

# BRIMAR

## RECEIVING VALVE 6CD6G

### APPLICATION REPORT VAD/507.9

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**1.0 INTRODUCTION:** The Brimar 6CD6G is a high slope tetrode designed for operation as the line scan output valve in television receivers employing wide angle deflection cathode ray tubes. A particular feature is its high peak anode current capacity with low anode and screen voltage making it suitable for use from a low voltage HT rail. It is intended for use in conjunction with an efficiency diode so that the HT voltage is supplied partly by the receiver power supply and partly by the energy stored in the magnetic circuit. Used in this way the 6CD6G is capable of supplying the power necessary for the scan and E.H.T. voltage of wide angle CR tubes up to 17 in. diagonal at least.

**2.0 DESCRIPTION:** The valve consists of a low impedance tetrode utilising a twin cathode assembly to obtain high cathode emission. Special precautions have been taken to ensure adequate screen grid cooling to prevent screen primary emission. The top and bottom support micas are sprayed and slotted so that a long leakage path exists from the other electrodes to the anode, which is brought out to a top cap. This is necessary as the valve must withstand several thousand volts peak on its anode during the fly-back pulse.

The whole structure is mounted in an ST16 bulb and based with an International Octal Base.

### 3.0 CHARACTERISTICS:

**3.1 Cathode:** Indirectly heated  
 Voltage 6.3 volts  
 Current (Nominal) 2.5 amperes  
 Max. Heater to Cathode Voltage 250 volts

**3.2 Dimensions:** Max. Overall Length 5-11/16 ins.  
 Max. Diameter 2-1/16 ins.  
 Max. Seated Height 5-1/8 ins.

**3.3 Base:** International Octal, Medium Shell, 6 Pin

**3.4 Basing Connections:** Pin 1 No Connection NC  
 Pin 2 Heater h  
 Pin 3 Cathode, Beam Plates k, bp  
 Pin 4 No Pin NP  
 Pin 5 Control Grid g<sub>1</sub>  
 Pin 6 No Pin NP  
 Pin 7 Heater h  
 Pin 8 Screen Grid g<sub>2</sub>  
 T.C. Anode a

**3.5 Mounting Position:** The valve may be mounted vertically with the base up or down, but in the former case the bulb should be supported in some way. Horizontal mounting may be used if the vertical plane passes through both Pins 2 and 7.

### 3.6 Inter-electrode Capacitances:

NO EXTERNAL SHIELD:

Input	26 pF
Output	10 pF
Anode to Grid	1.0 pF
Heater to Cathode	20 pF

### 3.7 Ratings:

TETRODE CONNECTED:

Max. DC Anode Voltage	700 volts
Max. Peak Positive Anode Voltage*	6,000 volts
Max. Peak Negative Anode Voltage*	-1,500 volts

### 3.7 RATINGS—continued

Max. Anode Dissipation	15 watts
Max. DC Screen Voltage	175 volts
Max. Screen Dissipation	3.0 watts
Max. DC Anode Current	170 mA
Max. Peak Cathode Current	500 mA
Max. DC Grid Voltage	—50 volts
Max. Peak Grid Voltage*	—150 volts
Max. Grid I Circuit Resistance	1.0 M $\Omega$
Max. Bulb Temperature (at hottest point)	210° C

\* For normal television service where the pulse width does not exceed 15% of the duty cycle. For the present B.B.C. 405 lines 25 frame interlaced system this is approximately 15  $\mu$  seconds.

#### TRIODE CONNECTED ( $g_2$ connected to anode):

Max. DC Anode Voltage	200 volts
Max. Anode Dissipation	16.5 watts
Max. DC Anode Current	180 mA
Max. DC Grid I Voltage	—50 volts
Max. Grid I Circuit Resistance	1 M $\Omega$
Max. Bulb Temperature (at hottest point)	210° C

### 3.8 Static Characteristics:

#### TETRODE CONNECTION:

Anode Voltage	175	200	volts
Screen Voltage	175	150	volts
Grid Voltage	—30	—30	volts
Anode Current	100	64	mA
Screen Current	6	3	mA
Mutual Conductance	7.5	6.7	mA/V
Anode Impedance	10,000	15,000	ohms
Inner Amplification Factor ( $\mu_{g1 g2}$ )	3.8	3.5	

#### TRIODE CONNECTION ( $g_2$ connected to a):

Anode Voltage	200	volts
Grid Voltage	—42	volts
Anode Current	75	mA
Mutual Conductance	6.2	mA/V
Anode Impedance	570	ohms

### 3.9 Characteristic Curves: Curves are attached to this report as follows:

Anode and Screen Currents versus Anode Voltage $V_{g2}$ 175 volts	307-323
Anode and Screen Currents versus Anode Voltage $V_{g2}$ 150 volts	307-269
Anode and Screen Currents versus Anode Voltage $V_{g2}$ 125 volts	307-322
Anode and Screen Currents versus Anode Voltage $V_{g2}$ 100 volts	307-321
Anode Current versus Anode Voltage, Triode Connected	307-324

### 4.0 TYPICAL OPERATION:

**4.1 Television Line Output Valve:** A circuit is shown on 307-52 giving a basic arrangement for a television line output stage using the 6CD6G in conjunction with the 6U4GT efficiency diode. The energy stored in the magnetic field of the line output transformer and deflector coils is released in the oscillations appearing during the fly-back period. The efficiency diode

permits only the normal overswing to take place and damps out the oscillations. The current in the overswing is forced to decay in a linear manner through the deflector coils by the linearising coil and condensers, and provides nearly half the scan power. The remainder of the scanning current is supplied directly by the 6CD6G. The DC voltage available from the efficiency diode is connected in series with the anode supply to the 6CD6G from the HT rail of the receiver. 150 to 250 volts of boost are available from this source making operation from an HT rail as low as 180 volts quite possible. The power supply, therefore, has to supply the losses in the circuit, the recovered energy being available for recirculation at the beginning of each scanning cycle.

To obtain the highest possible efficiency it is important that the iron and copper losses in the output transformer and deflector coils should be as low as possible. This requires that a low loss core material must be employed and that it should have a high permeability to reduce, as far as possible, the number of turns necessary for the required inductance.

