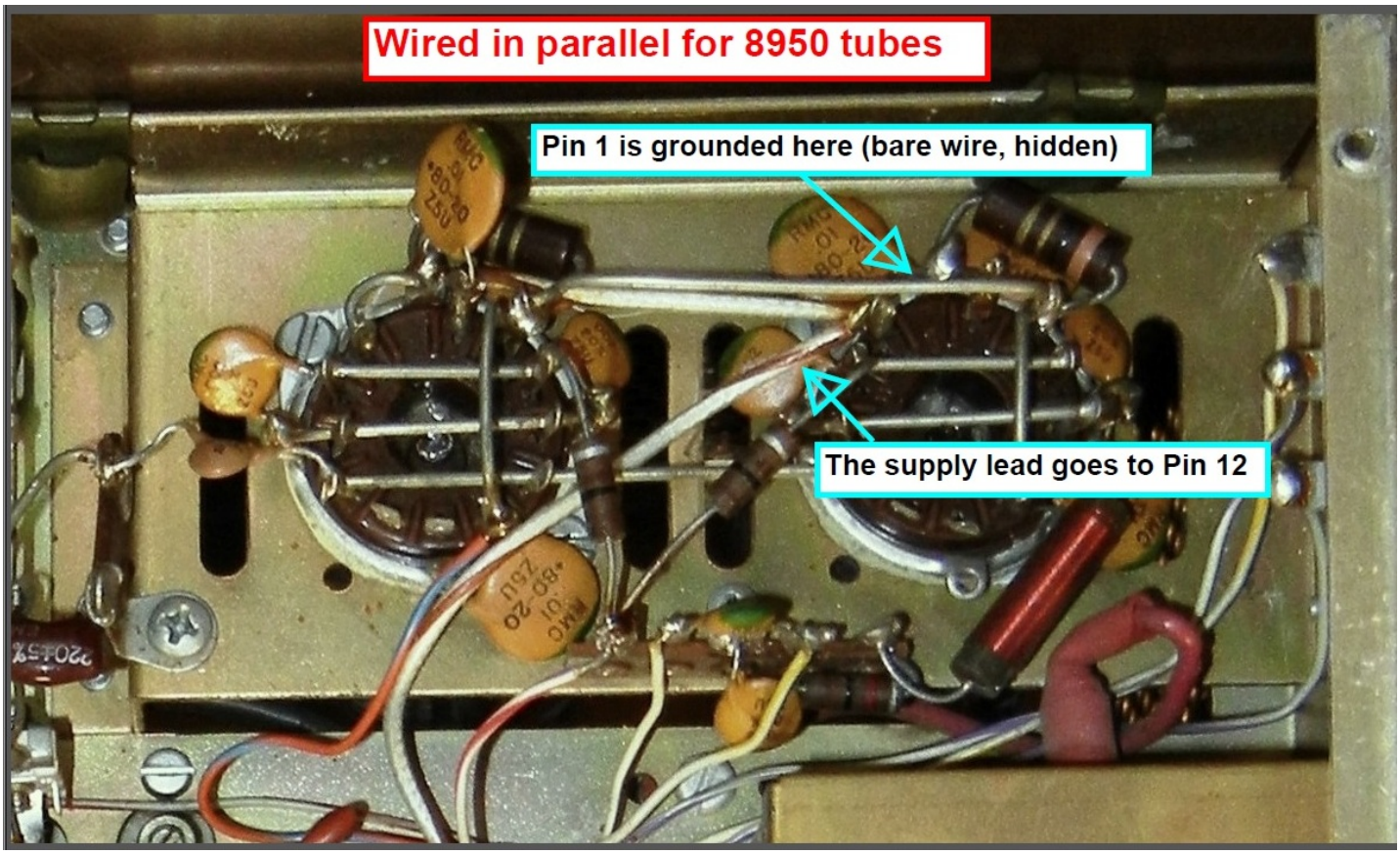
CONVERTING A SWAN 700CX TRANSCEIVER FROM THE 8950 TUBE TO A 6LB6

