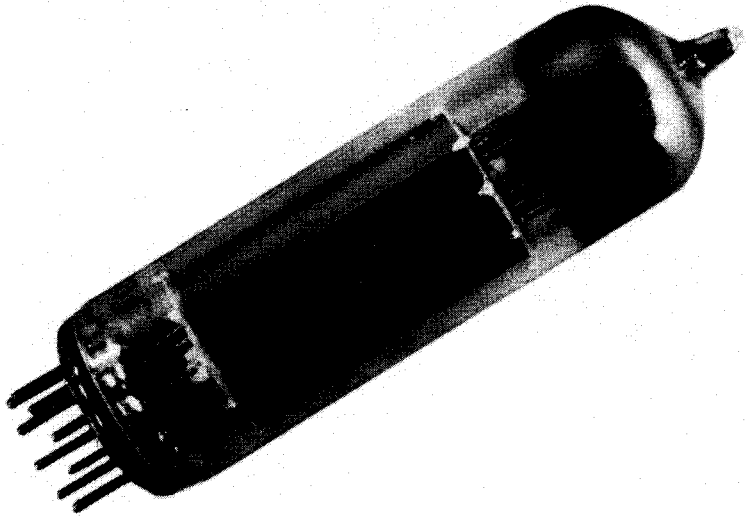




6BQ5



OUTPUT PENTODE

## APPLICATION REPORT

**INTRODUCTION:** The Brimar valve type 6BQ5 is a miniature indirectly-heated high-slope output pentode, having a heater intended for operation in parallel with other valves in A.C. operated equipment. It is primarily designed for use in the output stages of radio receivers and amplifiers, and is identical with the European type EL84.

**NOTE:** The maximum ratings given in this report are absolute maxima and should not be exceeded in any circumstances.





**DESCRIPTION:** The valve consists of a high mutual conductance pentode unit mounted in a standard T6 $\frac{1}{2}$  bulb and fitted with the B9A (Noval) base. The R.E.T.M.A. base code is 9CV.

This Report contains characteristics of the valve and details of its use as a pentode or triode in single-ended and push-pull amplifiers.

### CHARACTERISTICS:

<b>Cathode:</b>	Indirectly heated, unipotential	
	Voltage	6.3 volts
	Current	0.76 ampere (nominal)
	Max. D.C. Heater-Cathode potential	100 volts

N.B. The heater voltage should not vary by more than 7% of the rated value when the valve is used under Class A or AB1 conditions, or 5% when used under Class B conditions.

<b>Dimensions:</b>	Max. over-all length	3-3/32 ins.
	Max. diameter	7/8 in.
	Max. seated height	2-13/16 ins.

**Base:** B9A

**Base Connections:** Pin 1 Internal Connection  
 Pin 2 Grid No. 1  
 Pin 3 Cathode, Grid No. 3  
 Pin 4 Heater  
 Pin 5 Heater  
 Pin 6 Internal Connection  
 Pin 7 Plate  
 Pin 8 Internal Connection  
 Pin 9 Grid No. 2

**Ratings:** (Design Centre Maxima, unless otherwise stated)

#### PENTODE CONNECTIONS:

*Max. Plate Voltage	300 volts
Max. Plate Voltage ( $I_p = 0$ )	550 volts
*Max. Plate Dissipation	12 watts
*Max. Screen Voltage	300 volts
Max. Screen Voltage ( $I_{g2} = 0$ )	550 volts
Max. Screen Dissipation (no signal)	2 watts
Max. Screen Dissipation (max. signal)	4 watts
Max. Cathode Current	65 mA
Max. Negative Grid No. 1 Voltage	-100 volts
Grid No. 1 Circuit Resistance (auto bias)	1 megohm
Grid No. 1 Circuit Resistance (fixed bias)	0.3 megohm
†Max. Bulb Temperature	250°C.

\* If the heater, plate and screen grid voltages are derived from an accumulator by means of a vibrator,  $E_p$  max. = 250 volts  $E_{g2}$  max. = 250 volts and  $W_p$  max. = 9 watts.

† Absolute maximum.



**PENTODE CHARACTERISTICS:**

Plate Voltage	250 volts
Screen Voltage	250 volts
Plate Current	48 mA
Screen Current	5.5 mA
Grid Voltage	-7.3 volts
Mutual Conductance	11.3 mA/V
Plate Impedance	38 K $\Omega$
Inner Amplification Factor	19

**TRIODE CONNECTIONS (Pins 7 and 9 strapped):‡**

Max. Plate Voltage	300 volts
Max. Total Plate and Screen Dissipation	14 watts

‡ In order to avoid parasitic oscillation pins 7 and 9 should be connected via a 100 $\Omega$  resistor.

**TRIODE CHARACTERISTICS:**

Plate Voltage	250 volts
Plate Current	55 mA
Grid Voltage	-7.2 volts
Mutual Conductance	12.75 mA/V
Plate Impedance	1520 $\Omega$
Amplification Factor	19.4

**Inter-electrode Capacitances (Measured without external shield):**

Input	11.0 pF approx.
Output	6.0 pF approx.
Plate to Grid No. 1	0.5 pF max.
Grid No. 1 to Heater	0.25 pF max.

**Mounting:** The valve may be mounted in any position.

**Ventilation:** As this valve runs appreciably hot in operation the layout and design of equipment should be such that adequate ventilation is afforded to ensure a safe bulb temperature under all conditions. The bulb temperature at the hottest point should never exceed 250°C.

**Characteristic Curves:** Curves are attached to this Report which show the following:

Curve No. 307.380 ( $I_p/E_p$ ): Plate current plotted against plate voltage for various values of grid voltage, with  $E_{g2} = 200$  volts.

Curve No. 307.381 ( $I_p/E_p$ ): Plate current plotted against plate voltage for various values of grid voltage with  $E_{g2} = 250$  volts.

Curve No. 307.382 ( $I_p/E_p$ ): Plate current plotted against plate voltage for various values of grid voltage with  $E_{g2} = 300$  volts.

Curve No. 307.383 ( $I_p/E_p$ ): Plate current plotted against plate voltage for various values of grid voltage, when connected as a triode ( $g_2 - p$ ).

Curve No. 307.384 ( $I_p/E_g$ ): Plate and screen currents plotted against grid voltage for  $E_p = E_{g2} = 200$  volts and  $E_p = E_{g2} = 250$  volts.





With reference to the plate current-plate voltage curves, it should be noted that the line showing the maximum plate dissipation limit is a straight line for plate voltages above 275 volts and is drawn to meet the point  $I_p = 0$ ,  $E_p = 550$ . This indicates the progressive derating in plate dissipation required for plate voltages between the normal maximum 300 volts, and the maximum supply voltage 550 volts. The continuation of the dotted curve beyond 275 volts shows the plate dissipation curve as it would appear if unaffected by derating.

#### TYPICAL OPERATION:

##### Class A operation, single ended pentode connection:

Plate Voltage	200	250	250	250	volts
Screen Voltage	200	200	250	250	volts
Grid Voltage	-4.6	-5.8	-8.6	-7.3	volts
Autobias Resistor	82	160	210	140	ohms (nominal)
Plate Current (zero signal)	50	34	36	48	mA
Screen Current (zero signal)	5.65	3.8	4.0	5.5	mA
Optimum Load	4000	7000	7000	5200	ohms
Power Output	3.20	4.45	4.30	5.7	watts
Total Distortion	6.5	9.65	10	10	%
R.M.S. Input Voltage	3.3	3.4	3.5	4.0	volts

Curves are attached to this Report which show the relation between power output, distortion, R.M.S. input voltage, screen current and plate current for the above conditions. Curve No. 307-385 for  $E_p = E_{g2} = 200$  volts is taken using autobias. Curve No. 307-386 for  $E_p = 250$  volts,  $E_{g2} = 200$  volts and Curves Nos. 307-387 and 307-388 for  $E_p = E_{g2} = 250$  volts are taken under fixed bias conditions.