**4.11 Grid Drive Requirements:** The 6CD6G must be cut off rapidly and maintained at cut-off during the fly-back period. The rapidity of cut-off is important as on it depends the maximum E.H.T. voltage that may be derived from the positive fly-back pulse. The 6CD6G must be maintained at cut-off during the fly-back period as if it is then conducting it absorbs the energy normally recoverable from the magnetic circuit. To accomplish this rapid cut-off the grid drive waveshape of the 6CD6G should have a sharp negative peak, which is normally obtained by shunting a resistance capacity peaking network across the grid to earth circuit.

Care must be taken that the maximum grid to cathode voltage of  $-150$  volts is not exceeded. Normally a peak to peak drive voltage of 130 volts is adequate. The valve should be worked in a Class 'B' condition, the point of commencement of conduction coinciding with the point where the scan power from the efficiency diode is exhausted, which occurs a little to the left of screen centre. If too much drive is applied overlapping of the scan occurs at the centre and bright vertical lines appear in this region of the picture.

**4.12 Protection in the Event of Drive Failure:** A small amount of cathode bias is desirable to protect the 6CD6G in the event of failure of the drive voltage, as the valve would then be without bias. As the screen grid is supplied through a series resistor the electrode voltages fall to a low value and protection is not difficult. The 6CD6G will withstand short period overloads of up to 30 watts anode dissipation without harm.

**4.13 Screen Dissipation:** The maximum screen dissipation should not be exceeded under operating conditions or screen primary emission is liable to appear. This is caused by overheating of the screen which then emits electrons to the anode during the time the latter is highly positive. This occurs during the flyback period when the valve should be cut-off, and the effect is the same as if true cut-off has not been achieved. The valve then absorbs some of the recovery energy and amplitude of scan and E.H.T. voltage suffers.

**4.14 Peak Anode Voltage:** On the peak of the flyback pulse the anode voltage rises to a value the amplitude of which depends upon the rapidity of cut-off, the peak value of the anode current the instant before cut-off, the inductance of that portion of the line output transformer in series with the anode and the total effective stray capacitance appearing across the anode to earth circuit. This last factor, the stray capacitance, is of great importance; a few extra picofarads can cause several per cent reduction in the E.H.T. voltage, particularly on the overwind section where the lead to the anode of the E.H.T. rectifier is attached.

The peak anode voltage must not be allowed to exceed 6,000 volts positive. If there is any doubt as to whether this figure is being reached a check should be carried out with a peak reading voltmeter. A convenient arrangement for this purpose consists of a 1T2 rectifier, its filament supplied from a small 1.5 volt cell, connected in series with an electrostatic voltmeter and small reservoir condenser. The rectifier and battery can be mounted on a probe to reduce self capacity and simplify insulation problems. The application of the meter to the circuit will involve a slight drop in peak voltage due to capacity and leakage loading; the extent of this drop, which can normally be neglected, can be estimated by observation of the change in picture brightness of the CR Tube.

**4.15 Peak Cathode Current:** The circuit should be so designed that the peak cathode current is not greater than 400 mA, as although the 6CD6G is capable of supplying a higher peak current than this, due allowance must be made for deterioration during valve life.

**4.16 Practical Circuits:** For complete circuits with component specifications and full operating conditions reference should be made to the circuit reports on 'Time Bases for Wide Angle CR Tubes'. In these reports will be found specifications for the line output transformer width and linearity controls. Further similar circuit reports will be issued as new components and cathode ray tubes become available.

**4.2 Audio Frequencies:** The 6CD6G may be used as an audio frequency power output valve either tetrode or triode connected. Although not designed with this application in view its low impedance and low operating screen voltage make it of use where the anode voltage supply is limited. Below is given a table summarizing the characteristics under Class 'A' conditions.

**4.21 TRIODE CONNECTED (g<sub>2</sub> connected to a):**

**Single Ended Class 'A' Amplifier:**

Anode Voltage	200 volts
Grid Voltage	—32 volts
Cathode Bias Resistor	470 ohms
Anode Current (no signal)	72.5 mA
Peak Grid Input Voltage	28 volts
Anode Load	2,000 ohms
Power Output	1.5 watts
Total Harmonic Distortion	5%

The relation between power output, distortion and input signal is shown on 307.325.

**Push-Pull Class 'A' Amplifier:**

Anode Voltage	200 volts
Grid Voltage	—33.5 volts
Cathode Bias Resistor	240 ohms
Anode Current (no signal)	140 mA
Peak Grid to Grid Input Voltage	62 volts
Anode to Anode Load	1,500 ohms
Power Output	4.8 watts
Total Harmonic Distortion	2.7%

The relation between power output, distortion and input signal is shown on 307.326.

NOTE—A low value resistor of 50 to 100 ohms should be connected between grid 2 and anode when the valve is used triode connected to prevent parasitic oscillation.

## 4.22 TETRODE CONNECTED:

### Single Ended Class 'A' Amplifier:

Anode Voltage	200 volts
Screen Voltage	110 volts
Grid Voltage	—14 volts
Cathode Bias Resistor	180 ohms
Anode Current (no signal)	80 mA
Screen Current (no signal)	2.4 mA
Screen Current (max. signal)	5.3 mA
Peak Grid Input Voltage	11.2 volts
Anode Load	1,500 ohms
Power Output	4.7 watts
Total Harmonic Distortion	13%

The relation between power output, distortion and input signal is shown on 307.327.

### Push-Pull Class 'A' Amplifier:

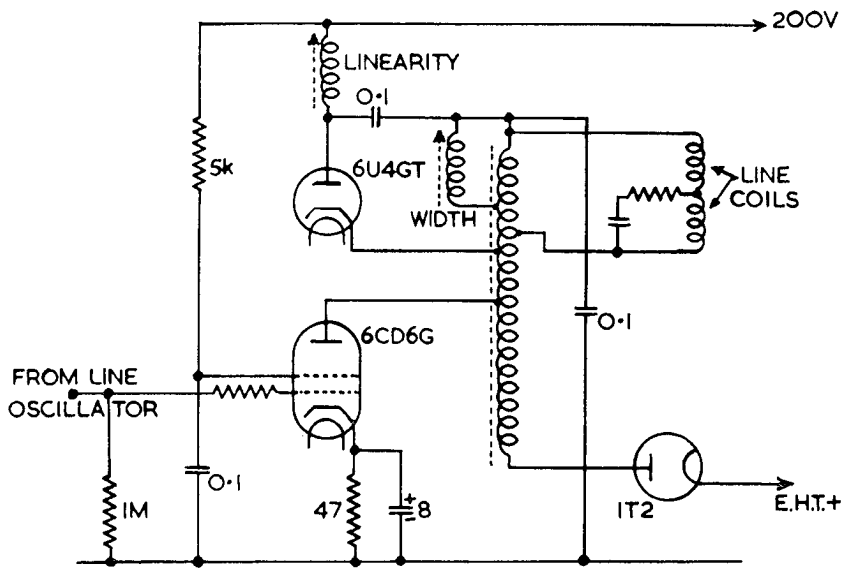
Anode Voltage	110	200	volts
Screen Voltage	110	110	volts
Grid Voltage	—11.7	—14	volts
Cathode Bias Resistor	56	90	ohms
Anode Current (no signal)	200	160	mA
Screen Current (no signal)	13.2	4.8	mA
Screen Current (max. signal)	16.3	11.6	mA
Peak Grid to Grid Input Voltage	22.6	28	volts
Anode to Anode Load	1,000	3,000	ohms
Power Output	5.0	13.5	watts
Total Harmonic Distortion	1.0	1.75	%

