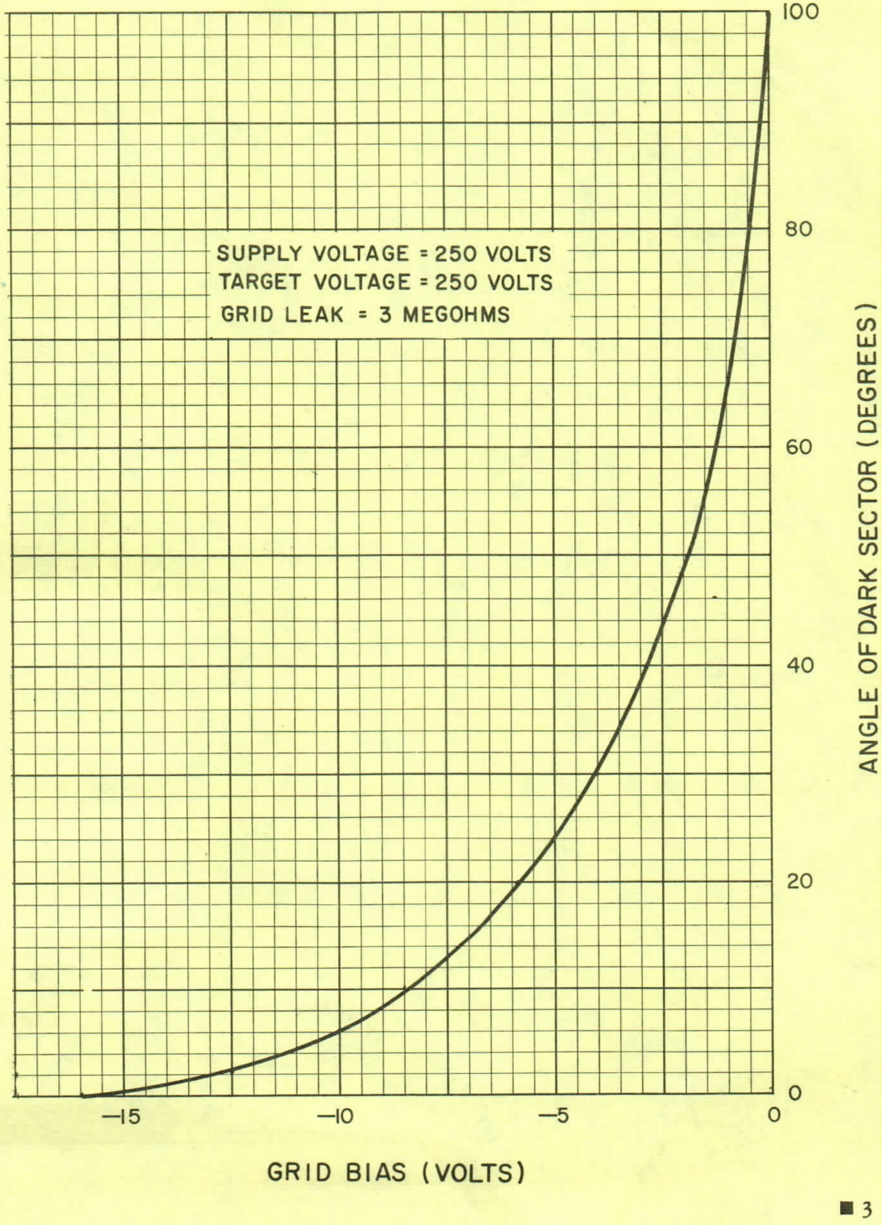
Typical Operation Conditions

Plate Supply Voltage	250 volts	
Target Voltage	250 volts	
Plate Series Resistor	0.5 megohm	
Grid Series Resistor	3 megohms	
Grid Voltage	−1	−10.5 volts
Shadow Angle	65	5 degrees
Plate Current	0.37	0.02 mA
Target Current	2.0	2.3 mA

[1] The grid voltage should never be more positive than this value.

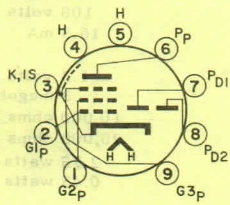
6DA5/EM81

LIGHT SECTOR CHARACTERISTICS



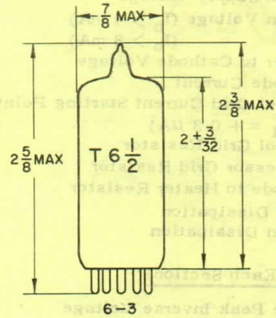
AMPEREX TUBE TYPE 6DC8/EBF89

The 6DC8/EBF89 is a double diode-pentode having a common cathode. It is especially designed for use as an RF or IF amplifier. The diodes are for AM detection and AGC and the pentode features a high transconductance which is important in AM/FM and TV applications.



PIN CONNECTIONS

1 - GRID NO. 2, PENTODE
2 - GRID NO. 1, PENTODE
3 - CATHODE, INTERNAL SHIELD
4 - HEATER
5 - HEATER
6 - PLATE OF PENTODE
7 - PLATE OF DIODE NO. 1
8 - PLATE OF DIODE NO. 2
9 - GRID NO. 3, PENTODE



GENERAL CHARACTERISTICS

MECHANICAL

Overall Dimensions	see outline drawing
Bulb	T6½
Outline	6-3
Base	E9-1
Mounting Position	any

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel or series supply
Heater Voltage	6.3 volts
Heater Current	300 mA

Direct Interelectrode Capacitances

Pentode Section

Input	5 $\mu\mu$f
Output	5.2 $\mu\mu$f
Plate to Control Grid	< .0025 $\mu\mu$f
Control Grid to Heater	< 0.05 $\mu\mu$f

Diode Sections

Diode 1	2.5 $\mu\mu$f
Diode 2	2.5 $\mu\mu$f
Diode 1 to Diode 2	0.25 $\mu\mu$f
Diode 1 to Heater	0.015 $\mu\mu$f
Diode 2 to Heater	0.003 $\mu\mu$f

Between Diode and Pentode Sections

Diode 1 to Control Grid	0.0008 $\mu\mu$f
Diode 2 to Control Grid	0.001 $\mu\mu$f
Diode 1 to Plate	0.15 $\mu\mu$f
Diode 2 to Plate	0.025 $\mu\mu$f

6DC8/EBF89

Maximum Ratings, (Design Center Values)

Pentode Section

Plate Supply Voltage	550 volts
Plate Voltage	300 volts
Screen Supply Voltage	550 volts
Screen Voltage ($I_b > 4$ mA)	300 volts
($I_b > 8$ mA)	125 volts
Heater to Cathode Voltage	100 volts
Cathode Current	16.5 mA
Control Grid Current Starting Point ($I_{c1} = + 0.3\ \mu A$)	— 1.3 volts
Control Grid Resistor	3 megohms [1]
Suppressor Grid Resistor	10,000 ohms
Cathode to Heater Resistor	20,000 ohms
Plate Dissipation	2.25 watts
Screen Dissipation	0.45 watts

Diodes (Each Section)

Diode Peak Inverse Voltage	200 volts
Diode Current	0.8 mA
Diode Peak Current	5.0 mA
Diode Current Starting Point ($I_d = + 0.3\ \mu A$)	— 1.3 volts

Characteristics

Plate Voltage	250	250	200	170	volts
Screen Voltage	100	80	100	100	volts
Suppressor Voltage	0	0	0	0	volts
Negative Grid Voltage	2	1 [2]	1.5	1 [2]	volts
Plate Current	9	9	11	12	mA
Screen Current	2.7	2.7	3.3	4	mA
Transconductance	3800	4500	4500	5000	micromhos
Amplification Factor, G1 to G2	20	20	20	20	
Plate Resistance	1.0	0.9	0.6	0.4	megonm

Typical Operation

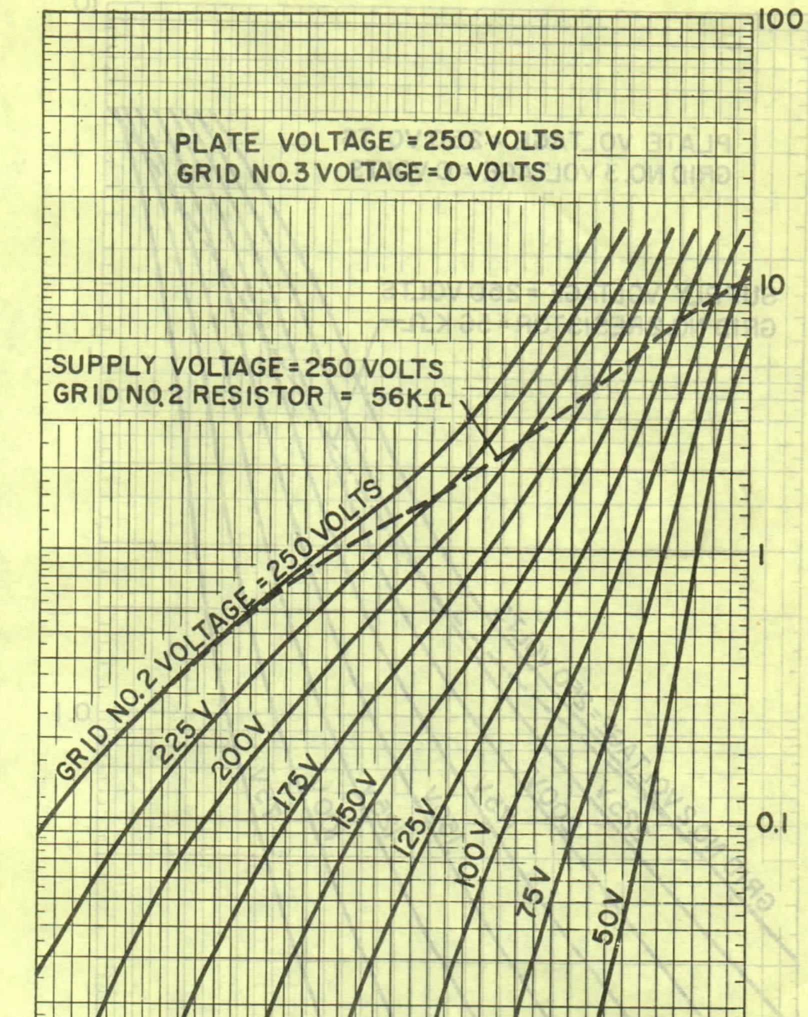
Plate Supply Voltage	250		250		200		volts
Suppressor Voltage	0		0		0		volts
Screen Grid Series Resistance	56		62		30		kilohms
Control-Grid Voltage	−2	−20	−1	−20	−1.5	−2.0	volts
Plate Current	9	-	9	-	11	-	mA
Screen Current	2.7	-	2.7	-	3.3	-	mA
Transconductance	3800	200	4500	200	4500	120	micromhos
Plate Resistance	1.0	-	0.9	-	0.6	-	megohm

1 22 megohms with grid current biasing.

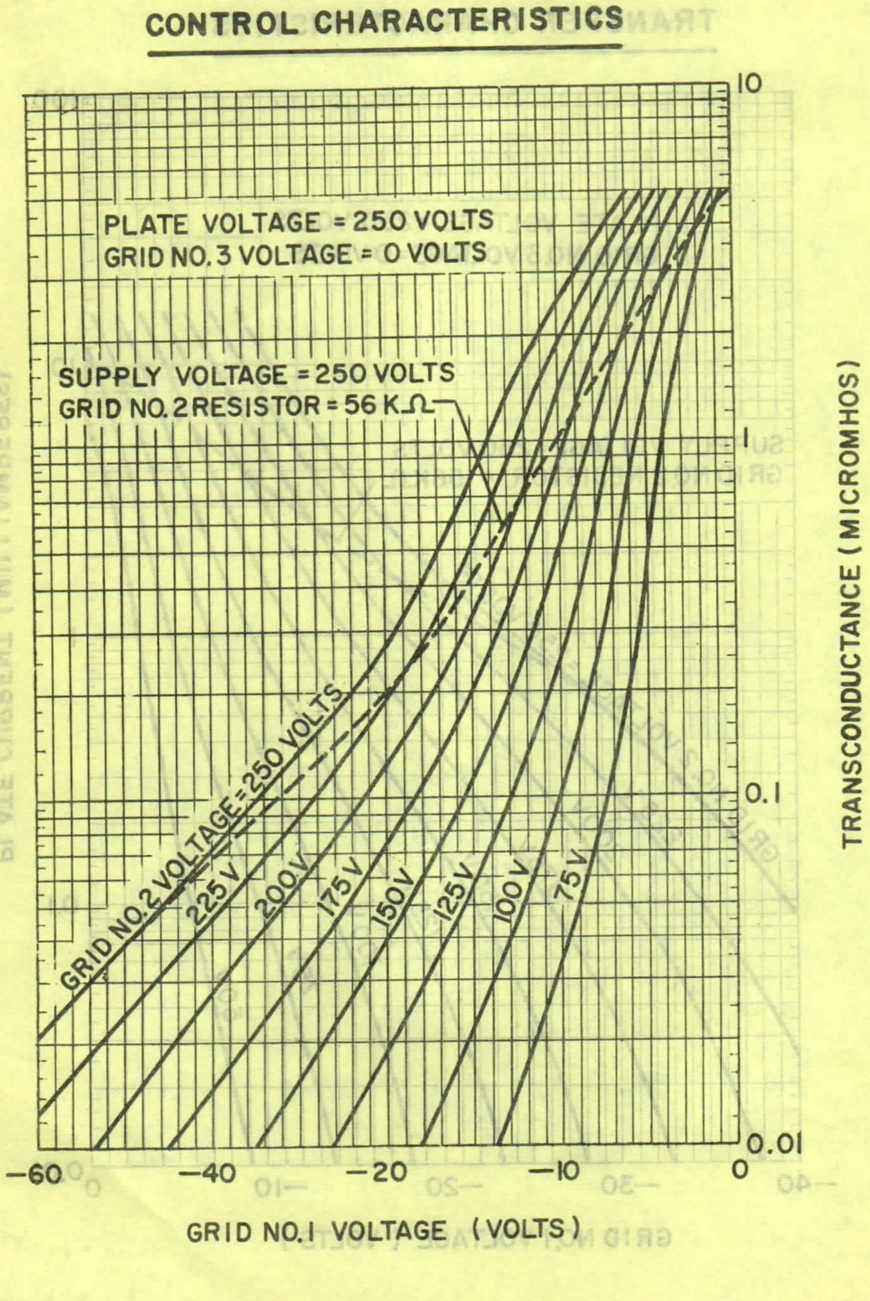
2 At this value grid current may occur. If this is not permissable, the negative grid voltage should be increased to 1.5 volts.

6DC8/EBF89

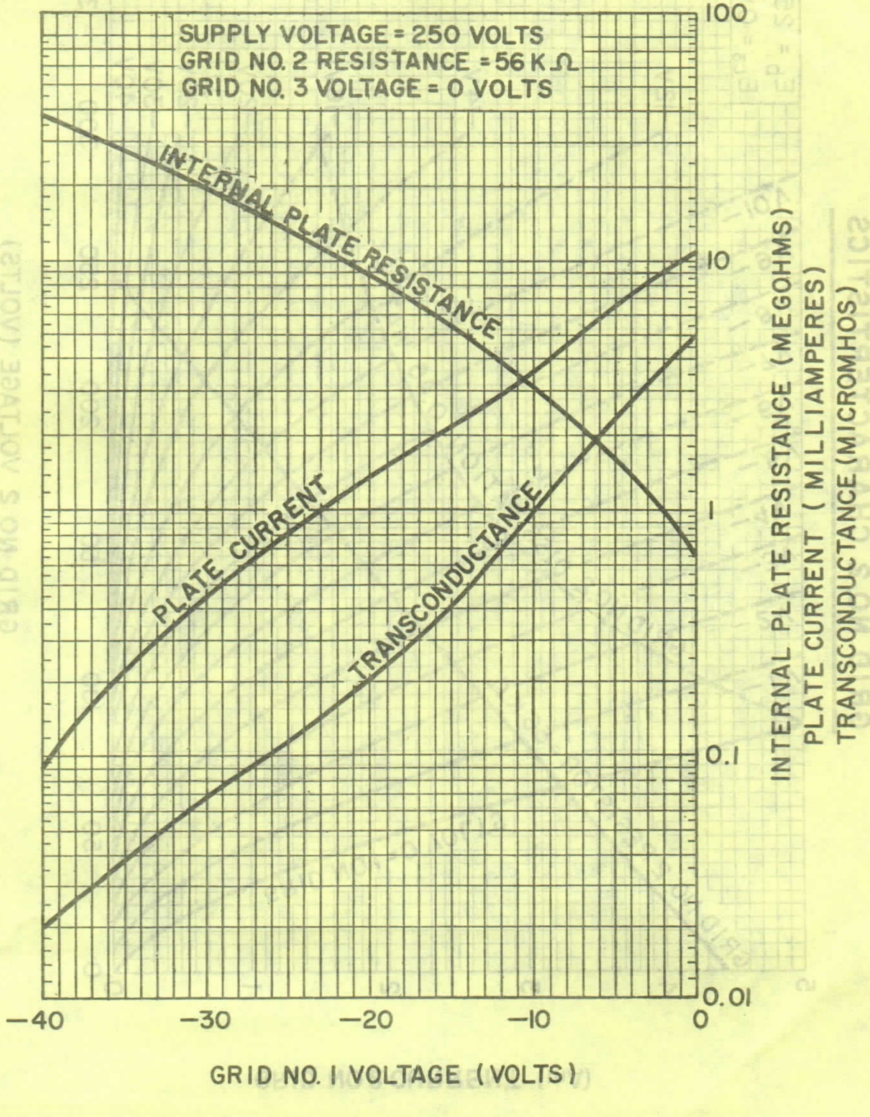
TRANSFER CHARACTERISTICS



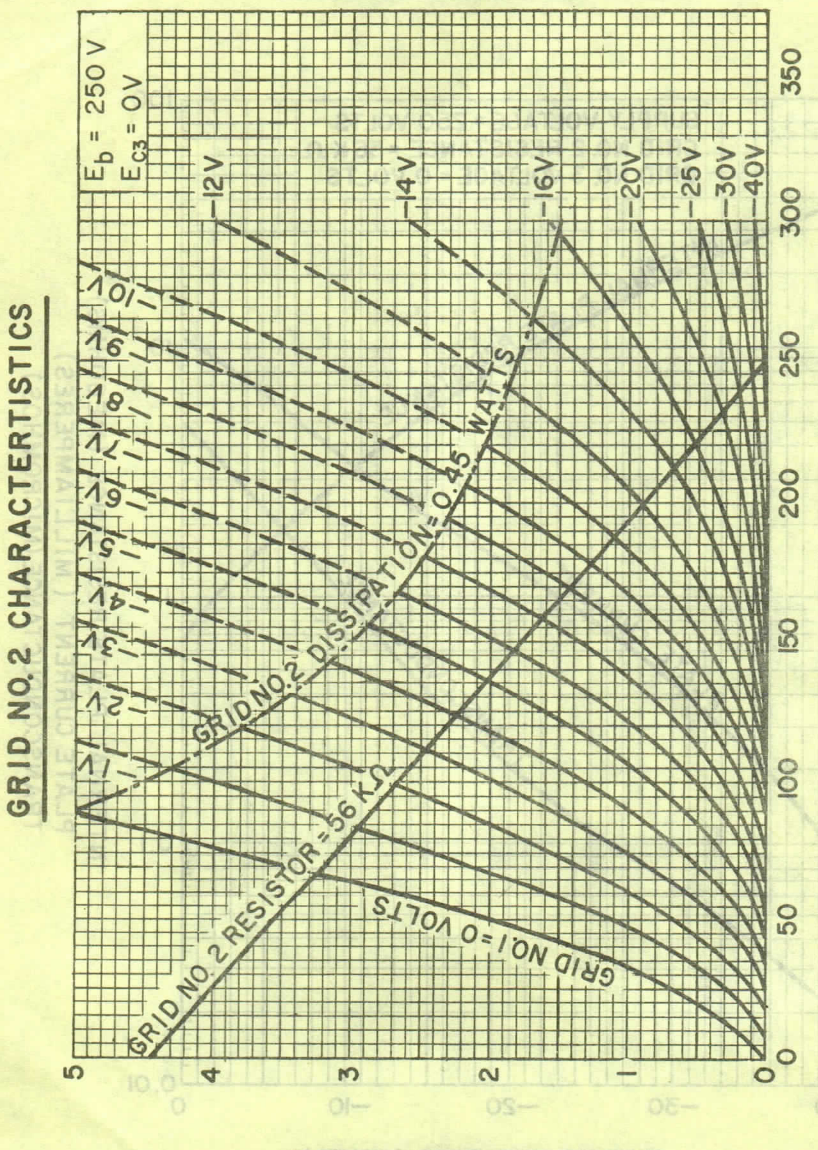
6DC8/EBF89


CONTROL CHARACTERISTICS
PLATE VOLTAGE = 250 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
SUPPLY VOLTAGE = 250 VOLTS
GRID NO. 2 RESISTOR = 56 KΩ
GRID NO. 2 VOLTAGE = 250 VOLTS
225 V
200 V
175 V
150 V
125 V
100 V
75 V
10
1
0.1
0.01
TRANSCONDUCTANCE (MICROMHOS)
−60
−40
−20
−10
0
GRID NO. 1 VOLTAGE (VOLTS)

AVERAGE CHARACTERISTICS



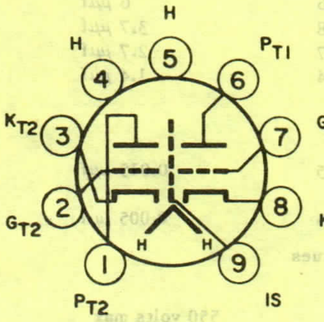
6DC8/EBF89


GRID NO. 2 CHARACTERISTICS
E_b = 250 V
E_{c3} = 0V
GRID NO. 2 VOLTAGE (VOLTS)
GRID NO.2 CURRENT (mA)
0
50
100
150
200
250
300
350
0
1
2
3
4
5
GRID NO.1 = 0 VOLTS
GRID NO. 2 RESISTOR = 56 KΩ
GRID NO. 2 DISSIPATION = 0.45 WATTS
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-12V
-14V
-16V
-20V
-25V
-30V
-40V

AMPEREX TUBE TYPE 6DJ8/ECC88

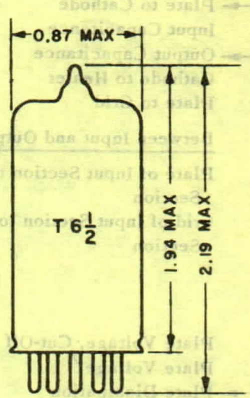
TENTATIVE DATA

The 6DJ8/ECC88 is a frame grid sharp cut-off twin triode with separate cathodes designed for use in cascode circuits, RF and IF amplifiers, mixer and phase inverter stages. The tube features high transconductance, low noise properties, as well as extreme reproducibility of characteristics as a result of the frame grid construction. The heater is designed for parallel operation from a 6.3 volt supply.



PIN CONNECTIONS

1. PLATE, TRIODE 2
2. GRID, TRIODE 2
3. CATHODE, TRIODE 2
4. HEATER
5. HEATER
6. PLATE, TRIODE I
7. GRID, TRIODE I
8. CATHODE, TRIODE I
9. INTERNAL SHIELD



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Mounting Position	any
Dimensions	see outline drawing
Bulb	T6½
Outline	6-2
Base	E9-1
Base Connection	9DE

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel supply
Heater Voltage (ac or dc)	6.3 volts
Heater Current	365 mA

6DJ8/ECC88

Direct Interelectrode Capacitances	Without External Shield	With External Shield
Grounded Input Section [1]		
Plate to Grid	1.4	1.4 μμf
Input Capacitance	3.3	3.3 μμf
Output Capacitance	1.8	2.5 μμf
Grid to Heater	0.13	0.13 μμf
Grounded Grid Output Section [1]		
Plate to Cathode	0.18	0.16 μμf
Input Capacitance	6	6 μμf
Output Capacitance	2.8	3.7 μμf
Cathode to Heater	2.7	2.7 μμf
Plate to Grid	1.4	1.4 μμf
Between Input and Output Section		
Plate of Input Section to Plate of Output Section	0.045	0.015 μμf
Grid of Input Section to Plate of Output Section	0.005	0.005 μμf

Maximum Ratings, Absolute Values
Each Section

Plate Voltage, Cut-Off Condition	550 volts max
Plate Voltage [2]	130 volts max
Plate Dissipation	1.8 watts max
Cathode Current	25 mA max
Negative Grid Voltage	50 volts max
Series Grid Resistor	1 megohm max
Heater-Cathode	50 volts max
Voltage Between Cathode of Output Section and Heater (Cathode Positive, Heater Negative)	150 volts max 130 volts max (DC component)
Cathode-Heater Resistance	20,000 ohms max

Typical Characteristics
Each Section

Plate Voltage	90 volts
Negative Grid Voltage	1.3 volts
Plate Current	15 mA
Transconductance	12,500 micromhos
Amplification Factor	33
Equivalent Noise Resistance	300 ohms

[1] Triode No. 1 should be used as the grounded cathode input section of the cascode amplifier and Triode No. 2 as the grounded grid output section.

[2] In order not to exceed the maximum permissible plate voltage when the cascode amplifier is controlled, it is necessary to use a voltage divider for the grid of the grounded grid section With grid current biasing for the grounded cathode section the plate voltage across this section should not be more than 75 volts in the uncontrolled condition.

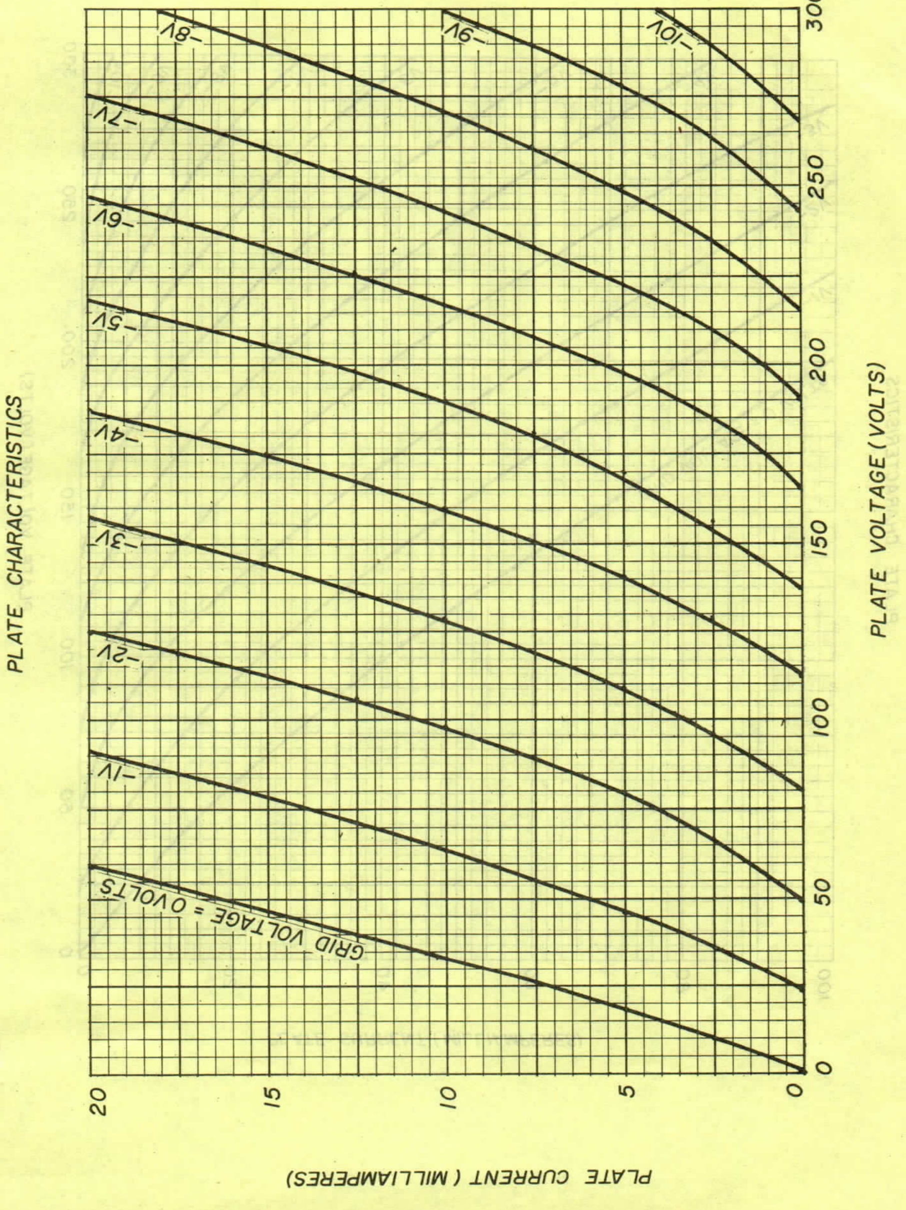
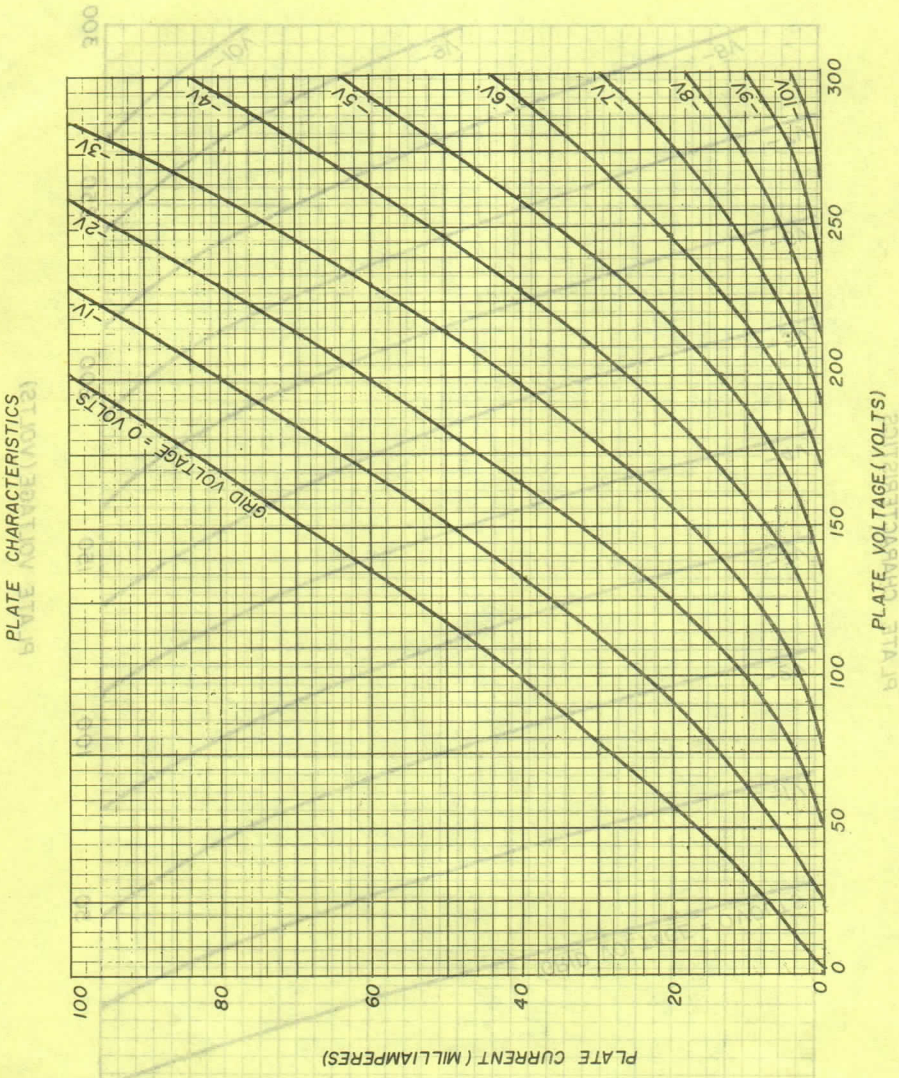


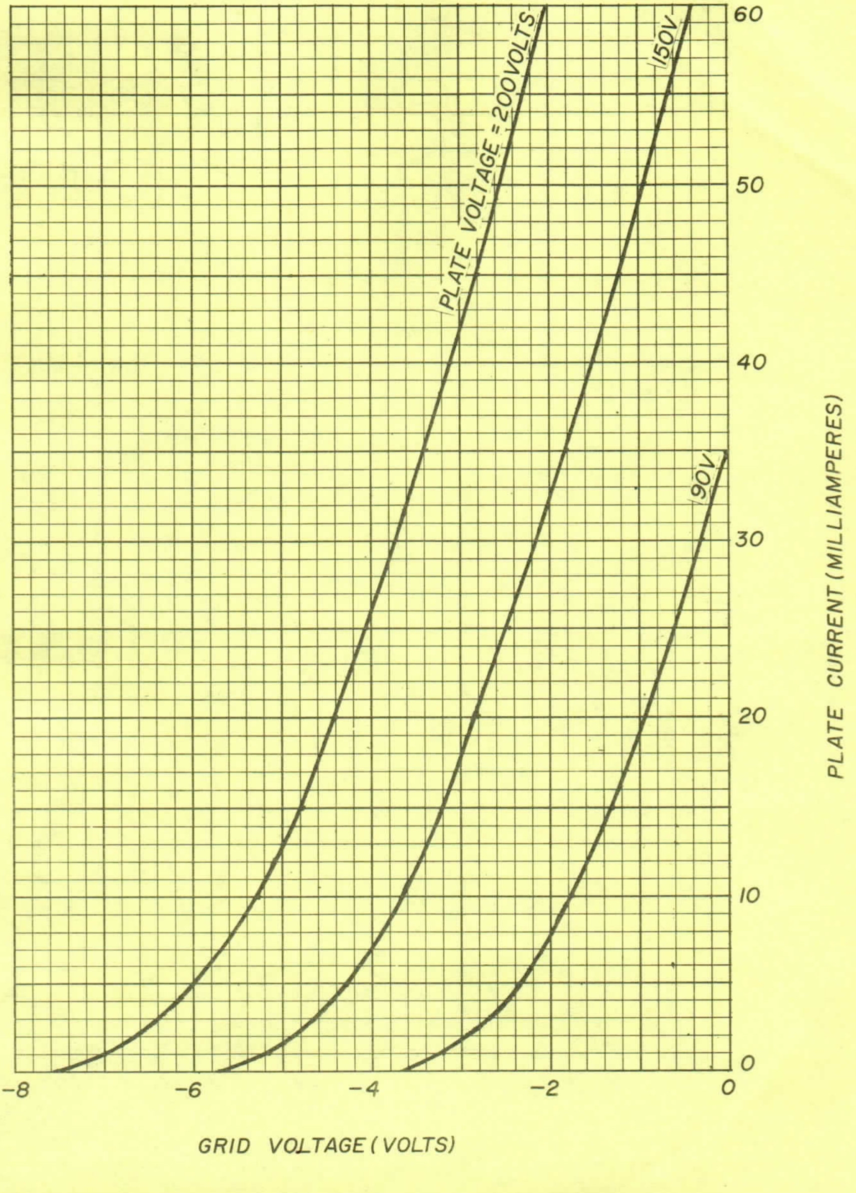
PLATE CHARACTERISTICS
GRID VOLTAGE = 0 VOLTS
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
0
50
100
150
200
250
300
PLATE VOLTAGE (VOLTS)
0
5
10
15
20
PLATE CURRENT (MILLIAMPERES)

6DJ8/ECC88



Revised 9/60

TRANSFER CHARACTERISTICS



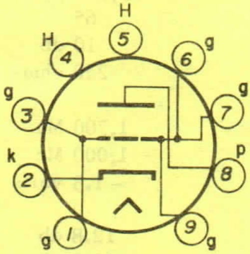
AMPEREX TUBE TYPE 6DL4

TENTATIVE DATA

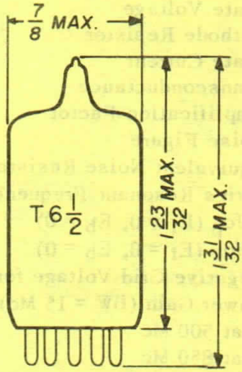
The Amperex 6DL4/EC88 is a single triode for use as an RF grounded-grid amplifier in UHF tuners for television receivers.

Low output capacitance permits the design of a higher impedance plate circuit, so that higher gain may be obtained. Due to the higher RF gain, signal-to-noise ratio is reduced.

The 6DL4/EC88 also features reduced oscillator radiation because of an improved pinning sequence. Very effective shielding of the plate and cathode by the grid is obtained, and even the most stringent radiation restrictions can be met without special requirements.



PIN CONNECTIONS
1. GRID
2. CATHODE
3. GRID
4. HEATER
5. HEATER
6. GRID
7. GRID
8. PLATE
9. GRID



GENERAL CHARACTERISTICS

MECHANICAL

Maximum Dimensions	see outline drawing
Bulb	T 6½
Base	Noval

ELECTRICAL

Heating	parallel supply	
Heater Voltage	6.3 volts	
Heater Current	165 ma	

Direct Interelectrode Capacitances

	Without External Shield	With External[1] Shield
Plate to Grid	1.2 pf	1.7 pf
Plate to Cathode	0.05 pf	- -
Plate to Cathode + Heater	0.075 pf	0.055 pf
Grid to Cathode	3.2 pf	- -
Grid to Cathode + Heater	3.7 pf	3.8 pf

1 Inside diameter 0.874 inch

6DL4

Maximum Ratings, Design Center Values

Plate Voltage (Zero Plate Current)	550 volts
Plate Voltage	230 volts
Plate Dissipation	2 watts
Cathode Current	13 ma
Negative Grid Voltage	50 volts
Grid Circuit Resistance (R_K = 100 ohms)	1 megohm
Heater to Cathode Voltage	100 volts

Typical Characteristics

Plate Voltage	160 volts
Cathode Resistor	100 ohms
Plate Current	12.5 ma
Transconductance	13,500 μmhos
Amplification Factor	65
Noise Figure	10 db
Equivalent Noise Resistance	240 ohms
Series Resonant Frequency [2]	
fo_p ($E_f = 0$, $E_b = 0$)	1,700 Mc
fo_k ($E_f = 0$, $E_b = 0$)	1,000 Mc
Negative Grid Voltage for $I_g = + 0.3\ \mu a$ ($E_b = 0$)	− 1.3 volts
Power Gain (BW = 15 Mc)	
at 500 Mc	12.8 db
at 850 Mc	12.0 db
Backward Attenuation (BW = 15 Mc)	
at 500 Mc	28 db
at 850 Mc	29 db
at 700 Mc (maximum attenuation)	34 db
Maximum Noise Figure (850 Mc)	11 db

2 Measured between a point on the relevant tube pin close to the tube bottom, and a point, close to the relevant pin, on a metal reference plane placed against the tube bottom. The tube is screened by a metal cylinder (int. diam. 0.874 in.) placed upon the metal reference plane.

All pins, except the relevant one, are connected to the reference plane with a negligible impedance.

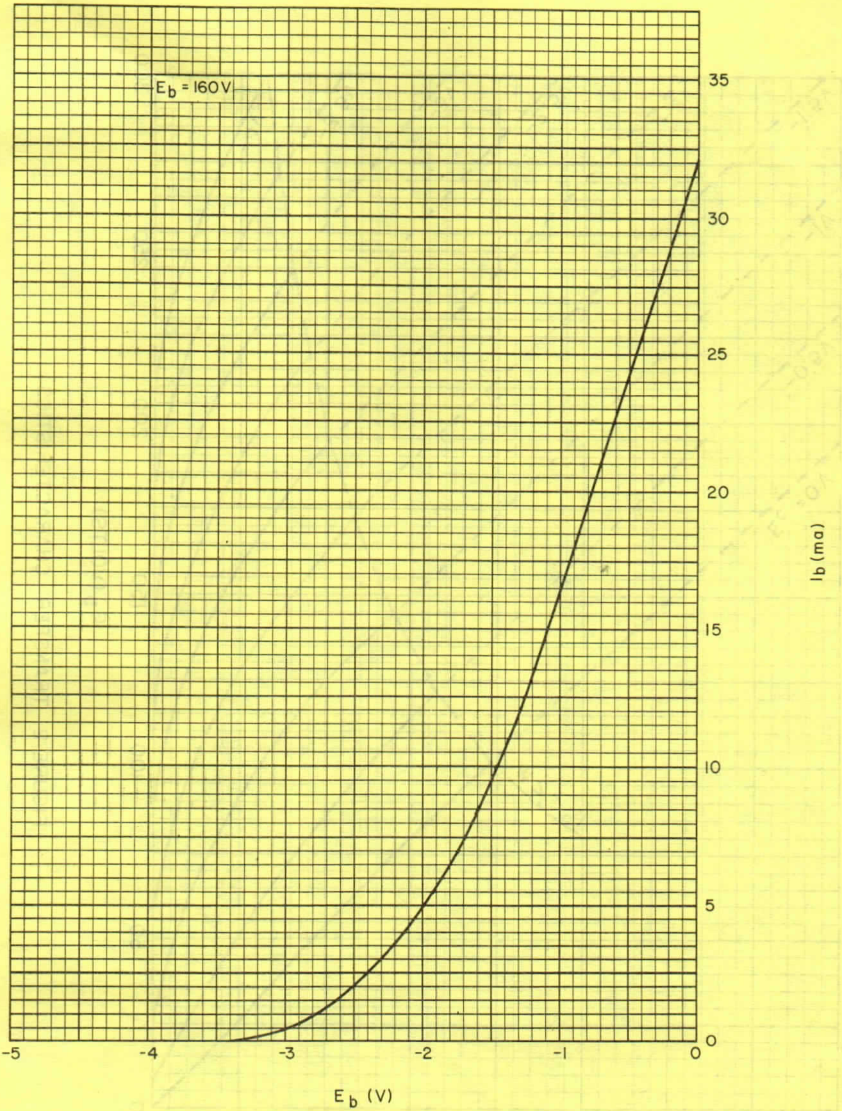


FIGURE 1 PLATE CHARACTERISTIC

6DL4

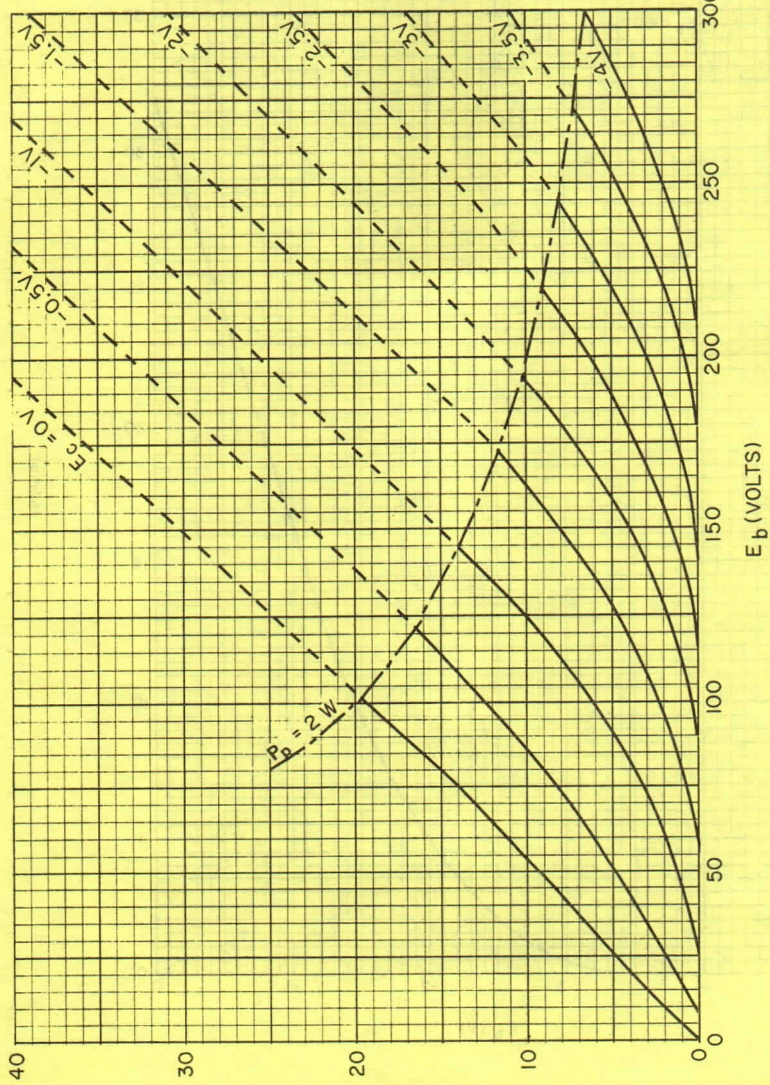
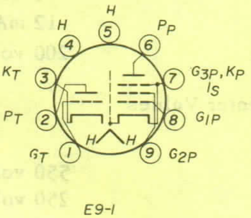


FIGURE 2 TRANSFER CHARACTERISTICS

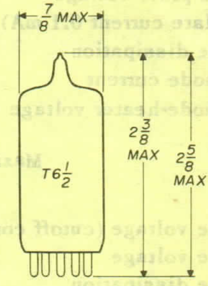
AMPEREX TUBE TYPE 6DX8/ECL84

TENTATIVE DATA

The Amperex 6DX8/ECL84 is a triode-pentode with separate cathodes. The triode is designed for use in circuits for keyed AGC, sync-separation, sync-amplification and noise suppression. The pentode is designed for use as a video output tube.



PIN CONNECTIONS
1. GRID, TRIODE
2. PLATE, TRIODE
3. CATHODE, TRIODE
4. HEATER
5. HEATER
6. PLATE, PENTODE
7. GRID NO.3, PENTODE, CATHODE, PENTODE, INTERNAL SHIELD
8. GRID NO.1, PENTODE
9. GRID NO.2, PENTODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	Noval, E9-1
Outline	6 - 3
Dimensions	see outline drawing

ELECTRICAL

Heating	indirect by AC or DC parallel supply
Heater voltage	6.3 volts
Heater Current	720 ma

Direct Interelectrode Capacitances

Triode Section

Input	3.8 pf
Output	2.3 pf
Plate to grid	2.7 pf
Grid to heater	< 0.1 pf

Pentode Section

Input	8.7 pf
Output	4.2 pf
Plate to grid No. 1	< 0.1 pf

Between Triode and Pentode Section

Plate of triode to grid No. 1 of Pentode	0.01 pf
Grid of triode to grid No. 1 of pentode	< 0.01 pf

6DX8/ECL84

Maximum Ratings, Design Center Values
Triode Section

Plate voltage (cutoff condition)	550 volts max
Plate voltage	250 volts max
Peak plate voltage (Plate current 0.1 mA)	600 volts max [1]
Plate dissipation	1 watt max
Cathode current	12 mA max
Cathode-heater voltage	200 volts max

Maximum Ratings, Design Center Values
Pentode Section

Plate voltage (cutoff condition)	550 volts max
Plate voltage	250 volts max
Plate dissipation	4 watts max
Grid No. 2 voltage (cutoff condition)	550 volts max
Grid No. 2 voltage	250 volts max
Grid No. 2 dissipation	1.7 watts max
Cathode Current	40 mA max
Cathode-heater voltage	200 volts max

Typical Characteristics
Triode Section

Plate Voltage	200 volts
Negative grid voltage	1.7 volts
Plate current	3 mA
Transconductance	4000 micromhos
Amplification factor	65
Negative grid voltage (Grid current = + 0.3 μA)	1.3 volts

Typical Characteristics
Pentode Section

Plate Voltage	170	200	220 volts
Grid No. 2 voltage	170	200	220 volts
Negative grid No. 1 voltage	2.1	2.9	3.4 volts
Plate current	18	18	18 mA
Grid No. 2 current	3.0	3.0	3.0 mA
Transconductance	11,000	10,400	10,000 micromhos
Internal plate resistance	100,000	130,000	150,000 ohms
Amplification Factor Grid No. 2, Grid No. 1	36	36	36
Negative Grid No. 1 voltage (Grid No. 1 current = + 0.3 μA)	1.3	1.3	1.3 volts

1 Pulse duration 18% max of a cycle with a maximum of 18 microseconds.

6DX8/ECL84

Typical Operation

Pentode Section as Video Output Tube

Supply voltage = Grid No. 2 voltage	170	200	220 volts
Plate load resistance	3000	3000	3000 ohms
Negative grid No. 1 voltage	2	2.8	3.3 volts
Plate current	18	18	18 mA
Grid No. 2 current	3.2	3.1	3.1 mA
Transconductance	10,400	10,000	9700 micromhos

Maximum Circuit Values

Triode Section

External resistance between grid and ground (fixed bias)	1 megohm max
External resistance between grid and ground (self bias)	3 megohms max
Cathode-heater resistance	20,000 ohms max

Pentode Section

External resistance between grid and ground (fixed bias)	1 megohm max
External resistance between grid and ground (self bias)	3 megohms max
Cathode-heater resistance	20,000 ohms max

6DX8/ECL84

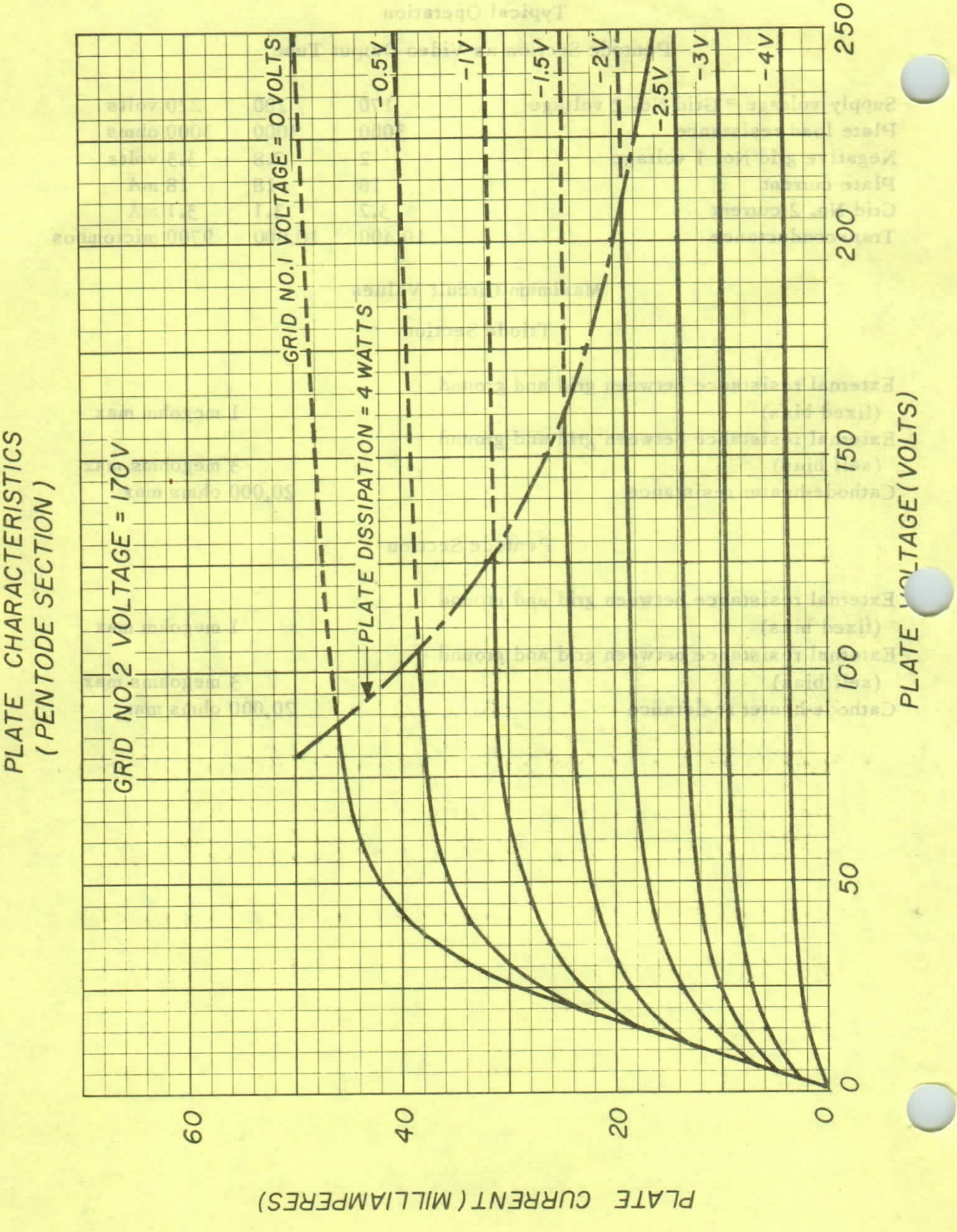


PLATE CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 170V
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-4V
PLATE DISSIPATION = 4 WATTS
PLATE VOLTAGE (VOLTS)
250
200
150
100
50
0
60
40
20
0
PLATE CURRENT (MILLIAMPERES)

6DX8/ECL84

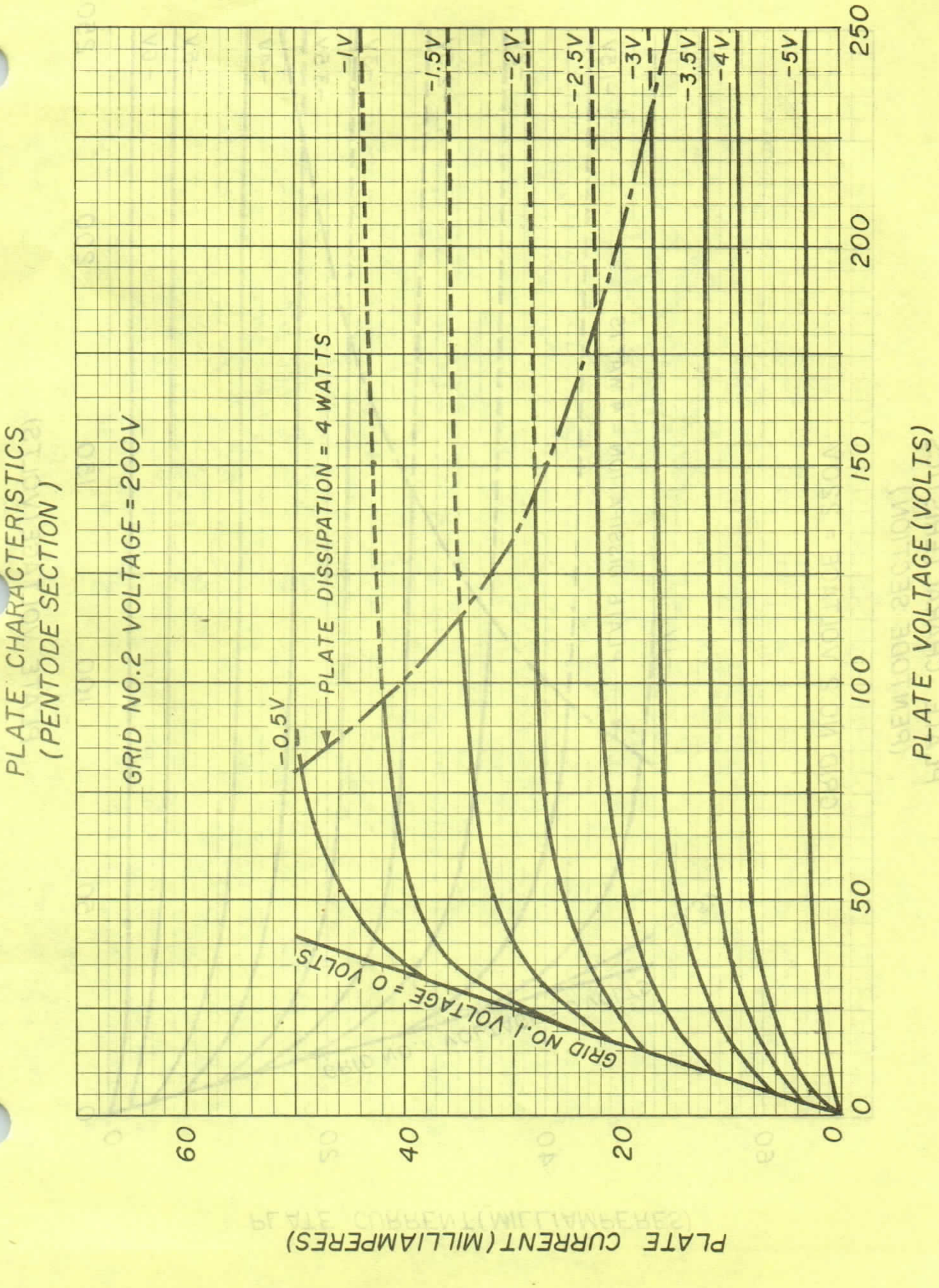


PLATE CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 200V
PLATE DISSIPATION = 4 WATTS
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-3.5V
-4V
-5V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
20
40
60

6DX8/ECL84

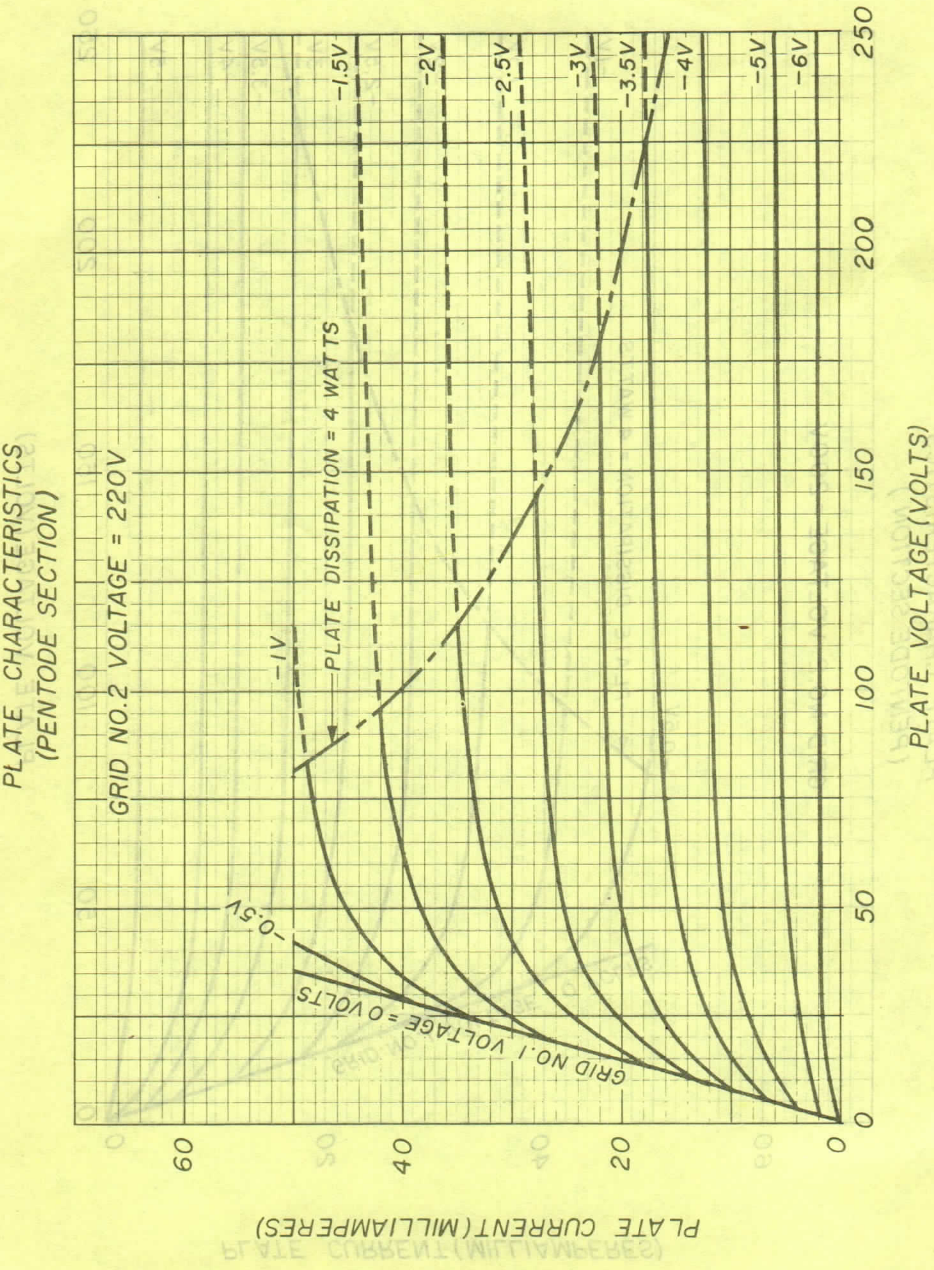
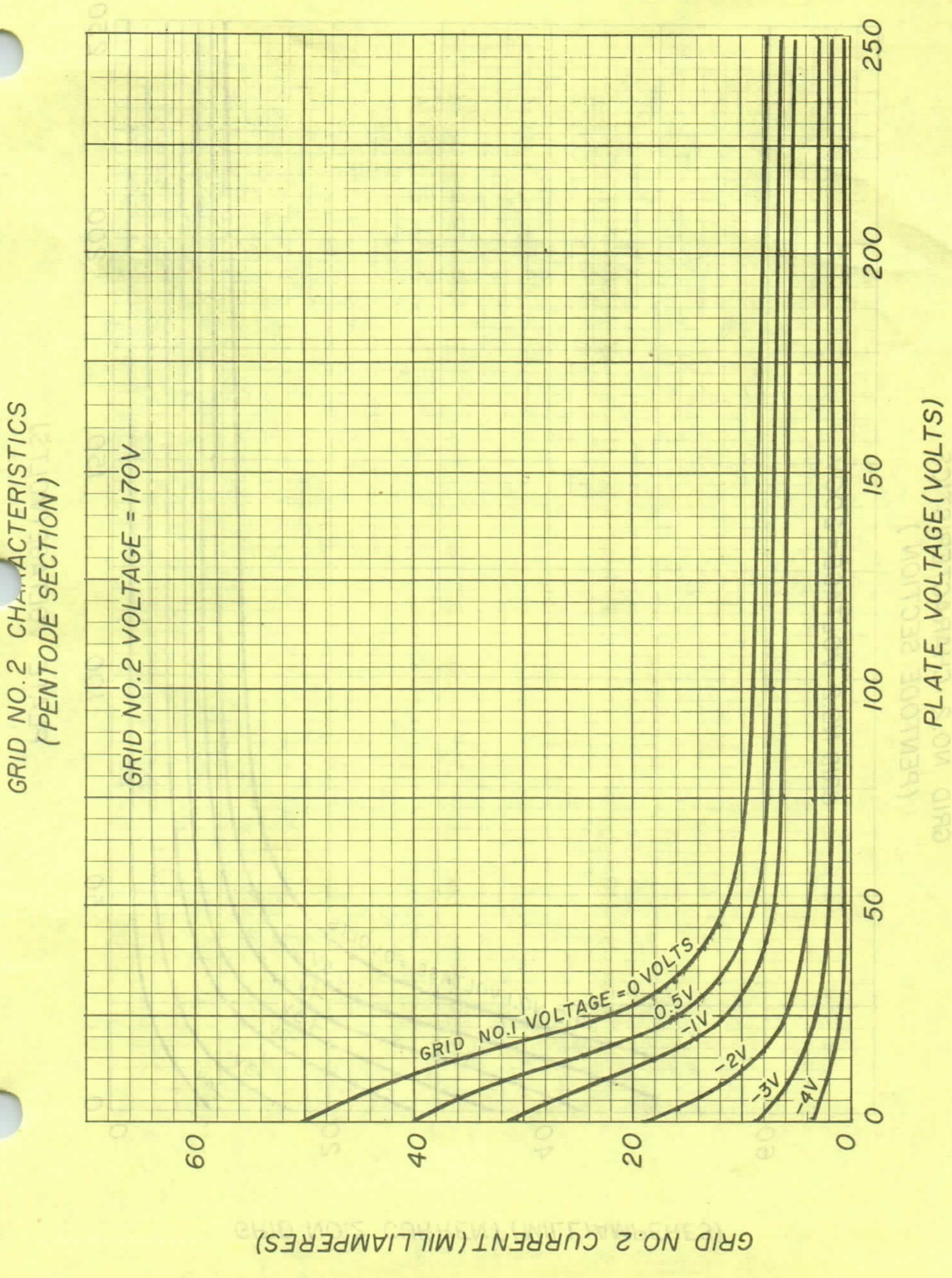
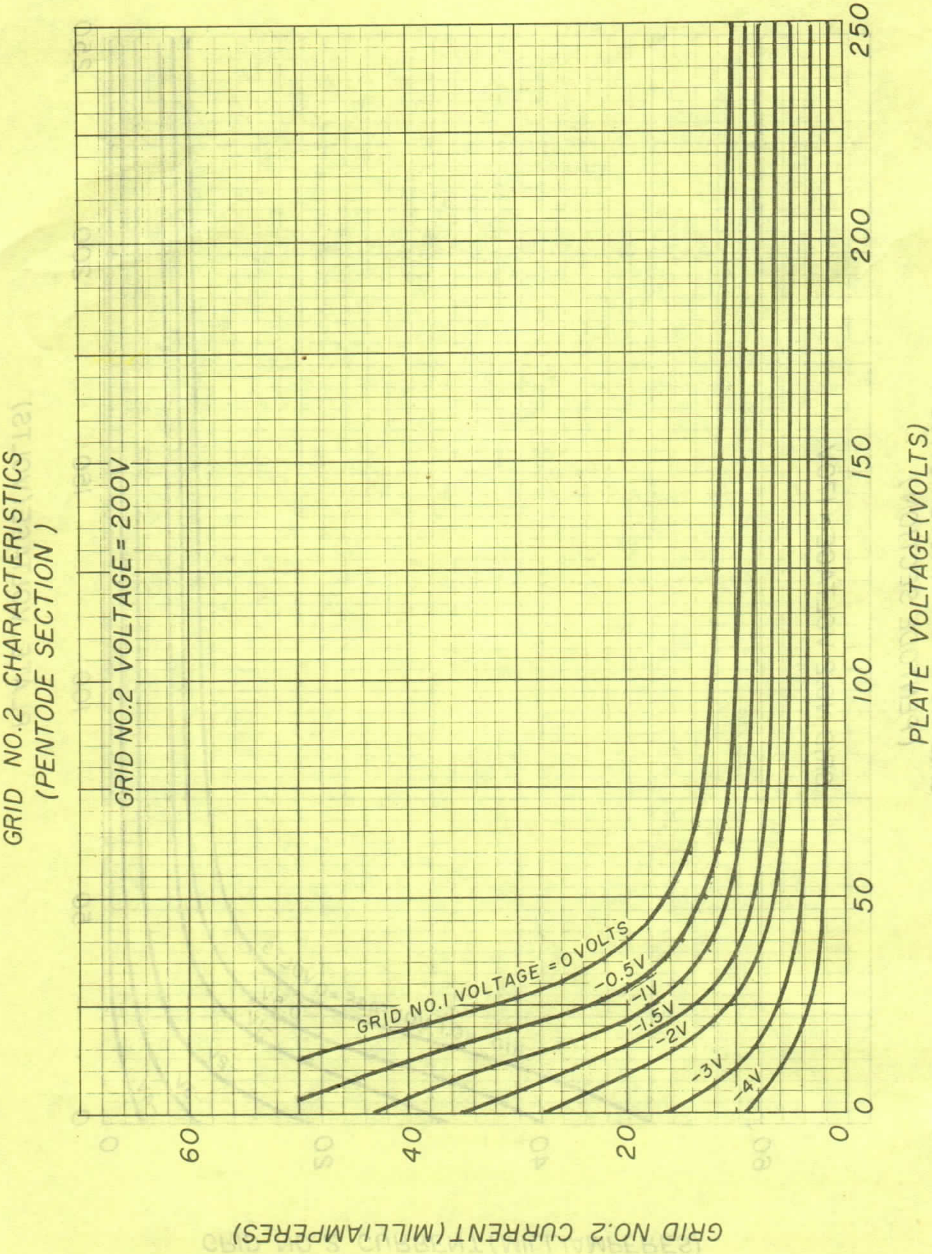
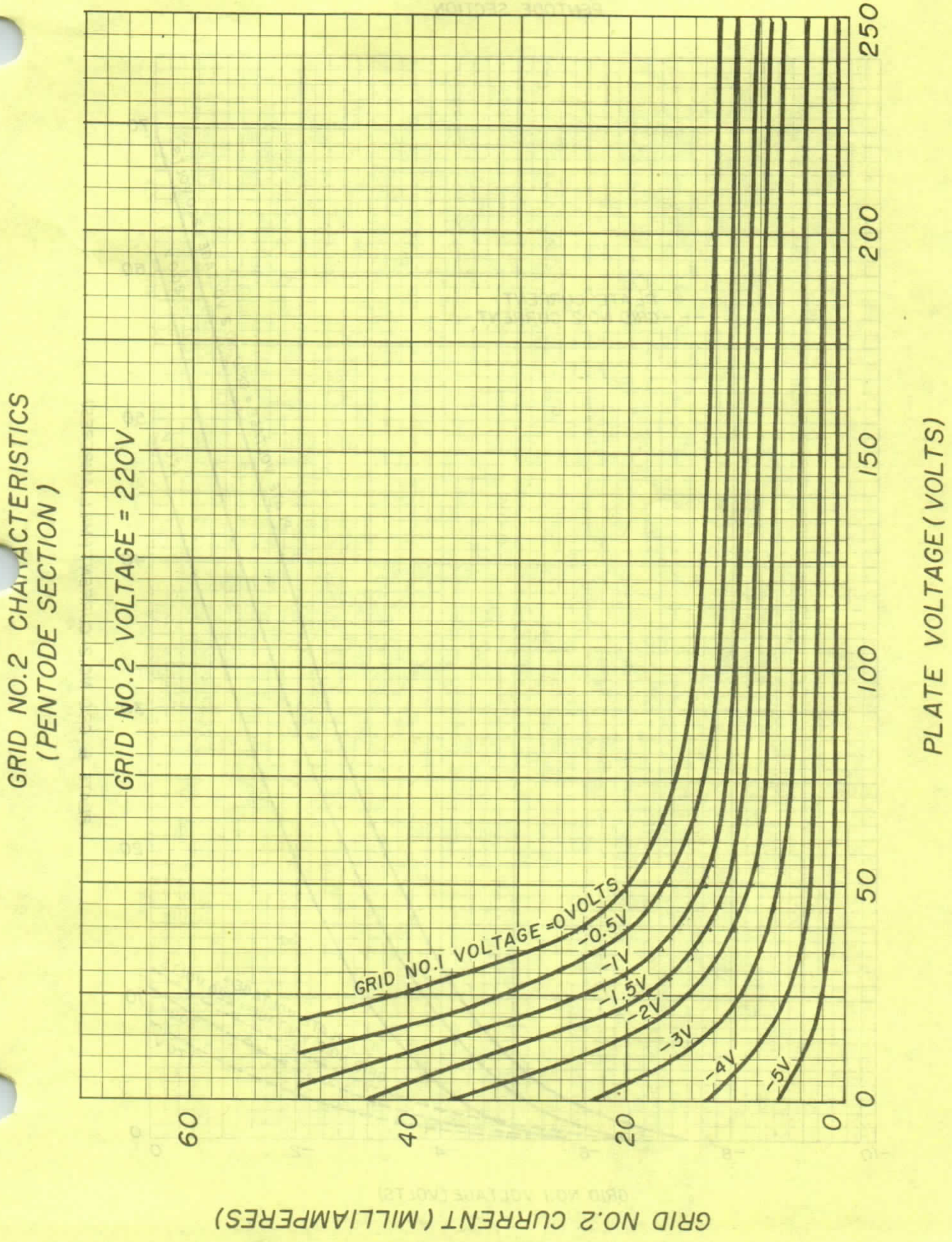


PLATE CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 220V
PLATE DISSIPATION = 4 WATTS
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-3.5V
-4V
-5V
-6V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
20
40
60


GRID NO.2 CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 170V
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-2V
-3V
-4V
0
50
100
150
200
250
PLATE VOLTAGE (VOLTS)
0
20
40
60
GRID NO.2 CURRENT (MILLIAMPERES)

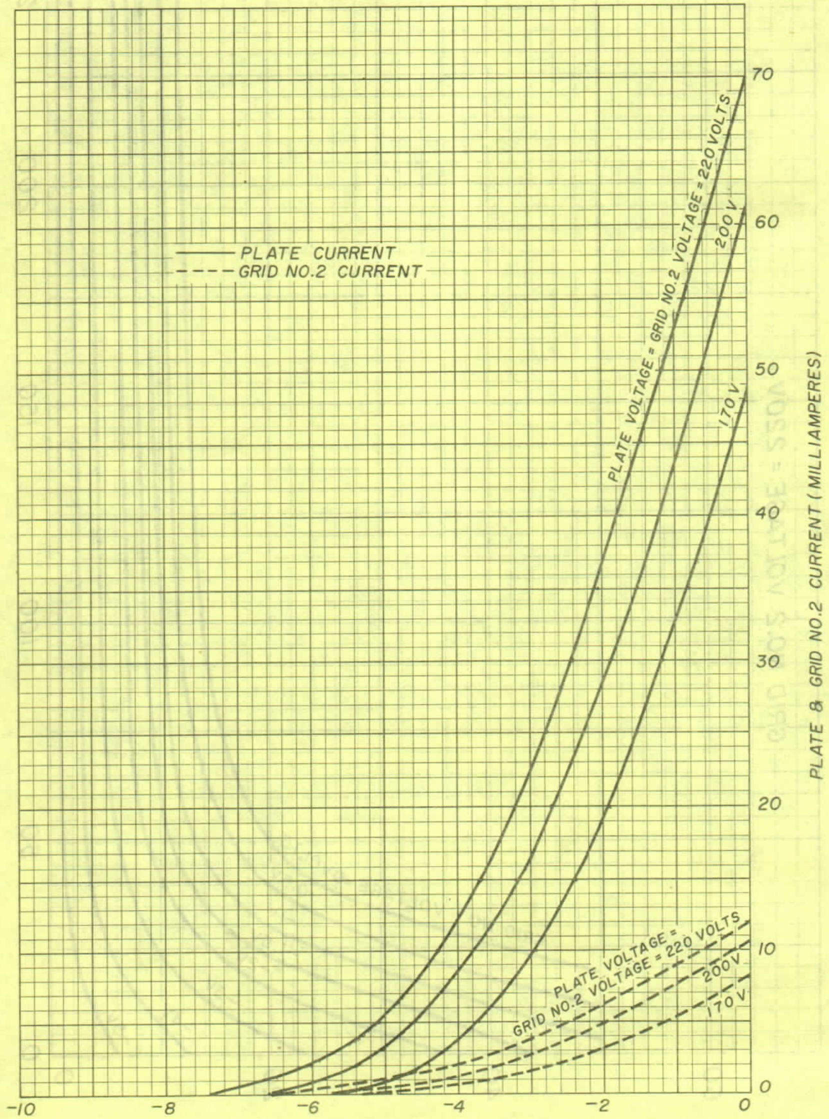
6DX8/ECL84

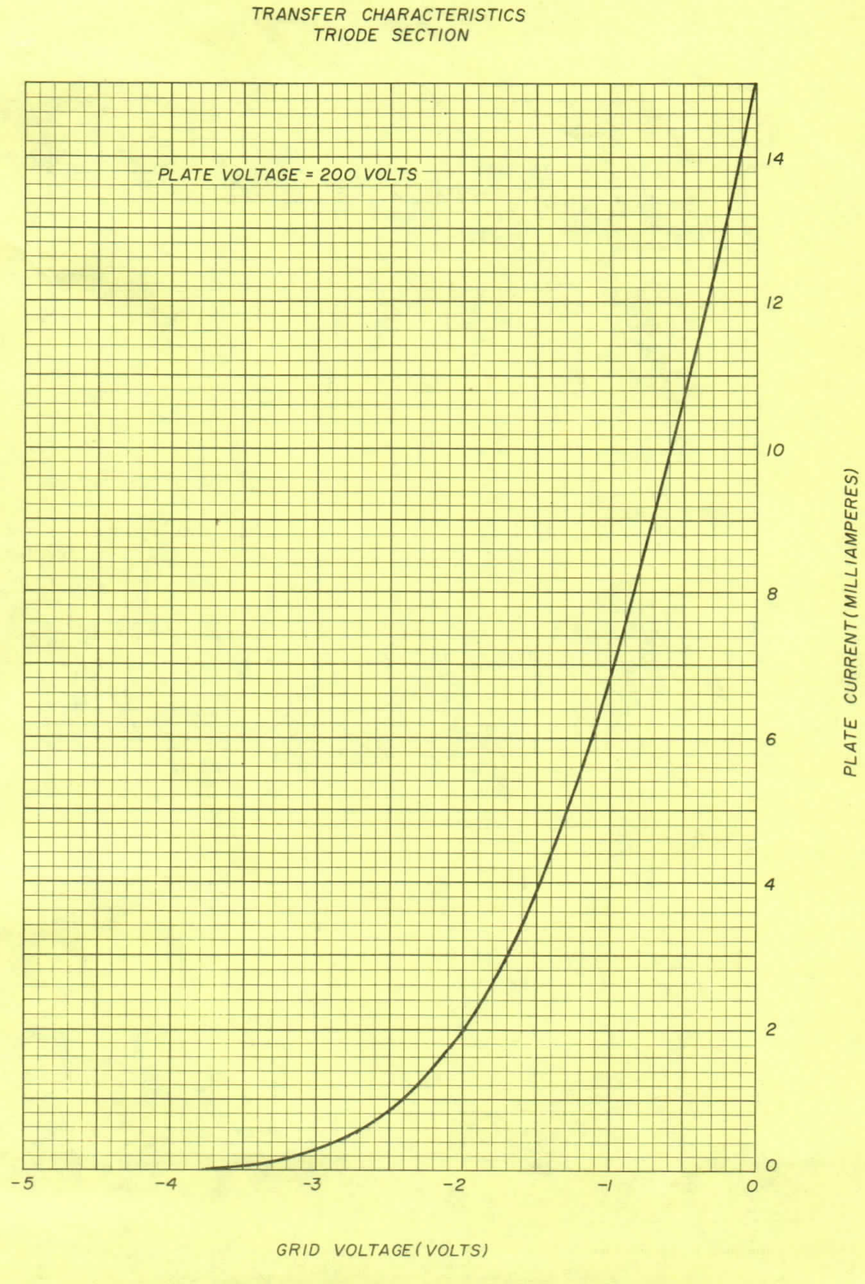

GRID NO.2 CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 200V
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-1.5V
-2V
-3V
-4V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
GRID NO.2 CURRENT (MILLIAMPERES)
0
20
40
60


GRID NO.2 CHARACTERISTICS
(PENTODE SECTION)
GRID NO.2 VOLTAGE = 220V
GRID NO.1 VOLTAGE = 0 VOLTS
-0.5V
-1V
-1.5V
-2V
-3V
-4V
-5V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
GRID NO.2 CURRENT (MILLIAMPERES)
60
40
20
0

6DX8/ECL84

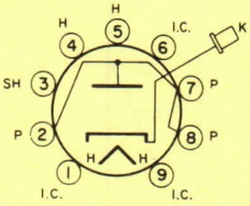
TRANSFER CHARACTERISTICS
PENTODE SECTION




TRANSFER CHARACTERISTICS
TRIODE SECTION
PLATE VOLTAGE = 200 VOLTS
14
12
10
8
6
4
2
0
PLATE CURRENT (MILLIAMPERES)
−5
−4
−3
−2
−1
0
GRID VOLTAGE (VOLTS)

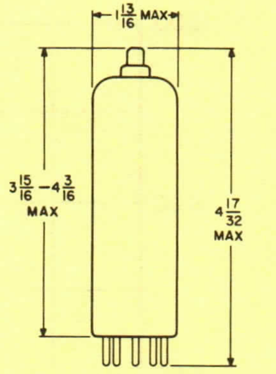
AMPEREX TUBE TYPE 6EC4

The 6EC4 is a damper diode for use in horizontal deflection circuits of color TV receivers.



PIN CONNECTIONS

1- INTERNAL CONNECTION
2- PLATE
3- SHIELD
4- HEATER
5- HEATER
6- INTERNAL CONNECTION
7- PLATE
8- PLATE
9- INTERNAL CONNECTION
K- CAP-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Dimensions	see outline drawing

ELECTRICAL

Heating[1]	indirect by AC or DC, series supply
Heater Voltage	6.3 volts
Heater Current	2.1 amps
Interelectrode Capacitances	
Plate to Cathode Capacitance	13.5 pf
Cathode to Heater	3.7 pf

MAXIMUM RATINGS

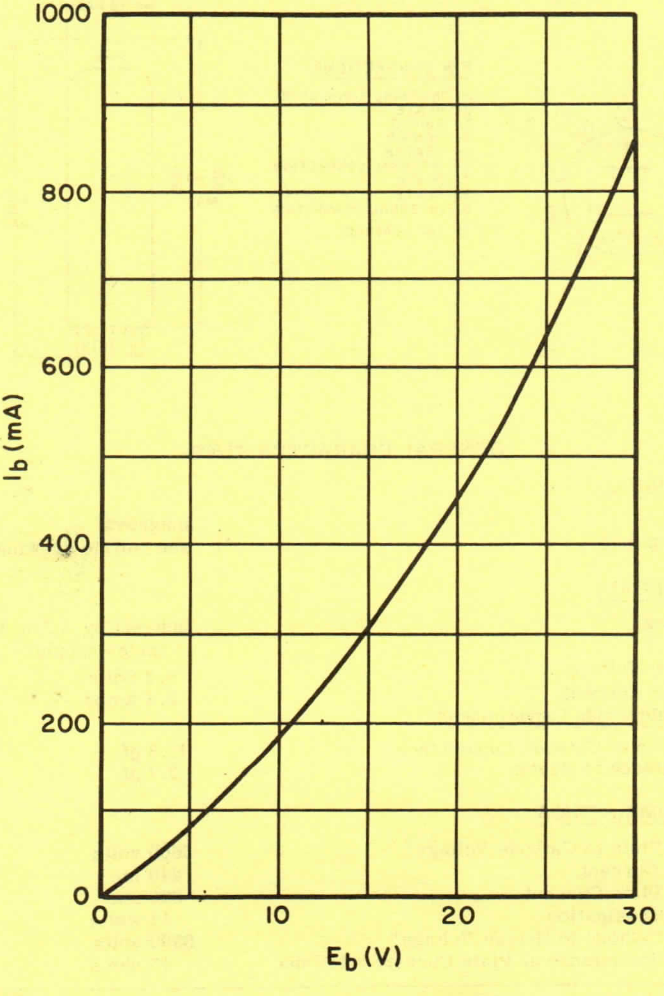
Peak Plate to Cathode Voltage[2]	5600 volts
Plate Current	440 ma
Peak Plate Current	800 ma
Plate Dissipation	11 watts
Peak Cathode to Heater Voltage[2]	6300 volts
Diode Resistance at Plate Current = 440 ma	45 ohms

[1] The minimum resistance between any heater pin of a heater chain and the supply should be 100 ohms. This resistance may entirely or partially consist of the hot resistance of a part of the heater chain.

[2] Maximum pulse duration is 22% of one cycle and 18 μsec.

8/65

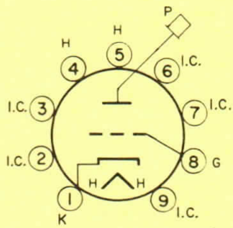
6EC4



AMPEREX TUBE TYPE 6ED4/ED500

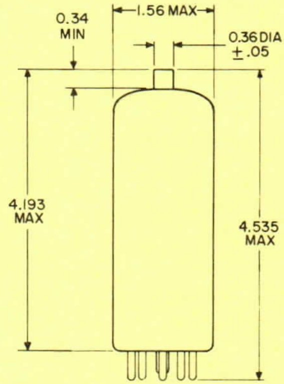
TENTATIVE DATA

The Amperex 6ED4/ED500 is a shunt stabilizer triode designed for use in olor television receivers.



PIN CONNECTIONS

1- CATHODE
2- INTERNAL CONNECTION
3- INTERNAL CONNECTION
4- HEATER
5- HEATER
6- INTERNAL CONNECTION
7- INTERNAL CONNECTION
8- GRID
9- INTERNAL CONNECTION
P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	magnoval

ELECTRICAL

Heater Supply	indirect AC or DC series supply
Heater Voltage	6.3 volts
Heater Current	350 ma

MAXIMUM RATINGS (DESIGN CENTER - unless noted)

Plate Voltage	25,000 volts
Plate Current	1.5 ma
Plate Dissipation	30 watts
Plate Dissipation (absolute limit)	40 watts[1]
Negative Grid Voltage	150 volts[2]
Grid Circuit Resistance	5 megohms
Cathode to Heater Voltage	
Cathode Positive	400 VDC + 250 VAC
Cathode Negative	250 volts

1. Permissible only during short periods; in total, up to a maximum of 10% of the operating time of the tube.
2. During set warm-up, 440 volts maximum.

Precautions: X-ray shielding may be required to give protection against excessive radiation.

(OVER)

6ED4/ED500

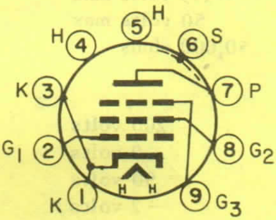
TYPICAL OPERATING CHARACTERISTICS

Plate Voltage	25,000 volts
Grid Voltage Change for a Plate Current Change of 0.1 to 1.5 ma	<11 volts
Negative Grid Voltage (I_p = 100 μa)	18 to 40 volts

AMPEREX TUBE TYPE 6EH7

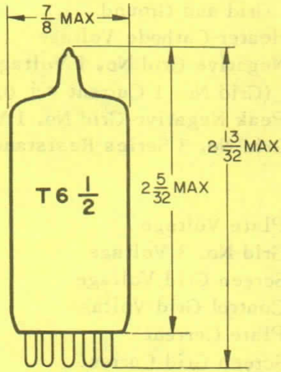
TENTATIVE DATA

The Amperex 6EH7/EF183 is a frame grid remote cut-off pentode designed for use as an IF amplifier in television receivers. Its high variable transconductance with low interelectrode and feed-back capacitance enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO. 2
9 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E 9-1
Dimensions	see outline drawing

ELECTRICAL

Cathode	coated, unipotential
Heater voltage	6.3 volts
Heater current	300 mA

Direct Interelectrode Capacitances

Input	9.5 pf
Output	3 pf
Plate to Grid No. 1	0.0055 pf
Grid No. 1 to Grid No. 2	2.8 pf

6EH7

Maximum Ratings, Design Maximum Values

Plate Voltage (Zero Plate Current)	550 volts max
Plate Voltage	250 volts max
Plate Dissipation	2.5 watts max
Screen Grid Voltage (Zero Grid Current)	550 volts max
Screen Grid Voltage	250 volts max
Screen Grid Dissipation	0.65 watts max
Cathode Current	20 mA max
External Resistance between Control Grid and Ground	1 megohm max
Heater-Cathode Voltage	150 volts max
Negative Grid No. 1 Voltage (Grid No. 1 Current = + 0.3 μA)	−1.3 volts max
Peak Negative Grid No. 1 Voltage	50 volts max
Grid No. 3 Series Resistance	50,000 ohms

Typical Characteristics

Plate Voltage	200 volts
Grid No. 3 Voltage	0 volts
Screen Grid Voltage	90 volts
Control Grid Voltage	− 2 volts
Plate Current	12 mA
Screen Grid Current	4.5 mA
Transconductance	12,500 micromhos
Internal Plate Resistance	0.5 megohms
Input Resistance	13,000 ohms
(f = 40 mc)	
Equivalent Noise Resistance (f = 40 mc)	490 ohms

Typical Operation [1]

	Min		Typ		Max		
Plate Voltage	170		200		230		volts
Screen Grid Supply Voltage	170		200		230		volts
Grid No. 3 Voltage	0		0		0		volts
Screen Grid Series Resistance	15,000		24,000		39,000		ohms
Negative Control Grid Voltage	1.8	7.5	2	9.5	2.1	12	volts
Plate Current	14	2.7	12	2.7	10.5	2.4	ma
Transconductance	14,000	700	12,500	620	10,600	500	micromhos

[1] Operation with cathode bias resistor and/or screen grid resistor is recommended.

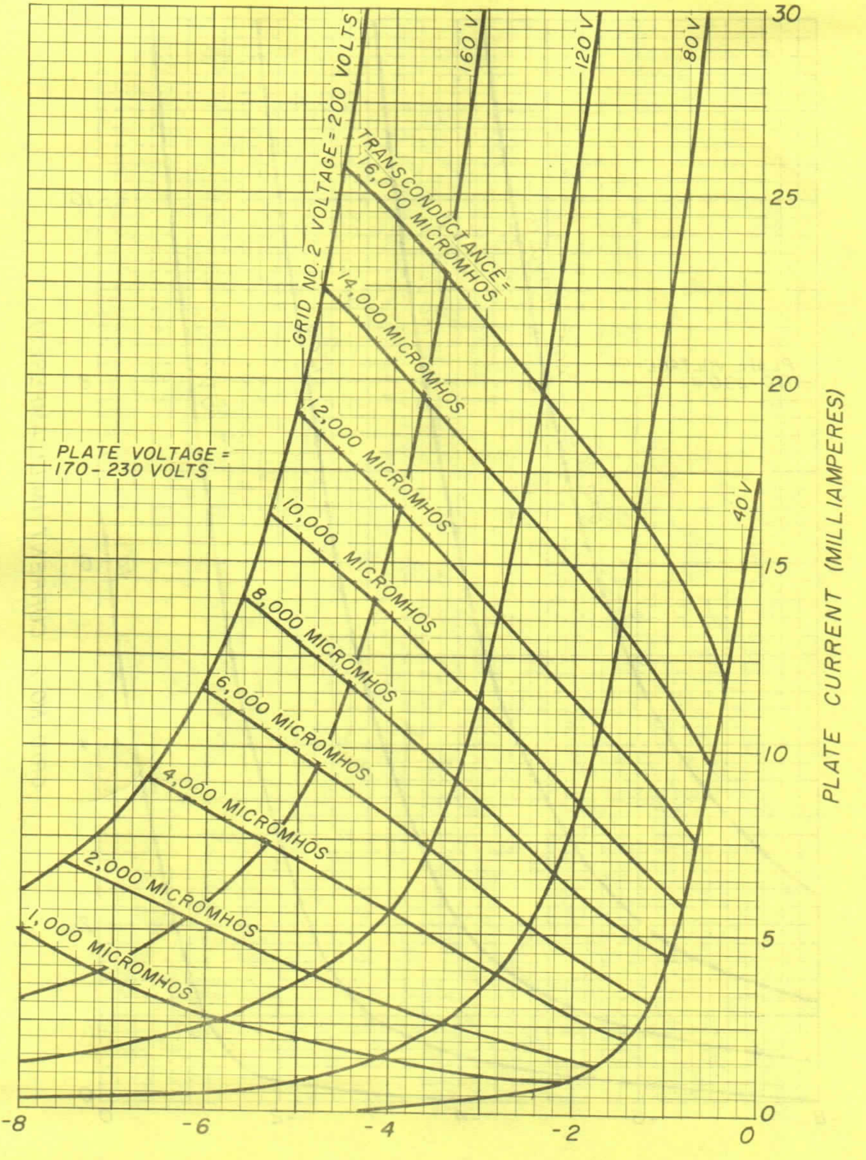


FIGURE 1-AVERAGE CHARACTERISTICS

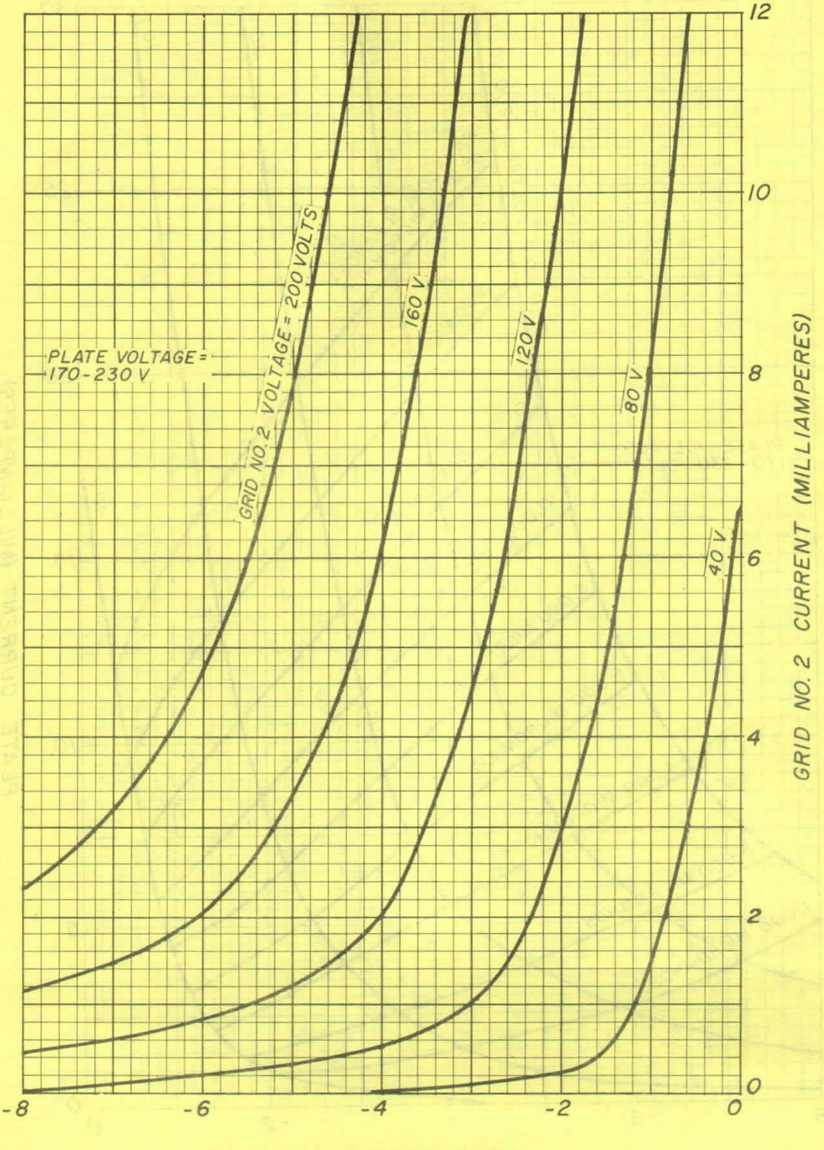


FIGURE 2- SCREEN GRID CHARACTERISTICS

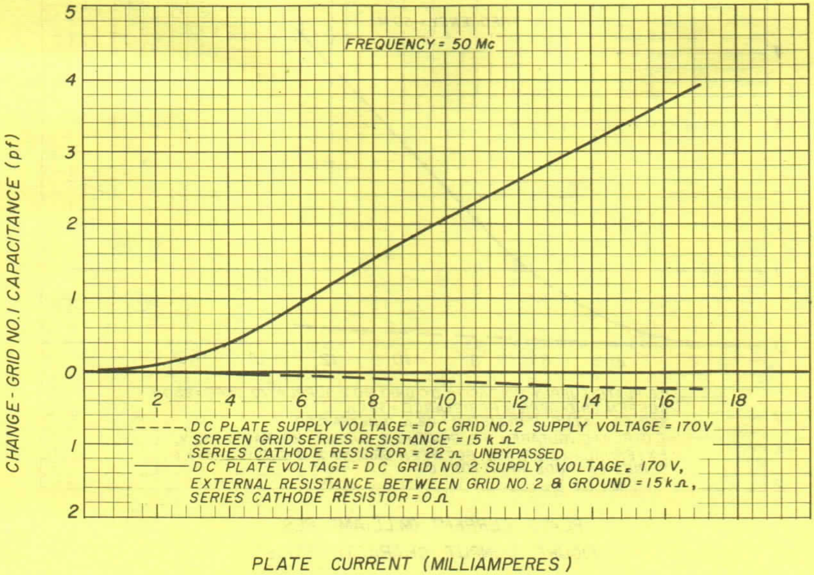


FIGURE 3 - INPUT CHARACTERISTICS

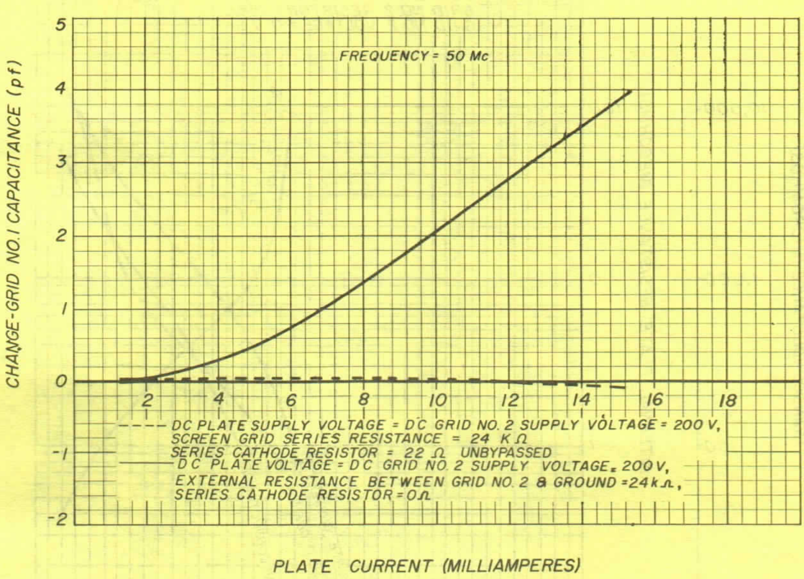


FIGURE 4-INPUT CHARACTERISTICS

6EH7

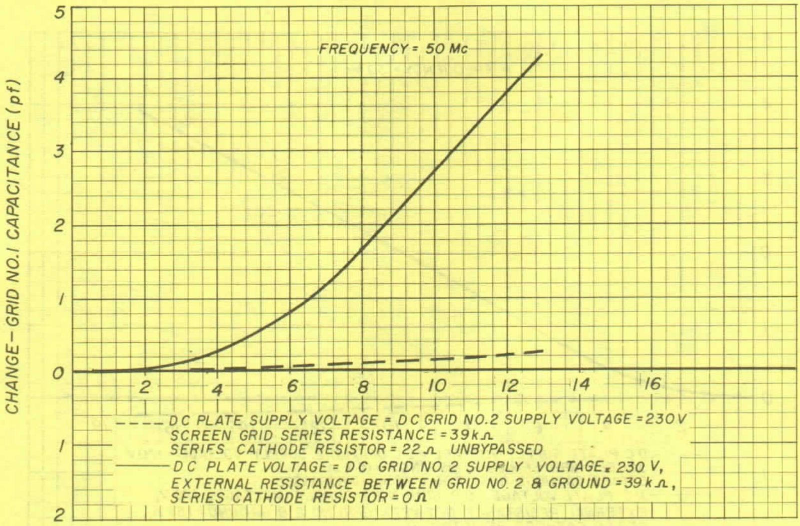


FIGURE 5-INPUT CHARACTERISTICS

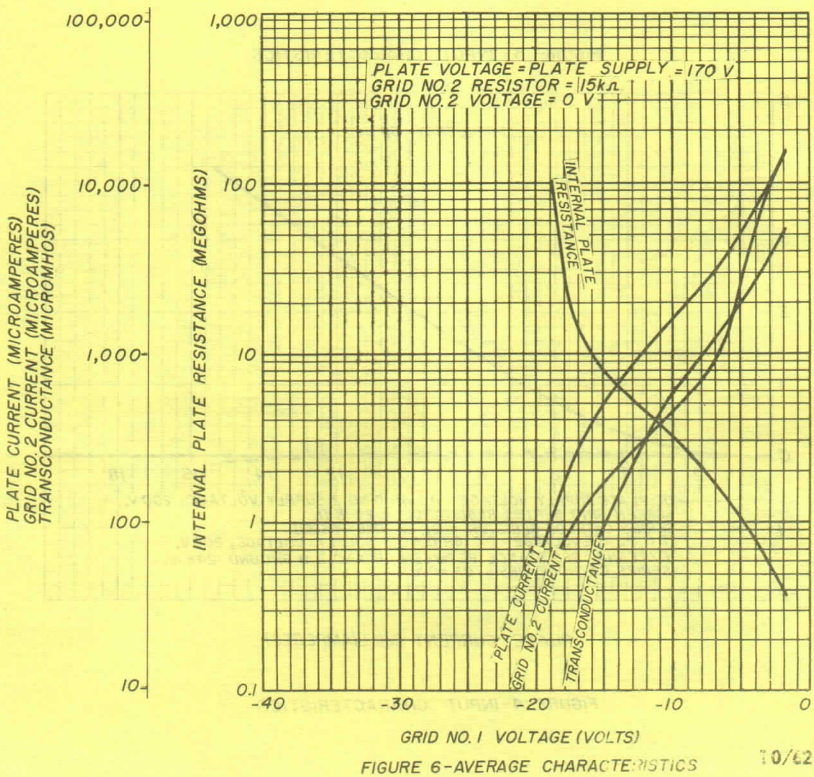


FIGURE 6-AVERAGE CHARACTERISTICS

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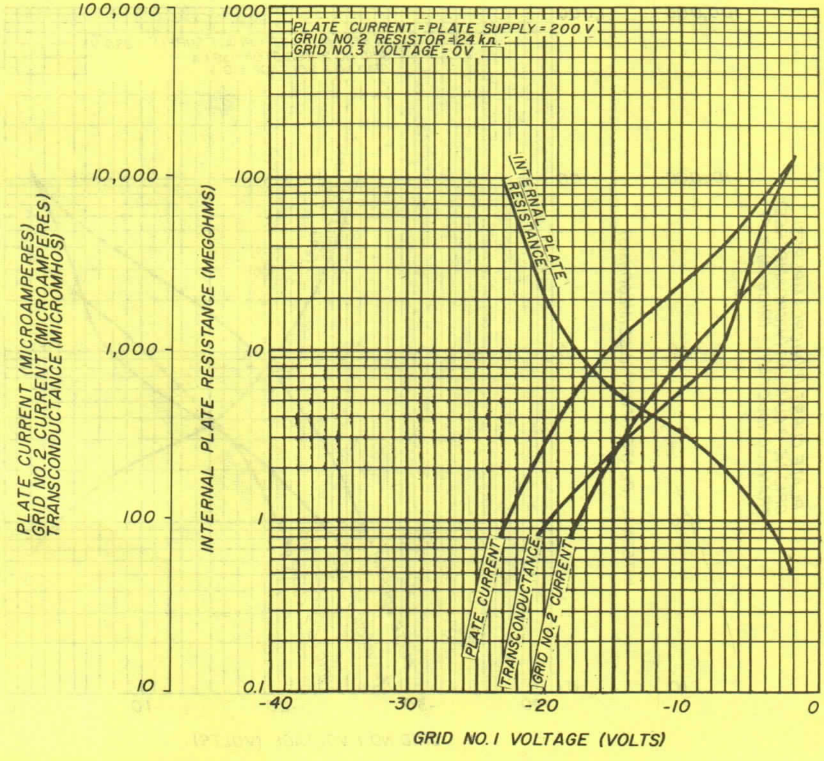


FIGURE 7–AVERAGE CHARACTERISTICS

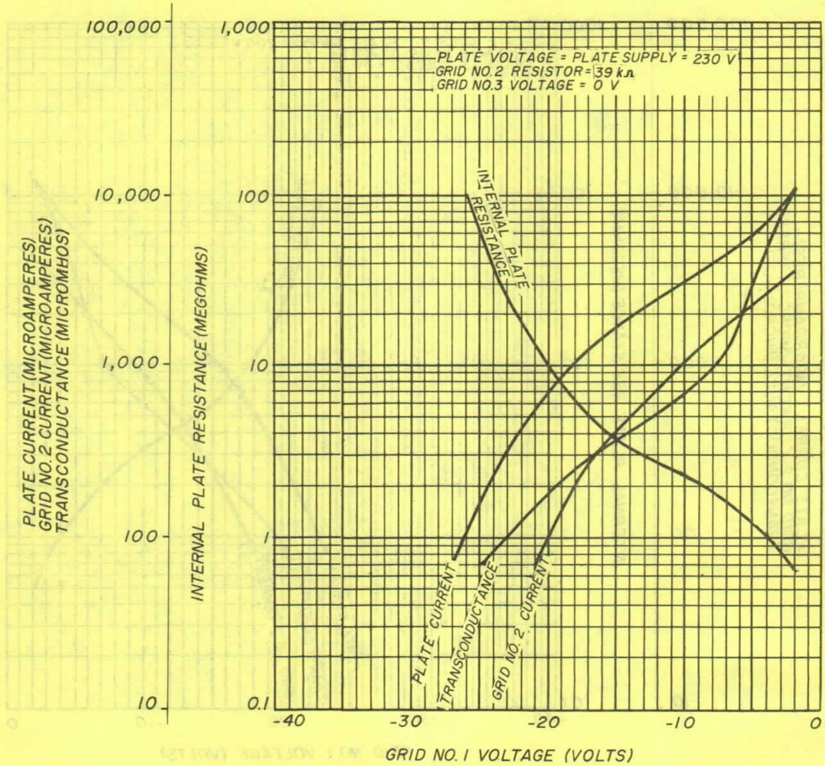


FIGURE 8-AVERAGE CHARACTERISTICS

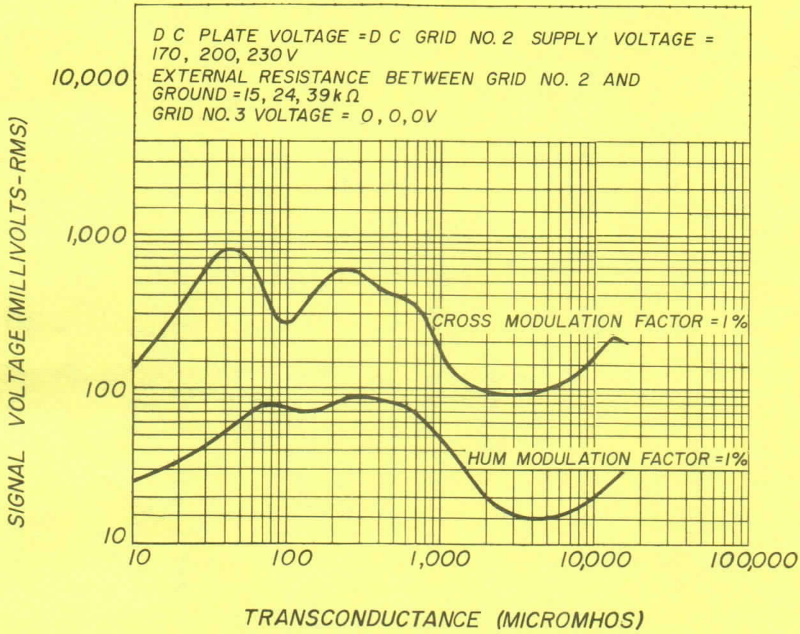
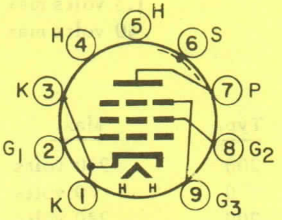


FIGURE 9-AVERAGE CHARACTERISTICS

AMPEREX TUBE TYPE 6EJ7

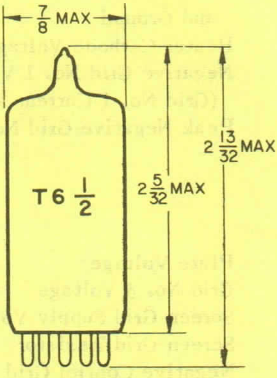
TENTATIVE DATA

The Amperex 6EJ7/EF184 is a frame grid sharp cut-off pentode designed for use as an IF amplifier in television receivers. Its high transconductance with low interelectrode and feed-back capacitances, enables the construction of simplified broad band amplifiers having high stability. The higher gain per stage in many instances reduces the number of tubes required in the television IF strip.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - SHIELD
7 - PLATE
8 - GRID NO.2
9 - GRID NO.3



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	**T6½**
Base	**E 9-1**
Dimensions	**see outline drawing**

ELECTRICAL

Cathode	**coated, unipotential**
Heater Arrangement	**parallel or series supply**
Heater Voltage (ac or dc)	**6.3 volts**
Heater Current	**300 mA**

Direct Interelectrode Capacitances

Input	**10 pf**
Output	**3 pf**
Plate to Grid No. 1	**0.0055 pf**
Grid No. 1 to Grid No. 2	**2.8 pf**

Maximum Ratings, Design Center Values

Plate Voltage (I_b = 0)	550 volts max
Plate Voltage	250 volts max
Plate Dissipation	2.5 watts max
Screen Voltage (I_b = 0)	550 volts max
Screen Voltage	250 volts max
Screen Dissipation [1]	0.9 watts max
Cathode Current	25 mA max
External Resistance between Control Grid and Ground	1 megohm max
Heater-Cathode Voltage	150 volts max
Negative Grid No. 1 Voltage (Grid No. 1 Current = + 0.3 μA)	1.3 volts max
Peak Negative Grid No. 1 Voltage	50 volts max

Typical Operation [2,3]

	Min.	Typ.	Max.
Plate Voltage	170	200	230 volts
Grid No. 3 Voltage	0	0	0 volts
Screen Grid Supply Voltage	170	200	230 volts
Screen Grid Resistor	0	7.5	15 kohms
Negative Control Grid Voltage	2	2.5	3 volts
Cathode Resistor	140	140	140 ohms
Plate Current	10	10	10 ma
Screen Grid Current	4.1	4.1	4.1 ma
Transconductance	15,600	15,600	15,600 micromhos
Internal Plate Resistance	330,000	510,000	680,000 ohms
Amplification Factor of Grid No. 1 with respect to Grid No. 2	60	60	60
Input Resistance (40 mc)	9,500	9,800	10,000 ohms
Equivalent Noise Resistance (40 mc)	300	330	350 ohms

Negative Grid No. 1 Voltage
(Grid No. 1 current = + 0.3 μA)
E_b = 0 — 1.3 volts

---

1 During a heating-up period not exceeding fifteen seconds this value may be max. 1.5 W. as the values of E_{c2} specified under operating characteristics P_{c2} will not be exceeded.

2 Operation with cathode bias resistor is recommended.

3 In order to ensure a good performance with respect to cross-modulation and microphony, the 6EJ7/EF184 should not be used in circuits with automatic gain control.

For such applications a tube with a variable amplification factor such as the Amperex type 6EH7/EF183 is recommended.

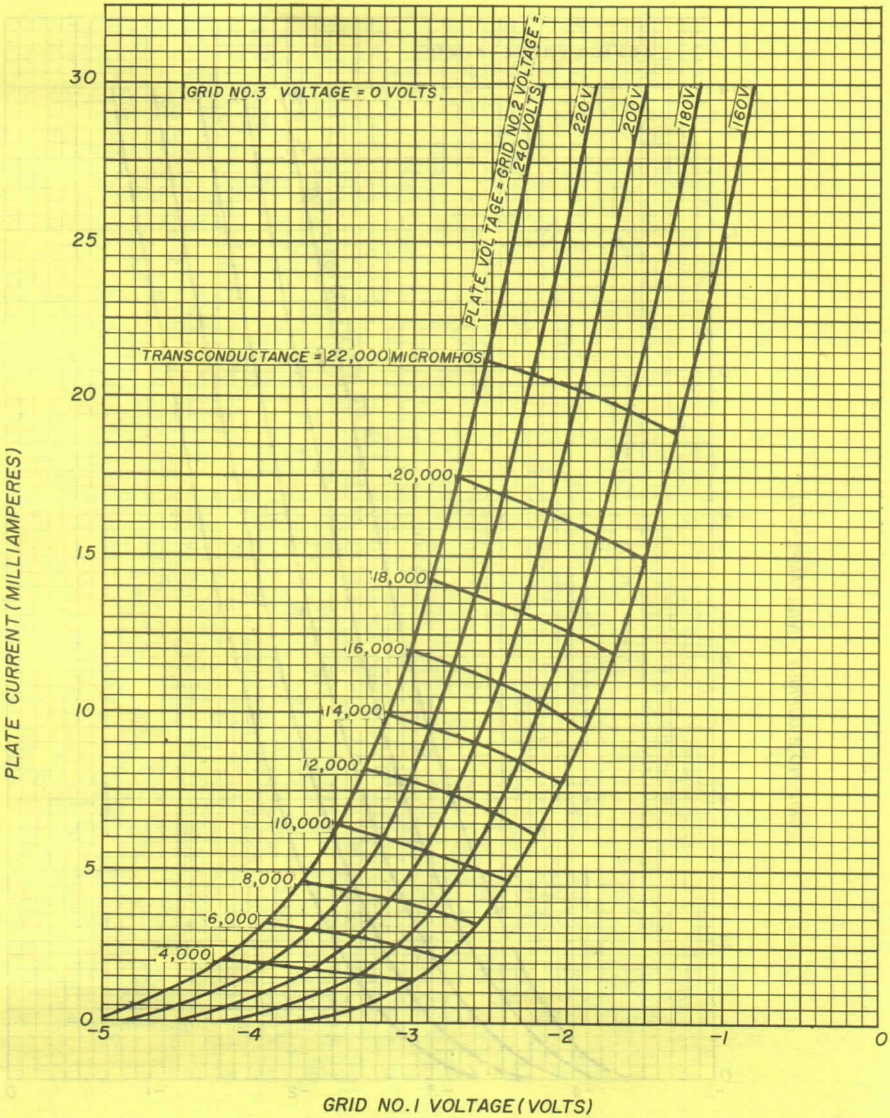


FIGURE 1 - AVERAGE CHARACTERISTICS

6EJ7

SCREEN CHARACTERISTICS

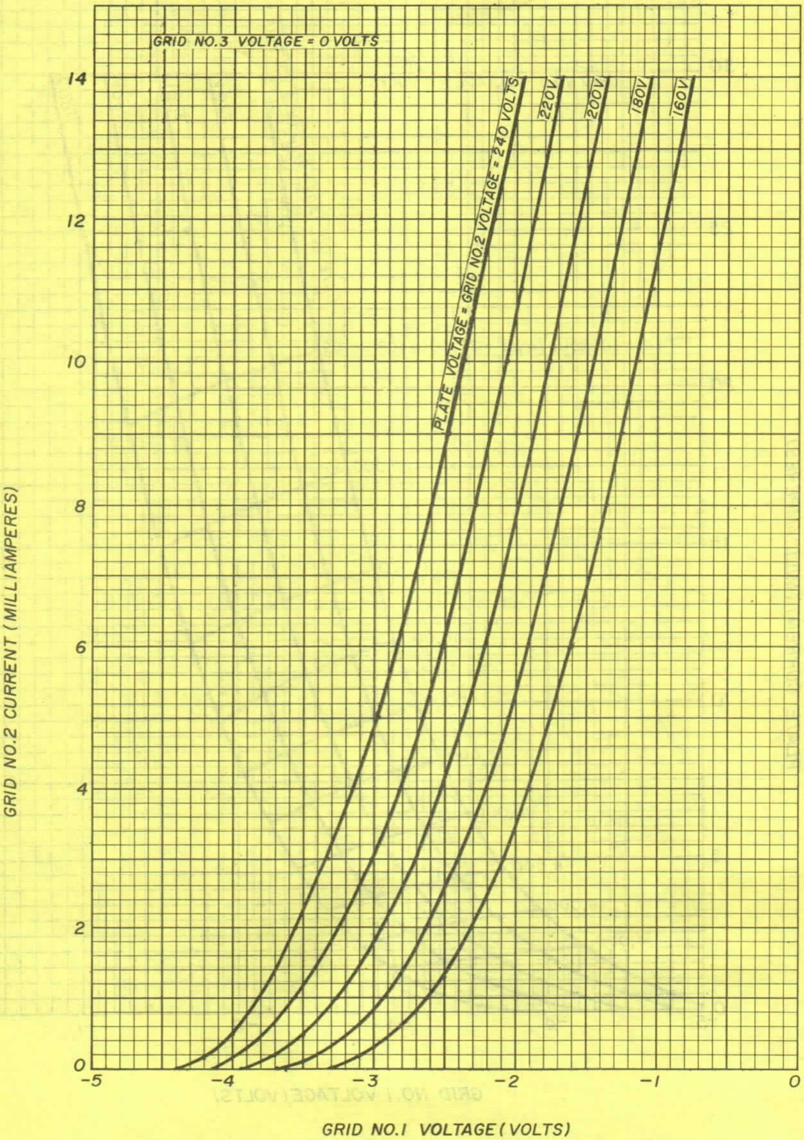
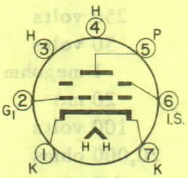


FIGURE 2-GRID NO. 2 CHARACTERISTICS

AMPEREX TUBE TYPE 6ER5

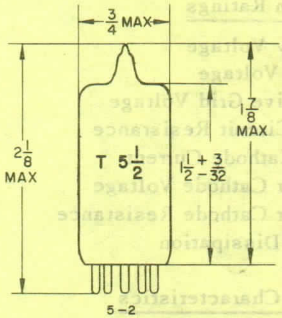
The Amperex 6ER5 is a miniature frame grid shielded triode with remote cut-off. It is especially designed for service in VHF tuners for television receivers and is controlled for low noise figure at 220 Mc/s and operation at low supply voltages.

A high transconductance and input impedance give the 6ER5 a very high gain bandwidth product, and the remote cut-off insures low intermodulation distortion. The two cathode pins serve the purpose of insuring low lead inductance and a separately connected shield reduces direct grid to plate capacitance to simplify neutralization.



PIN CONNECTIONS

1. CATHODE
2. GRID NO.1
3. HEATER
4. HEATER
5. PLATE
6. INTERNAL SHIELD
7. CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5½
Envelope	5-2
EIA Basing Designation	7FN
Base	E7-1
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential

Heater Characteristics

Heater Arrangement	parallel supply
Heater Voltage	6.3 volts
Heater Current	180 mA

6ER5

Direct Interelectrode Capacitances	without external shield	with external shield
Input	4.4	4.4 $\mu\mu f$
Output	3.0	4.0 $\mu\mu f$
Grid to Heater	0.28 max	0.28 $\mu\mu f$ max
Plate to Cathode	0.24	0.20 $\mu\mu f$
Cathode to Grid	3.1	3.1 $\mu\mu f$
Cathode to Heater	2.5	2.5 $\mu\mu f$
Plate to Grid	0.38	0.36 $\mu\mu f$

Maximum Ratings

Supply Voltage	550 volts
Plate Voltage	250 volts
Negative Grid Voltage	50 volts
Grid Circuit Resistance	1 megohm
D-C Cathode Current	20 mA
Heater Cathode Voltage	100 volts
Heater Cathode Resistance	20,000 ohms
Plate Dissipation	2.2 watts

Typical Characteristics

Plate Voltage	200 volts
Grid No. 1 Voltage	− 1.2 volts
Plate Current	10 mA
Transconductance	10,500 micromhos
Amplification Factor	80
Negative Grid Voltage (S = 500 micromhos)	3.8 volts
Negative Grid Voltage (S = 100 micromhos)	5.6 volts

Cross Modulation

A-C Input Voltage (K = 1%, S = 10,500 micromhos)[1]	100 mV rms min.
A-C Input Voltage (K = 1%, S = 500 micromhos)[1]	100 mV rms
A-C Input Voltage (K = 1%, S = 100 micromhos)[1]	100 mV rms min.

[1] K = cross modulation factor.

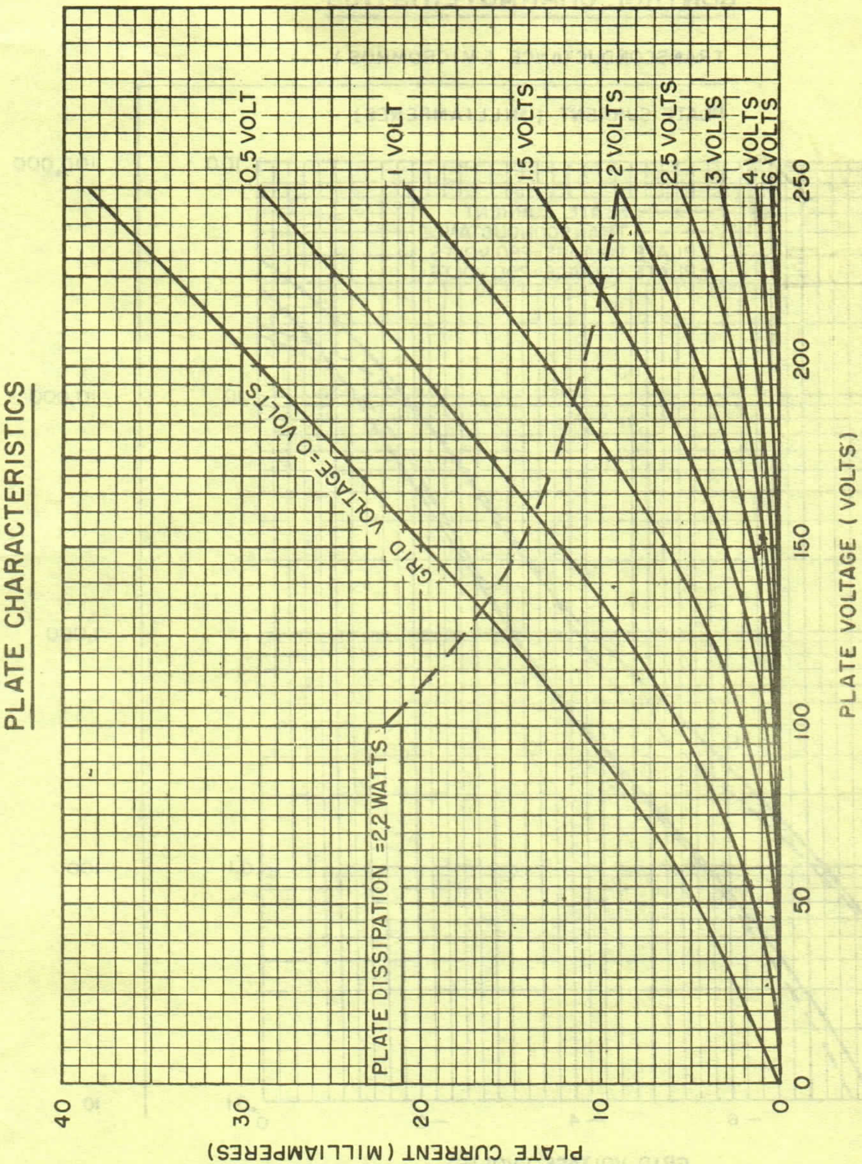
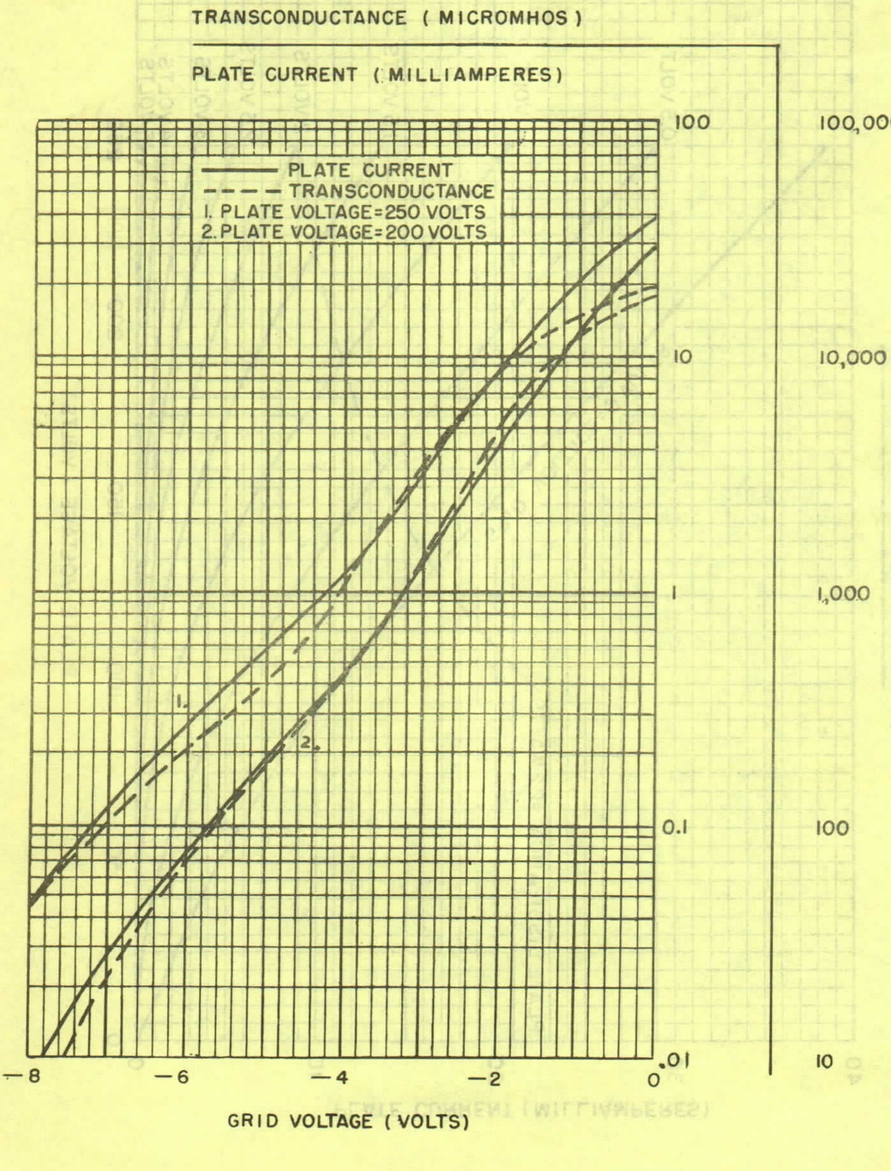


PLATE CHARACTERISTICS
GRID VOLTAGE = 0 VOLTS
0.5 VOLT
1 VOLT
1.5 VOLTS
2 VOLTS
2.5 VOLTS
3 VOLTS
4 VOLTS
6 VOLTS
PLATE DISSIPATION = 2.2 WATTS
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
10
20
30
40

6ER5

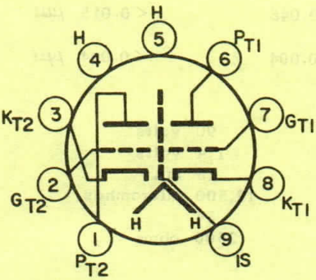
CONTROL CHARACTERISTICS



AMPEREX TUBE TYPE 6ES8

TENTATIVE DATA

The 6ES6 is a high performance frame grid twin triode with remote cut-off characteristics. It is designed for use as a low noise cascode tube in premium television tuners. The remote cut-off feature has been designed so as to reduce intermodulation under strong signal conditions, while allowing extremely sensitive performance of the tuner in weak signal areas.

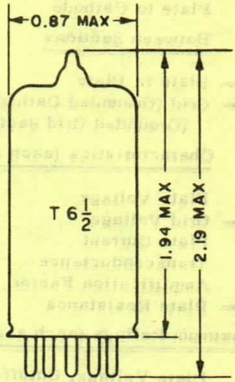


PIN CONNECTIONS

1. PLATE, TRIODE 2
2. GRID, TRIODE 2
3. CATHODE, TRIODE 2
4. HEATER
5. HEATER
6. PLATE, TRIODE 1
7. GRID, TRIODE 1
8. CATHODE, TRIODE 1
9. INTERNAL SHIELD

$\left.\begin{array}{l}1\text{–}3\end{array}\right\}$ GROUNDED GRID OUTPUT SECTION

$\left.\begin{array}{l}6\text{–}8\end{array}\right\}$ GROUNDED CATHODE INPUT SECTION



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Base	E9-1
Bulb	T6½
Outline	6-7
Base Connection	9DE
Mounting Position	any

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel supply
Heater Voltage	6.3 volts
Heater Current	365 mA

6ES8

Direct Interelectrode Capacitances

Grounded Cathode Section	without external shield	with external shield
Plate to Grid	1.9	1.9 μμf
Grid to (Cathode + Heater + Shield)	3.5	3.5 μμf
Plate to (Cathode + Heater + Shield)	1.7	2.3 μμf
Grid to Heater	< 0.28	< 0.28 μμf
Grounded Grid Section		
Plate to Grid	1.9	1.9 μμf
Cathode to (Grid + Heater + Shield)	6.0	6.0 μμf
Plate to (Grid + Heater + Shield)	3.4	4.0 μμf
Cathode to Heater	3.0	3.0 μμf
Plate to Cathode	0.18	0.17 μμf
Between Sections		
Plate to Plate	< 0.045	< 0.015 μμf
Grid (Grounded Cathode Section) to Plate (Grounded Grid Section)	< 0.004	< 0.004 μμf

Characteristics (each section)

Plate Voltage	90 volts
Grid Voltage	− 1.4 volts
Plate Current	15 mA
Transconductance	12,500 micromhos
Amplification Factor	34
Plate Resistance	2500 ohms

Maximum Ratings (each section) [1], [4]

Plate Voltage, Cutoff Condition	550 volts
Plate Voltage	130 volts
Cathode Current	22 mA
Negative Grid Voltage	50 volts
Plate Dissipation	1.8 watts
Grid Circuit Resistance (grounded grid section)	0.5 megohm
Grid Circuit Resistance (grounded cathode section)	1 megohm
Heater to Cathode Voltage (grounded cathode section)	50 volts
Heater to Cathode Voltage [2] (grounded grid section; cathode positive with respect to heater)	150 volts
Circuit Resistance between Cathode and Heater (grounded cathode section)	20,000 ohms

Typical Operation

In a cascode circuit with the grid of the output triode connected to a voltage divider.

Plate Voltage (2 tubes in series)	180 volts
Plate Current	15 mA
Transconductance	12,500 micromhos
Noise Figure in a Tuner (200 Mc/s)	6.5 db
Grid Voltage (Transconductance = 125 micromhos)	− 9 volts
Grid Voltage (Transconductance = 625 micromhos)	−5 volts
V_{in} for K = 1% (Transconductance ≐ 125 micromhos) [3]	500 mV

[1] It is necessary to use a voltage divider for the grid of the grounded grid section in order not to exceed the maximum permissable anode voltage when the cascode amplifier is controlled.

[2] DC component 130 V max

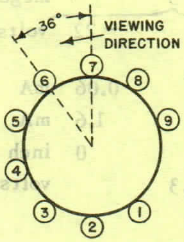
[3] K = cross modulation factor

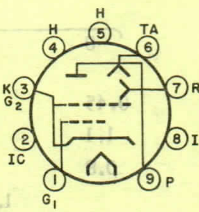
[4] Design Center

Revised 5/60

AMPEREX TUBE TYPE 6FG6/EM84

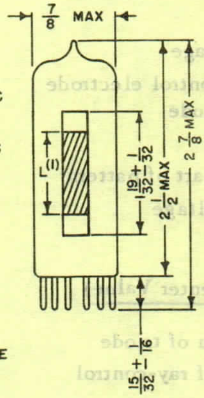
The 6FG6/EM84 is an indirectly heated tuning indicator with a built-in amplifying triode for use in broadcast receivers and tape recorders. The deflection electrode has its own base connection. The indicating pattern is a bar whose length varies with signal strength.





PIN CONNECTIONS

1- GRID NO. 1
2- INTERNALLY CONNECTED
3- CATHODE, GRID NO.2
4- HEATER
5- HEATER
6- TARGET
7- RAY-CONTROL ELECTRODE
8- INTERNALLY CONNECTED
9- PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Overall Length	2-7/8 inch max.
Seated Height	2-1/2 inch max.
Diameter	7/8 inch max.
Bulb	T6½
Base	E9-1
Mounting Position	Any

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel supply
Heater Voltage (ac or dc)	6.3 volts
Heater Current	270 mA

NOTES

1. Length of dark part of pattern (L) = 0.8 ± 0.2 inch at Rg = 3 megohm, Ecc = 0 volts
= 0.95 ± 0.2 inch at Rg = 0 ohms, Ecc = 0 volts

6FG6/EM84

Characteristics (Ray-Control Electrode Connected to Plate)

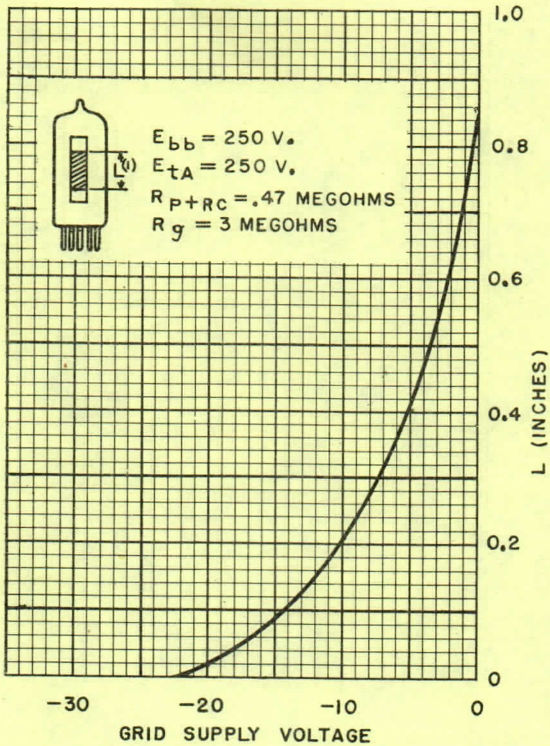
Supply Voltage	250		volts
Voltage at target	250		volts
Series resistor of ray-control electrode and plate of triode	0.47		megohm
Grid resistor [1]	3		megohm
Grid supply voltage	0	− 22	volts
Current to ray-control electrode and plate of triode	0.45	0.06	mA
Current to target	1.1	1.6	mA
Length of dark part of pattern	0.8	0	inch
Negative grid voltage ($I_c = +0.3$ uA)	1.3		volts max.

Ratings (Design Center Value)

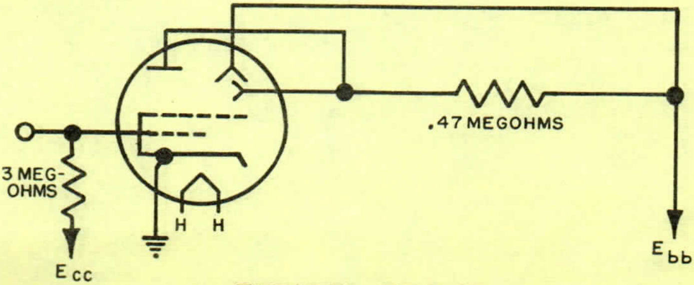
Plate dissipation of triode	0.5	watts max.
Supply voltage of ray-control electrode	550	volts max.
Voltage of ray-control electrode	300	volts max.
Supply voltage of target	550	volts max.
Voltage of target	300	volts max.
Voltage of target	150	volts min.
Cathode current	3.0	mA max.
Grid Resistor	3.0	megohm max.
Voltage between heater and cathode	100	volts max.
Bulb temperature	120	^{o}C max.

NOTES

1. Length of dark part of pattern (L) = 0.8 ± 0.2 inch at Rg = 3 megohm, Ecc = 0 volts
= 0.95 ± 0.2 inch at Rg = 0 ohms, Ecc = 0 volts



DEFLECTION CHARACTERISTICS FOR TYPICAL CIRCUIT



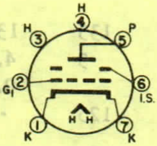
TYPICAL CIRCUIT

AMPEREX TUBE TYPE 6FY5

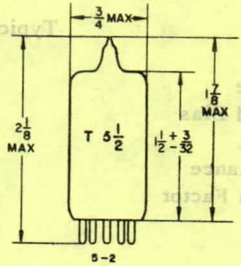
TENTATIVE DATA

The Amperex 6FY5 is a miniature frame grid shielded triode with remote cut-off It is especially designed for service in VHF tuners for television receivers and is controlled for low noise figure at 220 Mc/s and operation at low supply voltages.

A high transconductance and input impedance give the 6FY5 a very high gain bandwidth factor, and the remote cut-off insures low intermodulation distortion. The two cathode pins serve the purpose of insuring low lead inductance and a separately connected shield reduces direct grid to plate capacitance to simplify neutralization.



PIN CONNECTIONS
1. CATHODE
2. GRID NO.1
3. HEATER
4. HEATER
5. PLATE
6. INTERNAL SHIELD
7. CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5½
Outline	5-2
Base	E7-1
EIA Basing Designation	7FN
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heater	parallel supply
Heater Voltage	6.3 volts
Heater Current	200 mA

Direct Interelectrode Capacitances

	Without External Shield	With External Shield
Input	4.75	4.75 μμf
Output	3.3	4.3 μμf
Grid to Heater	0.28 max	0.28 μμf max
Plate to Cathode	0.25	0.21 μμf
Grid to Cathode	3.2	3.2 μμf
Cathode to Heater	2.5	2.5 μμf
Plate to Grid	0.50	0.48 μμf

6FY5

Maximum Ratings, Design Center Values

Plate Voltage	200 volts max
Plate Voltage (Zero Plate Current)	550 volts max
Plate Dissipation	2.2 watts max
Cathode Current	20 mA max
Negative Grid Voltage	50 volts max
Grid Circuit Resistance	1 megohm max
Cathode-Heater Voltage	100 volts max
Cathode-Heater Circuit Resistance	20,000 ohms max

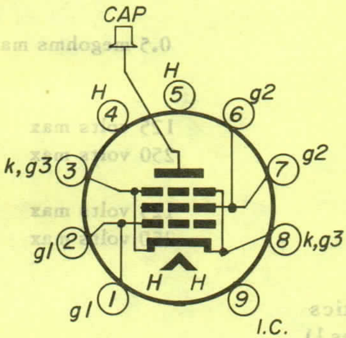
Typical Operation

Plate Voltage	135	135	135	135	volts
Negative Grid Bias	1	3.1	5	4.5	volts
Plate Current	11			0.1	mA
Transconductance	13,000	625	125	-	micromhos
Amplification Factor	70				

AMPEREX TUBE TYPE 6GB5

TENTATIVE DATA

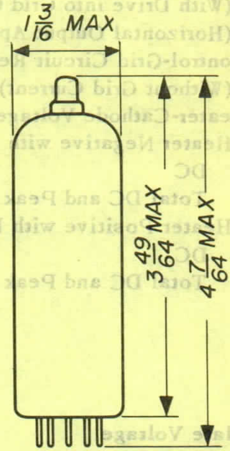
The 6GB5 is an all-glass beam power pentode designed for use in horizontal deflection output stages of TV receivers. It features a large plate to screen grid current ratio, because of the unique "Cavitrap" anode construction. The 6GB5 has an enlarged noval base: the magnoval base.



PIN CONNECTIONS

1. GRID NO.1
2. GRID NO.1
3. CATHODE, GRID NO.3
4. HEATER
5. HEATER
6. GRID NO.2
7. GRID NO.2
8. CATHODE, GRID NO.3
9. INTERNAL CONNECTION

CAP–PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Top Cap	EIA C 1-2
Base	magnoval, E9-23
Dimensions	see outline drawing
Mounting Position	any

ELECTRICAL

Heating	parallel supply
Heater Voltage (AC or DC)	6.3 volts
Heater Current	1.38 amps

6GB5

Maximum Ratings, Design Maximum Values

DC Plate Voltage	275 volts max
Peak Positive Pulse Plate Voltage	7700 volts max
Screen-Grid Voltage	275 volts max
Average Cathode Current	275 ma max
Plate Dissipation	see figure 1
Screen-Grid Dissipation	see figure 1
Control-Grid Circuit Resistance	
(With Drive into Grid Current)	
(Horizontal Output Application Only)	2.2 megohms max
Control-Grid Circuit Resistance	
(Without Grid Current)	0.5 megohms max
Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	
DC	125 volts max
Total DC and Peak	250 volts max
Heater Positive with Respect to Cathode	
DC	125 volts max
Total DC and Peak	250 volts max

Typical Characteristics
(Instantaneous Values [1])

Plate Voltage	75 volts
Screen-Grid Voltage	200 volts
Control-Grid Voltage	–10 volts
Plate Current	440 ma
Screen-Grid Current	37 ma

---

[1] Not to be tested under DC conditions.

Operating Characteristics
Stabilized Circuits (Operation Above the Knee)

Supply Voltage		170			200			230		volts
Minimum Value of Screen-Grid Resistor [2]		1.2			1.5			2.2		kohms
Screen-Grid Voltage	110	130	150	130	150	170	160	180	200	volts
Plate Voltage at End of Scan [3]	50	55	59	55	59	63	61	65	70	volts
Control-Grid Voltage at End of Scan [4]		−10			−10			−10		volts
Peak Plate Current [5]	150	210	270	210	270	330	300	360	420	mA

Non Stabilized Circuits (Drive Below the Knee)

Supply Voltage	170	200	230	volts
Minimum Value of Screen-Grid Resistor	2.2	2.2	2.2	kohms
Control-Grid Voltage at End of Scan [4]	+ 1	+ 1	+ 1	volts
Peak Plate Current [5]	200	250	320	mA

---

[2] The quoted values are the minimum values of R_{g2} which are required to prevent an excessive screen-grid dissipation during the warm-up period.

[3] These values refer to nominal line voltage. At a line voltage 10% below nominal the tube will still operate above the knee.

[4] The minimum required control-grid voltage for cut-off during the flyback is —120 volts.

[5] To allow for tube spread, deterioration during the life and line voltage 10% below nominal, the specified values for peak plate current should not be exceeded at the specified conditions for a nominal line voltage.

MAXIMUM PERMISSIBLE SCREEN-GRID DISSIPATION AS A FUNCTION OF THE PLATE DISSIPATION

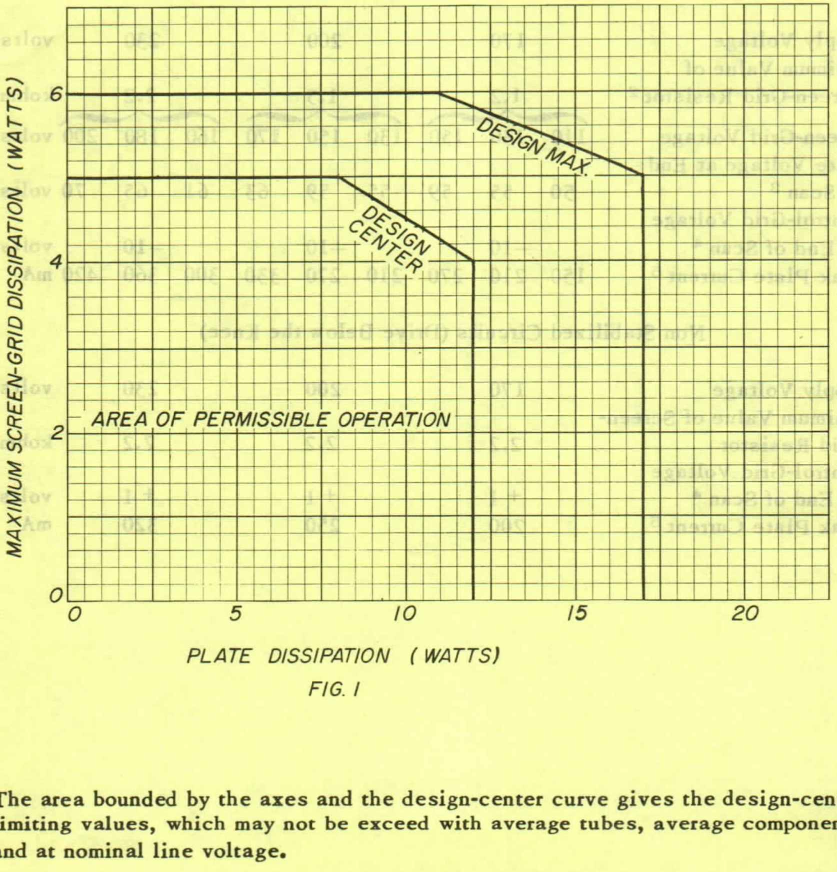


FIG. I

The area bounded by the axes and the design-center curve gives the design-center limiting values, which may not be exceed with average tubes, average components and at nominal line voltage.

The area bounded by the axes and the design-maximum curve gives the design-maximum limiting values, which may not be exceed with average tubes under the most unfavorable conditions.