##### Class A Operation, single ended, triode connection ( $g_2 - p$ ):

Plate Voltage	250	volts
Plate Current (zero signal)	35	mA
Cathode Resistor	270	ohms
Plate Load	3.5	K $\Omega$
Power Output	1.9	watts
R.M.S. Input Voltage	6.7	volts
Distortion (2nd and 3rd Harmonics)	8.2%	

Curve No. 307-389 attached to this Report, shows the relation between power output, distortion, and R.M.S. input voltage for the valve connected as a triode.

##### Class ABI operation, push-pull pentode connections:

Plate Voltage	200	250	300	volts
Screen Voltage	200	250	300	volts
Grid Voltage	-6.5	-9.0	-10.4	volts
Autobias Resistor	100	130	130	ohms (nominal)
Plate Current (zero signal)	58	62.5	80	mA
Plate Current (max signal)	65	75	92.5	mA
Screen Current (zero signal)	6.5	7.0	8.5	mA
Screen Current (max. signal)	10.4	15	20	mA
R.M.S. A.F. grid to grid voltage	10.0	15.0	19.5	volts





Output Load ( plate to plate )	7000	8000	8000 ohms
Power Output	6.3	10.9	17 watts
Total Harmonic Distortion	2.03	2.32	3.18 %

NOTE: Values given are for two valves.

Curves are attached to this Report which show the relation between power output, distortion, R.M.S. input voltage, plate current and screen current for three values of plate and screen voltage. Curve No. 307-390 applies for 200 volt operation, Curve No. 307-391 for 250 volt operation and Curve No. 307-392 for 300 volt operation. All three curves are taken under auto-bias conditions.

**Class ABI operation, push-pull ultra-linear connection (43% screen tap):**

Plate Voltage	300	volts
Screen Voltage	300	volts
Cathode Current (zero signal)	80	mA
Cathode Current (max. signal)	90	mA
R.M.S. Input Voltage (grid to grid)	16	volts
Plate to plate load	8000	ohms
Power Output	11	watts
Total Distortion	0.7	%

NOTE: Values given are for two valves.

Separate cathode resistors of 270 ohms each are employed. The screen of each valve is taken to points on the output transformer primary such that 43% of the total turns on each half-primary are enclosed between the screen tap and the centre-tap.

Curve No. 307-393 attached to this Report shows the relation between power output, distortion, R.M.S. input voltage and cathode current.

**Class ABI operation, push-pull triode connection (g<sub>2</sub>—P):**

Plate Voltage	250	300	volts
Plate Current (zero signal)	41	49	mA
Plate Current (max. signal)	45	54	mA
Cathode Bias Resistor	270	270	ohms
Output Load (plate to plate)	10000	10000	ohms
R.M.S. Input Voltage (grid to grid)	16.5	20	volts
Power Output	3.4	5.2	watts
Total Distortion	1.8	2.0	%

NOTE: Values given are for two valves.

Curves are attached to this Report which show the relation between power output, distortion, R.M.S. input voltage, plate current and screen current. Curve No. 307-394 applies for 250 volt operation and Curve No. 307-395 for 300 volt operation.



**Class B operation, push-pull pentode connection:**

Plate Voltage	250	300	volts
Screen Voltage	250	300	volts
Grid Voltage	-11.6	-14.7	volts
Plate Current (zero signal)	20	15	mA
Plate Current (max. signal)	75	92	mA
Screen Current (zero signal)	2.2	1.6	mA
Screen Current (max. signal)	15	22	mA
R.M.S. A.F. grid to grid voltage	16.0	20.0	volts
Output Load (plate to plate)	8000	8000	ohms
Power Output	11.0	17	watts
Total Harmonic Distortion	3	4.0	%

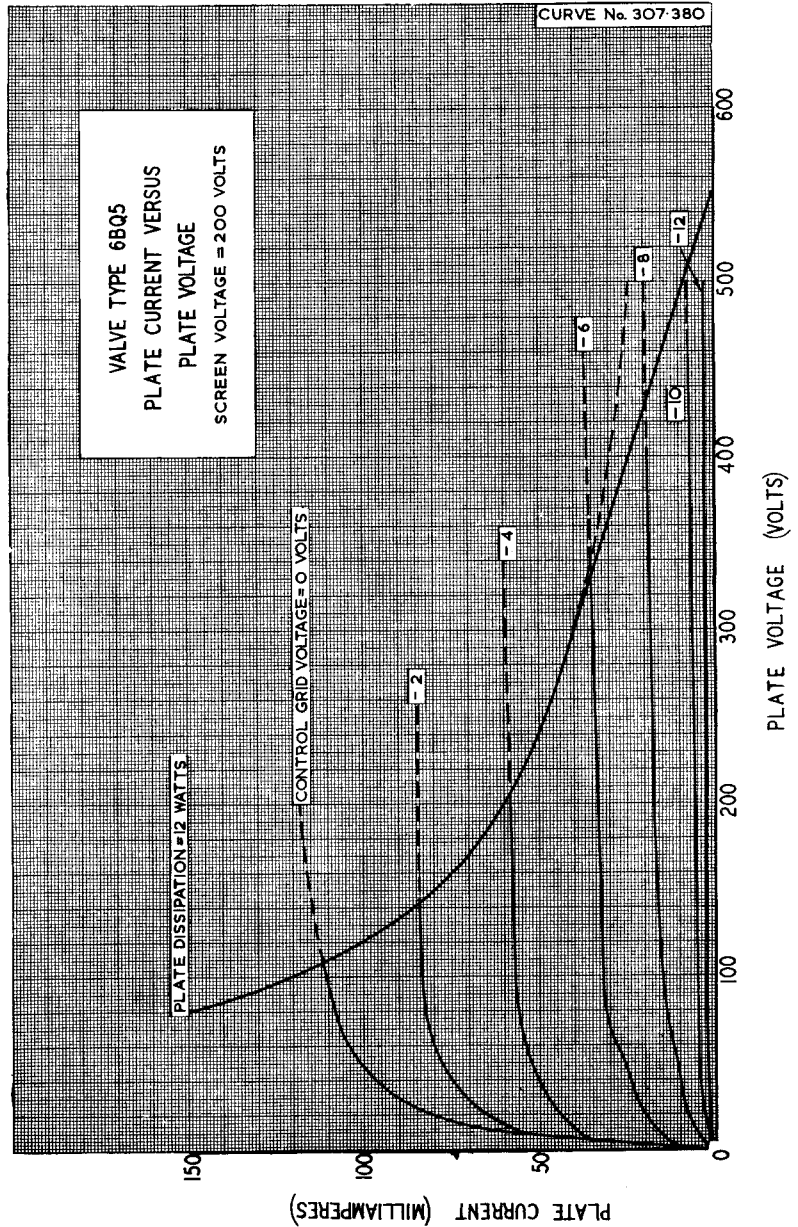
NOTE: Values given are for two valves.