The relation between power output, distortion and input signal is shown on 307.328 for the 200 volt condition and 307.329 for the 110 volt condition.

Because its primary application is in television where Class 'A' working is not normal, greater emphasis is placed on operational testing in typical circuitry than on normal static tests under Class 'A' conditions. Consequently when the 6CD6G is used as an audio amplifier, rather wider variations in characteristics may be experienced than those which are normally encountered and it is partly for this reason that this valve is not recommended for audio frequency amplifier work.

Nevertheless, there may be occasions when it is desired to take advantage of the special characteristics of this valve, so operating data and curves for AF amplifier service are included in this report.

**4.3 Series Stabiliser Valve in Regulated Power Supply:** The 6CD6G is suitable for this application connected as a triode. Although the anode dissipation is rather low for this work (16.5 watts), the lower volt drop somewhat outweighs this disadvantage. Care must be taken that the anode dissipation is not allowed to exceed the rated figure when the power supply is delivering high current at low output voltage.



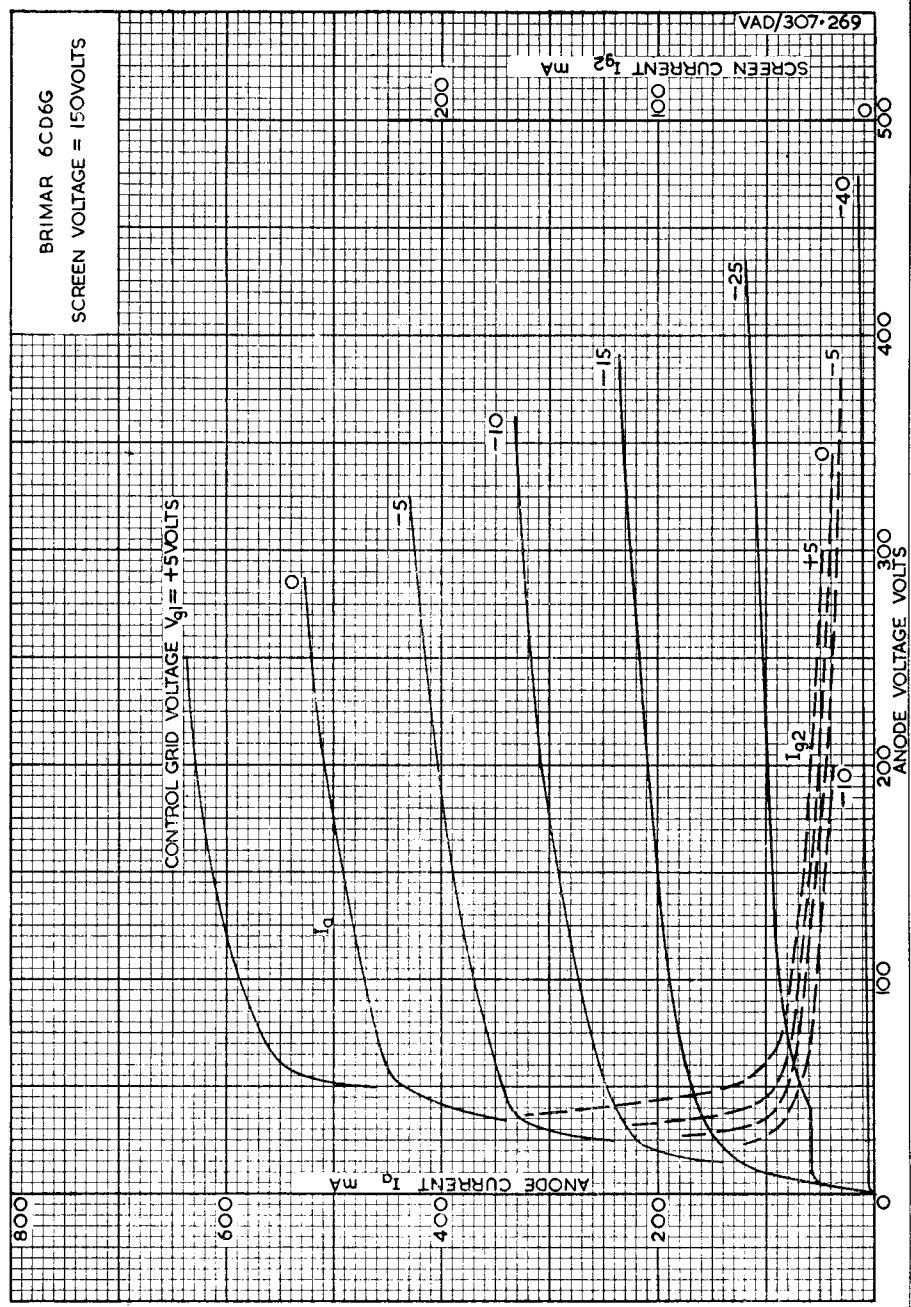
TELEVISION LINE OUTPUT CIRCUIT





BRIMAR 6CD6G

SCREEN VOLTAGE = 150VOLTS



VAD/307-269

SCREEN CURRENT  $I_{g2}$  mA

CONTROL GRID VOLTAGE  $V_{g1} = +5$  VOLTS

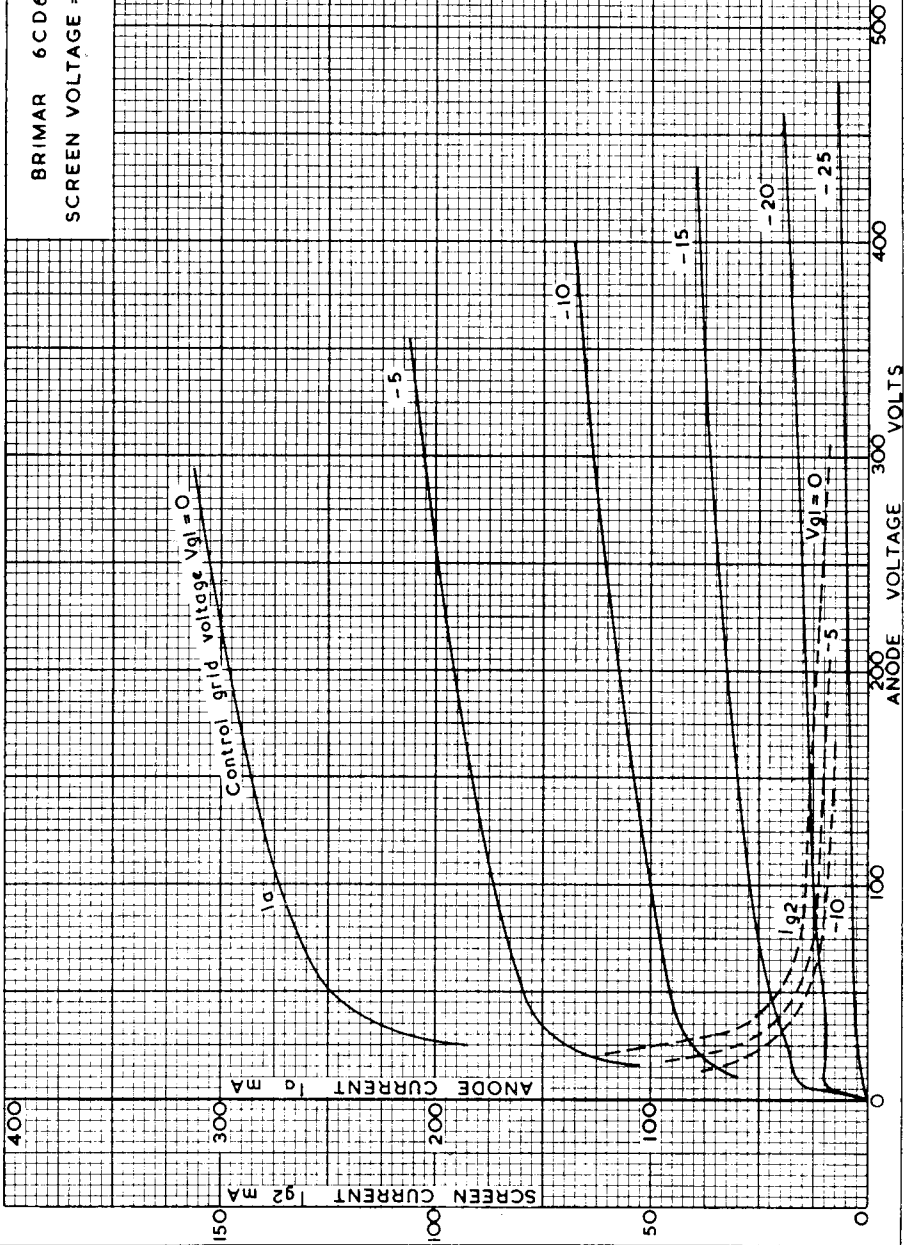
ANODE CURRENT  $I_a$  mA

ANODE VOLTAGE VOLTS

BRIMAR 6CD6G

SCREEN VOLTAGE = 100 V.