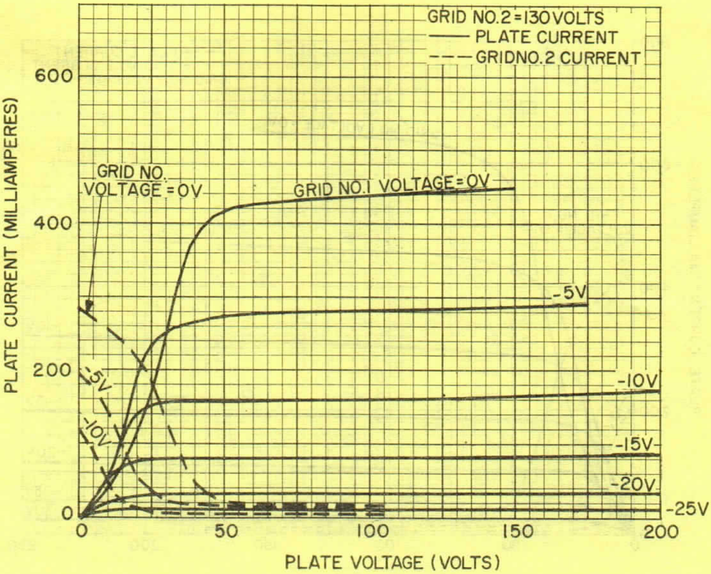


FIGURE 2 – PLATE CHARACTERISTICS

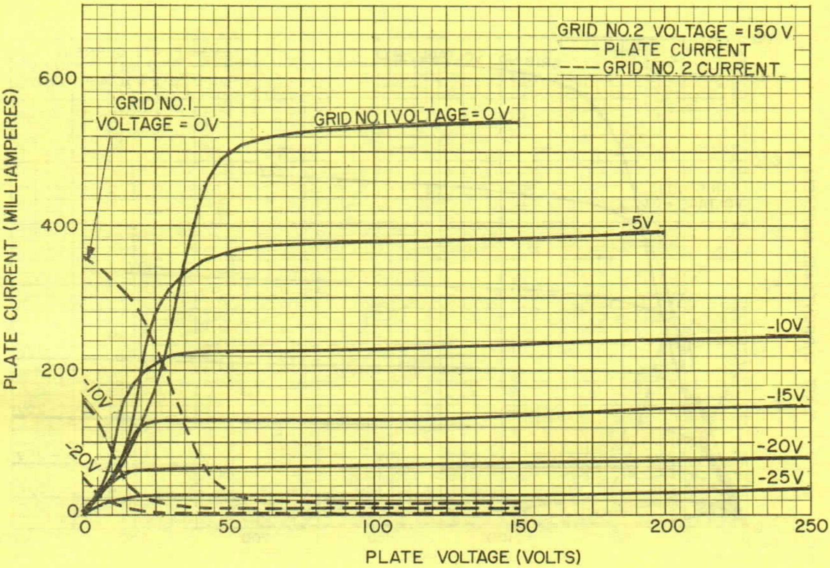


FIGURE 3 – PLATE CHARACTERISTICS

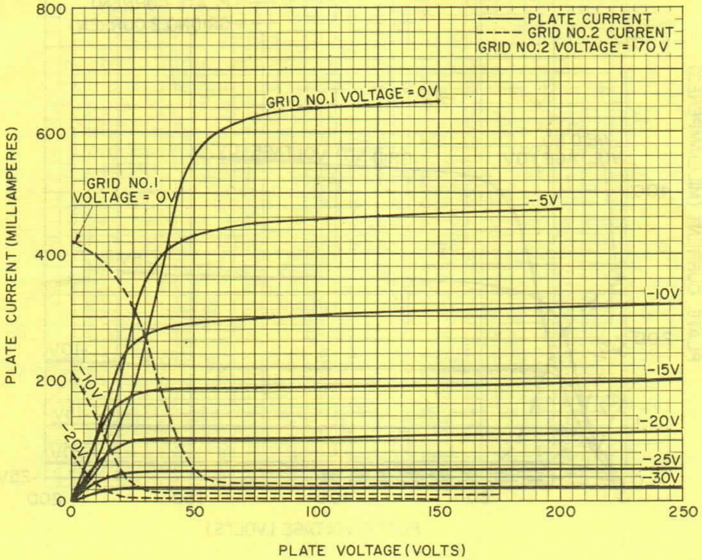


FIGURE 4 – PLATE CHARACTERISTICS

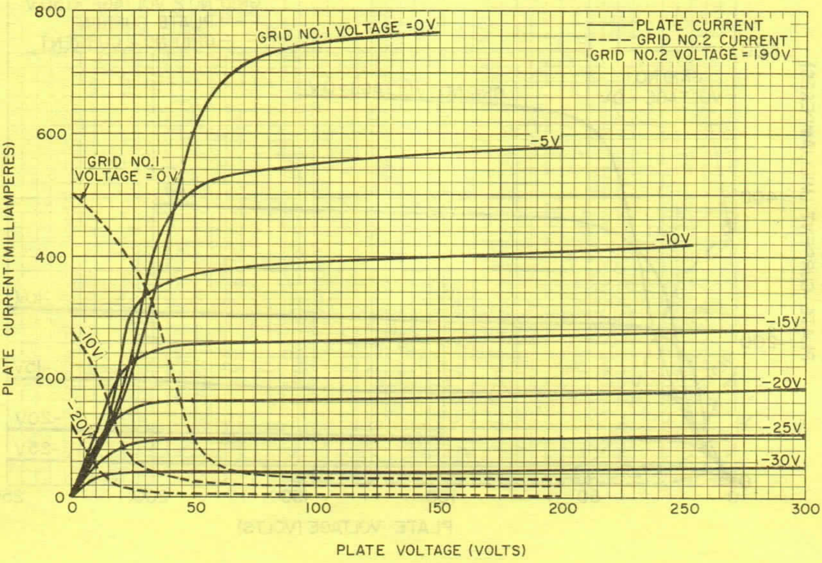


FIGURE 5 – PLATE CHARACTERISTICS

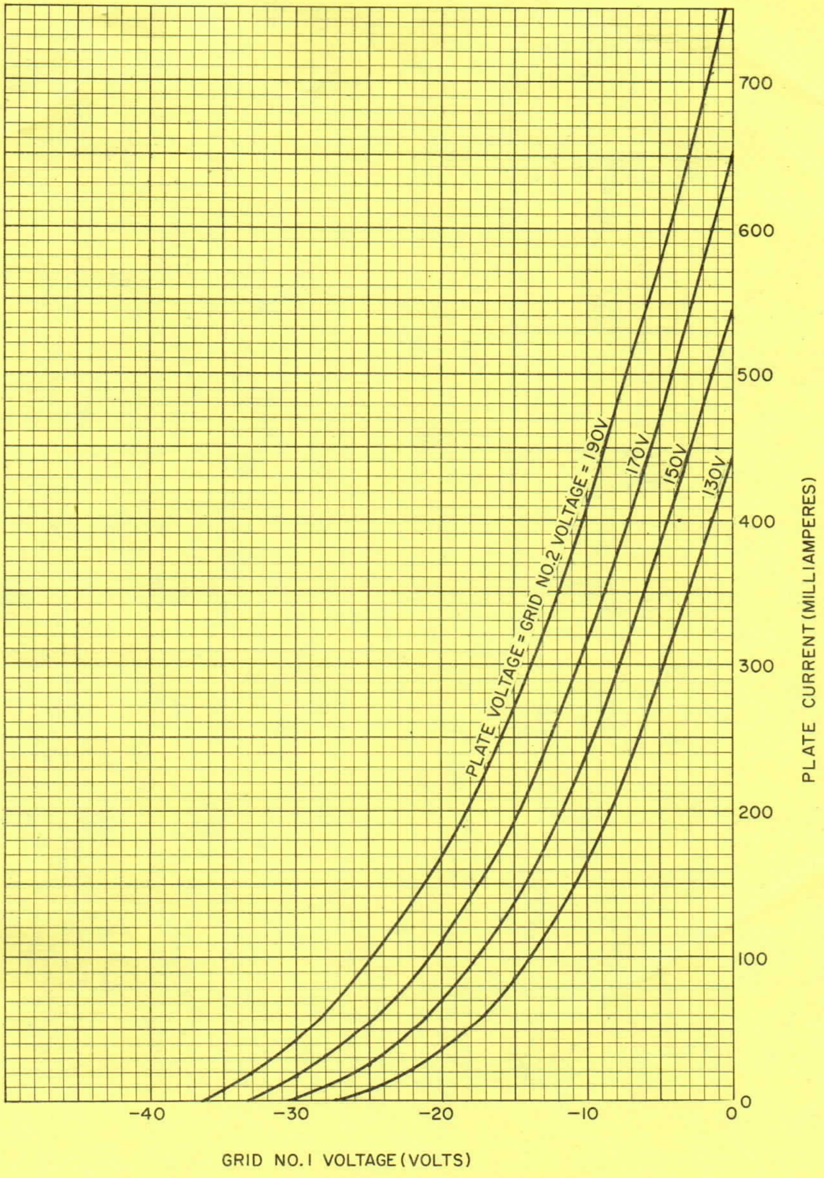
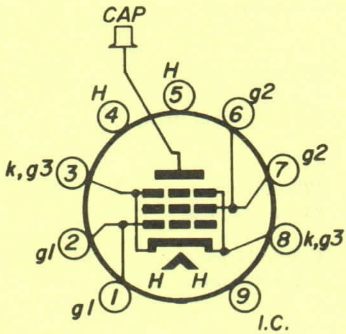


FIGURE 6 — TRANSFER CHARACTERISTICS

AMPEREX TUBE TYPE 6GB5A

TENTATIVE DATA

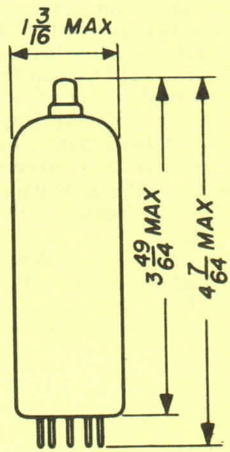
The 6GB5A is an all-glass beam power pentode designed for use in horizontal deflection output stages of TV receivers. It features a large plate to screen grid current ratio, because of the unique "Cavitrap" anode construction. The 6GB5A has an enlarged noval base: the magnoval base.



PIN CONNECTIONS

1. GRID NO.1
2. GRID NO.1
3. CATHODE, GRID NO.3
4. HEATER
5. HEATER
6. GRID NO.2
7. GRID NO.2
8. CATHODE, GRID NO.3
9. INTERNAL CONNECTION

CAP – PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Top Cap	EIA C 1-2
Base	magnoval, E9-23
Dimensions	see outline drawing
Mounting Position	any

ELECTRICAL

Heating	parallel supply
Heater Voltage (AC or DC)	6.3 volts
Heater Current	1.38 amps

6GB5A

Maximum Ratings, Design Maximum Values

DC Plate Voltage	275 volts max.
Peak Positive Pulse Plate Voltage	7700 volts max.
Screen-Grid Voltage	275 volts max.
Average Cathode Current	275 ma max.
Plate Dissipation (See Figure 1)	22.5 watts
Screen-Grid Dissipation (See Figure 1)	6 watts
Control-Grid Circuit Resistance (With Drive into Grid Current) (Horizontal Output Application Only)	2.2 megohms max.
Control-Grid Circuit Resistance (Without Grid Current)	0.5 megohms max.
Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	
DC	125 volts max.
Total DC and Peak	250 volts max.
Heater Positive with Respect to Cathode	
DC	125 volts max.
Total DC and Peak	250 volts max.

Typical Characteristics
(Instantaneous Values[1])

Plate Voltage	75 volts
Screen-Grid Voltage	200 volts
Control-Grid Voltage	-10 volts
Plate Current	440 ma
Screen-Grid Current	37 ma

[1] Not to be tested under DC conditions.

Operating Characteristics

Stabilized Circuits (Operation Above the Knee)

Supply Voltage		170			200			230		volts
Minimum Value of Screen-Grid Resistor [2]		1.2			1.5			2.2		kohms
Screen-Grid Voltage	110	130	150	130	150	170	160	180	200	volts
Plate Voltage at End of Scan [3]	50	55	59	55	59	63	61	65	70	volts
Control-Grid Voltage at End of Scan [4]		−10			−10			−10		volts
Peak Plate Current [5]	150	210	270	210	270	330	300	360	420	mA

Non Stabilized Circuits (Drive Below the Knee)

Supply Voltage	170	200	230	volts
Minimum Value of Screen-Grid Resistor	2.2	2.2	2.2	kohms
Control-Grid Voltage at End of Scan [4]	+ 1	+ 1	+ 1	volts
Peak Plate Current [5]	200	250	320	mA

---

[2] The quoted values are the minimum values of R_{g2} which are required to prevent an excessive screen-grid dissipation during the warm-up period.

[3] These values refer to nominal line voltage. At a line voltage 10% below nominal the tube will still operate above the knee.

[4] The minimum required control-grid voltage for cut-off during the flyback is −120 volts.

[5] To allow for tube spread, deterioration during the life and line voltage 10% below nominal, the specified values for peak plate current should not be exceeded at the specified conditions for a nominal line voltage.

Maximum Permissible Screen-Grid Dissipation As
A Function Of The Plate Dissipation

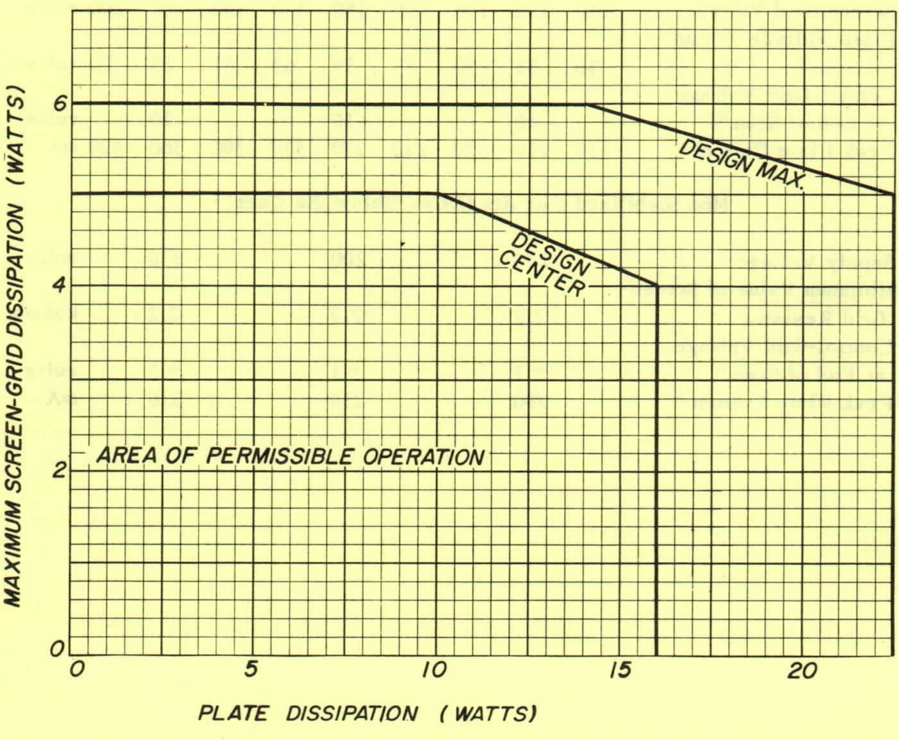


Figure 1

The area bounded by the axes and the design-center curve gives the design-center limiting values, which may not be exceeded with average tubes, average components and at nominal line voltage.

The area bounded by the axes and the design-maximum curve gives the design-maximum limiting values, which may not be exceeded with average tubes under the most unfavorable conditions.

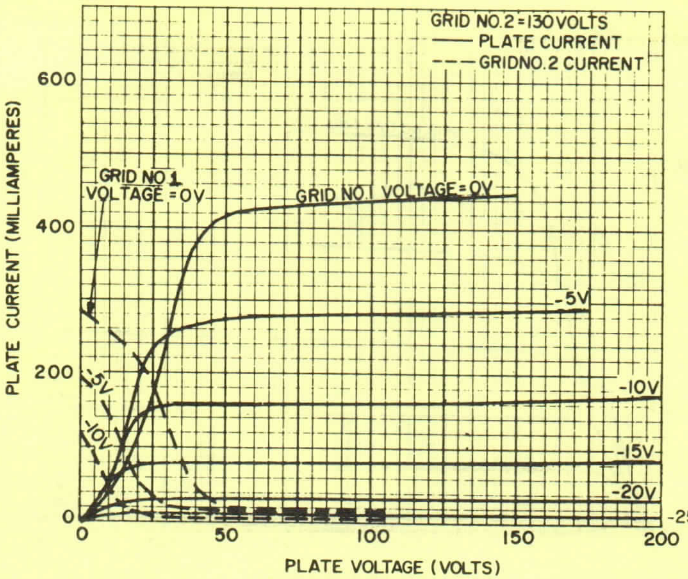


FIGURE 2 – PLATE CHARACTERISTICS

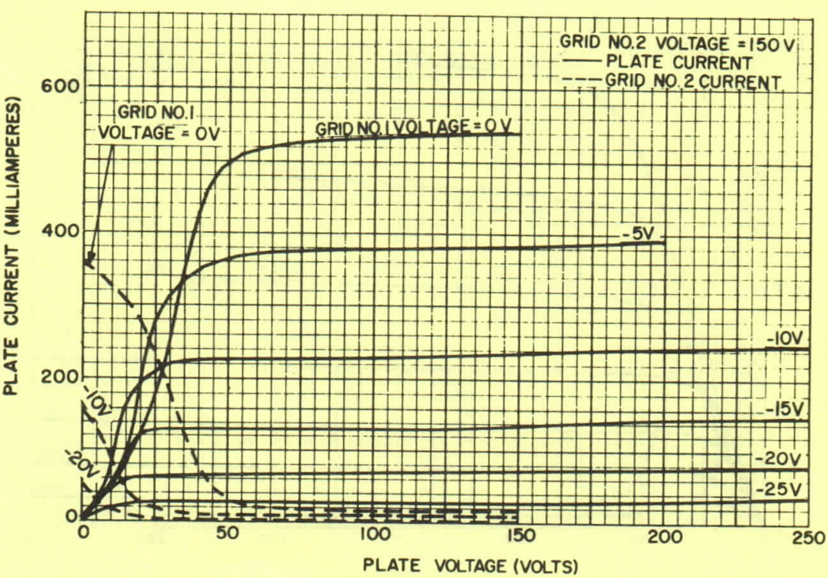


FIGURE 3 – PLATE CHARACTERISTICS

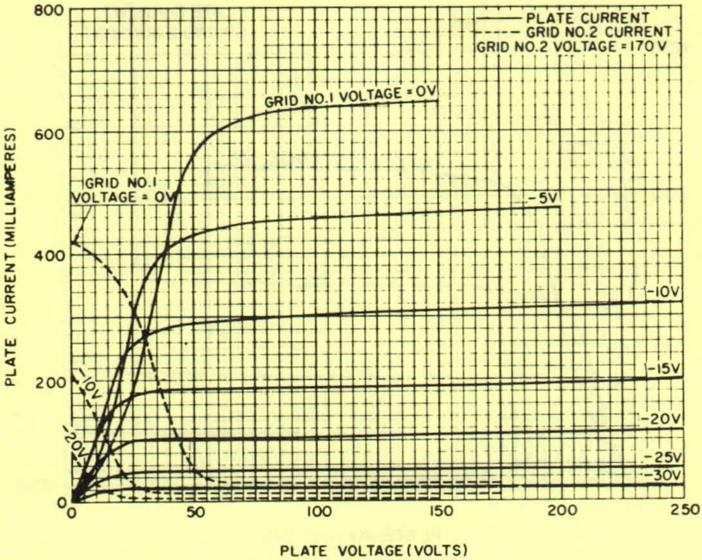


FIGURE 4 – PLATE CHARACTERISTICS

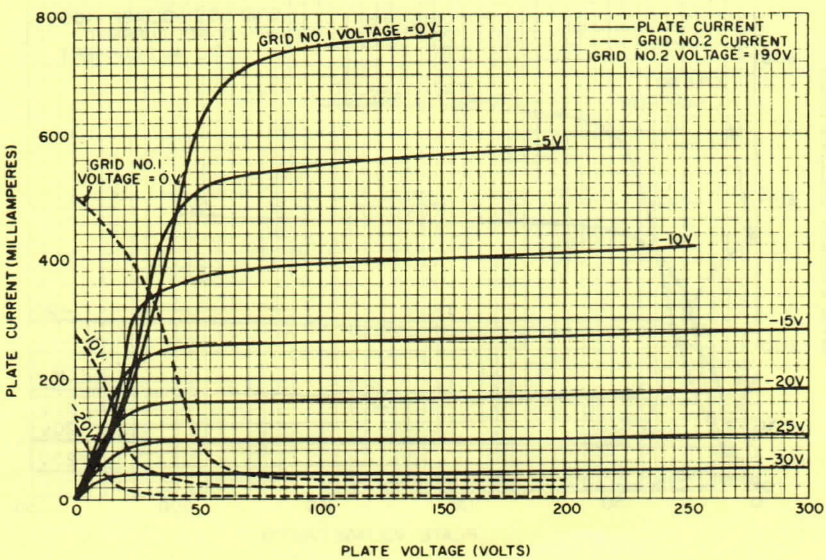


FIGURE 5 – PLATE CHARACTERISTICS

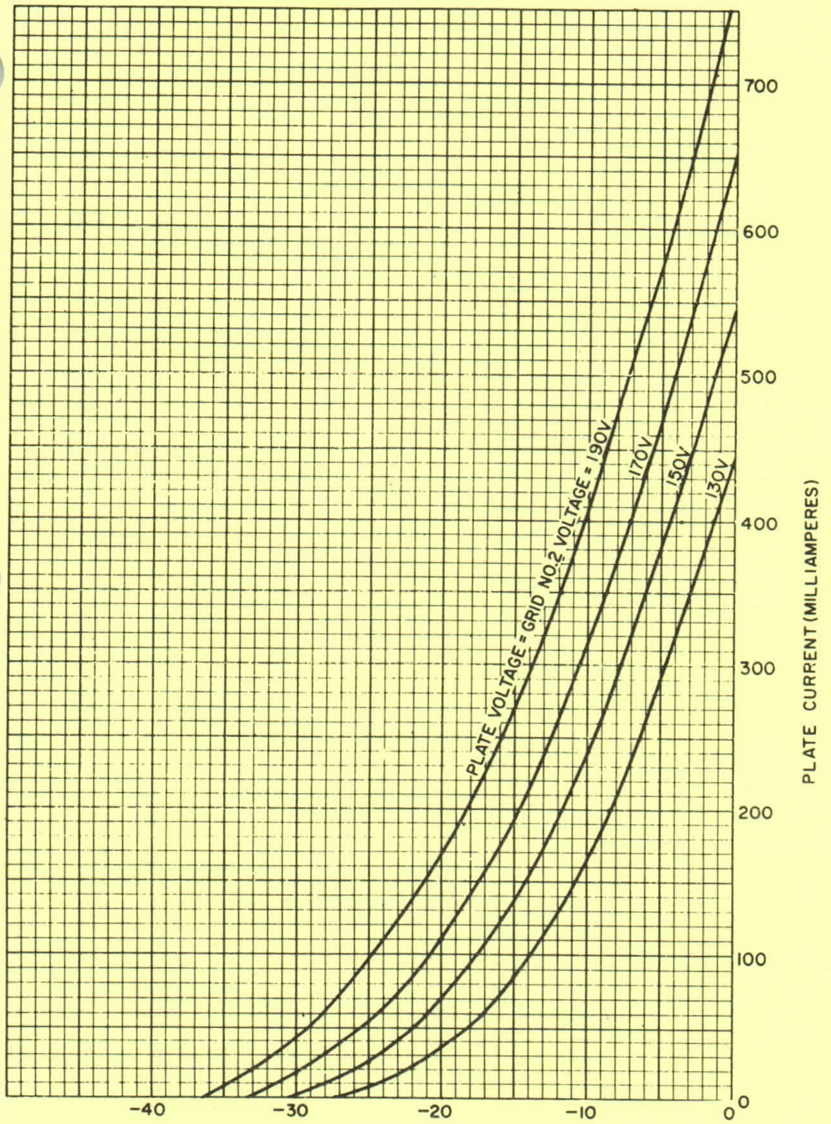


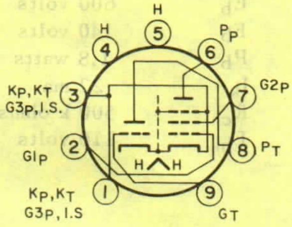
FIGURE 6 — TRANSFER CHARACTERISTICS

AMPEREX TUBE TYPE 6GJ7

TENTATIVE DATA

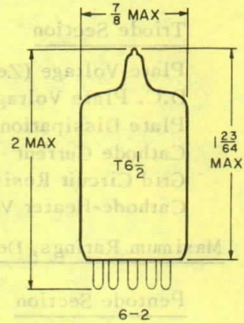
The Amperex 6GJ7 is an Ampliframe triode-pentode for oscillator mixer service in television applications. The high gm Ampliframe triode insures stable oscillator performance even at low line voltages. The Ampliframe pentode section has an extremely high conversion transconductance of 4700 μmhos.

The varying pitch control grid makes possible the application of automatic gain control of the mixer, when the tube is used as an IF Amplifier in integrated UHF - VHF tuners.



PIN CONNECTIONS

1. CATHODES, PENTODE GRID NO.3, INTERNAL SHIELD
2. PENTODE GRID NO.1
3. CATHODES, PENTODE GRID NO.3, INTERNAL SHIELD
4. HEATER
5. HEATER
6. PENTODE PLATE
7. PENTODE GRID NO.2
8. TRIODE PLATE
9. TRIODE GRID



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	Noval E9-1
Outline	6- 2
Dimensions	see outline drawing

ELECTRICAL

Heating	Indirect by AC or DC parallel supply
Heater Voltage	6.3 volts
Heater Current	410 ma

Direct Interelectrode Capacitances

Triode Section

Plate to Grid	C_{pg}	1.8 pf
Grid to Cathode and Heater	C_{kh}	3.3 pf
Plate to all except G1	C_{out}	1.7 pf

Pentode Section (with external shield)

Input	C_{in}	6.2 pf
Output	C_{out}	3.5 pf
Plate to Grid No. 1	C_{pg1}	.009 pf
Grid No. 1 to Grid No. 2	C_{g1-g2}	1.5 pf

Direct Interelectrode Capacitances (Cont'd.)

Between Triode and Pentode Sections	
Triode Plate to Pentode Plate	< .025 pf
Pentode Plate to Triode Grid	< .01 pf
Triode Plate to Pentode Grid No. 1	< .01 pf
Triode Grid to Pentode Grid No. 1	< .01 pf

Maximum Ratings, Design Maximum Values

Triode Section

Plate Voltage (Zero Plate Current)	E_b	600 volts
D.C. Plate Voltage	E_b	140 volts
Plate Dissipation	P_b	1.8 watts
Cathode Current	I_k	22 ma
Grid Circuit Resistance	R_c	500 k ohms
Cathode-Heater Voltage [1]	E_{hk}	110 volts

Maximum Ratings, Design Maximum Values

Pentode Section

Plate Voltage (Zero Plate Current)	E_b	600 volts
D.C. Plate Voltage	E_b	275 volts
Plate Dissipation	P_b	2.4 watts
Screen Grid Voltage (Cold Condition)	E_{c2}	600 volts
D.C. Grid No. 1 Voltage	E_{c1}	−50 volts
D.C. Grid No. 2 Voltage	E_{c2}	275 volts
Grid No. 2 Power Dissipation [2]	P_{g2}	0.55 watts
Cathode Current	I_k	20 ma
Grid No. 1 Circuit Resistance (Automatic Bias)	R_{g1}	2.2 megohms
Grid No. 1 Circuit Resistance (Fixed Bias)	R_{g1}	1 megohm
Cathode-Heater Voltage [1]	E_{hk}	110 volts

Typical Characteristics

Triode Section

D.C. Plate Voltage	E_b	100 volts
Plate Current	I_b	15 ma
Mutual Conductance	G_m	9000 μmhos
Amplification Factor	μ	20
Grid Voltage	E_{c1}	−3 volts
Grid Bias for $I_{c1} = +\ 0.3\ \mu a$	E_{c1}	−1.3 volts max

1 The hum should be minimized in intercarrier receiver applications by limiting the heater-cathode voltage to 100 volts rms, and in AM receivers to 50 volts rms.

2 When negative control grid bias is between −1.5 and 2.0 volts, screen dissipation is limited to 0.50 watts. When this bias is greater than −2 volts, maximum screen dissipation is 0.36 watts.

Typical Characteristics

Pentode Section

D.C. Plate Voltage	E_b	170 volts
D.C. Grid No. 2 Voltage	E_{c2}	120 volts
Plate Current	I_b	10 ma
D.C. Grid No. 2 Current	I_{c2}	3.0 ma
Transconductance	G_m	11,000 μmhos
Internal Plate Resistance	r_p	$>$350,000 ohms
D.C. Grid No. 1 Voltage	E_{c1}	-1.2 volts
Amplification Factor, Grid No. 2 to Grid No. 1	μ_{g2-g1}	$\approx$ 55
Grid Bias for $I_{c1} = +0.3\ \mu a$	E_{c1}	-1.3 volts max
Equivalent Noise Resistance	R_n	1500

Typical Operation

Triode as Oscillator

D.C. Plate Supply Voltage	E_{bb}	200	200 volts
Plate Load Resistance	R_L	8200	12,000 ohms
External Grid to Cathode Resistance	R_{g-k}	10,000	10,000 ohms
Plate Current	I_b	16	12 ma
Oscillator Voltage (effective)	V_{osc}	4.5	3.3 volts(eff.)
Transconductance (effective)[3]	G_m	3700	3700 μmhos

Pentode Section as Mixer

Plate Supply Voltage	E_{bb}	200	200 volts
Plate Load Resistance	R_p	2700	4700 ohms
D.C. Grid No. 2 Supply Voltage	E_{cc2}	200	200 volts
Grid No. 2 Resistance	R_{g2}	27,000	27,000 ohms
D.C. Grid No. 1 Supply Voltage	E_{cc1}	-1.2	0 volts
Grid No. 1 Resistance	R_{g1}	0.1	1 megohm
Oscillator Voltage (effective)	V_{osc}	1.6	1.6 volts
Plate Current	I_b	10	9 ma
D.C. Grid No. 2 Current	I_{c2}	3	2.8 μa
D.C. Grid No. 1 Current	I_{c1}	$\approx$ 10	$\approx$ 2.3 μa
Conversion Transconductance	G_m	5000	4700 μmhos
Input Resistance at 200 mc		600	600 ohms

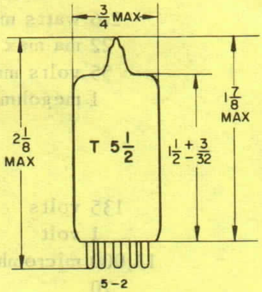
Pentode Section as an IF Amplifier

Plate Supply Voltage	E_{bb}	200	200 volts
Plate Load Resistance	R_p	2700	4700 ohms
Grid No. 2 Resistance	R_{g2}	27,000	27,000 ohms
Grid No. 1 Resistance	R_{g1}	0.1	1 megohm
D.C. Grid No. 1 Supply Voltage	E_{cc1}	-1.2	0 volts
Plate Current	I_b	10	12.5 ma
D.C. Grid No. 2 Current	I_{c2}	3	3.7 ma
Transconductance	G_m	11,000	14,000 μmhos
D.C. Grid No. 1 Voltage for $G_m/100$	E_{c1}	-12	-15 volts
Input Resistance at (50 mc)		10,000	10,000 ohms
D.C. Grid No. 2 Supply Voltage	E_{bc2}	200	200 volts

[3] Without higher harmonics.

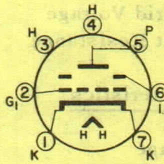
AMPEREX TUBE TYPE 6GK5

The Amperex 6GK5 is an Ampliframe, gain controlled triode. It is designed for use as an RF amplifier in VHF television tuners.



PIN CONNECTIONS

1. CATHODE
2. GRID NO. 1
3. HEATER
4. HEATER
5. PLATE
6. INTERNAL SHIELD
7. CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5½
Base	E7-1
Outline	5-2
Basing	7FN
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heating	parallel supply
Heater Voltage	6.3 volts
Heater Current	200 ma

Heater Ratings (Design Maximum Values)

Heater Voltage [1]	5.3 volts min. 7.3 volts max.
Maximum Heater to Cathode Voltage; Total DC and Peak	110 volts
Maximum Circuit Resistance Between Heater and Cathode	20 k ohms

Direct Interelectrode Capacitances (Shielded)

Grid to Plate	0.48 pf
Input	4.7 pf
Output	3.3 pf
Plate to Cathode	0.180 pf
Grid to Cathode	3.2 pf
Heater to Cathode	2.5 pf
Heater to Grid	0.28 pf max

[1] Equipment should be designed so that at normal supply voltage the tube will operate at a heater voltage which deviates less than plus or minus 7% from the specified nominal value.

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6GK5

Mamimum Ratings, Design Maximum Values

Plate Voltage	220 volts max
Plate Voltage (Zero Plate Current)	600 volts max
Plate Dissipation	2.6 watts max
DC Cathode Current	22 ma max
Negative Grid Voltage	55 volts max
Grid Circuit Resistance	1 megohm max

Typical Characteristics

Plate Voltage	135 volts
Negative Grid Voltage	1 volt
Transconductance	13,000 micromhos
Amplification Factor	70
Plate Resistance	5,200 ohms
Negative Grid Voltage for Transconductance = 1,300 micromhos	2.55 volts
Negative Grid Voltage for Transconductance = 130 micromhos	5.0 volts

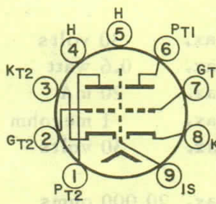
Typical Operation

Plate Supply Voltage	135	135	135 volts
Plate Series Resistance	1	1	1 k ohm
Grid Current	10	-	- μa
Negative Grid Voltage (Approx,)	-	2.4	4.7 volts
Transconductance	17,500	1,750	175 micromhos
Plate Current (Approx.)	19.5	1.3	0.12 ma

AMPEREX TUBE TYPE 6GM8/ECC86

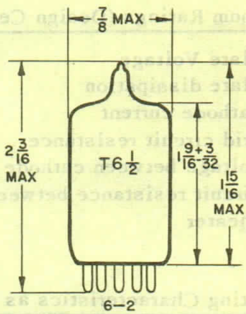
TENTATIVE DATA

The Amperex 6GM8/ECC86 is a frame grid, twin triode designed for low supply voltage applications. It is especially suitable for instrumentation and industrial applications as a direct-coupled wide band amplifier and for automobile radio sets as an RF amplifier and self-oscillating mixer. The tube can be directly operated from a storage battery.



PIN CONNECTIONS

1 – PLATE, TRIODE NO.2
2 – GRID , TRIODE NO.2
3 – CATHODE, TRIODE NO.2
4 – HEATER
5 – HEATER
6 – PLATE, TRIODE NO.1
7 – GRID , TRIODE NO.1
8 – CATHODE, TRIODE NO.1
9 – INTERNAL SHIELD



GENERAL CHARACTERISTICS

MECHANICAL

Maximum Dimensions	see outline drawing
Bulb	T6½
Outline	6-2
Base	E9-1
Basing	9DE
Mounting position	any

ELECTRICAL

Cathode	coated, unipotential
Heater voltage	6.3 volts
Heater current	330 mA

Direct Interelectrode Capacitances (Each Section)

Output	1.8 μμf
Input	3 μμf
Plate to grid	1.3 μμf

Between the 2 sections

Plate to plate	max.	0.05 μμf
Grid to grid	max.	0.005 μμf
Plate section 1 to grid section 2	max.	0.005 μμf
Plate section 2 to grid section 1	max.	0.005 μμf

6GM8/ECC86

Typical Characteristics (each section)

Plate Voltage	6.3 volts
Grid voltage	− 0.4 volt
Plate current	0.9 mA
Transconductance	2600 micromhos
Amplification Factor	14

Maximum Ratings (Design Center Values)

Plate Voltage	max.	30 volts
Plate dissipation	max.	0.6 watt
Cathode current	max.	20 mA
Grid circuit resistance	max.	1 megohm
Voltage between cathode and heater	max.	30 volts
Circuit resistance between cathode and heater	max.	20,000 ohms

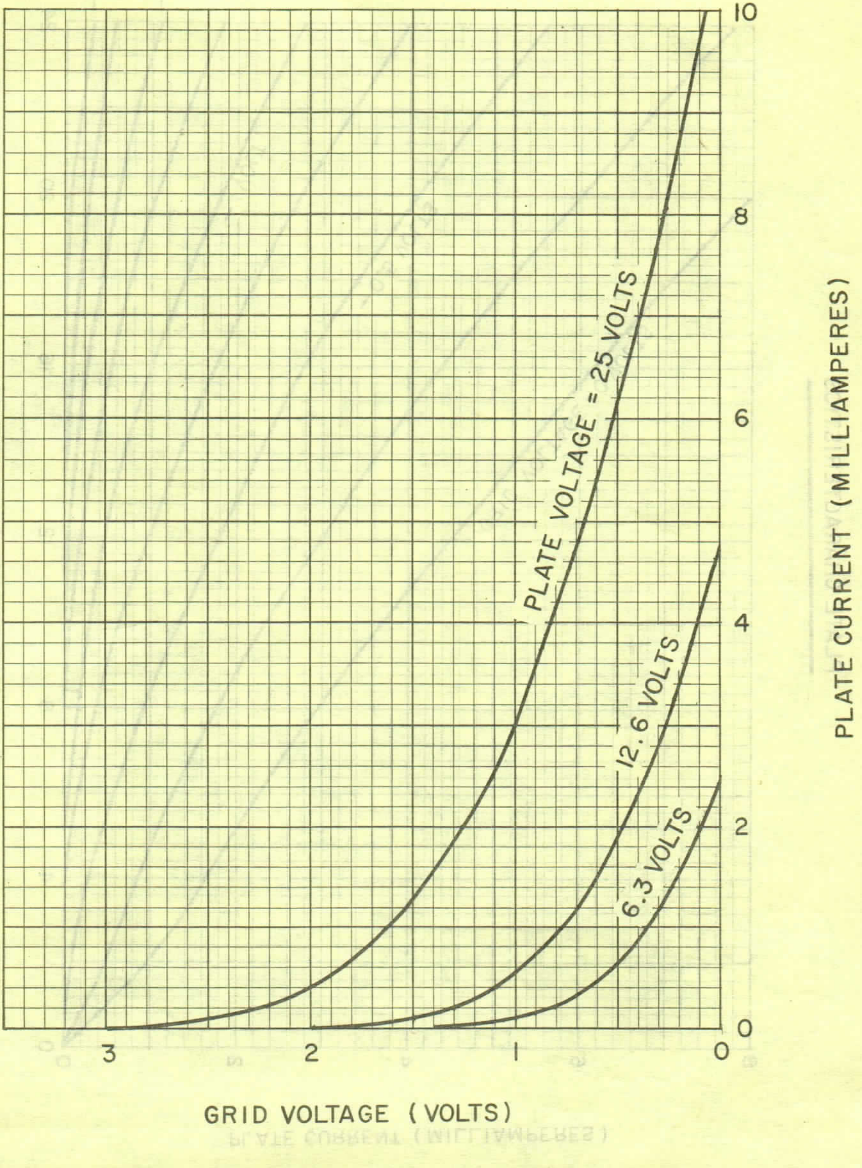
Operating Characteristics as RF Amplifier (each section)

Plate Voltage	6.3	12.6	25 volts
Grid supply voltage	0	0	0 volts
Grid circuit resistance	0.1	0.1	0.1 megohm
Plate current	0.9	2.5	7.5 mA
Transconductance	2600	4600	7800 micromhos
Internal resistance	5000	3400	2100 ohms
Equivalent noise resistance	1000	--	-- ohms

Operating Characteristics As Self-Oscillating Mixer (each section)

Plate supply voltage	6.3	12.6	25 volts
Plate circuit resistance	500	500	500 ohms
Grid circuit resistance	0.22	0.22	0.22 megohm
Oscillator voltage	0.7	1.0	1.5 volts (rms)
Plate Current	0.4	1.0	2.6 mA
Conversion transconductance	800	1300	2000 micromhos
Internal resistance	11000	8000	5300 micromhos

PLATE CHARACTERISTICS



6GM8/ECC86

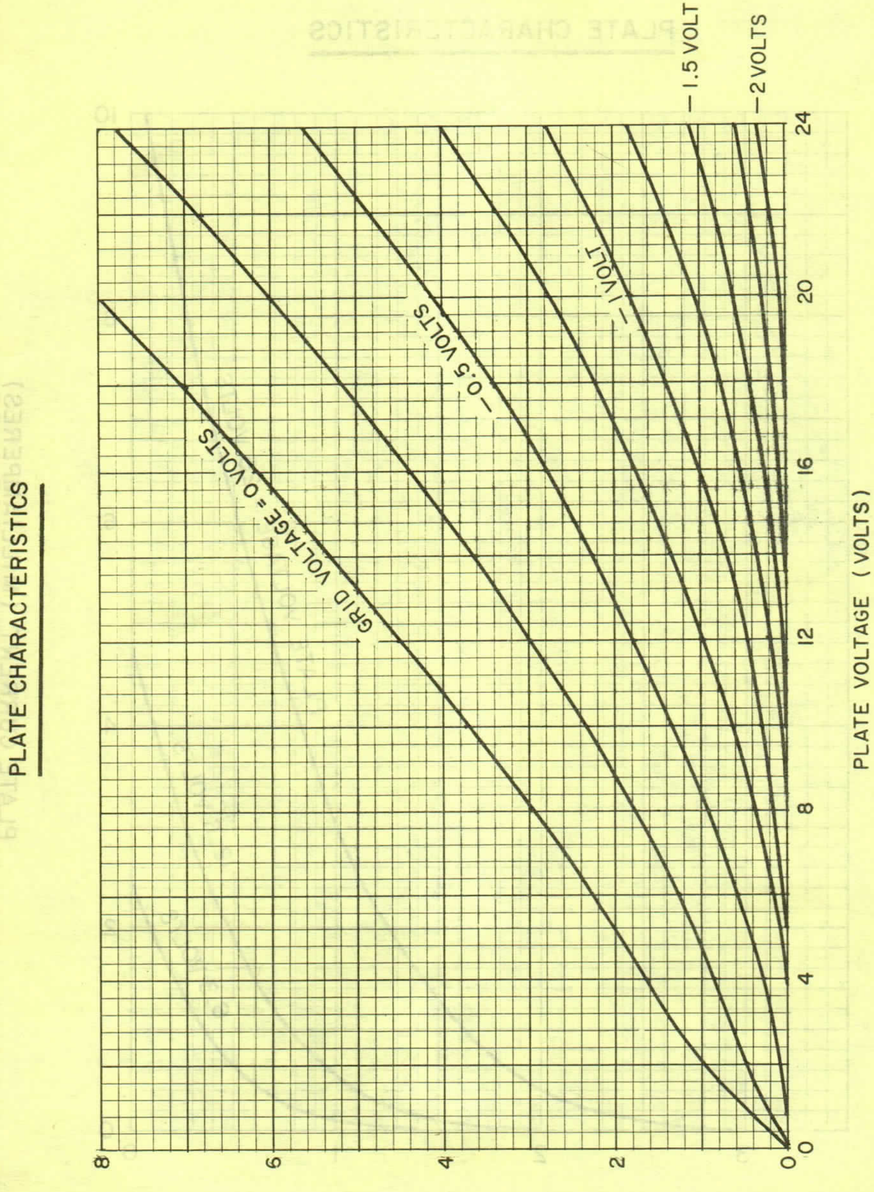
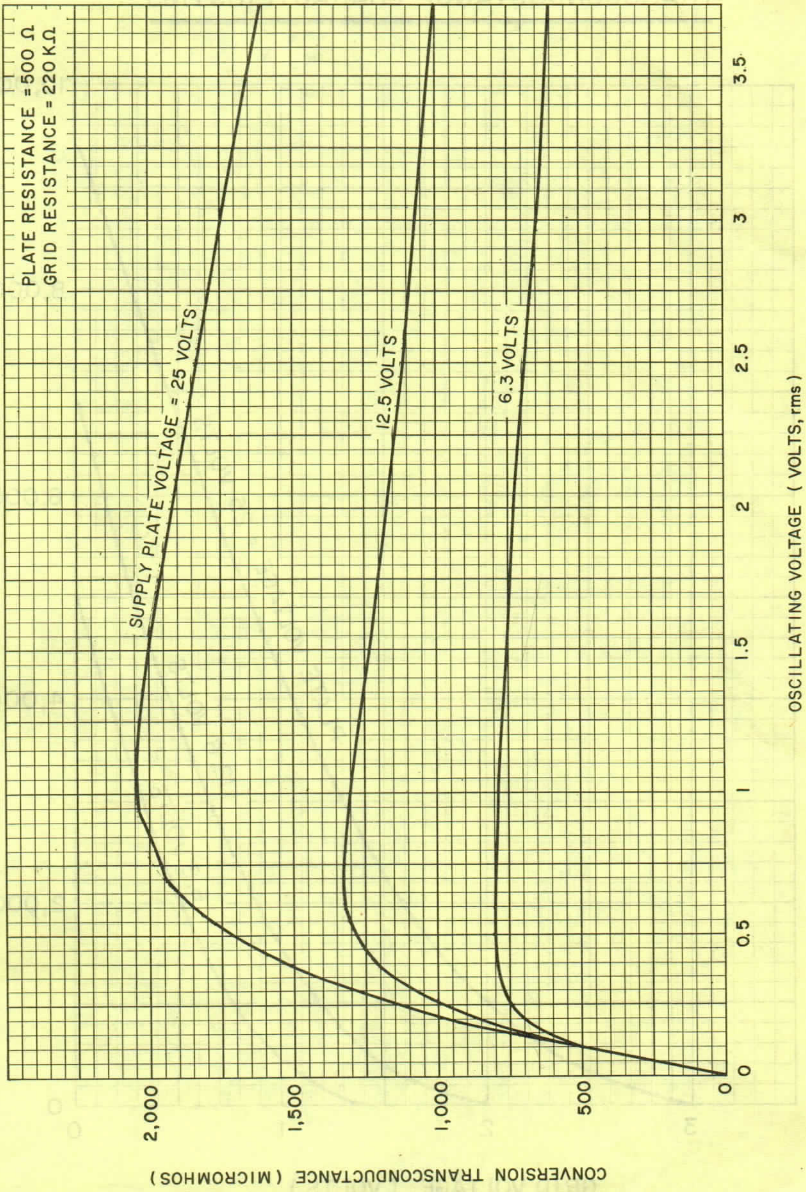


PLATE CHARACTERISTICS
GRID VOLTAGE = 0 VOLTS
— 0.5 VOLTS
— 1 VOLT
— 1.5 VOLT
— 2 VOLTS
PLATE VOLTAGE (VOLTS)
PLATE CURRENT (MILLIAMPERES)
0
4
8
12
16
20
24
0
2
4
6
8

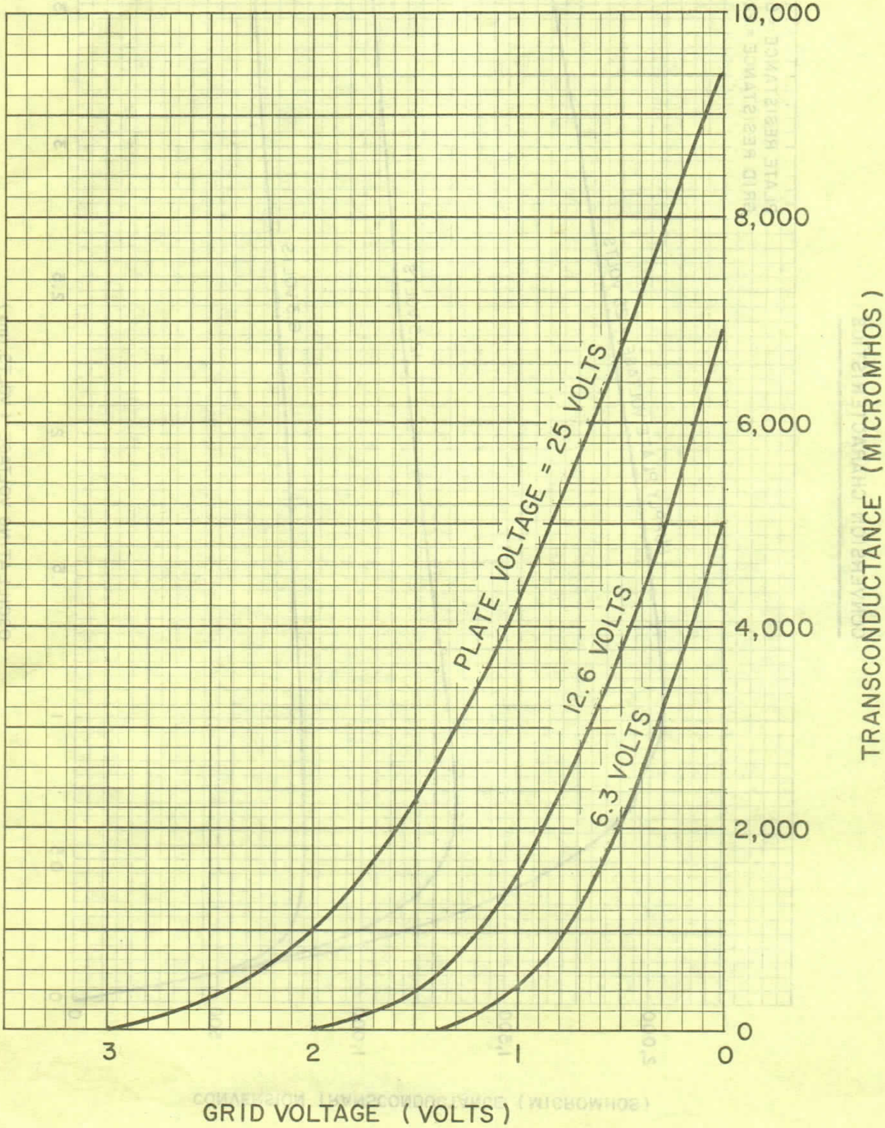
6GM8/ECC86

CONVERSION CHARACTERISTICS



6GM8/ECC86

TRANSCONDUCTANCE CHARACTERISTICS

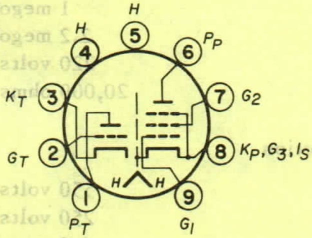


AMPEREX TUBE TYPE 6GV8/ECL85

TENTATIVE DATA

The 6GV8/ECL85 is a triode-pentode especially intended for use in vertical output stages, particularly 110° picture tubes. Special attention has been paid to properties important for this application, such as microphony, linearity and S-effect.

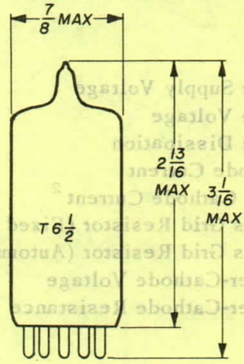
The 6GV8/ECL85 features shadowed grid to keep screen grid current small.



E9-1

PIN CONNECTIONS

1. PLATE, TRIODE SECTION
2. GRID NO.1, TRIODE SECTION
3. CATHODE, TRIODE SECTION
4. HEATER
5. HEATER
6. PLATE, PENTODE SECTION
7. GRID NO.2
8. GRID NO.3, CATHODE, PENTODE SECTION INTERNAL SHIELD
9. GRID NO.1, PENTODE SECTION



6-4

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	E9 - 1, Noval
Bulb	T 6½
Outline	6-4
Basing	9LY

ELECTRICAL

Heating	parallel supply
Heater Voltage	6.3 volts
Heater Current	900 mA

6GV8/ECL85

Maximum Ratings, Absolute Values

Pentode Section

Plate Voltage, Cut-Off Condition	550 volts max
Plate Voltage	250 volts max
Peak Plate Voltage [1]	2000 volts max
Plate Dissipation	7 watts max
Screen Grid Voltage, Cut-Off Condition	550 volts max
Screen Grid Voltage	250 volts max
Screen Grid Dissipation	2 watts max
Cathode Current	75 mA max
Series Grid Resistor (Fixed Bias)	1 megohm max
Series Grid Resistor (Automatic Bias)	2.2 megohms max
Heater-Cathode Voltage	220 volts max
Heater-Cathode Resistance	20,000 ohms max

Triode Section

Plate Supply Voltage	550 volts max
Plate Voltage	250 volts max
Plate Dissipation	0.5 watts
Cathode Current	15 mA max
Peak Cathode Current [2]	200 mA max
Series Grid Resistor (Fixed Bias)	1 megohm max
Series Grid Resistor (Automatic Bias)	3.3 megohms max
Heater-Cathode Voltage	220 volts max
Heater-Cathode Resistance	20,000 ohms max

---

1 Maximum pulse duration 5% of a cycle with a maximum of 1 msec.

2 Maximum pulse duration 200 μsec. If a larger flyback is required Peak Cathode Current = 100 mA with a max pulse duration of 400 μsec.

6GV8/ECL85

Typical Characteristics

Pentode Section

Plate Voltage	170 volts
Screen Grid Voltage	170 volts
Plate Current	41 mA
Screen Grid Current	2.7 mA
Negative Control Grid Voltage	15 volts
Transconductance	7500 micromhos
Amplification Factor - Grid No. 1 to Grid No. 2	7
Internal Plate Resistance	25,000 ohms

Pentode Section
(Knee Current of Average New Tube)

Plate Voltage	50	65 volts
Screen Grid Voltage	170	210 volts
Plate Current	200	240 mA
Screen Grid Current	40	50 mA
Negative Control Grid Voltage	1	1 volt

Triode Section

Plate Voltage	100 volts
Plate Current	5 mA
Negative Grid Voltage	0.8 volts
Transconductance	6500 micromhos
Amplification Factor	50
Internal Plate Resistance	7600 ohms

Typical Operation
Pentode Section[3]

	[4]	[4]	[5]
Plate Voltage At End Of The Scan	55	55	75 volts min
Screen Grid Voltage	170	200	210 volts
Negative Control Grid Voltage At End Of The Scan[6]	6	9.5	11 volts
Peak Plate Current	135	135	125 mA
Nominal Screen Grid Dissipation	1.1	1.4	1.35 watts

---

3 If the vertical sweep circuit is designed so that full deflection is obtained at the nominal line voltage, and E_b min, E_{c2} and i_b have their specified values, full deflection can still be obtained, with an end of life tube at the lower limit of the spread in characteristics, provided E_{c1} at the end of the scan is -1 V. This even holds for a line voltage that is 10% below its nominal value.

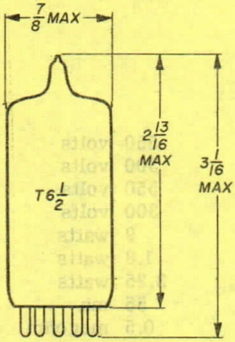
4 Non-stabilized circuits.

5 Stabilized circuits

6 For an average new tube.

AMPEREX TUBE TYPE 6GW8

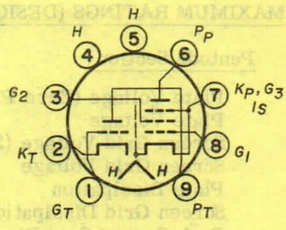
The Amperex 6GW8 is a triode-pentode with separate cathodes. The pentode section is designed for audio output in audio amplifiers or television receivers. The triode section is suitable for amplification in these applications using a supply voltage of around 250 volts for both sections.



6-4

PIN CONNECTIONS

1. GRID NO.1, TRIODE SECTION
2. CATHODE, TRIODE SECTION
3. GRID NO.2
4. HEATER
5. HEATER
6. PLATE, PENTODE SECTION
7. CATHODE, PENTODE SECTION
   GRID NO.3, INTERNAL SHIELD
8. GRID NO.1, PENTODE SECTION
9. PLATE, TRIODE SECTION



E9-1

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	E 9-1, Noval
Outline	6-4

ELECTRICAL

Heating	indirect, AC or DC parallel supply
Heater Voltage	6.3 volts
Heater Current	660 ma

Direct Interelectrode Capacitances

Pentode Section

Control Grid to All Other Elements except Plate	10 pf
Plate to Control Grid	0.4 pf max.
Control Grid to Heater	0.24 pf max.

Triode Section

Grid to All Other Elements except Plate	2.3 pf
Plate to All Other Elements except Control Grid	2.5 pf
Plate to Grid	1.4 pf
Grid to Heater	0.006 pf max.

Direct Interelectrode Capacitances (Cont.)

Between Triode and Pentode Section

Plate of Triode to Control Grid of Pentode	0.2 pf max.
Grid of Triode to Plate of Pentode	0.006 pf max.
Grid of Triode to Control Grid of Pentode	0.02 pf max.
Plate of Triode to Plate of Pentode	0.15 pf max.

MAXIMUM RATINGS (DESIGN CENTER VALUES)

Pentode Section

Plate Voltage (Zero Plate Current)	550	volts
Plate Voltage	300	volts
Screen Grid Voltage (Zero Grid Current)	550	volts
Screen Grid Voltage	300	volts
Plate Dissipation	9	watts
Screen Grid Dissipation	1.8	watts
Peak Screen Grid Dissipation	3.25	watts
Cathode Current	55	ma
Grid Resistor[1]	0.5	megohm
Negative Control Grid Voltage (Control Grid Current = 0.3 μa)	1.3	volts
Cathode-Heater Voltage	100	volts

Triode Section

Plate Voltage (Zero Plate Current)	550	volts
Plate Voltage	300	volts
Plate Dissipation	0.5	watt
Cathode Current	4	ma
Grid Resistor[1]	1	megohm
Negative Grid Voltage (Grid Current = 0.3 μa)	1.3	volts
Cathode-Heater Voltage	100	volts

TYPICAL CHARACTERISTICS

Pentode Section (See Figures 3, 4 and 5)

Plate Voltage	250	volts
Screen Grid Voltage	250	volts
Negative Control Grid Voltage	7	volts
Plate Current	36	ma
Screen Grid Current	6	ma
Transconductance	10,000	μmhos
Plate Resistance	48,000	ohms
Amplification Factor - Grid No. 1 to Grid No. 2	21	

[1] This value applies to operation with fixed bias. It may be multiplied by the DC inverse feedback factor, caused by a cathode, screen grid or plate resistor, to a maximum of 10 megohms.

TYPICAL CHARACTERISTICS (Cont.)

Triode Section (See Figures 1 and 2)

Plate Voltage	250 volts
Negative Grid Voltage	1.9 volts
Plate Current	1.2 ma
Transconductance	1600 µmhos
Amplification Factor	100

TYPICAL OPERATION

Pentode Section - Class A-AF Output Stage[a]

Plate Voltage		250			250		volts
Screen Grid Voltage		250			250		volts
Cathode Resistor		170			270		ohms
AC Plate Load Resistor		7000			10,000		ohms
Signal Voltage	0	0.3	3.2	0	0.28	2.7	volts rms
Plate Current	36	--	37	26	--	27	ma
Screen Grid Current	6	--	10.2	4.4	--	8.0	ma
Power Output	0	0.05	4.0	0	0.05	2.8	watts
Total Distortion	--	0.95	10	--	1.1	10	%
		(See Figure 6)			(See Figure 7)		

Pentode Section - Class AB-AF Output Stage

Plate Voltage		250			300		volts
Screen Grid Voltage		250			300		volts
Cathode Resistor		90			130		ohms
AC Plate Load Resistor		8.2k			9.1k		ohms
Signal Voltage	0	0.24	5.1	0	0.26	8.4	volts rms
Plate Current	2x32.5	--	2x37.5	2x31	--	2x36.5	ma
Screen Grid Current	2x5.6	--	2x8.9	2x5.5	--	2x11.0	ma
Power Output	0	0.05	10	0	0.05	13.6	watts
Total Distortion	--	<0.4	5.0	--	<0.4	4.0	%
		(See Figure 8)			(See Figure 9)		

[a] During measurement the cathode voltage is kept constant.

TYPICAL OPERATION (Cont.)

Triode Section - AF Amplifier

Plate Supply Voltage	200	250	250	300	volts
Plate Current	0.42	0.6	0.6	0.8	ma
Output Voltage	3.2	3.2	5	9	volts rms
Voltage Gain	66	70	75	80	
Total Distortion	0.6	0.4	0.4	0.4	%
Plate Load Resistance	220	220	220	220	k ohms
Signal Source Resistance	47	47	47	47	k ohms
Grid Resistor of Following Tube	0.68	0.68	10	10	megohms
Grid Resistor	10	10	10	10	megohms

SPECIAL RATINGS

Hum and Microphonics

The triode section can be used without special precautions against microphonic effect and hum in circuits in which an input voltage of ≥4 millivolts rms gives an output of 50 milliwatts. Under this condition, with Z_g (at f = 60 cps) ≤500 k ohms C_k ≥100 μf and pin 4 grounded, the hum level will be at least 60 db down.

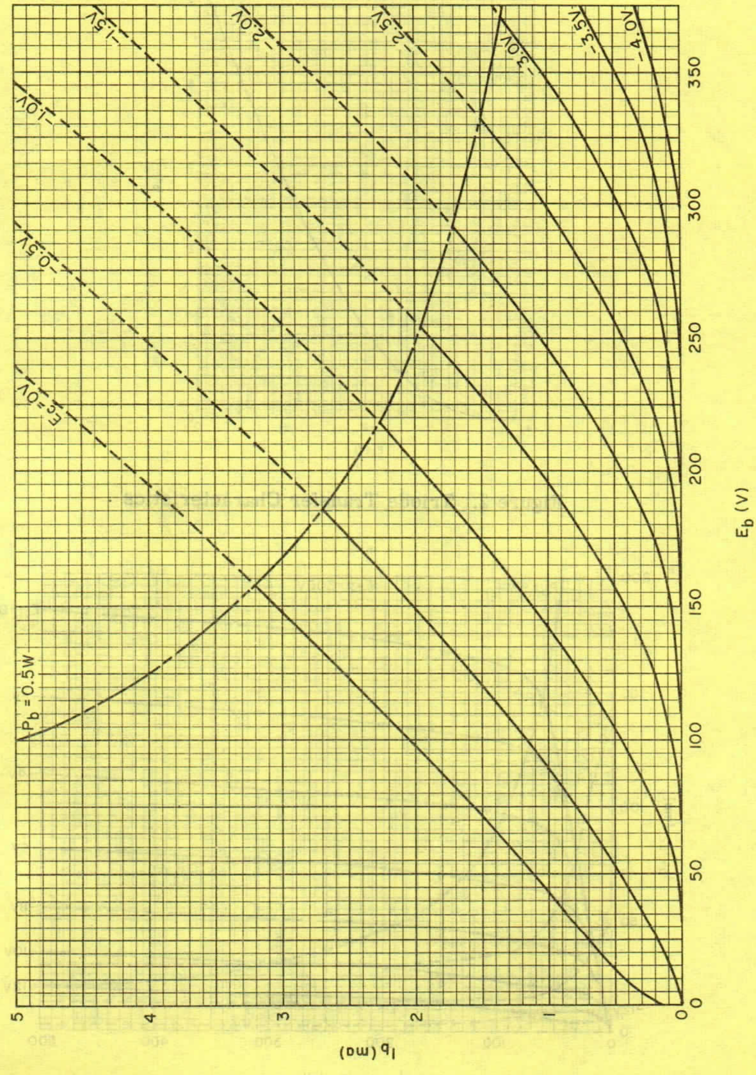


Figure 1. Triode Plate Characteristics

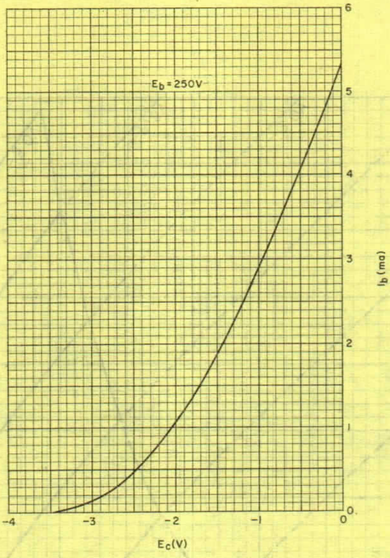


Figure 2. Triode Transfer Characteristics

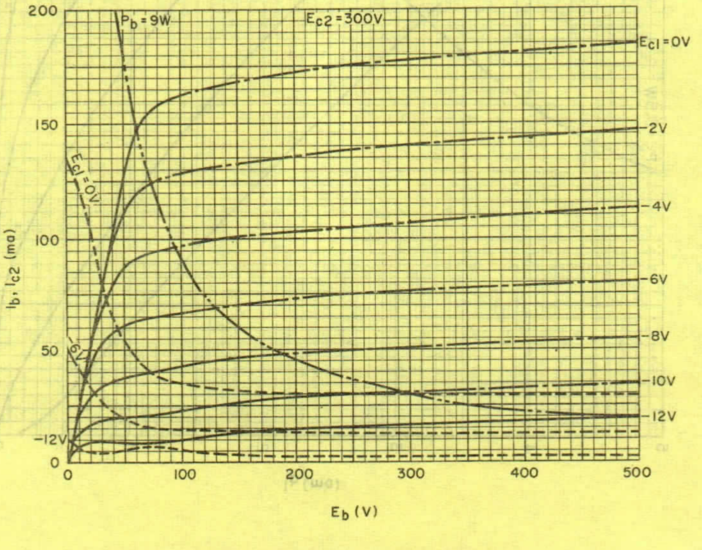


Figure 3. Pentode Plate Characteristics

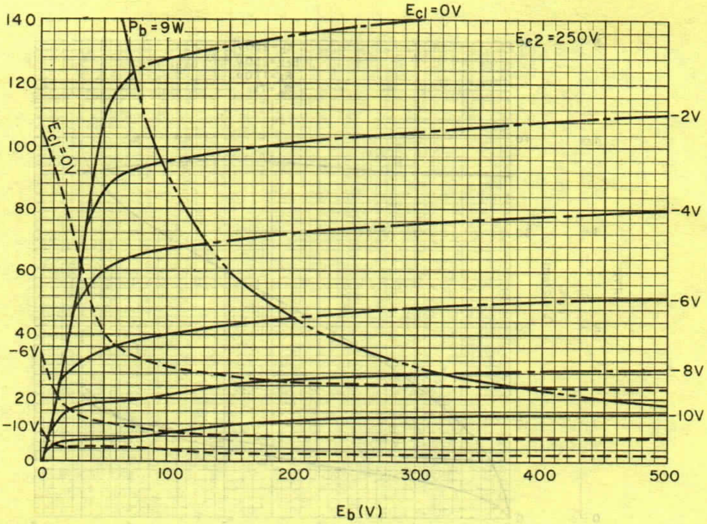


Figure 4. Pentode Plate Characteristics

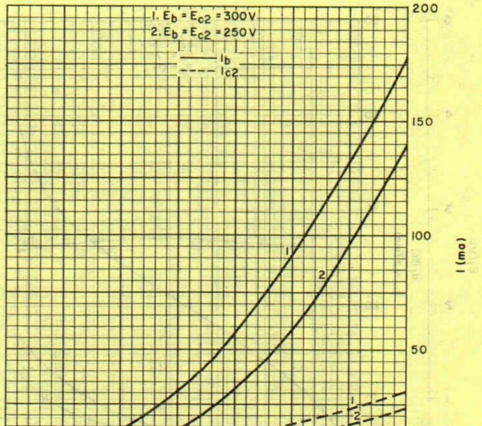


Figure 5. Pentode Transfer Characteristics

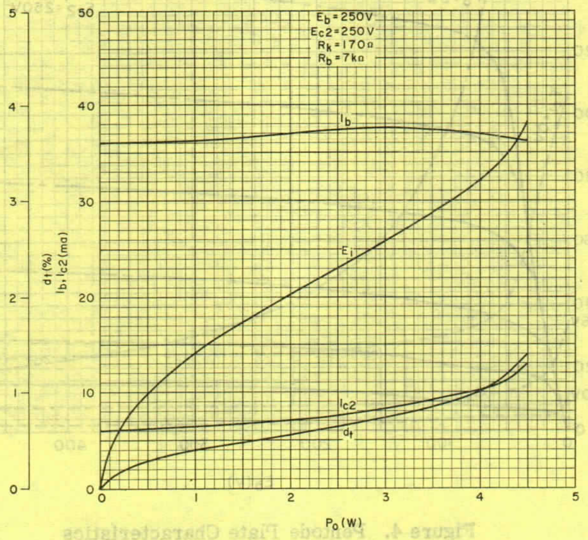


Figure 6. Pentode Operating Characteristics

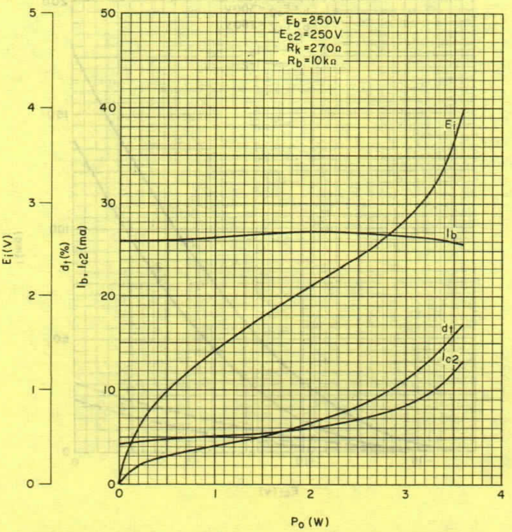


Figure 7. Pentode Operating Characteristics

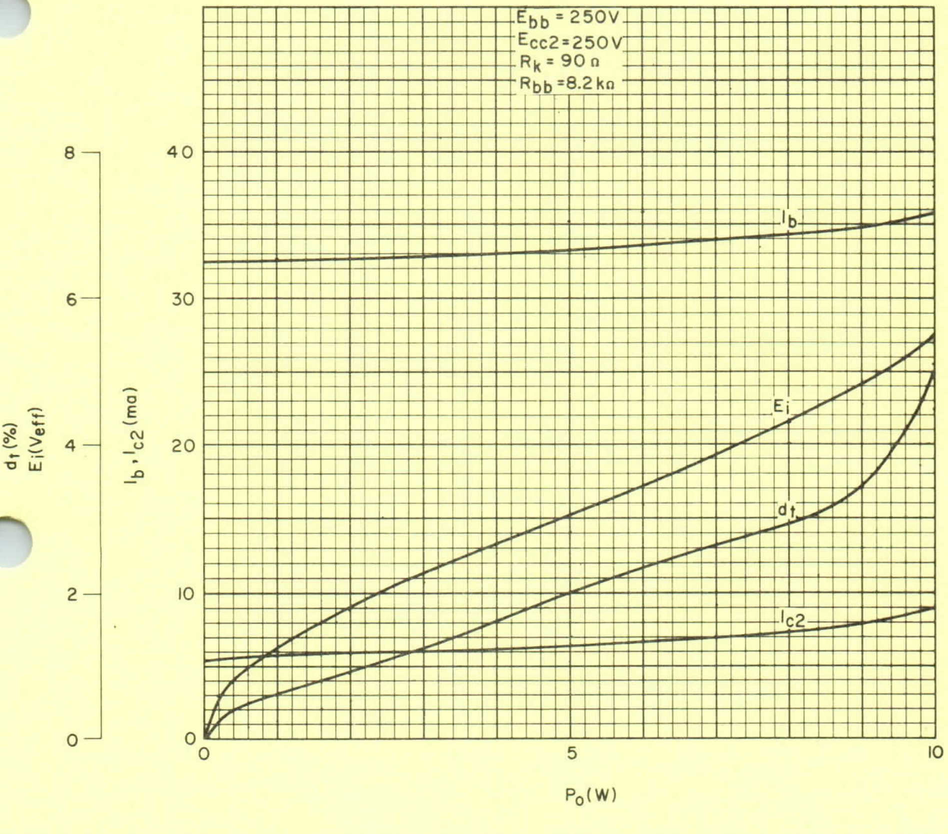


Figure 8. Pentode Operating Characteristics

6GW8

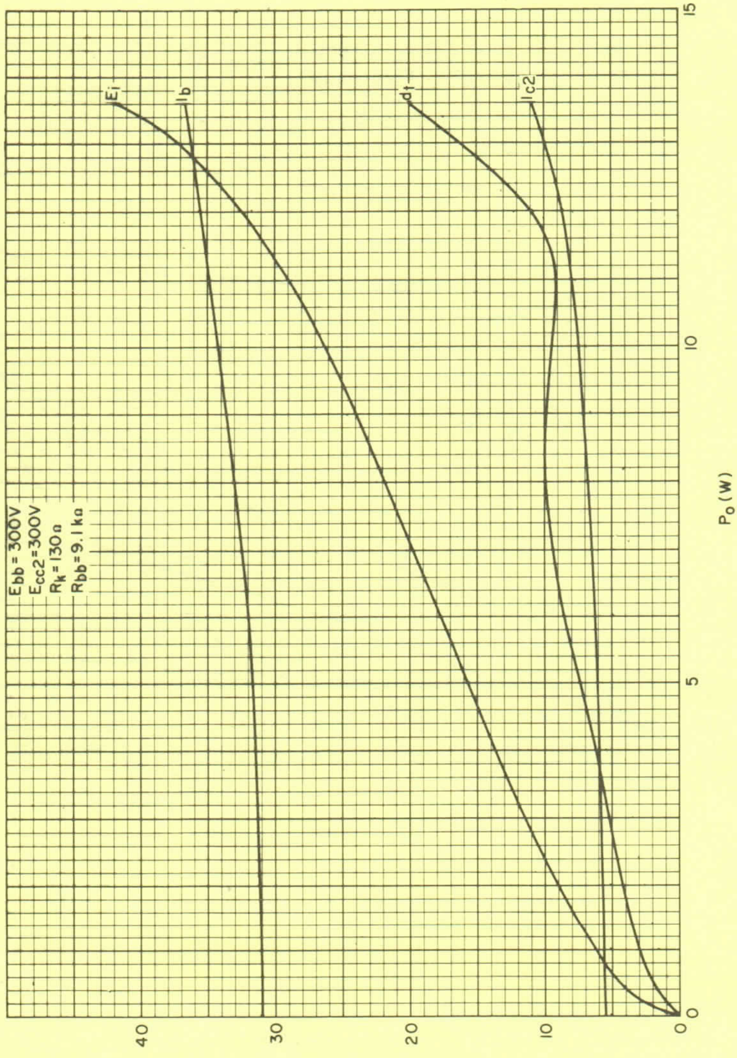
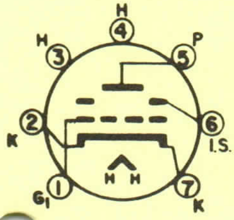


Figure 9. Pentode Operating Characteristics

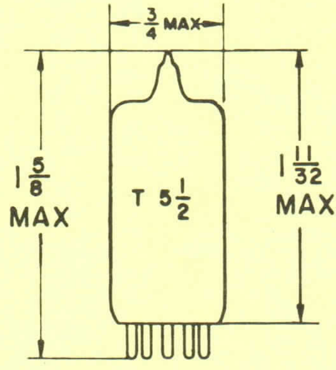
AMPEREX TUBE TYPE 6HA5

The Amperex 6HA5 is an Ampliframe, shielded triode for use as an RF amplifier in VHF television tuners. This tube is designed to have high input impedance at high frequencies, which, in conjunction with its extremely low interelectrode capacitances, ensures high stage gain; yet its very low input grid resistance assures a low noise figure.



PIN CONNECTIONS

1. GRID NO. 1
2. CATHODE
3. HEATER
4. HEATER
5. PLATE
6. INTERNAL SHIELD
7. CATHODE



5-1

GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5-1/2
Outline	5 - 1
Base	miniature 7 pin
Dimensions	see outline drawing

ELECTRICAL

Heater	indirect by AC-DC parallel supply
Heater Voltage	6.3 volts
Heater Current	180 ma
Direct Interelectrode Capacitances (with external shield)	
Output	3.0 pf
Input	4.5 pf
Plate to Grid	0.35 pf
Plate to Cathode	0.080 pf
Grid to Cathode	3.3 pf
Grid to Heater	0.070 pf (max)
Cathode to Heater	2.3 pf

6HA5

MAXIMUM RATINGS, DESIGN CENTER VALUES

	Symbol	Value
DC Plate Voltage	E_b	200 volts
Plate Voltage (Zero Plate Current)	E_{bb}	550 volts
Plate Dissipation	P_b	2.2 watts
Cathode Current	I_k	20 ma
Grid Voltage	E_c	-50 volts
Grid Circuit Resistance[1]	R_g	1 megohm
Cathode-Heater Voltage	E_{hk}	100 volts

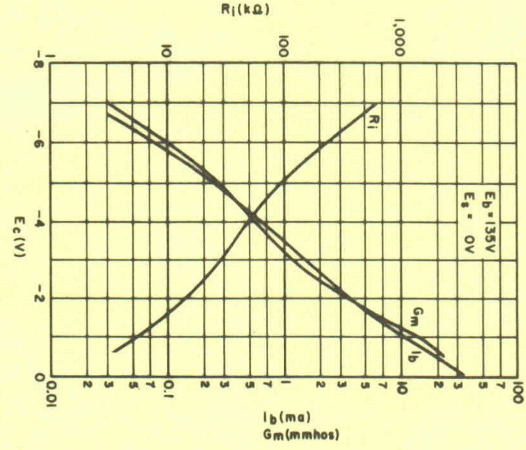
TYPICAL CHARACTERISTICS

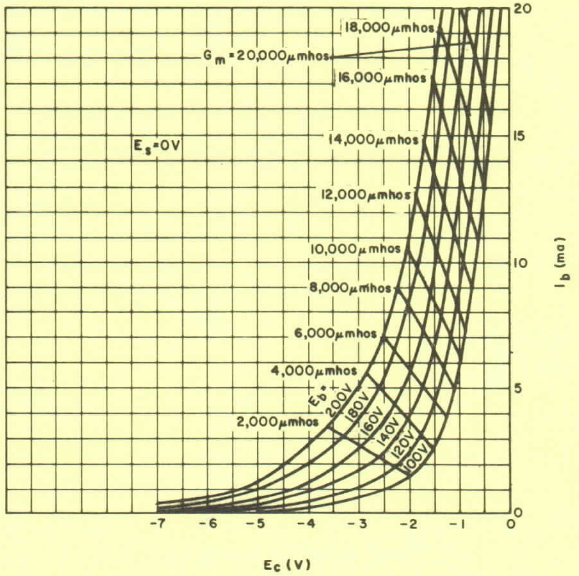
DC Plate Voltage	E_b	135	135	135 volts
Internal Shield Voltage	E_s	0	0	0 volt
DC Grid Voltage	E_c	-1	-2.8	-5.9 volts
Plate Current	I_p	11.5	--	-- ma
Transconductance	G_m	14, 500	1450	145 μmhos
Amplification Factor	μ	76	--	--
Grid Bias for $I_c = +0.3$ μa max.		--	-1.3	-- volts

OPERATING CHARACTERISTICS

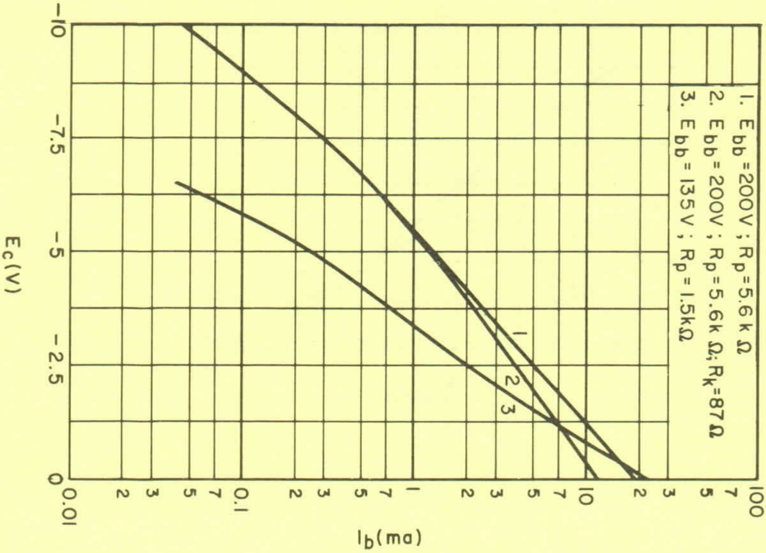
DC Plate Supply Voltage	E_{bb}	135	200	200 volts
Internal Shield Voltage	E_s	0	0	0 volt
Plate Load Resistance	R_p	1500	5600	5600 ohms
Cathode Bias Resistor	R_k	0	0	87 ohms
DC Grid Current	I_c	20	20	-- μa
Plate Current	I_p	16.5	16.5	11.5 ma
Transconductance	G_m	20, 000	20, 000	14, 500 μmhos
Amplification Factor	μ	84	84	76
Grid Cut-Off Voltage:				
For 0.1 G_m	E_c	-2.3	-3.2	-3.8 volts
For 0.01 G_m	E_c	-5.3	-7.7	-8.3 volts

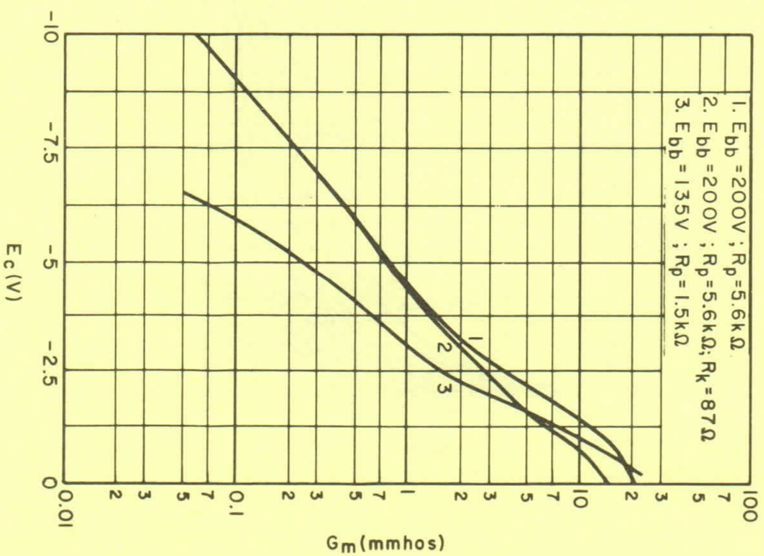
[1] When applied in AGC circuits, Grid Circuit Resistance = 3 megohms (max).

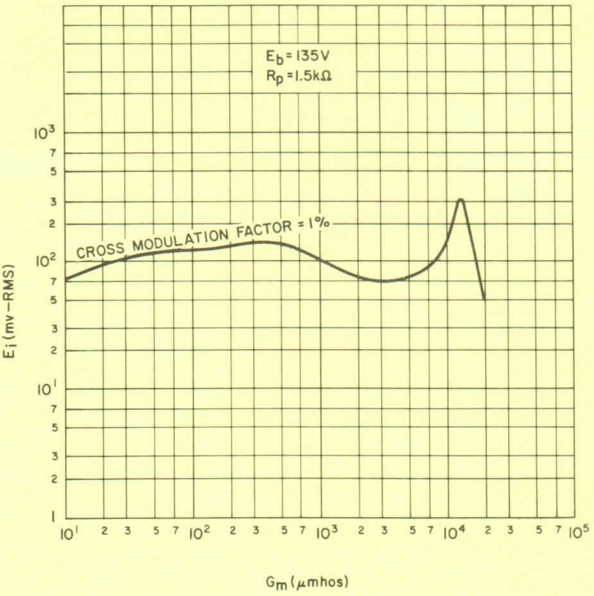

Ri(kΩ)
1
10
100
1,000
Ri
Eb=135V
Es= 0V
Gm
Ib
Ec(V)
-8
-6
-4
-2
0
0.01
0.1
1
10
100
Ib(ma)
Gm(mmhos)


18,000μmhos
Gm=20,000μmhos
16,000μmhos
14,000μmhos
12,000μmhos
10,000μmhos
8,000μmhos
6,000μmhos
4,000μmhos
2,000μmhos
Eb=
200V
180V
160V
140V
120V
100V
Es=0V
Ib (ma)
20
15
10
5
0
-7
-6
-5
-4
-3
-2
-1
0
Ec (V)

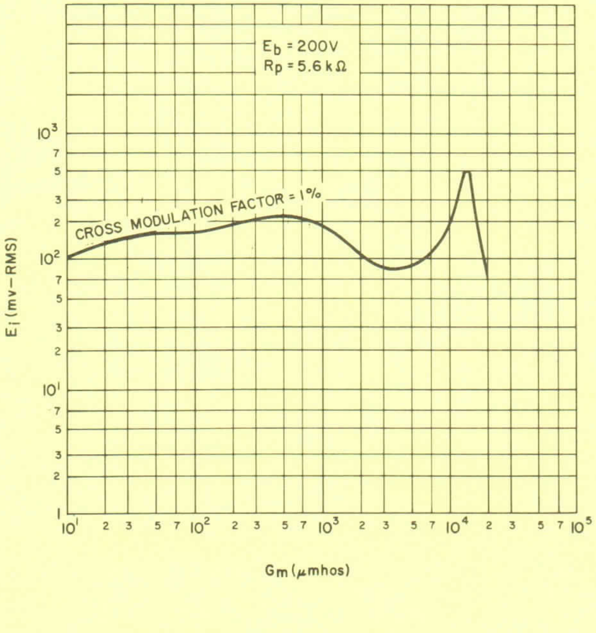
6HA5


1. Ebb = 200V ; Rp = 5.6 k Ω
2. Ebb = 200V ; Rp = 5.6k Ω; Rk = 87 Ω
3. Ebb = 135V ; Rp = 1.5kΩ
Ec(V)
-10
-7.5
-5
-2.5
0
0.01
2
3
5
7
0.1
2
3
5
7
1
2
3
5
7
10
2
3
5
7
100
Ib(ma)
1
2
3


1. Ebb = 200V ; Rp = 5.6kΩ
2. Ebb = 200V ; Rp = 5.6kΩ; Rk = 87 Ω
3. Ebb = 135V ; Rp = 1.5kΩ
Ec(V)
-10
-7.5
-5
-2.5
0
0.01
2
3
5
7
0.1
2
3
5
7
1
2
3
5
7
10
2
3
5
7
100
Gm(mmhos)
1
2
3



E_b = 135V
R_p = 1.5kΩ
CROSS MODULATION FACTOR = 1%
E_i (mv−RMS)
G_m (μmhos)

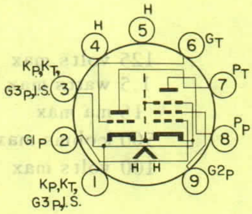


E_b = 200V
R_p = 5.6 kΩ
CROSS MODULATION FACTOR = 1%
E_i (mv−RMS)
G_m (μmhos)

AMPEREX TUBE TYPE 6HG8

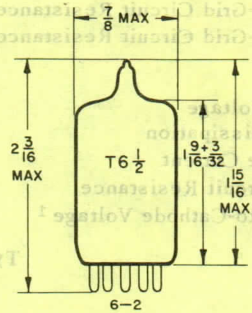
TENTATIVE DATA

The 6HG8 is a triode-pentode designed for use in the mixer stage of VHF tuners in television receivers. The pentode section incorporates a frame-grid and consequently has a high mutual conductance.



PIN CONNECTIONS

1. CATHODE, PENTODE; CATHODE, TRIODE; GRID NO. 3, PENTODE; INTERNAL SHIELD
2. GRID NO. 1, PENTODE
3. CATHODE, PENTODE; CATHODE, TRIODE; GRID NO. 3, PENTODE; INTERNAL SHIELD.
4. HEATER
5. HEATER
6. GRID, TRIODE
7. PLATE, TRIODE
8. PLATE, PENTODE
9. GRID NO. 2, PENTODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T-6½
Base	Noval, E9-1
Outline	6-2

ELECTRICAL

Heating	indirect, AC or DC parallel supply
Heater Voltage	6.3 volts
Heater Current	340 ma

Direct Interelectrode Capacitances (without external shield)

Plate (Pentode) to Plate (Triode)	< 0.25 pf
Plate (Pentode) to Grid (Triode)	< 0.03 pf
Control Grid (Pentode) to Plate (Triode)	< 0.02 pf
Control Grid (Pentode) to Grid (Triode)	< 0.02 pf

Pentode Section

Plate to Control Grid	<0.025 pf
Input	6.0 pf
Output	3.6 pf
Control Grid to Screen Grid	1.8 pf

Triode

Grid to Cathode and Heater	2.1 pf
Plate to Cathode and Heater	1.0 pf
Plate to Grid	2.1 pf

6HG8

Maximum Ratings, Design-Center Values

Pentode Section

Plate Voltage	250 volts max
Plate Dissipation	2.0 watts max
Screen-Grid Voltage	150 volts max
Screen-Grid Dissipation	500 mw max
Cathode Current	18 ma max
Control-Grid Circuit Resistance (Cathode Bias)	500 k ohms max
Control-Grid Circuit Resistance (Fixed Bias)	250 k ohms max

Triode Section

Plate Voltage	125 volts max
Plate Dissipation	1.5 watts max
Cathode Current	15 ma max
Grid Circuit Resistance	500 k ohms max
Heater-to-Cathode Voltage [1]	100 volts max

Typical Characteristics

Pentode Section

Plate Voltage	170 volts
Screen-Grid Voltage	150 volts
Control-Grid Voltage	−1.5 volts
Plate Current	10 ma
Screen-Grid Current	3.3 ma
Transconductance	12,000 micromhos
Internal Plate Resistance	350 k ohms
Amplification Factor (Grid No. 1 to Grid No. 2)	60
Equivalent Noise Resistance	1.0 k ohms

Triode Section

Plate Voltage	100 volts
Grid Voltage	−3.0 volts
Plate Current	14 ma
Transconductance	6000 micromhos
Amplification Factor	17

Operating Characteristics in Mixer Stage

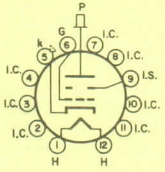
Pentode Section

Plate Voltage	190 volts
Screen-Grid Supply Voltage	190 volts
Screen-Grid Resistor	18 k ohms
Control-Grid Resistor	100 k ohms
Plate Current	8.5 ma
Screen-Grid Current	2.7 ma
Oscillator Voltage	2.3 volts rms
Conversion Transconductance	4500 micromhos

[1] To fulfil hum requirements on AM sound, it is necessary for heater-to-cathode voltage to be less than 50 volts rms.

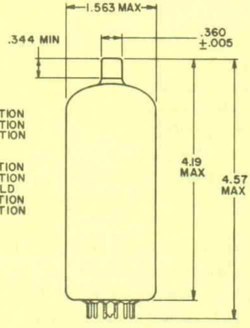
AMPEREX TUBE TYPE 6HT5

The 6HT5 is a shunt stabilizer triode intended for use in color television receivers.



PIN CONNECTIONS

1 – HEATER
2 – INTERNAL CONNECTION
3 – INTERNAL CONNECTION
4 – INTERNAL CONNECTION
5 – CATHODE
6 – GRID
7 – INTERNAL CONNECTION
8 – INTERNAL CONNECTION
9 – HIGH VOLTAGE SHIELD
10 – INTERNAL CONNECTION
11 – INTERNAL CONNECTION
12 – HEATER
P – PLATE (TOP CAP)



GENERAL CHARACTERISTICS

Mechanical

Bulb	T-12, Glass
Base	E12-74, Button 12-Pin
Basing	12HC
Cap	C1-34, Small
Mounting Position	any

Electrical

Heater Characteristics	
Heater Supply	A.C. or D.C. parallel supply
Heater Voltage	6.3 ± 0.6 volts
Heater Current	350 ma
Direct Interelectrode Capacitances (unshielded)	
Plate to Grid	0.02 pf
Plate to Cathode and Heater	0.03 pf
Grid to Cathode and Heater	1.5 pf

Typical Characteristics

Plate Voltage	25,000 volts
Shield Voltage	0 volt
Grid Voltage change for a Plate Current change from 0.1 to 1.5 ma	10 volts max.
Grid Voltage at Ia = 1.5 ma	-7 to-30 volts
at Ia = 0.1 ma	-40 volts max.

6HT5

Maximum Ratings (Design Maximum Rating System)

Plate Voltage During Operation (abs. max. value)[1]	27,500	volts
Plate Current	1.5	ma
Plate Dissipation	35	watts
Plate Dissipation (abs. max. value)[2]	40	watts
Negative Grid Voltage[3]	150	volts
Grid Circuit Resistor	5	Megohms
Cathode to Heater Voltage		
Cathode Positive with Respect to Heater	400	volts D.C. +
	250	volts A.C.
Cathode Negative with Respect to Heater	250	volts
Shield to Cathode Voltage		
Shield Positive with respect to Cathode	0	volt
Shield Negative with respect to Cathode[4]	400	volts

Precaution: X-ray shielding may be required to give protection against excessive radiation.

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[1] If due to a circuit failure the plate current becomes 0 ma the plate voltage should never exceed 45,000 volts (abs. max. value)

[2] Permissable only during short periods; in total up to a maximum of 10% of the operation time of the tube.

[3] During equipment warm up and for brief interval during receiver adjustment this voltage may rise to 440 volts max.

[4] The shield connected to pin 9 is provided to shield grid and cathode from the high plate voltage.

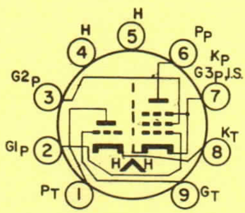
It is recommended to connect the shield directly to ground, with a minimum lead inductance.

The modulating influence of possible hum ripple on the shield to cathode voltage should be taken into account; the sensitivity for these variations in Vs/k is 2.5 microamps/volt max.

AMPEREX TUBE TYPE 6JW8

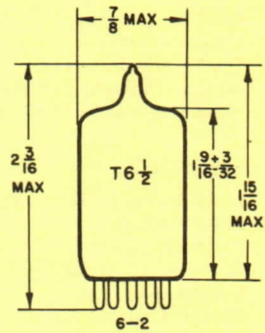
The Amperex 6JW8 is a triode-pentode intended for use as a horizontal oscillator and frequency control tube in television receivers. The triode section may be used as a reactance tube and the pentode section as an oscillator and pulse shaper.

The 6JW8 includes special structural and control features to minimize hum and microphonism. The insulation resistance of both the triode and the pentode section is assured by 3000 hour life tests.



PIN CONNECTIONS

1- PLATE, TRIODE
2- GRID NO. 1, PENTODE
3- GRID NO. 2, PENTODE
4- HEATER
5- HEATER
6- PLATE, PENTODE
7- CATHODE, PENTODE; GRID NO. 3, PENTODE; INTERNAL SHIELD
8- CATHODE, TRIODE
9- GRID, TRIODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T6-1/2
Base	Noval, 9 pin

ELECTRICAL

Heating	indirect, AC or DC series supply
Heater Voltage	6.3 volts
Heater Current	430 ma
Direct Interelectrode Capacitances	
Pentode Section	
Grid No. 1	5.4 pf
Plate to Grid No. 1	0.060 pf
Grid No. 1 to Filament	<0.1 pf
Triode Section	
Grid	2.4 pf
Plate to Grid	1.5 pf
Grid to Filament	<0.1 pf

MAXIMUM RATINGS (DESIGN CENTER VALUES)

Pentode Section

Plate Voltage, Zero Plate Current	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.2 watts
Grid No. 2 Voltage, Zero Plate Current	550 volts
Grid No. 2 Voltage	250 volts
Grid No. 2 Dissipation	0.8 watt
Grid No. 1 Circuit Resistance (Fixed Bias)	0.56 megohm
Grid No. 1 Circuit Resistance (Self Bias)	1.0 megohm
Cathode Current	15 ma
Peak Cathode Current[1]	50 ma
Heater-Cathode Voltage	100 volts
Input Impedance at 60 cycles	300 k ohms

Triode Section

Plate Voltage, Zero Plate Current	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.4 watts
Grid No. 1 Circuit Resistance	3 megohms
Cathode Current	10 ma
Heater-Cathode Voltage	100 volts
Input Impedance at 60 cycles	50 k ohms

TYPICAL CHARACTERISTICS

Pentode Section

Plate Voltage	100 volts
Grid No. 2 Voltage	100 volts
Grid No. 1 Voltage	-1 volt
Plate Current	6 ma
Grid No. 2 Current	1.7 ma
Transconductance	5500 μmhos
Input Resistance	0.4 megohm
Amplification Factor (Grid No. 1 to Grid No. 2)	47
Plate Current (E_{g1} = 0V)	12.5 ma
Grid No. 2 Current (E_{g1} = 0V)	3.5 ma
Grid No. 1 Voltage ($E_b = E_{g2}$ = 200V, I_b = 10 μa)	<-16 volts
Grid No. 1 Voltage (I_{c1} = +0.3 μa)	-1.3 volts

[1] Duty cycle 30% maximum; pulse time 30 μsec. maximum.

TYPICAL CHARACTERISTICS (Cont.)

Triode Section

Plate Voltage	200	volts
Grid Voltage	-2	volts
Plate Current	3.5	ma
Transconductance	3500	μmhos
Input Resistance	20	k ohms
Amplification Factor	70	
Plate Current (I_c = 10 μa)	10	ma
Grid Voltage (I_c = +0.3 μa)	-1.3	volts

6JW8

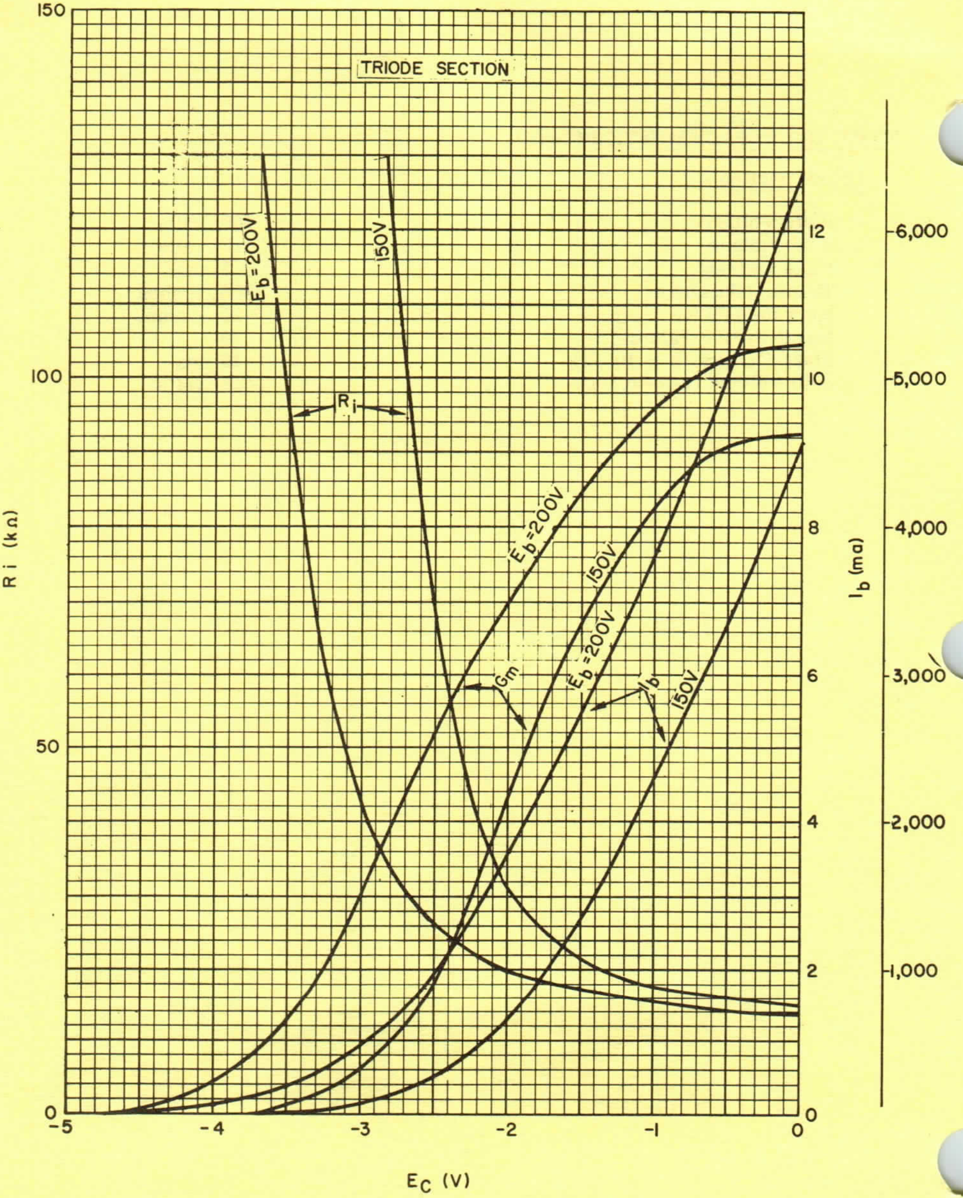


Figure 1. Transfer Characteristics - Triode Section

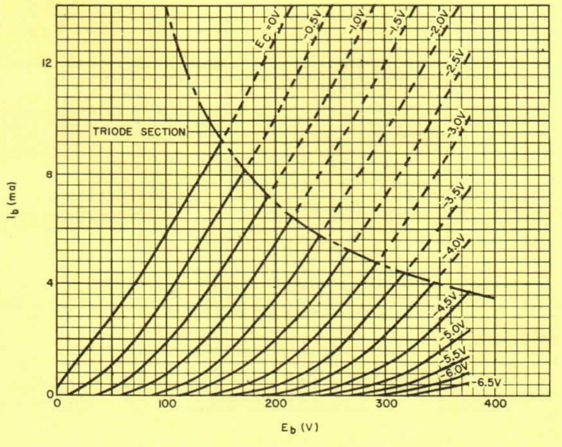


Figure 2. Plate Characteristics - Triode Section

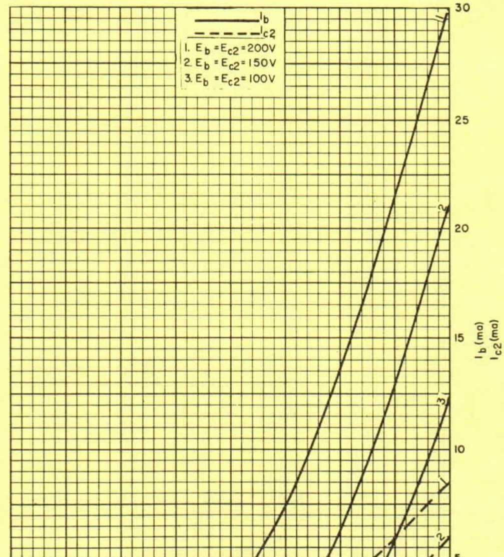


Figure 3. Transfer and Grid No. 2 Characteristics vs Grid No. 1 Voltage - Pentode Section

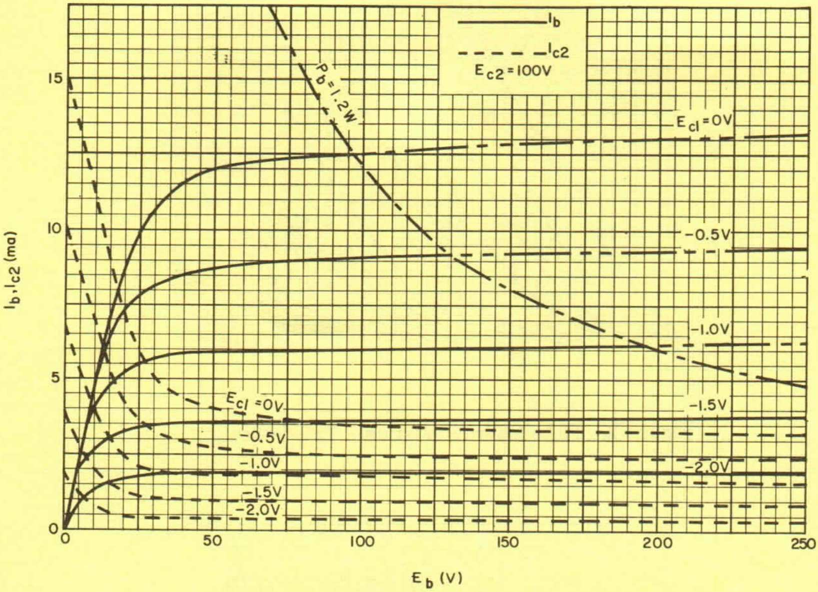


Figure 4. Plate Characteristics - Pentode Section

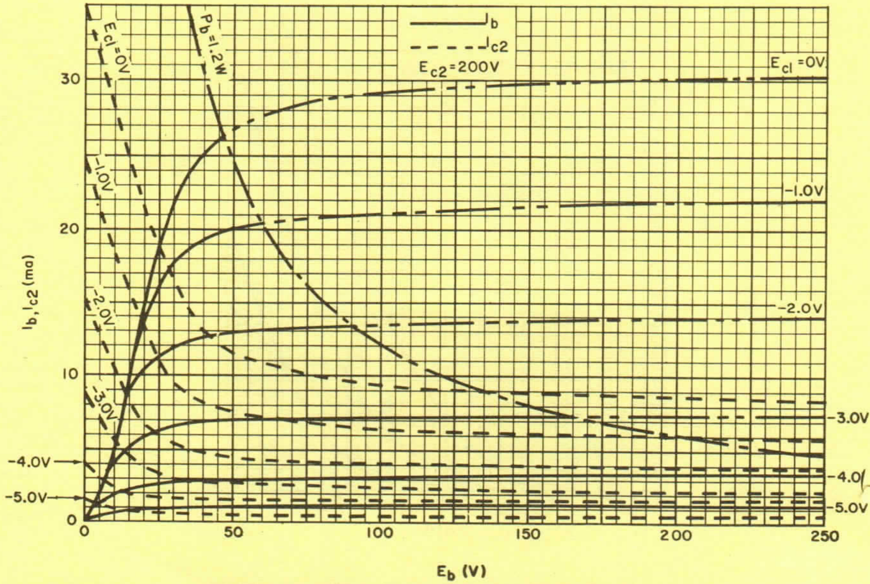


Figure 5. Plate Characteristics - Pentode Section

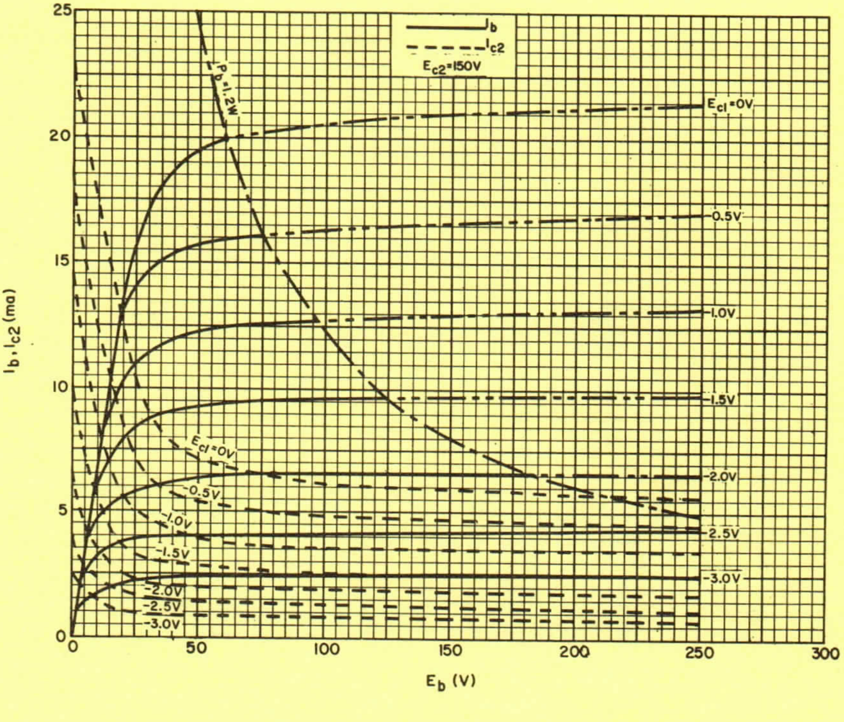
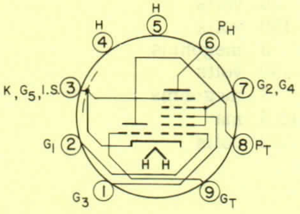


Figure 6. Plate Characteristics - Pentode Section

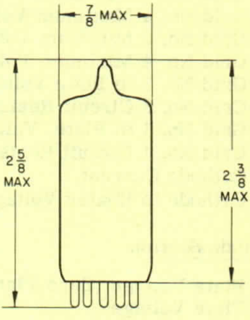
AMPEREX TUBE TYPE 6JX8

The Amperex 6JX8 is a triode-heptode for use as sync separator, noise inverter and sync amplifier.



PIN CONNECTIONS

1 - GRID NO.3, HEPTODE SECTION
2 - GRID NO.1, HEPTODE SECTION
3 - CATHODE, GRID NO.5, HEPTODE SECTION, INTERNAL SHIELD
4 - HEATER
5 - HEATER
6 - PLATE, HEPTODE SECTION
7 - GRID NO.2, HEPTODE SECTION GRID NO.4, HEPTODE SECTION
8 - PLATE, TRIODE SECTION
9 - GRID, TRIODE SECTION



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 5-1/2
Outline	5-3
Base	Noval

ELECTRICAL

Heater Characteristics	indirect, AC or DC, series or parallel supply
Heater Voltage	6.3 volts
Heater Current	300 ma
Direct Interelectrode Capacitances	
Triode Section	
Grid Capacitance	3.0 pf
Plate to Grid Capacitance	1.1 pf
Pentode Section	
Plate to Grid No. 1	<0.009 pf

Between Triode and Heptode Sections

Heptode		Triode	
Grid No. 1	to	Grid	<0.10 pf
Grid No. 1	to	Plate	<0.08 pf
Grid No. 3	to	Plate	<0.13 pf
Plate	to	Grid	<0.09 pf
Plate	to	Plate	<0.25 pf

MAXIMUM RATINGS (DESIGN CENTER SYSTEM)

Heptode Section

Plate Voltage (Zero Plate Current)	550	volts
Plate Voltage	250	volts
Plate Dissipation	1.7	watts
Grid No. 2 Voltage (Zero Current)	550	volts
Grid No. 4 Voltage (Zero Current)	550	volts
Grid No. 2 Maximum Voltage	250	volts
Grid No. 4 Maximum Voltage	250	volts
Grid No. 2 Minimum Voltage	10	volts
Grid No. 4 Minimum Voltage	10	volts
Grid No. 3 to Plate Voltage	-150	volts
Grid No. 3 Circuit Resistance	3	megohms
Grid No. 1 to Plate Voltage	-150	volts
Grid No. 1 Circuit Resistance	3	megohms
Cathode Current	12.5	ma
Cathode to Heater Voltage	100	volts

Triode Section

Plate Voltage (Zero Plate Current)	550	volts
Plate Voltage	250	volts
Plate Dissipation	1.3	watts
Grid to Plate Voltage	-200	volts
Grid Circuit Resistance	3	megohms
Cathode Current	10	ma
Cathode to Heater Voltage	100	volts

TYPICAL CHARACTERISTICS

Heptode Section

Plate Voltage	135	volts
DC Grid No. 1 Voltage	0	volt
DC Grid No. 2 Voltage	14	volts
DC Grid No. 3 Voltage	0	volt
DC Grid No. 4 Voltage	14	volts
Plate Current	1.7	ma
Grid No. 2 Current	0.9	ma
Grid No. 4 Current	0.9	ma
Transconductance	2200	μmhos
Grid No. 3 Voltage (E_{g1} = 0V, I_p = 20 μa)	-2	volts
Grid No. 1 Voltage (E_{g3} = 0V, I_p = 20 μa)	-1.9	volts
Grid No. 3 Voltage (I_{g3} = 0.3 μa)	<-1.3	volts
Grid No. 1 Voltage (I_{g1} = 0.3 μa)	<-1.3	volts

Triode Section

Plate Voltage	200	50	volts
Grid Voltage	-11	0	volts
Plate Current	<0.1	3	ma
Transconductance	--	3700	μmhos
Amplification Factor	--	50	
Grid Voltage (I_g = 0.3 μa)	--	<-1.3	volts

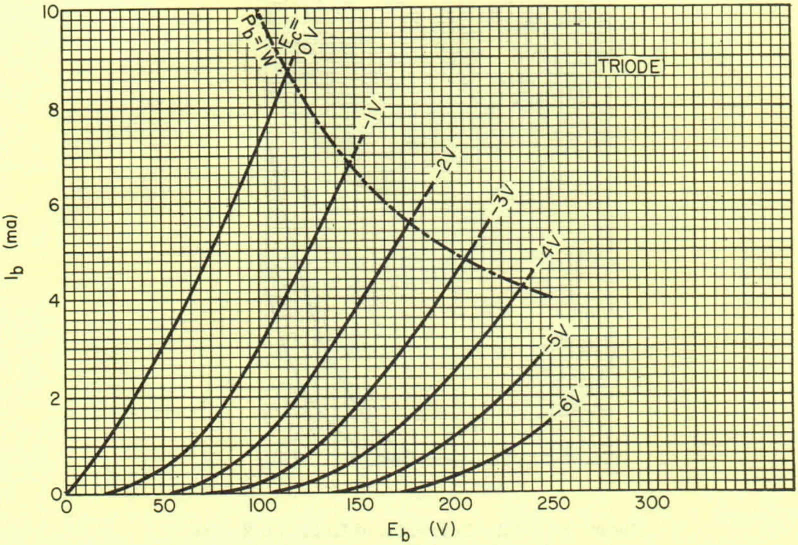


Figure 1. Transfer Characteristics - Triode Section

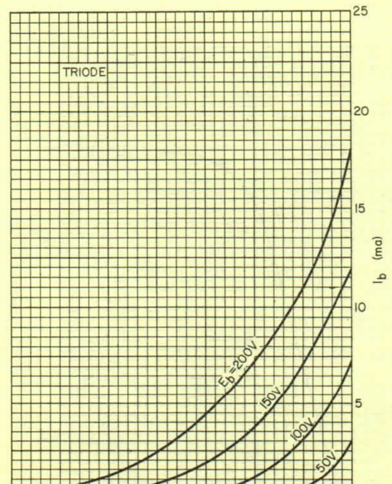


Figure 2. Plate Characteristics - Triode Section

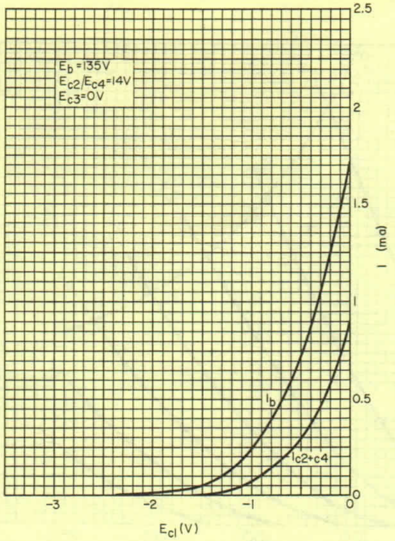


Figure 3. Plate Current and Grid No. 2 plus Grid No. 4 Current vs. Grid No. 1 Voltage - Heptode Section

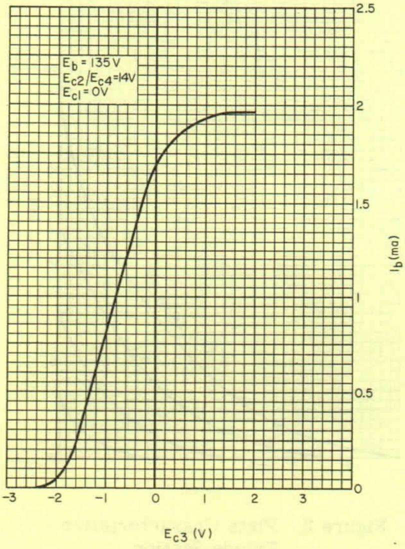
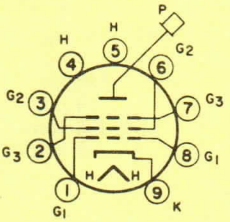


Figure 4. Plate Current vs. Grid No. 3 Voltage - Heptode Section

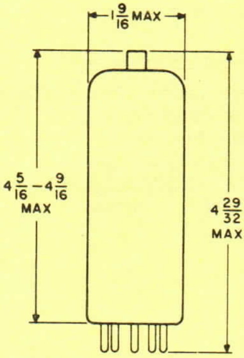
AMPEREX TUBE TYPE 6KG6

The 6KG6 is an output pentode designed for use in horizontal deflection circuits of color television receivers operating at supply voltages of 240 to 270 volts.



PIN CONNECTIONS

1- GRID NO.1
2- GRID NO.3
3- GRID NO.2
4- HEATER
5- HEATER
6- GRID NO.2
7- GRID NO.3
8- GRID NO.1
9- CATHODE
P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Dimensions	see outline drawing

ELECTRICAL

Heating	indirect by AC or DC, series supply
Heater Voltage	6.3 volts
Heater Current	2 amps
Interlectrode Capacitances	
Plate to Grid No. 1	2.5 pf
Grid No. 1 to Heater	200 mpf

MAXIMUM RATINGS

Plate Voltage (Zero Current)	700 volts
Peak Plate Voltage	7000 volts
Grid No. 2 Voltage (Zero Current)	700 volts
Grid No. 2 Voltage	250 volts
Plate Dissipation[1]	34 watts
Grid No. 2 Dissipation	7 watts
Cathode Current	500 ma
Cathode to Heater Voltage	250 volts
Grid No. 1 Resistance	
Fixed Bias	0.25 megohm
Stabilized Circuits	2.2 megohms

[1] A plate dissipation of 34 watts should not be exceeded under the worst probable operating conditions at normal picture width.

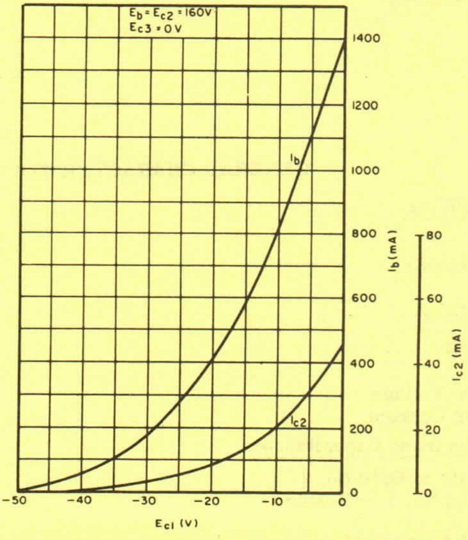
6KG6

TYPICAL CHARACTERISTICS[2]

Plate Voltage	160	45 volts
Grid No. 2 Voltage	160	160 volts
Grid No. 1 Voltage	0	0 volts
Plate Current	1400	1000 (min.) ma
Grid No. 2 Current	45	-- ma
Grid No. 3 Voltage	0	0 volts

TYPICAL OPERATION[3]

Plate Voltage (End of Scan)[4]	60V + 0.1 V_b
Peak Plate Current	1 amp
Plate Current	440 ma
Grid No. 2 Current	40 ma
Grid No. 2 Voltage	175 volts
Grid No. 3 Voltage[5]	0 volts



[2] In order not to exceed the maximum ratings for Plate and Grid No. 2 Dissipation, these characteristics should be measured under pulse conditions.

[3] The minimum required cut off voltage during flyback is 170 volts at:

Plate Voltage	=	7000 volts
Grid No. 2 Voltage	=	175 volts
Grid No. 1 Impedance	=	1 k ohm at horizontal frequency.

[4] The value $0.1V_b$ is included to allow for 10% variation of the supply voltage. When selecting supply voltage care should be taken not to exceed the maximum rated plate cut off voltage.

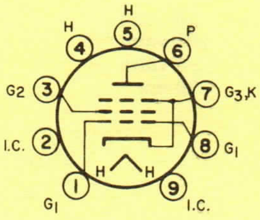
[5] For optimum suppression of Barkhausen oscillations and snivets, the beam plates may be connected to a voltage of +15 volts.

AMPEREX TUBE TYPE 6KW6

This tube is designed to be used as an output pentode in the vertical deflection circuits of color TV receivers.

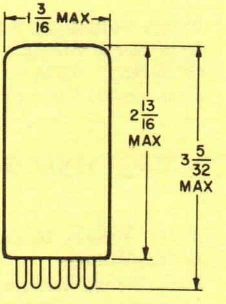
QUICK REFERENCE DATA

Plate Voltage	400 volts max.
Peak Plate Voltage	2,500 volts max.
Plate Dissipation	12 watts max.
Grid No. 2 Dissipation	2.5 watts max.
Cathode Current	100 ma max.



PIN CONNECTIONS

1-GRID NO.1
2-INTERNAL CONNECTION
3-GRID NO.2
4-HEATER
5-HEATER
6-PLATE
7-GRID NO.3, CATHODE
8-GRID NO.1
9-INTERNAL CONNECTION



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	Magnoval

ELECTRICAL

Heater Supply	indirect AC or DC series supply
Heater Voltage	6.3 volts
Heater Current	850 ma

Direct Interelectrode Capacitances

Grid No. 1 to Heater	< 200 mpf
Anode to Grid No. 1	1.8 pf

TYPICAL CHARACTERISTICS (measured under pulse conditions)

Anode Voltage	190 volts
Grid No. 2 Voltage	190 volts
Grid No. 1 Voltage	-17 volts
Anode Current	60 ma
Grid No. 2 Current	4.5 ma

OPERATING CHARACTERISTICS

Anode Voltage at End of Scan	70 volts
Grid No. 2 Voltage	200 volts
Grid No. 1 Voltage	-5 volts
Peak Anode Current	230 ma

LIMITING VALUES (design center rating system)

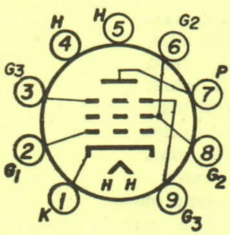
Anode Voltage in Cold Condition	700 volts
Anode Voltage	400 volts
Peak Anode Voltage	2,500 volts
Anode Dissipation	12 watts
Grid No. 2 Voltage in Cold Condition	700 volts
Grid No. 2 Voltage	275 volts
Grid No. 2 Dissipation	3.5 watts
Cathode Current	100 ma
Cathode to Heater Voltage	220 volts
Grid No. 1 Circuit Resistance	1 megohm

AMPEREX TUBE TYPE 6LD6

TENTATIVE DATA

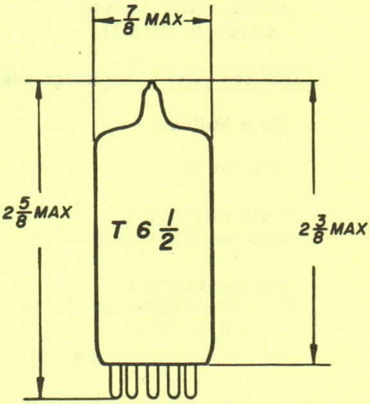
VIDEO OUTPUT PENTODE

Lumince output tube in color T. V. receivers.



PIN CONNECTION

1 – CATHODE
2 – GRID NO. 1
3 – GRID NO.3
4 – HEATER
5 – HEATER
6 – GRID NO.2
7 – PLATE
8 – GRID NO. 2
9 – GRID NO. 3



General Characteristics

MECHANICAL

Dimensions	see outline drawing
Base	Noval
Bulb	T 6-1/2

ELECTRICAL

Heater	indirect AC or DC series supply
Heater Current	800 mA
Heater Voltage	6.3 volts

Direct Interelectrode Capacitances

Plate to all except Grid No. 1	4 pf
Grid No. 1 to all except Plate	20 pf
Plate to Grid No. 1	0.075 pf

TYPICAL CHARACTERISTICS

Plate Voltage	170 volts
Grid No. 2 Voltage	170 volts
Grid No. 3 Voltage	0 volts
Grid No. 1 Supply Voltage	0 volts
Cathode Resistor (decoupled)	25 ohms
Plate Current	30 mA
Grid No. 2 Current	6.5 mA
Transconductance	40,000 μmhos
Amplification Factor (Grid 1 to Grid 2)	70 --

LIMITING VALUES (design center rating system unless otherwise stated)

Plate Voltage	550 volts max.
	300 volts max.
Grid No. 2 Voltage	550 volts max.
	300 volts max.
Plate Dissipation	6 watts max.
Grid No. 2 Dissipation	2.5 watts max.
	3.0 watts max.[1]
Cathode Current	100 mA max.
Grid No. 1 Resistor	0.1 m ohms max.
at $R_k \geq 39\ \Omega$	0.5 m ohms max.
Cathode to Heater Voltage	200 volts max.

OPERATING CONDITIONS (Negative Modulation)

E_b = 250 V
R_b = 330 ohms
R_{av} = 560 ohms
R_p = 2.7 k ohms
R_{g2} = 5.6 k ohms
R_k 2) = 39 ohms
$+E_{bg_1}$ = 4.5 V

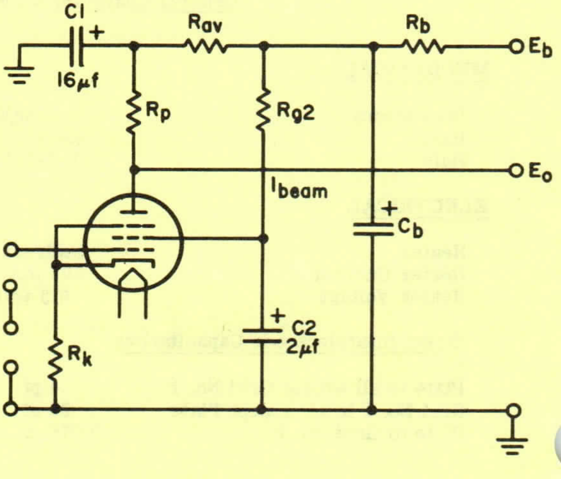


Figure 1

1 Design maximum rating system including no signal conditions.
2 Without by-pass capacitor.

E_{o_1}	=	100 V
E_{opp}	≥	140 V
Video-linearity	≥	0.8
E_{ipp}	ca.	5 V
I_{beam}	max.	7 mA

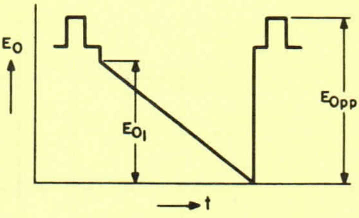


Figure 2

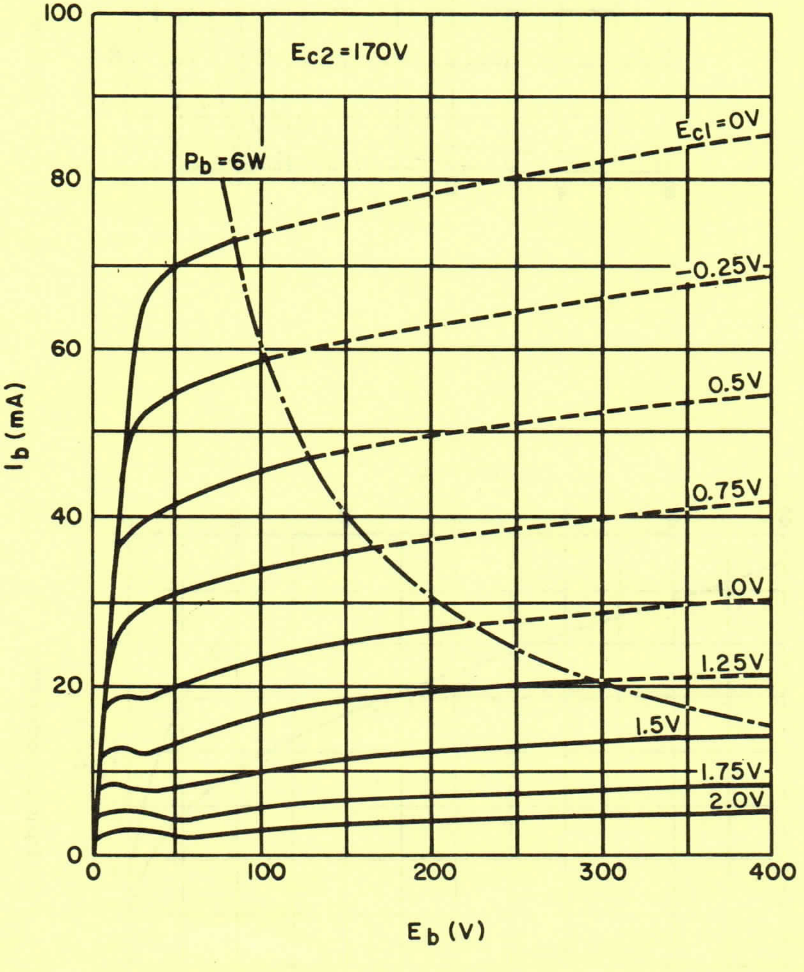
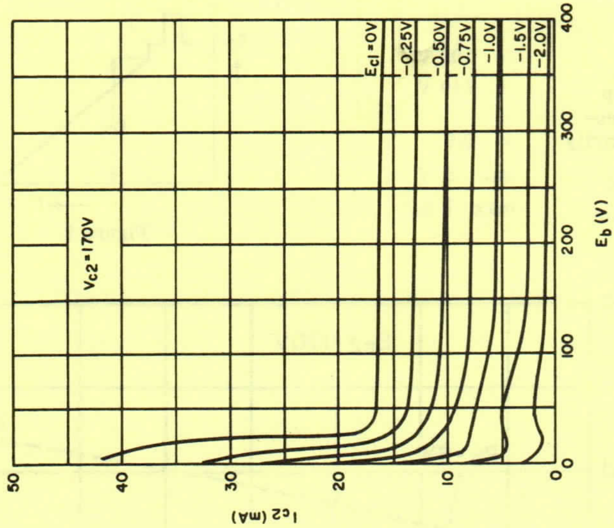
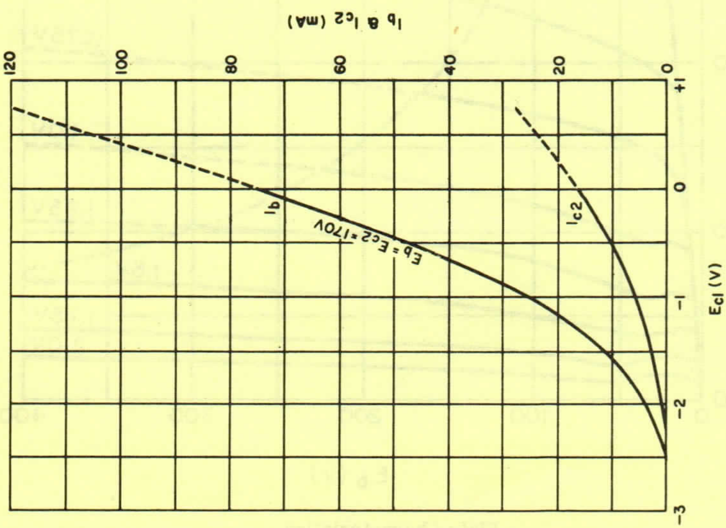


Plate Characteristics



Transfer Characteristics



Input Characteristics

AMPEREX TUBE TYPE 6LN8

The Amperex 6LN8 has the same electrical characteristics as the Amperex 6BL8 except that it is designed for 450 ma controlled warm-up series string operation.

The heater characteristics are:

Heater Voltage	6.0 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 6LX8

The Amperex 6LX8 has the same electrical characteristics as the Amperex 6JW8 except that it is designed for 450 ma controlled warm-up series string operation.

The heater characteristics are:

Heater Voltage	6.0 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 6Q4/EC80

The 6Q4/EC80 is a high mu triode with high transconductance intended for use as an amplifier and mixer in grounded grid circuits at frequencies up to about 500 megacycles. In order to obtain stable operation at these frequencies, the self-inductance of the grid lead has been reduced by connecting the grid to four base pins in parallel. The cathode is indirectly heated, oxide coated.

GENERAL CHARACTERISTICS

ELECTRICAL DATA

Cathode	coated, unipotential
Heater voltage (A.C. or D.C.)	6.3 volts
Heater current	0.48 amp

Direct Interelectrode Capacitances

Grid to cathode + heater [1]	5.1 uuf
Grid + heater to cathode [1]	9.3 uuf
Grid to plate [1]	3.4 uuf
Grid + heater to plate [1]	3.4 uuf
Plate to cathode	max. 0.075 uuf
Plate to cathode + heater	max. 0.08 uuf
Cathode to heater	max. 8.0 uuf

Characteristics - Amplifier Class A_1

Plate voltage	250 volts
Grid voltage	−1.5 volts
Plate current	15 mA
Transconductance	12000 micromhos
Amplification factor	80
Power gain at 300 Mc (bandwidth 4.5 Mc)	15 db
Noise figure at 300 MC (bandwidth 4.5 Mc)	8 db

MECHANICAL DATA

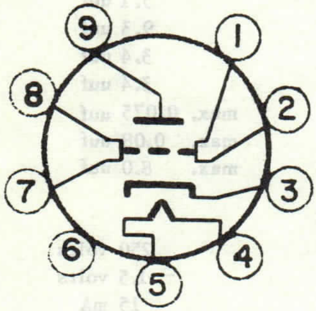
Base	9 pin, miniature (9S-0-0)
Bulb	T 6½
Max. overall length	2 3/16 inches
Max. diameter	7/8 inches
Mounting position	any

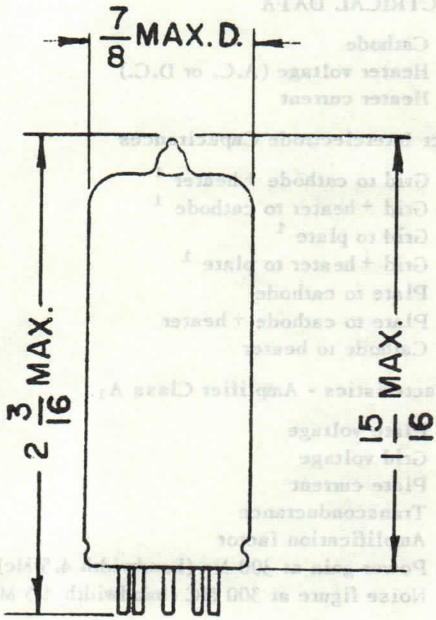
[1] Pin number 6 connected to the grid pins.

6Q4/EC80

MAXIMUM RATINGS (absolute values)

Plate voltage (without current)	550 max.	volts
Plate voltage	300 max.	volts
Plate dissipation	4 max.	watts
Grid voltage at grid current = + 0.3 microamp	— 1.3 max.	volts
Cathode current	15 max.	ma
External resistance between heater and cathode	0.02 max.	megohm
Voltage between heater and cathode	100 max.	volts
Grid resistance	0.3 max.	megohms





PIN CONNECTIONS

PIN NO. 1 = GRID
PIN NO. 2 = GRID
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = NO CONNECTION
PIN NO. 7 = GRID
PIN NO. 8 = GRID
PIN NO. 9 = PLATE

Revised 7/55

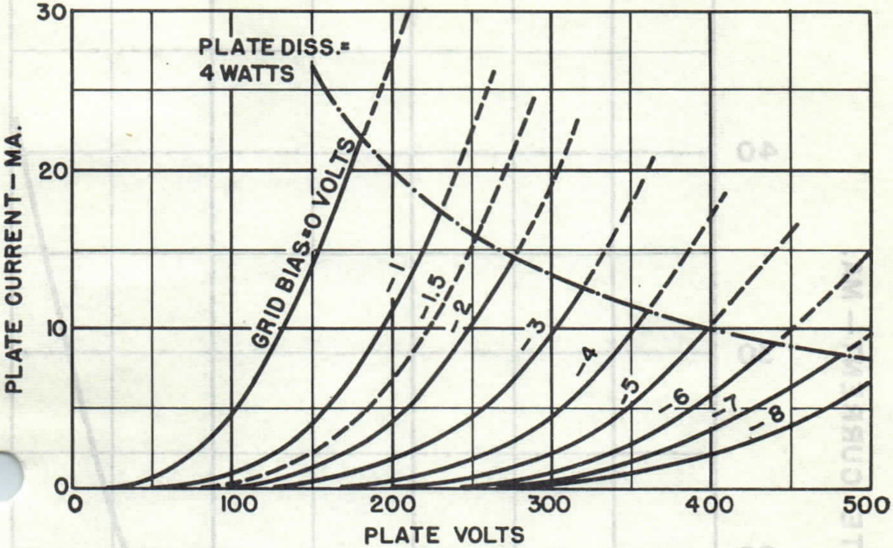


PLATE DISS.= 4 WATTS
GRID BIAS=0 VOLTS
-1
-1.5
-2
-3
-4
-5
-6
-7
-8
PLATE CURRENT—MA.
30
20
10
0
0
100
200
300
400
500
PLATE VOLTS

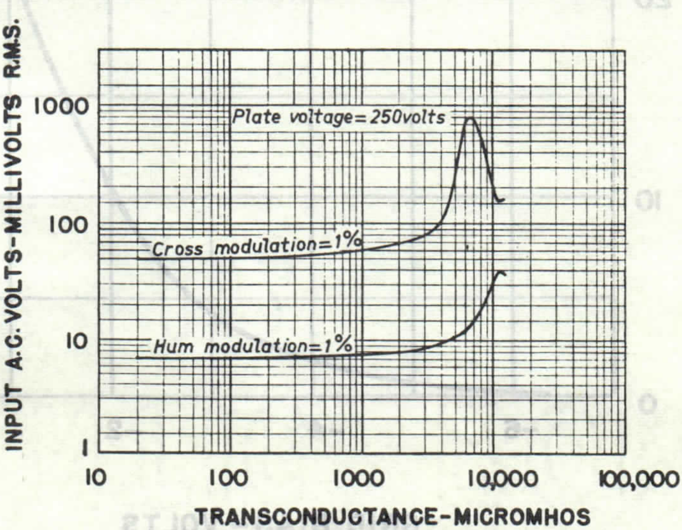


Plate voltage=250volts
Cross modulation=1%
Hum modulation=1%
INPUT A.C. VOLTS-MILLIVOLTS R.M.S.
1000
100
10
1
10
100
1000
10,000
100,000
TRANSCONDUCTANCE-MICROMHOS

6Q4/EC80

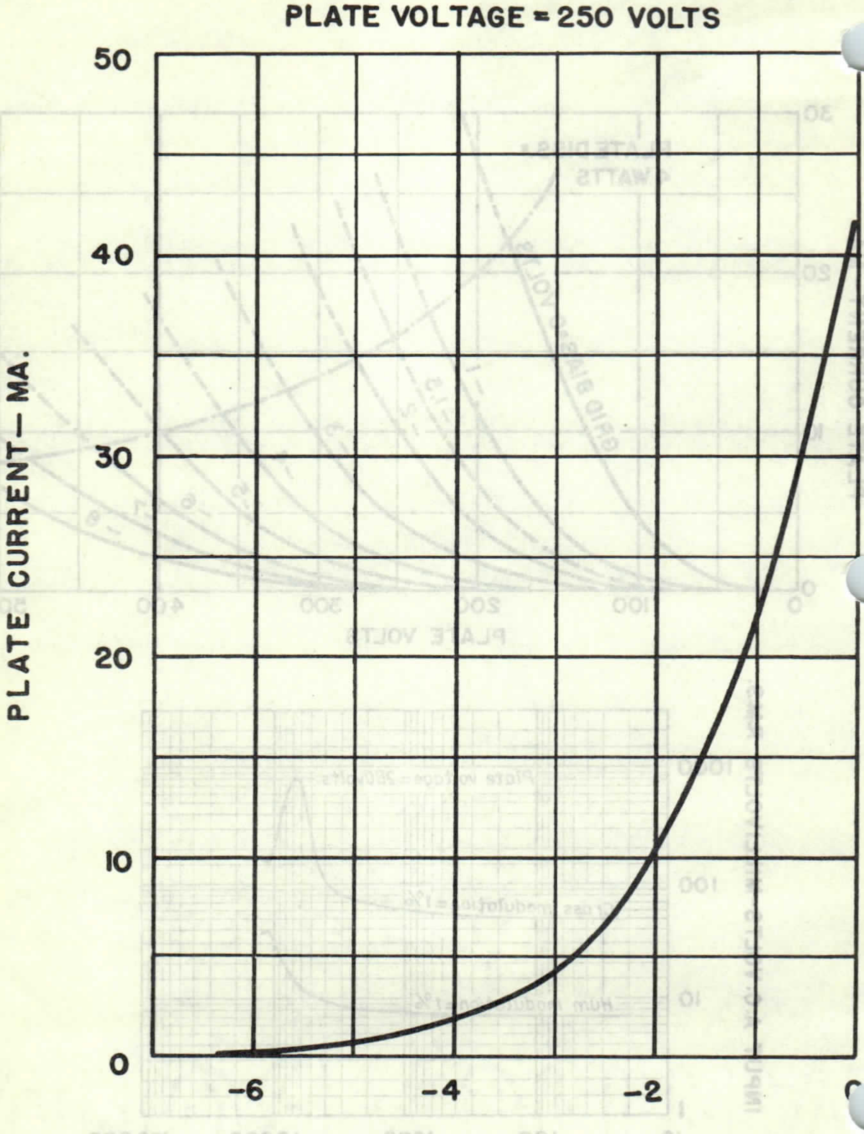


PLATE VOLTAGE = 250 VOLTS
50
40
30
20
10
0
PLATE CURRENT — MA.
-6
-4
-2
0
GRID BIAS — VOLTS

AMPEREX TUBE TYPE 6V4/EZ80

The 6V4/EZ80 is a high vacuum, full wave, miniature rectifier with a noval base. Its small size and generous ratings make it particularly suitable for application in compact Hi-Fi component designs.

GENERAL CHARACTERISTICS

Heater	indirectly heated cathode, coated unipotential
Voltage (A.C.)	6.3 volts
Current	0.6 amperes
Base	Noval, 9 pin
Max. Overall Length	2 5/8 inches
Max. Diameter	7/8 inch

MAXIMUM RATINGS (Design Center Values) ←

A.C. Supply (plate to plate) Voltage (rms)	700	volts
Cathode to Filament Voltage	500	volts
Peak Plate Current	270	mA
D.C. Output Current	90	mA
Max. Capacity (condenser input filter)	50	uf
Peak Inverse Voltage	1000	volts max. ←

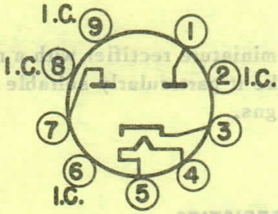
TYPICAL OPERATING CONDITIONS

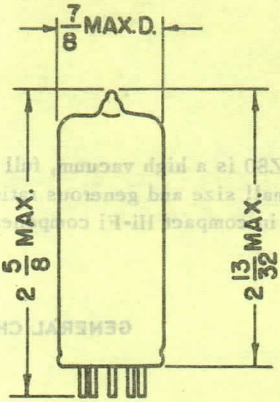
A.C. Supply (plate to plate) Voltage	2x250	2x275	2x300	2x350	volts
D.C. Output Current	90	90	90	90	mA
Limiting Plate Resistance *	2x125	2x175	2x215	2x300	Ω

* See circuit diagram and curve.

Revised 8/56

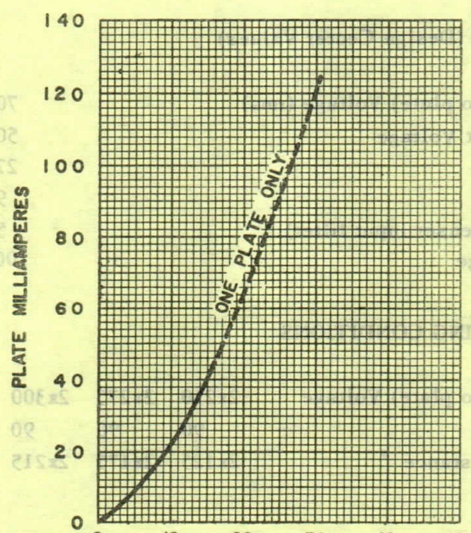
6V4/EZ80

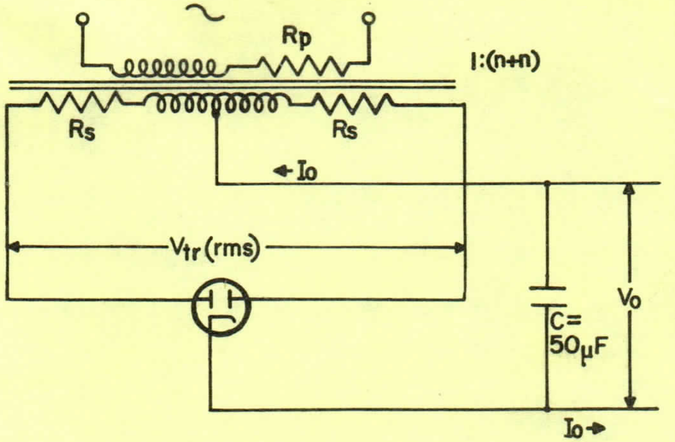




PIN CONNECTIONS

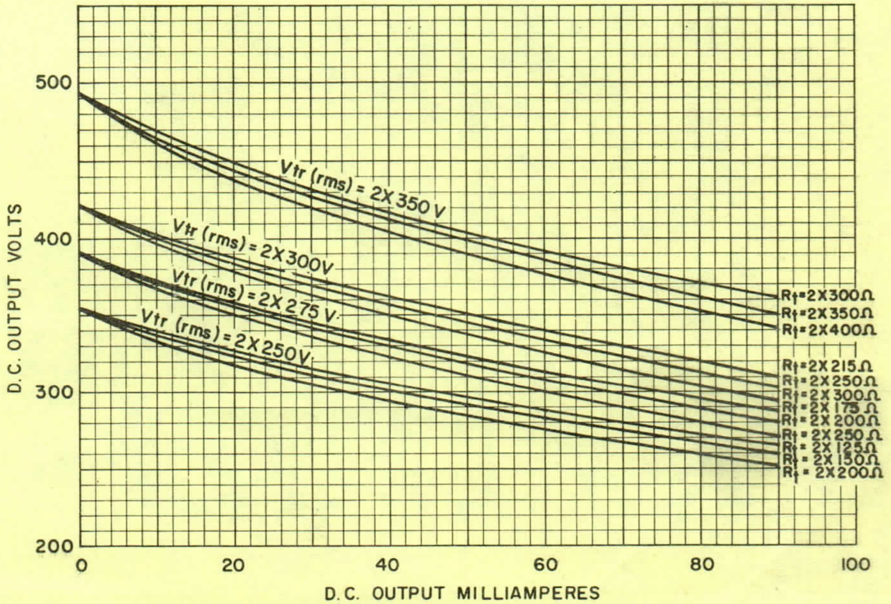
PIN NO. 1 = PLATE NO. 1
PIN NO. 2 = INTERNALLY CONNECTED
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = INTERNALLY CONNECTED
PIN NO. 7 = PLATE NO. 2
PIN NO. 8 = INTERNALLY CONNECTED
PIN NO. 9 = INTERNALLY CONNECTED





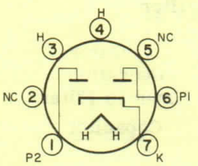
$$R_t = R_s + n^2 R_p$$

MAX. RATINGS AS INFLUENCED BY CIRCUIT PARAMETERS



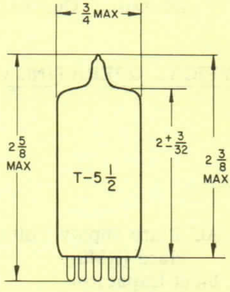
AMPEREX TUBE TYPE 6X4

The Amperex 6X4 is an indirectly heated cathode type power rectifier. Its low voltage drop and small size make it ideally suitable for use with vibrator type inverters in automobile receivers.



