Mullard

RECEIVING VALVES
AND
TELEVISION PICTURE TUBES

1

Mullard
TECHNICAL HANDBOOK

VOL. 1

RECEIVING AND AMPLIFYING VALVES
SPECIAL QUALITY RECEIVING VALVES
TELEVISION PICTURE TUBES

Mullard **VOLUME 1** **(Parts I and II)**

Receiving and Amplifying Valves

Special Quality Receiving Valves

Television Picture Tubes

Issued by
CENTRAL TECHNICAL SERVICES
MULLARD LIMITED
MULLARD HOUSE, TORRINGTON PLACE, LONDON W.C.1
TELEPHONE: 01-580 6633 *Telex:* 264341

GENERAL INDEX TO VOLUME ONE

GENERAL INDEX TO VOLUME ONE

PART II

GENERAL INDEX TO VOLUME ONE

Mullard Technical Handbook

GENERAL INDEX TO VOLUME ONE

This index of Mullard receiving and amplifying valves, special quality receiving valves and television picture tubes will be reissued periodically to incorporate the latest information. It does not include data sheets for maintenance type receiving valves and cathode ray tubes which are contained in Volume 2.

Data sheets for types starred thus (*) have not yet been published but will be issued when they are available. A guarantee that these valves and tubes will become available is not implied by their inclusion in this list.

The issue number or date given against each type shows the latest information published and should correspond to that given on the data sheet at the bottom left-hand corner of each page.

LIST OF SYMBOLS

	Inside Valve	Outside Valve
Resistance	r	R
Reactance	x	X
Impedance	z	Z
Admittance	y	Y
Mutual Inductance	m	M
Capacitance	c	C
Capacitance at Working Temperature	c_w	
Power	p	P

3. AUXILIARY SYMBOLS

Battery or other source of supply	b
Inverse (Voltage or Current)	inv
Ignition (Voltage)	ign
Extinction (Voltage)	ext
No Signal	o
Input	in
Output	out
Total	tot
Centre Tap	ct

4. COMPLEX SYMBOLS

Symbols in Sections 1 and 3 above may be used as subscripts to symbols in Section 2, to denote such magnitudes as Anode Current, Grid Volts, etc., e.g.:—

Anode Voltage ...	V_a	Anode Current (A.C. r.m.s.)	$I_{a(r.m.s.)}$
Control-Grid Voltage	V_{g1}	No Signal Anode Current ...	$I_{a(o)}$
Anode Supply Voltage	$V_{a(b)}$	Control-Grid Current ...	I_{g1}
Filament Voltage ...	V_f	Total Distortion	D_{tot}
Heater Voltage ...	V_h	3rd Harmonic Distortion ...	D_3
Anode Dissipation ...	p_a	Equivalent Noise Resistance	R_{eq}
Output Power ...	P_{out}	Limiting Resistor	R_{lim}
Drive Power	P_{drive}	Cathode Bias Resistor	R_k
Anode Current (D.C.)	I_a		

	Internal	External
Anode Resistance	r_a	R_a
Insulation Resistance (heater to cathode)	r_{h-k}	
Resistance between Control-Grid and Cathode ...	r_{g1-k}	R_{g1-k}
Capacitance (cold)—		
Anode to all other electrodes		c_{a-all}
Anode to control-grid		c_{a-g1}
Control-grid to cathode at working temperature		$c_{g1-k(w)}$
Control-grid to all other electrodes except anode (Input Capacitance)		c_{in}
Anode to all other electrodes except control-grid (Output Capacitance)		c_{out}
Inner Amplification Factor		μ_{g1-g2}

LIST OF SYMBOLS

These symbols are based on British Standard Specification No. 1409 : 1950.
" Letter Symbols for Electronic Valves ".

1. SYMBOLS FOR ELECTRODES

Anode	a	Fluorescent Screen or Target...	t
Cathode	k	External Metallisation	M
Grid	g	Internal Metallisation	m
Heater	h	Deflector Electrodes	x or y
Filament	f	Internal Shield	s
Beam Plates	bp	Resonator	Res ←

NOTE 1. In valves having more than one grid, the grids are distinguished by numbers—g_1, g_2, etc., g_1 being the grid nearest the cathode

NOTE 2. In multiple valves, electrodes of the different sections may be distinguished by adding one of the following letters:

Diode	d	Hexode	h
Triode...	t	Heptode	h
Tetrode	q	Octode	h
Pentode	p	Rectifier	r

Thus, the grid of the triode section of a triode-hexode is denoted by g_t.

NOTE 3. Two or more similar electrodes which cannot be distinguished by any of the above means may be denoted by adding one or more primes to indicate to which electrode system the electrode forms a part.
Thus, the anode of the first diode in a double diode valve is denoted a′.

2. SYMBOLS FOR ELECTRIC MAGNITUDES

Voltages		Current	
Direct Voltage	V	Direct Current	I
Alternating Voltage (r.m.s.)	$V_{r.m.s.}$	Alternating Current (r.m.s.)	$I_{r.m.s.}$
Alternating Voltage (mean)	V_{av}	Alternating Current (mean)	I_{av}
Alternating Voltage (peak)	v_{pk}	Alternating Current (peak)	i_{pk}
Peak Inverse Voltage ...	P.I.V.	No Signal Current	I_o

Miscellaneous

Frequency	f	Anode Efficiency	η
Amplification Factor ...	μ	Sensitivity	S
Mutual Conductance ...	g_m	Brightness	B
Conversion Conductance...	g_c	Temperature	T
Distortion	D	Time	t

Part IV

Semiconductor diodes
Photodiodes and phototransistors

Part V

Rectifier diodes
Rectifier diode stacks

Part VI

Thyristors
Thyristor stacks

Volume 5

Fixed capacitors
Variable capacitors
Fixed resistors
Variable resistors
Non-linear resistors
Electromechanical components
Ultra-high vacuum devices
Tuners
Piezoxide components

Volume 6

Part I

Permanent magnets
Wound ferrite assemblies
Magnetic recorder heads
Ferroxcube multi-aperture devices
Ferroxcube storage cores
Ferroxcube switch cores
Memory systems

Part II

Ferroxcube rods, tubes and beads
Ferroxcube U-cores and yokes
Ferroxcube toroids
Ferroxcube transformer cores
Ferroxcube pot cores

Part III

Vinkors
High frequency vinkors

Part IV

IEC size vinkors
IEC size transformer pot cores

Volume 7

Integrated circuits

Made and printed in England by Wightman & Co. Ltd., 1-3 Brixton Road, London, S.W.9

TECHNICAL HANDBOOK SERVICE

CONTENTS

FILING DATA SHEETS

The prompt use of these postcards will ensure that, as far as is humanly possible, our mailing records and your Handbook are maintained up to date. This can be achieved, however, only with the co-operation of Handbook owners, not only by notifying us of change of address but by filing new data sheets as soon as they are received and removing obsolete sheets.

Neglect of this simple task may lead to loss of data sheets, and an incomplete Handbook congested with out-of-date information.

We occasionally receive letters from Handbook subscribers who have allowed their Handbooks to become disorganised, asking whether they may return them to us to be made up to date. **Please note that we cannot undertake this service.** What we can do, however, is to send you a copy of the latest index so that you can check the contents of your Handbook. We will then send you, free of charge, copies of sheets which may be missing.

CORRESPONDENCE

Correspondence concerning the Handbook Service should be addressed to:

Mullard Limited,
Central Technical Services,
Mullard House,
Torrington Place,
London, W.C.1.

When writing, please quote the SERIAL NUMBER which is given on the introduction page of each Handbook. This number links up with our records and mailing system, and is repeated in the address on every set of supplementary sheets issued. By quoting this number you will save us a great deal of work and avoid delays in answering your letters.

TECHNICAL HANDBOOK SERVICE

PREFACE

In order that you may obtain the maximum benefit from your Mullard Technical Handbook, we ask you to read carefully this short description of the Handbook Service and how it is organised.

By following the simple suggestions given you will ensure that your Handbook is always up to date, and will avoid much unnecessary correspondence and work both at your end and ours.

