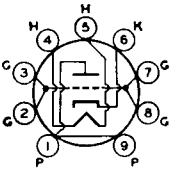
6BC4 MEDIUM-MU TRIODE



9DR

Miniature type used as an rf amplifier in the cathode-drive circuits of uhf television tuners covering the frequency range of 470 to 890 MHz. Outlines section, 6A; requires miniature 9-contact socket.

Heater Voltage (ac/dc)	6.3	volts
Heater Current	0.225	ampere
Peak Heater-Cathode Voltage	±75 max	volts
Direct Interelectrode Capacitances (Approx.):		
Grid to Plate	1.6	pF
Grid to Heater and Cathode	2.9	pF
Plate to Heater and Cathode	0.26	pF
Heater to Cathode	2.7	pF

Class A_1 Amplifier

MAXIMUM RATINGS (Design-Center Values)

Plate Voltage	250	volts
Cathode Current	25	mA
Plate Dissipation	2.5	watts

CHARACTERISTICS

Plate Supply Voltage	150	volts
Cathode-Bias Resistor	100	ohms
Amplification Factor	48	
Plate Resistance (Approx.)	4800	ohms
Transconductance	10000	μmhos
Plate Current	14.5	mA
Grid Voltage (Approx.) for plate current of 10 μA	—10	volts

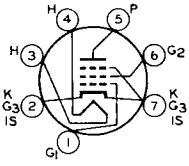
MAXIMUM CIRCUIT VALUES

Grid-Circuit Resistance:		
For fixed-bias operation	Not recommended	
For cathode-bias operation	0.5	megohm

6BC5 Refer to chart at end of section.

6BC5/6CE5 SHARP-CUTOFF PENTODE

3BC5/3CE5



7BD

Miniature type used in compact radio equipment as an rf or if amplifier at frequencies up to 400 MHz. Outlines section, 5C; requires miniature 7-contact socket. For typical operation as resistance-coupled amplifier, refer to **Resistance-Coupled Amplifier section.** Type 3BC5/3CE5 is identical with type 6BC5/6CE5 except for heater ratings.

	3BC5/3CE5	6BC5/6CE5	
Heater Voltage (ac/dc)	3.15	6.3	volts
Heater Current	0.6	0.3	ampere
Heater Warm-up Time (Average)	11	—	seconds
Heater-Cathode Voltage:			
Peak value	±200 max	±90 max	volts
Average value	100 max	—	volts
Direct Interelectrode Capacitances:			
Pentode Connection:			
Grid No.1 to Plate	0.030 max		pF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield	6.5		pF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield	1.8		pF
Triode Connection:*			
Grid No.1 to Plate and Grid No.2	2.5		pF
Grid No.1 to Cathode, Heater, Grid No.3, and Internal Shield	3.9		pF
Plate and Grid No.2 to Cathode, Heater, Grid No.3, and Internal Shield	3		pF

* Grid No.2 connected to plate.

Class A_1 Amplifier

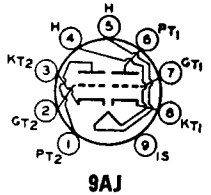
MAXIMUM RATINGS (Design-Center Values)	Triode Connection*	Pentode Connection	
Plate Voltage	300	300	volts
Grid-No.2 (Screen-Grid) Supply Voltage	—	300	volts
Grid-No.2 Voltage	—	See curve page 300	
Grid-No.1 (Control-Grid) Voltage, Positive-bias value	0	0	volts
Plate Dissipation	2.5	2	watts
Grid-No.2 Input:			
For grid-No.2 voltages up to 150 volts	—	0.5	watt
For grid-No.2 voltages between 150 and 300 volts	—	See curve page 300	

CHARACTERISTICS	Triode Connection*		Pentode Connection			
Plate Supply Voltage	180	250	100	125	250	volts
Grid-No.2 Supply Voltage	—	—	100	125	150	volts
Cathode-Bias Resistor	330	820	180	100	180	ohms
Amplification Factor	42	40	—	—	—	
Plate Resistance (Approx.)	0.006	0.009	0.6	0.5	0.8	megohm
Transconductance	6000	4400	4900	6100	5700	μmhos
Plate Current	8	6	4.7	8	7.5	mA
Grid-No.2 Current	—	—	1.4	2.4	2.1	mA
Grid-No.1 Voltage (Approx.) for plate current of 10 μA	—	—	—5	—6	—8	volts

* Grid No.2 connected to plate.