PIN CONNECTIONS

1 — PLATE NO.2
2 — NO CONNECTION
3 — HEATER
4 — HEATER
5 — NO CONNECTION
6 — PLATE NO I
7 — CATHODE



5-3

GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Bulb	T 5-1/2
Base	E 7-1
EIA Basing Diagram	5BS
Mounting Position	any

ELECTRICAL

Heater Characteristics	
Heater Voltage[1]	6.3 ± 0.6 volts
Heater Current	600 ma
Maximum Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	
DC	450 volts
Total DC and Peak	450 volts
Heater Negative with Respect to Cathode	
DC	100 volts
Total DC and Peak	200 volts
Tube Voltage Drop (tube conducting 70 ma, each plate)	22 volts

[1] When used in automotive service from a 6 volt battery source, the permissible range in heater voltage is from 5.0 to 8.0 volts.

MAXIMUM RATINGS (DESIGN CENTER)

Peak Inverse Plate Voltage	1250 volts
AC Plate Supply Voltage RMS, each plate	See Figure 1
DC Output Current, each plate	See Figure 1
Steady State Peak Plate Current, each plate (Figure 2)	
Transient Peak Plate Current, each plate (Figure 3)	1.1 amps
Vibrator Operation (min. Duty Cycle = 75%)	
DC Output Voltage (at filter input)	350 volts
DC Output Current, each plate	45 ma

TYPICAL OPERATING CHARACTERISTICS - Full-Wave Rectifier

	Sine Wave Operation Input to Filter		Vibrator Operation Input to Filter	
	Capacitor	Choke	Capacitor	
AC Plate Supply Voltage Each Plate (RMS)[2]	325	400	---	volts
Input Capacitor	10	---	10	μf
Input Choke	---	10	---	henrys
Effective Plate Supply Impedance Each Plate	525	---	---	ohms
DC Output Current	70	70	70	ma
DC Output Voltage at Filter Input (approx.)	310	340	340	volts

[2] AC plate supply voltage is measured without load.

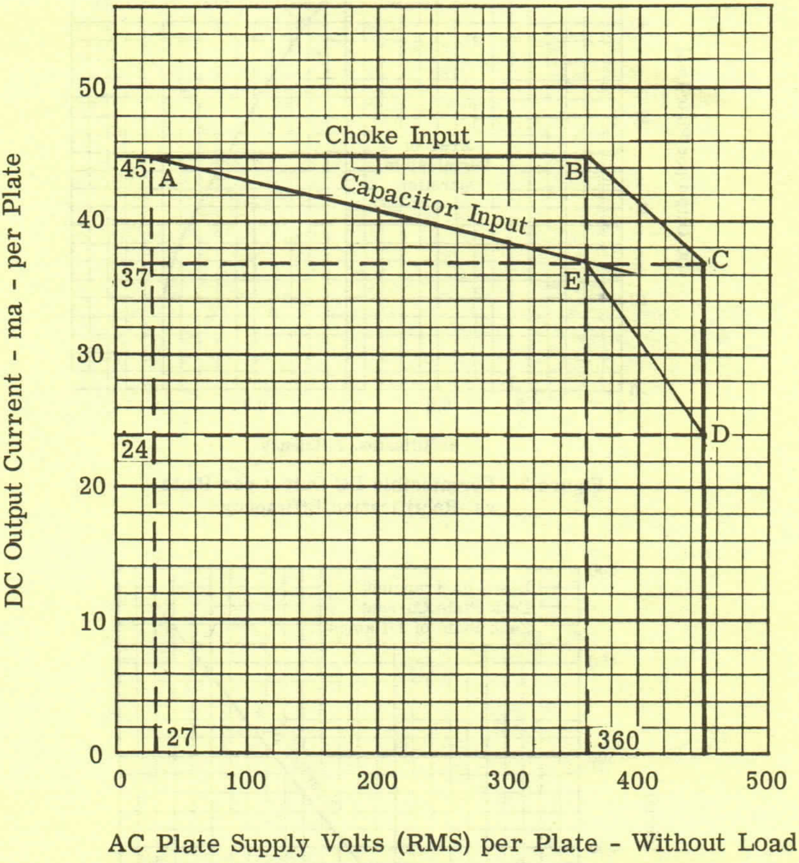


Figure 1. Permissible DC Output Current per Plate vs. AC Plate Supply Voltage (RMS) per Plate (no load)

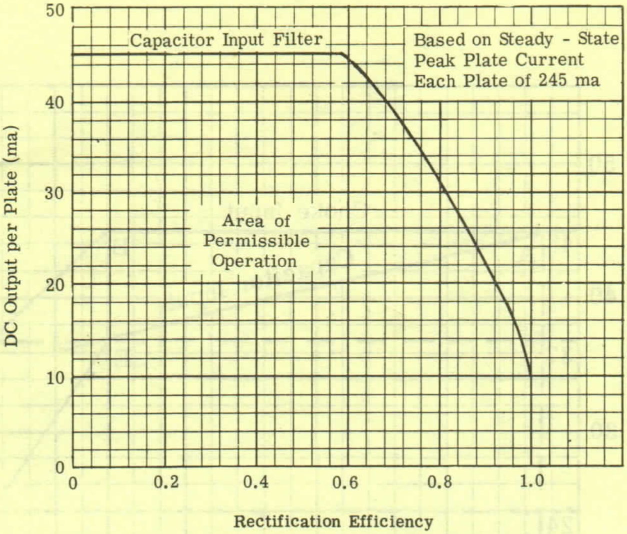


Figure 2. Permissible DC Output per Plate vs. Rectification Efficiency

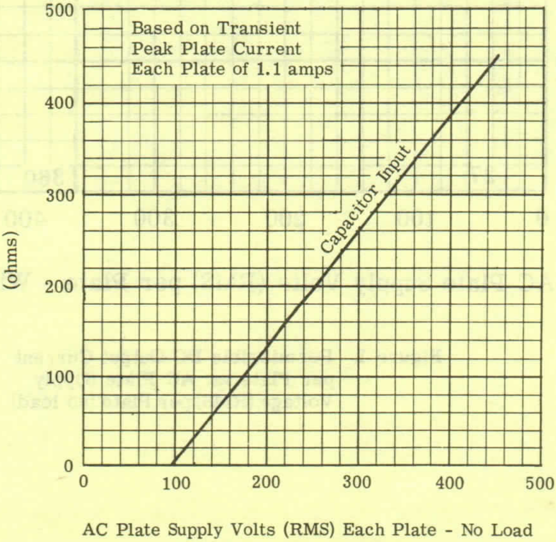


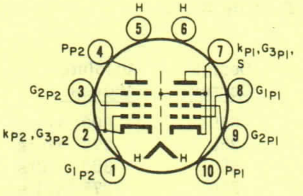
Figure 3. Minimum Plate Supply Resistance per Plate

AMPEREX TUBE TYPES 6Y9, 11Y9, 16Y9

TENTATIVE DATA

The Amperex 6Y9, 11Y9 and 16Y9 are dual-pentode tubes with Decal bases. They are designed for use in television receivers: Pentode No. 1 as a video output pentode and Pentode No. 2 as a sound IF amplifier, AGC amplifier or sync separator. The extremely low capacitances between sections prevent interference and make it possible to use both sections as a cascade amplifier.

Pentode No. 1 can provide 100 volt composite video signal at a plate load of 2 k ohms.

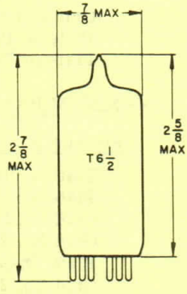


PIN CONNECTIONS

1- GRID NO.1
2- CATHODE, GRID NO.3
3- GRID NO.2
4- PLATE
5- HEATER
6- HEATER
7- CATHODE, GRID NO.3 SHIELD
8- GRID NO.1
9- GRID NO.2
10- PLATE

PENTODE NO.2 SECTION (pins 1–4)

PENTODE NO.1 SECTION (pins 7–10)



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Decal

ELECTRICAL

Heater Supply	indirect, AC or DC series or parallel			
	6Y9	11Y9	16Y9	
Heater Voltage	6.3	11.0	16.5	volts
Heater Current	800	450	300	ma

6Y9, 11Y9, 16Y9

Direct Interelectrode Capacitances (without external shield)

Pentode No. 1

Plate to All Other Elements (except grid No. 1)	7 pf
Grid No. 1 to All Other Elements (except plate)	12 pf
Plate to Grid No. 1	95 mpf

Pentode No. 2

Plate to All Other Elements (except grid No. 1)	11 pf
Grid No. 1 to All Other Elements (except plate)	10 pf
Plate to Grid No. 1	140 mpf
Grid No. 1 to Heater	<100 mpf

Between Pentode No. 1 and Pentode No. 2

Plate to Plate	<150 mpf
Grid to Grid	<10 mpf
Plate of Pentode No. 1 to Control Grid of Pentode No. 2	<100 mpf
Plate of Pentode No. 2 to Control Grid of Pentode No. 2	<5 mpf

MAXIMUM RATINGS

Pentode No. 1 Section	Design Center	Absolute Values	
Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Plate Dissipation	5.0	5.8	watts
Grid No. 2 Dissipation	2.5[1]	2.9[2]	watts
Cathode Current	60[3]	66[4]	ma
Grid No. 1 Resistance	1	1	megohms
Heater to Cathode Voltage	200	200	volts

Pentode No. 2 Section

Plate Voltage (zero plate current)	550	600	volts
Plate Voltage	250	275	volts
Grid No. 2 Voltage (zero grid current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Plate Dissipation	1.5	1.75	watts
Grid No. 2 Dissipation	0.5	0.6	watts
Cathode Current	15	16.5	ma
Grid No. 1 Resistance	1	1	megohms
Heater to Cathode Voltage	200	200	volts

[1] For short periods, screen dissipation = 3.2 watts (max.).
[2] For short periods, cathode current = 85 ma (max.).
[3] For short periods, screen dissipation = 3.5 watts (max.).
[4] For short periods, cathode current = 93 ma (max.).

TYPICAL CHARACTERISTICS

	Pentode No. 1	Pentode No. 2	
Plate Voltage	170	150	volts
Grid No. 2 Voltage	170	150	volts
Grid No. 1 Voltage	-2.6	-2.3	volts
Plate Current	30	10	ma
Grid No. 2 Current	6.5	3.0	ma
Transconductance	21,000	8500	μmhos
Amplification Factor (grid No. 1 to grid No. 2)	38	35	
Internal Resistance	40	160	k ohms

TYPICAL OPERATING CHARACTERISTICS

Pentode No. 1 - Video Output (Figure 1)

Supply Voltage	135		230	250	250	volts
Supply Series Resistor (RV)[5]	0		820	1200	0	ohms
Voltage at $E_{bb'}$	--		190	190	0	volts
Plate Resistance	2.2	4.7	2	3.9	3.3	k ohms
Grid No. 2 Resistor	0	0	1	1	3.9	k ohms
Cathode Resistor	6.8	6.8	6.8	6.8	15	ohms
Peak to Peak Input Signal	2.5	1.4	3.6	1.8	5.5	volts
Peak to Peak Output Signal	90	90	100	100	160	volts

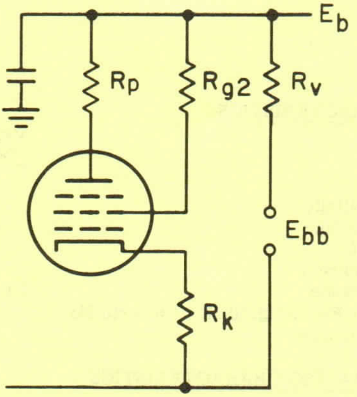
Pentode No. 2 - Sync Separator

Supply Voltage	100-140	200-250	volts
Plate Resistance	50	50	k ohms
Grid No. 2 Voltage	75	75	volts
Grid No. 1 Resistor	1	1	megohm
Grid No. 1 Voltage	-2.6	-2.7	volts
Plate Current	0.1	0.1	ma
Transconductance	250	200	μmhos

Pentode No. 2

	AGC Amplifier	IF Amplifier		
Plate Voltage	100-150	135	150	volts
Grid No. 2 Voltage	60	135	150	volts
Grid No. 1 Voltage	-1.3	-1.9	-2.3	volts
Plate Current	1.0	10	10	ma
Transconductance	2500	8700	8500	μmhos

[5] RV given to avoid excessive plate dissipation.



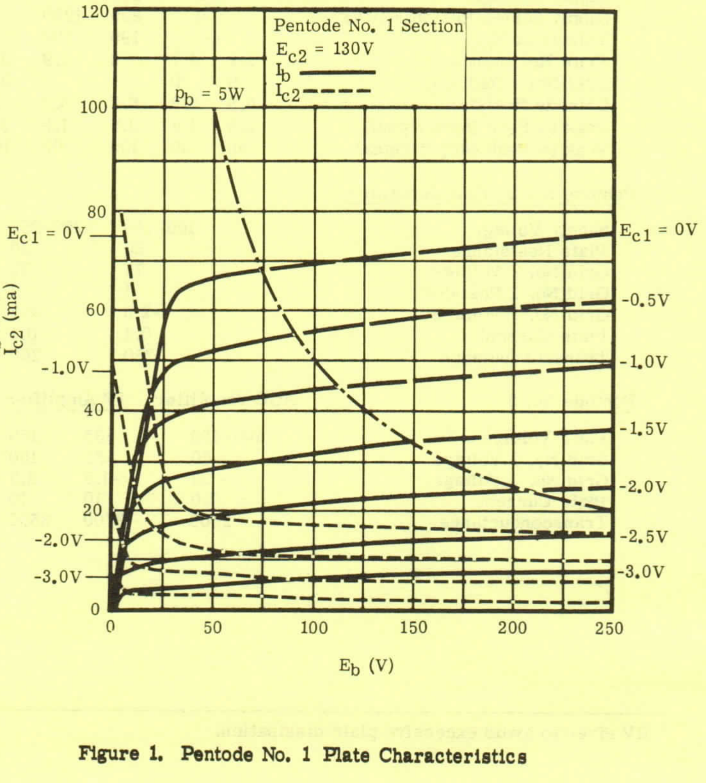


Figure 1. Pentode No. 1 Plate Characteristics

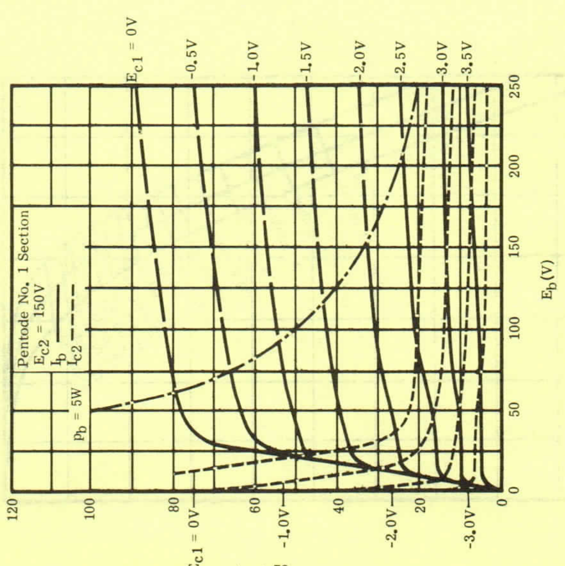


Figure 2. Pentode No. 1 Plate Characteristics

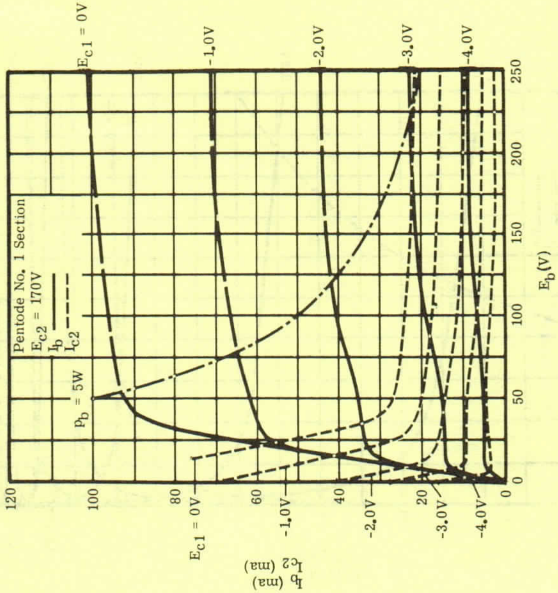


Figure 3. Pentode No. 1 Plate Characteristics

6Y9, 11Y9, 16Y9

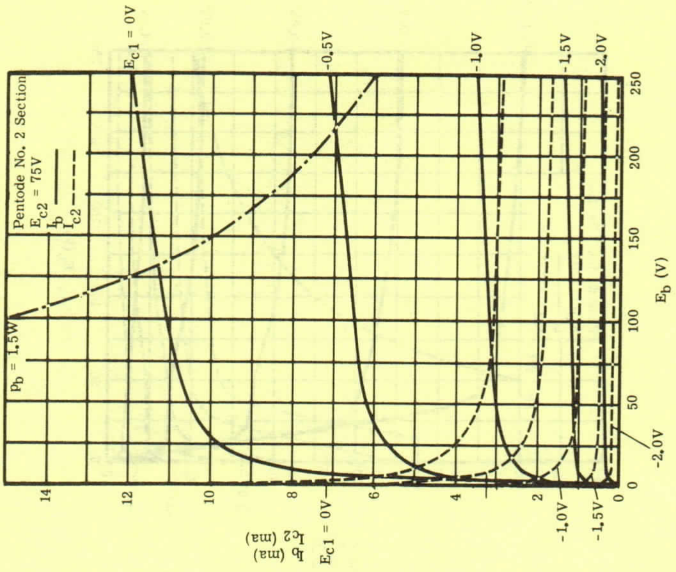


Figure 5. Pentode No. 2 Plate Characteristics

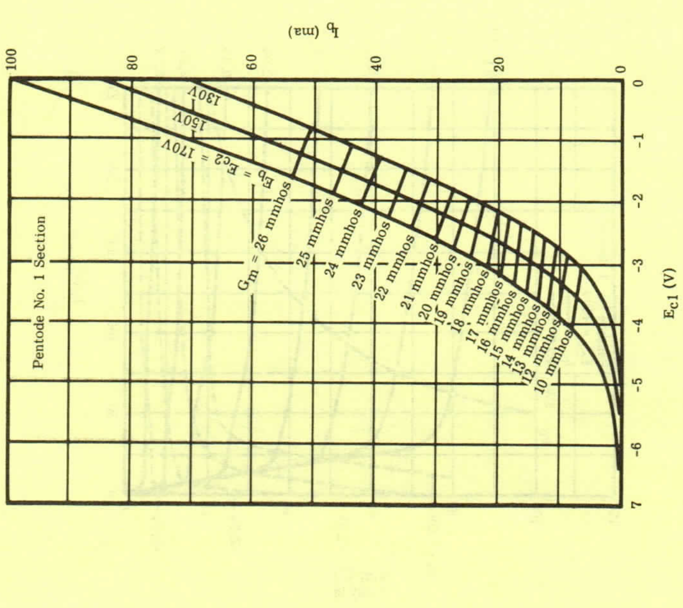


Figure 4. Pentode No. 1 Average Characteristics

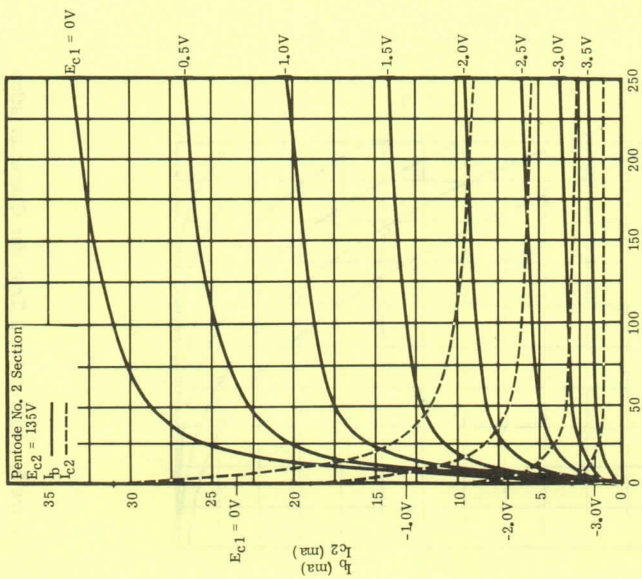


Figure 6. Pentode No. 2 Plate Characteristics

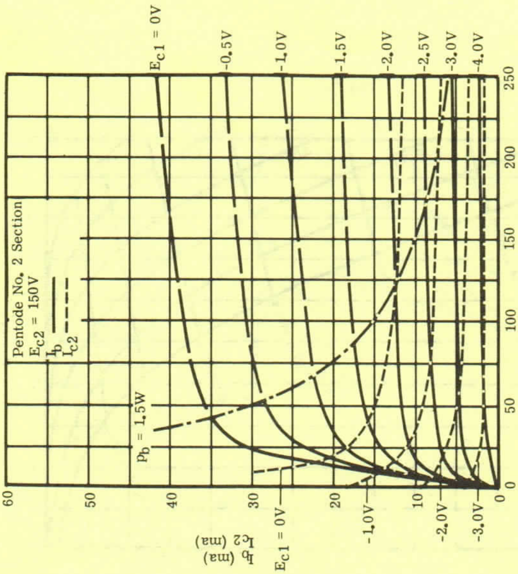


Figure 7. Pentode No. 2 Plate Characteristics

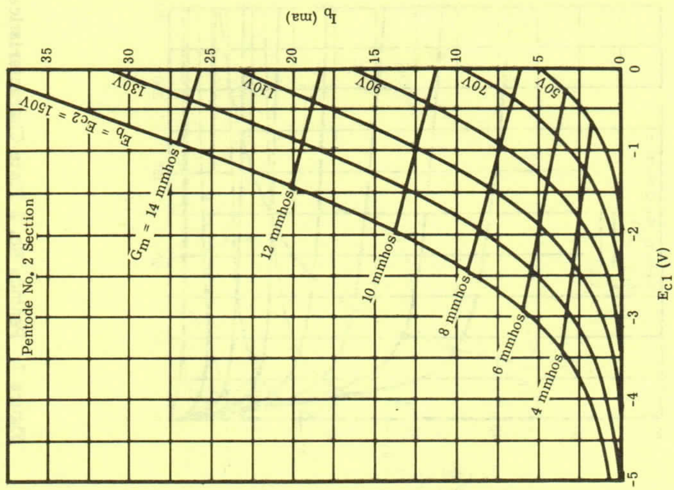


Figure 9. Pentode No. 2 Average Characteristics

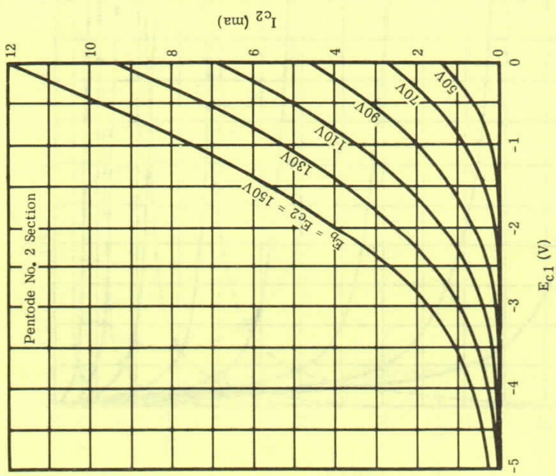


Figure 8. Pentode No. 2 Transfer Characteristics

TENTATIVE DATA

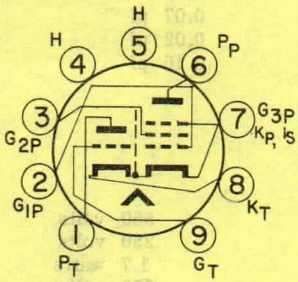
The Amperex 7HG8 is a combined triode and high-slope Ampliframe RF pentode for use for 300 ma series string operation as an oscillator-mixer in VHF television tuners.

The 7HG8 is electrically equivalent to the 6HG8 with the exception of the following ratings.

Heater Arrangement	series supply
Heater Voltage	8 volts
Heater Current	300 ma

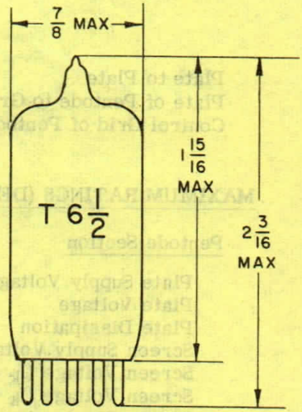
AMPEREX TUBE TYPE 9A8

The Amperex 9A8 is a miniature triode-pentode with separate cathodes especially designed for use as a combined oscillator-mixer in TV and AM/FM receivers.



PIN CONNECTION

1– PLATE, TRIODE
2– GRID NO. 1 PENTODE
3– GRID NO. 2 PENTODE
4– HEATER
5– HEATER
6– PLATE, PENTODE
7– GRID NO. 3 PENTODE
CATHODE, PENTODE
INTERNAL SHIELD
8– CATHODE, TRIODE
9– GRID, TRIODE



6–2

GENERAL CHARACTERISTICS

MECHANICAL

Base	E 9-1
Bulb	T 6-1/2
Outline	6-2
Mounting Position	any

ELECTRICAL

Cathodes (2)	coated, unipotential

Heater Characteristics

Heater Arrangement	AC or DC series supply
Heater Voltage	9 volts
Heater Current	300 ma

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Interelectrode Capacitances

	Triode Section	Pentode Section
Input	2.5	5.2 pf
Output	1.8	3.4 pf
Plate to Grid	1.5	0.025 pf

	Between Triode and Pentode Sections
Plate to Plate	0.07 pf
Plate of Pentode to Grid of Triode	0.02 pf
Control Grid of Pentode to Plate of Triode	0.16 pf

MAXIMUM RATINGS (DESIGN CENTER VALUES)

Pentode Section

Plate Supply Voltage	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.7 watts
Screen Supply Voltage	550 volts
Screen Voltage (I_k = 14 ma)	175 volts
Screen Voltage (I_k < 10 ma)	200 volts
Screen Dissipation[1]	0.5 watt
Cathode Current	14 ma
Grid Series Resistance (Cathode Bias)	1 megohm
Grid Series Resistance (Fixed Bias)	0.5 megohm
Negative Grid Voltage (I_{g1} = 0.3 μa)	1.3 volts
Voltage between Cathode and Heater	100 volts

Triode Section

Plate Supply Voltage	550 volts
Plate Voltage	250 volts
Plate Dissipation	1.5 watts
Cathode Current	14 ma
Grid Series Resistance	0.5 megohm
Negative Grid Voltage (I_g = +0.3 μa)	1.3 volts
Voltage between Cathode and Heater	100 volts

[1] If plate dissipation is less than 1.2 watts, the maximum value of the screen dissipation may be increased to 0.75 watts.

TYPICAL CHARACTERISTICS

Pentode Section

Plate Voltage	170	volts
Screen Voltage	170	volts
Grid Voltage	-2	volts
Plate Current	10	ma
Screen Current	2.8	ma
Transconductance	6,200	μmhos
Amplification Factor	47	
Plate Resistance	0.4	megohm
Input Resistance (F = 50 Mc)	10,000	ohms
Equivalent Noise Resistance	1,500	ohms

Triode Section

Plate Voltage	100	volts
Grid Voltage	-2	volts
Plate Current	14	ma
Transconductance	5,000	μmhos
Amplification Factor	20	

TYPICAL OPERATION - CONVERTER SERVICE[2]

Plate Voltage	170	170	volts
Screen Voltage	170	170	volts
Grid Resistance	0.1	0.1	megohm
Cathode Resistor	330	820	ohms
Oscillator Voltage	3.5	3.5	volts
Plate Current	6.5	5.2	ma
Screen Current	2.0	1.5	ma
Grid Current	20	0	μa
Conversion Conductance	2,200	2,100	μmhos
Internal Resistance	0.8	0.87	megohm

[2] The triode should be used in a Colpitts rather than a Hartley type oscillator circuit.

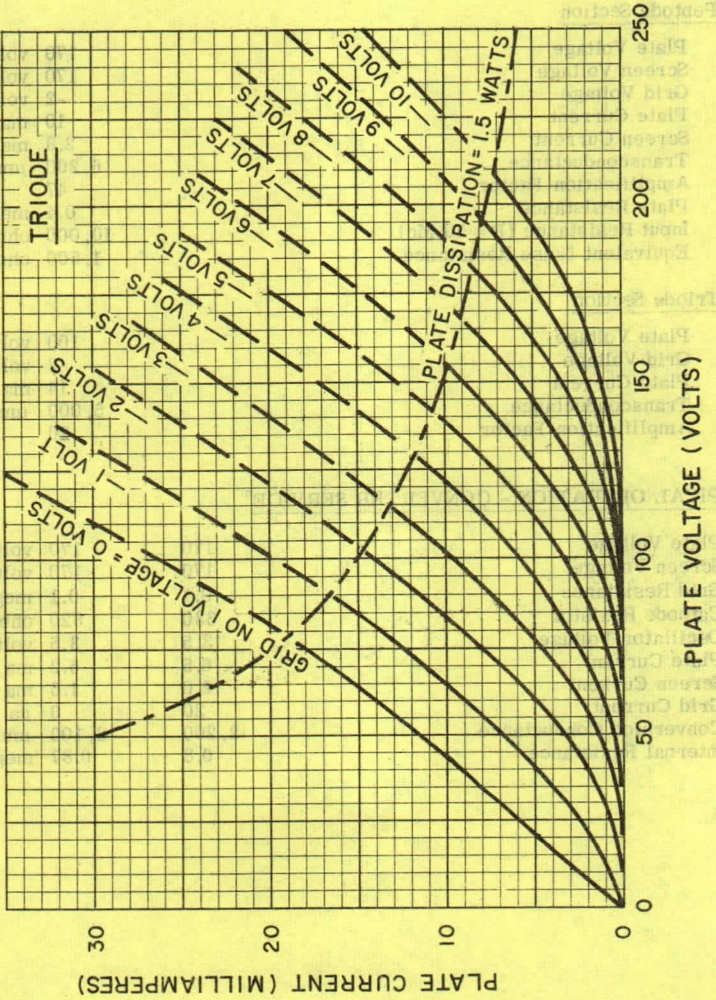


Figure 1. Triode Plate Characteristics

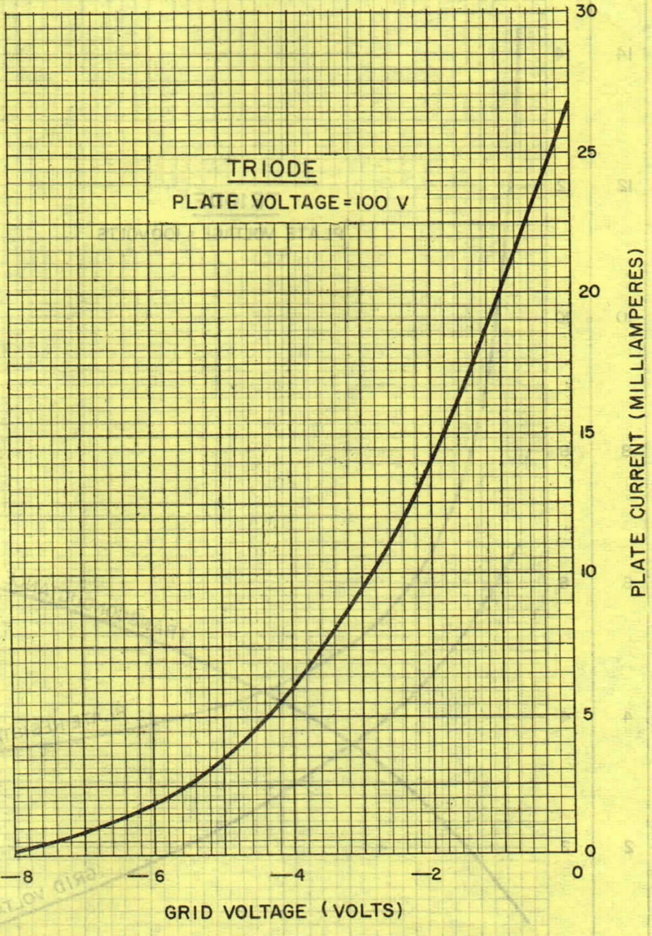


Figure 2. Triode Transfer Characteristics

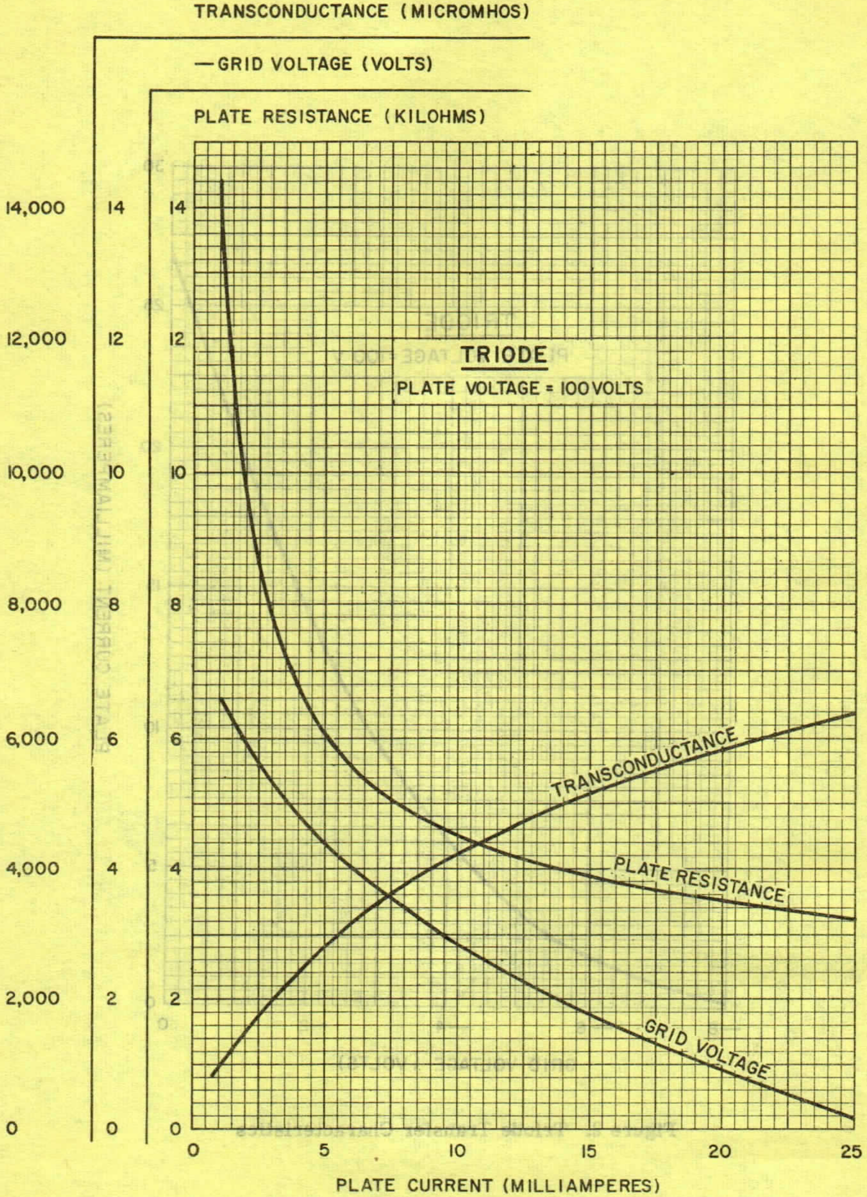


Figure 3. Triode Average Characteristics

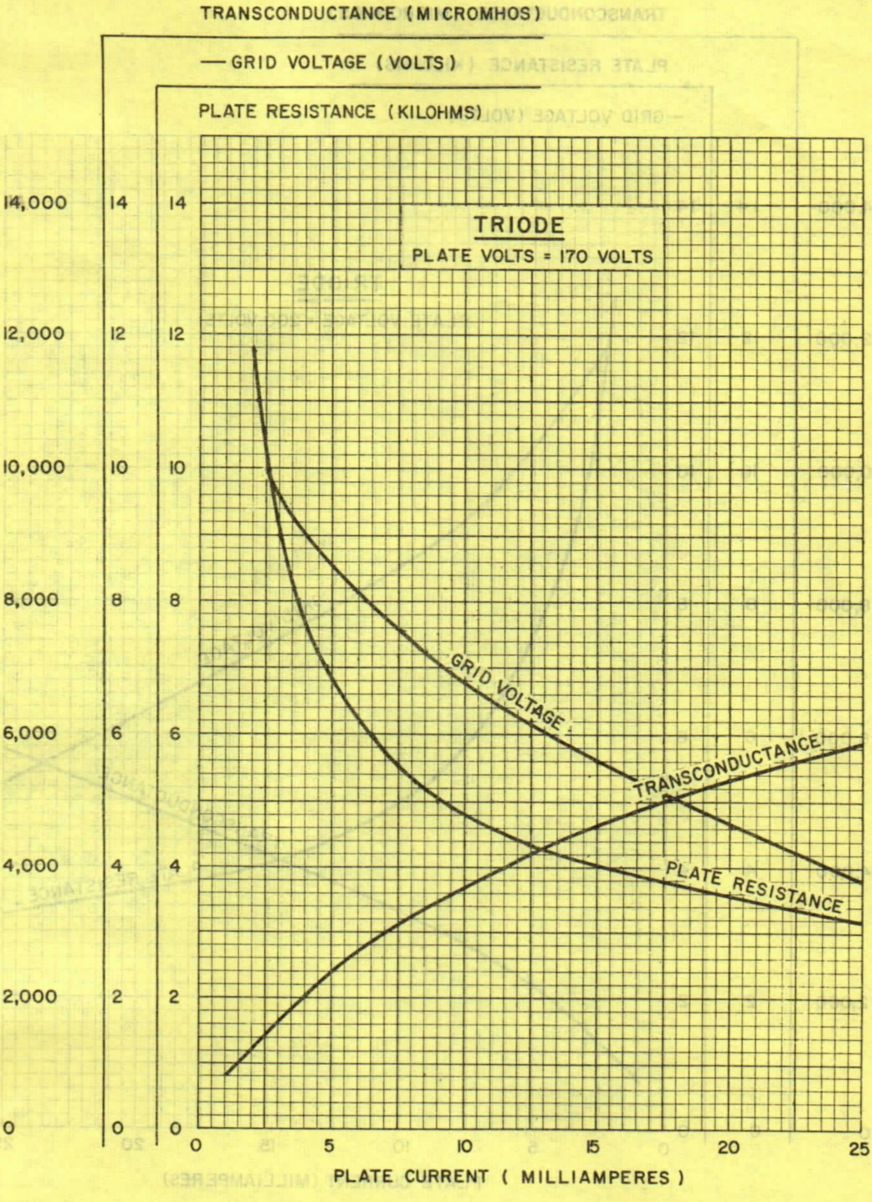


Figure 4. Triode Average Characteristics

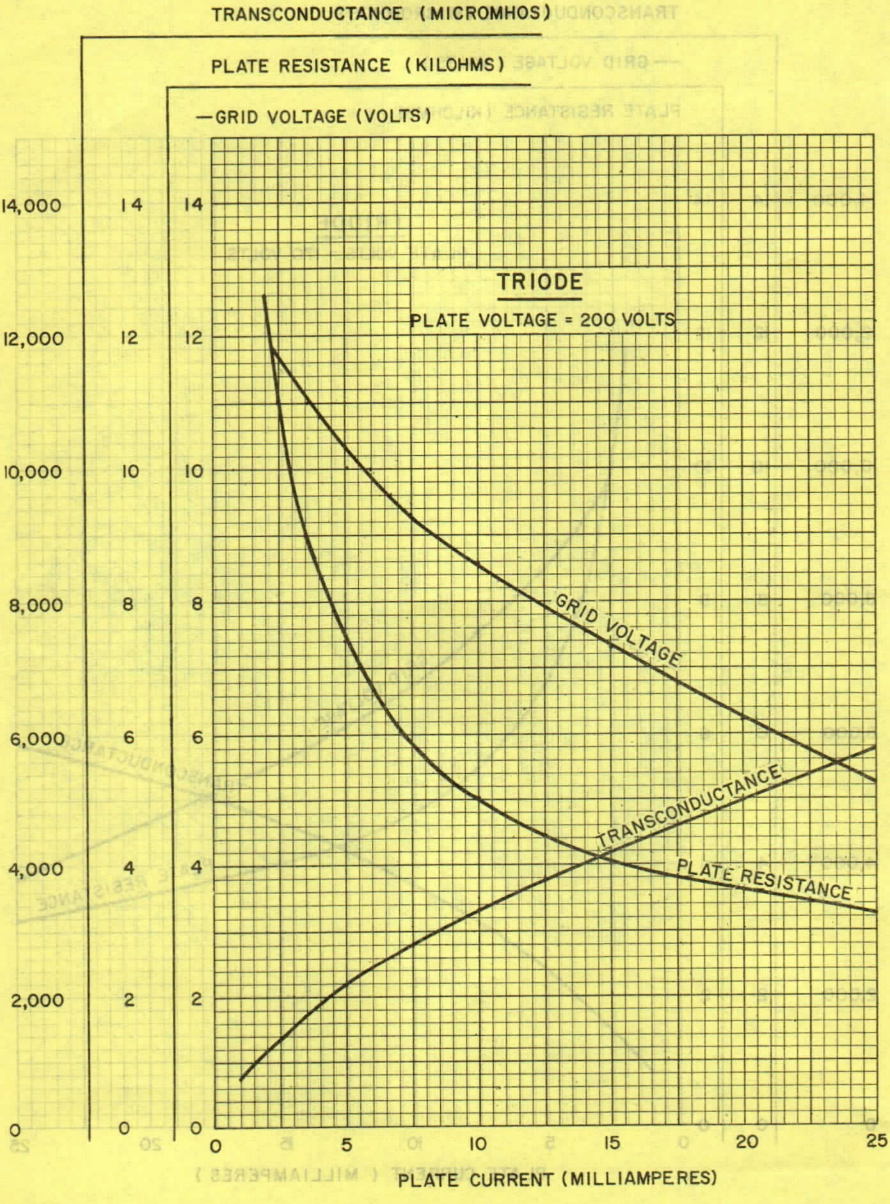


Figure 5. Triode Average Characteristics

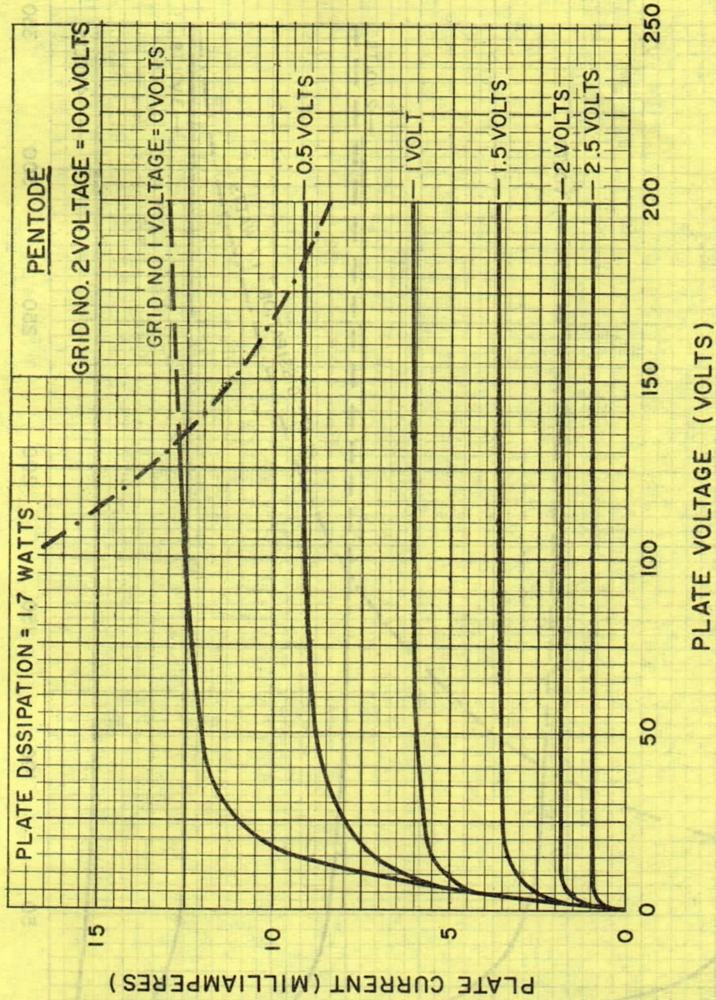


Figure 6. Pentode Plate Characteristics

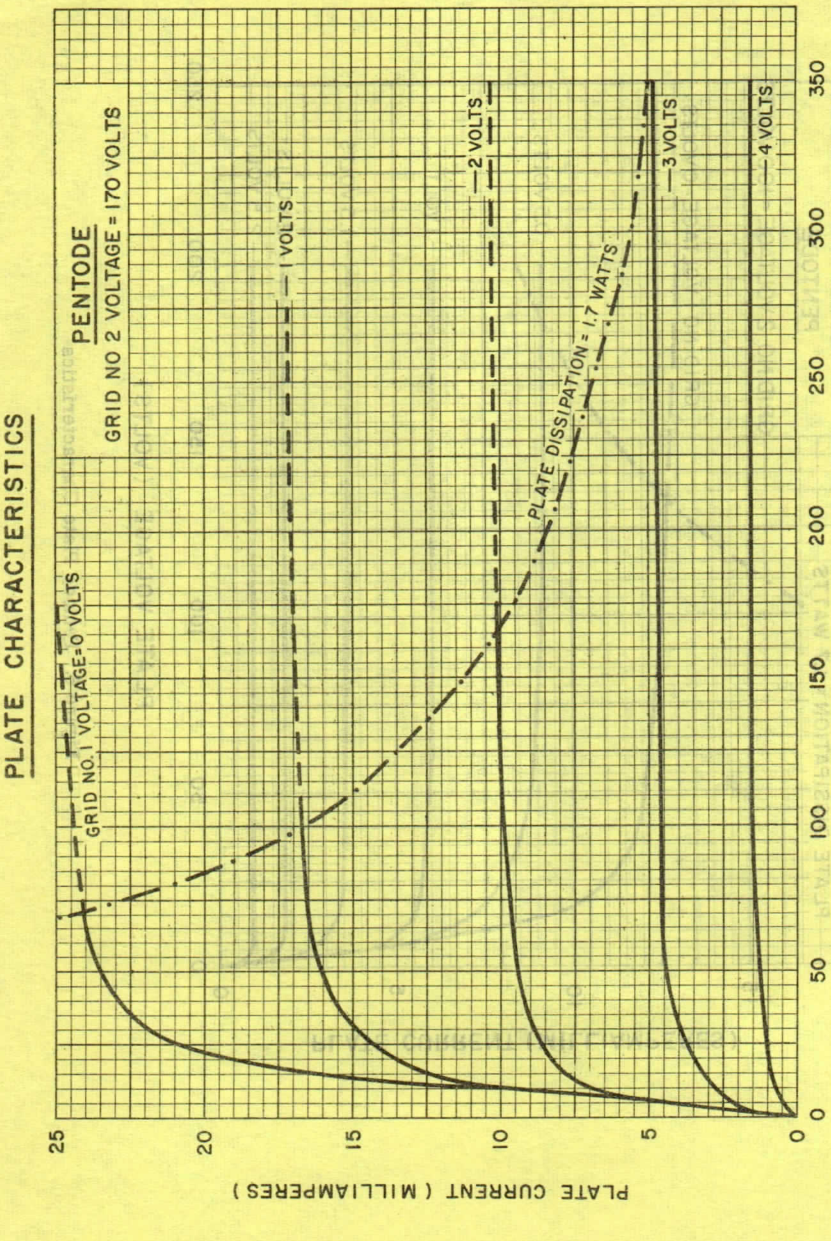


Figure 7. Pentode Plate Characteristics

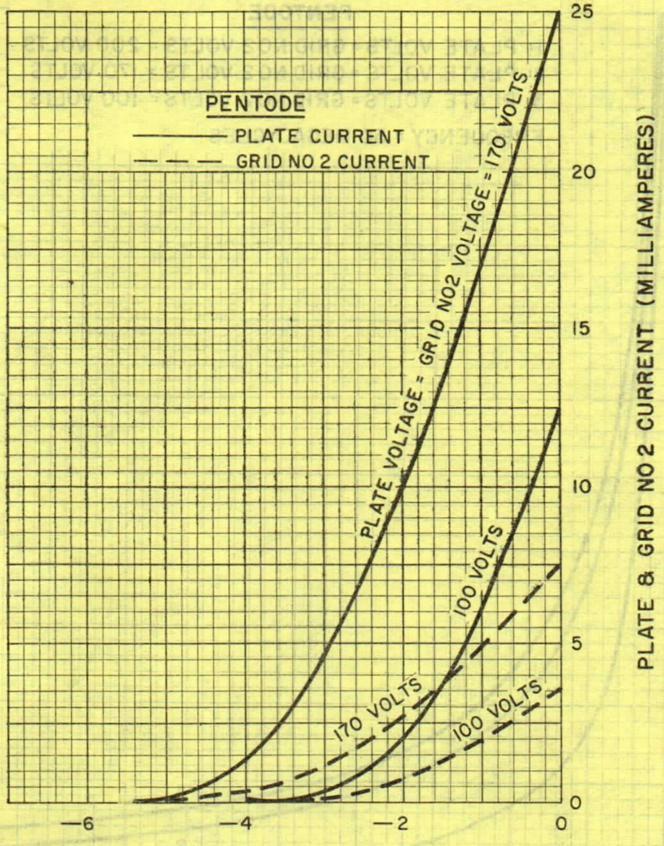


Figure 8. Pentode Transfer Characteristics

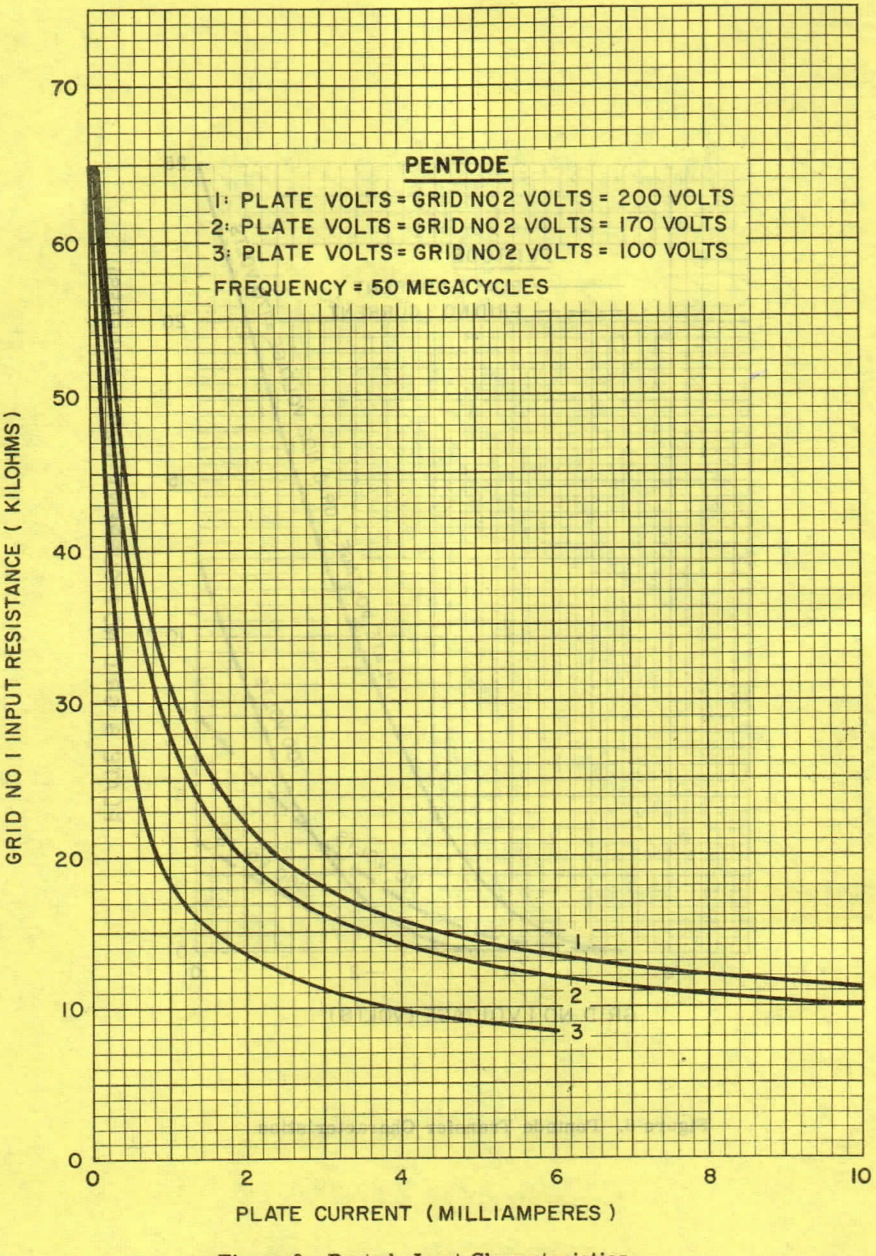


Figure 9. Pentode Input Characteristics

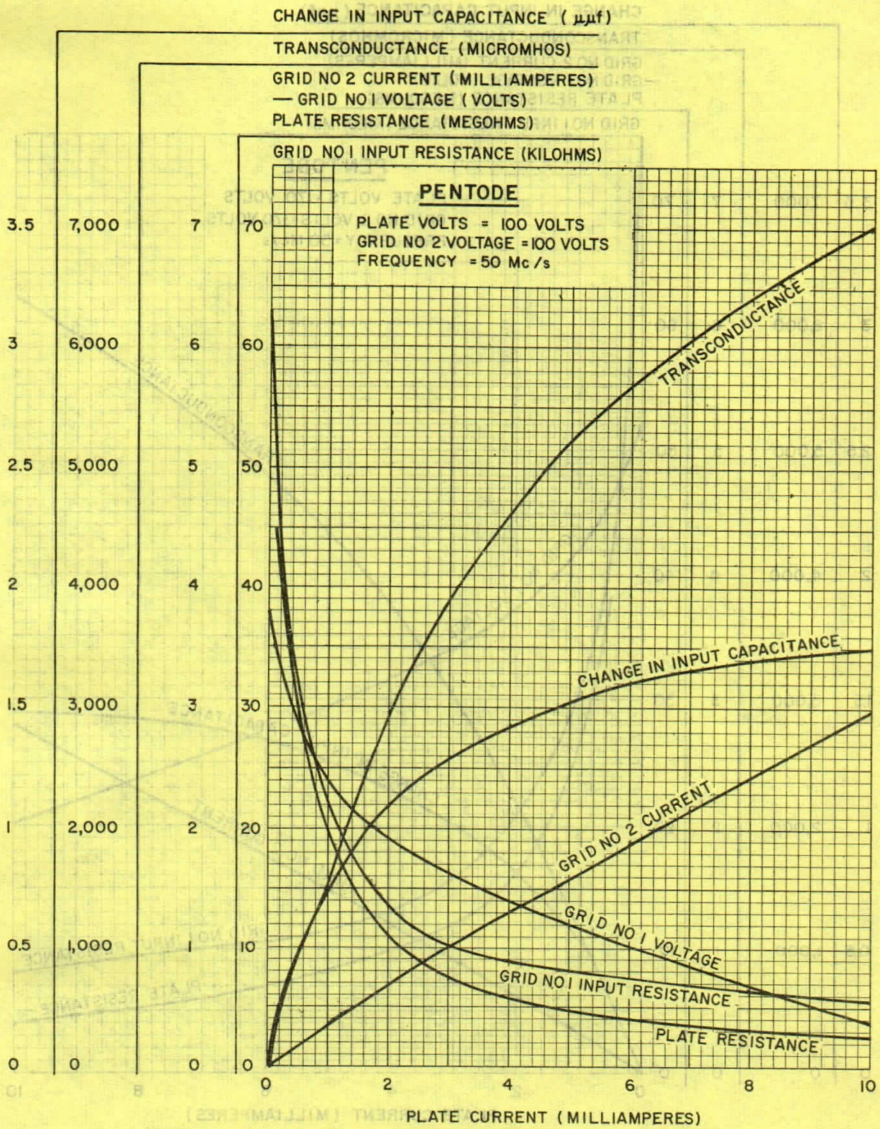


Figure 10. Pentode Characteristics at 50 Mc

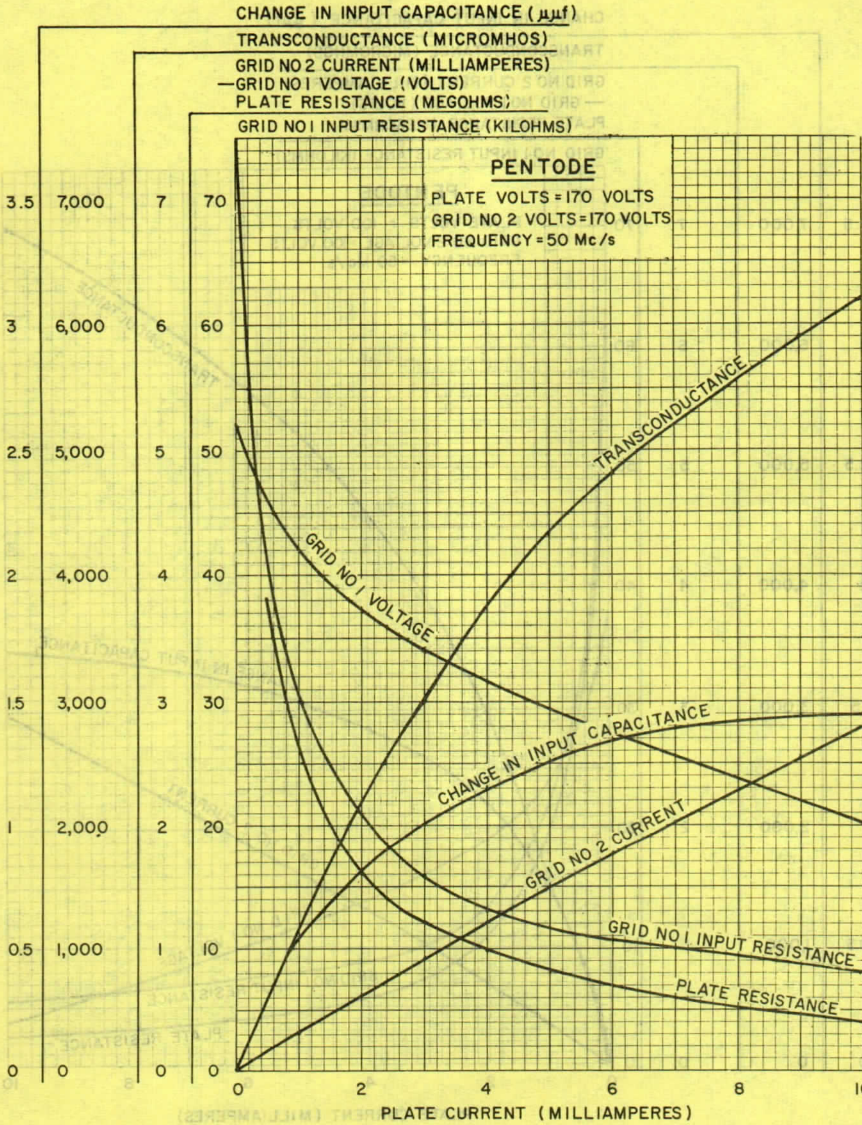


Figure 11. Pentode Characteristics at 50 Mc

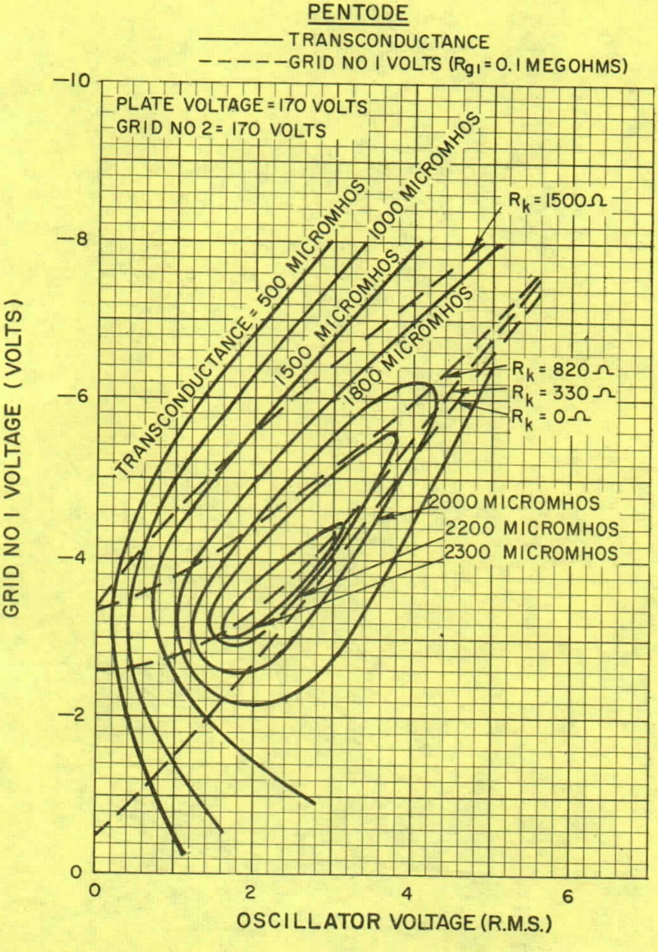
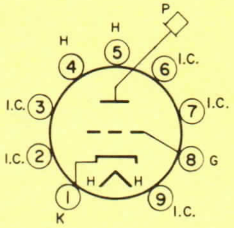


Figure 12. Pentode Operating Characteristics

AMPEREX TUBE TYPE 9ED4/PD500

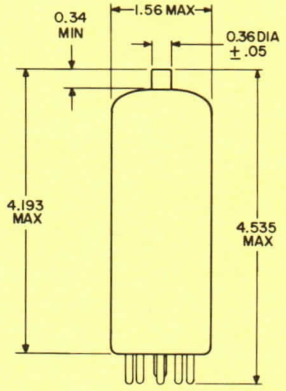
TENTATIVE DATA

The Amperex 9ED4/PD500 is a shunt stabilizer triode designed for color TV receivers.



PIN CONNECTIONS

1- CATHODE
2- INTERNAL CONNECTION
3- INTERNAL CONNECTION
4- HEATER
5- HEATER
6- INTERNAL CONNECTION
7- INTERNAL CONNECTION
8- GRID
9- INTERNAL CONNECTION
P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	magnoval

ELECTRICAL

Heater Supply	indirect AC or DC series supply
Heater Voltage	7.3 volts
Heater Current	300 ma

MAXIMUM RATINGS (DESIGN CENTER - unless noted)

Plate Voltage	25,000 volts
Plate Current	1.5 ma
Plate Dissipation	30 watts
Plate Dissipation (absolute limit)	40 watts[1]
Negative Grid Voltage	150 volts[2]
Grid Circuit Resistance	5 megohms
Cathode to Heater Voltage	
Cathode Positive	400 VDC + 250 VAC
Cathode Negative	250 volts

1. Permissible only during short periods; in total, up to a maximum of 10% of the operating time of the tube.

2. During set warm-up, 440 volts maximum.

Precautions: X-ray shielding may be required to give protection against excessive radiation.

9ED4/PD500

TYPICAL OPERATING CHARACTERISTICS

Plate Voltage	25,000 volts
Grid Voltage Change for a Plate Current Change of 0.1 to 1.5 ma	<11 volts
Negative Grid Voltage (I_p = 100 μa)	18 to 40 volts

AMPEREX TUBE TYPE 10CW5

The Amperex 10CW5 has the same electrical characteristics as the Amperex 6CW5/EL86 except that the heater ratings are as indicated below.

The 10CW5 is designed for 450 ma controlled warm-up series string operation.

Heater Voltage	10.6 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 10DX8

TENTATIVE DATA

The Amperex 10DX8 is a triode-pentode with separate cathodes for 450 ma series string operation. The triode is designed for use in circuits for keyed AGC, sync-separation, sync-amplification and noise suppression. The pentode is designed for use as a video output tube.

The 10DX8 is electrically equivalent to the 6DX8, except for the following ratings.

Heater Arrangement	series supply
Heater Voltage	10.2 volts
Heater Current	450 ma

AMPEREX TUBE TYPE 12AT7/ECC81

The 12AT7/ECC81 [1] is a miniature twin triode designed for use as an oscillator mixer or amplifier in TV and FM receivers. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt heater supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	Coated, unipotential		
	Series	**Parallel**	
Heater Voltage, AC or DC	12.6	6.3	volts
Heater Current [2]	0.15	0.3	amps
Direct Interelectrode Capacitances	**With Shield [3]**	**Without Shield**	
Input (each section)	2.3	2.3	uuf
Output (section 1)	1.15	0.45	uuf
Output (section 2)	1.45	0.35	uuf
Grid to Plate (each section)	1.6	1.6	uuf
Heater to Cathode	2.5	2.5	uuf

MECHANICAL

Maximum Overall Dimensions	
Length	2 3/16 inches
Seated Height	1 15/16 inches
Diameter	7/8 inch
Mounting Position	any
Base	Samll button, 9 pin RETMA #9A

[1] The 12AT7/ECC81 is a direct, high-quality replacement for other brands of the 12AT7.

[2] When used in equipment which employs series-connected heaters, a current-limiting device must be inserted to limit the current when switching on.

[3] With external shield (RETMA #315) connected to cathode of section under test.

12AT7/ECC81

MAXIMUM RATINGS (Each Section)

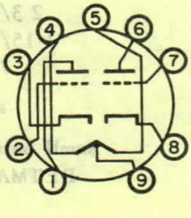
Design Center Values

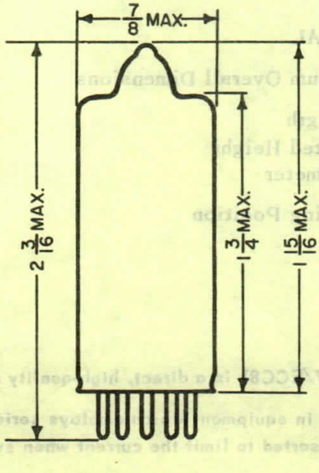
Zero Signal Plate Voltage	550	volts
Plate Voltage	300	volts
Plate Dissipation	2.5	watts
Cathode Current	15	mA
Grid Voltage	− 50	volts
Grid Voltage (Grid Current = + 0.3 uA)	− 1.3	volts
Grid Resistance[4]	1	megohm
Heater to Cathode Voltage	90	volts
Heater to Cathode Resistance	20,000	ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

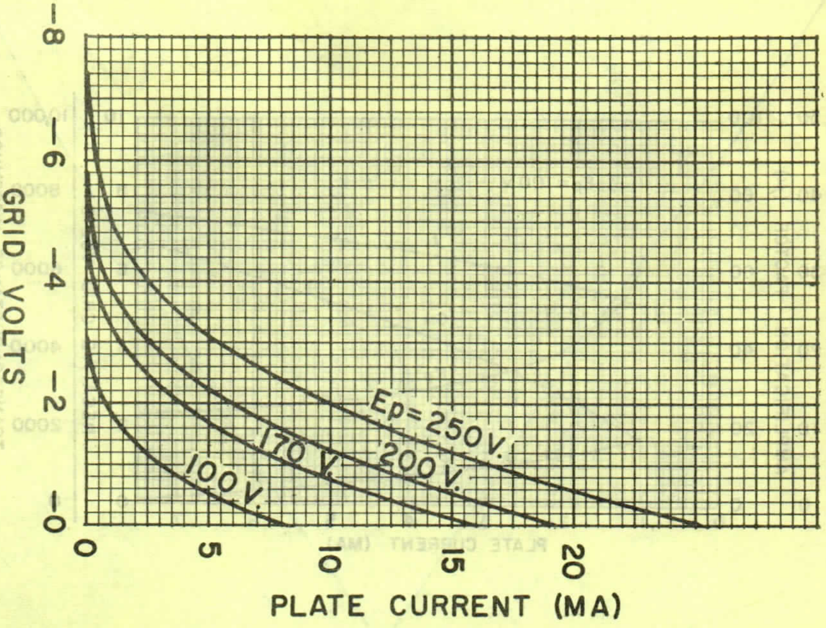
Plate Voltage	100	170	200	250	volts
Grid Voltage	− 1.0	− 1.0	− 1.0	− 2.0	volts
Plate Current	3.0	8.5	11.5	10.0	mA
Transconductance	3750	5900	6700	5500	micromhos
Amplification Factor	62	66	70	60	
Plate Resistance	16.5	11.0	10.5	11.0	K ohms





[4] **With self bias.**

12AT7/ECC81



GRID VOLTS
-8
-6
-4
-2
-0
Ep=250 V.
200 V.
170 V.
100 V.
0
5
10
15
20
PLATE CURRENT (MA)

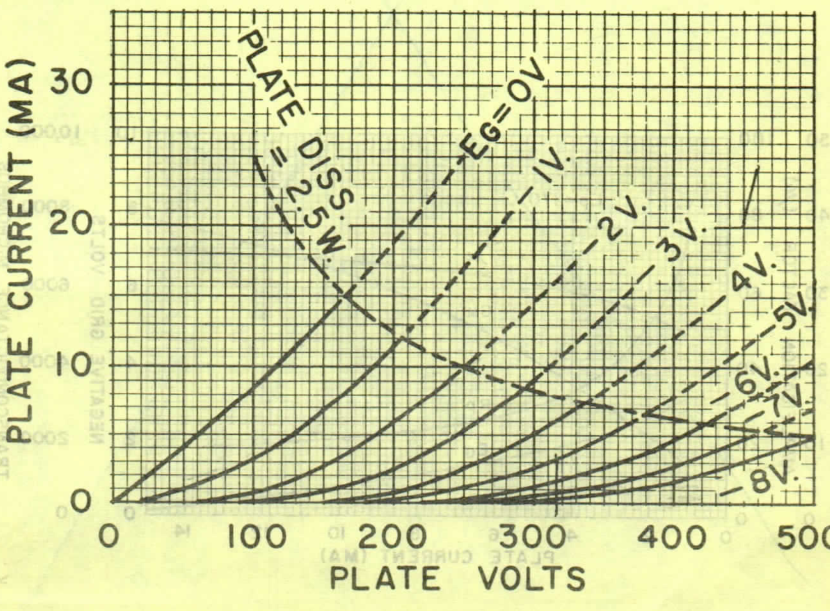
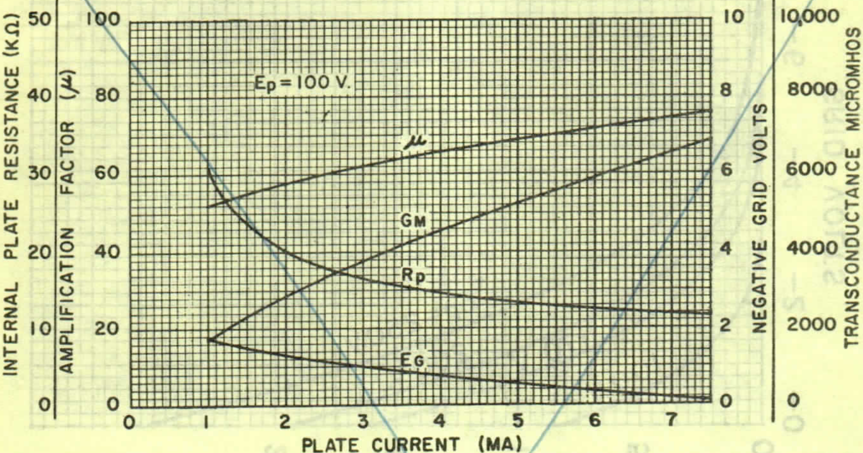
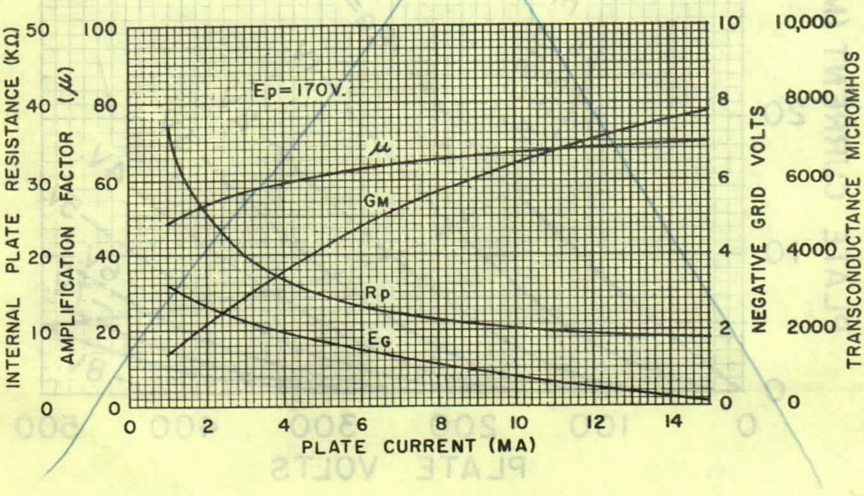


PLATE CURRENT (MA)
30
20
10
0
PLATE DISS.=2.5 W.
EG=OV
1V.
2V.
3V.
4V.
5V.
6V.
7V.
8V.
0
100
200
300
400
500
PLATE VOLTS

12AT7/ECC81


INTERNAL PLATE RESISTANCE (KΩ)
AMPLIFICATION FACTOR (μ)
Ep = 100 V.
μ
GM
Rp
EG
NEGATIVE GRID VOLTS
TRANSCONDUCTANCE MICROMHOS
PLATE CURRENT (MA)
0 1 2 3 4 5 6 7
0 10 20 30 40 50
0 20 40 60 80 100
0 2 4 6 8 10
0 2000 4000 6000 8000 10,000


INTERNAL PLATE RESISTANCE (KΩ)
AMPLIFICATION FACTOR (μ)
Ep = 170 V.
μ
GM
Rp
EG
NEGATIVE GRID VOLTS
TRANSCONDUCTANCE MICROMHOS
PLATE CURRENT (MA)
0 2 4 6 8 10 12 14
0 10 20 30 40 50
0 20 40 60 80 100
0 2 4 6 8 10
0 2000 4000 6000 8000 10,000

AMPEREX TUBE TYPE 12AU7/ECC82

The 12AU7/ECC82[1] is a miniature, low-gain, medium-mu twin triode, each section of which has an individual cathode connection. The construction of the 12AU7/ECC82 is such that noise and microphony are reduced to a minimum. Hum is reduced by use of a coiled tungsten heater. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	Coated, unipotential	
	Series	**Parallel**
Heater Voltage, AC or DC	12.6	6.3 volts
Heater Current[2]	0.15	0.3 amps
Direct Interelectrode Capacitances		
	With Shield[3]	**Without Shield**
Grid to Plate (each section)	1.6	1.6 uuf
Input (each section)	2.0	1.8 uuf
Output (Section 1)	2.1	00.5 uuf
Output (section 2)	2.1	0.37 uuf

MECHANICAL

Maximum Overall Dimensions	
Length	2 3/16 inches
Seated Height	1 15/16 inches
Diameter	7/8 inch
Mounting Position	any
Base	Small Button, 9 pin RETMA # 9A

[1] The 12AU7/ECC82 is a direct, high-quality replacement for other brands of the 12AU7.

[2] When used in equipment which employs series-connected heaters, a current-limiting device must be inserted to limit the current when switching on.

[3] With external shield (RETMA # 315) connected to cathode of section under test.

12AU7/ECC82

MAXIMUM RATINGS (Each Section)

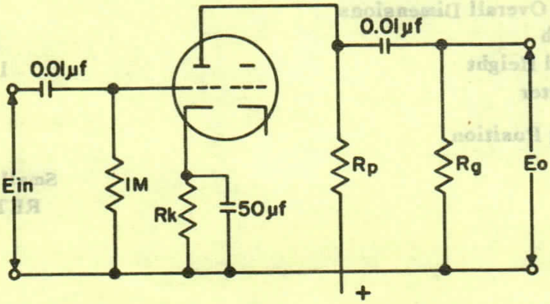
Design Center Values

Zero Signal Plate Voltage	550	volts
Plate Voltage	300	volts
Plate Dissipation	2.75	watts
Cathode Current	20	mA
Grid Voltage	−100	volts
Grid to Plate Voltage	−250	volts
Grid Voltage (Grid current = + 0.3 uA)	−1.3	volts
Grid Resistance [4]	1	megohm
Heater to Cathode Voltage	180	volts
Heater to Cathode Resistance	20,000	ohms
Heater to Cathode Resistance [5]	150,000	ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

Plate Voltage	100	250	volts
Grid Voltage	0	−8.5	volts
Amplification Factor	19.5	17	
Plate Resistance (approx.)	6250	7700	ohms
Transconductance	3100	2200	micromhos
Plate Current	11.8	10.5	mA



Rp = 0.047 MΩ
Rg = 0.15 MΩ

CLASS A RESISTANCE-COUPLED AMPLIFIER, EACH SECTION

[4] With self bias.

[5] In phase inverting circuits.

Rp = 0.047 MΩ   Rg = 0.15 MΩ   Rk = 1.2 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion [7]
100	1.20	11	13.5	5.6
150	1.82	18	1.35	6.1
200	2.41	26	13.5	6.3
250	3.02	34	13.5	6.4
300	3.65	43	13.5	6.5
350	4.30	51	13.5	6.6
400	5.00	59	13.5	6.7

Rp = 0.1 MΩ   Rg = 0.33 MΩ   Rk = 2.2 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion [7]
100	0.66	10	14	4.8
150	0.98	17	14	5.6
200	1.30	25	14	5.8
250	1.63	32	14	5.9
300	1.97	41	14	6.0
350	2.30	49	14	6.1
400	2.62	57	14	6.2

Rp = 0.22 MΩ   Rg = 0.68 MΩ   Rk = 3.9 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion [7]
100	0.33	8	14.5	4.0
150	0.50	15	14.5	4.4
200	0.66	22	14.5	4.7
250	0.82	28	14.5	4.8
300	0.98	36	14.5	4.9
350	1.16	43	14.5	5.0
400	1.31	50	14.5	5.1

[6] **Grid current = + 0.3 μA.**

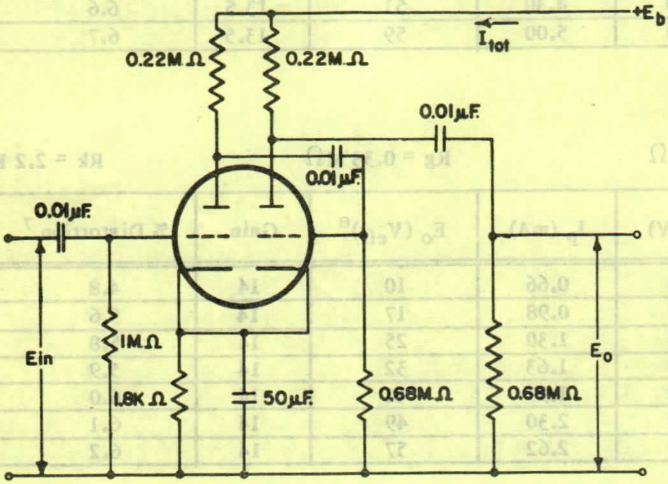
[7] **Approximately proportional to output voltage**

12AU7/ECC82

Class A Resistance - Coupled Amplifier

Two Sections in Cascade

Supply Voltage	250	350	volts
Total Current	1.66	2.33	mA
Output Voltage [6]	15	25	volts (RMS)
Gain	178	178	
Total Distortion [7]	2	2	%



APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 50 millivolts when the tube is mounted in the near vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%.

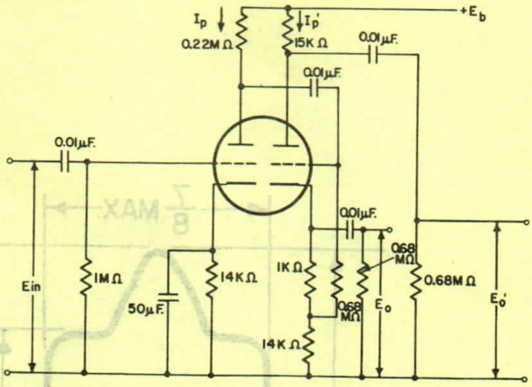
HUM

The hum and noise level will be better than −60 db when the grid circuit impedance is less than 0.3 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is decoupled by a capacitor of at least 100 uuf.

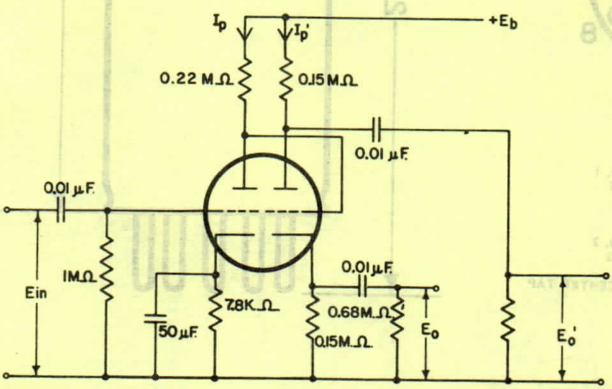
[6] **Grid current = + 0.3 μA.**

[7] **Approximately proportional to output voltage**

Operating Characteristics as a Phase Inverter



Supply Voltage	250	350	volts
Plate Current (I_p)	0.82	1.16	mA
Plate Current ($I_p{}'$)	4.5	6.3	mA
Output Voltage[6]	13	20	volts (RMS)
Voltage Gain	11	11	
Percent Distortion [7]	1.5	1.5	%

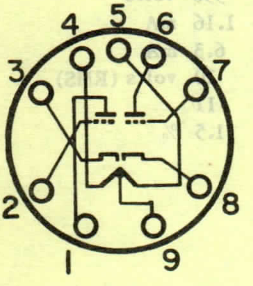


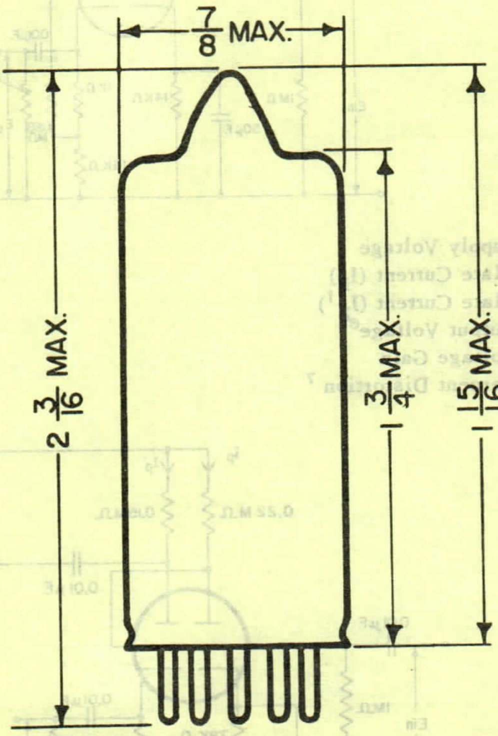
Supply Voltage	250	350	volts
Plate Current (I_p)	0.70	1.00	mA
Plate Current ($I_p{}'$)	0.68	0.93	mA
Output Voltage[6]	15	24	volts (RMS)
Voltage Gain	11	11	
Percent Distortion [7]	1.0	1.0	%

[6] **Grid Current = + 0.3 μA.**

[7] **Approximately proportional to output voltage.**

12AU7/ECC82

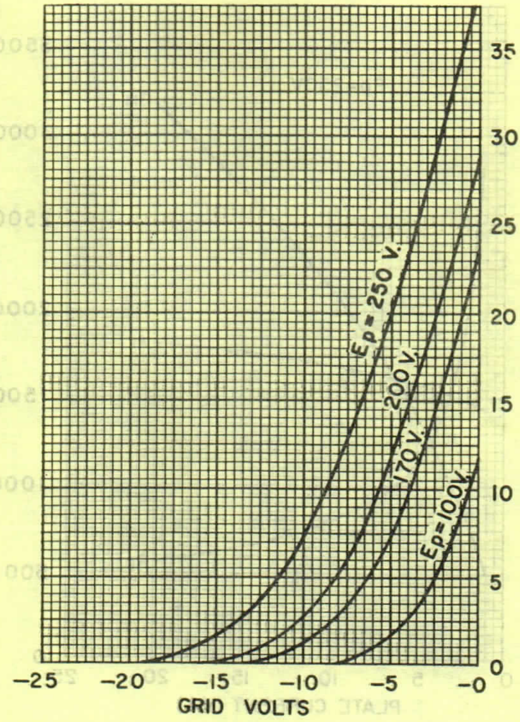


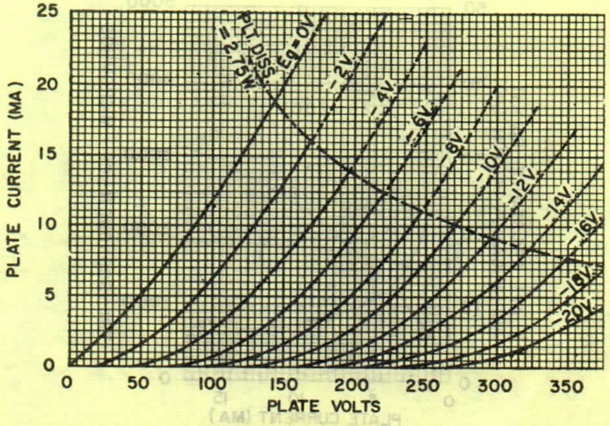


PIN CONNECTIONS

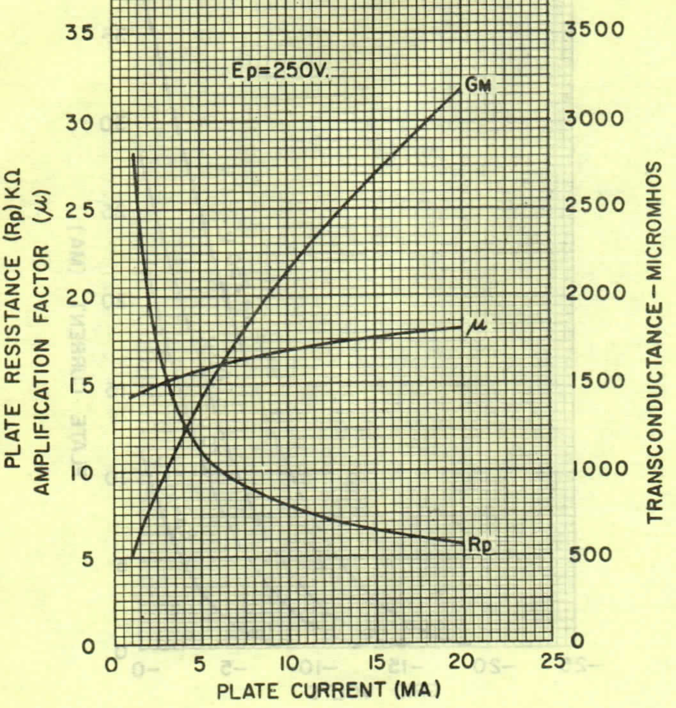
PIN NO. 1 = PLATE NO. 1
PIN NO. 2 = GRID NO. 1
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = PLATE NO. 2
PIN NO. 7 = GRID NO. 2
PIN NO. 8 = CATHODE
PIN NO. 9 = HEATER CENTER TAP

12AU7/ECC82

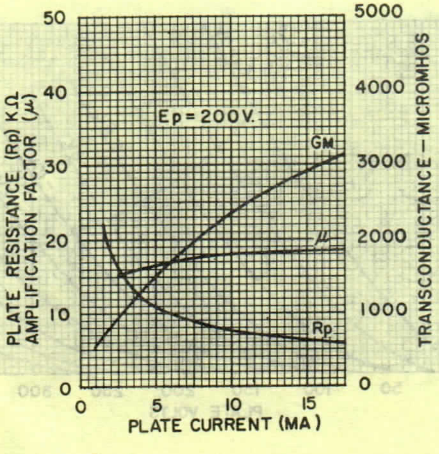

35
30
25
20
15
10
5
0
PLATE CURRENT (MA)
Ep=250 V.
200 V.
170 V.
Ep=100V.
−25
−20
−15
−10
−5
−0
GRID VOLTS


25
20
15
10
5
0
PLATE CURRENT (MA)
PLT. DISS. = 2.75W.
Eg=0V.
−2V.
−4V.
−6V.
−8V.
−10V.
−12V.
−14V.
−16V.
−18V.
−20V.
0
50
100
150
200
250
300
350
PLATE VOLTS

12AU7/ECC82



Ep=250V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE – MICROMHOS
PLATE CURRENT (MA)
0
5
10
15
20
25
30
35
500
1000
1500
2000
2500
3000
3500



Ep = 200V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE – MICROMHOS
PLATE CURRENT (MA)
0
10
20
30
40
50
1000
2000
3000
4000
5000
5
15

12AU7/ECC82

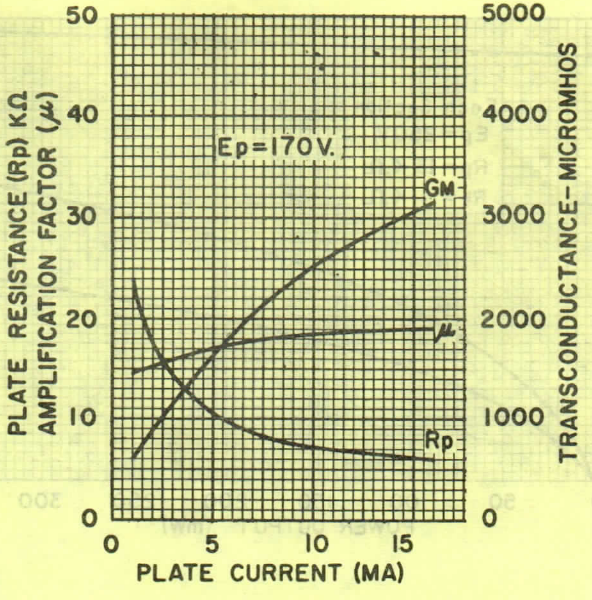


PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE–MICROMHOS
Ep=170V.
GM
μ
Rp
PLATE CURRENT (MA)
0
5
10
15
20
30
40
50
1000
2000
3000
4000
5000

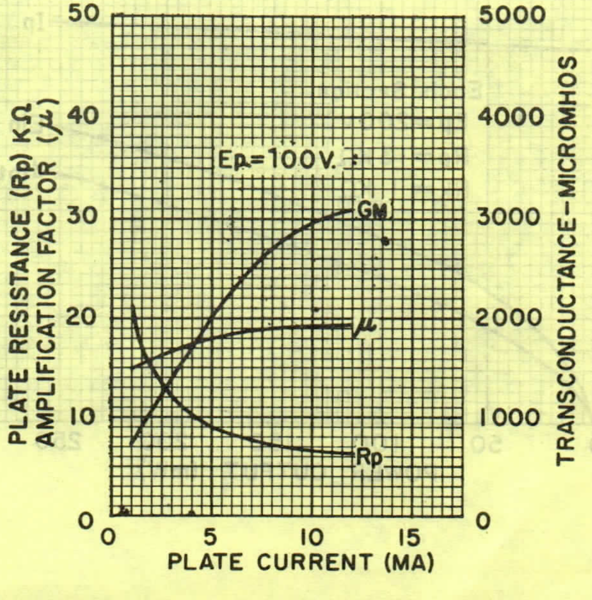
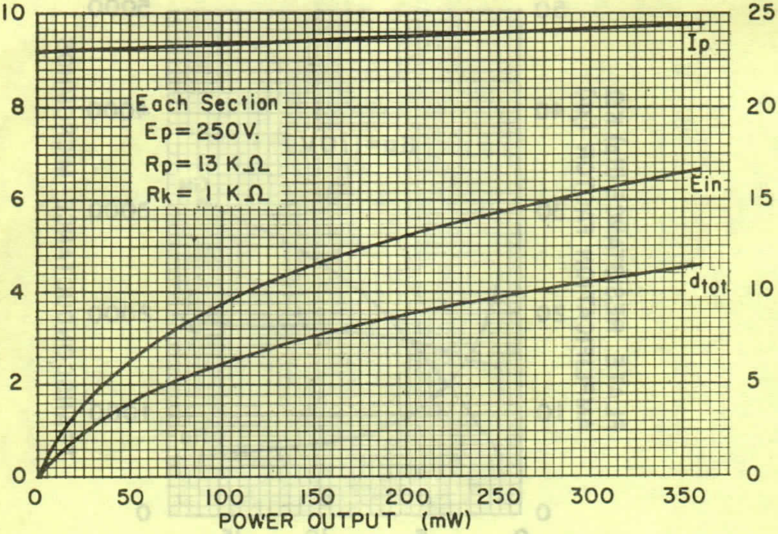
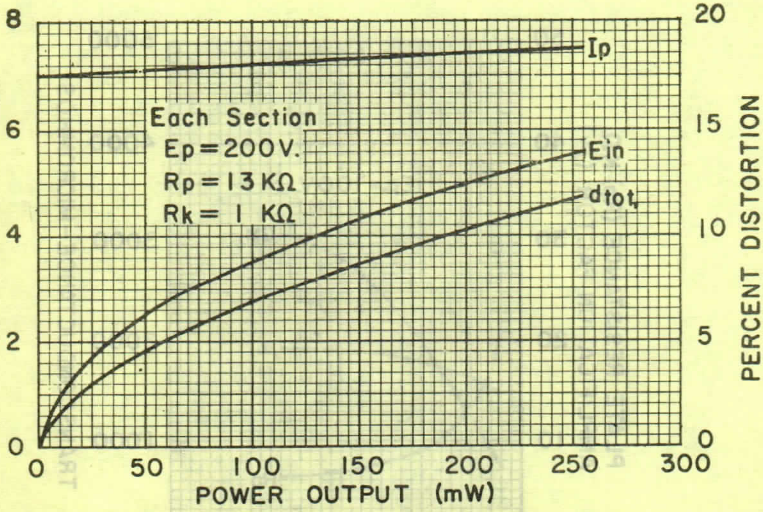


PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE–MICROMHOS
Ep=100V.
GM
μ
Rp
PLATE CURRENT (MA)
0
5
10
15
20
30
40
50
1000
2000
3000
4000
5000

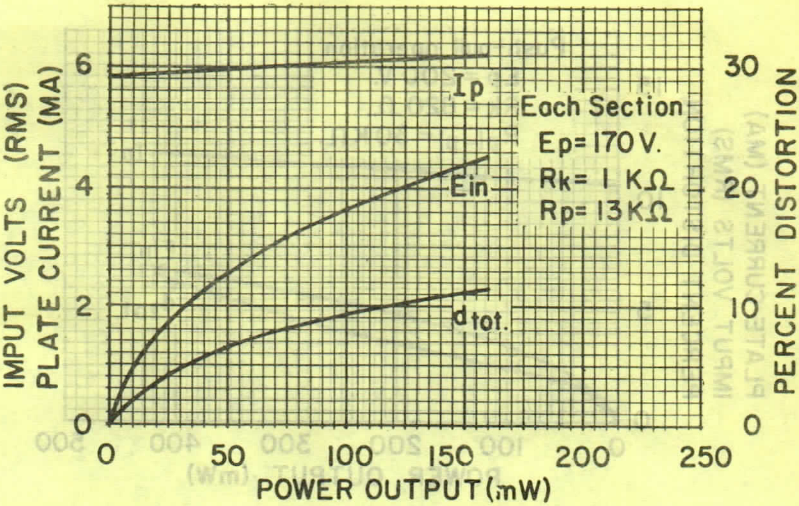
12AU7/ECC82

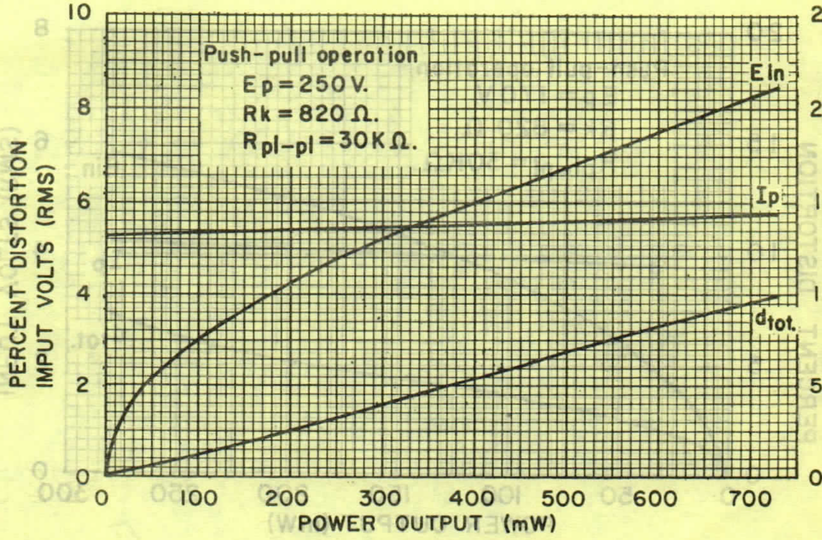


Each Section
Ep=250V.
Rp=13 KΩ
Rk=1 KΩ
Ip
Ein
dtot
IMPUT VOLTS—(RMS)
PLATE CURRENT-(MA)
PERCENT DISTORTION
POWER OUTPUT (mW)
0
2
4
6
8
10
0
5
10
15
20
25
0
50
100
150
200
250
300
350

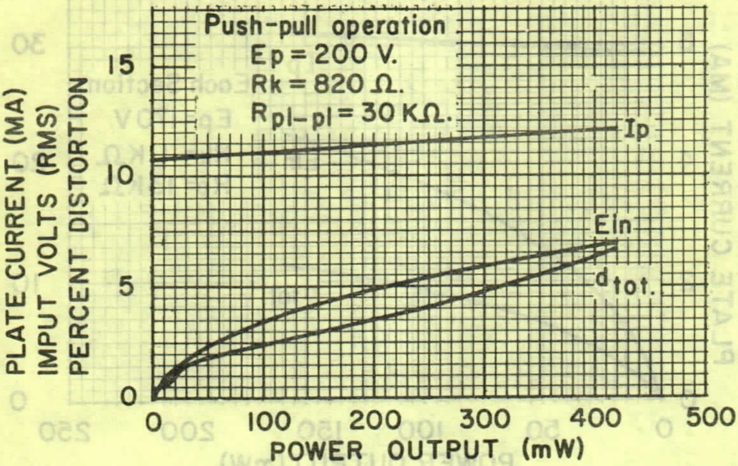


Each Section
Ep=200V.
Rp=13 KΩ
Rk=1 KΩ
Ip
Ein
dtot
PLATE CURRENT (MA)
IMPUT VOLTS—(RMS)
PERCENT DISTORTION
POWER OUTPUT (mW)
0
2
4
6
8
0
5
10
15
20
0
50
100
150
200
250
300

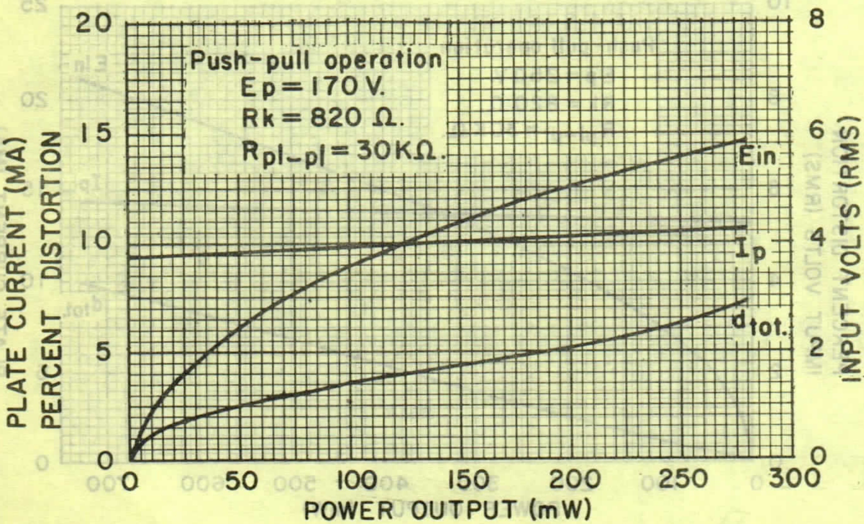

Ip
Each Section
Ep= 170 V.
Rk= 1 KΩ
Rp= 13 KΩ
Ein
dtot.
IMPUT VOLTS (RMS)
PLATE CURRENT (MA)
PERCENT DISTORTION
0
2
4
6
10
20
30
50
100
150
200
250
POWER OUTPUT (mW)


Push-pull operation
Ep = 250 V.
Rk = 820 Ω.
Rpl-pl = 30 K Ω.
Ein
Ip
dtot.
PERCENT DISTORTION
IMPUT VOLTS (RMS)
PLATE CURRENT (MA)
0
2
4
6
8
10
5
10
15
20
25
100
200
300
400
500
600
700
POWER OUTPUT (mW)

12AU7/ECC82



Push-pull operation
Ep = 200 V.
Rk = 820 Ω.
Rpl-pl = 30 KΩ.
PLATE CURRENT (MA)
IMPUT VOLTS (RMS)
PERCENT DISTORTION
0
5
10
15
Ip
Ein
dtot.
0
100
200
300
400
500
POWER OUTPUT (mW)



Push-pull operation
Ep = 170 V.
Rk = 820 Ω.
Rpl-pl = 30 KΩ.
PLATE CURRENT (MA)
PERCENT DISTORTION
0
5
10
15
20
INPUT VOLTS (RMS)
0
2
4
6
8
Ein
Ip
dtot.
0
50
100
150
200
250
300
POWER OUTPUT (mW)

AMPEREX TUBE TYPE 12AX7/ECC83

The 12AX7/ECC83[1] is a miniature, high-mu twin triode, each section of which has an individual cathode connection. The construction of the 12AX7/ECC83 is such that noise and microphony are reduced to a minimum. Hum is reduced by the use of a coiled tungsten heater. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt heater supply.

The 12AX7/ECC83 is particularly suited for use in resistance - coupled voltage amplifiers such as those used in the preamplifier and input stages of Hi-Fi amplifiers, phase inverters, multivibrators and numerous industrial control circuits where high voltage gain is desired.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	Coated, unipotential	
	Series	Parallel
Heater Voltage, AC or DC	12.6	6.3 volts
Heater Current[2]	0.15	0.3 amps
Direct Interelectrode Capacitances		
	With Shield[3]	Without Shield
Grid to Plate (each section)	1.7	1.7 uuf
Input (each section)	1.8	1.6 uuf
Output (section 1)	1.9	0.46 uuf
Output (section 2)	1.9	0.34 uuf

MECHANICAL

Maximum Overall Dimensions	
Length	2 3/16 inches
Seated Height	1 15/16 inches
Diameter	7/8 inch
Mounting Position	any
Base	Small button, 9 pin RETMA #9A

1 The 12AX7/ECC83 is a direct, high-quality replacement for other brands of the 12AX7.

2 When used in equipment which employs series - connected heaters, a current-limiting device must be inserted to limit the current when switching on.

3 With external shield (RETMA #315) connected to cathode of section under test.

12AX7/ECC83

MAXIMUM RATINGS (Each Section)

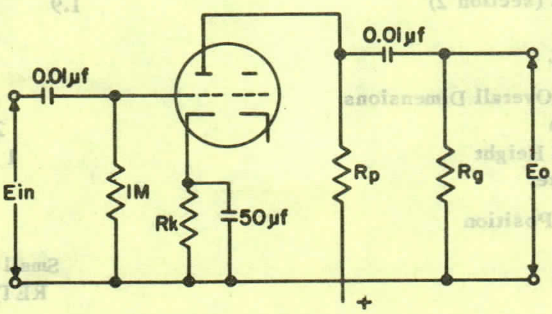
Design Center Values

Zero Signal Plate Voltage	550	volts
Plate Voltage	300	volts
Plate Dissipation	1.0	watt
Cathode Current	8	mA
Grid Voltage	−50	volts
Grid Voltage (Grid current = + 0.3 uA)	−1.3	volts
Grid Resistance [4]	2	megohms
Heater to Cathode Voltage	180	volts
Heater to Cathode Resistance	20,000	ohms
Heater to Cathode Resistance [5]	150,000	ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

Plate Voltage	100	250	volts
Grid Voltage	− 1.0	−2.0	volts
Amplification Factor	100	100	
Plate Resistance (approx.)	80,000	62,500	ohms
Transconductance	1250	1600	micromhos
Plate Current	0.5	1.2	mA



Rp = 0.047 MΩ
Rg = 0.15 MΩ

CLASS A RESISTANCE-COUPLED AMPLIFIER, EACH SECTION

4 With self bias.

5 In phase inverting circuits.

12AX7/ECC83

Rp = 0.047 MΩ   Rg = 0.15 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
200	1500	0.86	18	34	8.5
250	1200	1.18	23	37.5	7.0
300	1000	1.55	26	40	5.0
350	820	1.98	33	42.5	4.4
400	680	2.45	37	44	3.6

Rp = 0.1 MΩ   Rg = 0.33 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (Veff)[6]	Gain	% Distortion[7]
200	1800	0.65	20	50	4.8
250	1500	0.86	26	54.5	3.9
300	1200	1.11	30	57	2.7
350	1000	1.40	36	61	2.2
400	820	1.72	38	63	1.7

Rp = 0.22 MΩ   Rg = 0.68 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
200	3300	0.36	24	56	4.6
250	2700	0.48	28	66.5	3.4
300	2200	0.63	36	72	2.6
350	1500	0.85	37	75.5	1.6
400	1200	1.02	38	76.5	1.1

6 E_o at grid current starting point.

7 The total harmonic distortion is approximately proportional to the output voltage

12AX7/ECC83

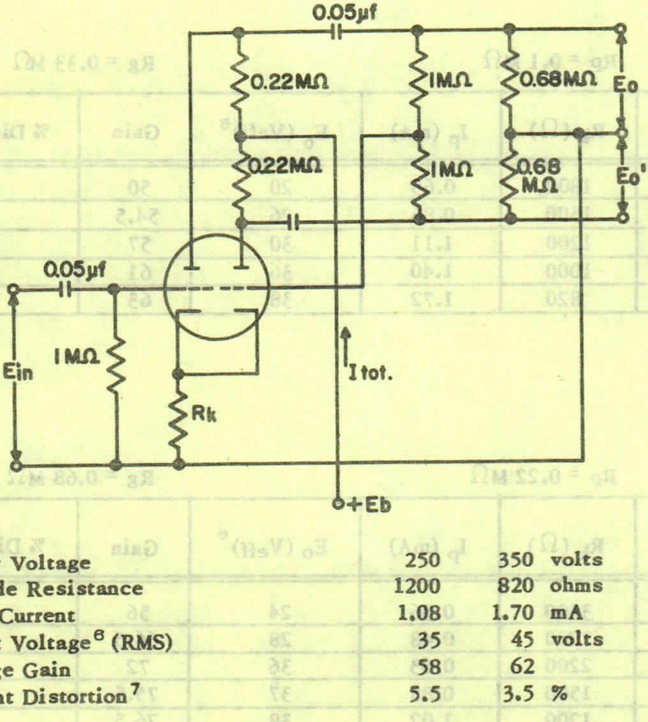
APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 50 millivolts when the tube is mounted in the near vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%.

HUM

The hum and moise level will be better than - 60 db when the grid circuit impedance is less than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is decoupled by a capacitor of at least 100 uf.

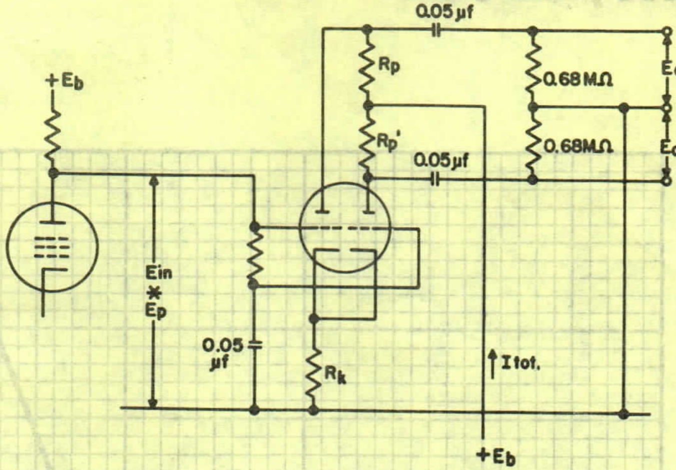


Supply Voltage	250	350	volts
Cathode Resistance	1200	820	ohms
Total Current	1.08	1.70	mA
Output Voltage[6] (RMS)	35	45	volts
Voltage Gain	58	62	
Percent Distortion[7]	5.5	3.5	%

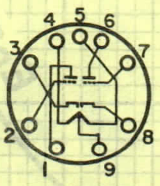
[6] E_o at grid current starting point.

[7] The total harmonic distortion is approximately proportional to the output voltage.

12AX7/ECC83

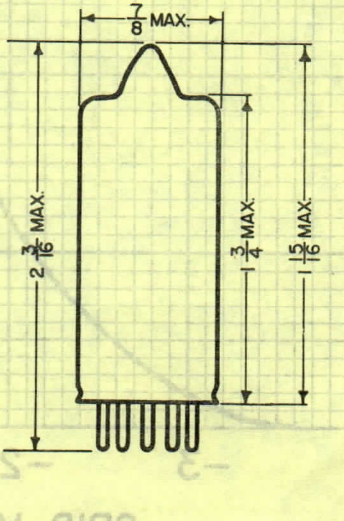


Supply Voltage	250	350	volts
Plate Voltage *	65	90	volts
Total Current	1.0	1.2	mA
Cathode Resistance	68,000	82,000	ohms
Plate Load Resistance (R_p)	0.1	0.15	megohm
Plate Load Resistance (R_p')	0.1	0.15	megohm
Output Voltage[6] (RMS)	20	35	volts
Voltage Gain	25	27	
Percent Distortion[7]	1.8	1.8	%



PIN CONNECTIONS

PIN NO. 1 = PLATE NO. 1
PIN NO. 2 = GRID NO. 1
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = PLATE NO. 2
PIN NO. 7 = GRID NO. 2
PIN NO. 8 = CATHODE
PIN NO. 9 = HEATER CENTER TAP



6 E_o at grid current starting point.

7 The total harmonic distortion is approximately proportional to the output voltage.

12AX7/ECC83

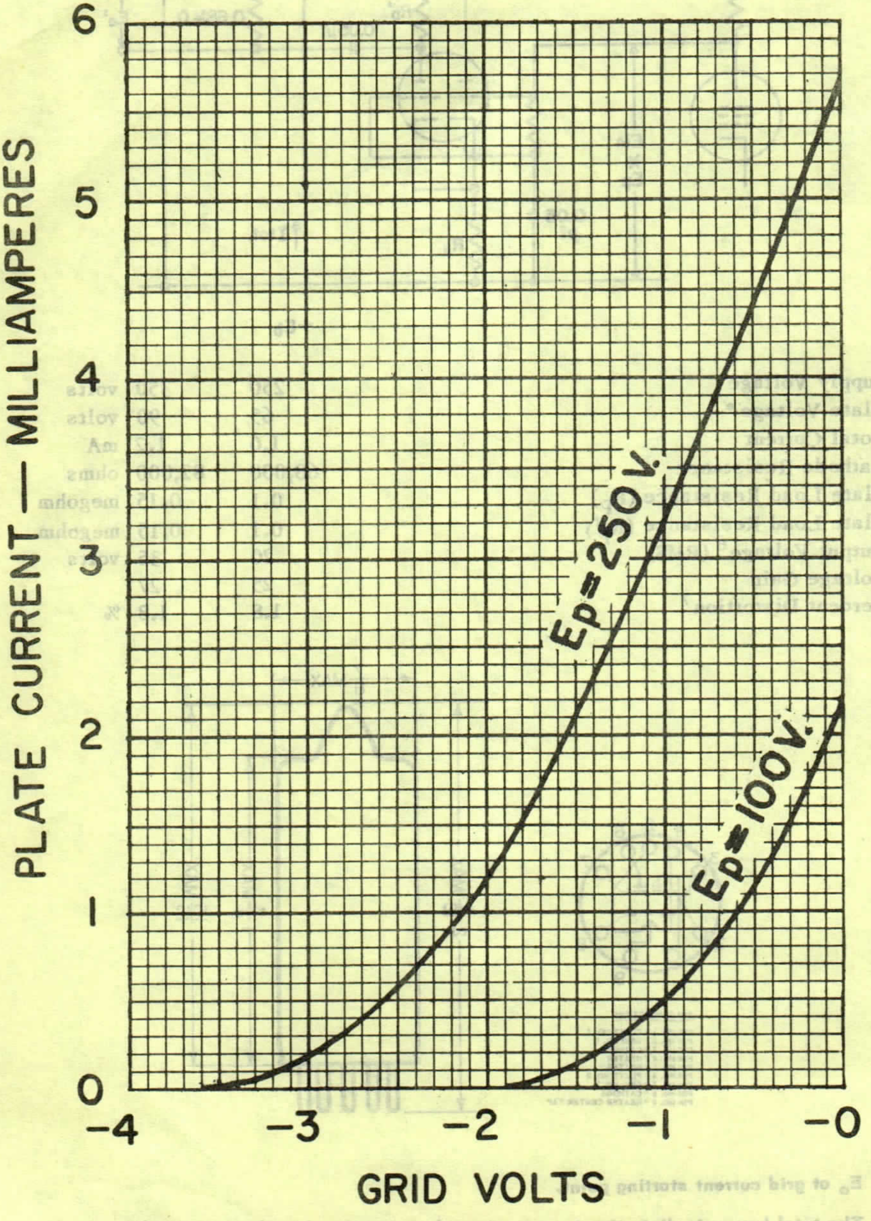
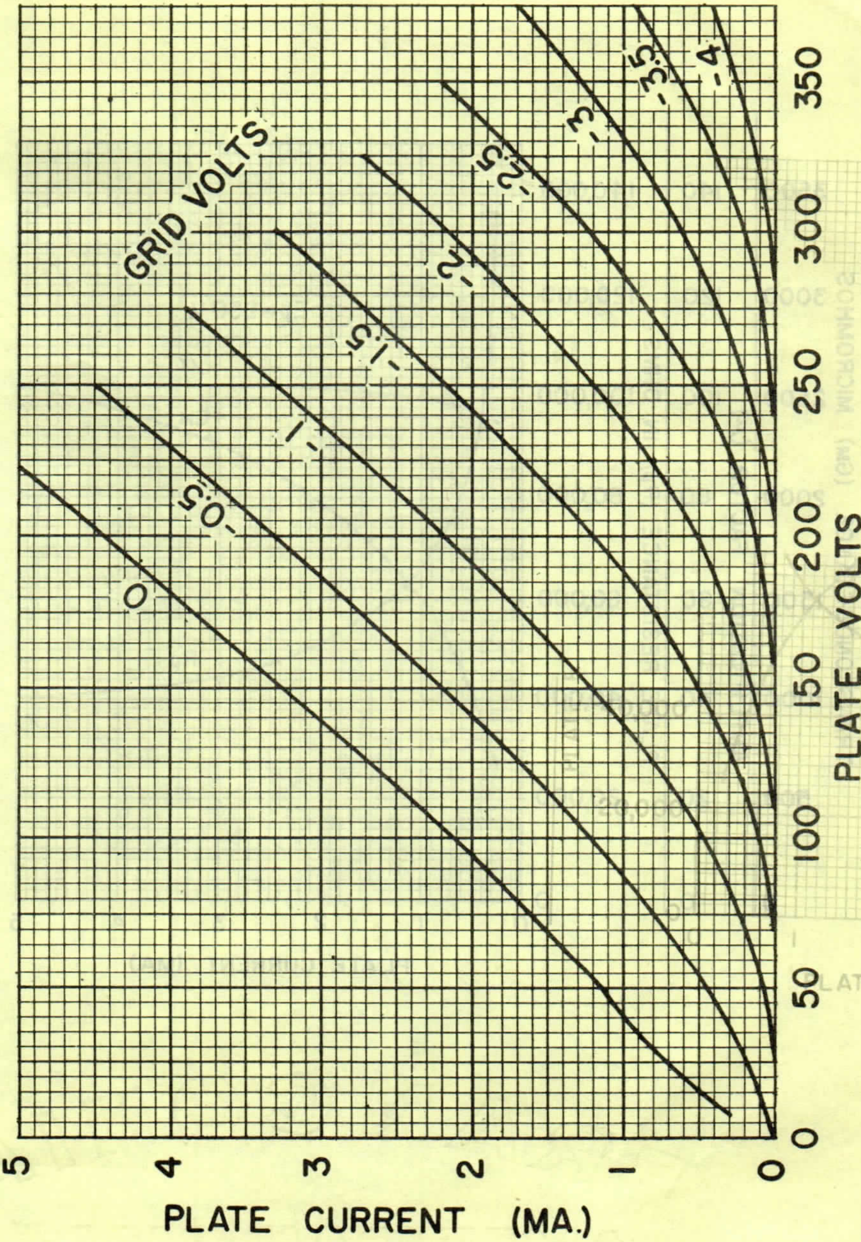
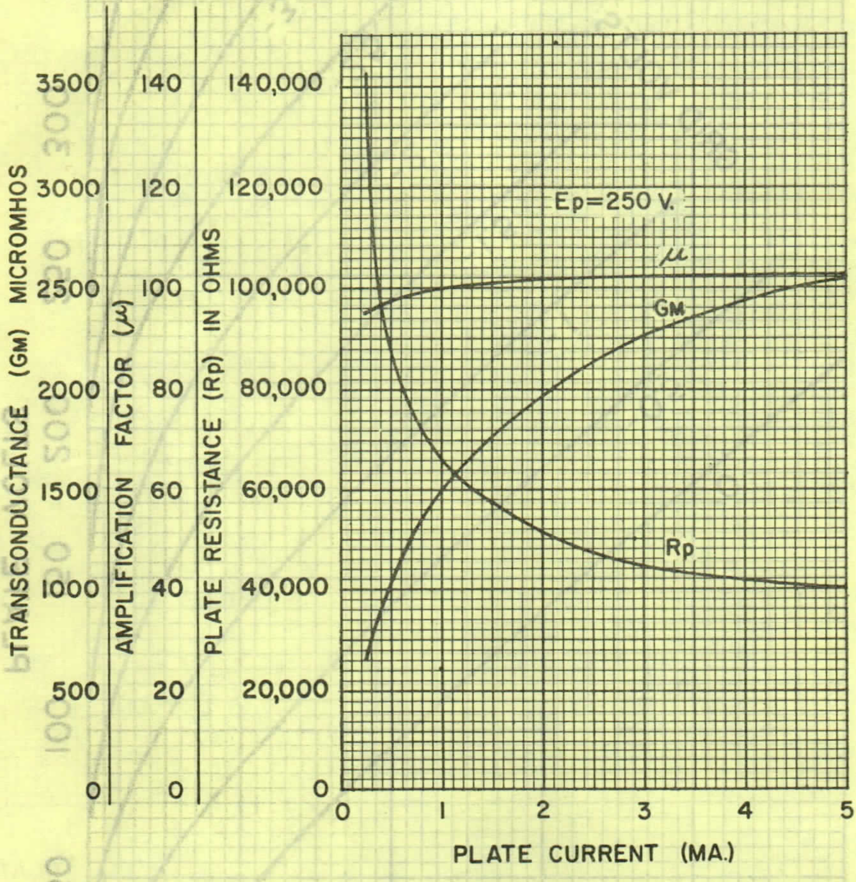


PLATE CURRENT — MILLIAMPERES
6
5
4
3
2
1
0
Ep=250 V.
Ep=100 V.
−4
−3
−2
−1
−0
GRID VOLTS

12AX7/ECC83

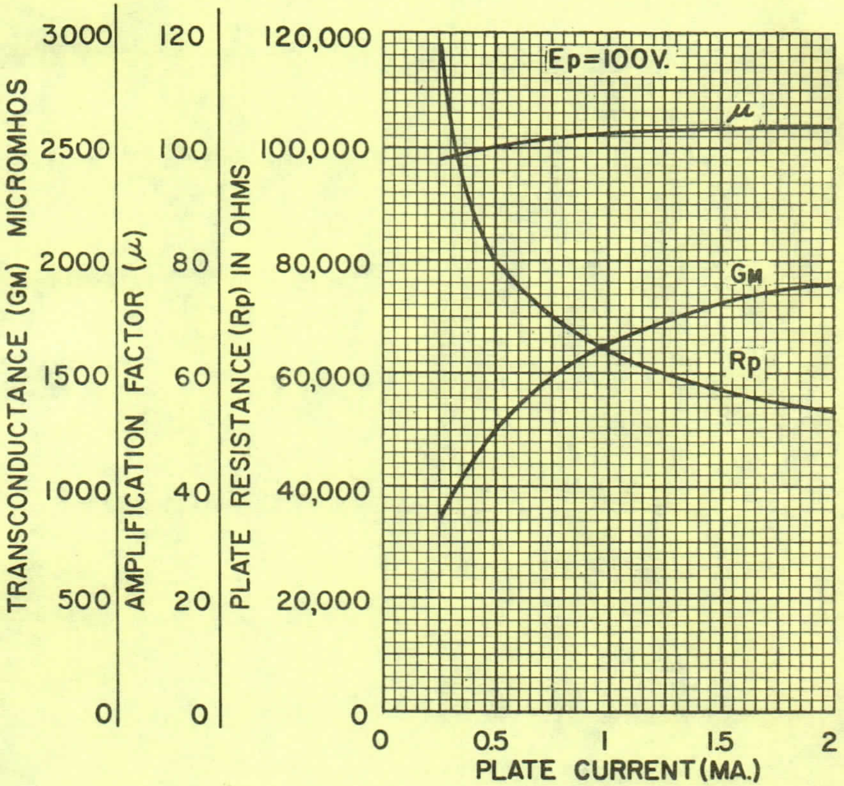

GRID VOLTS
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
PLATE VOLTS
0
50
100
150
200
250
300
350
PLATE CURRENT (MA.)
5
4
3
2
1
0

12AX7/ECC83



TRANSCONDUCTANCE (GM) MICROMHOS
AMPLIFICATION FACTOR (μ)
PLATE RESISTANCE (Rp) IN OHMS
3500 140 140,000
3000 120 120,000
2500 100 100,000
2000 80 80,000
1500 60 60,000
1000 40 40,000
500 20 20,000
0 0 0
0 1 2 3 4 5
PLATE CURRENT (MA.)
Ep=250 V.
μ
GM
Rp

12AX7/ECC83


TRANSCONDUCTANCE (GM) MICROMHOS
3000
2500
2000
1500
1000
500
0
AMPLIFICATION FACTOR (μ)
120
100
80
60
40
20
0
PLATE RESISTANCE (Rp) IN OHMS
120,000
100,000
80,000
60,000
40,000
20,000
0
Ep=100V.
μ
GM
Rp
0
0.5
1
1.5
2
PLATE CURRENT (MA.)

AMPEREX TUBE TYPE 15CW5

The Amperex 15CW5 is a high current low voltage output pentode designed for 300 ma series string operation in medium power Hi-Fi amplifiers. A pair of tubes in class AB_1 push-pull operation yields an output up to 25 watts with only 1% distortion (without feedback).

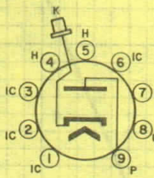
The 15CW5 is also useful in single ended push-pull circuits because of its highly efficient operation with relatively low supply voltage. In a typical transformerless circuit a pair of 15CW5 tubes can deliver up to 10 watts in class AB_1.

This tube is identical to the 6CW5 except for the following characteristics.

Heater Arrangement	series supply
Heater Voltage	15 volts
Heater Current	300 ma

AMPEREX TUBE TYPE 16AQ3

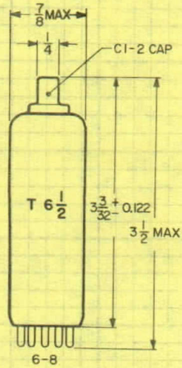
The Amperex 16AQ3 is a damper diode designed for use in television receiver horizontal sweep circuits.



PIN CONNECTIONS

1. INTERNALLY CONNECTED
2. INTERNALLY CONNECTED
3. INTERNALLY CONNECTED
4. HEATER
5. HEATER
6. INTERNALLY CONNECTED
7. INTERNALLY CONNECTED
8. INTERNALLY CONNECTED
9. PLATE

CAP-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T 6-1/2
Base	Noval
Outline	6-8

ELECTRICAL

Heating	series supply
Heater Voltage	16.4 volts
Heater Current	600 ma
Direct Interelectrode Capacitances	
Plate to All Other Elements	8.6 pf
Cathode to Heater	2.0 pf

MAXIMUM RATINGS, DESIGN CENTER VALUES

Plate Voltage, Cut-Off Condition	550 volts
Plate Voltage	250 volts
Plate Current	220 ma
Peak Plate Current	550 ma
Plate Dissipation	5 watts
Peak Plate-Cathode Voltage (cathode positive)[1]	6000 volts
Peak Plate-Cathode Voltage (cathode positive)[1,2]	7500 volts
Peak Heater-Cathode Voltage[1]	6600 volts

[1] Maximum pulse duration 22% of a cycle with a maximum of 18 μsec.

[2] Absolute maximum.

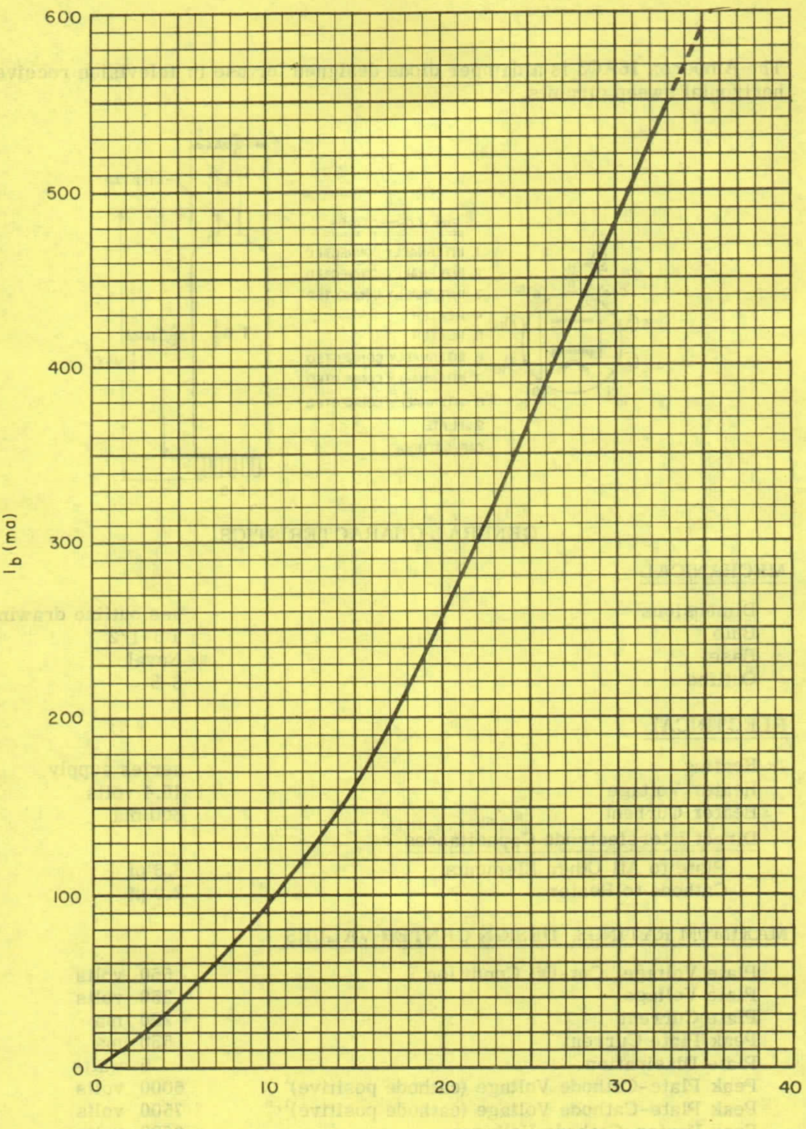


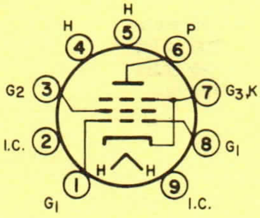
Figure 1. Plate Characteristics

AMPEREX TUBE TYPE 17KW6

This tube is designed to be used as an output pentode in the vertical deflection circuits of color TV receivers.

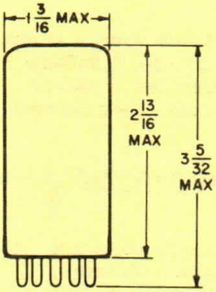
QUICK REFERENCE DATA

Plate Voltage	400 volts max.
Peak Plate Voltage	2,500 volts max.
Plate Dissipation	12 watts max.
Grid No. 2 Dissipation	2.5 watts max.
Cathode Current	100 ma max.



PIN CONNECTIONS

1-GRID NO.1
2-INTERNAL CONNECTION
3-GRID NO.2
4-HEATER
5-HEATER
6-PLATE
7-GRID NO.3, CATHODE
8-GRID NO.1
9-INTERNAL CONNECTION



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	Magnoval

ELECTRICAL

Heater Supply	indirect AC or DC series supply
Heater Voltage	17.0 volts
Heater Current	300 ma

Direct Interelectrode Capacitances

Grid No. 1 to Heater	< 200 mpf
Anode to Grid No. 1	1.8 pf

TYPICAL CHARACTERISTICS (measured under pulse conditions)

Anode Voltage	190 volts
Grid No. 2 Voltage	190 volts
Grid No. 1 Voltage	-17 volts
Anode Current	60 ma
Grid No. 2 Current	4.5 ma

OPERATING CHARACTERISTICS

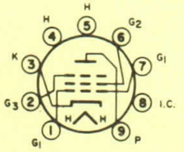
Anode Voltage at End of Scan	70 volts
Grid No. 2 Voltage	200 volts
Grid No. 1 Voltage	-5 volts
Peak Anode Current	230 ma

LIMITING VALUES (design center rating system)

Anode Voltage in Cold Condition	700 volts
Anode Voltage	400 volts
Peak Anode Voltage	2,500 volts
Anode Dissipation	12 watts
Grid No. 2 Voltage in Cold Condition	700 volts
Grid No. 2 Voltage	275 volts
Grid No. 2 Dissipation	3.5 watts
Cathode Current	100 ma
Cathode to Heater Voltage	220 volts
Grid No. 1 Circuit Resistance	1 megohm

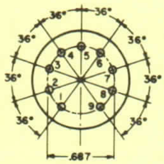
AMPEREX TUBE TYPE 19KF6

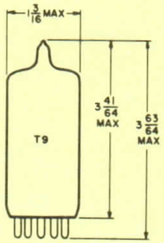
The Amperex 19KF6 is an output pentode designed for use in horizontal deflection stages of TV receivers with low supply voltage (135 VDC).



PIN CONNECTIONS

1- GRID NO.1
2- GRID NO.3
3- CATHODE
4- HEATER
5- HEATER
6- GRID NO.2
7- GRID NO.1
8- INTERNAL CONNECTION
9- PLATE





GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Bulb	T-9
Dimensions	see outline drawing
Mounting Position	any

ELECTRICAL

Heating	indirect AC or DC, parallel supply
Heater Voltage	19.5 volts
Heater Current	450 ma

MAXIMUM RATINGS

	Design Center	Design Maximum	Units
Peak Plate Voltage	5000	5500	volts
Grid No. 2 Voltage (Zero Current)	550	600	volts
Grid No. 2 Voltage	250	275	volts
Plate Dissipation	12 (or 8)	17 (or 11)	watts
Grid No. 2 Dissipation	4 (or 5)	5 (or 6)	watts
Cathode Current	320	350	ma
Cathode to Heater Voltage	220	240	volts
Grid No. 1 Resistor[1]	0.5	0.55	megohm

[1] For line output circuits Grid No. 1 resistor is 2.2 megohms (design center) and 2.4 megohms (design maximum).

19KF6

TYPICAL CHARACTERISTICS (Instantaneous Values)

Plate Voltage	130 volts
Grid No. 2 Voltage	130 volts
Grid No. 3 Voltage	0 volt
Grid No. 1 Voltage	0 volt
Plate Current	650 ma
Grid No. 2 Current	30 ma

OPERATING CHARACTERISTICS (Instantaneous Values, Drive Below Knee)

Plate Voltage	40 volts
DC Grid No. 2 Supply Voltage	135 volts
Grid No. 2 Resistance[2]	820 ohms
Grid No. 3 Voltage[3]	0 volt
Grid No. 1 Voltage	0 volt
Plate Current	450 ma
Maximum Negative Grid No. 1 Voltage with: Plate Voltage = 5000V, Grid No. 2 Voltage = 135V, Plate Current = 40 μa	100 volts

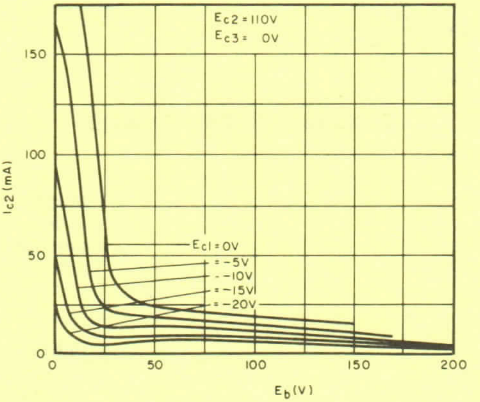


Figure 1. Screen Characteristics

[2] To prevent excessive Grid No. 1 Dissipation during warm-up the following minimum values of R_{g2} are required.

Plate Supply	Grid No. 2 Resistor
135V	820 ohms
170V	1200 ohms
230V	2200 ohms

[3] For optimum suppression of Barkhausen oscillations or snivets the beam plates may be connected to a voltage of +20 volts.

The current to these beam plates is dependent on the plate load and may vary as a function of the beam current in the picture tube.

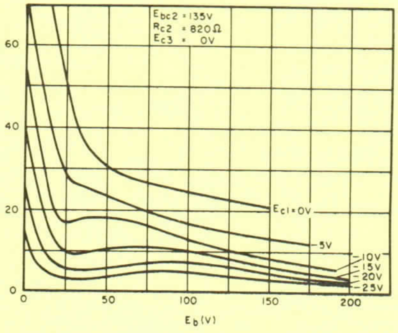


Figure 2. Screen Characteristics

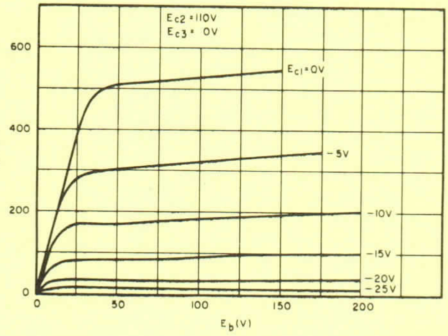


Figure 3. Plate Characteristics

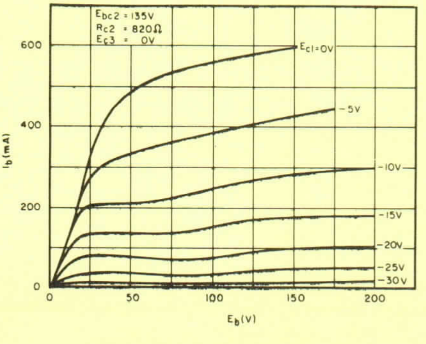


Figure 4. Plate Characteristics

AMPEREX TUBE TYPE 20AQ3

The Amperex 20AQ3 has the same electrical characteristics as the Amperex 6AL3 except that it is designed for 450 ma controlled warm-up series string operation.

The heater characteristics are:

Heater Voltage	20.2 volts ± 10%
Heater Current	450 ma

AMPEREX TUBE TYPE 27GB5

TENTATIVE DATA

The 27GB5 is an all-glass beam power pentode designed for use in horizontal deflection output stages of TV receivers. It features a large plate to screen grid current ratio. The 27GB5 has an enlarged noval base: the magnoval base.

The 27GB5 is electrically identical to the Amperex 6GB5 except for the following heater characteristics:

Heating	series supply
Heater Voltage	27 volts
Heater Current	300 ma

AMPEREX TUBE TYPE 27KG6

The 27KG6 is an output pentode designed for use in horizontal deflection circuits of color television receivers operating at supply voltages of 240 to 270 volts. It is identical to the 40KG6 except for heater characteristics.

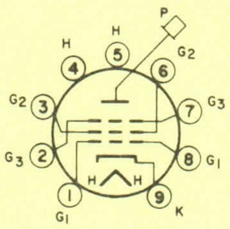
Heater Voltage	26.7 volts
Heater Current	450 ma

The 28EC4 is a damper diode for use in horizontal deflection circuits of color TV receivers. It is identical to the 42EC4 except for heater characteristics.

Heater Voltage	28 volts
Heater Current	450 ma

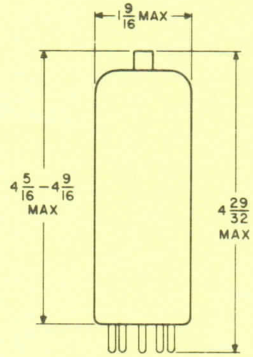
AMPEREX TUBE TYPE 40KG6

The Amperex 40KG6 is an output pentode specifically designed for use in horizontal deflection circuits of color television receivers operating at supply voltages of 240 to 270 volts.



PIN CONNECTIONS

1- GRID NO.1
2- GRID NO.3
3- GRID NO.2
4- HEATER
5- HEATER
6- GRID NO.2
7- GRID NO.3
8- GRID NO.1
9- CATHODE
P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Dimensions	see outline drawing

ELECTRICAL

Heating	indirect by AC or DC, series supply
Heater Voltage	40 volts
Heater Current	300 ma
Interlectrode Capacitances	
Plate to Grid No. 1	2.5 pf
Grid No. 1 to Heater	200 nf

MAXIMUM RATINGS

Plate Voltage (Zero Current)	700 volts
Peak Plate Voltage	7000 volts
Grid No. 2 Voltage (Zero Current)	700 volts
Grid No. 2 Voltage	250 volts
Plate Dissipation[1]	34 watts
Grid No. 2 Dissipation	7 watts
Cathode Current	500 ma
Cathode to Heater Voltage	250 volts
Grid No. 1 Resistance	
Fixed Bias	0.25 megohm
Stabilized Circuits	2.2 megohms

[1] A plate dissipation of 34 watts should not be exceeded under the worst probable operating conditions at normal picture width.

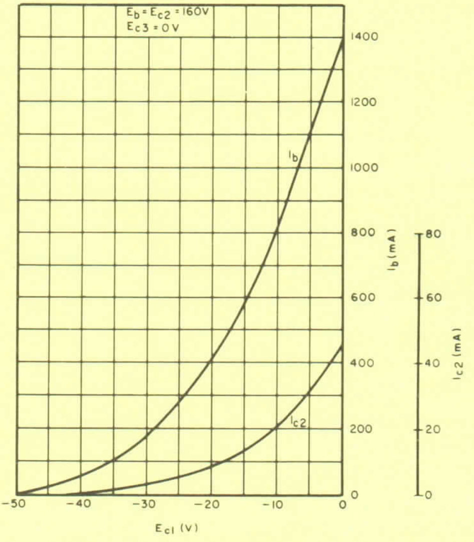
40KG6

TYPICAL CHARACTERISTICS[2]

Plate Voltage	160	45 volts
Grid No. 2 Voltage	160	160 volts
Grid No. 1 Voltage	0	0 volts
Plate Current	1400	1000 (min.) ma
Grid No. 2 Current	45	-- ma
Grid No. 3 Voltage	0	0 volts

TYPICAL OPERATION[3]

Plate Voltage (End of Scan)[4]	60V + 0.1 V_b
Peak Plate Current	1 amp
Plate Current	440 ma
Grid No. 2 Current	40 ma
Grid No. 2 Voltage	175 volts
Grid No. 3 Voltage[5]	0 volts



[2] In order not to exceed the maximum ratings for Plate and Grid No. 2 Dissipation, these characteristics should be measured under pulse conditions.

[3] The minimum required cut off voltage during flyback is 170 volts at:

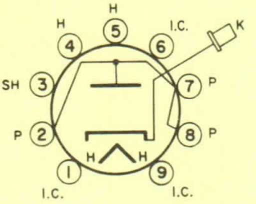
Plate Voltage	=	7000 volts
Grid No. 2 Voltage	=	175 volts
Grid No. 1 Impedance	=	1 k ohm at horizontal frequency.

[4] The value $0.1V_b$ is included to allow for 10% variation of the supply voltage. When selecting supply voltage care should be taken not to exceed the maximum rated plate cut off voltage.

[5] For optimum suppression of Barkhausen oscillations and snivets, the beam plates may be connected to a voltage of +15 volts.

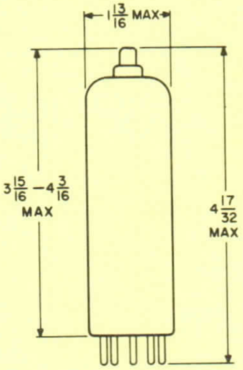
AMPEREX TUBE TYPE 42EC4

The Amperex 42EC4 is a damper diode for use in horizontal deflection circuits of color TV receivers operating at supply voltages of 240 to 270 volts.



PIN CONNECTIONS

1- INTERNAL CONNECTION
2- PLATE
3- SHIELD
4- HEATER
5- HEATER
6- INTERNAL CONNECTION
7- PLATE
8- PLATE
9- INTERNAL CONNECTION
K- CAP-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Base	magnoval
Dimensions	see outline drawing

ELECTRICAL

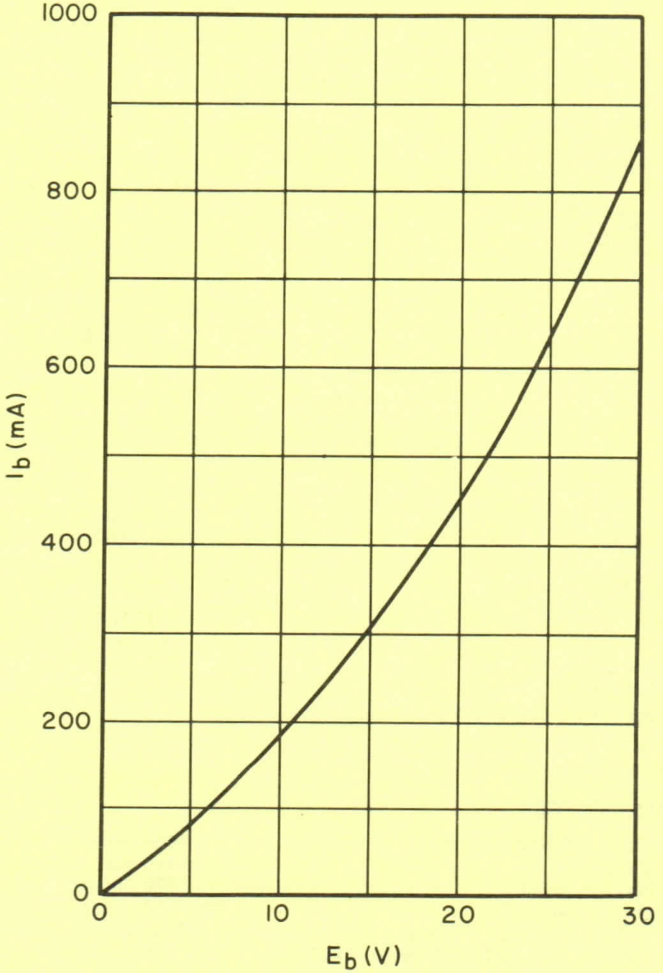
Heating[1]	indirect by AC or DC, series supply
Heater Voltage	42 volts
Heater Current	300 ma
Interelectrode Capacitances	
Plate to Cathode Capacitance	13.5 pf
Cathode to Heater	3.7 pf

MAXIMUM RATINGS

Peak Plate to Cathode Voltage[2]	5600 volts
Plate Current	440 ma
Peak Plate Current	800 ma
Plate Dissipation	11 watts
Peak Cathode to Heater Voltage[2]	6300 volts
Diode Resistance at Plate Current = 440 ma	45 ohms

[1] The minimum resistance between any heater pin of a heater chain and the supply should be 100 ohms. This resistance may entirely or partially consist of the hot resistance of a part of the heater chain.