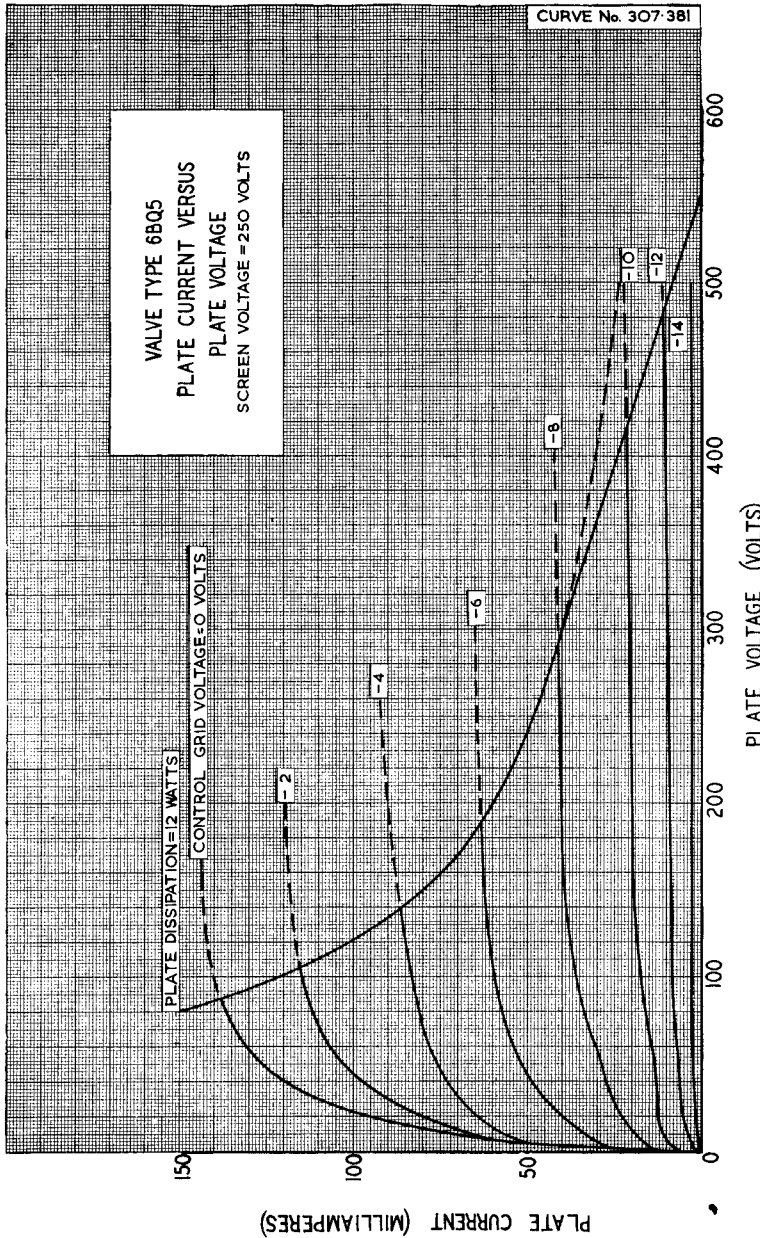
Curve No. 307-396 attached to this Report shows the relationship between power output distortion, R.M.S. input voltage, plate current and screen current for  $E_p = E_{g2} = 250$  volts, and Curve No. 307-397 for  $E_p = E_{g2} = 300$  volts.

Fixed bias is essential when Class B operation is employed and should be of good regulation.

**5.0 GENERAL RECOMMENDATIONS:** Due to the high slope of this valve, trouble may be experienced due to parasitic oscillation, and it is advised that a resistor of 10,000 ohms minimum value be connected in series with the grid, at the valve holder grid contact. In applications where grid current is drawn it would be preferable to use a resistor of 100 ohms connected in series with the plate at the valve holder plate contact.