THE HANDBOOK

The Mullard Technical Handbook is published in seven volumes plus a general index.

You may possess the complete Handbook, or only one or more of the volumes. Should you wish to obtain any volumes not in your possession, please write to Mullard Central Technical Services for subscription terms, quoting the serial number of your existing Handbook.

KEEPING THE HANDBOOK UP TO DATE

Each volume has a separate index, and is sent out complete with section dividers and all current data sheets in their correct positions. As new or revised sheets are issued, copies are sent to all subscribers, together with a list indicating the position in which each sheet should be filed.

ACKNOWLEDGMENT OF RECEIPT OF HANDBOOK

In order to ensure that these sheets reach the correct individual you are earnestly requested, immediately upon receipt of your Handbook, to detach and mail to us the "Acknowledgment of Receipt Card" which you will find just inside the cover. Please make sure that the name and full address to which supplements should be sent are clearly given in the space provided.

CHANGE OF ADDRESS OR OWNERSHIP

Any change in the name or address should be notified in a similar way by using the "Change of Address or Ownership Card" also included at the front of each Handbook.

RECEIVING AND
AMPLIFYING VALVES

VALVE TYPE NOMENCLATURE

The type nomenclature for Mullard receiving and amplifying valves generally consists of two or more letters followed by two, three or four figures. These symbols provide information concerning the principal uses of the valves, the heater or filament rating, and the type of base, according to the following code.

The first letter indicates the filament or heater voltage or current:

D—0.5 to 1.5V filament	H—150mA heater
E—6.3V filament	P—300mA heater
G—5.0V filament	U—100mA heater

Letters A(4.0V), C(200mA) and K(2.0V) have also been used.

The second and subsequent letters indicate the general class of valve:

A—single diode	H—hexode or heptode
B—double diode	K—heptode or octode
C—triode	L—output tetrode or pentode
D—output triode	M—electron beam indicator
E—tetrode	Y—half-wave rectifier
F—voltage amplifying pentode	Z—full-wave rectifier

Two or three of the above letters may be combined, e.g. BC—double-diode triode.

The first figure of the serial number indicates the type of base:

1—Miscellaneous bases (see note below)
2—B10B(10-pin) base (previously used for B8G base)
3—Octal base
4—B8A base
5—B9D(magnoval) base (previously used for miscellaneous bases)
6 and 7—Previously used for subminiature bases
8—B9A (noval) base
9—B7G base

In some earlier type numbers with three figures, if the first figure is 1 then the second figure indicates the type of base, e.g., ECC189—B9A base.

The remaining figures make up the serial number indicating a particular design or development. In future, all valves designed for 'entertainment' applications will have a serial number of three figures. Valves designed for 'professional' applications will have a serial number of four figures.

Exceptions

Some valves for 'professional' applications have a type number in which the figures follow the first letter and precede the second and subsequent letters, e.g., E88CC. Other 'professional' valves have a type number consisting of the letter 'M' followed by a four-figure serial number commencing with the figure '8', e.g. M8080.

Examples

PCF806	P 300mA heater	C triode	F voltage amplifying pentode	806 B9A base 'Entertainment' applications
EC1000	E 6.3V heater	C triode	1000 Miscellaneous (subminiature) base 'Professional' applications	

GENERAL OPERATIONAL RECOMMENDATIONS

The following recommendations have been based on the British Standard Code of Practice CP1005: Parts 1 and 2, 1954, " The Use of Electronic Valves ".

1. DEFINITIONS OF RATING SYSTEMS

Unless otherwise stated, all limiting values given in the Mullard Technical Handbook are in accordance wih the design-centre rating system. The design-maximum and absolute-maximum rating systems may be used in certain circumstances. The following definitions of these three rating systems are based on those agreed by the International Electrotechnical Commission:–

1.1 Design-centre rating system

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey valve of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the valve manufacturer to provide acceptable serviceability of the valve in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electron devices in the equipment.

The equipment manufacturer should design so that initially no design-centre value for the intended service is exceeded with a bogey valve in equipment operating at the stated normal supply voltage. A bogey valve is one whose characteristics have the published nominal values for the type. For a bogey valve for any particular application, only those characteristics which are directly related to the application need be considered.

1.2 Design-maximum rating system

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

These values are chosen by the valve manufacturer to provide acceptable serviceability of the valve, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the valve 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 valve 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 characteristics of all other electron devices in the equipment.

1.3 Absolute-maximum rating system

Absolute-maximum ratings are limiting values of operating and environmental conditions applicable to any valve of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the valve manufacturer to provide acceptable serviceability of the valve, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the valve under consideration and all other electron devices in the equipment.

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

2. INTERPRETATION OF DESIGN-CENTRE RATINGS

When the circuit designer uses the design-centre system he should realise that the valve manufacturer takes into account the effects of normal random variations in conditions and components and assumes that normal good practice is followed in the design and use of components. No allowance is made for discrete changes in conditions or components.

2.1 Rated supply voltage and its variation

In equipment which is to operate from the normal supply mains a voltage tap should be provided for every declared mains voltage. Where this is not practicable however, and two or more declared voltages are covered by one tap, compliance with the design-centre system must be checked on the highest and lowest declared voltages in each tap. For the purpose of checking, all devices must be bogey.

If the equipment is checked in this way and the designer has complied with all other relevant sections in these recommendations the equipment can be operated from a supply that has normally-encountered voltage variations of up to $\pm 10\%$. (The normal ratio of power variation to voltage variation of approximately 2 : 1 is assumed. If the ratio is greater than 2 : 1 in a particular circuit, the maximum permissible dissipation at which any valve can operate must be reduced accordingly below the limiting value.) Where a valve is recommended solely for low voltage operation (as in the car-radio range) allowance has already been made for the variations in accumulator voltage, which can be greater than 10%. For further recommendations see section 3.1.5.

For valves intended for operation from dry batteries where the relevant maximum battery voltage is quoted under limiting values, due allowance has already been made for the fact that the battery terminal voltage is higher for a new battery and falls during life. For mains operation, the maximum battery voltage quoted under limiting values should be taken as the limiting value on the design centre system. For further recommendations on battery and battery-mains operation of filamentary valves see section 3.2.

2.2 Equipment components and their variations

In an equipment the operation of any one component is to some extent dependent on every other component in that equipment. It is good practice to use self bias, such as provided by a cathode resistor or grid current bias (see section 5.3), rather than fixed bias. When this is done, further components can be added as long as the added variations are not large compared with those already existing, as in general the addition of a component to a circuit reduces the effects of the variations of the other components already in that circuit, besides adding the effect of its own variations.

If a power valve or high-slope valve is operated within 20% of its maximum dissipation rating, a $\pm 10\%$ tolerance cathode-bias resistor should be used. If a cathode-bias resistor cannot be used, then with a pentode or other multigrid valve a screen-grid dropping resistor having a $\pm 10\%$ tolerance should be incorporated (see section 5.4). Similarly, with a triode a dropping resistor should be used in the anode circuit (see section 5.6). Valves should not be used in circuits where their operating conditions are dependent on another circuit or valve, unless the more important transferred variations are small compared with the variations in the operating conditions. When two valves are used in push-pull, for example, separate cathode-bias resistors should be used.

2.3 Equipment control adjustment

The valve manufacturer's responsibilities do not include conditions produced by gross maladjustment of controls which result in incorrect operation of the equipment.

When a pentode or other multigrid valve is used under conditions where the equipment control adjustment affects the valve operating conditions, special attention must be paid to the screen-grid operating conditions (see section 5.4).

In equipment which has multiple functions (e.g. transmitter/receivers, t.v./f.m. receivers, etc.), it is assumed that the valves are used within their ratings in all modes of equipment operation.

2.4 Load variation

The valve manufacturer takes responsibility for the changes in valve operating conditions which are caused by the normal random variations of any component connected externally as a load, provided that normal good practice has been followed in the design and use of the component. Where definite changes occur in the load, all ratings should be checked at the worst long period running condition.