Refer to chart at end of section. **6BC7**

For replacement use type 6BC8/6BZ8. **6BC8**



9AJ

6BC8/6BZ8

MEDIUM-MU TWIN TRIODE

4BC8

Miniature type used as a cascode amplifier in vhf television tuners and in push-pull cathode-drive rf amplifiers. **Outlines section, 6B;** requires miniature 9-contact socket. Type 4BC8 is identical with type 6BC8/6BZ8 except for heater ratings.

	4BC8	6BC8/6BZ8	
Heater Voltage (ac/dc)	4.2	6.3	volts
Heater Current	0.6	0.4	ampere
Heater Warm-up Time (Average)	11	—	seconds
Heater-Cathode Voltage:			
Peak value	±200* max	±200* max	volts
Average value	100 max	100 max	volts
Direct Interelectrode Capacitances*:	Unit No.1	Unit No.2	
Grid to Plate	1.2	1.2	pF
Grid to Cathode, Heater, and Internal Shield	2.6	—	pF
Cathode to Grid, Heater, and Internal Shield	—	5.5	pF
Plate to Cathode, Heater, and Internal Shield	1.3	—	pF
Plate to Grid, Heater, and Internal Shield	—	2.4	pF
Plate to Cathode	—	0.12	pF
Heater to Cathode	2.8	2.8	pF
Plate of Unit No.1 to Plate of Unit No.2	0.02 max		pF
Plate of Unit No.2 to Plate and Grid of Unit No.1	0.04 max		pF

* Rating may be as high as 300 volts under cutoff conditions, when tube is used as a cascode amplifier, the two units are connected in series, and heater is negative with respect to cathode.
* With external shield connected to internal shield.

Class A_1 Amplifier (Each Unit)

MAXIMUM RATINGS (Design-Maximum Values)		
Plate Voltage	250*	volts
Cathode Current	22	mA
Plate Dissipation	2.2	watts
CHARACTERISTICS		
Plate Supply Voltage	150	volts
Cathode-Bias Resistor	220	ohms
Plate Resistance (Approx.)	5300	ohms
Amplification Factor	35	
Transconductance	6200	μmhos
Plate Current	10	mA
Grid Voltage (Approx.) for transconductance of 50 μmhos	—13	volts

MAXIMUM CIRCUIT VALUES

Grid-Circuit Resistance ..... 0.5 megohm

* Rating may be as high as 300 volts under cutoff conditions, when tube is used as a cascode amplifier, the two units are connected in series, and heater is negative with respect to cathode.

6BD4
6BD4A — Refer to chart at end of section.

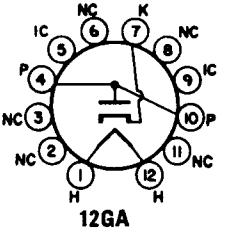
6BD6 — Refer to chart at end of section.

6BD11 — Refer to chart at end of section.

6BE3 — For replacement use type 6BE3/6BZ3.

6BE3/6BZ3 — HALF-WAVE VACUUM RECTIFIER

12BE3, 17BE3/17BZ3



12GA

Duodecar type used as damper tube in horizontal-deflection circuits of color and black-and-white television receivers. Outlines section, 8D; requires duodecar 12-contact socket. Types 12BE3 and 17BE3/17BZ3 are identical with type 6BE3/6BZ3 except for heater ratings.

	6BE3/6BZ3	12BE3	17BE3/17BZ3	
Heater Voltage (ac/dc)	6.3	12.6	16.8	volts
Heater Current	1.2	0.6	0.46	ampere
Heater Warm-up Time (Average)	—	11	11	seconds
Direct Interelectrode Capacitances (Approx.):				
Plate to Cathode, and Heater			10	pF
Cathode to Heater, and Plate			8	pF
Heater to Cathode			3.4	pF

Damper Service

For operation in a 525-line, 30-frame system

MAXIMUM RATINGS (Design-Maximum Values)

Peak Inverse Plate Voltage#		5000	volts
Peak Plate Current		1200	mA
Average Plate Current		200	mA
Plate Dissipation		6.5	watts
Heater-Cathode Voltage:			
Peak value	+300	—5000	volts
Average value	+100	—900	volts

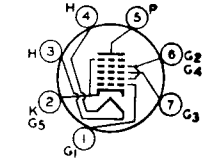
CHARACTERISTIC Instantaneous Value

Tube Voltage Drop for dc plate current of 350 mA	25	volts

Pulse duration must not exceed 15% of a horizontal scanning cycle (10 microseconds).