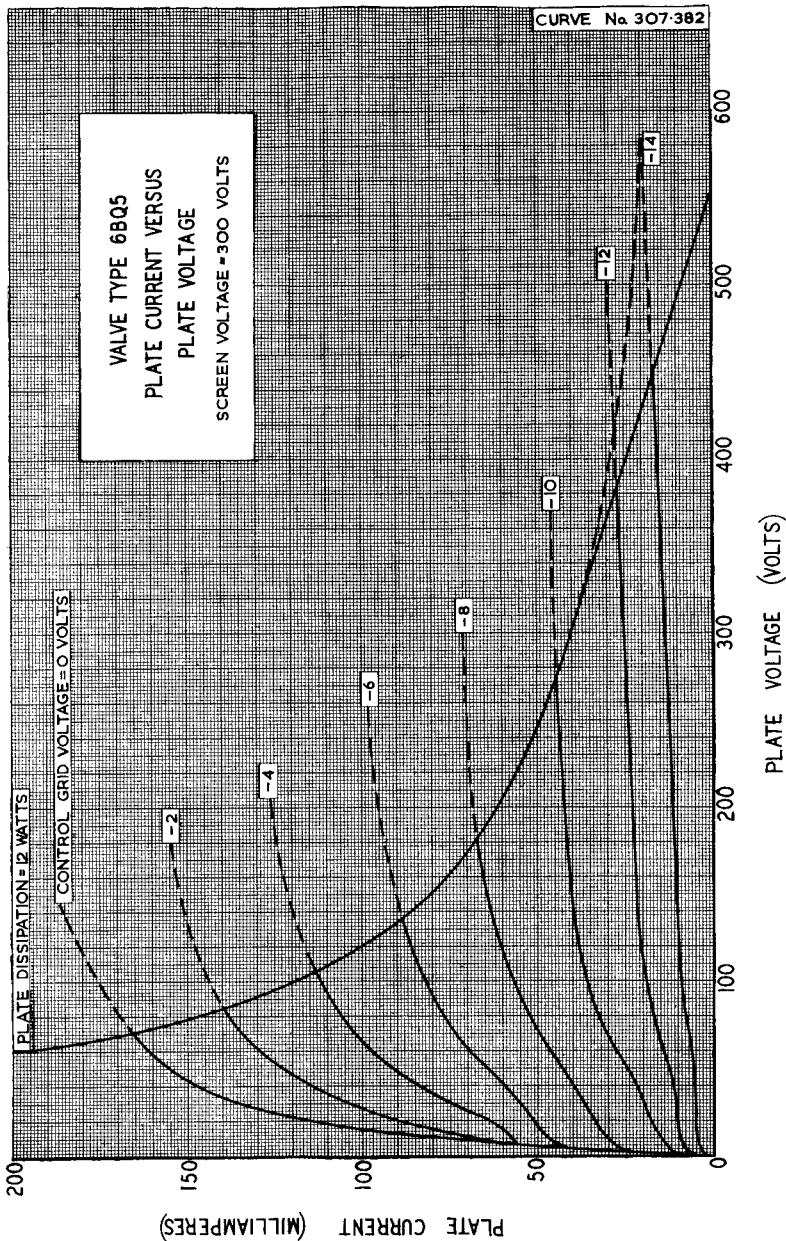


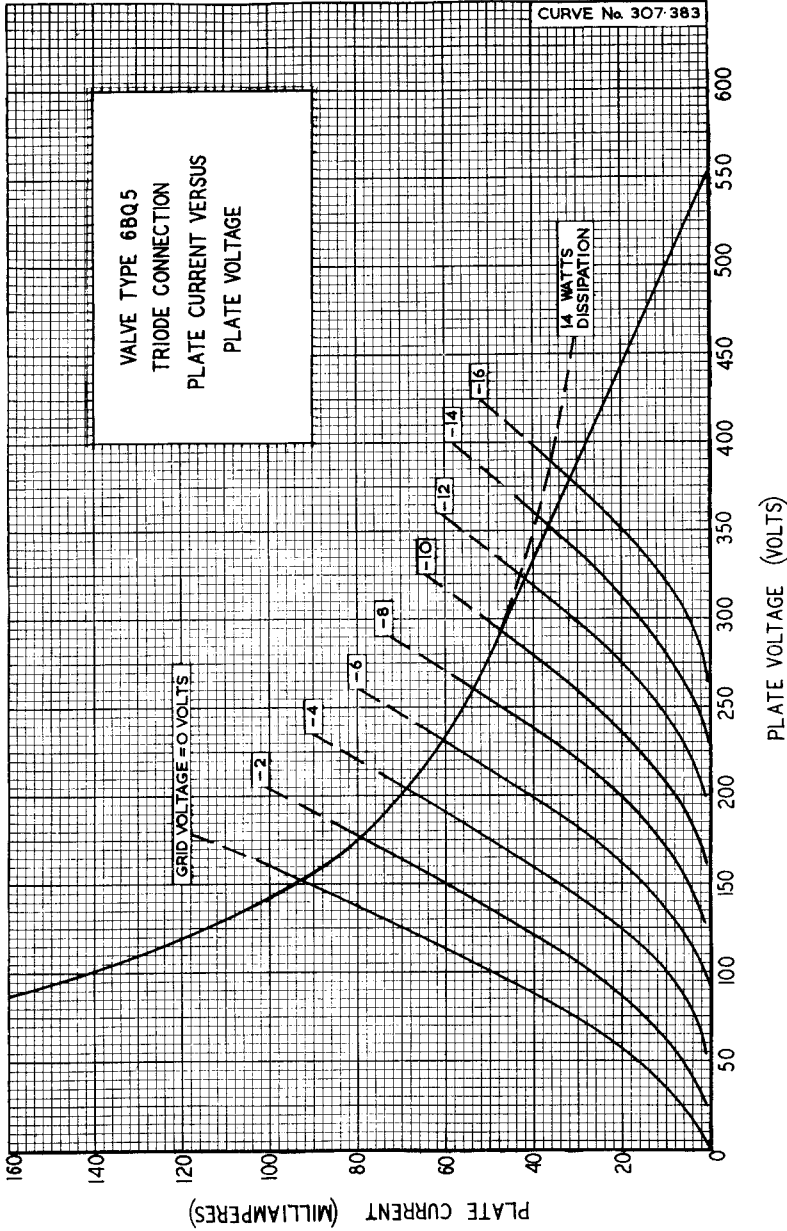


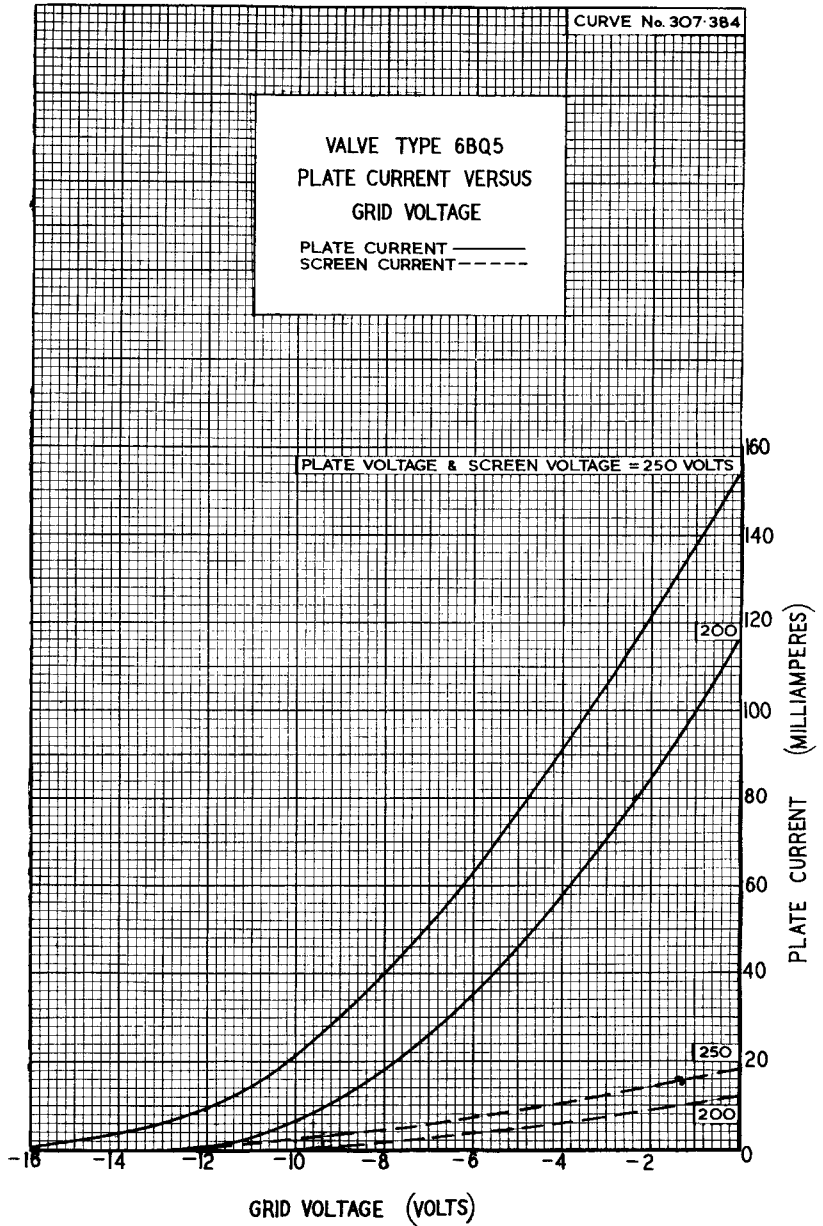




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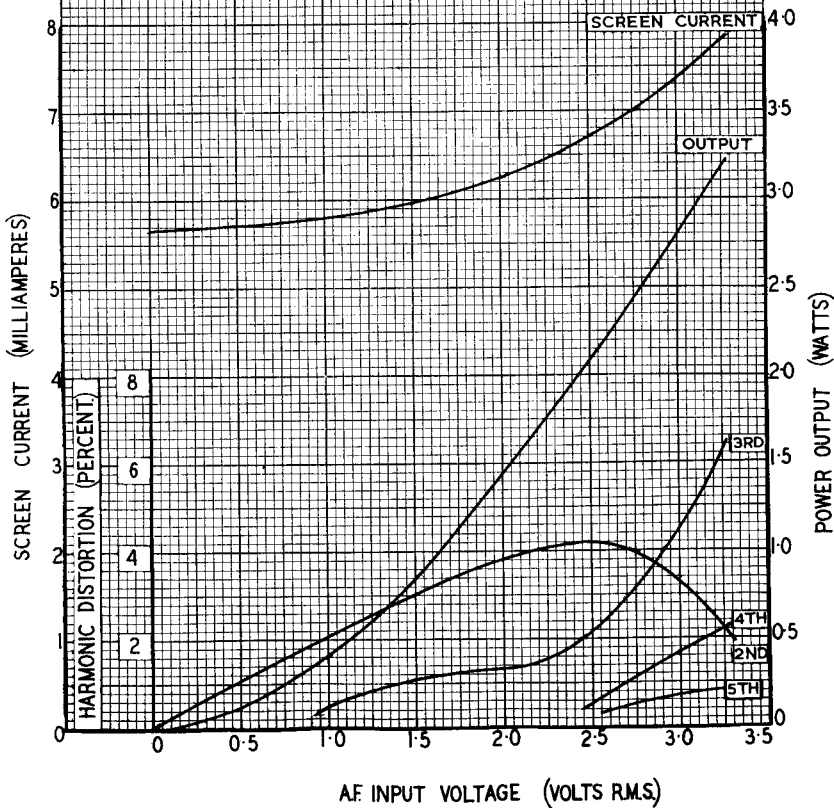




CURVE No. 307-385

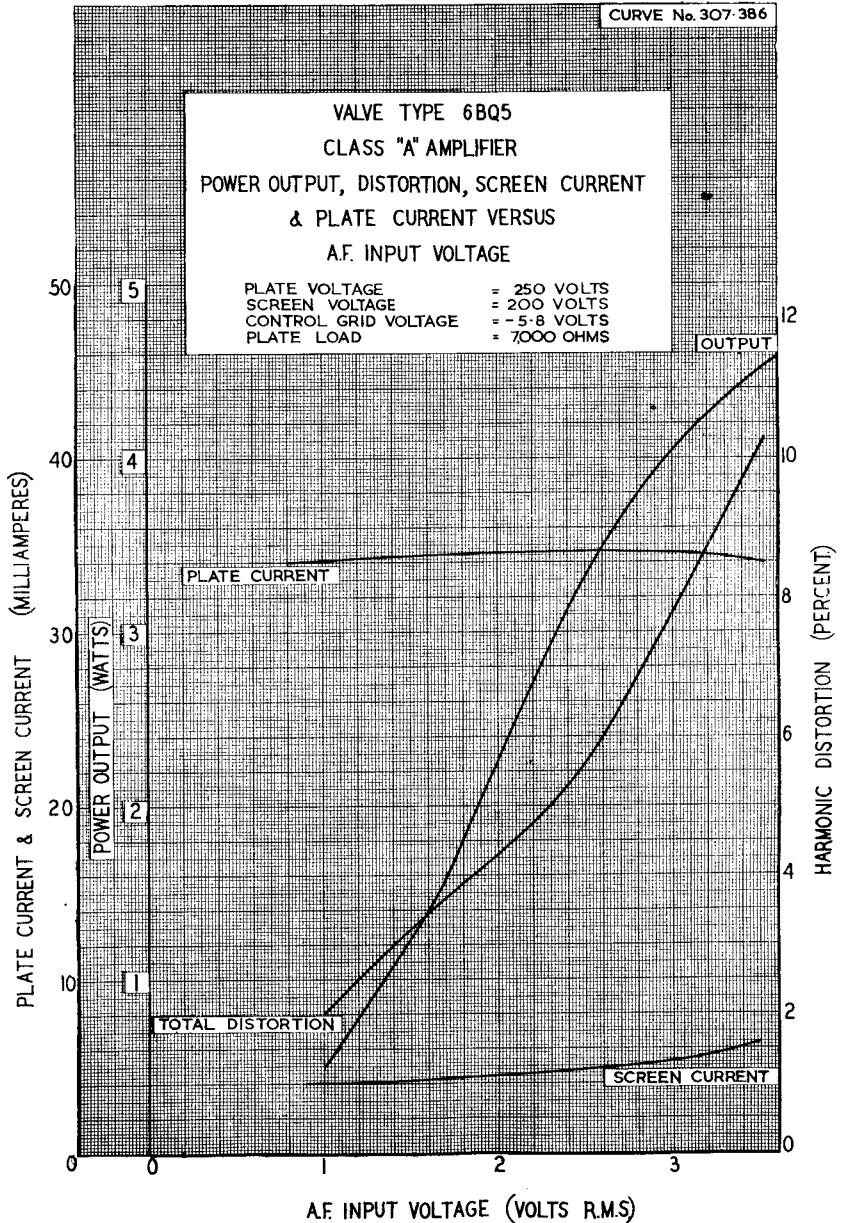
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 CLASS "A" AMPLIFIER  
 POWER OUTPUT, DISTORTION & SCREEN CURRENT  
 VERSUS A.F. INPUT VOLTAGE