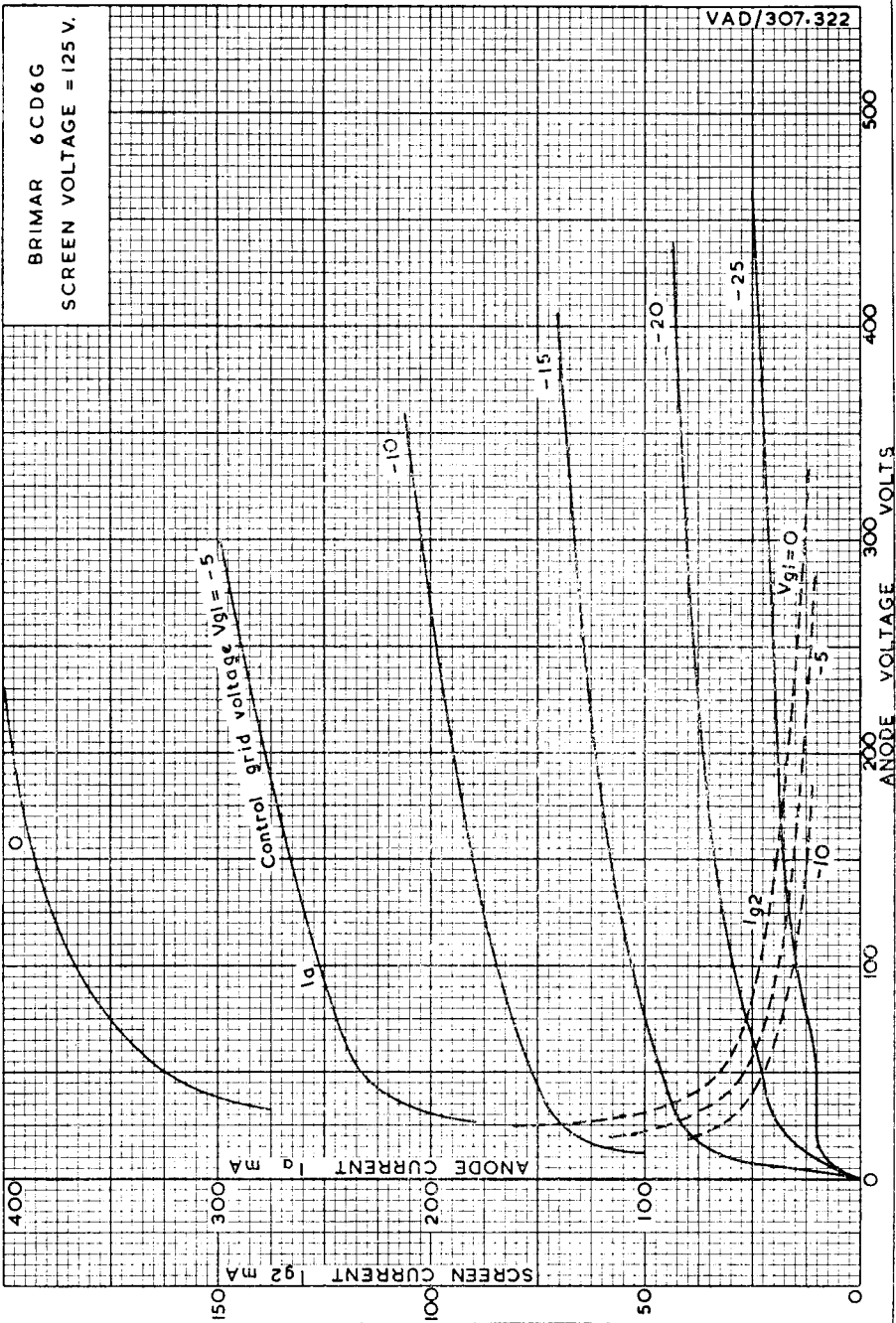
VAD/307.321



BRIMAR 6CD6G

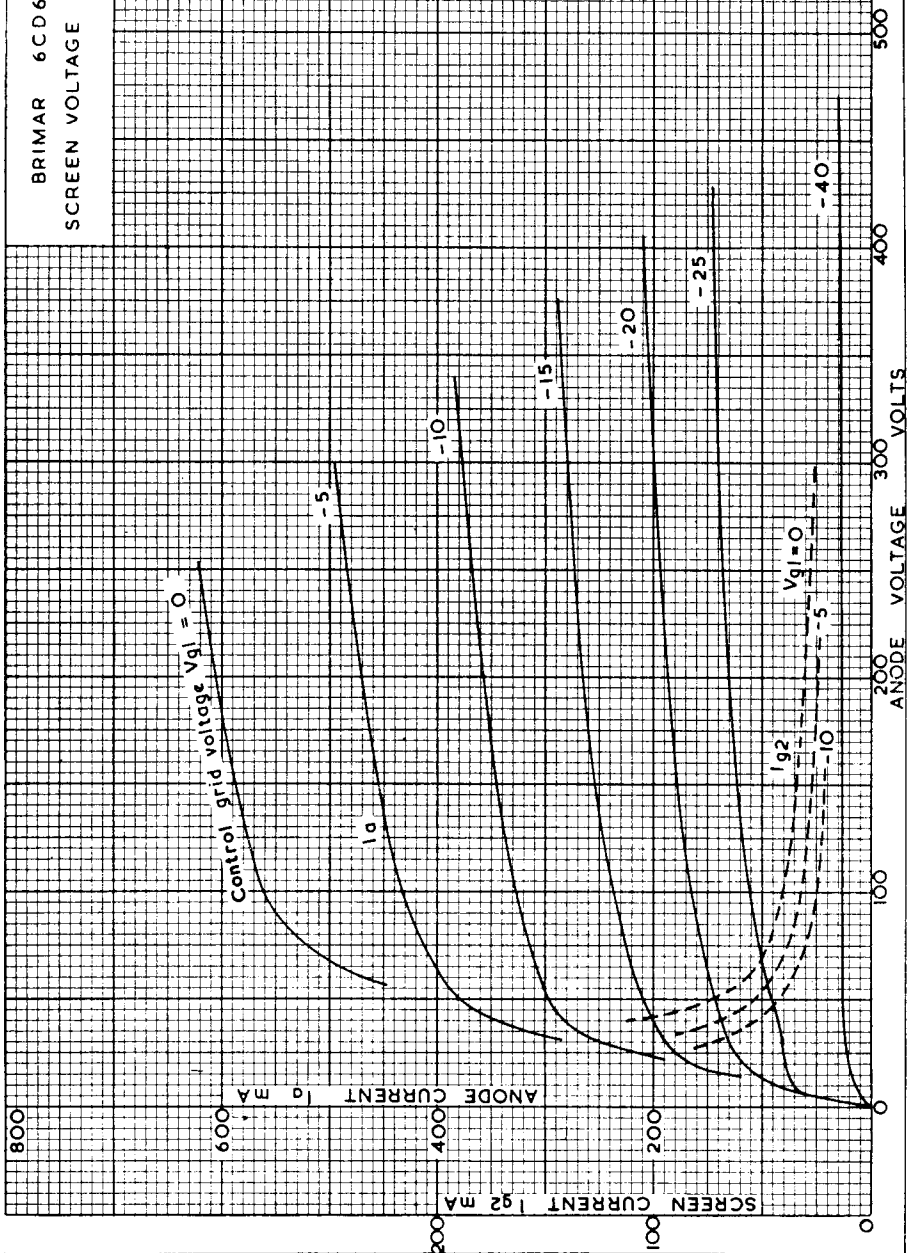
SCREEN VOLTAGE = 125 V.