[2] Maximum pulse duration is 22% of one cycle and 18 μsec.



1000
800
600
400
200
0
I_b (mA)
0
10
20
30
E_b (V)

AMPEREX TUBE TYPE 5651

The 5651 is a miniature voltage reference tube of the cold cathode discharge type. It is designed for use in D.C. amplifiers, stable regulated power supplies, oscilloscope calibrators and similar applications.

Special processing of the tube and its elements insures extremely stable operation and freedom from long and short term drift.

The AMPEREX 5651 has many of the design and processing features of the popular AMPEREX tube type OG3.

GENERAL CHARACTERISTICS

ELECTRICAL

Maximum Ratings, absolute values

D.C. Starting Voltage (min.)[1]	115 volts
D.C. Operating Current (max.)	3.5 ma
D.C. Operating Current (min.)	1.5 ma
Ambient Temperature Limits	−55 to + 90°C

Typical Operation

Recommended D.C. Operating Current	2.5 ma
Operating Voltage at 1.5 ma (min.)	82 volts
Operating Voltage at 3.5 ma (max.)	92 volts
Voltage Regulation (I_a = 1.5 − 3.5 ma) (average)	0.8 volt
Voltage Regulation (I_a = 1.5 − 3.5 ma) (max.)	3 volts
Stability[2]	0.1 volt

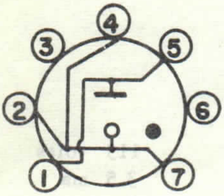
MECHANICAL

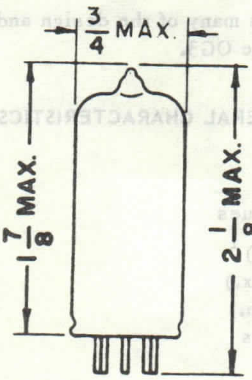
Cathode	Cold Cathode
Base	Miniature Button-7 Pin
Bulb	T 5½
Max. Overall Height	2 1/8"
Max. Seated Height	1 7/8"
Max. Diameter	3/4"
Mounting Position	any

[1] With an illumination of 50 - 500 lumens.

[2] The maximum voltage fluctuation at any current level within the operating current range.

5651



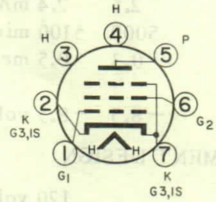


Basing Connections

Pin 1 - Plate
Pin 2 - Cathode
Pin 3 - Internally Connected
Pin 4 - Cathode
Pin 5 - Plate
Pin 6 - Internally Connected
Pin 7 - Cathode

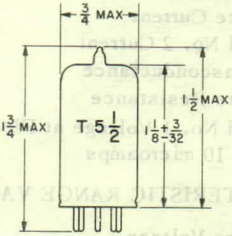
AMPEREX TUBE TYPE 5654

The 5654 is a reliable sharp cutoff pentode for use as a wide band, high frequency RF and IF amplifier. It is designed to provide reliable service under the shock and vibration conditions encountered in aircraft and mobile applications.



PIN CONNECTIONS

1. GRID NO. 1
2. CATHODE, GRID NO. 3 AND INTERNAL SHIELD
3. HEATER
4. HEATER
5. PLATE
6. GRID NO. 2
7. CATHODE, GRID NO. 3 AND INTERNAL SHIELD



MECHANICAL

Cathode	coated, unipotential
Base	E7-1
Basing Designation	7BD
Bulb	T5½
Outline	5-1
Mounting Position	any

ELECTRICAL

Heater Voltage [1]	6.3 volts
Heater Current at 6.3 volts [1]	175 mA

Direct Interelectrode Capacitances (With External Shield)

Output Capacitance	2.85 ± 0.4 $\mu\mu$f
Input Capacitance	4.0 ± 0.6 $\mu\mu$f
Between Plate and Grid No. 1	0.02 $\mu\mu$f max

Maximum Ratings (Absolute Limits)

Plate Voltage	200 volts max
Plate Voltage (Without Current)	550 volts max
Plate Dissipation	1.85 watts max
Grid No. 2 Voltage	155 volts max
Grid No. 2 Voltage (Without Current)	550 volts max
Cathode Current	20 mA max
Grid No. 1 Circuit Resistance	0.5 megohm max
Voltage Between Cathode and Heater	130 volts max
Bulb Temperature	165°C max

1 The maximum deviation of the heater current at a heater voltage of 6.3 volts is ± 15 mA. In order to obtain a prolonged tube life the maximum variation of the heater voltage should be less than ± 10% (absolute limits).

5654

Typical Characteristics

Plate Voltage	120	180 volts
Grid No. 2 Voltage	120	120 volts
Cathode Resistor	180	180 ohms
Plate Current	7.5	7.7 mA
Grid No. 2 Current	2.5	2.4 mA
Transconductance	5000	5100 micromhos
Plate Resistance	0.3	0.5 megohm
Grid No. 1 Voltage at Plate Current of 10 microamps	−8.5	−8.5 volts

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

Plate Voltage	120 volts
Grid No. 2 Voltage	120 volts
Grid No. 1 Voltage	−2 volts
Plate Current	3 − 12 mA
Transconductance	3500−6500 micromhos
Negative Grid No. 1 Current (Grid Series Resistor = 0.1 Megohm)	0.1 μA

Shock and Vibration [2]

The tube can withstand vibrations of 2.5 g at 50 cps for a period of 32 hours. It can also withstand impact accelerations up to 500 g (measured with the N.R.L. impact machine for electronic devices, lifting the hammer over an angle of 30°).

Heater Cycling [2]

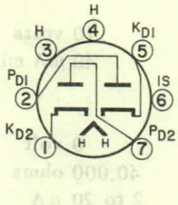
The tube can withstand a minimum of 2000 cycles under the following conditions:

Heater Voltage (cycled 1 minute on and 1 minute off)	7.5 volts
Voltage Between Cathode and Heater (Cathode Negative With Respect to the Heater)	100 volts dc
Plate Voltage	0 volt
Grid No. 2 Voltage	0 volt
Grid No. 1 Voltage	0 volt

[2] These test conditions are only given for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions.

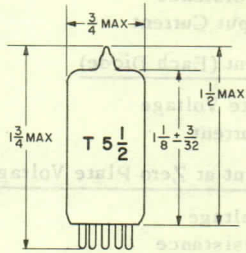
AMPEREX TUBE TYPE 5726

The 5726 is a reliable twin diode with separate cathodes for use in professional equipment as a detector or low-current power rectifier. It is designed to give reliable service under the shock and vibration conditions encountered in aircraft and mobile applications.



PIN CONNECTIONS

1. CATHODE DIODE NO. 2
2. PLATE DIODE NO. 1
3. HEATER
4. HEATER
5. CATHODE DIODE NO. 1
6. INTERNAL SHIELD
7. PLATE DIODE NO. 2



MECHANICAL

Cathode	coated, unipotential
Base	E7-1
Bulb	T5½
Outline	5-1
Mounting Position	any

ELECTRICAL

Heater Voltage	6.3 volts ± 10%
Heater Current	300 ± 25 mA
Resonant Frequency for Each Diode	700 Mc/s

Direct Interelectrode Capacitances (Measured With External Shield; Each Section)

Plate to All Other Elements	3.2 ± 0.8 $\mu\mu$f
Cathode To All Other Elements	3.9 ± 0.8 $\mu\mu$f
Plate Diode No. 1 to Plate Diode No. 2	0.026 $\mu\mu$f

Maximum Ratings (Absolute Limits, Each Diode)

Peak Inverse Plate Voltage	360 volts max
Plate Current	10 mA max
Steady State Peak Plate Current	60 mA max
Peak Voltage Between Cathode and Heater	360 volts max
Bulb Temperature [1]	165°C max

Operating Characteristics As Half-Wave Rectifier (Each Diode)

Plate Supply Voltage	117 volts rms
Minimum Total Plate Supply Resistance	300 ohms
Input Capacitor of the Smoothing Filter	8 μf
D-C Output Current	9 mA max

[1] Tube life and reliability of performance will be enhanced by operation at lower temperature.

5726

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

D-C Output Current From Full-Wave Rectifier	
Transformer Voltage	2x 165 volts rms
Total Plate Supply Resistance	2x300 ohms
Input Capacitor of the Smoothing Filter	8 μf
Load Resistance	11,000 ohms
D-C Output Current	16 mA min
Plate Current (Each Diode)	
D-C Plate Voltage	10 volts
Plate Current	40 mA min
Plate Current at Zero Plate Voltage (Each Diode)	
Plate Voltage	0 volt
Load Resistance	40,000 ohms
Plate Current	2 to 20 μA
Plate Current Difference (Between the Diodes)	
Plate Voltage	0 volt
Load Resistance	40,000 ohms
Plate Current Difference	5 μA max
Heater Cathode Leakage Current	
Heater to Cathode Voltage	100 volts
Heater to Cathode Current	10 μA max
Interelectrode Leakage Resistance	
Interelectrode Voltage	300 volts d-c
Interelectrode Leakage Resistance	100 megohms min

Heater Cycling [2] The tube can withstand a minimum of 2000 cycles of heater switching under the following conditions:

Heater Voltage (cycled 1 minute on, 1 minute off)	7.5 volts
Heater to Cathode Voltage (Cathode Negative with respect to heater)	135 volts d-c
Plate Voltage	0 volt

Shock Rating [2] — about 700 g

Forces as applied by the N.R.L. impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 48° in each of 4 different positions of the tube.

Fatigue Rating [2] — 2.5 g

Vibrational forces for a period of 32 hours at a frequency of 25 cycles per second in each of 3 positions of the tube.

[2] These test conditions are only given for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions.

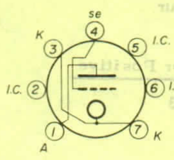
AMPEREX TUBE TYPE 5823

TENTATIVE DATA

The Amperex 5823 is a triode, gas-filled cold cathode trigger tube. This miniature tube fulfills the requirements for use as a relay tube in the "on-off" control of low current circuits. Its unusual characteristics make it of interest in relay, counter and computing circuits, welding timers, power switching, remote control and industrial control circuits.

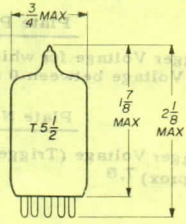
A small pulse applied to the trigger electrode will place the tube in operation by starting the gas discharge between the trigger electrode and cathode. Thereafter, the discharge will be transferred to the main gap between plate and cathode. Thus the trigger electrode may be used to energize a relay connected in the plate circuit of the tube.

The Amperex 5823 requires no heater power, consequently no warmup time is required. During standby periods the tube is inoperative so that long life may be expected.



4CK

PIN CONNECTIONS
1. ANODE
2. INTERNAL CONNECTION
3. CATHODE
4. STARTER ELECTRODE
5. INTERNAL CONNECTION
6. INTERNAL CONNECTION
7. CATHODE



5-2

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Mounting Position	any
Base	7 pin miniature, 4CK
Bulb	T 5½
Outline	5 - 2

ELECTRICAL

Average Plate-Cathode Breakdown Voltage with Trigger Voltage Zero or Positive	290 volts
Average Plate-Cathode Burning Voltage at 25 ma	62 volts
Average Trigger-Cathode Breakdown Voltage with Plate Voltage Zero or Positive	80 volts
Average Trigger-Cathode Voltage when Breakdown has occured (Plate-Cathode Current 25 ma)	61 volts
Ionization time (approx) [1]	20 μsec
Deionization time [1]	500 μsec
Average Trigger-Cathode Current Required to cause Transfer (E_b = 140 volts)	50 μa

[1] With an instantaneous plate voltage of 185 volts, peak positive trigger bias voltage of +70 volts, peak positive trigger input pulse of +50 volts, trigger series resistor of 0.1 meg and 820 ohms plate series resistor.

5823

Maximum Ratings, Absolute Values

Plate and Trigger both Positive

Plate-Cathode Voltage at which self-ignition will not occur [2]	200 volts max
Trigger-Cathode Breakdown voltage [2]	105 volts min
Trigger-Cathode Voltage at which Trigger Breakdown will not occur [3]	73 volts max
Trigger-Cathode Current necessary to cause Transfer	
E_b=140 volts peak	400 μa max
E_b= 175 volts peak [4]	160 μa max
Plate-Cathode Voltage drop [5]	85 volts max
Trigger-Cathode Voltage drop [6]	75 volts max
Peak Cathode Current	100 ma max
Average Cathode Current (Averaging time = 15 seconds)	25 ma max
Peak Trigger Current (with Positive Trigger Voltage)	100 ma max
Ambient Temperature	-60°C to $+75^{\circ}$C max

Plate Positive and Trigger Zero or Negative

Plate-Trigger Voltage for which Breakdown will not occur (Trigger Voltage between 0 and -65 volts)	200 volts max

Plate Negative and Trigger Zero or Positive

Plate-Trigger Voltage (Trigger Voltage between 0 and 73 volts approx) [7,8]	180 volts max

Typical Operation

For Use as a Relay Tube with 50 Cycle AC Supply

Plate Supply Voltage	117 volts rms
AC Trigger Voltage:	
Positive Prefiring Voltage	70 volts max
Positive Triggering Voltage	35 volts min
Firing Voltage [9]	105 volts min

APPLICATION NOTES

This tube is recommended for operation in those cases where the plate and trigger are both positive.

The tube may be used in rectifier applications where:

Peak Inverse Voltage = 200 volts max
Peak Cathode Current = 100 mA max
Average Cathode Current = 25 mA

It is not recommended that tube be operated with a cathode current of less than 8 mA.

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2 With a variable DC plate voltage Vtr = 0 volts, plate circuit series resistor of 3,000 ohms and trigger series resistor of 50,000 ohms

3 With DC plate voltage of 0 volts, variable DC trigger voltage, plate circuit series resistor of 3000 ohms and 50,000 ohms trigger series resistor.

4 With variable DC trigger voltage, plate circuit series resistor of 3000 ohms and 2 meg trigger series resistor.

5 With DC plate voltage of 230 volts, DC trigger voltage of 91 volts, DC cathode current of 50 ma, plate series resistor of 3000 ohms and 50,000 ohms trigger series resistor.

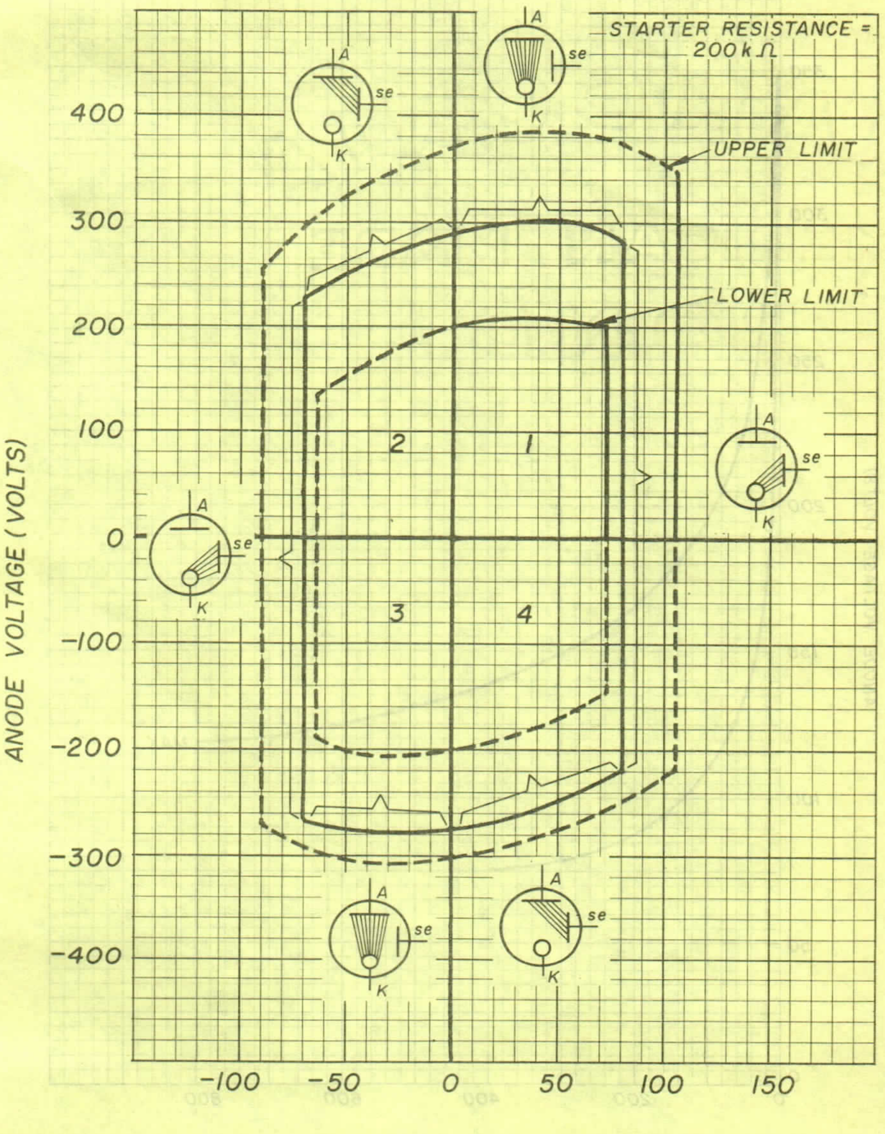
6 With DC plate voltage of 9 volts, variable DC trigger voltage, DC trigger current of 10 ma and 3000 ohms trigger series resistor.

7 The tube must not draw current while plate is negative.

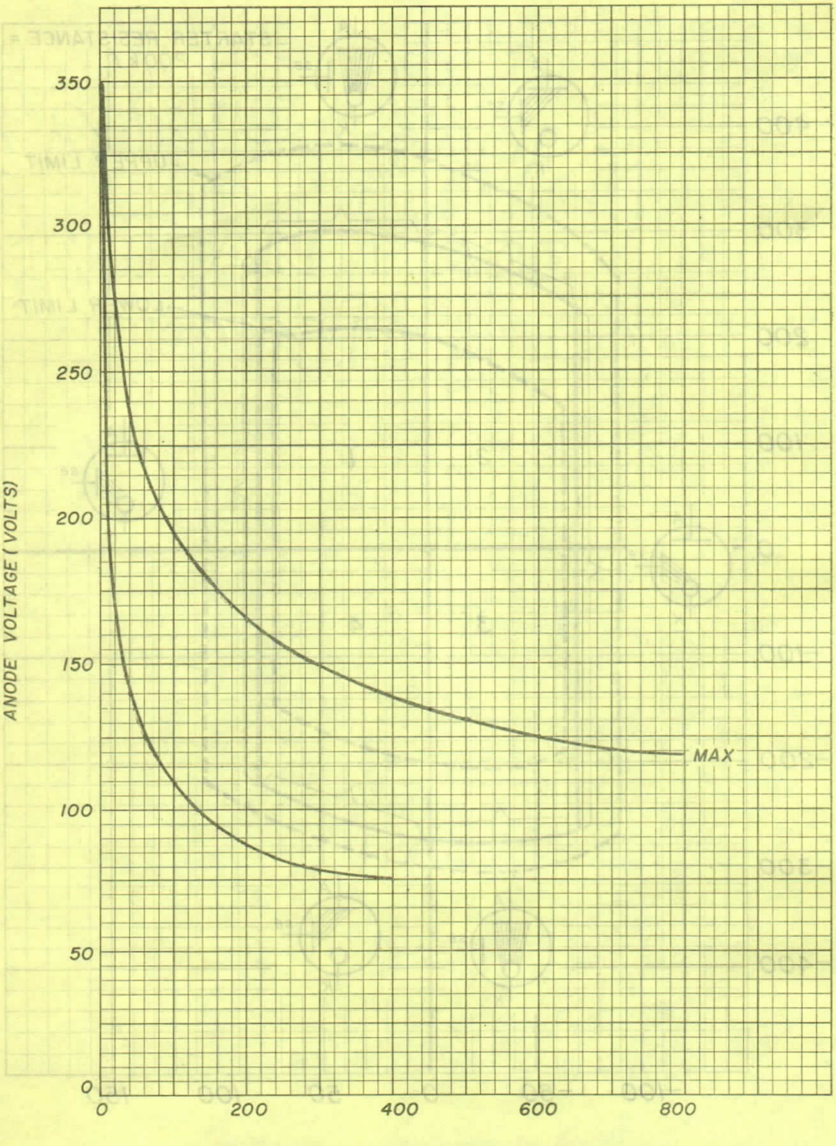
8 Stronglight, such as sunlight, should not be allowed to fall on the tube.

9 Sum of in-phase instantaneous prefiring voltage and instantaneous triggering voltage.

BREAKDOWN CHARACTERISTICS



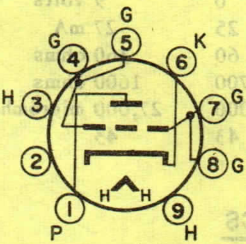
TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 5842

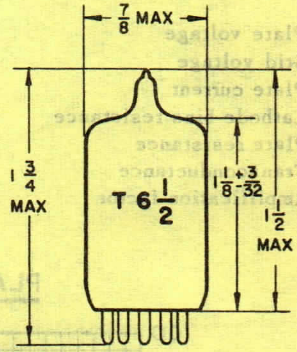
The 5842 is a miniature triode designed for grounded grid application in wide band amplifier stages where a high figure of merit is required. It features low noise, high gain, and high transconductance.

The 5842 is a plug-in replacement for the 417A in existing equipment.



PIN CONNECTIONS

1 - PLATE
2 - NO CONNECTION
3 - HEATER
4 - GRID
5 - GRID
6 - CATHODE
7 - GRID
8 - GRID
9 - HEATER



6-1

GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Bulb	T 6½
Outline	6-1
Base	E9-1
Mounting position	any

ELECTRICAL

Heater voltage	6.3 volts
Heater current	300 mA

Direct Interelectrode Capacitances (without external shield) (Grounded Grid)

Input (K to g + h)	9.0 $\mu\mu f$
Output (p to g + h)	1.8 $\mu\mu f$
Plate to cathode and heater	0.55 $\mu\mu f$

Revised 4/63

5842

Maximum Ratings, Absolute Values

Heater voltage (ac or dc)	6.3 ± 10% volts max
Heater to cathode voltage	55 volts max
Plate voltage	200 volts max
Cathode current	38 mA max
Plate dissipation	4.5 watts max
Bulb temperature	160°C max

Typical Operation

Plate voltage	150	130 volts
Grid voltage	0	9 volts
Plate current	25	27 mA
Cathode bias resistance	60	360 ohms
Plate resistance	1700	1600 ohms
Transconductance	25,000	27,000 micromhos
Amplification factor	43	43

PLATE CHARACTERISTICS

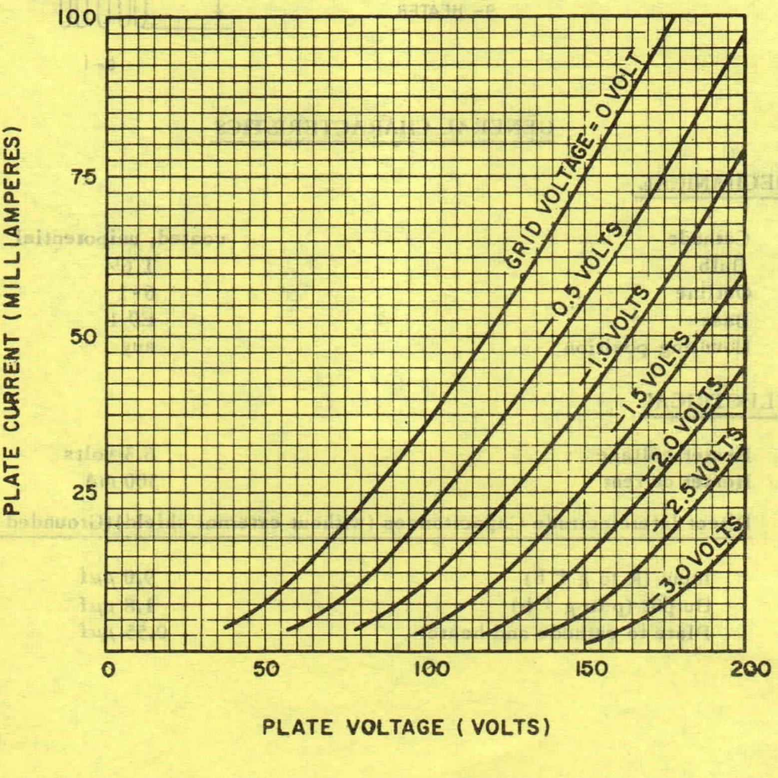
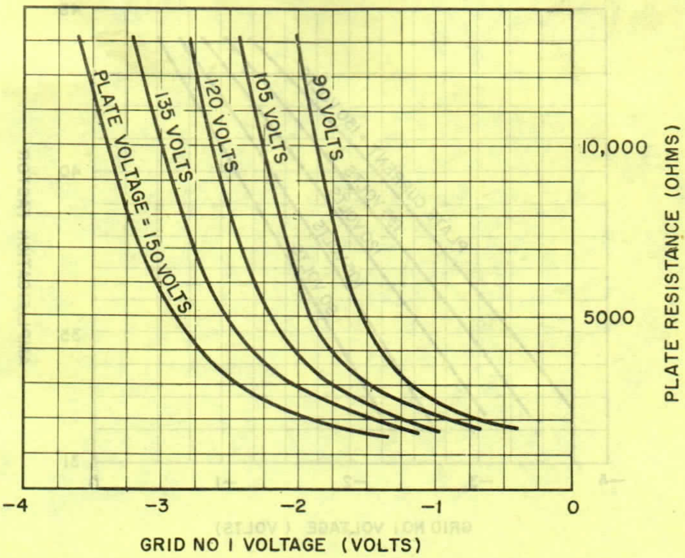
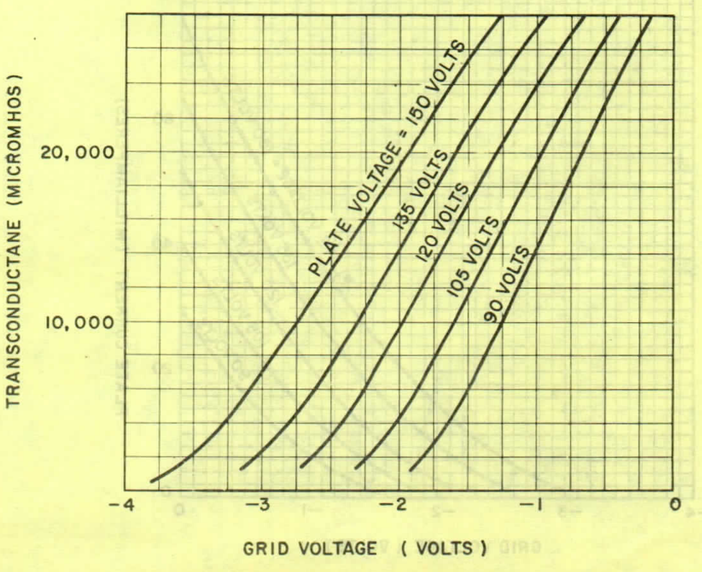


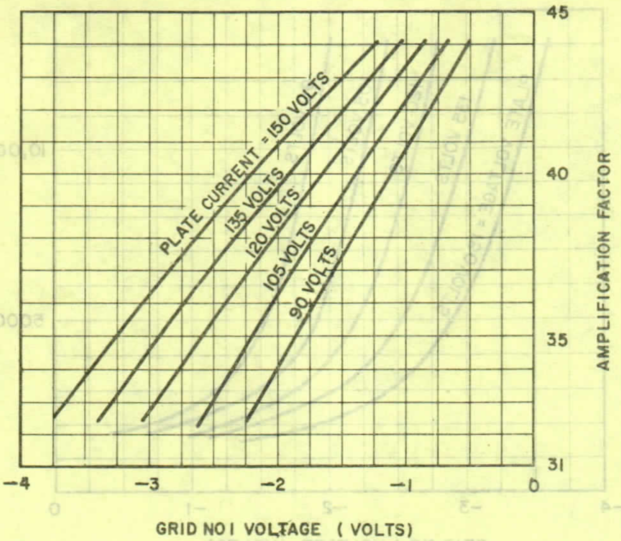
PLATE RESISTANCE CHARACTERISTICS



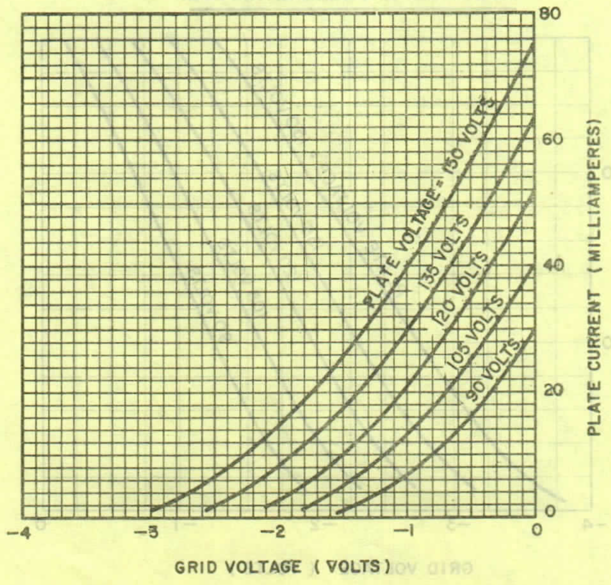
AVERAGE CHARACTERISTICS



AMPLIFICATION FACTOR CHARACTERISTICS



TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 5847

The 5847 is a high-gain, miniature pentode designed for applications in broad-band amplification where its high figure of merit is required. It is a plug-in replacement for the type 404A. The 5847 is intended for replacement purposes only in existing equipment. For new equipment designs, the Amperex type 6688 is recommended. The 6688 has a different base pin arrangement and higher transconductance.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Voltage		6.3 volts
Heater Current		300 mA

Direct Interelectrode Capacitances	Without External Shield	With External Shield (EIA #315)	
Grid to Plate (max.)	0.05	0.04	$\mu\mu f$
Input	7.0	7.1	$\mu\mu f$
Output	2.5	2.9	$\mu\mu f$

Characteristics & Typical Operation

		*
Plate Voltage	150	160 volts
Screen Grid Voltage	150	160 volts
Cathode Bias Resistance	110	600 ohms
Control Grid Voltage	——	+ 8.5 volts
Plate Current	13.0	13.0 mA
Screen Grid Current	4.5	4.5 mA
Transconductance	12500	12500 micromhos

MECHANICAL

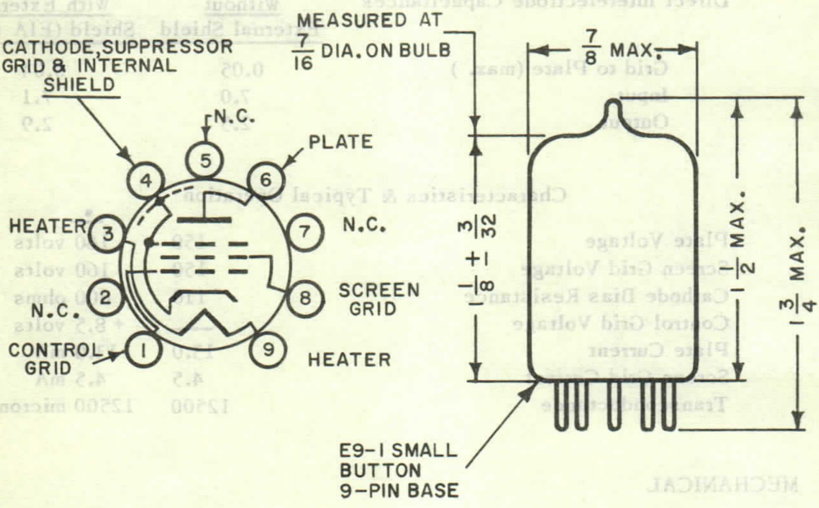
Base	Small button, 9 pin
Max. Overall Length	1¾ inches
Max. Seated Height	1½ inches
Max. Diameter	7/8 inche
Mounting Position	any

* Operating conditions to minimize gain variations due to supply voltage fluctuations.

5847

MAXIMUM RATINGS (Design Center Values)

Plate Voltage	180 volts
Plate Dissipation	3.0 watts
Screen Grid Voltage	180 volts
Screen Grid Dissipation	0.75 watt
Cathode Current	35 mA
Heater-Cathode Voltage	50 volts
Grid Resistance	0.1 megohn



5847

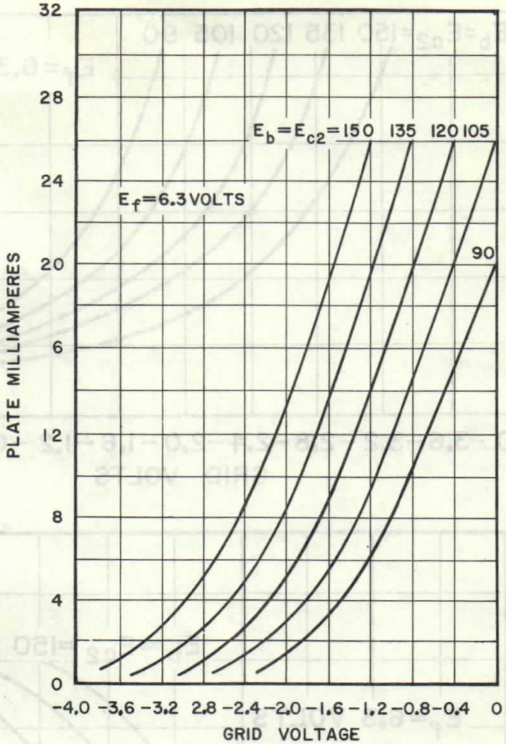
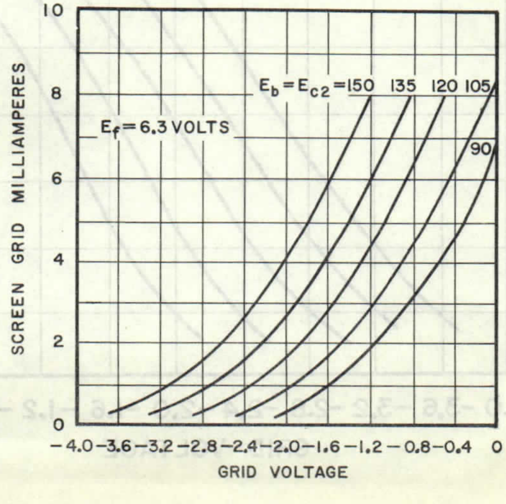


PLATE MILLIAMPERES
GRID VOLTAGE
$E_b = E_{c2} = 150$ 135 120 105
90
$E_f = 6.3$ VOLTS
32
28
24
20
16
12
8
4
0
-4.0 -3.6 -3.2 -2.8 -2.4 -2.0 -1.6 -1.2 -0.8 -0.4 0



SCREEN GRID MILLIAMPERES
GRID VOLTAGE
$E_b = E_{c2} = 150$ 135 120 105
90
$E_f = 6.3$ VOLTS
10
8
6
4
2
0
-4.0 -3.6 -3.2 -2.8 -2.4 -2.0 -1.6 -1.2 -0.8 -0.4 0

5847

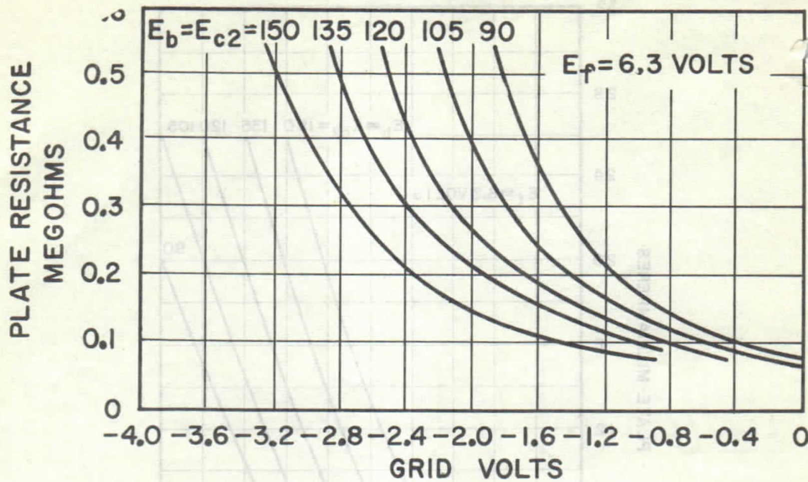
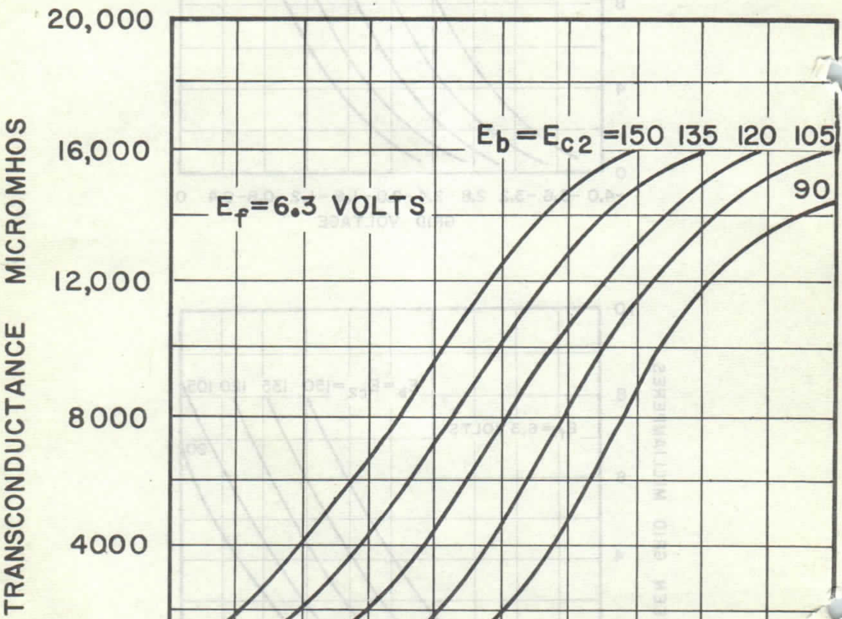


PLATE RESISTANCE MEGOHMS
GRID VOLTS
$E_b = E_{c2}$ = 150 135 120 105 90
E_f = 6.3 VOLTS
0.5
0.4
0.3
0.2
0.1
0
-4.0 -3.6 -3.2 -2.8 -2.4 -2.0 -1.6 -1.2 -0.8 -0.4 0

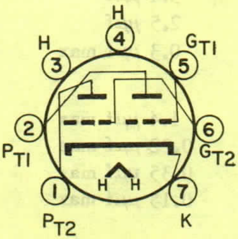


TRANSCONDUCTANCE MICROMHOS
GRID VOLTAGE
$E_b = E_{c2}$ = 150 135 120 105
90
E_f = 6.3 VOLTS
20,000
16,000
12,000
8000
4000
0
-4.0 -3.6 -3.2 -2.8 -2.4 -2.0 -1.6 -1.2 -0.8 -0.4 0

AMPEREX TUBE TYPE 5920/E90CC

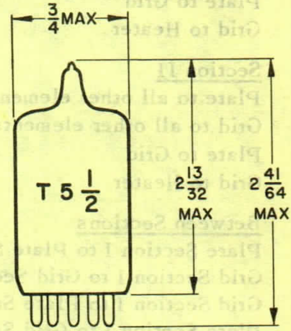
The Amperex 5920/E90CC is a long-life, reliable twin triode designed for use in computer circuits. Operation of the tube for long periods under cut-off conditions will not cause deterioration of the emission surface. The tube is not intended for use in circuits critical as to hum, microphonics or noise.

The 5920/E90CC is one of the Amperex "Premium Quality 10,000 Hour" tubes.



PIN CONNECTIONS

1-PLATE, TRIODE 2
2-PLATE, TRIODE 1
3-HEATER
4-HEATER
5-GRID, TRIODE 1
6-GRID, TRIODE 2
7-CATHODE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Base	miniature 7 pin (7BF)
Bulb	T 5½
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heating	indirect by ac or dc parallel or series supply
Heater Voltage [1]	6.3 volts
Heater current at 6.3 volts [1]	400 mA

[1] To obtain a life of 10,000 hours with parallel heater connections, the maximum variation of heater voltage should be less than ±5% maximum. In the case of series heater connections, the maximum variation of the heater current due to voltage fluctuations and tolerances in the associated components should be less than ±1.5%.

5920/E90CC

Direct Interelectrode Capacitances

Cathode to heater	6.5 $\mu\mu$f
Section I	
Plate to all other elements	0.35 $\mu\mu$f
Grid to all other elements	3.4 $\mu\mu$f
Plate to Grid	2.5 $\mu\mu$f
Grid to Heater	0.15 $\mu\mu$f max
Section II	
Plate to all other elements	0.4 $\mu\mu$f
Grid to all other elements	3.4 $\mu\mu$f
Plate to Grid	2.5 $\mu\mu$f
Grid to Heater	0.3 $\mu\mu$f max
Between Sections	
Plate Section I to Plate Section II	1.4 $\mu\mu$f max
Grid Section I to Grid Section II	0.22 $\mu\mu$f max
Grid Section I to Plate Section II	0.35 $\mu\mu$f max
Plate Section I to Grid Section II	0.15 $\mu\mu$f max

Maximum Ratings, Absolute Values
(Each Section)

Heater Voltage	6.3 volts ±5%
Plate Voltage	300 volts max
Plate Voltage (Zero Plate Current)	600 volts max
Plate Dissipation	2 watts max
Cathode Current	15 mA max
Peak Cathode Current [2]	75 mA max
Negative Grid Voltage	100 volts max
Peak Negative Grid Voltage	200 volts max
Positive Grid Voltage	0 volts max
Grid Current	250 μA max
Peak Grid Current [2]	1 mA max
Grid Circuit Resistance (with fixed bias)	0.5 megohm max
Grid Circuit Resistance (with automatic bias)	1 megohm max
Voltage between Heater and Cathode	100 volts max
Bulb Temperature	170°C max

2 Averaging time = 10 milliseconds max

Typical Operation

(Each Section)

Plate Voltage	100 volts
Plate Current	8.5 mA
Negative Grid Voltage	2.1 volts
Cathode Resistor	250 ohms
Plate Current (Negative Grid Bias = 2.1 volts)	8.5 ± 4 mA
Grid Voltage starting point (Grid Bias at Grid Current = + 0.3 μA)	0.2 volts
Negative Grid Current (Resistance between Grid and Ground = 0.1 megohm) [3]	0.5 μA max
Cathode Heating Time	12 sec
	17 sec max
Insulation between any two Electrodes	20 megohms
Insulation between Cathode (positive) and Heater (negative)	2 megohms
Transconductance [3]	6000 micromhos
Amplification Factor	27

Typical Operation

Computer Service

(Each Section)

Supply Voltage	150 volts
Plate Circuit Resistor	20,000 ohms
Grid Circuit Resistor	47,000 ohms
Plate Current at Zero Grid Bias [3]	5.6 ± 0.6 mA
Plate Current at Grid Bias = −10 volts [3]	0 - 0.1 mA

(The maximum difference between the negative grid voltages of the two units for plate currents of 0.1 mA is 2 volts) [3]

[3] End of life is reached when one or more of the characteristics given below have changed to the following values.

Transconductance	< 3000 micromhos
Plate Current at Zero Grid Bias	< 4.5 mA
Negative Grid Current	> 2.5 μA
Plate Current at Grid Bias = −10 V	> 0.1 mA
Cut-Off Balance	0 ± 2 volts

5920/E90CC

Characteristics Range Value for Equipment Design

Heater Current ($E_n = 6.3\,V$)	380 - 420 mA
Plate Current ($E_b = 100\,V$, $E_g = -2.1\,V$)	4.5 - 12.5 mA
Transconductance ($E_b = 100\,V$, $R_k = 250\,\Omega$)	4500 - 7500 micromhos
Plate Current ($E_{bb} = 150\,V$, $R_b = 20\,K\Omega$, $R_g = 47\,K\Omega$, $V_R = 0\,V$)	5.0 - 6.2 mA
Plate Current ($E_{bb} = 150\,V$, $R_b = 20\,K\Omega$, $R_g = 47\,K\Omega$, $V_R = -10\,V$)	0.1 mA max
Cut-Off Balance ($E_{bb} = E_{bb}' = 150\,V$, $R_b = R_b' = 20\,K\Omega$, $R_g = R_g' = 47\,K\Omega$, $I_a = I_a' = 0.1\,mA$)	2 volts max
Negative Grid Current ($E_b = 100\,V$, $R_K = 250\,\Omega$)	0.2 μA max
Cathode-Heater Current (cathode positive) ($E_{K/n} = 100\,V$, $R = 1\,M\Omega$)	15 μA max
Insulation (between any two electrodes, E = 300 V)	20 megohms min

Direct Interelectrode Capacitances

Section I	
Plate to Grid	2.0 - 3.0 $\mu\mu$f
Plate to all other Elements	0.25 - 0.45 $\mu\mu$f
Grid to all other Elements	3.0 - 4.0 $\mu\mu$f
Grid to Heater	0.15 $\mu\mu$f max
Section II	
Plate to Grid	2.0 - 3.0 $\mu\mu$f
Plate to all other Elements	0.30 - 0.50 $\mu\mu$f
Grid to all other Elements	3.0 - 4.0 $\mu\mu$f
Grid to Heater	0.3 $\mu\mu$f max
Between the Sections	
Plate Section I to Plate Section II	1.4 $\mu\mu$f
Grid Section I to Grid Section II	0.22 $\mu\mu$f max
Plate Section I to Grid Section II	0.35 $\mu\mu$f max
Plate Section II to Grid Section I	0.15 $\mu\mu$f max

APPLICATION NOTE

It is advisable to restrict the circuit resistance between heater and cathode to values less than 20,000 ohms for stable operation.

5920/E90CC

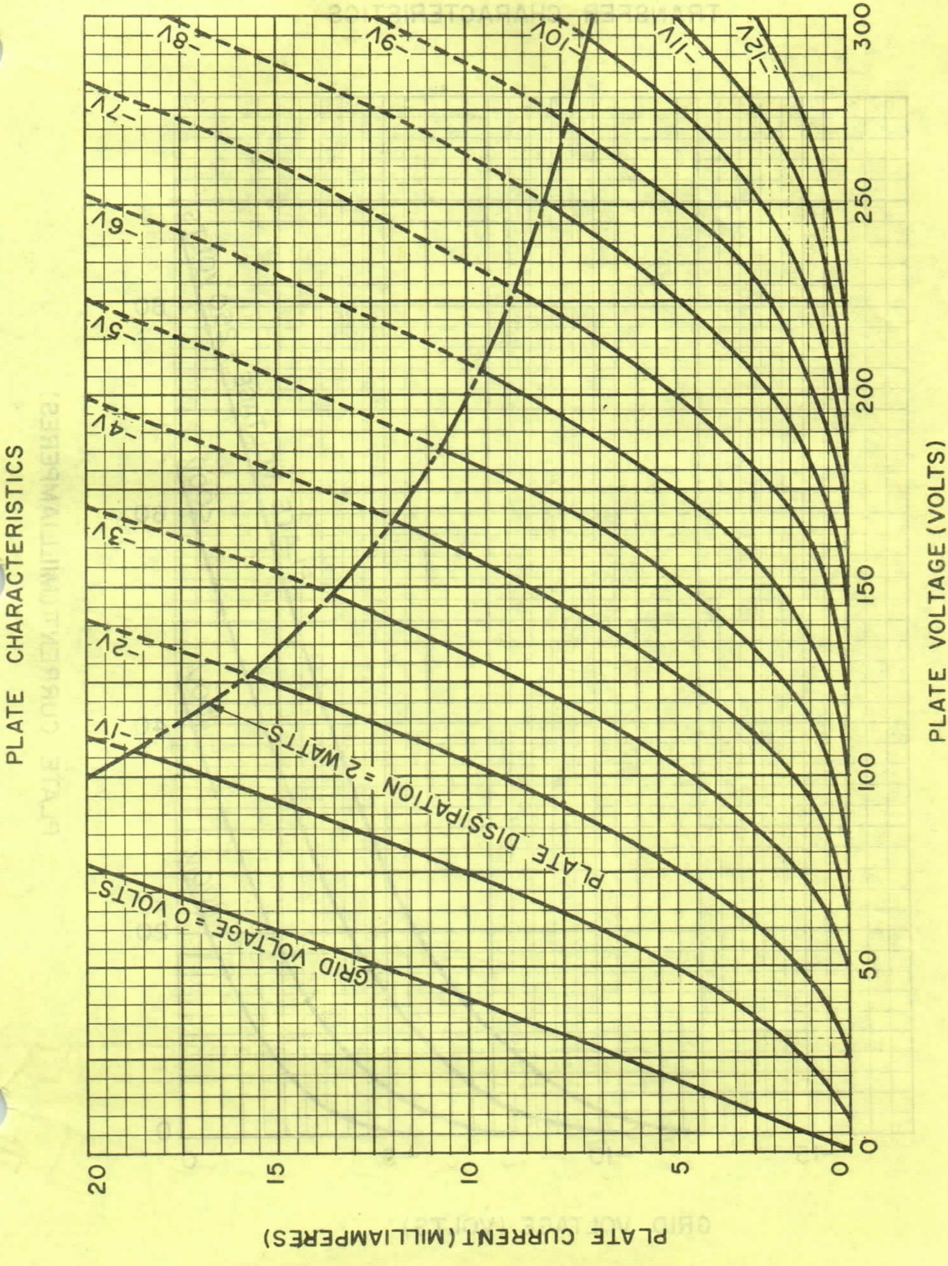
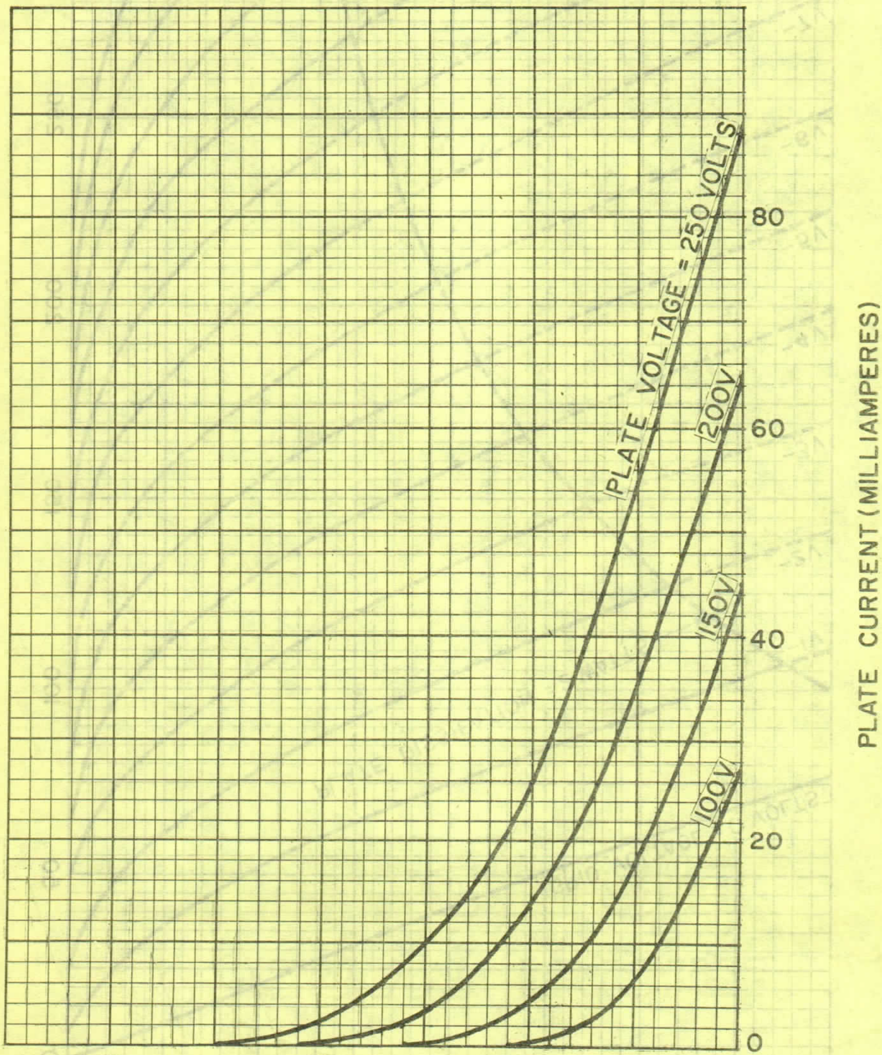


PLATE CHARACTERISTICS
GRID VOLTAGE = 0 VOLTS
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-11V
-12V
PLATE DISSIPATION = 2 WATTS
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
300
PLATE CURRENT (MILLIAMPERES)
0
5
10
15
20

5920/E90CC

TRANSFER CHARACTERISTICS



GRID VOLTAGE (VOLTS)

Revised 8/60

AMPEREX TUBE TYPE 6007/5913

The 6007 is a sub-miniature pentode output amplifier for hearing-aids and other purposes, where small size, light weight and low battery drain are important. The 6007 has flexible silvered terminal leads which may be soldered directly to the circuit elements. The wires are arranged in a straight line so that, if they are cut off to a length of 0.2" the tube can be fitted in a standard 5-pin subminiature socket.

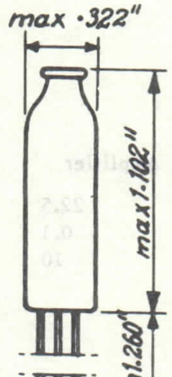
GENERAL CHARACTERISTICS

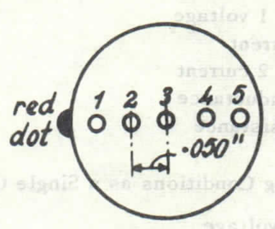
MECHANICAL

Filament	coated
Bulb	T2
Base	none
Maximum diameter	0.322"
Mounting position	any

Basing connections - JETEC basing designation 5J

1. Plate
2. Grid No. 2
3. + Filament
4. Grid No. 1
5. — Filament





Wire length	0.2"
Spacing	0.05"
Diameter	0.016"

ELECTRICAL

Filament Voltage	1.25 volts DC
Filament Current	13.3 mA

Direct Interelectrode Capacitances

Grid No. 1 to all other electrodes	2.5 $\mu\mu$f
Plate to all other electrodes	2.2 $\mu\mu$f
Plate to Grid No. 1	max. 0.2 $\mu\mu$f

6007/5913

Maximum Ratings

Plate voltage	45	volts
Plate dissipation	25	milliwatts
Grid No. 2 voltage	45	volts
Grid No. 2 dissipation	6	milliwatts
Cathode current	600	microamps
Grid No. 1 voltage (when grid No. 1 current = + 0.3 microamp)	− 0.2	volt
Circuit resistance between grid No. 1 and filament	10	megohms
Filament voltage	max. 1.55	volt
Filament voltage	min. 0.9	volt

Typical Characteristics

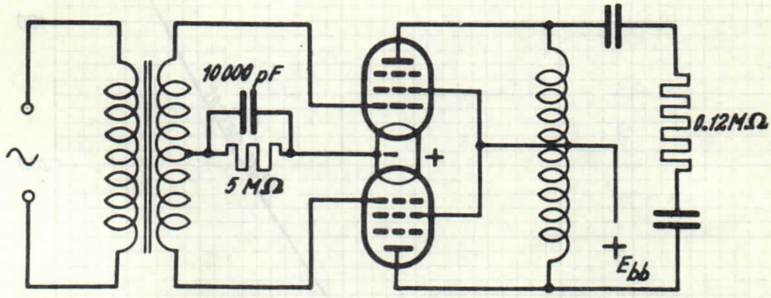
Plate voltage	22.5	volts
Grid No. 2 voltage	22.5	volts
Grid No. 1 voltage	− 0.2	volt
Plate current	475	microamps
Grid No. 2 current	100	microamps
Transconductance	420	micromhos
Plate resistance	0.4	megohms

Operating Conditions as a Single Output Amplifier

Battery voltage		22.5		volts
Plate load resistor		0.1		megohm
Grid leak resistor		10		megohms
Input voltage	0		0.45	volt (RMS)
Plate current	0.50		0.34	mA
Grid No. 2 current	0.095		0.09	mA
Power output	0		1.8	milliwatt
Total harmonic distortion	0		10	%
Battery voltage		45		volts
Plate load resistor		0.1		megohm
Grid leak resistor		3		megohms
Cathode resistor		5600		ohms
Input voltage	0		0.8	volt (RMS)
Plate current	0.42		0.42	mA
Grid No. 2 current	0.08		0.11	mA
Power output	0		6	milliwatts
Total harmonic distortion	0		10	%

Operating Conditions as a Push-Pull Amplifier (Class AB1)

Battery voltage		22.5		volts
Plate load resistor (plate to plate)		0.12		megohm
Grid leak resistor		5		megohms
Input voltage	0		0.7	volt (RMS)
Plate current	0.97		0.49	mA
Grid No. 2 current	0.21		0.16	mA
Power Output	0		4.2	milliwatts
Total harmonic distortion	0		8.5	%



6007/5913

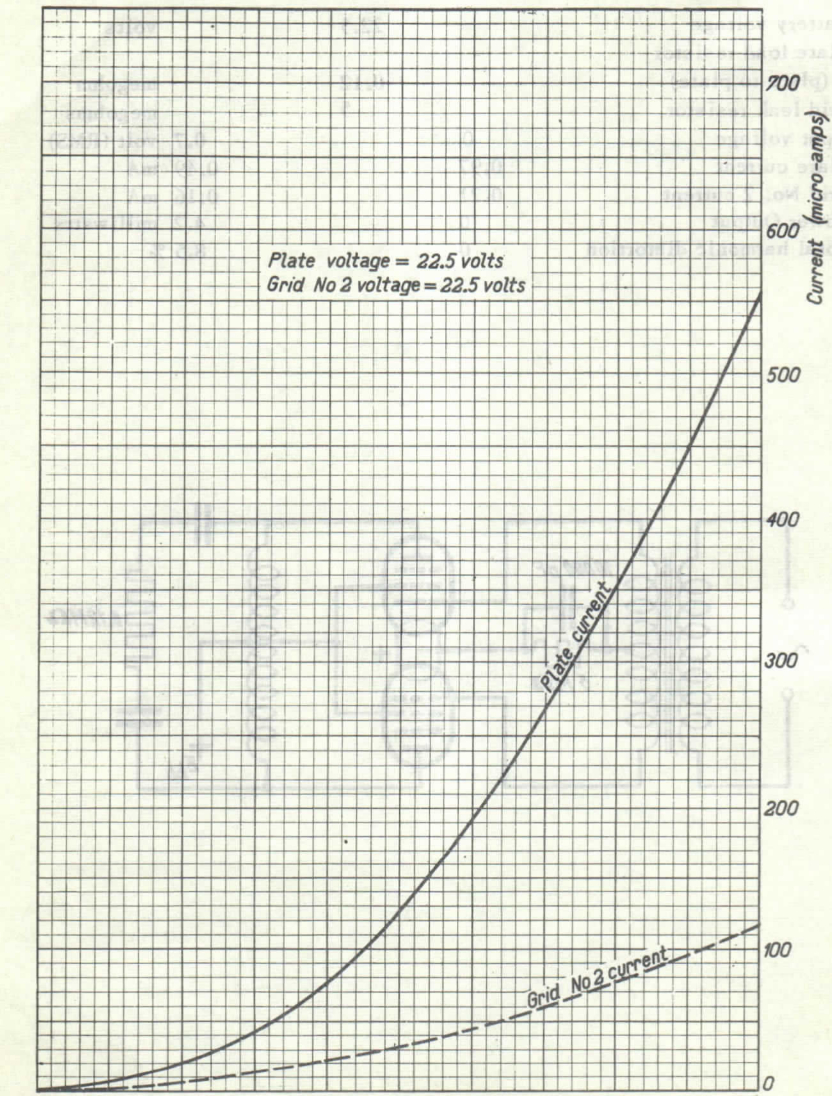
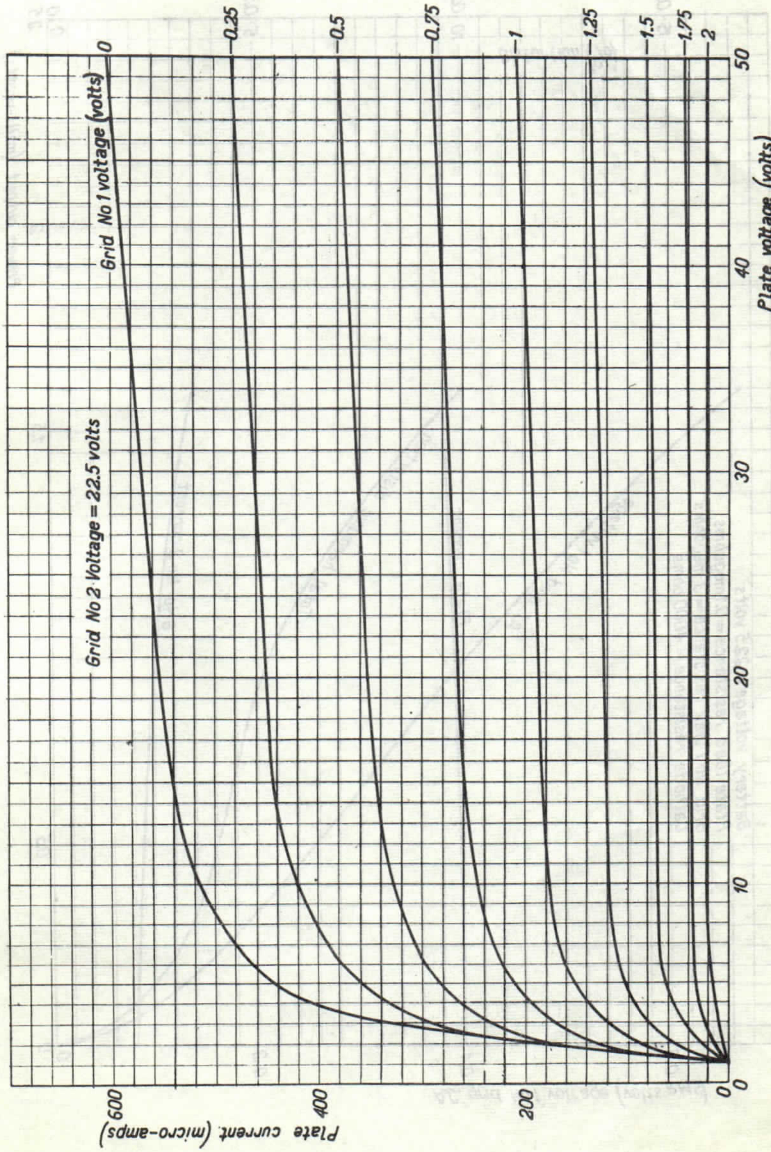


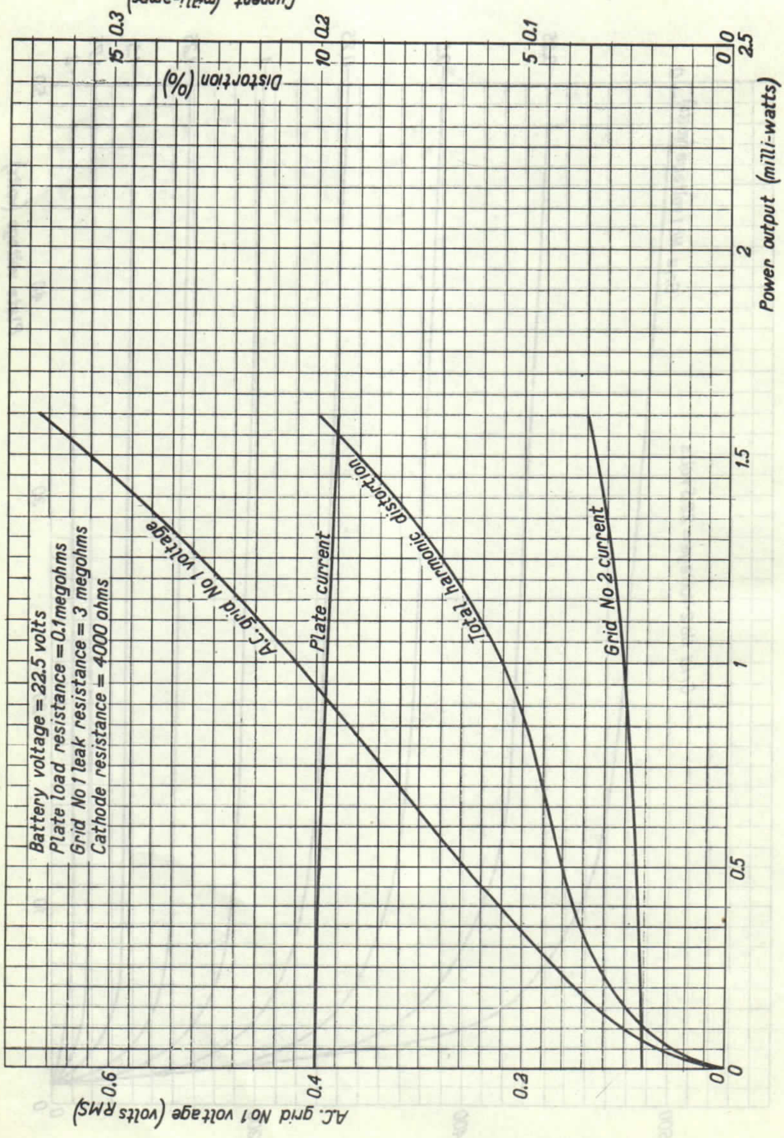
Plate voltage = 22.5 volts
Grid No 2 voltage = 22.5 volts
Plate current
Grid No 2 current
Current (micro-amps)
700
600
500
400
300
200
100
0
−2.5
−2
−1.5
−1
−0.5
0
Grid No 1 voltage (volts)

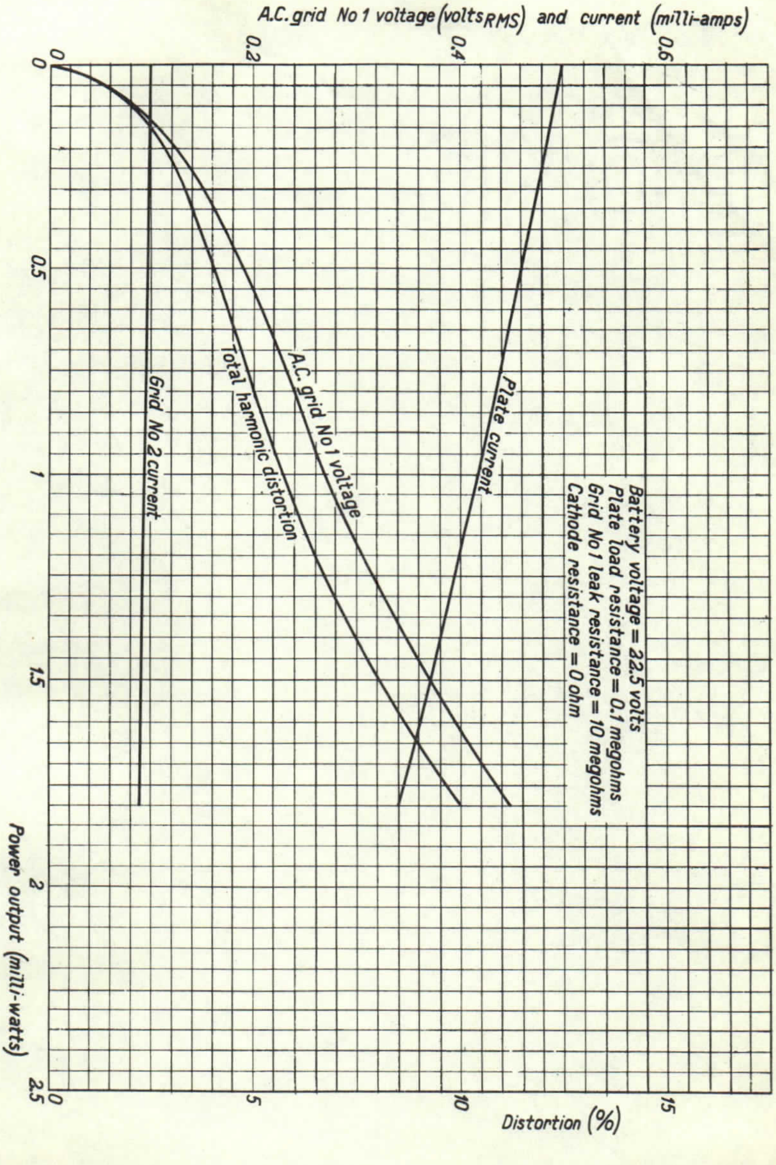
6007/5913



Grid No 1 voltage (volts)
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
Grid No 2 Voltage = 22.5 volts
Plate voltage (volts)
0
10
20
30
40
50
Plate current (micro-amps)
200
400
600

6007/5913


Battery voltage = 22.5 volts
Plate load resistance = 0.1 megohms
Grid No 1 leak resistance = 3 megohms
Cathode resistance = 4000 ohms
A.C. grid No 1 voltage
Plate current
Total harmonic distortion
Grid No 2 current
Current (milli-amps)
Distortion (%)
Power output (milli-watts)
A.C. grid No 1 voltage (volts RMS)



A.C. grid No 1 voltage (volts RMS) and current (milli-amps)
0
0.2
0.4
0.6
Power output (milli-watts)
0
0.5
1
1.5
2
2.5
Distortion (%)
0
5
10
15
Grid No 2 current
Total harmonic distortion
A.C. grid No 1 voltage
Plate current
Battery voltage = 22.5 volts
Plate load resistance = 0.1 megohms
Grid No 1 leak resistance = 10 megohms
Cathode resistance = 0 ohm

AMPEREX TUBE TYPE 6008/5911

The 6008 is a sub-miniature pentode voltage amplifier for hearing-aids and other purposes, where small size, light weight and low battery drain are important. The 6008 has flexible silvered terminal leads which may be soldered directly to the circuit elements. The wires are arranged in a straight line so that, if they are cut off to a length of 0.2" the tube can be fitted in a standard 5-pin sub-miniature socket.

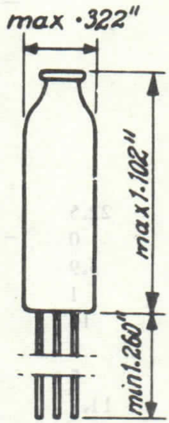
GENERAL CHARACTERISTICS

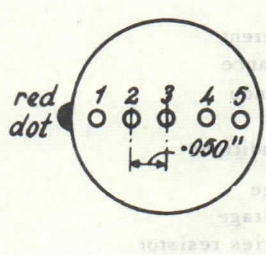
MECHANICAL

Filament	coated
Bulb	T2
Base	none
Maximum diameter	0.322"
Mounting position	any

Basing connections - JETEC basing designation 5J

1. Plate
2. Grid No. 2
3. + filament
4. Grid No. 1
5. − filament





Wire Length	0.2"
Spacing	0.05"
Diameter	0.016"

ELECTRICAL

Filament voltage	0.625 volt DC
Filament current	13.3 mA

Direct interelectrode capacitances

Grid No. 1 to all other electrodes	1.5 $\mu\mu f$
Plate to all other electrodes	1.5 $\mu\mu f$
Plate to Grid No. 1	max. 0.2 $\mu\mu f$

6008/5911

Plate Voltage	45	volts
Plate dissipation	1.5	milliwatt
Grid No. 2 voltage	45	volts
Grid No. 2 dissipation	0.5	milliwatt
Cathode current	75	microamps
Grid No. 1 voltage (when grid No. 1 current = + 0.3 microamp)	− 0.2	volt
Circuit resistance between grid No. 1 and filament	10	megohms
Filament voltage	max. 0.78	volt
Filament voltage	min. 0.45	volt

Typical Characteristics

Plate voltage	22.5	volts
Grid No. 2 voltage	18	volts
Grid No. 1 voltage	− 1.15	volt
Plate current	50	microamps
Grid No. 2 current	10	microamps
Transconductance	100	micromhos
Plate Resistance	4	megohm

Operating Conditions

Battery voltage	22.5	22.5	volts
Grid No. 1 voltage	0	− 0.63	volts
Grid No. 2 series resistor	3.9	2.7	megohms
Plate resistor	1	1	megohm
Grid leak resistor	10 [1]	5	megohms
Grid leak resistor of the next tube	5	10	megohms
Plate current	11.7	11.8	microamps
Grid No. 2 current	2.5	3.0	microamps
Voltage gain	31	30	
Total harmonic distortion at an output voltage of 3 volts RMS	5	5	%

[1] The input damping of the tube is about 6 megohms in this case.

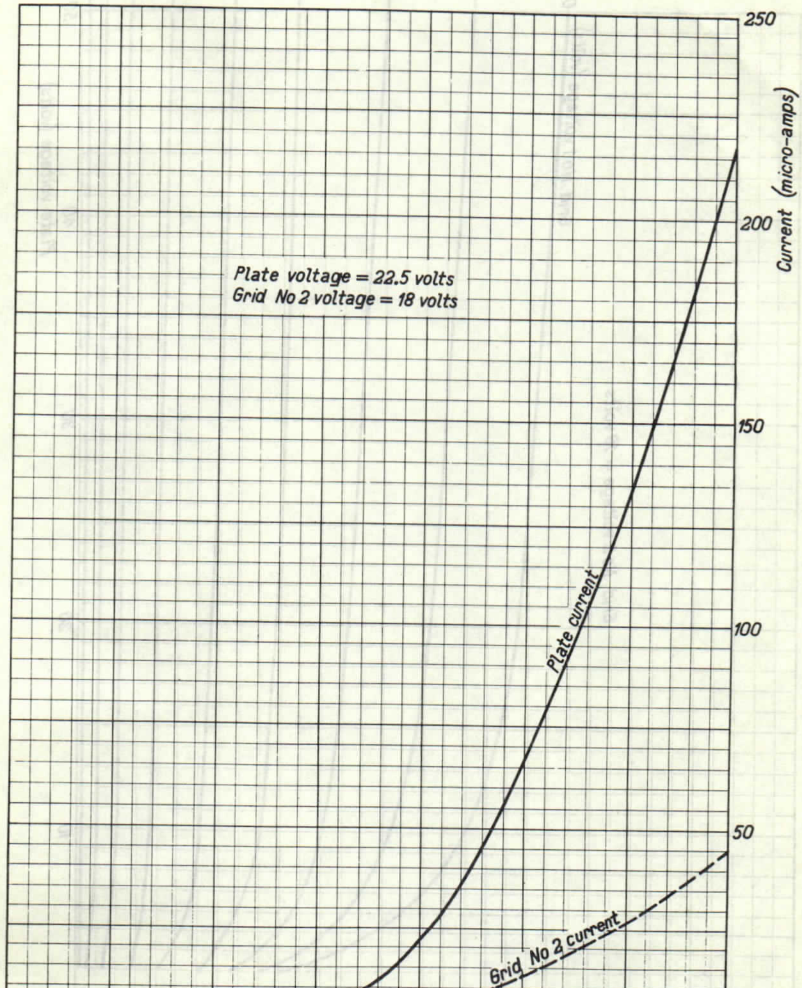
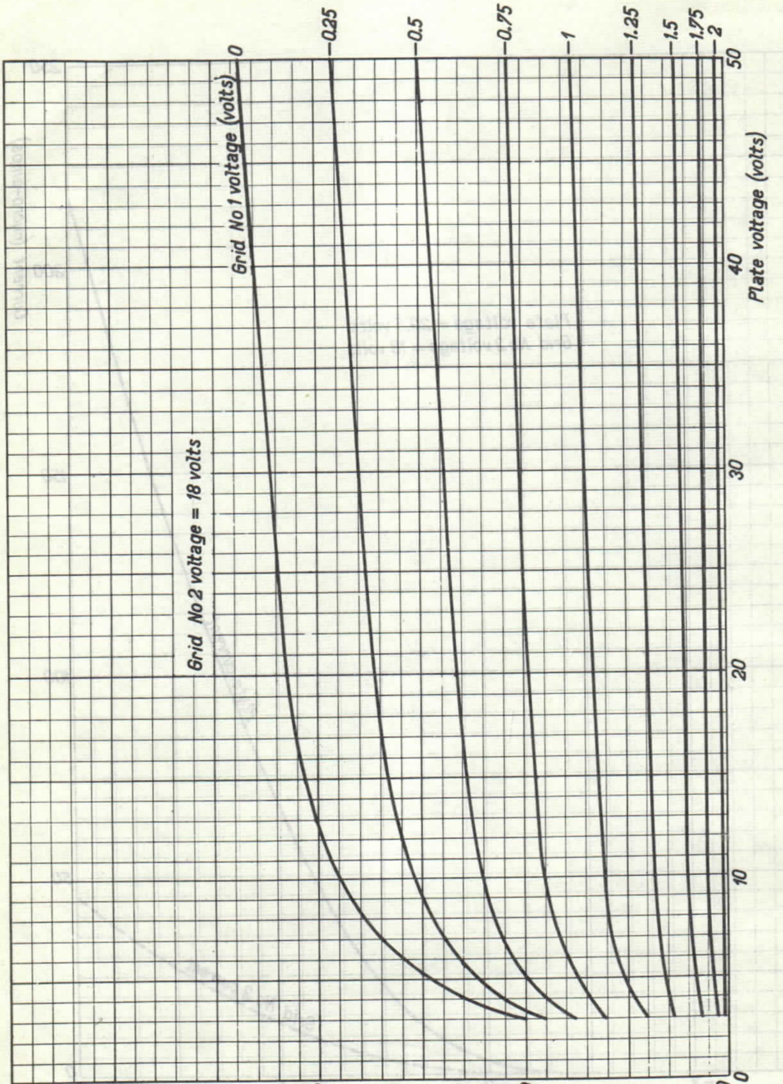


Plate voltage = 22.5 volts
Grid No 2 voltage = 18 volts
Plate current
Grid No 2 current
250
200
150
100
50
0
Current (micro-amps)
−3
−2
−1
0
Grid No 1 voltage (volts)

6008/5911



Grid No 1 voltage (volts)
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
Grid No 2 voltage = 18 volts
Plate voltage (volts)
0
10
20
30
40
50
Plate current (micro-amps)
0
100
200
300

AMPEREX TUBE TYPE 6084/E80F

The 6084 is a ruggedized amplifier pentode designed for use in circuits where high gain and low noise are important.

The cathode is oxide coated, indirectly heated. Among the applications in which the 6084 has provided extremely satisfactory service are microphone amplifiers and pre-amplifiers in sensitive measuring circuits.

It is one of the AMPEREX "Premium Quality" tubes and is guaranteed for a minimum life of 10,000 hours when operated within ratings.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode		coated, unipotential
Heater voltage [1]		6.3 volts
Heater current at 6.3 volts [1]		0.3 ± 0.015 amp.

Direct Interelectrode Capacitances

Input capacitance		5.0 ± 0.5 uuf
Output capacitance		7.3 ± 0.5 uuf
Plate to grid No. 1	max.	0.025 uuf
Grid No. 1 to heater	max.	0.002 uuf
Heater to cathode		3.7 uuf

Typical Characteristics

Plate voltage		250 volts
Grid No. 3 voltage		0 volt
Grid No. 2 voltage		100 volts
Cathode resistor		550 ohms
Plate current [2]		3 ± 0.5 ma
Grid No. 2 current [2]		0.65 ± 0.2 ma
Transconductance [2]		1850 ± 350 micromhos
Amplification factor of grid No. 2 with respect to grid No. 1		25
Plate resistance	1.5 megohm nom.,	1.0 megohm min.

[1] **In order to obtain a useful life of 10,000 hours in case of parallel supply, the maximum variation of the heater voltage should be less than ±5% (absolute limit)**
In order to obtain a useful life of 10,000 hours in case of series supply, the maximum variation of the heater current due to voltage fluctuations and tolerances in the circuit components should be less than ±1.5% (absolute limit)

[2] **The end point of life is reached when one or more of the characteristics have changed to the following values:**

Plate current	**2.0 ma**
Grid No. 2 current	**0.35 ma**
Transconductance	**1200 micromhos**
Negative grid current (grid series resistor = 0.1 megohm)	**0.2 microamps**

6084/E80F

Equivalent noise resistance (bandwidth 0-10 000 c/s; grid No. 1 circuit resistance =0 ohm)	40,000	ohms	max.
Plate current at grid No. 1 bias = −7.5 volts	20	microamps	max.
Grid current starting point. Grid No. 1 bias at grid No. 1 current = + 0.3 uA	− 1.3	volts	max.
Negative grid current (grid series resistor 0.1 megohm) [2]	0.1	microamps	max.
Grid No. 1 hum voltage (grid leak = 1 megohm)	5	microvolts	max.
Insulation between cathode and heater (voltage between cathode and heater 120 volts) [3]	10	megohms	min.

MECHANICAL

Base	Small button Noval 9-pin, JETEC 9BJ
Bulb	T6½
Maximum diameter	7/8"
Maximum overall length	2 5/8"
Mounting position	Any
Shock and vibration	See note 4

MAXIMUM RATINGS (absolute values)

Heater voltage		6.3	volts ±5%
Plate voltage	max.	300	volts
Plate voltage without current	max.	600	volts
Plate dissipation	max.	1.3	watts
Grid No. 2 voltage	max.	200	volts
Grid No. 2 voltage without current	max.	600	volts
Grid No. 2 dissipation	max.	0.4	watt
Grid No. 1 negative bias	max.	100	volts
Grid No. 3 negative bias	max.	100	volts
Cathode current	max.	9	ma
Grid No. 1 circuit resistance		see curve	
→ Voltage between heater and cathode (cath. pos., heater neg.)	max.	120	volts
→ Voltage between heater and cathode (cath. neg., heater pos.)	max.	60	volts
Bulb temperature	max.	170°	C

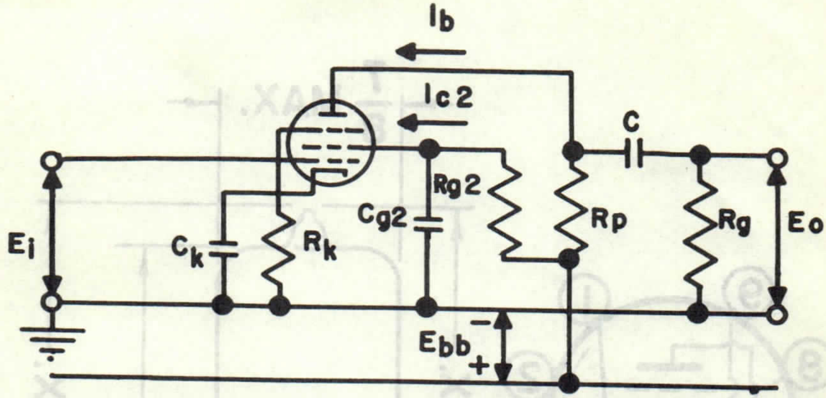
2 **The end point of life is reached when one or more of the characteristics have changed to the following values:**

Plate current	2.0 ma
Grid No. 2 current	0.35 ma
Transconductance	1200 micromhos
Negative grid current (grid series resistor = 0.1 megohm)	0.2 microamps

3 **In order to prevent the operation of the tube from being affected by variations of the heater to cathode insulation, it is advisable to keep the external resistance between heater and cathode less than 20,000 ohms.**

4 **The tube can withstand vibrations of 2.5 g for 96 hours at 50 c/s and the peak impact acceleration obtained with the aid of the N.R.L. impact machine for electronic devices, lifting the hammer through an angle of 30°.**

TYPICAL OPERATING CONDITIONS for use as Resistance-Coupled A.F. Amplifier



Rp = 0.22 megohm; Rg = 0.68 megohm Ck = 50 uf
Cg2 = 0.5 uf
C = 0.01 uf

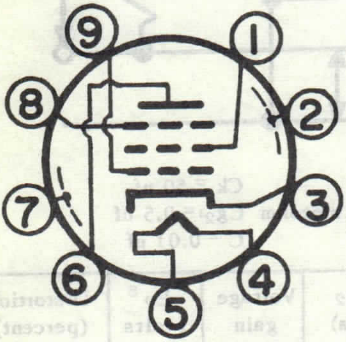
Ebb (Volts)	Rg2 (megohm)	Rk (ohms)	Ib (ma)	Ic2 (ma)	Voltage gain (Eo/Ei)	Eo [5] (volts rms)	Distortion [5] (percent)
100	1.0	3300	0.29	0.07	120	8	1.7
200	1.2	1800	0.61	0.13	165	20	1.6
250	1.2	1500	0.80	0.17	175	25	1.4
300	1.2	1200	0.98	0.20	190	30	1.1
400	1.2	1000	1.37	0.28	200	40	0.9

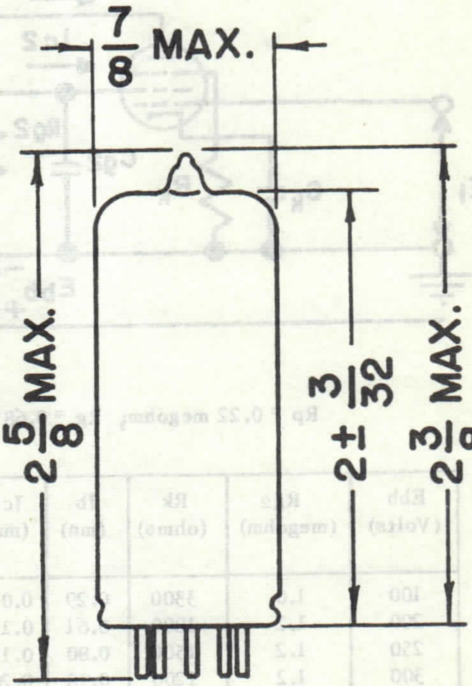
TYPICAL OPERATING CONDITIONS for use as Electrometer Pentode

Heater voltage	4.5	volts
Plate voltage	40	volts
Grid No. 3 voltage	0	volt
Grid No. 2 voltage	40	volts
Grid No. 1 bias	− 1.6	volts
Plate current	40	microamps
Grid No. 2 current	0	microamps
Grid No. 1 current	max. 10^{-10}	amp

[5] At grid current starting point.

6084/E80F





PIN 1 = GRID #2
PIN 2 = INTERNAL SHIELD
PIN 3 = CATHODE
PIN 4 = HEATER
PIN 5 = HEATER
PIN 6 = PLATE
PIN 7 = INTERNAL SHIELD
PIN 8 = GRID #3
PIN 9 = GRID #1

6084/E80F

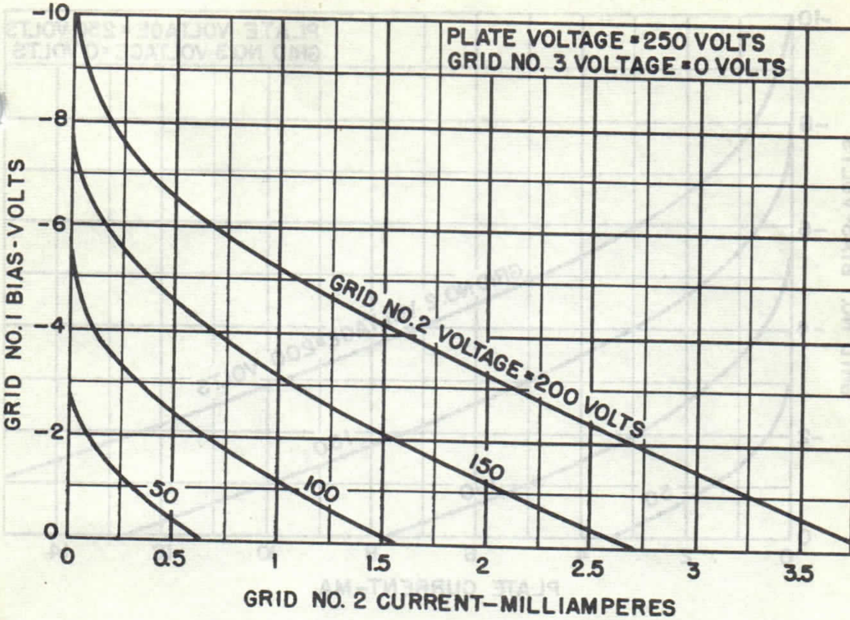
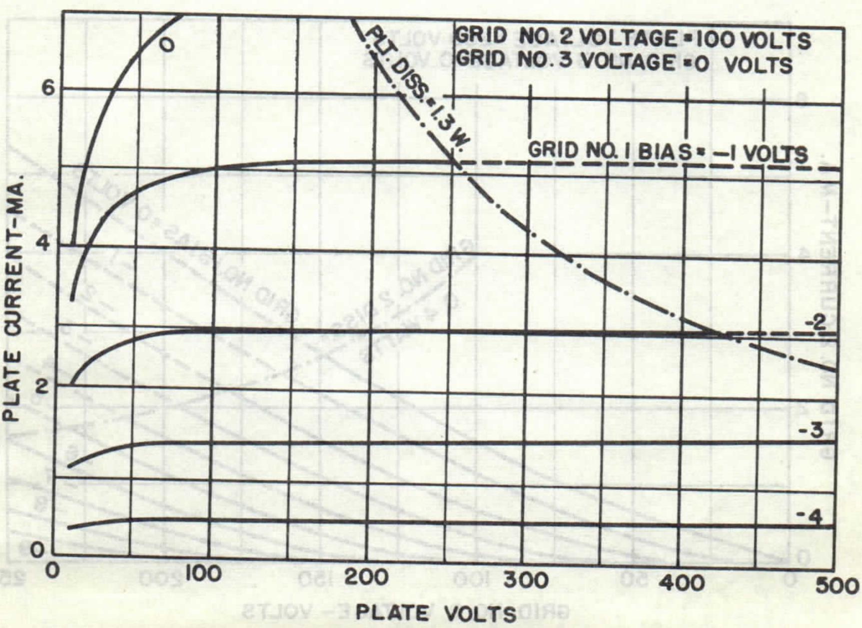


PLATE VOLTAGE = 250 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 200 VOLTS
150
100
50
GRID NO. 1 BIAS-VOLTS
-10
-8
-6
-4
-2
0
0
0.5
1
1.5
2
2.5
3
3.5
GRID NO. 2 CURRENT—MILLIAMPERES


GRID NO. 2 VOLTAGE = 100 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
PLT. DISS. = 1.3 W.
GRID NO. 1 BIAS = −1 VOLTS
0
-2
-3
-4
PLATE CURRENT-MA.
6
4
2
0
0
100
200
300
400
500
PLATE VOLTS

6084/E80F

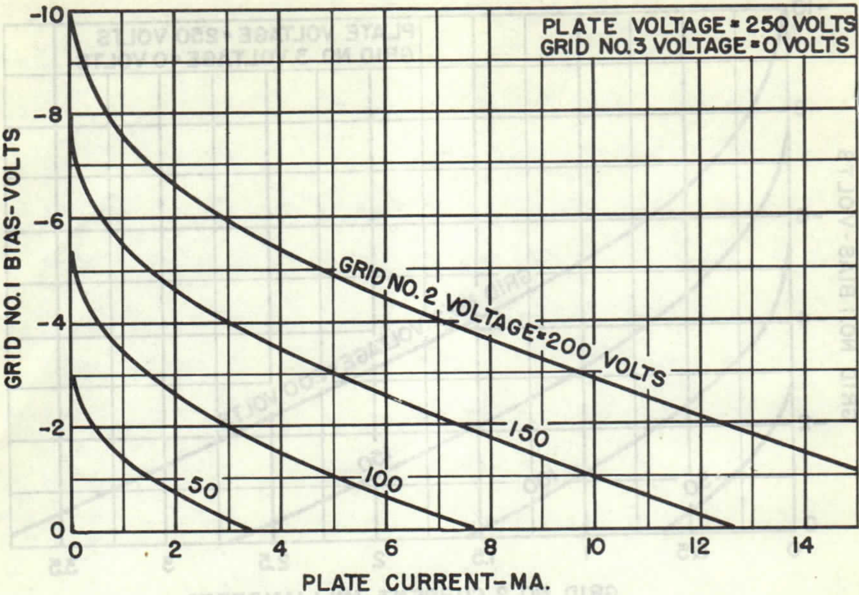


PLATE VOLTAGE = 250 VOLTS
GRID NO.3 VOLTAGE = 0 VOLTS
GRID NO.1 BIAS-VOLTS
-10
-8
-6
-4
-2
0
GRID NO. 2 VOLTAGE = 200 VOLTS
150
100
50
0
2
4
6
8
10
12
14
PLATE CURRENT-MA.

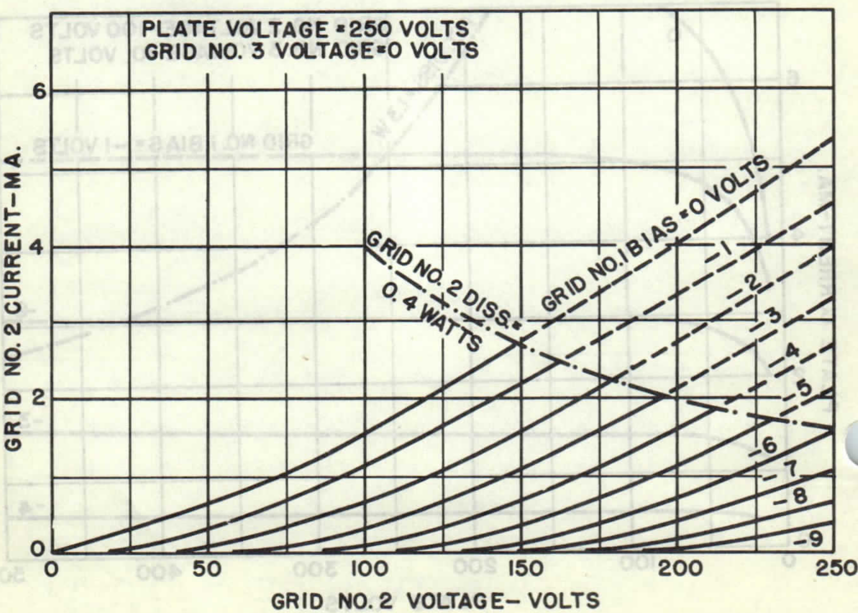


PLATE VOLTAGE = 250 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 CURRENT-MA.
6
4
2
0
GRID NO.1 BIAS = 0 VOLTS
-1
-2
-3
-4
-5
-6
-7
-8
-9
GRID NO. 2 DISS. = 0.4 WATTS
0
50
100
150
200
250
GRID NO. 2 VOLTAGE- VOLTS

6084/E80F

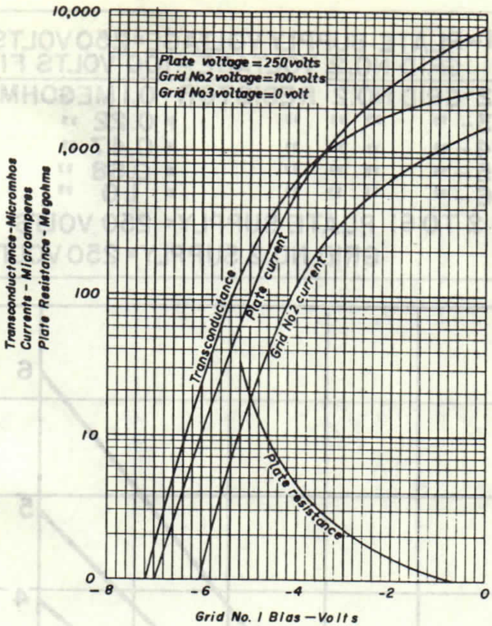


Plate voltage = 250 volts
Grid No2 voltage = 100 volts
Grid No3 voltage = 0 volt
Transconductance - Micromhos
Currents - Microamperes
Plate Resistance - Megohms
10,000
1,000
100
10
0
-8
-6
-4
-2
0
Transconductance
Plate current
Grid No2 current
Plate resistance
Grid No. 1 Bias — Volts

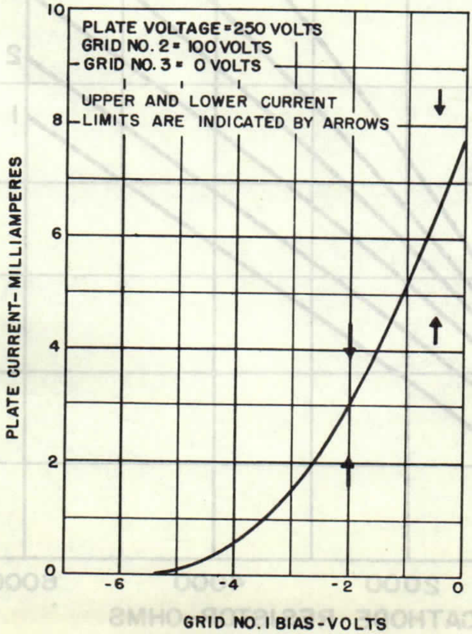
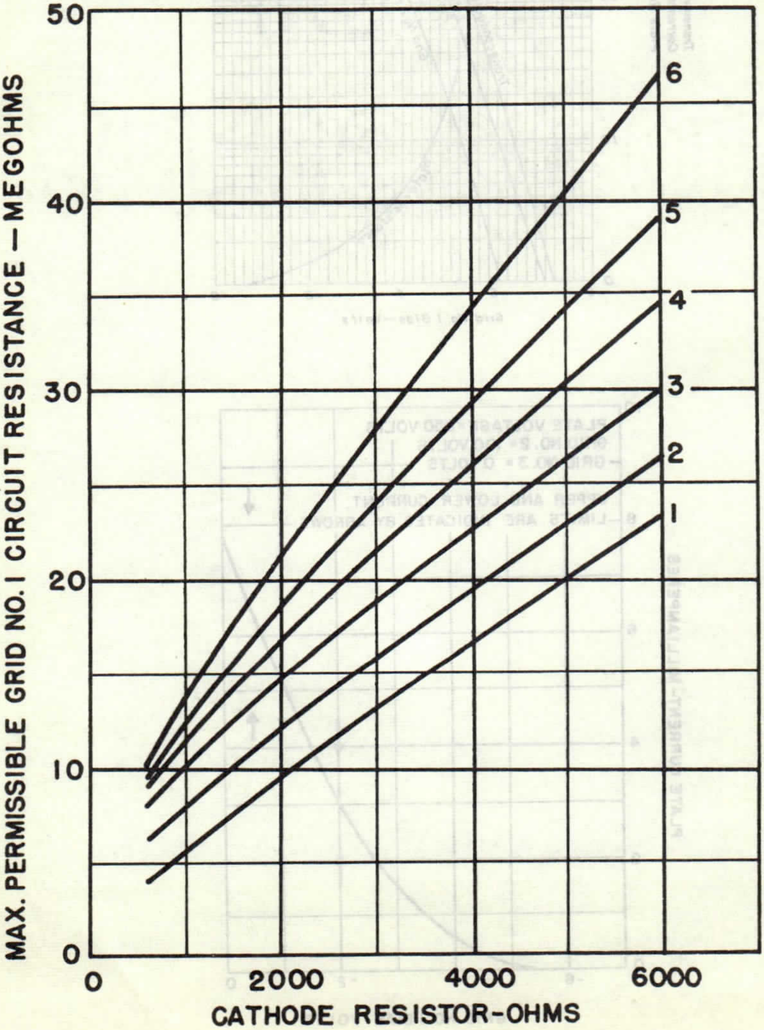


PLATE VOLTAGE = 250 VOLTS
GRID NO. 2 = 100 VOLTS
GRID NO. 3 = 0 VOLTS
UPPER AND LOWER CURRENT
LIMITS ARE INDICATED BY ARROWS
PLATE CURRENT-MILLIAMPERES
10
8
6
4
2
0
-6
-4
-2
0
GRID NO. I BIAS-VOLTS

6084/E80F

CURVE: 1-PLATE SUPPLY VOLTAGE = 250 VOLTS
GRID NO. 2 VOLTAGE = 100 VOLTS FIXED
2-GRID NO. 2 RESISTOR = 0.1 MEGOHM
3- " " " " = 0.22 "
4- " " " " = 0.47 "
5- " " " " = 0.68 "
6- " " " " = 1.0 "
CURVES 2 TO 6: PLATE SUPPLY = 250 VOLTS
GRID NO. 2 SUPPLY = 250 VOLTS



AMPEREX TUBE TYPE 6085/E80CC

The 6085 is a medium mu twin triode designed for industrial and communication applications where long-life and resistance to shock and vibration are important. The cathode is oxide coated, indirectly heated.

The two heaters can be used A.C. or D.C., in parallel or in series. Aside from the heaters which have a common connection, the triode units are completely separate permitting flexibility in circuit applications.

The 6085 is one of the AMPEREX "Premium Quality, 10,000 Hour" tubes.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	coated, unipotential
Heater voltage [1]	6.3 or 12.6 volts
Heater current at 6.3 volts [1]	0.6 ± 0.03 amp
Heater current at 12.6 volts [1]	0.3 ± 0.015 amp.

Direct Interelectrode Capacitances

	Without shield	With shield [2]
Triode No. 1		
Input capacitance	2.4	2.6 ± 0.7 μμf
Output capacitance	0.45	3.5 ± 0.7 μμf
Plate to grid	3.1	3.0 ± 0.6 μμf
Grid to heater	max. 0.23	max. 0.23 μμf
Cathode to heater	4.8	4.8 μμf
Triode No. 2		
Input capacitance	2.4	2.6 ± 0.7 μμf
Output capacitance	0.55	3.0 ± 0.7 μμf
Plate to grid	3.0	3.0 ± 0.6 μμf
Grid to heater	max. 0.23	max. 0.23 μμf
Cathode to heater	4.8	4.8 μμf
Between triode No. 1 and triode No. 2		
Plate to plate	1.45	1.3 ± 0.4 μμf
Grid to grid	max. 0.013	max. 0.013 μμf
Plate of triode No. 1 to grid of triode No. 2	max. 0.1	max. 0.1 μμf
Plate of triode No. 2 to grid of triode No. 1	max. 0.065	max. 0.065 μμf

1 **In order to obtain a useful tube life of 10,000 hours in case of parallel supply, the maximum variation of the heater voltage should be less than ± 5% (absolute limit) In order to obtain a useful tube life of 10,000 hours in case of series supply, the maximum variation of the heater current due to voltage fluctuations and tolerances in the parts should be less than ± 1.5% (absolute limit).**

2 **Length of shielding can = 2¾", inner diameter = 7/8".**

6085 / E80CC

Typical Characteristics (each section)

Plate voltage			250 volts
Cathode resistor			920 ohms
Plate current [3]			6.0 ± 0.6 ma
Transconductance [3]			2700 ± 500 micromhos
Amplification factor			27
Plate resistance			10,000 ohms
Plate resistance		min.	7000 ohms
Plate current difference of the two sections at a grid bias of −5.5 volts ($R_k = 0$)		max.	3.0 ma
Plate current at a grid bias of −17 volts and with a plate resistor of 1 megohm		max.	15 microamps
Grid current starting point. Grid bias at a grid current of + 0.3 microamp		max.	− 1.3 volts
Negative grid current (grid series resistor = 0.1 megohm) [3]		max.	0.5 microamps
Grid hum voltage (grid leak = 0.5 megohm, plate current = 1.5 ma)		max.	75 microvolts
Insulation between cathode and heater (voltage between cathode and heater = 120 volts)		min.	10 megohms
Cathode heating time	16 sec.	max.	23 sec.
Cathode cooling time		min.	13 sec.

MECHANICAL

Base	Small button, 9 pin (JETEC #9A)
Maximum Diameter	7/8"
Maximum Overall length	3 1/16"
Mounting Position	any
Shock & Vibration	See note 4

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

Maximum Ratings (absolute values, each section)

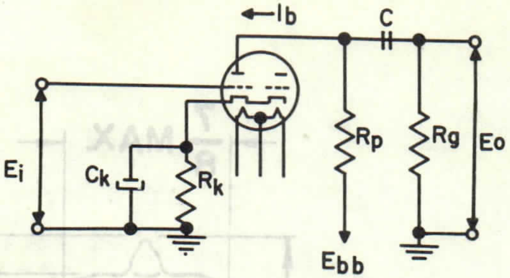
Heater voltage		6.3 volts ± 5%
Plate voltage	max.	300 volts
Plate voltage without current	max.	600 volts
Plate dissipation	max.	2 watts
Grid negative bias	max.	200 volts
Grid circuit resistance	max.	1 megohm
Grid current	max.	0.3 ma
Peak grid current	max.	30 ma
Cathode current	max.	12 ma
Peak cathode current (peak grid current less than 30 ma, duty cycle less than 0.005)	max.	150 ma
Peak cathode current (peak grid current less than 2 ma, duty cycle less than 0.2)	max.	30 ma
Voltage between heater and cathode	max.	120 volts
Circuit resistance between heater and cathode	max.	0.1 megohm
Bulb temperature	max.	170° C

3 **The end point of life is reached when one or more of the characteristics have changed to the following values:**

Plate current	**min.**	**4.3 ma**
Transconductance	**min.**	**1800 micromhos**
→ **Negative grid current (grid series resistor = 0.1 megohm)**	**max.**	**1.0 microamp**

4 **The tube can withstand vibrations of 2.5 g for 96 hours at 50 c/s as well as the peak impact acceleration obtained with the N.R.L. impact machine for electronic devices, when lifting the hammer at an angle of 30°.**

OPERATING CONDITIONS for use as resistance - coupled A.F. amplifier



Rp = 0.047 megohm; Rk = 1200 ohms; Rg = 0.15 megohm; Ck = 50 uf C = 0.01 uf

Ebb (volts)	Ib (ma)	Voltage gain	Eo [5] (volts, rms)	Distortion [6] (percent)
200	1.86	18.5	20	3.3
250	2.45	18.5	30	3.8
300	3.15	18.5	40	4.0
350	3.80	18.5	50	4.1
400	4.40	18.5	60	4.2

Rp = 0.1 megohm; Rk = 2200 ohms; Rg = 0.33 megohm; Ck = 50 uf C = 0.01 uf

Ebb (volts)	Ib (ma)	Voltage gain	Eo [5] (volts, rms)	Distortion [6] (percent)
200	1.00	20	22	3.1
250	1.30	20	32	3.4
300	1.65	20	42	3.5
350	1.95	20	52	3.6
400	2.30	20	63	3.7

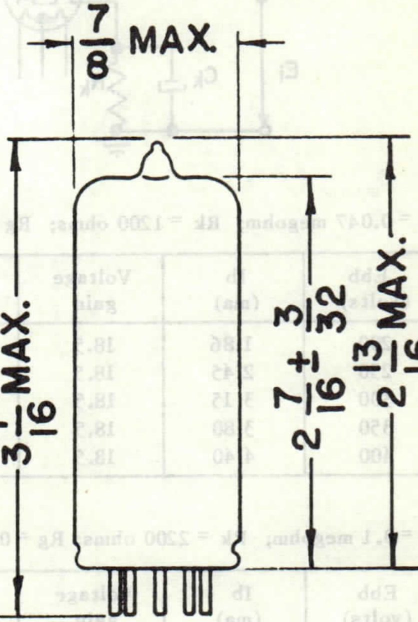
Rp = 0.22 megohm; Rk = 3900 ohms; Rg = 0.68 megohm Ck = 50 uf C = 0.01 uf

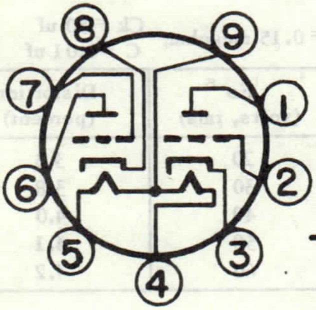
Ebb (volts)	Ib (ma)	Voltage gain	Eo [5] (volts, rms)	Distortion [6] (percent)
200	0.52	20	19	2.3
250	0.67	21	29	2.6
300	0.83	21	38	3.0
350	0.99	21	47	3.1
400	1.15	21	58	3.2

[5] **Output voltage at grid current starting point**

[6] **At lower output voltages the distortion is approximately proportional to the voltage.**

6085/E80CC





PIN 1 = PLATE
PIN 2 = GRID
PIN 3 = CATHODE
} TRIODE NO. 1

PIN 4 = HEATER
PIN 5 = HEATER

PIN 6 = PLATE
PIN 7 = GRID
PIN 8 = CATHODE
} TRIODE NO. 2

PIN 9 = HEATER C.T.

6085/E80CC

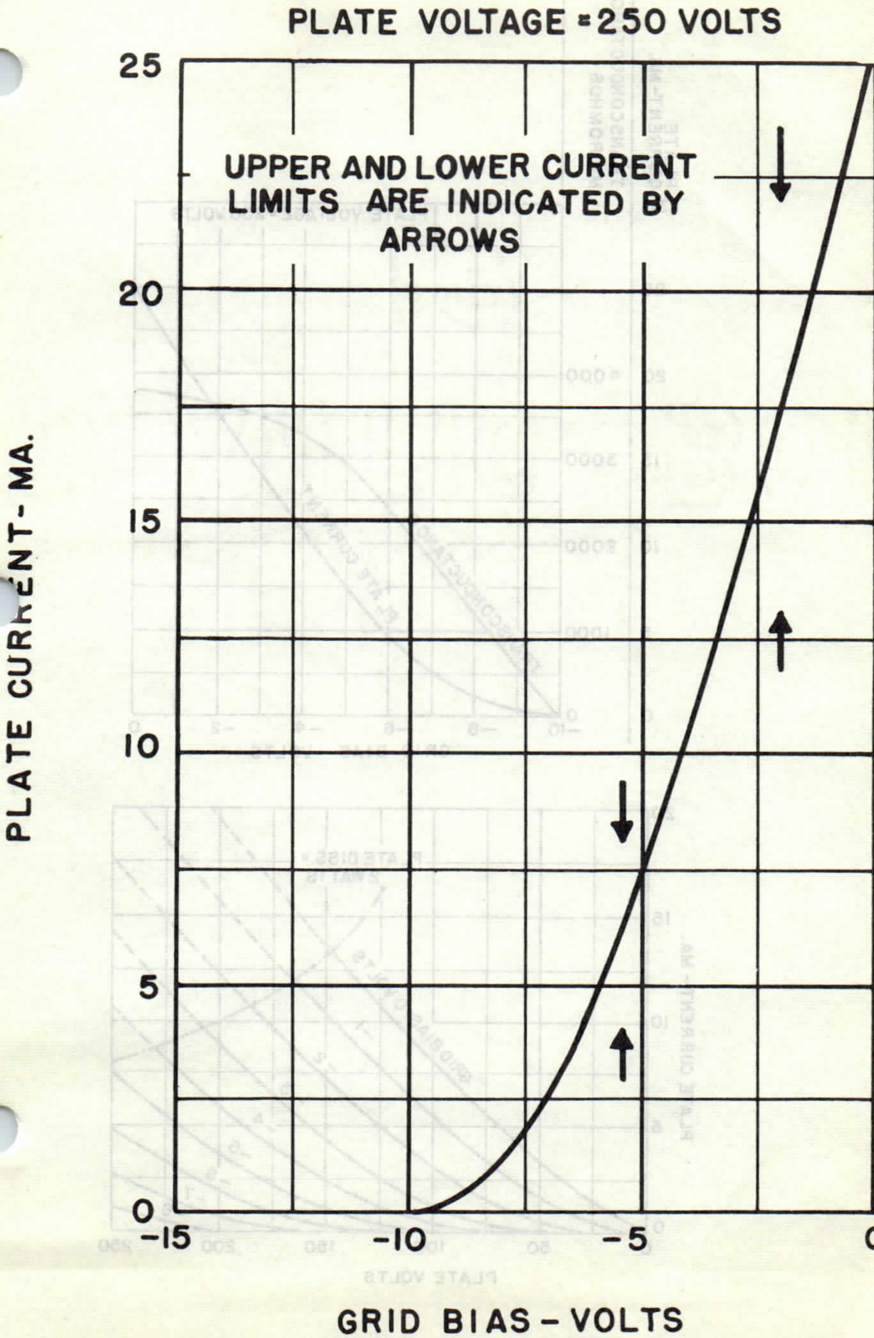


PLATE VOLTAGE = 250 VOLTS
UPPER AND LOWER CURRENT LIMITS ARE INDICATED BY ARROWS
PLATE CURRENT - MA.
25
20
15
10
5
0
-15
-10
-5
0
GRID BIAS - VOLTS

6085/E80CC

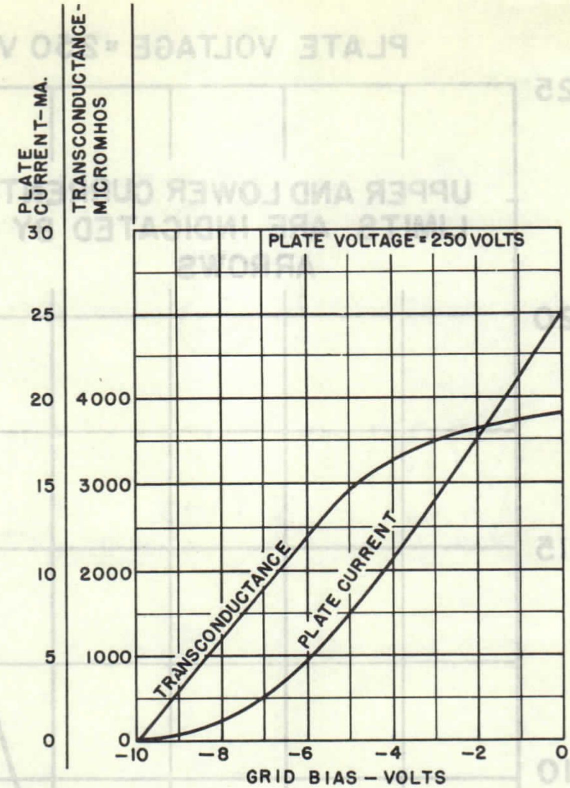


PLATE CURRENT–MA.
TRANSCONDUCTANCE–MICROMHOS
PLATE VOLTAGE = 250 VOLTS
TRANSCONDUCTANCE
PLATE CURRENT
30
25
20
15
10
5
0
4000
3000
2000
1000
0
–10
–8
–6
–4
–2
0
GRID BIAS – VOLTS

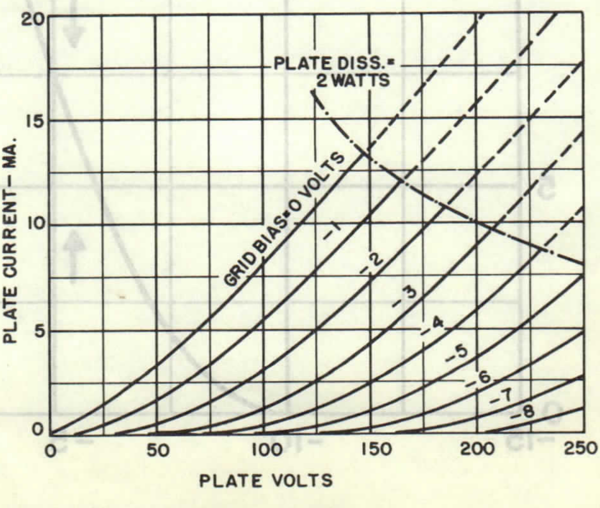


PLATE CURRENT– MA.
PLATE DISS.= 2 WATTS
GRID BIAS=0 VOLTS
–1
–2
–3
–4
–5
–6
–7
–8
20
15
10
5
0
0
50
100
150
200
250
PLATE VOLTS

AMPEREX TUBE TYPE 6189

The Amperex 6189[1] is a miniature, medium-mu twin triode, each section of which has an individual cathode connection. The construction of the 6189 is such that noise and microphony are reduced to a minimum. Hum is reduced by use of a coiled tungsten heater. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt supply.

The 6189 is one of the Amperex "Premium Quality, 10,000 Hour" tubes.

GENERAL CHARACTERISTICS

MECHANICAL

Maximum Overall Dimensions	
Length	2-3/16 inches
Seated Height	1-15/16 inches
Diameter	7/8 inch
Mounting Position	any
Base	Small Button, 9 pin RETMA #9A

ELECTRICAL

	Series	Parallel
Cathode	Coated, unipotential	
Heater Voltage, AC or DC	12.6	6.3 volts
Heater Current[2]	0.15	0.3 amps

Direct Interelectrode Capacitances

	With Shield[3]	Without Shield
Grid to Plate (each section)	1.6	1.6 uuf
Input (each section)	2.0	1.8 uuf
Output (Section 1)	2.1	0.5 uuf
Output (section 2)	2.1	0.37 uuf

1. The 6189 is a Premium Quality Version of the 12AU7.
2. When used in equipment which employs series-connected heaters, a current-limiting device must be inserted to limit the current when switching on.
3. With external shield (RETMA #315) connected to cathode of section under test.

11/65

MAXIMUM RATINGS (Each Section)

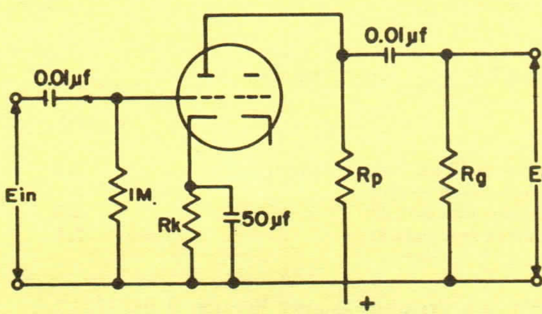
Design Center Values

Zero Signal Plate Voltage	550 volts
Plate Voltage	300 volts
Plate Dissipation	2.75 watts
Cathode Current	20 mA
Grid Voltage	−100 volts
Grid to Plate Voltage	−250 volts
Grid Voltage (Grid current = + 0.3 uA)	−1.3 volts
Grid Resistance [4]	1 megohm
Heater to Cathode Voltage	180 volts
Heater to Cathode Resistance	20,000 ohms
Heater to Cathode Resistance [5]	150,000 ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

Plate Voltage	100	250	volts
Grid Voltage	0	−8.5	volts
Amplification Factor	19.5	17	
Plate Resistance (approx.)	6250	7700	ohms
Transconductance	3100	2200	micromhos
Plate Current	11.8	10.5	mA



Rp = 0.047 MΩ
Rg = 0.15 MΩ

CLASS A RESISTANCE-COUPLED AMPLIFIER, EACH SECTION

[4] With self bias.

[5] In phase inverting circuits.

Rp = 0.047 MΩ Rg = 0.15 MΩ Rk = 1.2 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
100	1.20	11	13.5	5.6
150	1.82	18	1.35	6.1
200	2.41	26	13.5	6.3
250	3.02	34	13.5	6.4
300	3.65	43	13.5	6.5
350	4.30	51	13.5	6.6
400	5.00	59	13.5	6.7

Rp = 0.1 MΩ Rg = 0.33 MΩ Rk = 2.2 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
100	0.66	10	14	4.8
150	0.98	17	14	5.6
200	1.30	25	14	5.8
250	1.63	32	14	5.9
300	1.97	41	14	6.0
350	2.30	49	14	6.1
400	2.62	57	14	6.2

Rp = 0.22 MΩ Rg = 0.68 MΩ Rk = 3.9 KΩ

E_{bb} (V)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
100	0.33	8	14.5	4.0
150	0.50	15	14.5	4.4
200	0.66	22	14.5	4.7
250	0.82	28	14.5	4.8
300	0.98	36	14.5	4.9
350	1.16	43	14.5	5.0
400	1.31	50	14.5	5.1

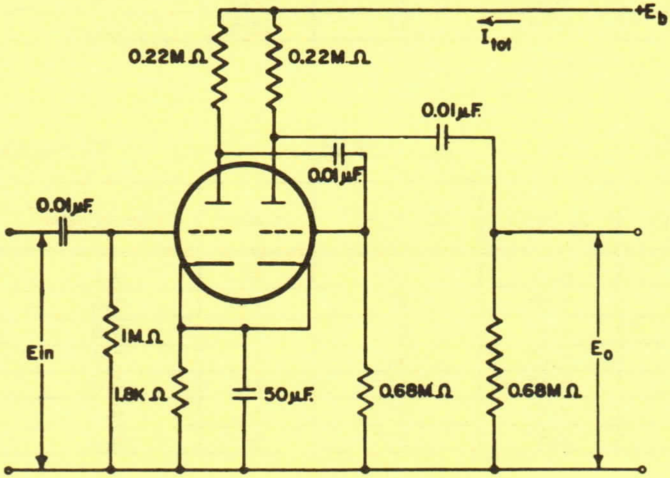
[6] Grid current = + 0.3 μA.

[7] Approximately proportional to output voltage

Class A Resistance - Coupled Amplifier

Two Sections in Cascade

Supply Voltage	250	350	volts
Total Current	1.66	2.33	mA
Output Voltage [6]	15	25	volts (RMS)
Gain	178	178	
Total Distortion [7]	2	2	%



APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 50 millivolts when the tube is mounted in the near vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%.

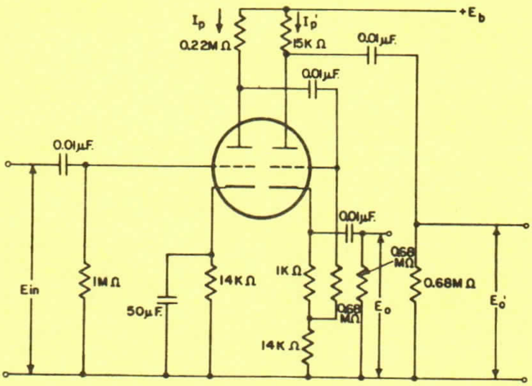
HUM

The hum and noise level will be better than −60 db when the grid circuit impedance is less than 0.3 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is decoupled by a capacitor of at least 100 uuf.

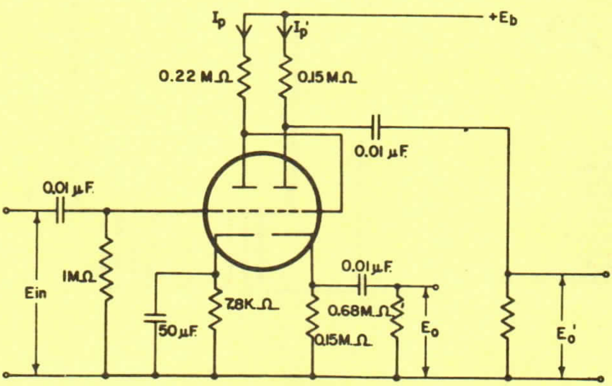
[6] Grid current = + 0.3 μA.

[7] Approximately proportional to output voltage

Operating Characteristics as a Phase Inverter



Supply Voltage	250	350	volts
Plate Current (I_p)	0.82	1.16	mA
Plate Current (I_p')	4.5	6.3	mA
Output Voltage[6]	13	20	volts (RMS)
Voltage Gain	11	11	
Percent Distortion [7]	1.5	1.5	%

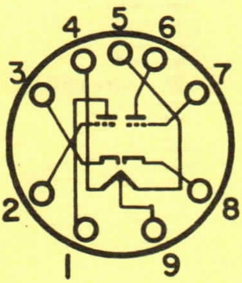


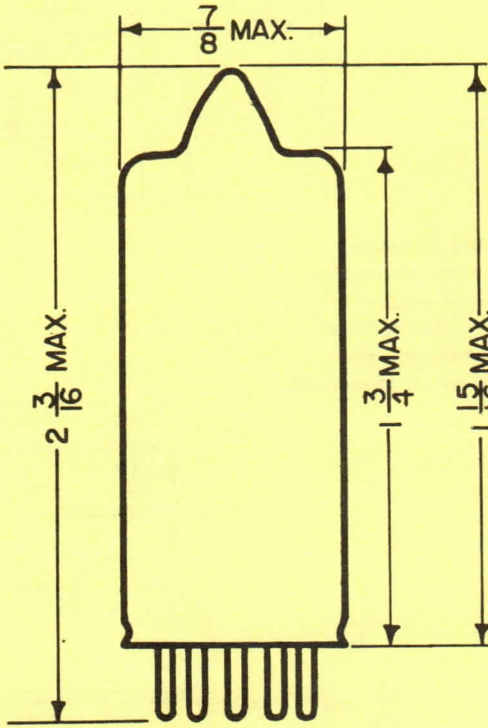
Supply Voltage	250	350	volts
Plate Current (I_p)	0.70	1.00	mA
Plate Current (I_p')	0.68	0.93	mA
Output Voltage[6]	15	24	volts (RMS)
Voltage Gain	11	11	
Percent Distortion [7]	1.0	1.0	%

[6] Grid Current = + 0.3 μA.

[7] Approximately proportional to output voltage.

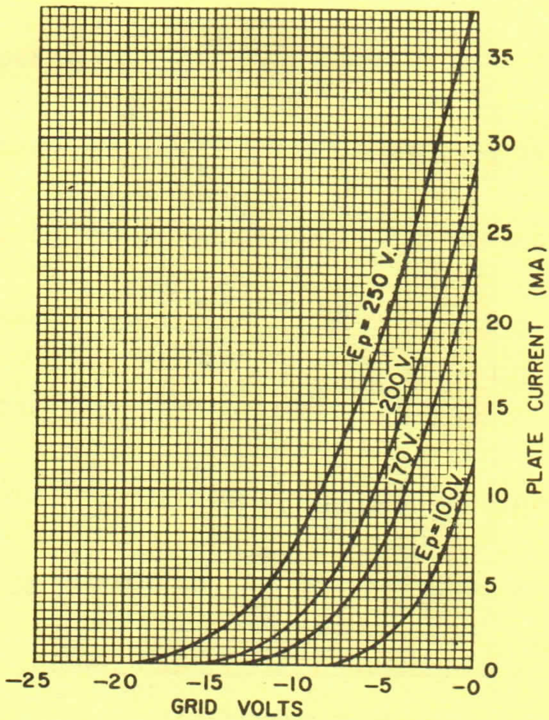
6189

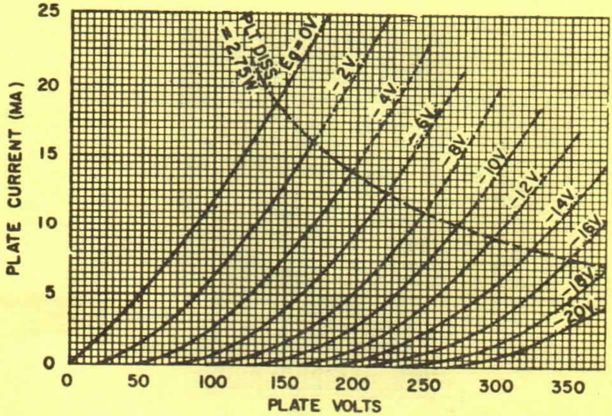




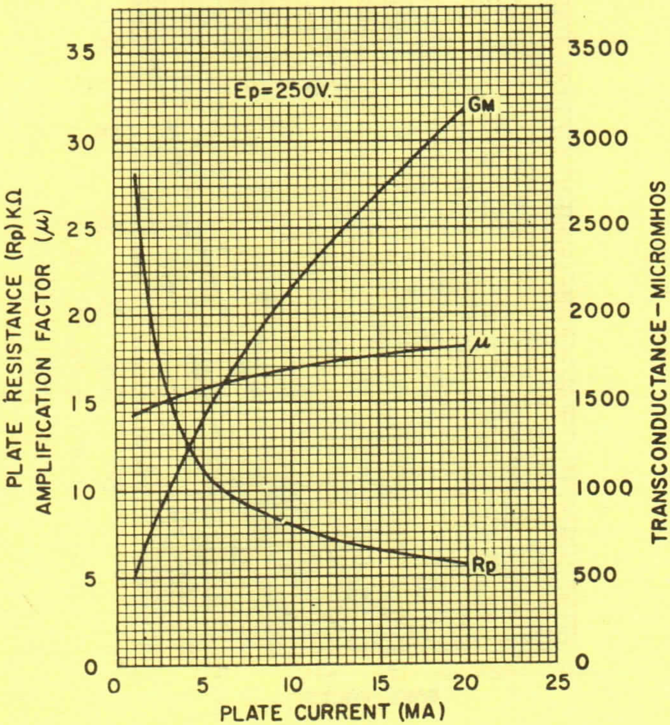
PIN CONNECTIONS

PIN NO. 1 = PLATE NO. 1
PIN NO. 2 = GRID NO. 1
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = PLATE NO. 2
PIN NO. 7 = GRID NO. 2
PIN NO. 8 = CATHODE
PIN NO. 9 = HEATER CENTER TAP

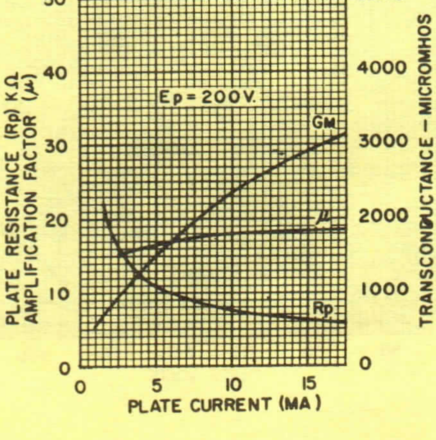

Ep=250 V.
200 V.
170 V.
Ep=100 V.
35
30
25
20
15
10
5
0
PLATE CURRENT (MA)
−25
−20
−15
−10
−5
−0
GRID VOLTS


PLT DISS.
=2.75 W.
Eg=0V.
−2V.
−4V.
−6V.
−8V.
−10V.
−12V.
−14V.
−16V.
−18V.
−20V.
25
20
15
10
5
0
PLATE CURRENT (MA)
0
50
100
150
200
250
300
350
PLATE VOLTS

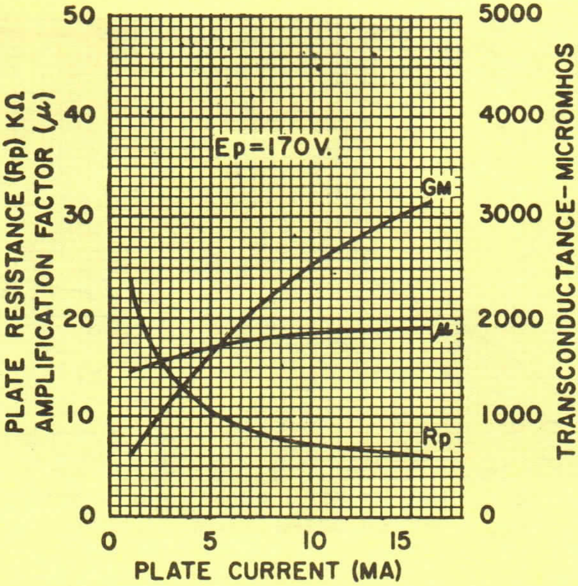
6189



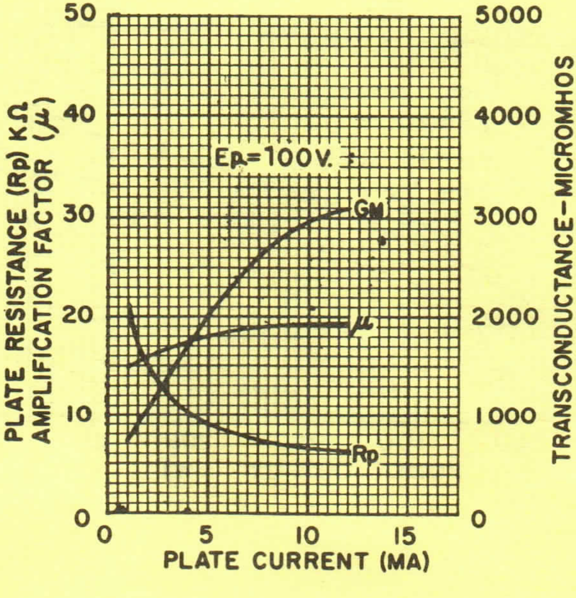
Ep=250V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE - MICROMHOS
PLATE CURRENT (MA)
0
5
10
15
20
25
30
35
500
1000
1500
2000
2500
3000
3500



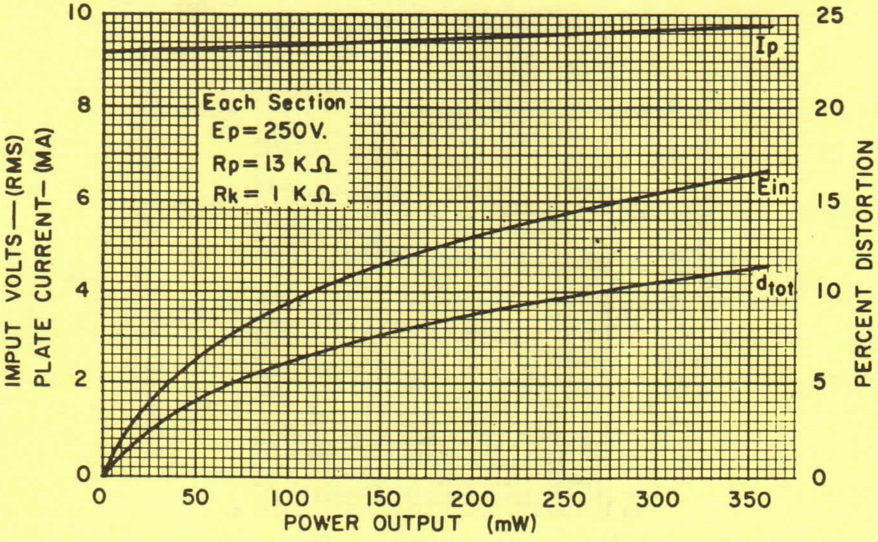
Ep = 200V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE - MICROMHOS
PLATE CURRENT (MA)
0
5
10
15
20
30
40
50
1000
2000
3000
4000
5000

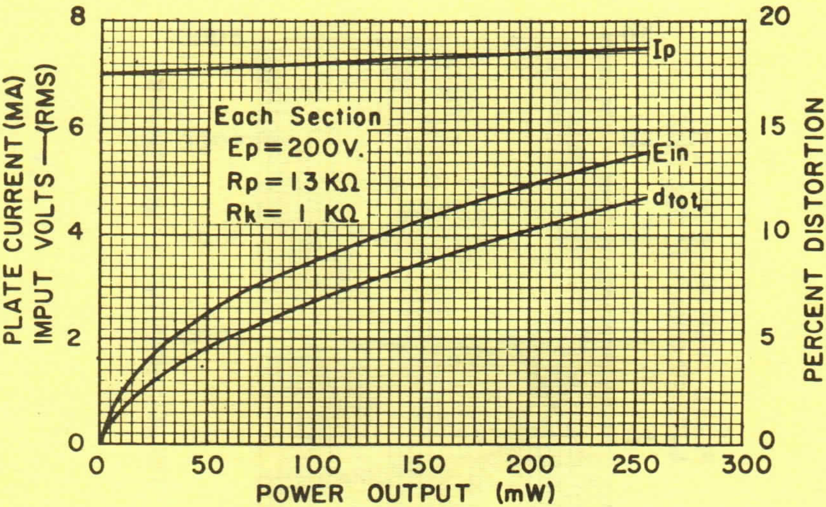


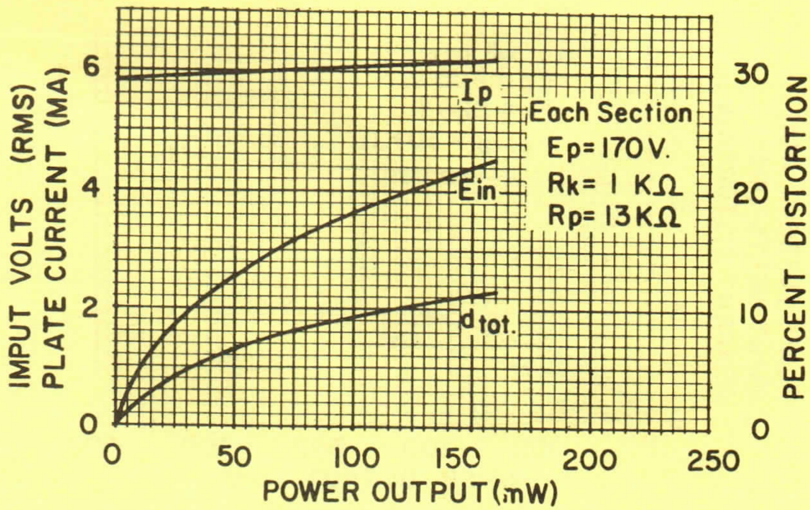
Ep=170V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE-MICROMHOS
PLATE CURRENT (MA)
0
10
20
30
40
50
1000
2000
3000
4000
5000
5
15

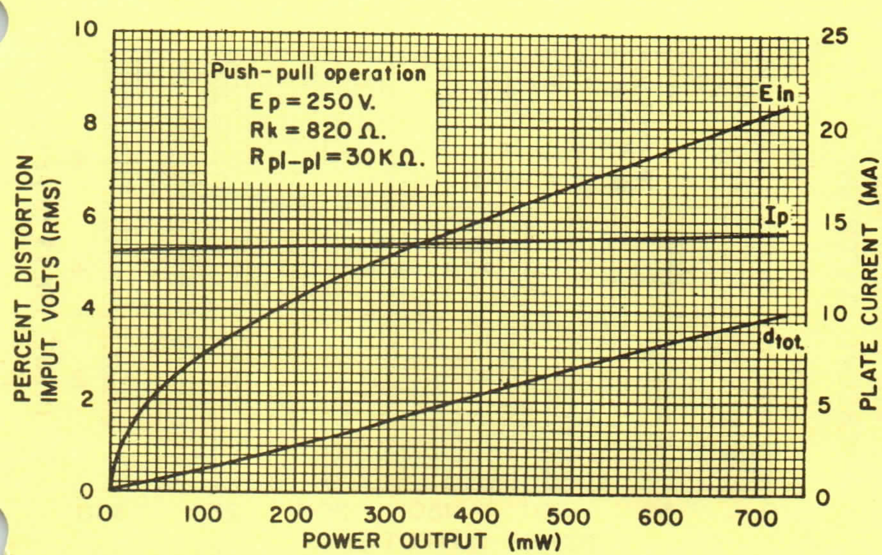


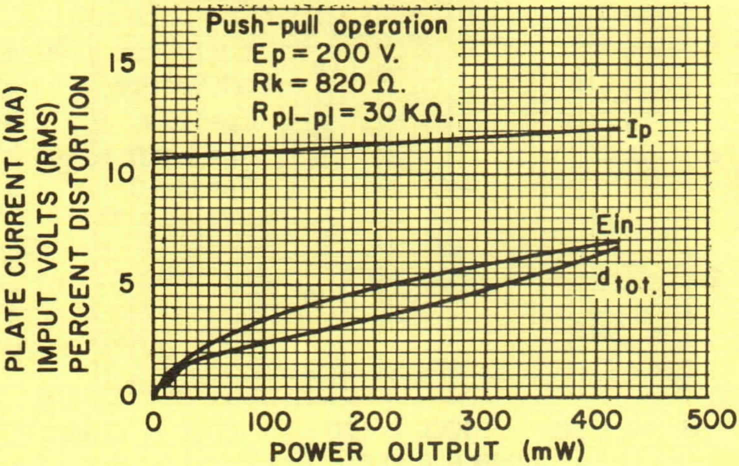
Ep=100V.
GM
μ
Rp
PLATE RESISTANCE (Rp) KΩ
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE-MICROMHOS
PLATE CURRENT (MA)
0
10
20
30
40
50
1000
2000
3000
4000
5000
5
15

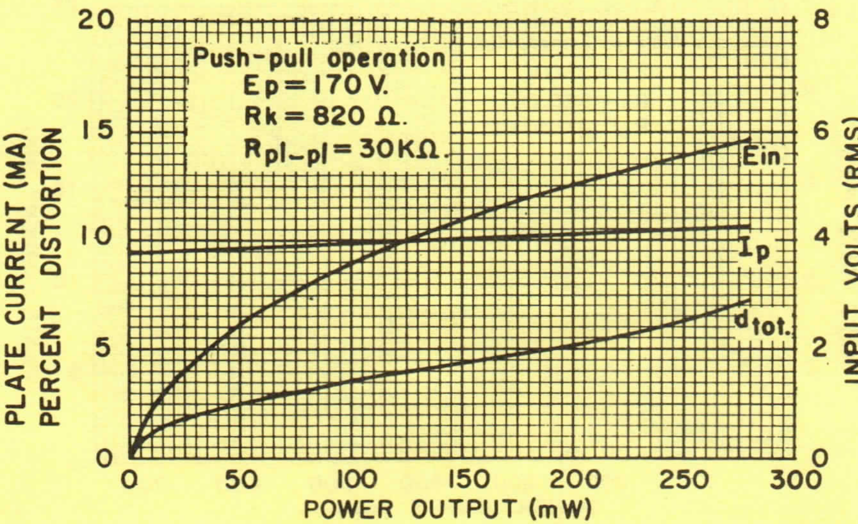

Each Section
Ep = 250V.
Rp = 13 KΩ
Rk = 1 KΩ
Ip
Ein
dtot
IMPUT VOLTS — (RMS)
PLATE CURRENT — (MA)
PERCENT DISTORTION
POWER OUTPUT (mW)
0
50
100
150
200
250
300
350
2
4
6
8
10
5
15
20
25


Each Section
Ep = 200V.
Rp = 13 KΩ
Rk = 1 KΩ
Ip
Ein
dtot
PLATE CURRENT (MA)
IMPUT VOLTS — (RMS)
PERCENT DISTORTION
POWER OUTPUT (mW)
0
50
100
150
200
250
300
2
4
6
8
5
10
15
20


IMPUT VOLTS (RMS)
PLATE CURRENT (MA)
PERCENT DISTORTION
POWER OUTPUT (mW)
Ip
Ein
d tot.
Each Section
Ep= 170 V.
Rk= 1 KΩ
Rp= 13 KΩ
0
2
4
6
10
20
30
50
100
150
200
250


PERCENT DISTORTION
IMPUT VOLTS (RMS)
PLATE CURRENT (MA)
POWER OUTPUT (mW)
Push-pull operation
Ep = 250 V.
Rk = 820 Ω.
Rpl-pl = 30 K Ω.
Ein
Ip
d tot.
0
2
4
6
8
10
5
15
20
25
100
200
300
400
500
600
700

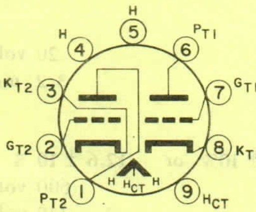

Push-pull operation
Ep = 200 V.
Rk = 820 Ω.
Rpl-pl = 30 KΩ.
Ip
Ein
dtot.
PLATE CURRENT (MA)
IMPUT VOLTS (RMS)
PERCENT DISTORTION
0
5
10
15
0
100
200
300
400
500
POWER OUTPUT (mW)


Push-pull operation
Ep = 170 V.
Rk = 820 Ω.
Rpl-pl = 30 KΩ.
Ein
Ip
dtot.
PLATE CURRENT (MA)
PERCENT DISTORTION
0
5
10
15
20
INPUT VOLTS (RMS)
0
2
4
6
8
0
50
100
150
200
250
300
POWER OUTPUT (mW)

AMPEREX TUBE TYPE 6201

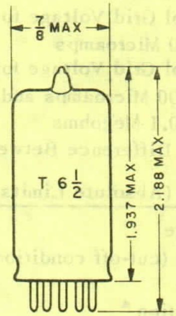
The 6201 is a premium quality shock and vibration resistant twin triode designed for use as an RF amplifier in grounded grid circuits; as a frequency changer below 300 mc/s; in mobile and industrial equipment with intermittent operation, and in on-off control applications where operation under cut-off conditions is required.

The 6201 is an improved version of the 12AT7/ECC81.



PIN CONNECTIONS

1. PLATE, TRIODE 2
2. GRID, TRIODE 2
3. CATHODE, TRIODE 2
4. HEATER, TRIODE 2
5. HEATER, TRIODE 1
6. PLATE, TRIODE 1
7. GRID, TRIODE 1
8. CATHODE, TRIODE 1
9. HEATER, CENTER TAP



MECHANICAL

Cathode	coated, unipotential
Bulb	T-6½
Outline	6 - 2
Base	E9 - 1
Base Connections	9A
Mounting Position	Any

ELECTRICAL

	parallel	series [1]
Heater Voltage	6.3 V	12.6 V
Heater Current	300 mA	150 ± 7.5 mA

Interelectrode Capacitances (One Section)	no external shield	with external shield [2]
Between Grid and All Other Electrodes Except the Plate	2.5 ± 0.5	2.5 μμf
Between Plate and All Other Electrodes Except the Grid	0.45 ± 0.25	1.2 μμf
Between Plate and Grid	1.6 ± 0.3	1.6 μμf
Between Cathode and Heater	2.8 ± 0.7	2.8 μμf
Between Plates of Both Sections	0.24 ± 0.9	μμf

In Grounded Grid Circuit [3] (One Section)		
Between Cathode and Grid + Heater	5.0	5.0 μμf
Between Plate and Grid + Heater	1.9	2.7 μμf
Between Plate and Cathode	0.2	0.18 μμf

[1] In case of series supply a heater current limitation should be provided in order to avoid excessive current during switching on.