2.5 Signal variation

The valve manufacturer accepts responsibility for changes in the operating conditions due to random variations in signal (fading etc.) but not due to discrete changes (switching, or tuning to stations of varying strengths). When a.g.c. is used, the operating conditions of the valves will change with the strength of signal received. The operating conditions of all the stages (controlled and uncontrolled) must therefore be checked under their worst long period running conditions.

2.6 Environment

It is good practice to ensure that the bulb and base temperatures are kept low. They should not exceed the published limiting values in the environment for which the equipment is designed. Where equipment may be run under more than one condition it should be checked at each condition. If the maximum temperature ratings are not given on the data sheet of the valve in question, see Fig. 1 (Appendix III).

Care should be taken to ensure that the minimum pressure in the environment for which the equipment is designed is not less than the published limit. In general, B7G and B9A based valves can be used at pressures down to approximately 50mm Hg (that is up to altitudes of about 60,000ft). The manufacturer's advice should be sought if it is desired to operate octal-based valves at pressures below 525mm Hg (that is above altitudes of about 10,000ft).

2.7 Other electron devices

The valve manufacturer takes responsibility for changes in operating conditions caused by the variations in the characteristics of all other electron devices in the equipment, provided that normal good practice has been followed in the use of each electron device, i.e. the added variations are not large compared with those already existing.

3. HEATER AND FILAMENT RATINGS

3.1 Indirectly heated valves

3.1.1 Parallel operation (mains supply)

The heater voltage of individual valves must be within ±7% of the rated value (unless otherwise stated) when the supply voltage is at its nominal value, and valves with bogey heater characteristics are employed.

This variation is normally dependent upon more than one factor. The total variation may be taken as the square root of the sum of the squares of the individual variations arising from the effects of the tolerances of the separate factors, provided that no one of these deviations exceeds ±5%.

If a tap is used for more than one input voltage (as provided for in paragraph 2.1) the heater voltage of each valve must be checked on the highest and lowest declared voltages covered by the tap and should be within ±4% of the rated value.

3.1.2 Series operation (mains supply)

The heater current of series connected valves should be within ±3.5% of the rated value when the supply voltage is at its nominal value, and valves with bogey heater characteristics are employed.

This variation is normally dependent upon more than one factor. The total variation may be taken as the square root of the sum of the squares of the individual variations arising from the effects of the tolerances of the separate factors, provided that no one of these variations exceeds ±2.5%.

If a tap is used for more than one input voltage (as provided for in paragraph 2.1) the heater current must be checked on the highest and lowest declared voltages covered by the tap and should be within ±2% of the rated value.

In applications where a wide variation in the dynamic characteristics of the valve is acceptable, as for example in simple a.m. broadcast receivers and low-cost amplifiers, the heater current tolerance may be increased from ±3.5% to ±5%. This allows for the use of three taps to cover the range 200 to 250V even in applications where the chain consists mainly of a dropping resistor. It is permissible for the heater voltage to rise to a maximum value 50% in excess of the nominal rated value during switching and the warming-up period when using valves with nominal heater characteristics, unless otherwise stated.

3.1.3 Pulse and r.f. operation of heaters

When a valve heater is operated from a pulse or r.f. supply, special care should be taken to ensure that the correct power is delivered to the heater and that the peak voltage across the heater is not excessive.

In many rectifier applications, the valve will be required to supply only small currents. In these cases a relaxation of the normal ±7% heater voltage tolerance is allowed for some valve types. Details of the permissible relaxation are given on the appropriate data sheets.

3.1.4 Fluctuations in mains supply voltage

In addition to the tolerances quoted in 3.1.1, 3.1.2 and 3.1.3 above, fluctuations in the mains supply voltage not exceeding ±10% are permissible. These conditions are, however, the worst which are acceptable, and it is better practice to maintain the heater as close to its nominal rating as is possible.

Closer adherence to the rated heater voltage or current produces optimum valve life and performance.

3.1.5 Parallel, series or series-parallel operation from accumulators

When valve heaters are supplied in parallel from a 6.3V "on charge" accumulator, a resistor must be included to make up the difference between the heater voltage and the "on charge" battery voltage of 7V.

When valve heaters are supplied from an accumulator and are connected in a series-parallel arrangement, as is common for mobile operation, equalising bars should be used: that is, the points in the parallel chains which are at equal potential should be interconnected. It is necessary to have at least two, and preferably three, heaters connected in parallel in the resulting series-parallel arrangements, so that the variations are reduced to those which are expected with parallel operation. If this is done, up to four 6.3V valves can be connected in series and fed from an "on charge" 24V accumulator, or two from a 12V accumulator, provided that a resistor is included to make up the difference between the total heater voltage and the nominal "on charge" battery voltage. The nominal "on charge" battery voltages may be taken as 28V and 14V respectively.

If it is then required to operate from an accumulator that is not on charge, e.g. under emergency conditions, the equipment designer must ensure that his circuits will operate satisfactorily with any valves of the types in question, both when new and throughout life. It is suggested that the series dropping resistor should be switched out of circuit during "off charge" operation. The advice of the valve manufacturer can be sought on any specific points. Where life and reliability are of particular importance, with a series-parallel heater arrangement the supply voltage variation should be kept to a minimum, preferably less than ±2%.

3.2 Filamentary Valves

3.2.1 Parallel operation

3.2.1.1 *1.25V filamentary valves*

Valves with 1.25V filaments are designed to be operated from a dry cell with a rated terminal voltage of 1.3V. The lowest filament voltage at which the valve may be expected to operate satisfactorily is approximately 1.0V. If these valves are operated from dry cells with a rated terminal voltage of 1.5V, a suitable dropping resistor must be used.

3.2.1.2 *1.4V filamentary valves*

Valves with 1.4V filaments are designed to be operated from a dry cell with a rated terminal voltage of 1.5V. The lowest filament voltage at which the valve may be expected to operate satisfactorily is approximately 1.1V.

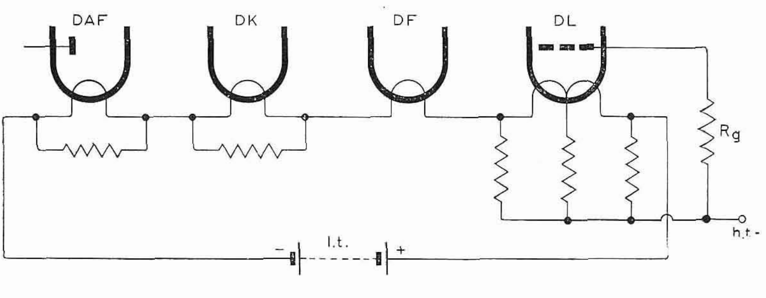
3.2.2 Series operation

Valves with 1.4V filaments may be used with their filaments in series. Valves with 1.25V filaments are not recommended for this form of operation.

3.2.2.1 *Operation from dry cells*

If valves with 1.4V filaments are operated with their filaments in series from dry cell batteries, shunting resistors will be required to by-pass sufficient cathode current to ensure that the correct filament current flows in the chain. In order to calculate the required value of shunt resistor the division of cathode current between the two filament limbs must be known or determined by measurement. In equipment which has separate h.t. and l.t. batteries, the question of battery replacement must be considered. If the bias for the output valve is not made independent of the l.t. battery, large variations can occur in the cathode current of the output stage when the h.t. and l.t. batteries are renewed at different times.

For this reason the following circuit is preferred:



3.2.2.2 *Mains operation*

When valves are operated in series from the mains supply via a dropping resistor, the voltage drop across each 1.4V filament section should have a nominal value of 1.3V. At 1.3V the filament current of the 25mA range is 24mA and of the 50mA range is 48mA. The filament current in the chain should be within ±2% of these values. The voltage drop across the series resistor should be at least six times the sum of the filament voltages in order to minimise the effect of variation in the resistance of individual filaments. The series resistor should preferably be adjusted in each receiver to the required nominal value. It must have a positive temperature coefficient and should be designed to reach a stable temperature shortly after switching on. If these recommendations are followed the equipment can be operated from a mains supply that has normally-encountered voltage variations of up to ±10%.

If the equipment is to be used on mains only, and not on dry cells, shunt resistors can be used throughout, instead of the by-pass resistors shown in the recommended circuit. In order to calculate the value of shunt resistor required, the division of cathode current between the two filament limbs must again be known.

