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WASHINGTON			
Seattle	98134	3451 Marginal Way	(206) 622-0808
WISCONSIN			
Milwaukee	53201	538 N. Broadway Avenue	(414) 276-1800

WESTINGHOUSE ELECTRIC CORPORATION
ELECTRONIC TUBE DIVISION
P. O. BOX 284
ELMIRA, N.Y.

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Westinghouse

WESTINGHOUSE ELECTRIC CORP.
ELECTRONIC TUBE DIVISION
P. O. BOX 284, ELMIRA, NEW YORK

NOVEMBER, 1965

INDEX TO WESTINGHOUSE DATA BOOK FOR ENTERTAINMENT RECEIVING AND TELEVISION PICTURE TUBES

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November 17, 1958

MEDIUM-MU TRIODE TYPES 2AF4, 2AF4-A, 3AF4-A, 6AF4 AND 6AF4-A

The 2AF4, 2AF4-A, 3AF4-A, 6AF4 and 6AF4-A are miniature 7-pin medium-mu triodes designed for local oscillator service in television receivers which operate in the ultra-high-frequency region. Internal lead inductance is reduced by employing double connections to the plate and grid.

The 2AF4, 2AF4-A and 3AF4-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:

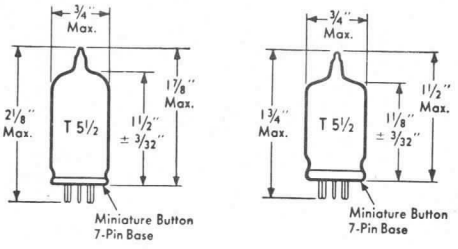
Cathode			Coated Unipotential	
Heater:	2AF4 2AF4-A	3AF4-A	6AF4 6AF4-A	
Voltage (ac or dc)	2.35	3.2	6.3	Volts
Current	0.6 §	0.45 §	225	Ampere
Warm-Up Time●	11	11	-	Seconds
Direct Interelectrode Capacitances:				
Grid to Plate□			1.9	uuf
Input□			2.2	uuf
Output□			1.4	uuf
Heater to Cathode▲			2.2	uuf
Resonant Frequency (approx.)			1000	Mc.

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Basing	7DK
Mounting Position	Any
Outline:	
2AF4, 6AF4	5-2
2AF4-A, 3AF4-A, 6AF4-A	5-1

● Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current

§ ± 6%



UHF OSCILLATOR SERVICE

MAXIMUM RATINGS:

Design Maximum Values

DC Plate Voltage	150	max.	Volts
DC Grid Voltage	-50	max.	Volts
DC Grid Current	2	max.	Ma.
Plate Input	2.5	max.	Watts
Plate Dissipation	2.5	max.	Watts
DC Cathode Current	24	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	50	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	25	max.	Volts
Total DC + Peak	50	max.	Volts
Grid-Circuit Resistance:			
Fixed-Bias Operation	Not Recommended		
Cathode-Bias Operation	0.5	max.	Megohm

TYPICAL OPERATION at 1000 Mc:

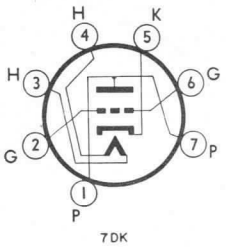
	at	
Plate Supply Voltage	100	Volts
Plate Resistor	220	Ohms
Grid Resistor	10000	Ohms
Plate Current	17	Ma.
Grid Current	750	uamp

CHARACTERISTICS as Class A Amplifier:

Plate Voltage	80	Volts
Cathode Bias Resistor	150	Ohms
Amplification Factor	13.5	
Plate Resistance	2100	Ohms
Transconductance	6500	umhos
Plate Current	17.5	Ma.

□ JETEC Shield No. 316 connected to Pin 5

▲ JETEC Shield No. 316 connected to Pin 1



7DK

Supersedes 2AF4 Data Sheet Dated November 5, 1954
Supersedes 2AF4-A Data Sheet Dated April 1, 1955
Supersedes 6AF4 Data Sheet Dated May 1, 1954
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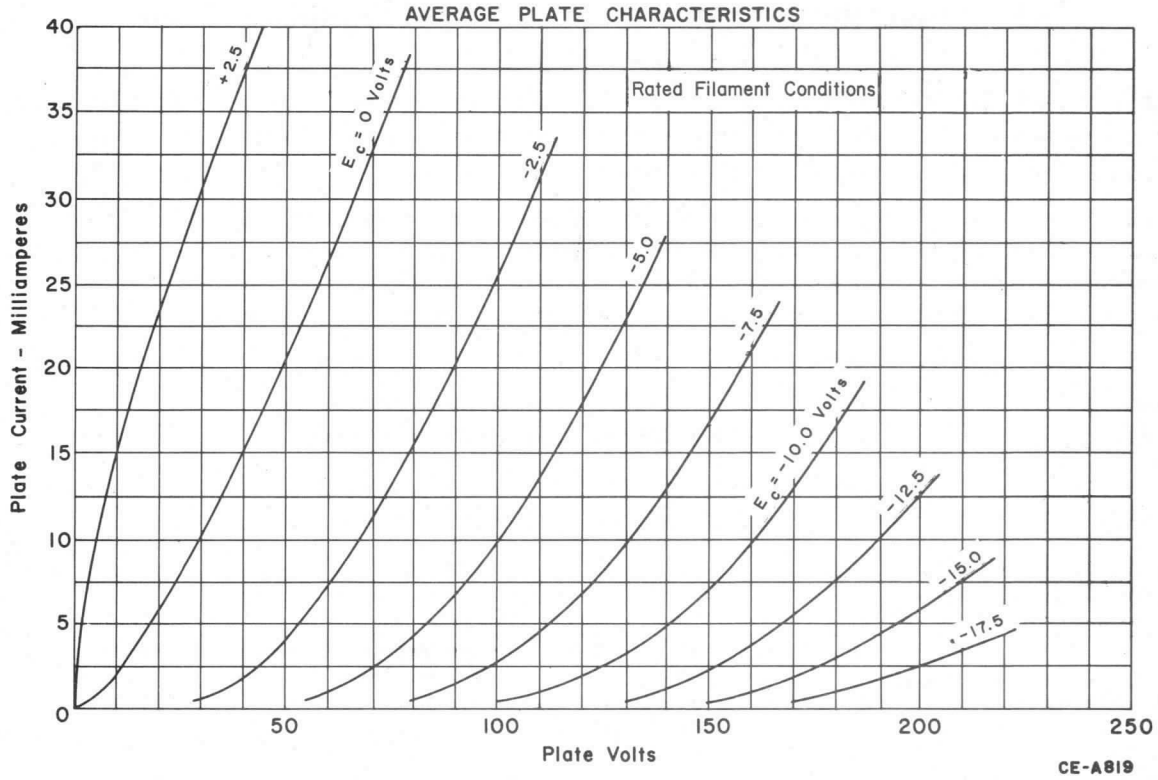
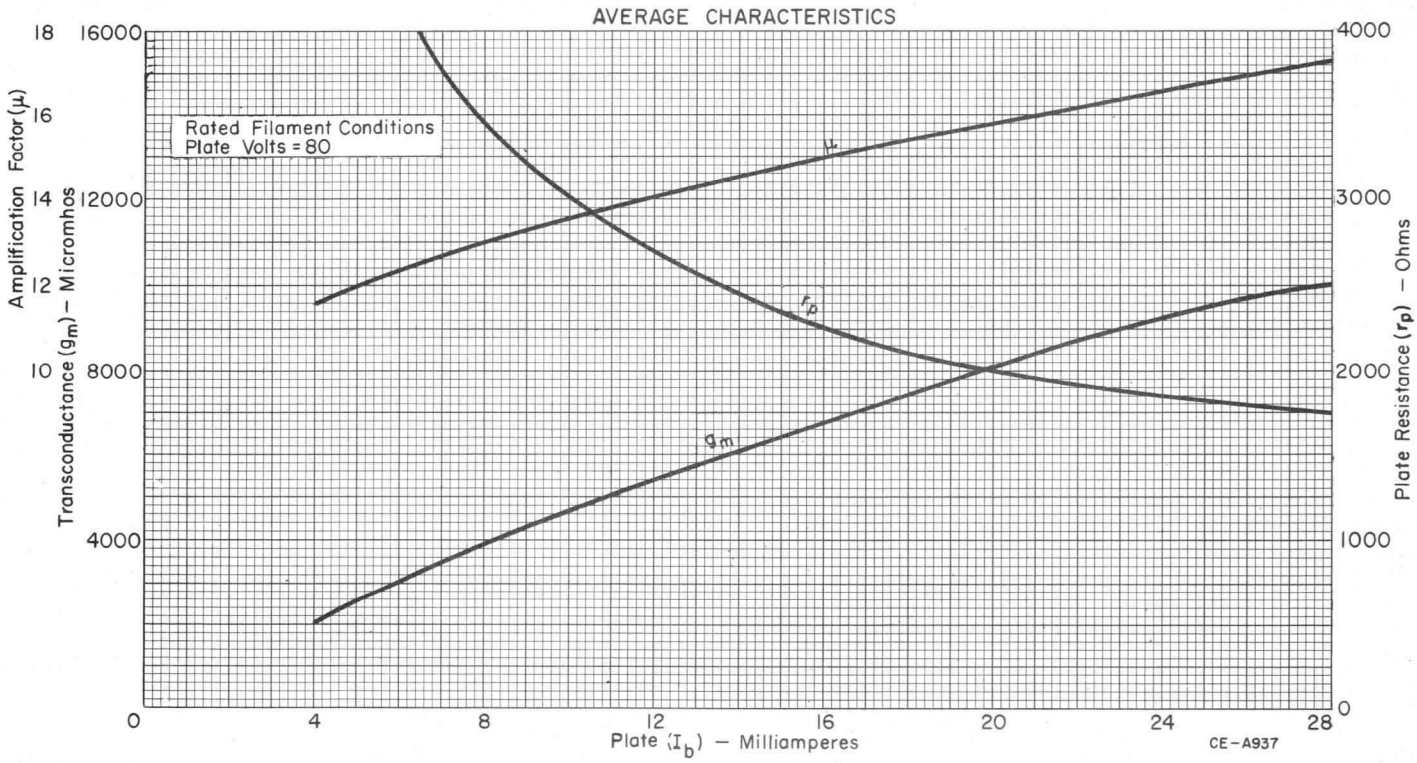

AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Plate Current - Milliamperes
Plate Volts
+2.5
Ec = 0 Volts
-2.5
-5.0
-7.5
Ec = -10.0 Volts
-12.5
-15.0
-17.5
0
5
10
15
20
25
30
35
40
50
100
150
200
250
CE-A819


AVERAGE CHARACTERISTICS
Rated Filament Conditions
Plate Volts = 80
Amplification Factor (μ)
Transconductance (gm) - Micromhos
Plate Resistance (rp) - Ohms
μ
rp
gm
18
16
14
12
10
16000
12000
8000
4000
4000
3000
2000
1000
0
4
8
12
16
20
24
28
Plate (Ib) - Milliamperes
CE-A937

Sept. 10, 1954

R-F Amplifier Pentode Type 6AG5

The 6AG5 is a 7-pin miniature sharp-cutoff pentode designed for service as an r-f or i-f amplifier up to 400 mc. The 6AG5 features two cathode leads which help isolate the input and output circuits thus minimizing degeneration.

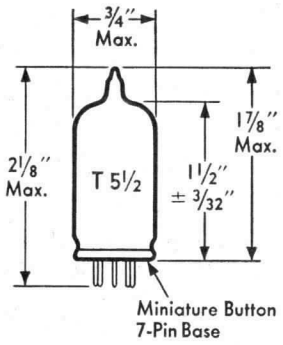
GENERAL DATA

Electrical:

Cathode	Coated Unipotential	
Heater		
Voltage	6.3 ac or dc	Volts
Current	0.3	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid to Plate	0.030 max.	μμf
Input	6.5	μμf
Output	1.8	μμf

Mechanical:

Bulb	T-5½
Base	Miniature Button 7-Pin
Basing	7BD
Mounting Position	Any



CE-A552

MAXIMUM RATINGS

Design Center Values

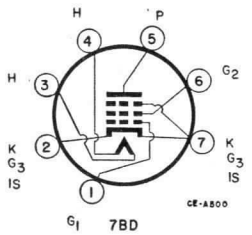
	Triode Connection	Pentode Connection	
Plate Voltage	300	300 max.	Volts
Screen Voltage	*	150 max.	Volts
Plate Dissipation	2.5	2.0 max.	Watts
Screen Dissipation	—	0.5 max.	Watts
Heater-Cathode Voltage	90	90 max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

Amplifier - Class A_1

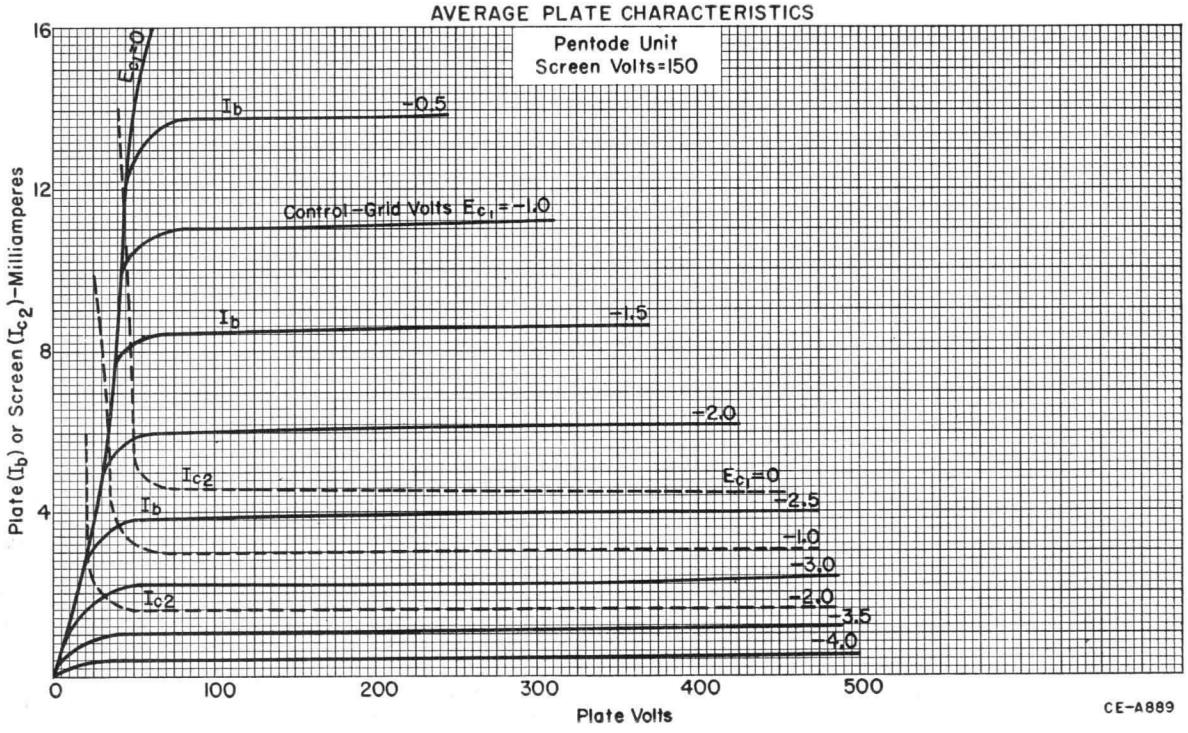
	Triode Connection		Pentode Connection			
Plate Voltage	180	250	100	125	250	Volts
Screen Voltage	*	*	100	125	150	Volts
Cathode Bias Resistor	350	825	100	100	200	Ohms
Suppressor	Connected to Cathode Internally					
Amplification Factor	45	42	—	—	—	
Transconductance	5700	3800	4750	5100	5000	μmhos
Plate Resistance (Approx.)	7900	11000	300000	500000	800000	Ohms
Plate Current	7.0	5.5	5.5	7.2	7.0	Ma.
Screen Current	—	—	1.6	2.1	2.0	Ma.
Grid Bias for I_b = 10 μa	—	—	−5	−6	−8	Volts

* Screen Connected to Plate.

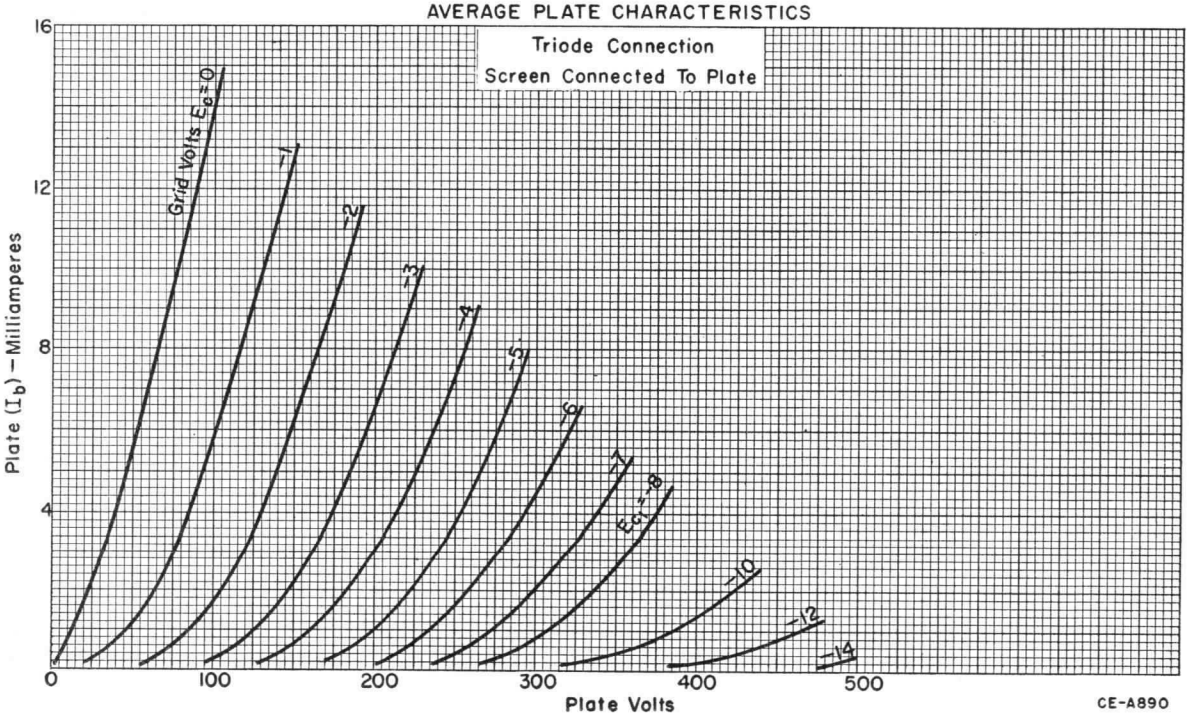


BOTTOM VIEW

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



Westinghouse

3AL5
6AL5
12AL5

April 1, 1961

TWIN DIODE TYPES 3AL5, 6AL5 AND 12AL5

The 3AL5, 6AL5 and 12AL5 are miniature 7-pin twin diode types designed for service as detectors in FM and television circuits as well as automatic-volume-control rectifiers. They are also used as ratio detectors in a-c operated FM receivers. Each diode can be used independently of the other or combined in parallel or full-wave connection. The resonant frequency of each section is approximately 700 megacycles per second.

The 3AL5 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	3AL5	6AL5	12AL5	
Voltage (ac or dc)	3.15	6.3 ± 10%	12.6	Volts
Current	0.60	0.30	0.15	Ampere
Warm-up Time (Approx.) ▲	11	--	--	Seconds
Direct Interelectrode Capacitances:				
		Shielded ★	Unshielded	
Plate 1 to Cathode 1, Heater, and Internal Shield †		3.2	2.5	μμf
Plate 2 to Cathode 2, Heater, and Internal Shield ††		3.2	2.5	μμf
Cathode 1 to Plate 1, Heater, and Internal Shield †		3.6	3.4	μμf
Cathode 2 to Plate 2, Heater, and Internal Shield ††		3.6	3.4	μμf
Plate 1 to Plate 2 (Grounded Shield) (Max.)		.026	.068	μμf

MECHANICAL:

Bulb	T-5-1/2
Base	Small-Button Miniature 7-Pin
Basing	6BT
Mounting Position	Any

MAXIMUM RATINGS:

Design Maximum Values			
Peak Inverse Plate Voltage	330	max.	Volts
Peak Plate Current per Plate	54	max.	Ma.
DC Output Current per Plate	9	max.	Ma.
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	330	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

HALF-WAVE RECTIFIER ★★

Characteristics and Typical Operation			
AC Voltage per Plate (RMS)	117		Volts
Minimum Total Effective Plate Supply Impedance per Plate	300		Ohms
DC Output Current per Plate	9		Ma.

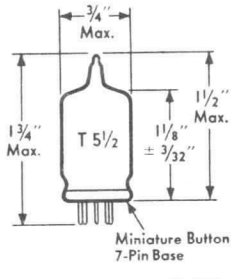
★★ Units used separately or in parallel.

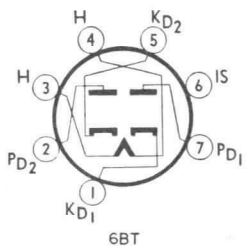
★ External Shield No. 316 tied to pin 6.

† Ground Plate and Cathode Unit 2.

†† Ground Plate and Cathode Unit 1.

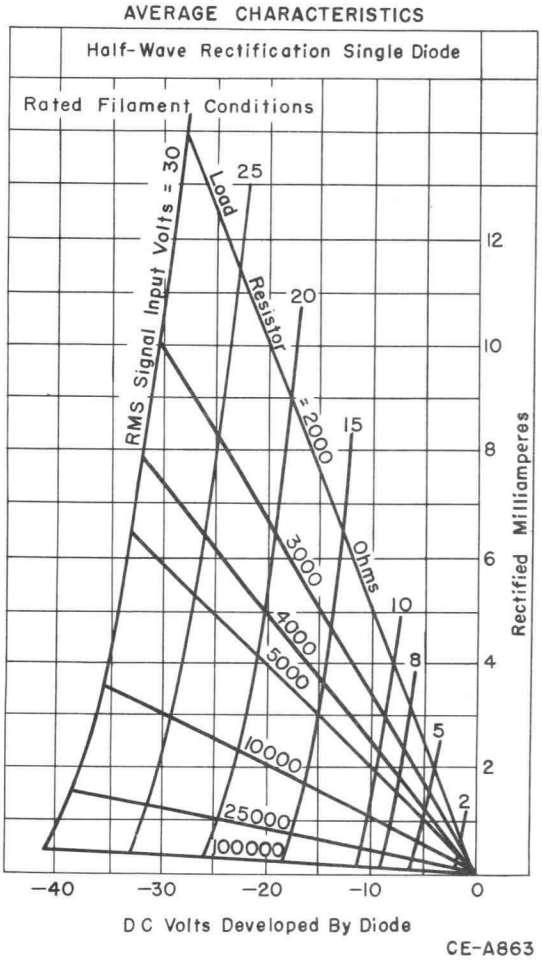
▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

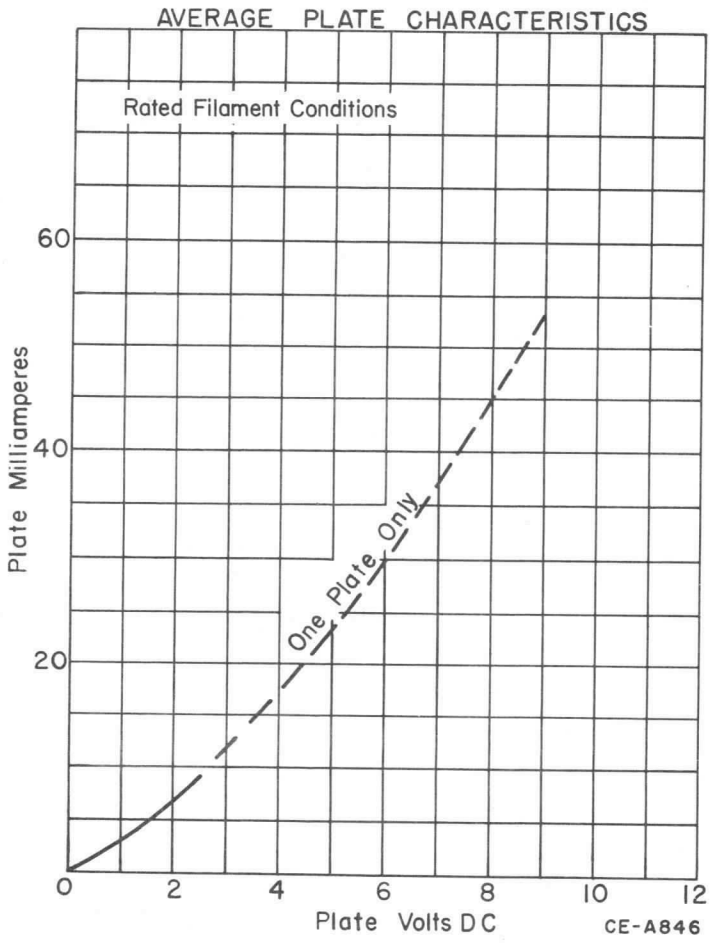




6BT

Westinghouse





Westinghouse®

5AN8
6AN8
6AN8A

August 15, 1962

MEDIUM-MU TRIODE–SHARP CUT-OFF PENTODE TYPES 5AN8, 6AN8 AND 6AN8A

The 5AN8, 6AN8 and 6AN8A are 9-pin miniature triode-pentode types designed for service in television receivers. The high transconductance pentode unit may be used as an i-f amplifier, video amplifier, agc amplifier and reactance tube. The triode unit may be used in low-frequency oscillator, sync separator, sync clipper and phase splitter circuits. The tube is designed so that coupling between the triode and pentode units is held to a minimum.

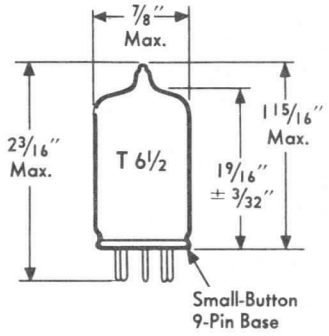
The 5AN8 and 6AN8A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

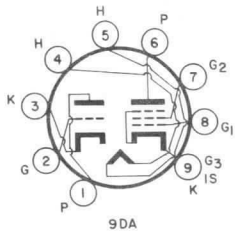
ELECTRICAL

Cathodes			Coated Unipotential	
Filament:	5AN8	6AN8	6AN8A	
Voltage (ac or dc)	4.7	6.3	6.3	Volts
Current	0.60	0.45	0.45	Ampere
Warm-up Time (Note 1)	11	–	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Triode Unit:				
Grid to Plate			1.5	μμf
Input			2.0	μμf
Output			0.26	μμf
Pentode Unit:				
Grid 1 to Plate			0.04 max.	μμf
Input			7.0	μμf
Output			2.4	μμf
Triode Grid to Pentode Plate			0.02 max.	μμf
Pentode Grid 1 to Triode Plate			0.02 max.	μμf
Pentode Plate to Triode Plate			0.15 max.	μμf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9DA
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330 max.	Volts
Grid 2 Supply Voltage	–	330 max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Chart	
Grid 1 Voltage			
Positive Bias Value	0	0 max.	Volts
Plate Dissipation	2.8	2.3 max.	Watts
Grid 2 Input	–	0.55 max.	Watt
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	200 max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	100 max.	Volts
Total DC + Peak	200	200 max.	Volts

MAXIMUM CIRCUIT VALUES

Grid 1 Circuit Resistance			
Cathode-Bias Operation	1.0	1.0 max.	Megohm
Fixed-Bias Operation	0.5	0.25 max.	Megohm

TYPICAL OPERATING CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Supply Voltage	150	125	Volts
Grid 2 (Screen) Supply Voltage	–	125	Volts
Grid 1 (Control-Grid) Voltage	–3	–	Volts
Cathode-Bias Resistor	–	56	Ohms
Amplification Factor	21	–	–
Plate Resistance (Approx.)	4700	170000	Ohms
Transconductance	4500	7800	μmhos
Grid 1 Bias Cutoff (Note 2)	–17	–6	Volts
Plate Current	15	12	Ma.
Grid 2 Current	–	3.8	Ma.
Plate Current at Grid Volts = –3	–	1.6	Ma.

PRINTED IN U.S.A.

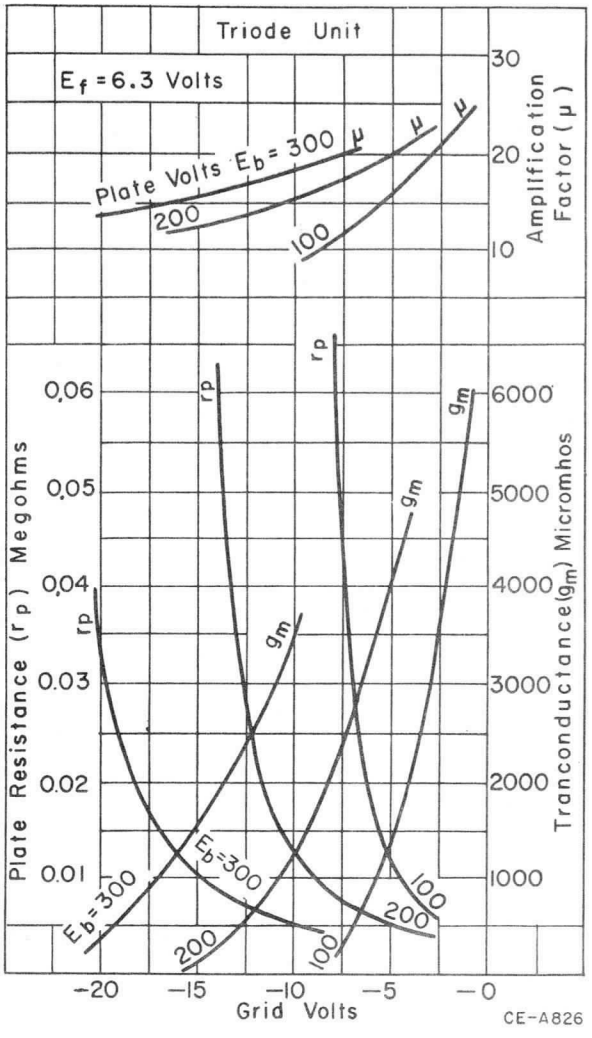
Receiving Tube Section

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

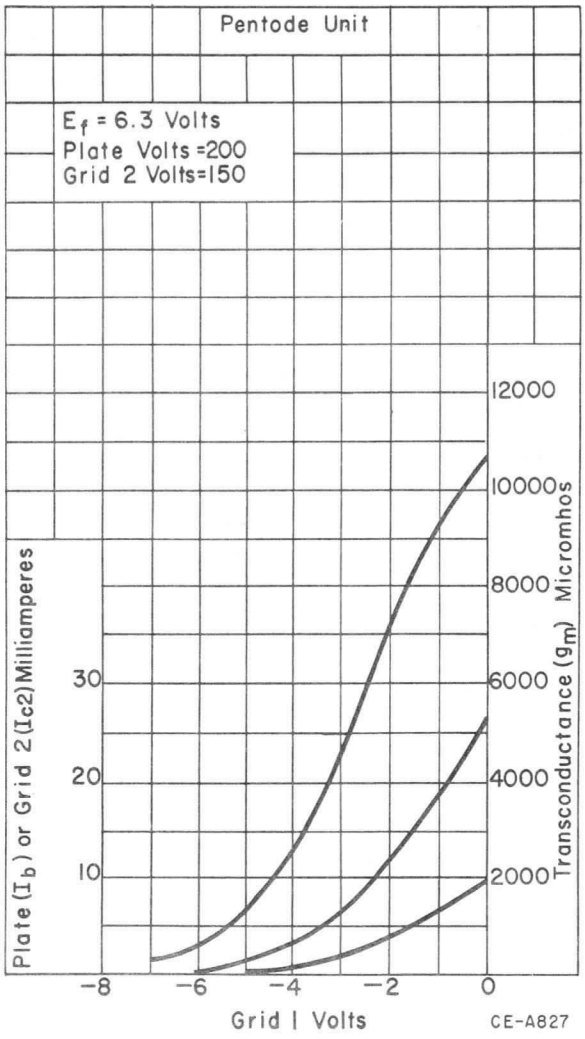
NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. For plate current of 20 microamperes.

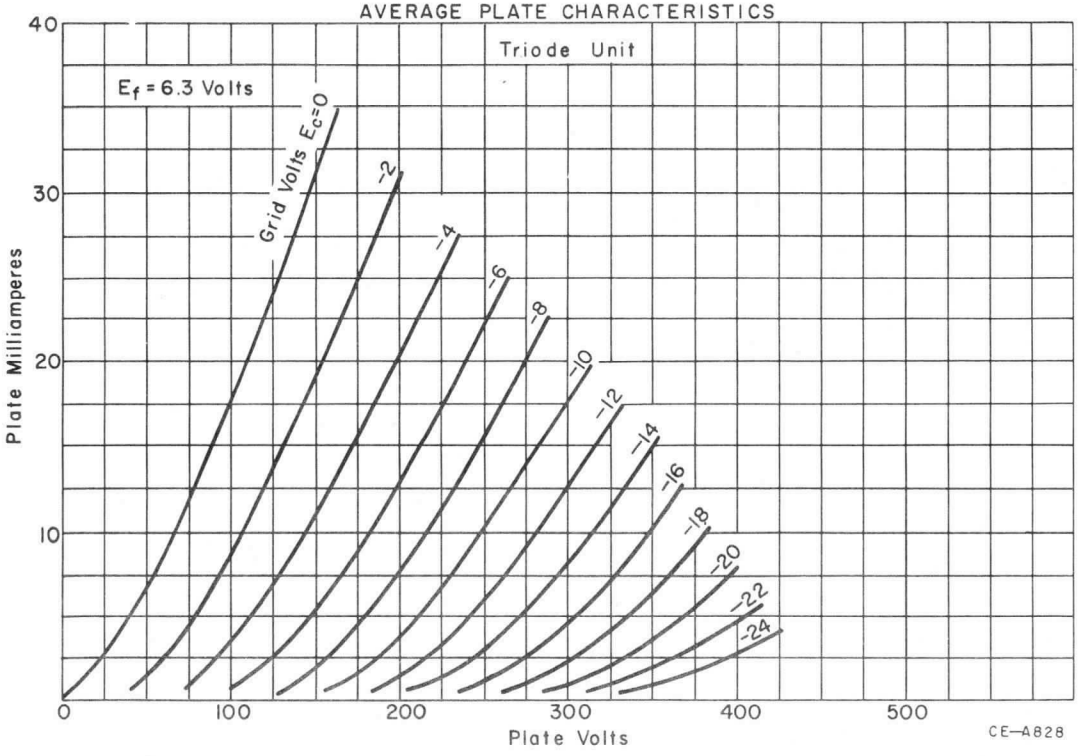
AVERAGE CHARACTERISTICS



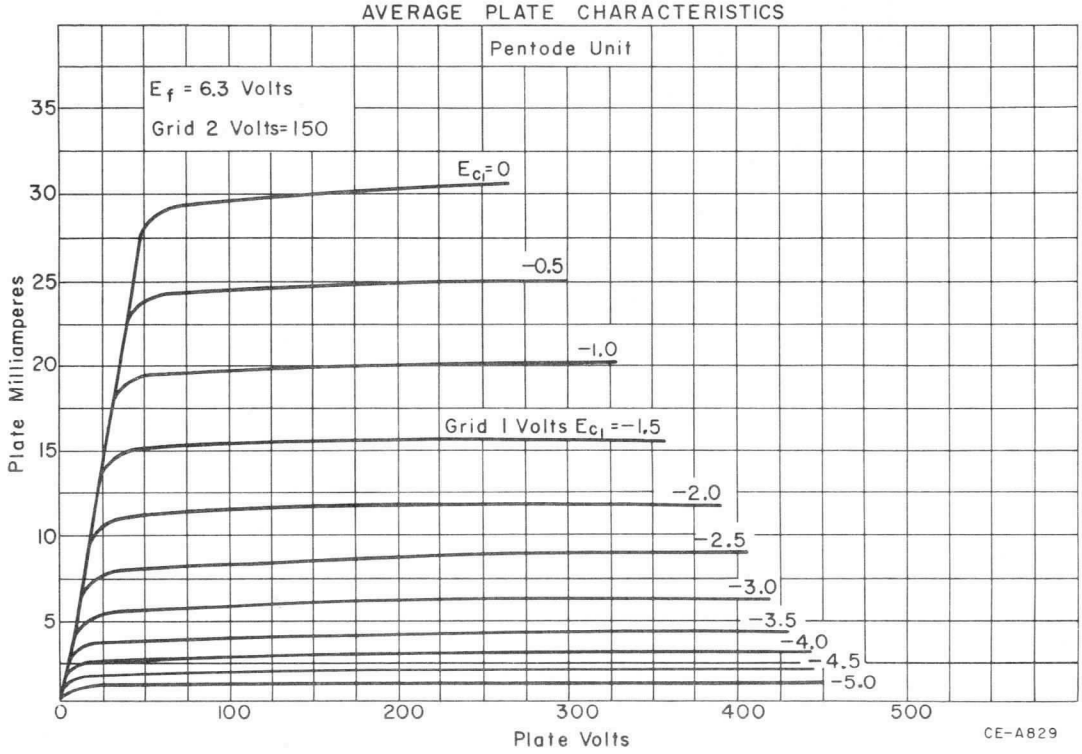
AVERAGE CHARACTERISTICS

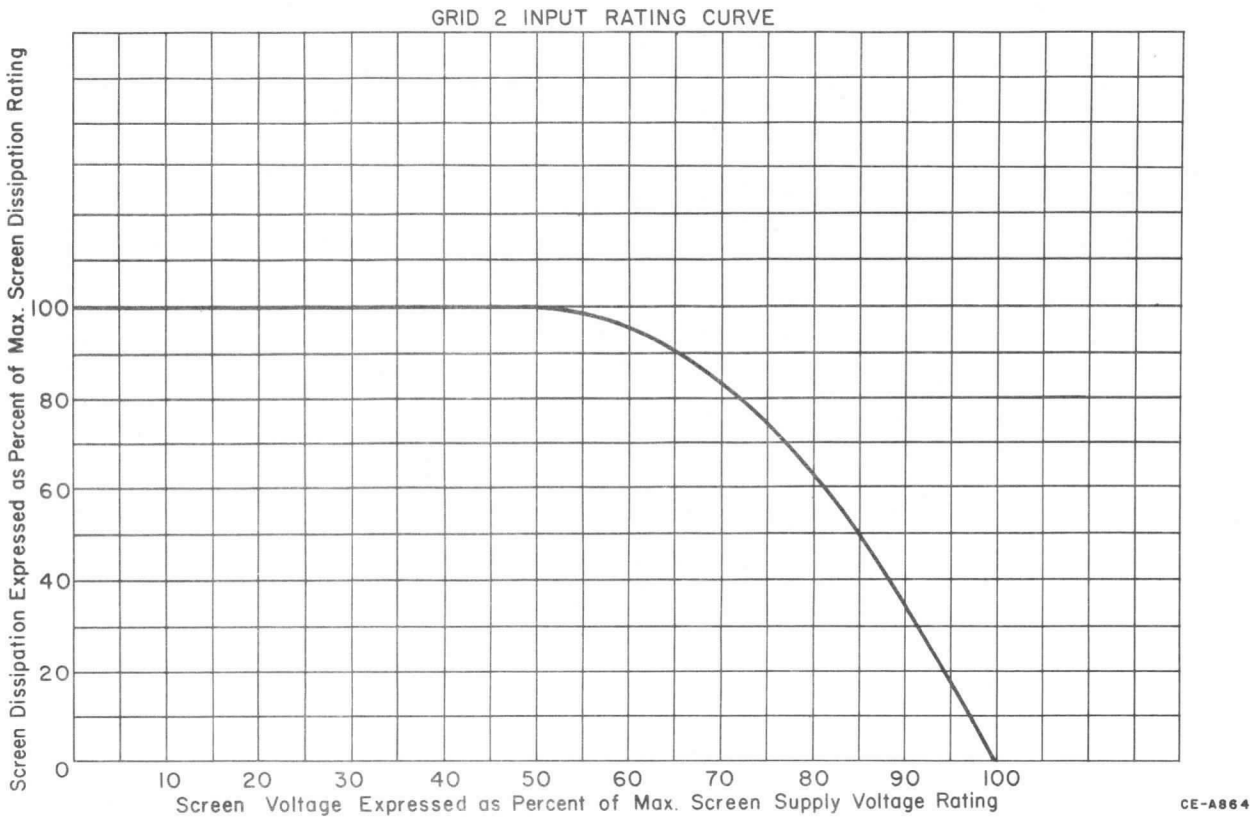


AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS





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October 1, 1958

BEAM POWER AMPLIFIER TYPES 5AQ5, 6AQ5, 6AQ5-A AND 12AQ5

The 5AQ5, 6AQ5, 6AQ5-A and 12AQ5 are miniature 7-pin beam power pentode types designed for service as audio output amplifiers in home or automobile receivers. They may also be used as vertical deflection amplifiers in television receiver sweep circuits.

The 5AQ5 and 6AQ5-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

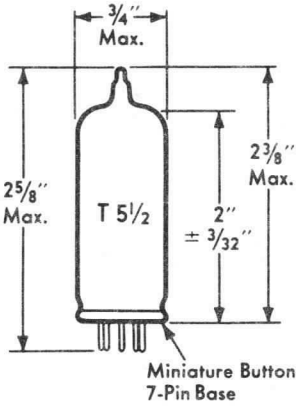
GENERAL DATA

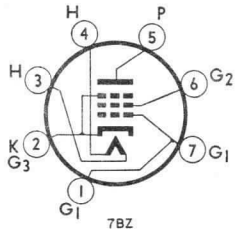
ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	5AQ5	6AQ5 6AQ5-A	12AQ5	
Voltage (ac or dc)	4.7	6.3	12.6	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time▲	11	11●	-	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid 1 to Plate			0.35	uuf
Input			8.3	uuf
Output			8.2	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	7-Pin Miniature (JETEC E7-1)
Outline	5-3
Basing	7BZ
Mounting Position	Any





AF POWER AMPLIFIER - CLASS A

MAXIMUM RATINGS:

Design Center Values

Plate Voltage			250	max.	Volts
Grid 2 Voltage (Screen)			250	max.	Volts
Plate Dissipation			12	max.	Watts
Grid 2 Dissipation			2	max.	Watts
Heater-Cathode Voltage:	5AQ5 6AQ5-A	6AQ5	12AQ5		
Heater Negative with Respect to Cathode:					
Total DC + Peak	200	90	100	max.	Volts
Heater Positive with Respect to Cathode:					
DC Component	100	-	100	max.	Volts
DC + Peak	200	90	100	max.	Volts
Bulb Temperature□					250° C
Grid 1 Circuit Resistance:					
Fixed Bias			0.1	max.	Megohm
Cathode Bias			0.5	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	180	250	Volts
Grid 2 Voltage	180	250	Volts
Control Grid Voltage	-8.5	-12.5	Volts
Peak AF Control Grid Voltage	8.5	12.5	Volts
Zero-Signal Plate Current	29	45	Ma.
Max.-Signal Plate Current	30	47	Ma.
Zero-Signal Grid 2 Current	3	4.5	Ma.
Max.-Signal Grid 2 Current	4	7	Ma.
Plate Resistance, approx.	58000	52000	Ohms
Transconductance	3700	4100	umhos
Load Resistance	5500	5000	Ohms
Power Output	2.0	4.5	Watts
Total Harmonic Distortion, approx.	8	8	Percent

Supersedes 5AQ5 Data Sheet Dated November 5, 1954
Supersedes 6AQ5 Data Sheet Dated July 1, 1954
Supersedes 12AQ5 Data Sheet Dated April 1, 1955

Receiving Tube Section

AF POWER AMPLIFIER - CLASS AB1

MAXIMUM RATINGS:

Design Center Values

Plate Voltage		250	max.	Volts
Grid 2 Voltage		250	max.	Volts
Plate Dissipation		12	max.	Watts
Grid 2 Dissipation		2	max.	Watts
Heater-Cathode Voltage:	5AQ5 6AQ5 6AQ5-A / 12AQ5			
Heater Negative with Respect to Cathode:				
Total DC + Peak	200 / 90	100	max.	Volts
Heater Positive with Respect to Cathode:				
DC Component	100 / -	100	max.	Volts
DC + Peak	200 / 90	100	max.	Volts
Bulb Temperature□		250	max.	°C
Grid 1 Circuit Resistance:				
For Fixed Bias		0.1		Megohm
For Cathode Bias		0.5		Megohm

TYPICAL PUSH-PULL OPERATION

(Values for two tubes unless otherwise specified)

Plate Voltage	250	Volts
Grid 2 Voltage	250	Volts
Grid 1 Voltage	-15	Volts
Peak AF Grid-to-Grid Voltage	30	Volts
Transconductance (per tube)	3750	umhos
Zero Signal Plate Current	70	Ma.
Max. Signal Plate Current	79	Ma.
Zero Signal Screen Current	5.0	Ma.
Max. Signal Screen Current	13	Ma.
Plate Resistance (per tube)	60000	Ohms
Effective Load Resistance:		
Plate-to-Plate	10000	Ohms
Total Harmonic Distortion	5	Percent
Power Output	10	Watts

VERTICAL DEFLECTION AMPLIFIER§

Triode Connection #

MAXIMUM RATINGS:

Design Center Values, except as noted

Plate Voltage	315			Volts
Peak Positive Plate Voltage	1200	abs.	max.	Volts
Plate Dissipation♦	9		max.	Watts
Peak Negative Grid Voltage	250		max.	Volts
Average Cathode Current	35		max.	Ma.
Peak Cathode Current	105		max.	Ma.
Grid Circuit Resistance Cathode Bias	2.2		max.	Megohms

TRIODE CONNECTED CHARACTERISTICS:

Plate Voltage	250	Volts
Grid Voltage	-12.5	Volts
Plate Current	49.5	Ma.
Transconductance	5000	umhos
Amplification Factor	9.8	
Plate Resistance	1960	Ohms
Grid Voltage, approx.:		
for I_b = 0.5 ma.	-36	Volts

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

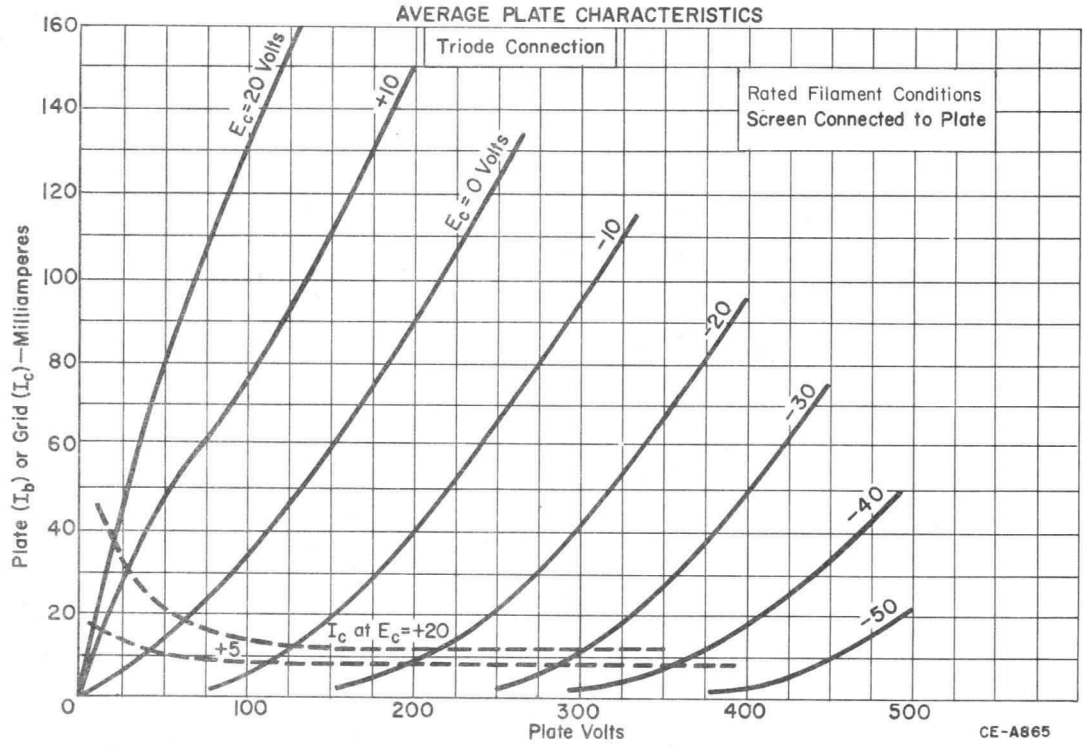
♦ Stages operating with grid leak bias must use an adequate cathode bias resistor or similar means in order to protect the tube in the absence of excitation.

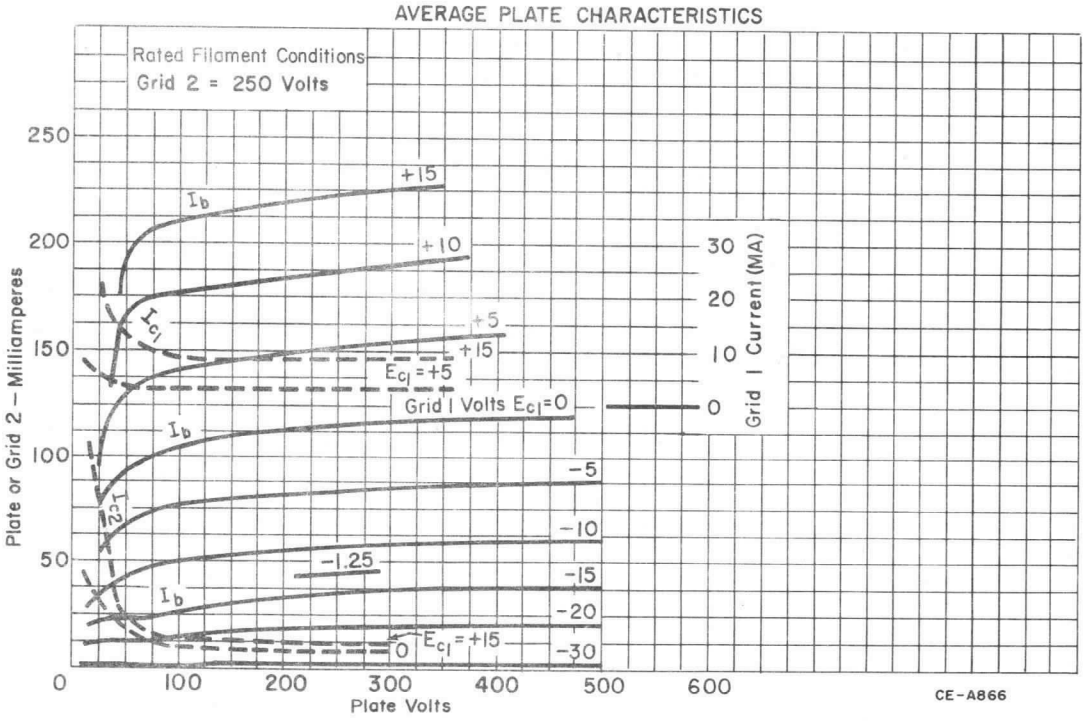
● Applies to 6AQ5-A only.

§ For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle.

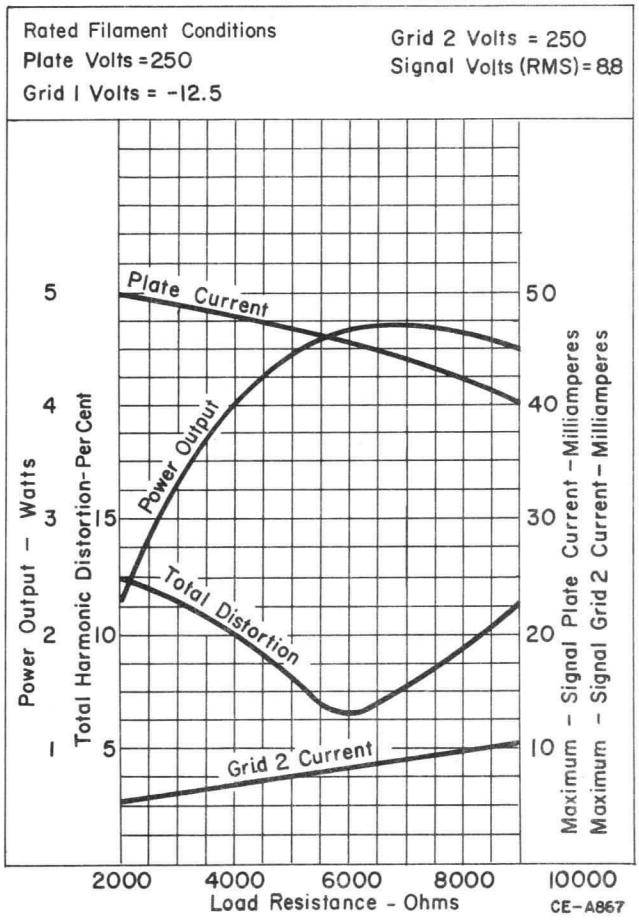
Plate and grid 2 tied together.

□ High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.


AVERAGE PLATE CHARACTERISTICS
Triode Connection
Rated Filament Conditions
Screen Connected to Plate
Plate (I_b) or Grid (I_c) — Milliamperes
Plate Volts
E_c=20 Volts
+10
E_c=0 Volts
-10
-20
-30
-40
-50
I_c at E_c=+20
+5
CE-A865


AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Grid 2 = 250 Volts
Plate or Grid 2 — Milliamperes
Plate Volts
Grid 1 Current (MA)
I_b
I_{c1}
+15
+10
+5
E_{c1}=+5
Grid 1 Volts E_{c1}=0
-5
-10
-1.25
-15
-20
-30
E_{c1}=+15
0
CE-A866

OPERATION CHARACTERISTICS



FULL-WAVE VACUUM RECTIFIER TYPE 5AS4A

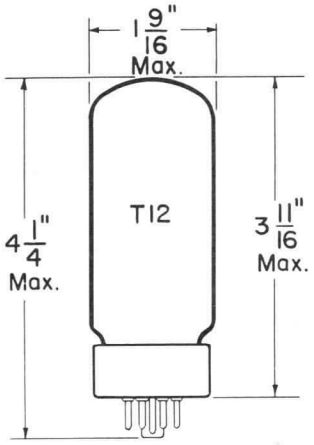
The 5AS4A is a glass-octal full-wave high-vacuum rectifier designed for service in power supplies of equipment requiring high current. The tube should be mounted vertically, but horizontal mounting is permissible if pins 1 and 4 are in a vertical plane. Like all power handling tubes, the 5AS4A should be adequately ventilated.

ELECTRICAL

Cathode	Coated Filament	
Heater:		
Voltage (ac or dc)	5.0	Volts
Current	3.0	Amperes

MECHANICAL

Bulb	T-12
Base	Short Medium Shell Octal 5-Pin (JEDEC B5-121) Short Medium Shell Octal 8-Pin (JEDEC B8-118)
Outline	12-15
Basing	5T
Mounting Position	Vertical or Horizontal-with Pins 1 and 4 in Vertical Plane



12-15

RECTIFIER SERVICE

MAXIMUM RATINGS

Design Center Values

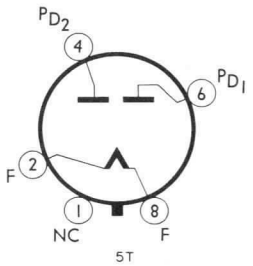
Peak Inverse Plate Voltage	1550 max.	Volts
Maximum AC Plate Supply Voltage		
Each Plate (RMS)	550 max.	Volts
Maximum DC Output Current		
Each Plate	See Chart I	
Steady-State Peak Plate Current		
Each Plate (See Chart II)	1.0 max.	Ampere
Transient Peak Plate Current		
Each Plate (See Chart III)	4.6 max.	Amperes

TYPICAL OPERATION AS FULL-WAVE RECTIFIER

	Input to Filter Capacitor	Input to Filter Choke		
AC Plate Supply Voltage				
Each Plate (RMS)	300	450	550	Volts
Input Capacitor	40	40	–	μf
Input Choke	–	–	10	Henrys
Effective Plate Supply Resistance Each Plate	21	67	–	Ohms
DC Output Current	300	275	275	Ma.
DC Output Voltage at Filter Input	290	460	420	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop		
Tube Conducting		
225 ma. Each Plate	44	Volts
275 ma. Each Plate	50	Volts
300 ma. Each Plate	54	Volts



5T

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the 5AS4A is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are interdependent, and they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and choke-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor input filter, operation is permissible within the area bounded by points F A E D G: with choke-input filter, operation is permissible within the area bounded by points F A B C D G.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined by the equation

$$\text{Rectification Efficiency} = \frac{E}{\sqrt{2}\ E_S}$$

where E is the dc output voltage at input to filter and E_S is the rms plate supply voltage per plate.

Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of

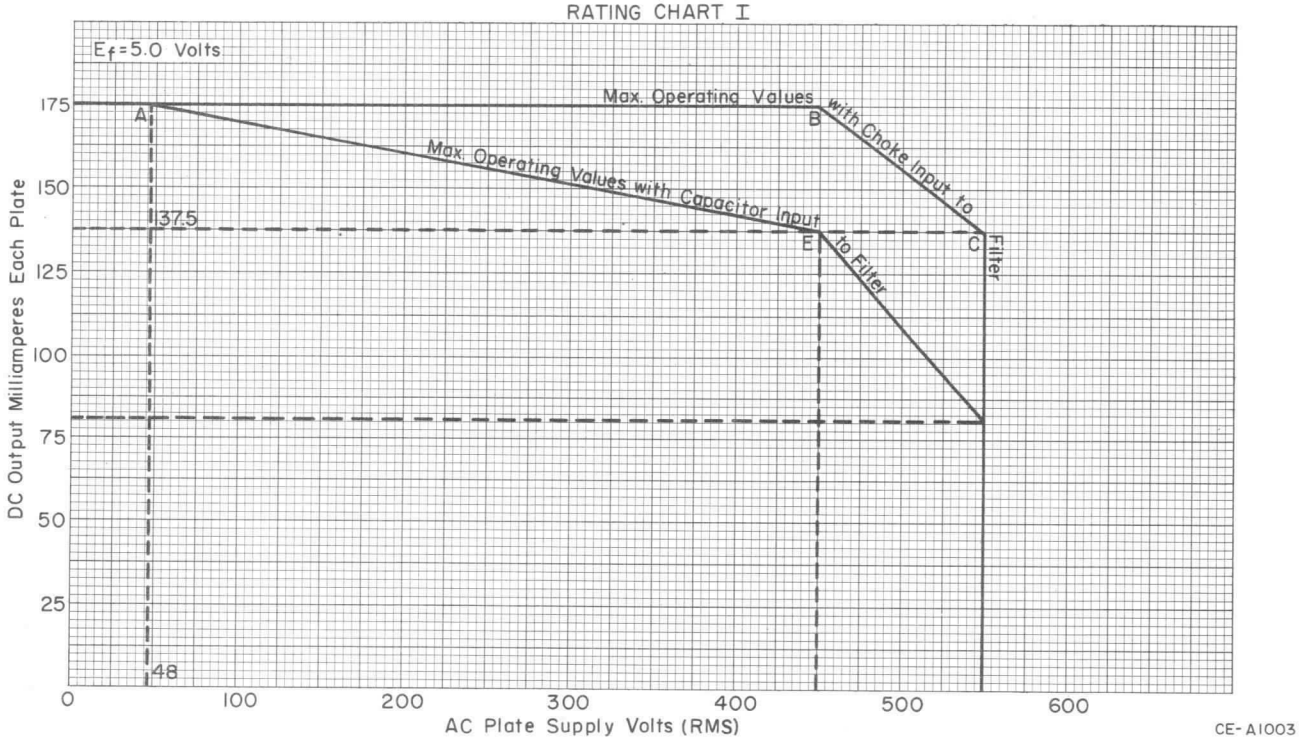
$$R_S = N^2 R_{PRI} + R_{SEC} + R_A$$

where N is the voltage step up ratio of the plate transformer, R_{PRI} is the dc resistance of the transformer primary, R_{SEC} is the average dc resistance of each transformer secondary section, and R_A is the additional resistance required.

In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

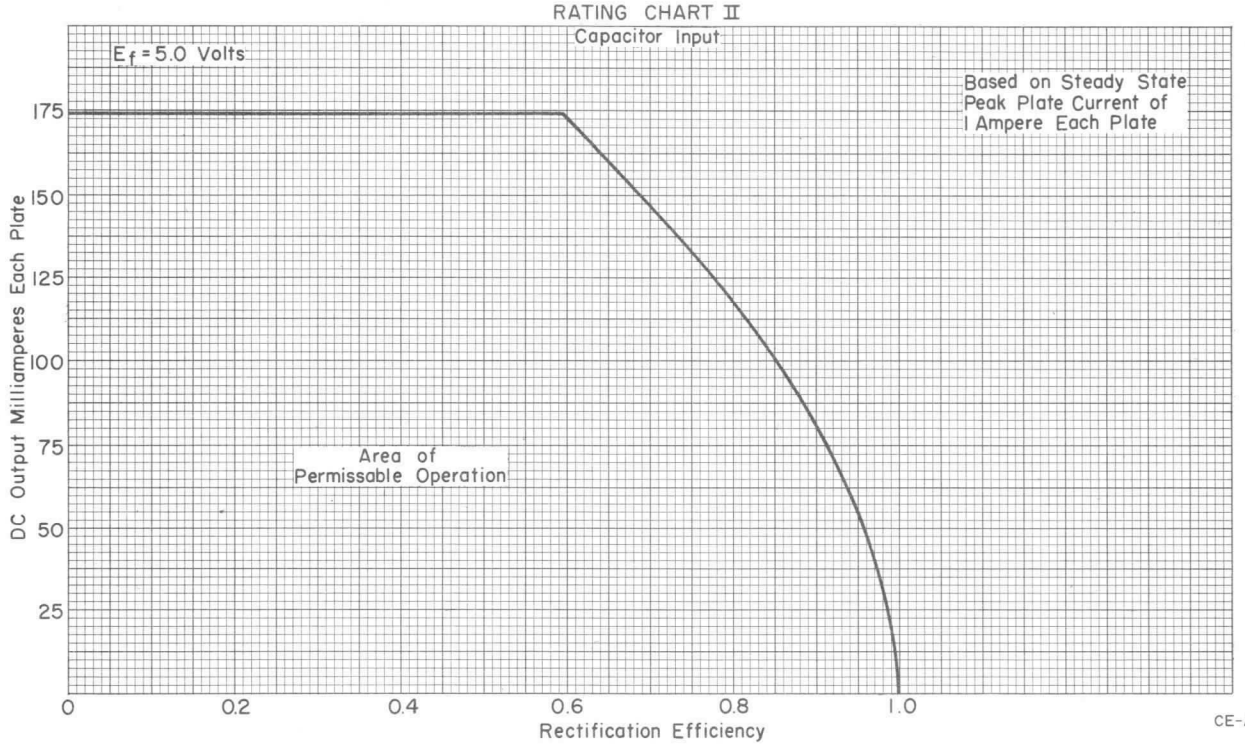
If a capacitor greater than 40 μfd is used the effective plate-supply impedance should be increased to prevent exceeding the maximum peak plate current rating.

RATING CHART I



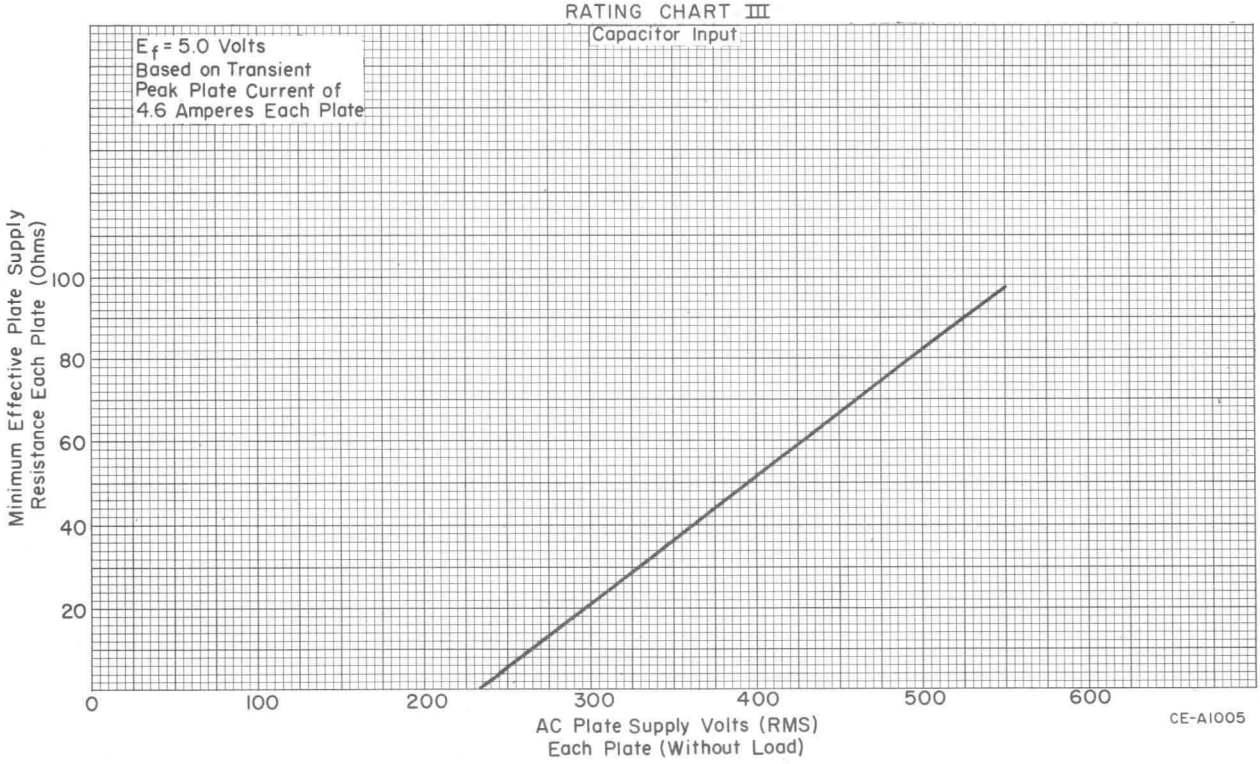
CE-A1003

RATING CHART II
Capacitor Input



CE-A1004

RATING CHART III
Capacitor Input



CE-A1005

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November 19, 1958

TWIN-DIODE HIGH-MU TRIODE TYPES 6AT6 AND 12AT6

The 6AT6 and 12AT6 are 7-pin miniature twin diode and high-mu triode types used as combined detector, amplifier, and AVC tubes in automobile and ac-operated radio receivers.

GENERAL DATA

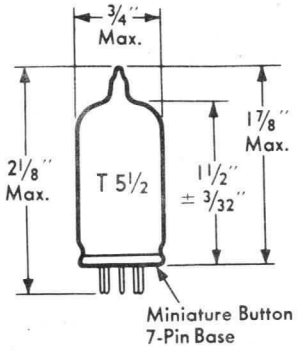
ELECTRICAL:

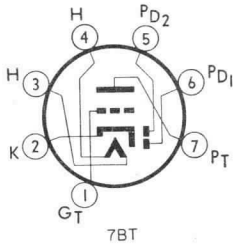
Cathode	Coated Unipotential		
Heater:	6AT6	12AT6	
Voltage (ac or dc)	6.3	12.6	Volts
Current	0.30	0.15	Ampere
Direct Interelectrode Capacitances:			
	Shielded□	Unshielded	
Grid to Plate	2.0	2.0	uuf
Input	2.2	2.2	uuf
Output	1.2	0.8	uuf
Diode Plate No. 2 to Triode Grid	0.04	0.04 max.	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7BT
Mounting Position	Any

□ With external shield No. 316 connected to Pin 2.





7BT

AMPLIFIER - CLASS A

Triode Unit

MAXIMUM RATINGS:
Design-Center Values

Plate Voltage	300	max.	Volts
Grid Voltage:			
Positive Bias Value	0	max.	Volts
Plate Dissipation	0.5	max.	Watts
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	90	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	100	250	Volts
Grid Voltage	-1	-3	Volts
Amplification Factor	70	70	
Plate Resistance (approx.)	54000	58000	Ohms
Transconductance	1300	1200	umhos
Plate Current	0.8	1.0	Ma.

Diode Units

MAXIMUM RATINGS:
Design-Center Values

DC Output Current per Plate	1.0	max.	Ma.
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	90	max.	Volts

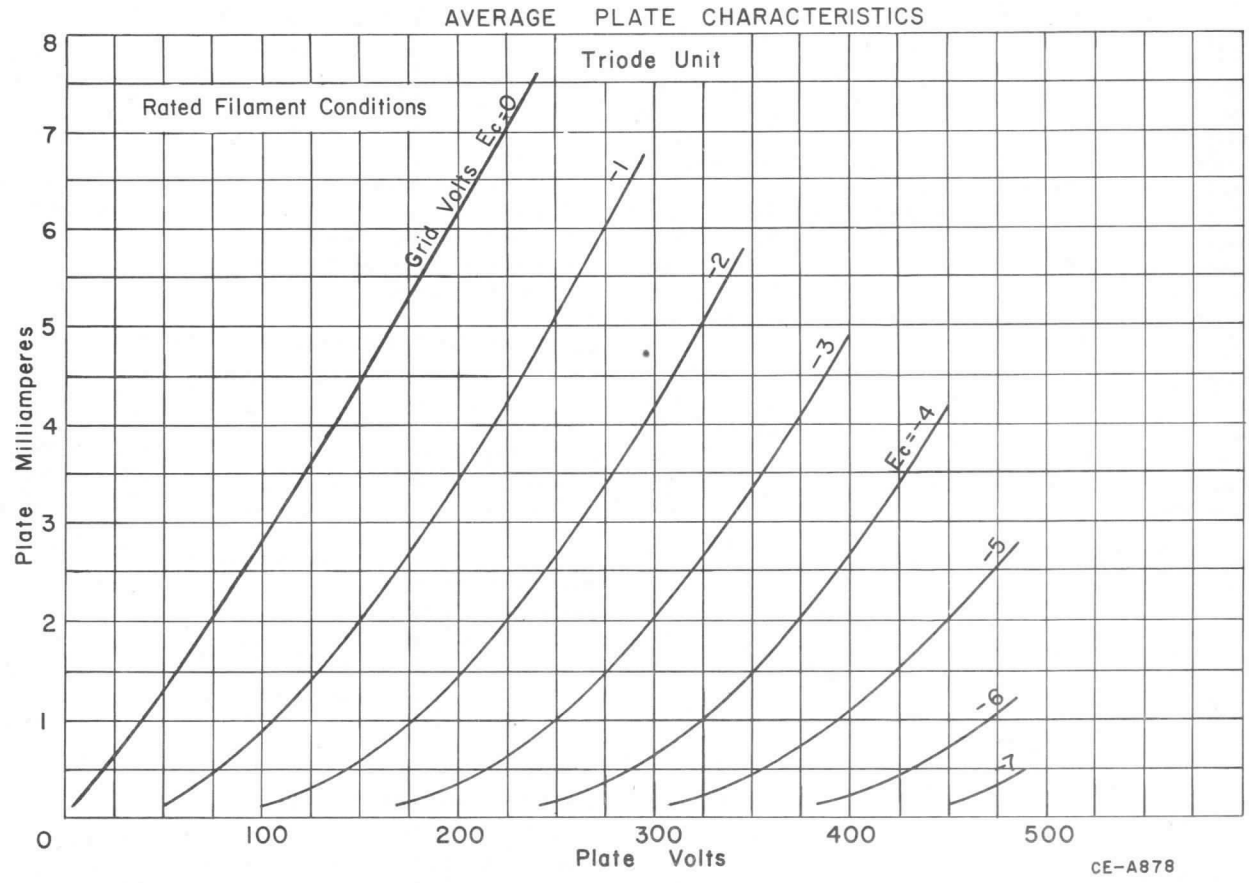
CHARACTERISTICS:

Average Plate Current (Each Unit) with 10VDC	2.0		Ma.

RESISTANCE COUPLED AMPLIFIER DATA:

Plate Supply Voltage	90	250	Volts
Plate Load Resistor	0.22	0.47	Megohm
Grid Voltage	0	0	Volts
Grid Resistor	10	10	Megohms
Coupling Condenser:			
Input	0.01	0.01	uf
Output	0.01	0.01	uf
Grid Resistor of Following Stage	0.47	0.47	Megohm
Max. Signal Source Impedance	1000	1000	Ohms
Distortion	5	5	Percent
Output Voltage	8	34	Volts
Voltage Gain at 400 cps	35	46	Volts

Supersedes 6AT6 Data Sheet Dated October 1, 1954
Supersedes 12AT6 Data Sheet Dated August 5, 1954


AVERAGE PLATE CHARACTERISTICS
Triode Unit
Rated Filament Conditions
Grid Volts Ec=0
-1
-2
-3
Ec=-4
-5
-6
-7
Plate Milliamperes
0
1
2
3
4
5
6
7
8
100
200
300
400
500
Plate Volts
CE-A878

High-Mu Twin-Triode Type 12AT7

The 12AT7 is a 9-pin miniature twin-triode designed for use in compact equipment as a grounded-grid amplifier or frequency converter in the FM and television broadcast bands. Each triode unit is independent of the other except for a common heater. The center-tapped heater permits use on either 6.3 volt or series type heater circuits.

GENERAL DATA

Electrical:

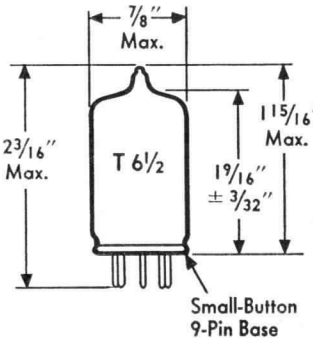
Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage	12.6	6.3	AC or DC Volts
Current	0.15	0.3	Ampere
Direct Interelectrode Capacitances:			
	Unshielded	Shielded*	
Grid to Plate (Each Unit)	1.5	1.5	μμf
Input (Each Unit)	2.2	2.2	μμf
Output (Unit 1)	0.5	1.2	μμf
Output (Unit 2)	0.4	1.5	μμf
Heater to Cathode	2.4	2.4	μμf
Grounded-Grid Operation:	Unshielded	Shielded**	
Plate to Cathode (Each Unit)	0.2	0.2	μμf
Input (Each Unit)	4.6	4.6	μμf
Output (Each Unit)	1.8	2.6	μμf

* With external shield 315 connected to cathode of section under test.

** With external shield 315 connected to grid of section under test.

Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-Pin
Basing	9A
Mounting Position	Any



AMPLIFIER — CLASS A_1

Each Unit

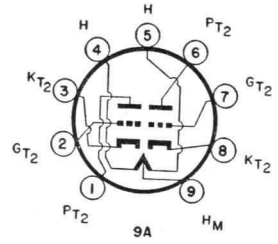
Maximum Ratings

Design-Center Values

Plate Voltage	300 max.		Volts
Plate Dissipation	2.5 max.		Watts
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	90 max.		Volts
Grid Voltage	−50 max.		Volts

Characteristics and Typical Operation

Plate Voltage	100	250	Volts
Cathode Bias Resistor	270	200	Ohms
Plate Current	3.7	10	Ma.
Plate Resistance	15000	10900	Ohms
Amplification Factor	60	60	
Transconductance	4000	5500	μmhos
Grid Voltage (Approx.) for $I_b = 10$ μamp	−5	−12	Volts

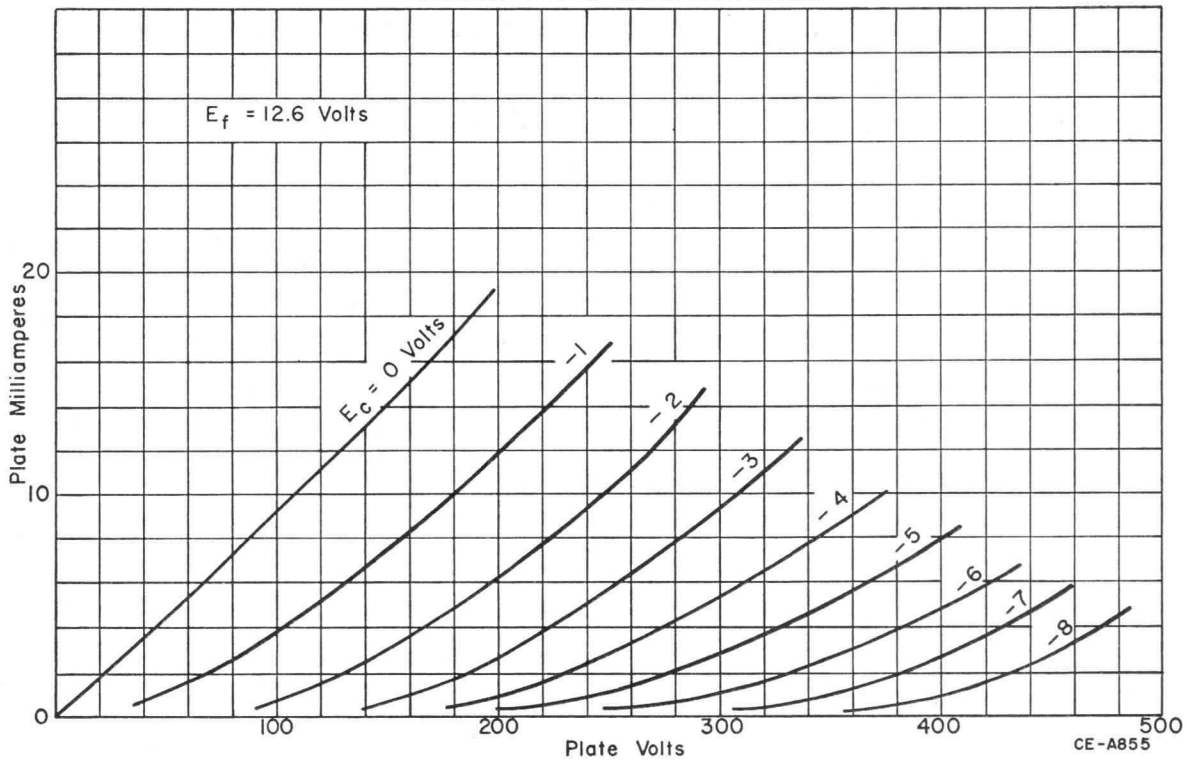


Bottom View

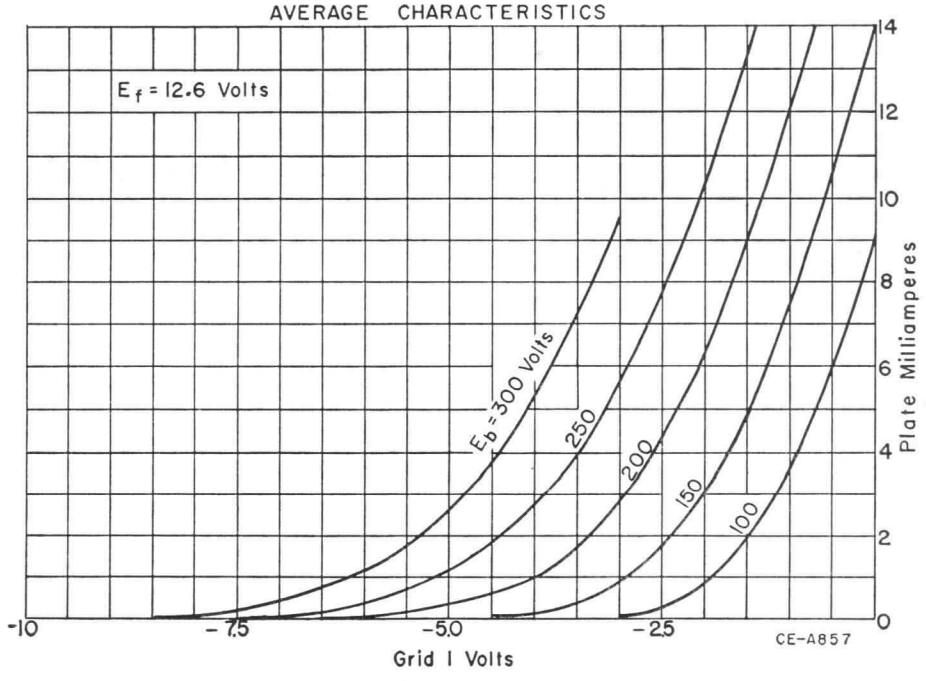
CE-A554

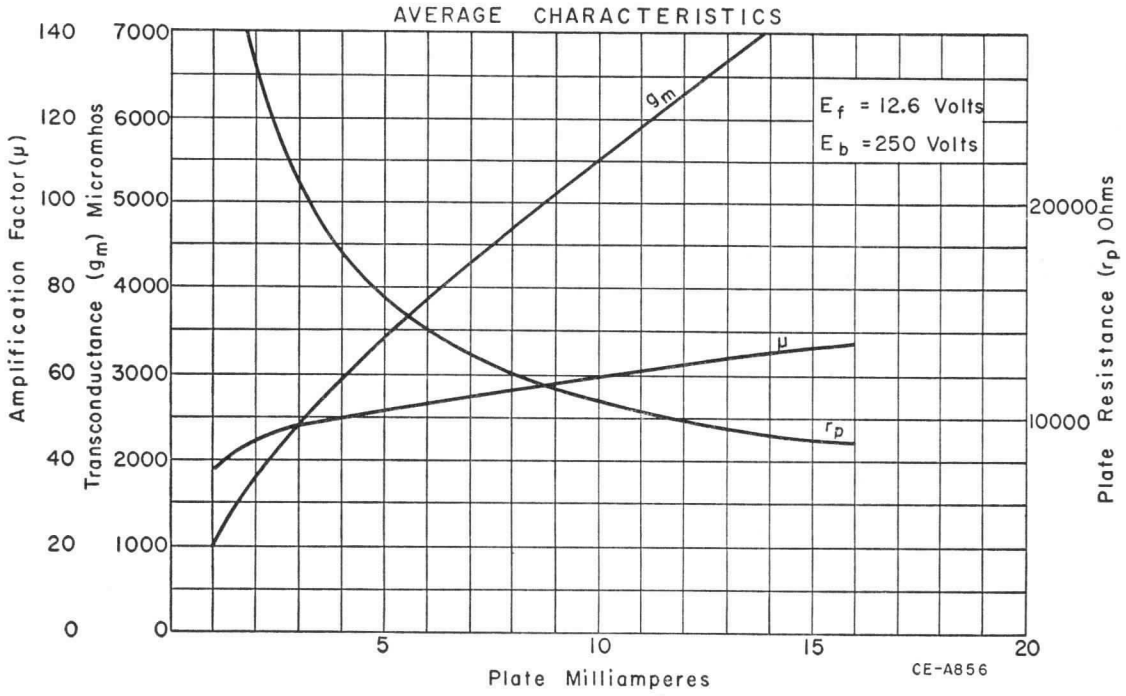
YOU CAN BE SURE ... IF IT'S Westinghouse

AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS




AVERAGE CHARACTERISTICS
Amplification Factor (μ)
Transconductance (g_m) Micromhos
Plate Resistance (r_p) Ohms
Plate Milliamperes
E_f = 12.6 Volts
E_b = 250 Volts
g_m
μ
r_p
140
120
100
80
60
40
20
0
7000
6000
5000
4000
3000
2000
1000
0
20000
10000
5
10
15
20
CE-A856

Westinghouse

5AT8
6AT8
6AT8A

July 1, 1963

TRIODE PENTODE CONVERTER TYPES 5AT8, 6AT8 AND 6AT8A

The 5AT8, 6AT8 and 6AT8A are 9-pin miniature medium-mu triode and sharp-cutoff pentode types designed for service as combined oscillator and mixer tubes in VHF television circuits. Except for the common cathode, the triode and pentode units are electrically independent.

The 5AT8 and 6AT8A have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

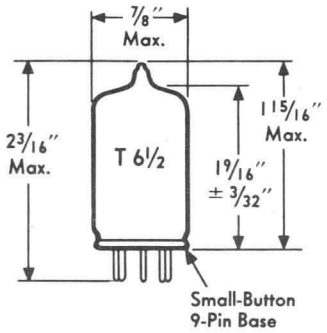
Cathode	Coated Unipotential			
Heater:	5AT8	6AT8	6AT8A	
Voltage	4.7	6.3 ± 10%	6.3	Volts
Current	0.6 ±6%	0.45	0.45 ±6%	Ampere
Warm-Up Time (Note 1)	11	–	11	Seconds

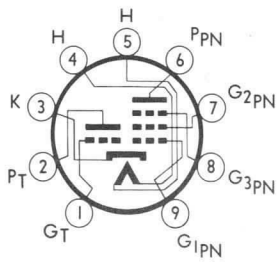
Direct Interelectrode Capacitances:

	Unshielded		Shielded (Note 2)		
Triode Unit:					
Grid to Plate	1.5		1.5		pf
Input	2.0		2.4		pf
Output	0.5		1.0		pf
Pentode Unit:					
Grid 1 to Plate	0.06	max.	0.03	max.	pf
Input	4.6		4.8		pf
Output	0.9		1.6		pf
Pentode Grid 1 to Triode Plate	0.05	max.	0.04	max.	pf
Pentode Plate to Triode Plate	0.05	max.	0.008	max.	pf
Heater to Cathode	6.0		6.0 (Note 3)		pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9DW
Mounting Position	Any





9DW

MAXIMUM RATINGS

Design Maximum Values

	Triode	Pentode		
Plate Voltage	275	275	max.	Volts
Grid 2 Supply Voltage	–	275	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve			
Grid 1 (Control Grid) Voltage				
Positive Bias Value	0	0	max.	Volts
Plate Dissipation	1.7	2.3	max.	Watts
Grid 2 Input	–	0.45	max.	Watt
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total DC + Peak	200		max.	Volts
Heater Positive with Respect to Cathode				
DC	100		max.	Volts
Total DC + Peak	200		max.	Volts

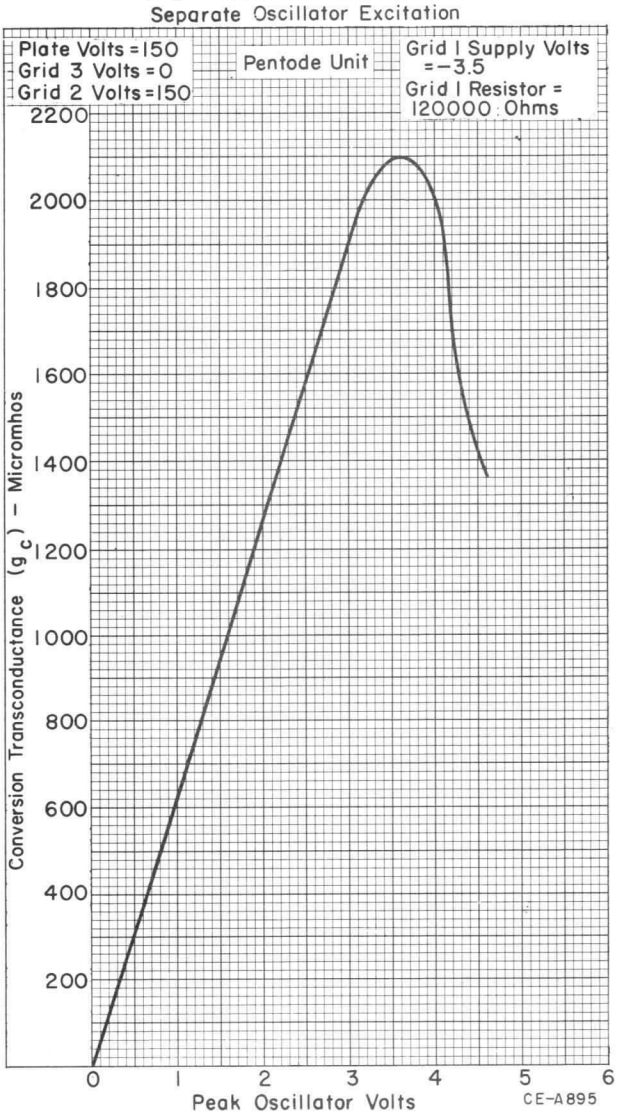
TYPICAL OPERATING CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 3 (Suppressor)	–	Connected to Cathode at Socket	
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	-1.0	-1.0	Volts
Amplification Factor	40	–	–
Plate Resistance (Approx.)	6000	300000	Ohms
Transconductance	6500	5500	μmhos
Grid 1 Bias 20 μamp. Plate Current	-7	-6.5	Volts
Plate Current	12	9	Ma.
Grid 2 Current	–	2.2	Ma.

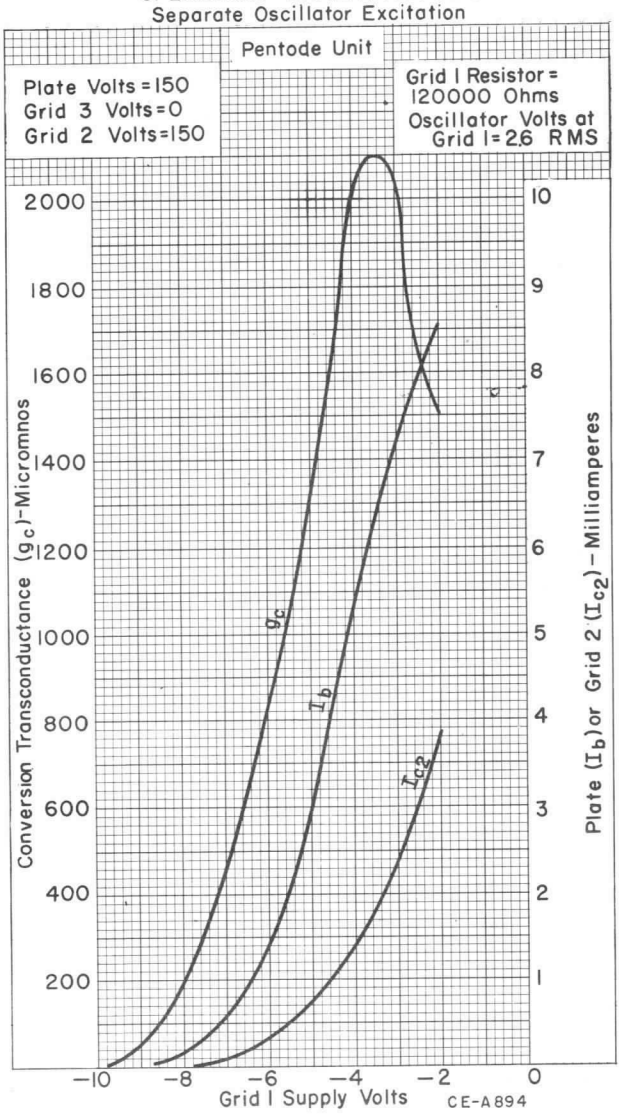
NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. JEDEC Shield #315 connected to pin 3.
3. JEDEC Shield #315 connected to ground.

OPERATION CHARACTERISTIC
Separate Oscillator Excitation

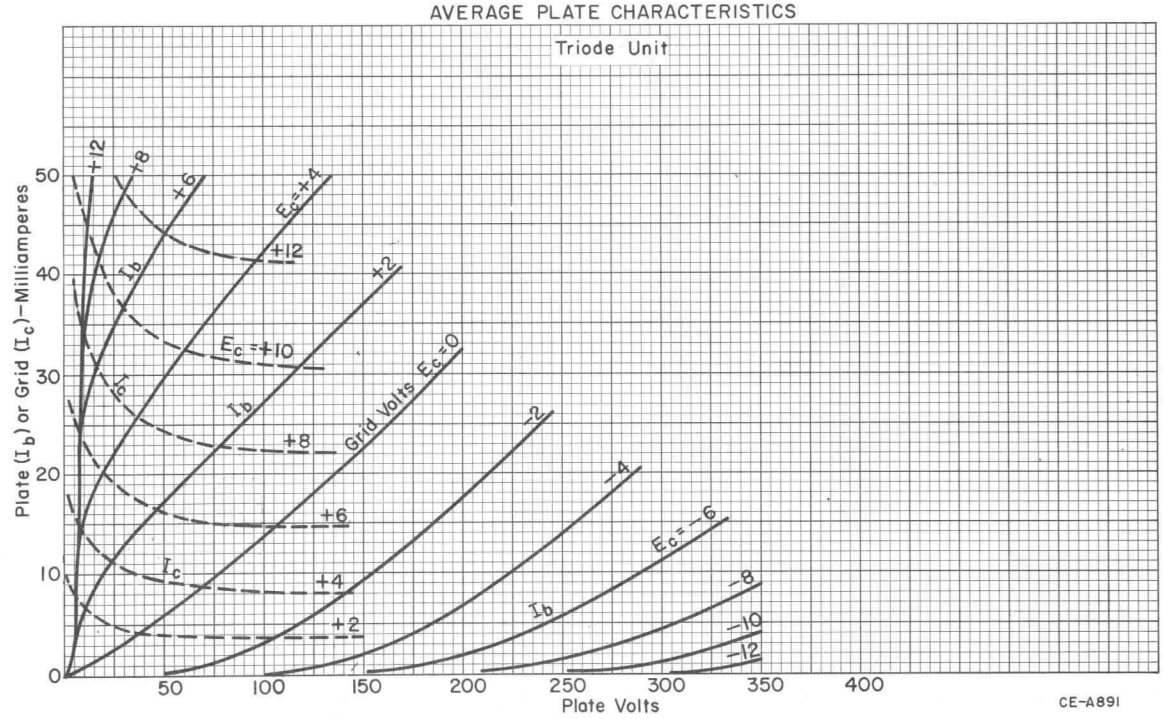


OPERATION CHARACTERISTICS
Separate Oscillator Excitation



AVERAGE PLATE CHARACTERISTICS

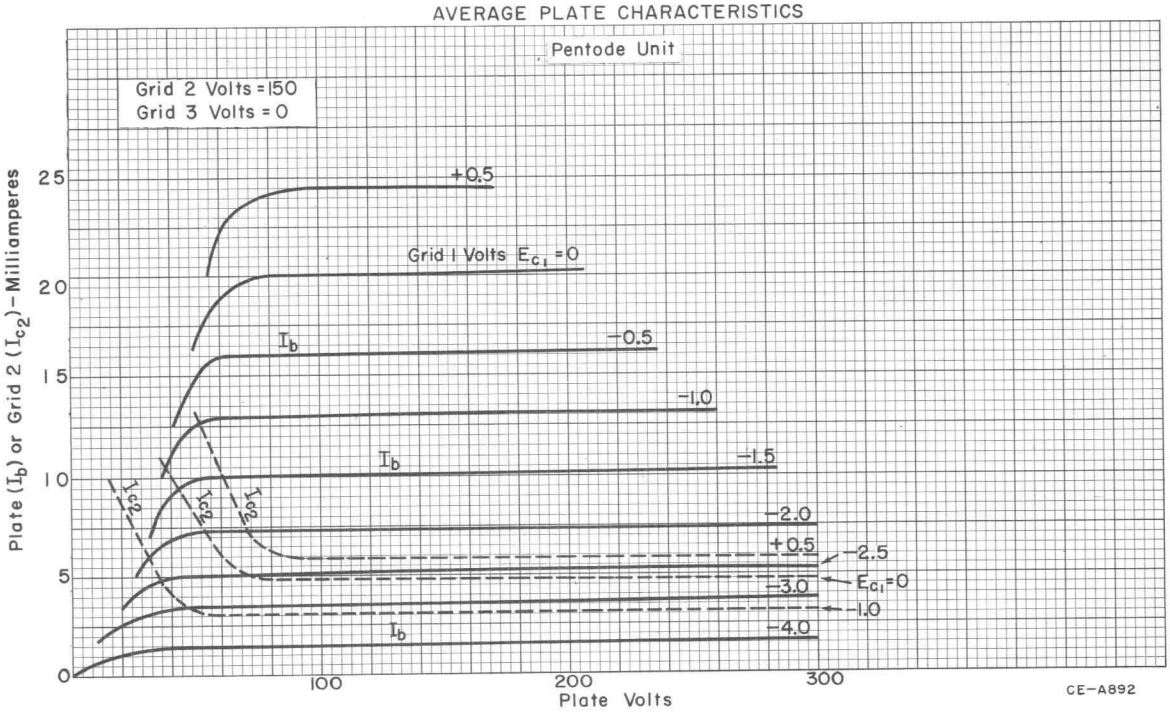
Triode Unit



CE-A891

AVERAGE PLATE CHARACTERISTICS

Pentode Unit



CE-A892

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May 15, 1958

TELEVISION DAMPING DIODE TYPES 6AU4-GTA and 19AU4-GTA

The 6AU4-GTA and 19AU4-GTA are 6-pin octal indirectly heated half-wave rectifiers designed for service as damping diodes in horizontal deflection circuits of black and white and color television receivers.

The 19AU4-GTA has been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes similarly designed and having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	6AU4-GTA	19AU4-GTA	
Voltage (ac or dc)	6.3	18.9	Volts
Current	1.8	0.6 ± 6%	Ampere
Warm-up Time■	. .	11	Seconds
Direct Interelectrode Capacitances (Unshielded):#			
Heater to Cathode		3.2	uuf
Plate to Cathode and Heater		7.0	uuf
Cathode to Plate and Heater		10.0	uuf

MECHANICAL:

Bulb	T-9
Base	Short Intermediate Shell Octal 6-Pin (JETEC B6-60)
Outline	9-44
Basing	4CG
Mounting Position	Any

MAXIMUM RATINGS in DAMPER SERVICE:▲

Design Center Values

Peak Inverse Voltage	4500*	max.	Volts
Peak Plate Current	1100	max.	Ma.
DC Plate Current	190	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
DC Component	900	max.	Volts
Total DC and Peak	4500	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC and Peak	300	max.	Volts
Plate Dissipation	6	max.	Watts
Voltage Drop at 350 Ma, approx.	25		Volts

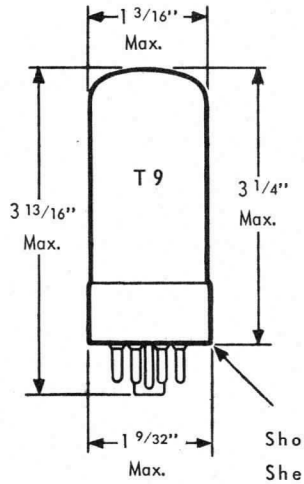
NOTES

■ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

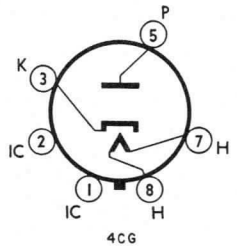
▲ For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle.

* Absolute Maximum Value, not to be exceeded at any time.

\# Tie unused pins to heater.



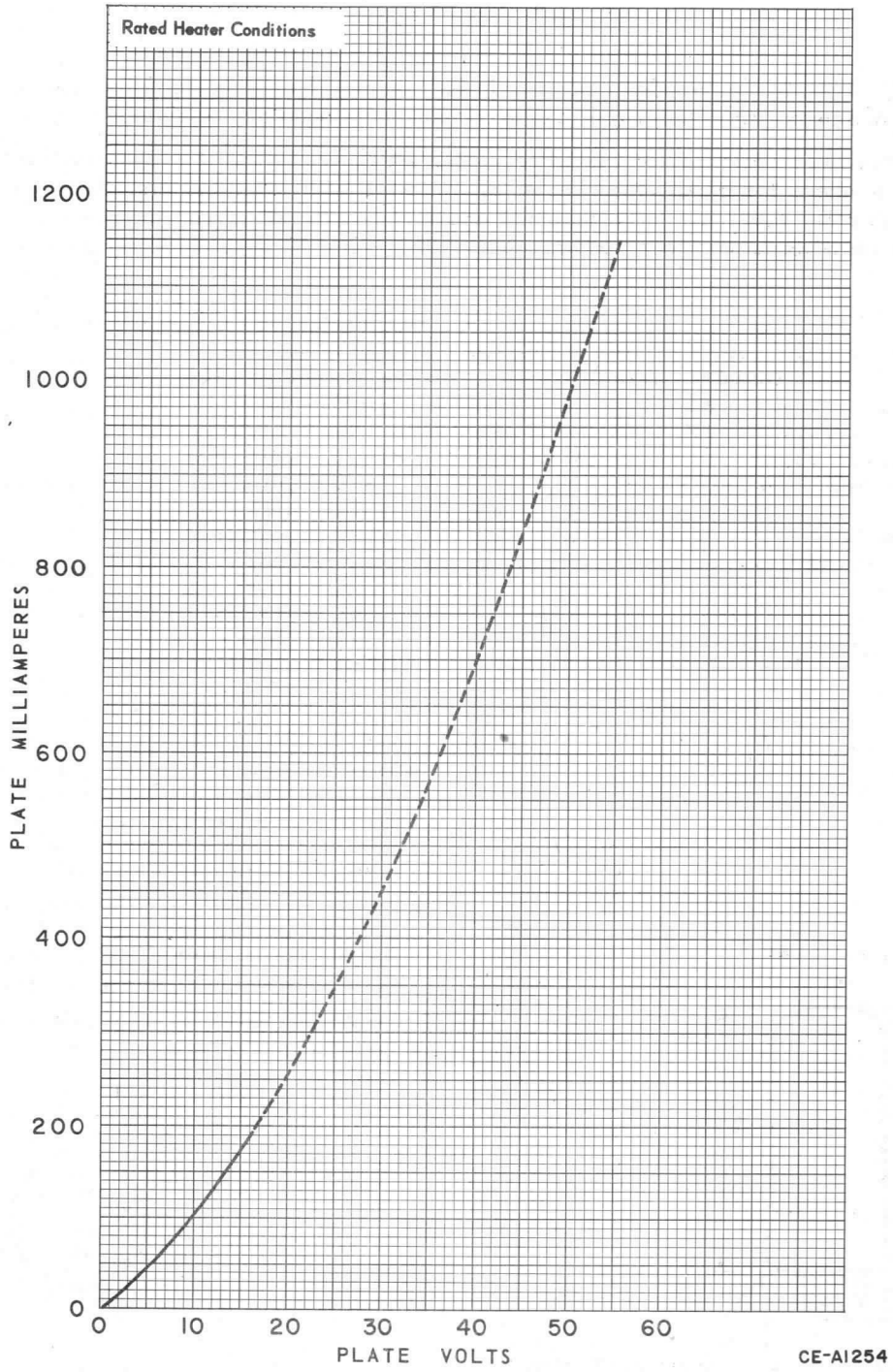
Short Intermediate Shell Octal Base



BOTTOM VIEW

NOTE: Pins 1, 2, 4, 6 must not be used as tie points.

AVERAGE CHARACTERISTIC



Westinghouse

3AU6
4AU6
6AU6
6AU6-A
12AU6

August 15, 1962

SHARP-CUTOFF PENTODE TYPES 3AU6, 4AU6, 6AU6, 6AU6-A AND 12AU6

The 3AU6, 4AU6, 6AU6, 6AU6-A and 12AU6 are 7-pin miniature sharp-cutoff pentode types designed for service as a wide-band, high gain, high frequency amplifier. The low grid-plate capacity and high transconductance of these types allows good performance as an intermediate frequency amplifier. They are also commonly employed as audio voltage amplifiers.

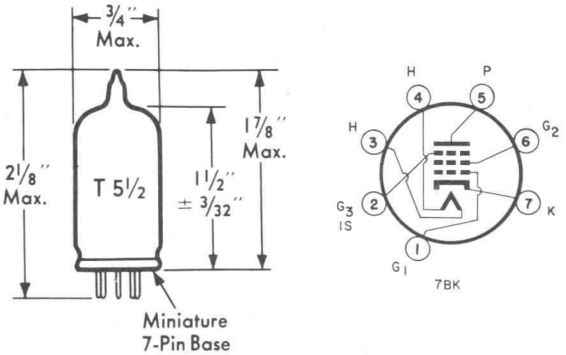
The 3AU6, 4AU6 and 6AU6-A have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential				
Heater:		6AU6			
	3AU6	4AU6	6AU6-A	12AU6	
Voltage (ac or dc)	3.15	4.2	6.3	12.6	Volts
Current	0.60	0.45	0.30	0.15	Ampere
Warm-up Time (Note 1)	11	11	11	--	Seconds
Direct Interelectrode Capacitances:					
Pentode Connection:	Unshielded		Shielded (Note 2)		
Grid to Plate (Max.)	0.0035		0.0035		μμf
Input	5.5		5.5		μμf
Output	5.0		5.0		μμf
Triode Connection (Note 3):					
Grid to Plate	2.6		2.6		μμf
Input	3.2		3.2		μμf
Output	1.2		8.5		μμf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7BK
Mounting Position	Any



MAXIMUM RATINGS

Design Maximum Values

	Triode Connection	Pentode Connection	
Plate Voltage	275	330 max.	Volts
Grid 2 Supply Voltage	(Note 3)	330 max.	Volts
Grid 2 Voltage	(Note 3)	See Grid 2 Input Rating Chart	
Plate Dissipation	3.5	3.5 max.	Watts
Grid 2 Dissipation	–	0.75 max.	Watts
Grid 1 Voltage, Positive Bias Value	0	0 max.	Volts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

AMPLIFIER - CLASS A

CHARACTERISTICS AND TYPICAL OPERATION

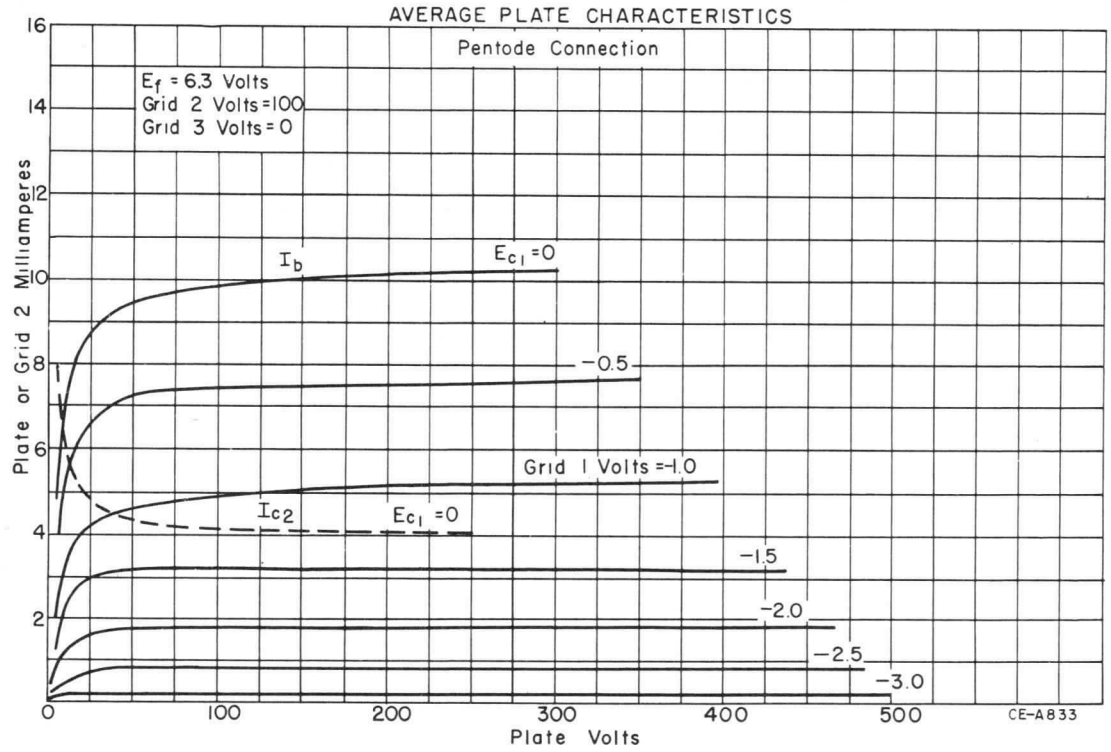
Plate Voltage	100	250	250	Volts
Grid 2 Voltage	100	125	150	Volts
Grid 3 Voltage	Connected to Cathode			
Cathode Resistor	150	100	68	Ohms
Transconductance	3900	4500	5200	μmhos
Plate Resistance	0.5	1.5	1.0	Megohm
Grid 1 Cutoff Bias (Note 4)	–4.2	–5.5	–6.5	Volts
Plate Current	5.0	7.6	10.6	Ma.
Grid 2 Current	2.1	3.0	4.3	Ma.

CHARACTERISTICS (Triode Connected)

Plate Voltage	250	Volts
Cathode Resistor	330	Ohms
Amplification Factor	36	–
Plate Resistance (Approx.)	.0075	Megohm
Transconductance	4800	μmhos
Plate Current	12.2	Ma.

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield No. 316 connected to cathode.
3. Grids 2 and 3 connected to plate.
4. For Plate Current of 10 μa.


AVERAGE PLATE CHARACTERISTICS
Pentode Connection
Ef = 6.3 Volts
Grid 2 Volts = 100
Grid 3 Volts = 0
Plate or Grid 2 Milliamperes
Plate Volts
Ib
Ec1 = 0
-0.5
Grid 1 Volts = -1.0
Ic2
Ec1 = 0
-1.5
-2.0
-2.5
-3.0
0
100
200
300
400
500
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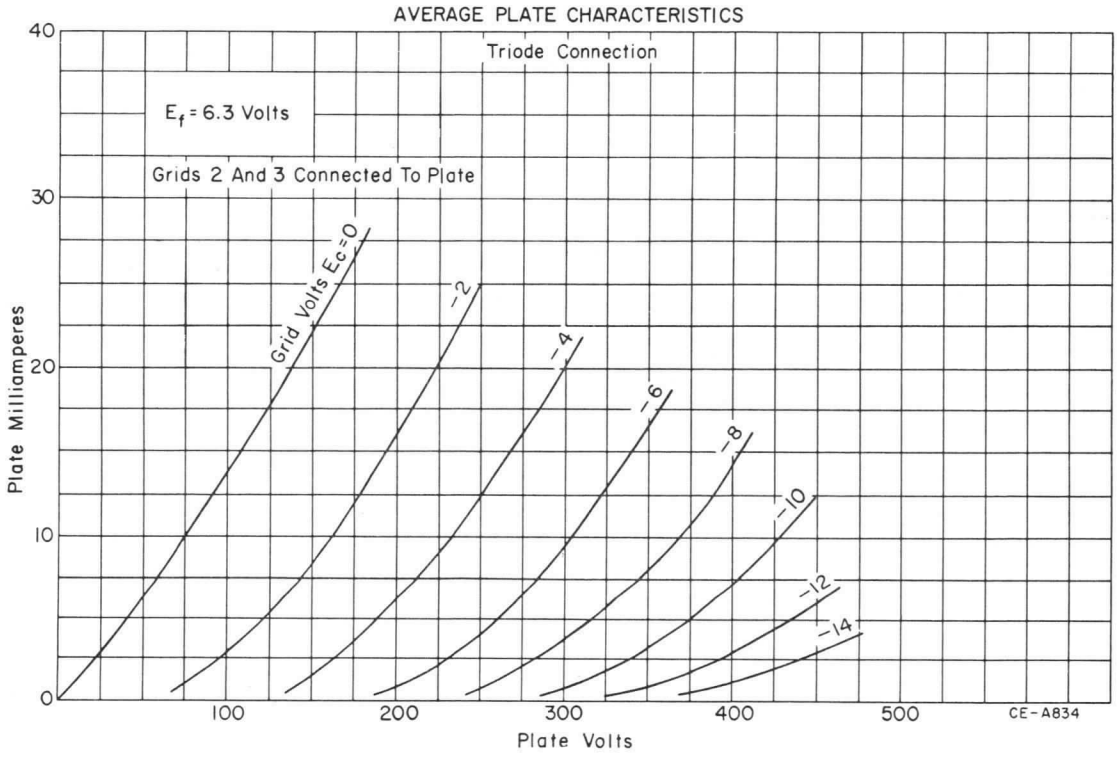
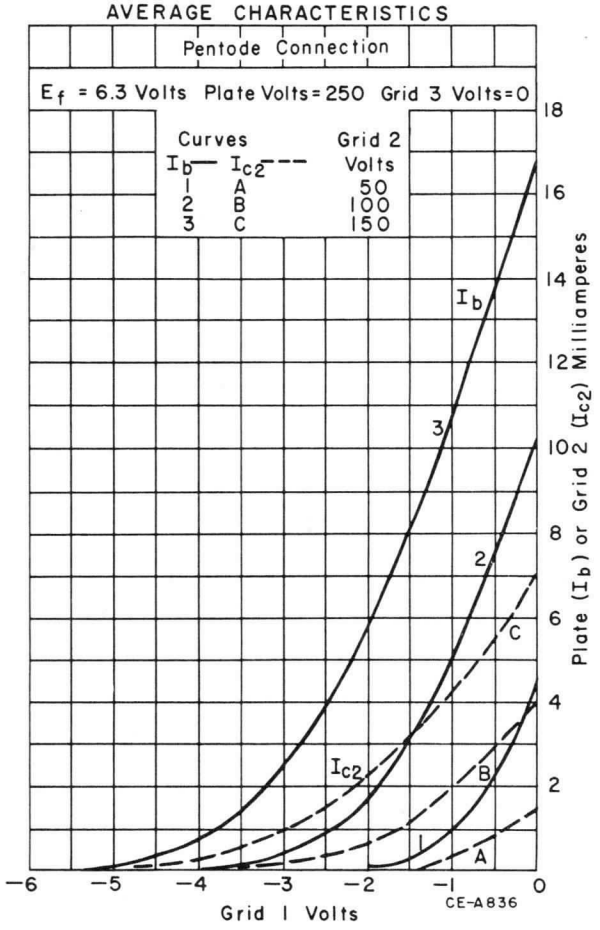
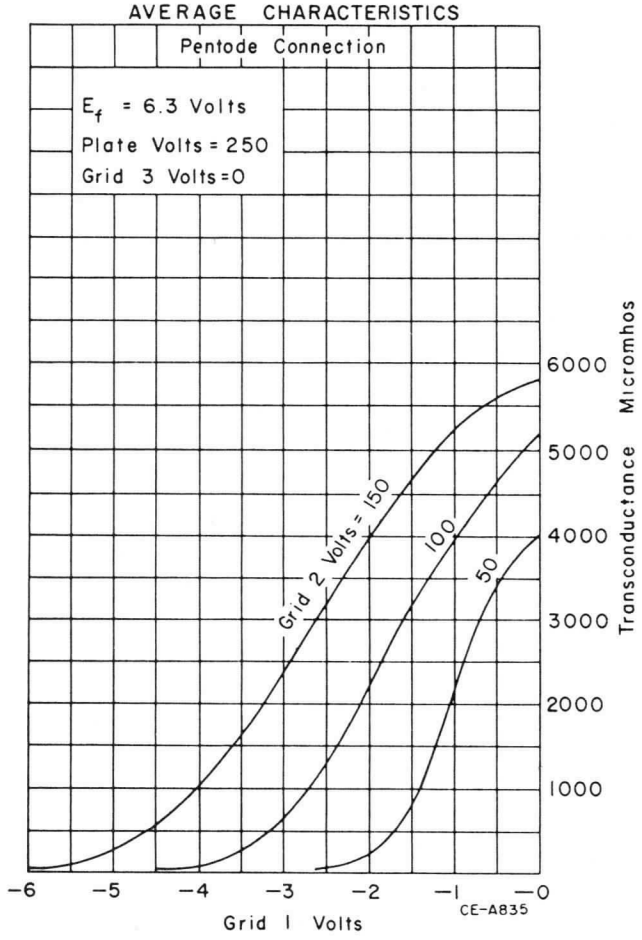
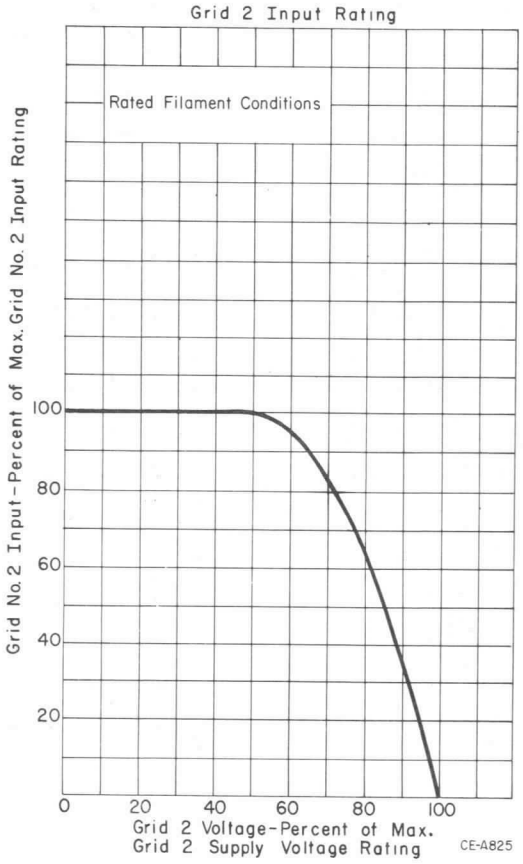

AVERAGE PLATE CHARACTERISTICS
Triode Connection
Ef = 6.3 Volts
Grids 2 And 3 Connected To Plate
Plate Milliamperes
Plate Volts
Grid Volts Ec = 0
-2
-4
-6
-8
-10
-12
-14
0
10
20
30
40
100
200
300
400
500
CE-A834

AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS





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March 16, 1955

Twin Triode Type 7AU7

The 7AU7 is a medium-mu twin triode of the 9-pin miniature type with characteristics like those of the 6SN7-GT. Its applications include multivibrators, synchronizing amplifiers, oscillators, mixers, and industrial controls. Except for heater ratings, the 7AU7 is identical with the 12AU7.

The 7AU7 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

Electrical:

Cathodes	Two, Coated Unipotential		
Heater	Series	Parallel	
Voltage	7.0	3.5	ac or dc Volts
Current	0.3	0.6	Ampere
Warm-Up Time*		11	Seconds

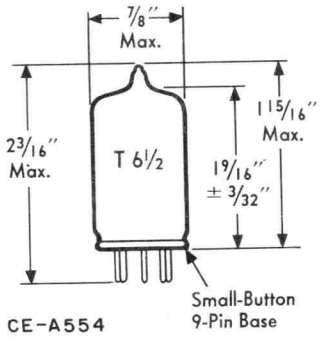
Direct Interelectrode Capacitances (Unshielded):

	Unit No. 1	Unit No. 2	
Grid to Plate	1.5	1.5	μμf
Grid to Cathode	1.6	1.6	μμf
Plate to Cathode	0.50	0.35	μμf

Mechanical:

Bulb	T-6 1/2
Base	JETEC E9-1, Small Button 9-pin
Basing	9A
Mounting Position	Any

*See page 3.



CE-A554

CLASS A1 AMPLIFIER
Each Unit

Maximum Ratings
Design Center Values

Plate Voltage	300 max.	Volts
Plate Dissipation	2.75 max.	Watts
Cathode Current	20 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

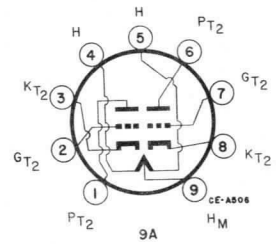
Characteristics

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	μmhos
Plate Current	11.8	10.5	Ma.

Maximum Circuit Values
For Maximum Rated Conditions

Grid-Circuit Resistance

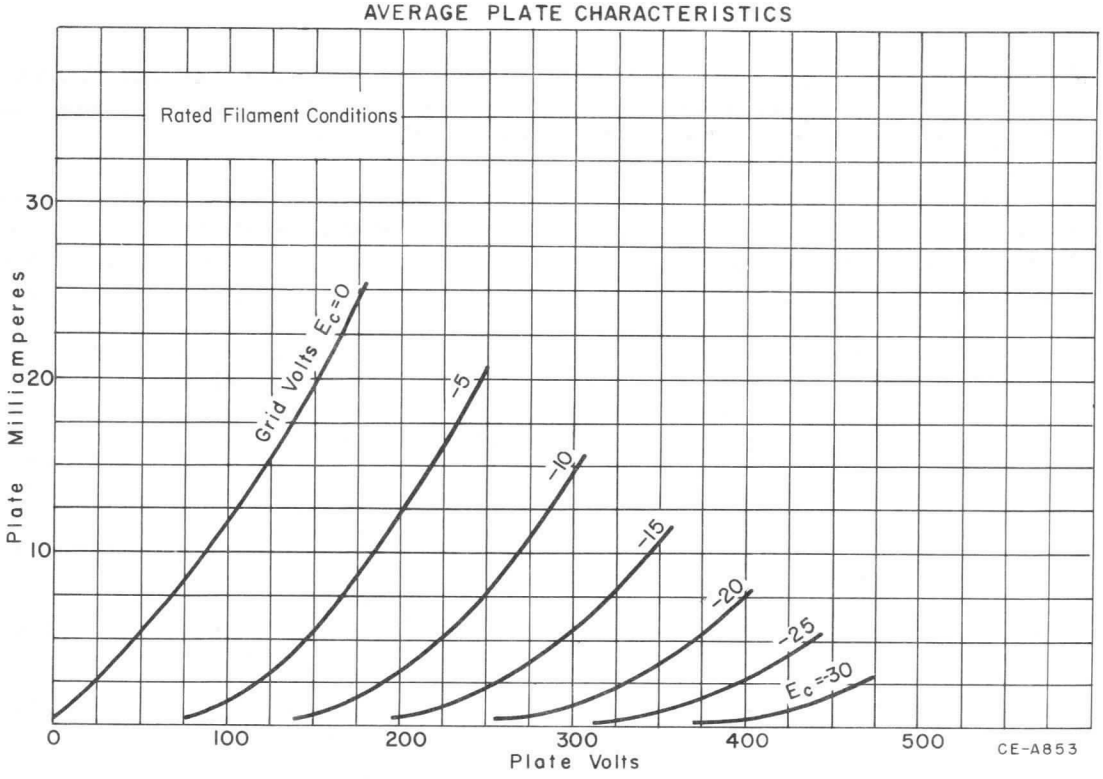
Cathode-Bias Operation	1.0 max.	Megohm
Fixed-Bias Operation	0.25 max.	Megohm



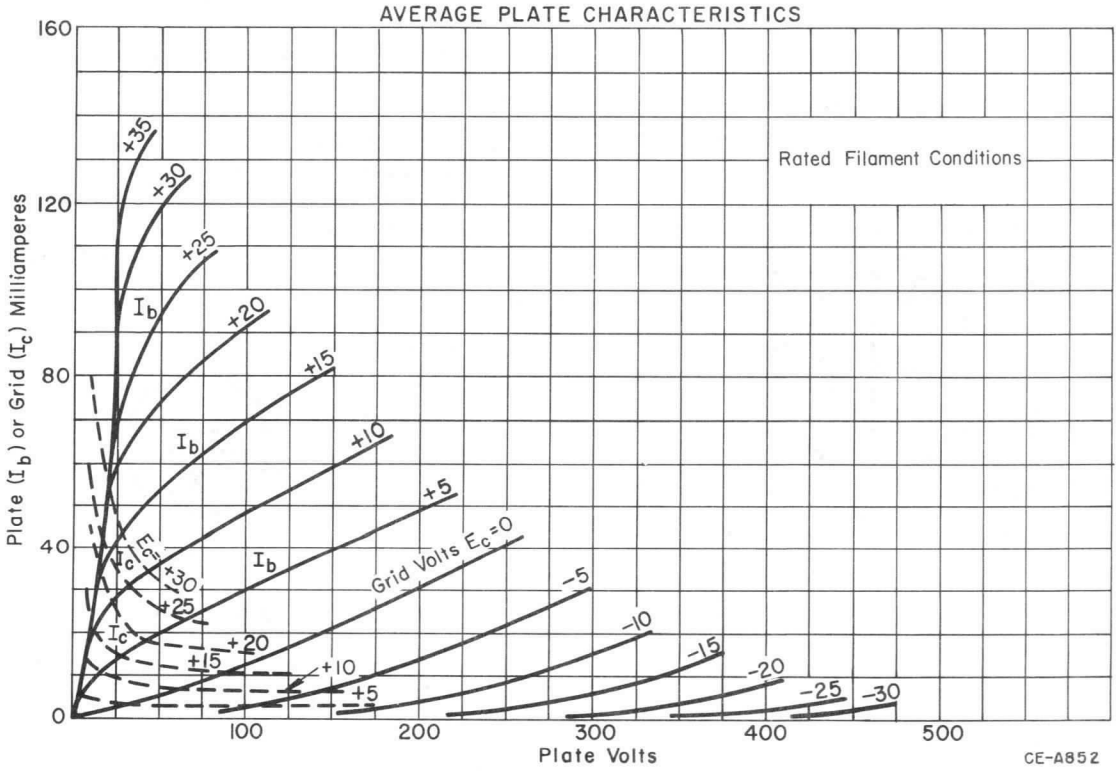
9A

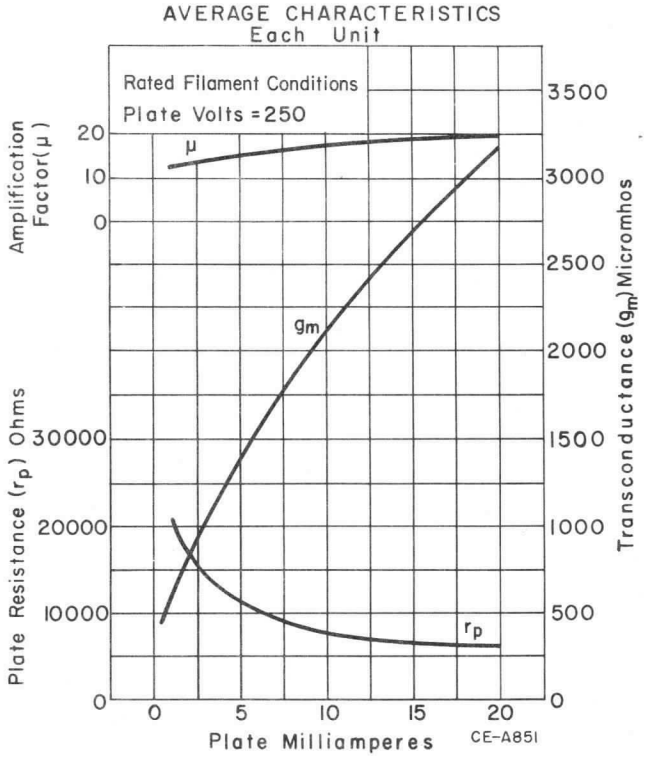
Bottom View

AVERAGE PLATE CHARACTERISTICS



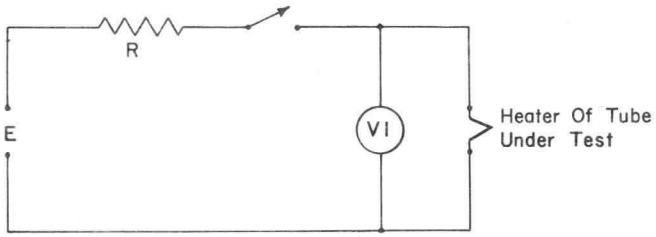
AVERAGE PLATE CHARACTERISTICS





HEATER WARM-UP TIME MEASUREMENTS

Heater warm-up time is defined as the time required for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1) in the circuit shown below. The conditions used in conjunction with the test circuit depend upon the rated heater voltage and current of the tube under test as indicated.



CE-A933

E —Applied Voltage, RMS or DC	13.9	Volts
R —Total Series Resistance	17.5	Ohms
V_1—Heater Test Voltage, RMS or DC	2.78	Volts
E_f—Rated Heater Voltage of Tube Under Test	3.5	Volts
I_f —Rated Heater Current of Tube Under Test	0.6	Ampere

TWIN TRIODE TYPES 12AU7 AND 12AU7-A

The 12AU7 and 12AU7-A are medium-mu twin triode types of the 9-pin miniature type. Its applications include multivibrators, synchronizing amplifiers, oscillators, mixers, and industrial controls. The tube may be operated from either a 6.3-volt or 12.6-volt heater supply, and it has separate cathode terminals for each triode.

The 12AU7-A is designed to have lower microphonic noise than the 12AU7 and is thus particularly well adapted to industrial control and television horizontal oscillator applications.

ELECTRICAL:

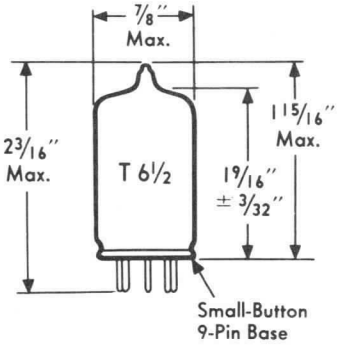
Cathodes	Coated Unipotential		
Heater:	Series	Parallel	
Voltage	12.6	6.3	AC or DC Volts
Current	0.15	0.3	Ampere
Direct Interelectrode Capacitances (Unshielded):			
	Unit No. 1	Unit No. 2	
Grid to Plate	1.5	1.5	$\mu\mu$f
Grid to Cathode	1.6	1.6	$\mu\mu$f
Plate to Cathode	0.50	0.35	$\mu\mu$f

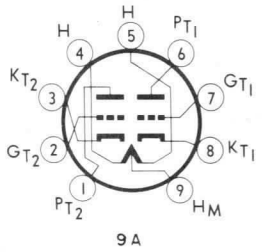
MECHANICAL:

Bulb	T-6-½
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9A
Mounting Position	Any

MAXIMUM RATINGS:
Design Maximum Values
Each Unit, Except as Noted

As	Class A_1 Amplifier	Vertical # Deflection Amplifier		
Plate Voltage	330	330	max.	Volts
Peak Positive Plate Voltage (Abs. Max.)	- -	1200	max.	Volts
Peak Negative Grid Voltage	- -	275	max.	Volts
Plate Dissipation:				
Each Plate	2.75	2.75*	max.	Watts
Both Plates	5.5	5.5*	max.	Watts
Cathode Current	22	22	max.	Ma.
Peak Cathode Current	- -	66	max.	Ma.
Heater-Cathode Voltage				
Heater Positive with Respect to Cathode				
D-C Component	100	100	max.	Volts
Total D-C and Peak	200	200	max.	Volts
Heater Negative with Respect to Cathode				
Total D-C and Peak	200	200	max.	Volts
Grid Circuit Resistance:				
Fixed Bias	0.25	- -	max.	Megohm
Cathode Bias	1.0	- -	max.	Megohms





9A

MAXIMUM RATINGS:
Design Maximum Values (Each Unit, Except as Noted)

As	Vertical # Deflection Oscillator	Horizontal # Deflection Oscillator		
Plate Voltage	330	330	max.	Volts
Peak Negative Grid Voltage	440	660	max.	Volts
Plate Dissipation:				
Each Plate	2.75	2.75	max.	Watts
Both Plates	5.5	5.5	max.	Watts
Cathode Current	22	22	max.	Ma.
Peak Cathode Current	66	330	max.	Ma.
Heater-Cathode Voltage				
Heater Positive with Respect to Cathode				
D-C Component	100	100	max.	Volts
Total D-C and Peak	200	200	max.	Volts
Heater Negative with Respect to Cathode				
Total D-C and Peak	200	200	max.	Volts

AMPLIFIER – CLASS A_1
Each Unit

CHARACTERISTICS:

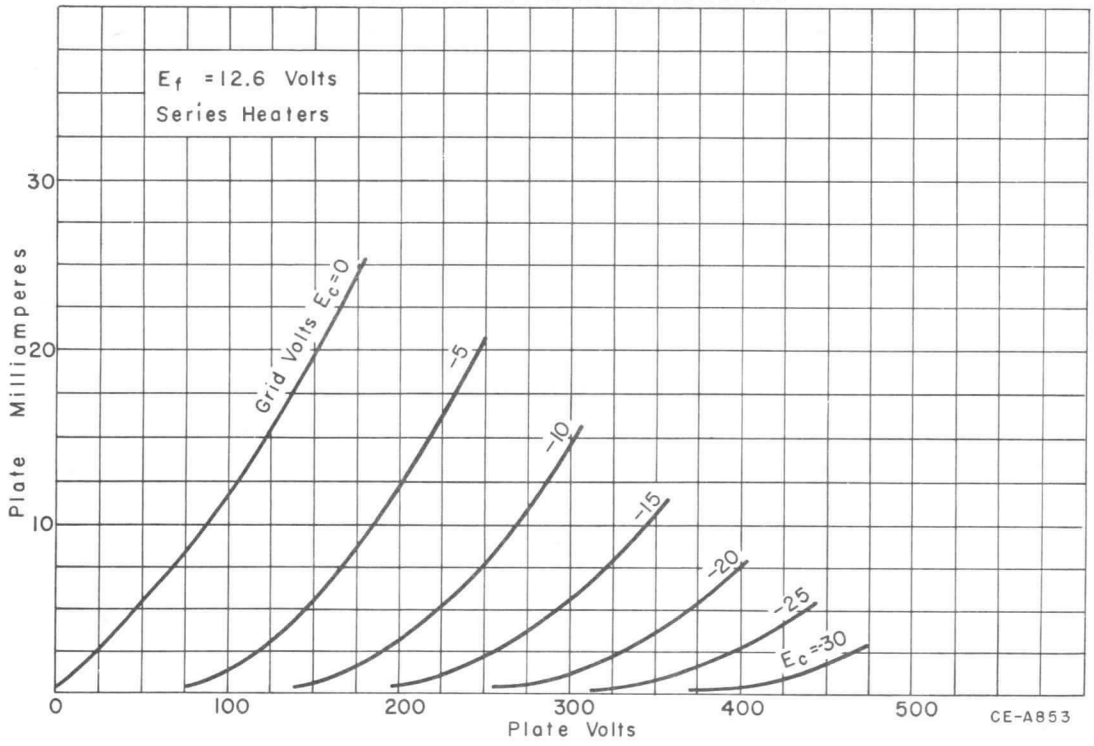
Plate Voltage	100	250	Volts
Grid Voltage	0	–8.5	Volts
Amplification Factor	19.5	17	
Plate Resistance (Approx.)	6250	7700	Ohms
Transconductance	3100	2200	μmhos
Plate Current	11.8	10.5	Ma.

NOTES

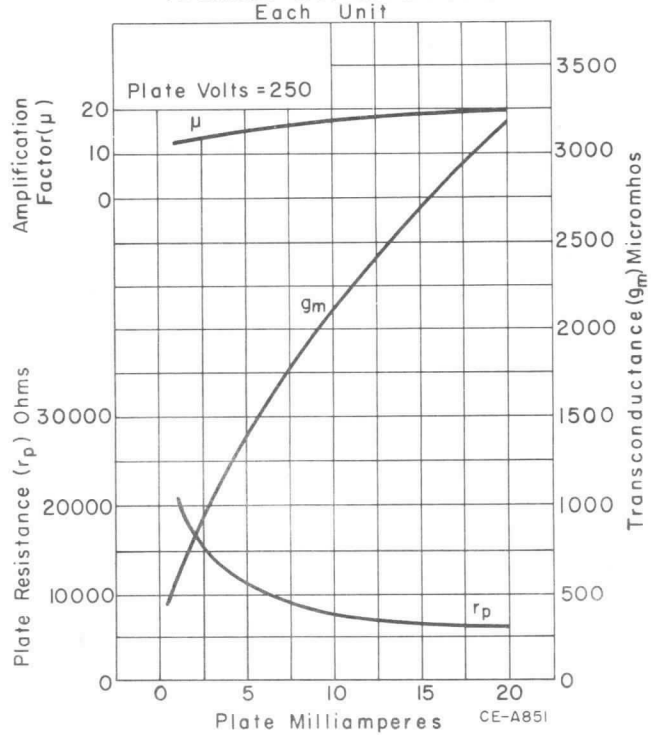
\# For operation in a 525-line, 30 frame system as described in, "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

★ Stages operating with grid-leak bias require an adequate cathode-bias resistor or other suitable means to protect the tube in the absence of excitation.

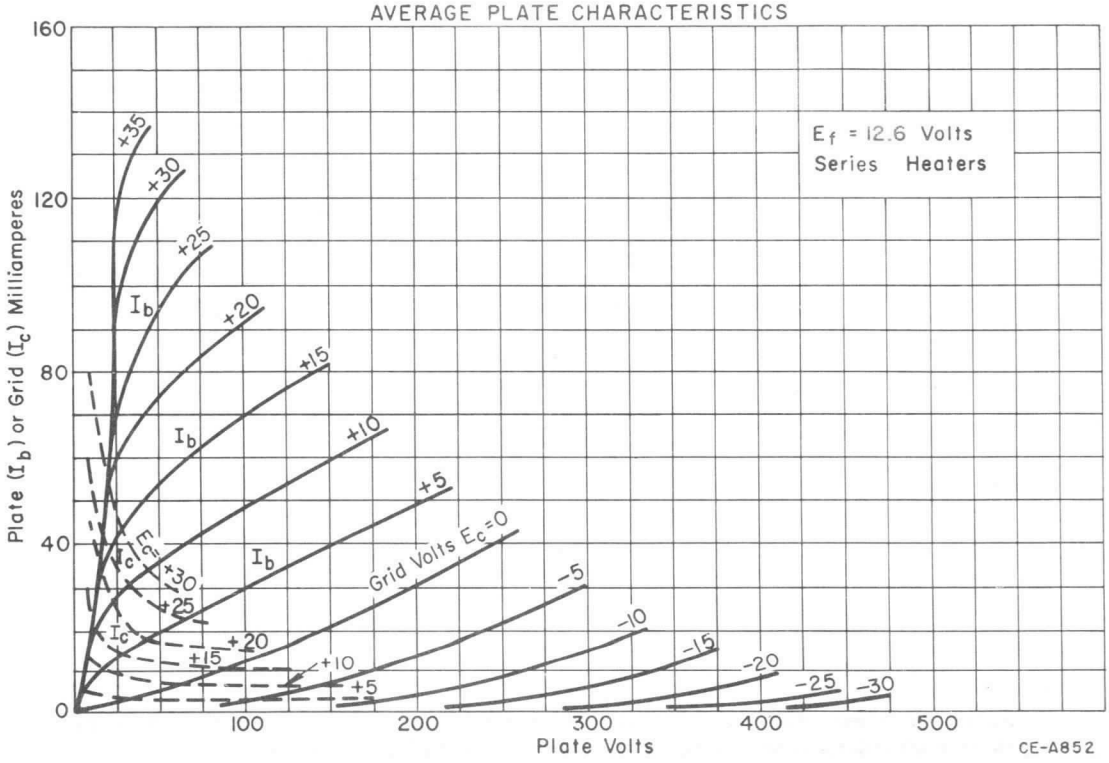
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS
Each Unit



AVERAGE PLATE CHARACTERISTICS



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Westinghouse

6AU8
6AU8A
8AU8

May 1, 1961

MEDIUM-MU TRIODE – SHARP-CUTOFF PENTODE TYPES 6AU8, 6AU8A AND 8AU8

The 6AU8, 6AU8A and 8AU8 are 9-pin miniature medium-mu triode and sharp-cutoff pentode types designed for service in color and black-and-white television receivers. The controlled cutoff triode unit is designed for service as a sync separator, sync clipper or blocking oscillator while the pentode unit is designed for operation as a video amplifier. The 6AU8A has a controlled plate knee characteristic.

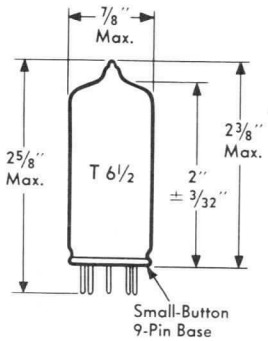
These types have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes having the same heater current, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

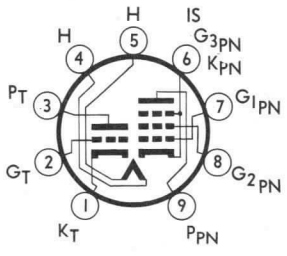
ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	6AU8 6AU8A	8AU8	
Voltage (ac or dc)	6.3	8.4	Volts
Current	0.60	0.45	Ampere
Warm-up Time (Approx.)▲	11	11	Seconds
Direct Interelectrode Capacitances: (Unshielded)			
Triode			
Grid to Plate	2.2		μμf
Input	2.6		μμf
Output	0.34		μμf
Pentode			
Grid 1 to Plate	0.44	max.	μμf
Input	7.5	max.	μμf
Output	2.4	max.	μμf
Coupling			
Pentode Grid 1 to Triode Plate	0.006	max.	μμf
Pentode Plate to Triode Grid	0.022	max.	μμf
Pentode Plate to Triode Plate	0.12	max.	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9DX
Mounting Position	Any





9DX

MAXIMUM RATINGS:

Design Maximum Values

	Triode	Pentode		
Plate Voltage	300	300	max.	Volts
Grid 2 Supply Voltage	--	300	max.	Volts
Grid 2 Voltage	--		See Grid 2 Input Rating Chart	
Plate Dissipation	2.5	3	max.	Watts
Grid 2 Dissipation	--	1.0	max.	Watts
Positive Grid 1 Bias Voltage	--	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

	Triode	Pentode	
Plate Voltage	150	200	Volts
Grid 2 Voltage	--	125	Volts
Cathode Bias Resistor	150	82	Ohms
Amplification Factor	40	--	
Plate Resistance (Approx.)	8200	150000	Ohms
Transconductance	4900	7000	μmhos
Plate Current	9	15	Ma.
Grid 2 Current	--	3.4	Ma.
Grid 1 Voltage	-6.5□	-8□	Volts

▲ Heater Warm-Up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

□ For plate current of 100 microamperes.

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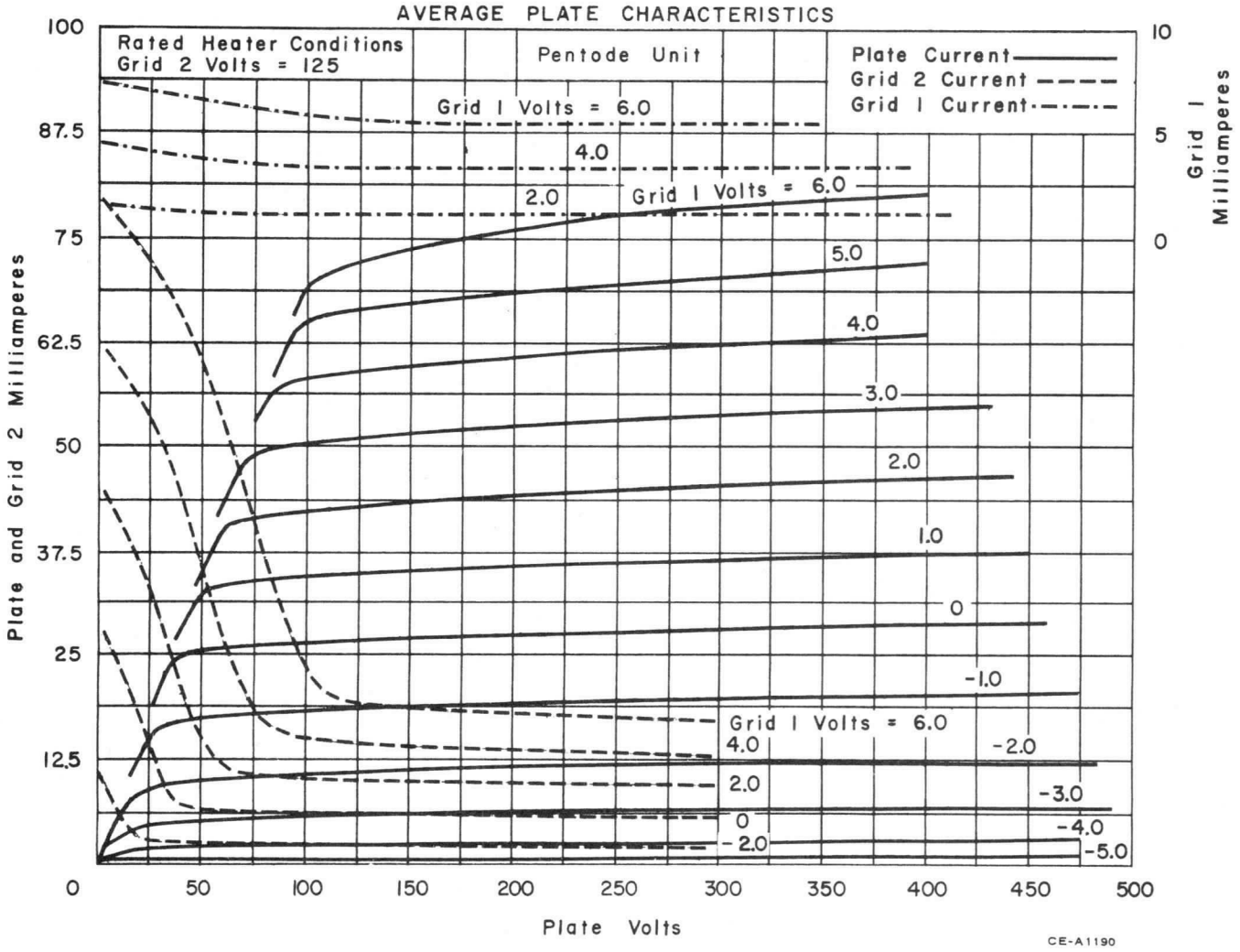
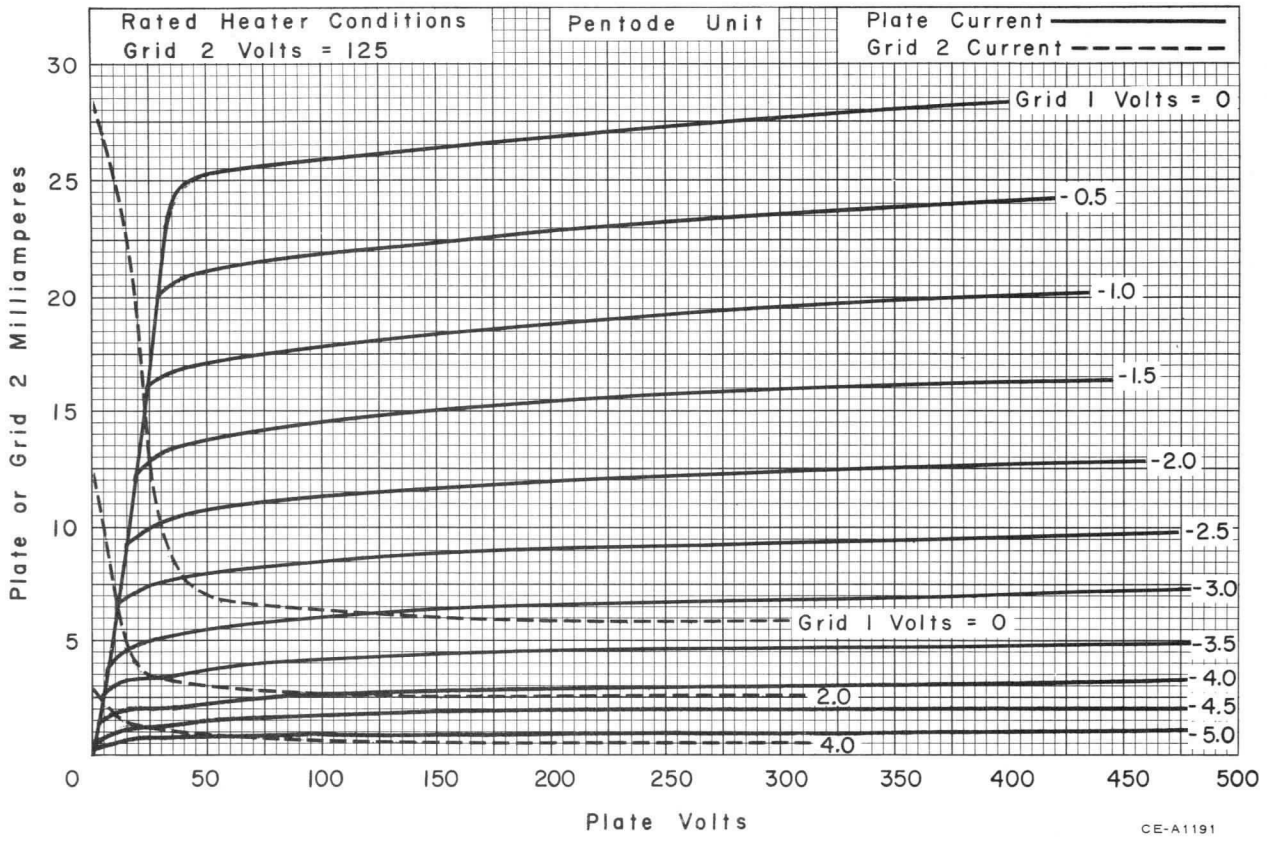
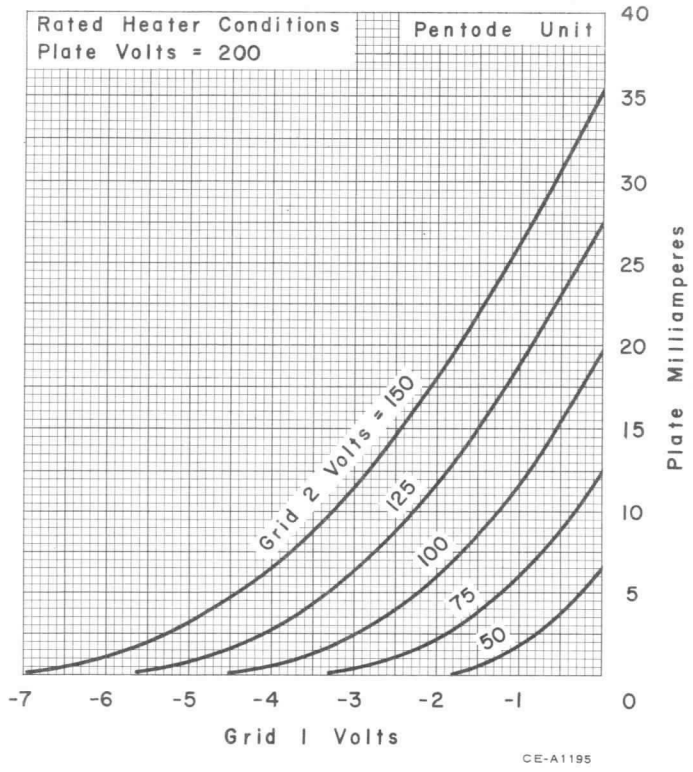

AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Pentode Unit
Plate Current
Grid 2 Current
Grid 1 Current
Grid 1 Volts = 6.0
4.0
2.0
Grid 1 Volts = 6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
Grid 1 Volts = 6.0
4.0
2.0
0
-2.0
-2.0
-3.0
-4.0
-5.0
Plate and Grid 2 Milliamperes
Grid 1 Milliamperes
Plate Volts
100
87.5
75
62.5
50
37.5
25
12.5
0
10
5
0
0
50
100
150
200
250
300
350
400
450
500
CE-A1190

AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



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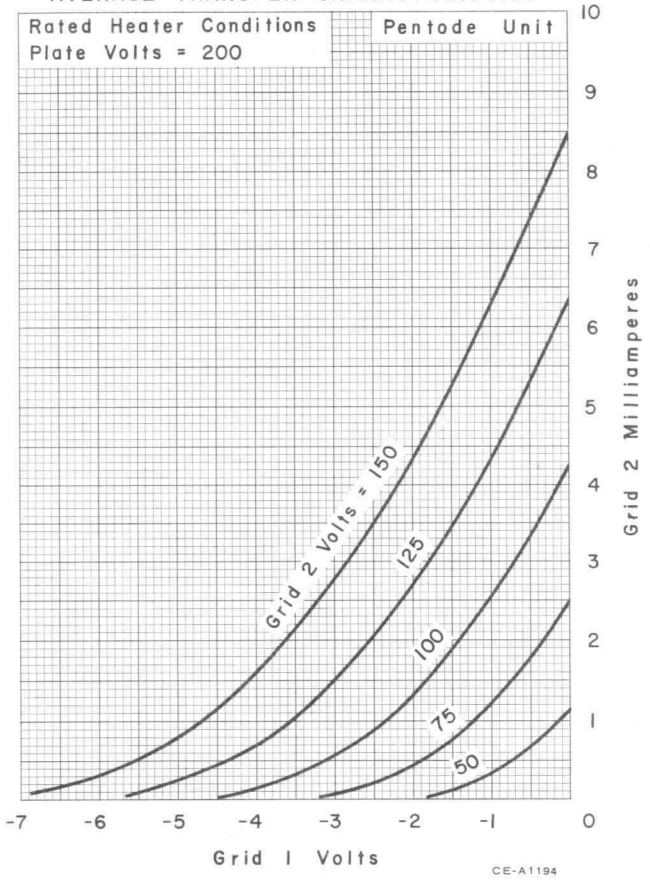

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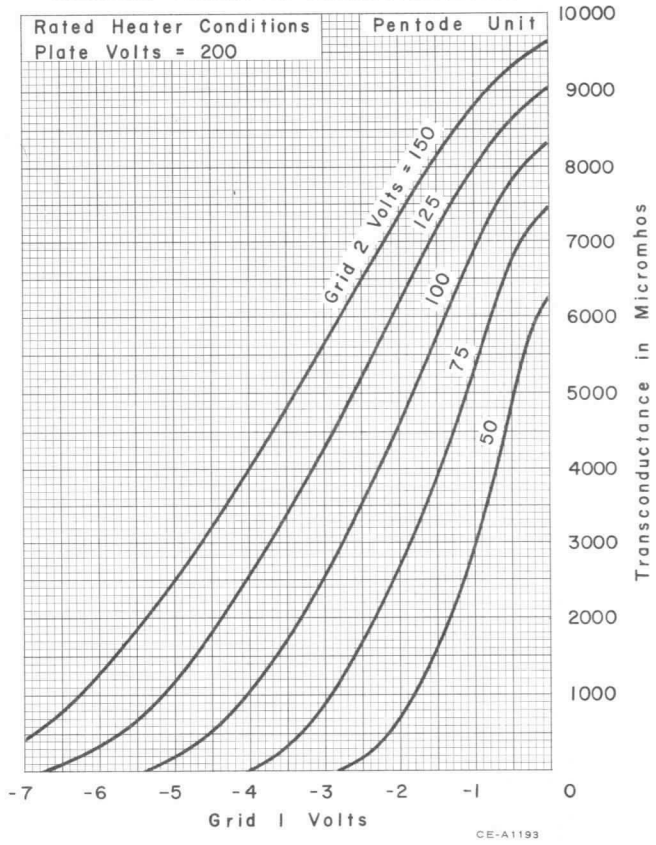

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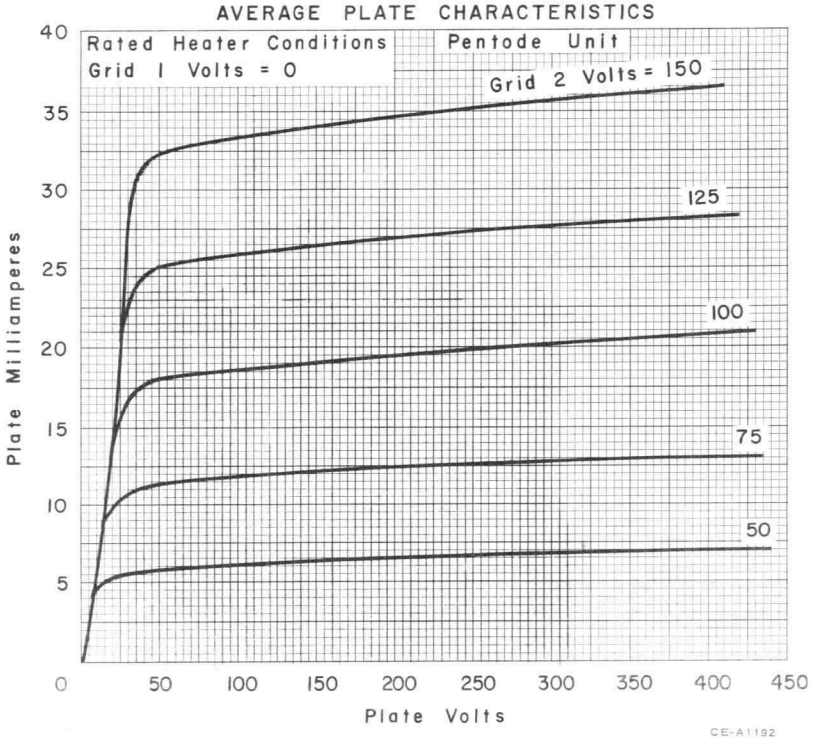
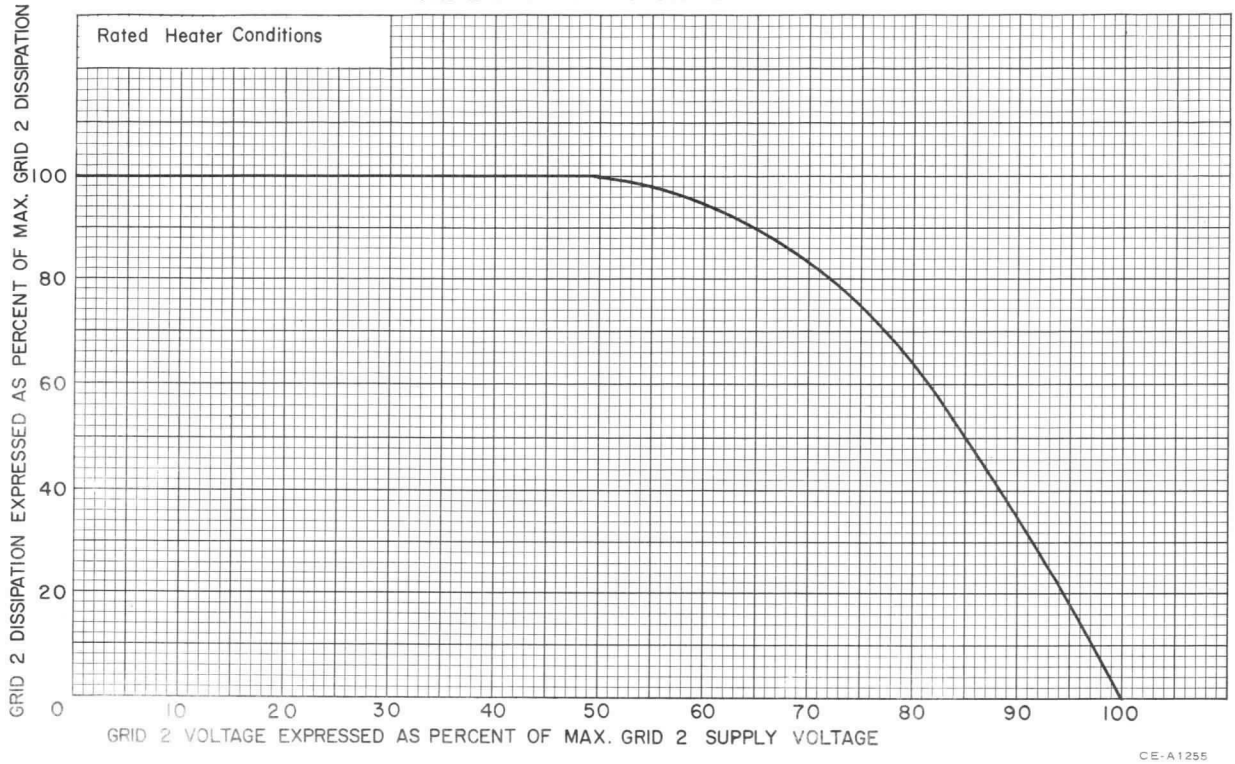
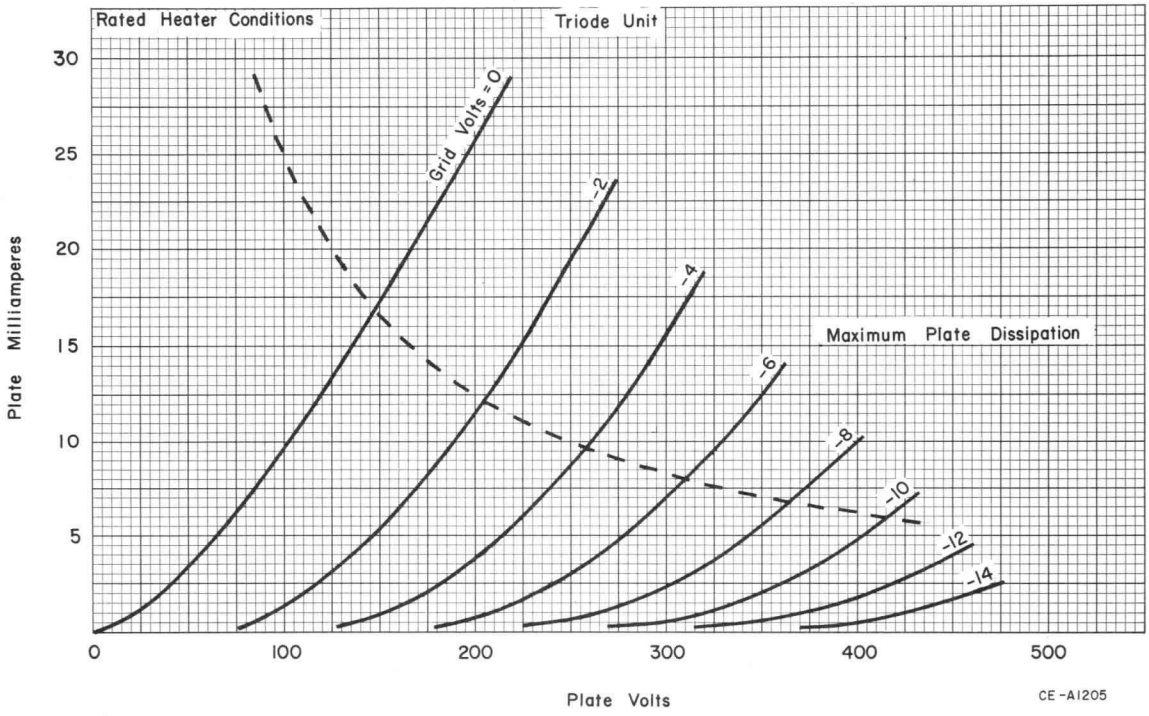


GRID 2 INPUT RATING CURVE



AVERAGE PLATE CHARACTERISTICS



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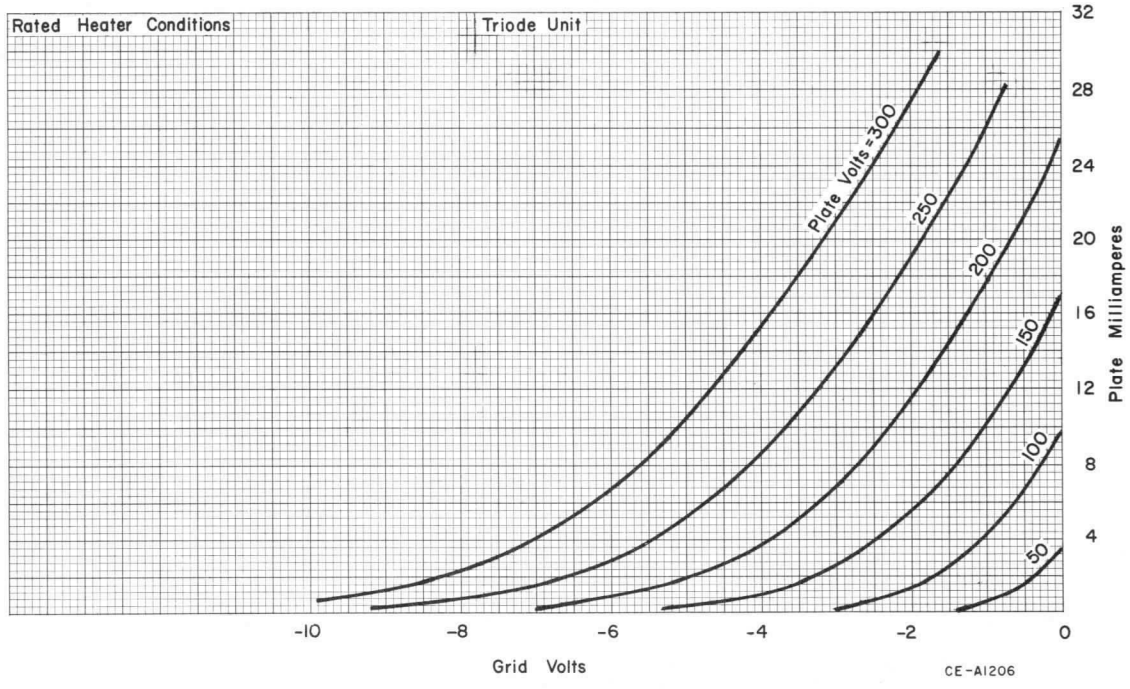
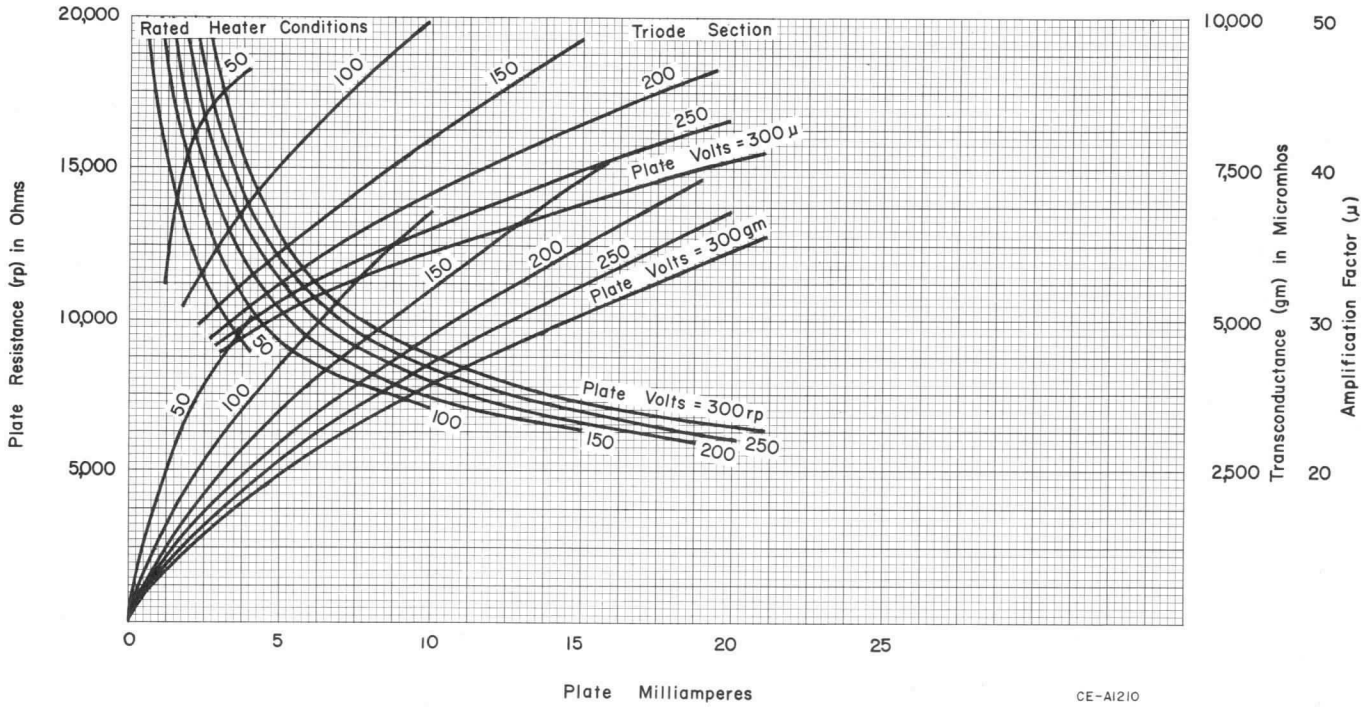


AVERAGE TRANSFER CHARACTERISTICS



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TWIN DIODE HIGH-MU TRIODE TYPES 3AV6, 6AV6 AND 12AV6

The 3AV6, 6AV6 and 12AV6 are 7-pin miniature duo-diode high-mu triode types designed for service as combined detector, amplifier, and automatic volume control tube in automobile and ac operated radio receivers. Coupling between the diode and triode sections is minimized by the use of internal shielding.

The 3AV6 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential			
Heater:	3AV6	6AV6	12AV6	
Voltage (ac or dc)	3.15	6.3	12.6	Volts
Current	0.60	0.30	0.15	Ampere
Warm-up Time (Note 1)	11	–	–	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Triode Grid to Triode Plate		2.0		μμf
Triode Input		2.2		μμf
Triode Output		0.8		μμf
Diode 2 Plate to Triode Grid		0.04 max.		μμf

MECHANICAL

Bulb	T-5½
Base	Small-Button Miniature 7-pin
Basing	7BT
Mounting Position	Any

MAXIMUM RATINGS

Design Maximum Values

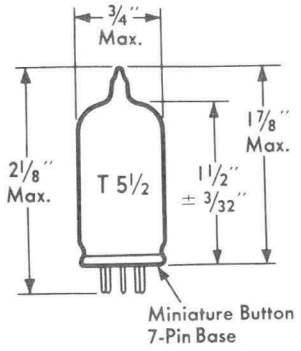
Triode Plate Voltage	330 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Positive with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Negative with Respect to Cathode		
DC Component	100 max.	Volts
DC + Peak	200 max.	Volts
Positive DC Grid Voltage	0 max.	Volts
Triode Plate Dissipation	0.55 max.	Watt
Diode Plate DC Current	1.0 max.	Ma.

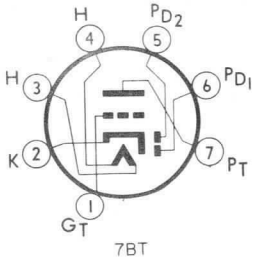
CHARACTERISTICS AND TYPICAL OPERATION

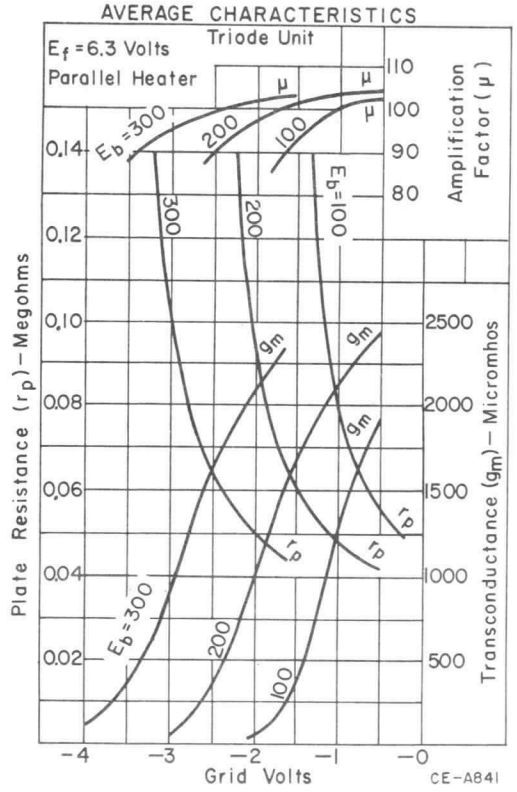
Plate Voltage	100	250	Volts
Grid Voltage (Note 2)	–1	–2	Volts
Amplification Factor	100	100	–
Plate Resistance	80000	62500	Ohms
Transconductance	1250	1600	μmhos
Plate Current	0.5	1.2	Ma.

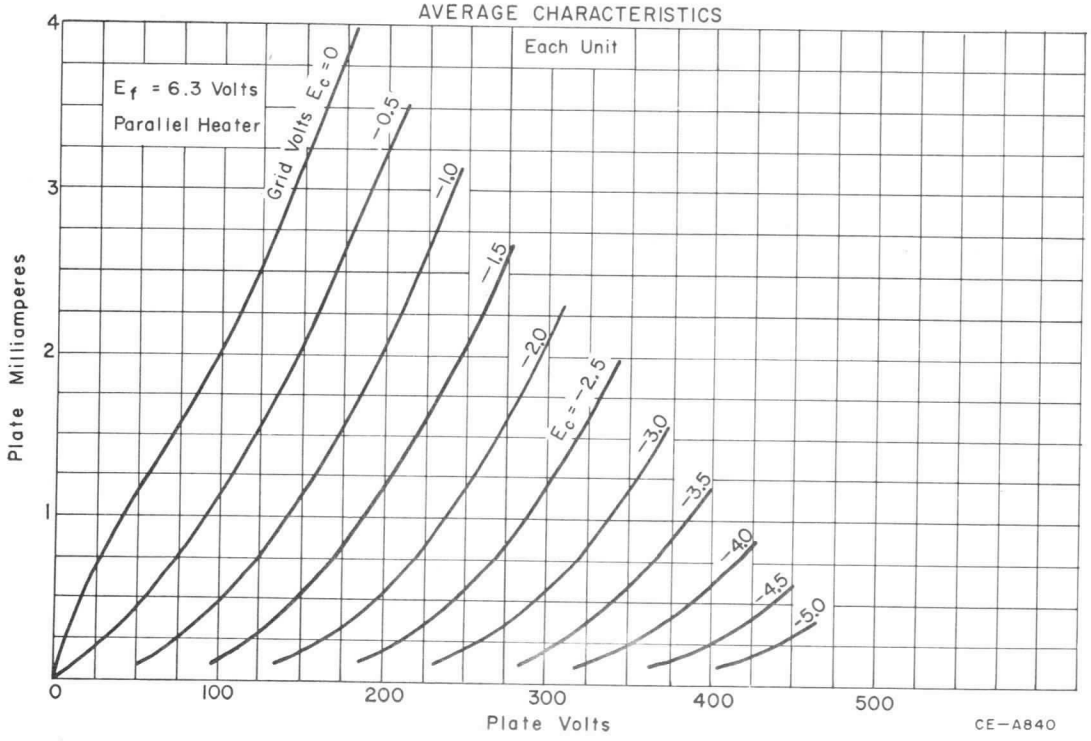
NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Grid bias for the triode unit may be obtained from a fixed source, such as a fixed-voltage tap on the dc power supply or from a cathode-bias resistor. Diode-biasing is not recommended because of the probability of plate-current cutoff.









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FULL-WAVE VACUUM RECTIFIER TYPE 5AW4

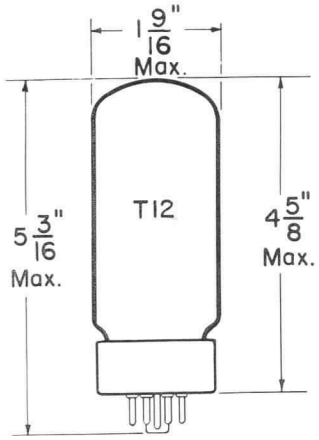
The 5AW4 is a glass-octal full-wave high-vacuum rectifier designed for service in power supplies of equipment requiring high current. The tube should be mounted vertically, but horizontal mounting is permissible if pins 1 and 4 are in a vertical plane. Like all power handling tubes, the 5AW4 should be adequately ventilated.

ELECTRICAL

Cathode	Coated Filament	
Heater:		
Voltage (ac or dc)	5.0	Volts
Current	3.7	Amperes

MECHANICAL

Bulb	T-12
Base	Medium Shell Octal 5-Pin (JEDEC B5-15)
Basing	5T
Mounting Position	Vertical or Horizontal with Pins 1 and 4 in Vertical Plane.



RECTIFIER SERVICE

MAXIMUM RATINGS (Note 1)

Design Center Values

Peak Inverse Plate Voltage	1550	max.	Volts
Maximum AC Plate Supply Voltage			
Each Plate (RMS)	550	max.	Volts
Steady-State Peak Plate Current			
Each Plate	0.75	max.	Ampere
Transient Peak Plate Current			
Each Plate (See Chart III)	4.0	max.	Amperes

TYPICAL OPERATION AS FULL-WAVE RECTIFIER

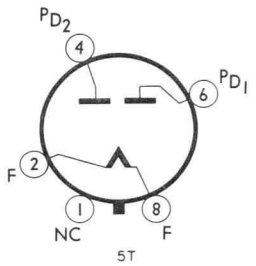
	Input to Filter Capacitor	Input to Filter Choke	
AC Plate Supply Voltage			
Each Plate (RMS)	450	550	Volts
Input Capacitor	10	–	μf
Input Choke	–	10	Henrys
Effective Plate Supply Resistance Each Plate	153	–	Ohms
DC Output Current	250	250	Ma.
DC Output Voltage at Filter Input	422	–	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop with Tube Conducting 250 ma. Each Plate	46	Volts

NOTE

1. All maximum ratings are not attainable at the same time. If operation is lenient in one parameter, it may be more severe in others.



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HIGH-MU TRIODE-SHARP-CUTOFF PENTODE TYPE 6AW8-A AND 8AW8-A

The 6AW8-A and 8AW8-A are 9-pin miniature high-mu triode and sharp-cutoff pentode types designed for service in series heater string television receivers. The triode unit is intended for service as a sync separator while the pentode unit is designed for operation as a video amplifier.

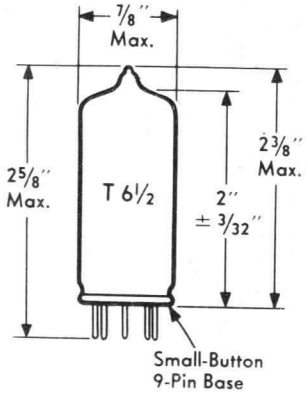
The 6AW8-A and 8AW8-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

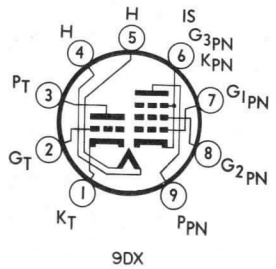
ELECTRICAL:

Cathodes	Coated Unipotential			
Heater:	6AW8-A	8AW8-A		
Voltage (ac or dc)	6.3	8.4		Volts
Current	0.60±6%	0.45±6%		Ampere
Warm-up Time (Approx.)▲	11	11		Seconds
Direct Interelectrode Capacitances:				
Triode	Shielded♦	Unshielded		
Grid to Plate	2.2	2.2		μμf
Input	3.4	3.2		μμf
Output	3.0	1.8		μμf
Pentode				
Grid 1 to Plate	0.04	0.05	max.	μμf
Input	10	10		μμf
Output	4.5	3.6		μμf
Coupling				
Pentode Grid 1 to Triode Plate	.005	.008	max.	μμf
Pentode Plate to Triode Plate	0.025	0.15	max.	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9DX
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	--	330	max.	Volts
Grid 2 Voltage	--	See Grid 2 Input Rating Curve		
Plate Dissipation	1.1	3.75	max.	Watts
Grid 2 Dissipation	--	1.1	max.	Watts
Positive Grid 1 Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS

	Triode	Pentode		
Plate Voltage	200	200	65	Volts
Grid 2 Voltage	--	150	150	Volts
Grid 1 Voltage	−2	--	0	Volts
Cathode Bias Resistor	--	150	--	Ohms
Amplification Factor	70	--	--	
Plate Resistance (Approx.)	--	200000	--	Ohms
Tranconductance	4000	9500	--	μmhos
Plate Current	4.0	15	46□	Ma.
Grid 2 Current	--	3.5	15□	Ma.
Grid 1 Cutoff Voltage⊕	−5	−8	--	Volts

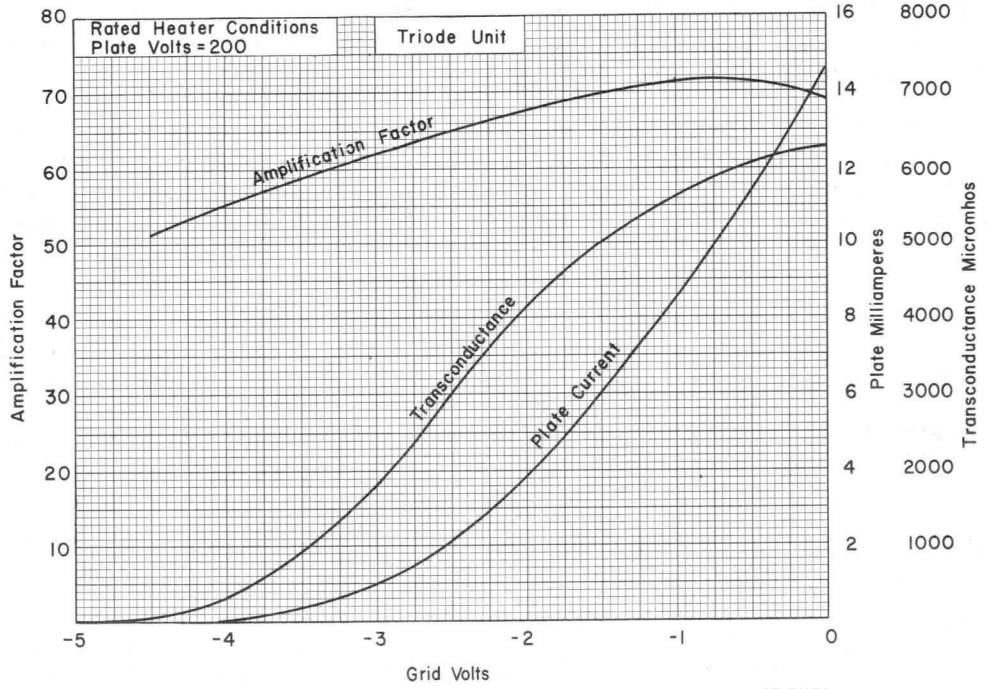
♦ Shield No. 315 tied to cathode of section under test.

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

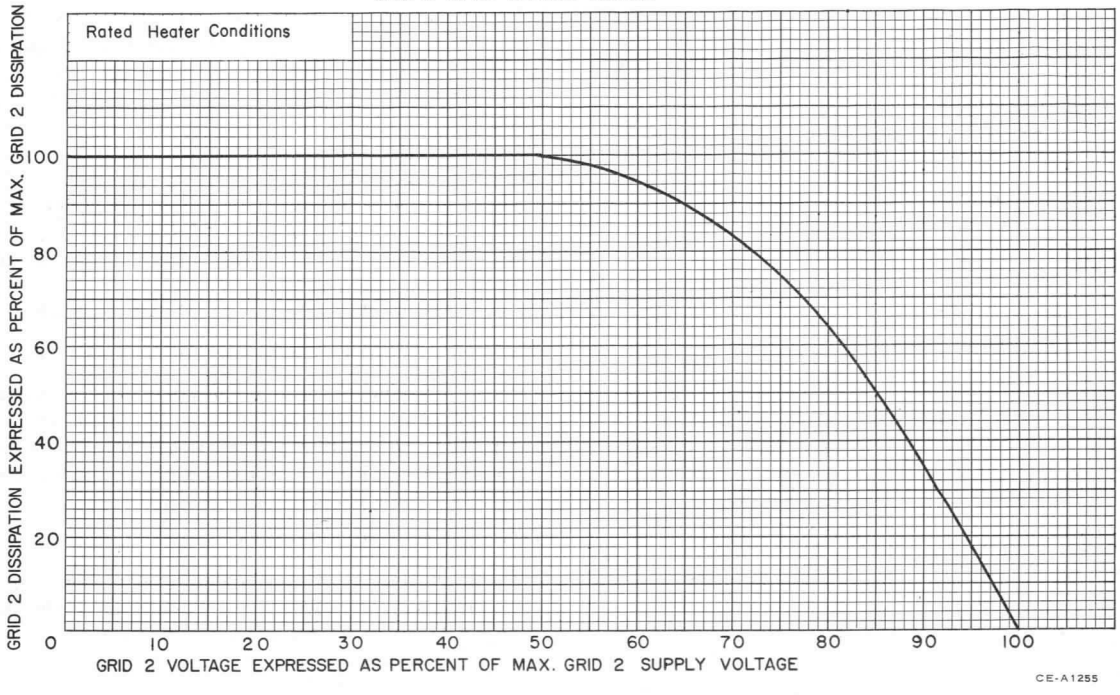
⊕ For plate current of 20 microamperes.

□ These values can be measured by a method involving a recurrent waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

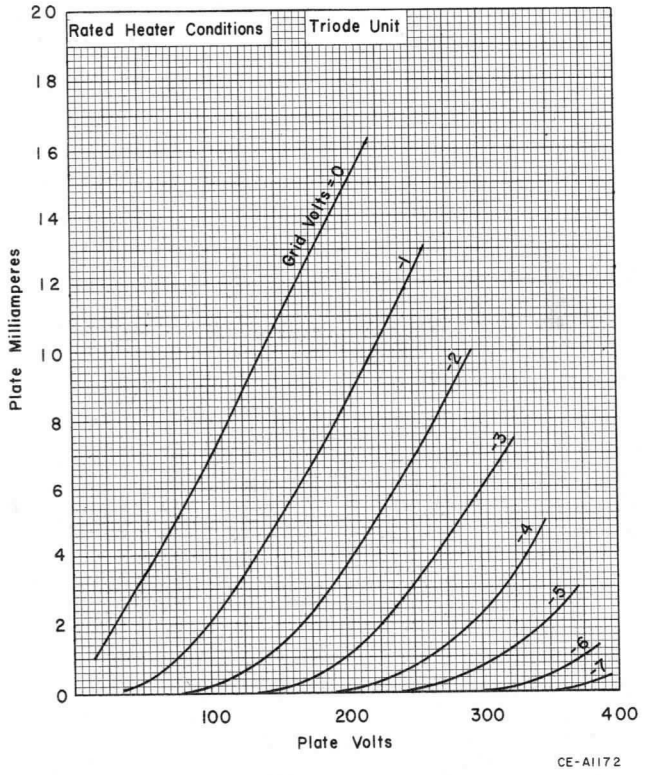
AVERAGE TRANSFER CHARACTERISTICS



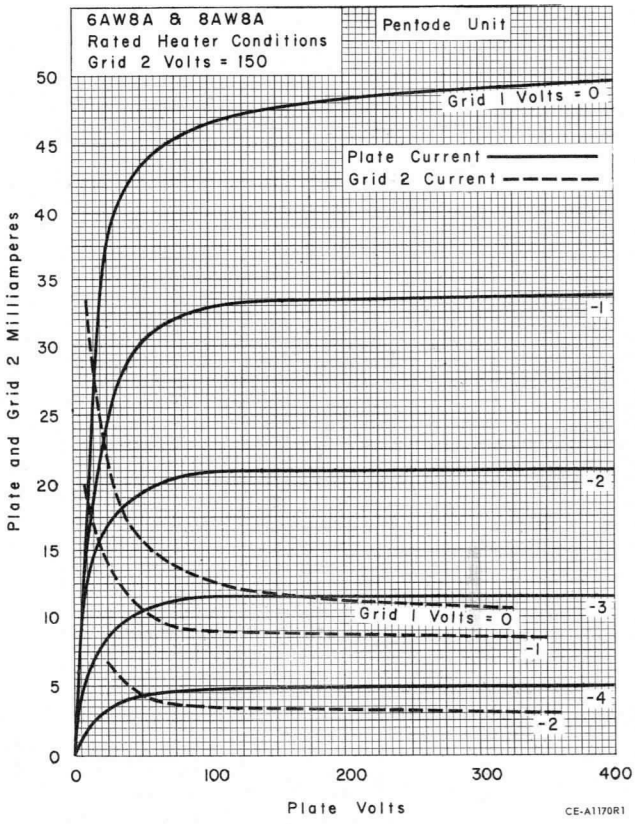
GRID 2 INPUT RATING CURVE



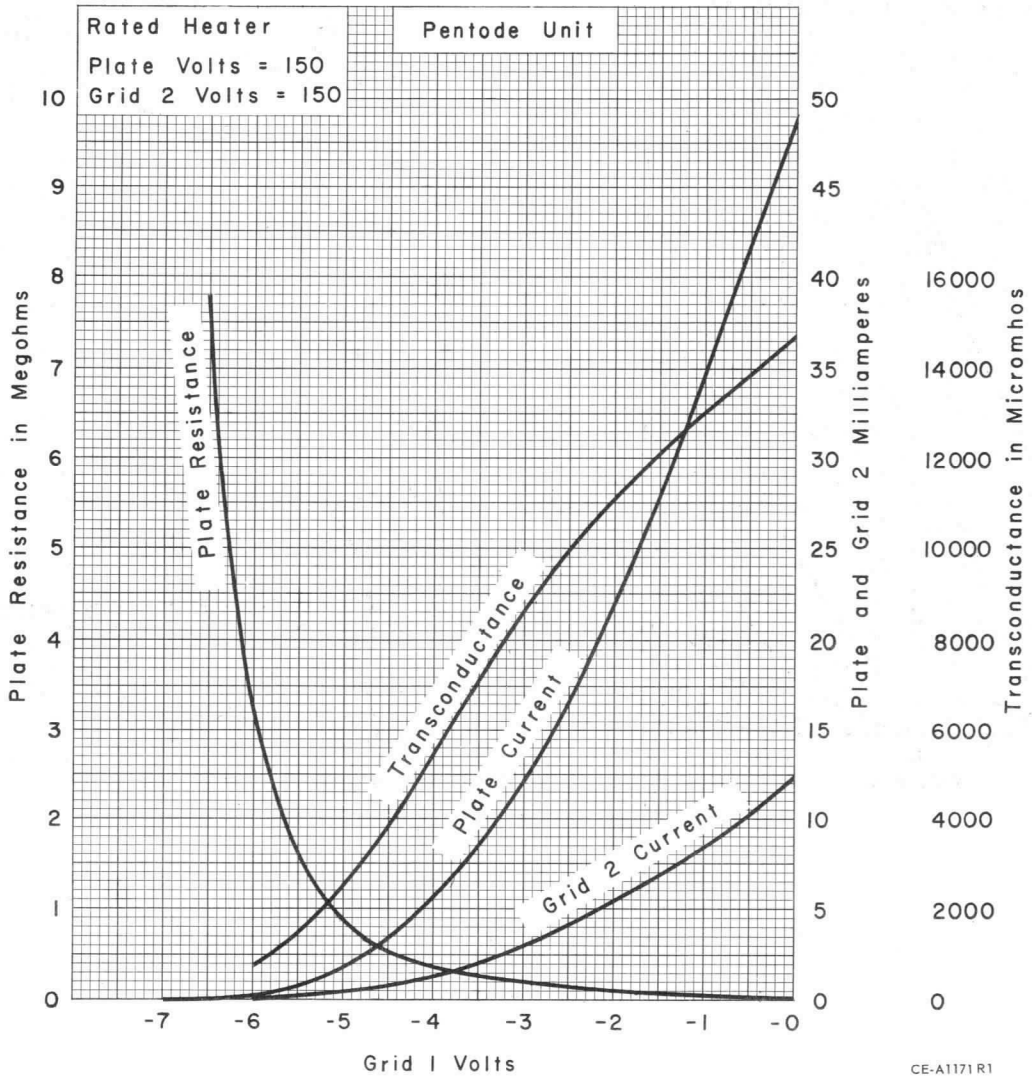
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



CE-A1171 R1

Westinghouse

6AX4-GT
6AX4-GTB
12AX4-GTA
17AX4-GT
25AX4-GT

April 15, 1960

TELEVISION DAMPING DIODE TYPES
6AX4-GT, 6AX4-GTB, 12AX4-GTA, 17AX4-GT AND 25AX4-GT

The 6AX4-GT, 6AX4-GTB, 12AX4-GTA, 17AX4-GT and 25AX4-GT are 6-pin octal indirectly-heated half-wave rectifiers designed for service as the damping diode in horizontal deflection circuits of television receivers.

The 12AX4-GTA and 17AX4-GT have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Unipotential					
Heater:	6AX4-GT 6AX4-GTB	12AX4-GTA	17AX4-GT	25AX4-GT		
Voltage (ac or dc)	6.3	12.6	16.8	25.0	Volts	
Current	1.2	0.60	0.45	0.30	Amperes	
Warm-up Time⊕	--	11	11	--	Seconds	
Direct Interelectrode Capacitances:						
Heater to Cathode	4.0	$\mu\mu$f				
Plate to Cathode and Heater	5.0	$\mu\mu$f				
Cathode to Plate and Heater	8.5	$\mu\mu$f				

MECHANICAL:

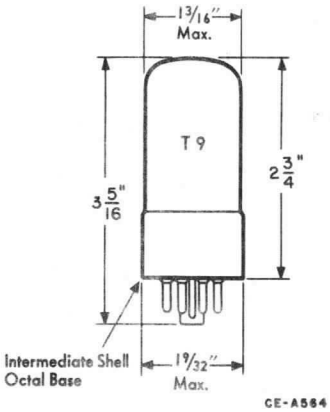
Bulb	T-9
Base	Short Intermediate-Shell Octal
Basing	4CG
Mounting Position	Any

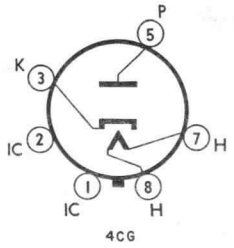
MAXIMUM RATINGS:
TV DAMPER DIODE SERVICE ★

	Design Maximum Values 6AX4-GTB	Design Center Values 6AX4-GT 12AX4-GTA 17AX4-GT 25AX4-GT		
Peak Inverse Voltage	5000	4400♦	max.	Volts
Peak Plate Current	1000	750	max.	Ma.
DC Plate Current	165	125	max.	Ma.
Plate Dissipation	5.3	4.8	max.	Watts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode:				
DC Component	900	900	max.	Volts
Total DC and Peak	5000	4400	max.	Volts
Heater Positive with Respect to Cathode:				
DC Component	100	100	max.	Volts
Total DC and Peak	300	300	max.	Volts

CHARACTERISTIC:

Voltage Drop with Plate Current of 250 Ma	32	Volts





Pins 1, 2, 4, 6 must not be used as tie points.

★ For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle. Operation as a power rectifier is not recommended.

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

♦ Absolute Maximum Value.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

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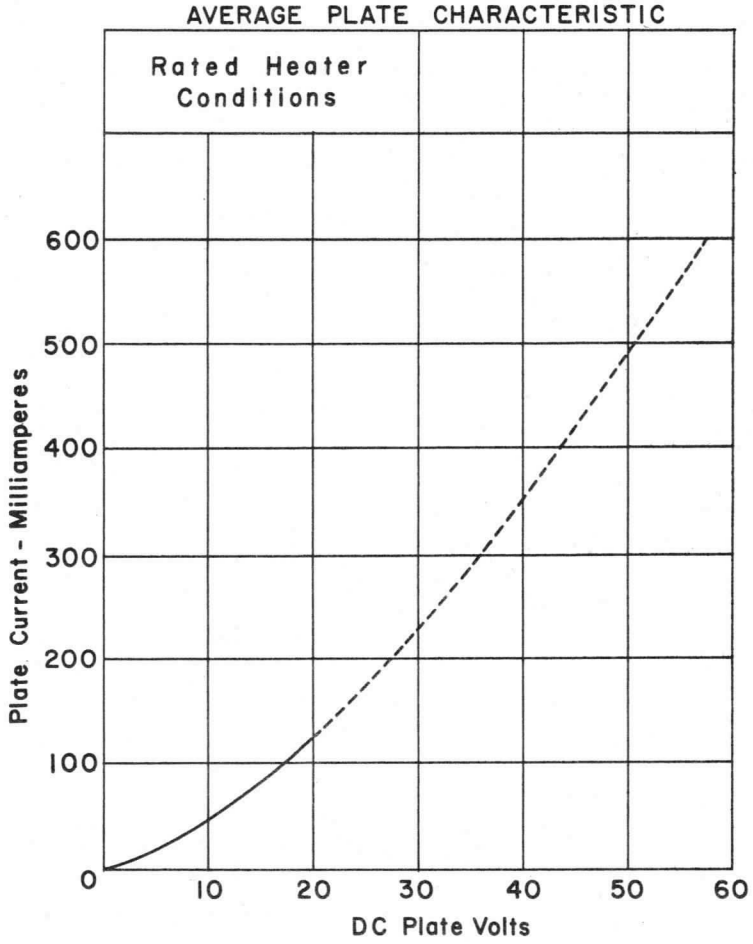
AVERAGE PLATE CHARACTERISTIC



CE-A818 R1

HIGH-MU TWIN-TRIODE TYPES 12AX7 AND 12AX7A

The 12AX7 and 12AX7A are 9-pin miniature twin triode types designed for service as a voltage amplifier or phase inverter. They may also be used as a multivibrator or oscillator in industrial control equipment.

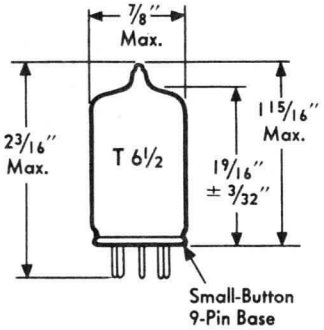
The 12AX7A features several design and processing improvements resulting in lower hum and microphonic noise. An improvement in the performance of a high gain, low level, audio pre-amplifier will result from replacement of a type 12AX7 with a type 12AX7A.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage (ac or dc)	12.6	6.3	Volts
Current	0.15	0.30	Ampere
Direct Interelectrode Capacitances (Unshielded):	Unit 1	Unit 2	
Grid to Plate	1.7	1.7	μμf
Input	1.6	1.6	μμf
Output	0.46	0.34	μμf

MECHANICAL

Bulb	T-6½
Base	Small-Button Noval 9-Pin
Outline	6-2
Basing	9A
Mounting Position	Any



AMPLIFIER - CLASS A_1

Each Unit

MAXIMUM RATINGS

Design-Maximum Values

Plate Voltage	330	max.	Volts
Plate Dissipation	1.2	max.	Watts
Grid Voltage:			
Negative Bias Value	-55	max.	Volts
Positive Bias Value	0	max.	Volts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

TYPICAL OPERATION

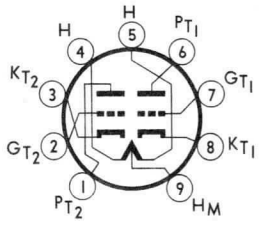
Plate Voltage	100	250	Volts
Grid Voltage	-1	-2	Volts
Amplification Factor	100	100	-
Plate Resistance	80000	62500	Ohms
Transconductance	1250	1600	μmhos
Plate Current	0.5	1.2	Ma.

EQUIVALENT NOISE AND HUM VOLTAGE

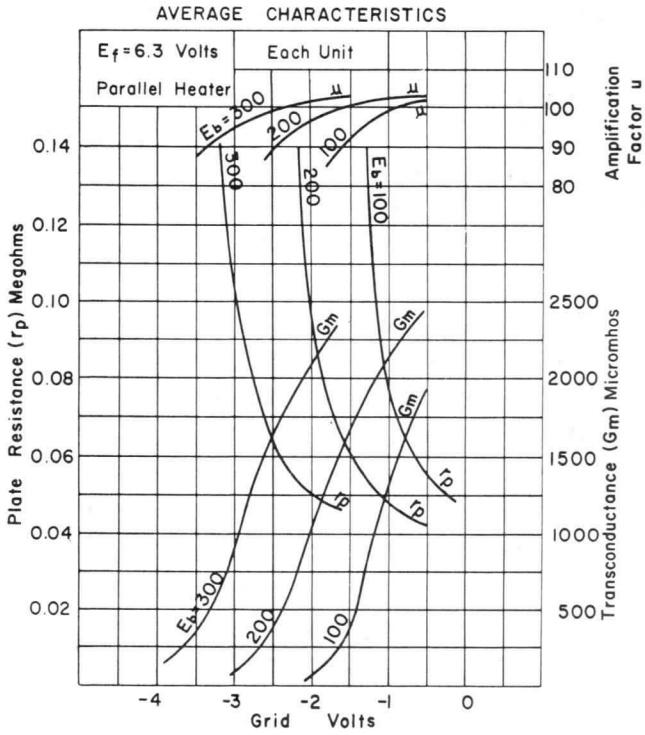
Each Unit, Referenced to Grid, Average RMS Value (Note 1)	1.8	μVolts

NOTE

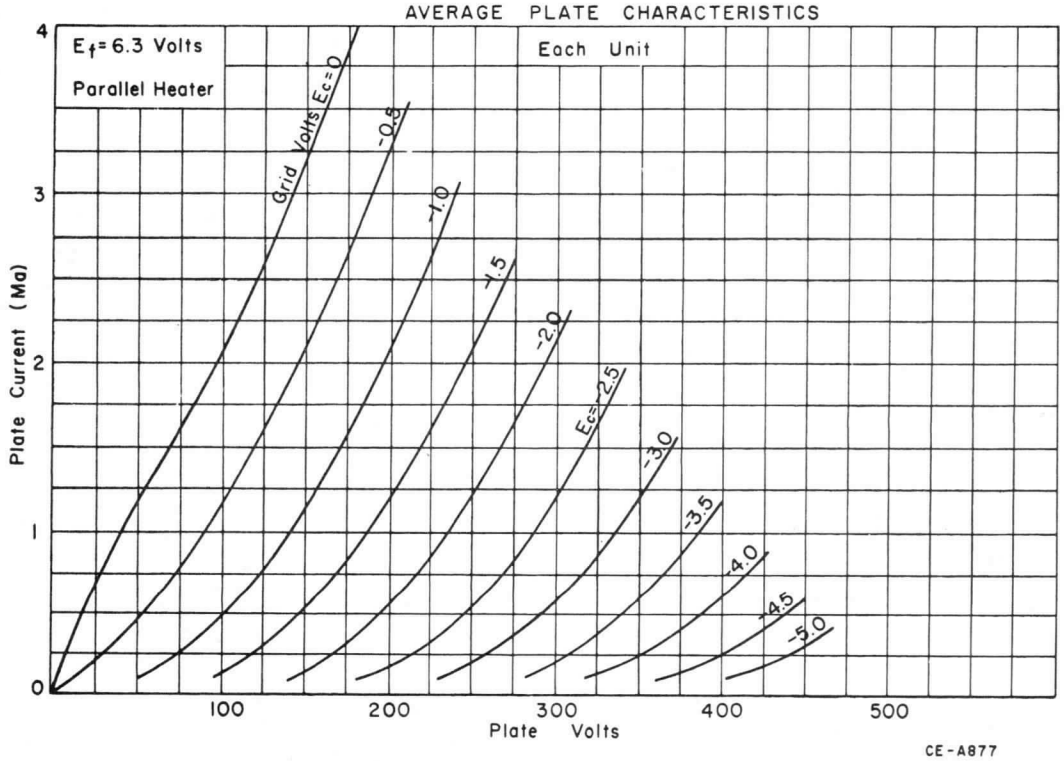
1. Heater Volts = 6.3 (ac), heater transformer CT grounded, Plate Supply Volts = 250, Plate Load Ohms = 100000, Cathode Bias Ohms = 2700, Cathode Bypass μf = 100, Grid Resistor = 0, Measured from 25 to 10000 cps.



9A



CE-A876



CE-A877

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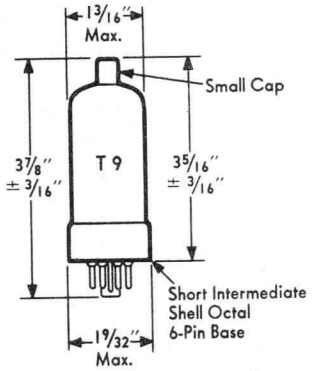
May 15, 1958

HALF-WAVE VACUUM RECTIFIER TYPE 1B3-GT

The 1B3-GT is a glass octal directly heated diode designed for service as a high voltage, low current rectifier. This tube is particularly well suited for service as the high voltage rectifier in television receivers because it has very good insulation between plate and filament and requires only 200 milliamperes of filament current.

GENERAL DATA

ELECTRICAL:		
Filament (Coated):		
Voltage (ac or dc)	1.25▲	Volts
Current	0.20	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Plate to Filament	1.3	uuf
MECHANICAL:		
Bulb		T-9
Base		Intermediate Shell Octal (JETEC B5-82, B6-8, B7-166) Short Intermediate Shell Octal (JETEC B5-85, B6-60, B7-147)
Outline		9-51 or 9-52
Basing		3C
Mounting Position		Any



CE-A574

MAXIMUM RATINGS

DESIGN-CENTER VALUES:

(Except as Indicated)	Flyback Rectifier♦	RF Voltage Rectifier	
Inverse Plate Voltage			
DC Component	21000 max.	-	Volts
Total DC and Peak	26000 max.	33000 abs. max.	Volts
Steady-State Peak Plate Current	50	30 max.	Ma.
DC Output Current	0.5	1.0 max.	Ma.
Frequency of Supply Voltage			
Maximum	-	100 max.	Kc.
Minimum	-	1.5 min.	Kc.

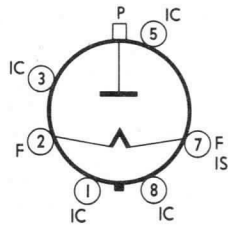
AVERAGE CHARACTERISTICS

Tube Voltage Drop (Approx.) . With Plate Current of 7.0 Ma. dc	100	Volts

♦ For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

▲ The filament voltage must never be less than 1.05 volts or more than 1.45 volts.

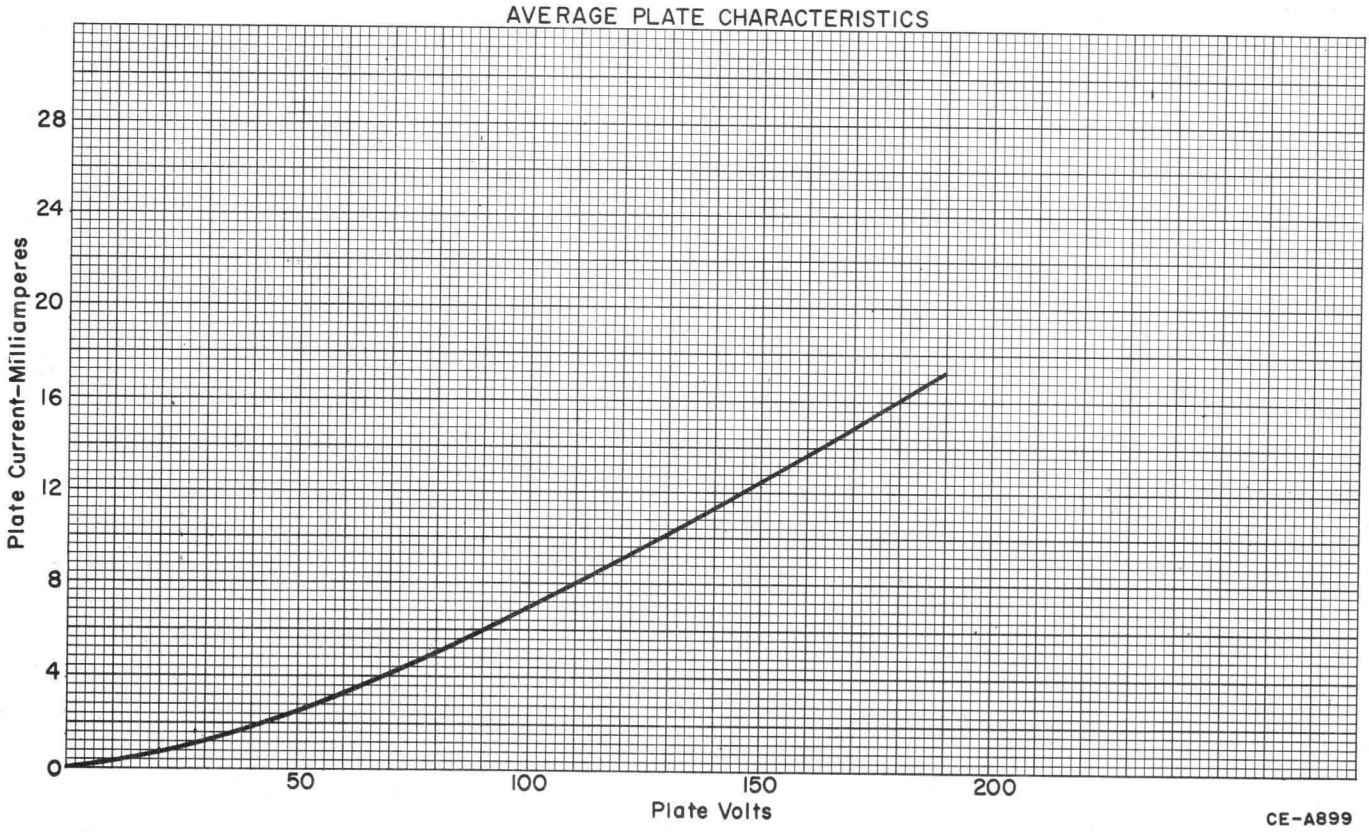
Inasmuch as the tube rating permits operation at high voltage, shielding of the tube for x-ray radiation may be needed.



3C

BOTTOM VIEW

Socket Terminals 1, 3, 4, 5, 6 and 8 shall not be used as tie points although terminals 1, 3, 5 and 8 may be connected to terminal 7 to reduce corona discharge.


AVERAGE PLATE CHARACTERISTICS
Plate Current-Milliamperes
0
4
8
12
16
20
24
28
50
100
150
200
Plate Volts
CE-A899

Westinghouse

3BA6
6BA6
12BA6

June 15, 1961

REMOTE-CUTOFF PENTODE TYPES 3BA6, 6BA6 AND 12BA6

The 3BA6, 6BA6 and 12BA6 are 7-pin miniature receiving tubes used as rf amplifiers in ac/dc standard broadcast receivers, in FM receivers, and in wide-band high-frequency applications. The low grid-1-to-plate capacitance minimizes regeneration, and they have high transconductance.

The 3BA6 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	3BA6	6BA6	12BA6	
Voltage (ac or dc)	3.15	6.3	12.6	Volts
Current	0.60	0.30	0.15	Ampere
Warm-up Time (Approx.)▲	11	--	--	Seconds
Direct Interelectrode Capacitances: (Unshielded):				
Grid to Plate	0.0035	max.		$\mu\mu$f
Input	5.5			$\mu\mu$f
Output	5.0			$\mu\mu$f

MECHANICAL:

Bulb	T-5-½
Base	JEDEC E7-1, Small Button 7-Pin
Basing	7BK
Mounting Position	Any

MAXIMUM RATINGS:

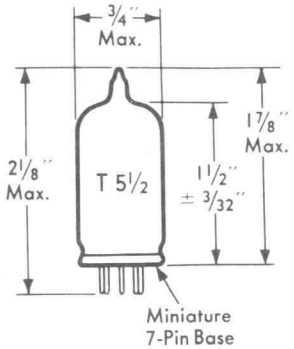
Design Maximum Values

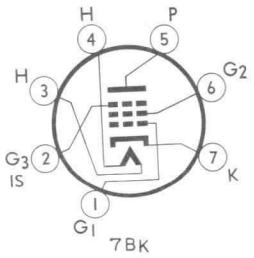
Plate Voltage	330	max.	Volts
Grid 2 (Screen) Supply Voltage	330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Grid 1 (Control Grid) Voltage:			
Negative Bias Value	55	max.	Volts
Positive Bias Value	0	max.	Volts
Plate Dissipation	3.4	max.	Watts
Grid 2 Dissipation	0.6	max.	Watts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

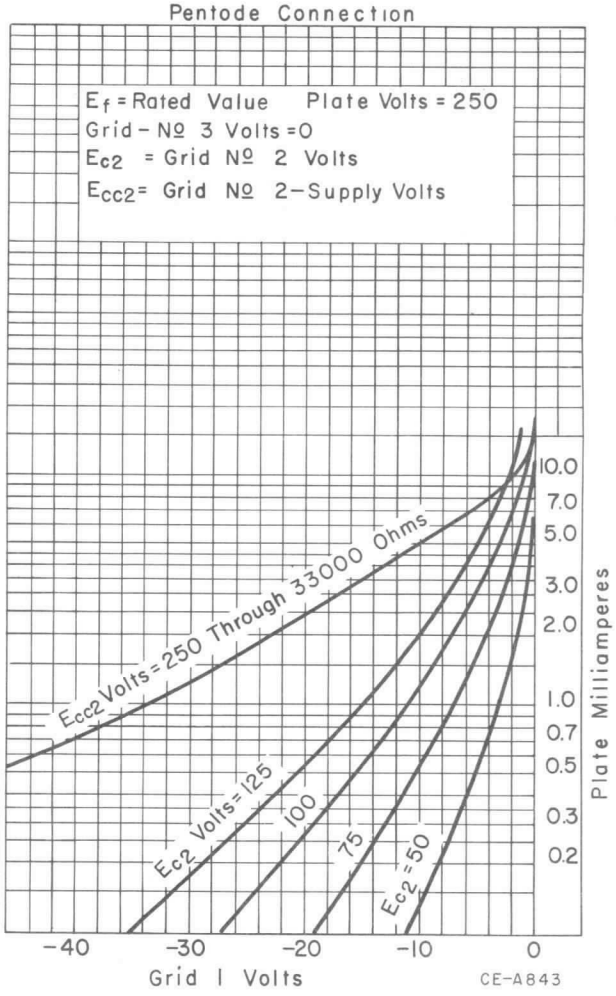
Plate Voltage	100	250	Volts
Grid 2 Voltage	100	100	Volts
Grid 3 (Suppressor) Voltage	Connected to Cathode at Socket		
Cathode-Bias Resistor	68	68	Ohms
Plate Resistance (Approx.)	0.25	1.0	Megohms
Transconductance	4300	4400	μmhos
Grid 1 Bias (Approx.) for transconductance of 40 μmhos	−20	−20	Volts
Plate Current	10.8	11	Ma.
Grid 2 Current	4.4	4.2	Ma.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

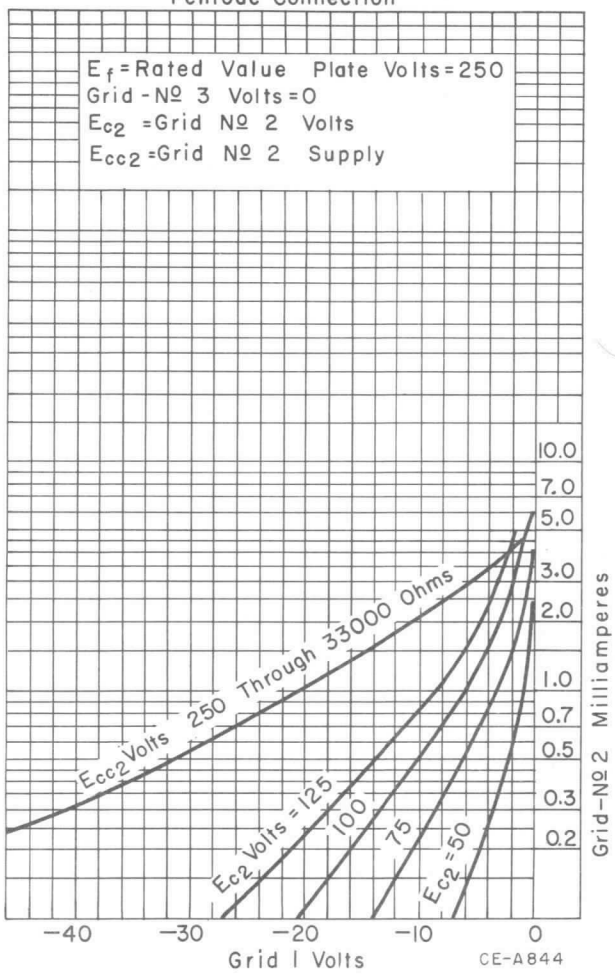


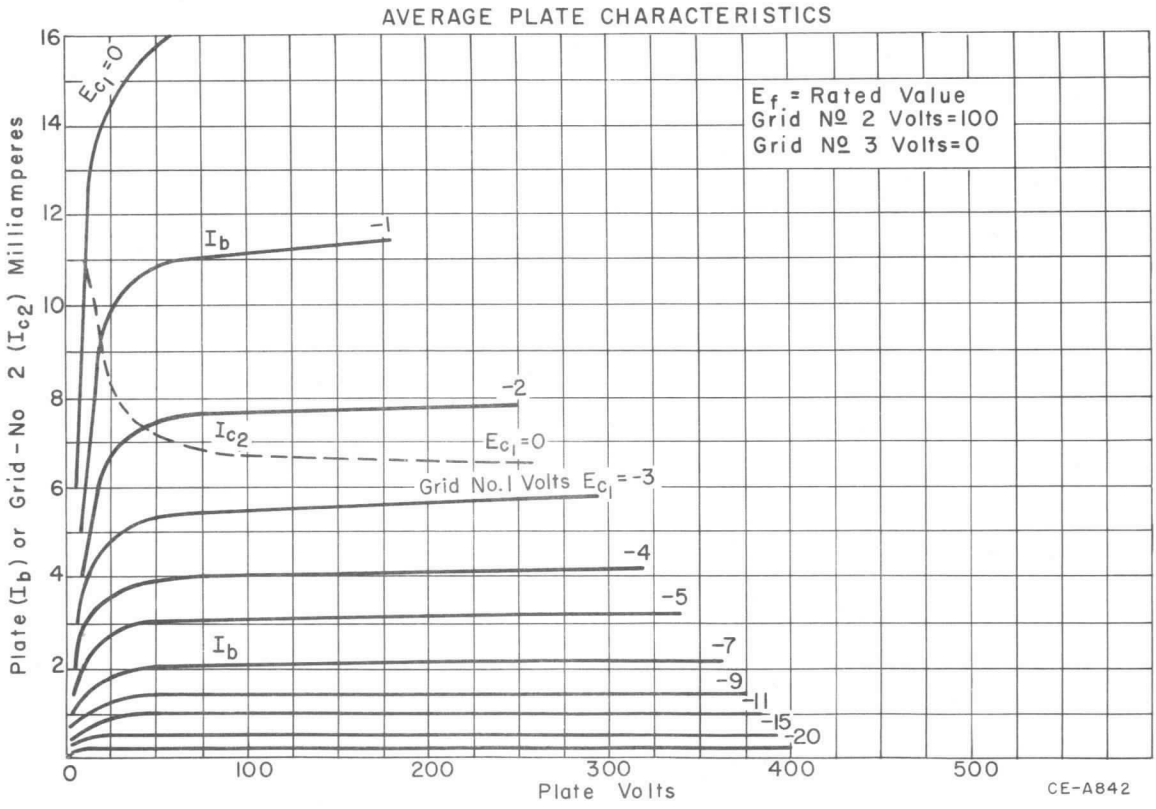


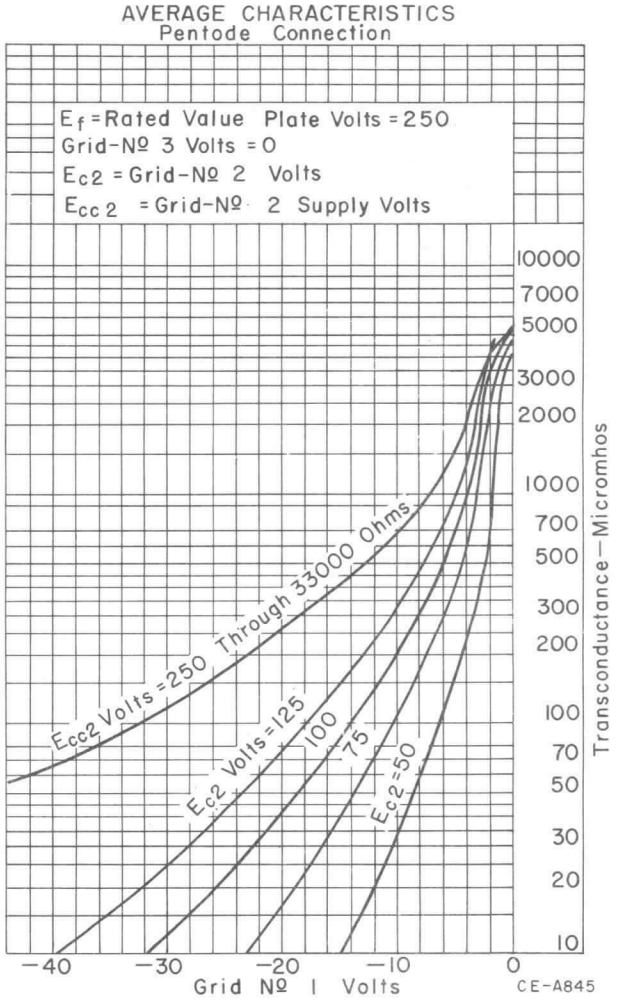
AVERAGE CHARACTERISTICS
Pentode Connection

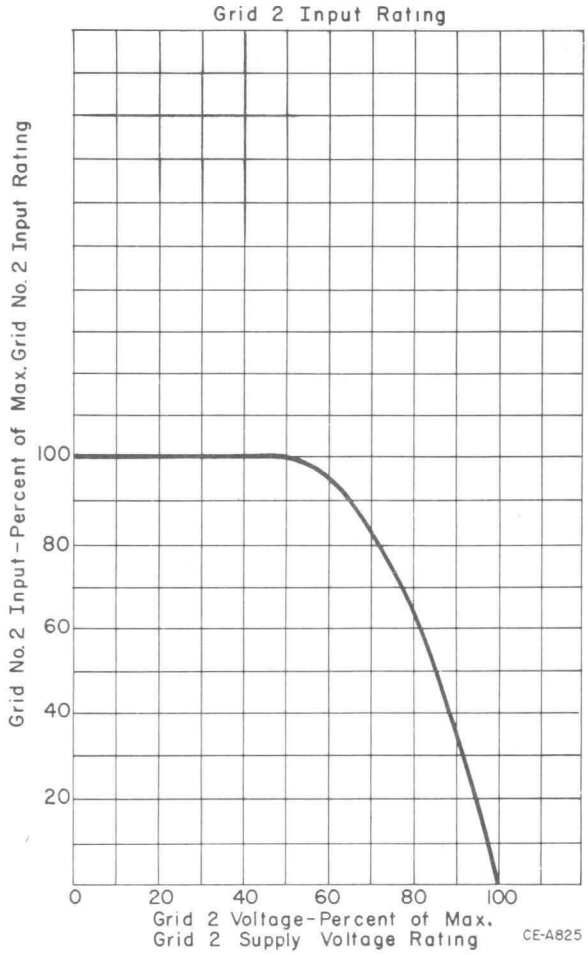


AVERAGE CHARACTERISTICS
Pentode Connection




AVERAGE PLATE CHARACTERISTICS
Ef = Rated Value
Grid No 2 Volts=100
Grid No 3 Volts=0
Plate (Ib) or Grid-No 2 (Ic2) Milliamperes
Plate Volts
Ec1=0
Ib
Ic2
Grid No.1 Volts Ec1=-3
-1
-2
-4
-5
-7
-9
-11
-15
-20
0
100
200
300
400
500
2
4
6
8
10
12
14
16
CE-A842





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Westinghouse

3BC5
4BC5
6BC5

July 1, 1963

SHARP-CUTOFF PENTODE TYPES 3BC5, 4BC5 AND 6BC5

The 3BC5, 4BC5 and 6BC5 are 7-pin miniature sharp-cutoff pentode types designed for service as high gain i-f or r-f amplifiers at frequencies up to 400 megacycles. They feature high transconductance and low grid 1-to-plate capacitance.

The 3BC5 and 4BC5 have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential			
Heater:	3BC5	4BC5	6BC5	
Voltage	3.15	4.2	6.3 ± 10%	Volts
Current	0.60 ±6%	0.45 ±6%	0.3	Ampere
Warm-Up Time (Note 1)	11	11	–	Seconds

Direct Interelectrode Capacitances:	Unshielded		Shielded (Note 2)		
Pentode Connection:					
Grid 1 to Plate	0.03	max.	0.02	max.	pf
Input	6.5		6.6		pf
Output	1.8		2.6		pf
Triode Connection (Grid 2 connected to plate)					
Grid 1 to Plate	2.5		2.5		pf
Input	3.9		4.0		pf
Output	3.0		4.3		pf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7BD
Mounting Position	Any

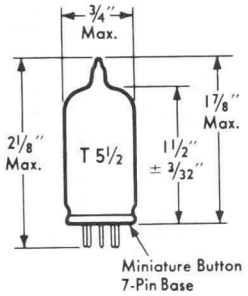
MAXIMUM RATINGS

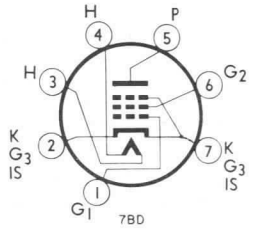
Design Maximum Values

Plate Voltage	330 max.	Volts
Grid 2 Supply Voltage	330 max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve	
Grid 1 Voltage:		
Positive Bias Value	0 max.	Volts
Plate Dissipation	2.3 max.	Watts
Grid 2 Input	0.55 max.	Watts
Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC	100 max.	Volts
Total DC + Peak	200 max.	Volts

TYPICAL OPERATION AND CHARACTERISTICS

Plate Voltage	100	125	250	Volts
Grid 2 Voltage	100	125	150	Volts
Cathode Bias Resistor	180	100	180	Ohms
Plate Resistance (Approx.)	0.6	0.5	0.8	Megohm
Transconductance	4900	6100	5700	μmhos
Grid 1 Voltage (Approx.) for I_b = 10 μamp.	–5	–6	–8	Volts
Plate Current	4.7	8.0	7.5	Ma.
Grid 2 Current	1.4	2.4	2.1	Ma.





TRIODE CONNECTED (Note 3)

MAXIMUM RATINGS

Design Maximum Values

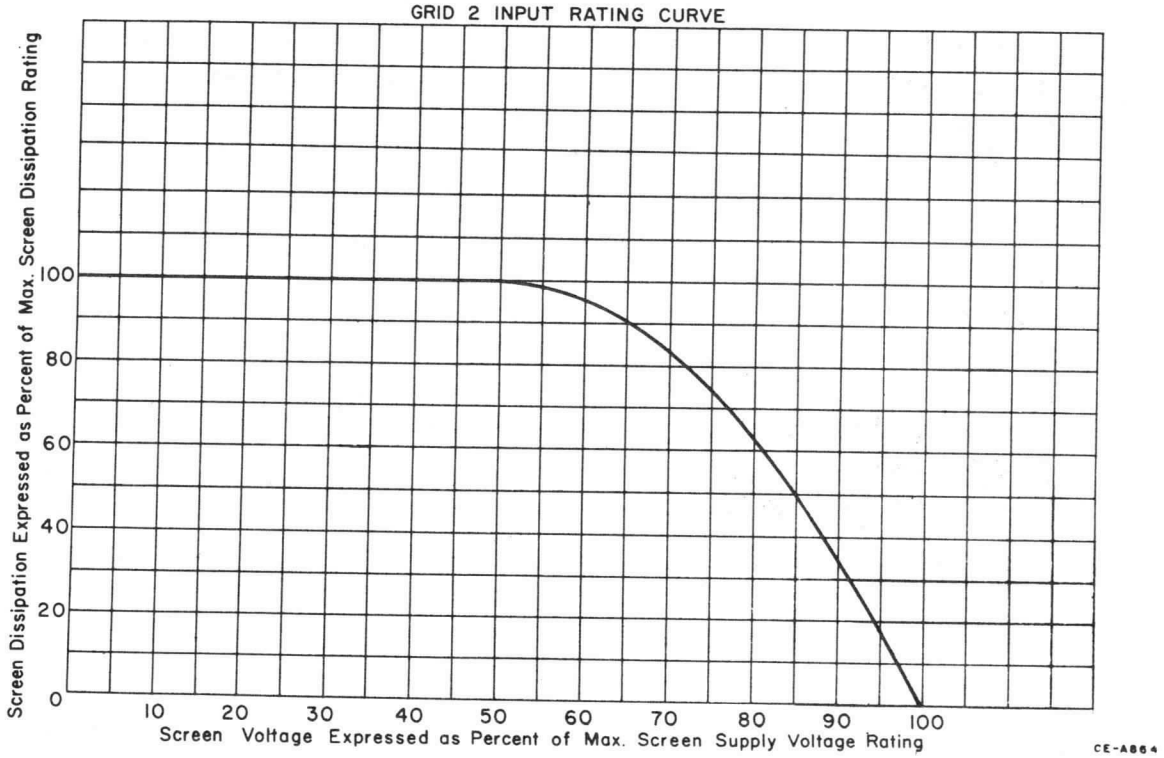
Plate Voltage	330	max.	Volts
Grid 1 Voltage:			
Positive Bias Value	0	max.	Volts
Plate Dissipation	2.9	max.	Watts
Peak Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC	100	max.	Volts
Total DC + Peak	200	max.	Volts

TYPICAL OPERATION AND CHARACTERISTICS

Plate Voltage	180	250	Volts
Cathode-Bias Resistor	330	820	Ohms
Amplification Factor	42	40	–
Plate Resistance (Approx.)	6000	9000	Ohms
Transconductance	6000	4400	μmhos
Plate Current	8	6	Ma.

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. JEDEC Shield #315 connected to cathode.
3. Grid 2 connected to Plate.



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Westinghouse

6BE3
12BE3
17BE3

February 1, 1965

TELEVISION DAMPING DIODE TYPE 6BE3, 12BE3 AND 17BE3

The 6BE3, 12BE3 and 17BE3 are 12-pin button based indirectly-heated half-wave rectifiers designed for television damping diode service in horizontal deflection circuits.

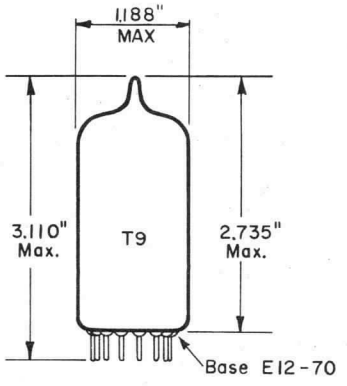
The 12BE3 and 17BE3 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

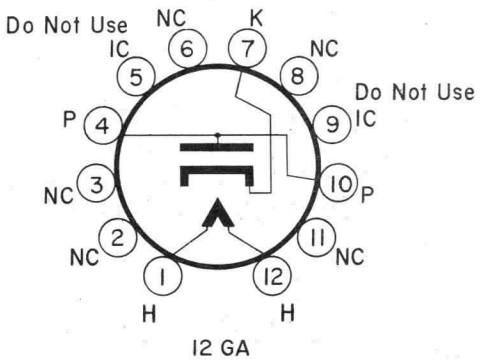
ELECTRICAL

Cathode			Coated Unipotential	
Heater:	6BE3	12BE3	17BE3	
Voltage (ac or dc)	6.3 ± 0.6	12.6	16.8	Volts
Current	1.2	0.60 ± 0.04	0.45 ± 0.03	Ampere
Warm-Up Time (Note 1)	–	11	11	Seconds
Direct Interelectrode Capacitances:				
Heater to Cathode			3.4	pf
Plate to Cathode and Heater			8.0	pf
Cathode to Plate and Heater			10	pf

MECHANICAL

Bulb	Glass, T-9
Base	EIA E12-70
Basing	EIA 12 GA
Mounting Position	Any





DAMPER SERVICE (Note 2)

MAXIMUM RATINGS

Design Maximum Values (Note 3)

Peak Inverse Voltage	5000	max.	Volts
Peak Plate Current	1200	max.	Ma.
DC Plate Current	200	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
DC Component	900	max.	Volts
Total DC and Peak	5000	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC and Peak	300	max.	Volts
Plate Dissipation	6.5	max.	Watts

CHARACTERISTIC

Voltage Drop at Ib = 350 mA	25	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle. In a 525 line, 30 frame system, 15% of one horizontal scanning cycle is 10 microseconds.

3. Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron tube of a specified type as defined by its published data and should not be exceeded under the worst probable conditions.

   The tube manufacturer chooses these values to provide acceptable serviceability of the tube, making allowance for the effects of changes in operating conditions due to variations in the characteristics of the tube under consideration.

   The equipment manufacturer should design so that initially and throughout life, no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all other electron devices in the equipment.

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October 15, 1958

PENTAGRID CONVERTER TYPES 3BE6, 6BE6 AND 12BE6

The 3BE6, 6BE6 and 12BE6 are 7-pin pentagrid converter types designed for combined oscillator and mixer service in ac/dc and auto receivers.

The 3BE6 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

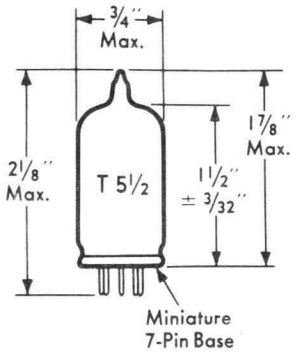
ELECTRICAL:

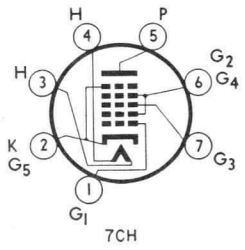
Cathode	Coated Unipotential			
Heater:	3BE6	6BE6	12BE6	
Voltage (ac or dc)	3.15	6.3	12.6	Volts
Current	0.60	0.30	0.15	Ampere
Warm-up Time (approx.) ▲	11	..	..	Seconds

Direct Interelectrode Capacitances:	Unshielded	Shielded †	
Grid 3 to all other Electrodes (RF Input)	7	7	max. uuf
Plate to all other Electrodes (Mixer Output)	8	13	uuf
Grid 1 to all other Electrodes (Osc. Input)	5.5	5.5	max. uuf
Grid 3 to Plate	0.30	0.25	max. uuf
Grid 3 to Grid 1	0.15	0.15	max. uuf
Grid 1 to Plate	0.1	0.05	max. uuf
Grid 1 to Cathode & Grid 5	3	3	uuf
Cathode and Grid 5 to all other Electrodes except Grid 1	15	20	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7CH
Mounting Position	Any





Supersedes 3BE6 Data Sheet Dated January 5, 1955
Supersedes 6BE6 Data Sheet Dated July 20, 1954
Supersedes 12BE6 Data Sheet Dated June 15, 1954

Receiving Tube Section

CONVERTER SERVICE

MAXIMUM RATINGS:
Design Center Values

Plate Voltage	300	max.	Volts
Grids 2 and 4 Voltage	100	max.	Volts
Grid 2 and 4 Supply Voltage	300	max.	Volts
Plate Dissipation	1.0	max.	Watts
Grids 2 and 4 Dissipation	1.0	max.	Watts
Total Cathode Current	14	max.	Ma.
Grid 3 Voltage:			
Negative Bias Value	50	max.	Volts
Positive Bias Value	0	max.	Volts

Heater-Cathode Voltage:	3BE6	6BE6		
	3BE6	12BE6		
Heater Negative with Respect to Cathode:				
Total DC + Peak	200	90	max.	Volts
Heater Positive with Respect to Cathode:				
DC Component	100	..	max.	Volts
Total DC + Peak	200	90	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:
with Separate Excitation*

Plate Voltage	100	250	Volts
Grids 2 and 4 Voltage	100	100	Volts
Grid 3 Voltage	-1.5	-1.5	Volts
Grid 1 Voltage (rms)	10	10	Volts
Grid 1 Resistor	20000	20000	Ohms
Plate Resistance (approx.)	0.4	1	Megohm
Conversion Transconductance	455	475	umhos
Grid 3 Voltage (approx.) for Conversion Transconductance of:			
10 umhos	-30	-30	Volts
100 umhos	-6	-6	Volts
Plate Current	2.6	2.9	Ma.
Grids 2 and 4 Current	7	6.8	Ma.
Grid 1 Current	0.5	0.5	Ma.
Total Cathode Current	10.1	10.2	Ma.

OSCILLATOR CHARACTERISTICS:
Not Oscillating

Plate Voltage	100	Volts
Grids 2 and 4	Connected to Plate	
Grid 3 Voltage	0	Volts
Grid 1 Voltage	0	Volts
Transconductance	7250	umhos
Cathode Current	25	Ma.
Amplification Factor	20	
Grid 1 Cutoff Voltage♦	-11	Volts

* The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

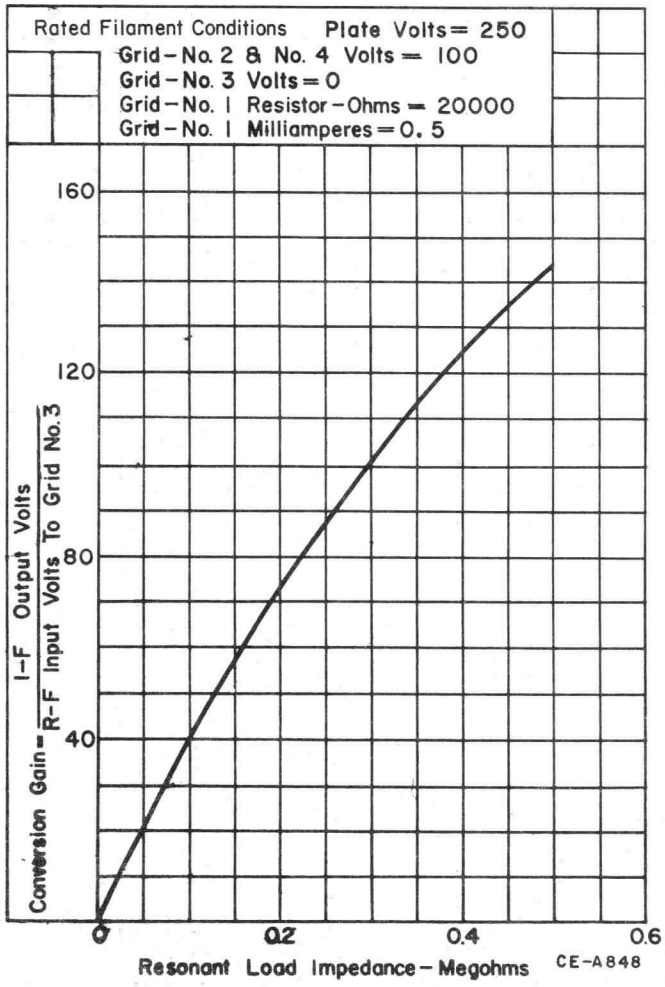
† External shield No. 316 connected to pin 2.

♦ For plate current of 10 microamperes.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

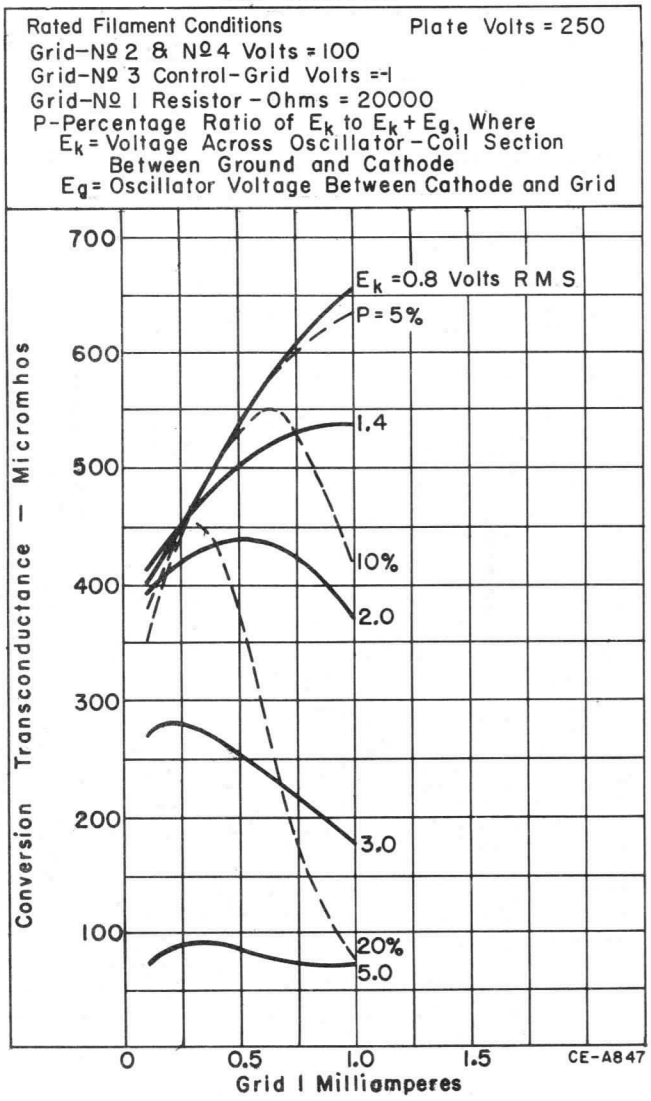
OPERATION CHARACTERISTIC

Self-Excitation



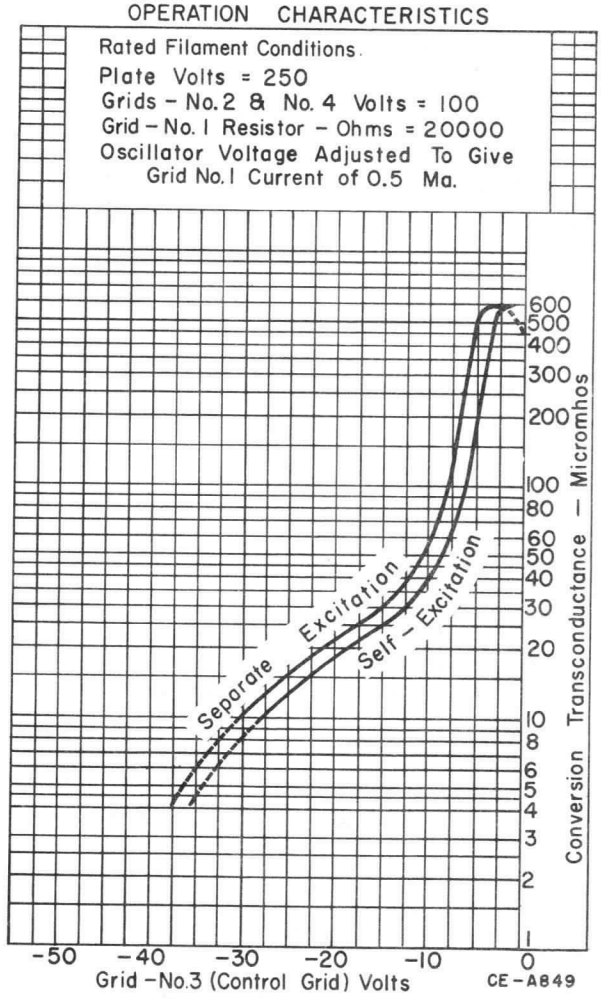
OPERATION CHARACTERISTICS

Self-Excitation



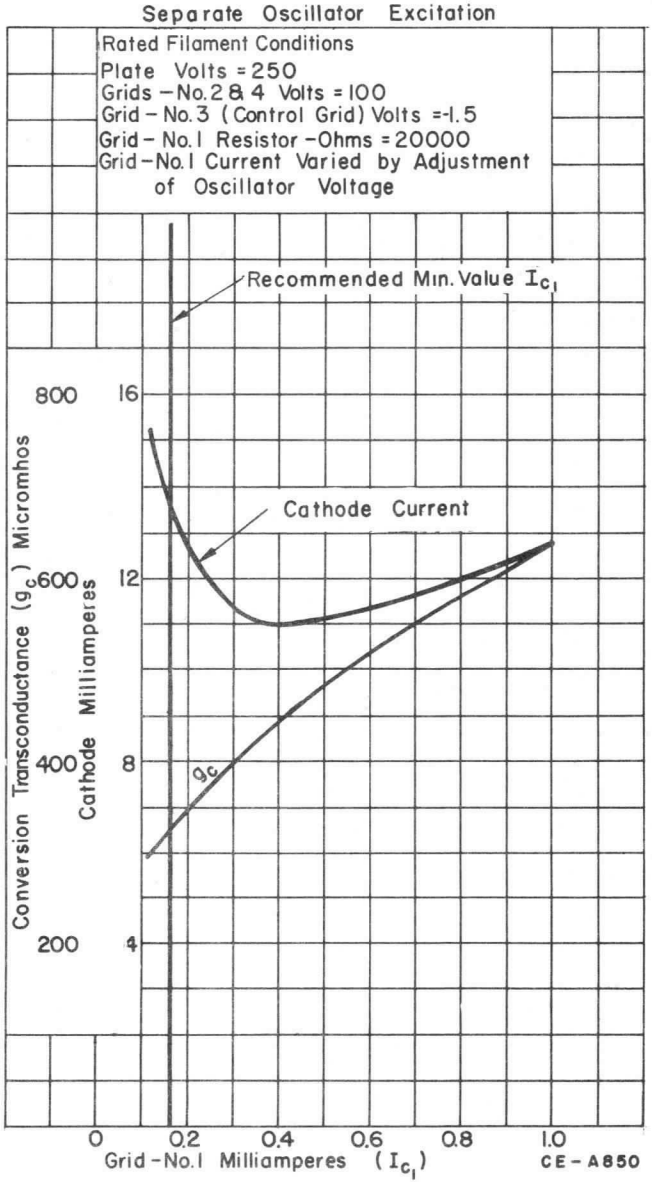
OPERATION CHARACTERISTICS

Rated Filament Conditions.
Plate Volts = 250
Grids – No. 2 & No. 4 Volts = 100
Grid – No. 1 Resistor – Ohms = 20000
Oscillator Voltage Adjusted To Give
Grid No. 1 Current of 0.5 Ma.



OPERATION CHARACTERISTICS
Separate Oscillator Excitation

Rated Filament Conditions
Plate Volts = 250
Grids – No. 2 & 4 Volts = 100
Grid – No. 3 (Control Grid) Volts = -1.5
Grid – No. 1 Resistor – Ohms = 20000
Grid – No. 1 Current Varied by Adjustment
of Oscillator Voltage



January 20, 1955

Medium-Mu Twin Triode Type 12BH7-A

The 12BH7-A is a medium-mu twin triode designed for the vertical deflection circuits of television receivers. In this application, one triode unit can be used as a vertical deflection amplifier while the other unit serves as a vertical oscillator. The 12BH7-A is particularly suitable for this type of operation as the cutoff rating is controlled. Except for the controlled cutoff rating and controlled heater warm-up characteristics, the 12BH7 is identical with the 12BH7-A.

The 12BH7-A has been designed for used in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

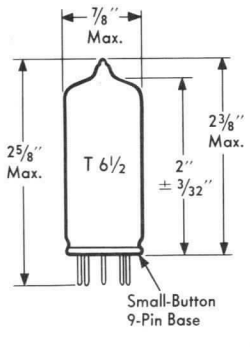
Electrical:

Cathodes	Two, Coated Unipotential		
Heater:	Series	Parallel	
Voltage	12.6	6.3	ac or dc Volts
Current	0.3	0.6	Ampere
Warm-up Time (Approx.)*	10.5		Seconds
Direct Interelectrode Capacitances (Unshielded):			
	Unit 1	Unit 2	
Grid to Plate	2.4	2.4	μμf
Grid 1 to Cathode and Heater	3.3	3.3	μμf
Plate to Cathode and Heater	0.5	0.4	μμf

Mechanical:

Bulb	T-6½
Base	Small Button 9-pin (JETEC E9-1)
Basing	9A
Mounting Position	Any

*See Page 3



AMPLIFIER — CLASS A_1

Values for each unit

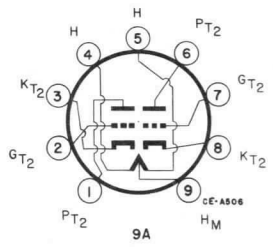
Maximum Ratings

Design Center Values

Plate Voltage	300 max.	Volts
Grid Voltage:		
Negative Bias Value	50 max.	Volts
Positive Bias Value	0 max.	Volts
Plate Dissipation	3.5 max.	Watts
Cathode Current	20 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

Characteristics

Plate Voltage	250	Volts
Grid Voltage	−10.5	Volts
Amplification Factor	17	
Plate Resistance (Approx.)	5500	Ohms
Transconductance	3100	μmhos
Plate Current	11.5	Ma.
Grid Voltage (Approx.) for Plate Current of 10 μamp.	−25	Volts



Bottom View

VERTICAL DEFLECTION AMPLIFIER
Values for each unit

Maximum Ratings
Design Center Values

For Operation in 525-line, 30-frame system**

DC Plate Voltage	500 max.	Volts
Peak Positive Pulse Plate Voltage#†	1350 max.	Volts
DC Grid Voltage	−50 max.	Volts
Peak Negative-Pulse Grid Voltage†	200 max.	Volts
Plate Dissipation†	3.5 max.	Watts
DC Cathode Current	20 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

Maximum Circuit Values

Grid Circuit Resistance:

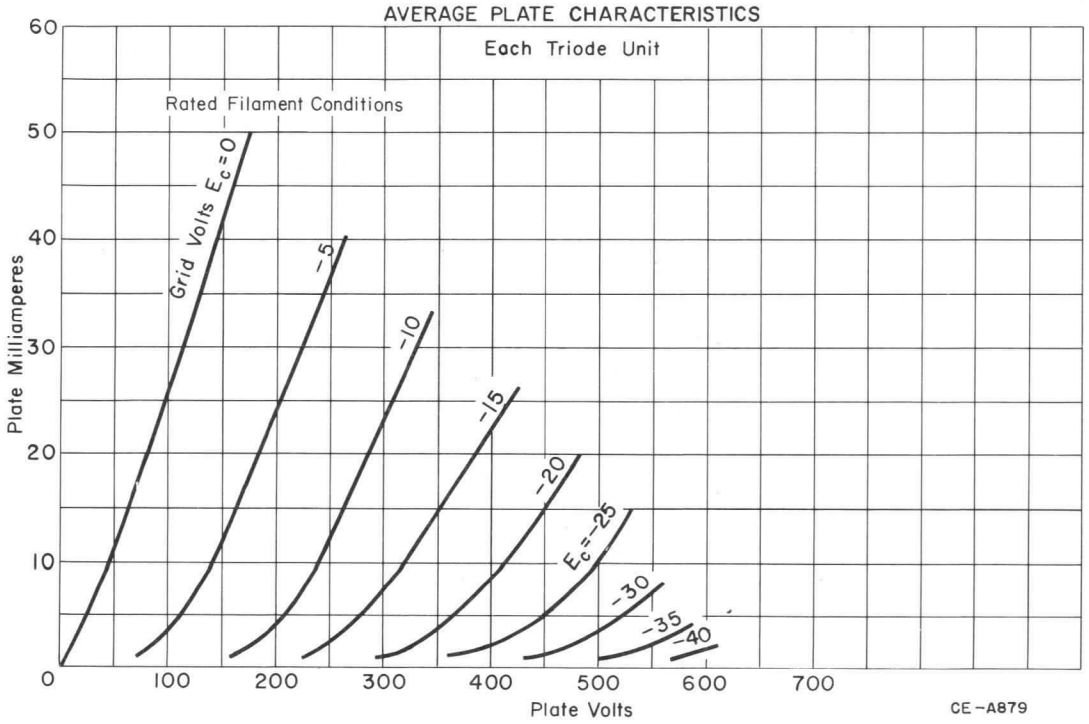
For Cathode-bias operation	2.5 max. Megohms
For Fixed-bias operation	1 max. Megohm

Cathode-Bias Resistance—Sufficient cathode-bias resistance should be used to protect the tube in case of failure of excitation and consequent loss of bias.

** As described in "Standards of Good Engineering Practice for Television Broadcast Stations," Federal Communication Commission.

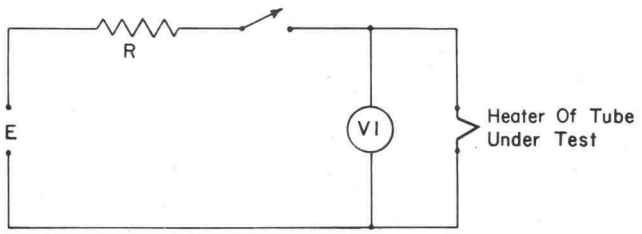
Duration of the voltage pulse must not exceed 15 per cent of one scanning cycle, or 2.5 milliseconds in a 525-line, 30-frame system.

† From the viewpoint of tube life, these values should not be exceeded by more than 10 per cent under any condition of high line voltage or misadjustment of any controls.



HEATER WARM-UP TIME MEASUREMENTS

Heater warm-up time is defined as the time required for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1) in the circuit shown below. The conditions used in conjunction with the test circuit depend upon the rated heater voltage and current of the tube under test.



CE-A933

E —Applied Voltage, RMS or DC	25	Volts
R —Total Series Resistance	31.5	Ohms
V_1—Heater Voltage, RMS or DC	5.0	Volts
E_f—Rated Heater Voltage	6.3	Volts
I_f—Rated Heater Current	0.6	Amperes

MEDIUM-MU TRIODE - SHARP CUT-OFF PENTODE TYPE 6BH8

The 6BH8 is a 9-pin miniature triode-pentode type designed for service in television receivers. The high transconductance pentode unit may be used as an i-f amplifier, video amplifier, agc amplifier and reactance tube. The triode unit may be used in low-frequency oscillator, sync separator, sync clipper and phase splitter circuits.

The 6BH8 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

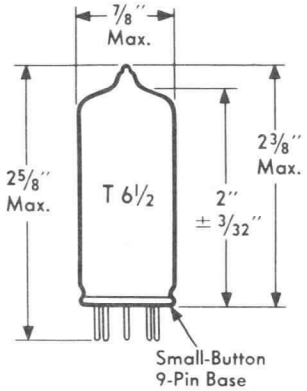
GENERAL DATA

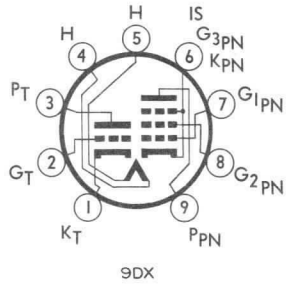
ELECTRICAL:

Cathode	Coated Unipotential	
Heater:	6BH8	
Voltage	6.3 ac or dc	Volts
Current	0.6 ± 6%	Ampere
Warm-up Time (Approx.)*	11	Seconds
Direct Interelectrode Capacitances (Unshielded):		
Triode Unit		
Grid to Plate	2.4	μμf
Input	2.6	μμf
Output	0.38	μμf
Pentode Unit		
Grid 1 to Plate	0.046	μμf
Input	7	μμf
Output	2.4	μμf
Triode Grid to Pentode Plate	0.016	μμf
Pentode Grid 1 to Triode Plate	0.004	μμf
Pentode Plate to Triode Plate	0.095	μμf

MECHANICAL:

Bulb	T-6 1/2
Base	Miniature 9-Pin (JETEC E9-1)
Outline	6-3
Basing	9DX
Mounting Position	Any





MAXIMUM RATINGS

DESIGN CENTER VALUES:

	Triode Unit	Pentode Unit	
Plate Voltage	300 max.	300 max.	Volts
Grid 2 Supply Voltage	...	300 max.	Volts
Grid 2 Voltage		See Grid 2 Input Rating Chart	
Grid 1 Voltage			
Positive Bias Value	0 max.	0 max.	Volts
Plate Dissipation	2.5 max.	3.0 max.	Watts
Grid 2 Input	...	1.0 max.	Watt
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200 max.	200 max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100 max.	100 max.	Volts
Total DC + Peak	200 max.	200 max.	Volts

MAXIMUM CIRCUIT VALUES:

Grid 1 Circuit Resistance**			
Cathode-Bias Operation	1.0 max.	1.0 max.	Megohm
Fixed-Bias Operation	0.5 max.	0.25 max.	Megohm

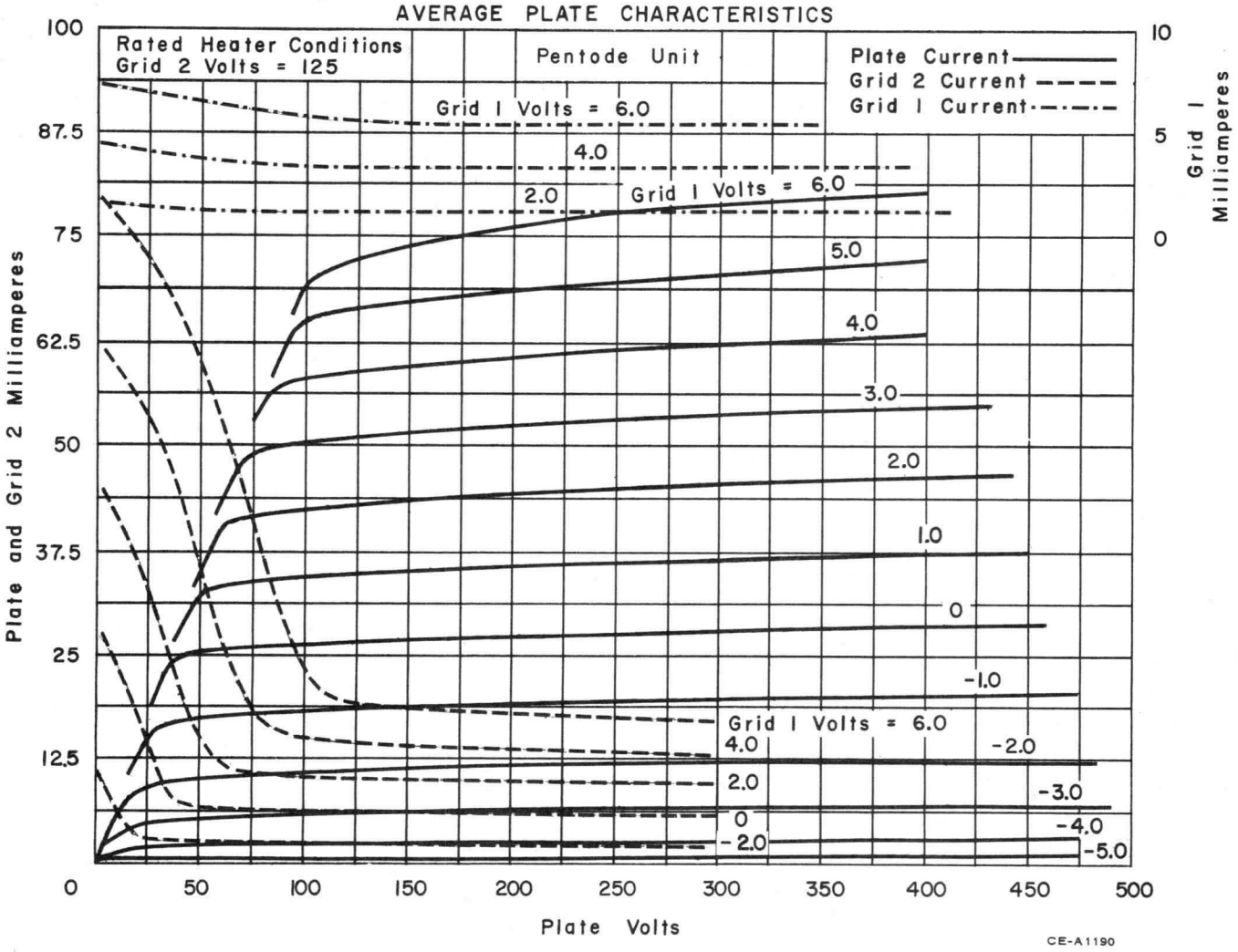
CHARACTERISTICS AND TYPICAL OPERATION

CLASS A_1 AMPLIFIER	Triode Unit	Pentode Unit	
Plate Supply Voltage	150	200	Volts
Grid 2 (Screen) Supply Voltage	...	125	Volts
Grid 1 (Control-Grid) Voltage	-5	...	Volts
Cathode-Bias Resistor	...	82	Ohms
Amplification Factor	17	...	
Plate Resistance (Approx.)	5150	150000	Ohms
Transconductance	3300	7000	umhos
Grid 1 Cutoff Voltage♦ (Approx.)	-14	-8	Volts
Plate Current	9.5	15	Ma.
Grid 2 Current	...	3.4	Ma.