[2] Connected to cathode of section under test.

[3] External shield connected to grid.

6201

Typical Characteristics (Each Section)

Plate Supply Voltage	100	250 volts
Cathode Resistor	270	200 ohms
Plate Current	3.3	10 mA
Transconductance	4,000	5,500 micromhos
Plate Resistance	14,300	10,900 ohms
Amplification Factor	57	60
Cut-off Control Grid Voltage for Plate Current of 10 Microamps	5	12 volts
Cut-off Control Grid Voltage for Plate Current of 100 Microamps and Plate Resistor of 0.1 Megohms		20 volts max
Plate Current Difference Between Sections		3.2 mA max

Maximum Ratings (Absolute Limits; Each Section)

Heater Voltage	6.3 ± 10% or 12.6 ± 10 %
Plate Voltage (cut-off condition)	600 volts
Plate Voltage	330 volts
Plate Dissipation [4]	2.8 watts
Cathode Current	18 mA
Grid Current	250 microamps
Negative Grid Voltage	55 volts
Grid Circuit Resistance (Cathode Bias)	1 megohm max
Grid Circuit Resistance (Fixed Bias)	0.25 megohm max
Voltage Between Heater and Cathode	100 volts
External Resistance Between Heater and Cathode	20,000 ohms
Bulb Temperature [4]	200°C

SPECIAL RATINGS AND PERFORMANCE DATA[5]

Heater Cycling Ratings

Cycles of Intermittent Operation — 2000 cycles min

$V_f = 7.5$ V, Cycles 1 Minute on and 1 Minute Off

$V_a = V_g = 0$ V, $V_{-k/+f} = 135$ V

Shock Ratings

Impact Acceleration In Any Direction — approx. 600 g

Forces as Applied by the N.R.L. Impact Machine for Electronic Devices Caused By 5 Blows of the Hammer Lifted Over an Angle of 42°.

Fatigue Ratings

Vibrational Acceleration in Any Direction — 2.5 g

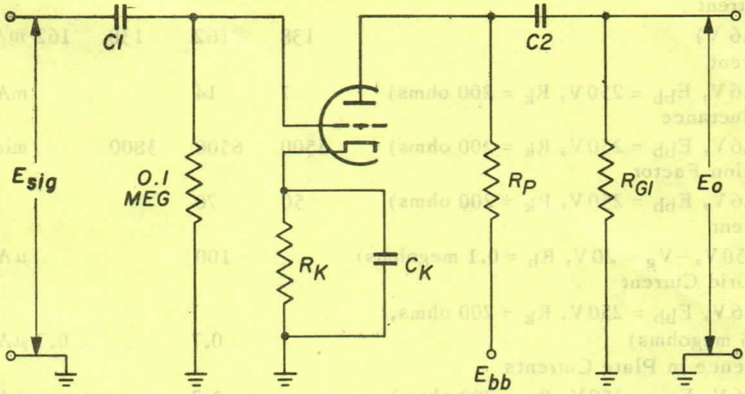
Vibrational Forces for a Period of 32 Hours at a Frequency of 25 Cycles per Second, in Each of the Three Directions

[4] Tube life and reliability of performance will be improved by operation at lower value.

[5] These test conditions are only given for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions

Operating Conditions as AF Amplifier

C_1, C_2, and C_k should be chosen so high that inverse feedback and decrease in alternating voltage are negligible.



For Driving from Low-Ohmic Voltage Sources (200 ohms approx)

		E_b = 90 Volts			E_b = 180 Volts			E_b = 300 Volts		
R_p (Mohm)	$R_g{}'$ (Mohm)	R_k (ohm)	E_o [6]	E_o/E_i [7]	R_k (ohm)	E_o [6]	E_o/E_i [7]	R_k (ohm)	E_o [6]	E_o/E_i [7]
0.10	0.10	1600	5.3	26	1100	12	31	1000	22	32
0.10	0.24	1800	7.8	29	1400	17	33	1200	30	33
0.24	0.24	3800	7.2	28	2800	16	32	2300	28	34
0.24	0.51	4200	9.4	30	3300	20	33	2800	35	33
0.51	0.51	8000	8.3	28	5600	18	31	4900	31	33
0.51	1.0	9600	10	29	6700	23	32	6000	38	33

For Driving from High-Ohmic Voltage Sources (0.1 Megohm approx)

		E_b = 90 Volts			E_b = 180 Volts			E_b = 300 Volts		
R_p (Mohm)	$R_g{}'$ (Mohm)	R_k (ohm)	E_o [6]	E_o/E_i [7]	R_k (ohm)	E_o [6]	E_o/E_i [7]	R_k (ohm)	E_o [6]	E_o/E_i [7]
0.10	0.10	2000	9.9	25	1200	17	31	900	35	33
0.10	0.24	2400	13	27	1400	28	33	1200	47	33
0.24	0.24	4700	12	27	2900	25	32	2300	42	34
0.24	0.51	5300	15	28	3600	31	33	2900	52	34
0.51	0.51	9300	13	27	6000	27	31	5000	45	33
0.51	1.0	11000	16	28	7100	33	32	6400	55	34

6 Max E_o for d_t = 5% approx.

7 At E_o = 2 Vrms

6201

Characteristics Range Value for Equipment (Each Unit)

	Initial Min	Initial Max	End of Life [8] Min	End of Life [8] Max	
Heater Current (E_f = 12.6 V)	138	162	138	162	mA
Plate Current (E_f = 12.6 V, E_{bb} = 250 V, R_k = 200 ohms)	7	14			mA
Transconductance (E_f = 12.6 V, E_{bb} = 250 V, R_k = 200 ohms)	4500	6500	3800		micromhos
Amplification Factor (E_f = 12.6 V, E_{bb} = 250 V, R_k = 200 ohms)	50	70			
Plate Current (E_{bb} = 250 V, $-V_g$ = 20 V, R_b = 0.1 megohms)		100			μA
Negative Grid Current (E_f = 12.6 V, E_{bb} = 250 V, R_k = 200 ohms, R_g = 0.5 megohms)		0.7		0.7	μA
Max Difference in Plate Currents (E_f = 12.6 V, E_{bb} = 250 V, R_k = 200 ohms)		3.2			mA
Cathode - Heater Current ($E_{k/f}$ = 100 V, E_f = 12.6 V, units in parallel)		10		10	μA
Grid to Cathode Insulation Resistance (E_f = 12.6 V, E_b = 100 V, Cathode positive)	100		50		megohms
Plate to Cathode Insulation Resistance (E_f = 12.6 V, E_b = 300 V, Cathode positive)	100		50		megohms
Interface resistance				50	ohms

Direct Interelectrode Capacitances (without external shield)

(One Section)	Min	Max	
Input	2.0	3.0	$\mu\mu$f
Output	0.2	0.7	$\mu\mu$f
Plate to Grid	1.3	1.9	$\mu\mu$f
Cathode to Heater	2.1	3.5	$\mu\mu$f
Plate to Plate (both sections)	0.15	0.33	$\mu\mu$f

Vibrational Noise Output

Vibrational acceleration 2.5 g at 25 cps

E_f= 12.6 V, E_{bb} = 250 V, $-V_g$ = 3 V, R_L = 2000 ohms
Units in parallel 100 mV

---

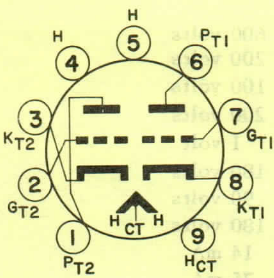
[8] Life test conditions:

Heater Voltage	12.6 volts
Supply Voltage	250 volts
Cathode Resistor	200 ohms
Grid Resistor	0.5 megohms
Cathode - Heater Voltage	135 volts
Bulb Temperature	200°C

AMPEREX TUBE TYPE 6211

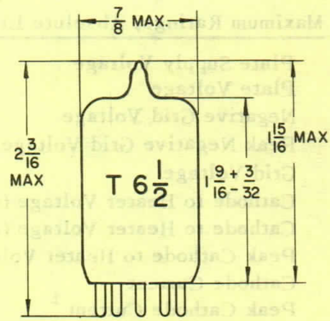
The 6211 is a twin triode with separate cathodes designed for application in computer circuits not critical as to hum, microphony, and noise. Operation of the tube for long periods of time under cut-off conditions will not cause deterioration of the emission surface.

The 6211 is one of the Amperex 10,000 hour, "Premium Quality" tubes.



PIN CONNECTIONS

1 - PLATE, TRIODE NO 2
2 - GRID, TRIODE NO 2
3 - CATHODE, TRIODE NO 2
4 - HEATER
5 - HEATER
6 - PLATE, TRIODE NO 1
7 - GRID, TRIODE NO 1
8 - CATHODE, TRIODE NO 1
9 - HEATER CENTER TAP



6-2

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Bulb	T6½
Envelope	6-2
Base	E9-1
Mounting	vertical, base up or down or horizontal, pins 2 and 8 in a horizontal plane

ELECTRICAL

	parallel	series	
Heater Voltage	6.3 ± 5%	12.6 ± 5%	volts
Heater Current	300	150	amps

Direct Interelectrode Capacitances

	Triode No. 1	Triode No. 2	
Input	2.9	2.9	μμf
Output	0.45	0.35	μμf
Plate to Grid	2.5	2.5	μμf
Cathode to Heater	3	3	μμf

	Between Sections	
Plate to Plate	0.85	μμf
Grid to Grid	0.06	μμf

Maximum Ratings, Absolute Limits (Each Section)

Plate Supply Voltage	600 volts
Plate Voltage	200 volts
Negative Grid Voltage	100 volts
Peak Negative Grid Voltage [1]	200 volts
Grid Voltage	1 volt
Cathode to Heater Voltage (cathode positive)	180 volts
Cathode to Heater Voltage (cathode negative)	90 volts
Peak Cathode to Heater Voltage (cathode negative)	180 volts
Cathode Current	14 mA
Peak Cathode Current [1]	75 mA
Grid Current	2 mA
Peak Grid Current [1]	50 mA
Plate Dissipation	1.5 watts
Bulb Temperature	120°C

Typical Characteristics

Plate Voltage	100	150	85	volts
Plate Current	4.6	0.1	16	mA
Grid Supply Voltage	—	—	85	volts
Grid Voltage	—	−10	—	volts
Cathode Resistor	470	—	—	ohms
Grid Resistor	—	—	425	Kohms
Internal Plate Resistance	7500	—	—	ohms
Transconductance	3600	—	—	micromhos
Amplification Factor	27	—	—	

[1] Maximum pulse time 10 microseconds; duty cycle, 1%.

6211

Characteristics Range Values for Equipment Design

	Initial Life min	Initial Life max	End of Life min	End of Life max	
Heater Current (E_f = 6.3 V)	285	315	285	315	mA
Plate Current (E_f = 6.3 V, R_k = 470 ohms, E_b = 100 V)	3.6	5.6	1.6	—	mA
Plate Current (E_f = 6.3 V, E_b = 150 V, E_c = – 10 ohms)	—	100	—	100	μA
Plate Current (E_f = 6.3 V, E_{cc} = 85 V, E_b = 85 V, R_g = 425 Kohms)	12	20	7.2	—	mA
Negative Grid Current (E_f = 6.3 V, E_c = 2 V, E_b = 100 V, R_g = 0.1 meg.)	—	0.2	—	1	μA
Cathode to Heater Current $E_{f/k}$ = 180 V, E_f =6.3 V, R = 1 meg, cathode positive)	—	15	—	30	μA
Transconductance (E_f = 6.3 V, E_{bb} = 100 V, R_k = 470 ohms)	2700	4500	1600	—	micromhos
Insulation Resistance (E_f = 6.3 V, V = 200 V)	100	—	20	—	megs

Direct Interelectrode Capacitances

	Initial Life min.	Initial Life max	
Triode No. 1			
Input	2.4	3.4	$\mu\mu$f
Output	0.3	0.6	$\mu\mu$f
Plate to Grid	2	3	$\mu\mu$f
Triode No. 2			
Input	2.4	3.4	$\mu\mu$f
Output	0.23	0.47	$\mu\mu$f
Plate to Grid	2	3	$\mu\mu$f
Between Sections			
Plate to Plate	—	1.1	$\mu\mu$f
Grid to Grid	—	0.06	$\mu\mu$f

Life Test Conditions

Heater Voltage	6.3	volts
Plate Supply Voltage	150	volts
Grid Supply Voltage	150	volts
Plate Resistor	4300	ohms
Grid Resistor (I_c = 200 μA)	1.8	meg
Cathode to Heater Voltage (cathode positive)	180	volts

Maximum Ratings, Absolute limits for Circuit Design

Grid Resistor (fixed bias)	0.2 meg
Grid Resistor (automatic bias)	0.5 meg

6211

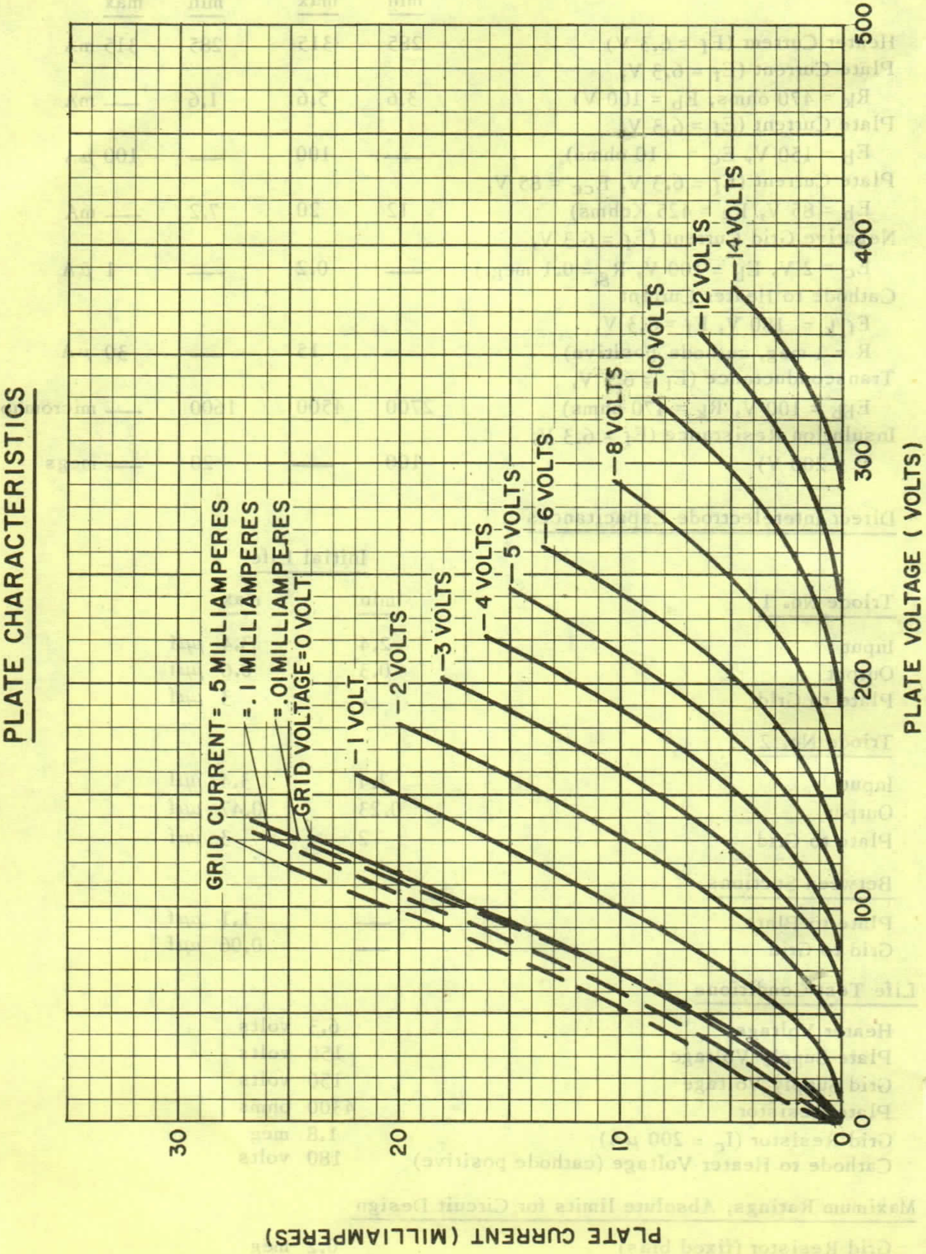
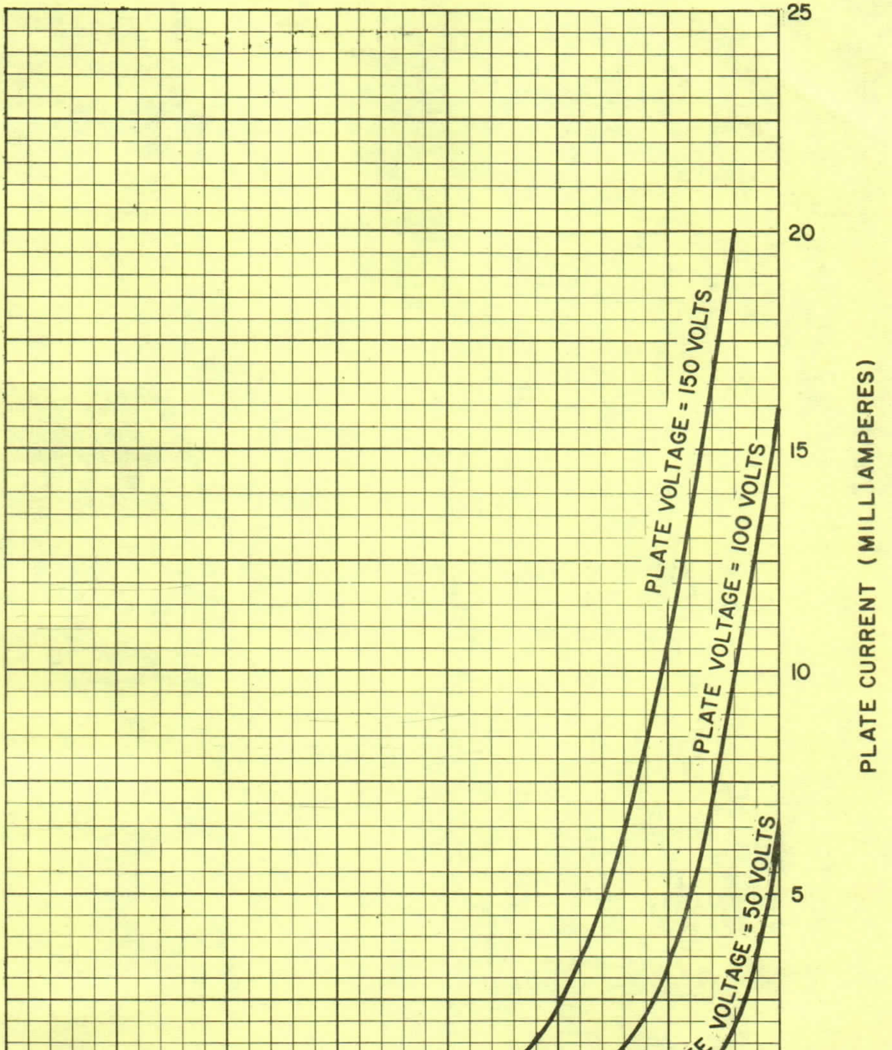


PLATE CHARACTERISTICS
GRID CURRENT = .5 MILLIAMPERES
= .1 MILLIAMPERES
= .01 MILLIAMPERES
GRID VOLTAGE = 0 VOLT
−1 VOLT
−2 VOLTS
−3 VOLTS
−4 VOLTS
−5 VOLTS
−6 VOLTS
−8 VOLTS
−10 VOLTS
−12 VOLTS
−14 VOLTS
PLATE VOLTAGE (VOLTS)
0
100
200
300
400
500
PLATE CURRENT (MILLIAMPERES)
0
10
20
30

6211

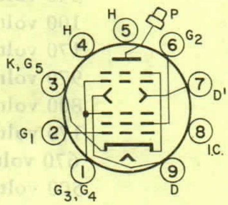
TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 6218/E80T

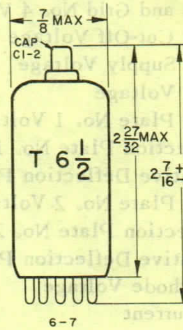
The 6218/E80T is a miniature, 9 pin modulated beam deflection tube having a ribbon shaped beam. It is designed for use as a phase discriminator and pulse generator in pulse controlled oscillator circuits operating at frequencies up to 375 Mc/s.

The 6218/E80T is one of the Amperex "Premium Quality, 10,000 hour" tubes.



PIN CONNECTIONS

1 - GRID NO. 3, GRID NO. 4
2 - GRID NO. 1
3 - CATHODE, GRID NO. 5
4 - HEATER
5 - HEATER
6 - GRID NO. 2
7 - DEFLECTION PLATE
8 - INTERNAL CONNECTION
9 - DEFLECTION PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	unipotential
Outline	T-6½
Bulb	6-7
Cap	C1-2
Base	E9-1
Base Diagram	9CG
Mounting Position	any
Shock Resistance	500g

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel supply
Voltage	6.3 volts ± 10%
Current	150 mA

Direct Interelectrode Capacitances	nom.	max.	
Grid No. 1 to All Other Electrodes	2.2	3.5	μμf
Deflection Plate No. 1 to All Other Electrodes	3.0	4.5	μμf
Deflection Plate No. 2 to All Other Electrodes	3.0	4.5	μμf
Plate to All Other Electrodes	-	2.0	μμf
Deflection Plate No. 1 to Grid No. 2	-	0.1	μμf
Deflection Plate No. 2 to Grid No. 2	-	0.1	μμf
Grid No. 1 to Grid No. 2	-	0.9	μμf
Deflection Plate No. 1 to Plate	-	0.02	μμf
Deflection Plate No. 2 to Plate	-	0.02	μμf

6218/E80T

Maximum Ratings, Absolute Values

Plate Cut-Off Voltage	600 volts
Plate Voltage	330 volts
Grid No. 3 and Grid No. 4 Cut-Off Voltage	600 volts
Grid No. 3 and Grid No. 4 Voltage	330 volts
Grid No. 2 Cut-Off Voltage	600 volts
Grid No. 2 Supply Voltage	330 volts
Grid No. 2 Voltage	100 volts
Deflection Plate No. 1 Voltage	170 volts
Peak Deflection Plate No. 1 Voltage	970 volts
Peak Negative Deflection Plate No. 1 Voltage	800 volts
Deflection Plate No. 2 Voltage	170 volts
Peak Deflection Plate No. 2 Voltage	670 volts
Peak Negative Deflection Plate No. 2 Voltage	500 volts
Heater-Cathode Voltage	50 volts
Cathode Current	5.5 mA

Typical Characteristics

Plate Voltage	100 volts
Grid No. 3 and Grid No. 4 Voltage	250 volts
Grid No. 2 Voltage	70 volts
Grid No. 1 Voltage	0 volts
Deflection Plate No. 1 Voltage	120 volts
Deflection Plate No. 2 Voltage [1]	120 volts
Plate Current	1.35 ± 0.45 mA
Cathode Current	2.0 mA
Plate Current ($\Delta E_{D2} = 7.5V$)	0.25 mA
Grid No. 1 Voltage ($I_b \leq 50\ \mu A$)	−20 volts

[1] Adjusted for maximum plate current

6218/E80T

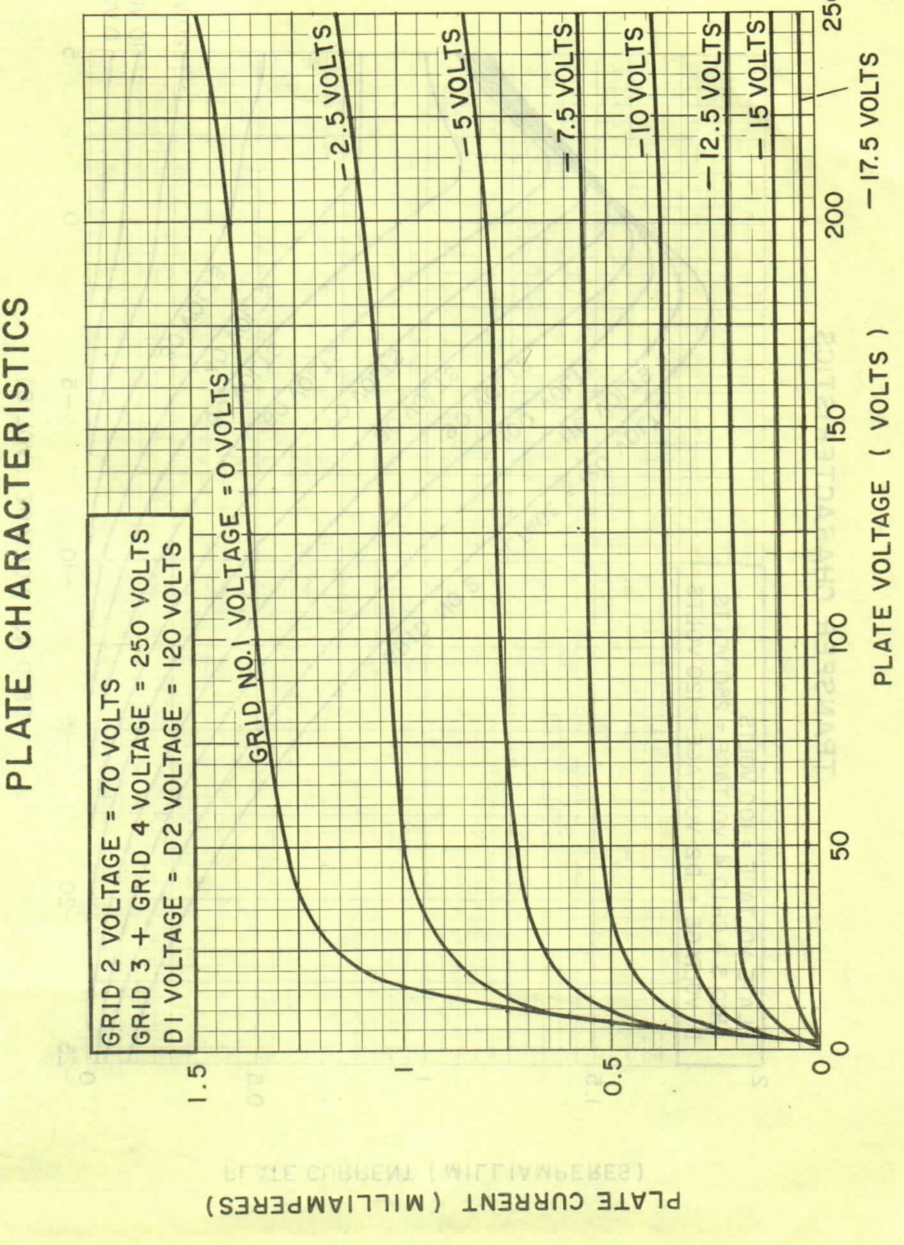
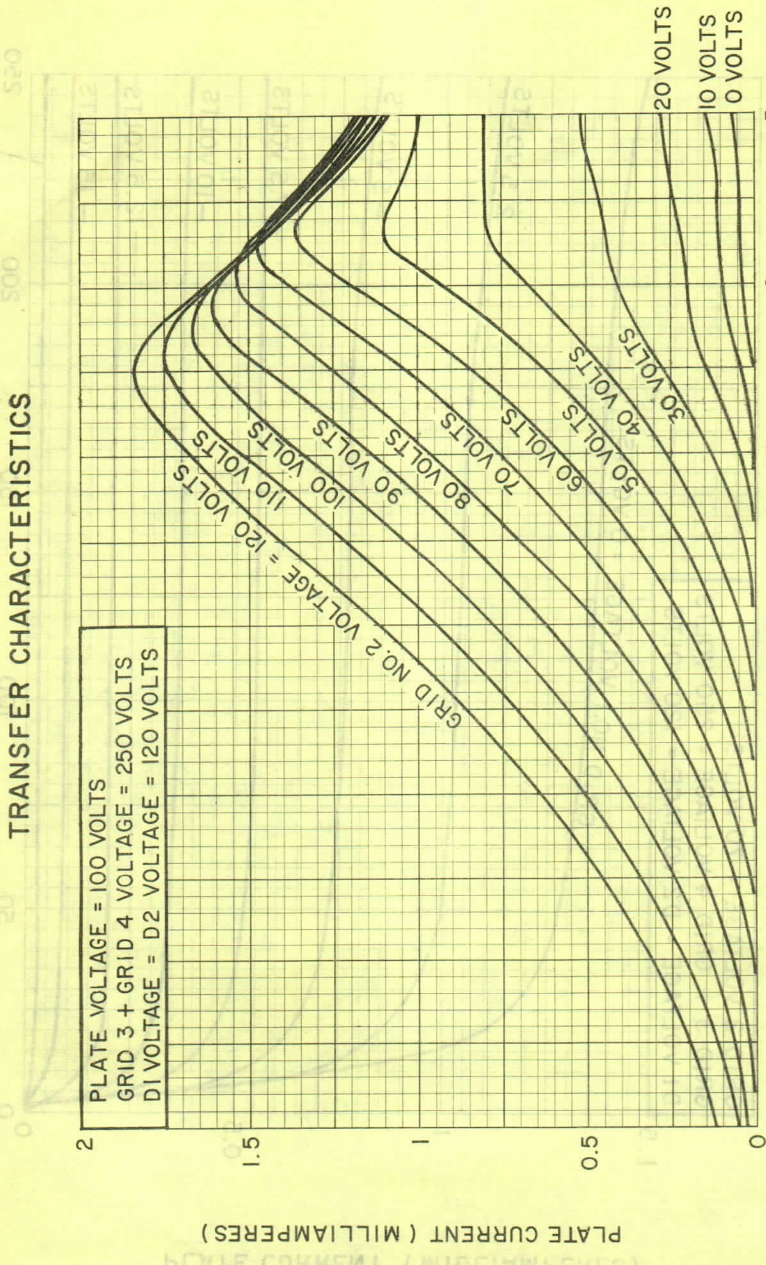


PLATE CHARACTERISTICS
GRID 2 VOLTAGE = 70 VOLTS
GRID 3 + GRID 4 VOLTAGE = 250 VOLTS
D1 VOLTAGE = D2 VOLTAGE = 120 VOLTS
GRID NO.1 VOLTAGE = 0 VOLTS
− 2.5 VOLTS
− 5 VOLTS
− 7.5 VOLTS
− 10 VOLTS
− 12.5 VOLTS
− 15 VOLTS
− 17.5 VOLTS
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
0.5
1
1.5

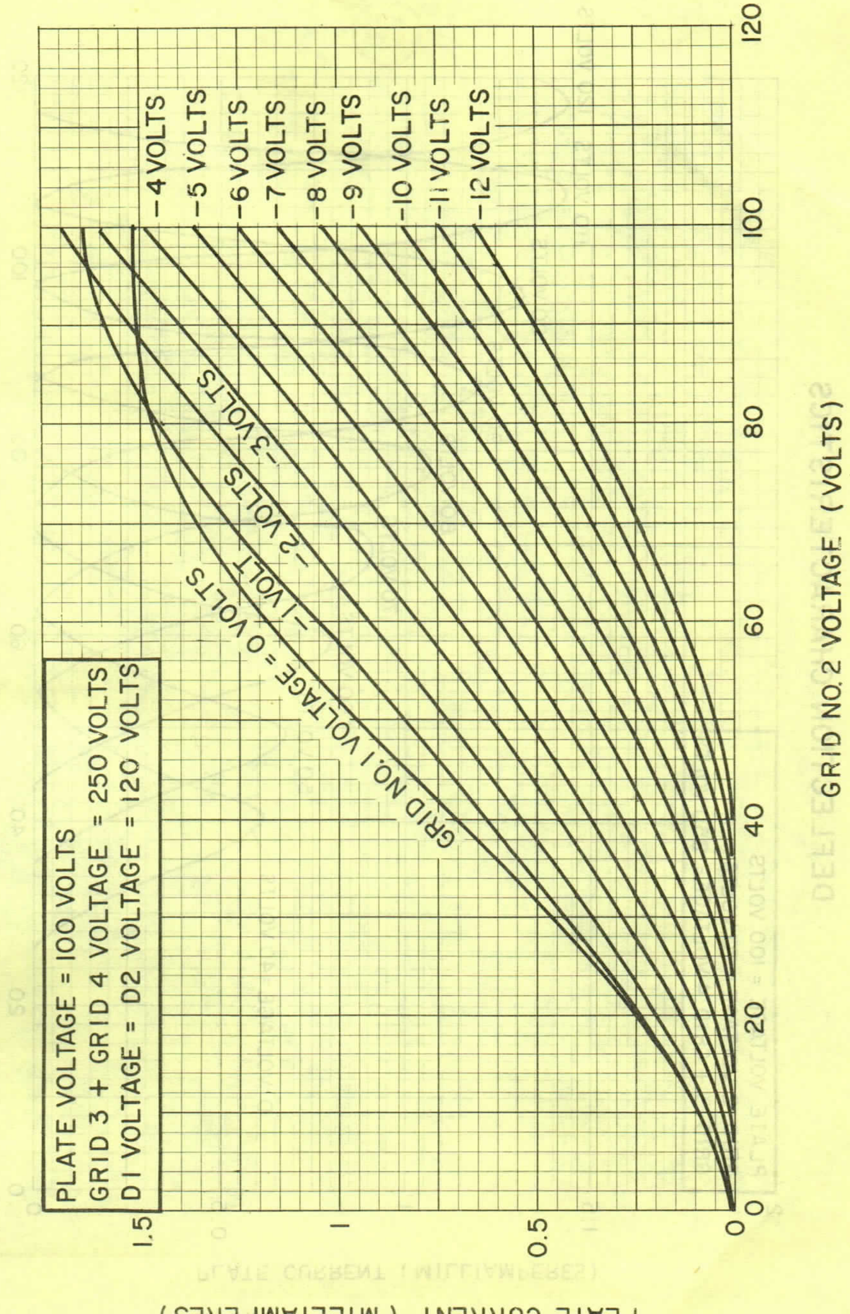
6218/E80T



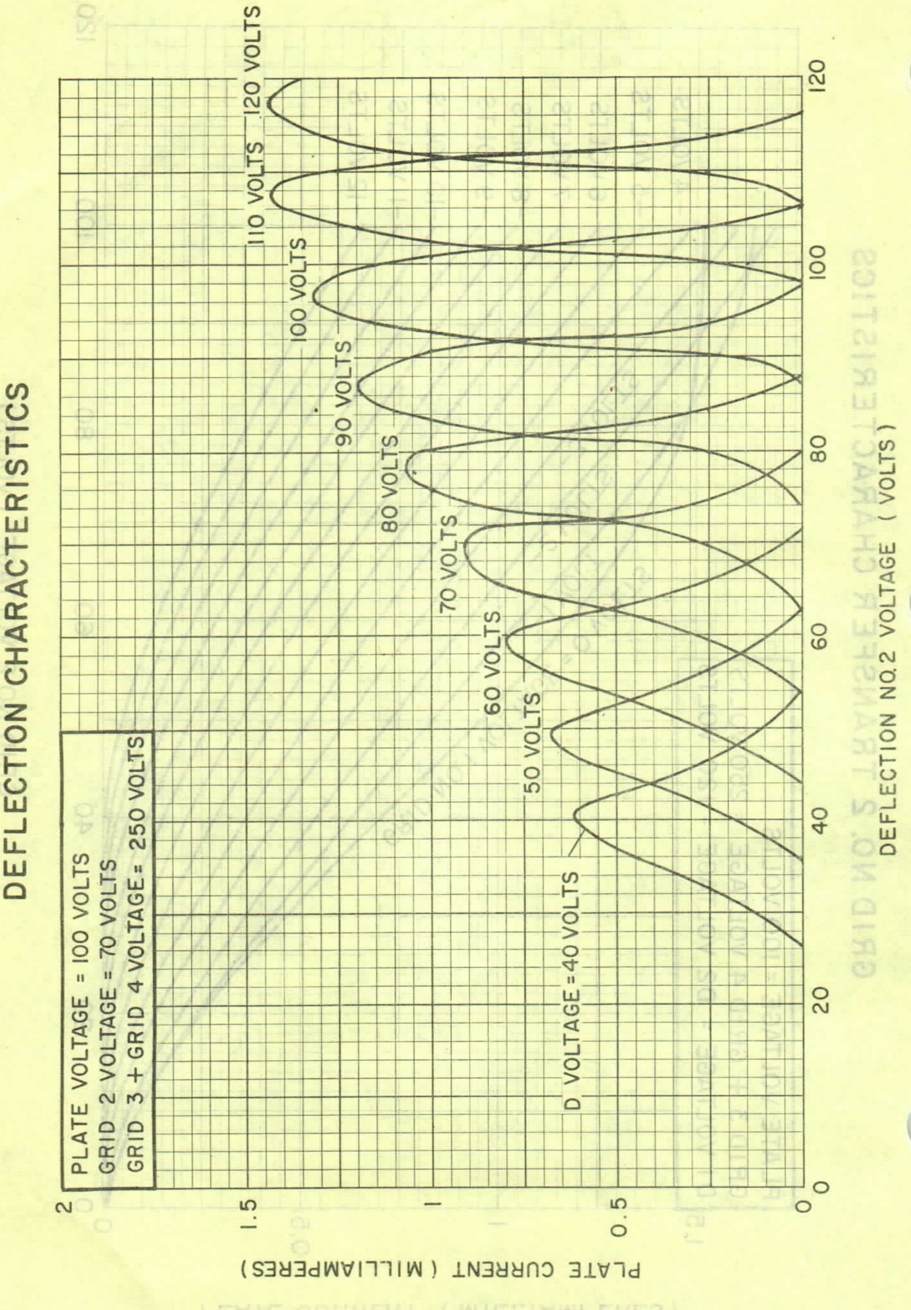
TRANSFER CHARACTERISTICS
PLATE VOLTAGE = 100 VOLTS
GRID 3 + GRID 4 VOLTAGE = 250 VOLTS
D1 VOLTAGE = D2 VOLTAGE = 120 VOLTS
GRID NO. 2 VOLTAGE = 120 VOLTS
110 VOLTS
100 VOLTS
90 VOLTS
80 VOLTS
70 VOLTS
60 VOLTS
50 VOLTS
40 VOLTS
30 VOLTS
20 VOLTS
10 VOLTS
0 VOLTS
PLATE CURRENT (MILLIAMPERES)
GRID NO. 1 VOLTAGE (VOLTS)
2
1.5
1
0.5
0
-25
-20
-15
-10
-5
0
5

6218/E80T

GRID NO. 2 TRANSFER CHARACTERISTICS



6218/E80T



DEFLECTION CHARACTERISTICS
PLATE VOLTAGE = 100 VOLTS
GRID 2 VOLTAGE = 70 VOLTS
GRID 3 + GRID 4 VOLTAGE = 250 VOLTS
D VOLTAGE = 40 VOLTS
50 VOLTS
60 VOLTS
70 VOLTS
80 VOLTS
90 VOLTS
100 VOLTS
110 VOLTS
120 VOLTS
PLATE CURRENT (MILLIAMPERES)
DEFLECTION NO.2 VOLTAGE (VOLTS)
0
0.5
1
1.5
2
20
40
60
80
100
120

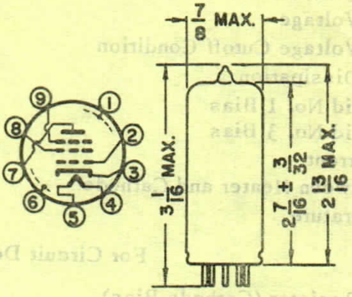
AMPEREX TUBE TYPE 6227/E80L

The Amperex type 6227/E80L is a rugged pentode designed for industrial equipment and instrumentation in which resistance to shock and vibration, long-life and reliability of performance are of prime importance.

The 6227/E80L is one of the Amperex "Premium Quality 10,000 Hour" tubes.

PIN CONNECTIONS

PIN #1 = INTERNAL SHIELD
PIN #2 = GRID #1
PIN #3 = CATHODE
PIN #4 = HEATER
PIN #5 = HEATER
PIN #6 = INTERNAL SHIELD
PIN #7 = PLATE
PIN #8 = GRID #2
PIN #9 = GRID #3



GENERAL CHARACTERISTICS

MECHANICAL	
Base	Noval with gold plated pins
Dimensions	see outline drawing
Mounting position	any
Bulb	T 6½
Shock and Vibration	see note 1
ELECTRICAL	
Cathode	coated, unipotential
Heater voltage [2]	6.3 volts
Heater current at 6.3 volts [2]	0.75 amps
Direct Interelectrode Capacitances	
Input	11.0 $\mu\mu$f
Output	7.0 $\mu\mu$f
Plate to Grid No. 1	0.1 $\mu\mu$f max
Grid No. 1 to Heater	0.25 $\mu\mu$f max
Heater to Cathode	7.0 $\mu\mu$f

1 Shock rating = 500 g (approx)

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of four different directions.

Fatigue rating = 2.5 g

Vibrated forces for a period of 32 hours at a frequency of 50 cycles per second in each of the three planes.

These test conditions are given only for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions.

2 In order to obtain a useful tube life of 10,000 hours in the case of parallel supply, the maximum variation of the heater voltage should be less than ± 5% (absolute maximum rating). In order to obtain a useful tube life of 10,000 hours in a series connection the maximum variation of the heater current due to voltage fluctuations and tolerances in the circuit components should be less than ± 1.5% (absolute maximum ratings).

Revised 3/60

6227/E80L

Maximum Ratings, Absolute Values

Heater Voltage (parallel supply)	6.3 volts ± 5%
Heater Current (series supply)	0.75 amps ± 1.5%
Plate Voltage	300 volts max
Plate Voltage Cutoff Condition	600 volts max
Plate Dissipation	8 watts max
Grid No. 2 Voltage	300 volts max
Grid No. 2 Voltage Cutoff Condition	600 volts max
Grid No. 2 Dissipation	2.6 watts max
Negative Grid No. 1 Bias	100 volts max
Negative Grid No. 3 Bias	100 volts max
Cathode Current	50 mA max
Voltage Between Heater and Cathode	120 volts max
Bulb Temperature	225 °C max

For Circuit Design

Grid No. 1 Resistor (Cathode Bias)	1 megohm max
External Resistance between Cathode and Heater	20,000 ohms max

Class A_1 Amplifier
Typical Operation

Plate Voltage	200	250	volts
Grid No. 3 Voltage	0	0	volts
Grid No. 2 Voltage	200	-	volts
Grid No. 2 Supply Voltage	-	250	volts
Grid No. 2 Series Resistor	-	1000	ohms
Cathode Resistor	130	270	ohms
Plate Current	30	24	mA
Grid No. 2 Current	4.1	3.3	mA
Plate Resistance	90	-	Kohms
AC Load Resistance	7000	10,000	ohms
Power Output (at total distortion = 10%)	2.7	2.8	watts
Transconductance	9000	-	micromhos
Amplification Factor of Grid No. 2 with Respect to Grid No. 1	21.5	-	

Two Tubes Class AB - Amplifier
Typical Operation

Plate Voltage		200			250		volts
Grid No. 3 Voltage		0			0		volts
Grid No. 2 Voltage		200			250		volts
Cathode Resistor		130			150		ohms
AC Load Resistance (plate to plate)		9000			9000		ohms
Input AC Voltage	0	0.31	5.2	0	0.32	7.8	volts rms
Plate Current	2x20.6	-	2x24.6	2x23.5	-	2x29.5	mA
Grid No. 2 Current	2x2.8	-	2x4.9	2x3.2	-	2x6.6	mA
Power Output	-	0.05	5.7	-	0.05	9.0	watts
Distortion	-	-	3.0	-	-	4.5	%

Revised 3/60

6227/E80L

Characteristics Range Value for Equipment Design

	Initial Min	Initial Max	End of Life [3] Min	End of Life [3] Max	
Heater Current ($E_f = 6.3\,V$)	0.71	0.79	0.71	0.79	amps
Plate Current ($E_{bb} = E_{cc2} = 204.5\,V$, $E_{c3} = 0\,V$, $R_k = 130\,\Omega$)	2.65	33.5	21		mA
Grid No. 2 Current ($E_{bb} = E_{cc2} = 204.5\,V$, $E_{c3} = 0\,V$, $R_k = 130\,\Omega$)	2.7	5.5	2		mA
Transconductance ($E_{bb} = E_{cc2} = 204.5$, $E_{c3} = 0\,V$, $R_k = 130\,\Omega$)	7400	10,600	6000		micromhos
Negative Grid No. 1 Current ($E_{bb} = E_{cc2} = 204.5\,V$, $E_{c3} = 0\,V$, $R_k = 130\,\Omega$)		0.5		1.0	μA
Plate current ($E_b = E_{c2} = 200\,V$, $E_{c3} = 0\,V$, $E_{c1} = -14\,V$)		0.2			mA
Power Output ($E_b = E_{c2} = 200\,V$, $E_{c3} = 0\,V$, $I_b = 30\,mA$)	2.0				watts
Hum Voltage (referred to Grid No. 1)[4] ($E_b = E_{c2} = 200\,V$, $R_k = 130\,\Omega$, $R_b = 1\,K\Omega$)		0.25			millivolts
Heater-Cathode Leakage Current ($E_{hk} = 120\,V$, K pos., $R_{series} = 1\,M\Omega$)		15		20	μA
Insulation Resistance (between 2 Arbitrary Electrodes) ($E = 300\,V$, Cathode Positive)	50		10		megohms

Direct Interelectrode Capacitances	Min	Max	
Input	10.2	11.8	$\mu\mu f$
Output	6.5	7.5	$\mu\mu f$
Plate to Grid No. 1		0.1	$\mu\mu f$
Grid No. 1 to Heater		0.25	$\mu\mu f$

---

[3] Conditions of life test operation are:

Heater Voltage	6.3 volts
Plate Voltage	200 volts
Grid No. 2 voltage	200 volts
Grid No. 3 voltage	0 volts
Cathode resistor	130 ohms
Cathode-heater voltage (cathode positive)	120 volts
Life expectancy	10,000 hours

[4] Measured with flat response filter. Frequency of filament supply 50 c/s. Center tap of filament transformer grounded.

6227/E80L

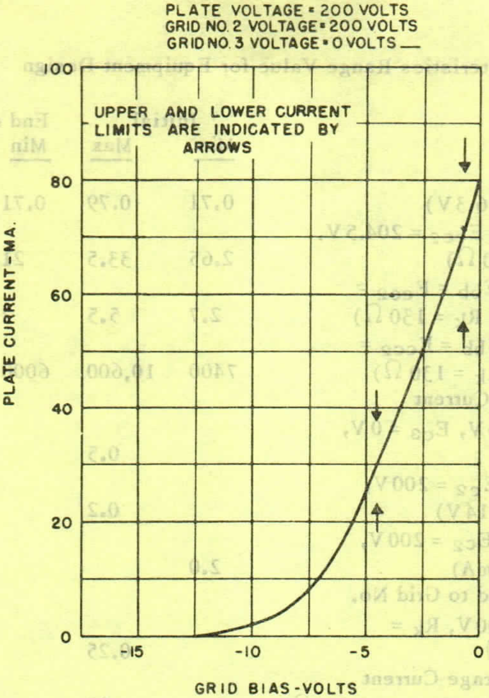


PLATE VOLTAGE = 200 VOLTS
GRID NO. 2 VOLTAGE = 200 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
UPPER AND LOWER CURRENT LIMITS ARE INDICATED BY ARROWS
PLATE CURRENT - MA.
100
80
60
40
20
0
-15
-10
-5
0
GRID BIAS - VOLTS

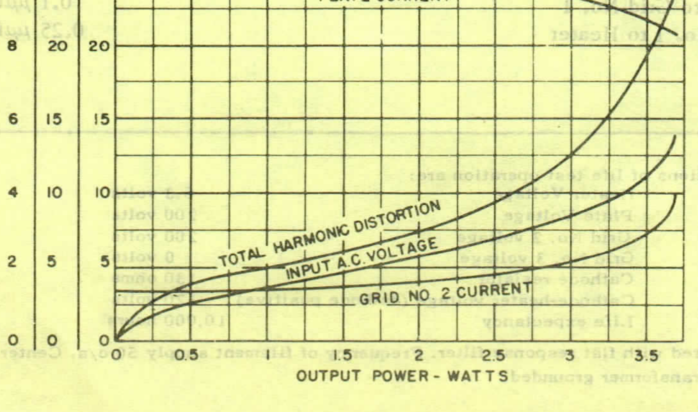


PLATE VOLTAGE = 250 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 250 VOLTS
A.C. LOAD RESISTANCE = 10,000 OHMS
GRID NO. 2 SERIES RESISTOR = 1000 OHMS
CATHODE RESISTOR = 270 OHMS
INPUT A.C. VOLTS
DISTORTION %
CURRENT MA.
PLATE CURRENT
TOTAL HARMONIC DISTORTION
INPUT A.C. VOLTAGE
GRID NO. 2 CURRENT
10
25
8
20
6
15
4
10
2
5
0
0.5
1
1.5
2
2.5
3
3.5
OUTPUT POWER - WATTS

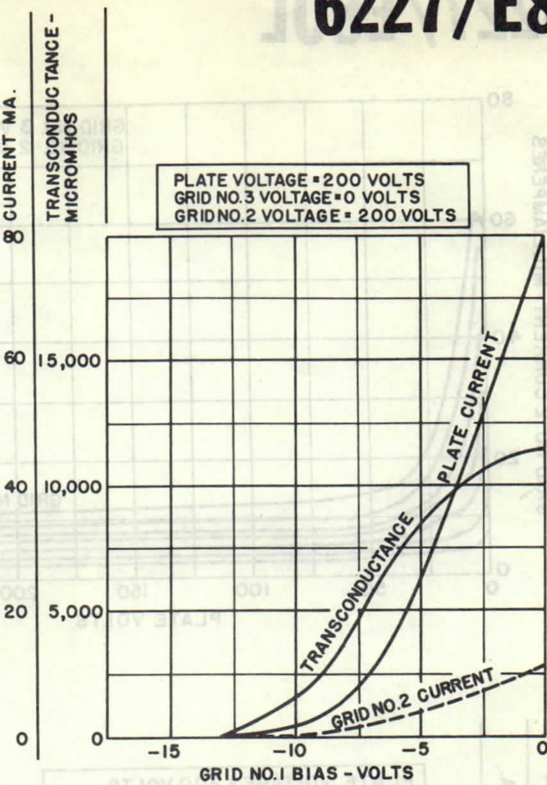
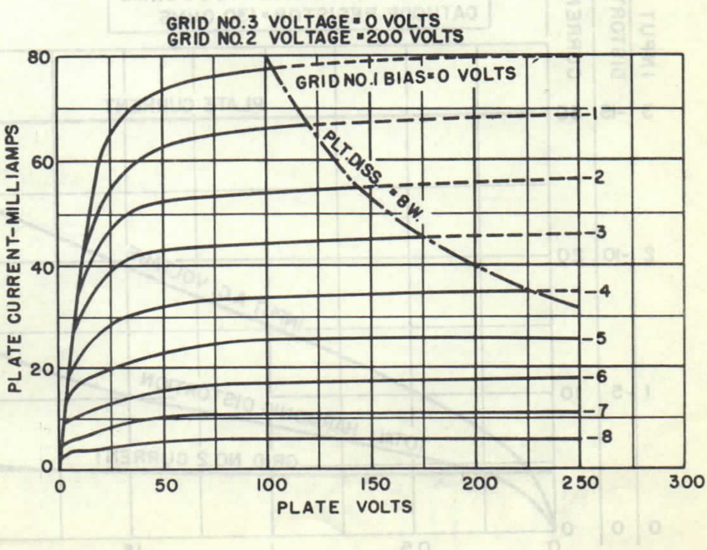
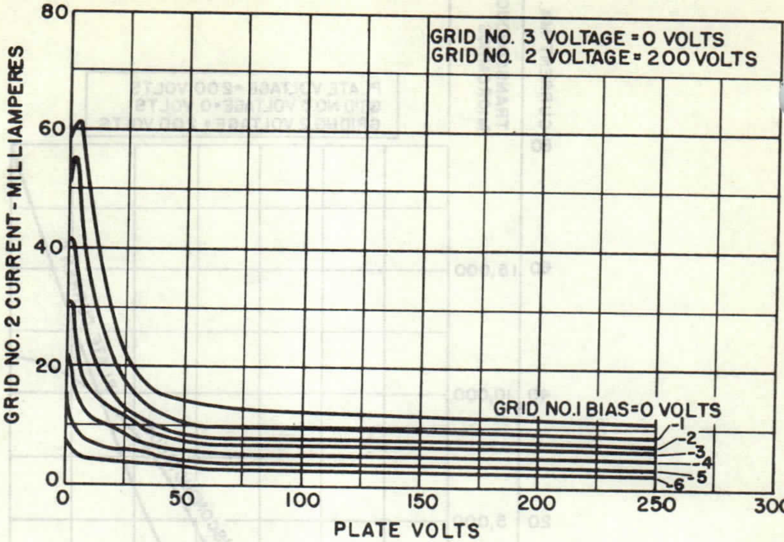


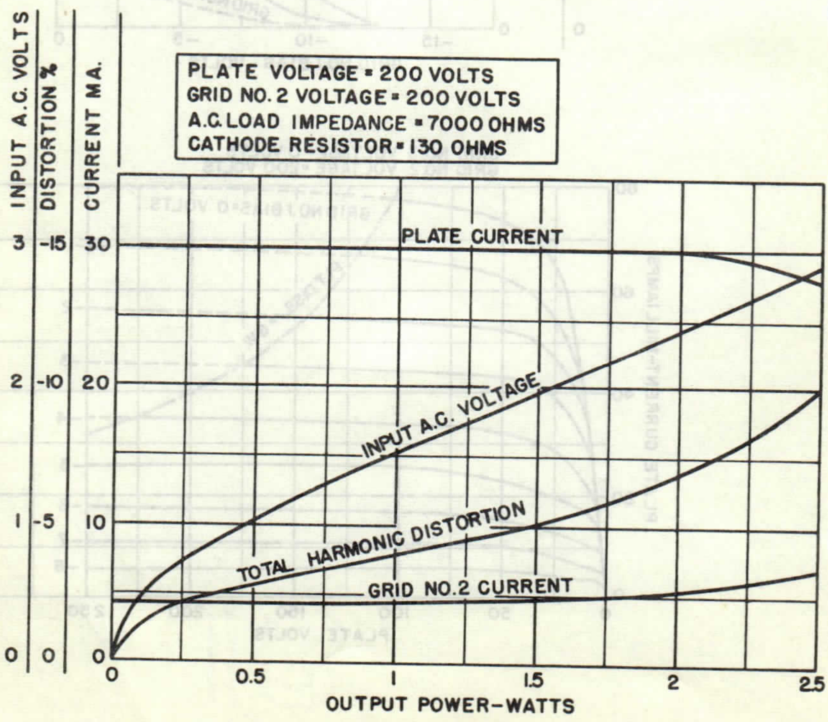
PLATE VOLTAGE = 200 VOLTS
GRID NO.3 VOLTAGE = 0 VOLTS
GRID NO.2 VOLTAGE = 200 VOLTS
CURRENT MA.
TRANSCONDUCTANCE - MICROMHOS
80
60
40
20
0
15,000
10,000
5,000
PLATE CURRENT
TRANSCONDUCTANCE
GRID NO.2 CURRENT
-15
-10
-5
0
GRID NO.1 BIAS - VOLTS


GRID NO.3 VOLTAGE = 0 VOLTS
GRID NO.2 VOLTAGE = 200 VOLTS
GRID NO.1 BIAS = 0 VOLTS
PLT. DISS. = 8W.
-1
-2
-3
-4
-5
-6
-7
-8
PLATE CURRENT-MILLIAMPS
80
60
40
20
0
50
100
150
200
250
300
PLATE VOLTS

6227/E80L



GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 200 VOLTS
GRID NO. 2 CURRENT - MILLIAMPERES
80
60
40
20
0
GRID NO.1 BIAS=0 VOLTS
-1
-2
-3
-4
-5
-6
0
50
100
150
200
250
300
PLATE VOLTS



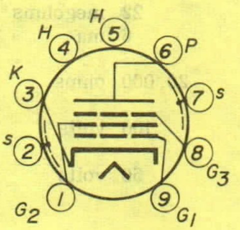
INPUT A.C. VOLTS
DISTORTION %
CURRENT MA.
PLATE VOLTAGE = 200 VOLTS
GRID NO. 2 VOLTAGE = 200 VOLTS
A.C. LOAD IMPEDANCE = 7000 OHMS
CATHODE RESISTOR = 130 OHMS
3 -15 30
2 -10 20
1 -5 10
0 0 0
PLATE CURRENT
INPUT A.C. VOLTAGE
TOTAL HARMONIC DISTORTION
GRID NO.2 CURRENT
0
0.5
1
1.5
2
2.5
OUTPUT POWER-WATTS

AMPEREX TUBE TYPE 6267

TENTATIVE DATA

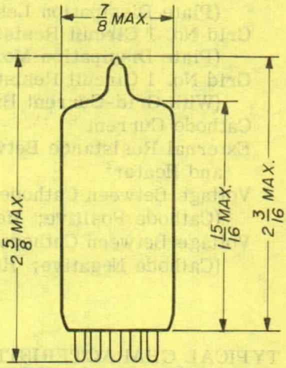
The 6267 is a low noise, audio frequency, voltage amplifier pentode designed for pre-amplifier and input stage applications in high-fidelity sound reproducing equipment. This tube incorporates a bifilar tungsten heater for hum reduction.

This tube is particularly useful where low voltage input signals must be amplified.



PIN CONNECTIONS

1. GRID NO. 2
2. INTERNAL SHIELD
3. CATHODE
4. HEATER
5. HEATER
6. PLATE
7. INTERNAL SHIELD
8. GRID NO. 3
9. GRID NO. 1



GENERAL CHARACTERISTICS

MECHANICAL

Maximum Overall Dimensions	
Length	2-5/8 inches
Seated Height	2-3/16 inches
Bulb	T 6-1/2
Mounting Position	any
Base	Noval, 9 pin
Basing	JETEC No. 9CQ

ELECTRICAL

Cathode	coated, unipotential
Heater Voltage	6.3 volts
Heater Current	200 ma

Direct Interelectrode Capacitances

Plate to All Elements except Grid No. 1	5 pf
Grid No. 1 to All Elements except Plate	4 pf
Plate to Grid No. 1	<0.05 pf
Grid No. 1 to Heater	<0.0025 pf

MAXIMUM RATINGS (DESIGN CENTER)

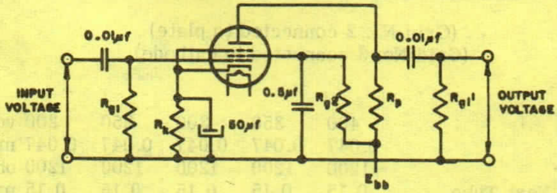
Plate Voltage (Zero Plate Current)	550 volts
Plate Voltage	300 volts
Plate Dissipation	1 watt
Grid No. 2 Voltage (Zero Grid Current)	550 volts
Grid No. 2 Voltage	200 volts
Grid No. 2 Dissipation	0.2 watt
Grid No. 1 Circuit Resistance (Plate Dissipation Less Than 0.2 watt)	10 megohms
Grid No. 1 Circuit Resistance (Plate Dissipation More Than 0.2 watt)	3 megohms
Grid No. 1 Circuit Resistance (With Grid-Current Biasing)	22 megohms
Cathode Current	6 ma
External Resistance Between Cathode and Heater[1]	20,000 ohms
Voltage Between Cathode and Heater (Cathode Positive; Heater Negative)	100 volts
Voltage Between Cathode and Heater (Cathode Negative; Heater Positive)	50 volts

TYPICAL CHARACTERISTICS

Plate Voltage	250 volts
Grid No. 3 Voltage	0 volts
Grid No. 2 Voltage	140 volts
Grid No. 1 Bias	-2 volts
Plate Current	3 ma
Grid No. 2 Current	0.6 ma
Transconductance	2000 μmhos
Plate Resistance	2.5 megohms
Amplification Factor of Grid No. 2 with Respect to Grid No. 1	38
Equivalent Noise Resistance, Bandwidth 30 - 10,000 cps	0.1 megohm (max.)
Plate Resistance	2.5 megohms

[1] When used as a phase inverter immediately preceding the output stage, resistance may be 120,000 ohms.

OPERATING CHARACTERISTICS AS AN AF AMPLIFIER (PENTODE CONNECTED)



Load Resistance, R_p = 100,000 ohms
Grid Resistor, R_{g1} = 330,000 ohms
Total Distortion = 5%

Supply Voltage	400	350	300	250	200	100 volts
Cathode Current	3.3	2.9	2.5	2.1	1.7	1.0 ma
Screen Resistor, R_{g2}	0.39	0.39	0.39	0.39	0.39	0.47 megohm
Cathode Resistor, R_K	1.0	1.0	1.0	1.0	1.0	1.5 k ohms
Voltage Gain[2]	124	120	116	112	106	95
Output Voltage - RMS	87	75	64	50	40	22 volts

Load Resistance, R_p = 220,000 ohms
Screen Resistor, R_{g2} = 1 megohm
Grid Resistor, R_{g1} = 680,000 ohms

Supply Voltage	400	350	300	250	200	100 volts
Cathode Current	1.6	1.4	1.1	0.9	0.8	0.6 ma
Cathode Resistor, R_K	2.2	2.2	2.2	2.2	2.2	2.7 k ohms
Voltage Gain[2]	200	196	188	180	170	150
Output Voltage - RMS	73	63	54	46	36	24.5 volts

APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 10 millivolts when the tube is mounted in the vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%.

HUM

The hum level will be less than 5 microvolts when the grid circuit impedance is less than 0.5 megohms (at 60 cps) and the cathode resistor is decoupled by a capacitor of at least 100 μf.

[2] Measured at small input voltages.

OPERATING CHARACTERISTICS

Triode Connected RC Coupled AF Amplifier

(Grid No. 2 connected to plate)
(Grid No. 3 connected to cathode)

Supply Voltage	400	350	300	250	200	volts
Load Resistance	0.047	0.047	0.047	0.047	0.047	megohm
Cathode Resistor	1200	1200	1200	1200	1200	ohms
Grid Resistor of Next Tube	0.15	0.15	0.15	0.15	0.15	megohm
Plate Current	3.7	3.2	2.7	2.3	1.9	ma
Voltage Amplification	24.5	24.5	24	23.5	23.5	
Output Voltage at Grid Current Start	64	53	43	32	22	volts (rms)
Total Harmonic Distortion[3]	4.5	4.0	3.8	3.5	3.1	%
Supply Voltage	400	350	300	250	200	volts
Load Resistance	0.1	0.1	0.1	0.1	0.1	megohm
Cathode Resistor	2200	2200	2200	2200	2200	ohms
Grid Resistor of Next Tube	0.33	0.33	0.33	0.33	0.33	megohm
Plate Current	2.0	1.7	1.5	1.3	1.0	ma
Voltage Amplification	28.5	28.5	28.5	28	27.5	
Output Voltage at Grid Current Start	73	62	50	39	27.5	volts (rms)
Total Harmonic Distortion[3]	4.0	4.0	3.8	3.7	3.3	%
Supply Voltage	400	350	300	250	200	volts
Load Resistance	0.22	0.22	0.22	0.22	0.22	megohm
Cathode Resistor	3900	3900	3900	3900	3900	ohms
Grid Resistor of Next Tube	0.68	0.68	0.68	0.68	0.68	megohm
Plate Current	1.1	0.9	0.8	0.7	0.5	ma
Voltage Amplification	32	31.5	31	30.5	30.5	
Output Voltage at Grid Current Start	74	62	51	39	28	volts (rms)
Total Harmonic Distortion[3]	3.8	3.7	3.7	3.5	3.1	%

SPECIAL RATINGS

Sensitivity

A sensitivity of 0.5 millivolts for an output of 50 milliwatts (or 5 millivolts for 0.5 watt output) is permissible in equipment where an output of 50 milliwatts in the loudspeaker does not produce an average acceleration on the tube greater than 0.015 g at any frequency higher than 500 cps and greater than 0.06 g at any frequency lower than 500 cps.

Hum

At grid No. 1 impedance less than 0.5 megohms (f = 50 cps), cathode capacitance greater than 100 μf and pin 4 grounded, the hum level will typically be 3 microvolts, with a maximum value of 5 microvolts. With the centertap of the heater supply grounded these values will be 1 and 2 microvolts respectively.

Noise

The low frequency noise in terms of an equivalent voltage on the control grid is approximately 2 microvolts for the 25 - 10,000 cps range at a supply voltage of 250 volts and a plate load resistance of 0.1 megohms.

[3] The distortion at lower output levels is proportional to the output voltage.

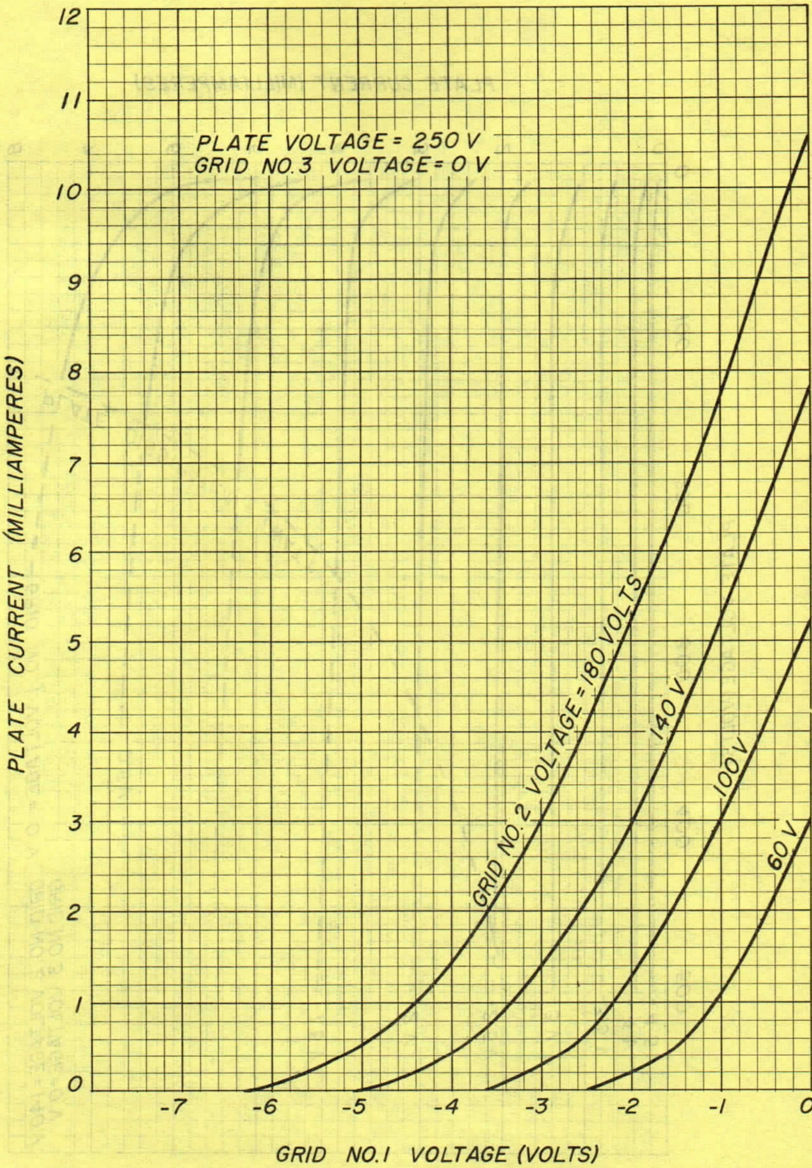


Figure 1. Plate Characteristics

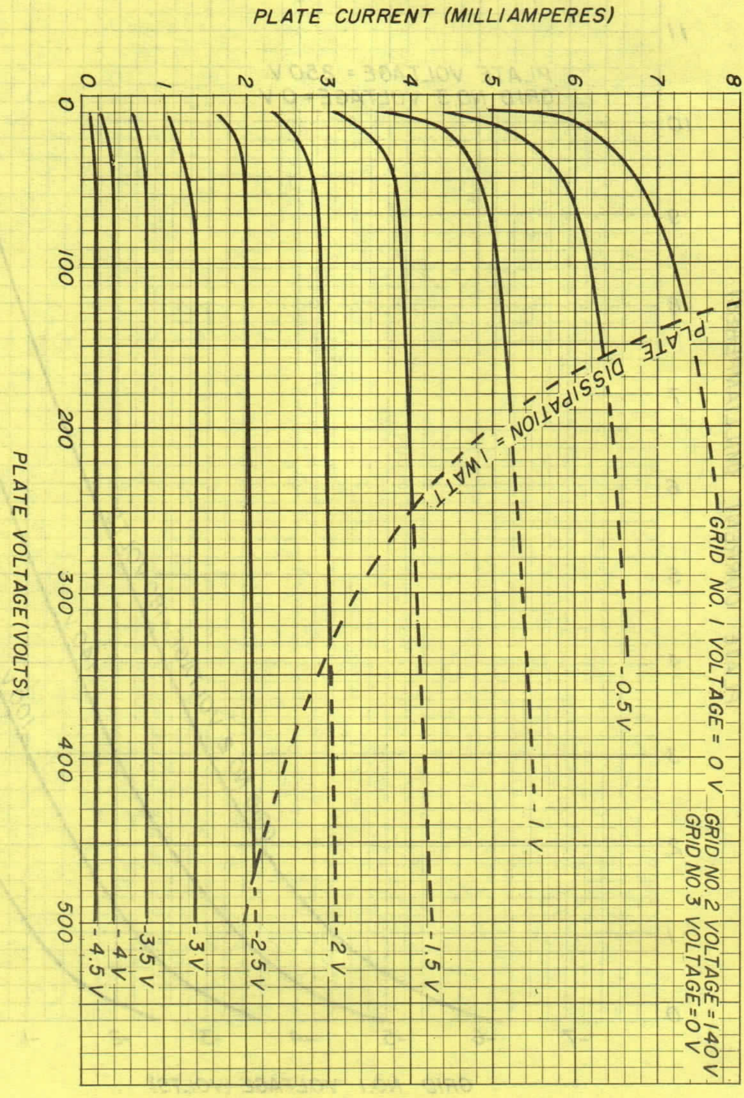


Figure 2. Plate Characteristics

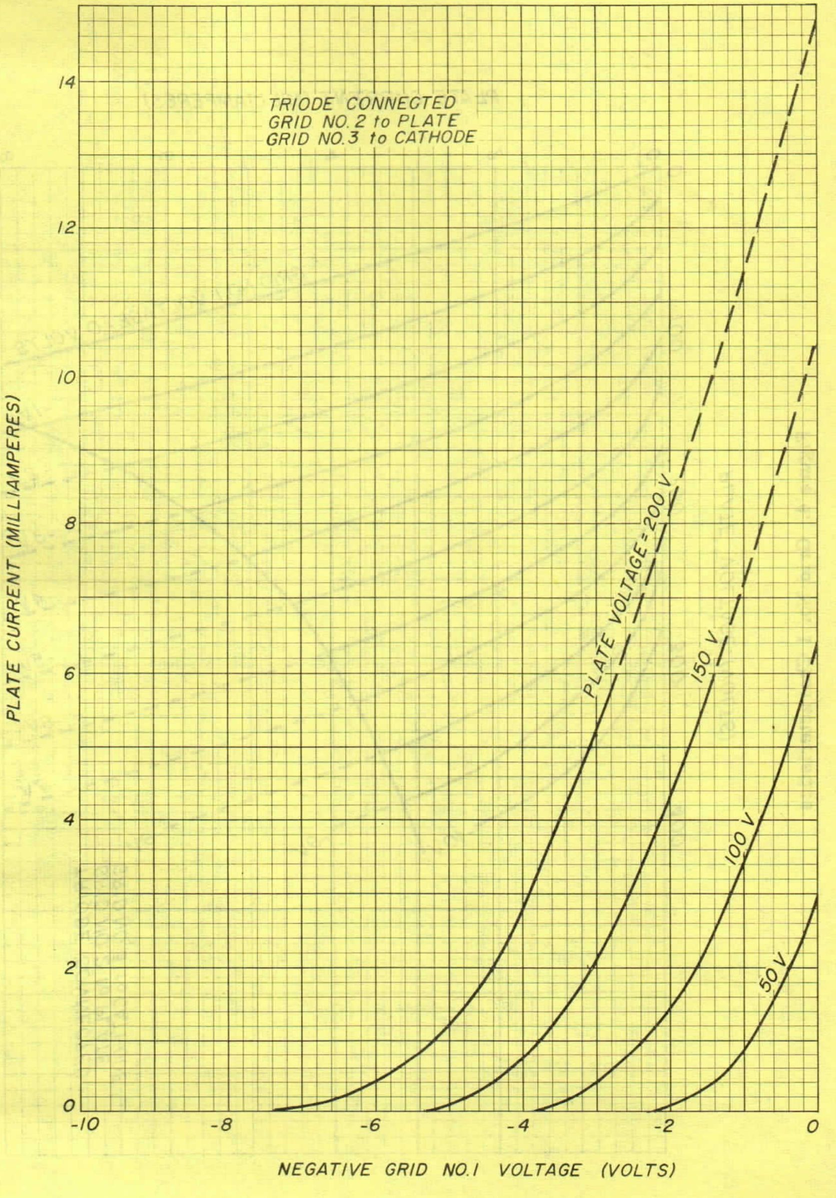


Figure 3. Transfer Characteristics

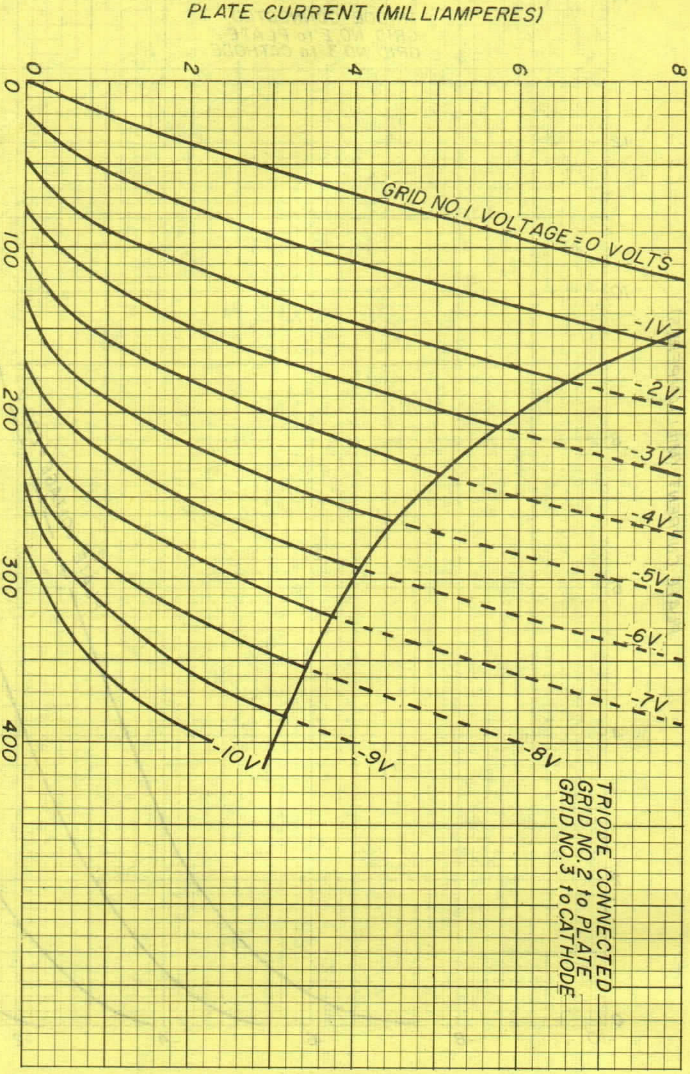


Figure 4. Grid No. 1 Characteristics

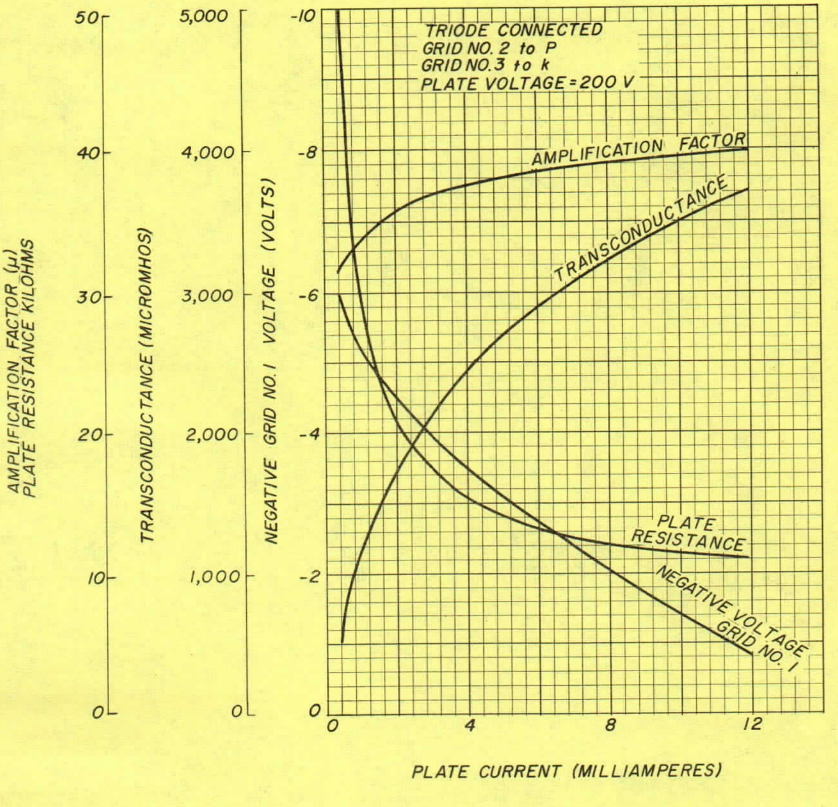


Figure 5. Average Characteristics

AMPEREX TUBE TYPE 6354/150B2

The 6354/150B2 is a two electrode, inert gas filled, cold cathode tube for use in voltage regulator applications.

ELECTRICAL DATA

	MIN.	BOGEY	MAX.	
D.C. anode supply voltage [1]	180	—	—	volts
Anode voltage drop	145	150	157	volts
Anode breakdown voltage [2]	—	—	180	volts
Regulation	—	—	5	volts
Variation of anode voltage drop during 1000 hrs. (I_b = 10 ma)	—	—	1	percent ←
Temperature coefficient of anode voltage drop	—	10	—	mv/°C
Incremental resistance at 10 ma	—	250	—	ohms

MECHANICAL DATA

Mounting Position	any
Max. overall length	2 1/8 inches
Max. diameter	3/4 inch
Base	7 pin, miniature

MAXIMUM RATINGS (absolute values)

Maximum average starting current	40 ma
Maximum averaging time	40 seconds
Maximum D.C. cathode current	15 ma
Minimum D.C. cathode current	5 ma
Maximum frequency	0 cycles/sec.
Ambient temperature limits	−55° to + 90°C

1 To assure starting throughout tube life, not less than the specified supply voltage should be provided.

2 In the presence of some ambient illumination. In complete darkness there may be considerable delay in igniting the tube.

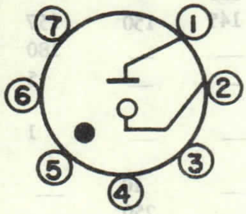
NOTES

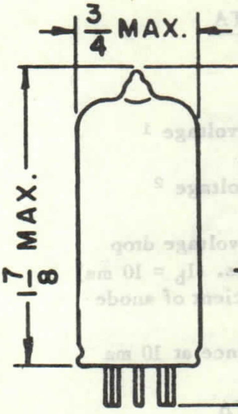
(a) The tube should be operated only with the cathode negative and the anode positive.

(b) Equilibrium conditions are reached within 3 minutes.

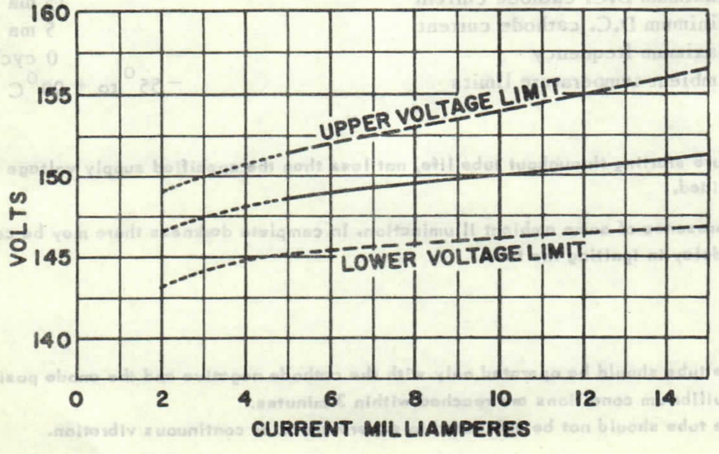
(c) The tube should not be subjected to severe shock or continuous vibration.

6354/150B2





PIN NO. 1 = PLATE
PIN NO. 2 = CATHODE
PIN NO. 3 = INTERNALLY CONNECTED
PIN NO. 4 = INTERNALLY CONNECTED
PIN NO. 5 = INTERNALLY CONNECTED
PIN NO. 6 = INTERNALLY CONNECTED
PIN NO. 7 = INTERNALLY CONNECTED



Revised 6/55

AMPEREX TUBE TYPE 6370/EIT

The 6370/EIT is a decade counter tube designed for counting equipment and electrical impulse indicator circuits. It will replace several tubes and their indicator lamps as well as other components in such circuits. In comparison with the usual flip-flop circuits, counters employing the 6370/EIT have simpler circuitry, fewer components and can be constructed in a more compact size. Because of the low current drain in 6370/EIT counters, simple and less expensive power supplies can be used.

The 6370/EIT has extremely long life and is highly dependable due to the great care taken in manufacturing and the processing of the elements.

The result of the counting circuit can be viewed directly on the fluorescent screen of the tube. This is accomplished by using the applied electrical pulses to deflect the tubes' ribbon-shaped electron beam which is focussed on the fluorescent screen. At the point where the beam strikes the screen, a light spot is produced.

The electron beam has 10 stable positions which are marked with the numerals 0-9 on the fluorescent screen. Each pulse moves the beam to the next position. At the tenth pulse, the beam returns automatically to its zero position, whereby the 6370/EIT, via an interstage coupling tube, can pass an impulse to a second decade counter tube circuited behind the first. This second 6370/EIT counts "tens" whereas the first one counts "units". By placing several 6370/EIT's in cascade, the units, tens, hundreds, thousands, etc., can be read directly.

The counting speed of the 6370/EIT depends upon the circuit used. A circuit published in the AMPEREX bulletin "20D/4602-E-12-54" (available without charge upon request) describes the application of this tube for speeds of 100,000 counts per second. A multi-decade predetermined counter is also described in this bulletin.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	coated, unipotential
Heater voltage	6.3 volts
Heater current	0.3 amp
Direct Interelectrode Capacitances	
Plate to all other elements	10.5 $\mu\mu$f
Deflecting electrode (d) to all other elements	3.5 $\mu\mu$f
Deflecting electrode (d') to all other elements	3.8 $\mu\mu$f
Reset plate to all other elements	4.9 $\mu\mu$f
Grid No. 1 to all other elements	6.8 $\mu\mu$f
Grid No. 4 to all other elements	7.7 $\mu\mu$f

MECHANICAL

Base	duodecal, 12 pin
Bulb	tubular, max. dia. 1 15/32"
RETMA basing designation	12 U
Mounting position	any, except with tube horizontal and the fluorescent screen down
→ Socket	Amperex # S-13264 or equal

6370/EIT

MAXIMUM RATINGS - Design Center Values

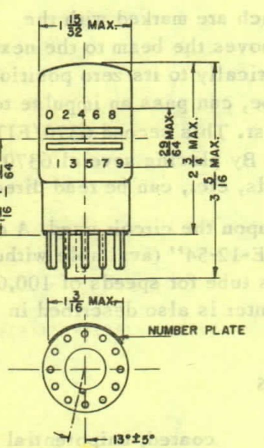
Supply Voltage	**400 volts max.**

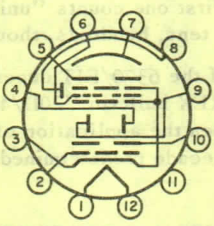
OPERATING CHARACTERISTICS

(For dependable operation (max. 30,000 counts per second) the circuit diagram, Fig. 3, is prescribed. For 100,000 counts per second circuit write for application bulletin.)

Supply Voltage[1]	300 volts
Grid No. 1 Voltage	11.9 ± 0.15 volts
Grid No. 2 Voltage	300 volts
Deflecting electrode voltage	156 ± 1.5 volts
Fluorescent layer voltage	300 volts
Cathode current	0.95 mA
Grid No. 2 current	0.1 mA
Cathode Resistor	15,000 ohms ± 1%
Grid No. 4 series resistor	47,000 ohms ± 5%
Plate series resistor	1 megohm ± 1%
Reset plate series resistor	39,000 ohms ± 10%

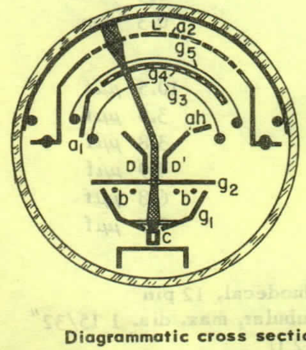
The voltages are with respect to the chasis in the circuit diagram Fig. 3





BASING CONNECTION PIN NO.	ELEMENT
1 —	HEATER
2 —	GRID NO. I (CONTROL GRID)
3 —	CATHODE AND GRIDS NO. 3 AND 5 (SUPPRESSOR GRIDS)
4 —	DEFLECTING ELECTRODE (D')
5 —	PLATE
6 —	GRID NO. 4 (SLOTTED ELECTRODE)
7 —	FLUORESCENT LAYER
8 —	RESET PLATE
9 —	DEFLECTING ELECTRODE (D)
10 —	GRID NO. 2 (ACCELERATING ELECTRODE)
11 —	INTERNALLY CONNECTED
12 —	HEATER

FIG. 1



c	—	CATHODE
g1	—	CONTROL GRID
b	—	BEAM FORMING ELECTRODES
g2	—	ACCELERATING ELECTRODE
D	—	LEFT DEFLECTION ELECTRODE
D'		RIGHT DEFLECTION ELECTRODE
ah	—	AUXILIARY ANODE
g3, g5	—	SUPPRESSOR GRIDS
g4	—	SLOTTED ELECTRODE
a1	—	RESET ANODE
a2		ANODE
L		CONDUCTING LAYER COATED WITH FLUORESCENT MATERIAL

FIG. 2

Diagrammatic cross section of the 6370/EIT showing the electrode system

[1] **Provided the ratio of the supply voltages of grid No. 1 and the deflecting electrode (d) is strictly maintained, there is no need to stabilize the supply voltage (permissible fluctuations ± 10%). In the circuit, Fig. 3, this has been realized by using 1% precision resistors for the voltage divider R_1, R_2 and R_3.**

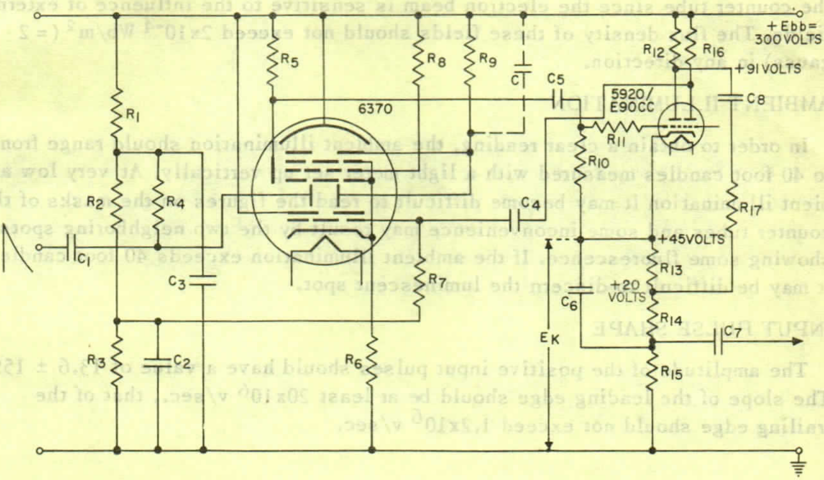


FIG. 3

Circuit diagram of a decade counter stage equipped with the 6370/EIT. The interstage circuit is equipped with a 5920/E90CC tube acting as a monostable vibrator. (The parasitic capacitance C in parallel with R_9 should be reduced to the minimum by keeping the wiring as short as possible)

R_1 = 68,000 ohms ± 1%
R_2 = 68,000 ohms ± 1%
R_3 = 5600 ohms ± 1%
R_4 = 15,000 ohms ± 2%
R_5 = 39,000 ohms ± 10%
R_6 = 15,000 ohms ± 1%
R_7 = 0.33 megohm ± 10%
R_8 = 47,000 ohms ± 5%
R_9 = 1 megohm ± 1%
R_{10} = 0.56 megohm ± 10%
R_{11} = 5600 ohms ± 10%
R_{12} = 39,000 ohms ± 2%
R_{13} = 4700 ohms ± 2%

R_{14} = 2700 ohms ± 2%
R_{15} = 1000 ohms ± 1%
R_{16} = 3300 ohms ± 2%
R_{17} = 0.15 megohm ± 2%

C_1 = (see note 2)
C_2 = 0.39 μf ± 20%
C_3 = 0.15 μf ± 20%
C_4 = 6800 $\mu\mu$f ± 10%
C_5 = 220 $\mu\mu$f ± 10%
C_6 = 68 $\mu\mu$f ± 2%
C_7 = 680 $\mu\mu$f ± 5%
C_8 = 68 $\mu\mu$f ± 2%

[2] When preceeded by an input pulse shaper with a 5920/E90CC tube C_1 should be 6800 $\mu\mu$f ± 10%; when preceeded by an interstage pulse shaper with a 5920/E90CC tube, C_1 should be 680 $\mu\mu$f ± 5%

6370/EIT

SENSITIVITY TO MAGNETIC FIELDS

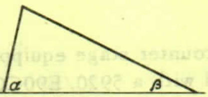
Care should be taken to prevent magnetic fields from upsetting the operation of the counter tube since the electron beam is sensitive to the influence of external fields. The flux density of these fields should not exceed 2×10^{-4} Wb/m^2 (= 2 gauss) in any direction.

AMBIENT ILLUMINATION

In order to obtain a clear reading, the ambient illumination should range from 4 to 40 foot candles measured with a light meter set up vertically. At very low ambient illumination it may become difficult to read the figures on the masks of the counter tubes and some inconvenience may result by the two neighboring spots showing some fluorescence. If the ambient illumination exceeds 40 foot candles it may be difficult to discern the luminescent spot.

INPUT PULSE SHAPE

The amplitude of the positive input pulses should have a value of 13.6 ± 15%. The slope of the leading edge should be at least 20×10^6 v/sec., that of the trailing edge should not exceed 1.2×10^6 v/sec.



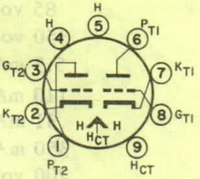
TAN $\alpha > 20 \times 10^6$ V/SEC.
TAN $\beta < 1.2 \times 10^6$ V/SEC.

FIG. 4

AMPEREX TUBE TYPE 6463

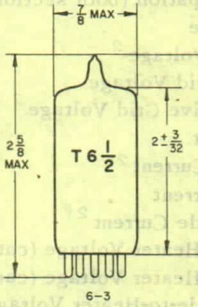
The Amperex 6463 is a miniature, medium-mu twin triode designed for use in computor applications. The 6463 is especially suited for frequency divider circuits due to the high zero-bias plate current and sharp cut-off. Operation for long periods of time under cutoff conditions will not cause deterioration of the emission surface. The 6463 also features heater-cathode construction designed for reliable service under conditions of intermittent operation.

The 6463 is one of the Amperex "Premium Quality, 10,000 Hour" tubes.



PIN CONNECTIONS

1-PLATE, TRIODE 2
2-CATHODE, TRIODE 2
3-GRID, TRIODE 2
4-HEATER
5-HEATER
6-PLATE, TRIODE 1
7-CATHODE, TRIODE 1
8-GRID, TRIODE 1
9-HEATER CENTER TAP



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Bulb	T6-½
Outline	6-3
Base	E9-1
Mounting Position	any
Shock and Vibration	see note 1

ELECTRICAL

Heater Characteristics

Heater Arrangement	parallel	series
Heater Voltage	6.3 ± 5%	12.6 ± 5% volts
Heater Current	600	300 mA

Direct Interelectrode Capacitances

	Triode No. 1	Triode No. 2	
Input	3.4	3.4	μμf
Output	0.6	0.5	μμf
Plate to Grid	5.2	5.4	μμf
Cathode to Heater	3.5	3.5	μμf

	Between Sections
Grid to Grid	< 0.025 μμf
Plate to Plate	0.9 μμf

NOTES

1 The tube has a fatigue rating of 2.5 g obtained over a period of 32 hours at a frequency of 25 c/s and a shock rating of 500 g obtained with 5 blows applied by the NRL impact machine with the hammer lifted over an angle of 30°. These conditions are given only as an evaluation of the ruggedness of the tube and should not be interpreted as suitable operating conditions.

6463

Maximum Ratings, Absolute Values (Each Section)

Plate Supply Voltage	660 volts
Plate Voltage	330 volts
Peak Plate Voltage [2]	660 volts
Plate Dissipation	4.4 watts
Plate Dissipation (both sections)	7.7 watts
Grid Voltage	1.5 volts
Peak Grid Voltage [2]	25 volts
Negative Grid Voltage	85 volts
Peak Negative Grid Voltage [2]	350 volts
Grid Current	5.5 mA
Peak Grid Current [2]	110 mA
Cathode Current	31 mA
Peak Cathode Current [2]	350 mA
Cathode-to-Heater Voltage (cathode positive)	200 volts
Cathode-to-Heater Voltage (cathode negative)	100 volts
Peak Cathode-to-Heater Voltage (cathode negative)	200 volts
Bulb Temperature [3]	180°C

Typical Characteristics

Plate Supply Voltage	250 volts
Plate Current	14.5 mA
Cathode Resistor	620 ohms
Transconductance	5200 micromhos
Amplification Factor	20

Operating Characteristics

Plate Voltage	100	120	200	volts
Plate Current	29	21	<1	mA
Negative Grid Voltage	--	− 2	− 15	volts
Grid Current	200	--	--	μA

NOTES

[2] Maximum pulse duration, 10 microseconds; duty cycle, 1%.

[3] Operation at a lower temperature will increase tube life and reliability of performance.

Characteristic Range Values for Equipment Design	Initial Life min	Initial Life max	End of life[4] min	End of life[4] max	
Heater Current (E_f = 6.3 V)	570	630	-	-	μA
Plate Current (E_b = 100 V, I_c = 200 μA)	24	-	17	-	mA
Plate Current (E_b = 120 V, E_c = −2 V)	14	28	10	-	mA
Plate Current (E_b = 200 V, E_c = −15 V)	-	1	-	1	mA
Heater-Cathode Leakage Current E_{kf} = 200 V, Cathode positive, series resistor = 1 meg)	-	15	-	20	μA
Insulation Resistance between Two Arbitrary Electrodes	100	-	20	-	megohms
Negative Grid Current (E_b = 120 V, E_c = −2 V, R_g = 0.1 meg)	-	0.2	-	1	μA
Transconductance (E_{bb} = 250 V, R_k = 620 Ω)	3900	6500	-	-	micromhos

Direct Interelectrode Capacitances	Initial Life min	Initial Life max
Triode No. 1		
Input	2.9	3.9 $\mu\mu$f
Output	0.4	0.8 $\mu\mu$f
Plate to Grid	4.6	5.8 $\mu\mu$f
Triode No. 2		
Input	2.9	3.9 $\mu\mu$f
Output	0.35	0.65 $\mu\mu$f
Plate to Grid	4.8	6.0 $\mu\mu$f
Between Sections		
Grid to Grid		0.025 $\mu\mu$f
Plate to Plate		1.2 $\mu\mu$f

Maximum Ratings, Absolute Values for Circuit Design

Grid resistor (automatic bias)	1 megohm
Grid resistor (fixed bias)	0.5 megohm

Maximum Ratings, Absolute Values for Equipment Design

Grid circuit resistance (automatic bias)	1 megohm
Grid circuit resistance (fixed bias)	0.5 megohm

NOTE

[4] Conditions of life test operation are:

Heater Voltage	6.3 volts
Plate Supply voltage	150 volts
Cathode resistor	90 ohms
Plate resistor	390 ohms
Grid Circuit series resistor	100 kohms
Heater-cathode voltage* (cathode negative)	120 volts

* The value of heater-cathode voltage given should not be interpreted as a suitable operating condition.

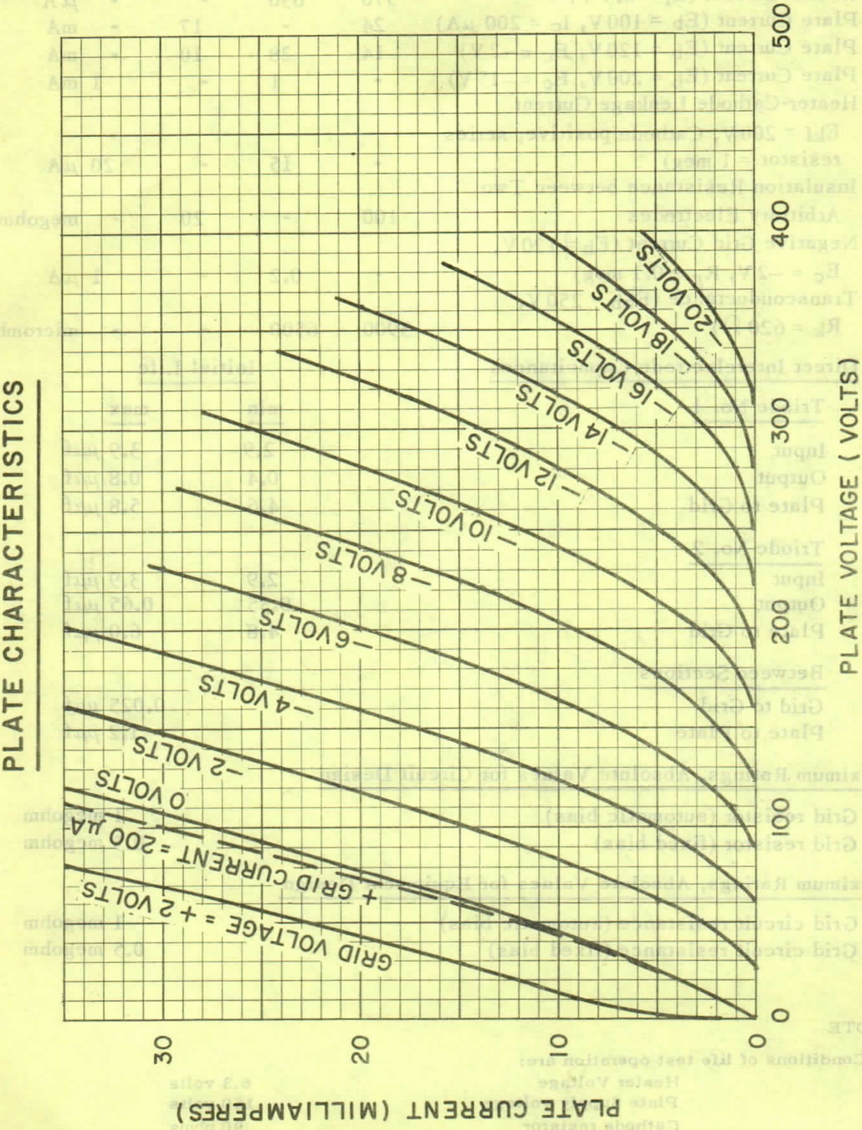
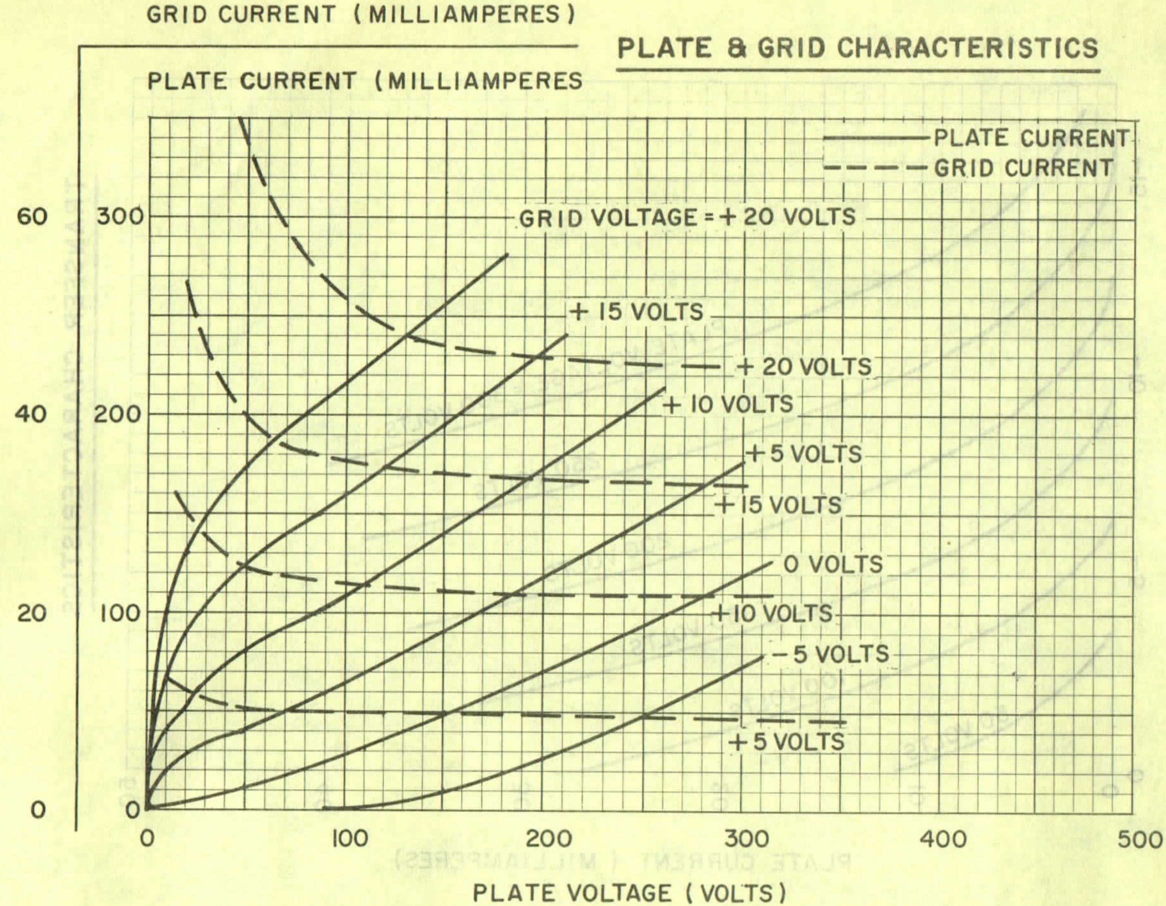


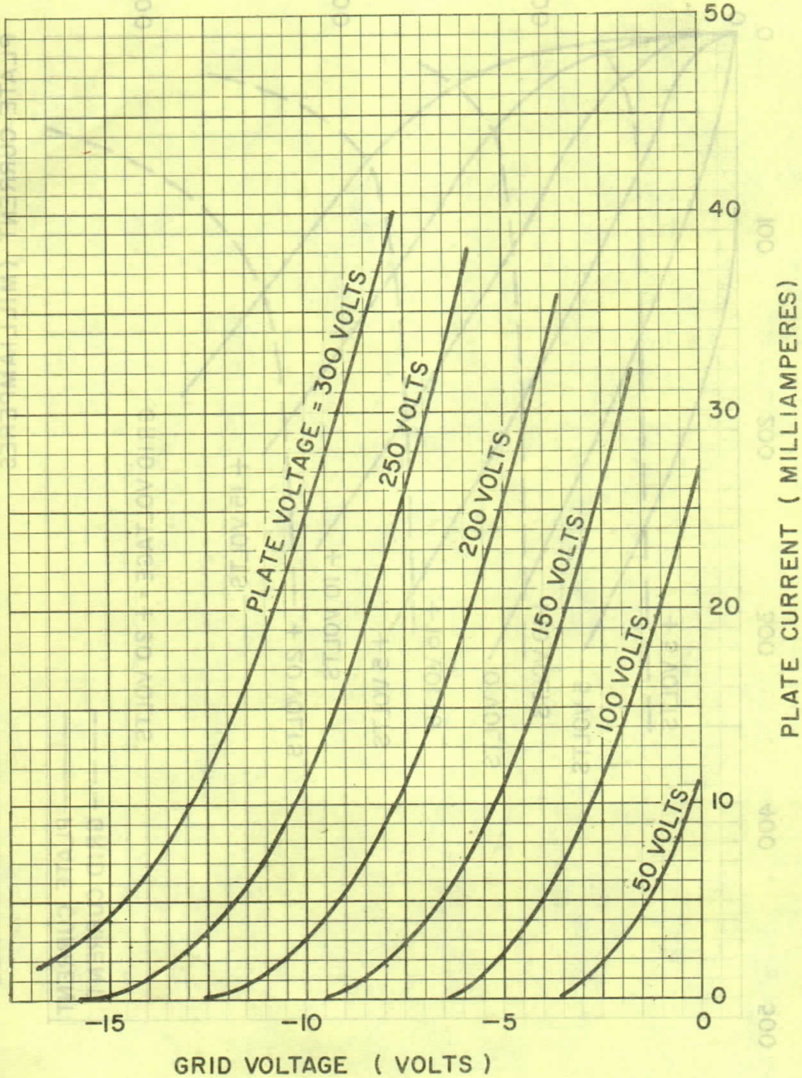
PLATE CHARACTERISTICS
PLATE VOLTAGE (VOLTS)
PLATE CURRENT (MILLIAMPERES)
0
100
200
300
400
500
0
10
20
30
GRID VOLTAGE = +2 VOLTS
+ GRID CURRENT = 200 µA
0 VOLTS
-2 VOLTS
-4 VOLTS
-6 VOLTS
-8 VOLTS
-10 VOLTS
-12 VOLTS
-14 VOLTS
-16 VOLTS
-18 VOLTS
-20 VOLTS

PLATE & GRID CHARACTERISTICS



6463

TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 6681

The Amperex 6681[1] is a miniature, high-mu twin triode, each section of which has an individual cathode connection. The construction of the 6681 is such that noise and microphony are reduced to a minimum. Hum is reduced by the use of a coiled tungsten heater. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt heater supply.

The 6681 is particularly suited for use in resistance - coupled voltage amplifiers such as those used in the preamplifier and input stages of Hi-Fi amplifiers, phase inverters, multivibrators and numerous industrial control circuits where high voltage gain, long life and reliability are desired.

The 6681 is one of the Amperex "Premium Quality, 10,000 Hour" tubes.

GENERAL CHARACTERISTICS

MECHANICAL

Maximum Overall Dimensions	
Length	2-3/16 inches
Seated Height	1-15/16 inches
Diameter	7/8 inch
Mounting Position	any
Base	Small Button, 9 pin RETMA #9A

ELECTRICAL

Cathode	Coated, unipotential	
	Series	Parallel
Heater Voltage, AC or DC	12.6	6.3 volts
Heater Current[2]	0.15	0.3 amps

Direct Interelectrode Capacitances

	With Shield[3]	Without Shield
Grid to Plate (each section)	1.7	1.7 uuf
Input (each section)	1.8	1.6 uuf
Output (section 1)	1.9	0.46 uuf
Output (section 2)	1.9	0.34 uuf

1. The 6681 is a Premium Quality replacement for the 12AX7.

2. When used in equipment which employs series - connected heaters, a current-limiting device must be inserted to limit the current when switching on.

3. With external shield (RETMA #315) connected to cathode of section under test.

MAXIMUM RATINGS (Each Section)

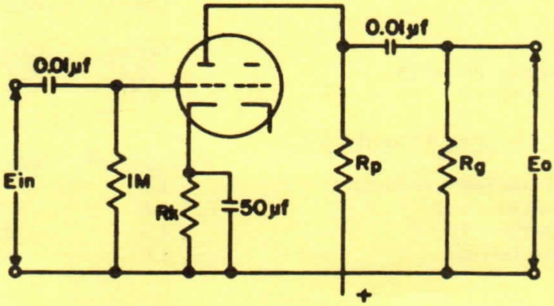
Design Center Values

Zero Signal Plate Voltage	550	volts
Plate Voltage	300	volts
Plate Dissipation	1.0	watt
Cathode Current	8	mA
Grid Voltage	−50	volts
Grid Voltage (Grid current = + 0.3 uA)	−1.3	volts
Grid Resistance [4]	2	megohms
Heater to Cathode Voltage	180	volts
Heater to Cathode Resistance	20,000	ohms
Heater to Cathode Resistance [5]	150,000	ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

Plate Voltage	100	250	volts
Grid Voltage	− 1.0	−2.0	volts
Amplification Factor	100	100	
Plate Resistance (approx.)	80,000	62,500	ohms
Transconductance	1250	1600	micromhos
Plate Current	0.5	1.2	mA



Rp = 0.047 MΩ
Rg = 0.15 MΩ

CLASS A RESISTANCE-COUPLED AMPLIFIER, EACH SECTION

[4] With self bias.

[5] In phase inverting circuits.

Rp = 0.047 MΩ   Rg = 0.15 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
200	1500	0.86	18	34	8.5
250	1200	1.18	23	37.5	7.0
300	1000	1.55	26	40	5.0
350	820	1.98	33	42.5	4.4
400	680	2.45	37	44	3.6

Rp = 0.1 MΩ   Rg = 0.33 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (Veff)[6]	Gain	% Distortion[7]
200	1800	0.65	20	50	4.8
250	1500	0.86	26	54.5	3.9
300	1200	1.11	30	57	2.7
350	1000	1.40	36	61	2.2
400	820	1.72	38	63	1.7

Rp = 0.22 MΩ   Rg = 0.68 MΩ

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff})[6]	Gain	% Distortion[7]
200	3300	0.36	24	56	4.6
250	2700	0.48	28	66.5	3.4
300	2200	0.63	36	72	2.6
350	1500	0.85	37	75.5	1.6
400	1200	1.02	38	76.5	1.1

[6] E_o at grid current starting point.

[7] The total harmonic distortion is approximately proportional to the output voltage

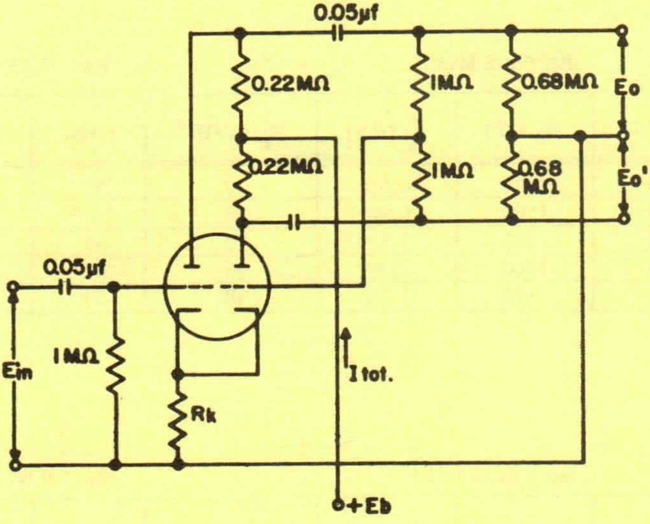
APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 50 millivolts when the tube is mounted in the near vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%.

HUM

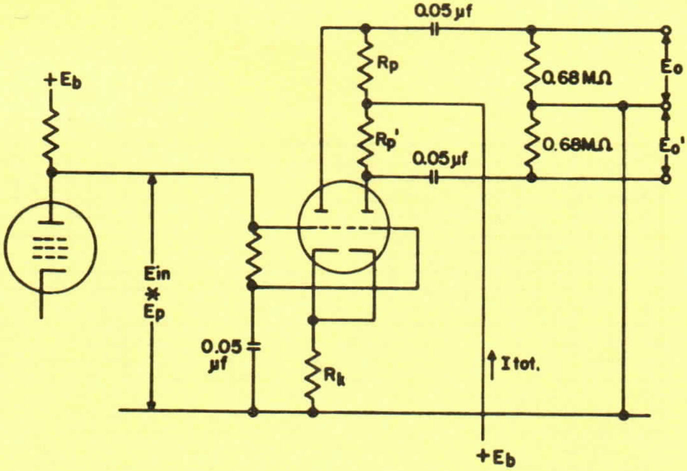
The hum and moise level will be better than - 60 db when the grid circuit impedance is less than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is decoupled by a capacitor of at least 100 uf.



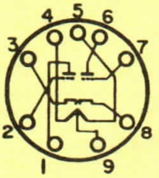
Supply Voltage	250	350	volts
Cathode Resistance	1200	820	ohms
Total Current	1.08	1.70	mA
Output Voltage[6] (RMS)	35	45	volts
Voltage Gain	58	62	
Percent Distortion[7]	5.5	3.5	%

[6] E_o at grid current starting point.

[7] The total harmonic distortion is approximately proportional to the output voltage.

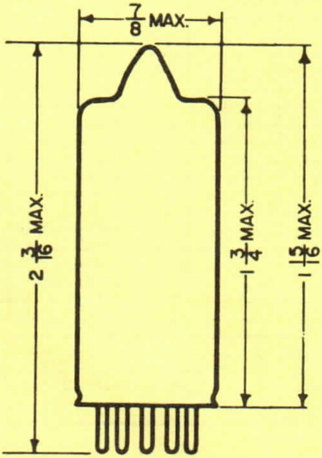


Supply Voltage	250	350	volts
Plate Voltage *	65	90	volts
Total Current	1.0	1.2	mA
Cathode Resistance	68,000	82,000	ohms
Plate Load Resistance (R_p)	0.1	0.15	megohm
Plate Load Resistance (R_p')	0.1	0.15	megohm
Output Voltage[6] (RMS)	20	35	volts
Voltage Gain	25	27	
Percent Distortion[7]	1.8	1.8	%



PIN CONNECTIONS

PIN NO. 1 = PLATE NO. 1
PIN NO. 2 = GRID NO. 1
PIN NO. 3 = CATHODE
PIN NO. 4 = HEATER
PIN NO. 5 = HEATER
PIN NO. 6 = PLATE NO. 2
PIN NO. 7 = GRID NO. 2
PIN NO. 8 = CATHODE
PIN NO. 9 = HEATER CENTER TAP



6 E_o at grid current starting point.

7 The total harmonic distortion is approximately proportional to the output voltage.

6681

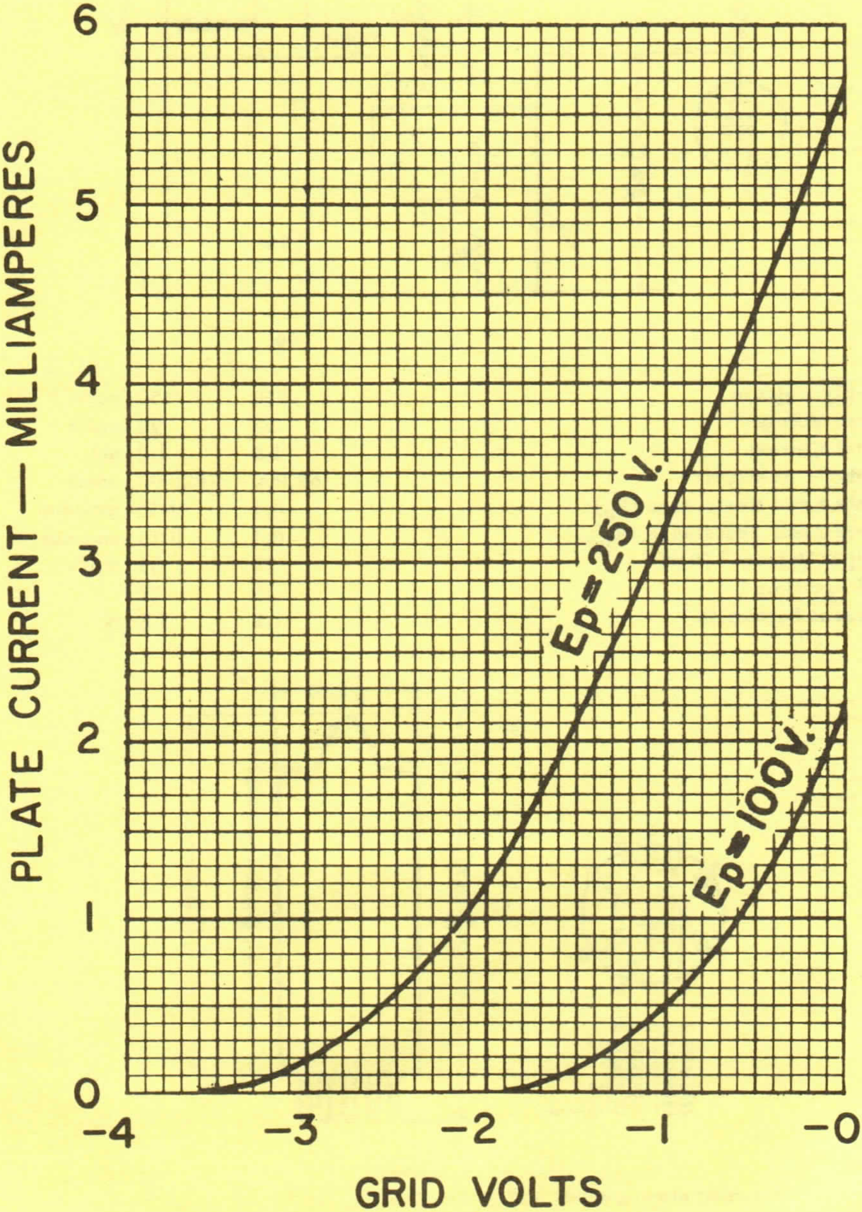
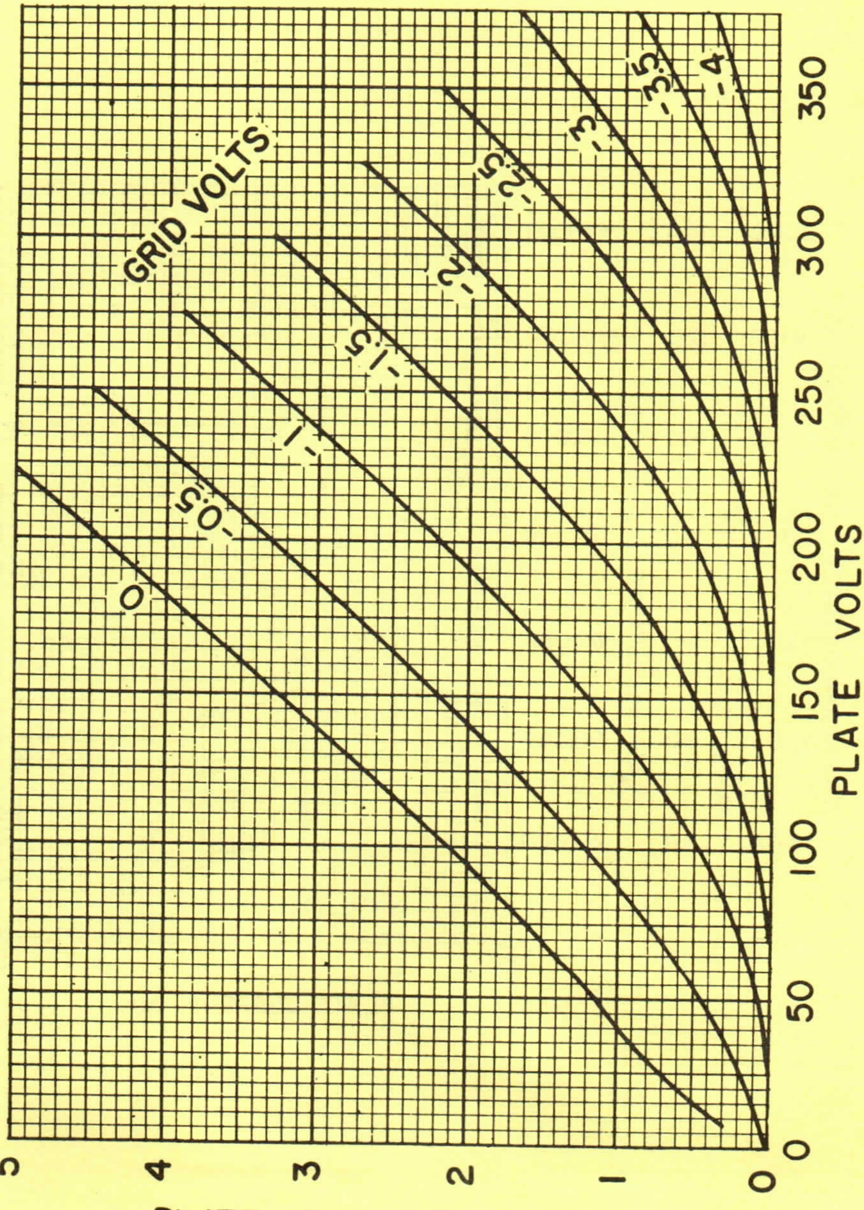
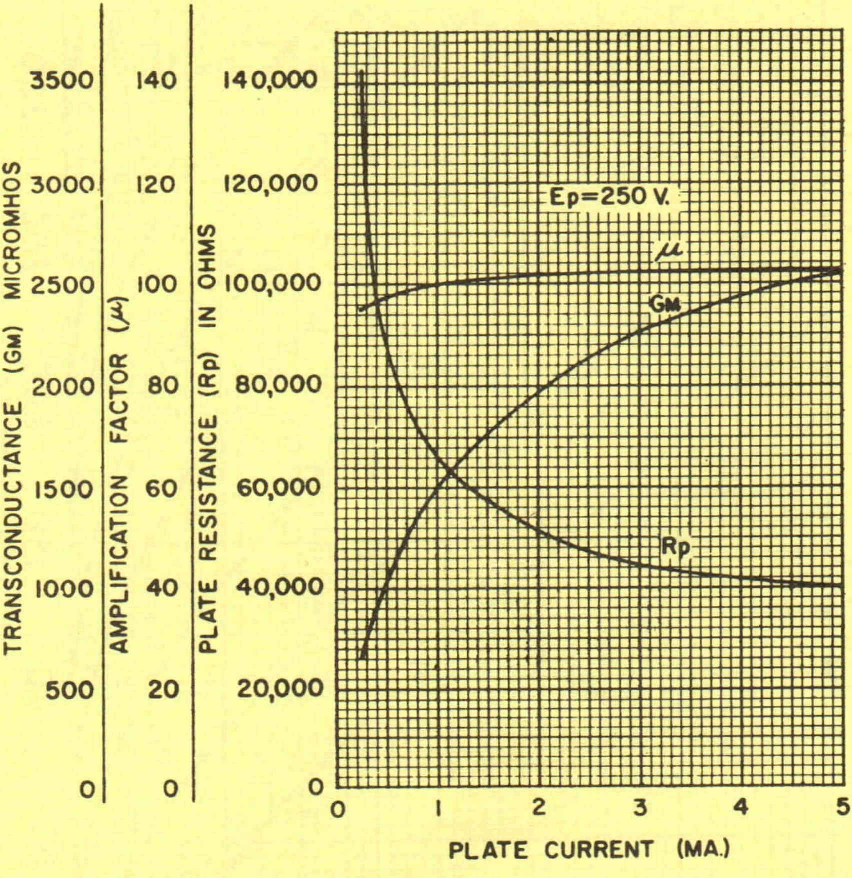


PLATE CURRENT — MILLIAMPERES
6
5
4
3
2
1
0
−4
−3
−2
−1
−0
GRID VOLTS
Ep = 250 V.
Ep = 100 V.

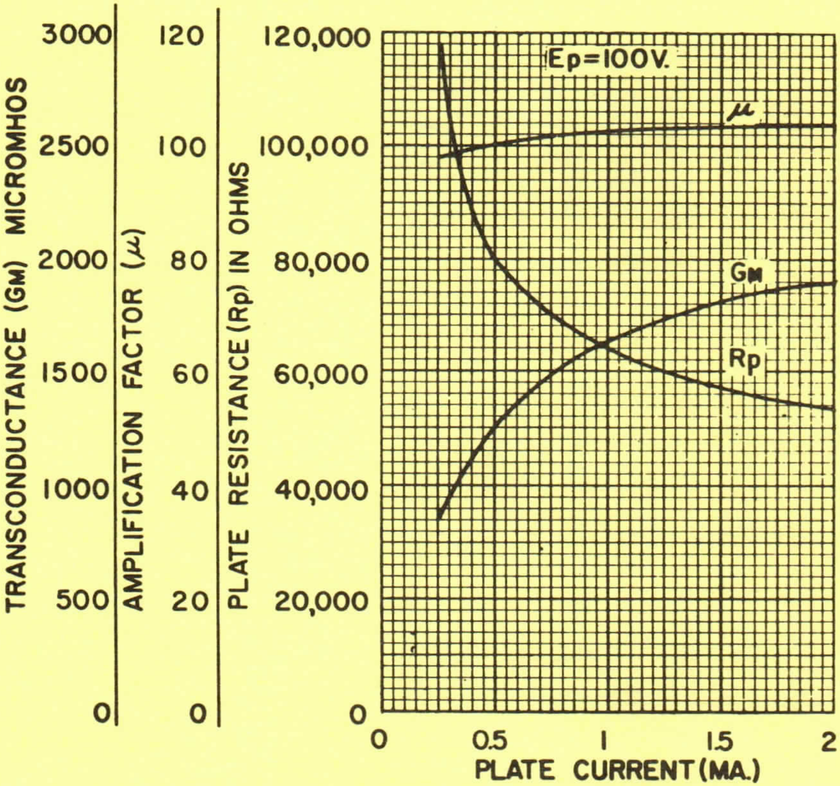
6681


GRID VOLTS
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
PLATE VOLTS
0
50
100
150
200
250
300
350
PLATE CURRENT (MA.)
0
1
2
3
4
5

6681



TRANSCONDUCTANCE (GM) MICROMHOS
3500
3000
2500
2000
1500
1000
500
0
AMPLIFICATION FACTOR (μ)
140
120
100
80
60
40
20
0
PLATE RESISTANCE (Rp) IN OHMS
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Ep=250 V.
μ
GM
Rp
0
1
2
3
4
5
PLATE CURRENT (MA.)


TRANSCONDUCTANCE (GM) MICROMHOS
3000
2500
2000
1500
1000
500
0
AMPLIFICATION FACTOR (μ)
120
100
80
60
40
20
0
PLATE RESISTANCE (Rp) IN OHMS
120,000
100,000
80,000
60,000
40,000
20,000
0
Ep=100V.
μ
GM
Rp
0
0.5
1
1.5
2
PLATE CURRENT (MA.)

AMPEREX TUBE TYPE 6686/E81L

The 6686/E81L is an internally screened, output pentode designed especially for telephone equipment and instrumentation where reliability of performance and long-life are of utmost importance. The 6686/E81L is one of the AMPEREX "Premium Quality", 10,000 hour tubes.

The cathode is oxide coated, indirectly heated. The tube has high mutual conductance at low plate current and is useful in line amplifiers. The low output and input capacitances make it suitable for application in wide-band amplifiers such as used in carrier telephone systems on balanced cables. Other applications are in multivibrators, oscillators, channel amplifiers, carrier telegraph systems and accurate measuring apparatus.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode		**oxide coated, unipotential**
Heater voltage [1]		**6.3 volts**
Heater current at 6.3 volts [1]		**0.375 ±0.02 amp**

Direct Interelectrode Capacitances

Input capacitance		**11.5 ±0.8 uuf**
Output capacitance		**6.5 ±0.6 uuf**
Plate to grid No. 1	**max.**	**0.02 uuf**
Grid No. 1 to heater	**max.**	**0.2 uuf**
Heater to cathode		**4.2 uuf**
Input capacitance (cathode current = 25 ma)		**14.3 uuf**
Radiation capacitance of the plate [2]	**max.**	**0.06 uuf**
Radiation capacitance of the grid No. 1 [2]	**max.**	**0.12 uuf**

Typical Characteristics

Plate voltage	**210 volts**
Grid No. 3 voltage	**0 volts**
Grid No. 2 voltage	**210 volts**
Cathode resistor	**120 ohms**
Plate current [3]	**20 ±3 ma**

[1] **In order to obtain a useful tube life of 10,000 hours in case of parallel supply, the maximum variation of the heater voltage should be less than ±5% (absolute limit)**
In order to obtain a useful tube life of 10,000 hours in case of series supply, the maximum variation of the heater current due to voltage fluctuations and tolerances in the circuit components should be less than ± 1.5% (absolute limit).

[2] **The radiation capacitance is the capacitance of the related electrode to a surrounding box with an inner diameter of 2 inches and a height of 3 7/8 inches, the other electrodes being grounded.**

[3] **The end point of life is reached when one or more of the characteristics have changed to the following values:**

Plate current	**13.5 ma**
Grid No. 2 current	**3.1 ma**
Transconductance	**7800 micromhos**
Negative grid current (grid series resistor = 0.1 megohm)	**0.1 microamp**

6686/E81L

Grid No. 2 current [3]		5.3 ± 1.2 ma
Transconductance [3]		11000 ± 1500 micromhos
Amplification factor-Screen to Control Grid		36
Plate resistance		0.3 megohm (min. 0.2 megohm)
Equivalent noise resistance (R.F.)		1200 ohms
Control grid bias at plate current of 0.5 ma	max.	− 8.5 volts
Grid current starting point (Grid No. 1 bias at grid No. 1 current = + 0.3 microamp)	max.	− 1.1 volts
Negative grid current (grid series resistor 0.1 megohm) [3]	max.	0.5 microamp
Grid No. 1 hum voltage (grid leak = 0.5 megohm)	max.	0.2 millivolt
Decrease of transconductance when the heater voltage is decreased 10%	max.	10 %
Insulation between two electrodes	min.	100 megohms
Insulation between cathode and heater (cathode-heater voltage = 120 volts) [4]	min.	5 megohms
Cathode heating time	16 sec. (max.	22 sec.)
Cathode cooling time	15 sec. (min.	7 sec.)

MECHANICAL

Base	Small button, 9 pin (JETEC #9CJ)
Maximum diameter	7/8 inch
Maximum length	2 5/8 inch
Mounting position	any

Maximum Ratings (Design center values)

Plate voltage	max.	210 volts
Plate voltage without current	max.	550 volts
Plate dissipation	max.	4.5 watts
Grid No. 2 voltage	max.	210 volts
Grid No. 2 voltage without current	max.	550 volts
Grid No. 2 dissipation	max.	1.2 watt
Cathode current	max.	30 ma
Grid No. 1 circuit resistance (with cathode bias)	max.	0.5 megohm
Voltage between heater and cathode	max.	120 volts
Bulb temperature	max.	170 °C
Grid No. 1 circuit resistance (with fixed bias)	max.	0.25 megohm

[3] **The end point of life is reached when one or more of the characteristics have changed to the following values:**

Plate current	**13.5 ma**
Grid No. 2 current	**3.1 ma**
Transconductance	**7800 micromhos**
Negative grid current (grid series resistor = 0.1 megohm)	**1.0 microamp**

[4] **In order to prevent the operation of the tube from being influenced by variations of the heater to cathode insulation it is advisable to keep the external resistance between heater and cathode less than 20,000 ohms.**

6686/E81L

Typical Operation as Pre-Amplifier

Plate voltage	210	volts
Grid No. 3 voltage	0	volt
Grid No. 2 voltage	210	volts
Cathode resistor	180	ohms
Plate current	15	ma
Grid No. 2 current	4	ma
Transconductance	10,000	micromhos
Plate resistance	0.4	megohm
Load A.C. resistance	20,000	ohms
Voltage gain	44.7	db.

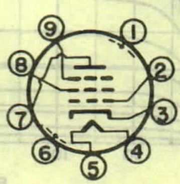
Typical Operation - Class A Output Amplifier

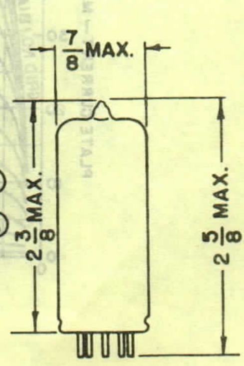
Plate voltage	210	volts
Grid No. 3 voltage	0	volt
Grid No. 2 voltage	210	volts
Cathode resistor	120	ohms
Plate current	20	ma
Grid No. 2 current	5.3	ma
Transconductance	11,000	micromhos
Plate resistance	0.3	megohm
Load A.C. resistance	15,000	ohms
Input A.C. voltage	0.95	volt (rms)

	Min.	Nom.	Nom.	Max.	
Power output	0.7	1.0	0.1	-	watts
Total harmonic distortion	-	5	1.2	2.0%	

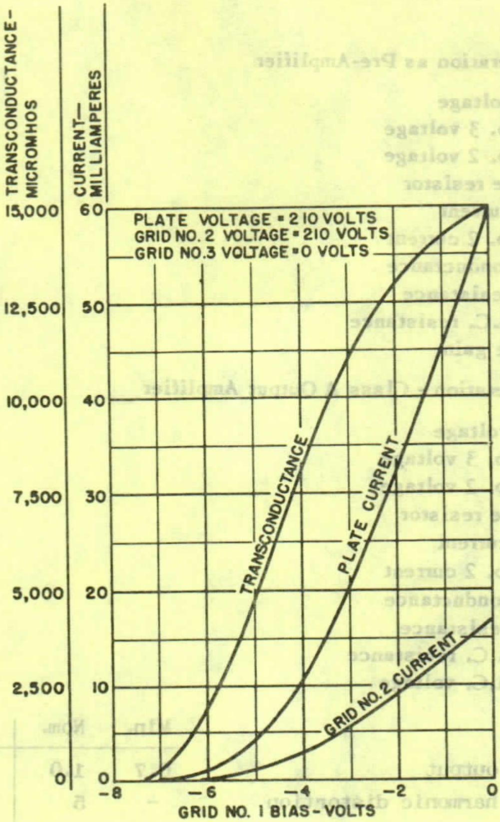
PIN CONNECTIONS

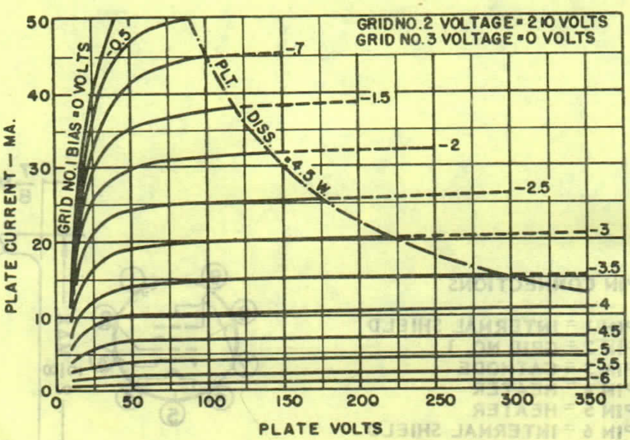
PIN 1 = INTERNAL SHIELD
PIN 2 = GRID NO. 1
PIN 3 = CATHODE
PIN 4 = HEATER
PIN 5 = HEATER
PIN 6 = INTERNAL SHIELD
PIN 7 = PLATE
PIN 8 = GRID NO. 2
PIN 9 = GRID NO. 3





6686/E81L


TRANSCONDUCTANCE-MICROMHOS
CURRENT-MILLIAMPERES
PLATE VOLTAGE = 210 VOLTS
GRID NO. 2 VOLTAGE = 210 VOLTS
GRID NO.3 VOLTAGE = 0 VOLTS
15,000
12,500
10,000
7,500
5,000
2,500
0
60
50
40
30
20
10
0
TRANSCONDUCTANCE
PLATE CURRENT
GRID NO. 2 CURRENT
-8
-6
-4
-2
0
GRID NO. 1 BIAS-VOLTS


GRID NO. 2 VOLTAGE = 210 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
PLATE CURRENT — MA.
GRID NO. 1 BIAS = 0 VOLTS
-0.5
-.7
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
PLT. DISS. 4.5 W.
50
40
30
20
10
0
0
50
100
150
200
250
300
350
PLATE VOLTS

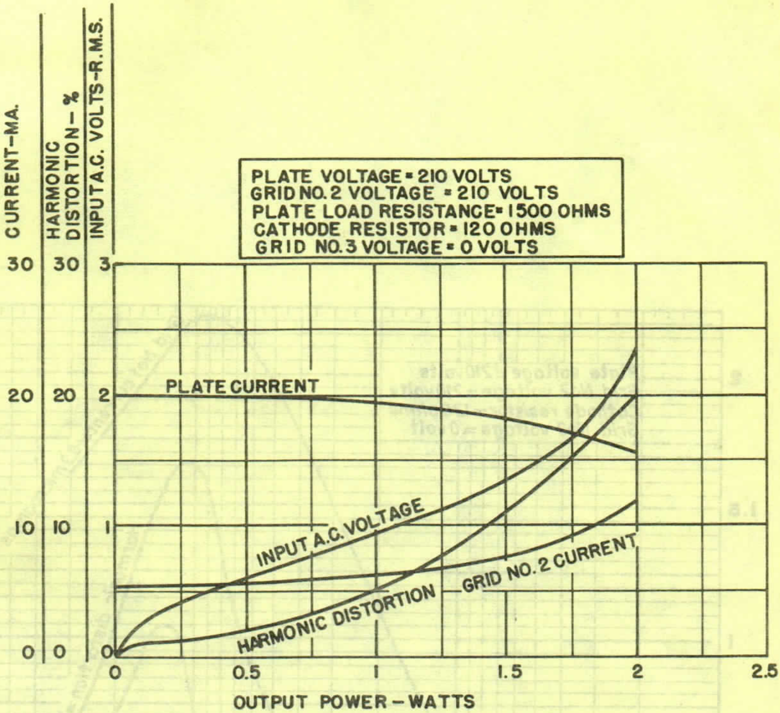


PLATE VOLTAGE = 210 VOLTS
GRID NO. 2 VOLTAGE = 210 VOLTS
PLATE LOAD RESISTANCE = 1500 OHMS
CATHODE RESISTOR = 120 OHMS
GRID NO. 3 VOLTAGE = 0 VOLTS
CURRENT-MA.
HARMONIC DISTORTION-%
INPUT A.C. VOLTS-R.M.S.
PLATE CURRENT
INPUT A.C. VOLTAGE
GRID NO. 2 CURRENT
HARMONIC DISTORTION
OUTPUT POWER-WATTS

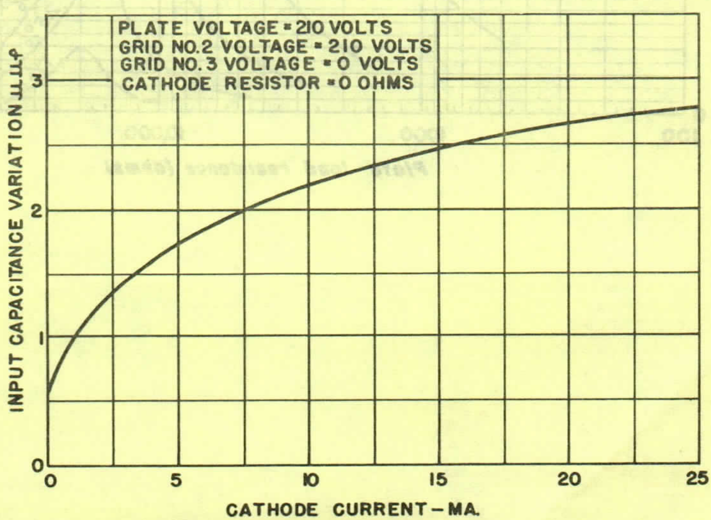


PLATE VOLTAGE = 210 VOLTS
GRID NO. 2 VOLTAGE = 210 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
CATHODE RESISTOR = 0 OHMS
INPUT CAPACITANCE VARIATION μμf
CATHODE CURRENT-MA.

6686/E81L

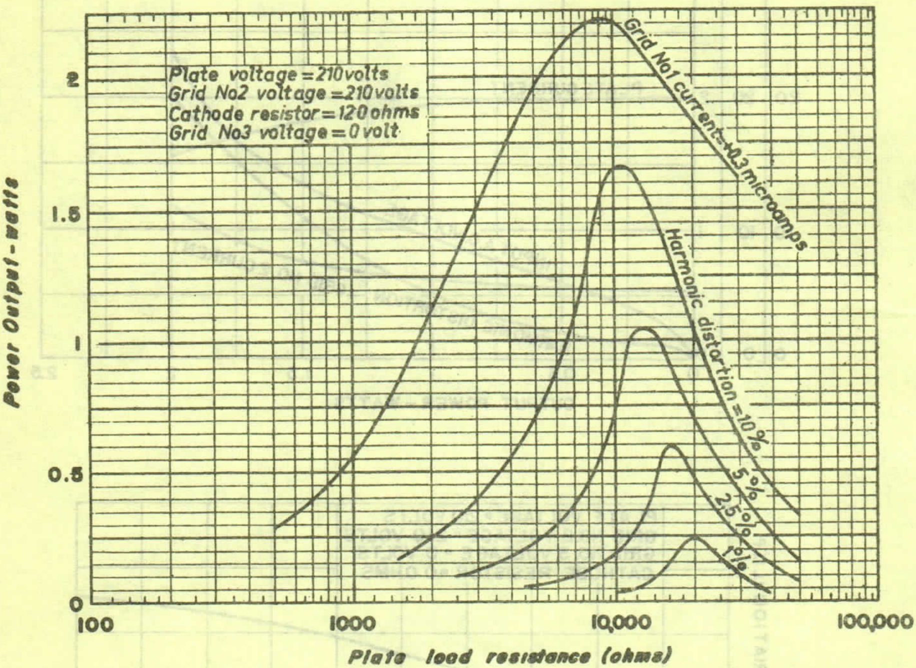
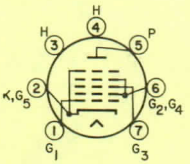


Plate voltage = 210 volts
Grid No2 voltage = 210 volts
Cathode resistor = 120 ohms
Grid No3 voltage = 0 volt
Grid No1 current = 0.3 microamps
Harmonic distortion = 10%
5%
2.5%
1%
Power Output - watts
2
1.5
1
0.5
0
100
1000
10,000
100,000
Plate load resistance (ohms)

AMPEREX TUBE TYPE 6687/E91H

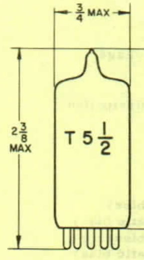
The 6687/E91H is a dual control heptode for use as a gated amplifier in computer and "on-off" control circuits.

It is one of the Amperex "Premium Quality 10,000" tubes.