4. CAPACITANCES

Unless otherwise stated, the capacitances quoted are measured at 1Mc/s with the valve cold in a fully screened socket, with or without an external shield, as stated on the individual data sheets. In practice, allowance should be made for the increase in capacitances due to space-charge effects in the valve, the capacitance of the valve holder itself, and the wiring.

An explanation of symbols for capacitances is given in Appendix II (p. 15).

5. VALVE ELECTRODES

5.1 General

Valves should always be operated with a d.c. connection between each electrode and the cathode.

It should be noted that the secondary-emission characteristics of valve electrodes may vary from valve to valve, and the use of these characteristics is not in general recommended, except in the case of valves designed as secondary-emission valves.

5.2 Cathode

5.2.1 Voltage between cathode and heater

The maximum values of cathode-to-heater voltage quoted on individual data sheets are the maximum d.c. values (unless otherwise stated) and apply to that side of the heater where the cathode-to-heater voltage is greater.

Where a.c. or a.c. and d.c. exist between heater and cathode, the d.c. component must not exceed the published value, and in addition the maximum instantaneous value occurring must never exceed twice the published value, or 300V whichever is the lesser, unless a specific rating is quoted. This applies to pulse voltages as well as sine-wave voltages.

The cathode-to-heater voltage should always be kept as low as possible, and it is preferable to have the cathode positive with respect to the heater. Where the cathode-to-heater voltage cannot be kept low, it is helpful, in the interests of reliability, if the d.c. resistance is kept as high as possible, consistent with the circuit requirements for hum and cathode-to-heater leakage current.

5.2.2 External resistance between cathode and heater

When cathode resistors of high value are used, the valve performance may be influenced by leakage between heater and cathode, which may give rise to difficulties when valves are replaced or the leakage between heater and cathode varies during life. A maximum value of 20kΩ is therefore recommended for the external resistance between cathode and heater. The maximum may however be increased up to 1MΩ if the d.c. component of the cathode-to-heater voltage is such that its instantaneous value never drops below three times the r.m.s. value of the heater voltage. The hum voltage produced across the resistance might assume a rather high value under these conditions.

5.2.3 Rectifier cathodes

Disintegration of the cathode coating may occur in both indirectly heated and directly heated rectifiers if the total resistance in series with the anode is less than that specified on the data sheet for the particular valve. The value of the resistance depends upon the effective resistance, R_t due to the transformer.

$$R_t = R_s + n^2 R_p$$

Where:

Rs = Resistance of the transformer secondary in anode circuit.

Rp = Resistance of the transformer primary.

n = Secondary to primary ratio in half-wave circuits or half-secondary to primary ratio in full-wave circuits.

If the resistance R_t is less than the minimum specified value for the limiting resistance, an additional series resistance must be included in the lead to each anode. The wattage rating of this resistor should be at least three times that required for d.c. only.

5.3 Control grid

In general, it is good practice to keep the resistance of the circuit between the control grid and the cathode as low as possible. It should not exceed the maximum value quoted on the data sheet.

Unless otherwise stated the value of R_{g1-k} max. given in the limiting values refers to operation of the valve with fixed bias. The maximum value for cathode bias operation can be obtained from Fig. 3 (Appendix III).

If grid current biasing is employed, the value of grid resistor will depend on the application. For a.f. voltage amplifiers the grid resistor value should be high (preferably greater than 10MΩ) but not greater than 22MΩ. For r.f. and i.f. valves the value for normal cathode bias should not be exceeded (i.e. twice the fixed bias value).

The values of currents and dissipations should be checked when the grid is connected to cathode. High-slope valves ($g_m > 5$mA/V) should not generally be operated with grid current bias only unless some d.c. feed-back is included in the form of a screen-grid dropper (in the case of a pentode) or an anode dropper (in the case of a triode), and a low value of cathode resistor (such as that required to compensate for variations in input capacitance with a.g.c.) is incorporated. Compliance with the design-centre limiting values must then be checked with the grid connected directly to the negative end of this cathode resistor.

When valves are operated under conditions chosen to give low control-grid currents, the grid resistor value may be very high. If this mode of operation is required the advice of the valve manufacturer should be sought.

In circuits where positive control-grid current flows, either continuously or intermittently, the limiting values relevant to the control grid must never be exceeded.

Where large signals are applied to the grid of a valve, a grid resistor should be used so that the bias is obtained by grid current rectification, and the variations in the drive will not noticeably affect the valve operating conditions. When this is done, it should be ascertained that limiting values will not be exceeded in the event of loss of drive. This risk may be avoided by providing sufficient cathode bias.

If fixed bias is used for a valve, provision should be made for adjusting the bias so that the nominal value of anode current flows. This is particularly important in the case of class "B" output valves when separate adjust-ment should be provided for each valve.

5.4 Screen grid

The rating chart in Fig. 2(p. 17) can be used to relate screen-grid dissipation to screen-grid voltage, provided that other limiting values are not exceeded, and that a resistor is used in the screen-grid circuit.

For large signal applications, in which the operating conditions of the valve can be varied (for example, by varying the drive) the screen-grid dissipation must be checked at the worst long period running conditions and also during the warm-up period. With speech and music the average level is low compared with the peaks, and operation will be quite satis-factory if the screen-grid dissipation is checked at points up to one third of the output power.

In general, the effect of the cathode resistor is reduced by large signals, and a screen-grid resistor becomes necessary. This resistor normally need not drop more than 20% of the h.t. line voltage. If this resistor is un-bypassed, it need only drop about 10% of the h.t. line voltage.

When a valve with a screen grid is connected as a triode, and specific recommendations are not given in the data, the dissipations of the anode and screen grid should not exceed their individual maximum ratings.

5.5 Suppressor grid

The suppressor grid should normally be connected directly to the cathode or to the negative end of the cathode resistor whichever is more convenient. The suppressor grid should not be used as a control grid unless specific recommendations are made in the data. Where the suppressor grid is so used, care should be taken not to exceed the maximum screen-grid dissipation. When a valve is connected as a triode, the suppressor grid should be connected directly to the cathode, except where other recommendations are given in the data. In applications where the suppressor grid is liable to be driven positive, the value of R_{g3-k} should not exceed 50kΩ unless otherwise stated.

5.6 Anode

The rating chart given in Fig. 2 can be used to relate anode dissipation to anode voltage, providing that other limiting values are not exceeded, and that the load used in the anode circuit is a resistor. For large signal applications, the anode dissipation must be checked at the worst long period running condition.

When a triode is used in large signal applications, some resistance should be included in series with its anode. The value required is very dependent on the application, and in the extreme when a triode is biased beyond cut-off and driven well into the positive grid region, e.g. as in class "C" operation, the load impedance in the anode circuit may be sufficient. In this application, however, the use of a cathode resistor is generally recommended to safeguard the valve in the event of loss of drive. If class "B" operation is to be used without a cathode resistor, it must be remembered that large variations can occur near the cut-off point. It is therefore necessary to ensure that all valves will operate at about the same condition, e.g. adjust the bias of each valve to give the required no-signal anode current.

6. MECHANICAL CONSIDERATIONS

6.1 Mounting position

Unless otherwise stated in the published data, valves can be mounted in any position.

6.2 Valve holders

Detailed drawings of pin spacing, diameter and length are given in BS448: 1953 "Electronic–valve Bases, Caps and Holders". When wiring a valve holder for an all-glass based valve, a wiring jig should be inserted to prevent the contacts being displaced. Such displacement could cause damage to the pins when a valve is inserted in the holder. Dimensions for suitable jigs are given in BS448. Pins marked IC on the base diagram in the data sheet may have been used for connections within the valve. The corresponding contacts on the valve holder must be left free and not be used as anchoring points when wiring.

6.3 Valves with flexible leads

Valves with flexible leads do not normally employ plug-in valve holders and it is usually necessary to secure them in position solely by means of the envelope. Any such support should not cause undue stress to be placed on the flexible leads. Attention should also be given to the effect this mounting may have upon bulb temperature.