6BE6 — PENTAGRID CONVERTER

12BE6



7CH

Miniature type used as converter in AM and FM receivers. Outlines section, 5C; requires miniature 7-contact socket. For general discussion of pentagrid types, see Frequency Conversion in Electron Tube Applications section. Type 12BE6 is identical with type 6BE6 except for heater ratings.

	6BE6	12BE6	
Heater Voltage (ac/dc)	6.3	12.6	volts
Heater Current	0.3	0.15	ampere

Heater-Cathode Voltage:			
Peak value	±200 max	±200 max	volts
Average value	100 max	100 max	volts
Direct Interelectrode Capacitances:	Unshielded	Shielded*	
Grid No.3 to Plate	0.30 max	0.25 max	pF
Grid No.3 to Grid No.1	0.15 max	0.15 max	pF
Grid No.1 to Plate	0.10 max	0.05 max	pF
Grid No.3 to All Other Electrodes	7	7	pF
Grid No.1 to All Other Electrodes	5.5	5.5	pF
Plate to All Other Electrodes	8.0	13.0	pF
Grid No.1 to Cathode and Grid No.5	3	3	pF
Cathode and Grid No.5 to All Other Electrodes except Grid No.1	15	20	pF

* With external shield connected to cathode and grid No.5.

Converter

MAXIMUM RATINGS (Design-Maximum Values)

Plate Voltage	330	volts
Grids-No.2-and-No.4 (Screen-Grid) Voltage	110	volts
Grids-No.2-and-No.4 Supply Voltage	330	volts
Cathode Current	15.5	mA
Plate Dissipation	1.1	watts
Grids-No.2-and-No.4 Input	1.1	watts
Grid-No.3 Voltage:		
Negative-bias value	55	volts
Positive-bias value	0	volts
Heater-Cathode Voltage:		
Peak value	200	volts
Average value	100	volts

TYPICAL OPERATION (Separate Excitation)*

Plate Voltage	100	250	volts
Grids-No.2-and-No.4 (Screen-Grid) Voltage	100	100	volts
Grid-No.1 (Oscillator-Grid) Voltage (rms)	10	10	volts
Grid-No.3 (Control-Grid) Voltage	—1.5	—1.5	volts
Grid-No.1 (Oscillator-Grid) Resistor	20000	20000	ohms
Plate Resistance (Approx.)	0.4	1	megohm
Conversion Transconductance	455	475	μmhos
Plate Current	2.6	2.9	mA
Grids-No.2-and-No.4 Current	7.0	6.8	mA
Grid-No.1 Current	0.5	0.5	mA
Cathode Current	10.1	10.2	mA
Grid-No.3 Voltage for conversion transconductance of 10 μmhos	—30	—30	volts

NOTE: The transconductance between grid No.1 and grids No.2 and No.4 connected to plate (not oscillating) is approximately 7250 μmhos under the following conditions: grids No.1 and No.3 at 0 volts; grids No.2 and No.4 and plate at 100 volts. Under the same conditions, the cathode current is 25 mA, and the amplification factor is 20. Grid-No.1 voltage (Approx.) for plate current of 10 μA is —11 volts.

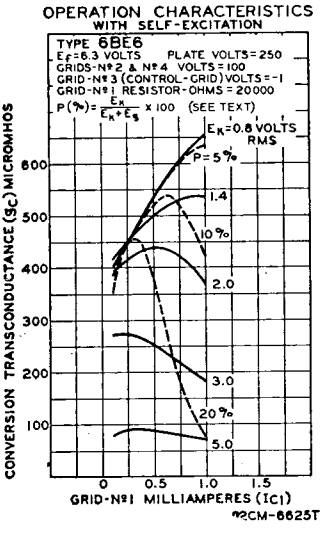
* The characteristics shown with separate excitation correspond very closely with those obtained in a self-excited circuit operating with zero bias.