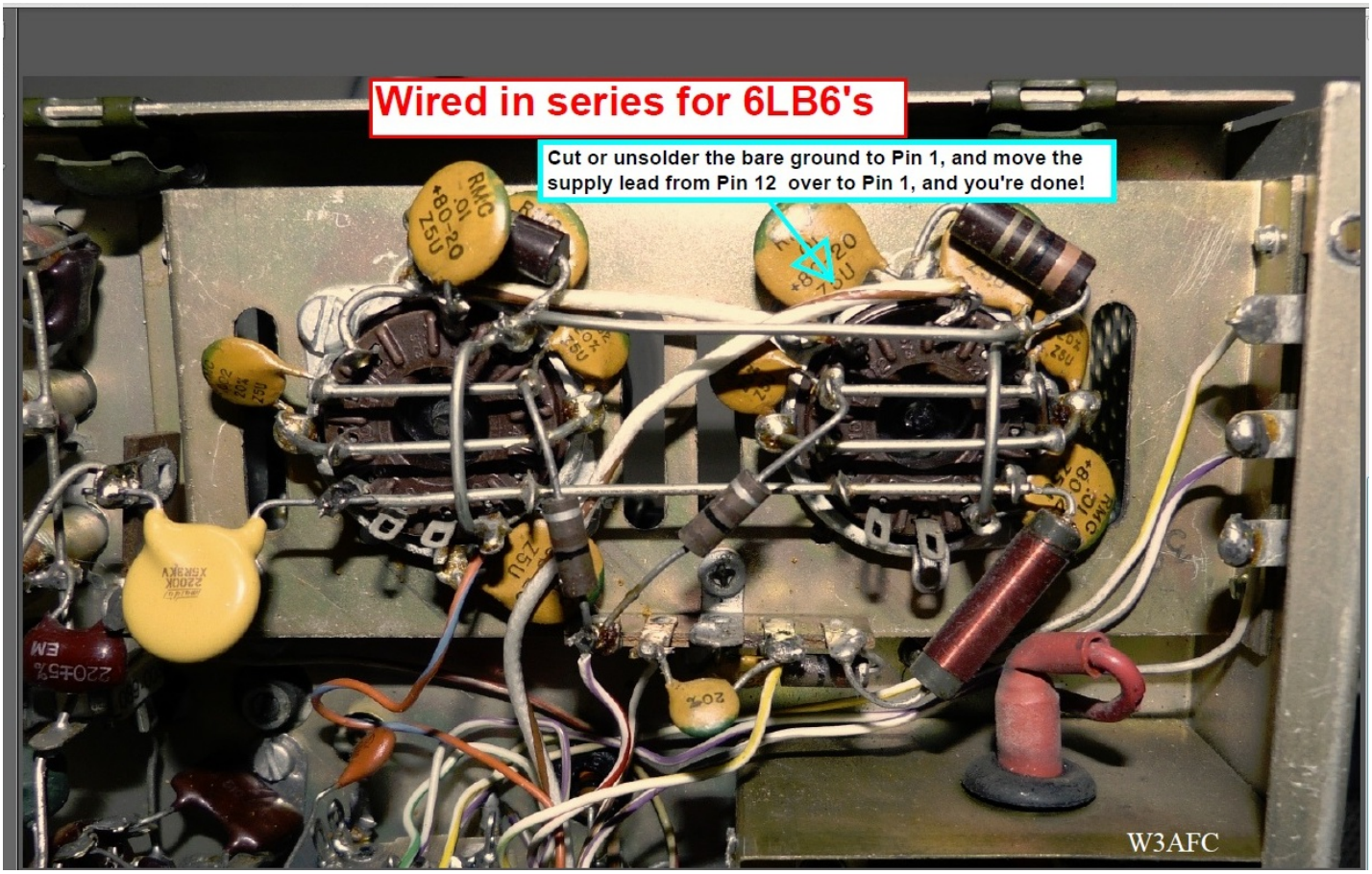
If you own a Swan 700CX or other HAM transceiver that uses two 8950 RF tubes for the Power Amplifier (PA), and you're experiencing sticker shock over the price of replacement tubes, then this short paper is for you. The 6LB6 works very well in the 700CX. In fact, I didn't even have to re-neutralize mine after the swap. The tubes have the same envelope height also, making the job easier. My 700CX has been banging down doors during DX for the past 3 years, and the power hasn't dropped a bit.