Direct soldered connections to the leads must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

Precautions should be taken during soldering to ensure that the glass temperature at the seal is not allowed to rise excessively. One simple method is to clamp a thermal shunt to the wire between the glass and the point being soldered.

6.4 Dimensions

Only the dimensions given on the data sheets should be used in the design of equipment. Dimensions taken from individual valves must never be used for this purpose.

7. COOLING

As stated in Section 2.6 the bulb and/or base temperatures must not exceed the published maxima, and it is in general good practice to take steps to ensure that the bulb and base temperatures are kept low.

Use may be made of all three methods of cooling, namely convection, radiation and conduction.

7.1 Convection and radiation cooling

A valve mounted in free air is cooled by convection currents and by radiation to its surroundings. In order to make these methods most efficient it is necessary to ensure as free a circulation of air round the valve as possible and to maintain neighbouring bodies at as low a temperature as possible.

The design of valve screening or retaining devices should conform to the above principles; that is to say, the device should permit free circulation of cooling air and should reflect as little heat as possible back to the bulb. Where adequate convection cooling cannot be realised because of mechanical limitations, high altitude, or high temperature of the air available for circulation, forced-air cooling or conduction cooling must be adopted.

7.2 Conduction cooling

Conduction cooling is obtained by mounting the valve in contact with a mass of material which has good heat-conducting properties. This material then acts as a "heat sink." The clamp or can which is used to couple the valve to the heat sink should ensure good thermal contact with the bulb and base of the valve, and should also ensure that the maximum base temperature of 165°C is never exceeded. Heat-sink cooling is particularly suitable for use with flexible-lead valves, as the mechanical arrangements are not likely to allow "free air" cooling, although it should be remembered that the base temperature may be higher than with plug-in valves.

8. MICROPHONY

Whenever a valve is subjected to vibration, some disturbance in the output of the valve occurs. The effect of this disturbance will depend on the individual application. The published data often make reference to the microphonic sensitivity of different valve types, and this should be noted when a valve type is chosen for a specific application. Where the effects of microphony are found to be objectionable, special steps may have to be taken to reduce the vibration reaching the valve. The chassis itself may show wide variations in amplitude of vibration over its area, due to resonances; therefore favourable location of the valve, or local strengthening of the chassis, may appreciably reduce microphony.

A further reduction may be obtained by the use of antivibration mountings, but these are likely to be completely ineffective if the vibrations reaching the valve are being transmitted through the air and not through the chassis.

9. HUM

If an a.c. supply is used for valve heaters, the cathode current may be modulated by capacitance and leakage effects between the heater and other electrodes, or by the magnetic field of the heater. This modulation can give rise to hum. The most important electrodes in this respect are the cathode and the control grid. The published limiting value of V_{h-k} does not give any information about the resulting hum level, but is the maximum permissible voltage below which there is reasonably little danger of breakdown occurring between cathode and heater. The greater the a.c. component between heater and cathode (or control grid), the greater will be the hum. With a.f. valves the hum frequency will appear in the audio output; with i.f. and r.f. valves it will appear as modulation hum.

Hum can also be caused if the leakage resistance between cathode and heater is included in an a.f. or r.f. circuit. If it is included in a tuned circuit, the frequency to which the circuit is tuned may be altered by changes in the physical or electrical properties of the cathode-heater insulation (e.g. by vibration of the heater at the supply frequency), resulting in modulation hum.

The presence of leakage currents may become apparent as hum or background noise. It is particularly important that idle valve-holder contacts in the proximity of the control-grid contact should not be used as anchoring points for wires which are connected to the a.c. supply, as this practice may introduce hum via the capacitances or leakages between valve-holder contacts. This consideration is of particular importance at high supply frequencies.

APPENDIX I – DEFINITIONS AND INTERPRETATION OF DATA

The principal characteristics quoted for each receiving valve in this Handbook are normally those corresponding to the given value of anode current.

The values given are the mean values of measurements made on a large number of valves. All voltages are measured with respect to the cathode, unless otherwise stated.

The following definitions are intended to assist in interpreting the data, as some of these are not sufficiently well known:

V_a max. (V_{g2} max. etc.) — The maximum positive voltage which can be applied to the electrode at full dissipation. At higher electrode voltages the electrode dissipation must be reduced in accordance with the rating chart (Fig. 2).

$V_{a(b)}$ max. ($V_{g2(b)}$ max. etc.) — The maximum voltage (positive or negative) which can be applied to the valve electrode when the valve is cold. If semiconductor diodes or metal rectifiers are used to supply the h.t. in an equipment for instance, the h.t. rail may rise to this value after switching on but before the valves have warmed up.

$i_{a(pk)}$ max. (Rectifiers) — The maximum permissible steady-state peak anode current.

$i_{a(surge)}$ max. (Rectifiers) — The maximum permissible instantaneous anode current under switching conditions with the valve hot.

V_{g1} ($I_{g1} = +0.3\mu A$) — The control-grid voltage at which the positive grid current (with no other electrode voltages applied, unless otherwise stated) is $0.3\mu A$. The value is normally not more negative than –1.3V, and with a limit valve $+0.3\mu A$ will flow at this voltage. In any application where positive grid current is not permissible, the grid must always be biased more negative than this value.

g_m — The mutual conductance is the relation between a change in anode current and the corresponding change in control-grid voltage, with the anode (and screen-grid) voltage constant.

$$g_m = \frac{\delta I_a}{\delta V_g} \text{ (}V_a\text{ constant)}$$

μ — The amplification factor is defined as the ratio of a change in anode voltage to the corresponding change in control-grid voltage, the anode current remaining constant.

$$\mu = \frac{\delta V_a}{\delta V_g} \text{ (}I_a\text{ constant)}$$

r_a — The anode impedance is the ratio of a change in anode voltage to the corresponding change in anode current, with control-grid (and screen-grid) voltage constant.

$$r_a = \frac{\delta V_a}{\delta I_a} \text{ (}V_{g1}\text{ constant)}$$

g_m, μ and r_a are related by the expression:

$$\mu = g_m . r_a$$

$g_{m\ (eff)}$

When a valve is used as a class "C" oscillator, the anode current contains components at the fundamental and harmonics of this frequency because the valve is driven over the whole of the grid base. The simple value of g_m is no longer useful for making calculations, so the effective mutual conductance is given. This is defined as:

$$g_{m(eff)} = \frac{\text{Fundamental frequency component of anode current}}{\text{Fundamental frequency component of grid voltage}}$$

g_c

The conversion conductance of a frequency changer is the relation between the intermediate frequency component of anode current to the grid input voltage at signal frequency.

$$g_c = \frac{\text{Intermediate frequency component of anode current}}{\text{Signal frequency component of grid input voltage}}$$

μ_{g1-g2}

The "inner-mu" is the amplification factor from control grid to screen grid.

$$\mu_{g1-g2} = \frac{\delta V_{g2}}{\delta V_{g1}} \ (I_k \text{ constant})$$

r_{g1}

Input damping resistance. This is given at a particular frequency and is the resistive component of the input impedance that the valve presents to the input circuit between grid and cathode. Over a limited range, the value at other frequencies can be calculated approximately from the formula:

$$r_{g1} \text{ (at } f_1) = r_{g1} \text{ (at } f_2) \times \left(\frac{f_2}{f_1}\right)^2$$

R_{eq}

Equivalent noise resistance. This is the value of a resistance which, if introduced into the grid circuit of a perfectly noiseless valve, would produce noise of the same level as that of the shot and partition noise occurring in the actual valve. It does not include flicker effect which occurs mainly in the audio frequency band. The figures quoted in the data are measured values. Curves showing R_{eq} plotted against g_m or I_a are given for some valve types.

Noise factor

The noise factor of a circuit is the ratio of the signal-to-noise ratio at the input to the signal-to-noise ratio at the output. It is dependent upon the equivalent noise resistance, the transit time component of input resistance, circuit resistance and source resistance. The figures quoted in the data are measured values.