PLATE VOLTAGE = 200 VOLTS  
 SCREEN VOLTAGE = 200 VOLTS  
 PLATE CURRENT = 50 mA  
 PLATE LOAD = 4,000 OHMS  
 AUTOBIAS RESISTOR = 82 OHMS





CURVE No. 307-386

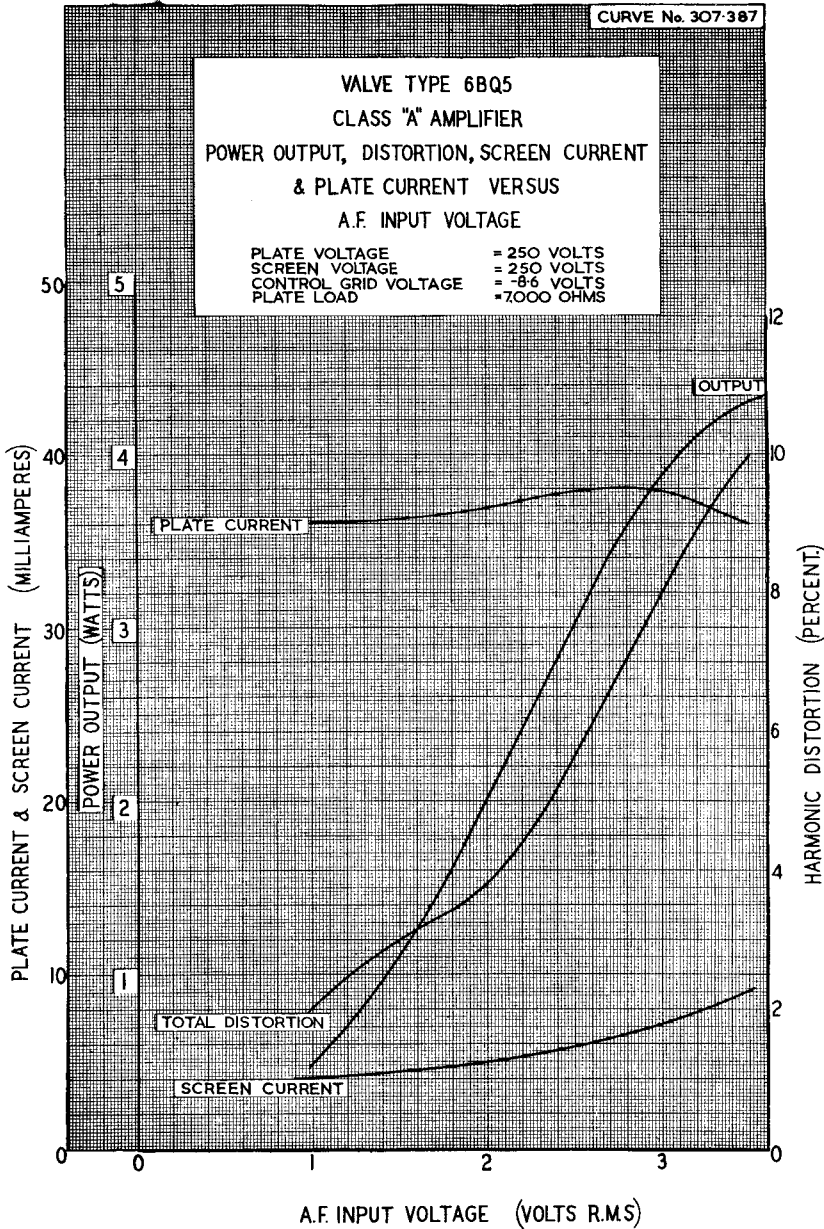


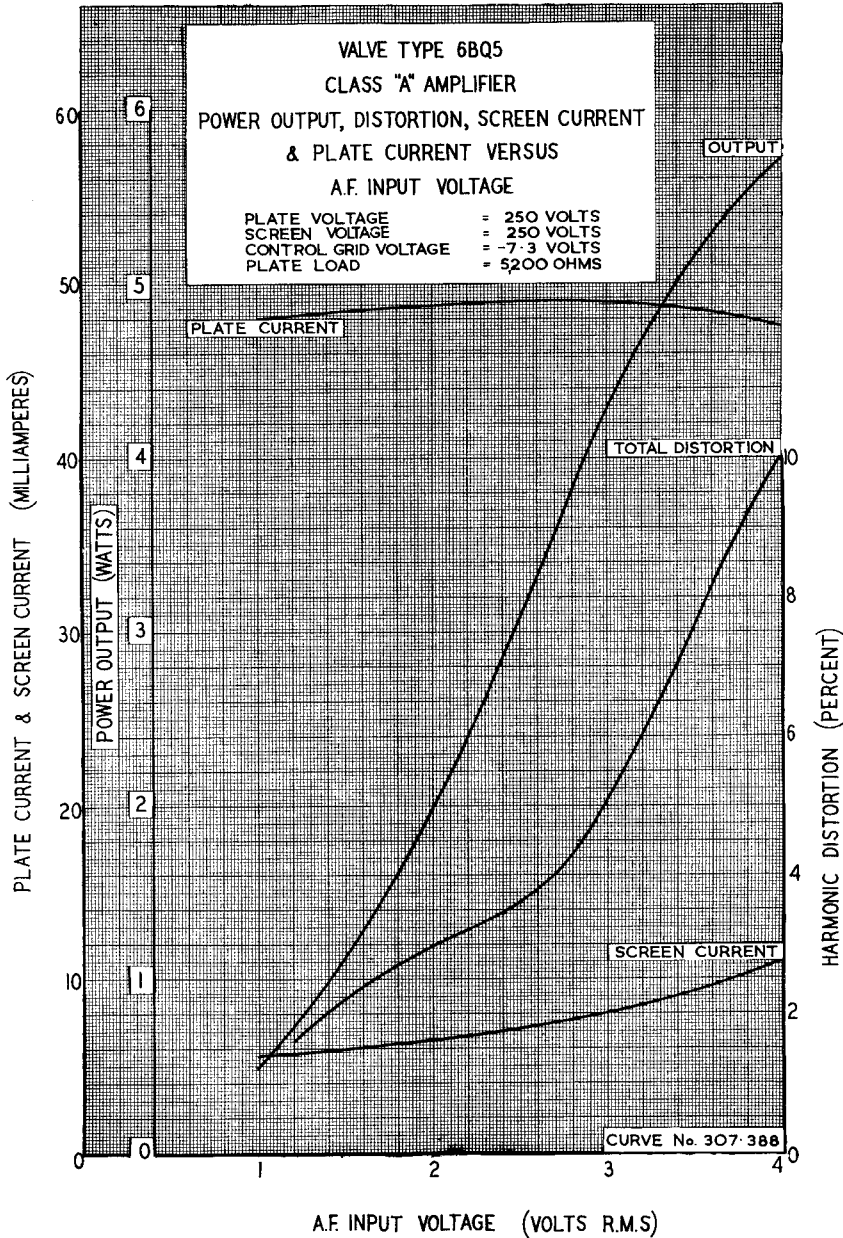


CURVE No. 307-387

VALVE TYPE 6BQ5  
 CLASS "A" AMPLIFIER  
 POWER OUTPUT, DISTORTION, SCREEN CURRENT  
 & PLATE CURRENT VERSUS  
 A.F. INPUT VOLTAGE