PIN CONNECTIONS

1 - GRID NO. 1
2 - CATHODE, GRID NO. 5
3 - HEATER
4 - HEATER
5 - PLATE
6 - GRID NO. 2, GRID NO. 4
7 - GRID NO. 3



GENERAL CHARACTERISTICS

MECHANICAL

Maximum dimensions	see outline drawing
Bulb	T5½
Outline	see outline drawing
Basing	7CH
Mounting Position	any

ELECTRICAL

Cathode	coated, unipotential
Heating	indirect by A.C. or D.C. parallel supply
Heater voltage	6.3 volts [1]
Heater Current	270 mA [2]

Direct Interelectrode Capacitances (without external shield)

Output capacitance	7.9 $\mu\mu f$
Input capacitance Grid No. 1	5.4 $\mu\mu f$
Input capacitance Grid No. 3	7.0 $\mu\mu f$
Plate to Grid No. 1	< 0.08 $\mu\mu f$
Plate to Grid No. 3	< 0.45 $\mu\mu f$
Grid No. 1 to Grid No. 3	< 0.2 $\mu\mu f$

NOTES:

1 In order to prolong tube life, variation of heater voltage should be less than ±5% (absolute values).

2 At heater voltage = 6.3 volts the spread of heater current from tube to tube may be ±14 mA

6687/E91H

Maximum Ratings (absolute Values)

Plate Voltage (at zero plate current)	500 volts max
Plate voltage	250 volts max
Grid No. 2, Grid No. 4 voltage (at zero Grid No. 2, Grid No. 4 current)	500 volts max
Voltage Grid No. 2 and Grid No. 4	100 volts max
Negative Grid No. 3 voltage	100 volts max
Grid No. 3 voltage	0 volts max
Negative peak Grid No. 3 voltage	200 volts max
Peak Grid No. 3 voltage	90 volts max
Negative Grid No. 1 voltage	100 volts max
Grid No. 1 voltage	0 volts max
Negative peak Grid No. 1 voltage	200 volts max
Peak Grid No. 1 Voltage	see note 3
Plate dissipation	1.0 watts max
Grid No. 2 and Grid No. 4 dissipation	1.0 watts max
Grid No. 1 dissipation	0.5 watts max
Grid No. 3 dissipation	0.5 watts max
Cathode current	20 mA max
Peak cathode current	70 mA max
Heater-cathode voltage	120 volts max
Resistor Grid No. 1 (fixed bias)	0.5 megohms
Resistor Grid No. 1 (automatic bias)	1.0 megohms
Resistor Grid No. 3 (fixed bias)	0.5 megohms
Resistor Grid No. 3 (automatic bias)	1.0 megohms

Typical Characteristics

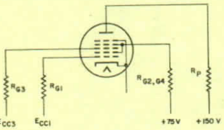


FIG. 1

Plate supply voltage	150	150	150	150	volts
Voltage supply (Grid No. 2, Grid No. 4)	75	75	75	75	volts
Voltage supply Grid No. 1	0	0	− 10	0	volts
Voltage supply Grid No. 3	0	−10	0	+ 55	volts
Plate resistor	20,000	20,000	20,000	- -	ohms
Resistor Grid No. 2, Grid No. 4	470	470	470	- -	ohms
Resistor Grid No. 1	47,000	47,000	47,000	- -	ohms
Resistor Grid No. 3	47,000	47,000	47,000	- -	ohms
Plate current	> 5.5 < 7.0	< 0.2	< 0.2	- -	mA
Current Grid No. 3	- -	- -	- -	> 0	mA

Insulation resistance between cathode and heater (Heater Voltage = 6.3 volts, Heater Cathode Voltage = 120 volts) — min 8 megohms

Inverse Grid No. 1 and Grid No. 3 Current (measured in figure 1)

Plate Supply voltage	150 volts
Supply voltage (Grid No. 2, Grid No. 4)	75 volts
Supply voltage Grid No. 1	−1.5 volts
Supply voltage Grid No. 3	−1.5 volts
Plate resistor	20,000 ohms
Resistor Grid No. 2, Grid No. 4	470 ohms
Resistor Grid No. 1	47,000 ohms
Resistor Grid No. 3	47,000 ohms
Negative Grid No. 1 current	0.2 μA max
Negative Grid No. 3 current	0.5 μA max

Operating Characteristics As A Mixer

Plate Voltage	250 volts
Voltage Grid No. 2 and Grid No. 4	100 volts
Voltage Grid No. 3 [4]	− 5 volts
Oscillator voltage	10 volts rms
Resistor Grid No. 1	20,000 ohms
Plate Current	3.3 mA
Current Grid No. 1	530 μA
Current Grid No. 2 and Grid No. 4	6.5 mA
Conversion transconductance	450 micromhos
Plate resistance	0.85 megohms

[3] Limited by peak cathode current and Grid No. 1 dissipation.
[4] Oscillator voltage on Grid No. 1; signal voltage on Grid No. 3.

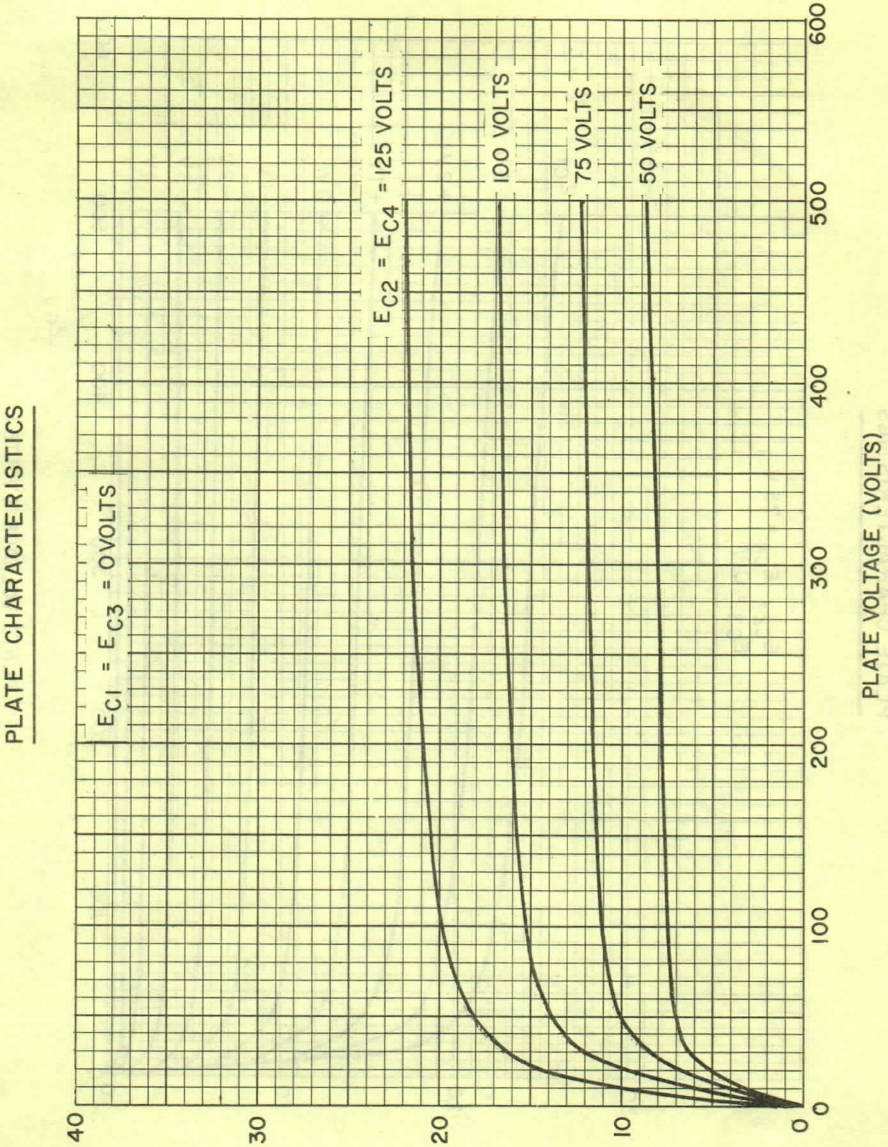
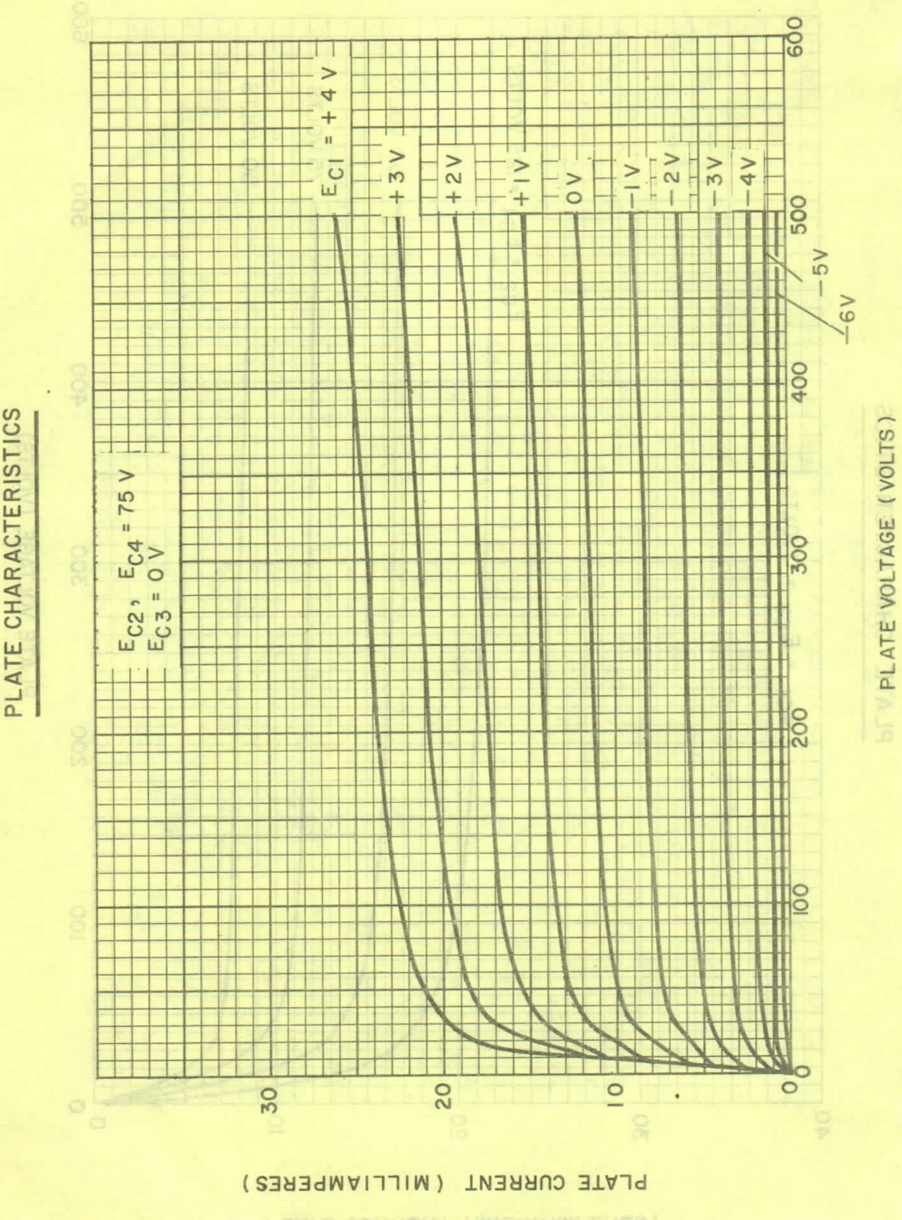


PLATE CHARACTERISTICS
$E_{C1} = E_{C3} = 0$ VOLTS
$E_{C2} = E_{C4} = 125$ VOLTS
100 VOLTS
75 VOLTS
50 VOLTS
PLATE VOLTAGE (VOLTS)
PLATE CURRENT (MILLIAMPERES)
0
100
200
300
400
500
600
10
20
30
40

6687/E91H



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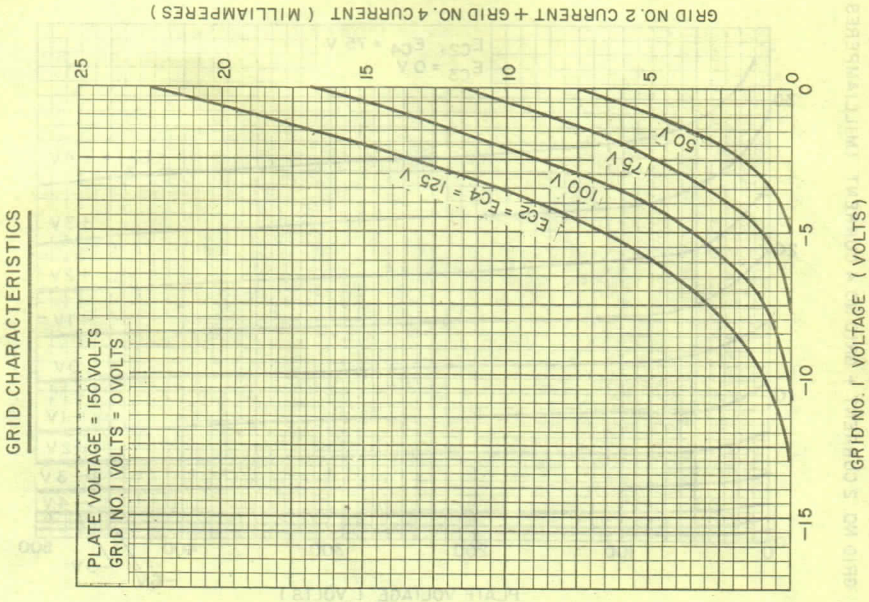
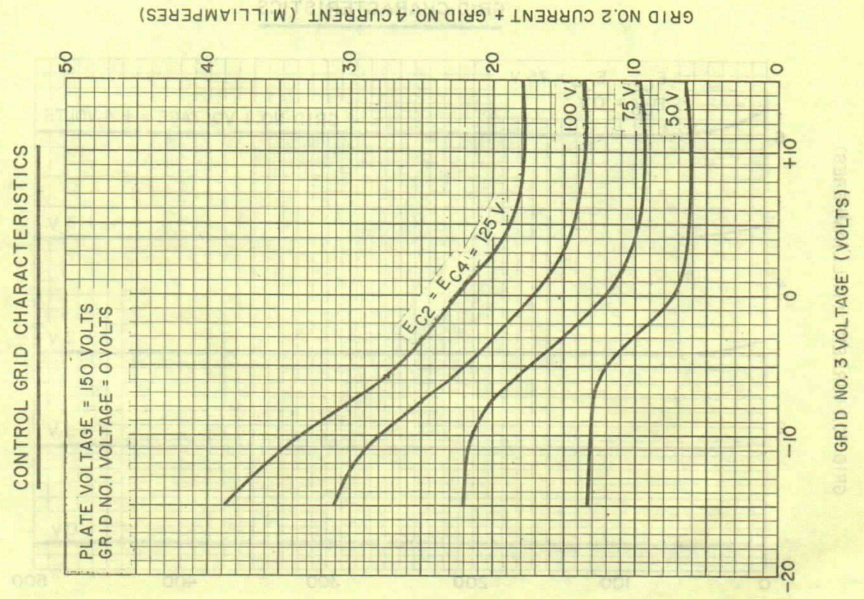
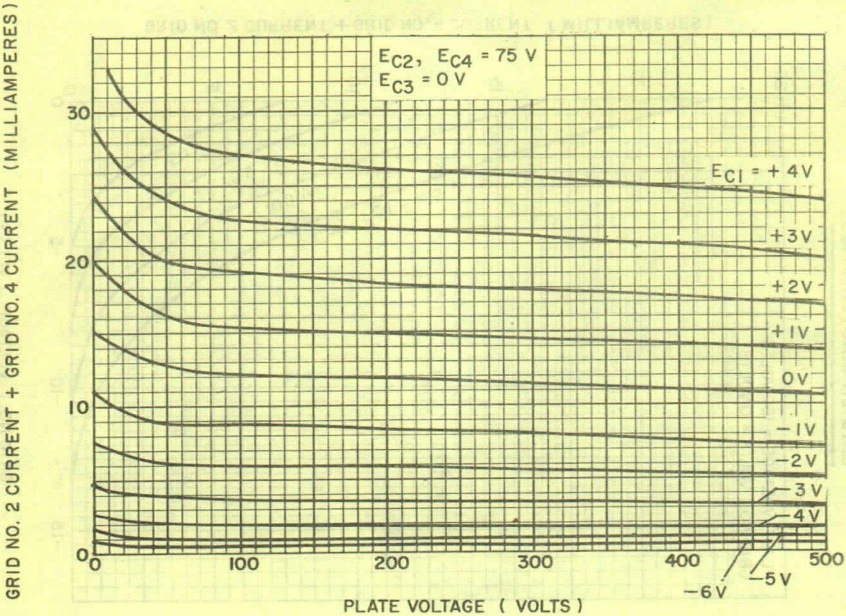

GRID CHARACTERISTICS
PLATE VOLTAGE = 150 VOLTS
GRID NO. I VOLTS = 0 VOLTS
GRID NO. 2 CURRENT + GRID NO. 4 CURRENT (MILLIAMPERES)
25
20
15
10
5
0
GRID NO. I VOLTAGE (VOLTS)
0
−5
−10
−15
EC2 = EC4 = 125 V
100 V
75 V
50 V

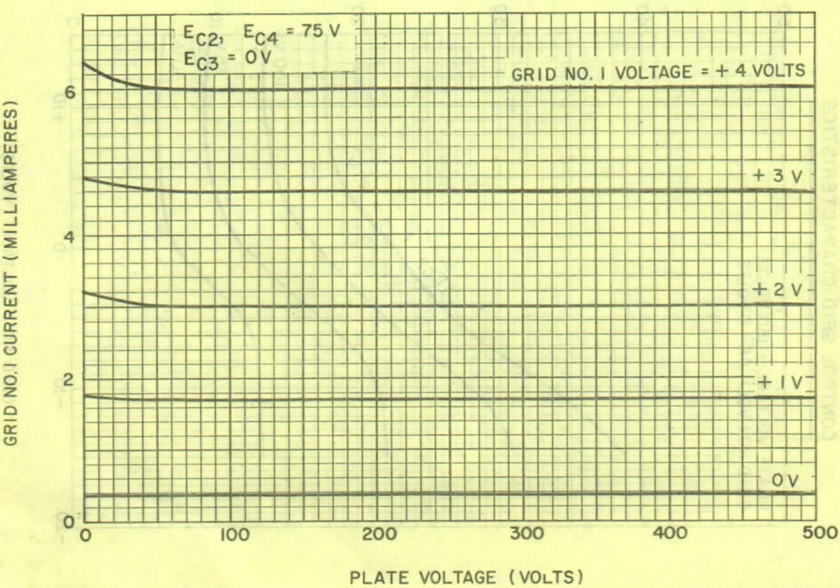

CONTROL GRID CHARACTERISTICS
PLATE VOLTAGE = 150 VOLTS
GRID NO. I VOLTAGE = 0 VOLTS
GRID NO. 2 CURRENT + GRID NO. 4 CURRENT (MILLIAMPERES)
50
40
30
20
10
0
GRID NO. 3 VOLTAGE (VOLTS)
+10
0
−10
−20
EC2 = EC4 = 125 V
100 V
75 V
50 V

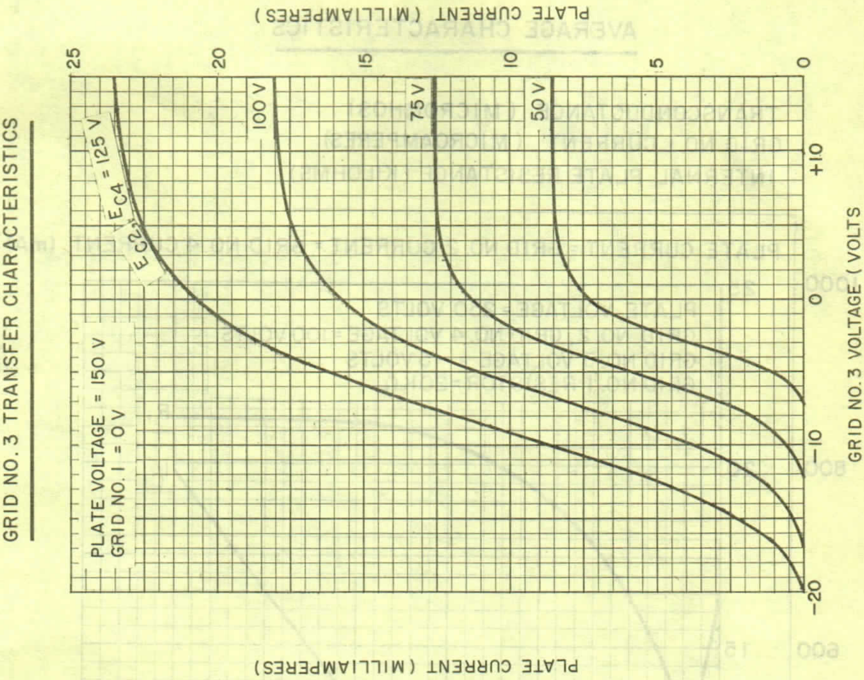
6687/E91H

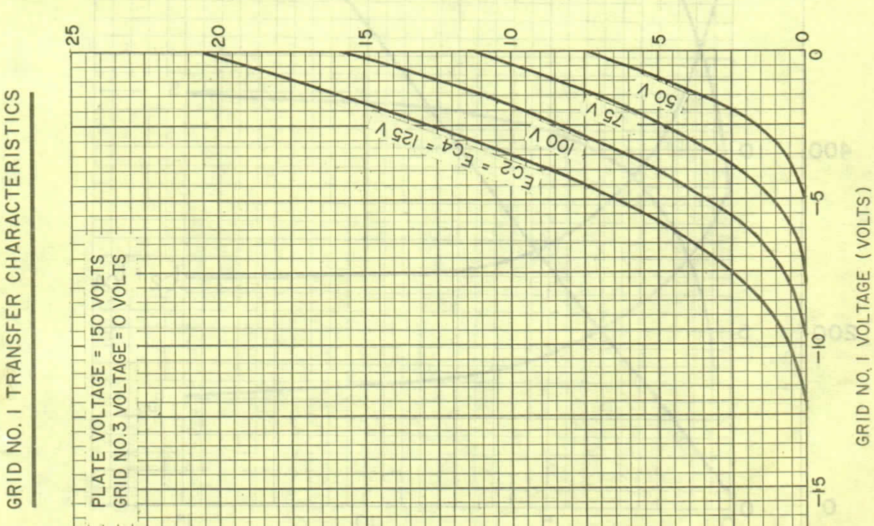
SCREEN GRID CHARACTERISTICS



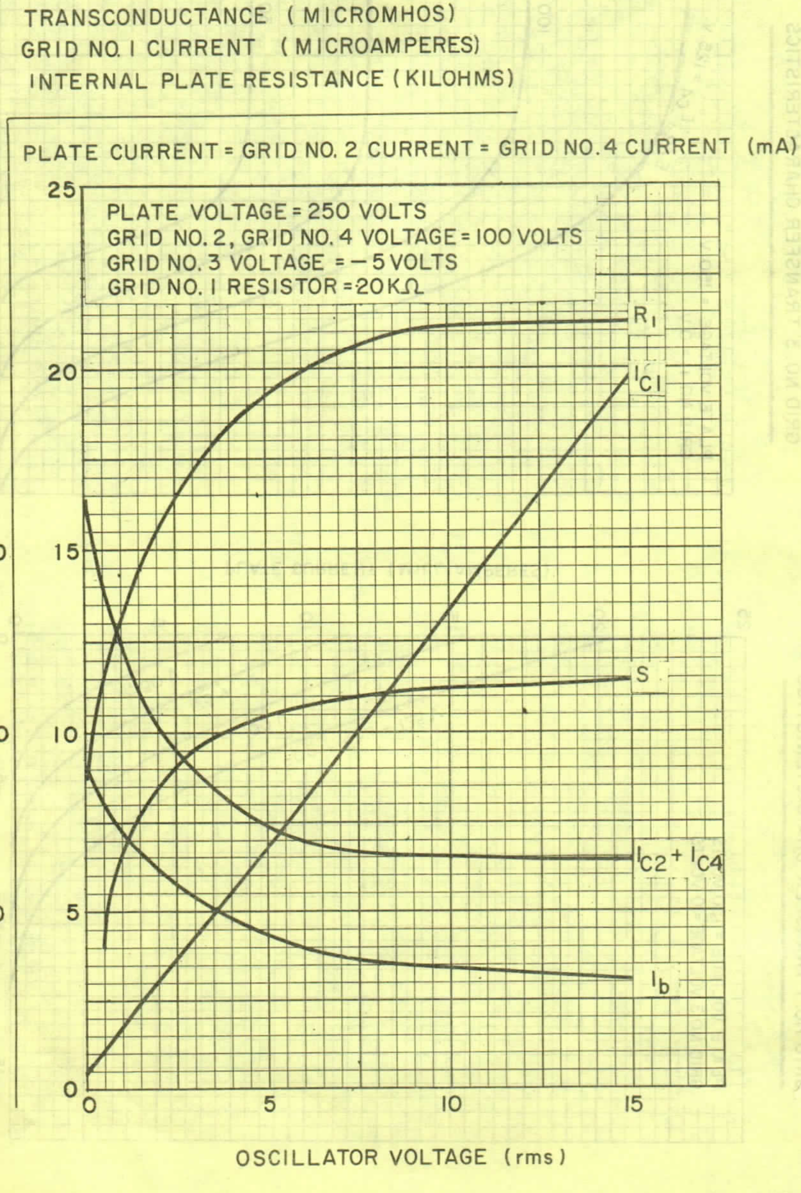
GRID CHARACTERISTICS




GRID NO. 3 TRANSFER CHARACTERISTICS
PLATE VOLTAGE = 150 V
GRID NO. 1 = 0 V
$E_{C2} = E_{C4} = 125$ V
100 V
75 V
50 V
PLATE CURRENT (MILLIAMPERES)
0
5
10
15
20
25
GRID NO. 3 VOLTAGE (VOLTS
+10
0
−10
−20


GRID NO. 1 TRANSFER CHARACTERISTICS
PLATE VOLTAGE = 150 VOLTS
GRID NO.3 VOLTAGE = 0 VOLTS
$E_{C2} = E_{C4} = 125$ V
100 V
75 V
50 V
PLATE CURRENT (MILLIAMPERES)
0
5
10
15
20
25
GRID NO. 1 VOLTAGE (VOLTS)
0
−5
−10
−15

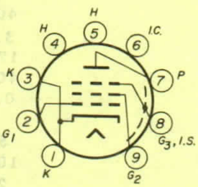
AVERAGE CHARACTERISTICS



AMPEREX TUBE TYPE 6688

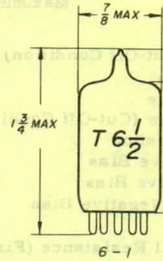
The Amperex 6688 is a shock resistant, broad-band amplifier pentode designed for use in unsupervised communication equipment and reliable instrumentation. It has applications in coaxial cable amplifiers, video amplifiers, broad-band IF amplifiers in communications links and TV equipment. The cathode is indirectly heated, oxide coated.

The 6688 is one of the Amperex "Premium Quality, 10,000 Hour" tubes.



PIN CONNECTIONS

1 - CATHODE
2 - GRID NO. 1
3 - CATHODE
4 - HEATER
5 - HEATER
6 - INTERNALLY CONNECTED
7 - PLATE
8 - GRID NO. 3, SHIELD
9 - GRID NO. 2



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Mounting Position	any
Bulb	T 6½
→ Base	small button, 9 pin E 9-1
→ Basing	9EQ
→ Outline	6-1
Shock and Vibration	see note 1

ELECTRICAL

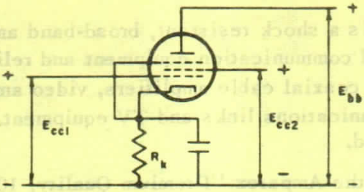
Cathode	coated, unipotential
Heating	AC or DC, parallel supply
Heater Voltage [2]	6.3 volts
Heater Current	0.3 ± 0.015 amps

Direct Interelectrode Capacitances [3]

	Min	Bogey	Max	
Grid No. 1 to All Other Elements	6.6	7.5	8.4	$\mu\mu$f
Plate to All Other Elements	2.5	3.0	3.5	$\mu\mu$f
Plate to Grid No. 1	-	0.018	0.03	$\mu\mu$f
Plate to Cathode	-	-	0.1	$\mu\mu$f
Grid No. 1 to Heater	-	-	0.1	$\mu\mu$f
Grid No. 1 to All Other Elements (Cathode Current = 16.3 mA)	-	11.1	-	$\mu\mu$f

See Page 4 for notes.

CLASS A AMPLIFIER



Maximum Ratings, Absolute Values

Plate Voltage	210 volts max
Plate Voltage (Cut-Off Condition)	400 volts max
Plate Dissipation	3.0 watts max
Grid No. 2 Voltage	175 volts max
Grid No. 2 Voltage (Cut-Off Condition)	400 volts max
Grid No. 2 Dissipation	0.9 watts max
Grid No. 1 Positive Bias	0 volts max
Grid No. 1 Negative Bias	50 volts max
Grid No. 1 Peak Negative Bias	100 volts max
Cathode Current	25 mA max
Grid No. 1 Circuit Resistance (Fixed Bias)	0.25 megohm max
Grid No. 1 Circuit Resistance (Automatic Bias)	0.5 megohm max
Heater-Cathode Voltage	60 volts max
Heater-Cathode Resistance [4]	20,000 ohms max
Bulb Temperature	155 °C max

Typical Operation As Pentode [5]

	I	II	
Plate Supply Voltage	190	180	volts
Grid No. 3 Voltage	0	0	volts
Grid No. 2 Supply Voltage	160	150	volts
Grid No. 1 Supply Voltage	9	0	volts
Series Cathode Resistor	630	100	ohms
→ Plate Current [6]	13.0 ± 0.8	11.5	mA
→ Grid No. 2 Current	3.3 ± 0.4	2.9	mA
Negative Grid No. 1 Current [6] (R_{g1} = 0.1 megohm)	0.5	-	μA
→ Transconductance [6]	16,500 ± 2300	15,900	micromhos
Amplification Factor - Grid No. 2 to Grid No. 1	50	-	
Internal Plate Resistance	90,000 min 45,000	-	ohms ohms
Equivalent Noise Resistance (RF)	460 max 650	-	ohms ohms
Grid No. 1 Hum Voltage [7] (R_{g1} = 0.5 megohm)	100	-	microvolts
→ AC Plate Load Resistor	1000	-	ohms
→ Signal Voltage	0.1	-	volts rms
→ Second Harmonic Distortion	1.6	-	%
Cathode Heating Time (At Half Quiescent Plate Current)	12 max 18		sec sec
Negative Grid No. 1 Bias [8] (At Plate Current = 0.8 mA)	max 4.5		volts
Negative Grid No. 1 Bias [8] (At Grid No. 1 Current = 0.3 μA)	max 0.5		volts

See Page 4 for notes.

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Typical Operation as Triode

(Grid No. 2 Connected to Plate)

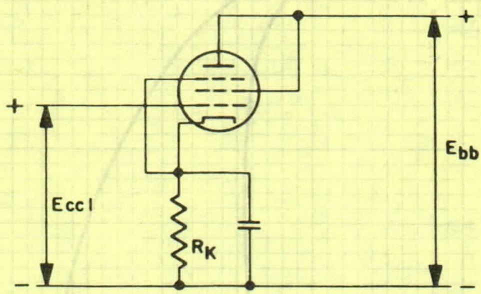
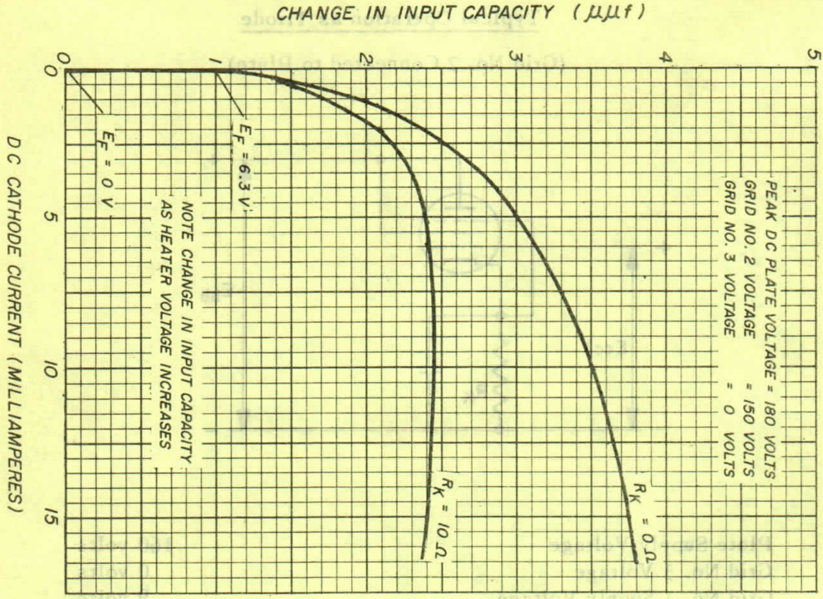


Plate Supply Voltage	160 volts
Grid No. 3 Voltage	0 volts
Grid No. 1 Supply Voltage	9 volts
Series Cathode Resistor	620 ohms
Plate Current	16.5 mA
Transconductance	18,500 micromhos
Amplification Factor	50
Internal Plate Resistance	2700 ohms
Equivalent Noise Resistance (RF)	225 ohms
Input Conductance at 100 Mc [8]	500 μA/V
Phase Angle of Slope at 50 Mc [8]	9°
Cathode-Heater Resistance	4 megohms min
Insulation Between Two Arbitrary Electrodes	20 megohms min

See Page 4 for notes.



1 The tubes can withstand vibration of 2.5 g for 96 hours at 50 cps and impact of about 300 g. (measured with NRL impact machine)

2 In order to obtain prolonged tube life, the maximum variation of the heater voltage should be less than ± 5%.

3 Measured with an external shield with an internal diameter of 7/8 inches. During the measurements pin 6 is floating.

4 In order to prevent operation of the tube from being influenced by variations of the heater to cathode insulation, it is advisable to keep the external resistance between heater and cathode less than 20,000 ohms.

5 Operation of the tube under conditions given in Column I is recommended because of the small spread in characteristics.

6 The end of life is reached when one or more of these characteristics have changed to the following values:

Plate Current	11.5 mA
Transconductance	11,000 micromhos
Negative Grid Current (Grid Resistor = 0.1 megohm)	1.0 μA

7 This value has been measured at a power line frequency of 50 cps with the electrical center of the heater grounded. The voltage has been measured in the plate circuit with the aid of a band-pass filter, linear from 30 - 200 cps and is referred to grid no. 1 as a hum voltage. The cathode resistor is decoupled by a capacitance of 1000 μf.

8 At: Plate Voltage = 180 volts
Grid No. 2 Voltage = 150 volts
Grid No. 3 Voltage = 0 volts

9 Pins 1 and 3 are interconnected.

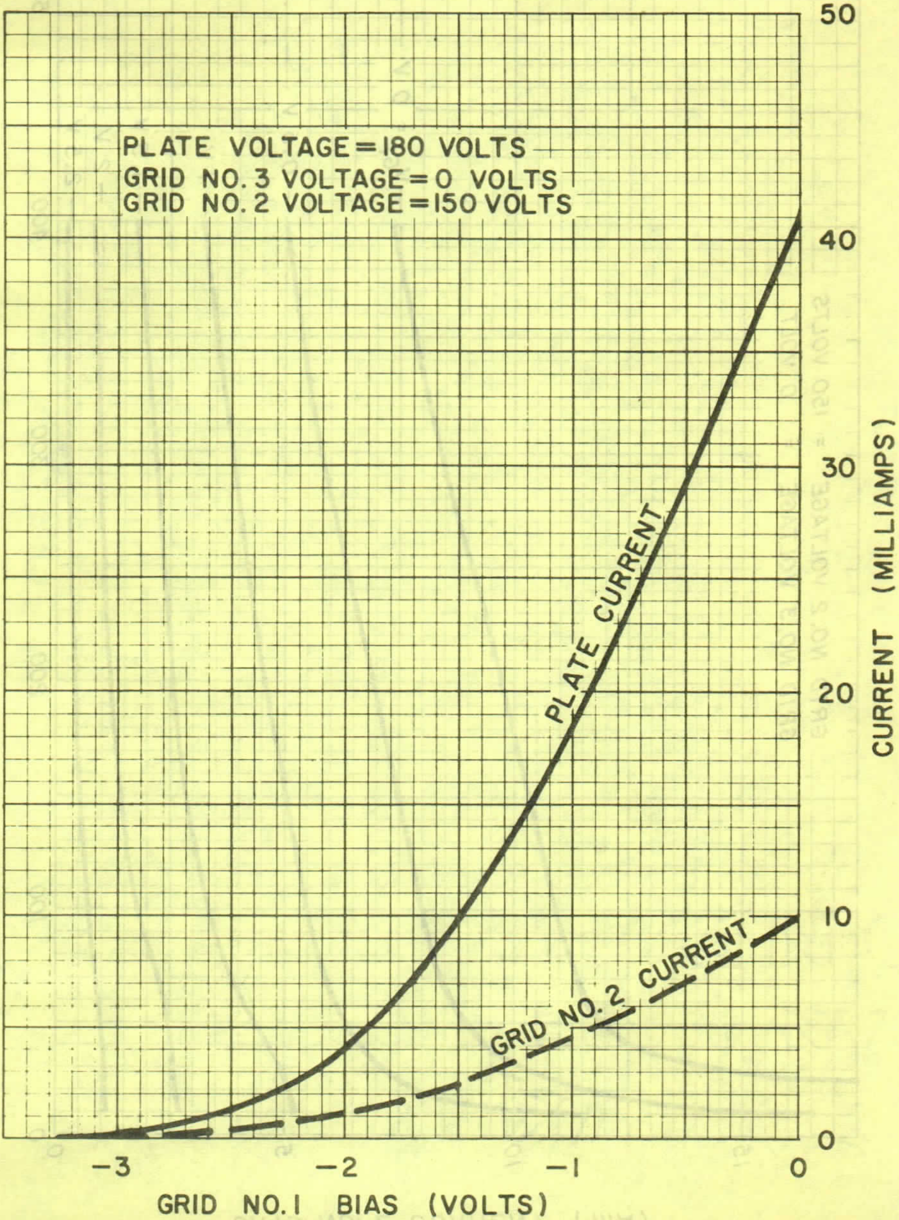
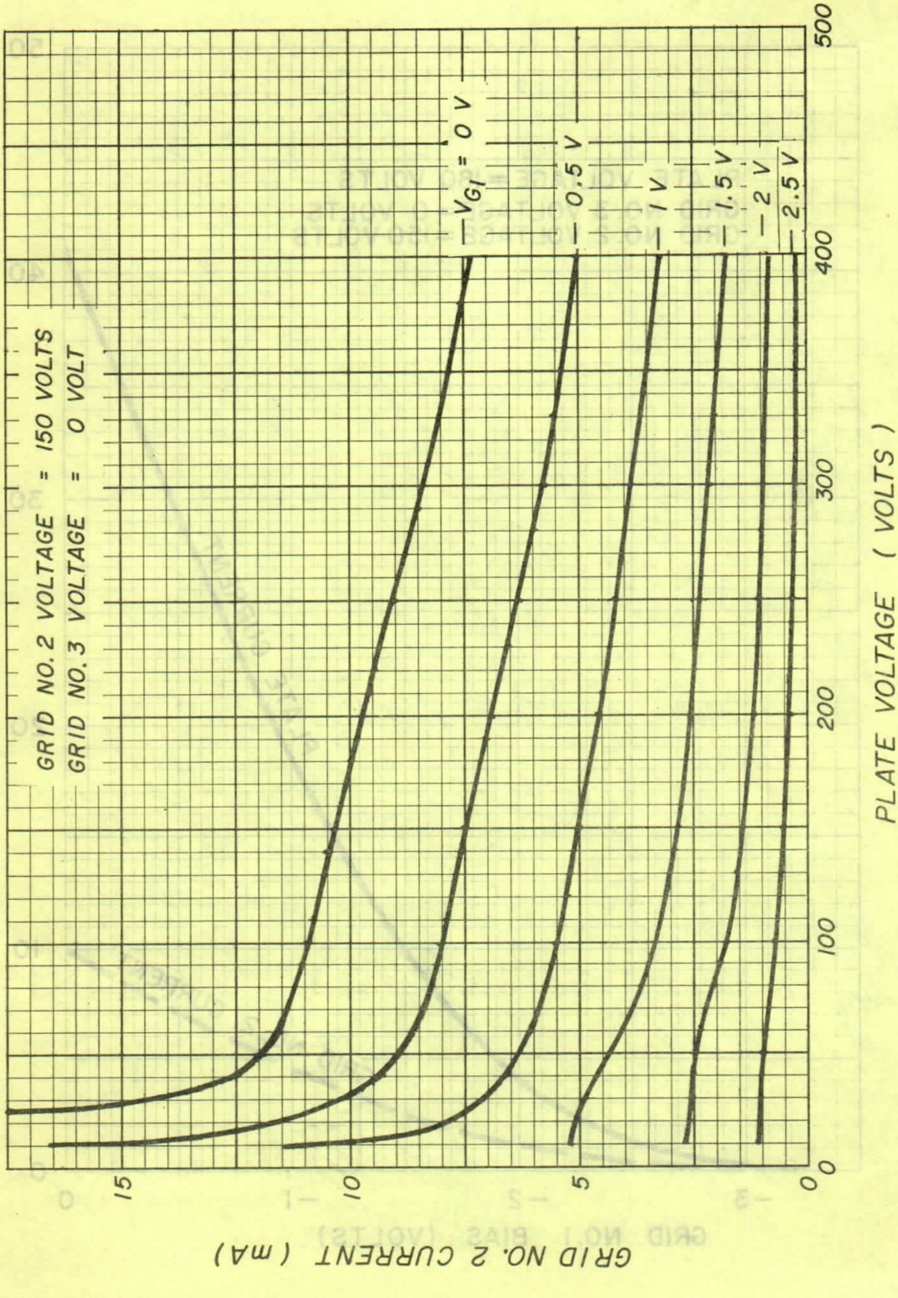
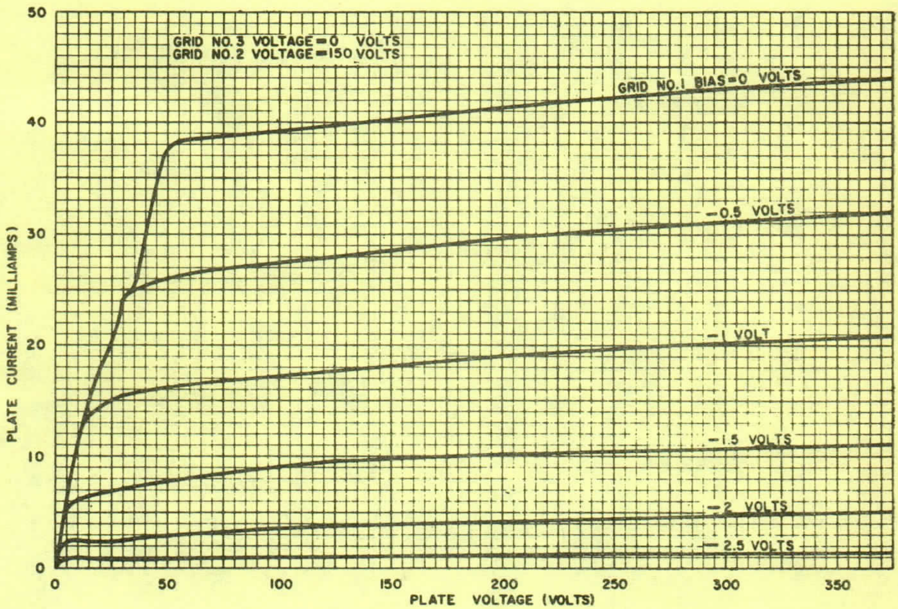


PLATE VOLTAGE = 180 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 150 VOLTS
PLATE CURRENT
GRID NO. 2 CURRENT
50
40
30
20
10
0
CURRENT (MILLIAMPS)
−3
−2
−1
0
GRID NO. 1 BIAS (VOLTS)



GRID NO. 2 VOLTAGE = 150 VOLTS
GRID NO. 3 VOLTAGE = 0 VOLT
V_{G1} = 0 V
-0.5 V
-1 V
-1.5 V
-2 V
-2.5 V
0
100
200
300
400
500
PLATE VOLTAGE (VOLTS)
0
5
10
15
GRID NO. 2 CURRENT (mA)

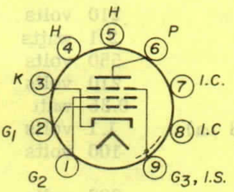

GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 150 VOLTS
GRID NO. 1 BIAS = 0 VOLTS
−0.5 VOLTS
−1 VOLT
−1.5 VOLTS
−2 VOLTS
−2.5 VOLTS
PLATE CURRENT (MILLIAMPS)
0
10
20
30
40
50
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
300
350

AMPEREX TUBE TYPE 6689

The Amperex 6689 is a long life pentode designed for unsupervised communication equipment, carrier telephone applications, wide band amplifiers, measuring equipment and industrial control circuits.

The tube has a high figure of merit making it suitable for use in line amplifiers of coaxial systems. Other features are low heater current requirement, low input and output capacitance, internal shielding construction and small size.

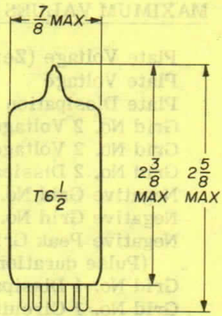
The 6689 is one of the Amperex "Premium Quality 10,000 Hour" tubes.



9BK

PIN CONNECTIONS

1. GRID NO.2
2. GRID NO.1
3. CATHODE
4. HEATER
5. HEATER
6. PLATE
7. INTERNAL CONNECTION
8. INTERNAL CONNECTION
9. GRID NO.3, INTERNAL SHIELD



GENERAL CHARACTERISTICS

MECHANICAL

Base	Noval
Basing	9 BK
Bulb	T 6-1/2
Dimensions	see outline drawing
Mounting Position	any

ELECTRICAL

Heating	indirect by AC or DC series or parallel supply
Cathode	coated, unipotential
Heater Voltage[1]	6.3 volts
Heater Current[1]	0.3 amp

[1] In parallel connected supplies, heater voltage should not vary more than ± 5% for maximum life. In series connected supplies, it should not vary more than ± 1.5%.

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Direct Interelectrode Capacitances

	Nom.	Max.	
Plate to All Elements Except Grid No. 1	3.6	4.2	pf
Grid No. 1 to All Elements Except Plate	8.0	8.7	pf
Plate to Grid No. 1	--	<0.015	pf
Grid No. 1 to Heater	--	<0.15	pf
Heater to Cathode	4.0	--	pf
Grid No. 1 (Cathode Current = 12.1 ma)	10.8	--	pf
Radiation Capacitance of Plate[2]	--	<0.025	pf
Radiation Capacitance of Grid No. 1[3]	--	<0.025	pf

MAXIMUM VALUES (DESIGN CENTER)

Plate Voltage (Zero Plate Current)	550	volts
Plate Voltage	210	volts
Plate Dissipation	2.1	watts
Grid No. 2 Voltage (Zero Grid Current)	550	volts
Grid No. 2 Voltage	210	volts
Grid No. 2 Dissipation	0.35	watt
Negative Grid No. 1 Voltage (Grid No. 1 Current = 0.3 μa)	1.1	volts
Negative Grid No. 1 Voltage	100	volts
Negative Peak Grid No. 1 Voltage (Pulse duration = 200 μsec., Duty cycle = 10%)	200	volts
Grid No. 1 Dissipation	50	mw
Grid No. 1 Circuit Resistance	1	megohm
Cathode Current	16	ma
Peak Cathode Current (Pulse duration = 200 μsec., Duty Cycle = 10%)	80	ma
Cathode to Heater Voltage	100	volts
Cathode to Heater Circuit Resistance[3]	20,000	ohms
Bulb Temperature	170°C	

[2] The radiation capacitance is the capacitance of the electrode to a cylindrical shield with an inner diameter of 2 inches and a height of 3-7/8 inches, the other electrodes being grounded.

[3] In order to prevent the operation of the tube from being influenced by variation of the heater to cathode insulation, it is advisable to keep the external resistance between heater and cathode less than 20,000 ohms.

TYPICAL CHARACTERISTICS

Plate Voltage	210	volts
Grid No. 3 Voltage	0	volts
Grid No. 2 Voltage	120	volts
Cathode Circuit Resistance	165	ohms
Plate Current[4]	10±1.3	ma
Grid No. 2 Current[4]	2.1±0.4	ma
Transconductance[4]	9000±1200	μmhos
Plate Resistance	0.5	megohm (typ.)
Plate Resistance	0.3	megohm (min.)
Amplification Factor	34	
Equivalent Noise Resistance (RF)	750	ohms (typ.)
Equivalent Noise Resistance (RF)	1000	ohms (max.)
Equivalent Noise Resistance (bandwidth = 0 - 10,000 cycles)	36,000	ohms (max.)
Negative Grid No. 1 Current (Grid No. 1 Circuit Resistance = 0.1 megohm)	0.5	μa (max.)
Negative Grid No. 1 Voltage (Plate Current = 0.5 ma, Cathode Circuit Resistance = 0)	5	volts
Negative Grid No. 1 Voltage (Plate Current = 0.5 ma, Cathode Circuit Resistance = 0)	5.25	volts (max.)
Grid No. 1 Hum Voltage (Grid No. 1 Circuit Resistance = 0.5 megohm)	0.5	mv (max.)
Heater-Cathode Leakage Current (V_f = 6.13V, V_{hk} = 100V, Series Resistor = 1 megohm)	15	μa (max.)
Insulation Resistance between any two Electrodes	100	megohms (min.)

TYPICAL OPERATING CHARACTERISTICS AS A CLASS A AMPLIFIER

Plate Voltage	120	210	volts
Grid No. 3 Voltage	0	0	volts
Grid No. 2 Supply Voltage	120	120	volts
Grid No. 2 Circuit Resistance	5600	5600	ohms
Cathode Circuit Resistance	180	180	ohms
Plate Current	8.3	8.3	ma
Grid No. 2 Current	1.7	1.7	ma
Transconductance	8200	8200	μmhos
Plate Resistance	0.42	0.44	megohm
Plate Circuit Impedance	10,000	20,000	ohms
Output Power (at 10% Distortion)	340	660	mw
Input AC Voltage (at 10% Distortion)	1.1	1.1	volts (RMS)
Output Power (Grid No. 1 Current = 0.3 μa)[5]	400	870	mw
Input AC Voltage (Output Power = 50 mw)	0.35	0.25	volts (RMS)

[4] The end of life is reached when one or more of the characteristics have changed to the following values:

Plate Current	≤ 7 ma
Grid No. 2 Current	≤ 1.2 ma
Transconductance	≤6400 μmhos
Negative Grid No. 1 Current (Grid No.1 Circuit Resistance = 0.1 megohm)	≤ 1.0 μa

[5] Measured with a control grid series resistor of 0.33 megohm.

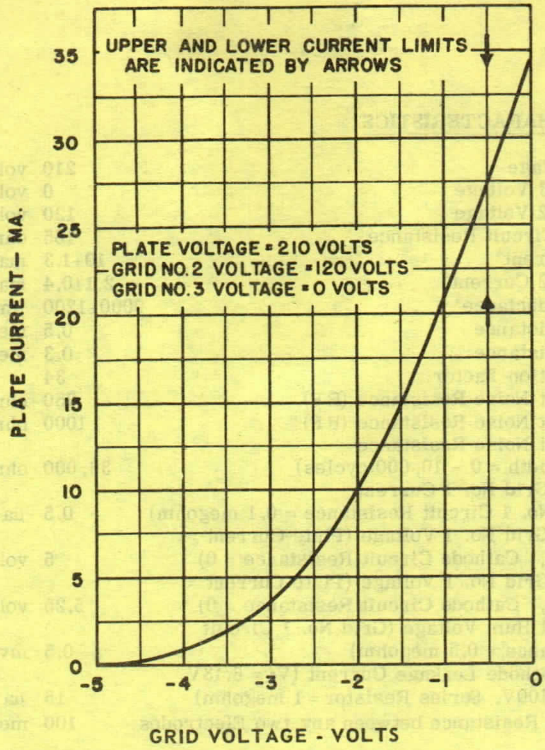


Figure 1. Transfer Characteristics

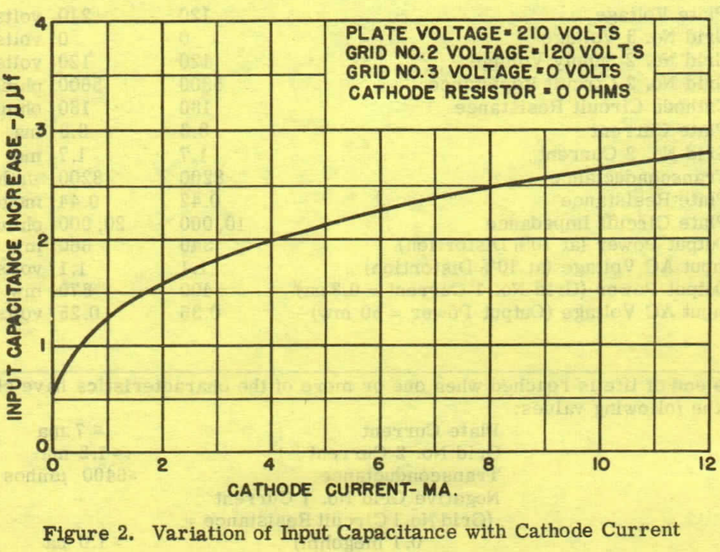


Figure 2. Variation of Input Capacitance with Cathode Current

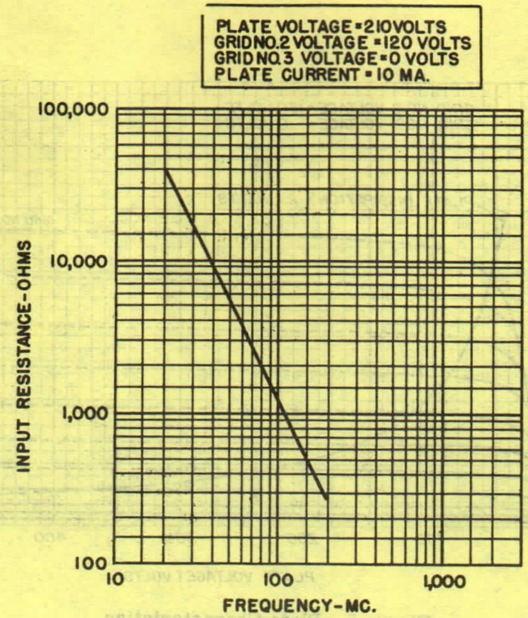


Figure 3. Input Resistance vs. Frequency

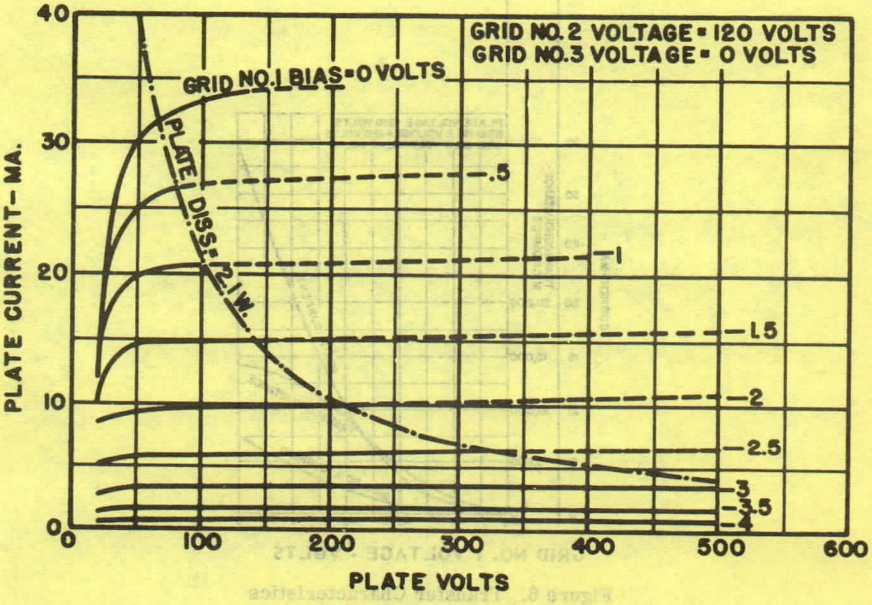


Figure 4. Plate Characteristics

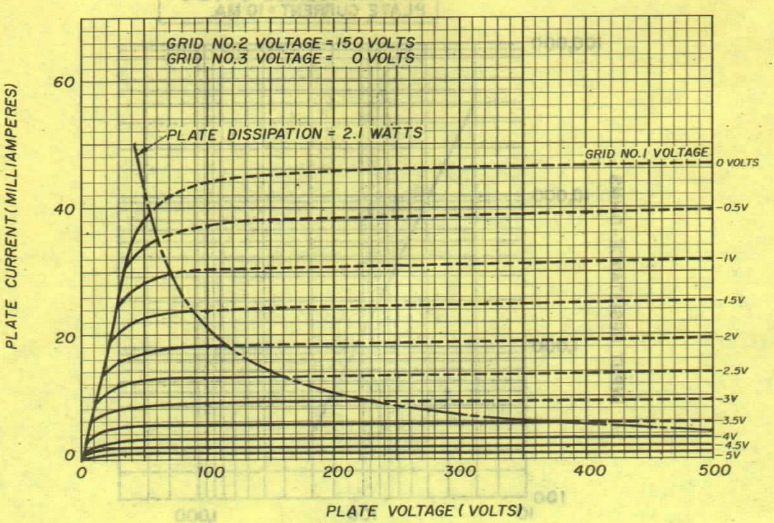


Figure 5. Plate Characteristics

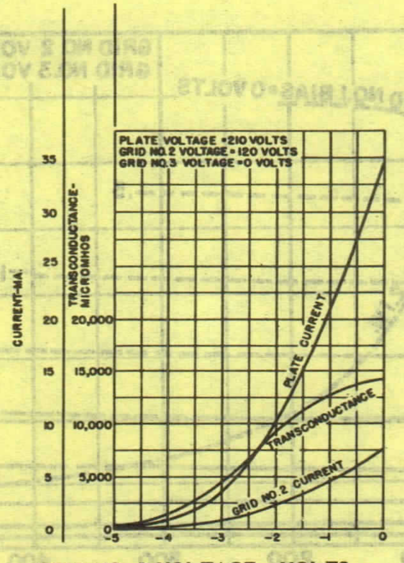


Figure 6. Transfer Characteristics

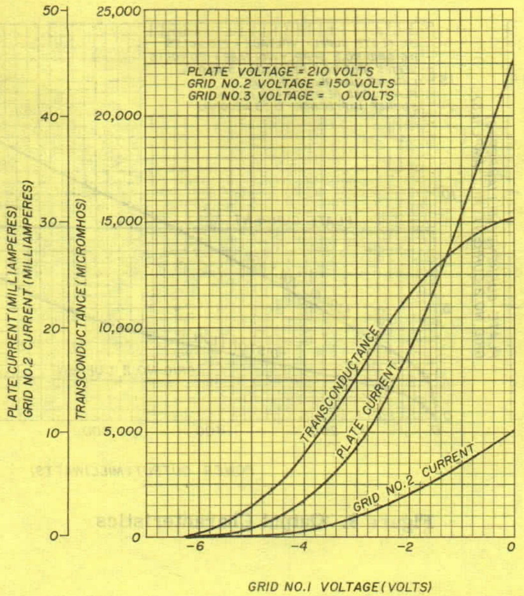


Figure 7. Transfer and Transconductance Characteristics

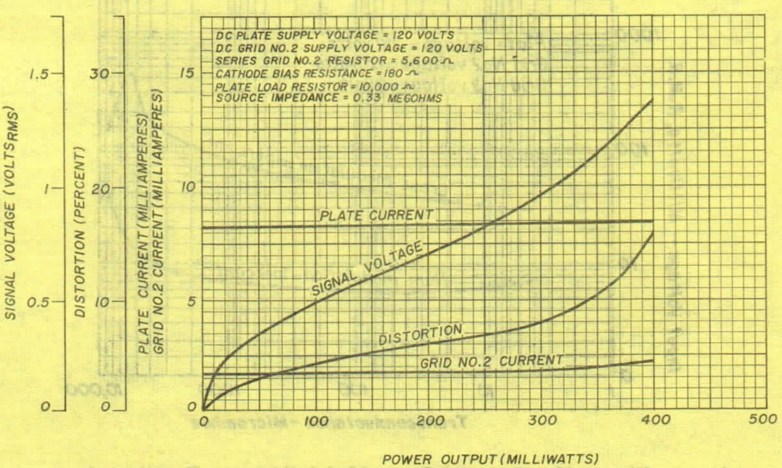


Figure 8. Output Characteristics

CIRCUIT PERFORMANCE

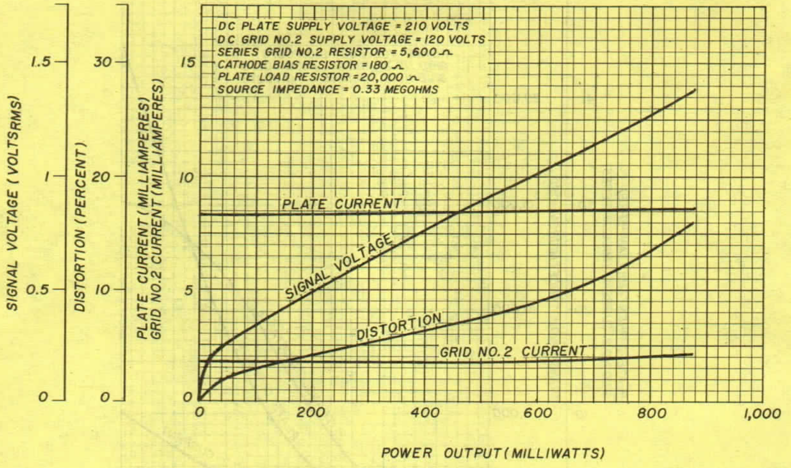


Figure 9. Output Characteristics

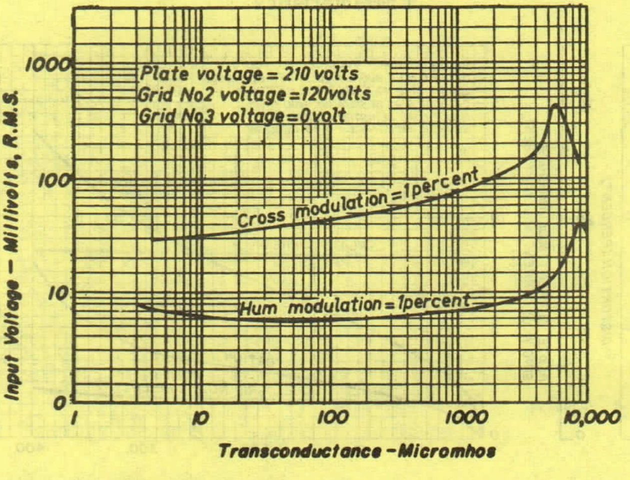


Figure 10. Hum and Cross Modulation as a Function of Signal and Transconductance

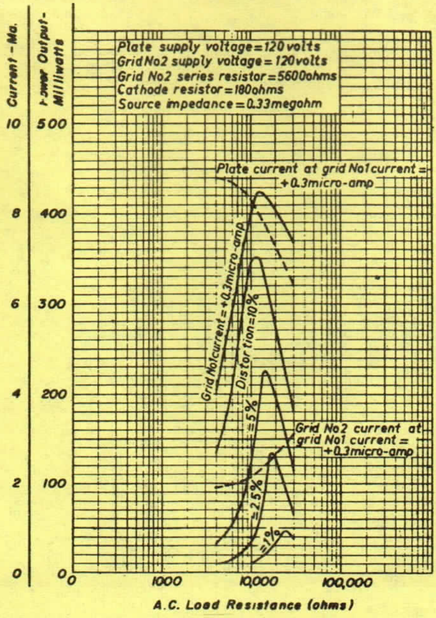


Figure 11. Output Characteristics as a Function of AC Load Resistance

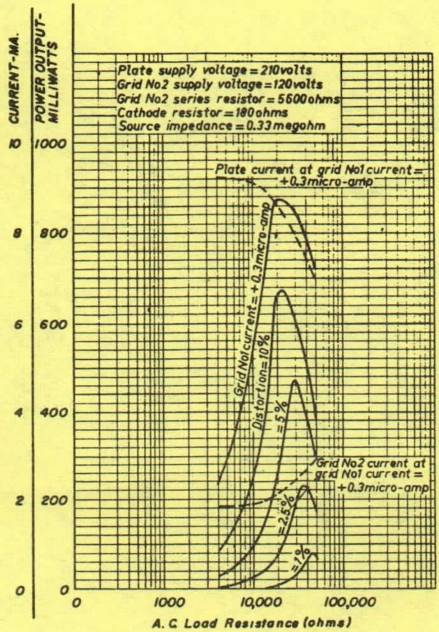
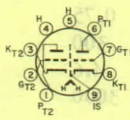


Figure 12. Output Characteristics as a Function of AC Load Resistance

AMPEREX TUBE TYPE 6922/E88CC

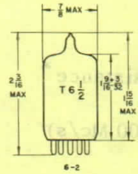
The 6922/E88CC is a miniature twin triode especially designed for use in cascode circuits, RF and AF amplifiers, mixers and phase inverter stages, and as a multivibrator and cathode follower in computers.

Featured are extremely long life, ruggedized construction, high transconductance, and low noise. Operation for long periods of time under cut-off conditions will not cause deterioration of the emission surface. The 6922/E88CC is one of Amperex's "Premium Quality 10,000 hour" tubes.



PIN CONNECTIONS

1- PLATE, TRIODE 2
2- GRID, TRIODE 2
3- CATHODE, TRIODE 2
4- HEATER
5- HEATER
6- PLATE, TRIODE 1
7- GRID, TRIODE 1
8- CATHODE, TRIODE 1
9- INTERNAL SHIELD



6-2

GENERAL CHARACTERISTICS

MECHANICAL	
Bulb	T6½
Outline	6-2
Base	E9-1
Base Diagram	9DE
Mounting Position	any
Shock and Vibration	see note 1
ELECTRICAL	
Heater Voltage	6.3 volts
Heater Current	300 mA

Direct Interelectrode Capacitances (without external shield)

	Section I	Section II
Grid to Cathode + Heater	3.1	3.1 μμf
Plate to Cathode + Heater	0.5	0.4 μμf
Grid to Cathode + Heater + Shield	3.1	3.1 μμf
Plate to Cathode + Heater + Shield	1.75	1.65 μμf
Plate to Grid	1.4	1.4 μμf
Plate to Cathode	0.18	0.18 μμf
Plate to Shield	1.3	1.3 μμf
Cathode to Heater	2.6	2.7 μμf

	Between Sections
Plate to Plate	.045 μμf
Grid to Grid	.005 μμf
Plate of Triode 1 to Grid of Triode 2	.005 μμf
Plate of Triode 2 to Grid of Triode 1	.005 μμf
Grid of Triode 1 to Cathode of Triode 2	.005 μμf
Grid of Triode 2 to Cathode of Triode 1	.005 μμf

Grounded Grid	Section I	Section II
Plate to Grid + Heater + Shield	3.0	2.9 μμf
Cathode to Grid + Heater + Shield	6.0	6.0 μμf

[1] A shock rating of about 500 g was obtained by using the NRL impact machine to deliver 5 blows to the tube at an angle of 30° in each of four different directions.
A fatigue rating of 2.5 g was obtained by applying vibrational forces for 32 hours in each of three directions at a frequency of 50 c/s.
These conditions are given for evaluation of mechanical ruggedness. They are not to be interpreted as suitable operating conditions.

6922/E88CC

Typical Characteristics

Plate Supply Voltage	100 [2]	90	volts
Grid Supply Voltage	9	0	volts
Plate Current	15	12	mA
Transconductance	12,500	11,500	micromhos
Amplification Factor	33	- -	
Cathode Resistor	680	120	ohms
RMS Grid Voltage [3]	0.75	- -	volts
Equivalent Noise Resistance [4]	300	- -	ohms
Noise Factor [5]	4.6	- -	db
Input Damping (F = 100 Mc/s)	3000	- -	ohms

Maximum Ratings, Design Center Values (Each Section)

Cold Cathode Plate Voltage	550 volts
Plate Supply Voltage	400 volts
Plate Voltage	220 volts
Plate Voltage ($P_{p.}$ = 0.8 W)	250 volts
Negative Grid Voltage	100 volts
Peak Negative Grid Voltage [6]	200 volts
Cathode-to-Heater Voltage (cathode positive)	120 volts
Heater-to-Cathode Voltage (cathode negative)	60 volts
Cathode Current	20 mA
Peak Cathode Current [6]	100 mA
Plate Dissipation	1.5 watts
Plate Dissipation [7]	1.8 watts
Grid Dissipation	0.03 watts
Maximum Bulb Temperature	170°C

2 Operation under conditions listed in this column is recommended because of the small spread in characteristics.

3 AC voltage of grid current ($I_c = 0.3\ \mu A$)

4 Measured at f = 45 Mc/s.

5 Measured in a cascode circuit at f = 200 Mc/s and matched for minimum noise.

6 Pulse duration, 200 microseconds max; duty cycle, 10%.

7 Maximum plate dissipation of both sections = 2 watts.

Revised 9/59

Typical Operation

Computer Circuits

Plate Supply Voltage	60		150 volts
Plate Current [8]	9		33 mA
Negative Grid Voltage (I_b = 0.1 mA)	-		6.5 volts
Negative Grid Voltage (I_b = 5 μA)	-		15 volts
Grid to Grid Voltage (I_b = 0.1 mA)			< 2 volts

Class A Additive Mixer

Plate Supply Voltage	60	90	150 volts
Oscillator Voltage (rms)	2	2.5	3 volts
Plate Current	4.7	7.7	11 mA
Conversion Conductance	2900	3500	4100 micromhos
Internal Resistance	8300	7000	6100 ohms
Plate Load Resistance	0	1000	3900 ohms
Grid Resistor	1	1	1 meg

Class A Amplifier (Each Section)

Plate Voltage		220	volts
Plate Load Resistance		20,000	ohms
Negative Grid Voltage		— 6.8	volts
Input Voltage (rms)	0	1.5	4.5 volts
Plate Current	6.5	-	9.2 mA
Output Power	-	0.05	0.5 watt
Distortion	-	-	7 %

Class B Amplifier (Sinusoidal Wave; Both Sections, Push-Pull)

Plate Voltage		200	volts
Load Impedance (Plate to Plate)		22,000	ohms
Negative Grid Voltage		6	volts
Input Voltage (rms)	0	0.9	4.0 volts
Plate Current	2 x 5	-	2 x 9 mA
Power Output	-	0.05	1.2 watts
Distortion	-	-	3 %

Class B Audio Amplifier (Both Sections, Push-Pull)

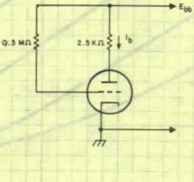
Plate Voltage		200	volts
Load Impedance (Plate to Plate)		10,000	ohms
Negative Grid Voltage		6	volts
Input Voltage (rms)	0	0.9	4.0 volts
Plate Current	2 x 5	-	2 x 13.5 mA
Power Output	-	0.05	1.5 watts
Distortion	-	-	4 %

Hum Referred to Grid (E_{bb} = 90V, I_b = 15 mA, R_k = 0.5 meg, fully screened tubeholder, straight response curve filter, frequency of heater supply voltage = 50 c/s + 3% 500 c/s) — 50 μV max

Maximum Ratings for Circuit Design

Grid Resistor [10] — 1 meg

[8] Circuit used for measurements:



Measuring time 1 second max.

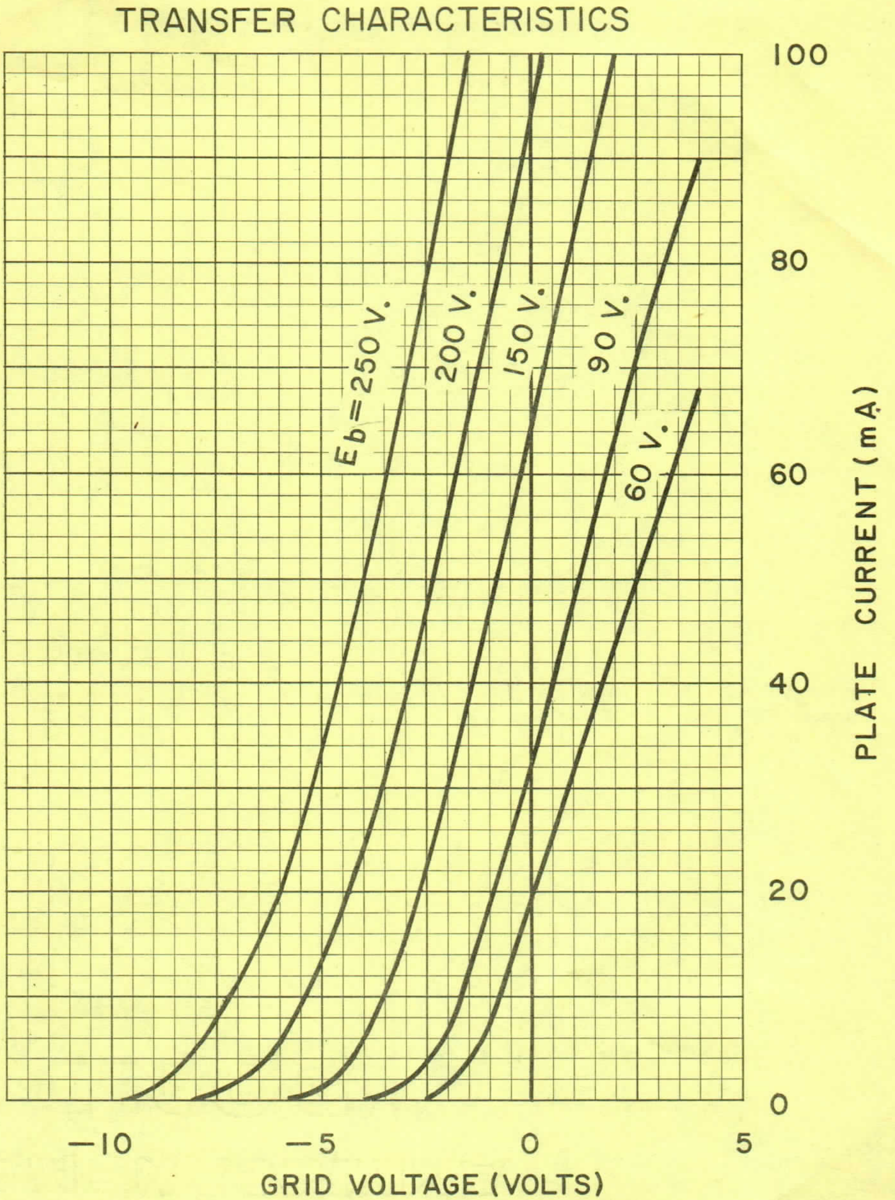
[9] Conditions of life test operation:

Heater Voltage	6.3 volts
Grid Supply Voltage	9 volts
Plate Supply Voltage	100 volts
Heater-to-Cathode Voltage (cathode negative)	60 volts
Plate Current (approx.)	15 mA
Cathode Resistor	680 ohms
Grid Resistor	47 kilohms

[10] Fixed bias is permitted for plate currents below 5 mA only.

6922/E88CC

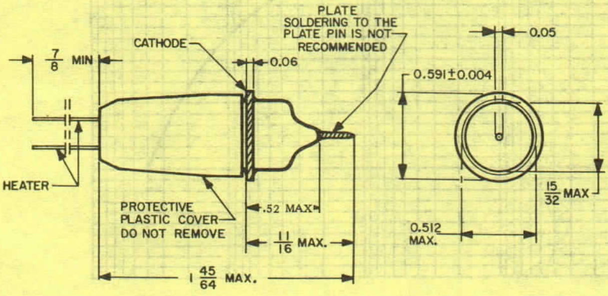
Revised 9/59


TRANSFER CHARACTERISTICS
Eb=250 V.
200 V.
150 V.
90 V.
60 V.
100
80
60
40
20
0
PLATE CURRENT (mA)
−10
−5
0
5
GRID VOLTAGE (VOLTS)

AMPEREX TUBE TYPE 6923/EA52

The 6923 is a vacuum diode of disc-seal construction for use in U.H.F. voltmeters for measurements up to 1000 megacycles per second. The diode is also applicable in U.H.F. monitoring devices.

The disc-seal construction permits easy insertion into coaxial probes and the anode pin connection is excellently suited to serve as the probe contact when the circuitry makes this possible.



NOTE

SOLDERING TO THE PLATE PIN IS NOT RECOMMENDED

GENERAL CHARACTERISTICS

ELECTRICAL

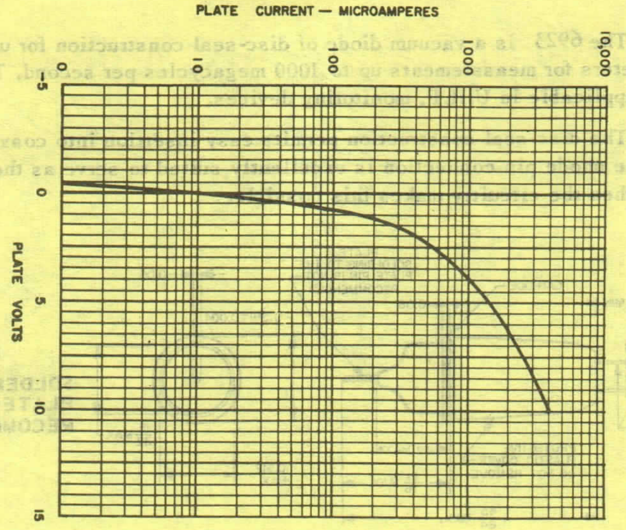
	MIN.		MAX.	
Cathode				coated, unipotential
Heater Voltage, AC or DC	5.6	6.3	7.0	volts
Heater Current	—	0.3	—	amps
Direct Interelectrode Capacitance				
Plate to Cathode			0.5	$\mu\mu$f max.
Insulation Resistance				
Plate to Cathode			10,000	megohms
Plate Characteristic				
Diode Voltage (at plate current of 0.5 mA)			3	volts max.

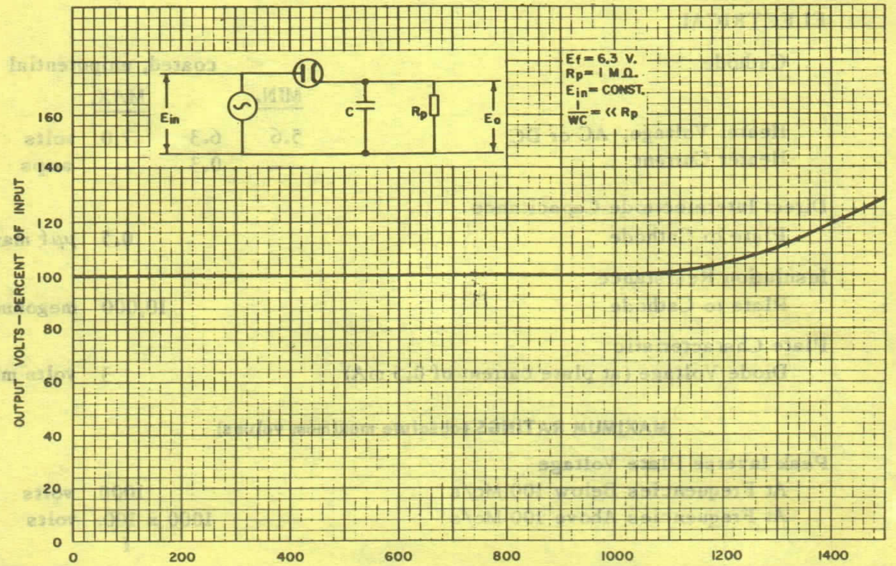
MAXIMUM RATINGS (absolute maximum values)

Peak Inverse Plate Voltage		
At Frequencies Below 100 Mc/s	1000	volts
At Frequencies Above 100 Mc/s	$1000 \times \frac{100}{f}$	volts
Cathode Current	300	microamps
Peak Cathode Current	5	milliamps
Voltage Between Cathode and Heater	50	volts
Resistance Between Cathode and Heater	20	K ohms

Revised 12/62

6923/EA52



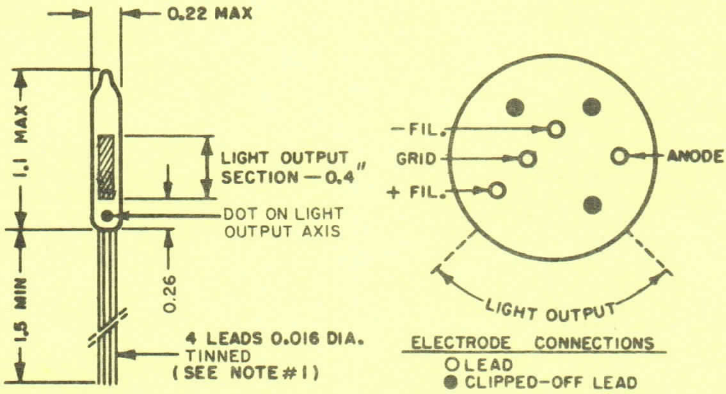


OUTPUT VOLTS AS A FUNCTION OF FREQUENCY

AMPEREX TUBE TYPE 6977

The Amperex 6977 is a high-vacuum, subminiature indicator triode with a type P15 phosphor-coated anode which displays a bright blue-green light when the grid bias is zero. A negative bias of only three volts will extinguish the light, and it is therefore particularly adaptable to transistorized circuitry. The filament may be operated from either ac or dc.

The 6977 is manufactured to the same high quality and reliability standards as the other Amperex computer tubes. It is designed for a life of 20, 000 hours.



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	subminiature, T1
Diameter	0.220 inch max.
Height (Seated)	1.1 inches max.
Length of Lead[1]	1.5 inches min.
Mounting Position	see Application Data

ELECTRICAL

Filament Characteristics	
Filament Voltage (ac or dc)	1.0 ± 5% volts
Filament Current	30 ma
Interelectrode Capacitances	
Anode to Grid	1.8 pf
Anode to Filament	1.1 pf
Grid to Filament	1.0 pf

[1] Soldered connection to leads must be at least 3/16 inch from glass seal. Bending of leads must be at least 1/16 inch from glass seal.

6977

RATINGS(ABSOLUTE MAXIMUM)

Anode Voltage (Zero Anode Current)	100 volts max.
Anode Voltage (Max. Anode Current)	65 volts max.
Positive Grid Supply Voltage	0 volts max.
Negative Grid Voltage	50 volts max.
Anode Current	750 μa max.
Grid Resistance	1 meg. max.
	0.1 meg. min.

CHARACTERISTICS

Heater Voltage (V_{eff})[2]	1.0 volts
Anode Voltage (dc)	50 volts
Series Grid Resistor	100,000 ohms
For Maximum Light Output[3]	
Grid Supply Voltage[4]	0 volts
Anode Current	585 μa
For Zero Light Output	
Grid Supply Voltage	-3 volts
Anode Current	<5 μa

SHOCK RATING[5] 500 g's

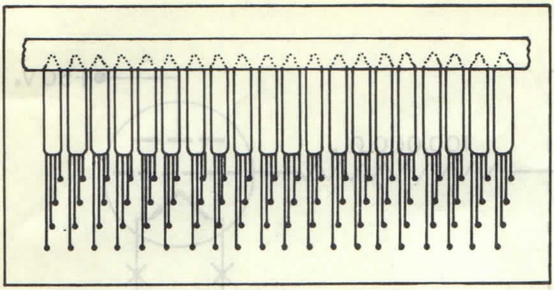
(Five blows at 30° or over in four different positions on NRL impact machine)

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

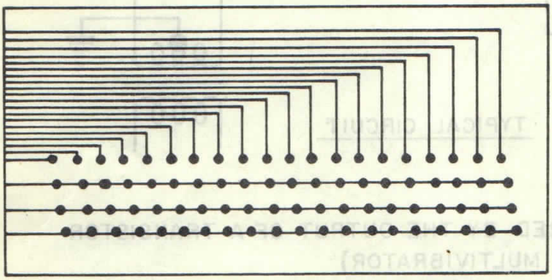
	Min.	Bogey	Max.	Units
Anode Current, 0 hour				
E_b = 50 Vdc, R_g = 100,000 ohms, E_c = 0V[4]	430	585	740	μa
Filament Current				
E_f = 1.0 Vac	24	30	36	ma
Insulation Resistance				
E_c = -50 Vdc	100	--	--	megohms

---

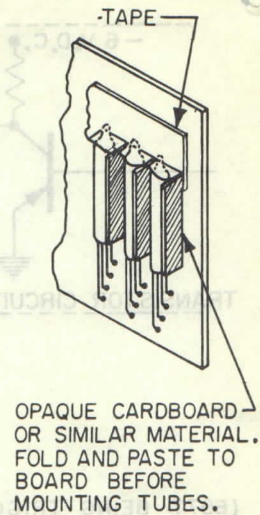
[2] Center tap of filament transformer grounded to B-.
[3] Typical light output = 1-1.5 millicandle/cm^2 or 2.9-4.4 foot-lamberts.
[4] With respect to filament transformer center tap.
[5] These test conditions are given as an evaluation only.

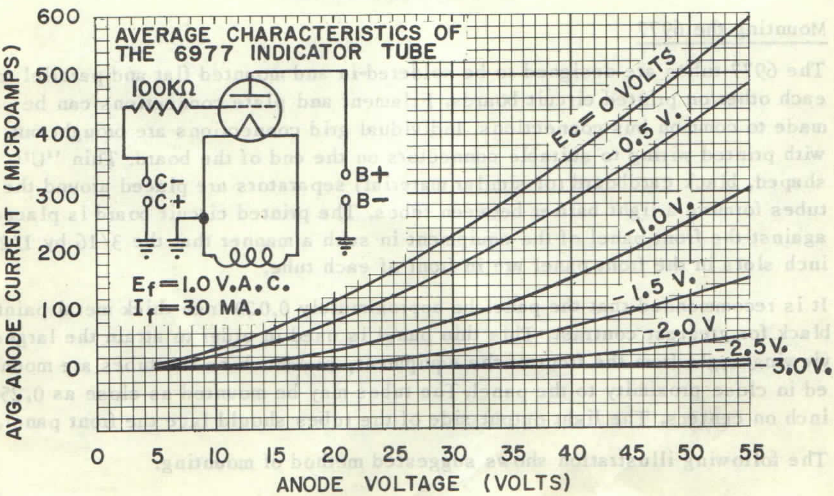


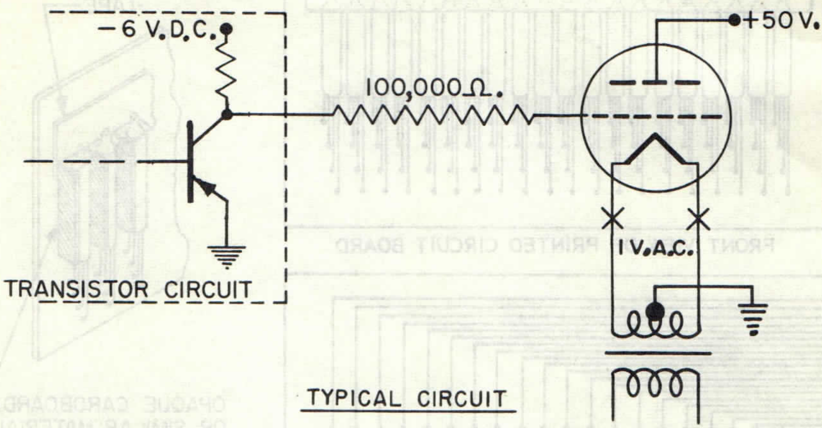
FRONT VIEW OF PRINTED CIRCUIT BOARD



PRINTED WIRING SIDE OF BOARD







(6977 BEING TRIGGERED BY THE OUTPUT OF A TRANSISTOR MULTIVIBRATOR)

APPLICATION DATA

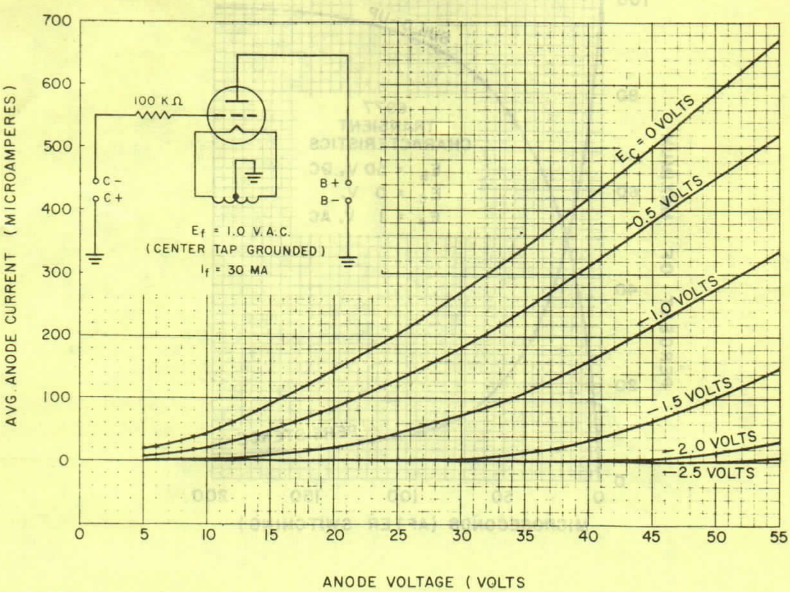
Mounting the 6977

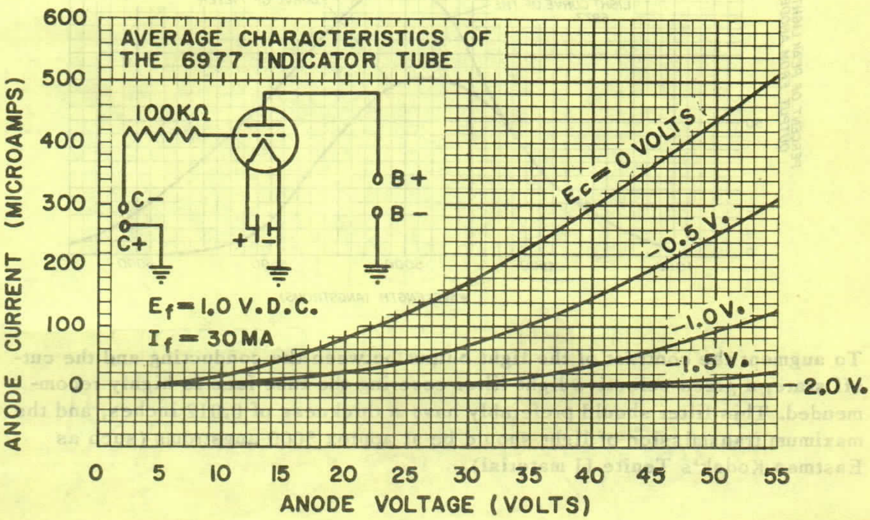
The 6977 tubes are designed to be soldered-in and mounted flat and parallel to each other on printed circuit boards. Filament and plate connections can be made to common bus connections. Individual grid connections are brought out with printed wiring to suitable connectors on the end of the board. Thin "U" shaped, black cardboard (or similar material) separators are placed around the tubes forming a light barrier between tubes. The printed circuit board is placed against the front panel of the equipment in such a manner that the 3/16 by 1/2 inch slots in the front panel are in front of each tube.

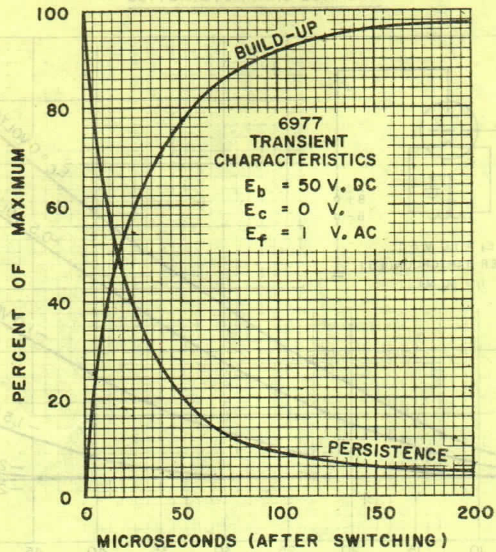
It is recommended that the panel be approximately 0.020 inch thick metal painted black for greatest contrast. This thin panel is used in order to attain the largest viewing angle from the front of the equipment, inasmuch as the tubes are mounted in close proximity to the panel. The tubes may be mounted as close as 0.250 inch on centers. The light output side of the tubes should face the front panel.

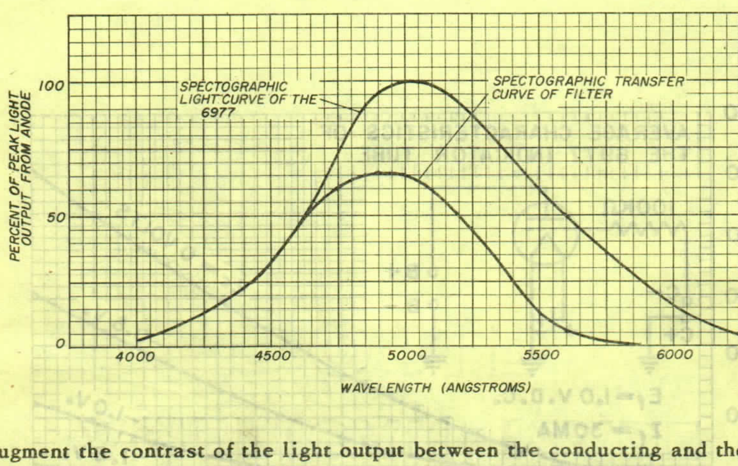
The following illustration shows suggested method of mounting.

AVERAGE CHARACTERISTICS









To augment the contrast of the light output between the conducting and the cut-off state, a green selective light filter covering the tube face is highly recommended. This filter should preferably have a thickness of 0.012 inches, and the maximum transmission of light should be at approx 5000 angstroms (such as Eastman Kodak's Tenite II material).

AMPEREX TUBE TYPE 7025

The Amperex 7025 [1] is a miniature 9-pin, high-mu twin triode in which hum and noise have been significantly reduced. A center tapped heater permits operation of the tube from either a 6.3 or 12.6 volt heater supply.

The 7025 is suitable for application in resistance-coupled voltage amplifiers particularly the preamplifier and input stages of Hi-Fi amplifiers, and also phase inverter, multibibrator and other industrial control circuits where high voltage gain is an important design consideration.

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Mounting position	any
Base	small button, 9 pin, E9-1
Bulb	T-6½
Outline	6-2

ELECTRICAL

Cathode	coated, unipotential	
	Series	Parallel
Heater Voltage AC or DC	12.6	6.3 volts
Heater Current [2]	0.15	0.3 amps
Average equivalent noise and hum voltage (Referenced to grid, each section) [3]	1.8 microvolts rms	
Maximum equivalent noise and hum voltage (Referenced to grid, each section) [4]	7 microvolts rms	

Direct Interelectrode Capacitances	With Shield [5]	Without Shield
Grid to Plate (each section)	1.7	1.7 $\mu\mu f$
Input (each section)	1.8	1.6 $\mu\mu f$
Output (section 1)	1.9	0.46 $\mu\mu f$
Output (section 2)	1.9	0.34 $\mu\mu f$

1 The 7025 is a direct high quality replacement for the 12AX7.

2 When used in equipment which employs series-connected heaters, a current-limiting device must be inserted to limit the current when switching on.

3 Measured under the following conditions:

Heater voltage (parallel connection)	6.3 volts ac
Center tap of heater transformer grounded	
Plate supply voltage	250 volts dc
Plate load resistor	100,000 ohms
Cathode resistor (Bypassed by 100 μf capacitor)	
Grid resistor	0 ohms
Amplifier covering frequency range	25 to 10,000 cps

4 Same conditions as in note 3 except that the cathode resistor is not bypassed and grid resistor has a value of 50,000 ohms.

5 With external shield (RETMA #315) connected to cathode of section under test.

7025

MAXIMUM RATINGS (Each Section)

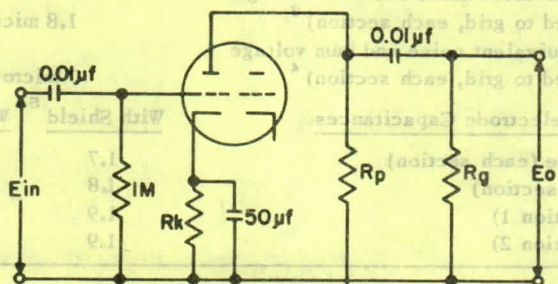
Design Center Values

Zero Signal Plate Voltage	550 volts
Plate Voltage	300 volts
Plate Dissipation	1.0 watt
Cathode Current	8 mA
Grid Voltage	− 50 volts
Grid Voltage (Grid current = + 0.3 μA)	− 0.9 volts
Grid Resistance [6]	2 megohms
Heater to Cathode Voltage	180 volts
Heater to Cathode Resistance	20,000 ohms
Heater to Cathode Resistance [7]	150,000 ohms

Typical Operating Conditions

Class A Amplifier (Each Section)

Plate Voltage	100	250 volts
Grid Voltage	− 1.0	− 2.0 volts
Amplification Factor	100	100
Plate Resistance (approx.)	80,000	62,500 ohms
Transconductance	1250	1600 micromhos
Plate Current	0.5	1.2 mA



Rp = 0.047 MΩ
Rg = 0.15 MΩ

CLASS A RESISTANCE-COUPLED AMPLIFIER, EACH SECTION

6 With self bias.

7 In phase inverting circuits.

$R_p = 0.047\ M\Omega$ $R_g = 0.15\ M\Omega$

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff}) [8]	Gain	% Distortion [9]
200	1500	0.86	18	34	8.5
250	1200	1.18	23	37.5	7.0
300	1000	1.55	26	40	5.0
350	820	1.98	33	42.5	4.4
400	680	2.45	37	44	3.6

$R_p = 0.1\ M\Omega$ $R_g = 0.33\ M\Omega$

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff}) [8]	Gain	% Distortion [9]
200	1800	0.65	20	50	4.8
250	1500	0.86	26	54.5	3.9
300	1200	1.11	30	57	2.7
350	1000	1.40	36	61	2.2
400	820	1.72	38	63	1.7

$R_p = 0.22\ M\Omega$ $R_g = 0.68\ M\Omega$

E_{bb} (V)	R_k (Ω)	I_p (mA)	E_o (V_{eff}) [8]	Gain	% Distortion [9]
200	3300	0.36	24	56	4.6
250	2700	0.48	28	66.5	3.4
300	2200	0.63	36	72	2.6
350	1500	0.85	37	75.5	1.6
400	1200	1.02	38	76.5	1.1

[8] E_o at grid current starting point.

[9] The total harmonic distortion is approximately proportional to the output voltage.

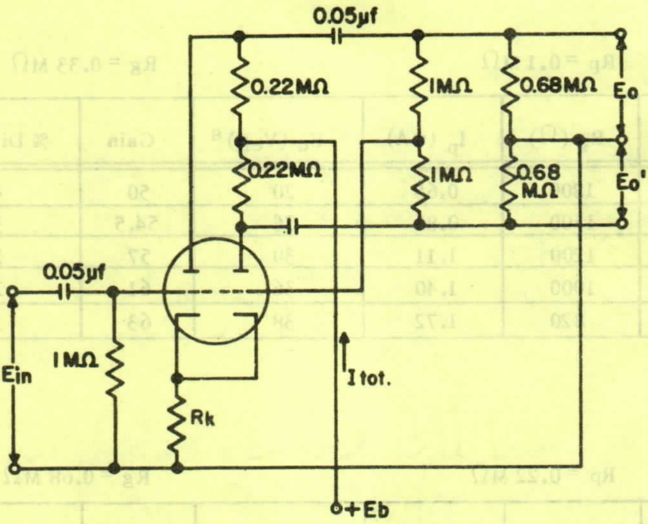
APPLICATION NOTES

MICROPHONICS

The tube can be used without special precautions against microphonic effect in amplifiers in which the input voltage is higher than 50 millivolts when the tube is mounted in the near vicinity of a 5 watt loud speaker with an acoustical efficiency of 5%,

HUM

The hum and noise level will be better than - 60 db when the grid circuit impedance is less than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is decoupled by a capacitor of at least 100 μf.



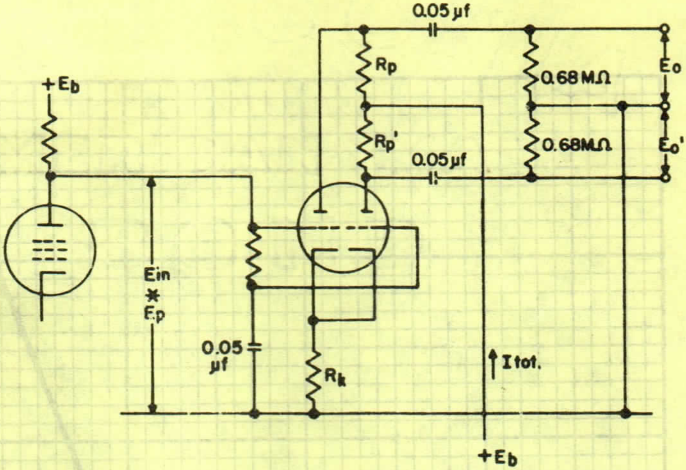
Supply Voltage	250	350 volts
Cathode Resistance	1200	820 ohms
Total Current	1.08	1.70 mA
Output Voltage [8] (RMS)	35	45 volts
Voltage Gain	58	62
Percent Distortion [9]	5.5	3.5 %

---

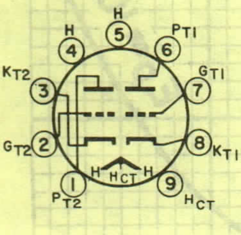
8 E_o at grid current starting point.

9 The total harmonic distortion is approximately proportional to the output voltage.

7025

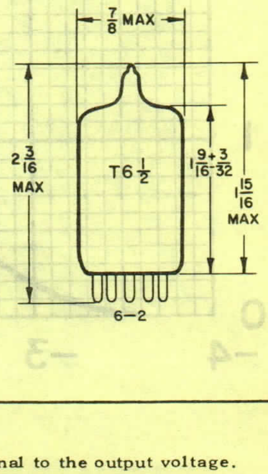


Supply Voltage	250	350 volts
Plate Voltage	65	90 volts
Total Current	1.0	1.2 mA
Cathode Resistance	68,000	82,000 ohms
Plate Load Resistance (R_p)	0.1	0.15 megohm
Plate Load Resistance ($R_p{}'$)	0.1	0.15 megohm
Output Voltage (RMS) [8]	20	35 volts
Voltage Gain	25	27
Percent Distortion [9]	1.8	1.8 %



PIN CONNECTIONS

1 – PLATE, TRIODE NO.2
2 – GRID, TRIODE NO.2
3 – CATHODE, TRIODE NO.2
4 – HEATER
5 – HEATER
6 – PLATE, TRIODE NO.1
7 – GRID, TRIODE NO.1
8 – CATHODE, TRIODE NO.1
9 – HEATER CENTER TAP



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[8] E_o at grid current starting point.

[9] The total harmonic distortion is approximately proportional to the output voltage.

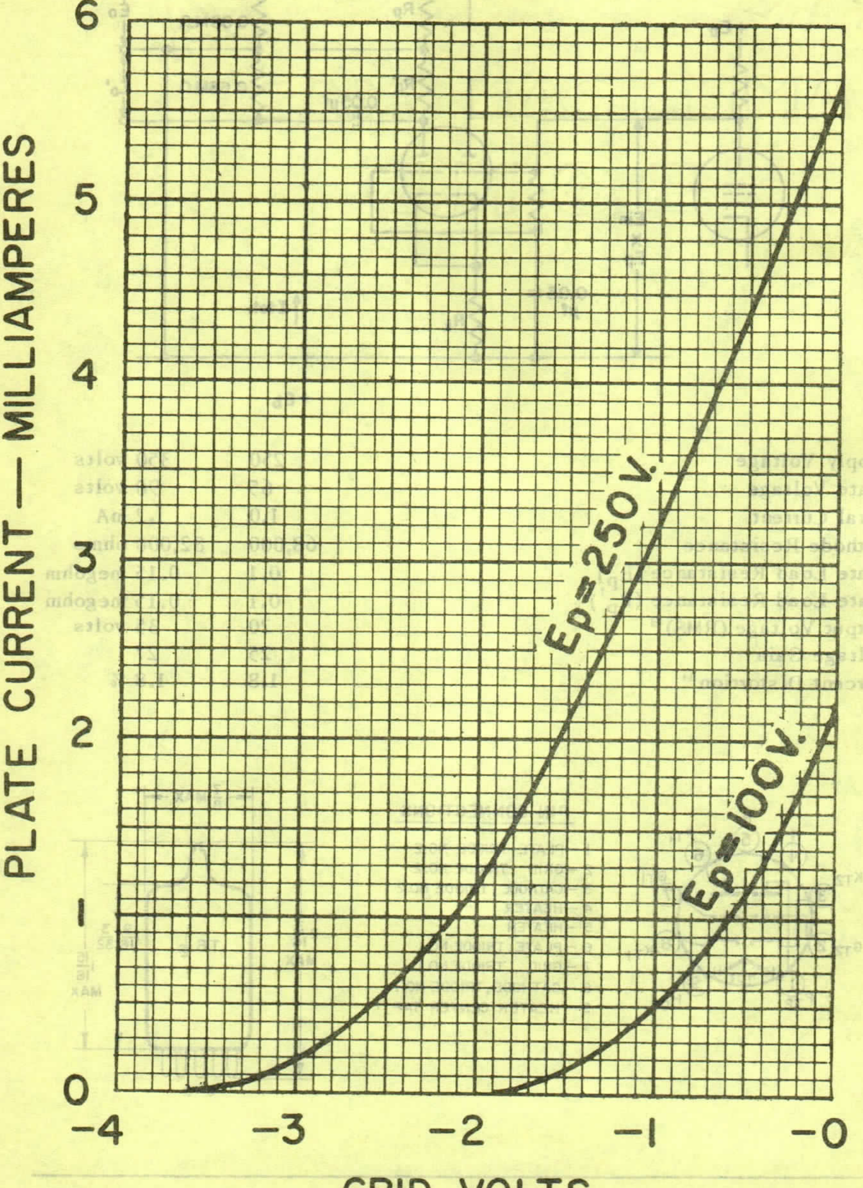
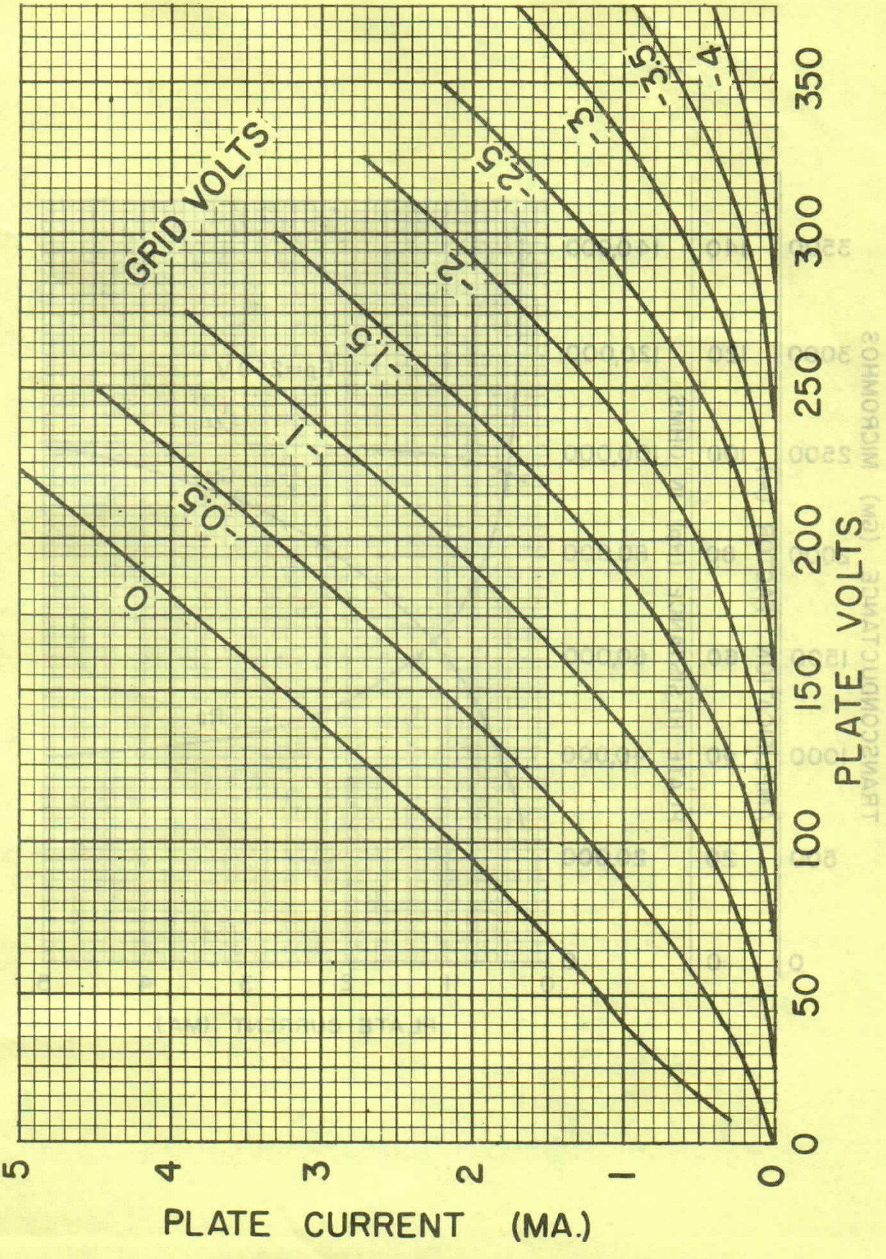
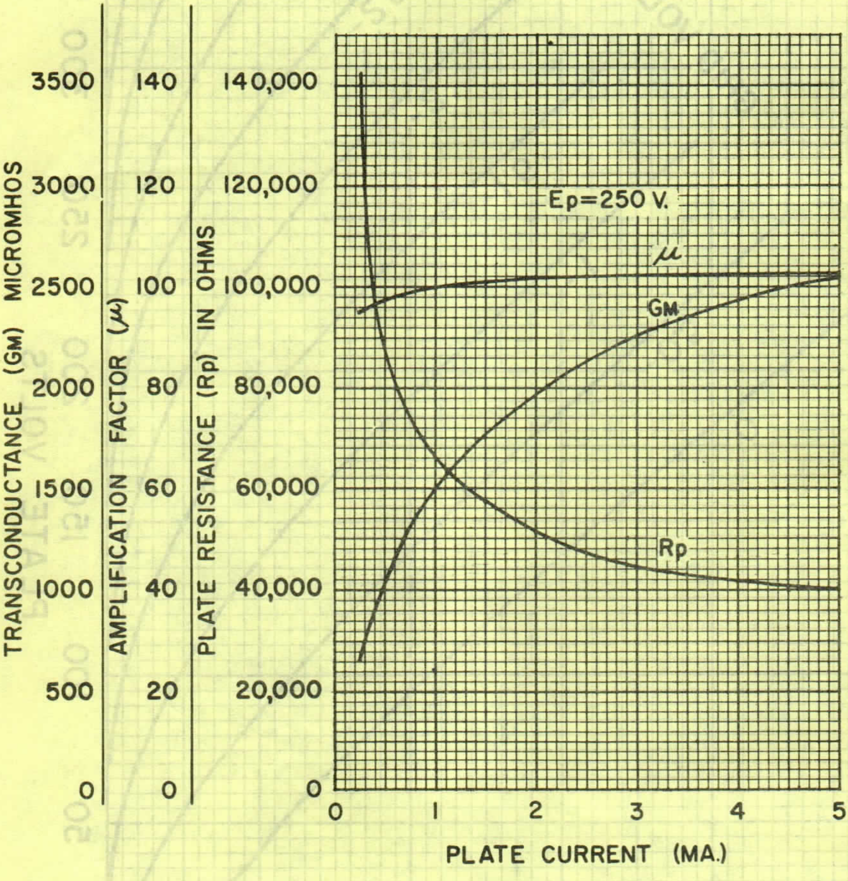


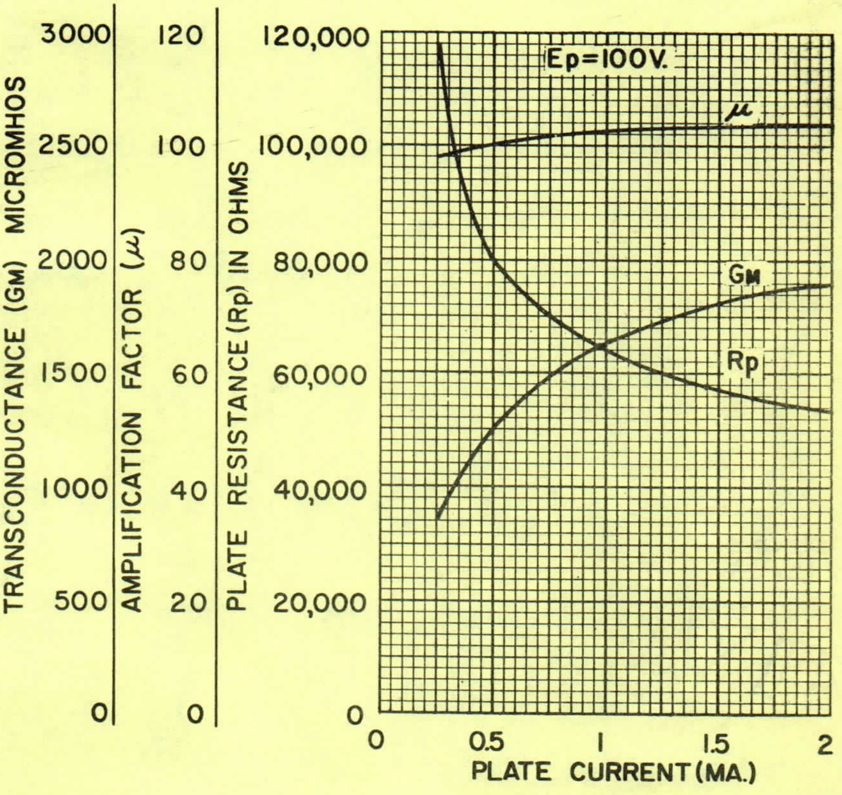
PLATE CURRENT — MILLIAMPERES
6
5
4
3
2
1
0
-4
-3
-2
-1
-0
GRID VOLTS
Ep=250 V.
Ep=100 V.


GRID VOLTS
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
PLATE VOLTS
0
50
100
150
200
250
300
350
PLATE CURRENT (MA.)
0
1
2
3
4
5

7025



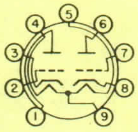
TRANSCONDUCTANCE (GM) MICROMHOS
3500
3000
2500
2000
1500
1000
500
0
AMPLIFICATION FACTOR (μ)
140
120
100
80
60
40
20
0
PLATE RESISTANCE (Rp) IN OHMS
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Ep=250 V.
μ
GM
Rp
0
1
2
3
4
5
PLATE CURRENT (MA.)


TRANSCONDUCTANCE (GM) MICROMHOS
3000
2500
2000
1500
1000
500
0
AMPLIFICATION FACTOR (μ)
120
100
80
60
40
20
0
PLATE RESISTANCE (Rp) IN OHMS
120,000
100,000
80,000
60,000
40,000
20,000
0
Ep=100V.
μ
GM
Rp
0
0.5
1
1.5
2
PLATE CURRENT (MA.)

AMPEREX TUBE TYPE 7062

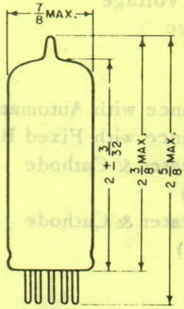
The Amperex 7062 is a twin triode with separate cathodes, designed for applications in computer circuits. The 7062 will maintain its emission capabilities for long periods of operation under cut-off conditions. It is not intended for low-level audio use.

The 7062 is one of the Amperex "Premium Quality 10,000 Hour" tubes.



PIN CONNECTIONS

1 – PLATE NO. 2
2 – GRID NO. 2
3 – CATHODE NO. 2
4 – FILAMENT
5 – FILAMENT
6 – PLATE NO. 1
7 – GRID NO. 1
8 – CATHODE NO. 1
9 – FILAMENT CENTER TAP



GENERAL CHARACTERISTICS

MECHANICAL

Mounting Position	any
Dimensions	see outline drawing
Outline	6 - 3
Base	small button, 9 pin, E9-1
Bulb	T-6½
Bulb Temperature	170°C max

ELECTRICAL

Cathode	coated, unipotential
Heater voltage (AC or DC)	6.3 volts (pins 9 & 4 + 5)
	12.6 volts (pins 4 & 5)
Heater Current at 6.3 volts	400 mA
Heater Current at 12.6 volts	200 mA

Direct Interelectrode Capacitances	Section 1	Section 2
Input	3.5	3.5 $\mu\mu f$
Output	0.5	0.45 $\mu\mu f$
Grid to Plate	2.2	2.3 $\mu\mu f$
Heater to Cathode	3.5	3.5 $\mu\mu f$

	Between 2 Sections
Plate No. 1 to Plate No. 2	< 1.3 $\mu\mu f$
Grid No. 1 to Grid No. 2	< 0.06 $\mu\mu f$

7062

MAXIMUM RATINGS (Absolute Values, Each Section)

Plate Voltage (At Zero Plate Current)	600 V max
Plate Voltage	275 V max
Plate Dissipation	2.0 W max
Cathode Current	20 mA max
Peak Cathode Current [1]	200 mA max
Negative Grid Voltage	100 V max
Peak Negative Grid Voltage [1]	200 V max
Positive Grid Voltage	1.0 V max
Grid Current	2.0 mA max
Peak Grid Current [1]	50 mA max
→ Grid Circuit Resistance with Automatic Bias	1 Meg. max
Grid Circuit Resistance with Fixed Bias	0.5 Meg. max
Voltage Between Heater & Cathode (Cathode Positive)	200 V max
Voltage Between Heater & Cathode (Cathode Negative)	100 V max

Typical Operation
(Each Section)

Plate Voltage	150	100 volts
Negative Grid Voltage	1.85	0.8 volts
Plate Current	8.5	8.5 mA
Transconductance	6400	7800 micromhos
→ Amplification Factor	46	50
Plate Resistance	7200	6400 ohms

Typical Characteristics For Computer Circuit Design [2]

		I	II
Plate Voltage		150	100 V
Grid Supply Voltage		−7.5	100 V
Series Grid Resistor		0	0.5 Meg.
Plate Current	max.	0.15	18 mA

---

1 Pulse time max 10 μsec at a duty cycle of 1%.

2 Clamped grid operation in column II.

Characteristics Range Value for Equipment Design

	Min.	Max.	End of Life
Heater Current (Ef = 6.3 V)	380	420	—— mA
Plate Current (Ebb = 150 V , Rk = 220 Ω, Rg = 0.1 Meg)	6.3	10.7	5.0 mA
Transconductance (Ebb = 150 V , Rk = 220 Ω, Rg = 0.1 Meg.)	5300	8100	4000 μmhos
Plate Current (Eb = 150 V , Eg = −7.5 V)	—	150	150 μA
Grid Voltage Difference Between Sections [Ebb = 150 V , Ib (both sections) = 0.15 mA]	—	< 2.0	2.0 V
Plate Current (Eb = Eg = 100 V , Rg = 0.15 Meg.)	13.6	22	9.5 mA
Negative Grid Current (Ebb = 150 V , Rk = 220 Ω, Rg = 0.1 Meg.)	—	< 0.2	1.0 μA
Cathode to Heater Leakage Current [Ekf = 200 V (cathode positive); R_{series} = 1 meg.		< 15	30 μA
Insulation Resistance Between Any 2 Electrodes		>100	20 meg.

Direct Interelectrode Capacitances

Section 1

Input	3.0 - 4.0 μμf
Output	0.3 - 0.7 μμf
Plate to Grid	1.8 - 2.6 μμf

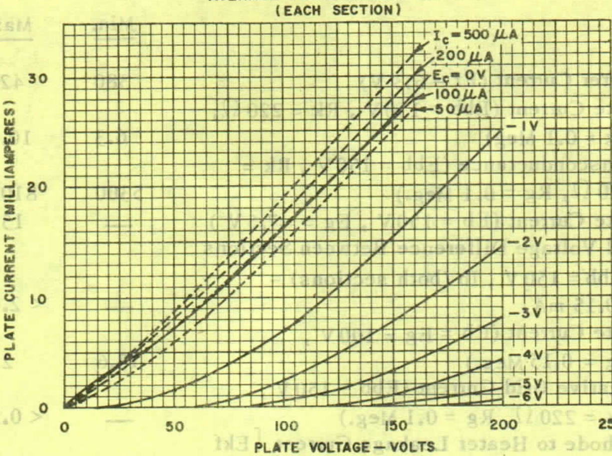
Section 2

Input	3.0 - 4.0 μμf
Output	0.25 - 0.65 μμf
Plate to Grid	1.9 - 2.7 μμf

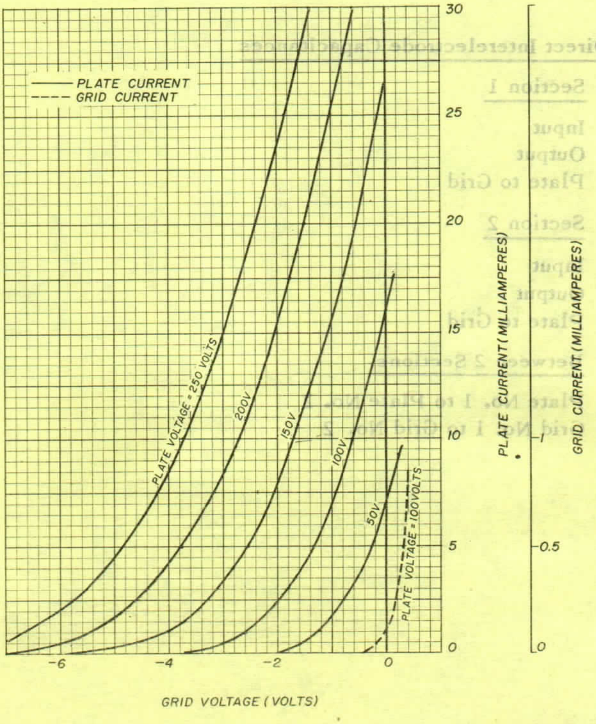
Between 2 Sections

Plate No. 1 to Plate No. 2	< 1.3 μμf
Grid No. 1 to Grid No. 2	< 0.06 μμf

AVERAGE PLATE CHARACTERISTICS
(EACH SECTION)



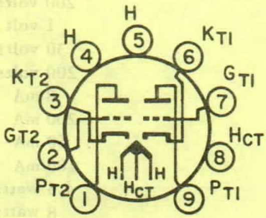
TRANSFER CHARACTERISTICS
(EACH SECTION)



AMPEREX TUBE TYPE 7119/E182CC

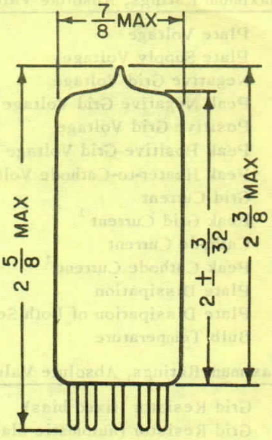
The Amperex 7119/E182CC is a medium-mu, high perveance, twin triode designed for application in computer circuits. The tube features exceptional freedom from cathode interface and is characterized by high zero-bias plate current. In many applications the tube is a replacement for the 5687.

The 7119/E182CC is one of the Amperex "Premium Quality 10,000 Hour" tubes.



PIN CONNECTIONS

1-PLATE, TRIODE 2
2-GRID, TRIODE 2
3-CATHODE, TRIODE 2
4-HEATER
5-HEATER
6-CATHODE, TRIODE 1
7-GRID, TRIODE 1
8-HEATER CENTER TAP
9-PLATE, TRIODE 1



GENERAL CHARACTERISTICS

MECHANICAL DATA

Cathode	coated, unipotential
Base	E9-1
Bulb	T6½
Outline	6-3
Base Connections	9-H
Mounting Position	Any

ELECTRICAL

Heater Characteristics

	Series	Parallel	
Heater Voltage	12.6 ± 5%	6.3 ± 5%	volts
Heater Current	320	640	mA

Direct Interelectrode Capacitances

	Triode No. 1	Triode No. 2
Input	6.0	6.0 $\mu\mu f$
Output	1.1	1.0 $\mu\mu f$
Plate to Grid	4.0	4.1 $\mu\mu f$
Cathode to Heater	4.0	4.0 $\mu\mu f$

	Between Sections
Grid to Grid	0.15 $\mu\mu f$
Plate to Plate	0.6 $\mu\mu f$
Plate of Triode 1 to Grid of Triode 2	0.1 $\mu\mu f$
Plate of Triode 2 to Grid of Triode 1	0.1 $\mu\mu f$

7119/E182CC

Characteristics (Each Section)

Plate Voltage	120	150 volts
Grid Voltage	−2	−14 volts
Plate Current	36	max 0.2 mA
Transconductance	15,000	micromho
Amplification Factor	24	

Maximum Ratings, Absolute Values (Each Section)

Plate Voltage	300 volts
Plate Supply Voltage	600 volts
Negative Grid Voltage	100 volts
Peak Negative Grid Voltage [1]	200 volts
Positive Grid Voltage	1 volt
Peak Positive Grid Voltage [1]	30 volts
Peak Heater-to-Cathode Voltage	200 volts
Grid Current	8 mA
Peak Grid Current [1]	200 mA
Cathode Current	60 mA
Peak Cathode Current [1]	400 mA
Plate Dissipation	4.5 watts
Plate Dissipation of Both Sections	8 watts
Bulb Temperature	160°C

Maximum Ratings, Absolute Values for Circuit Design

Grid Resistor (fixed bias)	0.5 megohm
Grid Resistor (automatic bias)	1 megohm

Characteristic Range Values for Equipment Design

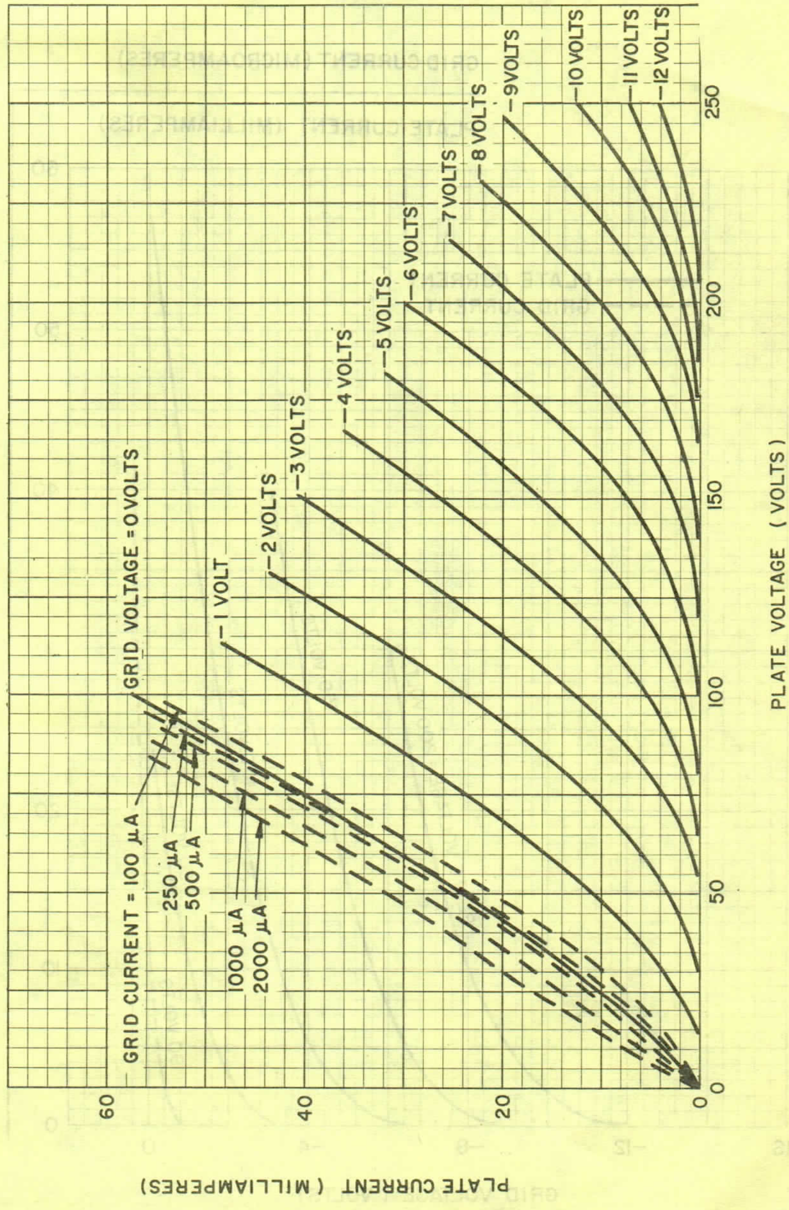
	Min	Max
Heater Current	605	675 mA
Plate Current ($E_b = 90V$, $I_c = 250\ \mu A$)	41	62 mA
Plate Current ($E_b = 120V$, $E_c = -2V$)	26	45 mA
Plate Current ($E_b = 150V$, $E_c = -14V$)	--	0.2 mA
Negative grid current ($E_b = 120V$, $E_c = -2V$, $R_g = 0.1$ meg)	- -	0.2 mA
Heater-Cathode leakage current ($E_{hk} = 200V$, R = 1 meg)	- -	15 μA
Transconductance ($E_b = 120V$, $R_k = 55$ ohms)	11,200	18,800 micromho
Insulation resistance	100	- - megohms

Direct Interelectrode Capacitances

	Min	Max
Triode No. 1		
Input	5.3	6.7 $\mu\mu f$
Output	0.75	1.45 $\mu\mu f$
Plate to grid	3.4	4.6 $\mu\mu f$
Triode No. 2		
Input	5.3	6.7 $\mu\mu f$
Output	0.65	1.35 $\mu\mu f$
Plate to grid	3.4	4.8 $\mu\mu f$
Between Sections		
Grid to grid	- -	0.15 $\mu\mu f$
Plate to plate	- -	0.8 $\mu\mu f$
Plate of Triode 1 to grid of Triode 2	- -	0.1 $\mu\mu f$
Plate of Triode 2 to grid of Triode 1	- -	0.1 $\mu\mu f$

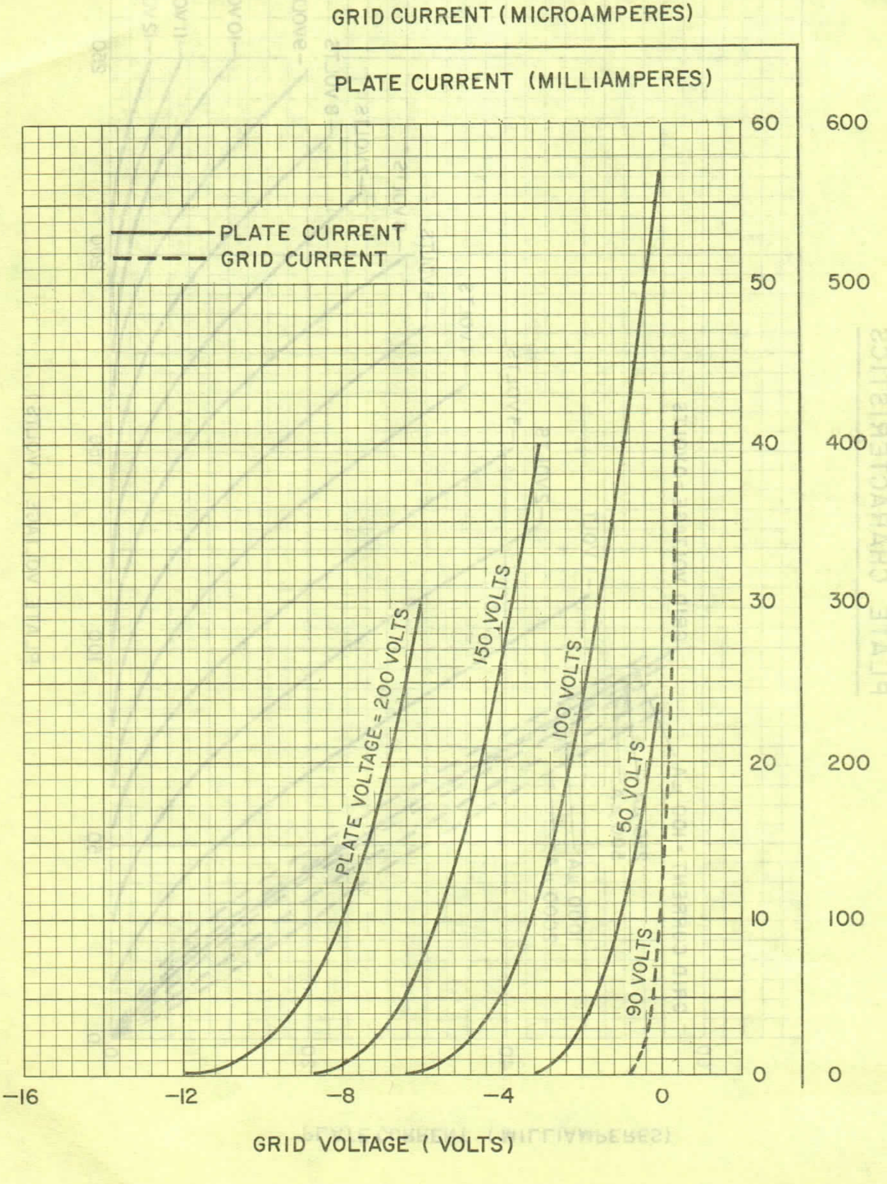
[1] Pulse duration, 10 microseconds; duty cycle, 1%.

PLATE CHARACTERISTICS



7119/E182CC

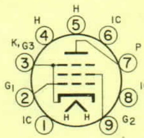
TRANSFER CHARACTERISTICS



Revised 9/59

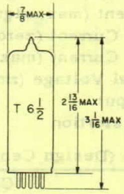
AMPEREX TUBE TYPE 7189

The Amperex type 7189 is a 9 pin miniature pentode designed for use as a power amplifier in high fidelity audio equipment. It is a specially tested and improved tube intended for use in amplifiers of over 20 watt capabilities.



PIN CONNECTIONS

1. INTERNALLY CONNECTED
2. GRID NO. 1
3. CATHODE AND GRID NO. 3
4. HEATER
5. HEATER
6. INTERNALLY CONNECTED
7. PLATE
8. INTERNALLY CONNECTED
9. GRID NO. 2



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated, unipotential
Base	E9-1
Bulb	T6½
Outline	6-4
Mounting Position	any

ELECTRICAL

Heater Voltage	6.3 volts
Heater Current	0.76 amps

Direct Interelectrode Capacitances

Input Capacitance	10.8 $\mu\mu f$
Output Capacitance	6.5 $\mu\mu f$
Plate to Grid No. 1	0.5 $\mu\mu f$
Grid No. 1 to Heater	0.25 $\mu\mu f$

Typical Characteristics

Plate Voltage	250 volts
Grid No. 2 Voltage	250 volts
Plate Current	48 mA
Grid No. 2 Current	5.5 mA
Grid No. 1 Voltage	−7.3 volts
Transconductance	11,300 micromhos
Plate Resistance	40,000 ohms
Amplification Factor (Grid No. 1 to Grid No. 2)	19.5

Maximum Ratings (Design Center Values)

Class AB_1 Fixed Bias Audio Amplifier
(Pentode Connection)

Plate Voltage	400 volts
Plate Dissipation	12 watts
Grid No. 2 Voltage	300 volts
Grid No. 2 Dissipation (zero signal)	2.0 watts
Grid No. 2 Dissipation (max. signal)	4.0 watts
Cathode Current	65 mA
Grid Resistance (fixed bias)	300,000 ohms
Heater to Cathode Voltage	100 volts

7189

Typical Operation (Fixed Bias - Two Tubes - Push Pull)

Plate Voltage	400 volts
Grid No. 2 Voltage	300 volts
Grid No. 1 Voltage	−15 volts
Plate to Plate Load Resistance	8000 ohms
Plate Current (zero signal)	2x7.5 mA
Plate Current (max. signal)	2x52.5 mA
Grid No. 2 Current (zero signal)	2x0.8 mA
Grid No. 2 Current (max. signal)	2x12.5 mA
Input Signal Voltage (rms)	10.5 volts
Power Output	24 watts
Percent Distortion	4.0 %

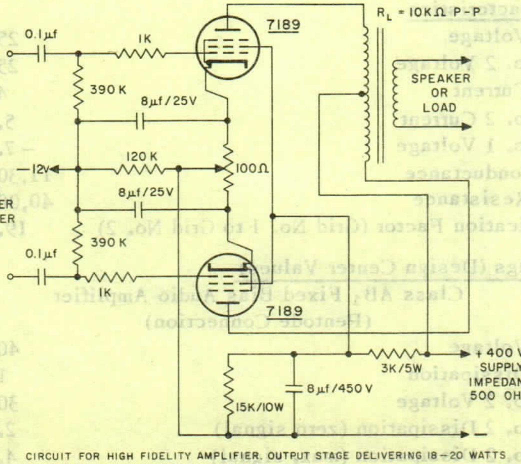
Maximum Ratings (Design Center Values)

Class AB_1 Audio Amplifier
(Distributed Load Connection)

Plate and Grid No. 2 Supply Voltage	375 volts
Plate Dissipation	12 watts
Grid No. 2 Dissipation (zero signal)	2 watts
Grid No. 2 Input (max signal)	4 watts
Cathode Current	65 mA
Grid Resistance (cathode bias)	1 megohm
Heater to Cathode Voltage	100 volts

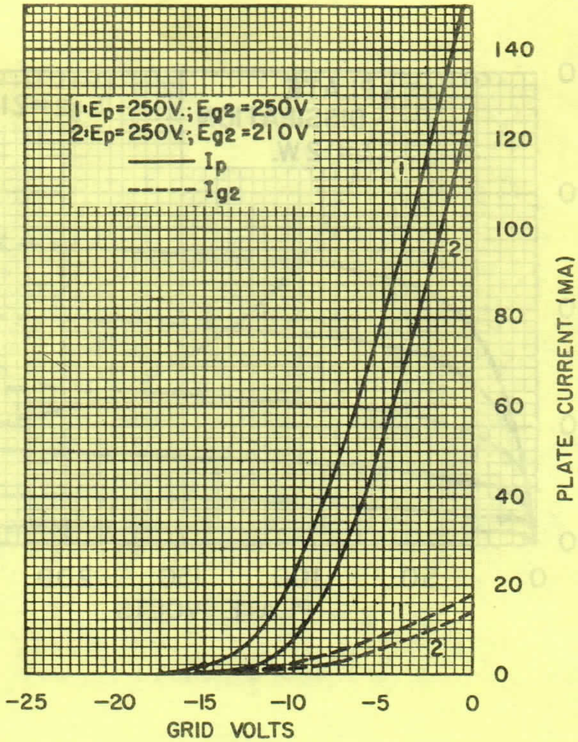
Typical Operation (Cathode Bias - Two Tubes - Push Pull)

Plate Supply Voltage	375 volts
Grid No. 2 Supply Voltage	see note 1
Common Cathode Resistance	220 ohms
Plate to Plate Load Resistance	11,000 ohms
Plate and Grid No. 2 Current (zero signal)	2x35 mA
Plate and Grid No. 2 Current (max signal)	2x40.5 mA
Input Signal Voltage (rms)	12.5 volts
Power Output	16.5 watts
Percent Distortion	3 %



CIRCUIT FOR HIGH FIDELITY AMPLIFIER. OUTPUT STAGE DELIVERING 18 – 20 WATTS DEPENDING ON TRANSFORMER EFFICIENCY

[1] Screen voltage is obtained from taps located at 43% of the plate winding turns.