So, what will you lose? If one tube filament opens, you will have zero output. If an 8950 fails, you will still have half power as long as you notice that and don't burn up the remaining tube.

Here's what you have now. Both tubes have one side of their filament grounded through a short bare wire.



The next step is easy. You just cut out the ground wire, move the supply wire, and you're done!



The two tubes are almost identical electrically. The 8950 has pin 6 tied to pin 2 internally, and in the rig, and the 6LB6 does not.But in this application, that doesn't make a difference.

Now, the 6KD6 with its 33 watt RMS plate dissipation would also be a good choice as a replacement for the 8950, but if you've priced those recently, you may get sticker shock also. The 6KD6 sells for $85-$95 for a matched pair used, on eBay, which puts them almost in the same price range as the 8950.

APPENDIX

The next few pages contain the data sheets for the 8950, and the 6LB6, and a truly bestial tube, the 6LF6. I'm determined to buy a couple of these and try them in my rig. With an RMS plate dissipation of 40 watts vs 33 for the 8950, they HAVE to be more rugged. But they are taller, so that might be an issue. I'll update this little paper as I continue my experiments.

ELECTRONIC INNOVATIONS IN ACTION

TUBES

PRELIMINARY

—PRODUCT INFORMATION—

BEAM PENTODE

8950

LINEAR AMPLIFIER AND RF PO APPLICATIONS

- 400 MA DC CATHODE CURRENT
- 33 WATTS PLATE DISSIPATION
- 1.4 AMP PEAK CATHODE CURRENT

The 8950 is a compactron beam power pentode primarily designed for RF Power Output applications. Features of the 8950 are dual cathode and grid connections for lower lead inductance, and a 13.0 volt heater. The 8950 is suitable for mobile and marine equipment applications having 12 volt battery supplies.

GENERAL

ELECTRICAL

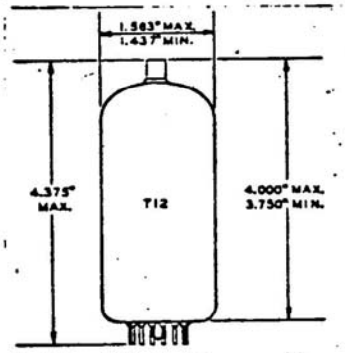
Cathode Coated Unipotential

Heater Characteristics and Ratings
Heater Voltage, AC or DC . . . . . 13.0 Volts
Heater Current . . . . . 1.1 Amperes
Direct Interelectrode Capacitances, approximate
Grid No. 1 to Plate: (g1 to p) . . . . 0.6 pf
Input: . . . . . 36 pf
Output: . . . . . 18 pf

MECHANICAL

Operating Position Any
Envelope T-12
Top Cap C1-1, Small
Base E12-74
Outline Drawing
Maximum Diameter 1.563''
Maximum Over all Length 4.375''
Maximum Seated Height 4.000''

PHYSICAL DIMENSIONS

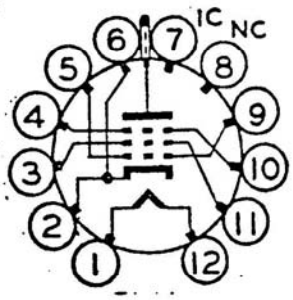


EIA 12-90

TERMINAL CONNECTIONS

Pin 1 – Heater
Pin 2 – Cathode
Pin 3 – Grid 2
Pin 4 – Grid 3 (Beam Plate)
Pin 5 – Grid 1
Pin 6 – Cathode
Pin 7 – Internal Connection (Do not use)
Pin 8 – No Connection
Pin 9 – Grid 1
Pin 10 – Grid 3 (Beam Plate)
Pin 11 – Grid 2
Pin 12 – Heater
Cap – Plate