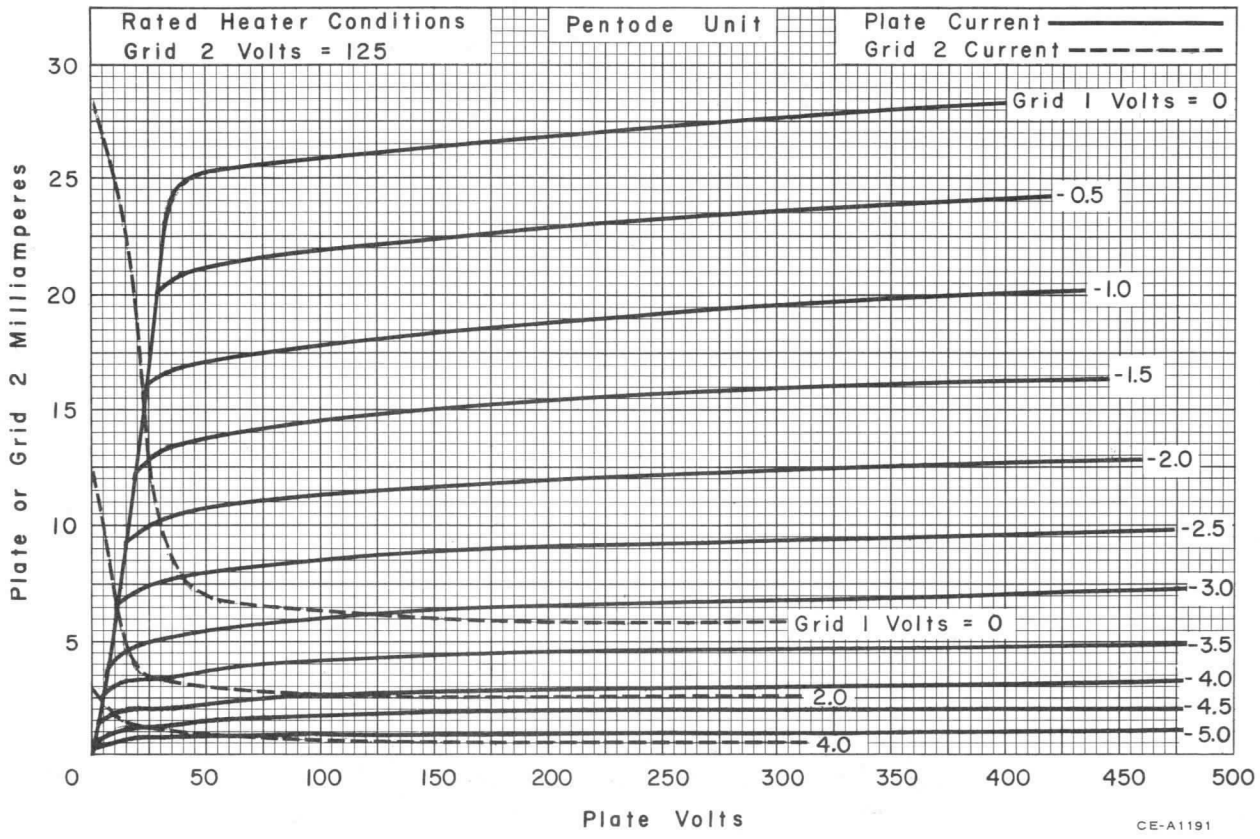
* Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

** If either unit is operating at maximum rated conditions, grid 1 circuit resistances for both units should not exceed the stated values.

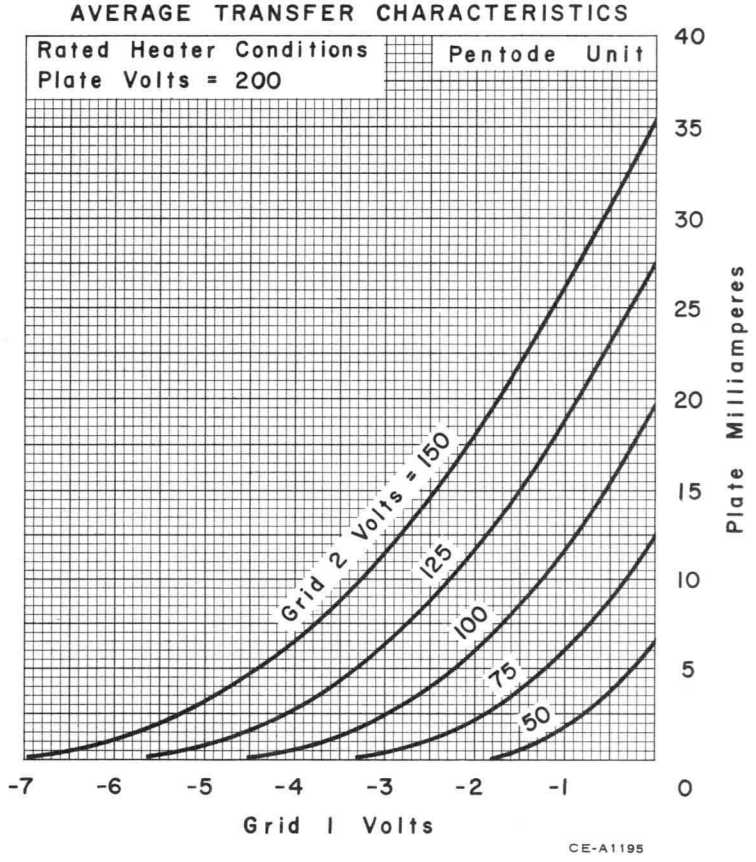
♦ For plate current of 100 μamp.


AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Pentode Unit
Plate Current
Grid 2 Current
Grid 1 Current
Grid 1 Volts = 6.0
4.0
2.0
Grid 1 Volts = 6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
Grid 1 Volts = 6.0
4.0
2.0
0
-2.0
-2.0
-3.0
-4.0
-5.0
Plate and Grid 2 Milliamperes
Grid 1 Milliamperes
Plate Volts
100
87.5
75
62.5
50
37.5
25
12.5
0
10
5
0
50
100
150
200
250
300
350
400
450
500
CE-A1190

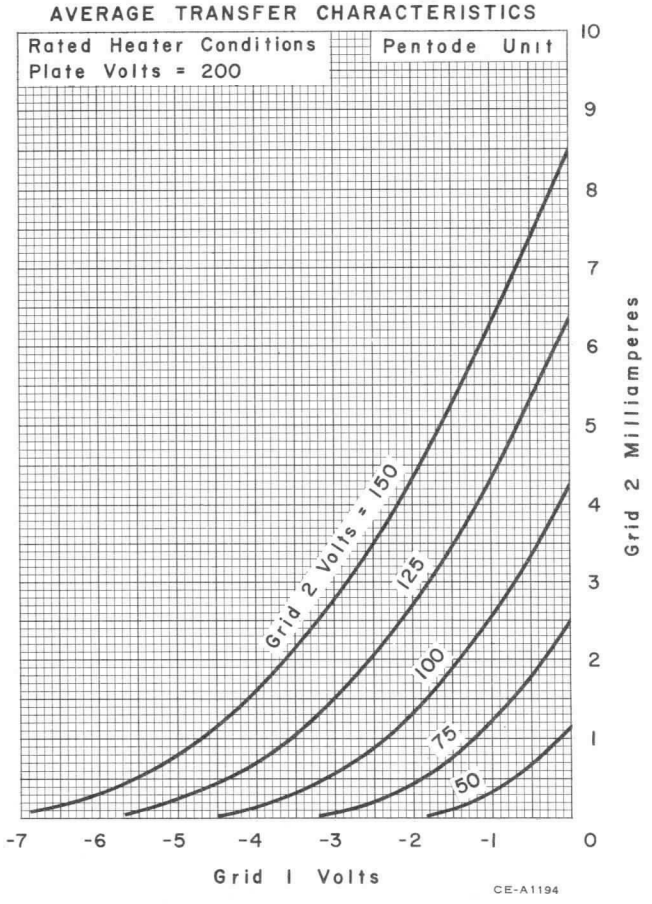
AVERAGE PLATE CHARACTERISTICS



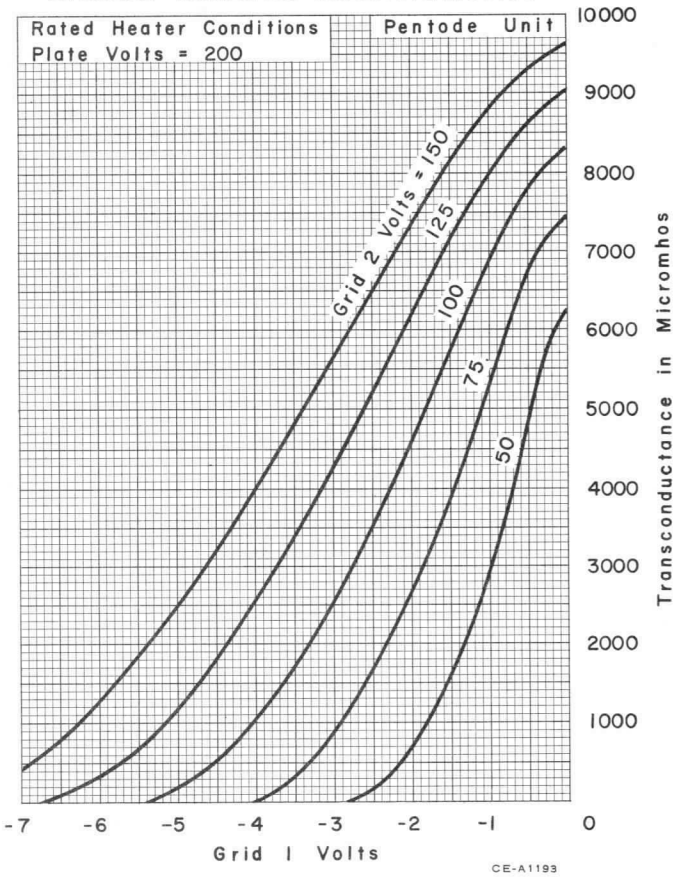
AVERAGE TRANSFER CHARACTERISTICS



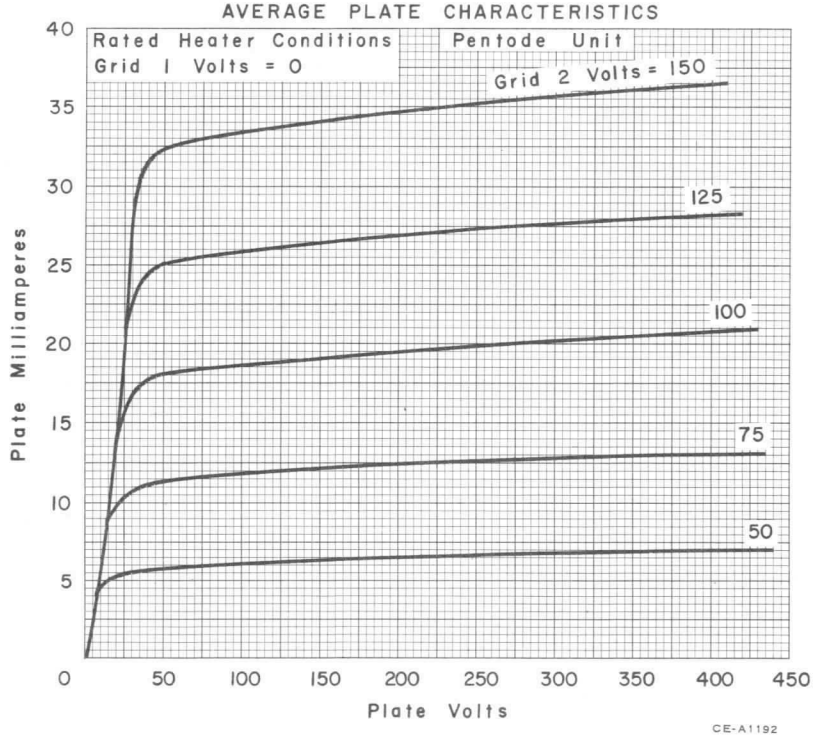
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

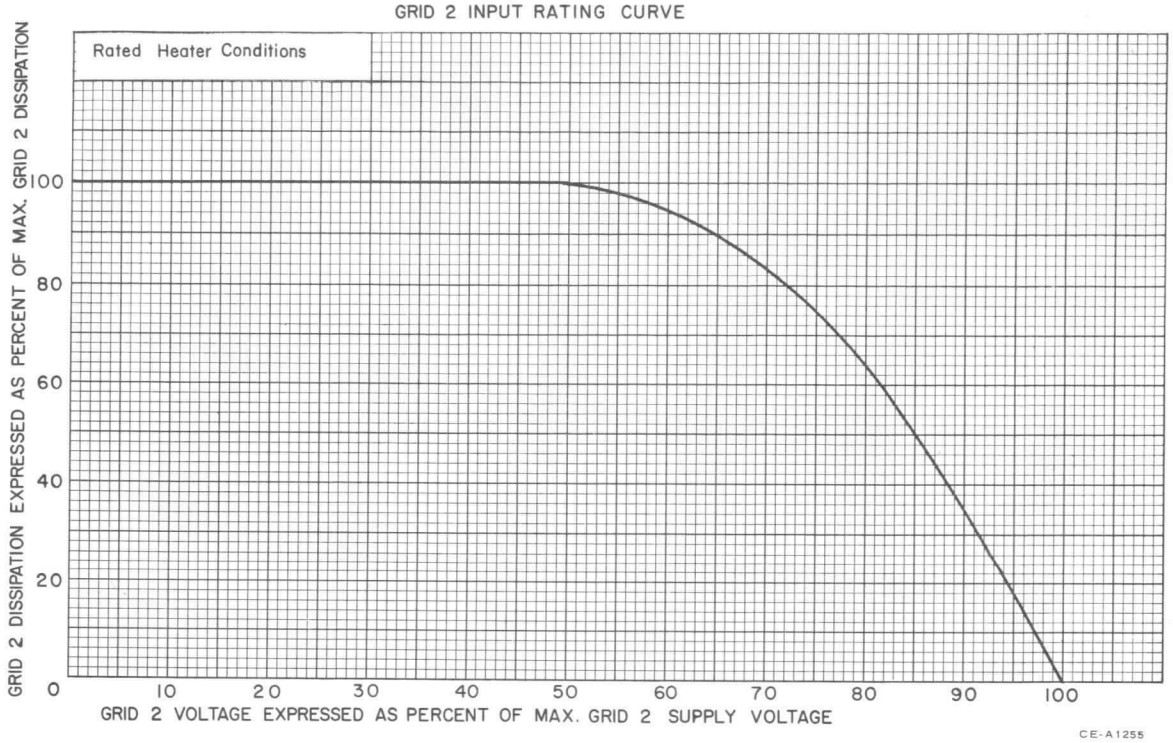


AVERAGE PLATE CHARACTERISTICS



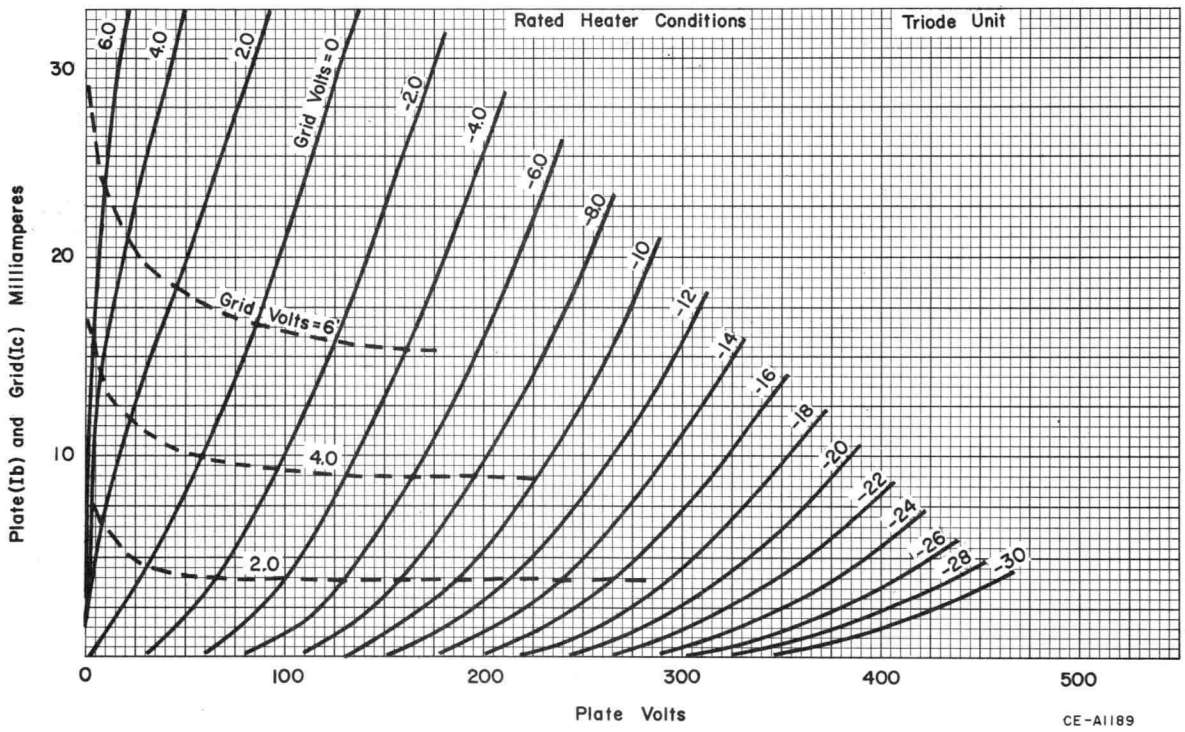
CE-A1192

GRID 2 INPUT RATING CURVE

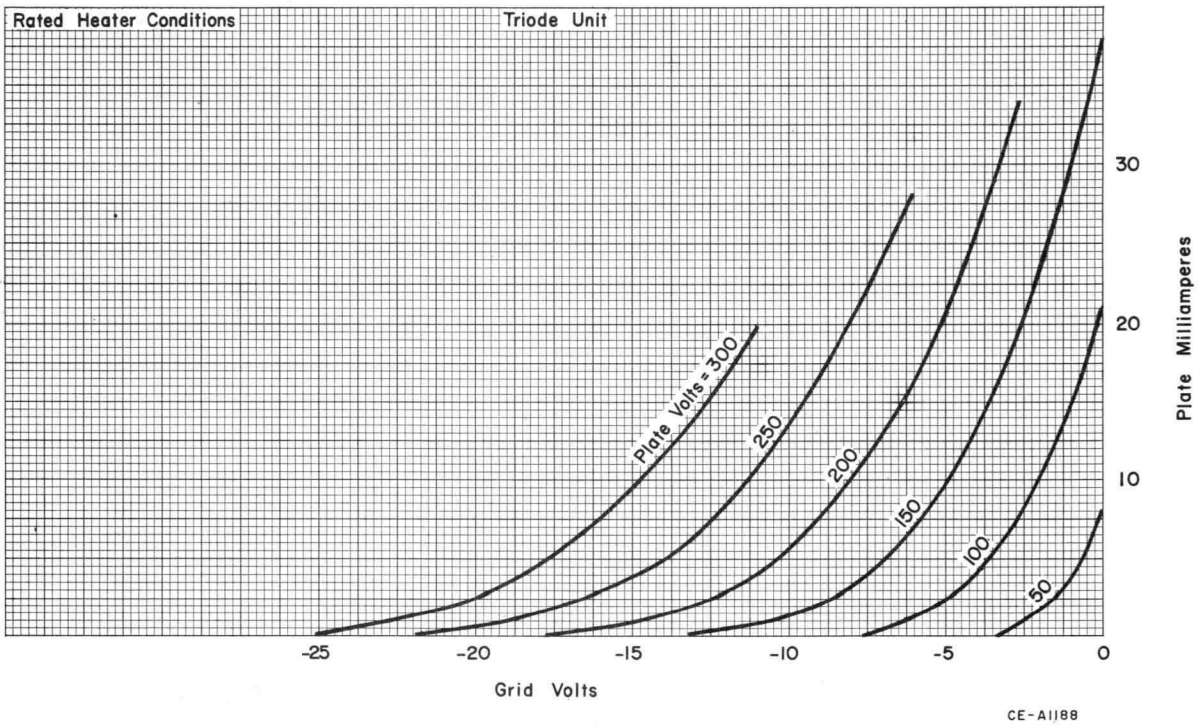


CE-A1255

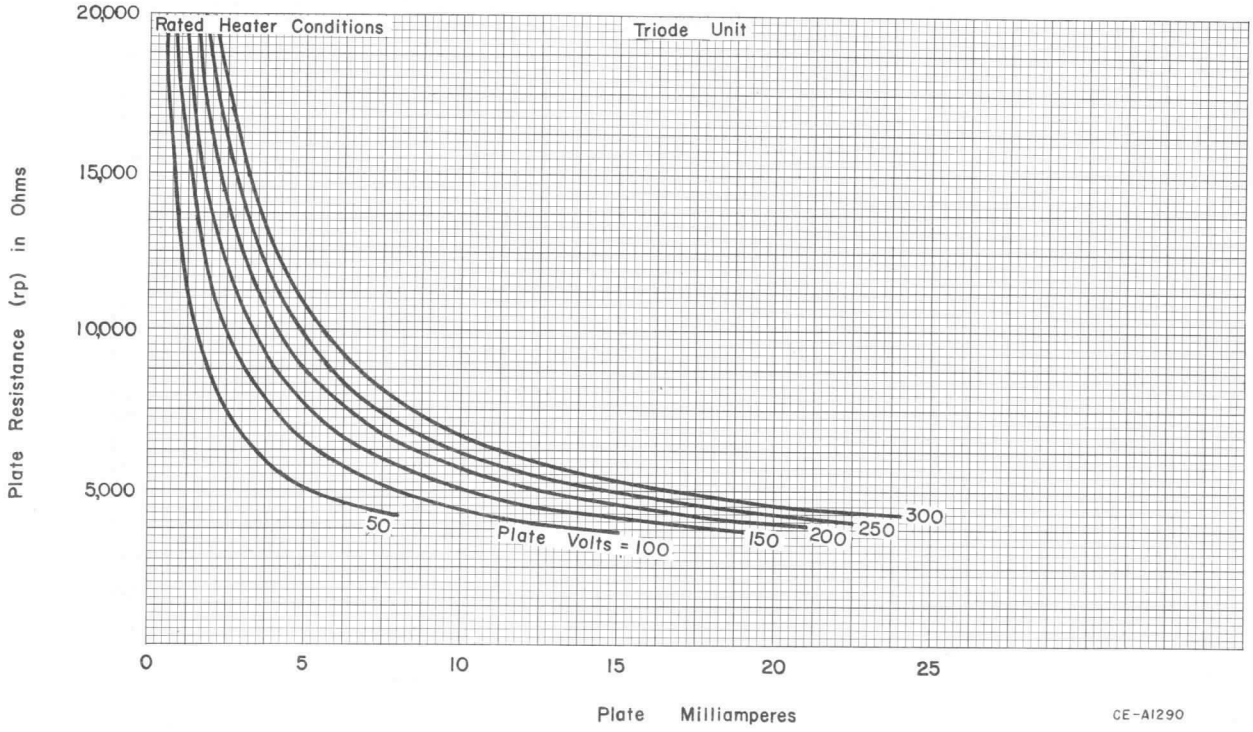
AVERAGE PLATE CHARACTERISTICS



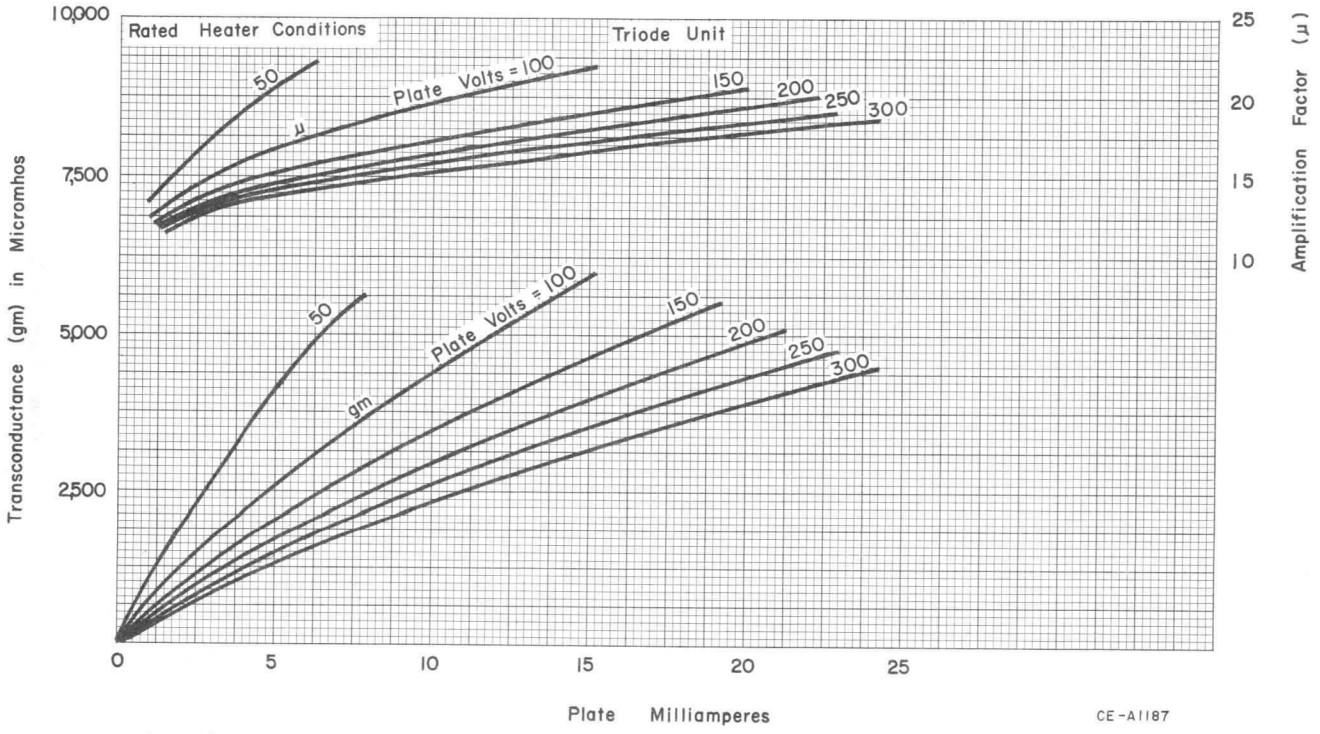
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



August 5, 1954

Beam Power Amplifier Type 6BK5

The 6BK5 is a 9-pin miniature beam power amplifier designed for service in the power output stages of television and radio receivers. The 6BK5 can also be used as a video amplifier. The tube features high power sensitivity, high transconductance, and high plate efficiency.

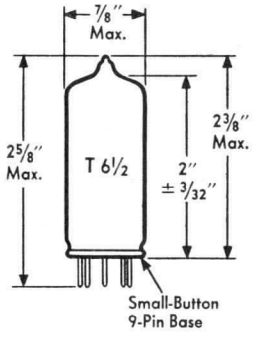
GENERAL DATA

Electrical:

Cathode	Coated Unipotential	
Filament		
Voltage	6.3 ac or dc	Volts
Current	1.2	Amperes
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.6	μμf
Input	13	μμf
Output	5.0	μμf

Mechanical:

Bulb	T-6½
Base	E9-1, Small Button 9-Pin
Basing	9BQ
Mounting Position	Any



MAXIMUM RATINGS

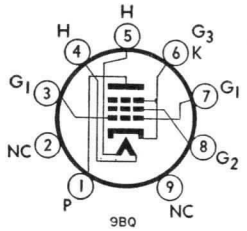
Design Center Values

Plate Voltage	250	Volts
Grid 2 Voltage	250	Volts
Positive Grid 1 Voltage	0	Volts
Plate Dissipation	9	Watts
Screen Dissipation	2.5	Watts
Heater-Cathode Voltage		
Heater Positive or Negative with Respect to Cathode	100	Volts
Grid 1 Circuit Resistance		
Fixed Bias	0.1	Megohm
Cathode Bias	0.5	Megohm

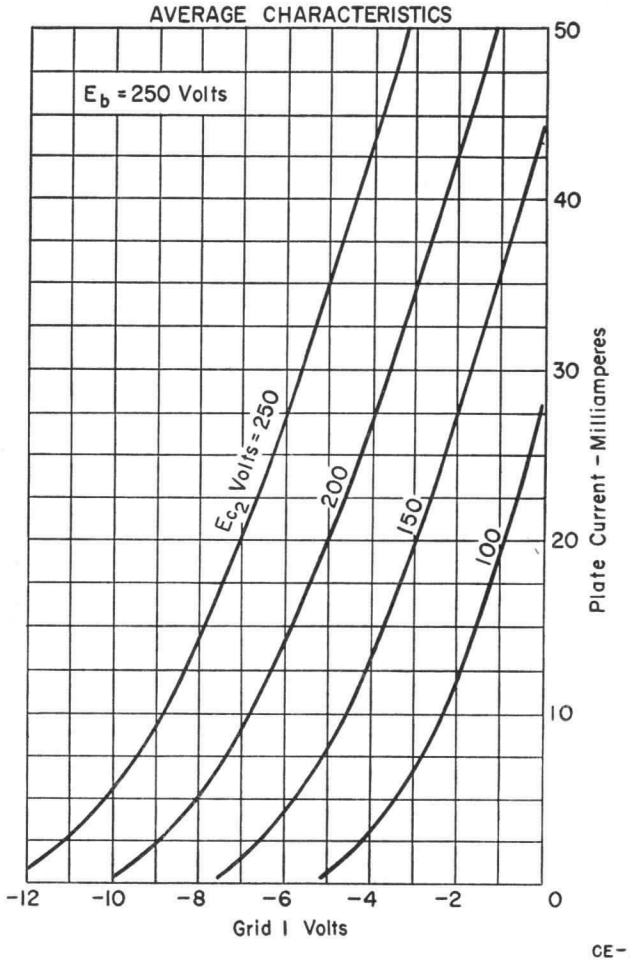
AMPLIFIER - CLASS A_1

Characteristics and Typical Operation

Plate Voltage	250	Volts
Grid 2 Voltage	250	Volts
Grid 1 Voltage	−5.0	Volts
Peak A-F Grid 1 Voltage	5.0	Volts
Plate Resistance (Approx.)	100000	Ohms
Transconductance	8500	μmhos
Zero Signal Plate Current	35	ma.
Maximum Signal Plate Current (Approx.)	37	ma.
Zero Signal Screen Current	3.5	ma.
Maximum Signal Screen Current	10	ma.
Load Resistance	6500	Ohms
Total Harmonic Distortion (Approx.)	7	Per Cent
Power Output	3.5	Watts



BOTTOM VIEW



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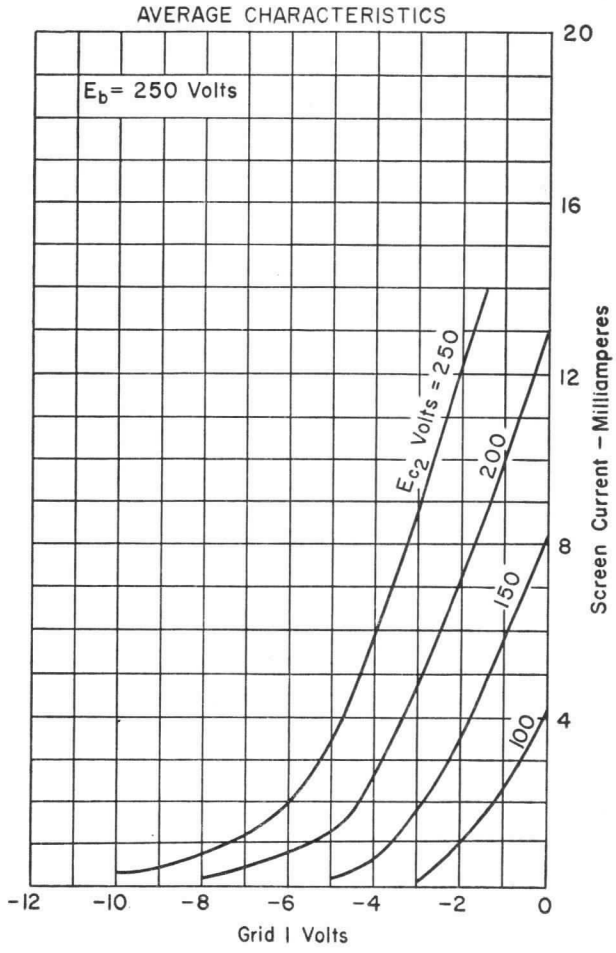

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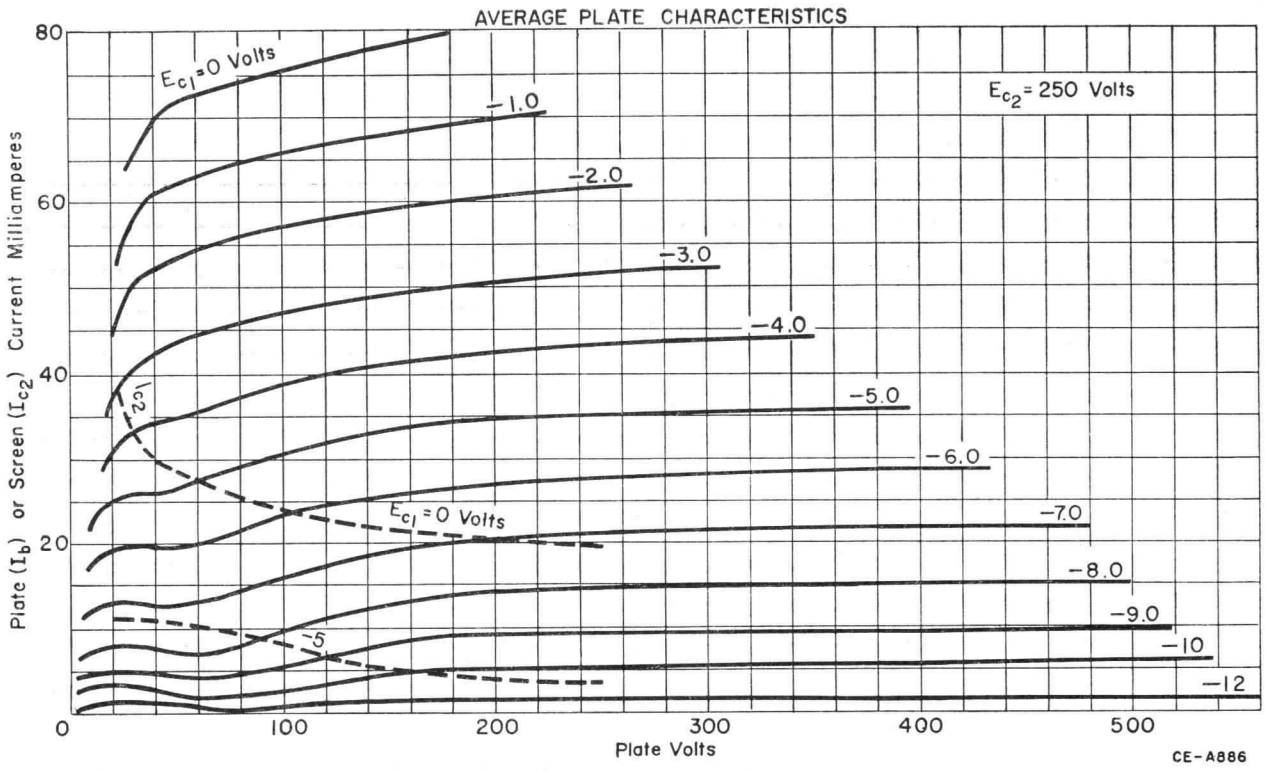
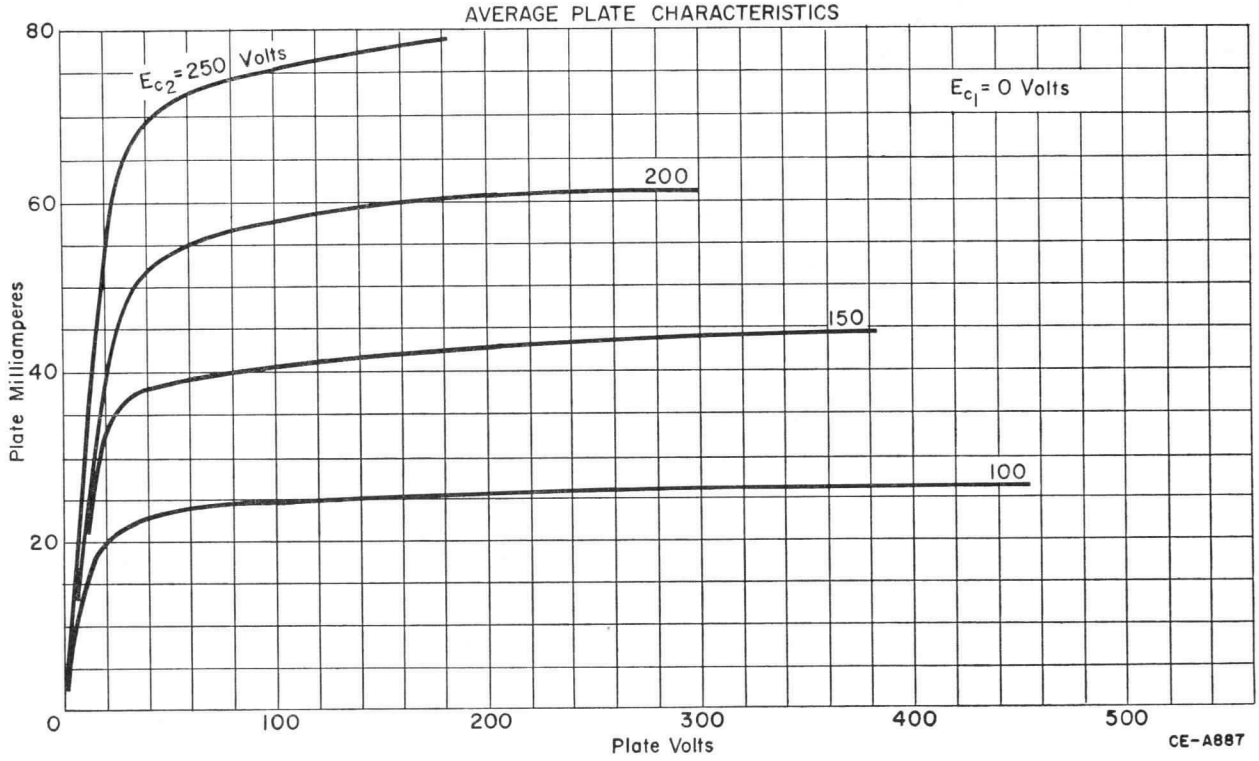
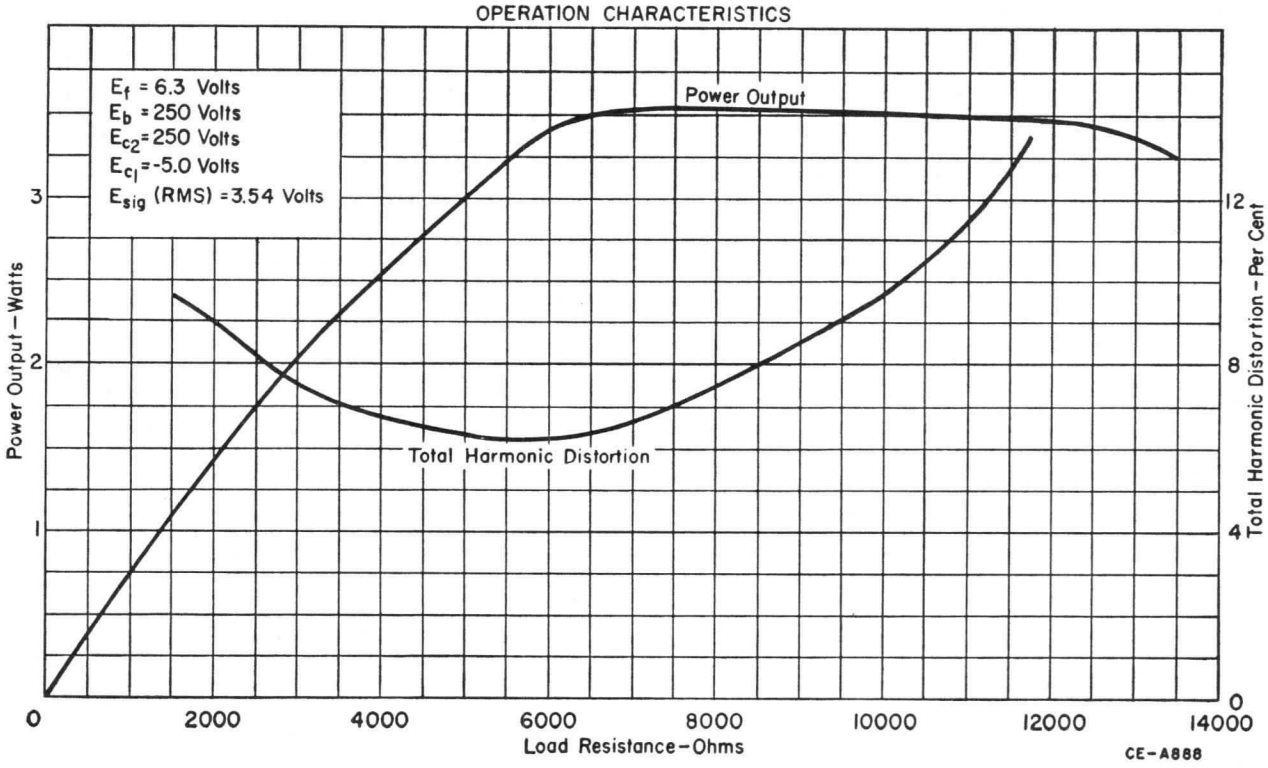

AVERAGE PLATE CHARACTERISTICS
Plate (I_b) or Screen (I_{c2}) Current Milliamperes
Plate Volts
E_{c2} = 250 Volts
E_{c1} = 0 Volts
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10
-12
I_{c2}
E_{c1} = 0 Volts
-5
0
20
40
60
80
100
200
300
400
500
CE-A886


AVERAGE PLATE CHARACTERISTICS
Plate Milliamperes
Plate Volts
E_{c2} = 250 Volts
E_{c1} = 0 Volts
200
150
100
0
20
40
60
80
100
200
300
400
500
CE-A887


OPERATION CHARACTERISTICS
E_f = 6.3 Volts
E_b = 250 Volts
E_{c2} = 250 Volts
E_{c1} = -5.0 Volts
E_{sig} (RMS) = 3.54 Volts
Power Output
Total Harmonic Distortion
Power Output – Watts
Total Harmonic Distortion – Per Cent
Load Resistance – Ohms
0
1
2
3
4
8
12
2000
4000
6000
8000
10000
12000
14000
CE-A888

November 10, 1954

Beam Power Amplifier Type 12BK5

The 12BK5 is a 9-pin miniature beam power amplifier designed for service in the power output stages of television and radio receivers. The 12BK5 can also be used as a video amplifier. The tube features high power sensitivity, high transconductance, and high plate efficiency. Except for heater ratings the 12BK5 is identical with the 6BK5.

The 12BK5 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

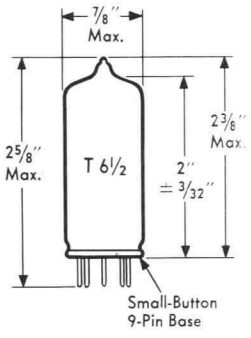
Electrical:

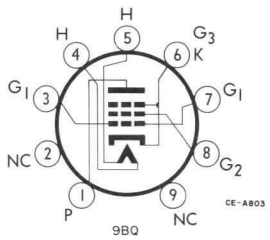
Cathode	Coated Unipotential	
Filament		
Voltage	12.6 ac or dc	Volts
Current	0.6	Ampere
Warm-up Time (Approx.)*	10.5	Seconds
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.6	μμf
Input	13	μμf
Output	5.0	μμf

Mechanical:

Bulb	T-6½
Base	E9-1, Small Button 9-Pin
Basing	9BQ
Mounting Position	Any

* See Page 4





MAXIMUM RATINGS

Design Center Values

Plate Voltage	250 max.	Volts
Grid 2 Voltage	250 max.	Volts
Positive Grid 1 Voltage	0 max.	Volts
Plate Dissipation	9 max.	Watts
Screen Dissipation	2.5 max.	Watts
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

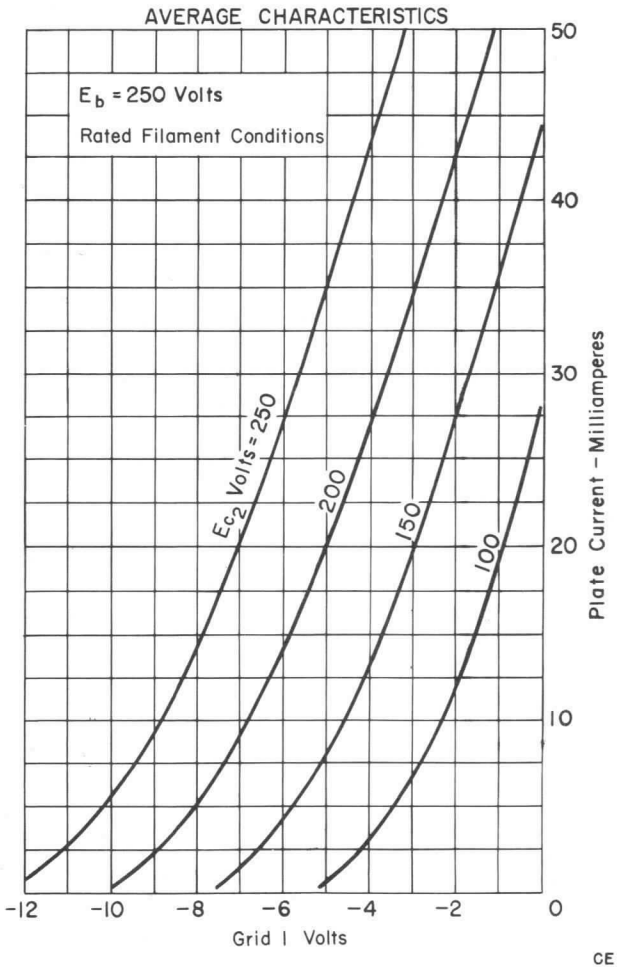
AMPLIFIER — CLASS A_1

Characteristics and Typical Operation

Plate Voltage	250	Volts
Grid 2 Voltage	250	Volts
Grid 1 Voltage	-5.0	Volts
Peak A-F Grid 1 Voltage	5.0	Volts
Plate Resistance (Approx.)	100000	Ohms
Transconductance	8500	μmhos
Zero Signal Plate Current	35	ma.
Maximum Signal Plate Current (Approx.)	37	ma.
Zero Signal Screen Current	3.5	ma.
Maximum Signal Screen Current	10	ma.
Load Resistance	6500	Ohms
Total Harmonic Distortion (Approx.)	7	Per Cent
Power Output	3.5	Watts

Maximum Circuit Values

Grid 1 Circuit Resistance		
Fixed Bias	0.1 max.	Megohm
Cathode Bias	0.5 max.	Megohm



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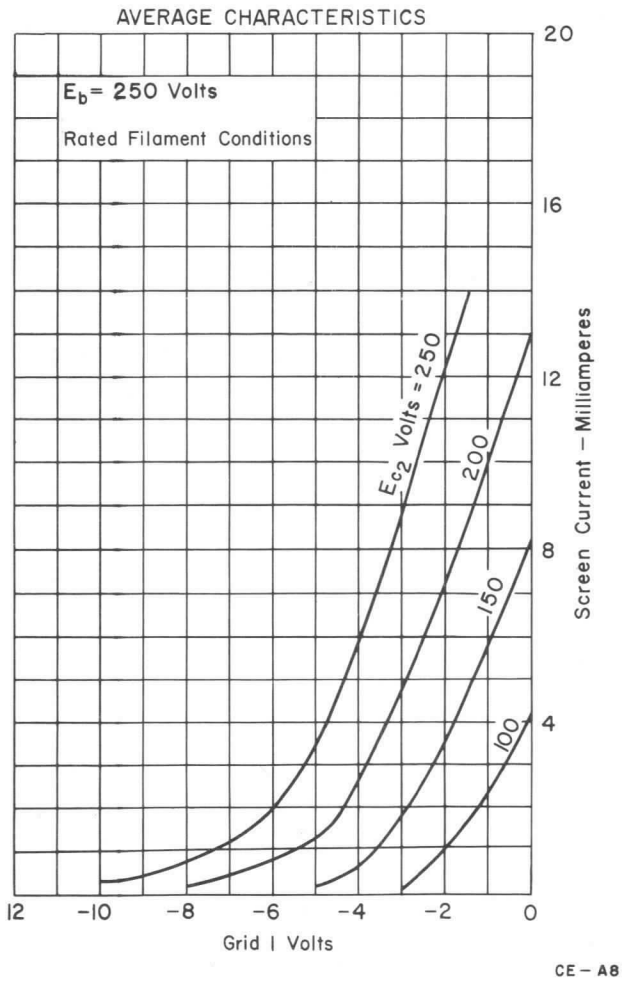
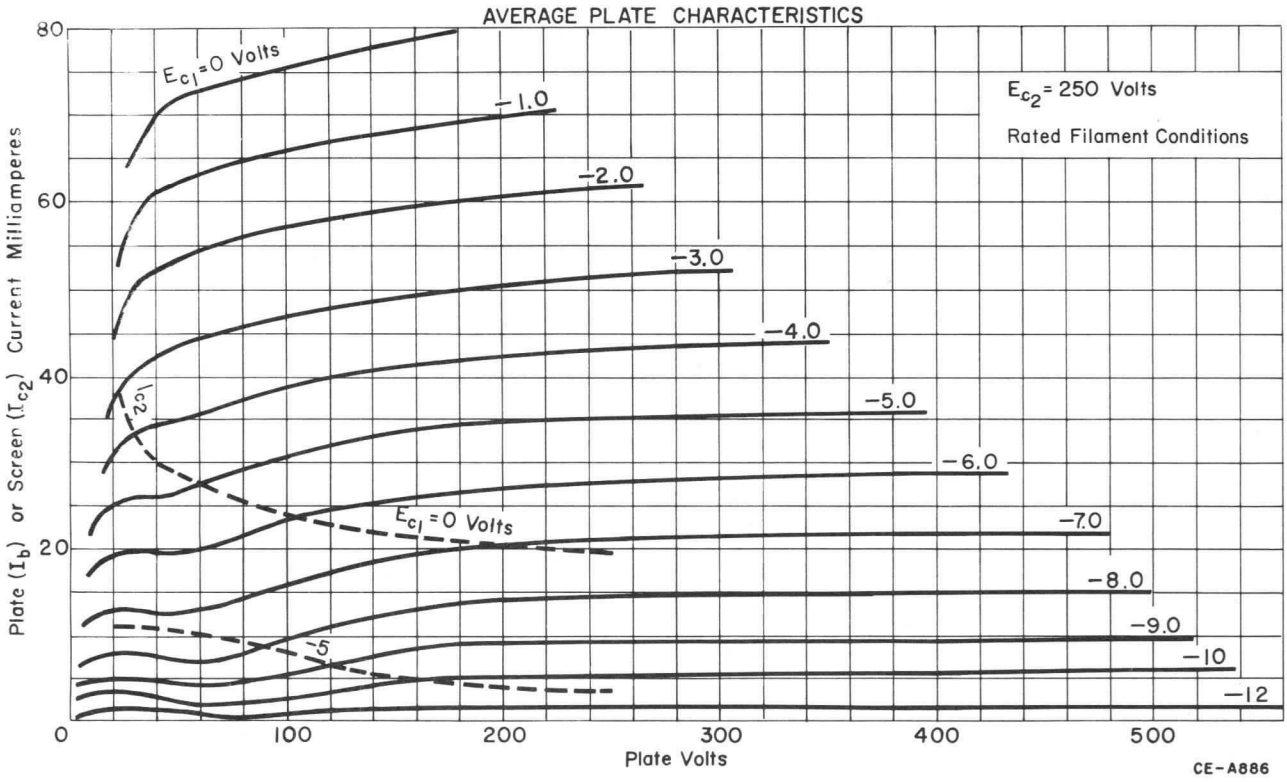
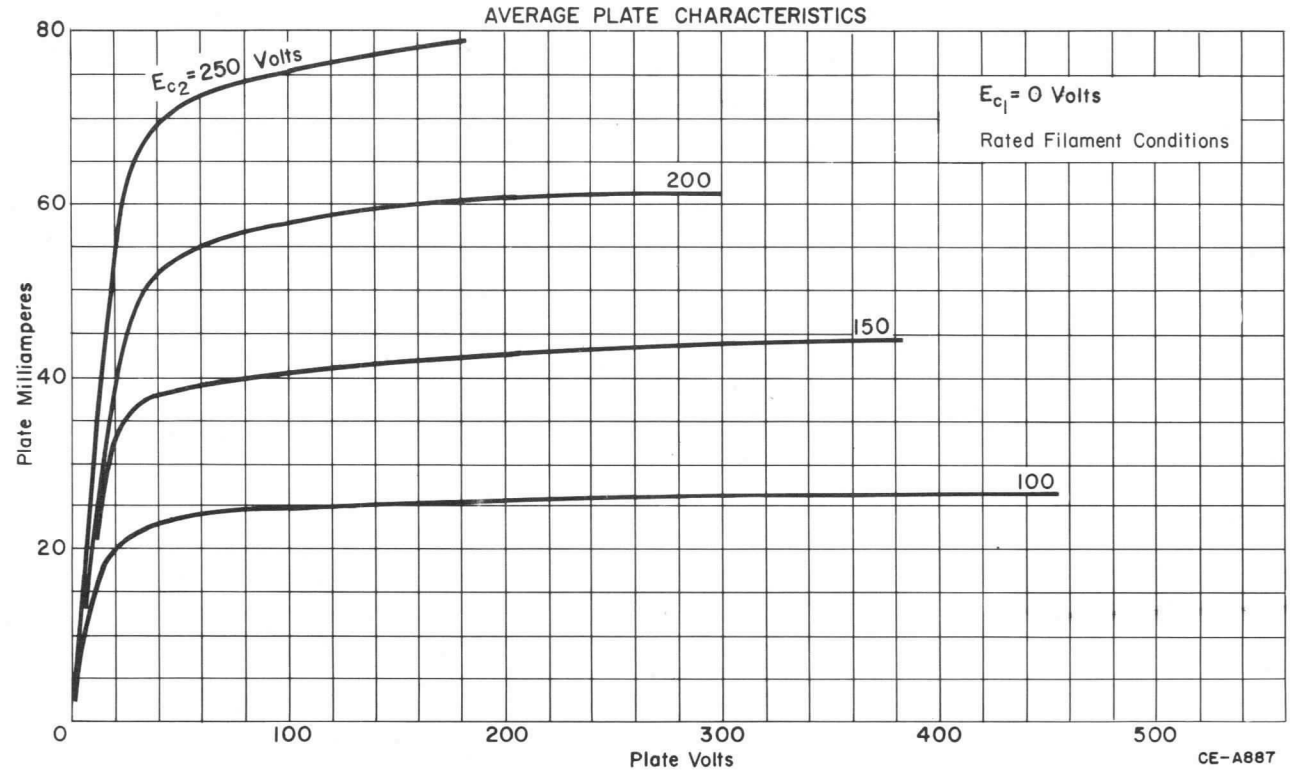
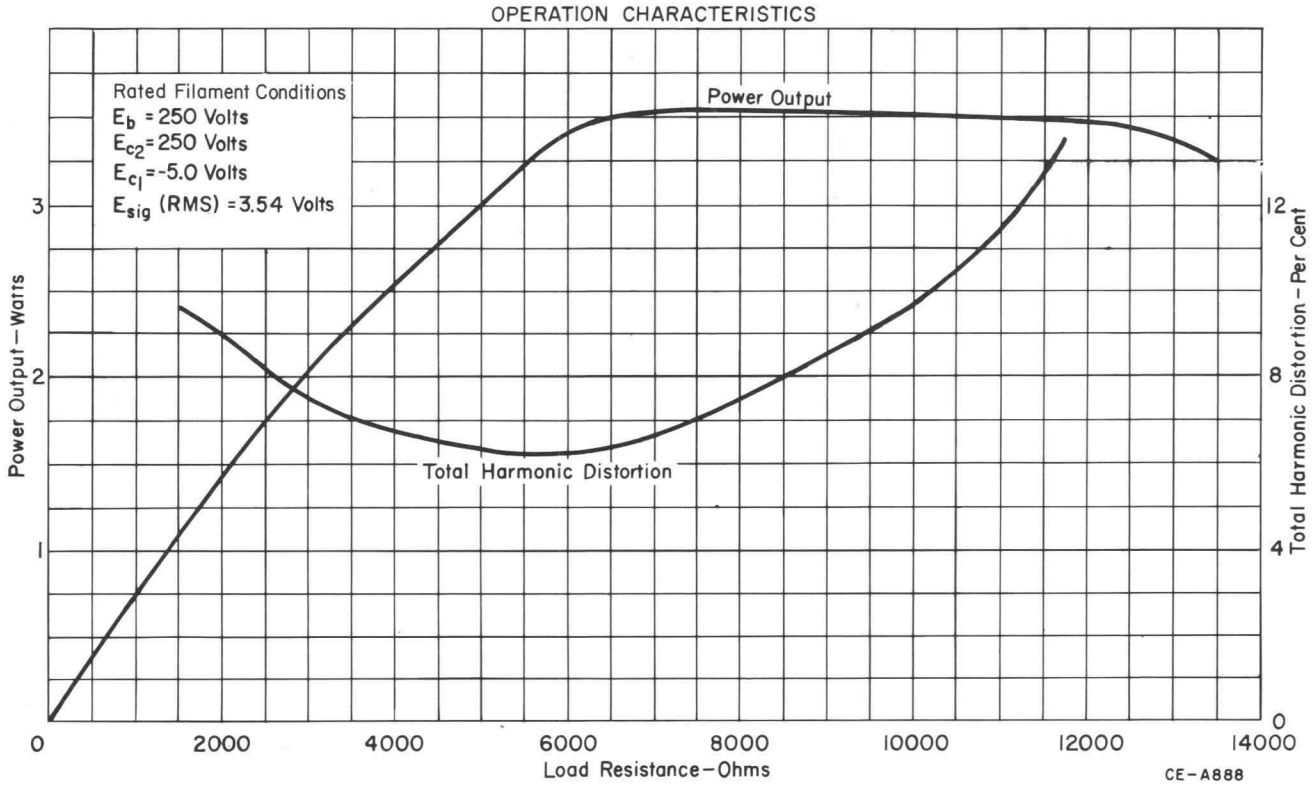


CE-A885

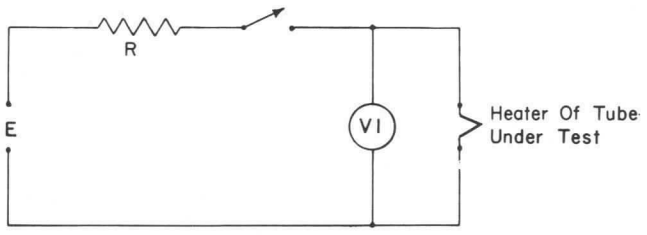

AVERAGE PLATE CHARACTERISTICS
E_{c_1}=0 Volts
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10
-12
E_{c_2}= 250 Volts
Rated Filament Conditions
I_{c_2}
E_{c_1}=0 Volts
-5
Plate (I_b) or Screen (I_{c_2}) Current Milliamperes
Plate Volts
0
20
40
60
80
100
200
300
400
500
CE-A886


AVERAGE PLATE CHARACTERISTICS
E_{c_2}=250 Volts
200
150
100
E_{c_1}= 0 Volts
Rated Filament Conditions
Plate Milliamperes
Plate Volts
0
20
40
60
80
100
200
300
400
500
CE-A887



HEATER WARM-UP TIME MEASUREMENTS

Heater warm-up time is defined as the time required for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1) in the circuit shown below. The conditions used in conjunction with the test circuit depend upon the rated heater voltage and current of the tube under test as indicated.



E —Applied Voltage, RMS or DC	50	Volts
R —Total Series Resistance	63	Ohms
V_1—Heater Test Voltage, RMS or DC	10.0	Volts
E_f—Rated Heater Voltage of Tube Under Test	12.6	Volts
I_f —Rated Heater Current of Tube Under Test	0.6	Ampere

HIGH FREQUENCY TWIN TRIODE TYPE 6BK7-B

The 6BK7-B is a 9-pin miniature twin triode designed for use as the low-noise VHF amplifier in cascode TV tuners. These types have high gain and high cascode transconductance.

The 6BK7-B has been designed for use in receivers which employ series connected heaters, especially in television receivers having the picture-tube heater in series with other heaters. When it is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3		Volts
Current	0.45		Ampere
Warm-Up Time (Approx.)▲	11		Seconds
Direct Interelectrode Capacitances: (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	1.8	1.8	μμf
Plate to Cathode	0.22	0.22 max.	μμf
Heater to Cathode	2.8	3	μμf
Input	3	3	μμf
Output	1	0.9	μμf
Grounded Grid Operation:			
Input	6	6	μμf
Output	2.4	2.4	μμf
Plate of Unit 1 to Plate of Unit 2	0.075		μμf
Grid of Unit 2 to Grid of Unit 1	0.004		μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9AJ
Mounting Position	Any

MAXIMUM RATINGS:

Design-Center Values

Plate Voltage	300	max.	Volts
Grid Voltage (Negative Bias Value)	50	max.	Volts
Plate Dissipation	2.7	max.	Watts
Peak Heater-Cathode Voltage:			
Heater Positive with Respect to Cathode■	200	max.	Volts
Heater Negative with Respect to Cathode⊕	200	max.	Volts

CLASS A AMPLIFIER:

Characteristics: (per unit)

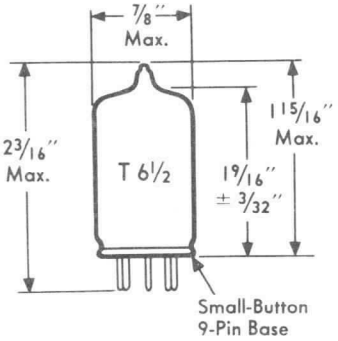
Plate Voltage	150	Volts
Cathode Bias Resistor	56	Ohms
Amplification Factor	43	
Plate Resistance	4600	Ohms
Transconductance	9300	μmhos
Plate Current	18	Ma.
Grid Cutoff Voltage□	−11	Volts

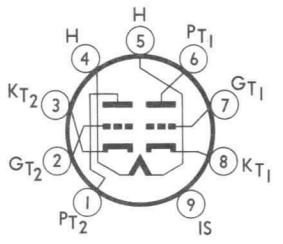
▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

□ For plate current of 10 microamperes.

■ Under cut-off conditions in cascode type circuits with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts.

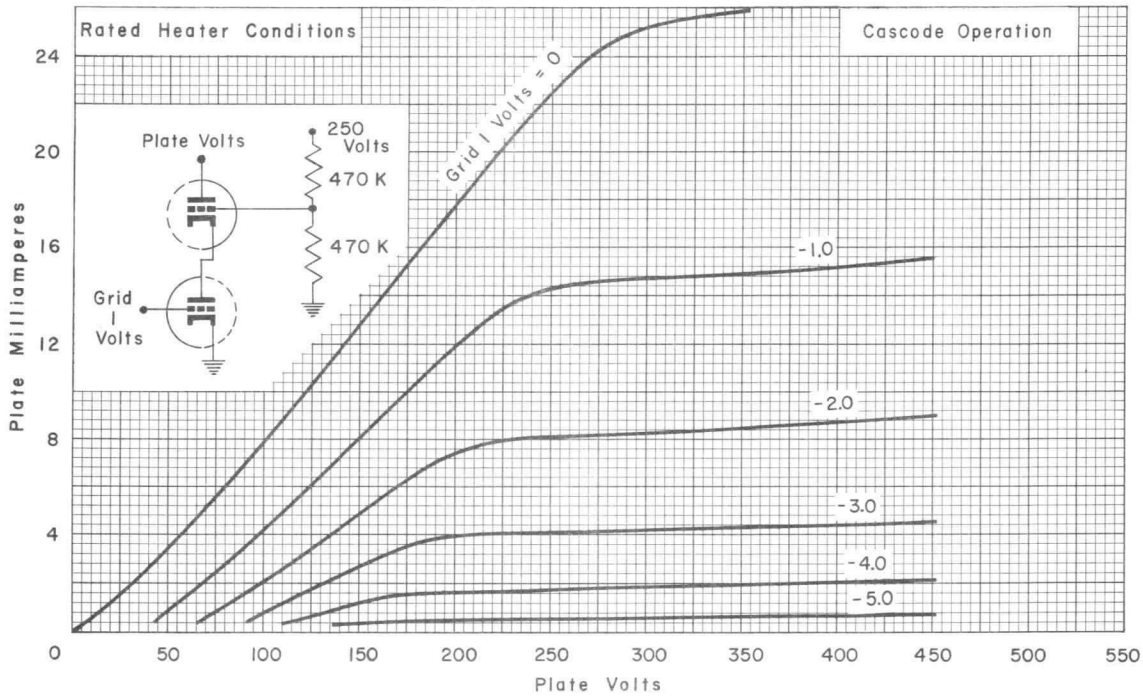
⊕ The dc component must not exceed 100 volts.





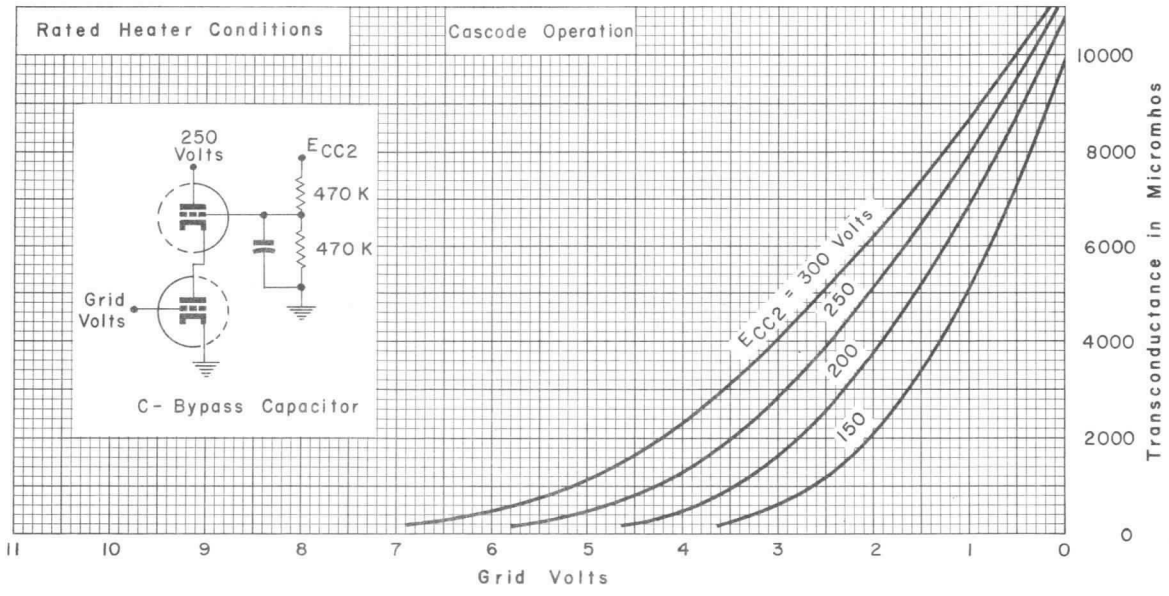
9AJ

AVERAGE PLATE CHARACTERISTICS



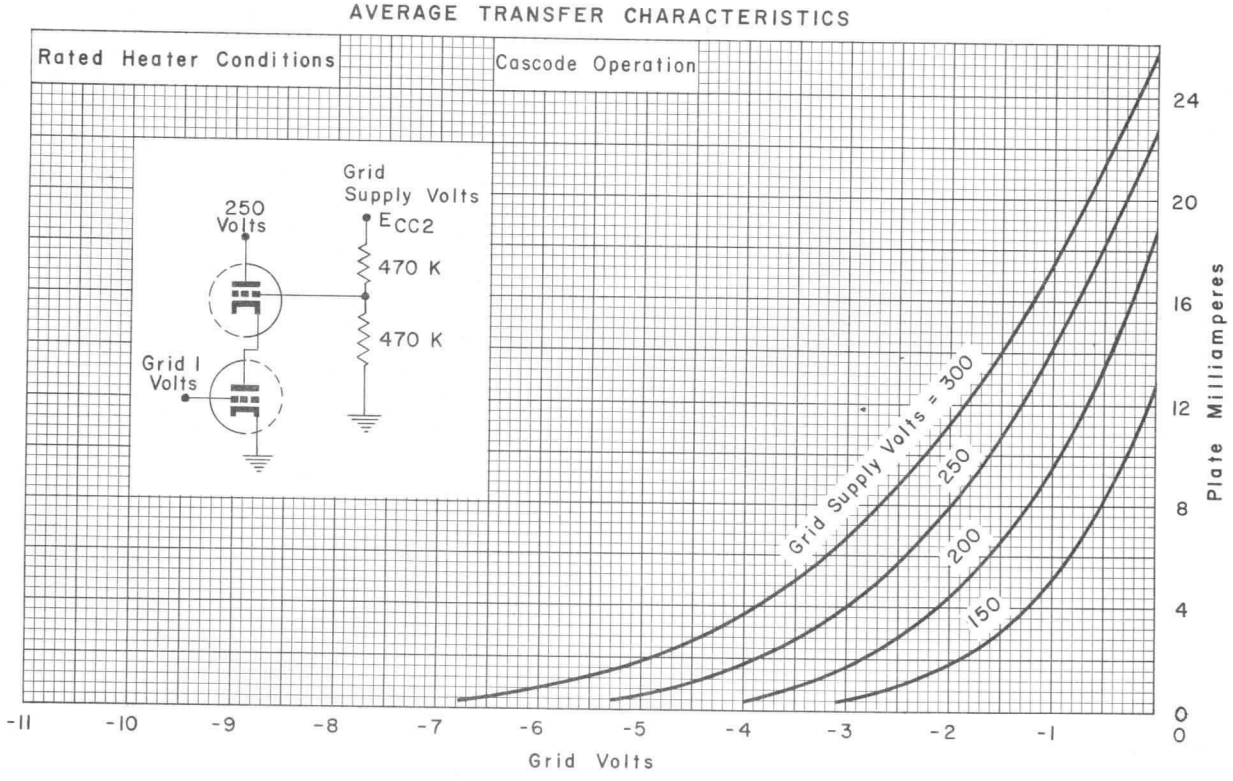
CE-A1591

AVERAGE TRANSFER CHARACTERISTICS



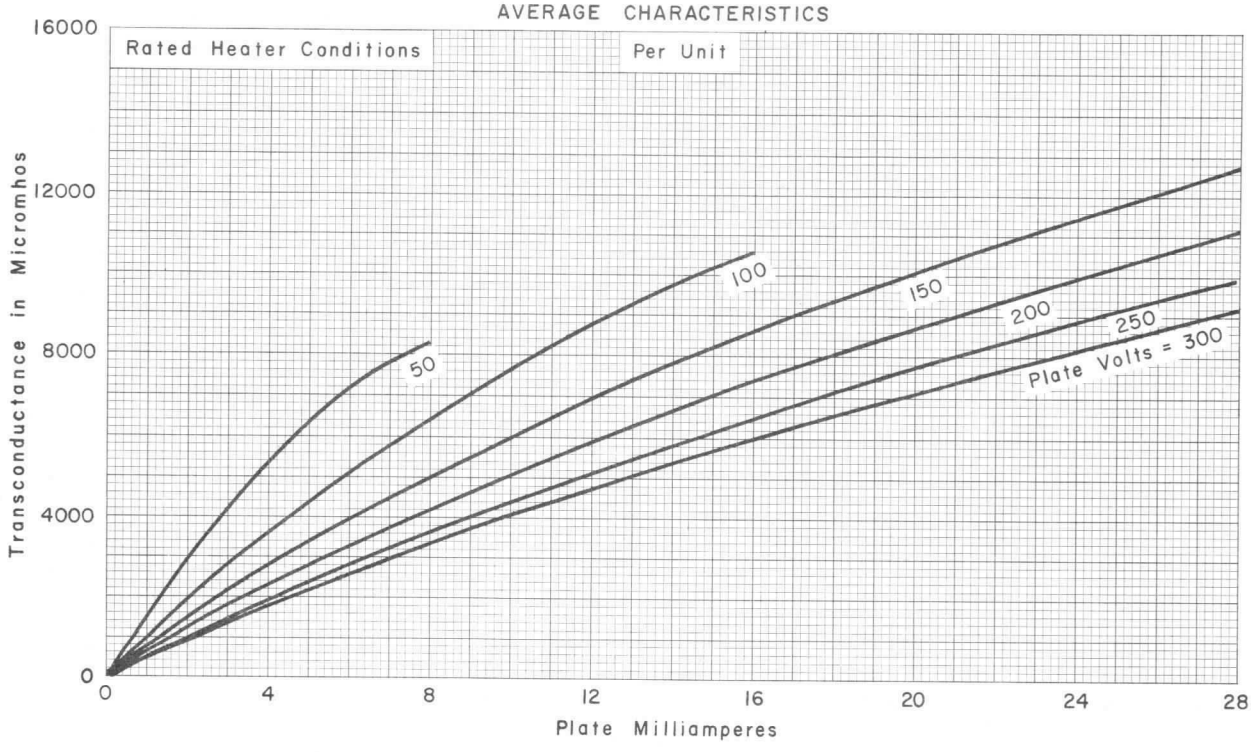
CE-A1592

AVERAGE TRANSFER CHARACTERISTICS



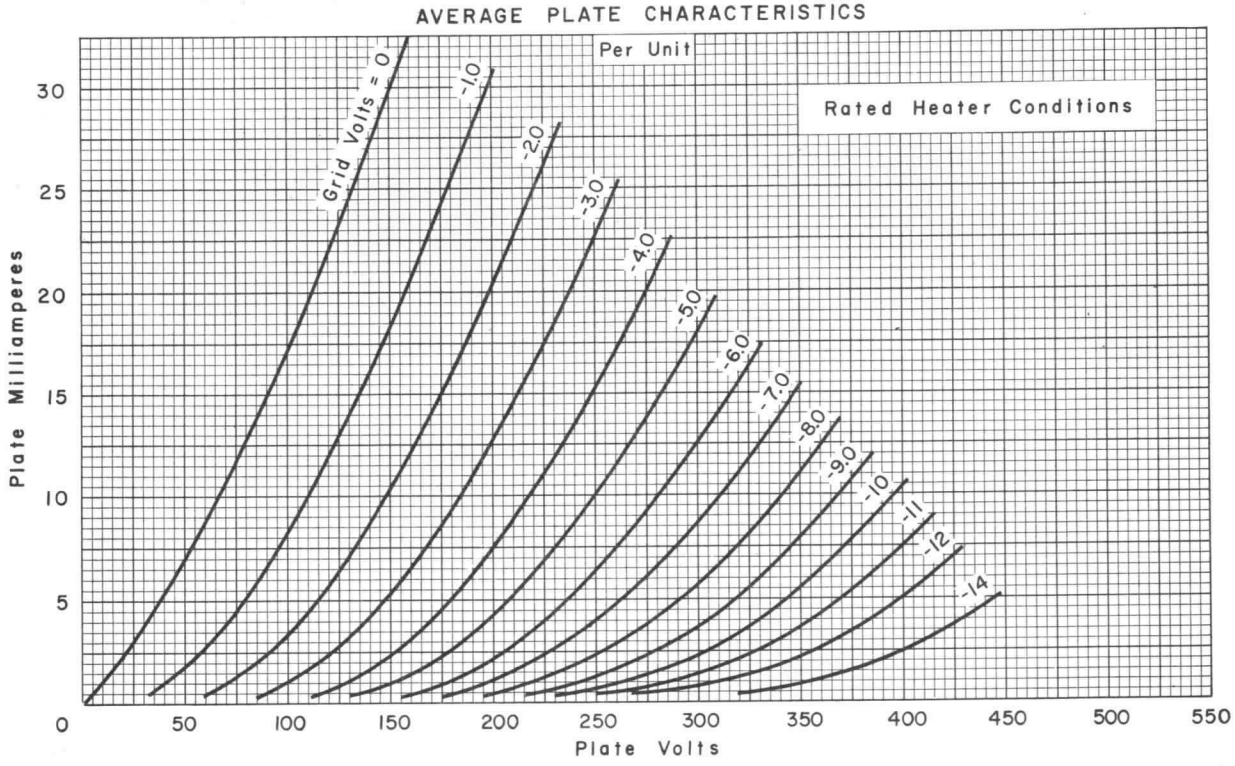
CE-A1593

AVERAGE CHARACTERISTICS



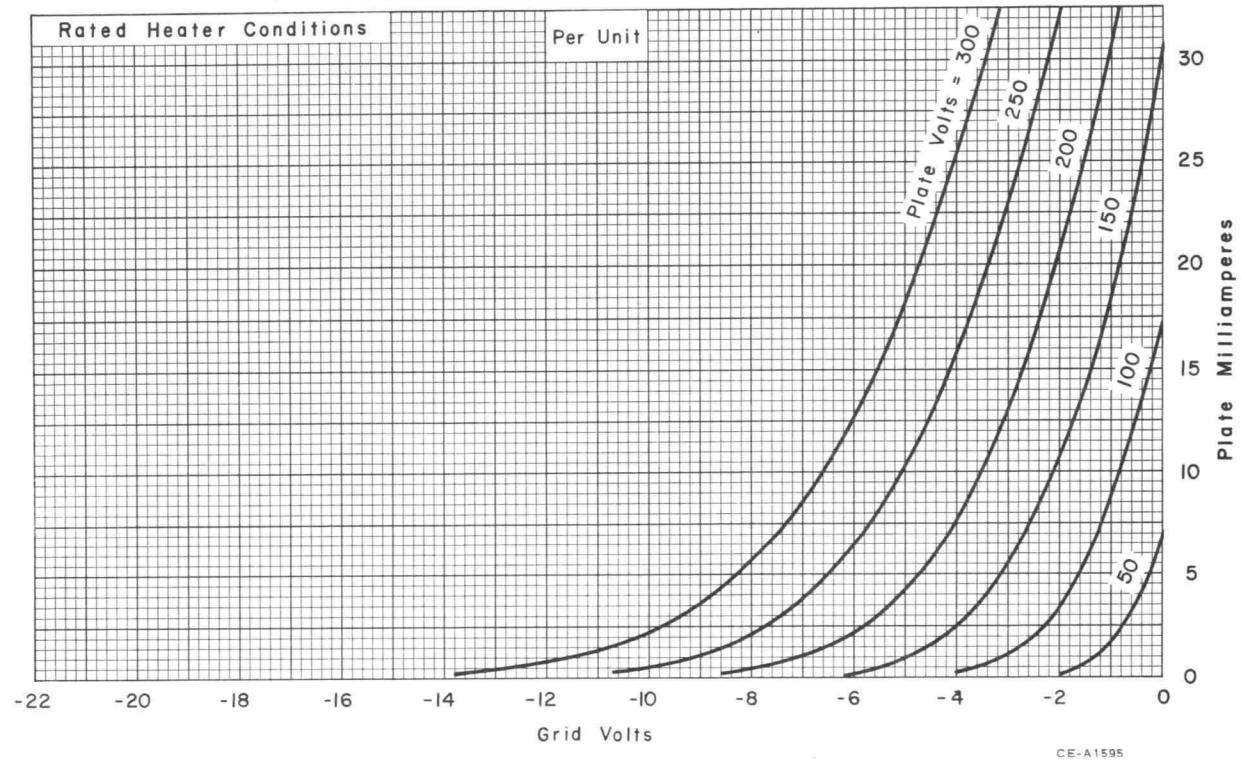
CE-A1596

AVERAGE PLATE CHARACTERISTICS

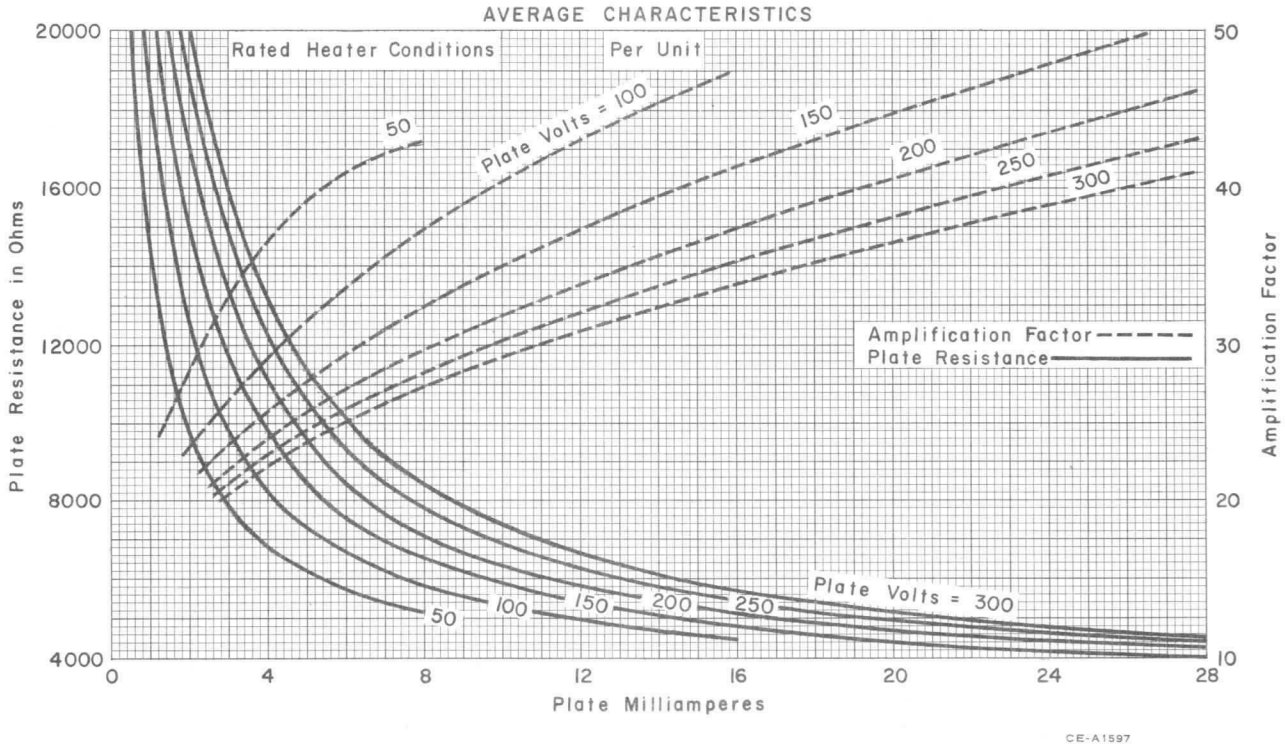


CE-A1594

AVERAGE TRANSFER CHARACTERISTICS



CE-A1595


AVERAGE CHARACTERISTICS
Rated Heater Conditions
Per Unit
Plate Volts = 100
50
150
200
250
300
Amplification Factor
Plate Resistance
Plate Volts = 300
50
100
150
200
250
Plate Resistance in Ohms
Amplification Factor
Plate Milliamperes
20000
16000
12000
8000
4000
50
40
30
20
10
0
4
8
12
16
20
24
28
CE-A1597

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Westinghouse

2BN4-A
3BN4-A
6BN4-A

May 1, 1961

V.H.F. AMPLIFIER TRIODE TYPES 2BN4-A, 3BN4-A AND 6BN4-A

The 2BN4-A, 3BN4-A and 6BN4-A are 7-Pin miniature-medium-mu triodes designed for service as grounded-grid r-f amplifiers in V.H.F. television receiver tuners. They are characterized by high transconductance and high transconductance per milliampere of plate current.

The 2BN4-A and 3BN4-A have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Direct Interelectrode Capacitances:	Shielded⊕	Unshielded	
Grid to Plate	1.2	1.1	μμf
Input	3.2	2.9	μμf
Output	1.4	0.7	μμf

Heater Characteristics:	2BN4-A	3BN4-A	6BN4-A	
Voltage	2.35	3.0	6.3 ± 10%	Volts
Current	0.60 ± 6%	0.45 ± 6%	0.20	Ampere
Warm-up Time♦	11	11	--	Seconds

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7EG
Mounting Position	Any
Cathode	Coated Unipotential

MAXIMUM RATINGS:

Design Center Values

Plate Voltage	275	max.	Volts
Positive Grid 1 Voltage	0	max.	Volts
Plate Dissipation	2.2	max.	Watts
Cathode Current	22	max.	Ma.
Grid Circuit Resistance	0.5	max.	Megohm
Heater-Cathode Voltage:			
Heater Negative or positive with Respect to Cathode			
Total DC and Peak	100	max.	Volts

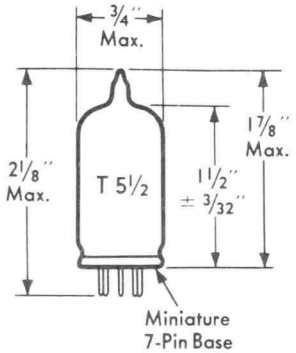
TYPICAL OPERATING CHARACTERISTICS:

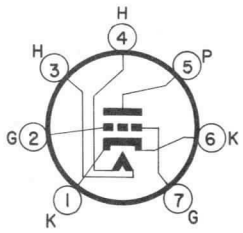
Plate Voltage	150	Volts
Cathode Bias Resistor	220	Ohms
Plate Resistance	5400	Ohms
Transconductance	7700	μmhos
Amplification Factor	43	
Grid Cutoff Bias★	-6.0	Volts
Plate Current	9.0	Ma.

⊕ With JEDEC Shield No. 316 connected to Pin 6.

♦ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

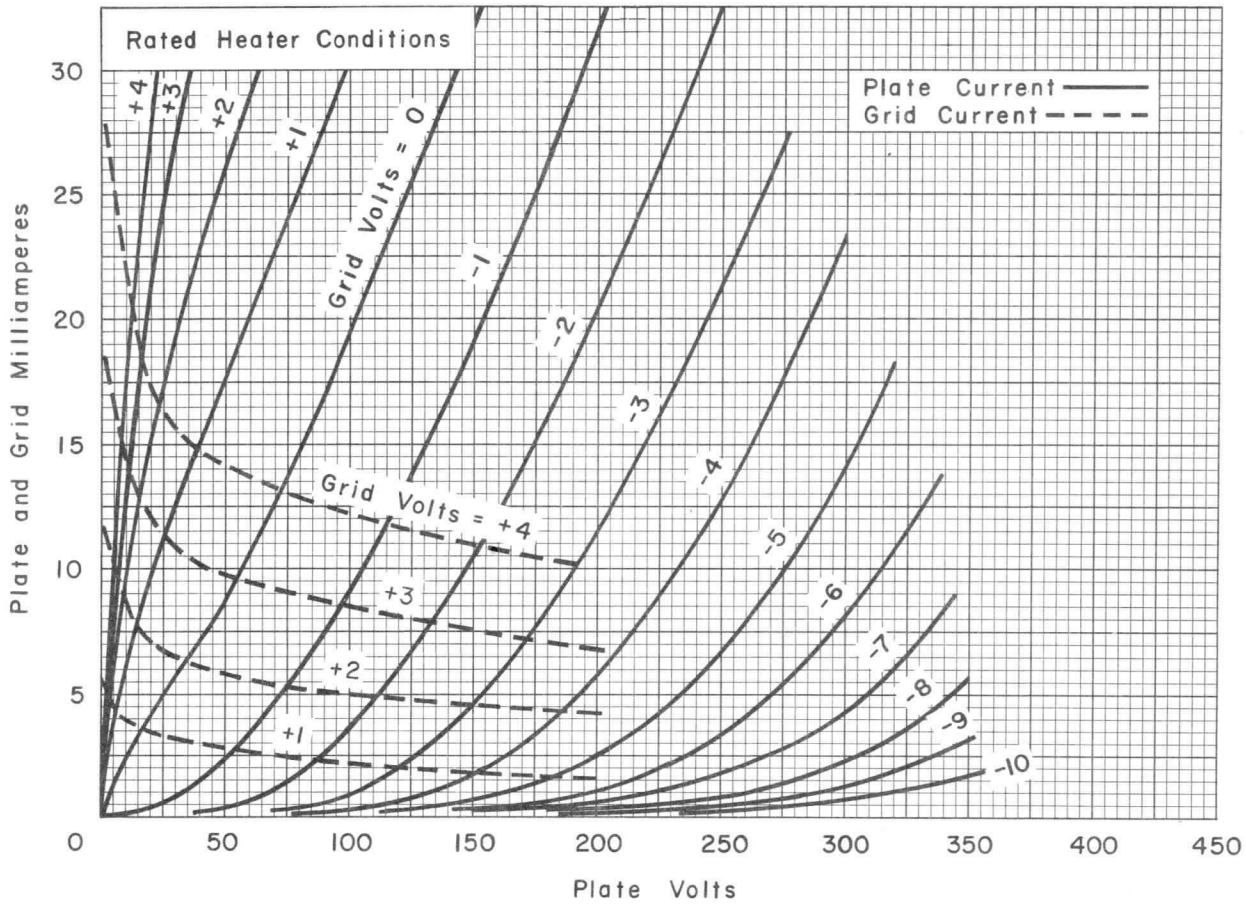
★ For plate current of 100 microamperes.





7EG

AVERAGE PLATE CHARACTERISTICS



CE-A1734

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January 27, 1958

GATED-BEAM DISCRIMINATOR TYPES
3BN6, 4BN6, 6BN6 and 12BN6

The 3BN6, 4BN6, 6BN6 and 12BN6 are 7-pin miniature gated-beam types designed for service as combined limiter, FM detector and audio voltage amplifier in frequency modulation and television receivers. These types may also be used as sync-clipper or limiter.

The 3BN6 and 4BN6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:

Cathode				Coated Unipotential	
Heater:	3BN6	4BN6	6BN6	12BN6	
Voltage (ac or dc)	3.15	4.2	6.3	12.6	Volts
Current	0.60■	0.45■	0.30	0.15	Ampere
Warm-up Time▲	11	11	..	..	Seconds
Direct Interelectrode Capacitances (Unshielded):					
Grid 1 to All				4.2	uuf
Grid 2 to All				3.3	uuf
Grid 1 to Grid 3 (max.)				0.004	uuf

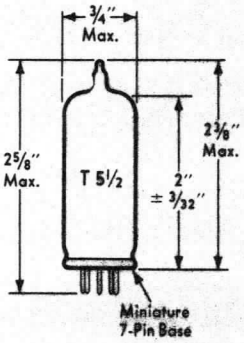
MECHANICAL:

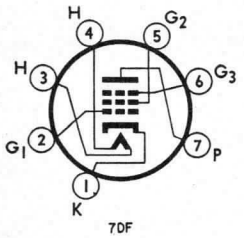
Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Basing	7DF
Mounting Position	Any

LIMITER-DISCRIMINATOR SERVICE

MAXIMUM RATINGS:

Design-Center Values		
Plate Supply Voltage	300 max.	Volts
Accelerator Voltage	100 max.	Volts
Peak Positive Limiter - Grid Voltage	55 max.	Volts
Total Cathode Current	11.5 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts





CHARACTERISTICS AND TYPICAL OPERATION:

Input-Signal Center Frequency	10.7	10.7	4.5	Mc
Frequency Deviation	±75	±75	±25	Kc
Plate Supply Voltage	85	285	270	Volts
Plate Voltage	63	122	121	Volts
Accelerator Voltage	55	100	100	Volts
Cathode-Bias Resistor (Variable)†	200-400	200-400	200-400	Ohms
Plate Load Resistor	85000	330000	330000	Ohms
Plate Linearity Resistor	470	1500	1000	Ohms
Integrating Capacitor	.002	.001	.001	uf
Coupling Capacitor	.25	.01	.25	uf
Minimum Signal Voltage for Limiting Action (RMS)*	1.25	1.25	1.25	Volts
Average DC Plate Current	0.25	0.49	0.44	Ma.
Accelerator Current	4.1	9.8	10.0	Ma.
Input Signal Level for AM Rejection Adjustment†	1.25	2.0	2.0	Volts
AM Rejection at Esig. = 2.0 Volts (RMS)	31	20	25	db
AM Rejection at Esig. = 3.0 Volts (RMS)	30	29	30	db
Total Harmonic Distortion	2.0	1.6	1.8	Per Cent
Peak Audio Output Voltage	6.0	16.6	16.8	Volts

* At signal levels above specified value limiting is within ±2 decibels.

† The cathode resistor should be adjusted for maximum AM rejection in the output of the limiter-discriminator stage at the specified signal level. AM rejection is measured with an applied signal containing 30% AM and 30% FM.

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

■ ± 6%

APPLICATION NOTES

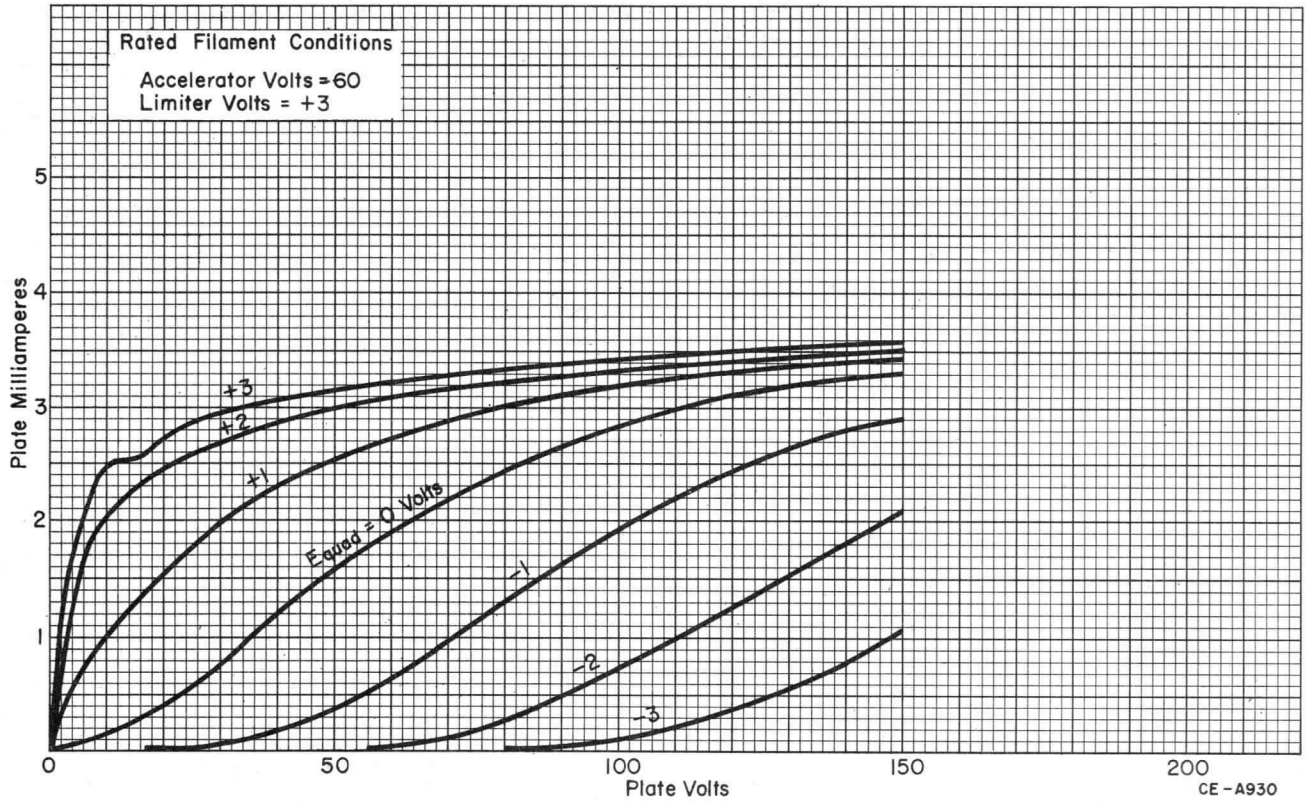
Adequate shielding between components of the limiter grid and the quadrature grid must be used to insure proper phasing of the voltage developed on the quadrature grid.

Standard deemphasis requirements for FM are included.

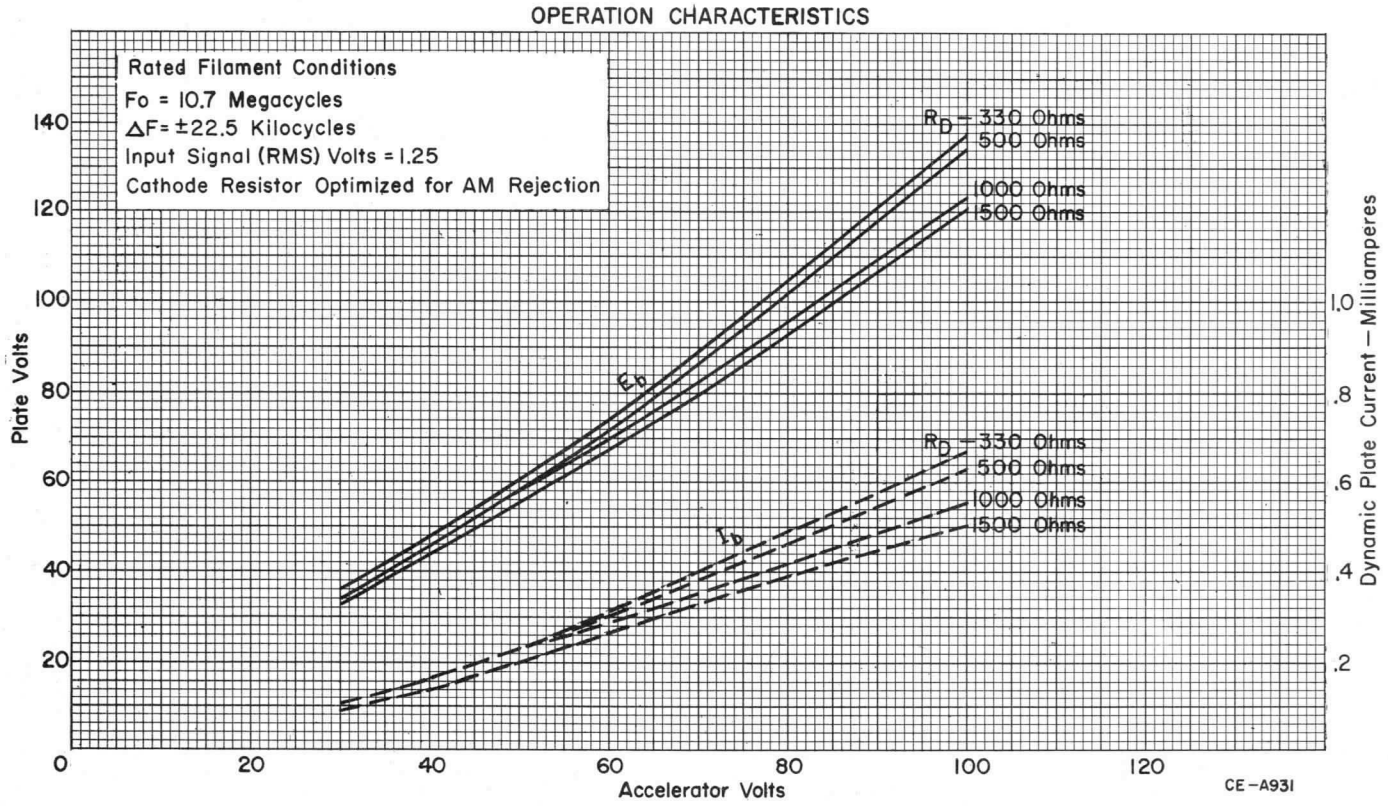
The Q of the quadrature grid circuit should be high enough to develop a minimum of 4 volts (RMS) signal with 2 volts (RMS) of the center-frequency signal applied to the limiter grid. It is recommended that the coil be shunted by a minimum of 10 uuf. The capacitance may be composed of tube input capacitance, stray capacitance, and distributed capacitance, as well as physical capacitance.

To obtain a symmetrical discriminator response curve in FM applications, the ratio of no signal plate current to plate current with an unmodulated signal must equal unity. When the value of accelerator voltage is chosen, the plate voltage applied to the tube may be found from drawing CE-A931. This will insure unity ratio of plate current. CE-A931 also shows the average dynamic plate current that flows with the specified plate and accelerator voltages. The plate load resistor should drop the plate supply voltage to the specified plate voltage.

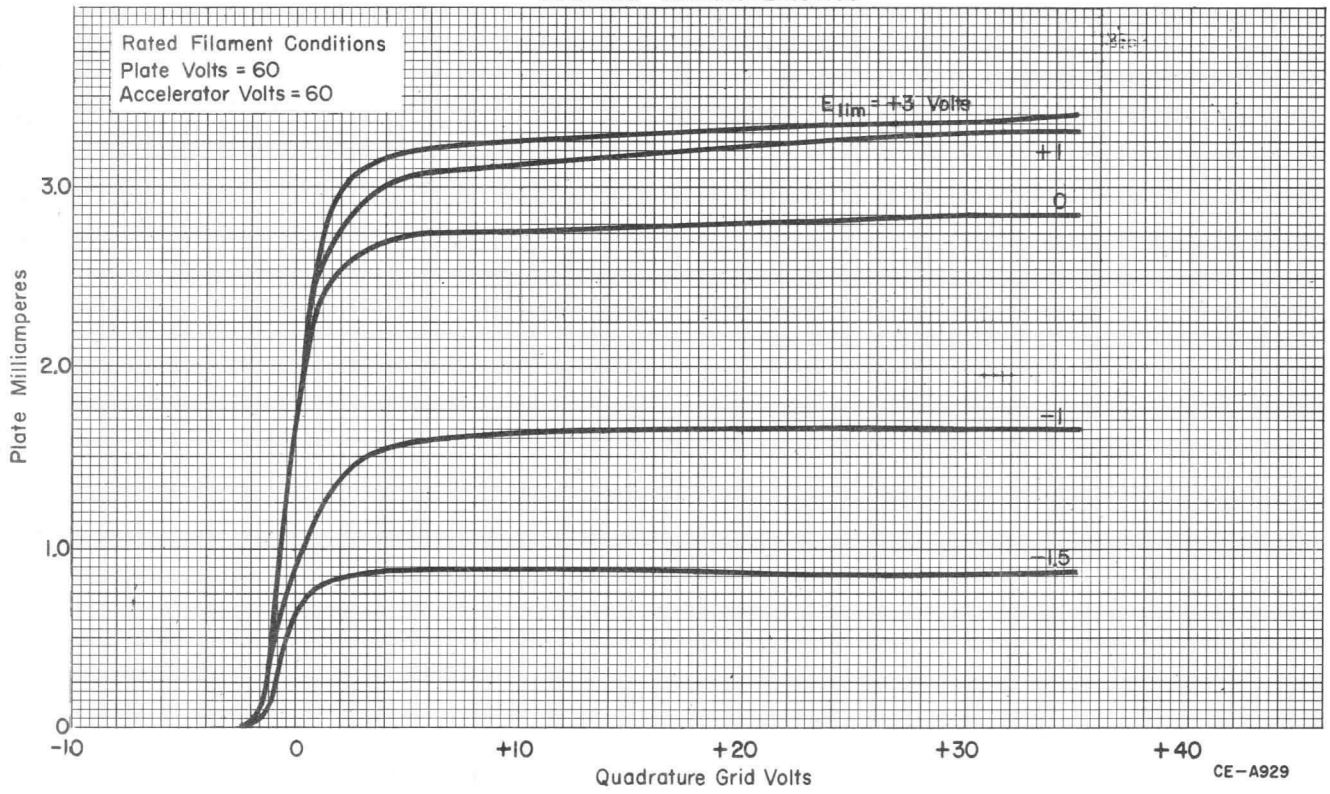
AVERAGE PLATE CHARACTERISTICS



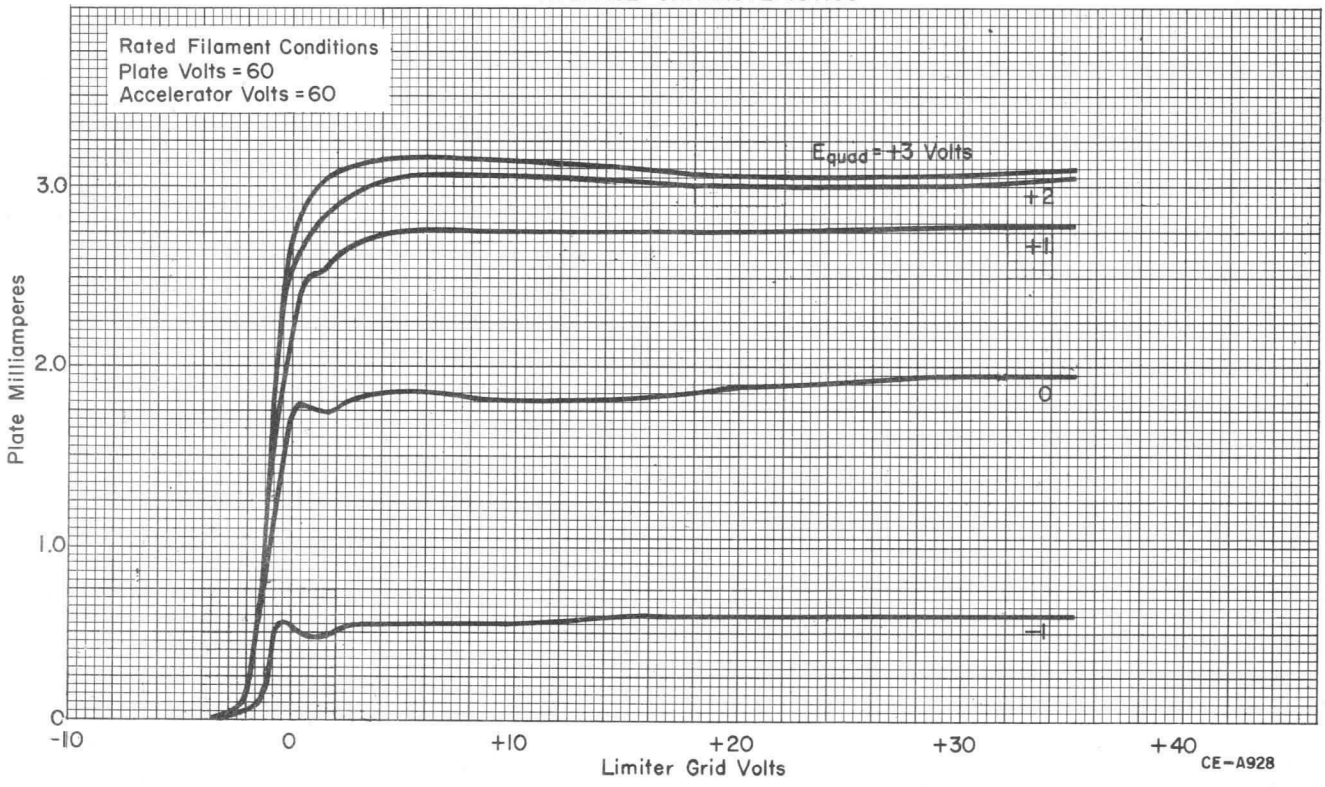
OPERATION CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



POWER PENTODE TYPES 6BQ5 and 8BQ5

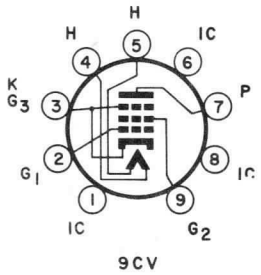
The 6BQ5 and 8BQ5 are 9-Pin miniature power pentodes designed for service as audio output amplifiers. They are intended for radio and television receivers and home music systems. The 6BQ5 and 8BQ5 combine high power sensitivity and plate efficiency with low distortion and driving voltage requirements.

The 8BQ5 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

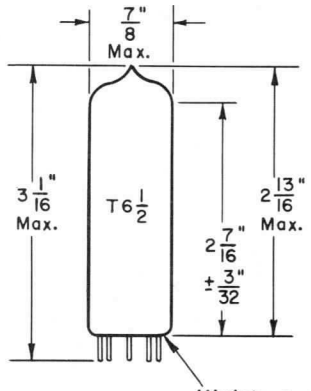
ELECTRICAL:			
Cathode	Coated Unipotential		
Heater:	6BQ5	8BQ5	
Voltage	6.3	8.0	Volts
Current	0.76	0.60 ± 6%	Ampere
Warm-up Time♦	--	11	Seconds
Direct Interelectrode Capacitances:			
Grid 1 to Plate	0.5	max.	μμf
Grid 1 to Heater	0.25	max.	μμf
Plate to All Other Elements	6.5		μμf
Grid 1 to All Other Elements	10.8		μμf

MECHANICAL:	
Bulb	T-6-1/2
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9CV
Mounting Position	Any

MAXIMUM RATINGS	AC Line	Vibrator		
Design Center Values:	Power Supply	Power Supply		
Plate Voltage	300	250	max.	Volts
Grid 2 Voltage	300	250	max.	Volts
Plate Diesipation	12	9	max.	Watts
Cutoff Operation:				
Plate Voltage	550		max.	Volts
Grid 2 Voltage	550		max.	Volts
Grid 2 Dissipation	2		max.	Watts
Grid 1 Negative Voltage	100		max.	Volts
Grid 1 Voltage for				
Grid 1 Current of 0.3 μampere	-1.3		max.	Volts
Cathode Current	65		max.	Ma.
Heater Cathode Voltage	± 100		max.	Volts
Grid 1 Circuit Values:				
Fixed Bias	0.3		max.	Meghom
Cathode Resistor Bias	1.0		max.	Meghom



9CV



CLASS A AMPLIFIER
(one tube)

Typical Operating Characteristics:						
For: Plate Voltage	250	Volts				
Grid 2 Voltage	250	Volts				
Grid 1 Voltage	-7.3	Volts				
or Cathode Bias Resistor	135	Ohms				
Plate Load Impedance	5200	Ohms				
With RMS Input AF Voltage of	0	0.3	3.4	4.3	4.7	Volts
Plate Current	48	--	--	49.5	49.2	Ma.
Grid 2 Current	5.5	--	--	10.8	11.6	Ma.
Transconductance	11300	--	--	--	--	μmhos
Plate Resistance	38000	--	--	--	--	Ohms
Amplification Factor ▲	19	--	--	--	--	
Power Output ■	0	0.05	4.5	5.7	6.0□	Watts
Distortion ■						
Total Harmonic	--	--	6.8	10	--	Percent
Second Harmonic	--	--	3.0	2.0	--	Percent
Third Harmonic	--	--	5.8	9.5	--	Percent

Typical Operating Characteristics:						
For: Plate Voltage	250	Volts				
Grid 2 Voltage	250	Volts				
Grid 1 Voltage	-7.3	Volts				
or Cathode Bias Resistor	135	Ohms				
Plate Load Impedance	4500	Ohms				
With RMS Input AF Voltage of	0	0.3	3.5	4.4	4.8	Volts
Plate Current	48	--	--	50.6	50.5	Ma.
Grid 2 Current	5.5	--	--	10	11	Ma.
Transconductance	11300	--	--	--	--	μmhos
Plate Resistance	38000	--	--	--	--	Ohms
Amplification Factor ▲	19	--	--	--	--	
Power Output ■	0	0.05	4.5	5.7	6.0□	Watts
Distortion:■						
Total Harmonic	--	--	7.5	10	--	Percent
Second Harmonic	--	--	5.7	5.0	--	Percent
Third Harmonic	--	--	4.5	8	--	Percent

Typical Operating Characteristics:						
For: Plate Voltage	250	Volts				
Grid 2 Voltage	250	Volts				
Grid 1 Voltage	-8.4	Volts				
or Cathode Bias Resistor	210	Ohms				
Plate Load Impedance	7000	Ohms				
With RMS Input AF Voltage of	0	0.3	3.5	5.5		Volts
Plate Current	36	--	36.8	36		Ma.
Grid 2 Current	4.1	--	8.5	14.6		Ma.
Transconductance	10000	--	--	--		μmhos
Plate Resistance	40000	--	--	--		Ohms
Amplification Factor ▲	19	--	--	--		
Power Output ■	0	0.05	4.2	5.6□		Watts
Distortion ■						
Total Harmonic	--	--	10	--		Percent
Second Harmonic	--	--	1.7	--		Percent
Third Harmonic	--	--	8.7	--		Percent

Typical Operating Characteristics:			
For: Plate Voltage	250	Volts	
Grid 2 Voltage	210	Volts	
Grid 1 Voltage	-6.4	Volts	
or Cathode Bias Resistor	160	Ohms	
Plate Load Impedance	7000	Ohms	

With RMS Input AF Voltage of	0	0.3	3.4	3.8	Volts
Plate Current	36	--	36.6	36.5	Ma.
Grid 2 Current	3.9	--	7.3	8.0	Ma.
Transconductance	10400	--	--	--	μmhos
Plate Resistance	40000	--	--	--	Ohms
Amplification Factor	19	--	--	--	
Power Output	0	0.05	4.3	4.7	Watts
Distortion					
Total Harmonic	--	--	10	--	Percent
Second Harmonic	--	--	1.8	--	Percent
Third Harmonic	--	--	9.3	--	Percent

PUSH-PULL CLASS AB AMPLIFIER

Typical Operating Characteristics for Two Tubes

For: Plate Voltage	250		Volts
Grid 2 Voltage	250		Volts
Common Cathode Bias Resistor	130		Ohms
Plate-to-Plate Load Impedance	8000		Ohms
With RMS Input AF Voltage of	0	8	Volts
Plate Current	62	75	Ma.
Grid 2 Current	7	15	Ma.
Power Output	0	11	Watts
Total Harmonic Distortion	--	3	Percent

Typical Operating Characteristics for Two Tubes

For: Plate Voltage	300		Volts
Grid 2 Voltage	300		Volts
Common Cathode Bias Resistor	130		Ohms
Plate-to-Plate Load Impedance	8000		Ohms
With RMS Input AF Voltage of	0	10	Volts
Plate Current	72	92	Ma.
Grid 2 Current	♦	22	Ma.
Power Output	0	17	Watts
Total Harmonic Distortion	--	4	Percent

PUSH-PULL CLASS B AMPLIFIER

Typical Operating Characteristics for Two Tubes

For: Plate Voltage	250		Volts
Grid 2 Voltage	250		Volts
Grid 1 Bias Voltage	-11.6		Volts
Plate-to-Plate Load Impedance	8000		Ohms
With RMS Input AF Voltage of	0	8	Volts
Plate Current	20	75	Ma.
Grid 2 Current	2.2	15	Ma.
Power Output	0	11	Watts
Total Harmonic Distortion	--	3	Percent

Typical Operating Characteristics for Two Tubes

For: Plate Voltage	300		Volts
Grid 2 Voltage	300		Volts
Grid 1 Bias Voltage	-14.7		Volts
Plate-to-Plate Load Impedance	8000		Ohms
With RMS Input AF Voltage of	0	10	Volts
Plate Current	15	92	Ma.
Grid 2 Current	1.6	22	Ma.
Power Output	0	17	Watts
Total Harmonic Distortion	--	4	Percent

TRIODE-CONNECTED CLASS A AMPLIFIER

(Grid 2 Connected to Plate)

Typical Operating Characteristics

Plate Voltage	250		Volts
Cathode Bias Resistor	270		Ohms
Plate Load Resistance	3500		Ohms
Input AF Voltage (RMS)	6.7		Volts
Zero Signal Plate Current	34		Ma.
Maximum Signal Plate Current	36		Ma.
Power Output	1.95		Watts
Total Harmonic Distortion	9		Percent
Input AF RMS Voltage for Power Output of Milliwatts	1.0		Volts

PUSH-PULL TRIODE CONNECTED CLASS A AMPLIFIER

(Grids No.2 Connected to Plates)

Typical Operating Characteristics for Two Tubes

Plate Voltage	250	300	Volts
Cathode Bias Resistor	270	270	Ohms
Plate-to-Plate Load Impedance	10000	10000	Ohms
Input AF Voltage (RMS)	8.3	10	Volts
Zero Signal Plate Current	40	48	Ma.
Maximum Signal Plate Current	43.4	52	Ma.
Power Output	3.4	5.2	Watts
Total Harmonic Distortion	2.5	2.5	Percent
Input AF RMS Voltage for Power Output of 50 Milliwatts	0.95	0.9	Volts

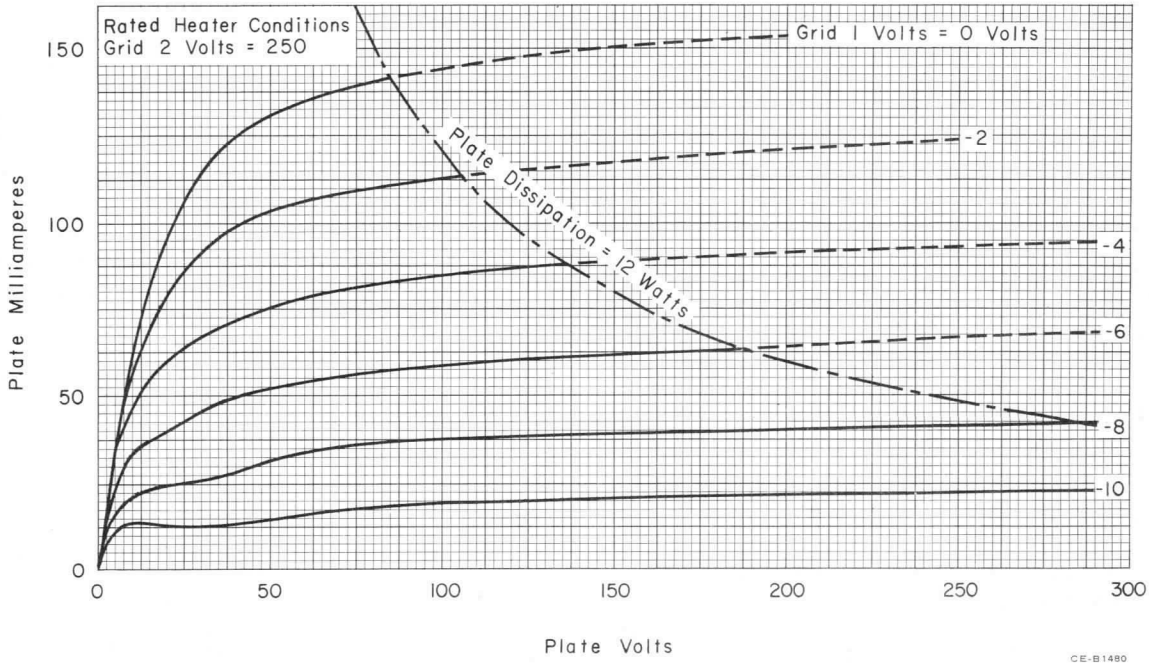
♦ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Amplification factor of grid 2 to grid 1.

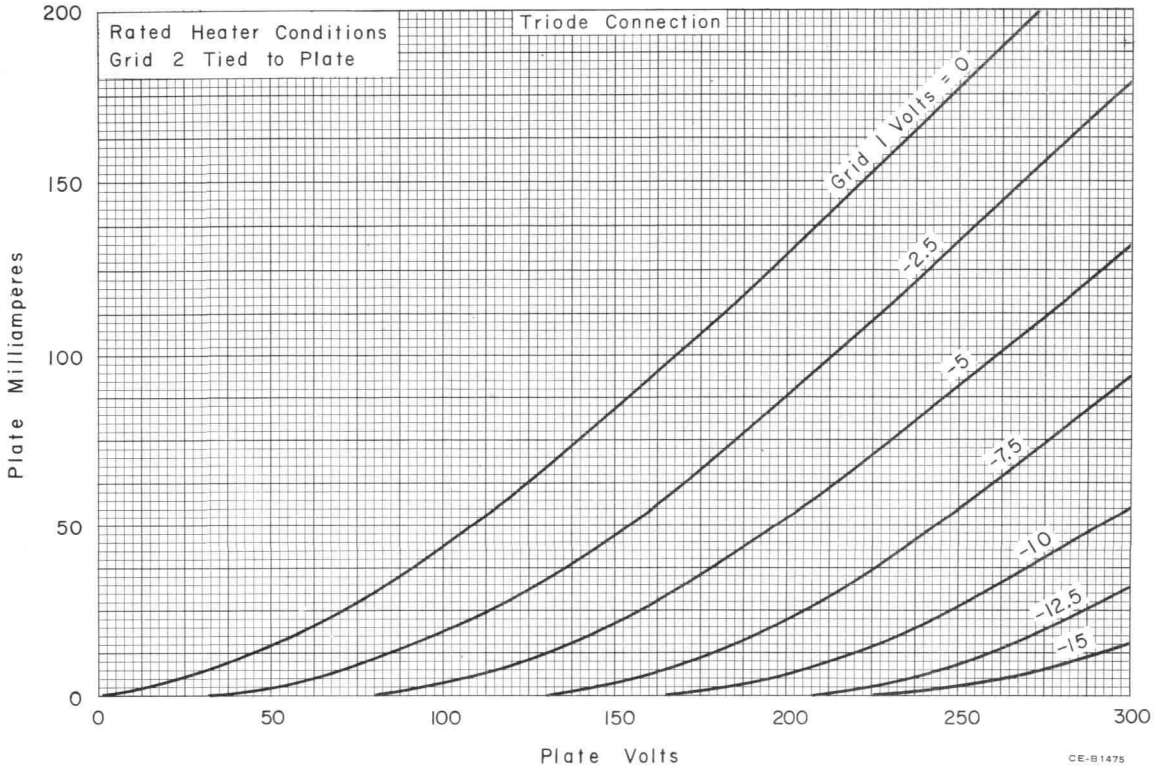
■ Measured with fixed bias.

□ Power output when grid starts to draw current.

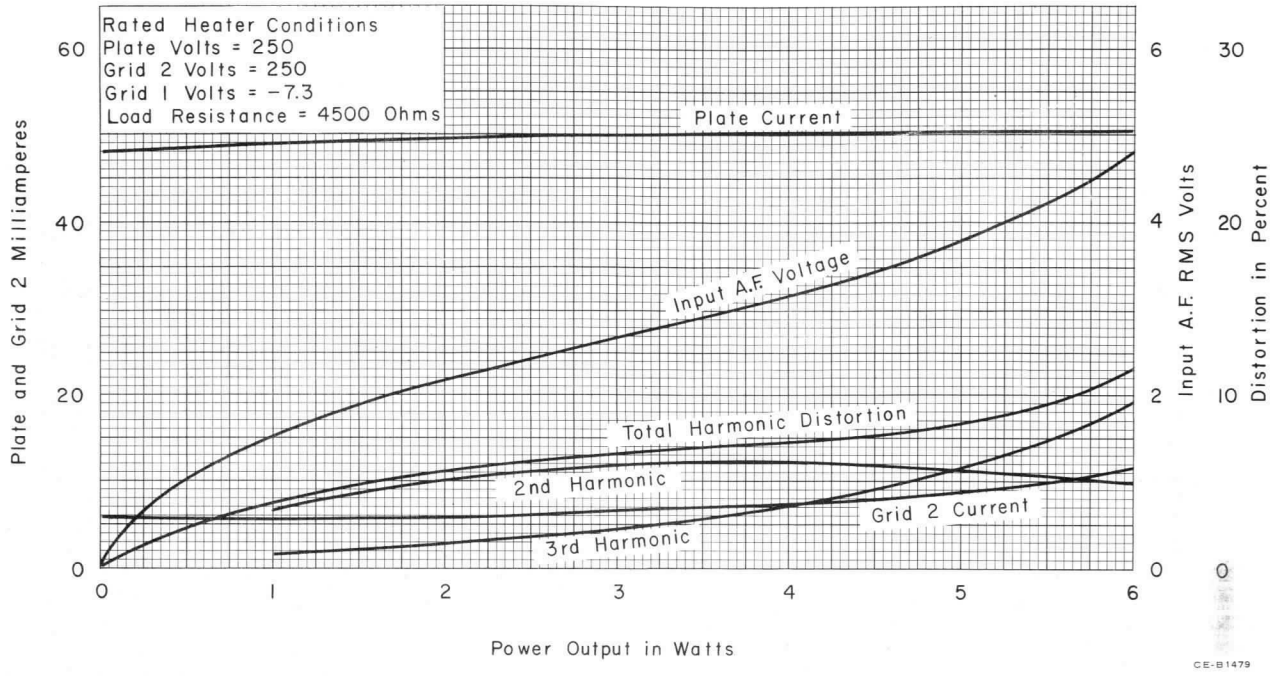
AVERAGE PLATE CHARACTERISTICS



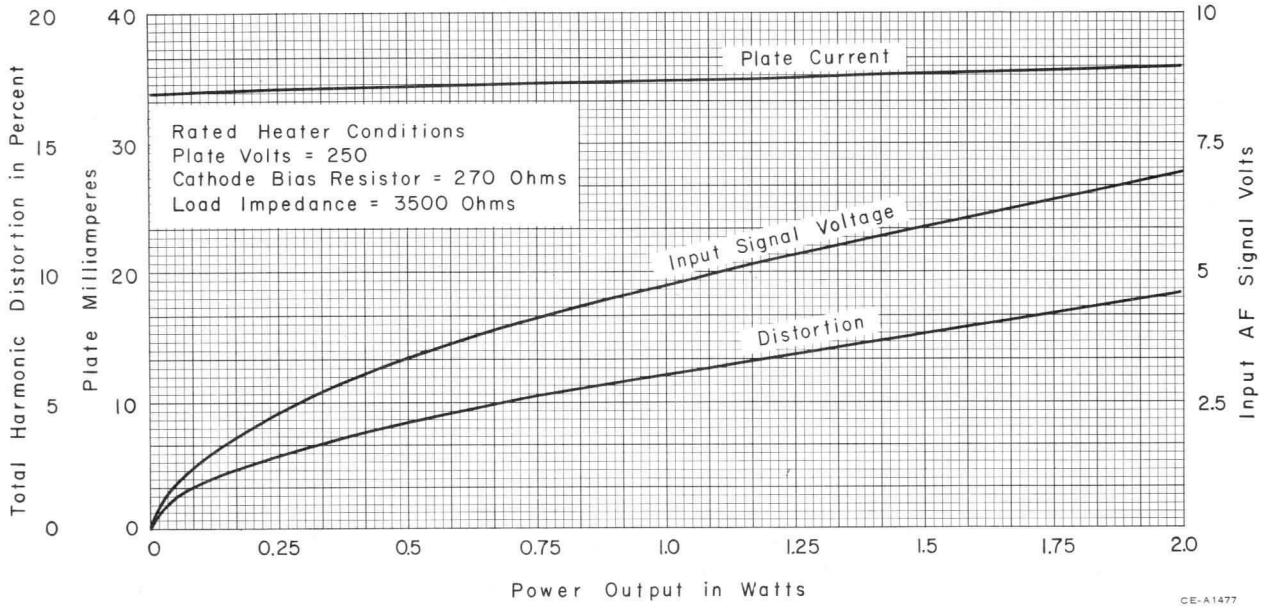
AVERAGE PLATE CHARACTERISTICS



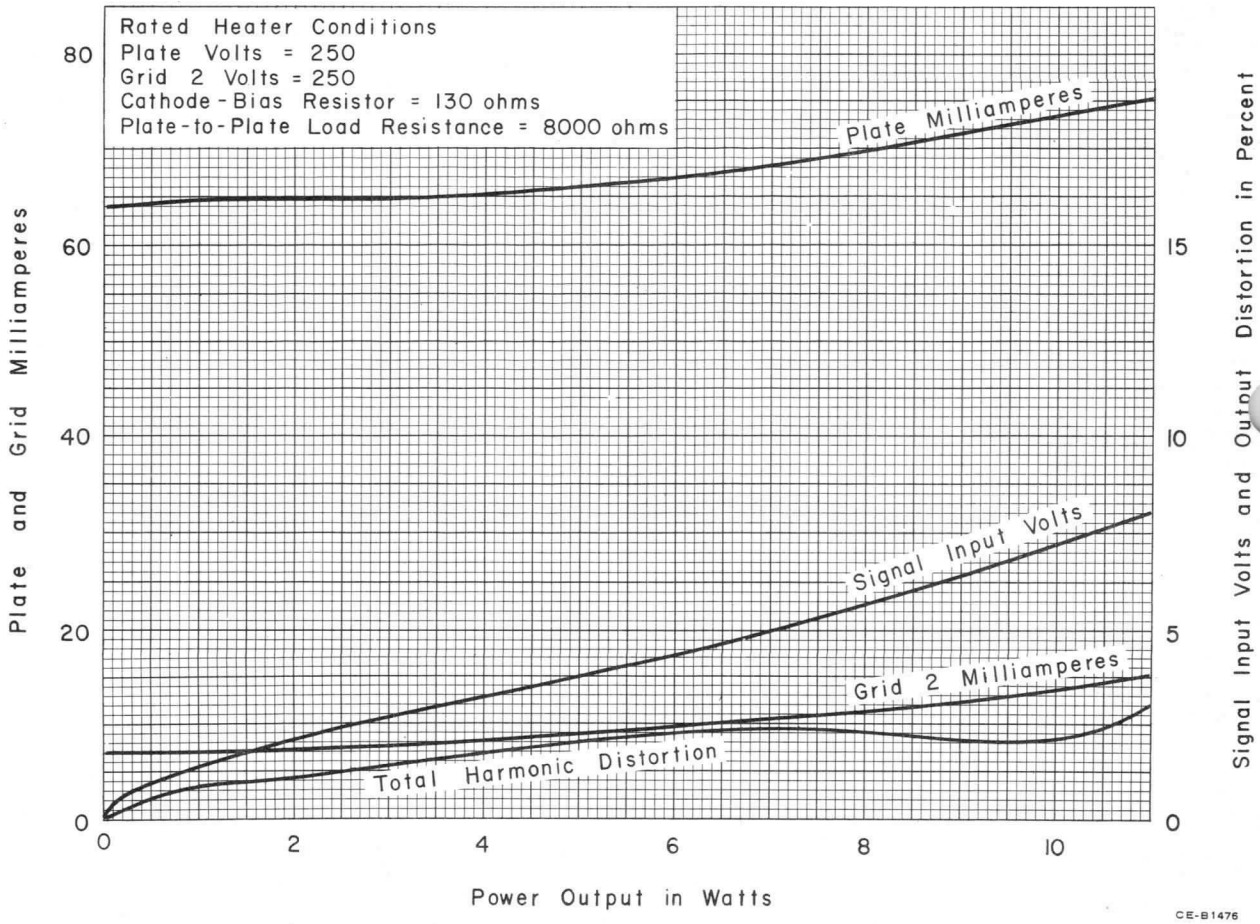
OPERATION CHARACTERISTICS



OPERATION CHARACTERISTICS
(TRIODE CONNECTION)



OPERATING CHARACTERISTICS
PUSH - PULL CLASS AB



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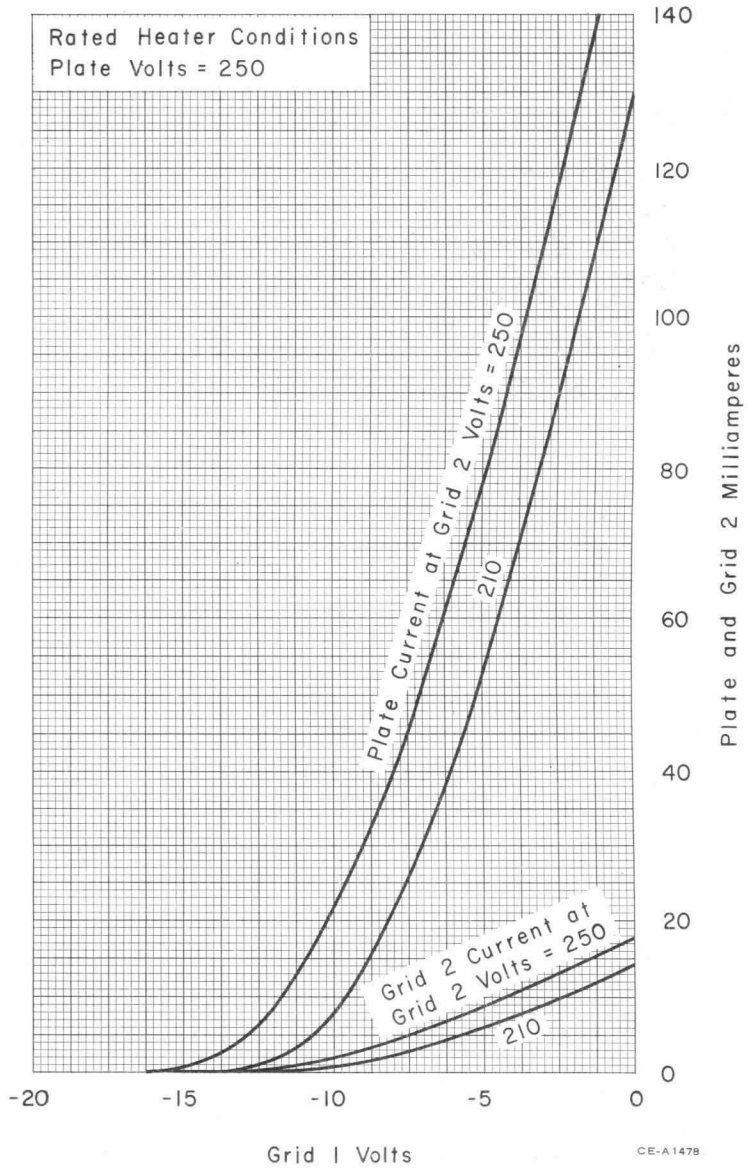
AVERAGE TRANSFER CHARACTERISTICS



Westinghouse®

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

January 27, 1958

BEAM POWER PENTODE TYPES 6BQ6-GTA AND 12BQ6-GTA

The 6BQ6-GTA and 12BQ6-GTA are glass octal beam-power pentodes designed for service as horizontal deflection output amplifiers in television receivers. The 6BQ6-GTA and 12BQ6-GTA are improved versions of the 6BQ6-GT and 12BQ6-GT respectively.

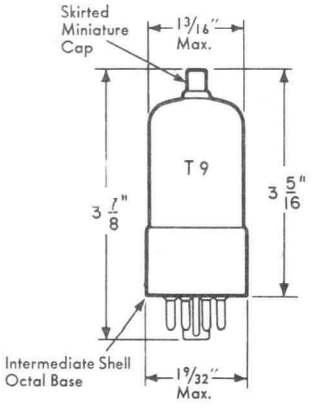
The 12BQ6-GTA has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:			
Cathode		Coated Unipotential	
Filament:	6BQ6-GTA	12BQ6-GTA	
Voltage (ac or dc)	6.3	12.6	Volts
Current	1.2	0.6 ± 6%	Ampere
Warm-up Time +	--	11	Seconds
Direct Interelectrode Capacitances (Unshielded):			
Grid to Plate		6	uuf
Input		15.0	uuf
Output		7.5	uuf
MECHANICAL:			
Bulb		T-9	
Base		Intermediate Shell Octal	
Basing		6AM	
Top Cap		C1-3, Skirted Miniature	
Mounting Position		Any	

HORIZONTAL DEFLECTION AMPLIFIER♦

MAXIMUM RATINGS:			
Design Center Values			
D.C. Plate Supply Voltage:			
(Boost + D.C. Power Supply)	600	max.	Volts
Peak Positive Plate Voltage	6000 abs.	max.	Volts
Peak Negative Plate Voltage	1250	max.	Volts
Plate Dissipation▲	11	max.	Watts
Peak Negative Grid 1 Voltage	300	max.	Volts
D.C. Grid 2 Voltage	175	max.	Volts
Grid 2 Dissipation	2.5	max.	Watts
Average Cathode Current	110	max.	Ma.
Peak Cathode Current	400	max.	Ma.
Grid 1 Circuit Resistance	0.47	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



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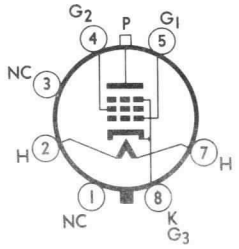


6AM

AVERAGE CHARACTERISTICS

PENTODE OPERATION		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	-22.5	Volts
Plate Current	55	Ma.
Grid 2 Current	2.1	Ma.
Transconductance	5500	umhos
Plate Resistance	20000	Ohms
ZERO BIAS		
Plate Voltage□	60	Volts
Grid 2 Voltage□	150	Volts
Plate Current⊕	225	Ma.
Grid 2 Current⊕	25	Ma.
CUTOFF		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Plate Current	1.0	Ma.
Grid 1 Voltage	-46	Volts
TRIODE AMPLIFICATION FACTOR		
Plate Voltage	150	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	-22.5	Volts
Amplification Factor	4.3	

NOTES

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

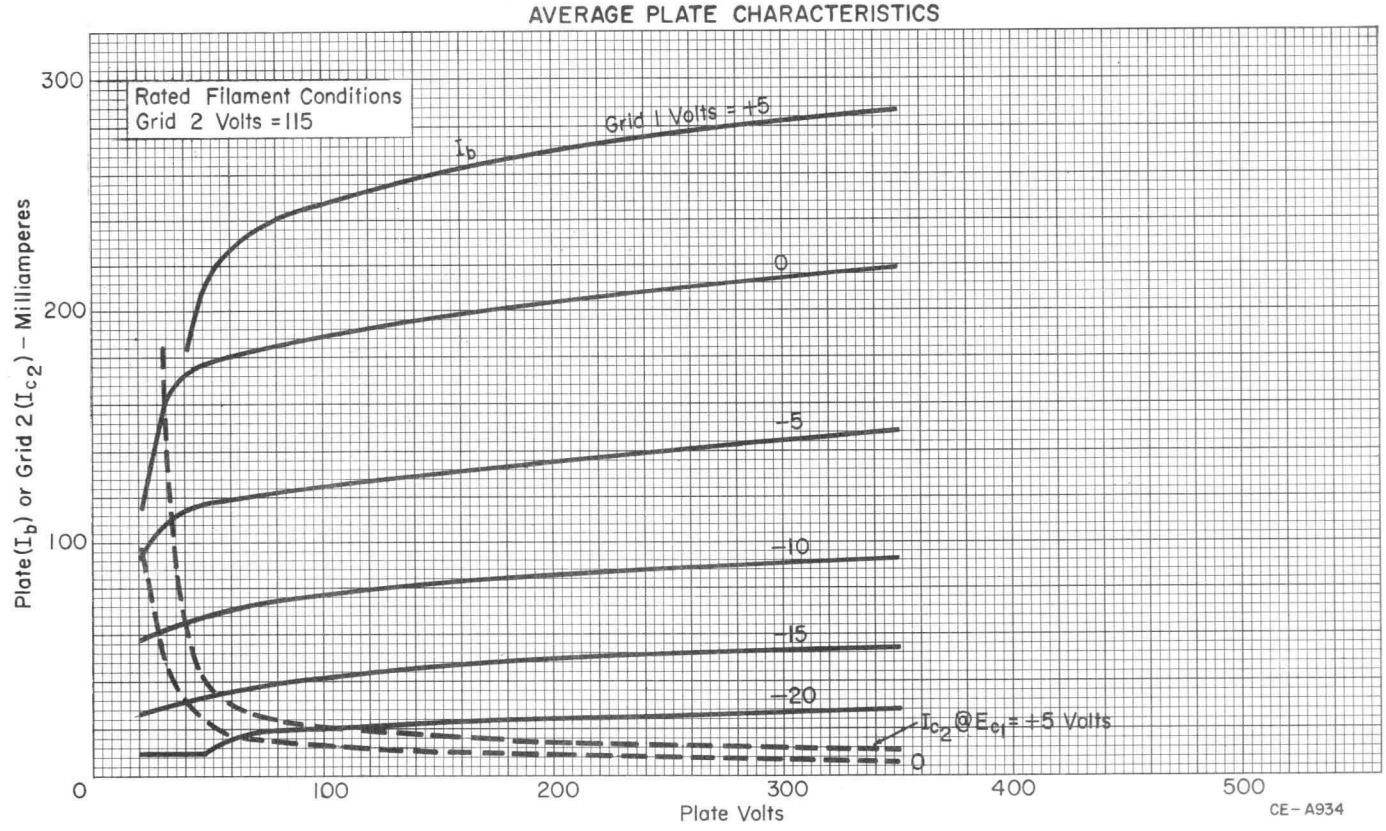
▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

+ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

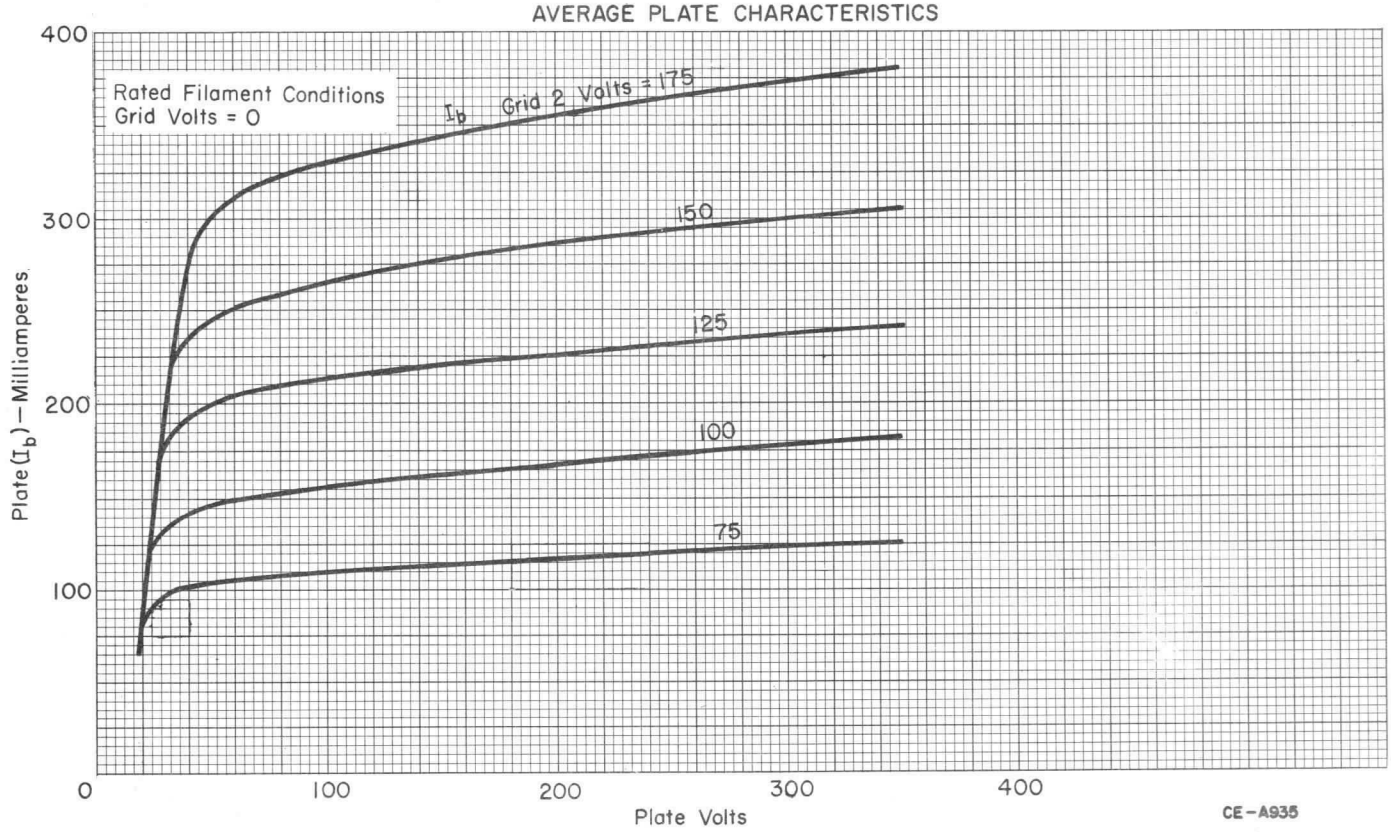
□ Applied for short interval (maximum of two seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

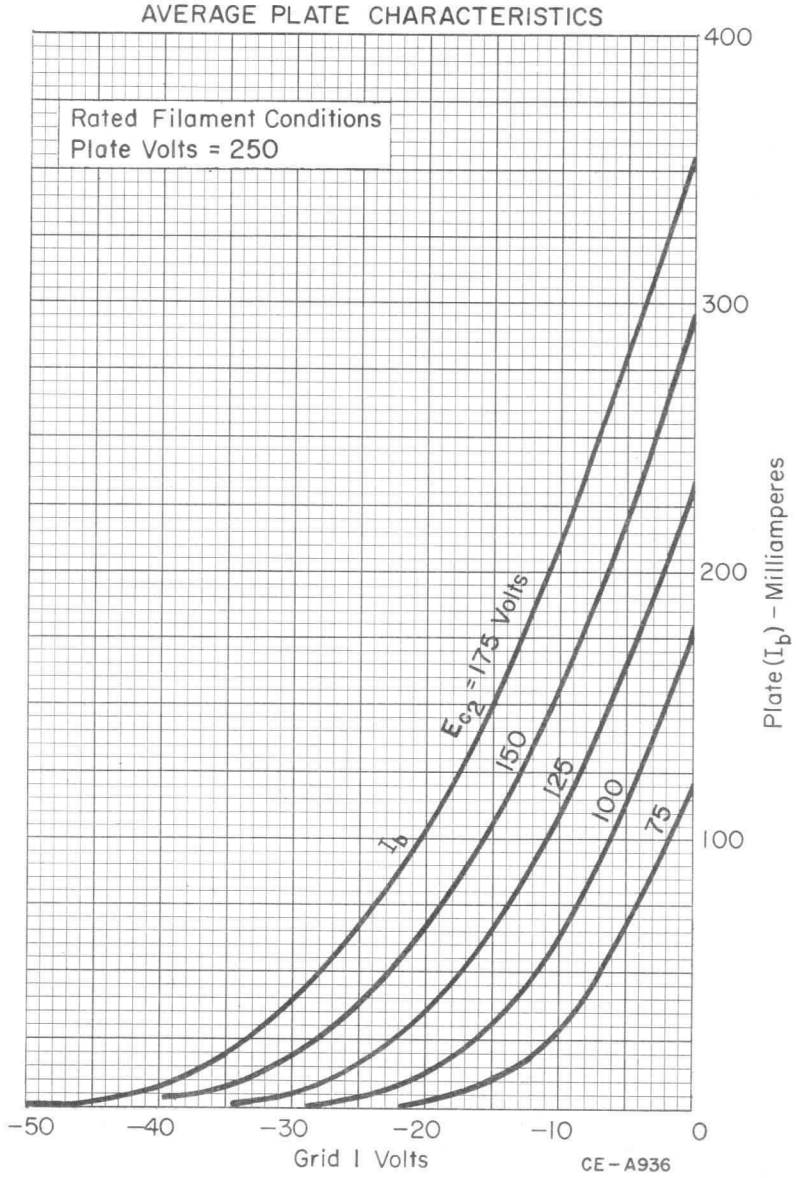
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



HORIZONTAL AMPLIFIER BEAM PENTODE TYPE 6BQ6-GTB

The 6BQ6-GTB is an octal based beam-power pentode designed for service as the output amplifier in horizontal deflection circuit in a television receiver. This type is characterized by high zero-bias plate current and high maximum peak positive pulse plate voltage ratings.

ELECTRICAL:

Cathode	Coated Unipotential	
Filament:		
Voltage (ac or dc)	6.3	Volts
Current	1.20	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid to Plate	0.6	μμf
Input	15.0	μμf
Output	7.0	μμf

MECHANICAL:

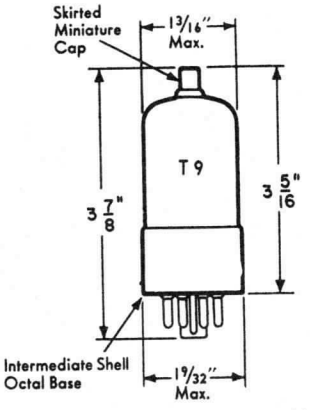
Bulb	T-9
Base	Intermediate Shell Octal
Basing	6AM
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER♦

MAXIMUM RATINGS:

Design Center Values

D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	600	max.	Volts
Peak Positive Plate Voltage	6000 abs.	max.	Volts
Peak Negative Plate Voltage	1250	max.	Volts
Plate Dissipation▲	11	max.	Watts
Peak Negative Grid 1 Voltage	300	max.	Volts
D.C. Grid 2 Voltage	200	max.	Volts
Grid 2 Dissipation	2.5	max.	Watts
Average Cathode Current	110	max.	Ma.
Peak Cathode Current	400	max.	Ma.
Grid 1 Circuit Resistance	0.47	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



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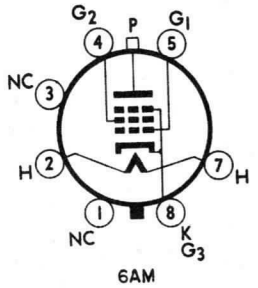


6AM

AVERAGE CHARACTERISTICS

PENTODE OPERATION:		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	−22.5	Volts
Plate Current	57	Ma.
Grid 2 Current	2.1	Ma.
Transconductance	5900	μmhos
Plate Resistance	14500	Ohms
ZERO BIAS:		
Plate Voltage□	60	Volts
Grid 2 Voltage□	150	Volts
Plate Current⊕	260	Ma.
Grid 2 Current⊕	26	Ma.
CUTOFF:		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Plate Current	1.0	Ma.
Grid 1 Voltage	−43	Volts
TRIODE AMPLIFICATION FACTOR:		
Plate Voltage	150	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	−22.5	Volts
Amplification Factor	4.3	

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

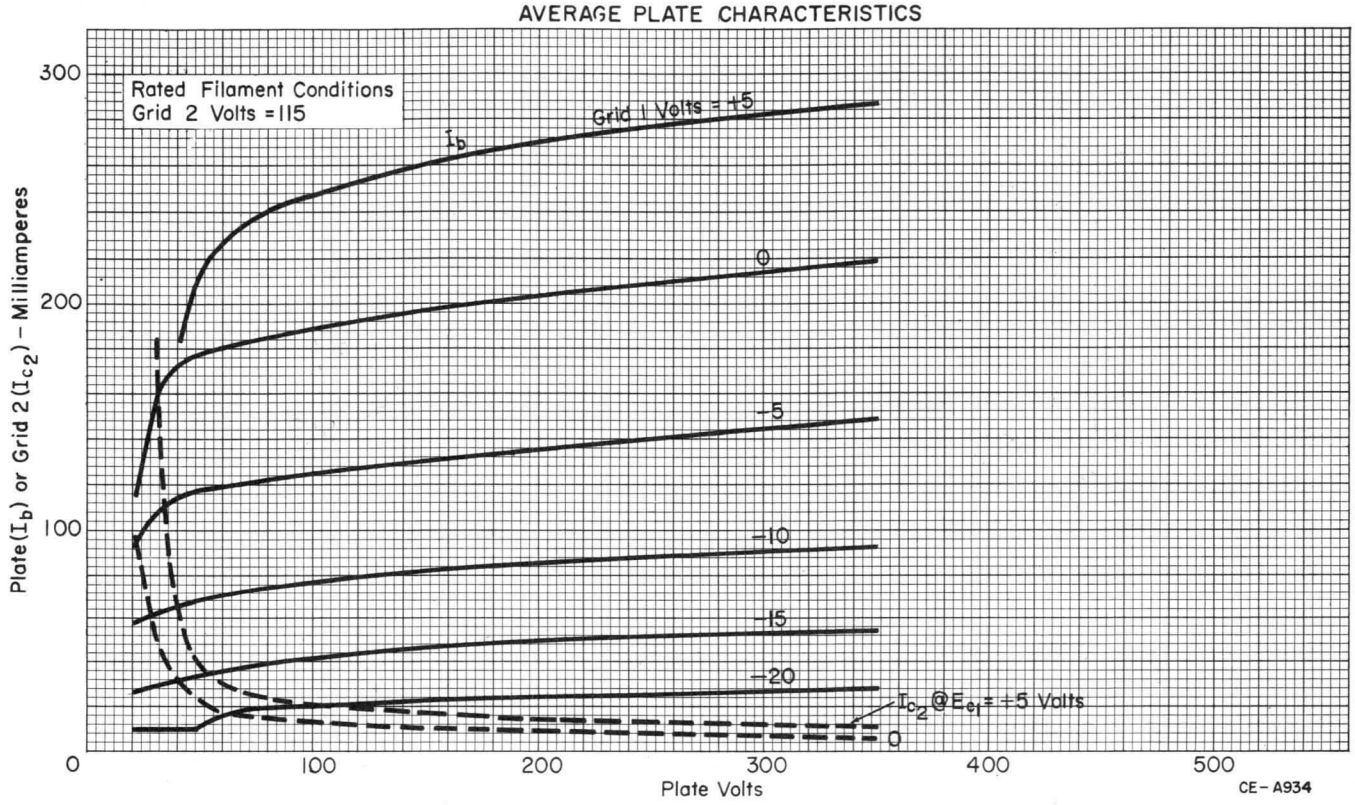
▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

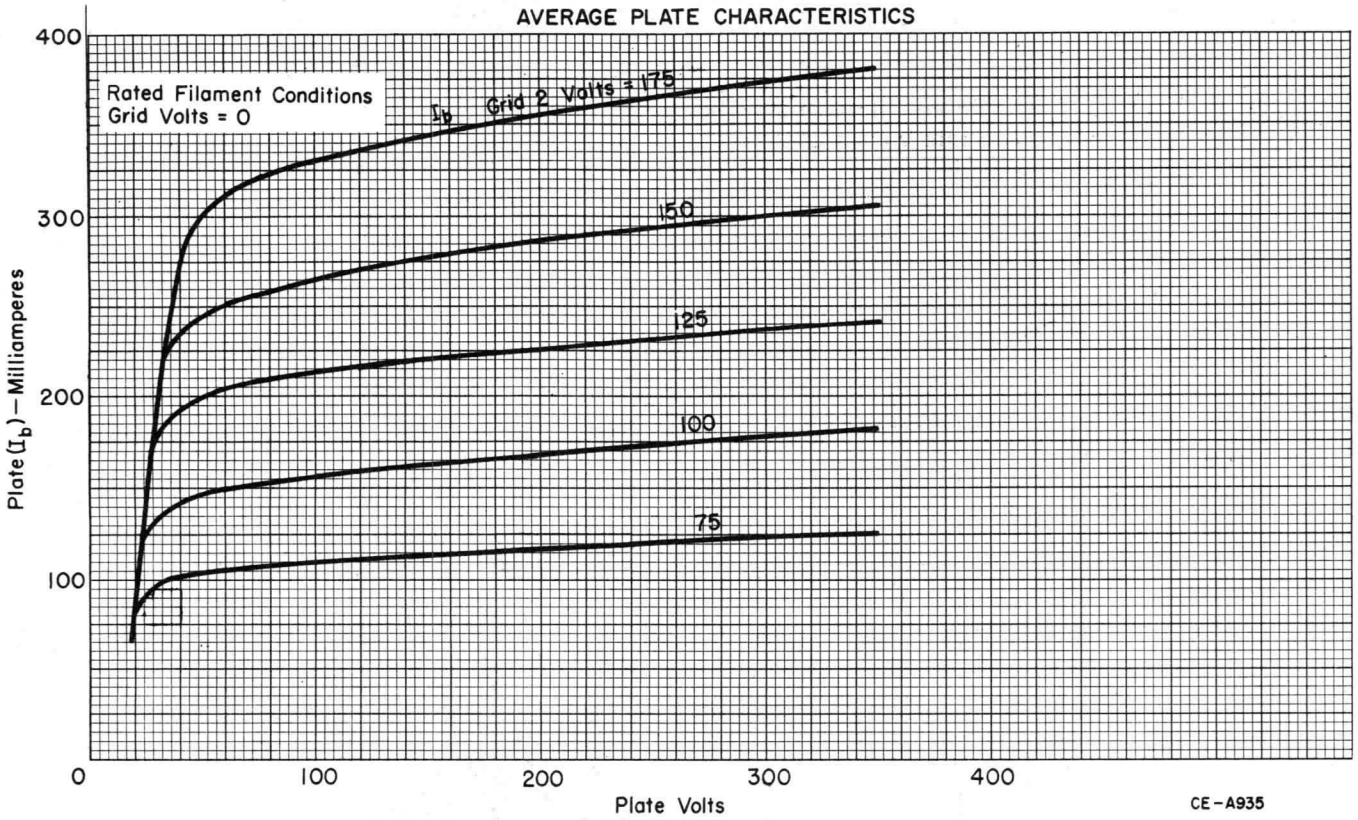
+ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

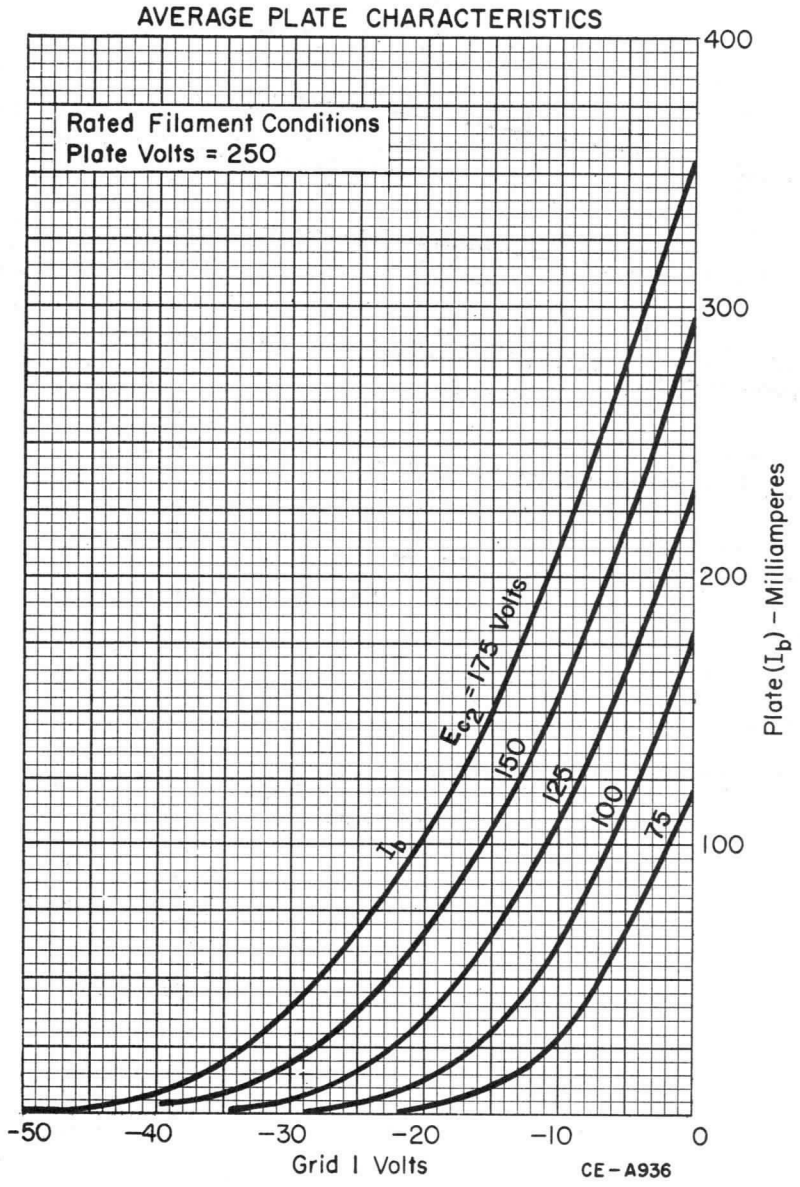
□ Applied for short interval (maximum of two seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

AVERAGE PLATE CHARACTERISTICS




AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Grid Volts = 0
I_b Grid 2 Volts = 175
150
125
100
75
400
300
200
100
0
100
200
300
400
Plate (I_b) — Milliamperes
Plate Volts
CE-A935


AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Plate Volts = 250
400
300
200
100
Plate (I_b) – Milliamperes
E_{c2} = 175 Volts
150
125
100
75
I_b
-50
-40
-30
-20
-10
0
Grid 1 Volts
CE-A936

March 15, 1955

Medium-Mu Twin Triode Type 4BQ7-A

The 4BQ7-A is a 9-pin miniature, medium-mu, twin triode designed for use as the first amplifier in tuners of UHF television receivers. It is also intended for service in other applications that require a high-gain, low-noise amplifier.

The 4BQ7-A has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

Electrical:

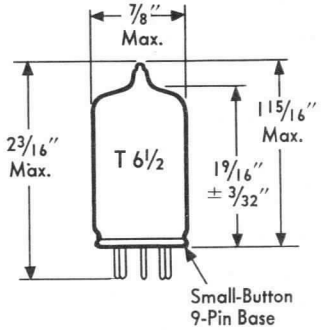
Cathodes	Two, Coated Unipotential		
Heater:			
Voltage	4.2 ac or dc		Volts
Current	0.6		Ampere
Warm-Up Time **	11		Seconds
Direct Interelectrode Capacitances (external shield No. 315):	Unit 1	Unit 2	
Grid to Plate	1.15	1.15	μμf
Plate to Cathode	0.15 max.	0.15 max.	μμf
Heater to Cathode	2.65	2.70	μμf
Input	2.85	4.95 *	μμf
Output	1.35	2.27*	μμf
Plate, Unit 1 to Plate, Unit 2	0.010 max.		μμf
Plate, Unit 2 to Plate and Grid, Unit 1	0.024 max.		μμf

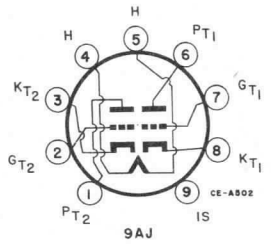
*With grounded grid.

**See Page 3.

Mechanical:

Bulb	T-6 1/2
Base	Small Button 9-pin (JETEC E9-1)
Basing	9AJ
Mounting Position	Any





Bottom View

CE-A554

AMPLIFIER — CLASS A_1

Each Unit

Maximum Ratings

Design Center Values

Plate Voltage	250† max.	Volts
Cathode Current	20 max.	Ma.
Plate Dissipation	2 max.	Watts
Peak-Heater Cathode Voltage:		
Heater Positive with Respect to Cathode	200 max.	Volts
Heater Negative with Respect to Cathode	200† max.	Volts

† Under cutoff conditions in r-f grounded-grid circuit with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts.

Characteristics

Plate Voltage	150	Volts
Cathode-Bias Resistor	220	Ohms
Plate Current	9	Ma.
Transconductance	6400	μmhos
Plate Resistance	6100	Ohms
Amplification Factor	39	
Grid Bias (Approx.) for Plate Current of 10 μamp	−10	Volts

Typical Operation—Grounded Grid Circuit with Direct-Coupled Drive

Unit No. 1 (driver-tube) is directly coupled to Unit No. 2 (driven rf-grounded-grid amplifier tube.)

	Unit 1	Unit 2	
Plate Supply Voltage	250	250	Volts
Plate Voltage	135	115	Volts
Grid Voltage	−1	—	Volt
Cathode Bias Resistor	100	—	Ohms
Plate Current	10	10	Ma.
Grid Current	0	0	Ma.
Grid Voltage (Approx.) for Plate Current of 10 μamp	−14	—	Volts

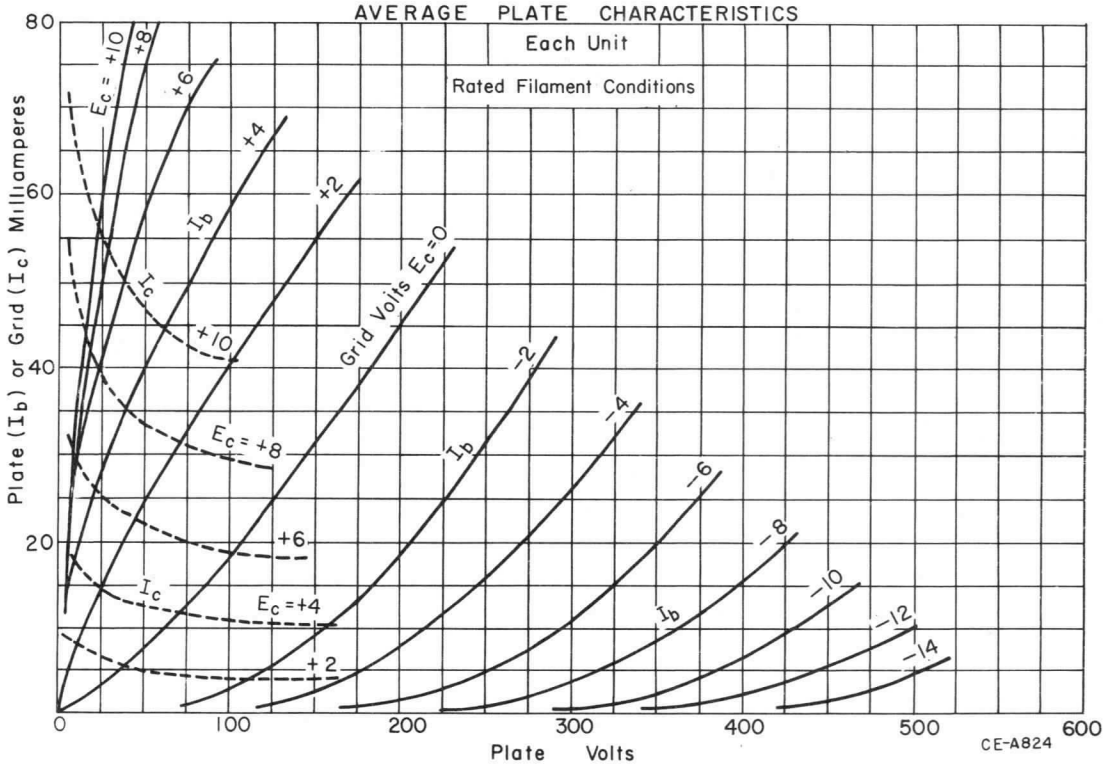
Maximum Circuit Values (Each Unit)

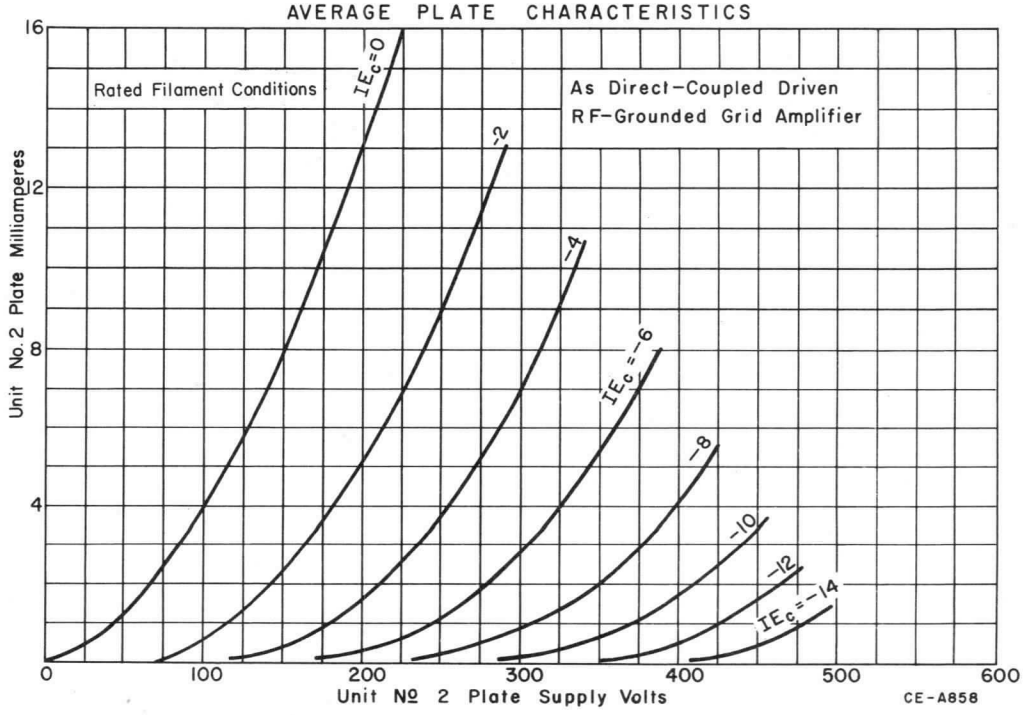
Grid Circuit Resistance	.5 max. Megohm

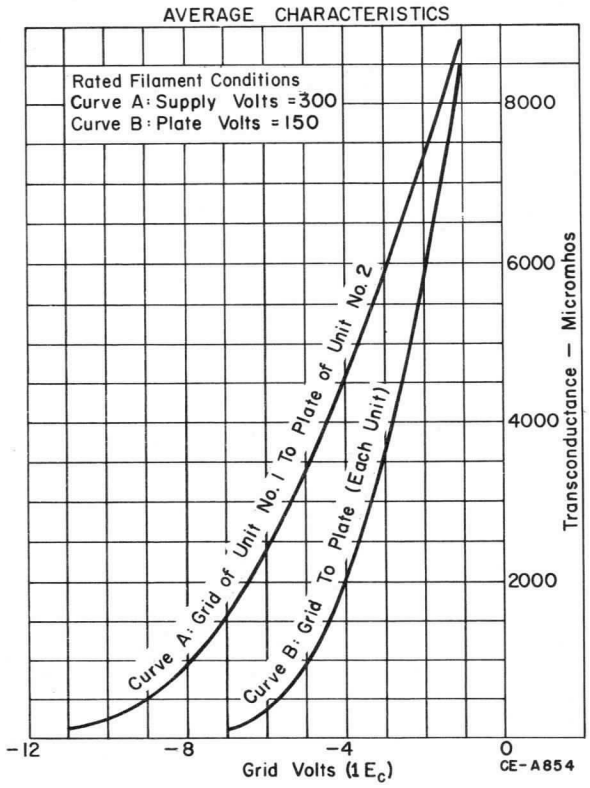
Typical Operation—Push-Pull Grounded Grid Circuit

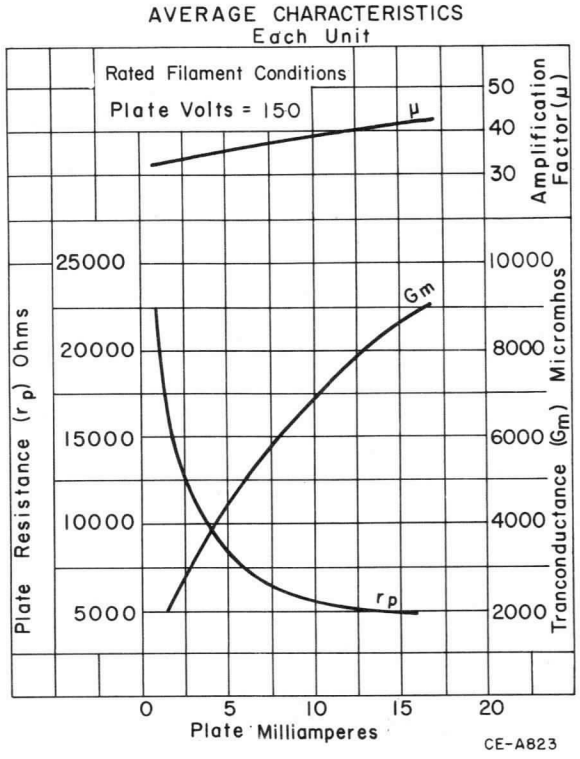
Plate Voltage	150	Volts
Grid Voltage	−2‡	Volts
Cathode Resistor	100	Ohms
Plate Current	10	Ma.

‡Obtained from cathode resistor.


AVERAGE PLATE CHARACTERISTICS
Each Unit
Rated Filament Conditions
Plate (Ib) or Grid (Ic) Milliamperes
Plate Volts
Grid Volts Ec=0
Ec = +10
+8
+6
+4
+2
-2
-4
-6
-8
-10
-12
-14
Ib
Ic
CE-A824

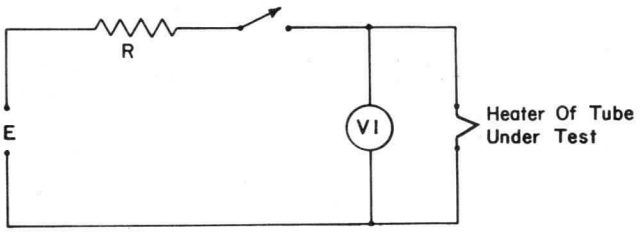

AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
As Direct-Coupled Driven
RF-Grounded Grid Amplifier
Unit No.2 Plate Milliamperes
Unit Nº 2 Plate Supply Volts
IEc=0
-2
-4
IEc=-6
-8
-10
-12
IEc=-14
CE-A858





HEATER WARM-UP TIME MEASUREMENTS

Heater warm-up time is defined as the time required for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1) in the circuit shown below. The conditions used in conjunction with the test circuit depend upon the rated heater voltage and current of the tube under test.



CE-A933

E —Applied Voltage, RMS or DC	16.7	Volts
R —Total Series Resistance	21	Ohms
V_1—Heater Voltage, RMS or DC	3.33	Volts
E_f—Rated Heater Voltage	4.2	Volts
I_f —Rated Heater Current	0.6	Ampere

Medium-Mu Triode Type 6BQ7-A

The 6BQ7-A is a 9-pin miniature, medium-mu, twin triode designed for use as the first amplifier in tuners of UHF television receivers. It is also intended for service in other applications that require a high gain, low noise amplifier.

GENERAL DATA

Electrical:

Cathodes	Two, Coated Unipotential		
Heater:			
Voltage	6.3 ac or dc		Volts
Current	0.4		Ampere
Direct Interelectrode Capacitances (external shield No. 315):	Unit 1	Unit 2	
Grid to Plate	1.15	1.15	μμf
Input	2.85	4.95 *	μμf
Output	1.35	2.27 *	μμf
Plate to Cathode	0.15 max.	0.15 max.	μμf
Plate, Unit 1 to Plate, Unit 2	0.010 max.		μμf
Plate, Unit 2 to Plate and Grid, Unit 1	0.024 max.		μμf

* With grounded grid.

Mechanical:

Bulb	T-6-1/2
Base	E9-1, Small Button 9-pin
Basing	9AJ
Mounting Position	Any

AMPLIFIER — CLASS A_1

Each Unit

Maximum Ratings

Design Center Values

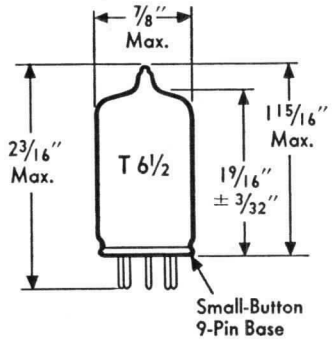
Plate Voltage	250† max.		Volts
Cathode Current	20 max.		Ma.
Plate Dissipation	2 max.		Watts
Peak Heater — Cathode Voltage:			
Heater Positive with Respect to Cathode	200 max.		Volts
Heater Negative with Respect to Cathode	200† max.		Volts

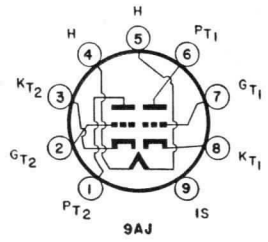
† Under cutoff conditions in r-f grounded-grid circuit with direct-coupled drive, it is permissible for this voltage to be as high as 300 volts.

Characteristics

Each Unit

Plate Voltage	150	Volts
Cathode — Bias Resistor	220	Ohms
Plate Current	9	Ma.
Transconductance	6400	μmhos
Plate Resistance	6100	Ohms
Amplification Factor	39	
Grid Bias (Approx.) for Plate Current of 10 μamp	−10	Volts





Bottom View

CE-A554

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CLASS A_1 AMPLIFIER (Cont.)

Typical Operation — Push-Pull Grounded Grid Circuit: Each Unit

Plate Voltage	150	Volts
Grid Voltage	−2‡	Volts
Cathode Resistor	100	Ohms
Plate Current	10	Ma.

‡ Obtained from cathode resistor.

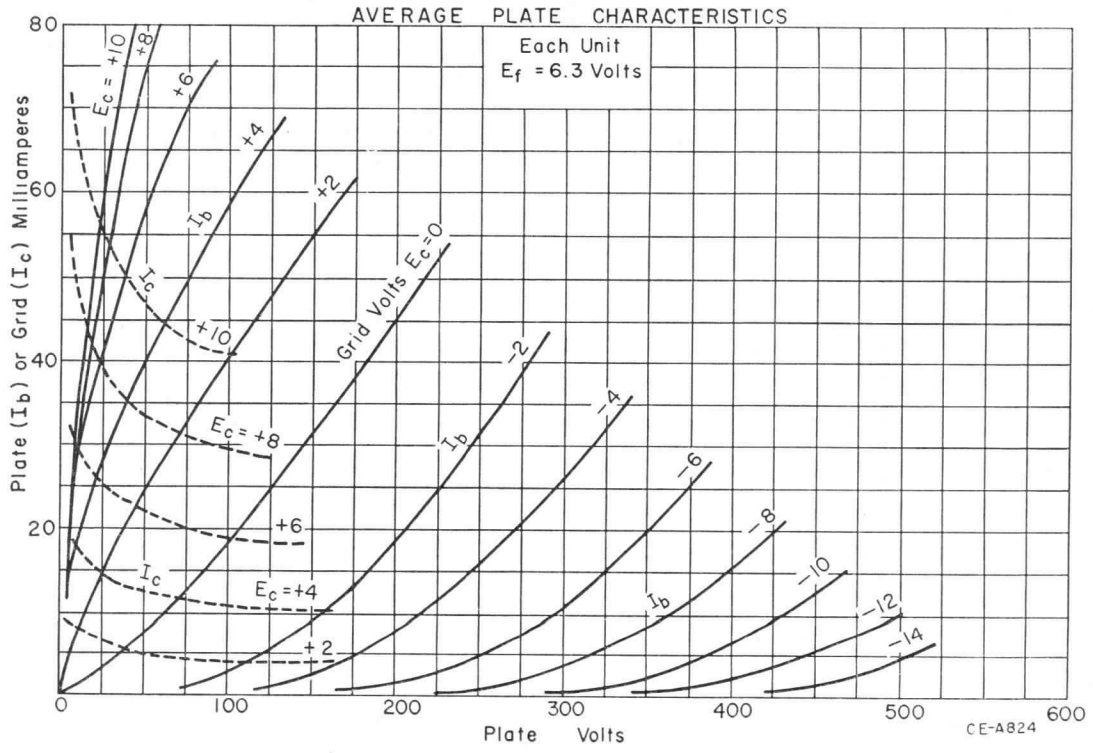
Typical Operation — Grounded Grid Circuit with Direct-Coupled Drive:

Unit No. 1 (driver-tube) is directly coupled to Unit No. 2 (driven rf-grounded-grid amplifier tube.)

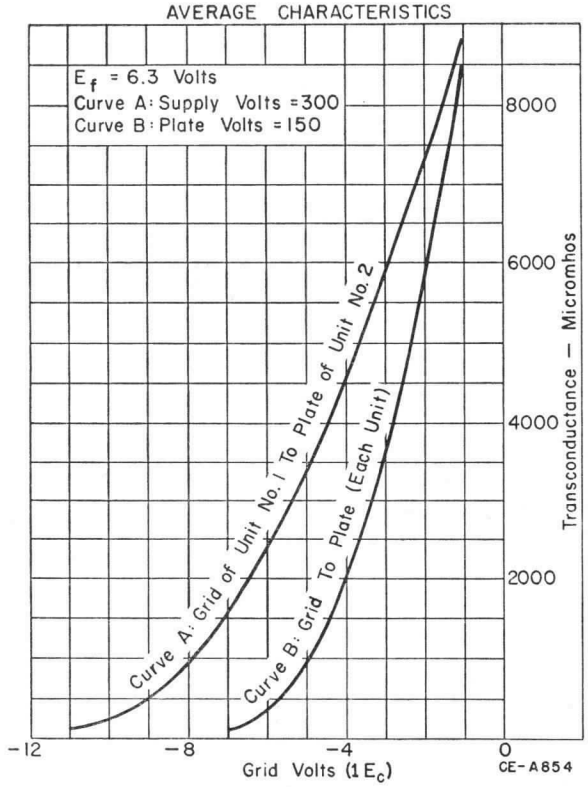
	Unit 1	Unit 2	
Plate Supply Voltage	250	250	Volts
Plate Voltage	135	115	Volts
Grid Voltage	−1	−	Volts
Cathode Bias Resistor	100	−	Ohms
Plate Current	10	10	Ma.
Grid Current	0	0	Ma.
Grid Voltage (Approx.) for Plate Current of 10 μamp	−14	−	Volts
Peak Heater — Cathode Voltage:			
Heater Negative with Respect to Cathode	1	250	Volts

Maximum Circuit Values (Each Unit)

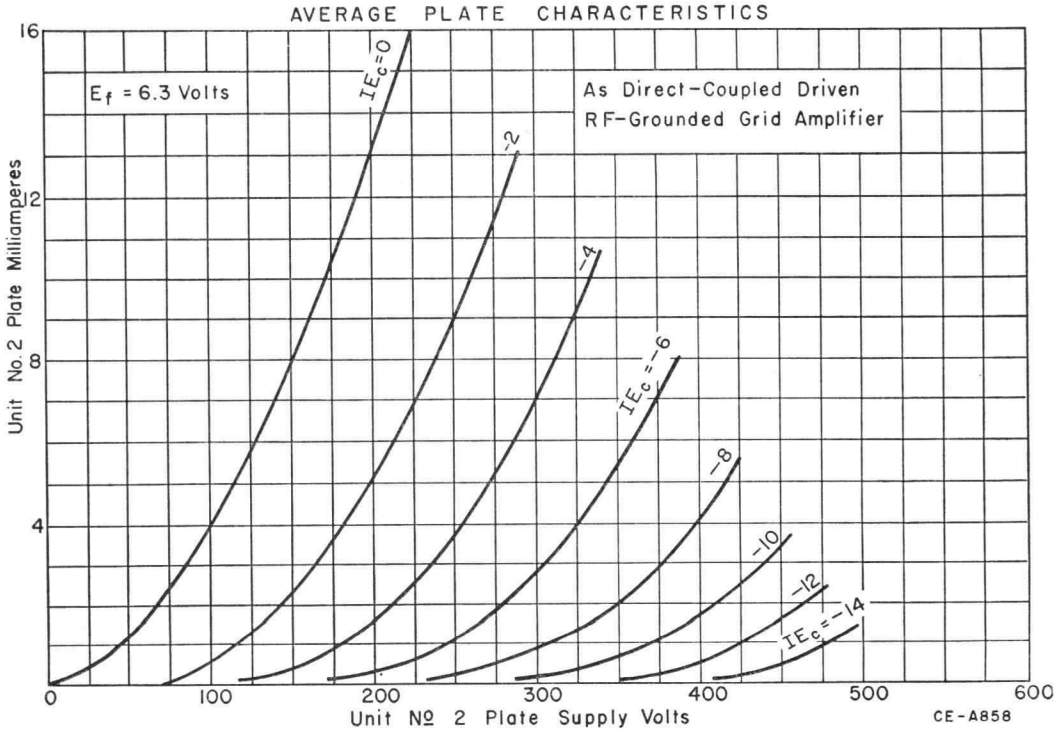
Grid Circuit Resistance ..... .5 max. Megohm



AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



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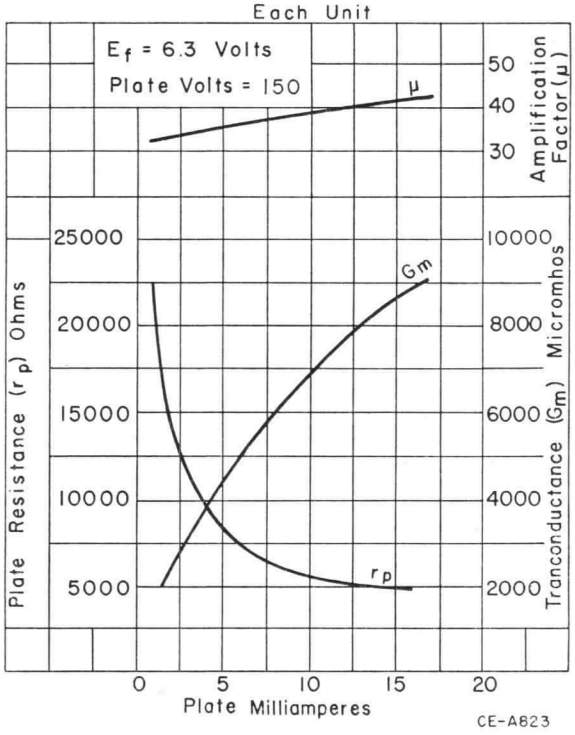
AVERAGE CHARACTERISTICS
Each Unit



May 15, 1958

HIGH FREQUENCY TWIN TRIODE TYPES 4BS8, 5BS8 and 6BS8

The 4BS8, 5BS8 and 6BS8 are 9-pin miniature twin triodes designed for use as low-noise VHF amplifiers in cascode operation. These types have high gain and high cascode transconductance. They are designed for operation with section 2 (pins 1, 2, and 3) as input section of the cascode circuit.

The 4BS8 and 5BS8 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	4BS8	5BS8	6BS8	
Voltage (ac or dc)	4.5	5.6	6.3	Volts
Current	0.6●	0.45●	0.4	Ampere
Warm-Up Time (Approx.)▲	11	11	..	Seconds
Direct Interelectrode Capacitances: (Shielded)*				
	Unit 1	Unit 2		
Grid to Plate	1.15	1.15		uuf
Plate to Cathode	0.15	0.15	max.	uuf
Heater to Cathode	2.60	2.6		uuf
Input	2.60			uuf
Output	1.2			uuf
Plate of Unit 1 to Plate of Unit 2		0.010		uuf
Plate of Unit 2 to Plate and Grid of Unit 1		0.024		uuf
Grounded Grid Operation:				
Input		5.0		uuf
Output		2.2		uuf

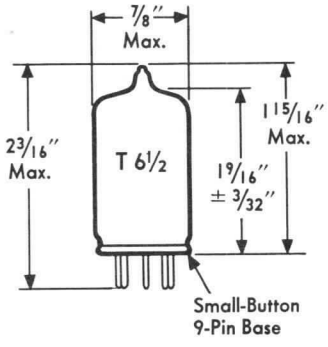
MECHANICAL:

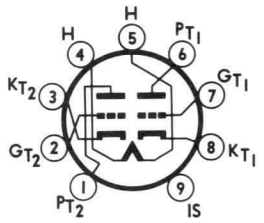
Bulb	T-6-1/2
Base	Miniature 9-Pin (JETEC E9-1)
Outline	6-2
Basing	9AJ
Mounting Position	Any

MAXIMUM RATINGS:

Design-Center Values

Plate Voltage	150 max. Volts
Cathode Current	20 max. Ma.
Plate Dissipation	2.0 max. Watts
Peak Heater-Cathode Voltage:	
Heater Positive with Respect to Cathode	200 max. Volts
Heater Negative with Respect to Cathode	200 max. Volts





9AJ

CLASS A AMPLIFIER

Characteristics: (per unit)

Plate Voltage	150	Volts
Cathode Bias Resistor	220	Ohms
Amplification Factor	36	
Plate Resistance	5000	Ohms
Transconductance	7200	umhos
Plate Current	10	Ma.
Unit 2 Grid Cutoff Voltage□	-7	Volts

CASCODE OPERATION

Characteristics:

Plate Supply Voltage	250	Volts
Grid Voltage	-1	Volts
Plate Current	16	Ma.
Transconductance	10000	umhos
Grid Cutoff Voltage■	-6	Volts

MAXIMUM CIRCUIT VALUE: (Each Unit)

Grid Circuit Resistance	0.5 max. Megohm

● ± 6%

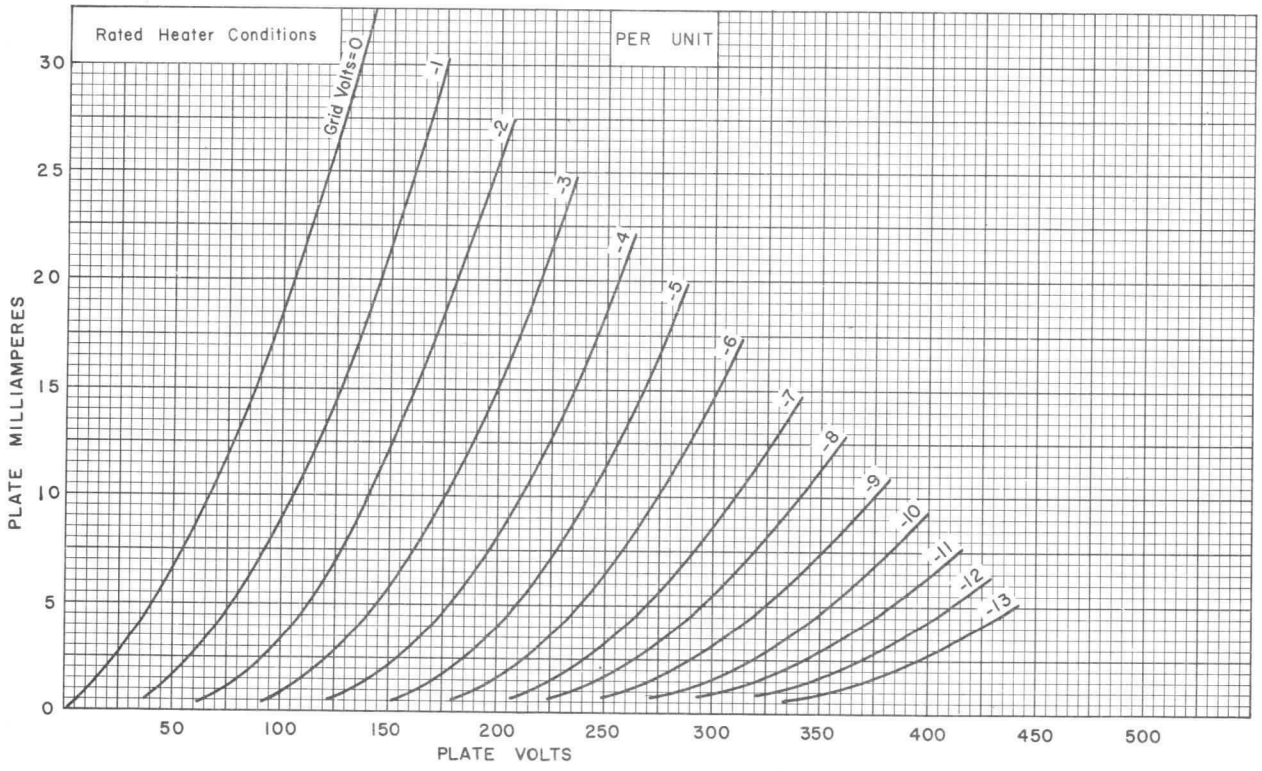
* With external shield JETEC No. 315 connected to ground.

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

□ For plate current of 10 microamperes.

■ For transconductance of 50 umhos.

AVERAGE PLATE CHARACTERISTICS



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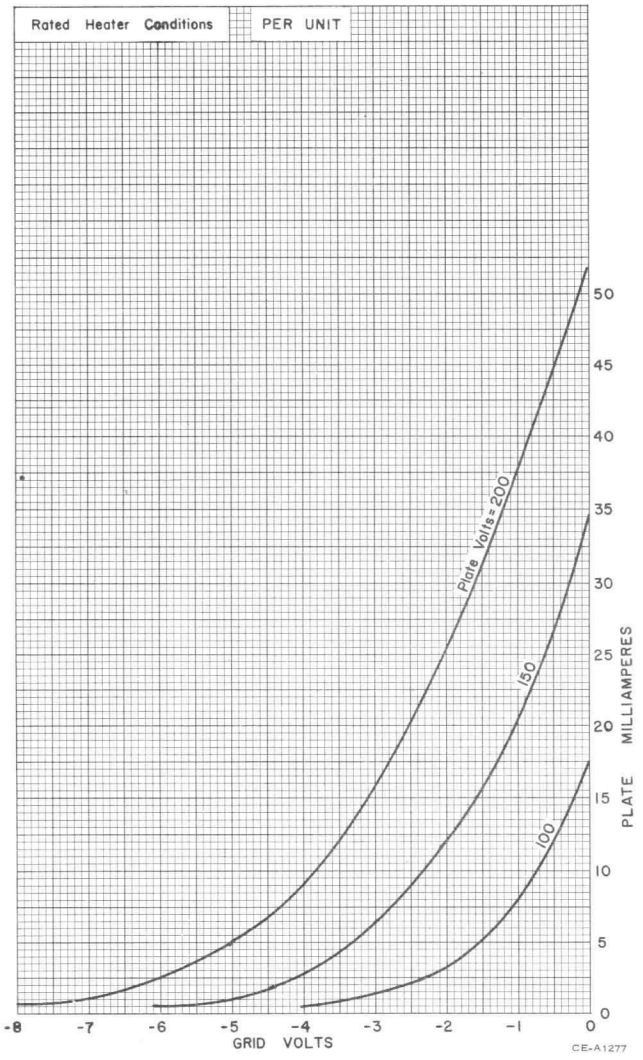
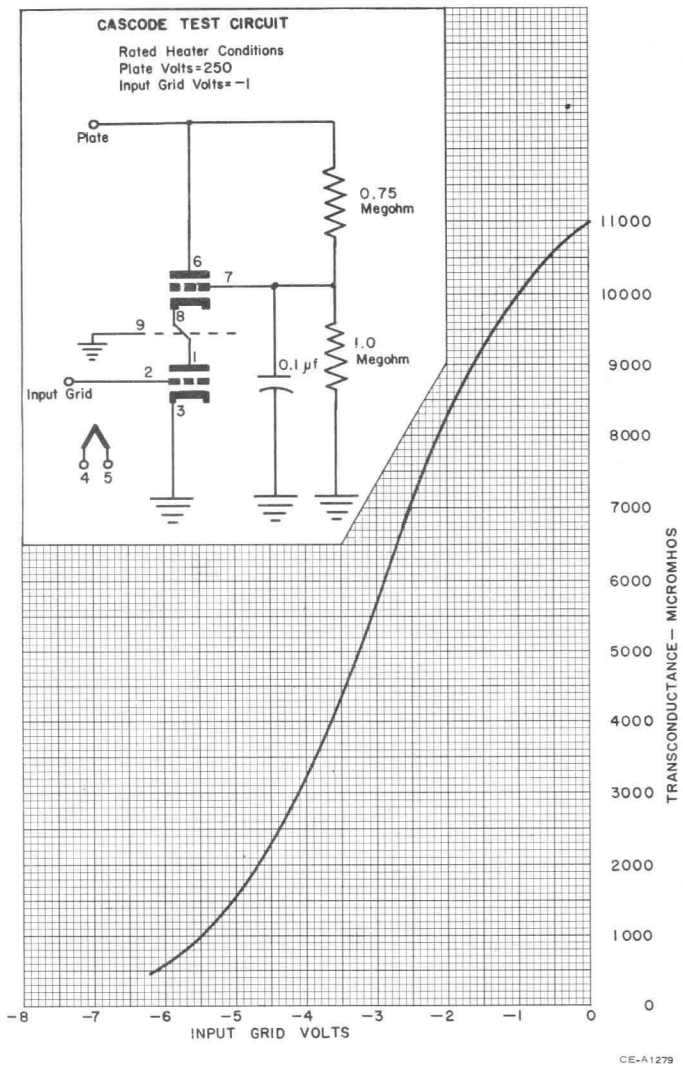
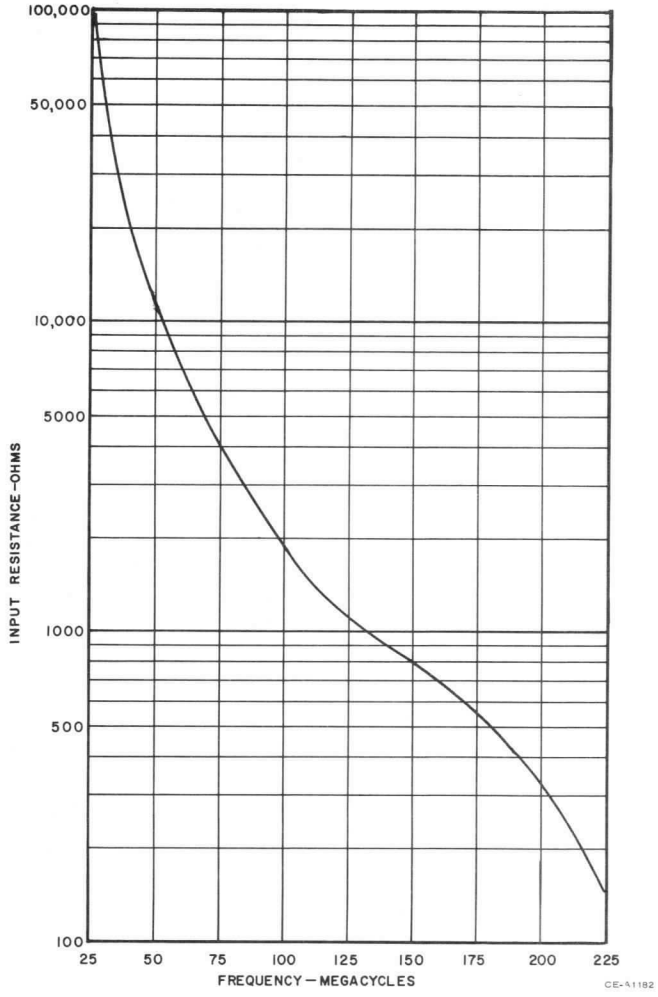
AVERAGE TRANSFER CHARACTERISTICS



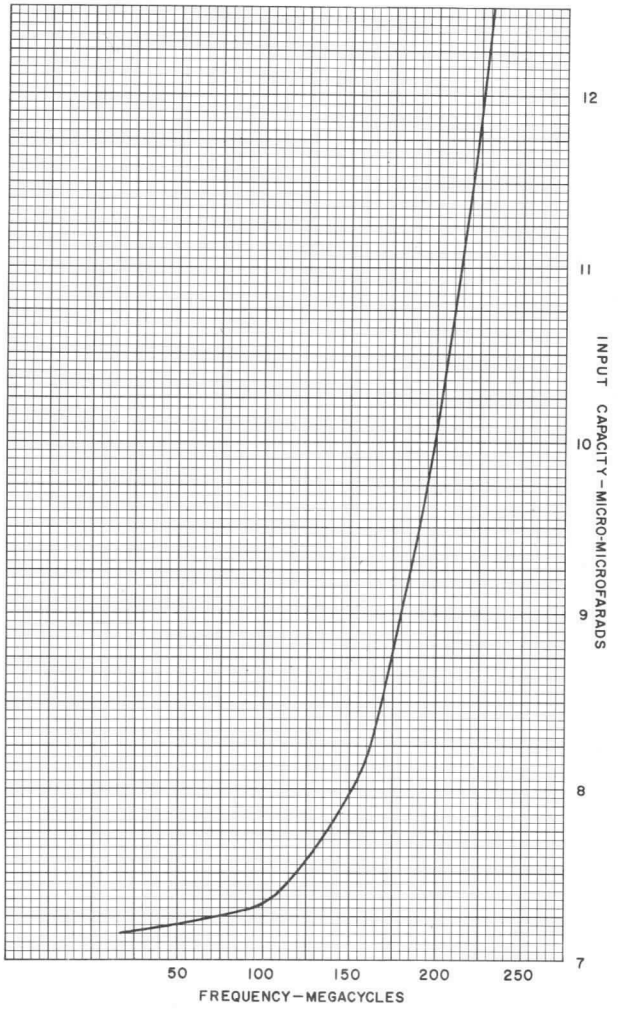
CASCODE TRANSCONDUCTANCE



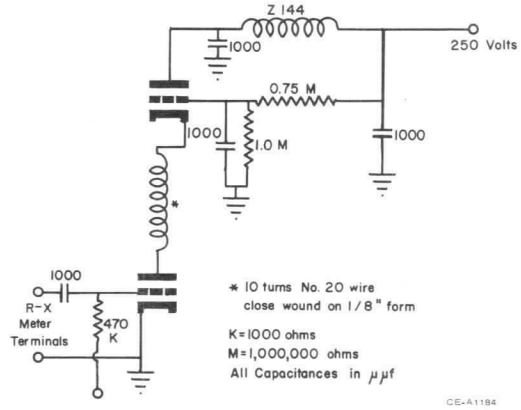
HOT INPUT RESISTANCE



HOT INPUT CAPACITY



CASCODE TEST CIRCUIT
FOR
RESISTANCE AND CAPACITY



The information contained herein is furnished without assuming any obligations. The description and illustration of circuits herein does not convey to the purchaser of tubes any license for circuits under the patent claims of Westinghouse Electric Corporation or others.

TWIN PENTODE TYPES 3BU8, 4BU8 AND 6BU8

The 3BU8, 4BU8 and 6BU8 are 9-pin miniature twin pentode types designed for service as the sync separator and keyed AGC rectifier in television receivers. The units have separate plates and grids 3 and common heater cathode, grid 1 and grid 2. With suitable circuitry, voltages may be applied to grid 1 to suppress noise pulses from both the sync and AGC circuits.

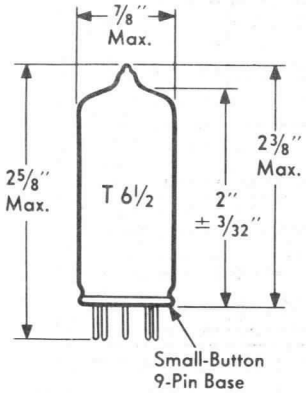
The 3BU8 and 4BU8 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

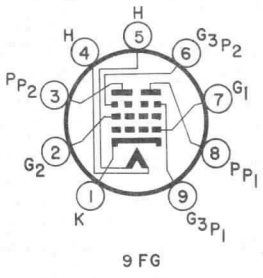
ELECTRICAL:

Cathode			Coated Unipotential	
Heater:	3BU8	4BU8	6BU8	
Voltage (ac or dc)	3.15	4.2	6.3 ± 10%	Volts
Current	0.60 ± 6%	0.45 ± 6%	0.30	Amperes
Warm-Up Time (Note 1)	11	11	--	Seconds
Direct Interelectrode Capacitances: (Unshielded)				
Grid 3 to Plate (Each Unit)			1.9	μμf
Grid 1 to All Other Electrodes			6.0	μμf
Grid 3 (Each Unit) to All Other Electrodes			3.6	μμf
Plate (Each Unit) to All Other Electrodes			3.0	μμf
Grid 3, Unit 1 to Grid 3, Unit 2 (Max.)			0.015	μμf

MECHANICAL:

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-3
Basing	9FG
Mounting Position	Any





9 FG

MAXIMUM RATINGS:

Design Maximum Values (Note 2)			
Plate Voltage	300	max.	Volts
Grid 3 Voltage:			
Positive DC	3.0	max.	Volts
Negative DC	50	max.	Volts
Positive Peak	50	max.	Volts
Grid 2 Voltage	150	max.	Volts
Grid 1 Voltage (Negative DC)	50	max.	Volts
Plate Dissipation (Each Unit)	1.1	max.	Watts
Grid 2 Dissipation	0.75	max.	Watts
DC Cathode Current	12	max.	Ma.
Heater Voltage with respect to Cathode:			
Positive DC Component	100	max.	Volts
Positive DC and Peak	200	max.	Volts
Negative DC and Peak	200	max.	Volts

LIMITING CIRCUIT VALUES:

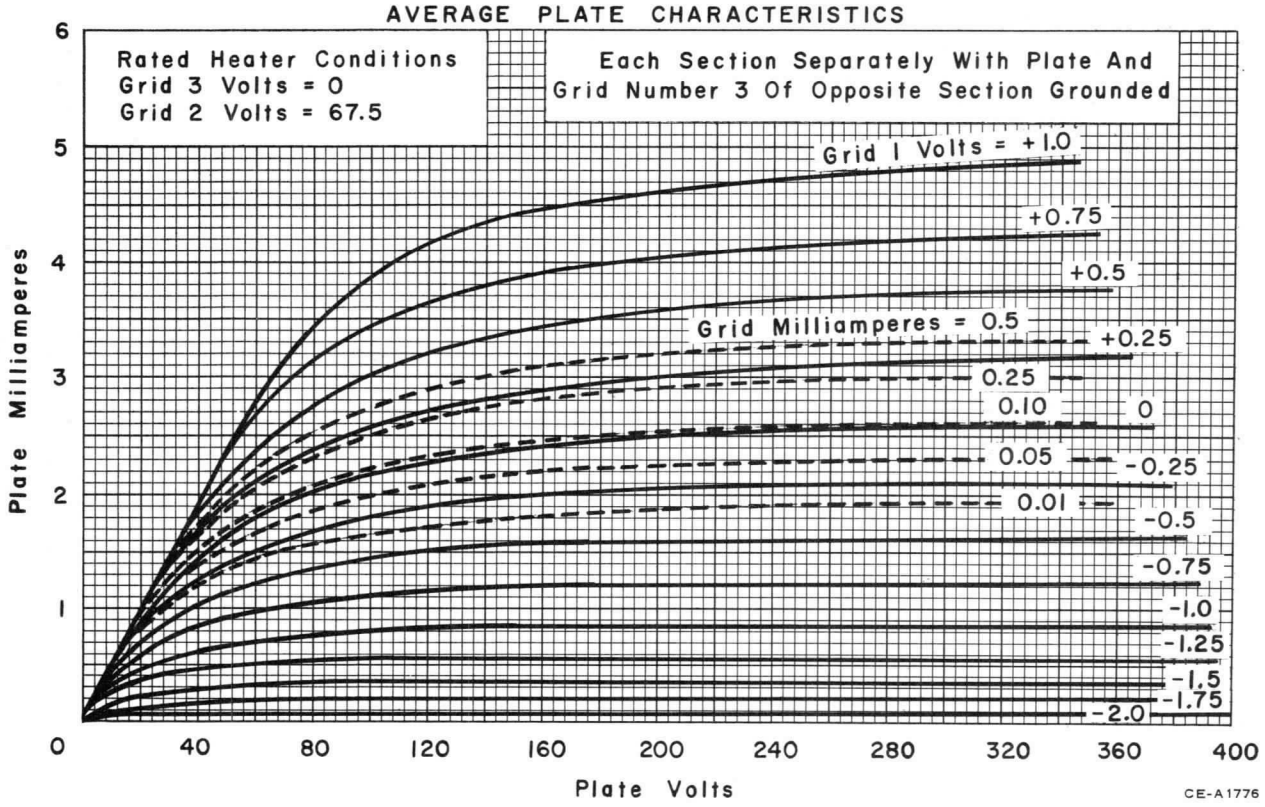
Grid 1 Circuit Resistance	0.5	max.	Megohms
Grid 3 Circuit Resistance (Each Unit)	0.5	max.	Megohms

TYPICAL OPERATING CHARACTERISTICS:

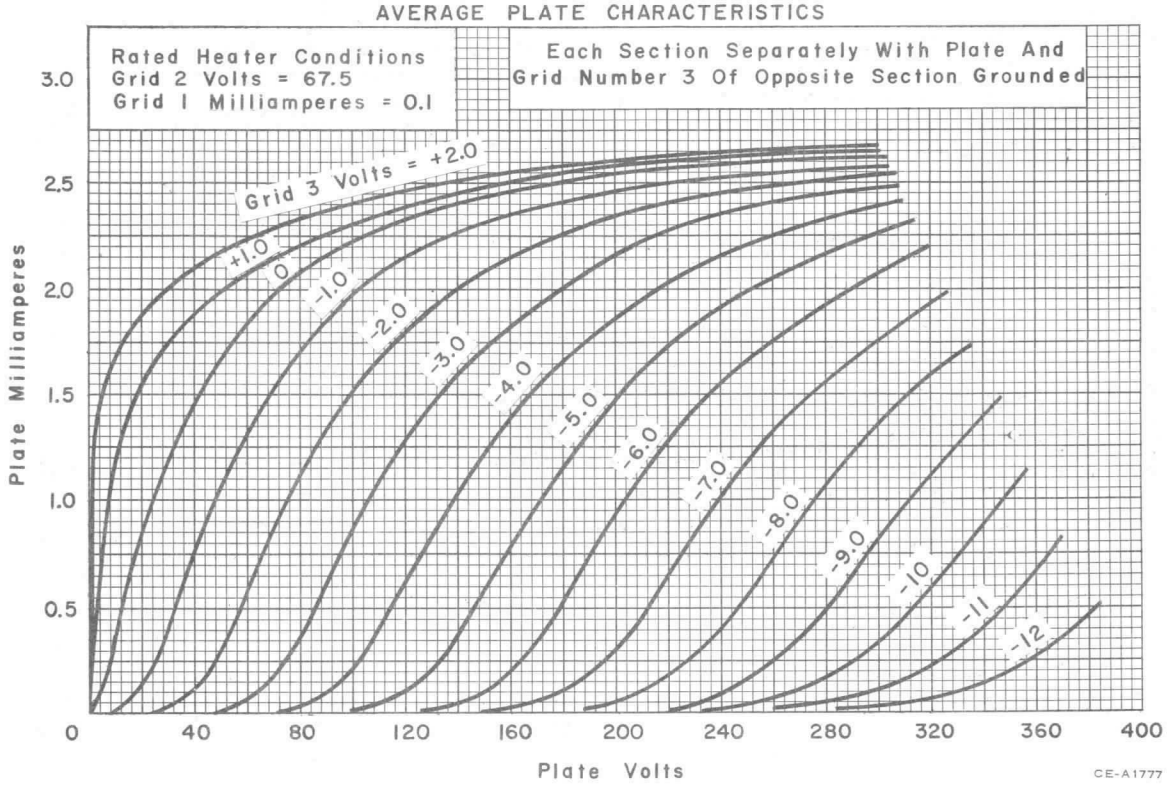
Both Units Operating			
Plate Voltage	100	100	Volts
Grid 3 Voltage	-10	0	Volts
Grid 2 Voltage	67.5	67.5	Volts
Grid 1 Voltage (Note 3)	--	--	Volts
Plate Current (Each Unit)	--	2.2	Ma.
Grid 2 Current	6.5	3.3	Ma.
Cathode Current	6.6	7.8	Ma.
Each Unit Operating (Note 4)			
Plate Voltage	100	100	Volts
Grid 3 Voltage	0	0	Volts
Grid 2 Voltage	67.5	67.5	Volts
Grid 1 Voltage	0	(Note 3)	Volts
Grid 3 Transconductance	--	180	μmhos
Grid 1 Transconductance	1500	--	μmhos
Plate Current	--	2.2	Ma.
Grid 3 Cutoff Voltage (Note 5)	--	-4.5	Volts
Grid 1 Cutoff Voltage (Note 5)	--	-2.3	Volts

NOTES

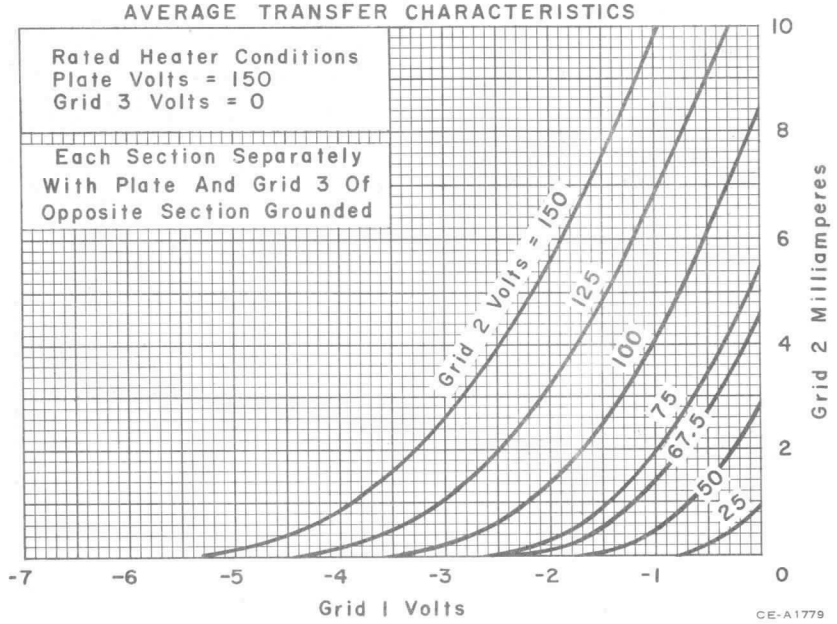
1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions. The tube manufacturer chooses these values to provide acceptable serviceability of the tube, talking responsibility for the effects of changes in operating conditions due to variations in tube characteristics. The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation, signal variation, and environmental conditions.
3. For grid 1 current of 100 microamperes.
4. With Plate and Grid 3 of other unit grounded.
5. For Plate current of 100 microamperes.



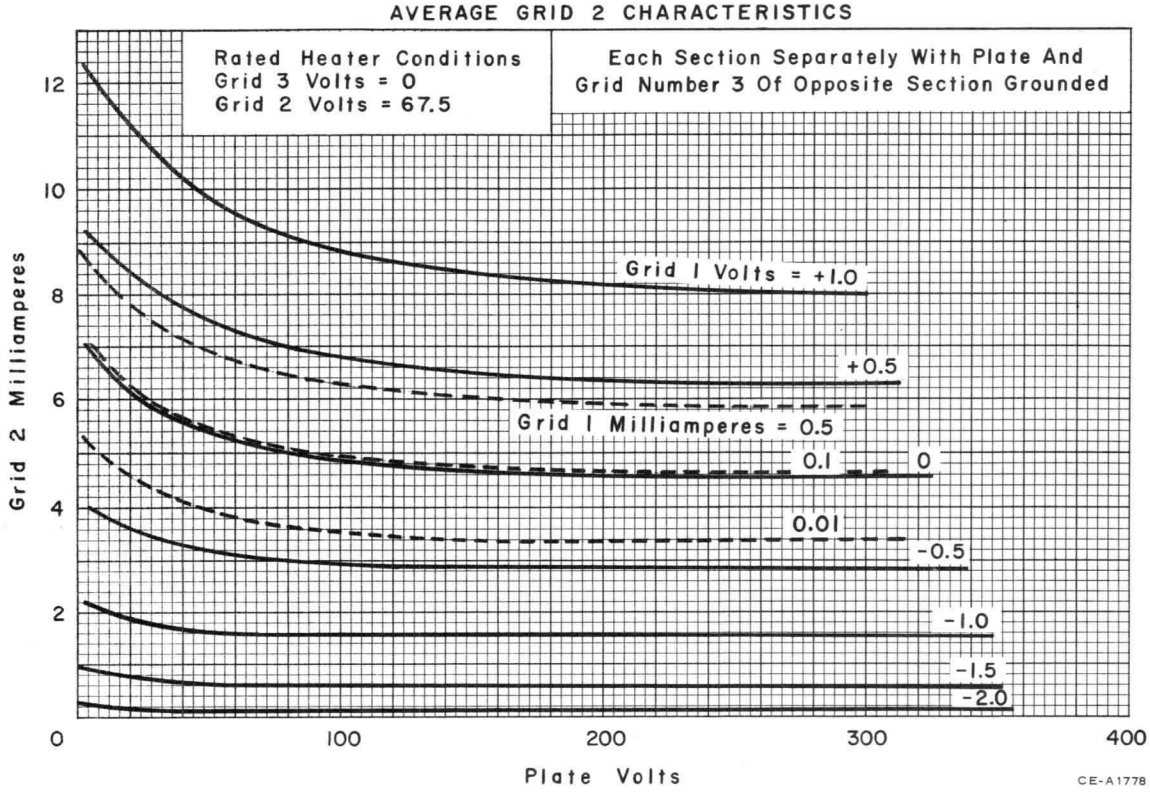
AVERAGE PLATE CHARACTERISTICS



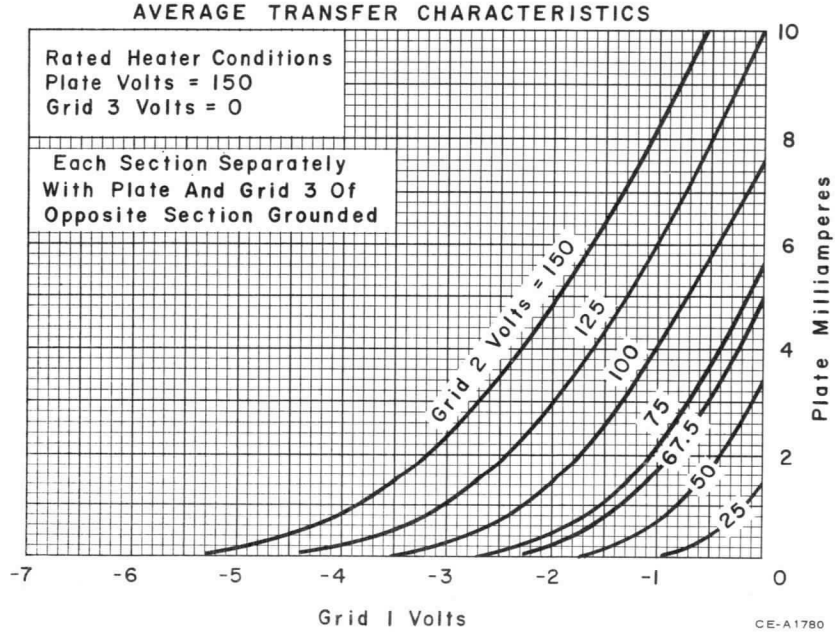
AVERAGE TRANSFER CHARACTERISTICS

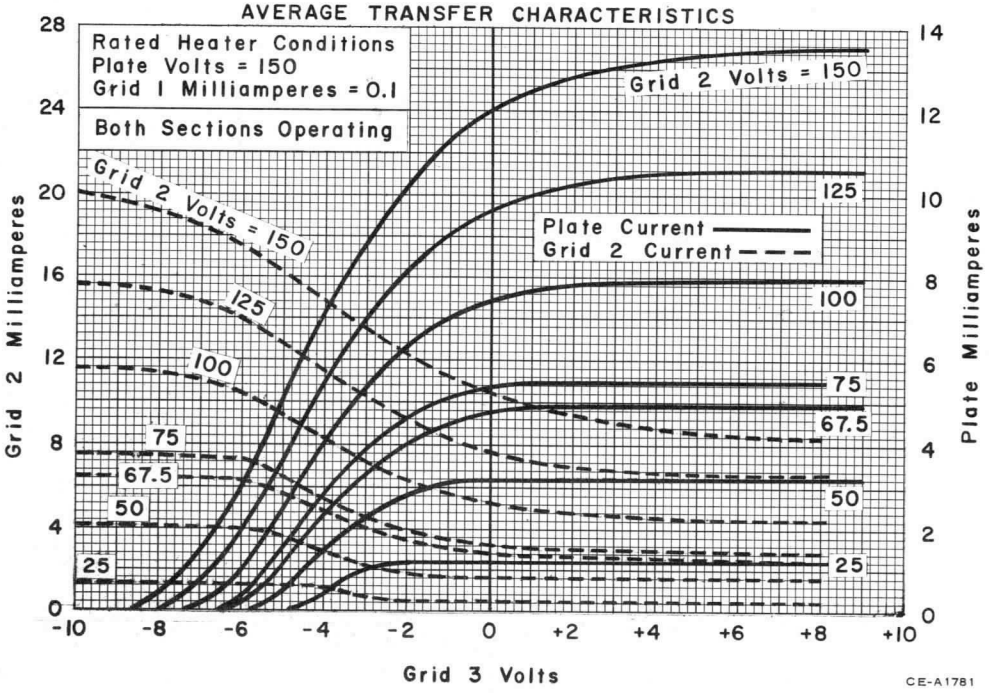


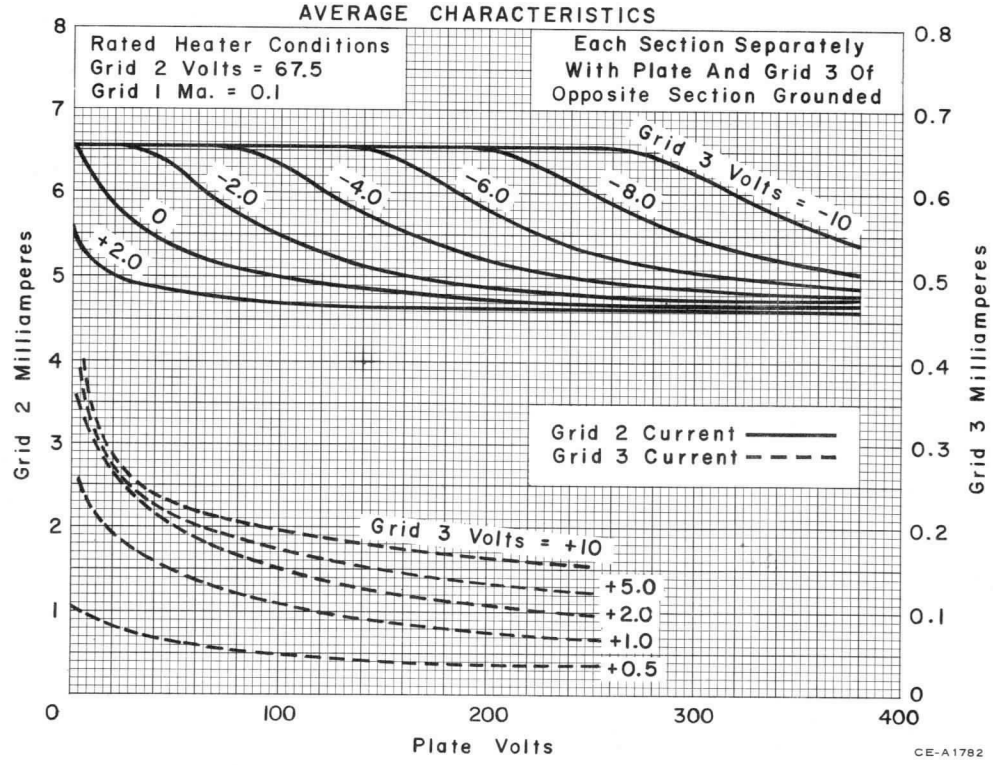
AVERAGE GRID 2 CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS




AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 150
Grid 1 Milliamperes = 0.1
Both Sections Operating
Plate Current
Grid 2 Current
Grid 2 Volts = 150
125
100
75
67.5
50
25
Grid 2 Milliamperes
Plate Milliamperes
Grid 3 Volts
CE-A1781


AVERAGE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 67.5
Grid 1 Ma. = 0.1
Each Section Separately
With Plate And Grid 3 Of
Opposite Section Grounded
Grid 2 Current
Grid 3 Current
Grid 3 Volts = -10
-8.0
-6.0
-4.0
-2.0
0
+2.0
Grid 3 Volts = +10
+5.0
+2.0
+1.0
+0.5
Grid 2 Milliamperes
Grid 3 Milliamperes
Plate Volts
CE-A1782

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HIGH-TRANSCONDUCTANCE PENTODE TYPE 12BV7

The 12BV7 is a high-transconductance pentode type designed for service as video amplifier. This type is capable of supplying large output voltage across a low value of load resistance with a low supply voltage.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage	12.6	6.3	Volts
Current	0.3	0.6	Ampere
Direct Interelectrode Capacitances (Unshielded):			
Grid to Plate	0.055		μμf
Input	11.0		μμf
Output	3.0		μμf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-pin (JEDEC E9-1)
Outline	6-3
Basing	9BF
Mounting Position	Any

DESIGN-CENTER VALUES

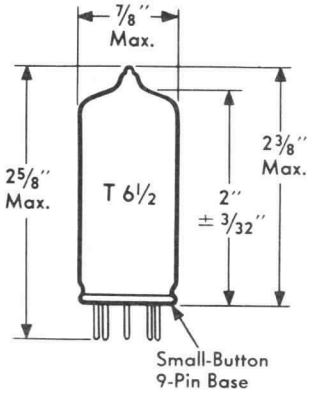
Plate Voltage	300	max.	Volts
Screen Voltage	175	max.	Volts
Plate Dissipation	6.25	max.	Watts
Screen Dissipation	1.0	max.	Watt
Control Grid Resistance:			
Fixed Bias	0.25	max.	Megohm
Cathode Bias	1.0	max.	Megohm
Control Grid Voltage:			
Negative	50	max.	Volts
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

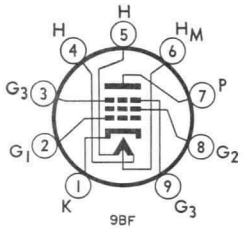
CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	250	Volts
Screen Voltage	150	Volts
Cathode Bias Resistor	68	Ohms
Transconductance	13000	μmhos
Plate Resistance	85000	Ohms
Grid 1 Cutoff Voltage (Note 1)	−12	Volts
Plate Current	27	Ma.
Screen Current	6.0	Ma.
Amplification Factor (Triode Connected)	28	–

NOTE

1. For plate current of 20 microamperes.





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HIGH-TRANSCONDUCTANCE PENTODE TYPES 12BY7 AND 12BY7-A

The 12BY7 and 12BY7-A are high-transconductance pentode types designed for service as video amplifiers. These types are capable of supplying large output voltages across low values of load resistance with low supply voltages.

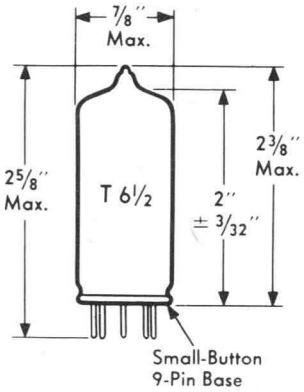
The 12BY7-A has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

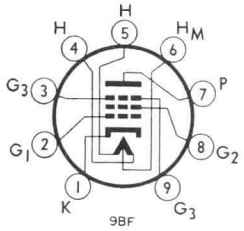
ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage	12.6	6.3	Volts
Current	0.3	0.6	Ampere
Warm-up Time (Approx.)♦	--	11	Seconds
Direct Interelectrode Capacitances (Unshielded):			
Grid to Plate		0.063	μμf
Input		10.2	μμf
Output		3.5	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-pin (JEDEC E9-1)
Outline	6-3
Basing	9BF
Mounting Position	Any





DESIGN-CENTER VALUES

Plate Voltage	300	max.	Volts
Screen Voltage	180	max.	Volts
Plate Dissipation	6.5	max.	Watts
Screen Dissipation	1.1	max.	Watt
Control Grid Resistance:			
Fixed Bias	.25	max.	Megohm
Cathode Bias	1.0	max.	Megohm
Control Grid Voltage:			
Negative	50	max.	Volts
Positive	0	max.	Volts
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	250	Volts
Screen Voltage	180	Volts
Cathode Bias Resistor	100	Ohms
Transconductance	11000	μmhos
Plate Resistance	93000	Ohms
Grid 1 Cutoff Voltage⊕	-11.6	Volts
Plate Current	26	Ma.
Screen Current	5.75	Ma.
Amplification Factor (Triode Connected)	28.5	
Amplification Factor	1035	

♦ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

⊕ For plate current of 20 microamperes.

May 24, 1957

SEMI-REMOTE CUTOFF PENTODE TYPES 3BZ6, 4BZ6, AND 6BZ6

The 3BZ6, 4BZ6, and 6BZ6 are 7-pin miniature semi-remote-cutoff pentodes designed for service as intermediate frequency amplifiers in television receivers. They are characterized by high transconductance and low interelectrode capacitances which permit them to perform well as wide band, high frequency amplifiers. In addition, they feature a cutoff characteristic designed to operate the tube without distortion over a wide range of input signal amplitudes.

The 3BZ6 and 4BZ6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:

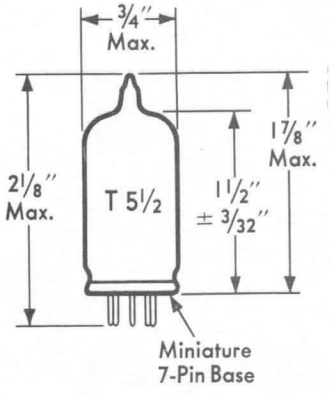
Cathode			Coated Unipotential	
Heater	3BZ6	4BZ6	6BZ6	
Voltage (ac or dc)	3.15	4.2	6.3	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time ▲	11	11	...	Seconds

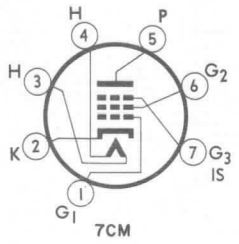
Direct Interelectrode Capacitances:

	Shielded ♦	Unshielded	
Grid 1 to Plate	0.015	0.025	uuf
Input	7.0	7.0	uuf
Output	3.0	2.0	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any





MAXIMUM RATINGS:

Design Maximum Values

Plate Voltage	330 max. Volts
Grid 2 Supply Voltage	330 max. Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve
Plate Dissipation	2.3 max. Watts
Grid 2 Dissipation	0.55 max. Watts
Grid 1 Voltage	
Positive Value	0 max. Volts
Heater-Cathode Voltage	
Heater Negative with Respect to Cathode:	
Total DC and Peak	200 max. Volts
Heater Positive with Respect to Cathode:	
DC Component	100 max. Volts
Total DC and Peak	200 max. Volts

TYPICAL OPERATION AND CHARACTERISTICS

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to Cathode at Socket	
Grid 2 Voltage	125	Volts
Cathode Bias Resistor	56	Ohms
Plate Resistance	0.26	Megohm
Transconductance	8000	umhos
Plate Current	14	Ma.
Grid 2 Current	3.6	Ma.
Grid 1 Cutoff Bias*	-19	Volts

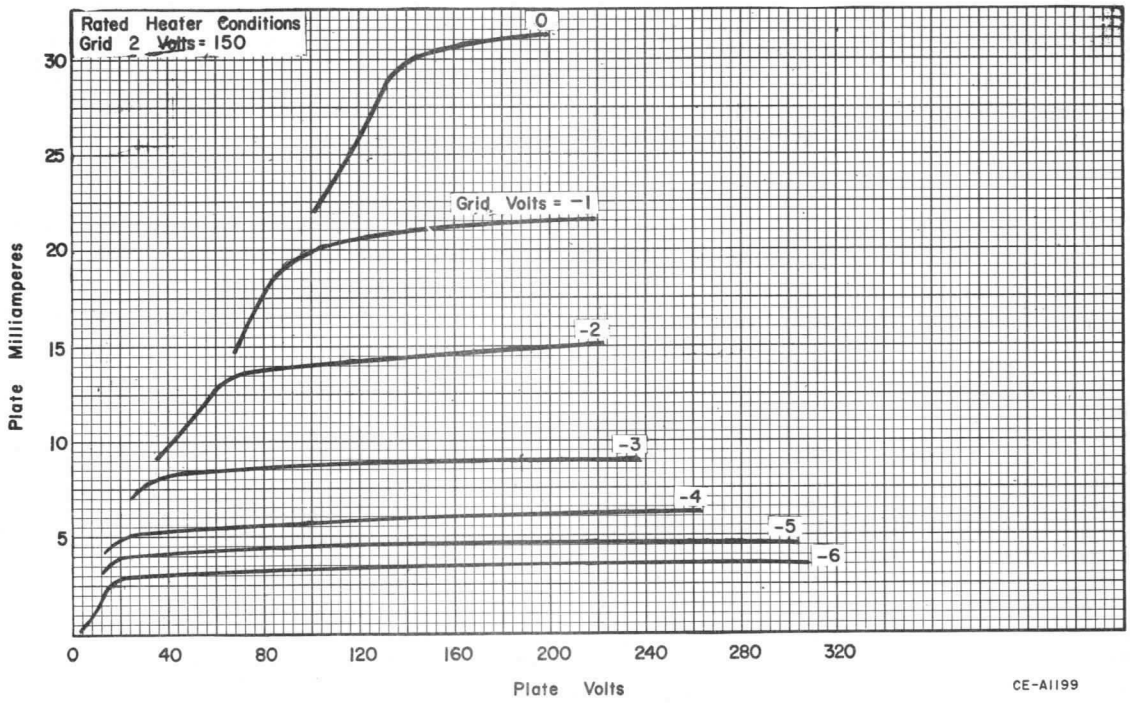
NOTES

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a curcuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

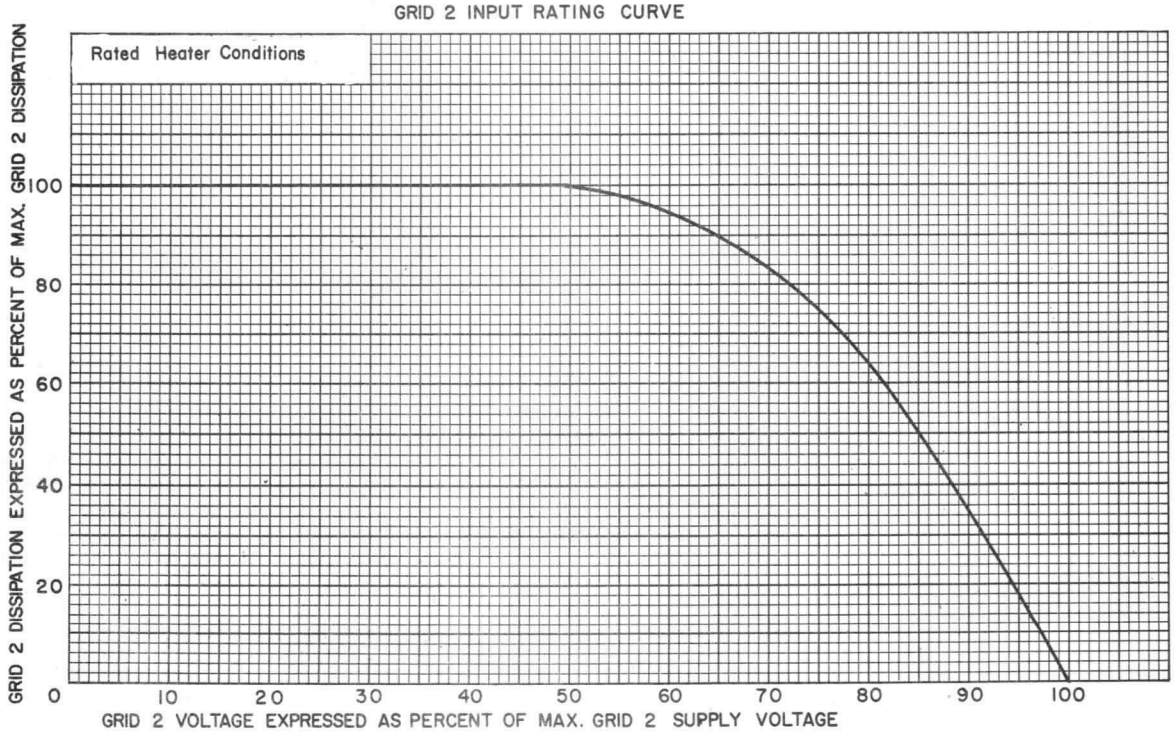
* For transconductance of 50 umho.

♦ JETEC Shield No. 316 connected to cathode.

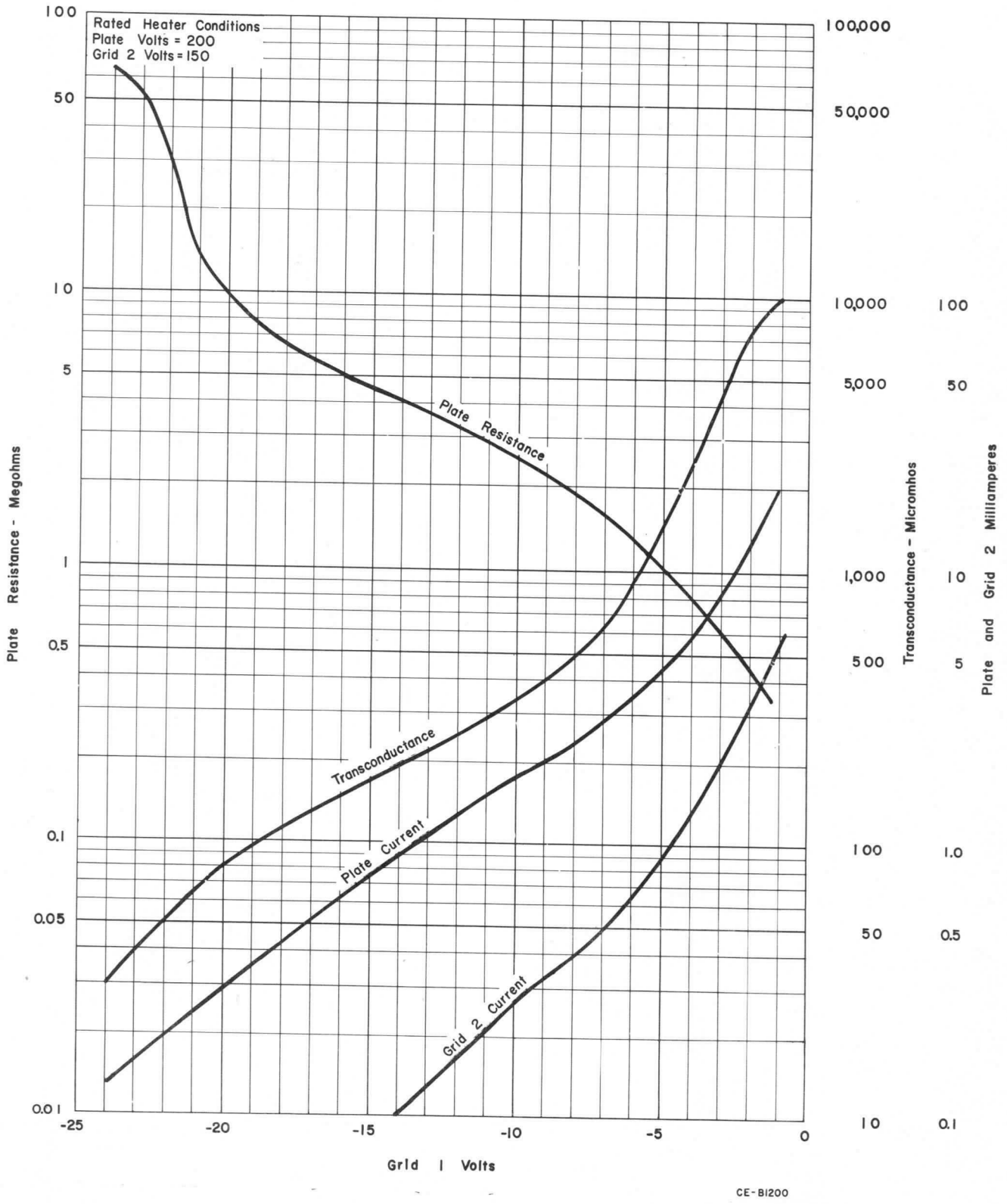
AVERAGE PLATE CHARACTERISTICS



GRID 2 INPUT RATING CURVE



AVERAGE TRANSFER CHARACTERISTICS



CE-81200

January 27, 1958

MEDIUM-MU TWIN TRIODE TYPES 4BZ7 AND 6BZ7

The 4BZ7 and 6BZ7 are 9-pin miniature twin-triode types designed for service as low-noise VHF amplifiers, particularly in cascode operation. These types have higher gain and higher mutual conductance than the 6BQ7-A and are otherwise similar.

The 4BZ7 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

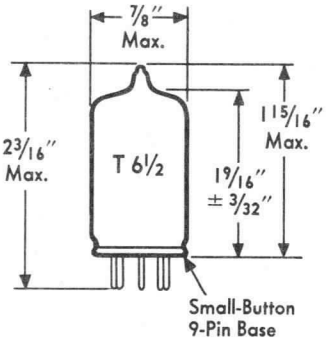
GENERAL DATA

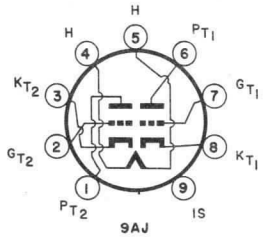
ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	4BZ7	6BZ6	
Voltage (ac or dc)	4.2	6.3	Volts
Current	0.6	0.4	Ampere
Warm-up Time (Approx.) ▲	11	..	Seconds
Direct Interelectrode Capacitances: (Shielded) ♦	Unit 1	Unit 2	
Grid to Plate	1.2	1.15	uuf
Plate to Cathode	0.12	0.15	uuf
Heater to Cathode	2.60	2.70	uuf
Input	2.6	5.0□	uuf
Output	1.2	2.2□	uuf
Plate of Unit 1 to Plate of Unit 2		0.010 max.	uuf
Plate of Unit 2 to Plate and Grid of Unit 1		0.024 max.	uuf

MECHANICAL:

Bulb	T-6-1/2
Base	Miniature 9-Pin (JETEC E9-1)
Outline	6-2
Basing	9AJ
Mounting Position	Any





AMPLIFIER - CLASS A

Each Unit

MAXIMUM RATINGS:

Design-Center Values

DC Plate Voltage	250 max.	Volts
DC Cathode Current	20 max.	Ma.
Plate Dissipation	2.0 max.	Watts
Peak Heater-Cathode Voltage:		
Heater Positive with Respect to Cathode	200♦ max.	Volts
Heater Negative with Respect to Cathode	200 max.	Volts
Maximum Circuit Value: (Each Unit)		
Grid Circuit Resistance	0.5 max.	Megohm

CHARACTERISTICS:

Plate Voltage	150	Volts
Cathode Bias Resistor	220	Ohms
Amplification Factor	36	
Plate Resistance	5300	Ohms
Plate Current	10	Ma.
Grid Voltage (Approx.) for I_b = 600 ua	-7.0	Volts
Transconductance	6800	umhos

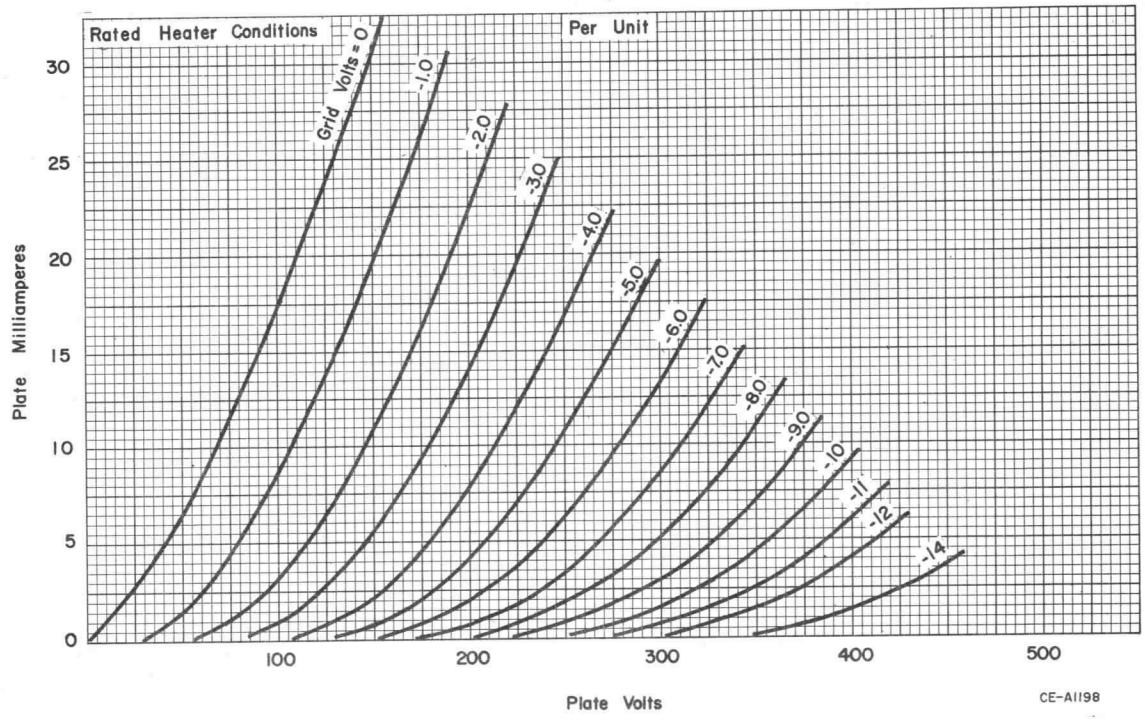
□ Read as grounded grid amplifier

♦ D.C. only 100 volts.

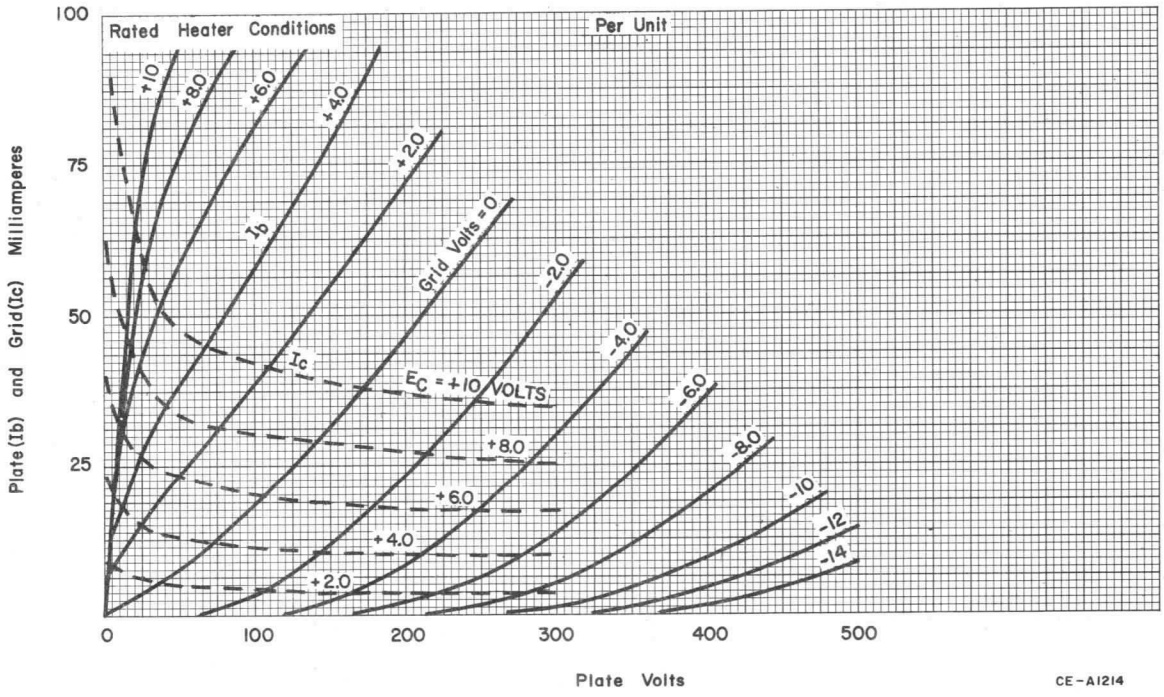
♦ With JETEC shield No. 315 connected to pin 9.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

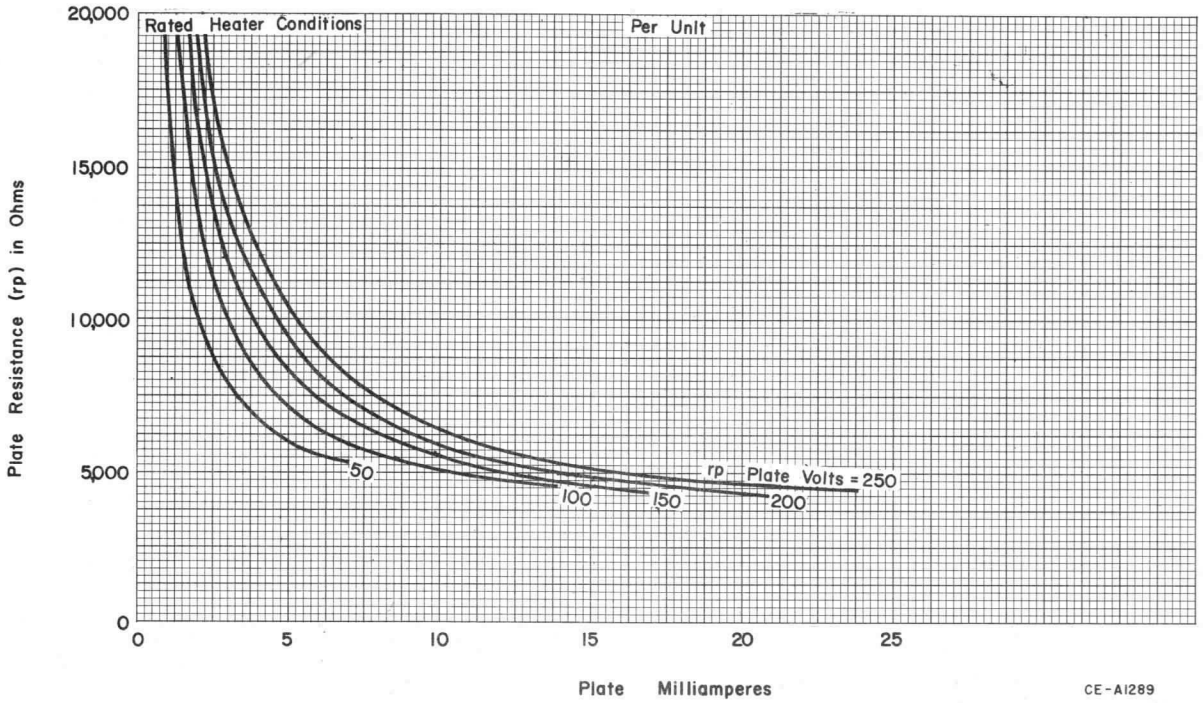
AVERAGE PLATE CHARACTERISTICS



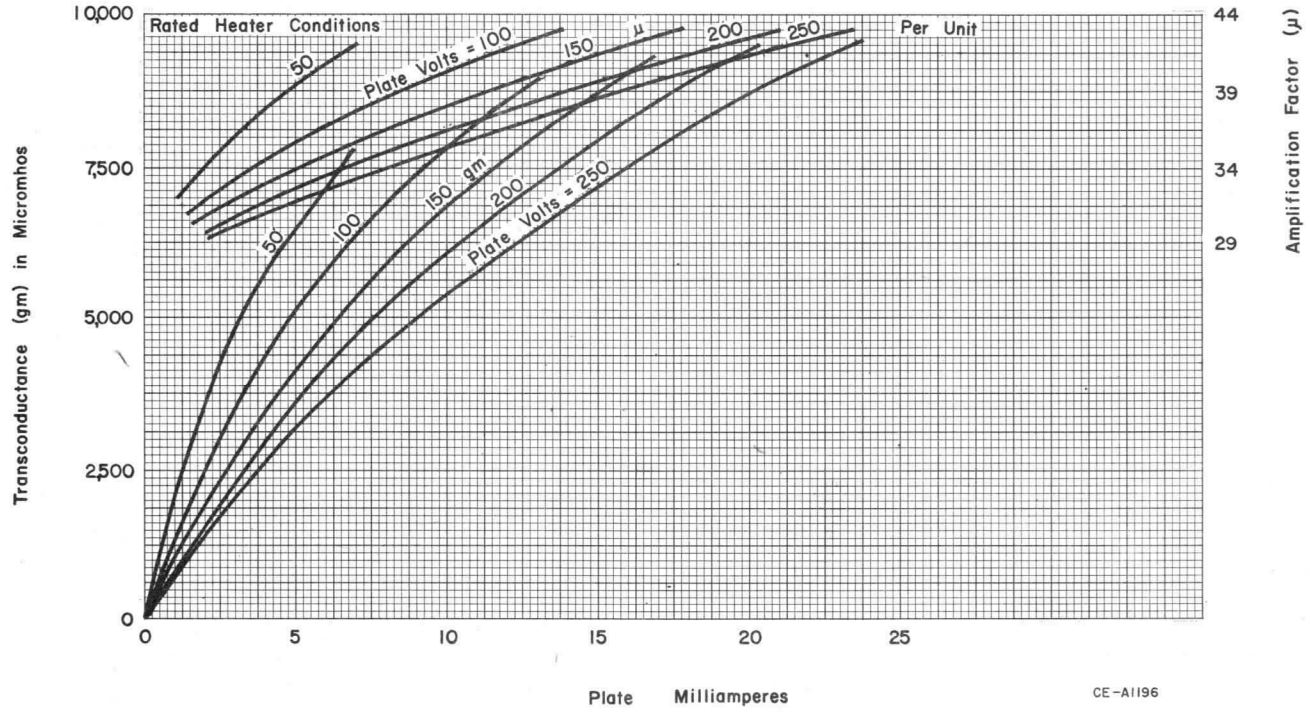
AVERAGE PLATE CHARACTERISTICS



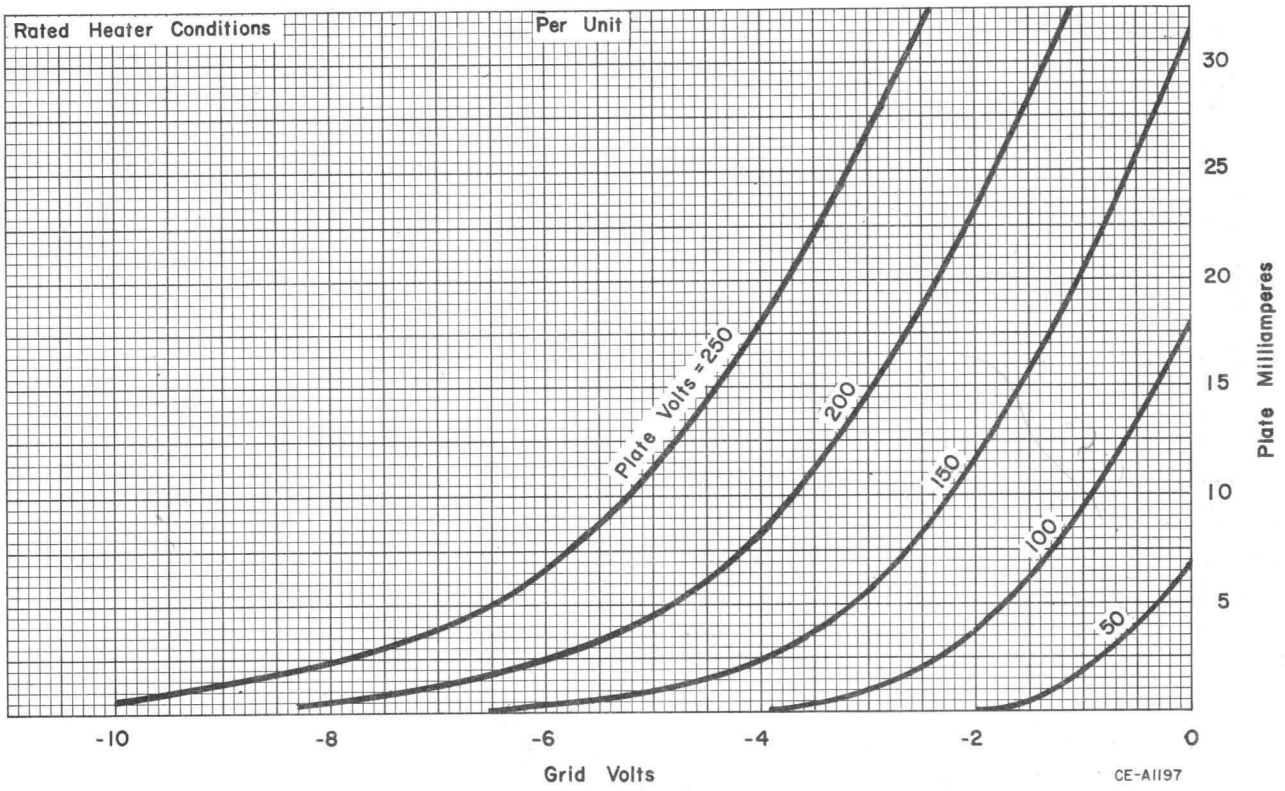
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AUDIO-OUTPUT BEAM-POWER AMPLIFIER TYPES
6CU5, 12C5, 12CU5, 17CU5, 25C5 and 50C5

The 6CU5, 12C5, 12CU5, 17CU5, 25C5 and 50C5 are 7-pin miniature beam-power pentode types designed for service as the audio output amplifier tube in amplitude-modulated, frequency-modulated and television receivers. These types are characterized by high power sensitivity and high plate efficiency at the comparatively low plate and grid 2 voltage normally available in power-transformerless receivers.

The 12C5, 12CU5 and 17CU5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:

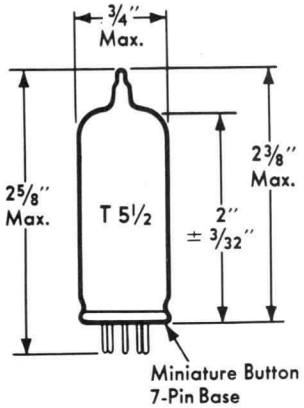
Cathode				Coated Unipotential		
Heater:	6CU5	12C5 12CU5	17CU5	25C5	50C5	
Voltage (ac or dc)	6.3	12.6	16.8	25.0	50.0	Volts
Current	1.2	0.60♦	0.45♦	0.30	0.15	Ampere
Warm-up Time (Approx.)▲	-	11	11	..	..	Seconds

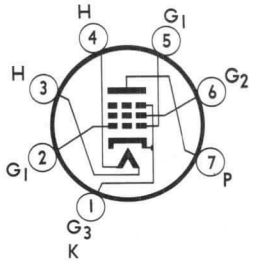
Direct Interelectrode Capacitances (Unshielded):

Grid 1 to Plate	0.6	μμf
Input	13	μμf
Output	8.5	μμf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





7CV

AF POWER AMPLIFIER - CLASS A

MAXIMUM RATINGS:

Design-Center Values

Plate Voltage	135 max.	Volts
Grid 2 (Screen) Voltage	117 max.	Volts
Plate Dissipation	6.0 max.	Watts
Grid 2 Dissipation	1.25 max.	Watts
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
DC + Peak	200 max.	Volts
Bulb Temperature at Hottest Point on Bulb Surface*	220 max.	°C
Grid 1 Circuit Resistance:		
Cathode Bias Operation	0.5 max.	Megohm
Fixed Bias Operation	0.1 max.	Megohm

TYPICAL OPERATION AND CHARACTERISTICS:

Plate Voltage	120	Volts
Grid 2 Voltage	110	Volts
Grid 1 (Control Grid) Voltage	-8.0	Volts
Peak AF Grid 1 Voltage	8.0	Volts
Plate Resistance (Approx.)	10000	Ohms
Transconductance	7500	umhos
Zero Signal Plate Current	49	Ma.
Max. Signal Plate Current	50	Ma.
Zero Signal Grid 2 Current	4	Ma.
Max. Signal Grid 2 Current	8.5	Ma.
Load Resistance	2500	Ohms
Total Harmonic Distortion	10	Per Cent
Max. Signal Power Output	2.3	Watts

* High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

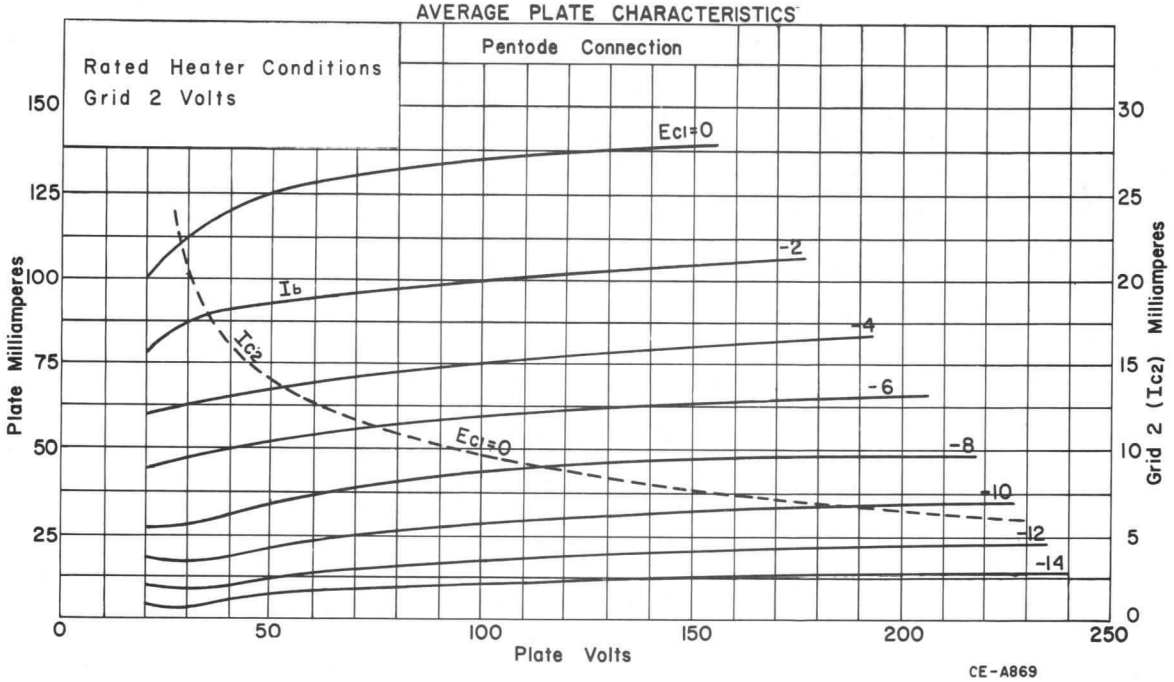
▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

♦ ± 6%

Supersedes 12C5 Sheet Dated October 15, 1954 and 50C5 Sheet Dated July 1, 1954

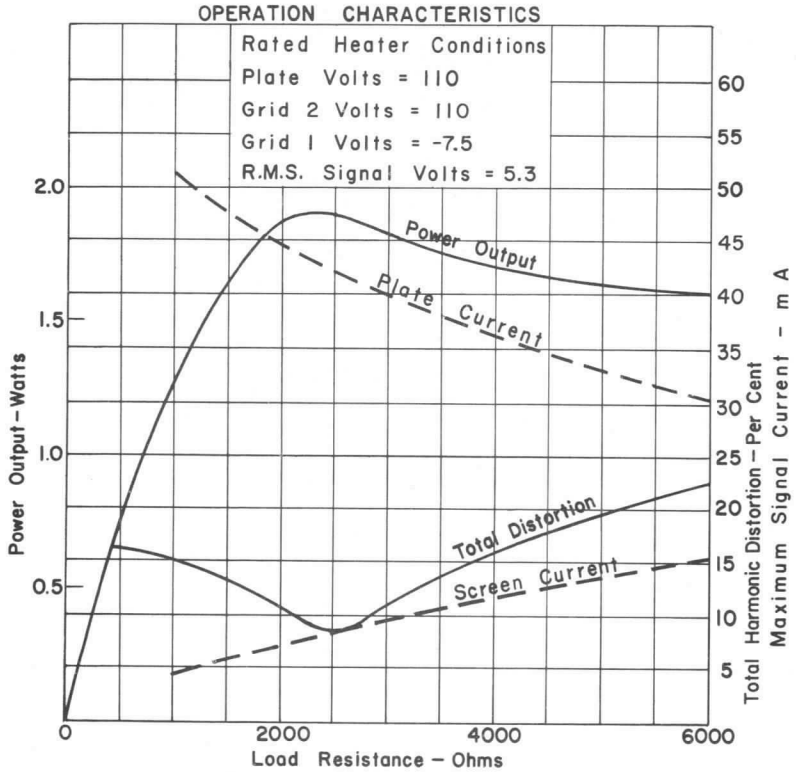
Receiving Tube Section

AVERAGE PLATE CHARACTERISTICS



CE-A869

OPERATION CHARACTERISTICS



CE-A868

AUDIO-OUTPUT BEAM-POWER AMPLIFIER TYPE 35C5

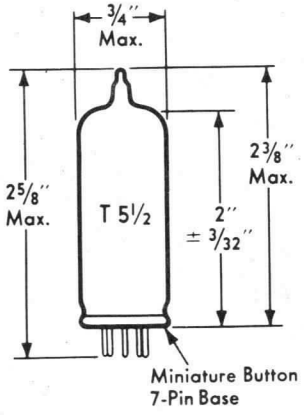
The 35C5 is a 7-pin miniature beam-power pentode type designed for service as the audio output amplifier tube in amplitude-modulated and frequency-modulated receivers and in record players. These types are characterized by high power sensitivity and high plate efficiency at the comparatively low plate and grid 2 voltage normally available in power-transformerless receivers.