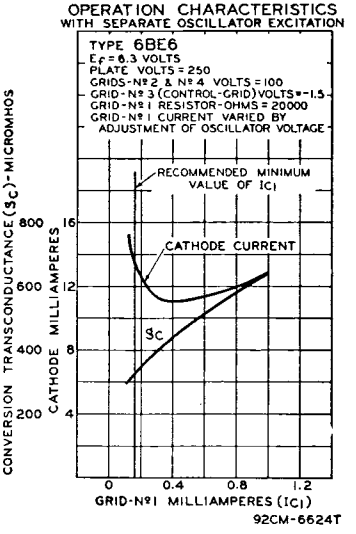
Installation and Application

Because of the special structural arrangement of the 6BE6, a change in signal-grid voltage produces little change in cathode current. Consequently, an rf voltage on the signal grid produces little modulation of the electron current flowing in the cathode circuit. This feature is important because it is desirable that the impedance in the cathode circuit should produce little degeneration or regeneration of the signal-frequency input and intermediate-frequency output. Another important feature is that, because signal-grid voltage has very little effect on the space charge near the cathode, changes in avc bias produce little change in oscillator transconductance and in the input capacitance of grid No.1. There is, therefore, little detuning of the oscillator by avc bias.

A typical self-excited oscillator circuit employing the 6BE6 is given in the Circuits section.

In the 6BE6 operation characteristics curves with self-excitation, E_k is the voltage across the oscillator-coil section between cathode and ground; E_g is the oscillator voltage between cathode and grid.





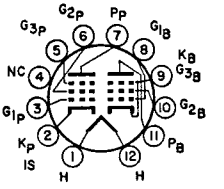
6BF5 Refer to chart at end of section.

6BF6 Refer to chart at end of section.

6BF11

12BF11, 17BF11, 24BF11

BEAM POWER TUBE—SHARP-CUTOFF PENTODE



12EZ

Duodecar type used as combined detector and amplifier tube in color and black-and-white television receivers. The dual-control, sharp-cutoff pentode unit is used as an FM detector and the beam power unit as an af output amplifier. **Outlines section,** 8C; requires duodecar 12-contact socket. Types 12BF11, 17BF11 and 24BF11 are identical with type 6BF11 except for heater ratings.

	6BF11	12BF11	17BF11	24BF11	
Heater Voltage (ac/dc)	6.3	12.6	16.8	24.2	volts
Heater Current	1.2	0.6	0.45	0.315	amperes
Heater Warm-up Time (Average)	—	11	11	11	seconds
Heater-Cathode Voltage:					
Peak value	±200 max	±200 max	±200 max	±200 max	volts
Average value	100 max	100 max	100 max	100 max	volts
Direct Interelectrode Capacitances:					
Pentode Unit:					
Grid No.1 to Plate				0.36	pF
Grid No.3 to Plate				3.2	pF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield				6.5	pF
Grid No.3 to Cathode, Heater, Grid No.1, Grid No.2, Plate, and Internal Shield				8	pF
Grid No.1 to Grid No.3				0.11	pF
Beam Power Unit:					
Grid No.1 to Plate				0.24	pF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield				13	pF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield				10	pF
Pentode Plate to Beam Power Plate				0.13	pF

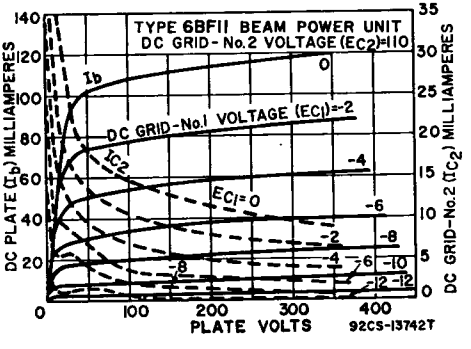
Beam Power Unit as Class A_1 Amplifier

MAXIMUM RATINGS (Design-Maximum Values)

Plate Voltage	165	volts
Grid-No.2 (Screen-Grid) Voltage	150	volts
Average Cathode Current	65	mA
Plate Dissipation	6.5	watts
Grid-No.2 Input	1.8	watts

TYPICAL OPERATION

Plate Voltage	145	volts
Grid-No.2 Voltage	110	volts
Grid-No.1 (Control-Grid) Voltage	—6	volts
Peak AF Grid-No.1 Voltage	6	volts
Zero-Signal Plate Current	36	mA
Maximum-Signal Plate Current	40	mA
Zero-Signal Grid No.2 Current	3	mA
Maximum-Signal Grid-No.2 Current	9	mA
Plate Resistance (Approx.)	0.03	megohm
Transconductance	8600	μmhos



Load Resistance	3000	ohms
Total Harmonic Distortion	10	per cent
Maximum-Signal Power Output	2.4	watts