BASING DIAGRAM



MAXIMUM RATINGS

DESIGN-MAXIMUM VALUES

DC Plate Voltage	800	Volts
Peak Positive Pulse Plate Voltage	6500	Volts
Screen Voltage	250	Volts
Peak Negative Grid-Number 1 Voltage	250	Volts
Plate Dissipation	33	Watts
Screen Dissipation	5	Watts
DC Cathode Current	400	Milliamperes
Peak Cathode Current	1400	Milliamperes
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode		
DC Component	100	Volts
Total DC and Peak	200	Volts
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volts
Grid-Number 1 Circuit Resistance ▲		
With Fixed Bias	0.1	Megohm
With Cathode Bias	Not Recommended	
Bulb Temperature at Hottest Point ♦	240	°C

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.

CHARACTERISTICS AND TYPICAL OPERATION

Plate Voltage	175	Volts
Beam Plates-Connected to Cathode at Socket		
Screen Voltage	110	Volts
Grid Number 1 Voltage	-21	Volts
Plate Resistance, approximate	□	Ohms
Transconductance	16000	Micromhos
Plate Current	120	Milliamperes
Screen Current	2.0	Milliamperes
Grid-Number 1 Voltage, approximate		
Ib = 1.0 Milliamperes	42	Volts
Triode Amplification Factor	□	

ELECTRONIC INNOVATIONS IN ACTION

TUBES

—PRODUCT INFORMATION—

Compactron Beam Pentode

6LB6

FOR TV HORIZONTAL-DEFLECTION AMPLIFIER APPLICATIONS

The 6LB6 is a compactron beam-power pentode primarily designed for use as the horizontal-deflection amplifier in color television receivers. It is characterized by having a very low knee voltage, high plate-to-screen ratio, and high peak current capability. These efficiency factors make the 6LB6 widely adaptable for use in circuits using shunt or variable-bias type regulation with B+ supply voltages from 240 to over 400 volts. Its low knee minimizes "snivets" without the necessity of supplying special voltages to the beam plates.

GENERAL

ELECTRICAL

Cathode - Coated Unipotential

Heater Characteristics and Ratings

Heater Voltage, AC or DC*. . . .	6.3±0.6	Volts
Heater Current‡	2.25	Amperes

Direct Interelectrode Capacitances, approximate§

Grid-Number 1 to Plate: (g1 to p) .	0.44	pf
Input: g1 to (h + k + g2 + b.p.) .	33	pf
Output: p to (h + k + g2 + b.p.) .	18	pf

MECHANICAL

Operating Position - Any
Envelope - T-12, Glass
Base - E12-74, Button 12-Pin
Top Cap - C1-2, Skirted Miniature
Outline Drawing - EIA 12-90

Maximum Diameter	1.563	Inches
Minimum Diameter	1.437	Inches
Maximum Over-all Length. . . .	4.375	Inches
Maximum Seated Height	4.000	Inches
Minimum Seated Height	3.750	Inches

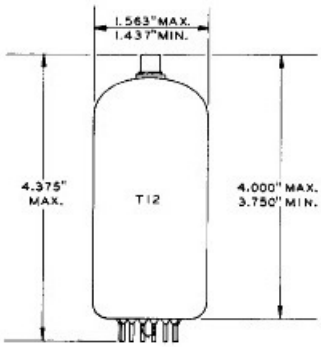
MAXIMUM RATINGS

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.