K

Cross-modulation factor. This is the ratio of the modulation depth of the wanted signal caused by a modulated interfering carrier, to the modulation depth of the wanted signal appearing on the wanted carrier at the output of the valve. This assumes that both carriers are modulated to the same depth. It may be considered to be independent of the amplitude of the wanted signal where this amplitude is small, and to be proportional to the square of the amplitude of the interfering signal.

Cross-modulation figures and curves are given for valve types which are designed for a.g.c. operation. The curves given in the valve data show the amplitude of the interferring signal required to give a cross-modulation factor of 1%, plotted against g_m or g_c.

m_h — Modulation hum. Curves of hum input voltage plotted against g_m or g_c are also given for valve types which are designed for a.g.c. operation. These curves show the input voltage at the control grid which will cause the carrier to be modulated to a depth of 1%.

APPENDIX II – CAPACITANCE SYMBOLS

The system of symbols for inter-electrode capacitances in general use at present does not always make it clear where certain of the valve electrodes are connected in making the measurement. For this reason the International Electrotechnical Commission has proposed an alternative system, for use in cases of ambiguity.

In both systems the symbol consists of a letter c followed by subscript letters indicating the valve electrodes between which the capacitance is measured. In addition, the IEC alternative system includes in brackets the valve elements which are connected to reference earth. In order to shorten the symbols in this system, the following two abbreviations are used:

- R – remaining elements of the same unit(s), shields, metal parts (e.g. external shields, base sleeves, unused pins or leads, etc.).
- u – Inactive units of multiple valves.

Examples

Present system	*Alternative system*	
c_{in}	$c_{g1-R(a)}$	Capacitance measured between the input electrode (g_1) and all other electrodes except the output electrode (a).
c_{out}	$c_{a-R(g1)}$	Capacitance measured between the output electrode (a) and all other electrodes except the input electrode (g_1).
$c_{a'-g'}$	$c_{a'-g'(Ru)}$	Capacitance measured between anode and grid of the first section of a double triode. Cathode of first section, all electrodes of second section, heater and any shield etc., earthed.
c_{g-k+h}	$c_{gt-R(atu)}$	Capacitance between triode grid and cathode + heater (in a triode pentode). Triode anode and pentode section earthed.

APPENDIX III – RATING CHARTS

Bulb Temperature Rating Chart

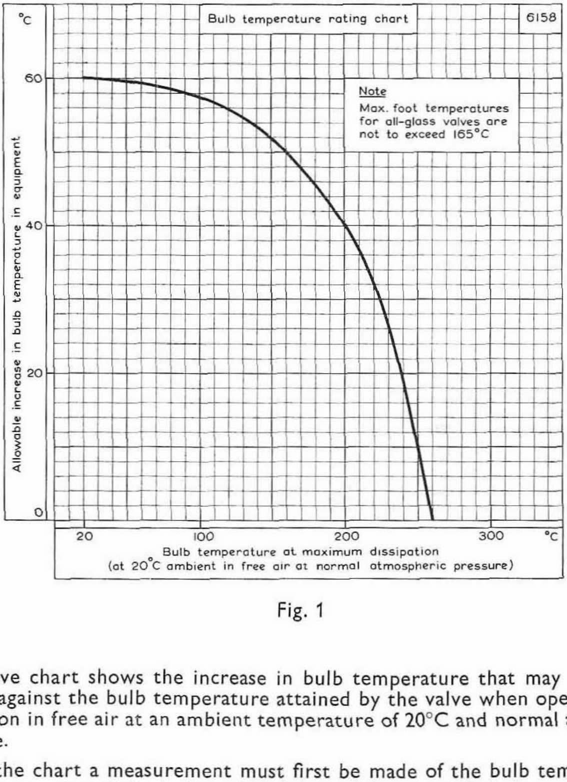


Fig. 1

The above chart shows the increase in bulb temperature that may be allowed, plotted against the bulb temperature attained by the valve when operated at full dissipation in free air at an ambient temperature of 20°C and normal atmospheric pressure.

To use the chart a measurement must first be made of the bulb temperature at the hottest point of the bulb under the conditions specified above. The hottest point of the bulb is normally opposite the centre of the anode, on the minor axis.

The chart can then be used to read off the permissible increase in bulb temperature, and hence establish a maximum bulb temperature for the valve type concerned.

For example, a power valve operated at full dissipation may be found to have a bulb temperature of 220°C. Reference to the chart shows the allowable increase in bulb temperature to be 32°C. The maximum bulb temperature for this type is therefore 252°C. A valve which has very little dissipation may have a bulb temperature of 120°C. The chart shows that in this case the bulb temperature may be allowed to rise (due to increased ambient) by 56°C, giving a final bulb temperature of 176°C.

This curve allows approximately 60°C increase in ambient temperature for valves having bulb temperatures up to 200°C (or 165°C in the case of sub-miniature valves).

The designer should ensure that the maximum bulb temperature rating given by the above chart is not exceeded in his equipment under normal operating conditions.

The maximum foot temperature of all-glass valves must not exceed 165°C, measured on the glass adjacent to the hottest pin. This is generally the anode pin in the case of high dissipation valves, or the heater pins in the case of low dissipation valves.

Electrode Dissipation Plotted Against Electrode Voltage

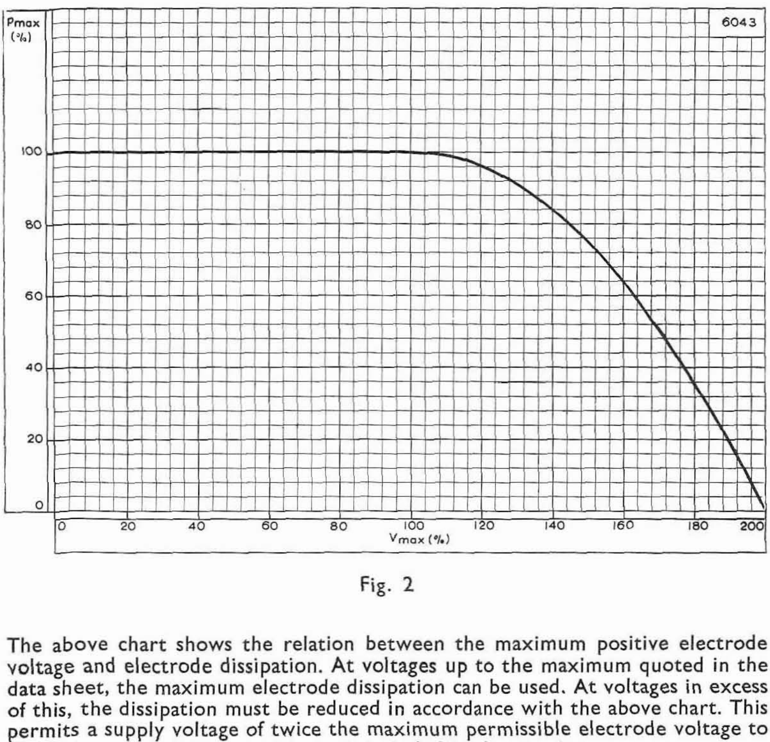


Fig. 2

The above chart shows the relation between the maximum positive electrode voltage and electrode dissipation. At voltages up to the maximum quoted in the data sheet, the maximum electrode dissipation can be used. At voltages in excess of this, the dissipation must be reduced in accordance with the above chart. This permits a supply voltage of twice the maximum permissible electrode voltage to be used, provided that a resistance is included in the circuit.

In cases where a value of $V_{a(b)}$ max. or $V_{g2(b)}$ max. is given which is less than twice the V_a max. or V_{g2} max. for the valve, the supply voltage must not exceed this value.

Maximum Value of Grid-to-Cathode Resistor

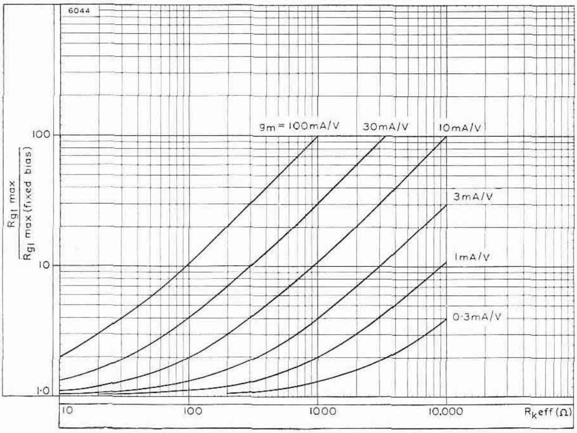


Fig. 3

To find the maximum value of grid-to-cathode resistor which can be used in a given circuit, the mutual conductance of the valve in circuit and the effective cathode resistor must be known. The mutual conductance of the valve in circuit can be determined by measurement.