MAXIMUM CIRCUIT VALUES

Grid-No.1-Circuit Resistance:		
For fixed-bias operation	0.25	megohm
For cathode-bias operation	0.5	megohm

Pentode Unit as Class A_1 Amplifier

CHARACTERISTICS

Plate Supply Voltage	150	volts
Grid No.3 (Control-Grid)	Connected to negative end of cathode resistor	
Grid-No.2 (Screen-Grid) Supply Voltage	100	volts
Grid No.1 (Control Grid)	Connected to negative end of cathode resistor	
Cathode-Bias Resistor	560	ohms
Plate Resistance (Approx.)	0.15	megohm
Transconductance, Grid No.1 to Plate	1000	μmhos
Transconductance, Grid No.3 to Plate	400	μmhos
Plate Current	1.3	mA
Grid-No.2 Current	2	mA
Grid-No.1 Voltage (Approx.) for plate current of 10 μA	—4.5	volts
Grid-No.3 Voltage (Approx.) for plate current of 10 μA	—4.5	volts

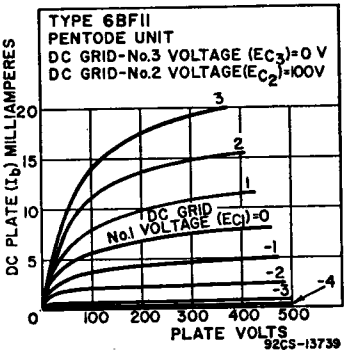
Pentode Unit as FM Sound Detector

MAXIMUM RATINGS (Design-Maximum Values)

Plate Voltage	330	volts
Grid-No.3 Voltage	28	volts
Grid No.2 Supply Voltage	330	volts
Grid-No.2 Voltage	See curve page 300	
Grid-No.1 (Control-Grid) Voltage, Positive-bias value	0	volts
Plate Dissipation	1.7	watts
Grid-No.2 Input:		
For grid-No.2 voltages up to 165 volts	1.1	watts
For grid-No.2 voltages between 165 and 330 volts	See curve page 300	

MAXIMUM CIRCUIT VALUES

Grid-No.1-Circuit Resistance:		
For fixed-bias operation	0.25	megohm
For cathode-bias operation	0.5	megohm



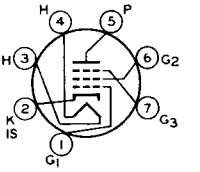
6BG6G
6BG6GA Refer to chart at end of section.

6BH3 Refer to chart at end of section.

6BH3A Refer to chart at end of section.

6BH6 SHARP-CUTOFF PENTODE

Miniature type used as rf amplifier particularly in ac/dc receivers and in mobile equipment where low heater-current drain is important. It is particularly useful in high-frequency, wide-band applications. **Outlines section,** 5C; requires miniature 7-contact socket.



7CM

Heater Voltage (ac/dc)	6.3	volts
Heater Current	0.15	ampere
Peak Heater-Cathode Voltage	±90 max	volts
Direct Interelectrode Capacitances:*		
Grid No.1 to Plate	0.0035 max	pF
Grid No.1 to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield	5.4	pF
Plate to Cathode, Heater, Grid No.2, Grid No.3, and Internal Shield	4.4	pF

* Without external shield, or with external shield connected to cathode.

Class A_1 Amplifier

MAXIMUM RATINGS (Design-Center Values)

Plate Voltage	300	volts
Grid-No.2 (Screen-Grid) Voltage	See curve page 300	
Grid-No.2 Supply Voltage	300	volts
Grid-No.1 (Control-Grid) Voltage:		
Negative-bias value	50	volts
Positive-bias value	0	volts
Plate Dissipation	3	watts
Grid-No.2 Input:		
For grid-No.2 voltages up to 150 volts	0.5	watt
For grid-No.2 voltages between 150 and 300 volts	See curve page 300	

CHARACTERISTICS

Plate Voltage	100	250	volts
Grid No.3	Connected to cathode at socket		
Grid-No.2 Voltage	100	150	volts
Grid-No.1 Voltage	—1	—1	volt
Plate Resistance (Approx.)	0.7	1.4	megohms
Transconductance	3400	4600	μmhos
Plate Current	3.6	7.4	mA
Grid-No.2 Current	1.4	2.9	mA
Grid-No.1 Voltage (Approx.) for plate current of 10 μA	—5	—7.7	volts