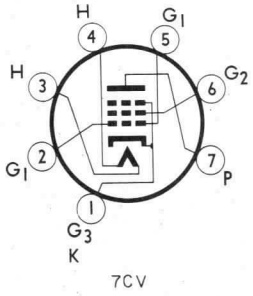
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	35.0	Volts
Current	0.15	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.6	pf
Input	12	pf
Output	9	pf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





MAXIMUM RATINGS

Design-Maximum Values

Plate Voltage	150 max.	Volts
Grid 2 (Screen) Voltage	130 max.	Volts
Plate Dissipation	5.2 max.	Watts
Grid 2 Dissipation	1.1 max.	Watts
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
DC + Peak	200 max.	Volts
Bulb Temperature at Hottest Point on Bulb Surface (Note 1)	250 max.	°C
Grid 1 Circuit Resistance:		
Cathode Bias Operation	0.5 max.	Megohm
Fixed Bias Operation	0.1 max.	Megohm

TYPICAL OPERATION AND CHARACTERISTICS

Plate Voltage	110	Volts
Grid 2 Voltage	110	Volts
Grid 1 (Control Grid) Voltage	−7.5	Volts
Peak AF Grid 1 Voltage	7.5	Volts
Plate Resistance (Approx.)	13000	Ohms
Transconductance	5800	μmhos
Zero Signal Plate Current	40	Ma.
Max. Signal Plate Current	41	Ma.
Zero Signal Grid 2 Current	3	Ma.
Max. Signal Grid 2 Current	7	Ma.
Load Resistance	2500	Ohms
Total Harmonic Distortion	10	Percent
Max. Signal Power Output	1.5	Watts

NOTE

1. High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

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March 1, 1960

SHARP-CUTOFF PENTODE TYPES 3CB6, 4CB6 AND 6CB6

The 3CB6, 4CB6 and 6CB6 are 7-pin miniature sharp-cutoff pentode types designed for service as wide-band radio-frequency or intermediate-frequency amplifiers in television receivers. They feature very high transconductance combined with low interelectrode capacitance values. Separate pins are provided for grid 3 and the cathode to permit the use of an unbypassed cathode resistor to minimize the effects of regeneration.

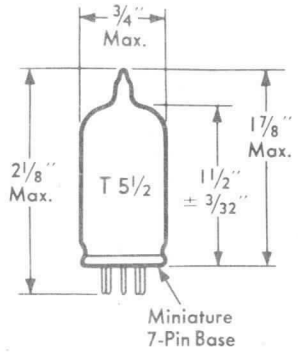
The 3CB6 and 4CB6 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

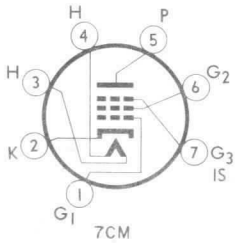
ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	3CB6	4CB6	6CB6	
Voltage (ac or dc)	3.15	4.2	6.3	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time▲	11	11	--	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid 1 to Plate	0.025	max.		μμf
Input	6.5			μμf
Output	2.0			μμf

MECHANICAL:

Bulb	T-5½
Base	Miniature, 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	330	max.	Volts
Grid 2 Supply Voltage	330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.3	max.	Watts
Grid 2 Input	0.55	max.	Watt
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

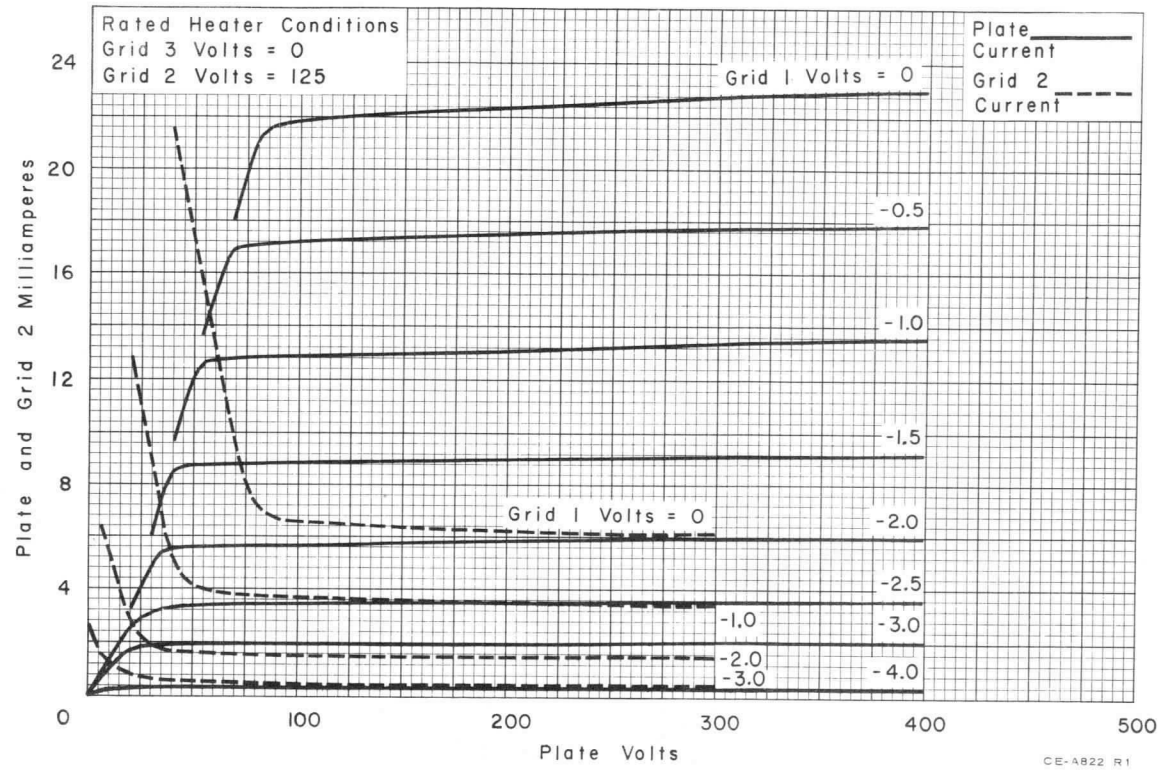
Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to cathode at socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (approx.)	0.28	Megohm
Transconductance	8000	μmhos
Grid 1 Cutoff Bias⊕	-6.5	Volts
Plate Current	13	Ma.
Grid 2 Current	3.7	Ma.
Grid 1 to Cathode Voltage for Plate Current of 2.8 ma.	-3	Volts

⊕ For plate current of 20 microamperes.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

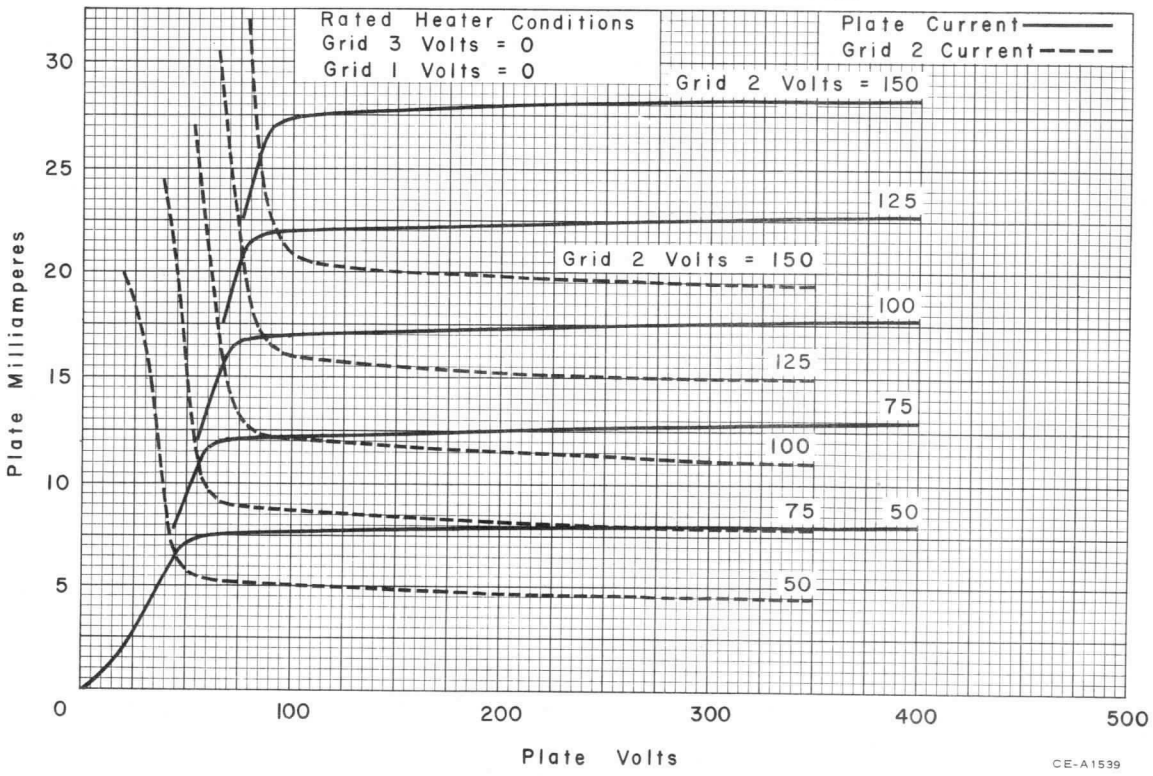
Westinghouse®

AVERAGE PLATE CHARACTERISTICS



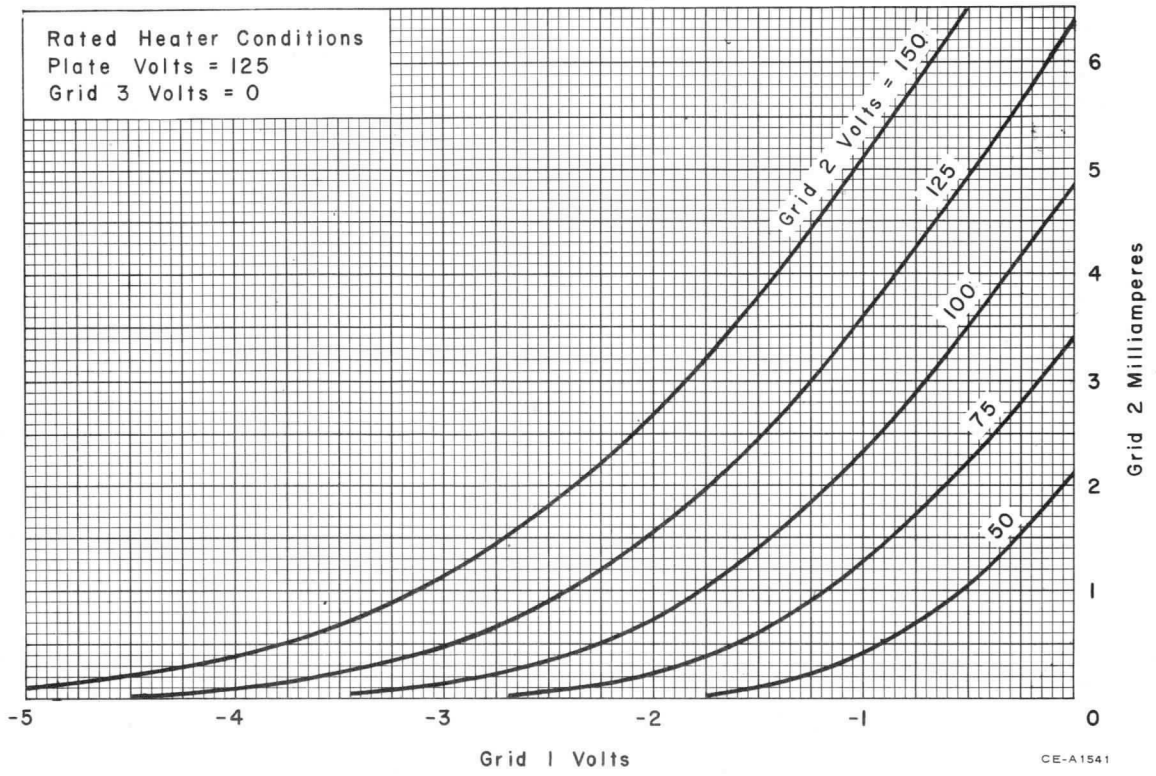
CE-A822 R1

AVERAGE PLATE CHARACTERISTICS

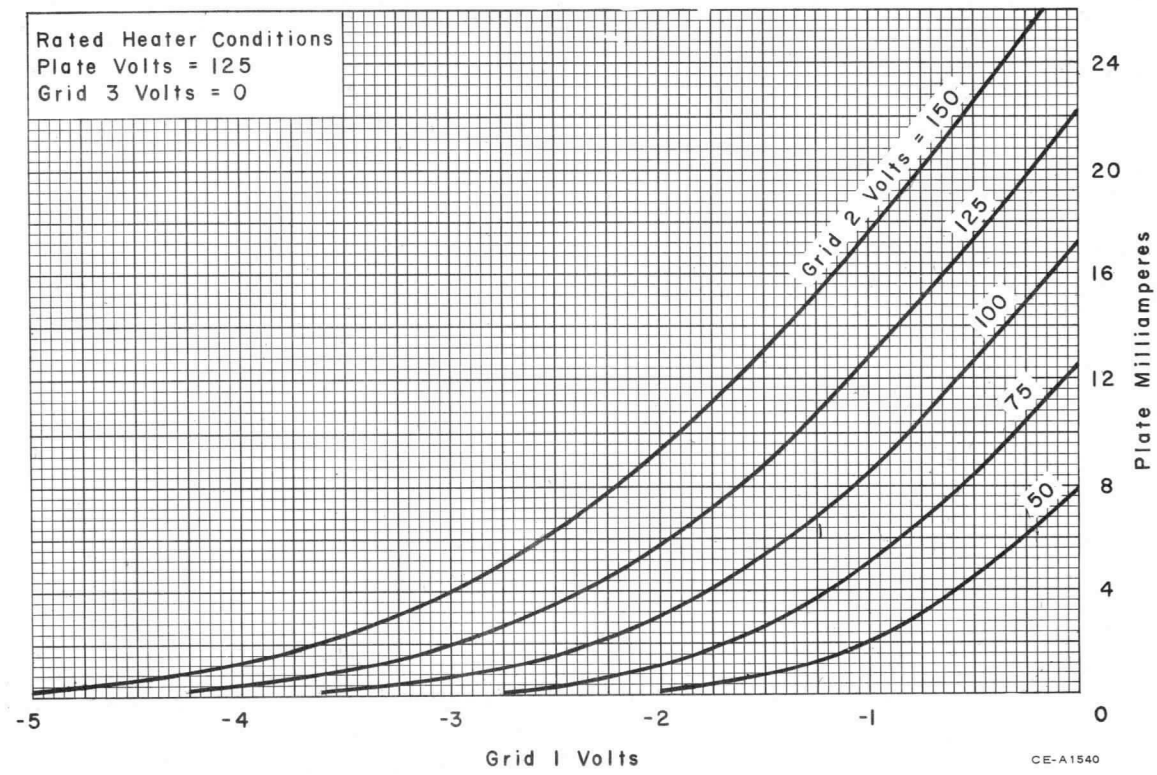


CE-A1539

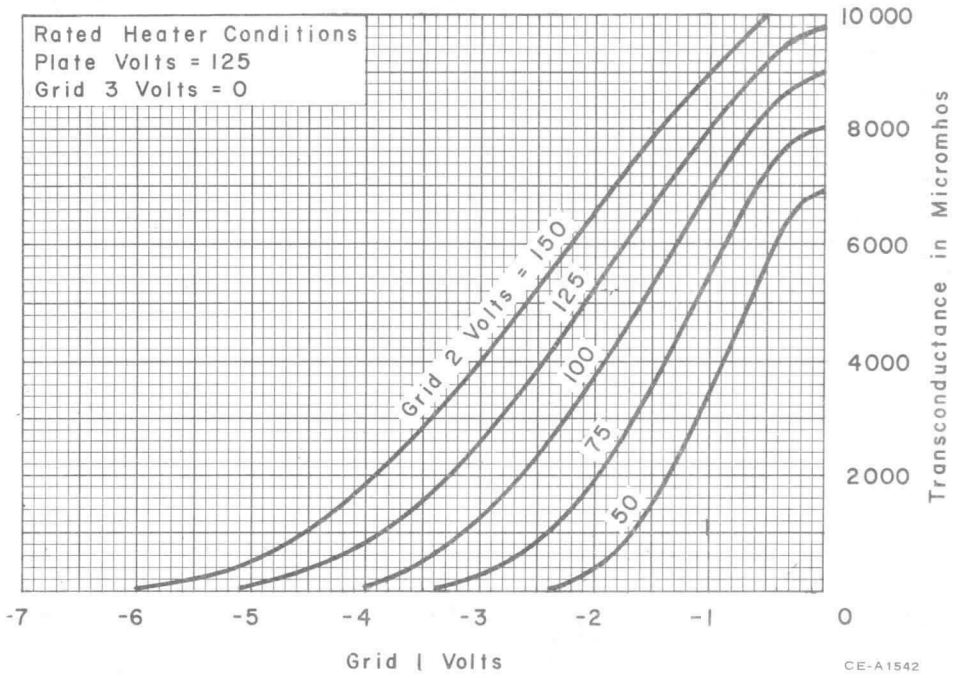
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPE 6CD6-GA

The 6CD6-GA is an octal based beam-power pentode type designed for service as the output amplifier in horizontal deflection circuits in television receivers. This type is characterized by high zero bias plate current and high DC plate supply voltage ratings. These features with a plate dissipation rating of 20 watts make this tube especially desirable for its designed service.

ELECTRICAL:

Cathode	Coated Unipotential	
Filament:		
Voltage (ac or dc)	6.3 ± 10%	Volts
Current	2.5	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid to Plate	1.1	μμf
Input	22	μμf
Output	8.5	μμf

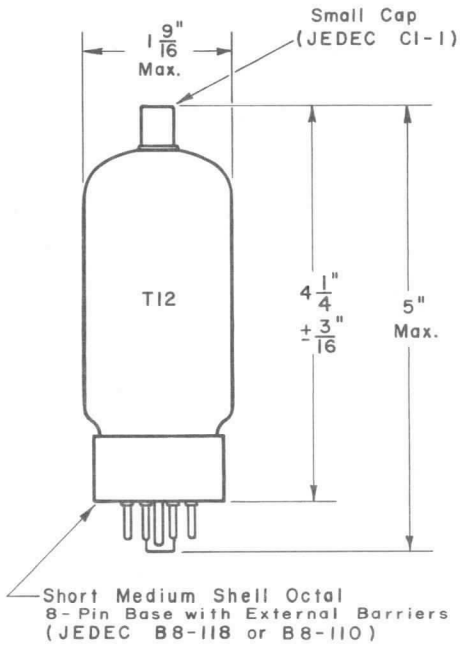
MECHANICAL:

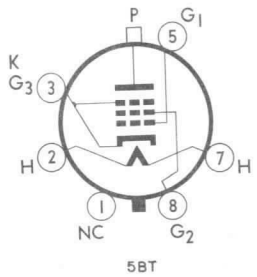
Bulb	T-12
Base	Short Shell Medium Octal
Basing	5BT
Top Cap	C1-1
Mounting Position §	Vertical

MAXIMUM RATINGS:

Design Center Values

D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	700	max.	Volts
Peak Positive Plate Voltage	7000 abs.	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Plate Dissipation ▲	20	max.	Watts
Peak Negative Grid 1 Voltage	200	max.	Volts
D.C. Grid 2 Voltage	175	max.	Volts
Grid 2 Dissipation	3	max.	Watts
Average Cathode Current	200	max.	Ma.
Peak Cathode Current	700	max.	Ma.
Grid 1 Circuit Resistance	0.47	max.	Megohm
Bulb Temperature (At Hottest Point)	225	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts





5BT

AVERAGE CHARACTERISTICS

PENTODE OPERATION:

Plate Voltage	175	Volts
Grid 2 Voltage	175	Volts
Grid 1 Voltage	−30	Volts
Plate Current	75	Ma.
Grid 2 Current	5.5	Ma.
Transconductance	7700	μmhos
Plate Resistance	7200	Ohms

ZERO BIAS:

Plate Voltage□	60	Volts
Grid 2 Voltage□	100	Volts
Plate Current⊕	230	Ma.
Grid 2 Current⊕	21	Ma.

CUTOFF:

Plate Voltage	175	Volts
Grid 2 Voltage	175	Volts
Plate Current	1.0	Ma.
Grid 1 Voltage (Approx.)	−55	Volts

TRIODE AMPLIFICATION FACTOR:

Plate Voltage	175	Volts
Grid 2 Voltage	175	Volts
Grid 1 Voltage	−30	Volts
Amplification Factor	3.9	

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

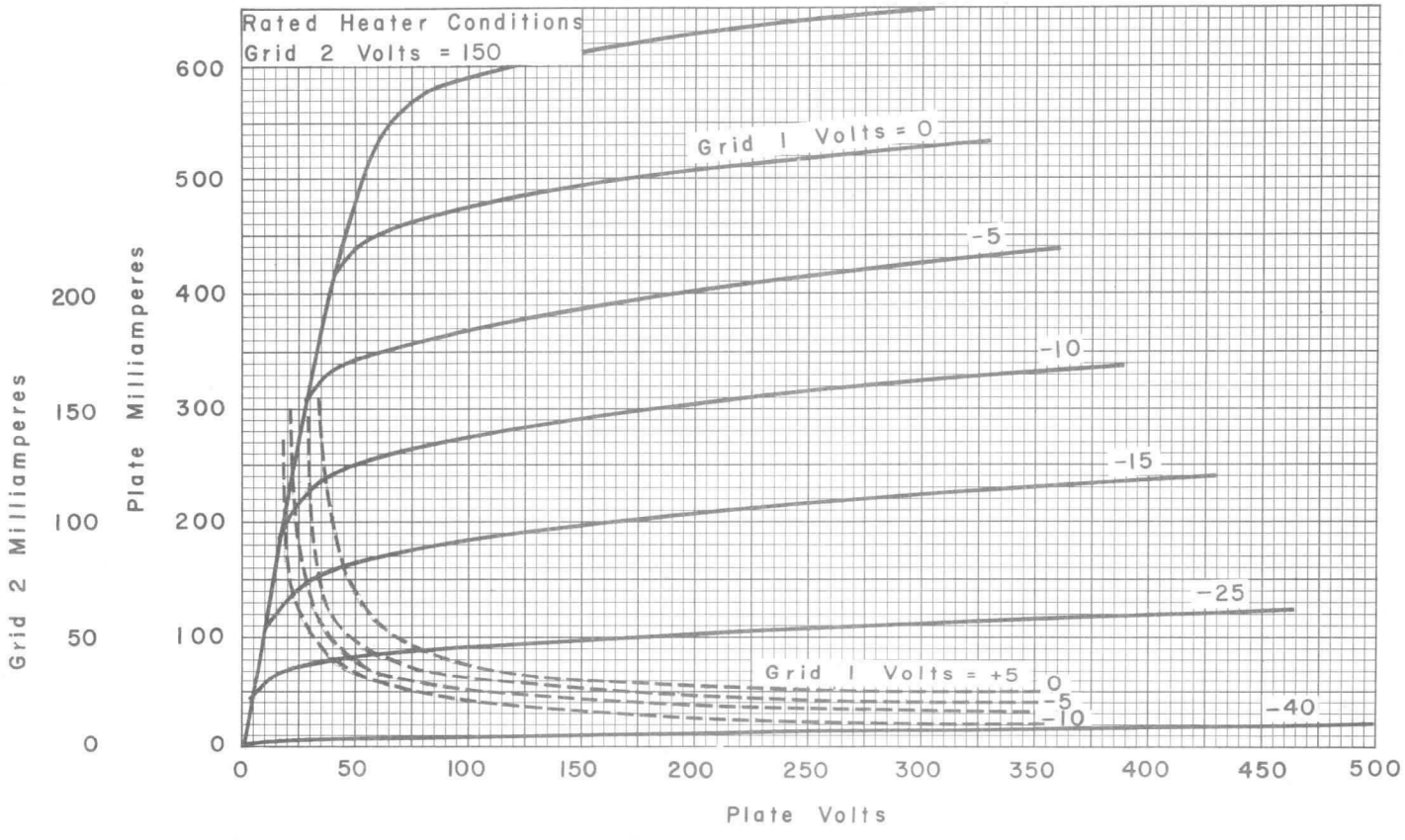
▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

□ Applied for short interval (maximum of 2 seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

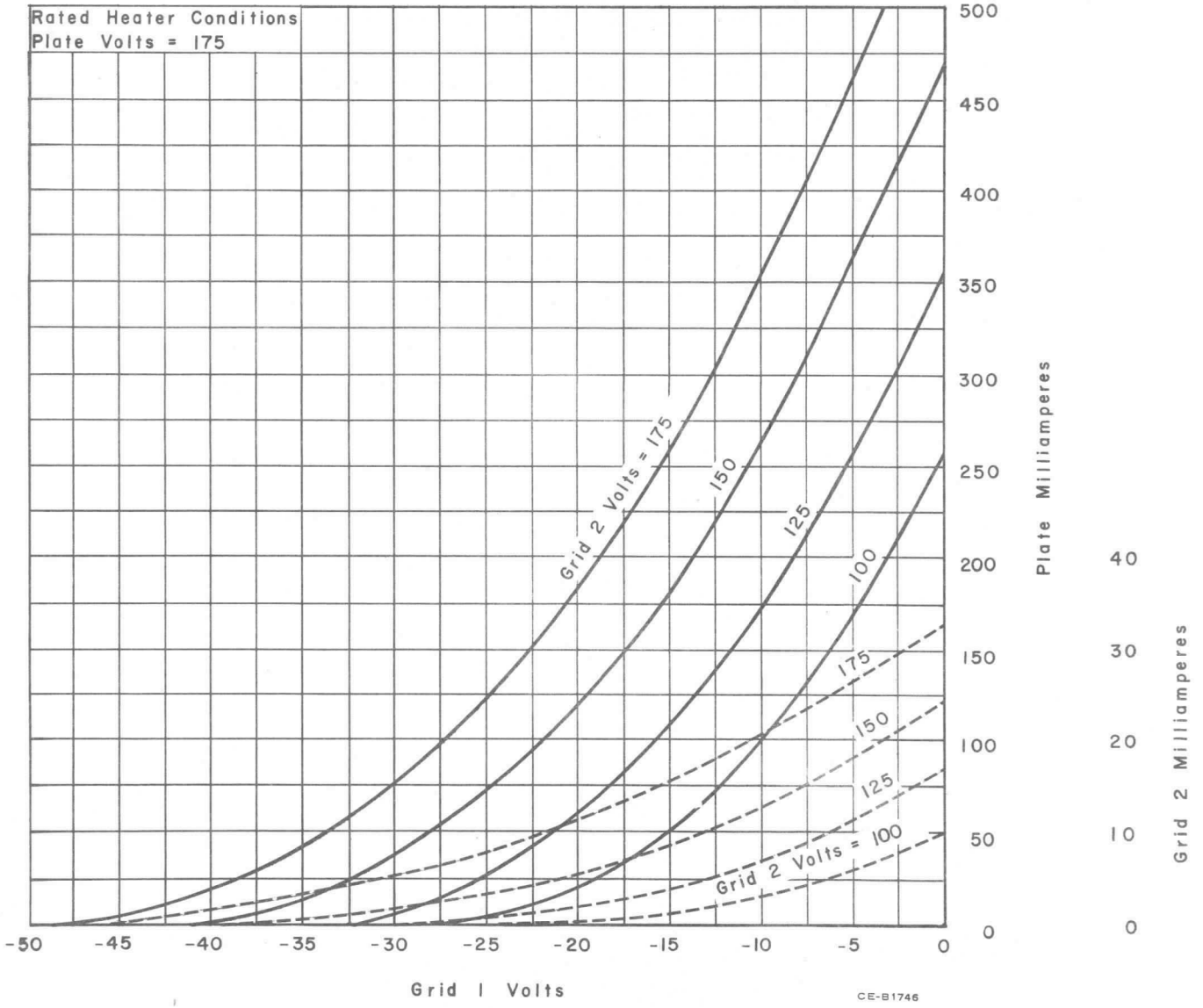
§ Vertical position is preferred. However, horizontal operation is permitted if plane of pins 2 and 7 is vertical.

AVERAGE PLATE CHARACTERISTICS

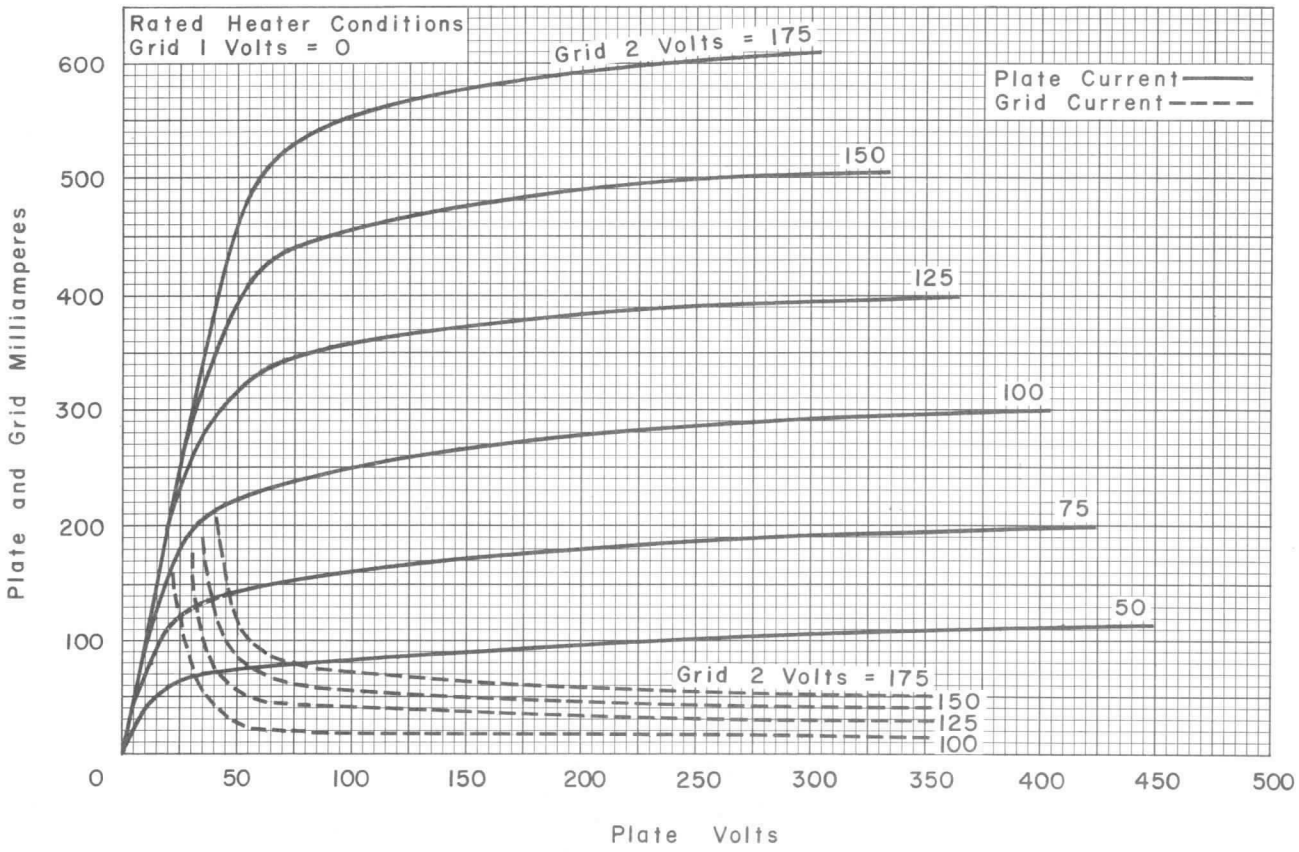


CE-A1744

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



CE-A1745

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Westinghouse

3CF6
4CF6
6CF6

February 1, 1961

SHARP-CUTOFF PENTODE TYPES 3CF6, 4CF6 AND 6CF6

The 3CF6, 4CF6 and 6CF6 are 7-pin miniature sharp-cutoff pentode types designed for service as intermediate-frequency amplifiers in television receivers. They feature high transconductance with low interelectrode capacitance. Separate pins are provided for grid 3 and the cathode to permit the use of an unbypassed cathode resistor to minimize the effects of regeneration.

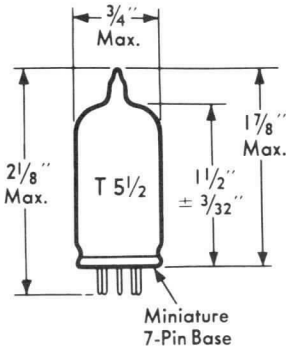
The 3CF6 and 4CF6 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode			Coated Unipotential	
Heater:	3CF6	4CF6	6CF6	
Voltage (ac or dc)	3.15	4.2	6.3 ± 10%	Volts
Current	0.60 ± 6%	0.45 ± 6%	0.30	Ampere
Warm-up Time ▲	11	11	--	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid 1 to Plate			0.025 max.	μμf
Input			6.5	μμf
Output			2.0	μμf

MECHANICAL:

Bulb	T-5½
Base	Miniature, 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any



MAXIMUM RATINGS:

Design Maximum Values

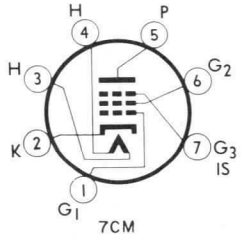
Plate Voltage	330	max.	Volts
Grid 2 Supply Voltage	330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.3	max.	Watts
Grid 2 Input	0.55	max.	Watt
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

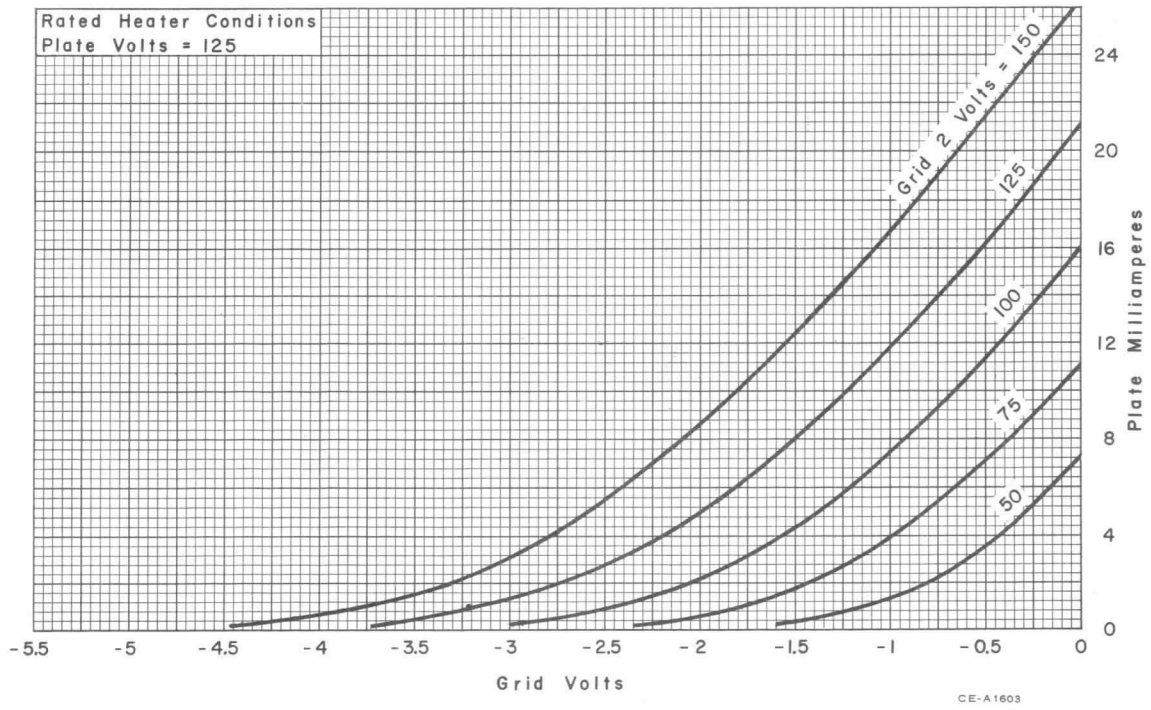
Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to cathode at socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (approx.)	0.3	Megohm
Transconductance	7800	μmhos
Grid 1 Cutoff Bias ⊕	-6.0	Volts
Plate Current	12.5	Ma.
Grid 2 Current	3.7	Ma.
Grid 1 to Cathode Voltage for Plate Current of 2.2 ma.	-3	Volts

⊕ For plate current of 20 microamperes.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

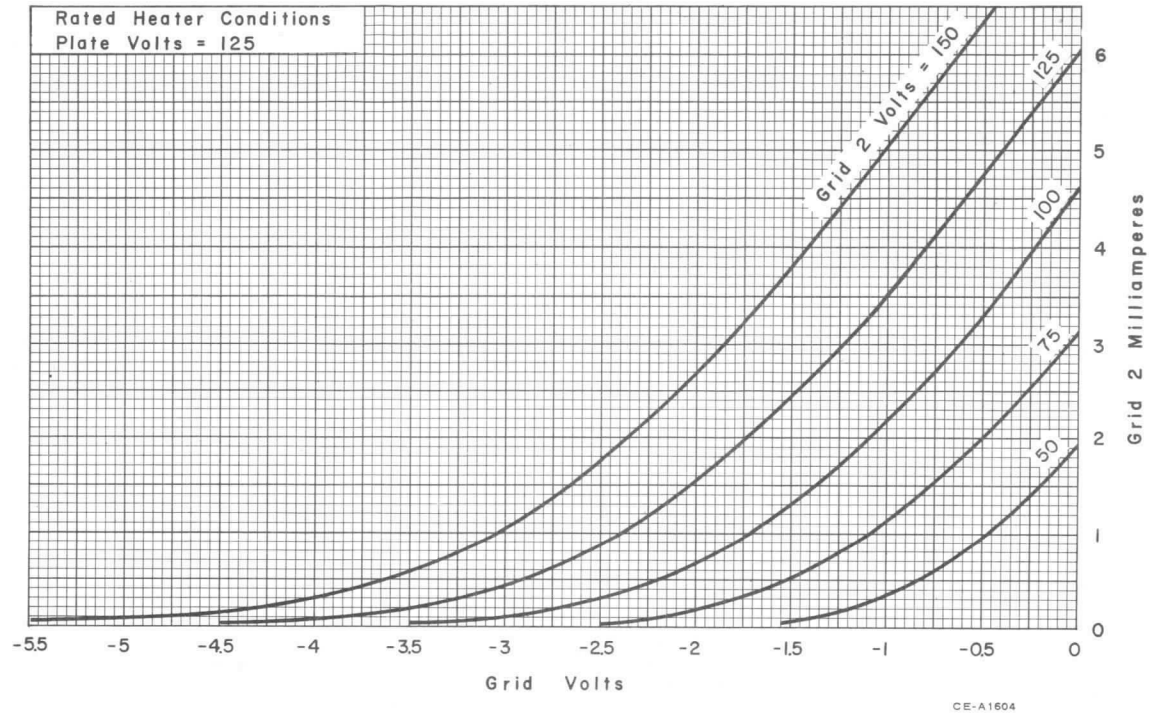


AVERAGE TRANSFER CHARACTERISTICS



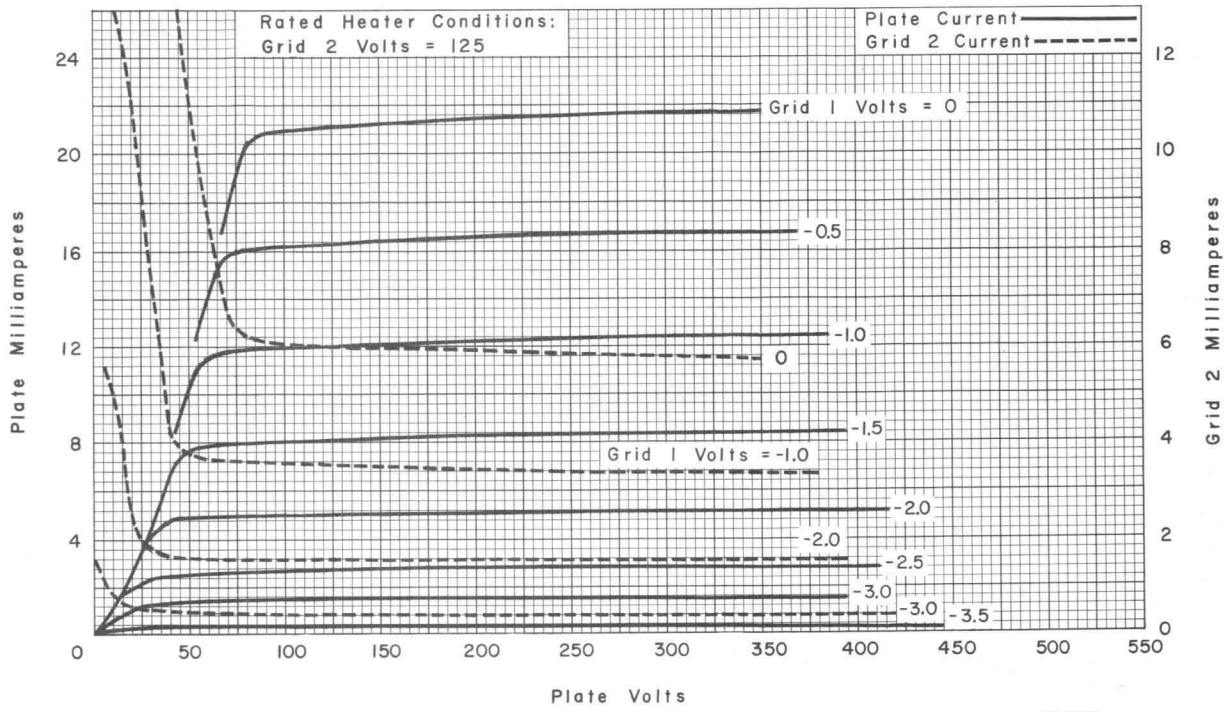
CE-A1603

AVERAGE TRANSFER CHARACTERISTICS



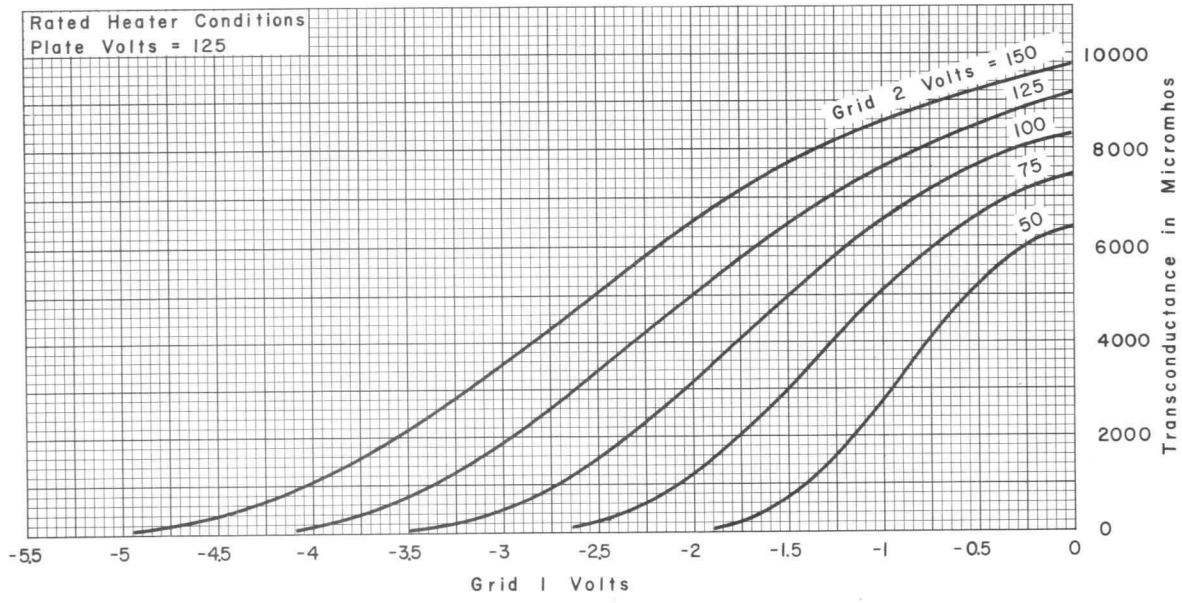
CE-A1604

AVERAGE PLATE CHARACTERISTICS



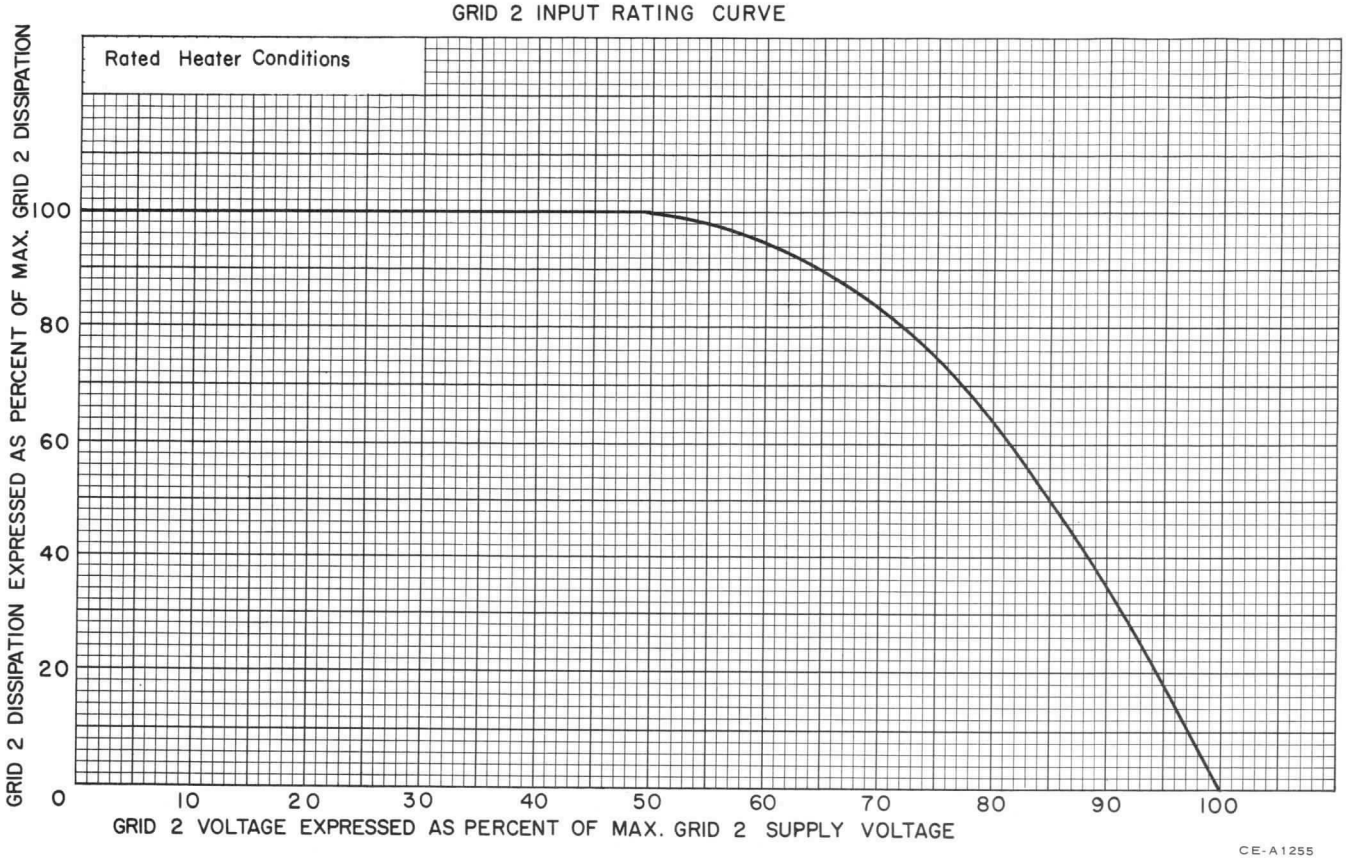
CE-A1602

AVERAGE TRANSFER CHARACTERISTICS



CE-A1605

GRID 2 INPUT RATING CURVE



CE-A1255

TWIN TRIODE TYPES 6CG7 AND 8CG7

The 6CG7 and 8CG7 are 9-pin miniature medium-mu twin triode types designed for use as vertical deflection oscillators and horizontal deflection oscillators in television receivers. They may also be used as phase inverters, multivibrators, and resistance-coupled amplifiers in electronic equipment.

The 6CG7 and 8CG7 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathodes	Coated Unipotential		
Heater:	6CG7	8CG7	
Voltage (ac or dc)	6.3	8.4	Volts
Current	0.60 ± 6%	0.45 ± 6%	Ampere
Warm-up Time▲	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	4.0	4.0	μμf
Input	2.3	2.3	μμf
Output	2.2	2.2	μμf

MECHANICAL:

Bulb	T-6½
Base	JEDEC E9-1 (Small Button 9-Pin)
Basing	9AJ
Mounting Position	Any

MAXIMUM RATINGS:

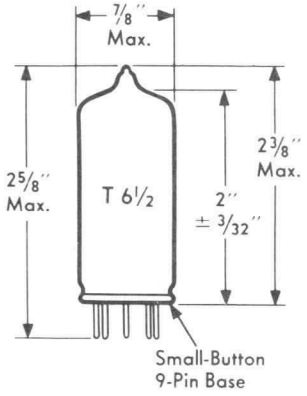
Design Maximum Values			
Plate Voltage	330	max.	Volts
Grid Voltage:			
Positive Bias Value	0	max.	Volts
Plate Dissipation:			
Each Plate	4.0	max.	Watts
Both Plates	5.7	max.	Watts
Cathode Current	22	max.	Ma.
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

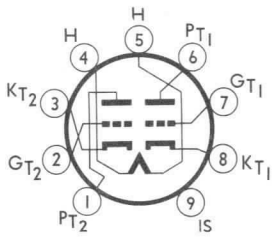
MAXIMUM CIRCUIT VALUE:

Grid Circuit Resistance			
Fixed Bias Operation	1.0	max.	Megohm

CHARACTERISTICS:

Plate Voltage	90	250	Volts
Grid Voltage	0	−8	Volts
Amplification Factor	20	20	
Plate Resistance (Approx.)	6700	7700	Ohms
Transconductance	3000	2600	μmhos
Grid Voltage for Plate Current of 10 μamp	−7	−18	Volts
Plate Current for Grid Voltage of −12.5 Volts	- -	1.3	Ma.
Plate Current	10	9	Ma.





9AJ

MAXIMUM RATINGS:
Design Maximum Values

	Vertical † Deflection Oscillator	Horizontal † Deflection Oscillator		
DC Plate Voltage	330	330	max.	Volts
Peak Negative Pulse Grid Voltage	440#	660**	max.	Volts
Cathode Current				
Peak	77	330	max.	Ma.
DC	22	22	max.	Ma.
Plate Dissipation				
Each Plate	4.0	4.0	max.	Watts
Both Plates	5.7	5.7	max.	Watts
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

MAXIMUM CIRCUIT VALUES:

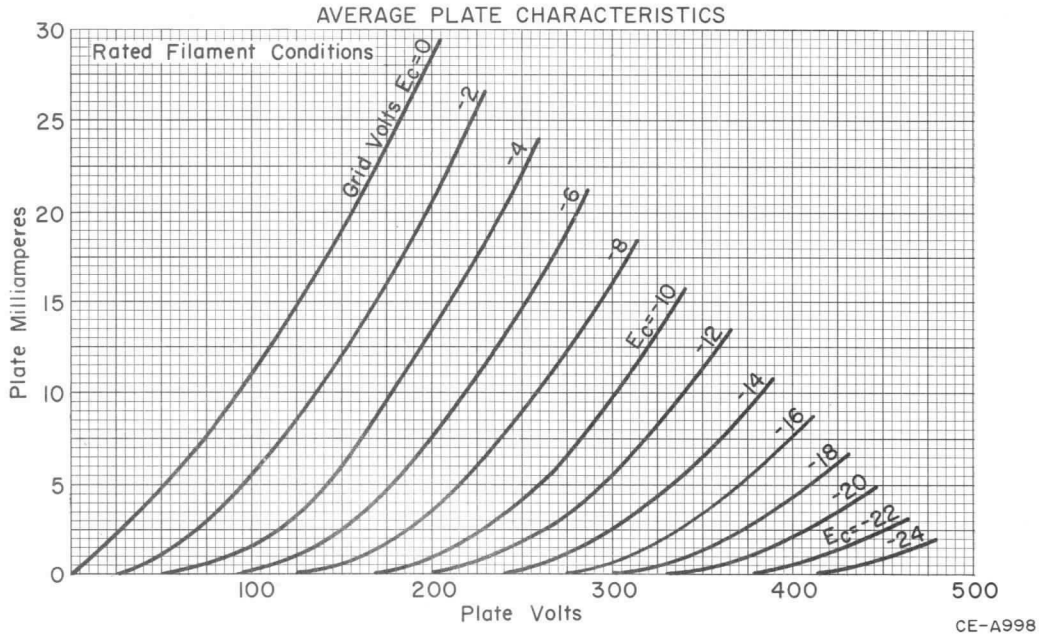
Grid Circuit Resistance				
Fixed-Bias, Grid-Resistor Bias, or Cathode-Bias Operation	2.2	2.2	max.	Megohms

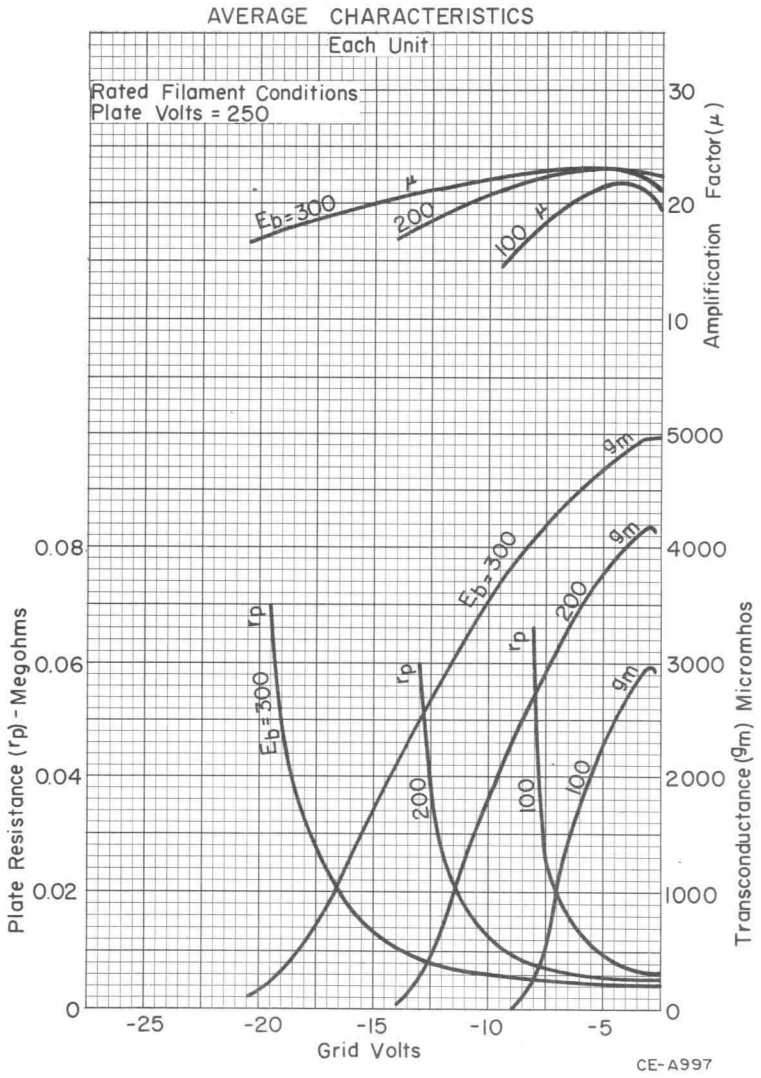
▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

† For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations," Federal Communications Commission

This rating is applicable where the duration of the voltage pulse does not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.

** This rating is applicable where the duration of the voltage pulse does not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.


AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Grid Volts Ec=0
-2
-4
-6
-8
Ec=-10
-12
-14
-16
-18
-20
Ec=-22
-24
Plate Milliamperes
0
5
10
15
20
25
30
100
200
300
400
500
Plate Volts
CE-A998



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December 1, 1956

Triode Pentode Converter Types 5CG8, 6CG8 and 6CG8-A

The 5CG8, 6CG8 and 6CG8-A are 9-pin miniature medium-mu triode and sharp-cutoff pentode types designed for service as combined oscillator and mixer in television receiver tuners using an intermediate frequency of approximately 40 mc.

The 5CG8 and 6CG8-A have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

Electrical:

Cathode			Coated Unipotential	
Heater	5CG8	6CG8	6CG8-A	
Voltage (ac or dc)	4.7	6.3	6.3	Volts
Current	0.60	0.45	0.45	Amperes
Warm-up Time●	11	..	11	Seconds

Direct Interelectrode Capacitances

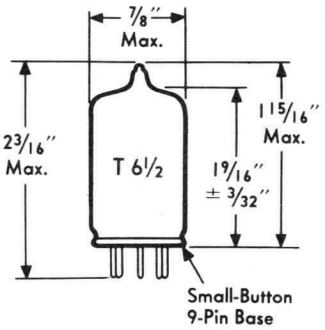
	Unshielded	Shielded#	
Triode Unit			
Grid to plate	1.5	1.5	μμf
Input	2.6	3.0	μμf
Output	0.05	1.0	μμf
Pentode Unit			
Grid 1 to Plate	0.03 max.	0.016 max.	μμf
Input	4.8	5.0	μμf
Output	0.9	1.6	μμf
Heater to Cathode	5.5	5.5□	μμf
Pentode Grid 1 to Triode Plate	0.05 max.	0.04 max.	μμf
Pentode Plate to Triode Plate	0.05 max.	0.007 max.	μμf

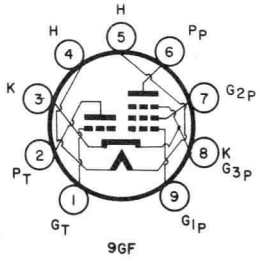
Mechanical:

Bulb	T-6-½
Base	Miniature 9-pin (JETEC E9-1)
Basing	9GF
Outline	6-2
Mounting	Any

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	100	250	Volts
Grid 2 Voltage	..	150	Volts
Cathode Bias Resistor	100	200	Ohms
Amplification Factor	40	..	
Plate Resistance (Approx.)	6900	750000	Ohms
Transconductance	5800	4600	μmhos
Grid 1 Bias (Approx.) for I_b of 10 μamp	-10	-10	Volts
Plate Current	8.5	7.7	Ma.
Grid 2 Current	..	1.6	Ma.





Receiving Tube Section

CONVERTER SERVICE

Maximum Ratings

Design Center Values

	Triode Unit as Osc.	Pentode Unit as Mixer	
Plate Voltage	250 max.	250 max.	Volts
Grid 3 (Suppressor) Voltage	..	0 max.	Volts
Grid 2 (Screen) Voltage		See Grid 2 Input Rating Curve	
Grid 2 Supply Voltage	..	250 max.	Volts
Grid 1 (Control Grid) Voltage			
Negative Bias Value	40 max.	40 max.	Volts
Positive Bias Value	0 max.	0 max.	Volts
Plate Dissipation	1.5 max.	2.0 max.	Watts
Grid 2 Input	..	0.5 max.	Watt
Grid 1 Input	0.5 max.	..	Watt
Heater Cathode Voltage			
Heater Positive with Respect to Cathode			
D-C Component		100 max.	Volts
Total D-C and Peak		200 max.	Volts
Heater Negative with Respect to Cathode			
Total D-C and Peak		200 max.	Volts

Maximum Circuit Values

Grid 1 Circuit Resistance		
Fixed-Bias Operation	0.1 max.	Megohm
Cathode-Bias Operation	0.5 max.	Megohm

Typical Operation

	Triode Unit as 250 Mc. Osc.†	Pentode Unit as Mixer††	
Plate Voltage	150	150	Volts
Grid 2 Voltage	..	150	Volts
Mixer Grid 1 Supply Voltage	..	-3.5	Volts
Oscillator Voltage (rms) at Mixer Grid 1	..	2.6	Volts
Mixer Grid 1 Circuit Resistance	..	120000	Ohms
Oscillator Grid Resistor	2700	..	Ohms
Conversion Transconductance	..	2100	μmhos
Plate Current	13	6.2	Ma.
Grid 2 Current	..	1.8	Ma.
Grid 1 Current	3.6	..	Ma.
Grid 1 Current	..	2.0	μamp
Oscillator Power Output (Approx.)	0.5	..	Watt

• Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

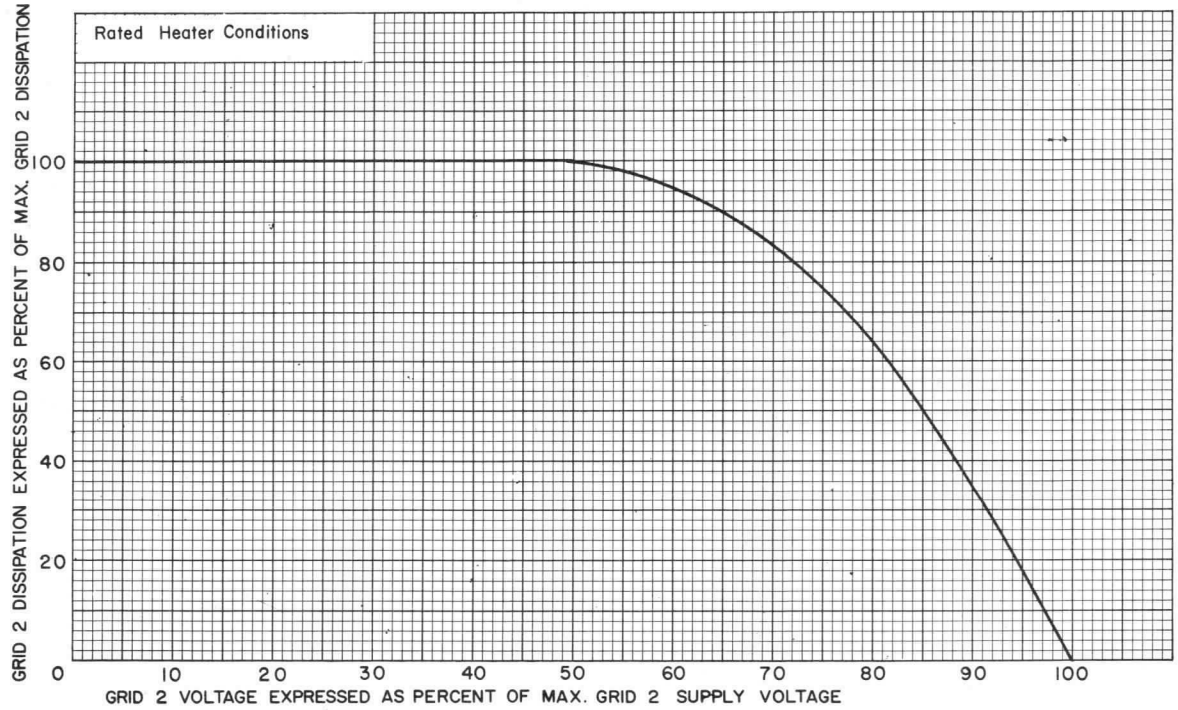
With JETEC shield #315 connected to Cathode.

□ With JETEC shield #315 connected to ground.

† In television or FM receivers it is generally desirable to operate the oscillator with less power input than shown in order to avoid over-excitation and excessive oscillation radiation.

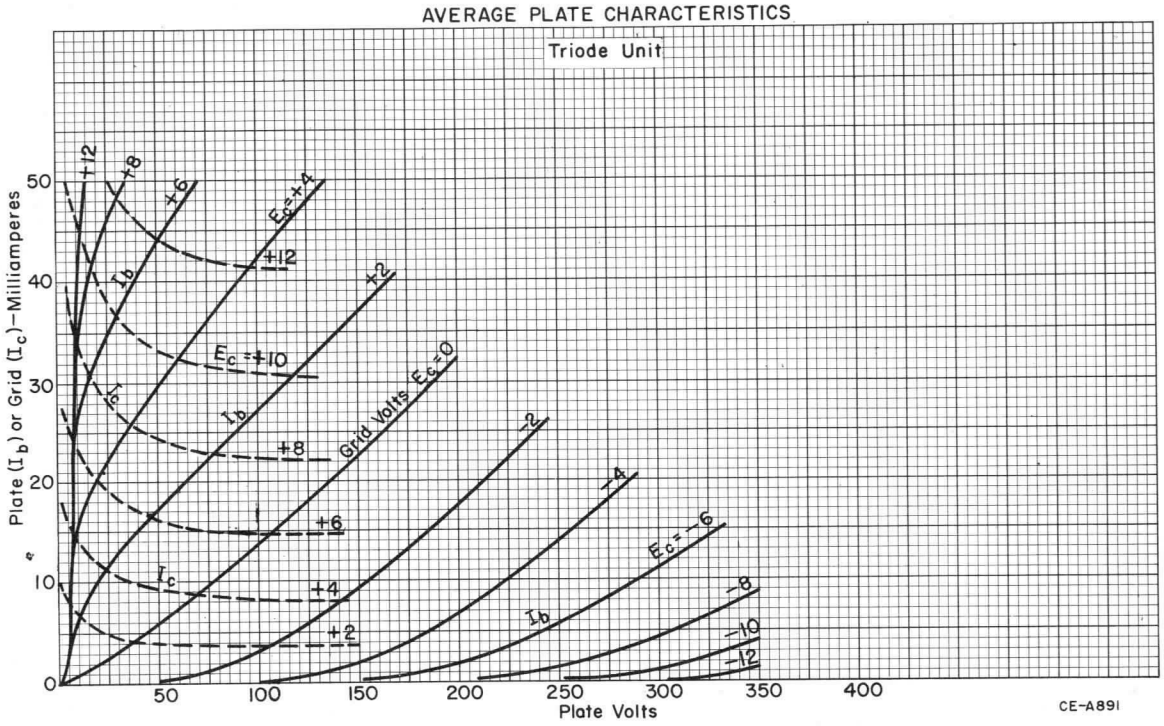
††With separate excitation and triode unit grounded.

GRID 2 INPUT RATING CURVE

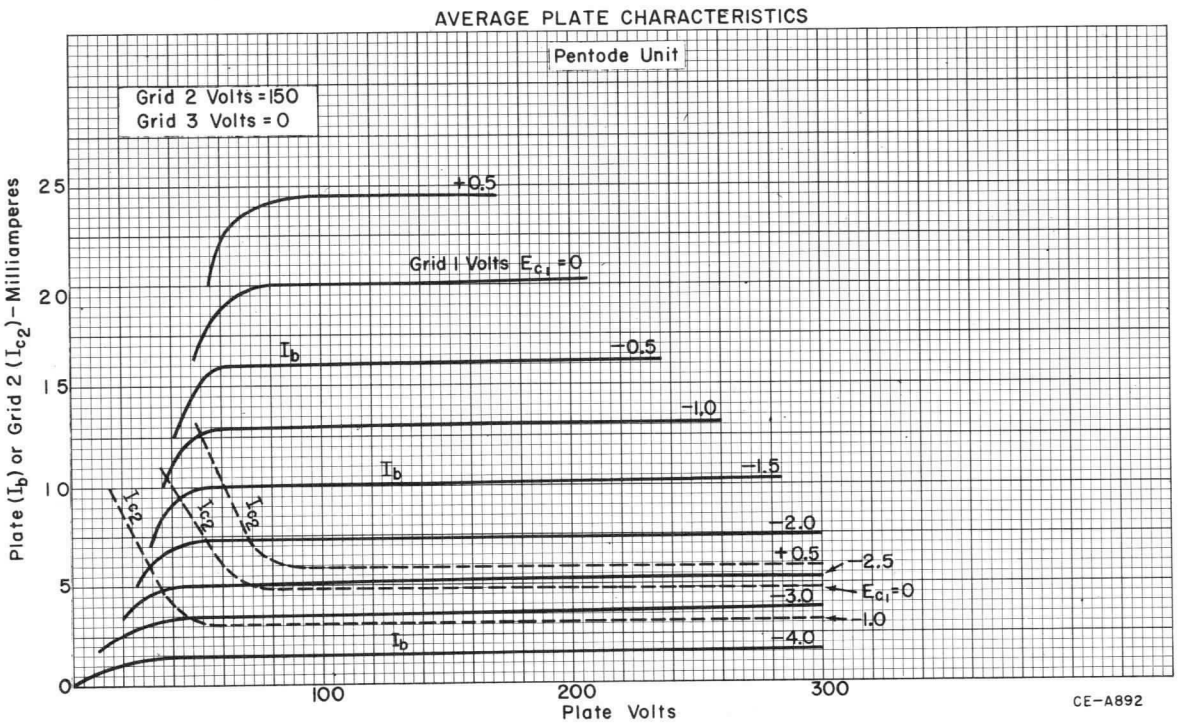


GE-A1255

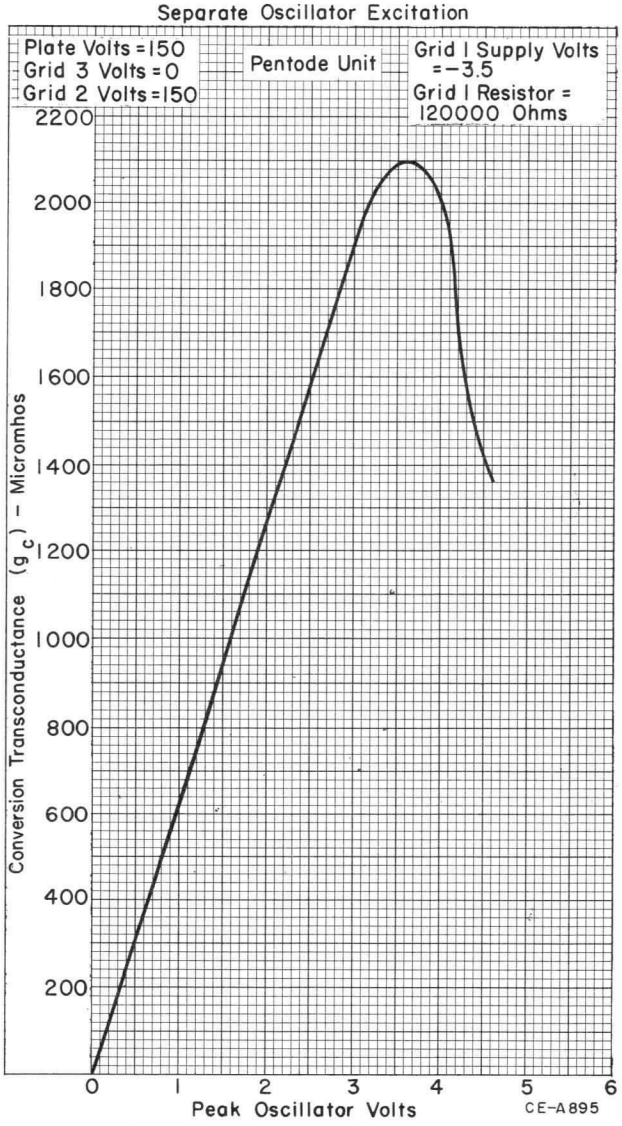
AVERAGE PLATE CHARACTERISTICS



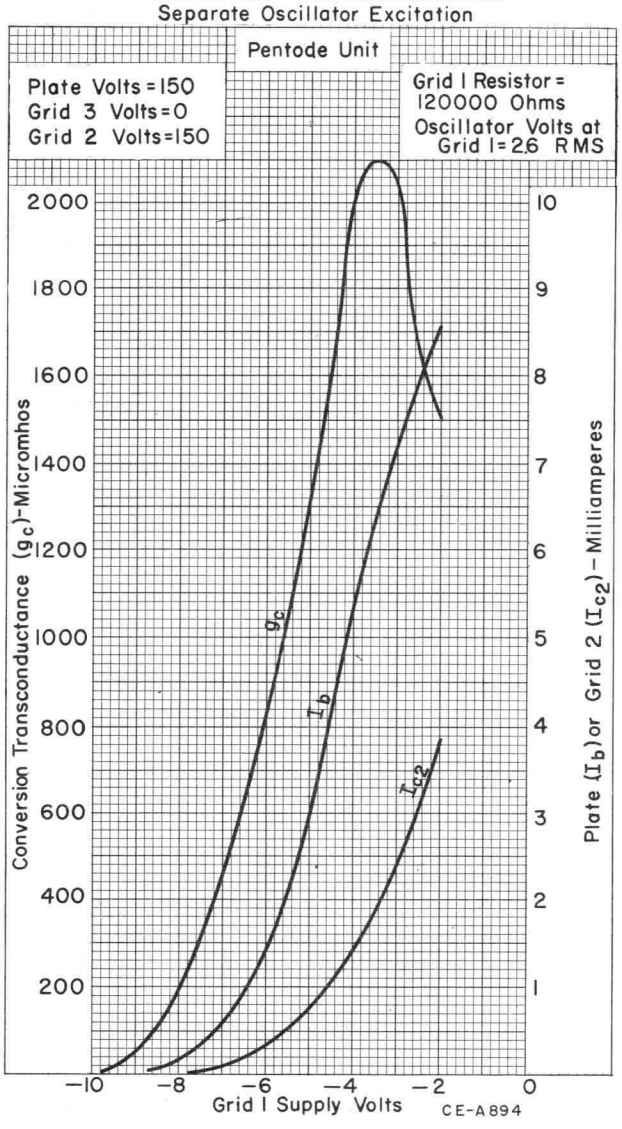
AVERAGE PLATE CHARACTERISTICS



OPERATION CHARACTERISTIC
Separate Oscillator Excitation



OPERATION CHARACTERISTICS
Separate Oscillator Excitation



TRIODE - TETRODE TYPES 5CL8-A AND 6CL8-A

The 5CL8-A and 6CL8-A are 9-pin miniature triode-tetrode types designed for combined oscillator-mixer service in television and frequency modulation receivers. Each section of the 5CL8-A and 6CL8-A has a separate cathode and is electrically independent. These tubes perform well at the higher frequencies and each may be used advantageously in applications normally requiring two tubes.

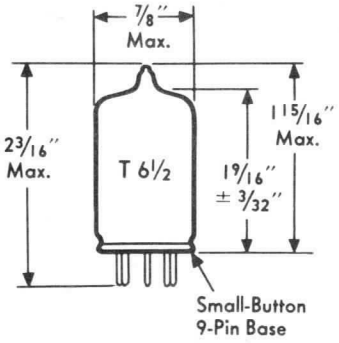
The 5CL8-A and 6CL8-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current ratings, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

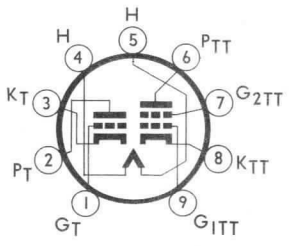
ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	5CL8-A	6CL8-A		
Voltage (ac or dc)	4.7	6.3		Volts
Current	0.60 ± 6%	0.45 ± 6%		Ampere
Warm-up Time (Approx.)□	11	11		Seconds
Direct Interelectrode Capacitances:	Shielded	Unshielded		
Triode Unit:				
Grid to Plate	1.8	1.8		μμf
Input	2.8	2.8		μμf
Output	2.0	1.5		μμf
Tetrode Unit:				
Grid 1 to Plate	0.01♦	0.02	max.	μμf
Input	5.0	5.0		μμf
Output	3.0	2.0		μμf
Coupling:				
Tetrode Grid 1 to Triode Plate	0.01♦	0.015	max.	μμf
Tetrode Plate to Triode Plate	0.03♦	0.15	max.	μμf
Heater to Cathode:				
Tetrode Unit	3.0⊕	3.0		μμf
Triode Unit	3.0⊕	3.0		μμf

MECHANICAL:

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E-9-1)
Outline	6-2
Basing	9FX
Mounting Position	Any





9FX

MAXIMUM RATINGS

Design Maximum Values

	Triode Unit		Tetrode Unit		
Plate Voltage	330		330	max.	Volts
Grid 2 Supply Voltage	- -		330	max.	Volts
Grid 2 Voltage			See Grid 2 Input Rating Curve		
Grid 1 Voltage:					
Positive Bias Value	0		0	max.	Volts
Plate Dissipation	2.5		3.0	max.	Volts
Grid 2 Dissipation	- -		0.55	max.	Watt
Grid 1 Circuit Resistance:					
Fixed Bias	0.5		0.25	max.	Megohm
Cathode Resistor Bias	1.0		1.0	max.	Megohm
Heater-Cathode Voltage					
Heater Negative with Respect to Cathode					
Total DC + Peak	200	max.	200	max.	Volts
Heater Positive with Respect to Cathode					
DC Component	100	max.	100	max.	Volts
Total DC + Peak	200	max.	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:

	Triode Unit	Tetrode Unit	
Plate Voltage	125	125	Volts
Grid 2 (Screen) Voltage	- -	125	Volts
Grid 1 Voltage	−1	−1	Volts
Amplification Factor	40	- -	
Plate Resistance (Approx.)	5000	200,000	Ohms
Transconductance	8000	6500	μmhos
Grid 1 Cutoff Bias▲	−9	−9	Volts
Plate Current	14	12	Ma.
Grid 2 Current	- -	4	Ma.

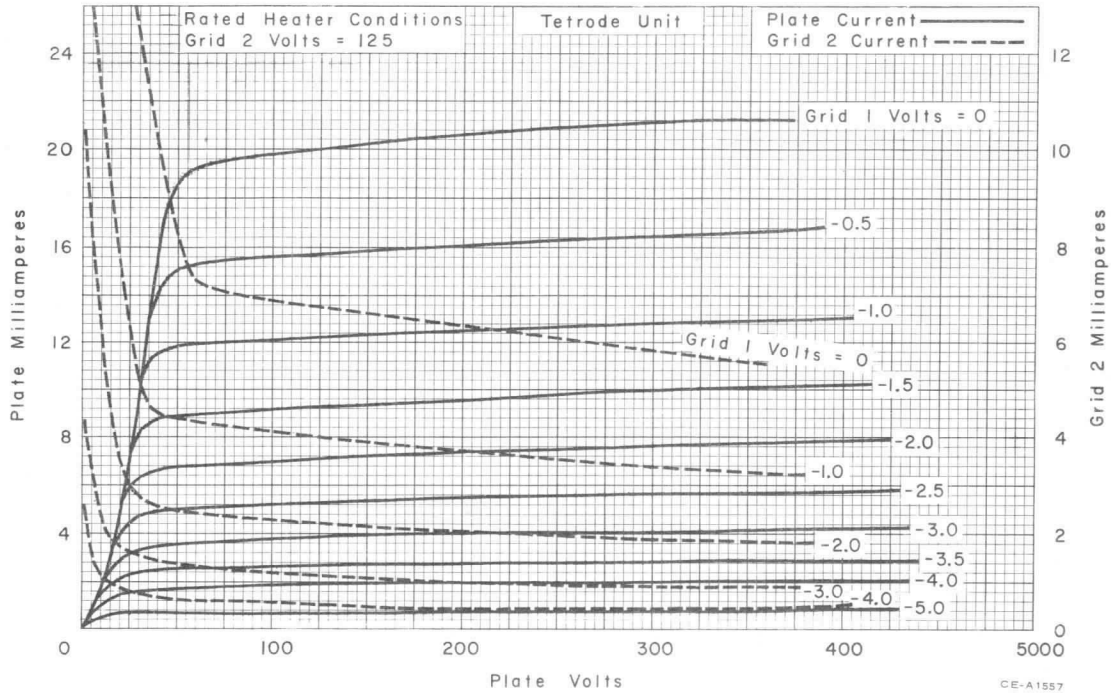
□ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

♦ External shield No. 315 tied to pin 4.

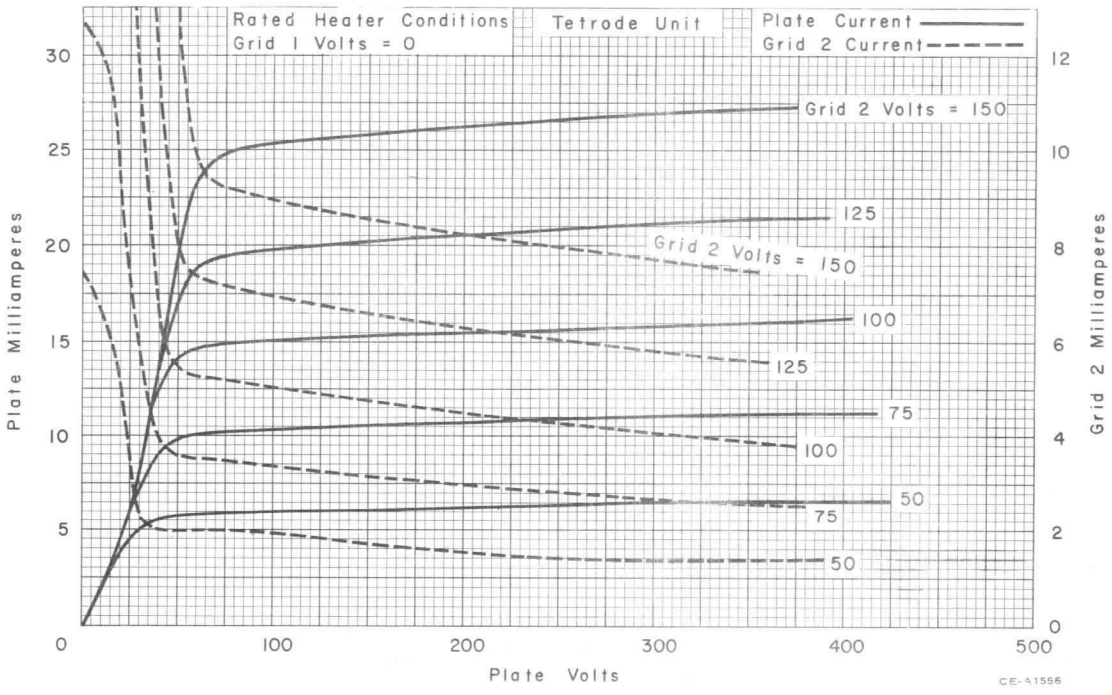
⊕ External shield No. 315 tied to pin 6.

▲ For plate current of 20 microamperes.

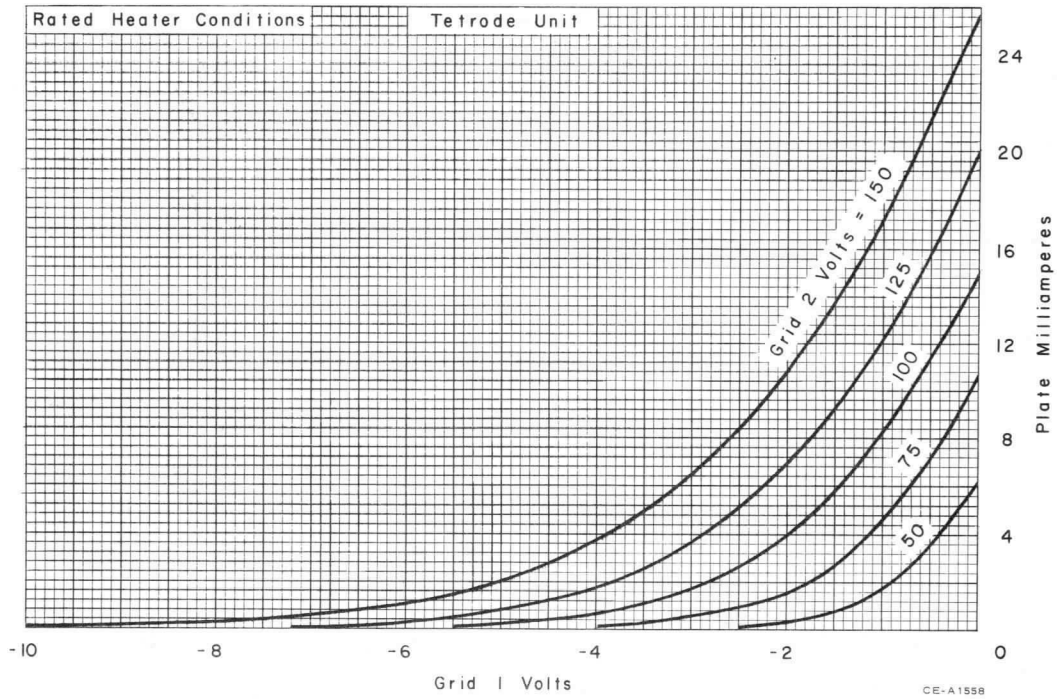
AVERAGE PLATE CHARACTERISTICS



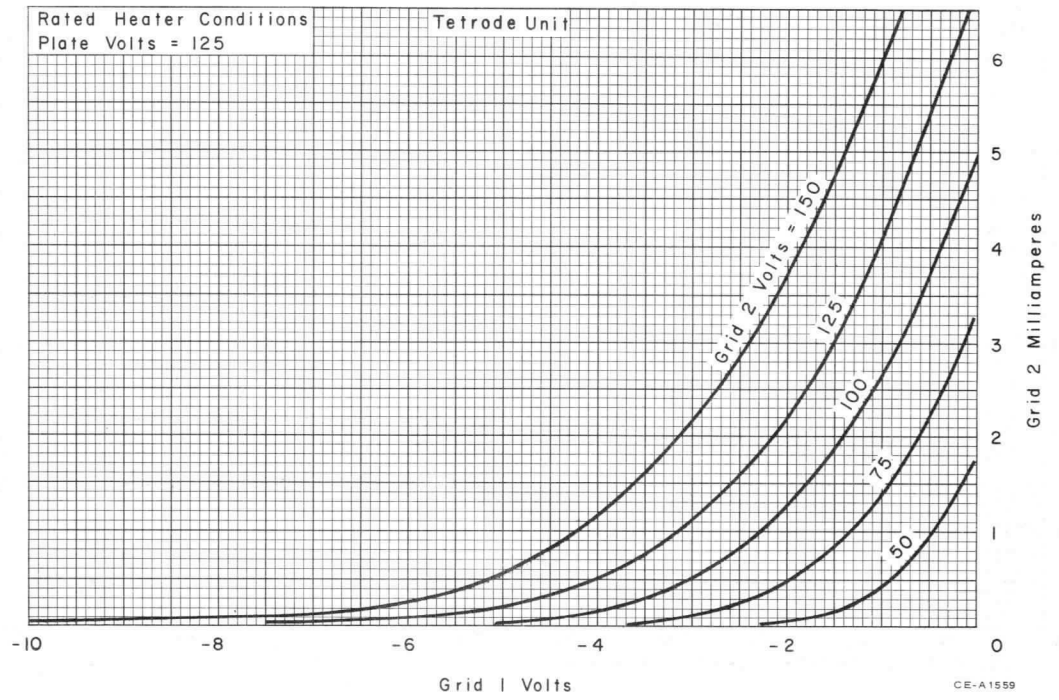
AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



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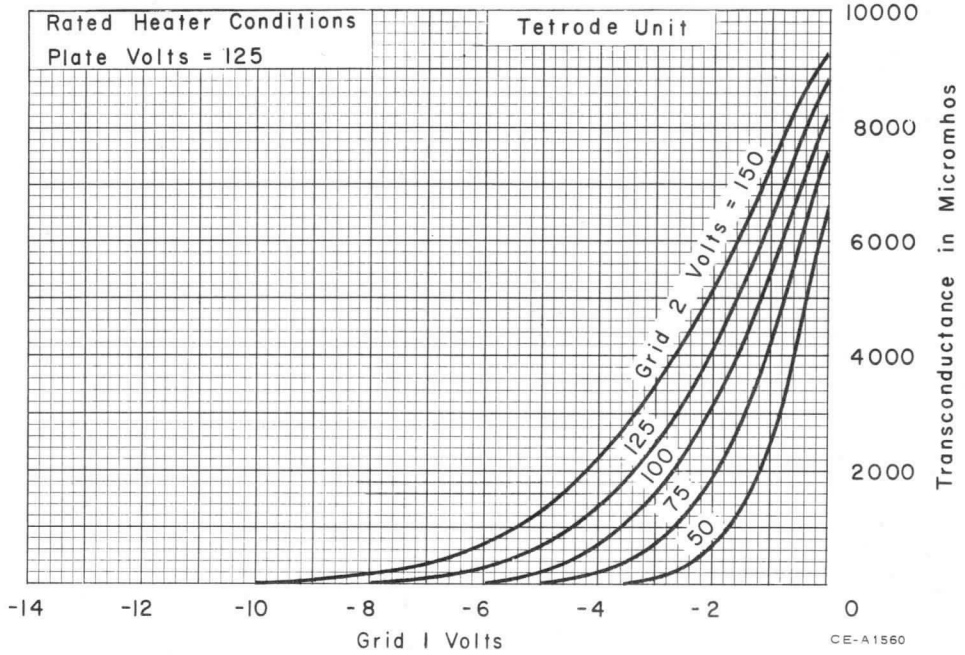
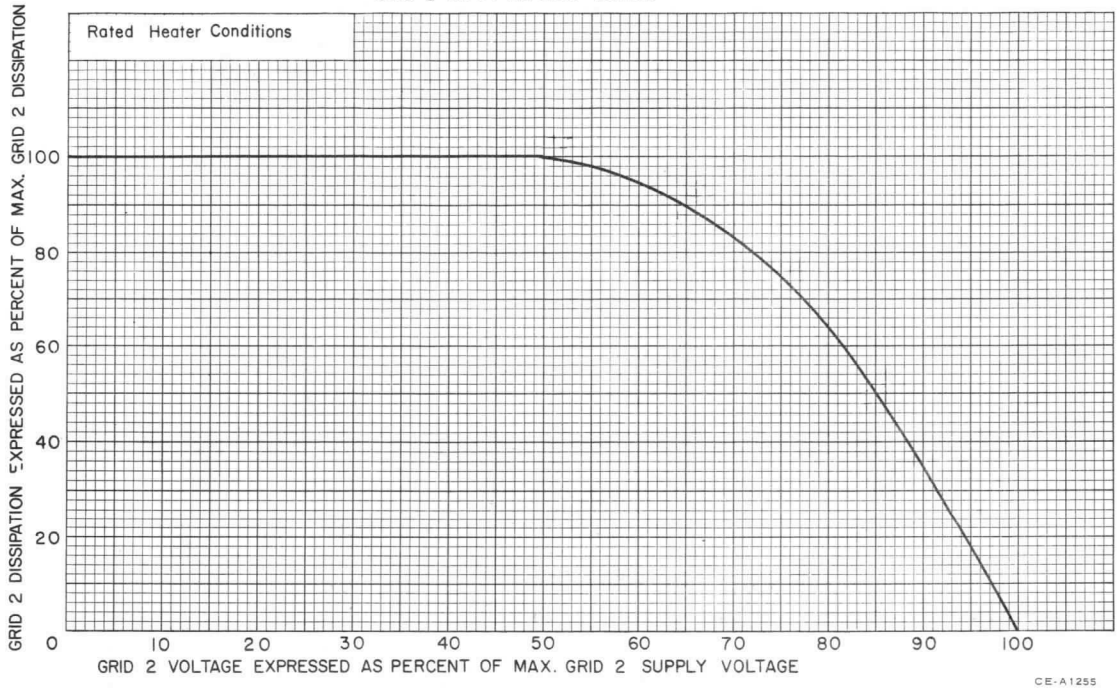


GRID 2 INPUT RATING CURVE



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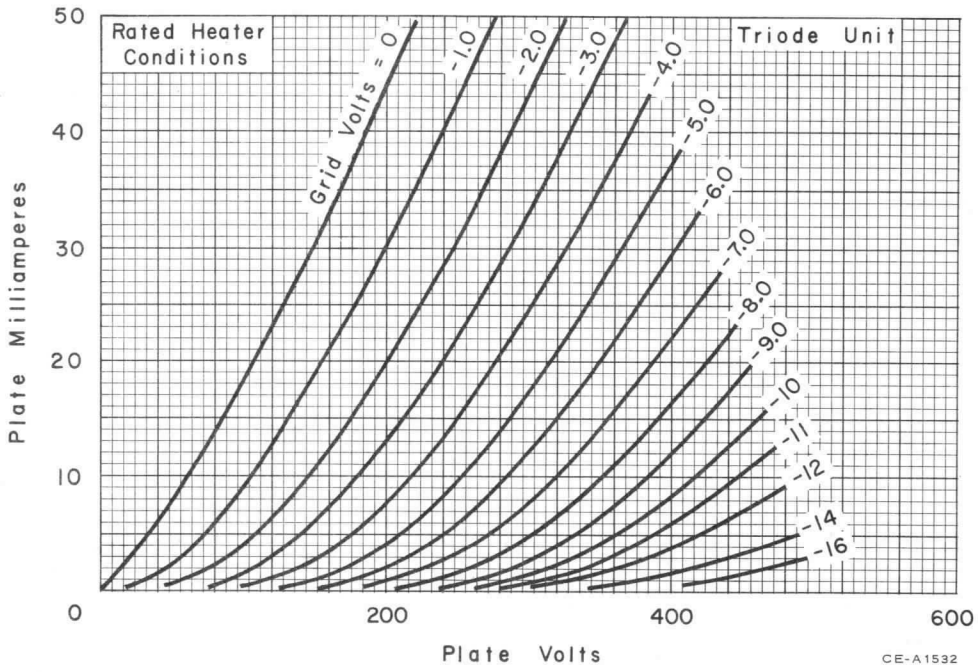

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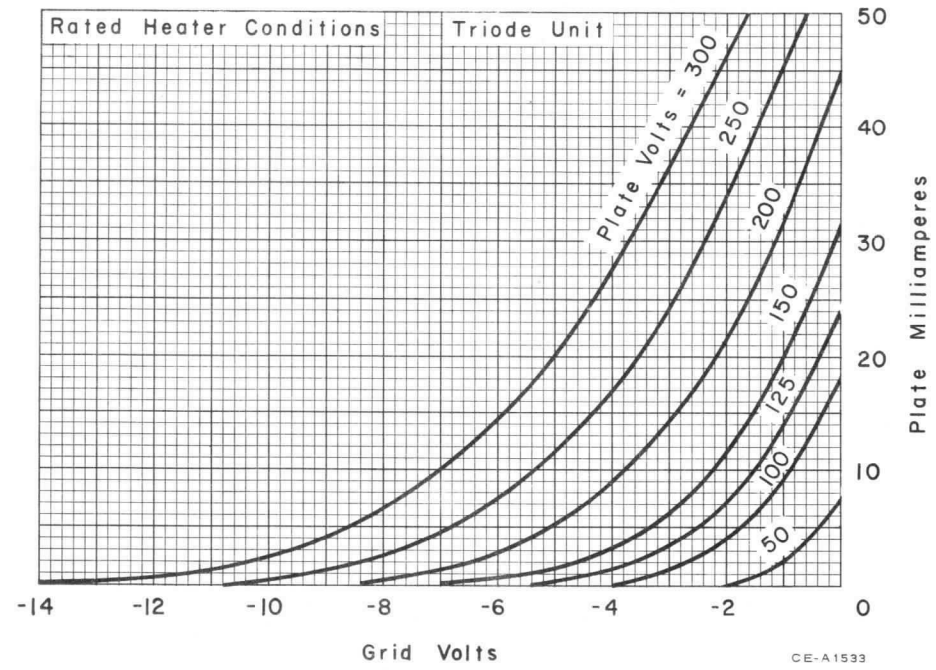

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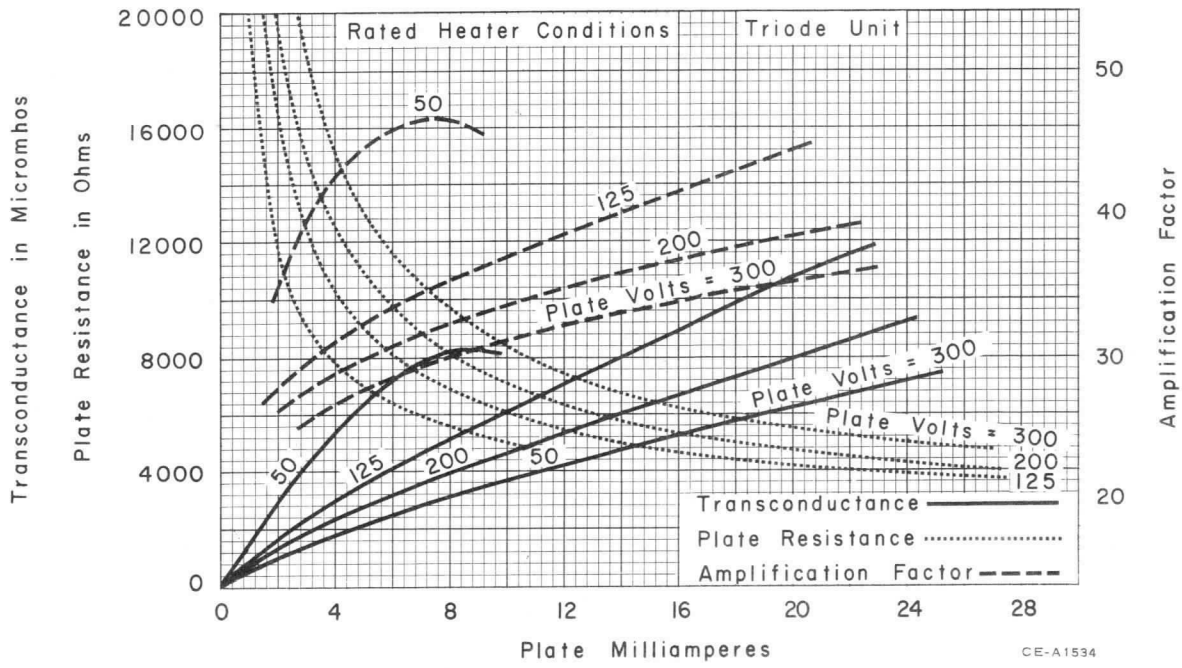


TRIODE-TETRODE TYPE 19CL8A

The 19CL8A is a 9-pin miniature triode-tetrode type designed for combined oscillator-mixer service in television and frequency modulation receivers. Each section of the 19CL8A has a separate cathode and is electrically independent. It performs well at the higher frequencies and may be used advantageously in applications normally requiring two tubes.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	18.9		Volts
Current	0.15		Ampere
Direct Interelectrode Capacitances:	Shielded	Unshielded	
Triode Unit:			
Grid to Plate	1.8	1.8	pf
Input	2.8	2.8	pf
Output	2.0	1.5	pf
Tetrode Unit:			
Grid 1 to Plate	0.01	0.02	pf
Input	5.0	5.0	pf
Output	3.0	2.0	pf
Coupling:			
Tetrode Grid 1 to Triode Plate	0.01 (Note 1)	0.015 max.	pf
Tetrode Plate to Triode Plate	0.03 (Note 1)	0.15 max.	pf
Heater to Cathode:			
Tetrode Unit	3.0 (Note 2)	3.0	pf
Triode Unit	3.0 (Note 2)	3.0	pf

MECHANICAL

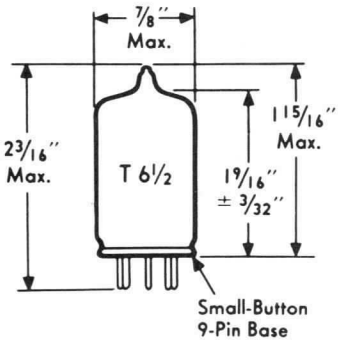
Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-2
Basing	9FX
Mounting Position	Any

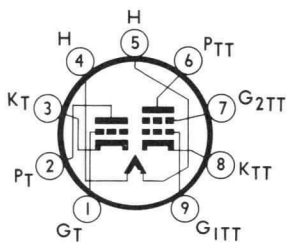
MAXIMUM RATINGS

Design Maximum Values	Triode Unit		Tetrode Unit		
Plate Voltage	330		330	max.	Volts
Grid 2 Supply Voltage	–		330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve				
Grid 1 Voltage:					
Positive Bias Value	0		0	max.	Volts
Plate Dissipation	2.5		3.0	max.	Volts
Grid 2 Dissipation	–		0.55	max.	Watt
Grid 1 Circuit Resistance:					
Fixed Bias	0.5		0.25	max.	Megohm
Cathode Resistor Bias	1.0		1.0	max.	Megohm
Heater-Cathode Voltage					
Heater Negative with Respect to Cathode					
Total DC + Peak	200	max.	200	max.	Volts
Heater Positive with Respect to Cathode					
DC Component	100	max.	100	max.	Volts
Total DC + Peak	200	max.	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS

	Triode Unit	Tetrode Unit	
Plate Voltage	125	125	Volts
Grid 2 (Screen) Voltage	–	125	Volts
Grid 1 Voltage	–1	–1	Volts
Amplification Factor	40	–	
Plate Resistance (Approx.)	5000	200,000	Ohms
Transconductance	8000	6500	μmhos
Grid 1 Cutoff Bias (Note 3)	–9	–9	Volts
Plate Current	14	12	Ma.
Grid 2 Current	–	4	Ma.





9FX

NOTES

1. External shield No. 315 tied to pin 4.
2. External shield No. 315 tied to pin 6.
3. For plate current of 20 microamperes.

NOTICE: For characteristic curves, see data sheet for types 5CL8A & 6CL8A.

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Receiving Tube Section

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Westinghouse

6CM7
8CM7

January 15, 1961

DUAL TRIODE TYPES 6CM7 AND 8CM7

The 6CM7 and 8CM7 are dual triodes with dissimilar sections designed for use in television receivers. Triode No. 1 (Pins No. 6, 7 & 8) is designed for service as a vertical deflection oscillator. Triode No. 2 (Pins No. 1, 3 & 9) is designed for operation as a high efficiency vertical deflection output amplifier.

The 6CM7 and 8CM7 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

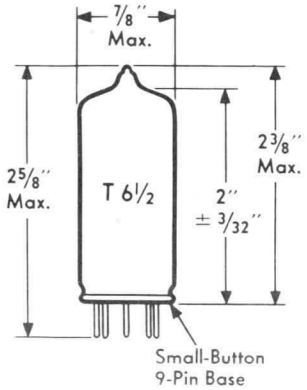
ELECTRICAL:

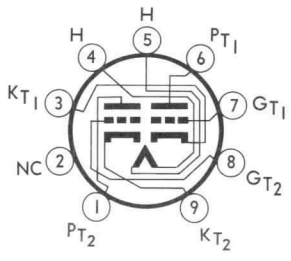
Cathodes	Coated Unipotential		
Heater:	6CM7	8CM7	
Voltage (ac or dc)	6.3	8.4	Volts
Current	0.60 ± 6%	0.45 ± 6%	Ampere
Warm-up Time ▲	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	3.8	3.0	μμf
Input	2	3.5	μμf
Output	0.5	0.4	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9ES
Mounting Position	Any

⊕ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions. The tube manufacturer chooses these values to provide acceptable serviceability of the tube, talking responsibility for the effects of changes in operating conditions due to variations in tube characteristics. The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation, signal variation, and environmental conditions.





9ES

MAXIMUM RATINGS: Design Maximum Values⊕	Triode No. 1 as Vertical Deflection Oscillator	Triode No. 2 as Vertical Deflection Amplifier §		
Plate Voltage	550	550	max.	Volts
Peak Positive Pulse Plate Voltage (Abs.Max.).	- -	2200	max.	Volts
Peak Negative Grid Voltage §	220	220	max.	Volts
Plate Dissipation.	1.45	6.0	max.	Watts
Cathode Current	17	22	max.	Ma.
Peak Cathode Current.	77	77	max.	Ma.
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total D.C. and Peak.	200	200	max.	Volts
Heater Positive with Respect to Cathode				
D.C. Component	100	100	max.	Volts
Total D.C. and Peak.	200	200	max.	Volts
Grid Circuit Resistance.	2.2	2.5♦	max.	Meg.

CLASS A AMPLIFIER

CHARACTERISTICS AND TYPICAL OPERATION:

	Triode No. 1	Triode No. 2	
Plate Voltage	200	250	Volts
Grid Voltage	–7	–8	Volts
Plate Current	5	20	Ma.
Plate Resistance	10500	4100	Ohms
Transconductance	2000	4400	μmhos
Amplification Factor.	21	18	
Grid Voltage for Plate Current of 1 Ma.	–10	- -	Volts
Grid Cutoff Voltage★	–14	- -	Volts

★ For Plate Current of 10 microamperes.

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

§ For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

♦ For cathode bias operation. For fixed bias, value is 1.0 megohm.

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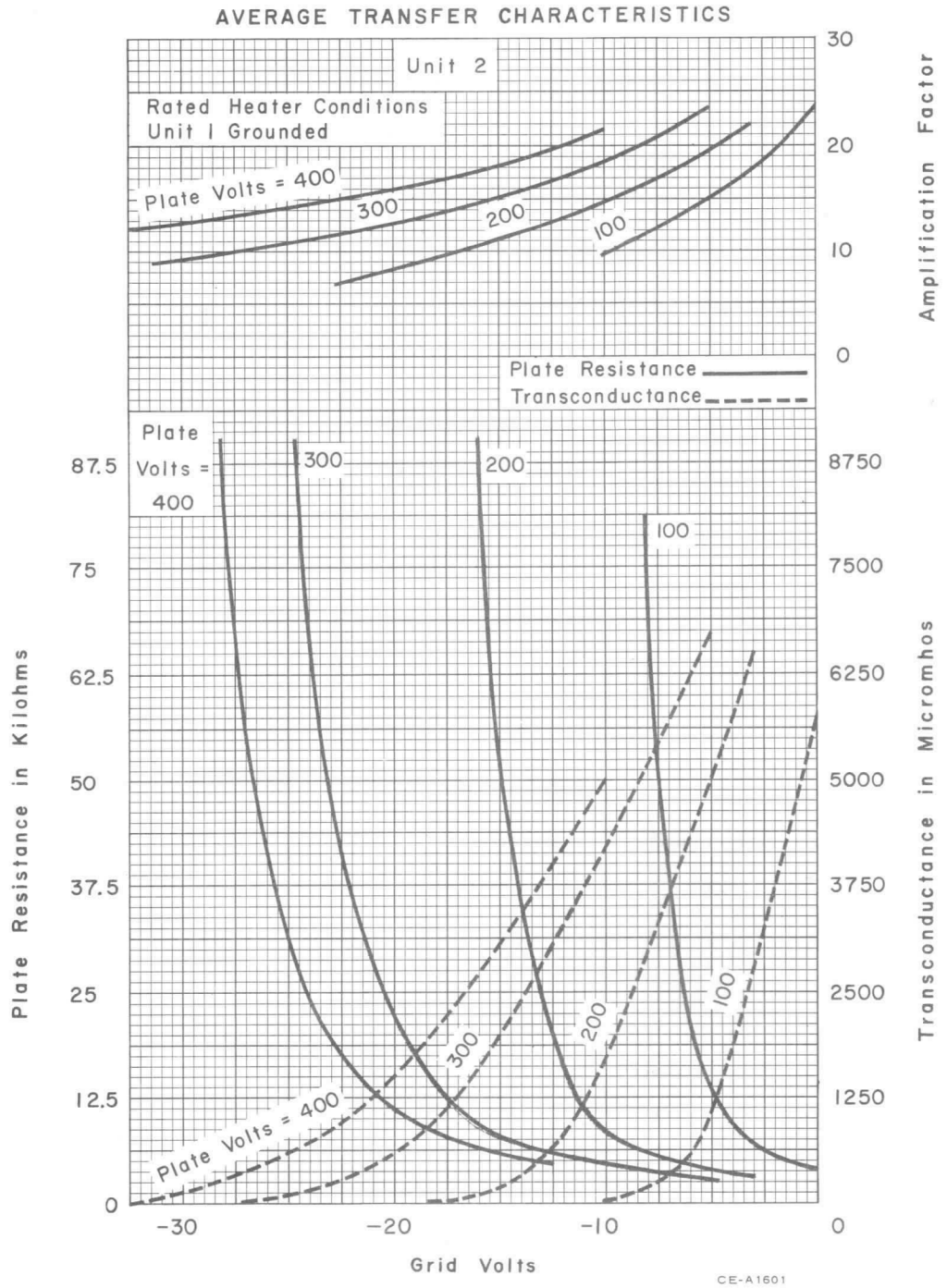
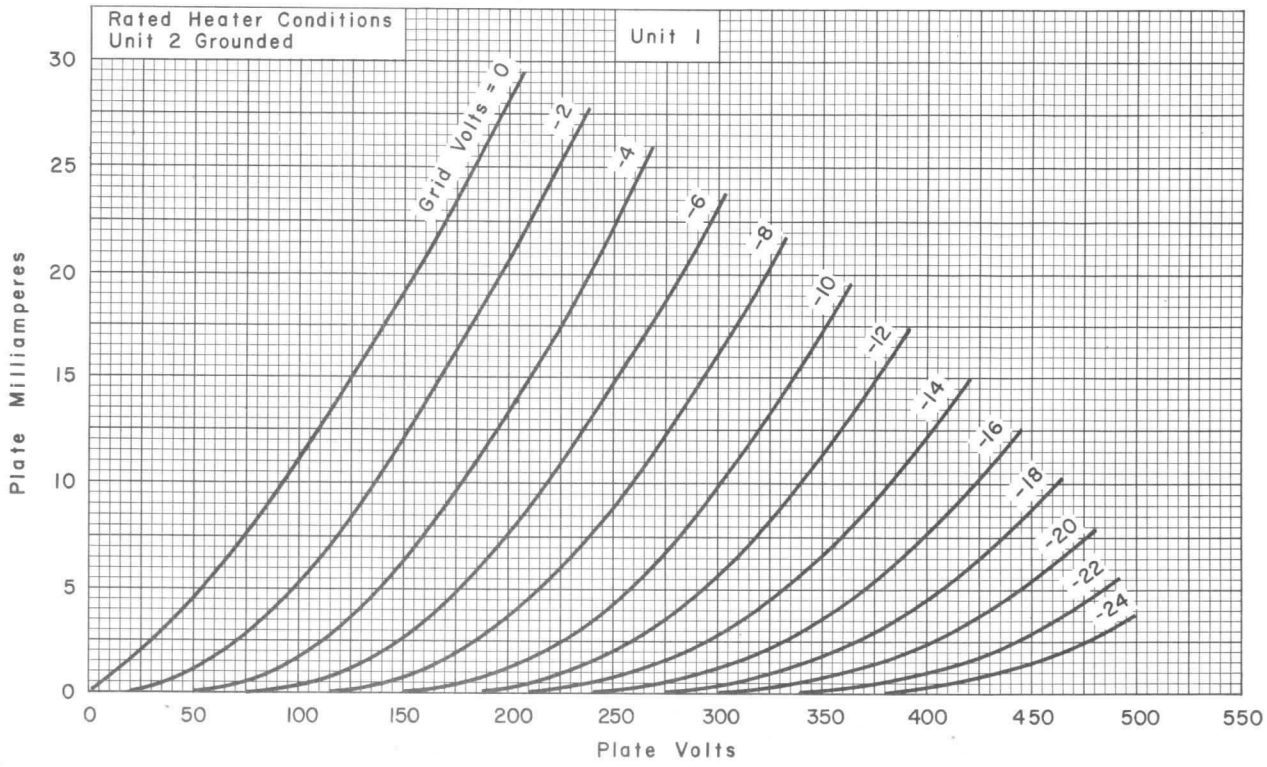
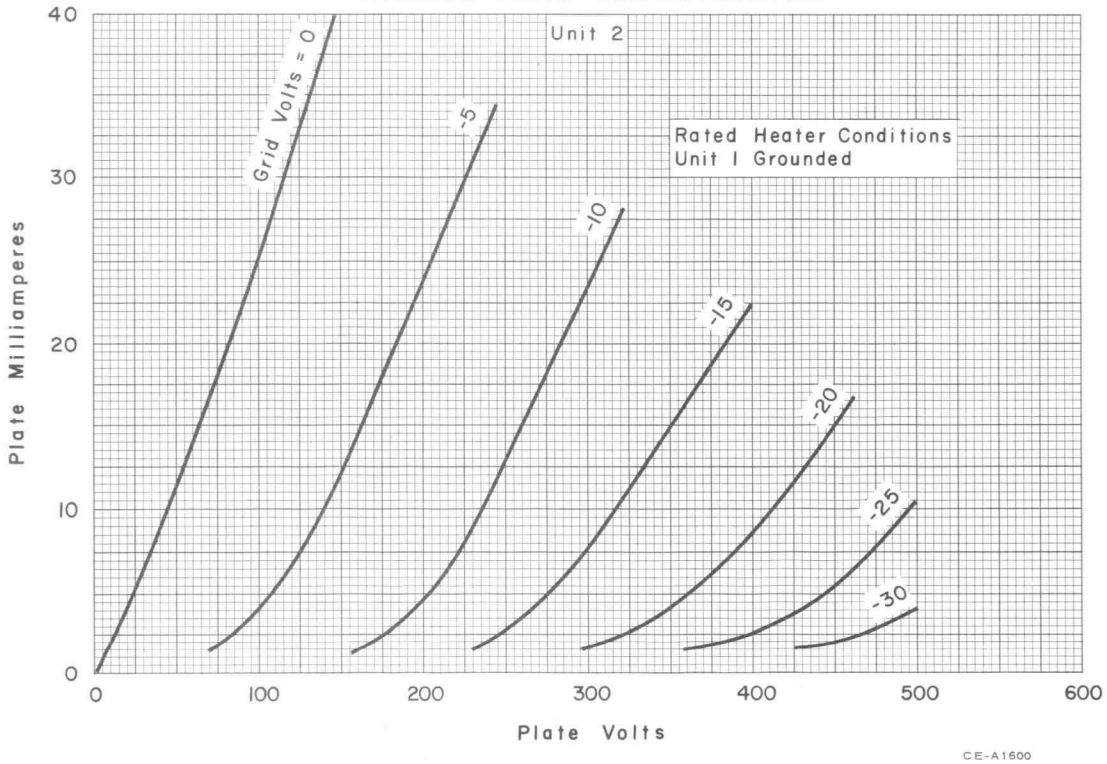


AVERAGE PLATE CHARACTERISTICS



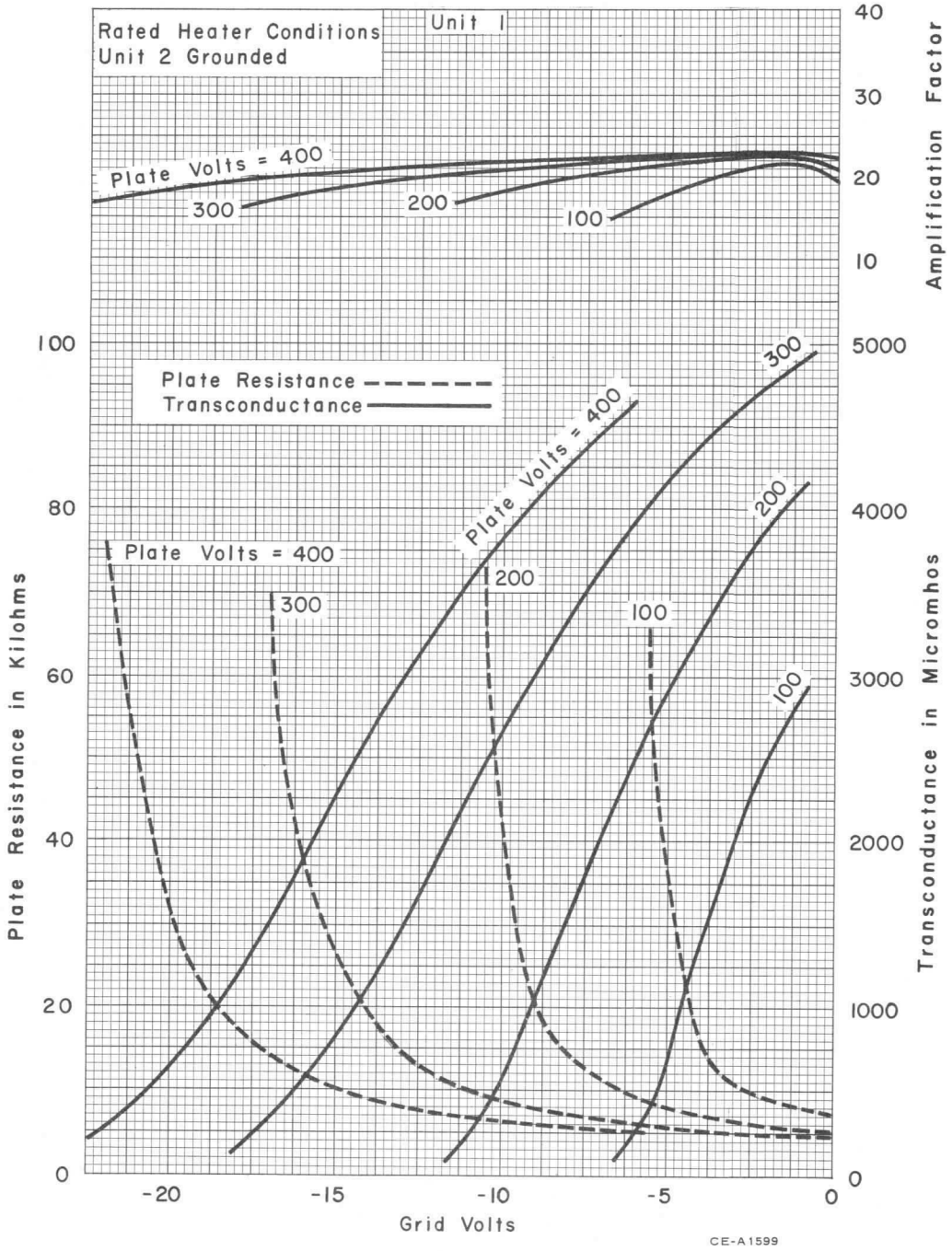
CE-A1598

AVERAGE PLATE CHARACTERISTICS



CE-A1600

AVERAGE TRANSFER CHARACTERISTICS



DUPLEX-DIODE, TRIODE TYPE 6CN7

The 6CN7 is a 9-pin miniature duplex-diode and high mu triode type designed for service as a combined horizontal-phase detector and reactance tube in television receivers. The triode section has a cathode separate from the diode sections and may be used in sync-separator, sync-amplifier or audio amplifier circuits.

The parallel heater connected 6CN7 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathodes	Coated Unipotential		
Heater:	Series	Parallel	
Voltage (ac or dc)	6.3 ± 10%	3.15	Volts
Current	0.30	0.60 ± 6%	Ampere
Warm-up Time	–	11	Seconds
Direct Interelectrode Capacitances (Unshielded)			
Triode Grid to Plate		1.8	μμf
Triode Input		1.5	μμf
Triode Output		0.5	μμf
Grid to Either Diode Plate		0.006	μμf
Diode 1 Plate to Cathode & Heater		3.6	μμf
Diode 2 Plate to Cathode & Heater		3.6	μμf

MECHANICAL

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-2
Basing	9EN
Mounting Position	Any

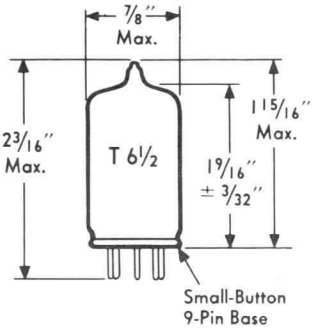
MAXIMUM RATINGS

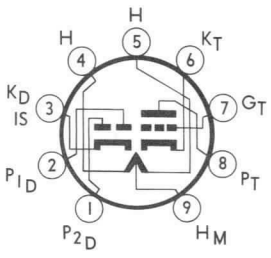
Design-Maximum Values

Triode Plate Voltage	330	max.	Volts
Triode Grid Voltage:			
Positive Bias Value	0	max.	Volts
Triode Plate Dissipation	1.1	max.	Watts
Triode Heater-Cathode Voltage:			
Heater Negative with respect to Cathode:			
Total DC & Peak	200	max.	Volts
Heater Positive with respect to Cathode:			
DC Component	100	max.	Volts
Total DC & Peak	200	max.	Volts
Diode DC Plate Current (Each Unit)	5.5	max.	Ma.
Diode Heater-Cathode Voltage:			
Heater Negative with respect to Cathode:			
Total DC & Peak	200	max.	Volts
Heater Positive with respect to Cathode:			
DC Component	100	max.	Volts
Total DC & Peak	200	max.	Volts

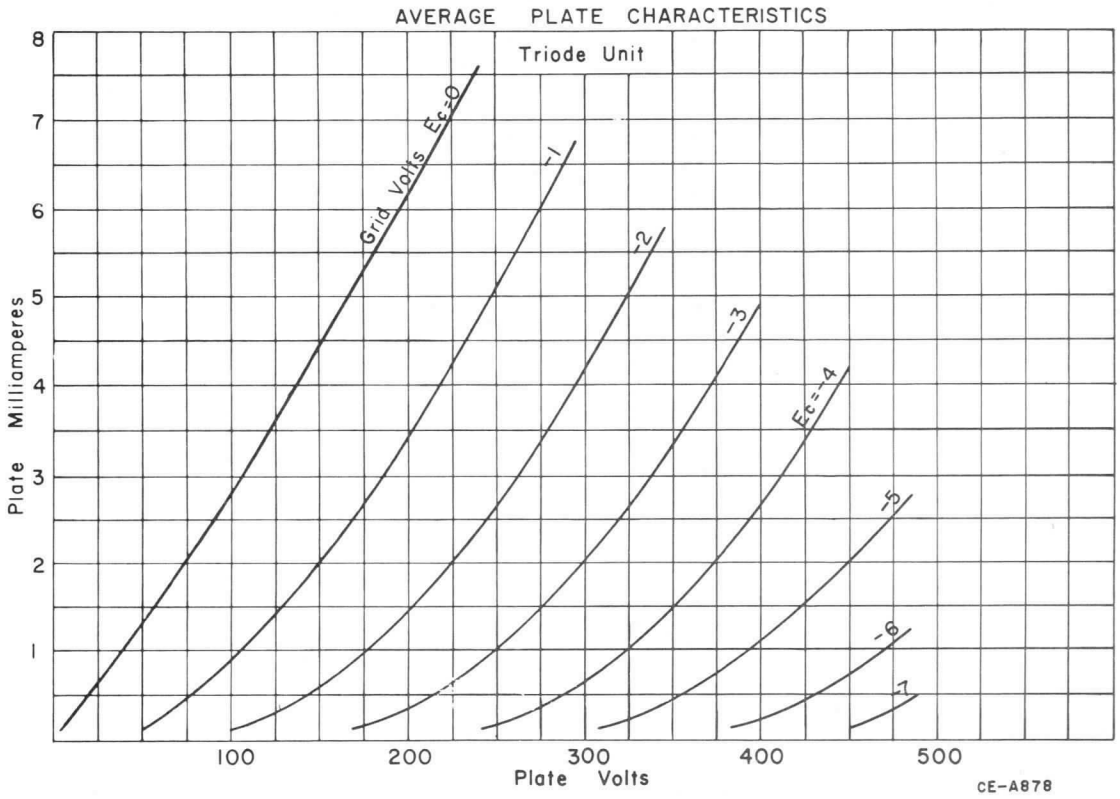
CHARACTERISTICS AND TYPICAL OPERATION

Triode Plate Voltage	100	250	Volts
Triode Grid Voltage	−1	−3	Volts
Triode Amplification Factor	70	70	–
Triode Plate Resistance	54000	58000	Ohms
Triode Transconductance	1300	1200	μmhos
Triode Plate Current	0.8	1.0	Ma.
Diode Current at 5 Volts (Each Unit)	–	20	Ma.





9EN



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6CQ4
17CQ4

September 15, 1962

TELEVISION DAMPING DIODE TYPES AND 17CQ4

The 6CQ4 and 17CQ4 are octal based indirectly-heated half-wave rectifiers designed for television damping diode service in horizontal deflection circuits. The design incorporates a unique glass button suspension and insulation feature which virtually eliminates plate-cathode mica arcing and permits a peak inverse plate voltage rating which is conservative for 110° autotransformer deflection systems. The heater-cathode design and processing control has been improved to permit a pulse voltage breakdown rating equal to the greatly improved inverse rating. Tube voltage drop and DC plate current ratings have been established which permits single tube operation in low B+ as well as wide deflection angle TV systems.

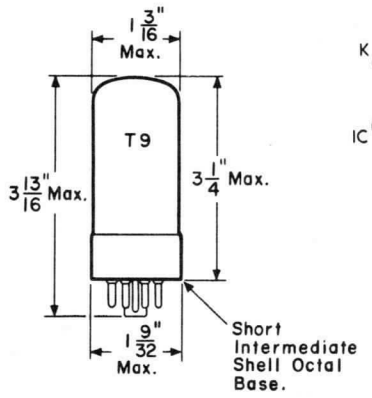
The 17CQ4 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

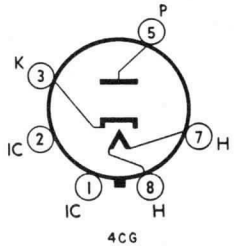
ELECTRICAL

Cathode	Coated Unipotential		
Heater:	6CQ4	17CQ4	
Voltage (ac or dc)	6.3±0.6	17.0	Volts
Current	1.6	0.6	Ampere
Warm-Up-Time (Note 1)	–	11	Seconds
Direct Interelectrode Capacitances:			
Heater to Cathode	4.0		μμf
Plate to Cathode and Heater	8.5		μμf
Cathode to Plate and Heater	11.5		μμf

MECHANICAL

Bulb	T-9
Base (Note 2)	Intermediate-Shell Octal 5-Pin (JEDEC B5-147) Short Intermediate-Shell Octal 5-Pin (JEDEC B5-85)
Basing	4CG
Mounting Position	Any





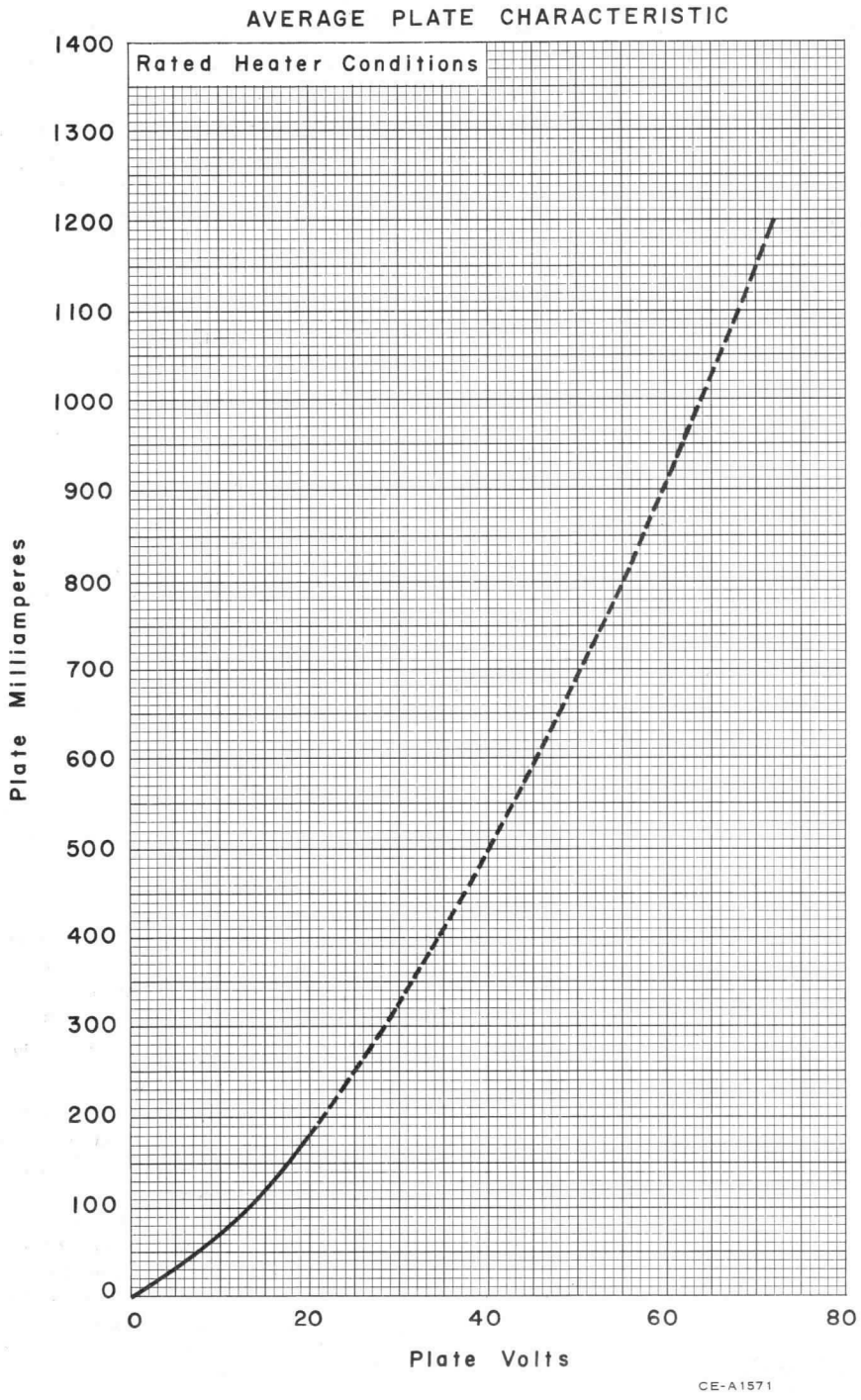
9-44

DAMPER SERVICE (Note 3)

MAXIMUM RATINGS			
Design Maximum Values			
Peak Inverse Voltage	5500	max.	Volts
Peak Plate Current	1200	max.	Ma.
DC Plate Current	190	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode	900	max.	Volts
Total DC and Peak	5500	max.	Volts
Heater Positive with Respect to Cathode	100	max.	Volts
Total DC and Peak	300	max.	Volts
Voltage Drop at I_b = 250 Ma.	25	–	Volts
Plate Dissipation	6.5	max.	Watts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. The JEDEC B5-85 and B5-147 bases specified for use with the above tube type do not have pins in base positions 1, 4, and 6. However positions 1 and 6 have internal connections terminating in stem leads. Base terminal position 2 has a base pin which may be connected to a stem lead. Because of the close proximity of stem leads to the socket pin clips when the tube is seated in the socket, circuit tie points should not be made to socket terminals 1, 2, 4 and 6 unless adequate precautions are taken against voltage breakdown in both the tube base and the socket. To reduce the possibility of arcover, it is recommended socket clips for positions 1, 2, 4 and 6 be removed from the damper tube socket.
3. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle.



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DUAL-CONTROL HEPTODE TYPES 3CS6, 4CS6 AND 6CS6

The 3CS6, 4CS6 and 6CS6 are 7-pin miniature dual-control heptode types designed for service as combined sync separator and sync clipper tubes. In a well-designed circuit they, develop a constant sync output as the sharp cutoff characteristics of grid 3 are particularly suitable to this type of operation.

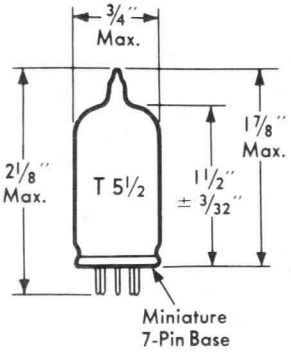
The 3CS6 and 4CS6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristics is controlled.

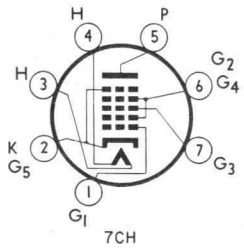
ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	3CS6	4CS6	6CS6	
Voltage	3.15	--	6.3	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time♦	11	11	--	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid 1 to Plate		0.07	max.	μμf
Grid 3 to Plate		0.36	max.	μμf
Grid 1 Input		5.5		μμf
Grid 3 Input		7.0		μμf
Output		7.5		μμf
Coupling (Grid 1 to Grid 3)		0.22	max.	μμf

MECHANICAL:

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CH
Mounting Position	Any





MAXIMUM RATINGS

Design Center Values

Plate Voltage	300	max.	Volts
Plate Dissipation	1.0	max.	Watt
Grid 2 and Grid 4 Voltage	100	max.	Volts
Grid 2 and Grid 4 Supply Voltage	300	max.	Volts
Grid 2 and Grid 4 Dissipation	1.0	max.	Watt
Cathode Current	14	max.	Ma.
Grid 1 Circuit Resistance	0.47	max.	Megohm
Grid 3 Circuit Resistance	2.2	max.	Megohm
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
DC + Peak	200	max.	Volts

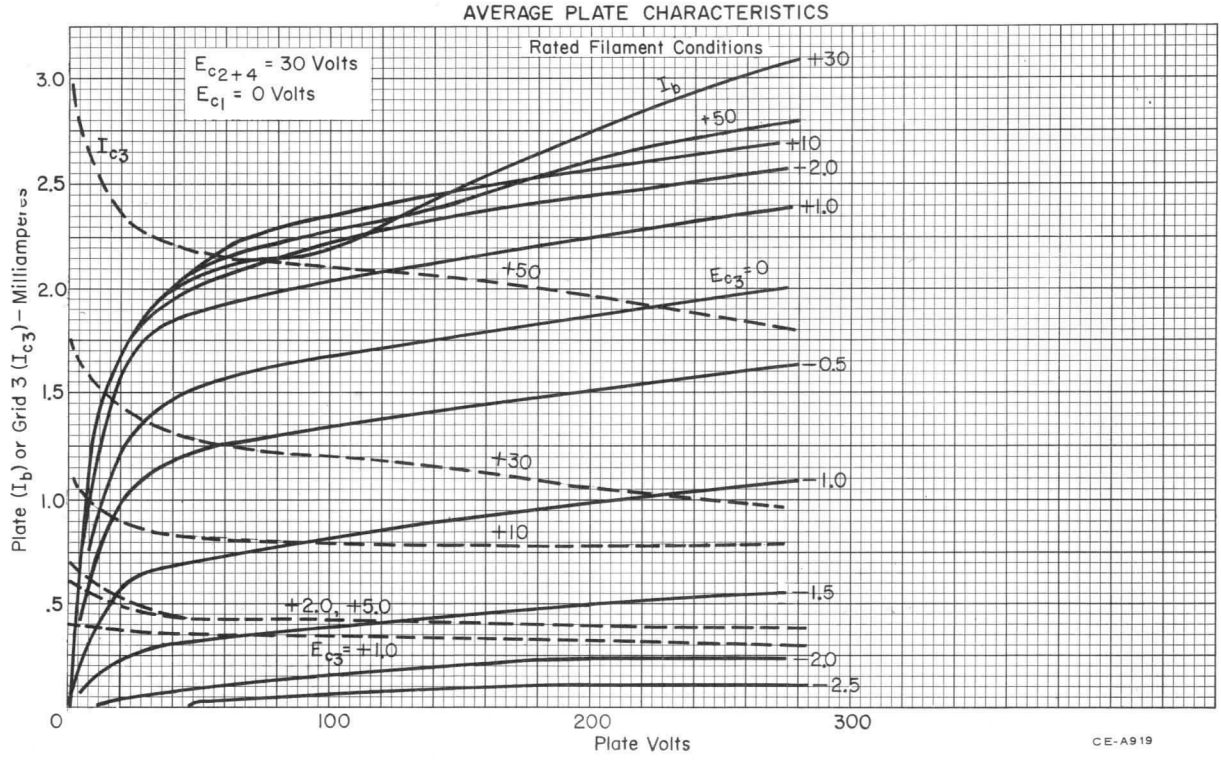
CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	10	100	100	Volts
Grid 2 Voltage	30	30	30	Volts
Grid 1 Voltage	0	0	-1.0	Volts
Grid 3 Voltage	0	-1.0	0	Volts
Plate Current	2.0	0.8	1.0	Ma.
Grid 2 Current	4.5	5.5	1.3	Ma.
Transconductance				
Grid 1	--	--	1100	μmhos
Grid 3	--	1500	--	μmhos
Plate Resistance (Approx.)	--	0.7	1.0	Megohm
Grid 1 Cutoff Voltage⊕	--	--	-2.5	Volts
Grid 3 Cutoff Voltage⊕	--	-2.2	--	Volts

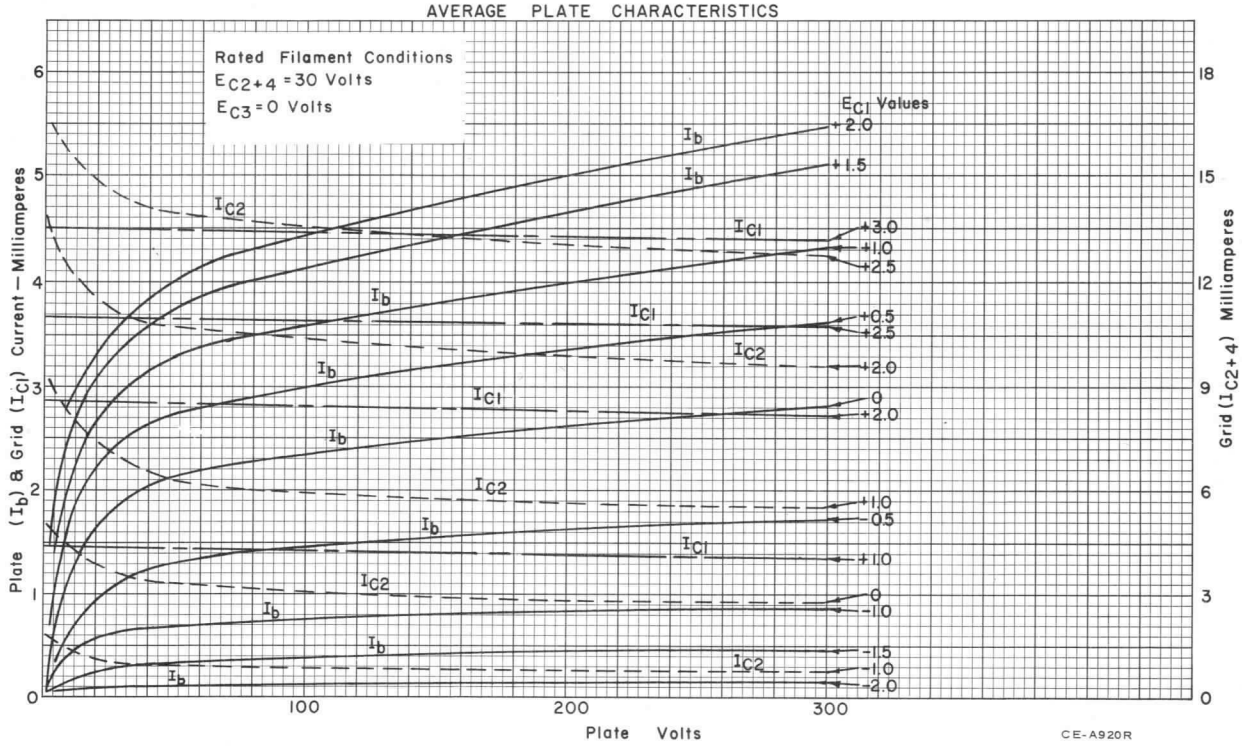
⊕ For plate current of 50 microamperes.

♦ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

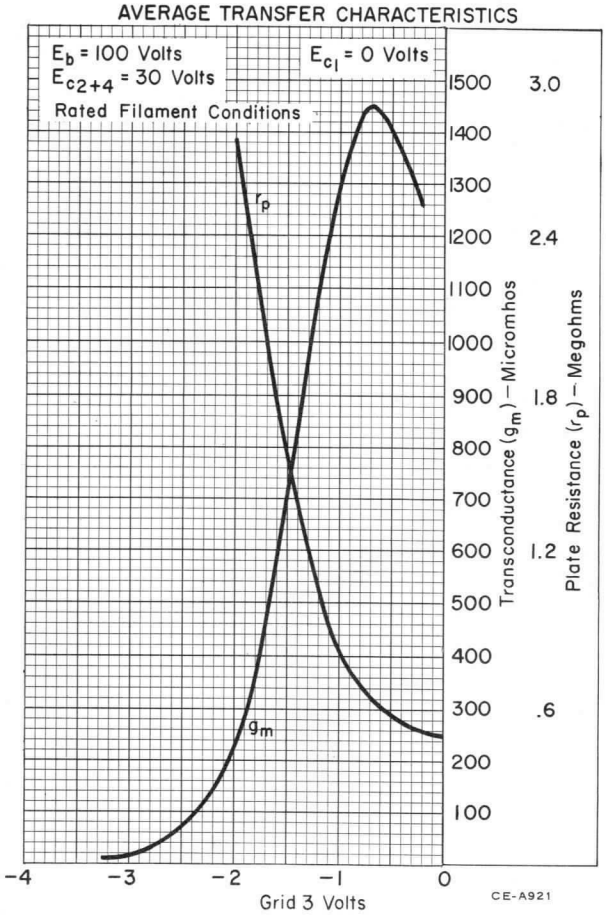
AVERAGE PLATE CHARACTERISTICS



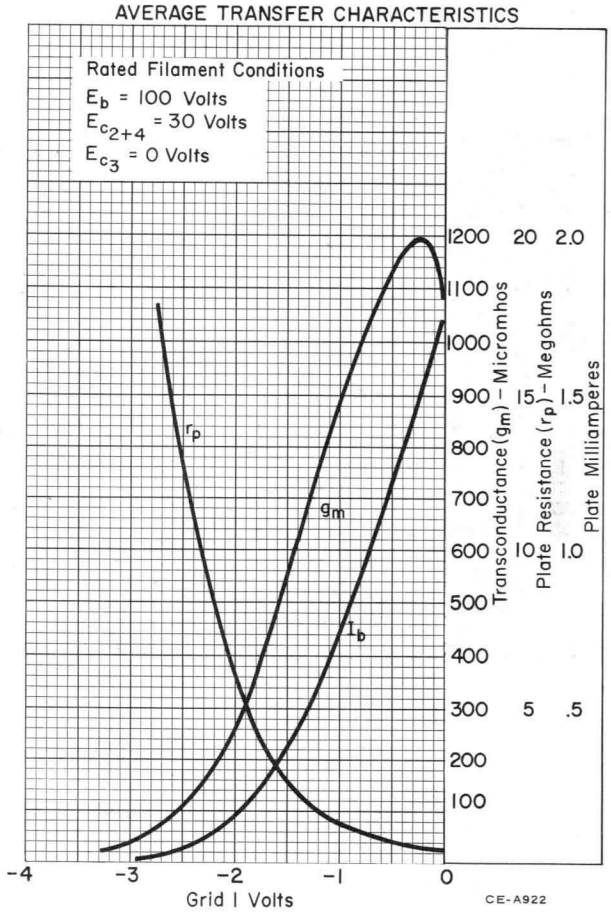
AVERAGE PLATE CHARACTERISTICS



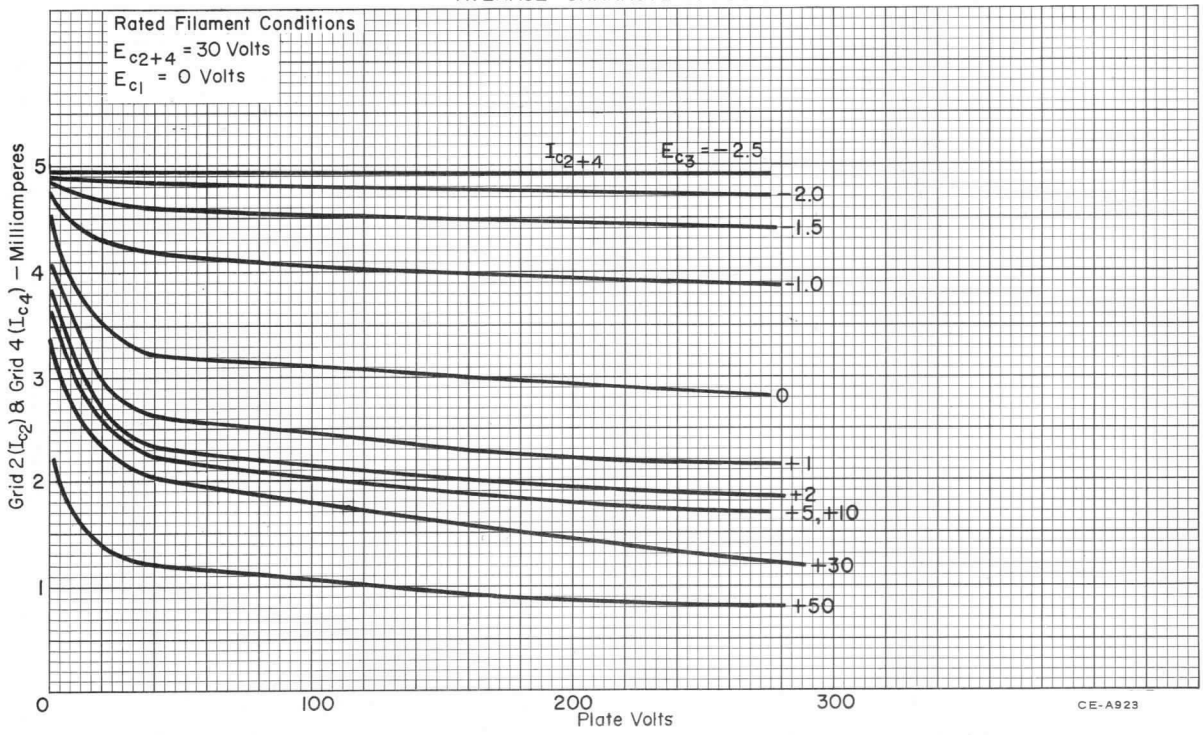
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE CHARACTERISTICS



September 9, 1957

DUAL TRIODE TYPES 6CS7 and 8CS7

The 6CS7 and 8CS7 are dual triodes with dissimilar sections designed for use in television receivers. Triode No. 1 (Pins No. 6, 7 & 8) is designed for service as a vertical deflection oscillator. Triode No. 2 (Pins No. 1, 3 & 9) is designed for operation as a high efficiency vertical deflection output amplifier.

The 6CS7 and 8CS7 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

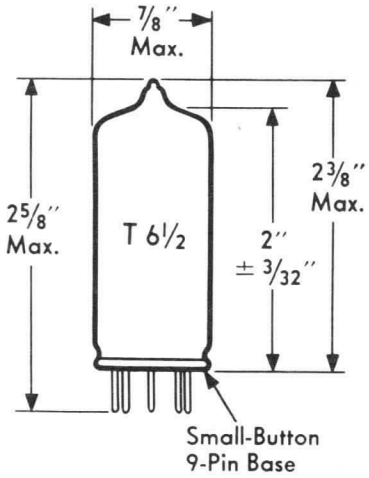
GENERAL DATA

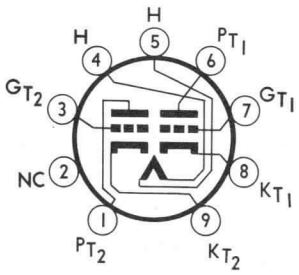
ELECTRICAL:

Cathodes		Coated Unipotential	
Heater:	6CS7	8CS7	
Voltage (ac or dc)	6.3	8.4	Volts
Current	0.60±6%	0.45±6%	Ampere
Warm-up Time▲	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	2.6	2.6	μμf
Input	1.8	3.0	μμf
Output	0.5	0.5	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JETEC E9-1)
Outline	6-3
Basing	9EF
Mounting Position	Any





9EF

MAXIMUM RATINGS

Design Center Values (except as noted)

	Triode No. 1 as Vertical Deflection Oscillator	Triode No. 2 as Vertical Deflection Amplifier §	
Plate Voltage	500	500 max.	Volts
Peak Positive Pulse Plate Voltage (Abs. Max.)		2200 max.	Volts
Peak Negative Grid Voltage	400	250 max.	Volts
Plate Dissipation	1.25	6.5 max.	Watts
Cathode Current	20	30 max.	Ma.
Peak Cathode Current	70	105 max.	Ma.
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total D.C. and Peak	200	200 max.	Volts
Heater Positive with Respect to Cathode			
D.C. Component	100	100 max.	Volts
Total D.C. and Peak	200	200 max.	Volts
Grid Circuit Resistance	2.2	2.2 max.	Meg.

CLASS A AMPLIFIER

CHARACTERISTICS AND TYPICAL OPERATION

	Triode No. 1	Triode No. 2	
Plate Voltage	250	250	Volts
Grid Voltage	-8.5	-10.5	Volts
Plate Current	10.5	19	Ma.
Plate Resistance	7700	3450	Ohms
Transconductance	2200	4500	μmhos
Amplification Factor	17	15.5	
Grid Voltage for Plate Current of 3 Ma.		-16	Volts
Grid Cutoff Voltage	-24★	-22♦	Volts

★ For Plate Current of 10 μa.

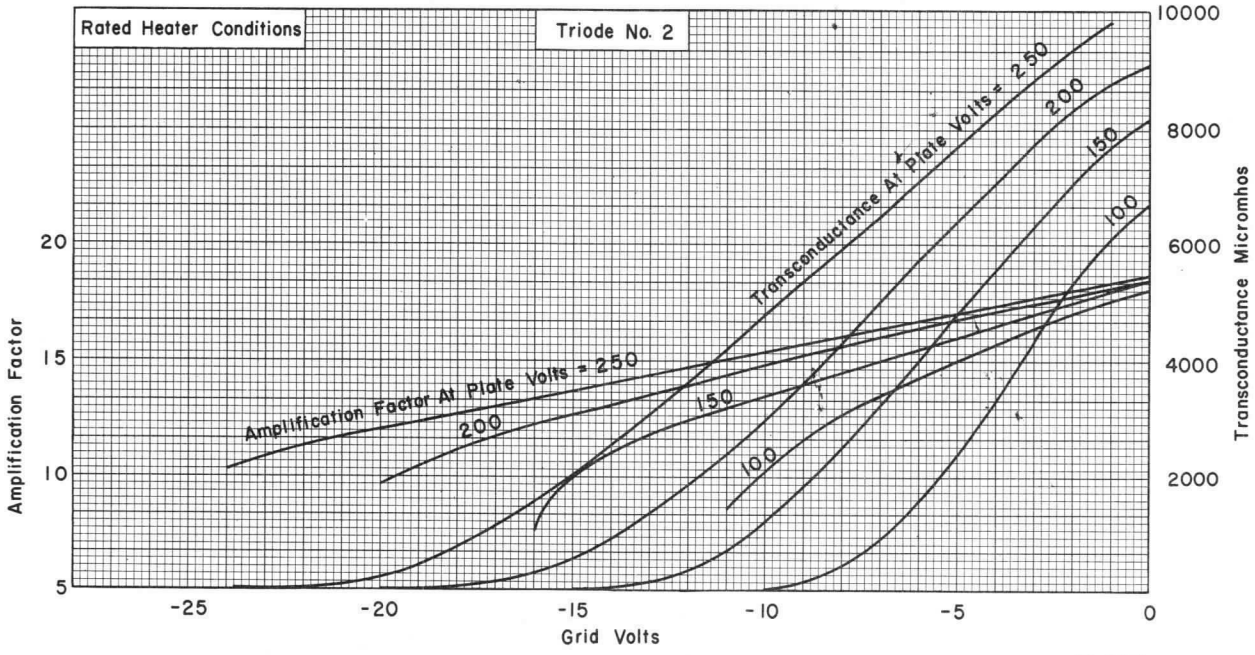
♦ For Plate Current of 50 μa.

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

§ For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

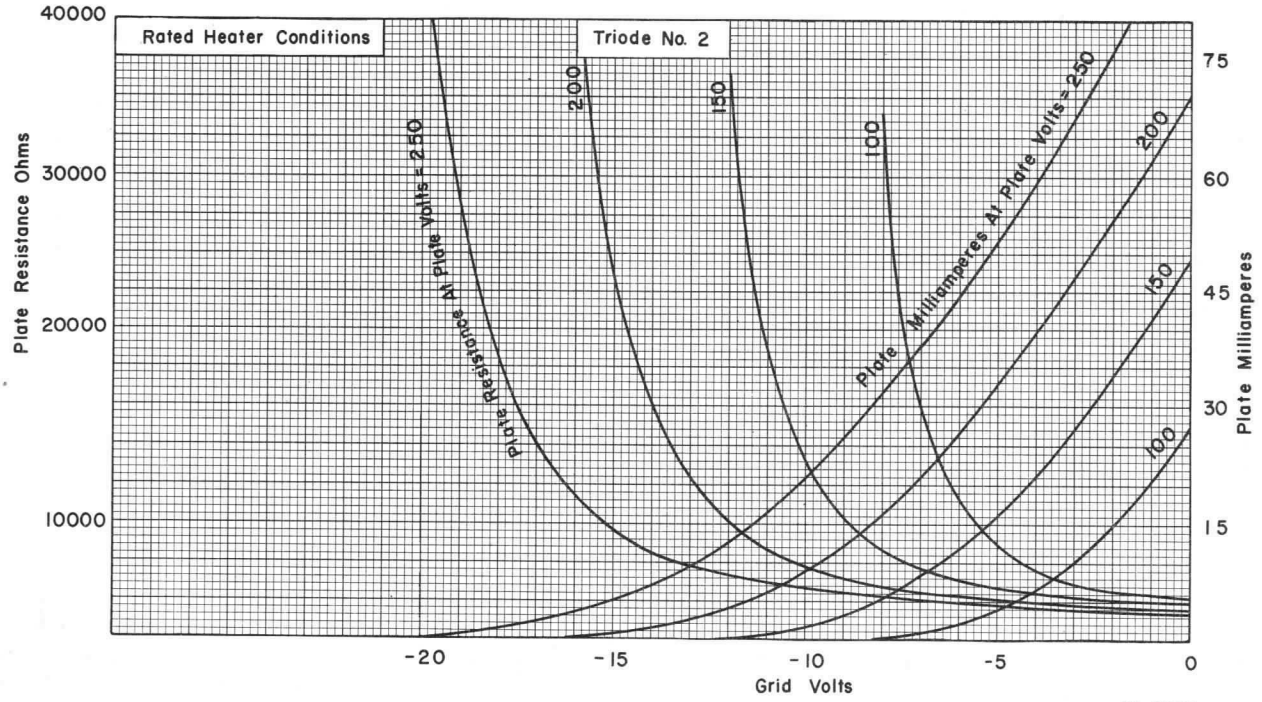
Receiving Tube Section

AVERAGE CHARACTERISTICS



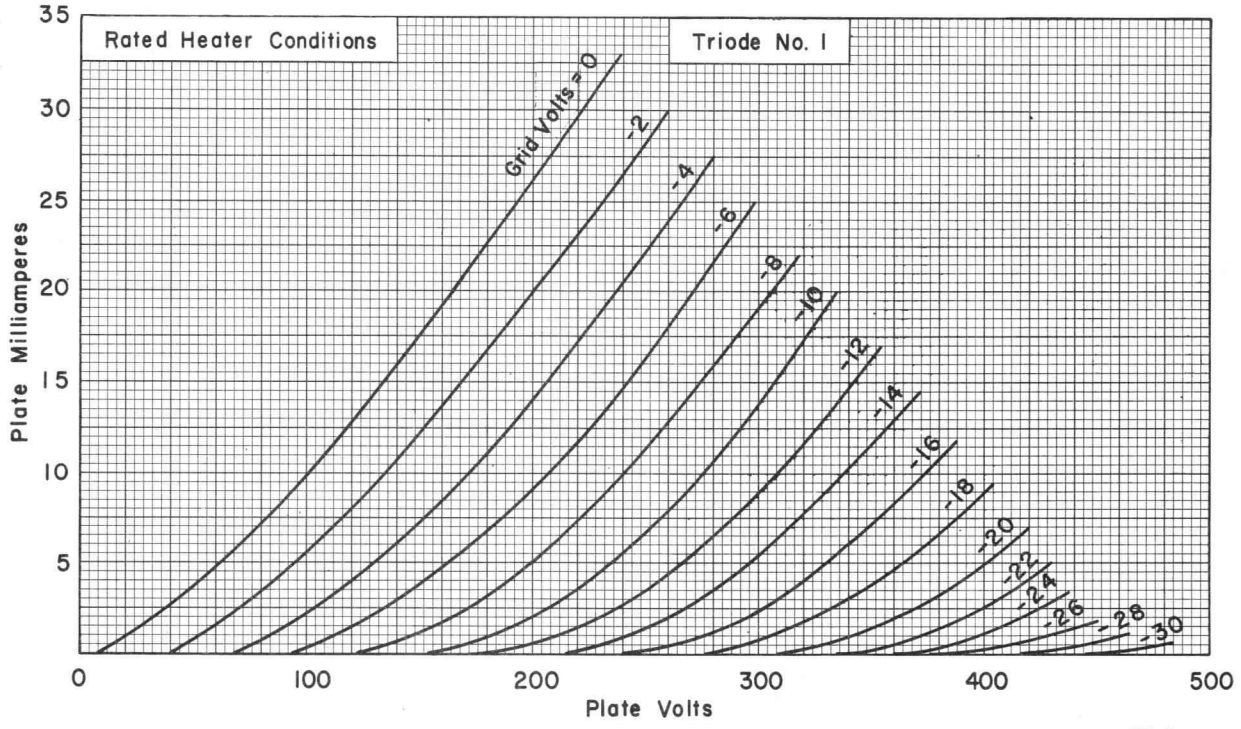
CE-AII178

AVERAGE TRANSFER CHARACTERISTICS



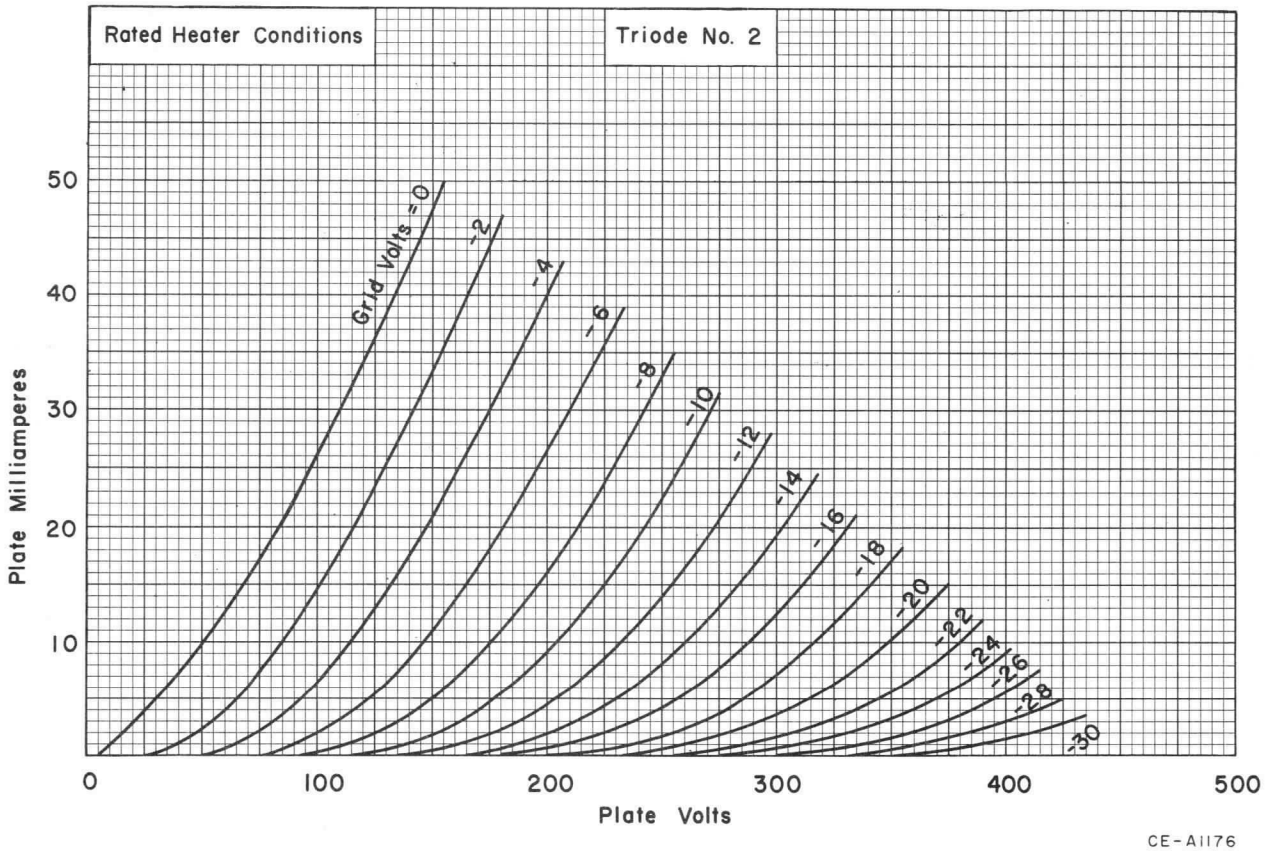
CE-AI204

AVERAGE PLATE CHARACTERISTICS



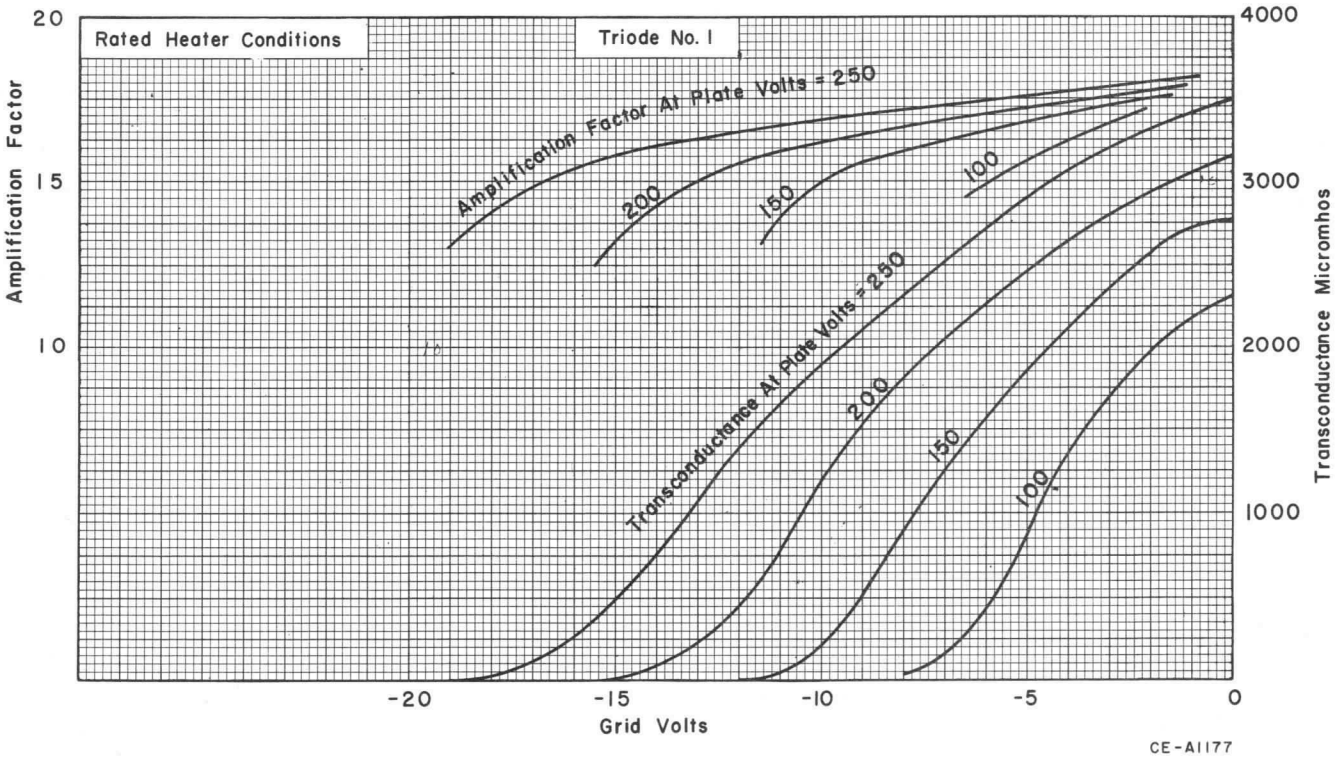
CE-A1174

AVERAGE PLATE CHARACTERISTICS

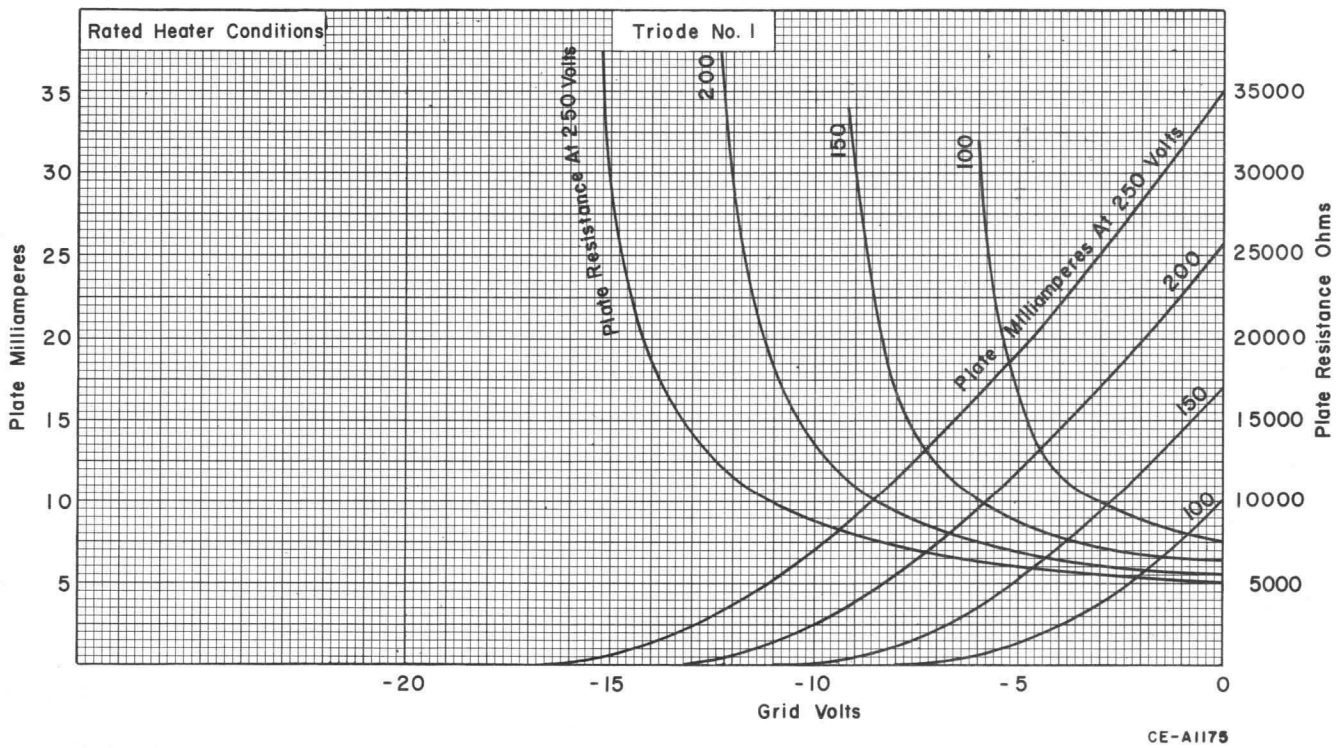


CE-A1176

AVERAGE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



October 1, 1957

HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6CU6, 6CU6/6BQ6-GA, 12CU6, 12CU6/12BQ6-GA AND 25CU6/25BQ6-GA

The 6CU6, 6CU6/6BQ6-GA, 12CU6, 12CU6/12BQ6-GA and 25CU6/25BQ6-GA are octal based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero-bias plate current and high maximum peak positive pulse plate voltage ratings.

The 12CU6 and 12CU6/12BQ6-GA have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When they are employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

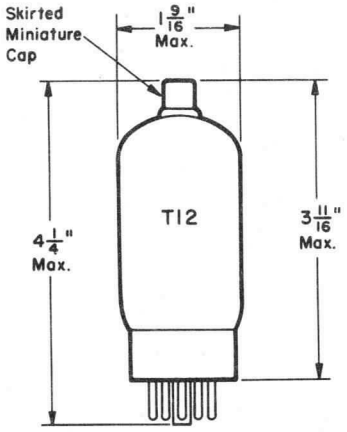
GENERAL DATA

ELECTRICAL:

Cathode			Coated Unipotential	
Filament:	6CU6 6CU6/ 6BQ6-GA	12CU6 12CU6/ 12BQ6-GA	25CU6 25CU6/ 25BQ6-GA	
Voltage (ac or dc)	6.3	12.6	25.0	Volts
Current	1.20	0.60	0.30	Ampere
Warm-up Time+	..	11	..	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid to Plate			0.6	uuf
Input			15.0	uuf
Output			7.0	uuf

MECHANICAL:

Bulb	T-12
Base	Intermediate Shell Octal
Basing	6AM
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

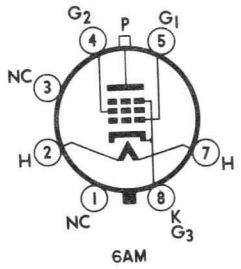


HORIZONTAL DEFLECTION AMPLIFIER

MAXIMUM RATINGS:

Design Center Values

D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	600	max.	Volts
Peak Positive Plate Voltage	6000 abs.	max.	Volts
Peak Negative Plate Voltage	1250	max.	Volts
Plate Dissipation▲	11	max.	Watts
Peak Negative Grid 1 Voltage	300	max.	Volts
D.C. Grid 2 Voltage	200	max.	Volts
Grid 2 Dissipation	2.5	max.	Watts
Average Cathode Current	110	max.	Ma.
Peak Cathode Current	400	max.	Ma.
Grid 1 Circuit Resistance	0.47	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
HeaterPositive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



6AM

AVERAGE CHARACTERISTICS

PENTODE OPERATION		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	-22.5	Volts
Plate Current	57	Ma.
Grid 2 Current	2.1	Ma.
Transconductance	5900	umhos
Plate Resistance	14500	Ohms
ZERO BIAS		
Plate Voltage□	60	Volts
Grid 2 Voltage□	150	Volts
Plate Current⊕	260	Ma.
Grid 2 Current⊕	26	Ma.
CUTOFF		
Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Plate Current	1.0	Ma.
Grid 1 Voltage	43	Volts
TRIODE AMPLIFICATION FACTOR		
Plate Voltage	150	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	-22.5	Volts
Amplification Factor	4.3	Volts

ϕ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations: Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

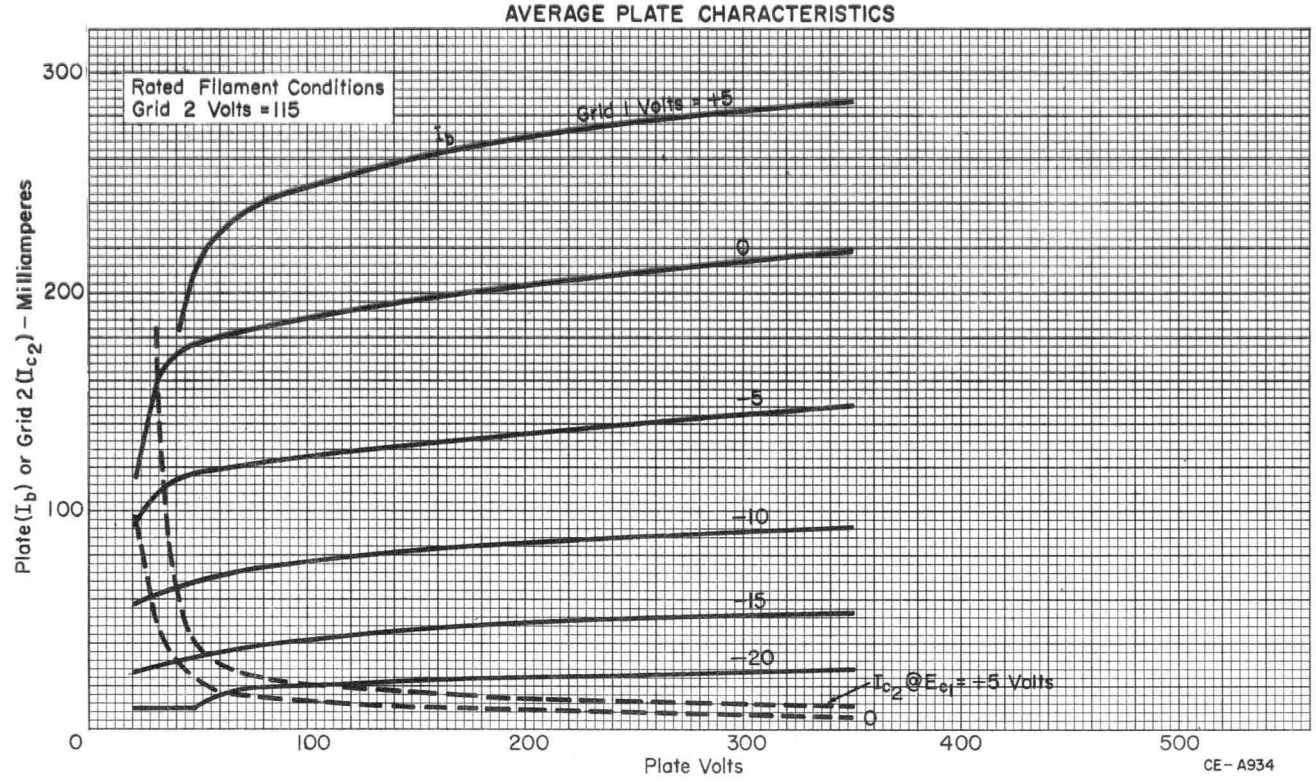
▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

+ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

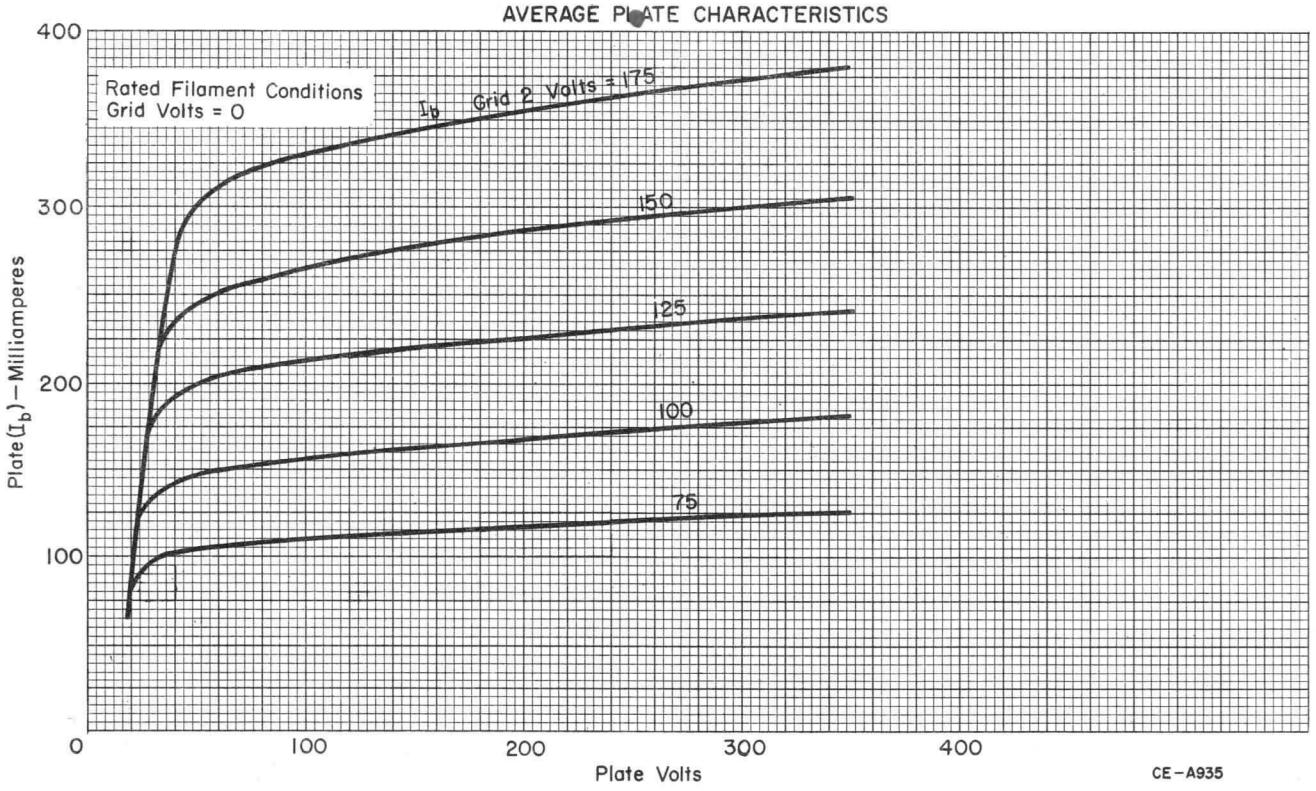
□ Applied for short interval (maximum of two seconds) so as not to damage tube.

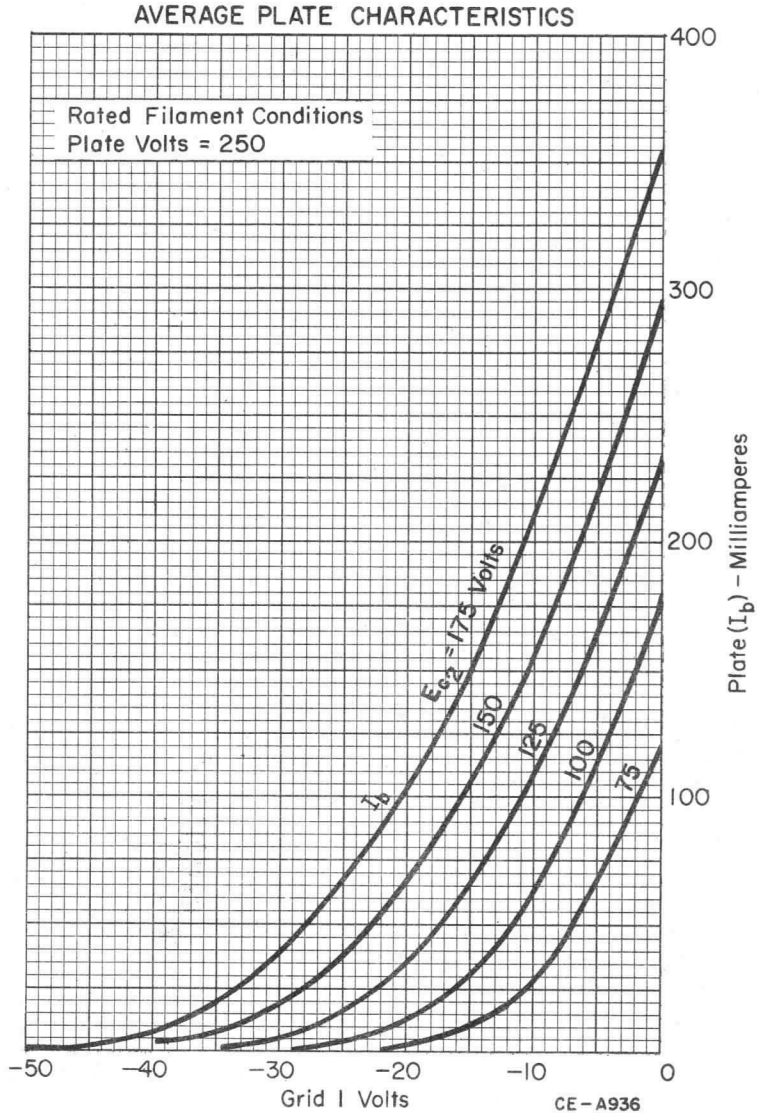
⊕ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS




AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Plate Volts = 250
400
300
200
100
Plate (I_b) - Milliamperes
E_{c2} = 175 Volts
150
125
100
75
I_b
−50
−40
−30
−20
−10
0
Grid 1 Volts
CE-A936

October 1, 1958

SHARP CUTOFF TETRODE TYPES 2CY5, 3CY5, 4CY5 and 6CY5

The 2CY5, 3CY5, 4CY5 and 6CY5 are miniature sharp cutoff tetrodes designed particularly for service in VHF tuners of television receivers. The structural and process features of these tubes provide improved gain-to-noise ratio. The high input impedance permits a most favorable gain-bandwidth factor. The high input impedance is made possible in part by use of two cathode leads, while high plate current to screen current ratio contributes to low noise output. These high performance tubes are further designed to operate with the relatively low plate and screen potentials encountered in series string sets.

The 2CY5, 3CY5 and 4CY5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

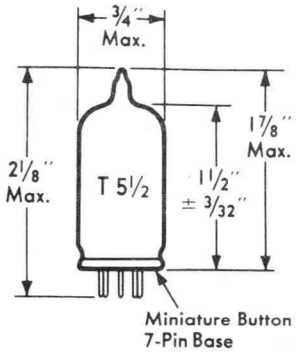
ELECTRICAL:

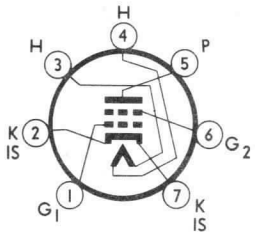
Cathode				Coated Unipotential	
Heater:	2CY5	3CY5	4CY5	6CY5	
Voltage (ac or dc)	2.4	2.9	4.5	6.3	Volts
Current	0.6	0.45	0.30	0.20	Ampere
Warm-up Time ▲	11	11	11	. .	Seconds
Direct Interelectrode Capacitance (Shielded)*:					
Grid 1 to Plate				0.030	max. uuf
Input				4.4	uuf
Output				2.80	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7EW
Mounting Position	Any

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.





7EW

MAXIMUM RATINGS:

Design Maximum Values**

Plate Voltage		180	max. Volts
Grid 2 (Screen) Supply Voltage		180	max. Volts
Grid 2 Voltage		See Grid 2 Input Rating Chart	
Plate Dissipation		2.0	max. Watts
Grid 2 Dissipation		0.5	max. Watts
Grid 1(Control Grid) Voltage:			
Positive Value		0	max. Volts
Cathode Current		20	max. Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:	2,3,4CY5	6CY5	
Total DC and Peak	200	100	max. Volts
Heater Positive with Respect to Cathode:			
DC	100	50	max. Volts
Total DC and Peak	200	100	max. Volts
Grid Circuit Resistance		.5	Megohm

CHARACTERISTICS & TYPICAL OPERATION:

Plate Voltage	125	Volts
Grid 2 Voltage	80	Volts
Grid 1 Voltage	-1	Volts
Plate Resistance	0.125	Megohm
Transconductance	8000	umhos
Grid 1 Cutoff Bias #	-6	Volts
Plate Current	10	Ma.
Grid 2 Current	1.4	Ma.

* With JETEC shield no. 316 connected to cathode.

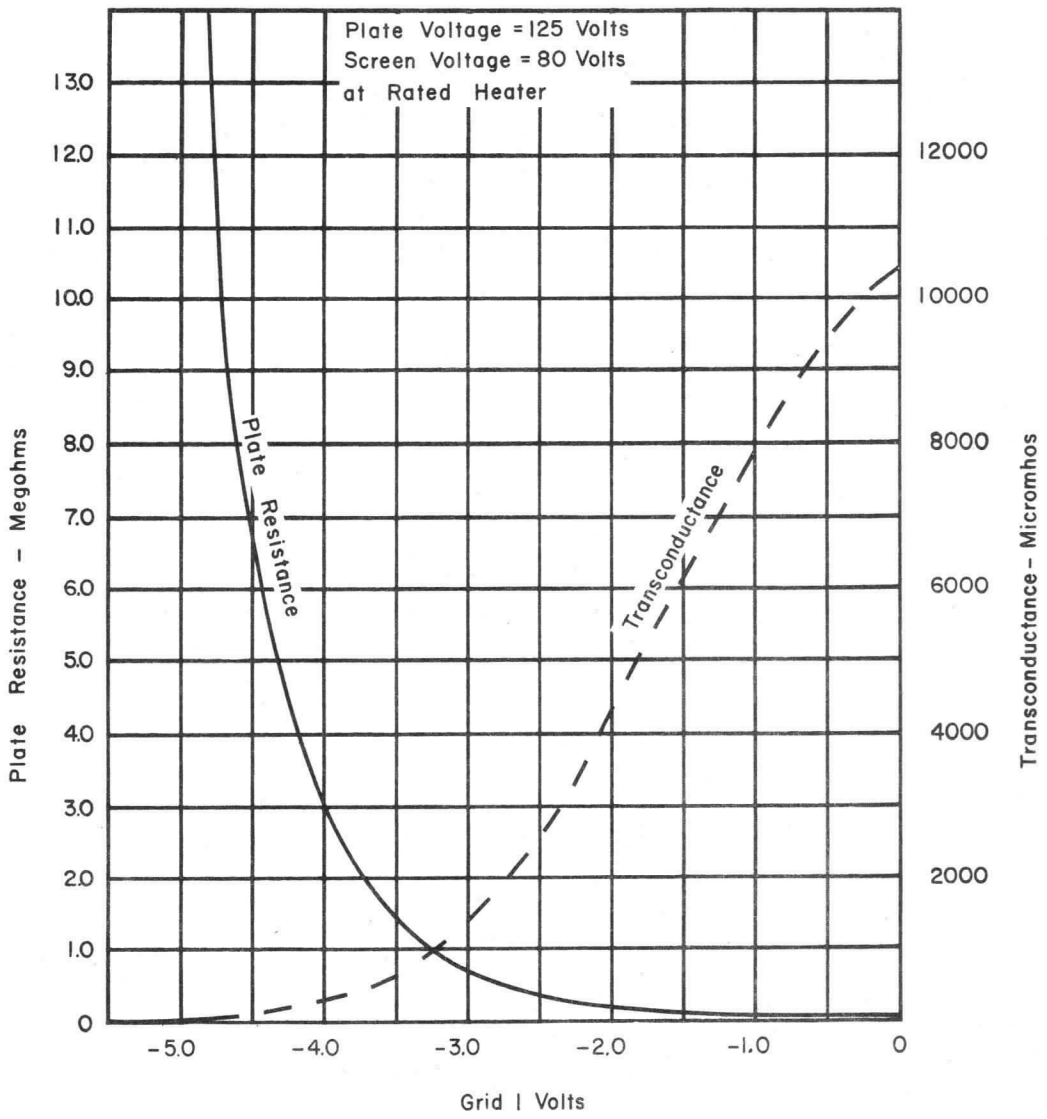
\# For Plate Current of 20 ua.

**Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibllity for the effects of changes in operating conditions due to variations in device characteristics.

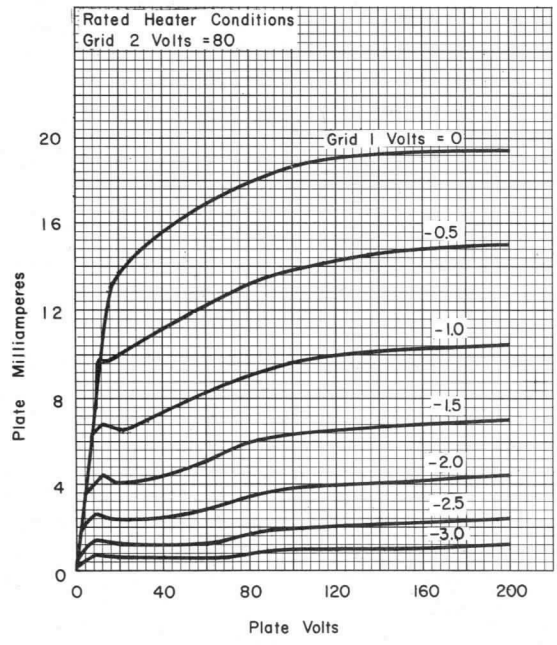
The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

AVERAGE CHARACTERISTICS



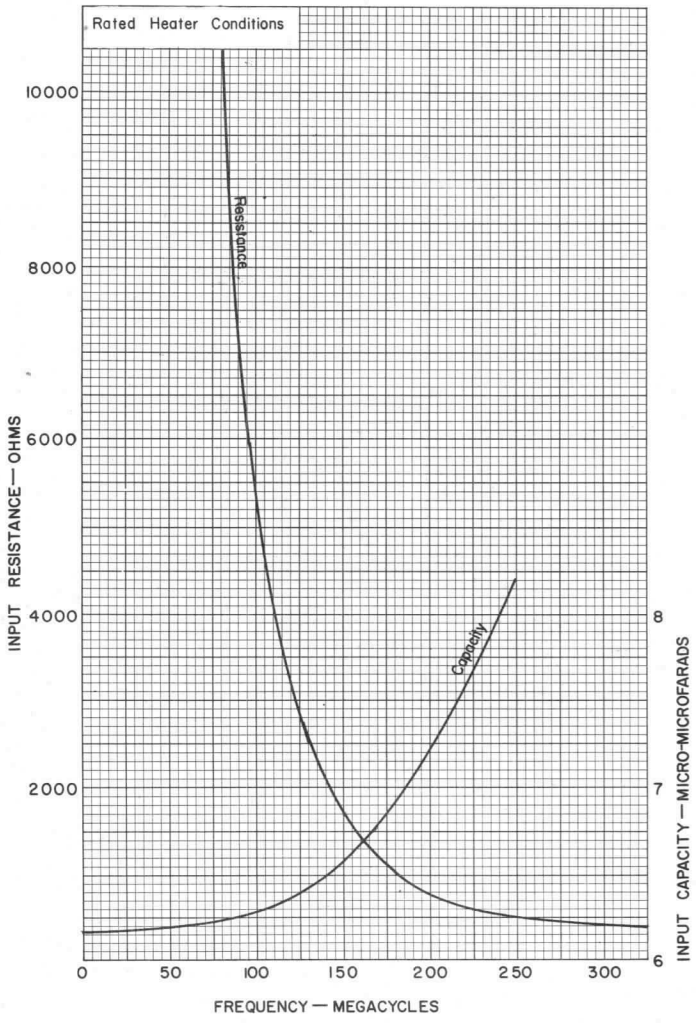
CE-A1257R1

AVERAGE PLATE CHARACTERISTICS



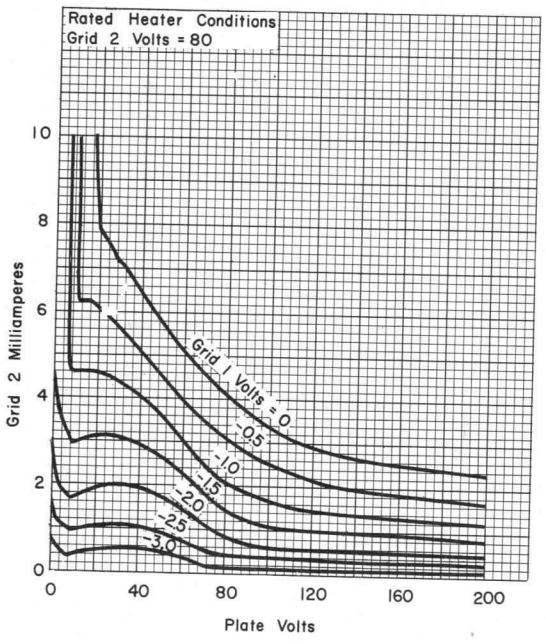
CE-A1381R1

HOT INPUT IMPEDANCE CHARACTERISTICS



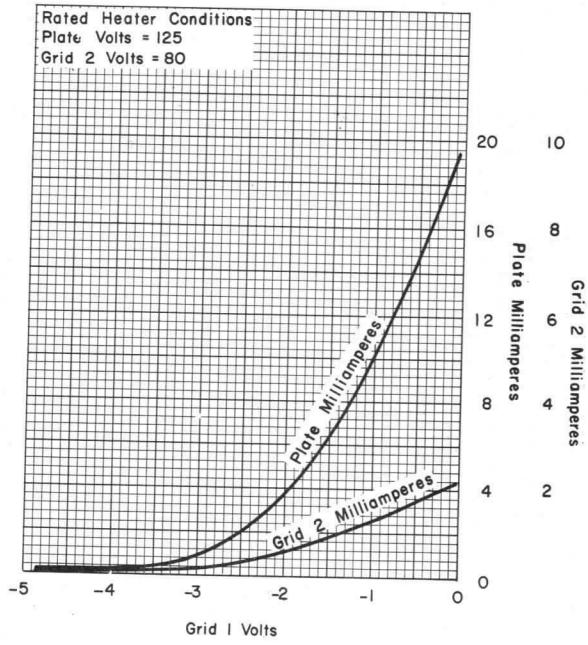
CE-A1258

AVERAGE GRID 2 CHARACTERISTICS



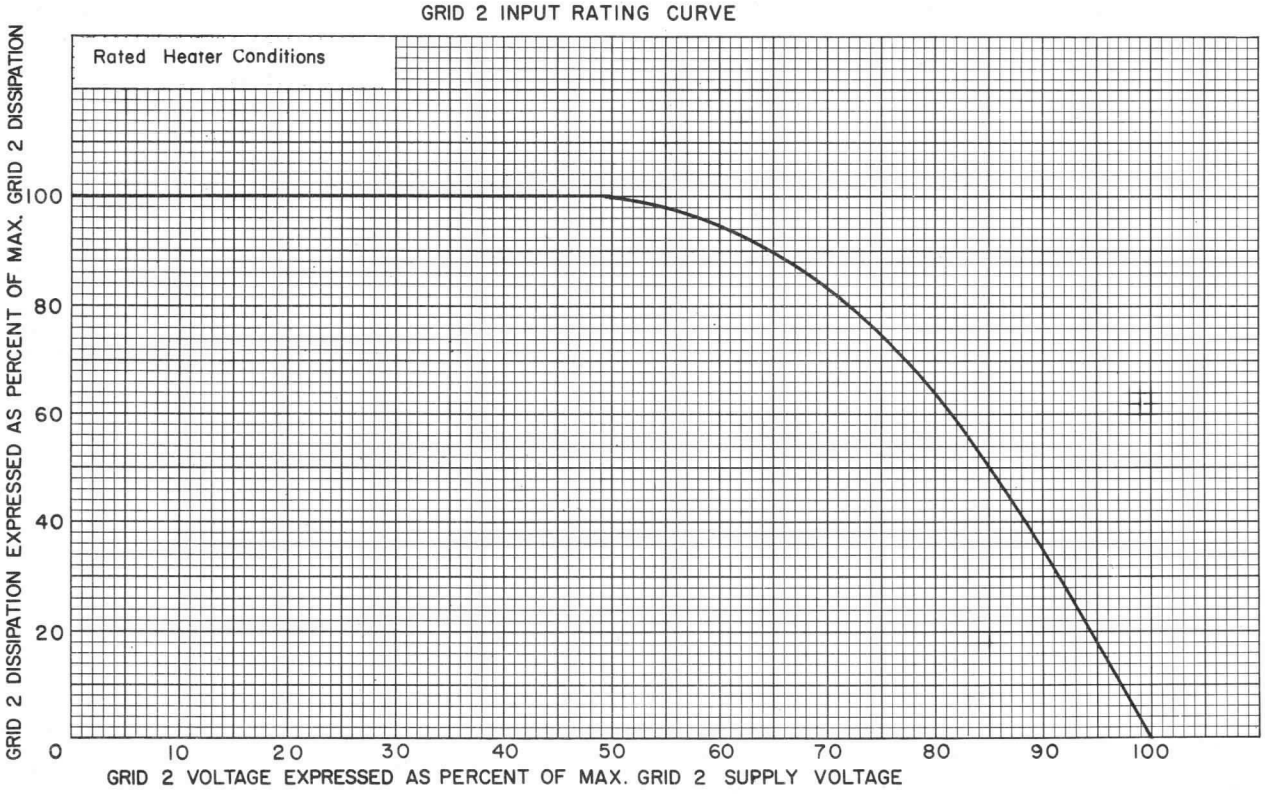
CE-A1387R1

AVERAGE TRANSFER CHARACTERISTICS



CE-A1256R2

GRID 2 INPUT RATING CURVE



December 19, 1958

DUAL-CONTROL SHARP-CUTOFF PENTODE TYPE 6DB6

The 6DB6 is a 7-pin miniature dual-control sharp-cutoff pentode designed for service as a color demodulator in television receivers. The sharp-cutoff characteristic of grid 3 and the high grid 1 and grid 3 to plate transconductance make this tube ideal for gating, mixing and sync separator applications also.

GENERAL DATA

ELECTRICAL:		
Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.3	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.0035	uuf
Grid 3 to Plate	1.5	uuf
Grid 1 Input	6.0	uuf
Output	5.0	uuf
Grid 3 to All Other Elements	3.0	uuf
Coupling (Grid 1 to Grid 3)	0.09	uuf
MECHANICAL:		
Bulb	T-5-1/2	
Base	Miniature 7-Pin (JETEC E7-1)	
Outline	5-2	
Basing	7EN	
Mounting Position	Any	

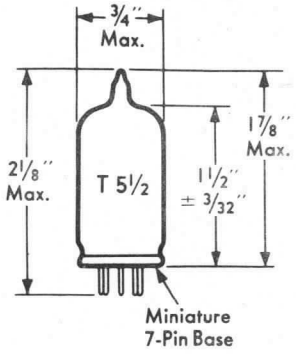
CHARACTERISTICS

Plate Voltage	150	Volts
Grid 2 (Screen) Voltage	150	Volts
Grid 3 Voltage	-3.0	Volts
Grid 1 Voltage	*-1.0	Volts
Plate Resistance	50,000	Ohms
Transconductance:		
Grid 1 to Plate	2050	umhos
Grid 3 to Plate	1000	umhos
Plate Current	5.8	Ma.
Grid 2 Current	6.6	Ma.
Grid 1 Cutoff□	-6.5	Volts
Grid 3 Cutoff♦	-9.5	Volts

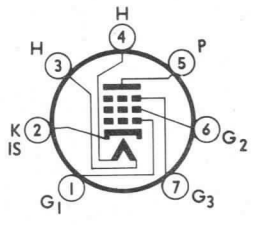
MAXIMUM RATINGS:

Design Center Values

Plate Voltage	300 max.	Volts
Grid 2 Supply Voltage	300 max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart	
Positive Grid 1 Voltage	0 max.	Volts
Plate Dissipation	3.0 max.	Watts
Grid 2 Dissipation	1.0 max.	Watt
Heater-Cathode Voltage:		
Heater Positive with Respect to Cathode:		
DC Component	100 max.	Volts
Total DC and Peak	200 max.	Volts
Heater Negative with Respect to Cathode:		
Total DC and Peak	200 max.	Volts

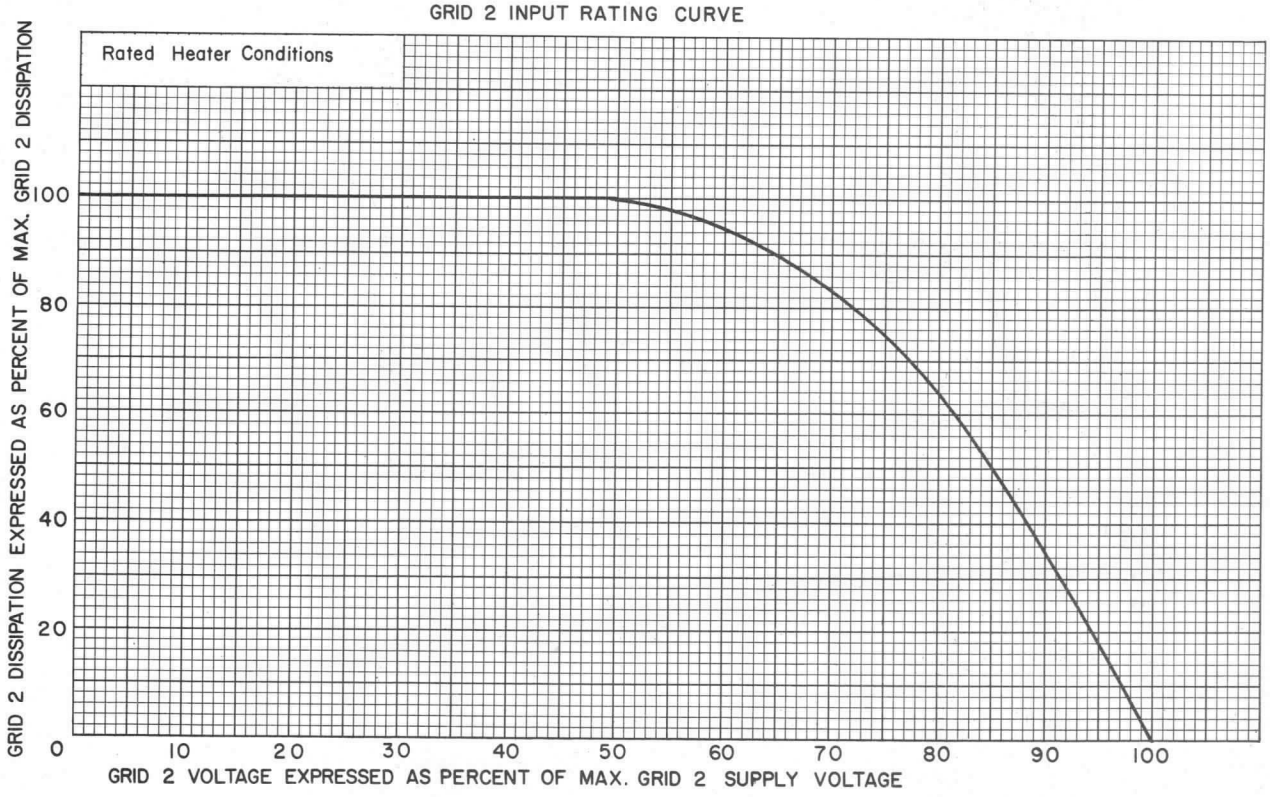


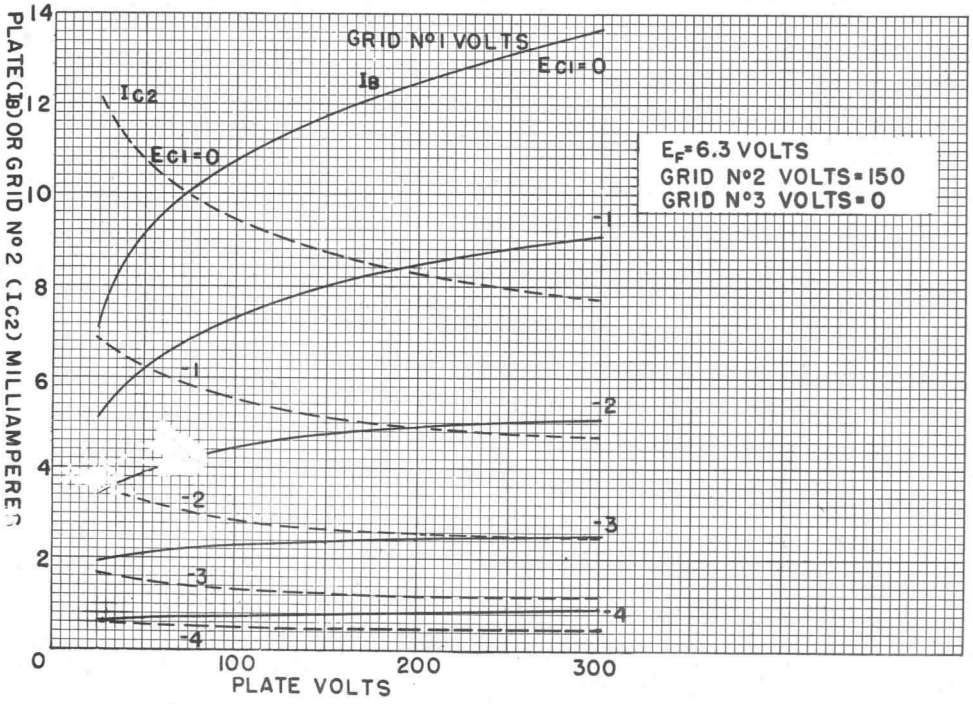
Miniature 7-Pin Base



7EN

GRID 2 INPUT RATING CURVE





FULL-WAVE VACUUM RECTIFIER TYPE 3DG4

The 3DG4 is a glass-octal, full-wave high-vacuum rectifier having a directly heated coated cathode and designed for service in power supplies of high current requirements. The tube may be mounted in any position. Like all power handling tubes, the 3DG4 should be adequately ventilated.

ELECTRICAL

Cathode	Directly Heated Coated Cathode	
Voltage (ac or d-c)	3.3 ± 10%	Volts
Current	3.8	Amperes

MECHANICAL

Bulb	T-12
Base	Short, Medium Shell Octal, 5-Pin
Basing	5DE
Mounting Position	Any

RECTIFIER SERVICE

MAXIMUM RATINGS

Design Maximum Values

Peak Inverse Plate Voltage	1050 max.	Volts
AC Plate Supply Voltage Each Plate (RMS)	See Rating Chart 1	
Maximum DC Output Current Each Plate	See Rating Chart 1	
Steady-State Peak Plate Current Each Plate (See Chart II)	1200 max.	Ma.
Transient Peak Plate Current Each Plate (See Chart III)	6.5 max.	Ampere
Bulb Temperature	200 max.	°C

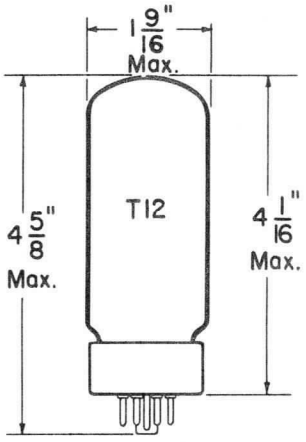
TYPICAL OPERATION AS FULL-WAVE RECTIFIER

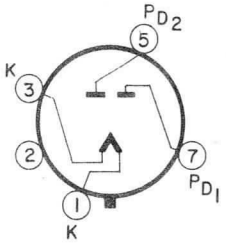
Capacitor Input to Filter

AC Plate Supply Voltage Each Plate (RMS)	275	Volts
Input Capacitor	40	μf
Effective Plate Supply Resistance Each Plate	32	Ohms
DC Output Current	350	Ma.
DC Output Voltage at Filter Input	300	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop (Measured with Tube Conducting 350 Ma. Each Plate)	25	Volts





5DE

APPLICATION NOTES

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the 3DG4 is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are interdependent, and they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and for choke-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor-input filter, operation is permissible within the area bounded by points F A E D G; with choke-input filter, operation is permissible within the area bounded by points F A B C D G.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined by the equation:

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}\ Es}$$

where $\bar{E}$ is the dc output voltage at input to filter and Es is the rms plate supply voltage per plate.

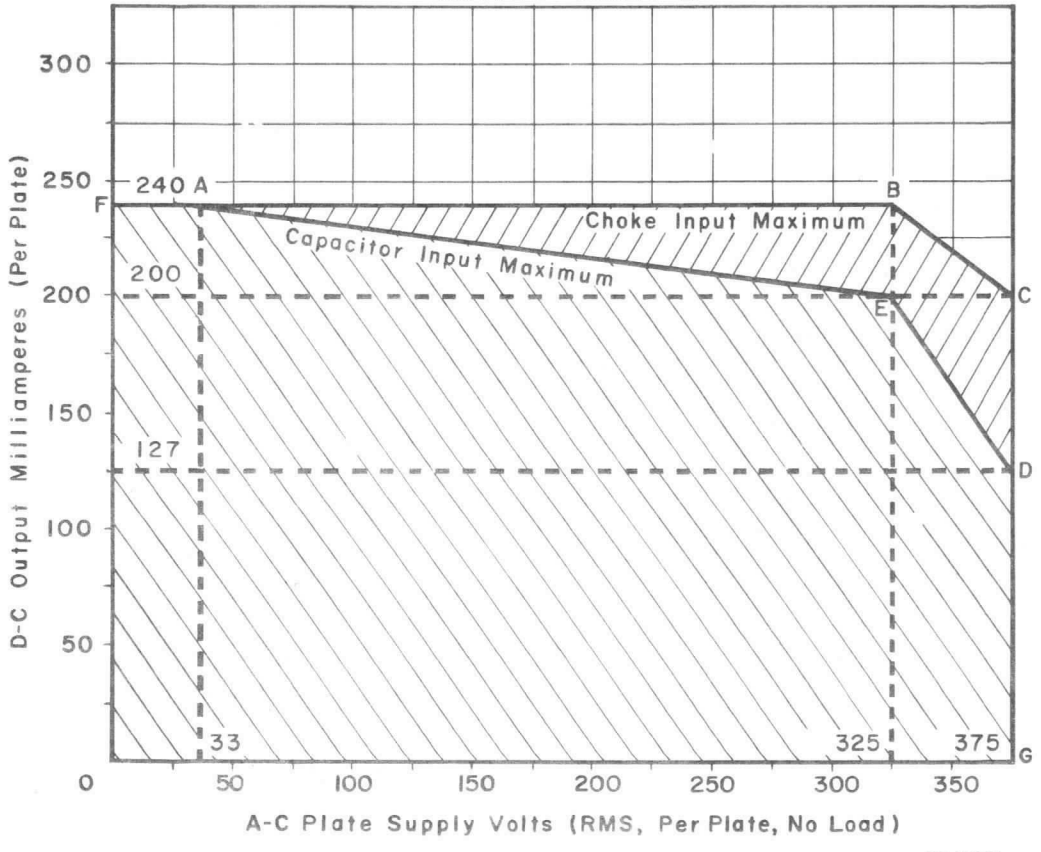
Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of:

$$R_S = N^2 R_{PRI.} + R_{SEC.} + R_A$$

where N is the voltage step-up ratio of the plate transformer, $R_{PRI.}$ is the dc resistance of the transformer primary, $R_{SEC.}$ is the average dc resistance of each transformer secondary section, and R_A is the additional resistance required.

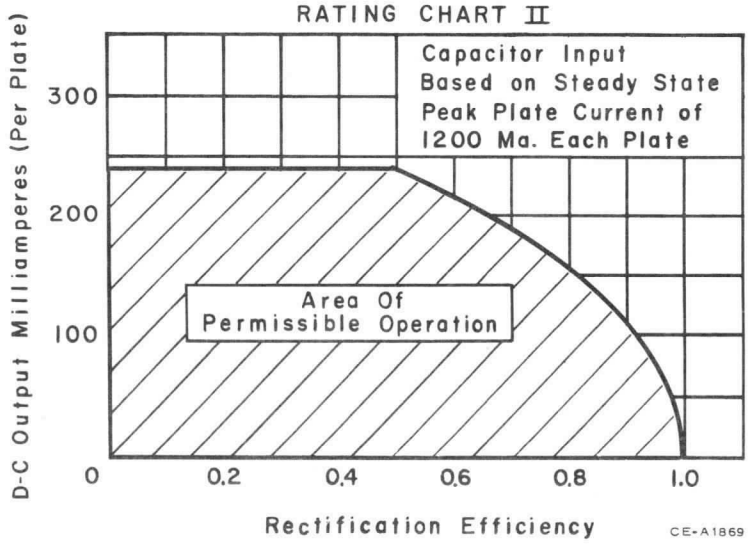
In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

RATING CHART I

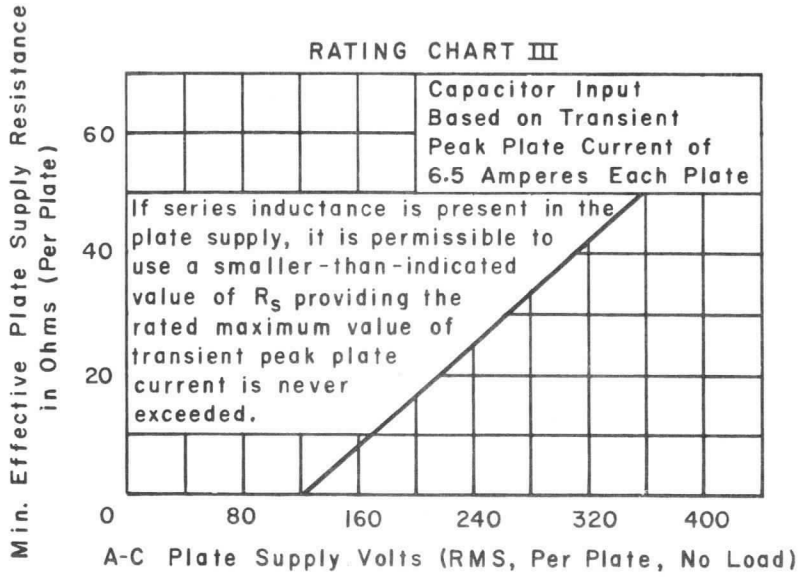


CE-A1868

RATING CHART II



RATING CHART III



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BEAM POWER AMPLIFIER TYPE 6DG6-GT

The 6DG6-GT is a beam pentode type used in the audio output stage. This type features high power sensitivity and plate efficiency at low plate and screen voltages.

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	1.2	Amperes
Direct Interelectrode Capacitances:		
Grid to Plate	0.6	μμf
Input	15	μμf
Output	10	μμf

MECHANICAL:

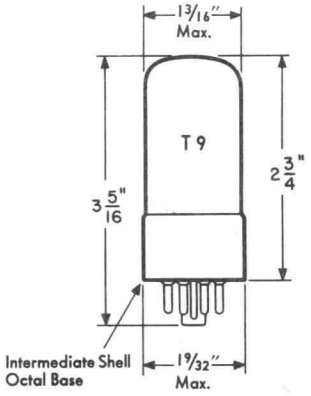
Bulb	T-9
Base	Intermediate Shell Octal 7-Pin (JEDEC B7-7)
Basing	7AC
Mounting Position	Any

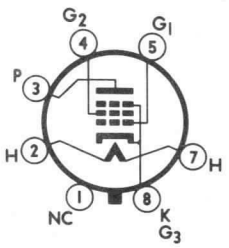
MAXIMUM RATINGS:

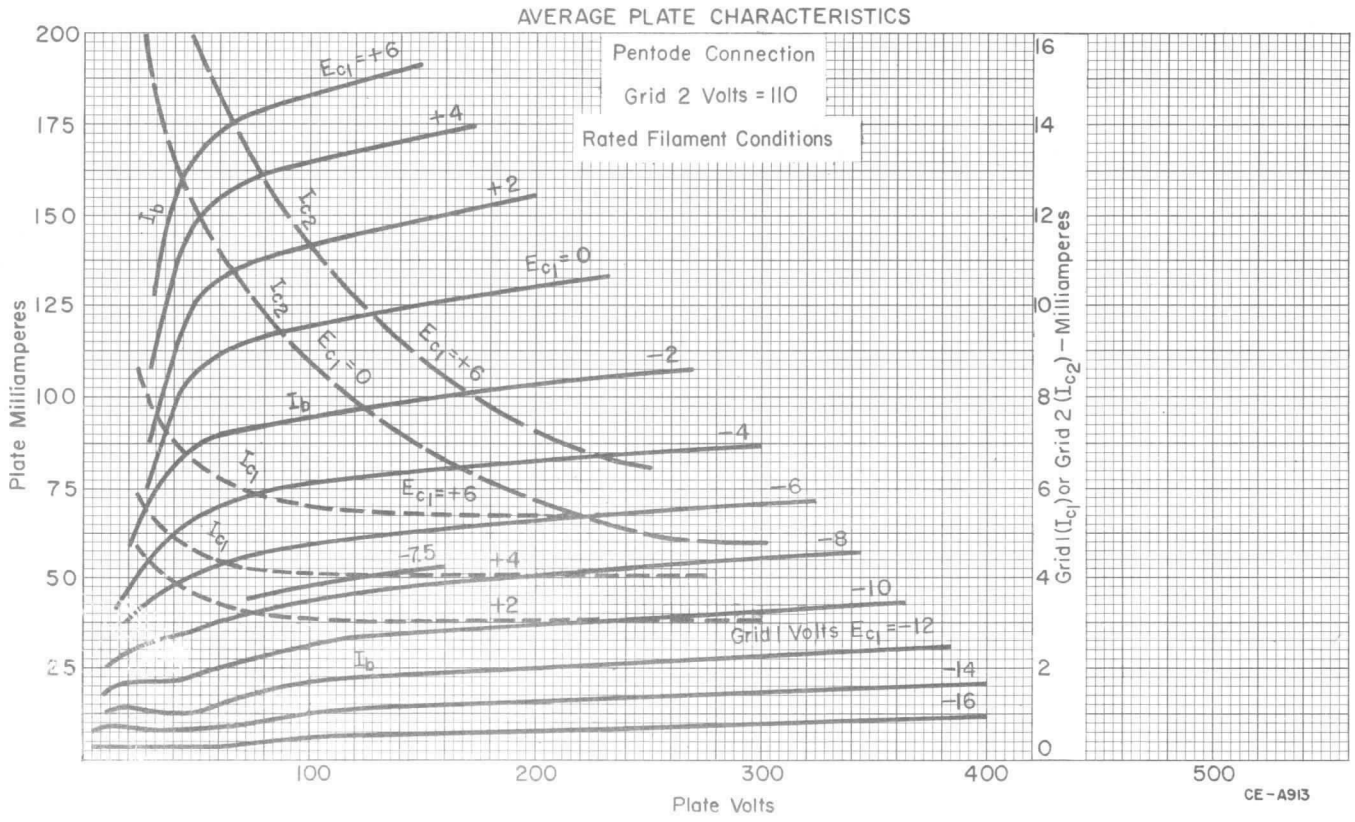
Design Center Values			
Plate Voltage	200	max.	Volts
Plate Dissipation	10	max.	Watts
Screen Voltage	125	max.	Volts
Screen Dissipation	1.25	max.	Watts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts
Grid Circuit Resistance:			
Cathode Bias	0.5	max.	Megohm
Fixed Bias	0.1	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION:

Class A_1 Amplifier			
Plate Voltage	110	200	Volts
Screen Voltage	110	125	Volts
Control Grid Voltage	–7.5	--	Volts
Cathode Bias Resistor	--	180	Ohms
Peak A-F Control Grid Voltage	7.5	8.5	Volts
Zero Signal Plate Current	49	46	Ma.
Zero Signal Screen Current	4	2.2	Ma.
Max. Signal Plate Current	50	47	Ma.
Max. Signal Screen Current	10	8.5	Ma.
Transconductance	8000	8000	μmhos
Plate Resistance, Approx.	13000	28000	Ohms
Load Resistance	2000	4000	Ohms
Power Output	2.1	3.8	Watts
Total Harmonic Distortion	10	10	Per Cent







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HIGH FREQUENCY TWIN TRIODE TYPE 6DJ8

The 6DJ8 is a 9-pin miniature twin triode designed for use as low-noise VHF amplifier for cascode operation. This type has high gain and high cascode transconductance. It is designed for operation with section 1 (pins 6,–7, and 8) as input section of the cascode circuit.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	0.365		Ampere
Direct Interelectrode Capacitances: (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	1.4	1.4	μμf
Plate to Cathode	--	0.18	μμf
Heater to Cathode	--	2.7	μμf
Grid to Heater	0.13	--	μμf
Input	3.3	--	μμf
Output	1.8	--	μμf
Grounded Grid Operation:			
Input	--	6.0	μμf
Output	--	2.8	μμf
Plate of Unit 1 to Plate of Unit 2	0.045 max.		μμf
Plate of Unit 2 to Plate and Grid of Unit 1	0.005 max.		μμf

MECHANICAL:

Bulb	T-6-½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9AJ
Mounting	Any

MAXIMUM RATINGS:

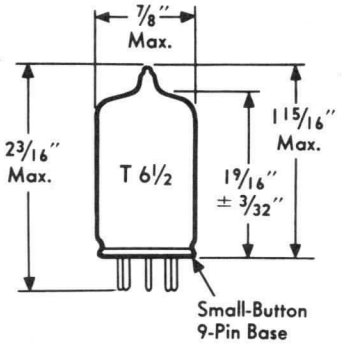
Design-Center Values

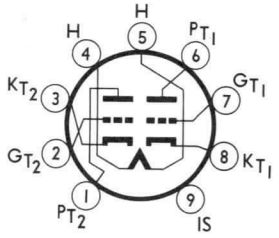
Plate Voltage⊕	130 max.		Volts
Plate Voltage (Not Conducting)	550 max.		Volts
Cathode Current	25 max.		Ma.
Plate Dissipation	1.8 max.		Watts
Negative Grid DC Voltage	50 max.		Volts
Grid Circuit Resistance	1.0 max.		Megohm
Heater-Cathode Voltage:			
	Unit 1	Unit 2	
Heater Positive or Negative with respect to Cathode, Total DC and Peak	50	-- max.	Volts
Heater Negative with respect to Cathode: DC Component	--	130 max.	Volts
Total DC and Peak	--	150 max.	Volts
Circuit Resistance Between Heater and Cathode	20000	20000 max.	Ohms

TYPICAL OPERATING CHARACTERISTICS

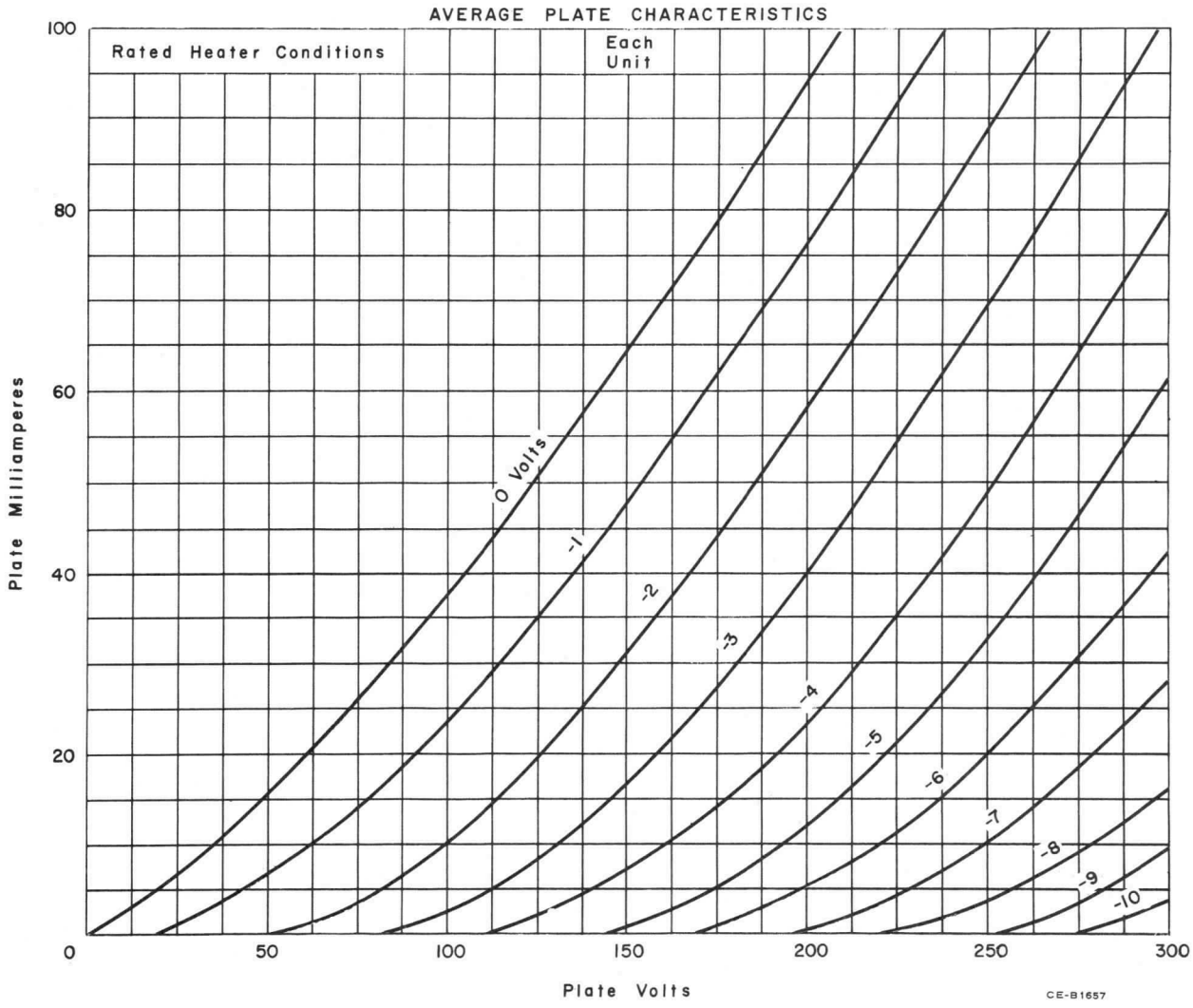
	(Each Unit)	
Plate Voltage⊕	90	Volts
Grid Bias Voltage	-1.3	Volts
Plate Current	15	Ma.
Amplification Factor	33	
Transconductance	12500	μmhos
Equivalent Noise Resistance	300	Ohms

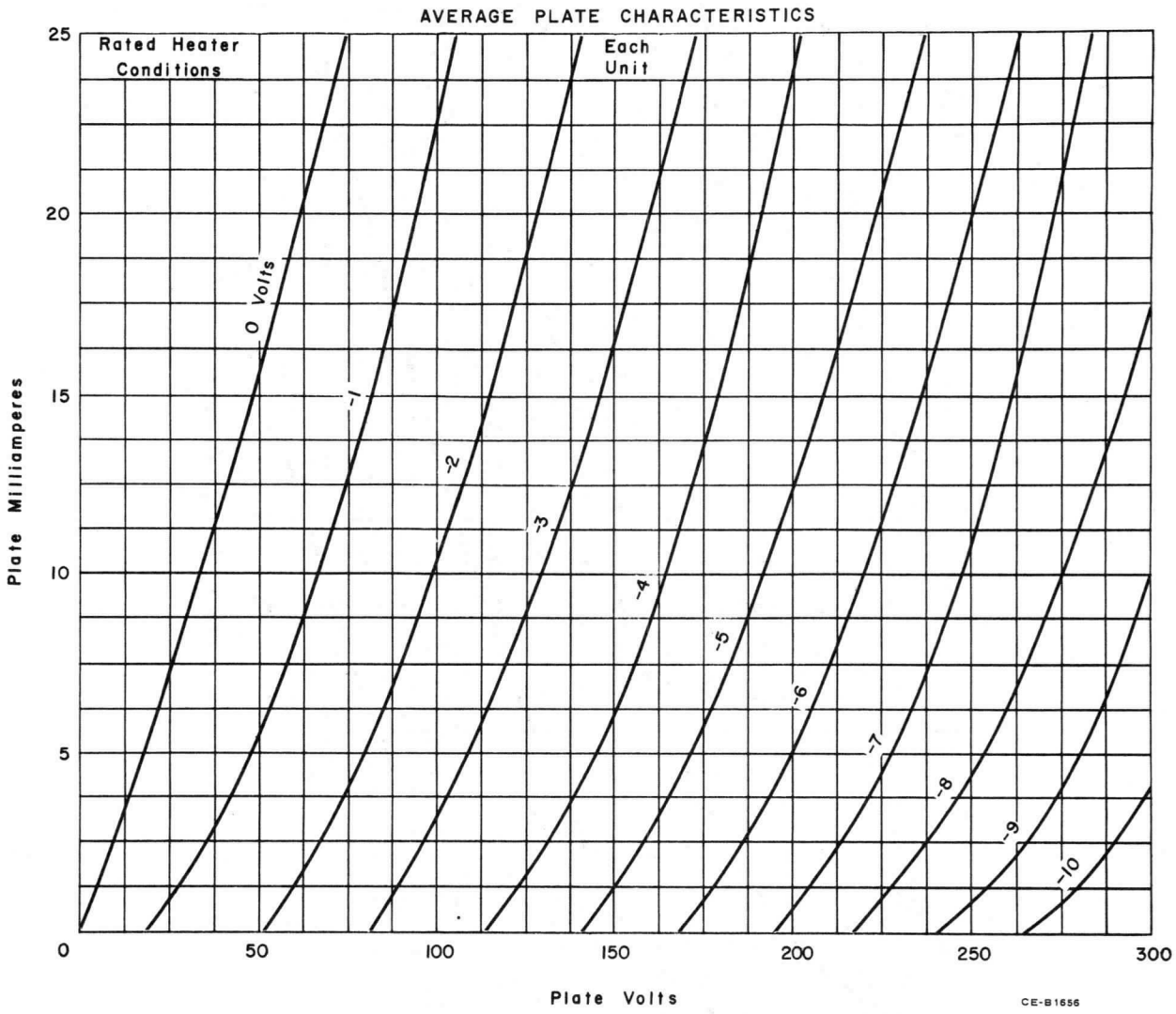
⊕ A voltage divider should be used to supply operating potential for the grid of the grounded-grid unit to ensure operation within the plate voltage rating. The voltage between plate and cathode of the grounded-cathode unit should not exceed 75 volts when using grid current bias and no agc voltage is applied.



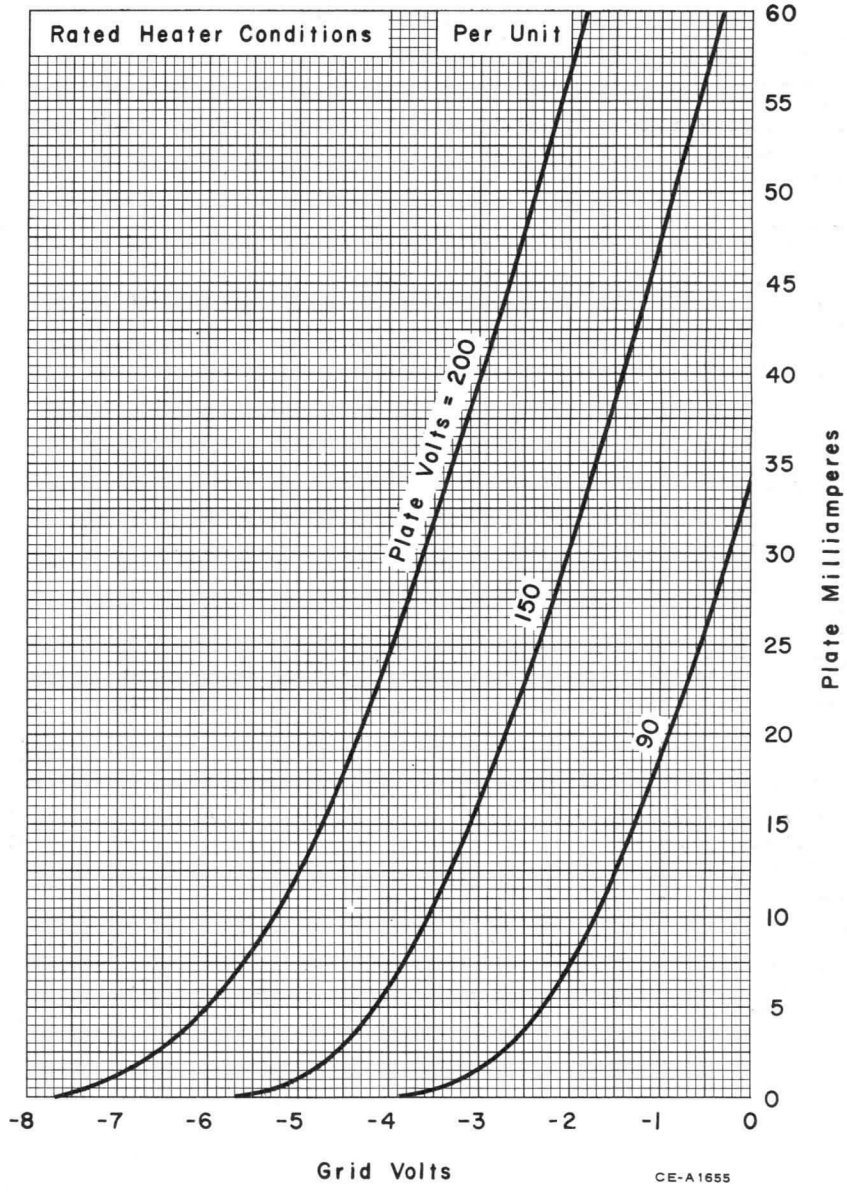


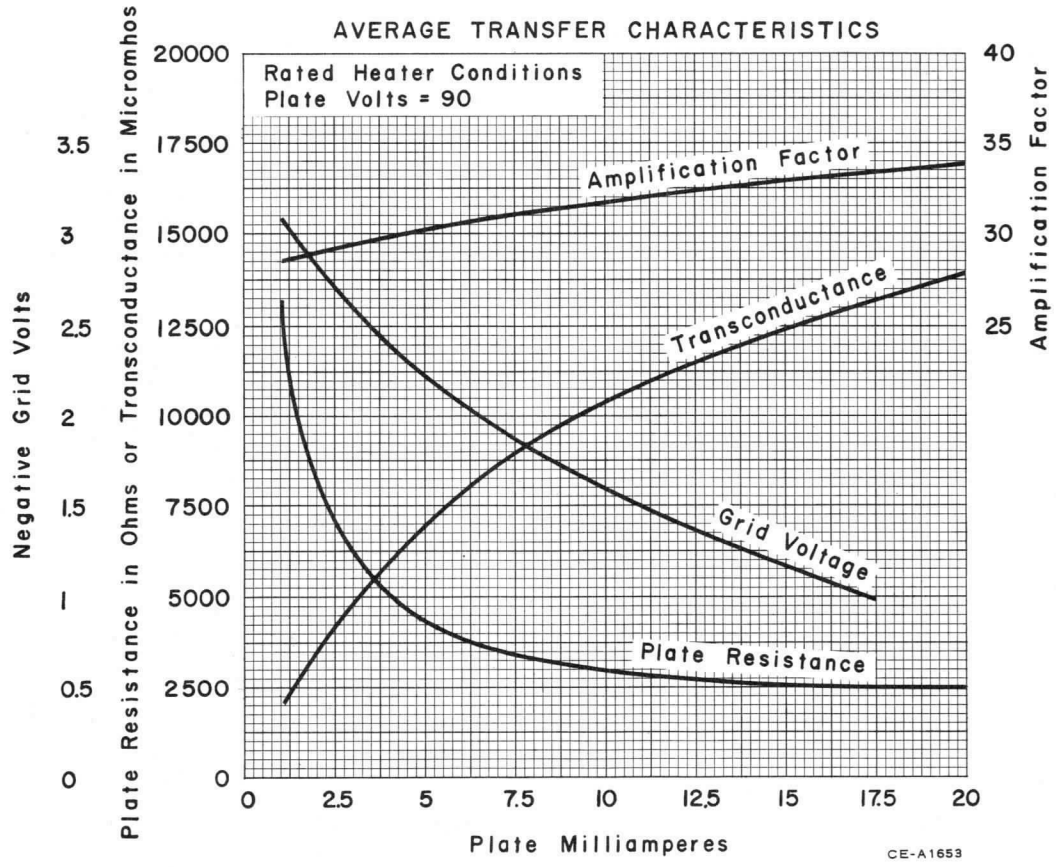
9AJ

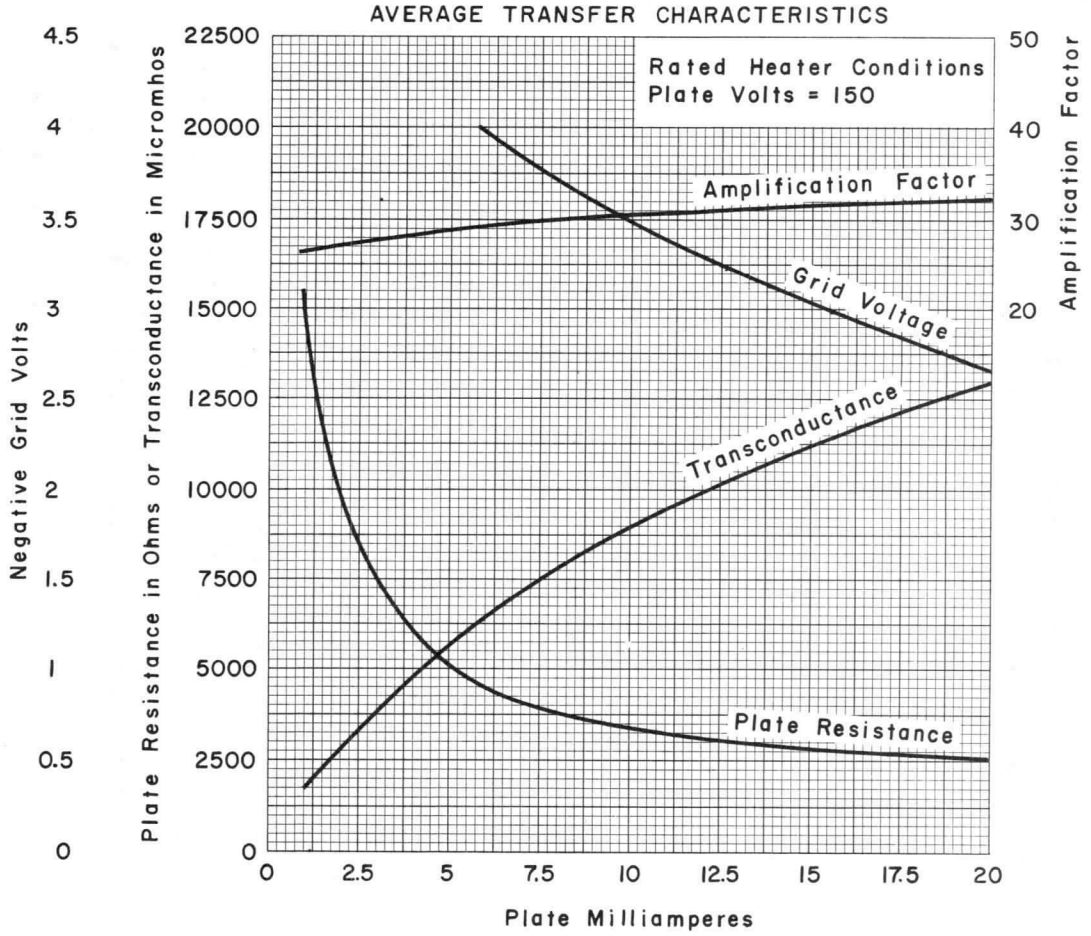

AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Each Unit
Plate Milliamperes
Plate Volts
0 Volts
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
0
20
40
60
80
100
50
100
150
200
250
300
CE-B1657


AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Each Unit
0 Volts
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
Plate Milliamperes
Plate Volts
0
5
10
15
20
25
50
100
150
200
250
300
CE-B1656

AVERAGE TRANSFER CHARACTERISTICS




AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 90
Amplification Factor
Transconductance
Grid Voltage
Plate Resistance
Negative Grid Volts
Plate Resistance in Ohms or Transconductance in Micromhos
Amplification Factor
Plate Milliamperes
0
0.5
1
1.5
2
2.5
3
3.5
2500
5000
7500
10000
12500
15000
17500
20000
25
30
35
40
0
2.5
5
7.5
10
12.5
15
17.5
20
CE-A1653


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 150
Amplification Factor
Grid Voltage
Transconductance
Plate Resistance
Negative Grid Volts
Plate Resistance in Ohms or Transconductance in Micromhos
Amplification Factor
Plate Milliamperes
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
50
40
30
20
0
2.5
5
7.5
10
12.5
15
17.5
20
CE-A1654

March 30, 1959

SHARP-CUTOFF PENTODE TYPES 3DK6, 4DK6 and 6DK6

The 3DK6, 4DK6 and 6DK6 are 7-pin miniature sharp-cutoff pentodes designed for service as wide-band high frequency amplifiers. The very high transconductance at low plate and screen potentials combined with the low interelectrode capacitances make them particularly desirable as if amplifiers in television receivers.

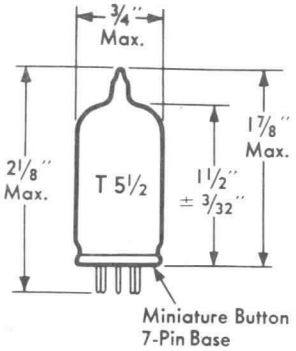
The 3DK6 and the 4DK6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

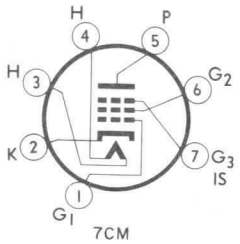
ELECTRICAL:

Cathode			Coated Unipotential	
Heater:	3DK6	4DK6	6DK6	
Voltage (ac or dc)	3.15	4.2	6.3 ± 10%	Volts
Current	0.6 ± 6%	0.45 ± 6%	0.3	Ampere
Warm-up Time▲	11	11		Seconds
Direct Interelectrode Capacitances				Unshielded
Grid 1 to Plate			0.025 max.	μμf
Input			6.3	μμf
Output			1.9	μμf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any





MAXIMUM RATINGS:

Design Maximum Values

Plate Voltage			330 max.	Volts
Grid 2 Supply Voltage			330 max.	Volts
Grid 2 Voltage			See Grid 2 Input Rating Curve	
Plate Dissipation			2.3 max.	Watts
Grid 2 Dissipation			0.55 max.	Watts
Grid 1 Voltage:				
Positive Value			0 max.	Volts
Heater-Cathode Voltage:				
	3DK6	6DK6		
Heater Negative with Respect	4DK6			
to Cathode: DC Component	200	– –	max.	Volts
Total DC and Peak	300	200	max.	Volts
Heater Positive with Respect				
to Cathode: DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts

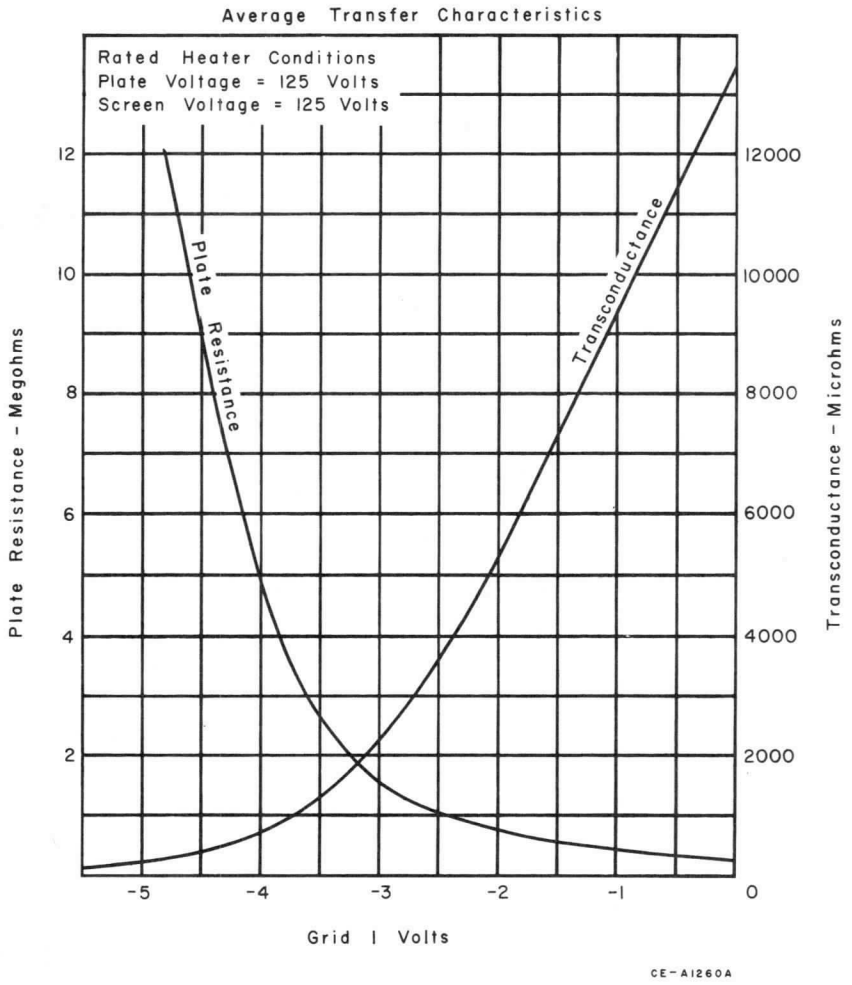
TYPICAL OPERATION AND CHARACTERISTICS:

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to Cathode at Socket	
Grid 2 Voltage	125	Volts
Cathode Bias Resistor	56	Ohms
Plate Resistance (approx.)	0.35	Megohm
Transconductance	9800	μmhos
Plate Current	12.0	Ma.
Grid 2 Current	3.8	Ma.
Grid 1 Cutoff Bias*	-6.5	Volts

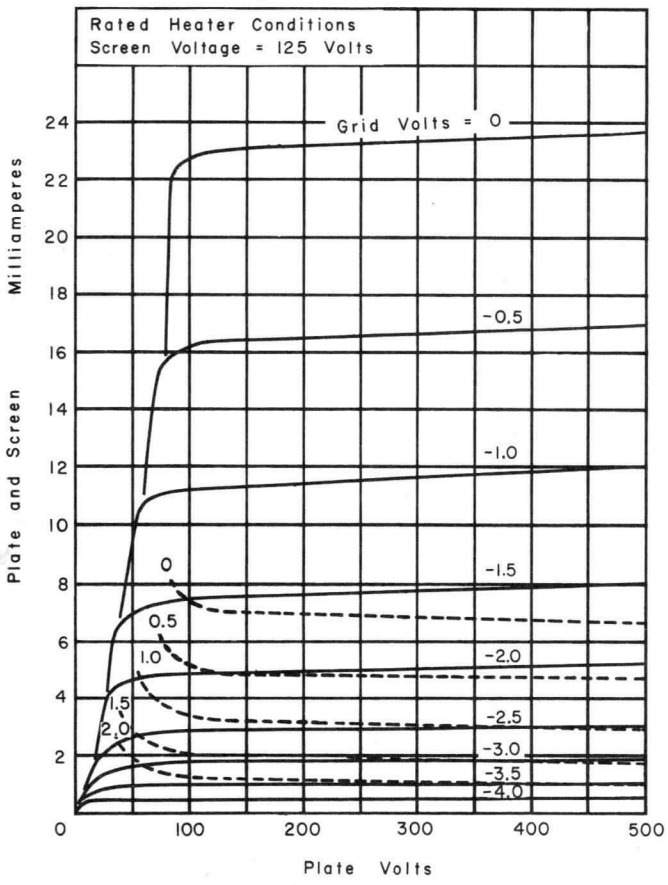
NOTES

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

* For Plate Current of 20 μa

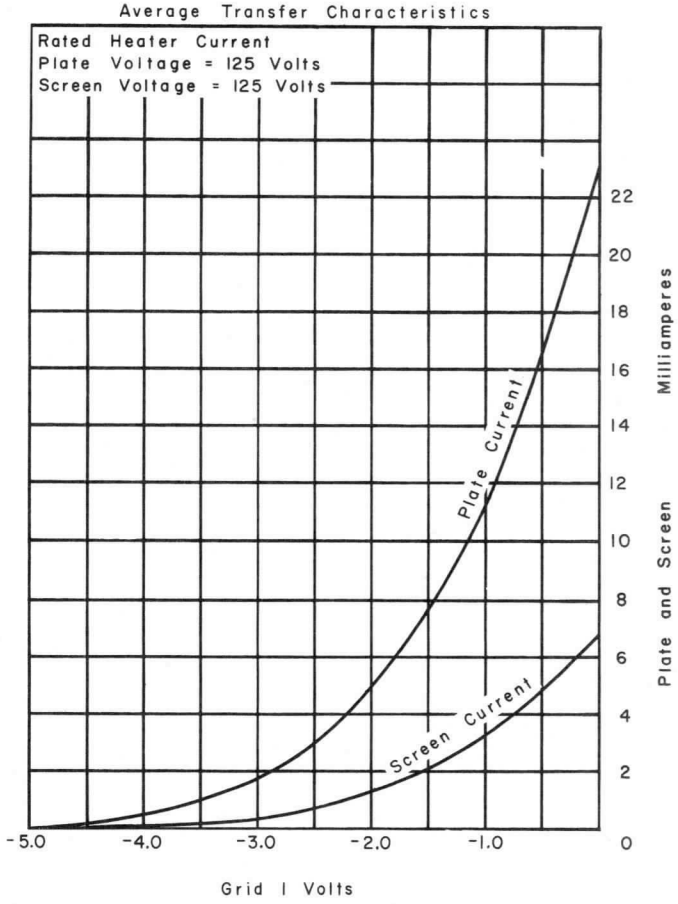

Average Transfer Characteristics
Rated Heater Conditions
Plate Voltage = 125 Volts
Screen Voltage = 125 Volts
Plate Resistance
Transconductance
Plate Resistance - Megohms
Transconductance - Microhms
12
10
8
6
4
2
12000
10000
8000
6000
4000
2000
0
-5
-4
-3
-2
-1
Grid 1 Volts
CE-A1260A

Average Plate Characteristics



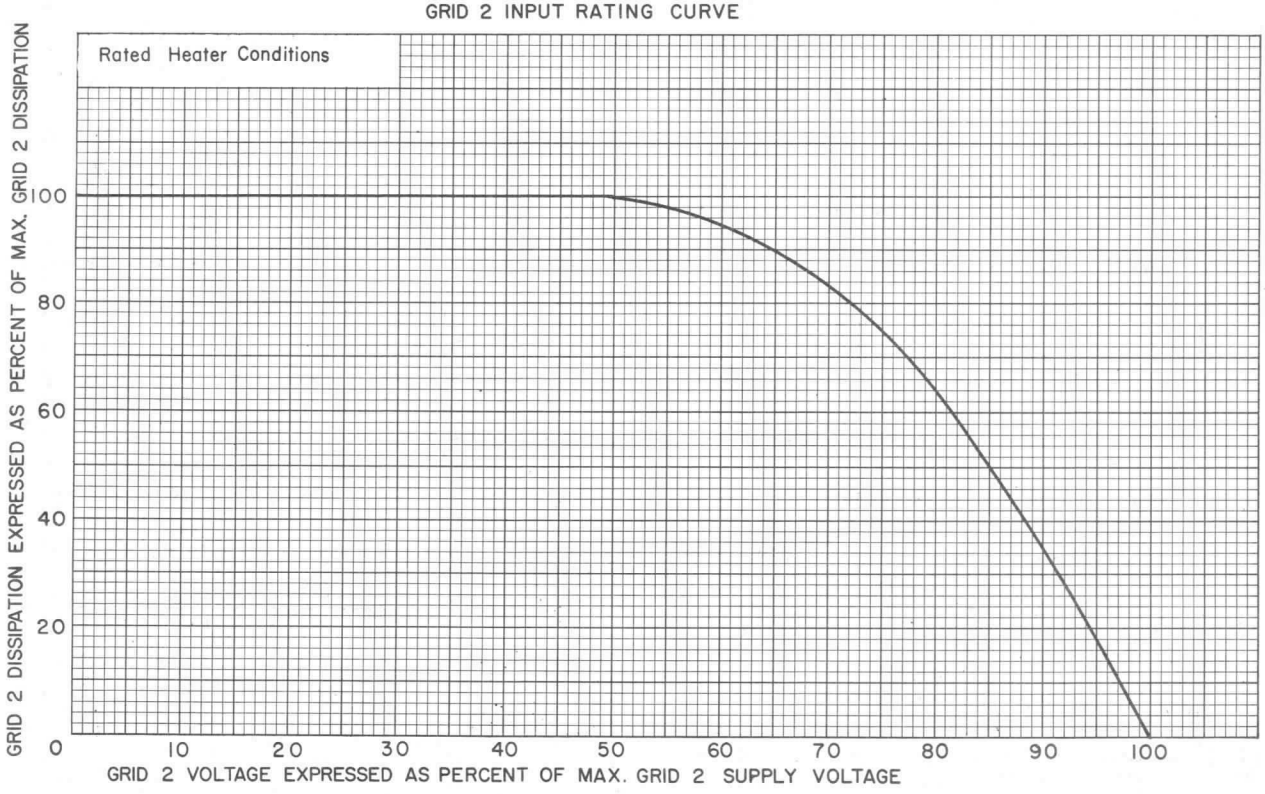
CE-A1373

Average Transfer Characteristics



CE-A1259A

GRID 2 INPUT RATING CURVE



TELEVISION DAMPING DIODE TYPE 6DM4 AND 17DM4

The 6DM4 and 17DM4 are octal based indirectly-heated half-wave rectifiers designed for television damping diode service in horizontal deflection circuits.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:	6DM4	17DM4	
Voltage (ac or dc)	6.3 ± 10%	16.8	Volts
Current	1.2	0.45±6%	Ampere
Warm-Up Time (Note 1)	–	11	Seconds
Direct Interelectrode Capacitances:			
Heater to Cathode	4		μμf
Plate to Cathode and Heater	8.5		μμf
Cathode to Plate and Heater	11.5		μμf

MECHANICAL

Bulb	T-9
Base Note 2 . Short Intermediate-Shell Octal 5-Pin (JEDEC B5-85)	
Basing	4CG
Mounting Position	Any

DAMPER SERVICE (Note 3)

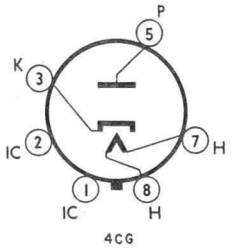
MAXIMUM RATINGS

Design Maximum Values

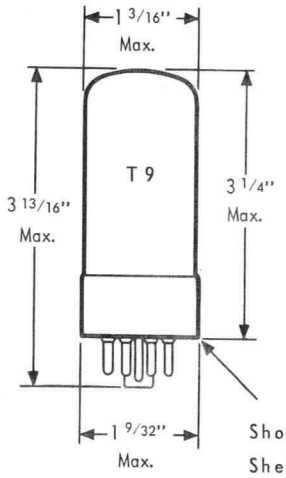
Peak Inverse Voltage	5000	max.	Volts
Peak Plate Current	1100	max.	Ma.
DC Plate Current	175	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode	900	max.	Volts
Total DC and Peak	5000	max.	Volts
Heater Positive with Respect to Cathode	100	max.	Volts
Total DC and Peak	300	max.	Volts
Voltage Drop at I_b = 400 Ma.	35		Volts
Plate Dissipation	6.5	max.	Watts

NOTES

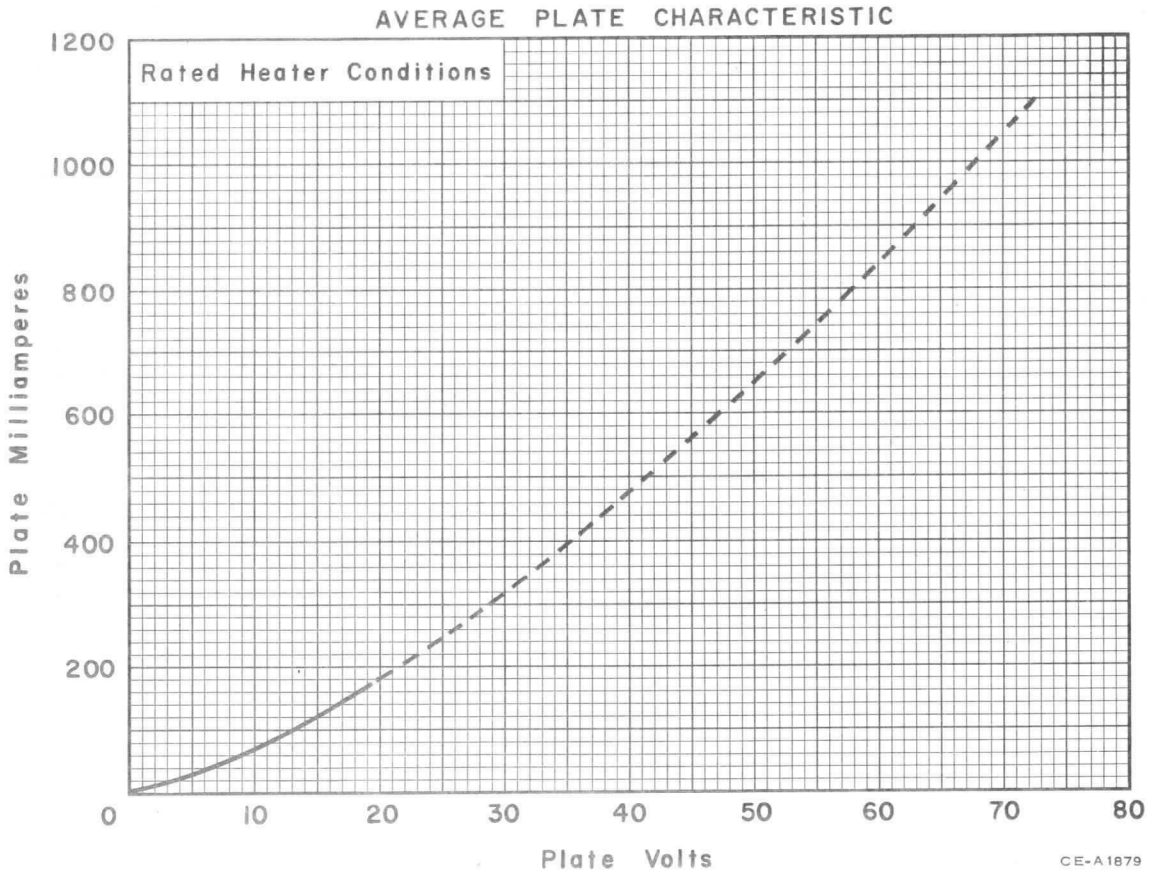
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. The JEDEC B5-85 base specified for use with the above tube types do not have pins in base positions 1, 4, and 6. However positions 1 and 6 have internal connections terminating in stem leads. Base terminal position 2 has a base pin which may be connected to a stem lead. Because of the close proximity of stem leads to the socket pin clips when the tube is seated in the socket, circuit tie points should not be made to socket terminals 1, 2, 4 and 6 unless adequate precautions are taken against voltage breakdown in both the tube base and the socket. To reduce the possibility of arcover, it is recommended socket clips for positions 1, 2, 4 and 6 be removed from the damper tube socket.
3. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle.



4CG



Short Intermediate Shell Octal Base



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Westinghouse

6DM4A
12DM4A
17DM4A

January 1, 1963

TELEVISION DAMPING DIODE TYPE 6DM4A, 12DM4A AND 17DM4A

The 6DM4A, 12DM4A and 17DM4A are octal based indirectly-heated half-wave rectifiers designed for television damping diode service in horizontal deflection circuits.