The effective cathode resistor for a triode is given approximately by:

$$R_{k(eff)} = R_k + \frac{R_a}{\mu}$$

and for a tetrode or pentode by:

$$R_{k(eff)} = \frac{I_k}{I_a} \cdot R_k + \frac{I_{g2}}{I_a} \cdot \frac{R_{g2}}{\mu_{g1-g2}}$$

From these two values, the value of R_{g1-k} max. which may be used in the circuit can be obtained from the graph.

Example

A pentode is to be used in a circuit under the following conditions:

$I_a = 8mA$	$\mu_{g1-g2} = 47$	$R_k = 200\Omega$
$I_{g2} = 2mA$	$g_m = 5mA/V$	$R_{g2} = 47k\Omega$

The value of R_{g1-k} max. (fixed bias) is 1.0MΩ. The effective cathode resistor is therefore

$$\frac{10}{8} \times 0.2 + \frac{2}{8} \cdot \frac{47}{47} = 0.5k\Omega.$$

From the chart a value of $\frac{R_{g1} \text{ max.}}{R_{g1} \text{ max. (fixed bias)}}$ of 3.5 is obtained for these two values. The maximum value which can be used in this case is therefore 3.5MΩ.

HALF-WAVE RECTIFIER DY51

High voltage half-wave rectifier with wired-in connections. Suitable for application in portable t.v. receivers.

HEATER ←

V_h	1.4	V
I_h	550	mA
Heater voltage tolerances $I_{out} \leq 200\mu A$	±15*	%
$I_{out} > 200\mu A$	±7*	%

*These tolerances apply when the power supply voltage is at its nominal value and when a valve having bogey heater characteristics is employed. In addition, fluctuations in the mains supply voltage not exceeding ±10% are permissible.

MOUNTING POSITION Any

NOTE - Direct soldered connections to the leads of this valve must be at least 10mm from the seal and care should be taken not to bend the leads near the seal.

CAPACITANCE

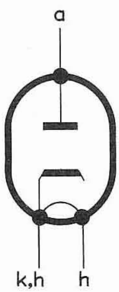
c_{a-k}	0.8	pF

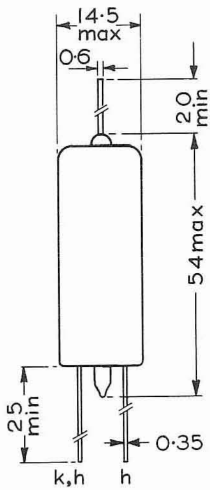
LIMITING VALUES

P.I.V. max.	15	kV
$I_{a\ (out)}$ max.	350	μA
*$i_{a(pk)}$ max	40	mA ←
C max.	2000	pF

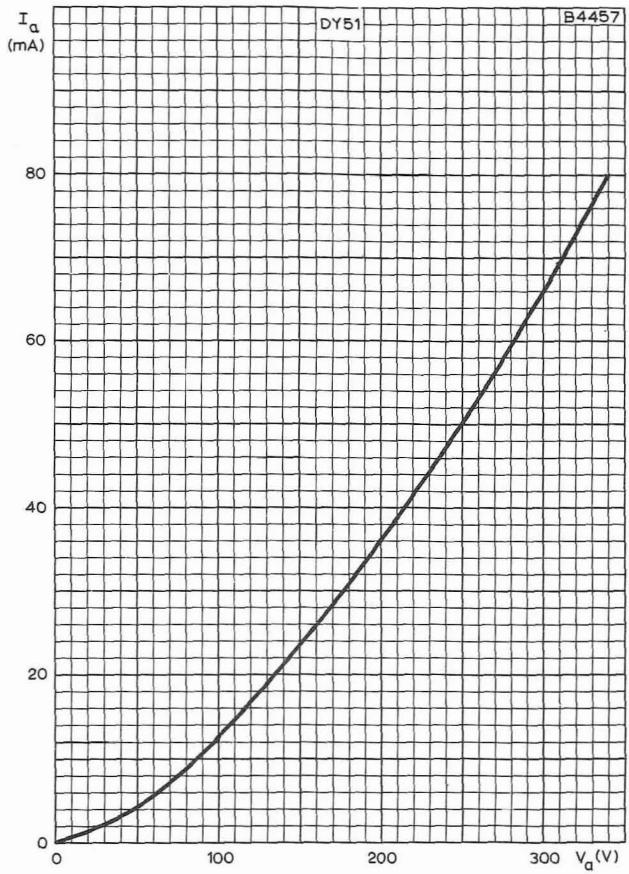
*Maximum pulse duration 10% of one cycle with a maximum of 10μs ←

4778





All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

High voltage half-wave rectifiers for television line fly-back e.h.t. supply. The DY87 is electrically identical to the DY86 but has a chemically treated bulb to prevent flash-over under conditions of high humidity.

HEATER

Vh		1.4	V
Ih		550	mA
Heater voltage tolerances	Iout < 200 µA	± 15*	%
	Iout > 200 µA	± 7*	%

* These tolerances apply when the power supply voltage is at its nominal value and when a valve having bogey heater characteristics is employed. In addition fluctuations in the mains supply voltage not exceeding ± 10 % are permissible.

CAPACITANCES

ca-(h+k+s)	1.55	pF

DESIGN CENTRE RATINGS

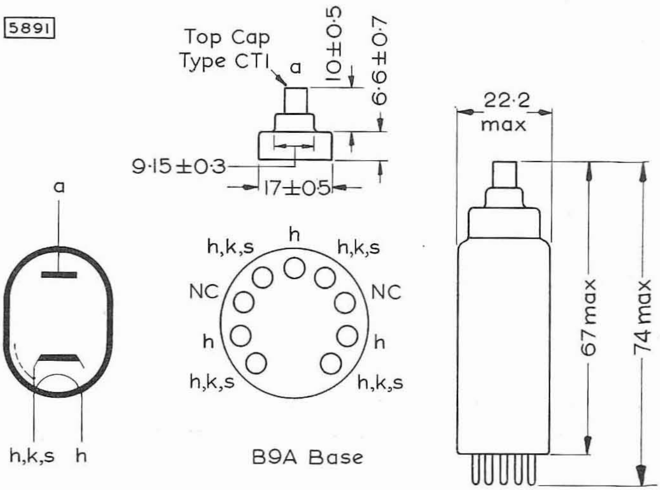
Pulsed input		
* P.I.V. max.	22	kV
‡ ia (pk) max.	40	mA
Iout max.	500	µA
C max.	2000	pF

* Maximum duration 22 % of a line scanning cycle with a maximum of 18 µs.
‡ Maximum duration 10 % of a line scanning cycle with a maximum of 10 µs.

WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16 kV. The level of X-radiation is likely to be considerably higher when the heater circuit of the tube is open.

5891



All dimensions in mm

Pins 1, 4, 6 and 9 may be used for fixing an anti-corona shield.

Pins 3 and 7 may only be connected to points in the heater circuit and must not be earthed.

U.H.F. DIODE

EA52

Disc seal diode primarily intended for use as a measurements diode at frequencies up to 1000Mc/s.

HEATER

Suitable for series or parallel operation a.c. or d.c.