PHYSICAL DIMENSIONS

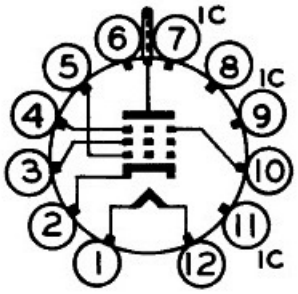


EIA 12-90

TERMINAL CONNECTIONS

Pin 1 - Heater
Pin 2 - Cathode
Pin 3 - Grid Number 2 (Screen)
Pin 4 - Beam Plates
Pin 5 - Grid Number 1
Pin 6 - No Connection
Pin 7 - Internal Connection - Do Not Use
Pin 8 - No Connection
Pin 9 - Internal Connection - Do Not Use
Pin 10 - Beam Plates
Pin 11 - Internal Connection - Do Not Use
Pin 12 - Heater
Cap - Plate

BASING DIAGRAM



EIA 12GJ

GENERAL ELECTRIC

MAXIMUM RATINGS (Cont'd)

HORIZONTAL-DEFLECTION AMPLIFIER SERVICE¶—
DESIGN-MAXIMUM VALUES UNLESS OTHERWISE INDICATED

DC Plate-Supply Voltage (Boost + DC Power Supply)	990	Volt
Peak Positive Pulse Plate Voltage (Absolute Maximum Value)	7000	Volt
Peak Negative Pulse Plate Voltage	100	Volt
Positive DC Beam Plate Voltage	0	Volt
Screen Voltage	200	Volt
Peak Negative Grid-Number 1 Voltage	300	Volt
Plate Dissipation# (Absolute Maximum Value)	30	Watt
Screen Dissipation	5.0	Watt
DC Cathode Current	315	Mill
Peak Cathode Current	1100	Mill
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode		
DC Component	100	Volt
Total DC and Peak	200	Volt
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volt
Grid Number 1 Circuit Resistance		
With Feedback-Type High Voltage Regulation	1.2	Mego
With Shunt-Type High Voltage Regulation (Switching Mode)	10.0	Mego
Beam Plate Circuit Resistance	0	Ohms
Bulb Temperature∆	200	C

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS

Plate Voltage	5000	45	50	150	Volt
Beam Plates Connected to Cathode at Socket					
Screen Voltage	110	160	110	110	Volt
Grid-Number 1 Voltage	---	0	---	-20	Volt
Plate Resistance, approximate	---	---	---	6600	Ohms
Transconductance	---	---	---	13400	Micr
Plate Current	---	900**	560**	105	Mill
Screen Current	---	110**	46**	2.0	Mill
Grid-Number 1 Voltage, approximate					
Ib = 1.0 Milliamperes	-125	---	---	-40	Volt
Triode Amplification Factor‡‡	---	---	---	4.0	

NOTES

* The equipment designer should design the equipment so that heater voltage is centered at the spe bogey value, with heater supply variations restricted to maintain heater voltage within the spec tolerance.

‡ Heater current of a bogey tube at Ef = 6.3 volts.

§ Without external shield.

¶ For operation in a 525-line, 30-frame television system as described in "Standards of Good Engin Practice Concerning Television Broadcast Stations," Federal Communications Commission. The duty of the voltage pulse must not exceed 15 percent of one scanning cycle.

\# In stages operating with grid-leak bias, an adequate cathode-bias resistor or other suitable mea required to protect the tube in the absence of excitation.

∆ Measured using a thermocouple attached to a 0.1-inch wide phosphor-bronze ring placed at the hot location on the bulb.

** Values measured by a method involving a recurrent waveform such that the plate and screen dissip will be kept within ratings in order to prevent damage to the tube.

‡‡ Triode connection (screen tied to plate) with Eb = Ec2 = 125 volts, and Ec1 = -25 volts.