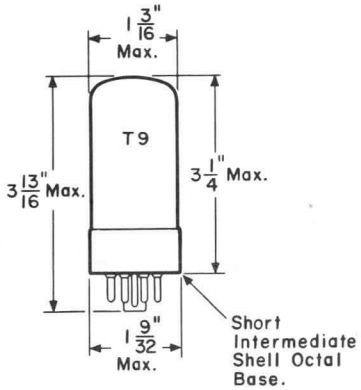
The 12DM4A and 17DM4A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode			Coated Unipotential	
Heater:	6DM4A	12DM4A	17DM4A	
Voltage (ac or dc)	6.3 ± 10%	12.6	16.8	Volts
Current	1.2	0.60 ± 0.04	0.45 ± 0.03	Ampere
Warm-Up Time (Note 1)	–	11	11	Seconds
Direct Interelectrode Capacitances:				
Heater to Cathode			4	μμf
Plate to Cathode and Heater			8.5	μμf
Cathode to Plate and Heater			11.5	μμf

MECHANICAL

Bulb	T-9
Base (Note 2)	Intermediate-Shell Octal 5-Pin (JEDEC B5-85)
	Short Intermediate-Shell Octal 5-Pin (JEDEC B5-147)
Basing	4CG
Mounting Position	Any



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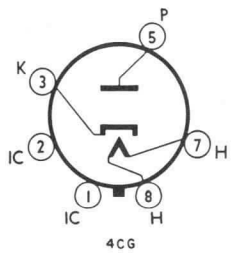


4CG

DAMPER SERVICE (Note 3)

MAXIMUM RATINGS

Design Maximum Values

Peak Inverse Voltage	5000 max.		Volts
Peak Plate Current	1200 max.		Ma.
DC Plate Current	200 max.		Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode	900 max.		Volts
Total DC and Peak	5000 max.		Volts
Heater Positive with Respect to Cathode	100 max.		Volts
Total DC and Peak	300 max.		Volts
Voltage Drop at I_b = 400 Ma.	35		Volts
Plate Dissipation	6.5 max.		Watts

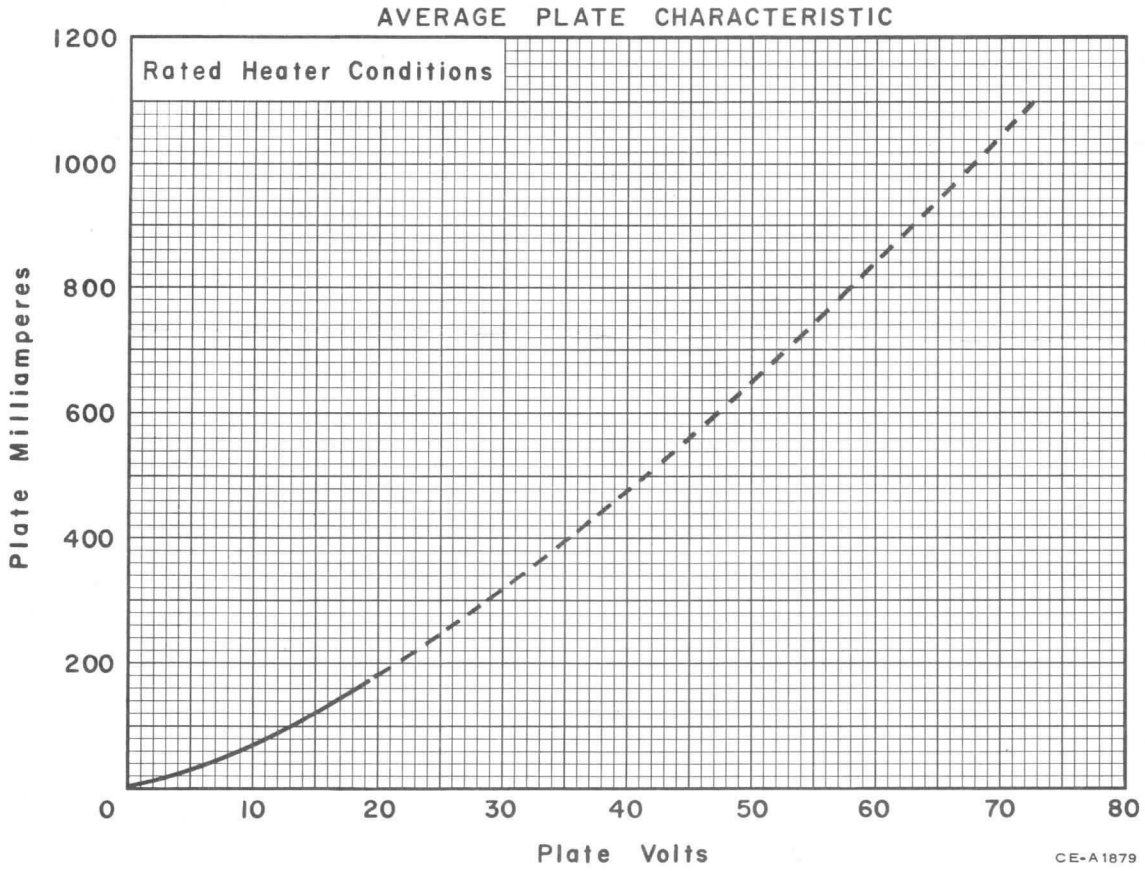
NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. The bases specified for use with these tube types do not have pins in base positions 1, 4, and 6. However positions 1 and 6 have internal connections terminating in stem leads. Base terminal position 2 has a base pin which may be connected to a stem lead. Because of the close proximity of stem leads to the socket pin clips when the tube is seated in the socket, circuit tie points should not be made to socket terminals 1, 2, 4 and 6 unless adequate precautions are taken against voltage breakdown in both the tube base and the socket. To reduce the possibility of arcover, it is recommended socket clips for positions 1, 2, 4 and 6 be removed from the damper tube socket.
3. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle. In a 525 line, 30 frame system, 15% of one horizontal scanning cycle is 10 microseconds.

PRINTED IN U.S.A.

Receiving Tube Section

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK



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May 15, 1958

HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6DQ6, 6DQ6-A, 12DQ6, 12DQ6-A, 17DQ6 and 17DQ6-A

The 6DQ6, 6DQ6-A, 12DQ6, 12DQ6-A, 17DQ6 and 17DQ6-A are octal based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero bias plate current, high plate current to grid 2 current ratio and high DC plate supply voltage ratings. These features with a plate dissipation rating of 15 watts make this tube especially desirable for its designed service.

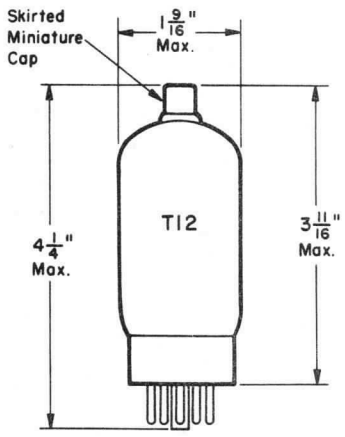
The 12DQ6, 12DQ6-A, 17DQ6 and 17DQ6-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current ratings, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode			Coated Unipotential	
Filament:	6DQ6 6DQ6-A	12DQ6 12DQ6-A	17DQ6 17DQ6-A	
Voltage (ac or dc)	6.3	12.6	16.8	Volts
Current	1.20	0.60 ± 6%	0.45 ± 6%	Ampere
Warm-up Time+	--	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid to Plate			.55	uuf
Input			15.0	uuf
Output			7.0	uuf

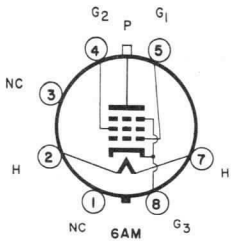
MECHANICAL:

Bulb	T-12
Base	Short Shell Octal
Basing	6AM
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any



MAXIMUM RATINGS:

Design Center Values	6DQ6 6DQ6-A 12DQ6 12DQ6-A 17DQ6 17DQ6-A		
D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	550	700	max. Volts
Peak Positive Plate Voltage	6000	6000	abs. max. Volts
Peak Negative Pulse Plate Voltage	1375	1375	max. Volts
Plate Dissipation▲	15	15	max. Watts
Peak Negative Grid 1 Voltage	300	300	max. Volts
D.C. Grid 2 Voltage	175	200	max. Volts
Grid 2 Dissipation	2.5	3	max. Watts
Average Cathode Current	120	140	max. Ma.
Peak Cathode Current	440	440	max. Ma.
Grid 1 Circuit Resistance♦	0.47	1.0	max. Megohm
Bulb Temperature (At Hottest Point)	220	220	max. °C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	200	max. Volts
Heater Positive with Respect to Cathode DC Component	100	100	max. Volts
Total DC + Peak	200	200	max. Volts



AVERAGE CHARACTERISTICS

PENTODE OPERATION

	6DQ6 12DQ6 17DQ6	6DQ6-A 12DQ6-A 17DQ6-A	
Plate Voltage	250	250	Volts
Grid 2 Voltage	150	150	Volts
Grid 1 Voltage	-22.5	-22.5	Volts
Plate Current	75	75	Ma.
Grid 2 Current	2.4	2.4	Ma.
Transconductance	6000	6600	umhos
Plate Resistance	20000	20000	Ohms

ZERO BIAS

Plate Voltage□	60	60	Volts
Grid 2 Voltage□	150	150	Volts
Plate Current⊕	300	300	Ma.
Grid 2 Current⊕	27	27	Ma.

CUTOFF

Plate Voltage	250	250	Volts
Grid 2 Voltage	150	150	Volts
Plate Current	1.0	1.0	Ma.
Grid 1 Voltage (Approx.)	-50	-46	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	150	150	Volts
Grid 2 Voltage	150	150	Volts
Grid 1 Voltage	-22.5	-22.5	Volts
Amplification Factor	4.1	4.1	

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

\+ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current

♦ Using grid-leak bias

□ Applied for short interval (maximum of 2 seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

Westinghouse

6DQ6-B
12DQ6-B
17DQ6-B

December 1, 1961

HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6DQ6-B, 12DQ6-B AND 17DQ6-B

The 6DQ6-B, 12DQ6-B and 17DQ6-B are octal based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero bias plate current, high plate current to grid 2 current ratio and high DC plate supply voltage ratings. These features with a plate dissipation rating of 18 watts make this tube especially desirable for its designed service.

The 12DQ6-B and 17DQ6-B have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current ratings, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode		Coated Unipotential		
Filament:	6DQ6-B	12DQ6-B	17DQ6-B	
Voltage (ac or dc)	6.3 ± 10%	12.6	16.8	Volts
Current	1.20	0.60 ± 6%	0.45 ± 6%	Ampere
Warm-up Time +	--	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid to Plate			0.5	μμf
Input			15	μμf
Output			7	μμf

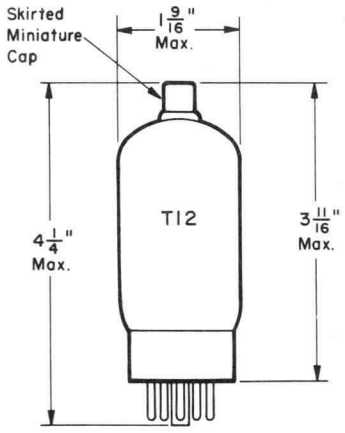
MECHANICAL:

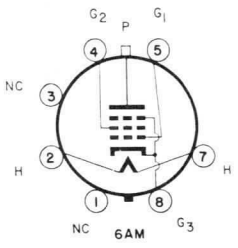
Bulb	T-12
Base	Short Medium Shell Octal
Basing	6AM
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER ♦

MAXIMUM RATINGS:
Design Maximum Values

D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Plate Dissipation ▲	18	max.	Watts
Peak Negative Grid 1 Voltage	330	max.	Volts
D.C. Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.6	max.	Watts
Average Cathode Current	175	max.	Ma.
Peak Cathode Current	610	max.	Ma.
Grid 1 Circuit Resistance ♦	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts





WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

AVERAGE CHARACTERISTICS

PENTODE OPERATION			
Plate Voltage		250	Volts
Grid 2 Voltage		150	Volts
Grid 1 Voltage		-22.5	Volts
Plate Current		65	Ma.
Grid 2 Current		1.8	Ma.
Transconductance		7300	μmhos
Plate Resistance		18000	Ohms
ZERO BIAS			
Plate Voltage□		60	Volts
Grid 2 Voltage□		150	Volts
Plate Current⊕		345	Ma.
Grid 2 Current⊕		27	Ma.
CUTOFF			
Plate Voltage	250	5000	Volts
Grid 2 Voltage	150	150	Volts
Plate Current	1	1	Ma.
Grid 1 Voltage (Approx.)	-42	-100	Volts
TRIODE AMPLIFICATION FACTOR			
Plate Voltage		150	Volts
Grid 2 Voltage		150	Volts
Grid 1 Voltage		-22.5	Volts
Amplification Factor		4.4	

NOTES

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

\+ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

♦ Using grid-leak bias.

□ Applied for short interval (maximum of 2 seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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BEAM-POWER PENTODE TYPES 6DT5 AND 12DT5

The 6DT5 and 12DT5 are 9-pin miniature beam-power pentodes designed for service as vertical deflection output amplifiers in television receiver chassis featuring a 110° diagonal deflection angle picture tube and a B+ supply voltage of 250 volts. These types are characterized by high zero-bias plate current and a high plate current to grid 2 current ratio.

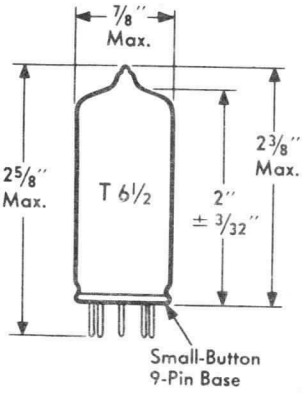
The 12DT5 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

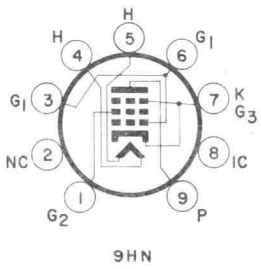
GENERAL DATA

ELECTRICAL:			
Cathode		Coated Unipotential	
Heater:	6DT5	12DT5	
Voltage	6.3	12.6 (ac or dc)	Volts
Current	1.2	0.60 ± 6%	Ampere
Warm-up Time▲		11	Seconds
Direct Interelectrode Capacitances: (Unshielded)			
Grid 1 to Plate		0.57	uuf
Input		12.5	uuf
Output		4.9	uuf
MECHANICAL:			
Bulb			T-6-1/2
Base		Miniature 9-Pin (JETEC E9-1)	
Outline			6-3
Basing			9HN
Mounting Position			Any

CHARACTERISTICS

Plate Voltage	60	80	250	Volts
Grid 2 (Screen) Voltage	150	250	250	Volts
Grid 1 Voltage	0□	0□	-16.5	Volts
Transconductance	--	--	6200	umhos
Plate Current	95	195	44	Ma.
Grid 2 Current	8.5	19	1.5	Ma.
Grid 1 Cutoff Voltage■	--	--	-35	Volts





9HN

VERTICAL DEFLECTION SERVICE♦

DEFLECTING 110° PICTURE TUBE

MAXIMUM RATINGS:			
Design Maximum Values (Except as Noted)			
Plate Voltage	315	max.	Volts
Peak Positive Pulse Plate Voltage	2200 *abs*	max.	Volts
Grid 2 Voltage	285	max.	Volts
Peak Negative Pulse Grid 1 Voltage	-250	max.	Volts
Plate Dissipation§	9.0	max.	Watts
Grid 2 Dissipation	2.0	max.	Watts
Cathode Current:			
Average	55	max.	Ma.
Peak	190	max.	Ma.
Heater - Cathode Voltage:			
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC and Peak	200	max.	Volts
Heater Negative with Respect to Cathode			
Total DC and Peak	200	max.	Volts
Grid 1 Circuit Values			
Fixed Bias	0.5	max.	Megohm
Cathode Bias	1.0	max.	Megohm

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

■ For plate current of 100 uamperes.

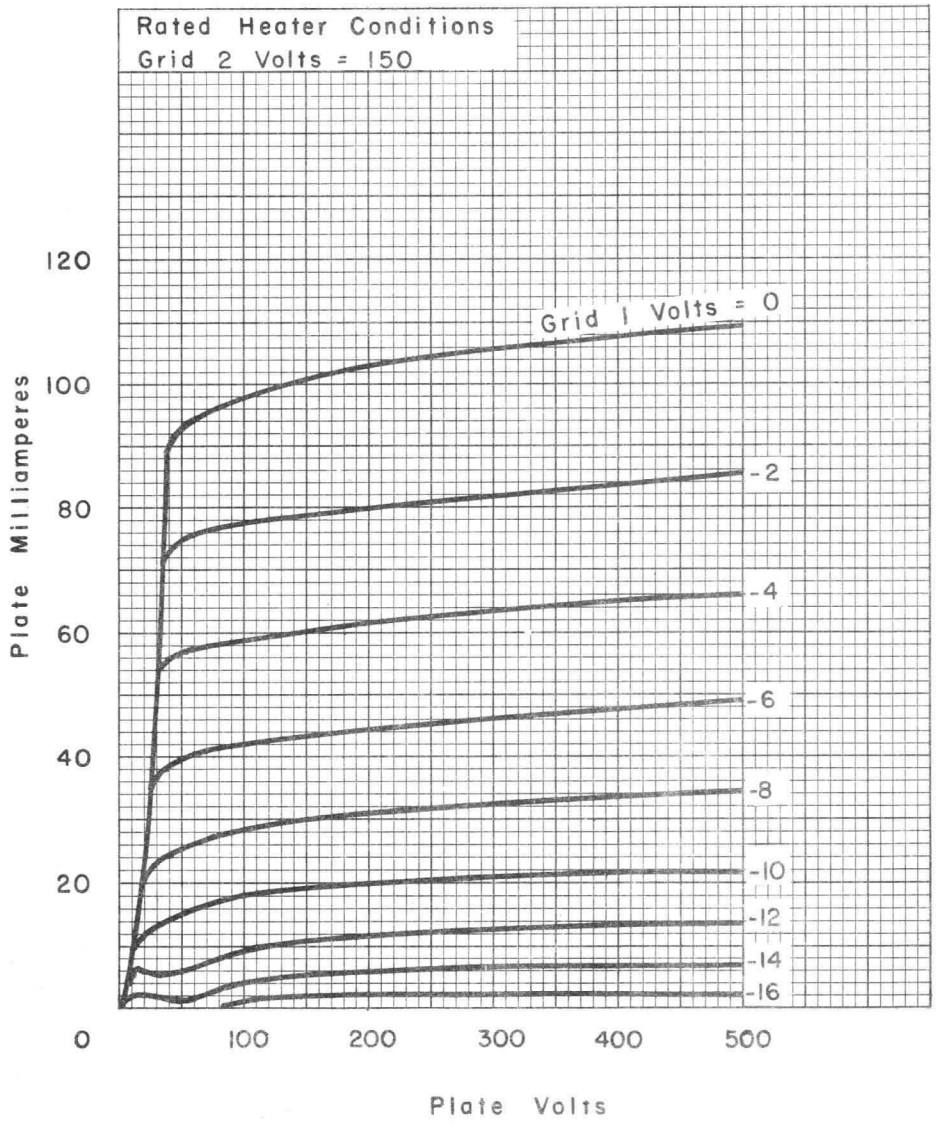
□ Applied for short interval (maximum of 2 seconds) so as not to damage tube.

⊕ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

♦ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations: Federal Communications Commission" the duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

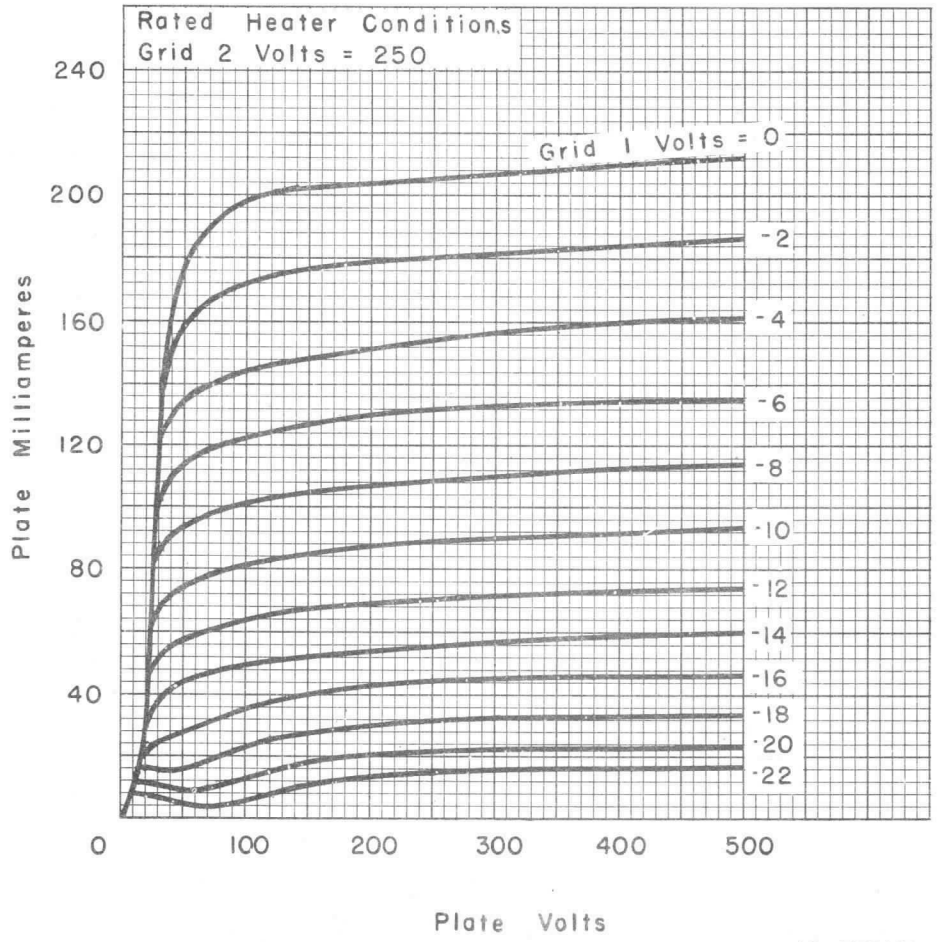
§ Stages operating with grid leak bias must use an adequate cathode bias resistor or similar arrangement to protect the tube in the absence of excitation.

AVERAGE PLATE CHARACTERISTICS



CE-A1406

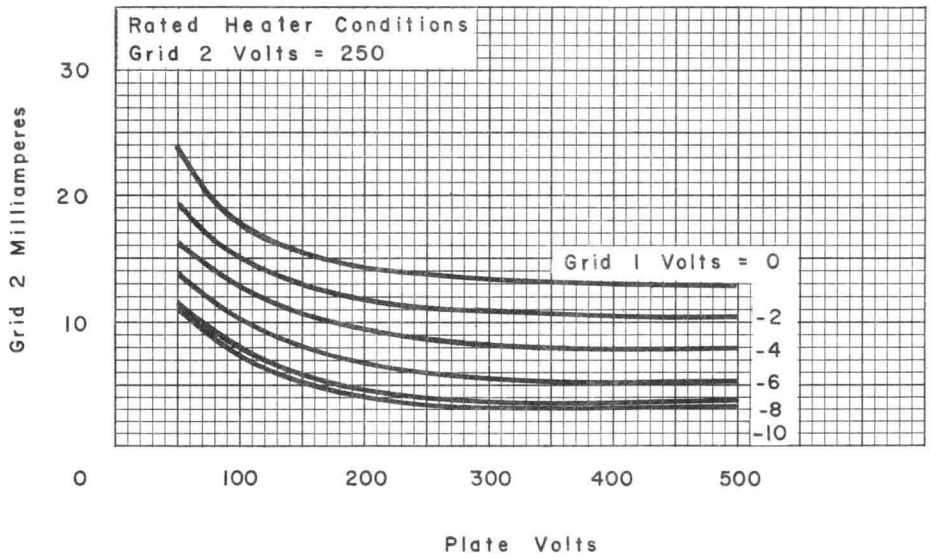
AVERAGE PLATE CHARACTERISTICS



CE-A1294 RI

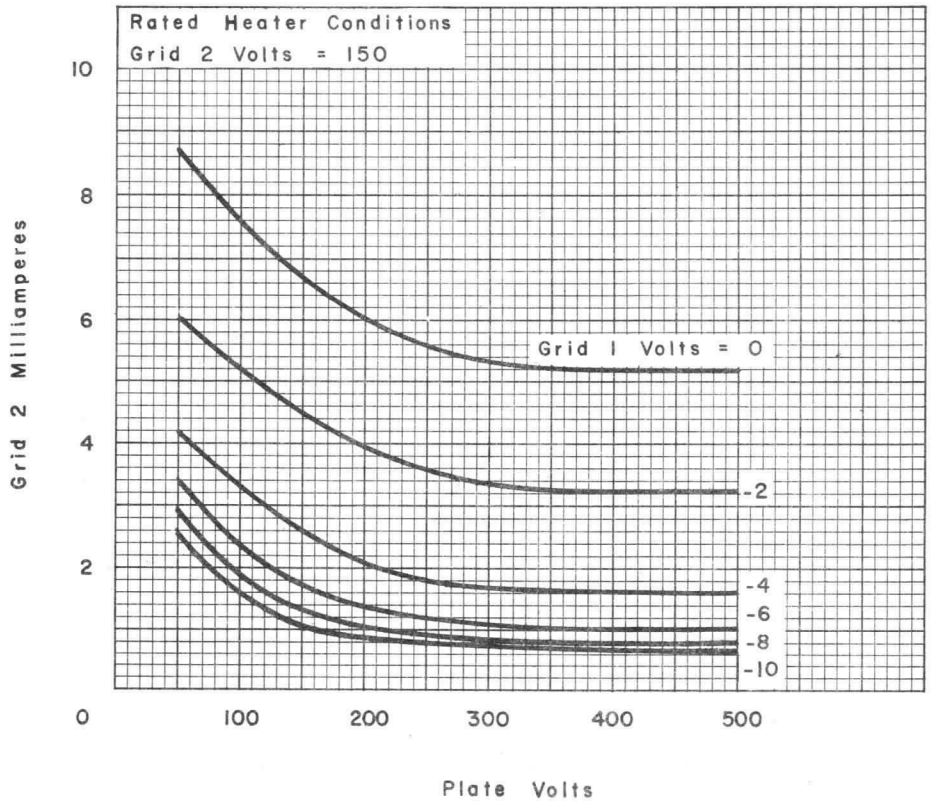
Westinghouse®

AVERAGE GRID 2 CHARACTERISTICS



CE-A1296R1

AVERAGE GRID 2 CHARACTERISTICS



CE-A1407

February 1, 1957

Dual-Control-Grid Pentode Types 3DT6, 4DT6 and 6DT6

The 3DT6, 4DT6 and 6DT6 are miniature 7-pin dual-control-grid pentodes designed for service as combined limiter, FM detector and audio voltage amplifier in television receivers. Since both Grid No. 1 and Grid No. 3 exhibit sharp-cutoff characteristics, these tubes are also well suited to gating, mixing and delay circuits.

The 3DT6 and 4DT6 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

Electrical:

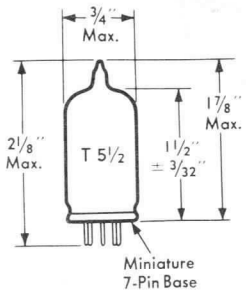
Cathode			Coated Unipotential	
Heater:	3DT6	4DT6	6DT6	
Voltage (ac or dc)	3.15	4.2	6.3	Volts
Current	0.60±6%	0.45±6%	0.3	Ampere
Warm-up Time△	11	11		Seconds
Direct Interelectrode Capacitances			Shielded#	
Grid 1 to Plate			0.02	μμf
Grid 3 to Plate			1.4	μμf
Grid 1 Input*			5.8	μμf
Grid 3 to All Elements			6.1	μμf
Grid 1 to Grid 3			0.1	μμf

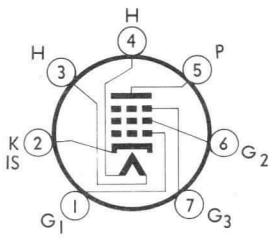
Mechanical:

Bulb	T-5½
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7EN
Mounting Position	Any

Characteristics as a Class A Amplifier

Plate Voltage	150	Volts
Grid 3 Voltage	0	Volts
Grid 2 Voltage	100	Volts
Cathode Bias Resistor	560	Ohms
Plate Resistance (approx.)	0.15	Megohms
Grid 1 Transconductance	800	μmhos
Grid 3 Transconductance	515	μmhos
Grid 1 Cutoff Bias□	-4.5	Volts
Grid 3 Cutoff Bias□	-3.5	Volts
Plate Current	1.1	Ma.
Grid 2 Current	2.1	Ma.





7EN

LIMITER FM DETECTOR SERVICE

Maximum Ratings:

Design-Center Values

Plate Voltage	300	max.	Volts
Grid 3 Voltage	25	max.	Volts
Grid 2 (Screen) Supply Voltage	300	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve		
Grid 1 Voltage:			
Positive DC Value	0	max.	Volts
Plate Dissipation	1.5	max.	Watts
Grid 2 Dissipation	1.0	max.	Watts
Heater-Cathode Voltage			
Heater Positive with respect to Cathode			
DC Component	100	max.	Volts
Total DC and peak	200	max.	Volts
Heater Negative with respect to Cathode			
Total DC and peak	200	max.	Volts

Maximum Circuit Values:

Grid 1 Circuit Resistance			
For fixed bias operation	0.25	max.	Megohm
For cathode bias operation	0.5	max.	Megohm

NOTES

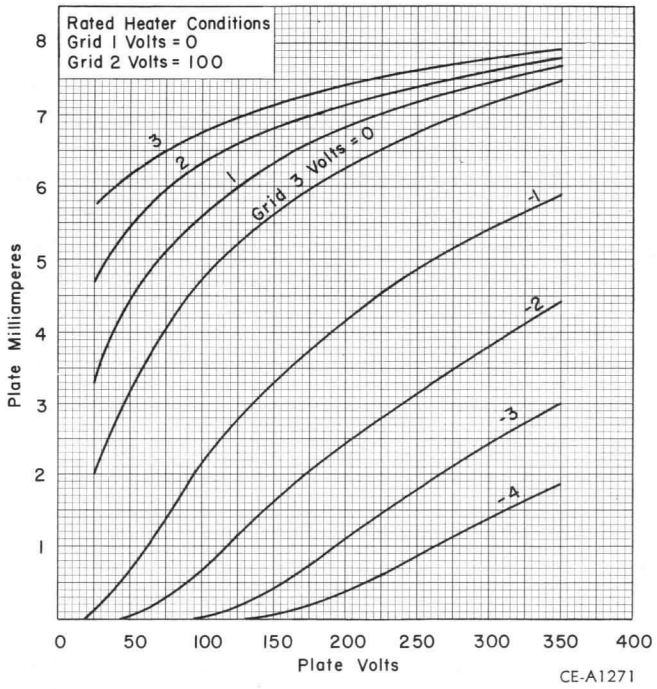
With JETEC shield #316 connected to Cathode.

□ For Plate Current of 20 μamp.

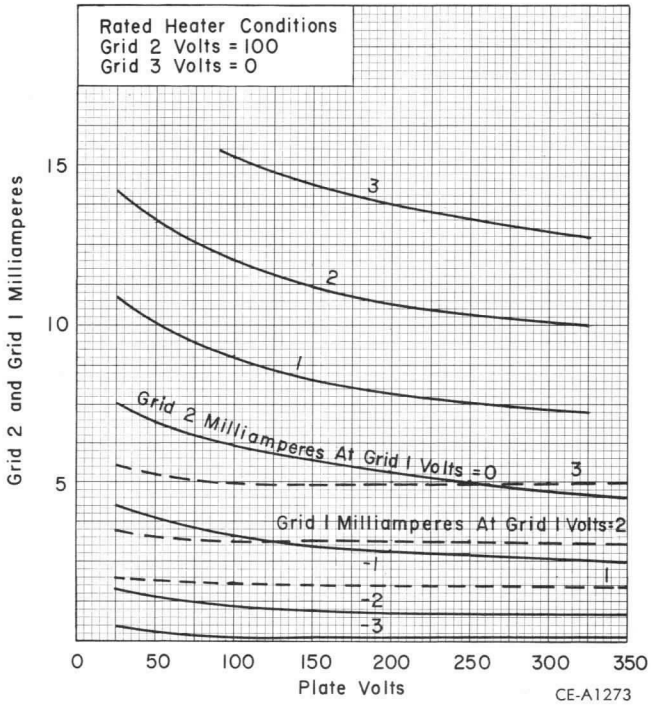
△ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

* Grid 1 to all elements of tube except plate.

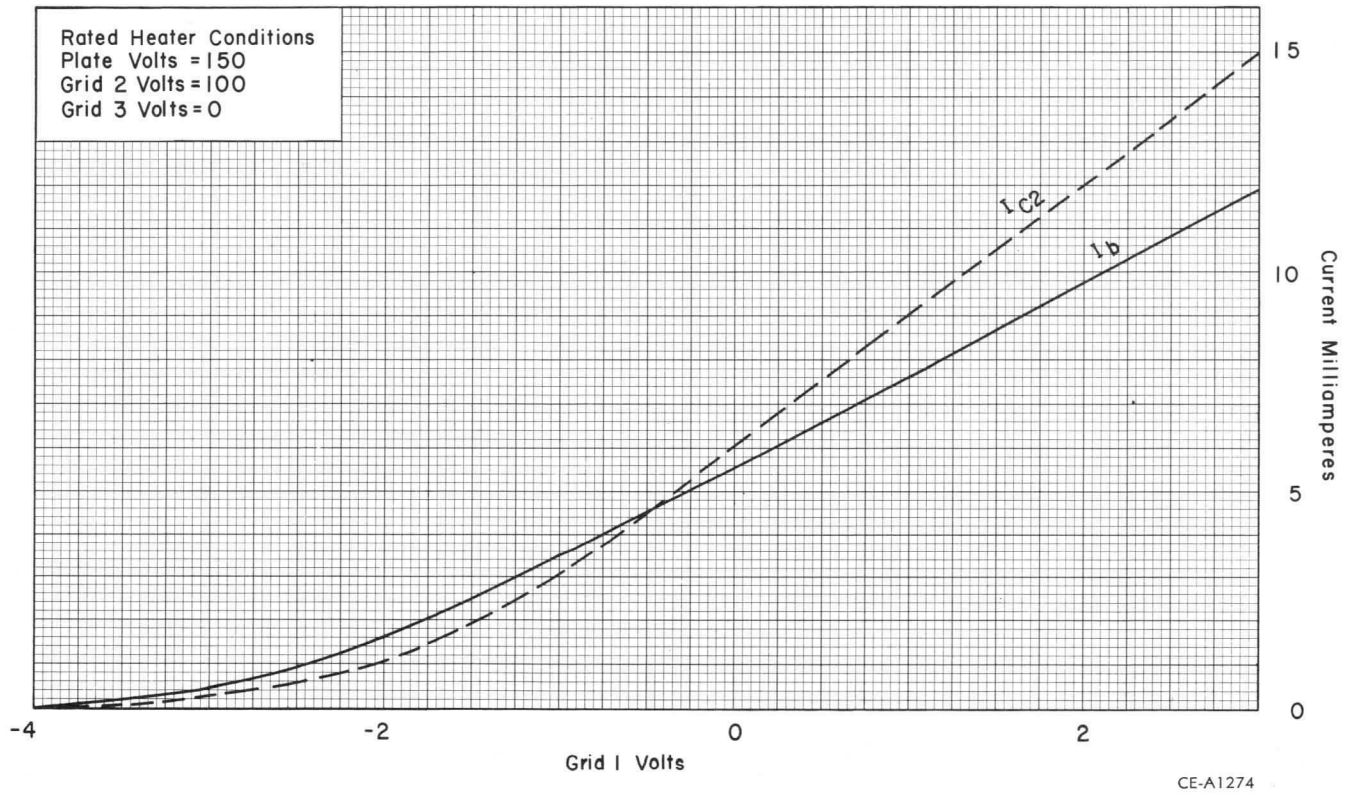
AVERAGE PLATE CHARACTERISTICS



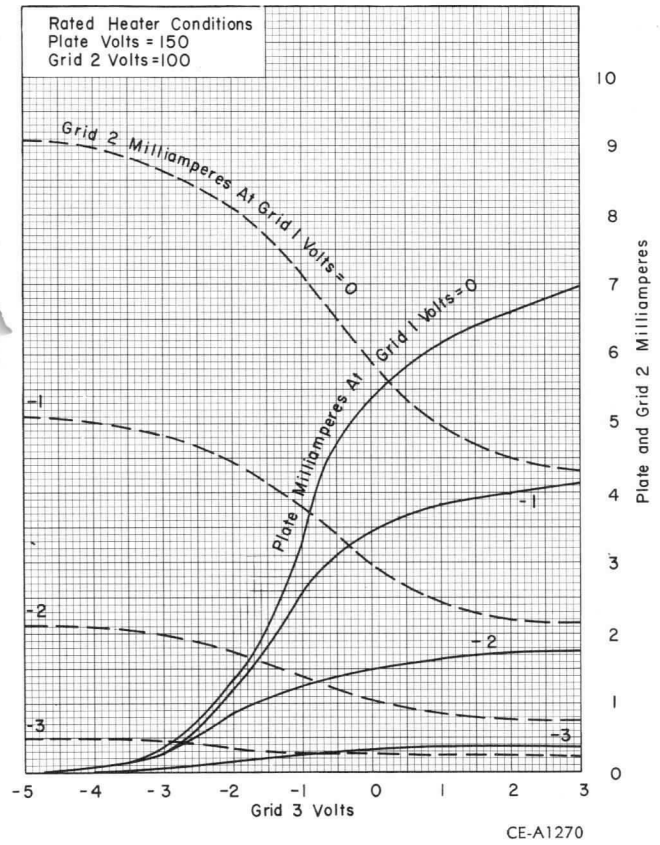
AVERAGE CHARACTERISTICS



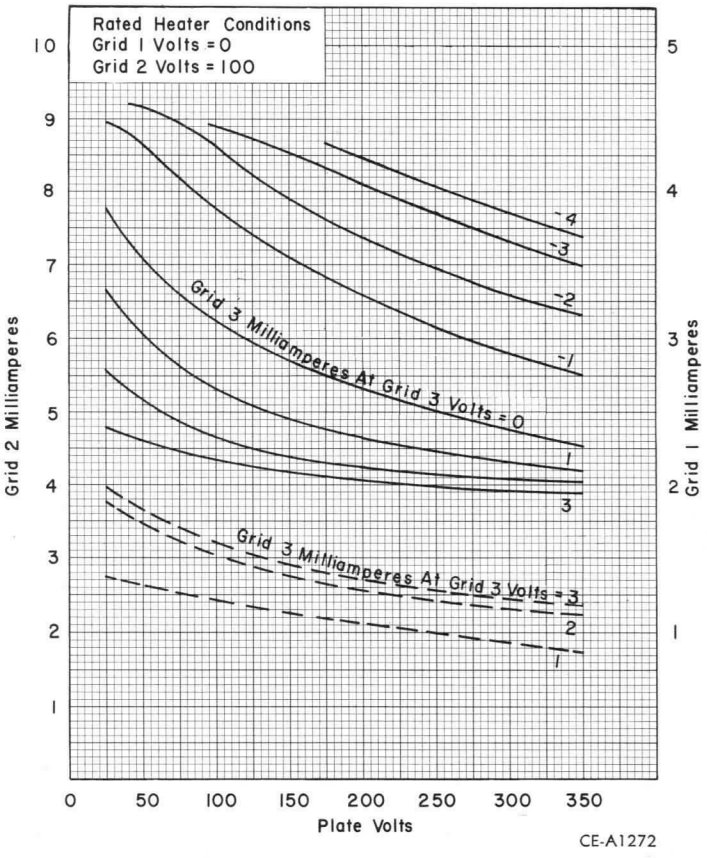
AVERAGE CHARACTERISTICS



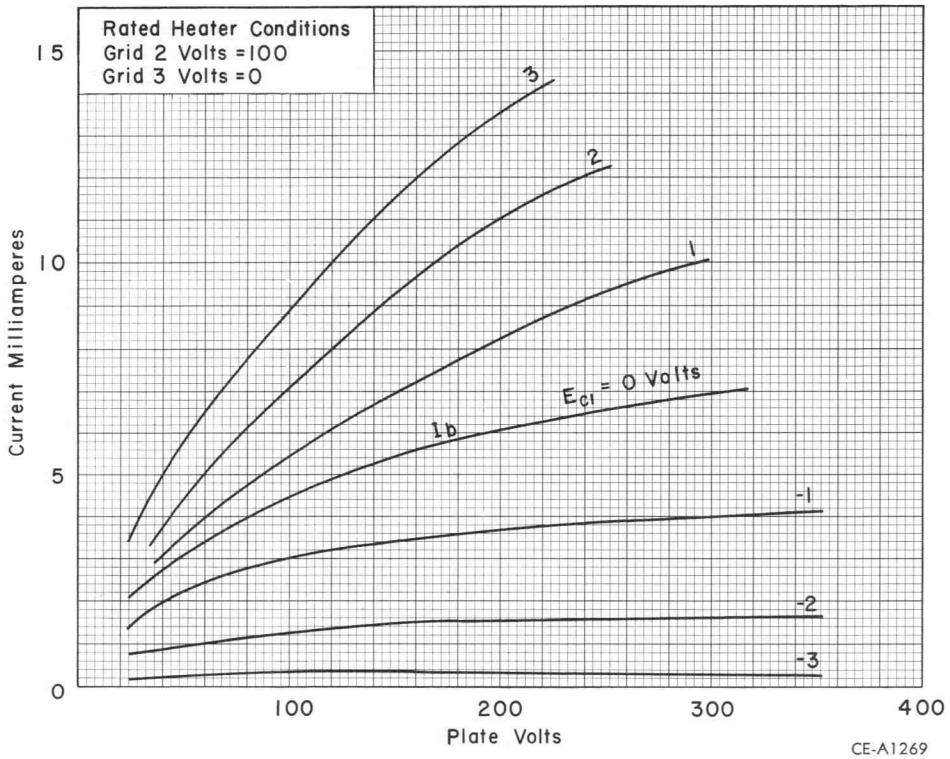
AVERAGE CHARACTERISTICS



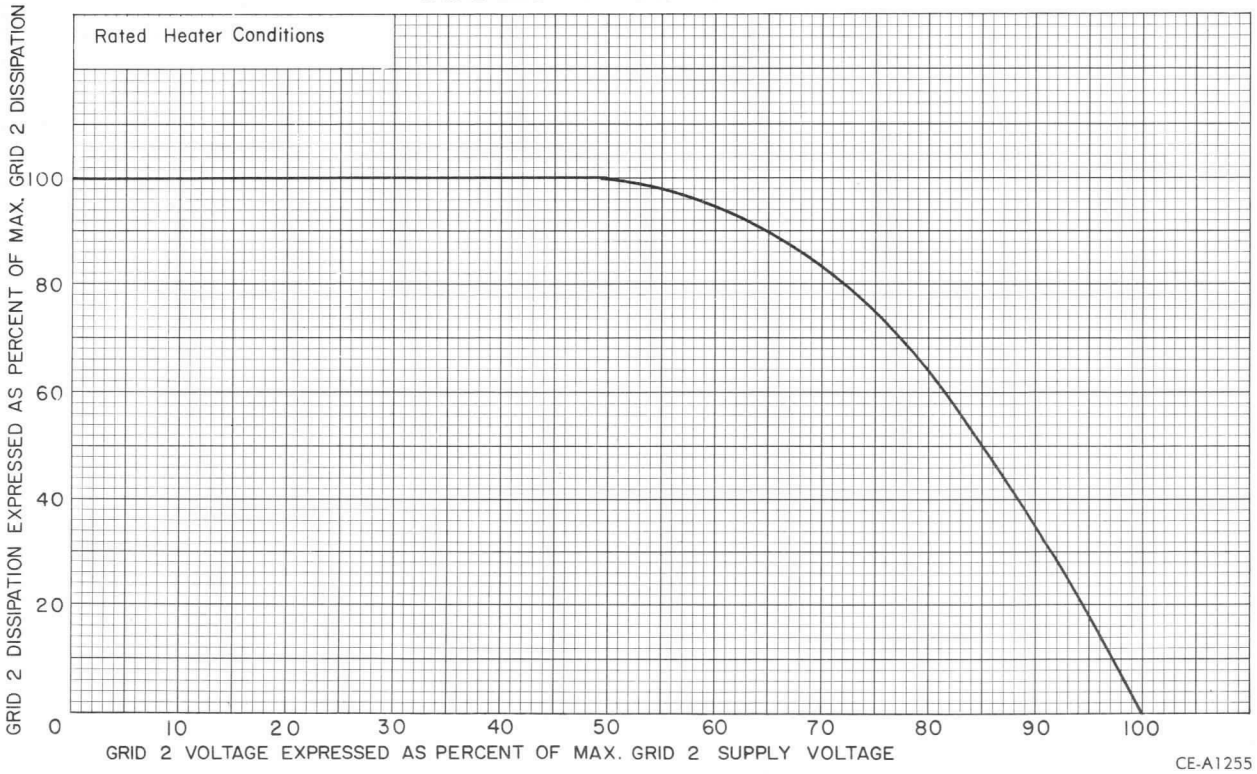
AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



GRID 2 INPUT RATING CURVE



Westinghouse

2DX4
3DX4
6DX4

January 1, 1963

UHF TRIODE TYPES 2DX4, 3DX4 AND 6DX4

The 2DX4, 3DX4 and 6DX4 are miniature 7-pin triodes designed for local oscillator service in television receivers which operate in the ultra-high-frequency region. Internal lead inductance is reduced by employing double connections to the plate and grid.

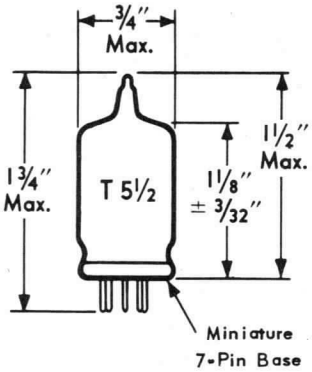
The 2DX4 and 3DX4 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode		Coated Unipotential		
Heater:	2DX4	3DX4	6DX4	
Voltage (ac or dc)	2.4	3.0	6.3 ± 0.6	Volts
Current	0.6 ± 0.040	0.45 ± 0.030	0.20	Ampere
Warm-Up Time (Note 1)	11	11	–	Seconds
Direct Interelectrode Capacitances:		Shielded	Unshielded	
Grid to Plate		1.6	1.6	μμf
Input		3.9	3.7	μμf
Output		1.5	0.38	μμf
Plate to Cathode		0.18	0.20	μμf
Grid to Cathode		3.6	3.6	μμf
Heater to Cathode		3.4	3.4	μμf

MECHANICAL

Bulb	T-5-1/2
Base	Miniature 7-Pin (JEDEC E7-1)
Basing	7DK
Mounting Position	Any
Outline	5-1



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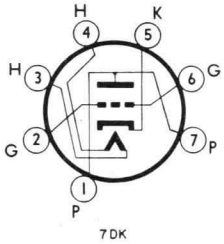

7DK

UHF OSCILLATOR SERVICE

MAXIMUM RATINGS

Design Maximum Values

DC Plate Voltage	150	max.	Volts
DC Grid Voltage	–50	max.	Volts
DC Grid Current	2	max.	Ma.
Plate Dissipation	2.2	max.	Watts
DC Cathode Current	20	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	100	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	50	max.	Volts
Total DC + Peak	100	max.	Volts

TYPICAL OPERATION at 1000 Mc: (Note 2)

Plate Supply Voltage	100	Volts
Plate Resistor	220	Ohms
Grid Resistor	10000	Ohms
Plate Current	14	Ma.
Grid Current	250	μamp

CHARACTERISTICS

Plate Voltage	85	Volts
Cathode Bias Resistor	150	Ohms
Amplification Factor	30	–
Plate Resistance	2700	Ohms
Transconductance	11000	μmhos
Plate Current	10	Ma.

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. Measured in JEDEC standard UHF oscillator No. 400.

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Receiving Tube Section

WESTINGHOUSE ELECTRIC CORPORATION ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

May 15, 1958

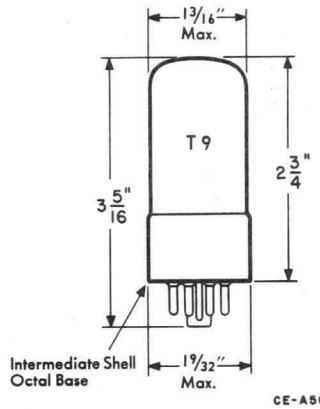
TELEVISION DAMPING DIODE TYPES 6DA4, 12D4 and 17D4

The 6DA4, 12D4 and 17D4 are 6-pin octal indirectly-heated half-wave rectifiers designed for service as the damping diode in horizontal deflection circuits of television receivers.

The 12D4 and 17D4 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:				
Cathode			Unipotential	
Heater:	6DA4	12D4	17D4	
Voltage (ac or dc)	6.3	12.6	16.8	Volts
Current	12	0.6	0.45	Ampere
Warm-up Time (Approx.)**	--	11	11	Seconds
Direct Interelectrode Capacitances:				
Heater to Cathode		3.0		uuf
Plate to Cathode and Heater		6.0		uuf
Cathode to Plate and Heater		8.0		uuf
MECHANICAL:				
Bulb			T-9	
Base			Intermediate-Shell Octal 6-Pin (JETEC B6-8)	
			Short Intermediate-Shell Octal 6-Pin (JETEC B6-60)	
Basing			4CG	
Mounting Position			Any	



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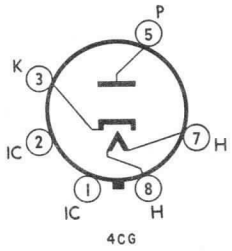


4CG

NOTE: Pins 1, 2, 4, 6 must not be used as tie points.

DAMPER SERVICE*

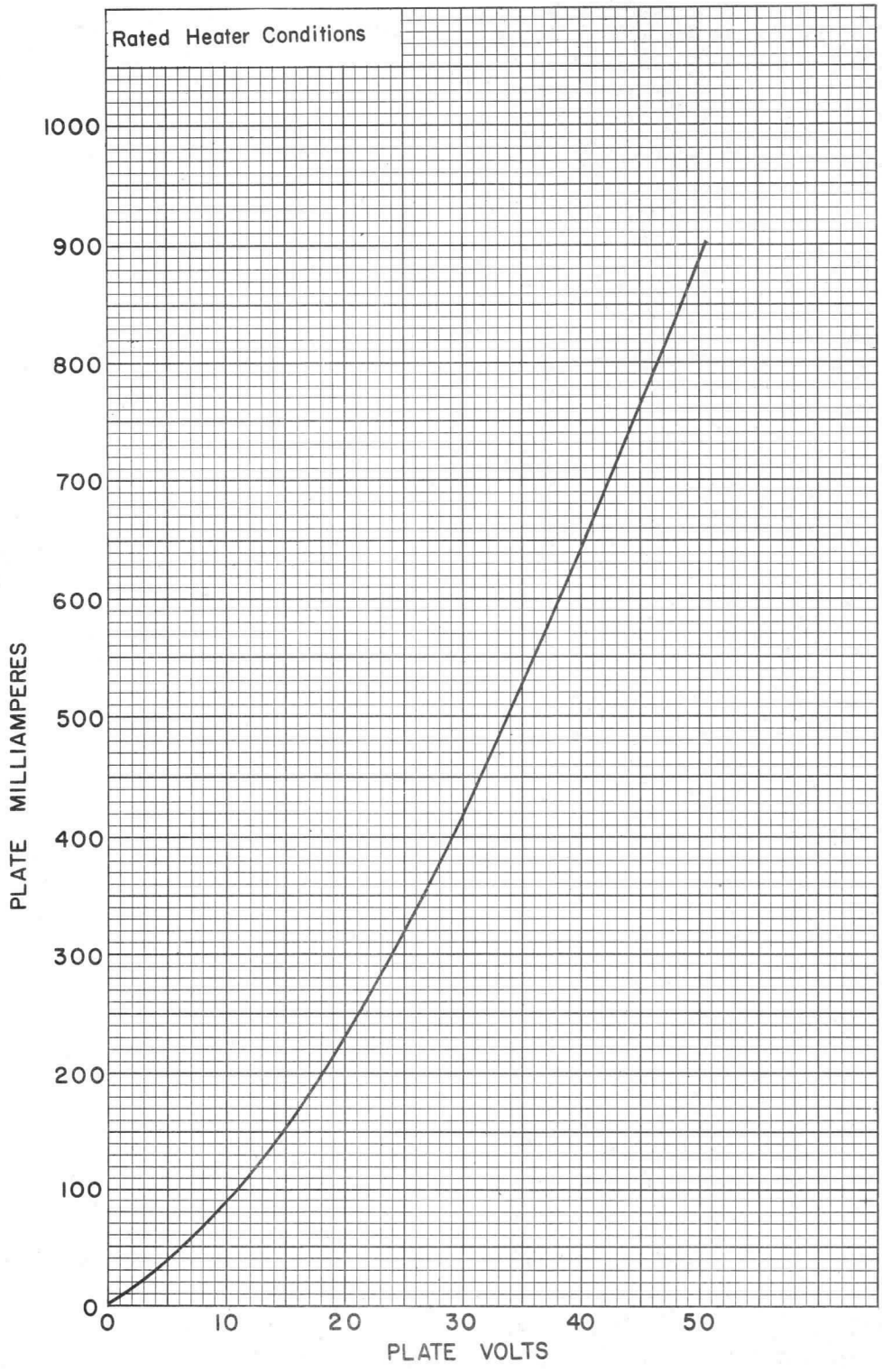
MAXIMUM RATINGS:		
Design Maximum Values (n)		
Peak Inverse Voltage	4400 max.	Volts
Peak Plate Current	900 max.	Ma.
DC Plate Current	155 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode	900 max.	Volts
Total DC and Peak	4400 max.	Volts
Heater Positive with Respect to Cathode	100 max.	Volts
Total DC and Peak	300 max.	Volts
Voltage Drop at I_b = 250 Ma.	21	Volts
Plate Dissipation	5.5 max.	Watts

* For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle.

n Design-Maximum Ratings are the limiting values expressed with respect to bogie tubes at which satisfactory tube life can be expected to occur in the types of service for which the tube is rated. Therefore the equipment designed must establish the circuit design so that initially and throughout equipment life no Design-Maximum value is exceeded with a bogie tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation and environmental conditions.

** Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

AVERAGE CHARACTERISTICS



TRIODE-PENTODE CONVERTER TYPES 5EA8 and 6EA8

The 5EA8 and 6EA8 are 9-Pin miniature medium-mu triode and sharp-cutoff pentode types designed for service as combined oscillator and mixer in television receiver tuners using an intermediate frequency of approximately 40 mc.

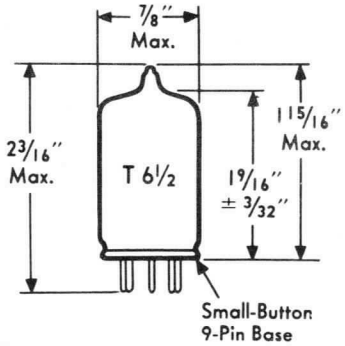
The 5EA8 and 6EA8 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

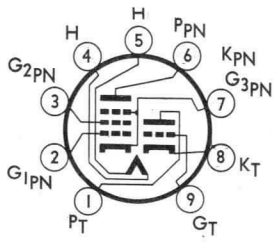
ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	5EA8	6EA8	
Voltage (ac or dc)	4.7	6.3	Volts
Current	0.60±6%	0.45±6%	Amperes
Warm-up Time●	11	11	Seconds
Direct Interelectrode Capacitances:			
Triode Unit	Unshielded	Shielded #	
Grid to plate	1.7	1.7	μμf
Input	3.0	3.2	μμf
Output	0.3	1.1	μμf
Heater to Cathode	3.0	3.0□	μμf
Pentode Unit			
Grid 1 to Plate	0.02 max.	0.01 max	μμf
Input	5.0	5.0	μμf
Output	2.6	3.4	μμf
Heater to Cathode	3.0	3.0□	μμf

MECHANICAL:

Bulb	T-6-½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9AE
Outline	6-2
Mounting	Any





9AE

MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330	max. Volts
Grid 2 (Screen) Voltage	--	See Grid 2 Input Rating Curve	
Grid 2 Supply Voltage	--	330	max. Volts
Grid 1 (Control Grid) Voltage Positive Bias Value	0	0	max. Volts
Plate Dissipation	3.0	3.1	max. Watts
Grid 2 Input	--	0.55	max. Watt
Heater Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100	max. Volts
Total DC and Peak	200	200	max. Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	max. Volts

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	150	125	Volts
Grid 2 Voltage	--	125	Volts
Grid 1 Voltage	--	-1.0	Volts
Cathode Bias Resistor	56	--	Ohms
Amplification Factor	40	--	
Plate Resistance (approx.)	5000	80000	Ohms
Transconductance	8500	6400	μmhos
Grid 1 Cutoff Bias ⊕	-12	-9	Volts
Plate Current	18	12	Ma.
Grid 2 Current	--	4.0	Ma.

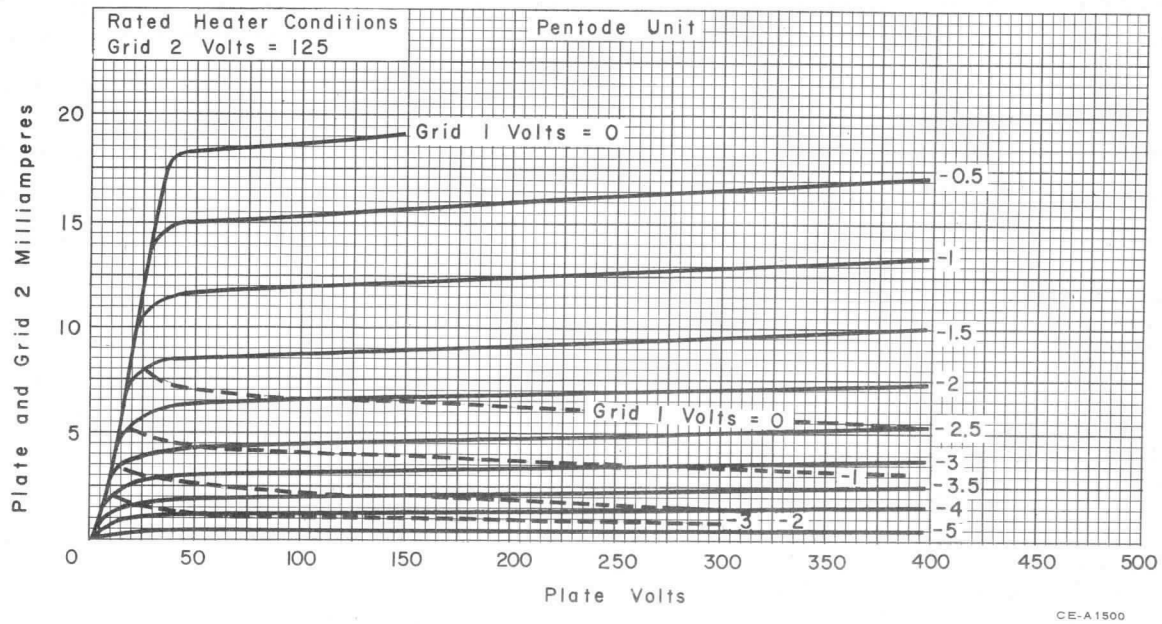
● Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

With JEDEC shield #315 connected to Cathode of unit under test.

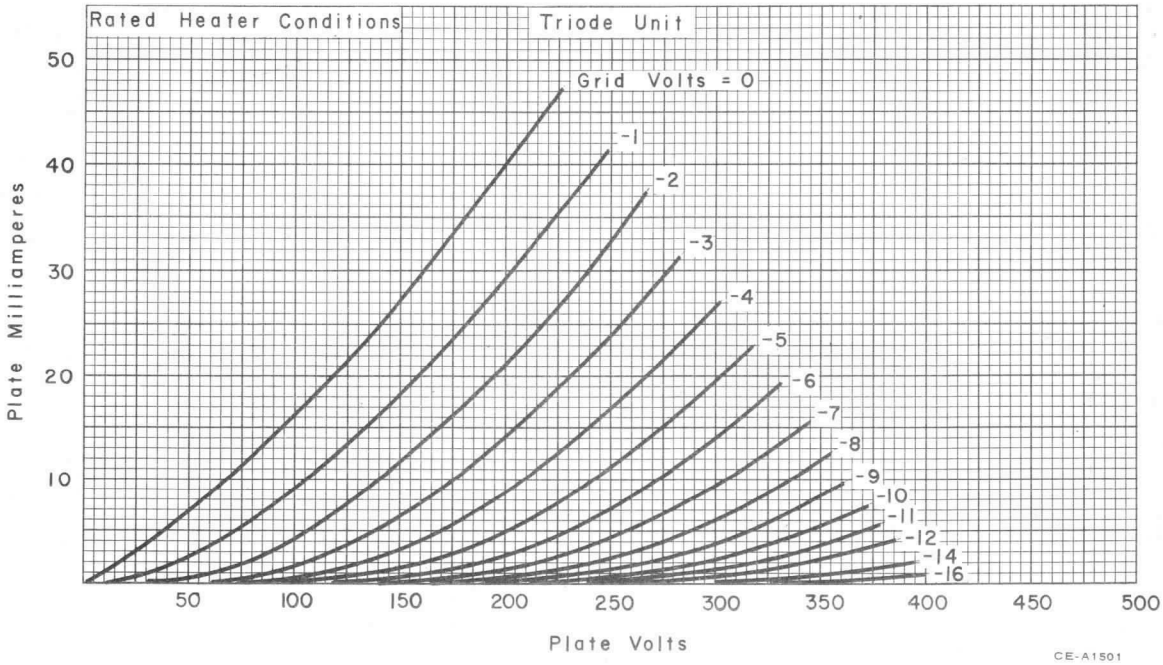
□ With JEDEC shield #315 connected to ground.

⊕ For plate current of 10 microamperes.

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



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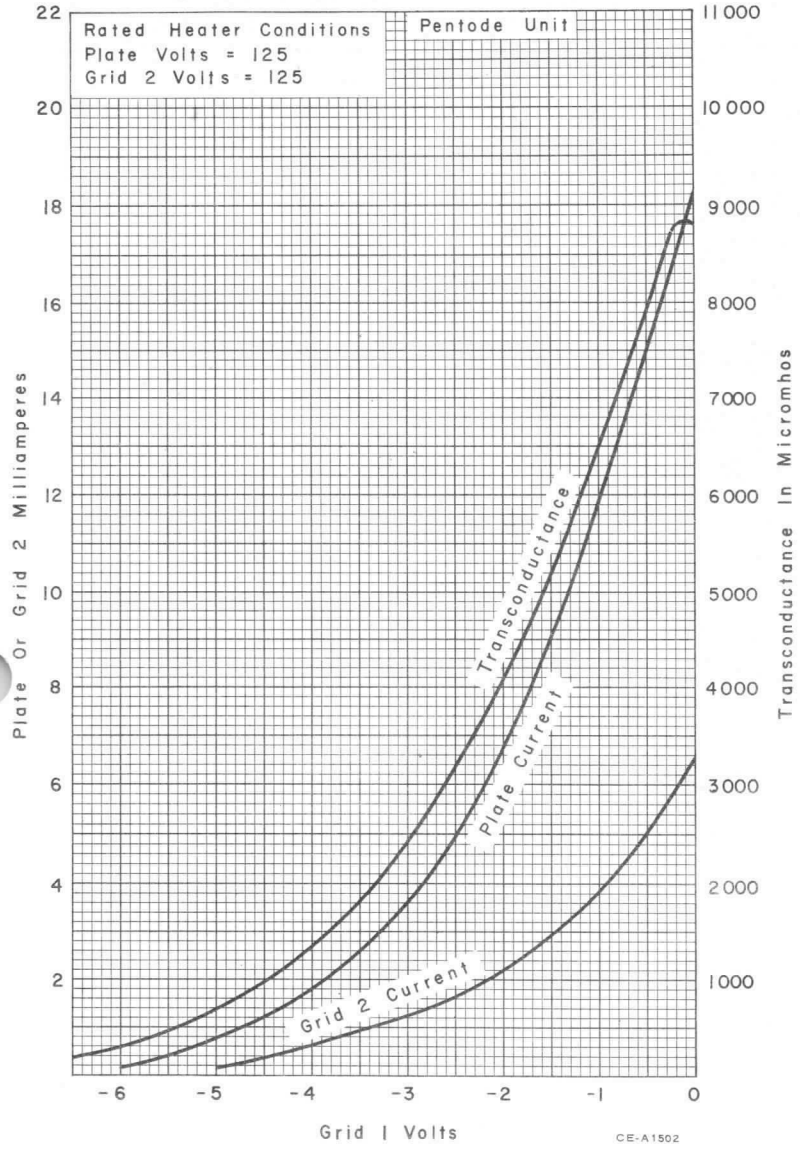
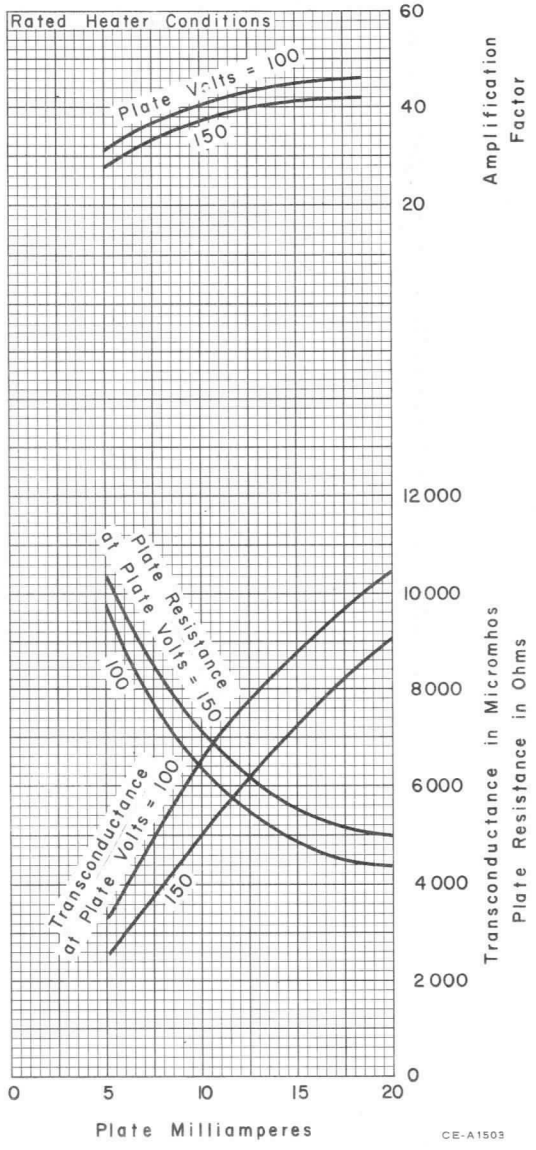


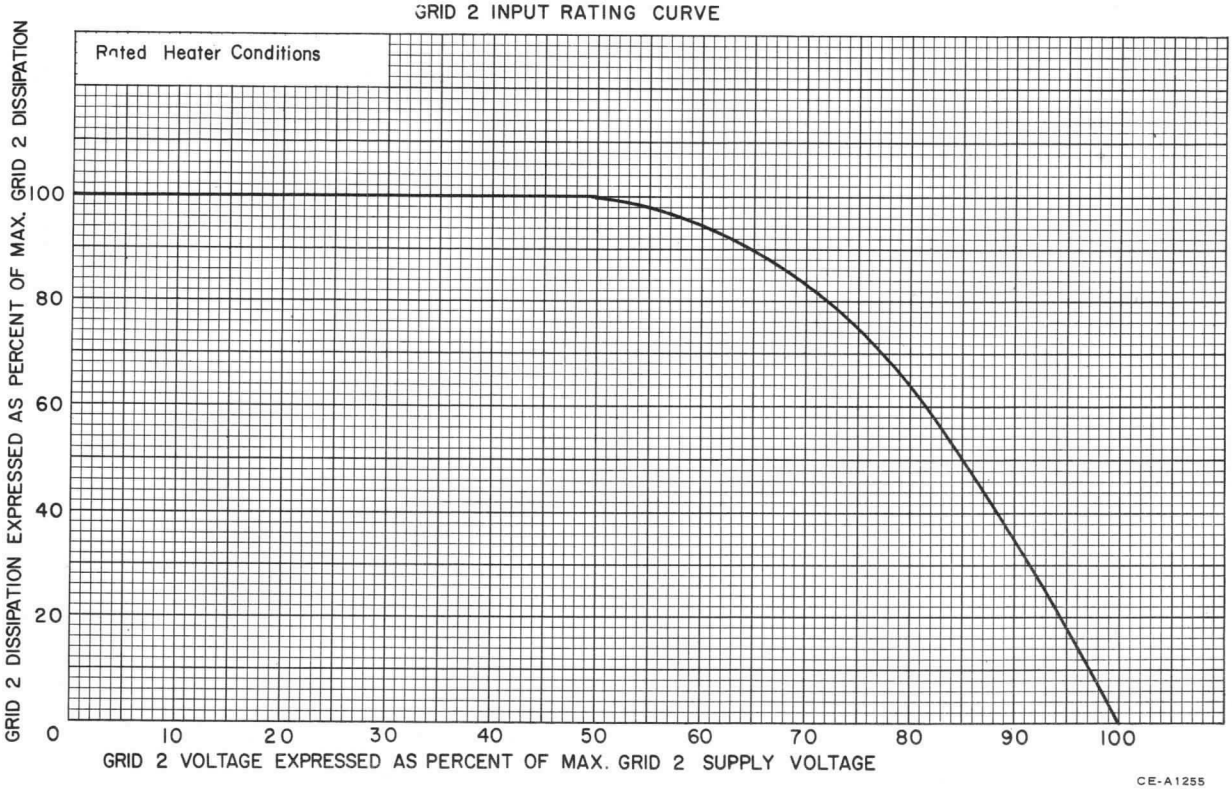
CE-A1502

AVERAGE CHARACTERISTICS
Triode Unit



CE-A1503

GRID 2 INPUT RATING CURVE



CE-A1255

TRIODE-PENTODE CONVERTER TYPE 19EA8

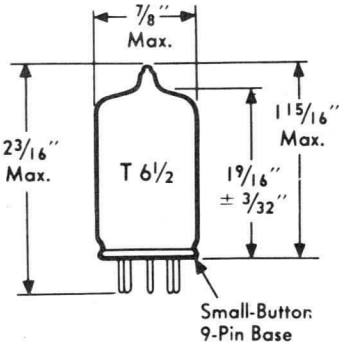
The 19EA8 is a 9-Pin miniature medium-mu triode and sharp-cutoff pentode type designed for service as combined oscillator and mixer in FM receivers.

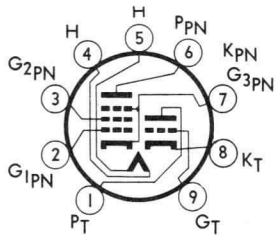
ELECTRICAL

Cathode	Coated Unipotential			
Heater:				
Voltage (ac or dc)	18.9	Volts		
Current	0.15	Amperes		
Direct Interelectrode Capacitances:				
Triode Unit	Unshielded		Shielded (Note 1)	
Grid to Plate	1.7		1.7	pf
Input	3.0		3.2	pf
Output	0.3		1.1	pf
Heater to Cathode	3.0		3.0 (Note 2)	pf
Pentode Unit				
Grid 1 to Plate	0.02	max.	0.01	max. pf
Input	5.0		5.0	pf
Output	2.6		3.4	pf
Heater to Cathode	3.0		3.0 (Note 2)	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9AE
Outline	6-2
Mounting	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330	max. Volts
Grid 2 (Screen) Voltage	See Grid 2 Input Rating Curve		
Grid 2 Supply Voltage	–	330	max. Volts
Grid 1 (Control Grid) Voltage Positive Bias Value	0	0	max. Volts
Plate Dissipation	3.0	3.1	max. Watts
Grid 2 Input	–	0.55	max. Watt
Heater Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100	max. Volts
Total DC and Peak	200	200	max. Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	max. Volts

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	150	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–	–1.0	Volts
Cathode Bias Resistor	56	–	Ohms
Amplification Factor	40	–	–
Plate Resistance (Approx.)	5000	80000	Ohms
Transconductance	8500	6400	μmhos
Grid 1 Cutoff Bias (Note 3)	–12	–9	Volts
Plate Current	18	12	Ma.
Grid 2 Current	–	4.0	Ma.

NOTES

1. With JEDEC Shield #315 connected to Cathode of unit under test.
2. With JEDEC Shield #315 connected to ground.
3. For plate current of 10 microamperes.

NOTICE: For characteristic curves, see data sheet for types 5EA8 & 6EA8.

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Receiving Tube Section

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HIGH-MU TRIODE - SHARP-CUTOFF PENTODE TYPES
6EB8 and 8EB8

The 6EB8 and 8EB8 are 9-pin miniature high-mu triode and sharp-cutoff pentode types designed for service in color and black-and-white television receivers. The triode unit is designed for service as a sync separator, sync clipper and phase inverter while the pentode unit is designed for operation as a video amplifier.

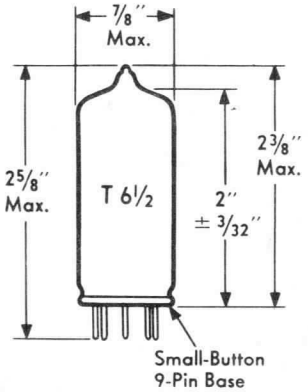
The 8EB8 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

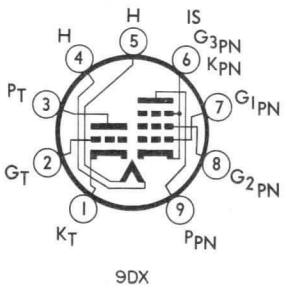
ELECTRICAL:

	6EB8	8EB8	
Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%	8.0	Volts
Current	0.75	0.6 ± 6%	Ampere
Warm-up Time (approx.) ▲	--	11	Seconds
Direct Interelectrode Capacitances: (unshielded)			
Triode			
Grid to Plate		4.4	μμf
Input		2.4	μμf
Output		0.36	μμf
Pentode			
Grid 1 to Plate		0.1 max.	μμf
Input		11	μμf
Output		4.2	μμf
Coupling			
Pentode Grid 1 to Triode Plate		.005 max.	μμf
Pentode Plate to Triode Grid		0.018 max.	μμf
Pentode Plate to Triode Plate		0.17 max.	μμf

MECHANICAL:

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9DX
Mounting Position	Any





9DX

MAXIMUM RATINGS
Design Maximum Values

	Triode	Pentode		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	--	330	max.	Volts
Grid 2 Voltage	--	See CE-A825		
Plate Dissipation	1.0	5	max.	Watts
Grid 2 Dissipation	--	1.1	max.	Watts
Positive Grid 1 Bias Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

	Triode	Pentode		
Plate Voltage	250	45	200	Volts
Grid 2 Voltage	--	125	125	Volts
Grid 1 Voltage	-2	0	--	Volts
Cathode Bias Resistor	--	--	68	Ohms
Amplification Factor	100	--	--	
Plate Resistance (approx.)	37000	--	75000	Ohms
Transconductance	2700	--	12500	μmhos
Plate Current	2	40★	25	Ma.
Grid 2 Current	--	15★	7	Ma.
Grid 1 Voltage	-5⊕		-9□	Volts

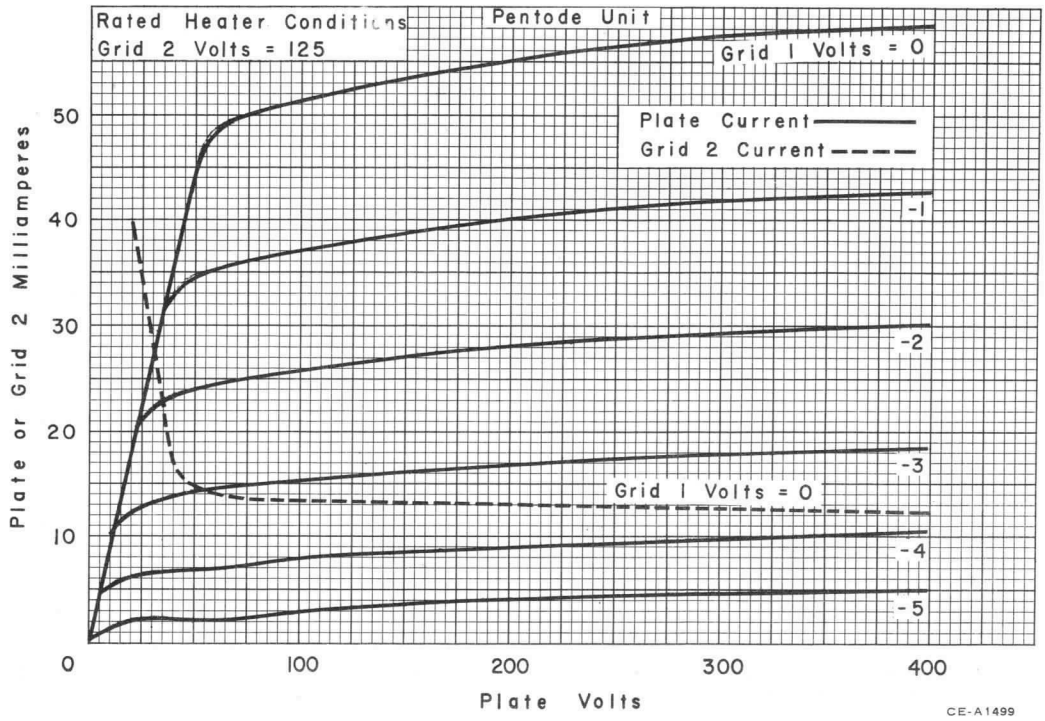
▲ Heater Warm-Up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

★ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

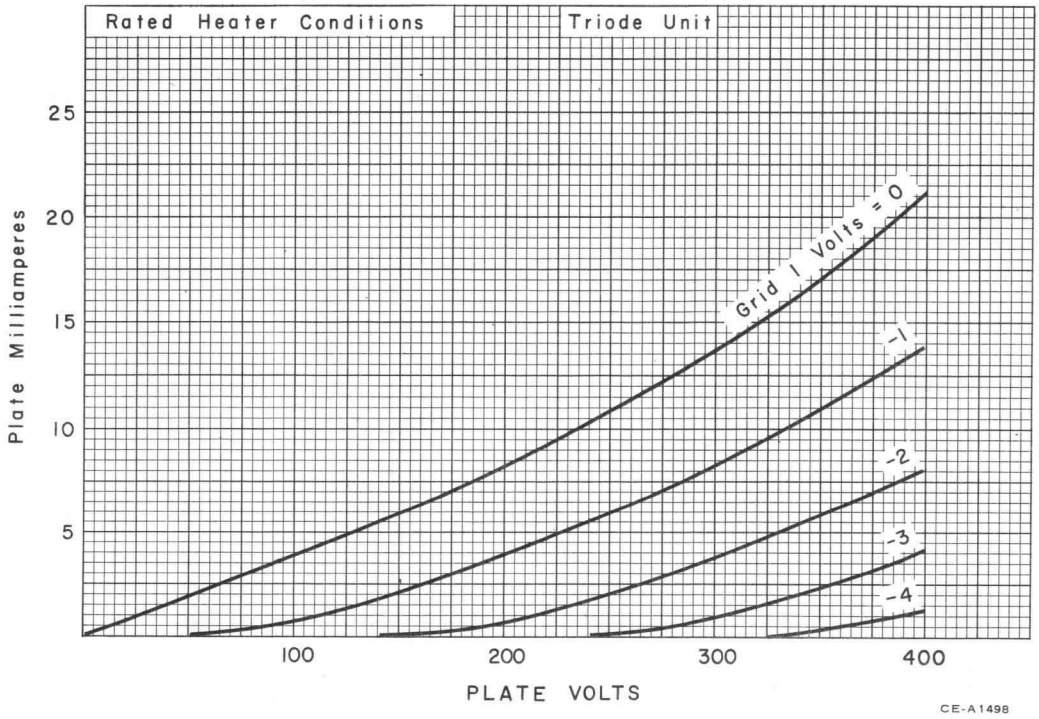
⊕ For plate current of 20 microamperes.

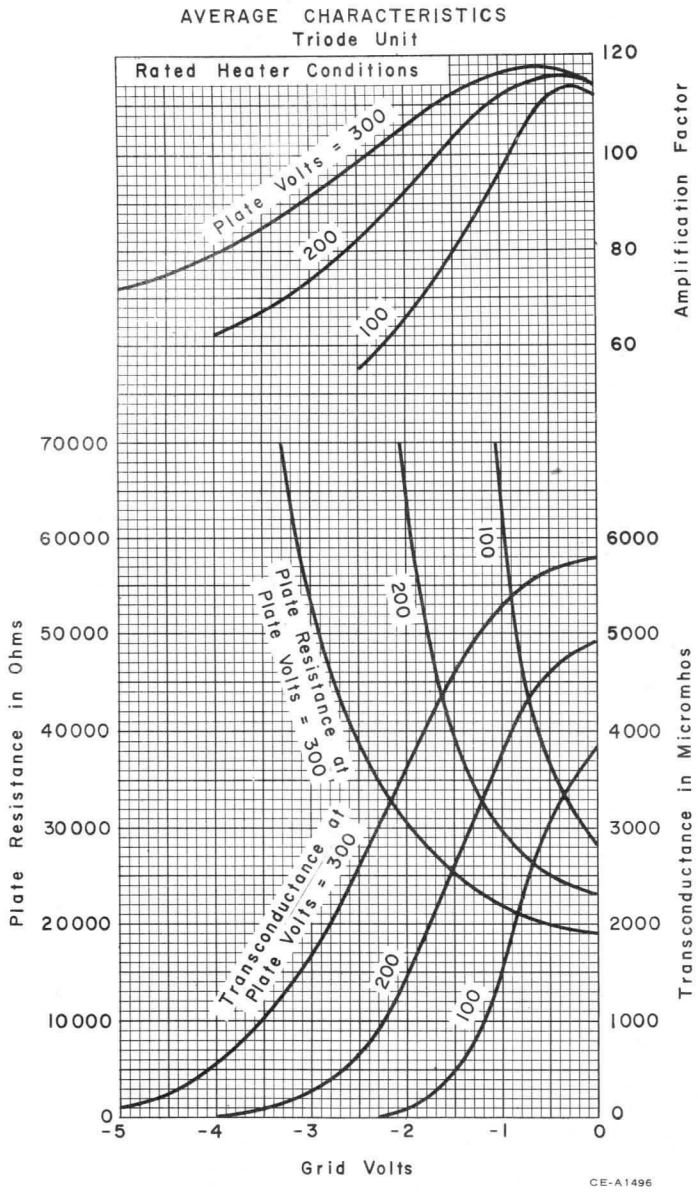
□ For plate current of 100 microamperes.

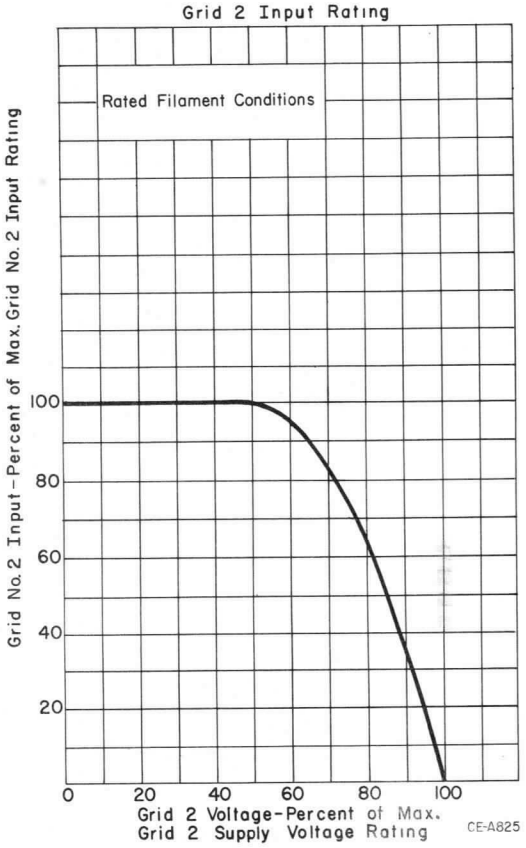
AVERAGE PLATE CHARACTERISTICS



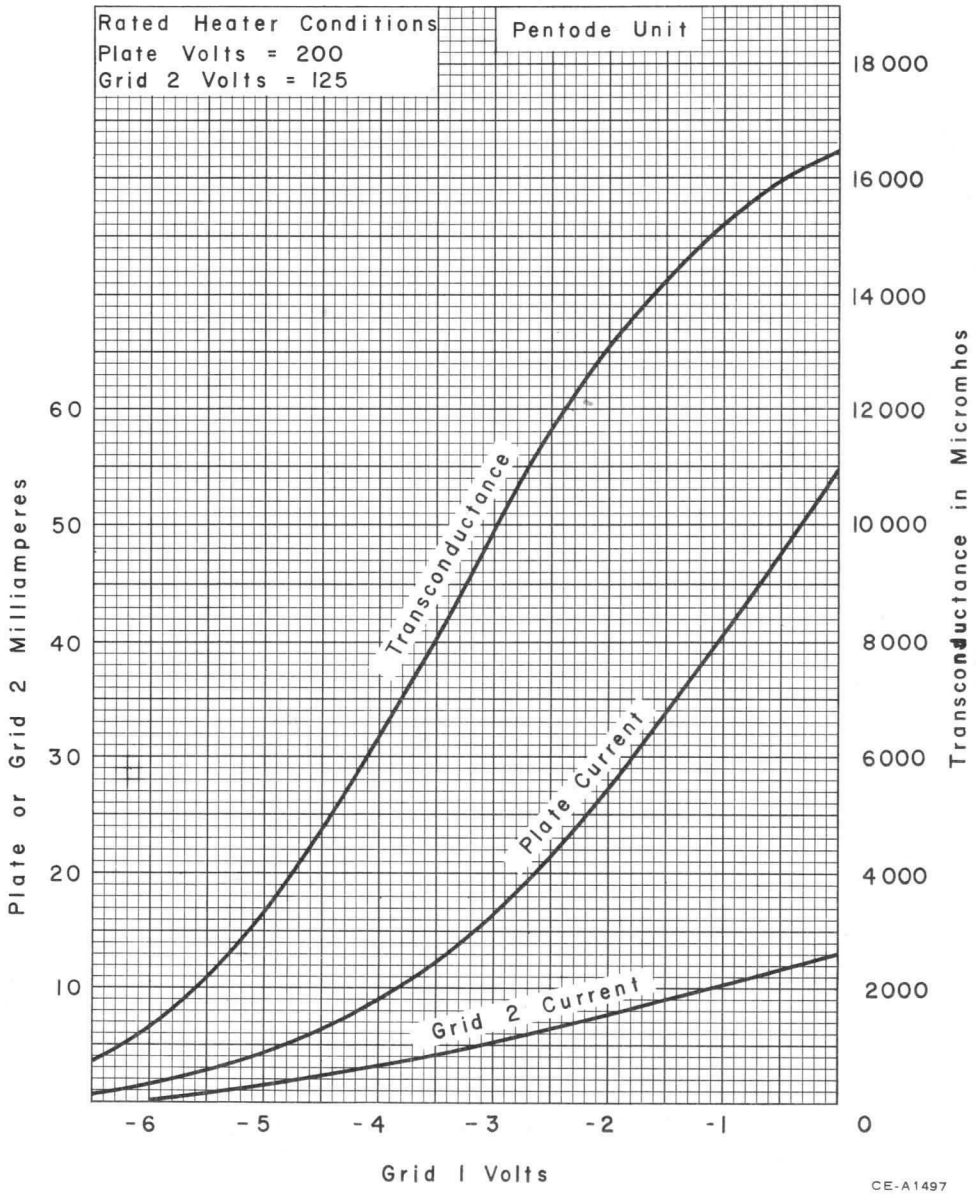
AVERAGE PLATE CHARACTERISTICS




AVERAGE CHARACTERISTICS
Triode Unit
Rated Heater Conditions
Plate Volts = 300
200
100
Plate Resistance at Plate Volts = 300
Transconductance at Plate Volts = 300
Plate Resistance in Ohms
Amplification Factor
Transconductance in Micromhos
Grid Volts
CE-A1496


Grid 2 Input Rating
Rated Filament Conditions
Grid No. 2 Input-Percent of Max. Grid No. 2 Input Rating
Grid 2 Voltage-Percent of Max. Grid 2 Supply Voltage Rating
CE-A825

AVERAGE CHARACTERISTICS



Westinghouse®

6EH5
12EH5
25EH5
50EH5

November 1, 1959

POWER PENTODE TYPES 6EH5, 12EH5, 25EH5 and 50EH5

The 6EH5, 12EH5, 25EH5 and 50EH5 are 7-pin miniature power pentode types designed for service as audio output tubes in radio and television receivers and audio amplifiers in record players and tape recorders. The outstanding feature of these types is their high power sensitivity permitting very low drive voltage.

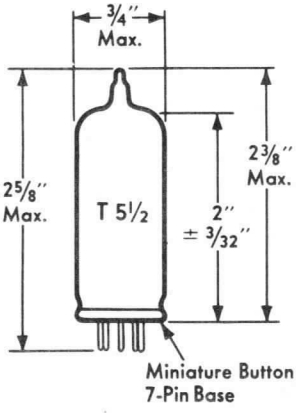
The 12EH5 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

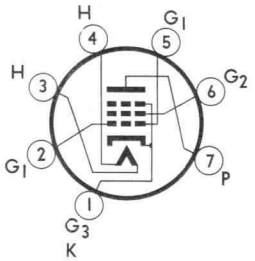
ELECTRICAL:

Cathode	Coated Unipotential				
Heater:	6EH5	12EH5	25EH5	50EH5	
Voltage (ac or dc)	6.3	12.6	25.0	50.0	Volts
Current	1.20	0.60	0.30	0.15	Ampere
Warm-up Time♦	--	11	--	--	Seconds
Direct Interelectrode Capacitances (Unshielded):					
Grid 1 to Plate	0.65				μμf
Input	17				μμf
Output	9				μμf

MECHANICAL:

Bulb	T-5½
Base	7-Pin Miniature (JEDEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





7CV

MAXIMUM RATINGS

Design Center Values

Plate Voltage	135	max.		Volts
Grid 2 Voltage (Screen)	117	max.		Volts
Grid 1 Positive Voltage	0	max.		Volts
Plate Dissipation	5	max.		Watts
Grid 2 Dissipation	1.75	max.		Watts
Bulb Temperature□	220	max.		°C
Grid 1 Circuit Resistance:				
Fixed Bias	0.1	max.		Megohms
Cathode-Resistor Bias	0.5	max.		Megohms
Heater-Cathode Voltage:	6EH5	12EH5		
Heater Negative with Respect to cathode:	25EH5 50EH5			
Total DC + Peak	200	300	max.	Volts
Heater Positive with Respect to Cathode:				
DC component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS

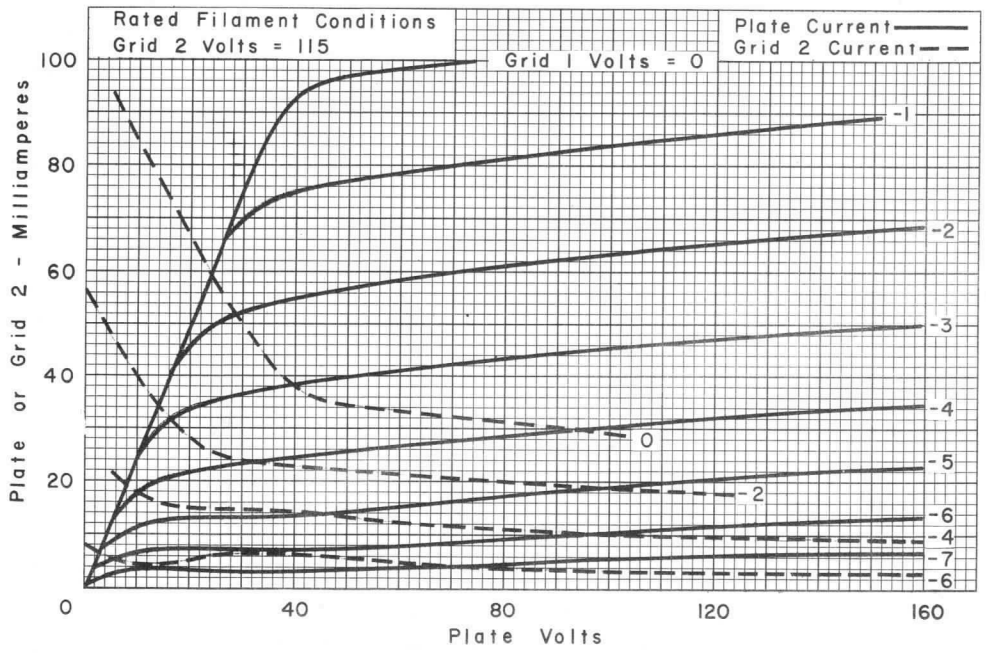
Plate Voltage	110	Volts
Grid 2 Voltage	115	Volts
Cathode Bias Resistor	62	Ohms
Peak AF-Signal Grid 1 Voltage	3	Volts
Zero-Signal Plate Current	42	Ma.
Max.-Signal Plate Current	42	Ma.
Zero-Signal Grid 2 Current (Screen)	11.5	Ma.
Max.-Signal Grid 2 Current (Screen)	14.5	Ma.
Plate Resistance (approx.)	11000	Ohms
Transconductance	14600	μmhos
Load Resistance	3000	Ohms
Power Output	1.4	Watts
Total Harmonic Distortion	7	Per Cent

♦ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

□ High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

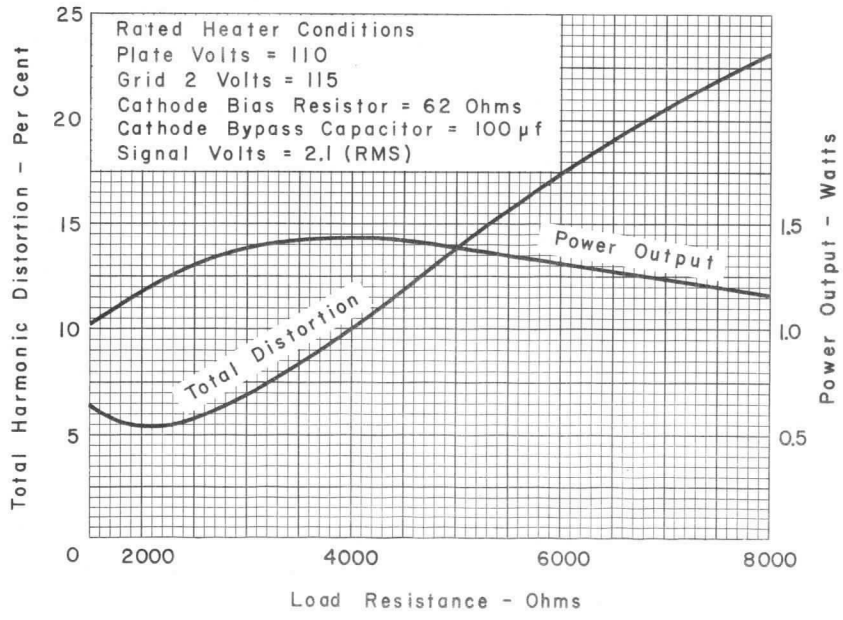
WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

AVERAGE PLATE CHARACTERISTICS



CE-A1505

AVERAGE PLATE CHARACTERISTICS



CE-A1504

POWER PENTODE TYPE 35EH5

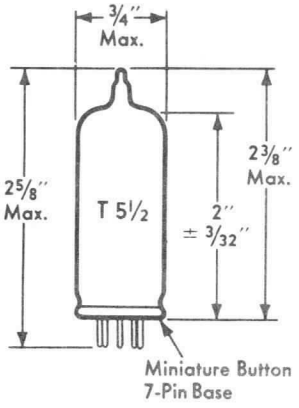
The 35EH5 is a 7-pin miniature power pentode type designed for service as audio output tube in radio and television receivers and audio amplifiers in record players and tape recorders. The outstanding feature of this type is high power sensitivity permitting very low drive voltage.

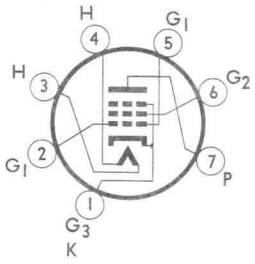
ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	35	Volts
Current	0.15	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.65	μμf
Input	17	μμf
Output	9	μμf

MECHANICAL:

Bulb	T-5½
Base	7-Pin Miniature (JEDEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





7CV

MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	150	max.	Volts
Grid 2 Voltage (Screen)	130	max.	Volts
Grid 1 Positive Voltage	0	max.	Volts
Plate Dissipation	5	max.	Watts
Grid 2 Dissipation	1.75	max.	Watts
Bulb Temperature□	220	max.	°C
Grid 1 Circuit Resistance:			
Fixed Bias	0.1	max.	Megohms
Cathode-Resistor Bias	0.5	max.	Megohms
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:

Plate Voltage	110	Volts
Grid 2 Voltage	115	Volts
Cathode Bias Resistor	62	Ohms
Peak AF-Signal Grid 1 Voltage	3	Volts
Zero-Signal Plate Current	32	Ma.
Max.-Signal Plate Current	32	Ma.
Zero-Signal Grid 2 Current (Screen)	7.2	Ma.
Max.-Signal Grid 2 Current (Screen)	12	Ma.
Plate Resistance (Approx.)	14000	Ohms
Transconductance	12000	μmhos
Load Resistance	3000	Ohms
Power Output	1.2	Watts
Total Harmonic Distortion	8	Per Cent

NOTE

□ High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

DUAL TRIODE TYPE 6EM7

The 6EM7 is a dual triode with dissimilar sections designed for use in television receivers. High mu triode No. 1 (Pins No. 4, 5 & 6) is designed for service as a vertical deflection oscillator. Triode No. 2 (Pins No. 1, 2 & 3) is designed for operation as a high efficiency vertical deflection output amplifier and has a low mu.

ELECTRICAL:

Cathodes	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	0.90		Ampere
Direct Interelectrode Capacitances (Unshielded):	Unit 1	Unit 2	
Grid to Plate	4.8	10.0	μμf
Input	2.2	7.0	μμf
Output	0.6	1.8	μμf

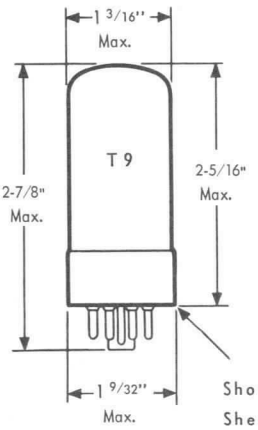
MECHANICAL:

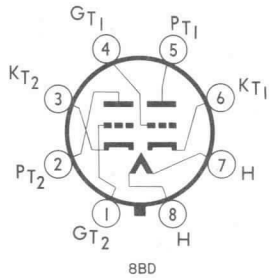
Bulb	T-9
Base	Short Intermediate Shell Octal (JEDEC B8-58)
Outline	9-37
Basing	8BD
Mounting Position	Any

⊕ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, talking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation, signal variation, and environmental conditions.





MAXIMUM RATINGS:

Design Maximum Values (except as noted)⊕

	Triode No. 1 as Vertical Deflection Oscillator	Triode No. 2 as Vertical Deflection Amplifier §		
Plate Voltage	330	330	max.	Volts
Peak Positive Pulse Plate Voltage (Abs.Max.)	--	1500	max.	Volts
Peak Negative Pulse Grid Voltage	400	250	max.	Volts
Plate Dissipation ▲	1.5	10	max.	Watts
Cathode Current	22	50	max.	Ma.
Peak Cathode Current	77	175	max.	Ma.
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total DC and Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts
Grid Circuit Resistance	2.2	2.2	max.	Meg.

CHARACTERISTICS AND TYPICAL OPERATION:

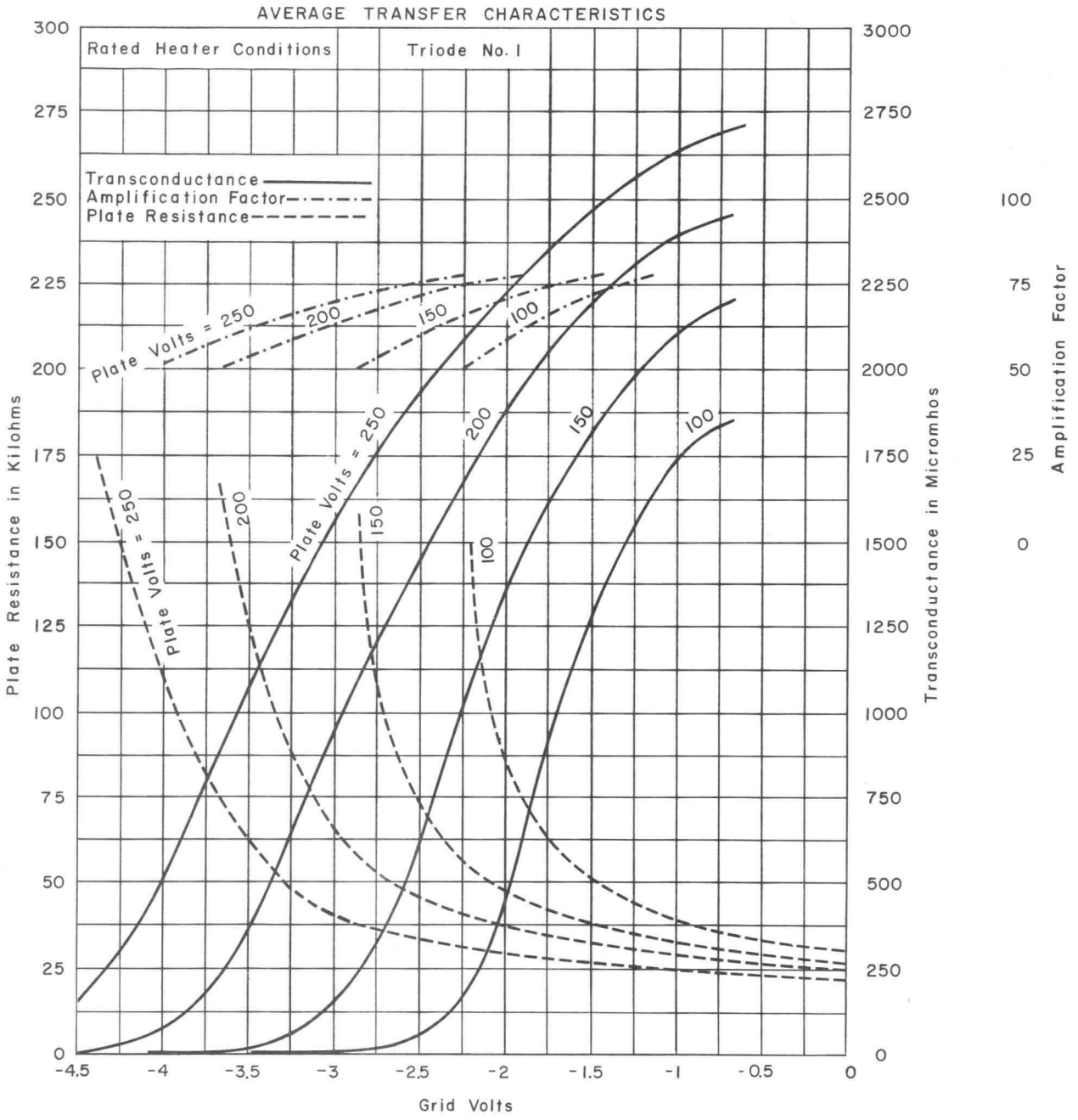
	Triode No. 1	Triode No. 2		
Plate Voltage	250	150	60	Volts
Grid Voltage	-3	-20	0	Volts
Plate Current	1.4	50	95	Ma.
Plate Resistance	40000	750	--	Ohms
Transconductance	1600	7200	--	μmhos
Amplification Factor	68	5.4	--	
Grid Voltage for Plate Current of 10 Ma.	--	-28	--	Volts
Grid Cutoff Voltage	-5.5★	-45♦	--	Volts

★ For Plate Current of 10 microamperes.

♦ For Plate Current of 100 microamperes.

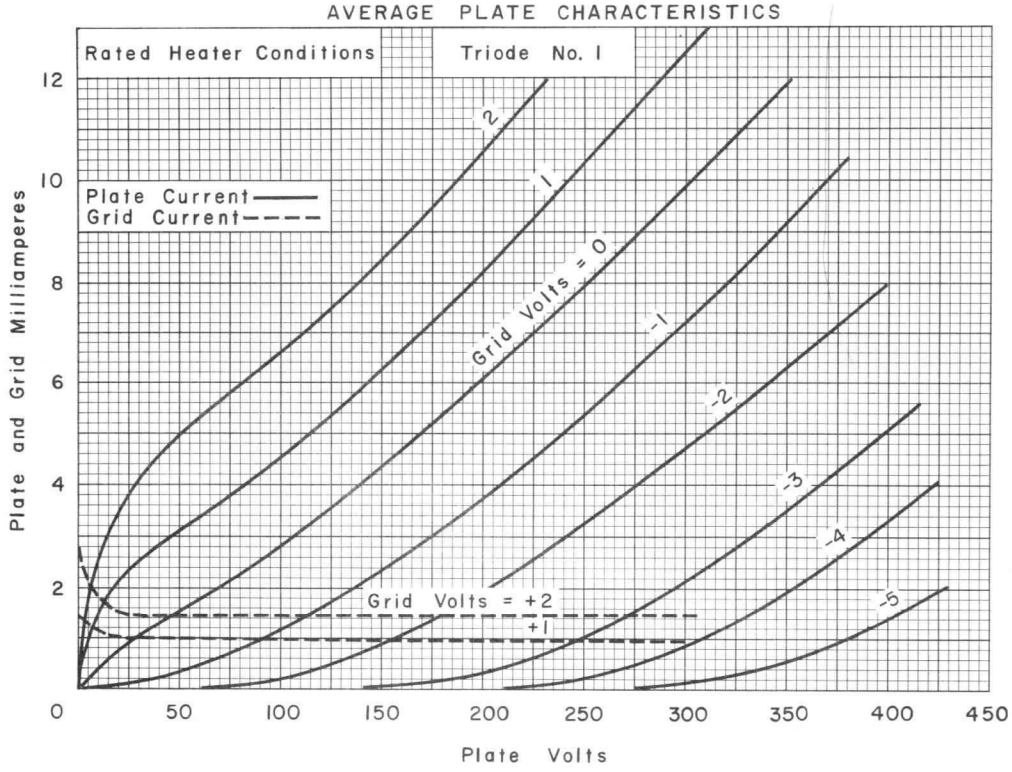
▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

§ For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Triode No. 1
Transconductance
Amplification Factor
Plate Resistance
Plate Volts = 250
200
150
100
Plate Resistance in Kilohms
Transconductance in Micromhos
Amplification Factor
Grid Volts
300
275
250
225
200
175
150
125
100
75
50
25
0
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
100
75
50
25
0
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0

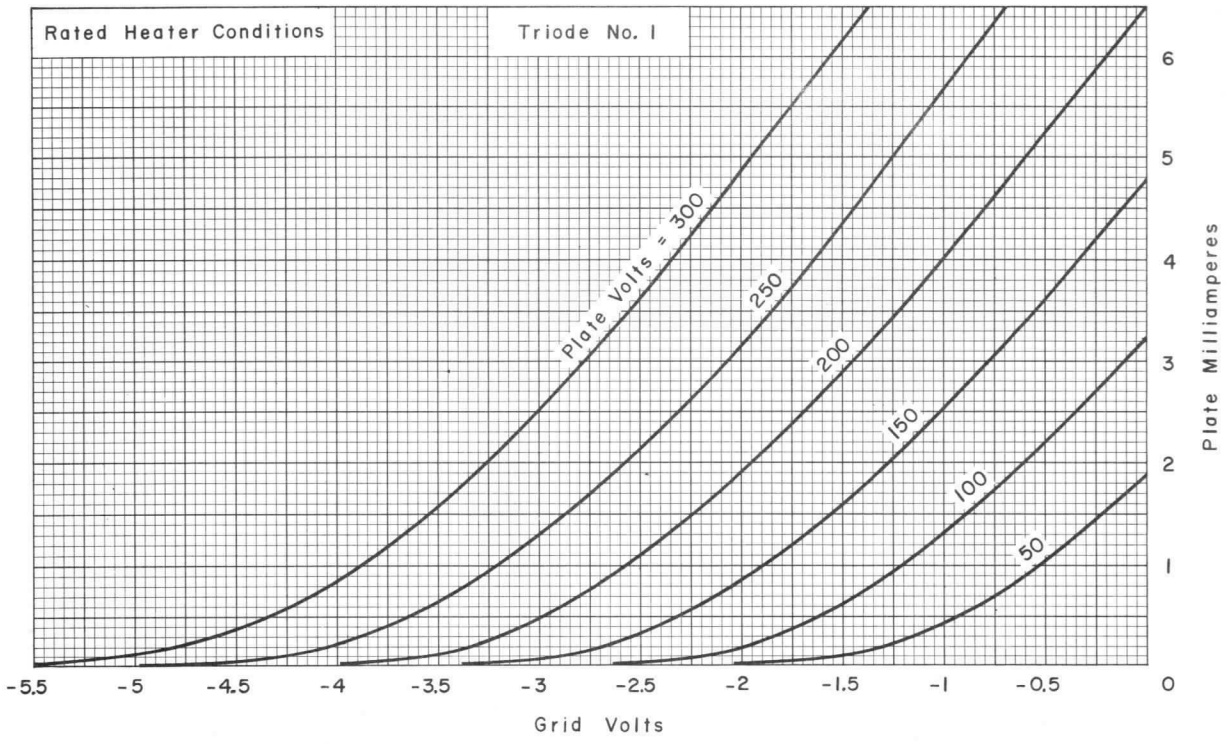
CE-B1738

AVERAGE PLATE CHARACTERISTICS

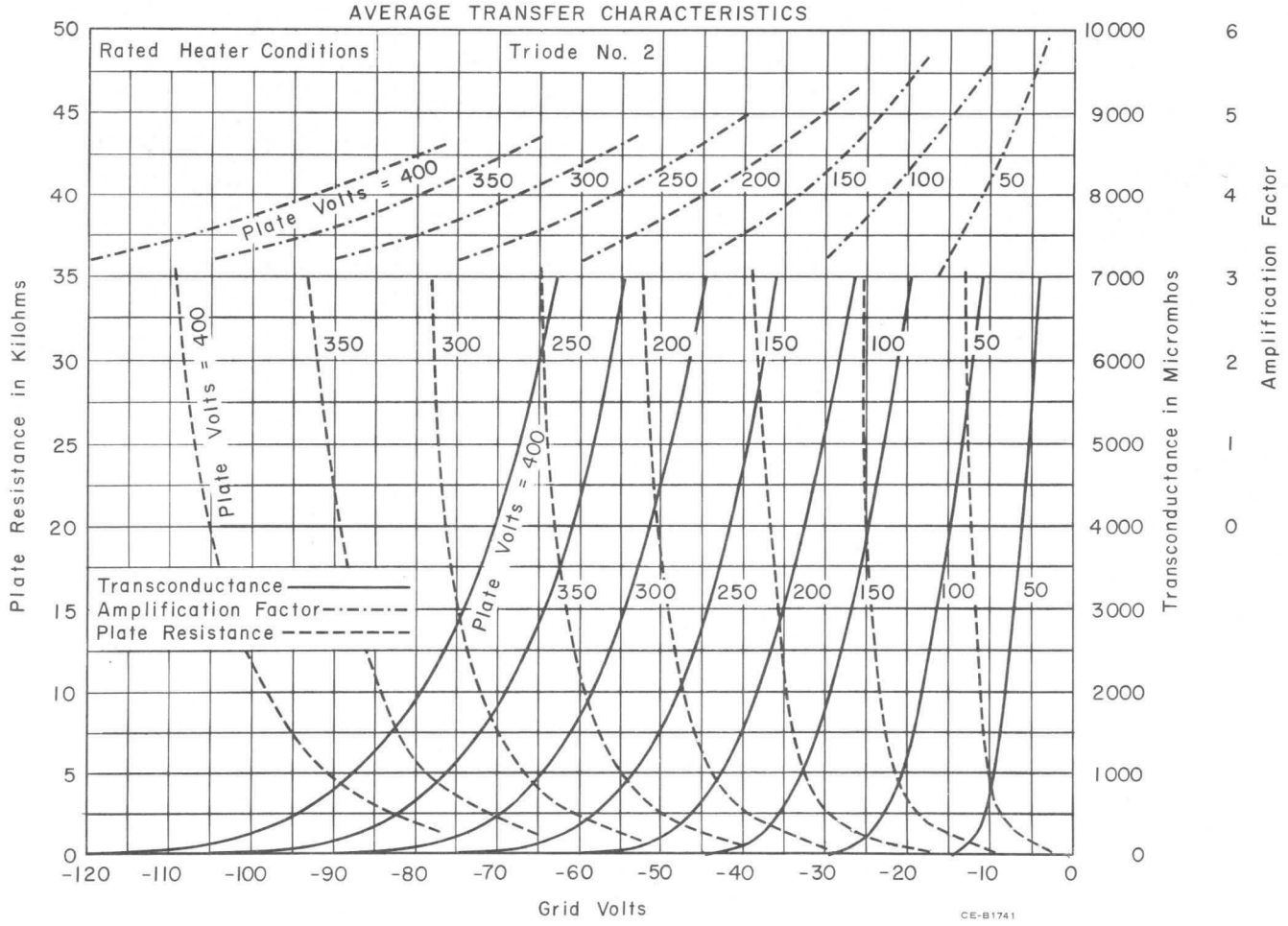


CE-A1736

AVERAGE TRANSFER CHARACTERISTICS



CE-A1737


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Triode No. 2
Plate Volts = 400
350
300
250
200
150
100
50
Transconductance
Amplification Factor
Plate Resistance
Plate Resistance in Kilohms
Transconductance in Micromhos
Amplification Factor
Grid Volts
50
45
40
35
30
25
20
15
10
5
0
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
6
5
4
3
2
1
0
-120
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-90
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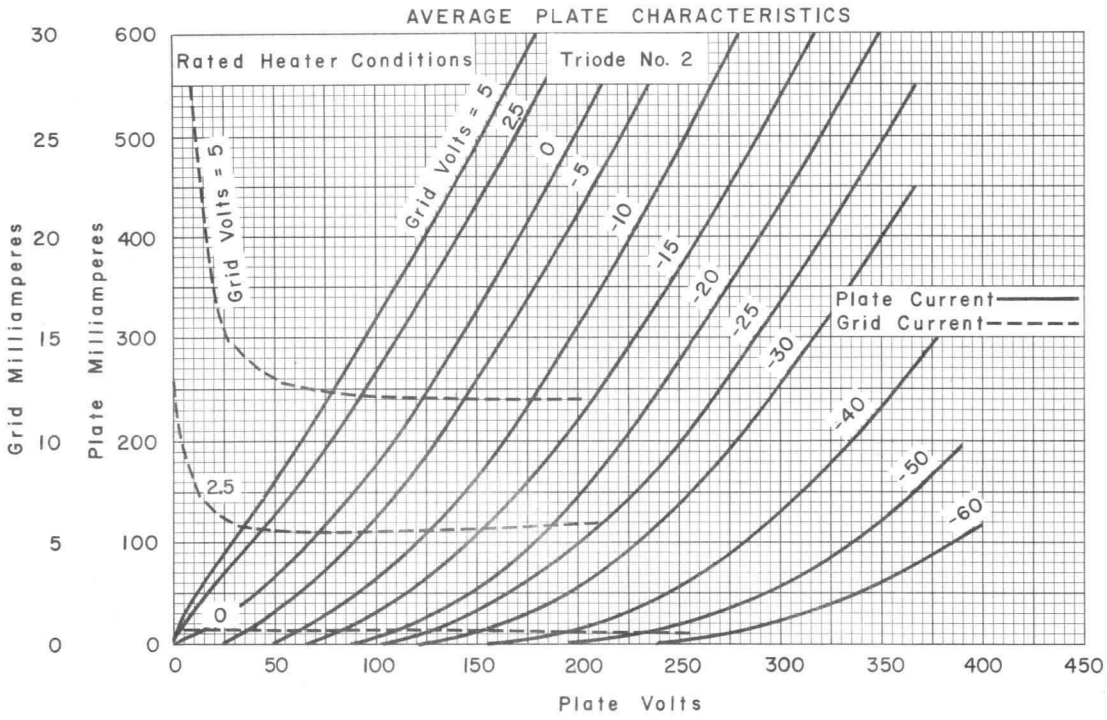
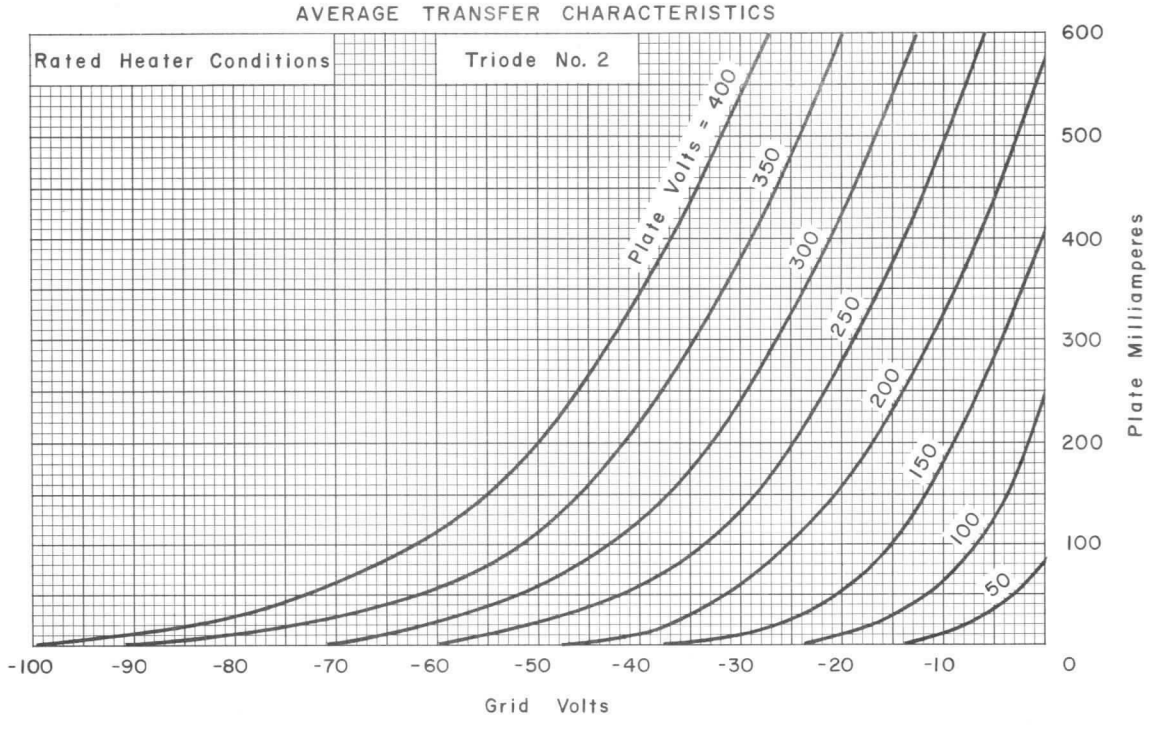
-30
-20
-10
0
CE-B1741



CE-A1739



CE-A1740

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December 15, 1958

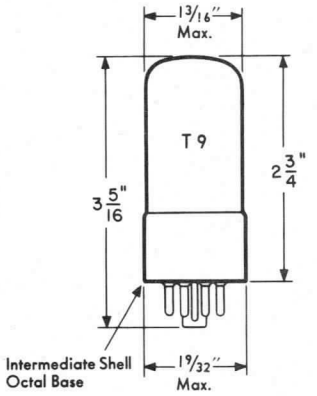
BEAM POWER AMPLIFIER TYPE 12EN6

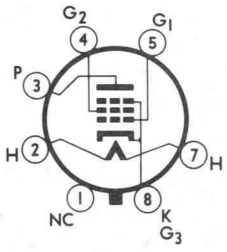
The 12EN6 is a glass octal beam power pentode designed for use as a vertical deflection amplifier in television receiver sweep circuits.

The 12EN6 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

ELECTRICAL:		
Cathode	Coated Unipotential	
Filament:		
Voltage	12.6 ac or dc	Volts
Current	0.6 ± 6%	Ampere
Warm-up Time (Approx.)**	11	Seconds
Direct Interelectrode Capacitances:		
Grid to Plate	0.65	uuf
Input	14	uuf
Output	8.0	uuf
MECHANICAL:		
Bulb	T-9	
Bases	Intermediate Shell Octal (JETEC B6-81) & (JETEC B7-7) Short Intermediate Shell Octal (JETEC B6-84) & (JETEC B7-59)	
Basing	7AC	
Mounting Position	Any	





VERTICAL DEFLECTION AMPLIFIER SERVICE■

MAXIMUM RATINGS:
Design Maximum Ratings

	Triode Connection▲	Pentode Connection		
D. C. Plate Voltage	300	300	max.	Volts
Peak Pos. Pulse Plate Volt.	1200	1200	max.	Volts
Plate Dissipation§	7.5	7.0	max.	Watts
Peak Negative Grid 1 Voltage	250	250	max.	Volts
D. C. Grid 2 Voltage	-	150	max.	Volts
Grid 2 Dissipation	-	1.25	max.	Watts
Average Cathode Current	50	50	max.	Ma.
Peak Cathode Current	175	175	max.	Ma.
Grid 1 Circuit Resistance	2.2	2.2	max.	Megohms
Heater-Cathode Voltage				
Heater Positive with Respect to Cathode				
DC Component		100	max.	Volts
Total DC & Peak		200	max.	Volts
Heater Negative with Respect to Cathode				
DC Component		200	max.	Volts
Total DC & Peak		300	max.	Volts

CHARACTERISTICS

Plate Voltage	50	200	Volts
Grid 2 Voltage	110	110	Volts
Grid 1 Voltage	0♦	-9.5	Volts
Plate Current	140	50	Ma.
Grid 2 Current	17	2.2	Ma.
Plate Resistance		28000	Ohms
Transconductance		8000	umhos
Grid 1 Cutoff Voltage (Approx.) ★		-35	Volts

** Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

■ For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Fed. Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

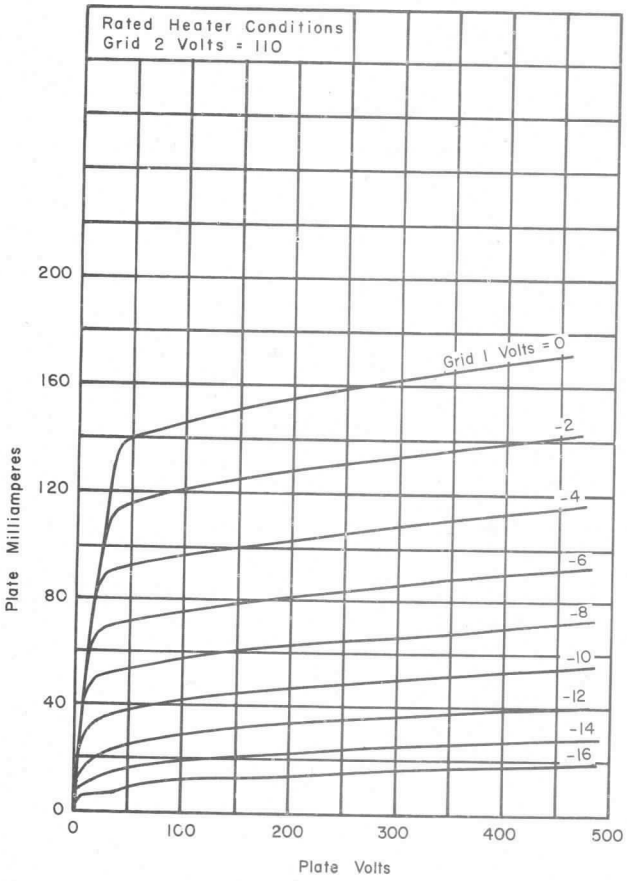
▲ With Grid 2 tied to plate.

§ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

♦ Applied for short interval (2 seconds maximum) so as not to damage the tube.

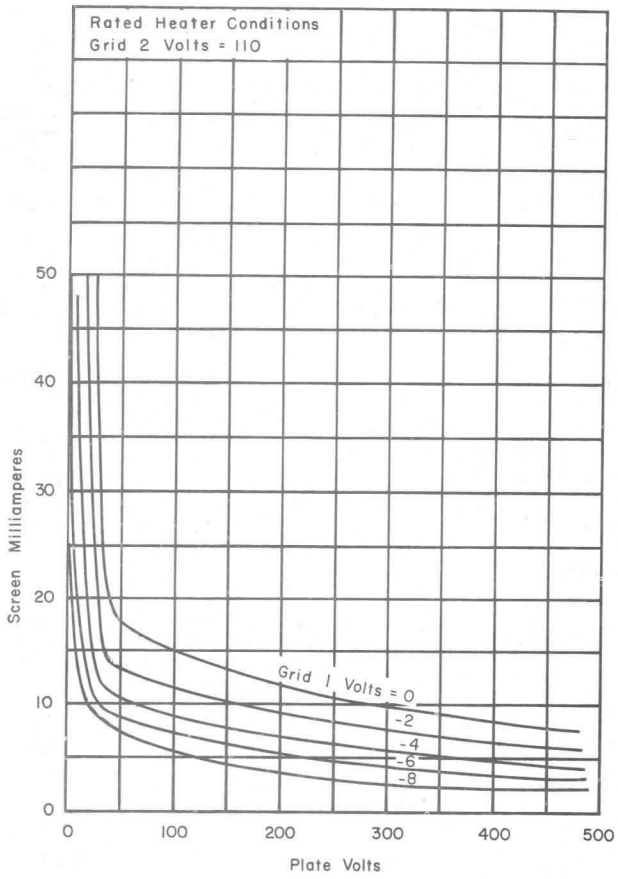
★ For plate current of 100 microamperes

AVERAGE PLATE CHARACTERISTICS



CE-AI377

AVERAGE SCREEN CHARACTERISTICS



CE-AI379

LOW LEVEL TWIN TRIODE TYPE 6EU7

The 6EU7 is a 9-pin miniature twin triode designed for service as a low level input voltage amplifier for tape recorders and high quality audio preamplifiers. The structural design of the 6EU7 results in greatly reduced microphonism, hum, noise and inter unit coupling. Good isolation of channels in stereo systems is thereby achieved.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	0.30		Ampere
Direct Interelectrode Capacitances (Unshielded):	Unit 1	Unit 2	
Grid to Plate	1.5	1.5	pf
Input	1.6	1.6	pf
Output	0.2	0.2	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9LS
Mounting Position	Any

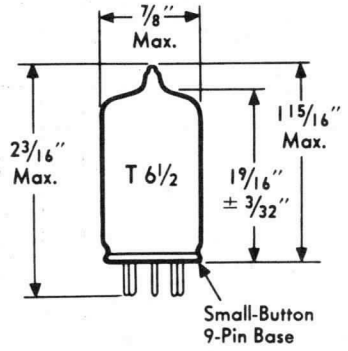
MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	330	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with respect to Cathode (Note 1)	200	max.	Volts
Plate Dissipation	1.2	max.	Watt
Grid Voltage:			
Negative Bias Value	55	max.	Volts
Positive Bias Value	0	max.	Volts

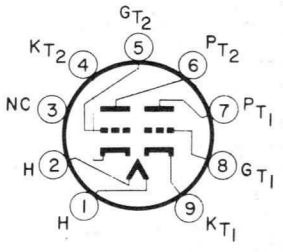
CHARACTERISTICS

Plate Voltage	100	250	Volts
Grid Voltage	−1	−2	Volts
Amplification Factor	100	100	−
Plate Resistance	80000	62500	Ohms
Transconductance	1250	1600	μmhos
Plate Current	0.5	1.2	Ma.
Equivalent Noise and Hum Voltage:			
Refered to Grid			
Average (Note 2)	1.8 rms		μVolts

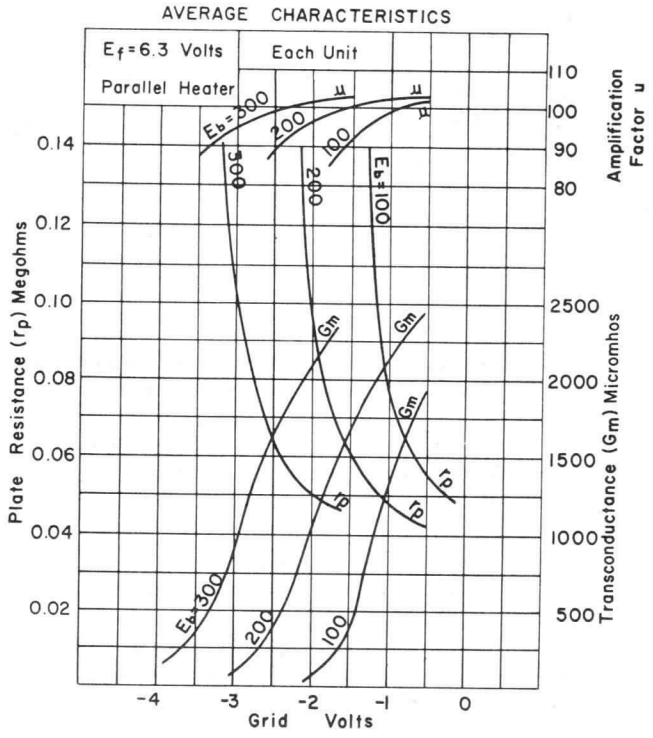


NOTES

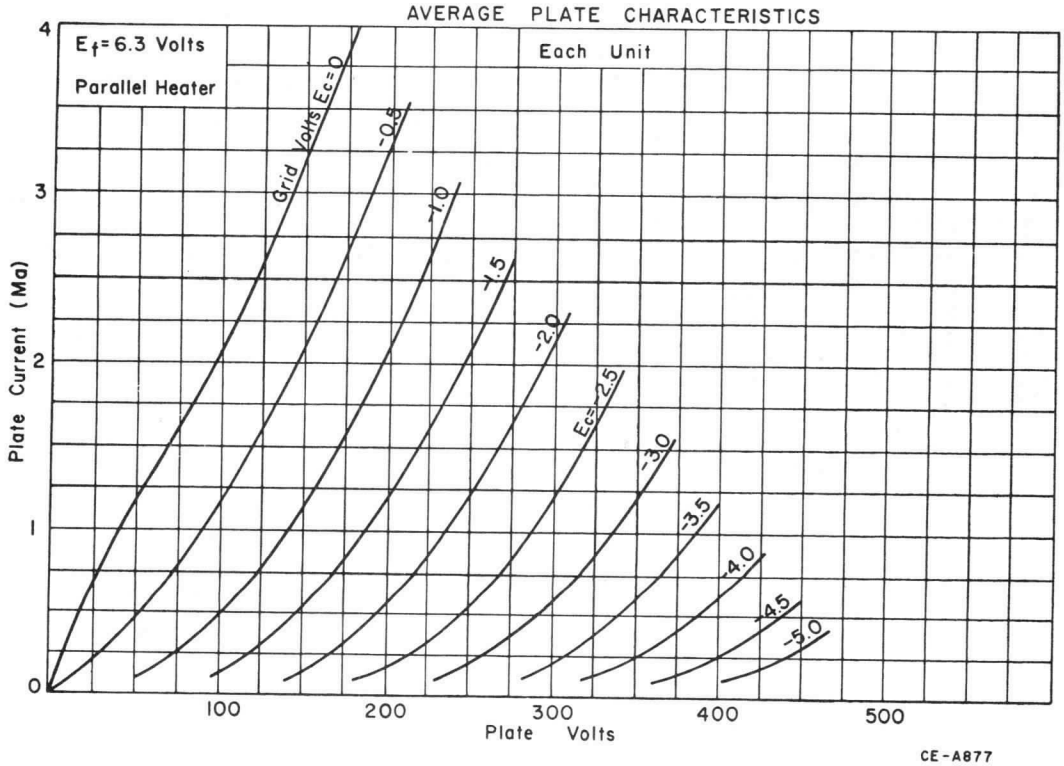
1. The d-c component must not exceed 100 volts.
2. Measured Under These Conditions:
   - Heater Circuit: 6.3 Volts AC, Centertap of Transformer Grounded.
   - Plate Circuit: Plate Supply Volts = 250, Plate Load = 100,000 ohms.
   - Cathode Circuit: Cathode Resistor = 2700 ohms by passed with 100 μf capacitor.
   - Grid Circuit: Grid Resistor = 0 ohms.
   - Frequency Range: 25 to 10,000 cycles/sec.



9LS



CE-A876



CE-A877

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Westinghouse®

2EV5
3EV5
6EV5

May 15, 1959

SHARP-CUTOFF TETRODE TYPES 2EV5, 3EV5 and 6EV5

The 2EV5, 3EV5 and 6EV5 are high gain, sharp-cutoff, seven-pin miniature tetrodes designed particularly for service in V.H.F. television tuners. Their high transconductance, extremely low screen current and high input impedance at 200 Mc. results in an improved noise figure.

Although the 2EV5, 3EV5 and 6EV5 are designed for high B+ operation, their low screen voltage requirements permit excellent performance with low B+ voltages.

The 2EV5, and 3EV5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

MECHANICAL DATA

Cathode	Coated Unipotential
Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7EW
Mounting Position	Any

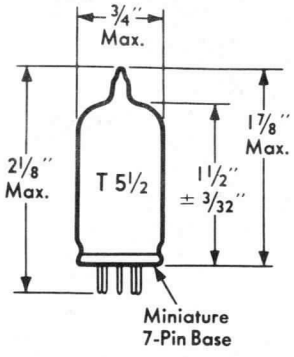
ELECTRICAL DATA

Heater Characteristics:	2EV5	3EV5	6EV5	
Voltage (ac or dc)	2.4	2.9	6.3	Volts
Current	0.60	0.45	0.20	Ampere
Warm-up Time ▲	11	11	--	Seconds

Direct Interelectrode Capacitance (Shielded) *:		
Grid 1 to Plate	0.035 max.	μμf
Input	4.50	μμf
Output	2.90	μμf

CHARACTERISTICS & TYPICAL OPERATION:

Plate Voltage	250	Volts
Grid 2 Voltage	80	Volts
Grid 1 Voltage	-1	Volts
Plate Resistance	0.150	Megohm
Transconductance	8800	μmhos
Grid 1 Cutoff Bias #	4.5	Volts
Plate Current	11.5	Ma.
Grid 2 Current	0.90	Ma.



Miniature 7-Pin Base

7EW

RATINGS

Design Maximum Values **

Plate Voltage			275 max.	Volts
Grid 2 Supply Voltage			180 max.	Volts
Grid 2 Voltage			See Grid 2 Input Rating Chart	
Plate Dissipation			3.25 max.	Watts
Grid 2 Dissipation			0.2 max.	Watts
Grid 1 Voltage:				
Positive Value			0 max.	Volts
Cathode Current			20 max.	Ma.
Heater Ratings:	2EV5	3EV5	6EV5	
Allowable Heater Voltage				
Maximum	--	--	6.9 max.	Volts
Minimum	--	--	5.7 min.	Volts
Allowable Heater Current				
Maximum	640	480	-- max.	Ma.
Minimum	560	420	-- min.	Ma.
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	100 max.	Volts
Heater Positive with Respect to Cathode:				
DC	100	100	50 max.	Volts
Total DC and Peak	200	200	100 max.	Volts
Grid Circuit Resistance	0.5	0.5	0.5	Megohm

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

\# For Transconductance of 100 μmhos.

* With JETEC shield No. 316 connected to Pin 2.

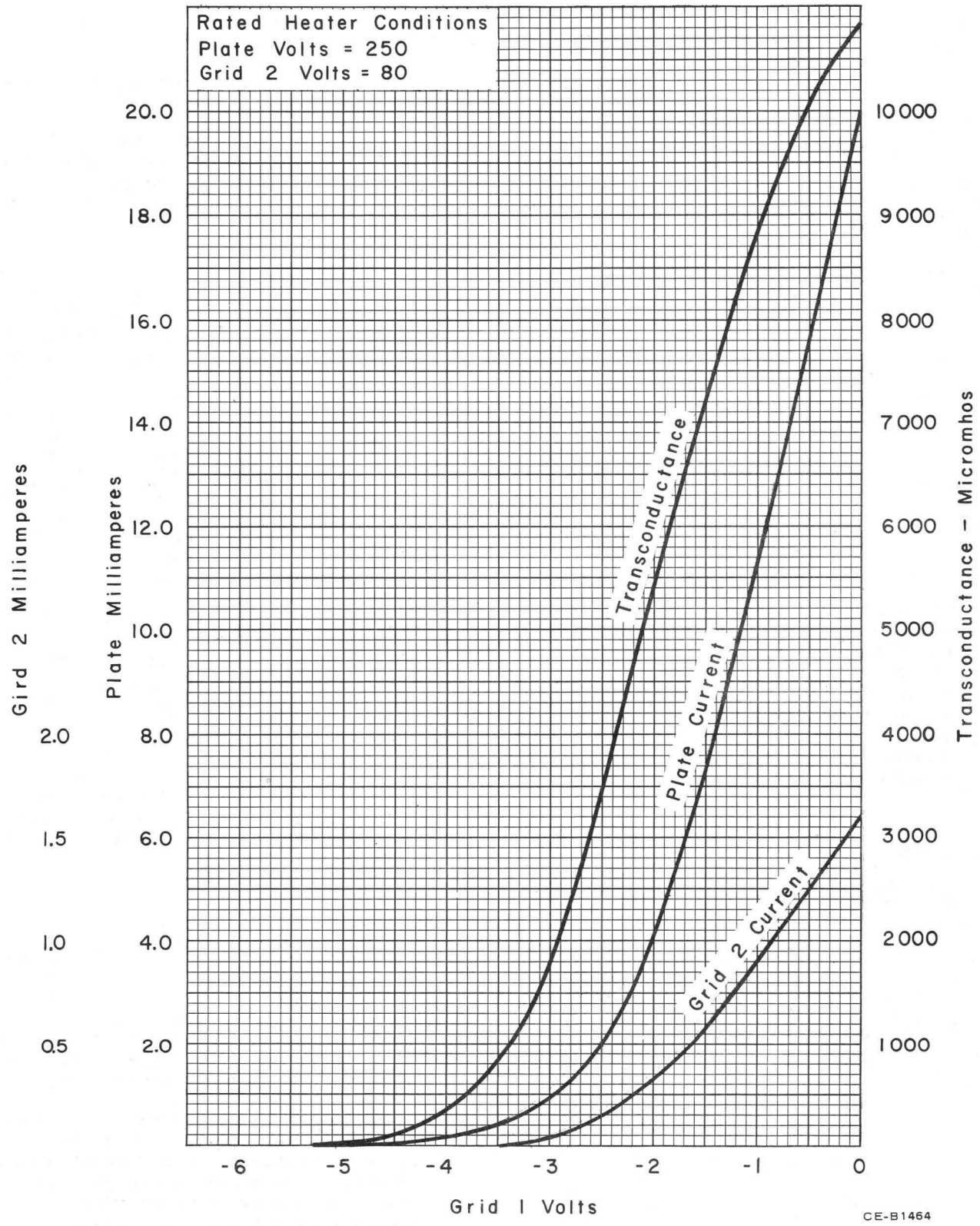
** Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron divice of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

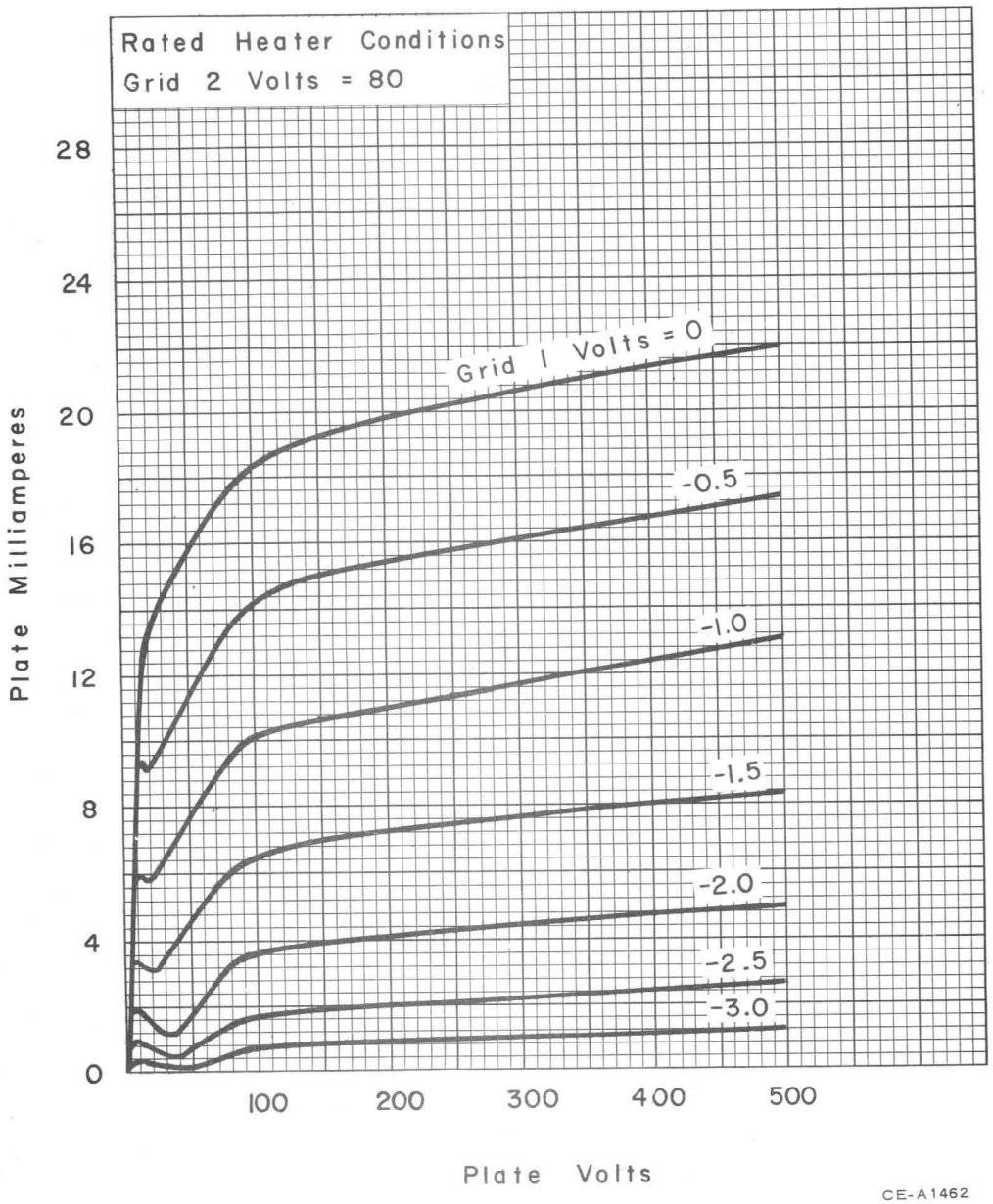
The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

Receiving Tube Section

AVERAGE TRANSFER CHARACTERISTICS

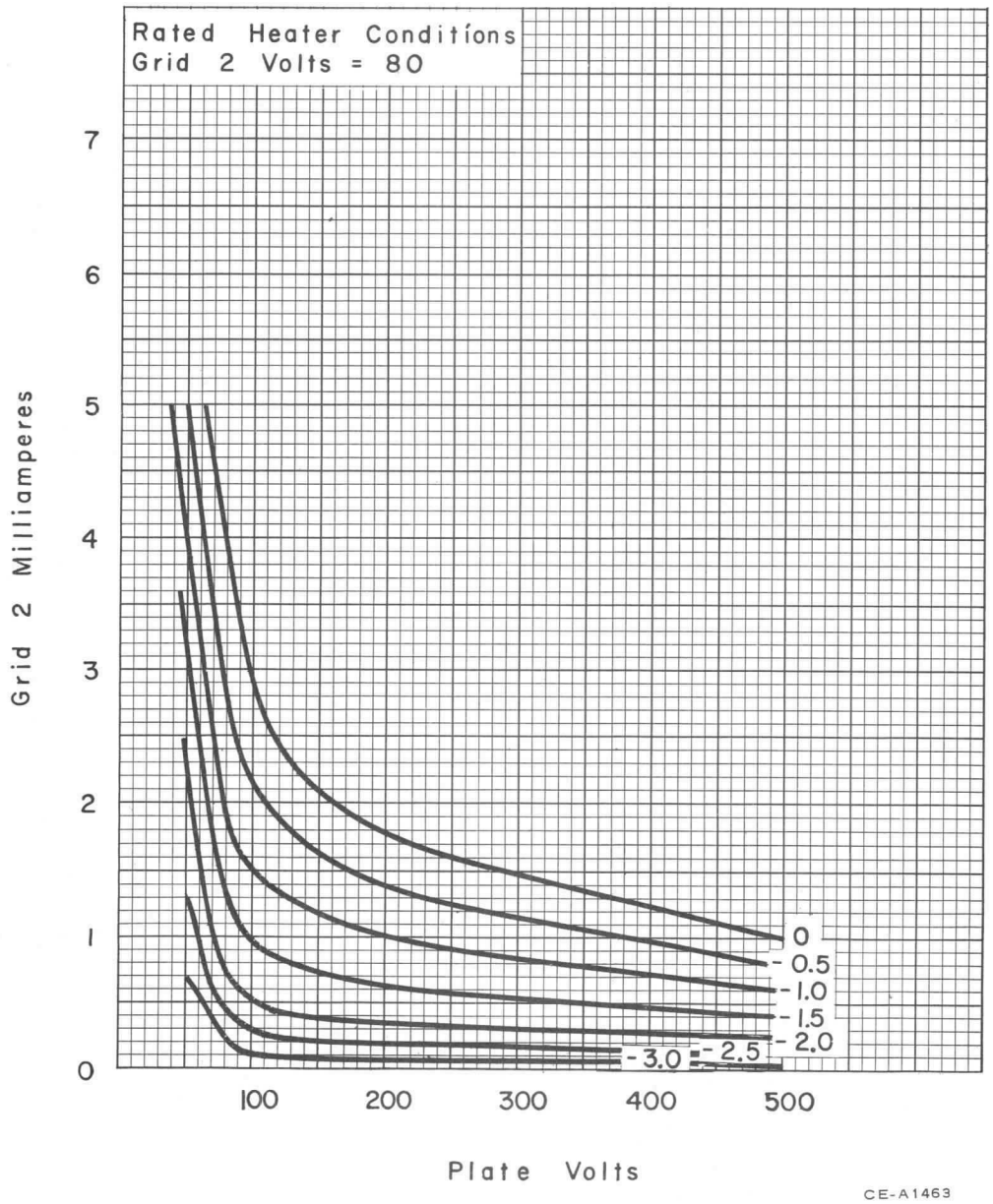


AVERAGE PLATE CHARACTERISTICS



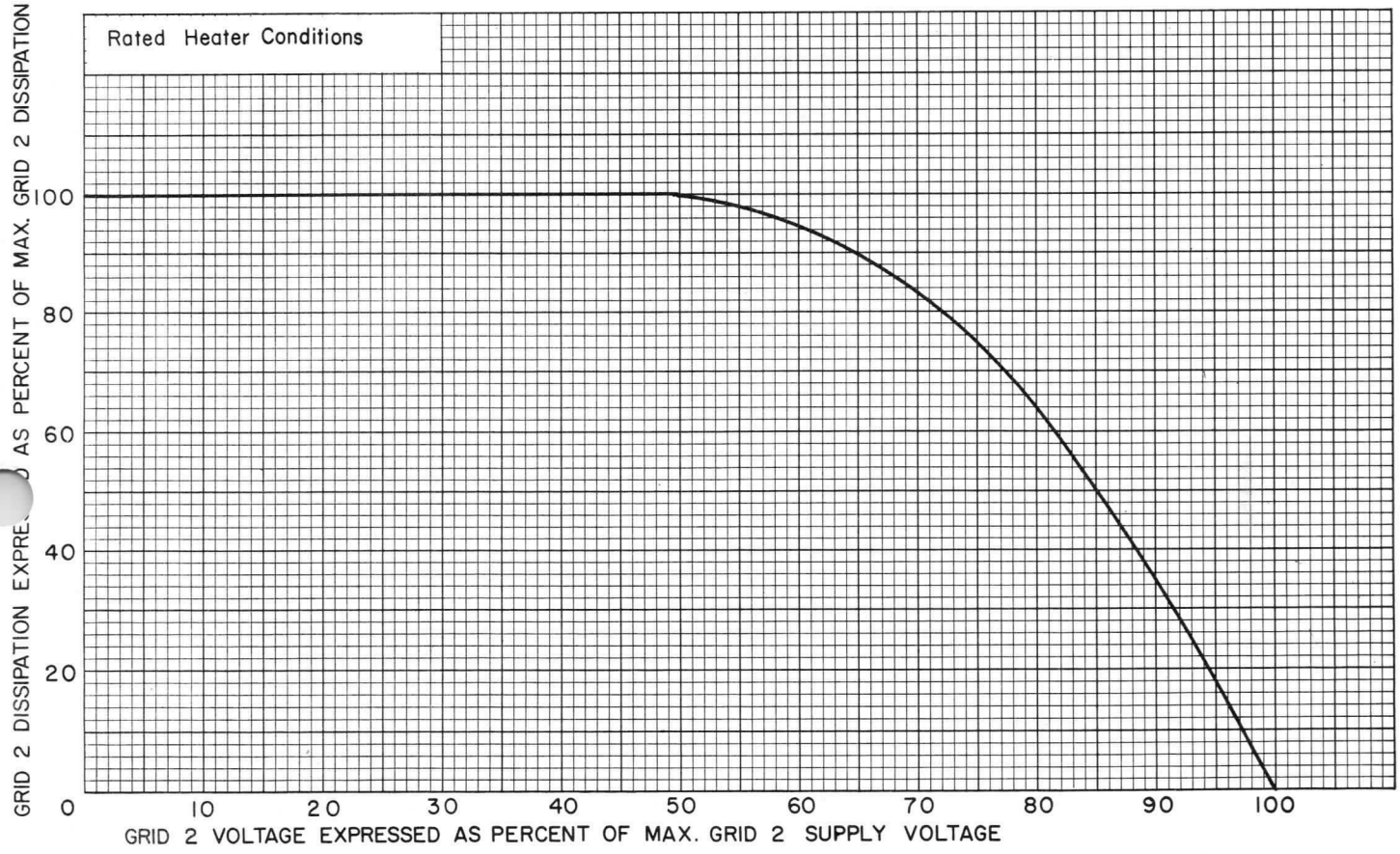
CE-A1462

AVERAGE GRID 2 CHARACTERISTICS



CE-A1463

GRID 2 INPUT RATING CURVE



CE-A1255

February 1, 1965

SHARP-CUTOFF PENTODE TYPE 6EW6

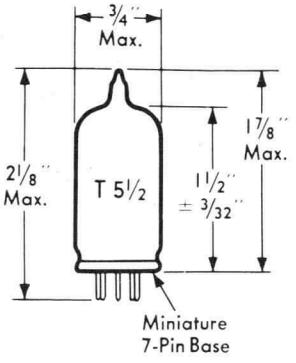
The 6EW6 is a 7-pin miniature sharp-cutoff pentode type designed for service as intermediate-frequency amplifiers in television receivers. They feature very high transconductance combined with low interelectrode capacitance values. Separate pins are provided for grid 3 and the cathode to permit the use of an unbypassed cathode resistor to minimize the effects of regeneration.

ELECTRICAL

Cathode		Coated Unipotential	
Heater:			
Voltage (ac or dc)		6.3 ± 10%	Volts
Current		0.40	Ampere
Direct Interelectrode Capacitances:			
	Unshielded	Shielded (Note 1)	
Grid 1 to Plate	0.04	0.03 max.	pF
Input	10	10	pF
Output	2.4	3.4	pF

MECHANICAL

Bulb	T-5½
Base	Miniature. 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any



MAXIMUM RATINGS

Design Maximum Values

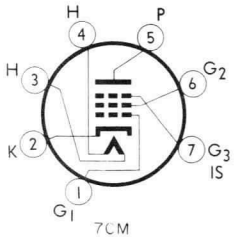
Plate Voltage	330 max.	Volts
Grid 2 Supply Voltage	330 max.	Volts
Grid 2 Voltage	See JEDEC J5-C4-2 Rating Chart	
Plate Dissipation	3.1 max.	Watts
Grid 2 Input	0.65 max.	Watt
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC and Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
DC + Peak	200 max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to Cathode at Socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (Approx.)	0.20	Megohm
Transconductance	14000	μmhos
Grid 1 Cutoff Bias (Note 2)	−3.5	Volts
Plate Current	11	mA
Grid 2 Current	3.2	mA

NOTES

1. With JEDEC Shield No. 316 connected to cathode.
2. For plate current of 20 microamperes.



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Westinghouse

5FG7
6FG7

April 15, 1961

TRIODE-PENTODE CONVERTER TYPES 5FG7 AND 6FG7

The 5FG7 and 6FG7 are 9-Pin miniature medium-mu triode and sharp-cutoff pentode types designed for service as combined oscillator and mixer in television receiver VHF tuners.

The 5EA8 and 6EA8 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

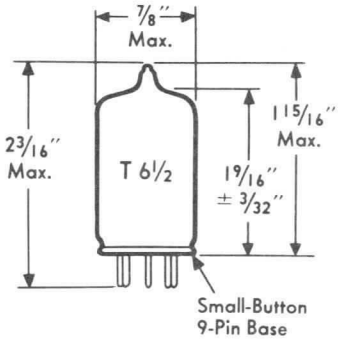
Cathode	Coated Unipotential		
Heater:	5FG7	6FG7	
Voltage (ac or dc)	4.7	6.3	Volts
Current	0.60 ± 6%	0.45 ± 6%	Amperes
Warm-up Time●	11	11	Seconds
Direct Interelectrode Capacitances:			
Triode Unit:	Unshielded	Shielded #	
Grid to Plate	1.8	1.8	μμf
Input	3.0	3.0	μμf
Output	1.3	1.9	μμf
Pentode Unit:			
Grid 1 to Plate	0.02 max.	0.01 max.	μμf
Input	5.0	5.0	μμf
Output	2.4	3.4	μμf
Heater to Cathode	6.0	6.0□	

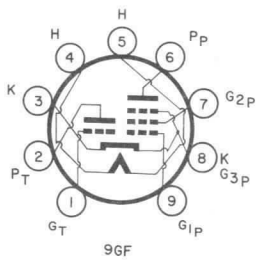
MECHANICAL:

Bulb	T-6-½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9GF
Outline	6-2
Mounting	Any

CHARACTERISTICS:

	Triode Unit	Pentode Unit		
Plate Voltage	125	125	100	Volts
Grid 2 Voltage	--	125	100	Volts
Grid 1 Voltage	−1.0	−1.0	0	Volts
Amplification Factor	43	--	--	
Plate Resistance (Approx.)	5700	180000	--	Ohms
Transconductance	7500	6000	7400	μmhos
Grid 1 Cutoff Bias⊕	−6.5	−7.5	--	Volts
Plate Current	13	11	--	Ma.
Grid 2 Current	--	4.0	--	Ma.





MAXIMUM RATINGS:
Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330	max. Volts
Grid 2 (Screen) Voltage	--	See Grid 2 Input Rating Curve	
Grid 2 Supply Voltage	--	330	max. Volts
Grid 1 (Control Grid) Voltage Positive Bias Value	0	0	max. Volts
Plate Dissipation	2.5	3.0	max. Watts
Grid 2 Input	--	0.55	max. Watt
Heater Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100	max. Volts
Total DC and Peak	200	200	max. Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	max. Volts

● Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

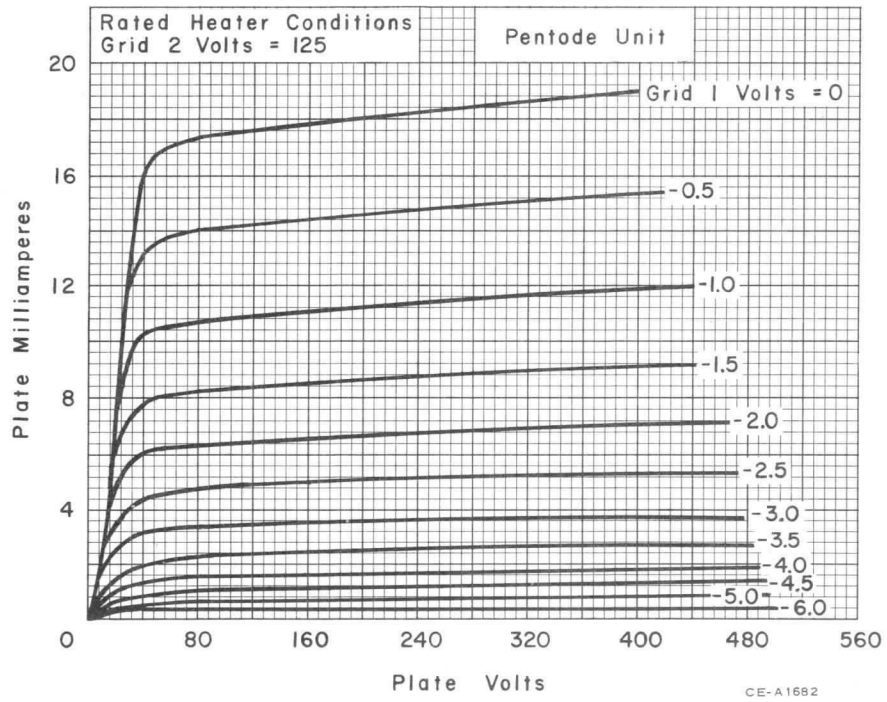
\# With JEDEC shield #315 connected to Cathode of unit under test.

□ With JEDEC shield #315 connected to ground.

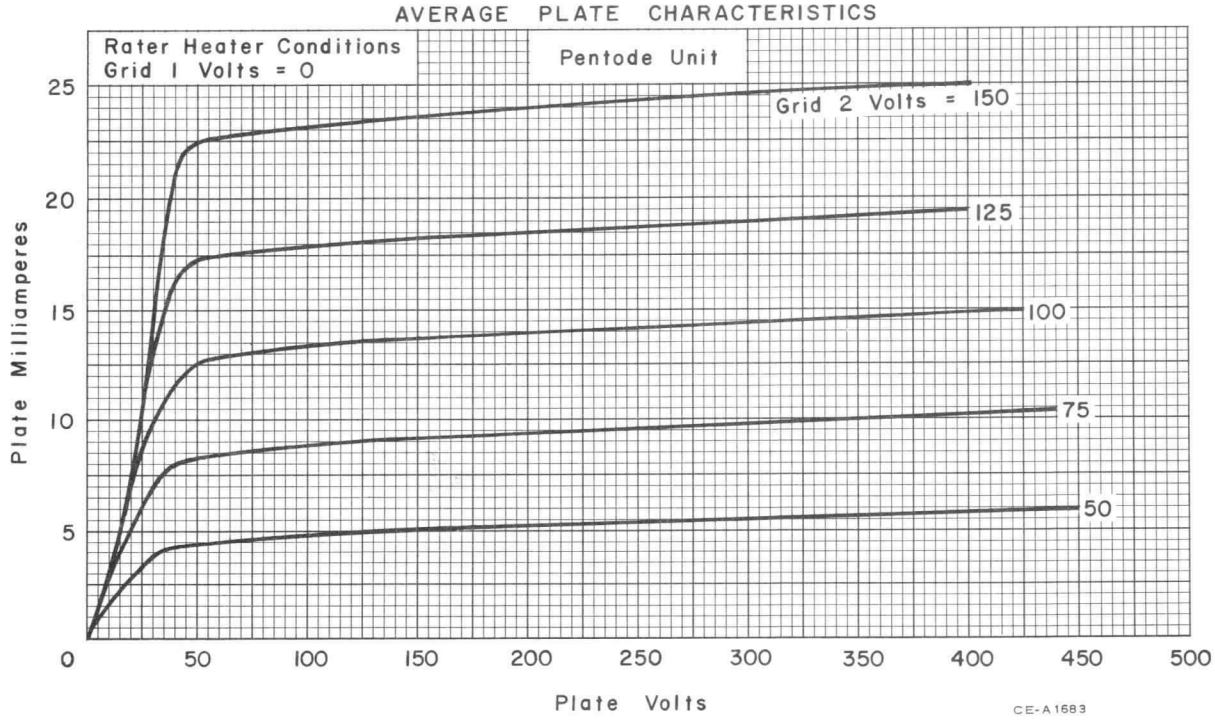
⊕ For plate current of 30 microamperes.

♦ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions. The tube manufacturer chooses these values to provide acceptable serviceability of the tube, talking responsibility for the effects of changes in operating conditions due to variations in tube characteristics. The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



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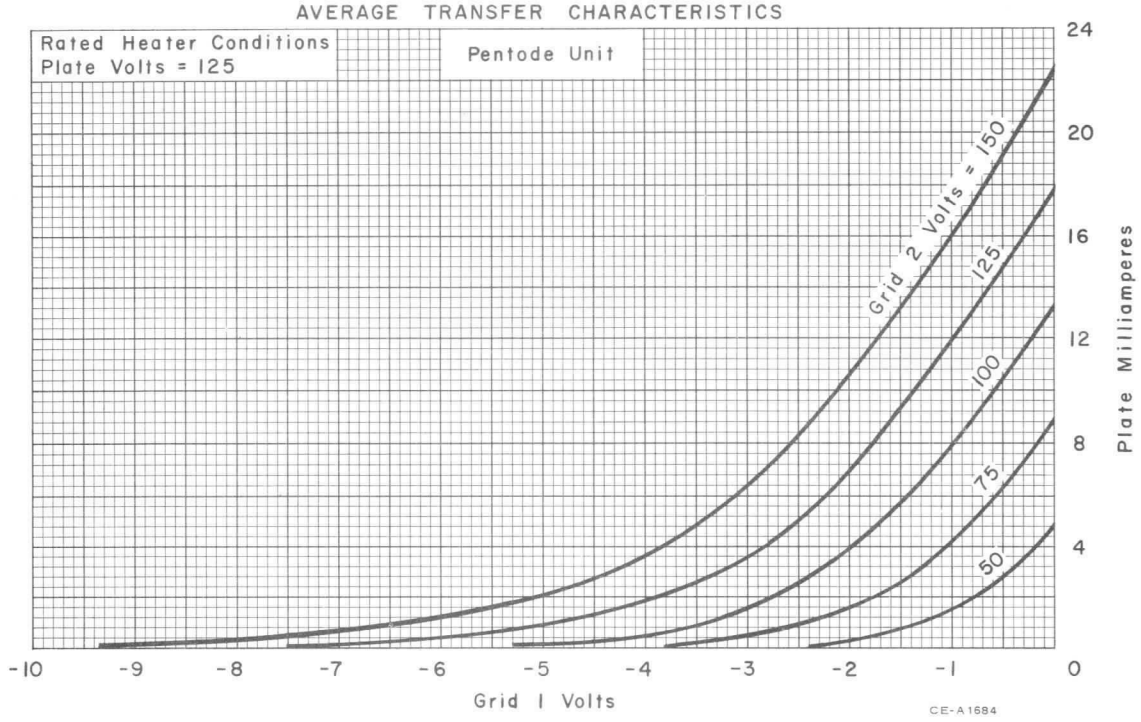

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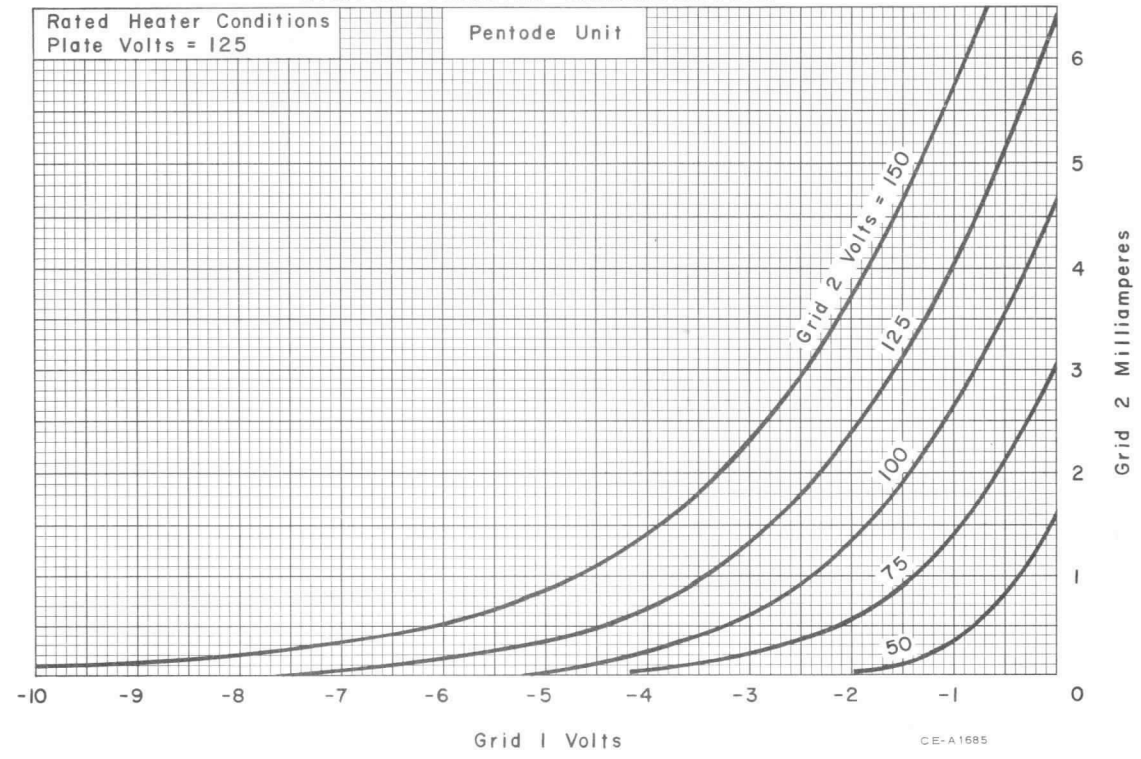

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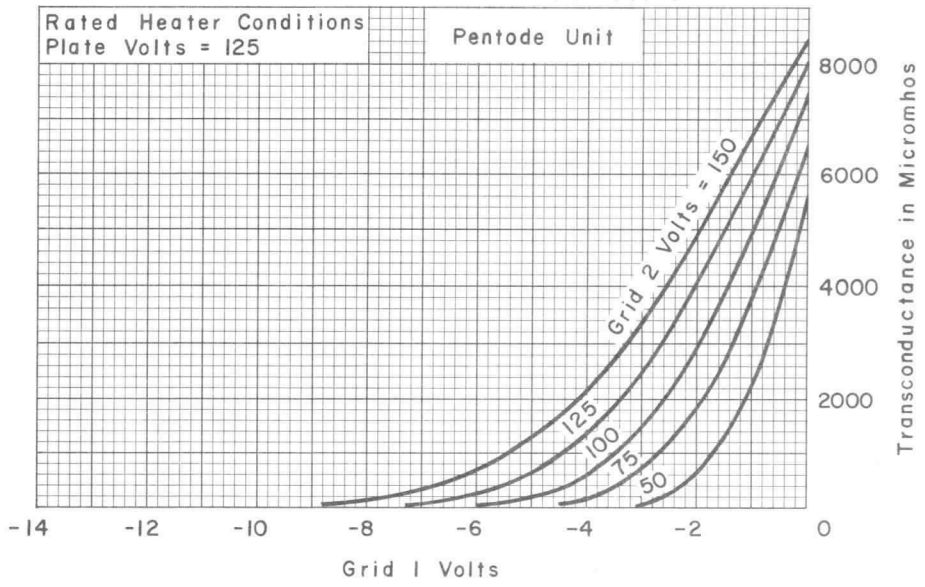
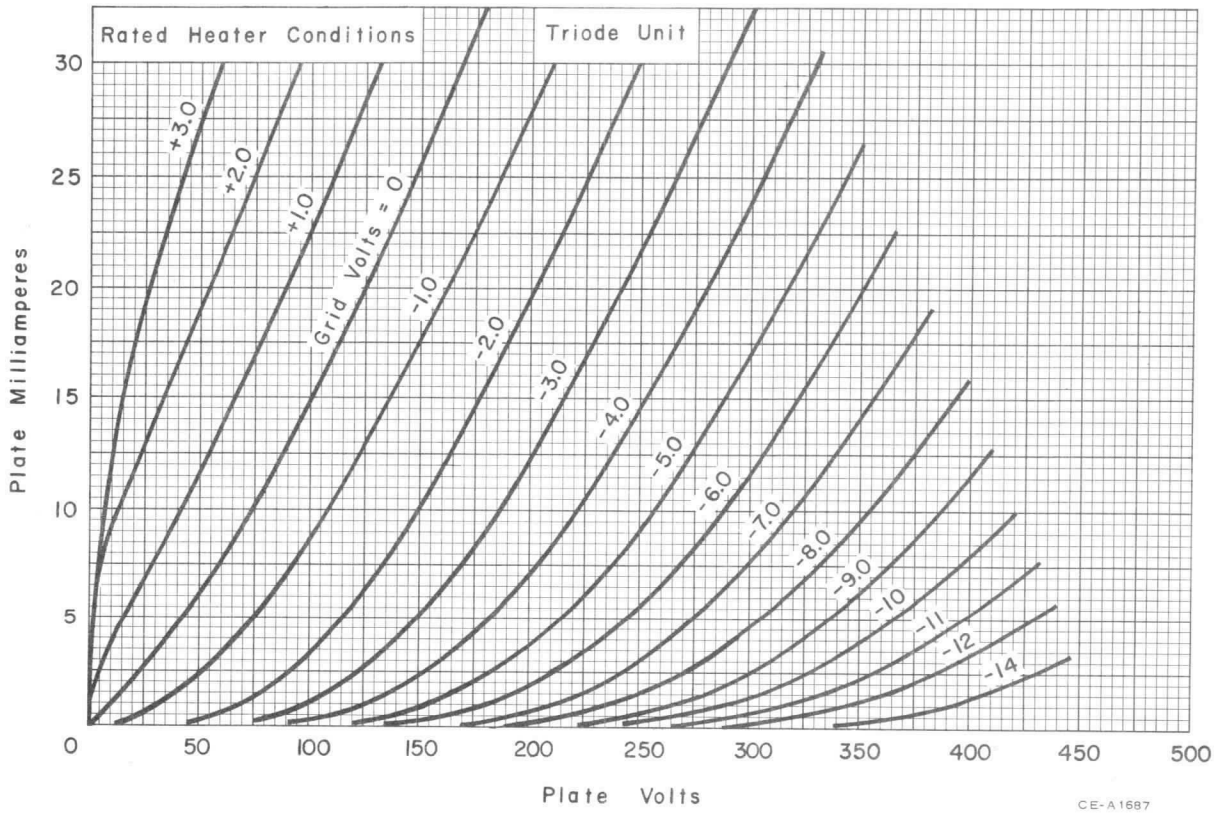


CE-A1686

AVERAGE PLATE CHARACTERISTICS



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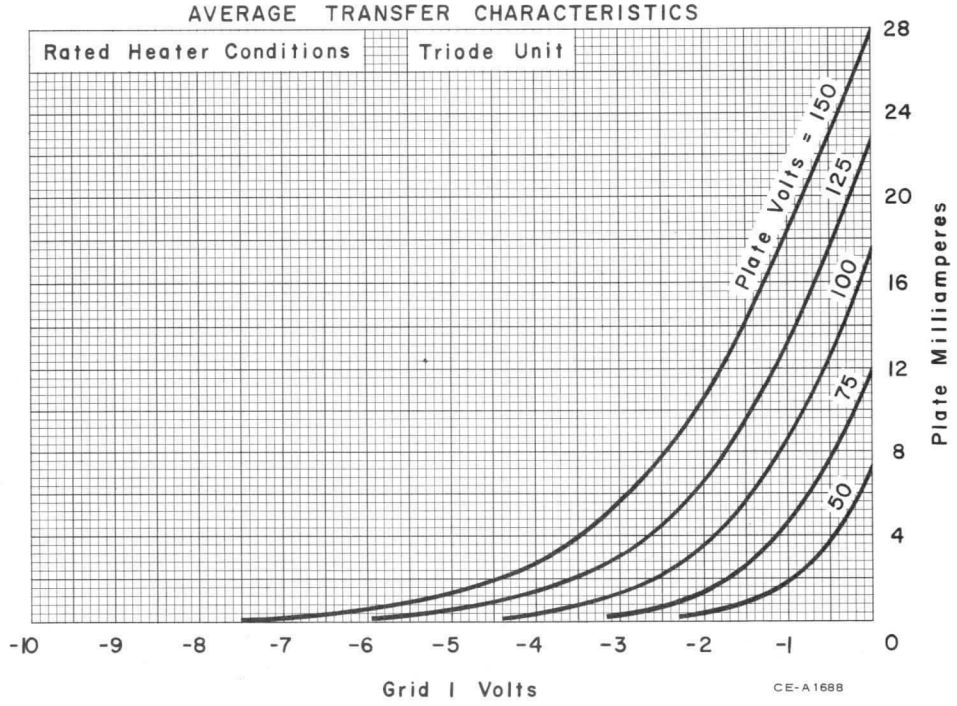

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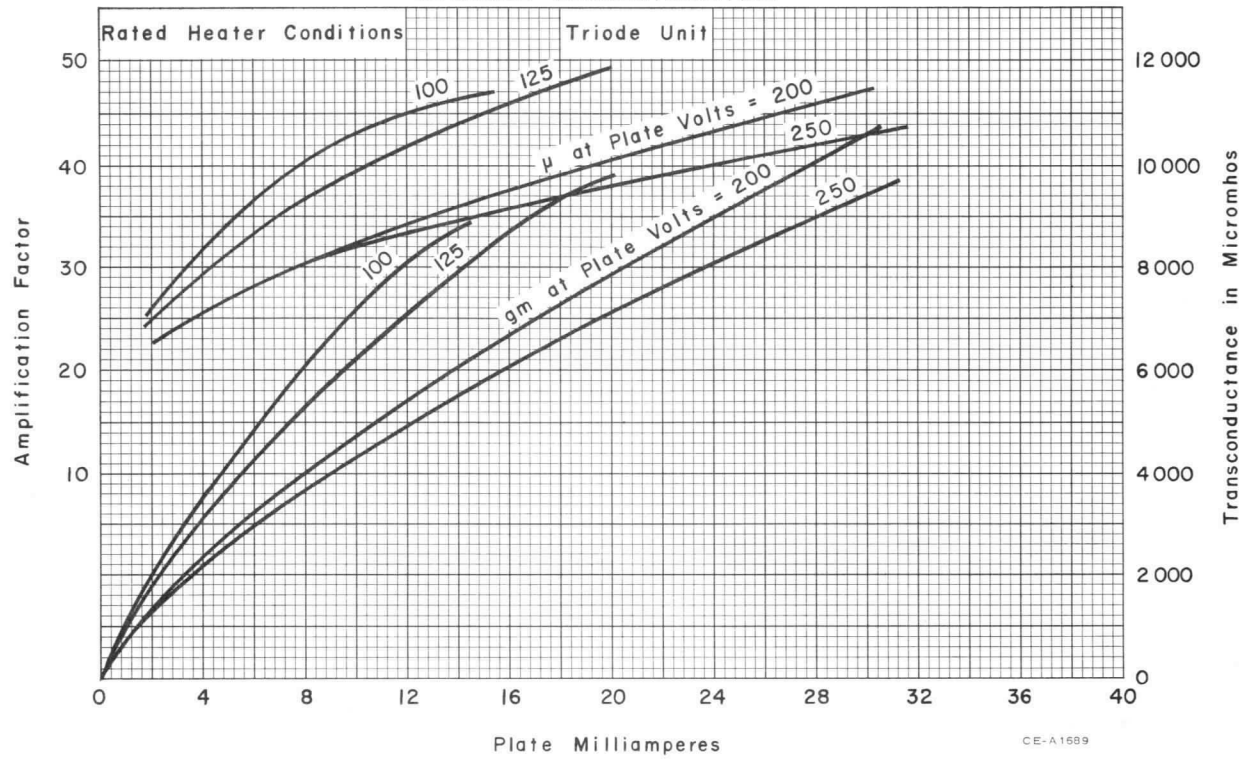
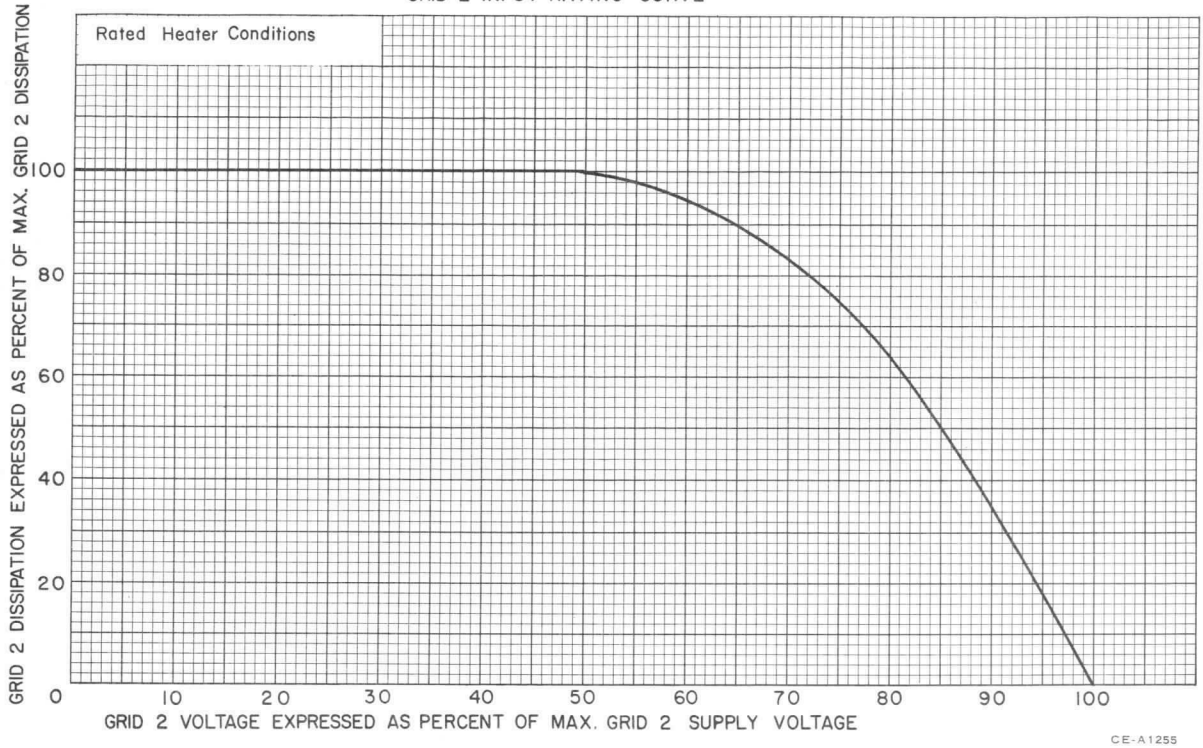


GRID 2 INPUT RATING CURVE



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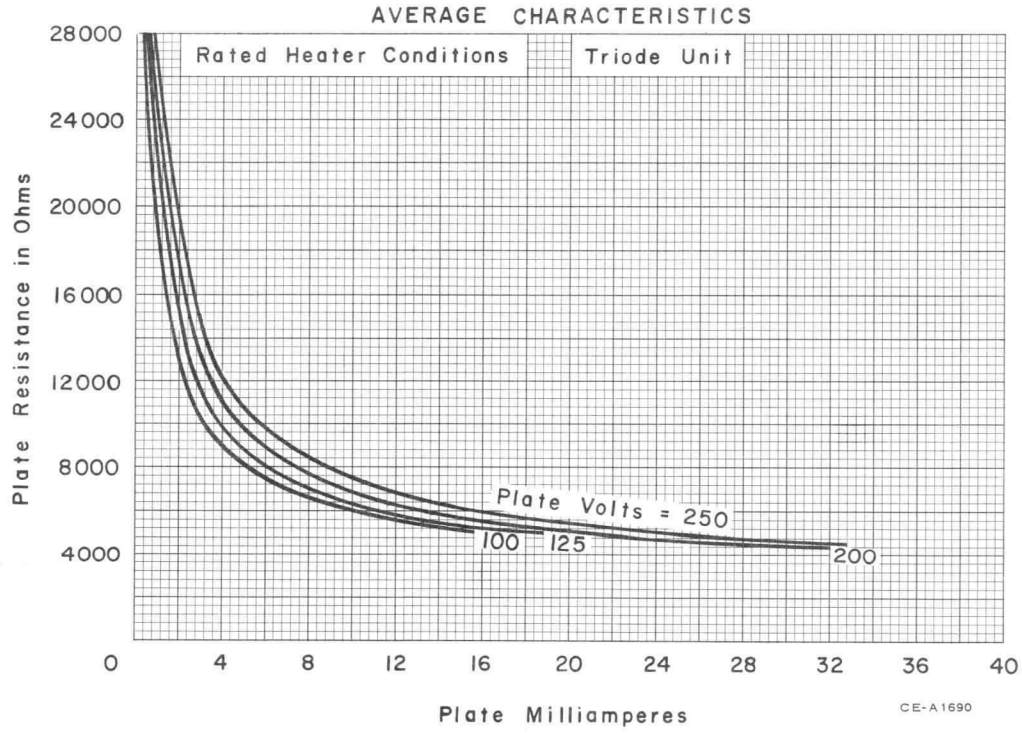


Westinghouse®

2FH5
3FH5
6FH5

February 1, 1960

SHARP-CUTOFF TRIODE TYPES 2FH5, 3FH5 AND 6FH5

The 2FH5, 3FH5 and 6FH5 are sharp-cutoff, seven-pin miniature triode types designed particularly for service in V.H.F. television tuners as grounded cathode r-f amplifiers.

The 2FH5, and 3FH5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

MECHANICAL:

Cathode	Coated Unipotential
Bulb	T-5-1/2
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7FP
Mounting Position	Any

ELECTRICAL:

Heater Characteristics:	2FH5	3FH5	6FH5	
Voltage (ac or dc)	2.35	3.0	6.3	Volts
Current	0.60	0.45	0.20	Ampere
Warm-up Time▲	11	11	--	Seconds

Direct Interelectrode Capacitance:	Unshielded	Shielded★		
Grid 1 to Plate	0.6	0.6	max.	μμf
Input	3.2	3.2		μμf
Output	3.2	4.0		μμf

RATINGS

Design Maximum Values

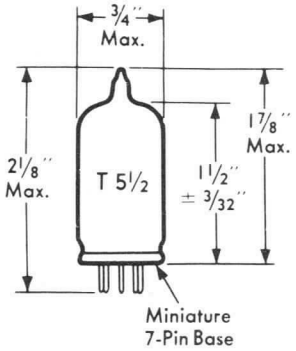
Plate Voltage	150 max.		Volts
Plate Dissipation	2.2 max.		Watts
Grid 1 Voltage:			
Positive Value	0 max.		Volts
Cathode Current	22 max.		Ma.
Grid Circuit Resistance	1.0 max.		Megohm

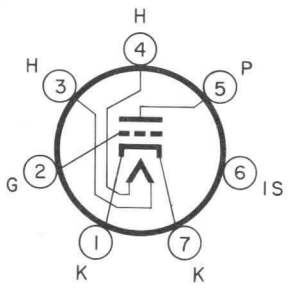
Heater Ratings:

Allowable Heater Voltage	2FH5	3FH5	6FH5		
Maximum	--	--	6.9	max.	Volts
Minimum	--	--	5.7	min.	Volts
Allowable Heater Current					
Maximum	640	480	--	max.	Ma.
Minimum	560	420	--	min.	Ma.
Heater-Cathode Voltage:					
Heater Negative with Respect to Cathode: DC	100	100	100	max.	Volts
Heater Positive with Respect to Cathode: DC	100	100	100	max.	Volts

CHARACTERISTICS & TYPICAL OPERATION:

Plate Voltage	135	Volts
Grid 1 Voltage	-1	Volts
Plate Resistance	5600	Ohms
Transconductance	9000	μmhos
Grid 1 Cutoff Bias#	-5.5	Volts
Plate Current	11.0	Ma.
Amplification Factor	50	





▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

For Plate current of 100 microamperes.

★ With JEDEC shield No. 316 connected to Pin 1.

September 15, 1962

TWIN TRIODE TYPES 6FQ7 AND 8FQ7

The 6FQ7 and 8FQ7 are 9-pin miniature medium-mu twin triode types designed for use as vertical deflection oscillators and horizontal deflection oscillators in television receivers. They may also be used as phase inverters, multivibrators, and resistance-coupled amplifiers in electronic equipment.

The 6FQ7 and 8FQ7 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathodes	Coated Unipotential		
Heater:	6FQ7	8FQ7	
Voltage (ac or dc)	6.3	8.4	Volts
Current	0.60 ±6%	0.45 ±6%	Ampere
Warm-up Time (Note 1)	11	11	Seconds
Direct Interelectrode Capacitances: (Unshielded)			
	Unit 1	Unit 2	
Grid to Plate	3.6	3.8	μμf
Input	2.4	2.4	μμf
Output	0.34	0.26	μμf
Plate Unit 1 to Plate Unit 2	1.0		μμf

MECHANICAL

Bulb	T-6½
Base	JEDEC E9-1 (Small Button 9-Pin)
Basing	9LP
Mounting Position	Any

MAXIMUM RATINGS

Design Maximum Values

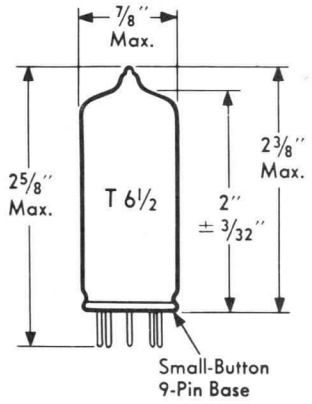
Plate Voltage	330	max.	Volts
Grid Voltage:			
Positive Bias Value	0	max.	Volts
Plate Dissipation:			
Each Plate	4.0	max.	Watts
Both Plates	5.7	max.	Watts
Cathode Current	22	max.	Ma.
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

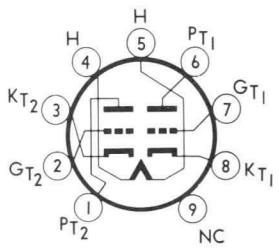
MAXIMUM CIRCUIT VALUE

Grid Circuit Resistance			
Fixed Bias Operation	1.0	max.	Megohm

CHARACTERISTICS

Plate Voltage	90	250	Volts
Grid Voltage	0	−8	Volts
Amplification Factor	20	20	–
Plate Resistance (Approx.)	6700	7700	Ohms
Transconductance	3000	2600	μmhos
Grid Voltage for Plate Current of 10 μamp	−7	−18	Volts
Plate Current for Grid Voltage of −12.5 Volts	–	1.3	Ma.
Plate Current	10	9	Ma.





9LP

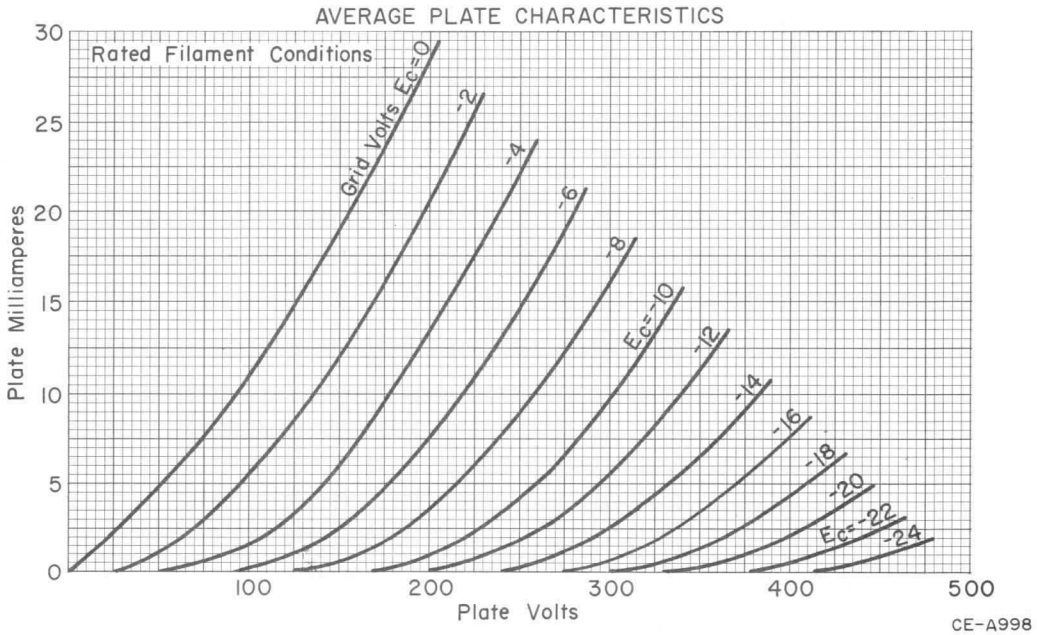
MAXIMUM RATINGS (Note 2)
Design Maximum Values

	Vertical Deflection Oscillator	Horizontal Deflection Oscillator		
DC Plate Voltage	330	330	max.	Volts
Peak Negative Pulse Grid Voltage	440 (Note 3)	660 (Note 4)	max.	Volts
Cathode Current				
Peak	77	33	max.	Ma.
DC	22	22	max.	Ma.
Plate Dissipation				
Each Plate	4	4.0	max.	Watts
Both Plates	5.7	5.7	max.	Watts
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

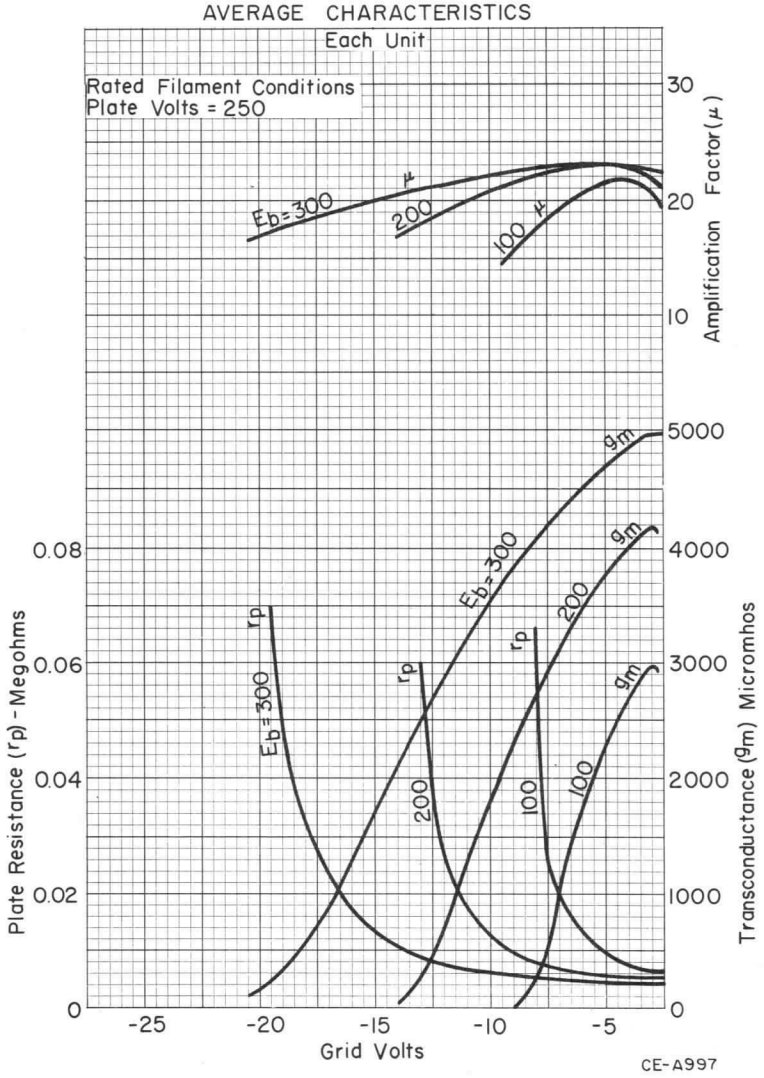
MAXIMUM CIRCUIT VALUES
Grid Circuit Resistance
Fixed-Bias, Grid-Resistor Bias, or Cathode-Bias Operation 2.2 2.2 max. Megohms

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations," Federal Communications Commission.
3. This rating is applicable where the duration of the voltage pulse does not exceed 15 per cent of one vertical scanning cycle. In a 525-line, 30-frame system, 15 per cent of one vertical scanning cycle is 2.5 milliseconds.
4. This rating is applicable where the duration of the voltage pulse does not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.



AVERAGE CHARACTERISTICS



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TRIODE - PENTODE TYPES 5FV8 AND 6FV8

The 5FV8 and 6FV8 are triode-pentode types designed for service in television receivers. The triode is used as the vertical deflection oscillator and the pentode is used as a general-purpose or intermediate-frequency amplifier. The outstanding feature of these tubes is their ability to maintain high values of interelement leakage resistance through-out life.

The 5FV8 and 6FV8 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode		Coated Unipotential			
Heater:		5FV8	6FV8		
Voltage (ac or dc)		4.7	6.3		Volts
Current		0.60	0.45		Amperes
Warm-up Time●		11	11		Seconds
Direct Interelectrode Capacitances:					
Triode Unit	Unshielded		Shielded■		
Grid to plate	1.8		1.8		μμf
Input	2.8		2.8		μμf
Output	1.5		2.0		μμf
Pentode Unit					
Grid 1 to Plate	0.020	max.	0.010	max.	μμf
Input	5.0		5.0		μμf
Output	2.0		3.0		μμf
Pentode Plate to Triode Plate	0.15	max.	0.03	max.	μμf

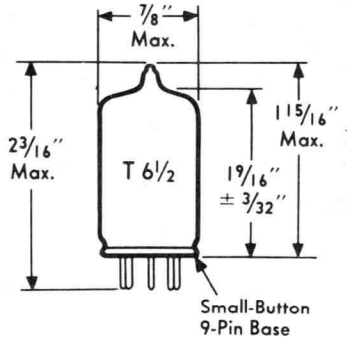
MECHANICAL:

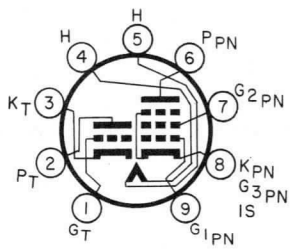
Bulb	T-6-½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9FA
Outline	6-2
Mounting	Any

RATINGS:

Design Maximum Values

	Triode Unit as Vertical Oscillator⊕	Pentode Unit		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	- -	330	max.	Volts
Grid 2 Voltage	- -		See Grid 2 Input Rating Chart	
Positive Peak Grid 1 Voltage				
Voltage	- -	0	max.	Volts
Negative Peak Pulse Grid Voltage	250	- -	max.	Volts
Cathode Current:				
Average	20	- -	max.	Ma.
Peak	70	- -	max.	Ma.
Plate Dissipation▲	2.0	2.3	max.	Watts
Grid 2 Dissipation	- -	0.55	max.	Watts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode:				
Total DC and Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode:				
DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts
Grid 1 Circuit Resistance:				
Fixed Bias	- -	0.25	max.	Megohm
Self Bias▲	3.0	1.0	max.	Megohms
Allowable Heater Current:	5FV8	6FV8		
Maximum	640	480	max.	Ma.
Minimum	560	420	min.	Ma.





9FA

TYPICAL OPERATING CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 2 Voltage	--	125	Volts
Grid 1 Voltage	-1.0	-1.0	Volts
Amplification Factor	40	----	
Plate Resistance (approx.)	5000	200000	Ohms
Transconductance	8000	6500	μmhos
Grid 1 Cutoff Bias♦	-9	-9	Volts
Plate Current	14	12	Ma.
Grid 2 Current	--	4	Ma.

● Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

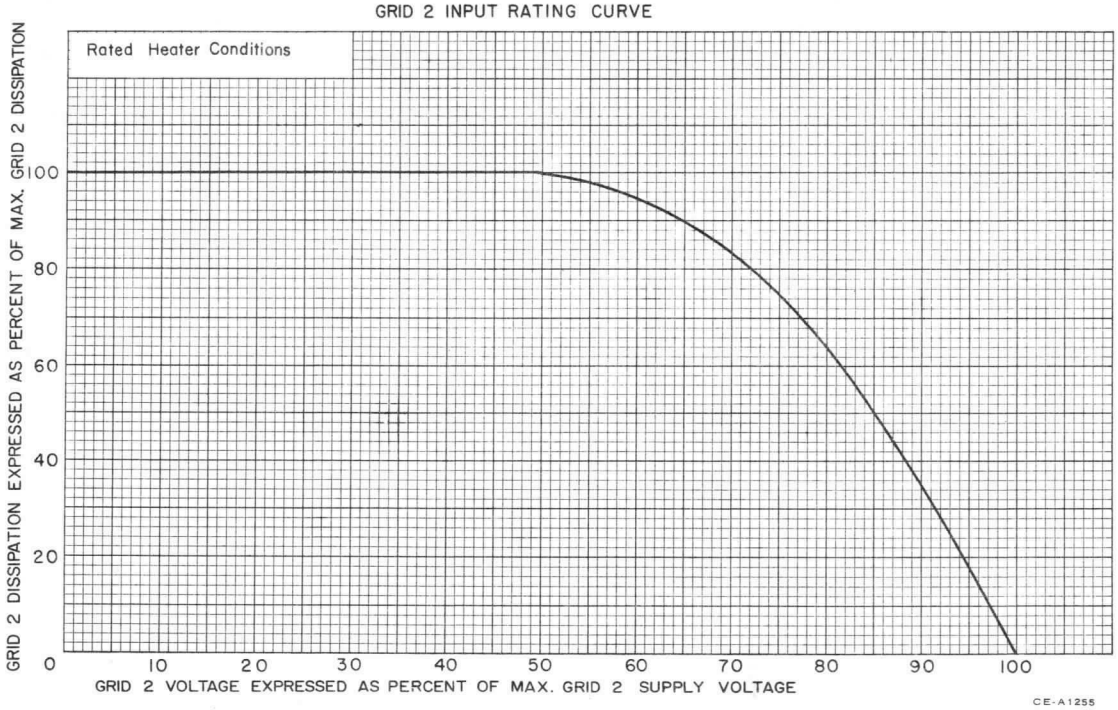
♦ For Plate Current of 20 μa.

▲ In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of exitation.

■ With JEDEC shield No. 315 connected to pin 4.

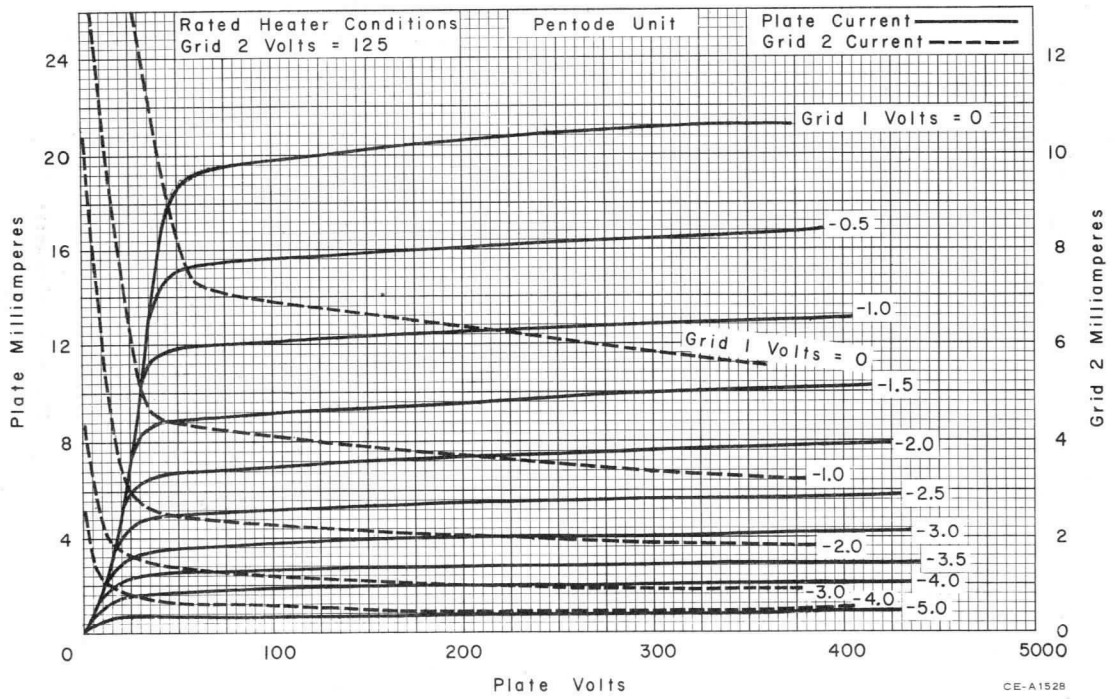
⊕ For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of one scaning cycle.

GRID 2 INPUT RATING CURVE

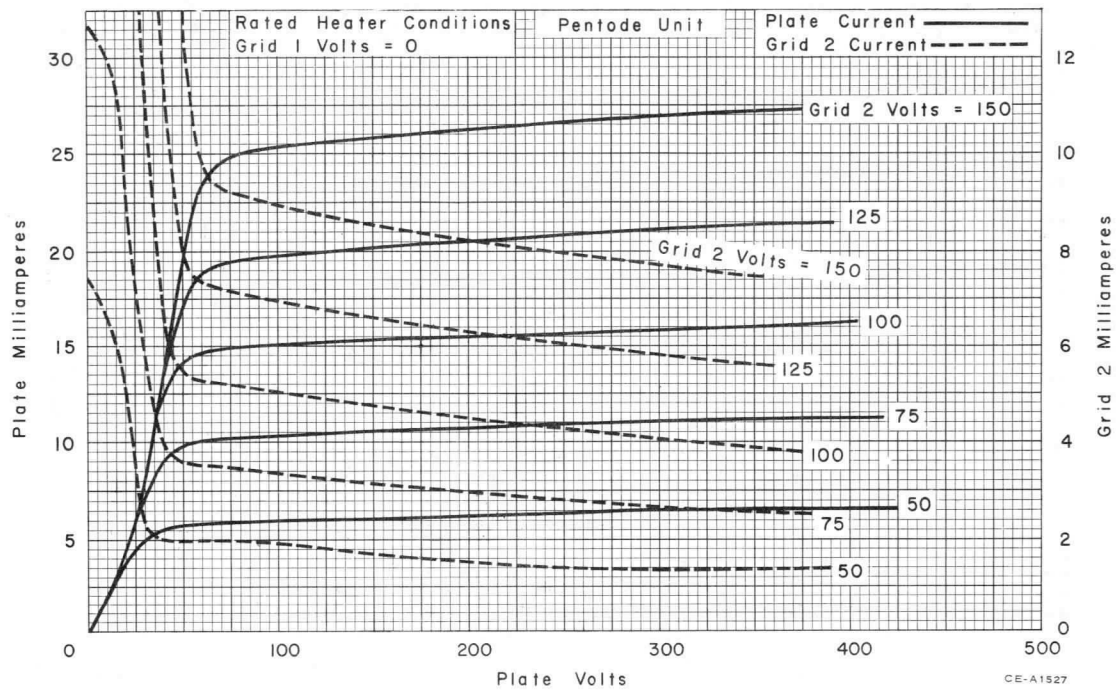


CE-A1255

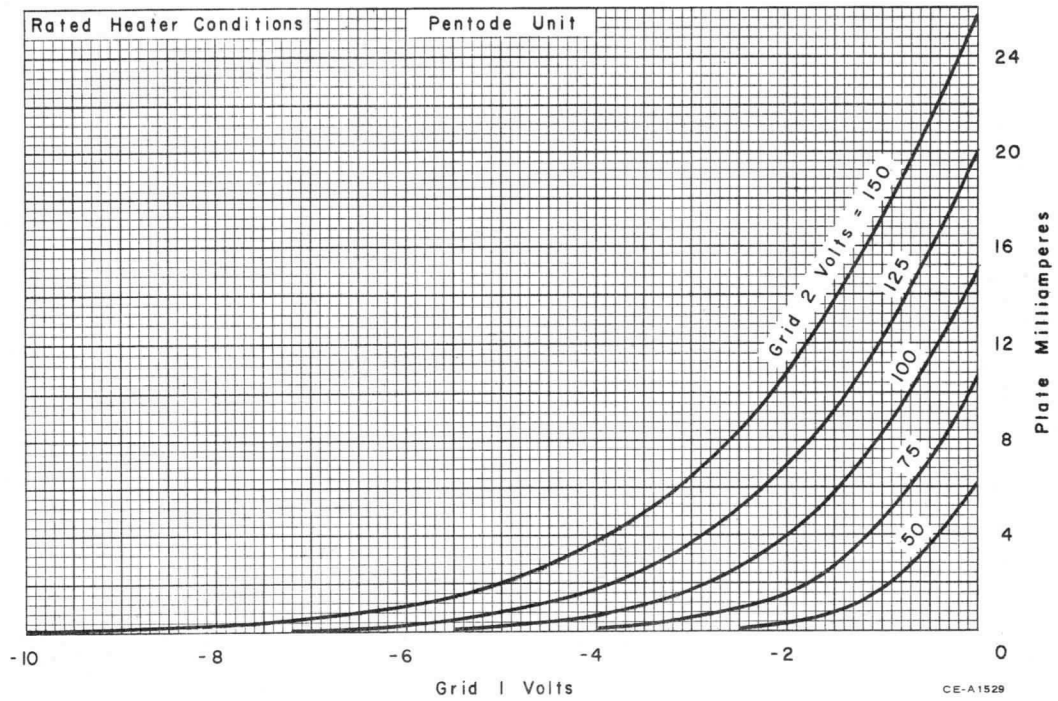
AVERAGE PLATE CHARACTERISTICS



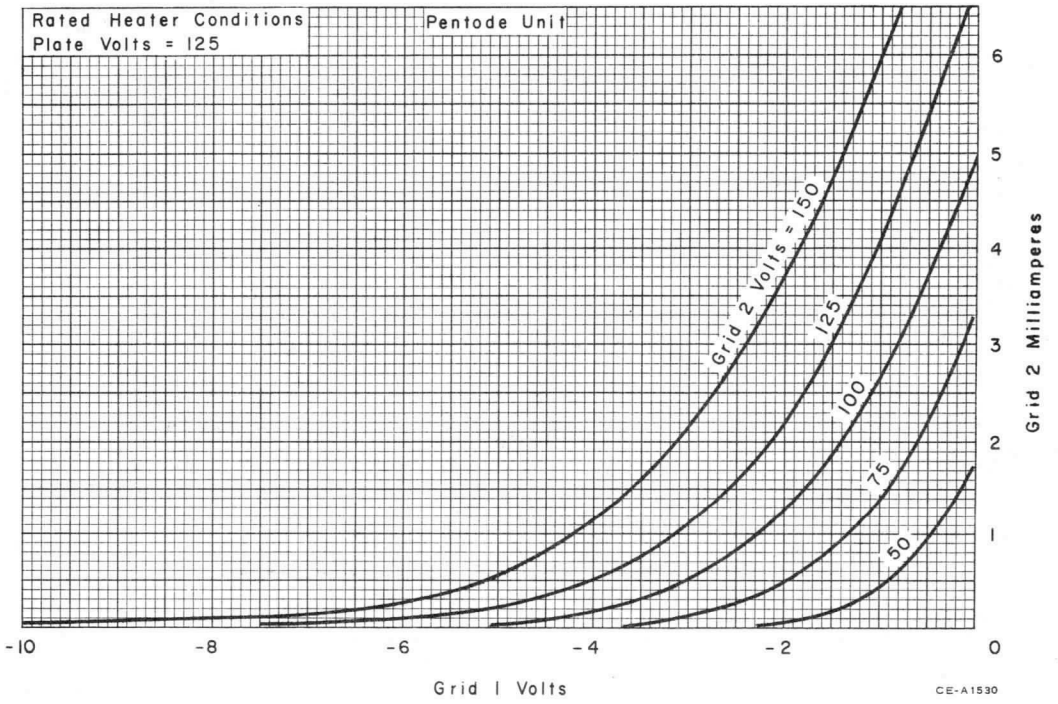
AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



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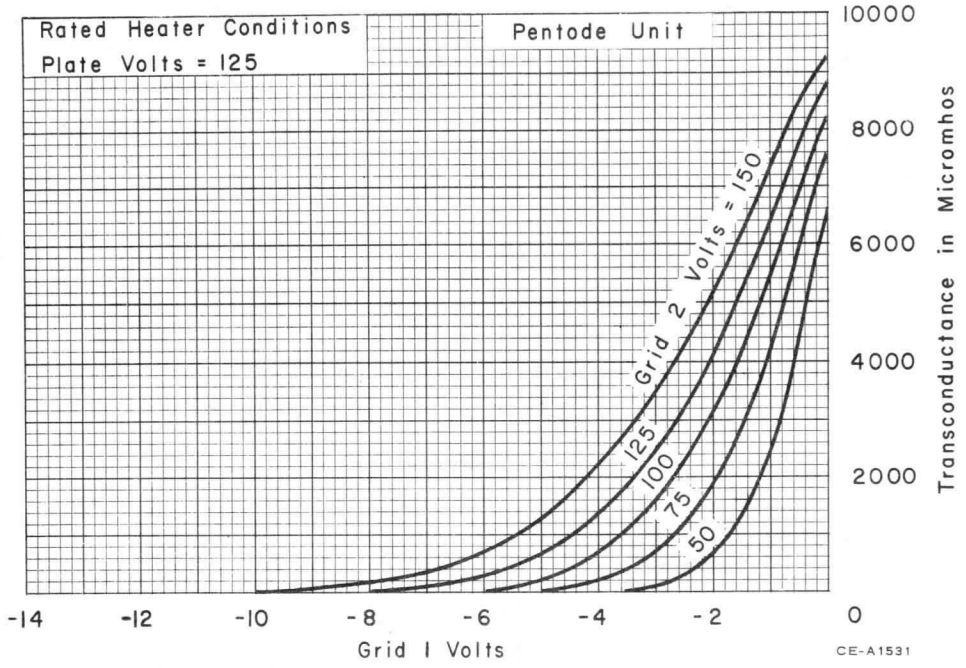

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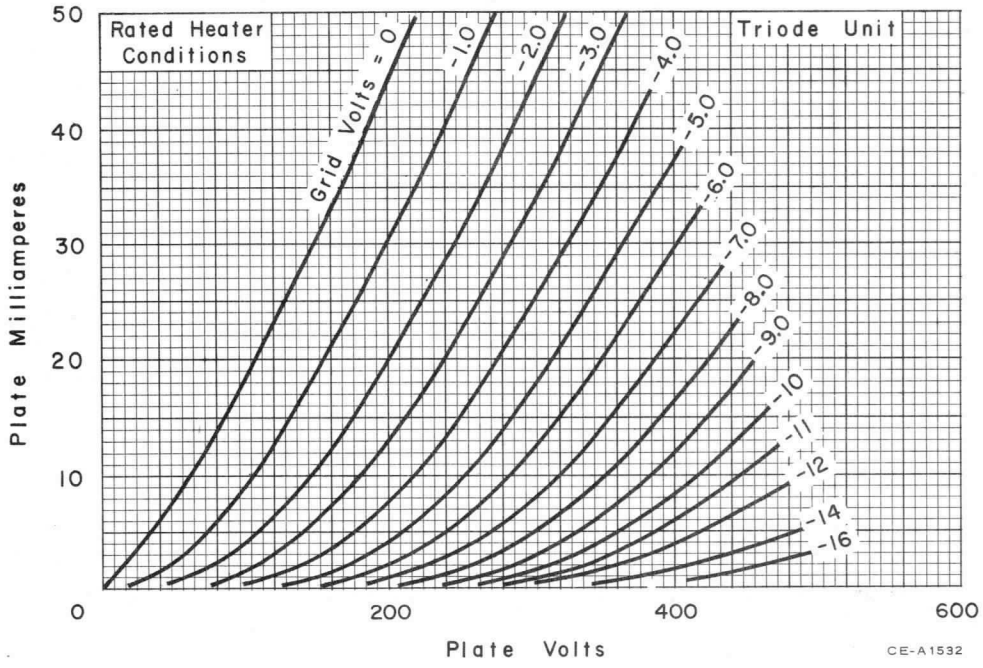

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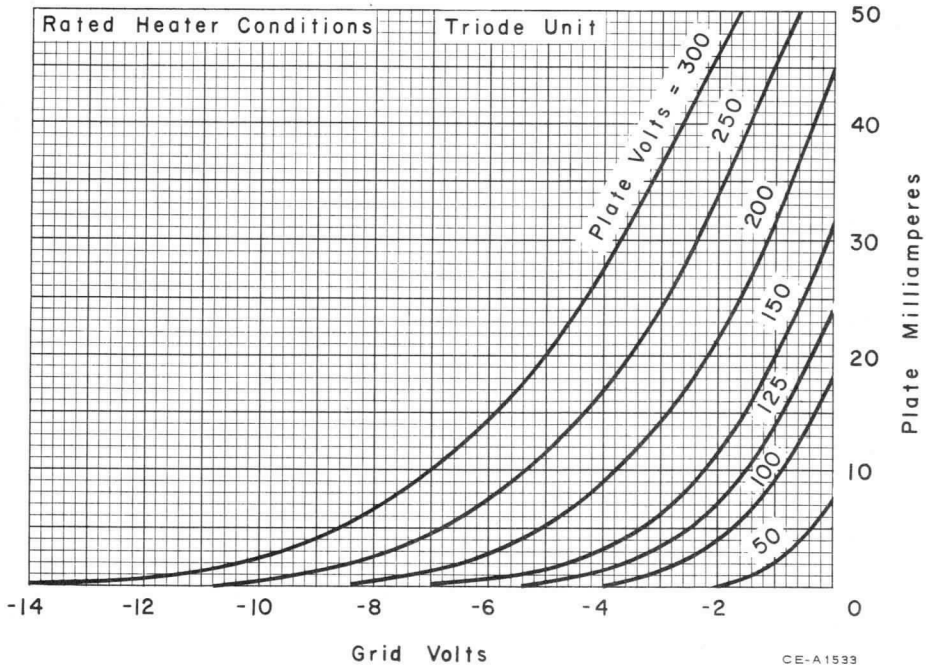

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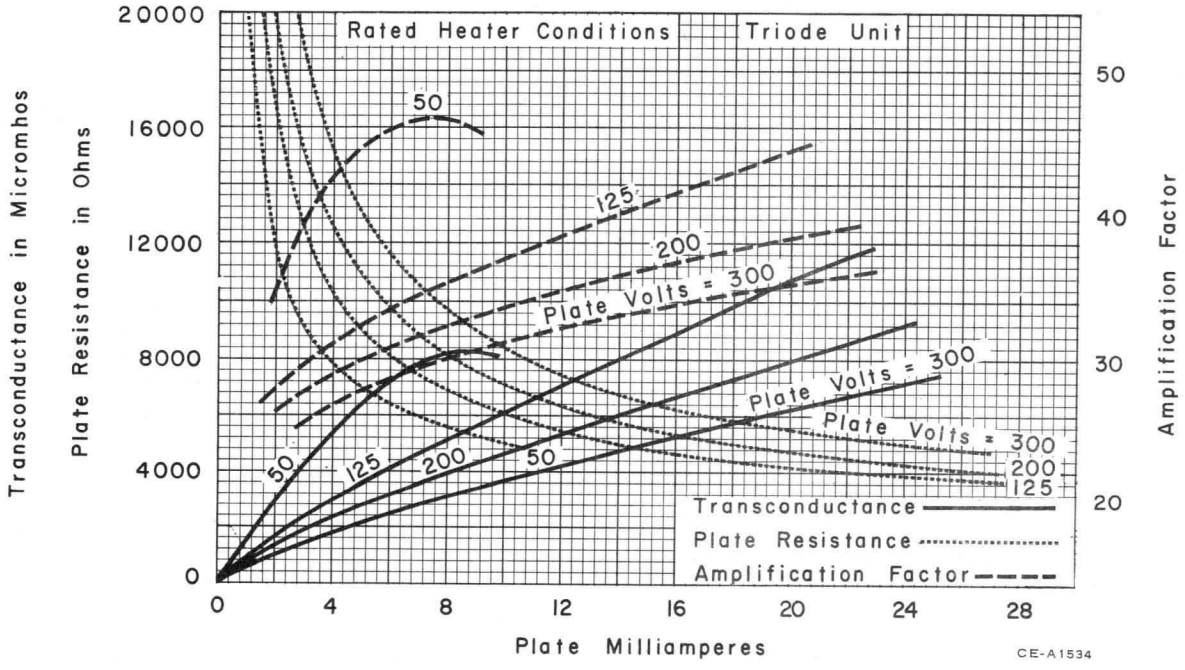


TRIODE - PENTODE TYPE 6FV8A

The 6FV8A is a triode-pentode type designed for service in television receivers. The triode is used as the vertical deflection oscillator and the pentode is used as a general-purpose or intermediate-frequency amplifier. The outstanding feature of this tube is its ability to maintain high values of interelement leakage resistance through-out life.

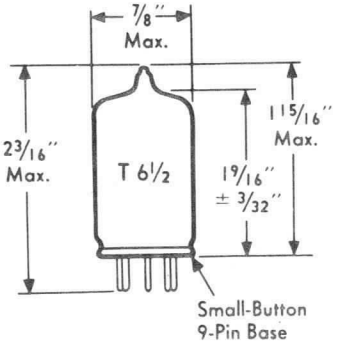
The 6FV8A has been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

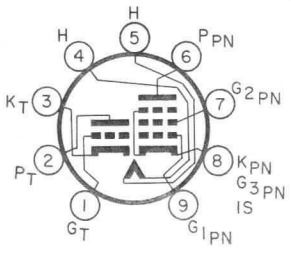
ELECTRICAL

Cathode	Coated Unipotential				
Heater:					
Voltage (ac or dc)	6.3				Volts
Current	0.45±6%				Amperes
Warm-up Time (Note 1)	11				Seconds
Direct Interelectrode Capacitances:					
Triode Unit	Unshielded		Shielded (Note 2)		
Grid to Plate	1.8		1.8		pf
Input	2.8		1.8		pf
Output	1.5		2.0		pf
Pentode Unit					
Grid 1 to Plate	0.020	max.	0.010	max.	pf
Input	5.0		5.0		pf
Output	2.0		3.0		pf
Pentode Plate to Triode Plate	0.15	max.	0.03	max.	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9FA
Outline	6-2
Mounting	Any





9FA

RATINGS

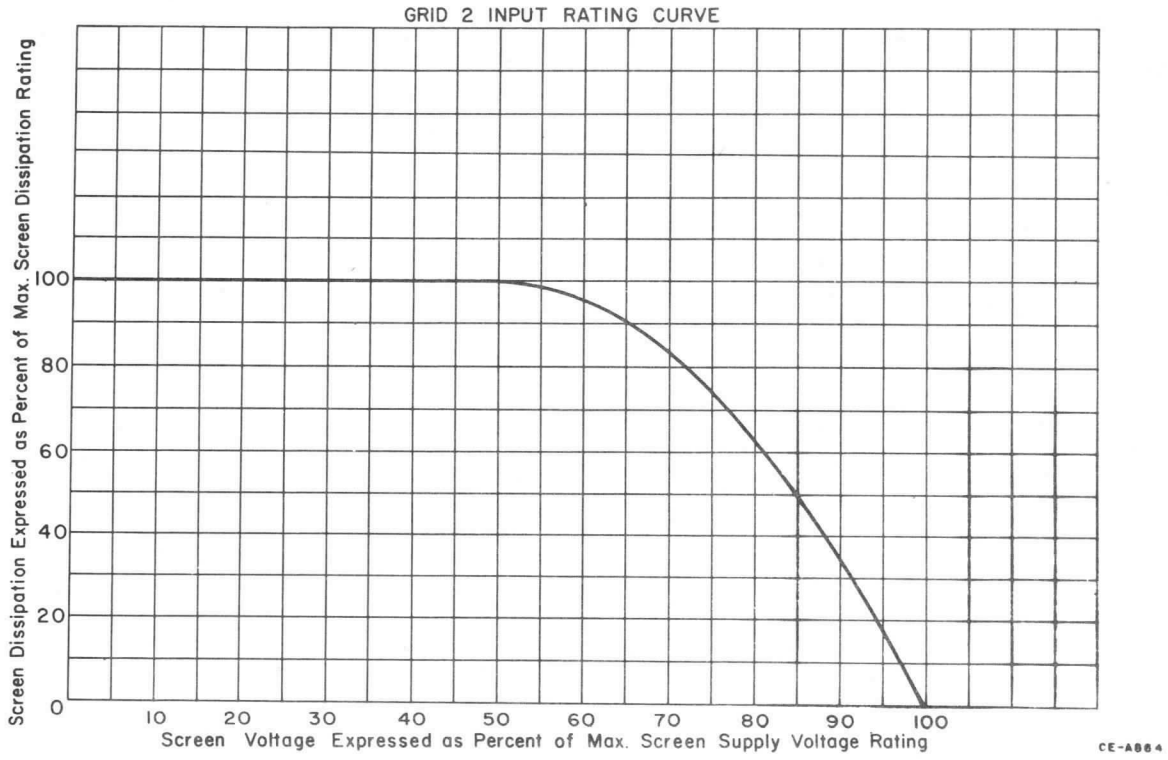
Design Maximum Values	Triode Unit as Vertical Oscillator (Note 3)	Pentode Unit		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart			
Positive Peak Grid 1 Voltage	–	0	max.	Volts
Negative Peak Pulse Grid Voltage	250	–	max.	Volts
Cathode Current:				
Average	20	–	max.	Ma.
Peak	70	–	max.	Ma.
Plate Dissipation (Note 4)	2.0	2.3	max.	Watts
Grid 2 Dissipation	–	0.55	max.	Watts
Grid 1 Circuit Resistance:				
Fixed Bias	–	0.25	max.	Megohm
Self Bias (Note 4)	3.0	1.0	max.	Megohms
Heater-Cathode Voltage: (Both Units)				
Heater Negative with Respect to Cathode:				
Total DC and Peak		200	max.	Volts
Heater Positive with Respect to Cathode:				
DC Component		100	max.	Volts
Total DC and Peak		200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–1.0	–1.0	Volts
Amplification Factor	45	–	–
Plate Resistance (Approx.)	5600	200000	Ohms
Transconductance	8000	6500	μmhos
Grid 1 Cutoff Bias (Note 5)	–7.5	–9	Volts
Plate Current	12	12	Ma.
Grid 2 Current	–	4	Ma.

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC Shield No. 315 connected to pin 4.
3. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of one scanning cycle.
4. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of exitation.
5. For Plate Current of 20 microamperes.



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January 15, 1963

POWER PENTODE TYPE 12FX5 AND 60FX5

The 12FX5 and 60FX5 are 7-pin miniature power pentode types designed for service as the audio output tube. The out-standing feature of these types is high power sensitivity. Very low drive voltage is required.

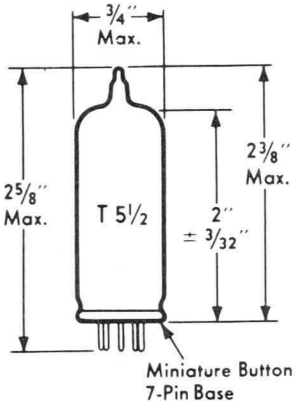
The 12FX5has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a current rating of 450 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

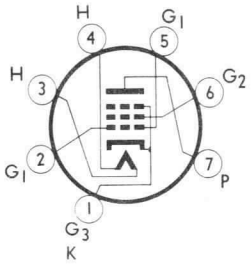
ELECTRICAL

Cathode	Coated Unipotential		
Heater:	12FX5	60FX5	
Voltage (ac or dc)	12.6	60 ± 10%	Volts
Current	0.45 ± 6%	0.10	Ampere
Warm Up Time (Note 1)	11	–	Seconds
Direct Interelectrode Capacitances (Unshielded):			
Grid 1 to Plate	0.65		μμf
Input	17		μμf
Output	9		μμf

MECHANICAL:

Bulb	T-5½
Base	7-Pin Miniature (JEDEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





MAXIMUM RATINGS:

Design Maximum Values			
Plate Voltage	150	max.	Volts
Grid 2 Voltage (Screen)	130	max.	Volts
Grid 1 Positive Voltage	0	max.	Volts
Plate Dissipation	5.5	max.	Watts
Grid 2 Dissipation	2	max.	Watts
Bulb Temperature (Note 2)	225	max.	°C
Grid 1 Circuit Resistance:			
Fixed Bias	0.1	max.	Megohms
Cathode-Resistor Bias	0.5	max.	Megohms
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:

Plate Voltage	110	Volts
Grid 2 Voltage	115	Volts
Cathode Bias Resistor	62	Ohms
Peak AF-Signal Grid 1 Voltage	3	Volts
Zero-Signal Plate Current	36	Ma.
Max.-Signal Plate Current	35	Ma.
Zero-Signal Grid 2 Current (Screen)	10	Ma.
Max.-Signal Grid 2 Current (Screen)	12	Ma.
Plate Resistance (Approx.)	17500	Ohms
Transconductance	13500	μmhos
Load Resistance	3000	Ohms
Power Output	1.3	Watts
Total Harmonic Distortion	8	Per Cent

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

POWER PENTODE TYPE 60FX5

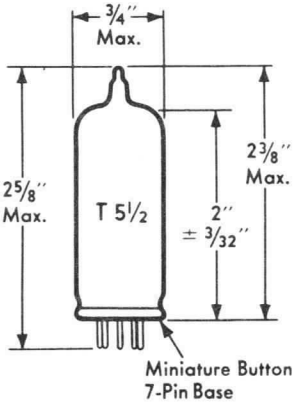
The 60FX5 is a 7-pin miniature power pentode type designed for service as audio output tube in record players. The out-standing feature of this type is high power sensitivity permitting very low drive voltage.

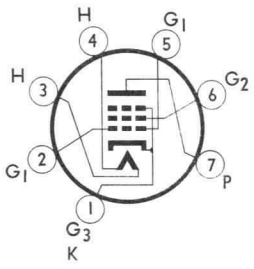
ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	60 ± 10%	Volts
Current	0.10	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.65	μμf
Input	17	μμf
Output	9	μμf

MECHANICAL:

Bulb	T-5½
Base	7-Pin Miniature (JEDEC E7-1)
Outline	5-3
Basing	7CV
Mounting Position	Any





MAXIMUM RATINGS:

Design Maximum Values

Plate Voltage	150	max.	Volts
Grid 2 Voltage (Screen)	130	max.	Volts
Grid 1 Positive Voltage	0	max.	Volts
Plate Dissipation	5.5	max.	Watts
Grid 2 Dissipation	2	max.	Watts
Bulb Temperature□	225	max.	°C
Grid 1 Circuit Resistance:			
Fixed Bias	0.1	max.	Megohms
Cathode-Resistor Bias	0.5	max.	Megohms
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:

Plate Voltage	110	Volts
Grid 2 Voltage	115	Volts
Cathode Bias Resistor	62	Ohms
Peak AF-Signal Grid 1 Voltage	3	Volts
Zero-Signal Plate Current	36	Ma.
Max.-Signal Plate Current	35	Ma.
Zero-Signal Grid 2 Current (Screen)	10	Ma.
Max.-Signal Grid 2 Current (Screen)	12	Ma.
Plate Resistance (Approx.)	17500	Ohms
Transconductance	13500	μmhos
Load Resistance	3000	Ohms
Power Output	1.3	Watts
Total Harmonic Distortion	8	Per Cent

NOTE

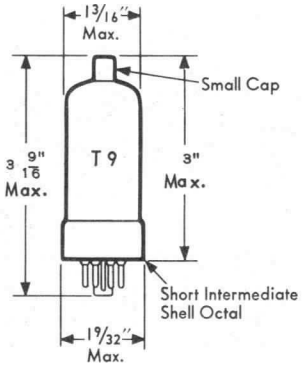
□ High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

HALF-WAVE VACUUM RECTIFIER TYPE 1G3-GT

The 1G3-GT is a glass octal directly heated diode designed for service as a high voltage, low current rectifier. This tube is particularly well suited for service as the high voltage rectifier in television receivers because it has very good insulation between plate and filament and requires only 200 milliamperes of filament current.

GENERAL DATA

ELECTRICAL:		
Filament (Coated):		
Voltage (ac or dc)	1.25▲	Volts
Current	0.20	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Plate to Filament	1.3	uuf
MECHANICAL:		
Bulb		T-9
Base		Intermediate Shell Octal (JETEC B5-82, B6-8, B7-166) Short Intermediate Shell Octal (JETEC B5-85, B6-60, B7-147)
Outline		9-51 or 9-52
Basing		3C
Mounting Position		Any



MAXIMUM RATINGS

DESIGN-CENTER VALUES:

(Except as Indicated)	Flyback Rectifier♦	RF Voltage Rectifier		
Inverse Plate Voltage				
DC Component	21000 max.			Volts
Total DC and Peak	26000 max.	33000 abs. max.		Volts
Steady-State Peak Plate Current	50	30	max.	Ma.
DC Output Current	0.5	1.0	max.	Ma.
Frequency of Supply Voltage				
Maximum	-	100	max.	Kc.
Minimum	-	1.5	min.	Kc.

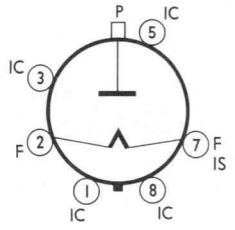
AVERAGE CHARACTERISTICS

Tube Voltage Drop (Approx.) With Plate Current of 7.0 Ma. dc	100	Volts

♦ For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

▲ The filament voltage must never be less than 1.05 volts or more than 1.45 volts.

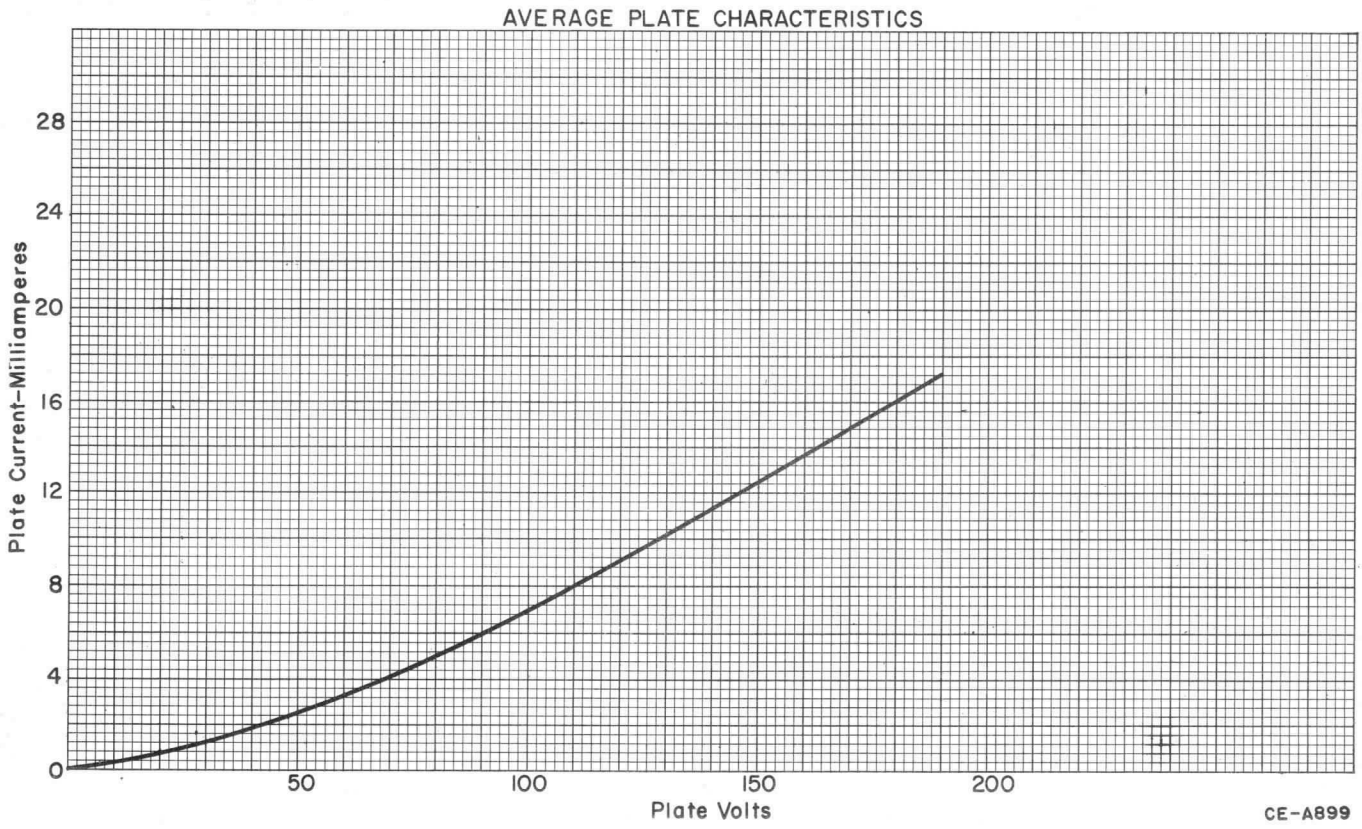
Inasmuch as the tube rating permits operation at high voltage, shielding of the tube for x-ray radiation may be needed.



3C

BOTTOM VIEW

Socket Terminals 1, 3, 4, 5, 6 and 8 shall not be used as tie points although terminals 1, 3, 5 and 8 may be connected to terminal 7 to reduce corona discharge.


AVERAGE PLATE CHARACTERISTICS
Plate Current-Milliamperes
0
4
8
12
16
20
24
28
50
100
150
200
Plate Volts
CE-A899

Westinghouse

6GC5

January 15, 1963

9T9 BEAM-POWER PENTODE TYPE 6GC5

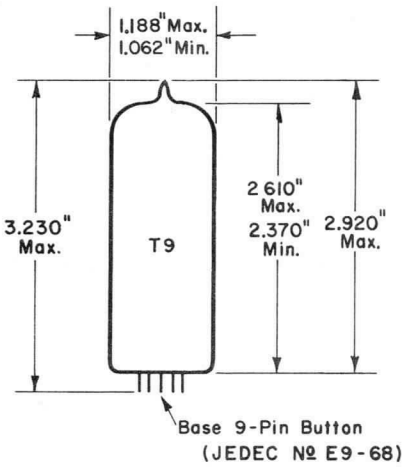
The 6GC5 is a 9T9 beam-power pentode type designed for service in the output stage of audio amplifiers. This type features high power sensitivity and plate efficiency at low plate and grid 2 voltages.

ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3 ± 0.6	Volts
Current	1.20	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to Plate	0.9	μμf
Input	18	μμf
Output	7	μμf

MECHANICAL

Bulb	T-9
Base	9-Pin Button Base (JEDEC E9-68)
Outline	9-71
Basing	9EU
Mounting Position	Any



MAXIMUM RATINGS

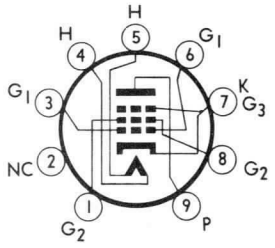
Design Maximum Values

Plate Voltage	220	max.	Volts
Plate Dissipation	12	max.	Watts
Grid 2 Voltage	140	max.	Volts
Grid Dissipation	1.4	max.	Watts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts
Grid 1 Circuit Resistance:			
Cathode Bias	0.5	max.	Megohm
Fixed Bias	0.1	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION

Class A_1 Amplifier

Plate Voltage	110	200	Volts
Grid 2 Voltage	110	125	Volts
Grid 1 Voltage	-7.5	–	Volts
Cathode Bias Resistor	–	180	Ohms
Peak A-F Grid 1 Voltage	7.5	8.5	Volts
Zero Signal Plate Current	49	46	Ma.
Zero Signal Grid 2 Current	4	2.2	Ma.
Max. Signal Plate Current	50	47	Ma.
Max. Signal Grid 2 Current	10	8.5	Ma.
Transconductance	8000	8000	μmhos
Plate Resistance, Approx.	13000	28000	Ohms
Load Resistance	2000	4000	Ohms
Power Output	2.1	3.8	Watts
Total Harmonic Distortion	10	10	Percent



9EU

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HIGH PERVEANCE TRIODE - SHARP CUTOFF PENTODE
TYPE 6GE8

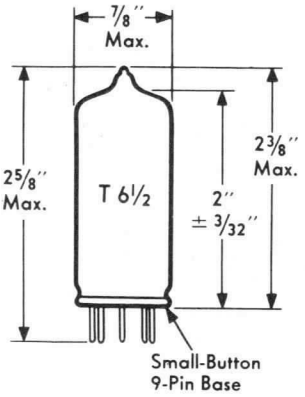
The 6GE8 is a 9-pin miniature high perveance triode and sharp cutoff pentode type designed for service in electronically regulated power supplies. The triode unit is used as a series regulating tube which is controlled by the pentode unit acting as a d-c amplifier.

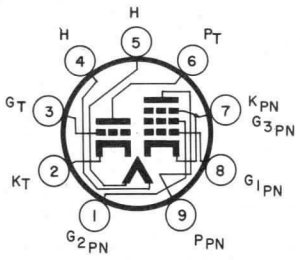
ELECTRICAL:

Cathodes	Coated Unipotential	
Heater:		
Voltage	6.3	Volts
Current	0.90	Ampere
Direct Interelectrode Capacitances (Unshielded)		
Triode Unit:		
Grid to Plate	7.5	μμf
Input	5.5	μμf
Output	1.3	μμf
Pentode Unit:		
Grid 1 to Plate	0.02	μμf
Input	8.0	μμf
Output	2.4	μμf

MECHANICAL:

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-3
Basing	9LC
Mounting Position	Any





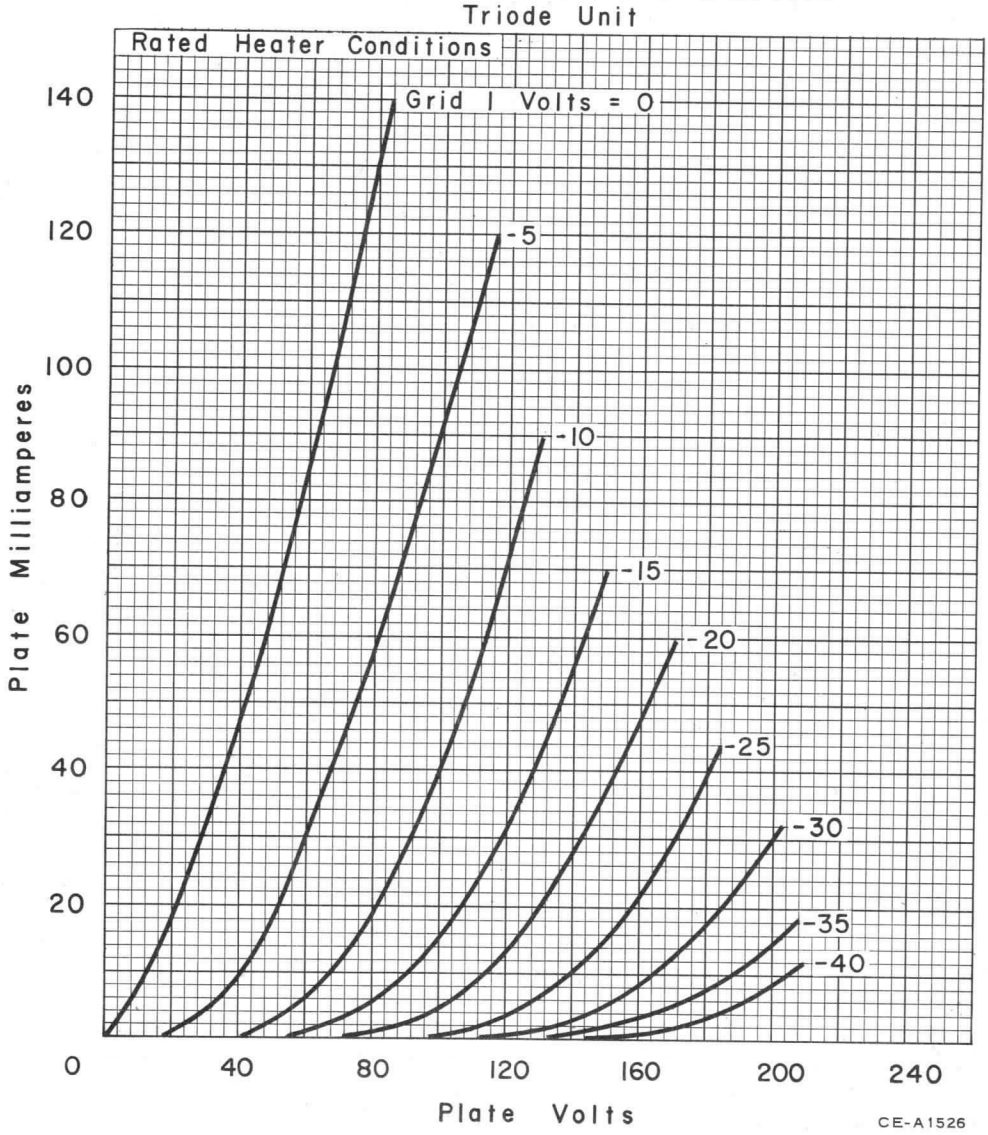
9 LC

MAXIMUM RATINGS Design Maximum Values	Pentode Unit	Triode Unit		
Plate Voltage	330	275	max.	Volts
Grid 2 Supply Voltage	275	--	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve			
Plate Dissipation	1.0	7.0	max.	Watts
Grid 2 Dissipation	0.5	--	max.	Watts
Cathode Current:				
Average	--	50	max.	Ma.
Peak	--	175	max.	Ma.
Heater Cathode Voltage:				
Heater Negative with Respect to Cathode	200	200	max.	Volts
Heater Positive with Respect to Cathode	100	100	max.	Volts
LIMITING CIRCUIT VALUES				
Grid Circuit Resistance:				
Self Bias	2.2	2.2	max.	Megohms

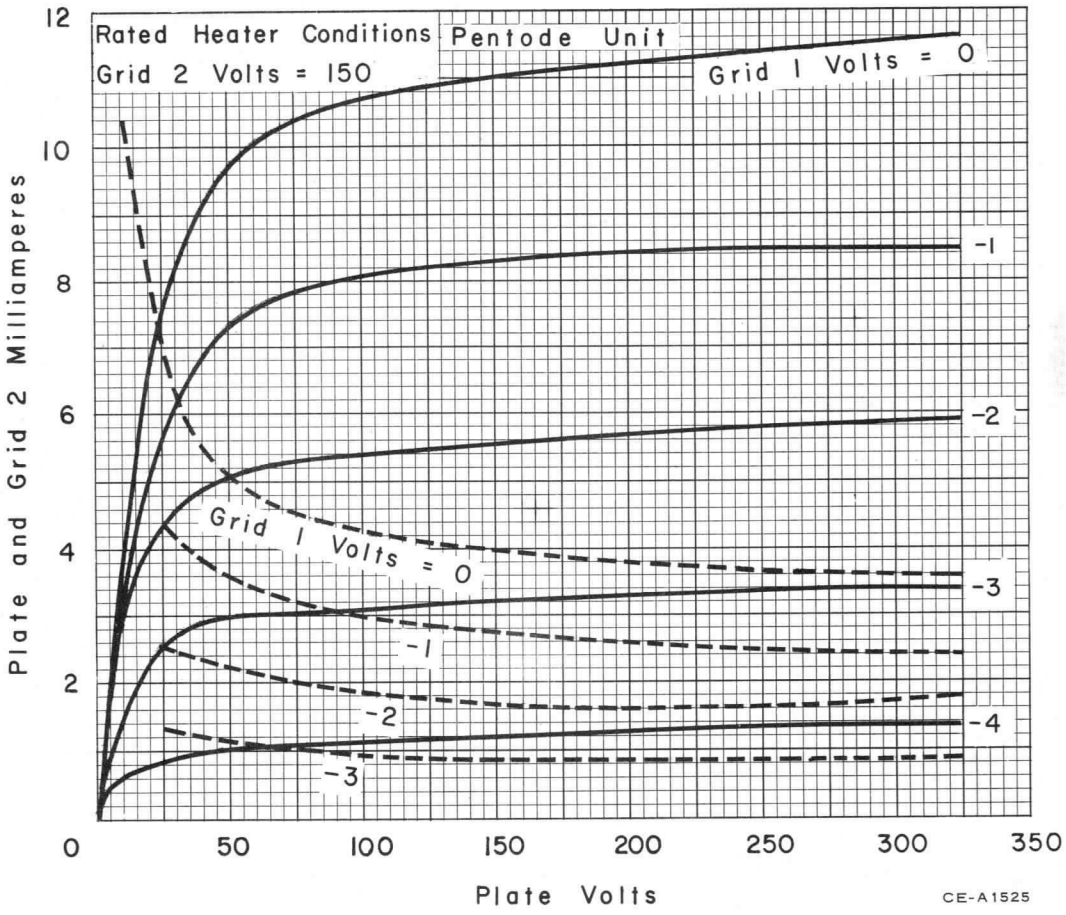
AVERAGE CHARACTERISTICS	Pentode	Triode	
Plate Voltage	150	150	Volts
Grid 2 Voltage	150	--	Volts
Grid 1 Voltage	-2	-21	Volts
Plate Resistance	340000	1,080	Ohms
Transconductance	3200	5000	μmhos
Amplification Factor	--	5.4	
Grid 1 Cutoff Voltage	-8⊕	-42♦	Volts
Plate Current	5.5	35	Ma.
Grid 2 Current	1.7	--	Ma.
Zero Bias Characteristic (Triode Unit)			
Plate Voltage		50	Volts
Grid Voltage		0	Volts
Plate Current		70	Ma.
Plate Resistance Characteristic (Pentode Unit)			
Plate Voltage		100	Volts
Grid 2 Voltage		50	Volts
Plate Current		100	μamperes
Plate Resistance		>7	Megohms

⊕ For plate current of 50 microamperes.
♦ For plate current of 500 microamperes.

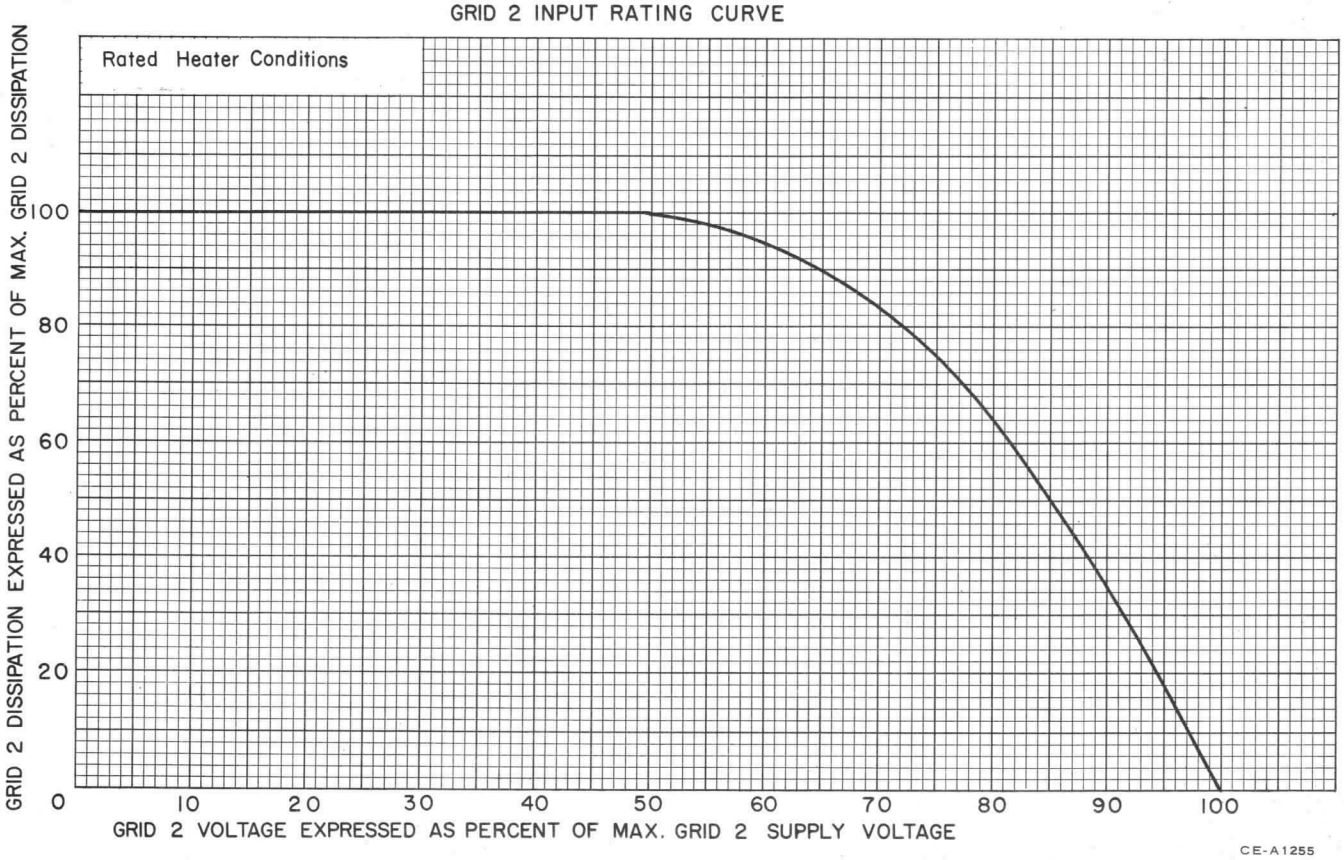
AVERAGE PLATE CHARACTERISTICS
Triode Unit



AVERAGE PLATE CHARACTERISTICS



GRID 2 INPUT RATING CURVE



CE-A1255

TRIODE-PENTODE TYPE 6GH8

The 6GH8 is a 9-Pin miniature medium-mu triode and sharp-cutoff pentode type designed for service as a general purpose tube in television receivers. The pentode unit is intended for horizontal oscillator service. The 6GH8 has been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3		Volts
Current	0.45±6%		Amperes
Warm-up Time (Note 1)	11		Seconds
Direct Interelectrode Capacitances:			
Triode Unit:	Unshielded	Shielded (Note 2)	
Grid to Plate	1.6	1.6	μμf
Input	3.4	3.6	μμf
Output	1.7	2.2	μμf
Heater to Cathode (Note 3)	3.0	3.0	μμf
Pentode Unit:			
Grid 1 to Plate	0.02 max.	0.015 max.	μμf
Input	5.5	5.5	μμf
Output	2.6	3.4	μμf
Heater to Cathode (Note 3)	3.0	3.0	μμf

MECHANICAL

Bulb	T-6-½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9AE
Outline	6-2
Mounting	Any

MAXIMUM RATINGS

Design Maximum Values

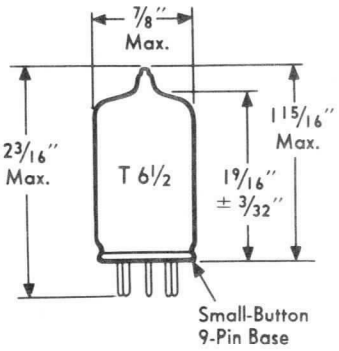
	Triode Unit	Pentode Unit as Horiz. Oscillator (Note 4)		
Plate Voltage	330	350	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Chart		
Grid 1 Voltage:				
Positive Bias Value	0	0	max.	Volts
Negative Peak Value	–	175	max.	Volts
Cathode Current:				
DC Value	–	20	max.	Ma.
Peak Value	–	300	max.	Ma.
Plate Dissipation	2.5	2.5	max.	Watts
Grid 2 Dissipation	–	0.55	max.	Watts
Heater-Cathode Voltage:				
Heater Positive with Respect to Cathode:				
DC Component	100	100	max.	Volts
DC & Peak	200	200	max.	Volts
Heater Negative with Respect to Cathode:				
DC & Peak	200	200	max.	Volts

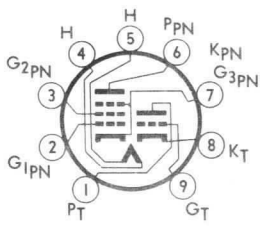
LIMITING CIRCUIT VALUES

Grid 1 Circuit Resistance:				
With Fixed Bias	2.2	2.2	max.	Megohms
With Cathode Resistor Bias	2.2	2.2	max.	Megohms

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–1	–1	Volts
Amplification Factor	46	–	–
Plate Resistance (Approx.)	5400	200000	Ohms
Transconductance	8500	7500	μmhos
Grid 1 Cutoff Bias (Note 5)	–8	–8	Volts
Plate Current	13.5	12	Ma.
Grid 2 Current	–	4	Ma.

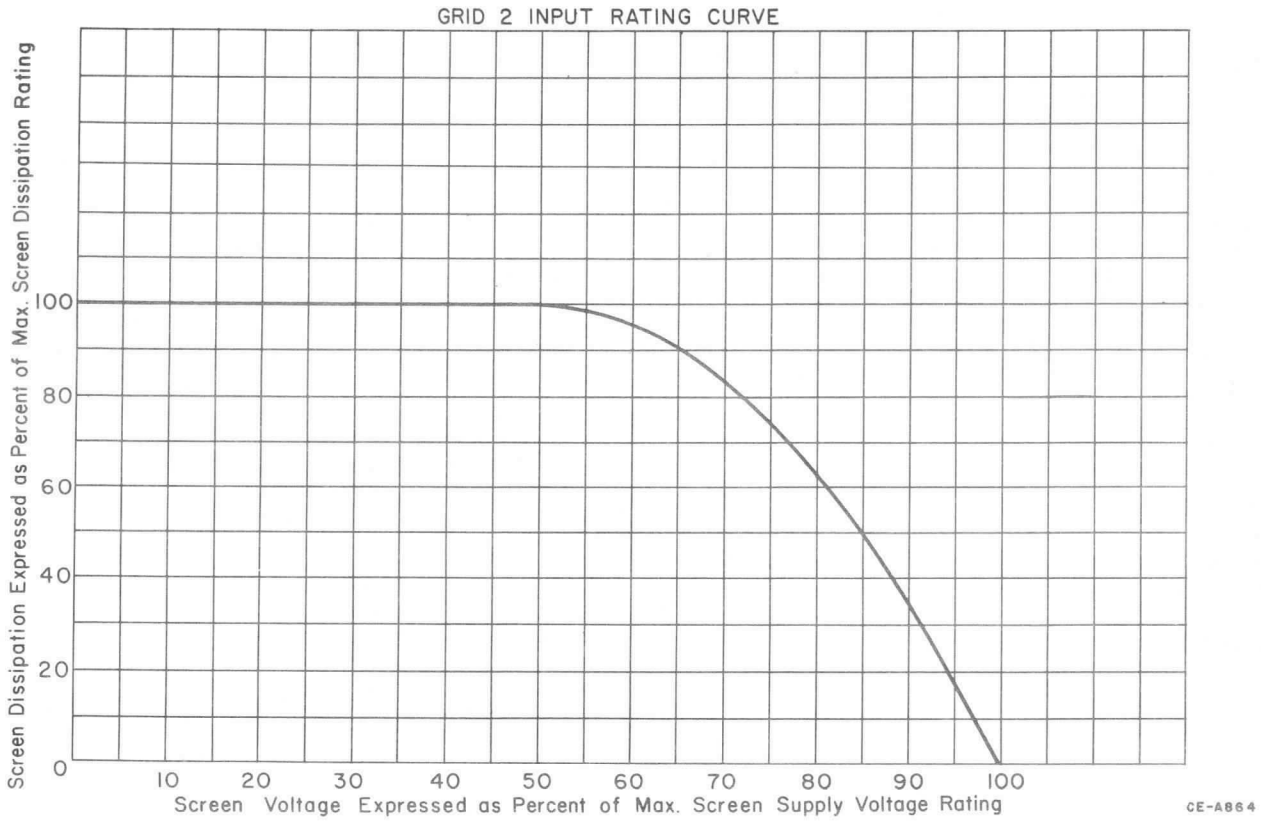




9AE

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. With JEDEC shield #315 connected to Cathode of unit under test.
3. With JEDEC shield #315 connected to ground.
4. For operation in a 525-line, 30-frame television system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission." The duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.
5. For plate current of 10 microamperes.



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Westinghouse

2GK5
3GK5
6GK5

May 15, 1961

SHARP–CUTOFF TRIODE 2GK5, 3GK5 AND 6GK5

The 2GK5, 3GK5 and 6GK5 are sharp-cutoff, seven-pin miniature triode types designed particularly for service in V.H.F. television tuners as grounded cathode r-f amplifiers.

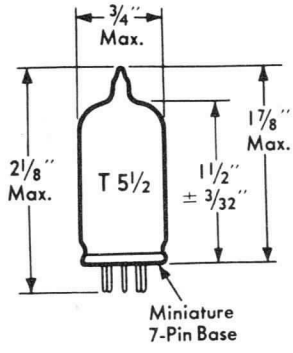
The 2GK5, and 3GK5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

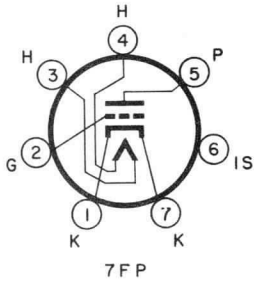
ELECTRICAL:

	2GK5	3GK5	6GK5	
Heater Characteristics:				
Voltage ac or dc)	2.35	3.0	6.3	Volts
Current	0.60	0.45	0.20	Ampere
Warm-up Time (Note 1)	11	11	--	Seconds
Direct Interelectrode Capacitance:	(Shielded)	(Note 2)		
Grid 1 to Plate		0.52 max.		μμf
Input		5.0		μμf
Output		3.5		μμf
Heater to Cathode		2.5		μμf

MECHANICAL:

Cathode	Coated Unipotential
Bulb	T-5-½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7FP
Mounting Position	Any





RATINGS:
Design Maximum Values

Plate Voltage	200	max.		Volts
Plate Dissipation	2.5	max.		Watts
Grid 1 Voltage:				
Negative Value	50	max.		Volts
Cathode Current	22	max.		Ma.
Grid Circuit Resistance (Self Bias)	1.0	max.		Megohm
Heater Ratings:				
Allowable Heater Voltage:	2GK5	3GK5	6GK5	
Maximum	--	--	6.9 max.	Volts
Minimum	--	--	5.7 min.	Volts
Allowable Heater Current:				
Maximum	640	480	-- max.	Ma.
Minimum	560	420	-- min.	Ma.
Heater-Cathode Voltage:				
Heatef Negative with Respect to Cathode DC	100	100	100 max.	Volts
Heater Positive with Respect to Cathode DC	100	100	100 max.	Volts

CHARACTERISTICS & TYPICAL OPERATION:

Plate Voltage	135	Volts
Grid 1 Voltage	-1	Volts
Plate Resistance	5400	Ohms
Transconductance	15000	μmhos
Grid 1 Cutoff Bias	See Note 3	
Plate Current	11.5	Ma.
Amplification Factor	78	
Hot Input Resistance (Note 4)	275	Ohms
Hot Input Capacitance (Note 4)	11.2	μμf
Noise Figure (Note 5)	4.7	db

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield No. 316 connected to Pin 1.
3. Grid Volts for gm = 150 μmhos: -4.2
   Grid Volts for gm = 1500 μmhos: -2.5
4. Measured at 200 Mc. with plate at signal ground.
5. In a 200 Mc. noise-matched, optimized, neutralized, grounded-cathode triode amplifier stage.

POWER PENTODE TYPE 6GK6

The 6GK6 is a 9-pin miniature power pentode designed for service as an audio or video output amplifier. It is intended for television receivers and combines high power sensitivity and plate efficiency with low distortion, low driving voltage requirements and low grid-plate capacitance.

ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage	6.3	Volts
Current	0.76	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to Plate	0.14 max.	pf
Plate to All Other Elements	7.0	pf
Grid 1 to All Other Elements	10.0	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9GK
Mounting Position	Any

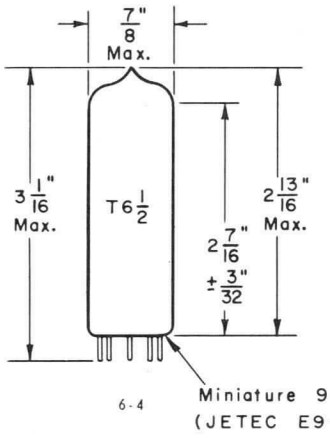
MAXIMUM RATINGS

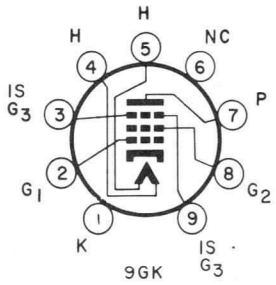
Design Maximum Values	AC Line Power Supply	Vibrator Power Supply		
Plate Voltage	330	275	max.	Volts
Grid 2 Voltage	330	275	max.	Volts
Plate Dissipation	13.2	9.9	max.	Watts
Cutoff Operation:				
Plate Voltage		605	max.	Volts
Grid 2 Voltage		605	max.	Volts
Grid 2 Dissipation		2	max.	Watts
Grid 1 Negative Voltage		100	max.	Volts
Grid 1 Voltage for Grid 1 Current of 0.3 μampere		−1.3	max.	Volts
Cathode Current		65	max.	Ma.
Heater Cathode Voltage		±100	max.	Volts
Grid 1 Circuit Values:				
Fixed Bias		0.3	max.	Megohm
Cathode Resistor Bias		1.0	max.	Megohm

CLASS A AMPLIFIER
(one tube)

TYPICAL OPERATING CHARACTERISTICS

Plate Voltage	250	Volts
Grid 2 Voltage	250	Volts
Grid 1 Voltage	−7.3	Volts
or Cathode Bias Resistor	135	Ohms
Plate Load Impedance	5200	Ohms
Plate Current (Zero Signal)	48	Ma.
Grid 2 Current (Zero Signal)	5.5	Ma.
Transconductance	11300	μmhos
Plate Resistance	38000	Ohms
Amplification Factor (Grid 2 to Grid 1)	19	–
Power Output	5.7	Watts
Distortion (Total Harmonic)	10	Percent





PUSH-PULL CLASS AB AMPLIFIER

TYPICAL OPERATING CHARACTERISTICS

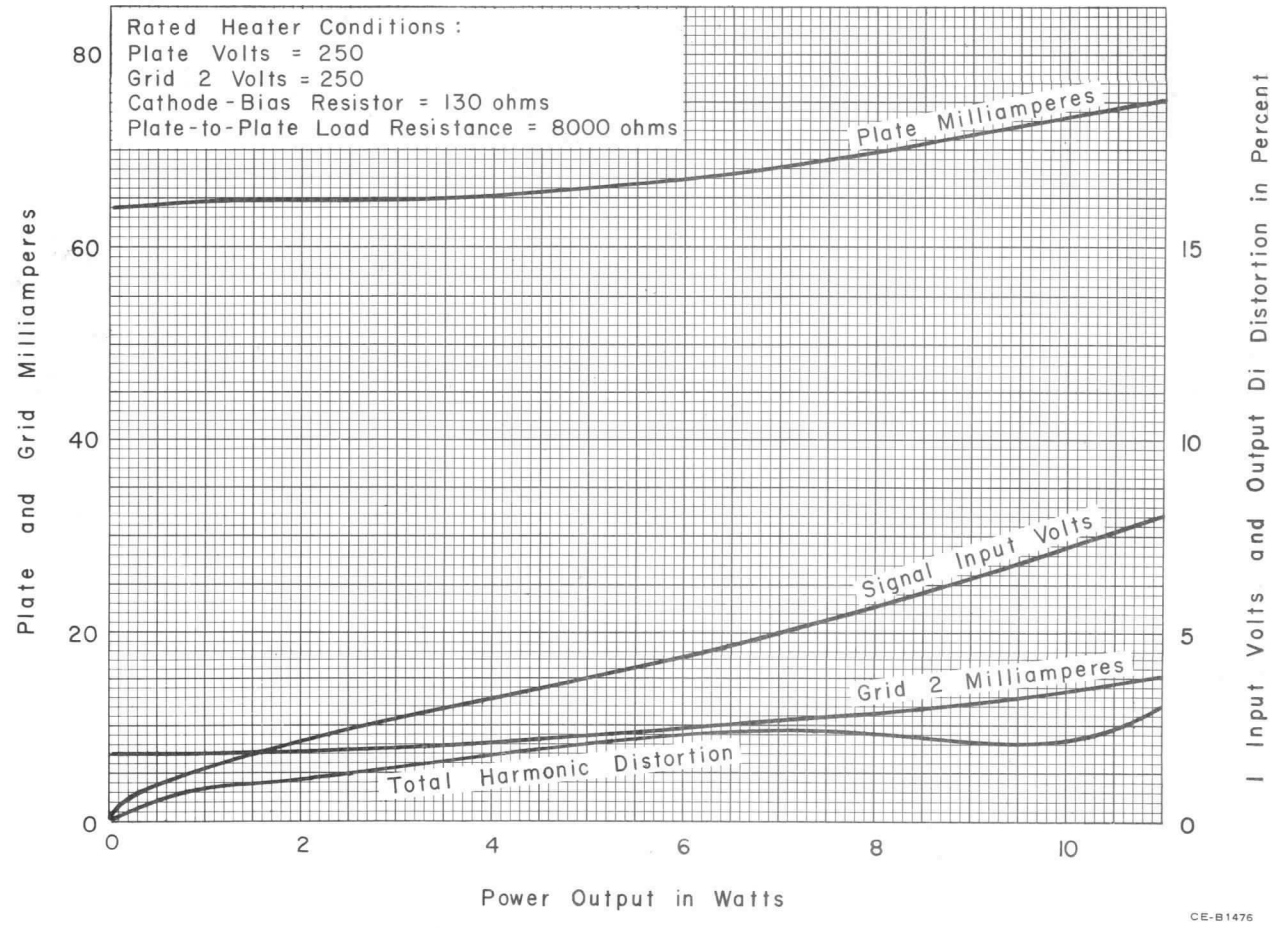
Plate Voltage	250	300	Volts
Grid 2 Voltage	250	300	Volts
Common Cathode Bias Resistor	130	130	Ohms
Plate-to-Plate Load Impedance	8000	8000	Ohms
RMS Input AF Voltage	8	10	Volts
Plate Current (Zero Signal)	62	72	Ma.
Plate Current (Max. Signal)	75	92	Ma.
Grid 2 Current (Zero Signal)	7	8	Ma.
Grid 2 Current (Max. Signal)	15	22	Ma.
Power Output	11	17	Watts
Total Harmonic Distortion	3	4	Percent

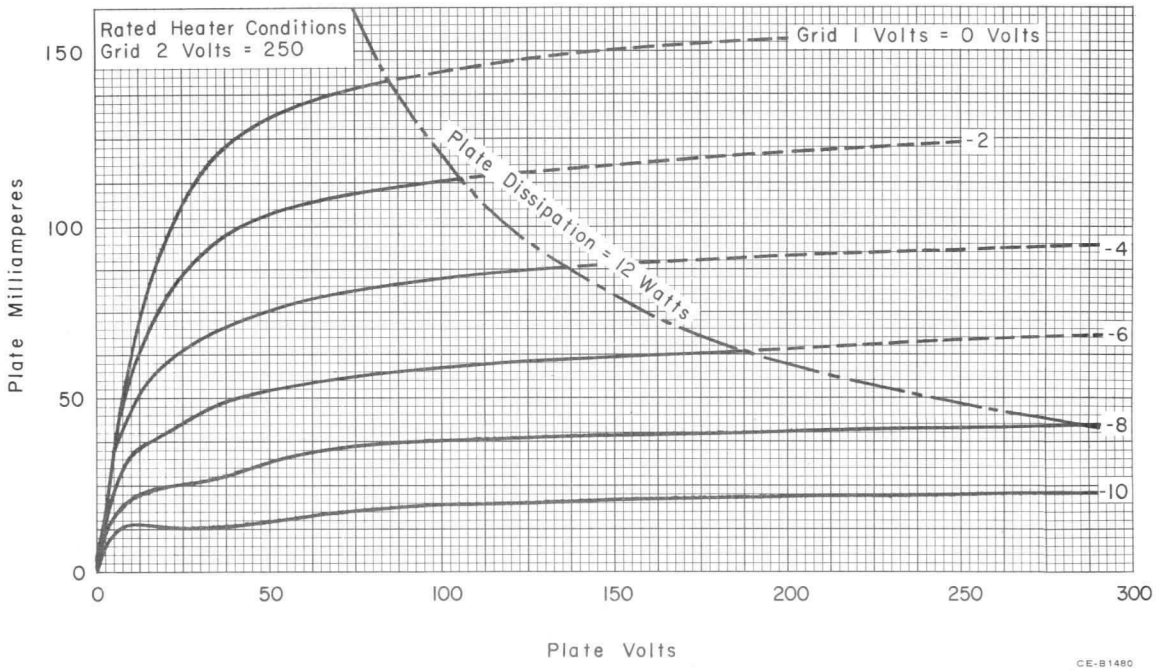
PUSH-PULL CLASS B AMPLIFIER

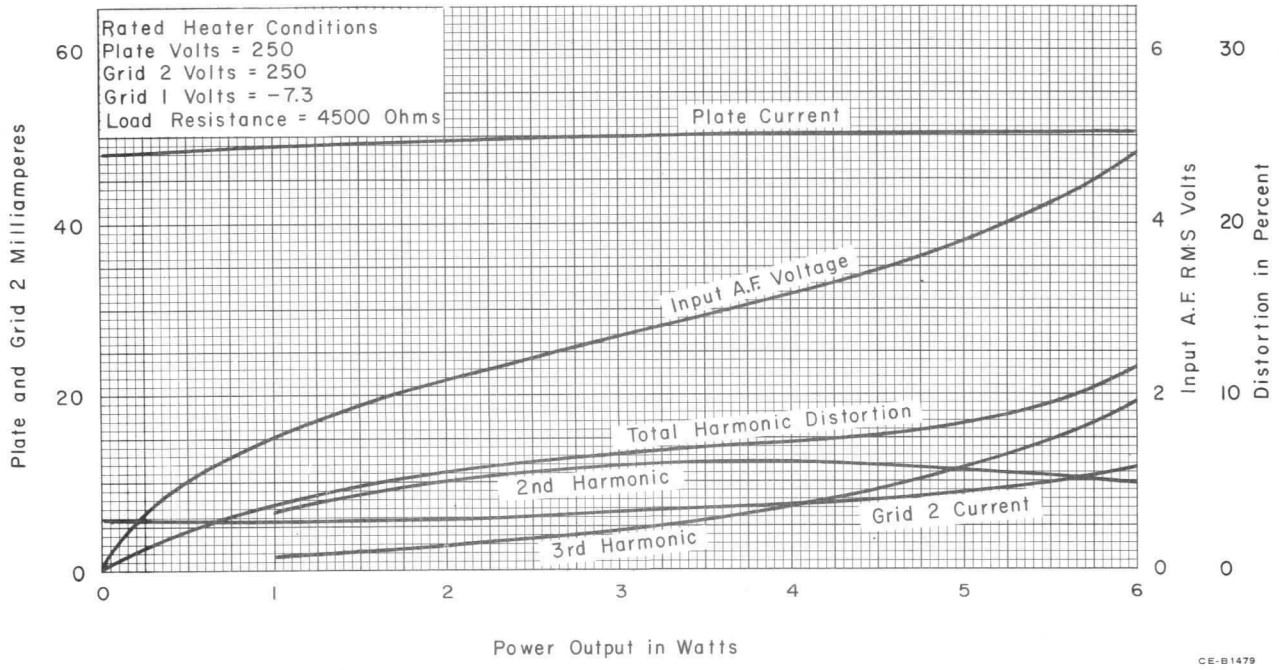
TYPICAL OPERATING CHARACTERISTICS

Plate Voltage	250	300	Volts
Grid 2 Voltage	250	300	Volts
Grid 1 Bias Voltage	-11.6	-14.7	Volts
Plate-to-Plate Load Impedance	8000	8000	Ohms
RMS Input AF Voltage	8	10	Volts
Plate Current (Zero Signal)	20	15	Ma.
Plate Current (Max. Signal)	75	92	Ma.
Grid 2 Current (Zero Signal)	2.2	1.6	Ma.
Grid 2 Current (Max. Signal)	15	22	Ma.
Power Output	11	17	Watts
Total Harmonic Distortion	3	4	Percent

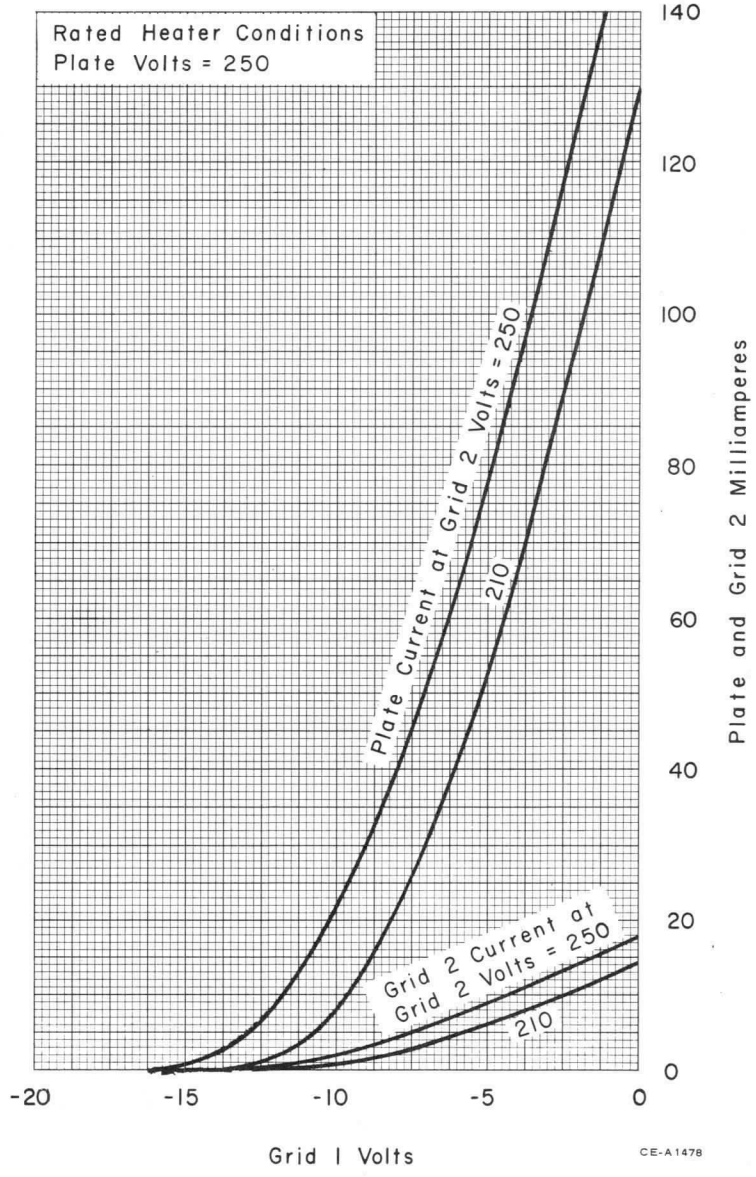
OPERATING CHARACTERISTICS
PUSH - PULL CLASS AB




Rated Heater Conditions
Grid 2 Volts = 250
Grid 1 Volts = 0 Volts
-2
-4
-6
-8
-10
Plate Dissipation = 12 Watts
Plate Milliamperes
Plate Volts
0
50
100
150
200
250
300
CE-B1480


Rated Heater Conditions
Plate Volts = 250
Grid 2 Volts = 250
Grid 1 Volts = −7.3
Load Resistance = 4500 Ohms
Plate Current
Input A.F. Voltage
Total Harmonic Distortion
2nd Harmonic
3rd Harmonic
Grid 2 Current
Plate and Grid 2 Milliamperes
Input A.F. RMS Volts
Distortion in Percent
Power Output in Watts
CE-B1479

AVERAGE TRANSFER CHARACTERISTICS



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DUAL TRIODE TYPE 6GL7

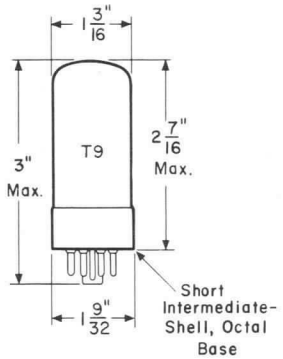
The 6GL7 is a dual triode with dissimilar sections designed for use in television receivers. High mu triode No. 1 (Pins No. 4, 5 & 6) is designed for service as a vertical deflection oscillator. Triode No. 2 (Pins No. 1, 2 & 3) is designed for operation as a high efficiency vertical deflection output amplifier and has a low mu.

ELECTRICAL

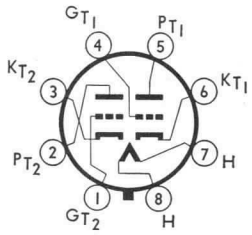
Cathodes	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	1.05		Ampere
Direct Interelectrode Capacitances (Unshielded):			
	Unit 1	Unit 2	
Grid to Plate	4.0	8.0	pf
Input	2.2	6.0	pf
Output	0.6	1.3	pf

MECHANICAL

Bulb	T-9
Base	Short Intermediate Shell Octal (JEDEC B8-58)
Outline	9-5
Basing	8BD
Mounting Position	Any



9-5



8BD

MAXIMUM RATINGS

Design Maximum Values (Note 1)

	Triode No. 1 as Vertical Deflection Oscillator	Triode No. 2 as Vertical Deflection Amplifier		
Plate Voltage	350	550	max.	Volts
Peak Positive Pulse Plate Voltage (Abs. Max.)	–	1500	max.	Volts
Peak Negative Pulse Grid Voltage	400	250	max.	Volts
Plate Dissipation (Note 2)	1.0	10	max.	Watts
Cathode Current	–	50	max.	Ma.
Peak Cathode Current	–	175	max.	Ma.
Heater-Cathode Voltage Heater Negative with Respect to Cathode				
Total DC and Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts
Grid Circuit Resistance:				
with Cathode Bias	2.2	2.2	max.	Meg.
with Fixed Bias	1.0	1.0	max.	Meg.

CHARACTERISTICS AND TYPICAL OPERATION

		Triode No. 1		Triode No. 2		
Plate Voltage	275	250	175	60	Volts
Grid Voltage	Note 3	–3	–25	0	Volts
Plate Current	13	2	46	100	Ma.
Plate Resistance	–	30000	780	–	Ohms
Transconductance	1600	2200	6400	–	μmhos
Amplification Factor	–	66	5	–	–
Grid Cutoff Voltage (Note 4)	–	–5.3	–60	–	Volts

NOTES

1. For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.
2. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
3. Adjust to 13 Ma. plate current.
4. For: Unit 1 current of 20 microamperes.
   Unit 2 current of 200 microamperes.

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Westinghouse

6GN8
8GN8

April 15, 1961

HIGH – MU TRIODE – SHARP – CUTOFF PENTODE TYPES 6GN8 AND 8GN8

The 6GN8 and 8GN8 are 9-pin miniature high-mu triode and sharp-cutoff pentode types designed for service in color and black-and-white television receivers. The triode unit is designed for service as a sync separator, sync clipper and phase inverter while the pentode unit is designed for operation as a video amplifier.

The 8GN8 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

	6GN8	8GN8		
Cathodes	Coated Unipotential			
Heater:				
Voltage (ac or dc)	6.3 ± 10%	8.0		Volts
Current	0.75	0.6 ±6%		Ampere
Warm-up Time (Approx.) ▲	--	11		Seconds
Direct Interelectrode Capacitances: (Unshielded)				
Triode:				
Grid to Plate		4.4		μμf
Input		2.4		μμf
Output		0.36		μμf
Pentode:				
Grid 1 to Plate		0.1	max.	μμf
Input		11		μμf
Output		4.2		μμf
Coupling:				
Pentode Grid 1 to Triode Plate		.005	max.	μμf
Pentode Plate to Triode Grid		0.018	max.	μμf
Pentode Plate to Triode Plate		0.17	max.	μμf

MECHANICAL:

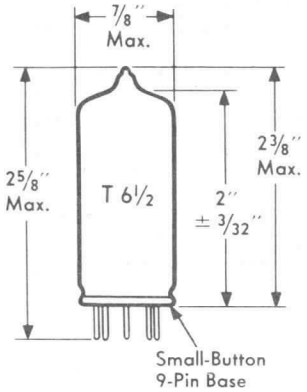
Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9DX
Mounting Position	Any

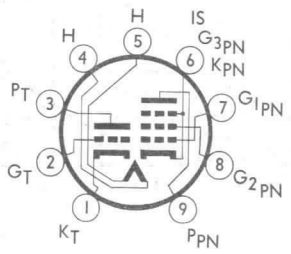
MAXIMUM RATINGS:
Design Maximum Values ♦

	Triode	Pentode		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	--	330	max.	Volts
Grid 2 Voltage	--	See CE-A825		
Plate Dissipation	1.0	5	max.	Watts
Grid 2 Dissipation	--	1.1	max.	Watts
Positive Grid 1 Bias Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

	Triode	Pentode		
Plate Voltage	250	60	200	Volts
Grid 2 Voltage	--	150	150	Volts
Grid 1 Voltage	-2	0	--	Volts
Cathode Bias Resistor	--	--	100	Ohms
Amplification Factor	100	--	--	
Plate Resistance (Approx.)	37000	--	60000	Ohms
Transconductance	2700	--	11500	μmhos
Plate Current	2	55★	25	Ma.
Grid 2 Current	--	18★	5.5	Ma.
Grid 1 Voltage	-5⊕		-10□	Volts





9DX

▲ Heater Warm-Up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

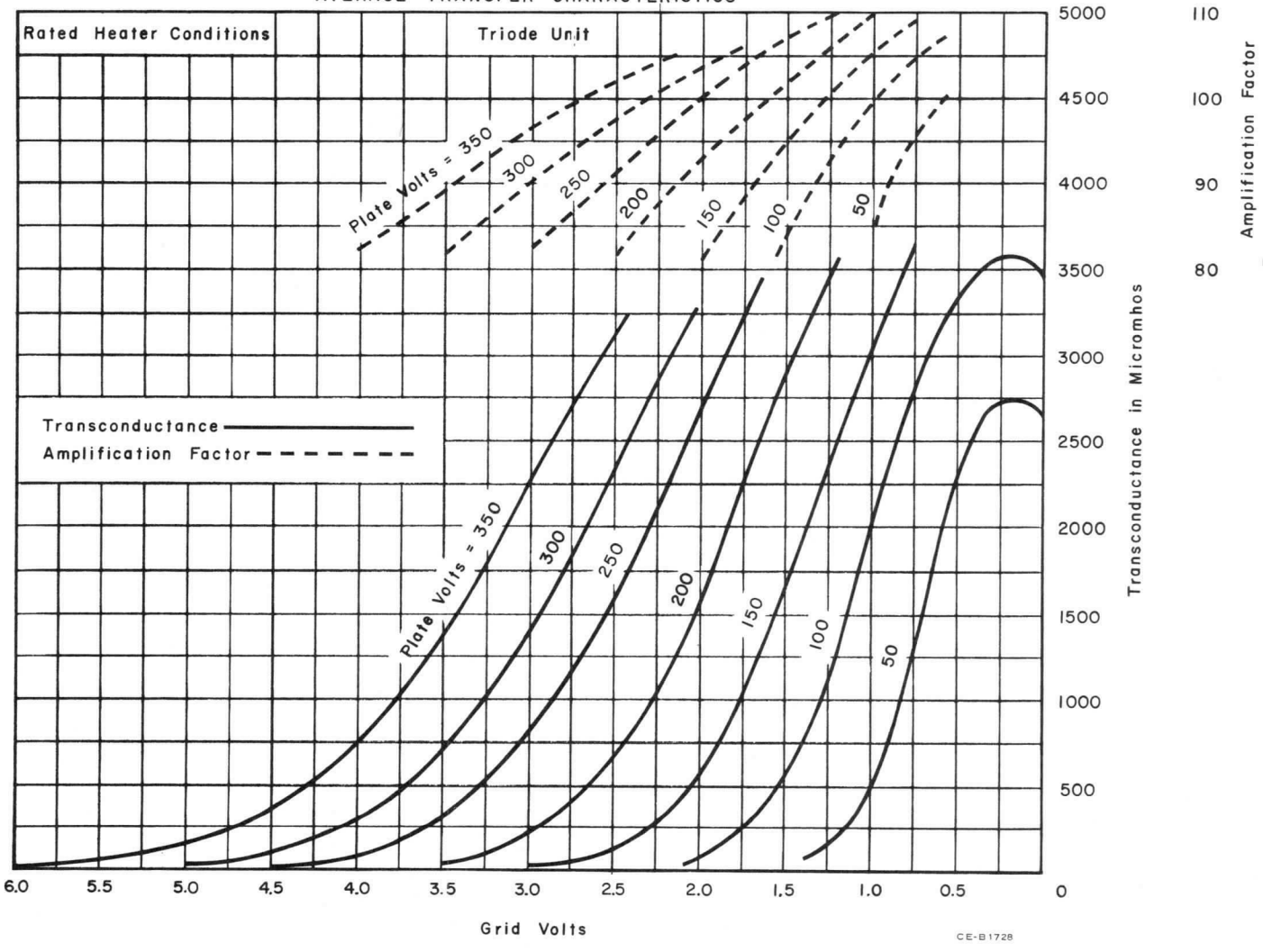
★ These values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

⊕ For plate current of 20 microamperes.

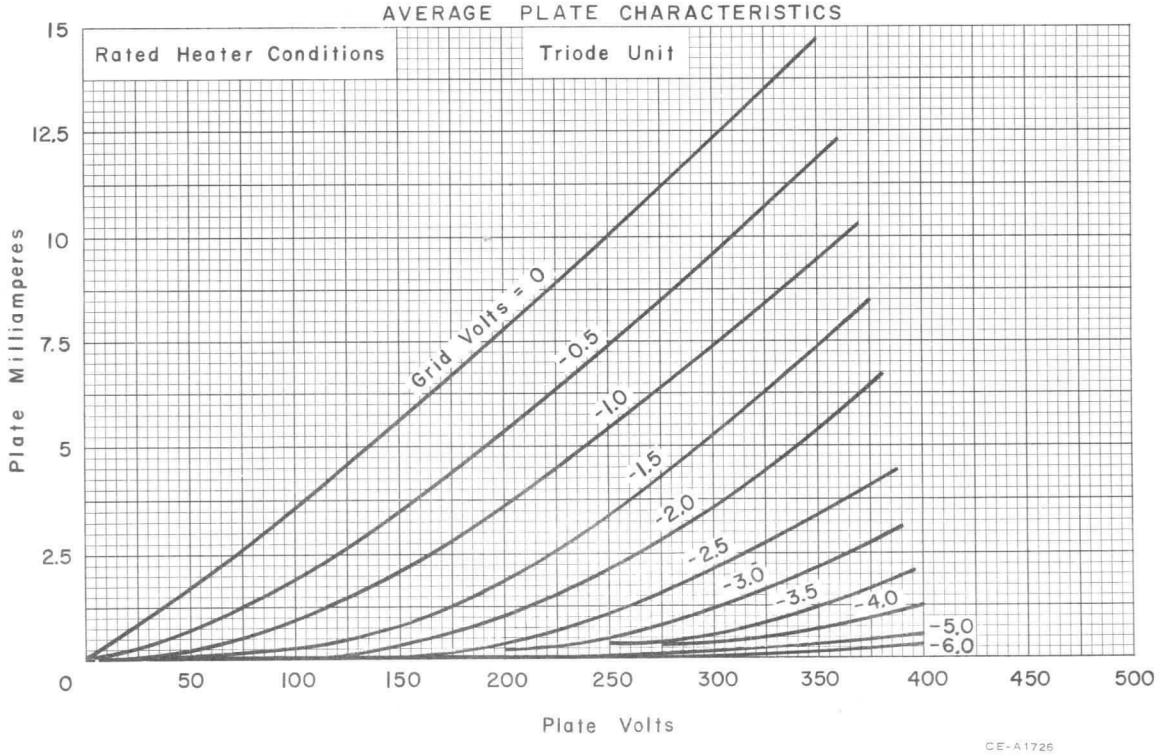
□ For plate current of 100 microamperes.

♦ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions. The tube manufacturer chooses these values to provide acceptable serviceability of the tube, talking responsibility for the effects of changes in operating conditions due to variations in tube characteristics. The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

AVERAGE TRANSFER CHARACTERISTICS

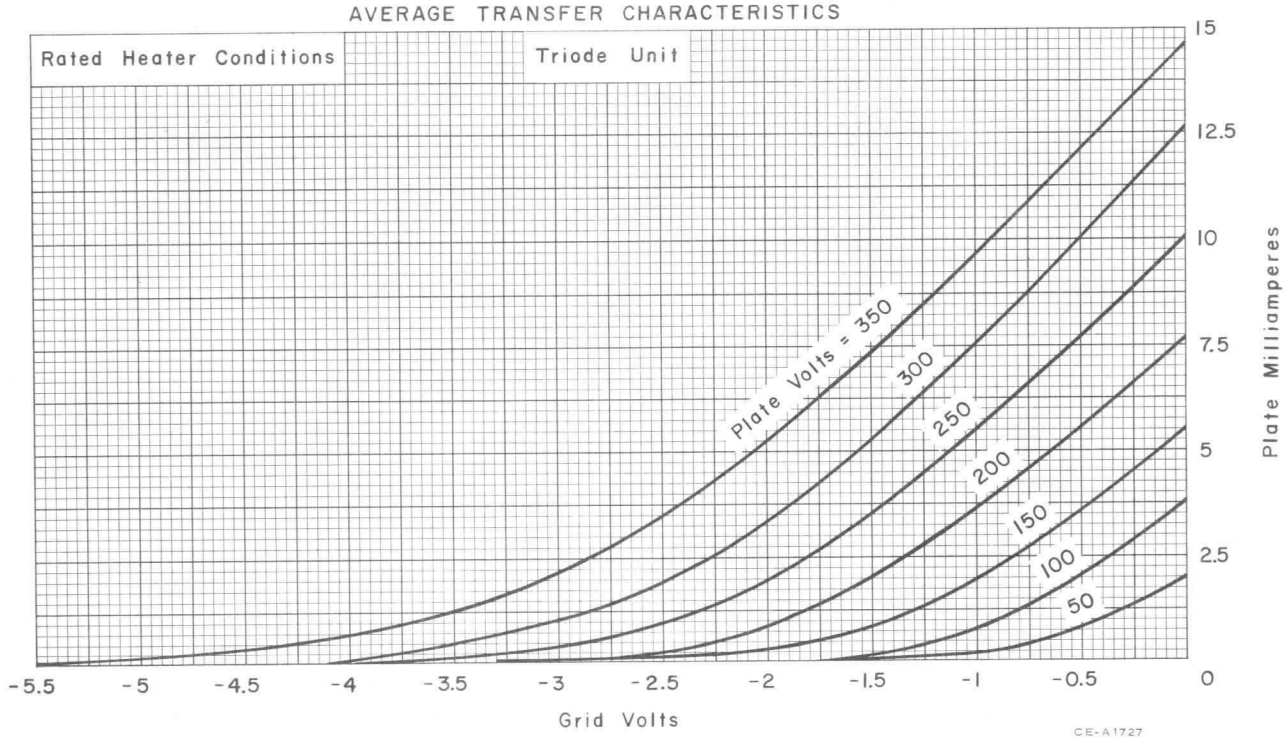


AVERAGE PLATE CHARACTERISTICS



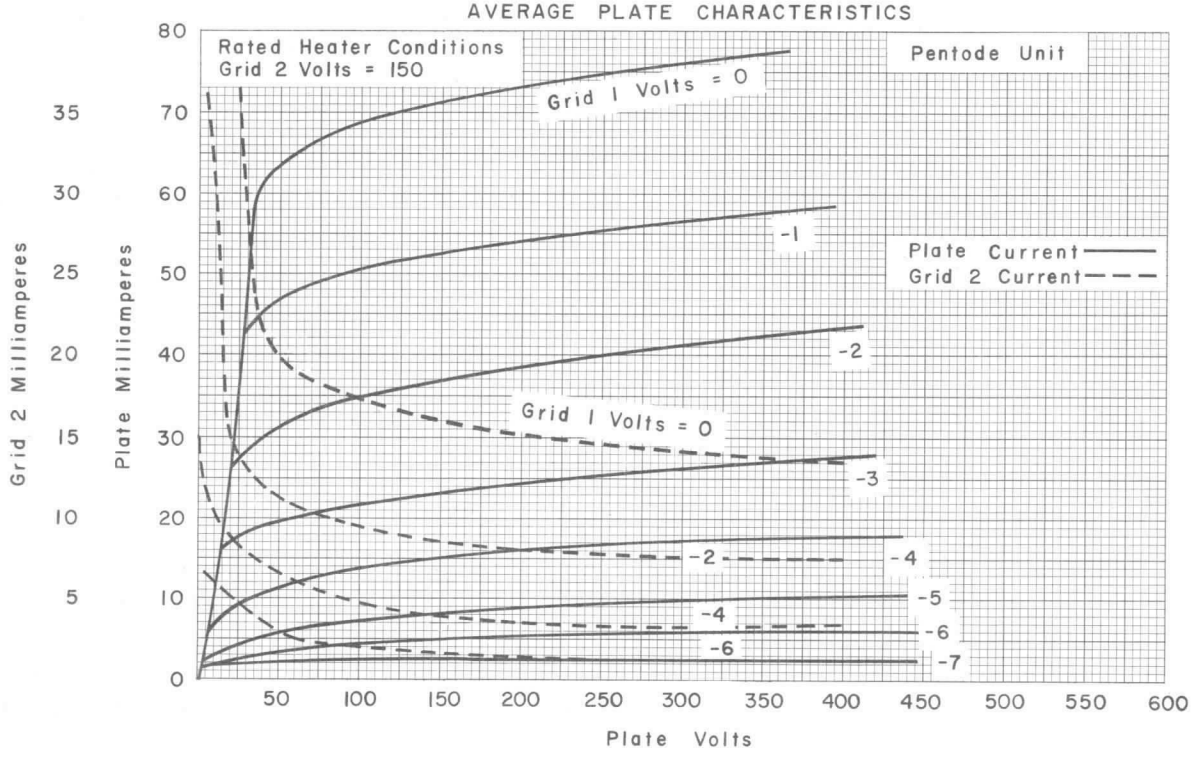
CE-A1726

AVERAGE TRANSFER CHARACTERISTICS



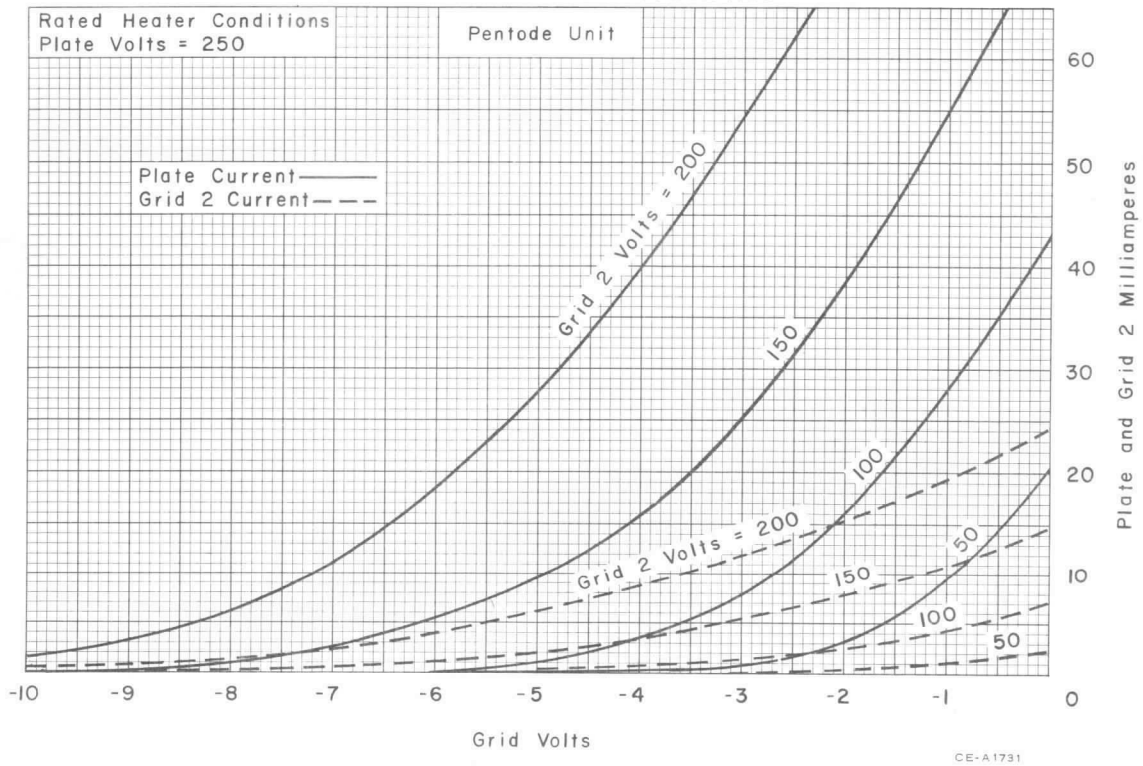
CE-A1727

AVERAGE PLATE CHARACTERISTICS



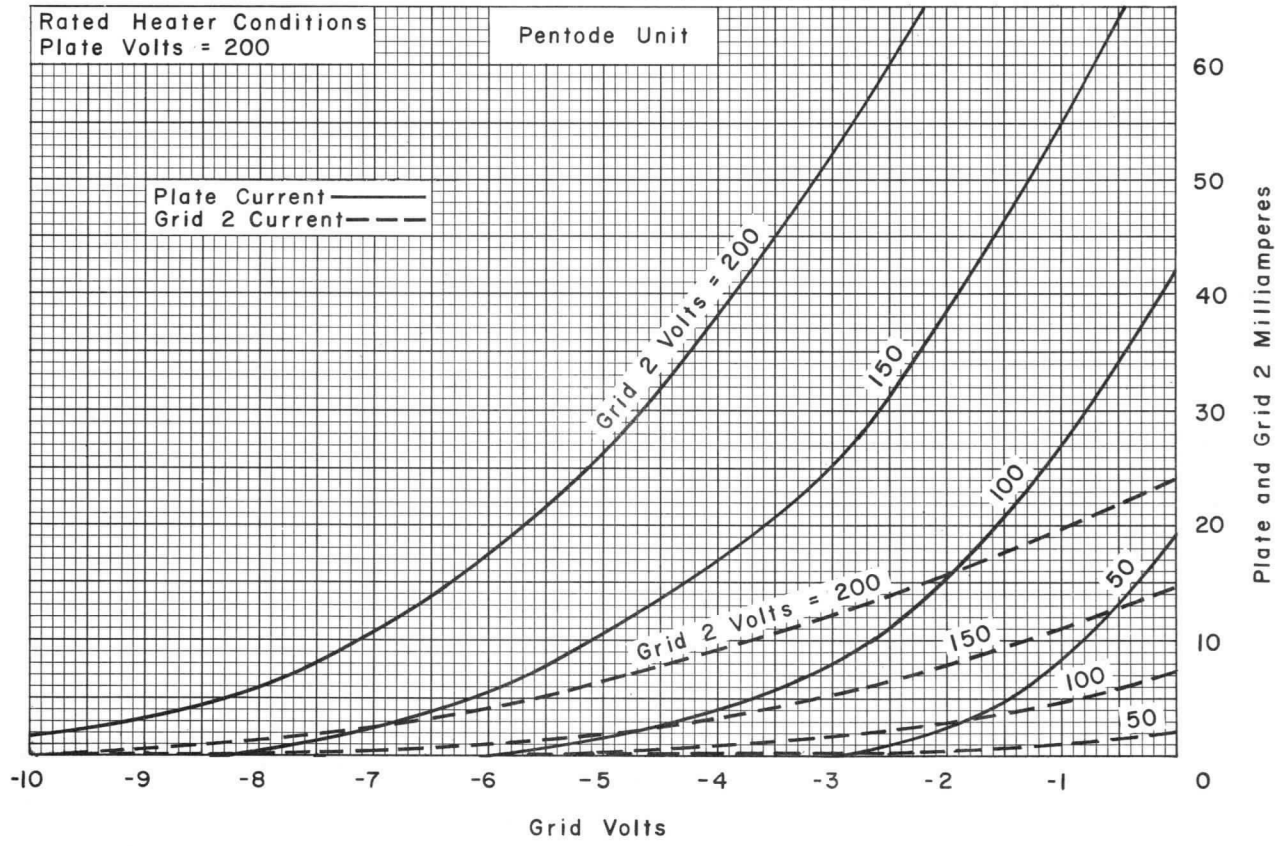
CE-A1729

AVERAGE TRANSFER CHARACTERISTICS



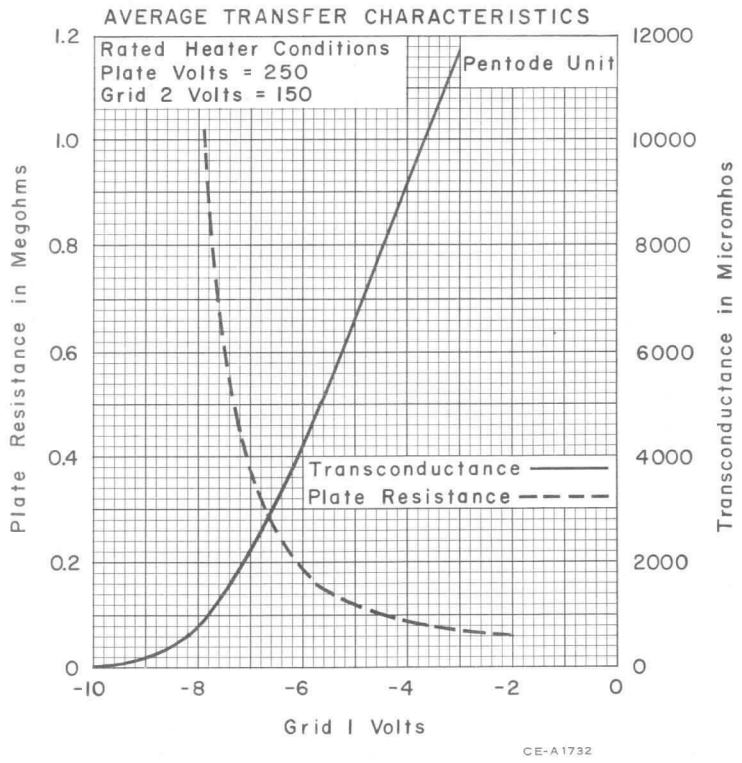
CE-A1731

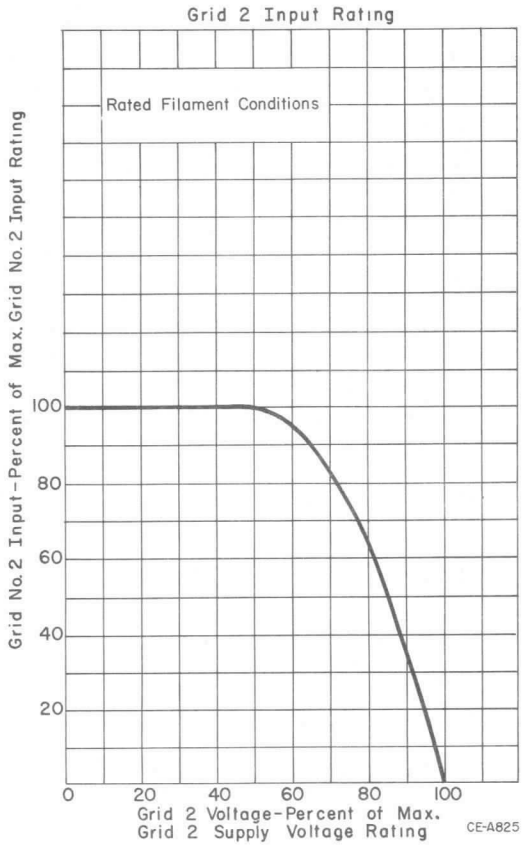
AVERAGE TRANSFER CHARACTERISTICS



CE-A1730

Westinghouse





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TWIN TRIODE TYPE 6GU7

The 6GU7 is a 9-Pin miniature medium-mu twin triode type designed for service in matrixing circuits of color television receivers. Its applications also include multivibrators, synchronizing amplifiers, oscillators, mixers, and industrial controls. The tube has separate cathode terminals for each triode.

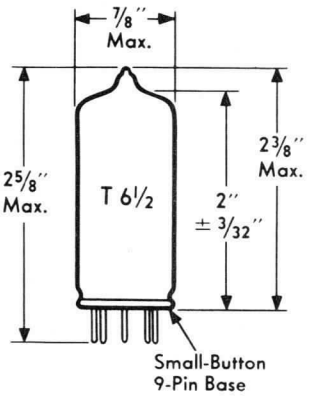
The 6GU7 has been designed for use in receivers which employ series-connected heaters. When it is employed in this type of circuit heater voltage surges are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL

Cathodes	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3		Volts
Current	0.60±0.04		Ampere
Warm Up-Time (Note 1)	11		Seconds
Direct Interelectrode Capacitances (Unshielded):			
	Unit 1	Unit 2	
Grid to Plate	3	3	pF
Input	3.4	3.6	pF
Output	0.44	0.34	pF
Plate Unit 1 to Plate Unit 2	1		pF

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	EIA 6-3
Basing	EIA 9LP
Mounting Position	Any



CLASS A AMPLIFIER

MAXIMUM RATINGS PER UNIT

Design Maximum Values

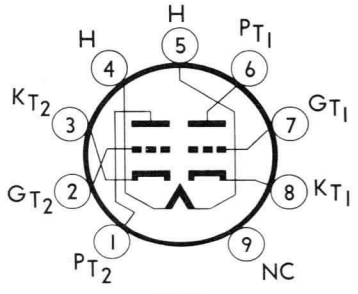
Plate Voltage	330 max.	Volts
Positive Grid Voltage	0 max.	Volts
Plate Dissipation	3 max.	Watts
Heater-Cathode Voltage:		
Heater Positive with Respect to Cathode:		
DC Component	100 max.	Volts
Total DC and Peak	200 max.	Volts
Heater Negative with Respect to Cathode:		
Total DC and Peak	200 max.	Volts
Grid Circuit Resistance:		
Fixed Bias	1.0 max.	Megohm

TYPICAL OPERATING CHARACTERISTICS

Plate Voltage	250	Volts
Grid Voltage	−10.5	Volts
Amplification Factor	17	–
Plate Resistance (Approx.)	5500	Ohms
Transconductance	3100	μmhos
Plate Current	11.5	mA
Plate Current at EC1 = −14	4	mA
Grid Cutoff Bias (Note 2)	−23	Volts

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For plate current of 50 microamperes.



9LP

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Westinghouse

6GW6
12GW6
17GW6

September 15, 1962

HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6GW6, 12GW6 AND 17GW6

The 6GW6, 12GW6 and 17GW6 are octal based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero bias plate current, high plate current to grid 2 current ratio and high DC plate supply voltage ratings. These features with a plate dissipation rating of 17.5 watts make this tube especially desirable for its designed service.

The 12GW6 and 17GW6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential			
Filament:	6GW6	12GW6	17GW6	
Voltage (ac or dc)	6.3 ± 10%	12.6	16.8	Volts
Current	1.20	0.60 ±6%	0.45 ±6%	Ampere
Warm-up Time (Note 1)	–	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid to Plate	0.5			μμf
Input	17			μμf
Output	7			μμf

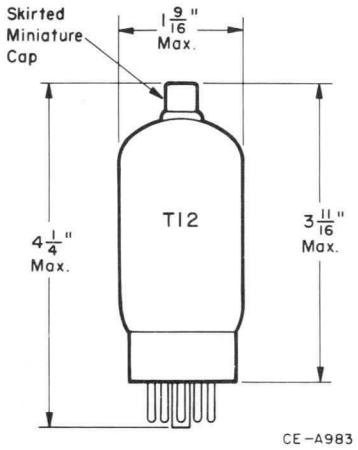
MECHANICAL

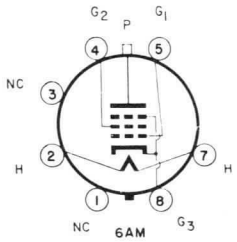
Bulb	T-12
Base	Short Medium Shell Octal (JEDEC B6-122)
Basing	6AM
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER (Note 2)

MAXIMUM RATINGS
Design Maximum Values

D.C. Plate Supply Voltage (Boost + D.C. Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Plate Dissipation (Note 3)	17.5	max.	Watts
Peak Negative Grid 1 Voltage	330	max.	Volts
D.C. Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.5	max.	Watts
Average Cathode Current	175	max.	Ma.
Peak Cathode Current	550	max.	Ma.
Grid 1 Circuit Resistance (Note 4)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	240	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts





AVERAGE CHARACTERISTICS

PENTODE OPERATION

Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	−22.5	Volts
Plate Current	70	Ma.
Grid 2 Current	2.1	Ma.
Transconductance	7100	μmhos
Plate Resistance	15000	Ohms

ZERO BIAS

Plate Voltage (Note 5)	60	Volts
Grid 2 Voltage (Note 5)	150	Volts
Plate Current (Note 6)	390	Ma.
Grid 2 Current (Note 6)	32	Ma.

CUTOFF

Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Plate Current	1	Ma.
Grid 1 Voltage (Approx.)	−42	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	150	Volts
Grid 2 Voltage	Connected to plate	
Grid 1 Voltage	−22.5	Volts
Amplification Factor	4.4	–

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.
3. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
4. Using grid-leak bias.
5. Applied for short interval (maximum of 2 seconds) so as not to damage tube.
6. These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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Westinghouse®

4GX7
5GX7
6GX7
8GX7

August 1, 1964

TRIODE & FRAME-GRID PENTODE CONVERTER
TYPES 4GX7, 5GX7, 6GX7 AND 8GX7

The 4GX7, 5GX7, 6GX7 and 8GX7 are medium-mu triode and sharp-cutoff frame-grid pentode types designed for oscillator-mixer service in V.H.F. television tuners. The pentode section features high transconductance and low grid 1-to-plate capacitance to ensure high gain with good stability in amplifier operation.

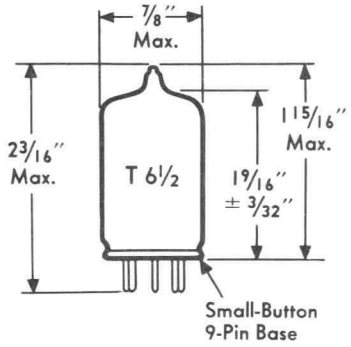
The 4GX7, 5GX7 and 8GX7 feature controlled heater warm-up time and render reliable service in properly designed series heater circuits.

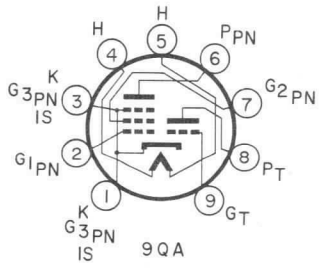
ELECTRICAL

Cathodes				Coated Unipotential	
Heater:	4GX7	5GX7	6GX7	8GX7	
Voltage	4.2	5.6	6.3	7.7	Volts
Current	0.60	0.45	0.40	0.30	Ampere
Warm-Up Time (Note 1)	11	11	–	11	Seconds
Direct Interelectrode Capacitances: Shielded (Note 2)					
Triode:					
Grid to Plate				1.2	pf
Input				2.3	pf
Output				1.9	pf
Pentode:					
Grid 1 to Plate				0.005	pf
Input				5.40	pf
Output				3.30	pf
Grid 1 to Grid 2				1.6	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9QA
Mounting Position	Any





RATINGS

Design Maximum Values

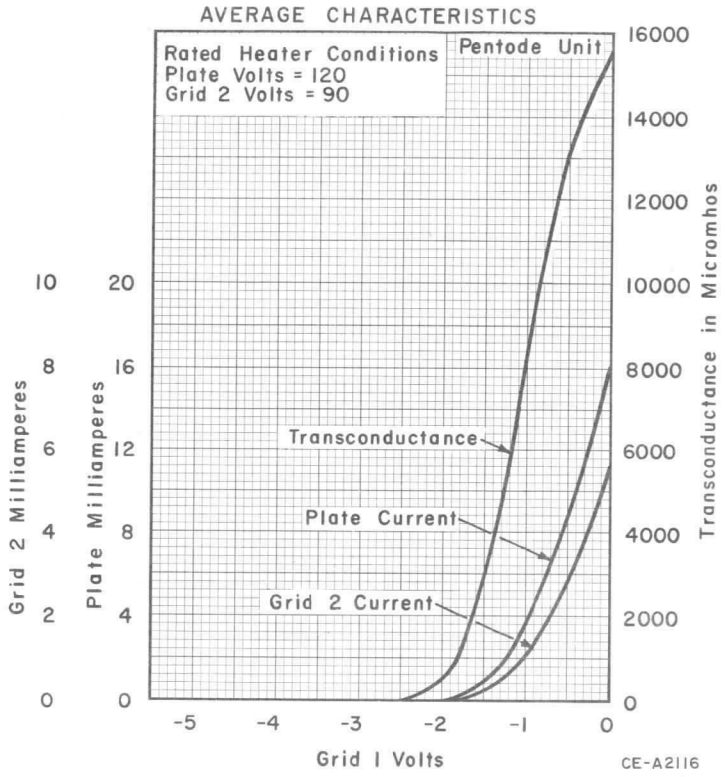
	Triode	Pentode		
Plate Voltage	275	275	max.	Volts
Grid 2 Supply Voltage	–	275	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Curve		
Plate Dissipation	1.5	2.2	max.	Watts
Grid 2 Dissipation	–	0.45	max.	Watts
Positive Grid 1 Voltage	0	0	max.	Volts
Negative Grid 1 Voltage	40	40	max.	Volts
Cathode Current	20	20	max.	Ma.
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	0.5	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

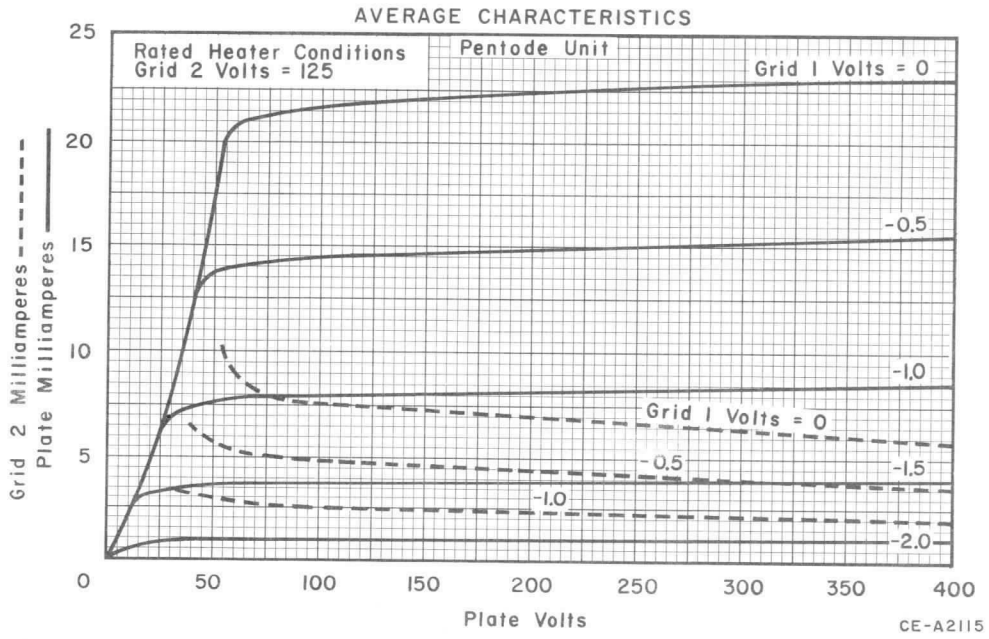
CHARACTERISTICS AND TYPICAL OPERATION

Triode Unit:			
Plate Voltage	100	125	Volts
Grid Voltage	–	–1.0	Volts
Grid Circuit Resistance	0.1	–	Megohm
Amplification Factor	–	40	–
Plate Resistance	–	4700	Ohms
Transconductance	8700	8500	μmhos
Plate Current	12.5	13	Ma.
Grid Cutoff Voltage (Note 3)	–6.0	–	Volts
Pentode Unit:			
Plate Voltage	120	125	Volts
Grid 2 Voltage	90	125	Volts
Grid 1 Voltage	–	–1.0	Volts
Grid 1 Circuit Resistance	0.1	–	Megohms
Plate Resistance	–	200000	Ohms
Transconductance	13000	11000	μmhos
Plate Current	8.5	8.0	Ma.
Grid 2 Current	2.8	2.5	Ma.
Grid 1 Cutoff Voltage (Note 3)	–2.5	–	Volts

NOTES

1. Heater Warm-Up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. With external shield connected to cathode.
3. For a plate current of 20 microamperes.


AVERAGE CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 120
Grid 2 Volts = 90
Pentode Unit
Transconductance
Plate Current
Grid 2 Current
Grid 2 Milliamperes
Plate Milliamperes
Transconductance in Micromhos
Grid 1 Volts
CE-A2116


AVERAGE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Pentode Unit
Grid 1 Volts = 0
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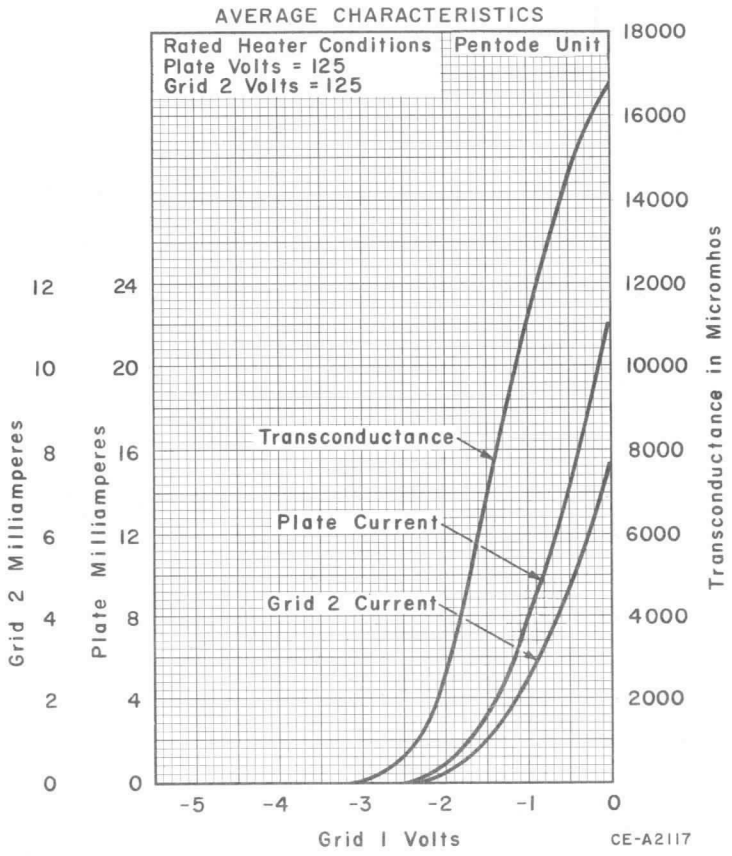
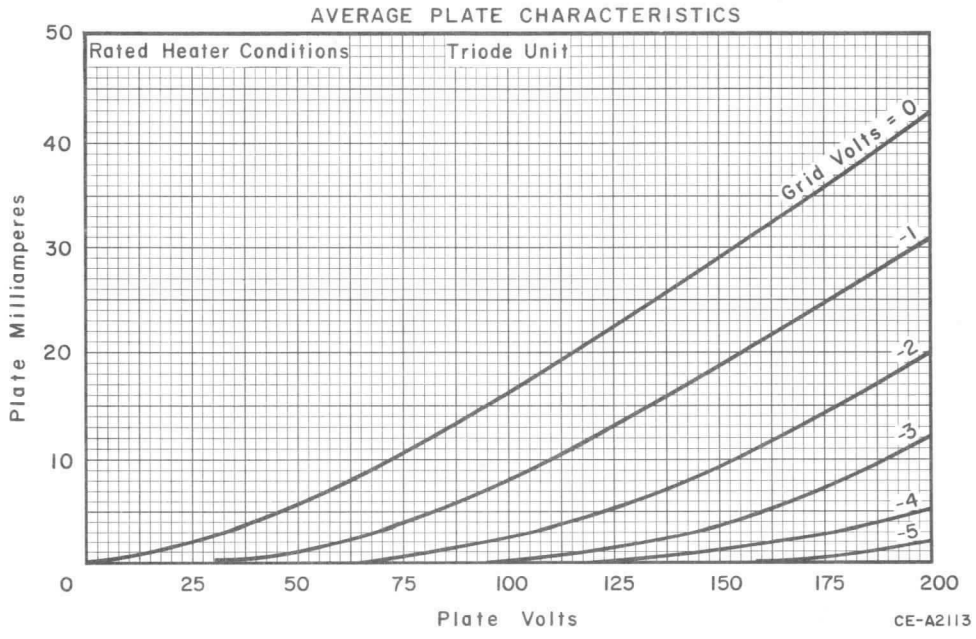
-1.0
-1.5
-2.0
Grid 2 Milliamperes
Plate Milliamperes
Plate Volts
CE-A2115


AVERAGE CHARACTERISTICS
Rated Heater Conditions
Pentode Unit
Plate Volts = 125
Grid 2 Volts = 125
Transconductance
Plate Current
Grid 2 Current
Grid 2 Milliamperes
Plate Milliamperes
Transconductance in Micromhos
Grid 1 Volts
CE-A2117


AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Triode Unit
Grid Volts = 0
-1
-2
-3
-4
-5
Plate Milliamperes
Plate Volts
CE-A2113

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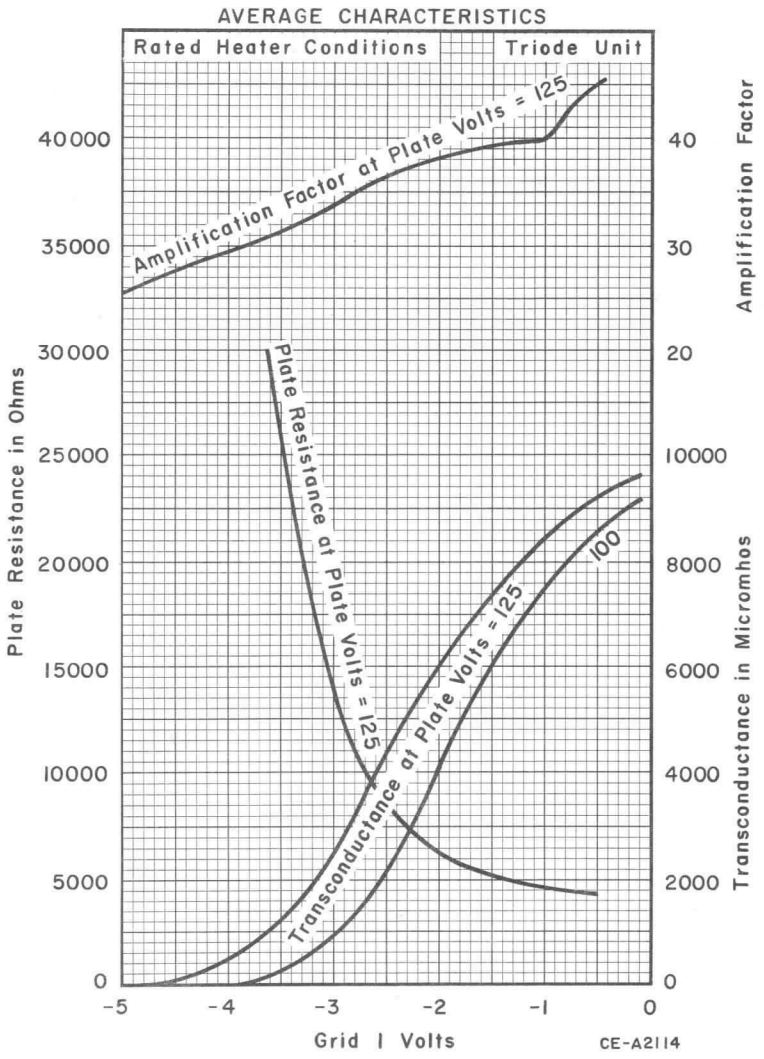

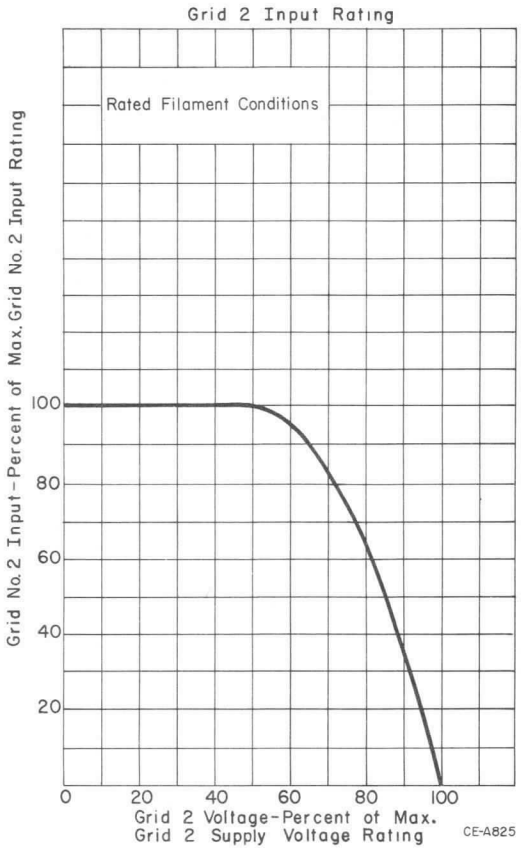

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HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6GY5 AND 21GY5

The 6GY5 and 21GY5 are 12-pin button based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers.

The 21GY5 has been designed for use in receivers which employ series connected heaters. When employed in this type of circuit, heater voltage surges are minimized because heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential		
Filament:	6GY5	21GY5	
Voltage (ac or dc)	6.3 ± 10%	21	Volts
Current	1.5	0.45 ± 6%	Ampere
Warm-up Time (Note 1)	–	11	Seconds
Direct Interelectrode Capacitances (Unshielded):			
Grid 1 to Plate	0.7		pf
Input	22		pf
Output	9		pf

MECHANICAL

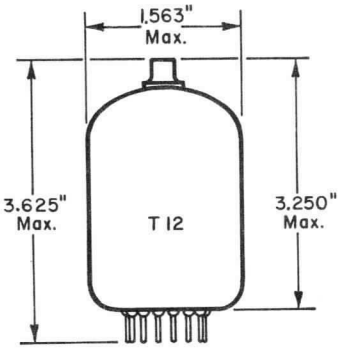
Bulb	T-12
Base	EIA E12-74
Outline	EIA 12-79
Basing	EIA 12DR
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER (Note 2)

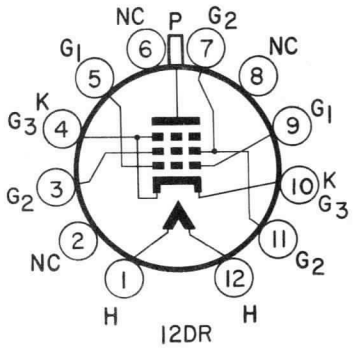
MAXIMUM RATINGS

Design Maximum Values

D.C. Plate Supply Voltage (Boost + D. C. Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Plate Dissipation (Note 3)	18	max.	Watts
Negative D.C. Grid 1 Voltage	55	max.	Volts
Peak Negative Grid 1 Voltage	330	max.	Volts
D.C. Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.5	max.	Watts
Average Cathode Current	230	max.	mA
Peak Cathode Current	800	max.	mA
Grid 1 Circuit Resistance (Note 4)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



12-79



12DR

AVERAGE CHARACTERISTICS

PENTODE OPERATION

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Grid 1 Voltage	−20	Volts
Plate Current	50	Ma.
Grid 2 Current	1.75	Ma.
Transconductance	9100	μmhos
Plate Resistance	11000	Ohms

ZERO BIAS

Plate Voltage (Note 5)	60	Volts
Grid 2 Voltage (Note 5)	130	Volts
Plate Current (Note 6)	410	Ma.
Grid 2 Current (Note 6)	24	Ma.

CUTOFF

Plate Voltage	130	5000	Volts
Grid 2 Voltage	130	130	Volts
Plate Current	1	1	Ma.
Grid 1 Voltage (Approx.)	−33	−66	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Grid 1 Voltage	−20	Volts
Amplification Factor	4.7	–

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.
3. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
4. Using grid-leak bias.
5. Applied for short interval (maximum of 2 seconds) so as not to damage tube.
6. These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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2HA5
3HA5
4HA5
6HA5

April 1, 1964

SHARP–CUTOFF TRIODE TYPES 2HA5, 3HA5, 4HA5 AND 6HA5

The 2HA5, 3HA5, 4HA5 and 6HA5 are sharp-cutoff, seven-pin miniature triode types designed particularly for service in V.H.F. television tuners as grounded cathode r-f amplifiers.

The 2HA5, 3HA5 and 4HA5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Heater Characteristics:	2HA5	3HA5	4HA5	6HA5	
Voltage (ac or dc)	2.4	2.9	4.0	6.3	Volts
Current	0.60	0.45	0.30	0.185	Ampere
Warm-up Time (Note 1)	11	11	11	–	Seconds

Direct Interelectrode Capacitance: (Shielded) (Note 2)

Grid 1 to Plate	0.34 max.	pf
Input	4.5	pf
Output	3.0	pf
Heater to Cathode	2.5	pf

MECHANICAL

Cathode	Coated Unipotential
Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-1
Basing	7GM
Mounting Position	Any

CHARACTERISTICS & TYPICAL OPERATION

Plate Voltage	120	135	Volts
Grid Voltage	0	–1	Volts
Grid Resistance	100000	–	Ohms
Transconductance	18000	14500	μmhos
Grid Cutoff Bias	(Note 3)	(Note 4)	–
Plate Current	15	12.5	Ma.
Amplification Factor	82	78	–
Hot Input Resistance (Note 5)	–	1000	Ohms
Hot Input Capacitance (Note 5)	–	8.5	pf
Noise Figure (Note 6)	4.0	4.2	db

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield No. 316 connected to Pin 2.
3. Grid volts = –5.1 for transconductance of 150 micromhos.
4. Grid Volts for gm = 150 μmhos: –4.2
   Grid Volts for gm = 1500 μmhos: –2.5
5. Measured at 200 Mc. with plate at signal ground.
6. In a 200 Mc. noise-matched, optimized, neutralized, grounded-cathode triode amplifier stage.

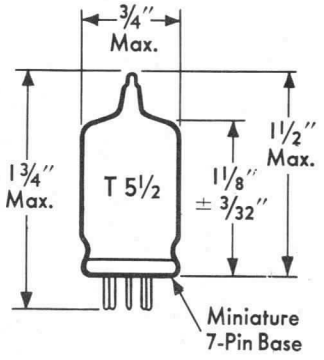
RATINGS

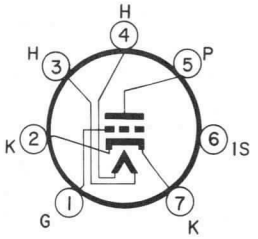
Design Maximum Values

Plate Voltage	200 max.	Volts
Plate Dissipation	2.6 max.	Watts
Grid Voltage:		
Negative Value	50 max.	Volts
Cathode Current	20 max.	Ma.
Grid Circuit Resistance (Self Bias)	1.0 max.	Megohm

Heater Ratings:

Allowable Heater Voltage:	2HA5	3HA5	4HA5	6HA5	
Maximum	–	–	–	6.9 max.	Volts
Minimum	–	–	–	5.7 min.	Volts
Allowable Heater Current:					
Maximum	640	480	320	– max.	Ma.
Minimum	560	420	280	– min.	Ma.
Heater-Cathode Voltage:					
Heater Negative with Respect to Cathode DC	100	100	100	100 max.	Volts
Heater Positive with Respect to Cathode DC	100	100	100	100 max.	Volts





7GM

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Receiving Tube

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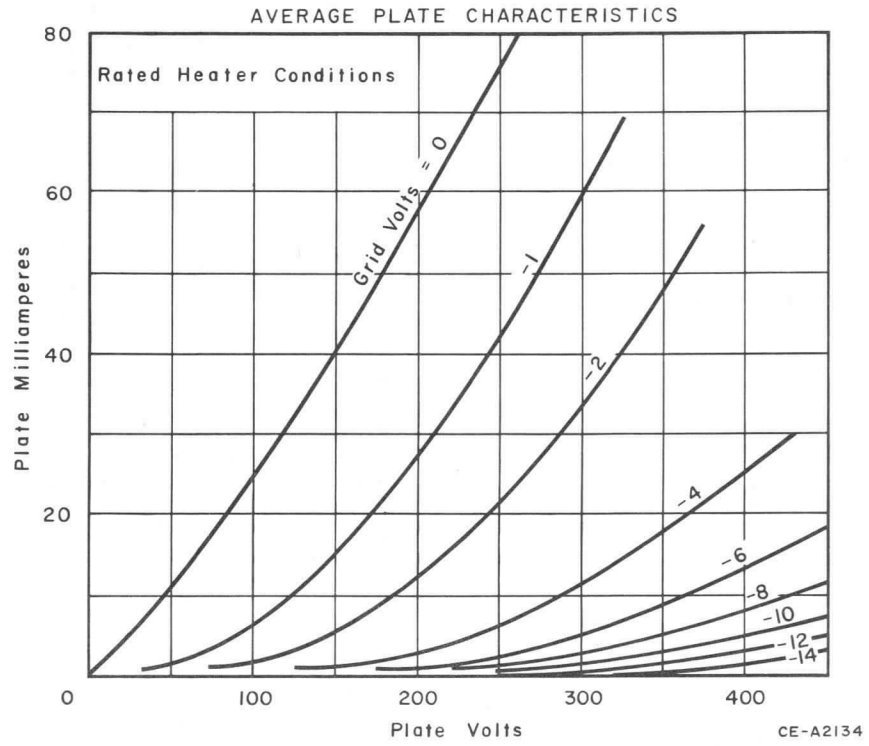
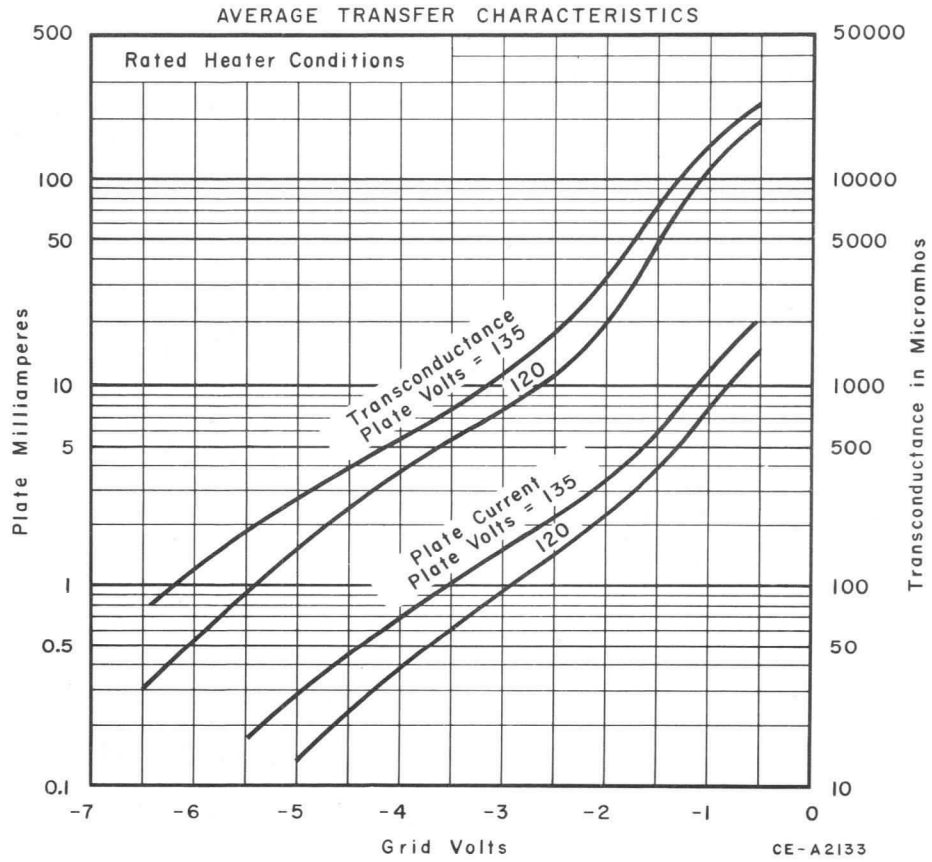

AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid Volts = 0
-1
-2
-4
-6
-8
-10
-12
-14
Plate Milliamperes
80
60
40
20
0
100
200
300
400
Plate Volts
CE-A2134


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Transconductance
Plate Volts = 135
120
Plate Current
Plate Volts = 135
120
Plate Milliamperes
500
100
50
10
5
1
0.5
0.1
50000
10000
5000
1000
500
100
50
10
Transconductance in Micromhos
-7
-6
-5
-4
-3
-2
-1
0
Grid Volts
CE-A2133

Westinghouse

5HB7
6HB7

January 15, 1965

TRIODE-PENTODE CONVERTER TYPES 5HB7 AND 6HB7

The 5HB7 and 6HB7 are 9-Pin miniature medium-mu triode and sharp-cutoff pentode types designed for service as combined oscillator and mixer in television receiver tuners using an intermediate frequency of approximately 40 mc.

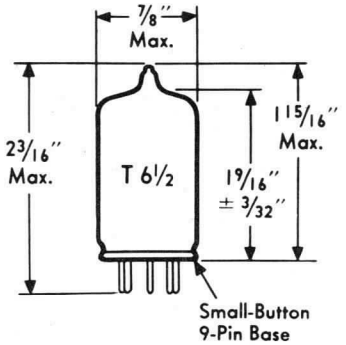
The 5HB7 and 6HB7 have been designed for use in receivers which employ series connected heaters. When each is employed in this type of circuit heater voltage surges are minimized inasmuch as the heater warm-up characteristic is controlled.

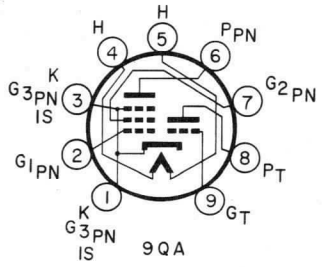
ELECTRICAL

Cathode	Coated Unipotential		
Heater:	5HB7	6HB7	
Voltage (ac or dc)	4.7	6.3	Volts
Current	0.60 ± 0.040	0.45 ± 0.030	Amperes
Warm-up Time (Note 1)	11	11	Seconds
Direct Interelectrode Capacitances:	Shielded (Note 2)		
Triode Unit:			
Grid to Plate	1.9		pF
Input	3.0		pF
Output	1.9		pF
Pentode Unit:			
Grid 1 to Plate	0.010	max.	pF
Input	5.0		pF
Output	3.4		pF
Heater to Cathode (Note 3)	3.8		pF

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	EIA 6-2
Basing	EIA 9QA
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330	max. Volts
Grid 2 (Screen) Voltage	–	See JEDEC J5-C4-2 Rating Curve	
Grid 2 Supply Voltage	–	330	max. Volts
Grid 1 (Control Grid) Voltage Positive Bias Value	0	0	max. Volts
Plate Dissipation	2.5	3.1	max. Watts
Grid 2 Input	–	0.55	max. Watt
Heater Cathode Voltage:			
Heater Positive with Respect to Cathode:			
DC Component	100	100	max. Volts
Total DC and Peak	200	200	max. Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	max. Volts

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	150	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–	–1	Volts
Cathode Bias Resistor	56	–	Ohms
Amplification Factor	40	–	–
Plate Resistance (Approx.)	5000	200000	Ohms
Transconductance	8500	6400	μmhos
Grid 1 Cutoff Bias (Note 4)	–12	–9	Volts
Plate Current	18	12	Ma.
Grid 2 Current	–	4	Ma.

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. With JEDEC shield #315 connected to Cathode of unit under test.
3. With JEDEC shield #315 connected to ground.
4. For plate current of 10 microamperes.

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Westinghouse

6HL5
12HL5
60HL5

August 1, 1964

BEAM-POWER AMPLIFIER TYPES 6HL5, 12HL5 AND 60HL5

The 6HL5, 12HL5 and 60HL5 are high perveance 9-Pin miniature beam power pentodes designed for service as the output stage in audio amplifiers. Their special feature is very high power sensitivity, resulting in low drive required for full power output.

ELECTRICAL

Cathode	Coated Unipotential			
Heater:	6HL5	12HL5	60HL5	
Voltage (ac or dc)	6.3	12.6	60	Volts
Current	0.95	0.45	0.10	Ampere

MECHANICAL

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-4
Basing	9QW
Mounting Position	Any

MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	330 max.	Volts
Grid 2 Voltage (Screen)	250 max.	Volts
Plate Dissipation	12 max.	Watts
Grid 2 Dissipation (Note 1)	2.5 max.	Watts
DC Cathode Current	110 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

MAXIMUM CIRCUIT VALUES

Grid 1 Circuit Resistance		
For Fixed Bias	0.1 max.	Megohm
For Cathode Bias	0.5 max.	Megohm

CHARACTERISTICS

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Bypassed Cathode Bias Resistor	56	Ohms
Plate Current	70	Ma.
Grid 2 Current	5	Ma.
Plate Resistance (Approx.)	7500	Ohms
Transconductance	17000	μmhos
Triode Amplification Factor	13	–
Grid 1 Cutoff Bias (Note 2)	–33	Volts

TYPICAL CLASS A AMPLIFIER OPERATION

	Cathode Bias (Note 3)	Cathode Bias (Note 4)	Fixed Bias	
Plate Voltage	130	140	140	Volts
Grid 2 Voltage	130	140	140	Volts
Grid 1 Voltage	–	–	–5.7	Volts
RMS A.F. Grid 1 Voltage	3.3	7.3	4.0	Volts
Cathode Bias Resistor	56	68	–	Ohms
Zero Signal Plate Current	70	72	71	Ma.
Zero Signal Grid 2 Current	5	4	4	Ma.
Max. Signal Plate Current	68	67	68.5	Ma.
Max. Signal Grid 2 Current	15	13.5	14.5	Ma.
Load Resistance	2000	2000	1700	Ohms
Power Output	3.0	3.5	4	Watts
Total Harmonic Distortion	8	8	9	Per Cent

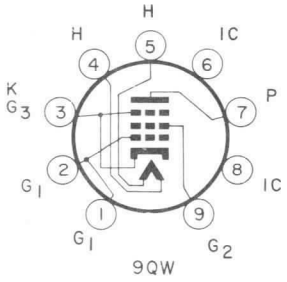
TYPICAL CLASS AB1 PUSH-PULL OPERATION

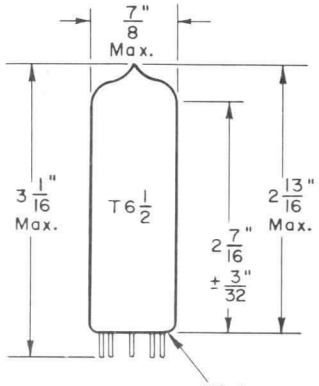
(Values are for 2 Tubes)

Plate Voltage	260	Volts
Grid 2 Voltage	130	Volts
Cathode Bias Resistor (Bypassed)	69	Ohms
Peak AF Grid 1-to-Grid 1 Voltage	16.5	Volts
Zero Signal Plate Current	90	Ma.
Zero Signal Grid 2 Current	3	Ma.
Max. Signal Plate Current	106	Ma.
Max. Signal Grid 2 Current	15	Ma.
Plate-to-Plate Load Resistance	5500	Ohms
Power Output	16.5	Watts
Total Harmonic Distortion	1.5	Per Cent

NOTES

1. Screen dissipation may be permitted to reach 4-watts during the periods of maximum input of speech and music signals.
2. For plate current of 100 microamperes.
3. Cathode resistor bypassed.
4. Cathode resistor not bypassed.





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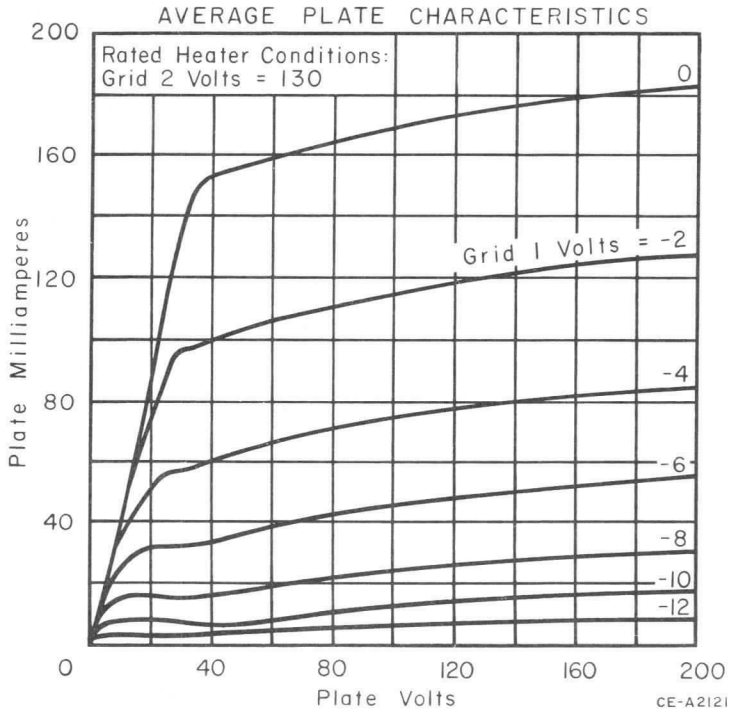
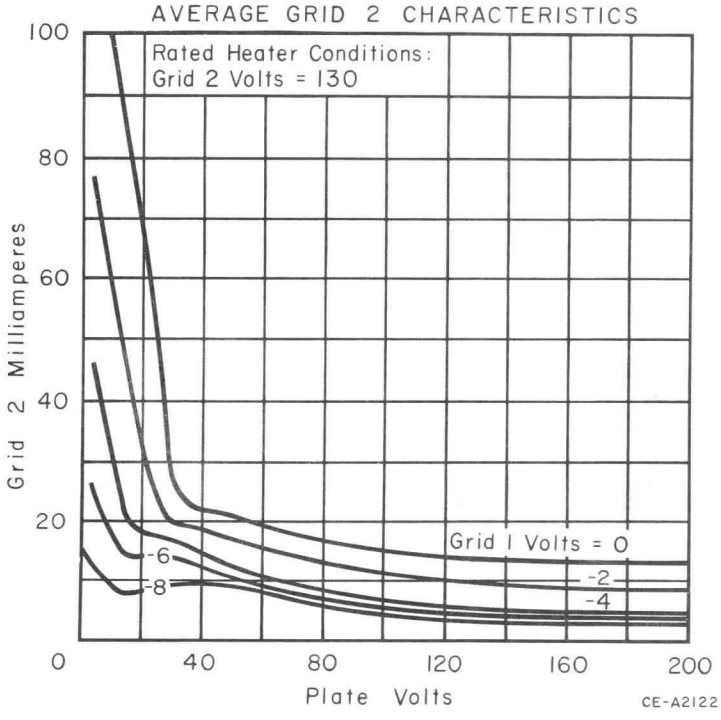
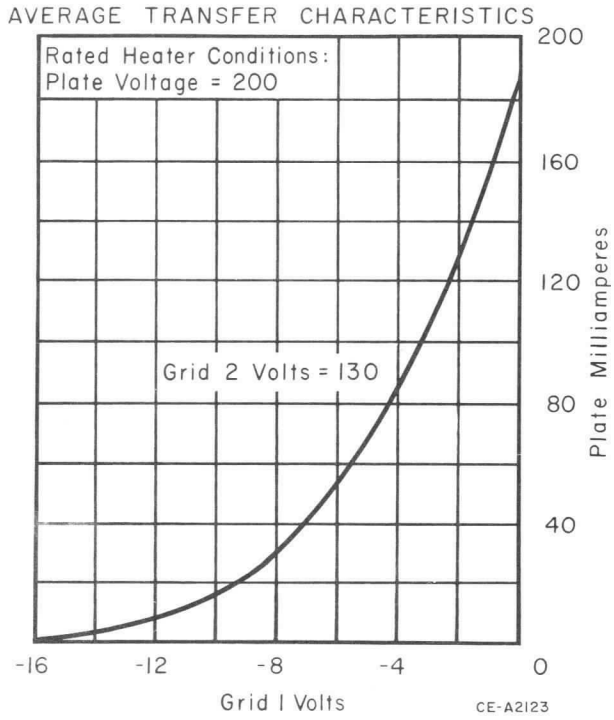
Receiving Tube Section

Westinghouse







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December 15, 1963

MEDIUM-MU TRIODE-SHARP-CUTOFF PENTODE TYPE 6HL8

The 6HL8 is a 9-Pin miniature medium-mu triode and sharp-cutoff pentode type designed for service in color television receivers. The triode unit is suitable for sync separator or low frequency oscillator or amplifier applications. The high-gm pentode unit can serve well as an I.F. or video amplifier.

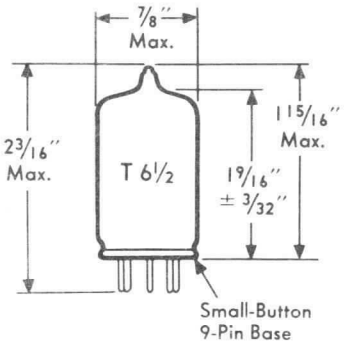
The 6HL8 has a heater designed to perform well in either series or parallel circuits. When connected in parallel, heater voltage must be maintained within specified limits. When series connected, heater current must be controlled.

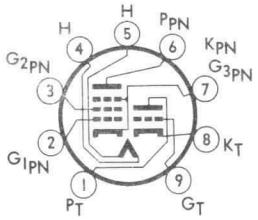
ELECTRICAL

Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage (ac or dc)	6.3	6.3 ± 10%	Volts
Current	0.60 ± 6%	0.60	Ampere
Warm-Up Time (Note 1)	11	–	Seconds
Direct Interelectrode Capacitances:			
Triode Unit	Unshielded	Shielded (Note 2)	
Grid to plate	2.8	2.8	pf
Input	2.8	3.0	pf
Output	1.6	2.4	pf
Pentode Unit			
Grid 1 to Plate	0.025 max.	0.03 max.	pf
Input	7.5	7.5	pf
Output	2.3	3.0	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9AE
Outline	6-2
Mounting	Any





9AE

MAXIMUM RATINGS

Design Maximum Values

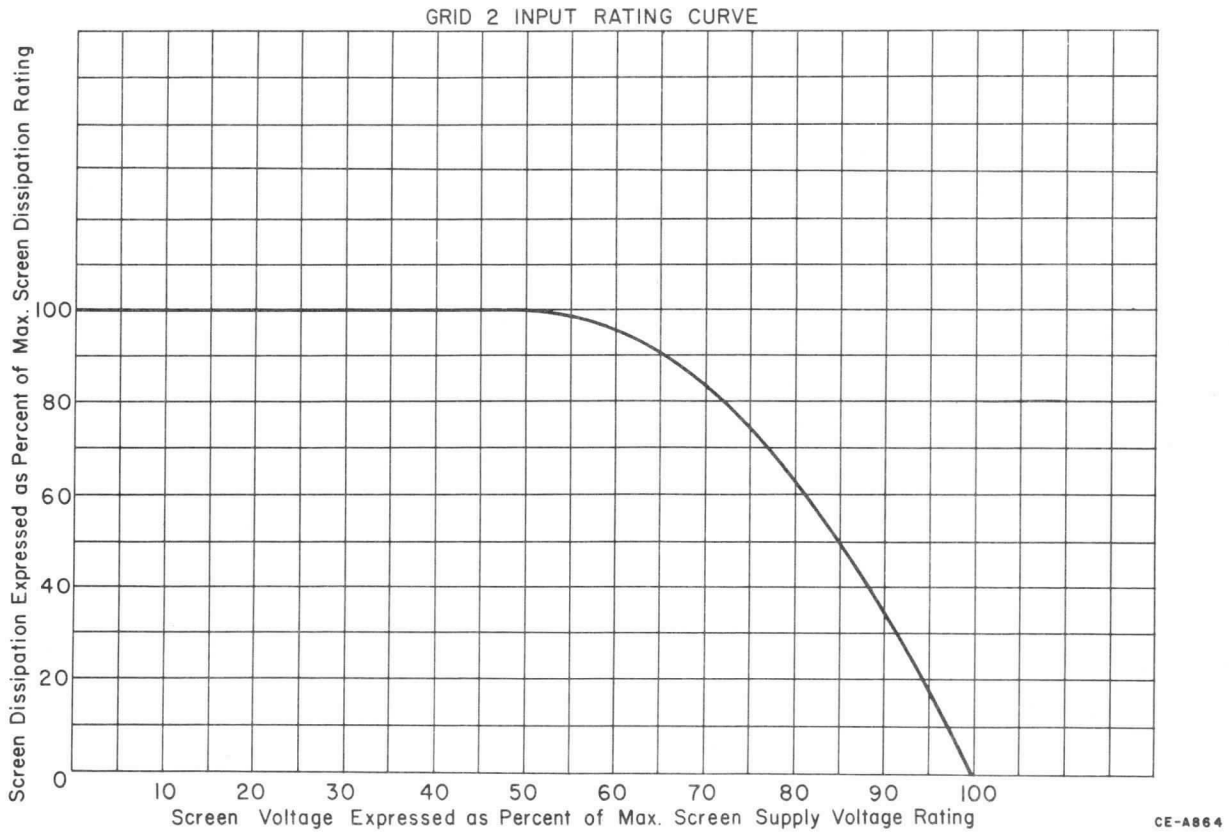
	Triode Unit	Pentode Unit		
Plate Voltage	330	330	max.	Volts
Grid 2 (Screen) Voltage	–	See Grid 2 Input Rating Curve		
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 1 (Control Grid) Voltage				
Positive Bias Value	0	0	max.	Volts
Plate Dissipation	2.5	2.5	max.	Watts
Grid 2 Input	–	0.55	max.	Watt
Heater Cathode Voltage				
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200	max.	Volts
Grid Circuit Resistance:				
Fixed Bias	1.0	–	max.	Megohm
Cathode Resistor Bias	1.0	–	max.	Megohm

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–1.0	–1.0	Volts
Amplification Factor	40	–	–
Plate Resistance (Approx.)	5000	150000	Ohms
Transconductance	7000	10000	μmhos
Grid 1 Cutoff Bias (Note 3)	–	–7	Volts
Plate Current	12.5	12	Ma.
Grid 2 Current	–	4.5	Ma.

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. With JEDEC shield #315 connected to Cathode of unit under test.
3. For plate current of 20 microamperes.



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Westinghouse®

2HM5
3HM5
4HM5
6HM5

April 1, 1964

SHARP-CUTOFF TRIODE 2HM5, 3HM5, 4HM5 AND 6HM5

The 2HM5, 3HM5, 4HM5 and 6HM5 are sharp-cutoff, seven-pin miniature triode types designed particularly for service in V.H.F. television tuners as grounded cathode r-f amplifiers. These types are electrically and mechanically similar to the 2HA5, 3HA5, 4HA5 and 6HA5 except for bulb length.

The 2HM5, 3HM5 and 4HM5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

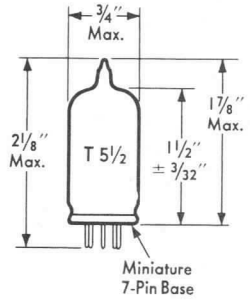
ELECTRICAL

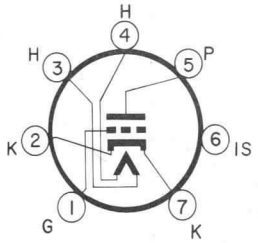
Heater Characteristics:	2HM5	3HM5	4HM5	6HM5	
Voltage (ac or dc)	2.4	2.9	4.0	6.3	Volts
Current	0.60	0.45	0.30	0.185	Ampere
Warm-up Time (Note 1)	11	11	11	–	Seconds

Direct Interelectrode Capacitance: (Shielded) (Note 2)		
Grid to Plate	0.34 max.	μμf
Input	4.5	μμf
Output	3.0	μμf
Heater to Cathode	2.5	μμf

MECHANICAL

Cathode	Coated Unipotential
Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7GM
Mounting Position	Any





7GM

RATINGS

Design Maximum Values

Plate Voltage				200 max.	Volts
Plate Dissipation				2.6 max.	Watts
Grid Voltage:					
Negative Value				50 max.	Volts
Cathode Current				20 max.	Ma.
Grid Circuit Resistance (Self Bias)				1.0 max.	Megohm
Heater Ratings:					
Allowable Heater Voltage:	2HM5	3HM5	4HM5	6HM5	
Maximum	–	–	–	6.9 max.	Volts
Minimum	–	–	–	5.7 min.	Volts
Allowable Heater Current:					
Maximum	640	480	320	– max.	Ma.
Minimum	560	420	280	– min.	Ma.
Heater-Cathode Voltage:					
Heater Negative with Respect to Cathode DC	100	100	100	100 max.	Volts
Heater Positive with Respect to Cathode DC	100	100	100	100 max.	Volts

CHARACTERISTICS & TYPICAL OPERATION

Plate Voltage	120	135	Volts
Grid Voltage	0	–1	Volts
Grid Resistance	0.1	0	Megohm
Transconductance	18,000	14,500	μmhos
Grid Cutoff Bias	See Note 6	See Note 3	
Plate Current	15.0	12.5	Ma.
Amplification Factor	82	78	–
Hot Input Resistance (Note 4)	–	1000	Ohms
Hot Input Capacitance (Note 4)	–	8.5	μμf
Noise Figure (Note 5)	4.0	4.2	db

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield No. 316 connected to Pin 2.
3. Grid Volts for gm = 150 μmhos: –5.7
   Grid Volts for gm = 1500 μmhos: –2.7
4. Measured at 200 Mc. with plate at signal ground. Ec1 = –1.5 Volt.
5. In a 200 Mc. noise-matched, optimized, neutralized, grounded-cathode triode amplifier stage.
6. Grid Volts for gm = 150 μmhos: –5.1

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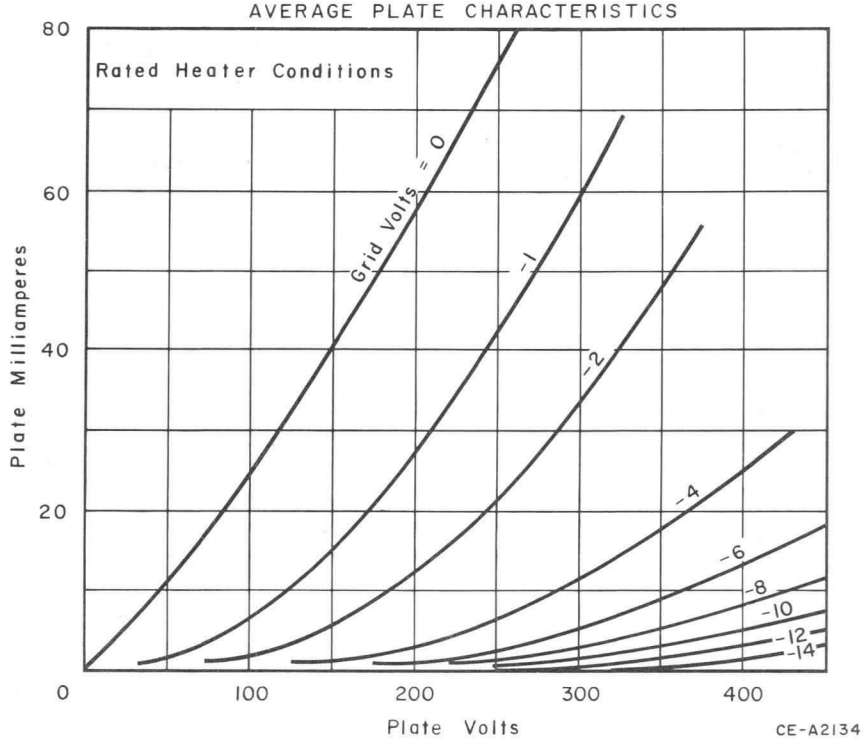
Receiving Tube Section

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

AVERAGE PLATE CHARACTERISTICS



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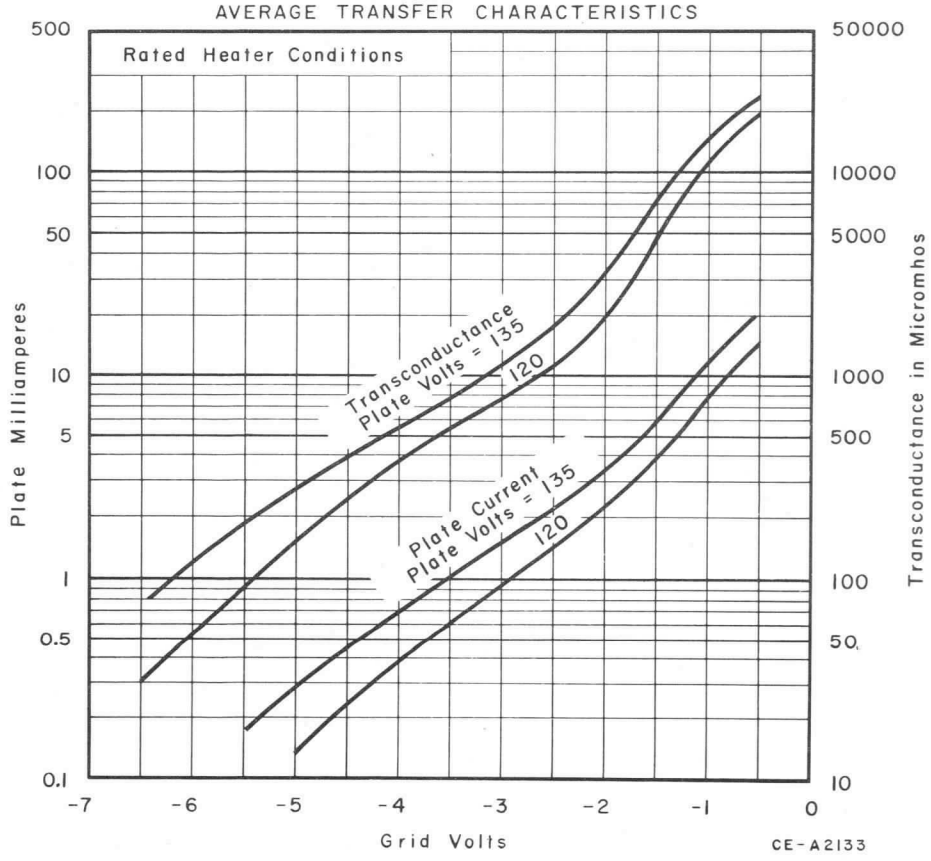
AVERAGE TRANSFER CHARACTERISTICS



CE-A2133

BEAM-POWER AMPLIFIER TYPE 50HN5

The 50HN5 is a high perveance 9-Pin miniature beam power pentode designed for service as the output stage in low cost audio amplifiers. Its special feature is very high power sensitivity, resulting in low drive required for full power output.

ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	50	Volts
Current	0.15	Ampere

MECHANICAL

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-4
Basing	9QW
Mounting Position	Any

MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	330 max.	Volts
Grid 2 Voltage (Screen)	250 max.	Volts
Plate Dissipation	12 max.	Watts
Grid 2 Dissipation (Note 1)	2.5 max.	Watts
DC Cathode Current	120 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode		
Total DC + Peak	200 max.	Volts
Heater Positive with Respect to Cathode		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts

MAXIMUM CIRCUIT VALUES

Grid 1 Circuit Resistance		
For Fixed Bias	0.1 max.	Megohm
For Cathode Bias	0.3 max.	Megohm

CHARACTERISTICS

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Bypassed Cathode Bias Resistor	56	Ohms
Plate Current	70	Ma.
Grid 2 Current	5	Ma.
Plate Resistance (Approx.)	7500	Ohms
Transconductance	17000	μmhos
Triode Amplification Factor	13	–
Grid 1 Cutoff Bias (Note 2)	–33	Volts

TYPICAL CLASS A AMPLIFIER OPERATION

	Cathode Bias (Note 3)	Cathode Bias (Note 4)	Fixed Bias	
Plate Voltage	130	140	140	Volts
Grid 2 Voltage	130	140	140	Volts
Grid 1 Voltage	–	–	–5.7	Volts
RMS A.F. Grid 1 Voltage	3.3	7.3	4.0	Volts
Cathode Bias Resistor	56	68	–	Ohms
Zero Signal Plate Current	70	72	71	Ma.
Zero Signal Grid 2 Current	5	4	4	Ma.
Max. Signal Plate Current	68	67	68.5	Ma.
Max. Signal Grid 2 Current	15	13.5	14.5	Ma.
Load Resistance	2000	2000	1700	Ohms
Power Output	3.0	3.5	4	Watts
Total Harmonic Distortion	8	8	9	Per Cent

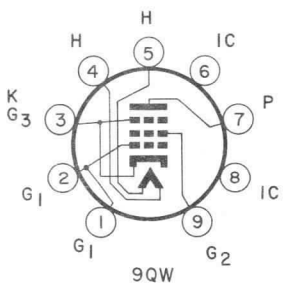
TYPICAL CLASS AB1 PUSH-PULL OPERATION

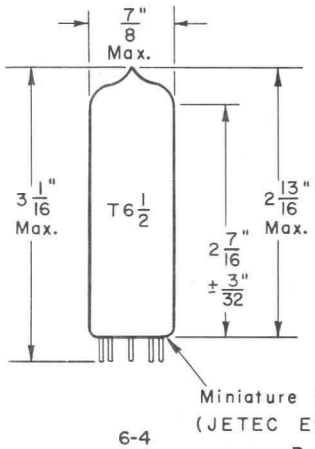
(Values are for 2 Tubes)

Plate Voltage	260	Volts
Grid 2 Voltage	130	Volts
Cathode Bias Resistor (Bypassed)	69	Ohms
Peak AF Grid 1-to-Grid 1 Voltage	16.5	Volts
Zero Signal Plate Current	90	Ma.
Zero Signal Grid 2 Current	3	Ma.
Max. Signal Plate Current	106	Ma.
Max. Signal Grid 2 Current	15	Ma.
Plate-to-Plate Load Resistance	5500	Ohms
Power Output	16.5	Watts
Total Harmonic Distortion	1.5	Per Cent

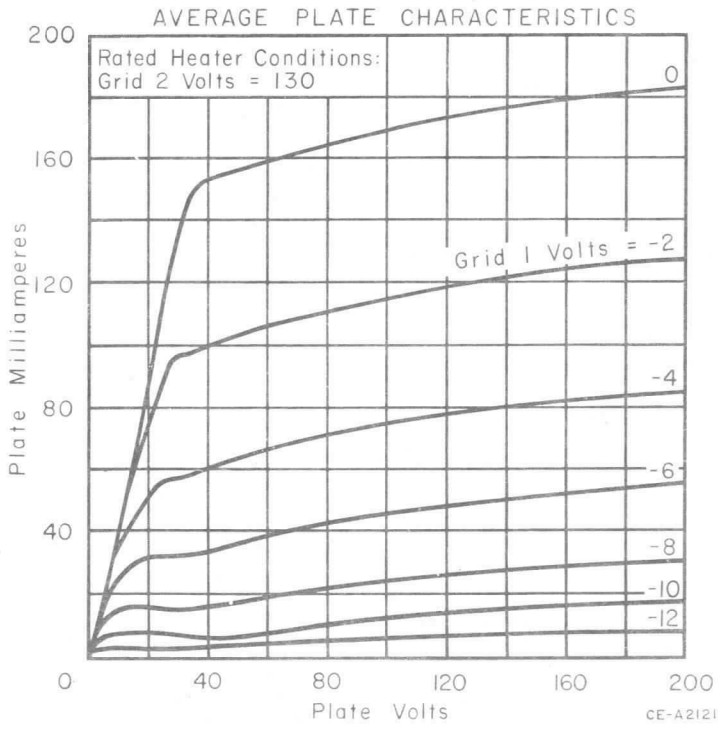
NOTES

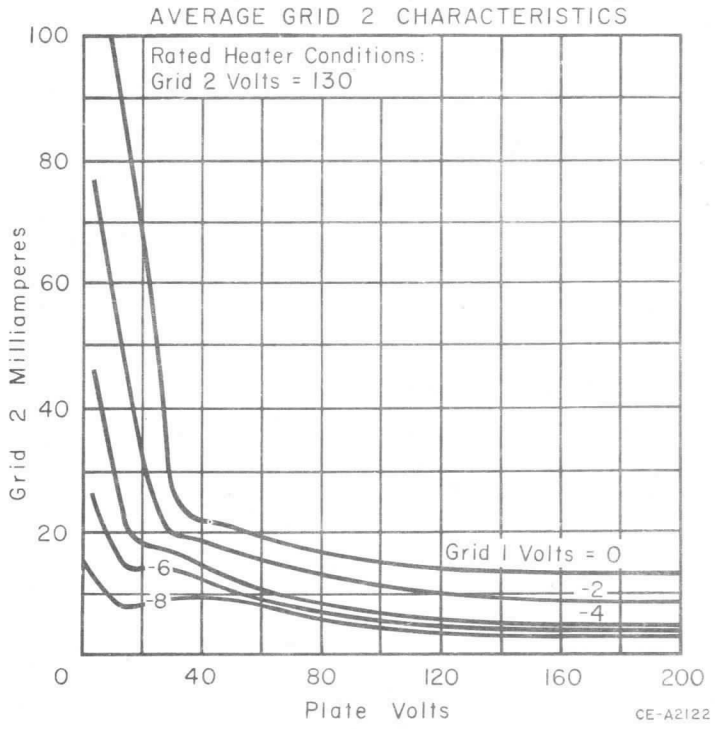
1. Screen dissipation may be permitted to reach 4-watts during the periods of maximum input of speech and music signals.
2. For plate current of 100 microamperes.
3. Cathode resistor bypassed.
4. Cathode resistor not bypassed.

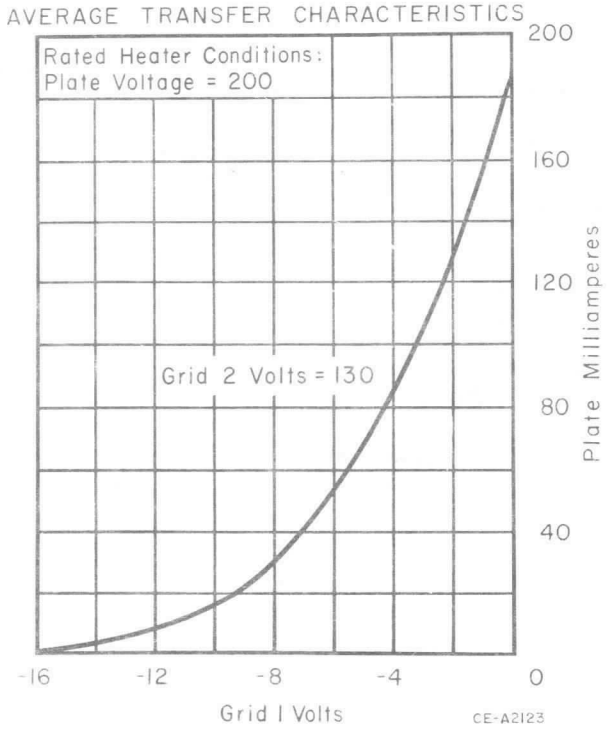




Westinghouse







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Westinghouse

3HM6
4HM6
6HM6

April 15, 1962

SHARP-CUTOFF PENTODE TYPES 3HM6, 4HM6 AND 6HM6

The 3HM6, 4HM6 and 6HM6 are sharp-cutoff, 9-Pin miniature frame-grid pentode types designed for service in television receiver I.F. amplifier stages. They feature very-high transconductance and low interelectrode capacitance values. The cathode is provided with 2 terminals to increase input impedance at high frequencies. Grid 3 is connected to a separate pin to facilitate grounding.

The 3HM6 and 4HM6 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential			
Heater:	3HM6	4HM6	6HM6	
Voltage (ac or dc)	3.15	4.2	6.3	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time (Note 1)	11	11	--	Seconds

Direct Interelectrode Capacitances:

	Shielded (Note 2)	Unshielded	
Grid 1 to Plate	0.024	0.031	μμf
Input	8.70	8.70	μμf
Output	3.00	2.15	μμf

MECHANICAL

Bulb	T-5½
Base	Miniature, 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9PM
Mounting Position	Any

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to cathode at socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (Approx.)	0.156	Megohm
Transconductance	15000	μmhos
Grid 1 Cutoff Bias (Note 3)	−3.0	Volts
Plate Current	13	Ma.
Grid 2 Current	3.2	Ma.
Hot Input Resistance (Note 4)	13000	Ohms
Hot Input Capacitance (Note 4)	7.40	μμf

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. With JEDEC Shield No. 315 connected to ground.
3. For transconductance of 100 μmhos.
4. Measured at 44 Mc. with unbypassed 56 ohm cathode resistor.

RATINGS

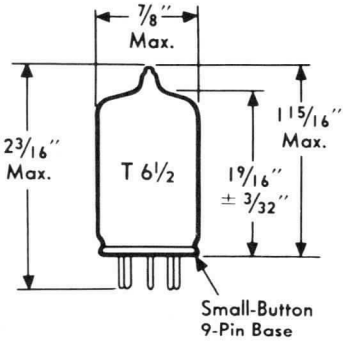
Design Maximum Values

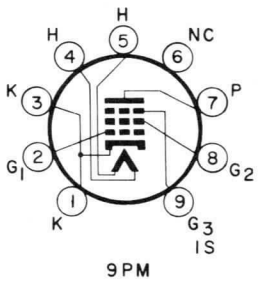
Plate Voltage	250	max.	Volts
Grid 2 Supply Voltage	250	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.5	max.	Watts
Grid 2 Input	0.6	max.	Watt
Grid 1 Negative Voltage	50	max.	Volts
Cathode Current	25	max.	Ma.
Grid 1 Circuit Resistance:			
Cathode Resistor Bias	1	max.	Megohm
Fixed Bias	0.25	max.	Megohm

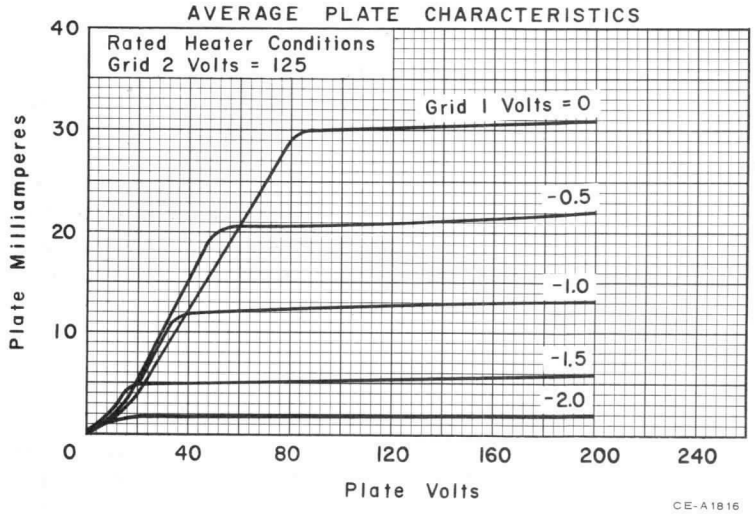
Heater:

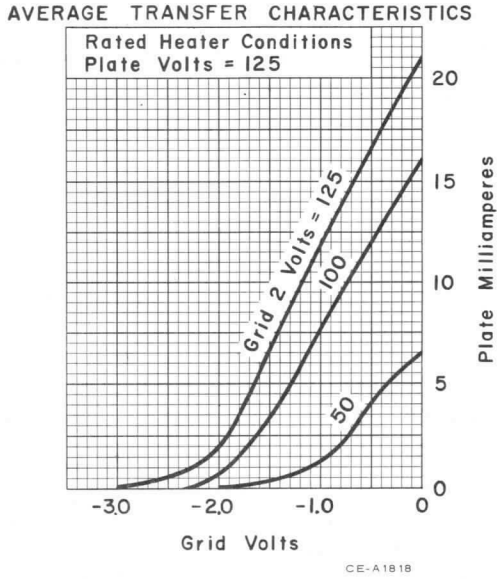
Voltage:	Minimum	Maximum	
6HM6	5.7	6.9	Volts
Current:			
3HM6	560	640	Ma.
4HM6	420	480	Ma.

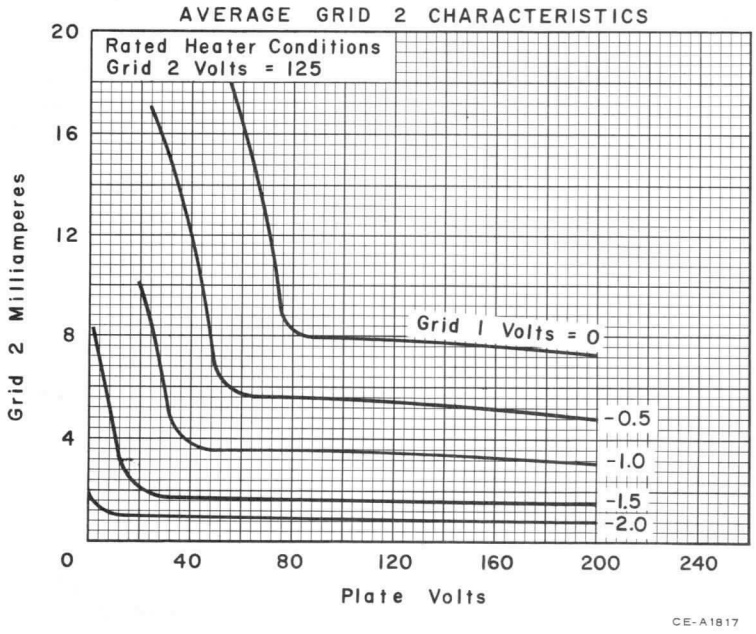
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC + Peak	200	max.	Volts

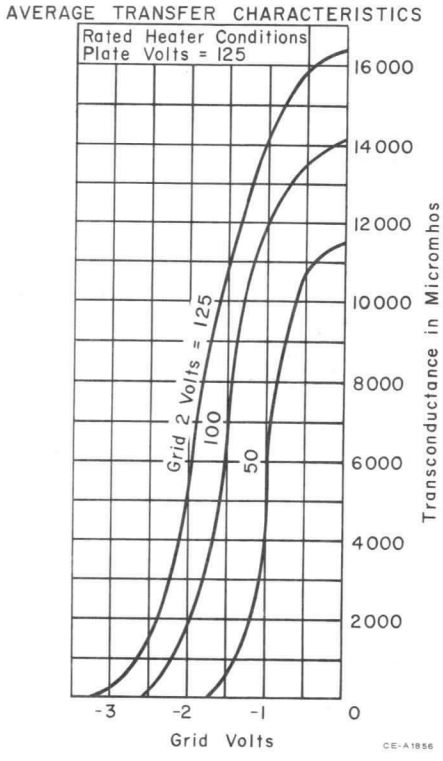


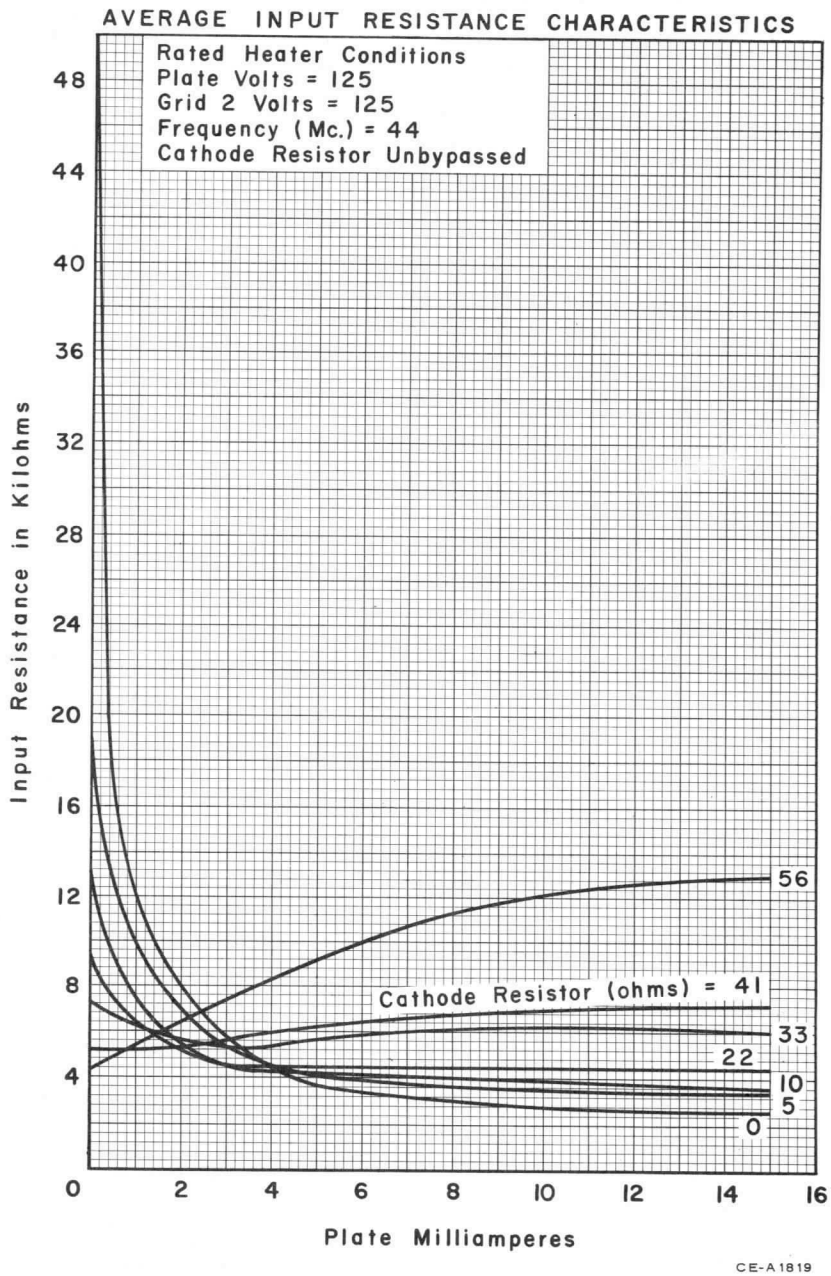


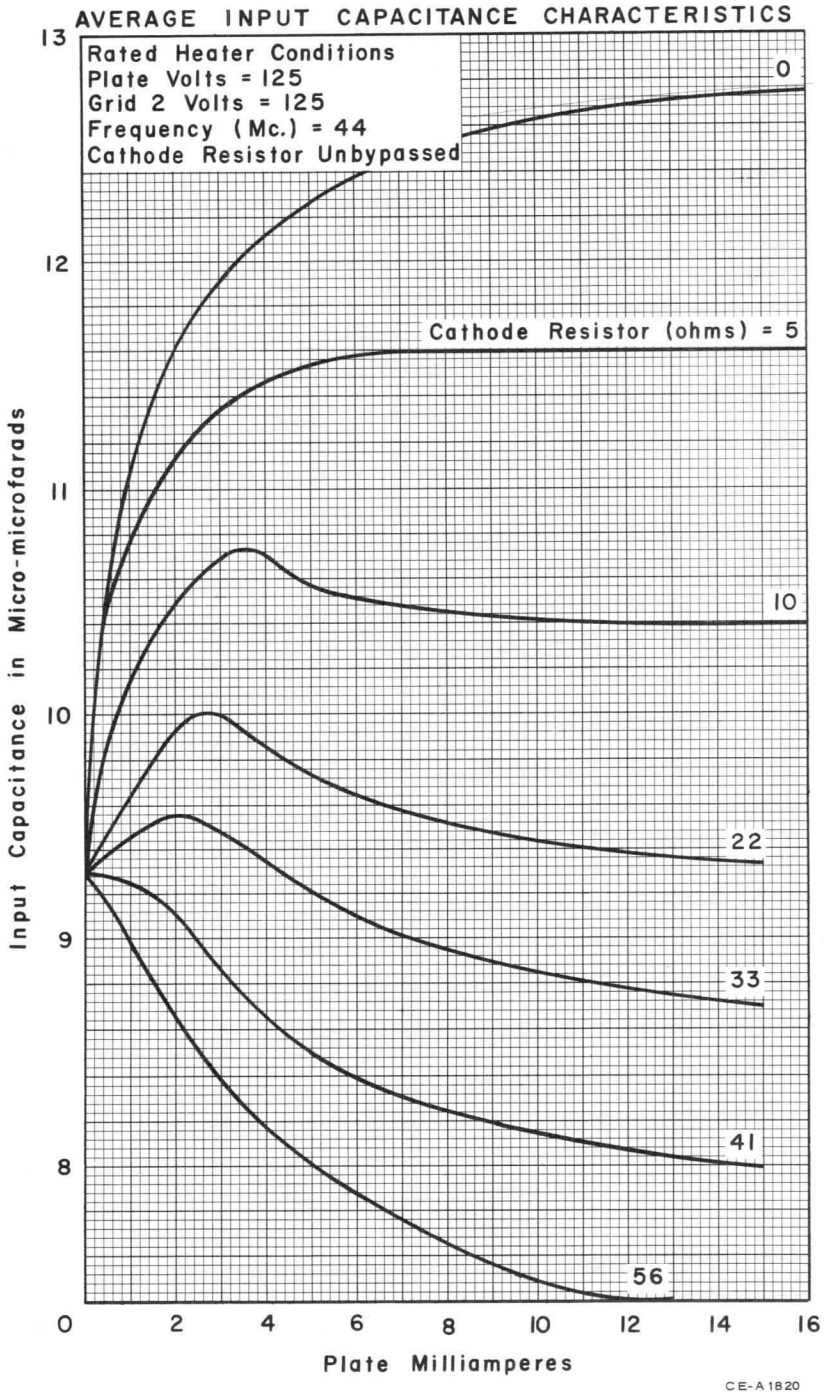

AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Grid 1 Volts = 0
-0.5
-1.0
-1.5
-2.0
Plate Milliamperes
Plate Volts
0
10
20
30
40
80
120
160
200
240
CE-A1816


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
100
50
Plate Milliamperes
Grid Volts
-3.0
-2.0
-1.0
0
5
10
15
20
CE-A1818


AVERAGE GRID 2 CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Grid 1 Volts = 0
-0.5
-1.0
-1.5
-2.0
Grid 2 Milliamperes
Plate Volts
0
4
8
12
16
20
40
80
120
160
200
240
CE-A1817


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
100
50
Transconductance in Micromhos
Grid Volts
-3
-2
-1
0
2000
4000
6000
8000
10000
12000
14000
16000
CE-A1856


AVERAGE INPUT RESISTANCE CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
Frequency (Mc.) = 44
Cathode Resistor Unbypassed
Input Resistance in Kilohms
48
44
40
36
32
28
24
20
16
12
8
4
0
2
4
6
8
10
12
14
16
Plate Milliamperes
Cathode Resistor (ohms) = 41
56
33
22
10
5
0
CE-A1819



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Westinghouse®

2HQ5
3HQ5
4HQ5
6HQ5

April 1, 1964

SHARP-CUTOFF TRIODE TYPES 2HQ5, 3HQ5, 4HQ5 AND 6HQ5

The 2HQ5, 3HQ5, 4HQ5 and 6HQ5 are sharp-cutoff, seven-pin miniature triode types designed particularly for service in V.H.F. television tuners as grounded cathode r-f amplifiers.

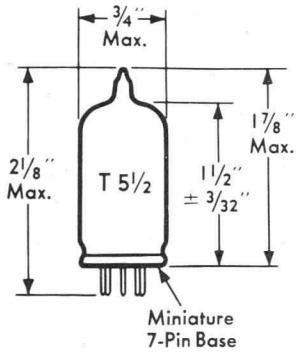
The 2HQ5, 3HQ5 and 4HQ5 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

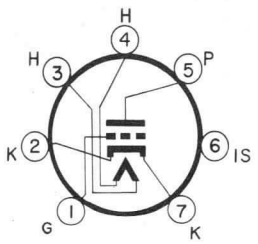
ELECTRICAL

Heater Characteristics:	2HQ5	3HQ5	4HQ5	6HQ5	
Voltage (ac or dc)	2.4	3.0	4.2	6.3	Volts
Current	0.60	0.45	0.30	0.20	Ampere
Warm-up Time (Note 1)	11	11	11	–	Seconds
Direct Interelectrode Capacitance: (Shielded) (Note 2)					
Grid 1 to Plate				0.52	pf
Input				5.0	pf
Output				3.5	pf
Heater to Cathode				2.5	pf

MECHANICAL

Cathode	Coated Unipotential
Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7GM
Mounting Position	Any





7GM

RATINGS

Design Maximum Values

Plate Voltage				200 max.	Volts
Plate Dissipation				2.5 max.	Watts
Grid Voltage:					
Negative Value				50 max.	Volts
Cathode Current				22 max.	Ma.
Grid Circuit Resistance (Self Bias)				1.0 max.	Megohm
Heater Ratings:					
Allowable Heater Voltage:	2HQ5	3HQ5	4HQ5	6HQ5	
Maximum	–	–	–	6.9 max.	Volts
Minimum	–	–	–	5.7 min.	Volts
Allowable Heater Current:					
Maximum	640	480	320	– max.	Ma.
Minimum	560	420	280	– Min.	Ma.
Heater-Cathode Voltage:					
Heater Negative with Respect to Cathode DC	100	100	100	100 max.	Volts
Heater Positive with Respect to Cathode DC	100	100	100	100 max.	Volts

CHARACTERISTICS & TYPICAL OPERATION:

Plate Voltage	135	Volts
Grid Voltage	-1	Volts
Plate Resistance	5400	Ohms
Transconductance	15000	μmhos
Grid Cutoff Bias	See Note 3	
Plate Current	11.5	Ma.
Amplification Factor	78	–
Hot Input Resistance (Note 4)	275	Ohms
Hot Input Capacitance (Note 4)	11.2	pf
Noise Figure (Note 5)	4.7	db

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield No. 316 connected to Pin 2.
3. Grid Volts for gm = 150 μmhos: -4.2
   Grid Volts for gm = 1500 μmhos: -2.5
4. Measured at 200 Mc. with plate at signal ground.
5. In a 200 Mc. noise-matched, optimized, neutralized, grounded-cathode triode amplifier stage.

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Westinghouse

6HS8

June 15, 1963

TWIN PENTODE TYPE 6HS8

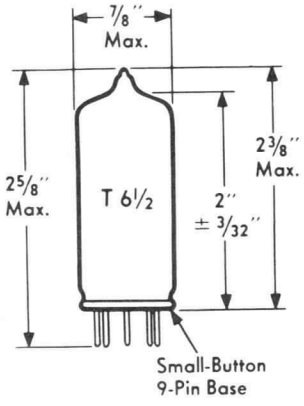
The 6HS8 is a 9-pin miniature twin pentode type designed for service as the sync separator and keyed AGC rectifier in television receivers. The units have separate plates and grids 3 and common heater cathode, grid 1 and grid 2. With suitable circuitry, voltages may be applied to grid 1 to suppress noise pulses from both the sync and AGC circuits.

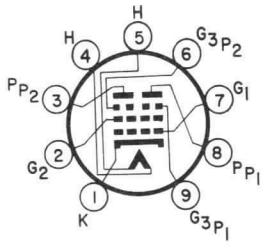
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3 ± 10%	Volts
Current	0.30	Amperes
Direct Interelectrode Capacitances: (Unshielded)		
Grid 3 to Plate (Each Unit)	2.0	pf
Grid 1 to All Other Electrodes	6.0	pf
Grid 3 (Each Unit) to All Other Electrodes	3.6	pf
Plate (Each Unit) to All Other Electrodes	3.0	pf
Grid 3, Unit 1 to Grid 3, Unit 2 (Max.)	0.015	pf

MECHANICAL

Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-3
Basing	9FG
Mounting Position	Any





9 FG

MAXIMUM RATINGS

Design Maximum Values (Note 1)

Plate Voltage	300 max.	Volts
Grid 3 Voltage:		
Positive DC	3.0 max.	Volts
Negative DC	50 max.	Volts
Positive Peak	50 max.	Volts
Grid 2 Voltage	150 max.	Volts
Grid 1 Voltage (Negative DC)	50 max.	Volts
Plate Dissipation (Each Unit)	1.1 max.	Watts
Grid 2 Dissipation	0.75 max.	Watts
DC Cathode Current	12 max.	Ma.
Heater Voltage with respect to Cathode:		
Positive DC Component	100 max.	Volts
Positive DC and Peak	200 max.	Volts
Negative DC and Peak	200 max.	Volts

LIMITING CIRCUIT VALUES

Grid 1 Circuit Resistance	0.5 max.	Megohms
Grid 3 Circuit Resistance (Each Unit)	0.5 max.	Megohms

TYPICAL OPERATING CHARACTERISTICS

Both Units Operating			
Plate Voltage	100	100	Volts
Grid 3 Voltage	−10	0	Volts
Grid 2 Voltage	67.5	67.5	Volts
Grid 1 Voltage (Note 2)	–	–	Volts
Plate Current (Each Unit)	–	2.0	Ma.
Grid 2 Current	7.0	4.4	Ma.
Cathode Current	7.1	8.5	Ma.
Each Unit Operating (Note 3)			
Plate Voltage	100	100	Volts
Grid 3 Voltage	0	0	Volts
Grid 2 Voltage	67.5	67.5	Volts
Grid 1 Voltage	0	(Note 2)	Volts
Grid 3 Transconductance	–	450	μmhos
Grid 1 Transconductance	1100	–	μmhos
Plate Current	–	2.0	Ma.
Grid 3 Cutoff Voltage (Note 4)	–	−3.5	Volts
Grid 1 Cutoff Voltage (Note 4)	–	−2.3	Volts

NOTES

1. Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worse probable conditions.
2. For grid 1 current of 100 microamperes.
3. With Plate and Grid 3 of other unit grounded.
4. For Plate current of 100 microamperes.

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Receiving Tube Section

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

Westinghouse®

3HT6
4HT6
6HT6

October 1, 1964

SEMI-REMOTE-CUTOFF PENTODE TYPES 3HT6, 4HT6 AND 6HT6

The 3HT6, 4HT6 and 6HT6 are semi-remote-cutoff, 9-pin miniature, frame-grid pentode types designed for service in television receiver I.F. amplifier stages. They feature very high transconductance and low interelectrode capacitance values. The cathode has 2 terminals to increase the input impedance at high frequencies. Grid 3 has a separate pin to facilitate grounding. Their semi-remote cutoff characteristic is desirable for use in a g c controlled stages.

The 3HT6 and 4HT6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential			
Heater:	3HT6	4HT6	6HT6	
Voltage (ac or dc)	3.15	4.2	6.3	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time (Note 1)	11	11	- -	Seconds
Direct Interelectrode Capacitances:	Shielded (Note 2)		Unshielded	
Grid 1 to Plate	0.024		0.031	μμf
Input	8.70		8.70	μμf
Output	3.00		2.15	μμf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9PM
Mounting Position	Any

RATINGS

Design Maximum Values

Plate Voltage	250	max.	Volts
Grid 2 Supply Voltage	250	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve		
Plate Dissipation	2.5	max.	Watts
Grid 2 Dissipation	0.6	max.	Watts
Grid 1 Negative Voltage	50	max.	Volts
Cathode Current	25	max.	Ma.
Grid 1 Circuit Resistance:			
Cathode Resistor Bias	1	max.	Megohm
Fixed Bias	0.25	max.	Megohm
Heater:			

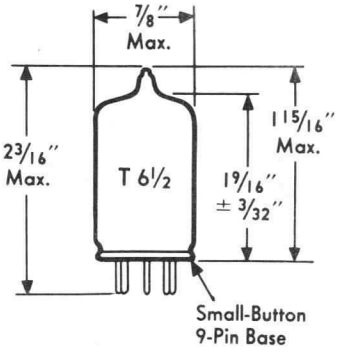
Heater: Voltage:	Minimum	Maximum	
6HT6	5.7	6.9	Volts
Current:			
3HT6	560	640	Ma.
4HT6	420	480	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
Total DC and Peak	200	max.	Volts

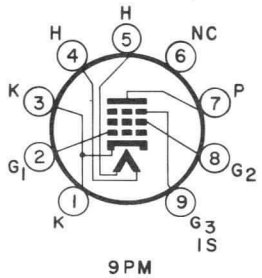
TYPICAL OPERATION AND CHARACTERISTICS

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to Cathode at Socket	
Grid 2 Voltage	125	Volts
Cathode Bias Resistor	56	Ohms
Plate Resistance	0.143	Megohm
Transconductance	14000	μmhos
Plate Current	15	Ma.
Grid 2 Current	4.0	Ma.
Grid 1 Cutoff Bias (Note 3)	-6.7	Volts
Cutoff Transconductance:		
For Grid 1 Volts = -1.5	12000	μmhos
For Grid 1 Volts = -3.5	300	μmhos
For Grid 1 Volts = -4.5	100	μmhos
Hot Input Resistance (Note 4)	12700	Ohms
Hot Input Capacitance (Note 4)	7.45	μμf

NOTES

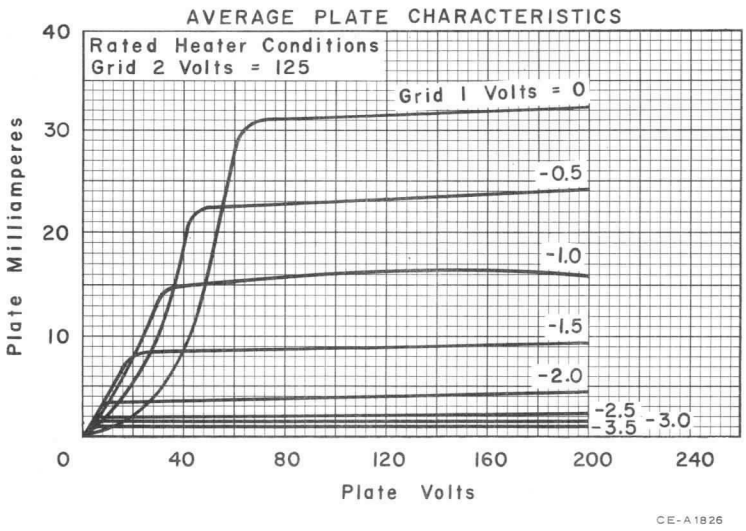
1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC Shield No. 315 connected to ground.
3. For transconductance of 50 μmhos.
4. Measured at 44 Mc with unbypassed 56 ohm cathode resistance.

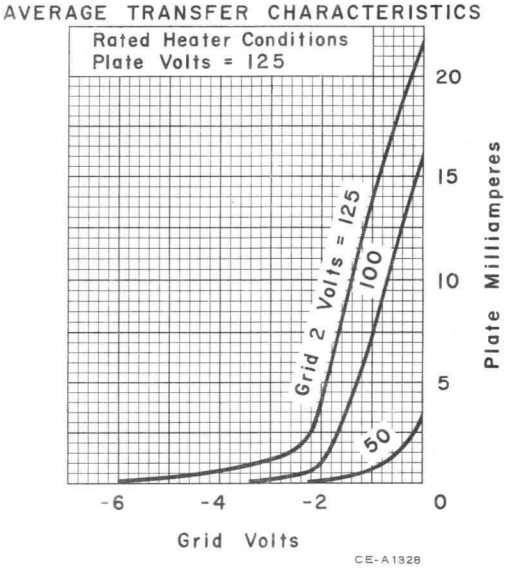


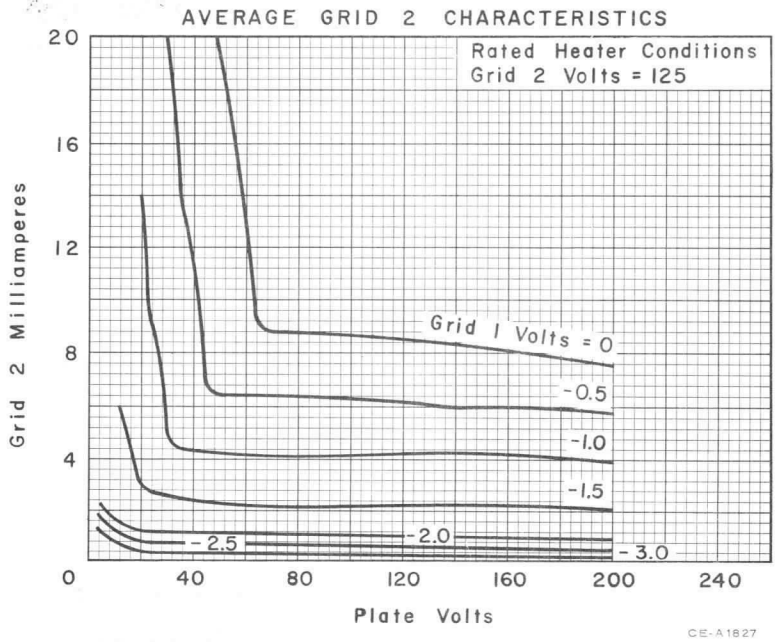


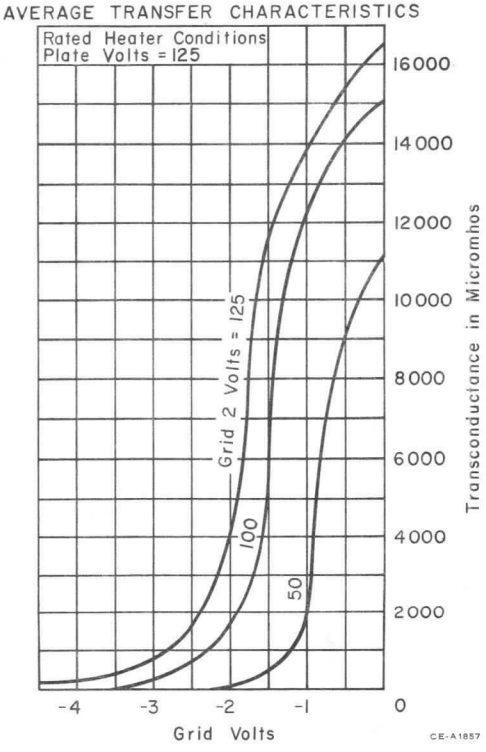
9PM

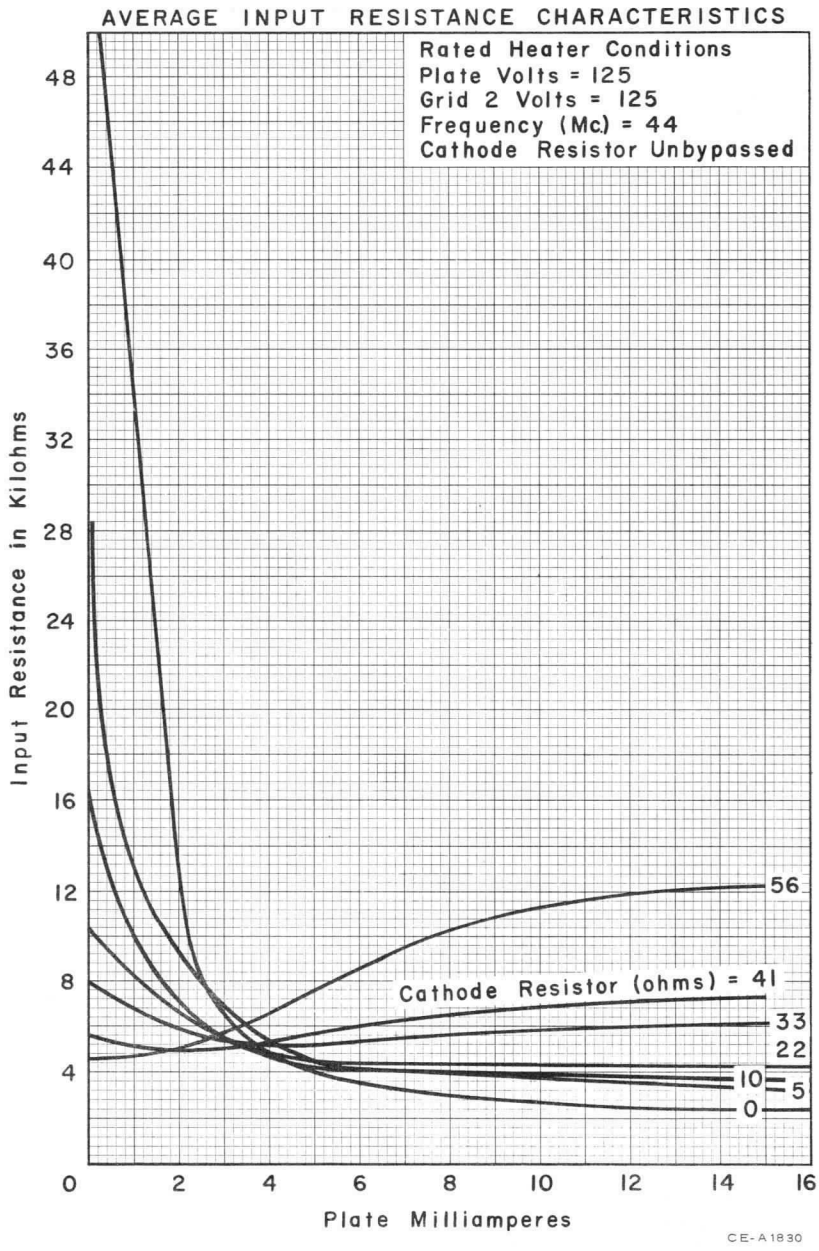
WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

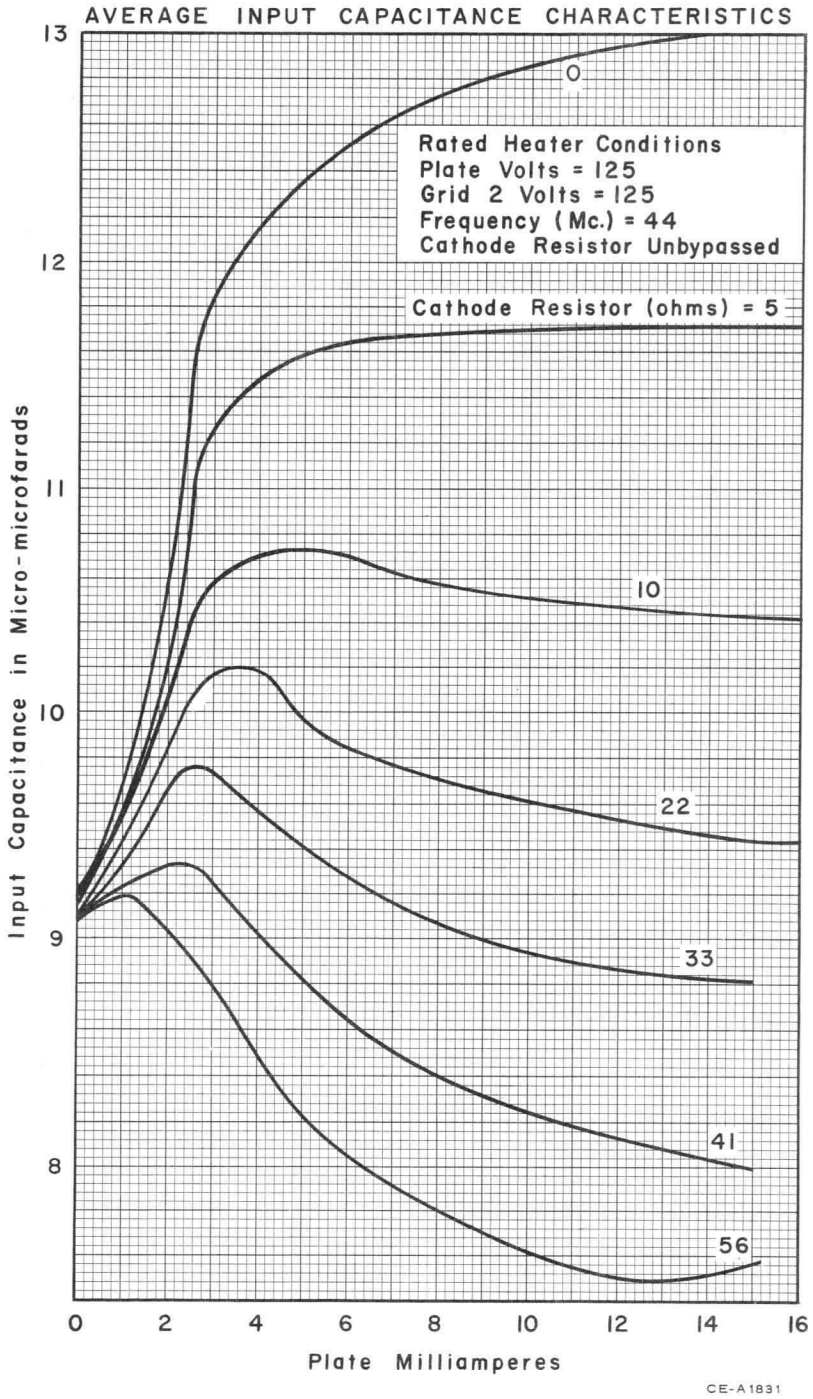

AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Grid 1 Volts = 0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.5
-3.0
Plate Milliamperes
Plate Volts
0
40
80
120
160
200
240
10
20
30
40
CE-A1826


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
100
50
Plate Milliamperes
Grid Volts
-6
-4
-2
0
5
10
15
20
CE-A1328


AVERAGE GRID 2 CHARACTERISTICS
Rated Heater Conditions
Grid 2 Volts = 125
Grid 1 Volts = 0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Grid 2 Milliamperes
Plate Volts
0
40
80
120
160
200
240
4
8
12
16
20
CE-A1827


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
100
50
Transconductance in Micromhos
Grid Volts
-4
-3
-2
-1
0
2000
4000
6000
8000
10000
12000
14000
16000
CE-A1857


AVERAGE INPUT RESISTANCE CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 125
Frequency (Mc.) = 44
Cathode Resistor Unbypassed
Input Resistance in Kilohms
48
44
40
36
32
28
24
20
16
12
8
4
0
2
4
6
8
10
12
14
16
Plate Milliamperes
Cathode Resistor (ohms) = 41
56
33
22
10
5
0
CE-A1830



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DUAL-CONTROL-GRID PENTODE TYPE 6HZ6

The 6HZ6 is a miniature 7-pin dual-control-grid pentode designed for service as combined limiter, FM detector and audio voltage amplifier in television receivers.

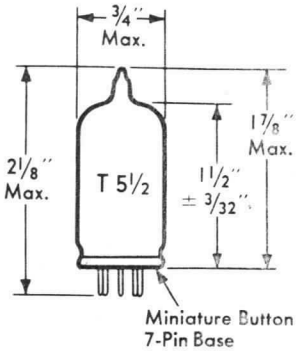
The 6HZ6 has been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

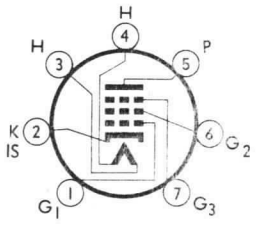
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.45±6%	Ampere
Warm-up Time (Note 1)	11	Seconds
Direct Interelectrode Capacitances:	Unshielded	
Grid 1 to Plate	0.023	μμf
Grid 3 to Plate	1.6	μμf
Grid 1 Input	8.2	μμf
Grid 3 Input	7.2	μμf
Grid 1 to Grid 3	0.09	μμf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7EN
Mounting Position	Any





7EN

LIMITER FM DETECTOR SERVICE

MAXIMUM RATINGS

Design Maximum Values

Plate Voltage	300	max.	Volts
Grid 3 Voltage:			
Positive DC & Peak Value	25	max.	Volts
Negative DC & Peak Value	100	max.	Volts
Grid 2 Supply Voltage	300	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Grid 1 Voltage:			
Positive DC Value	0	max.	Volts
Negative DC Value	50	max.	Volts
Plate Dissipation	1.7	max.	Watts
Grid 3 Dissipation	0.1	max.	Watts
Grid 2 Dissipation	1	max.	Watt
Heater-Cathode Voltage:			
Heater Positive with respect to Cathode:			
DC Component	100	max.	Volts
Total DC & Peak	200	max.	Volts
Heater Negative with respect to Cathode:			
Total DC & Peak	200	max.	Volts

TYPICAL OPERATION

Plate Voltage	150	Volts
Grid 3 Voltage	0	Volts
Grid 2 Voltage	100	Volts
Cathode Bias Resistor	180	Ohms
Plate Resistance (Approx.)	0.11	Megohms
Grid 1 Transconductance	3400	μmhos
Grid 3 Transconductance	600	μmhos
Grid 1 Cutoff Bias (Note 2)	−4.5	Volts
Grid 3 Cutoff Bias (Note 2)	−7	Volts
Plate Current	3.2	Ma.
Grid 2 Current	3.2	Ma.

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For Plate Current of 20 μamp.

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TV HIGH VOLTAGE RECTIFIER TYPE 1J3

The 1J3 is a glass octal, directly heated half wave rectifier designed for service as the high voltage rectifier in flyback type picture tube anode power supplies. Compact size is achieved with high inter-element insulation and high inverse voltage ratings.

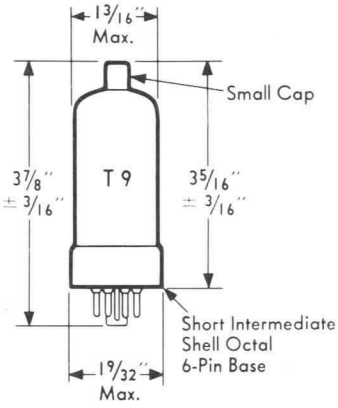
GENERAL DATA

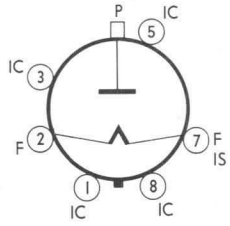
ELECTRICAL:

Filament (Coated):		
Voltage (ac or dc)	1.25*	Volts
Current	0.2	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Plate to Filament	1.6	uuf

MECHANICAL:

Bulb	T-9
Base	Intermediate-Shell Octal 6-Pin (JETEC B6-8)
	Short Intermediate-Shell Octal 6-Pin (JETEC B6-60)
Basing	3C
Mounting Position	Any





3C

BOTTOM VIEW

Socket terminals 4 and 6 may be used as tie points as or near filament potential. Terminals 1,3,4,5,6, and 8 may be connected to terminal 7 to reduce corona discharge.

FLYBACK RECTIFIER SERVICE †

MAXIMUM RATINGS:

Design-Maximum Values ▲

Peak Inverse Plate Voltage:			
DC Component	22000	max.	Volts
Total DC and Peak	26000	max.	Volts
Steady-State Peak Plate Current	50	max.	Ma.
DC Output Current	0.5	max.	Ma.

AVERAGE CHARACTERISTICS:

Tube Voltage Drop, approx.:		
Plate Current = 7.0 Ma.	225	Volts

* The filament voltage must never be less than 1.05 volts or more than 1.45 volts.

† For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

▲ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, taking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

NOTE: Inasmuch as the tube rating permits operation at high voltage, shielding of the tube for x-ray radiation may be needed.

Westinghouse

5J6
6J6
6J6-A

March 1, 1961

MEDIUM-MU TWIN TRIODE TYPES 5J6, 6J6 AND 6J6-A

The 5J6, 6J6 and 6J6-A are miniature 7-pin twin triode types designed for service as radio-frequency oscillators, amplifiers, or audio-frequency amplifiers. With the grids in push-pull and the plates in parallel, they can be used as mixers at frequencies up to 600 megacycles.

The 5J6 and 6J6-A have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	5J6	6J6 6J6-A	
Voltage (ac or dc)	4.7	6.3	Volts
Current	0.60	0.45	Amperes
Warm-up Time●	11	11□	Seconds
Direct Interelectrode Capacitances (Each Unit):		(Unshielded)	
Grid to Plate		1.5	μμf
Input		2.0	μμf
Output		0.4	μμf

MECHANICAL:

Bulb	T-5-1/2
Base	Small-Button Miniature 7-pin
Basing	7BF
Mounting Position	Any

MAXIMUM RATINGS:

Design-Center Values

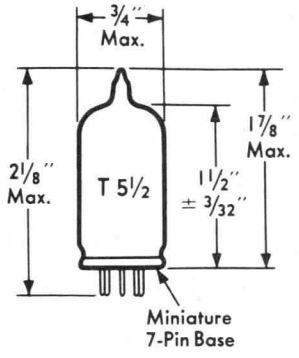
Plate Voltage	300	max.	Volts
Plate Dissipation	1.5	max.	Watts
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	100	max.	Volts

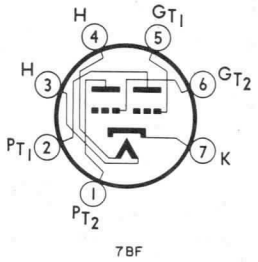
MAXIMUM CIRCUIT VALUES:

Grid-Circuit Resistance			
Cathode-Bias Operation	0.5	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	100	Volts
Cathode Bias Resistor (Common to Each Unit)	50	Ohms
Amplification Factor	38	
Plate Resistance	7100	Ohms
Transconductance	5300	μmhos
Plate Current	8.5	Ma.





OSCILLATOR – CLASS C
RF POWER AMPLIFIER & OSCILLATOR–CLASS C TELEGRAPHY

MAXIMUM RATINGS (Each Unit)
Design Center Values

DC Plate Voltage	300	max.	Volts
DC Grid Voltage	−40	max.	Volts
DC Plate Current	15	max.	Ma.
DC Grid Current	8	max.	Ma.
Plate Input	4.5	max.	Watts
Plate Dissipation	1.5	max.	Watts
Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	100	max.	Volts

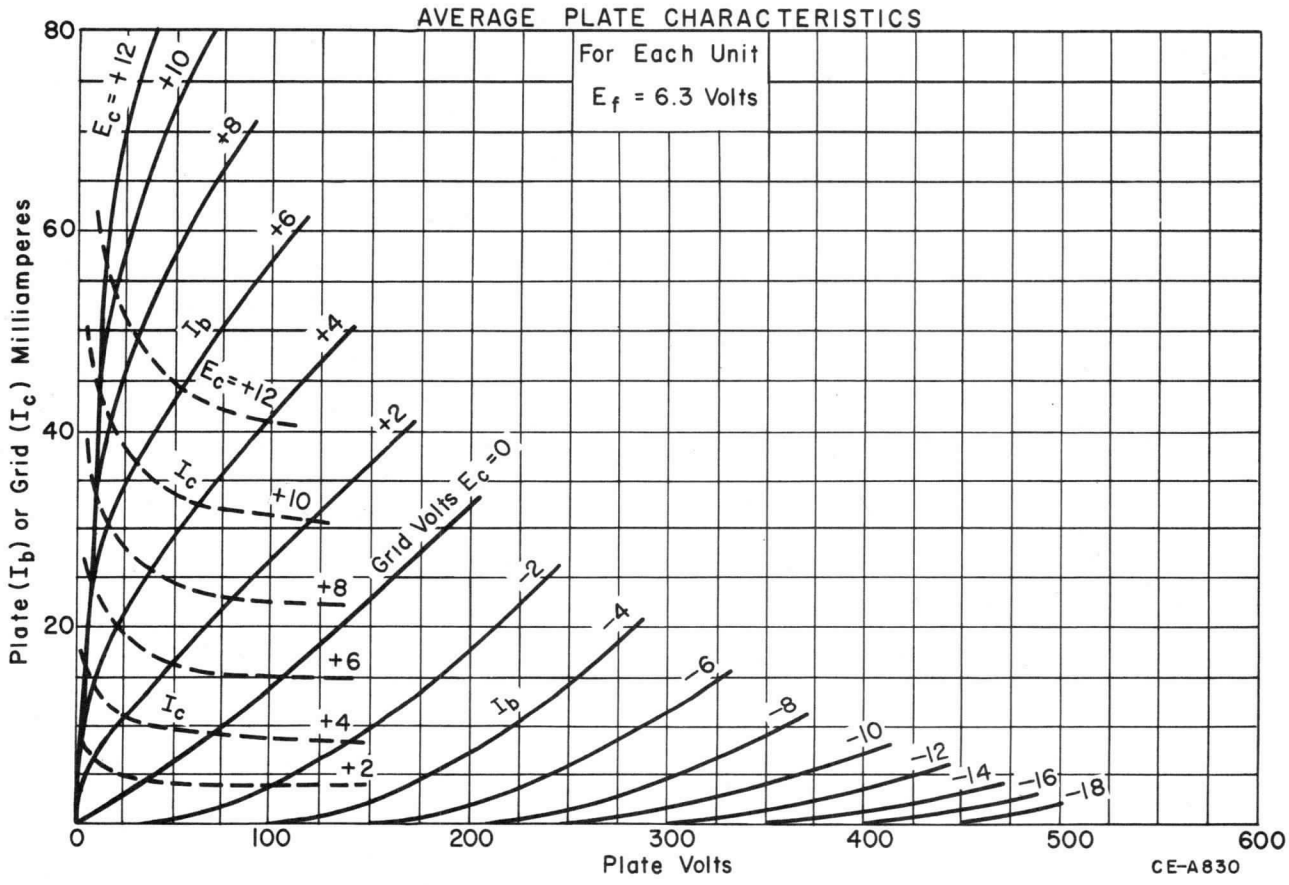
(TYPICAL PUSH-PULL OPERATION AT MODERATE FREQUENCIES)
Both Units

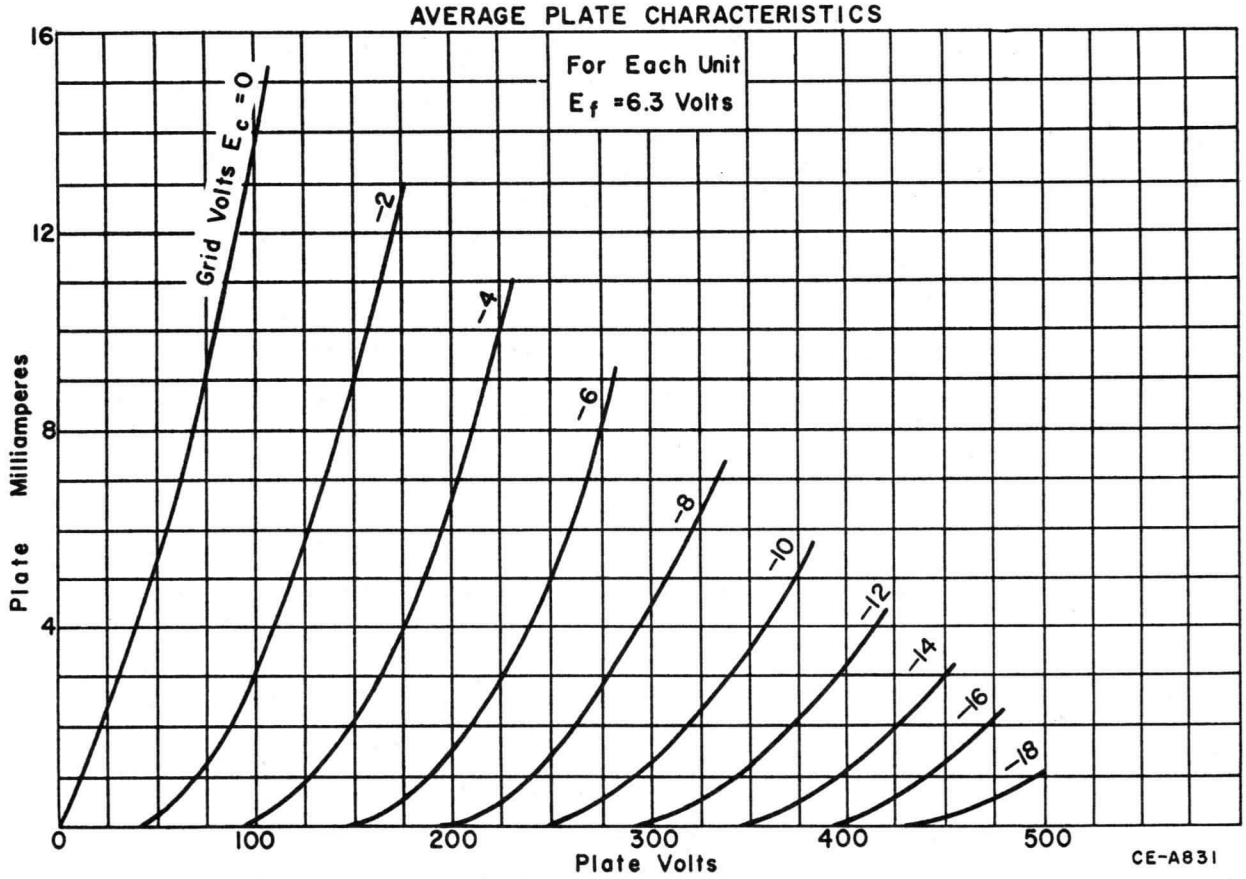
DC Plate Voltage	150	Volts
DC Grid Voltage:		
from a fixed supply of	−10	Volts
from a grid resistor of	625	Ohms
from a cathode resistor of	220	Ohms
DC Plate Current	30	Ma.
DC Grid Current (Approx.)	16	Ma.
Driving Power (Approx.)	0.35	Watts
Power Output (Approx.)	3.5	Watts

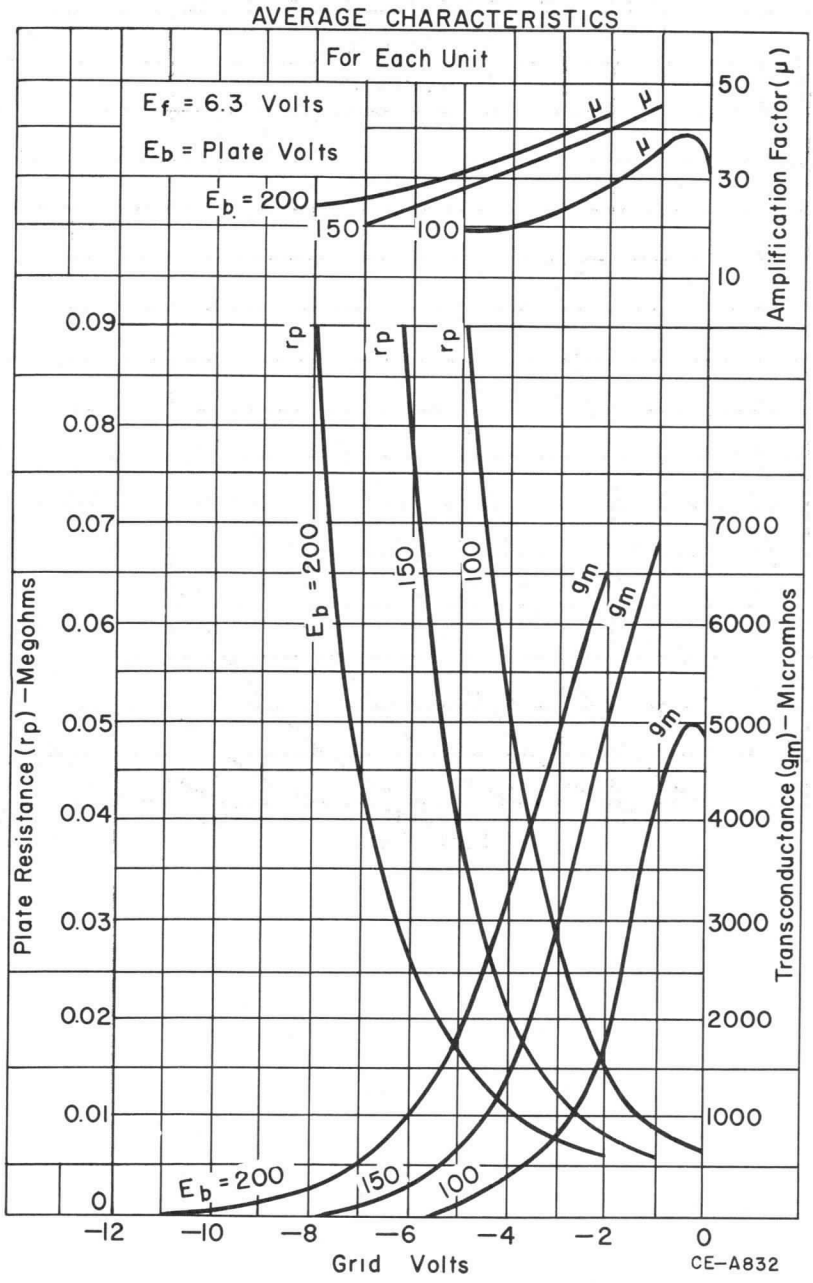
As a push-pull oscillator at 250 Mc approximately 1.0 watt can be obtained with a grid resistor of 2000 ohms common to both units and a plate voltage of 150 volts. Maximum rated plate dissipation must not be exceeded.

● Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

□ 6J6-A only.




AVERAGE PLATE CHARACTERISTICS
For Each Unit
E_f =6.3 Volts
Grid Volts E_c =0
-2
-4
-6
-8
-10
-12
-14
-16
-18
Plate Milliamperes
16
12
8
4
0
100
200
300
400
500
Plate Volts
CE-A831


AVERAGE CHARACTERISTICS
For Each Unit
E_f = 6.3 Volts
E_b = Plate Volts
E_b = 200
150
100
μ
μ
μ
50
30
10
Amplification Factor (μ)
rp
rp
rp
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Plate Resistance (r_p) – Megohms
E_b = 200
150
100
gm
gm
gm
7000
6000
5000
4000
3000
2000
1000
Transconductance (g_m) – Micromhos
E_b = 200
150
100
−12
−10
−8
−6
−4
−2
0
Grid Volts
CE-A832

Westinghouse

6JA8
10JA8

June 1, 1962

HIGH-MU TRIODE TETRODE TYPES 6JA8 AND 10JA8

The 6JA8 and 10JA8 are 9-pin miniature high-mu triode and tetrode types designed for service in color and black-and-white television receivers. The triode unit is designed for service as a sync separator, sync clipper and phase inverter while the tetrode unit is designed for operation as a video amplifier.

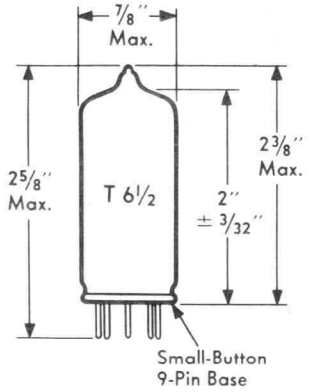
The 10JA8 has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 450 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

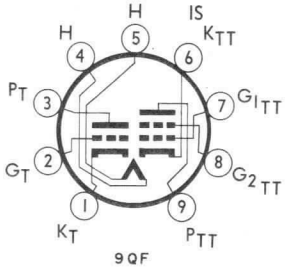
ELECTRICAL

Cathodes		Coated Unipotential		
Heater:	6JA8	10JA8		
Voltage (ac or dc)	6.3 ± 10%	10.5		Volts
Current	0.75	0.45 ± 6%		Ampere
Warm-up Time (Approx.) (Note 1)	–	11		Seconds
Direct Interelectrode Capacitances: (Unshielded)				
Triode:				
Grid to Plate	4.0			μμf
Input	2.5			μμf
Output	0.4			μμf
Pentode:				
Grid 1 to Plate	0.1		max.	μμf
Input	11			μμf
Output	4.8			μμf
Coupling:				
Pentode Grid 1 to Triode Plate	0.005		max.	μμf
Pentode Plate to Triode Grid	0.018		max.	μμf
Pentode Plate to Triode Plate	0.17		max.	μμf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-3
Basing	9QF
Mounting Position	Any





RATINGS

Design Maximum Values

	Triode	Tetrode		
Plate Voltage	300	330	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Curve		
Plate Dissipation	1	5	max.	Watts
Grid 2 Dissipation	–	1.5	max.	Watts
Positive Grid 1 Bias Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

Triode Unit:				
Plate Voltage	135	200		Volts
Grid Voltage	–2	–2		Volts
Amplification Factor	60	70		–
Plate Resistance	23000	17000		Ohms
Transconductance	2600	4000		μmhos
Plate Current	2	4		Ma.
Grid 1 Cutoff Voltage	–4.8	–7		Volts
Tetrode Unit:				
Plate Voltage	30	135	200	Volts
Grid 2 Voltage	135	135	135	Volts
Grid 1 Voltage	0	–1.5	–1.5	Volts
Plate Resistance	–	6600	7000	Ohms
Transconductance	–	12600	14000	μmhos
Plate Current (Note 2)	32	17	18	Ma.
Grid 2 Current (Note 2)	14	4.2	4	Ma.
Grid 1 Cutoff Voltage (Note 3)	–	–5	–5	Volts

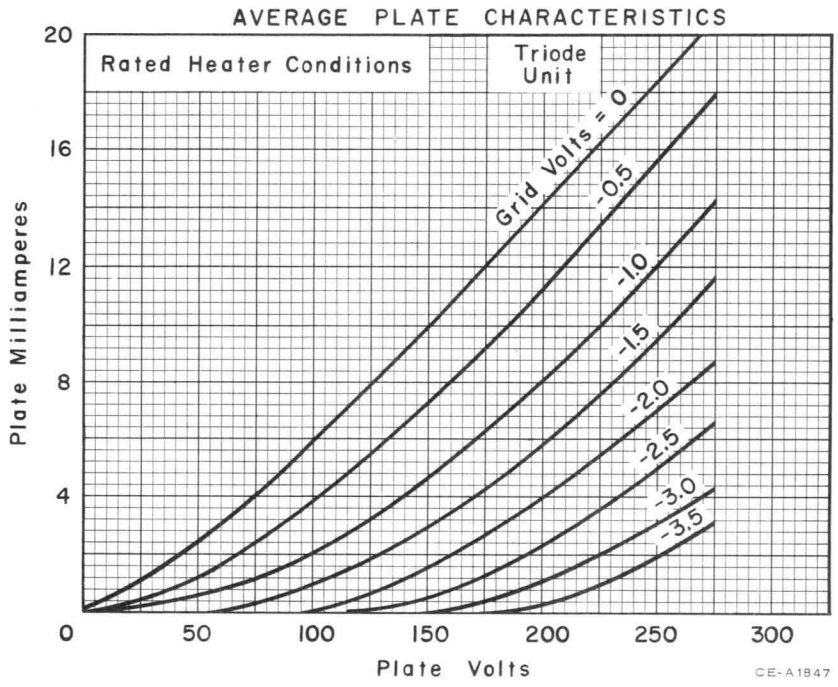
PRINTED IN U.S.A.

Receiving Tube Section

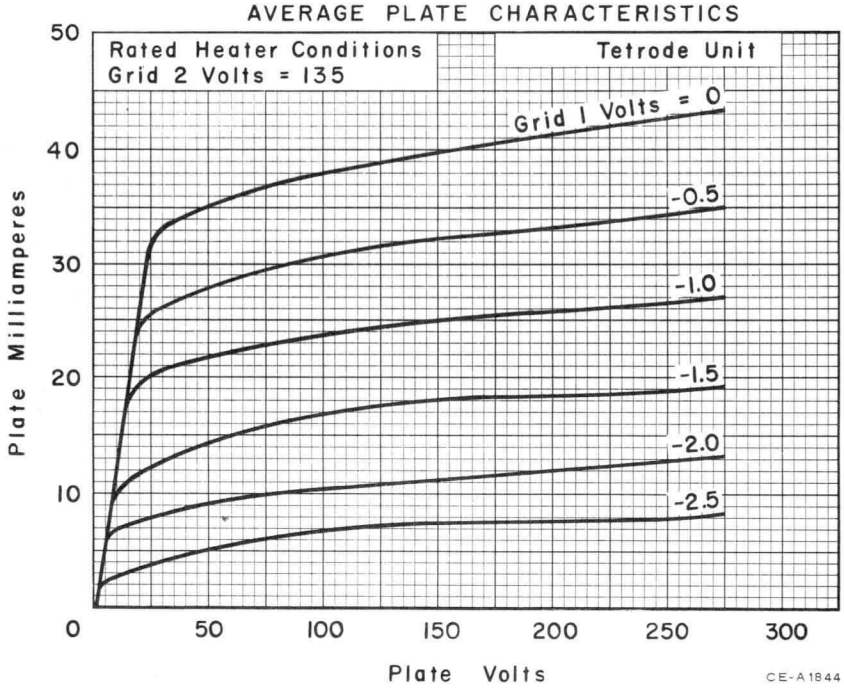
WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

NOTES

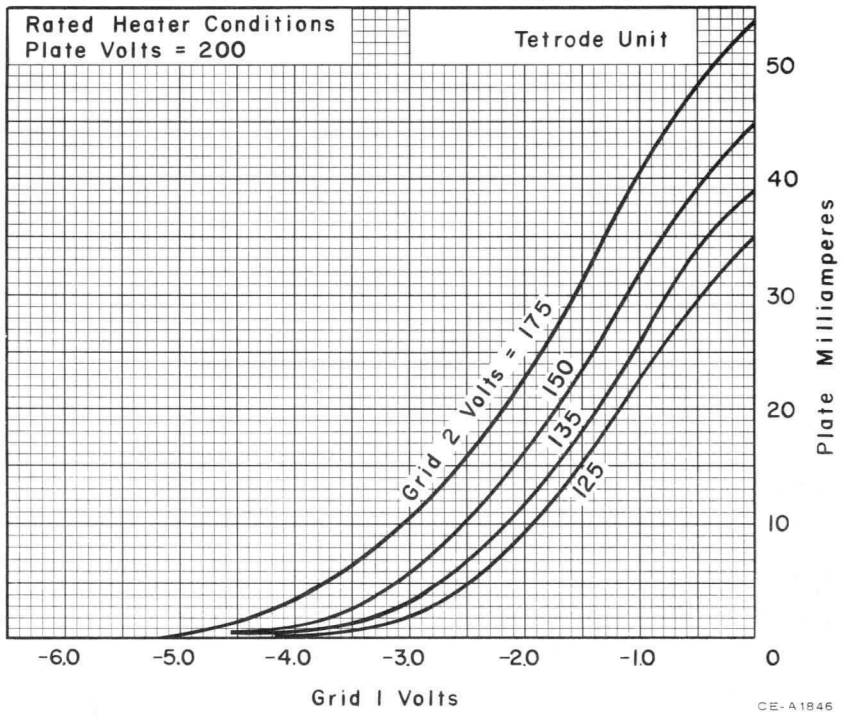
1. Heater Warm-Up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. The zero-bias values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.
3. For plate current of 10 microamperes.



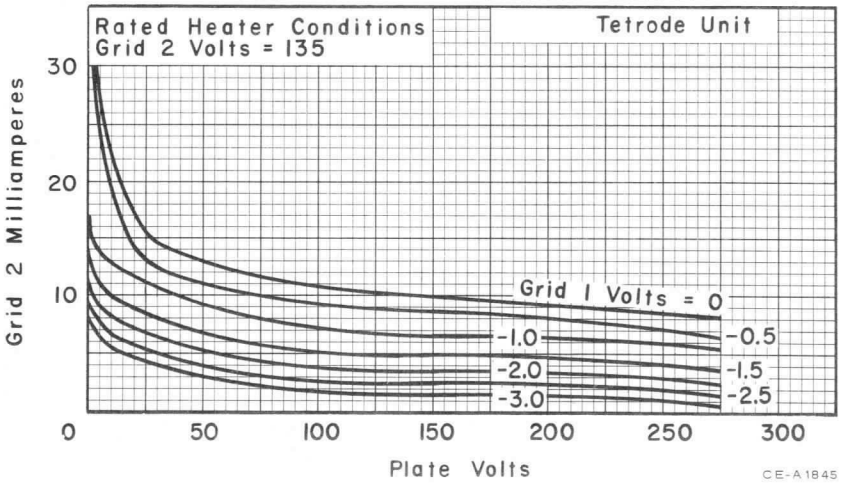
AVERAGE PLATE CHARACTERISTICS



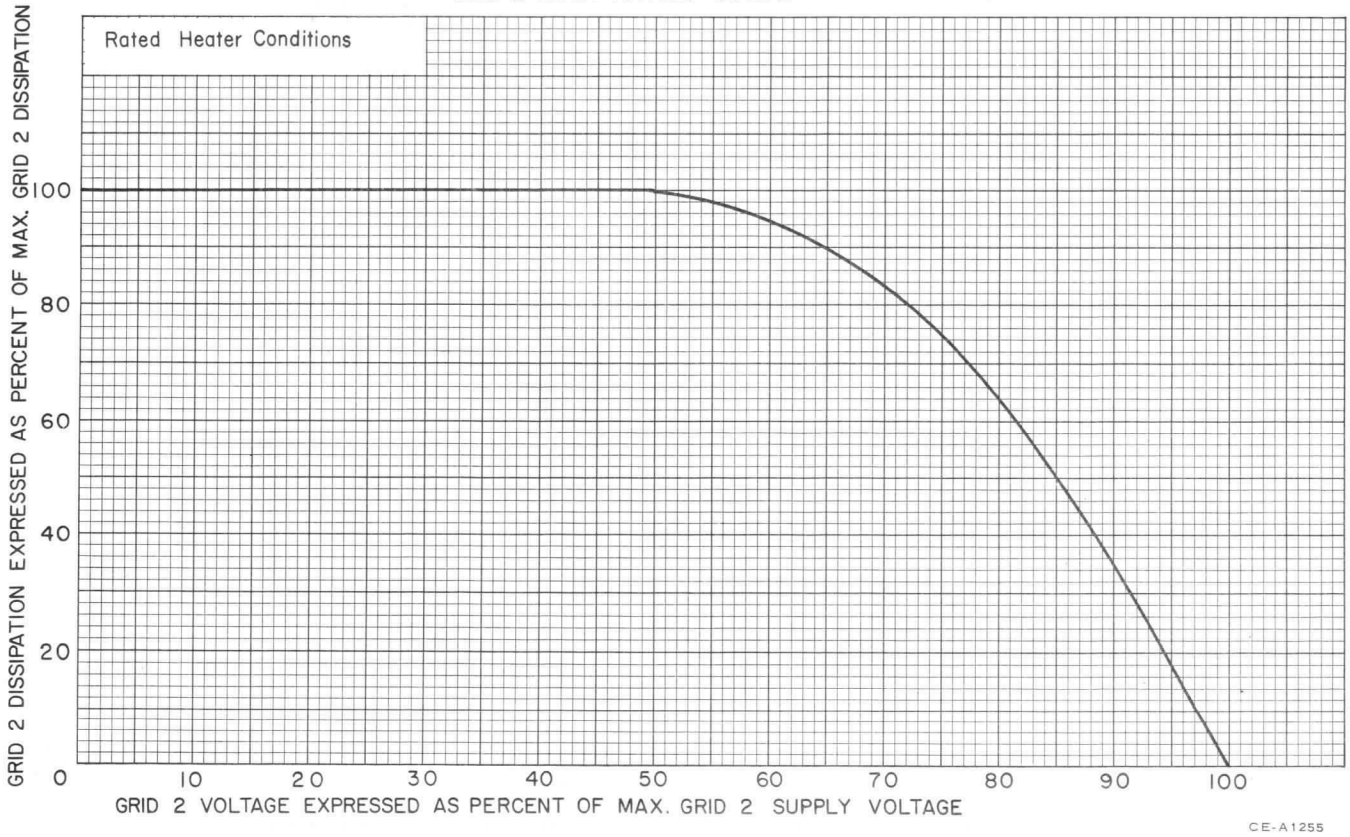
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE GRID 2 CHARACTERISTICS



GRID 2 INPUT RATING CURVE



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SHARP-CUTOFF PENTODE TYPES 3JC6, 4JC6 AND 6JC6

The 3JC6, 4JC6 and 6JC6 are sharp-cutoff, 9-pin miniature frame-grid pentode types designed for service in television receiver I.F. amplifier stages. They feature very-high transconductance and low interelectrode capacitance values. The cathode is provided with 2 terminals to increase input impedance at high frequencies. Grid 3 is connected to a separate pin to facilitate grounding. They have a specially designed internal shield to eliminate the need for an external shield.

The 3JC6 and 4JC6 have been designed for use in receivers which employ series connected heaters especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

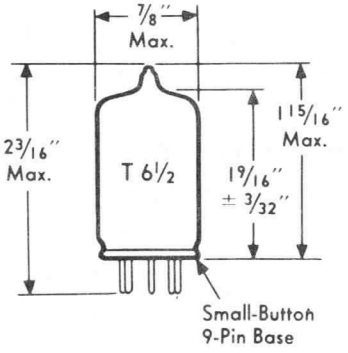
Cathode	Coated Unipotential			
Heater:	3JC6	4JC6	6JC6	
Voltage (ac or dc)	3.5	4.5	6.3±0.6	Volts
Current	0.60±0.040	0.45±0.030	0.30	Ampere
Warm-up Time (Note 1)	11	11	–	Seconds

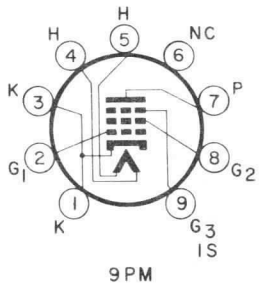
Direct Interelectrode Capacitances:

	Unshielded		
Grid 1 to Plate	0.019	max.	pf
Input	8.2		pf
Output	3.0		pf

MECHANICAL

Bulb	T-6½
Base	Miniature, 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9PM
Mounting Position	Any





9PM

RATINGS

Design Maximum Values

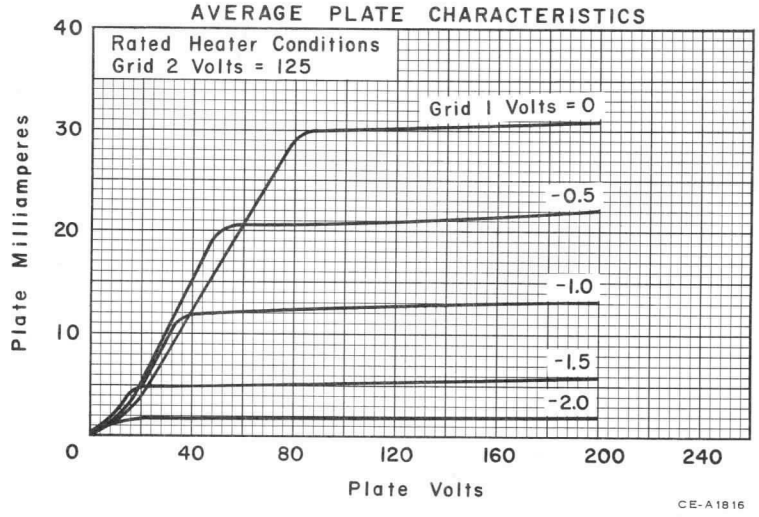
Plate Voltage	330	max.	Volts
Grid 2 Supply Voltage	330	max.	Volts
Grid 2 Voltage	See JEDEC J5-C4-2 Rating Chart		
Plate Dissipation	2.5	max.	Watts
Grid 2 Input	0.6	max.	Watt
Grid 1 Positive Bias Value	0	max.	Volts
Grid 1 Circuit Resistance:			
Cathode Resistor Bias	1	max.	Megohm
Fixed Bias	0.25	max.	Megohm
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC + Peak	200	max.	Volts
DC Component	100	max.	Volts

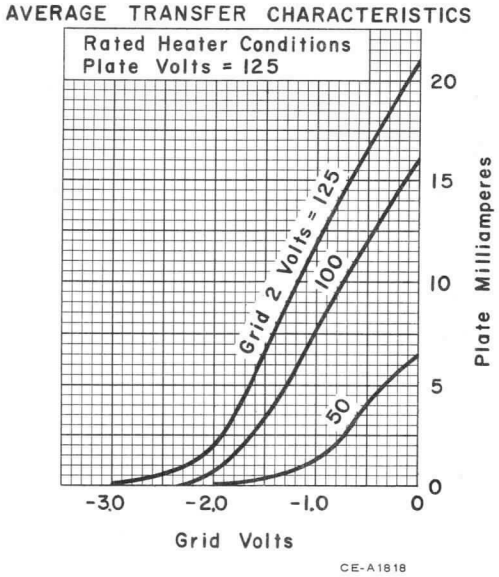
CHARACTERISTICS AND TYPICAL OPERATION

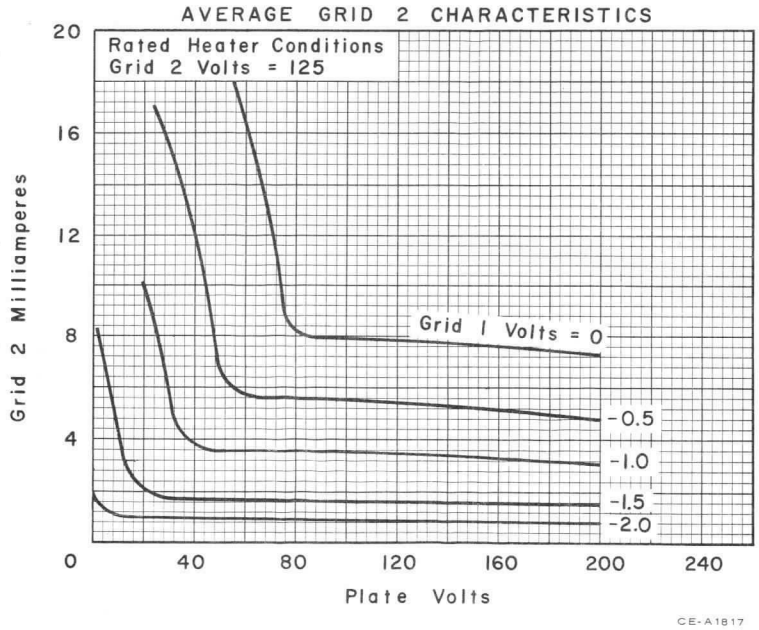
Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to cathode at socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (Approx.)	0.18	Megohm
Transconductance	15000	μmhos
Grid 1 Cutoff Bias (Note 2)	–3.0	Volts
Plate Current	13	Ma.
Grid 2 Current	3.2	Ma.

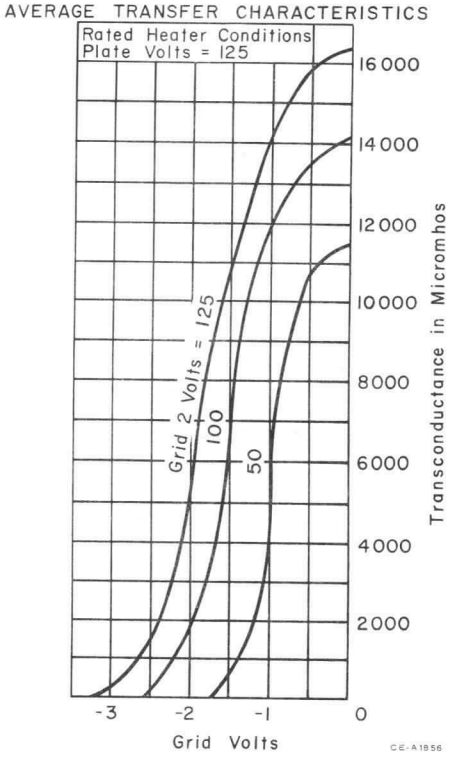
NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. For plate current of 100 microamperes.









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Westinghouse

3JD6
4JD6
6JD6

November 1, 1964

SEMI-REMOTE-CUTOFF PENTODE TYPES 3JD6, 4JD6 AND 6JD6

The 3JD6, 4JD6 and 6JD6 are semi-remote-cutoff, 9-pin miniature, frame-grid pentode types designed for service in television receiver I.F. amplifier stages. They feature very high transconductance and low interelectrode capacitance values. The cathode has 2 terminals to increase input impedance at high frequencies. Grid 3 has a separate pin to facilitate grounding. Their semi-remote cutoff characteristic is desirable for use in a g c controlled stages. They have a specially designed internal shield to eliminate the need for an external shield.

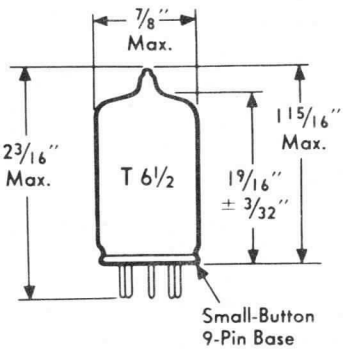
The 3JD6 and 4JD6 have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

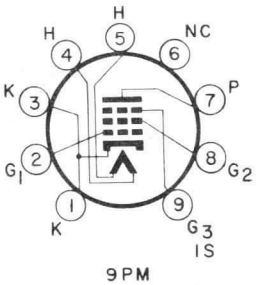
ELECTRICAL

Cathode			Coated Unipotential	
Heater:	3JD6	4JD6	6JD6	
Voltage (ac or dc)	3.5	4.5	6.3±0.6	Volts
Current	0.60±0.040	0.45±0.030	0.30	Ampere
Warm-up Time (Note 1)	11	11	–	Seconds
Direct Interelectrode Capacitances:			Unshielded	
Grid 1 to Plate			0.019 max.	pf
Input			8.2	pf
Output			3.0	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9PM
Mounting Position	Any





9PM

RATINGS

Design Maximum Values

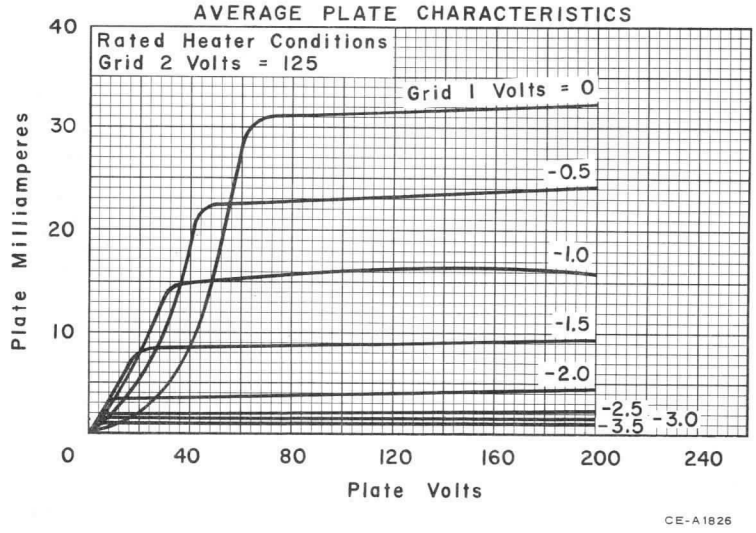
Plate Voltage	330	max.	Volts
Grid 2 Supply Voltage	330	max.	Volts
Grid 2 Voltage	See JEDEC J5-C4-2 Rating Curve		
Plate Dissipation	2.5	max.	Watts
Grid 2 Dissipation	0.6	max.	Watts
Grid 1 Positive Bias Value	0	max.	Volts
Grid 1 Circuit Resistance:			
Cathode Resistor Bias	1	max.	Megohm
Fixed Bias	0.25	max.	Megohm
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC and Peak	200	max.	Volts
Heater Positive with Respect to Cathode:			
Total DC and Peak	200	max.	Volts
DC Component	100	max.	Volts

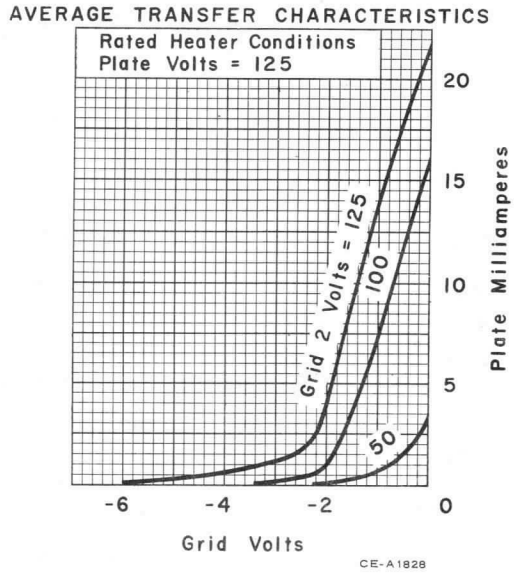
TYPICAL OPERATION AND CHARACTERISTICS

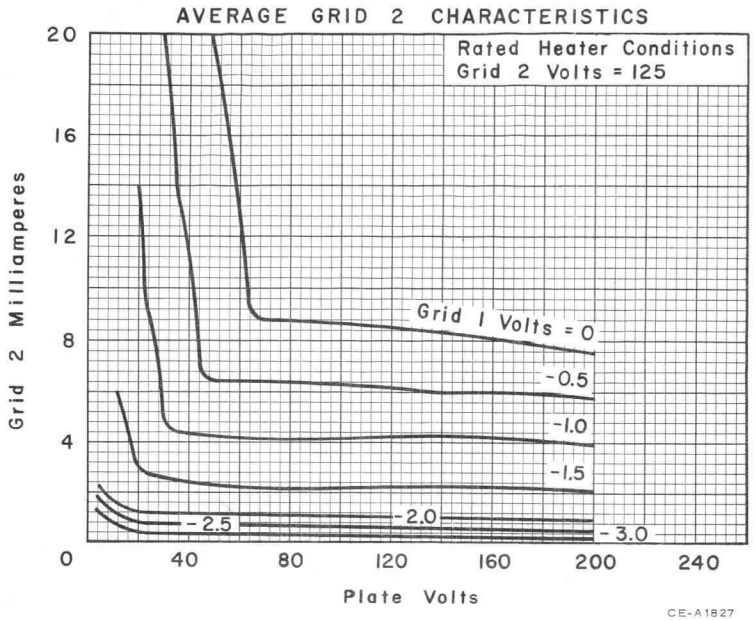
Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to Cathode at Socket	
Grid 2 Voltage	125	Volts
Cathode Bias Resistor	56	Ohms
Plate Resistance	0.16	Megohm
Transconductance	14000	μmhos
Plate Current	15	Ma.
Grid 2 Current	4.0	Ma.
Grid 1 Cutoff Bias (Note 2)	–4.5	Volts

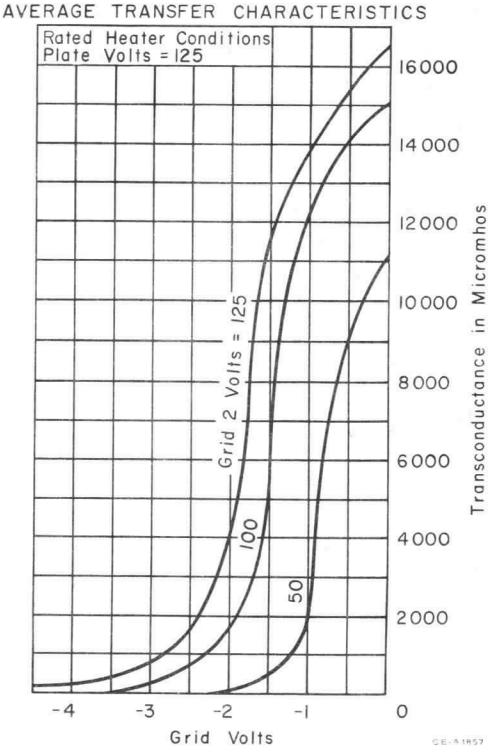
NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For transconductance of 600 μmhos.









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DUAL VHF TRIODE TYPE 6JK8

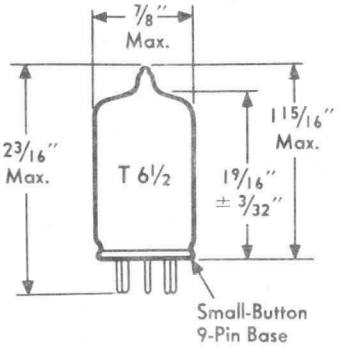
The 6JK8 is a dual VHF triode with dissimilar sections designed for use in FM tuners. Triode No. 1 (pins 6, 7 & 8) is designed for service as a combination oscillator-mixer. Triode No. 2 (pins 1, 2 & 3) features a frame grid and is intended for service as a high performance r-f amplifier.

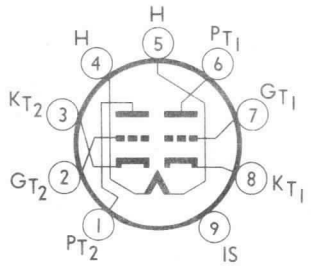
ELECTRICAL

Cathodes	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3		Volts
Current	0.40		Ampere
Direct Interelectrode Capacitances (Shielded) (Note 1):			
	Unit 1	Unit 2	
Grid to Plate	1.4	0.6	μμf
Input	3.0	5.0	μμf
Output	1.0	4.0	μμf
Heater to Cathode	2.8	2.8	μμf
Grid to Other Plate	0.003	max.	μμf
Plate to Other Plate	0.009	max.	μμf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9AJ
Mounting Position	Any





9AJ

MAXIMUM RATINGS

Design Maximum Values

	Triode No. 1 as Mixer-Oscillator	Triode No. 2 as r-f Amplifier	
Plate Voltage	165	200 max.	Volts
Negative Grid Voltage	50	50 max.	Volts
Plate Dissipation	1	2 max.	Watts
Cathode Current	22	22 max.	Ma.
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total D.C. and Peak	100	100 max.	Volts
Heater Positive with Respect to Cathode			
Total D.C. and Peak	100	100 max.	Volts
Grid Circuit Resistance (Note 2).	1.0	1.0 max.	Meg.

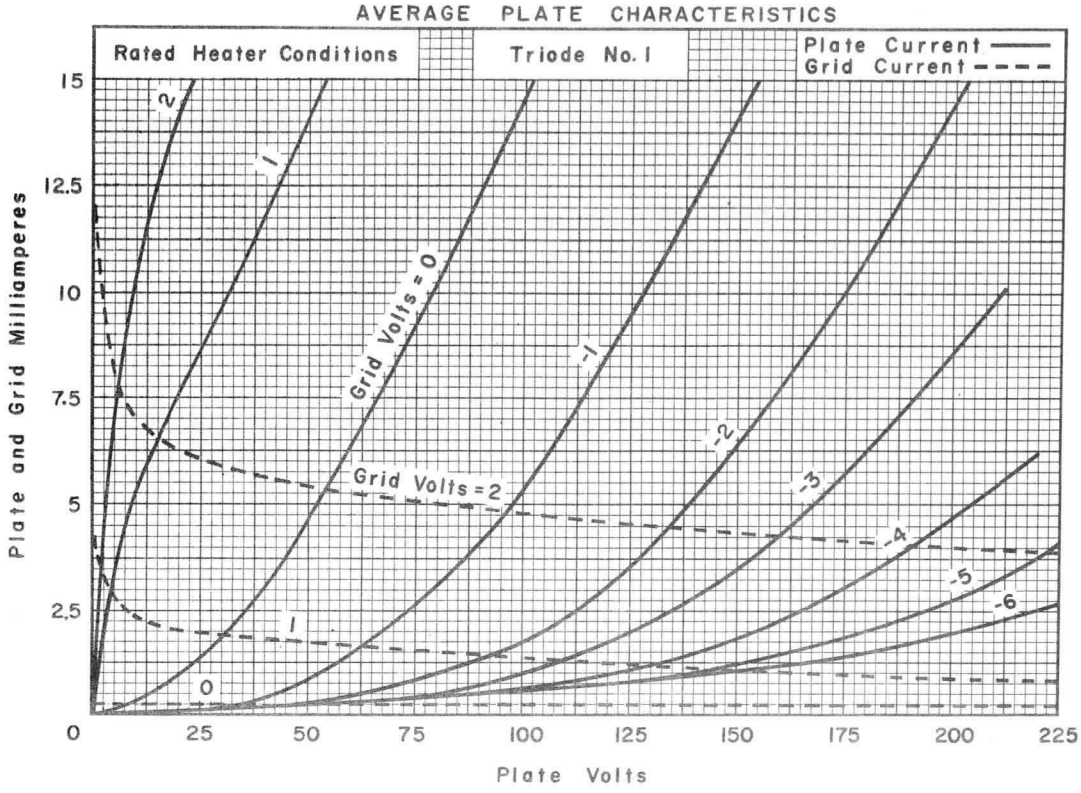
CHARACTERISTICS AND TYPICAL OPERATION

	Triode No. 1 as Mixer-Oscillator	Triode No. 2 as r-f Amplifier	
Plate Voltage	100	135	Volts
Grid Voltage	−1	−1.2	Volts
Plate Current	5.3	10	Ma.
Plate Resistance	8000	5400	Ohms
Transconductance	6800	13000	μmhos
Amplification Factor	55	70	–
Grid Voltage for Plate Current of 20 μA	−4.4	–	Volts
Grid Voltage for Transconductance of 150 μmhos	–	−5.5	Volts
Grid Voltage for Transconductance of 1500 μmhos	–	−2.8	Volts

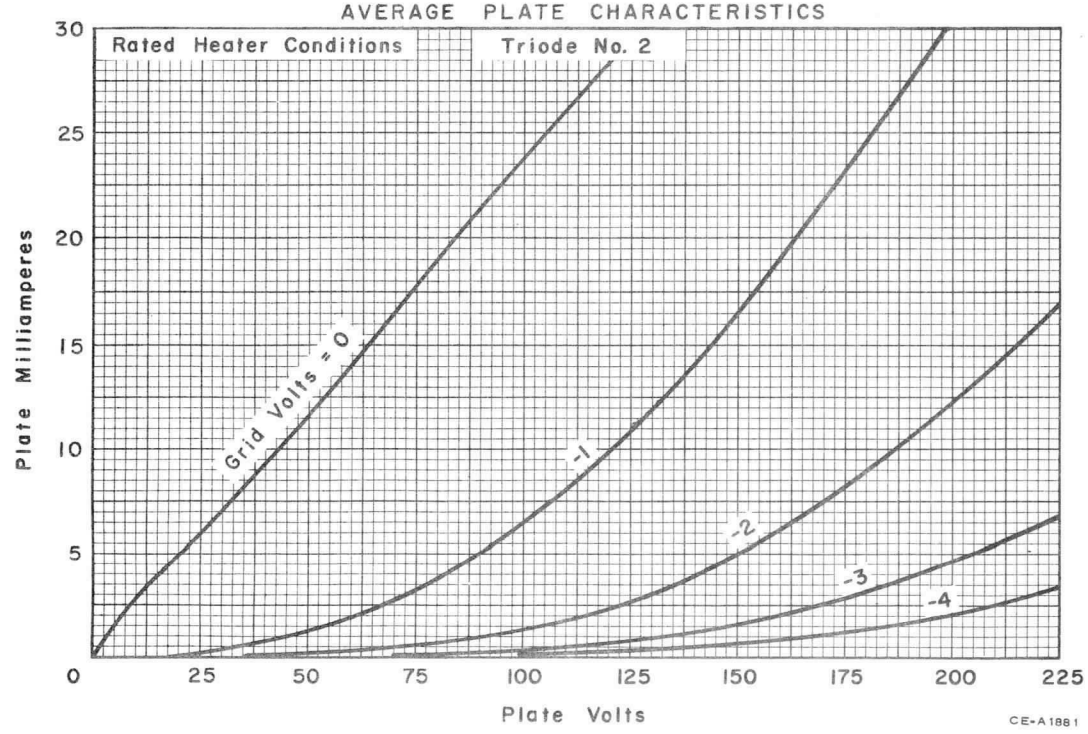
NOTES

1. With JEDEC Shield No. 315 connected to cathode of unit under test.
2. Self bias operation.

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



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HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6JM6, 12JM6 AND 17JM6

The 6JM6, 12JM6 and 17JM6 are 12-Pin, button-based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero bias plate current, high plate current to grid 2 current ratio and high DC plate supply voltage ratings. These features with a plate dissipation rating of 17.5 watts make this tube especially desirable for its designed service. Separate beam plate terminals can be used to suppress snivets.

The 12JM6 and 17JM6 have been designed for use in receivers which employ series connected heaters. When employed in this type of circuit heater voltage surges are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode		Coated Unipotential		
Filament:	6JM6	12JM6	17JM6	
Voltage (ac or dc)	6.3 ± 0.6	12.6	16.8	Volts
Current	1.20	0.60 ± 0.04	0.45 ± 0.03	Ampere
Warm-up Time (Note 1)	–	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid to Plate		0.6		pF
Input		16		pF
Output		7		pF

MECHANICAL

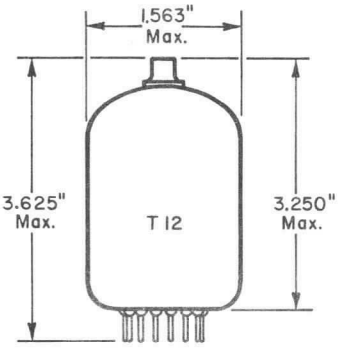
Bulb	T-12
Base	12-Pin Button (EIA E12-74)
Outline	EIA 12-79
Basing	12FJ
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER (Note 2)

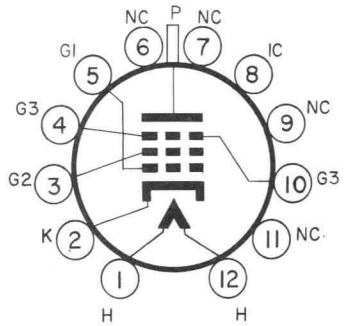
MAXIMUM RATINGS

Design Maximum Values (Note 3)

DC Plate Supply Voltage (Boost + DC Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Positive DC Beam Plate Voltage	70	max.	Volts
Plate Dissipation (Note 4)	17.5	max.	Watts
Negative DC Grid 1 Voltage	55	max.	Volts
Peak Negative Grid 1 Voltage	330	max.	Volts
DC Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.5	max.	Watts
Average Cathode Current	175	max.	mA
Peak Cathode Current	550	max.	mA
Grid 1 Circuit Resistance (Note 5)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



12-79



EIA 12FJ

AVERAGE CHARACTERISTICS

Beam Plates Connected to Cathode at Socket

PENTODE OPERATION

Plate Voltage	250	Volts
Grid 2 Voltage	150	Volts
Grid 1 Voltage	−22.5	Volts
Plate Current	65	mA
Grid 2 Current	1.8	mA
Transconductance	7300	μmhos
Plate Resistance	18000	Ohms

ZERO BIAS

Plate Voltage (Note 6)	60	Volts
Grid 2 Voltage (Note 6)	150	Volts
Plate Current (Note 7)	345	mA
Grid 2 Current (Note 7)	27	mA

CUTOFF

Plate Voltage	5000	250	Volts
Grid 2 Voltage	150	150	Volts
Plate Current	1	1	mA
Grid 1 Voltage (Approx.)	−100	−42	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	150	Volts
Grid 2 Voltage	Connected to plate	
Grid 1 Voltage	−22.5	Volts
Amplification Factor	4.4	–

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.
3. Design-Maximum Ratings are the limiting values expressed with respect to bogie tubes at which satisfactory tube life can be expected to occur in the types of service for which the tube is rated. Therefore the equipment designed must establish the circuit design so that initially and throughout equipment life no Design-Maximum value is exceeded with a bogie tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation and environmental conditions.
4. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
5. Using grid-leak bias.
6. Applied for short interval (maximum of 2 seconds) so as not to damage tube.
7. These values can be measured by a method involving a re-current waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6JN6, 12JN6 AND 17JN6

The 6JN6, 12JN6 and 17JN6 are 12-Pin, button-based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. These types are characterized by high zero bias plate current, high plate current to grid 2 current ratio and high DC plate supply voltage ratings. These features with a plate dissipation rating of 17.5 watts make this tube especially desirable for its designed service. Separate beam plate terminals can be used to suppress snivets.

The 12JN6 and 17JN6 have been designed for use in receivers which employ series connected heaters. When employed in this type of circuit heater voltage surges are minimized inasmuch as heater warm-up characteristic is controlled.

ELECTRICAL

Cathode		Coated Unipotential		
Filament:	6JN6	12JN6	17JN6	
Voltage (ac or dc)	6.3±0.6	12.6	16.8	Volts
Current	1.20	0.60±0.03	0.45±0.03	Ampere
Warm-up Time (Note 1)	–	11	11	Seconds
Direct Interelectrode Capacitances (Unshielded):				
Grid 1 to Plate		0.34		pF
Input		16		pF
Output		7		pF

MECHANICAL

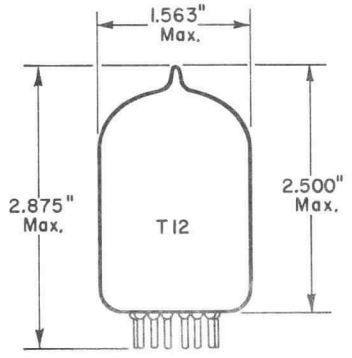
Bulb	T-12
Base	12-Pin Button (EIA E12-74)
Basing	12FK
Mounting Position	Any

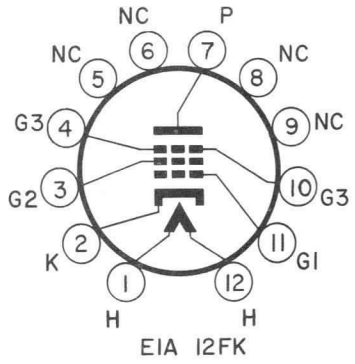
HORIZONTAL DEFLECTION AMPLIFIER (Note 2)

MAXIMUM RATINGS

Design Maximum Values (Note 3)

DC Plate Supply Voltage (Boost + DC Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Positive DC Beam Plate Voltage	70	max.	Volts
Plate Dissipation (Note 4)	17.5	max.	Watts
Negative DC Grid 1 Voltage	55	max.	Volts
Peak Negative Grid 1 Voltage	330	max.	Volts
DC Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.5	max.	Watts
Average Cathode Current	175	max.	mA
Peak Cathode Current	550	max.	mA
Grid 1 Circuit Resistance (Note 5)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts





EIA 12FK

AVERAGE CHARACTERISTICS

Beam Plates Connected to Cathode at Socket

PENTODE OPERATION			
Plate Voltage		250	Volts
Grid 2 Voltage		150	Volts
Grid 1 Voltage		−22.5	Volts
Plate Current		65	mA
Grid 2 Current		1.8	mA
Transconductance		7300	μmhos
Plate Resistance		18000	Ohms
ZERO BIAS			
Plate Voltage (Note 6)		60	Volts
Grid 2 Voltage (Note 6)		150	Volts
Plate Current (Note 7)		345	mA
Grid 2 Current (Note 7)		27	mA
CUTOFF			
Plate Voltage	5000	250	Volts
Grid 2 Voltage	150	150	Volts
Plate Current	1	1	mA
Grid 1 Voltage (Approx.)	−100	−42	Volts
TRIODE AMPLIFICATION FACTOR			
Plate Voltage		150	Volts
Grid 2 Voltage		Connected to plate	
Grid 1 Voltage		−22.5	Volts
Amplification Factor		4.4	—

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.
3. Design-Maximum Ratings are the limiting values expressed with respect to bogie tubes at which satisfactory tube life can be expected to occur in the types of service for which the tube is rated. Therefore the equipment designed must establish the circuit design so that initially and throughout equipment life no Design-Maximum value is exceeded with a bogie tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation and environmental conditions.
4. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
5. Using grid-leak bias.
6. Applied for short interval (maximum of 2 seconds) so as not to damage tube.
7. These values can be measured by a method involving a re-current waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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March 1, 1965

HORIZONTAL AMPLIFIER BEAM–POWER PENTODE TYPE 6JS6A

The 6JS6A is a 12-pin button based beam-power pentode type designed for service as output amplifier in horizontal deflection circuits in color television receivers. The 6JS6A is unilaterally interchangeable with the type 6JS6 and differs in having a lower plate knee voltage. Separate terminals for the beam plates can be used to minimize snivets.

ELECTRICAL

Cathode	Coated Unipotential	
Filament:		
Voltage (ac or dc)	6.3±0.6	Volts
Current	2.25	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Grid 1 to Plate	0.7	pF
Input	24	pF
Output	10	pF

MECHANICAL

Bulb	T-12
Base	EIA E12-74
Outline	EIA 12-89
Basing	EIA 12FY
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER (Note 1)

MAXIMUM RATINGS

Design Maximum Values

DC Plate Supply Voltage (Boost + DC Power Supply)	990	max.	Volts
Peak Positive Plate Voltage (Abs.)	7500	max.	Volts
Peak Negative Pulse Plate Voltage	1100	max.	Volts
Positive DC Beam Plate Voltage	70	max.	Volts
DC Grid 2 Voltage	190	max.	Volts
Peak Negative Grid 1 Voltage	250	max.	Volts
Plate Dissipation (Note 2)	28	max.	Watts
Grid 2 Dissipation	5.5	max.	Watts
Average Cathode Current	315	max.	mA
Peak Cathode Current	1100	max.	mA
Grid 1 Circuit Resistance (Note 3)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	225	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

AVERAGE CHARACTERISTICS

Beam Plates Connected to Cathode

PENTODE OPERATION

Plate Voltage	175	Volts
Grid 2 Voltage	125	Volts
Grid 1 Voltage	–25	Volts
Plate Current	125	mA
Grid 2 Current	4.5	mA
Transconductance	11300	μmhos
Plate Resistance	5600	Ohms

ZERO BIAS

Plate Voltage (Note 4)	62	Volts
Grid 2 Voltage (Note 4)	125	Volts
Plate Current (Note 5)	570	mA
Grid 2 Current (Note 5)	34	mA

CUTOFF

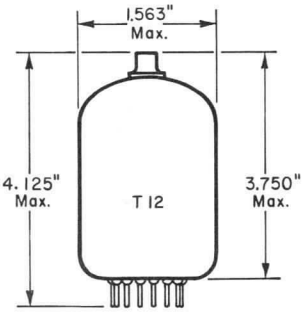
Plate Voltage	175	5000	Volts
Grid 2 Voltage	125	125	Volts
Plate Current	1	1	mA
Grid 1 Voltage (Approx.)	–54	–140	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	125	Volts
Grid 2 Voltage	125	Volts
Grid 1 Voltage	–25	Volts
Amplification Factor	3	–

NOTES

1. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.
2. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.
3. Using grid-leak bias.
4. Applied for short interval (maximum of 2 seconds) so as not to damage tube.
5. These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.



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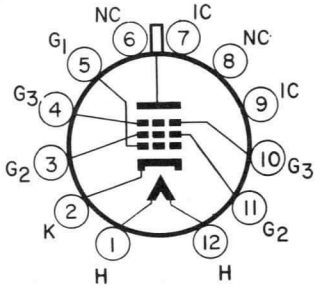

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HIGH-MU TRIODE-SHARP-CUTOFF PENTODE TYPE 6JT8

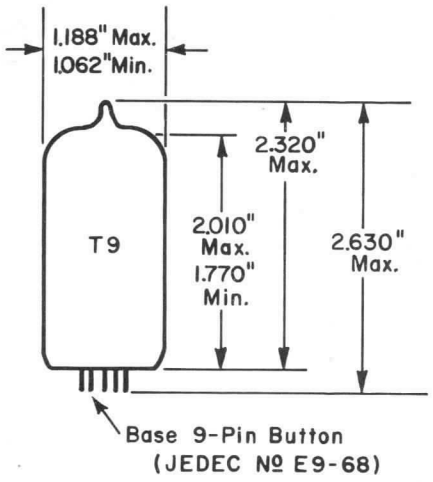
The 6JT8 is a 9-T9 bulb, high-mu triode and sharp-cutoff pentode type designed for service in television receivers. The triode unit is designed for service as a sync separator, sync clipper and phase inverter while the high-gm, frame-grid pentode unit is designed for operation as a video amplifier.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	0.725		Ampere
Direct Interelectrode Capacitances: (Unshielded)			
Triode			
Grid to Plate	3.2		μμf
Input	1.7		μμf
Output	1.6		μμf
Pentode			
Grid 1 to Plate	0.075	max.	μμf
Input	13		μμf
Output	3		μμf
Coupling			
Pentode Grid 1 to Triode Plate	0.004	max.	μμf
Pentode Plate to Triode Grid	0.02	max.	μμf
Pentode Plate to Triode Plate	0.13	max.	μμf

MECHANICAL

Bulb	T-9
Base	Miniature 9-Pin (JEDEC E9-68)
Outline	9-69
Basing	9DX
Mounting Position	Any



9-69

MAXIMUM RATINGS

Design Maximum Values

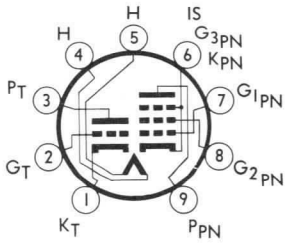
	Triode	Pentode		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Chart		
Plate Dissipation	1.0	4	max.	Watts
Grid 2 Dissipation	–	1.1	max.	Watts
Positive Grid 1 Bias Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC + Peak	200	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

	Triode	Pentode		
Plate Voltage	250	35	200	Volts
Grid 2 Voltage	–	100	100	Volts
Grid 1 Voltage	–2	0	–	Volts
Cathode Bias Resistor	–	–	82	Ohms
Amplification Factor	100	–	–	–
Plate Resistance (Approx.)	37000	–	50000	Ohms
Transconductance	2700	–	20000	μmhos
Plate Current (Note 1)	1.5	50	17	Ma.
Grid 2 Current (Note 1)	–	17	3.5	Ma.
Grid 1 Voltage (Note 2)	–5.3	–	–5	Volts

NOTES

1. Zero bias pentode values can be measured by a method involving a re-current waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.
2. For plate current of 20 microamperes in triode unit and 100 microamperes in pentode unit.



9DX

QUADRUPLE DIODE TYPE 6JU8A

The 6JU8A is a 9-pin miniature quadruple diode designed for service in color TV receivers and in stereo multiplex equipment. In color TV service the 6JU8A performs well in phase-detector and noise-immune color-killer circuits. In stereo multiplex service the 6JU8A is used in bridge-matrixing circuits. The internal connections particularly recommend the 6JU8A for the latter service.

ELECTRICAL

Cathodes	Coated Unipotential
Heater:	
Voltage	6.3 ± 0.6 Volts
Current	0.60 Ampere
Direct Interelectrode Capacitances: (Unshielded)	
Plate Unit 1 & Cathode Unit 2 to Cathode Unit 1	1.8 pF
Plate Unit 1 & Cathode Unit 2 to Plate Unit 2	2.2 pF
Plate Unit 2 to Internal Shield & Heater	0.62 pF
Plate Unit 3 & Cathode Unit 4 to Cathode Unit 3	1.9 pF
Plate Unit 3 & Cathode Unit 4 to Plate Unit 4	2.2 pF
Plate Unit 4 to Internal Shield & Heater	0.94 pF
Cathode Unit 1 to Internal Shield & Heater	1.8 pF
Cathode Unit 3 to Internal Shield & Heater	1.9 pF

MECHANICAL

Bulb	T-6½
Base	9-Pin Miniature (EIA E9-1)
Outline	EIA 6-2
Basing	EIA 9PQ
Mounting Position	Any

MAXIMUM RATINGS: (Per Unit)

Design Maximum Values (Note 1)

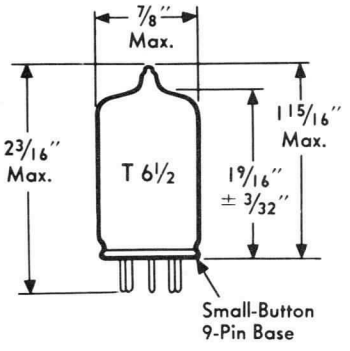
Peak Inverse Plate Voltage	300 max.	Volts
Peak Plate Current Per Plate	54 max.	mA
DC Output Current Per Plate	.9 max.	mA
Peak Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode	300 max.	Volts
Heater Positive with Respect to Cathode	300 max.	Volts

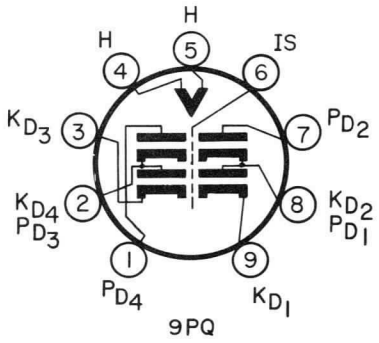
CHARACTERISTIC (Per Unit)

Plate Voltage (Note 2)	10	Volts
Plate Current (Note 2)	60	mA

NOTES

1. Design-Maximum Ratings are the limiting values expressed with respect to bogie tubes at which satisfactory tube life can be expected to occur in the types of service for which the tube is rated. Therefore the equipment designed must establish the circuit design so that initially and throughout equipment life no Design-Maximum value is exceeded with a bogie tube under the worst probable operating conditions with respect to supply-voltage variation, equipment control adjustment, load variation and environmental conditions.
2. Duty cycle of applied voltage must be such that Rated DC plate current is not exceeded.





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WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

HORIZONTAL AMPLIFIER BEAM-POWER PENTODE TYPES 6JZ6 AND 21JZ6

The 6JZ6 and 21JZ6 are 12-pin button based beam-power pentode types designed for service as output amplifier in horizontal deflection circuits in television receivers. They feature a separate grid 3 connection to help control snivets.

The 21JZ6 has been designed for use in receivers which employ series connected heaters. When employed in this type of circuit, heater voltage surges are minimized because heater warm-up characteristic is controlled.

ELECTRICAL

Cathode	Coated Unipotential		
Filament:	6JZ6	21JZ6	
Voltage (ac or dc)	6.3 ± 10%	21	Volts
Current	1.5	0.45 ± 6%	Ampere
Warm-up Time (Note 1)	–	11	Seconds
Direct Interelectrode Capacitances (Unshielded):			
Grid 1 to Plate	0.34		pF
Input	24		pF
Output	8.5		pF

MECHANICAL

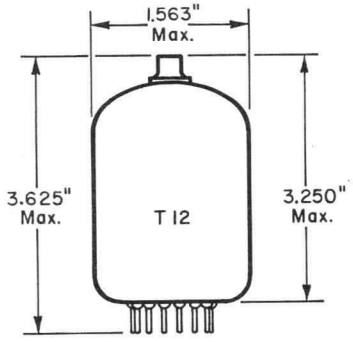
Bulb	T-12
Base	EIA E12-74
Outline	EIA 12-79
Basing	EIA 12GD
Top Cap	C1-3, Skirted Miniature
Mounting Position	Any

HORIZONTAL DEFLECTION AMPLIFIER (Note 2)

MAXIMUM RATINGS

Design Maximum Values

DC Plate Supply Voltage (Boost + DC Power Supply)	770	max.	Volts
Peak Positive Plate Voltage	6500	max.	Volts
Peak Negative Pulse Plate Voltage	1500	max.	Volts
Plate Dissipation (Note 3)	18	max.	Watts
Positive DC Beam-Plate Voltage	70	max.	Volts
Negative DC Grid 1 Voltage	55	max.	Volts
Peak Negative Grid 1 Voltage	330	max.	Volts
DC Grid 2 Voltage	220	max.	Volts
Grid 2 Dissipation	3.5	max.	Watts
Average Cathode Current	230	max.	mA
Peak Cathode Current	800	max.	mA
Grid 1 Circuit Resistance (Note 4)	1.0	max.	Megohm
Bulb Temperature (At Hottest Point)	220	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts



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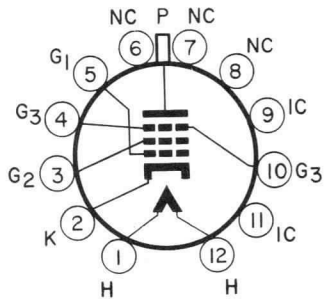

12 GD

AVERAGE CHARACTERISTICS

PENTODE OPERATION

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Grid 1 Voltage	−20	Volts
Plate Current	46	mA
Grid 2 Current	1.8	mA
Transconductance	9000	μmhos
Plate Resistance	9900	Ohms

ZERO BIAS

Plate Voltage	50	Volts
Grid 2 Voltage	130	Volts
Plate Current (Note 5)	450	mA
Grid 2 Current (Note 5)	29	mA

CUTOFF

Plate Voltage	130	5000	Volts
Grid 2 Voltage	130	130	Volts
Plate Current	1	1	mA
Grid 1 Voltage (Approx.)	−32	−64	Volts

TRIODE AMPLIFICATION FACTOR

Plate Voltage	130	Volts
Grid 2 Voltage	130	Volts
Grid 1 Voltage	−20	Volts
Amplification Factor	4.8	–

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

2. For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of the scanning cycle.

3. In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.

4. Using grid-leak bias.

5. These values can be measured by a method involving a recurrent waveform that such the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.

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May 15, 1965

MEDIUM-MU TRIODE, BEAM-PENTODE TYPE 17JZ8A

The 17JZ8A is a medium-mu triode, beam-power pentode in a T-9 bulb with a 12-Pin button base. It is designed to perform as the vertical deflection oscillator and amplifier in television receivers. The 17JZ8A is a higher plate current version of the 17JZ8 to ensure adequate vertical deflection.

The 17JZ8A has controlled heater warm-up time to ensure reliability in series heater circuits.

ELECTRICAL

Cathodes	Coated Unipotential	
Heater:		
Voltage (ac or dc)	16.8	Volts
Current	0.45 ± 0.03	Ampere
Warm-up Time (Note 1)	11	Seconds

Direct Interelectrode Capacitances (Unshielded):

	Pentode	Triode	
Grid 1 to Plate	0.34	3.6	pF
Input (G1 to H, K, G2 & BP)	11	2.2	pF
Output (P to H, K, G2 & BP)	7.0	0.7	pF

MECHANICAL

Bulb	T-9
Base	12-Pin Button (JEDEC E12-70)
Outline	9-58
Basing	12DZ
Mounting Position	Any

MAXIMUM RATINGS

Design Maximum Values

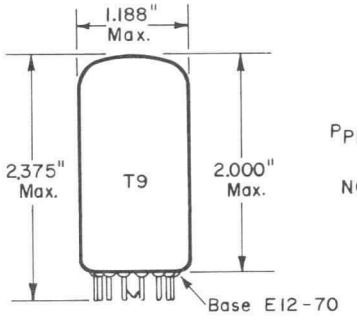
	Triode as Vertical Deflection Oscillator (Note 2)	Pentode as Vertical Deflection Amplifier (Note 2)		
Plate Voltage	250	250	max.	Volts
Peak Positive Pulse Plate Voltage (Abs.Max.)	–	2000	max.	Volts
Grid 2 Voltage	–	200	max.	Volts
Peak Negative Pulse Grid Voltage	400	150	max.	Volts
Plate Dissipation	1.0	8	max.	Watts
Grid 2 Dissipation	–	2	max.	Watts
Cathode Current	20	70	max.	mA
Peak Cathode Current	70	245	max.	mA
Heater-Cathode Voltage				
Heater Negative with Respect to Cathode				
Total DC and Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
Total DC and Peak	200	200	max.	Volts
Grid 1 Circuit Resistance:				
Fixed Bias	1.0	1.0	max.	Megohms
Cathode Resistor Bias	2.2	2.2	max.	Megohms

CHARACTERISTICS AND TYPICAL OPERATION

	Triode	Pentode		
Plate Voltage (Note 3)	150	120	45	Volts
Grid 2 Voltage (Note 3)	–	110	110	Volts
Grid Voltage	–5	–8	0	Volts
Plate Current	5.5	56	132	mA
Grid 2 Current	–	3.5	19	mA
Plate Resistance	8500	13100	–	Ohms
Transconductance	2350	7700	–	μmhos
Amplification Factor	20	–	–	–
Grid Cutoff Voltage	–11 (Note 4)	–25 (Note 5)	–	Volts

NOTES

1. Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.
3. Pentode zero bias values must only be applied for a short interval, (2 seconds max.) to prevent damage.
4. For Plate Current of 10 microamperes.
5. For Plate Current of 100 microamperes.



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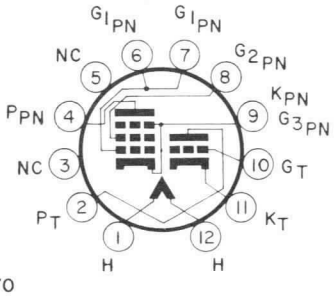
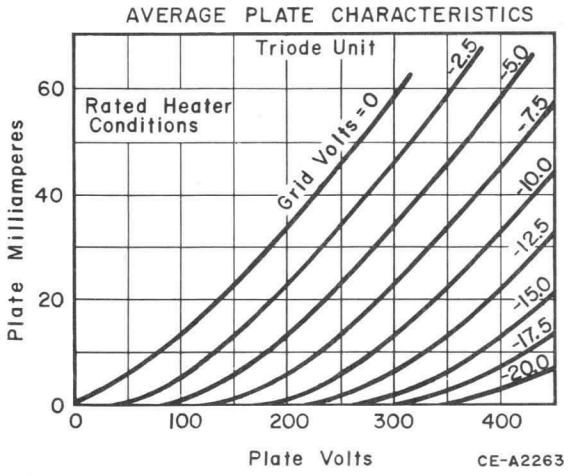
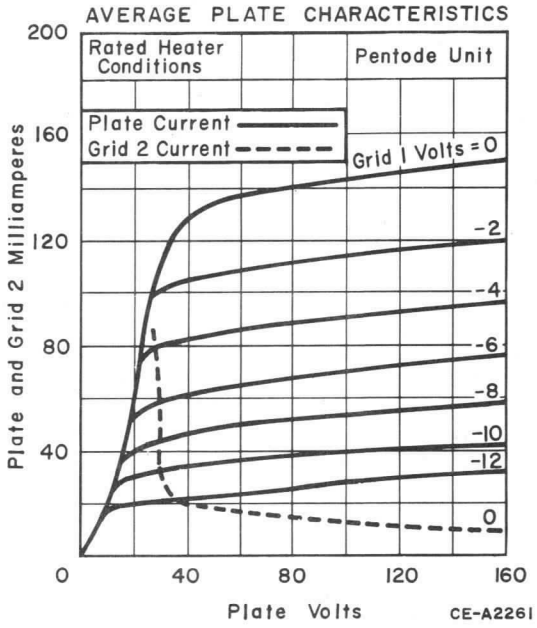
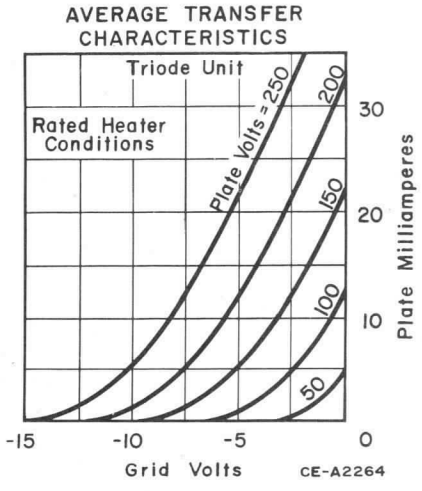
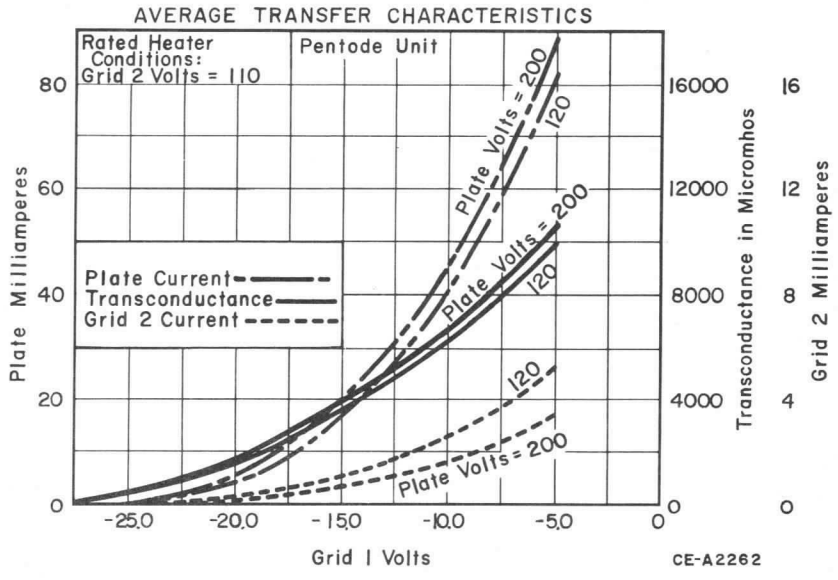


12 DZ









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November 1, 1959

TV HIGH VOLTAGE RECTIFIER TYPE 1K3

The 1K3 is a glass octal, directly heated half wave rectifier designed for service as the high voltage rectifier in flyback type picture tube anode power supplies. Compact size is achieved with high inter-element insulation and high inverse voltage ratings.

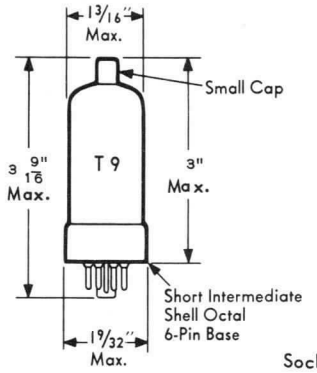
GENERAL DATA

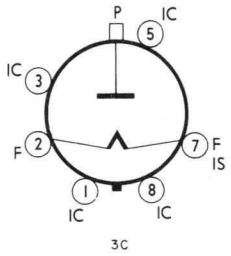
ELECTRICAL:

Filament (Coated):		
Voltage (ac or dc)	1.25*	Volts
Current	0.2	Ampere
Direct Interelectrode Capacitances (Unshielded):		
Plate to Filament	1.6	uuf

MECHANICAL:

Bulb	T-9
Base	Intermediate-Shell Octal 6-Pin (JETEC B6-8)
	Short Intermediate-Shell Octal 6-Pin (JETEC B6-60)
Basing	3C
Mounting Position	Any





3C

BOTTOM VIEW

Socket terminals 4 and 6 may be used as tie points as or near filament potential. Terminals 1,3,4,5,6, and 8 may be connected to terminal 7 to reduce corona discharge.

FLYBACK RECTIFIER SERVICE †

MAXIMUM RATINGS:

Design-Maximum Values ▲

Peak Inverse Plate Voltage:			
DC Component	22000	max.	Volts
Total DC and Peak	26000	max.	Volts
Steady-State Peak Plate Current	50	max.	Ma.
DC Output Current	0.5	max.	Ma.

AVERAGE CHARACTERISTICS:

Tube Voltage Drop, approx.:		
Plate Current = 7.0 Ma.	225	Volts

* The filament voltage must never be less than 1.05 volts or more than 1.45 volts.

† For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Station, Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15 per cent of one scanning cycle.

▲ Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, taking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

NOTE: Inasmuch as the tube rating permits operation at high voltage, shielding of the tube for x-ray radiation may be needed.

HIGH-MU TRIODE - SHARP-CUTOFF PENTODE TYPE 6KT8

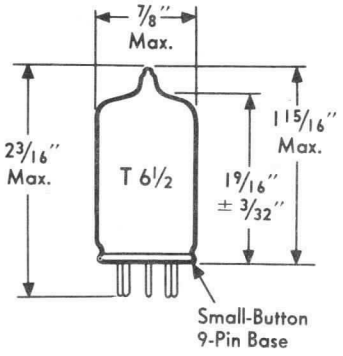
The 6KT8 is a 9-pin miniature high-mu triode and sharp-cutoff pentode type designed for service in color and black-and-white television receivers. The triode unit may serve as a sync separator, sync clipper or phase inverter while the pentode unit may be used as a video amplifier. The 6KT8 is also used in color amplifier and killer circuits.

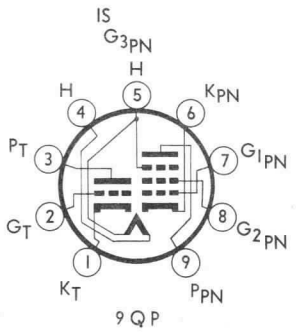
ELECTRICAL

Cathode	Coated Unipotential		
Heater:			
Voltage (ac or dc)	6.3 ± 10%		Volts
Current	0.60		Ampere
Direct Interelectrode Capacitances:			
Triode	Unshielded	Shielded (Note 1)	
Grid to Plate	3.0	3.0	pF
Input	3.2	3.2	pF
Output	1.6	2.4	pF
Pentode			
Grid 1 to Plate	0.046	0.03 max.	pF
Input	7.5	7.5	pF
Output	2.2	2.8	pF
Coupling			
Pentode Grid 1 to Triode Plate	0.006	0.002 max.	pF
Pentode Plate to Triode Grid	0.018	0.003 max.	pF

MECHANICAL

Bulb	T-6½
Base	Miniature 9-Pin (JEDEC E9-1)
Outline	6.2
Basing	9QP
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

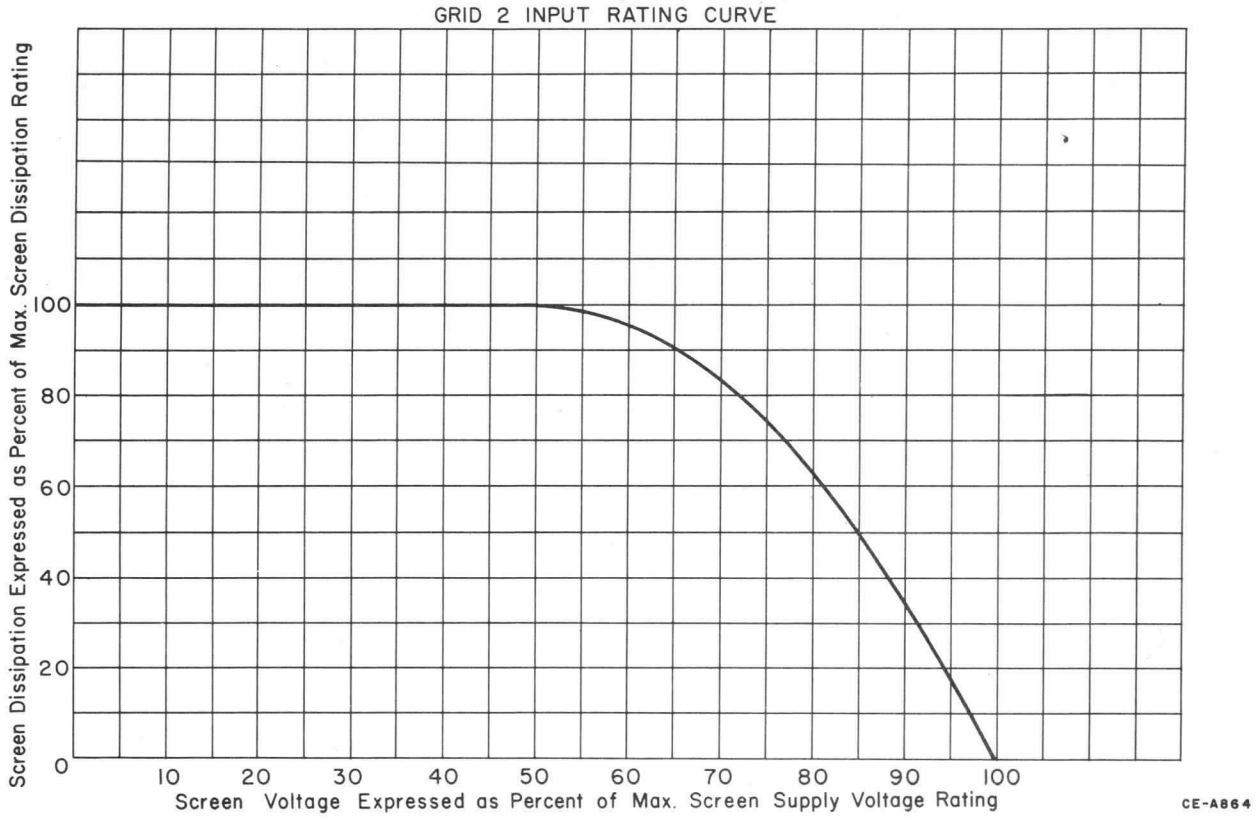
	Triode	Pentode		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Chart		
Plate Dissipation	1.0	2.5	max.	Watts
Grid 2 Dissipation	–	0.55	max.	Watts
Positive Grid 1 Bias Voltage	0	0	max.	Volts
Grid 1 Circuit Resistance				
Fixed Bias	0.5	0.25	max.	Megohm
Cathode Resistor Bias	1.0	1.0	max.	Megohm
Heater-Cathode Voltage: (Note 2)				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	20	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	20	max.	Volts
Total DC + Peak	200	20	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION

	Triode	Pentode	
Plate Voltage	250	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–2	–1	Volts
Amplification Factor	100	–	–
Plate Resistance (Approx.)	31500	150000	Ohms
Transconductance	3200	10000	μmhos
Plate Current	1.8	12	Ma.
Grid 2 Current	–	4.5	Ma.
Grid 1 Cutoff Voltage (Note 3)	–3.5	–7	Volts

NOTES

1. With EIA Shield No. 315 connected to pins 4 & 5.
2. Due to the element connections, this tube must be operated with pin 5 at or near ground potential. Pentode grid 3, internal shield and one side of the heater all connect to pin 5. The instantaneous total cathode to grid 3 voltage may not exceed plus 20 volts.
3. For plate current of 20 microamperes.



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December 15, 1963

TRIODE-PENTODE CONVERTER TYPE 6KZ8

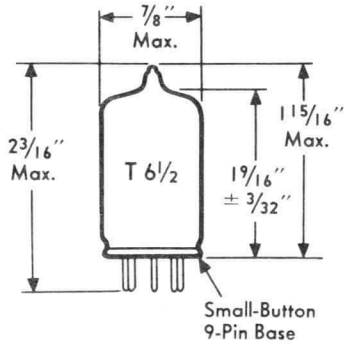
The 6KZ8 is a 9-Pin miniature medium-mu triode and sharp-cutoff pentode type designed for service as combined oscillator and mixer in television receiver tuners.

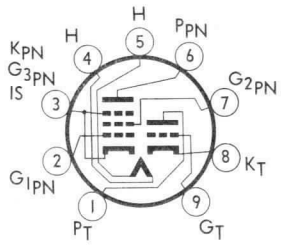
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3±0.6	Volts
Current	0.45	Amperes
Direct Interelectrode Capacitances: (Note 1)		
Triode Unit		
Grid to Plate	1.6	pf
Input	3.2	pf
Output	0.9	pf
Heater to Cathode (Note 2)	3.2	pf
Pentode Unit		
Grid 1 to Plate	0.01 max.	pf
Input	5.5	pf
Output	3.4	pf
Heater to Cathode (Note 2)	3.2	pf

MECHANICAL

Bulb	T-6½
Base	Miniature 9-pin (JEDEC E9-1)
Basing	9FZ
Outline	6-2
Mounting	Any





9FZ

MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit	
Plate Voltage	330	330 max.	Volts
Grid 2 (Screen) Voltage	–	See Grid 2 Input Rating Curve	
Grid 2 Supply Voltage	–	330 max.	Volts
Grid 1 (Control Grid) Voltage Positive Bias Value	0	0 max.	Volts
Plate Dissipation	2.5	2.5 max.	Watts
Grid 2 Input	–	0.55 max.	Watt
Heater Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100 max.	Volts
Total DC and Peak	200	200 max.	Volts
Heater Negative with Respect to Cathode, Total DC and Peak	200	200 max.	Volts

LIMITING CIRCUIT VALUES

Grid 1 Circuit Resistance:			
With Fixed Bias	0.25	0.25 max.	Megohm
With Cathode Resistor Bias	0.5	0.5 max.	Megohm

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	125	125	Volts
Grid 2 Voltage	–	125	Volts
Grid 1 Voltage	–1.0	–1.0	Volts
Amplification Factor	46	–	Ohms
Plate Resistance (approx.)	5400	200000	Ohms
Transconductance	8500	7500	μmhos
Grid 1 Cutoff Bias (Note 3)	–8	–8	Volts
Plate Current	13.5	12	Ma.
Grid 2 Current	–	4	Ma.

NOTES

1. With JEDEC shield #315 connected to Cathode of unit under test.
2. With JEDEC shield #315 connected to ground.
3. For plate current of 10 microamperes.

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October 1, 1958

BEAM POWER AMPLIFIER TYPES 12L6-GT, 25L6-GT AND 50L6-GT

The 12L6-GT, 25L6-GT and 50L6-GT are beam pentode types used in the output stage of ac-dc receivers. These types feature high power sensitivity and plate efficiency at low plate and screen voltages.

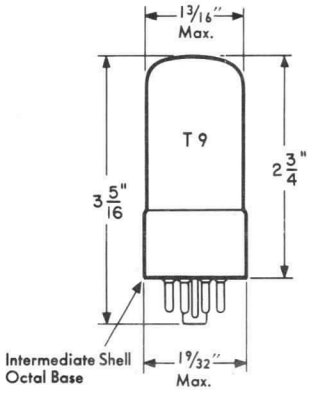
The 12L6-GT has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

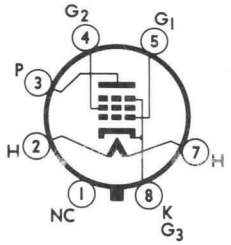
ELECTRICAL:

Cathode	Coated Unipotential			
Heater:	12L6-GT	25L6-GT	50L6-GT	
Voltage (ac or dc)	12.6	25.0	50.0	Volts
Current	0.6	0.30	0.15	Ampere
Warm-up Time, approx. ▲	11	--	--	Seconds
Direct Interelectrode Capacitances:				
Grid to Plate		0.8		uuf
Input		15		uuf
Output		9.0		uuf

MECHANICAL:

Bulb	T-9
Base	Intermediate Shell Octal 7-Pin (JETEC B7-7)
Basing	7AC
Mounting Position	Any





MAXIMUM RATINGS:

Design Center Values

Plate Voltage			200 max.	Volts
Plate Dissipation			10 max.	Watts
Screen Voltage			125 max.	Volts
Screen Dissipation			1.25 max.	Watts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode:	12L6GT	25L6GT	50L6GT	
Total DC + Peak	300	200	90 max.	Volts
Heater Positive with Respect to Cathode:				
DC Component	100	100	-- max.	Volts
Total DC + Peak	200	200	90 max.	Volts
Grid Circuit Resistance:				
Gathode Bias			0.5 max.	Megohm
Fixed Bias			0.1 max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION:

Class A_1 Amplifier

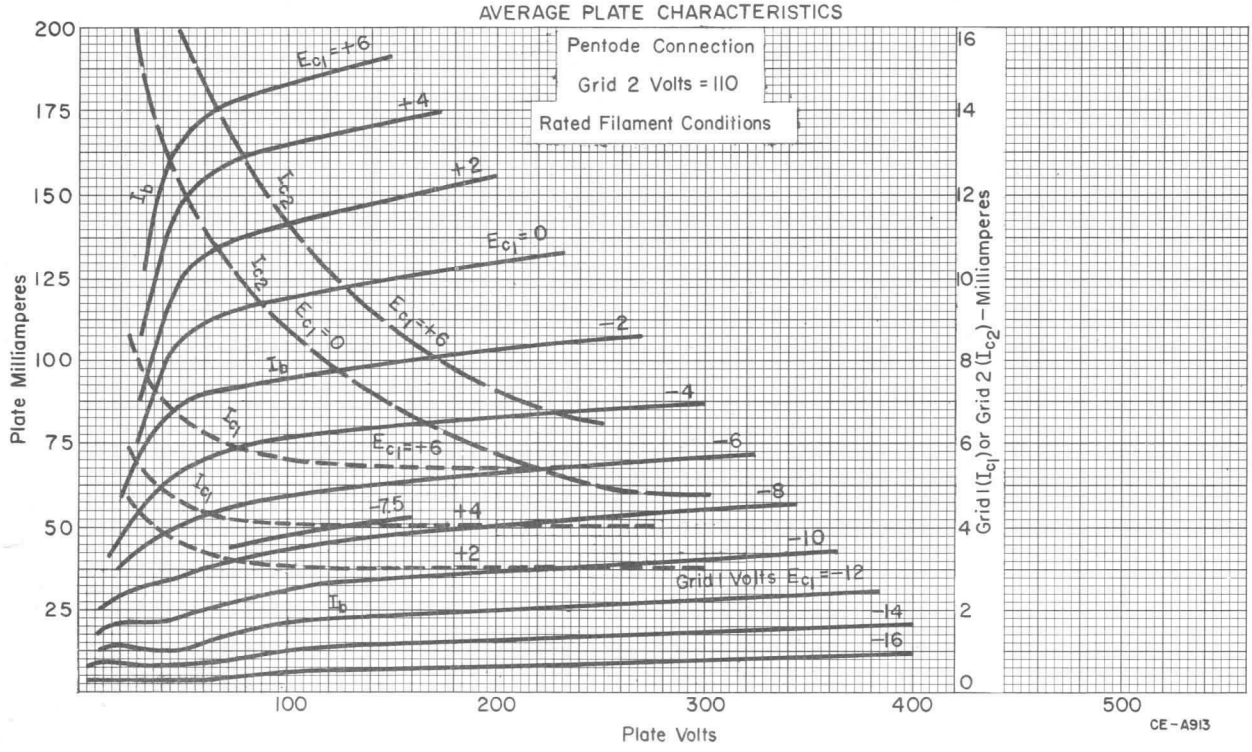
Plate Voltage	110	200	Volts
Screen Voltage	110	110	Volts
Control Grid Voltage	-7.5	-8	Volts
Peak A-F Control Grid Voltage	7.5	8	Volts
Zero Signal Plate Current	49	50	Ma.
Zero Signal Screen Current	4	2	Ma.
Max. Signal Plate Current	50	55	Ma.
Max. Signal Screen Current	11	7	Ma.
Transconductance	9000	9500	umhos
Plate Resistance, approx.	13000	30000	Ohms
Load Resistance	2000	3000	Ohms
Power Output	2.1	4.3	Watts
Total Harmonic Distortion	10	10	Percent

▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

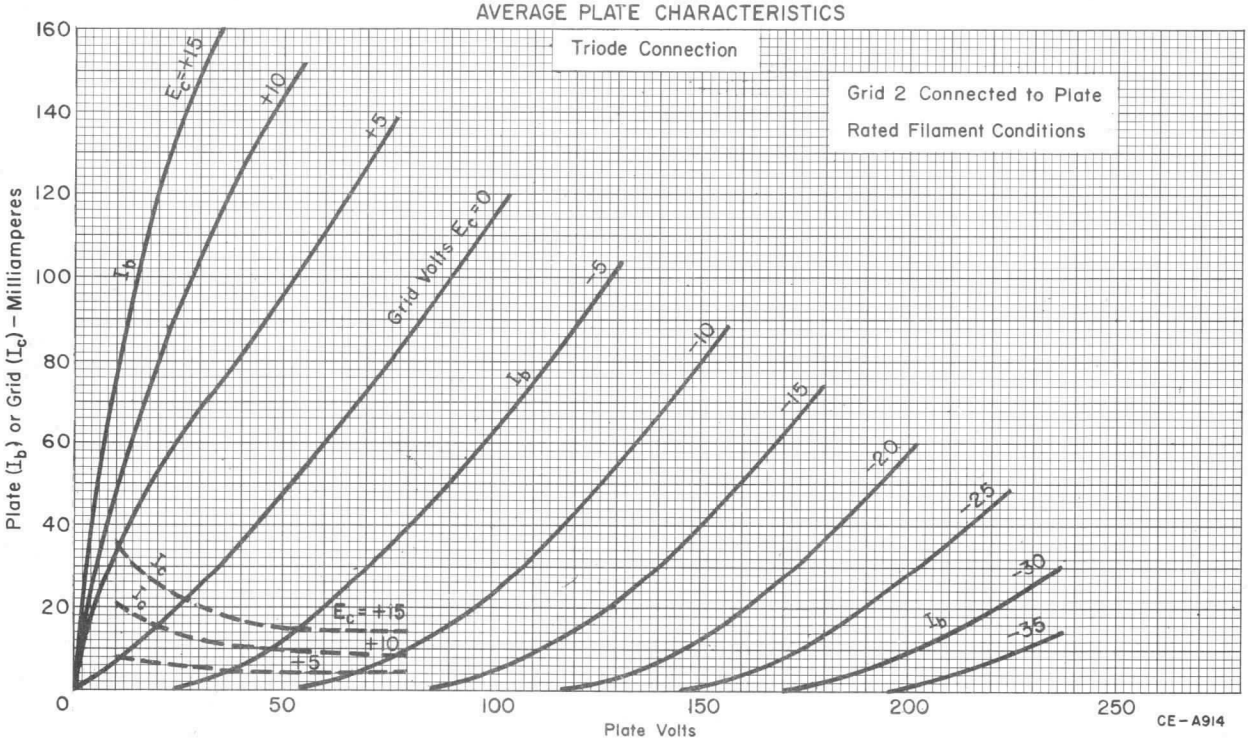
Supersedes 12L6-GT Sheet Dated October 15, 1954
Supersedes 25L6-GT Sheet Dated January 28, 1955
Supersedes 50L6-GT Sheet Dated January 28, 1955

Receiving Tube Section

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



BEAM POWER AMPLIFIER TYPE 35L6-GT

The 35L6-GT is a beam pentode type used in the output stage of ac-dc receivers. This type features high power sensitivity and plate efficiency at low plate and screen voltages.

ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	35.0	Volts
Current	0.15	Ampere
Direct Interelectrode Capacitances:		
Grid to Plate	0.6	μf
Input	13	μf
Output	9.5	μf

MECHANICAL

Bulb	T-9
Base	Intermediate Shell Octal 7-Pin (JEDEC B7-7)
Basing	7AC
Mounting Position	Any

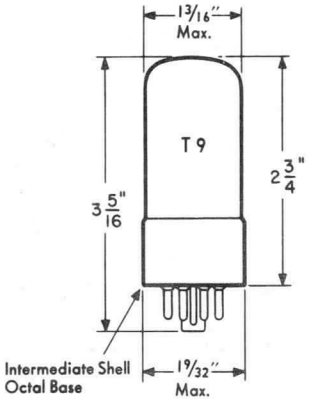
MAXIMUM RATINGS

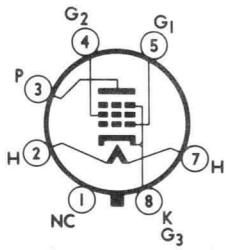
Plate Voltage	200	max.	Volts
Plate Dissipation	8.5	max.	Watts
Screen Voltage	125	max.	Volts
Screen Dissipation	1.0	max.	Watts
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC + Peak	90	max.	Volts
Heater Positive with Respect to Cathode:			
Total DC + Peak	90	max.	Volts
Grid Circuit Resistance:			
Cathode Bias	0.5	max.	Megohm
Fixed Bias	0.1	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION

Class A_1 Amplifier

Plate Voltage	110	200	Volts
Screen Voltage	110	125	Volts
Control Grid Voltage	-7.5	–	Volts
Cathode Bias Resistor	–	180	Ohms
Peak A-F Control Grid Voltage	7.5	8	Volts
Zero Signal Plate Current	40	43	Ma.
Zero Signal Screen Current	3	2	Ma.
Max. Signal Plate Current	41	43	Ma.
Max. Signal Screen Current	7	5.5	Ma.
Transconductance	5800	6100	μmhos
Plate Resistance, Approx.	14000	34000	Ohms
Load Resistance	2500	5000	Ohms
Power Output	1.5	3.0	Watts
Total Harmonic Distortion	10	10	Percent





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August 25, 1954

Medium-Mu Triodes Types 6S4 and 6S4-A

The 6S4 and 6S4-A are 9-pin miniature medium-mu triodes designed for use as vertical deflection amplifiers in television receivers. The tubes operate at relatively high plate currents at low plate voltages and can withstand the high pulse voltage encountered in vertical deflection amplifier service.