VAD/307.322



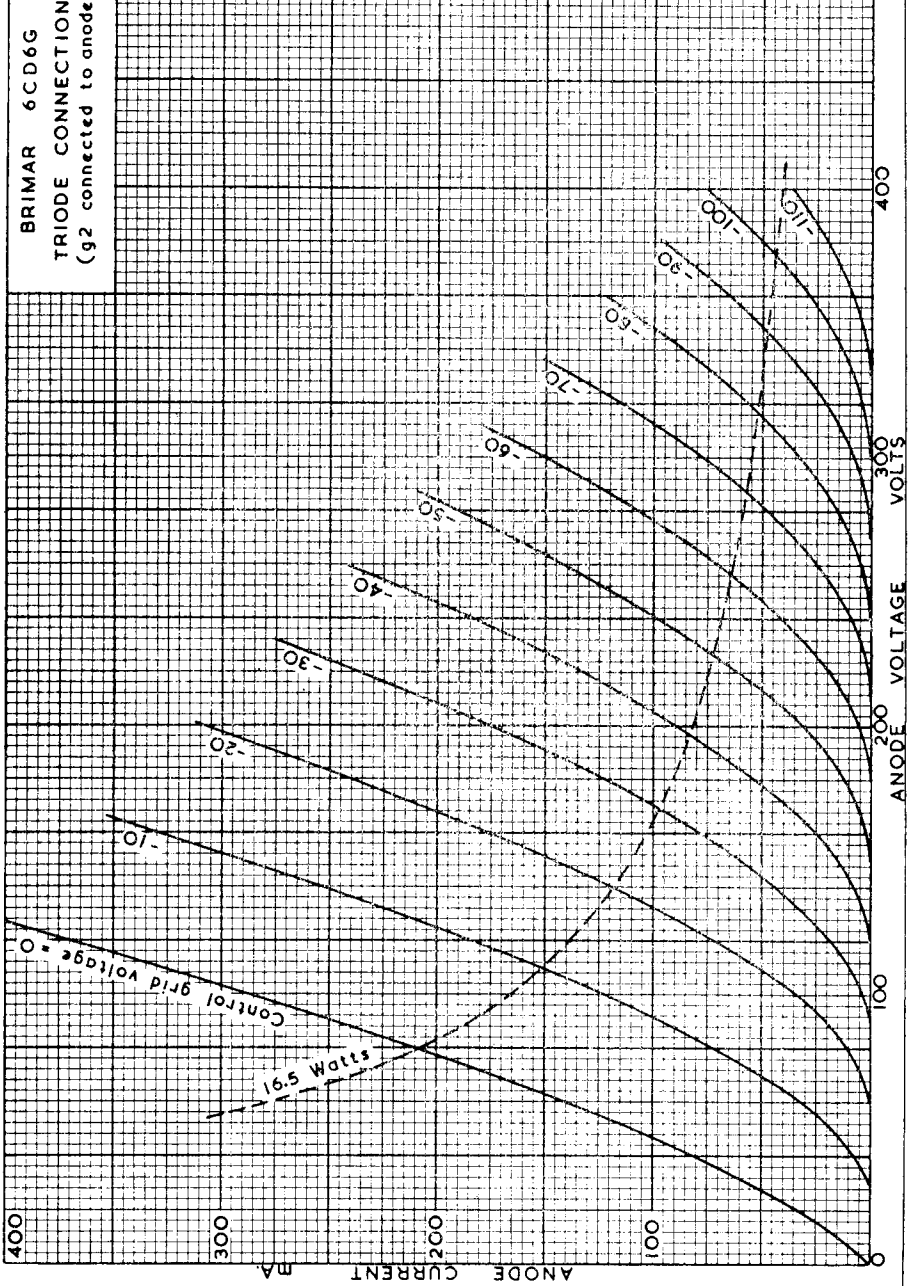
BRIMAR 6CD6G  
SCREEN VOLTAGE 175 V.

VAD/307.323



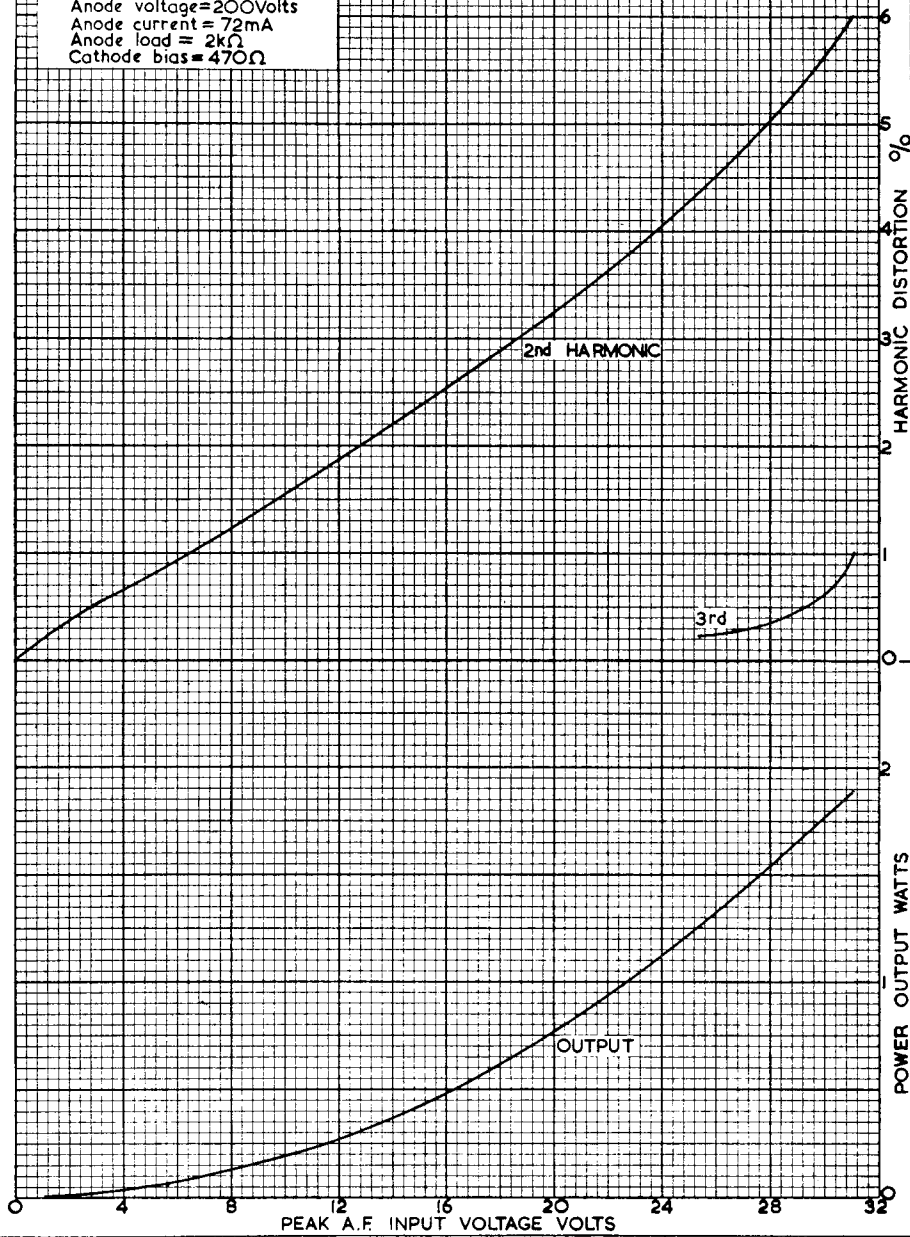
BRIMAR 6CD6G  
TRIODE CONNECTION  
(g<sub>2</sub> connected to anode)