ELECTRONIC INNOVATIONS IN ACTION

TUBES

—PRODUCT INFORMATION—

Compactron Beam Pentode

6KD6

FOR TV HORIZONTAL-DEFLECTION AMPLIFIER APPLICATIONS

- COLOR TV TYPE
- 33 WATTS PLATE DISSIPATION
- 280 VOLTS B+
- 400 MILLIAMPERES DC CATHODE CURRENT
- OVER 1 AMPERE PEAK CURRENT

The 6KD6 is a compactron beam-power pentode primarily designed for use as the horizontal-deflection amplifier in color television receivers. It is characterized by having a very low knee with a very high peak current of over an ampere. This results in a basic capability to scan 90-degree large screen color picture tubes at 25 KV from 280-volt power supplies. Its low knee minimizes "snivets" without the necessity of supplying special voltages to the beam plates.

GENERAL

ELECTRICAL

Cathode - Coated Unipotential

Heater Characteristics and Ratings

Heater Voltage, AC or DC*	6.3±0.6	Volts
Heater Current‡	2.85	Amperes
Direct Interelectrode Capacitances, approximate§		
Grid-Number 1 to Plate:		
(g1 to p)	0.8	pf
Input: g1 to (h + k + g2 + b.p.)	40	pf
Output: p to (h + k + g2 + b.p.)	16	pf

MECHANICAL

Operating Position - Any
Envelope - T-12, Glass
Base - E12-74, Button 12-Pin
Top Cap - C1-2, Skirted Miniature
Outline Drawing - EIA 12-118

Maximum Diameter	1.563	Inches
Minimum Diameter	1.437	Inches
Maximum Over-all Length	4.625	Inches
Maximum Seated Height	4.250	Inches
Minimum Seated Height	4.000	Inches

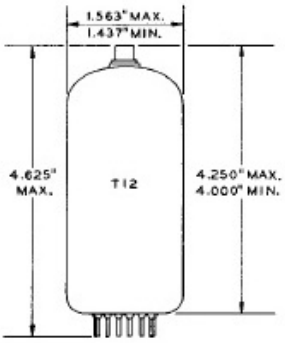
MAXIMUM RATINGS

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.

PHYSICAL DIMENSIONS

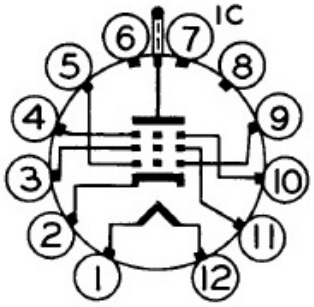


EIA 12-118

TERMINAL CONNECTIONS

Pin 1 - Heater
Pin 2 - Cathode
Pin 3 - Grid Number 2 (Screen)
Pin 4 - Beam Plates
Pin 5 - Grid Number 1
Pin 6 - No Connection
Pin 7 - Internal Connection - Do Not Use
Pin 8 - No Connection
Pin 9 - Grid Number 1
Pin 10 - Beam Plates
Pin 11 - Grid Number 2 (Screen)
Pin 12 - Heater
Cap - Plate

BASING DIAGRAM



EIA 12GW

GENERAL ELECTRIC

Supersedes Pages 1 and 2 of 6KD6 PI Sheet dated 1-67

MAXIMUM RATINGS (Cont'd)

HORIZONTAL-DEFLECTION AMPLIFIER SERVICE¶ — DESIGN-MAXIMUM VALUES UNLESS OTHERWISE INDICATED

DC Plate-Supply Voltage (Boost + DC Power Supply)	990	Volts
Peak Positive Pulse Plate Voltage	7000	Volts
Positive DC Beam Plate Voltage	20	Volts
Screen Voltage	200	Volts
Peak Negative Grid-Number 1 Voltage	250	Volts
Plate Dissipation# (Absolute-Maximum Value)	33	Watts
Screen Dissipation	5.0	Watts
DC Cathode Current	400	Milliamperes
Peak Cathode Current	1400	Milliamperes
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode		
DC Component	100	Volts
Total DC and Peak	200	Volts
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volts
Grid-Number 1 Circuit Resistance	2.2	Megohms
Beam Plate Circuit Resistance	0.01	Megohms
Bulb Temperature∆	225	C