PLATE VOLTAGE = 250 VOLTS  
 SCREEN VOLTAGE = 250 VOLTS  
 CONTROL GRID VOLTAGE = -8.6 VOLTS  
 PLATE LOAD = 7000 OHMS



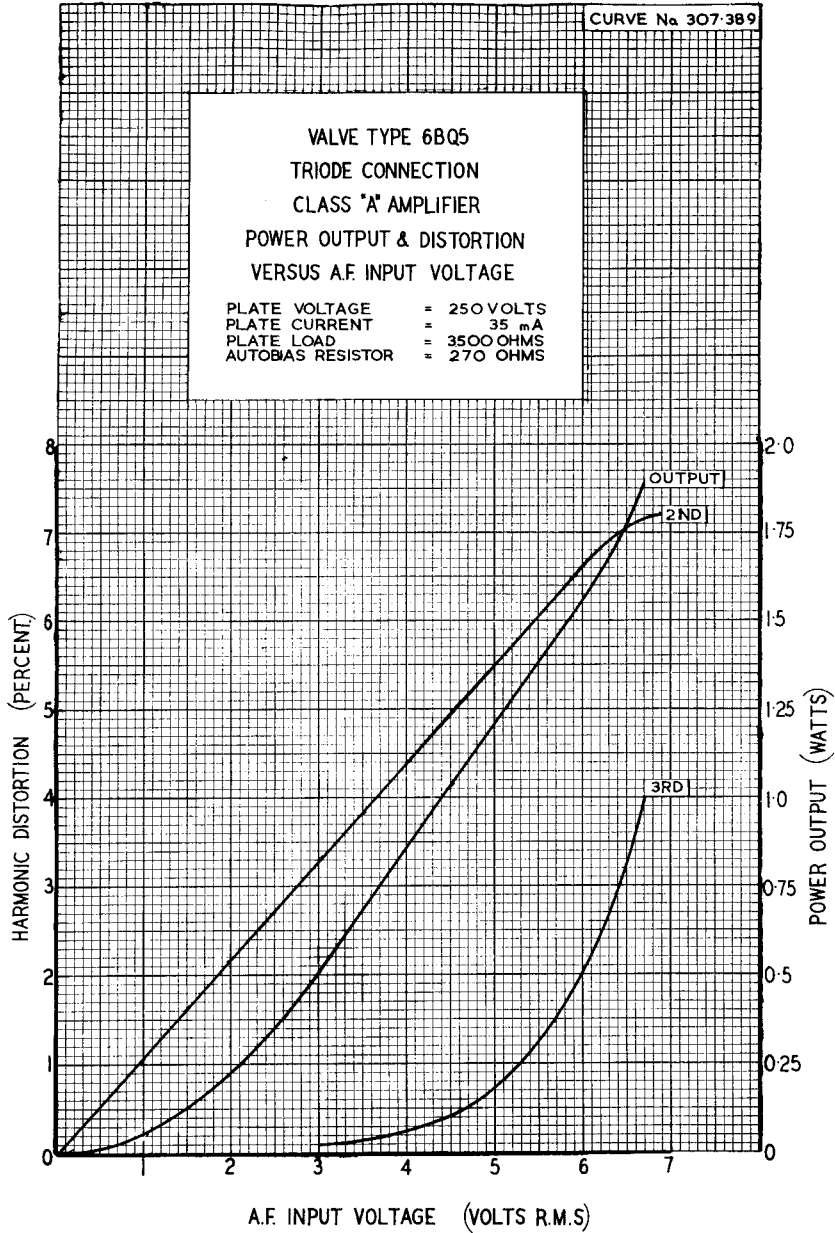




CURVE No 307-389

VALVE TYPE 6BQ5  
 TRIODE CONNECTION  
 CLASS "A" AMPLIFIER  
 POWER OUTPUT & DISTORTION  
 VERSUS A.F. INPUT VOLTAGE

PLATE VOLTAGE = 250 VOLTS  
 PLATE CURRENT = 35 mA  