VAD/307.324



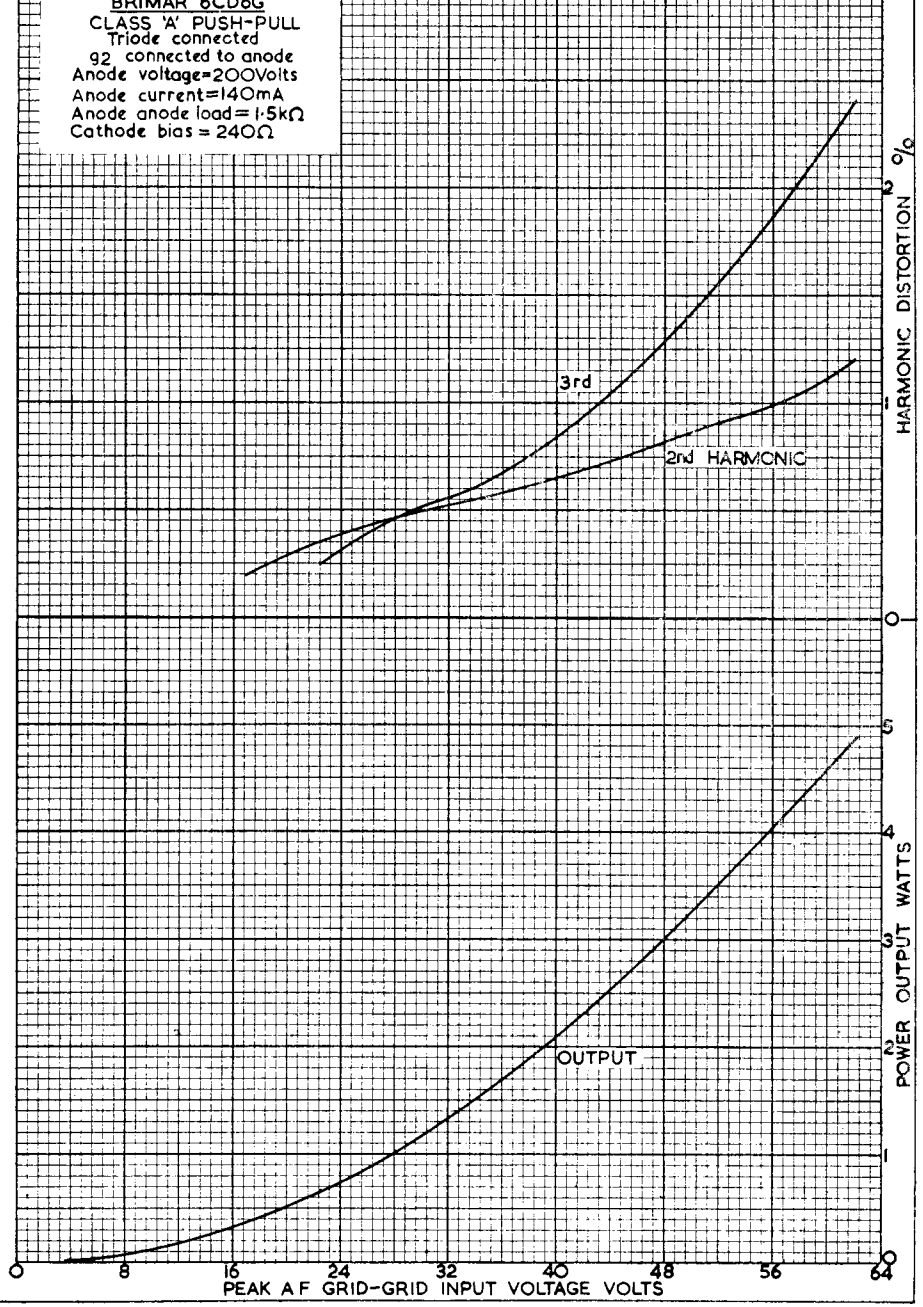
VAD/307-325

BRIMAR 6CD6G  
CLASS 'A'  
Triode connected  
g2 connected to anode  
Anode voltage=200Volts  
Anode current=72mA  
Anode load = 2k $\Omega$   
Cathode bias=470 $\Omega$



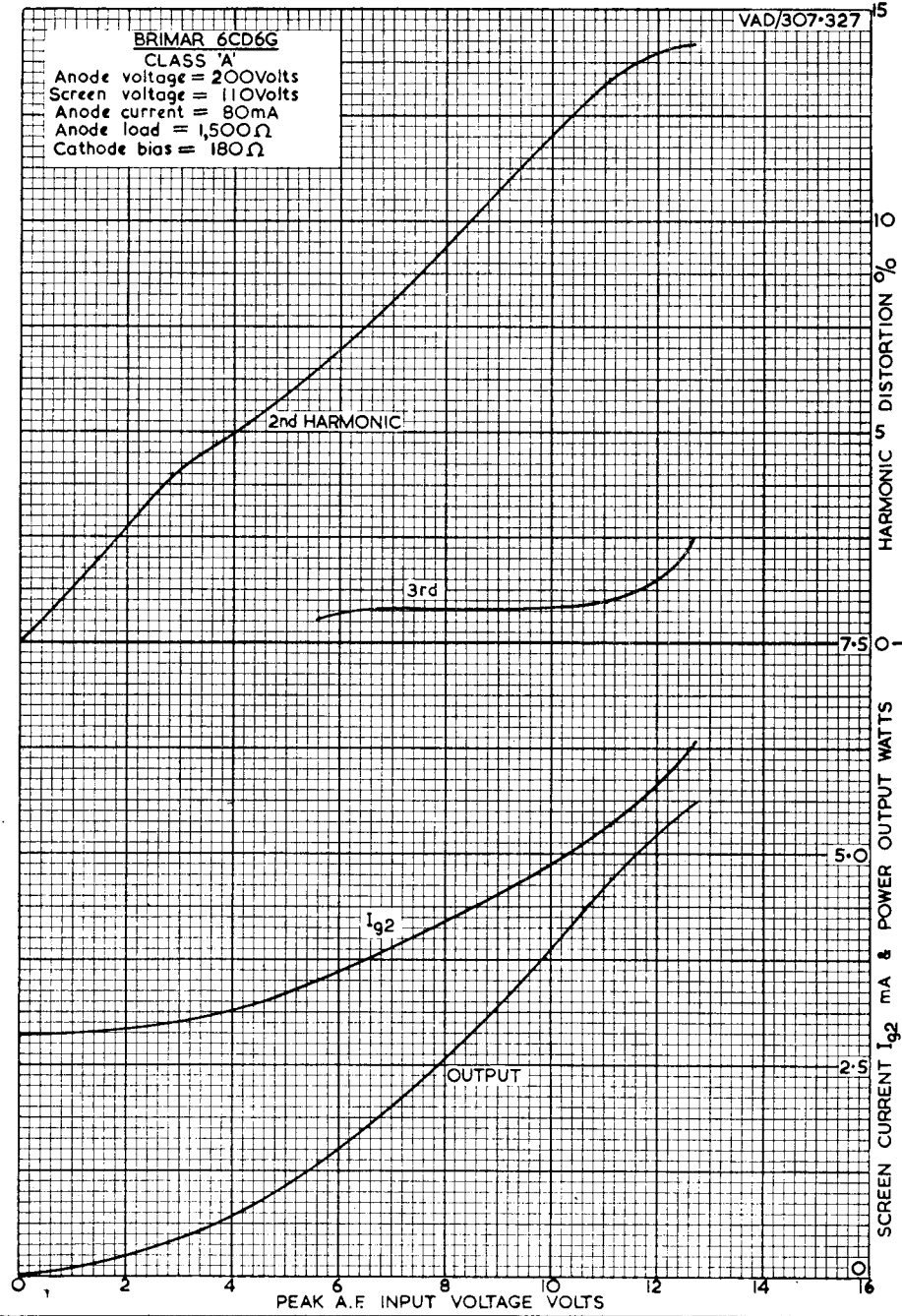
BRIMAR 6CD6G  
 CLASS 'A' PUSH-PULL  
 Triode connected  
 g2 connected to anode  
 Anode voltage=200Volts  
 Anode current=140mA  
 Anode anode load=1.5k $\Omega$   
 Cathode bias = 240 $\Omega$