The 6S4-A has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

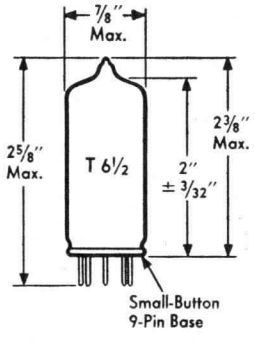
GENERAL DATA

Electrical:

Cathode	Coated Unipotential
Filament:	
Voltage	6.3 ac or dc Volts
Current	0.6 Ampere
Direct Interelectrode Capacitances:	
Grid to Plate	2.6 μμf
Input	4.2 μμf
Output	0.9 μμf

Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-pin
Basing	9 AC
Mounting Position	Any



MAXIMUM RATINGS

Design Center Values

Except as Noted

As **Vertical Deflection Amplifier***

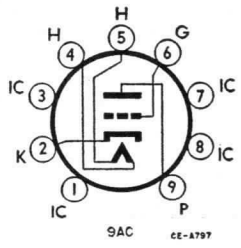
Plate Voltage	500	max.	Volts
Peak Positive Plate Voltage	2200	abs. max.	Volts
Plate Dissipation**	7.5	max.	Watts
Peak Negative Grid Voltage	250	max.	Volts
Average Cathode Current	30	max.	Ma.
Peak Cathode Current	105	max.	Ma.
Grid Circuit Resistance			
Cathode Bias	2.2	max.	Megohm

AVERAGE CHARACTERISTICS

Plate Voltage	250	Volts
Grid Voltage	−8	Volts
Plate Current	26	Ma.
Transconductance	4500	μmhos
Amplification Factor	16	
Plate Resistance	3600	Ohms
Plate Current, E_c = −15 Volts	4.5	Ma.
Grid Voltage for I_b = 50 μa.	−23	Volts

* For operation in a 525 line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle.

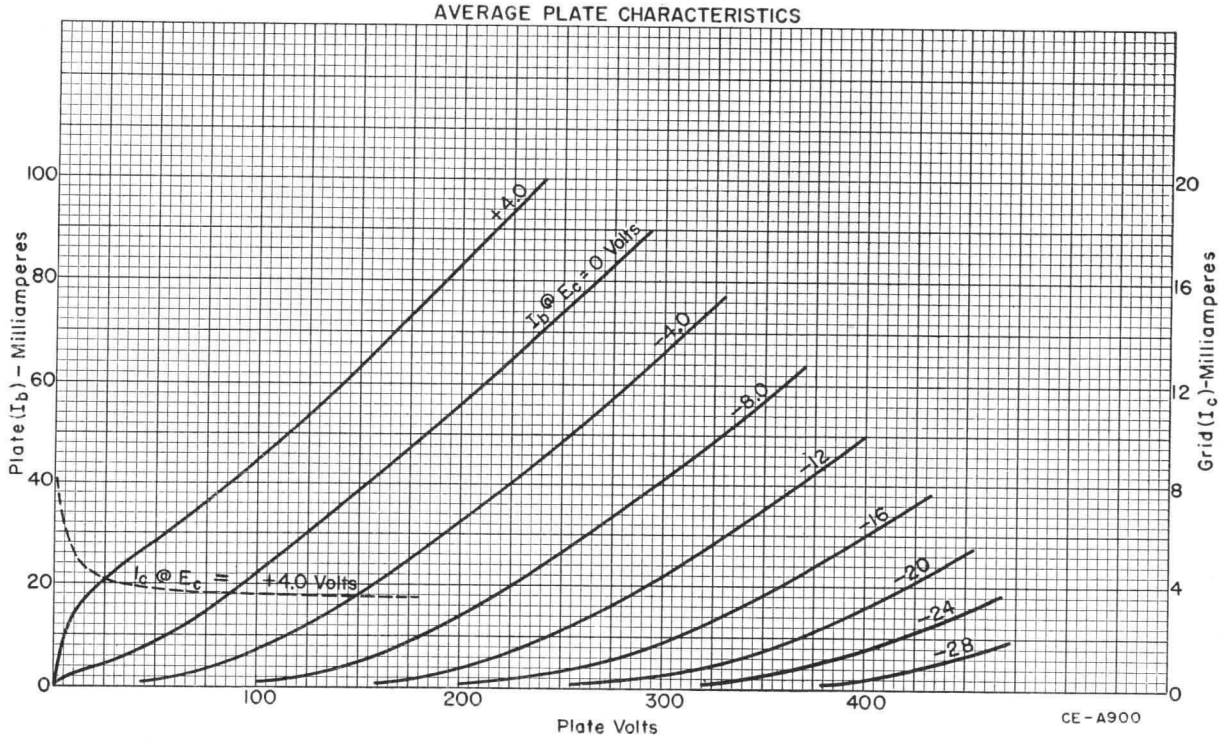
** Stages operating with grid leak bias must use an adequate cathode bias resistor or similar means in order to protect the tube in the absence of excitation.



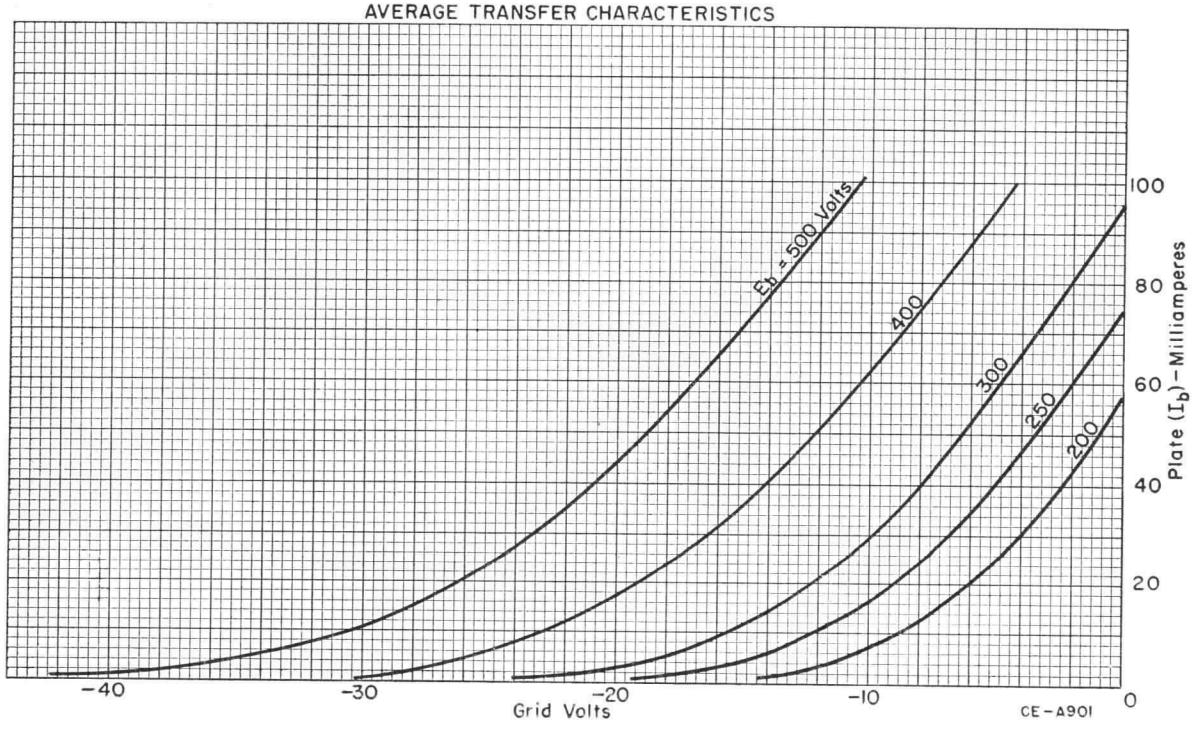
Bottom View

Receiving Tube Section

AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



Westinghouse

6SN7-GTA
6SN7-GTB
12SN7-GTA

April 15, 1961

TWIN TRIODE TYPES 6SN7-GTA, 6SN7-GTB AND 12SN7-GTA

The 6SN7-GTA, 6SN7-GTB and 12SN7-GTA are medium-mu twin triodes designed for use as combined vertical oscillators and vertical deflection amplifiers in television receivers. These types may also be used in general purpose applications such as resistance-coupled amplifiers, phase inverters and multivibrators.

The 6SN7-GTB has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

ELECTRICAL:

Cathodes	Coated Unipotential		
Heater:	6SN7-GTA 6SN7-GTB	12SN7-GTA	
Voltage (ac or dc)	6.3	12.6	Volts
Current	0.6	0.3	Ma.
Warm-up Time (Approx.)▲	11	--	Seconds

Direct Interelectrode Capacitances (Unshielded):

	Unit 1	Unit 2	
Grid to Plate	4.0	3.8	μμf
Input	2.2	2.6	μμf
Output	0.7	0.7	μμf

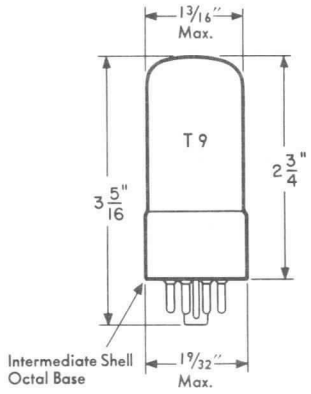
MECHANICAL:

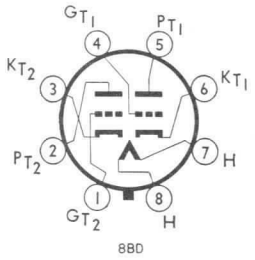
Bulb	T-9
Base	Intermediate Shell Octal 8-Pin
Basing	8BD
Mounting Position	Any

MAXIMUM RATINGS:

Design Center Values
Each Unit, Except as Noted

As	Class A_1 Amplifier	Vertical # Deflection Amplifier	
Plate Voltage	450	450 max.	Volts
Peak Positive Plate Voltage (Abs. Max.)	--	1500	Volts
Peak Negative Grid Voltage	--	250 max.	Volts
Plate Dissipation:			
Each Plate	5.0	5.0* max.	Watts
Both Plates	7.5	7.5* max.	Watts
Cathode Current	20	20 max.	Ma.
Peak Cathode Current	--	70 max.	Ma.
Heater-Cathode Voltage			
Heater Positive with Respect to Cathode			
D-C Component	100	100 max.	Volts
Total D-C and Peak	200	200 max.	Volts
Heater Negative with Respect to Cathode			
Total D-C and Peak	200	200 max.	Volts
Grid Circuit Resistance:			
Fixed Bias	1.0	-- max.	Megohm
Cathode Bias	1.0	2.2 max.	Megohms





MAXIMUM RATINGS:
Design Center Values (Each Unit, Except as Noted)

As	Vertical # Deflection Oscillator	Horizontal # Deflection Oscillator	
Plate Voltage	450	450 max.	Volts
Peak Negative Grid Voltage	400	600 max.	Volts
Plate Dissipation:			
Each Plate	5.0	5.0 max.	Watts
Both Plates	7.5	7.5 max.	Watts
Cathode Current	20	20 max.	Ma.
Peak Cathode Current	70	300 max.	Ma.
Heater-Cathode Voltage			
Heater Positive with Respect to Cathode			
D-C Component	100	100 max.	Volts
Total D-C and Peak	200	200 max.	Volts
Heater Negative with Respect to Cathode			
Total D-C and Peak	200	200 max.	Volts
Grid Circuit Resistance			
Fixed Bias	2.2	2.2 max.	Megohms
Cathode Bias	2.2	2.2 max.	Megohms

AMPLIFIER – CLASS A_1
Each Unit

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	90	250	250	Volts
Grid Voltage	0	−12.5	−8	Volts
Plate Current	10	1.3	9.0	Ma.
Plate Resistance (Approx.)	6700	- -	7700	Ohms
Transconductance	3000	- -	2600	μmhos
Amplification Factor	20	- -	20	
Grid Voltage for I_b = 10 μa. (Approx.)	−7.0	- -	−18	Volts

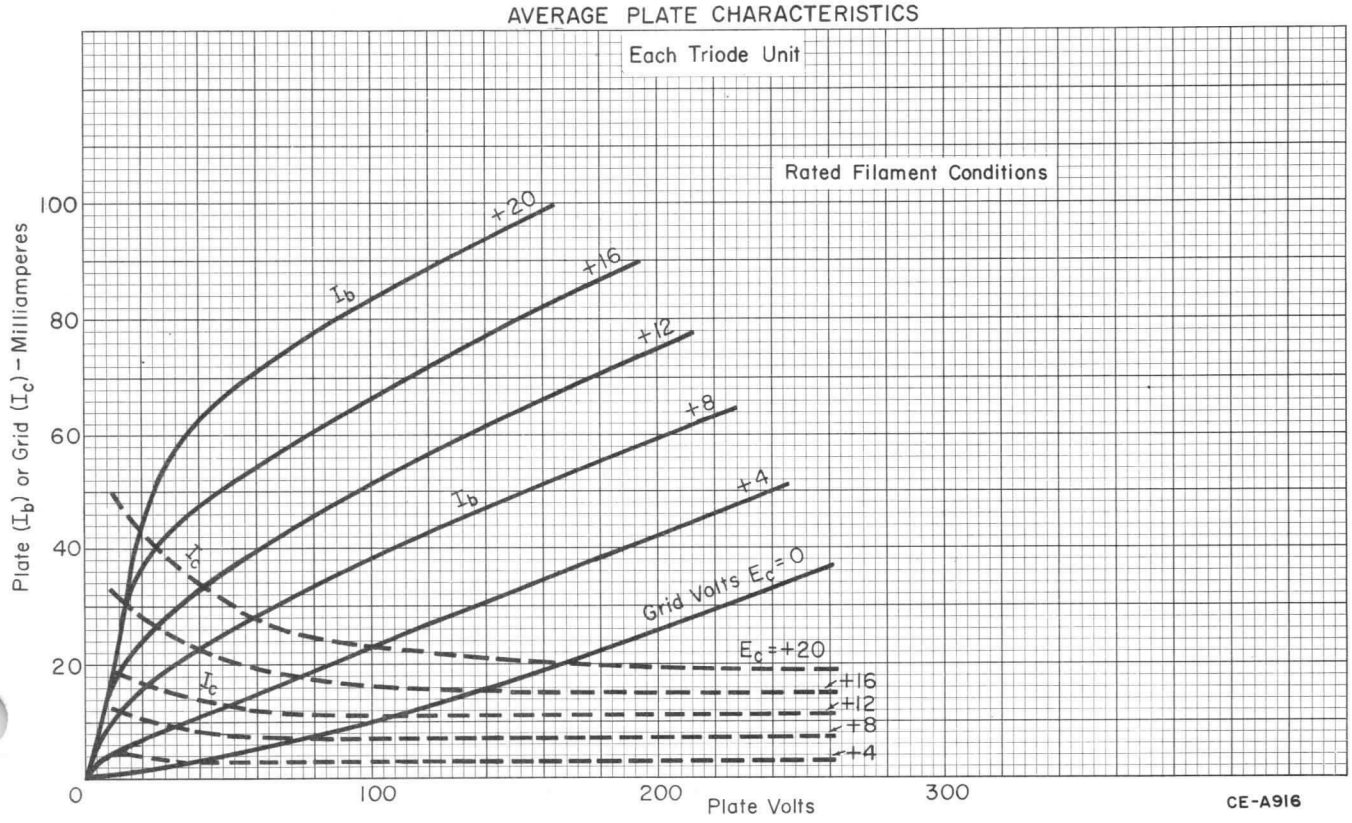
\# For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission". The duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

* Stages operating with grid-leak bias require an adequate cathode-bias resistor or other suitable means to protect the tube in the absence of excitation.

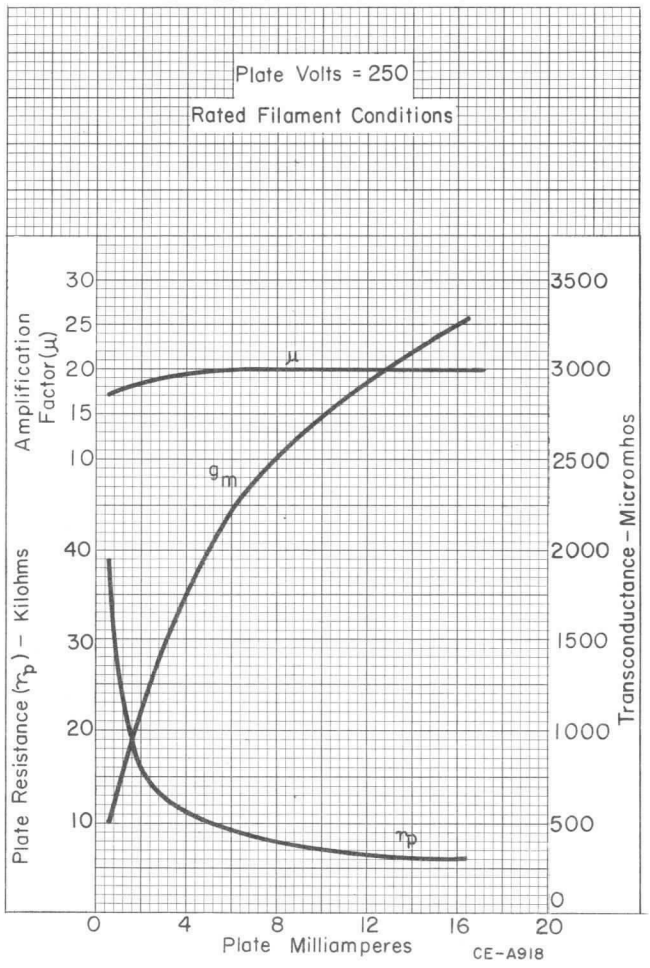
▲ Heater Warm-up Time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.

AVERAGE PLATE CHARACTERISTICS

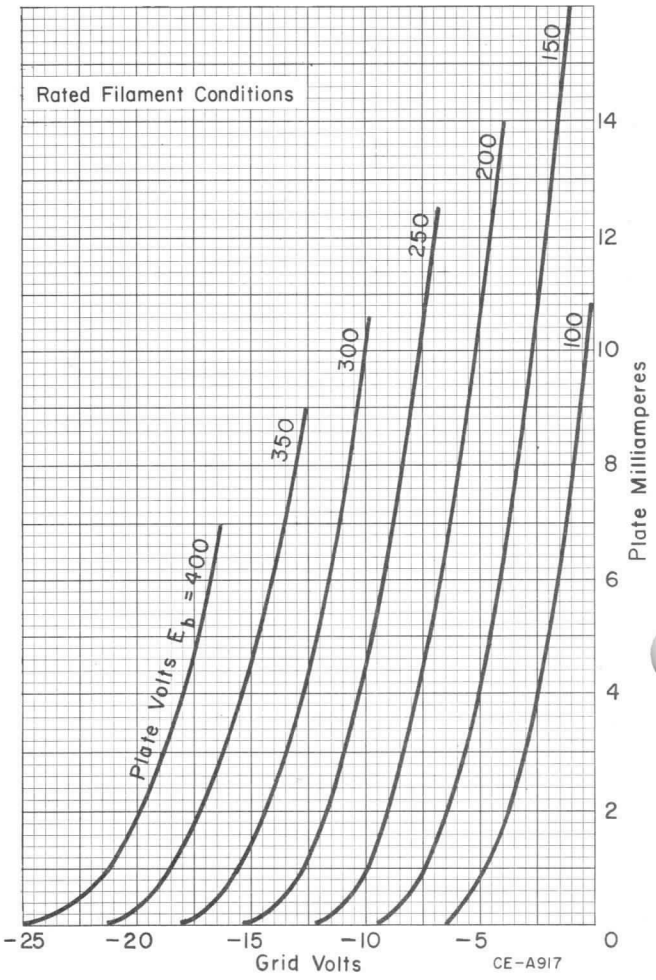
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



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November 10, 1954

Full-Wave Vacuum Rectifier Type 5U4-G

The 5U4-G is a glass octal full-wave high-vacuum rectifier designed for service in power supplies of high current requirements. The tube should be mounted vertically, but horizontal mounting is permissible if pins 1 and 4 are in a vertical plane. Like all power handling tubes, the 5U4-G should be adequately ventilated. Electrically, the 5U4-G is similar to the types 5X4-GT and 5Z3.

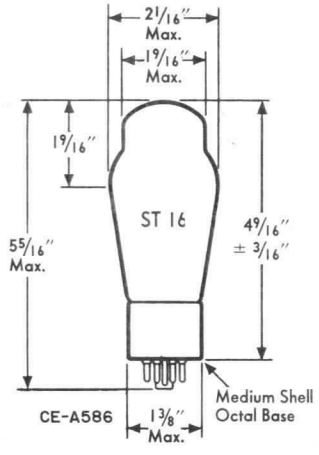
GENERAL DATA

Electrical:

Cathode	Coated Filament	
Voltage	5.0 ac or dc	Volts
Current	3.0	Amperes

Mechanical:

Bulb	ST-16
Base	B5-15, Medium Shell Octal 5-Pin
Basing	G-5T
Mounting Position	Vertical Horizontal with Pins 1 and 4 in Vertical Plane



RECTIFIER SERVICE*

Maximum Ratings

Design Center Values

Peak Inverse Plate Voltage	1550 max.	Volts
Maximum AC Plate Supply Voltage Each Plate (RMS)	See Chart I	
Maximum DC Output Current Each Plate	See Chart I	
Steady-State Peak Plate Current Each Plate (See Chart II)	800 max.	Ma.
Transient Peak Plate Current Each Plate (See Chart III)	4.0 max.	Ampere

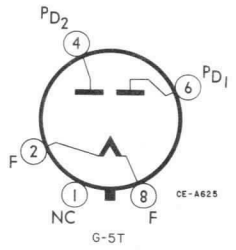
Typical Operation as Full-Wave Rectifier

	Input to Capacitor		Input to Filter Choke	
AC Plate Supply Voltage Each Plate (RMS)	450	300	550	Volts
Input Capacitor	40	40	..	μf.
Input Choke	..	..	10	Henrys
Effective Plate Supply Resistance Each Plate	85	35	..	Ohms
DC Output Current	225	245	225	Ma.
DC Output Voltage at Filter Input	470	290	440	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop (Measured with Tube Conducting 225 Ma. Each Plate)	44	Volts

* For use with sinusoidal supply voltages within the frequency range of 25 to 1000 cps.



APPLICATION NOTES

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the 5U4-G is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are interdependent, and they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and for choke-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor-input filter, operation is permissible within the area bounded by points F A E D G; with choke-input filter, operation is permissible within the area bounded by points F A B C D G.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined by the equation

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}\ E_s}$$

where $\bar{E}$ is the dc output voltage at input to filter and E_s is the rms plate supply voltage per plate.

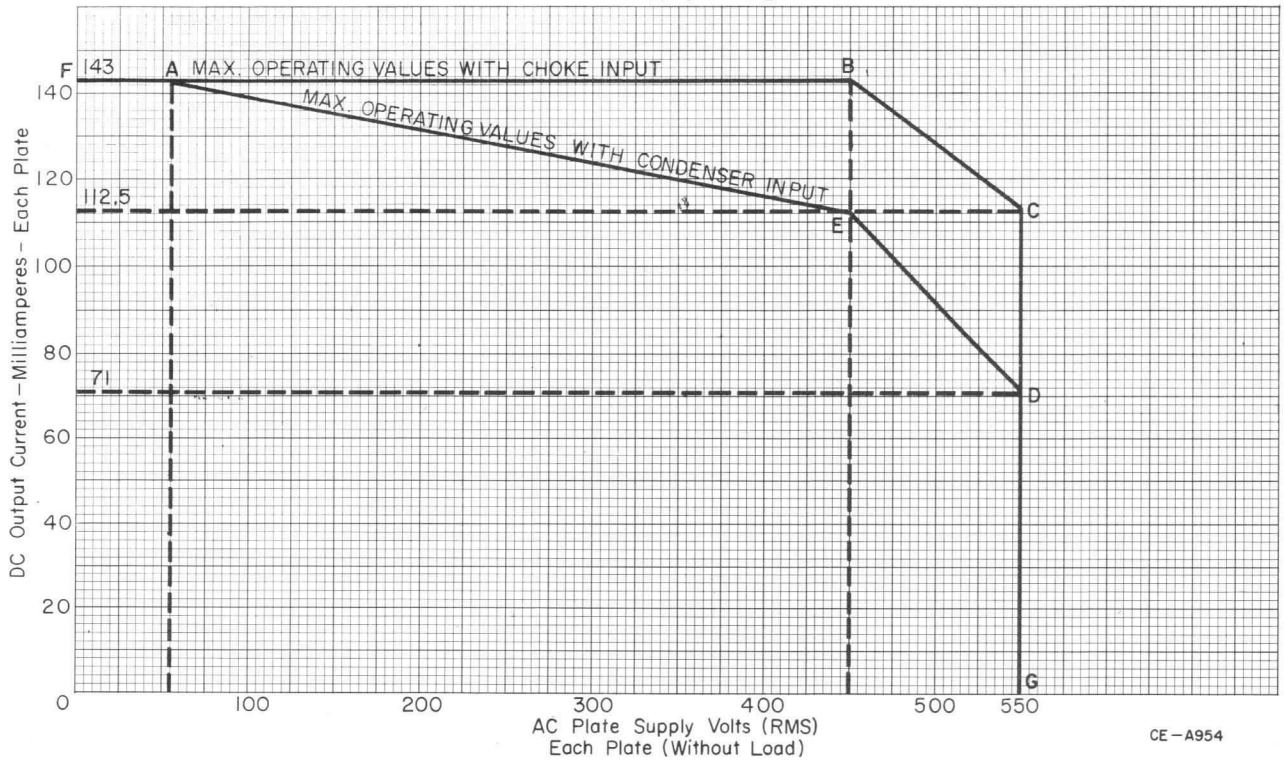
Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of

$$R_s = N^2R_{pri.} + R_{sec.} + R_a$$

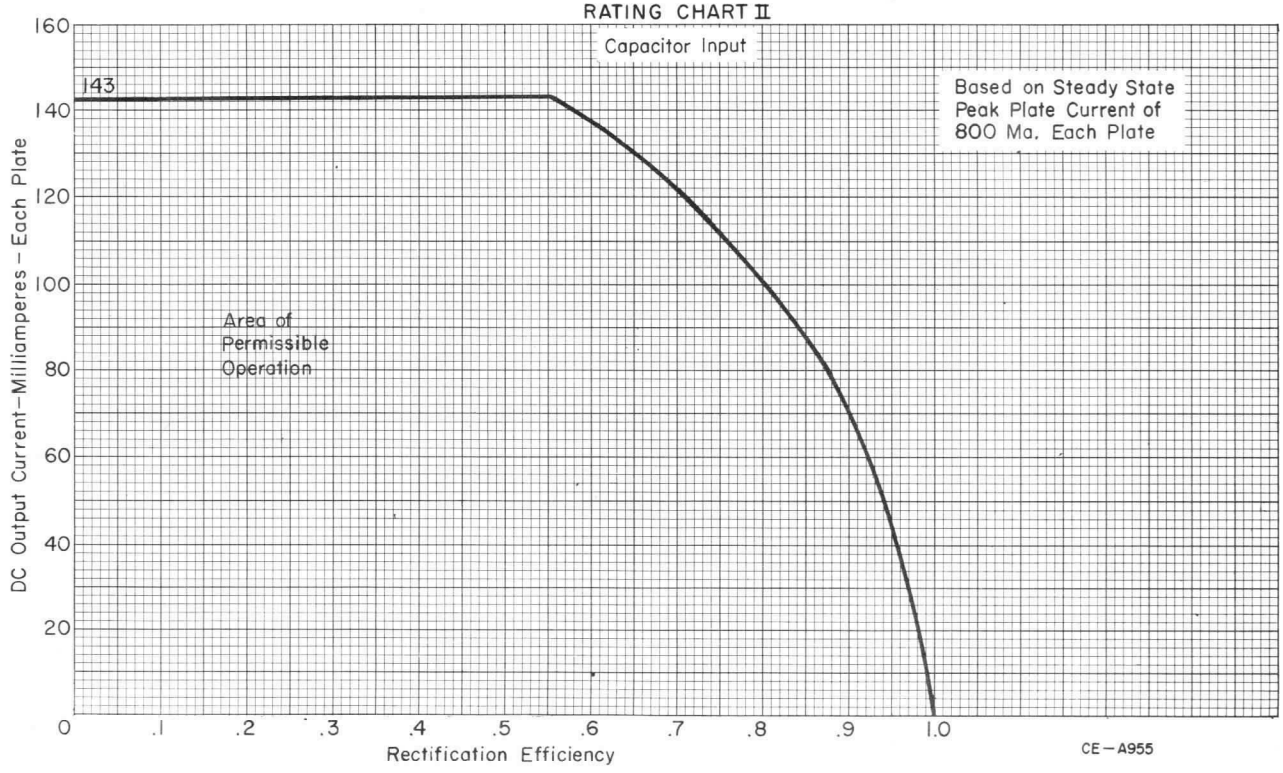
where N is the voltage step-up ratio of the plate transformer, $R_{pri.}$ is the dc resistance of the transformer primary, $R_{sec.}$ is the average dc resistance of each transformer secondary section, and R_a is the additional resistance required.

In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

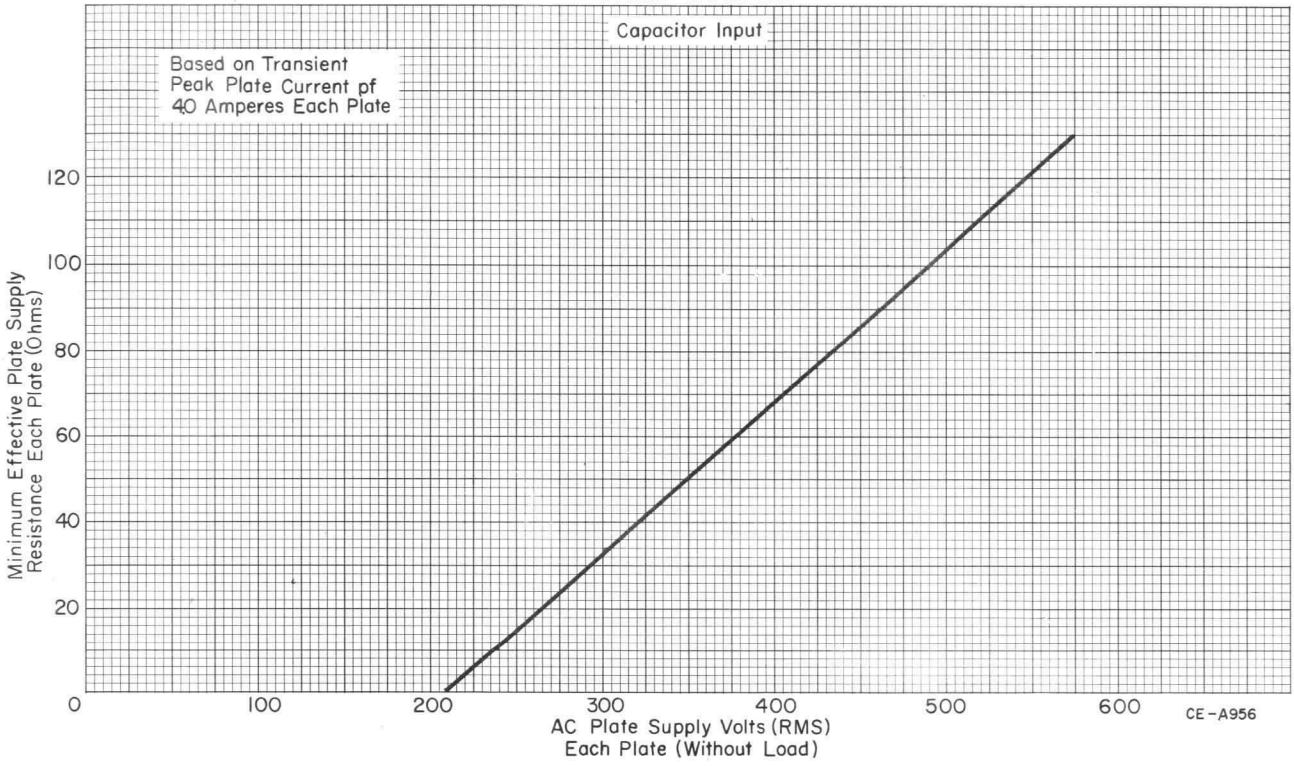
RATING CHART I



RATING CHART II



RATING CHART III



January 27, 1958

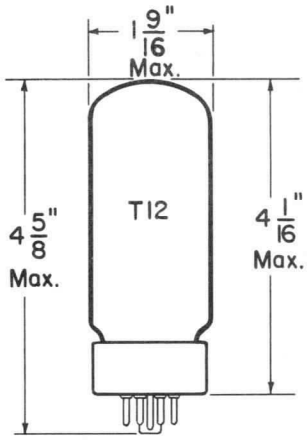
FULL-WAVE VACUUM RECTIFIER TYPE 5U4-GB

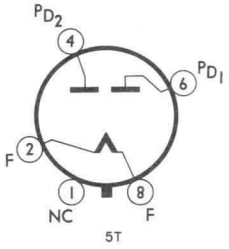
The 5U4-GB is a glass-octal full-wave high-vacuum rectifier designed for service in power supplies of equipment requiring high current.

The 5U4-GB is an improved version of the 5U4-G in that the 5U4-GB features higher peak and average current ratings. The heater characteristics and basing of the two tubes are identical. The tube should be mounted vertically, but horizontal mounting is permissible if pins 1 and 4 are in a vertical plane. Like all power handling tubes, the 5U4-GB should be adequately ventilated.

GENERAL DATA

ELECTRICAL:	
Cathode	Coated Filament
Heater:	
Voltage (ac or dc)	5.0 Volts
Current	3.0 Amperes
MECHANICAL:	
Bulb	T-12
Base	Short Medium Shell Octal 5-Pin (JETEC B5-121) Flared Medium Shell Octal (JETEC B5-127)
Basing	5T
Mounting Position	Vertical Horizontal-with Pins 1 and 4 in Vertical Plane





RECTIFIER SERVICE♦

MAXIMUM RATINGS:	
Design Center Values	
Peak Inverse Plate Voltage	1550 max. Volts
Maximum AC Plate Supply Voltage	
Each Plate (RMS)	550 max. Volts
Maximum DC Output Current	
Each Plate	See Chart I
Steady-State Peak Plate Current	
Each Plate (See Chart II)	1.0 max. Ampere
Transient Peak Plate Current	
Each Plate (See Chart III)	4.6 max. Amperes

TYPICAL OPERATION AS FULL-WAVE RECTIFIER

	Input to Filter Capacitor		Choke	
AC Plate Supply Voltage				
Each Plate (RMS)	300	450	550	Volts
Input Capacitor	40	40	..	uf
Input Choke	..	..	10	Henrys
Effective Plate Supply Resistance Each Plate	21	67	..	Ohms
DC Output Current	300	275	275	Ma.
DC Output Voltage at Filter Input	290	460	420	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop	
Tube Conducting	
225 ma. Each Plate	44 Volts
275 ma. Each Plate	50 Volts
300 ma. Each Plate	54 Volts

♦ For use with sinusoidal supply voltages within the frequency range of 25 to 1000 cps.

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are interdependent, and they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and chose-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor input filter, operation is permissible within the area bounded by points F A E D G: with chose-input filter, operation is permissible within the area bounded by points F A B C D G.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined by the equation

$$\text{Rectification Efficiency} = \frac{E}{2 \quad E_s}$$

where E is the dc output voltage at input to filter and E_s is the rms plate supply voltage per plate.

Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of

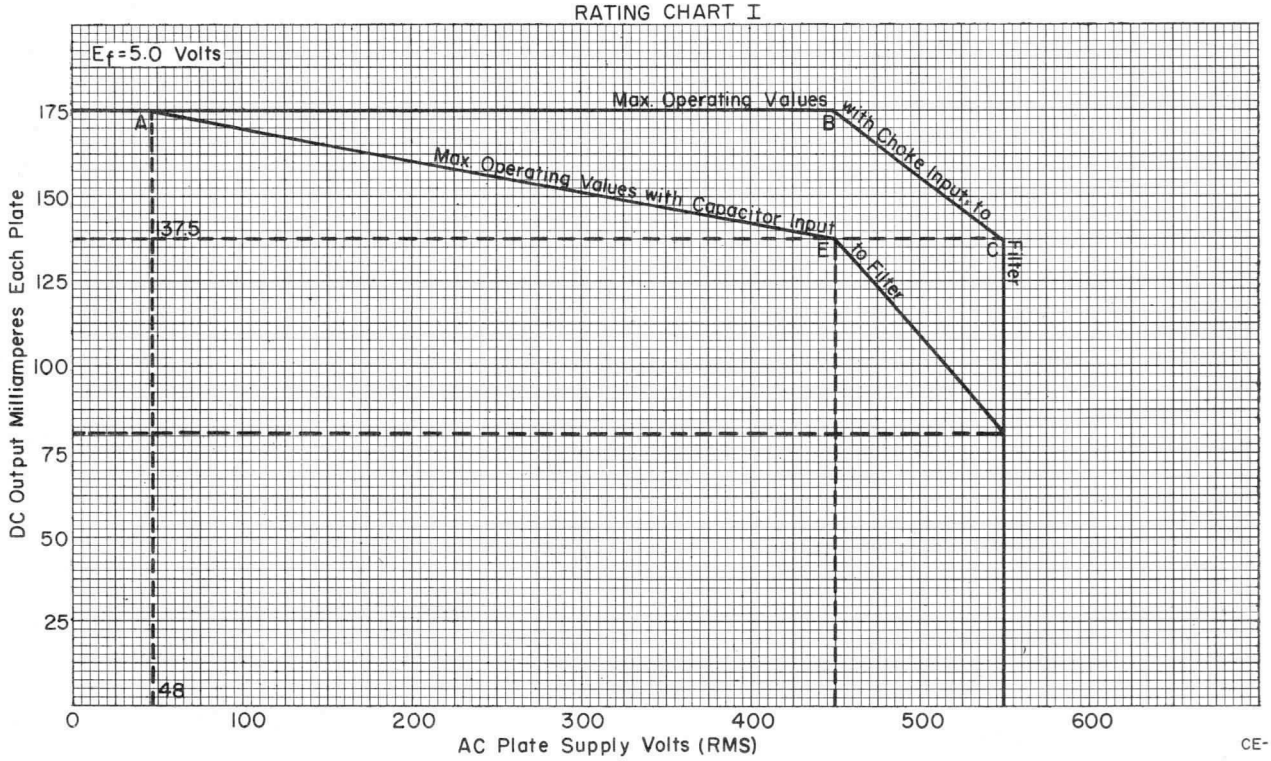
$$R_S = N^2 R_{PRI} + R_{SEC} + R_A$$

where N is the voltage step up ratio of the plate transformer, R_{PRI} is the dc resistance of the transformer primary, R_{SEC} is the average dc resistance of each transformer secondary section, and R_A is the additional resistance required.

In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

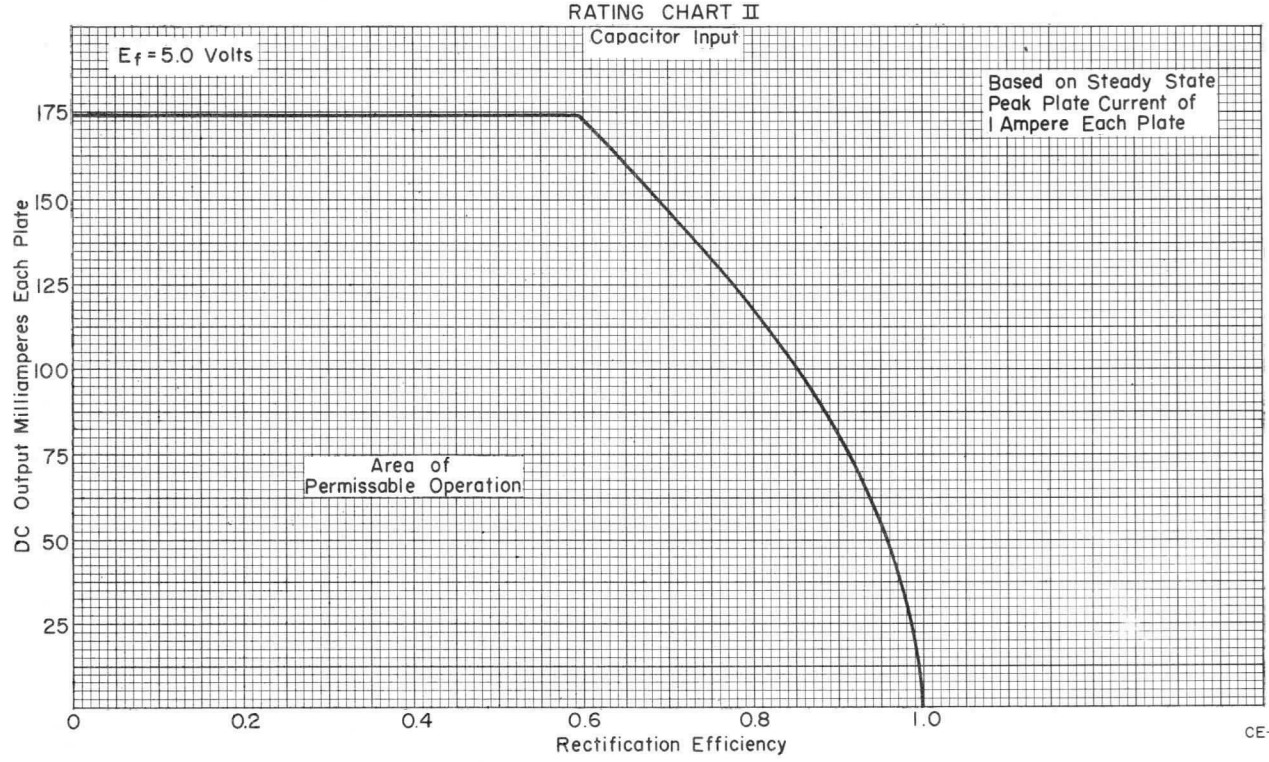
If a capacitor greater than 40 ufd is used the effective plate-supply impedance should be increased to prevent exceeding the maximum peak plate current rating.

RATING CHART I



CE-A1003

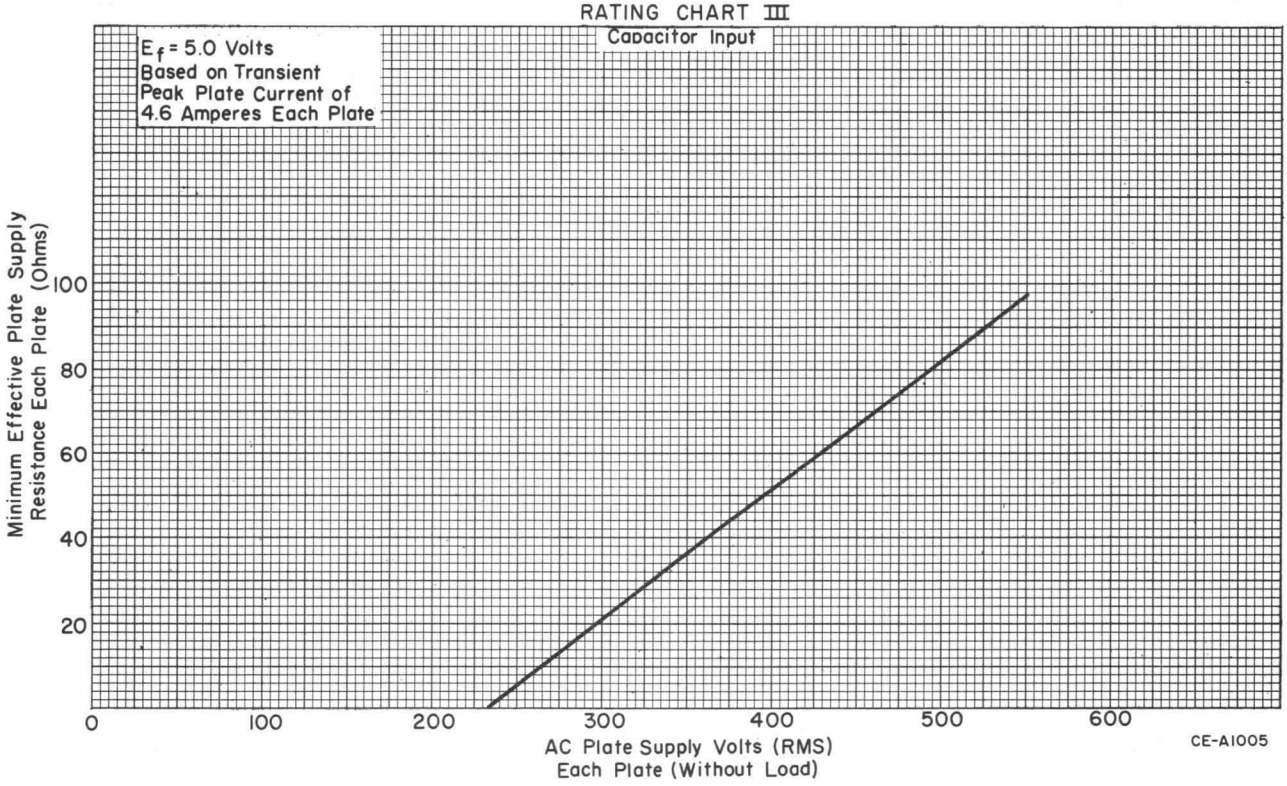
RATING CHART II



CE-A1004

RATING CHART III

Capacitor Input



Westinghouse

5U8
6U8
6U8-A

September 1, 1962

MEDIUM-MU TRIODE, SHARP-CUTOFF PENTODE TYPES 5U8, 6U8 AND 6U8-A

The 5U8, 6U8 and 6U8-A are 9-pin miniature triode-pentode types designed for service as combined oscillator and mixer in television and frequency modulation receivers. Each section of these tubes has a separate cathode and is electrically independent. The tubes perform well at the higher frequencies and may be used advantageously in applications normally requiring two tubes.

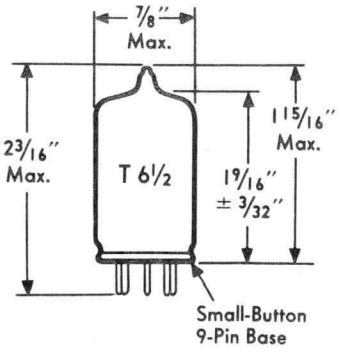
The 5U8 and 6U8-A have been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

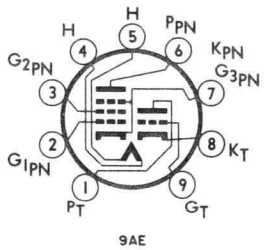
ELECTRICAL

Cathode		Coated Unipotential		
Heater:	5U8	6U8	6U8-A	
Voltage (ac or dc)	4.7	6.3 ± 10%	6.3	Volts
Current	0.60 ±6%	0.45	0.45 ± 6%	Ampere
Warm-up Time (Note 1)	11	–	11	Seconds
Direct Interelectrode Capacitances:				
Triode Unit:	Shielded (Note 2)	Unshielded		
Grid to Plate	1.8	1.8		μμf
Input	2.8	2.8		μμf
Output	2.0	1.5		μμf
Pentode Unit:				
Grid 1 to Plate	0.007 max.	0.015 max.		μμf
Input	5	5		μμf
Output	3.5	2.6		μμf
Coupling:				
Pentode Grid to Triode Plate	0.20	0.2		μμf
Pentode Plate to Triode Plate	0.02	0.1		μμf
Heater to Cathode				
Each Unit (Note 3)	3.0	3.0		μμf

MECHANICAL

Bulb	T-6½
Base	Small-Button Noval 9-Pin (JEDEC E9-1)
Outline	6-2
Basing	9AE
Mounting Position	Any





CONVERTER SERVICE

MAXIMUM RATINGS

Design Maximum Values

	Triode Unit	Pentode Unit		
Plate Voltage	330	330	max.	Volts
Grid 2 Supply Voltage	–	330	max.	Volts
Grid 2 Voltage	–	See Grid 2 Input Rating Chart		
Plate Dissipation	2.5	3.0	max.	Watts
Grid 2 Dissipation	–	0.55	max.	Watts
Grid 1 Voltage, Positive Bias Value	0	0	max.	Volts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak	200	200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component	100	100	max.	Volts
DC + Peak	200	200	max.	Volts

MAXIMUM CIRCUIT VALUES

Grid 1 Circuit Resistance:		
With Cathode Bias	1.0 max.	Megohms
With Fixed Bias	0.5 max.	Megohms

TYPICAL OPERATION

	Triode Unit	Pentode Unit	
Plate Supply Voltage	125	125	Volts
Grid 2 Voltage	–	110	Volts
Grid 1 Voltage	–1	–1	Ohms
Amplification Factor	40	–	–
Plate Resistance (Approx.)	–	200000	Ohms
Transconductance	7500	5000	μmhos
Grid 1 Bias (Approx.) for Plate Current of 20 μamp.	–9	–8	Volts
Plate Current	13.5	9.5	Ma.
Grid 2 Current	–	3.5	Ma.

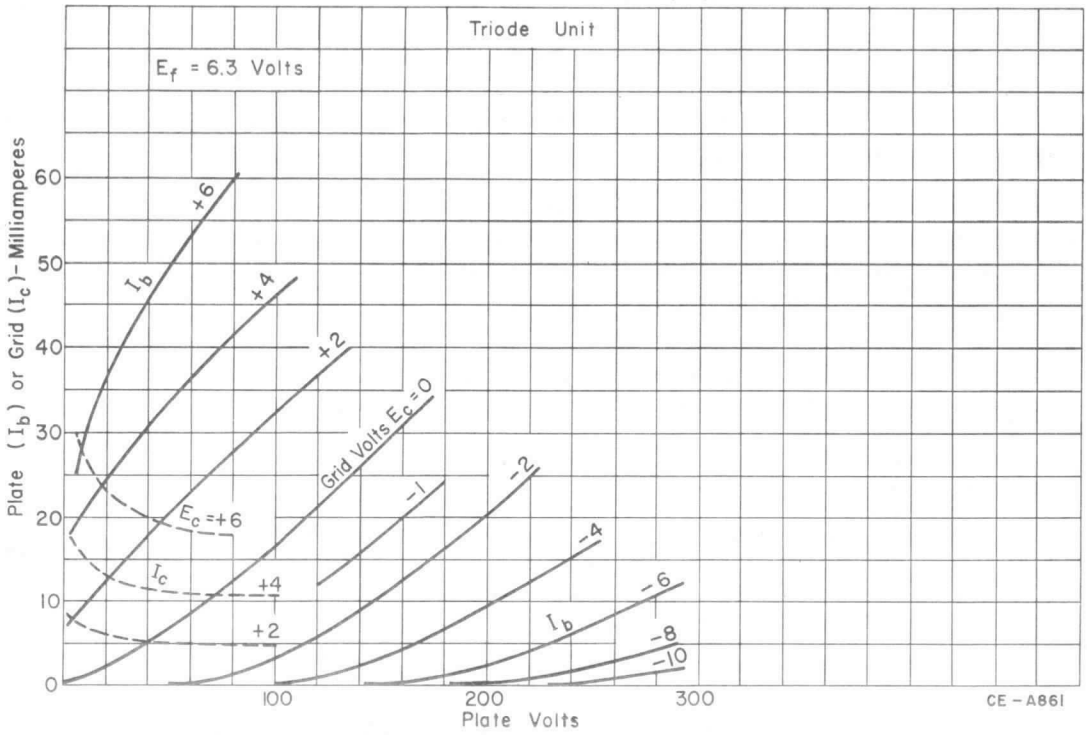
NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying four times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to three times rated heater voltage divided by rated heater current.
2. With JEDEC shield 315 connected to pin 4.
3. With JEDEC shield 315 connected to pin 6.

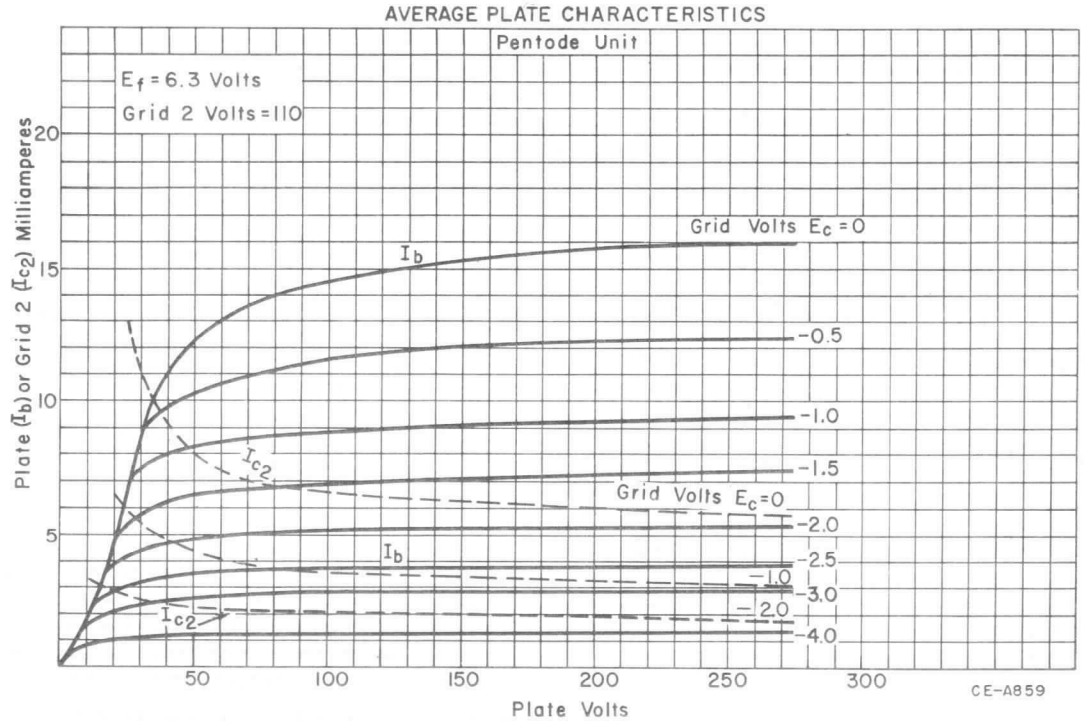
PRINTED IN U.S.A.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

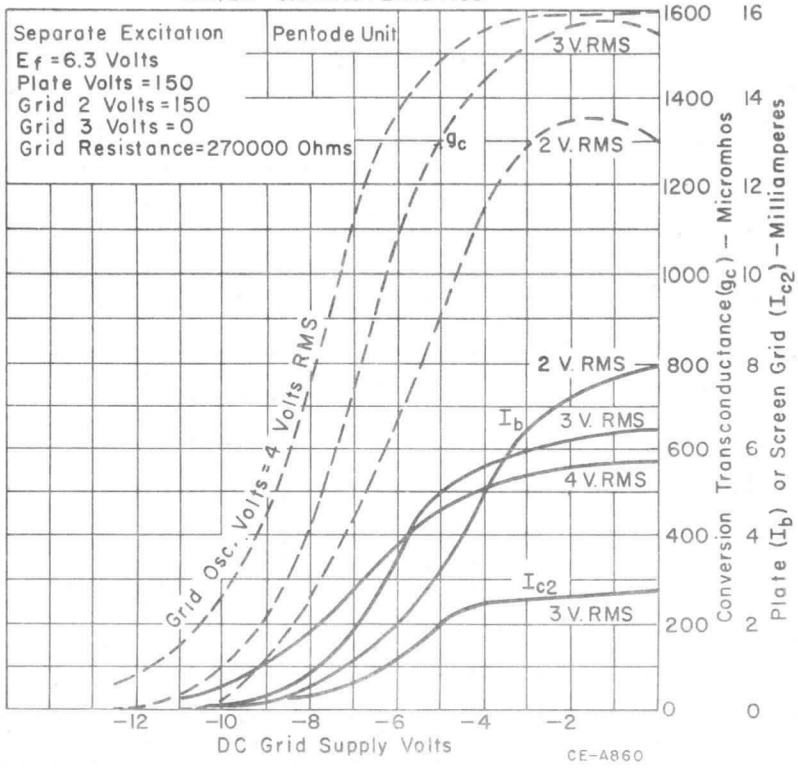
AVERAGE PLATE CHARACTERISTICS



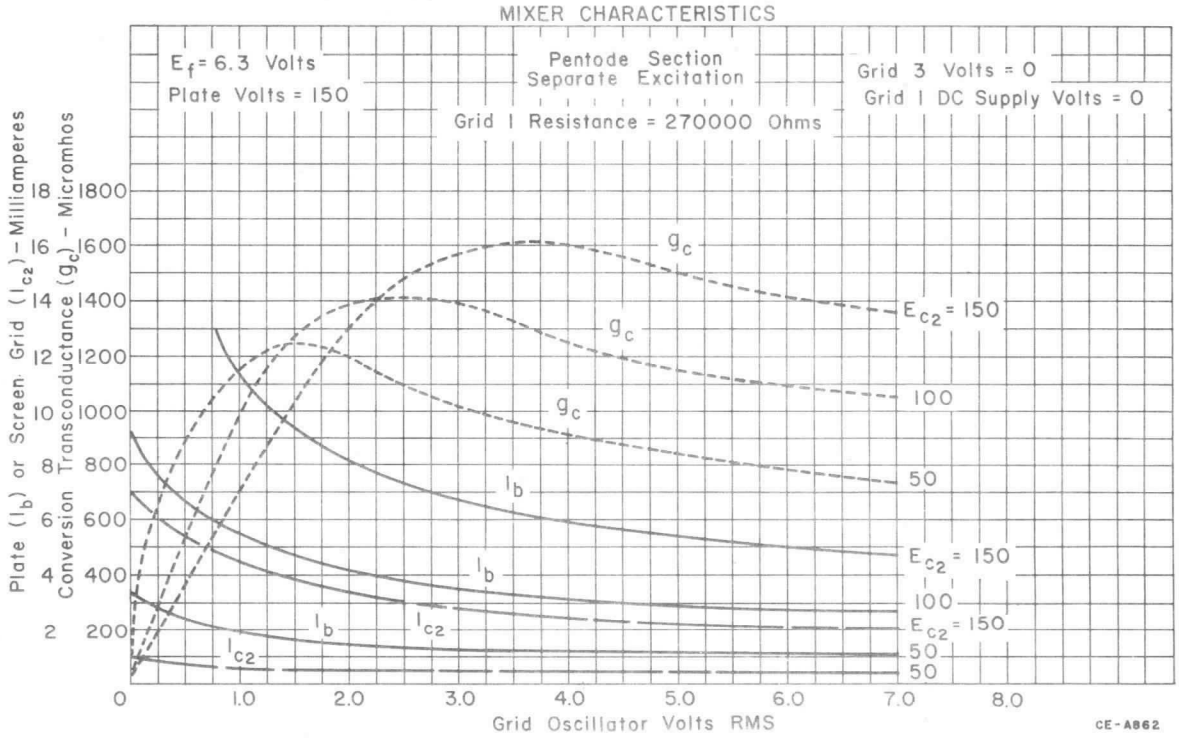
AVERAGE PLATE CHARACTERISTICS



MIXER CHARACTERISTICS



MIXER CHARACTERISTICS



GRID 2 INPUT RATING CURVE

CE-A864

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Westinghouse

5V6-GT
6V6-GT
6V6-GTA
12V6-GT

April 15, 1961

BEAM-POWER PENTODE TYPES 5V6-GT, 6V6-GT, 6V6-GTA AND 12V6-GT

The 5V6-GT, 6V6-GT, 6V6-GTA and 12V6-GT are beam-power types designed for service as power amplifiers where low heater and plate power with moderate output capabilities are desired.

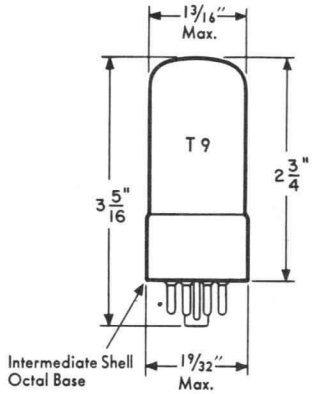
The 5V6-GT and 6V6-GTA have been designed for use in receivers which employ series connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When each is employed in this type of circuit with other tubes similarly designed having the same heater current rating, heater voltage surges across individual tubes are minimized inasmuch as heater warm-up characteristic is controlled.

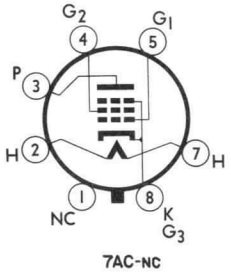
ELECTRICAL:

Cathode	Coated Unipotential			
	5V6GT	6V6GT 6V6-GTA	12V6GT	
Heater:				
Voltage (ac or dc)	4.7	6.3	12.6	Volts
Current	0.60	0.45	0.30	Ampere
Warm-up Time▲	11	11♦	- -	Seconds
Direct Interelectrode Capacitances: (Unshielded)				
Grid 1 to Plate		0.7		μμf
Input		9.0		μμf
Output		7.5		μμf

MECHANICAL:

Bulb	T-9
Base	Intermediate-Shell Octal 7-Pin (JEDEC B7-7)
Outline	9-41
Basing	7AC
Mounting Position	Any





7AC-NC

AF POWER AMPLIFIER - CLASS A

MAXIMUM RATINGS:

Design Center Values			
Plate Voltage	350	max.	Volts
Grid 2 Voltage (Screen)	315	max.	Volts
Plate Dissipation	14	max.	Watts
Grid 2 Dissipation	2.2	max.	Watts
Control Grid Circuit Resistance:			
Fixed Bias	0.1	max.	Megohm
Cathode Bias	0.5	max.	Megohm
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

MAXIMUM CIRCUIT VALUES:

Grid 1 Circuit Resistance:			
For Fixed Bias	0.1	max.	Megohm
For Cathode Bias	0.5	max.	Megohm

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	180	250	315	Volts
Grid 2 Voltage	180	250	225	Volts
Control Grid Voltage	-8.5	-12.5	-13.0	Volts
Peak AF Control Grid Voltage	8.5	12.5	13.0	Volts
Zero-Signal Plate Current	29	45	34	Ma.
Max. Signal Plate Current	30	47	35	Ma.
Zero-Signal Grid 2 Current	3	4.5	2.2	Ma.
Max.-Signal Grid 2 Current	4	7	6	Ma.
Plate Resistance (Approx.)	50000	50000	80000	Ohms
Transconductance	3700	4100	3750	μmhos
Load Resistance	5500	5000	8500	Ohms
Power Output	2.0	4.5	5.5	Watts
Total Harmonic Distortion (Approx.)	8	8	12	Per Cent

MAXIMUM CIRCUIT VALUES:

Grid 1 Circuit Resistance:		
For Fixed Bias	0.1	Megohm
For Cathode Bias	0.5	Megohm

TYPICAL PUSH-PULL OPERATION:
(Values for two tubes unless otherwise specified)

Plate Voltage	250	285	Volts
Grid 2 Voltage	250	285	Volts
Grid 1 Voltage	−15	−19	Volts
Peak AF Grid-to-Grid Voltage	30	38	Volts
Transconductance (Per Tube)	3750	3600	μmhos
Zero Signal Plate Current	70	70	Ma.
Maximum Signal Plate Current	79	92	Ma.
Zero Signal Screen Current	5.0	4	Ma.
Maximum Signal Screen Current	13	13.5	Ma.
Effective Load Resistance (Plate-to-Plate)	10000	8000	Ohms
Total Harmonic Distortion	5	3.5	Per Cent
Power Output	10	14	Watts
Plate Resistance (Per Tube)	60000	70000	Ohms

AF POWER AMPLIFIER - CLASS AB_1

MAXIMUM RATINGS:
Design-Center Values

Plate Voltage	250	max.	Volts
Grid 2 Voltage	250	max.	Volts
Plate Dissipation	12	max.	Watts
Grid 2 Dissipation	2	max	Watts
Bulb Temperature*	250	max.	°C
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

VERTICAL DEFLECTION AMPLIFIER●

Triode Connection #

MAXIMUM RATINGS:
Design Center Values

Plate Voltage	350	max.	Volts
Peak Positive Pulse Plate Voltage	1200	max.	Volts
Plate Dissipation■	10	max.	Watts
Peak Negative Pulse Grid Voltage	275	max.	Volts
Average Cathode Current	40	max.	Ma.
Peak Cathode Current	115	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
Total DC + Peak	200	max.	Volts
Heater Positive with Respect to Cathode			
DC Component	100	max.	Volts
Total DC + Peak	200	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	250	Volts
Grid Voltage	−12.5	Volts
Plate Current	49.5	Ma.
Transconductance	5000	μmhos
Amplification Factor	9.8	
Plate Resistance	1960	Ohms
Grid Voltage (Approx.) for I_b = 0.5 ma.	−36	Volts

● For operation in a 525 line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle.

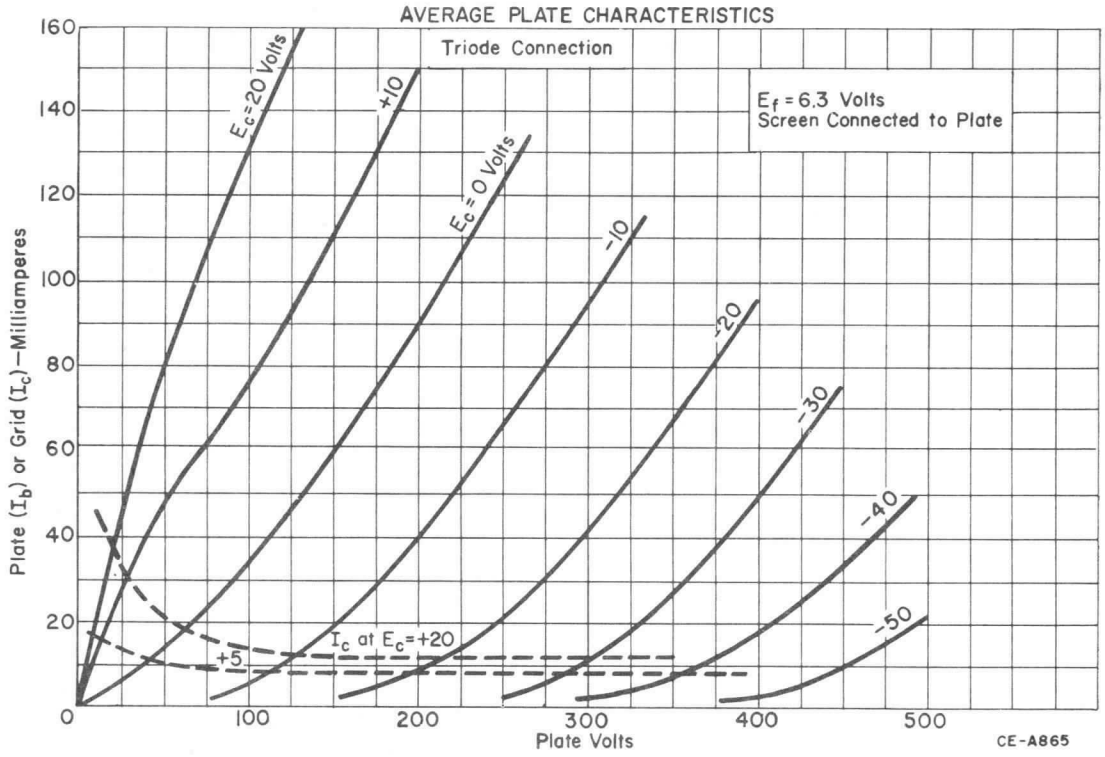
\# Plate and grid 2 tied together.

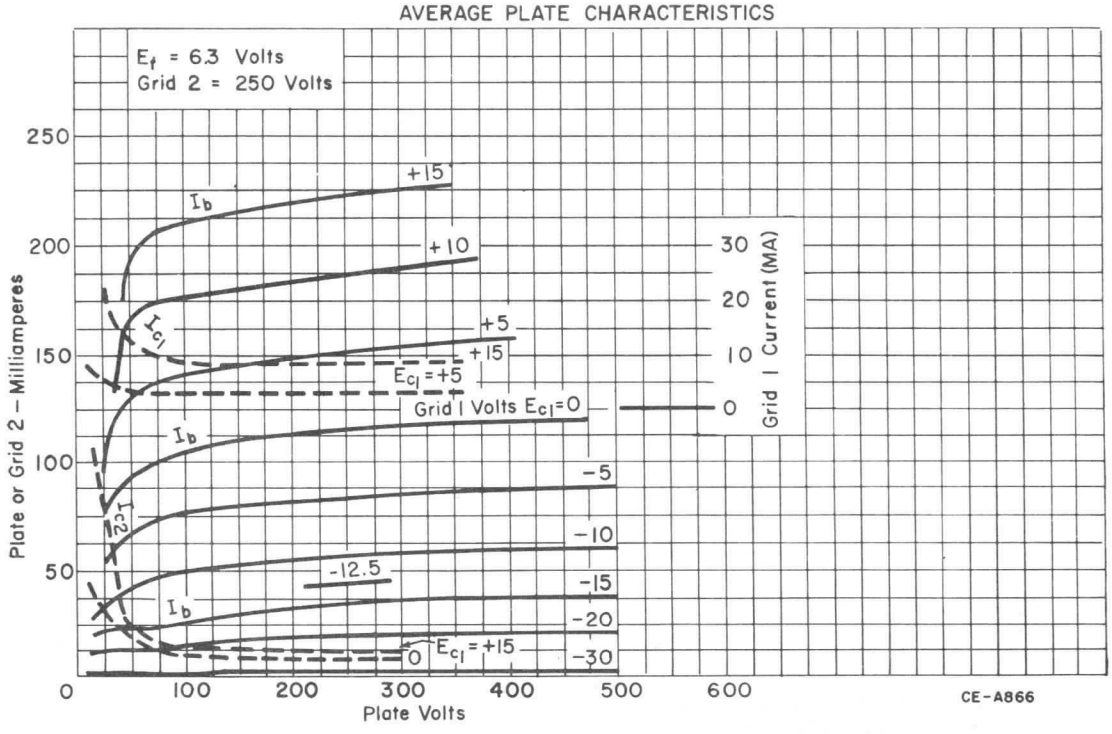
* High ambient temperature and shielding may necessitate a reduction in operating dissipation. When tube shields are used, it is advisable to paint both inside and outside surfaces of the tube shield a dull black and to provide ventilation slots to reduce operating temperature.

■ Stages operating with grid leak bias must use an adequate cathode bias resistor or similar means in order to protect the tube in the absence of excitation.

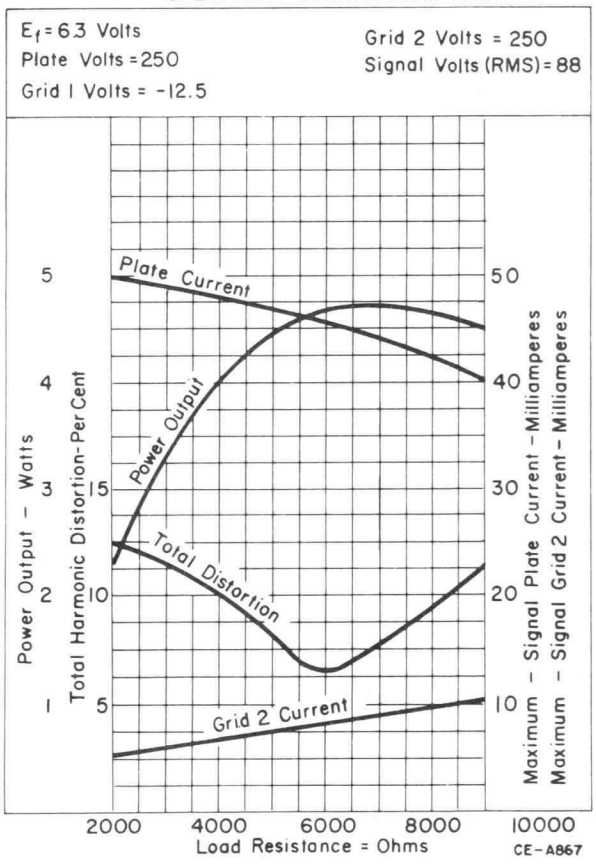
♦ 6V6-GTA only.

▲ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.


AVERAGE PLATE CHARACTERISTICS
Triode Connection
E_f = 6.3 Volts
Screen Connected to Plate
E_c=20 Volts
+10
E_c = 0 Volts
-10
-20
-30
-40
-50
I_c at E_c=+20
+5
Plate (I_b) or Grid (I_c)—Milliamperes
Plate Volts
0
20
40
60
80
100
120
140
160
100
200
300
400
500
CE-A865


AVERAGE PLATE CHARACTERISTICS
E_f = 6.3 Volts
Grid 2 = 250 Volts
+15
I_b
+10
I_{c1}
+5
+15
E_{c1} = +5
Grid 1 Volts E_{c1}=0
I_b
-5
I_{c1}
-10
-12.5
-15
I_b
-20
E_{c1} = +15
0
-30
Grid 1 Current (MA)
30
20
10
0
Plate or Grid 2 — Milliamperes
Plate Volts
0
50
100
150
200
250
100
200
300
400
500
600
CE-A866

OPERATION CHARACTERISTICS



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August 5, 1954

Half-Wave Vacuum Rectifier Type 35W4

The 35W4 is a 7-pin miniature half-wave rectifier designed for service in power supplies of ac-dc receivers. The heater is provided with a tap for operation of a panel lamp. The 35W4 must be adequately ventilated, as the tube operates at high temperatures.

GENERAL DATA

Electrical:

Cathode	Coated Unipotential		
Heater Voltage	Without Panel Lamp	With #40 or #47 Panel Lamp	
Entire Heater (pins 3 & 4)	35	32	ac or dc Volts
Panel Lamp Section (pins 4 & 6)	7.5	5.5	ac or dc Volts
Heater Current			
Between Pins 3 & 4	0.15	—	Ampere
Between Pins 3 & 6	—	0.15	Ampere

Mechanical:

Bulb	T-5½
Base	Small-Button Miniature 7-Pin
Basing	5BQ
Mounting Position	Any

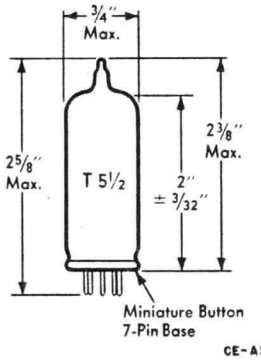
HALF-WAVE RECTIFIER

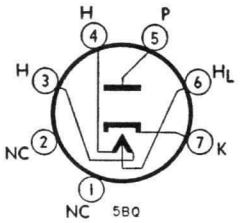
Maximum Ratings
Design Center Values

Peak Inverse Plate Voltage	330 max.	Volts
Peak Plate Current per Plate	600 max.	Ma.
Peak-Heater Cathode Voltage		
Heater Positive or Negative with Respect to Cathode	330 max.	Volts
Panel-Lamp-Section Voltage (RMS)		
When Panel Lamp Fails	15 max.	Volts
DC Output Current		
With Panel Lamp and No Shunting Resistor	60 max.	Ma.
With Panel Lamp and Shunting Resistor	90 max.	Ma.
Without Panel Lamp	100 max.	Ma.

Typical Operating Conditions
With #40 or #47 Panel Lamp
Half-Wave Rectifier—Capacitor Input to Filter

AC Plate Supply Voltage per Plate (RMS)	117	117	117	117	Volts
Filter Input Capacitor	40	40	40	40	μf
Minimum Effective Plate Supply Impedance per Plate*	15	15	15	15	Ohms
Panel Lamp Shunting Resistor	—	300	150	100	Ohms
DC Output Current	60	70	80	90	Ma.





BOTTOM VIEW

Typical Operating Conditions Without Panel Lamp**

Half-Wave Rectifier—Capacitor Input to Filter		
AC Plate Supply Voltage per Plate (RMS)	117	Volts
Filter Input Capacitor	40	μf
Minimum Effective Plate Supply Impedence per Plate*	15	Ohms
DC Output Voltage at Input to Filter (Approx.):		
At Half-Load Current of 50 ma.	135	Volts
At Half-Load Current of 100 ma.	120	Volts
DC Output Current	100	Ma.
Voltage Regulation (Approx.)		
Half-Load to Full-Load Current	15	Volts

Maximum Circuit Values:

Panel Lamp Shunting Resistor †

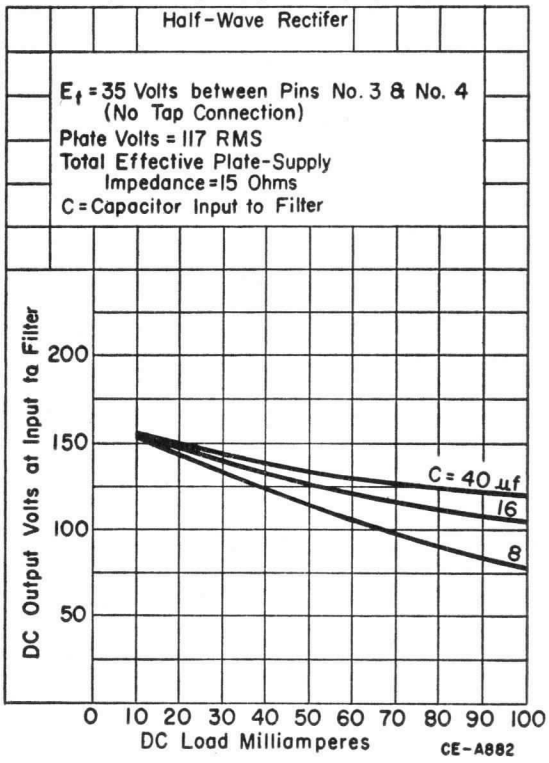
For DC Output Current of	70 ma.	800 max. Ohms
	80 ma.	400 max. Ohms
	90 ma.	250 max. Ohms

* When filter-input capacitors larger than the value indicated are used, it may be necessary to increase the plate supply impedance to keep within maximum ratings.

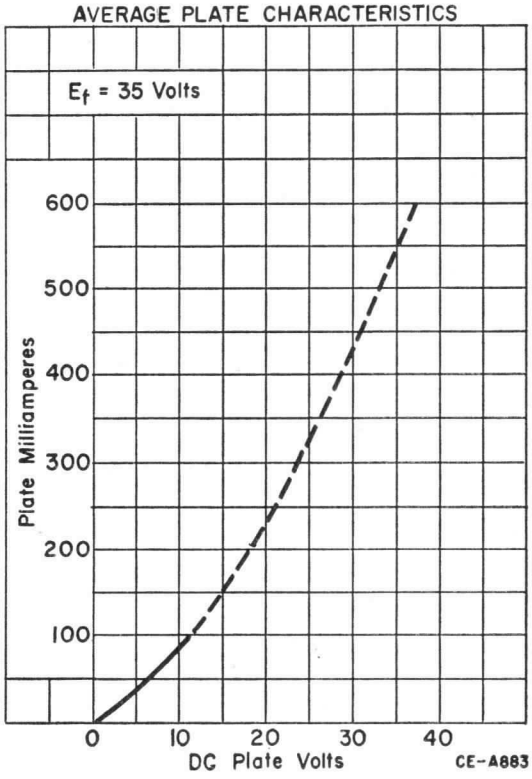
** Plate current must not flow through tap section.

† Required when DC output current is greater than 60 milliamperes.

OPERATION CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



October 1, 1962

TELEVISION DAMPING DIODE TYPE 6W4-GT AND 25W4-GT

The 6W4-GT and 25W4-GT are 6-pin octal indirectly-heated half-wave rectifiers designed for service as the damping diode in horizontal deflection circuits of television receivers.

ELECTRICAL

Cathode	Coated Unipotential		
Heater:	6W4-GT	25W4-GT	
Voltage (ac or dc)	6.3	25.0	Volts
Current	1.2	0.3	Ampere
Direct Interelectrode Capacitances:			
Heater to Cathode	7		$\mu\mu f$
Plate to Cathode and Heater	6		$\mu\mu f$
Cathode to Plate and Heater	13		$\mu\mu f$

MECHANICAL

Bulb	T-9
Base	Intermediate-Shell Octal 6-Pin (JEDEC B6-8) Short Intermediate-Shell Octal 6-Pin (JEDEC B6-60)
Basing	4CG
Mounting Position	Any

DAMPER DIODE SERVICE (Note 1)

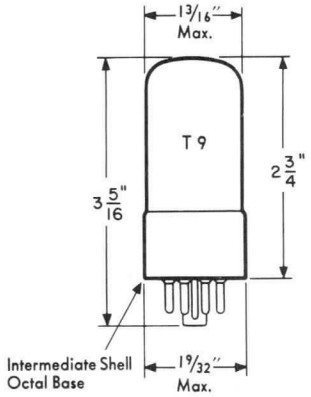
MAXIMUM RATINGS

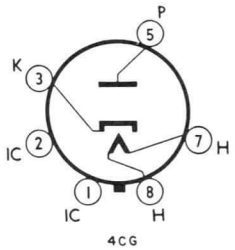
Design Center Values

Peak Inverse Voltage (Absolute)	3850	max.	Volts
Peak Plate Current	750	max.	Ma.
DC Plate Current	125	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to			
Cathode, DC (Absolute)	500	max.	Volts
Total DC and Peak	2300	max.	Volts
Heater Positive with Respect to			
Cathode, DC	100	max.	Volts
Total DC and Peak	300	max.	Volts
Voltage Drop at I_b = 250 Ma.	21	—	Volts
Plate Dissipation	3.5	max.	Watts

NOTE

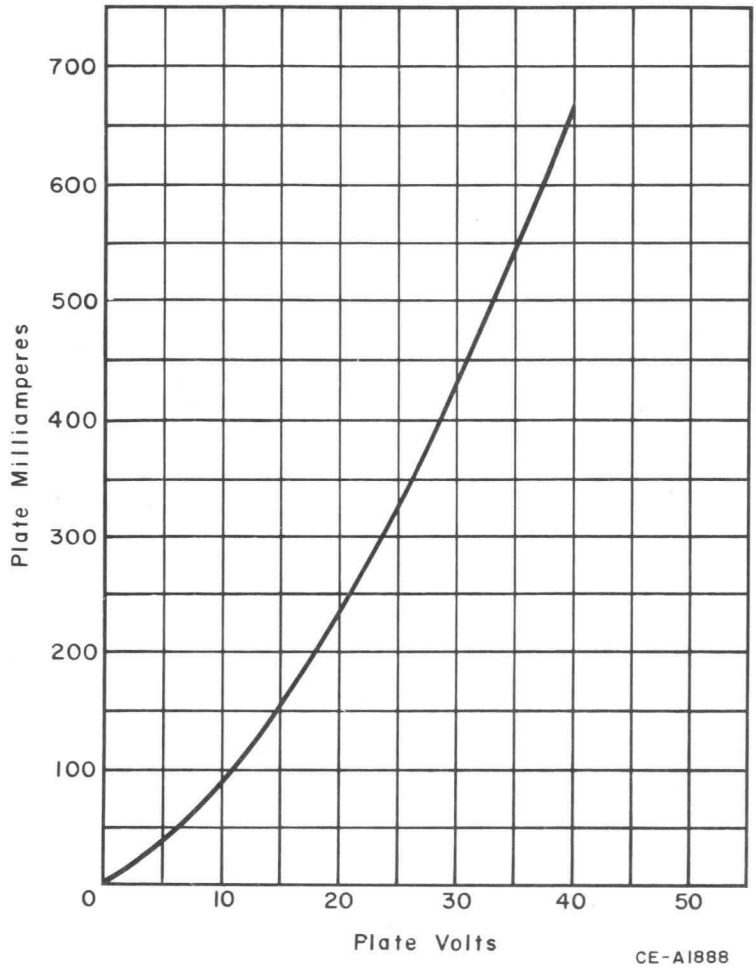
1. For operation in a 525 line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations, Federal Communications Commission". The duty of the horizontal voltage pulse not to exceed 15% of one scanning cycle.





4CG

AVERAGE PLATE CHARACTERISTIC



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March 18, 1955

Beam Power Amplifier Type 6W6-GT

The 6W6-GT is a glass octal beam power pentode designed for use as a vertical deflection amplifier in television receiver sweep circuits. It is also used as an audio-frequency power-output tube. The 6W6-GT features high sensitivity and efficiency and is capable of providing high power output at relatively low plate-supply voltages.

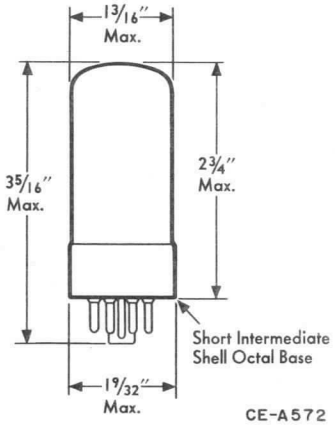
GENERAL DATA

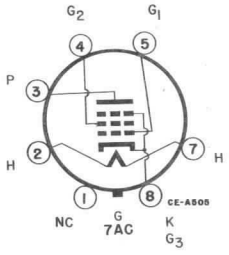
Electrical:

Cathode	Coated Unipotential	
Filament:		
Voltage	6.3 ac or dc	Volts
Current	1.2	Ampere
Direct Interelectrode Capacitances:		
Grid to Plate	0.8	μμf
Input	15.0	μμf
Output	9.0	μμf

Mechanical:

Bulb	T-9
Base	JETEC B7-7 (Intermediate Shell Octal 7-Pin)
Basing	G-7AC
Mounting Position	Any





Bottom View

AMPLIFIER — CLASS A_1

Maximum Ratings
Design Center Values (Except as Noted)

Plate Voltage	300	max.	Volts
Screen Voltage	150	max.	Volts
Plate Dissipation	10	max.	Watts
Screen Dissipation	1.25	max.	Watts

Characteristics and Typical Operation

Plate Voltage	110	200	Volts
Screen Voltage	110	125	Volts
Control Grid Voltage	-7.5		Volts
Cathode Bias Resistor		180	Ohms
Peak AF Control Grid Voltage	7.5	8.5	Volts
Zero-Signal Plate Current	49	46	Ma.
Zero-Signal Screen Current	4.0	2.2	Ma.
Max. Signal Plate Current	50	47	Ma.
Max. Signal Screen Current	10	8.5	Ma.
Plate Resistance (Approx.)	13000	28000	Ohms
Transconductance	8000	8000	μmhos
Load Resistance	2000	4000	Ohms
Max. Signal Power Output	2.1	3.8	Watts
Total Harmonic Distortion (Approx.)	10	10	Percent

Maximum Circuit Values

Grid 1 Circuit Resistance			
Fixed Bias	0.1	max.	Megohm
Cathode Bias	0.5	max.	Megohm

VERTICAL DEFLECTION AMPLIFIER *
Triode Connected

Maximum Ratings
Design Center Values

Plate Voltage	300	max.	Volts
Peak Positive Plate Voltage	1200 abs.	max.	Volts
Plate Dissipation**	7.5	max.	Watts
Peak Negative Grid Voltage	250	max.	Volts
Average Cathode Current	40	max.	Ma.
Peak Cathode Current	140	max.	Ma.

*, ** See Page 2.

VERTICAL DEFLECTION AMPLIFIER* (Continued)
Triode Connected

Characteristics

Plate Voltage	225	Volts
Grid Voltage	-30	Volts
Plate Current	22	Ma.
Transconductance	3800	μmhos
Amplification Factor	6.2	
Plate Resistance	1600	Ohms
Grid Voltage for I_b = 0.5 ma. (Approx.)	-42	Volts

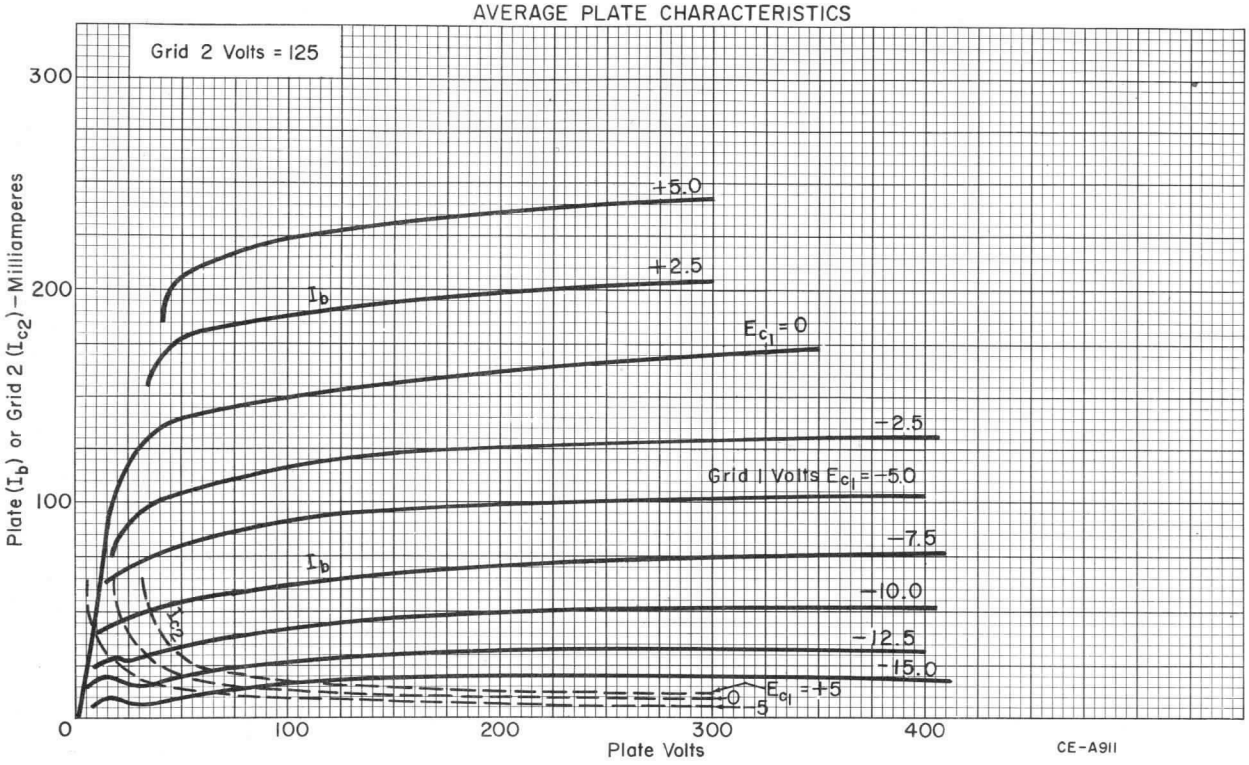
Typical Operation
90° Picture tube—17.2 kv 2nd Anode Voltage

Plate Supply Voltage	310	Volts
Plate Output Voltage		
Peak to Peak	535	Volts
Sawtooth Component	310	Volts
Grid Input Voltage		
Peak to Peak	110	Volts
Sawtooth Component	60	Volts
Average Cathode Current	35	Ma.
Peak Cathode Current	90	Ma.
Cathode Resistor	1100	Ohms

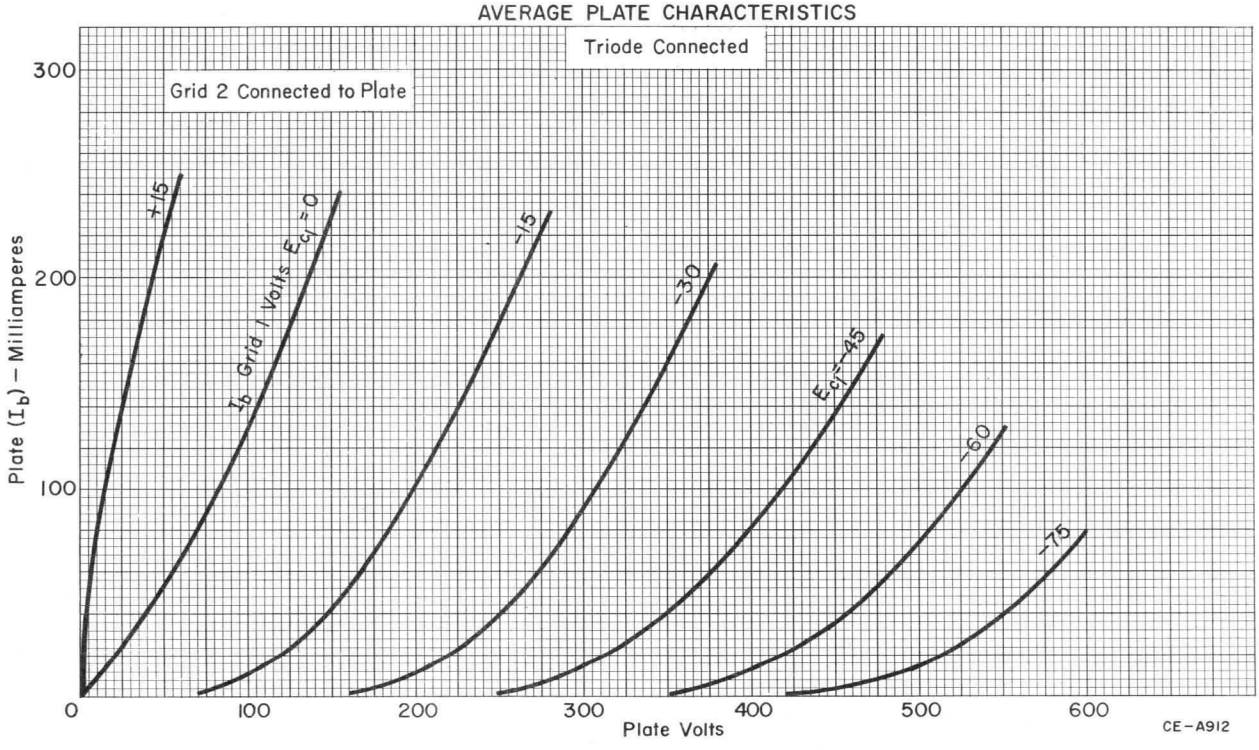
* For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission", the duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

**Stages operating with grid leak bias must use an adequate cathode bias resistor or similar arrangement to protect the tube in the absence of excitation.

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



September 24, 1954

Beam Power Amplifier Type 12W6-GT

The 12W6-GT is a glass octal beam power pentode designed for use as a vertical deflection amplifier in television receiver sweep circuits. It is also used as an audio-frequency power-output tube.

The 12W6-GT has been designed for use in receivers which employ series-connected heaters, especially in television receivers where the picture-tube heater is in series with other heaters. When it is employed in this type of circuit with other tubes having a heater current rating of 600 ma., heater voltage surges across individual tubes are minimized inasmuch as the heater warm-up characteristic is controlled.

GENERAL DATA

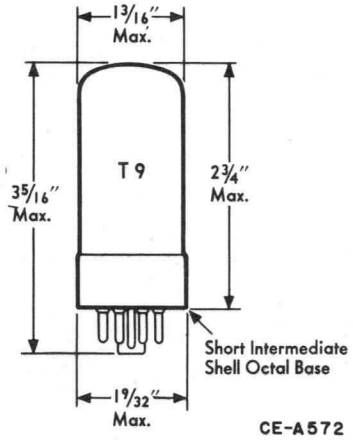
Electrical:

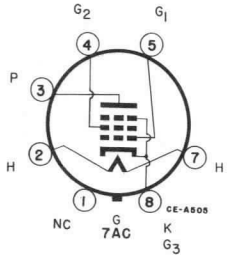
Cathode	Coated Unipotential	
Filament:		
Voltage	12.6 ac or dc	Volts
Current	0.6	Ampere
Warm-up Time (Approx.)**	10.5	Seconds
Direct Interelectrode Capacitances:		
Grid to Plate	0.8	μμf
Input	15	μμf
Output	9.0	μμf

**See Page 2

Mechanical:

Bulb	T-9
Base	B7-7 Intermediate Shell Octal
Basing	G-7AC
Mounting Position	Any





Bottom View

AMPLIFIER — CLASS A_1

Maximum Ratings
Design Center Values (Except as Noted)

Plate Voltage	300 max.		Volts
Screen Voltage	150 max.		Volts
Plate Dissipation	10 max.		Watts
Screen Dissipation	1.25 max.		Watts

Characteristics and Typical Operation

Plate Voltage	110	200	Volts
Screen Voltage	110	125	Volts
Control Grid Voltage	-7.5		Volts
Cathode Bias Resistor		180	Ohms
Peak AF Control Grid Voltage	7.5	8.5	Volts
Zero-Signal Plate Current	49	46	Ma.
Zero-Signal Screen Current	4.0	2.2	Ma.
Max. Signal Plate Current	50	47	Ma.
Max. Signal Screen Current	10	8.5	Ma.
Plate Resistance (Approx.)	13000	28000	Ohms
Transconductance	8000	8000	μmhos
Load Resistance	2000	4000	Ohms
Max. Signal Power Output	2.1	3.8	Watts
Total Harmonic Distortion (Approx.)	10	10	Percent

Maximum Circuit Values

Grid 1 Circuit Resistance			
Fixed Bias	0.1	max.	Megohm
Cathode Bias	0.5	max.	Megohm

VERTICAL DEFLECTION AMPLIFIER *
Triode Connected

Maximum Ratings
Design Center Values

Plate Voltage	300	max.	Volts
Peak Positive Plate Voltage	1200 abs.	max.	Volts
Plate Dissipation**	7.5	max.	Watts
Peak Negative Grid Voltage	250	max.	Volts
Average Cathode Current	40	max.	Ma.
Peak Cathode Current	140	max.	Ma.

VERTICAL DEFLECTION AMPLIFIER*—(Continued)
Triode Connected

Characteristics

Plate Voltage	225	Volts
Grid Voltage	-30	Volts
Plate Current	22	Ma.
Transconductance	3800	μmhos
Amplification Factor	6.2	
Plate Resistance	1600	Ohms
Grid Voltage for I_b = 0.5 ma. (Approx.).	-42	Volts

Typical Operation
90° Picture tube—17.2 kv 2nd Anode Voltage

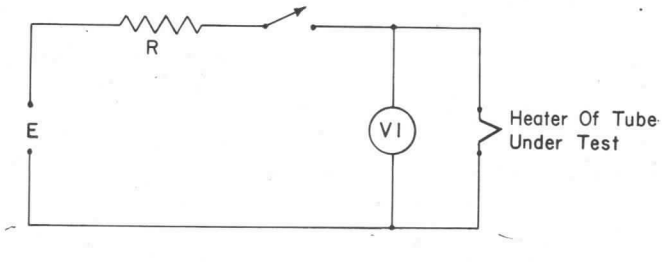
Plate Supply Voltage	310	Volts
Plate Output Voltage		
Peak to Peak	535	Volts
Sawtooth Component	310	Volts
Grid Input Voltage		
Peak to Peak	110	Volts
Sawtooth Component	60	Volts
Average Cathode Current	35	Ma.
Peak Cathode Current	90	Ma.
Cathode Resistor	1100	Ohms

* For operation in a 525-line, 30 frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations; Federal Communications Commission", the duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

**Stages operating with grid leak bias must use an adequate cathode bias resistor or similar arrangement to protect the tube in the absence of excitation.

**HEATER WARM-UP TIME MEASUREMENTS

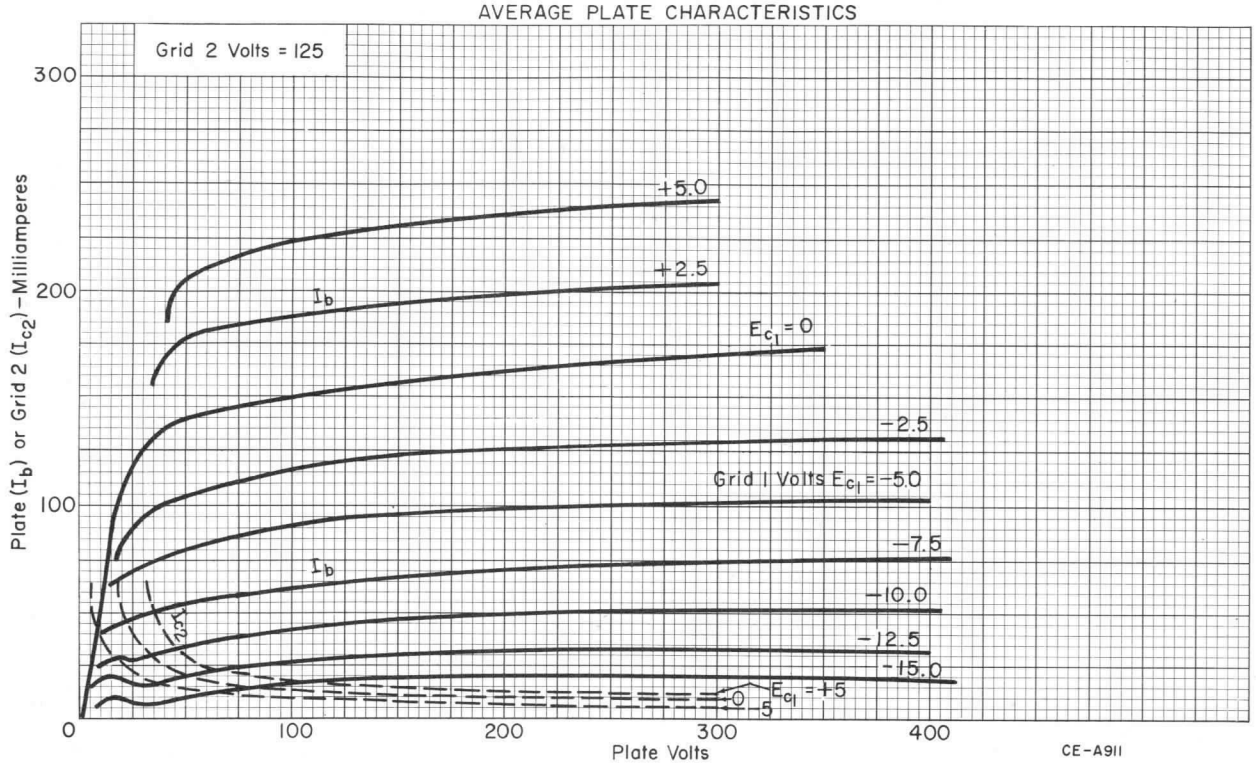
Heater warm-up time is defined as the time required for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1) in the circuit shown below. The conditions used in conjunction with the test circuit depend upon the rated heater voltage and current of the tube under test.



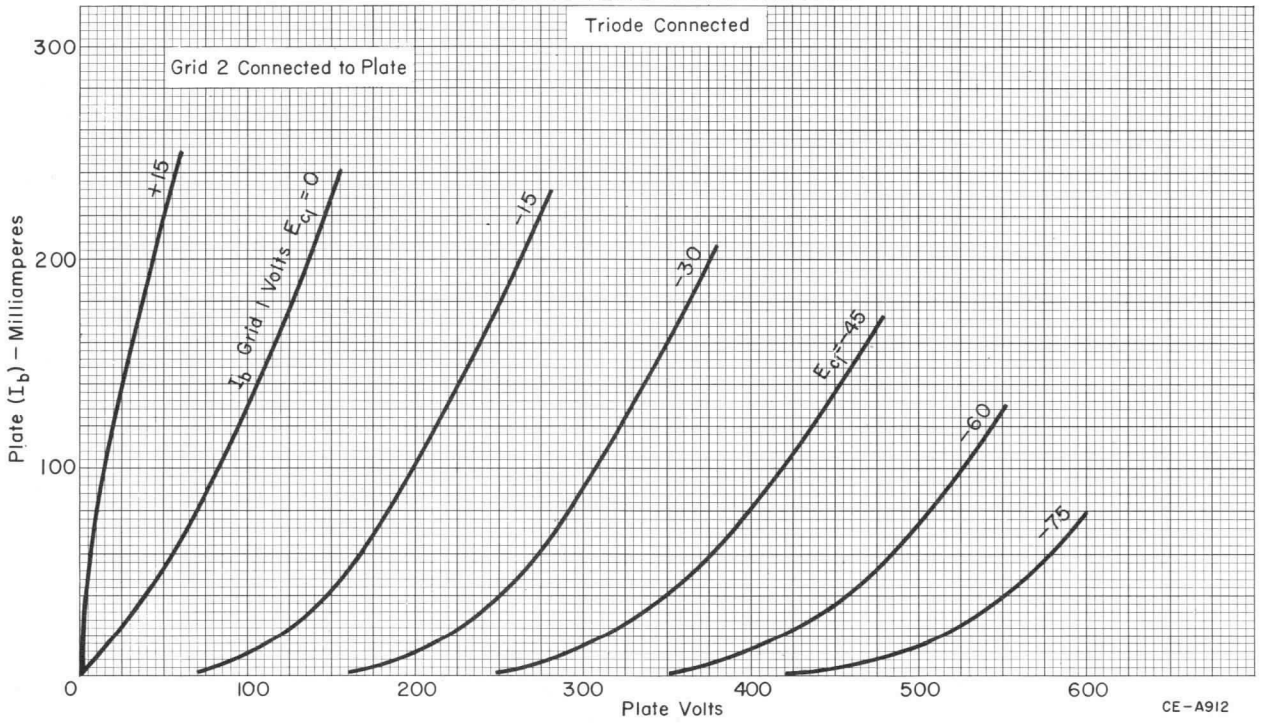
CE—A933

E —Applied Voltage, RMS or DC	50	Volts
R —Total Series Resistance	63	Ohms
V_1—Heater Test Voltage, RMS or DC	10.0	Volts
E_f—Rated Heater Voltage of Tube Under Test	12.6	Volts
I_f —Rated Heater Current of Tube Under Test	0.6	Ampere

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



Sept. 10, 1954

Half-Wave Rectifier Type 1X2-B

The 1X2-B is a 9-pin miniature high voltage rectifier designed for use as the high voltage rectifier in television receivers. The 1X2-B may be used either in flyback or rf types of power supply.

GENERAL DATA

Electrical:

Cathode	Coated Filament	
Filament		
Voltage	1.25	ac Volts
Current	0.2	Ampere
Direct Interelectrode Capacitances		
Plate to Filament	1.0	μμf

Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-pin (JETEC No. E9-1)
Basing	9Y
Mounting Position	Any

FLYBACK RECTIFIER*

Maximum Ratings
Design Center Values
(Unless Otherwise Noted)

Peak Inverse Plate Voltage	22000	abs. max.	Volts
Steady State Peak Plate Current	45	max.	Ma.
DC Output Current	0.5	max.	Ma.
Tube Voltage Drop**	100		Volts

* For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations", Federal Communications Commission. The duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

** Measured with tube conducting 7 ma.

Characteristics and Typical Operation

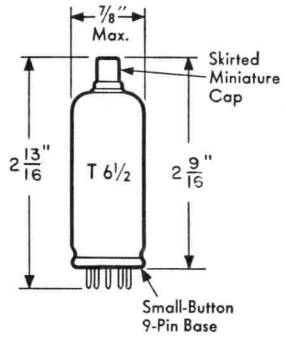
Positive Peak Plate Voltage	18000	Volts
Negative Peak Plate Voltage	2000	Volts
DC Output Voltage (Approx.)	18000	Volts
DC Output Current (Approx.)	100	μa

Notes:

Pins 3 and 7 can be used as a tie point for the filament dropping resistor and high voltage resistor. Do not connect to the low voltage circuits.

Inasmuch as the tube rating permits operation as high as 22000 volts (absolute max.), shielding of the tube for x-ray radiation may be needed. Relatively simple shielding should prove adequate, but the need for this precaution should be considered in equipment design.

When the filament is operated from a pulse-operated or rf power source, the color temperature of the filament may be visually checked in a darkened room by observing the reflection of the incandescent filament upon the surface of the internal shield. This color temperature may then be visually compared with the color temperature obtained when the filament of another 1X2-B is operated from a dc or low-frequency ac supply of 1.25 volts. This provides a convenient method for adjusting the amount of rf excitation to produce 1.25 volts (rms) at the filament terminals.



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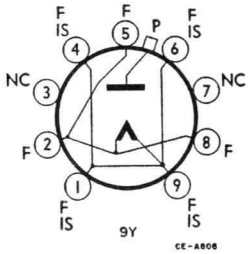
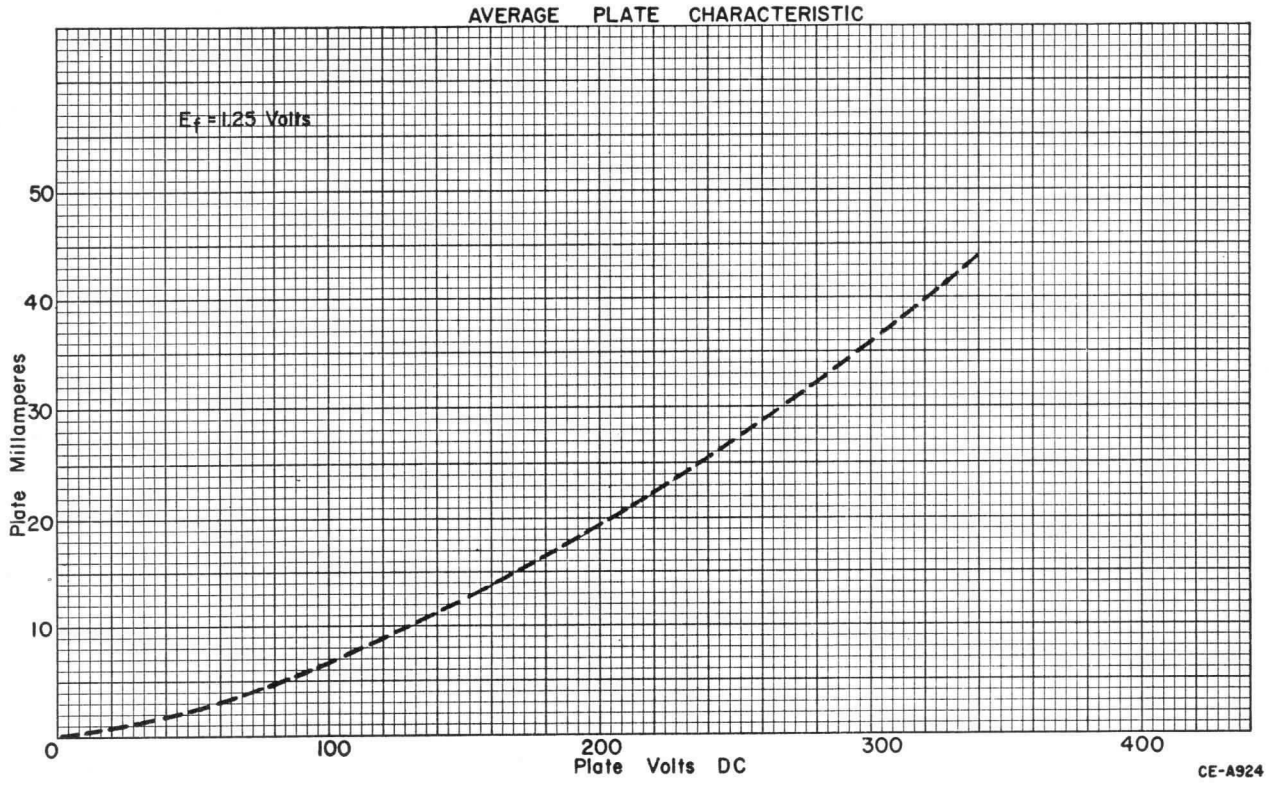


BOTTOM VIEW

Receiving Tube Section


AVERAGE PLATE CHARACTERISTIC
E_f = 1.25 Volts
Plate Millamperes
50
40
30
20
10
0
100
200
300
400
Plate Volts DC
CE-A924

September 22, 1958

FULL-WAVE VACUUM RECTIFIER TYPES 6X4 AND 12X4

The 6X4 and 12X4 are 7-pin miniature full-wave rectifiers designed for service in compact power supplies such as automobile and ac-operated radio receivers. Like all power handling tubes, they should be adequately ventilated.

GENERAL DATA

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	6X4	12X4	
Voltage (ac or dc)	6.3	12.6	Volts
Current	0.6	0.3	Ampere

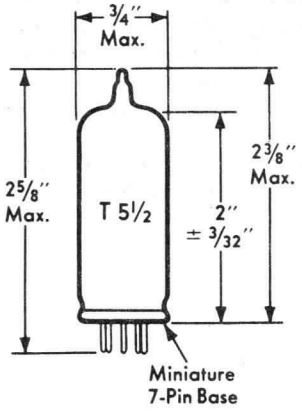
MECHANICAL:

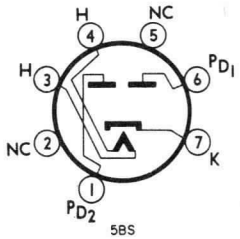
Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-3
Basing	5BS
Mounting Position	Any

RECTIFIER SERVICE*

MAXIMUM RATINGS:

Design-Center Values		
Peak Inverse Plate Voltage	1250 max.	Volts
AC Plate-Supply Voltage per Plate	See Rating Chart 1	
Steady-State Peak Plate:		
Current per Plate	245 max.	Ma.
Transient Peak Plate Current per Plate:		
Max. Duration 0.2 Second	1.1 max.	Ampere
DC Output Current	See Rating Chart 1	
Vibrator Operation:		
Duty Cycle	75 min.	Percent
DC Output Voltage	350 max.	Volts
DC Output Current (per plate)	45 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
DC Component	450 max.	Volts
Total DC + Peak	450 max.	Volts
Heater Positive with Respect to Cathode:		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts





TYPICAL OPERATION:

Full-Wave Rectifier	Input to Filter		
AC Plate Supply Voltage:	Capacitor	Choke	
Each Plate (RMS)	325	450	Volts
Filter Input Capacitor	10	-	uf
Filter Input Choke	-	10	Henrys
Total Plate-Supply Resistance per Plate	525	-	Ohms
DC Output Current	70	70	Ma.
DC Output Voltage at Filter Input:			
For DC Output Current of 35 Ma.	365	395	Volts
For DC Output Current of 70 Ma.	310	385	Volts
Tube Voltage Drop:			
I_b = 70 Ma. Each Plate		22	Volts

* For use with sinusoidal supply voltages within the frequency range of 25 to 1000 cycles per second.

RATING CHARTS AND OPERATION CHARACTERISTICS:

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the 12X4 is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are inter-dependent, nad they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and for choke-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor-input filter, operation is permissible within the area bounded by points FAEDG; with choke-input filter, operation is permissible within the area bounded by points FABCDG.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}\ E_s}$$

where $\bar{E}$ is the dc output voltage at input to filter and E_s is the rms plate supply voltage per plate.

Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of

$R_S = N\ R_{PRI.} + R_{SEC.} + R_A$

N = voltage step-up ratio of plate transformer

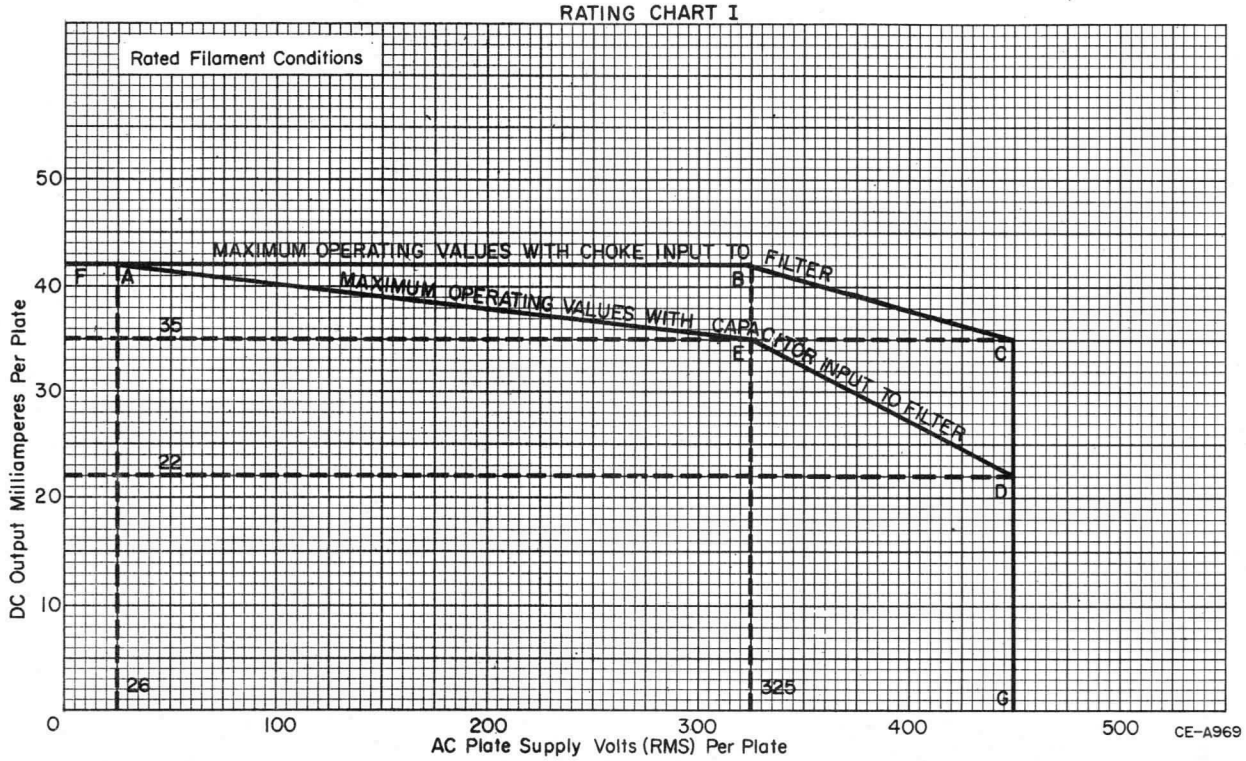
R_{PRI} = dc resistance of transformer primary

$R_{SEC.}$ = average dc resistance of each transformer secondary winding

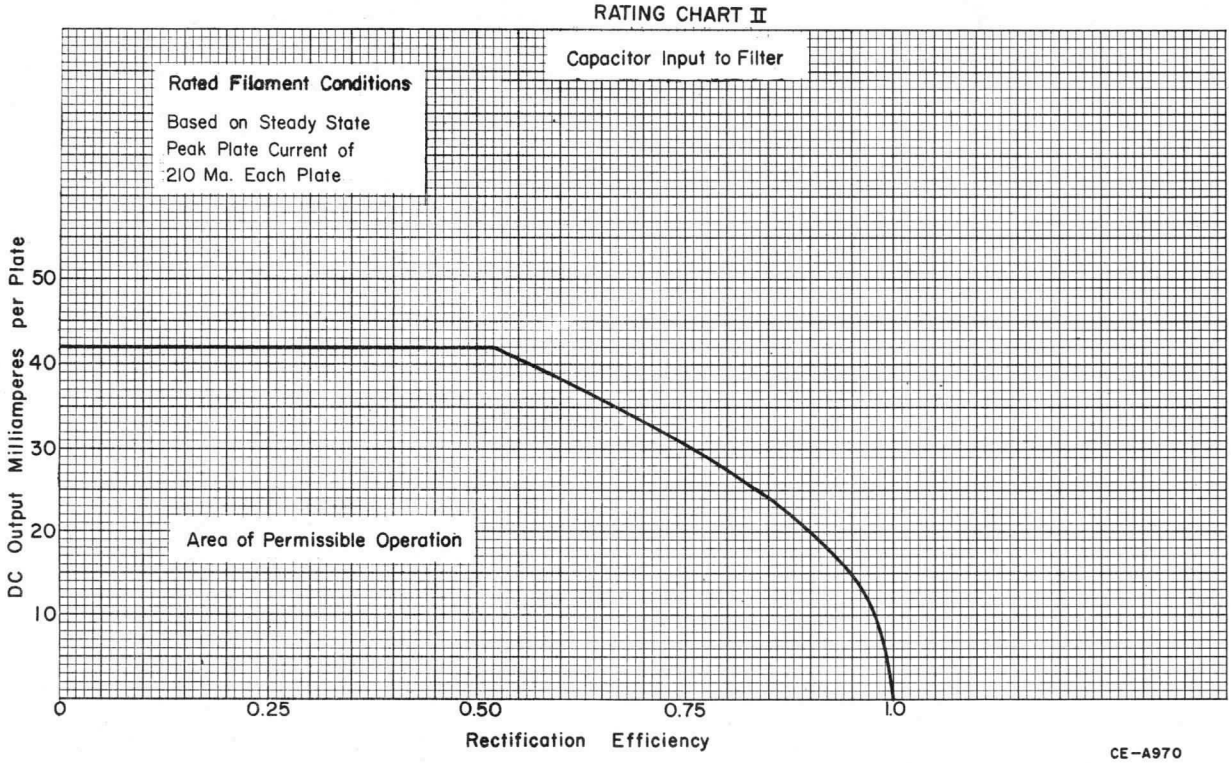
R_A = dc resistance of added series resistance per plate

In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

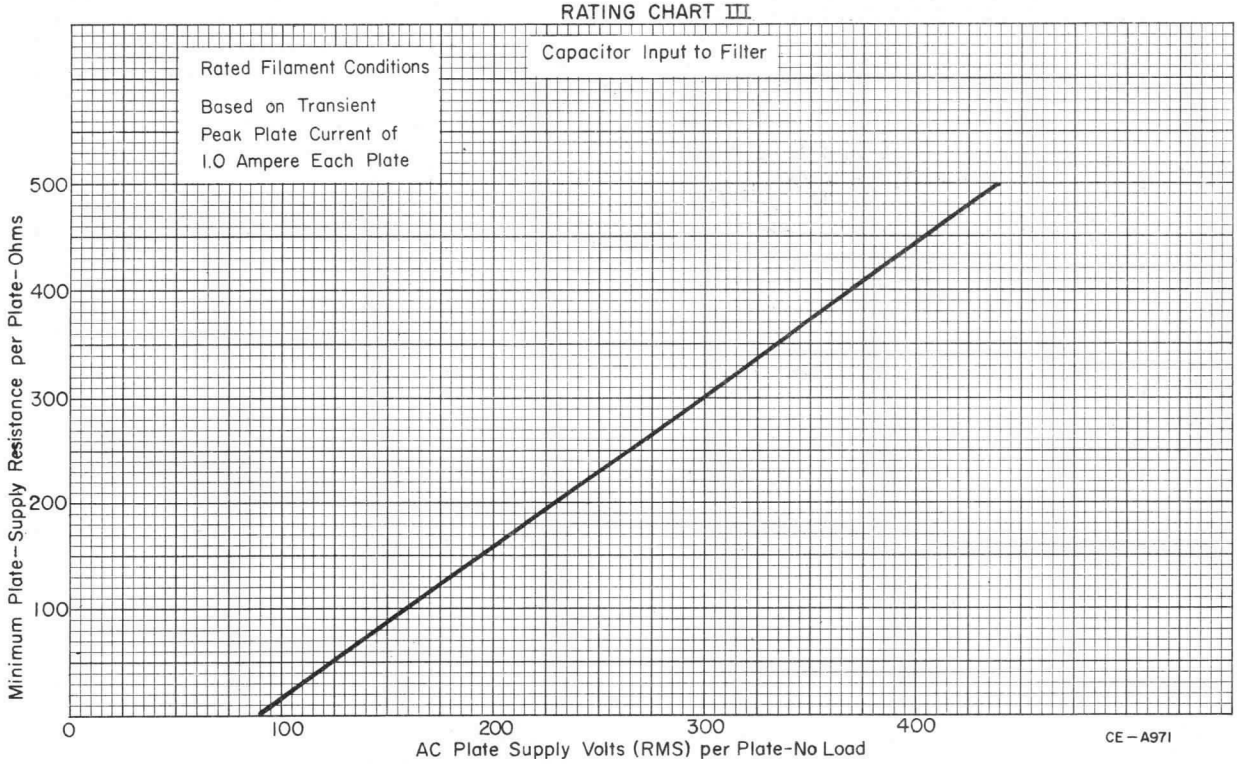
RATING CHART I



RATING CHART II



RATING CHART III



November 5, 1954

Triode Pentode Converter Type 6X8

The 6X8 is a 9-pin miniature medium-mu triode and sharp-cutoff pentode designed for service as a combined oscillator and mixer in television receivers using an intermediate frequency of approximately 40 mc. The mixer portion of the 6X8 is similar to a 6AG5, and the oscillator section of the 6X8 is similar to one unit of the 6J6.

GENERAL DATA

Electrical:

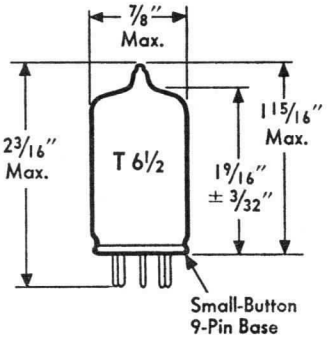
Cathode	Coated Unipotential		
Filament			
Voltage	6.3 ac or dc		Volts
Current	0.45		Ampere
Direct Interelectrode Capacitances:	Unshielded	External Shield #315 Connected to Cathode	
Triode Unit			
Grid to Plate	1.4	1.4	μμf
Input	2.0	2.6	μμf
Output	0.5	1.0	μμf
Pentode Unit			
Grid 1 to Plate	0.09 max.	0.06 max.	μμf
Input	4.3	4.5	μμf
Output	0.7	1.4	μμf
Pentode Grid 1 to Triode Plate	0.045 max.	0.035 max.	μμf
Pentode Plate to Triode Plate	0.040 max.	0.008 max.	μμf
Pentode Unit Connected as Triode*			
Grid 1 to Plate	1.4	1.3	μμf
Input	3.0	3.2	μμf
Output	1.6	2.0	μμf
Heater to Cathode	6.0	6.0	μμf

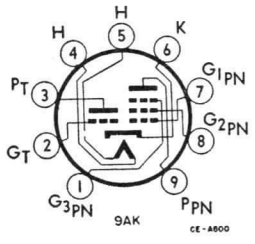
Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-Pin (JETEC E9-1)
Basing	9AK
Mounting Position	Any

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	100	250	Volts
Grid 3 (Suppressor)	—	Connected to cathode at socket	
Grid 2 Voltage	—	150	Volts
Cathode Bias Resistor	100	200	Ohms
Amplification Factor	40	—	
Plate Resistance (Approx.)	6900	750000	Ohms
Transconductance	5800	4600	μmhos
Grid 1 Bias (Approx.) for I_b of 10 μamp	−10	−10	Volts
Plate Current	8.5	7.7	Ma.
Grid 2 Current	—	1.6	Ma.
Pentode Unit Connected as Triode			
Plate Voltage		150	Volts
Grid 3		Connected to cathode at socket	
Grid 2		Connected to plate	
Cathode-Bias Resistor		250	Ohms
Amplification Factor		42	
Plate Resistance (Approx.)		7900	Ohms
Transconductance		4000	μmhos
Grid 1 Bias (Approx.) for I_b = 10 μamp		−10	Volts
Plate Current		7.8	Ma.





BOTTOM VIEW

CE-A554

Receiving Tube Section

CONVERTER SERVICE

Maximum Ratings

Design Center Values

	Triode Unit as Osc.	Pentode Unit as Mixer	
Plate Voltage	250 max.	250 max.	Volts
Grid 3 (Suppressor) Voltage	—	0 max.	Volts
Grid 2 (Screen) Voltage	—	See CE-A864	
Grid 2 Supply Voltage	—	250 max.	Volts
Grid 1 (Control Grid) Voltage			
Negative Bias Value	40 max.	40 max.	Volts
Positive Bias Value	0 max.	0 max.	Volts
Plate Dissipation	1.5 max.	2.0 max.	Watts
Grid 2 Input	—	0.4 max.	Watt
Grid 1 Input	0.5 max.	—	Watt
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	100 max.	100 max.	Volts

Pentode Unit as Triode-Connected Mixer*		
Plate Voltage	250 max.	Volts
Grid 1 (Control-Grid) Voltage		
Negative Bias Value	40 max.	Volts
Positive Bias Value	0 max.	Volts
Plate Dissipation	2.4 max.	Watts
Peak Heater-Cathode Voltage:		
Heater Positive or Negative with Respect to Cathode	100 max.	Volts

Typical Operation

	Triode Unit as 250 Mc. Osc.†	Pentode Unit as Mixer††	
Plate Voltage	150	150	Volts
Grid 3 (Suppressor)	—	Connected to cathode at socket	
Grid 2 Voltage	—	150	Volts
Mixer Grid 1 Supply Voltage	—	−3.5	Volts
Oscillator Voltage (rms) at Mixer Grid 1	—	2.6	Volts
Mixer Grid 1 Circuit Resistance	—	120000	Ohms
Oscillator Grid Resistor	2700	—	Ohms
Conversion Transconductance	—	2100	μmhos
Plate Current	13	6.2	Ma.
Grid 2 Current	—	1.8	Ma.
Grid 1 Current	3.6	—	Ma.
Grid 1 Current	—	2.0	μamp
Oscillator Power Output (Approx.)	0.5	—	Watt

Pentode Unit as Triode-Connected Mixer*		
Plate Voltage	150	Volts
Grid 1 Supply Voltage	−3.5	Volts
Oscillator Voltage (rms) at Grid 1	2.6	Volts
Grid 1 Circuit Resistance	120000	Ohms
Conversion Transconductance	2800	μmhos
Plate Current	7.8	Ma.
Grid 1 Current	2.0	μamp

Maximum Circuit Values

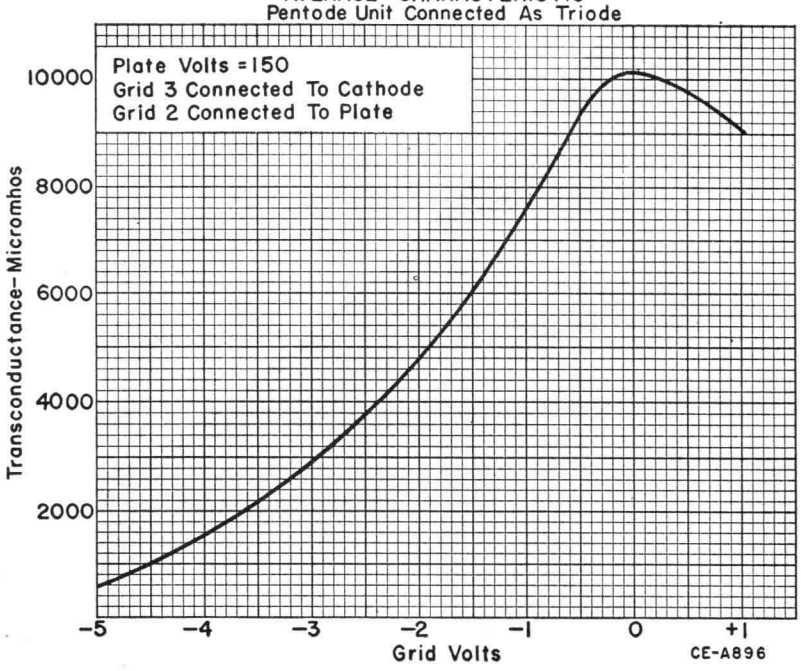
Grid 1 Circuit Resistance	
Fixed-Bias Operation	0.1 max. Megohm
Cathode-Bias Operation	0.5 max. Megohm

* Grid 2 connected to plate, grid 3 connected to cathode.

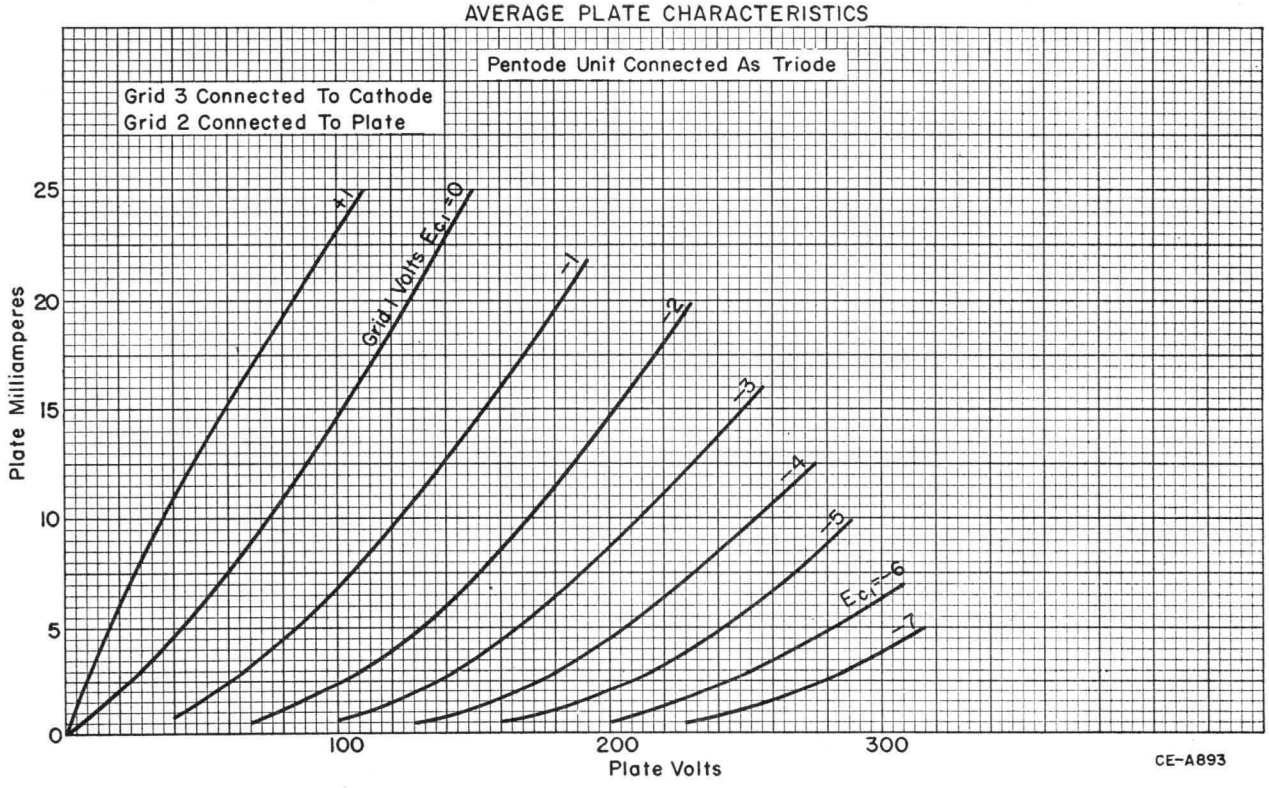
† In television or FM receivers it is generally desirable to operate the oscillator with less power input than shown in order to avoid over-excitation and excessive oscillation radiation.

†† With separate excitation and triode unit grounded.

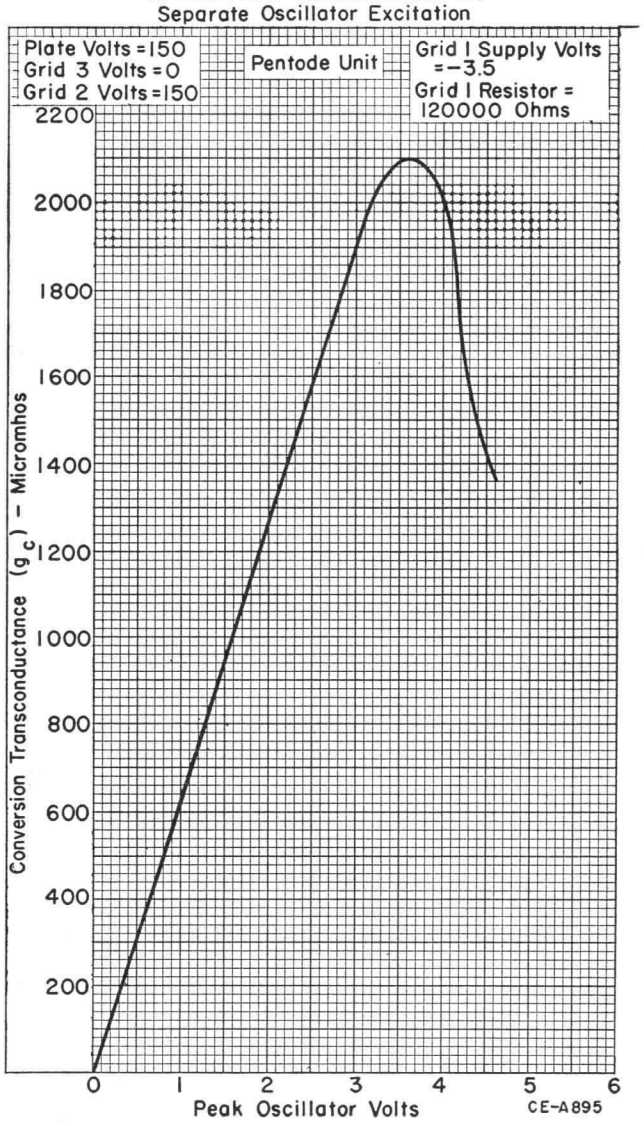
AVERAGE CHARACTERISTIC
Pentode Unit Connected As Triode



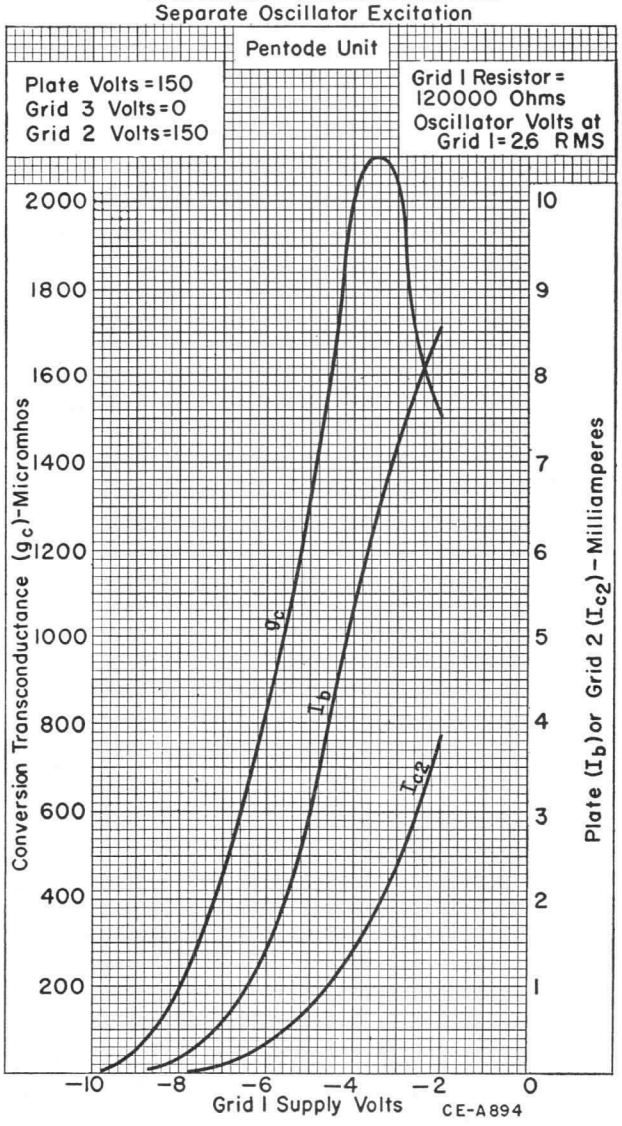
AVERAGE PLATE CHARACTERISTICS



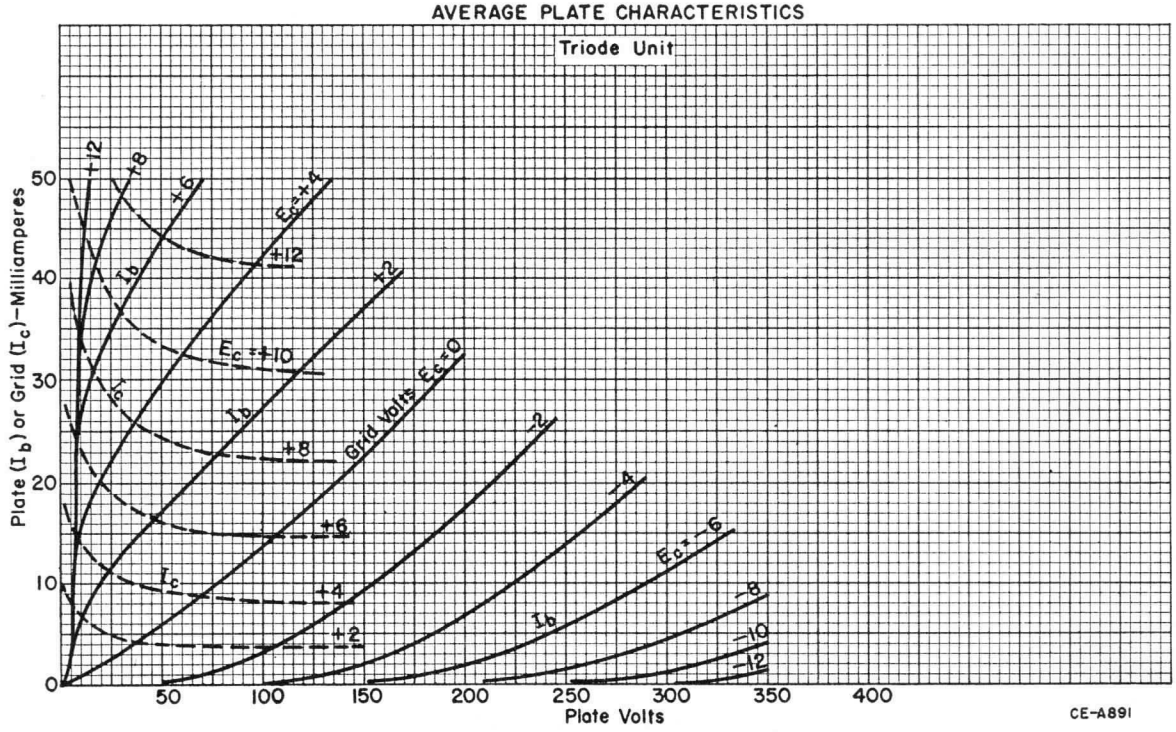
OPERATION CHARACTERISTIC
Separate Oscillator Excitation



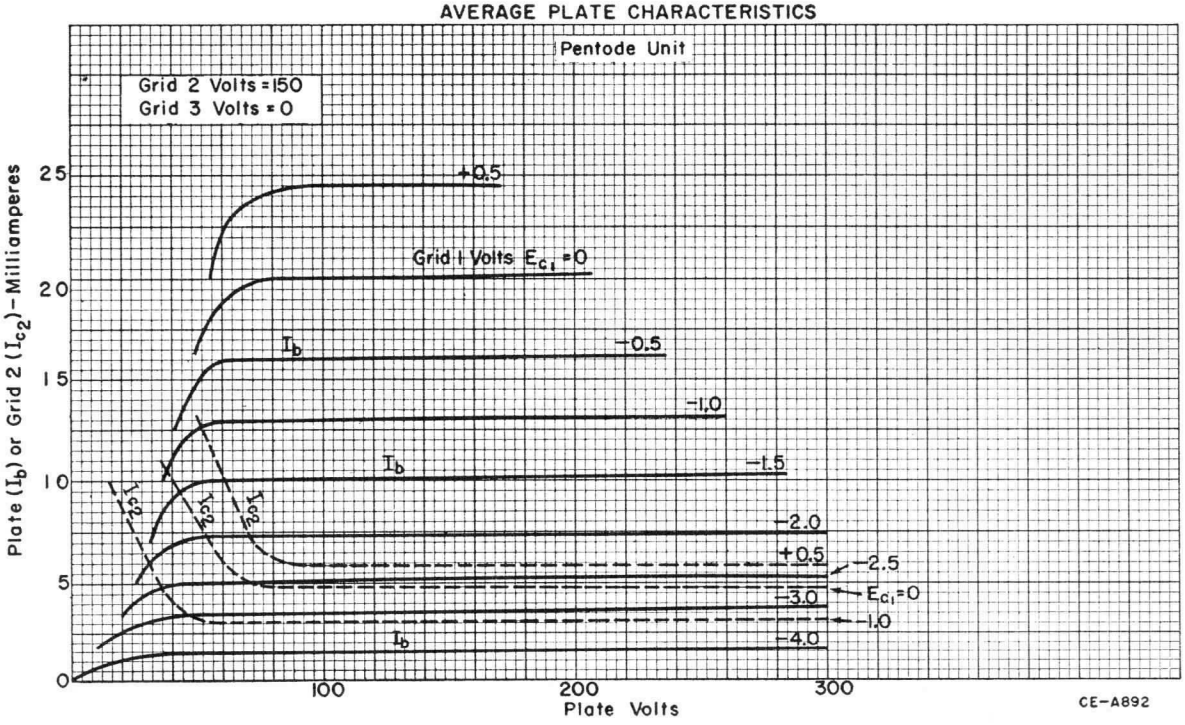
OPERATION CHARACTERISTICS
Separate Oscillator Excitation

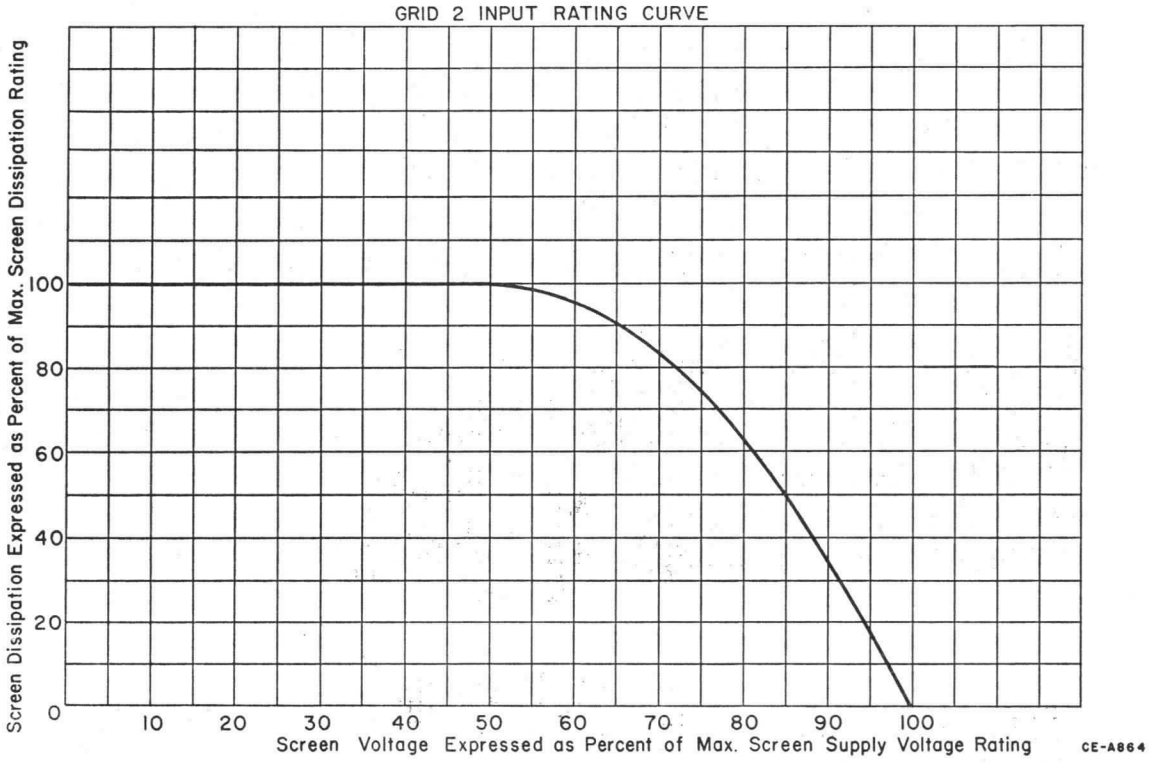


AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS




GRID 2 INPUT RATING CURVE
Screen Dissipation Expressed as Percent of Max. Screen Dissipation Rating
0
20
40
60
80
100
10
20
30
40
50
60
70
80
90
100
Screen Voltage Expressed as Percent of Max. Screen Supply Voltage Rating
CE-A864

Sept. 10, 1954

Half-Wave Rectifier Type 1X2-B

The 1X2-B is a 9-pin miniature high voltage rectifier designed for use as the high voltage rectifier in television receivers. The 1X2-B may be used either in flyback or rf types of power supply.

GENERAL DATA

Electrical:

Cathode	Coated Filament	
Filament		
Voltage	1.25	ac Volts
Current	0.2	Ampere
Direct Interelectrode Capacitances		
Plate to Filament	1.0	μμf

Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-pin (JETEC No. E9-1)
Basing	9Y
Mounting Position	Any

FLYBACK RECTIFIER*

Maximum Ratings
Design Center Values
(Unless Otherwise Noted)

Peak Inverse Plate Voltage	22000	abs. max.	Volts
Steady State Peak Plate Current	45	max.	Ma.
DC Output Current	0.5	max.	Ma.
Tube Voltage Drop**	100		Volts

* For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcast Stations", Federal Communications Commission. The duty cycle of the voltage pulse must not exceed 15% of one scanning cycle.

** Measured with tube conducting 7 ma.

Characteristics and Typical Operation

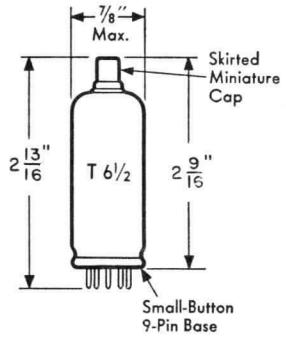
Positive Peak Plate Voltage	18000	Volts
Negative Peak Plate Voltage	2000	Volts
DC Output Voltage (Approx.)	18000	Volts
DC Output Current (Approx.)	100	μa

Notes:

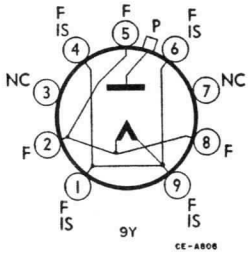
Pins 3 and 7 can be used as a tie point for the filament dropping resistor and high voltage resistor. Do not connect to the low voltage circuits.

Inasmuch as the tube rating permits operation as high as 22000 volts (absolute max.), shielding of the tube for x-ray radiation may be needed. Relatively simple shielding should prove adequate, but the need for this precaution should be considered in equipment design.

When the filament is operated from a pulse-operated or rf power source, the color temperature of the filament may be visually checked in a darkened room by observing the reflection of the incandescent filament upon the surface of the internal shield. This color temperature may then be visually compared with the color temperature obtained when the filament of another 1X2-B is operated from a dc or low-frequency ac supply of 1.25 volts. This provides a convenient method for adjusting the amount of rf excitation to produce 1.25 volts (rms) at the filament terminals.

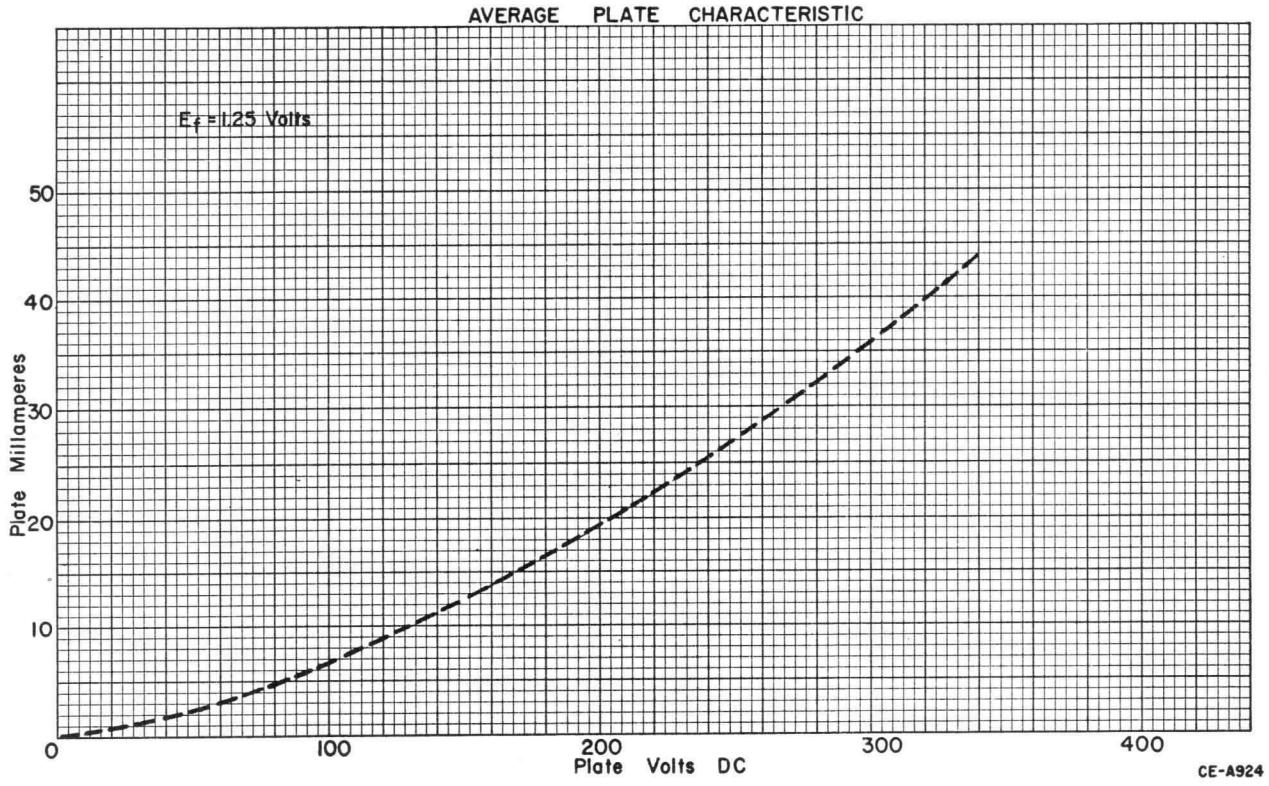


CE-A556



BOTTOM VIEW

Receiving Tube Section


AVERAGE PLATE CHARACTERISTIC
E_f = 1.25 Volts
Plate Millamperes
50
40
30
20
10
0
100
200
300
400
Plate Volts DC
CE-A924

September 22, 1958

FULL-WAVE VACUUM RECTIFIER TYPES 6X4 AND 12X4

The 6X4 and 12X4 are 7-pin miniature full-wave rectifiers designed for service in compact power supplies such as automobile and ac-operated radio receivers. Like all power handling tubes, they should be adequately ventilated.

GENERAL DATA

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	6X4	12X4	
Voltage (ac or dc)	6.3	12.6	Volts
Current	0.6	0.3	Ampere

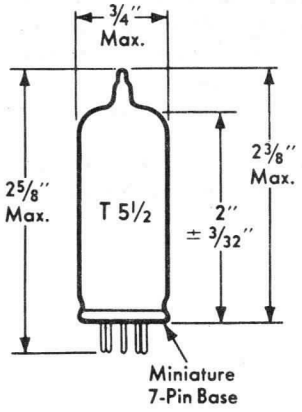
MECHANICAL:

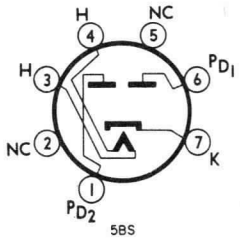
Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-3
Basing	5BS
Mounting Position	Any

RECTIFIER SERVICE*

MAXIMUM RATINGS:

Design-Center Values		
Peak Inverse Plate Voltage	1250 max.	Volts
AC Plate-Supply Voltage per Plate	See Rating Chart 1	
Steady-State Peak Plate:		
Current per Plate	245 max.	Ma.
Transient Peak Plate Current per Plate:		
Max. Duration 0.2 Second	1.1 max.	Ampere
DC Output Current	See Rating Chart 1	
Vibrator Operation:		
Duty Cycle	75 min.	Percent
DC Output Voltage	350 max.	Volts
DC Output Current (per plate)	45 max.	Ma.
Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
DC Component	450 max.	Volts
Total DC + Peak	450 max.	Volts
Heater Positive with Respect to Cathode:		
DC Component	100 max.	Volts
Total DC + Peak	200 max.	Volts





TYPICAL OPERATION:

Full-Wave Rectifier	Input to Filter		
AC Plate Supply Voltage:	Capacitor	Choke	
Each Plate (RMS)	325	450	Volts
Filter Input Capacitor	10	-	uf
Filter Input Choke	-	10	Henrys
Total Plate-Supply Resistance per Plate	525	-	Ohms
DC Output Current	70	70	Ma.
DC Output Voltage at Filter Input:			
For DC Output Current of 35 Ma.	365	395	Volts
For DC Output Current of 70 Ma.	310	385	Volts
Tube Voltage Drop:			
I_b = 70 Ma. Each Plate		22	Volts

* For use with sinusoidal supply voltages within the frequency range of 25 to 1000 cycles per second.

RATING CHARTS AND OPERATION CHARACTERISTICS:

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the 12X4 is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

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Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}\ E_s}$$

where $\bar{E}$ is the dc output voltage at input to filter and E_s is the rms plate supply voltage per plate.

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$R_S = N\ R_{PRI.} + R_{SEC.} + R_A$

N = voltage step-up ratio of plate transformer

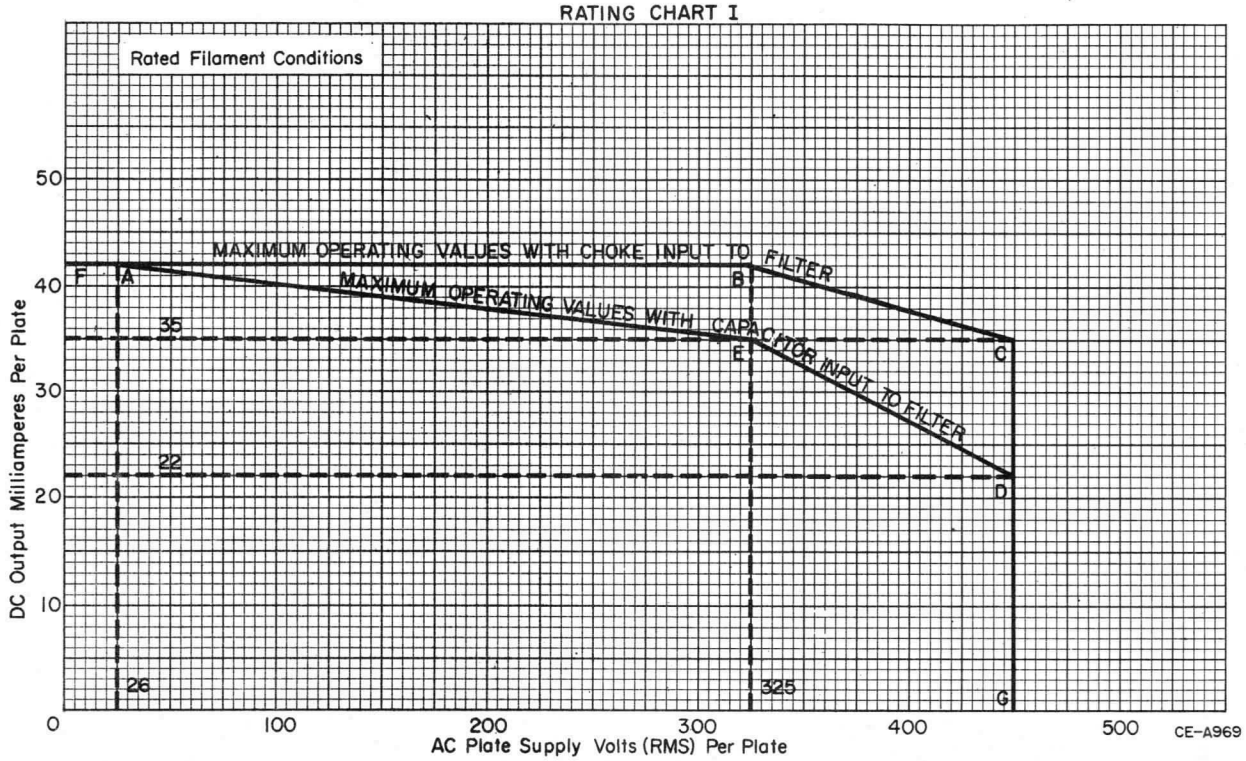
R_{PRI} = dc resistance of transformer primary

$R_{SEC.}$ = average dc resistance of each transformer secondary winding

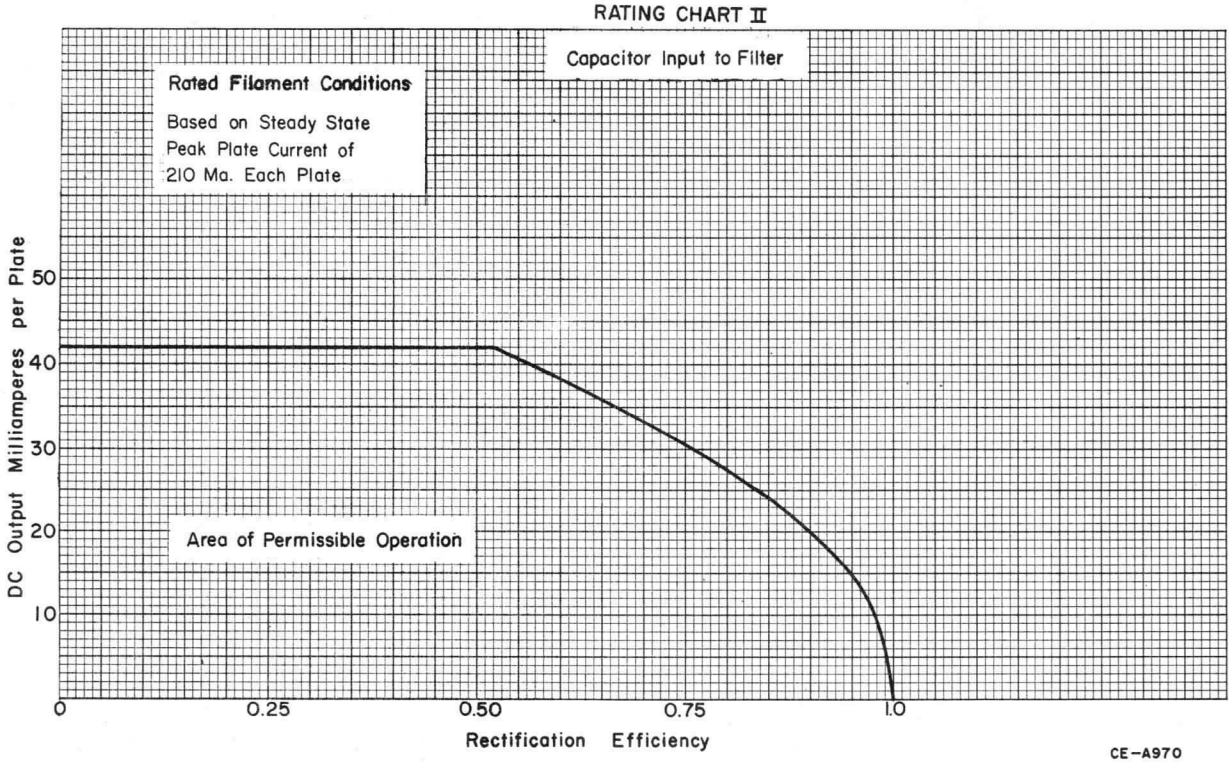
R_A = dc resistance of added series resistance per plate

In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.

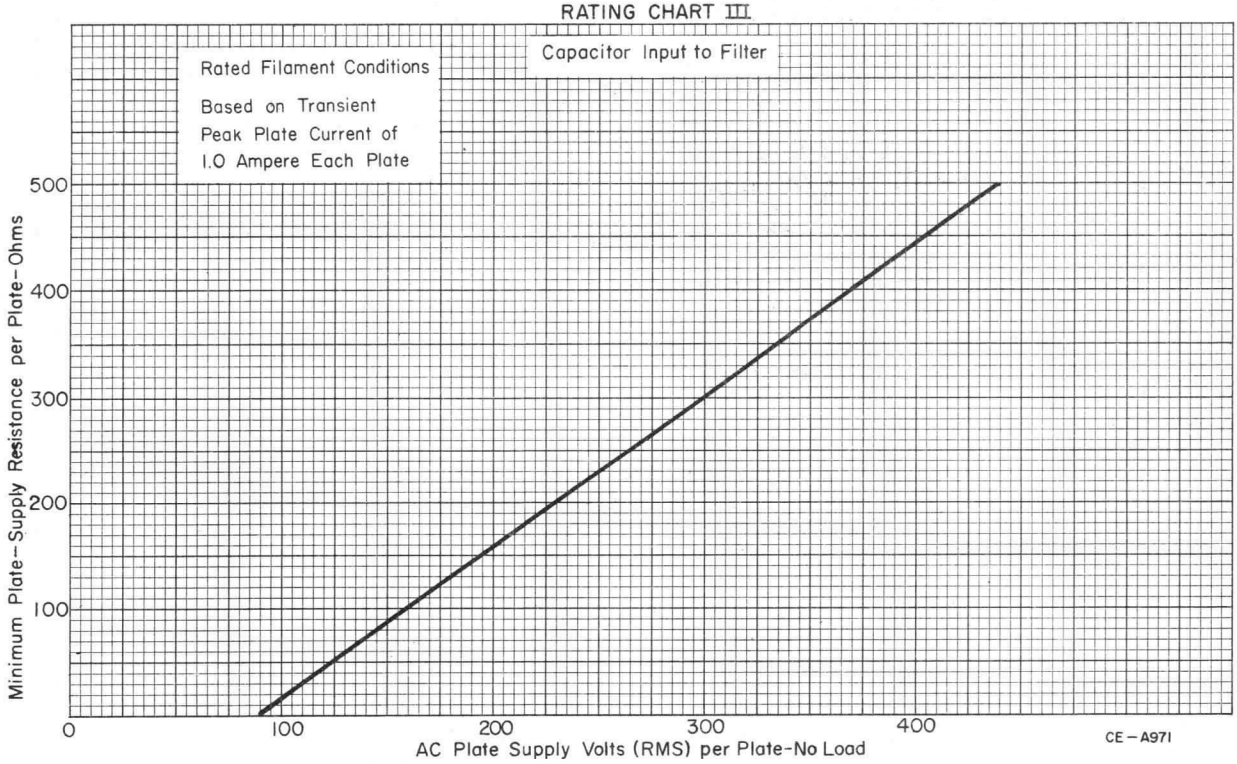
RATING CHART I



RATING CHART II



RATING CHART III



November 5, 1954

Triode Pentode Converter Type 6X8

The 6X8 is a 9-pin miniature medium-mu triode and sharp-cutoff pentode designed for service as a combined oscillator and mixer in television receivers using an intermediate frequency of approximately 40 mc. The mixer portion of the 6X8 is similar to a 6AG5, and the oscillator section of the 6X8 is similar to one unit of the 6J6.

GENERAL DATA

Electrical:

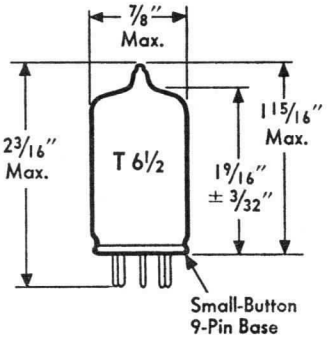
Cathode	Coated Unipotential		
Filament			
Voltage	6.3 ac or dc		Volts
Current	0.45		Ampere
Direct Interelectrode Capacitances:	Unshielded	External Shield #315 Connected to Cathode	
Triode Unit			
Grid to Plate	1.4	1.4	μμf
Input	2.0	2.6	μμf
Output	0.5	1.0	μμf
Pentode Unit			
Grid 1 to Plate	0.09 max.	0.06 max.	μμf
Input	4.3	4.5	μμf
Output	0.7	1.4	μμf
Pentode Grid 1 to Triode Plate	0.045 max.	0.035 max.	μμf
Pentode Plate to Triode Plate	0.040 max.	0.008 max.	μμf
Pentode Unit Connected as Triode*			
Grid 1 to Plate	1.4	1.3	μμf
Input	3.0	3.2	μμf
Output	1.6	2.0	μμf
Heater to Cathode	6.0	6.0	μμf

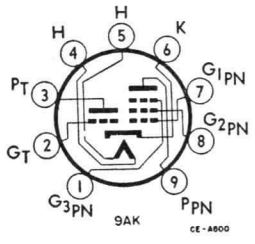
Mechanical:

Bulb	T-6½
Base	Small-Button Noval 9-Pin (JETEC E9-1)
Basing	9AK
Mounting Position	Any

CHARACTERISTICS

	Triode Unit	Pentode Unit	
Plate Voltage	100	250	Volts
Grid 3 (Suppressor)	—	Connected to cathode at socket	
Grid 2 Voltage	—	150	Volts
Cathode Bias Resistor	100	200	Ohms
Amplification Factor	40	—	
Plate Resistance (Approx.)	6900	750000	Ohms
Transconductance	5800	4600	μmhos
Grid 1 Bias (Approx.) for I_b of 10 μamp	−10	−10	Volts
Plate Current	8.5	7.7	Ma.
Grid 2 Current	—	1.6	Ma.
Pentode Unit Connected as Triode			
Plate Voltage		150	Volts
Grid 3		Connected to cathode at socket	
Grid 2		Connected to plate	
Cathode-Bias Resistor		250	Ohms
Amplification Factor		42	
Plate Resistance (Approx.)		7900	Ohms
Transconductance		4000	μmhos
Grid 1 Bias (Approx.) for I_b = 10 μamp		−10	Volts
Plate Current		7.8	Ma.





BOTTOM VIEW

CE-A554

Receiving Tube Section

CONVERTER SERVICE

Maximum Ratings

Design Center Values

	Triode Unit as Osc.	Pentode Unit as Mixer	
Plate Voltage	250 max.	250 max.	Volts
Grid 3 (Suppressor) Voltage	—	0 max.	Volts
Grid 2 (Screen) Voltage	—	See CE-A864	
Grid 2 Supply Voltage	—	250 max.	Volts
Grid 1 (Control Grid) Voltage			
Negative Bias Value	40 max.	40 max.	Volts
Positive Bias Value	0 max.	0 max.	Volts
Plate Dissipation	1.5 max.	2.0 max.	Watts
Grid 2 Input	—	0.4 max.	Watt
Grid 1 Input	0.5 max.	—	Watt
Peak Heater-Cathode Voltage:			
Heater Positive or Negative with Respect to Cathode	100 max.	100 max.	Volts

Pentode Unit as Triode-Connected Mixer*		
Plate Voltage	250 max.	Volts
Grid 1 (Control-Grid) Voltage		
Negative Bias Value	40 max.	Volts
Positive Bias Value	0 max.	Volts
Plate Dissipation	2.4 max.	Watts
Peak Heater-Cathode Voltage:		
Heater Positive or Negative with Respect to Cathode	100 max.	Volts

Typical Operation

	Triode Unit as 250 Mc. Osc.†	Pentode Unit as Mixer††	
Plate Voltage	150	150	Volts
Grid 3 (Suppressor)	—	Connected to cathode at socket	
Grid 2 Voltage	—	150	Volts
Mixer Grid 1 Supply Voltage	—	−3.5	Volts
Oscillator Voltage (rms) at Mixer Grid 1	—	2.6	Volts
Mixer Grid 1 Circuit Resistance	—	120000	Ohms
Oscillator Grid Resistor	2700	—	Ohms
Conversion Transconductance	—	2100	μmhos
Plate Current	13	6.2	Ma.
Grid 2 Current	—	1.8	Ma.
Grid 1 Current	3.6	—	Ma.
Grid 1 Current	—	2.0	μamp
Oscillator Power Output (Approx.)	0.5	—	Watt

Pentode Unit as Triode-Connected Mixer*		
Plate Voltage	150	Volts
Grid 1 Supply Voltage	−3.5	Volts
Oscillator Voltage (rms) at Grid 1	2.6	Volts
Grid 1 Circuit Resistance	120000	Ohms
Conversion Transconductance	2800	μmhos
Plate Current	7.8	Ma.
Grid 1 Current	2.0	μamp

Maximum Circuit Values

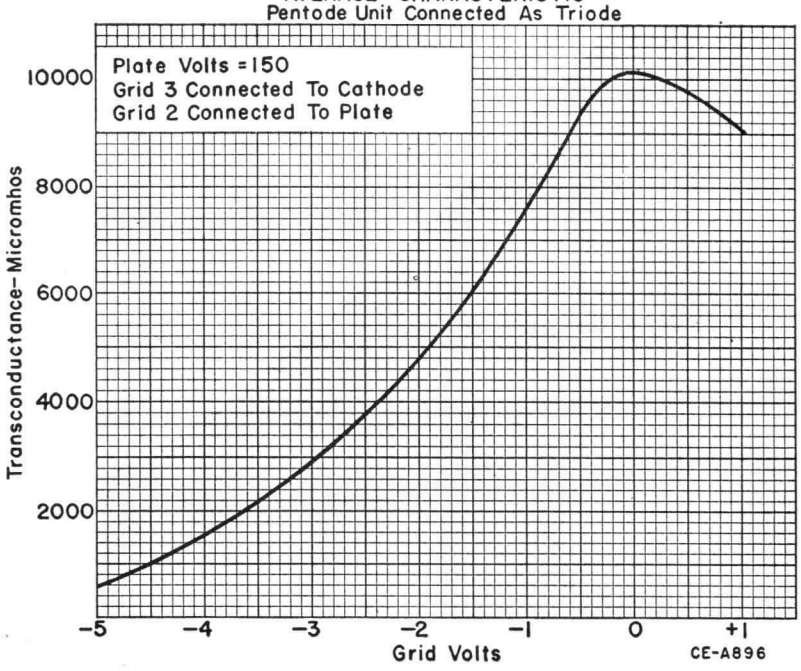
Grid 1 Circuit Resistance	
Fixed-Bias Operation	0.1 max. Megohm
Cathode-Bias Operation	0.5 max. Megohm

* Grid 2 connected to plate, grid 3 connected to cathode.

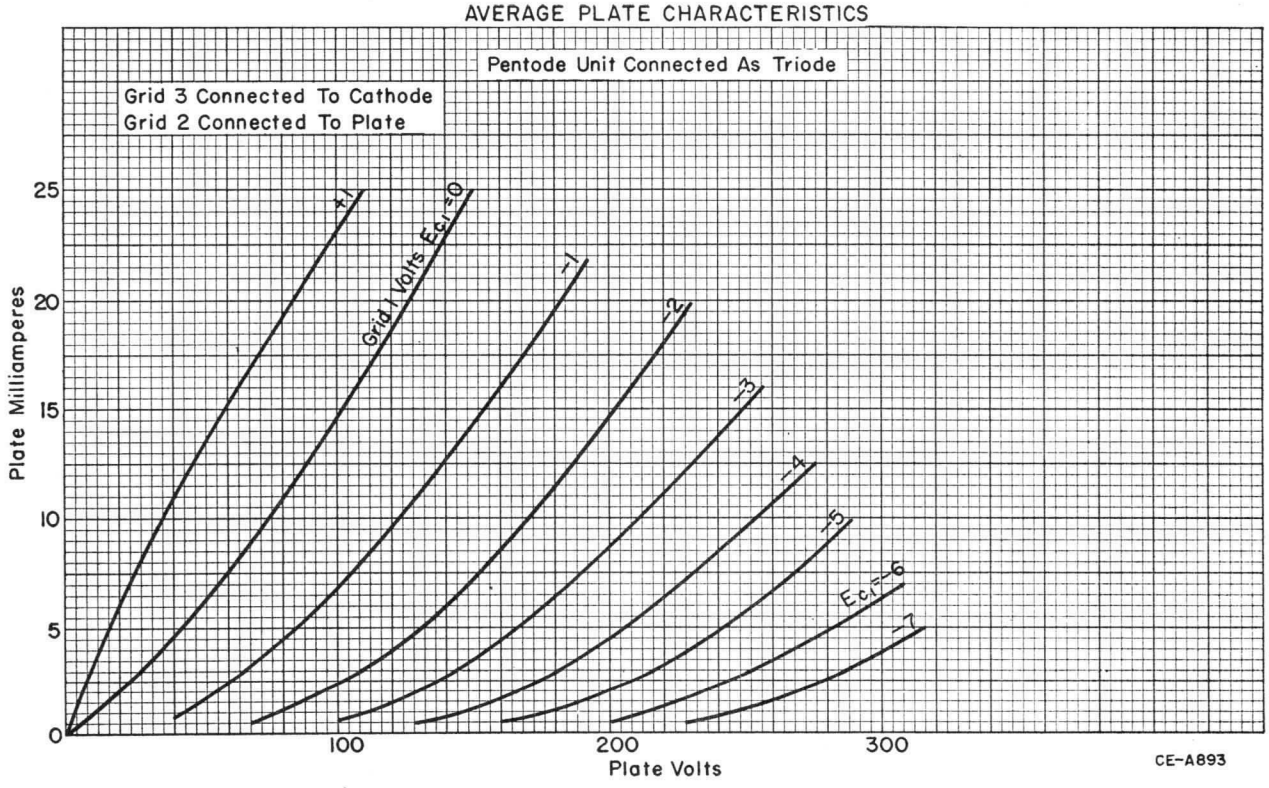
† In television or FM receivers it is generally desirable to operate the oscillator with less power input than shown in order to avoid over-excitation and excessive oscillation radiation.

†† With separate excitation and triode unit grounded.

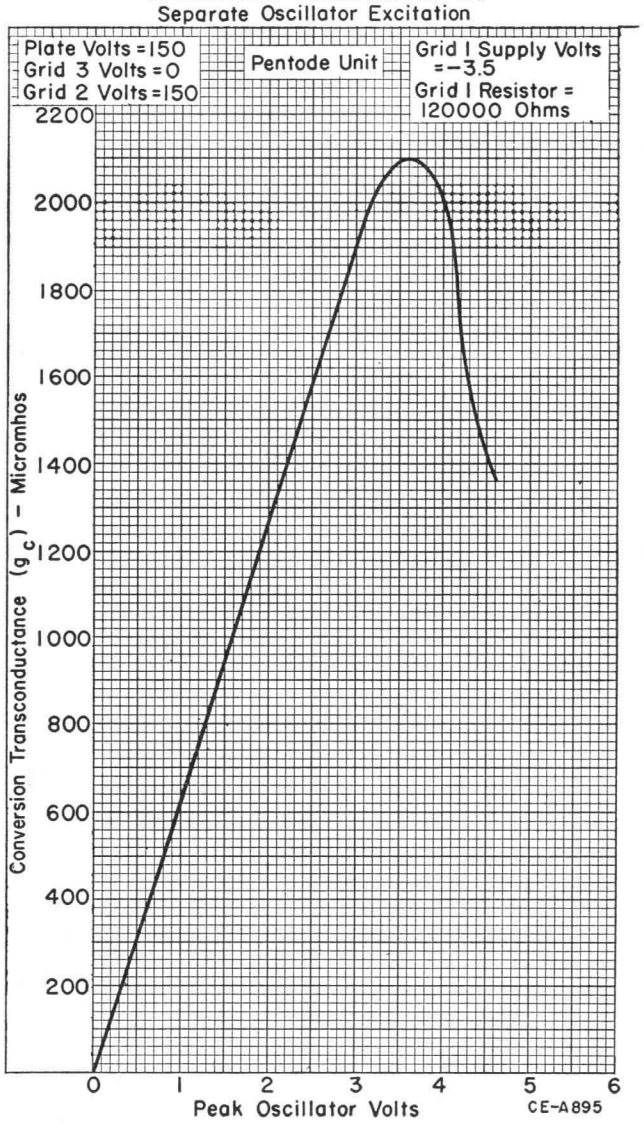
AVERAGE CHARACTERISTIC
Pentode Unit Connected As Triode



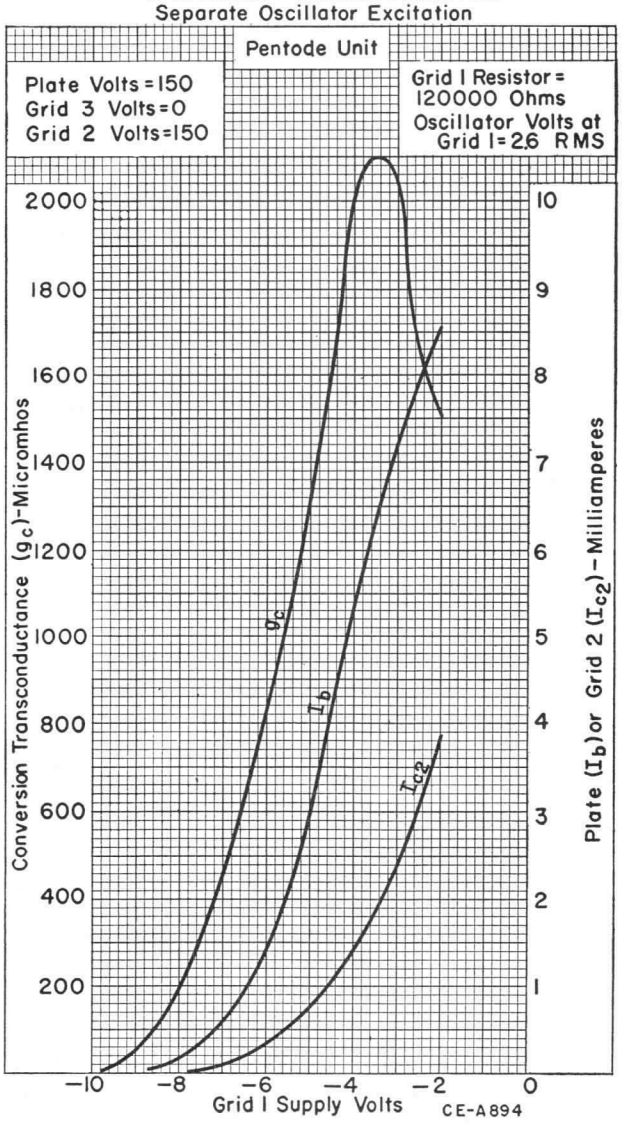
AVERAGE PLATE CHARACTERISTICS



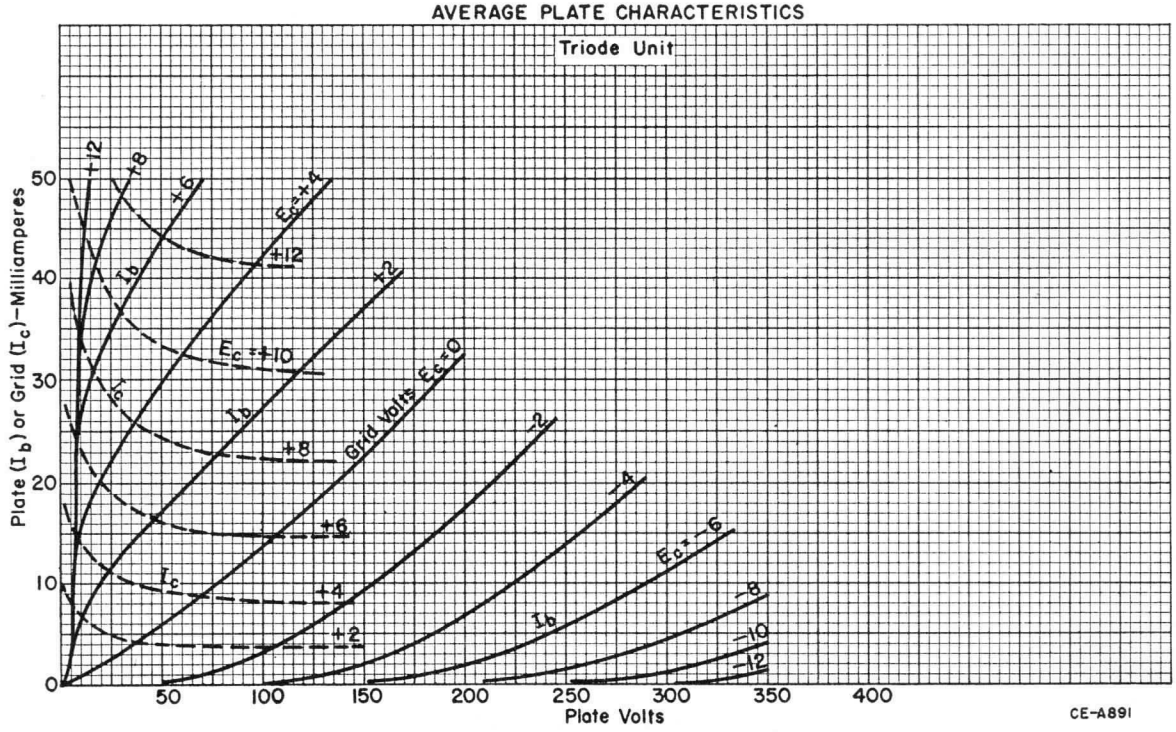
OPERATION CHARACTERISTIC
Separate Oscillator Excitation



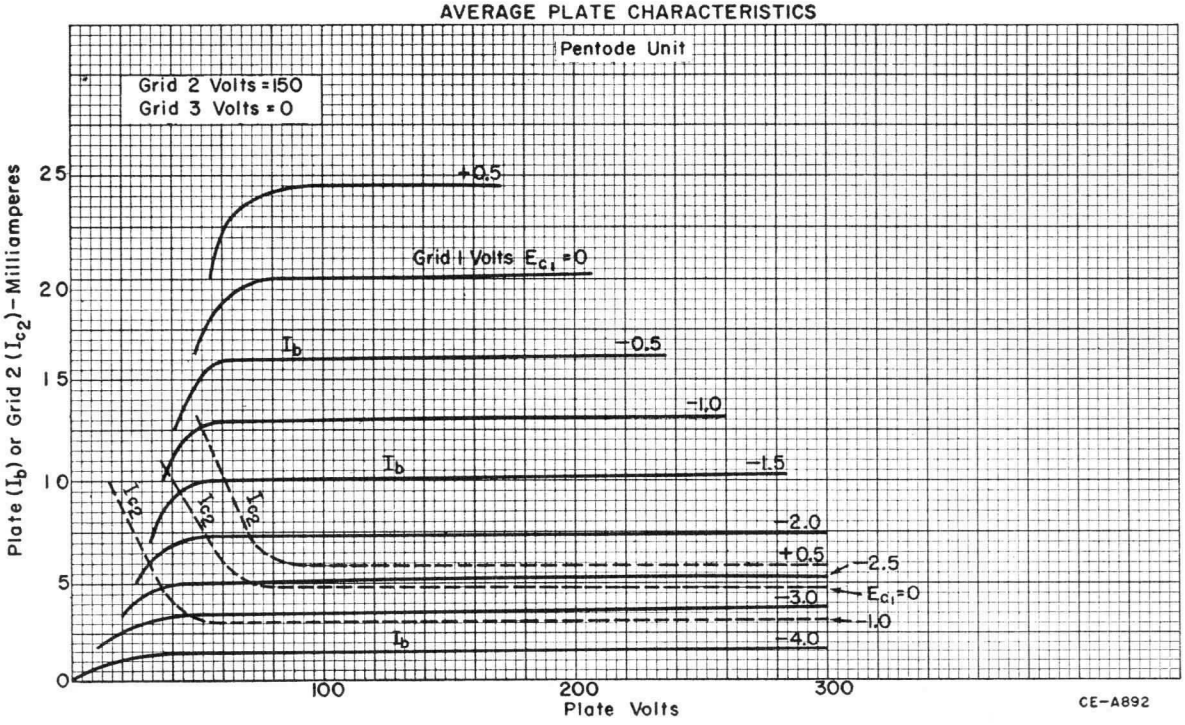
OPERATION CHARACTERISTICS
Separate Oscillator Excitation

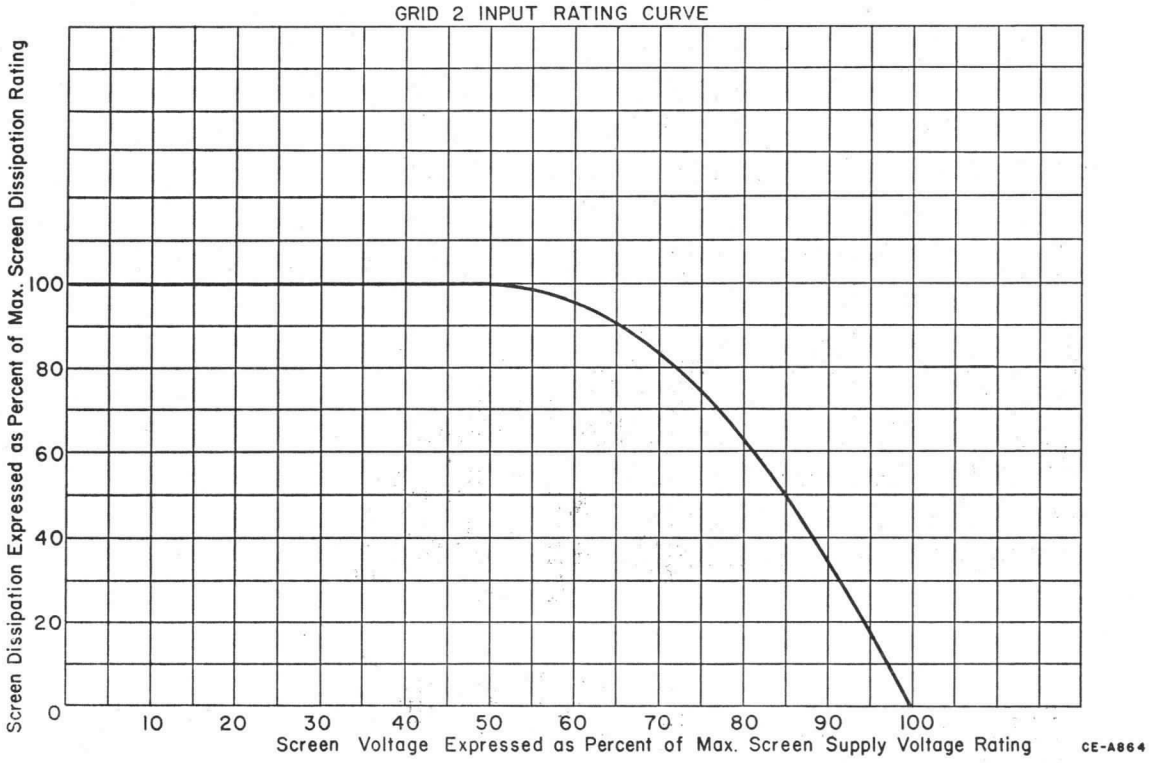


AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS




GRID 2 INPUT RATING CURVE
Screen Dissipation Expressed as Percent of Max. Screen Dissipation Rating
0
20
40
60
80
100
10
20
30
40
50
60
70
80
90
100
Screen Voltage Expressed as Percent of Max. Screen Supply Voltage Rating
CE-A864

FULL-WAVE VACUUM RECTIFIER TYPE 5Y3-GT

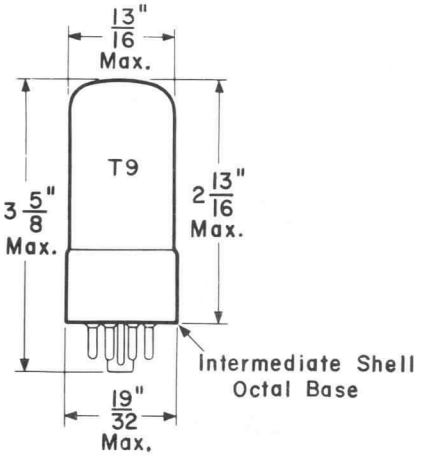
The 5Y3-GT is a glass-octal, full-wave high-vacuum rectifier designed for service in power supplies of moderate current requirements. The tube should be mounted vertically, but horizontal mounting is permissible if pins 2 and 4 are in a vertical plane. Like all power handling tubes, it should be adequately ventilated.

ELECTRICAL

Cathode	Coated Filament	
Voltage (ac or dc)	5.0	Volts
Current	2.0	Amperes

MECHANICAL

Bulb	T-9
Base	Intermediate Shell Octal (JEDEC B5-10) Short Intermediate Shell Octal (JEDEC B5-62)
Basing	G-5T
Mounting Position	Vertical or Horizontal with Pins 2 and 4 in Vertical Plane



9-13

RECTIFIER SERVICE

MAXIMUM RATINGS

Design Center Values

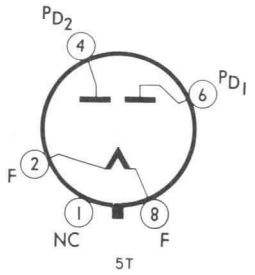
Peak Inverse Plate Voltage	1400	max.	Volts
AC Plate Supply Voltage Each Plate (RMS)	See Rating Chart I		
DC Output Current Each Plate	See Rating Chart I		
Steady-State Peak Plate Current Each Plate (See Rating Chart II)	440	max.	Ma.
Transient Peak Plate Current Each Plate (See Rating Chart III)	2.5	max.	Ampere

TYPICAL OPERATION AS FULL-WAVE RECTIFIER

	Input to Filter Capacitor	Input to Filter Choke	
AC Plate Supply Voltage Each Plate (RMS)	350	500	Volts
Input Capacitor	20	–	μf.
Input Choke	–	10	Henrys
Effective Plate Supply Resistance Each Plate	50	–	Ohms
DC Output Current	125	125	Ma.
DC Output Voltage at Filter Input	360	380	Volts

AVERAGE CHARACTERISTICS

Tube Voltage Drop (Measured with Tube Conducting 125 Ma. Each Plate)	50	Volts



APPLICATION NOTES

The application of maximum ratings to practical circuit design is clarified by the use of Rating Charts I, II, III. These charts present limiting conditions beyond which operation of the tube is not permitted. The charts together with laboratory measurements provide analysis of rectifier circuit operation.

The maximum ratings for ac plate supply voltage and dc output current are interdependent, and they are related to the type of filter circuit. The boundaries in Chart I for capacitor-input and for choke-input operation are based on limits of supply voltage, output current and plate dissipation. With capacitor-input filter, operation is permissible within the area bounded by points F A E D G; with choke-input filter, operation is permissible within the area bounded by points F A B C D G.

Chart II defines the permissible area of operation based on the maximum steady-state peak plate current. The rectification efficiency is defined by the equation:

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}\ Es}$$

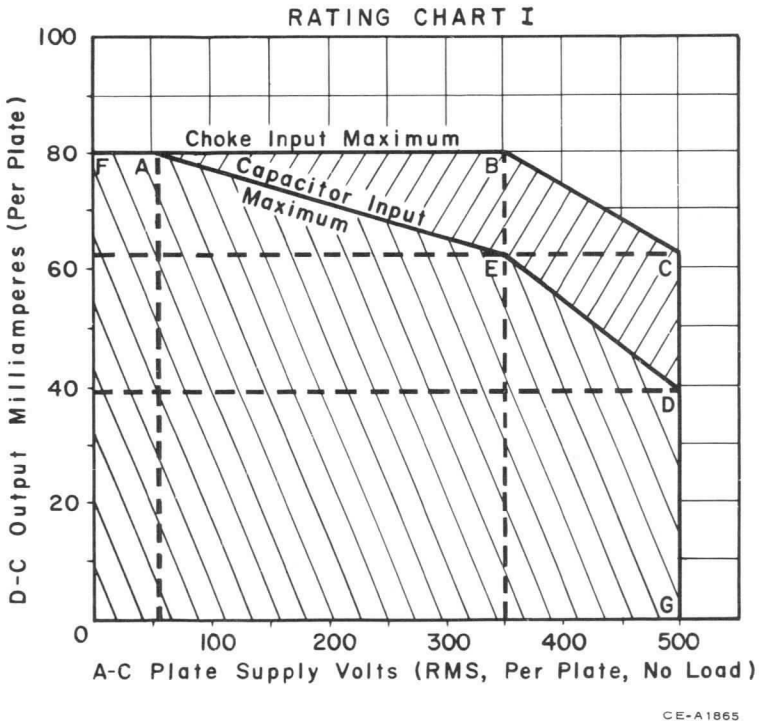
where $\bar{E}$ is the dc output voltage at input to filter and Es is the rms plate supply voltage per plate.

Chart III defines the minimum value of effective plate-supply resistance per plate for specific plate supply voltages such that the transient peak plate current per plate will be within the required maximum rating. This resistance consists of:

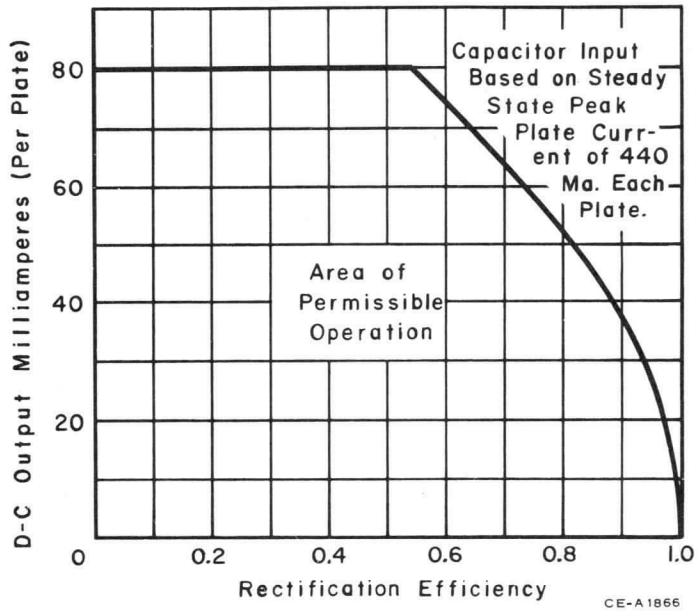
$$Rs = N^2 R_{PRI.} + R_{SEC.} + R_A$$

where N is the voltage step-up ratio of the plate transformer, $R_{PRI.}$ is the dc resistance of the transformer primary, $R_{SEC.}$ is the average dc resistance of each transformer secondary section, and R_A is the additional resistance required.

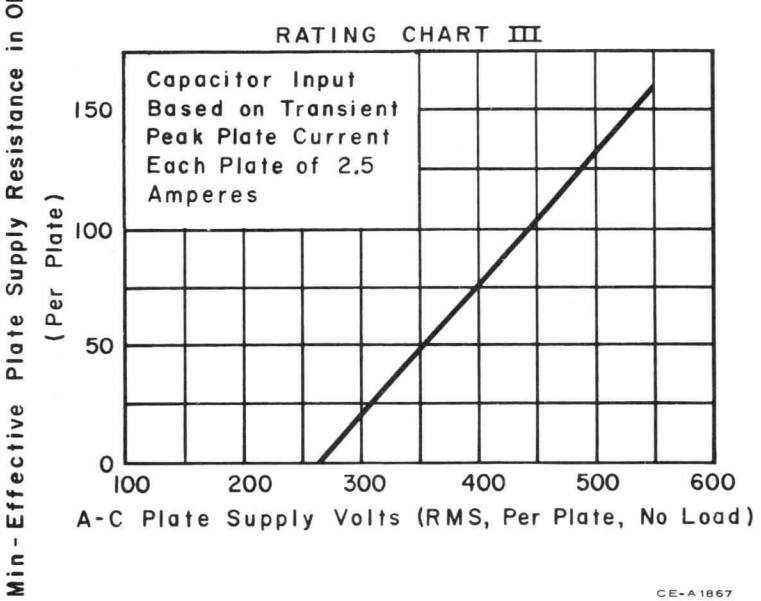
In these considerations, dc output voltage is measured at the input to the filter, and plate supply voltage is measured under no-load conditions.



RATING CHART II



RATING CHART III



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HALF-WAVE VACUUM RECTIFIER TYPE 35Z5-GT

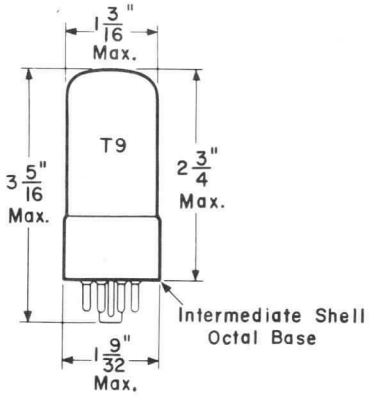
The 35Z5-GT is an octal half-wave rectifier designed for service in power supplies of ac-dc receivers. The heater is provided with a tap for operation of a panel lamp. This tube must be adequately ventilated, as the tube operates at high temperatures.

ELECTRICAL

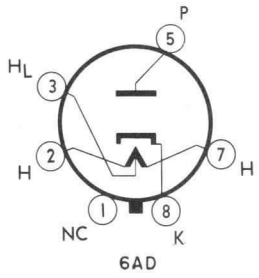
Cathode	Coated Unipotential		
Heater Voltage	Without Panel Lamp	With #40 or #47 Panel Lamp	
Entire Heater (Pins 2&7)	35	35	ac or dc Volts
Panel Lamp Section (Pins 2&3)	7.5	5.5	ac or dc Volts
Heater Current			
Between Pins 2&7	0.15	–	Ampere
Between Pins 3&7	–	0.15	Ampere

MECHANICAL

Bulb	T-9
Base	Short Int. Shell Octal
Basing	6AD
Mounting Position	Any



9-11



6AD

HALF-WAVE RECTIFIER

MAXIMUM RATINGS

Peak Inverse Plate Voltage	700 max.	Volts
Peak Plate Current Per Plate	600 max.	Ma.
Peak-Heater Cathode Voltage		
Heater Positive or Negative with Respect to Cathode	350 max.	Volts
Panel-Lamp-Section Voltage (RMS)		
When Panel Lamp Fails	15 max.	Volts
DC Output Current		
With Panel Lamp and No Shunting Resistor	60 max.	Ma.
With Panel Lamp and Shunting Resistor	90 max.	Ma.
Without Panel Lamp	100 max.	Ma.

TYPICAL OPERATING CONDITIONS

With #40 or #47 Panel Lamp

Half-Wave Rectifier—Capacitor Input to Filter

AC Plate Supply Voltage Per Plate (RMS)	117	117	117	117	235	Volts
Filter Input Capacitor	40	40	40	40	40	μf
Minimum Effective Plate Supply Impedance per Plate (Note 1)	15	15	15	15	100	Ohms
Panel Lamp Shunting Resistor	–	300	150	100	–	Ohms
DC Output Current	60	70	80	90	60	Ma.

TYPICAL OPERATING CONDITIONS Without Panel Lamp (Note 2)

Half-Wave Rectifier—Capacitor Input to Filter

AC Plate Supply Voltage Per Plate (RMS)	117	235	Volts
Filter Input Capacitor	40	40	μf
Minimum Effective Plate Supply Impedance Per Plate	15	100	Ohms
DC Output Voltage at Input to Filter (Approx.):			
At Half-Load Current of 50 ma.	140	280	Volts
At Full-Load Current of 100 ma.	120	235	Volts
DC Output Current	100	100	Ma.
Voltage Regulation (Approx.) Half-Load to Full-Load Current	20	45	Volts

MAXIMUM CIRCUIT VALUES

Panel Lamp Shunting Resistor (Note 3)

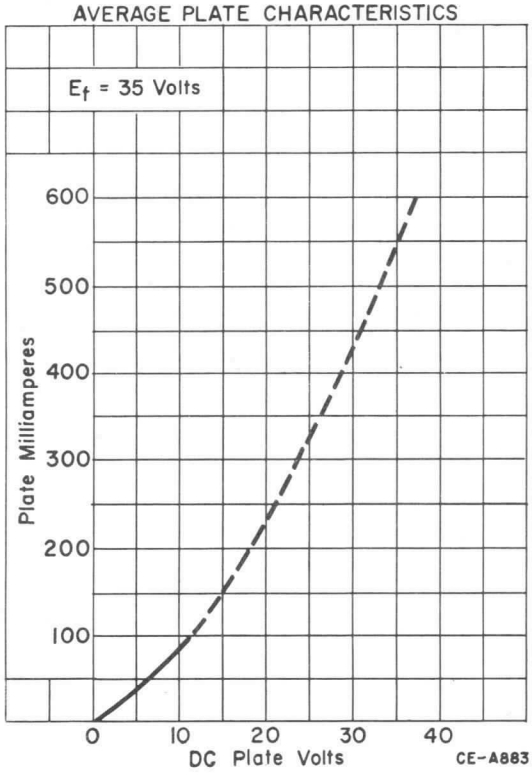
For DC Output Current of:

70 ma.	800 max.	Ohms
80 ma.	400 max.	Ohms
90 ma.	250 max.	Ohms

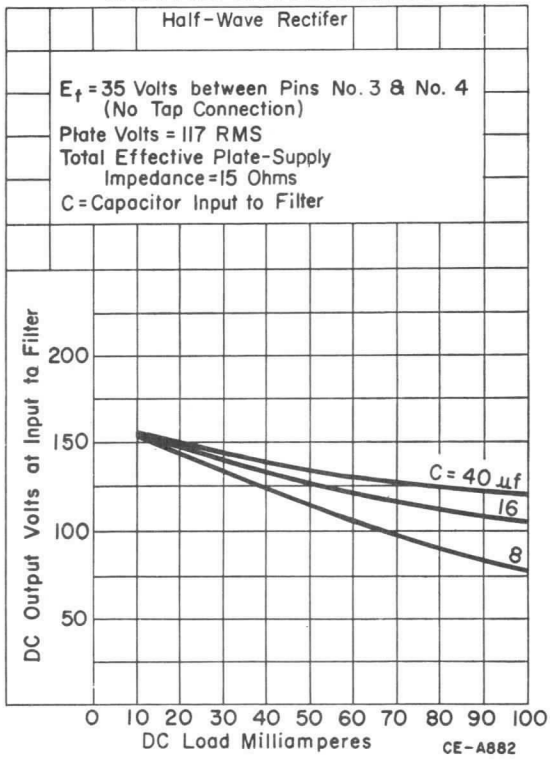
NOTES

1. When filter-input capacitors larger than the value indicated are used, it may be necessary to increase the plate supply impedance to keep within maximum ratings.
2. Plate current must not flow through tap section.
3. Required when DC output current is greater than 60 milliamperes.

AVERAGE PLATE CHARACTERISTICS



OPERATION CHARACTERISTICS



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October 1, 1958

LOW LEVEL TWIN TRIODE TYPE WL-7025

The WL-7025 is a 9-pin miniature twin triode designed for service as a low level input voltage amplifier for tape recorders and high quality audio preamplifiers. The structural design of the WL-7025 results in greatly reduced microphonism, hum and noise.

The WL-7025 may also be used to replace the 12AX7 to which it is electrically similar. The use of a WL-7025 in such replacement will result in substantial reduction in noise due to microphonism, induced hum and leakage.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	Series	Parallel	
Voltage (ac or dc)	12.6	6.3	Volts
Current	0.15	0.30	Ampere
Direct Interelectrode Capacitances (Unshielded):			
	Unit 1	Unit 2	
Grid to Plate	1.4	1.4	uuf
Input	1.6	1.6	uuf
Output	0.4	0.3	uuf

MECHANICAL:

Bulb	T-6-1/2
Base	Miniature 9-Pin (JETEC E9-1)
Outline	6-2
Basing	9A
Mounting Position	Any

MAXIMUM RATINGS:

Design-Center Values

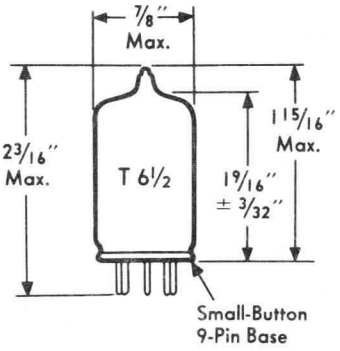
Plate Voltage	300	max.	Volts
Heater-Cathode Voltage:			
Heater Positive or Negative with respect to Cathode	180	max.	Volts
Plate Dissipation	1.0	max.	Watt
Grid Voltage:			
Negative Bias Value	50	max.	Volts
Positive Bias Value	0	max.	Volts

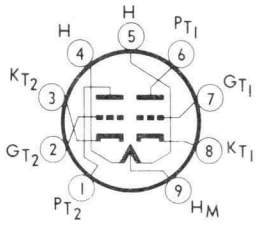
CHARACTERISTICS:

Plate Voltage	100	250	Volts
Grid Voltage	-1	-2	Volts
Amplification Factor	100	100	
Plate Resistance	80000	62500	Ohms
Transconductance	1250	1600	umhos
Equivalent Noise and Hum Voltage:			
Refered to Grid			
Average♦	1.8	rms u	Volts
Maximum▣	7	rms u	Volts

♦ Measured Under These Conditions:
Heater Circuit: (Parallel Connection) 6.3 Volts AC, Centertap of Transformer Grounded.
Plate Circuit: Plate Supply Volts = 250, Plate Load = 100,000 ohms.
Cathode Circuit: Cathode Resistor = 2700 ohms by passed with 100 uf capacitor.
Grid Circuit: Grid Resistor = 0 ohms.
Frequency Range: 25 to 10,000 cycles / sec.

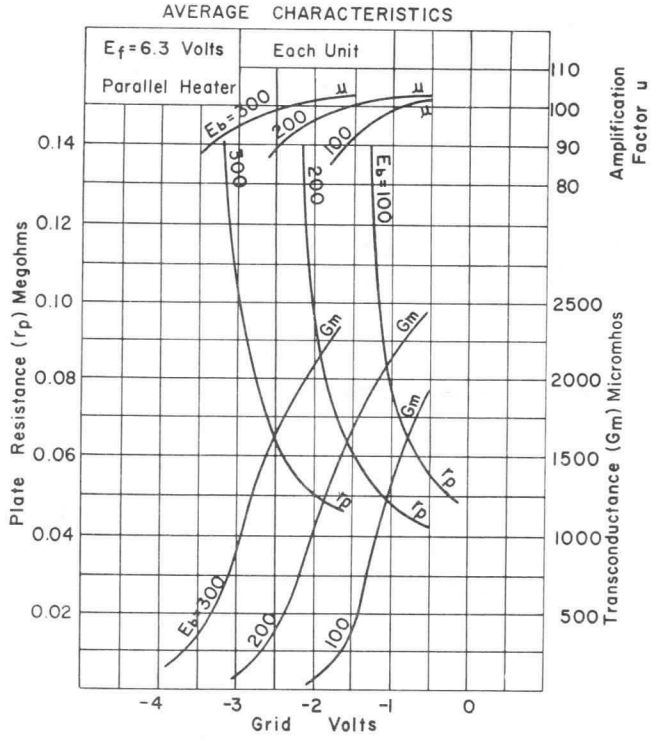
▣ Measured Under These Conditions:
Heater Circuit: (Parallel Connection) 6.3 Volts AC, Centertap of Transformer Grounded.
Plate Circuit: Plate Supply Volts = 250, Plate Load = 100,000 ohms.
Cathode Circuit: Cathode Resistor = 2700 ohms.
Grid Circuit: Grid Resistor = 50,000 ohms.





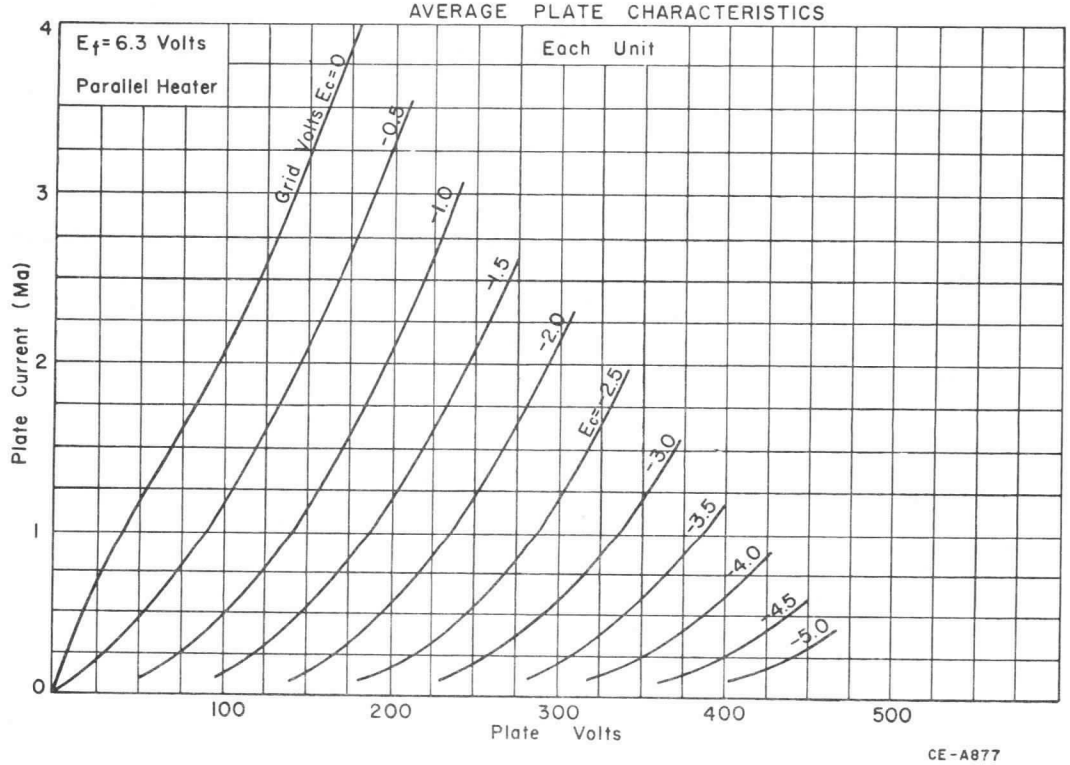
9A

AVERAGE CHARACTERISTICS



CE-A876

AVERAGE PLATE CHARACTERISTICS



CE-A877

SHARP – CUTOFF PENTODE TYPE 7056

The 7056 is a 7-pin miniature sharp-cutoff pentode type designed for service as a wide-band, high-frequency amplifier in communications equipment. The heater-cathode structure is designed to render dependable service throughout the range of voltages encountered in a storage battery-generator electrical system.

ELECTRICAL:

Cathode	Coated Unipotential		
Heater:			
Voltage Range (ac or dc)	12.0 to 15.0		Volts
Current at 13.5 Volts	0.150		Ampere
Direct Interelectrode Capacitances:	Unshielded	Shielded♦	
Grid 1 to Plate	0.02	0.01	max. μμf
Input	6.5	6.5	μμf
Output	2.0	3.0	μμf

MECHANICAL:

Bulb	T-5½
Base	Miniature, 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any

MAXIMUM RATINGS:

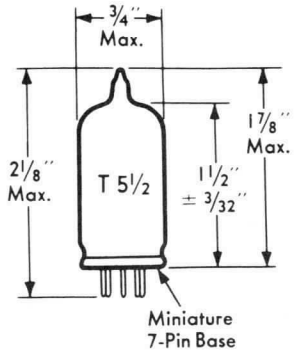
Absolute Maximum Values

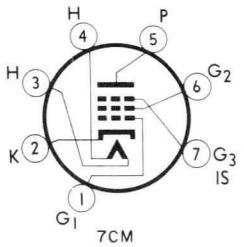
Plate Voltage	330	max.	Volts
Grid 2 Supply Voltage	330	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.0	max.	Watts
Grid 2 Input	0.5	max.	Watt
Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC and Peak	120	max.	Volts
Heater Positive with Respect to Cathode			
Total DC and Peak	120	max.	Volts

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	125	Volts
Grid 3 (Suppressor)	Connected to cathode at socket	
Grid 2 Voltage	125	Volts
Cathode-Bias Resistor	56	Ohms
Plate Resistance (approx.)	0.28	Megohm
Transconductance	8000	μmhos
Grid 1 Cutoff Bias⊕	–6.5	Volts
Plate Current	13	Ma.
Grid 2 Current	3.7	Ma.

⊕ For plate current of 100 microamperes.





CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Conditions	Min.	Max.	
Heater Current	1	0.138	0.164	Ampere
Transconductance	1, 2, 3 & 4	5000	7400	μmhos
Plate Current	1, 2 & 3	6.5	12.5	Ma.
Grid 2 Current	1, 2 & 3	1.6	4.0	Ma.
Reverse Grid 1 Current	1, 2 & 5	--	1	μA.
Heater-Cathode Leakage Current:				
Heater Negative with respect to Cathode	1 & 6	--	20	μA.
Heater Positive with respect to Cathode	1 & 6	--	20	μA.
Leakage Resistance:				
Between Grid and All Other Electrodes	1 & 7	50	--	Megohms
Between Plate and All Other Electrodes	1 & 8	50	--	Megohms

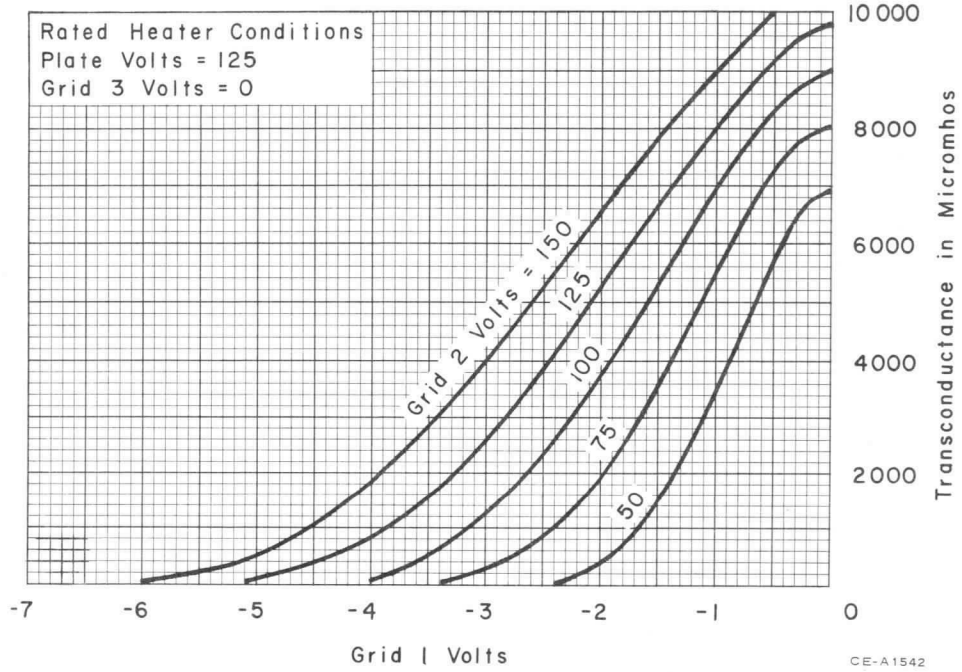
TEST CONDITIONS FOR CHARACTERISTICS

(1) Heater Volts = 13.5 (ac or dc)
(2) Plate Supply Volts = 200
Grid 3 Connected to Cathode at Socket
Grid 2 Supply Volts = 150
(3) Cathode Bias Resistor = 180 ohms
(4) Cathode Bypass Capacitor = 1000 μf
(5) Grid 1 Volts = −1.5
(6) Heater-to-Cathode Volts = 100 (dc)
(7) Grid to All-Other-Electrodes Volts = −100
(8) Plate to All-Other-Electrodes Volts = −300

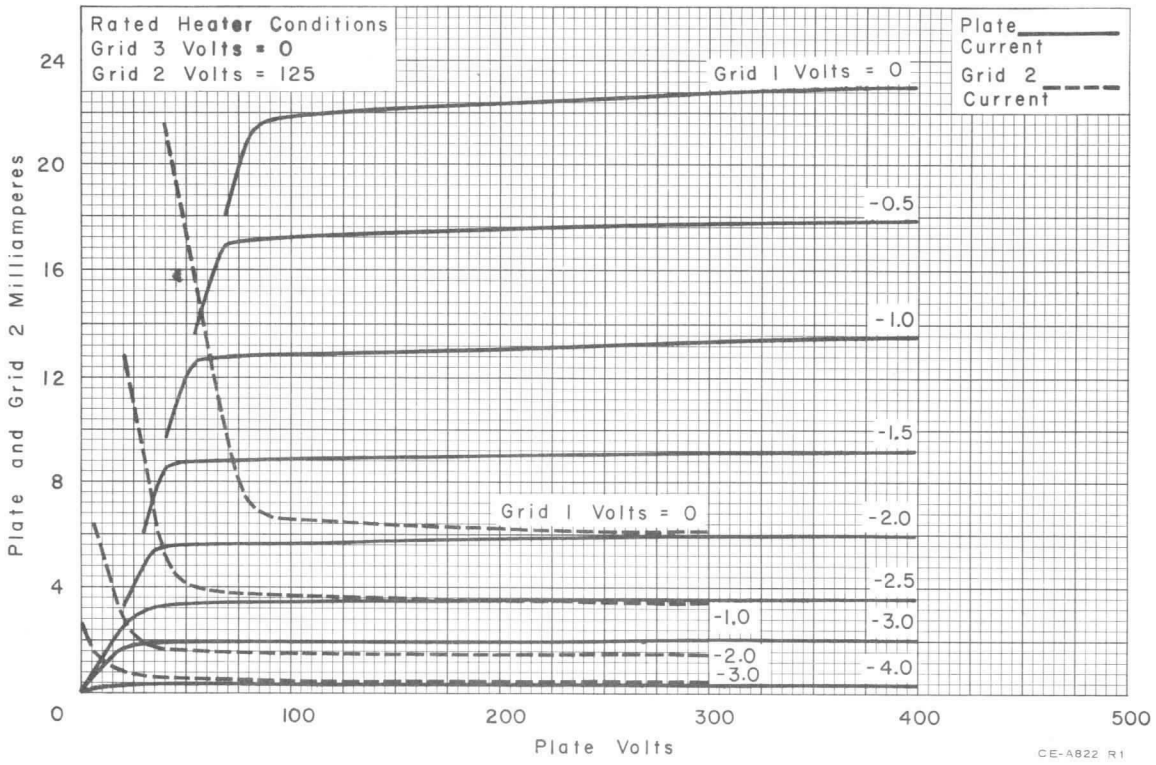
SPECIAL TESTS

Heater-Cycling Life:
Conditions:
Heater Volts = 17: On 1 minute, Off 4 minutes
Heater-to-Cathode Volts = −150
Duration:
2000 Cycles Minimum
Low-Frequency Vibration:
Conditions:
Heater Volts = 13.5
Plate Supply Volts = 200
Grid 3 Connected to Cathode at Socket
Grid 2 Volts = 150
Grid 1 Volts = −2
Plate Load Resistor = 2000 ohms
Vibrational Acceleration= 2.5 G at 25 cps
Result:
Noise Signal Output Volts = 2.5×10^{-1} (rms)
Intermittent Life:
Conditions:
Heater Volts = 15
Plate Dissipation: Maximum Rated
Grid 2 Input: Maximum Rated
Duration:
500 Hours Minimum

AVERAGE TRANSFER CHARACTERISTICS

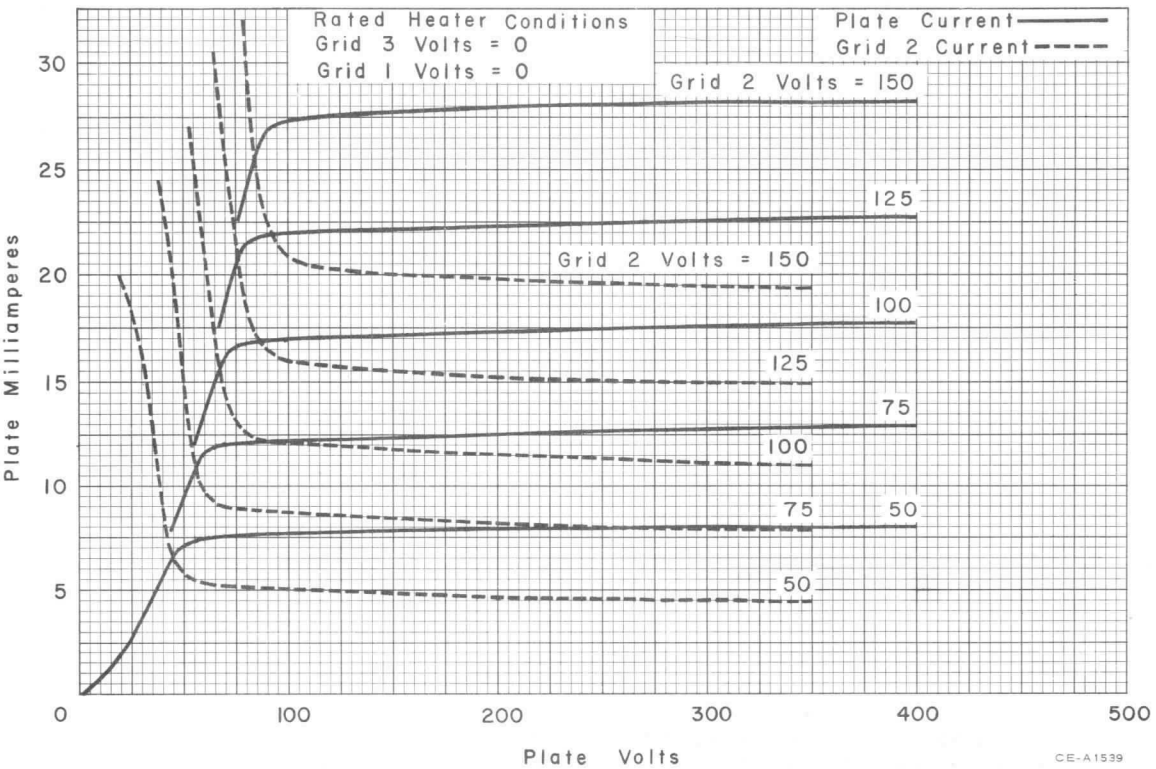


AVERAGE PLATE CHARACTERISTICS



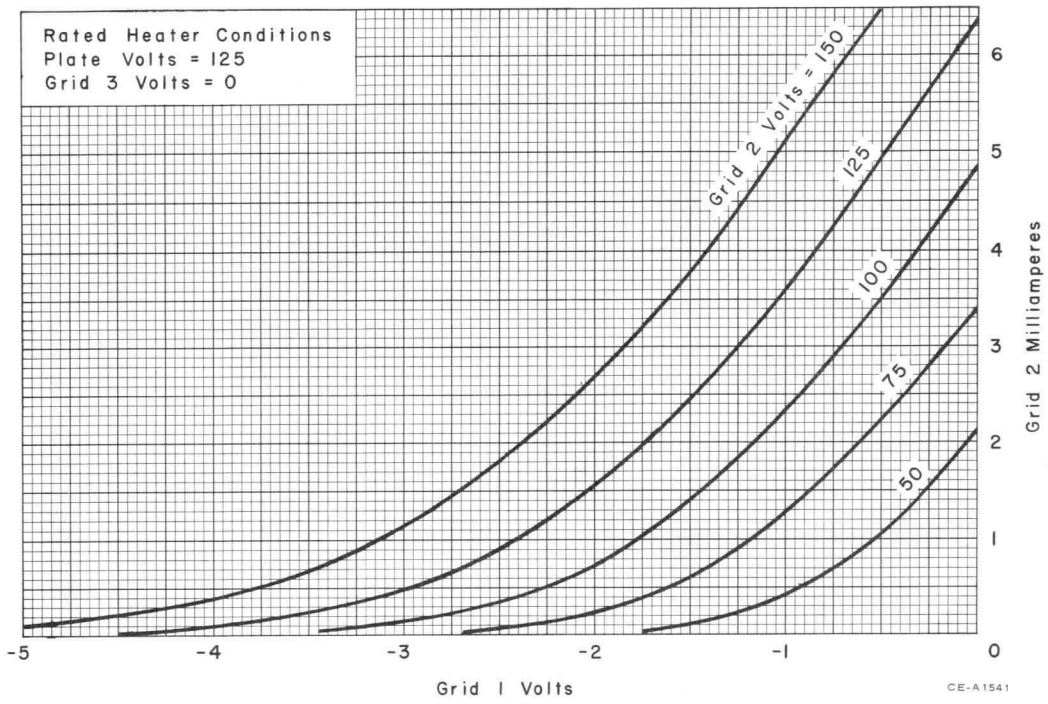
CE-A822 R1

AVERAGE PLATE CHARACTERISTICS

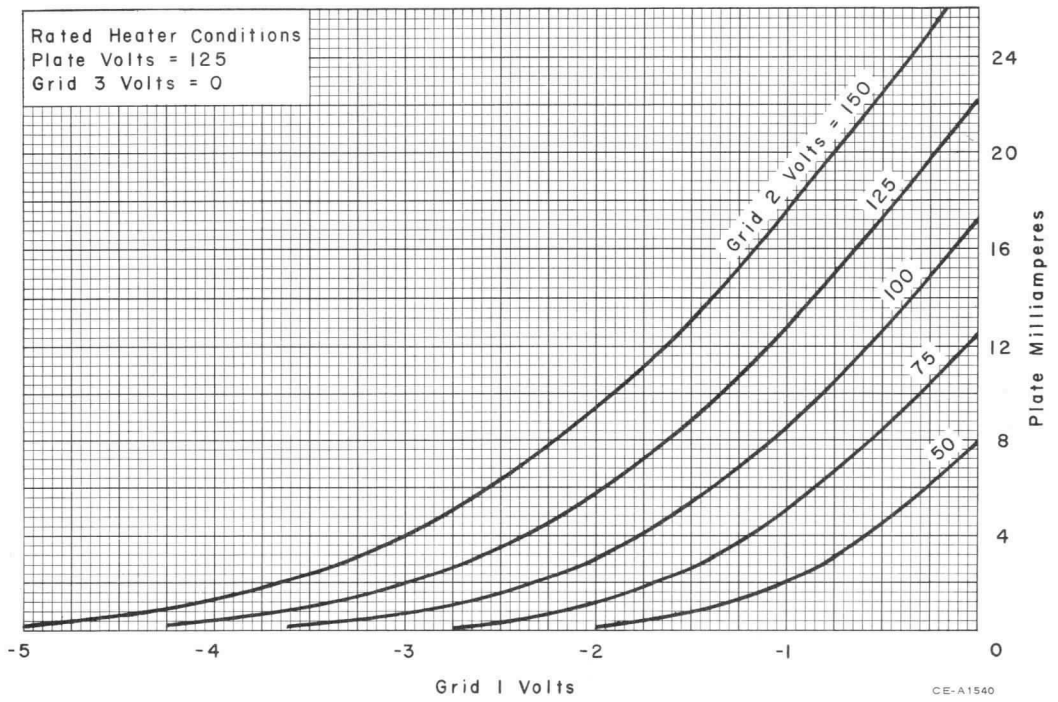


CE-A1539

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



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November 3, 1958

VHF TETRODE TYPE 7167

The 7167 is a 7-pin miniature sharp-cutoff tetrode designed particularly for service in mobile communication equipment. This type features high transconductance, high input impedance and low interelectrode capacitances. The electrical characteristics are similar to those of type 6CY5.

GENERAL DATA

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage, ac or dc	13.5	Volts
Current	0.090	Amperes
Direct Interelectrode Capacitances (Shielded):		
Grid 1 to Plate	.03	max. uuf
Input	4.4	uuf
Output	2.74	uuf

MECHANICAL:

Bulb	T-5-1/2
Base	Miniature 7-Pin (JETEC E7-1)
Outline	5-2
Basing	7EW
Mounting Position	Any

AMPLIFIER - CLASS A_1

MAXIMUM RATINGS:

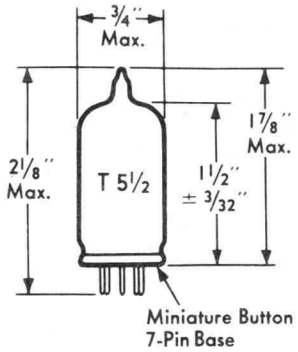
Design Maximum Values

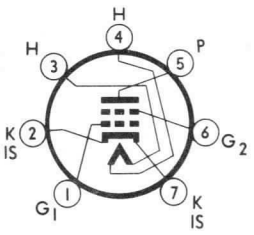
Heater Voltage Range:			
Maximum	15.5	max.	Volts
Minimum	11.8	min.	Volts
Plate Voltage	180	max.	Volts
Grid 2 (Screen) Supply Voltage	180	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.0	max.	Watts
Grid 2 Dissipation	.5	max.	Watts
Grid 1 Control Grid Voltage:			
Positive Value	0	max.	Volts
Cathode Current	20	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC and Peak	100	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	50	max.	Volts
Total DC and Peak	100	max.	Volts
Grid 1 Circuit Resistance	.5	max.	Megohm

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS:

Plate Voltage	125	Volts
Grid 2 Voltage	80	Volts
Grid 1 Voltage	-1	Volts
Plate Resistance	.125	Megohm
Transconductance	8000	umhos
Grid 1 Cutoff Bias*	-5	Volts
Plate Current	10	Ma.
Grid 2 Current	1.4	Ma.

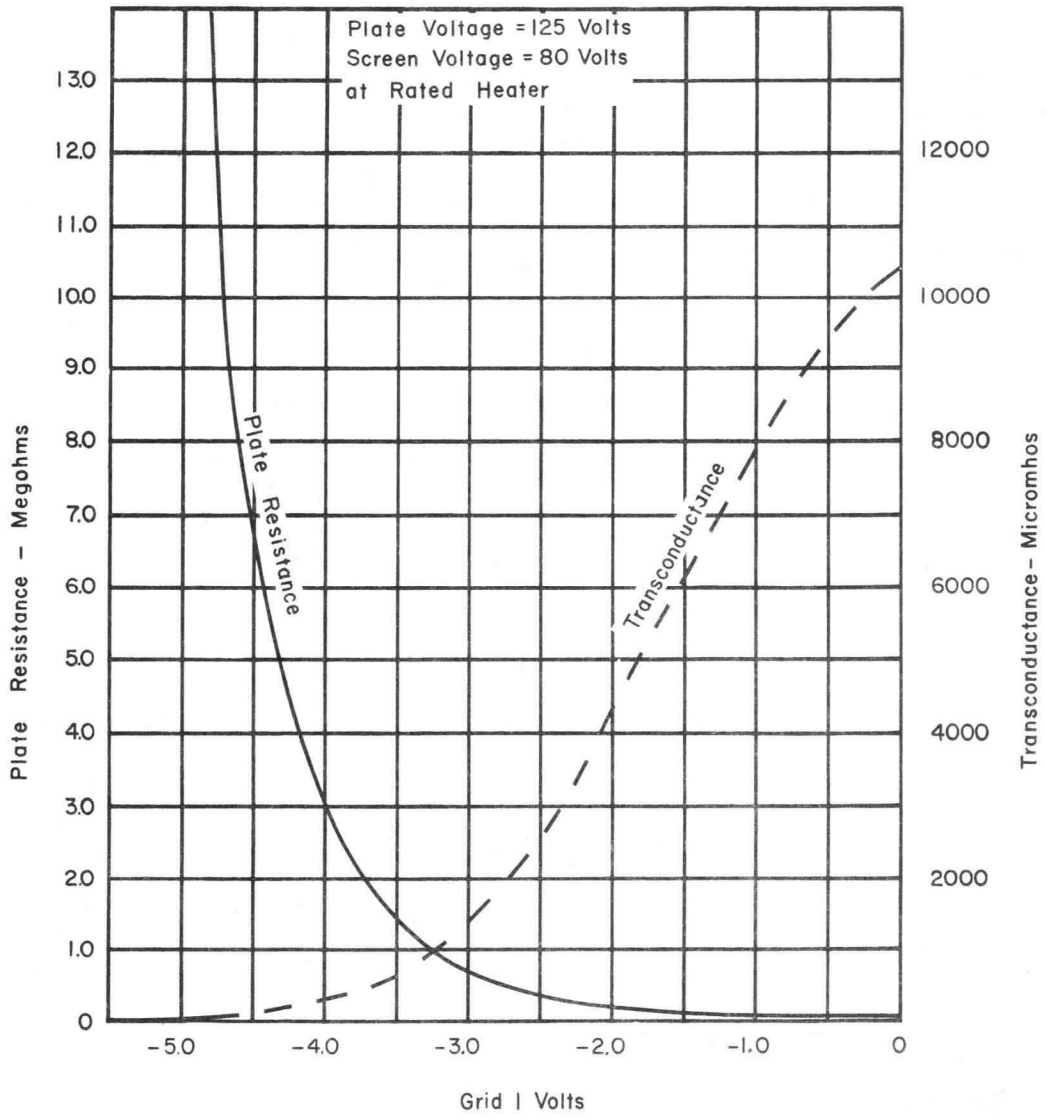
* For transconductance of 100 umhos





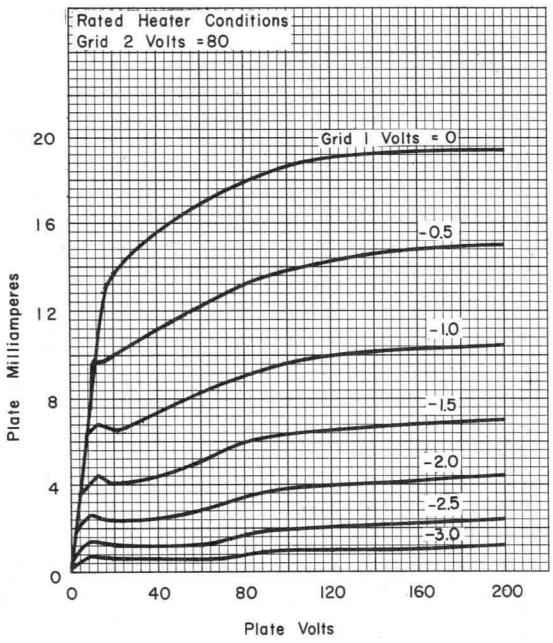
7EW

AVERAGE CHARACTERISTICS



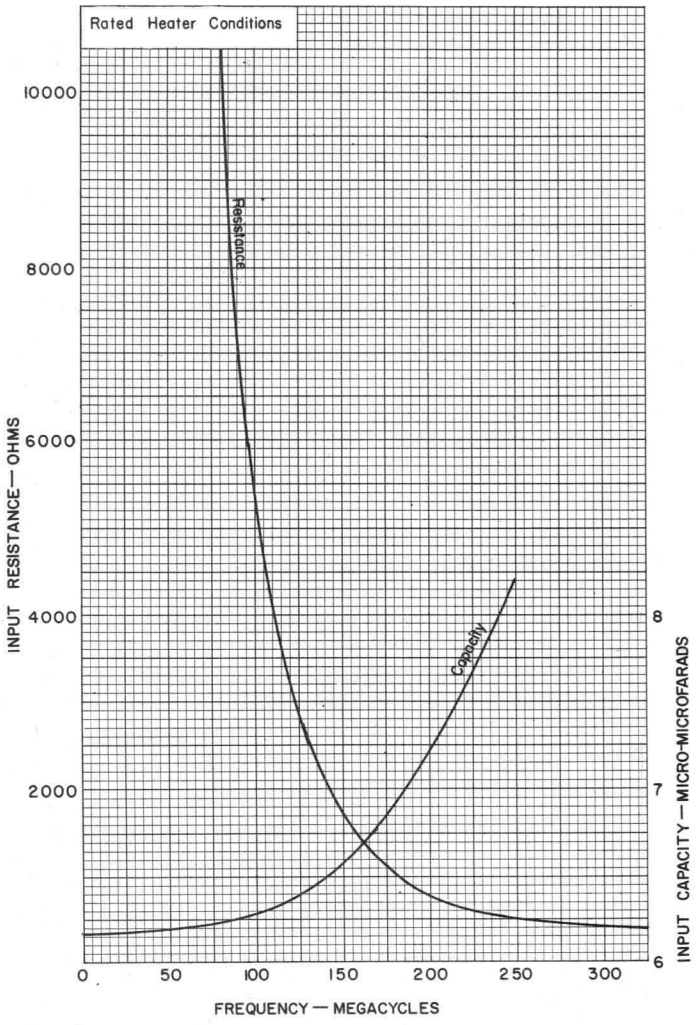
CE-A1257R1

AVERAGE PLATE CHARACTERISTICS



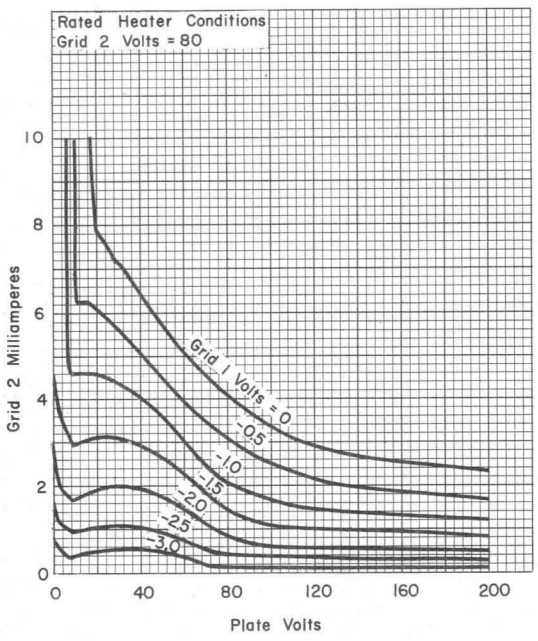
CE-A1381R1

HOT INPUT IMPEDANCE CHARACTERISTICS



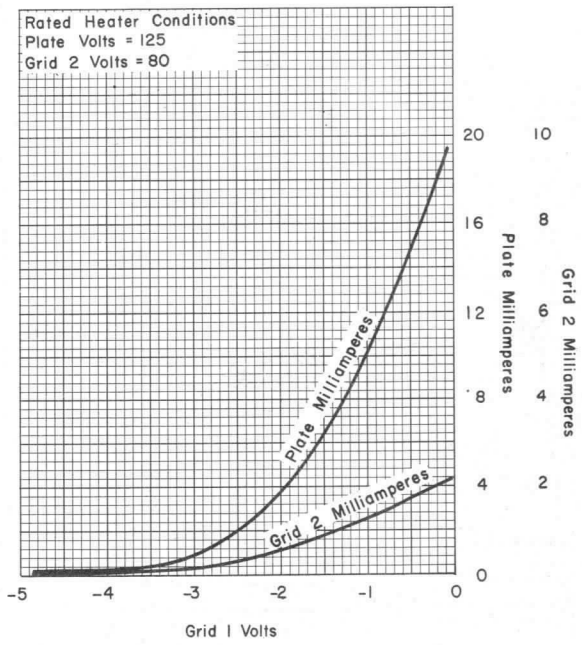
CE-A1258

AVERAGE GRID 2 CHARACTERISTICS

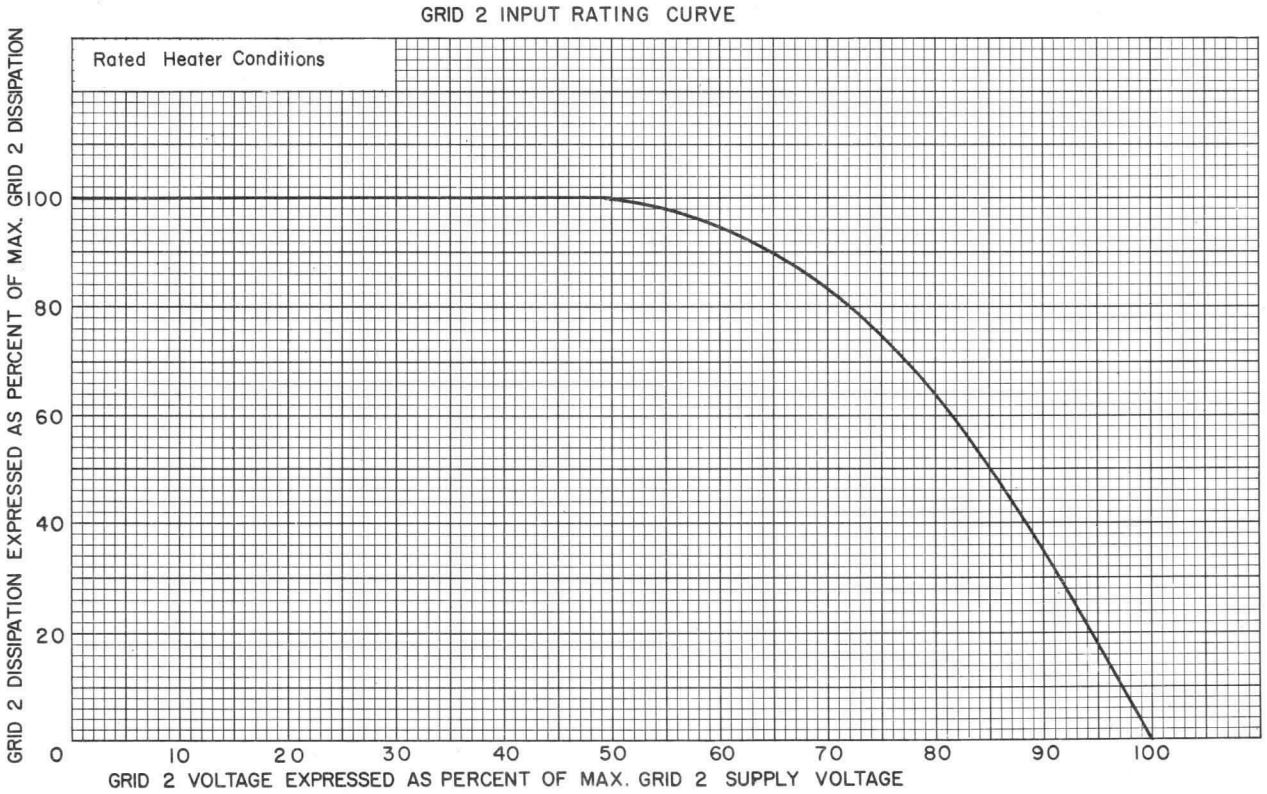


CE-A1387R1

AVERAGE TRANSFER CHARACTERISTICS



CE-A1256R2


GRID 2 INPUT RATING CURVE
Rated Heater Conditions
GRID 2 DISSIPATION EXPRESSED AS PERCENT OF MAX. GRID 2 DISSIPATION
0
20
40
60
80
100
10
20
30
40
50
60
70
80
90
100
GRID 2 VOLTAGE EXPRESSED AS PERCENT OF MAX. GRID 2 SUPPLY VOLTAGE
CE-A1255

Westinghouse®

POWER PENTODE TYPE 7189

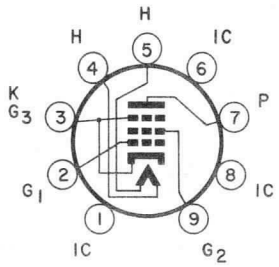
The 7189 is a 9-Pin miniature power pentode designed for service as audio output amplifier. It is intended for radio and television receivers and home music systems. The 7189 combines high power sensitivity and plate efficiency with low distortion and driving voltage requirements.

ELECTRICAL

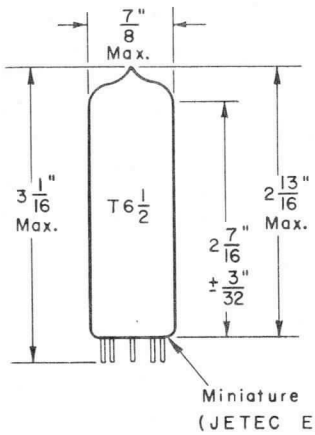
Cathode	Coated Unipotential	
Heater:		
Voltage	6.3	Volts
Current	0.76	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to Plate	0.5 max.	μμf
Grid 1 to Heater	0.25 max.	μμf
Plate to All Other Elements	6.5	μμf
Grid 1 to All Other Elements	10.8	μμf

MECHANICAL

Bulb	T-6-1/2
Base	Miniature 9-Pin (JEDEC E9-1)
Basing	9CV
Mounting Position	Any



9CV



Miniature 9-Pin
(JETEC E9-1)

MAXIMUM RATINGS

Design Center Values

Plate Voltage (Note 1)	400 max.		Volts
Grid 2 Voltage (Note 1)	300 max.		Volts
Plate Dissipation	12 max.		Watts
Grid 2 Dissipation (Note 2)	2 max.		Watts
Cathode Current	65 max.		Ma.
Heater Cathode Voltage	±100 max.		Volts
Grid 1 Circuit Values:			
Fixed Bias	0.3 max.		Megohm
Cathode Resistor Bias	1.0 max.		Megohm

CLASS A AMPLIFIER
(one tube)

Typical Operating Characteristics:

For: Plate Voltage	250			Volts
Grid 2 Voltage	250			Volts
Grid 1 Voltage	-7.3			Volts
or Cathode Bias Resistor	135			Ohms
Plate Load Impedance	5200			Ohms
With RMS Input AF Voltage of	0	4.3	4.7	Volts
Plate Current	48	49.5	49.2	Ma.
Grid 2 Current	5.5	10.8	11.6	Ma.
Transconductance	11300	–	–	Ohms
Amplification Factor (Note 3)	19	–	–	–
Power Output (Note 4)	0	5.7	6.0 (5)	Watts
Distortion: (Note 4)				
Total Harmonic	–	10	–	Percent
Second Harmonic	–	2.0	–	Percent
Third Harmonic	–	9.5	–	Percent

Typical Operating Characteristics:

For: Plate Voltage	250			Volts
Grid 2 Voltage	250			Volts
Grid 1 Voltage	-7.3			Volts
or Cathode Bias Resistor	135			Ohms
Plate Load Impedance	4500			Ohms
With RMS Input AF Voltage of	0	4.4	4.8	Volts
Plate Current	48	50.6	50.5	Ma.
Grid 2 Current	5.5	10	11	Ma.
Transconductance	11300	–	–	μmhos
Plate Resistance	38000	–	–	Ohms
Amplification Factor (Note 3)	19	–	–	–
Power Output (Note 4)	0	5.7	6.0 (5)	Watts
Distortion: (Note 4)				
Total Harmonic	–	10	–	Percent
Second Harmonic	–	5.0	–	Percent
Third Harmonic	–	8	–	Percent

Typical Operating Characteristics:

For: Plate Voltage			250	Volts
Grid 2 Voltage			250	Volts
Grid 1 Voltage			-8.4	Volts
or Cathode Bias Resistor			210	Ohms
Plate Load Impedance			7000	Ohms
With RMS Input AF Voltage of	0	3.5	5.5	Volts
Plate Current	36	36.8	36	Ma.
Grid 2 Current	4.1	8.5	14.6	Ma.
Transconductance	10000	–	–	μmhos
Plate Resistance	40000	–	–	Ohms
Amplification Factor (Note 3)	19	–	–	–
Power Output (Note 4)	0	4.2	5.6 (5)	Watts
Distortion: (Note 4)				
Total Harmonic	–	10	–	Percent
Second Harmonic	–	1.7	–	Percent
Third Harmonic	–	8.7	–	Percent

Typical Operating Characteristics:

For: Plate Voltage			250	Volts
Grid 2 Voltage			210	Volts
Grid 1 Voltage			-6.4	Volts
or Cathode Bias Resistor			160	Ohms
Plate Load Impedance			7000	Ohms
With RMS Input AF Voltage of	0	3.4	3.8	Volts
Plate Current	36	36.6	36.5	Ma.
Grid 2 Current	3.9	7.3	8.0	Ma.
Transconductance	10400	–	–	μmhos
Plate Resistance	40000	–	–	Ohms
Amplification Factor	19	–	–	–
Power Output	0	4.3	4.7	Watts
Distortion:				
Total Harmonic	–	10	–	Percent
Second Harmonic	–	1.8	–	Percent
Third Harmonic	–	9.3	–	Percent

PUSH-PULL CLASS AB AMPLIFIER

Typical Operating Characteristics for Two Tubes

For: Plate Voltage			250	Volts
Grid 2 Voltage			250	Volts
Common Cathode Bias Resistor			130	Ohms
Plate-to-Plate Load Impedance			8000	Ohms
With RMS Input AF Voltage of	0		8	Volts
Plate Current	62		75	Ma.
Grid 2 Current	7		15	Ma.
Power Output	0		11	Watts
Total Harmonic Distortion	–		3	Percent

Typical Operating Characteristics for Two Tubes

For: Plate Voltage	400		300	Volts
Grid 2 Voltage	300		300	Volts
Grid 1 Voltage	-15		–	Volts
Common Cathode Bias Resistor	–		130	Ohms
Plate-to-Plate Load Impedance	8000		8000	Ohms
With RMS Input AF Voltage of	0	10.5	0	10	Volts
Plate Current	15	105	72	92	Ma.
Grid 2 Current	1.6	25	8	22	Ma.
Power Output	0	24	0	17	Watts
Total Harmonic Distortion	–	4	–	4	Percent

PUSH-PULL CLASS B AMPLIFIER

Typical Operating Characteristics for Two Tubes

For: Plate Voltage		250	Volts
Grid 2 Voltage		250	Volts
Grid 1 Bias Voltage		-11.6	Volts
Plate-to-Plate Load Impedance		8000	Ohms
With RMS Input AF Voltage of	0	8	Volts
Plate Current	20	75	Ma.
Grid 2 Current	2.2	15	Ma.
Power Output	0	11	Watts
Total Harmonic Distortion	–	3	Percent

Typical Operating Characteristics for Two Tubes

For: Plate Voltage		300	Volts
Grid 2 Voltage		300	Volts
Grid 1 Bias Voltage		-14.7	Volts
Plate-to-Plate Load Impedance		8000	Ohms
With RMS Input AF Voltage of	0	10	Volts
Plate Current	15	92	Ma.
Grid 2 Current	1.6	22	Ma.
Power Output	0	17	Watts
Total Harmonic Distortion	–	4	Percent

TRIODE-CONNECTED CLASS A AMPLIFIER
(Grid 2 Connected to Plate)

Typical Operating Characteristics

Plate Voltage		250	Volts
Cathode Bias Resistor		270	Ohms
Plate Load Resistance		3500	Ohms
Input AF Voltage (RMS)		6.7	Volts
Zero Signal Plate Current		34	Ma.
Maximum Signal Plate Current		36	Ma.
Power Output		1.95	Watts
Total Harmonic Distortion		9	Percent
Input AF RMS Voltage for Power Output of 50 Milliwatts		1.0	Volts

PUSH-PULL TRIODE CONNECTED CLASS A AMPLIFIER
(Grids No. 2 Connected to Plates)

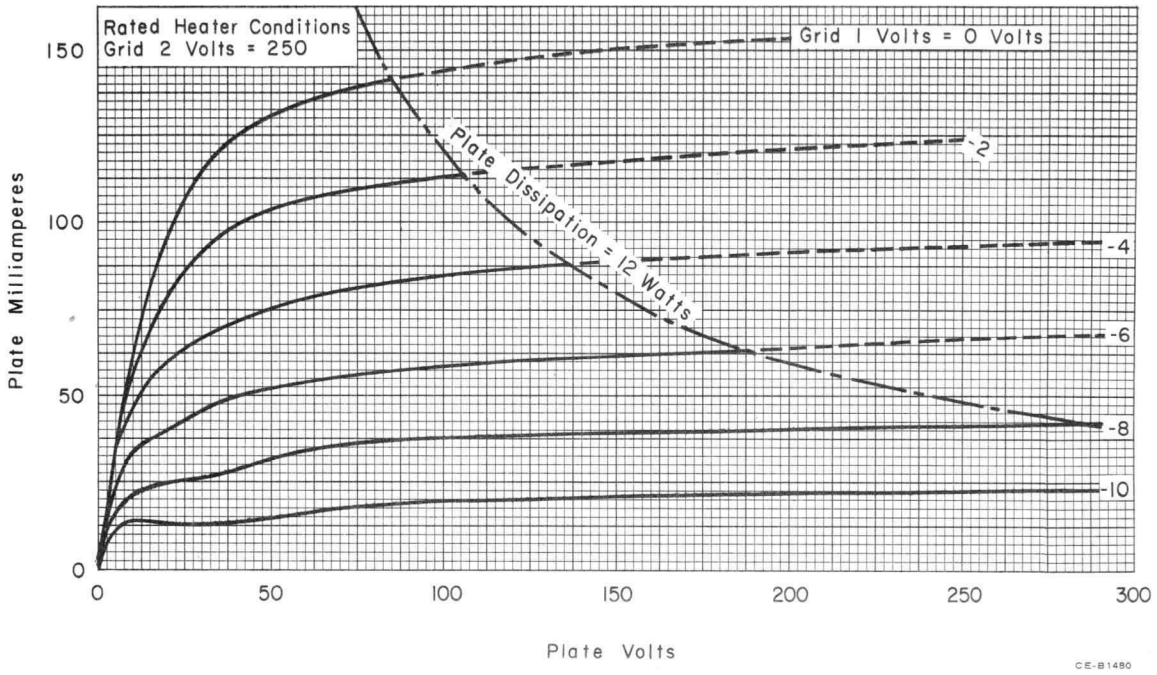
Typical Operating Characteristics for Two Tubes

Plate Voltage	250	300		Volts
Cathode Bias Resistor	270	270		Ohms
Plate-to-Plate Load Impedance	10000	10000		Ohms
Input AF Voltage (RMS)	8.3	10		Volts
Zero Signal Plate Current	40	48		Ma.
Maximum Signal Plate Current	43.4	52		Ma.
Power Output	3.4	5.2		Watts
Total Harmonic Distortion	2.5	2.5		Percent
Input AF RMS Voltage for Power Output of 50 Milliwatts	0.95	0.9		Volts

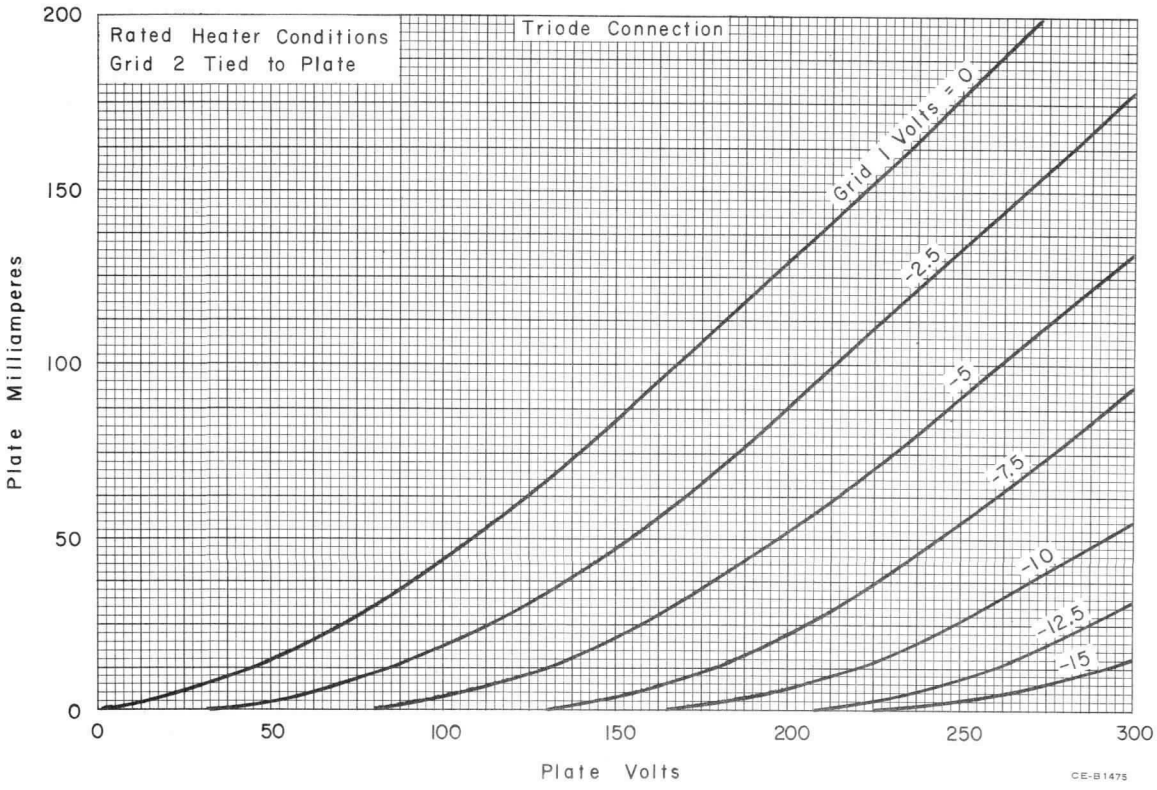
NOTES

1. For cathode bias operation this figure is 375 volts.
2. Max. Signal value is 4 watts.
3. Amplification factor of grid 2 to grid 1.
4. Measured with fixed bias.
5. Power output when grid starts to draw current.