 PLATE LOAD = 3500 OHMS  
 AUTOBIAS RESISTOR = 270 OHMS

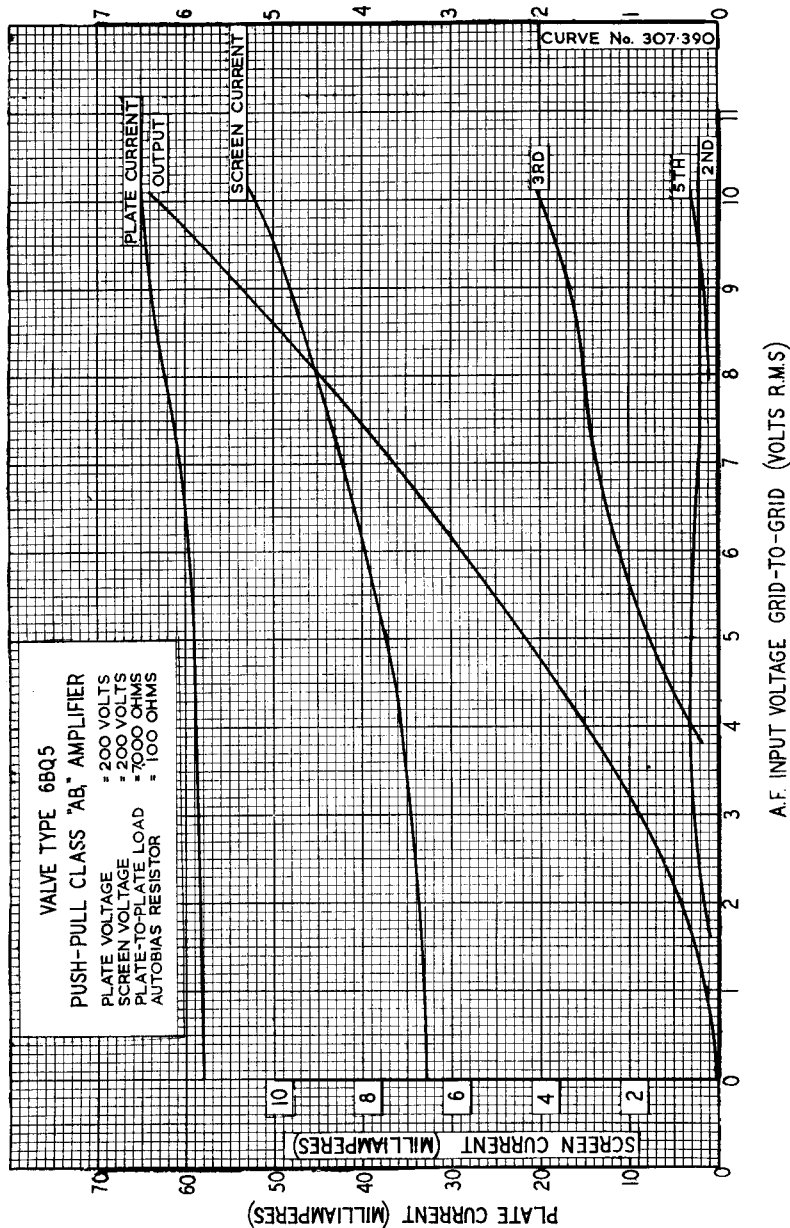


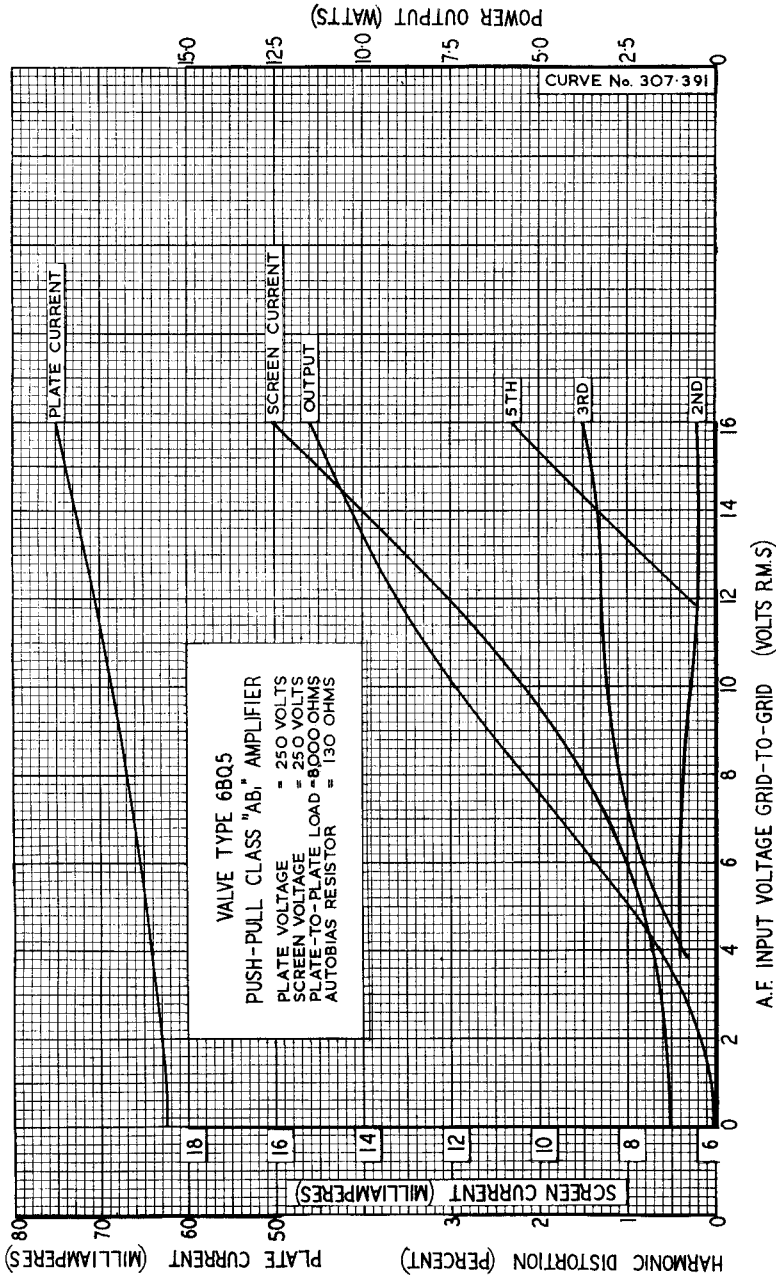


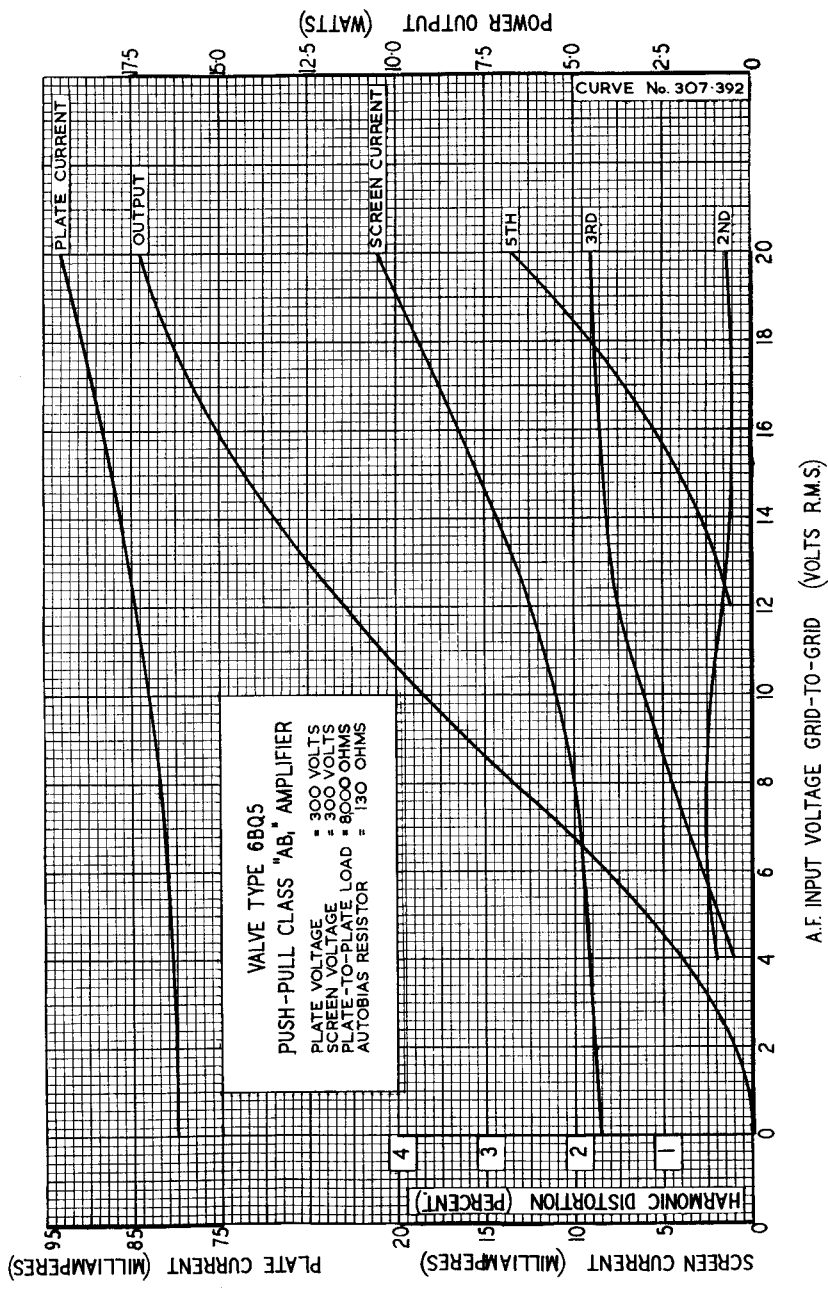


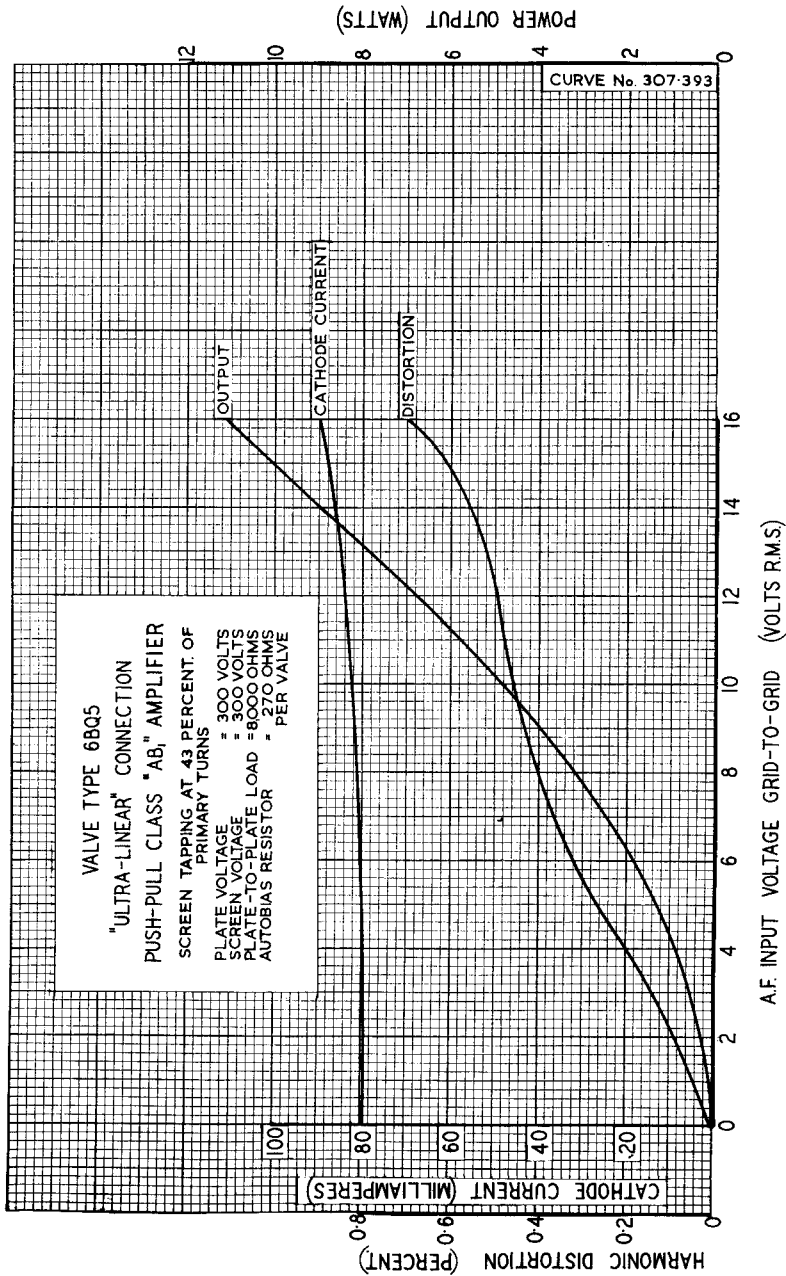
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POWER OUTPUT (WATTS) & HARMONIC DISTORTION (PERCENT)