VAD/307-326 3



VAD/307-327

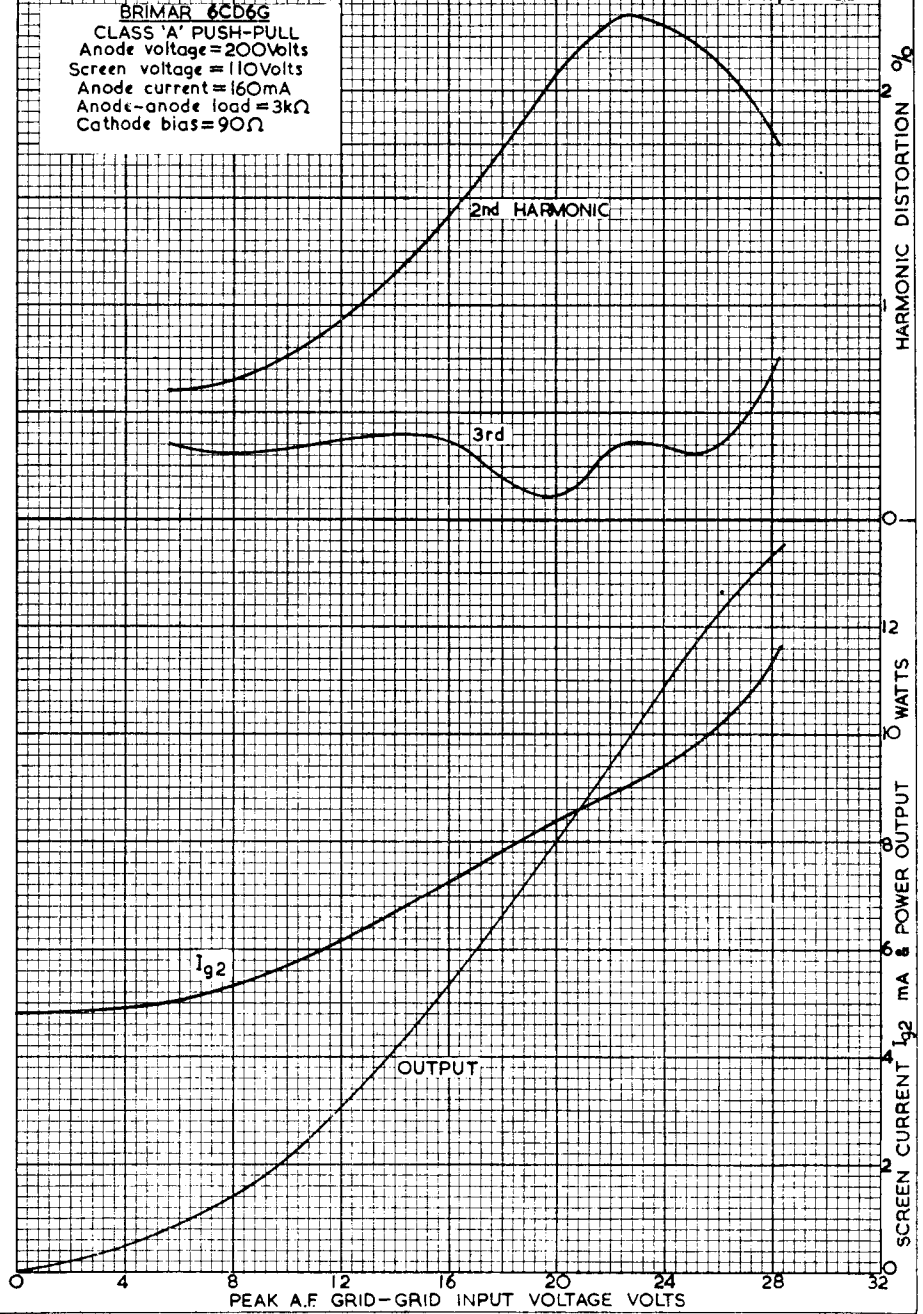
**BRIMAR 6CD6G**  
**CLASS 'A'**  
Anode voltage = 200Volts  
Screen voltage = 110Volts  
Anode current = 80mA  
Anode load = 1,500Ω  
Cathode bias = 180Ω





**BRIMAR 6CD6G**  
 CLASS 'A' PUSH-PULL  
 Anode voltage = 200Volts  
 Screen voltage = 110Volts  
 Anode current = 160mA  
 Anode-anode load = 3k $\Omega$   
 Cathode bias = 90 $\Omega$

VAD/307.328



VAD/307-329

BRIMAR 6CD6G  
CLASS A PUSH-PULL  
Anode voltage = 110Volts  
Screen voltage = 110Volts  
Anode current = 200mA  
Anode load = 1kΩ  
Cathode bias = 56Ω