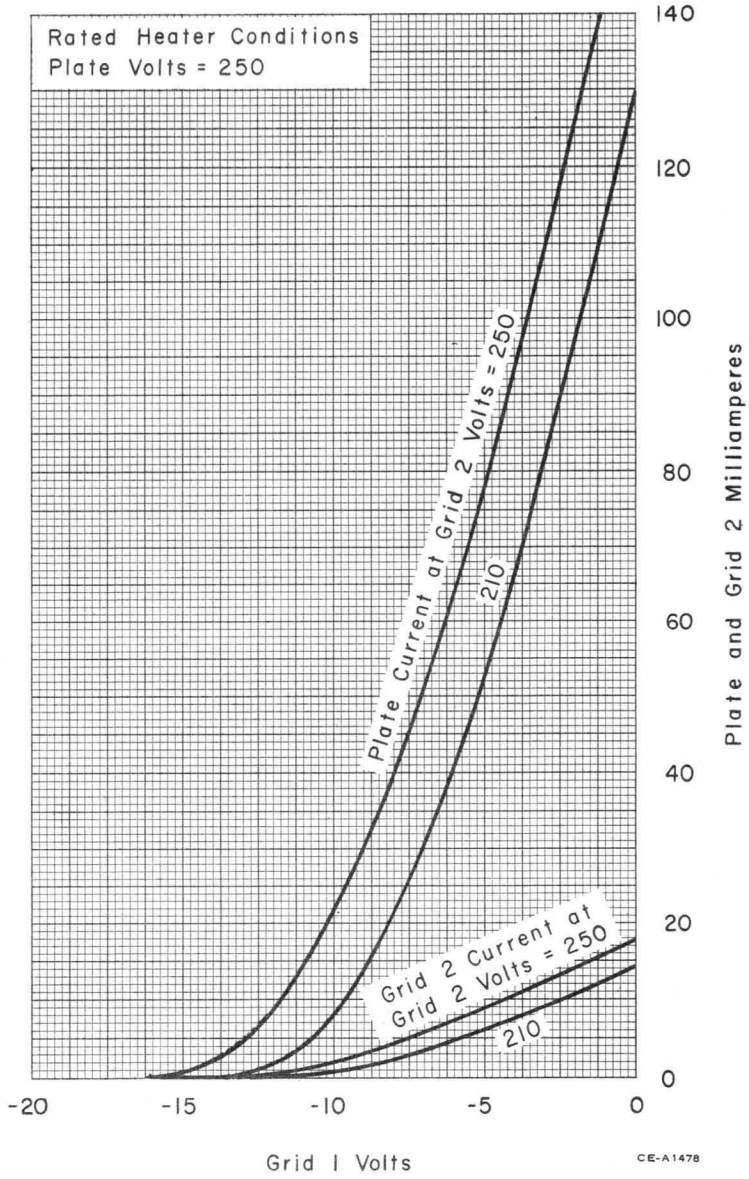
AVERAGE PLATE CHARACTERISTICS



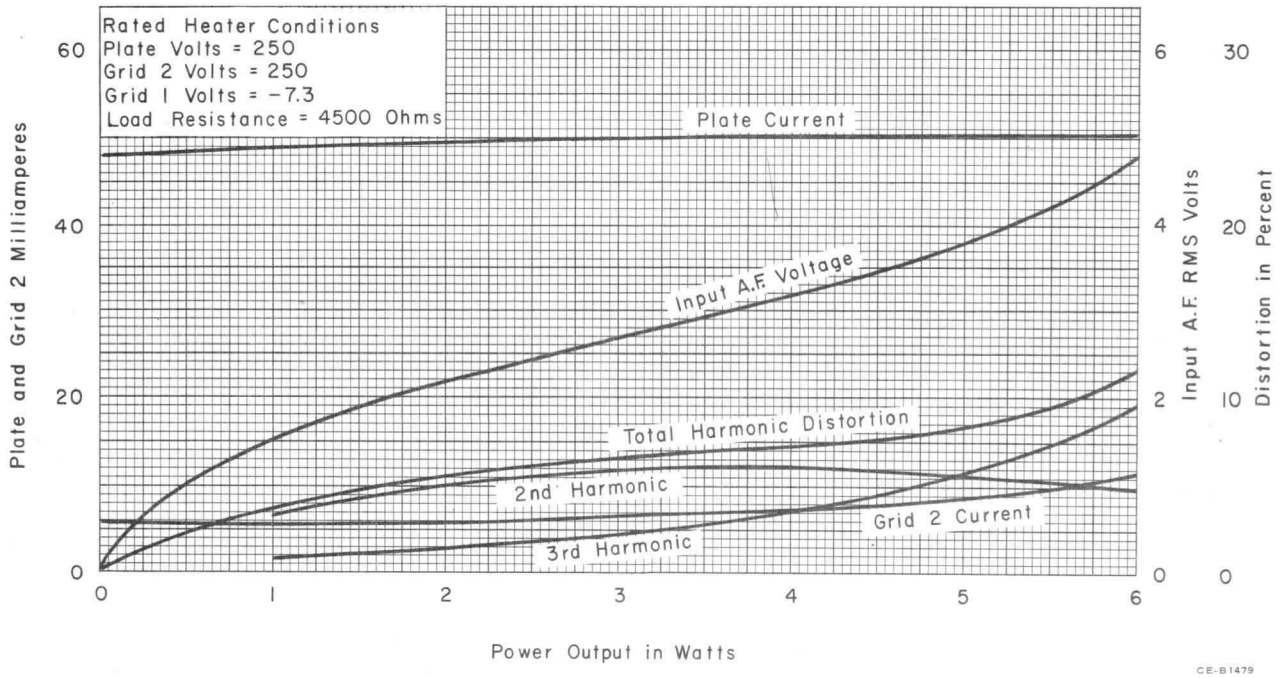
AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

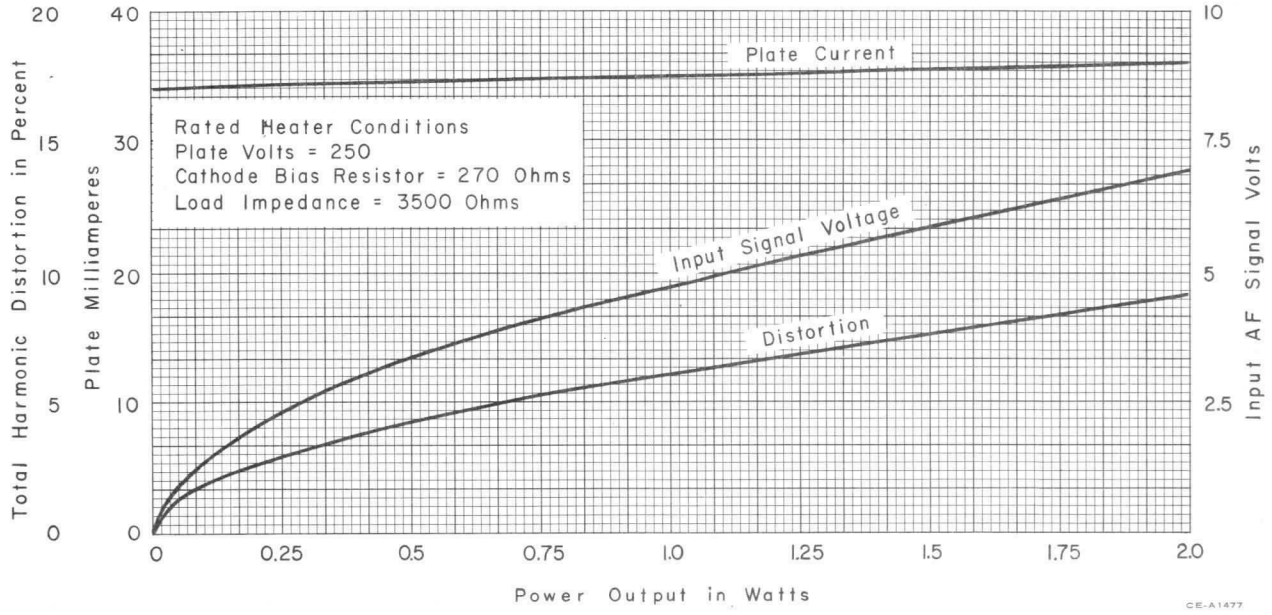


OPERATION CHARACTERISTICS



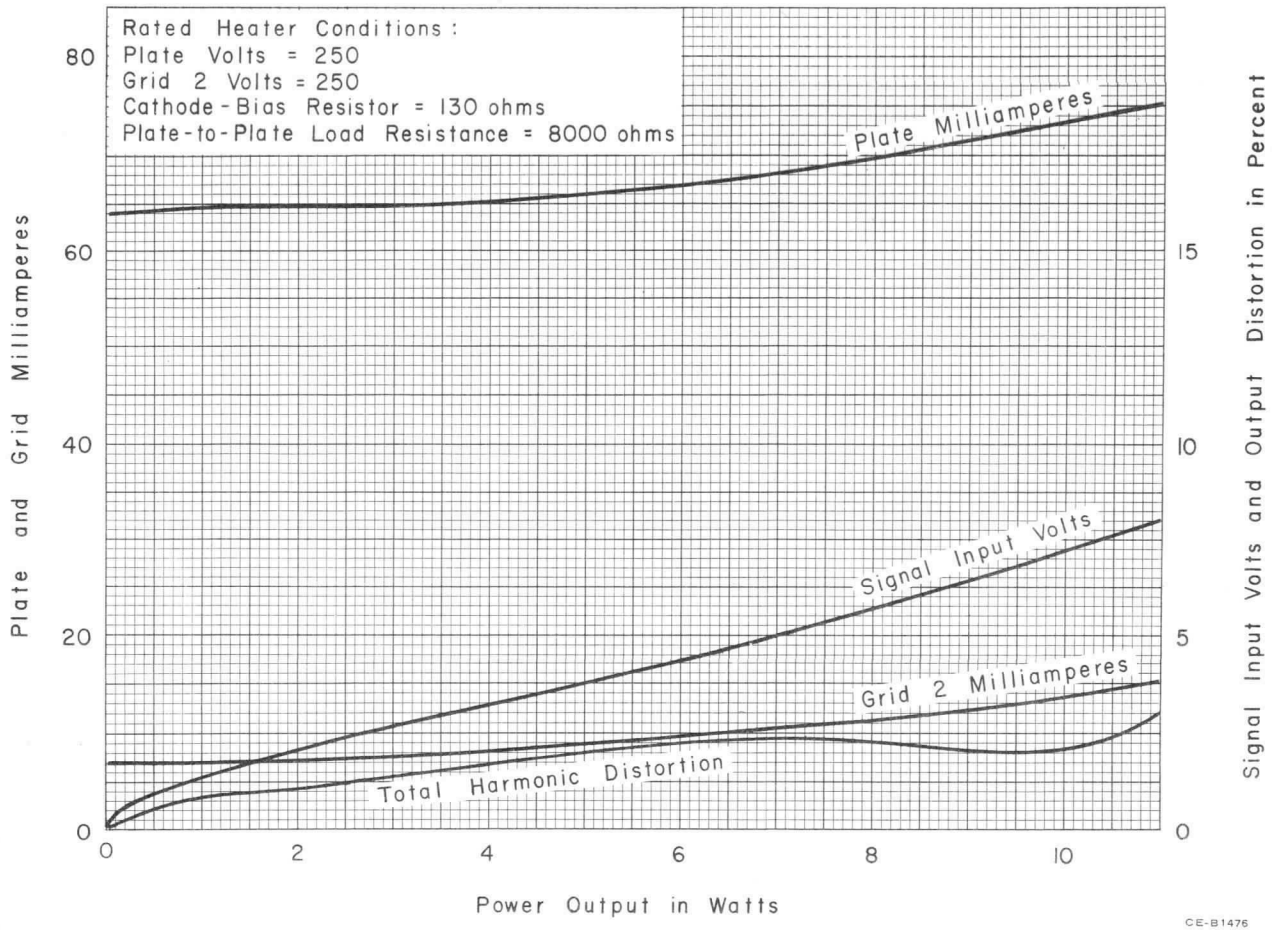
CE-B1479

OPERATION CHARACTERISTICS
(TRIODE CONNECTION)



CE-A1477

OPERATING CHARACTERISTICS
PUSH - PULL CLASS AB



CE-B1476

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BEAM-POWER PENTODE TYPE WL-7408

The WL-7408 is a glass octal beam-power pentode designed for service as an output amplifier tube in high quality sound systems. This tube is characterized by a plate voltage "knee" and cut-off voltage controlled to small variations. These features enable the WL-7408 to possess uniformity of power-output performance with a minimum of harmonic distortion. The WL-7408 is a direct replacement for the 6V6-GT.

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.45	Ampere
Direct Interelectrode Capacitances: (Unshielded)		
Grid 1 to Plate	0.7	μμf
Input	9.0	μμf
Output	7.5	μμf

MECHANICAL:

Bulb	T-9
Base	Intermediate-Shell Octal 7-Pin (JETEC B7-7)
Outline	9-41
Basing	7AC
Mounting Position	Any

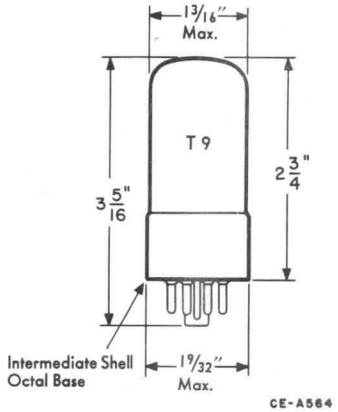
MAXIMUM RATINGS:

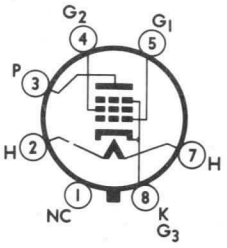
Design Maximum Values

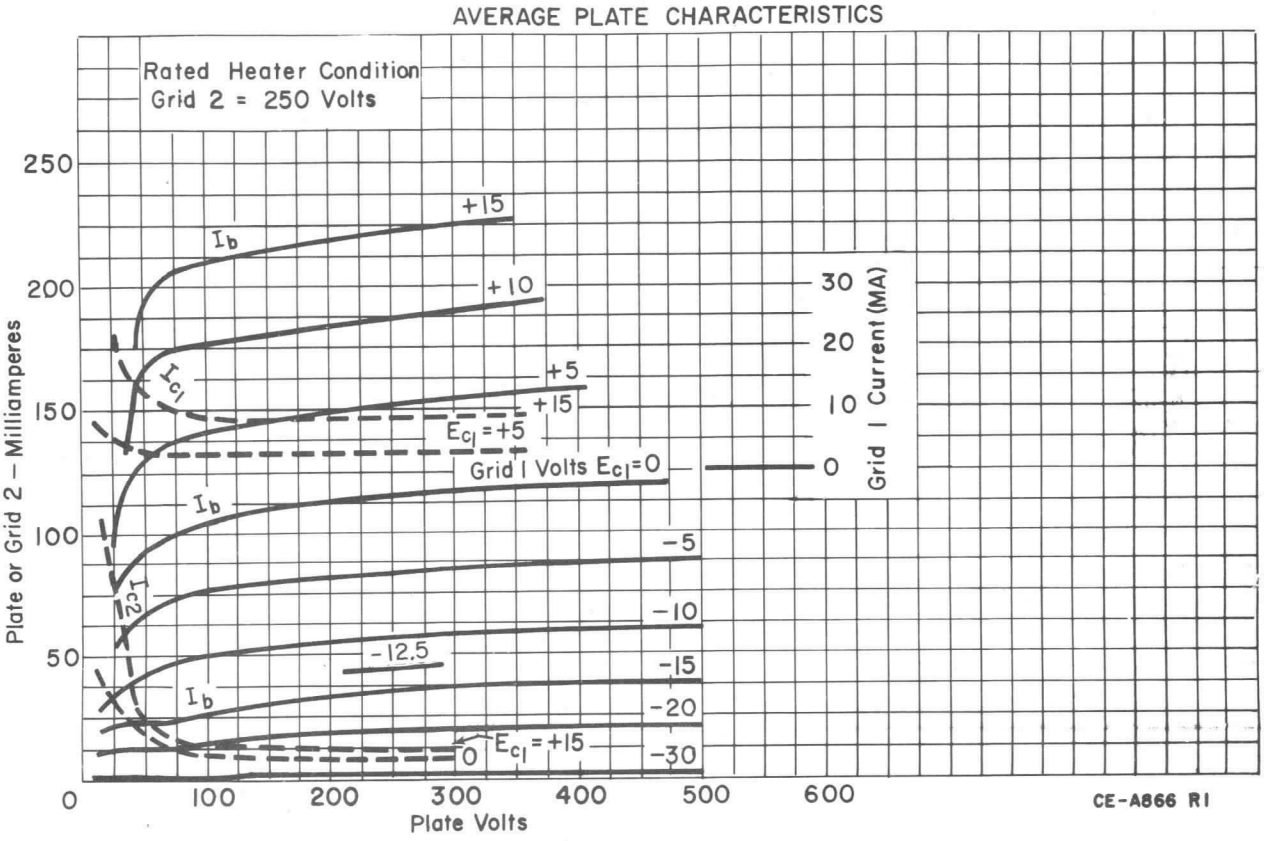
Plate Voltage	350	max.	Volts
Grid 2 Voltage (Screen)	315	max.	Volts
Plate Dissipation	14	max.	Watts
Grid 2 Dissipation	2.2	max.	Watts
Grid 1 Circuit Resistance:			
Fixed Bias	0.1	max.	Megohm
Cathode Bias	0.5	max.	Megohm
Max. Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC + Peak	200		Volts
Heater Positive with Respect to Cathode			
DC Component	100		Volts
DC + Peak	200		Volts

CHARACTERISTICS AND TYPICAL OPERATION:

Plate Voltage	60	250	Volts
Grid 2 Voltage	250	250	Volts
Grid 1 Voltage	0	-12.5	Volts
Peak AF Control Grid Voltage	--	12.5	Volts
Zero-Signal Plate Current	100	45	Ma.
Max. Signal Plate Current	--	47	Ma.
Zero-Signal Grid 2 Current	22	4.5	Ma.
Max.-Signal Grid 2 Current	--	7	Ma.
Plate Resistance (approx.)	--	50000	Ohms
Transconductance	--	4100	μmhos
Load Resistance	--	5000	Ohms
Power Output	--	4.5	Watts
Total Harmonic Distortion (approx.)	--	7	Per Cent






AVERAGE PLATE CHARACTERISTICS
Rated Heater Condition
Grid 2 = 250 Volts
Plate or Grid 2 – Milliamperes
Plate Volts
Grid 1 Current (MA)
Grid 1 Volts Ec1=0
Ec1 = +5
Ec1 = +15
+15
+10
+5
0
-5
-10
-12.5
-15
-20
-30
Ib
Ic1
Ic2
CE-A866 R1

BEAM POWER AMPLIFIER TYPE 7591

The 7591 is a glass octal beam power pentode designed for use as an audio frequency power output tube. The tube has high power sensitivity and high efficiency and is especially designed for applications where high power output is required. Plate construction with special heavy material of high heat conductivity will allow the use of the tube at a higher plate dissipation than is possible with conventional plates. A power output as high as 43 watts with 1.5% total harmonic distortion is available in push-pull Class AB1 application with 450 volt plate voltage and 350 screen voltage.

In ultra linear push-pull class AB1 operation, a power output of 32 watts with a total harmonic distortion of 1.0% is available with 400 volt plate voltage.

MECHANICAL:

Bulb	T-9 Glass
Base	Octal 7 Pin B7-233
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL:

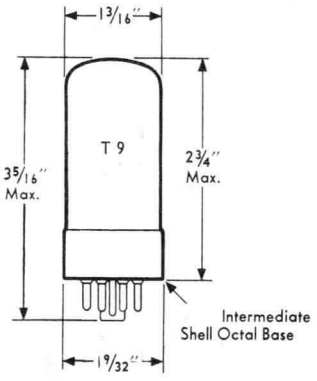
Heater Characteristics:		
Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.80	Amperes
Heater-Cathode Voltage (Design Maximum Values):		
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volts
Heater Positive with Respect to Cathode		
D.C.	100	Volts
Total D.C. and Peak	200	Volts
Direct Interelectrode Capacitances:		
Grid-to-Plate	.25	μμf
Input	10.0	μμf
Output	5.0	μμf

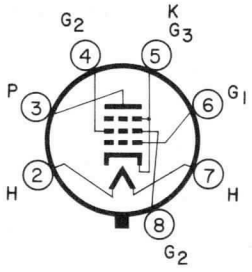
RATINGS

Design-Maximum Values:		
Plate Voltage	550	Volts
Screen Voltage	440	Volts
Plate Dissipation	19.0	Watts
Screen Dissipation	3.3♦	Watts
Cathode Current	85	Ma.
Grid No. 1 Circuit Resistance:		
With Fixed Bias	0.3	Megohms
With Cathode Bias	1.0	Megohms
Amplifier-Class A1-Typical Operation		
Plate Voltage	300	Volts
Screen Voltage	300	Volts
Grid No. 1 Voltage	−10	Volts
Peak A.F. Grid Voltage	10.0	Volts
Plate Current (Zero Signal)	60	Ma.
Plate Current (Max. Signal)	75	Ma.
Screen Current (Zero Signal)	8.0	Ma.
Screen Current (Max. Signal)	15.0	Ma.
Transconductance	10,200	Micromhos
Plate Resistance	29,000	Ohms
Triode Amplification Factor	16.8	
Load Resistance	3000	Ohms
Power Output	11	Watts
Total Harmonic Distortion	13	Percent

Push-Pull Class AB1 - Ultra-Linear▲ Operation (Values for Two Tubes)

	Fixed Bias	Cathode Bias	
Plate Supply Voltage	400	425	Volts
Grid 1 Voltage	−20.5	--	Volts
Cathode Resistor (Common to Two Tubes)	--	185	Ohms
Peak A.F. Grid-to-Grid Voltage	41	42	Volts
Zero Signal Plate Current	80	88	Ma.
Maximum Signal Plate Current	138	104	Ma.
Zero Signal Screen Current	11.5	13.0	Ma.
Maximum Signal Screen Current	26.4	17.5	Ma.
Effective Load, Plate-to-Plate	6600	6600	Ohms
Total Harmonic Distortion	1.0	2.0	Percent
Maximum Signal Power Output	32	26	Watts





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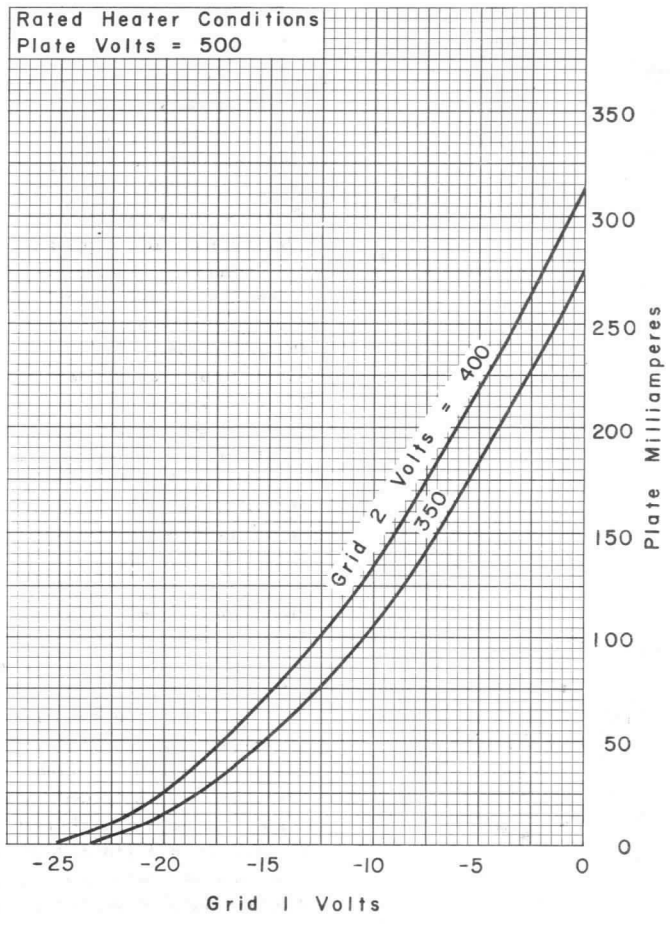
♦ Screen dissipation may be permitted to reach 6 watts during the periods of maximum input of speech and music signals. For efficient operation of the screen, the two screen connections, pins 4 and 8, should be externally tied together.

▲ Screen tapped at 40% of primary turns.

Push-Pull Class AB1 - Pentode Connection (Values for Two Tubes)

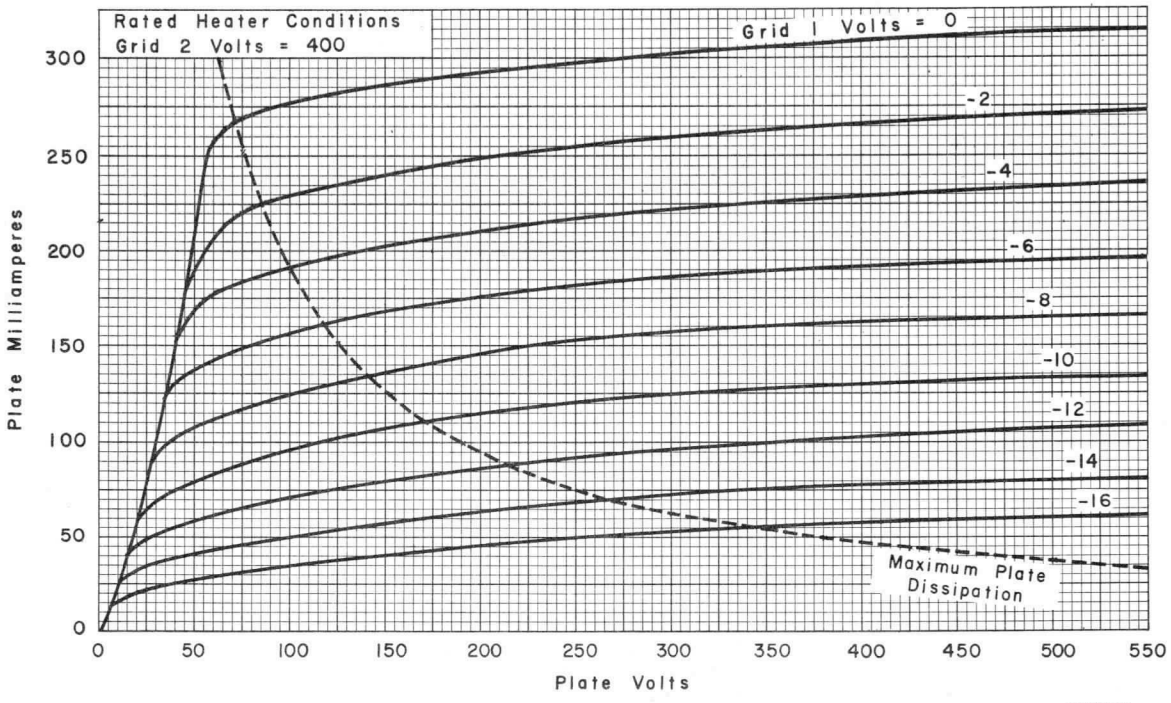
	Fixed Bias					Cathode Bias	
Plate Supply Voltage	300	350	400	450	450	450	Volts
Screen Supply Voltage	300	350	350	350	400	400	Volts
Grid 1 Voltage	−12.5	−15.5	−16.0	−16.5	−21	--	Volts
Common Cathode Resistor	--	--	--	--	--	200	Ohms
Peak AF Grid-to-Grid Voltage	25	31	32	33	42	28	Volts
Zero Signal Plate Current	86	92	85	77	66	82	Ma.
Max. Signal Plate Current	116	130	143	153	144	94	Ma.
Zero Signal Screen Current	12.6	13.0	11.0	9.6	9.4	11.5	Ma.
Max. Signal Screen Current	26.0	28.6	27.0	27.0	30.0	22	Ma.
Effective Load, Plate-to-Plate	6600	6600	6600	6600	6600	9000	Ohms
Total Harmonic Distortion	2.5	2.0	1.5	1.5	1.5	2.0	Percent
Maximum Signal Power Output	23	30	37	43	45	28	Watts

AVERAGE TRANSFER CHARACTERISTICS



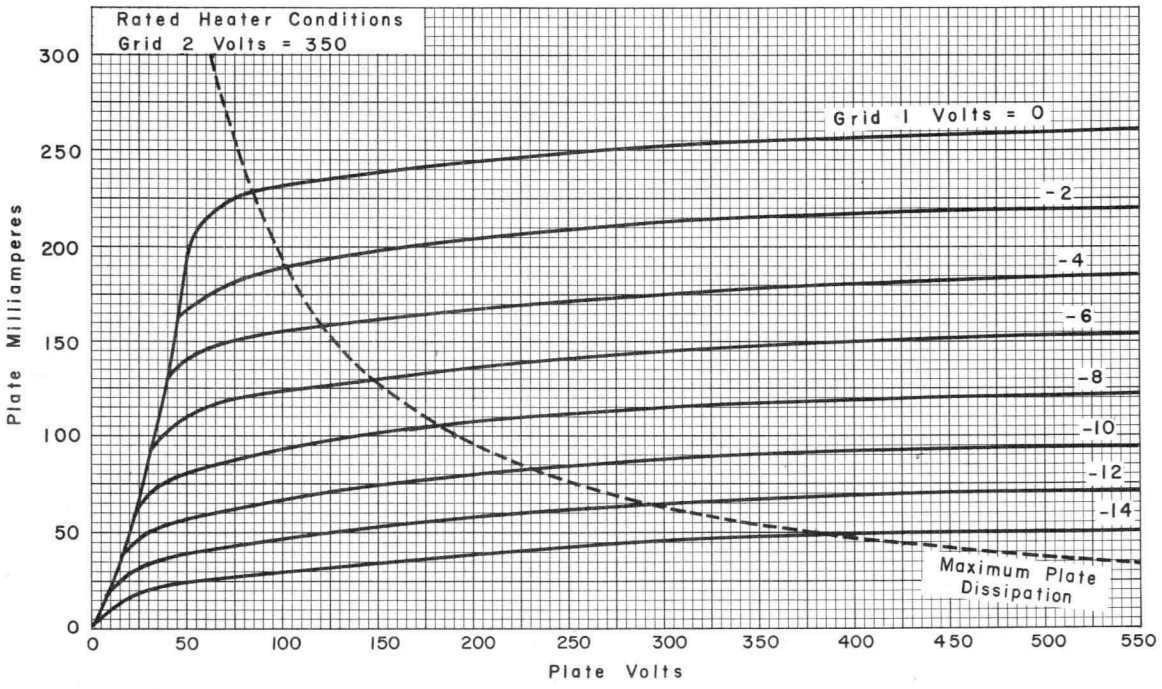
CE-A1551

AVERAGE PLATE CHARACTERISTICS



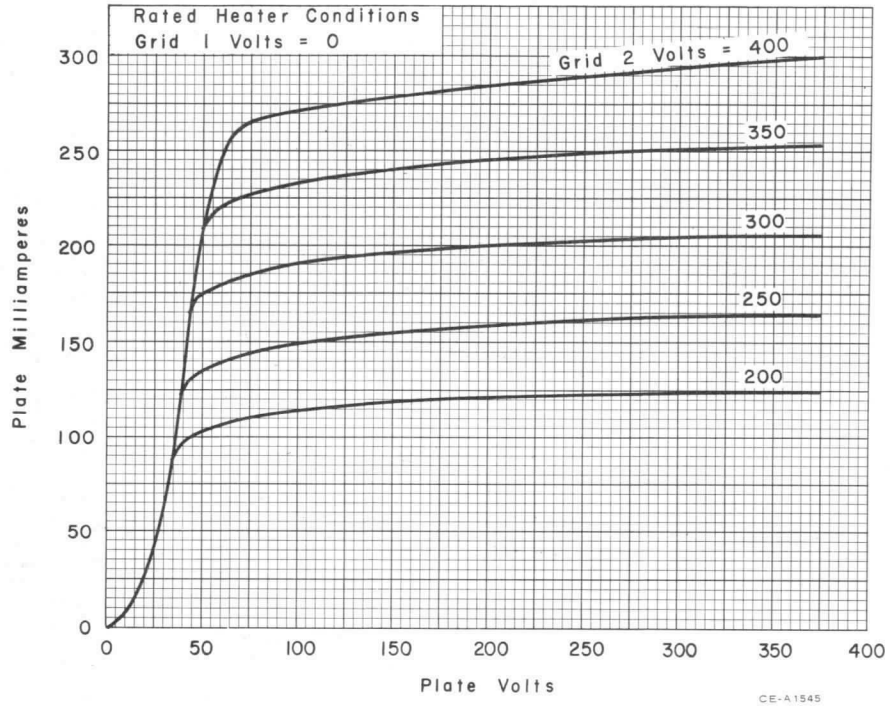
CE-A1543

AVERAGE PLATE CHARACTERISTICS

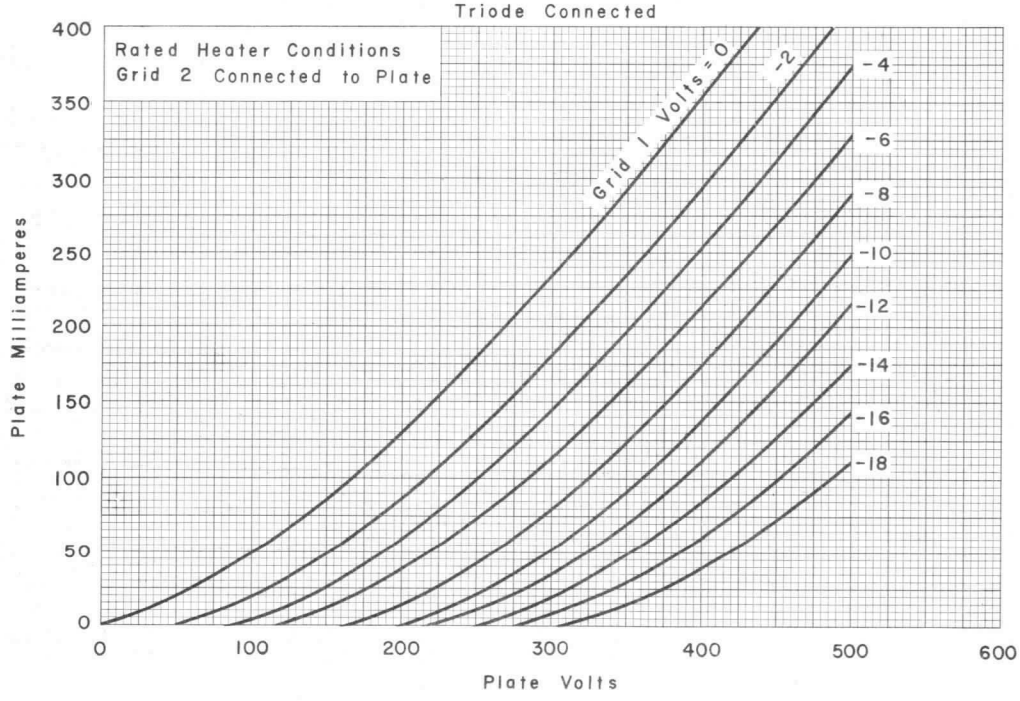


CE-A1544

AVERAGE PLATE CHARACTERISTICS

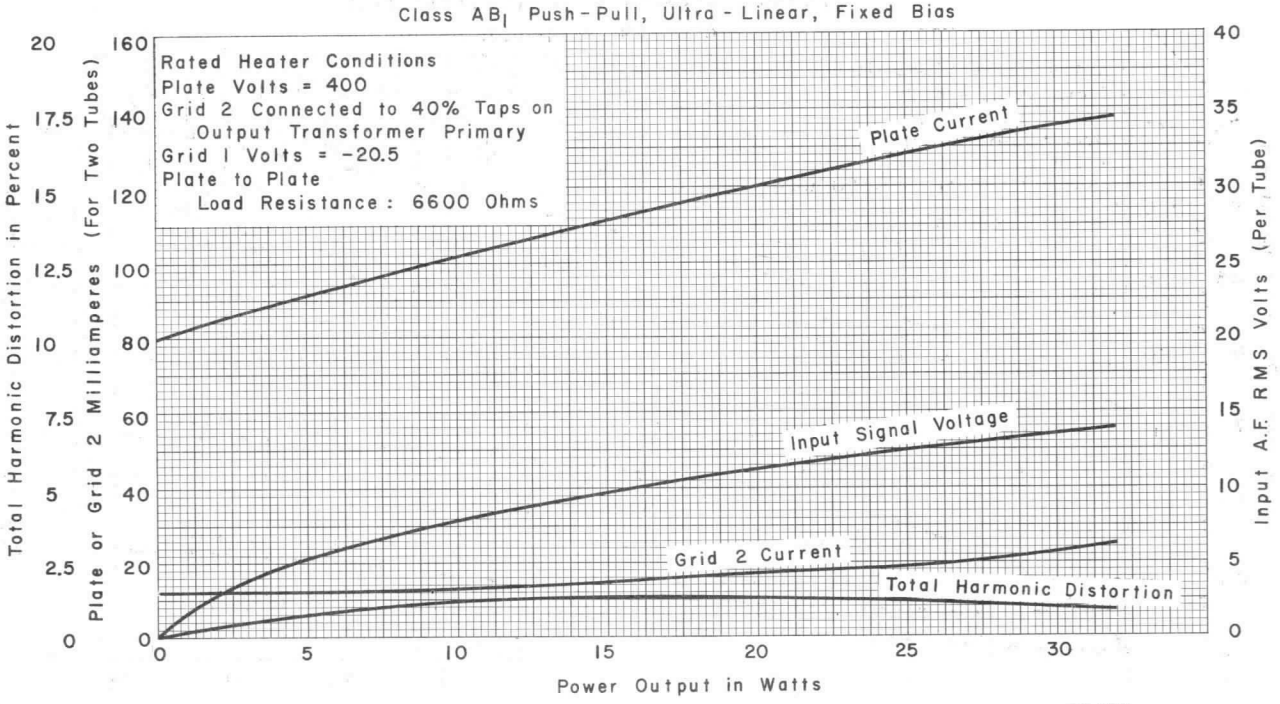


AVERAGE PLATE CHARACTERISTICS
Triode Connected



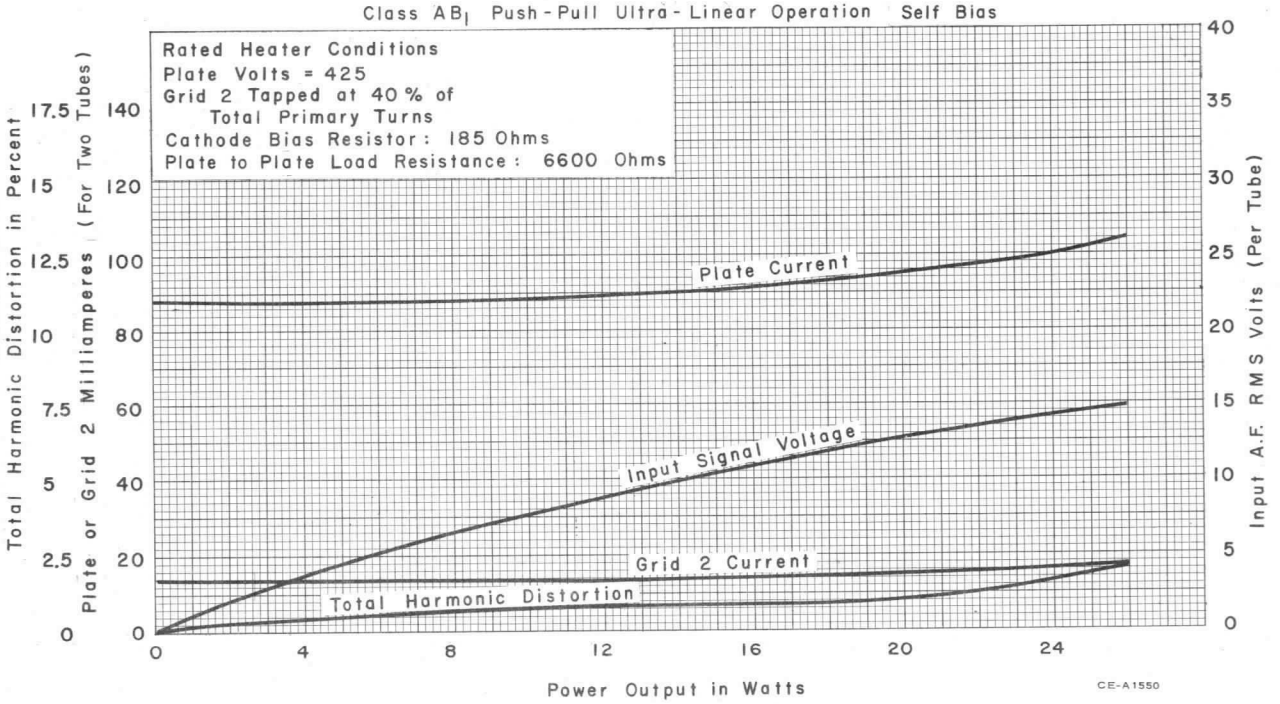
AVERAGE OPERATING CHARACTERISTICS

Class AB_1 Push-Pull, Ultra-Linear, Fixed Bias



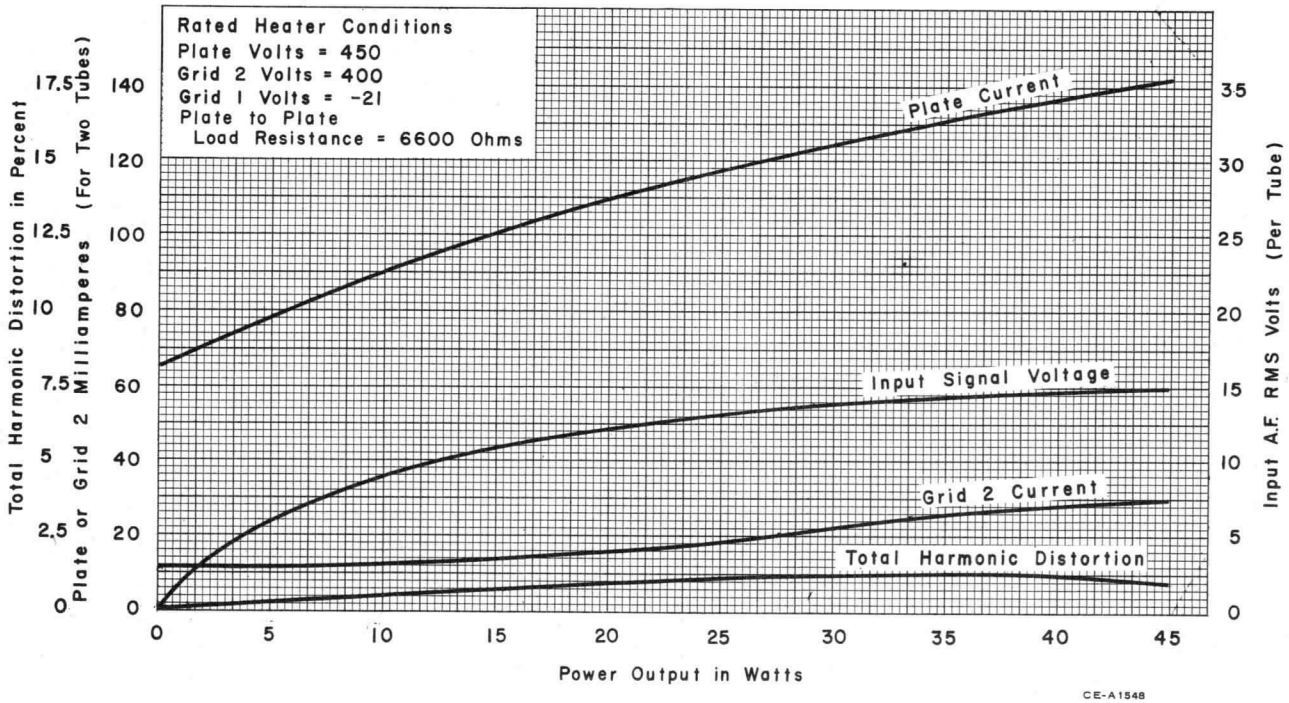
AVERAGE OPERATING CHARACTERISTICS

Class AB_1 Push-Pull Ultra-Linear Operation Self Bias



AVERAGE OPERATING CHARACTERISTICS

Class AB$_1$ Push-Pull



CE-A1548

Westinghouse

7591A

April 1, 1963

BEAM POWER AMPLIFIER TYPE 7591A

The 7591A is a glass octal beam power pentode designed for use as an audio frequency power output tube. The tube has high power sensitivity and high efficiency and is especially designed for applications where high power output is required. Plate construction with special heavy material of high heat conductivity will allow the use of the tube at a higher plate dissipation than is possible with conventional plates. A power output as high as 45 watts with 1.5% total harmonic distortion is available in push-pull Class AB1 application with 450 volt plate voltage and 400 screen voltage.

The 7591A is a direct replacement for type 7591 and has controlled zero-bias plate and screen currents. It also features a special low-loss base.

MECHANICAL:

Bulb	T-9 Glass
Base	Plaskon, Octal 7 Pin B7-238
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL:

Heater Characteristics:		
Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.80	Amperes
Heater-Cathode Voltage (Design Maximum Values):		
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volts
Heater Positive with Respect to Cathode		
D.C.	100	Volts
Total D.C. and Peak	200	Volts
Direct Interelectrode Capacitances:		
Grid-to-Plate	.25	μμf
Input	10.0	μμf
Output	5.0	μμf

RATINGS

Design-Maximum Values:

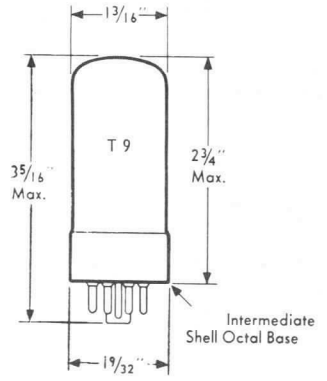
Plate Voltage	550	Volts
Screen Voltage	440	Volts
Plate Dissipation	19.0	Watts
Screen Dissipation (Note 1)	3.3	Watts
Cathode Current	90	Ma.
Grid No. 1 Circuit Resistance:		
With Fixed Bias	0.3	Megohms
With Cathode Bias	1.0	Megohms

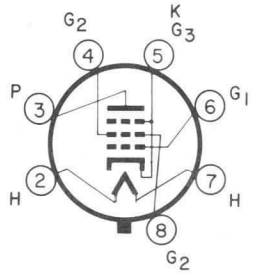
CHARACTERISTICS & TYPICAL OPERATION

Plate Voltage	60 (Note 2)	300	Volts
Screen Voltage	250 (Note 2)	300	Volts
Grid No. 1 Voltage	0	−10	Volts
Peak A.F. Grid Voltage	--	10.0	Volts
Plate Current (Zero Signal)	140 (Note 3)	60	Ma.
Plate Current (Max. Signal)	--	75	Ma.
Screen Current (Zero Signal)	30 (Note 3)	8.0	Ma.
Screen Current (Max. Signal)	--	15.0	Ma.
Transconductance	--	10,200	Micromhos
Plate Resistance	--	29,000	Ohms
Triode Amplification Factor	--	16.8	--
Load Resistance	--	3000	Ohms
Power Output	--	11	Watts
Total Harmonic Distortion	--	13	Percent

Push-Pull Class AB1 - Ultra-Linear (Note 4)
Operation (Values for Two Tubes)

	Fixed Bias	Cathode Bias	
Plate Supply Voltage	400	425	Volts
Grid 1 Voltage	−20.5	--	Volts
Cathode Resistor (Common to Two Tubes)	--	185	Ohms
Peak A.F. Grid-to-Grid Voltage	41	42	Volts
Zero Signal Plate Current	80	88	Ma.
Maximum Signal Plate Current	138	104	Ma.
Zero Signal Screen Current	11.5	13.0	Ma.
Maximum Signal Screen Current	26.4	17.5	Ma.
Effective Load, Plate-to-Plate	6600	6600	Ohms
Total Harmonic Distortion	1.0	2.0	Percent
Maximum Signal Power Output	32	26	Watts





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Push-Pull Class AB1 - Pentode Connection (Values for Two Tubes)

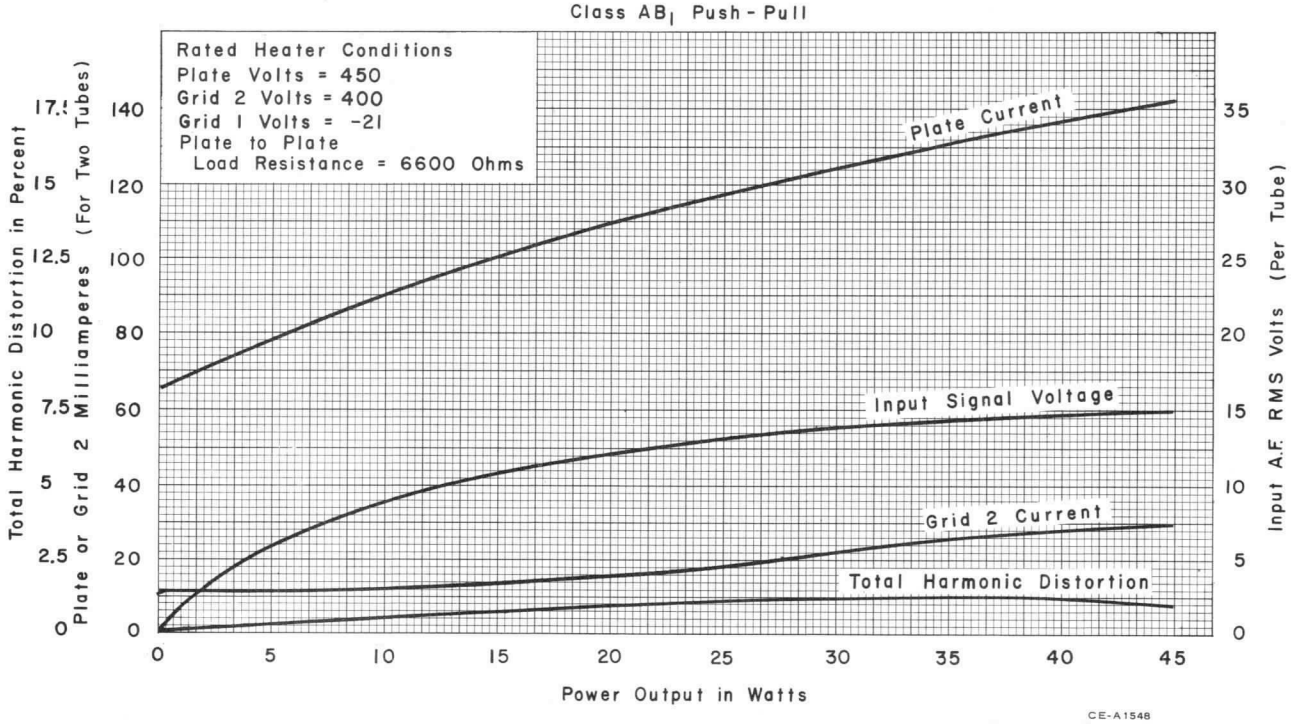
	Fixed Bias				Cathode Bias		
Plate Supply Voltage	300	350	400	450	450	450	Volts
Screen Supply Voltage	300	350	350	350	400	400	Volts
Grid 1 Voltage	−12.5	−15.5	−16.0	−16.5	−21	- -	Volts
Common Cathode Resistor	- -	- -	- -	- -	- -	200	Ohms
Peak AF Grid-to-Grid Voltage	25	31	32	33	42	28	Volts
Zero Signal Plate Current	86	92	85	77	66	82	Ma.
Max. Signal Plate Current	116	130	143	153	144	94	Ma.
Zero Signal Screen Current	12.6	13.0	11.0	9.6	9.4	11.5	Ma.
Max. Signal Screen Current	26.0	28.6	27.0	27.0	30.0	22	Ma.
Effective Load, Plate-to-Plate	6600	6600	6600	6600	6600	9000	Ohms
Total Harmonic Distortion	2.5	2.0	1.5	1.5	1.5	2.0	Percent
Maximum Signal Power Output	23	30	37	43	45	28	Watts

NOTES

1. Screen dissipation may be permitted to reach 6 watts during the periods of maximum input of speech and music signals. For efficient operation of the screen, the two screen connections, pins 4 and 8, should be externally tied together.
2. Applied for short interval (2 seconds maximum) so as not to damage tube.
3. These values can be measured by a method involving a recurrent waveform such that the plate and grid 2 dissipation will be kept within ratings to prevent damage to the tube.
4. Screen tapped at 40% of primary turns.

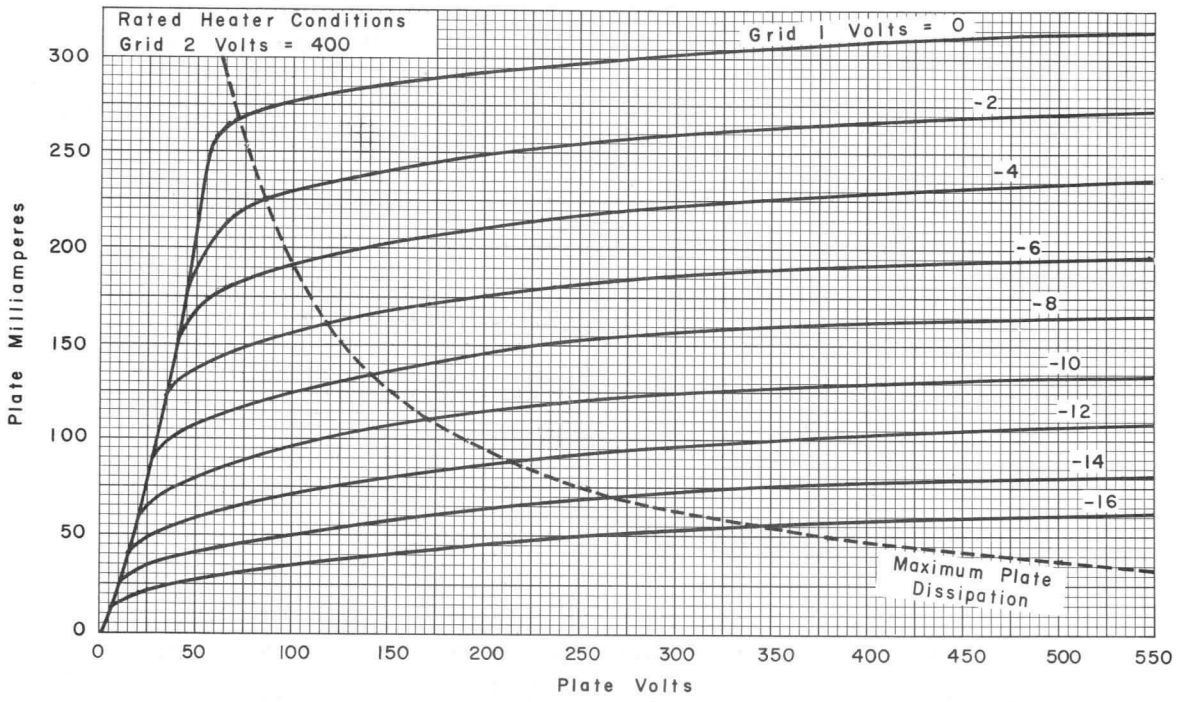
AVERAGE OPERATING CHARACTERISTICS

Class AB_1 Push-Pull



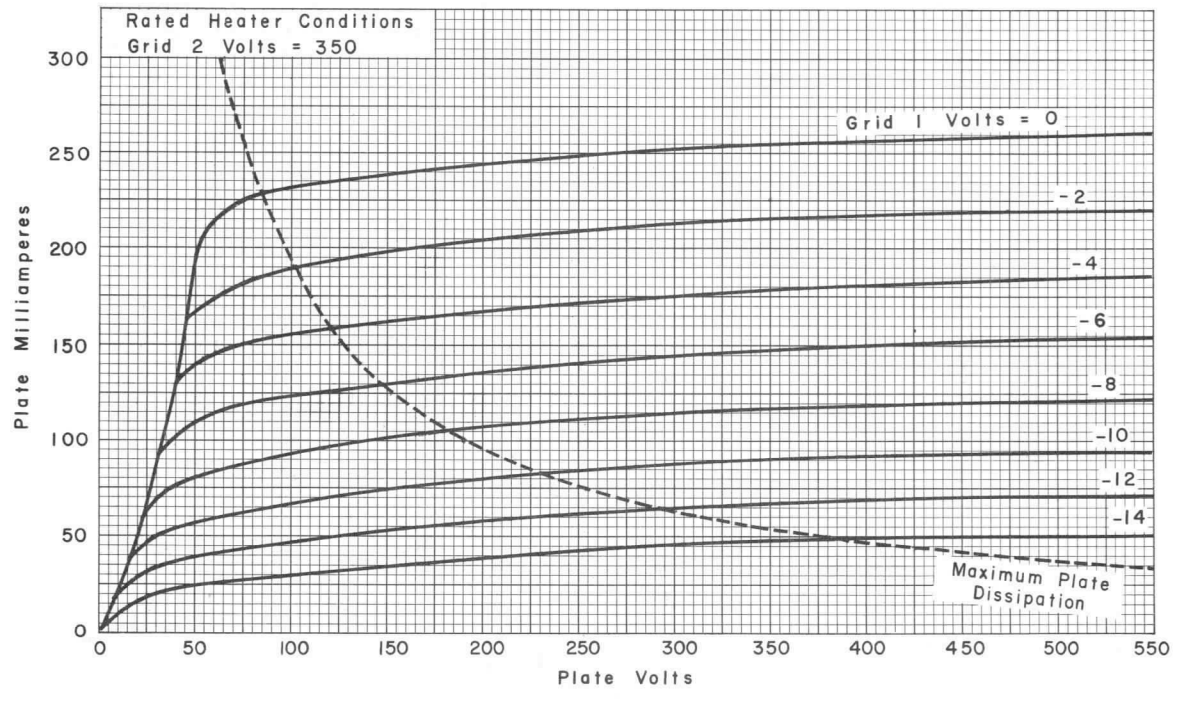
CE-A1548

AVERAGE PLATE CHARACTERISTICS



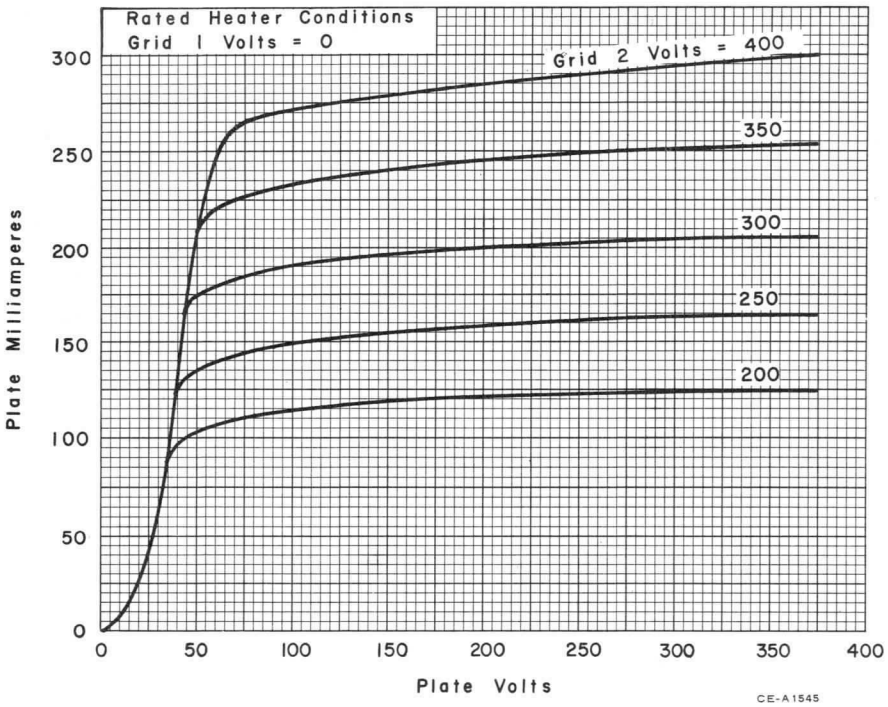
CE-A1543

AVERAGE PLATE CHARACTERISTICS



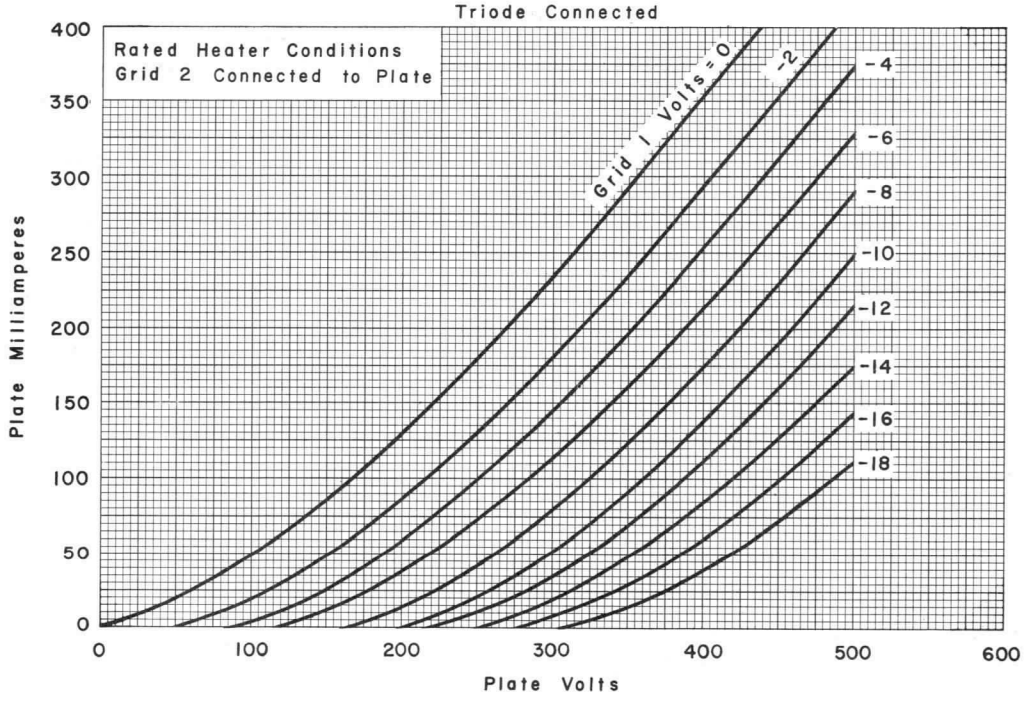
CE-A1544

AVERAGE PLATE CHARACTERISTICS



CE-A1545

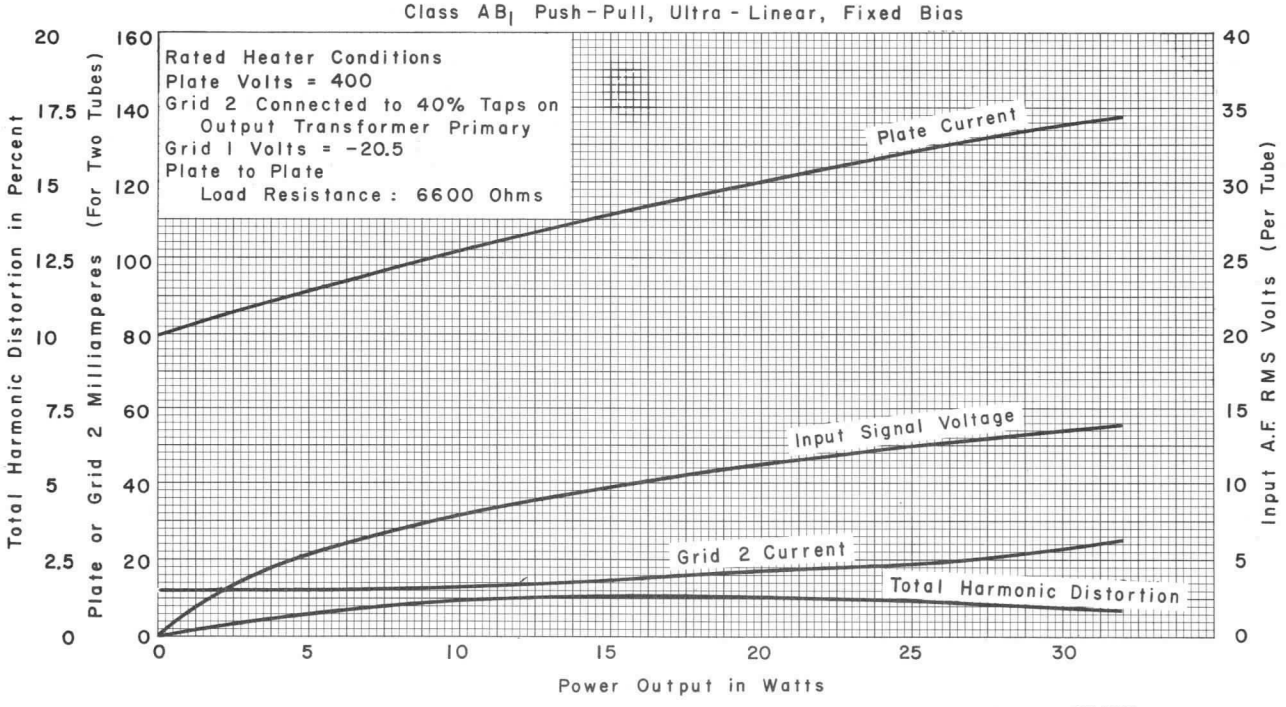
AVERAGE PLATE CHARACTERISTICS
Triode Connected



CE-A1546

AVERAGE OPERATING CHARACTERISTICS

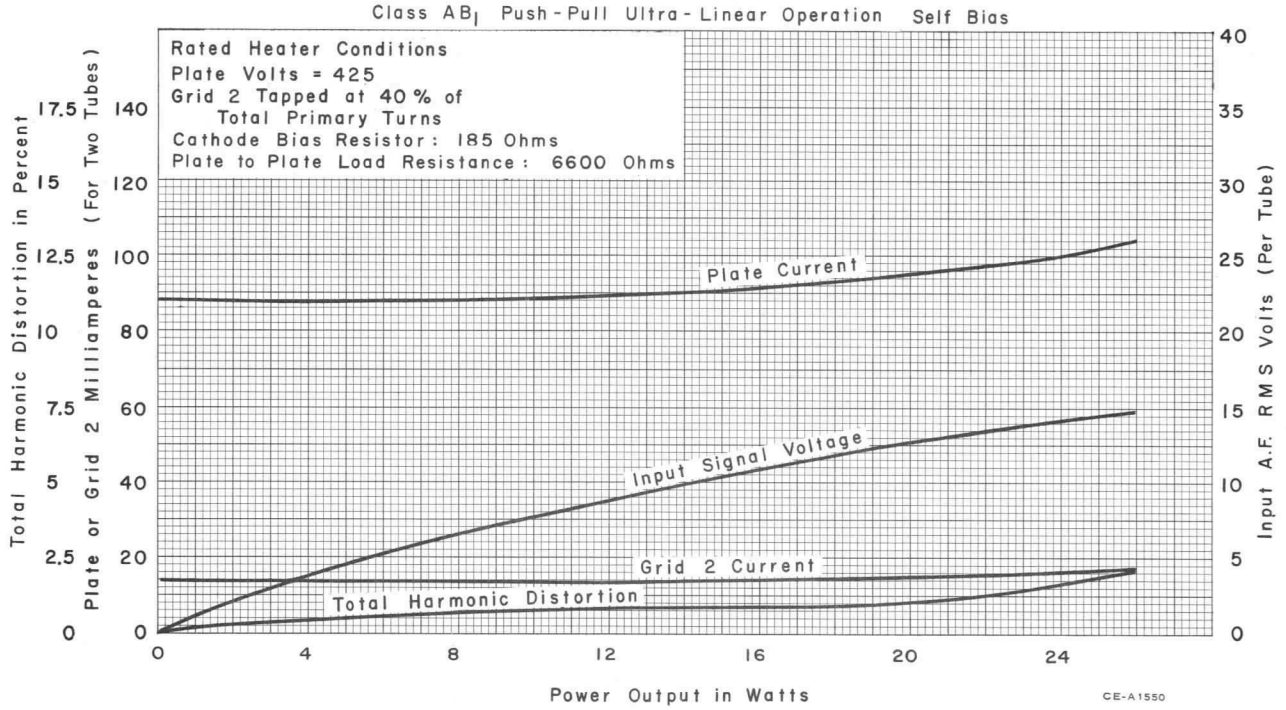
Class AB_1 Push-Pull, Ultra-Linear, Fixed Bias



CE-A1549

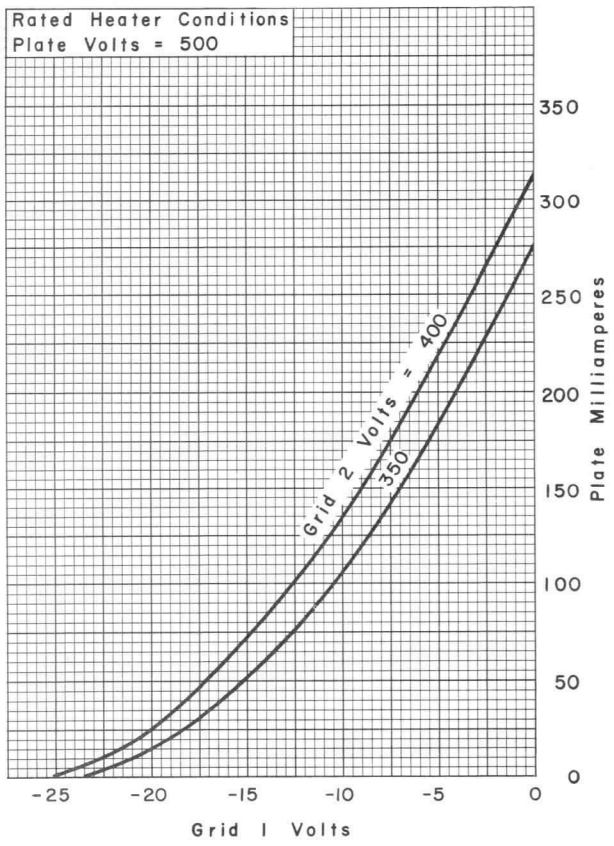
AVERAGE OPERATING CHARACTERISTICS

Class AB_1 Push-Pull Ultra-Linear Operation Self Bias



CE-A1550

AVERAGE TRANSFER CHARACTERISTICS



CE-A1551

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HIGH PERVEANCE TRIODE–SHARP CUTOFF PENTODE
TYPE 7734

The 7734 is a 9-pin miniature high perveance triode and sharp cutoff pentode type designed for service in electronically regulated power supplies. The triode unit is used as a series regulating tube which is controlled by the pentode unit acting as a d-c amplifier. Heater-cathode leakage and hum are controlled in pentode unit.

ELECTRICAL:		
Cathodes	Coated Unipotential	
Heater:		
Voltage	6.3	Volts
Current	0.90	Ampere
Direct Interelectrode Capacitances (Unshielded)		
Triode Unit:		
Grid to Plate	7.5	μμf
Input	5.5	μμf
Output	1.3	μμf
Pentode Unit:		
Grid 1 to Plate	0.2	μμf
Input	8.0	μμf
Output	2.4	μμf

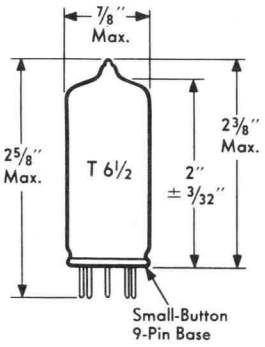
MECHANICAL:	
Bulb	T-6½
Base	9-Pin Miniature (JEDEC E9-1)
Outline	6-3
Basing	9LC
Mounting Position	Any

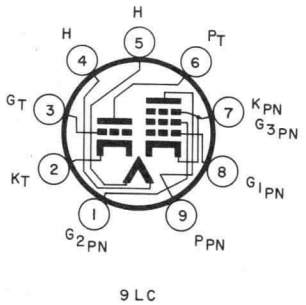
AVERAGE CHARACTERISTICS	Pentode	Triode	
Plate Voltage	150	150	Volts
Grid 2 Voltage	150	- -	Volts
Grid 1 Voltage	−2	−21	Volts
Plate Resistance	340000	1,080	Ohms
Transconductance	3200	5000	μmhos
Amplification Factor	- -	5.4	
Grid 1 Cutoff Voltage	−8⊕	−42♦	Volts
Plate Current	5.5	35	Ma.
Grid 2 Current	1.7	- -	Ma.

MAXIMUM RATINGS Design Maximum Values	Pentode Unit	Triode Unit		
Plate Voltage	330	275	max.	Volts
Grid 2 Supply Voltage	275	- -	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Curve			
Plate Dissipation	1.0	7.0	max.	Watts
Grid 2 Dissipation	0.5	- -	max.	Watts
Cathode Current:				
Average	- -	50	max.	Ma.
Peak	- -	175	max.	Ma.
Heater Cathode Voltage:				
Heater Negative with Respect to Cathode	300	300	max.	Volts
Heater Positive with Respect to Cathode	100	100	max.	Volts

LIMITING CIRCUIT VALUES			
Grid Circuit Resistance:			
Self Bias	2.2	2.2 max.	Megohms
Zero Bias Characteristic (Triode Unit)			
Plate Voltage		50	Volts
Grid Voltage		0	Volts
Plate Current		70	Ma.
Plate Resistance Characteristic (Pentode Unit)			
Plate Voltage		100	Volts
Grid 2 Voltage		50	Volts
Plate Current		100	μamperes
Plate Resistance		>7	Megohms

⊕ For plate current of 50 microamperes.
♦ For plate current of 500 microamperes.





Equivalent Noise and Hum (Pentode Section)

Referenced to the grid. Conditions as follows:

Plate and Screen Grid Supply Voltage	225	V.D.C.
Plate Load Resistor	250,000	ohms
Screen Grid Series Resistor	1,000,000	ohms
Cathode Resistor	5,100	ohms
Heater Voltage	6.3	V.A.C.

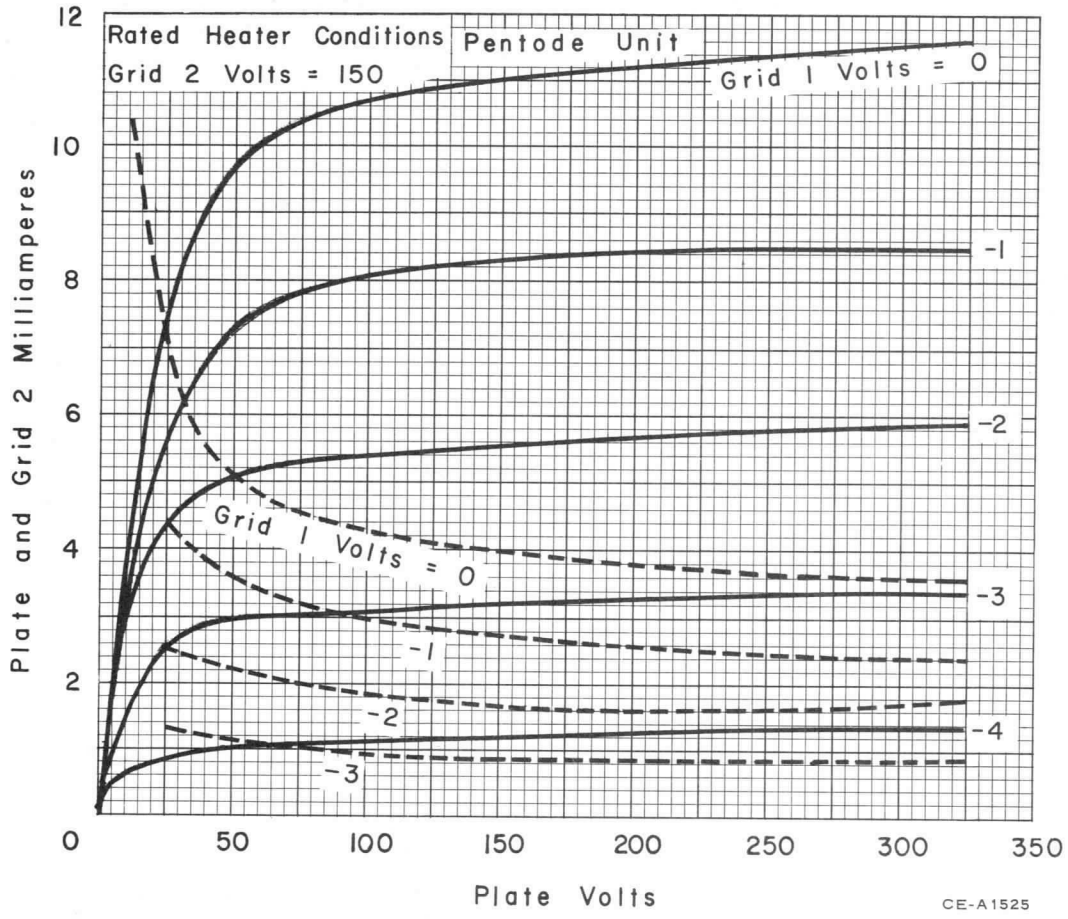
Heater Transformer Center Tap Tied to Ground.

Measured with an amplifier having bandwidth of 25 to 10,000 cps.

Average with grid resistor 1 megohm and 2000 μf cathode by-pass capacitor: 15 μ volts rms.

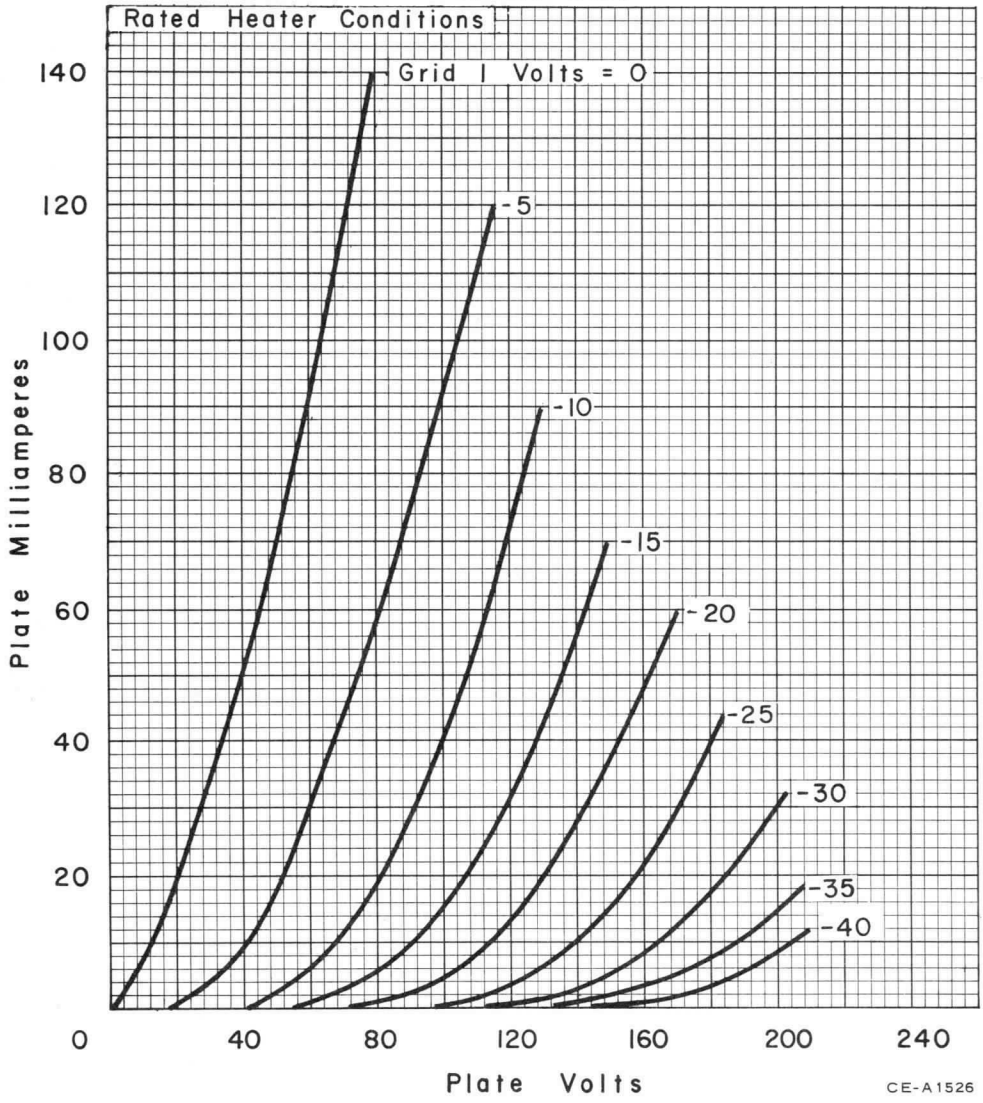
Average with grid resistor 1 megohm and cathode resistor unbypassed: 80 μ volts rms.

AVERAGE PLATE CHARACTERISTICS

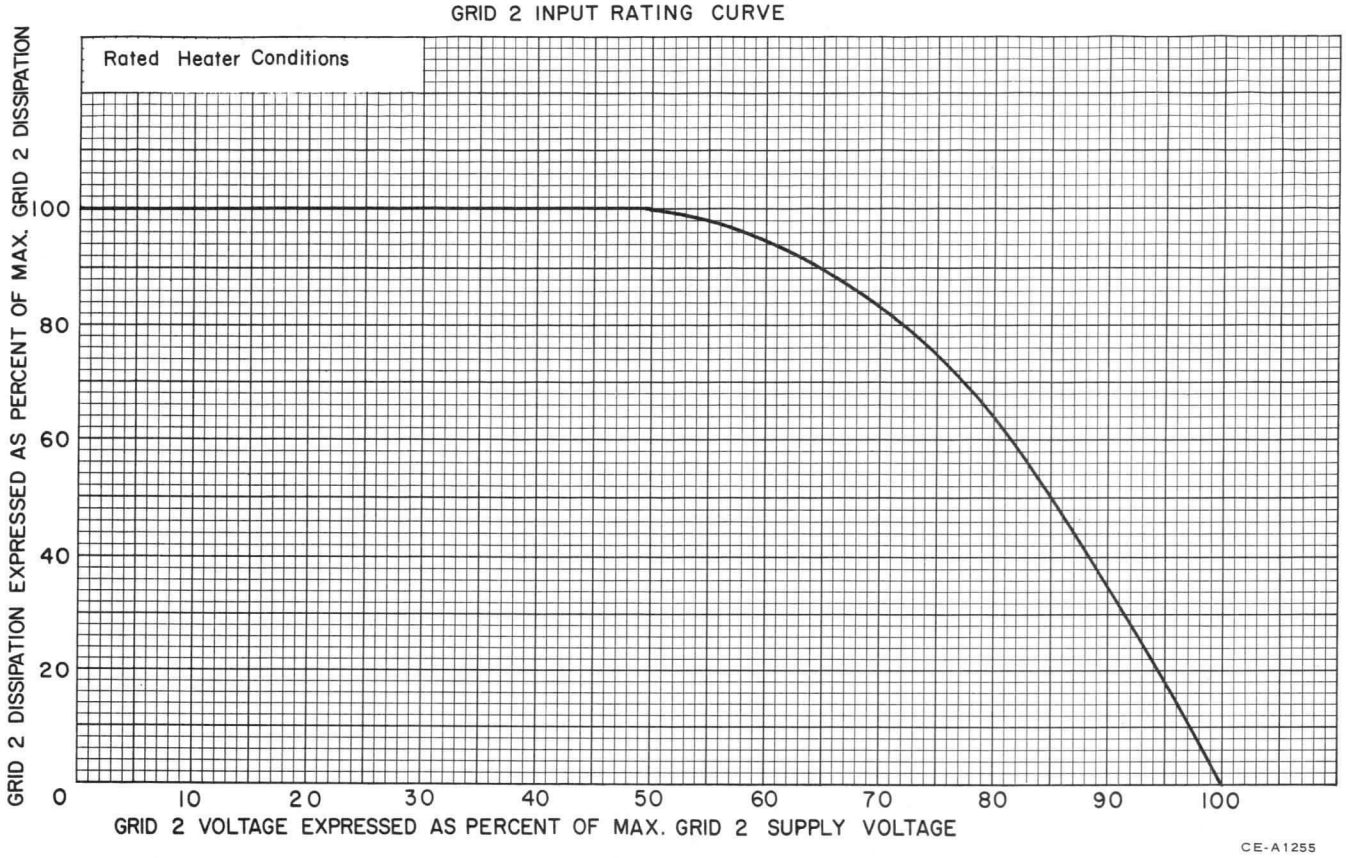


AVERAGE PLATE CHARACTERISTICS

Triode Unit



GRID 2 INPUT RATING CURVE



CE-A1255

VHF FREQUENCY-MULTIPLIER TYPE 8084

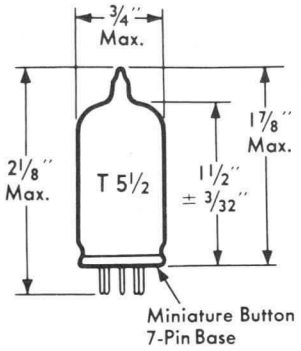
The 8084 is a 7-pin miniature, sharp-cutoff frame grid pentode designed particularly for service in mobile communication equipment as a VHF frequency multiplier. The 8084 is also suitable for VHF amplifier and oscillator circuits. The 8084 features a heater-cathode structure designed to render reliable operation when operated from a 6-cell storage battery primary power system.

ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage, ac or dc (Note 1)	13.5	Volts
Current	0.160	Amperes
Direct Interelectrode Capacitances (Shielded): (Note 2)		
Grid 1 to Plate	0.04 max.	μμf
Input	8.0	μμf
Output	3.0	μμf

MECHANICAL

Bulb	T-5-1/2
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7CM
Mounting Position	Any



AMPLIFIER - CLASS A_1

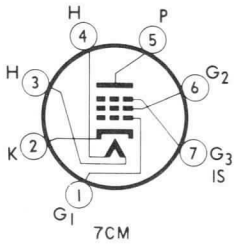
MAXIMUM RATINGS

Absolute Maximum Values

Plate Voltage	250	max.	Volts
Grid 3 Voltage	0	max.	Volts
Grid 2 (Screen) Supply Voltage	180	max.	Volts
Grid 2 Voltage	See Grid 2 Input Rating Chart		
Plate Dissipation	2.3	max.	Watts
Grid 2 Dissipation	0.5	max.	Watts
Grid 1 Control Grid Voltage:			
Positive Value	0	max.	Volts
Cathode Current	20	max.	Ma.
Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
Total DC and Peak	100	max.	Volts
Heater Positive with Respect to Cathode:			
DC Component	50	max.	Volts
Total DC and Peak	100	max.	Volts

TYPICAL OPERATING CHARACTERISTICS:

Plate Voltage	125	Volts
Grid 2 Voltage	80	Volts
Grid 1 Voltage	-1	Volts
Transconductance	10500	μmhos
Grid 1 Cutoff Bias (Note 3)	-3.5	Volts
Plate Current	7	Ma.
Grid 2 Current	1.7	Ma.



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WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

AMPLIFIER - CLASS C
OSCILLATOR - CLASS C
FREQUENCY MULTIPLIER - CLASS C

MAXIMUM RATINGS, CCS
Absolute Maximum Values

DC Plate Voltage	250	max.	Volts
DC Grid 3 Voltage	0	max.	Volts
DC Grid 2 Supply Voltage	180	max.	Volts
DC Grid 2 Voltage	See Grid 2 Input Rating Chart		
DC Grid 1 Voltage	−50	max.	Volts
DC Plate Current	15	max.	Ma.
DC Grid 2 Current	3	max.	Ma.
DC Grid 1 Current	1.5	max.	Ma.
Plate Dissipation	2.3	max.	Watts
Grid 2 Dissipation	0.5	max.	Watts
Grid 1 Circuit Resistance	0.1	max.	Megohms

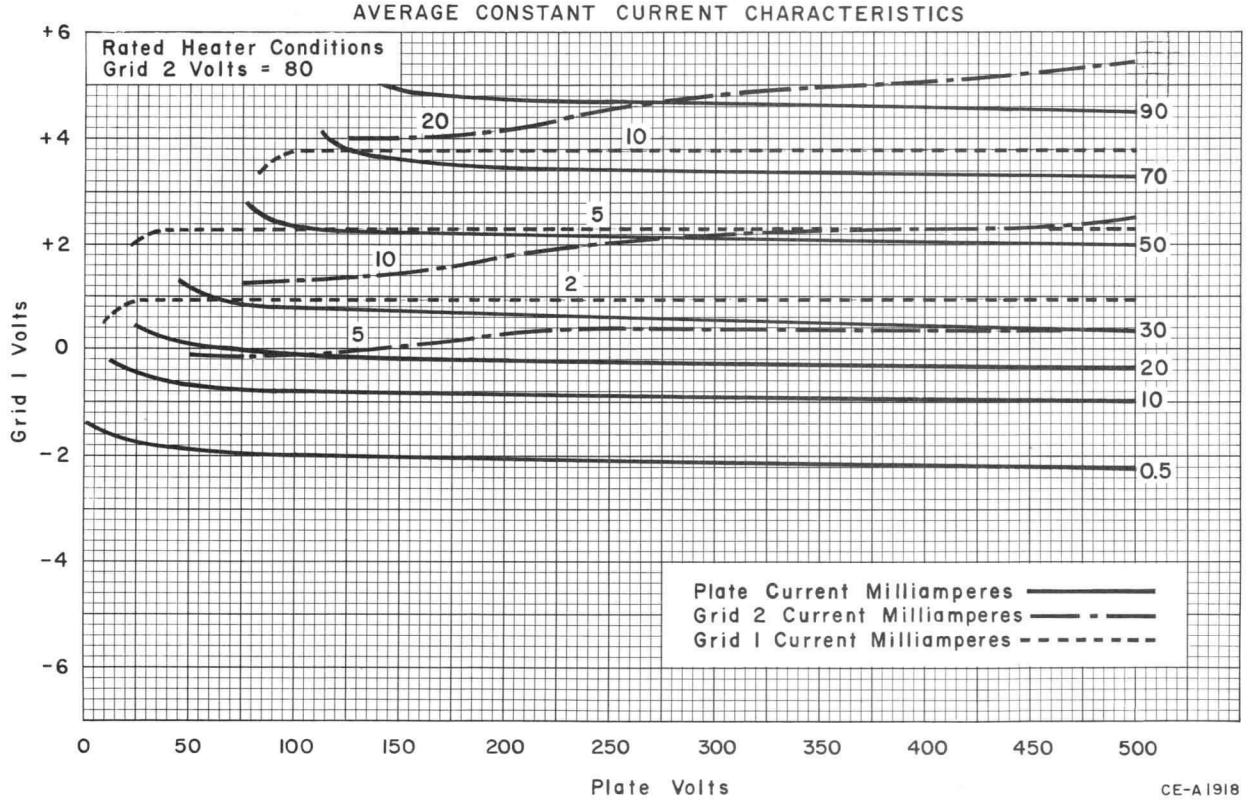
TYPICAL OPERATING CHARACTERISTICS
Tripler Service to 75 Mc. (Class C)

Plate Voltage	200	Volts
Grid 3 Voltage	0	Volts
Grid 2 Voltage	80	Volts
Grid 1 Voltage (Note 4)	−23	Volts
Peak RF Grid 1 Voltage	26	Volts
Plate Current	8.4	Ma.
Grid 2 Current	2.16	Ma.
Grid 1 Current (Approx.)	785	μAmperes
Driving Power	22	Milliwatts
Power Output (Approx.)	0.45	Watts

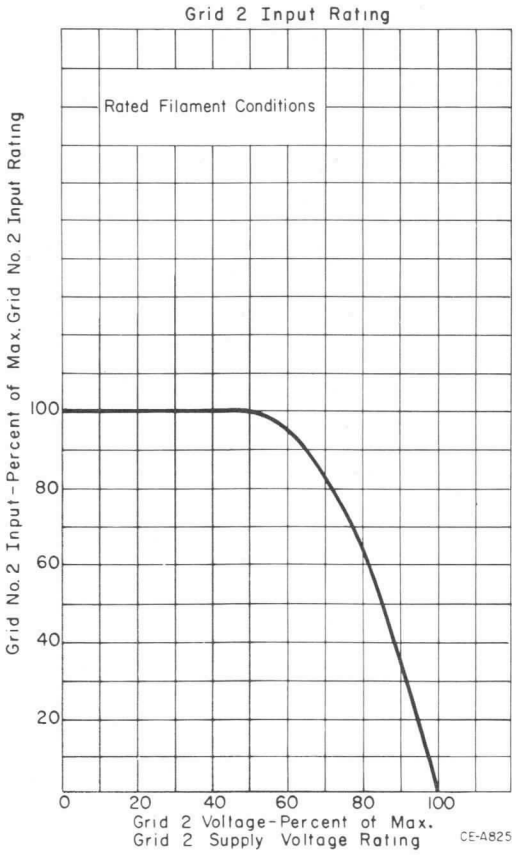
NOTES

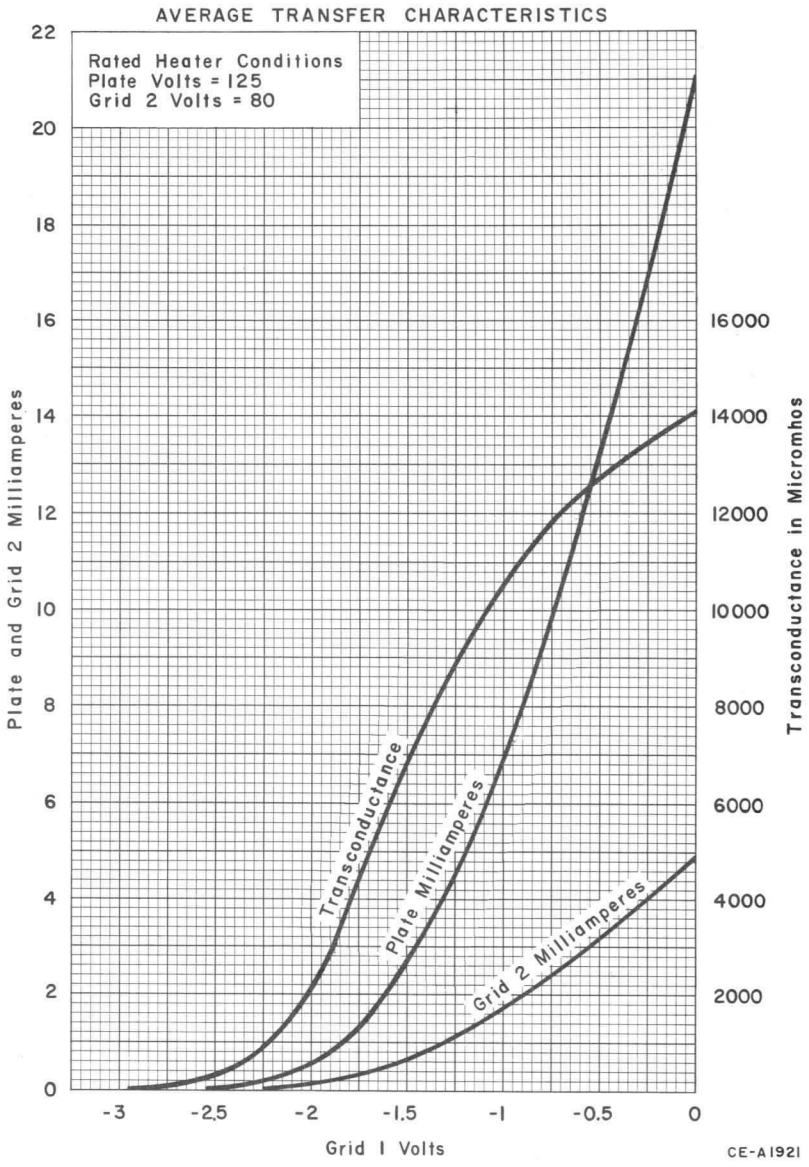
1. Heater voltage range is 11.8 to 15.5 volts.
2. With JEDEC Shield No. 316 connected to pin 2.
3. For transconductance of 100 micromhos.
4. Developed across a grid resistor of 30,000 ohms.

AVERAGE CONSTANT CURRENT CHARACTERISTICS

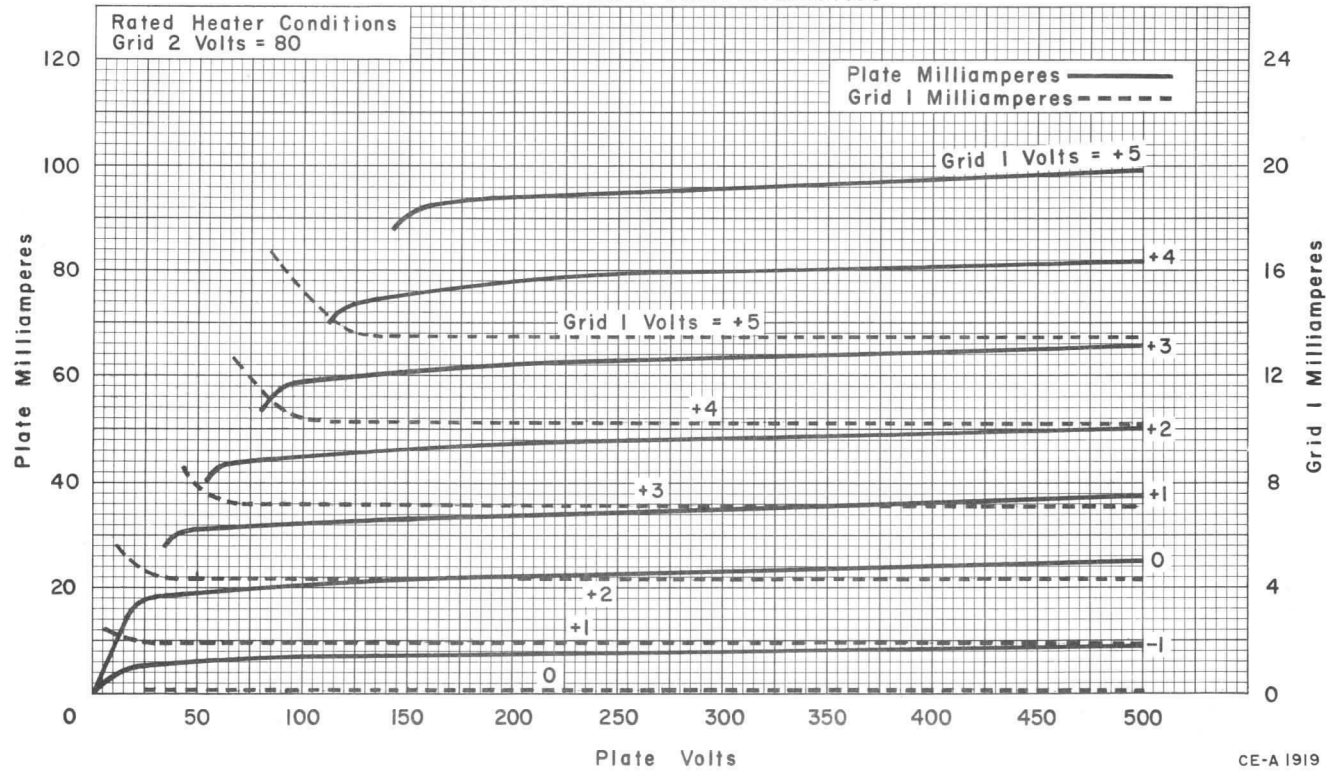


CE-A1918


Grid 2 Input Rating
Rated Filament Conditions
Grid No. 2 Input-Percent of Max. Grid No. 2 Input Rating
100
80
60
40
20
0
20
40
60
80
100
Grid 2 Voltage-Percent of Max. Grid 2 Supply Voltage Rating
CE-A825

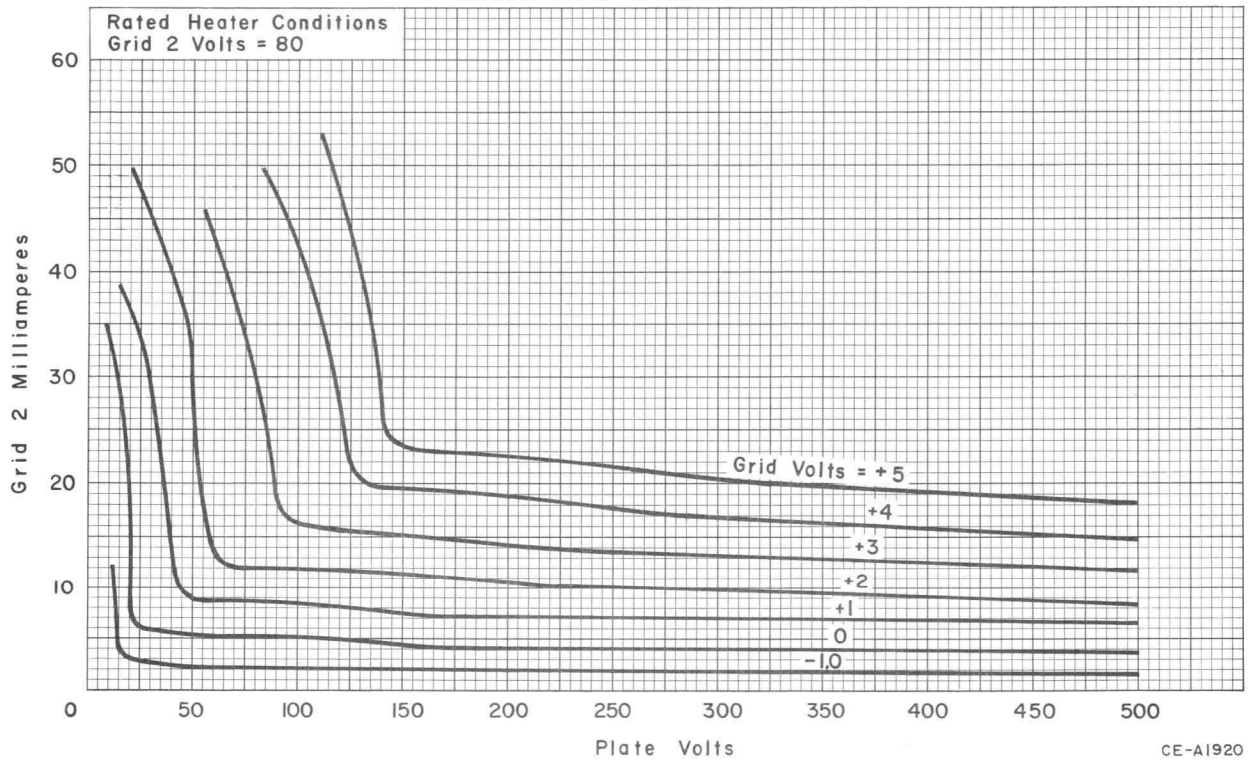

AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 125
Grid 2 Volts = 80
Plate and Grid 2 Milliamperes
22
20
18
16
14
12
10
8
6
4
2
0
Transconductance in Micromhos
16000
14000
12000
10000
8000
6000
4000
2000
Transconductance
Plate Milliamperes
Grid 2 Milliamperes
-3
-2.5
-2
-1.5
-1
-0.5
0
Grid 1 Volts
CE-A1921

AVERAGE PLATE CHARACTERISTICS



CE-A 1919

AVERAGE GRID 2 CHARACTERISTICS



CE-A1920

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Westinghouse

8417

December 1, 1963

BEAM-POWER PENTODE TYPE 8417

The 8417 is a glass octal, beam-power pentode designed for service as an output amplifier in high-fidelity, high-power sound systems. It has a 35 watt plate dissipation allowing design of push-pull amplifiers of 100 watts output. The 8417 features high power sensitivity and requires low drive for full power output. The 8417 is also suitable for use as a series tube in electronically regulated power supplies.

ELECTRICAL

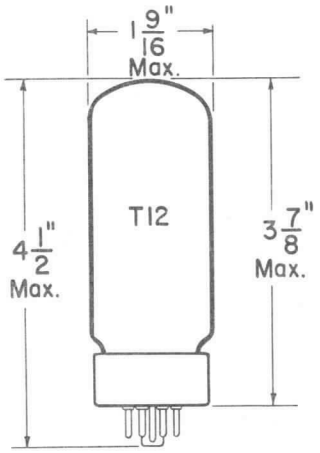
Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	1.6	Amperes
Direct Interelectrode Capacitances:		
Grid 1 - to - Plate	0.90	pf
Input	22	pf
Output	9.0	pf

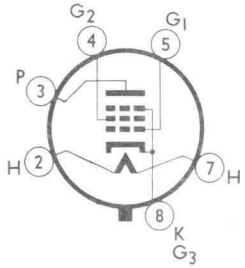
MECHANICAL

Bulb	T-12
Base	Plaskon, Short Shell Octal, 6-Pin
Basing	7S
Mounting Position	Any

CHARACTERISTICS

Plate Voltage	300	Volts
Screen Voltage	300	Volts
Grid No. 1 Voltage	−12	Volts
Plate Current	100	Ma.
Screen Current	5.5	Ma.
Transconductance	23000	Micromhos
Plate Resistance	16000	Ohms
Triode Amplification Factor	16.5	—
Grid 1 Cutoff Voltage (Note 1)	−37	Volts





RATINGS

Design-Maximum Values:			
Plate Voltage	660 max.		Volts
Screen Voltage	500 max.		Volts
Plate Dissipation (Note 2)	35 max.		Watts
Screen Dissipation (Note 3)	5 max.		Watts
Cathode Current	200 max.		Ma.
Grid No. 1 Circuit Resistance:			
With Fixed Bias	0.1 max.		Megohm
With Cathode Bias	0.25 max.		Megohm
Heater-Cathode Voltage:			
Heater Negative with respect to Cathode			
Total DC + Peak	200 max.		Volts
Heater Positive with respect to Cathode			
DC Component	100 max.		Volts
Total DC + Peak	200 max.		Volts

Push-Pull Class AB1 - Ultra-Linear (Note 4) Operation (Values for Two Tubes)			
Plate Supply Voltage	455		Volts
Grid 1 Voltage	−25		Volts
Peak A.F. Grid-to-Grid Voltage	45		Volts
Zero Signal Plate Current	146		Ma.
Maximum Signal Plate Current	314		Ma.
Effective Load, Plate-to-Plate	3500		Ohms
Total Harmonic Distortion	2.5		Percent
Maximum Signal Power Output	70		Watts

Push-Pull Class AB1- Pentode Connection (Values for Two Tubes)			
Plate Supply Voltage	400	560	Volts
Screen Supply Voltage	275	300	Volts
Grid 1 Voltage	−13	−15	Volts
Peak AF Grid-to-Grid Voltage	24	29	Volts
Zero Signal Plate Current	150	124	Ma.
Max. Signal Plate Current	294	290	Ma.
Zero Signal Screen Current	4.4	3.6	Ma.
Max. Signal Screen Current	34	36	Ma.
Effective Load, Plate-to-Plate	2800	4200	Ohms
Total Harmonic Distortion	2.5	2.5	Percent
Maximum Signal Power Output	65	100	Watts

NOTES

1. For plate current of 1 milliampere.
2. The bulb becomes hot during operation. To ensure adequate cooling, it is essential that free circulation of air be provided around the bulb.
3. Screen dissipation may be permitted to reach 8 watts during the periods of maximum input of speech and music signals.
4. Screen tapped at 40% of primary turns. Stated plate current includes screen current.

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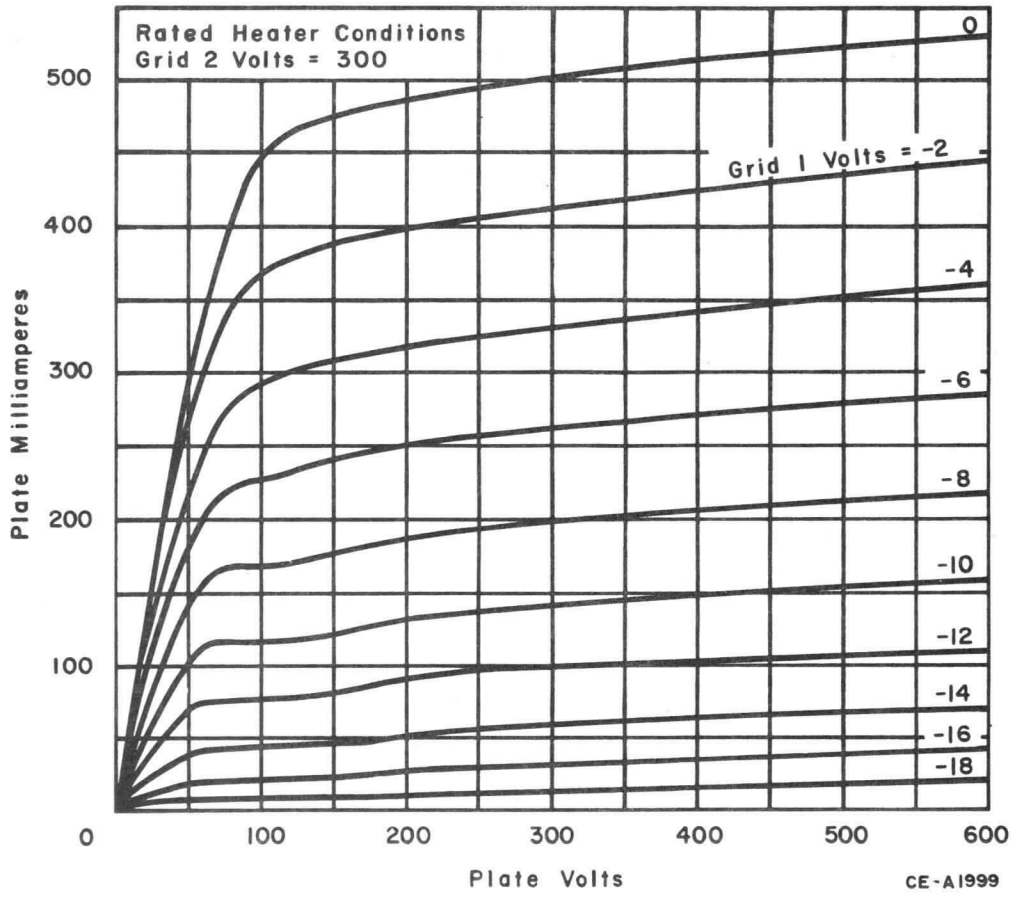
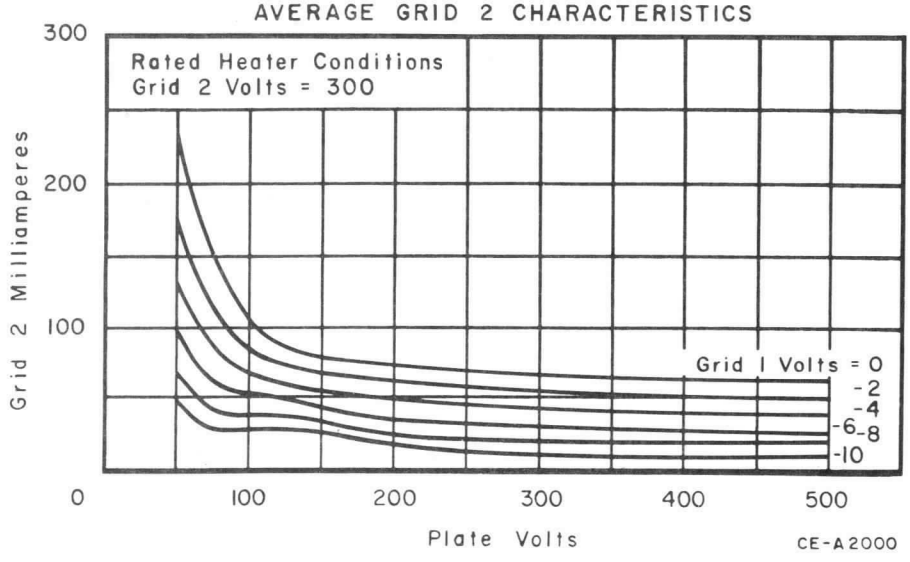
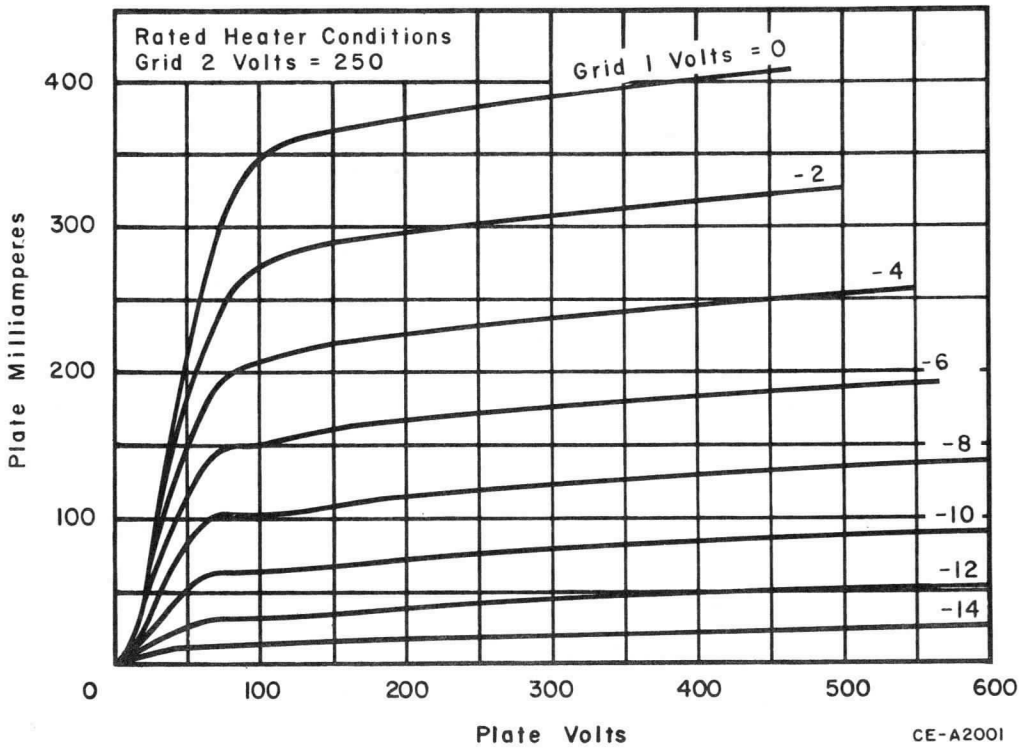
AVERAGE PLATE CHARACTERISTICS



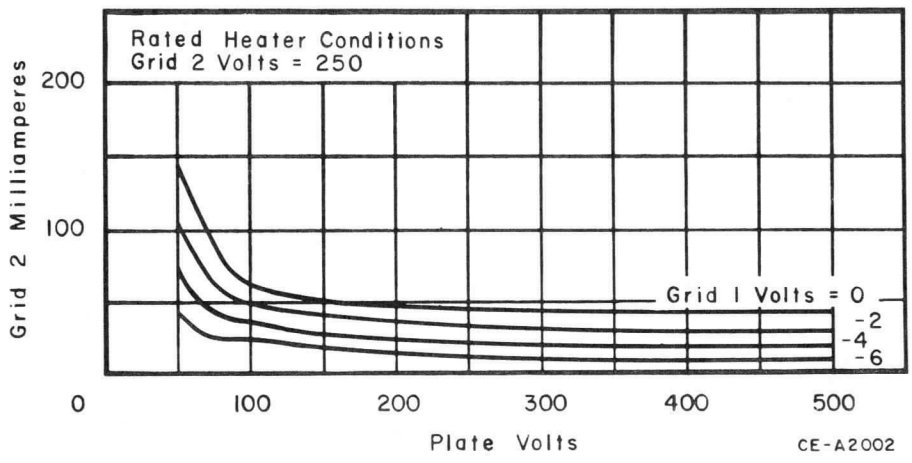
AVERAGE GRID 2 CHARACTERISTICS



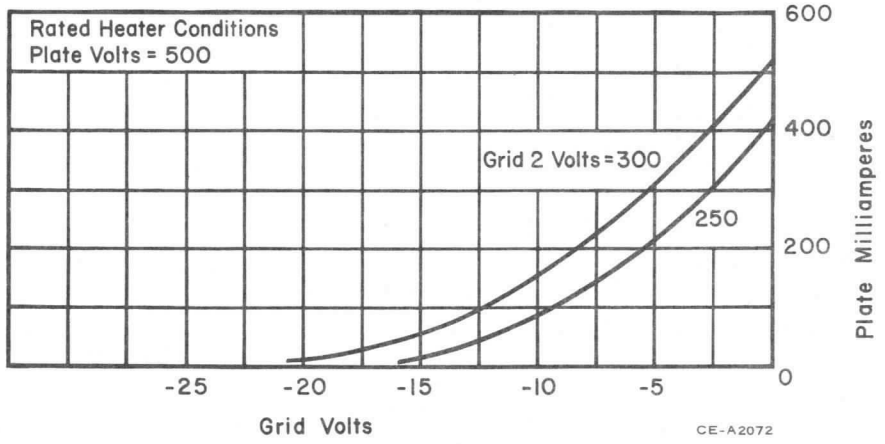
AVERAGE PLATE CHARACTERISTICS



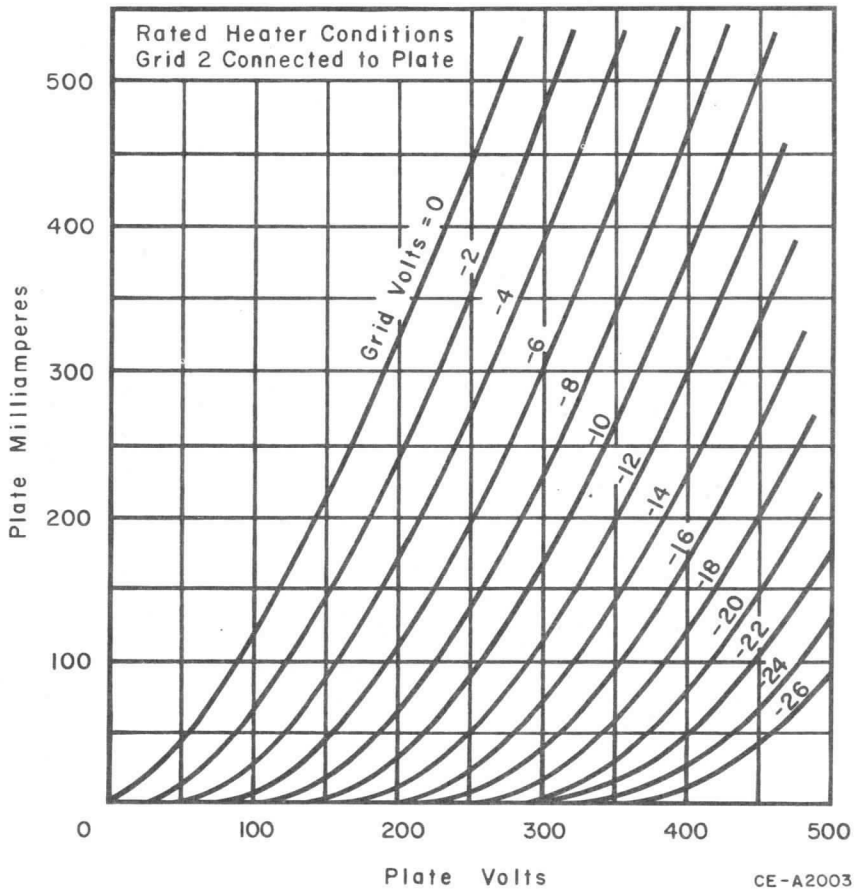
AVERAGE GRID 2 CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION



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SHARP-CUTOFF PENTODE TYPE 8425

The 8425 is a 7-pin miniature, sharp-cutoff pentode type designed for service in wide band IF and RF amplifiers. It is operationally similar to type 6AU6 but has a higher transconductance-to-plate-current ratio.

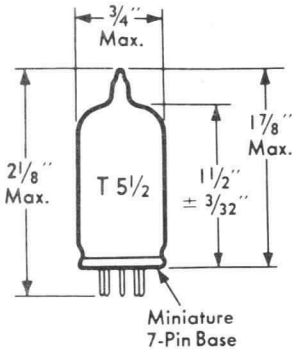
The 8425 features cathode materials and cathode coatings controlled for interface-free long life in industrial applications.

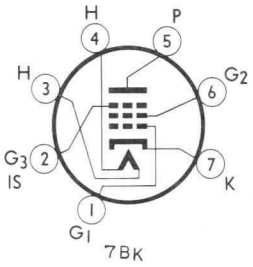
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3 ± 10%	Volts
Current	0.30	Ampere
Direct Interelectrode Capacitances:		
Pentode Connection:	Unshielded	
Grid to Plate (Max.)	0.0030	pf
Input	5.9	pf
Output	5.1	pf
Triode Connection (Note 1):		
Grid to Plate	2.5	pf
Input	3.6	pf
Output	1.1	pf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7BK
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Connection	Pentode Connection		
Plate Voltage	275	330	max.	Volts
Grid 2 Supply Voltage	(Note 1)	330	max.	Volts
Grid 2 Voltage	(Note 1)	See Grid 2 Input Rating Chart		
Plate Dissipation	3.5	3.5	max.	Watts
Grid 2 Dissipation	–	0.75	max.	Watts
Grid 1 Voltage, Positive Bias Value	0	0	max.	Volts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak		200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component		100	max.	Volts
DC + Peak		200	max.	Volts
Cathode Interface Impedance after 1000 Hour Life Test (Note 2)		5	max.	Ohms

AMPLIFIER - CLASS A

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	100	250	250	Volts
Grid 2 Voltage	100	125	150	Volts
Grid 3 Voltage	Connected to Cathode			
Cathode Resistor	150	100	68	Ohms
Transconductance	4500	5500	6200	μmhos
Plate Resistance	0.6	1.3	1.1	Megohm
Grid 1 Cutoff Bias (Note 3)	–4.1	–4.9	–5.8	Volts
Plate Current	4.8	7.4	10.5	Ma.
Grid 2 Current	1.9	2.8	4.1	Ma.

CHARACTERISTICS (Triode Connected)

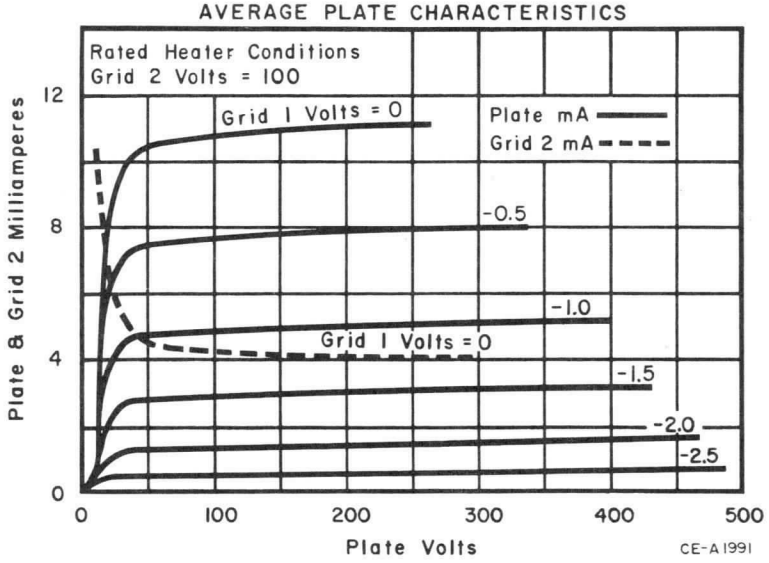
Plate Voltage	250	Volts
Cathode Resistor	330	Ohms
Amplification Factor	41	–
Transconductance	6000	μmhos
Plate Current	11.2	Ma.

NOTES

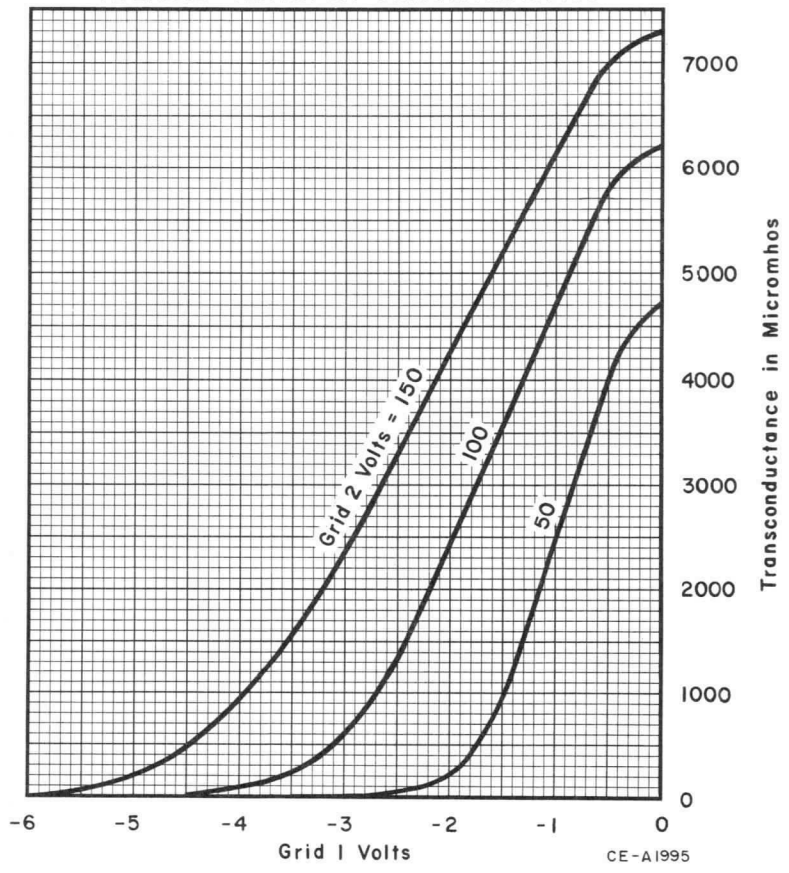
1. Grids 2 and 3 connected to plate.
2. Life Test Conditions:
   - Filament Volts = 6.5
   - Plate Volts = 250
   - Grid 2 Volts = 250
   - Grid 1 Resistor = 250K
   - Grid 1 Volts = –4.0
   - Grid 3 Volts = 0
   - Cathode ohms = 0
   - Heater to Cathode Volts = –200

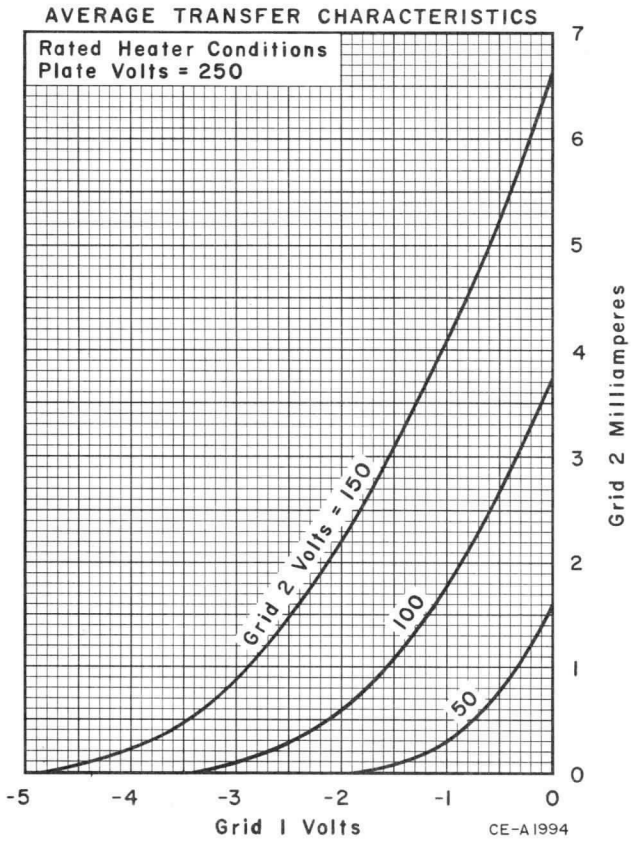
   Cathode-Interface Impedance Test:
   As detailed in ASTM-F300-61T; appendix III with Filament Volts = 5.7.
3. For plate current of 10 μa.

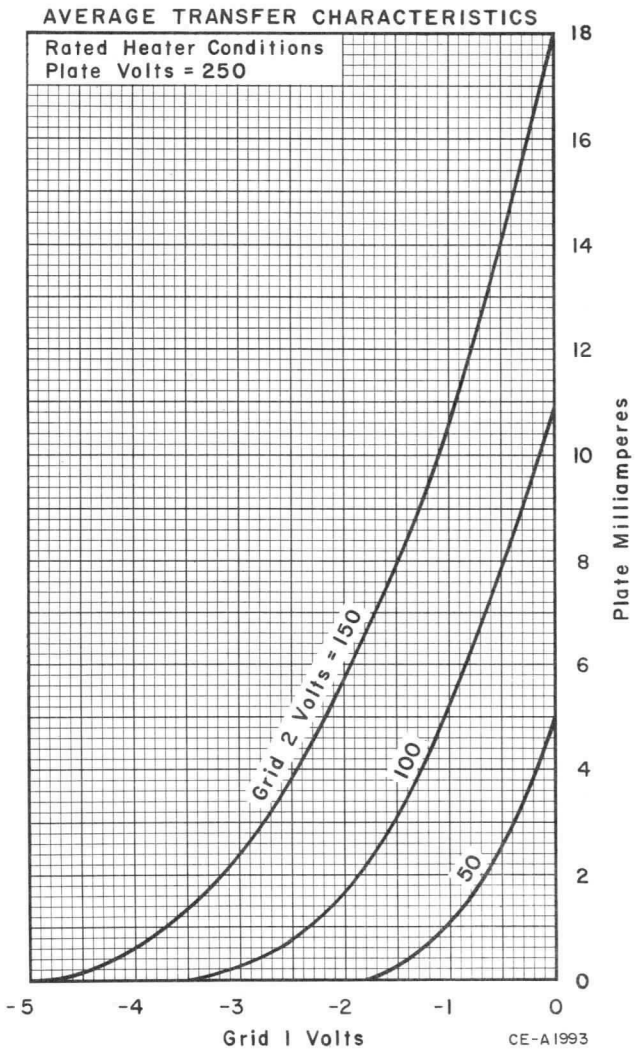
AVERAGE PLATE CHARACTERISTICS



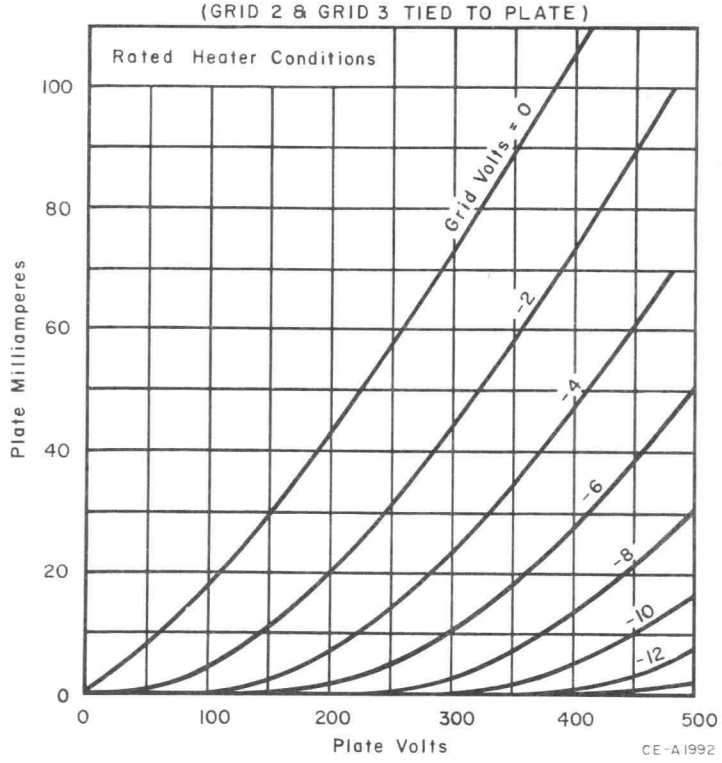
AVERAGE TRANSFER CHARACTERISTICS




AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 250
Grid 2 Volts = 150
100
50
-5
-4
-3
-2
-1
0
Grid 1 Volts
0
1
2
3
4
5
6
7
Grid 2 Milliamperes
CE-A1994


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 250
Grid 2 Volts = 150
100
50
-5
-4
-3
-2
-1
0
Grid 1 Volts
0
2
4
6
8
10
12
14
16
18
Plate Milliamperes
CE-A1993

AVERAGE PLATE CHARACTERISTICS
(GRID 2 & GRID 3 TIED TO PLATE)



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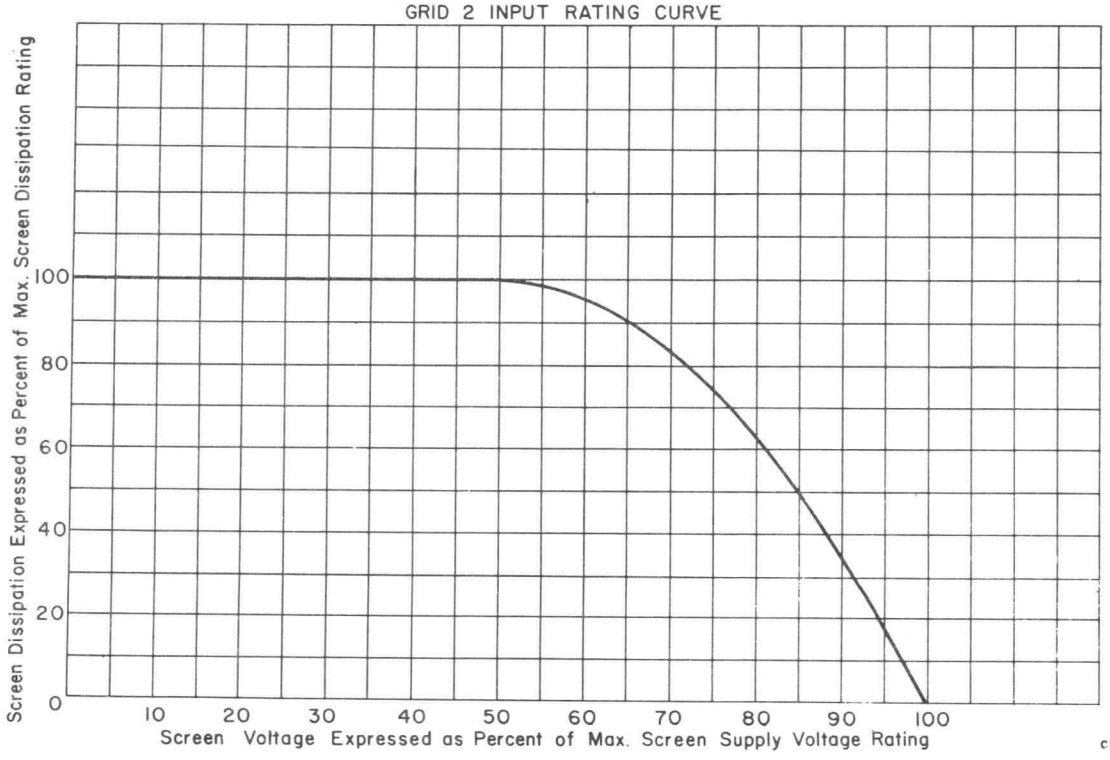
GRID 2 INPUT RATING CURVE



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Westinghouse

8426

July 1, 1963

SHARP-CUTOFF PENTODE TYPE 8426

The 8426 is a 7-pin miniature, sharp-cutoff pentode type designed for service in wide band IF and RF amplifiers. It is operationally similar to type 6AU6 but has a higher transconductance-to-plate-current ratio.

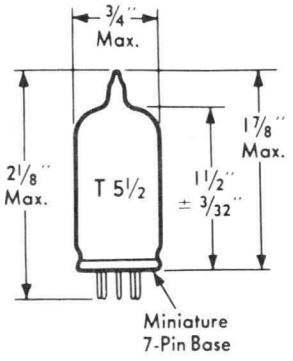
The 8426 features cathode materials and cathode coatings controlled for interface-free long life in industrial applications.

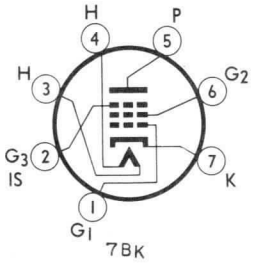
ELECTRICAL

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	12.6 ± 10%	Volts
Current	0.15	Ampere
Direct Interelectrode Capacitances:		
Pentode Connection:	Unshielded	
Grid to Plate (Max.)	0.0030	pf
Input	5.9	pf
Output	5.1	pf
Triode Connection (Note 1):		
Grid to Plate	2.5	pf
Input	3.6	pf
Output	1.1	pf

MECHANICAL

Bulb	T-5½
Base	Miniature 7-Pin (JEDEC E7-1)
Outline	5-2
Basing	7BK
Mounting Position	Any





MAXIMUM RATINGS

Design Maximum Values

	Triode Connection	Pentode Connection		
Plate Voltage	275	330	max.	Volts
Grid 2 Supply Voltage	(Note 1)	330	max.	Volts
Grid 2 Voltage	(Note 1)	See Grid 2 Input Rating Chart		
Plate Dissipation	3.5	3.5	max.	Watts
Grid 2 Dissipation	–	0.75	max.	Watts
Grid 1 Voltage, Positive Bias Value	0	0	max.	Volts
Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode				
Total DC + Peak		200	max.	Volts
Heater Positive with Respect to Cathode				
DC Component		100	max.	Volts
DC + Peak		200	max.	Volts
Cathode Interface Impedance after 1000 Hour Life Test (Note 2)		5	max.	Ohms

AMPLIFIER - CLASS A

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	100	250	250	Volts
Grid 2 Voltage	100	125	150	Volts
Grid 3 Voltage	Connected to Cathode			
Cathode Resistor	150	100	68	Ohms
Transconductance	4500	5500	6200	μmhos
Plate Resistance	0.6	1.3	1.1	Megohm
Grid 1 Cutoff Bias (Note 3)	-4.1	-4.9	-5.8	Volts
Plate Current	4.8	7.4	10.5	Ma.
Grid 2 Current	1.9	2.8	4.1	Ma.

CHARACTERISTICS (Triode Connected)

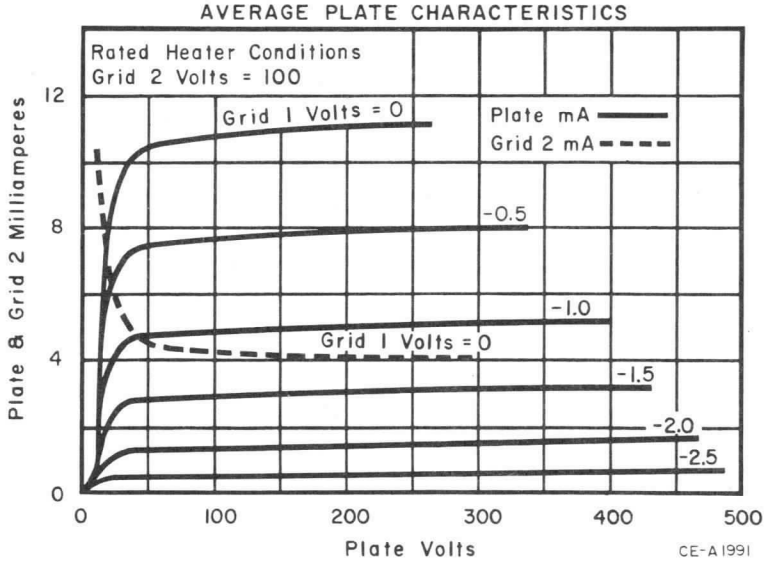
Plate Voltage	250	Volts
Cathode Resistor	330	Ohms
Amplification Factor	41	–
Transconductance	6000	μmhos
Plate Current	11.2	Ma.

NOTES

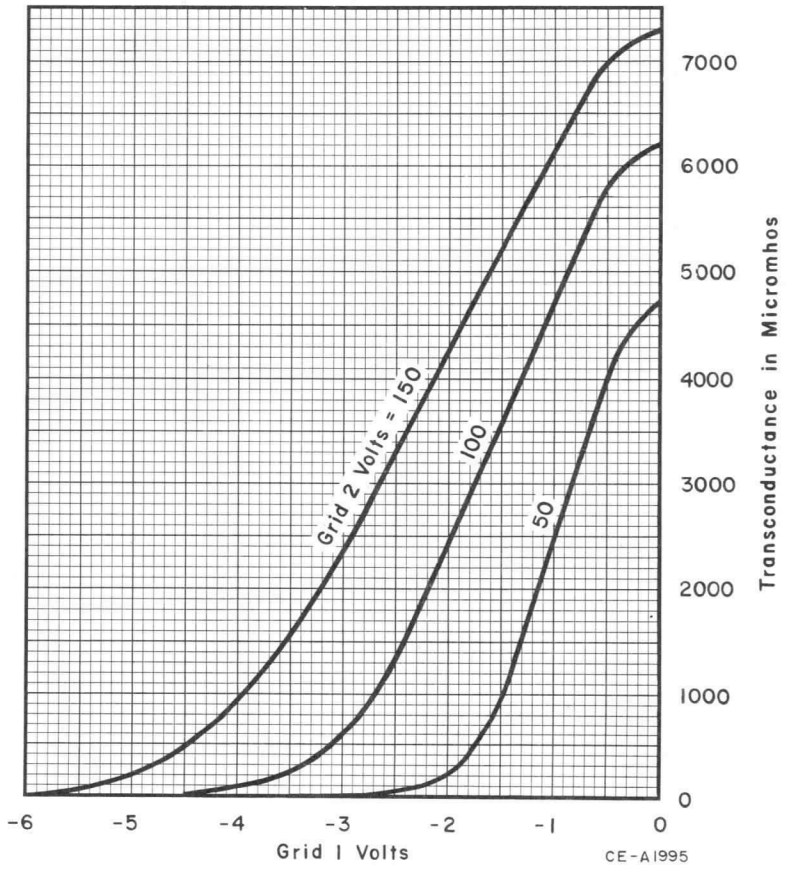
1. Grids 2 and 3 connected to plate.
2. Life Test Conditions:
   - Filament Volts = 13.0
   - Plate Volts = 250
   - Grid 2 Volts = 250
   - Grid 1 Resistor = 250K
   - Grid 1 Volts = -4.0
   - Grid 3 Volts = 0
   - Cathode ohms = 0
   - Heater-to Cathode Volts = -200

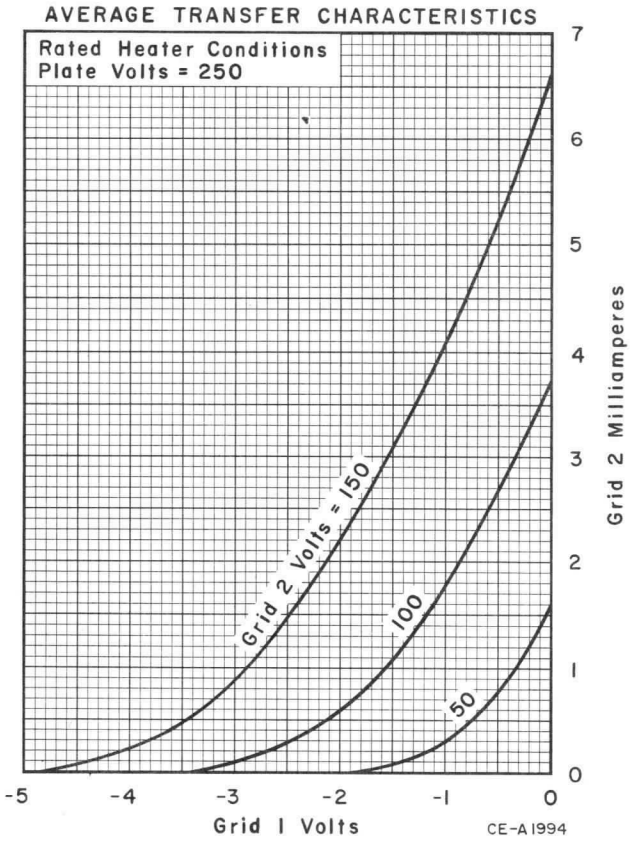
   Cathode-Interface Impedance Test:
   As detailed in ASTM-F300-61T; appendix III with Filament Volts = 11.4
3. For plate current of 10 μa.

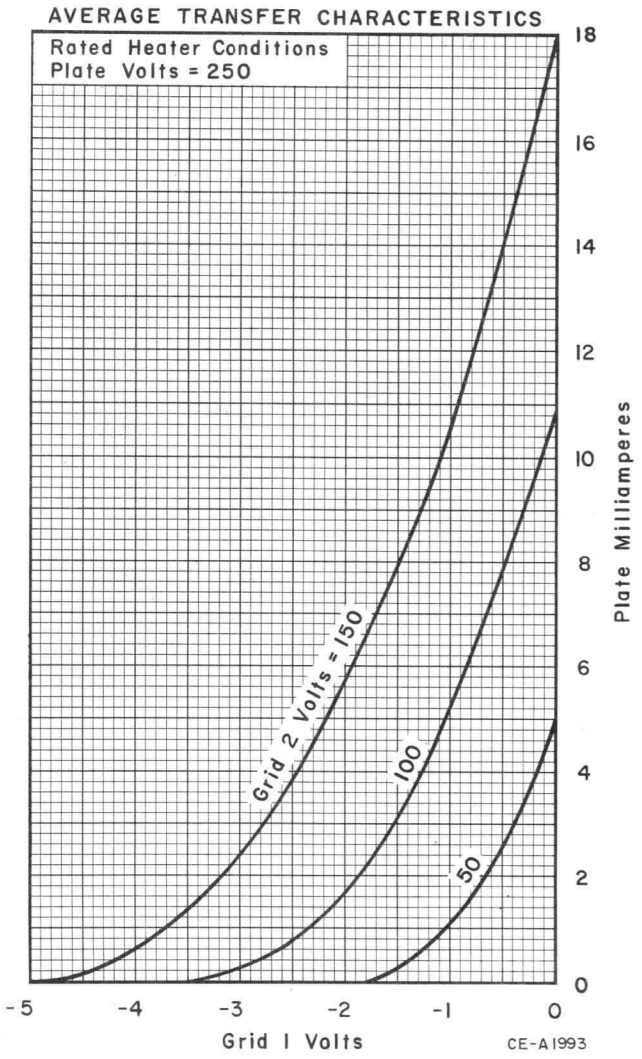
AVERAGE PLATE CHARACTERISTICS



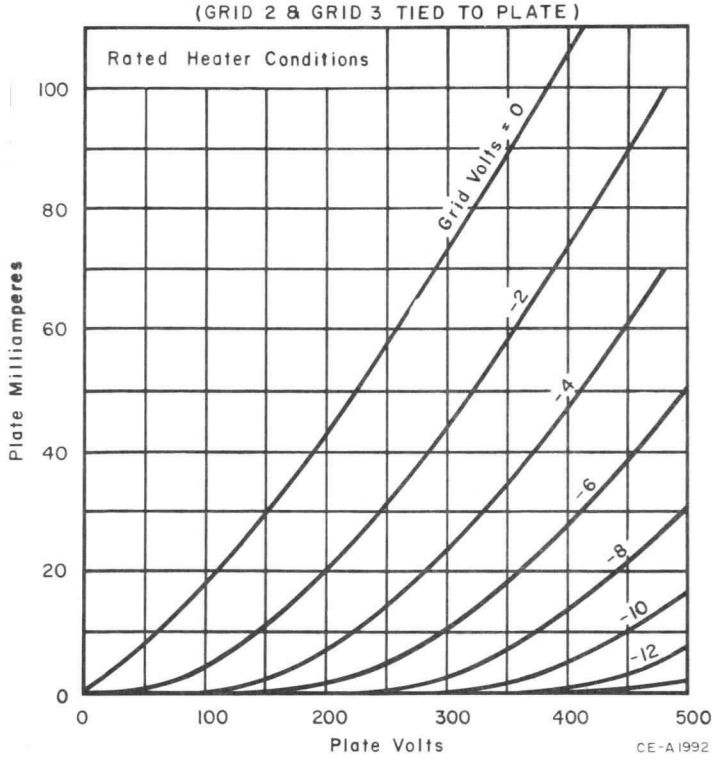
AVERAGE TRANSFER CHARACTERISTICS




AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 250
Grid 2 Volts = 150
100
50
-5
-4
-3
-2
-1
0
Grid 1 Volts
0
1
2
3
4
5
6
7
Grid 2 Milliamperes
CE-A1994


AVERAGE TRANSFER CHARACTERISTICS
Rated Heater Conditions
Plate Volts = 250
Grid 2 Volts = 150
100
50
-5
-4
-3
-2
-1
0
Grid 1 Volts
0
2
4
6
8
10
12
14
16
18
Plate Milliamperes
CE-A1993

AVERAGE PLATE CHARACTERISTICS
(GRID 2 & GRID 3 TIED TO PLATE)



GRID 2 INPUT RATING CURVE

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12BKP4

May 15, 1965

QUICK REFERENCE DATA

110° MAGNETIC DEFLECTION
10.125" × 7.625" SCREEN SIZE
4.375" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

BANDED
IMPLOSION PROTECTION

6.3 VOLT, 450 MA HEATER
LOW G2 VOLTAGE (50 VOLTS)
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

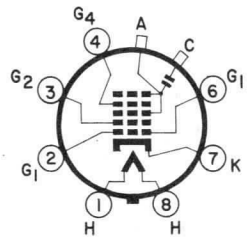
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	110	Degrees
Horizontal	99	Degrees
Vertical	80	Degrees
Direct Interelectrode Capacitances:		
Cathode to All other Electrodes (Approx.)	5	pF
Grid No. 1 to All other Electrodes (Approx.)	6	pF
External Conductive Coating to Anode:		
Minimum	500	pF
Maximum	800	pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5	Megohms
Heater Current at 6.3 Volts	450 ± 5%	mA
Heater Warm-up Time (Note 1)	.11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	48%

MECHANICAL

Over-all Length	9.348" ± 0.250"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	12.425" ± 0.100"
Width	10.987" ± 0.100"
Height	8.589" ± 0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	11.625"
Horizontal Axis	10.125"
Vertical Axis	7.625"
Area	74 Sq. Inches
Implosion Protection	Banded
Bulb Contact	J1-21
Base	B7-208
Basing	8HR
Net Weight	6 Pounds
Bulb	J99C1



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage	15000	Volts
Minimum Anode Voltage	9000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	70	Volts
Minimum Grid 2 Voltage	20	Volts
Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 2)	.10000	Ohms

TYPICAL CATHODE DRIVE OPERATION

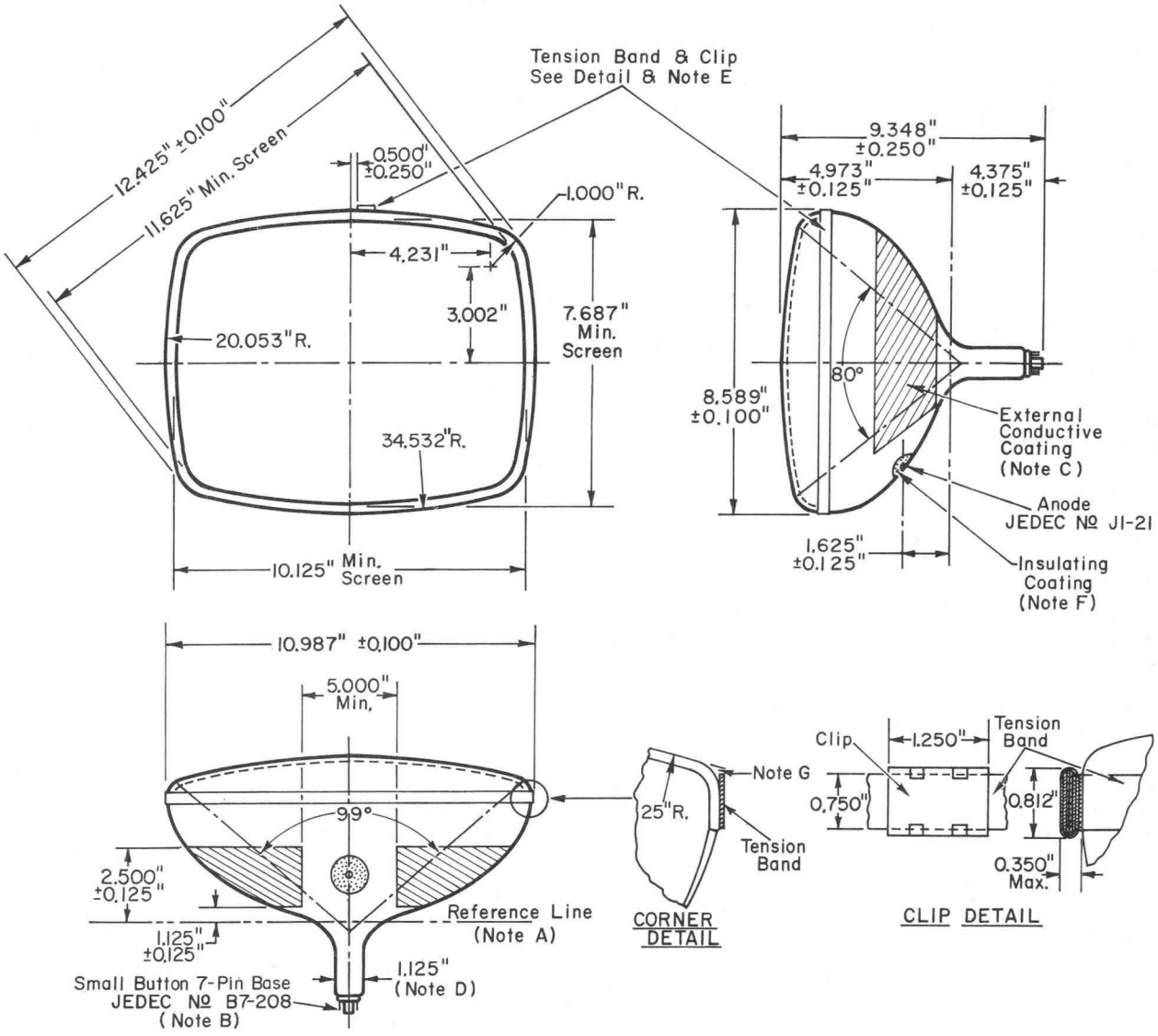
Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	12000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 3)	0 to 400	Volts
Grid 2 Voltage	50	Volts
Cathode Voltage for Raster Cutoff	35 to 55	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
3. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 10.125" by 7.625" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 2 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Transparent, insulating coating, 4" in diameter. Clean only with soft, dry, lintless cloth.

G. The tension band will extend towards the faceplate a maximum distance that will not exceed the intersection of the leading edge of the band and the extension of the faceplate radius.

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Westinghouse®

12BLP4

September 15, 1965

QUICK REFERENCE DATA

110° MAGNETIC DEFLECTION
10.125" × 7.625" SCREEN SIZE
4.375" NECK LENGTH

BANDED
IMPLOSION PROTECTION
LOW G2 VOLTAGE (30 VOLTS)

6.3 VOLT, 450 MA HEATER
SPHERICAL GRAY FILTER GLASS
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

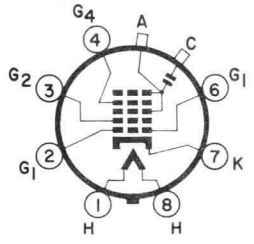
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	110	Degrees
Horizontal	99	Degrees
Vertical	80	Degrees
Direct Interelectrode Capacitances:		
Cathode to All other Electrodes (Approx.)	5	pF
Grid No. 1 to All other Electrodes (Approx.)	6	pF
External Conductive Coating to Anode:		
Minimum	800	pF
Maximum	1000	pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5	Megohms
Heater Current at 6.3 Volts	450 ± 5%	mA
Heater Warm-up Time (Note 1)	.11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	48%

MECHANICAL

Over-all Length	9.348" ± 0.250"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	12.425" ± 0.100"
Width	10.987" ± 0.100"
Height	8.589" ± 0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	11.625"
Horizontal Axis	10.125"
Vertical Axis	7.625"
Area	74 Sq. Inches
Implosion Protection	Banded
Bulb Contact	J1-21
Base	B7-208
Basing	8HR
Net Weight	6 Pounds
Bulb	J99C1



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage	16000	Volts
Minimum Anode Voltage	9000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	60	Volts
Minimum Grid 2 Voltage	20	Volts
Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 2)	.10000	Ohms

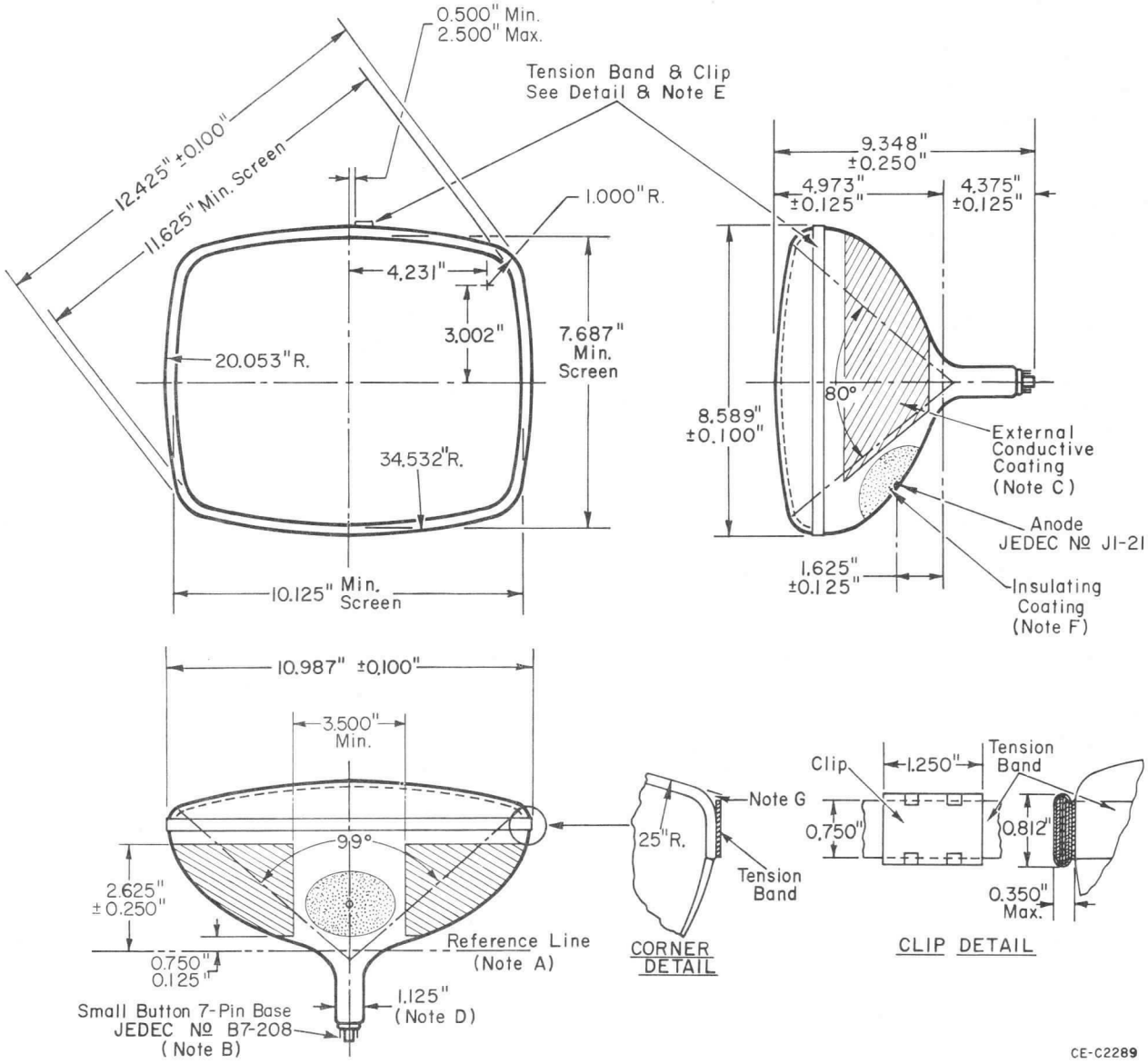
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	12000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 3)	0 to 400	Volts
Grid 2 Voltage	30	Volts
Cathode Voltage for Raster Cutoff	30 to 45	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
3. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 10.125" by 7.625" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 2 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Transparent, insulating coating, 3" in diameter. Clean only with soft, dry, lintless cloth.

G. The tension band will extend towards the faceplate a maximum distance that will not exceed the intersection of the leading edge of the band and the extension of the faceplate radius.

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Westinghouse

12BNP4

June 15, 1965

QUICK REFERENCE DATA

110° MAGNETIC DEFLECTION
10.125" × 7.625" SCREEN SIZE
4.375" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

BANDED
IMPLOSION PROTECTION

6.3 VOLT, 450 MA HEATER
G2 VOLTAGE (250 VOLTS)
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

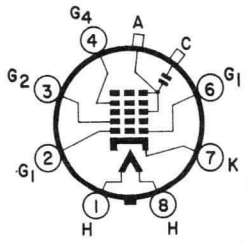
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	110	Degrees
Horizontal	99	Degrees
Vertical	80	Degrees
Direct Interelectrode Capacitances:		
Cathode to All other Electrodes (Approx.)	5	pF
Grid No. 1 to All other Electrodes (Approx.)	6	pF
External Conductive Coating to Anode:		
Minimum	500	pF
Maximum	750	pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5	Megohms
Heater Current at 6.3 Volts	450 ±5%	mA
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	48%

MECHANICAL

Over-all Length	9.348" ± 0.250"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	12.425" ± 0.100"
Width	10.987" ± 0.100"
Height	8.589" ± 0.100"
Minimum Useful Screen Dimensions (projected):	
Diagonal	11.625"
Horizontal Axis	10.125"
Vertical Axis	7.625"
Area	74 Sq. Inches
Implosion Protection	Banded
Bulb Contact	J1-21
Base	B7-208
Basing	8HR
Net Weight	6 Pounds



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage	16000	Volts
Minimum Anode Voltage	9000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	400	Volts
Minimum Grid 2 Voltage	200	Volts
Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 2)	10000	Ohms

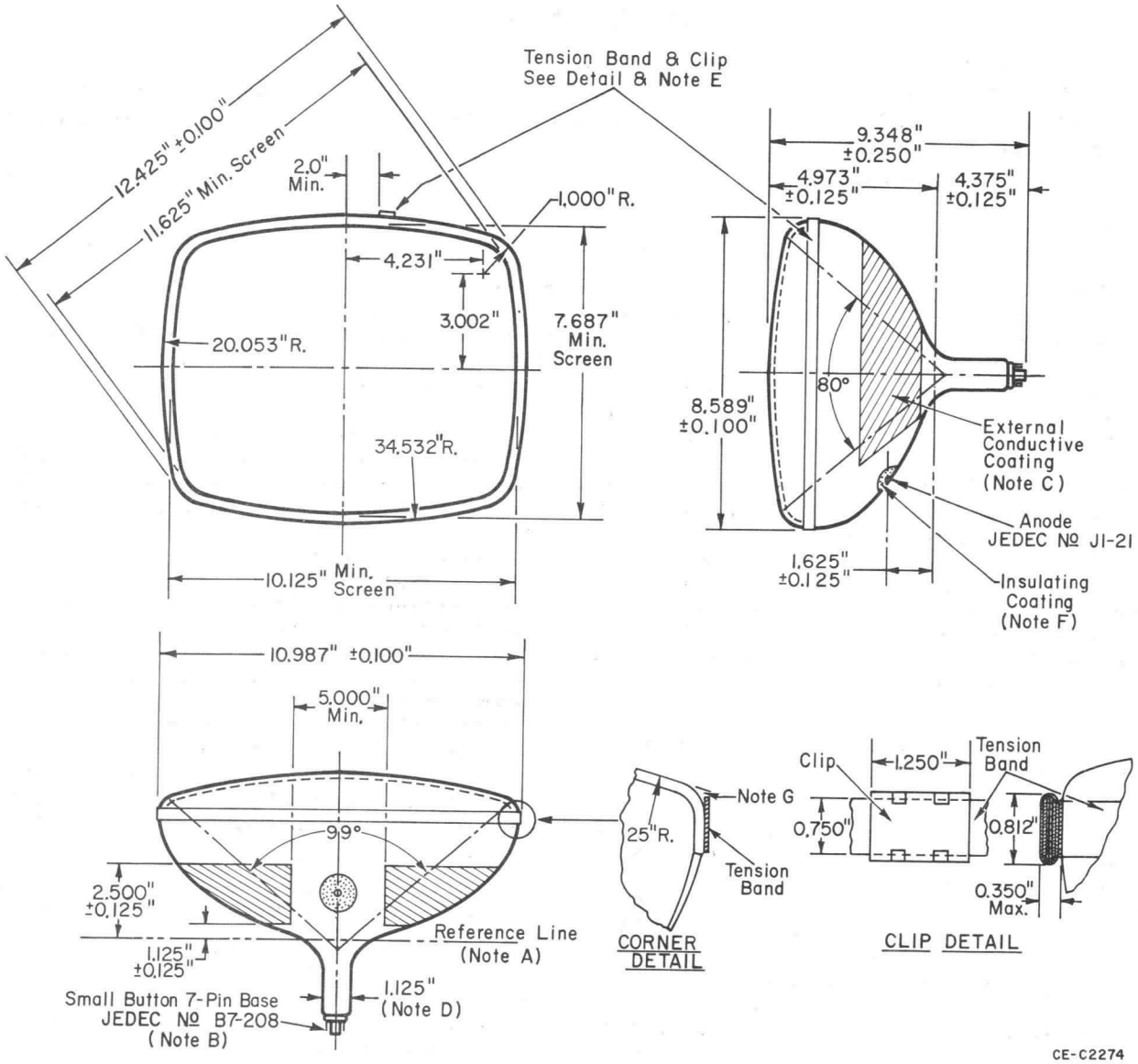
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	12000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 3)	0 to 400	Volts
Grid 2 Voltage	250	Volts
Cathode Voltage for Raster Cutoff	35 to 65	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
3. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 10.125" by 7.625" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 2 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Transparent, insulating coating, 3" in diameter. Clean only with soft, dry, lintless cloth.

G. The tension band will extend towards the faceplate a maximum distance that will not exceed the intersection of the leading edge of the band and the extension of the faceplate radius.

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TELEVISION PICTURE TUBE TYPE 17BZP4/17CAP4/17CKP4

110° Magnetic Deflection
Rectangular Glass Construction
Low-Voltage Electrostatic Focus

Straight Gun, No Ion Trap Required
14-3/4" × 11-11/16" Screen Size
12-13/16" Max. Overall Length

Aluminized Screen
Spherical Faceplate
External Conductive Coating

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.6	Ampere
Warm-up Time⊕	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	μμf
Cathode to all other Electrodes	5	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Screen:		
Phosphor	Aluminized P4	
Fluorescence	White	
Persistance	Short	
Focusing Method	Low-Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angle:		
Horizontal	105°	
Vertical	87°	
Diagonal	110°	
No-Ion-Trap Gun	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	14-3/4"
Height	11-11/16"
Diagonal	15-3/4"
Area	155 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (approx.)	78%
Bulb Dimensions (at greatest part):	
Width	15-5/8" ± 1/8"
Height	12-3/4" ± 1/8"
Diagonal	16-9/16" ± 1/8"
Bulb Number	J132½A1 or equiv.
Overall Length	12-9/16" ± 1/4"
Neck Length	5-7/16" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JETEC No. J1-21)
Base	Small Button, 7-Pin Style B (JETEC No. B7-183)
Basing	8HR
Net Weight (approx.)	10 lbs.

MAXIMUM RATINGS

Design Center Values

Anode Voltage†	16000	max.	Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode	180	max.	Volts
Heater Positive with Respect to Cathode	180	max.	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance■	10000	min.	Ohms
Grid 4 Circuit Resistance■	10000	min.	Ohms

GRID DRIVE OPERATION
(Video Signal Applied to Grid 1)

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	16000	Volts
Grid 2 Voltage	300	400	Volts
Grid 4 Voltage for Focus	0 to + 400	0 to + 400	Volts
Grid 1 Raster Cutoff Voltage	-28 to -72	-36 to -94	Volts

CATHODE DRIVE OPERATION
(Video Signal Applied to Cathode)

TYPICAL OPERATING CONDITIONS:

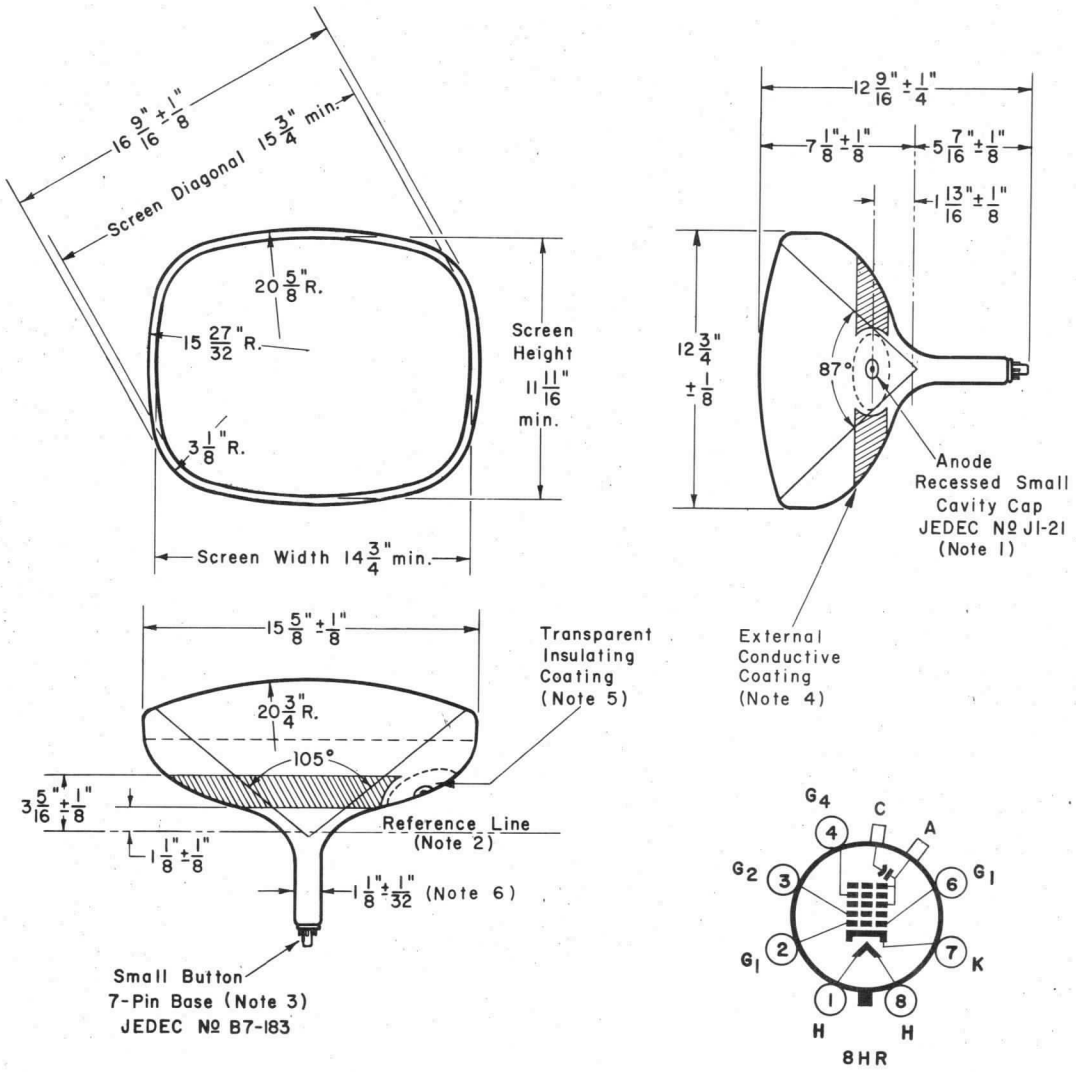
Anode to Grid 1 Voltage	14000	16000	Volts
Grid 2 to Grid 1 Voltage	300	400	Volts
Grid 4 to Grid 1 Voltage for Focus	0 to 400	0 to 400	Volts
Cathode to Grid 1 Raster Cutoff Voltage	28 to 60	36 to 78	Volts

† Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

X-RAY WARNING: Inasmuch as the tube rating permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltages in excess of 16 kilovolts.

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.



CE-C1369

NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

May 15, 1958

TELEVISION PICTURE TUBE TYPE 17CDP4

110° Magnetic Deflection
Rectangular Glass Construction
Low-Voltage Electrostatic Focus
Straight Gun, No Ion Trap Required
450 Ma Controlled Warm-Up Heater

Aluminized Screen
14-3/4" x 11-11/16" Screen Size
Spherical Faceplate
External Conductive Coating
12-13/16 Max. Overall Length

The 17CDP4 is a low-voltage electrostatic focus, rectangular glass picture tube. It has an aluminized screen, spherical neutral gray glass faceplate, external conductive coating, 8.4 volt, 450 ma. controlled warm-up heater and a no-ion-trap gun.

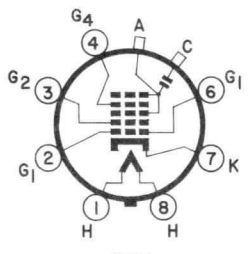
The 17CDP4 features 110° deflection-resulting in a shorter overall length than 17" 90° types. The use of a smaller neck diameter (1-1/8") permits this larger angle to be deflected with a relatively small extra amount of power over that required with a 90° tube.

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	8.4	Volts
Current	0.45	Ampere
Warm-Up Time (Approx.)	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	uuf
Cathode to all other Electrodes	5	uuf
External Conductive Coating to Anode:		
Maximum	1500	uuf
Minimum	800	uuf
Screen:		
Fluorescence	White	
Phosphor	No. 4 Sulfide Type	
Persistance	Short	
Focusing Method	Low-Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angle:		
Horizontal	105°	
Vertical	87°	
Diagonal	110°	
No-Ion-Trap Gun	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	14-3/4"
Height	11-11/16"
Diagonal	15-3/4"
Area	155 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (approx.)	78%
Bulb Dimensions (at greatest part):	
Width	15-5/8" ± 1/8"
Height	12-3/4" ± 1/8"
Diagonal	16-9/16" ± 1/8"
Bulb Number	J132½ (110°)
Overall Length	12-9/16" ± 1/4"
Anode Terminal	Recessed Small Cavity Cap (JETEC No. J1-21)
Base	Small Button, 7-Pin Style B (JETEC No. B7-183)
Basing	8HR
Net Weight (approx.)	10 lbs.



8HR

GRID DRIVE OPERATION

(Video Signal Applied to Grid 1)

MAXIMUM RATINGS:

Design Center Values

Anode Voltage †	16000 max.	Volts
Grid 4 Voltage:		
Positive Value	1000 max.	Volts
Negative Value	500 max.	Volts
Grid 2 Voltage	500 max.	Volts
Grid 1 Voltage:		
Negative Bias Value	140 max.	Volts
Negative Peak Value	200 max.	Volts
Positive Bias Value	0 max.	Volts
Positive Peak Value	2 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode	180 max.	Volts
Heater Positive with Respect to Cathode	180 max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	16000	Volts
Grid 2 Voltage	300	400	Volts
Grid 4 Voltage for Focus	0 to +400	0 to +400	Volts
Grid 1 Cutoff Voltage ▲	-28 to -72	-36 to -94	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5 max.	Megohms
Grid 2 Circuit Resistance ■	0.1 min.	Megohms
Grid 4 Circuit Resistance ■	0.1 min.	Megohms

† Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

▲ For visual extinction of focused raster.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

X-RAY WARNING: Inasmuch as the tube rating permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltages in excess of 16 kilovolts.

CATHODE DRIVE OPERATION

(Video Signal Applied to Cathode)

MAXIMUM RATINGS:

Design Center Values

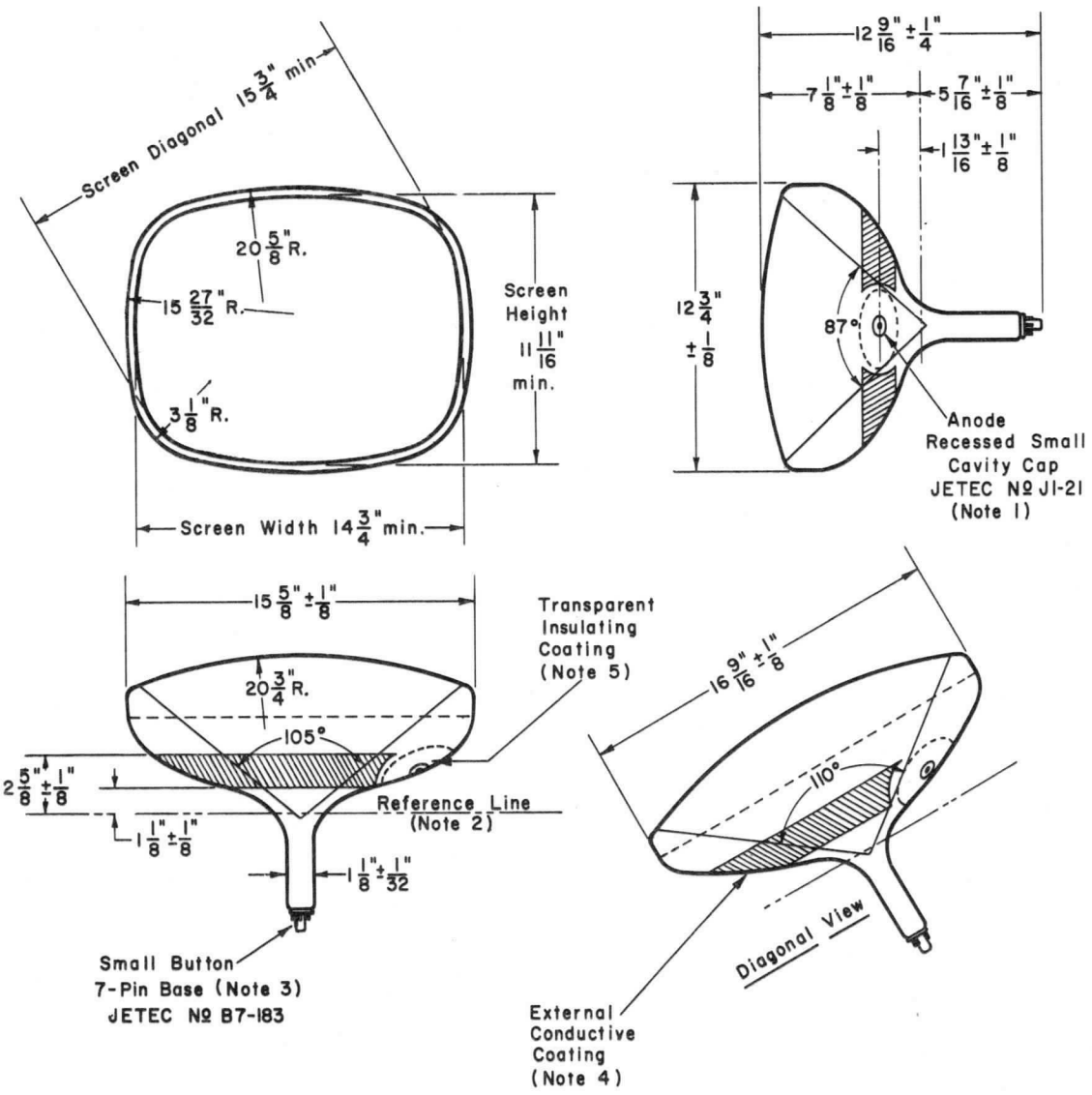
Anode to Grid 1 Voltage †	16000 max.	Volts
Grid 4 to Grid 1 Voltage:		
Positive Value	1000 max.	Volts
Negative Value	500 max.	Volts
Grid 2 to Grid 1 Voltage	640 max.	Volts
Cathode to Grid 1 Voltage:		
Positive Bias Value	140 max.	Volts
Positive Peak Value	200 max.	Volts
Negative Bias Value	0 max.	Volts
Negative Peak Value	2 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode	180 max.	Volts
Heater Positive with Respect to Cathode	180 max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage	14000	16000	Volts
Grid 2 to Grid 1 Voltage	300	400	Volts
Grid 4 to Grid 1 Voltage for Focus	0 to 400	0 to 400	Volts
Cathode to Grid 1 Cutoff Voltage ▲	28 to 60	28 to 60	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5 max.	Megohms
Grid 2 Circuit Resistance ■	0.1 min.	Megohms
Grid 4 Circuit Resistance ■	0.1 min.	Megohms



NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ±30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

December 5, 1958

TELEVISION PICTURE TUBE TYPE 17CFP4

90° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Electrostatic Focus
Lightweight Tube

External Conductive Coating
Spherical Faceplate
14-3/4" x 11-11/16" Picture
No Ion Trap

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.6	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	uuf
Cathode to all other Electrodes	5	uuf
External Conductive Coating:		
Maximum	1500	uuf
Minimum	1200	uuf
Screen:		
Phosphor	Aluminized P4	
Fluorescence	White	
Persistence	Short	
Focusing Method	Electrostatic	
Deflection Method	Magnetic	
Horizontal Angle, approx.	85°	
Vertical Angle, approx.	68°	
Diagonal Angle, approx.	90°	
No Ion Trap Gun	No Magnet Required	

MECHANICAL:

Mounting Position	Any	
Screen Dimensions:		
Screen Area, Min.	155	Sq. Inches
Height	11-11/16"	Min.
Width	14-3/4"	Min.
Diagonal	15-3/4"	Min.
Faceplate	Spherical Inner & Outer Surfaces	
Glass	Neutral Filter	
Transmission	79%	
Bulb	J132½C or equiv.	
Bulb Dimensions:		
Height	12-3/4" ± 1/8"	
Width	15-5/8" ± 1/8"	
Diagonal	16-9/16" ± 1/8"	
Neck Length	5-1/2"	
Overall Length	15" ± 3/8"	
Net Weight, approx.	10-1/2 Pounds	
Anode Terminal	Recessed Small Cavity Cap (JETEC J1-21)	
Base	Small Shell Duodecal 6-Pin (JETEC B6-63 or JETEC B6-203)	

MAXIMUM RATINGS:

Design Center Values

Anode Voltage*	16000	max.	Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	0	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode:			
During warmup period of 15 sec. max.	410	max.	Volts
After Equipment Warmup Period	180	max.	Volts
Heater Positive with Respect to Cathode	180	max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	Volts
Grid 4 Voltage	-50 to +350	Volts
Grid 2 Voltage ▲	300	Volts
Grid 1 Voltage for Raster Cutoff ■	-35 to -72	Volts

LIMITING CIRCUIT VALUES:

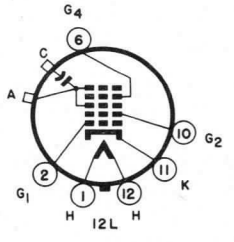
Grid 1 Circuit Resistance	1.5	max. Megohms
Grid 2 Circuit Resistance ♦	10000	ohms
Grid 4 Circuit Resistance ♦	10000	ohms

* Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12000 volts.

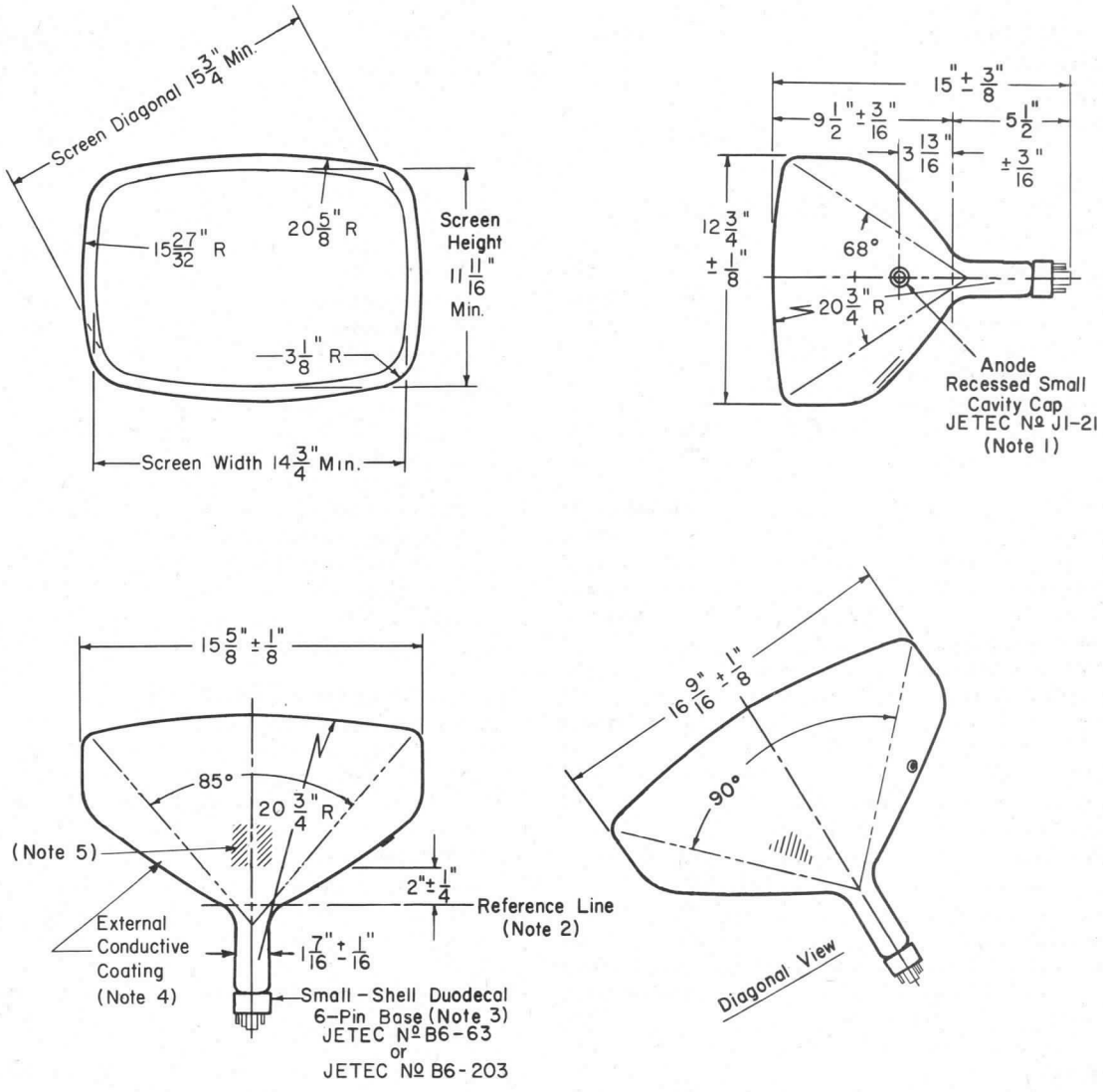
♦ Protective resistance in the Grid 2 and Grid 4 circuits is advisable to prevent damage to the tube.

■ Raster size is 11-11/16" x 14-3/4".

Inasmuch as the tube rating permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltage in excess of 16 kilovolts.



Cathode Ray Tube Section



NOTE 1: The plane through the tube axis and the base pin No. 6 may vary from the plane through the tube axis and the bulb terminal by an angular tolerance of ±30° measured about the tube axis. The bulb terminal is on the same side of the tube as pin No. 6.

NOTE 2: With the tube neck inserted through the flared end of REFERENCE-Line Gauge (JETEC No. 116) and with the tube seated in the gauge, the reference line is determined by the intersection of the plane cc' (face of the flared end) of the gauge with the glass funnel.

NOTE 3: The socket should not be mounted rigidly but it should be allowed to move freely and it should have flexible leads. The bottom circumference of the base shell will lie within a circle concentric with the bulb axis and having a diameter of 2-3/4".

NOTE 4: External conductive coating must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. × 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

TELEVISION PICTURE TUBE TYPE 23CGP4

92° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 450 Ma. Heater
Electrostatic Focus
5½" Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/8" × 19-1/4" Screen Size

ELECTRICAL

Focusing Method	Electrostatic	
Deflection Angles (Approx.)		
Horizontal	80	Degrees
Vertical	65	Degrees
Diagonal	92	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other Electrodes, approximate	5	μμf
Grid #1 to all other Electrodes, approximate	6	μμf
External Conductive Coating to Anode	2500 max.	μμf
	1700 min.	μμf
Heater Current at 6.3 Volts	450 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, (Approx.)	78	Percent

MECHANICAL

Overall Length	18 ± 3/8	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 ± 1/8	Inches
Width	20-1/2 ± 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal Axis	19-1/4	Inches
Vertical Axis	15-1/8	Inches
Area	282	Sq. Inches
Neck Length	5-1/2 ± 3/16	Inches
Bulb	J187C1	
Bulb Contact	J1-21	
Base	B6-203	
Basing	12L	
Weight	27	Pounds

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	22000	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage	+1200 –400	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

TYPICAL OPERATING CONDITIONS

Cathode Drive Service

Unless otherwise specified, all voltage values are positive with respect to Grid 1.

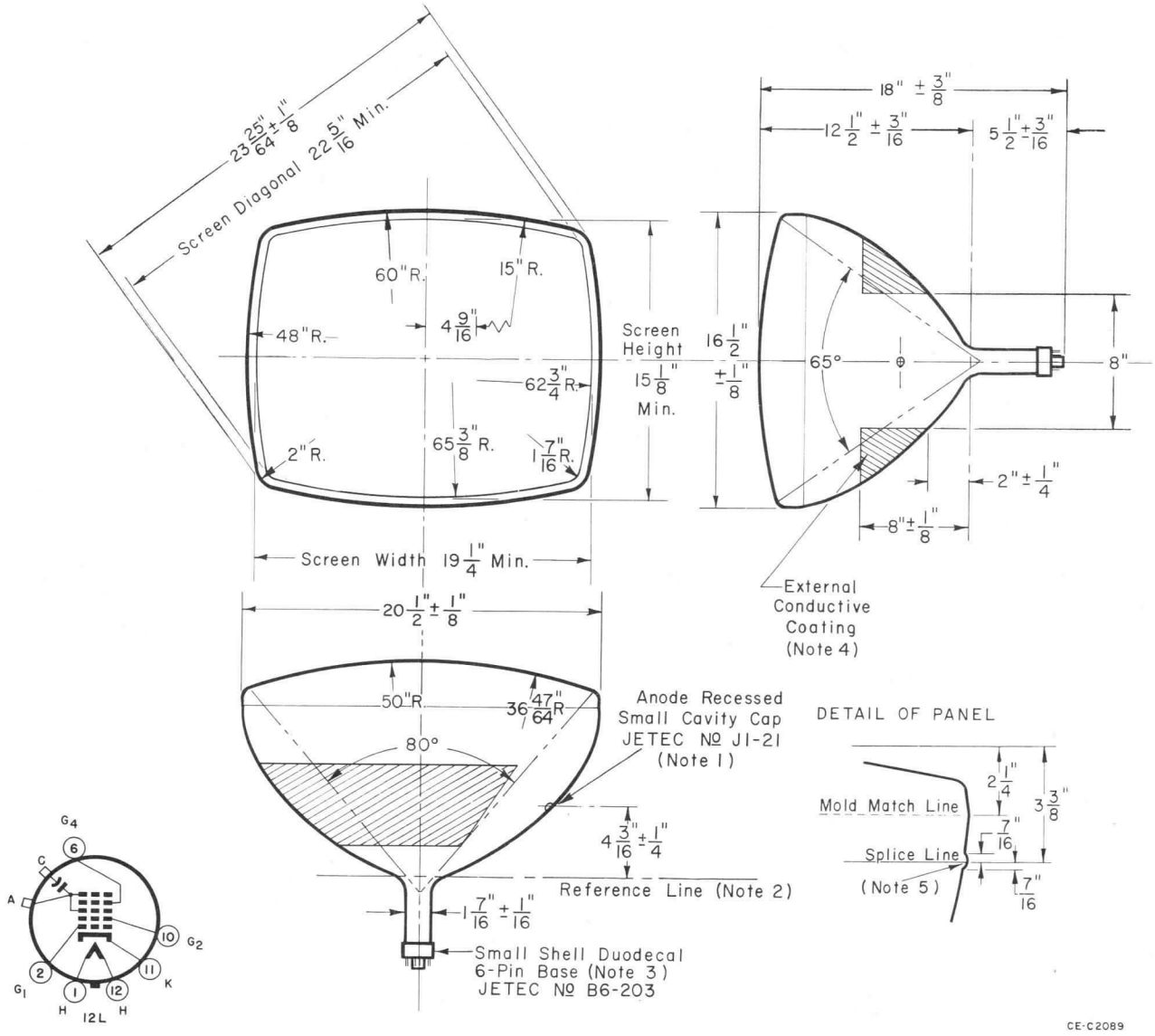
Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for Raster Cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid #1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	.10000	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts is not recommended.
3. It is recommended that not less than 300 volts on grid 2 be used as resolution is affected at lower voltages.
4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.



CE-C2089

1. Anode terminal alignment with pin 6 has angular tolerance about tube axis of ±30°.
2. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-3/4" from Yoke Reference Line.
3. Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 2-3/4" diameter circle concentric with tube axis.
4. External conductive coating forms supplementary filter capacitor and must be grounded.
5. Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

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TELEVISION PICTURE TUBE TYPE 17DHP4

110° Magnetic Deflection
Rectangular Glass Construction
Low-Voltage Electrostatic Focus
Straight Gun, No Ion Trap Required
450 Ma Controlled Warm-Up Heater

4-1/8" Neck Length

Aluminized Screen
14-3/4" x 11-11/16" Screen Size
Spherical Faceplate
External Conductive Coating
11-7/16" Max. Overall Length

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.45	Ampere
Warm-Up Time (approx.)♦	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	μμf
Cathode to all other Electrodes	5	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Screen:		
Fluorescence	White	
Phosphor	Aluminized P4	
Persistance	Short	
Focusing Method	Low-Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angle:		
Horizontal	105°	
Vertical	87°	
Diagonal	110°	
No-Ion-Trap Gun	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	14-3/4"
Height	11-11/16"
Diagonal	15-3/4"
Area	155 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (approx.)	78%
Bulb Dimensions (at greatest part):	
Width	15-5/8" ± 1/8"
Height	12-3/4" ± 1/8"
Diagonal	16-9/16" ± 1/8"
Bulb Number	J132½A1 or equiv.
Neck Length	4-1/8" ± 1/8"
Overall Length	11-1/4" ± 3/16"
Anode Terminal	Recessed Small Cavity Cap JEDEC No. J1-21
Base	Small Button, 7-Pin Style B JEDEC No. B7-208
Basing	8HR
Net Weight (approx.)	10 lbs.

♦ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

MAXIMUM RATINGS:

Design Center Values

Anode Voltage †	16000	max.	Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode §	180	max.	Volts
Heater Positive with Respect to Cathode	180	max.	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance■	10000	min.	Ohms
Grid 4 Circuit Resistance■	10000	min.	Ohms

GRID DRIVE OPERATION

(Video Signal Applied to Grid 1)

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	Volts
Grid 2 Voltage	500	Volts
Grid 4 Voltage for Focus	0 to +400	Volts
Grid 1 Cutoff Voltage▲	-43 to -72	Volts

CATHODE DRIVE OPERATION

(Video Signal Applied to Cathode)

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage	14000	Volts
Grid 2 to Grid 1 Voltage	500	Volts
Grid 4 to Grid 1 Voltage for Focus	0 to 400	Volts
Cathode to Grid 1 Cutoff Voltage▲	40 to 63	Volts

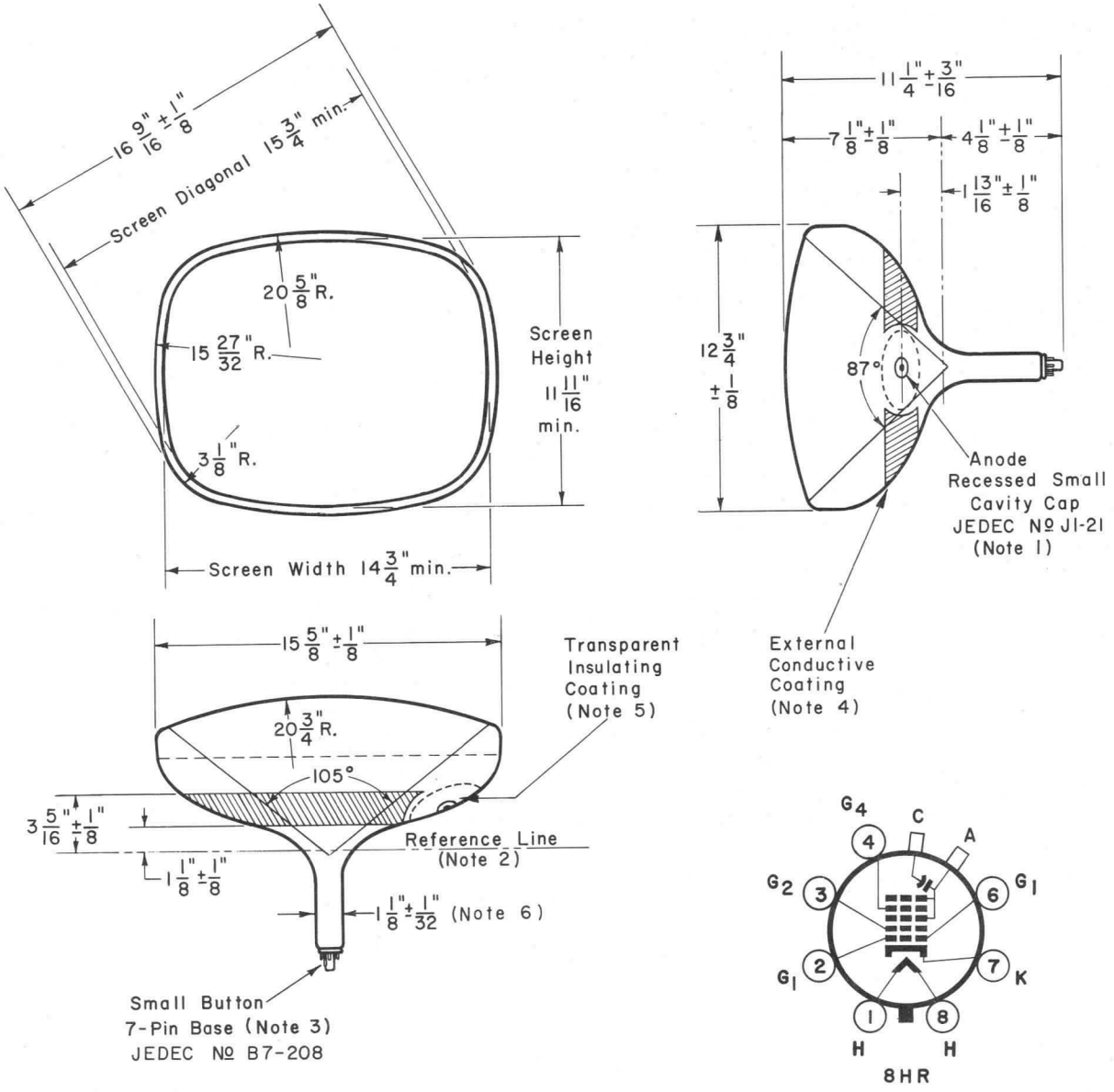
† Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

▲ For visual extinction of focused raster.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage to the tube.

X-RAY WARNING: Inasmuch as the tube rating permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltages in excess of 16 kilovolts.

§ A peak value of 410 volts design center maximum may be applied for not more than 15 seconds during equipment warm-up periods.



CE-C1369

NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

TELEVISION PICTURE TUBE TYPE 17DSP4

110° Magnetic Deflection
Rectangular Glass Construction
Low-Voltage Electrostatic Focus
Straight Gun, No Ion Trap Required
600 Ma Controlled Warm-Up Heater

4-1/8" Neck Length

Aluminized Screen
14-3/4" x 11-11/16" Screen Size
Spherical Faceplate
External Conductive Coating
11-7/16" Max. Overall Length

ELECTRICAL:

Cathode	Coated Unipotential
Heater:	
Voltage (ac or dc)	6.3 Volts
Current	0.6 Ampere
Warm-Up Time (approx.)♦	11 Seconds
Direct Interelectrode Capacitances:	
Grid 1 to all other Electrodes	6 μμf
Cathode to all other Electrodes	5 μμf
External Conductive Coating to Anode:	
Maximum	1500 μμf
Minimum	1000 μμf
Screen:	
Fluorescence	White
Phosphor	Aluminized P4
Persistance	Short
Focusing Method	Low-Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angle:	
Horizontal	105°
Vertical	87°
Diagonal	110°
No-Ion-Trap Gun	No Magnet Required

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	14-3/4"
Height	11-11/16"
Diagonal	15-3/4"
Area	155 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (approx.)	78%
Bulb Dimensions (at greatest part):	
Width	15-5/8" ± 1/8"
Height	12-3/4" ± 1/8"
Diagonal	16-9/16" ± 1/8"
Bulb Number	J132½A1 or equiv.
Neck Length	4-1/8" ± 1/8"
Overall Length	11-1/4" ± 3/16"
Anode Terminal	Recessed Small Cavity Cap JEDEC No. J1-21
Base	Small Button, 7-Pin Style B JEDEC No. B7-208
Basing	8HR
Net Weight (approx.)	10 lbs.

♦ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

MAXIMUM RATINGS:

Design Center Values

Anode Voltage †	16000 max.	Volts
Grid 4 Voltage:		
Positive Value	1000 max.	Volts
Negative Value	500 max.	Volts
Grid 2 Voltage	500 max.	Volts
Grid 1 Voltage:		
Negative Bias Value	140 max.	Volts
Negative Peak Value	200 max.	Volts
Positive Bias Value	0 max.	Volts
Positive Peak Value	2 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode §	180 max.	Volts
Heater Positive with Respect to Cathode	180 max.	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5 max.	Megohms
Grid 2 Circuit Resistance■	10000 min.	Ohms
Grid 4 Circuit Resistance■	10000 min.	Ohms

GRID DRIVE OPERATION

(Video Signal Applied to Grid 1)

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000 Volts
Grid 2 Voltage	400 Volts
Grid 4 Voltage for Focus	0 to +400 Volts
Grid 1 Cutoff Voltage▲	-45 to -90 Volts

CATHODE DRIVE OPERATION

(Video Signal Applied to Cathode)

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage	14000 Volts
Grid 2 to Grid 1 Voltage	450 Volts
Grid 4 to Grid 1 Voltage for Focus	0 to 400 Volts
Cathode to Grid 1 Cutoff Voltage▲	46 to 85 Volts

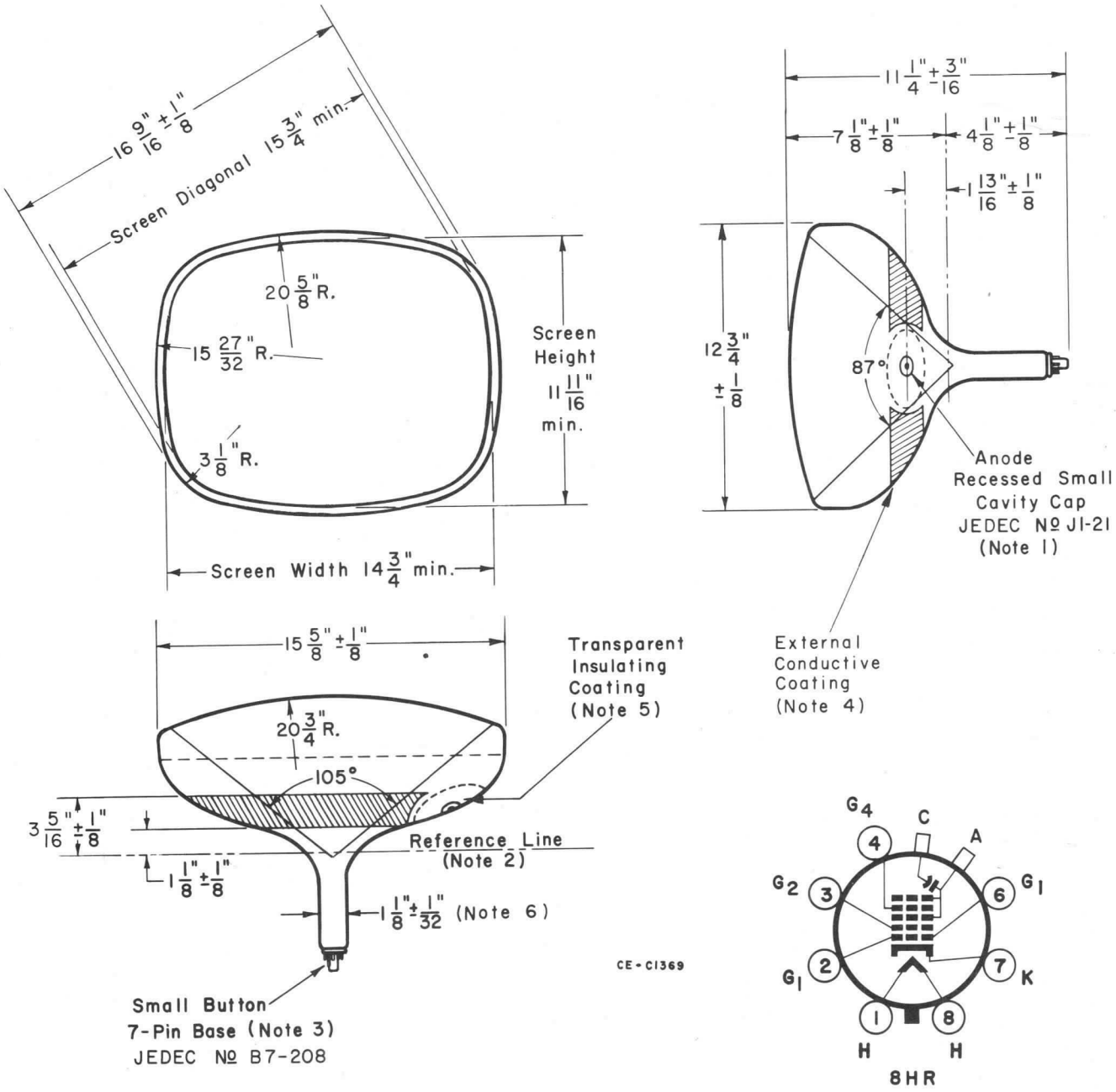
† Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

▲ For visual extinction of focused raster.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage to the tube.

X-RAY WARNING: Inasmuch as the tube rating permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltages in excess of 16 kilovolts.

§ A peak value of 410 volts design center maximum may be applied for not more than 15 seconds during equipment warm-up periods.



NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

TELEVISION PICTURE TUBE TYPE 17EBP4

The 17EBP4 is a 110° picture tube with a spherical grey glass faceplate, short neck length and an aluminized screen. This type has an external conductive coating with a special configuration such that it may be grounded by the tube mounting system.

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.45	Ampere
Warm-Up Time (Approx.)♦	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	μμf
Cathode to all other Electrodes	5	μμf
External Conductive Coating to Anode:		
Maximum	1700	μμf
Minimum	1100	μμf
Screen:		
Fluorescence	White	
Phosphor	Aluminized P4	
Persistence	Short	
Focusing Method	Low-Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angle:		
Horizontal	105°	
Vertical	87°	
Diagonal	110°	
No-Ion-Trap Gun	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	14-3/4"
Height	11-11/16"
Diagonal	15-3/4"
Area	155 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (Approx.)	78%
Bulb Dimensions (at greatest part):	
Width	15-5/8" ± 1/8"
Height	12-3/4" ± 1/8"
Diagonal	16-9/16" ± 1/8"
Bulb Number	J132½ A1 or equiv.
Neck Length	4-1/8" ± 1/8"
Overall Length	11-1/4" ± 3/16"
Anode Terminal	Recessed Small Cavity Cap JEDEC No. J1-21
Base	Small Button, 7-Pin Style B JEDEC No. B7-208
Basing	8HR
Net Weight (Approx.)	10 lbs.

♦ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

MAXIMUM RATINGS:

Design Maximum Values

Anode Voltage †	20000	max.	Volts
Grid 4 Voltage:			
Positive Value	1100	max.	Volts
Negative Value	550	max.	Volts
Grid 2 Voltage	700	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	154	max.	Volts
Negative Peak Value	220	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode §	200	max.	Volts
Heater Positive with Respect to Cathode	200	max.	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance■	10000	min.	Ohms
Grid 4 Circuit Resistance■	10000	min.	Ohms

GRID DRIVE OPERATION
(Video Signal Applied to Grid 1)

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	Volts
Grid 2 Voltage	500	Volts
Grid 4 Voltage for Focus	0 to +400	Volts
Grid 1 Cutoff Voltage▲	−43 to −72	Volts

CATHODE DRIVE OPERATION
(Video Signal Applied to Cathode)

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage	14000	Volts
Grid 2 to Grid 1 Voltage	500	Volts
Grid 4 to Grid 1 Voltage for Focus	0 to 400	Volts
Cathode to Grid 1 Cutoff Voltage▲	40 to 63	Volts

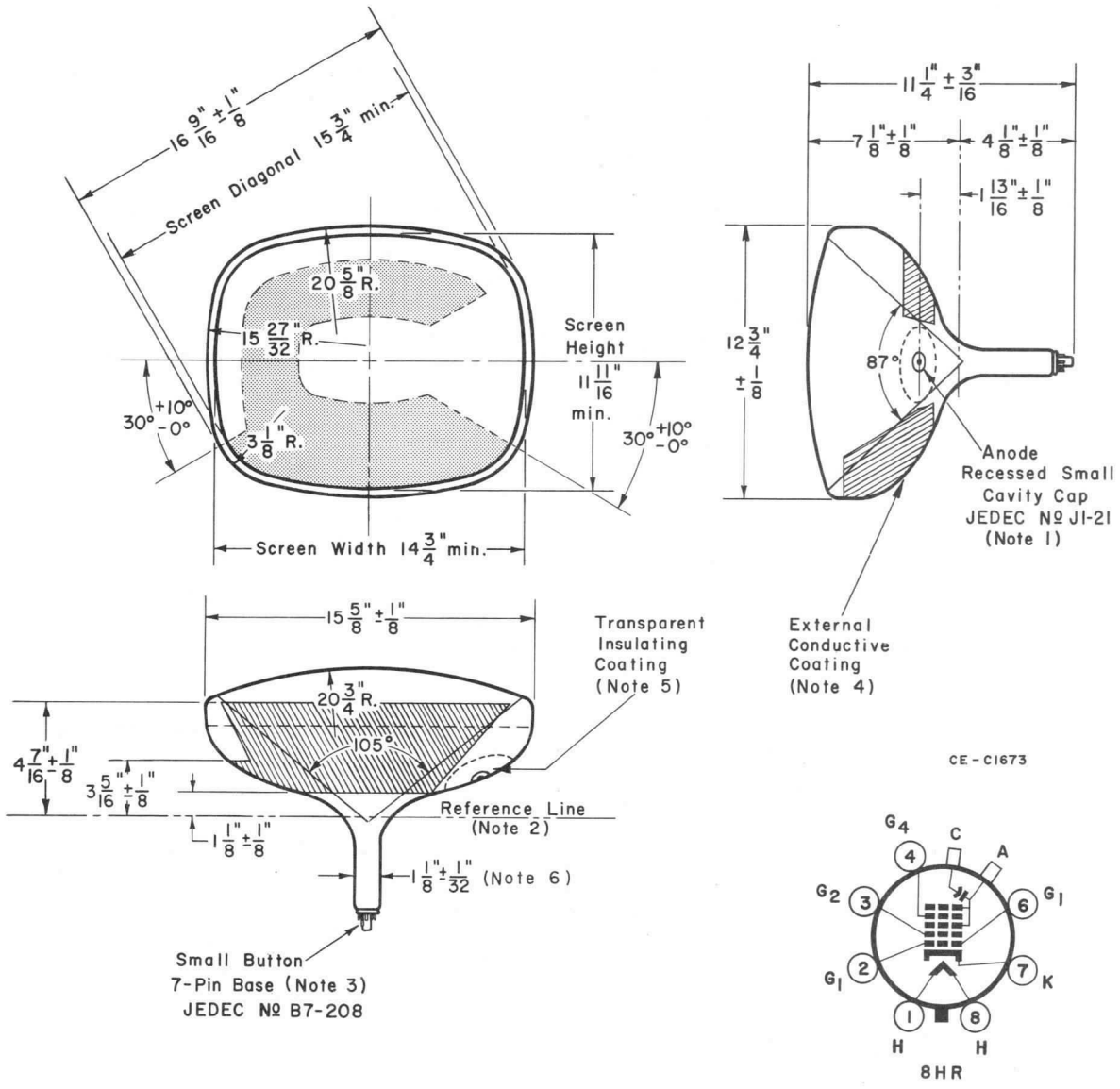
§ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

▲ For visual extinction of focused raster.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage to the tube.

X-RAY WARNING: Inasmuch as the tube rating permits operation at voltages as high as 22.0 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltages in excess of 16 kilovolts.

§ A peak value of 450 volts design center maximum may be applied for not more than 15 seconds during equipment warm-up periods.



NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

September 15, 1960

TELEVISION PICTURE TUBE TYPE 19ACP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

Electrostatic Focus
5-1/8" Neck Length
Low G_2 Voltage (50 Volts)

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" × 15-1/8" Screen Size

ELECTRICAL:

Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	$\mu\mu$f
Grid 1 to all other electrodes, (Approx.)	6	$\mu\mu$f
External Conductive Coating to Anode:		
Maximum	1500	$\mu\mu$f
Minimum	1000	$\mu\mu$f
Heater Current at 6.3 volts	600 ± 30	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	12-3/8 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	5-1/8 ± 1/8	Inches
Bulb	J149	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2 Lbs.	

RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	20000	Volts
Minimum Anode Voltage▲	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, –550	Volts
Maximum Grid 2 Voltage	70	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	50	Volts DC
Cathode Voltage for raster cutoff	35 to 50	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance†	10000	Ohms

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

† Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X–RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

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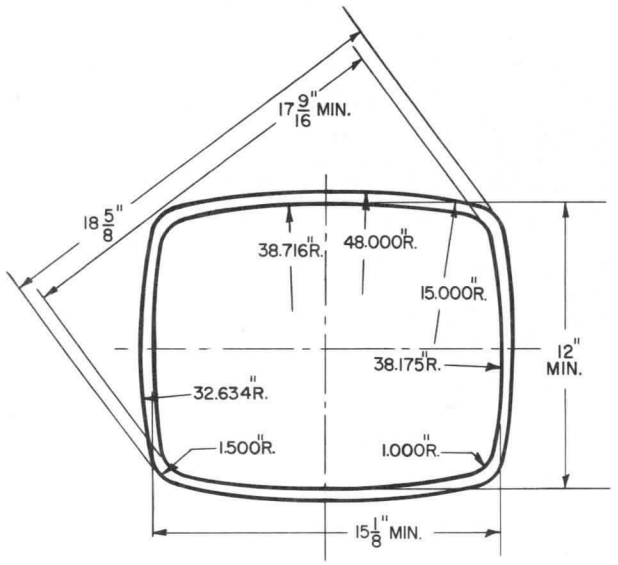

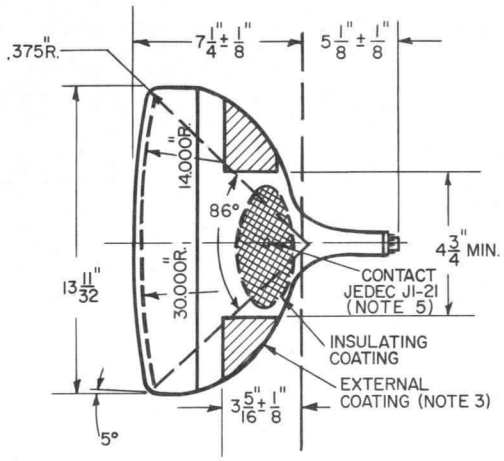

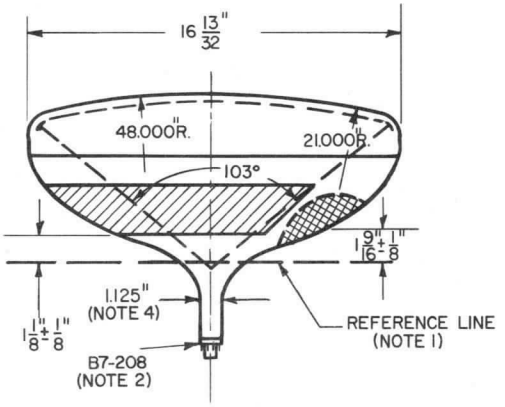

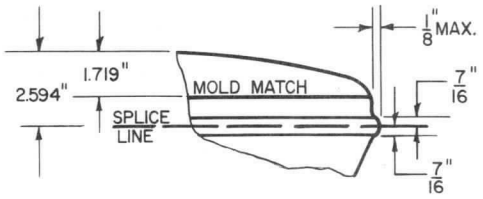

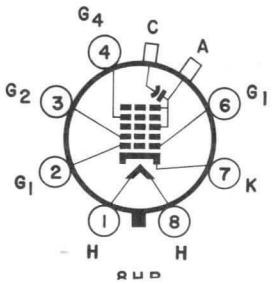

NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ± 30°.

TELEVISION PICTURE TUBE TYPE 19AHP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 450 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" × 15-1/8" Screen Size

ELECTRICAL:

Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	450 ± 5%	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	11-3/8 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	4-1/8 ± 1/8	Inches
Bulb	J149	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2 Lbs.	

RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	17600	Volts
Minimum Anode Voltage▲	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	650	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	500	Volts DC
Cathode Voltage for raster cutoff	40 to 63	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance†	10000	Ohms

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

† Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

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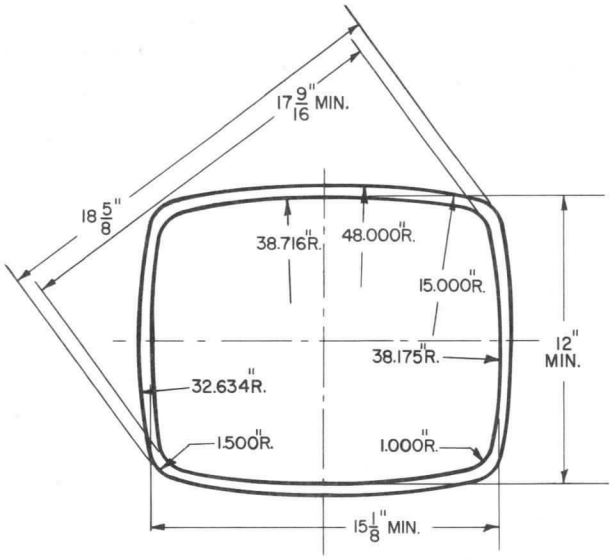

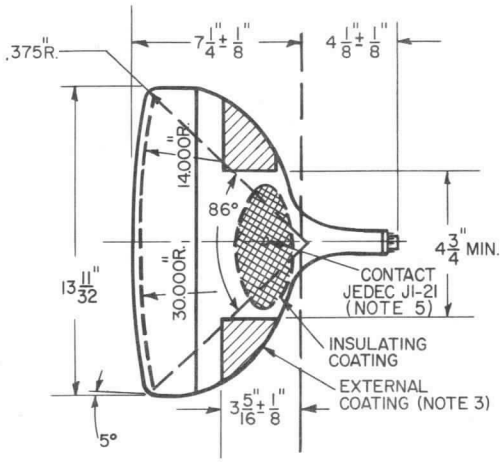

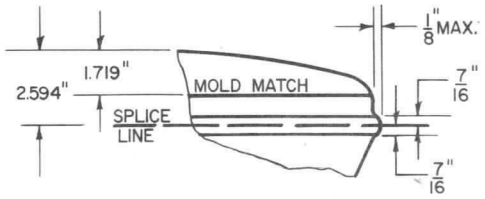

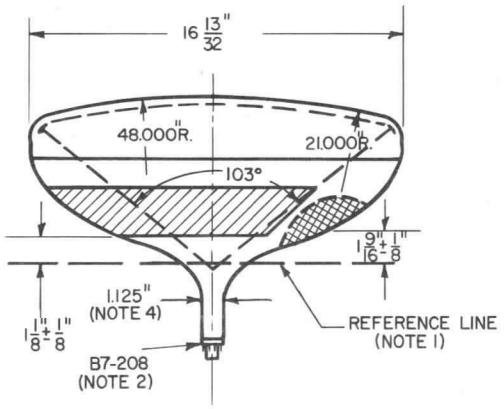

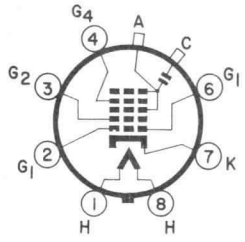

8HR

CE-C1634

NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ± 30°.

TELEVISION PICTURE TUBE TYPE 19ALP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 300 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" × 15-1/8" Screen Size

ELECTRICAL:

Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	300 ± 5%	Ma.
Heater Warm-up Time⊕	18	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	11-3/8 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	4-1/8 ± 1/8	Inches
Bulb	J149	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2 Lbs.	

RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage▲	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 45 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance†	10000	Ohms

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

† Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

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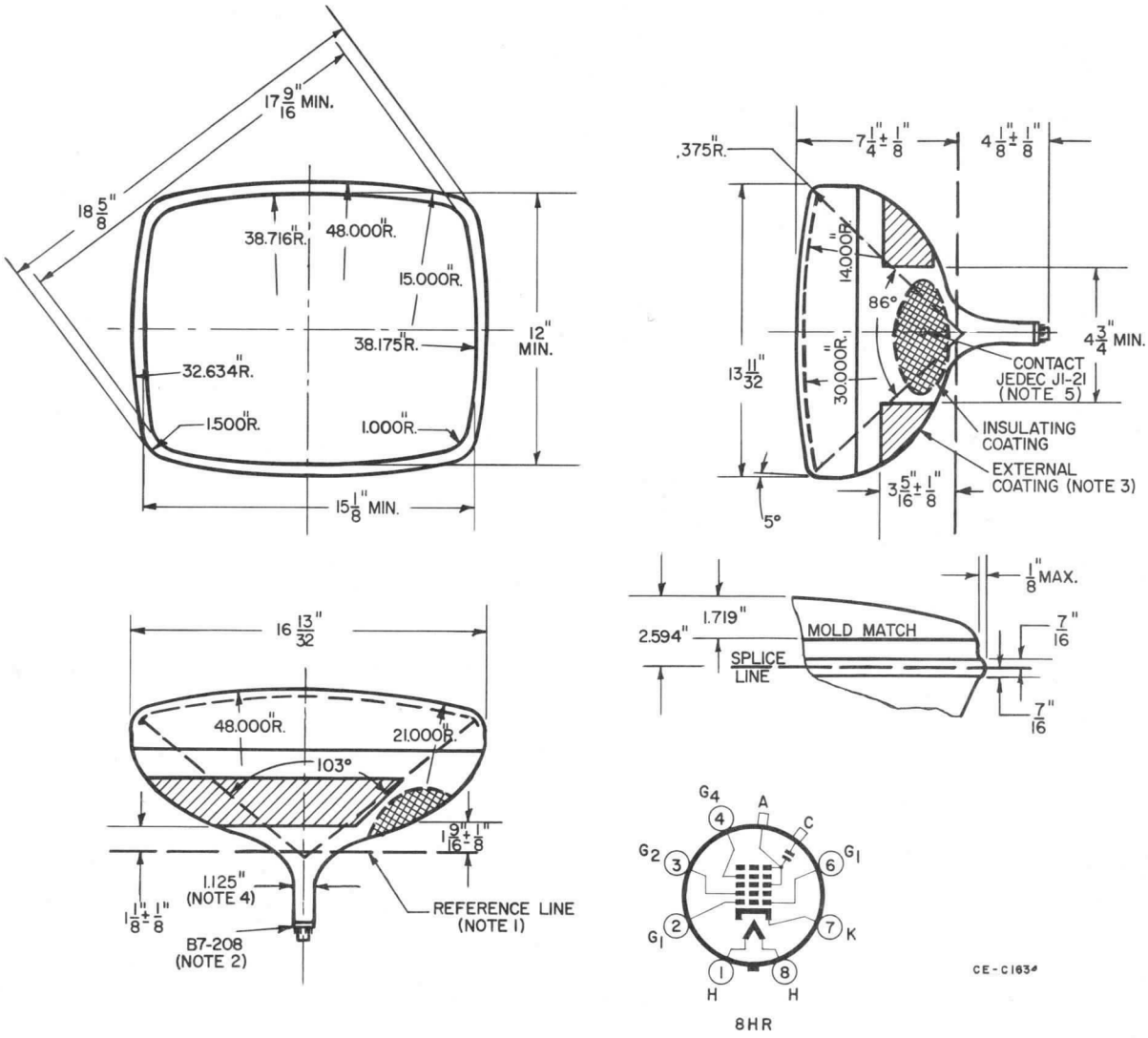


NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ± 30°.

TELEVISION PICTURE TUBE TYPE 19BFP4

92° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" x 15-1/8" Screen Size

ELECTRICAL:

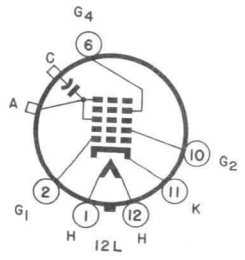
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	80	Degrees
Vertical	65	Degrees
Diagonal	92	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2000	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	600 ± 5%	Ma.
Heater warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	15-1/4 ± 3/8	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	5-1/2 ± 3/16	Inches
Bulb	J149B1	
Bulb Contact	J1-21	
Base	B6-203	
Basing	12L	
Weight	14-3/4	Pounds



RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	20000	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	400	Volts DC
Cathode Voltage for raster cutoff	34 to 79	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

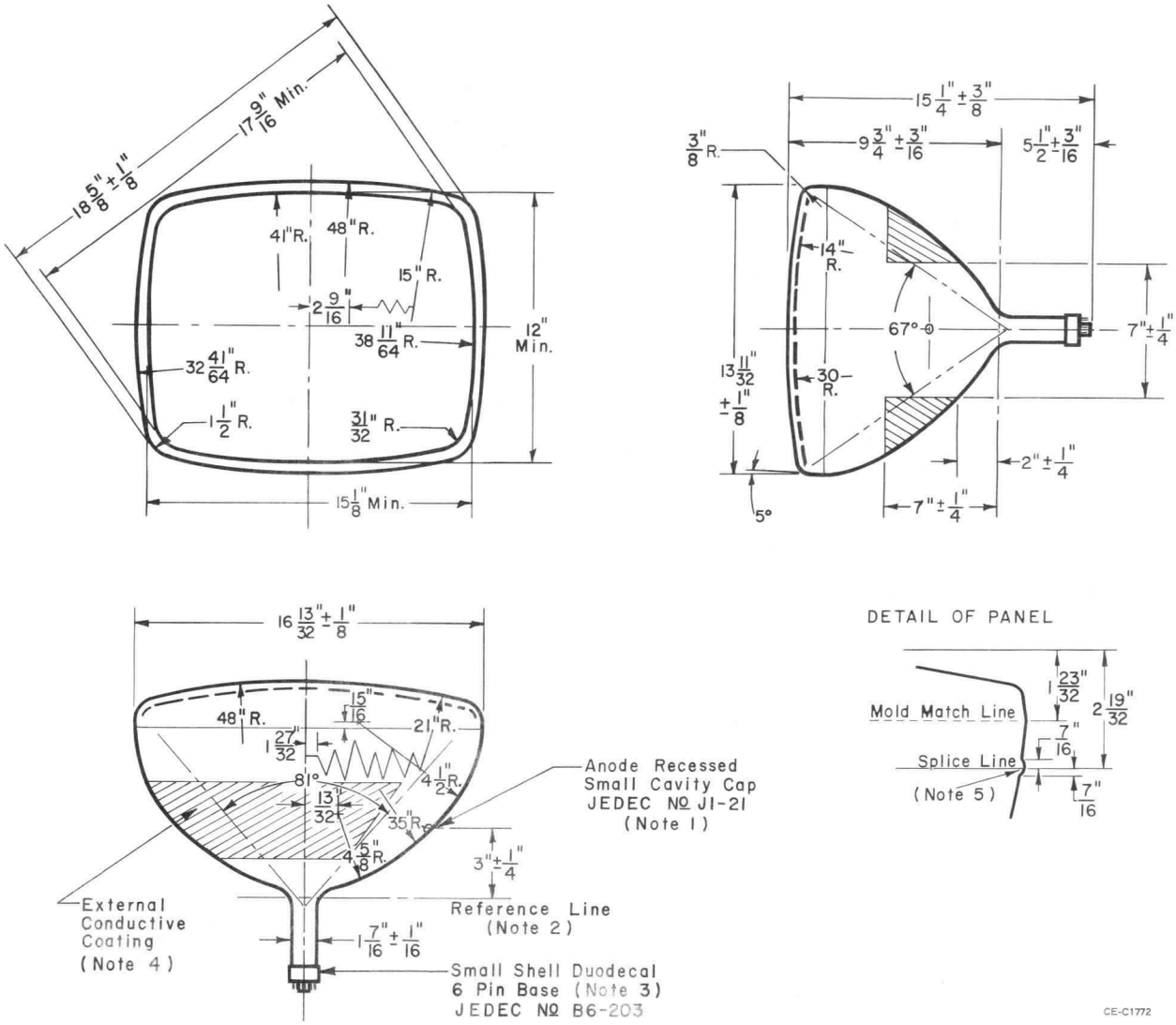
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts in not recommended.

3. It is recommended that not less than 300 volts on grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Base pin 6 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 2: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-3/4" from Yoke Reference Line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 2-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

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TELEVISION PICTURE TUBE TYPE 19BVP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" x 15-1/8" Screen Size

ELECTRICAL:

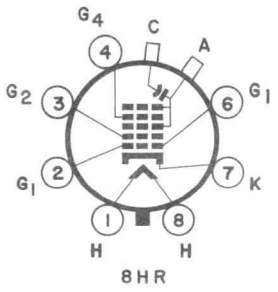
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	600 ± 5%	Ma.
Heater warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	11-3/4 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	4-1/2 ± 1/8	Inches
Bulb	J149A1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2	Pounds



RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	23500	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	20000	Volts DC
Grid 4 Voltage (Focusing Electrode)	250	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

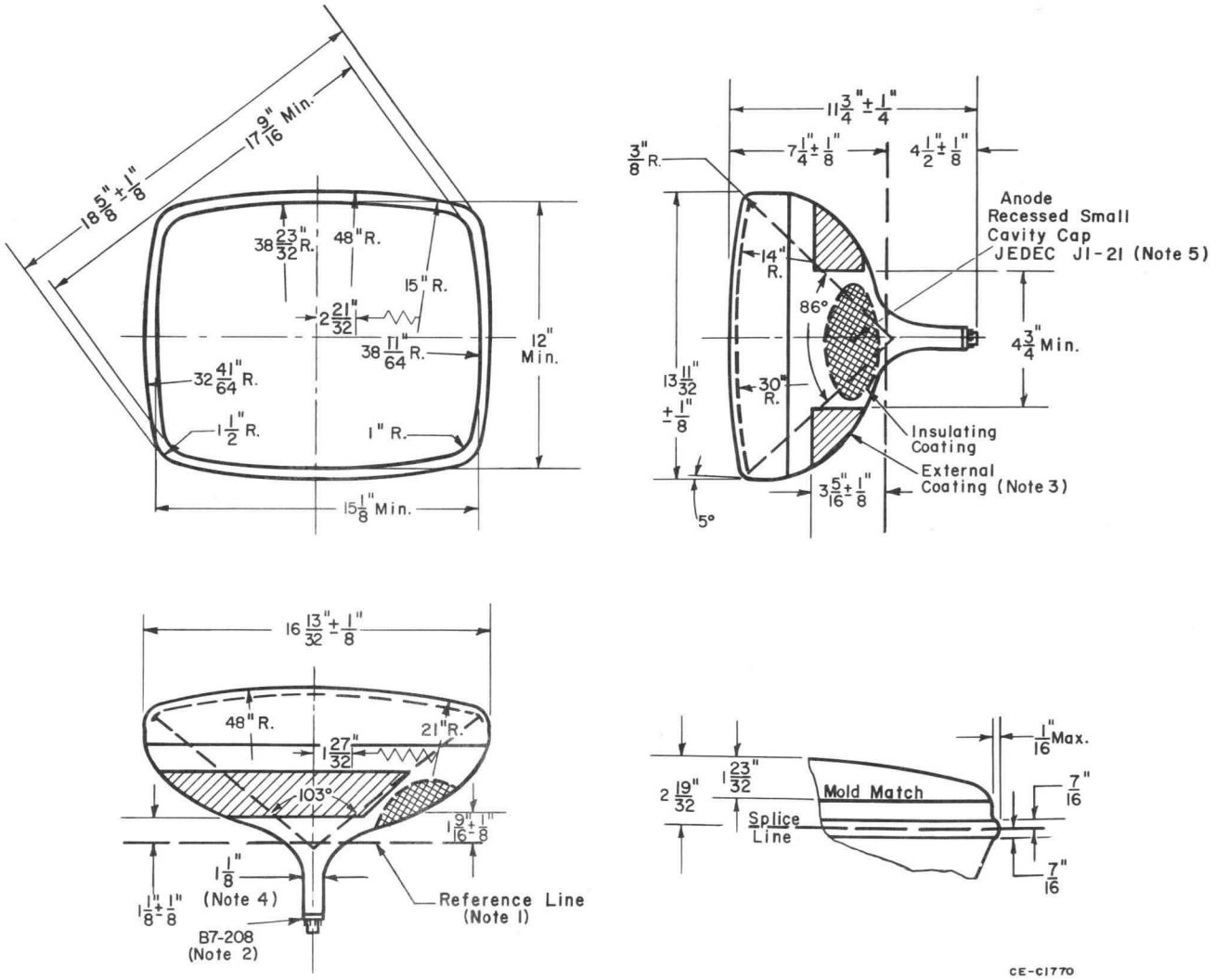
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement, The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

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TELEVISION PICTURE TUBE TYPE 19BWP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 450 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" x 15-1/8" Screen Size

ELECTRICAL:

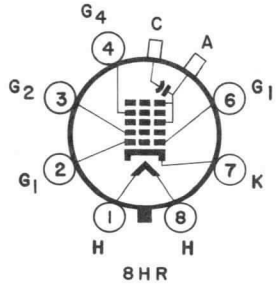
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	450 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4
Light Transmittance at Center, Approximate	78 Percent

MECHANICAL:

Overall Length	11-3/4 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	4-1/2 ± 1/8	Inches
Bulb	J149A1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2 Pounds	



8HR

RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	23500	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	20000	Volts DC
Grid 4 Voltage (Focusing Electrode)	250	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

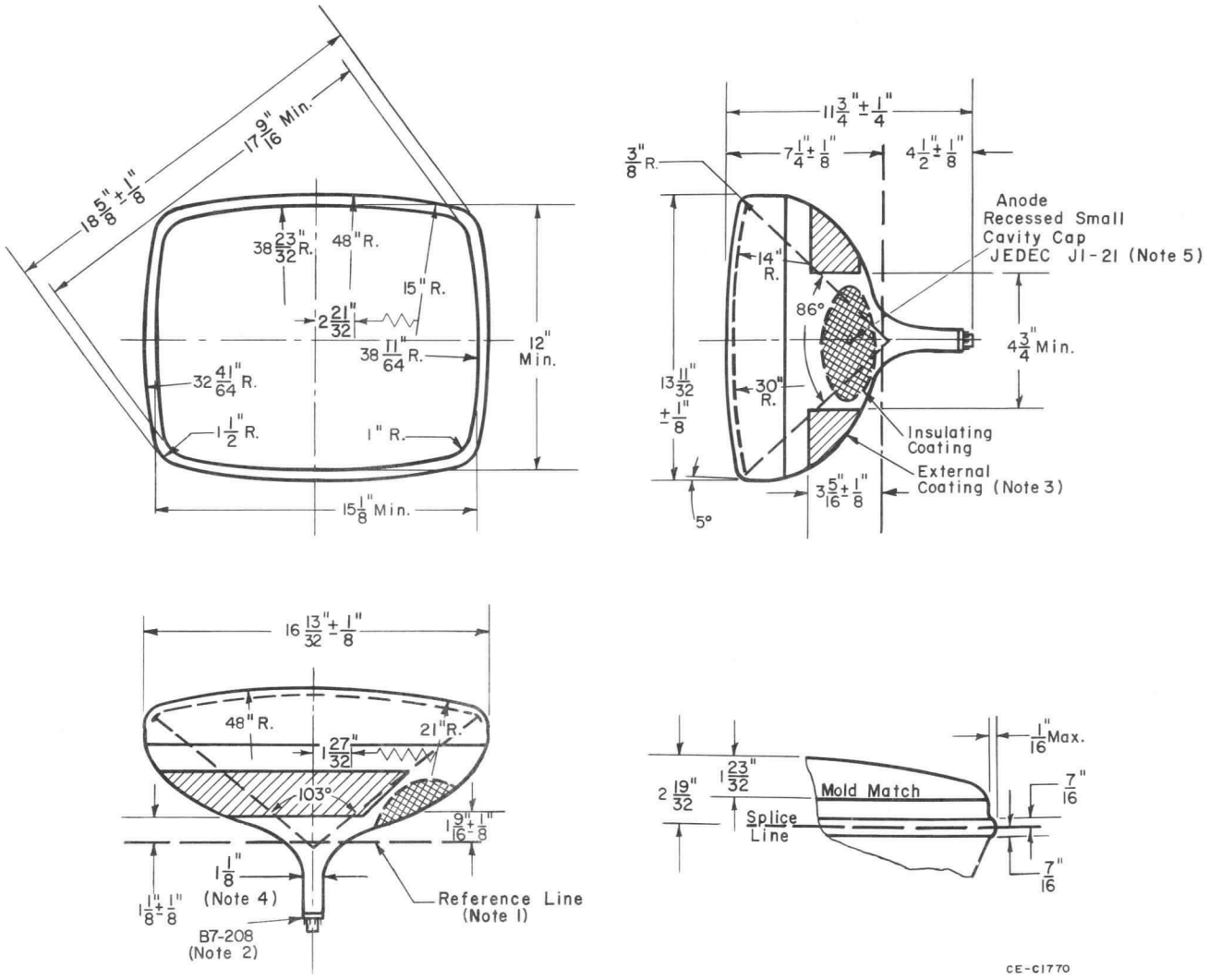
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

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TELEVISION PICTURE TUBE TYPE 19CMP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

Electrostatic Focus
4-3/8" Neck Length
Low G_2 Voltage (30 Volts)

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" × 15-1/8" Screen Size

ELECTRICAL

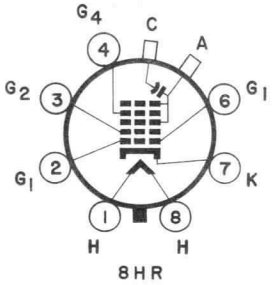
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 Volts	450 ± 5%	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, approximate	78	Percent

MECHANICAL

Overall Length	11-5/8 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	4-3/8 ± 1/8	Inches
Bulb	J149	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	13-1/2 Lbs.	



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	20000	Volts
Minimum Anode Voltage▲	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	60	Volts
Minimum Grid 2 Voltage	20	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	30	Volts DC
Cathode Voltage for raster cutoff	30 to 45	Volts DC

LIMITING CIRCUIT VALUES

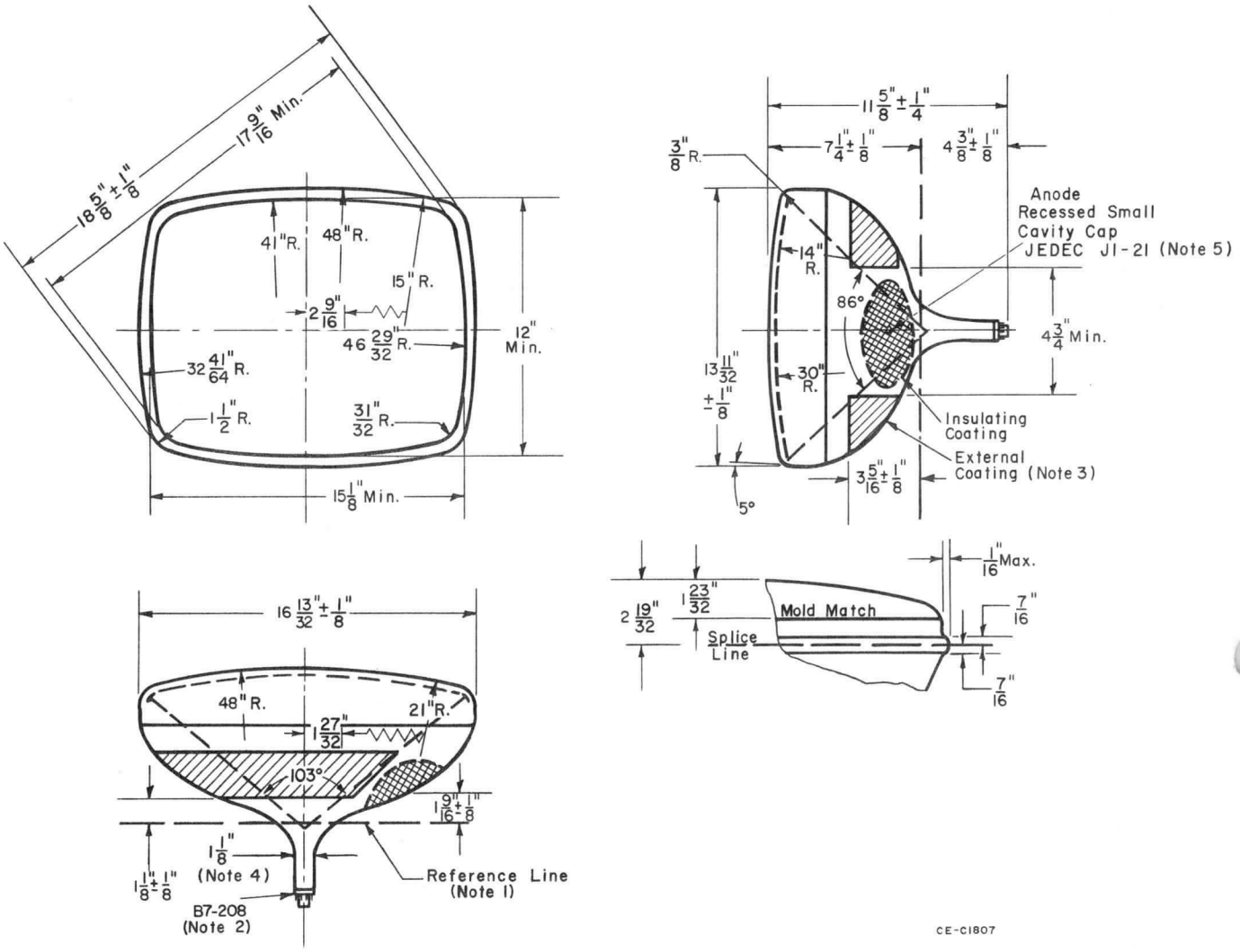
Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance†	10000	Ohms

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

† Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x.rays.



NOTE 1: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement, The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

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Westinghouse®

19EGP4

February 15, 1966

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
12" × 15.125" MIN. SCREEN SIZE
4.375" NECK LENGTH

FILLED-RIM IMPLOSION PROTECTION

6.3 VOLT, 450 MA HEATER
G2 VOLTAGE (50 VOLTS)
SPHERICAL GRAY FILTER GLASS

DETAILED DATA

ELECTRICAL

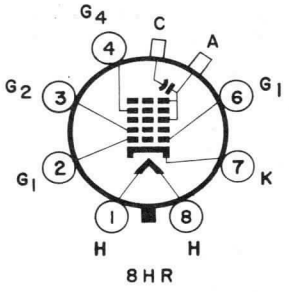
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	114 Degrees
Horizontal	102 Degrees
Vertical	86 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode: (Note 5)	
Minimum	1250 pF
Maximum	1750 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ±5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	49%

MECHANICAL

Over-all Length	11.625" ±0.250"
Neck Length	4.375" ±0.125"
Greatest Dimensions of Tube:	
Diagonal	20.875" ±0.094"
Width	17.125" ±0.063"
Height	14.078" ±0.063"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	17.562"
Horizontal Axis	15.125"
Vertical Axis	12.000"
Area	172 Sq. Inches
Implosion Protection	Filled Rim
Bulb Contact	EIA J1-21
Bulb	EIA J149F1
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	16.250 Pounds



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	21000 Volts
Minimum Anode Voltage	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	60 Volts
Minimum Grid 2 Voltage	20 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	300 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000 Ohms

TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode) (Note 4)	0 to 400 Volts
Grid 2 Voltage	50 Volts
Cathode Voltage for Raster Cutoff	35 to 55 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent arc damage.
4. With the cathode bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 12" by 15.125" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.
5. Includes implosion-protection hardware.

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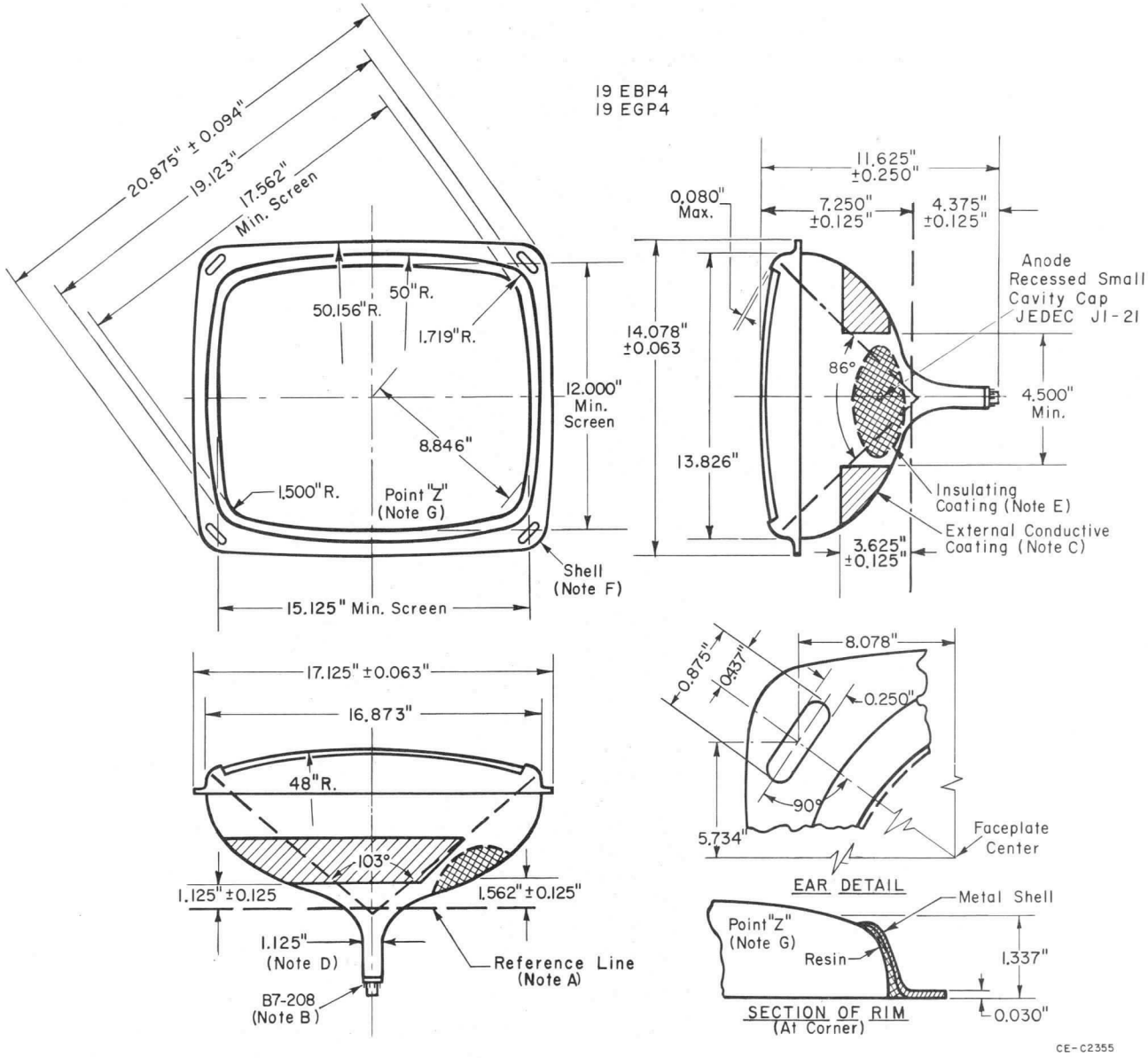

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Transparent insulating coating 3" in diameter. Clean only with soft, dry, lintless cloth.

F. Shell must be grounded.

G. Point "Z" is located on the tube diagonal at the faceplate surface.

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Westinghouse

19EJP4

December 1, 1965

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
12" × 15.188" MIN. SCREEN SIZE
4.375" NECK LENGTH
SPHERICAL GRAY FILTER GLASS
EXTERNAL CONDUCTIVE COATING

TENSION BAND
IMPLOSION PROTECTION

6.3 VOLT, 450 MA HEATER
LOW G2 VOLTAGE (30 VOLTS)
NO ION TRAP
ELECTROSTATIC FOCUS
ALUMINIZED SCREEN

DETAILED DATA

ELECTRICAL

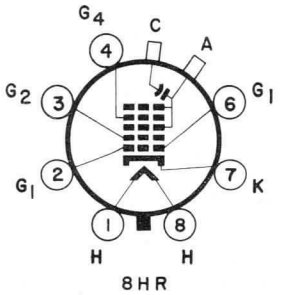
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	114 Degrees
Horizontal	103 Degrees
Vertical	86 Degrees
Direct Interelectrode Capacitances:	
Cathode to All other Electrodes (Approx.)	5 pF
Grid No. 1 to all other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1000 pF
Maximum	1500 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	49%

MECHANICAL

Over-all Length	11.625" ± 0.250"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	18.733" ± 0.125"
Width	16.552" ± 0.125"
Height	13.446" ± 0.125"
Minimum Useful Screen Dimensions (projected):	
Diagonal	17.562"
Horizontal Axis	15.188"
Vertical Axis	12"
Area	172 Sq. Inches
Implosion Protection	Tension Band
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	15 Pounds
Bulb	EIA J149F1



8HR

RATINGS

Design Maximum System
Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	20000 Volts
Minimum Anode Voltage	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	60 Volts
Minimum Grid 2 Voltage	20 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	300 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000 Ohms

TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400 Volts
Grid 2 Voltage	30 Volts
Cathode Voltage for Raster Cutoff	30 to 45 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.

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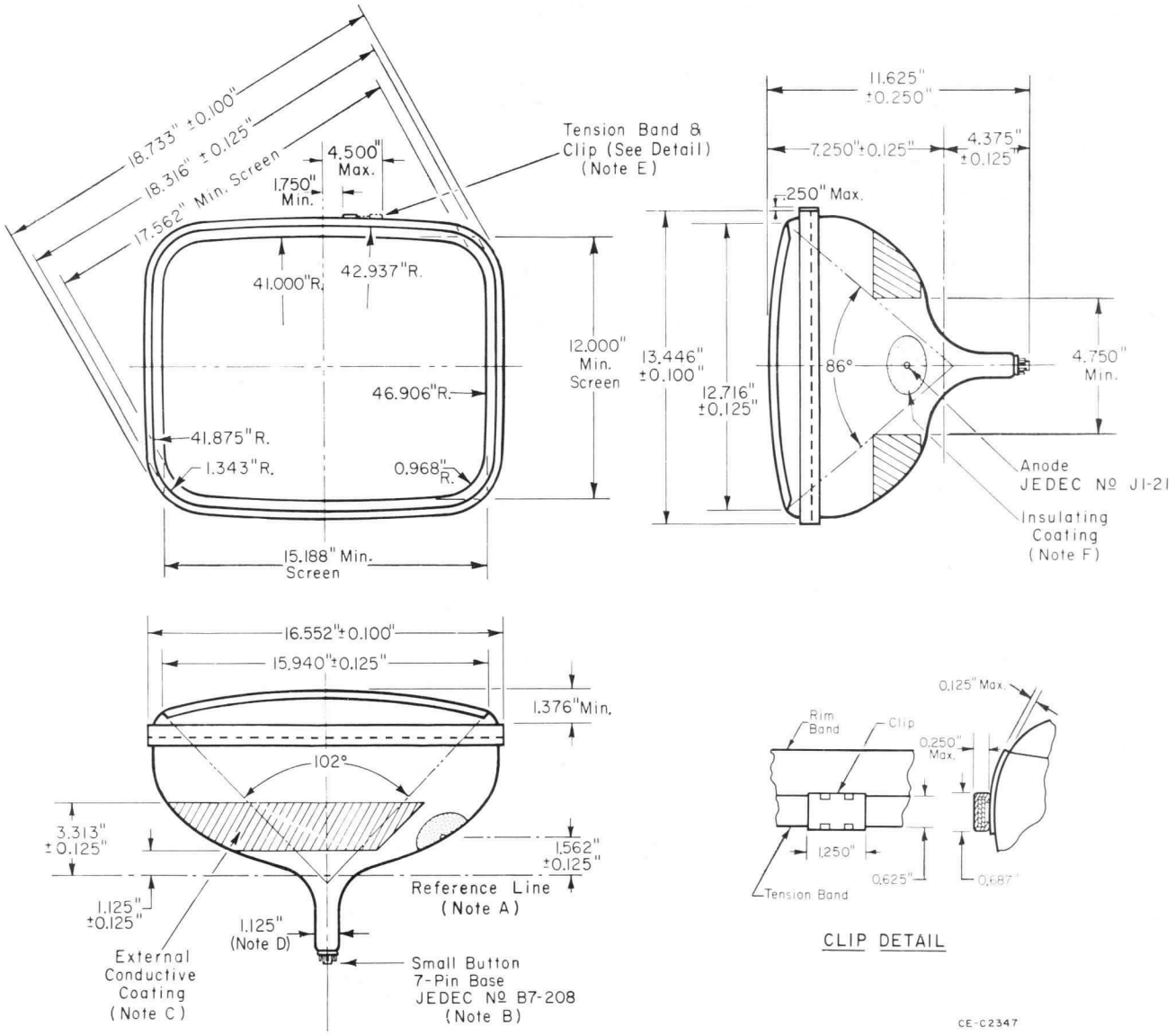

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

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July 15, 1965

TELEVISION PICTURE TUBE TYPE 19ELP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 mA Heater
Electrostatic Focus
4.125" Neck Length

External Conductive Coating
Spherical Faceplate
12.000" × 15.125" Screen Size

ELECTRICAL

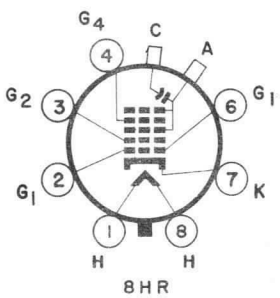
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to All Other Electrodes, (Approx.)	5	pF
Grid 1 to All Other Electrodes, (Approx.)	6	pF
External Conductive Coating to Anode:		
Maximum	1500	pF
Minimum	1000	pF
Heater Current at 6.3 Volts	600 ± 5%	mA
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center, Approximate	78 Percent

MECHANICAL

Overall Length	11.375" ± 0.250"
Greatest Dimensions of Tube:	
Diagonal	18.625" ± 0.125"
Width	16.406" ± 0.125"
Height	13.343" ± 0.125"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	17.562"
Horizontal	15.125"
Vertical	12.000"
Area	172 Sq. Inches
Neck Length	4.125" ± 0.125"
Bulb	EIA J149A1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Weight	13.5 Pounds



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	18000	Volts
Minimum Anode Voltage (Note 2)	10000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	550	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater Negative with Respect to Cathode During Warm-up Period not to Exceed 45 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	400	Volts DC
Cathode Voltage for Raster Cutoff	36 to 94	Volts DC

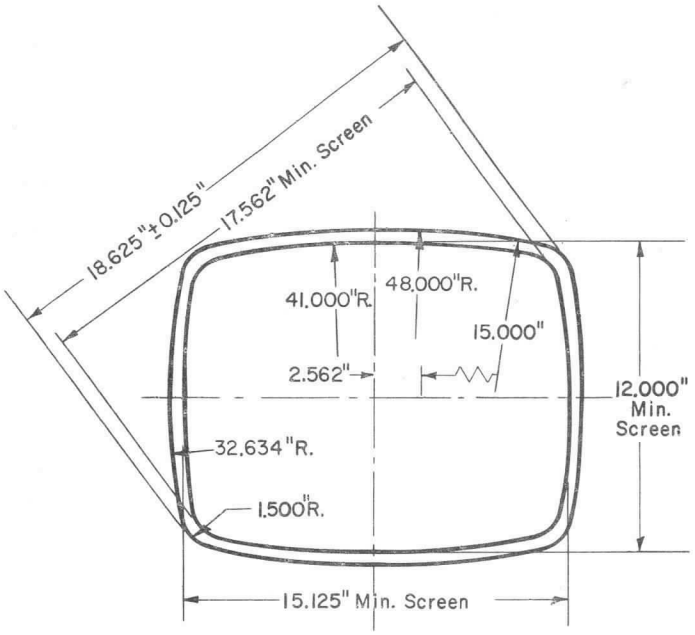
LIMITING CIRCUIT VALUES

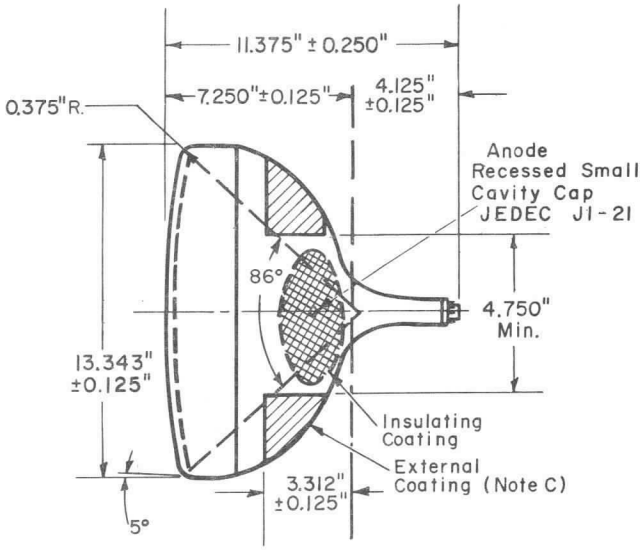
Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

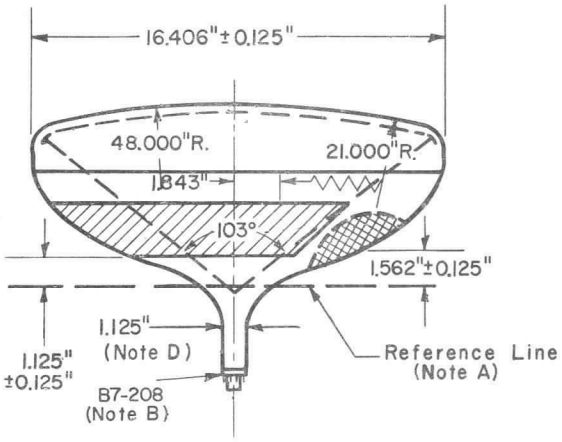
NOTES

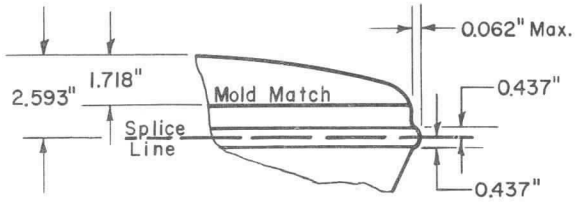
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 10000 volts is not recommended.
3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.
4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X – RAY WARNING: Operation with voltages in excess of 16 KV may require shielding to limit radiation of very soft x-rays.