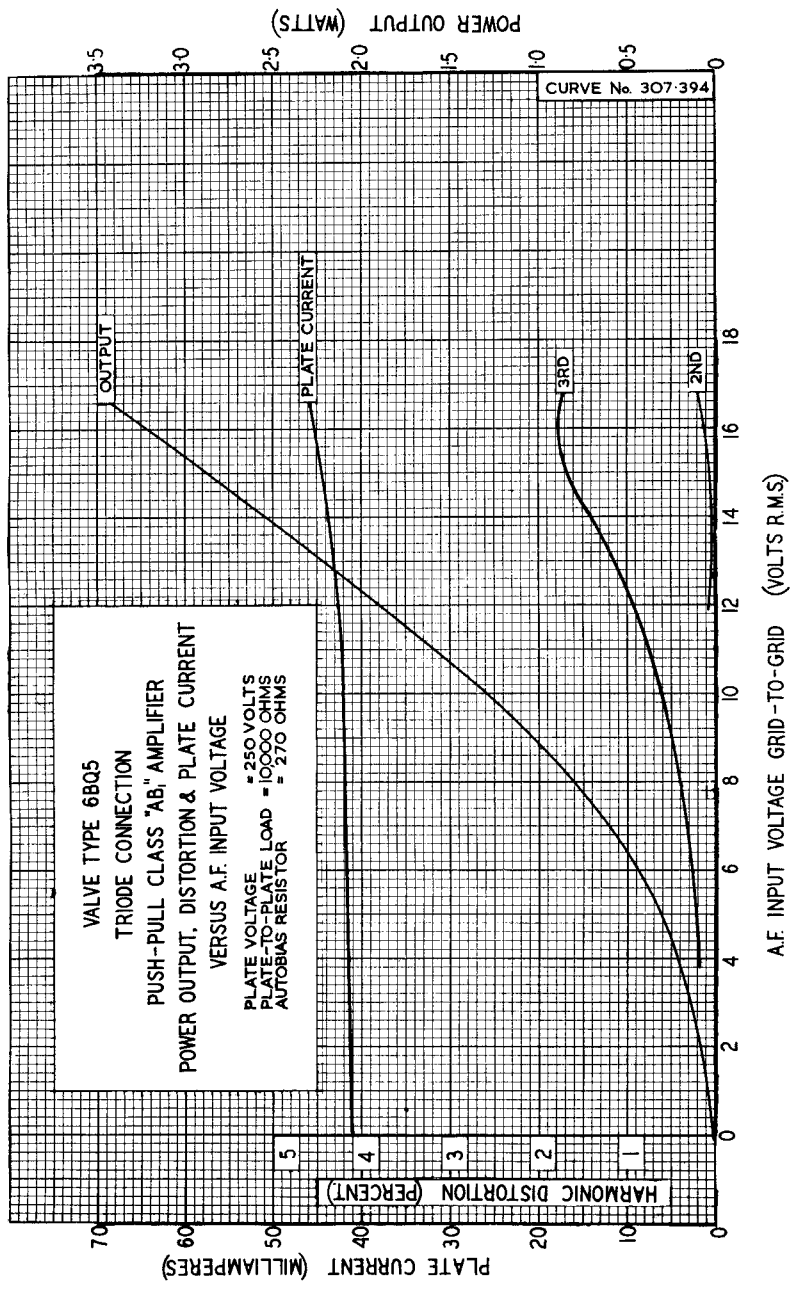
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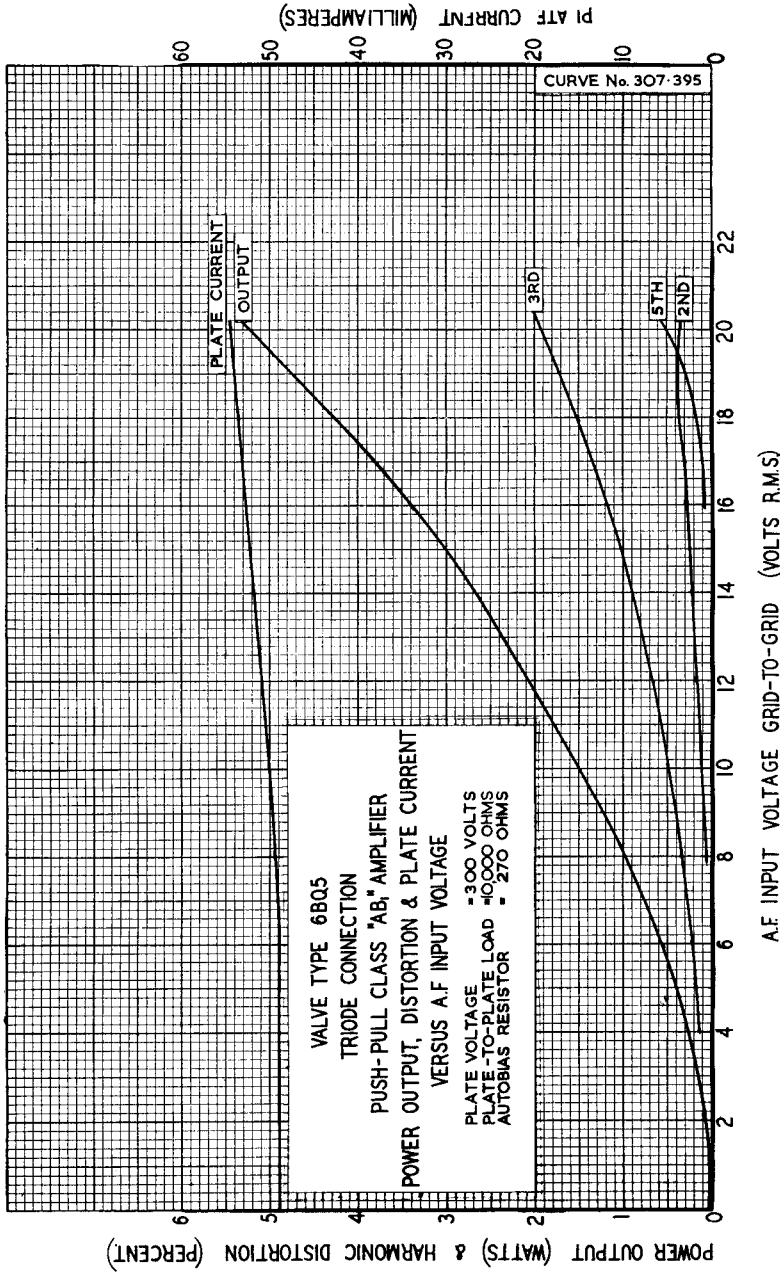


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