1: Ep=250V.; Eg2=250V
2: Ep=250V.; Eg2=210V
Ip
Ig2
1
2
1
2
140
120
100
80
60
40
20
0
PLATE CURRENT (MA)
−25
−20
−15
−10
−5
0
GRID VOLTS

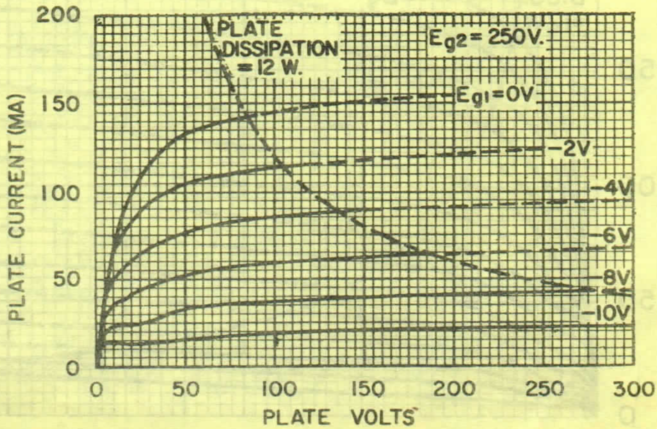


PLATE DISSIPATION = 12 W.
Eg2= 250V.
Eg1=0V
−2V
−4V
−6V
−8V
−10V
200
150
100
50
0
PLATE CURRENT (MA)
0
50
100
150
200
250
300
PLATE VOLTS

7189

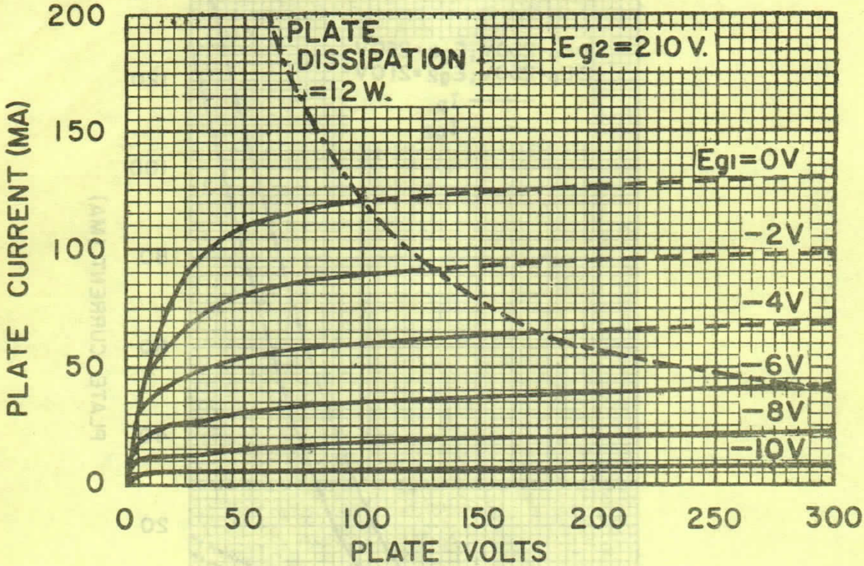
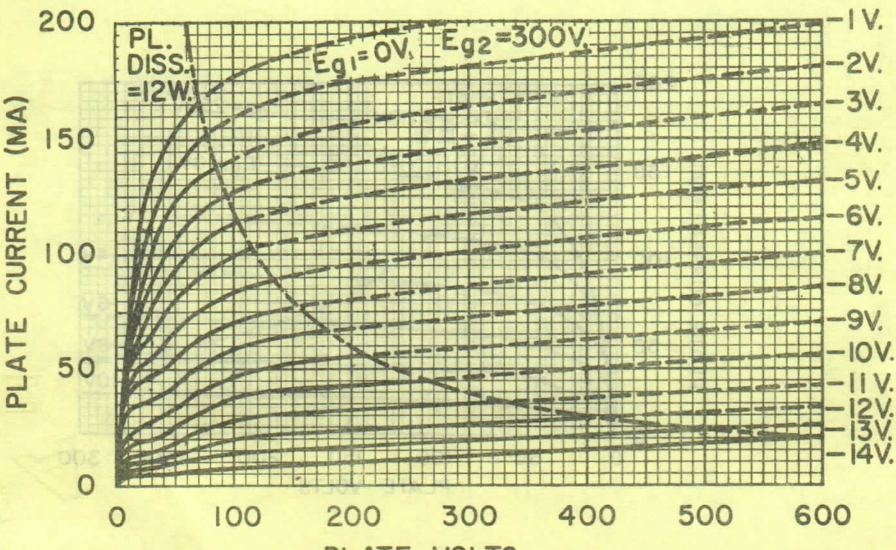
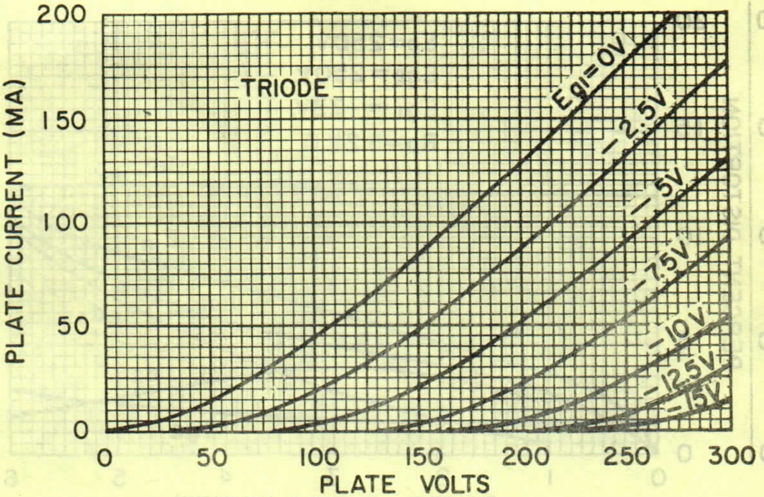
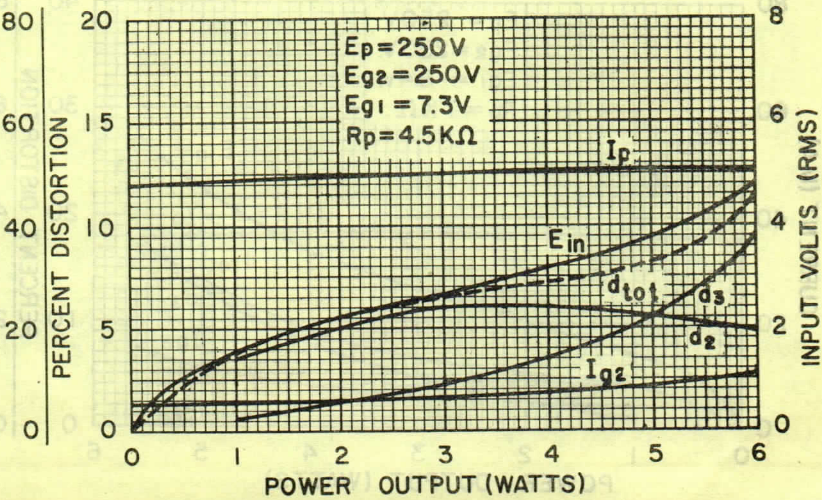


PLATE DISSIPATION =12 W.
Eg2=210 V.
Eg1=0V
-2V
-4V
-6V
-8V
-10V
PLATE CURRENT (MA)
200
150
100
50
0
0
50
100
150
200
250
300
PLATE VOLTS

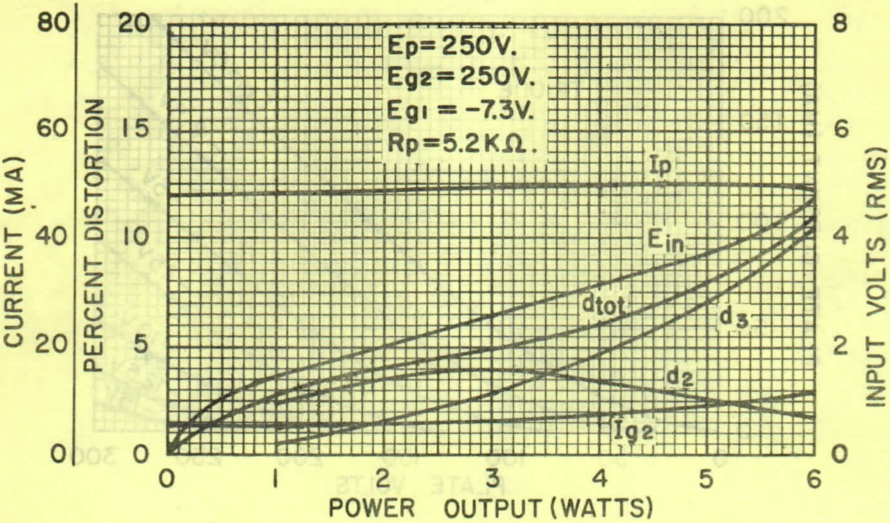


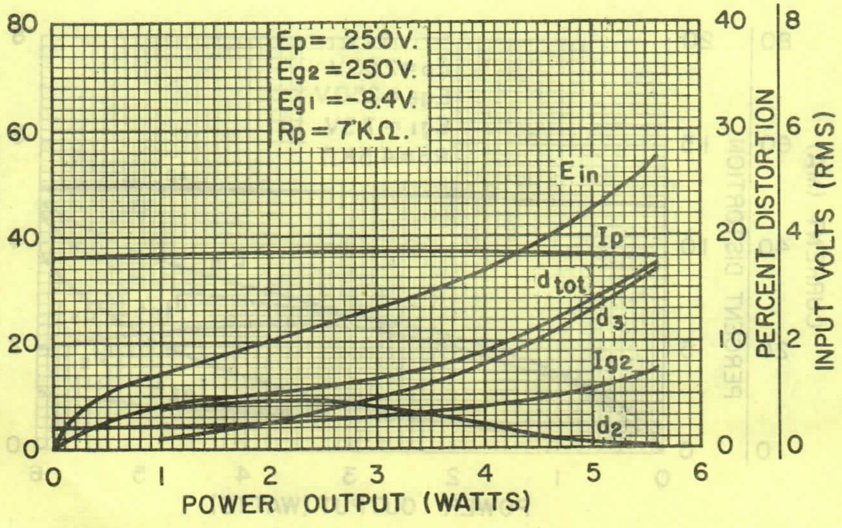
PL. DISS. =12W.
Eg1=0V, Eg2=300V.
-1 V.
-2V.
-3V.
-4V.
-5V.
-6V.
-7V.
-8V.
-9V.
-10V.
-11 V.
-12V.
-13V.
-14V.
PLATE CURRENT (MA)
200
150
100
50
0
0
100
200
300
400
500
600
PLATE VOLTS

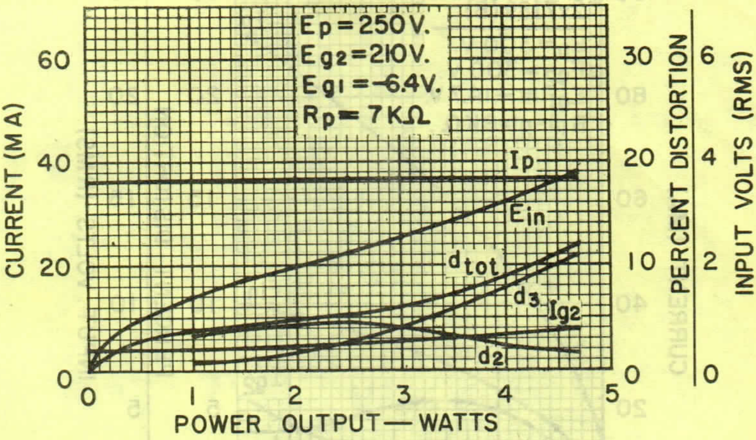

TRIODE
PLATE CURRENT (MA)
PLATE VOLTS
Eg1=0V
-2.5V
-5V
-7.5V
-10V
-12.5V
-15V
0
50
100
150
200
250
300

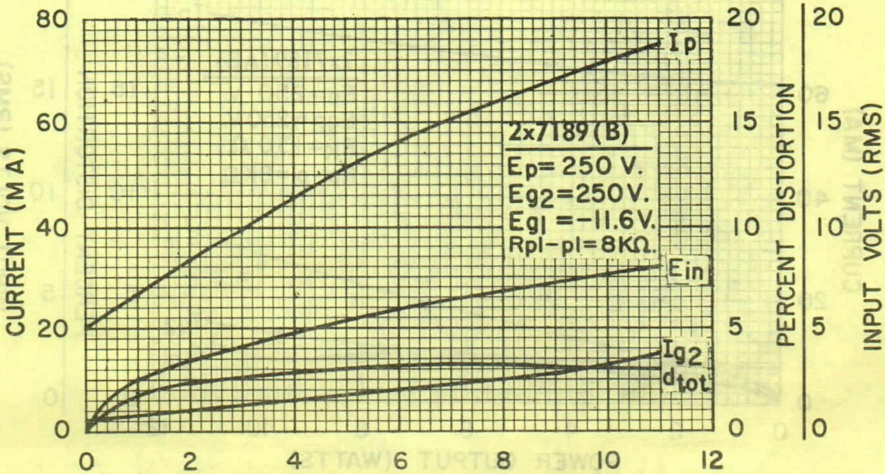

Ep=250V
Eg2=250V
Eg1=7.3V
Rp=4.5KΩ
Ip
Ein
dtot
d3
d2
Ig2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)

7189

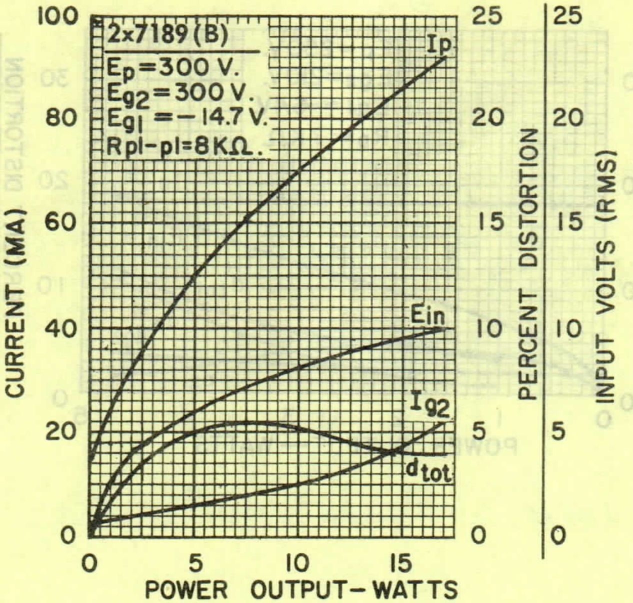

Ep=250V.
Eg2=250V.
Eg1=-7.3V.
Rp=5.2KΩ.
Ip
Ein
dtot
d3
d2
Ig2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)

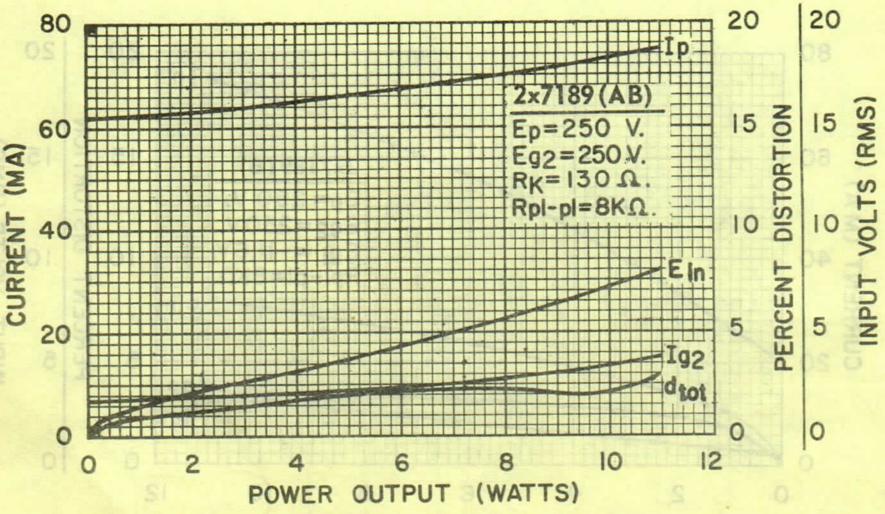

Ep= 250V.
Eg2=250V.
Eg1=-8.4V.
Rp= 7KΩ.
Ein
Ip
dtot
d3
Ig2
d2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)


Ep=250V.
Eg2=210V.
Eg1=-6.4V.
Rp=7KΩ
Ip
Ein
dtot
d3
Ig2
d2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT — WATTS

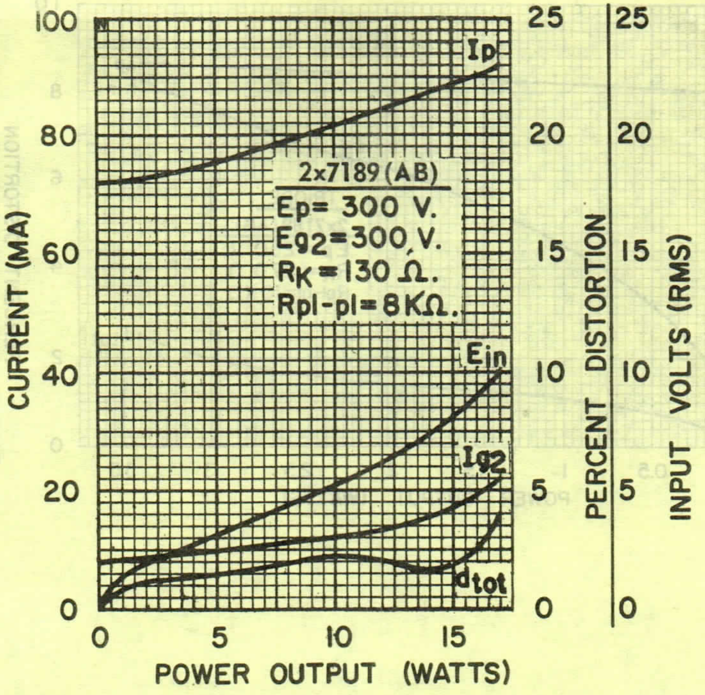

2x7189(B)
Ep= 250 V.
Eg2=250V.
Eg1=-11.6V.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT — WATTS

7189

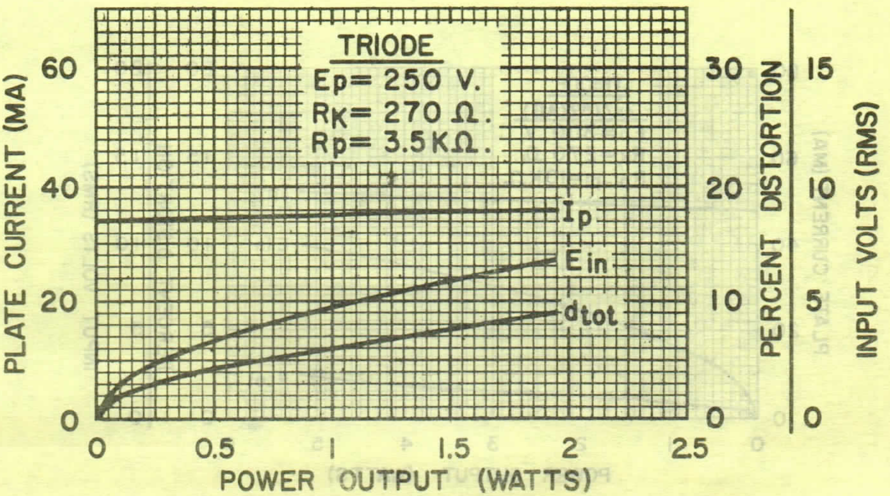

2x7189 (B)
Ep=300 V.
Eg2=300 V.
Eg1 =− 14.7 V.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT-WATTS
100
80
60
40
20
0
25
20
15
10
5
0
5
10
15


2x7189 (AB)
Ep=250 V.
Eg2=250 V.
RK= 130 Ω.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
80
60
40
20
0
20
15
10
5
2
4
6
8
10
12

7189

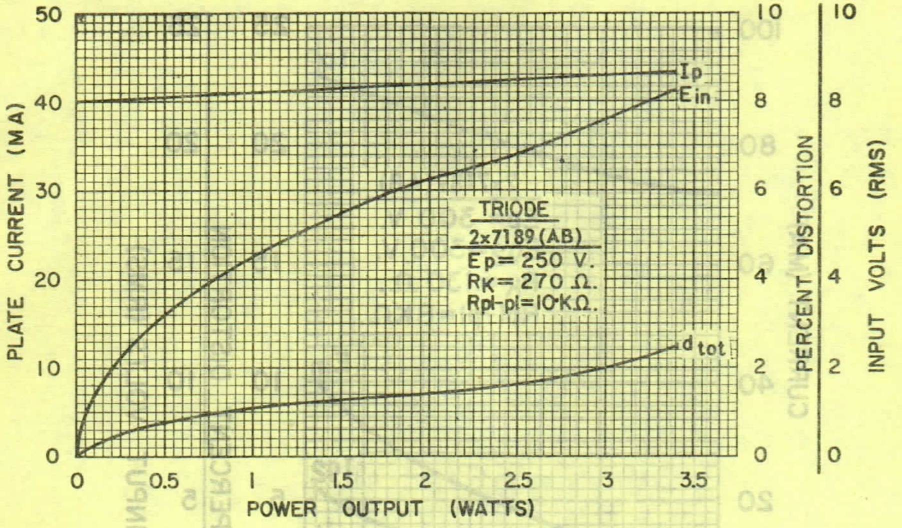


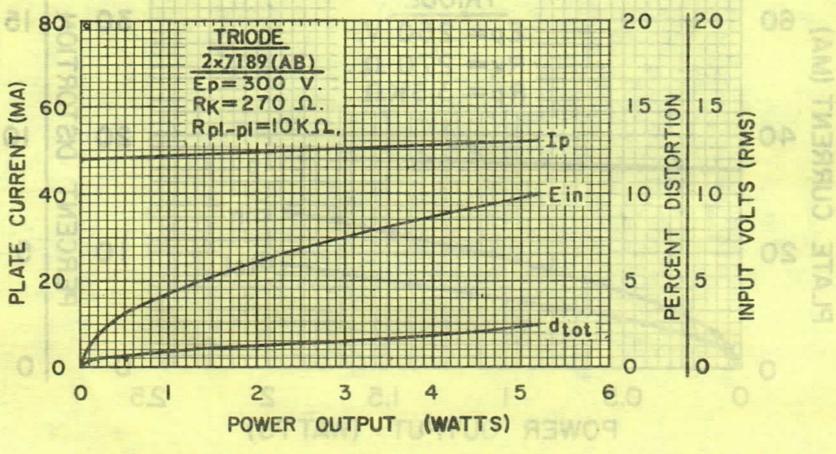
2x7189 (AB)
Ep= 300 V.
Eg2=300 V.
RK=130 Ω.
Rpl-pl=8 KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
5
10
15
20
25
40
60
80
100



TRIODE
Ep= 250 V.
RK= 270 Ω.
Rp= 3.5 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
0.5
1
1.5
2
2.5
20
40
60
10
30
15

7189

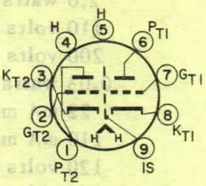

TRIODE
2×7189 (AB)
Ep= 250 V.
RK= 270 Ω.
Rpl-pl=10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
0.5
1
1.5
2
2.5
3
3.5
10
20
30
40
50
2
4
6
8


TRIODE
2×7189 (AB)
Ep= 300 V.
RK= 270 Ω.
Rpl-pl= 10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
1
2
3
4
5
6
20
40
60
80
10
15

AMPEREX TUBE TYPE 7308

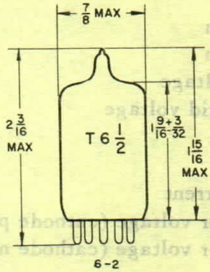
TENTATIVE DATA

The Amperex type 7308 is a special quality twin triode similar to the 6922 but intended for use in applications where extremely low microphonics and resistance to shock is required. It is particularly suitable for equipment such as oscilloscopes and broadband amplifiers, and in airborne equipment.



PIN CONNECTIONS

1- PLATE, TRIODE 2
2- GRID, TRIODE 2
3- CATHODE, TRIODE 2
4- HEATER
5- HEATER
6- PLATE, TRIODE 1
7- GRID, TRIODE 1
8- CATHODE, TRIODE 1
9- INTERNAL SHIELD



GENERAL CHARACTERISTICS

MECHANICAL

Base	Noval
Bulb	T 6½
Outline	6-2
Basing	9DE
Dimensions	see outline drawing

ELECTRICAL

Heating	parallel supply
Heater voltage	6.3 volts
Heater current	335 mA

Direct Interelectrode Capacitances

	Section I	Section II
Plate to (k+f+s)	1.75 μμf	1.65 μμf
Plate to (k+f)	0.5 μμf	0.4 μμf
Grid to (k+f+s)	3.1 μμf	3.1 μμf
Grid to (k+f)	3.1 μμf	3.1 μμf
Plate to grid	1.4 μμf	1.4 μμf
Plate to cathode	0.18 μμf	0.18 μμf
Cathode to heater	2.6 μμf	2.7 μμf
Plate to shield	1.3 μμf	1.3 μμf

	Between the two sections
Grid to Grid	0.005 μμf
Plate to plate	0.045 μμf
Plate to grid No. 2	0.005 μμf
Plate No. 2 to grid No. 1	0.005 μμf
Grid No. 1 to cathode No. 2	0.005 μμf
Grid No. 2 to cathode No. 1	0.005 μμf

Grounded grid

	Section I	Section II
Plate to (g+f+s)	3.0 μμf	2.9 μμf
Cathode (g+f+s)	6.0 μμf	6.0 μμf

7308

Maximum Ratings, Absolute Values
(Each Section Unless Otherwise Stated)

Heater Voltage	6.3 volts ± 5%
Plate voltage (cold cathode)	550 volts max
Plate voltage (Plate current = 0)	400 volts max
Plate voltage	250 volts max
Plate dissipation	1.65 watts max
Plate dissipation	2.0 watts max [1]
Negative grid voltage	110 volts max
Negative peak grid voltage	200 volts max [2]
Grid dissipation	0.03 watts max
Cathode current	22 mA max
Peak cathode current	110 mA max [2]
Cathode to heater voltage (cathode positive)	120 volts max
Cathode to heater voltage (cathode negative)	60 volts max
Bulb temperature	165°C max

Maximum Ratings, Absolute Values
Circuit Design

Grid resistance (automatic bias)	1 megohm max
Grid resistance (fixed bias)	0.5 megohm max

Typical Characteristics [3]

	A	B
Plate supply voltage	100	90 volts
Grid supply voltage	+ 9	0 volts
Cathode resistor	680	120 ohms
Plate current	15	12 mA
Transconductance	12,500	11,500 micromhos
Amplification factor	33	- -
Equivalent noise resistance [4]	250	- - ohms
Noise factor [5]	4.6	- - db
Input damping at f = 100 Mc/s	3000	- - ohms

1 Wa + Wa' = 2.2 watts max

2 T pulse = 200 microseconds max, duty cycle = 10% max.

3 Operations of the tube under the conditions as given in column A is recommended because of the small spread in characteristics.

4 Measured at f = 45 Mc/s.

5 Measured in a cascode circuit at f = 200 Mc/s and matched for minimum noise.

Operating Characteristics as Additive Mixer

Plate supply voltage	60	90	150	volts
Plate load resistor	0	1000	3900	ohms
Grid resistor	1	1	1	megohm
Oscillator voltage	2	2.5	3	volts rms
Plate current	4.7	7.7	11	mA
Conversion conductance	2900	3500	4100	micromhos
Input resistance	8300	7000	6100	ohms

Operating Characteristics as Output Tube - Class A

Plate voltage		220		volts
Plate resistance		20,000		ohms
Negative grid voltage		6.8		volts
Input voltage	0	1.5	4.5	volts rms
Plate current	6.5	-	9.2	mA
Output power	-	0.05	0.5	watts
Total distortion	-	-	7	%

Operating Characteristics as Push Pull Output Tube - Class B

Speech and Music Signals

Plate Voltage		200		volts
Plate to plate resistance		10,000		ohms
Negative grid voltage		6		volts
Input voltage	0	0.9	4.0	volts rms
Plate current	2x5	-	2x13.5	mA
Output power	-	0.05	1.5	watts
Total distortion	-	-	4	%

Operating Characteristics as Push Pull Output Tube - Class B

Sinusoidal Input Voltage

Plate voltage		200		volts
Plate to plate resistance		22,000		ohms
Negative grid voltage		6		volts
Input voltage	0	0.9	4.0	volts rms
Plate current	2x5	-	2x9	mA
Output power	-	0.05	1.2	watts
Total distortion	-	-	3	%

7308

Characteristic Range Value for Equipment Design

	Initial Min	Initial Max	End of Life[6] Min	End of Life[6] Max	
Heater Current	318	352	318	352	mA
Plate current (E_{bb} = 100 V, E_{cc} = 9 V, R_k = 680 Ω)	14.2	15.8	13.5		mA
Transconductance (E_{bb} = 100 V, E_{cc} = 9 V, R_k = 680 Ω)	10,500	14,500	9000		micromhos
Cathode-heater current ($E_{h/k}$ = 60 V, h neg.)		< 6		12	μA
Cathode-heater current ($E_{h/k}$ = 120 V, h pos.)		< 6		12	μA
Negative grid current (E_b = 90 V, I_b = 15 mA R series = 0.1 megohm)		0.1		1	μA
Isolation resistance between two arbitrary electrodes (D-C voltage = 200 V h pos.)	> 100	20			megohms
Difference in cathode voltage (for circuit see note 7 on page 5)		1.5			volts

Direct Interelectrode Capacitances (without external shield)

	Section I		Section II	
Plate to (k+f+s)	1.6	2.0 μμf	1.5	1.9 μμf
Plate to (k+f)	0.4	0.6 μμf	0.3	0.5 μμf
Grid to (k+f+s)	2.5	3.7 μμf	2.5	3.7 μμf
Grid to (k+f)	2.5	3.7 μμf	2.5	3.7 μμf
Plate to grid	1.2	1.6 μμf	1.2	1.6 μμf
Plate to cathode	0.14	0.22 μμf	0.14	0.22 μμf
Plate to shield	1.1	1.5 μμf	1.1	1.5 μμf

Between the two sections

Plate to plate	0.045 μμf max
Grid to grid	0.005 μμf max
Plate to grid No. 2	0.005 μμf max
Plate No. 2 to grid No. 1	0.005 μμf max
Grid No. 1 to cathode No. 2	0.005 μμf max
Grid No. 2 to cathode no. 1	0.005 μμf max

Grounded Grid	Section I		Section II	
Plate to (g+f+s)	2.7	3.3 μμf	2.6	3.2 μμf
Cathode to (g+f+s)	5.1	6.9 μμf	5.1	6.9 μμf

[6] Conditions of life test operation:

E_h	6.3 volts	$R_{g1} = R_{g2}$	47,000 ohms
$E_{cc} = E_{2cc}$	9 volts	$E_{k1/h} = E_{k2/h}$	60 volts (k neg)
$E_{1bb} = E_{2bb}$	100 volts	$I_{b1} = I_{b2}$	15 mA
$R_{k1} = R_{k2}$	680 ohms		

Hum (referred to the grid) [8]	50 μVolts max
Vibrational noise output	
E_{bb} = 100 V, R_b = 2000 ohms, E_c = + 9 V, R_k = 680 ohms, C_k = 1000 μf, Vibration 10 - 50 c/s, 2.5 g	0.1 volts max
E_{bb} = 270 V, R_b = 18,000 ohms, R_c = 1 megohm, R_k = 180 ohms, C_k = 50 μf, Vibration 50 - 5000 c/s, 0.5 g	0.14 volts max

Special Ratings

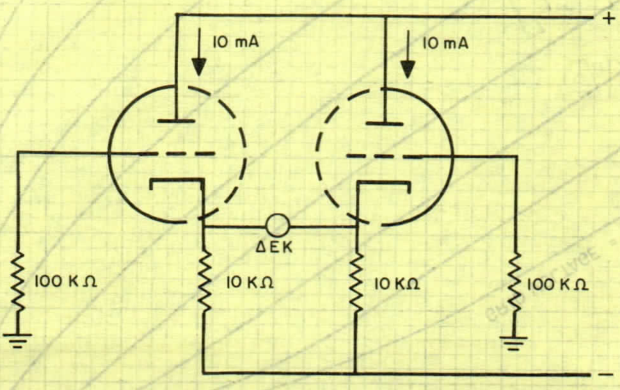
Shock rating [9]	abt. 500 g

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of four different directions.

Fatigue rating [9]	2.5 g

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of the three directions.

7



Circuit for checking difference in cathode voltage

8 E_{bb} = 90 V, I_b = 15 mA, R_k = 80 ohms, C_k = 1000 μf, R_c = 0.5 megohm, fully shielded tubeholder, straight response curve filter; frequency of the heater supply voltage = 50 c/s + 3% 500 c/s.

9 These test conditions are given only for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions.

7308

PLATE CHARACTERISTICS

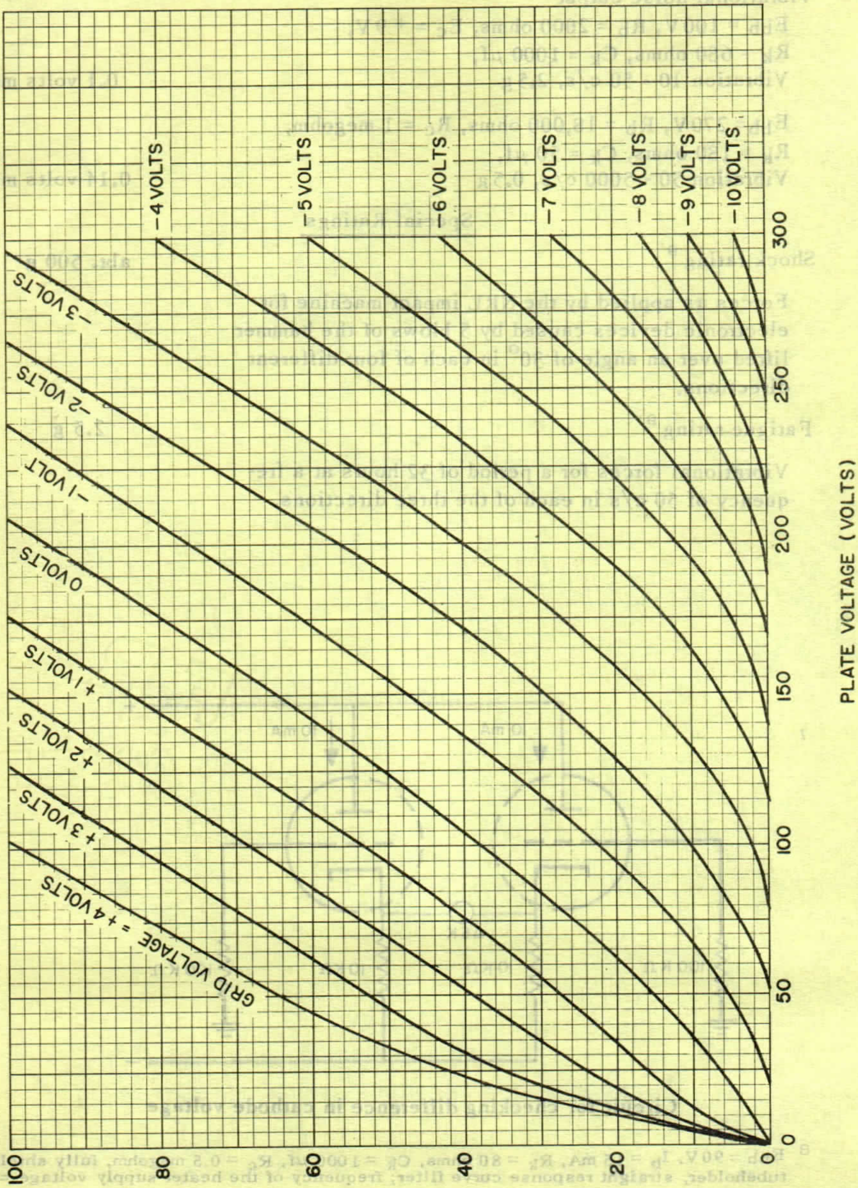
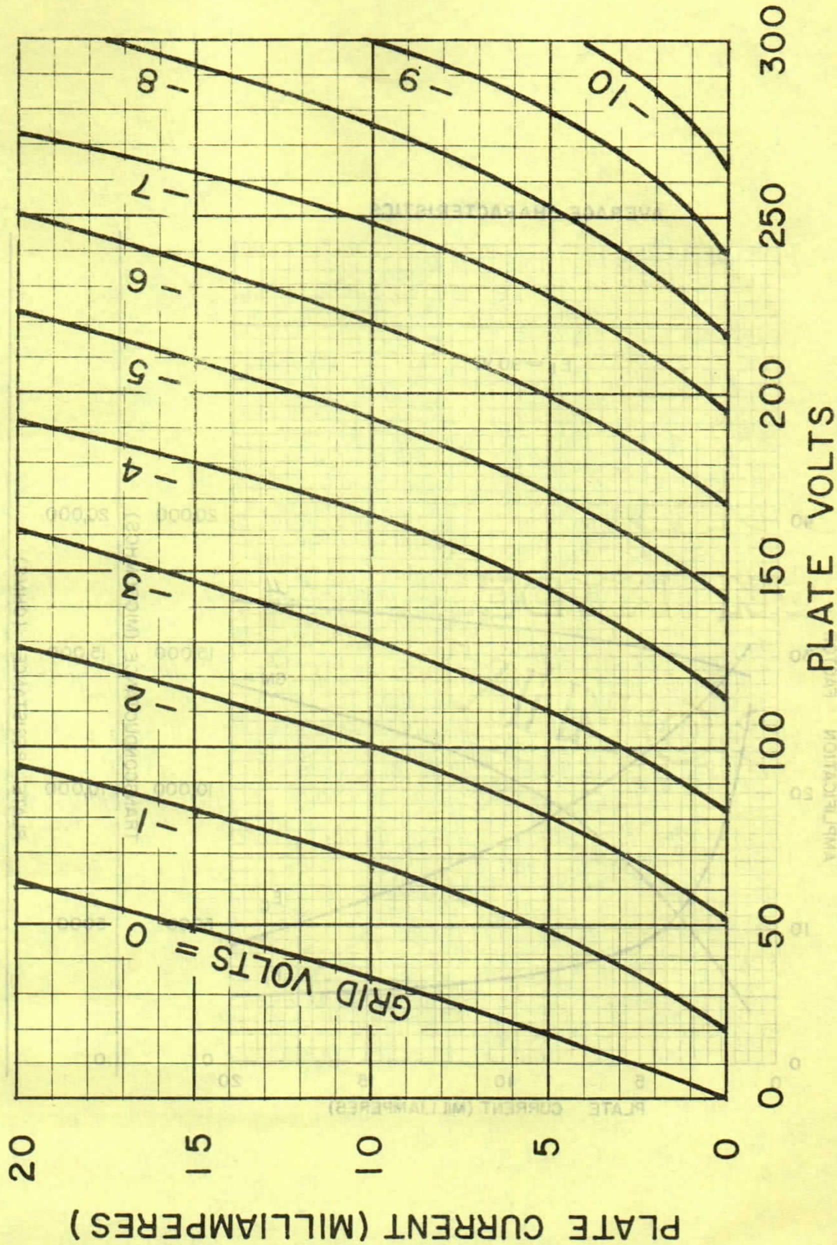
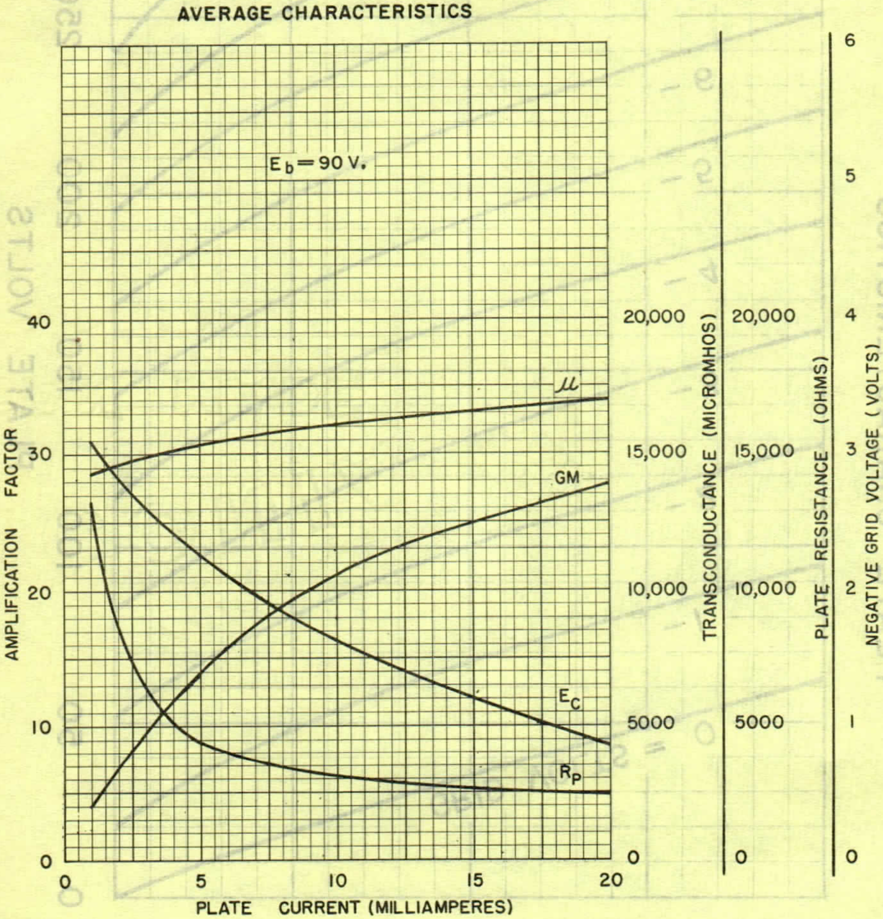
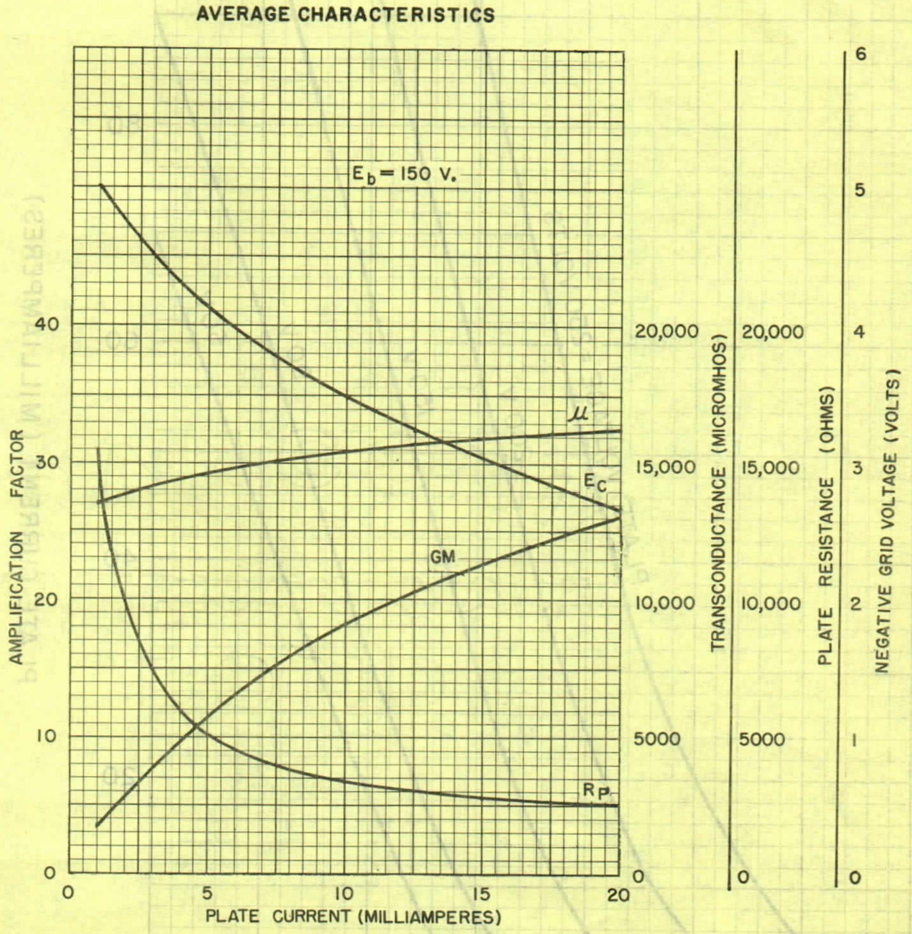


PLATE CHARACTERISTICS



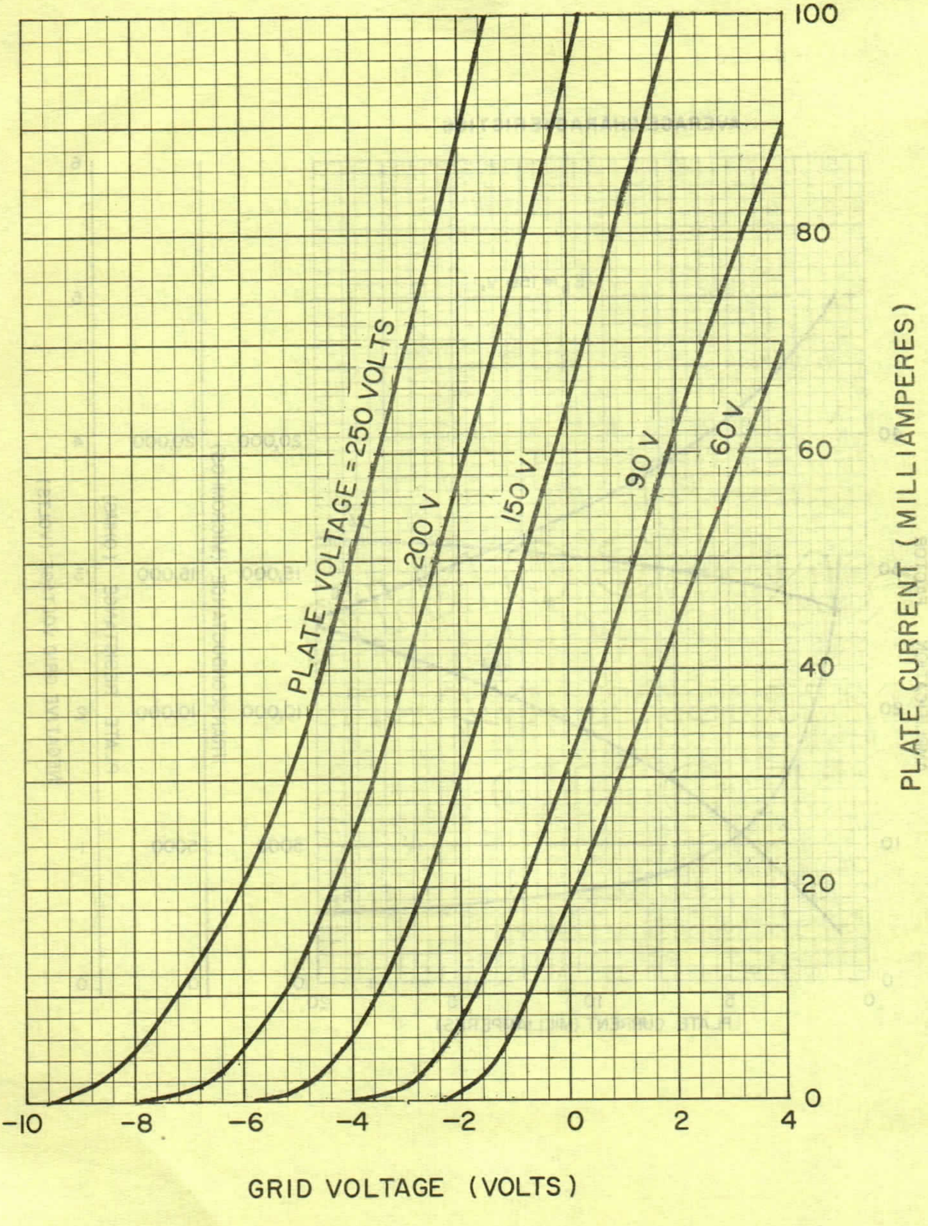

AVERAGE CHARACTERISTICS
E_b = 90 V.
μ
GM
E_C
R_P
AMPLIFICATION FACTOR
0
10
20
30
40
PLATE CURRENT (MILLIAMPERES)
0
5
10
15
20
TRANSCONDUCTANCE (MICROMHOS)
0
5000
10,000
15,000
20,000
PLATE RESISTANCE (OHMS)
0
5000
10,000
15,000
20,000
NEGATIVE GRID VOLTAGE (VOLTS)
0
1
2
3
4
5
6



AVERAGE CHARACTERISTICS
$E_b = 150$ V.
μ
E_C
GM
R_P
AMPLIFICATION FACTOR
0
10
20
30
40
0
5
10
15
20
PLATE CURRENT (MILLIAMPERES)
TRANSCONDUCTANCE (MICROMHOS)
0
5000
10,000
15,000
20,000
PLATE RESISTANCE (OHMS)
0
5000
10,000
15,000
20,000
NEGATIVE GRID VOLTAGE (VOLTS)
0
1
2
3
4
5
6

7308

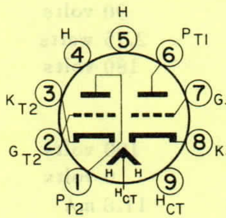
TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 7316

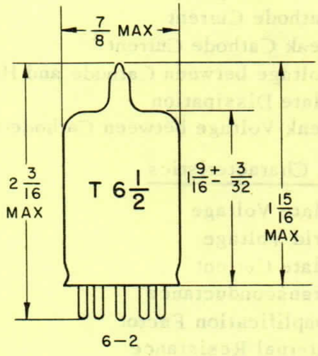
The ~~7136~~ 7316 is a medium μ, long life, reliable twin triode with separate cathodes designed for application in computer circuits not critical as to hum, microphony, and noise. Operation of the tube for long periods of time under cut off conditions will not cause deterioration of the emission surface.

GENERAL CHARACTERISTICS



PIN CONNECTIONS

1- PLATE, TRIODE 2
2- GRID, TRIODE 2
3- CATHODE, TRIODE 2
4- HEATER
5- HEATER
6- PLATE, TRIODE I
7- GRID, TRIODE I
8- CATHODE, TRIODE I
9- HEATER CENTER TAP



MECHANICAL

Cathode	coated, unipotential
Outline	6-2
Base	E9-1
Base Diagram	9A
Bulb	T6½
Max Bulb Temperature	120°C

ELECTRICAL

	parallel	series	
Heater Voltage	6.3 ± 5%	12.6 ± 5%	volts
Heater Current	300	150	mA

Direct Interelectrode Capacitances (Without External Shield)

	Triode No. 1	Triode No. 2
Plate to Grid	1.6 $\mu\mu$f	1.6 $\mu\mu$f
Input	1.8 $\mu\mu$f	1.8 $\mu\mu$f
Output	0.5 $\mu\mu$f	0.37 $\mu\mu$f
Cathode to Heater	3.0 $\mu\mu$f	3.0 $\mu\mu$f

	Between Sections
Grid to Grid	0.008 $\mu\mu$f
Plate to Plate	1.1 $\mu\mu$f
Plate No. 1 to Grid No. 2	0.09 $\mu\mu$f
Plate No. 2 to Grid No. 1	0.05 $\mu\mu$f

7316

Maximum Ratings (Absolute Values, Each Section)

Plate Supply Voltage	550 volts
Plate Voltage	250 volts
Negative Grid Voltage	100 volts
Negative Grid to Plate Voltage [1]	200 volts
Grid Voltage	0 volts
Cathode Current	20 mA
Peak Cathode Current [1]	100 mA
Voltage between Cathode and Heater	90 volts
Plate Dissipation	2.75 watts
Peak Voltage between Cathode and Heater	180 volts

Typical Characteristics

Plate Voltage	250 [2]	100 volts
Grid Voltage	−8.5	0 volts
Plate Current	10.5	11.8 mA
Transconductance	2200	3100 micromhos
Amplification Factor	17	19.5
Internal Resistance	7700	6250 ohms

Characteristic Range Values for Equipment Design

Heater Current ($E_f = 6.3$ V)	270	330 mA
Plate Current ($E_f = 6.3$ V, $E_b = 250$ V, $E_c = -8.5$ V)	6	15 mA
Plate Current ($E_f = 6.3$ V, $E_{bb} = 250$ V, $R_p = 1$ megohm, $E_c = -30$ V)		0.03 mA
Negative Grid Current ($E_f = 6.3$ V, $E_b = 250$ V, $E_c = -8.5$ V, $R_c = 0.1$ megohm)		0.1 μA
Insulation Resistance between Two Arbitrary Electrodes ($V = 250$ V)	100	megohms
Heater to Cathode Current ($E_f = 6.3$ V, $E_{kf} = 180$ V, $R = 1$ megohm, cathode positive)		15 μA

NOTES

1 Maximum pulse time, 10 microseconds; duty cycle, 1.0%

2 Do not use these values for a normal operation.

7316

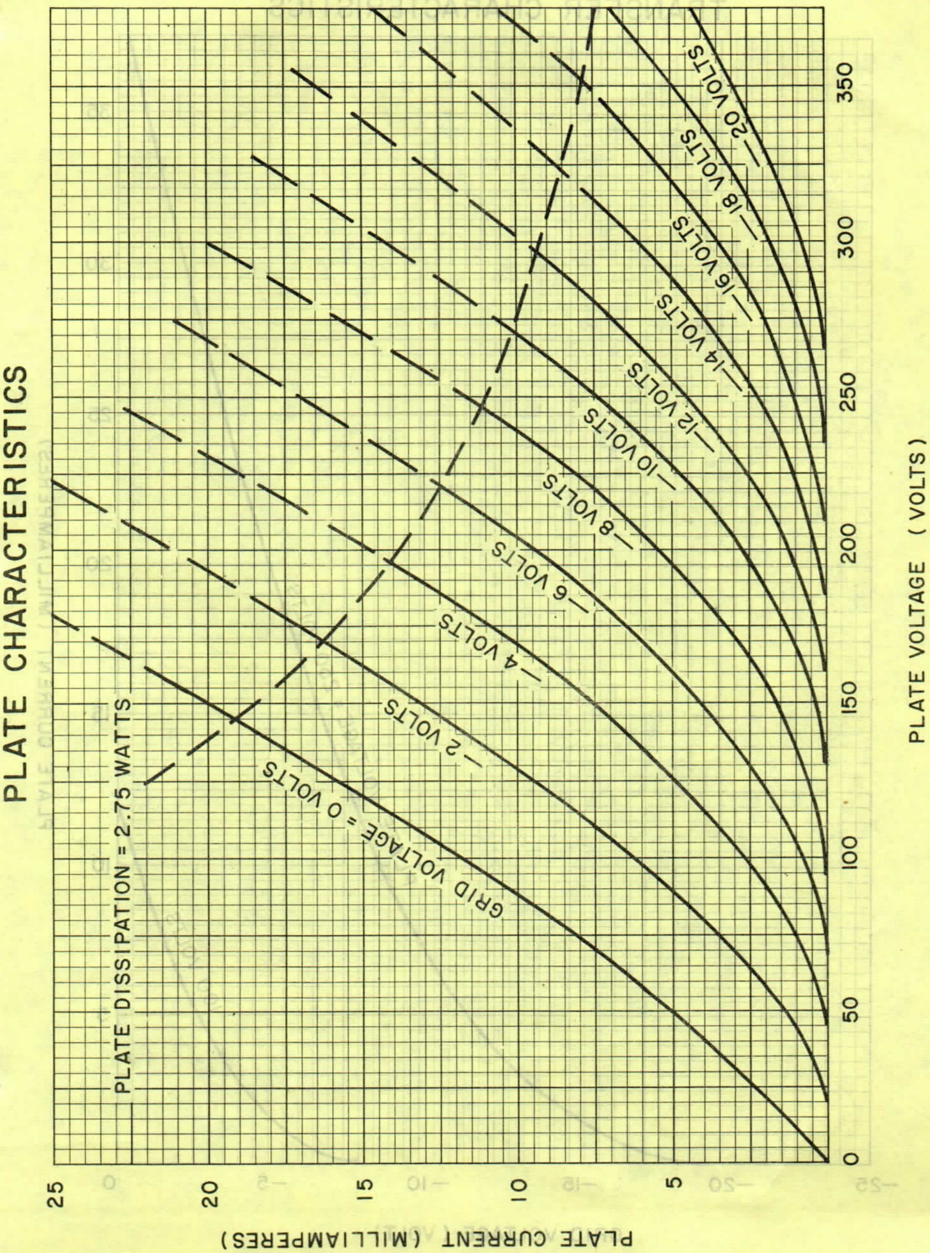
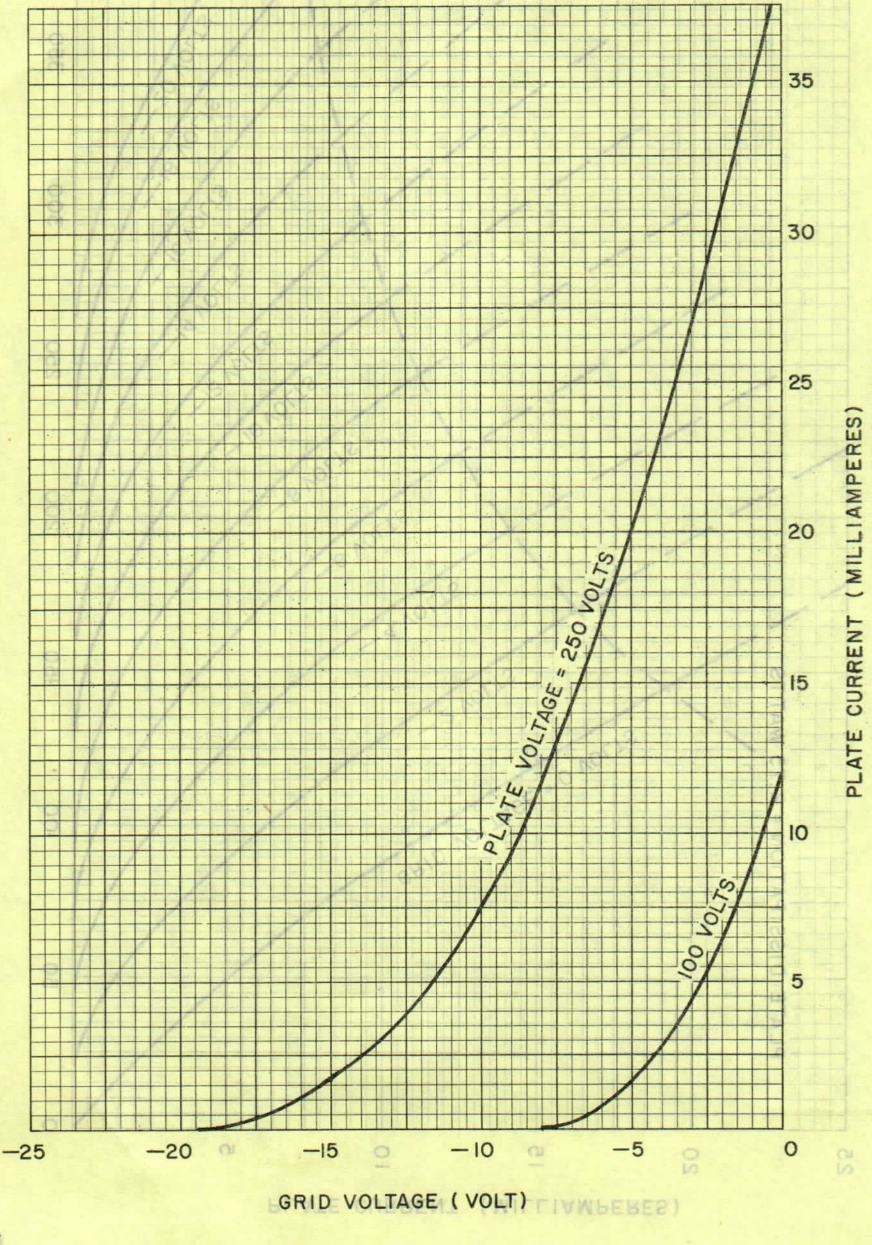


PLATE CHARACTERISTICS
PLATE DISSIPATION = 2.75 WATTS
GRID VOLTAGE = 0 VOLTS
-2 VOLTS
-4 VOLTS
-6 VOLTS
-8 VOLTS
-10 VOLTS
-12 VOLTS
-14 VOLTS
-16 VOLTS
-18 VOLTS
-20 VOLTS
0
50
100
150
200
250
300
350
PLATE VOLTAGE (VOLTS)
5
10
15
20
25
PLATE CURRENT (MILLIAMPERES)

7316

TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 7320

The Amperex 7320 is an output pentode designed for application in medium power Hi-Fi amplifiers. A pair of tubes in Class AB, push-pull conventional operation yields an output of up to 17 watts at 4% distortion (without feedback). In single-ended operation a power output of 5.7 watts can be obtained.

The true pentode characterisitcs of this tube reduce distortion at low instantaneous plate voltages which allow larger A.C. swings and increased undistorted output as compared with beam power tubes in the same power class.

The 7320 is one of the Amperex "Premium Quality, 10,000 Hour" tubes. It is a Premium Quality replacement for the 6BQ5.

GENERAL CHARACTERISTICS

MECHANICAL

Base	Small Button, 9 pin, RETMA #9CV
Max. Overall Length	3-1/16 inches
Max. Seated Height	2-13/16 inches
Max. Diameter	7/8 inch
Mounting Position	any

ELECTRICAL

Cathode	coated unipotential
Heater Voltage	6.3 volts
Heater Current	0.76 amps

Direct Interelectrode Capacitances

Grid No. 1 to all elements except plate	10.8 $\mu\mu$f
Plate to all other elements except Grid No. 1	6.5 $\mu\mu$f
Plate to Grid No. 1	0.5 $\mu\mu$f
Grid No. 1 to heater	0.25 $\mu\mu$f

Characteristics

Plate Voltage	250 volts
Grid No. 2 Voltage	250 volts
Plate Current	48 mA
Grid No. 2 Current	5.5 mA
Grid No. 1 Voltage	-7.3 volts
Transconductance	11,300 micromhos
Plate Resistance	40 KΩ
Amplification Factor (Grid No. 1 to Grid No. 2)	19.5

MAXIMUM RATINGS (Design Center)

Plate Voltage	300 volts
Plate Dissipation	12 watts
Grid No. 2 Voltage	300 volts
Grid No. 2 Dissipation (zero signal)	2.0 watts
Grid No. 2 Dissipation (max. signal)	4.0 watts
Cathode Current	65 mA
Grid Resistance (cathode bias)	1.0 MΩ
Grid Resistance (fixed bias)	300 KΩ
Filament to Cathode Voltage	100 volts

7320

Operating Conditions - Class A - One Tube

Plate Voltage	250	250	250	250	volts
Screen Grid Voltage	250	250	250	210	volts
Plate Load Resistance	5.2	4.5	7.0	7.0	KΩ
Cathode Resistance	135	135	210	160	Ω
Grid No. 1 Voltage	−7.3	−7.3	−8.4	−6.4	volts
Plate Current (zero signal)	48	48	36	36	mA
Plate Current (max. signal)	49.5	50.6	36.8	36.6	mA
Grid No. 2 Current (zero signal)	5.5	5.5	4.1	3.9	mA
Grid No. 2 Current (max. signal)	10.8	10.0	8.5	7.3	mA
Input (rms) Signal Voltage	4.3	4.4	3.5	3.4	volts rms.
Power Output	5.7	5.7	4.2	4.3	watts
Total Distortion (measured with fixed grid bias)	10	10	10	10	%

Operating Conditions - Class AB - Two Tubes, Push-Pull

Plate Voltage	250	300	volts
Grid No. 2 Voltage	250	300	volts
Common Cathode Resistance	130	130	Ω
Plate to Plate Load Resistance	8.0	8.0	KΩ
Plate Current (zero signal)	2x31	2x36	mA
Plate Current (max. signal)	2x37.5	2x46	mA
Grid No. 2 Current (zero signal)	2x3.5	2x4.0	mA
Grid No. 2 Current (max. signal)	2x7.5	2x11	mA
Input Signal Voltage (rms)	8	10	volts
Power Output	11	17	watts
Percent Distortion	3.0	4.0	%

Operating Conditions - Class B - Two Tubes, Push-Pull

Plate Voltage	250	300	volts
Grid No. 2 Voltage	250	300	volts
Grid No. 1 Voltage	−11.6	−14.7	volts
Plate to Plate Load Resistance	8.0	8.0	KΩ
Plate Current (zero signal)	2x10	2x7.5	mA
Plate Current (max. signal)	2x37.5	2x46	mA
Grid No. 2 Current (zero signal)	2x1.1	2x0.8	mA
Grid No. 2 Current (max. signal)	2x7.5	2x11	mA
Input Signal Voltage (rms)	8	10	volts (rms)
Power Output	11	17	watts
Percent Distortion	3.0	4.0	%

Class A - Triode Operation

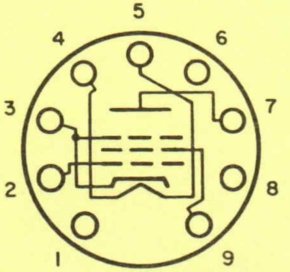
(Screen grid connected to plate)

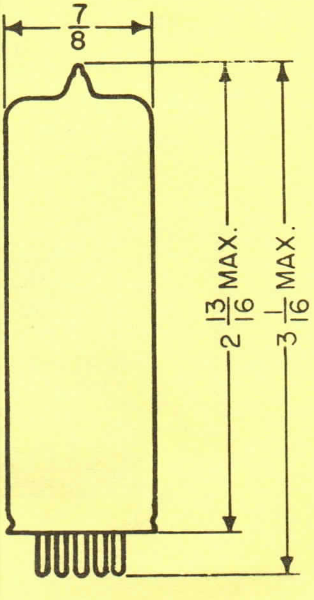
Plate Voltage	250 volts
Common Cathode Resistance	270 Ω
Plate Load Resistance	3.5 KΩ
Plate Current (zero signal)	34 mA
Plate Current (max. signal)	36 mA
Input Signal Voltage (rms)	6.7 volts (rms)
Power Output	1.95 watts
Percent Distortion	9.0 %

Class AB - Triode Operation

(Two tubes, push-pull. Screen grid connected to plate)

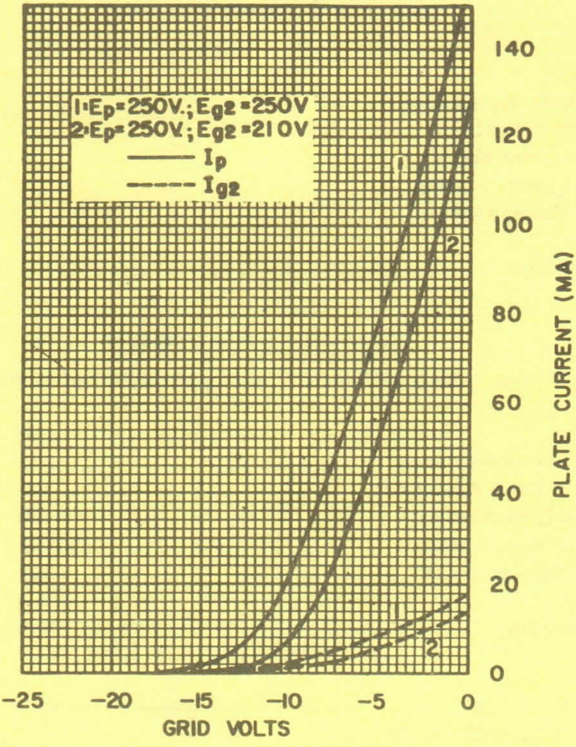
Plate Voltage	250	300	volts
Common Cathode Resistance	270	270	Ω
Plate to Plate Load Resistance	10	10	KΩ
Plate Current (zero signal)	2x20	2x24	mA
Plate Current (max. signal)	2x21.7	2x26.0	mA
Input Signal Voltage (rms)	8.3	10	volts (rms)
Power Output	3.4	5.2	watts
Percent Distortion	2.5	2.5	%





PIN CONNECTIONS

PIN. NO.	ELEMENT
1. —	INTERNALLY CONNECTED
2. —	GRID NO. 1.
3. —	CATHODE AND GRID NO. 3.
4. —	FILAMENT
5. —	FILAMENT
6. —	INTERNALLY CONNECTED
7. —	ANODE
8. —	INTERNALLY CONNECTED
9. —	GRID NO. 2.


1-Ep=250V.; Eg2=250V
2-Ep=250V.; Eg2=210V
Ip
Ig2
1
2
1
2
140
120
100
80
60
40
20
0
PLATE CURRENT (MA)
-25
-20
-15
-10
-5
0
GRID VOLTS

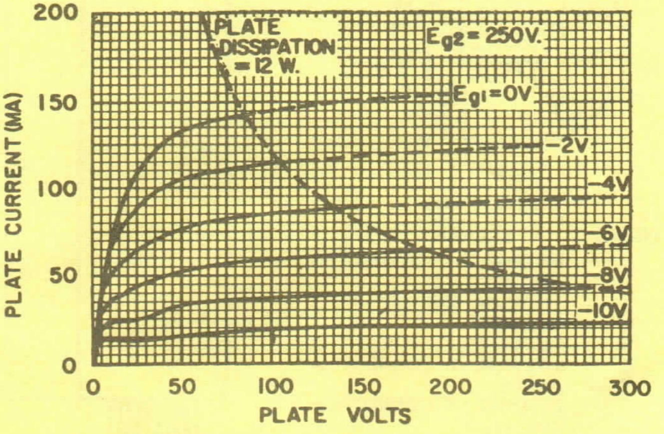


PLATE DISSIPATION =12 W.
Eg2=250V.
Eg1=0V
-2V
-4V
-6V
-8V
-10V
200
150
100
50
0
PLATE CURRENT (MA)
0
50
100
150
200
250
300
PLATE VOLTS

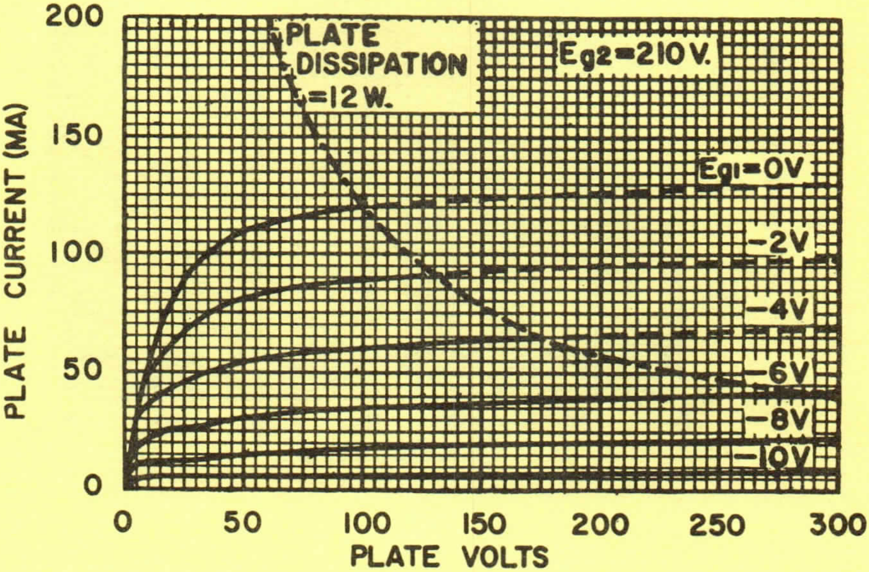
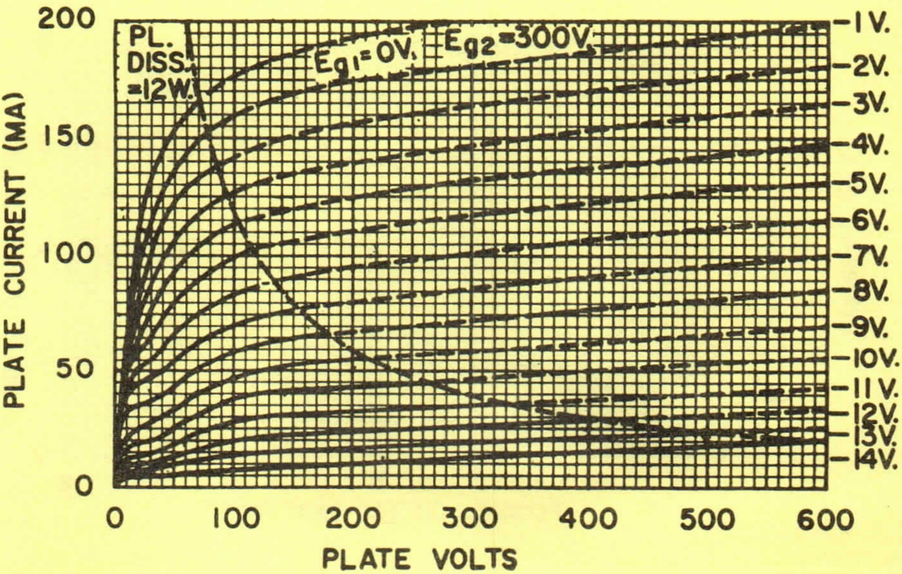
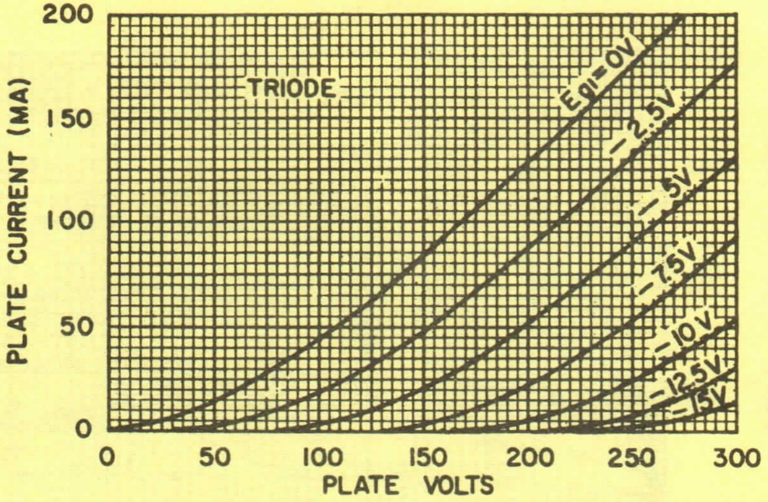
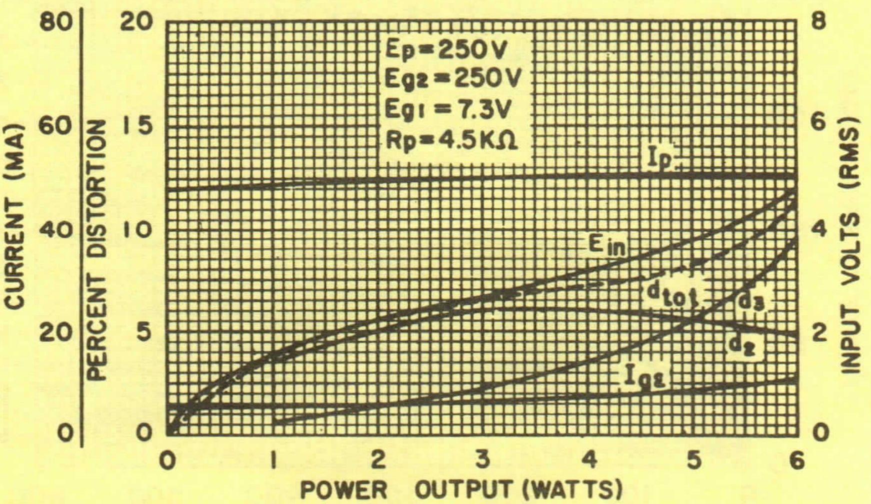


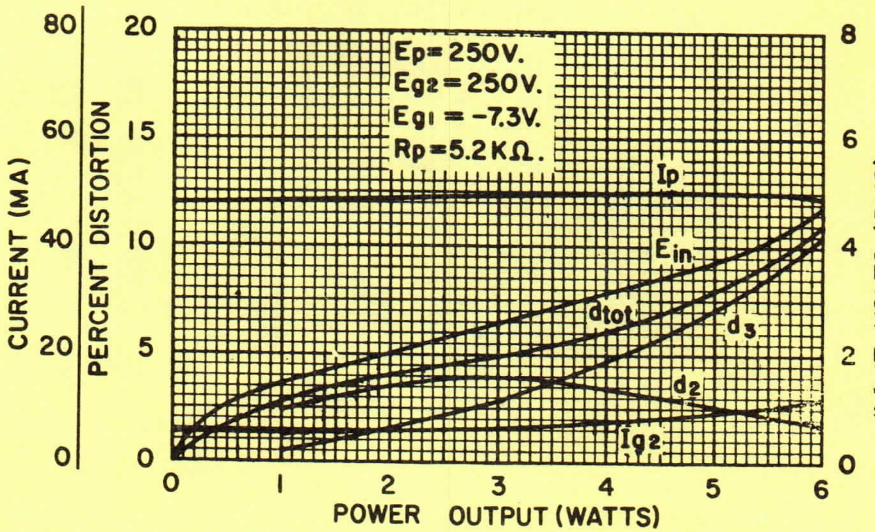
PLATE DISSIPATION =12 W.
Eg2=210V.
Eg1=0V
-2V
-4V
-6V
-8V
-10V
PLATE CURRENT (MA)
200
150
100
50
0
0
50
100
150
200
250
300
PLATE VOLTS

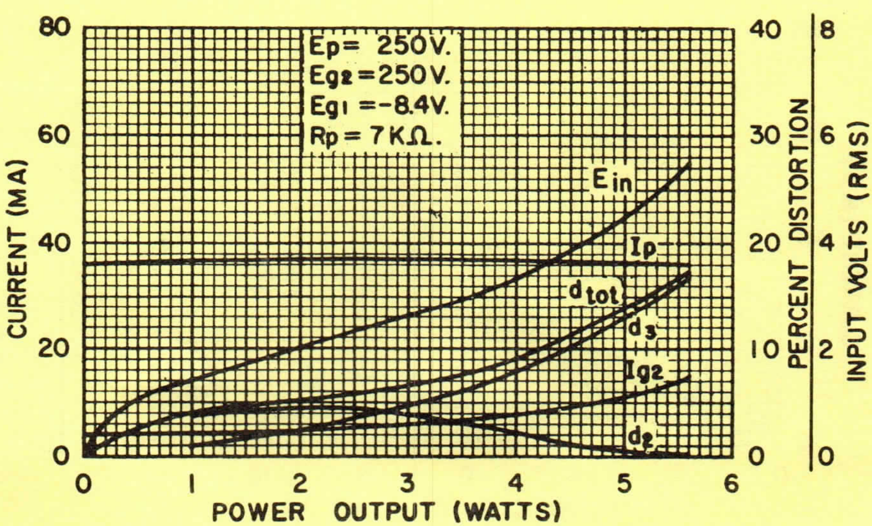

PL. DISS. =12W.
Eg1=0V.
Eg2=300V.
-1V.
-2V.
-3V.
-4V.
-5V.
-6V.
-7V.
-8V.
-9V.
-10V.
-11V.
-12V.
-13V.
-14V.
PLATE CURRENT (MA)
200
150
100
50
0
0
100
200
300
400
500
600
PLATE VOLTS

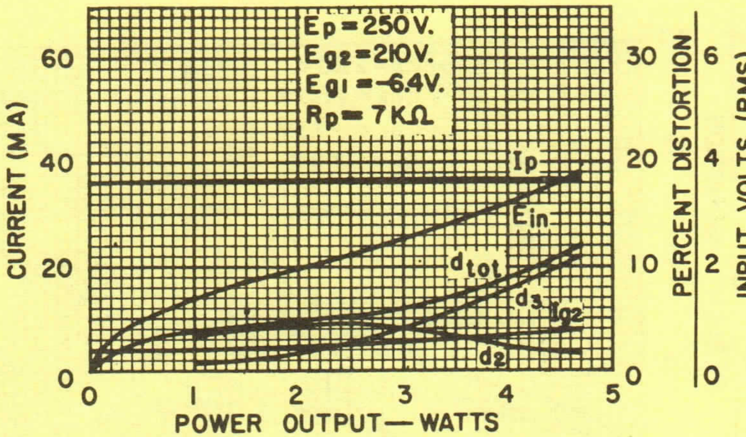
7320

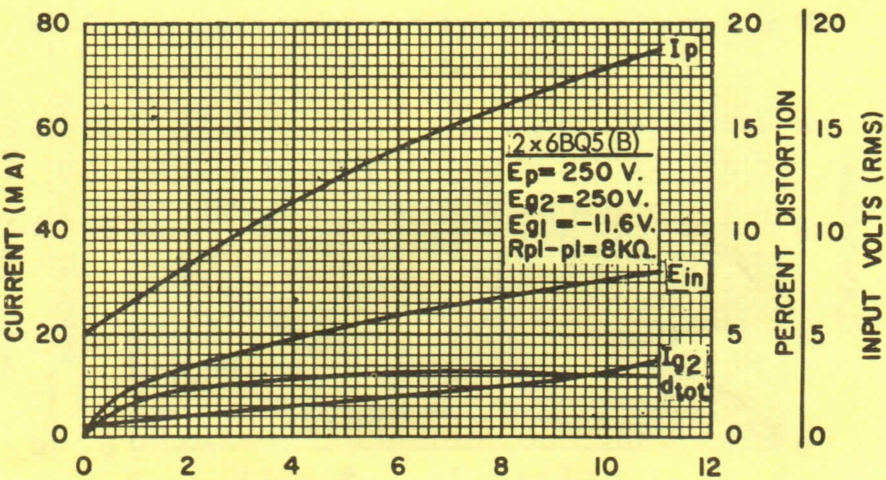

TRIODE
E_{g1}=0V
−2.5V
−5V
−7.5V
−10V
−12.5V
−15V
PLATE CURRENT (MA)
200
150
100
50
0
0
50
100
150
200
250
300
PLATE VOLTS

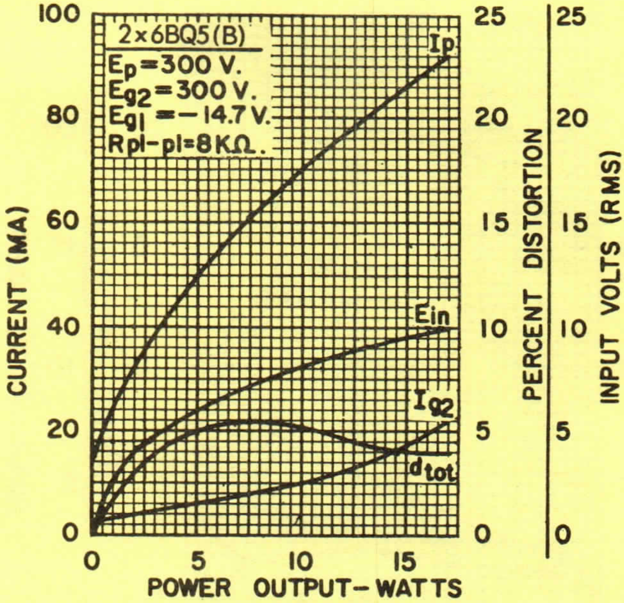

Ep = 250V
Eg2 = 250V
Eg1 = 7.3V
Rp = 4.5KΩ
Ip
Ein
dtot
d3
d2
Ig2
CURRENT (MA)
80
60
40
20
0
PERCENT DISTORTION
20
15
10
5
0
INPUT VOLTS (RMS)
8
6
4
2
0
0
1
2
3
4
5
6
POWER OUTPUT (WATTS)

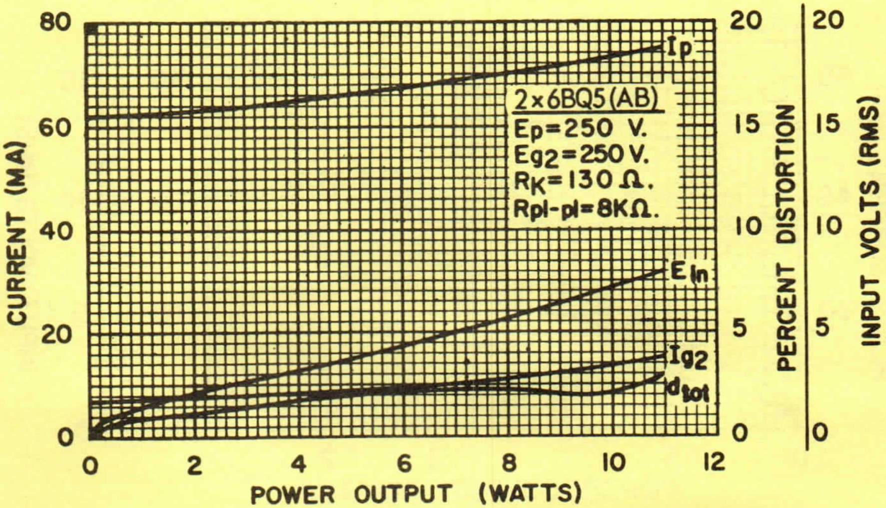

Ep= 250V.
Eg2 = 250V.
Eg1 = -7.3V.
Rp = 5.2 KΩ.
Ip
Ein
dtot
d3
d2
Ig2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)


Ep= 250V.
Eg2 = 250V.
Eg1 = -8.4V.
Rp = 7 KΩ.
Ein
Ip
dtot
d3
Ig2
d2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)

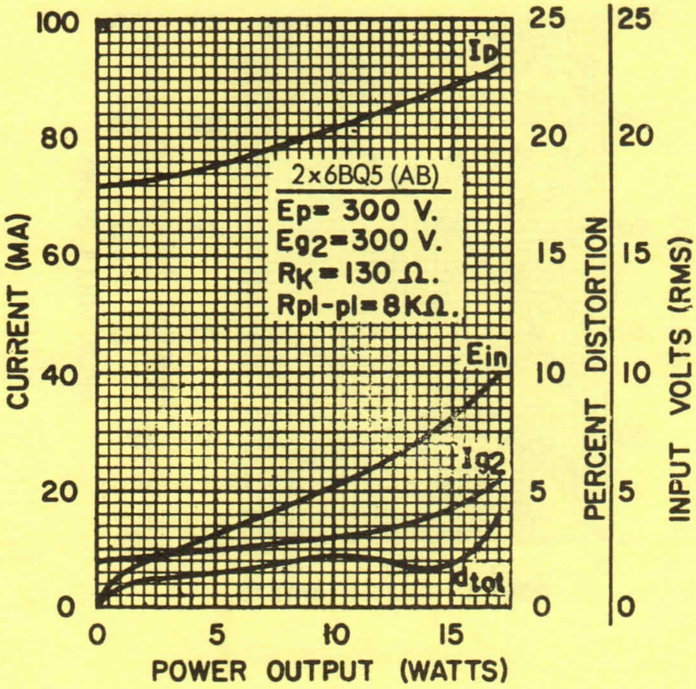

Ep=250V.
Eg2=210V.
Eg1=-6.4V.
Rp=7KΩ
Ip
Ein
dtot
d3
Ig2
d2
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT—WATTS


2×6BQ5(B)
Ep=250 V.
Eg2=250V.
Eg1=-11.6V.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT — WATTS

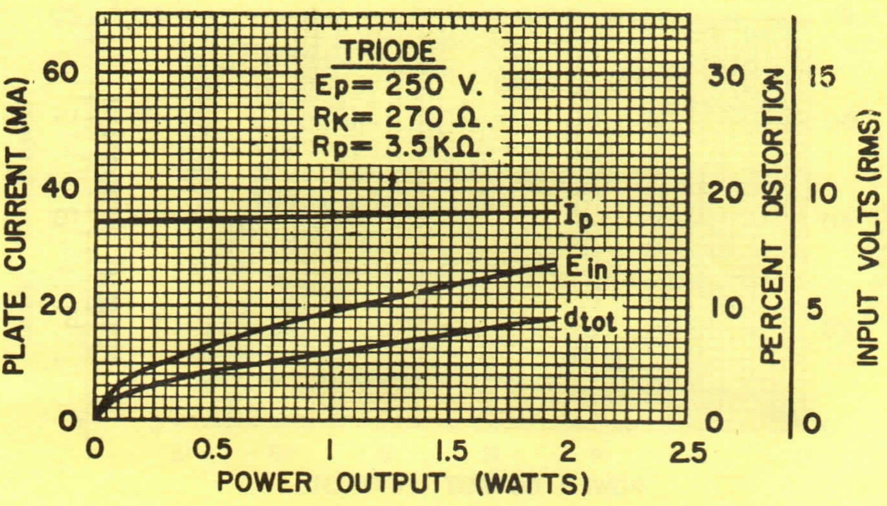

2×6BQ5(B)
Ep=300 V.
Eg2=300 V.
Eg1=−14.7 V.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT—WATTS
0
5
10
15
20
40
60
80
100
25


2×6BQ5(AB)
Ep=250 V.
Eg2=250 V.
RK=130 Ω.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
2
4
6
8
10
12
5
15
20
40
60
80

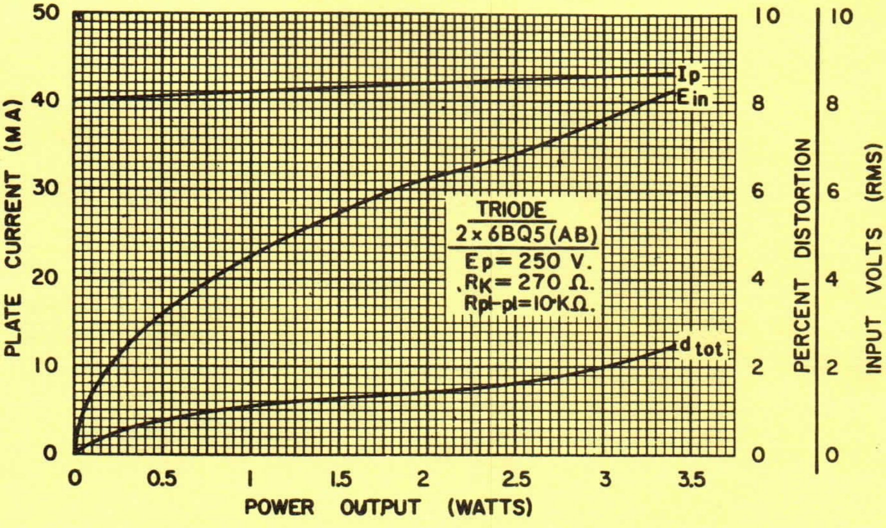
7320

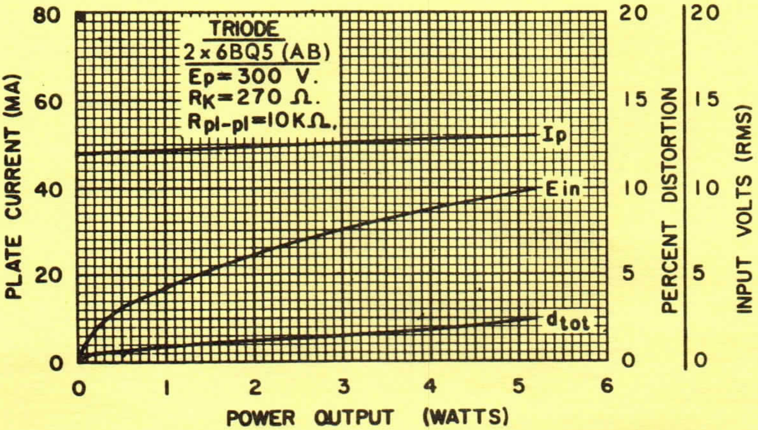


2×6BQ5 (AB)
Ep= 300 V.
Eg2=300 V.
RK=130 Ω.
Rpl-pl=8KΩ.
Ip
Ein
Ig2
dtot
CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
100
80
60
40
20
0
25
20
15
10
5
0
0
5
10
15



TRIODE
Ep= 250 V.
RK= 270 Ω.
Rp= 3.5KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
60
40
20
0
30
20
10
0
15
10
5
0
0
0.5
1
1.5
2
2.5


TRIODE
2 x 6BQ5 (AB)
Ep = 250 V.
RK = 270 Ω.
Rpl-pl = 10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
0.5
1
1.5
2
2.5
3
3.5
10
20
30
40
50
2
4
6
8


TRIODE
2 x 6BQ5 (AB)
Ep = 300 V.
RK = 270 Ω.
Rpl-pl = 10 KΩ.
Ip
Ein
dtot
PLATE CURRENT (MA)
PERCENT DISTORTION
INPUT VOLTS (RMS)
POWER OUTPUT (WATTS)
0
1
2
3
4
5
6
20
40
60
80
15

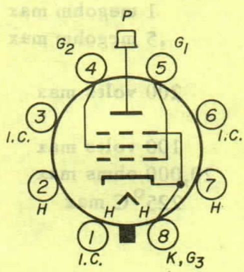
AMPEREX TUBE TYPE 7534

TENTATIVE DATA

The Amperex 7534 is a high transconductance output pentode designed for use as a wide-band amplifier, as a cathode follower, as a series stabilizer in electronic power supplies or as an output tube in class B push-pull circuits.

The 7534 contains two frame grids, one as control grid and one as screen grid. This modern construction makes a transconductance of 25,000 micromhos possible at the unusually low screen-grid current of 4 mA.

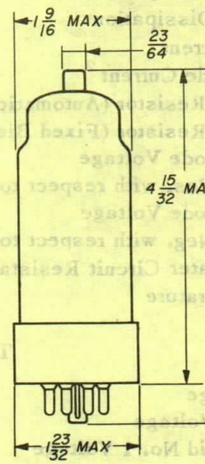
This tube is one of the Amperex "Premium Quality 10,000 Hour" tubes.



PIN CONNECTION

1- INTERNAL CONNECTION
2- HEATER
3- INTERNAL CONNECTION
4- GRID NO. 2
5- GRID NO. 1
6- INTERNAL CONNECTION
7- HEATER
8- CATHODE, GRID NO. 3

TOP CAP - PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base	octal
Mounting Position	any
Dimensions	see outline drawing

ELECTRICAL

Heating	parallel supply
Heater Voltage	6.3 volts
Heater Current	1.7 amps

Direct Interelectrode Capacitances

Input	35 $\mu\mu$f
Output	17 $\mu\mu$f
Plate to Grid No. 1	2 $\mu\mu$f max
Transconductance	25,000 micromhos
Amplification Factor, Grid No. 2 to Grid No. 1	6.5
Internal Plate Resistance	10,000 ohms

7534

Maximum Ratings, Absolute Values

Plate Voltage (Zero Current)	2000 volts max
Plate Voltage	900 volts max
Peak Plate Voltage [1]	6000 volts max
Grid No. 2 Voltage (Zero Current)	550 volts max
Grid No. 2 Voltage	250 volts max
Negative Grid No. 1 Voltage	150 volts max
Plate Dissipation	27.5 watts max
Grid No. 2 Dissipation	5.0 watts max
Grid No. 1 Dissipation	0.1 watts max
Cathode Current	300 mA max
Peak Cathode Current [2]	1.5 amps max
Series Grid Resistor (Automatic Bias)	1 megohm max
Series Grid Resistor (Fixed Bias)	.5 megohm max
Heater-Cathode Voltage (Cathode Pos. with respect to Heater)	200 volts max
Heater-Cathode Voltage (Cathode Neg. with respect to Heater)	100 volts max
Cathode-Heater Circuit Resistance	20,000 ohms max
Bulb Temperature	225°C max

Typical Operation

Plate Voltage	250 volts
Grid No. 2 Voltage	150 volts
Negative Grid No. 1 Voltage	15.5 volts
Plate Current	100 mA
Grid No. 2 Current	4 mA
Grid No. 1 Voltage for Plate Current = 1 mA	30 volts

---

1 Maximum pulse duration 18% of a cycle with a maximum of 18 microseconds.

2 Maximum pulse duration 10% of a cycle with a maximum of 4 milliseconds.

Push-Pull - Class B
(Two Tubes)

Typical Operation

Plate Voltage		300	volts
Grid No. 2 Voltage		150	volts
Negative Grid No. 1 Voltage		17	volts
Load Resistance (Plate to Plate)		1600	ohms
Input Voltage	0	0.245	9 volts rms
Plate Current	2x80	-	2x180 mA
Grid No. 2 Current	2x2.5	-	2x22 mA
Output Power	0	0.05	60 watts
Total Harmonic Distortion			5 %

End of Life [3]

The end of life is reached when one or more of the characteristics given below have changed to the indicated values:

Plate Current	< 60 mA
Transconductance	< 17,500 micromhos
Negative Grid No. 1 Current	>1 μA

Shock and Vibration Resistance

The tube can withstand during short time vibrational forces of 2.5 g at 50 c/s in various directions and impact shocks up to 500 g.

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[3] Conditions of life test are:

Heater Voltage	6.3 volts
Plate Supply Voltage	275 volts
Grid No. 2 Supply Voltage	180 volts
Grid No. 1 Supply Voltage	+ 15 volts
Cathode Resistor	300 ohms
Series Grid Resistor	47,000 ohms
Plate Current	100 mA
Heater-Cathode voltage (Cathode Pos)	220 volts

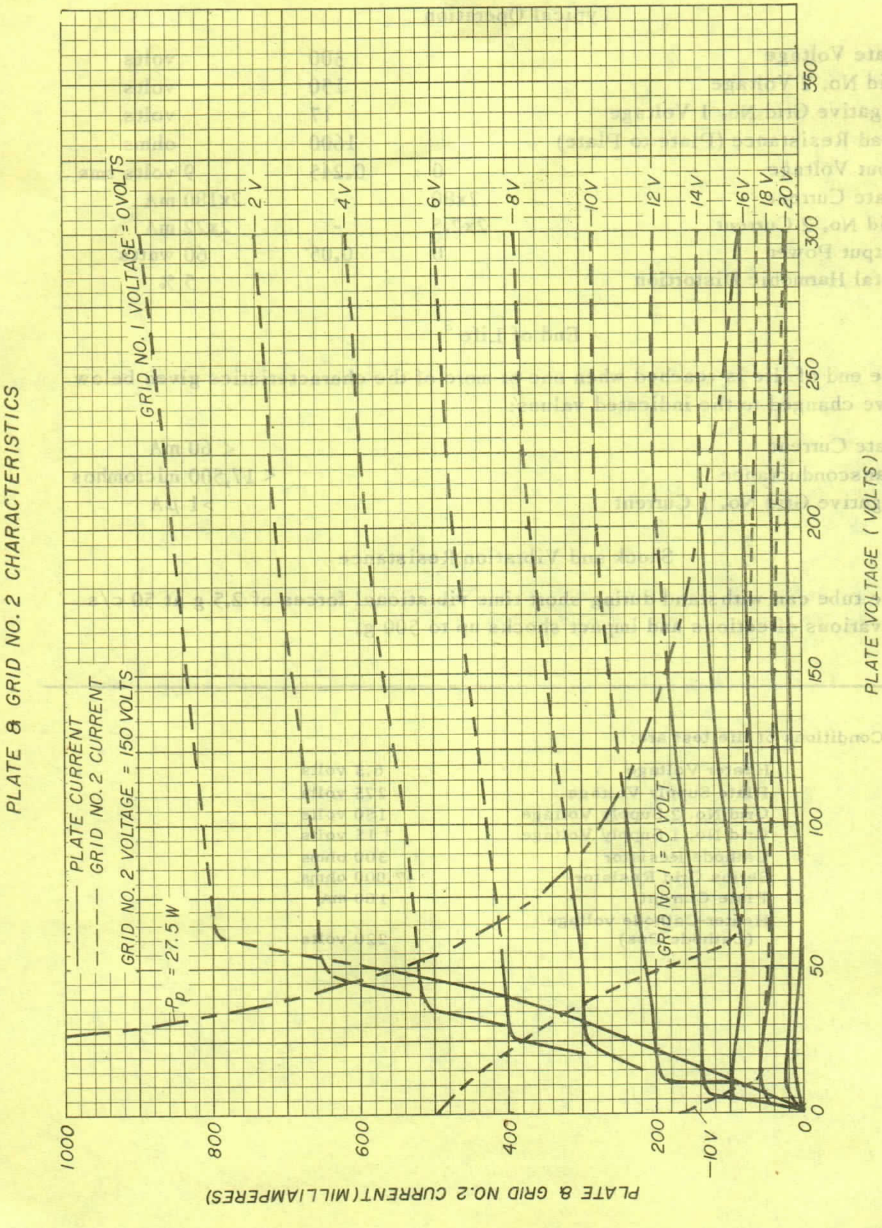
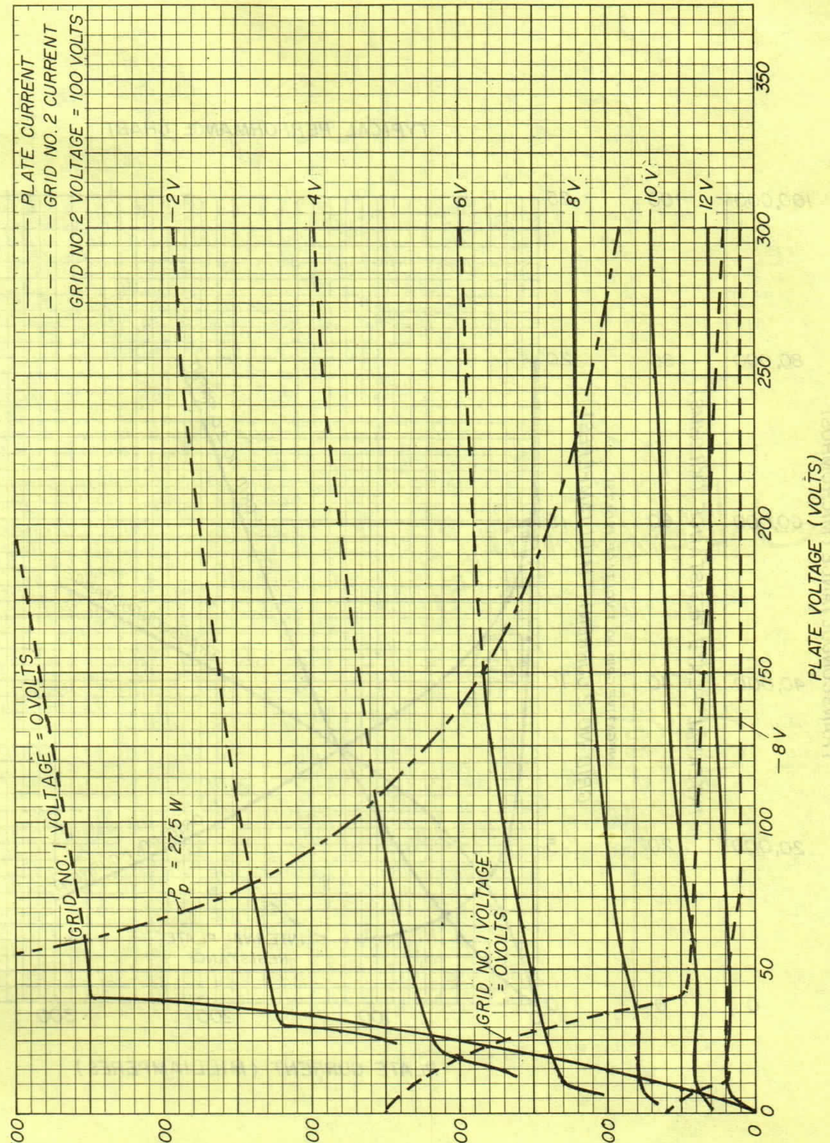
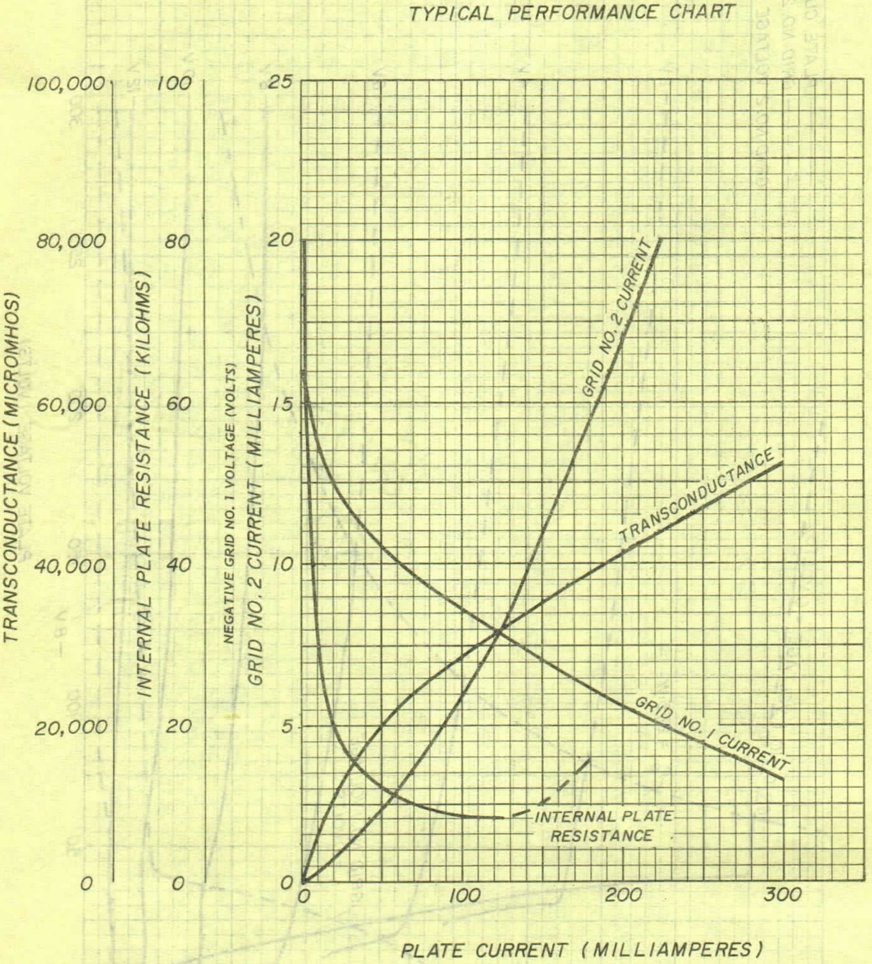
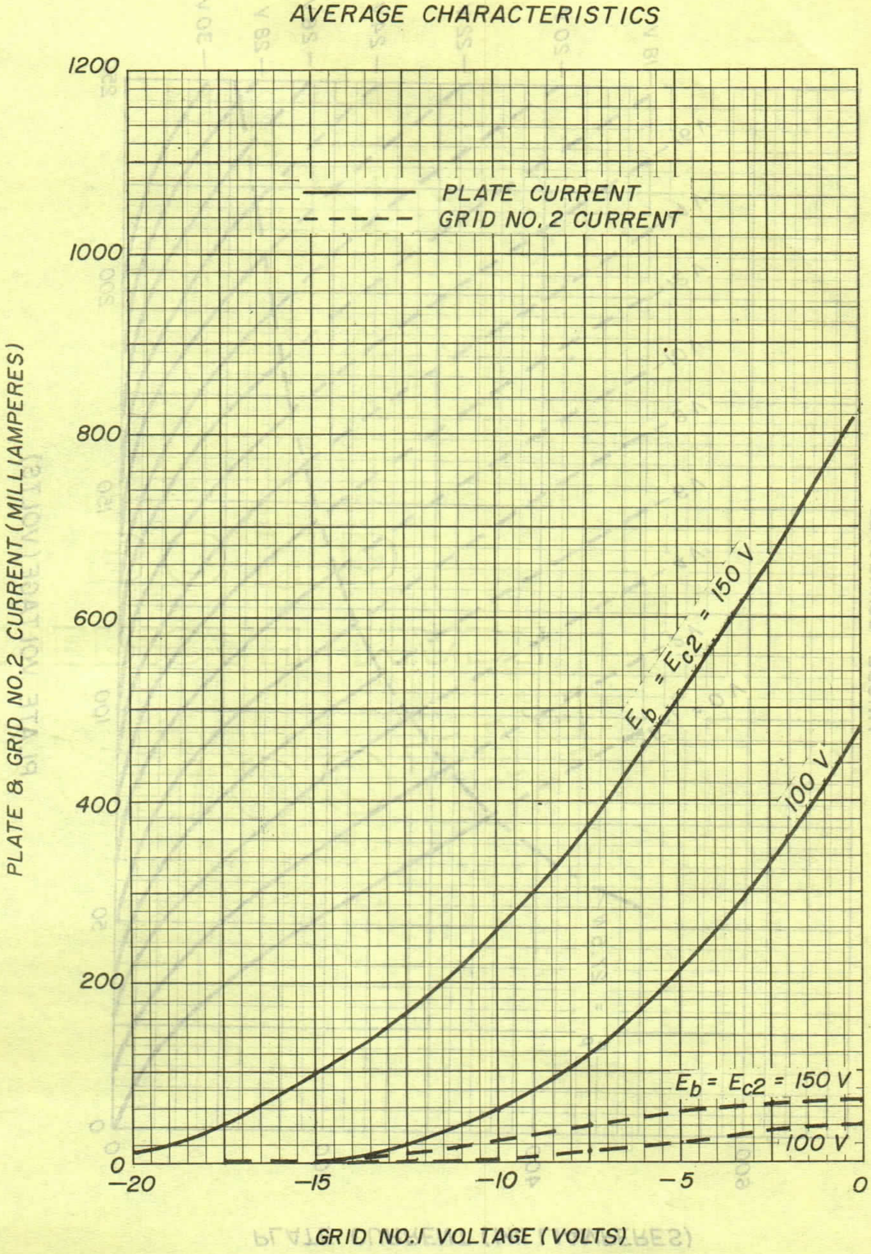


PLATE & GRID NO. 2 CHARACTERISTICS
PLATE CURRENT
GRID NO. 2 CURRENT
GRID NO. 2 VOLTAGE = 150 VOLTS
GRID NO. 1 VOLTAGE = 0 VOLTS
-2 V
-4 V
-6 V
-8 V
-10 V
-12 V
-14 V
-16 V
-18 V
-20 V
P_p = 27.5 W
GRID NO. 1 = 0 VOLT
-10 V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
300
350
PLATE & GRID NO. 2 CURRENT (MILLIAMPERES)
1000
800
600
400
200
0

PLATE & GRID NO. 2 CHARACTERISTICS




TYPICAL PERFORMANCE CHART
TRANSCONDUCTANCE (MICROMHOS)
100,000
80,000
60,000
40,000
20,000
0
INTERNAL PLATE RESISTANCE (KILOHMS)
100
80
60
40
20
0
NEGATIVE GRID NO. 1 VOLTAGE (VOLTS)
GRID NO. 2 CURRENT (MILLIAMPERES)
25
20
15
10
5
0
GRID NO. 2 CURRENT
TRANSCONDUCTANCE
GRID NO. 1 CURRENT
INTERNAL PLATE RESISTANCE
0
100
200
300
PLATE CURRENT (MILLIAMPERES)


AVERAGE CHARACTERISTICS
PLATE CURRENT
GRID NO. 2 CURRENT
$E_b = E_{c2} = 150$ V
100 V
$E_b = E_{c2} = 150$ V
100 V
PLATE & GRID NO.2 CURRENT (MILLIAMPERES)
1200
1000
800
600
400
200
0
−20
−15
−10
−5
0
GRID NO.1 VOLTAGE (VOLTS)

7534

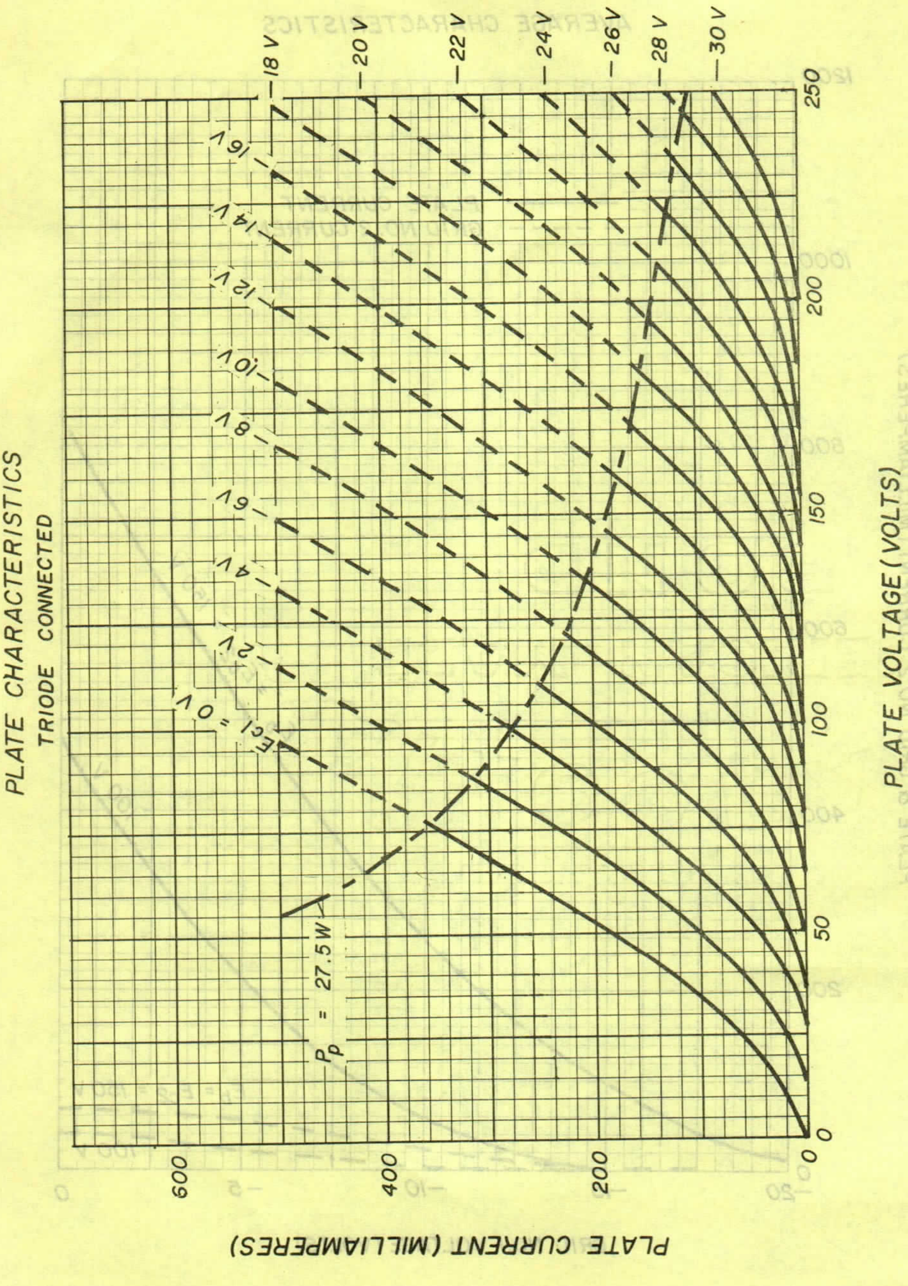


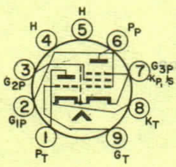
PLATE CHARACTERISTICS
TRIODE CONNECTED
Ec1 = 0 V
2 V
4 V
6 V
8 V
10 V
12 V
14 V
16 V
18 V
20 V
22 V
24 V
26 V
28 V
30 V
Pp = 27.5 W
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
200
400
600

AMPEREX TUBE TYPE 7643

TENTATIVE DATA

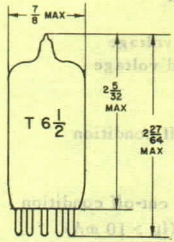
The Amperex 7643 is a premium quality, long life, ruggedized triode-pentode with separate cathode leads. The pentode section is designed for use as a mixer, RF or AF amplifier. The triode section is designed for use as an oscillator up to 300 Mc/s, multivibrator or blocking oscillator.

The 7643 will maintain its emission capabilities after long periods of operation under cut-off conditions.



PIN CONNECTION

1– PLATE, TRIODE
2– GRID NO. 1 PENTODE
3– GRID NO. 2 PENTODE
4– HEATER
5– HEATER
6– PLATE, PENTODE
7– GRID NO. 3 PENTODE CATHODE, PENTODE INTERNAL SHIELD
8– CATHODE, TRIODE
9– GRID, TRIODE



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	T 6½
Base	E9-1
Dimensions	see outline drawing
Mounting position	any

ELECTRICAL

Cathode	unipotential
Heater arrangement	parallel supply
Heater voltage [1]	6.3 volts
Heater current	330 mA

Direct Interelectrode Capacitances

Pentode Section

Control grid (between pins 2 and 3+4+5+7)	5.2 $\mu\mu f$
Plate (between pins 6 and 3+4+5+7)	3.4 $\mu\mu f$
Plate to control grid (between pins 6 and 2)	< 0.025 $\mu\mu f$
Control grid to filament (between pins 2 and 4+5)	< 0.160 $\mu\mu f$

Triode Section

Control grid (between pins 9 and 4+5+7+8)	2.5 $\mu\mu f$
Plate (between pins 1 and 4+5+7+8)	1.5 $\mu\mu f$
Plate to control grid (between pins 1 and 9)	1.5 $\mu\mu f$
Control grid to filament (between pins 9 and 4+5)	< 0.220 $\mu\mu f$

Between Pentode and Triode Sections

Plate to plate (between pins 6 and 1)	< 0.07 $\mu\mu f$
Plate of pentode to grid of triode (between pins 6 and 9)	< 0.02 $\mu\mu f$
Control grid of pentode to plate of triode (between pins 2 and 1)	< 0.16 $\mu\mu f$

Maximum Ratings, Absolute Values

Triode Section

Plate voltage, cut-off condition	550 volts max
Plate voltage	275 volts max
Plate dissipation	1.75 watts max
Peak grid voltage [2]	30 volts max
Grid dissipation	0.1 watts max
Cathode current	18 mA max
Peak cathode current [2]	100 mA max
Grid resistor	0.5 megohms max
Cathode to filament voltage	100 volts max
Negative control grid voltage	100 volts max

Pentode Section

Plate voltage, cut-off condition	550 volts max
Plate voltage	275 volts max
Plate dissipation	2.15 watts max
Screen grid voltage, cut-off condition	550 volts max
Screen grid voltage ($I_k > 10$ mA)	200 volts max
Screen grid voltage ($I_k < 10$ mA)	225 volts max
Screen grid dissipation ($P_p > 1.2$ W)	0.7 watts max
Screen grid dissipation ($P_p < 1.2$ W)	0.8 watts max
Cathode current	18 mA max
Control grid dissipation	0.1 watts max
Control grid resistor (automatic grid bias)	1 megohm max
Control grid resistor (fixed grid bias)	0.5 megohms max
Cathode to filament voltage	100 volts max
Negative control grid voltage	100 volts max
Bulb temperature	170°C max

Typical Operation

Triode Section

Plate supply voltage	100 volts
Cathode resistor	120 ohms
Plate current [3]	14 mA
Transconductance [3]	5000 micromhos
Negative grid current [3]	< 0.3 μA
Amplification factor	18

Pentode Section

Plate supply voltage	170 volts
Screen grid supply voltage	170 volts
Cathode resistor	155 ohms
Plate current [3]	10 mA
Screen grid current	2.8 mA
Transconductance [3]	6200 micromhos
Amplification factor (Grid No. 2 to Grid No. 1)	40
Plate resistance	0.4 megohms
Negative control grid current [3]	< 0.3 μA

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1 In order to obtain a prolonged tube life, the maximum variation of the heater voltage should be less than ±5% (absolute limits).

2 Max pulse duration 4% of a cycle with a max of 0.8 milliseconds.

3 The end point of life is reached when one or more of these characteristics have changed to the following values:

	Pentode	Triode
Plate Current	< 6	< 8.4 mA
Transconductance	< 4300	< 3500 micromhos
Negative control grid voltage	≧ 1	≧ 1 μA

Operating Characteristics
For Use as a Frequency Converter [4]

Plate supply voltage	170 volts
Screen grid supply voltage	170 volts
Input resistance	0.1 megohm
Cathode resistor	330 ohms
Oscillator voltage	3.5 volts rms
Plate current	8 mA
Screen grid current	2.5 mA
Control grid current	12 μA
Conversion conductance	2400 micromhos
Plate resistance	0.5 megohms

Operating Characteristics
Pentode Section
For Use as an RF Amplifier

Plate supply voltage	170 volts
Screen grid supply voltage	170 volts
Cathode resistor	155 ohms
Plate current	10 mA
Screen grid current	2.8 mA
Transconductance	6200 micromhos
Amplification factor (Grid No. 2 to Grid No. 1)	40
Plate resistance	0.4 megohms
Input resistance (f = 50 Mc/s)	10,000 ohms
Equivalent resistance	1500 ohms

Special Ratings

The pentode section of this tube can be used without special precautions against microphonic effect in AF circuits in which the input voltage = 50 mV for an output of 50 mW of the output tube.

Shock Resistance [5]

Shock rating = about 500 g

Forces as applied by the NRL inpact machine for electronic devices caused by 5 blows of the hammer, lifted over an angle of 30° in each of four different positions of the tube.

Vibration Resistance [5]

Vibration rating = 2.5 g

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of 3 positions of the tube.

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[4] Use of the triode in a Colpitts type of circuit and not in a Hartley type is recommended.

[5] These test conditions are only given for evaluation of the ruggedness of the tube. They are by no means to be interpreted as suitable operating conditions.

7643

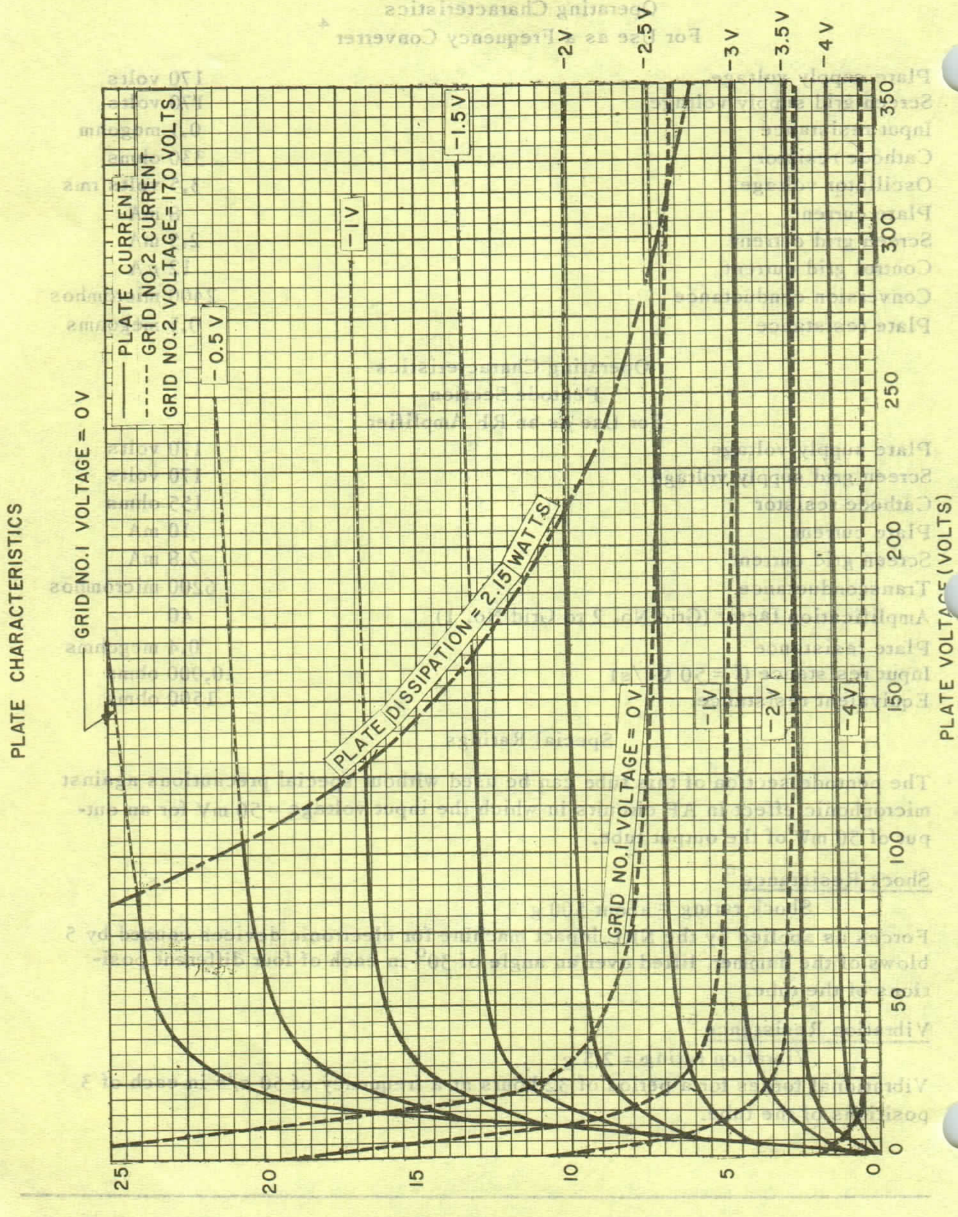
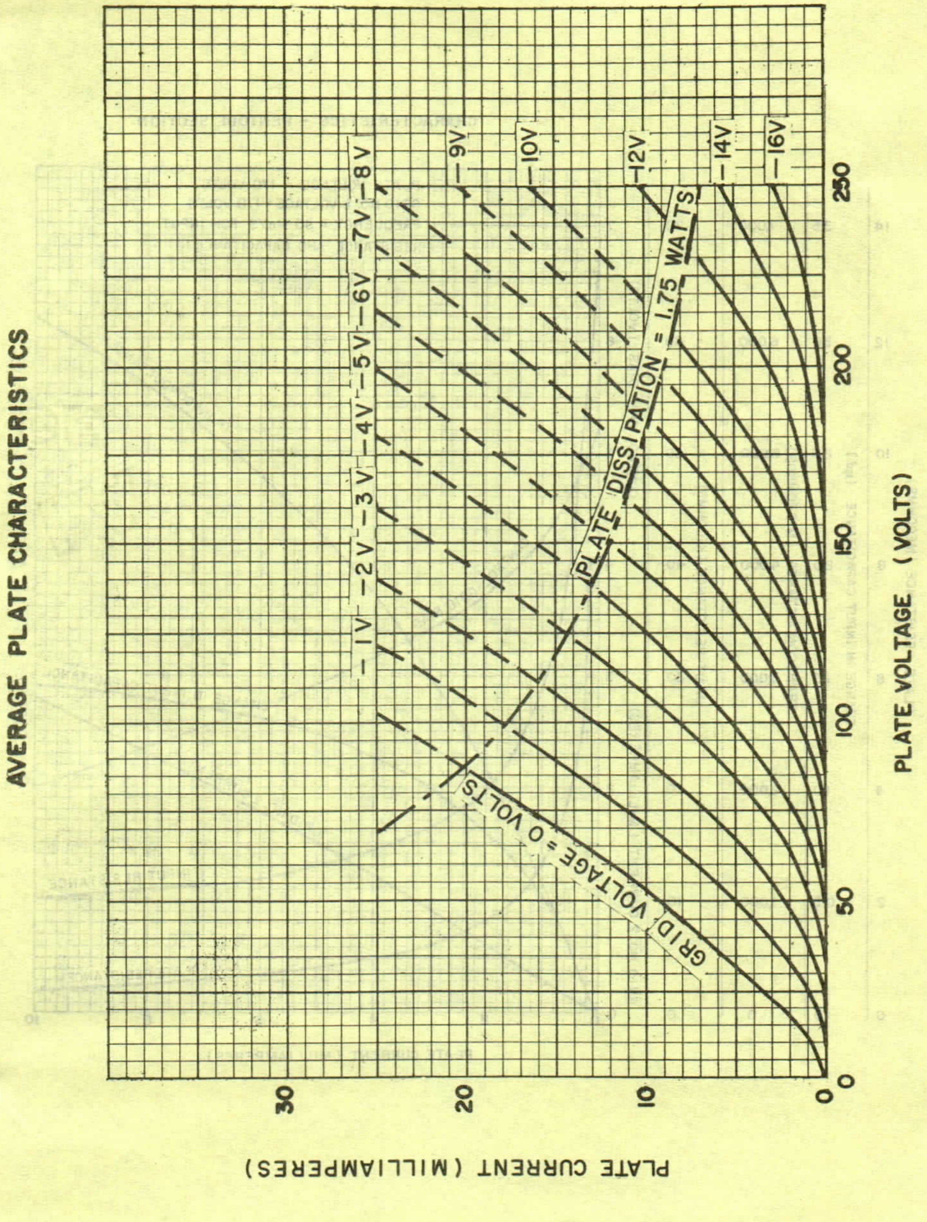
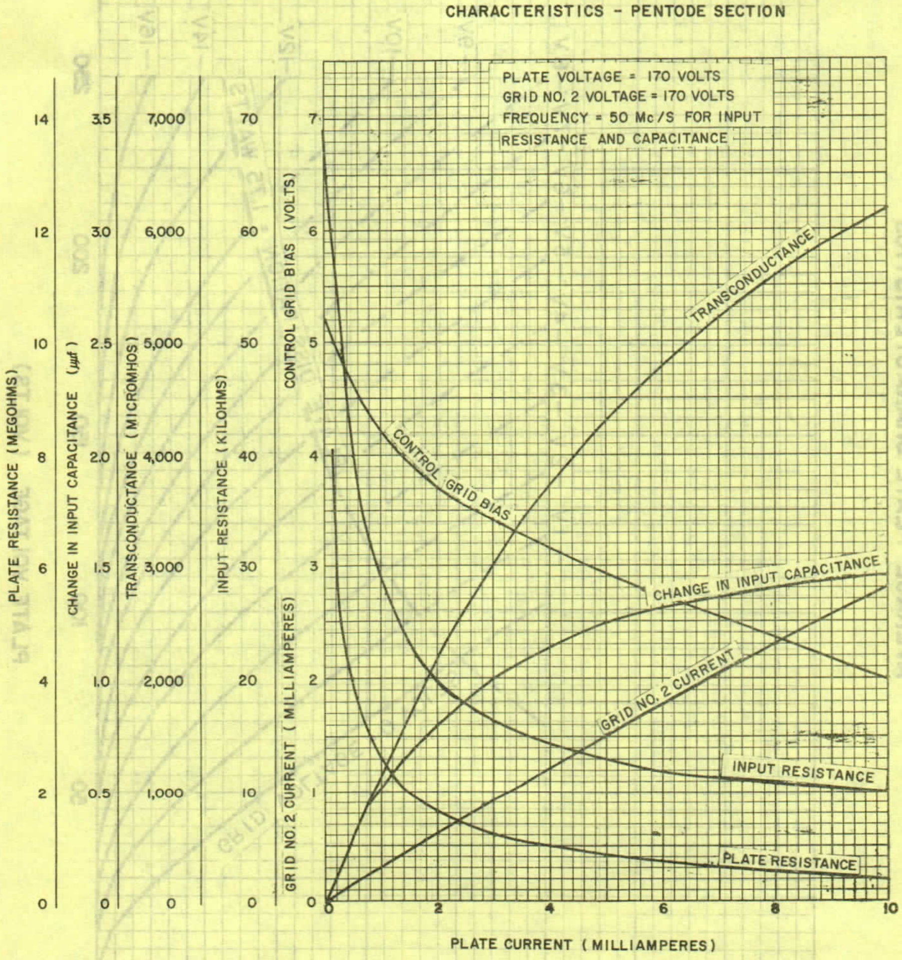
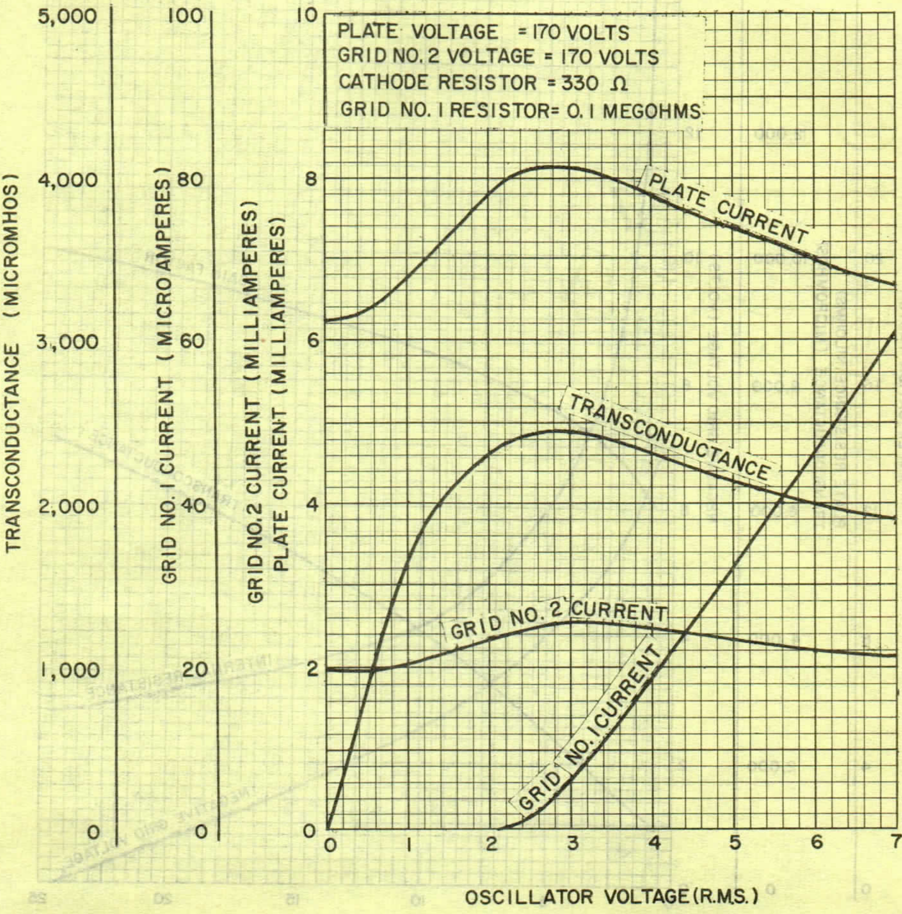


PLATE CHARACTERISTICS
GRID NO.1 VOLTAGE = 0 V
—— PLATE CURRENT
- - - - GRID NO.2 CURRENT
GRID NO.2 VOLTAGE = 170 VOLTS
-0.5 V
-1 V
-1.5 V
-2 V
-2.5 V
-3 V
-3.5 V
-4 V
PLATE DISSIPATION = 2.15 WATTS
GRID NO.1 VOLTAGE = 0 V
-1 V
-2 V
-4 V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
300
350
PLATE CURRENT (MILLIAMPERES)
0
5
10
15
20
25

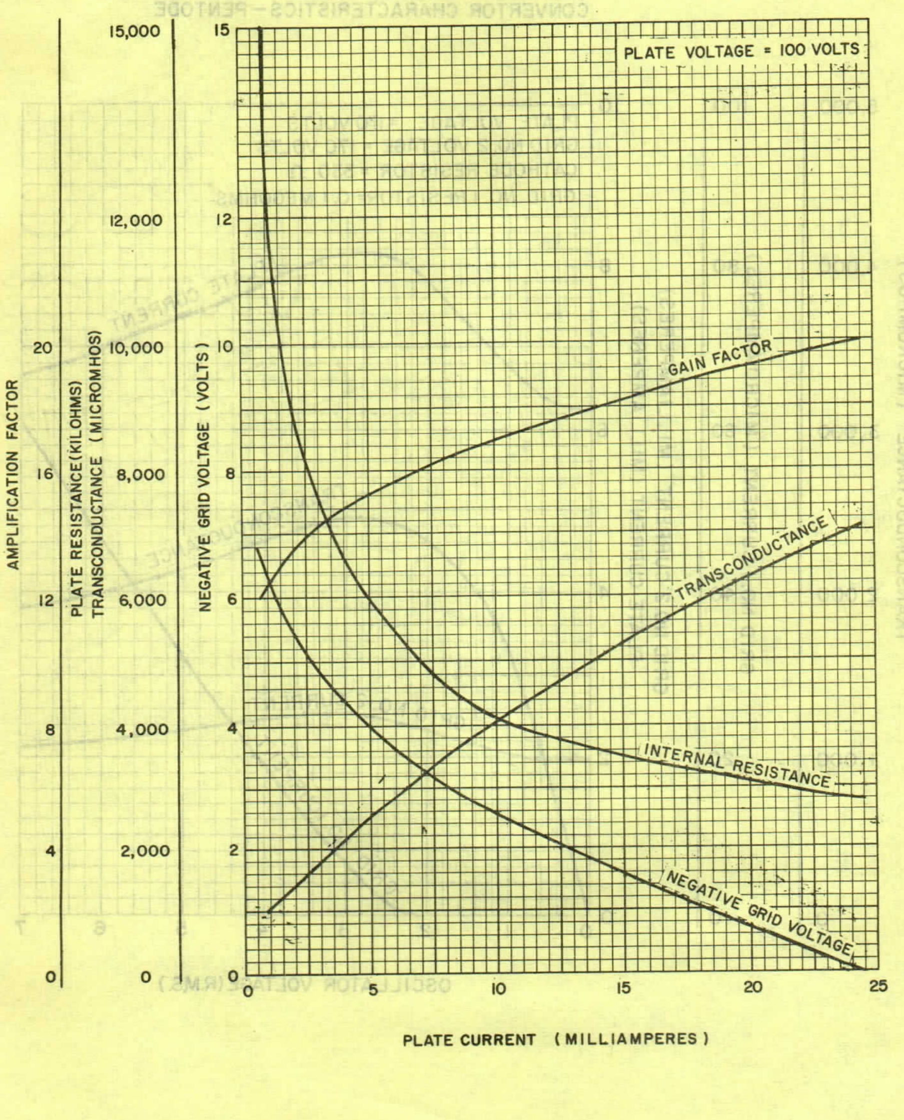

AVERAGE PLATE CHARACTERISTICS
GRID VOLTAGE = 0 VOLTS
—1V
—2V
—3V
—4V
—5V
—6V
—7V
—8V
—9V
—10V
—12V
—14V
—16V
PLATE DISSIPATION = 1.75 WATTS
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
PLATE CURRENT (MILLIAMPERES)
0
10
20
30


CHARACTERISTICS - PENTODE SECTION
PLATE VOLTAGE = 170 VOLTS
GRID NO. 2 VOLTAGE = 170 VOLTS
FREQUENCY = 50 Mc/S FOR INPUT RESISTANCE AND CAPACITANCE
PLATE RESISTANCE (MEGOHMS)
CHANGE IN INPUT CAPACITANCE (μμf)
TRANSCONDUCTANCE (MICROMHOS)
INPUT RESISTANCE (KILOHMS)
CONTROL GRID BIAS (VOLTS)
GRID NO. 2 CURRENT (MILLIAMPERES)
TRANSCONDUCTANCE
CONTROL GRID BIAS
CHANGE IN INPUT CAPACITANCE
GRID NO. 2 CURRENT
INPUT RESISTANCE
PLATE RESISTANCE
PLATE CURRENT (MILLIAMPERES)

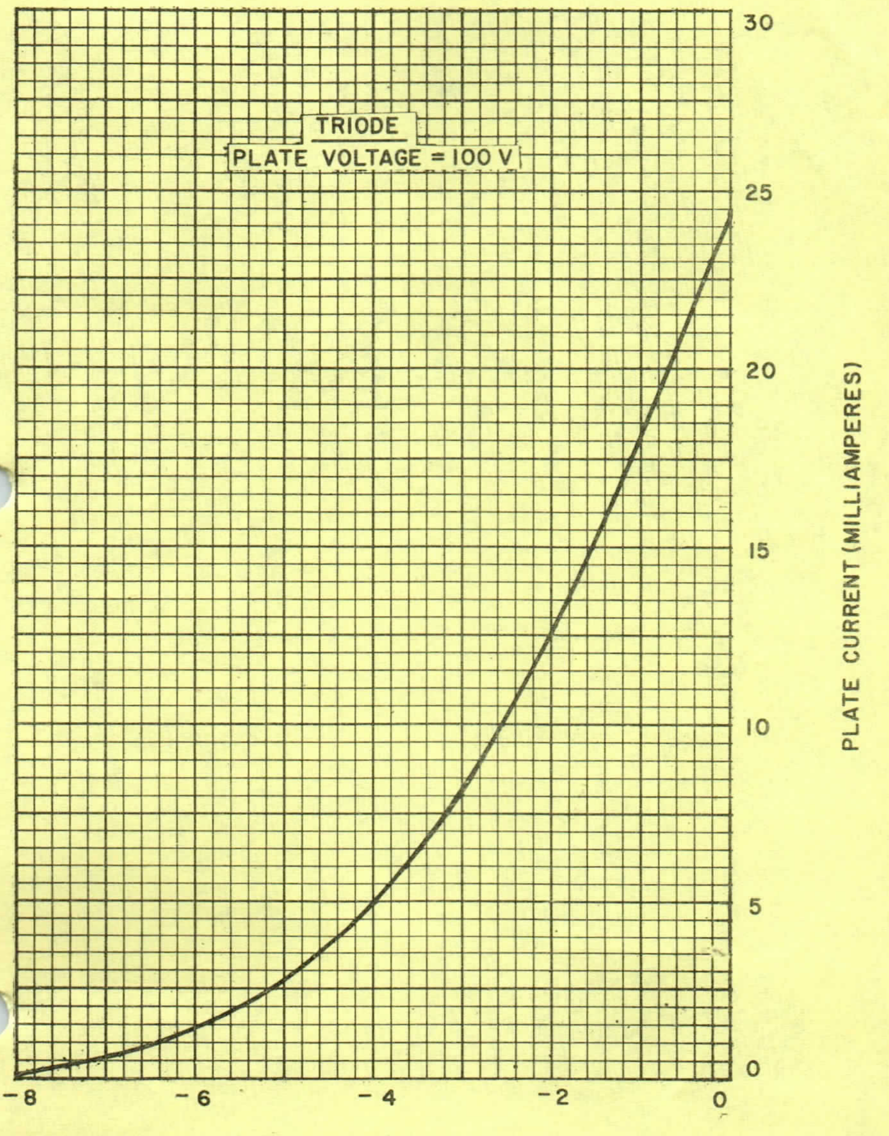
CONVERTOR CHARACTERISTICS—PENTODE



AVERAGE CHARACTERISTICS-TRIODE SECTION



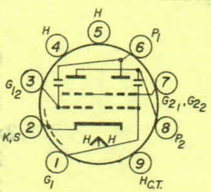
TRANSFER CHARACTERISTICS



AMPEREX TUBE TYPE 7699

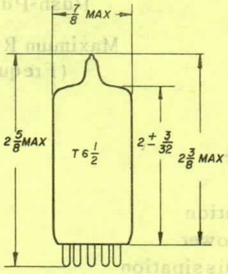
ADVANCE DATA

The Amperex 7699 is a wide band push-pull amplifier tube for application in test instruments, distributed amplifiers and computers. Stability of the Class A characteristics and low cathode interface are important features of this tube. The push-pull construction offers a high gain band width product coupled with low output capacitance. The screen and cathode, common to both halves of the tube, result in high input impedance due to low internal inductance. A high dissipation of 3 W per section enables the tube to drive low load impedances. This tube is not recommended for use in applications requiring operation in the positive grid region.



PIN CONNECTIONS

1 - CONTROL GRID OF UNIT NO. 1
2 - CATHODE & BEAM PLATES
3 - CONTROL GRID OF UNIT NO. 2
4 - HEATER
5 - HEATER
6 - PLATE OF UNIT NO. 1
7 - SCREEN GRID
8 - PLATE OF UNIT NO. 2
9 - HEATER CENTER TAP



6-3

GENERAL CHARACTERISTICS

MECHANICAL

Bulb Temperature	225°C max
Dimensions	see outline drawing
Bulb	T 6½
Outline	6 - 3
Base	Noval, 9 pin, JEDEC E9-1

ELECTRICAL

Cathode: indirectly heated, oxide coated

	Parallel	Series
Heater Voltage	6.3	12.6 volts
Heater Current	0.6	0.3 amps

7699

Direct Interelectrode Capacitances	Each Unit	Both Units Push-Pull
Output	1.6	0.95 μμf
Input	6.4	3.8 μμf
Plate to Grid No. 1 (internally neutralized)	0.15	

Amplification Factor (each unit)	
Grid No. 2 to Grid No. 1	
($E_p = E_{g2} = 150V$; $I_p = 25$ mA)	31
Mutual Conductance (each unit)	
($E_p = E_{g2} = 150V$; $I_p = 25$ mA)	10,500 micromhos

Push-Pull, Class A Amplifier

Maximum Ratings, Absolute Values
(Frequency up to 500 Mc)

	CCS
Plate Voltage	275 volts
Plate Current	2x45 mA
Plate Dissipation	2x3 watts
Plate Input Power	2x3 watts
Screen Grid Dissipation	2x1.25 watts
Control Grid Voltage	– 100 volts
Cathode Current	2x50 mA
Voltage between Cathode and Heater	± 90 volts

Typical Operation, Push-Pull

	CCS	CCS
Plate Voltage	150	200 volts
Screen Grid Voltage	150	150 volts
Effective Load Resistance (Plate to Plate)	10,560	17,400 ohms
Grid No. 1 Voltage	– 3.5	– 3.5 volts
Peak Drive Voltage, Grid to Grid	7	7 volts
Zero Signal Plate Current	2x13.5	2x14 mA
Maximum Signal Plate Current	2x15.8	2x15.8 mA
Zero Signal Screen Current	2x1.8	2x3.0 mA
Maximum Signal Screen Current	2x6.1	2x7.7 mA
Transconductance (per section)	7000	7500 micromhos
Total Distortion	1.0	2.0 %
Tube Power Output	1.75	2.66 watts

PLATE CHARACTERISTICS

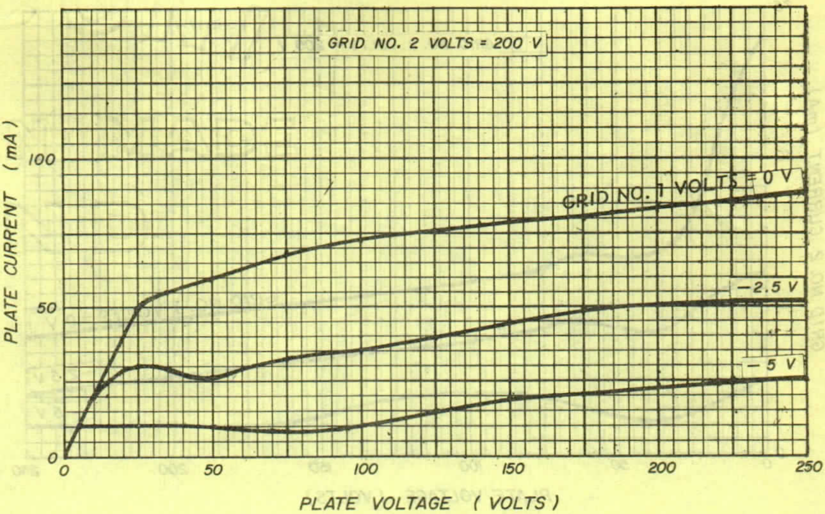
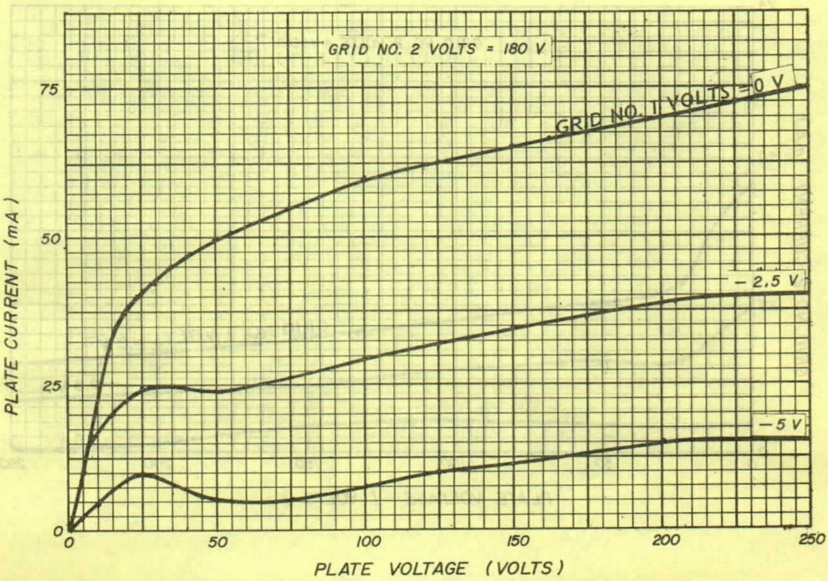
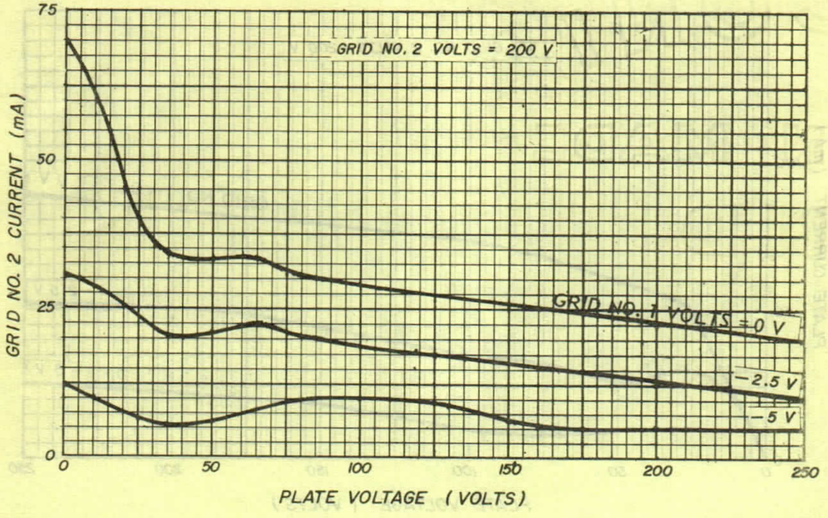


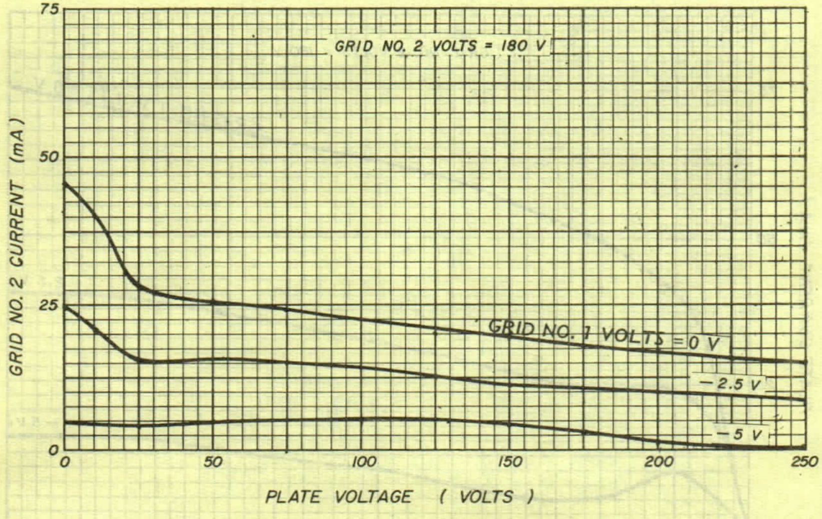
PLATE CHARACTERISTICS



GRID CHARACTERISTICS



GRID CHARACTERISTICS

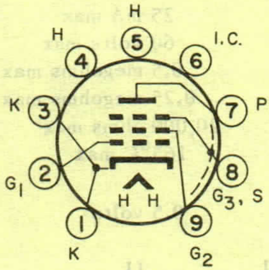


AMPEREX TUBE TYPE 7737

TENTATIVE DATA

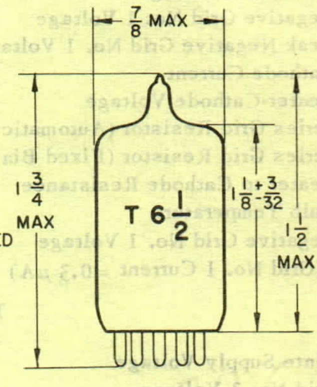
The Amperex 7737 is a ruggedized tube intended for use in environment subject to unusually high shock and vibration conditions and where freedom from microphony is essential. It has application in coaxial cable amplifiers, video amplifiers, broad-band IF amplifiers in communication links, and TV equipment.