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS

Plate Voltage	5000	45	60	150	Volts
Beam Plates Connected to Cathode at Socket					
Screen Voltage	110	160	110	110	Volts
Grid-Number 1 Voltage	---	0	0	-22.5	Volts
Plate Resistance, approximate	---	---	---	6000	Ohms
Transconductance	---	---	---	14000	Micromhos
Plate Current	---	1100**	780**	100	Milliamperes
Screen Current	---	110**	44**	2.0	Milliamperes
Grid-Number 1 Voltage, approximate Ib = 1.0 Milliamperes	-125	---	---	-40	Volts
Triode Amplification Factor‡‡	---	---	---	4.0	

NOTES

* The equipment designer should design the equipment so that heater voltage is centered at the specified bogey value, with heater supply variations restricted to maintain heater voltage within the specified tolerance.

‡ Heater current of a bogey tube at Ef = 6.3 volts.

§ Without external shield.

¶ For operation in a 525-line, 30-frame television system described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations", Federal Communications Commission. The duty cycle of the voltage pulse must not exceed 15 percent of one 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.

∆ Measured using a thermocouple attached to a 0.1-inch wide phosphor-bronze ring placed at the hottest location on the bulb.

** Values measured by a method involving a recurrent waveform such that the plate and screen dissipations will be kept within ratings in order to prevent damage to the tube.

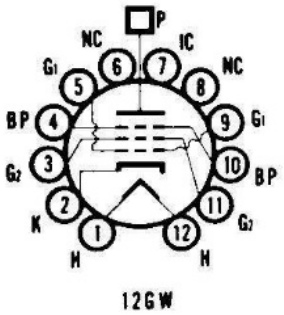
‡‡ Triode connection (screen tied to plate) with Eb = Ec2 = 150 volts, and Ec1 = -22.5 volts.

And now, the BEAST. The 6LF6

6LF6 20LF6	*Color Television Type* **HORIZONTAL DEFLECTION AMPLIFIER**

Beam Pentode

Construction.....Compactron T-12
Base E12-74
Top Cap C1-1
Basing 12GW
Outline
Maximum Diameter .....1.563 In.
Maximum Seated Height .....4.570 In.
Maximum Overall Height .....4.950 In.



ELECTRICAL DATA

HEATER OPERATION

	20LF6	6LF6	
Heater Voltage	20	6.3	Volts
Heater Current	0.6	2.0	Amp.

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid to Plate	3.0 pf
Input: g1 to (h + k + g2 + bp)	37 pf
Output: p to (h + k + g2 + bp)	18.5 pf

RATINGS (Design Maximum Rating System)

Horizontal Deflection Amplifier

DC Plate Supply Voltage at Zero Current (Max.)	990 Volts
Peak Positive Plate Voltage(1) (Max.)	8000 Volts
Beam Plate Voltage (Max.)	50 Volts
Grid No. 2 Voltage (Max.)	275 Volts
Peak Negative Grid No. 1 Voltage (Max.)	550 Volts
Plate Dissipation (Max.)	40 Watts
Peak Cathode Current (Max.)	1400 Ma
Beam Plate Circuit Resistance (Max.)	0.01 Megohms
Bulb Temperature (At Hottest Point) (Max.)	300 °C

AVERAGE CHARACTERISTICS (Measured Under Pulse Conditions)

	Max.	Min.	During Flyback
Plate Voltage	160	50	7000 Volts
Grid No. 2 Voltage	160	175	175 Volts
Grid No. 1 Voltage	0	−10	−185 Volts
Beam Plate Voltage	Tied to Cathode		
Plate Current	1400	800	<0.05 Ma
Grid No. 2 Current	45	70	— Ma

NOTE:

(1) Maximum pulse duration is 22% of a cycle, maximum 18 μsec.