CE-C1634 RI

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

C. External conductive coating forms supplementary filter capacitor and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

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Westinghouse®

19ERP4

September 15, 1965

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
12" × 15.125" MIN. SCREEN SIZE
4.125" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

BANDED IMPLOSION PROTECTION

6.3 VOLT, 600 MA HEATER
ALUMINIZED SCREEN
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

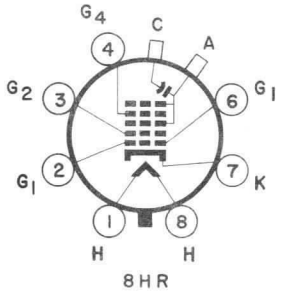
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	114 Degrees
Horizontal	102 Degrees
Vertical	86 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1750 pF
Maximum	1250 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	600 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	49%

MECHANICAL

Over-all Length	11.375" ± 0.250"
Neck Length	4.125" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	18.733" ± 0.100"
Width	16.552" ± 0.100"
Height	13.446" ± 0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	17.563"
Horizontal Axis	15.125"
Vertical Axis	12"
Area	172 Sq. Inches
Implosion Protection	Tension Band
Bulb Contact	EIA J1-21
Bulb	EIA J149F1
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	15 Pounds



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23000 Volts
Minimum Anode Voltage	11000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	550 Volts
Minimum Grid 2 Voltage	200 Volts
Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	300 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	.10000 Ohms

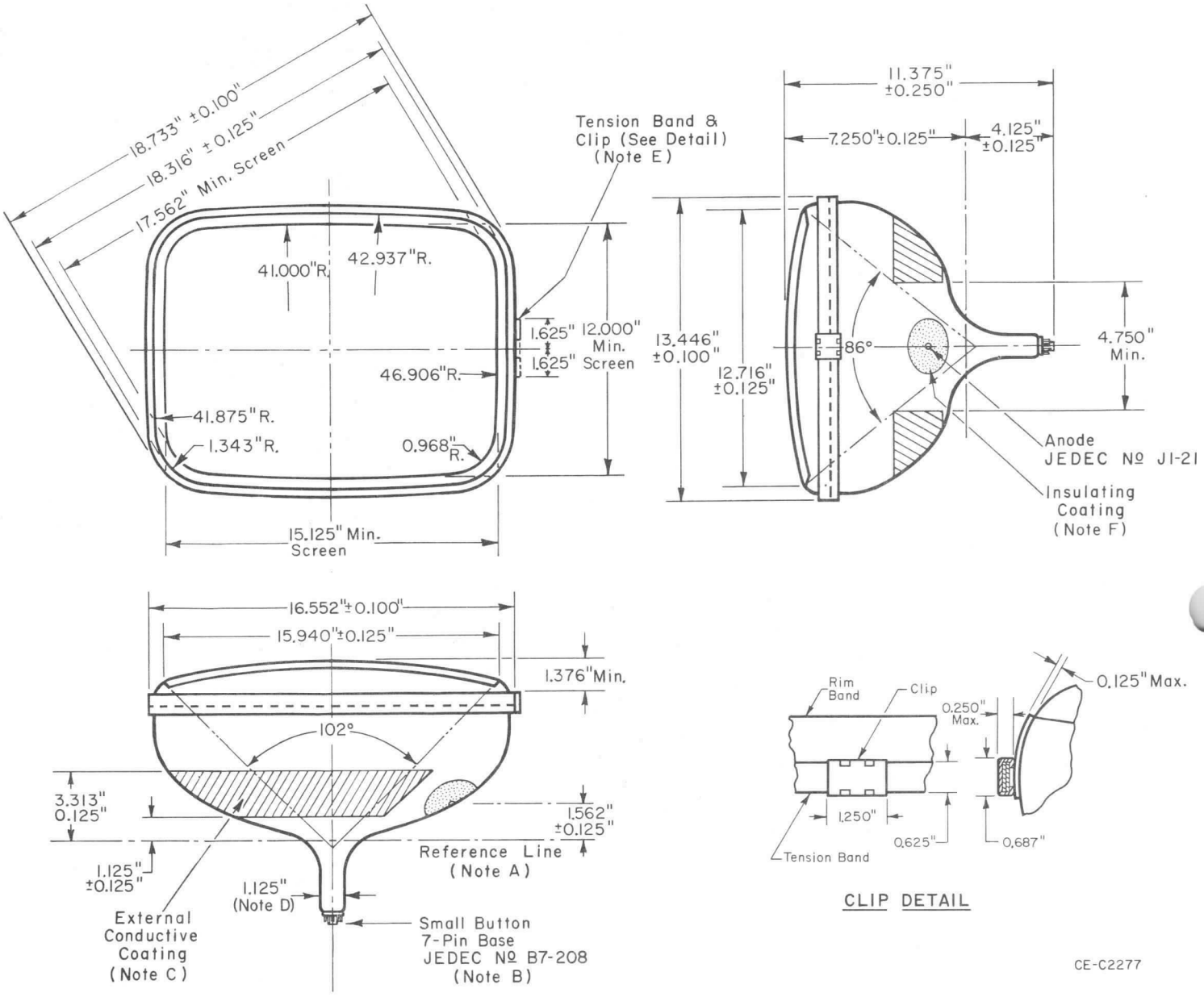
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	20000 Volts
Grid 4 Voltage (Focusing Electrode)	200 Volts
Grid 2 Voltage (Note 5)	400 Volts
Cathode Voltage for Raster Cutoff	36 to 78 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16 KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
4. With the cathode bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 12" by 15.125" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.
5. It is recommended that not less than 300 volts on grid 2 be used as resolution is affected at lower voltages.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Transparent insulating coating 3" in diameter. Clean only with soft, dry, lintless cloth.

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Westinghouse®

19FEP4A

September 15, 1965

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
12" × 15.125" MIN. SCREEN SIZE
4.375" NECK LENGTH
SPHERICAL GRAY FILTER GLASS
EXTERNAL CONDUCTIVE COATING

TENSION BAND
IMPLOSION PROTECTION

6.3 VOLT, 450 MA HEATER
LOW G2 VOLTAGE (30 VOLTS)
NO ION TRAP
ELECTROSTATIC FOCUS
ALUMINIZED SCREEN

DETAILED DATA

ELECTRICAL

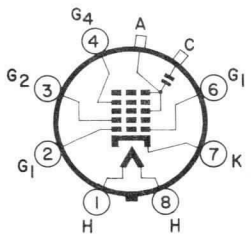
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	114 Degrees
Horizontal	103 Degrees
Vertical	86 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1250 pF
Maximum	1750 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	49%

MECHANICAL

Over-all Length	11.625" ± 0.250"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	18.733" ± 0.125"
Width	16.552" ± 0.125"
Height	13.446" ± 0.125"
Minimum Useful Screen Dimensions (projected):	
Diagonal	17.562"
Horizontal Axis	15.125"
Vertical Axis	12"
Area	172 Sq. Inches
Implosion Protection	Tension Band
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	15 Pounds
Bulb	EIA J149F1



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500 Volts
Minimum Anode Voltage	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	60 Volts
Minimum Grid 2 Voltage	20 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	200 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 2)	10000 Ohms

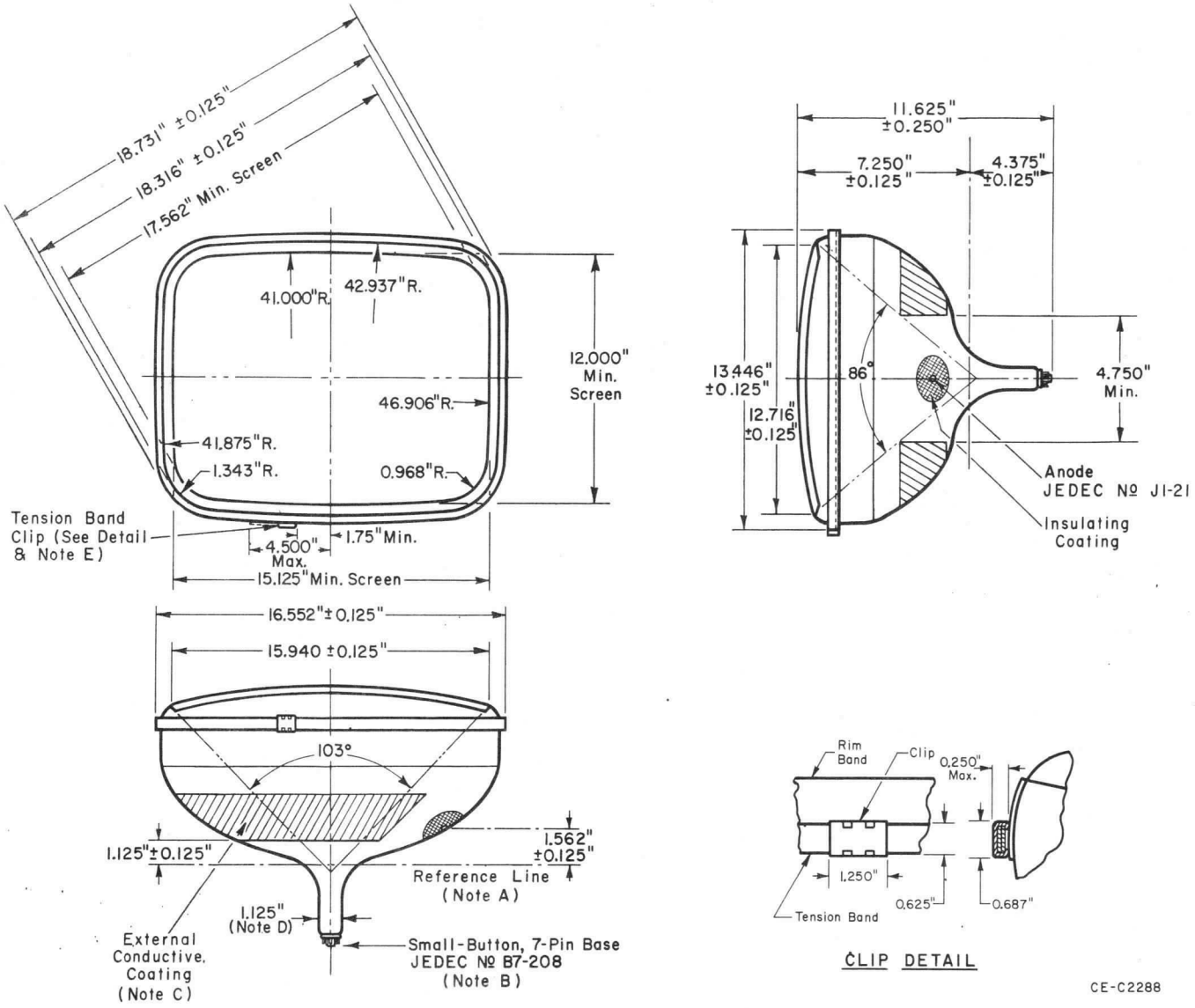
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400 Volts
Grid 2 Voltage	30 Volts
Cathode Voltage for Raster Cutoff	30 to 45 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16 KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

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Television Picture Tube

Westinghouse

Type: 19GEP4

19″ Black & White
Banded with Mounting Lugs Implosion Protection
114° Diagonal Magnetic Deflection
172 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater
400 Volt Grid 2

Electrical

Focusing Method . . Low Voltage Electrostatic
Deflection Method ..... Magnetic
Deflection Angles (Approx.):
- Diagonal ..... 114 Degrees
- Horizontal..... 102 Degrees
- Vertical ..... 86 Degrees

Direct Interelectrode Capacitances:
- Cathode to All Other Electrodes (Approx.) ..... 5 pF
- Grid No. 1 to All Other Electrodes (Approx.) ..... 6 pF
- External Conductive Coating to Anode: (Note 1)
  - Minimum ..... 1250 pF
  - Maximum ..... 1750 pF

Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum) ..... 5 Megohms
Heater Current at 6.3 Volts . . . 450 ± 5% mA
Heater Warm-up Time (Note 2) . . 11 Seconds

Optical

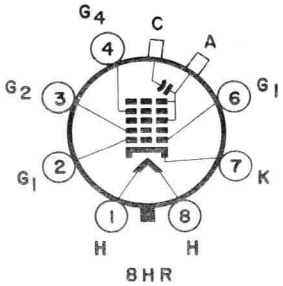
Phosphor Number ..... Aluminized P4
Light Transmittance at Center (Approx.) 49%

Mechanical

Over-all Length ..... 11.625″ ± 0.250″
Neck Length ..... 4.375″ ± 0.125″
Greatest Dimensions of Tube: (Excluding Mounting Lugs)
- Diagonal ..... 18.733″ ± 0.125″
- Width ..... 16.552″ ± 0.125″
- Height ..... 13.446″ ± 0.125″

Minimum Useful Screen Dimensions (projected):
- Diagonal ..... 17.562″
- Horizontal Axis ..... 15.188″
- Vertical Axis..... 12.000″
- Area ..... 172 Sq. Inches

Implosion Protection ..... Tension Band with Mounting Lugs
Bulb Contact ..... EIA J1-21
Base ..... EIA B7-208
Basing ..... EIA 8HR
Net Weight ..... 15 Pounds
Bulb ..... EIA J149-F1A



8HR

Ratings

Unless Otherwise Specified, Voltage Values are Positive and Measured with respect to Grid 1.

Maximum Anode Voltage (Note 3)	23000 Volts
Minimum Anode Voltage	11000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	550 Volts
Minimum Grid 2 Voltage	200 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	300 Volts
Heater Positive with respect to Cathode	200 Volts

Limiting Circuit Values

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000 Ohms

Typical Cathode Drive Operation

Unless Otherwise Specified, Voltage Values are Positive with respect to Grid 1.

Anode Voltage (Note 3)	18000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400 Volts
Grid 2 Voltage	400 Volts
Cathode Voltage for Raster Cut-off	36 to 78 Volts

Notes

1. Includes implosion protection hardware.
2. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
3. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
4. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.

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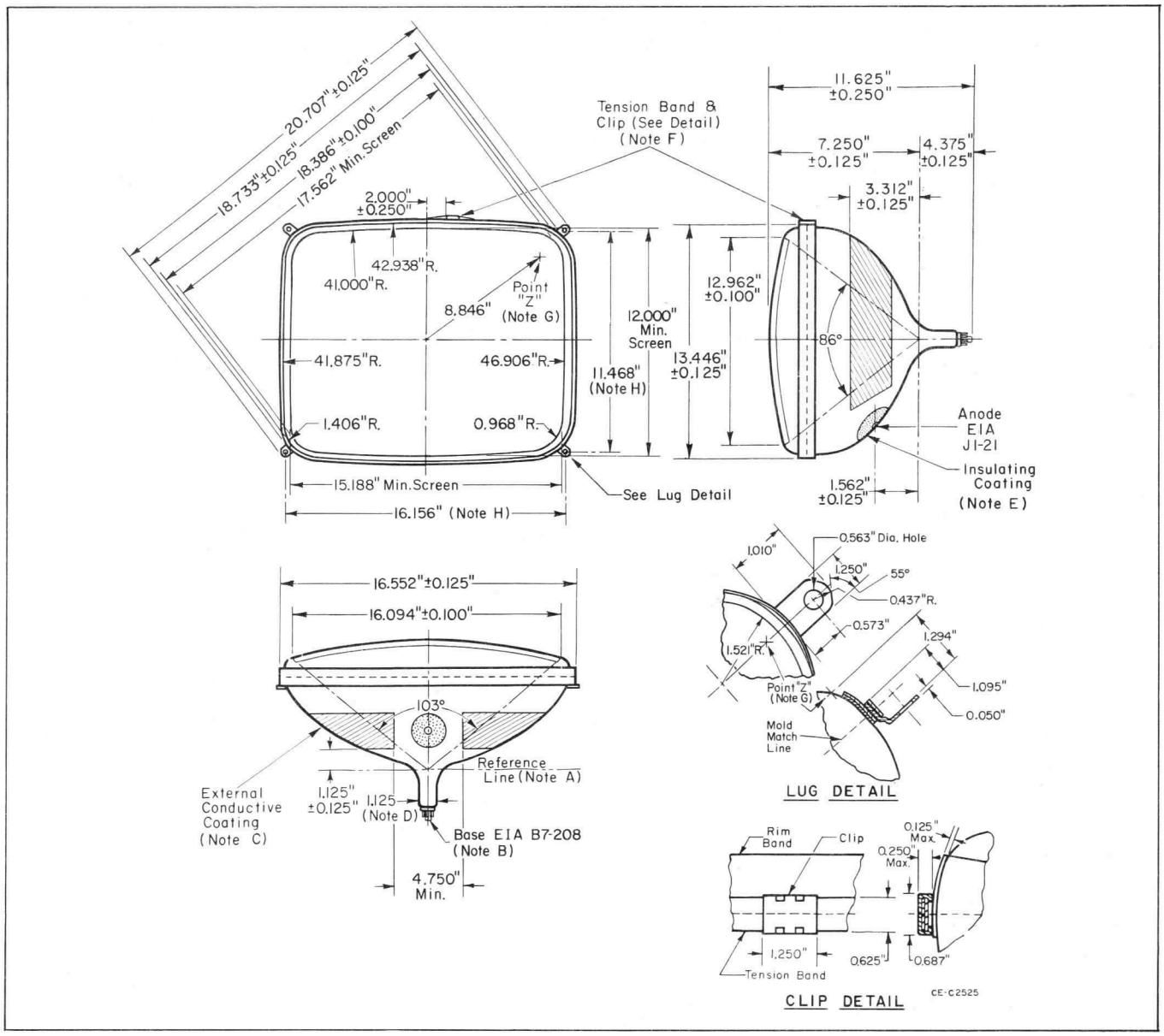
October 1968
New Information
S6–2B–11C, S5–10B, WI–600

Television Picture Tube

Type: 19GEP4

19″ Black & White
Banded with Mounting Lugs Implosion Protection
114° Diagonal Magnetic Deflection
172 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater
400 Volt Grid 2



Outline Notes

A. Yoke Reference Line is determined by plane surface of flared end of EIA Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125″ from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750″ diameter circle concentric with tube axis. Base pin 2 aligns with minor axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168″ at the splice.

E. Transparent insulating coating, 3″ in diameter. Clean only with soft, dry, lintless cloth.

F. Tension band must be grounded.

G. Point "Z" is located on the tube diagonal at the faceplate surface.

H. Tube shall fit on 0.312″ pegs centered at corners of 11.468″ x 16.156″ rectangle. (Suggested stud diameter is 0.200″ to 0.250″).

Westinghouse Electric Corporation
Electronic Tube Division, Elmira, N.Y. 14902
Printed in U.S.A.

TELEVISION PICTURE TUBE TYPE 19YP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
12" x 15-1/8" Screen Size

ELECTRICAL:

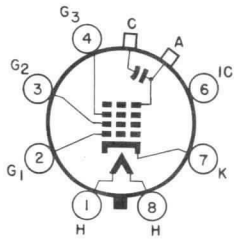
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	103	Degrees
Vertical	86	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	1500	μμf
Minimum	1000	μμf
Heater Current at 6.3 volts	600 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	10-13/16 ± 1/4	Inches
Greatest Dimensions of Tube:		
Diagonal	18-5/8 ± 1/8	Inches
Width	16-13/32 ± 1/8	Inches
Height	13-11/32 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	17-9/16	Inches
Horizontal	15-1/8	Inches
Vertical	12	Inches
Area	172	Sq. Inches
Neck Length	3-9/16 ± 1/8	Inches
Bulb	J149A1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8JR	
Weight	13-1/2 Pounds	



8 JR

RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	20000	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 3 Voltage (Focusing Electrode)	+850, −200	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	16000	Volts DC
Grid 3 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	41 to 69	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 3 Circuit Resistance (Note 4)	10000	Ohms

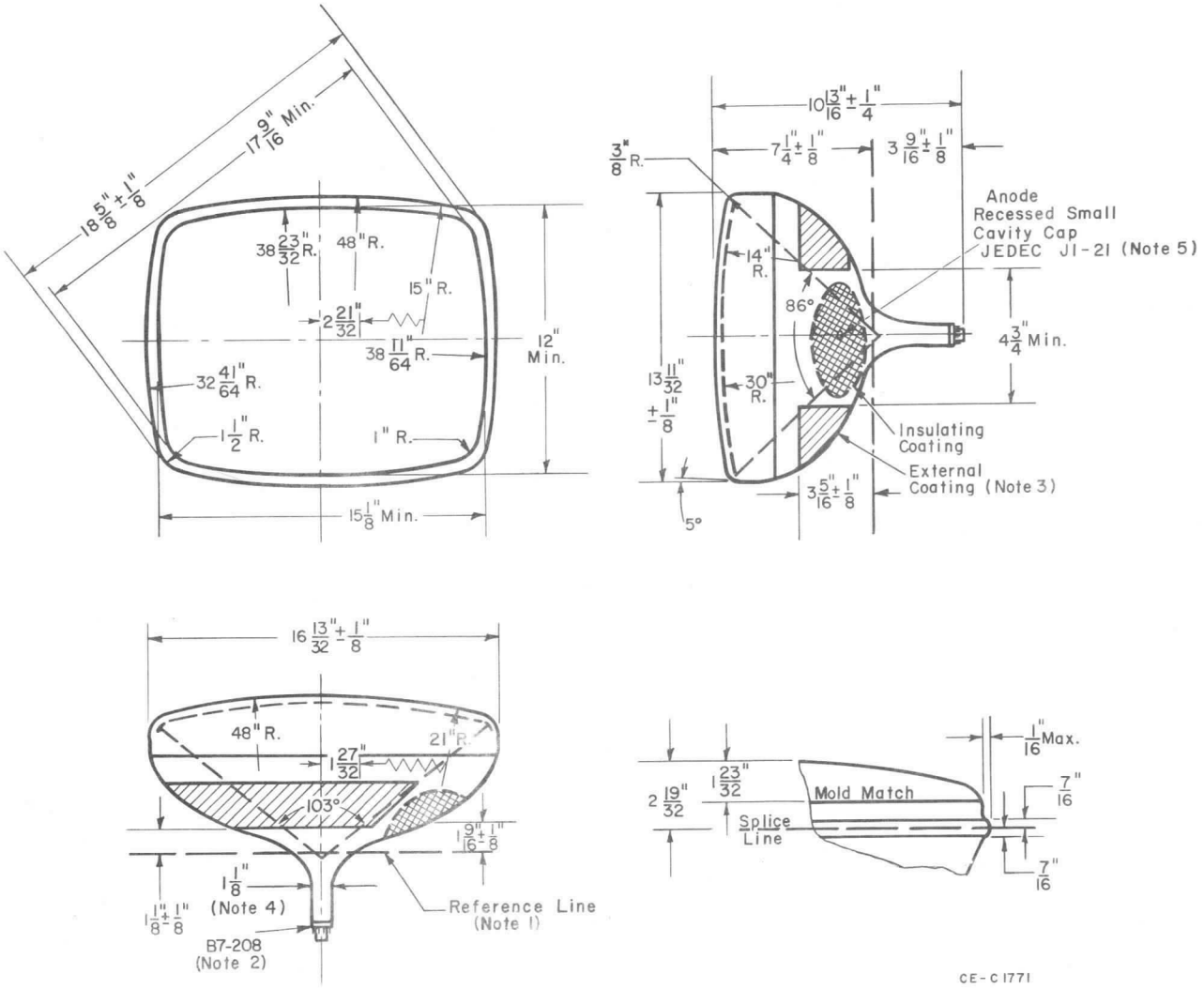
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts in not recommended.

3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 3 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

The information contained herein is supplied without assuming responsibility for infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Westinghouse Electric Corporation.

Television Picture Tube

Westinghouse

20″ Black & White
Tension Band Implosion Protection
114° Diagonal Deflection
184 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater
30 Volt Grid 2 - 20AEP4

Electrical

Focusing Method . . Low Voltage Electrostatic
Deflection Method ..... Magnetic
Deflection Angles (Approx.):
- Diagonal ..... 114 Degrees
- Horizontal ..... 99 Degrees
- Vertical ..... 82 Degrees

Direct Interelectrode Capacitances:
- Cathode to All Other Electrodes (Approx.) ..... 5 pF
- Grid No. 1 to All Other Electrodes (Approx.) ..... 6 pF
- External Conductive Coating to Anode:
  - Minimum ..... 1500 pF
  - Maximum ..... 2200 pF

Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum) ..... 5 Megohms
Heater Current at 6.3 Volts . . . 450 ± 5% mA
Heater Warm-up Time (Note 1) . . 11 Seconds

Optical

Phosphor Number ..... Aluminized P4
Light Transmittance at Center (Approx.) 44%

Mechanical

Over-all Length ..... 12.269″ ± 0.250″
Neck Length ..... 4.375″ ± 0.125″
Greatest Dimensions of Tube:
- Diagonal ..... 19.796″ ± 0.110″
- Width ..... 16.867″ ± 0.100″
- Height ..... 13.562″ ± 0.100″

Minimum Useful Screen Dimensions (projected):
- Diagonal ..... 18.625″
- Horizontal Axis ..... 15.500″
- Vertical Axis ..... 12.125″
- Area ..... 184 Sq. Inches

Implosion Protection ..... Tension Band
Bulb Contact ..... EIA J1-21
Base ..... EIA B7-208
Basing ..... EIA 8HR
Net Weight ..... 20 Pounds
Bulb ..... EIA J157½A1

Ratings

Unless Otherwise Specified, Voltage Values are Positive with respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500 Volts
Minimum Anode Voltage	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	60 Volts
Minimum Grid 2 Voltage	20 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	200 Volts
Heater Positive with respect to Cathode	200 Volts

Limiting Circuit Values

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000 Ohms

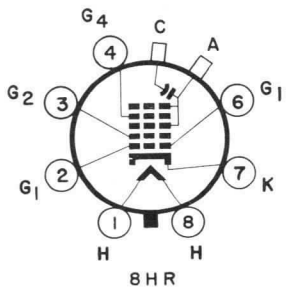
Typical Cathode Drive Operation

Unless Otherwise Specified, Voltage Values are Positive with respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400 Volts
Grid 2 Voltage	30 Volts
Cathode Voltage for Raster Cutoff	30 to 45 Volts

Notes

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.

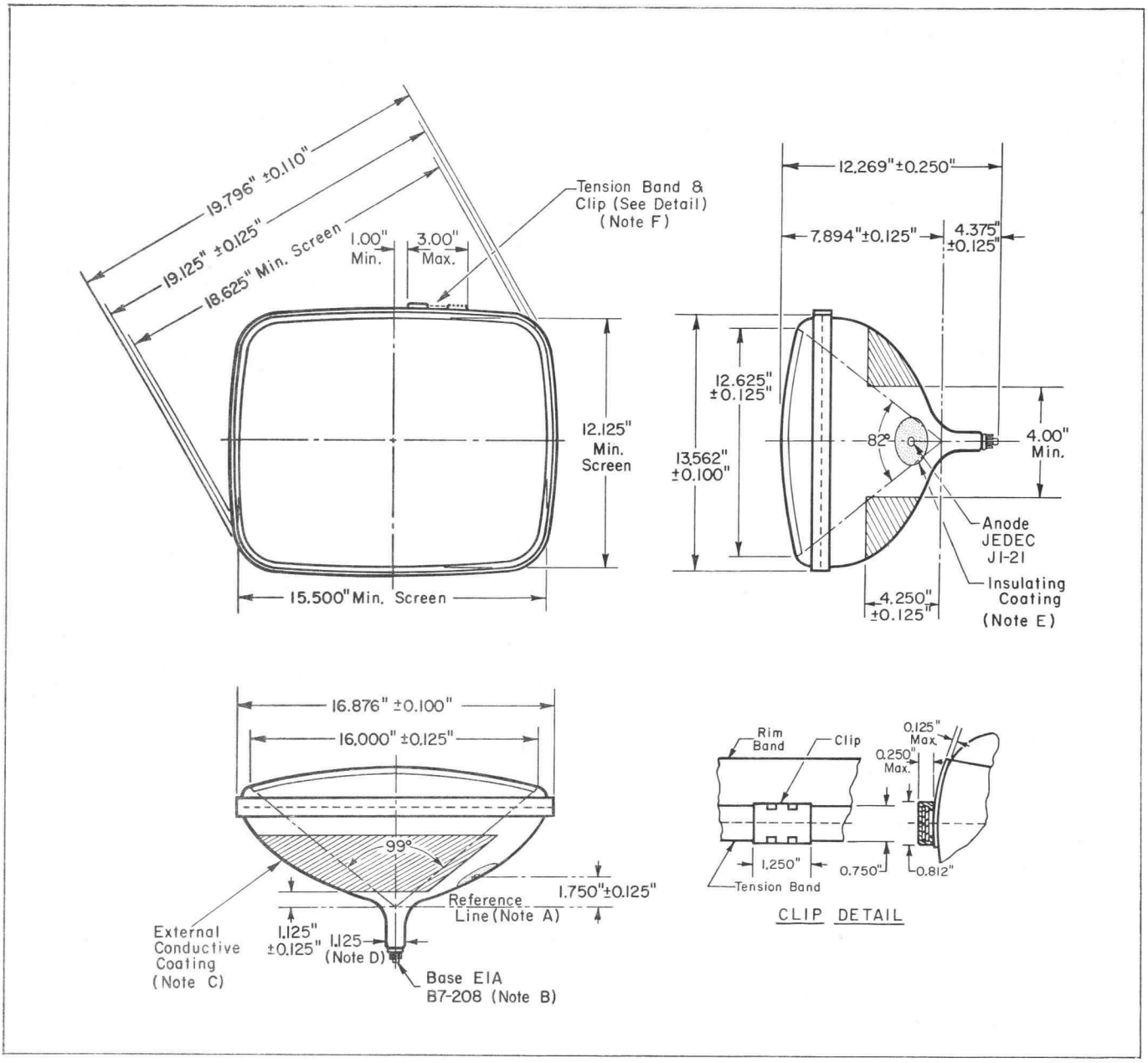


8HR

August 1968
New Information
S6–2B–11C, S5–10B, WI–600

Television Picture Tube

20″ Black & White
Tension Band Implosion Protection
114° Diagonal Deflection
184 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater
30 Volt Grid 2 - 20AEP4



Outline Notes

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750″ diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168″ at the splice.

E. Transparent insulating coating, 3″ in diameter. Clean only with soft, dry, lintless cloth.

F. Tension and rim bands must be grounded. The tension band will not extend in front of the rim band anywhere along the perimeter.

G. The maximum dimensions are to the outside of the tension band.

Westinghouse Electric Corporation
Electronic Tube Division
Printed in U. S. A.

April 1, 1957

TELEVISION PICTURE TUBE TYPE 21CBP4 AND 21CBP4-A

90° Deflection
Rectangular Glass Construction
Magnetic Deflection

Electrostatic Focus
No-Ion-Trap

External Conductive Coating
Spherical Face Plate
15-1/16" x 19-1/16" Picture Size

The 21CBP4 and 21CBP4-A are electrostatic focus, rectangular glass picture tubes. They both have spherical, neutral gray glass faceplates, an aluminized screen and an external conductive coating. The 21CBP4-A has a maximum anode voltage rating of 20,000 volts.

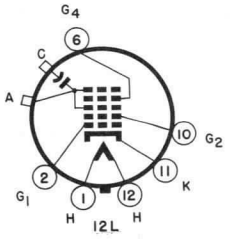
The 21CBP4 and 21CBP4-A feature a new-design no-ion-trap gun which is shorter than ion-trap guns. This new gun, in a 90° bulb, permits the design of a tube approximately 5 inches shorter than 70° tubes employing standard guns. This is advantageous to the design of a more compact television receiver cabinet.

ELECTRICAL:

Cathode	Coated Unipotential
Heater:	
Voltage	6.3 ac or dc Volts
Current	0.6 Ampere
Direct Interelectrode Capacitances:	
Grid 1 to all other Electrodes	6 uuf
Cathode to all other Electrodes	5 uuf
External Conductive Coating to Anode:	
Maximum	2500 uuf
Minimum	2000 uuf
Screen:	
Phosphor	No. 4 Sulfide Type
Fluorescence	White
Persistence	Short
Focusing Method	Low-Voltage Electrostatic
Deflection Method	Magnetic
Horizontal Angle (Approx.)	85°
Vertical Angle (Approx.)	68°
Diagonal Angle (Approx.)	90°
No-Ion-Trap Gun	No Magnet Required

MECHANICAL:

Mounting Position	Any
Screen Dimensions:	
Height	15-1/16" min.
Width	19-1/16" min.
Diagonal	20-1/4" min.
Face Plate	Spherical Outer and Inner Surfaces
Glass	Neutral Filter
Transmission	74 per cent
Bulb Dimensions:	
Height	16-3/8" = 1/8"
Width	20-1/4" = 1/8"
Diagonal	21-3/8" = 1/8"
Overall Length	18" = 3/8"
Anode Terminal	Recessed Small Cavity Cap (JETEC J1-21)
Base	Small Shell Duodecal 6-Pin (JETEC B6-63)



Bottom View
A - Grids 3 & 5, Collector.
C - External Conductive Coating

MAXIMUM RATINGS:

Design Center Values	
Anode, Grid 3 & 5 Voltage †	18000 max. Volts
Grid 4 Voltage	
Positive Value	1000 max. Volts
Negative Value	500 max. Volts
Grid 2 Voltage	500 max. Volts
Grid 1 Voltage	
Negative Bias Value	140 max. Volts
Positive Bias Value	0 max. Volts
Positive Peak Value	0 max. Volts
Peak Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warmup Period of 15 Seconds Maximum	410 max. Volts
After Equipment Warmup Period	180 max. Volts
Heater Positive with Respect to Cathode:	180 max. Volts

TYPICAL OPERATING CONDITIONS

For Anode Voltage	14000	18000 Volts
For Grid 2 Voltage	300	300 Volts
Grid 4 Voltage for Focus With Anode Current of 100 uamperes	-55 to 300	-70 to 396 Volts
Grid 1 Voltage for Visual Extinction of Focused Raster*	-28 to -72	-28 to -72 Volts
Maximum Circuit Value:		
Grid 1 Circuit Resistance		1.5 max. Megohms
Grid 2 Circuit Resistance▲		.1 min. Megohms
Focus Electrode Circuit Resistance▲		.1 min. Megohms

* Raster size 19-1/16" x 15-1/16".

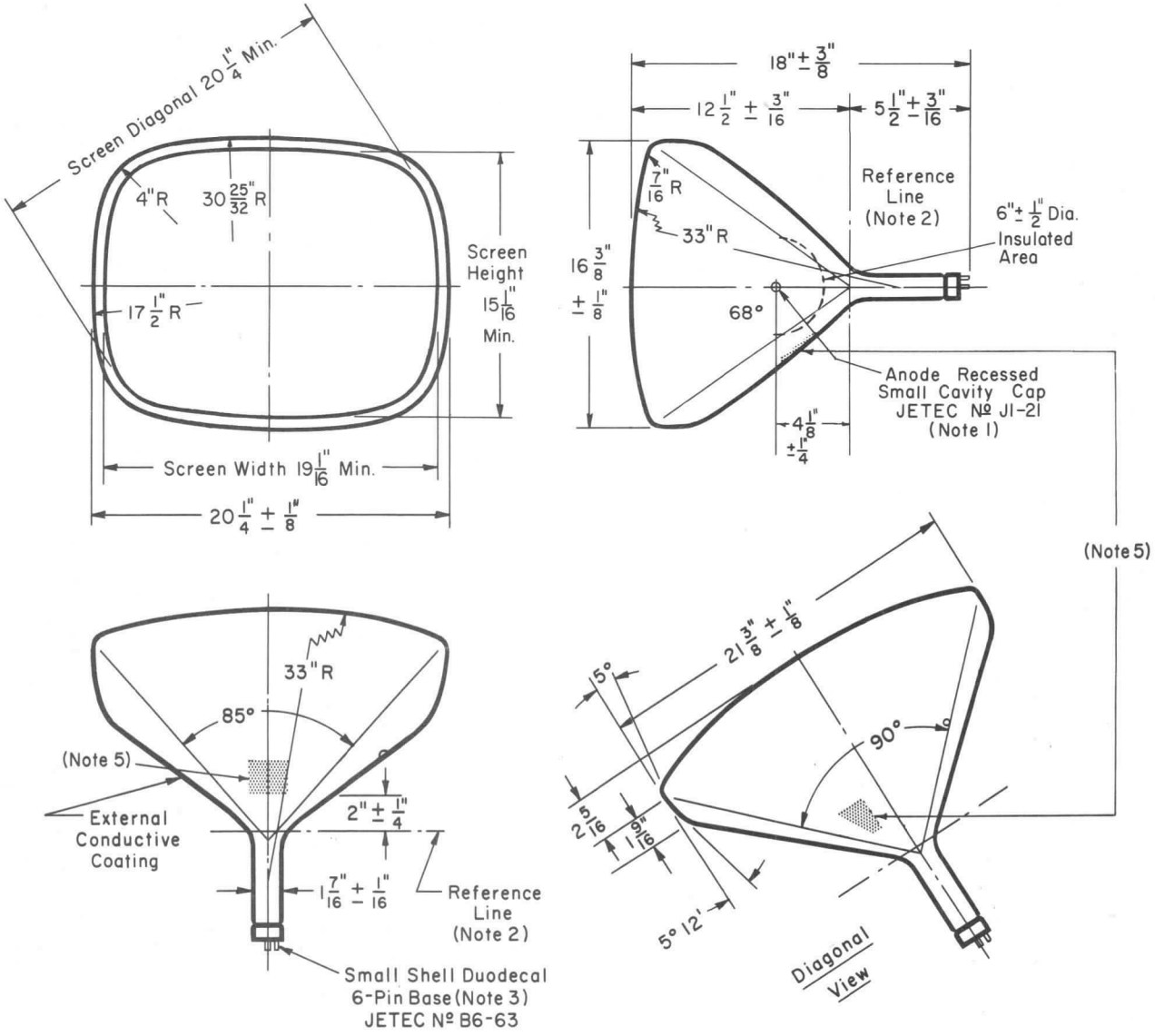
▲ Protective resistance in the Grid 2 and Focus Electrode circuit is advisable to prevent damage to the tube.

† Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 14000 volts.

Inasmuch as the tube rating permits operation at voltages as high as 22 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltage in excess of 16 kilovolts.

Cathode Ray Tube Section

OUTLINE DRAWING



CE-C1265

NOTE 1: The plane through the tube axis and the base pin No. 6 may vary from the plane through the tube axis and the bulb terminal by an angular tolerance of ±30° measured about the tube axis. The bulb terminal is on the same side of the tube as pin No. 6.

NOTE 2: With the tube neck inserted through the flared end of REFERENCE-Line Gauge (JETEC No. 116) and with the tube seated in the gauge, the reference line is determined by the intersection of the plane cc' (face of the flared end) of the gauge with the glass funnel.

NOTE 3: The socket should not be mounted rigidly but it should be allowed to move freely and it should have flexible leads. The bottom circumference of the base shell will lie within a circle concentric with the bulb axis and having a diameter of 2 3/4".

NOTE 4: External conductive coating must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. x 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

May 16, 1958

TELEVISION PICTURE TUBE TYPE 21CEP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Neutral Gray Glass

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/16" x 15-1/16" Picture

The 21CEP4 is a low-voltage-electrostatic focus, rectangular glass picture tube. It has a spherical neutral gray glass faceplate, an aluminized screen and an external conductive coating.

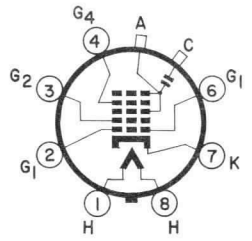
The 21CEP4 features wide angle (110°) deflection and an improved, short, electron gun. As a result of these features, the overall length is greatly reduced. Television receiver designers using this tube can employ more compact cabinets than were previously required for 21" tubes. The 21CEP4 also has a smaller diameter neck permitting more efficient deflection. By this means the power necessary to fully scan the picture area is little more than that required for a 90° Tube.

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.60	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	uuf
Cathode to all other Electrodes	5	uuf
External Conductive Coating to Anode:		
Maximum	2500	uuf
Minimum	2000	uuf
Screen:		
Phosphor	No. 4 Sulfide Type	
Fluorescence	White	
Persistance	Short	
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Horizontal Angle	105°	
Vertical Angle	87°	
Diagonal Angle	110°	
No Ion Trap	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions:	
Height	15-1/16"
Width	19-1/16"
Diagonal	20-1/4"
Area	262 sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission	73%
Bulb Dimensions:	
Height	16-3/8" ± 1/8"
Width	20-1/4" ± 1/8"
Diagonal	21-3/8" ± 1/8"
Overall Length	14-7/16" ± 5/16"
Anode Terminal	Recessed Small Cavity Cap (JETEC J1-21)
Base	Small Button 7-Pin ((JETEC B7-183)
Basing	8HR
Net Weight	23 Pounds



8HR

CATHODE DRIVE OPERATION

MAXIMUM RATINGS:

Design Center Values

Anode to Grid 1 Voltage	18000▲	max.	Volts
Grid 4 to Grid 1 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 to Grid 1 Voltage	640	max.	Volts
Cathode to Grid 1 Voltage:			
Positive Bias Value	140	max.	Volts
Positive Peak Value	200	max.	Volts
Negative Bias Value	0	max.	Volts
Negative Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode	180	max.	Volts
Heater Positive with respect to Cathode	180	max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage♦	14000	16000	Volts
Grid 4 to Grid 1 Voltage	0 to +400	0 to +400	Volts
Grid 2 to Grid 1 Voltage	300	400	Volts
Cathode to Grid 1 Voltage for Raster Cutoff	28 to 60	28 to 60	Volts

GRID DRIVE OPERATION

MAXIMUM RATINGS:

Design Center Values

Anode Voltage	18000▲	max.	Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode	180	max.	Volts
Heater Positive with respect to Cathode	180	max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode Voltage♦	14000	16000	Volts
Grid 4 Voltage	0 to +400	0 to +400	Volts
Grid 2 Voltage	300	400	Volts
Grid 1 Voltage for Raster Cutoff	-28 to -72	-36 to -94	Volts

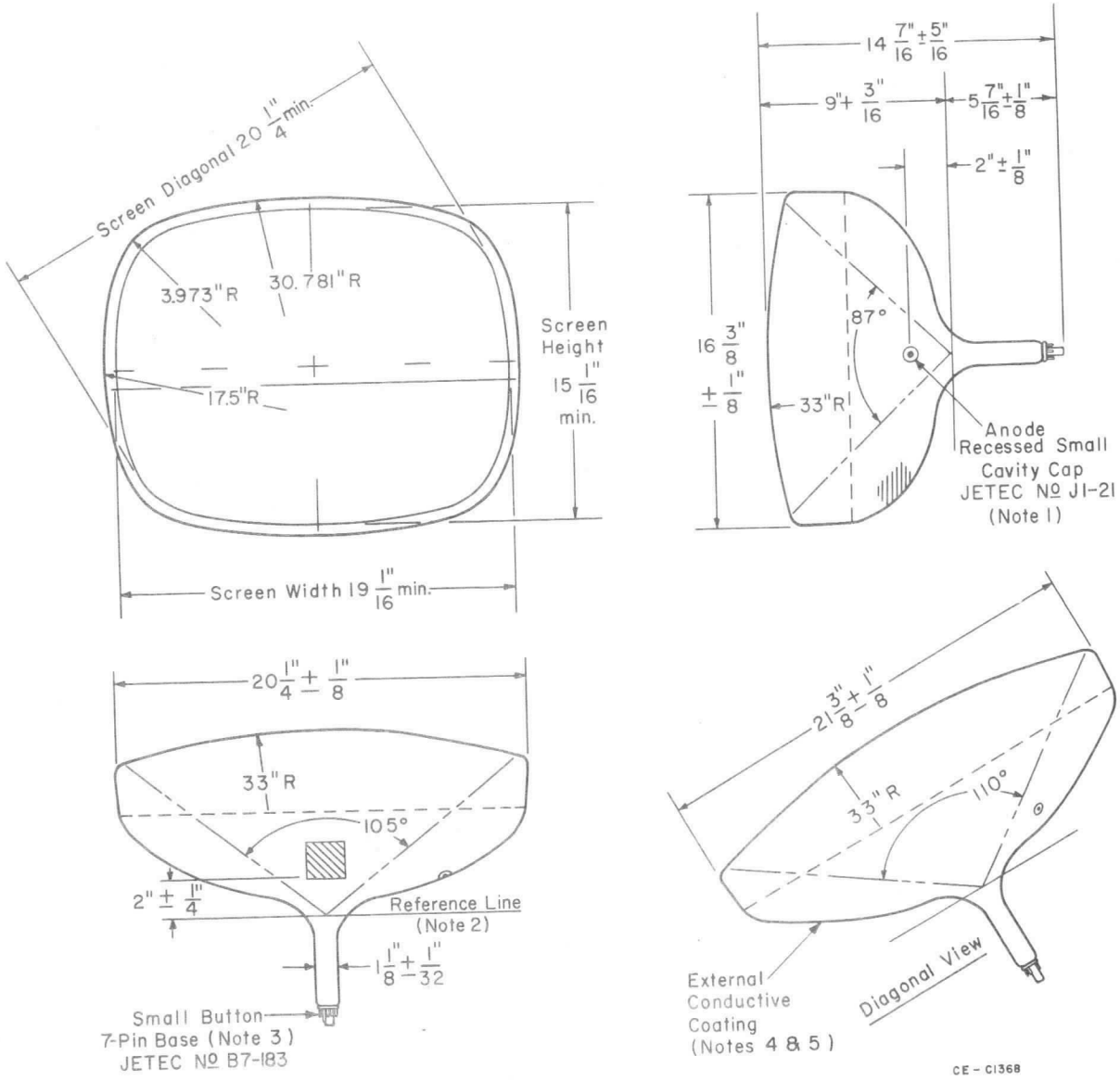
LIMITING CIRCUIT VALUES:

Grid 4 Resistance to Voltage Source■	0.10	min.	Megohms
Grid 2 Resistance to Voltage Source■	0.10	min.	Megohms
Grid 1 Circuit Resistance	1.5	max.	Megohms

♦ Operation with anode voltage or anode to grid 1 voltage less than 12000 volts is not recommended.

■ Protective resistance in the grid 4 and grid 2 circuits is advisable to prevent damage to the tube. If applicable, one resistor common to both circuits may be used.

▲ Inasmuch as the tube rating permits operation at voltages as high as 19.8 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed when operating conditions involve voltages in excess of 16 kilovolts.



NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ±30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress latual strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. x 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

December 15, 1958

TELEVISION PICTURE TUBE TYPE 21DAP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Neutral Gray Glass

Light Weight Bulb

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/16" x 15-1/16" Picture

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.60	Ampere
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	uuf
Cathode to all other Electrodes	5	uuf
External Conductive Coating to Anode:		
Maximum	2500	uuf
Minimum	2000	uuf
Screen:		
Phosphor	No. 4 Sulfide Type	
Fluorescence	White	
Persistance	Short	
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Horizontal Angle	105°	
Vertical Angle	87°	
Diagonal Angle	110°	
No Ion Trap	No Magnet Required	

MECHANICAL:

Mounting Position	Any
Screen Dimensions: Minimum	
Height	15-1/16"
Width	19-1/16"
Diagonal	20-1/4"
Area	262 sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission	74%
Bulb Dimensions: Bulb No.	J171G1 or Equiv.
Height	16-3/8" ± 1/8"
Width	20-1/4" ± 1/8"
Diagonal	21-3/8" ± 1/8"
Overall Length	14-11/16" ± 5/16"
Neck Length	5-7/16"
Anode Terminal	Recessed Small Cavity Cap (JETEC J1-21)
Base	Small Button 7-Pin ((JETEC B7-183)
Basing	8HR
Net Weight	20 Pounds

MAXIMUM RATINGS:

Design Center Values

Anode Voltage	18000▲ max.		Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Positive Bias Value	0	max.	Volts
Positive Peak Value	0	max.	Volts
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode #	180	max.	Volts
Heater Positive with respect to Cathode	180	max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode Voltage♦	14000	16000	Volts
Grid 4 Voltage	0 to 1400	0 to 400	Volts
Grid 2 Voltage	300	400	Volts
Grid 1 Voltage for Raster Cutoff	-28 to -72	-36 to -94	Volts

LIMITING CIRCUIT VALUES:

Grid 4 Resistance to Voltage Source■	10000	min.	Ohms
Grid 2 Resistance to Voltage Source■	10000	min.	Ohms
Grid 1 Circuit Resistance	1.5	max.	Megohms

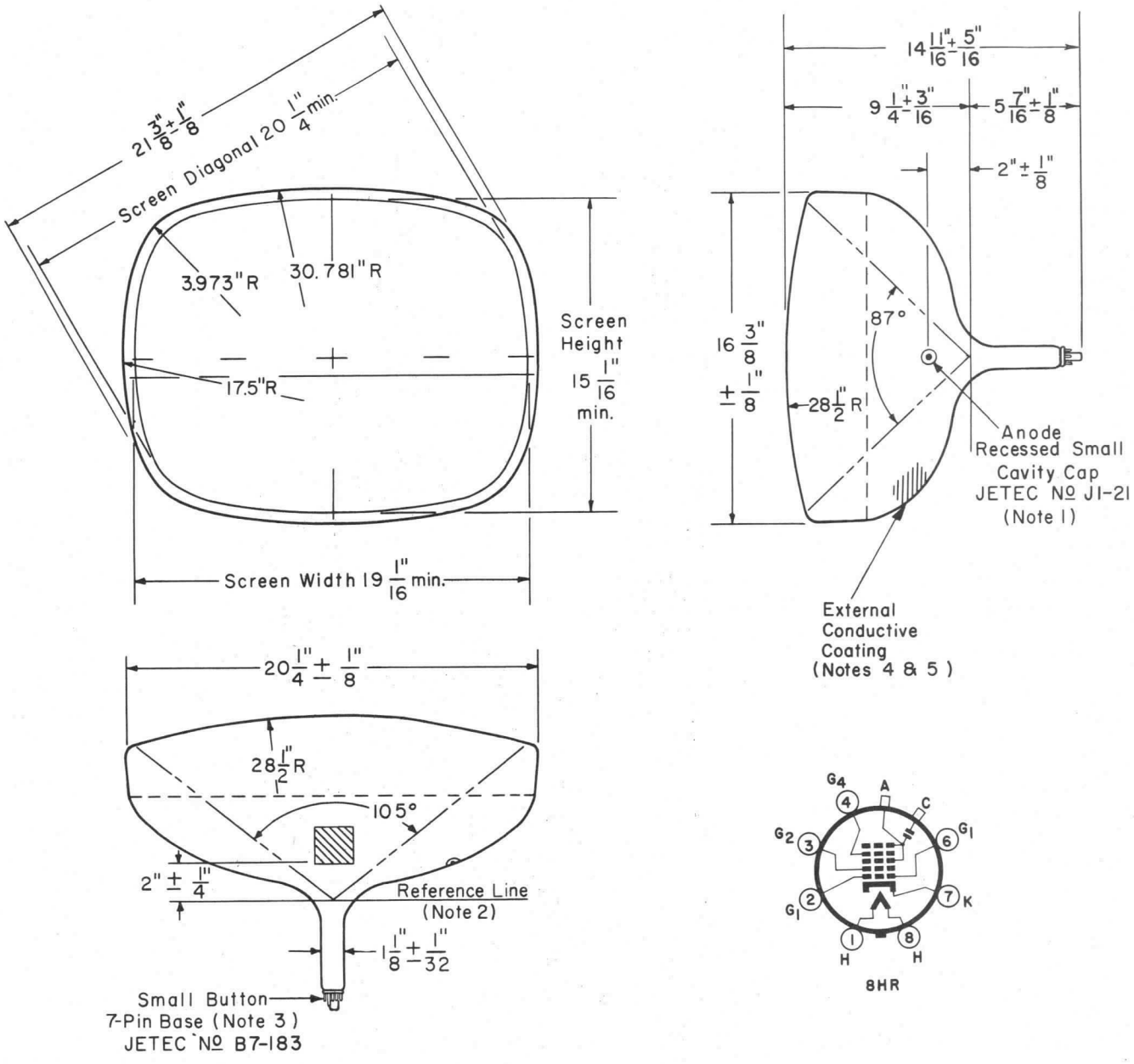
♦ Operation with anode voltage or anode to grid 1 voltage less than 12000 volts is not recommended.

■ Protective resistance in the grid 4 and grid 2 circuits is advisable to prevent damage to the tube. If applicable, one resistor common to both circuits may be used.

▲ Inasmuch as the tube rating permits operation at voltages as high as 19.8 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed when operating conditions involve voltages in excess of 16 kilovolts.

During 15 second warmup period this value may be 410 max. volts.

Note: With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.



CE-C1414

NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ±30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. × 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

December 3, 1958

TELEVISION PICTURE TUBE TYPE 21DLP4

90° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Electrostatic Focus
4-1/2" Neck Length

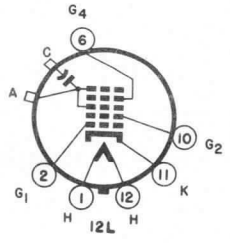
External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/16" x 15-1/16" Picture

ELECTRICAL:

Cathode	Coated Unipotential
Heater:	
Voltage (ac or dc)	6.3 Volts
Current	0.6 Ampere
Direct Interelectrode Capacitances:	
Grid 1 to all other Electrodes	6 uuf
Cathode to all other Electrodes	5 uuf
External Conductive Coating:	
Maximum	2500 uuf
Minimum	2000 uuf
Screen:	
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short
Focusing Method	Electrostatic
Deflection Method	Magnetic
Horizontal Angle (Approx.)	85°
Vertical Angle (Approx.)	68°
Diagonal Angle (Approx.)	90°
No Ion Trap Gun	No Magnet Required

MECHANICAL:

Mounting Position	Any
Screen Dimensions:	
Minimum Screen Area	262 Sq. In.
Height	15-1/16" Min.
Width	19-1/16" Min.
Diagonal	20-1/4" Min.
Face Plate	Spherical Outer and Inner Surfaces
Glass	Neutral Filter
Transmission	74 per cent
Bulb Number	J171E1 or Equiv.
Bulb Dimensions:	
Height	16-3/8" ± 1/8"
Width	20-1/4" ± 1/8"
Diagonal	21-3/8" ± 1/8"
Neck Length	4-1/2"
Overall Length	17" ± 3/8"
Net Weight (Approx.)	23 Pounds
Anode Terminal	Recessed Small Cavity Cap (JETEC J1-21)
Base	Short Small Duodecal 6-Pin (JETEC B6-203)



MAXIMUM RATINGS, Grid Drive Service:

Design Center Values

Anode Voltage■	20000 max.	Volts
Grid 4 Voltage:		
Positive Value	1000 max.	Volts
Negative Value	500 max.	Volts
Grid 2 Voltage	500 max.	Volts
Grid 1 Voltage:		
Negative Bias Value	140 max.	Volts
Negative Peak Value	200 max.	Volts
Positive Bias Value	0 max.	Volts
Positive Peak Value	0 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warmup Period of 15 sec. max.	410 max.	Volts
After Equipment Warmup Period	180 max.	Volts
Heater Positive with Respect to to Cathode	180 max.	Volts

TYPICAL OPERATING CONDITIONS, Grid Drive Service:

Anode Voltage*	14000	16000 Volts
Grid 4 Voltage	-50 to +350	0 to 400 Volts
Grid 2 Voltage♦	450	450 Volts
Grid 1 Voltage for Raster Cutoff▲	-45 to -105	-45 to -105 Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5 max.	Megohms
Grid 2 Circuit Resistance**	10000 min.	Ohms
Grid 4 Circuit Resistance**	10000 min.	Ohms

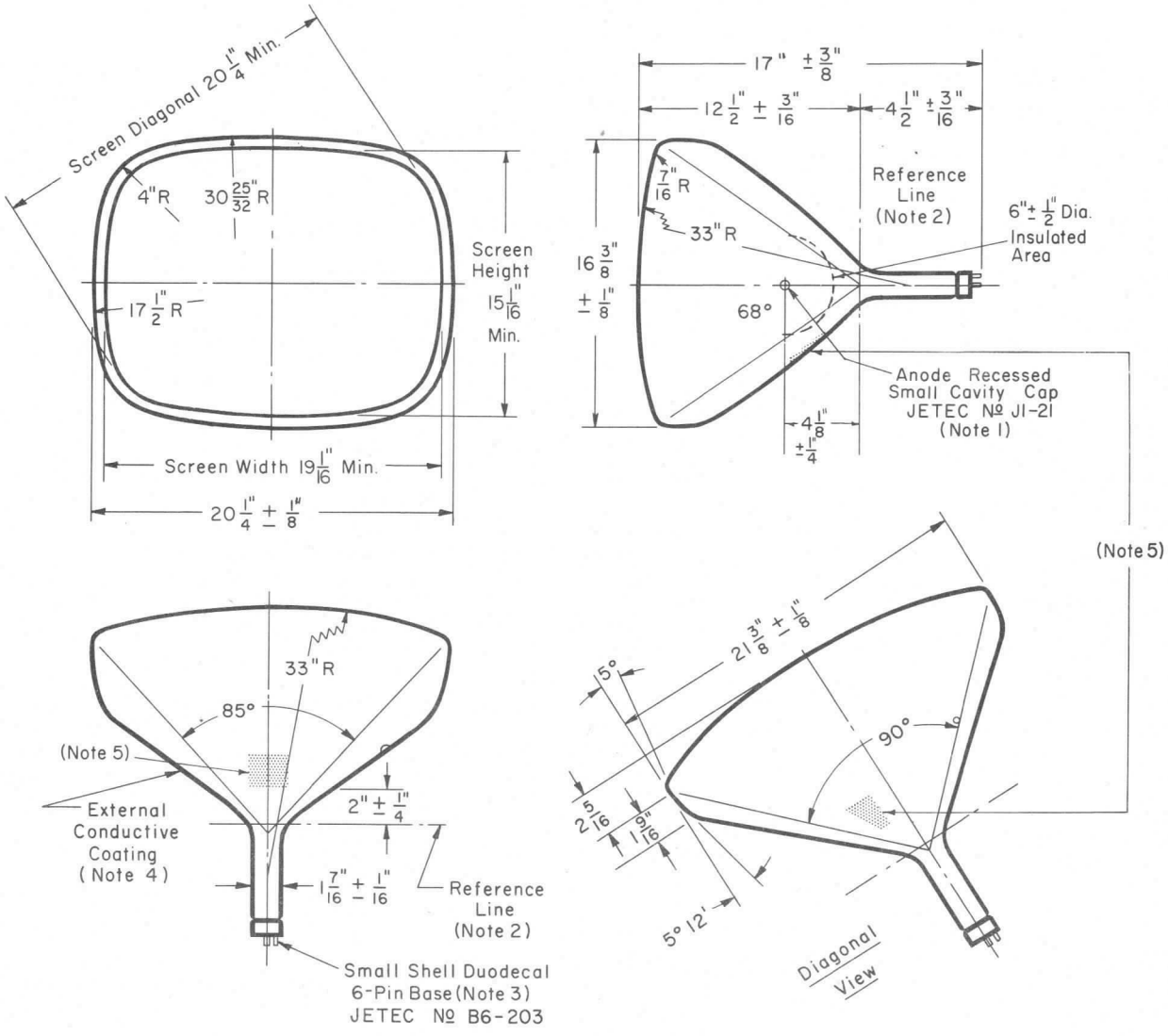
* Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12000 volts.

**Protective resistance in the G_2 and G_4 circuits is advisable to prevent damage to the tube.

▲ Raster size 19-1/16" x 15-1/16"

■ Inasmuch as the tube rating permits operation at voltages as high as 22 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed whenever the operating conditions involve voltage in excess of 16 kilovolts.

♦ It is recommended that Grid 2 be operated at a voltage greater than 300 volts since resolution is affected at lower voltages.



CE-C1404

NOTE 1: The plane through the tube axis and the base pin No. 6 may vary from the plane through the tube axis and the bulb terminal by an angular tolerance of ±30° measured about the tube axis. The bulb terminal is on the same side of the tube as pin No. 6.

NOTE 2: With the tube neck inserted through the flared end of REFERENCE-Line Gauge (JETEC No. 116) and with the tube seated in the gauge, the reference line is determined by the intersection of the plane cc' (face of the flared end) of the gauge with the glass funnel.

NOTE 3: The socket should not be mounted rigidly but it should be allowed to move freely and it should have flexible leads. The bottom circumference of the base shell will lie within a circle concentric with the bulb axis and having a diameter of 2 3/4".

NOTE 4: External conductive coating must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. x 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

TELEVISION PICTURE TUBE TYPE 21EMP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Neutral Gray Glass

4-3/8" Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/16" x 15-1/16" Picture

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.60	Ampere
Warm-up Time	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	uuf
Cathode to all other Electrodes	5	uuf
External Conductive Coating to Anode:		
Maximum	2500	uuf
Minimum	2000	uuf
Screen:		
Phosphor	Aluminized P-4	
Fluorescence	White	
Persistance	Short	
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Horizontal Angle	105°	
Vertical Angle	87°	
Diagonal Angle	110°	
No Ion Trap	No Magnet Required	

MECHANICAL:

Mounting Position	Any	
Screen Dimensions: Minimum		
Height	15-1/16"	
Width	19-1/16"	
Diagonal	20-1/4"	
Area	262 sq. Inches	
Faceplate	Spherical	
Glass	Neutral Gray	
Transmission	74%	
Bulb Dimensions: Bulb No.	J171H1 or Equiv.	
Height	16-3/8" ± 1/8"	
Width	20-1/4" ± 1/8"	
Diagonal	21-3/8" ± 1/8"	
Overall Length	13-3/8" ± 5/16"	
Neck Length	4-3/8" ± 1/8"	
Anode Terminal	JETEC J1-21	
Base	JETEC B7-208	
Basing	8HR	
Net Weight	23 Pounds	

MAXIMUM RATINGS:

Design Center Values

Anode Voltage	18000▲ max.		Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Positive Bias Value	0	max.	Volts
Positive Peak Value	0	max.	Volts
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode #	180	max.	Volts
Heater Positive with respect to Cathode	180	max.	Volts

TYPICAL OPERATING CONDITIONS:

Anode Voltage♦	16000 Volts
Grid 4 Voltage	0 to + 400 Volts
Grid 2 Voltage■	450 Volts
Grid 1 Voltage for Raster Cutoff	-45 to -105 Volts

LIMITING CIRCUIT VALUES:

Grid 4 Resistance to Voltage Source■	10000	min.	Ohms
Grid 2 Resistance to Voltage Source■	10000	min.	Ohms
Grid 1 Circuit Resistance	1.5	max.	Megohms

♦ Operation with anode voltage or anode to grid 1 voltage less than 11000 volts is not recommended.

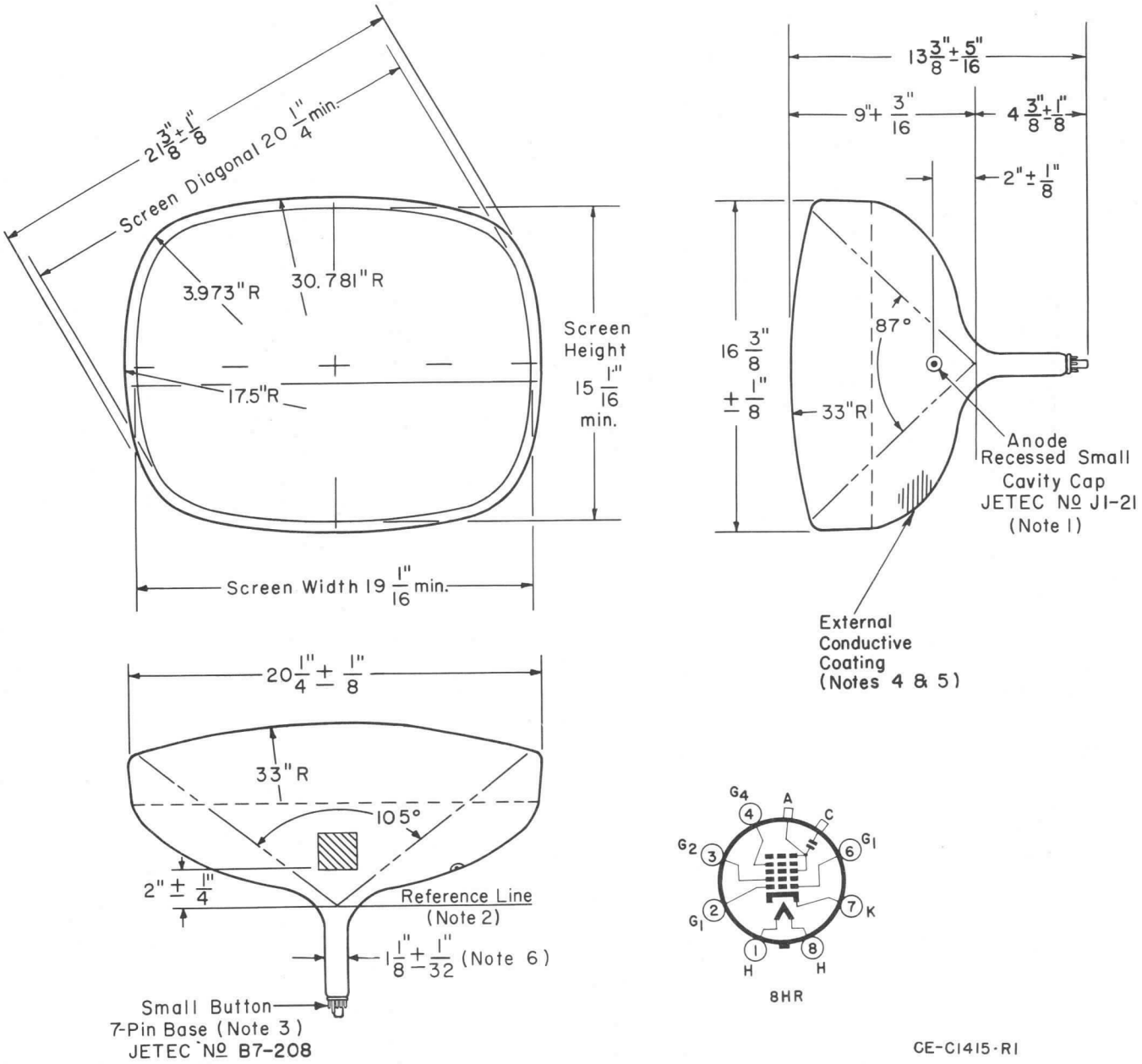
■ It is recommended that Grid 2 be operated at a voltage greater than 300 volts since resolution is affected at lower voltages.

■ Protective resistance in the grid 4 and grid 2 circuits is advisable to prevent damage to the tube. If applicable, one resistor common to both circuits may be used.

▲ Inasmuch as the tube rating permits operation at voltages as high as 19.8 kilovolts (absolute value), shielding of the tube for x-ray radiation may be needed when operating conditions involve voltages in excess of 16 kilovolts.

During 15 second warmup period this value may be 410 max. volts.

Note: With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.



NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Contact area of external conductive coating 2" min. × 2" min. located 2" ± 1/4" from Reference Line 90° counterclockwise from anode button as viewed from base end of tube.

NOTE 6: Maximum neck diameter at splice is 1.168".

Westinghouse®

21GAP4

Sept. 1, 1967

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
13.250" × 16.875" MIN. SCREEN SIZE
4.375" NECK LENGTH

BANDED
IMPLOSION PROTECTION
6.3 VOLT, 450 MA HEATER

ALUMINIZED SCREEN
30 VOLT GRID 2
SPHERICAL GRAY FILTER GLASS

DETAILED DATA

ELECTRICAL

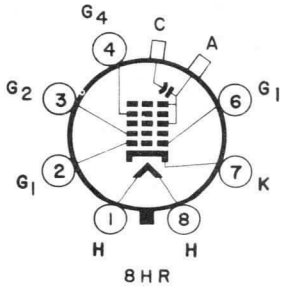
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	114 Degrees
Horizontal	102 Degrees
Vertical	85 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1300 pF
Maximum	2000 pF
Heater Current at 6.3 Volts	450 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	46%

MECHANICAL

Over-all Length	12.656" ±0.281"
Neck Length	4.375" ±0.125"
Greatest Dimensions of Tube:	
Diagonal	20.759" ±0.100"
Width	18.168" ±0.100"
Height	14.686" ±0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	19.625"
Horizontal Axis	16.875"
Vertical Axis	13.250"
Area	212 Sq. Inches
Implosion Protection	Banded
Bulb	EIA J165 1/4A1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	23 Pounds



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	60	Volts
Minimum Grid 2 Voltage	20	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	.10000	Ohms

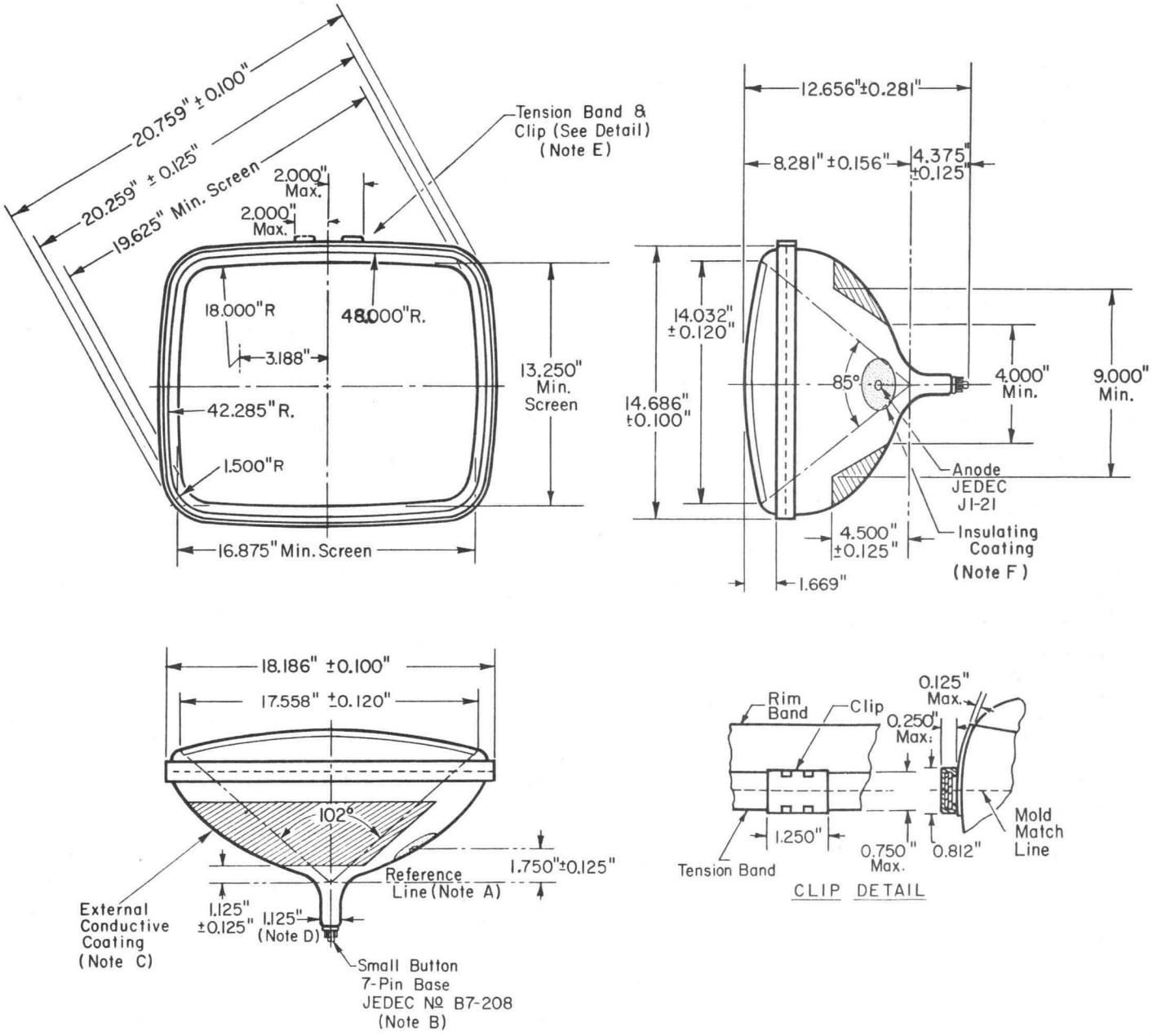
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000	Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts
Grid 2 Voltage	30	Volts
Cathode Voltage for Raster Cutoff	30 to 45	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.75" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.75" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be arounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Transparent insulating coating, 3" in diameter. Clean only with a soft, dry, lintless cloth.

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Westinghouse®

21GHP4

January 1, 1967

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
13.250" × 16.875" MIN. SCREEN SIZE
4.375" NECK LENGTH

6.3 VOLT, 450 MA HEATER
ELECTROSTATIC FOCUS
SPHERICAL FACEPLATE

DETAILED DATA

ELECTRICAL

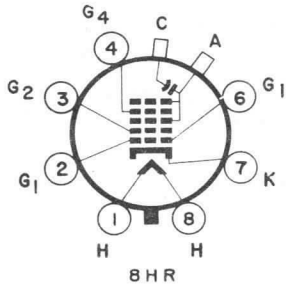
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	114	Degrees
Horizontal	102	Degrees
Vertical	85	Degrees
Direct Interelectrode Capacitances:		
Cathode to All Other Electrodes (Approx.)	5	pF
Grid No. 1 to All Other Electrodes (Approx.)	6	pF
External Conductive Coating to Anode:		
Minimum	1500	pF
Maximum	2300	pF
Heater Current at 6.3 Volts	450 ± 5%	mA
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	72%

MECHANICAL

Over-all Length	12.656" ± 0.281"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	20.649" ± 0.100"
Width	18.036" ± 0.100"
Height	14.576" ± 0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	19.625"
Horizontal Axis	16.875"
Vertical Axis	13.250"
Area	212 Sq. Inches
Bulb	EIA J165 1/4A1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	21 Pounds



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	60	Volts
Minimum Grid 2 Voltage	20	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	300	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000	Ohms

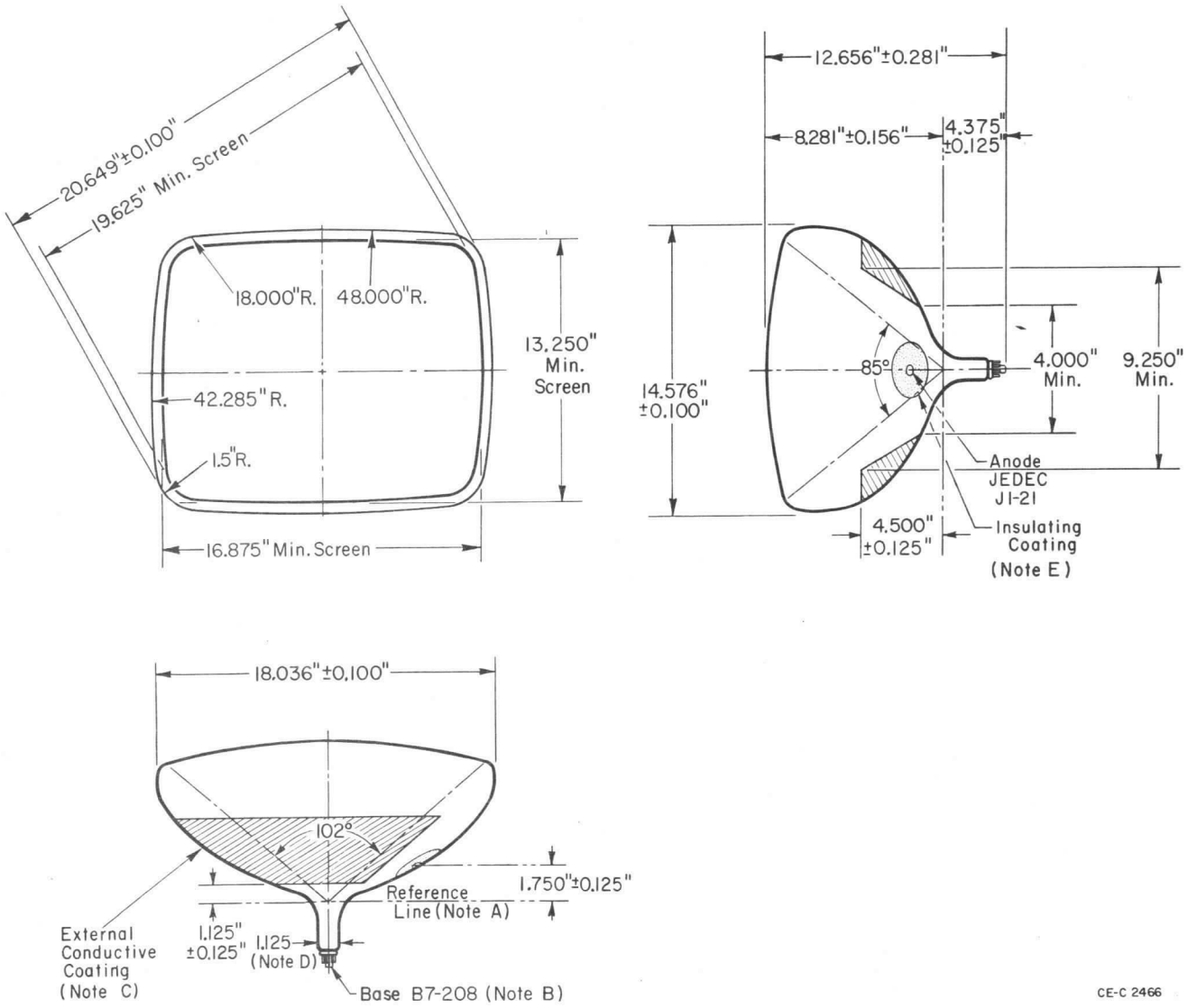
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 4)	0 to 400	Volts
Grid 2 Voltage	30	Volts
Cathode Voltage for Raster Cutoff	30 to 45	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
4. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 13.250" by 16.875" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.75" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Transparent insulating coating, 3" in diameter. Clean only with a soft, dry, lintless cloth.

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Westinghouse

21GKP4

September 15, 1967

QUICK REFERENCE DATA

114° MAGNETIC DEFLECTION
13.250" × 16.375" MIN. SCREEN SIZE
4.375" NECK LENGTH

BANDED
IMPLOSION PROTECTION
WITH MOUNTING LUGS

6.3 VOLT, 450 MA HEATER
ELECTROSTATIC FOCUS
SPHERICAL FACEPLATE

DETAILED DATA

ELECTRICAL

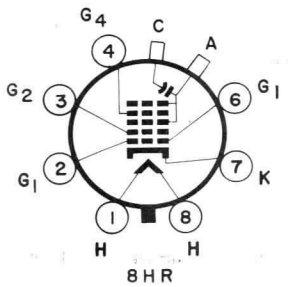
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	114	Degrees
Horizontal	102	Degrees
Vertical	85	Degrees
Direct Interelectrode Capacitances:		
Cathode to All Other Electrodes (Approx.)	5	pF
Grid No. 1 to All Other Electrodes (Approx.)	6	pF
External Conductive Coating to Anode: Note (1)		
Minimum	1700	pF
Maximum	2500	pF
Resistance between External Conductive Coating and Implosion Protection Hardware (Min.)	5	Megohms
Heater Current at 6.3 Volts	450 ± 5%	mA
Heater Warm-up Time (Note 2)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	46%

MECHANICAL

Over-all Length	12.656" ± 0.281"
Neck Length	4.375" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	20.884" ± 0.120"
Width	18.186" ± 0.120"
Height	14.686" ± 0.120"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	19.625"
Horizontal Axis	16.875"
Vertical Axis	13.250"
Area	212 Sq. Inches
Implosion Protection	Banded with Mounting Lugs
Bulb	EIA J165 1/4A1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	23.5 Pounds



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 3)	23000	Volts
Minimum Anode Voltage	12000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	60	Volts
Minimum Grid 2 Voltage	20	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	300	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 3)	16000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 5)	0 to 400	Volts
Grid 2 Voltage	50	Volts
Cathode Voltage for Raster Cutoff	35 to 55	Volts

NOTES

1. Includes implosion protection hardware.
2. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
3. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
4. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
5. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 13.250" by 16.875" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

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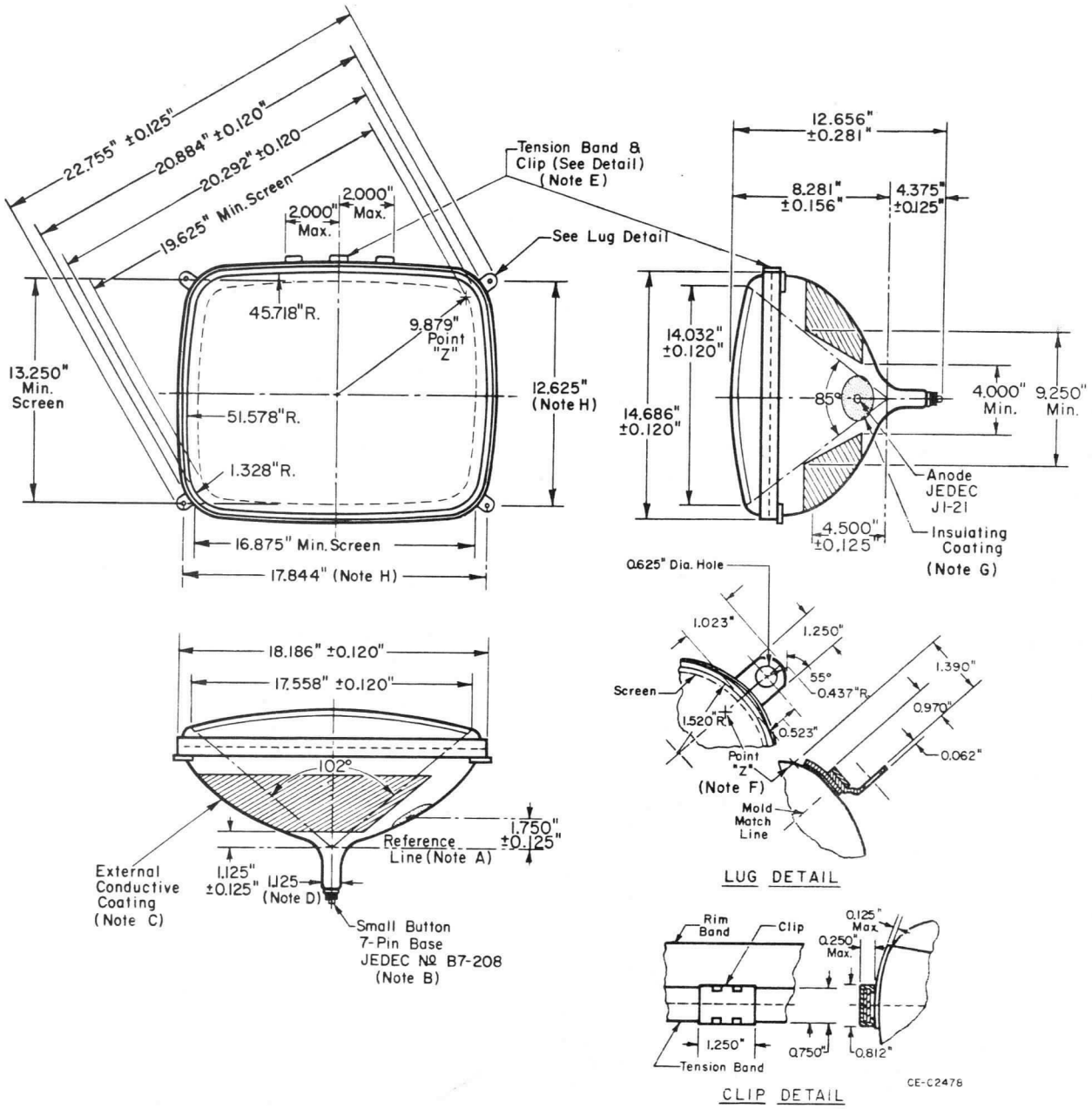

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Point "Z" is located on the tube diagonal at the faceplate surface.

G. Transparent insulating coating, 3" in diameter. Clean only with soft, dry, lintless cloth.

H. Tube shall fit on 0.25" pegs centered at corners of 12.625" × 17.844" rectangle. (Suggested stud diameter is 0.180" –0.250").

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Westinghouse

23ASP4

September 15, 1961

TELEVISION PICTURE TUBE TYPE 23ASP4

92° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/8" x 19-1/4" Screen Size

ELECTRICAL:

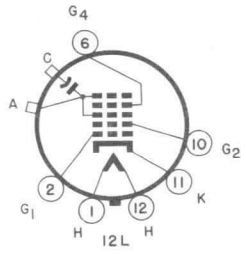
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	80	Degrees
Vertical	65	Degrees
Diagonal	92	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	1700	μμf
Heater Current at 6.3 volts	600 ± 5%	Ma.
Heater warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	17 ± 3/8	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 + 3/32 - 1/8	Inches
Width	20-1/2 + 1/16 - 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal	19-1/4	Inches
Vertical	15-1/8	Inches
Area	282	Sq. Inches
Neck Length	4-1/2 ± 3/16	Inches
Bulb	J187C1	
Bulb Contact	J1-21	
Base	B6-203	
Basing	12L	
Weight	27	Pounds



RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1200, -400	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	18000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

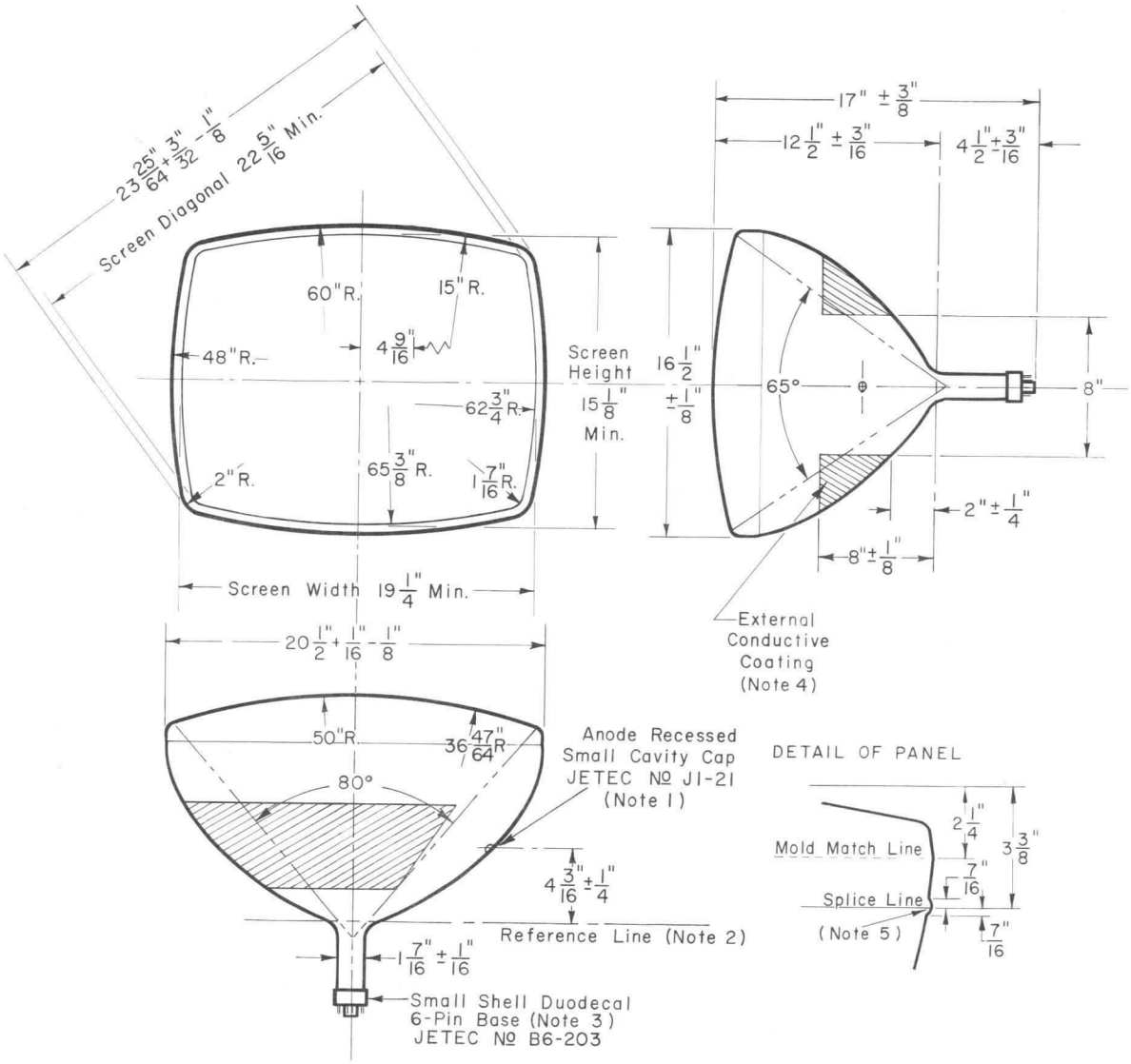
2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

3. It is recommended that not less than 300 volts on grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK



NOTE 1: Base pin 6 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 2: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-3/4" from Yoke Reference Line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 2-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

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TELEVISION PICTURE TUBE TYPE 23BDP4

92° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
Anti-Glare Twin-Face Panel
Integral Safety Glass

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/4" x 19-5/16" Screen Size

ELECTRICAL:

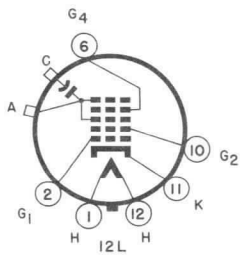
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	80	Degrees
Vertical	65	Degrees
Diagonal	92	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	2000	μμf
Heater Current at 6.3 volts	600 ± 5%	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	40	Percent

MECHANICAL:

Overall Length	18-5/16 ± 7/16	Inches
Greatest Dimensions of Tube:		
Diagonal	24-45/64 + 3/32 - 1/16	Inches
Width	21-5/16 ± 1/8	Inches
Height	17-13/32 + 3/32 - 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal	19-5/16	Inches
Vertical	15-1/4	Inches
Area	282	Sq. Inches
Neck Length	5-1/2 ± 3/16	Inches
Bulb	J187D1	
Anti-Glare Laminated Panel	FP198B1	
Bulb Contact	J1-21	
Base	B6-203	
Basing	12L	
Weight	34-1/2	Pounds



RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage ▲	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage□	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance†	10000	Ohms

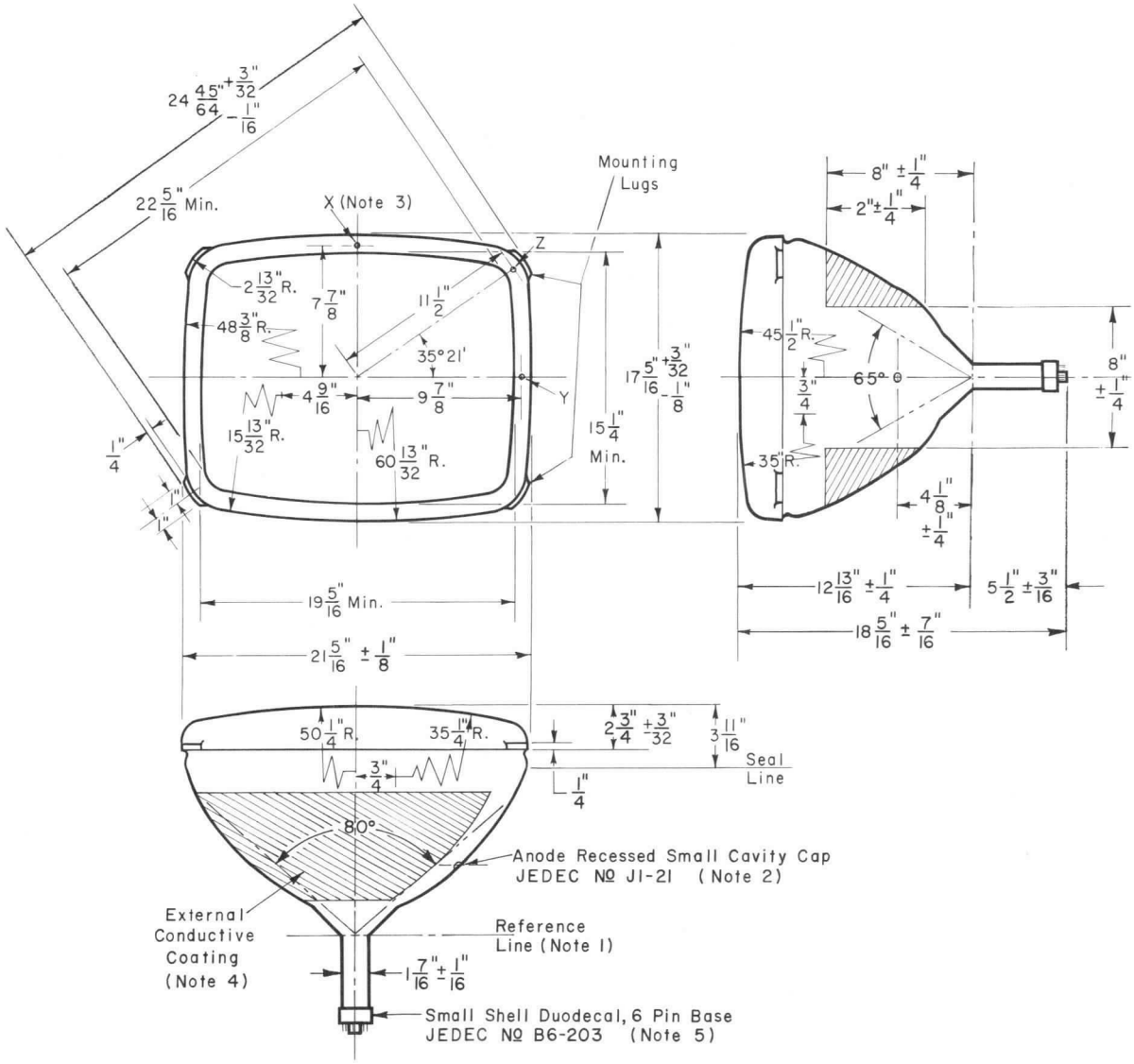
⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

▲ Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

† Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

□ It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.



NOTE 1: Yoke Reference Line is determined by plane C-C' of JEDEC Reference-Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-3/4" from Yoke Reference Line.

NOTE 2: Base pin 6 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 2-3/4".

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Westinghouse

23BEP4

September 15, 1961

TWIN PANEL TELEVISION PICTURE TUBE TYPE 23BEP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Twin Face Panel, Integral Safety Glass
Electrostatic Focus
5-1/8" Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-5/16" × 15-1/4" Screen Size

GENERAL:

Deflection Method	Magnetic
Focusing Method	Electrostatic
Deflection Angles (Approx.):	
Diagonal	110°
Horizontal	99°
Vertical	82°
Screen:	
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short
Faceplate	Spherical Gray Filter Glass
Laminated Panel	FP 198A1
Light Transmission (Approx.)	40%
Weight	33 Pounds

ELECTRICAL:

Heater:		
Voltage	6.3	Volts
Current	300 ± 5%	Ma.
Warm-up Time□	18	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other electrodes	6	$\mu\mu$f
Cathode to all other electrodes	5	$\mu\mu$f
External Conductive Coating:		
Maximum	2500	$\mu\mu$f
Minimum	2000	$\mu\mu$f

MECHANICAL:

Mounting Position	Any
Screen Dimensions:	
Screen Area	282 Sq. In. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions:	
Bulb	J187A1
Height	17-13/32" +3/32" −1/8"
Width	21-5/16" +1/8"
Diagonal	25-45/64" + 3/32" −1/16"
Overall Length	15-3/16" ± 3/8"
Neck Length	5-1/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR

MAXIMUM RATINGS:

Design Maximum Values

Unless otherwise specified, voltage values are positive and measured with respect to G_1.

Max. Anode Voltage	22000	max.	Volts
Min. Anode Voltage	12000	min.	Volts
Grid 4 Voltage:			
Positive Value	1100	max.	Volts
Negative Value	550	max.	Volts
Grid 2 Voltage	700	max.	Volts
Cathode Voltage:			
Negative Peak Value	2	max.	Volts
Negative Bias Value	0	max.	Volts
Positive Bias Value	154	max.	Volts
Positive Peak Value	220	max.	Volts
Peak Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
During Warm-up Period of 45 Sec. Max.	450	max.	Volts
After Equipment Warm-up Period	200	max.	Volts
Heater Positive with Respect to Cathode	200	max.	Volts

TYPICAL CATHODE DRIVE OPERATING CONDITIONS:

Unless otherwise specified, all voltage values are positive with respect to Grid 1.

Anode Voltage	16000	Volts
Grid 4 Voltage	0 to + 400	Volts
Grid 2 Voltage⊕	500	Volts
Cathode Voltage for Raster Cutoff	+45 to +95	Volts

LIMITING CIRCUIT VALUES:

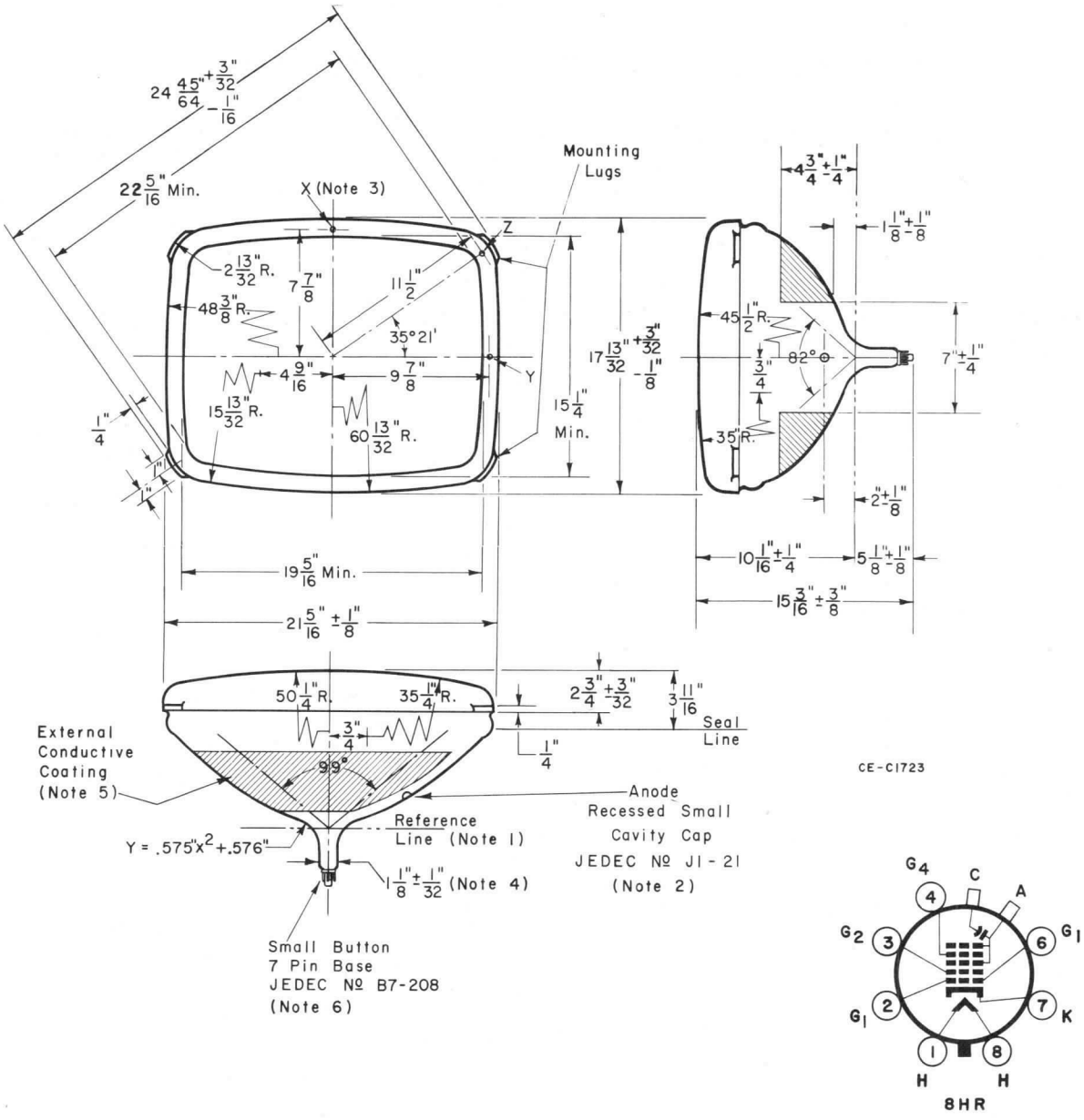
Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance▲	10,000	min.	Ohms
Grid 4 Circuit Resistance▲	10,000	min.	Ohms

▲ Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.

⊕ It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

□ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

September 1, 1962

TWIN PANEL TELEVISION PICTURE TUBE TYPE 23BP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Twin Face Panel, Integral Safety Glass
Electrostatic Focus
Extremely Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-5/16" × 15-1/4" Screen Size

GENERAL:

Deflection Method	Magnetic
Focusing Method	Electrostatic
Deflection Angles (approx.)	
Diagonal	110°
Horizontal	99°
Vertical	82°
Screen	
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short
Faceplate	Spherical Gray Filter Glass
Laminated Panel	FP198A1
Light Transmission (approx.)	40%
Weight	31 Pounds

ELECTRICAL:

Heater		
Voltage	6.3	Volts
Current	0.6	Ampere
Warm-up Time□	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other electrodes	6	μμf
Cathode to all other electrodes	5	μμf
External Conductive Coating		
Maximum	2500	μμf
Minimum	2000	μμf

MECHANICAL:

Mounting Position	Any
Screen Dimensions	
Screen Area	282 sq. in. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions	
Bulb	J187A1
Height	17-5/16" + 1/8" -1/16"
Width	21-5/16" + 1/8" -1/16"
Diagonal	24-45/64" + 3/32" -1/16"
Overall Length	14-7/16" ± 3/8"
Neck Length	4-3/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR

MAXIMUM RATINGS:

Design Center Values

Anode Voltage♦	20000	max.	Volts
Grid 4 Voltage			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage			
Negative Peak Value	200	max.	Volts
Negative Bias Value	140	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	0	max.	Volts
Peak Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
During Warm-up Period of 15 Sec. Max.	410	max.	Volts
After Equipment Warm-up Period	180	max.	Volts
Heater Positive with Respect to Cathode	180	max.	Volts

TYPICAL GRID DRIVE OPERATING CONDITIONS:

Anode Voltage	14000	Volts
Grid 4 Voltage	0 to + 400	Volts
Grid 2 Voltage⊕	450	Volts
Grid 1 Voltage for Raster Cutoff	-45 to -105	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance▲	10000	min.	Ohms
Grid 4 Circuit Resistance▲	10000	min.	Ohms

♦ Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12,000 volts.

▲ Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.

⊕ It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

□ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

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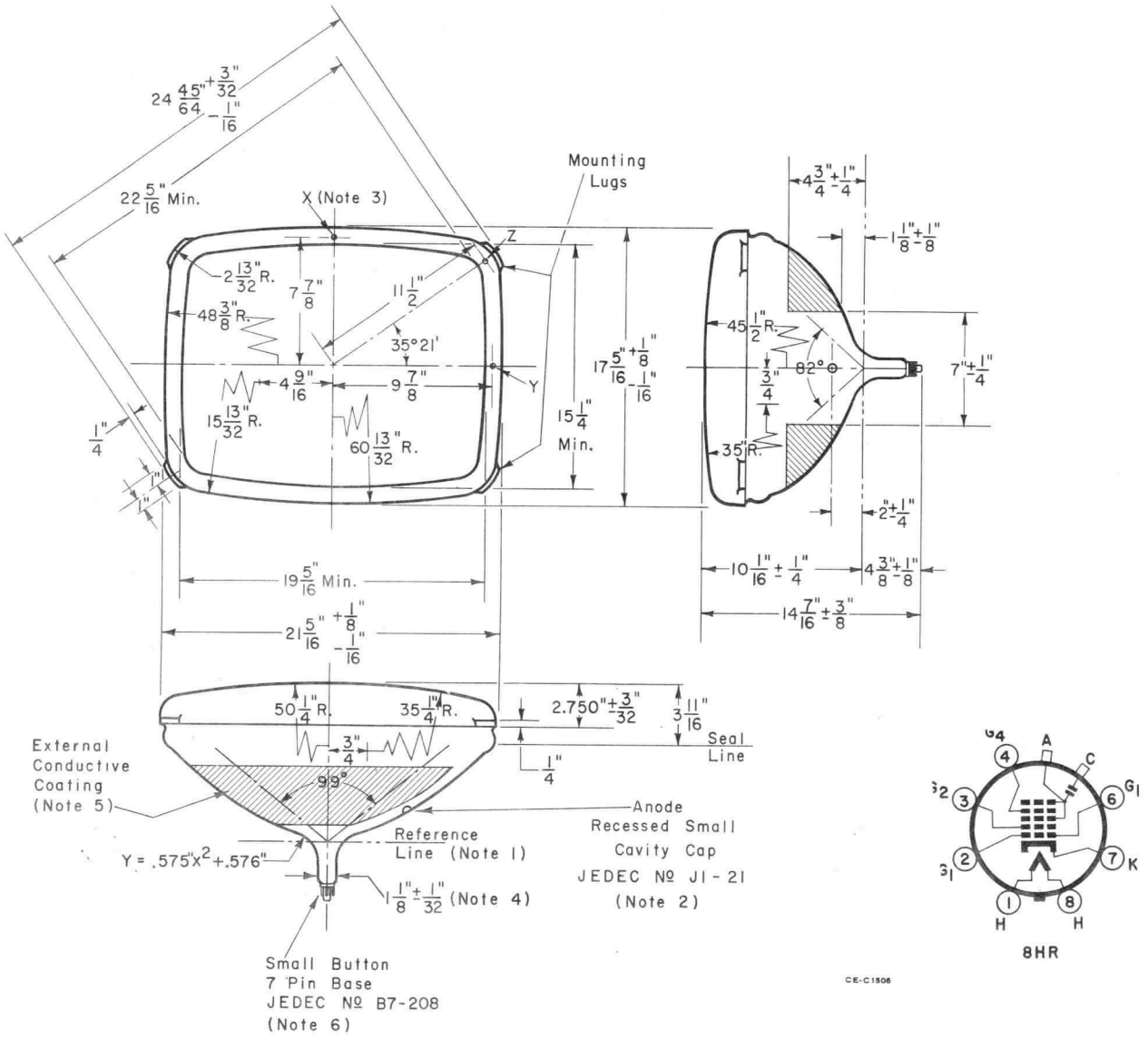

NOTE 1: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

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23BSP4

March 15, 1961

TWIN PANEL TELEVISION PICTURE TUBE TYPE 23BSP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Anti-Glare Twin Face Panel, Integral Safety Glass
Electrostatic Focus
5-1/8" Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-5/16" × 15-1/4" Screen Size

GENERAL:

Deflection Method	Magnetic
Focusing Method	Electrostatic
Deflection Angles (Approx.):	
Diagonal	110°
Horizontal	99°
Vertical	82°
Screen:	
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short
Faceplate	Spherical Gray Filter Glass
Laminated Panel	FP198B1
Light Transmission (Approx.)	40%
Weight	31 Pounds

ELECTRICAL:

Heater:		
Voltage	6.3	Volts
Current	.3	Ampere
Warm-up Time□	18	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other electrodes	6	μμf
Cathode to all other electrodes	5	μμf
External Conductive Coating:		
Maximum	2500	μμf
Minimum	2000	μμf

MECHANICAL:

Mounting Position	Any
Screen Dimensions:	
Screen Area	282 Sq. In. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions:	
Bulb	J187A1
Height	17-5/16" + 1/8" −1/16"
Width	21-5/16" + 1/8" −1/16"
Diagonal	25-45/64" + 3/32" −1/16"
Overall Length	15-3/16" ± 3/8"
Neck Length	5-1/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR

MAXIMUM RATINGS:

Design Maximum Values			
Anode Voltage♦	22000	max.	Volts
Grid 4 Voltage:			
Positive Value	1100	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	550	max.	Volts
Grid 1 Voltage:			
Negative Peak Value	220	max.	Volts
Negative Bias Value	154	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage			
Heater Negative with Respect to Cathode			
During Warm-up Period of 15 Sec. Max.	450	max.	Volts
After Equipment Warm-up Period	200	max.	Volts
Heater Positive with Respect to Cathode	200	max.	Volts

TYPICAL GRID DRIVE OPERATING CONDITIONS:

Anode Voltage	16000	Volts
Grid 4 Voltage	0 to +400	Volts
Grid 2 Voltage⊕	300	Volts
Grid 1 Voltage for Raster Cutoff	−35 to −72	Volts

LIMITING CIRCUIT VALUES:

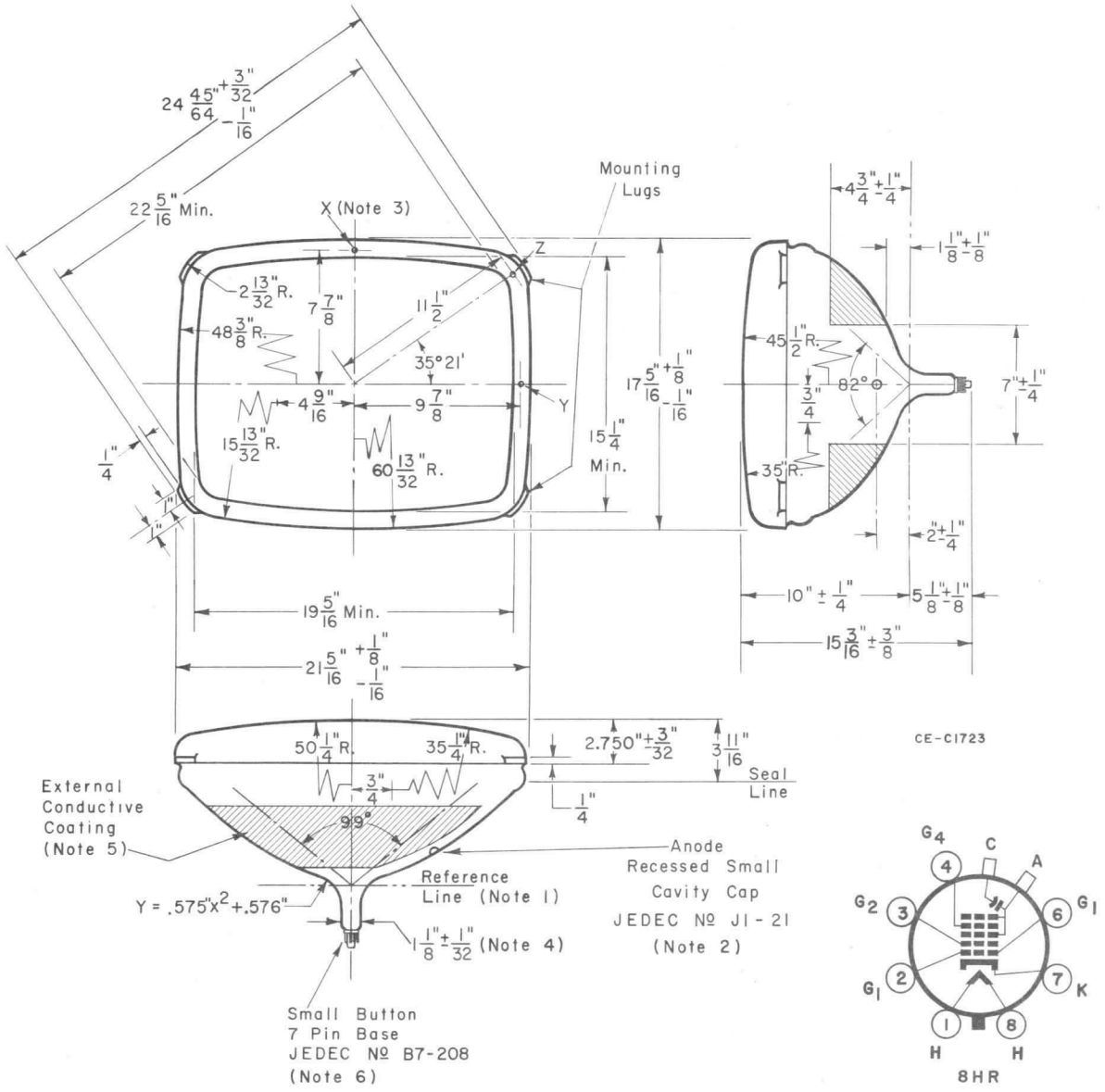
Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance▲	10000	min.	Ohms
Grid 4 Circuit Resistance▲	10000	min.	Ohms

♦ Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12,000 volts.

▲ Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.

⊕ It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

□ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

Westinghouse

23CQP4

March 1, 1962

TELEVISION PICTURE TUBE TYPE 23CQP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/4" × 15-3/16" Screen Size

ELECTRICAL:

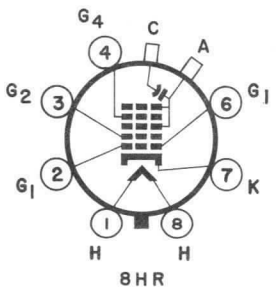
Focusing Method	Electrostatic	
Deflection Angles (Approx.):		
Horizontal	102	Degrees
Vertical	84	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, approximate	5	μμf
Grid #1 to all other electrodes, approximate	6	μμf
External Conductive Coating to Anode	2500 max.	μμf
	2000 min.	μμf
Heater Current at 6.3 volts	450 ± 5%	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, (Approx.)	78	Percent

MECHANICAL:

Overall Length	13-5/8 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 + 3/32 – 1/8	Inches
Width	20-1/2 + 1/16 – 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal axis	19-1/4	Inches
Vertical axis	15-1/8	Inches
Area	282	Sq. Inches
Neck Length	4-3/8 ± 1/8	Inches
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	24 Lbs.	



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage	23500	Volts
Minimum Anode Voltage	12,000	Volts
Maximum Grid 4 Voltage	+1100 –550	Volts
Maximum Grid 2 Voltage	700	Volts
Minimum Grid 2 Voltage	200	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS

Cathode Drive Service:

Unless otherwise specified, all voltage values are positive with respect to Grid 1.

Anode Voltage	17,000	Volts DC
Grid 4 Voltage (Focusing Electrode)□	250	Volts DC
Grid 2 Voltage	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid #1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance■	10000	Ohms

□ With the combined grid 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15-3/16" × 19-1/4" pattern from type 2F21 Monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

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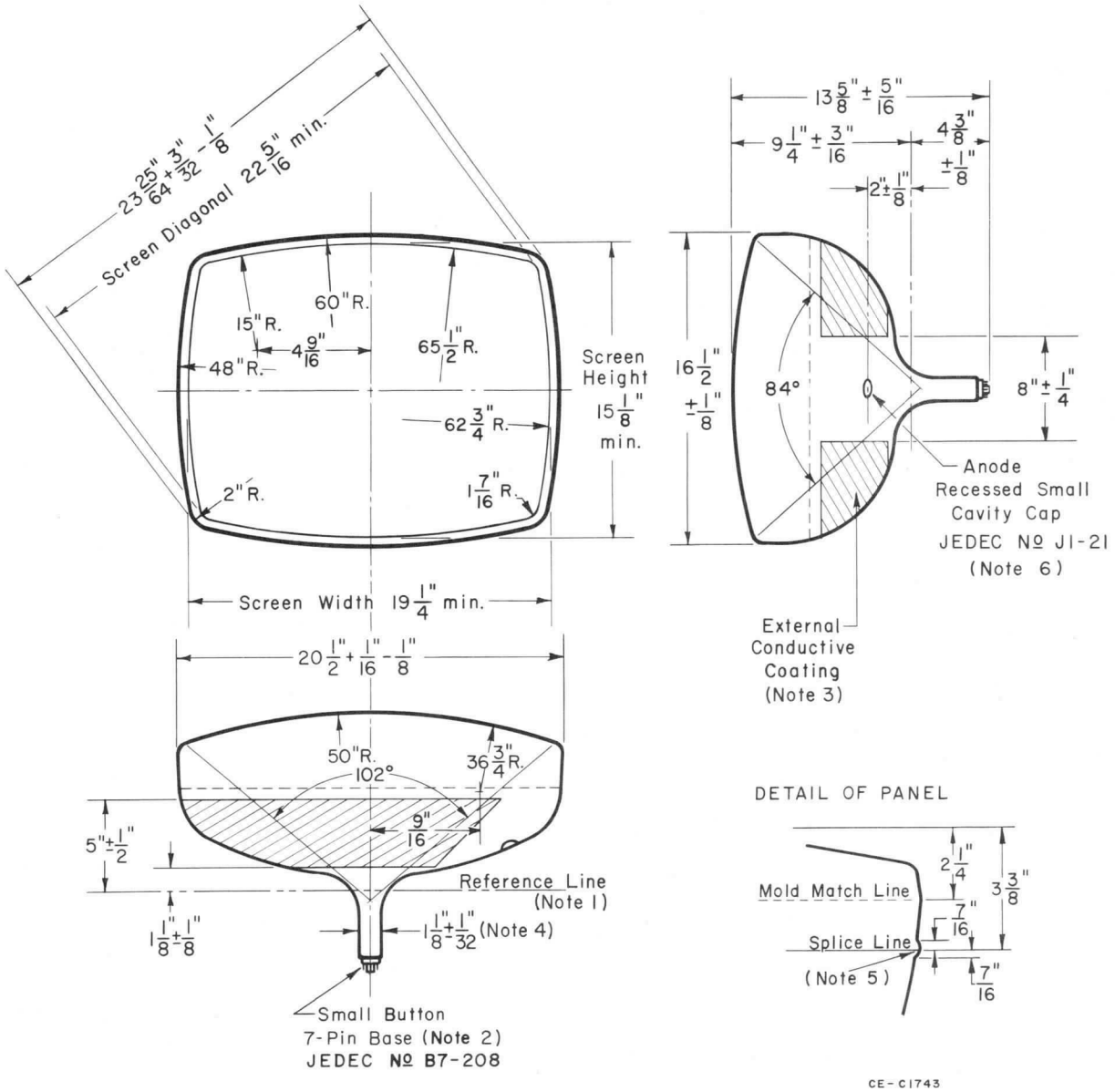


CE-C1743

NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

NOTE 6: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

Westinghouse

23DAP4

May 1, 1963

TELEVISION PICTURE TUBE TYPE 23DAP4

94° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
5" Neck Length
Low G_2 Voltage (50 Volts)

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/16" × 19-1/8" Screen Size

ELECTRICAL

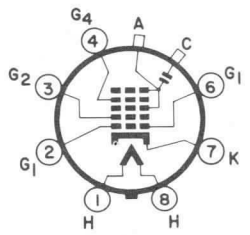
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	83	Degrees
Vertical	68	Degrees
Diagonal	94	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	1700	μμf
Heater Current at 6.3 Volts	600 ± 5%	Ma.
Heater warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL

Overall Length	17-5/64 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-3/8 ± 1/8	Inches
Width	20-1/2 ± 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-1/4	Inches
Horizontal	19-1/8	Inches
Vertical	15-1/16	Inches
Area	282	Sq. Inches
Neck Length	5 ± 1/8	Inches
Bulb	J187H1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight (Approx.)	27-1/2	Pounds



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	23000	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −400	Volts
Maximum Grid 2 Voltage	70	Volts
Minimum Grid 2 Voltage	40	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater Negative with Respect to Cathode During Warm-Up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-Up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	18000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	50	Volts DC
Cathode Voltage for Raster Cutoff	35 to 55	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts is not recommended.
3. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

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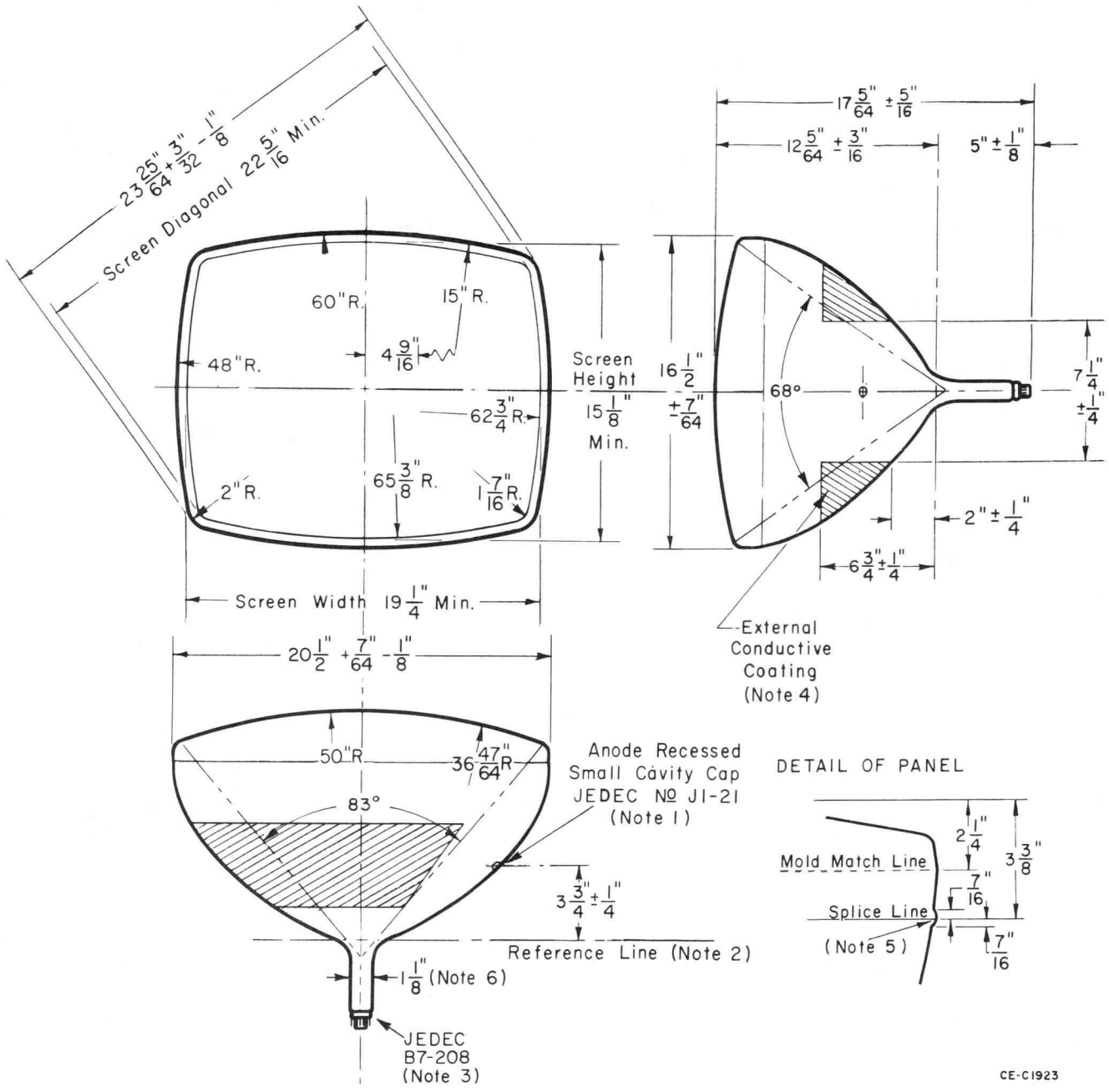

NOTE 1: Base pin 4 aligns with major axis and anode terminal within 30° and is on same side as anode terminal.

NOTE 2: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the tube axis and having diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any around the seal.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

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TELEVISION PICTURE TUBE TYPE 23DCP4

94° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 450 Ma. Heater
Electrostatic Focus
5" Neck Length
Low G_2 Voltage (30 Volts)

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/16" × 19-1/8" Screen Size

ELECTRICAL

Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	83	Degrees
Vertical	68	Degrees
Diagonal	94	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	1700	μμf
Heater Current at 6.3 Volts	450 ± 5%	Ma.
Heater warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL

Overall Length	17-5/64 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-3/8 ± 1/8	Inches
Width	20-1/2 ± 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-1/4	Inches
Horizontal	19-1/8	Inches
Vertical	15-1/16	Inches
Area	282	Sq. Inches
Neck Length	5 ± 1/8	Inches
Bulb	J187H1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight (Approx.)	27-1/2	Pounds

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	23500	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −400	Volts
Maximum Grid 2 Voltage	70	Volts
Minimum Grid 2 Voltage	20	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-Up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-Up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	18000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage	50	Volts DC
Cathode Voltage for Raster Cutoff	35 to 55	Volts DC

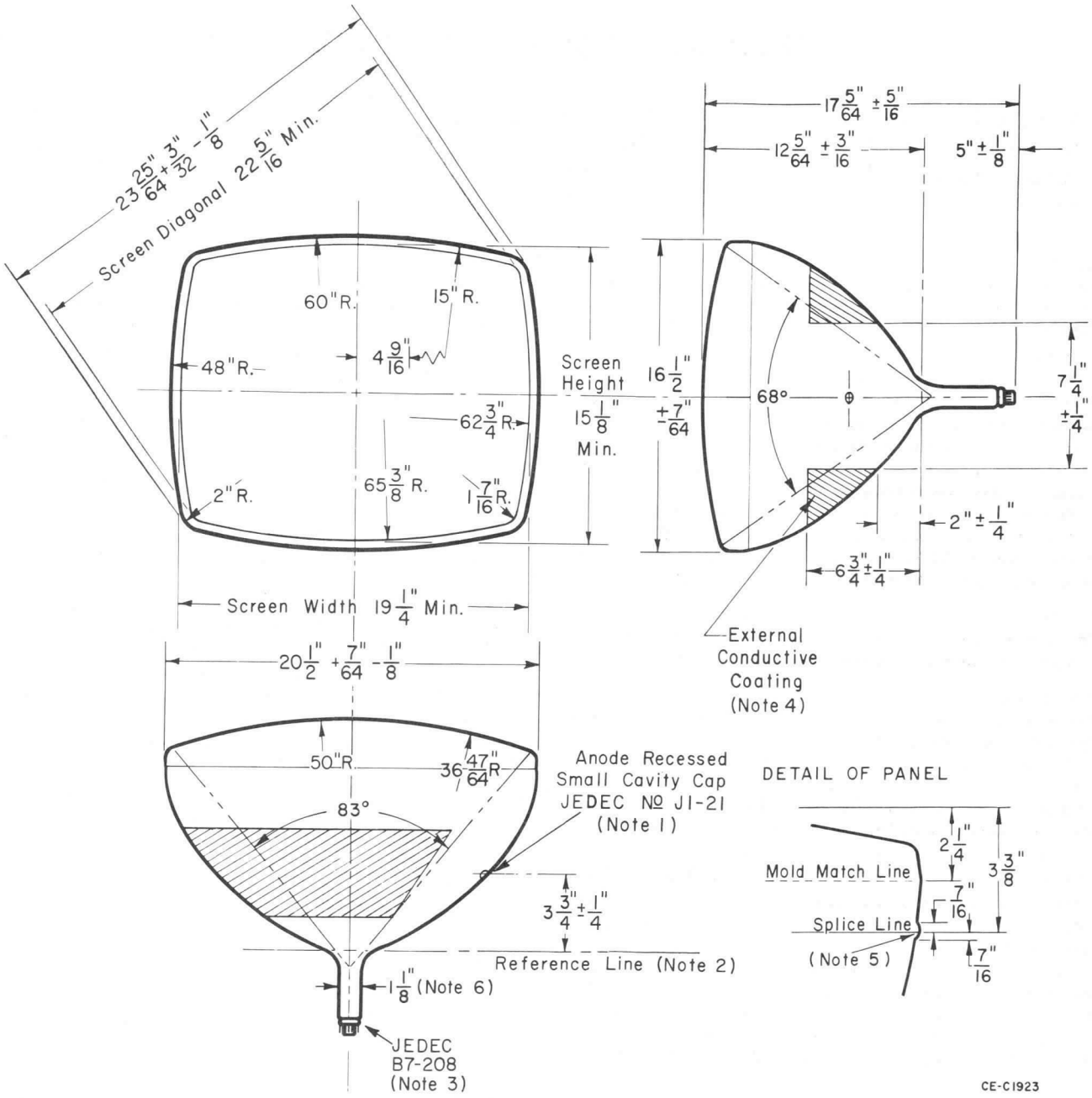
LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts is not recommended.
3. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Base pin 4 aligns with major axis and anode terminal within 30° and is on same side as anode terminal.

NOTE 2: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the tube axis and having diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any around the seal.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

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TELEVISION PICTURE TUBE TYPE 23DHP4

110° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 300 Ma. Heater
Electrostatic Focus
Twin-Face Panel
Integral Safety Glass

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/4" × 19-5/16" Screen Size

ELECTRICAL

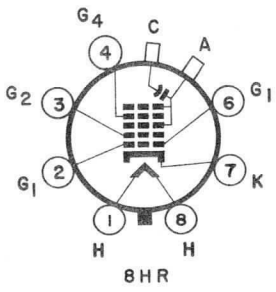
Focusing Method	Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	99	Degrees
Vertical	82	Degrees
Diagonal	110	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	2000	μμf
Heater Current at 6.3 Volts	300 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center, approximate	40 Percent

MECHANICAL

Mounting Position	Any
Screen Dimensions:	
Screen Area	282 sq. in. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions:	
Bulb	J187A1
Laminated Panel	FP198A1
Weight	31 lbs.
Height	17-5/16" + 1/8" –1/16"
Width	21-5/16" + 1/8" –1/16"
Diagonal	24-45/64" + 3/32" –1/16"
Overall Length	14-3/16" ± 3/8"
Neck Length	4-1/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, –550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

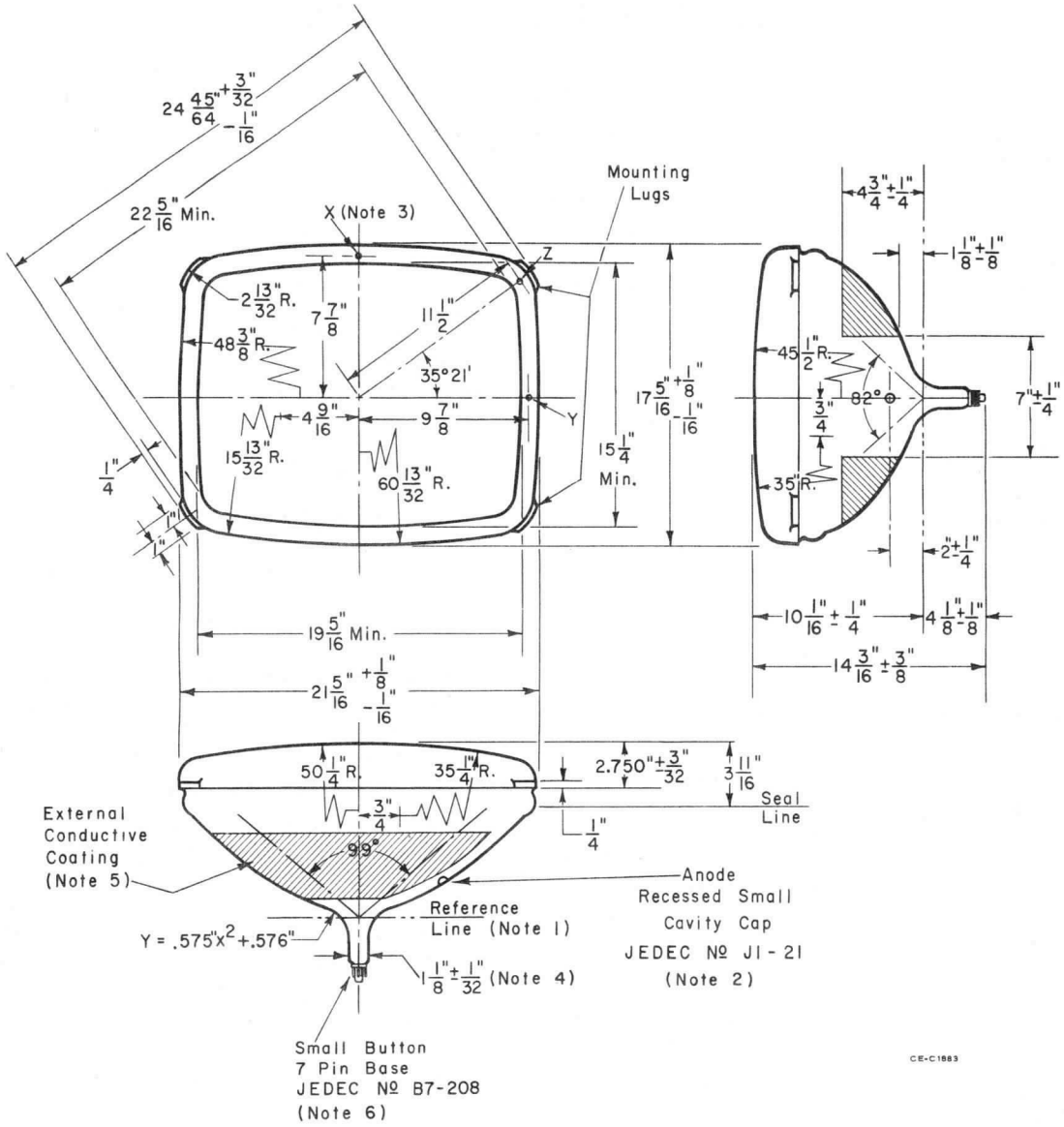
Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	400	Volts DC
Cathode Voltage for raster cutoff	36 to 78	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12,000 volts.
3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.
4. Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

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TELEVISION PICTURE TUBE TYPE 23DJP4

110° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 300 Ma. Heater
Electrostatic Focus
Anti-Glare Twin-Face Panel
Integral Safety Glass

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/4" × 19-5/16" Screen Size

ELECTRICAL

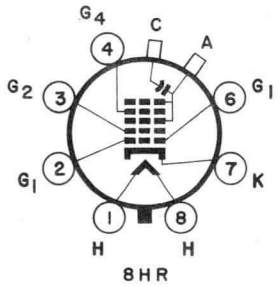
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	99	Degrees
Vertical	82	Degrees
Diagonal	110	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other Electrodes, (Approx.)	5	μμf
Grid 1 to all other Electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	2000	μμf
Heater Current at 6.3 Volts	300 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center, Approximate	40 Percent

MECHANICAL

Mounting Position	Any
Screen Dimensions:	
Screen Area	282 sq. in. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions:	
Bulb	J187A1
Anti-Glare Laminated Panel	FP198B1
Weight	31 lbs.
Height	17-5/16" + 1/8" −1/16"
Width	21-5/16" + 1/8" −1/16"
Diagonal	24-45/64" + 3/32" −1/16"
Overall Length	14-3/16" ± 3/8"
Neck Length	4-1/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS

CATHODE DRIVE SERVICE

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

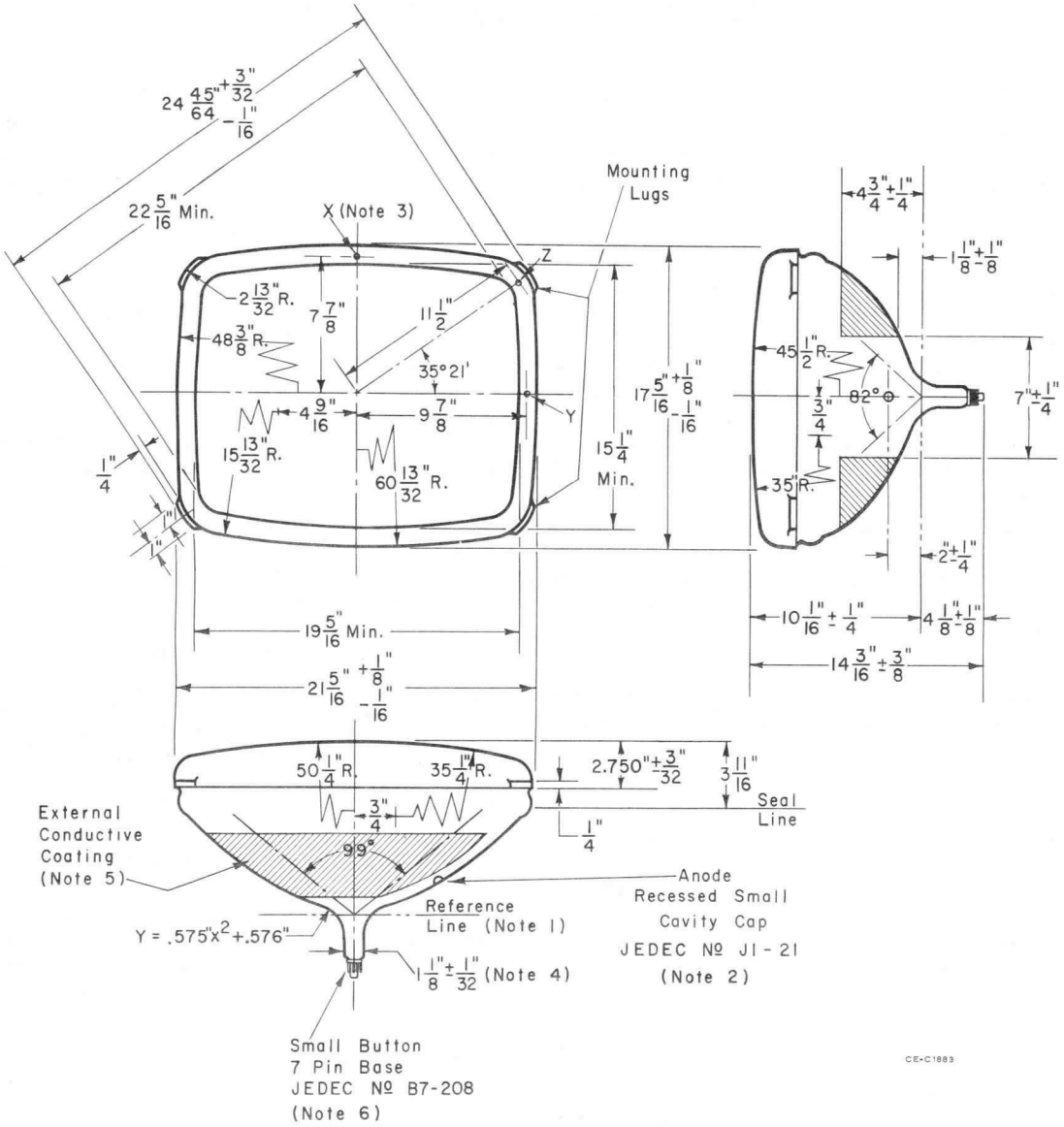
Anode Voltage	16000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	400	Volts DC
Cathode Voltage for Raster Cutoff	36 to 78	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12,000 volts.
3. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.
4. Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

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Westinghouse®

23EZP4

May 15, 1965

QUICK REFERENCE DATA

94° MAGNETIC DEFLECTION
15.125" × 19.250" MIN. SCREEN SIZE
5.000" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

IMPLOSION PROTECTION
BANDED WITH
MOUNTING LUGS

6.3 VOLT, 450 MA HEATER
LOW G2 VOLTAGE (50 VOLTS)
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

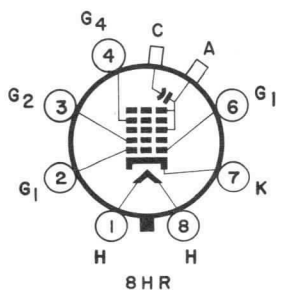
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	94	Degrees
Horizontal	83	Degrees
Vertical	68	Degrees
Direct Interelectrode Capacitances:		
Cathode to All other Electrodes (Approx.)	5	pf
Grid No. 1 to all other Electrodes (Approx.)	6	pf
External Conductive Coating to Anode:		
Minimum	1700	pf
Maximum	2500	pf
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5	Megohms
Heater Current at 6.3 Volts	450 ± 5%	mA.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	42%

MECHANICAL

Over-all Length	17.078" ± 0.312"
Neck Length	5.000" ± 0.125"
Greatest Dimensions of Tube: (Excluding Lugs)	
Diagonal	23.502" ± 0.100"
Width	20.654" ± 0.100"
Height	16.612" ± 0.100"
Minimum Useful Screen Dimensions (projected):	
Diagonal	22.312"
Horizontal axis	19.250"
Vertical axis	15.125"
Area	282 Sq. Inches
Implosion Protection	Banded with Mounting Lugs
Bulb Contact	J1-21
Base	B7-208
Basing	8HR
Net Weight	30 Pounds
Bulb	J187K1



8HR

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500	Volts
Minimum Anode Voltage	11000	Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	Volts
Maximum Grid 2 Voltage	70	Volts
Minimum Grid 2 Voltage	20	Volts
Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with Respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	Volts
After Equipment Warm-up Period	200	Volts
Heater Positive with Respect to Cathode	200	Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 2)	.10000	Ohms

TYPICAL CATHODE DRIVE OPERATION

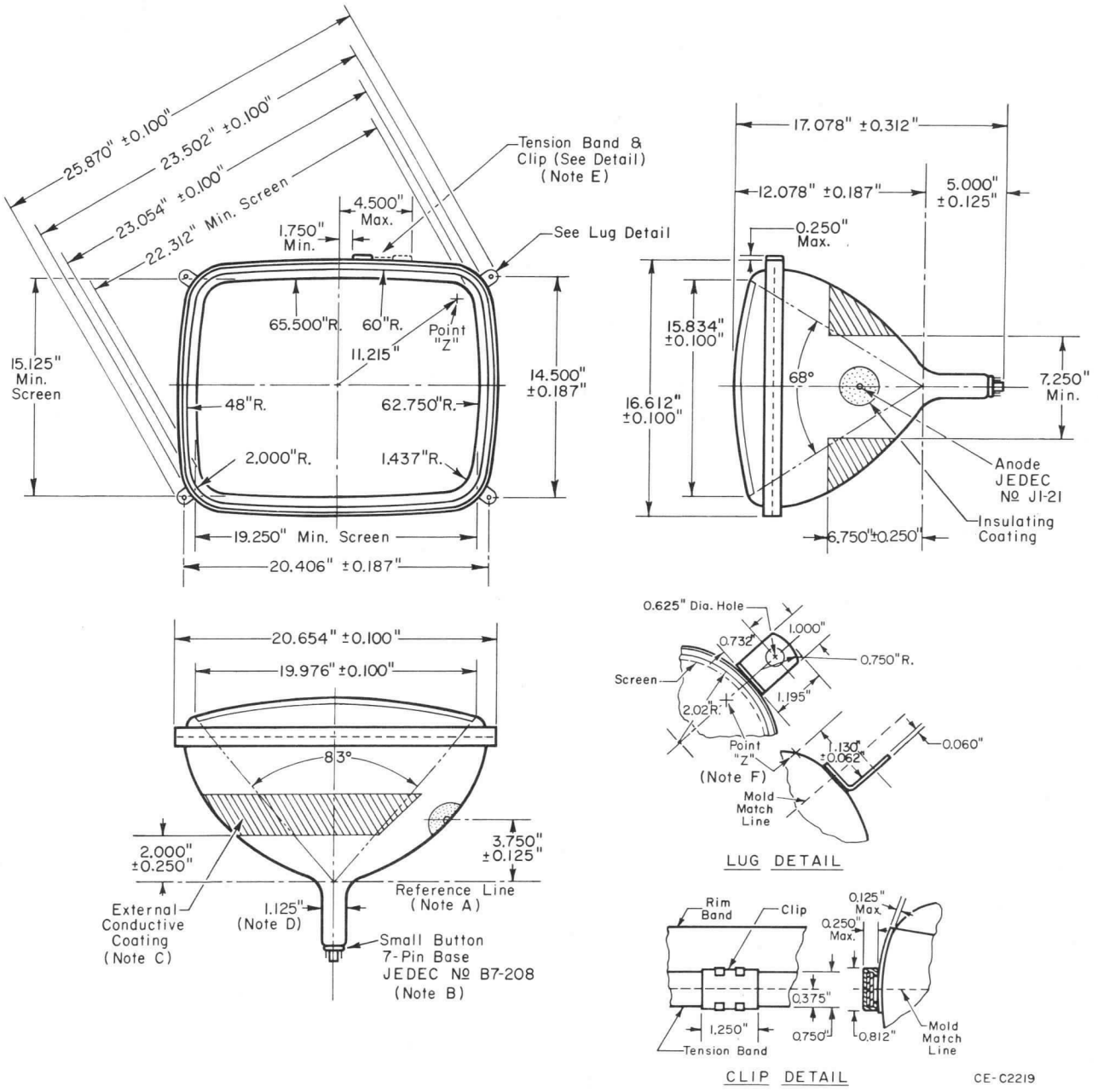
Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	18000	Volts
Grid 4 Voltage (Focusing Electrode) (Note 4)	0 to 400	Volts
Grid 2 Voltage	50	Volts
Cathode Voltage for Raster Cutoff	35 to 55	Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16 KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
4. With the combined Grid No. 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15.125" by 19.250" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Tension band must be grounded.

F. Point "Z" is located on the tube diagonal at the faceplate surface.

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Westinghouse

23FKP4

July 1, 1965

QUICK REFERENCE DATA

94° MAGNETIC DEFLECTION
15.125" × 19.250" MIN. SCREEN SIZE
5.125" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

INTEGRAL SAFETY GLASS
IMPLOSION PROTECTION

6.3 VOLT, 600 MA HEATER
ALUMINIZED SCREEN
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

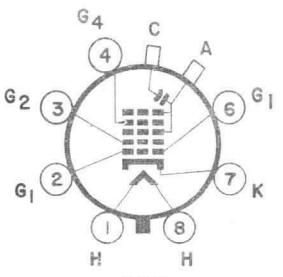
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	94 Degrees
Horizontal	83 Degrees
Vertical	68 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1700 pF
Maximum	2500 pF
Heater Current at 6.3 Volts	600 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	40%

MECHANICAL

Over-all Length	17.530" ± 0.375"
Neck Length	5.125" ± 0.125"
Greatest Dimensions of Tube:	
Diagonal	24.703" ± 0.093"
Width	21.312" ± 0.125"
Height	17.406" ± 0.093"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	22.312"
Horizontal Axis	19.250"
Vertical Axis	15.125"
Area	282 Sq. Inches
Implosion Protection	Integral Safety Glass
Bulb	EIA J187P1
Shield	EIA FP198A1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	30 Pounds



8HR

RATINGS

Design Maximum System
Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500 Volts
Minimum Anode Voltage	11000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, –550 Volts
Maximum Grid 2 Voltage	650 Volts
Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	200 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	.10000 Ohms

TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 500 Volts
Grid 2 Voltage (Note 4)	500 Volts
Cathode Voltage for Raster Cutoff	45 to 95 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
4. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.

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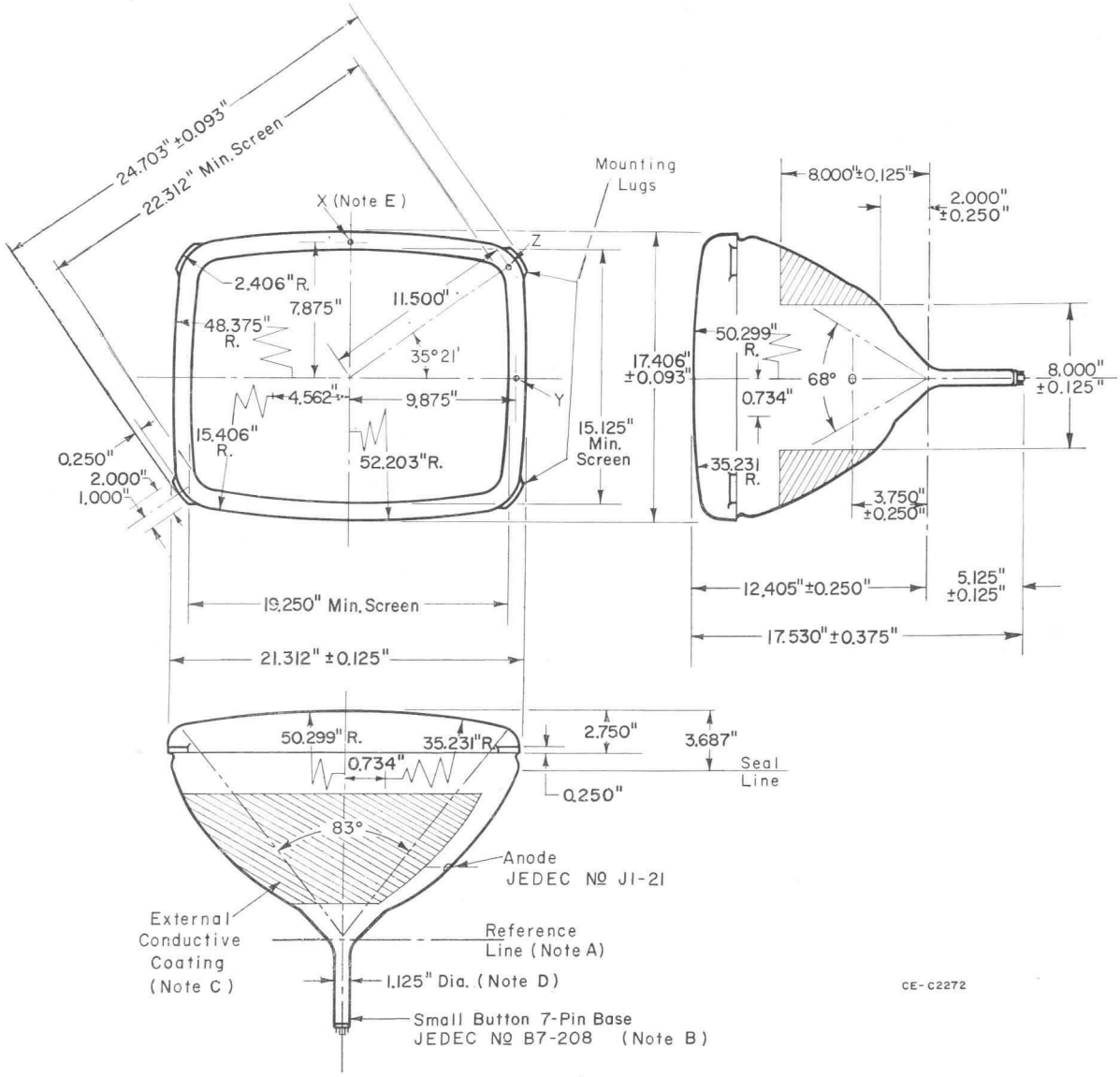

A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.75" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.75" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".
Plane of X to plane of edge of shield = 1.960" nom.

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Westinghouse

23FP4A

September 15, 1961

TELEVISION PICTURE TUBE TYPE 23FP4A

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/4" × 15-3/16" Screen Size

ELECTRICAL:

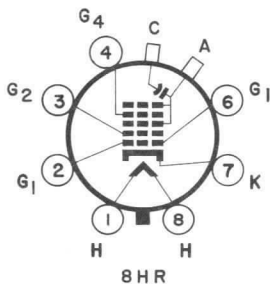
Focusing Method	Electrostatic	
Deflection Angles (Approx.):		
Horizontal	102	Degrees
Vertical	84	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, approximate	5	μμf
Grid #1 to all other electrodes, approximate	6	μμf
External Conductive Coating to Anode	2500 max.	μμf
	2000 min.	μμf
Heater Current at 6.3 volts	600 ± 30	Ma.
Heater Warm-up Time⊕	11	Seconds

OPTICAL

Phosphor Number	Aluminized P4	
Light Transmittance at Center, (Approx.)	78	Percent

MECHANICAL:

Overall Length	13-5/8 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 + 3/32 − 1/8	Inches
Width	20-1/2 + 1/16 − 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal axis	19-1/4	Inches
Vertical axis	15-1/8	Inches
Area	282	Sq. Inches
Neck Length	4-3/8 ± 1/8	Inches
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	24 Lbs.	



RATINGS
Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage	27500	Volts
Minimum Anode Voltage	12,000	Volts
Maximum Grid 4 Voltage	+1100 −550	Volts
Maximum Grid 2 Voltage	700	Volts
Minimum Grid 2 Voltage	200	Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	Volts
Maximum Negative Peak Value	2	Volts
Maximum Positive Bias Value	154	Volts
Maximum Positive Peak Value	220	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS
Cathode Drive Service:

Unless otherwise specified, all voltage values are positive with respect to Grid 1.

Anode Voltage	20,000	Volts DC
Grid 4 Voltage (Focusing Electrode)□	250	Volts DC
Grid 2 Voltage	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES

Maximum Grid #1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance■	10000	Ohms

□ With the combined grid 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15-3/16" × 19-1/4" pattern from type 2F21 Monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

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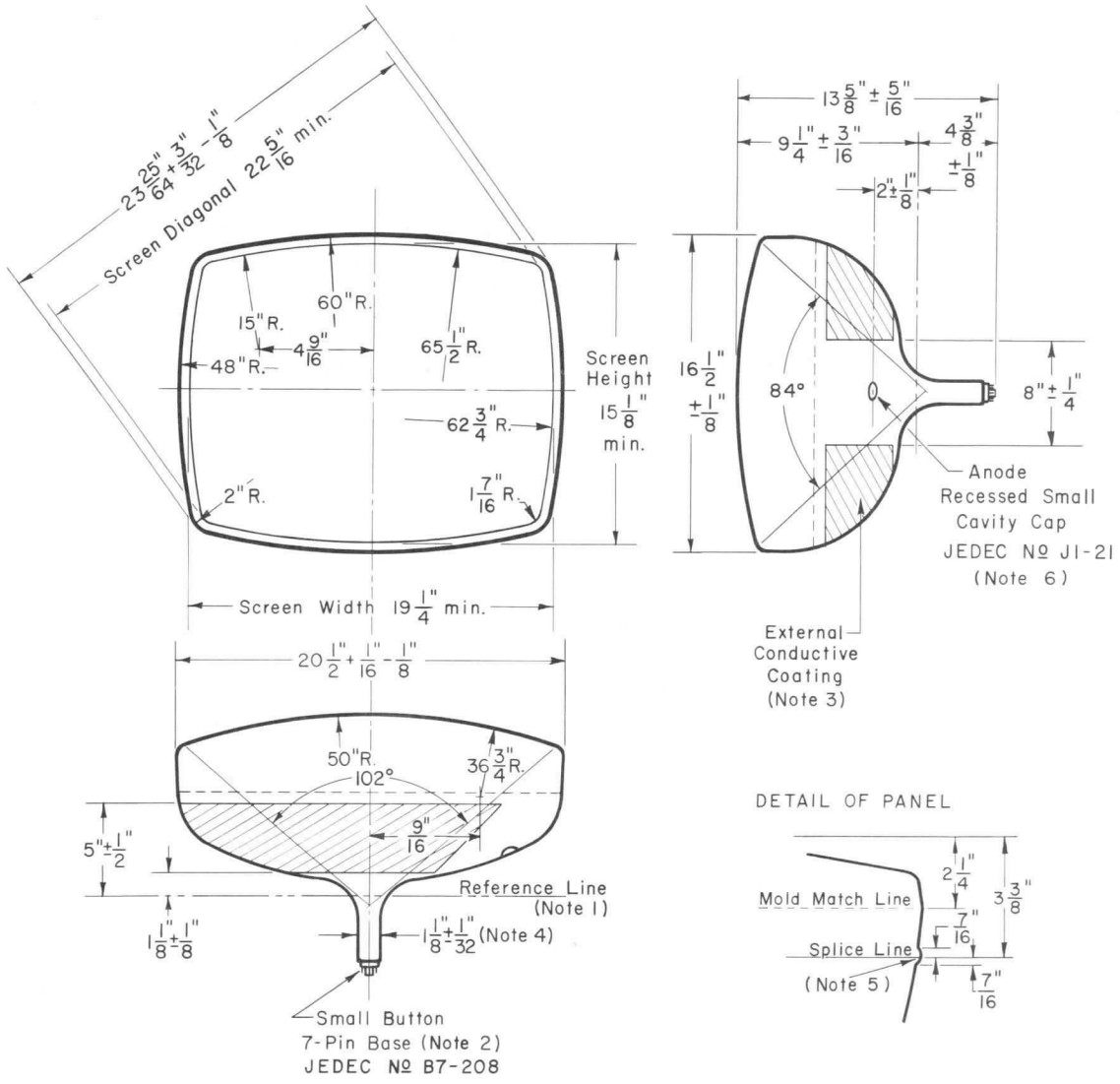


CE-C1743

NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

NOTE 6: Anode term alignment with pin 4 has angular tolerance about tube axis of ± 30°.

Westinghouse®

23FXP4

September 15, 1965

QUICK REFERENCE DATA

92° MAGNETIC DEFLECTION
15.125" × 19.250" MIN. SCREEN SIZE
5.000" NECK LENGTH
SPHERICAL GRAY FILTER GLASS

IMPLOSION-PROTECTION
BANDED WITH
MOUNTING LUGS

6.3 VOLT, 450 MA HEATER
ALUMINIZED SCREEN
NO ION TRAP
ELECTROSTATIC FOCUS

DETAILED DATA

ELECTRICAL

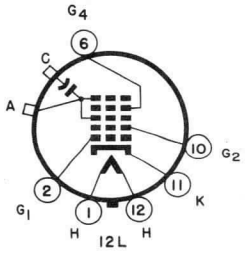
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	92 Degrees
Horizontal	80 Degrees
Vertical	65 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode:	
Minimum	1700 pF
Maximum	2500 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ± 5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	42%

MECHANICAL

Over-all Length	18.000" ± 0.312"
Neck Length	5.500" ± 0.125"
Greatest Dimensions of Tube: (Excluding Lugs)	
Diagonal	23.622" ± 0.125"
Width	20.654" ± 0.125"
Height	16.612" ± 0.100"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	22.312"
Horizontal Axis	19.250"
Vertical Axis	15.125"
Area	282 Sq. Inches
Implosion Protection	Banded with Mounting Lugs
Bulb	EIA J187J1
Bulb Contact	EIA J1-21
Base	EIA B6-203
Basing	EIA 12L
Net Weight	30 Pounds



RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	22000 Volts
Minimum Anode Voltage	11000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	700 Volts
Minimum Grid 2 Voltage	300 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	200 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000 Ohms

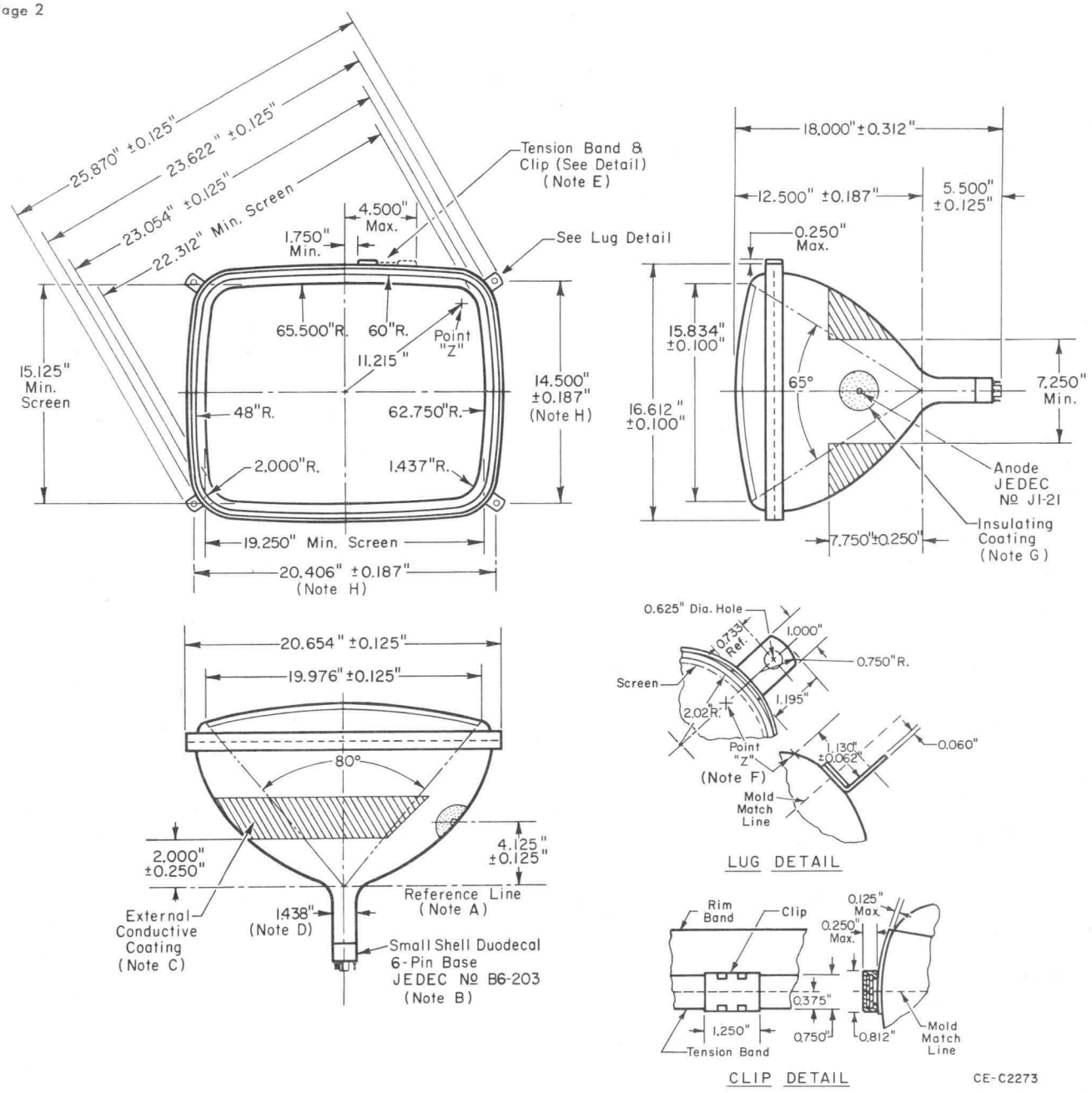
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	16000 Volts
Grid 4 Voltage (Focusing Electrode) (Note 4)	0 to 400 Volts
Grid 2 Voltage (Note 5)	500 Volts
Cathode Voltage for Raster Cutoff	45 to 95 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.
4. With the cathode bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15.187" by 19.250" pattern from type 2F21 monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.
5. It is recommended that not less than 300 volts on Grid 2 be used, as resolution is affected at lower voltages.



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 6 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.500" at the splice.

E. Tension band must be grounded.

F. Point "Z" is located on the tube diagonal at the faceplate surface.

G. Transparent insulating coating 3" in diameter. Clean only with soft, dry, lintless cloth.

H. Tube shall fit on 5/16" pegs centered at corners of 14.500" × 20.406" rectangle. (Suggested stud diameter is .200" – .250")

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Westinghouse

23HSP4

January 15, 1966

QUICK REFERENCE DATA

110° MAGNETIC DEFLECTION
15.125" × 19.250" MIN. SCREEN SIZE
4.625" NECK LENGTH

BANDED
WITH MOUNTING LUGS

6.3 VOLT, 450 MA HEATER
LOW G2 VOLTAGE (30 VOLTS)
SPHERICAL GRAY FILTER GLASS

DETAILED DATA

ELECTRICAL

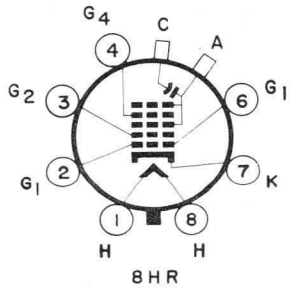
Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	110 Degrees
Horizontal	99 Degrees
Vertical	82 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode: (Note 5)	
Minimum	2000 pF
Maximum	2500 pF
Resistance Between External Conductive Coating and Mounting Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ±5% mA
Heater Warm-up Time (Note 1)	11 Seconds

OPTICAL

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	75.5%

MECHANICAL

Net Weight	26.5 Pounds
Over-all Length	14.375" ±0.281"
Neck Length	4.625" ±0.125"
Greatest Dimensions of Tube: (Excluding Lugs)	
Diagonal	23.622" ±0.125"
Width	20.654" ±0.125"
Height	16.612" ±0.125"
Minimum Useful Screen Dimensions (Projected):	
Diagonal	22.312"
Horizontal Axis	19.250"
Vertical Axis	15.125"
Area	282 Sq. Inches
Bulb	EIA J187E1
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR



8HR

RATINGS

Design Maximum System
Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Grid 1.

Maximum Anode Voltage (Note 2)	23500 Volts
Minimum Anode Voltage	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550 Volts
Maximum Grid 2 Voltage	60 Volts
Minimum Grid 2 Voltage	20 Volts
Cathode Voltage:	
Maximum Negative Bias Value	0 Volts
Maximum Negative Peak Value	2 Volts
Maximum Positive Bias Value	154 Volts
Maximum Positive Peak Value	220 Volts
Maximum Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode:	
During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	300 Volts
Heater Positive with Respect to Cathode	200 Volts

LIMITING CIRCUIT VALUES

Maximum Grid 1 Circuit Resistance	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 3)	10000 Ohms

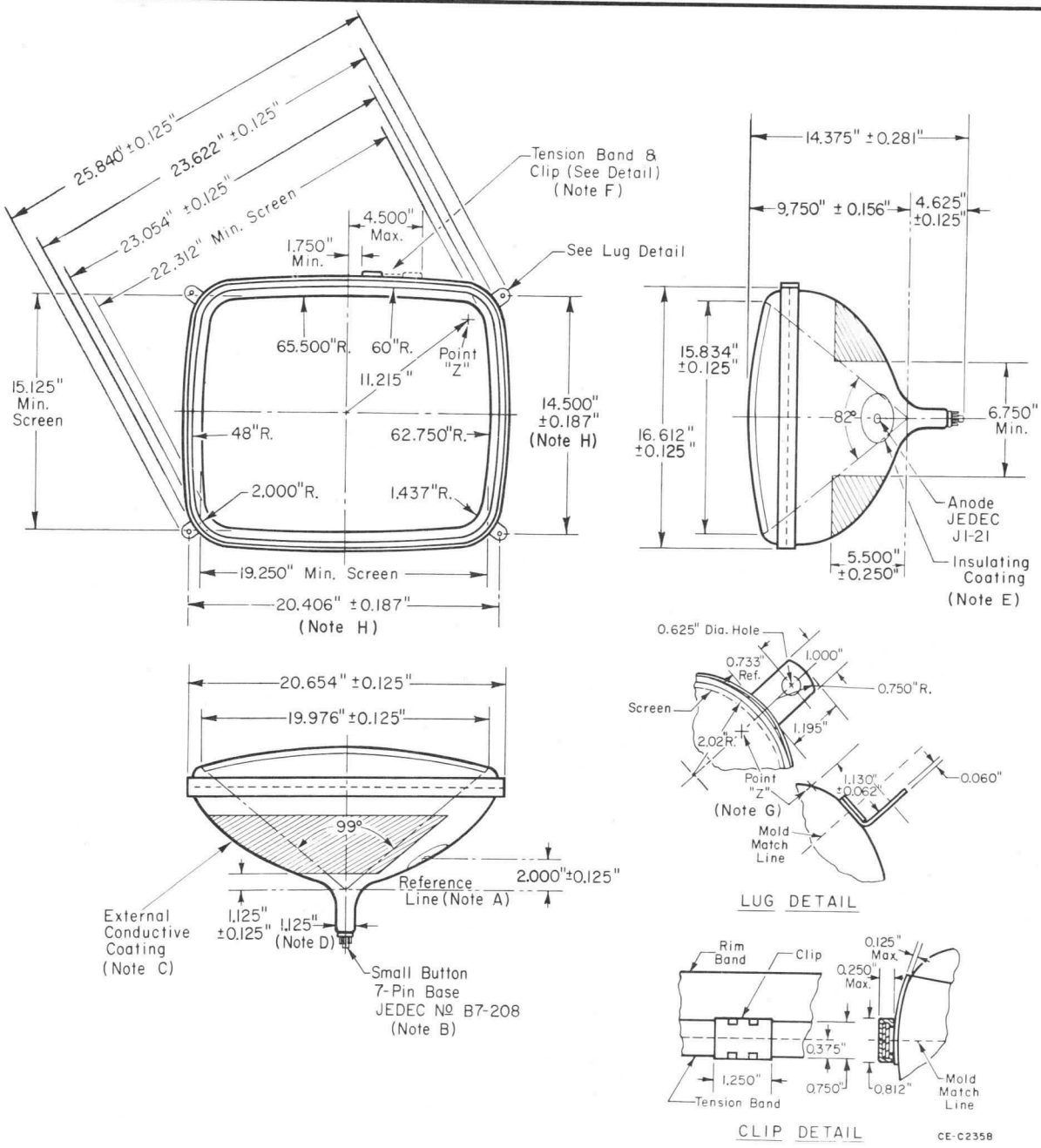
TYPICAL CATHODE DRIVE OPERATION

Unless Otherwise Specified, all Voltage Values are Positive with Respect to Grid 1.

Anode Voltage (Note 2)	18000 Volts
Grid 4 Voltage (Focusing Electrode) (Note 4)	0 to 400 Volts
Grid 2 Voltage	30 Volts
Cathode Voltage for Raster Cutoff	30 to 45 Volts

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
3. Protective resistance in the grids 2 & 4 circuits is advisable to prevent arc damage.
4. With the cathode bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15.125" by 19.250" pattern from type 2F21 monoscope or equivalent, individual tubes will have satisfactory focus at some value between 0 and 400 volts.
5. Includes mounting hardware. (Not an implosion protected system).



A. Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2.125" from Yoke Reference Line.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750" diameter circle concentric with tube axis. Base pin 4 aligns with major axis with in 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168" at the splice.

E. Transparent insulating coating, 3" in diameter. Clean only with soft, dry, lintless cloth.

F. Tension band must be grounded.

G. Point "Z" is located on the tube diagonal at the faceplate surface.

H. Tube shall fit on 5/16" pegs centered at corners of 14.500" × 20.406" rectangle. (Suggested stud diameter is 0.200" –0.250").

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Television Picture Tubes

Westinghouse

50 Volt Grid 2: 23HWP4
400 Volt Grid 2: 23HQP4

23" Black & White
Banded with Mounting Lugs Implosion Protection
110° Diagonal Deflection
282 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater

Electrical

Focusing Method	Low Voltage Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.)	
Diagonal	110 Degrees
Horizontal	99 Degrees
Vertical	82 Degrees
Direct Interelectrode Capacitances:	
Cathode to All Other Electrodes (Approx.)	5 pF
Grid No. 1 to All Other Electrodes (Approx.)	6 pF
External Conductive Coating to Anode: (Note 1)	
Minimum	2000 pF
Maximum	2500 pF
Resistance Between External Conductive Coating and Implosion Protection Hardware (minimum)	5 Megohms
Heater Current at 6.3 Volts	450 ± 5% mA
Heater Warm-up Time (Note 2)	11 Seconds

Optical

Phosphor Number	Aluminized P4
Light Transmittance at Center (Approx.)	42%

Mechanical

Over-all Length	14.875" ± 0.281"
Neck Length	5.125" ± 0.125"
Greatest Dimensions of Tube: (Excluding Mounting Lugs)	
Diagonal	23.662" ± 0.125"
Width	20.654" ± 0.125"
Height	16.612" ± 0.125"
Minimum Useful Screen Dimensions (projected):	
Diagonal	22.312"
Horizontal Axis	19.250"
Vertical Axis	15.125"
Area	282 Sq. Inches
Implosion Protection	Tension Band with Mounting Lugs
Bulb Contact	EIA J1-21
Base	EIA B7-208
Basing	EIA 8HR
Net Weight	27.5 Pounds
Bulb	EIA J187K1

Ratings

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with respect to Grid 1.	23HQP4	23HWP4
Maximum Anode Voltage (Note 3)	23000	22000 Volts
Minimum Anode Voltage	12000	12000 Volts
Maximum Grid 4 (Focusing Electrode) Voltage	+1100, −550	+1100, −550 Volts
Maximum Grid 2 Voltage	550	70 Volts
Minimum Grid 2 Voltage	200	30 Volts
Cathode Voltage:		
Maximum Negative Bias Value	0	0 Volts
Maximum Negative Peak Value	2	2 Volts
Maximum Positive Bias Value	154	154 Volts
Maximum Positive Peak Value	220	220 Volts
Maximum Heater-Cathode Voltage:		
Heater Negative with respect to Cathode:		
During Warm-up Period not to Exceed 15 Seconds	450	450 Volts
After Equipment Warm-up Period	200	300 Volts
Heater Positive with respect to Cathode	200	200 Volts

Limiting Circuit Values

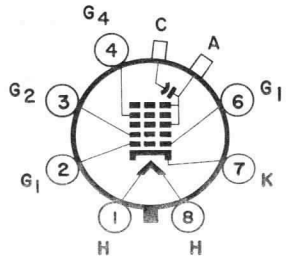
Maximum Grid 1 Circuit Resistance	1.5	1.5 Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	10000 Ohms

Typical Cathode Drive Operation

Unless Otherwise Specified, Voltage Values are Positive with respect to Grid 1.		
Anode Voltage (Note 3)	16000	16000 Volts
Grid 4 Voltage (Focusing Electrode)	0 to 400	0 to 400 Volts
Grid 2 Voltage	400	50 Volts
Cathode Voltage for Raster Cutoff	39 to 94	35 to 55 Volts

Notes

1. Includes implosion protection hardware.
2. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
3. Operation with voltage in excess of 16KV may require shielding to limit radiation of very soft X-rays.
4. Protective resistance in the grids 2 & 4 circuits is advisable to prevent damage.



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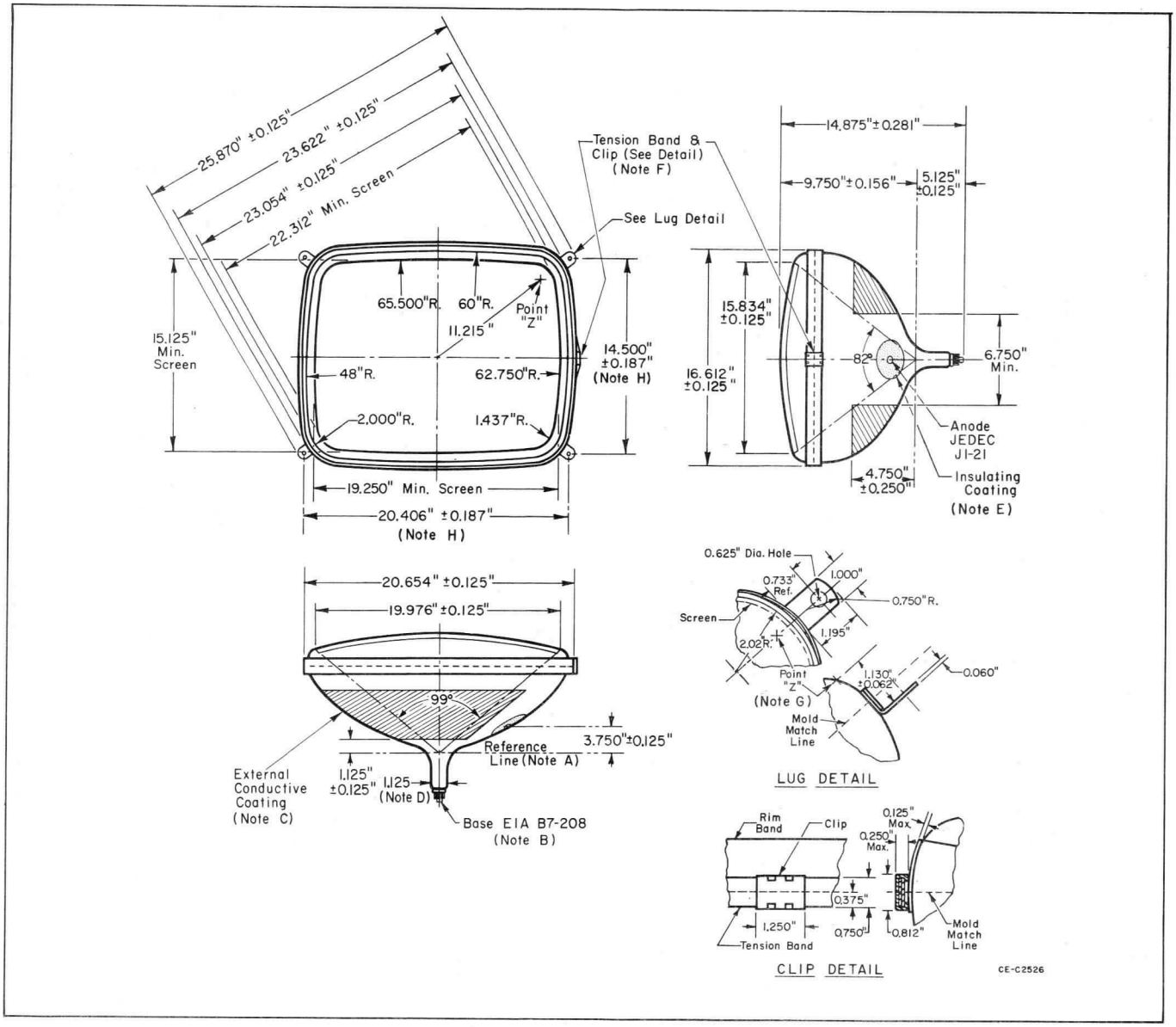
October 1968
New Information
S6–2B–11C, S5–10B, WI–600

Television Picture Tubes

50 Volt Grid 2: 23HWP4
400 Volt Grid 2: 23HQP4

23″ Black & White
Banded with Mounting Lugs Implosion Protection
110° Diagonal Deflection
282 Square Inch Screen
6.3 Volt, 0.45 Ampere Heater



Outline Notes

A. Yoke Reference Line is determined by plane surface of flared end of EIA Reference Line Gauge No. 126 when seated on funnel of tube. Contour of yoke area is given by formula: $y = 0.58\ x^2 + 0.576$, parabolic.

B. Lateral strains on base pins must be avoided. The socket should have flexible leads permitting movement. The perimeter of the base wafer will be inside a 1.750″ diameter circle concentric with tube axis. Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

C. External conductive coating forms supplementary filter capacitance and must be grounded.

D. Neck diameter may be a maximum of 1.168″ at the splice.

E. Transparent insulating coating, 3″ in diameter. Clean only with soft, dry, lintless cloth.

F. Tension band must be grounded.

G. Point "Z" is located on the tube diagonal at the faceplate surface.

H. Tube shall fit on 0.312″ pegs centered at corners of 14.500″ x 20.406″ rectangle. (Suggested stud diameter is 0.200″ to 0.250″).

Westinghouse Electric Corporation
Electronic Tube Division, Elmira, N. Y. 14902
Printed in U. S. A.

TELEVISION PICTURE TUBE TYPE 23MP4A

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus

External Conductive Coating
Spherical Faceplate
No Ion Trap
15-1/8" × 19-1/4" Screen Size

ELECTRICAL:

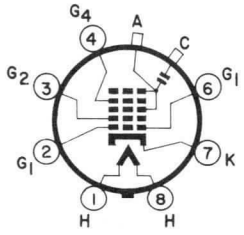
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	102	Degrees
Vertical	84	Degrees
Diagonal	114	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	1700	μμf
Heater Current at 6.3 Volts	600 + 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	78	Percent

MECHANICAL:

Overall Length	14-3/8 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 + 3/32 – 1/8	Inches
Width	20-1/2 + 1/16 – 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal Axis	19-1/4	Inches
Vertical Axis	15-1/8	Inches
Area	282	Sq. Inches
Neck Length	5-1/8 ± 1/8	Inches
Bulb	J187B1	
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Weight	24 Lbs.	



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RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	23500	Volts
Minimum Anode Voltage (Note 2)	11000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1250, –400	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode.	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	20000	Volts DC
Grid 4 Voltage (Focusing Electrode)	0 to 400	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

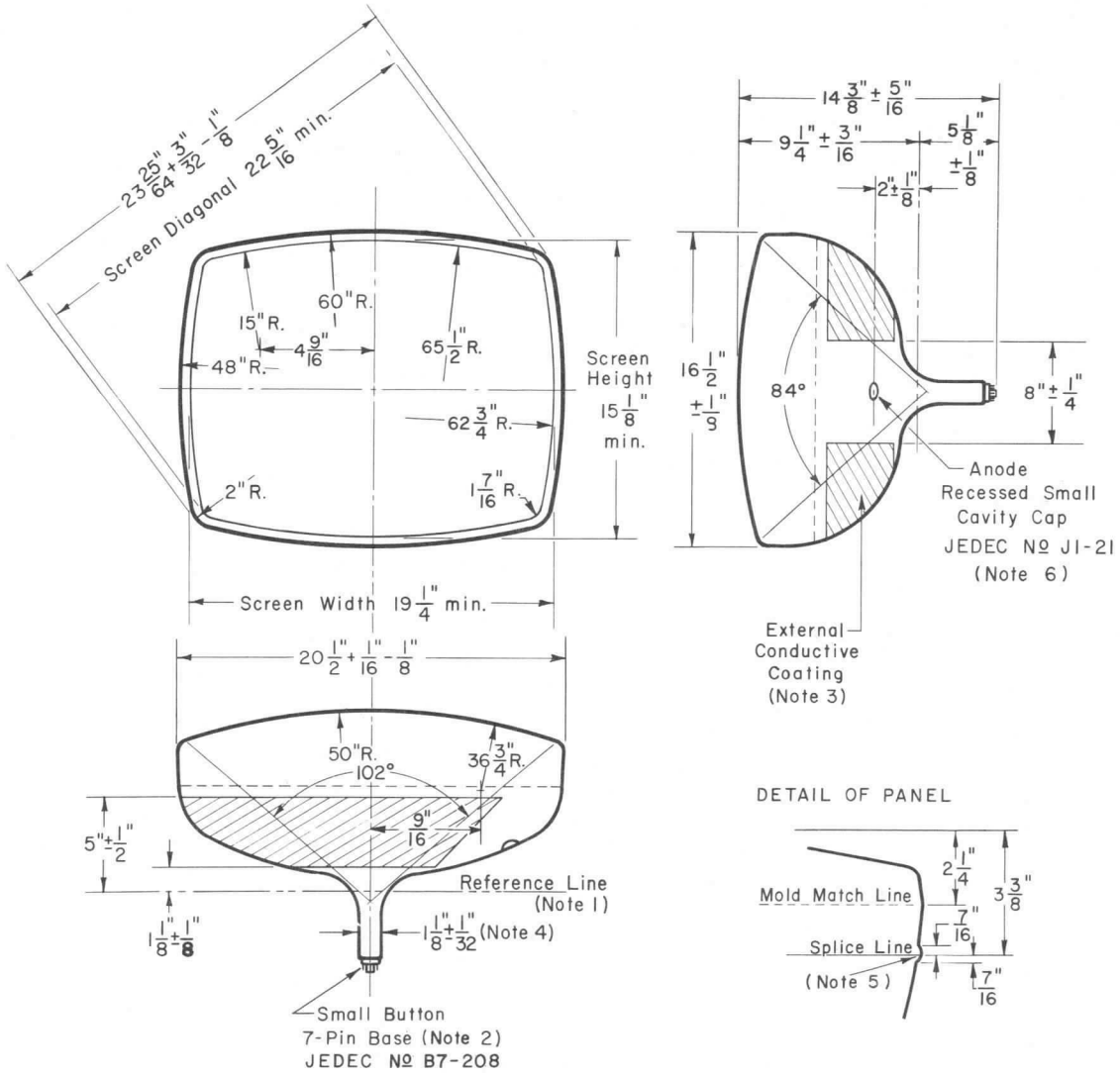
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 11000 volts in not recommended.

3. It is recommended that not less than 300 volts on grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: Anode terminal alignment with pin 4 has angular tolerance about tube axis of ±30°.

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TWIN PANEL TELEVISION PICTURE TUBE TYPE 23SP4

110° Magnetic Deflection
Rectangular Glass
Aluminized
Gray Filter Glass

Twin Face Panel, Integral Safety Glass
Electrostatic Focus
5⅛" Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19 5/16" × 15¼" Screen Size

GENERAL

Deflection Method	Magnetic
Focusing Method	Electrostatic
Deflection Angles (Approx.):	
Diagonal	110°
Horizontal	99°
Vertical	82°
Screen:	
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short
Faceplate	Spherical Gray Filter Glass
Laminated Panel	FP198A1
Light Transmission (Approx.)	40%
Weight	31 Pounds

ELECTRICAL

Heater:		
Voltage	6.3	Volts
Current	0.3	Ampere
Warm-up Time (Note 1)	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other electrodes	6	pf
Cathode to all other electrodes	5	pf
External Conductive Coating:		
Maximum	2500	pf
Minimum	2000	pf

MECHANICAL

Mounting Position	Any
Screen Dimensions:	
Screen Area	282 sq. in. Min.
Height	15-1/4" Min.
Width	19-5/16" Min.
Diagonal	22-5/16" Min.
Bulb Dimensions:	
Bulb	J187A1
Height	17-5/16" + 3/32" – 1/8"
Width	21-5/16" ± 1/8"
Diagonal	24-45/64" + 3/32" – 1/16"
Overall Length	15-3/16" ± 3/8"
Neck Length	5-1/8" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC J1-21)
Base	Small Button 7-Pin (JEDEC B7-208)
Basing	8HR

MAXIMUM RATINGS

Design Maximum Values

Anode Voltage (Note 2)	22000	max.	Volts
Grid 4 Voltage:			
Positive Value	1100	max.	Volts
Negative Value	–550	max.	Volts
Grid 2 Voltage	550	max.	Volts
Grid 1 Voltage:			
Negative Peak Value	220	max.	Volts
Negative Bias Value	154	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	0	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with Respect to Cathode			
During Warm-up Period of 15 Sec. Max.	450	max.	Volts
After Equipment Warm-up Period	200	max.	Volts
Heater Positive with Respect to Cathode	200	max.	Volts

TYPICAL GRID DRIVE OPERATING CONDITIONS

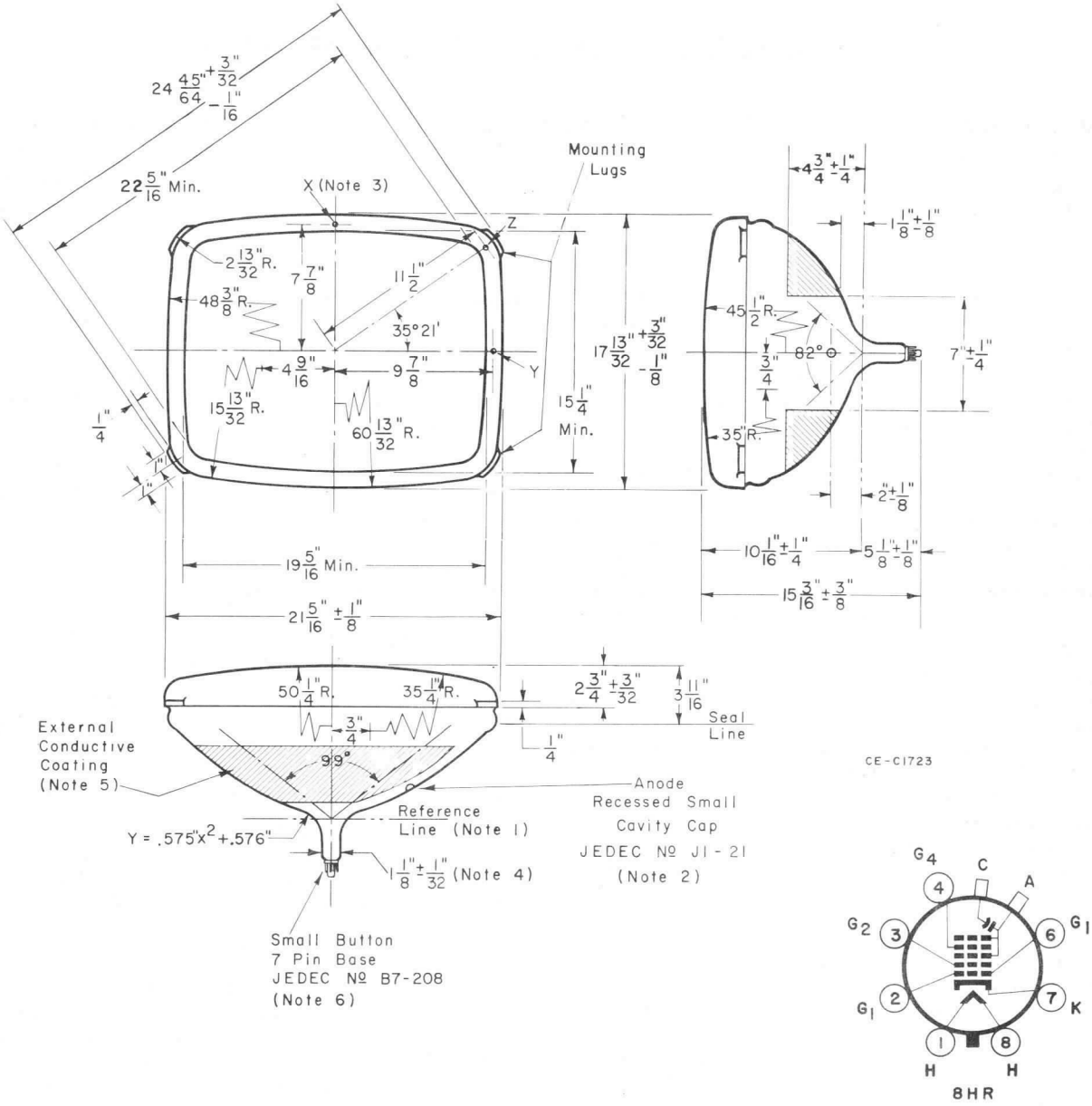
Anode Voltage	16000	Volts
Grid 4 Voltage	0 to + 400	Volts
Grid 2 Voltage	300	Volts
Grid 1 Voltage for Raster Cutoff	–35 to –72	Volts

LIMITING CIRCUIT VALUES

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance (Note 3)	10000	min.	Ohms
Grid 4 Circuit Resistance (Note 3)	10000	min.	Ohms

NOTES

1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.
2. Operation with voltage in excess of 16 KV may require shielding to limit radiation of very soft X-rays. Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 12,000 volts.
3. Protective resistance in the G2 and G4 circuits is advisable to prevent damage to the tube.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Base pin 4 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 3: Planes perpendicular to the axis and passing through points X, Y and Z are determined as follows:
Plane tangent to crown of face, to plane of X = 0.758" nom.
Plane of X to plane of Y = 0.463 ± 0.030".
Plane of X to plane of Z = 0.970 ± 0.030".

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

NOTE 5: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 6: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

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TELEVISION PICTURE TUBE TYPE 23VP4

114° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 300 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
19-1/4" × 15-3/16" Screen Size

ELECTRICAL:

Focusing Method			Electrostatic
Deflection Angles (Approx.):			
Horizontal	102		Degrees
Vertical	84		Degrees
Diagonal	114		Degrees
Direct Interelectrode Capacitances:			
Cathode to all other electrodes, approximate	5		μμf
Grid #1 to all other electrodes, approximate	6		μμf
External Conductive Coating to Anode	2500	max.	μμf
	2000	min.	μμf
Heater Current at 6.3 volts	300 ± 30		Ma.
Heater Warm-up Time⊕	18		Seconds

OPTICAL

Phosphor Number		Aluminized P4
Light Transmittance at Center, (Approx.)	78	Percent

MECHANICAL:

Overall Length	13-3/4 ± 5/16	Inches
Greatest Dimensions of Tube:		
Diagonal	23-25/64 + 3/32 − 1/8	Inches
Width	20-1/2 + 1/16 − 1/8	Inches
Height	16-1/2 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-5/16	Inches
Horizontal axis	19-1/4	Inches
Vertical axis	15-3/16	Inches
Area	278	Sq. Inches
Neck Length	4-1/2 ± 1/8	Inches
Bulb Contact	J1-21	
Base	B7-208	
Basing	8HR	
Bulb Contact Alignment:		
J1-21 contact aligns with pin position #4,	±30	Degrees
Base Alignment:		
Pin #4 aligns with horizontal picture axis	±30	Degrees

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

RATINGS

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive and Measured with Respect to Cathode

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage	11000	Volts
Maximum Grid 4 Voltage	+1100 −550	Volts
Maximum Grid 2 Voltage	550	Volts
Minimum Grid 2 Voltage	200	Volts
Grid 1 Voltage:		
Maximum Negative Bias Value	154	Volts
Maximum Negative Peak Value	220	Volts
Maximum Positive Bias Value	0	Volts
Maximum Positive Peak Value	2	Volts
Maximum Heater Voltage	6.93	Volts
Minimum Heater Voltage	5.67	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 45 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS

Grid Drive Service

Unless otherwise specified, all voltage values are positive with respect to cathode.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)□	200	Volts DC
Grid 2 Voltage	450	Volts DC
Grid 1 Voltage for raster cutoff.	−45 to −105	Volts DC

Cathode Drive Service:

Unless otherwise specified, all voltage values are positive with respect to Grid 1.

Anode Voltage	14000	Volts DC
Grid 4 Voltage (Focusing Electrode)□	250	Volts DC
Grid 2 Voltage	500	Volts DC
Cathode Voltage for raster cutoff.	45 to 95	Volts DC

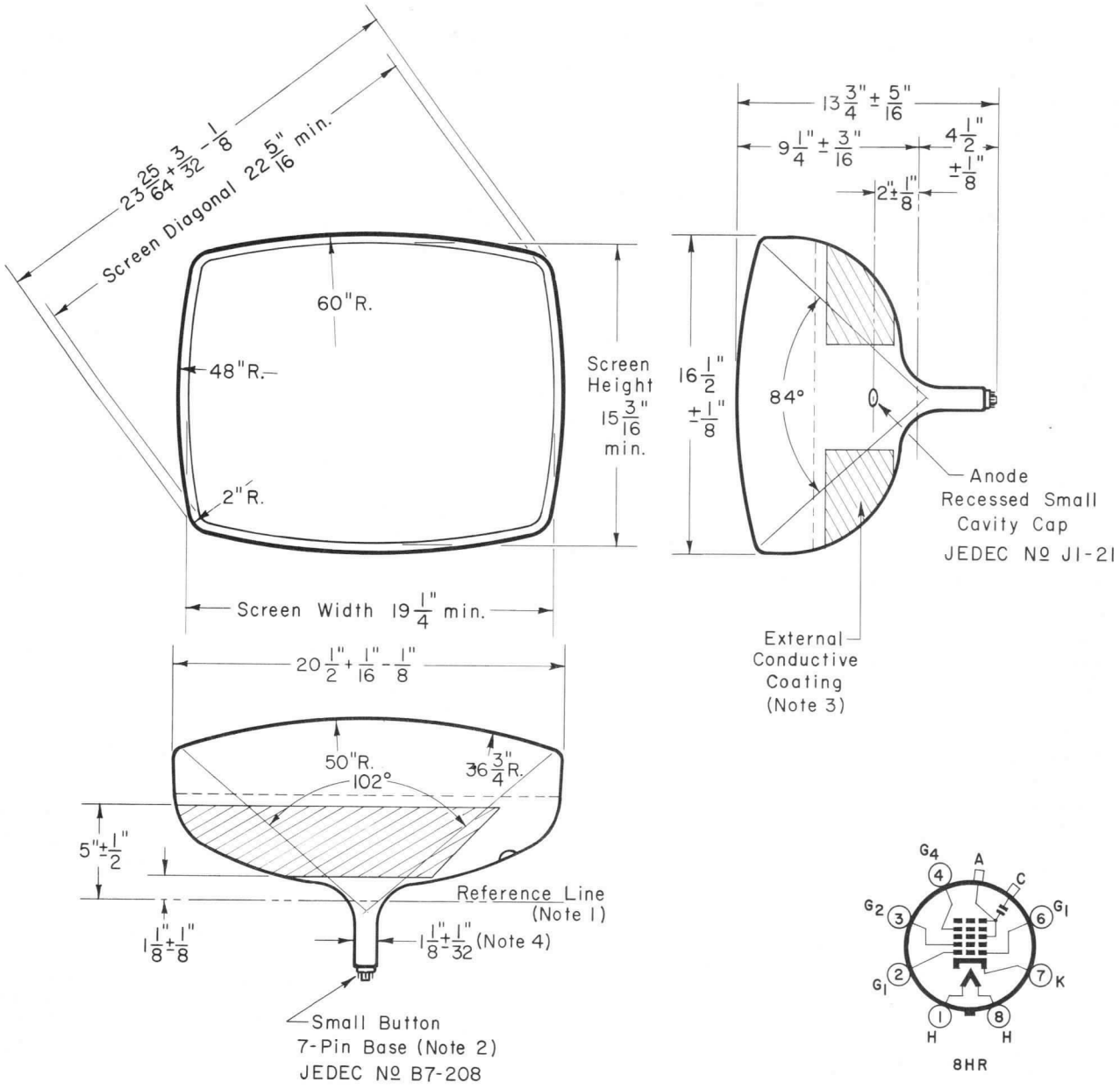
LIMITING CIRCUIT VALUES

Maximum Grid #1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance■	10000	Ohms

□ With the combined grid 1 bias voltage and video-signal voltage adjusted to give an anode current of 150 microamperes on a 15-3/16" × 19-1/4" pattern from type 2F21 Monoscope or equivalent. Individual tubes will have satisfactory focus at some value between 0 and 400 volts.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



NOTE 1: Yoke Reference Line is determined by plane surface of flared end of JEDEC Reference-Line Gauge No. 126 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-1/8" from Yoke Reference Line.

NOTE 2: Lateral strains on the base pins must be avoided. The socket should have flexible leads permitting free movement. The perimeter of the base wafer will be inside a 1-3/4" diameter circle concentric with tube axis.

NOTE 3: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 4: Neck diameter may be a maximum of 1.168" at the splice.

Westinghouse®

October 15, 1959

TELEVISION PICTURE TUBE TYPE 24AHP4

110° Magnetic Deflection
Rectangular Glass Construction
Low-Voltage Electrostatic Focus

Straight Gun, No Ion Trap Required
21-7/16" × 16-7/8" Screen Size
16-3/16" Max. Overall Length

Aluminized Screen
Spherical Faceplate
External Conductive Coating

ELECTRICAL:

Cathode	Coated Unipotential	
Heater:		
Voltage (ac or dc)	6.3	Volts
Current	0.6	Ampere
Warm-up Time⊕	11	Seconds
Direct Interelectrode Capacitances:		
Grid 1 to all other Electrodes	6	μμf
Cathode to all other Electrodes	5	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	2000	μμf
Screen:		
Phosphor	Aluminized P4	
Fluorescence	White	
Persistence	Short	
Focusing Method	Low-Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angle:		
Horizontal	105°	
Vertical	87°	
Diagonal	110°	

MECHANICAL:

Mounting Position	Any
Screen Dimensions (min. at greatest part):	
Width	21-7/16"
Height	16-7/8"
Diagonal	22-13/16"
Area	332 Sq. Inches
Faceplate	Spherical
Glass	Neutral Gray
Transmission (approx.)	76%
Bulb Dimensions (at greatest part):	
Width	22-11/16" ± 1/8"
Height	18-1/2" ± 1/8"
Diagonal	24" ± 1/8"
Bulb Number	J192C1 or Equiv.
Overall Length	15-7/8" ± 5/16"
Neck Length	5-7/16" ± 1/8"
Anode Terminal	Recessed Small Cavity Cap (JEDEC No. J1-21)
Base	Small Button, 7-Pin Style B (JEDEC No. B7-183)
Basing	8HR
Net Weight (approx.)	28 Lbs.

MAXIMUM RATINGS

Design Center Values

Anode Voltage †	20000	max.	Volts
Grid 4 Voltage:			
Positive Value	1000	max.	Volts
Negative Value	500	max.	Volts
Grid 2 Voltage	500	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	140	max.	Volts
Negative Peak Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode #	180	max.	Volts
Heater Positive with respect to Cathode	180	max.	Volts

LIMITING CIRCUIT VALUES:

Grid 1 Circuit Resistance	1.5	max.	Megohms
Grid 2 Circuit Resistance■	10000	min.	Ohms
Grid 4 Circuit Resistance■	10000	min.	Ohms

GRID DRIVE OPERATION
(Video Signal Applied to Grid 1)

TYPICAL OPERATING CONDITIONS:

Anode Voltage	14000	16000	Volts
Grid 2 Voltage	300	400	Volts
Grid 4 Voltage for Focus	-50 to +350	-50 to +350	Volts
Grid 1 Raster Cutoff Voltage	-28 to -72	-36 to -94	Volts

CATHODE DRIVE OPERATION
(Video Signal Applied to Cathode)

TYPICAL OPERATING CONDITIONS:

Anode to Grid 1 Voltage	14000	16000	Volts
Grid 2 to Grid 1 Voltage	300	400	Volts
Grid 4 to Grid 1 Voltage for Focus.	-50 to +350	-50 to +350	Volts
Cathode to Grid 1 Raster Cutoff Voltage	28 to 60	36 to 78	Volts

† Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts is not recommended.

■ Protective resistance in the grid 2 and grid 4 (focus electrode) circuit is advisable to prevent damage.

⊕ Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

During 15 second warm-up period this value may be 410 max. volts.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.

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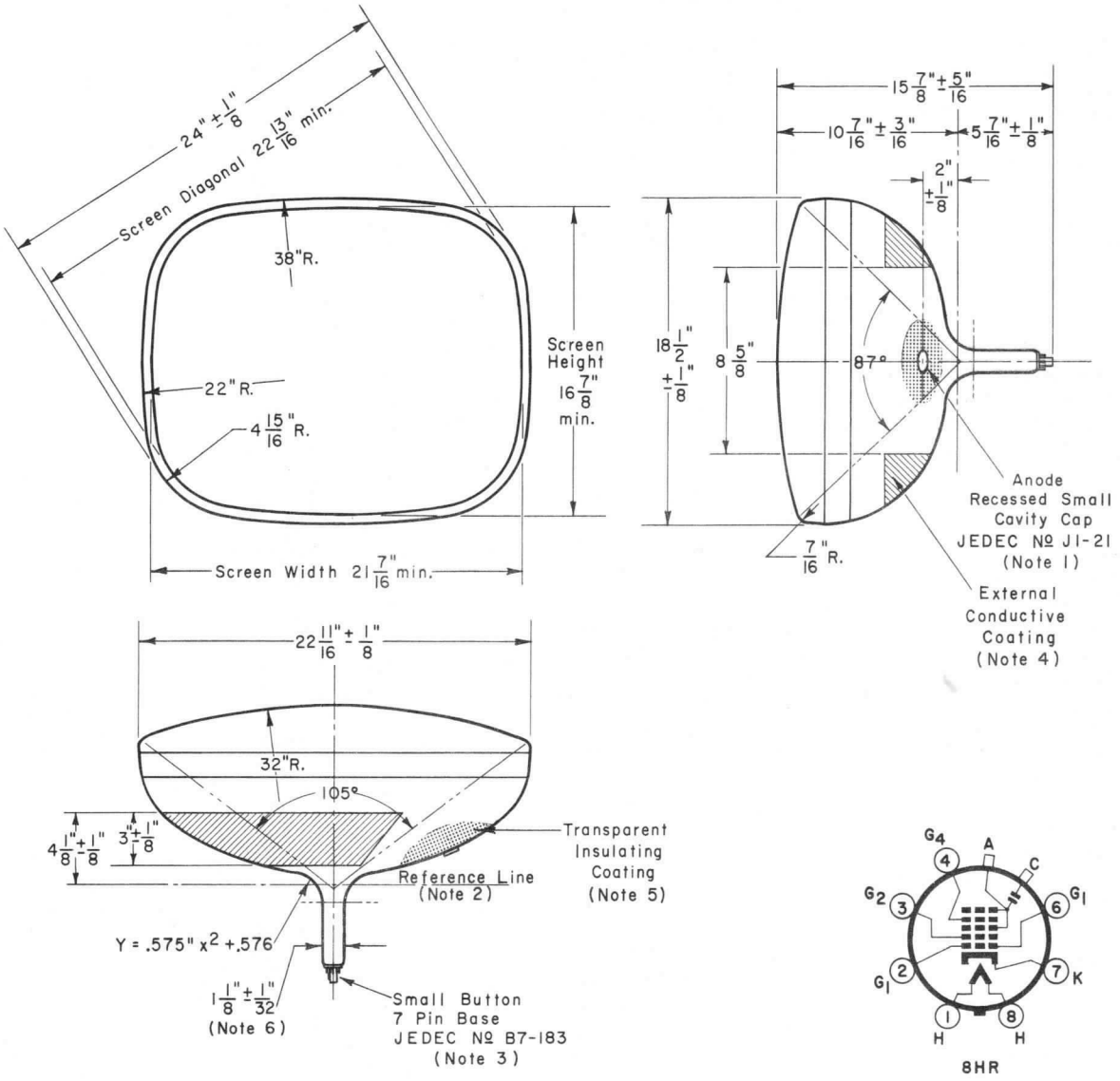


NOTE 1: The plane through the tube axis and base pin 4 may vary from the plane through the tube axis and the anode terminal by an angular tolerance of ± 30°. The anode terminal is on the same side of the tube as pin 4.

NOTE 2: With the tube neck inserted through the flared end of Reference Line Gauge JETEC No. 126 and with the tube seated in the gauge, the reference line is determined by the intersection of the plane face of the flared end of the gauge with the tube funnel. With a minimum neck length tube, the PM centering magnet (0 to 8 gaus) should extend no more than 2-1/8" from the yoke reference line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 1-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: To clean this area, wipe only with a soft, dry, lintless cloth. The transparent insulating coating is approx. 6" in diameter.

NOTE 6: Neck diameter may be a maximum of 1.168" at the splice.

Westinghouse

24AUP4

October 1, 1961

TELEVISION PICTURE TUBE TYPE 24AUP4

90° Magnetic Deflection
Rectangular Glass
Aluminized Screen
Gray Filter Glass

6.3 Volt, 600 Ma. Heater
Electrostatic Focus
Short Neck Length

External Conductive Coating
Spherical Faceplate
No Ion Trap
16-7/8" × 21-7/16" Screen Size

ELECTRICAL:

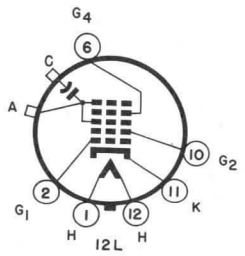
Focusing Method	Low Voltage Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	85	Degrees
Vertical	68	Degrees
Diagonal	90	Degrees
Direct Interelectrode Capacitances:		
Cathode to all other electrodes, (Approx.)	5	μμf
Grid 1 to all other electrodes, (Approx.)	6	μμf
External Conductive Coating to Anode:		
Maximum	2500	μμf
Minimum	1700	μμf
Heater Current at 6.3 Volts	600 ± 5%	Ma.
Heater Warm-up Time (Note 1)	11	Seconds

OPTICAL:

Phosphor Number	Aluminized P4	
Light Transmittance at Center, Approximate	74	Percent

MECHANICAL:

Overall Length	18-1/8 ± 3/8	Inches
Greatest Dimensions of Tube:		
Diagonal	24 ± 1/8	Inches
Width	22-43/64 ± 1/8	Inches
Height	18-7/16 ± 1/8	Inches
Minimum Useful Screen Dimensions (Projected):		
Diagonal	22-13/16	Inches
Horizontal	21-7/16	Inches
Vertical	16-7/8	Inches
Area	332	Sq. Inches
Neck Length	4-1/2 ± 3/16	Inches
Bulb	J192	
Bulb Contact	J1-21	
Base	B6-203	
Basing	12L	
Weight	32-1/2 Lbs.	



RATINGS:

Design Maximum System

Unless Otherwise Specified, Voltage Values are Positive with Respect to Grid 1.

Maximum Anode Voltage	22000	Volts
Minimum Anode Voltage (Note 2)	12000	Volts
Maximum Grid 4 Voltage (Focusing Electrode)	+1100, −550	Volts
Maximum Grid 2 Voltage	700	Volts
Cathode Voltage:		
Maximum Negative Value	0	Volts DC
Maximum Negative Peak Value	2	Volts
Maximum Positive Value	154	Volts DC
Maximum Positive Peak Value	220	Volts
Maximum Heater-Cathode Voltage		
Heater negative with respect to cathode		
During warm-up period not to exceed 15 seconds	450	Volts
After equipment warm-up period	200	Volts
Heater positive with respect to cathode	200	Volts

TYPICAL OPERATING CONDITIONS:

CATHODE DRIVE SERVICE:

Unless Otherwise Specified, All Voltage Values are Positive with Respect to Grid 1.

Anode Voltage	18000	Volts DC
Grid 4 Voltage (Focusing Electrode)	−75 to +400	Volts DC
Grid 2 Voltage (Note 3)	500	Volts DC
Cathode Voltage for raster cutoff	45 to 95	Volts DC

LIMITING CIRCUIT VALUES:

Maximum Grid 1 Circuit Resistance	1.5	Megohms
Minimum Grids 2 & 4 Circuit Resistance (Note 4)	10000	Ohms

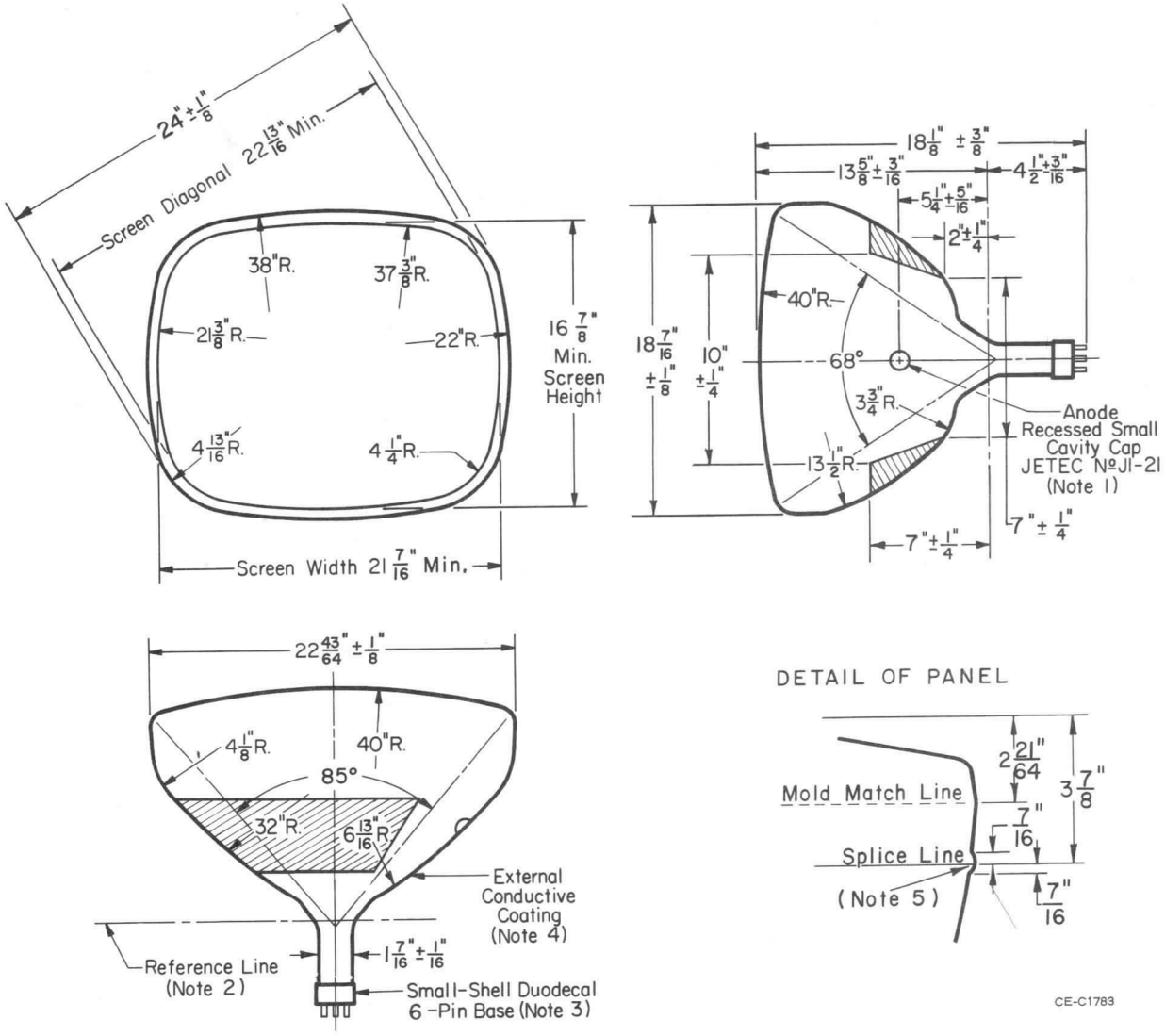
1. Heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times rated heater voltage divided by rated heater current.

2. Brilliance and definition decrease with decreasing anode voltage. Operation with anode voltage less than 12000 volts in not recommended.

3. It is recommended that not less than 300 volts on grid 2 be used, as resolution is affected at lower voltages.

4. Protective resistance in the grid 2 and grid 4 (focus electrode) circuits is advisable to prevent damage to the tube.

X-RAY WARNING: Operation with voltages in excess of 16KV may require shielding to limit radiation of very soft x-rays.



DETAIL OF PANEL

CE-C1783

NOTE 1: Base pin 6 aligns with major axis within 30° and is on same side as anode terminal.

NOTE 2: Yoke Reference Line is determined by plane C-C[1] of JEDEC Reference-Line Gauge No. 116 when seated on funnel of tube. With a minimum neck length tube, the PM centering magnet (0 to 8 gauss) should extend no more than 2-3/4" from Yoke Reference Line.

NOTE 3: The socket should not be mounted rigidly, but should be allowed to move freely and have flexible leads. The associated wiring should not impress lateral strains on the base pins. The bottom circumference of the base wafer will lie within a circle concentric with the bulb axis and having a diameter of 2-3/4".

NOTE 4: External conductive coating forms supplementary filter capacitor and must be grounded.

NOTE 5: Splice-line seal bulge may protrude a maximum of 1/16" from dimension surface at any point around the seal.

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Westinghouse

25VAFP22

90° Deflection

Astro-Brite 135 Color Picture Tube

- High brightness screen assembly
- New 3 x 4 aspect ratio
- Large viewing area - 315 Sq. In.
- High resolution gun - sharper pictures - better detail
- Light neutral screen appearance
- Rare earth (red) phosphor
- New Green Phosphor
- Unity Current Ratios
- Temperature Compensated Shadow Mask
- Integral Implosion Protection
- Increased X-Ray Absorption Panel and Funnel

The 25VAFP22 employs a new improved, high efficiency phosphor screen assembly. This assembly, in conjunction with a higher transmission panel, (50%), provides bright color pictures. The new 3 x 4 aspect ratio provides a larger, more rectangular viewing area of 315 square inches.

To further enhance picture detail, especially under highlight signal conditions, a new high resolution gun has been utilized in this type.

A neutral screen appearance is an added feature which is a result of the phosphors used in the screen. This feature results in a pleasing appearance when the tube is turned off.

The phosphors which are utilized in the screen are a yttrium oxide rare-earth red phosphors, and improved green and blue sulfide phosphors. The use of these phosphors and new improved techniques in screening processes provide the higher brightness screen assembly. The unity cathode-current ratio feature is maintained in the 25VAFP22 for the industry standard white temperature.

Other features of the 25VAFP22 include a temperature compensated shadow mask; integral implosion protection provided by formed rims and a tension band.

Electrical Data

Electron Guns, Three . . . Red Blue Green
Heater Current at
6.3 Volts . . . . . 0.900 Ampere
Focusing Method . . . . Electrostatic
Focus Lens . . . . . Bipotential
Convergence Method . . . . . Magnetic
Deflection Method . . . . . Magnetic
Deflection Angles (Approx.)
Diagonal . . . . . 90 Degrees
Horizontal . . . . . 78 Degrees
Vertical . . . . . 60 Degrees
Direct Interelectrode Capacitances (Approx.)
Grid 1 of any Gun to All Other Electrodes . . . . . 9 pF
Cathodes to All Guns (Parallel Connected) to All Other Electrodes . . . . . 12 pF
Focusing Electrode (Grid 3) to All Other Electrodes . . . . . 9 pF
External Conductive Coating to Anode:
Maximum . . . . . 2500 pF
Minimum . . . . . 2000 pF

Optical Data

Screen, on Inner Surface of Faceplate:
Type . . Aluminized Tri-color Phosphor Dot P22
Spacing between Centers of Adjacent Dot Triads (Approx.) . . . . . 0.029" (0.74 mm)
Light Transmission at Center (Approx.) 50%
Anti-reflection Treatment . . . . . No

Mechanical Data

Minimum Useful Screen Dimension (Projected):
Diagonal . . . . . 24.658" (626.31 mm)
Horizontal Axis . . . . . 20.776" (527.72 mm)
Vertical Axis . . . . . 15.582" (395.78 mm)
Area . . . . . 315 Sq. In. (2032.25 Sq. cm)
Bulb:
Funnel . . . . . JEDEC No. J209 D1
Panel . . . . . JEDEC No. FP-209¾ R1
Implosion Protection . . . . . Banded Rim
Weight . . . . . 44.5 Pounds (20.7 kg)

October 1970
Supersedes TD 86-641 dated February 1970
TC—2243-2

Westinghouse

Maximum and Minimum Ratings, Design Maximum Values

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode Voltage	27500	max.	Volts
	20000	min.	Volts
Total Anode Current, Long-Term Average	1000	max.	μA
Grid 3 (Focusing Electrode) Voltage	6000	max.	Volts
Peak-Grid 2 Voltage, Including Video Signal Voltage	1000	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	400	max.	Volts
Negative Operating Cutoff Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Heater Voltage (ac or dc):			
Under Operating Conditions (Note 1)	6.9	max.	Volts
	5.7	min.	Volts
Under Standby Conditions (Note 2)	5.5	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode:			
During Equipment Warm-up Period not exceeding 15 seconds	450	max.	Volts
After Equipment Warm-up Period:			
Combined AC and DC Value	200	max.	Volts
DC Component Value	200	max.	Volts
Heater Positive with respect to Cathode:			
AC Component Value	200	max.	Volts
DC Component Value	0	max.	Volts

Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode

For Anode Voltages between 20000 and 27500 Volts		
Grid 3 (Focusing Electrode) Voltage as a % of Anode Voltage	16.8 to 20	%
Grid 2 and Grid 1 Voltage for Visual Extinction of Focused Spot	See Figure 1	
Maximum Ratio of Grid 2 Voltages, Highest Gun to Lowest Gun in Any Tube (At Grid 1 spot cutoff voltage of −100 Volts)	1.86	
Heater Voltage:		
Under Operating Conditions: (Note 1)		
When Standby Operation is not Utilized	6.3	Volts
When 5.0 Volts Standby Operation is Utilized	6.0	Volts
Under Standby Conditions (Note 2)	5.0	Volts
Grid 3 Current (Total)	−45 to +15	μA
Grid 2 Current	− 5 to + 5	μA

To Produce White of 9300°K +27 M.P.C.D. (CIE Coordinates x = 0.281, y = 0.311):	*Red*	*Blue*	*Green*	
Percentage of Total Anode Current supplied by each gun (Average)	30	31	39	%

Ratio of Cathode Currents:	*Min.*	*Typ.*	*Max.*	
Red/Blue	.75	.95	1.25	−
Red/Green	.60	.75	1.10	−

Displacements, Measured at Center of Screen:		
Raster Centering Displacement:		
Horizontal	±0.45	Inch (±11.4 mm)
Vertical	±0.45	Inch (±11.4 mm)
Lateral Distance Between the Blue Beam and the Converged Red and Green Beams	±0.25	Inch (± 6.4 mm)
Radial Convergence Displacement excluding effects of Dynamic Convergence (each beam)	±0.37	Inch (± 9.4 mm)
Maximum Required Correction for Resister (Including Effect of Earth's Magnetic Field when Using Recommended Components) as Measured at the Center of the Screen in any Direction	0.005	Inch (0.13 mm)

Limiting Circuit Values

High-Voltage Circuits:			
Grid 3 Circuit Resistance (Note 3)	7.5	max.	Megohms
Low-Voltage Circuits:			
Effective Grid 1-to-Cathode-Circuit Resistance (each gun) (Note 4)	0.75	max.	Megohm

Notes

1. For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the dc biasing circuit for the heater should be between 100,000 ohms and 1 megohm.
2. The use of a 5-volt standby condition in conjunction with 6-volt operating condition is recommended to improve the reliability of the color picture tube by extending the emission wear-out life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the color picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.
3. In order to minimize the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the Grid 3 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.
4. The low-voltage circuits, including all heater circuits, should be analyzed by assuming the color picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the color picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 0.25 inch (6.4 mm) to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

Application Data

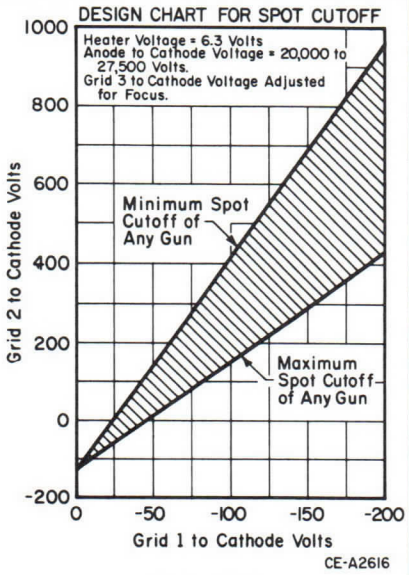


FIGURE 1

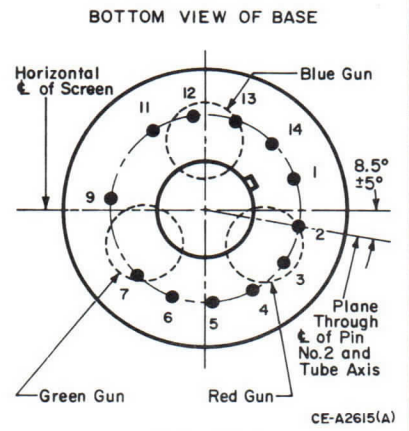


FIGURE 2

General Considerations

Tube Handling

The tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area and the edge of the protective window.

Support for the tube may be provided by a mounting system which supports the tube in the area in front of the seal line together with a pull-up ring or similar support on the tube funnel. The mounting system should not place mechanical stress on or cause abrasion of the tube particularly in the seal area and the edge of the protective window.

The color receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localized overheating due to poor contact.

General Considerations

The deflection yoke should not be used for supporting the picture tube. The yoke and tube axis must coincide and the yoke must be free to move along the neck for a distance of approximately 0.5 inch (13 mm) from its most forward position for adjustment purposes. The yoke mount should also provide for a small amount of rotational adjustment.

Positioning of Purity Magnet and Lateral Convergence Device

For best operation, it is recommended that the purity magnet and lateral convergence device be positioned as shown in Figure 4. The purity magnet (approximate strength of 10-gauss) should be centered on the neck over the Grid 3 cylinder, 1.10 inch from the centerline of the internal radial convergence pole pieces. The blue lateral convergence device should be positioned over the Grid 3 cylinder, 1.60 inch from the centerline of the internal convergence pole pieces.

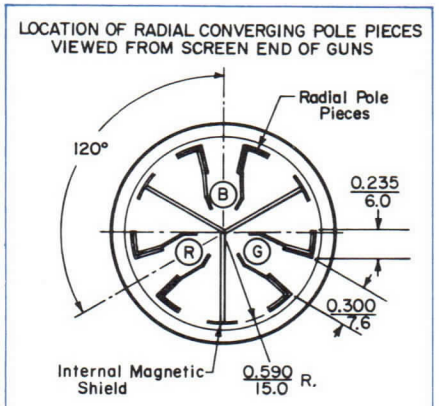


FIGURE 3

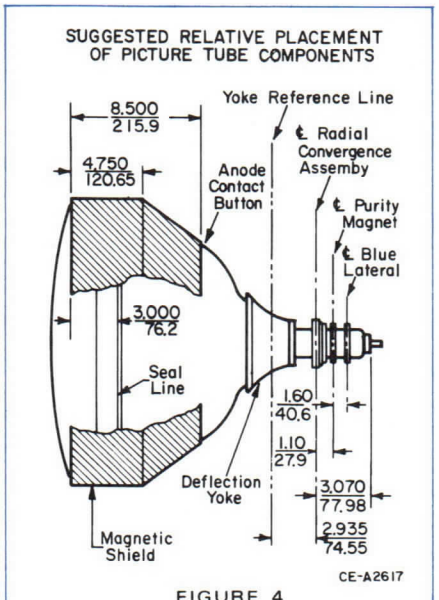


FIGURE 4

Index of Terminals

EIA Basing 14 BE

Pin	Gun	Element	Pin	Gun	Element
1	All	Heater	9	All	Grid 3
2	Red	Cathode	11	Blue	Cathode
3	Red	Grid 1	12	Blue	Grid 1
4	Red	Grid 2	13	Blue	Grid 2
5	Green	Grid 2	14	All	Heater
6	Green	Cathode	Cap	—	Anode
7	Green	Grid 1	C	Ext. Cond. Coat.	

X-Ray Warning

1. **X-radiation Registration Reference Point:** The maximum anode voltage at which the X-radiation emitted from this tube will not exceed 0.5 mR/h at 300 μA anode current is 35 kV.
2. **X-radiation Characteristics:** The X-radiation emitted from this picture tube, as measured in accordance with the procedure of JEDEC Publication 64A, will not exceed 0.5 mR/h throughout the useful life of the tube when operated within the Design Maximum Ratings: 27.5 kV anode voltage and 1000 μA anode current.

   The tube should not be operated beyond its Design Maximum Ratings stated above, but its X-radiation will not exceed 0.5 mR/h for anode voltage and current combinations given by the Isodose-Rate Limit Characteristics as shown in Figure XC-4.

   Operation above those values shown by the curve may result in failure of the television receiver to comply with the Federal Performance Standard for Television Receivers, Sub-Part C of Part 78 of Title 42, Code of Federal Regulations (PL-90-602), as published in the Federal Register, Volume 34, No. 247, of Thursday, December 25, 1969.

   Maximum X-radiation as a function of anode voltage at 300 μA anode current is shown by the curve of Figure XC-3. X-radiation at constant voltage varies linearly with anode current.

25VAF P22

90° Deflection

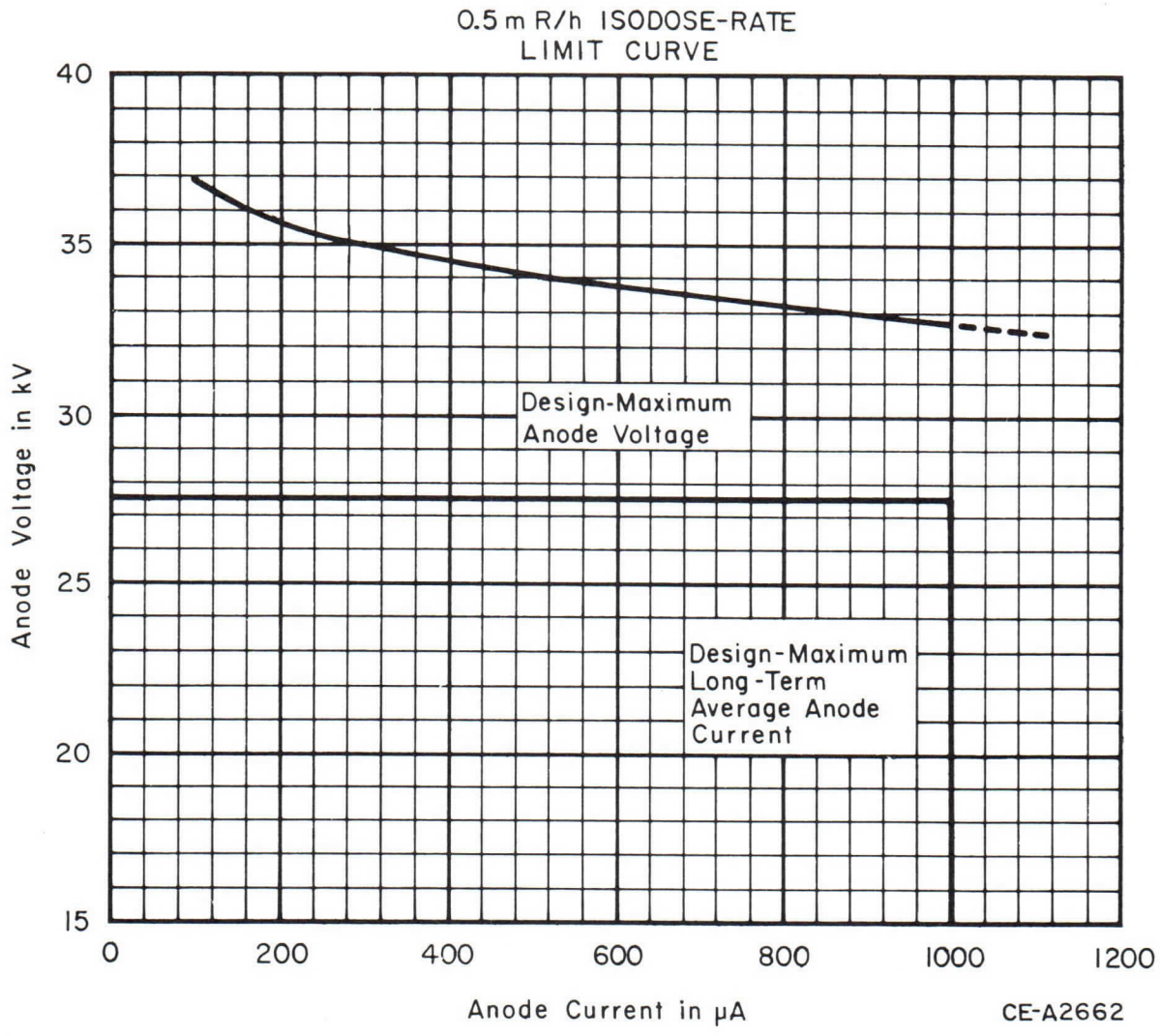


FIGURE XC-4

25VAFP22

90° Deflection

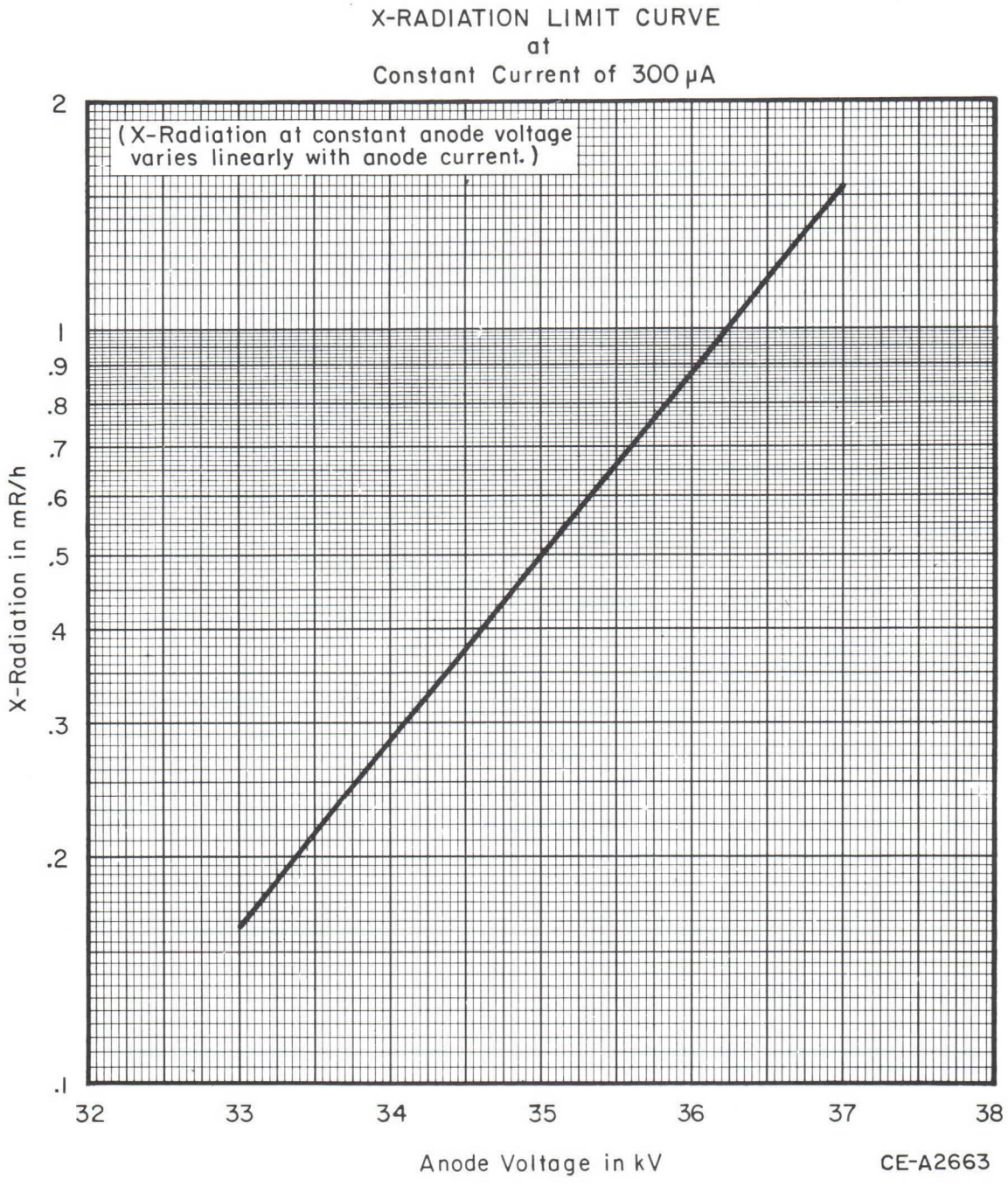
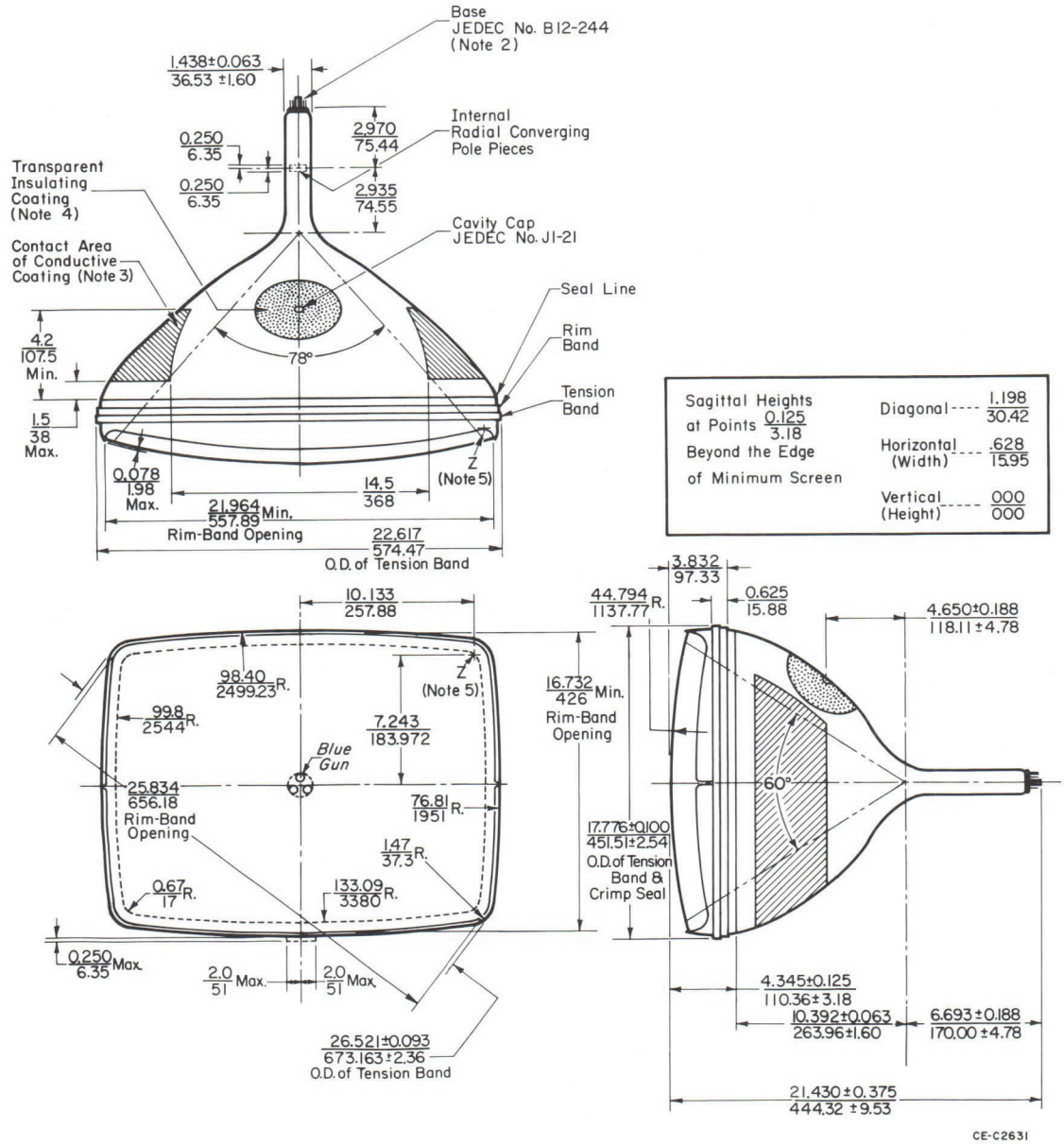


FIGURE XC-3

25 VAF P22

90° Deflection



(Dimensions in inches / mm unless otherwise shown) The millimeter dimensions are derived from the original inch dimensions, 1" = 25.4 mm exactly.

Outline Notes

1. With tube neck inserted through flared end of reference-line and neck-funnel-counter gauge (JEDEC No. G162) and with tube seated in gauge, the reference line is determined by the intersection of the plane C-C' of the gauge with the glass funnel.
2. Socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a 2-inch (51-mm) circle concentric with bulb axis.
3. The drawing shows the size and location of the contact area of the external conductive coating. The actual area of this coating will be greater than that of the contact area so as to provide the required capacitance. External conductive coating must be grounded with multiple contacts.
4. To clean this area, wipe only with soft, dry, lintless cloth.
5. "Z" is located on the outside surface of the faceplate, on the screen diagonal at a point 0.125" beyond the minimum screen.

Westinghouse Electric Corporation
Electronic Tube Division, Elmira, N.Y. 14902
Printed In U.S.A.

Westinghouse

25VAGP22

90° Deflection

Astro-Brite 135 Color Picture Tube

- High brightness screen assembly
- New 3 x 4 aspect ratio
- Large viewing area - 315 Sq. In.
- High resolution gun - sharper pictures - better detail
- Light neutral screen appearance
- Rare earth (red) phosphor
- New Green Phosphor
- Unity Current Ratios
- Temperature Compensated Shadow Mask
- Integral Implosion Protection with Mounting Lugs
- Increased X-Ray Absorption Panel and Funnel

The 25VAGP22 employs a new improved, high efficiency phosphor screen assembly. This assembly, in conjunction with a higher transmission panel, (50%), provides bright color pictures. The new 3 x 4 aspect ratio provides a larger, more rectangular viewing area of 315 square inches.

To further enhance picture detail, especially under highlight signal conditions, a new high resolution gun has been utilized in this type.

A neutral screen appearance is an added feature which is a result of the phosphors used in the screen. This feature results in a pleasing appearance when the tube is turned off.

The phosphors which are utilized in the screen are a yttrium oxide rare-earth red phosphors, and improved green and blue sulfide phosphors.The use of these phosphors and new improved techniques in screening processes provide the higher brightness screen assembly. The unity cathode-current ratio feature is maintained in the 25VAGP22 for the industry standard white temperature.

Other features of the 25VAGP22 include a temperature compensated shadow mask; integral implosion protection provided by formed rims and a tension band; mounting lugs.

Electrical Data

Electron Guns, Three	Red Blue Green
Heater Current at 6.3 Volts	0.900 Ampere
Focusing Method	Electrostatic
Focus Lens	Bipotential
Convergence Method	Magnetic
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	90 Degrees
Horizontal	78 Degrees
Vertical	60 Degrees
Direct Interelectrode Capacitances (Approx.):	
Grid 1 of any Gun to All Other Electrodes	9 pF
Cathodes to All Guns (Parallel Connected) to All Other Electrodes	12 pF
Focusing Electrode (Grid 3) to All Other Electrodes	9 pF
External Conductive Coating to Anode:	
Maximum	2500 pF
Minimum	2000 pF

Optical Data

Screen, on Inner Surface of Faceplate: Type	Aluminized Tri-color Phosphor Dot P22
Spacing between Centers of Adjacent Dot Triads (Approx.)	0.029″ (0.74 mm)
Light Transmission at Center (Approx.)	50%
Anti-reflection Treatment	No

Mechanical Data

Minimum Useful Screen Dimension (Projected):	
Diagonal	24.658″ (626.31 mm)
Horizontal Axis	20.776″ (527.72 mm)
Vertical Axis	15.582″ (395.78 mm)
Area	315 Sq. In. (2032.25 Sq. cm)
Bulb:	
Funnel	JEDEC No. J209 D1
Panel	JEDEC No. FP-209¾ R1
Implosion Protection	Banded Rim
Weight	44.5 Pounds (20.7 kg)

October 1970
Supersedes TD 86-640 dated January 1970
TC–2243-2

Westinghouse

Maximum and Minimum Ratings, Design Maximum Values

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode Voltage	27500	max.	Volts
	20000	min.	Volts
Total Anode Current, Long-Term Average	1000	max.	μA
Grid 3 (Focusing Electrode) Voltage	6000	max.	Volts
Peak-Grid 2 Voltage, Including Video Signal Voltage	1000	max.	Volts
Grid 1 Voltage:			
Negative Bias Value	400	max.	Volts
Negative Operating Cutoff Value	200	max.	Volts
Positive Bias Value	0	max.	Volts
Positive Peak Value	2	max.	Volts
Heater Voltage (ac or dc):			
Under Operating Conditions (Note 1)	6.9	max.	Volts
	5.7	min.	Volts
Under Standby Conditions (Note 2)	5.5	max.	Volts
Peak Heater-Cathode Voltage:			
Heater Negative with respect to Cathode:			
During Equipment Warm-up Period not exceeding 15 seconds	450	max.	Volts
After Equipment Warm-up Period:			
Combined AC and DC Value	200	max.	Volts
DC Component Value	200	max.	Volts
Heater Positive with respect to Cathode:			
AC Component Value	200	max.	Volts
DC Component Value	0	max.	Volts

Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode

For Anode Voltages between 20000 and 27500 Volts		
Grid 3 (Focusing Electrode) Voltage as a % of Anode Voltage	16.8 to 20	%
Grid 2 and Grid 1 Voltage for Visual Extinction of Focused Spot	See Figure 1	
Maximum Ratio of Grid 2 Voltages, Highest Gun to Lowest Gun in Any Tube (At Grid 1 spot cutoff voltage of −100 Volts)	1.86	
Heater Voltage:		
Under Operating Conditions: (Note 1)		
When Standby Operation is not Utilized	6.3	Volts
When 5.0 Volts Standby Operation is Utilized	6.0	Volts
Under Standby Conditions (Note 2)	5.0	Volts
Grid 3 Current (Total)	−45 to +15	μA
Grid 2 Current	− 5 to + 5	μA

To Produce White of 9300°K +27 M.P.C.D. (CIE Coordinates x = 0.281, y = 0.311):	*Red*	*Blue*	*Green*	
Percentage of Total Anode Current supplied by each gun (Average)	30	31	39	%

Ratio of Cathode Currents:	*Min.*	*Typ.*	*Max.*	
Red/Blue	.75	.95	1.25	—
Red/Green	.60	.75	1.10	—

Displacements, Measured at Center of Screen:			
Raster Centering Displacement:			
Horizontal	±0.45	Inch	(±11.4 mm)
Vertical	±0.45	Inch	(±11.4 mm)
Lateral Distance Between the Blue Beam and the Converged Red and Green Beams	±0.25	Inch	(± 6.4 mm)
Radial Convergence Displacement excluding effects of Dynamic Convergence (each beam)	±0.37	Inch	(± 9.4 mm)
Maximum Required Correction for Resister (Including Effect of Earth's Magnetic Field when Using Recommended Components) as Measured at the Center of the Screen in any Direction	0.005	Inch	(0.13 mm)

Limiting Circuit Values

High-Voltage Circuits:			
Grid 3 Circuit Resistance (Note 3)	7.5	max.	Megohms
Low-Voltage Circuits:			
Effective Grid 1-to-Cathode-Circuit Resistance (each gun) (Note 4)	0.75	max.	Megohm

Notes

1. For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the dc biasing circuit for the heater should be between 100,000 ohms and 1 megohm.
2. The use of a 5-volt standby condition in conjunction with 6-volt operating condition is recommended to improve the reliability of the color picture tube by extending the emission wear-out life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the color picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.
3. In order to minimize the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the Grid 3 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.
4. The low-voltage circuits, including all heater circuits, should be analyzed by assuming the color picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the color picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 0.25 inch (6.4 mm) to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

Application Data

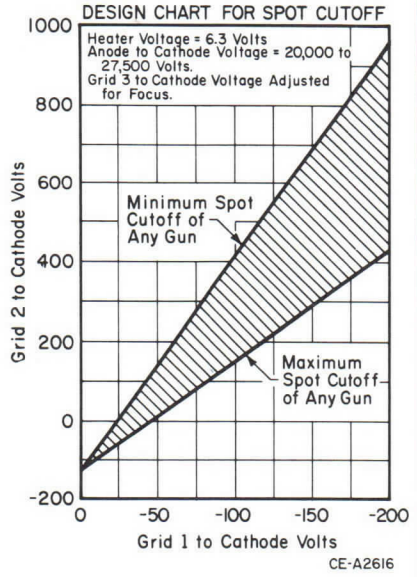


FIGURE 1

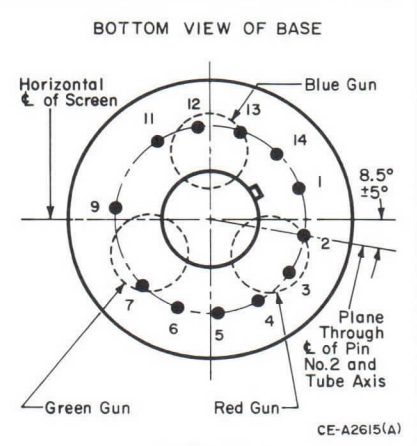


FIGURE 2

General Considerations

Tube Handling

The tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area and the edge of the protective window.

Support for the tube may be provided by a mounting system which supports the tube in the area in front of the seal line together with a pull-up ring or similar support on the tube funnel. The mounting system should not place mechanical stress on or cause abrasion of the tube particularly in the seal area and the edge of the protective window.

The color receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localized overheating due to poor contact.

Component Considerations

The deflection yoke should not be used for supporting the picture tube. The yoke and tube axis must coincide and the yoke must be free to move along the neck for a distance of approximately 0.5 inch (13 mm) from its most forward position for adjustment purposes. The yoke mount should also provide for a small amount of rotational adjustment.

Positioning of Purity Magnet and Lateral Convergence Device

For best operation, it is recommended that the purity magnet (approximate strength of 10-gauss) should be centered on the neck over the Grid 3 cylinder, 1.10 inch from the centerline of the internal radial convergence pole pieces. The blue lateral convergence device should be positioned over the Grid 3 cylinder, 1.60 inch from the centerline of the internal convergence pole pieces.

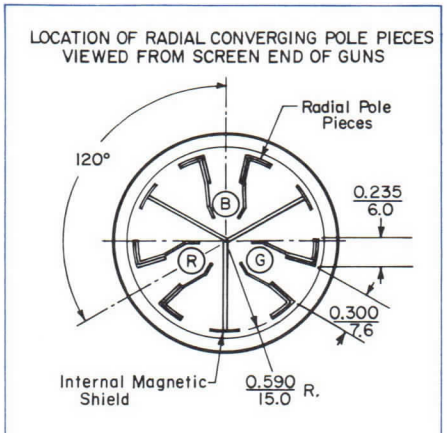


FIGURE 3

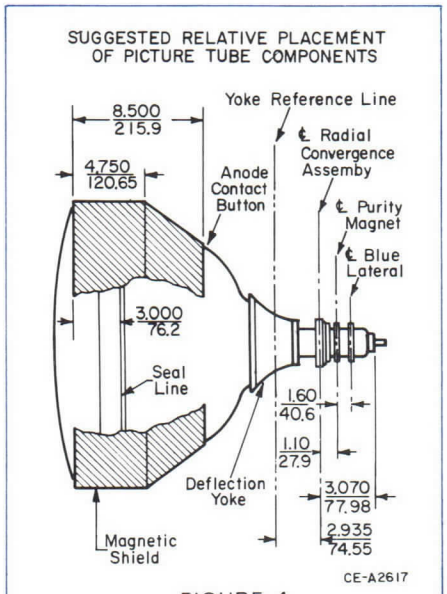


FIGURE 4

Index of Terminals

EIA Basing 14 BE

Pin	Gun	Element	Pin	Gun	Element
1	All	Heater	9	All	Grid 3
2	Red	Cathode	11	Blue	Cathode
3	Red	Grid 1	12	Blue	Grid 1
4	Red	Grid 2	13	Blue	Grid 2
5	Green	Grid 2	14	All	Heater
6	Green	Cathode	Cap	—	Anode
7	Green	Grid 1	C	Ext. Cond. Coat.	

X-Ray Warning

1. **X-radiation Registration Reference Point:** The maximum anode voltage at which the X-radiation emitted from this tube will not exceed 0.5 mR/h at 300 μA anode current is 35 kV.
2. **X-radiation Characteristics:** The X-radiation emitted from this picture tube, as measured in accordance with the procedure of JEDEC Publication 64A, will not exceed 0.5 mR/h throughout the useful life of the tube when operated within the Design Maximum Ratings: 27.5 kV anode voltage and 1000 μA anode current.

   The tube should not be operated beyond its Design Maximum Ratings stated above, but its X-radiation will not exceed 0.5 mR/h for anode voltage and current combinations given by the Isodose-Rate Limit Characteristics as shown in Figure XC-4.

   Operation above those values shown by the curve may result in failure of the television receiver to comply with the Federal Performance Standard for Television Receivers, Sub-Part C of Part 78 of Title 42, Code of Federal Regulations (PL-90-602), as published in the Federal Register, Volume 34, No. 247, of Thursday, December 25, 1969.

   Maximum X-radiation as a function of anode voltage at 300 μA anode current is shown by the curve of Figure XC-3. X-radiation at constant voltage varies linearly with anode current.

25VAG P22

90° Deflection

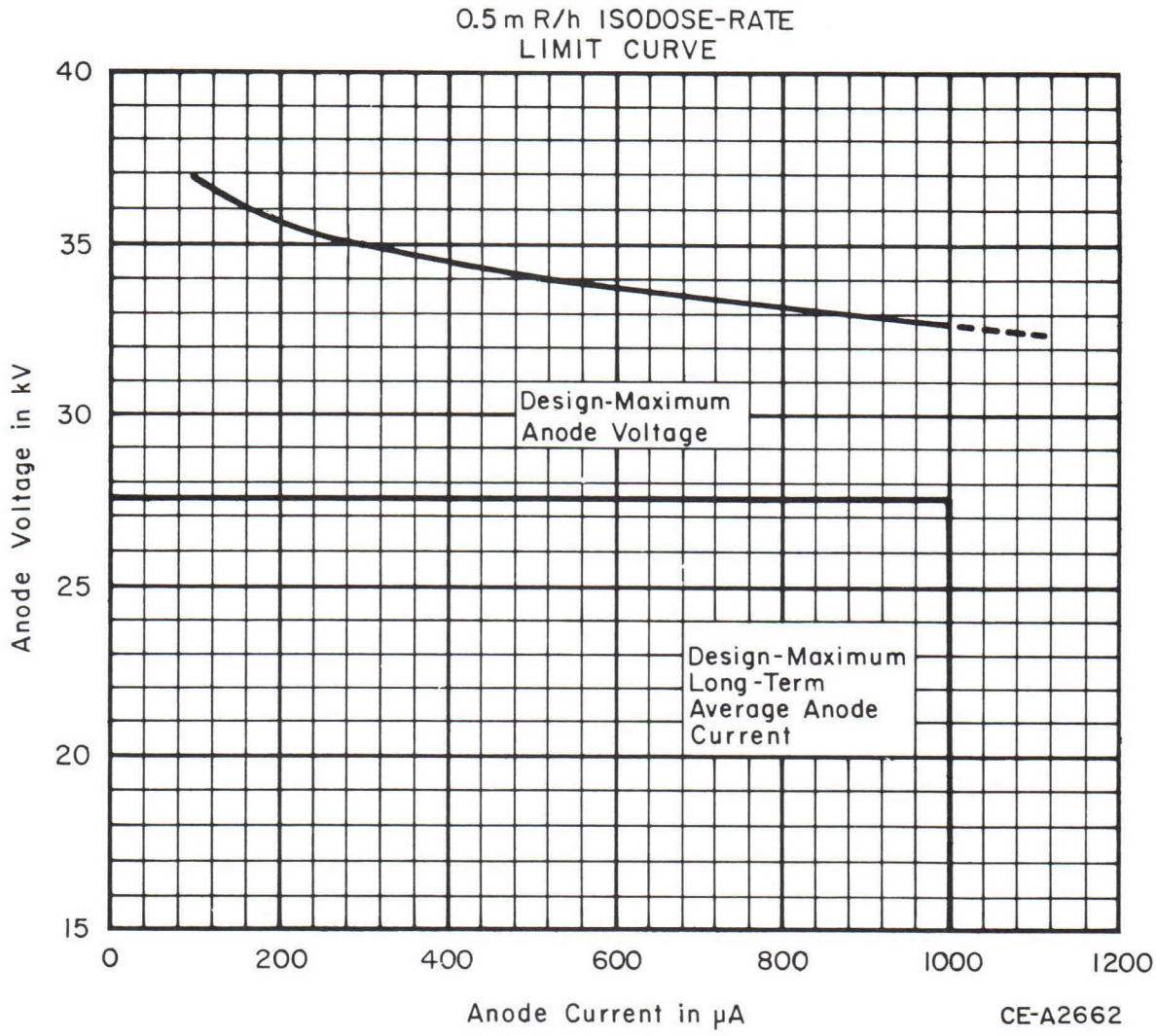


FIGURE XC-4

25VAG P22

90° Deflection

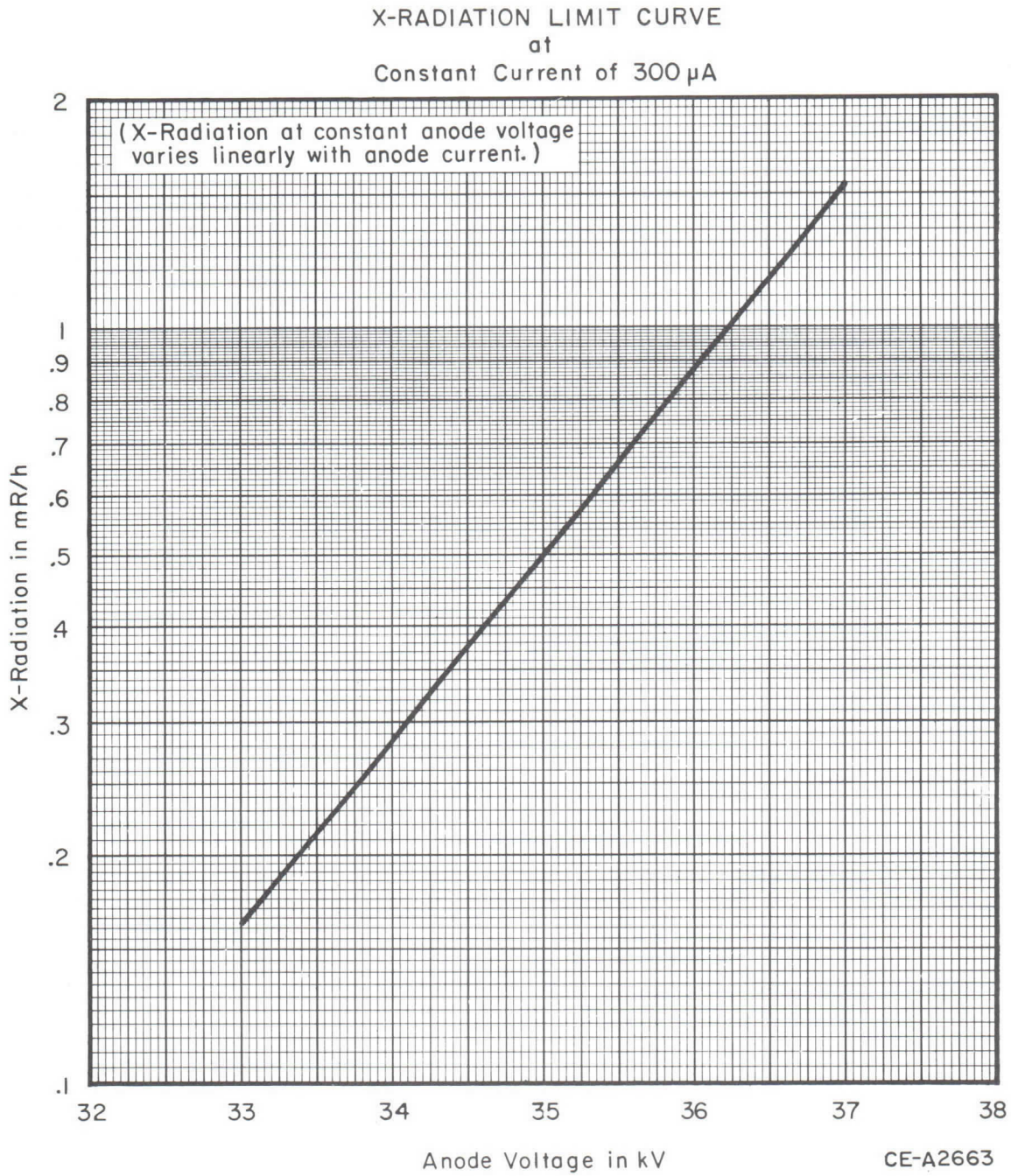
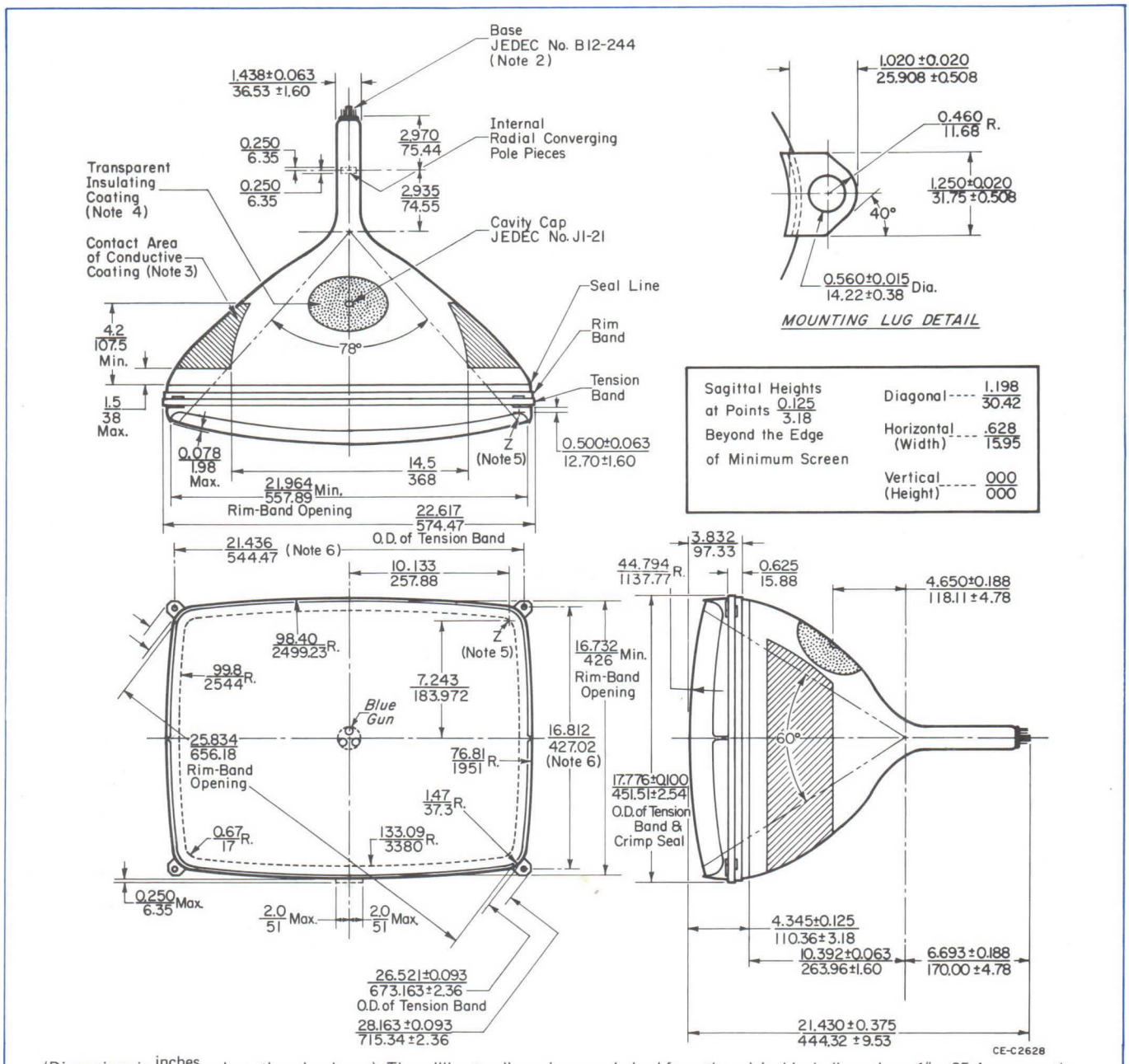


FIGURE XC-3

25 VAG P22

90° Deflection



(Dimensions in inches / mm unless otherwise shown) The millimeter dimensions are derived from the original inch dimensions, 1″ = 25.4 mm exactly.

Outline Notes

1. With tube neck inserted through flared end of reference-line and neck-funnel-counter gauge (JEDEC No. G162) and with tube seated in gauge, the reference line is determined by the intersection of the plane C-C′ of the gauge with the glass funnel.
2. Socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a 2-inch (51-mm) circle concentric with bulb axis.
3. The drawing shows the size and location of the contact area of the external conductive coating. The actual area of this coating will be greater than that of the contact area so as to provide the required capacitance. External conductive coating must be grounded with multiple contacts.
4. To clean this area, wipe only with soft, dry, lintless cloth.
5. "Z" is located on the outside surface of the faceplate, on the screen diagonal at a point 0.125″ beyond the minimum screen. This point is used as a reference for the mounting lugs.
6. The tolerance of the mounting lug holes will accommodate mounting screws up to 0.375″ (9.5 mm) in diameter when positioned on the true hole centers.

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