It is one of the Amperex "Premium Quality 10,000 Hour" tubes.



PIN CONNECTIONS

1- CATHODE
2- GRID NO. 1
3- CATHODE
4- HEATER
5- HEATER
6- INTERNALLY CONNECTED
7- PLATE
8- GRID NO. 3 & SHIELD
9- GRID NO. 2



6-1

GENERAL CHARACTERISTICS

MECHANICAL

Dimensions	see outline drawing
Mounting Position	any
Bulb	T-6½
Base	small button, 9 pin E 9-1
Basing	9MZ

ELECTRICAL

Heating	parallel supply
Heater Voltage [1]	6.3 volts
Heater Current	320 mA
Direct Interelectrode Capacitances	
Plate to all other Elements	3.3 $\mu\mu$f
Grid No. 1 to all other Elements	7.6 $\mu\mu$f
Plate to Grid No. 1	0.03 $\mu\mu$f max
Transconductance	16,500 micromhos
Amplification Factor - Grid No. 2 to Grid No. 1	53

[1] Minimum value of Heater Voltage = 6.0 V; Maximum Value of Heater Voltage = 6.6 V.

7737

Maximum Ratings, Absolute Values

Plate Voltage, Cut-Off Condition	400 volts max
Plate Voltage	210 volts max
Plate Dissipation	3.0 watts max
Grid No. 2 Voltage, Cut-Off Condition	400 volts max
Grid No. 2 Voltage	175 volts max
Grid No. 2 Dissipation	0.7 watts max
Grid No. 1 Voltage	0 volts max
Negative Grid No. 1 Voltage	50 volts max
Peak Negative Grid No. 1 Voltage	100 volts max
Cathode Current	25 mA max
Heater-Cathode Voltage	60 volts max
Series Grid Resistor (Automatic Bias)	0.5 megohms max
Series Grid Resistor (Fixed Bias)	0.25 megohms max
Heater to Cathode Resistance	20,000 ohms max
Bulb Temperature	165°C max
Negative Grid No. 1 Voltage (Grid No. 1 Current = 0.3 μA)	0.5 volts

Typical Operation [2]

	I	II	
Plate Supply Voltage	190	180	volts
Grid No. 3 Voltage	0	0	volts
Grid No. 2 Supply Voltage	160	150	volts
Grid No. 1 Supply Voltage	9	0	volts
Cathode Resistor	630	100	ohms
Plate Current	13	11.5	mA
Grid No. 2 Current	3.3	2.9	mA
Transconductance	16,500	15,900	micromhos
Amplification Factor - Grid No. 2 to Grid No. 1	53		
Internal Plate Resistance	100,000		ohms
Equivalent Noise Resistance (f = 45 Mc/s)	160		ohms

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2 Operation of the tube under the conditions as given in Column I is recommended because of the small spread in characteristics.

Characteristic Range Value for Equipment Design

	Initial Min	Initial Max	End of Life[3] Min	End of Life[3] Max	
Heater Current ($E_f = 6.3$ V)	295	345	295	345	mA
Plate Current ($E_f = 6.3$ V, $E_{bb} = 190$ V, $E_{c3} = 0$ V, $E_{cc2} = 160$ V, $E_{c1} = 9$ V, $R_k = 630$ ohms)	12.2	13.8	11.5		mA
Grid No. 2 Current ($E_f = 6.3$ V, $E_{bb} = 190$ V, $E_{c3} = 0$ V, $E_{cc2} = 160$ V, $E_{c1} = 9$ V, $R_k = 630$ ohms)	2.9	3.7			mA
Transconductance ($E_f = 6.3$ V, $E_{bb} = 190$ V, $E_{c3} = 0$ V, $E_{cc2} = 160$ V, $E_{c1} = 9$ V, $R_k = 630$ ohms)	14,200	18,800	11,000		micromhos
Negative Grid No. 1 Current ($E_f = 6.3$ V, $E_{bb} = 190$ V, $E_{c3} = 0$ V, $E_{cc2} = 160$ V, $E_{c1} = 9$ V, $R_k = 630$ ohms, $R_g = 0.1$ megohms)		0.2		0.5	μA
Heater-Cathode Current ($E_f = 6.3$ V, $E_{k/f} = 100$ V, $R_{series} = 0.1$ megohms, cathode positive or negative)		10		20	μA
Insulation Resistance ($E_f = 6.3$ V, V_{grid} ; all electrodes $= 100$ V, V_{plate} - all electrodes $= 300$ V, cathode positive)	100		50		megohms
Equivalent Signal Grid Hum Voltage[4] ($E_f = 6.3$ V, $E_{bb} = 207$ V, $R_p = 2000$ ohms, $E_{cc2} = 150$ V, $R_k = 78$ ohms, $C_k = 1000$ μf, $R_{g1} = 0.5$ meghoms)		100			microvolts
Vibrational Noise Output[5] ($E_f = 6.3$ V, $E_{bb} = 180$ V, $R_p = 2000$ ohms, $E_{c2} = 150$ V, $E_{c3} = 0$ V, $R_k = 78$ ohms (not bypassed))		500			millivolts
Vibrational Noise Output[6] ($E_f = 6.3$ V, $E_{bb} = 180$ V, $R_p = 2000$ ohms, $E_{c2} = 150$ V, $E_{c3} = 0$ V, $R_k = 78$ ohms (not bypassed))		200			millivolts
Plate Current ($E_f = 6.3$ V, $E_b = 180$ V, $E_{c3} = 0$ V, $E_{c2} = 150$ V, $E_{c1} = -4.5$ V)		0.8			mA

SPECIAL RATINGS [7]

Shock Rating abt. 500 g

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of four different directions.

Fatigue Rating 2.5 g

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of three directions.

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3 Life test conditions:

Heater Voltage	6.3 volts
Plate Supply Voltage	190 volts
Grid No. 3 Voltage	0 volts
Grid No. 2 Supply Voltage	160 volts
Grid No. 1 Voltage	9 volts
Cathode Resistor	630 ohms
Life Expectancy = 10,000 hours	

4 Center tap of the heater supply transformer grounded and cathode resistor decoupled by a capacitor of 1000μf. Measured with a line frequency of 50 c/s and a filter with a linear band-pass characteristic.

5 Vibrational acceleration 10 g peak, frequency range 50 to 2000 c/s.

6 Vibrational acceleration = 10 g peak, frequency 50 c/s

7 These test conditions are only given for evaluation of the ruggedness of the tube and should by no means be interpreted as suitable operating conditions.

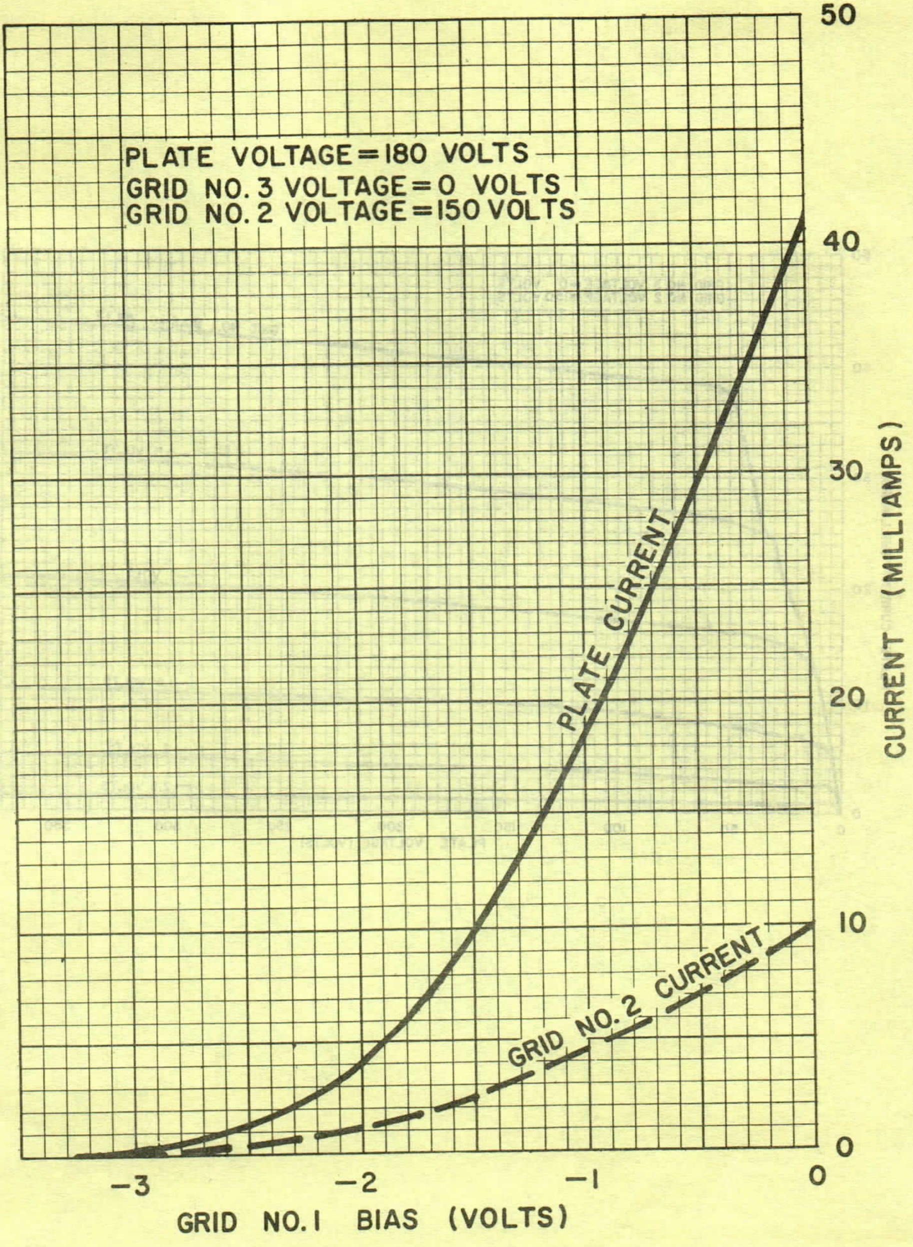
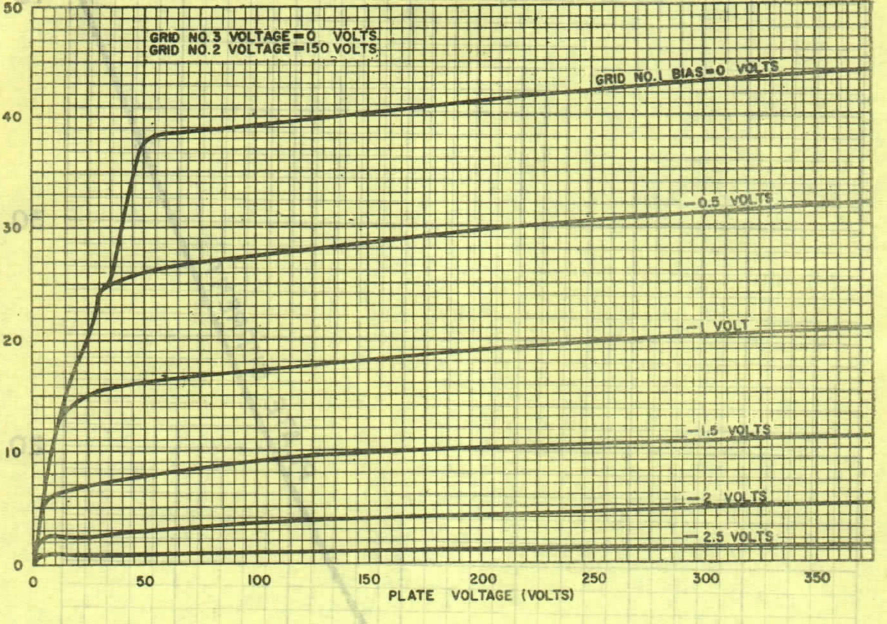


PLATE VOLTAGE=180 VOLTS
GRID NO. 3 VOLTAGE=0 VOLTS
GRID NO. 2 VOLTAGE=150 VOLTS
PLATE CURRENT
GRID NO. 2 CURRENT
50
40
30
20
10
0
CURRENT (MILLIAMPS)
−3
−2
−1
0
GRID NO. 1 BIAS (VOLTS)

7737



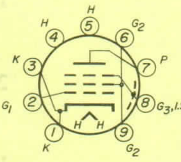
GRID NO. 3 VOLTAGE = 0 VOLTS
GRID NO. 2 VOLTAGE = 150 VOLTS
GRID NO. 1 BIAS = 0 VOLTS
−0.5 VOLTS
−1 VOLT
−1.5 VOLTS
−2 VOLTS
−2.5 VOLTS
PLATE CURRENT (MILLIAMPS)
PLATE VOLTAGE (VOLTS)
0
10
20
30
40
50
0
50
100
150
200
250
300
350

AMPEREX TUBE TYPE 7788

TENTATIVE DATA

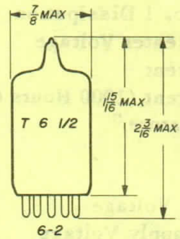
The Amperex 7788 is a dual frame grid, long life, shock and vibration resistant pentode, especially designed for use in broad-band amplifying circuits such as radio and television relay systems, coaxial telephone lines, radar equipment and oscilloscopes.

The 7788, an Amperex "Premium Quality, 10,000 Hour" tube, features extremely high transconductance and an excellent figure of merit. The low noise equivalent resistance is typically only 100 ohms pentode connected, and 60 ohms triode connected.



PIN CONNECTIONS

1- CATHODE
2- GRID NO. 1
3- CATHODE
4- HEATER
5- HEATER
6- GRID NO. 2
7- PLATE
8- GRID NO.3 & INTERNAL SHIELD
9- GRID NO. 2



GENERAL CHARACTERISTICS

MECHANICAL

Base	Noval, 9 pin
Bulb	T 6½

ELECTRICAL

Heating	indirect, parallel supply AC or DC
Heater Voltage	6.3 volts ±5%
Heater Current	340 ma

Direct Interelectrode Capacitances

	Without External Shield	With External Shield [1]
Output	3.5	4.1 pf
Input	16.0	16.0 pf
Change in Input Capacitance at $I_k = 40$ ma	9.0	9.0 pf
Plate to Grid No. 1	< 0.04	< 0.035 pf
Plate to Cathode	< 0.07	0.50 pf
Grid No. 1 to Heater	< 0.75	0.75 pf
Plate to Heater	< 0.45	0.45 pf

[1] Inside diameter of external shield = 7/8 inches; length = 1¾ inches.

7788

Maximum Ratings, Absolute Values

Plate Voltage, Zero Plate Current	400 volts max
Plate Voltage	250 volts max
Grid No. 2 Voltage, Zero Grid Current	400 volts max
Grid No. 2 Voltage	200 volts max
Negative Grid No. 1 Voltage	25 volts max
Peak Negative Grid No. 1 Voltage	50 volts max
Peak Positive Grid No. 1 Voltage	50 volts max
Plate Dissipation	5 watts max
Grid No. 2 Dissipation [2]	1 watt max
Peak Grid No. 1 Dissipation	0.01 watts max
Cathode to Heater Voltage	100 volts max
Cathode Current	50 ma
Cathode Current (1000 Hours Operation)	65 ma
Bulb Temperature [3]	200°C

Typical Operation

Plate Supply Voltage	135 volts
Grid No. 2 Supply Voltage	165 volts
Grid No. 3 Voltage	0 volts
Grid No. 1 Supply Voltage	+ 12.5 volts
Cathode Resistor	360 ohms
Plate Current	35 ma
Screen Current	5 ma
Transconductance	50,000 micromhos
Amplification Factor	58
Equivalent Noise Resistance (Pentode Connected)	100 ohms
Equivalent Noise Resistance (Triode Connected)	60 ohms
Input Conductance (100 mc)	2000 micromhos
Figure of Merit (Without External Shield) [4]	410 mc
Figure of Merit (With External Shield) [1, 4]	390 mc

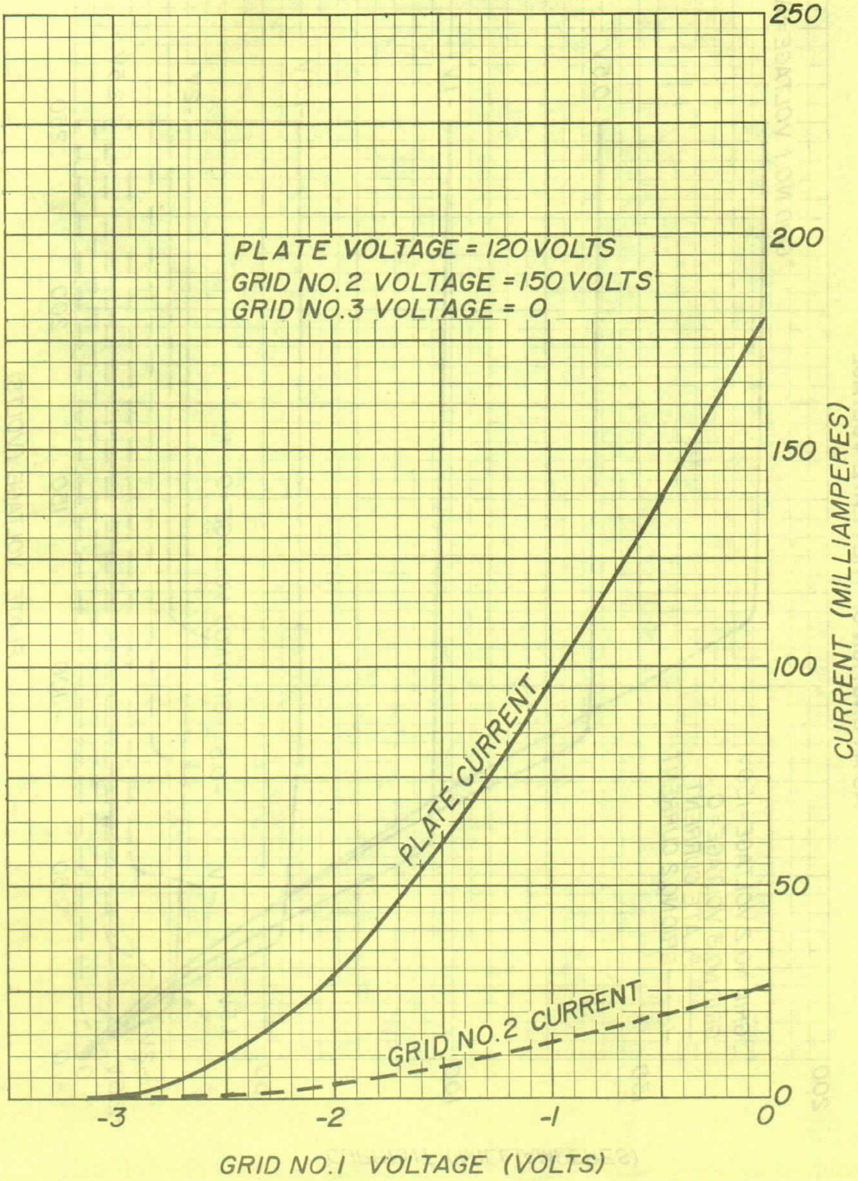
---

2 Care should be taken not to exceed the rated Grid No. 2 dissipation value due to switching of positive supply voltages.

3 A bulb temperature of 220°C is permissible, with reduced life.

4 Figure of Merit (Gain-Bandwidth Product) = $\frac{G_m}{2\pi(C_{in} + C_{out})}$

PLATE AND SCREEN GRID CURRENT AS A FUNCTION OF CONTROL-GRID VOLTAGE



7788

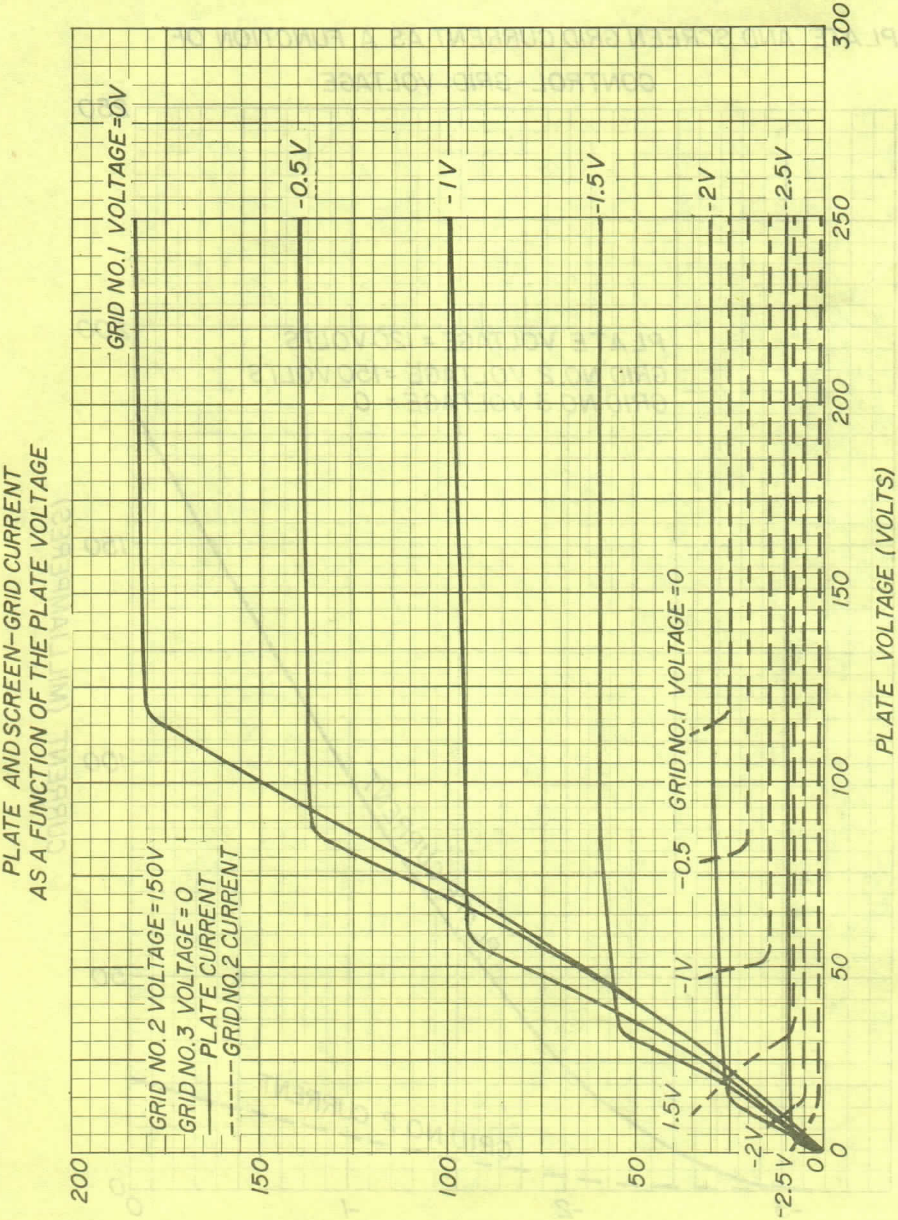


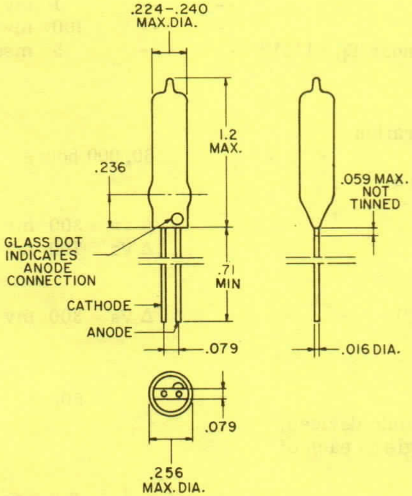
PLATE AND SCREEN-GRID CURRENT
AS A FUNCTION OF THE PLATE VOLTAGE
GRID NO.1 VOLTAGE=0V
-0.5V
-1V
-1.5V
-2V
-2.5V
GRID NO.2 VOLTAGE=150V
GRID NO.3 VOLTAGE=0
—— PLATE CURRENT
------ GRID NO.2 CURRENT
GRID NO.1 VOLTAGE=0
-0.5
-1V
1.5V
-2V
-2.5V
PLATE VOLTAGE (VOLTS)
0
50
100
150
200
250
300
CURRENT (MILLIAMPERES)
200
150
100
50
0

AMPEREX TUBE TYPE 8228/ZZ1000

TENTATIVE DATA

The Amperex 8228/ZZ1000 is a subminiature cold-cathode voltage reference tube for use in stable regulated power supplies, dc amplifiers, oscilloscope calibrators and similar applications.

Featuring an extremely low temperature coefficient of 0.0015% per °C, the 8228/ZZ1000 affords excellent regulation and uniformity. The rugged construction of this extremely small voltage reference tube insures reliability. It is designed for a life of 30,000 hours.



Note: The tube may be soldered directly into the circuit, but heat conducted to the glass to metal seal should be kept to a minimum by the use of a thermal shunt.

The tube may be dip-soldered at a temperature of 240°C for a maximum of 10 seconds up to a point 0.2 inch from the seal.

Care should be taken not to bend the leads nearer than 0.05 inch from the seal.

GENERAL CHARACTERISTICS

ELECTRICAL

Absolute Maximum Ratings

	Min.	Max.
Cathode Current[1]	2	4 ma
Peak Starting Current (T_{max} = 20 secs.)	--	20 ma
Peak Inverse Voltage	--	100 volts
Bulb Temperature		
Operating	-55°C	+125°C
Storage and Standby	-55°C	+100°C

[1] For use as a stabilizer tube $I_{C\,max}$ = 8 ma. At cathode currents between 2 and 8 ma jump voltages of 0.5V may occur.

8228/ZZ1000

CHARACTERISTICS (T_{amb} = 20 to 30°C)[2]

	Min.	Typ.	Max.	
Cathode Current (preferred operating point)	--	3.2	--	ma
Starting Voltage[3]	115	--	--	volts
DC Operating Voltage (I_C = 3.2 ma)[4]	80.1	81.0	82.5	volts
Incremental Resistance (I_C = 3.2 ma)[5]	--	200	400	ohms
AC Impedance (I_C = 2.7 ma to 3.7 ma)[6]	--	--	400	ohms
Temperature Coefficient of Operating Voltage at I_C = 3.2 ma				
Averaged over t_{bulb} = +20°C to +125°C	--	-1.2	-2	mv/°C
Averaged over t_{bulb} = -55°C to +20°C	--	-3.2	-4	mv/°C
Jump Voltage (I_C = 2 ma to 4 ma)[7]	--	--	100	mv
Noise Voltage				
Oscillation[8]	--	--	1	mv
Vibration[9]	--	--	100	mv
Ignition Breakdown Delay (in darkness E_b = 115V)	--	--	5	msec.

LIFE PERFORMANCE

Life Expectancy - Continuous Operation I_C = 3 ma	30,000 hours
Variation in DC Operating Voltage at I_C = 3 ma, t_{bulb} = 45°C	
0 to 100 hours	Δ Va = 300 mv
0 to 2000 hours	Δ Va = 700 mv
Variation in DC Operating Voltage During Storage and Standby	
0 to 2000 hours (t_{bulb} = 25°C)	Δ Va = 300 mv

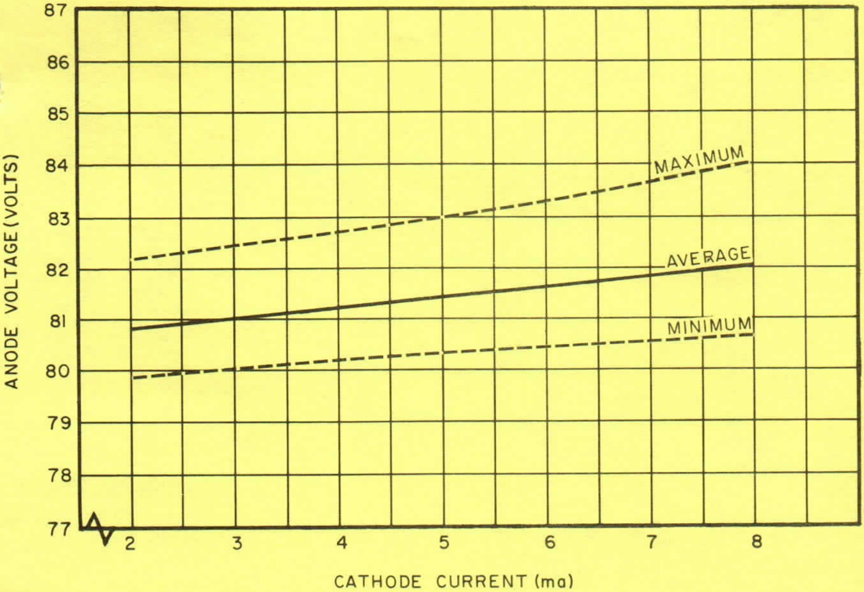
ENVIRONMENTAL RATINGS[10]

Shock Rating NRL impact machine for electronic devices; five blows with 30° hammer angle in each of four different planes.	500 g
Vibration Rating Vibrated for 32 hours at 50 cycles per second in each of three different planes.	2.5 g peak

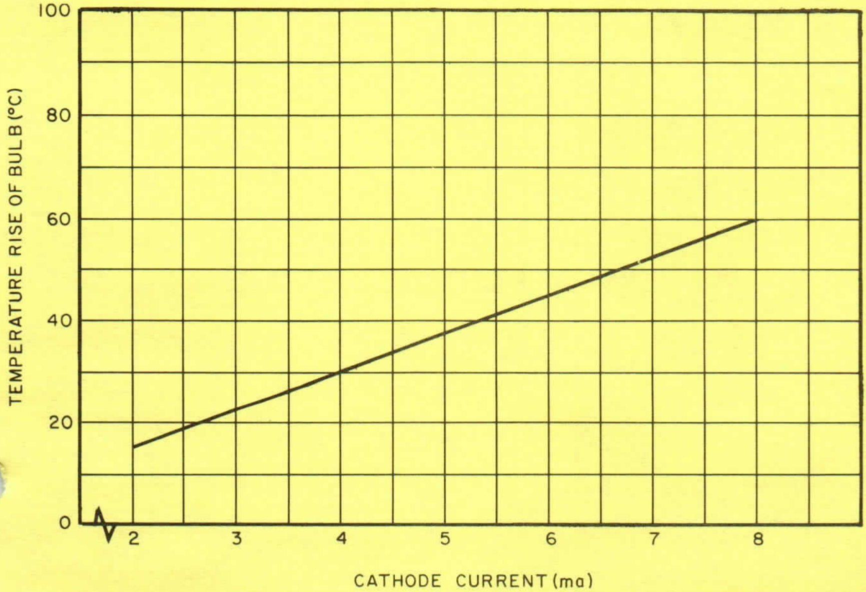
CIRCUIT NOTE

Maximum external shunt capacitor = 30 nf maximum
Minimum voltage to insure breakdown = 120 volts

[2] Thermal equilibrium is reached within 2 minutes after igniting the tube.
[3] Circuit design should provide ignition voltage of 120 volts minimum.
[4] Equilibrium conditions reached within 2 minutes after ignition.
[5] This is slope of V/I characteristic measured at a specified current.
[6] This is impedance of anode-cathode gap measured at I_C = 3 ma dc with 0.5 ma ac peak superimposed at 100 cycles.
[7] To avoid jump voltages over life, current variations around the preferred current should be limited to 0.3 ma.
[8] Oscillation + random at I_C = 2 to 4 ma, frequency band 10 cycles to 10 kilocycles.
[9] Vibration at I_C = 3.2 ma, g = 2.5, frequency = 10 to 50 cycles, frequency band = 1 to 100 cycles.
[10] These are quality evaluation conditions only. The tube is not intended to be operated continuously under these conditions.



ANODE VOLTAGE VS CATHODE CURRENT



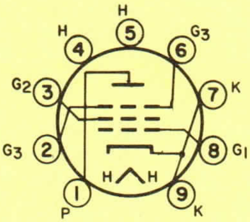
APPROX. TEMPERATURE RISE OF BULB VS CATHODE CURRENT
(IN FREE AIR)

AMPEREX TUBE TYPE 8233

TENTATIVE DATA

The 8233 is a Premium Quality 10,000 hour power pentode having 10 watts of plate dissipation and a transconductance of 45,000 micromhos at 50 ma. It is particularly suited for use as a wideband video, cathode follower, pulse or single sideband amplifier.

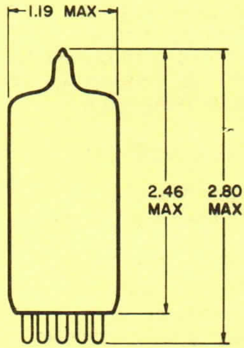
The 8233 is constructed in a magnoval envelope with double frame grids affording high gain and high dissipation with excellent uniformity.



MAGNOVAL
E9-23

PIN CONNECTIONS

1. PLATE
2. GRID NO.3
3. GRID NO.2
4. HEATER
5. HEATER
6. GRID NO.3
7. CATHODE
8. GRID NO.1
9. CATHODE



T-9 BULB

GENERAL CHARACTERISTICS

MECHANICAL

Bulb	See outline drawing
Base	Magnoval, E9-23
Dimensions	See outline drawing

ELECTRICAL

Heating	Indirect, parallel supply, AC or DC
Heater Voltage, E_f	6.3 volts ± 5%
Heater Current, I_f	600 ma

Interelectrode Capacitances

	Without External Shield	With External Shield	
Output, C_{out}	4	6	pf
Input, C_{in}	18	18	pf
Input with Cathode Current = 55.5 ma	28	28	pf
Plate to Control Grid, C_{pg} (Avg.)	0.091	0.072	pf
Plate to Control Grid, C_{pg} (Max.)	0.11	0.08	pf
Plate to Cathode, C_{pk}	0.125	0.09	pf
Control Grid to Heater, C_{g1h} (Avg.)	0.06	0.06	pf
Plate to Heater, C_{ph} (Avg.)	0.087	0.053	pf
Cathode to Heater, C_{kh} (Avg.)	5.5	5.5	pf

8233

Maximum Ratings, Absolute Values

	Symbol	Values	
Plate Voltage, Zero Plate Current	E_{bb}	400	volts
Plate Voltage	E_b	200	volts
Plate Dissipation	P_p	10	watts
Screen Grid Voltage, Zero Screen Grid Current		350	volts
Screen Grid Voltage	E_{c2}	175	volts
Screen Grid Dissipation	P_{g2}	1.5	watts
Control Grid Voltage (Negative)	E_{c1}	-55	volts
Control Grid Voltage (Positive)	E_{c1}	0	volts
Cathode Current	I_k	75	ma[1]
Control Grid Circuit Resistance	R_g	125	k ohms
Voltage Between Heater and Cathode	E_{hk}	200	volts
Bulb Temperature		190°C[1]	

Operating Conditions

Plate Voltage	140	volts[2]
Screen Grid Voltage	140	volts[2]
Suppressor Grid Voltage	0	volts
Control Grid Voltage	+12	volts[2]
Cathode Resistor	270	ohms
Plate Current	50	ma
Screen Grid Current	5.5	ma
Transconductance	45000	μmhos

Typical Characteristics

	Pentode	Triode[3]	
Plate Voltage	125	125	volts
Screen Grid Voltage	125	-	volts
Suppressor Grid Voltage	0	0	volts
Control Grid Voltage	-3	-3	volts
Plate Current	50	55.5	ma
Screen Grid Current	5.5	-	ma
Transconductance	45000	50000	μmhos
Plate Resistance, r_p	20000	-	ohms
Amplification Factor (μg 2 g1) or MU Factor	30	-	
Amplification Factor	-	30	
Input Resistance (at 50 mc)	1000	-	ohms

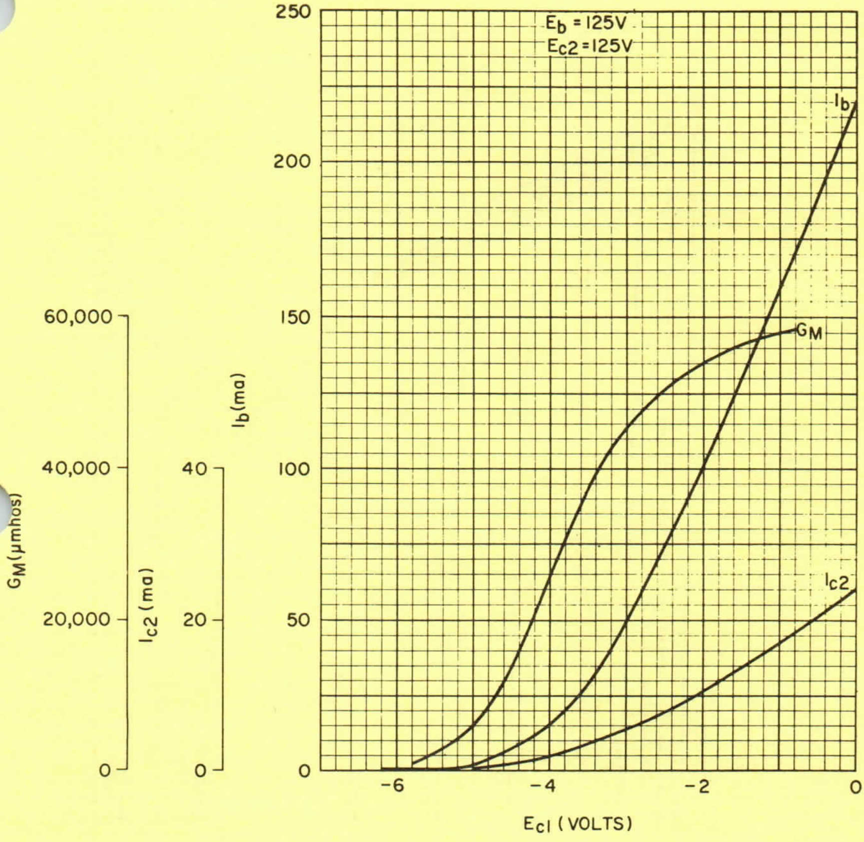
Input Damping (f = 100 mc; G_m = 45000 μmhos)

Transit Time	230 μamps/volt
Cathode Lead Inductance	4170 μamps/volts
Total	4400 μamps/volt

1. In applications where a long life is not required, the cathode current can equal 100 ma and the bulb temperature can be increased to 220°C.

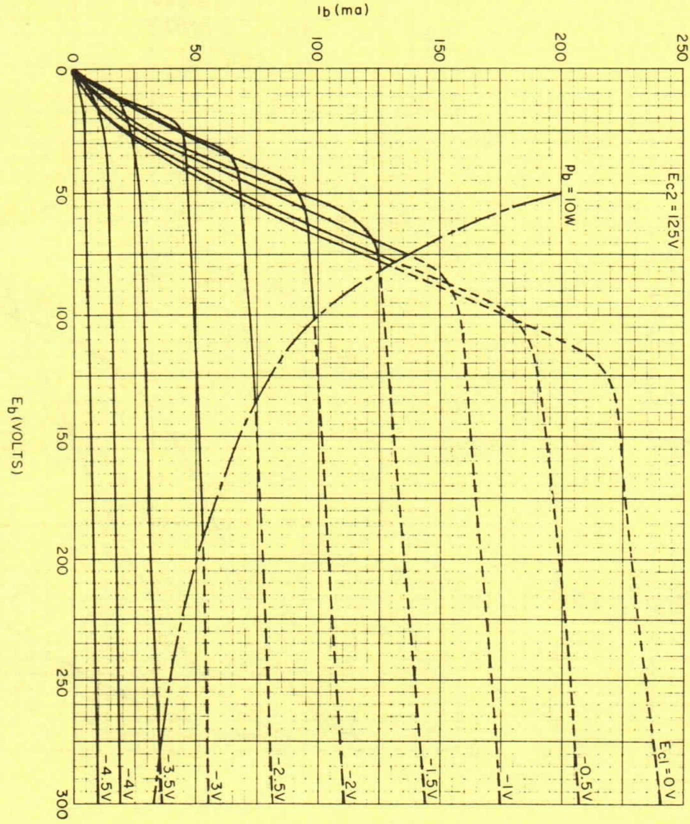
2. With respect to ground.

3. Plate connected to screen grid.



TYPICAL CURRENT CHARACTERISTICS AS A FUNCTION OF CONTROL GRID VOLTAGE (PENTODE CONNECTED)

FIGURE 1



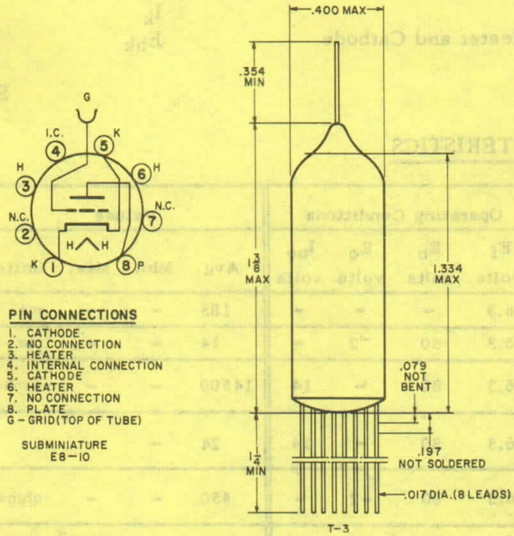
TYPICAL PLATE CHARACTERISTICS

FIGURE 2

AMPEREX TUBE TYPE 8254/EC1000

TENTATIVE DATA

The Amperex 8254/EC1000 is a Premium Quality, subminiature, frame grid Triode designed for use as a high-frequency probe tube. It features a transconductance of 14,500 μmhos at 14 ma, and a maximum grid current of only .01 microampere. The tube has a resonant frequency of 400 mc, while the input impedance at 250 mc is 450 ohms. The input grid is brought out through the top.



GENERAL CHARACTERISTICS

MECHANICAL

Bulb	Subminiature, T-3
Base	See outline drawing, E8-10
Dimensions	See outline drawing
Mounting Position	Any

ELECTRICAL

Cathode	Indirectly heated
Heater Arrangement	Parallel supply
Heater Voltage (AC or DC)	6.3 volts
Heater Current	185 ma

Interelectrode Capacitance (Without External Shield)

	Symbol	Avg. Values
Grid to Cathode	C_{gk}	3.5 pf
Grid to Plate	C_{gp}	1.9 pf
Grid to Filament	C_{gf}	0.05 pf
Plate to Cathode	C_{pk}	0.5 pf
Plate to Heater	C_{pn}	0.3 pf

8254/EC1000

MAXIMUM RATINGS, ABSOLUTE VALUES

	Symbol	Value
Plate Voltage, Zero Plate Current	E_{bb}	275 volts
Plate Voltage	E_b	110 volts
Plate Dissipation	P_p	1.5 watts
Grid Voltage	e_c	–55 volts
Cathode Current	I_k	22 ma
Voltage Between Heater and Cathode	E_{hk}	55 volts
Bulb Temperature		170°C
Grid Resistance		See note 4

OPERATING CHARACTERISTICS

Parameter	Operating Conditions E_f volts	E_b volts	E_c volts	I_{bo} volts	Values Avg.	Min.	Max.	Units	Comment
Filament Current, I_f	6.3	-	-	-	185	-	-	ma	-
Plate Current, I_b	6.3	80	−2	-	14	-	-	ma	-
Transconductance, G_m	6.3	80	-	14	14500	-	-	μmhos	-
Amplification Factor, μ	6.3	80	-	14	24	-	-	-	-
High Frequency Input Impedance	6.3	80	−2	-	450	-	-	ohms	at 250 mc
Grid Current, I_g	6.3	80	−2	-	-	-	-10^{-8}	amp	See Note 3
Input Resonant Frequency	6.3	80	−2	-	400	-	-	mc	
Hum	6.3	-	-	-	-	-	1	mv	See Notes 1 and 2
Noise (Flat response filter 0 to 10,000 cps)	6.3	80	−2	-	-	-	1	mv	See Note 2
Microphonics (Acceleration; peak value 4 g, 50 cps)	6.3	80	−2	-	-	-	1	mv	See Note 2

1 R_g = 500 K ohms, R_k = 100 ohms at 60 cps. The heater is grounded at its center. Frequency of heater supply = 60 cps $\pm$ 3%. 500 cps flat response low pass filter.

2 The noise voltage refers to the equivalent RMS value at grid.

3 Maximum value at 1000 hours.

4 The grid resistance, R_g, should be restricted to a value which will not permit maximum ratings to be exceeded at a grid current of -10^{-8} ampere. To calculate the maximum permissible value of R_g, the DC feedback of the operating circuit may be taken into account. In practice the maximum value of R_g will also be defined by the required current stability and the permissible hum level.

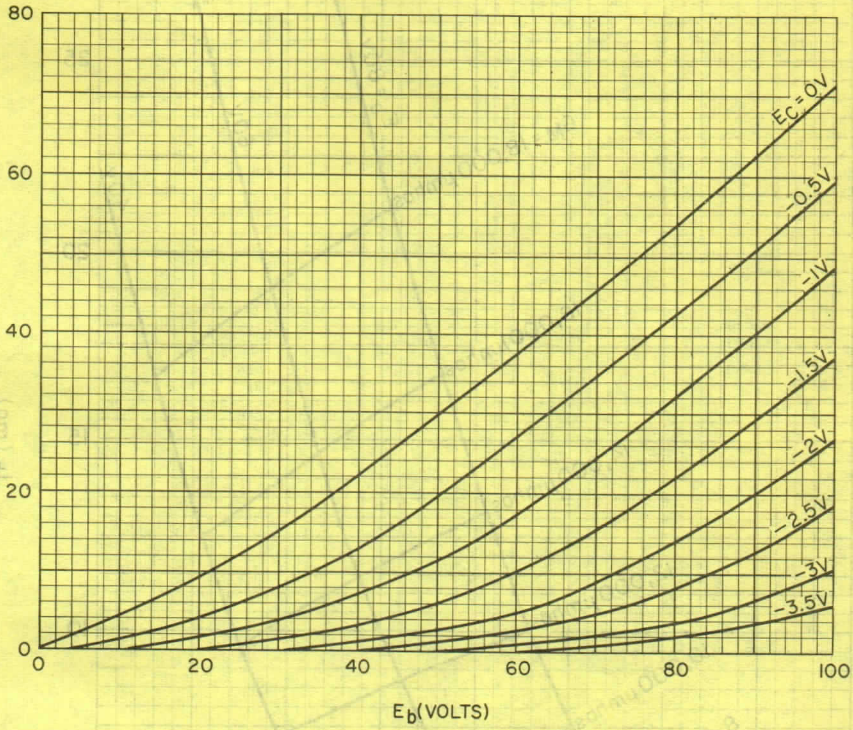
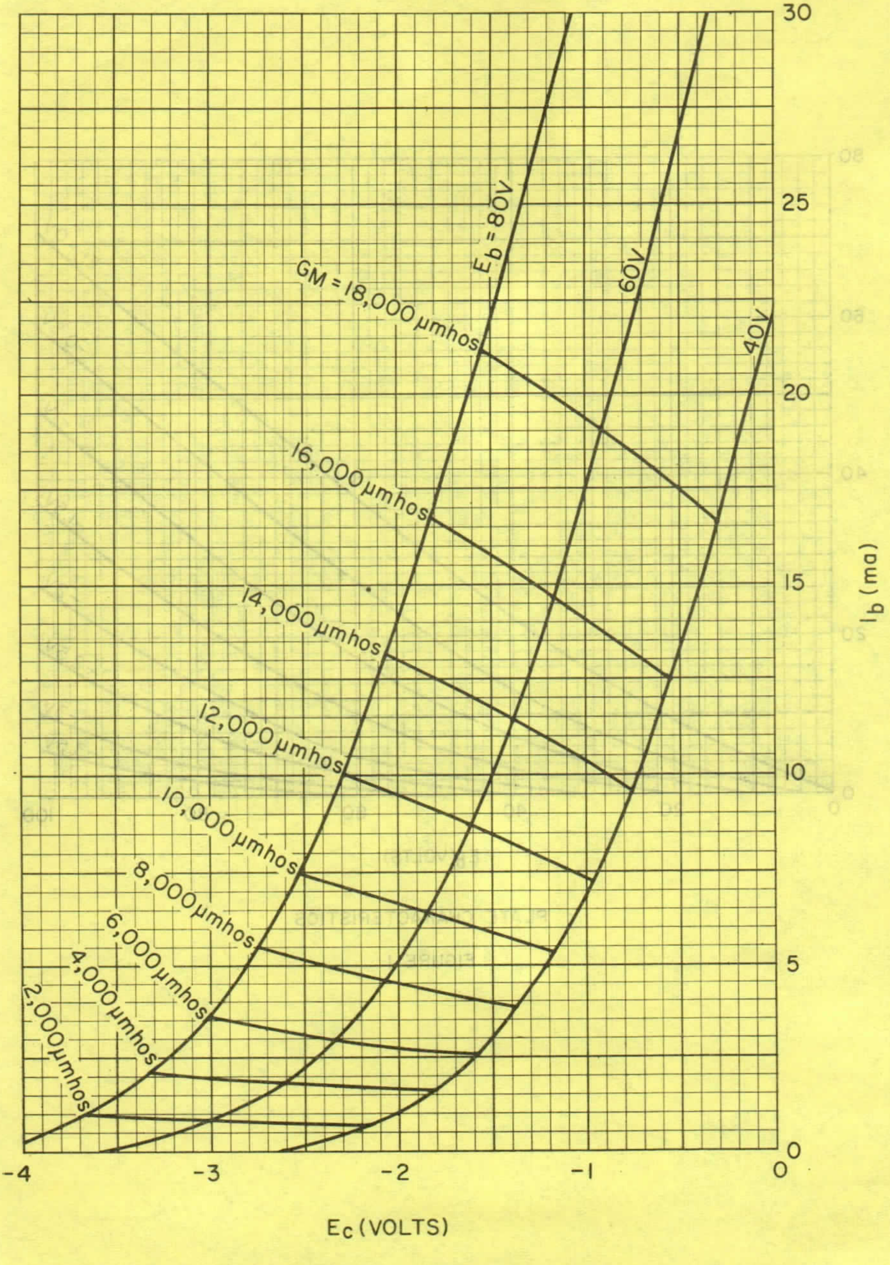


PLATE CHARACTERISTICS

FIGURE 1

8254/EC1000



TRANSFER CHARACTERISTICS

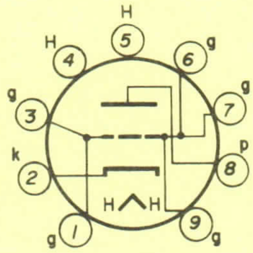
FIGURE 2

AMPEREX TUBE TYPE 8255

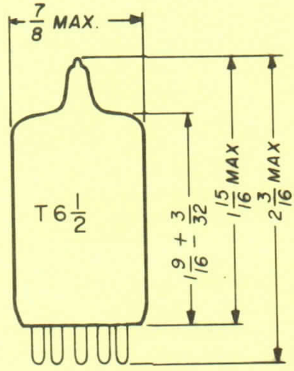
TENTATIVE DATA

The Amperex 8255 is a high μ triode for use primarily as a grounded grid UHF amplifier. It features a typical noise factor of 10 db at 850 Mc.

This type is an Amperex premium quality, 10,000 hour tube.



PIN CONNECTIONS
1. GRID
2. CATHODE
3. GRID
4. HEATER
5. HEATER
6. GRID
7. GRID
8. PLATE
9. GRID



GENERAL CHARACTERISTICS

MECHANICAL

Cathode	coated unipotential
Outline	6-2
Base	E 9-1
Bulb	T 6-1/2
Mounting Position	any

ELECTRICAL

Heater Characteristics	indirect, AC or DC, parallel supply
Heater Voltage	6.3 volts
Heater Current	155 ma ± 5%

Direct Interelectrode Capacitances

	Min.	Typ.	Max.	Units
Without External Shield, Plate to Grid	0.9	1.1	1.3	pf
With External Shield (inside diameter = 0.874 inch) Connected to Grid				
Plate to Grid	1.4	1.7	2.0	pf
Grid to Cathode and Heater	3.2	3.8	4.4	pf
Plate to Grid and Heater	0.035	0.05	0.065	pf

8255

ABSOLUTE MAXIMUM RATINGS

Plate Voltage (Zero Current)	400 volts
Plate Voltage	200 volts
Plate Dissipation	2.4 watts
Cathode Current	16.5 ma
Negative Grid Voltage	50 volts
Grid Resistance (R_K = 100 ohms)	1 megohm
Heater-Cathode Voltage	
Cathode Positive with Respect to Heater	125 volts
Cathode Negative with Respect to Heater	60 volts
Bulb Temperature	170°C

TYPICAL CHARACTERISTICS

Plate Voltage	160 volts
Grid Voltage	-1.25 volts
Plate Current	12.5 ma
Transconductance	13,500 micromhos
Amplification Factor	70
Input Resistance	5.2 k ohms
Equivalent Plate Resistance	240 ohms
Noise Figure (f = 850 Mc)	10 db
Input Series Resonance Frequency [1]	1700 Mc
Output Series Resonance Frequency [1]	1000 Mc
Grid Current (V_g = -1.3 V)	0.3 μa

RECOMMENDED OPERATING CONDITIONS AND CHARACTERISTICS

DC Plate Supply Voltage		175			160		volts
Cathode Resistance		820			100		ohms
DC Grid Supply Voltage		9			0		volts
Heater Voltage Average ±5%		6.3			6.3		volts
Cathode to Filament Current (cathode to filament, V = 125 volts)		15			15		μa
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Plate Current	--	12.5	--	9.5	12.5	16.1	ma
Transconductance	10500	13500	16500	--	13500	--	μmhos
Grid Current	--	--	--	--	--	-0.1	μa

[1] The resonance frequencies are measured with plate and heater voltages = 0V. The measurement is made between a point on the relevant tube pin close to the tube bottom and a point on a metal reference plane placed against the tube bottom. The second point should also be close to the relevant pin.

All pins except the relevant one are connected to the reference plane via a negligible impedance.

The tube is screened by a metal cylinder (Int. diameter 0.874 inch) placed upon the metal reference plane.

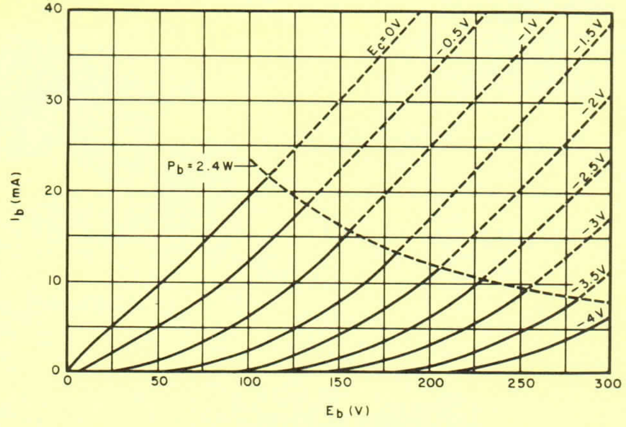


Figure 1. Plate Current vs. Plate Voltage

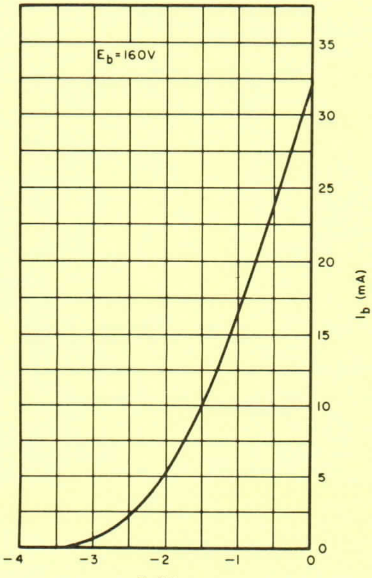
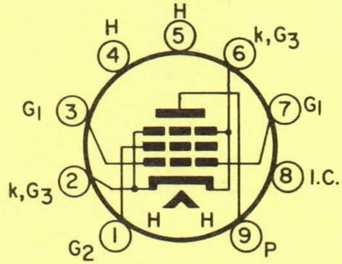


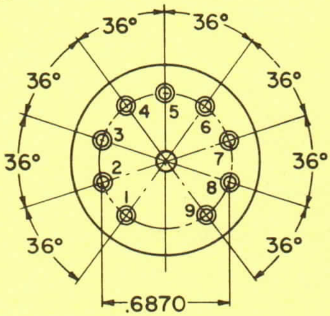
Figure 2. Plate Current vs. Grid Voltage

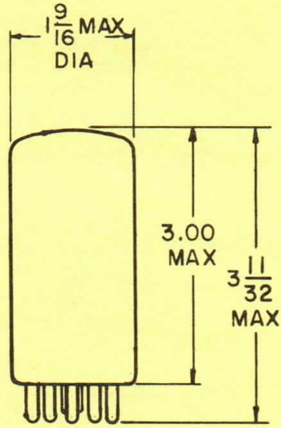
AMPEREX TUBE TYPE 8278

The Amperex 8278 is a magnoval beam power tetrode designed for 40 watt push-pull audio output with only a 250 volt supply. The very high transconductance of 23,000 micromhos, exceptional uniformity and reliability of this tube , are attained through the use of the Amperex ampliframe grid.



PIN CONNECTION
1. GRID NO.2
2. CATHODE, GRID NO.3
3. GRID NO.1
4. HEATER
5. HEATER
6. CATHODE, GRID NO.3
7. GRID NO.1
8. INTERNAL CONNECTION
9. PLATE





GENERAL CHARACTERISTICS

MECHANICAL

Bulb	See Outline drawing
Base	Magnoval
Outline	See Outline drawing
Dimensions	See Outline drawing

ELECTRICAL

Heating	Indirect AC-DC parallel supply
Heater Voltage	6.3 volts
Heater Current	1.2 amps

Interelectrode Capacitances (without external shield)

Grid No. 1 to all other elements except plate	22.5 pf
Grid No. 1 to plate	2.2 pf
Grid No. 1 to heater	
Plate to all other elements	325 nf
except Grid No. 1	12.6 pf

MAXIMUM RATINGS (Design Center Values)

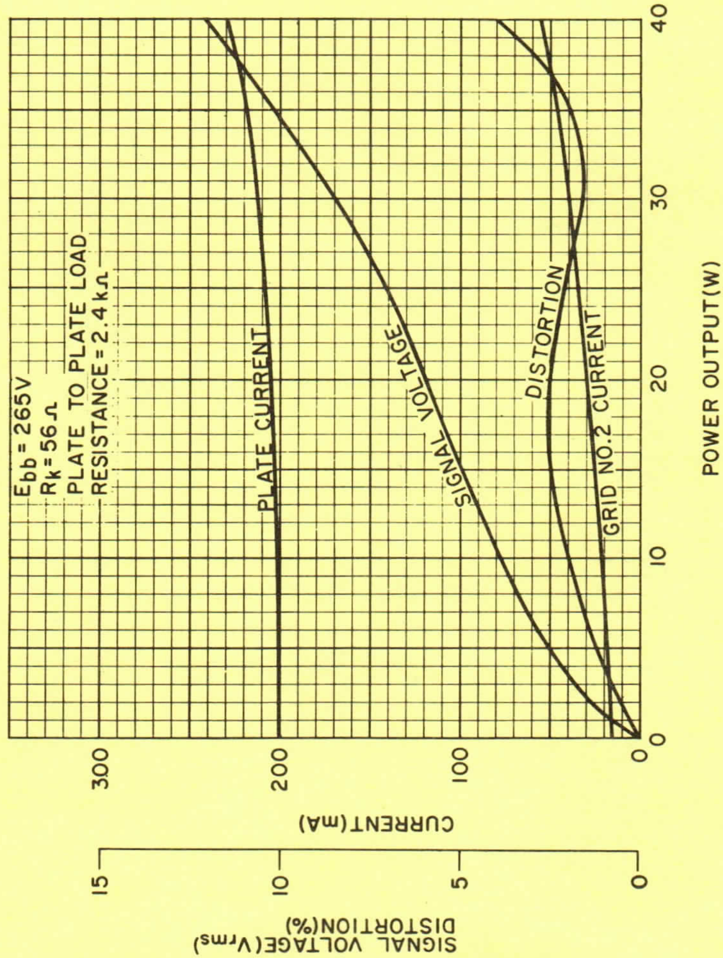
D.C. Plate Voltage (Zero Plate Current)	550 volts
Screen Grid Voltage (Cold Condition)	550 volts
D.C. Plate Voltage	300 volts
D.C. Grid No. 2 Voltage	300 volts
Cathode Current	200 ma
Plate Dissipation	27 watts
Grid No. 2 Power Dissipation (peak)	9 watts
Grid No. 2 Power Dissipation	6 watts
Control Grid Circuit Resistance (Automatic Bias)	0.5 megohm
Cathode-Heater Voltage	±100 volts

Typical Characteristics

D.C. Plate Current	250 volts
D.C. Grid No. 2 Voltage	250 volts
D.C. Grid No. 1 Voltage	13.2 volts
Plate Current	100 ma
D.C. Grid No. 2 Current	8.5 ma
Transconductance	23000 μmhos
Amplification Factor, Grid No. 2 to Grid No. 1	13
Internal Plate Resistance	7300 ohms

Typical Operating Conditions - Push-Pull Class AB

D.C. Plate Supply Voltage	265	265 volts
D.C. Grid No. 2 Supply Voltage	265	265 volts
Series Cathode Resistor (Common)	56	56 ohms
Plate to Plate Load Resistance	2400	2400 ohms
Plate Current	2x100	2x118 ma
D.C. Grid No. 2 Current	2x8.5	2x32.5 ma
Signal Voltage	0	11.5 volts rms
Harmonic Distortion	-	5%
Power Output	0	40 watts

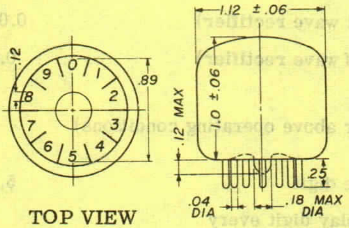


TYPICAL CHARACTERISTICS AS A FUNCTION OF POWER OUTPUT

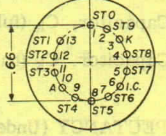
AMPEREX TUBE TYPE 8453/Z550M

GENERAL DESCRIPTION

The Amperex 8453/Z550M is a long-life, cold cathode, gas filled numerical indicator tube. It is top viewing with ten numbers 0 to 9 capable of individual indication with a bright red glow. The tube operates with a neon glow discharge on a pure molybdenum cathode. The pulsating dc supply voltage, after full or half wave rectification, causes one of the ten cathode numerals to glow. The particular numeral to glow is selected by raising the voltage level of the corresponding starter to a point at least 5 volts more positive with respect to the remaining starters by means of transistorized control circuits. Since the tube does not draw its power from the transistor control circuits, it presents negligible loading.



TOP VIEW



NOTES

Socket: Amperex Part No. B8.700.67.

Mount tube with pin 1 above pin 8 in vertical axis. Number 0 is aligned with pin 1 to within 3°.

LIMITING VALUES

Peak Anode Voltage, E^1	150 volts ac max. 90 volts ac min.
Frequency of Line Voltage	100 cps max. 40 cps min.
Voltage Between Starter and Anode, E_{st-a} 2, 3	30 volts max. 5 volts min.
Cathode Current, I_k	6 ma max. 2 ma min.
Starter Circuit Resistance, R_{st}	470 k ohms max. 100 k ohms min.
Bulb Temperature	+70°C max. -55°C min.

1. The rectified ac voltage should be freed from spikes by C_k, a capacitor of about 0.033 μf (for full wave rectifier) or 0.25 μf/tube (for a half wave rectifier).
2. To control the indication of a given figure, the potential of the starter of that figure should be raised at least 5 volts with respect to the remaining starters. The common starter bias potential may deviate by a maximum of ±5 volts dc from the anode potential.
3. In order to achieve longer life on continuous display of one digit, apply a voltage between starter and anode, E_{st-a} greater than 5 volts.

8453/Z550M

TYPICAL OPERATION

(See Figures 1 and 2 for typical circuit and Figure 3 for voltage sensitivity characteristic)

Line Voltage	117 volts ac
Voltage Between Starter and Anode, E_{st-a}	See Figure 2
Maintaining Voltage, E_a	84 volts
Starter Current, I_{st}	50 μa
Cathode Current, I_k	4 ma
Cathode Resistor, R_k	6.8 k ohms
Starter Series Resistor, R_{st} [4]	330 k ohms
Shunt Capacitor, C_k (full wave rectifier)	0.033 μf
Shunt Capacitor, C_k (half wave rectifier)	0.25 μf/tube

LIFE EXPECTANCY (Under above operating conditions)

Continuous display of one digit	5,000 hrs.
Sequential change of display digit every 100 hours or less	20,000 hrs. min.

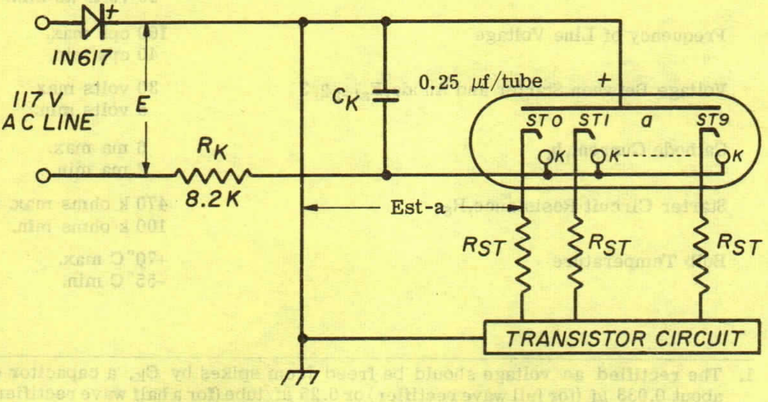


Figure 1. Typical Operating Circuit - Half Wave Rectifier

4. This resistor should be mounted close to the tube socket.

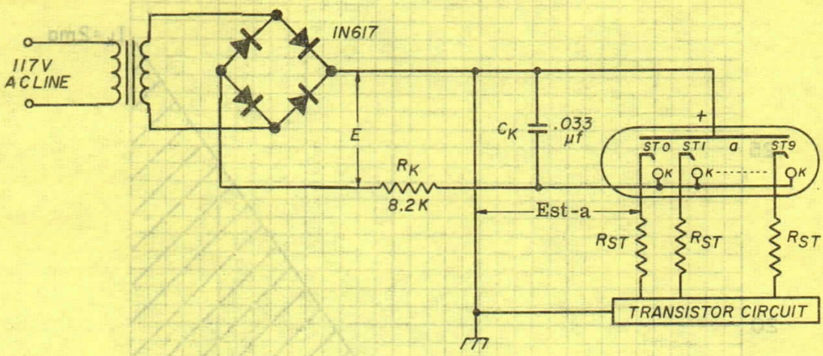


Figure 2. Typical Operating Circuit - Full Wave Rectifier

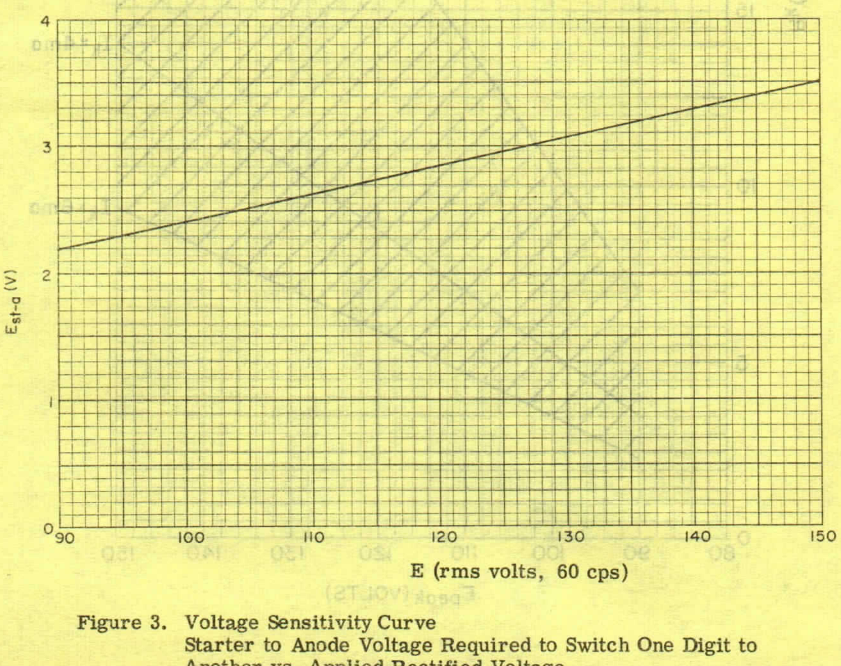


Figure 3. Voltage Sensitivity Curve
Starter to Anode Voltage Required to Switch One Digit to Another vs. Applied Rectified Voltage

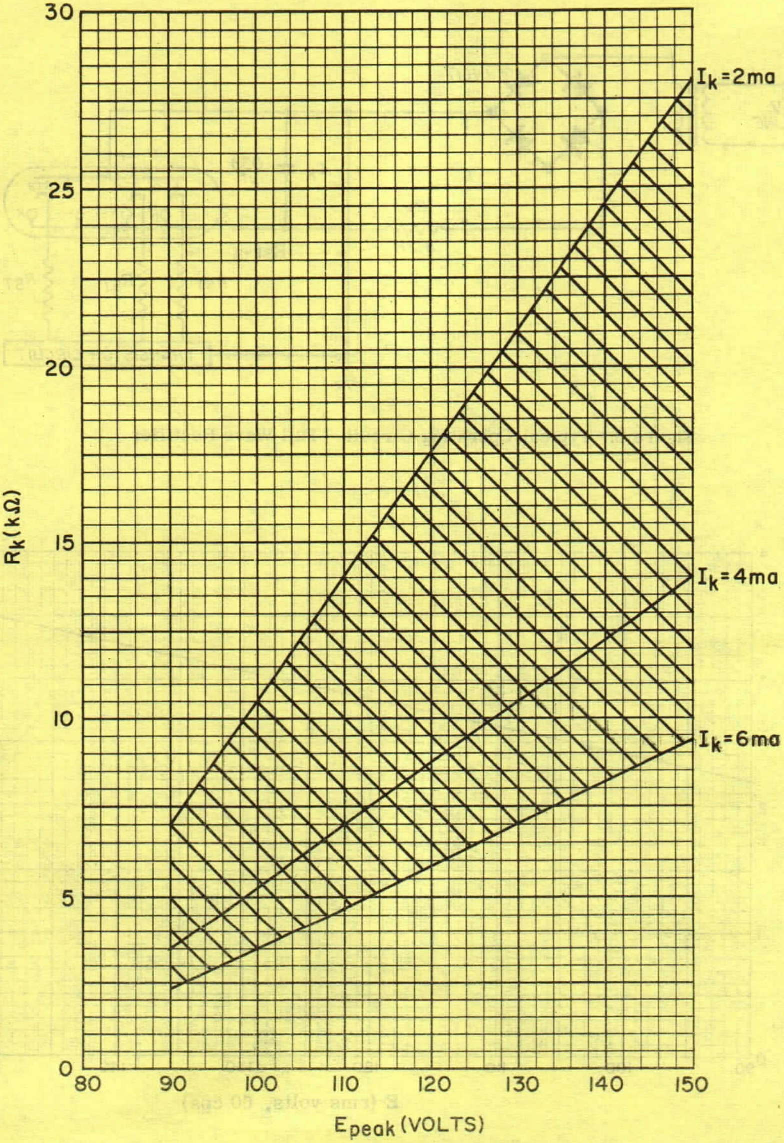


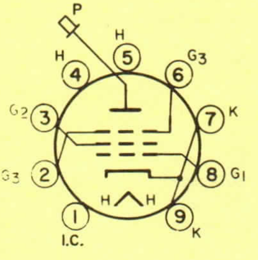
Figure 4. Area of Permissible Operation (shaded) as a Function of R_K and E_{peak}

AMPEREX TUBE TYPE 8608

TENTATIVE DATA

The 8608 is a Premium Quality power pentode having 10 watts of plate dissipation and a transconductance of 45,000 micromhos at 50 ma. It is particularly suited for use as a wideband video amplifier in applications requiring low output capacitance.

The 8608 is constructed in a magnoval envelope with double frame grids affording high gain and high dissipation with excellent uniformity.

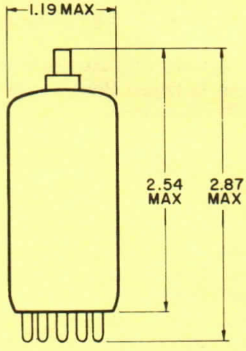


MAGNOVAL
E9-23

PIN CONNECTIONS

1. INTERNAL CONNECTION
2. GRID NO.3
3. GRID NO.2
4. HEATER
5. HEATER
6. GRID NO.3
7. CATHODE
8. GRID NO.1
9. CATHODE

P. PLATE CAP



T-9 BULB

GENERAL CHARACTERISTICS

MECHANICAL

Bulb	See outline drawing
Base	Magnoval, E9-23
Dimensions	See outline drawing

ELECTRICAL

Heating	Indirect, parallel supply, AC or DC
Heater Voltage, E_f	6.3 volts ± 5%
Heater Current, I_f	600 ma

Interelectrode Capacitances

	Without External Shield	
Output, C_{out}	3.2	pf
Input, C_{in}	18	pf
Input with Cathode Current = 55.5 ma	28	pf
Plate to Control Grid, C_{pg} (Avg.)	.110	pf
Plate to Control Grid, C_{pg} (Max.)	.150	pf
Plate to Cathode, C_{pk}	0.125	pf
Control Grid to Heater, C_{g1h} (Avg.)	0.06	pf
Plate to Heater, C_{ph} (Avg.)	0.087	pf
Cathode to Heater, C_{kh} (Avg.)	5.5	pf

8608

Maximum Ratings, Absolute Values

	Symbol	Values
Plate Voltage, Zero Plate Current	E_{bb}	300 volts
Plate Voltage	E_b	150 volts
Plate Dissipation	P_p	10 watts
Screen Grid Voltage, Zero Screen Grid Current		300 volts
Screen Grid Voltage	E_{c2}	150 volts
Screen Grid Dissipation	P_{g2}	1.5 watts
Control Grid Voltage (Negative)	E_{c1}	-55 volts
Control Grid Voltage (Positive)	E_{c1}	0 volts
Cathode Current	I_k	75 ma[1]
Control Grid Circuit Resistance	R_g	125 kohms
Voltage Between Heater and Cathode	E_{hk}	180 volts
Bulb Temperature		200 °C

Operating Conditions

Plate Voltage	140 volts[2]
Screen Grid Voltage	140 volts[2]
Suppressor Grid Voltage	0 volts
Control Grid Voltage	+12 volts[2]
Cathode Resistor	270 ohms
Plate Current	50 ma
Screen Grid Current	5.5 ma
Transconductance	45000 μmhos

Typical Characteristics

	Pentode	Triode[3]
Plate Voltage	125	125 volts
Screen Grid Voltage	125	- volts
Suppressor Grid Voltage	0	0 volts
Control Grid Voltage	-3	-3 volts
Plate Current	50	55.5 ma
Screen Grid Current	5.5	- ma
Transconductance	45000	50000 μmhos
Plate Resistance, r_p	20000	- ohms
Amplification Factor (μg2 g1) or MU Factor	30	-
Amplification Factor	-	30
Input Resistance (at 100 mc)	350	- ohms

Input Damping (f=100 mc; G_m = 45000 μmhos)

Transit Time	230 μamps/volt
Cathode Lead Inductance	4170 μamps/volt
Total	4400 μamps/volt

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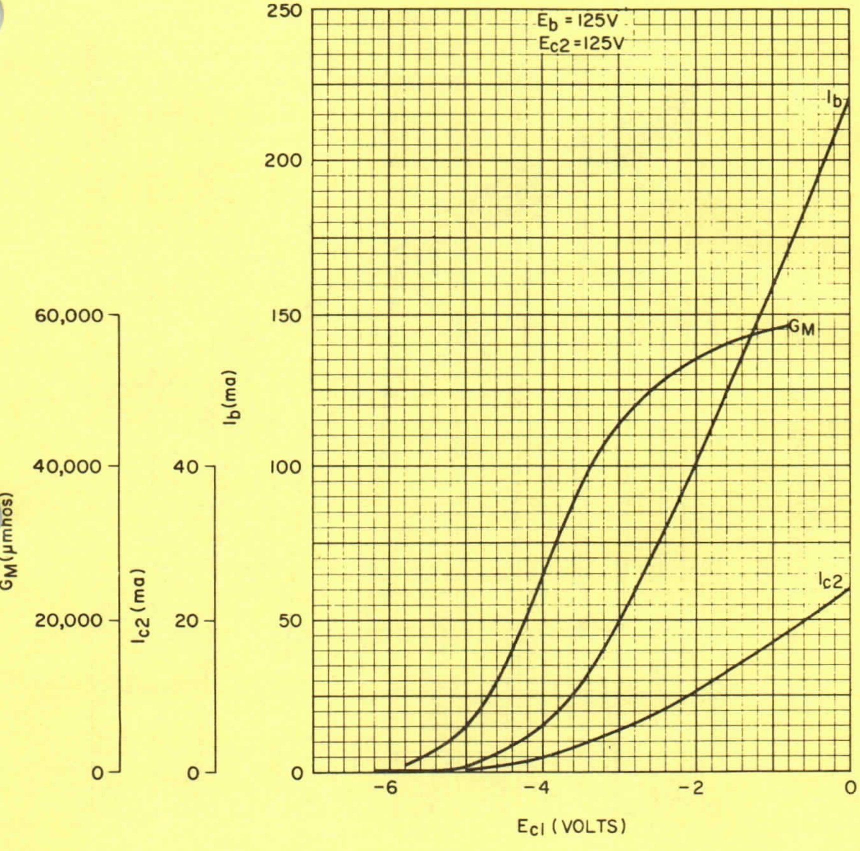
1. In applications where a long life is not required, the cathode current can equal 100 ma and the bulb temperature can be increased to 220° C.

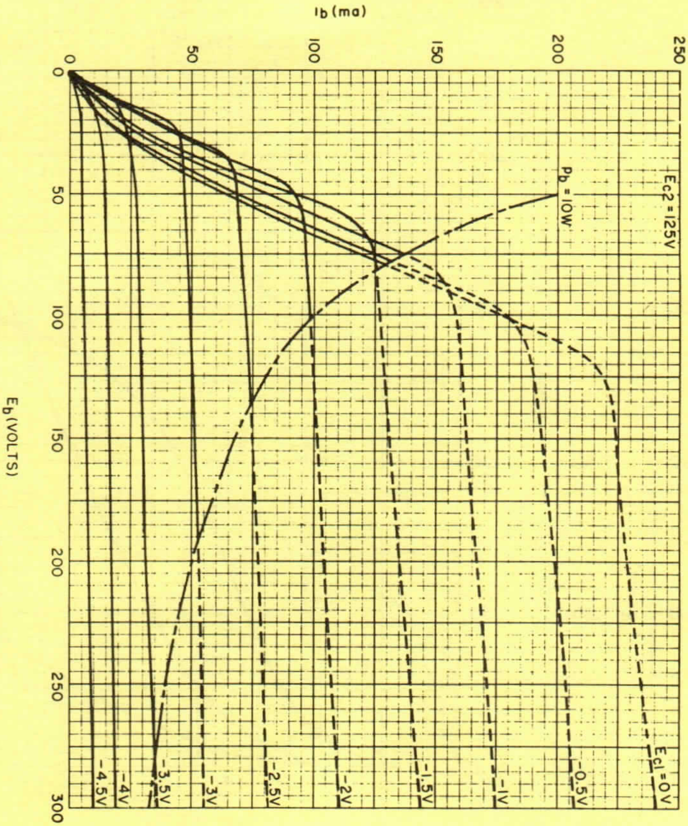
2. With respect to ground

3. Plate connected to screen grid



TYPICAL CURRENT CHARACTERISTICS AS A FUNCTION OF CONTROL GRID VOLTAGE (PENTODE CONNECTED)

FIGURE 1



TYPICAL PLATE CHARACTERISTICS

FIGURE 2

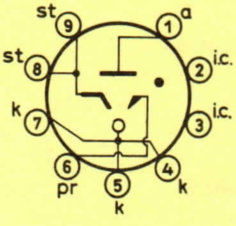
TRIGGER TUBE

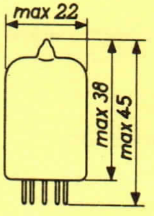
Gas-filled cold cathode trigger tube with electrical priming, and stable ignition characteristics, designed to be ignited only with positive voltages on the anode and starter intended for voltage control, sensitive relay applications, timers.

QUICK REFERENCE DATA			
Anode supply voltage	V_{ba}	240	V
Anode maintaining voltage	V_m	105	V
Max. average cathode current	I_k	40	mA
Starter to cathode ignition voltage	$V_{st\ ign}$	132	V
Starter transfer requirements			
capacitance	C_{st}	500	pF
current	I_{st}	45	μA

DIMENSIONS AND CONNECTIONS

Dimensions in mm





CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

(Initial and during life)

All values stated assume the presence of a priming discharge unless otherwise stated. This priming discharge can be established as follows:

Primer supply voltage	7)	V_{bpr}	max. 290 min. 150	V V
Recommended primer resistor	8)	R_{pr}	10	MΩ
Primer to cathode maintaining voltage		V_{mpr}	100	V
Primer current		I_{pr}	2 to 25	μA

7)8) See page 5.

9/66

A. STAND-BY (Main gap non-conducting)

Anode voltage, [1]				
positive at $I_{kav} < 25$ mA, $I_{kp} < 100$ mA [2]	V_a	max.	290	V
at $I_k > 25$ mA and/or $I_{kp} > 100$ mA [3]	V_a	max.	250	V
negative	$-V_a$	max.	90	V
Starter to cathode voltage,				
positive	V_{st}	max.	125	V
negative	$-V_{st}$	max.	75	V
Anode to starter voltage,				
positive	$V_{a\ st}$	max.	290	V
negative	$-V_{a\ st}$	max.	140	V
Starter pre-ignition current, [6]				
at I_{pr} = 2 to 25 μA	I_{st}		4×10^{-8}	A
at I_{pr} = 0 μA	I_{st}		5×10^{-10}	A

B. IGNITION

Anode voltage	V_a	min.	170	V
Starter to cathode ignition voltage (V_a = 280 V)				
Initial [5]	$V_{st\ ign}$	max. min.	137 128	V V
Max. variation during life	$\Delta V_{st\ ign}$	max.	± 2	%
Max. decrease of starter-to-cathode ignition voltage (V_a changed from 170 to 290 V)	$\Delta V_{st\ ign}$	max.	1.5	V
Starter to cathode maintaining voltage	$V_{st\ m}$		95	V
Starter series resistance (I_{pr} = 2 to 25 μA)	R_{st}	max.	100	MΩ
(I_{pr} = 0 μA)	R_{st}	max.	1000	MΩ

[1][2][3][5][6] See page 5.

B. IGNITION (continued)

Transfer requirements

Starter-to-cathode capacitance for transfer (limiting resistor = 0 to 2.2 kΩ) 9)				
V_a = 170 V	C_{st}	min.	2700	pF
V_a = 200 V	C_{st}	min.	1000	pF
V_a = 240 V	C_{st}	min.	500	pF
Starter limiting resistor 9)				
C_{st} < 4700 pF	R_{st}	min.	0	Ω
C_{st} = 4700 to 15000 pF	R_{st}	min.	2.2	kΩ
C_{st} > 15000 pF	R_{st}	min.	5.6	kΩ
Starter current required for transfer				
V_a = 240 V	I_{st}	min.	25	μA
V_a = 170 V	I_{st}	min.	500	μA
Ignition delay (I_{pr} = 2 to 25 μA; $V_{st} = V_{st\ ign} + 0.5$ V)			2	ms
(see curve) (I_{pr} = 0 μA; $V_{st} = V_{st\ ign} + 4$ V)			5	s

C. MAIN GAP CONDUCTING

Anode maintaining voltage (I_k = 10 mA) 4) and page B	V_m		105	V
Cathode current,				
average (T_{av} = 15 s)	I_k	max.	25	mA
(T_{av} = 20 ms)	I_k	max.	40	mA
peak (50 c/s duty or repetitive operation)	I_{kp}	max.	200	mA
(max. duration = 1 ms)	I_{kp}	max.	1	A
average during any conduction period	I_k	min.	8	mA
Starter-to-cathode maintaining voltage	$V_{m\ st}$		95	V
Starter current,				
positive peak	I_{st_p}		8	mA
negative 10)	I_{st}		0	mA

4)9)10) See page 5.

D. EXTINCTION

Components for self-extinguishing circuits (V_{ba} = 290 V)

C_{a-k} = min. 2700 pF (R_{lim} = 1 kΩ)

C_{st-k} = min. 500 pF

R_a = min. 1 MΩ

R_{st} = min. 1 MΩ

Recovery time (at I_{kp} = 8 to 20 mA)	3.5	ms
(at I_{kp} = 20 to 100 mA)	12	ms

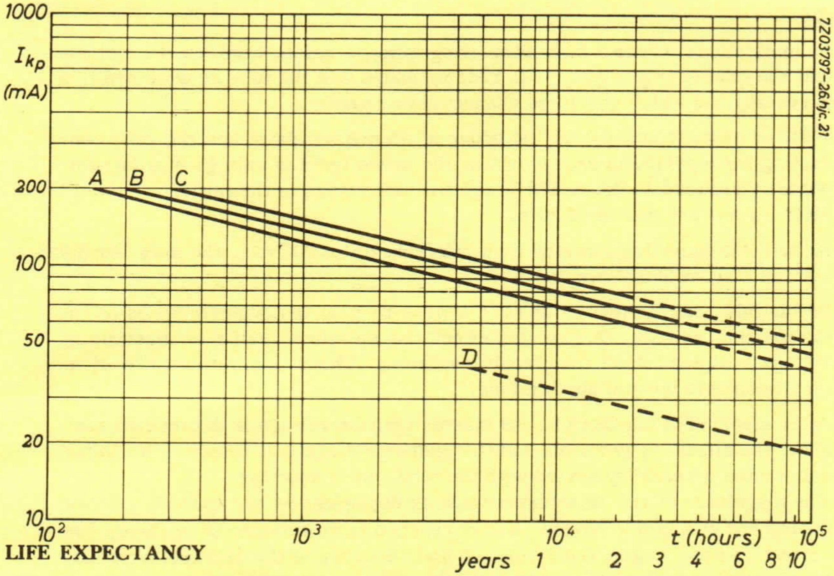
LIMITING VALUES (Absolute max. rating system)

Anode voltage,				
positive	V_a	max.	290	V
negative (I_{st} = 0 mA)	$-V_a$	max.	90	V
Cathode current,				
average (T_{av} = max. 15 s)	I_k	max.	25	mA
(T_{av} = max. 20 ms)	I_k	max.	40	mA
peak (50 c/s duty or repetitive operation)	I_{kp}	max.	200	mA
(max. duration = 1 ms)	I_{kp}	max.	1	A
Average cathode current during any conduction period	I_k	min.	8	mA
Negative starter-to-cathode voltage				
(I_k = I_{st} = 0 mA)	$-V_{st}$	max.	75	V
Peak starter current,				
positive	I_{stp}	max.	8	mA
negative (I_k = 0 mA [10])	$-I_{stp}$	max.	0	mA
Anode-to-starter voltage, (I_k = 0 mA)				
anode positive	V_{a-st}	max.	290	V
anode negative	$-V_{a-st}$	max.	140	V

[10]) See page 5.

NOTES

1. In applications where a high alternating voltage exists between the cathode and the tube surroundings, it is recommended that the tube be enclosed in a screening can which should be connected to cathode.
2. With an average current of the order of 15 mA or above and the tube conducting for a period in excess of 5 s, the anode ignition voltage may be temporarily reduced to below 290 V and will not return to the initial value until after a recovery period of 20 s.
3. In self-extinguishing circuits with currents up to 200 mA, the max. supply voltage may be 290 V d.c.
4. In this tube, oscillations of up to 10 V peak-to-peak are superimposed on the maintaining voltage. Due to this effect the measured value of maintaining voltage will depend on the circuit conditions. These oscillations are of no significance in normal applications.
5. After a period of conduction, the starter ignition voltage is depressed: however, the effect is reversible and the ignition voltage will return to its initial value after a recovery period with the tube non-conducting.
   The magnitude of the final depression is dependent on the cathode current during the conduction period, and is reached in an exponential manner. The curves on sheet C give the formation and recovery of the depression at various cathode currents for a nominal tube.
   In a repetitive circuit where the non-conducting period is short compared with the recovery time constant (e.g. 50 c/s operation), the depression can be obtained from the curve by using a direct current equal to the mean current passing through the tube.
6. In applications where pre-ignition current 4×10^{-8} A is required the primer should be left disconnected. In this case, the starter-to-cathode gap ionisation time may be of the order of seconds.
7. A period of the order of several seconds may elapse between the application of supply voltage to the primer and the establishment of a priming discharge.
8. The resistor between the primer and the supply voltage must be soldered directly to pin 6 of the tube socket. Stray circuit capacitance at the primer must be kept to less than 4 pF.
9. This is the sum of any resistors in the capacitance discharge circuit and may include a cathode resistor.
10. Negative starter current will flow during anode-to-cathode conduction in any circuit in which the starter is returned via a resistor to a potential with respect to cathode which is less than the starter-to-cathode maintaining voltage. It is preferable that the circuit should be designed to avoid this condition by keeping the starter supply voltage greater than the starter maintaining voltage. In those applications where this cannot be achieved, the maximum anode supply voltage must be reduced from 290 to 250 V and the magnitude of the negative starter current must be less than 1% of the cathode current.



LIFE EXPECTANCY

The curves show the life expectancy when the tube is run continuously at room temperature.

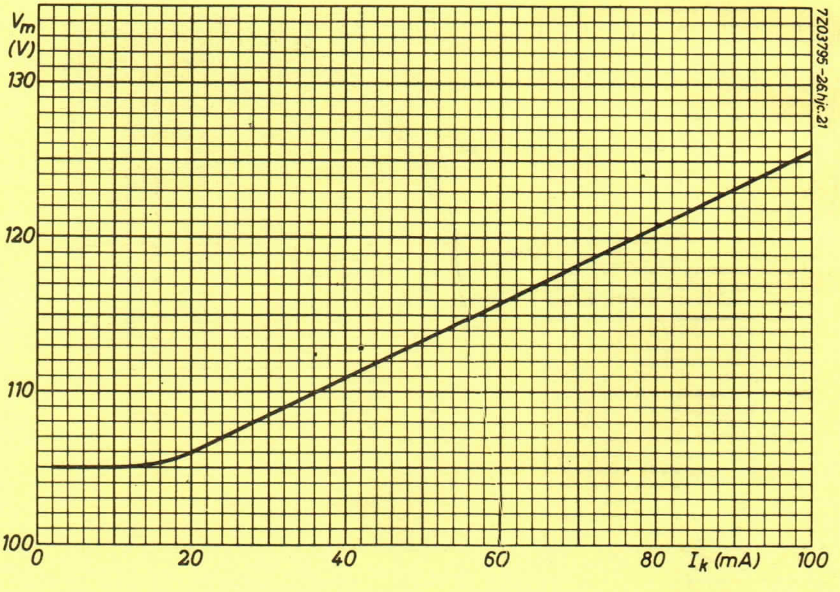
During periods of non-operation at room temperature the characteristics of the tube remain substantially constant. The total life expectancy in any given application is the sum of the non-operating periods and the operating life obtained from the curve.

For a given value of cathode current, it is estimated that 80% of all tubes will remain within the end points concerned for longer than the time shown.

The time during which the starter ignition voltage will remain within ±2% of its original value, when the tube is operating continuously at room temperature from a half-wave rectified supply, is dependent on the peak cathode current passed. Curve A shows the relationship between the peak current and the expected time for which the starter ignition voltage will remain within these limits. After this time the starter ignition voltage will fall steadily and the times at which it can be expected to have fallen by 4 and 8% are shown by lines B and C respectively.

Curve D shows the estimated length of time for which the change of starter ignition voltage can be expected to remain within ±2% when passing direct current at room temperature.

In self-extinguishing circuits with $I_{kp} < 200$ mA and $I_k < 0.8$ mA, the change of starter ignition voltage can be expected to remain within ±2% for more than 30 000 hours.



V_m
(V)
130
120
110
100
0
20
40
60
80
I_k (mA)
100
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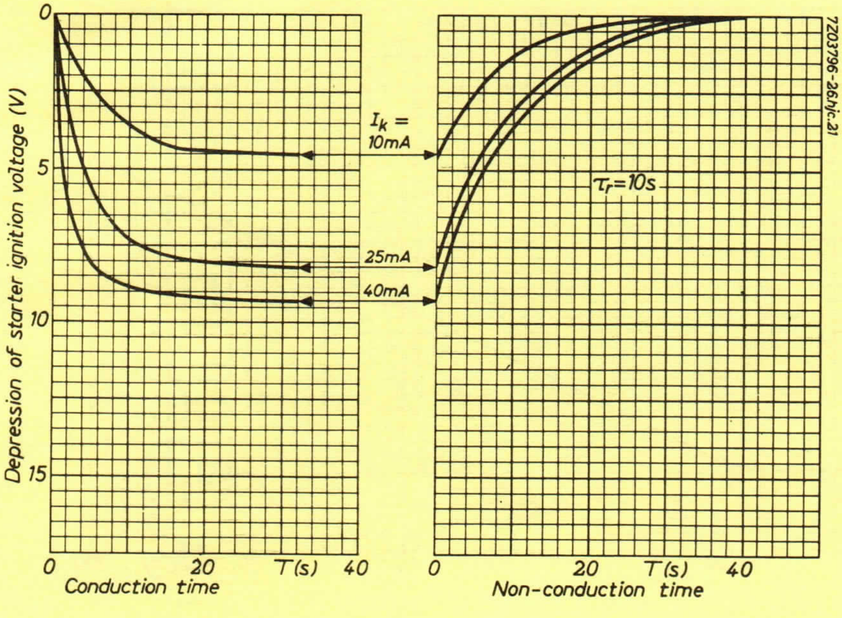


Formation and recovery curves of the starter ignition voltage for a nominal tube

AMPEREX TUBE TYPE ZA1004

GAS FILLED INDICATOR DIODE

Shock and vibration resistant cold-cathode gas-filled subminiature diode with visible glow-discharge for read-out purposes.
The tube contains two electrodes, a rod shaped molybdenum cathode and a concentric gauze anode.

APPLICATION

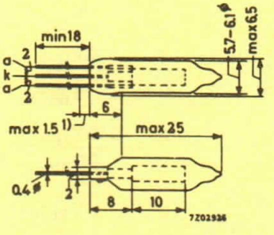
Indicator in low voltage transistor circuits. The diode can be used in combination with CdS photoconductive cells and it can be controlled by voltage signals down to 3 V.

QUICK REFERENCE DATA				
Ignition voltage	V_{ign}	=	90	V
Extinction voltage	V_{ext}	>	83.5	V
Cathode current	I_k	=	1	mA
Light intensity at I_k = 1 mA	E	=	60	lux

MECHANICAL DATA

Dimensions in mm

Type indication on pinch: yellow dot.



MOUNTING

The tube may be soldered directly into the circuit, but heat conducted to the glass-to-metall seals should be kept to a minimum by the use of a thermal shunt.
The leads may be dip-soldered to a minimum of 5 mm from the glass-to-metal seals at a solder temperature of 240 °C during max. 10 seconds.
If the tube is held in its position by the leads only, the connection of both anode leads is recommended.
Care should be taken not to bend the leads nearer than 1.5 mm from thé seals.

1) Not tinned

SHOCK AND VIBRATION RESISTANCE

These conditions are solely used to assess the mechanical quality of the tube. The tube must not be continuously operated under these conditions.

Shock resistance 500 g

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30^{o} in each of 4 positions of the tube.

Vibration resistance 2.5 g (peak)

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of 3 directions.

CHARACTERISTICS

Valid over 15000 operating hours within the preferred current range and at room temperature unless otherwise stated.
The electrical characteristics are independent of ambient illumination.

Non conduction

Anode voltage below which ignition will not occur in any tube	$V_{ign\,min.}$	=	88	V	
Insulation resistance	r_{isol}	>	300	MΩ	

Ignition

Ignition voltage,					
upper limit	$V_{ign\,max.}$	=	93	V	1)
individual variation during life	ΔV_{ign}	<	2.5	V	
Ignition delay at V_{ba} = 93 V	T_{delay}	=	0.05	s	2)
Temperature coefficient of ignition voltage	$\frac{\Delta V_{ign}}{\Delta t_{bulb}}$	<	-15	mV/°C	3)
Reignition voltage in case of full wave rectified a.c. supply	V_{reign}	<	101	V	4)
		>	96.5	V	4)

1) The ignition and extinction voltage depression (hysteresis) is max. 0.75 V per mA prior current measured 50 ms after cessation of conduction.

2) Due to the statistical nature of ignition delay values of delay time > 1 s may occasionally occur.

3) Characteristic range value for equipment design.

4) These values apply to 220 V (+10 %, -15 %), 50 c/s to 60 c/s full-wave rectified unsmoothed supply and assume conduction in the course of the preceeding half cycle, so that residual ionization eliminates delay of the following ignition.

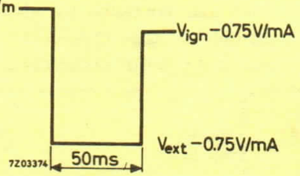
CHARACTERISTICS (continued)

Conduction

Cathode current,					
preferred range	I_k	=	0.4 to 2	mA	5)
peak	I_{kp}	=	3	mA	
Maintaining voltage	V_m	<	86 V + 4.25	V/mA	6)
		>	83 V + 2.5	V/mA	7)
Individual variation during life	ΔV_m	<	1.5	V	
Temperature coefficient of maintaining voltage	$\frac{\Delta V_m}{\Delta t_{bulb}}$	<	-15	mV/°C	3)
Rise in bulb temperature	$\frac{\Delta t_{bulb}}{\Delta I_k}$	=	10	°C/mA	
Light intensity,	E	>	30	lux/mA	8) 9)
individual minimum, measured over an angle of 70° averaged over the full circumference of the tube	E_{av}	>	60	lux/mA	8) 9)

Extinction

Extinction voltage	V_{ext}	>	83.5	V	1)



See note 1) page 2

5) Current excursions during ignition and extinction are not taken into account.
6) Valid within the range 0.1 mA to 3 mA.
7) Valid within the range 0.2 mA to 3 mA. Between 0.05 mA and 0.2 mA $V_{m\,min.} = V_{ext} = 83.5$ V.
8) Light intensity at a distance of 3.6 mm from the tube axis opposite the anode cylinder, measured with a standard Weston cell adopted to eye sensitivity. Because the emission of the neon discharge is mainly contained in the red region the illumination resistance of a CdS cell will be 1.5 to 2 times lower than in case of irradiation by a 2700 °K incandescent light source. The exact conversion factor depends on the type of CdS cell used.
9) At least 90% of the tubes will meet the figure stated.

RELIABILITY AND LIFE EXPECTANCY

The electrical characteristics have been assessed in a life test programme, totalling 3.0×10^6 tube hours with no failures, denoting a failure rate of better than 0.1 % per 1000 hours. The maximum test period was 19000 hours on 22 tubes. This failure rate is not expected to increase over the first 25000 hours of continuous operation within the preferred current range.

LIMITING VALUES (Absolute maximum rating system)

Cathode current, averaging time = 5 s	I_k	= max.	2.5	mA
Cathode current during conduction	I_k	= min.	0.1	mA [1]
Cathode current, peak	I_{kp}	= max.	3	mA
Anode voltage, negative peak	$-V_{ap}$	= max.	70	V
Bulb temperature	t_{bulb}	= min.	-55	$^{\circ}$C
		= max.	70 $^{\circ}$C + 10	$^{\circ}$C/mA
Altitude	h	= max.	24	km

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS

Principle of operation

The figures 1 and 2 show equivalent circuits for bistable multivibrators, equipped with p-n-p- and n-p-n transistors respectively, to which a read-out circuit has been added. The transistors are replaced by ideal switches, the voltage source V_T represents the available voltage that controls the diodes 2) and R_T is the output resistance as measured at the collector of the cut-off transistor.

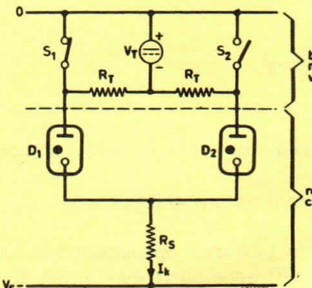


Fig. 1

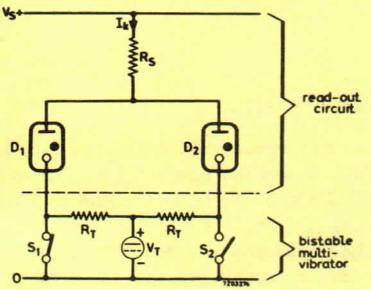


Fig. 2

1) Current excursions down to 50 μA with a duration < 1 s are permitted.

2) $V_T = V_{c.o.} - V_{sat}$ (V) in which

$V_{c.o.}$ = voltage between collector of the cut-off transistor and the common terminal (absolute value).

V_{sat} = voltage across the bottomed transistor (absolute value).

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

Correct read-out is obtained when only the diode corresponding to the bottomed transistor conducts. For this the following conditions must be met: [1])

(I) Ignition of the correct diode, corresponding to the bottomed transistor, when the other diode is conducting.

Thus: $V_{m\,min.} + I_k R_T + V_T > V_{ign\,max}$,

resulting in $I_k > \dfrac{10 - V_T}{R_T + 2.5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.2$ mA

(II) Extinction of the diode corresponding to the cut-off transistor, when the correct diode is conducting.

Thus: $V_{m\,max.} - V_T < V_{ext\,min}$,

resulting in $I_k < \dfrac{V_T - 2.5}{5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.1$ mA

(III) Non-ignition of the diode corresponding to the cut-off transistor when the correct diode is conducting.

Thus: $V_{m\,max.} - V_T < V_{ign\,min}$,

resulting in $I_k < \dfrac{V_T + 2}{5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.1$ mA

These conditions are shown graphically on page B.

Condensed instructions for designing the read-out circuit. [2])

The following directives are based on the requirement that correct read-out shall be ensured under worst case conditions, after the instant that the bistable circuit has reached its final stationary state. It is irrelevant whether the read-out diodes follow the changes of state of the multivibrator during its dynamic operation or not.

A choice can be made between the following modes of operating the diodes, namely by means of:

(A) a constant direct current

(B) a constant direct current on which a pulse is superimposed prior to reading-out. Three kinds of pulses are possible:
- a) a positive going pulse;
- b) a negative going pulse;
- c) a positive going pulse followed by a negative going one

(C) an unsmoothed current supplied by a full wave rectifier.

---

1) It is assumed that the supply voltage V_s exceeds the ignition voltage of the gas diodes, so that ignition of at least one diode is ensured; the most adverse situation being that only the wrong diode conducts.

2) For a detailed analysis of the design procedure please apply to the manufacturer.

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

In fig. 3, schematically representing these waveforms, the required minimum duration of the superimposed pulses is indicated;
t_s denotes the instant at which the bistable circuit reaches its final state.

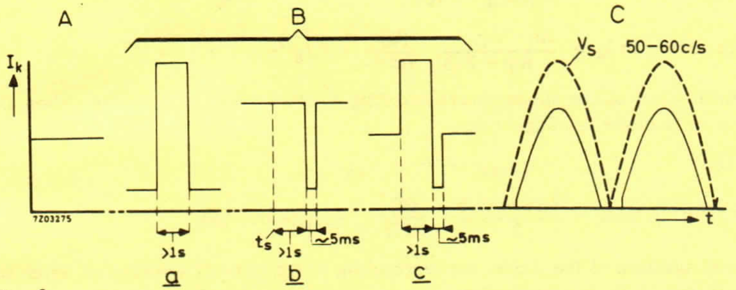


Fig. 3

The conditions to be obeyed by the current I_k are specified in the table below:

Mode of operation		Values of I_k lower limit	Values of I_k upper limit	V_T
(A) constant direct current		(I)	(II)	> 5 V
(B) direct current with superimposed:				
(a) positive going pulses	steady state current	-	(II)	> 4.5 V
	pulse current	(I)	-	
(b) negative going pulses	steady state current	(I)	(III)	> 3 V
	pulse current	-	(II)	
(c) positive and negative going pulses	steady state current	-	(III)	> 3 V
	positive going pulse	(I)	-	
	negative going pulse	-	(II)	
(C) rectified alternating current, peak value of I_k		(I)	(III)	> 4.5 V [1]

This table should be read in conjunction with the specified recommended operating conditions and limiting values.

---

[1] Since both diodes are extinguished at the end of each half cycle of the supply voltage, condition (II) is not required, and is replaced by the condition that only the correct diode will reignite. The lower limit is thus given by the spread of the reignition voltage (e.i. 4.5 V).

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

The minimum available value of V_T being known, the points of intersection with the curves I, II and III on page B, and hence the limits of I_k (I_{kI}, I_{kII} and I_{kIII}) can be determined. This having been done, the required values of $V_{S\,min}$ and R_S can be evaluated from the following expressions: [1]

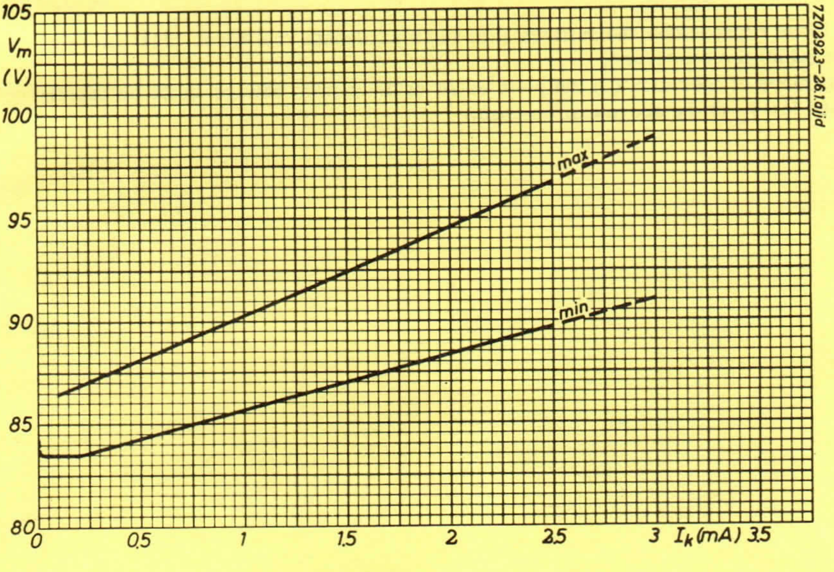
$$\frac{V_{S\,min} - V_{ign\,max}}{R_{S\,max}} = I_{kI} \qquad (1)$$

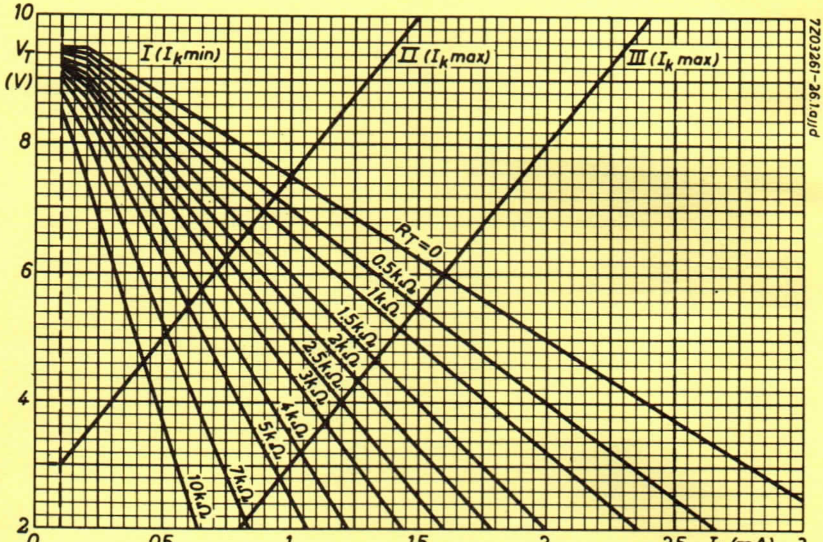
$$\frac{V_{S\,max} - V_{ext\,min} - V_T}{R_{S\,min}} = I_{kII} \qquad (2)$$

$$\frac{V_{S\,max} - V_{ign\,min} - V_T}{R_{S\,min}} = I_{kIII} \qquad (3)$$

In these expressions the suffices min and max denote the worst case limits of the quantities concerned.
For mode of operation (C) the peak value of the supply voltage must be substituted for V_S in the above expressions.

[1]) The use of equivalent circuits for establishing the exact conditions I, II, and III leads to a negligible error in the expressions (1), (2) and (3).


105
V_m
(V)
100
95
90
85
80
0
0.5
1
1.5
2
2.5
3
I_k(mA)
3.5
max
min
7Z02923-26.1ajd


10
8
6
4
2
V_T
(V)
I ($I_k$min)
II ($I_k$max)
III ($I_k$max)
R_T=0
0.5kΩ
1kΩ
1.5kΩ
2kΩ
2.5kΩ
3kΩ
4kΩ
5kΩ
7kΩ
10kΩ
0
0.5
1
1.5
2
2.5
3
I_k (mA)
7Z03261-26.1.a/d

AMPEREX TUBE TYPE ZC1030

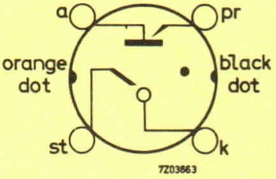
TRIGGER TUBE

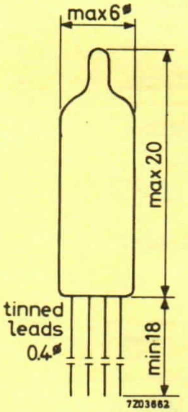
Very small ruggedised cold cathode trigger tube for use in high-speed counting and switching circuits.

QUICK REFERENCE DATA			
Anode supply voltage	$V_{b_{a-k}}$	240	V
Anode maintaining voltage	$V_{m_{a-k}}$	102	V
Cathode current	I_k	2	mA
Starter to cathode ignition voltage	$V_{st-k_{ign}}$	130	V

DIMENSIONS AND CONNECTIONS

Dimensions in mm





MOUNTING

The tube may be soldered directly into the circuit but heat conducted to the glass should be kept to a minimum by the use of a thermal shunt.

The leads may be dip-soldered to minimum 5 mm from the glass to metal seals at a solder temperature of 240 °C during maximum 10 s.

Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

The primer and starter circuit resistors and condensors should be mounted close to the tube.

The tube should not be mounted close to conductors or components which give rise to strong electrical fields.

REMARK

Instantaneous values are denoted by a lower case letter symbol.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

Valid over life and full temperature range unless otherwise stated. The tube characteristics are independent of ambient light and assume the presence of a continuous priming discharge.

Priming requirements

Anode to primer supply voltage	$V_{b_{a-pr}}$	> 170	V
Anode to primer maintaining voltage see page A	$V_{m_{a-pr}}$	110	V
Primer current	I_{pr}	10 to 30	μA

STAND-BY (main-gap non-conducting)

Anode to cathode voltage,			
positive	V_{a-k}	< 290	V
negative	$-V_{a-k}$	< 80	V
Anode to starter voltage,			
positive	V_{a-st}	< 315	V
negative	$-V_{a-st}$	< 80	V
Starter to cathode voltage,			
positive	V_{st-k}	< 115	V
negative	$-V_{st-k}$	< 100	V
Primer current	I_{pr}	< 30	μA

IGNITION REQUIREMENTS

D.C. triggering

Anode to cathode voltage	V_{a-k}	> 180	V
Starter to cathode voltage to ensure ignition	$V_{st-k_{ign}}$	> 145	V
Starter to cathode capacitor to ensure transfer	C_{st-k}	100	pF

IGNITION REQUIREMENTS (continued)

Bias + pulse triggering

Anode to cathode voltage	V_{a-k}	175	190	V
Starter coupling capacitor	C_{st}	90	30	pF
Starter to cathode voltage	V_{st-k}	145	145	V
Ionisation product	IP	40	40	V μs [1]
Starter series resistance	R_{st}	10	10	kΩ

MAIN-GAP CONDUCTING

Anode maintaining voltage at I_k = 2 mA (see page A)	V_{ma-k}	99 to 104	V
Cathode current range	I_k	1 to 4	mA
Recommended negative starter current at I_k = 2 mA	$-I_{st}$	50 to 200	μA
Dynamic maintaining voltage		See page B	

EXTINCTION REQUIREMENTS

Anode to cathode voltage (see page C)	v_{a-k}	90 + a . t	V
Anode to starter voltage (see page C)	v_{a-st}	115 + a . t	V

in which t in μs
a = 2.8 V/μs at I_a = 1 mA prior anode current
a = 2.1 V/μs at I_a = 2 mA prior anode current
a = 1.9 V/μs at I_a = 3 mA prior anode current

Anode to cathode voltage	V_{a-k}	290 - 5 I_a	V [2]
Anode to starter voltage	V_{a-st}	315 - 5 I_a	V [2]
Dynamic maintaining voltage		See page B	

[1] The ionisation product is the product of effective pulse amplitude and pulse duration ($\int_0^t dVdt$) required on the starter for ignition. The effective pulse amplitude is that part of the pulse which exceeds the static starter ignition voltage. The calculation should be based on a highest value of $V_{st-k_{ign}}$ of 145 V

[2] I_a in mA anode current prior to extinction.

LIMITING VALUES (Absolute max. rating system)

Anode to cathode voltage, negative	$-V_{a-k}$	max.	80	V
Starter to cathode voltage, negative	$-V_{st-k}$	max.	80	V
Cathode current, average during any conduction period	I_k	min.	1	mA
average (T_{av} = max. 20 ms)	I_k	max.	4	mA
Envelope temperature	t_{bulb}	max. 70 ^{o}C	+10	^{o}C/mA
		min.	-55	^{o}C

ENVIRONMENTAL CONDITIONS

1. The tube may ignite spontaneously under the influence of a strong electric field (See "Mounting")

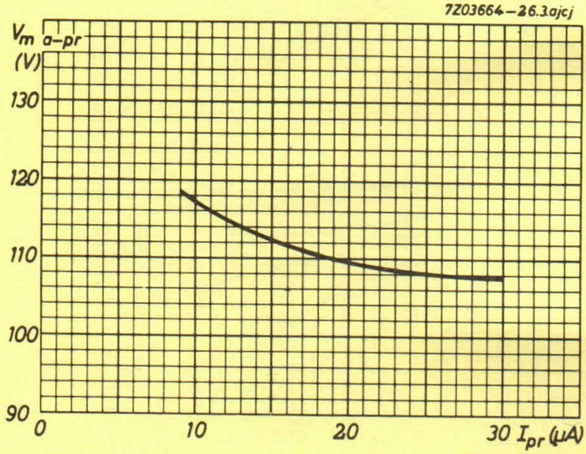
2. The tube may ignite spontaneously under the influence of nuclear radiation but the characteristics will not be permanently affected up to a level of 10^{16}nvt (fast neutrons/cm^2)

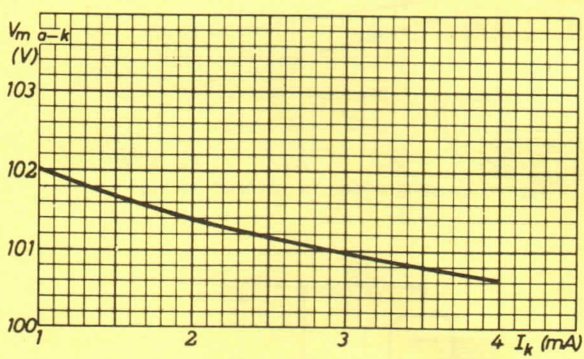
3. Shock and vibration resistance

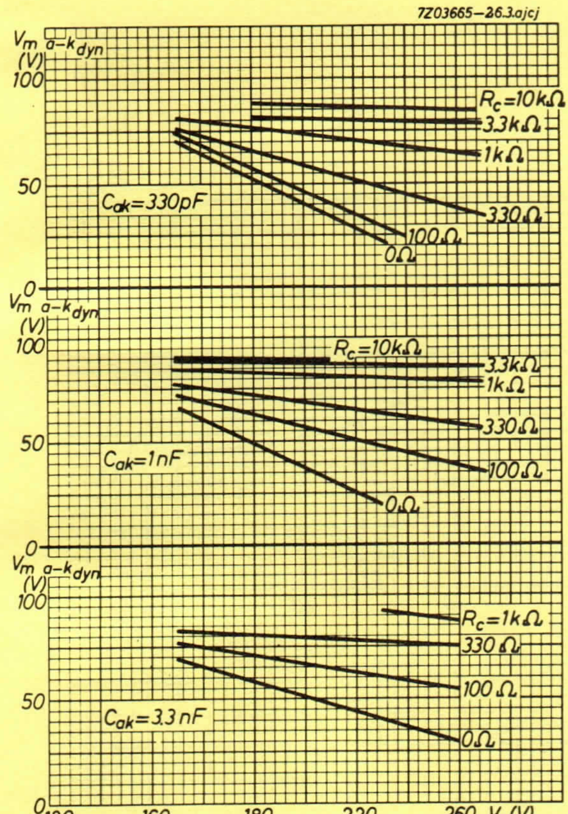
   These conditions are solely used to assess the mechanical quality of the tube. The tube must not be continuously operated under these conditions.

   Shock resistance 500 g
   Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30^{o} in each of 4 positions of the tube.

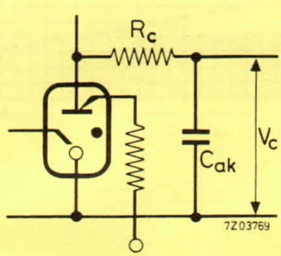
   Vibration resistance 2.5 g_{peak}
   Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of three directions.


7Z03664—26.3ajcj
V_m a–pr
(V)
130
120
110
100
90
0
10
20
30 I_{pr} (μA)


V_m a–k
(V)
103
102
101
100
1
2
3
4 I_k (mA)



Typical dynamic anode to cathode voltage



AMPEREX TUBE TYPE ZC1031

ADVANCE DATA

Very small ruggedized cold cathode neon-filled trigger tube for use in shiftregisters for moving displays. The tube has a pure molybdenum cathode to ensure stable characteristics and long life expectancy.

CHARACTERISTICS AND CIRCUIT DESIGN VALUES

Priming Conditions:

Minimum anode to primer supply voltage	V_{ba-pr}	180 volts
Anode to primer maintaining voltage	V_{m-pr}	130-145 volts
Recommended primer resistance (at $V_{ba-pr} = 180$ volts)	R_{pr}	10 megohms
Primer Current	I_{pr}	5-15 μa

ANODE AND TRIGGER CHARACTERISTICS

Anode to cathode maintaining voltage (at 3 ma)	V_m	108-115 volts
Trigger to cathode ignition voltage	V_t ign = min.	145 volts
at: V_{ba} = 180 volts	V_t ign = max.	180 volts
C_{t-k} = 100 pf		
Maximum anode to cathode voltage	V_{a-k} = max.	320 volts
Minimum anode to cathode voltage (effective pulse voltage on trigger 180 volts)	V_{a-k} min at C_t = 150 V at 33 pf; 145 V at 56 pf; 140 V at 100 pf	

Light output at 3 ma measured at 40 inches from the top of the tube (Westoncell corrected for eye sensitivity) $\approx$ .0018 foot candles

EXTINCTION CHARACTERISTICS (See Figure 1)

Maximum permissible anode to cathode voltage after extinction (at I_k = 3 ma prior to extinction) this function is valid for $70\ V \leq v_{a-k} \leq 275\ V$

$$v_{a-k} = 60 + 220\ (1-e^{-t/60}) \quad \text{volts}$$

Maximum permissible anode to trigger voltage after extinction (at I_k = 3 ma prior to extinction) this function is valid for $95\,V \leq v_{t-k} \leq 300\,V$

$$v_{a-t} = 85 + 220\ (1-e^{-t/60})\ \text{volts}$$

(t in μs after extinction)

8/66

ZC1031

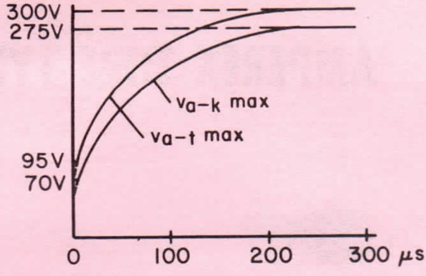
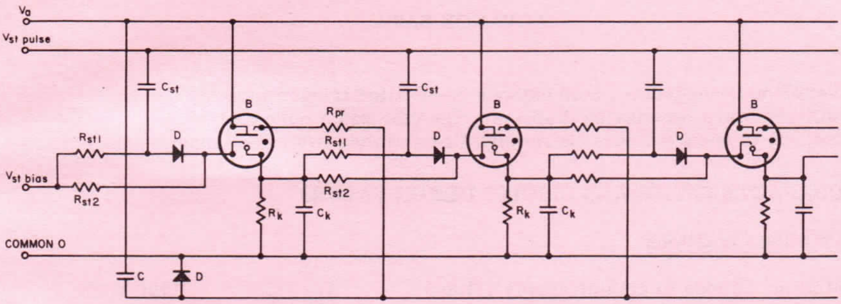


FIGURE 1

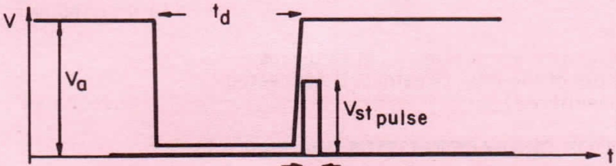
Typical Shiftregister with ZC1031



Parts List:

R_k	36 Kohm	± 10% (e.o.l.)	1/2 watt
R_{pr}	10 Megohms	± 20% (e.o.l.)	1/8 watt
R_{st1}	1 Megohm	± 10% (e.o.l.)	1/4 watt
R_{st2}	18 Megohms	± 20% (e.o.l.)	1/8 watt
C_{st}	1, 2 nf	± 20% (e.o.l.)	
C_k	220 pf		
C	220 nf		
D	BYX 10		
B	ZC1031		

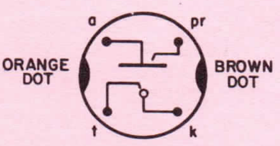
Anode Pulse Time Diagram:

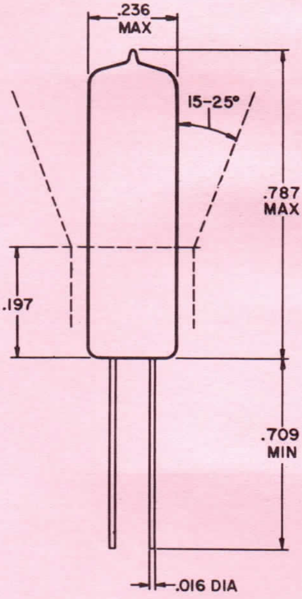


V_a	220 V ± 5%
$t_{d\ min}$	150 μs
$t_{d\ max}$	200 μs
$V_{st\ pulse}$	125 V ± 5%
$t_{p\ min}$	10 μs
$t_{p\ max}$	20 μs
$V_{st\ bias}$	100 V

ZC1031

DIMENSIONS AND CONNECTIONS Dimensions in inches





MOUNTING

The tube may be soldered directly into the circuit but heat conducted to the glass should be kept to a minimum by the use of a thermal shunt.

The leads may be dip-soldered to a minimum of 0.2 inches from the glass to metal seals at a solder temperature of 240°C for a maximum of 10 seconds.

Care should be taken not to bend the leads nearer than 0.059 inches from the seals.

Primer and trigger circuit resistors should be mounted close to the tube to avoid stray capacitances.

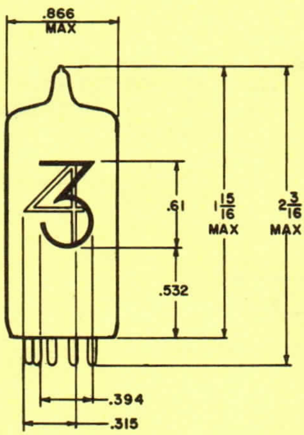
The tube should not be mounted close to conductors or components which give rise to strong electrical fields.

AMPEREX *Bi-Qui* TUBES - TYPES ZM 1030 ZM 1032

TENTATIVE DATA

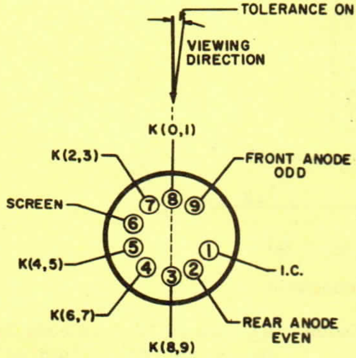
The ZM1030 and ZM1032 ***Bi-Qui*** tubes are biquinary numerical indicator tubes with the numerals 0 to 9. Each is a cold cathode, gas filled indicator consisting of two anodes and five pairs of cathodes with a screen between the odd and even cathodes. They are side viewing with the numerals capable of individual indication as a bright red glow.

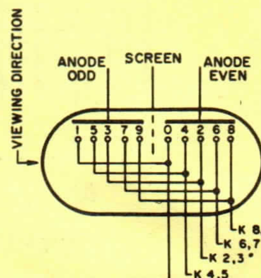
The ZM1030 has a red lacquer coating applied externally to reduce glare while the ZM1032 has no external coating. Both tubes are electrically identical and are designed for 20, 000 hours of operation.



QUICK REFERENCE DATA

Anode Current	4 ma
DC Supply Voltage	200 volts
Extinguishing Voltage	110 volts (max)
Max. Bulb Temperature	+70° C
Min. Bulb Temperature	-55° C
Mechanical	
Bulb	T 6-1/2
Base	E 9-1





ELECTERICAL CHARACTERISTICS
(See Figure 1)

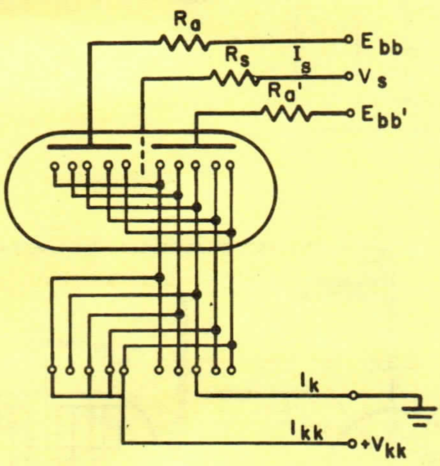
Typical DC Operation with Cathode Bias ($T_A = 25°$ C)

Anode Supply Voltage for "On" Anode	E_{bb}	180	200	220	250	300	volts
Maintaining Voltage	V_m	140	140	140	140	140	volts
Anode Series Limiting Resistor	R_a	10	15	20	27	39	k ohms
Screen Supply Voltage	V_s	50	50	50	50	50	volts
Cathode Bias Voltage [1]	V_{kk}	50	50	50	50	50	volts
Anode Supply Voltage for "Off" Anode	E_{bb}'	100	100	100	100	100	volts
Screen Series Limiting Resistor	R_s	10	10	10	10	10	k ohms

Typical AC operation with Cathode Bias ($T_A = 25°$C)

Same as DC operation except for the following:

	Ebb:	170	220	250	300	volts
For 1/2 - wave AC	Ra:	10	18	24	33	k ohms
(50 - 60 cycles)	V_M:		(See fig. 6)			
For full-wave AC	Ra:	15	27	33	47	k ohms
(50-60 cycles)	V_M:		(See fig. 6)			



$(I_a = I_k + I_{kk} + I_s)$

Figure 1 Schematic

E_{bb}	Anode Supply Voltage for "On" Anode	I_{kk}	Sum of "Off" Cathode Currents
V_s	Screen Supply Voltage	R_a	Anode Series Limiting Resistor
E_{bb}'	Anode Supply Voltage for "Off" Anode	R_s	Screen Series Limiting Resistor
V_{kk}	Potential Difference between "On" and "Off" Cathodes	R_a'	"Off" Anode Series Limiting Resistor
I_k	Cathode Current		

LIMITING VALUES, For DC Operation

Reference point for all electrode voltages is the "on" cathode.
During operation no electrode should be left floating. See Fig. 1.

	Symbol	Value	Units
Ignition Voltage (voltage necessary for breakdown between anode and cathode)[3]	V_{ign}	170 (max.)	volts
Anode Current Average, during any conduction period[4]	I_a	3 (min.)	ma
Anode Current Average, T_{av} = 20 ms	I_a	5 (max.)	ma
Peak, 50 to 60 pps	$\hat{I}_a$	12 (max.)	ma
Cathode Selecting Voltage[5]	V_{kk}	40 (min.)	volts
	V_{kk}	110 (max.)	volts
Screen Voltage[4]	V_s	40 (min.)	volts
		80 (max.)	volts
"Off" Anode Supply Voltage	$E_{bb'}$	85 (min.)	volts
	$E_{bb'}$	115 (max.)	volts
"Off" Anode Series Limiting Resistor	$R_{a'}$	1 (min.)	k ohms
	$R_{a'}$	100 (max.)	k ohms

SCREEN CHARACTERISTICS

Figure 3 depicts screen current as a function of screen voltage. The ruled area denotes the working area of the tube. A load line is also shown.

The screen current varies with anode current: each ma increase, or decrease, of anode current results in a maximum 30% increase, or decrease, of the screen current.

The upper limit of screen voltage should not exceed 80 volts. Beyond this point the screen cannot separate the odd and even compartments. When this value of screen voltage is exceeded the likelihood of odd and even numerals being lighted is greatly increased. The lower limit on screen voltage is fixed by the fact that when the screen voltage falls low enough, it begins to act like a cathode with its usual characteristic glow.

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1. With low cathode bias voltages the current "I_{kk}" to the "Off" cathodes will increase and the readability of the "On" cathode will be affected.
2. Maximum life is obtained when sequentially changing the display from one numeral to another every 100 hours or less.
3. The minimum supply voltage should be as stated. However, the use of the highest voltage available with the appropriate series resistor to maintain the anode current within the specified limit is recommended. The use of "Constant Current Operation" (high supply voltage with high anode resistor) is recommended when designing equipment operating over a wide temperature range.
4. Temporary current excursions down to 2.5 mA and up to 6.5 mA caused by supply voltage variations are permissible.
5. The cathode selecting voltage is the voltage difference V_{kk} used for discrimination between the "Off" cathodes and the "On" cathode.
6. The recommended screen supply is +50 volts connected to the burning cathode by a 10,000 ohm resistor. Other voltage and resistor combinations are possible provided that the limiting values are not exceeded. (See Figure 2)

PRINCIPLE OF OPERATION

The transparent screen divides the tube into two sections; the rear one containing the even anode and the cathode numerals 0 - 2 - 4 - 6 - 8, and the front containing the odd anode and the cathode numeral 1 - 3 - 5 - 7 - 9. The cathodes are internally connected in pairs 0 - 1, 2 - 3, 4 - 5, 6 - 7, 8 - 9.

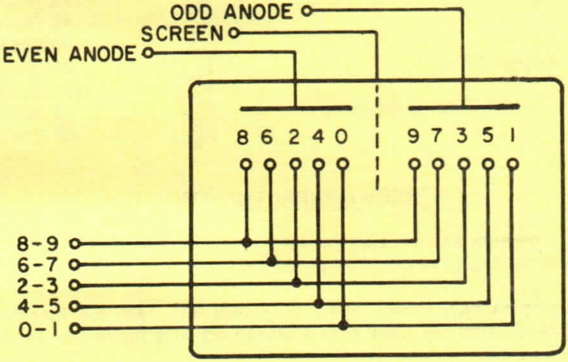

Figure 2

By applying a suitable voltage between a cathode pair and the "odd" anode the odd number of the pair will be covered by a neon glow. Switching from one number to the other of a pair is accomplished by decreasing the voltage on the operating anode and simultaneously increasing the voltage on the other anode. (See note 5)

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[5] When switching from one digit to another the tube should not be allowed to de-ionize. Thus circuits should be designed to ensure that switching time does not exceed 1 msec. When mechanical or other low speed switching is used, a "make-before-break" arrangement is preferred. During switching, the screen connection and supply should be maintained.

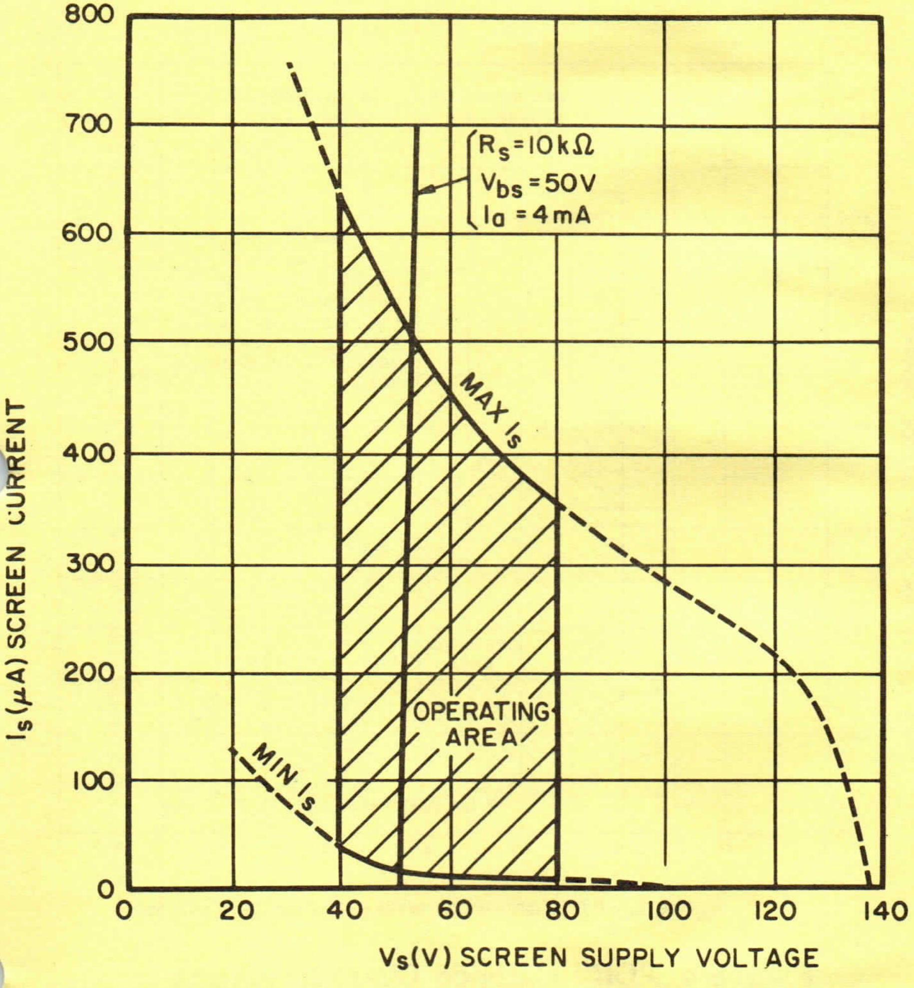

Figure 3 Screen Characteristics.

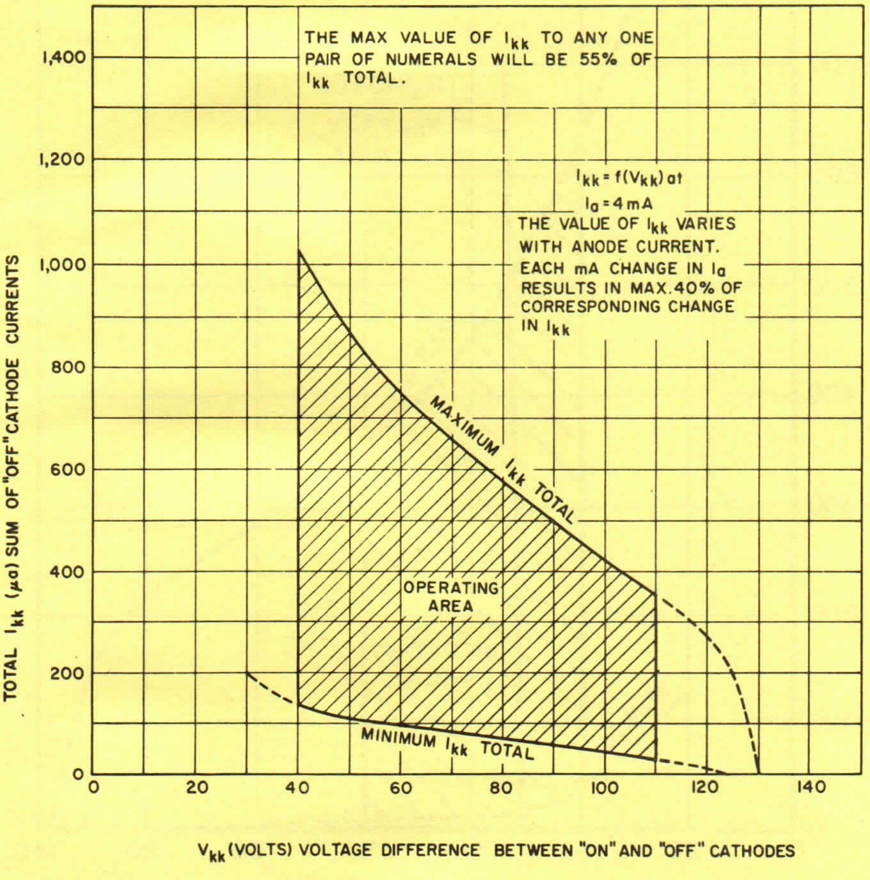

Figure 4 "Off" Cathode Characteristics

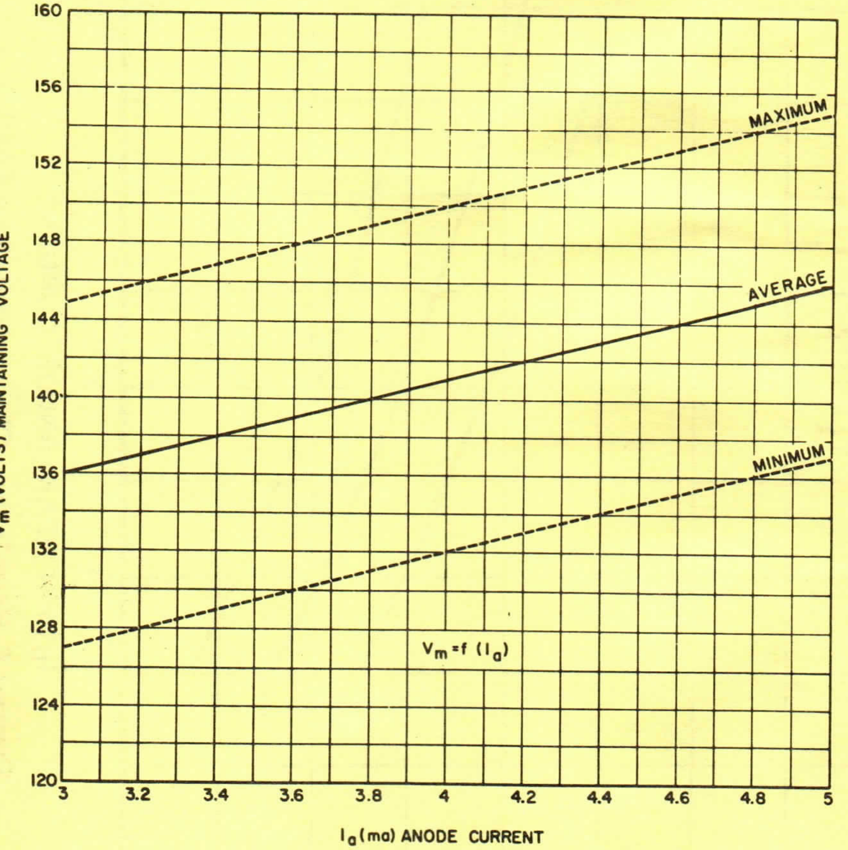

Figure 5 Regulation Characteristics (DC)

ZM1030-ZM1032

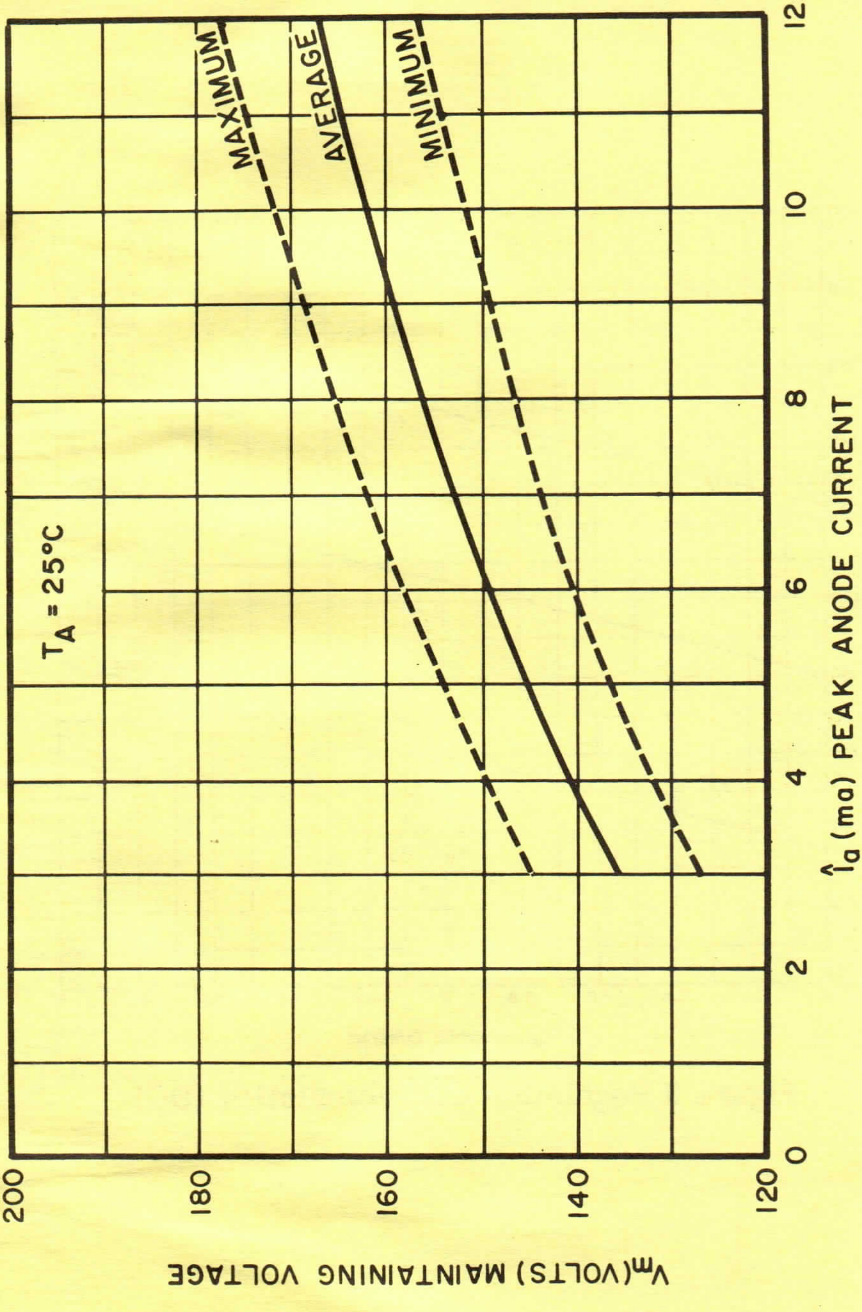

Figure 6 Regulation Characteristics (AC)