V_h	6.3	V
I_h	300	mA

The absolute maximum variation of heater voltage is ± 0.7V

CAPACITANCE

c_{a-k}	<0.5	pF

CHARACTERISTICS

V_a ($I_a = 500\mu A$)	<3.0	V

INSULATION

Insulation between anode and cathode	$>10^4$	MΩ

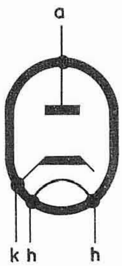
LIMITING VALUES (absolute ratings)

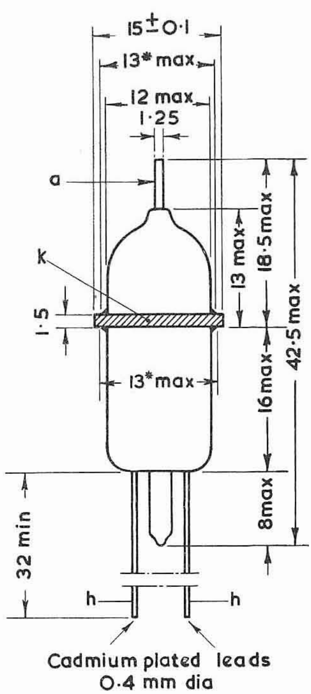
*P.I.V. max. ($f < 100$Mc/s)	1.0	kV
I_k max.	300	µA
$i_{k(pk)}$ max.	5.0	mA
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

*At frequencies greater than 100 Mc/s, the maximum P.I.V. is $\frac{10^5}{f}$ V, where f is the frequency in Mc/s.

EA52

U.H.F. DIODE

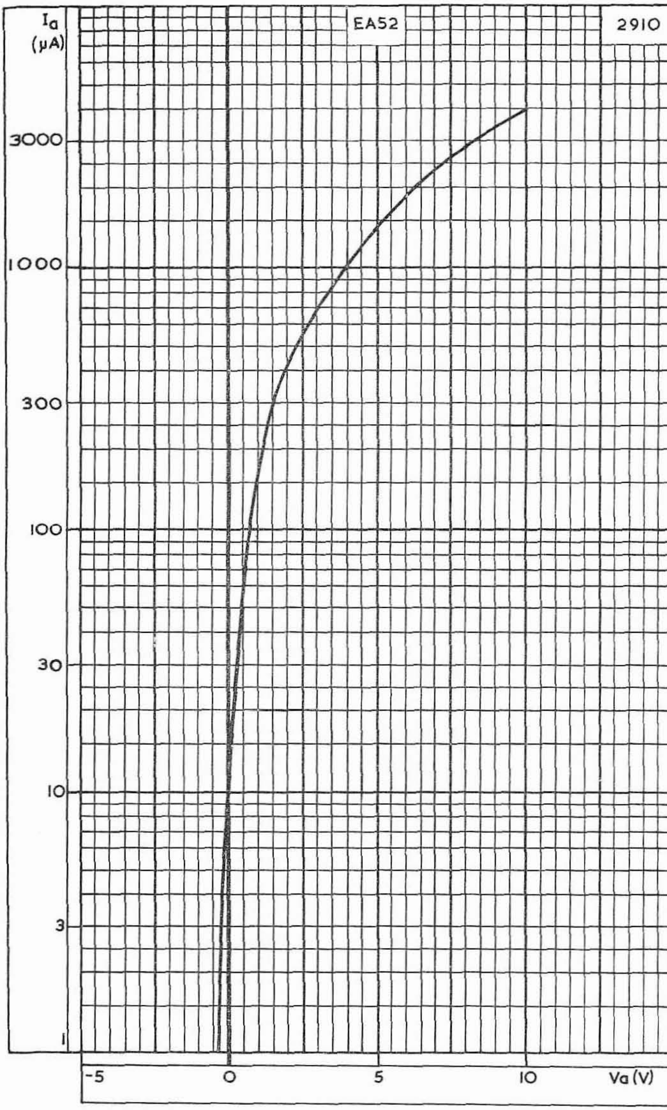




2922 All dimensions in mm

* Max diameter of the glass seal

Note.—Direct soldered connections to the leads of this valve must be at least 7mm from the seal and any bending of the valve leads must be at least 1·5mm from the seal.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TRIPLE DIODE TRIODE

EABC80

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

HEATER

V_h	6.3	V
I_h	450	mA

CAPACITANCES ←

$c_{at-a'd}$	<0.12	pF
$c_{at-k''d}$	<0.01	pF
$c_{at-a'''d}$	<0.1	pF
$c_{g-a'd}$	<0.07	pF
$c_{g-k''d}$	<0.005	pF
$c_{g-a'''d}$	<0.02	pF

Triode Section

c_{in}	1.9	pF
c_{out}	1.4	pF
c_{at-g}	2.0	pF
c_{g-h}	<0.04	pF

Diode Sections

$c_{a'd-(h+kt,k'd,k'''d,s)}$	0.8	pF
$c_{a''d-(h+k''d+kt,k'd,k'''d,s)}$	4.8	pF
$c_{a'''d-(h+kt,k'd,k'''d,s)}$	4.8	pF
$c_{k''d-all}$	4.9	pF
$c_{a'd-h}$	<0.25	pF
$c_{a'''d-h}$	<0.2	pF
$c_{k''d-h}$	2.5	pF

CHARACTERISTICS ←

Triode Section

V_a	100	250	V
V_g	−1.0	−3.0	V
I_a	0.8	1.0	mA
g_m	1.45	1.4	mA/V
μ	70	70	
r_a	48	50	kΩ

Diode Sections

$r_{a'd}$ ($V_{a'd}=+10V$)	5.0	kΩ ←
$r_{a''d}$ ($V_{a''d}=+5V$)	200	Ω
$r_{a'''d}$ ($V_{a'''d}=+5V$)	200	Ω
$r_{a''d}/r_{a'''d}$	0.65 to 1.5	

EABC80

TRIPLE DIODE TRIODE

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER* (with grid current biasing) ←

V_b (V)	R_a (k Ω)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%) for $V_{out(r.m.s.)}$ =3V	=5V	=8V	R_g† (k Ω)
170	47	1.25	32	0.6	1.1	2.0	150
170	100	0.82	42	0.5	0.8	1.3	330
170	220	0.46	51	0.4	0.5	1.1	680
200	47	1.6	34	0.5	0.9	1.5	150
200	100	1.0	44	0.4	0.6	1.0	330
200	220	0.56	53	0.3	0.4	0.9	680
250	47	2.2	36	0.3	0.6	1.0	150
250	100	1.4	47	0.25	0.5	0.8	330
250	220	0.76	54	0.2	0.25	0.6	680

*Measured with a grid resistor of 10MΩ.

†R_g=grid resistor of following value.

LIMITING VALUES

Triode Section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
I_k max.	5.0	mA
V_g max. (I_g=+0.3μA)	−1.3	V
*R_{g-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

*With grid current biasing R_{g-k} max.=22MΩ.

Diode Sections ←

P.I.V.$_{(a'd)}$ max.	350	V
P.I.V.$_{(a''d)}$ max.	350	V
P.I.V.$_{(a'''d)}$ max.	350	V
$I_{a'd}$ max.	1.0	mA
$I_{a''d}$ max.	10	mA
$I_{a'''d}$ max.	10	mA
$i_{a'd(pk)}$ max.	6.0	mA
$i_{a''d(pk)}$ max.	75	mA
$i_{a'''d(pk)}$ max.	75	mA

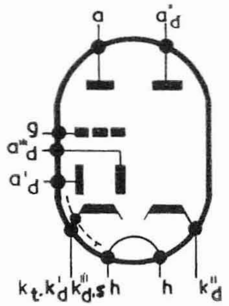
TRIPLE DIODE TRIODE

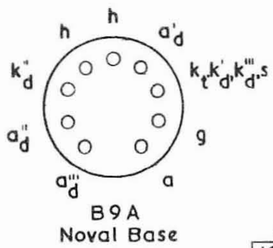
EABC80

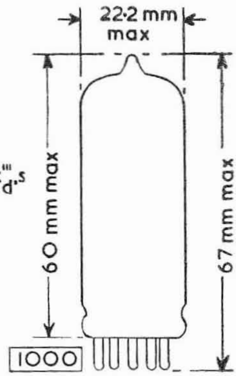
Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

MICROPHONY

This valve can be used without special precautions against microphony in circuits in which the input voltage is not less than 10mV for an output of 50mW from the output stage at 800c/s and higher frequencies.



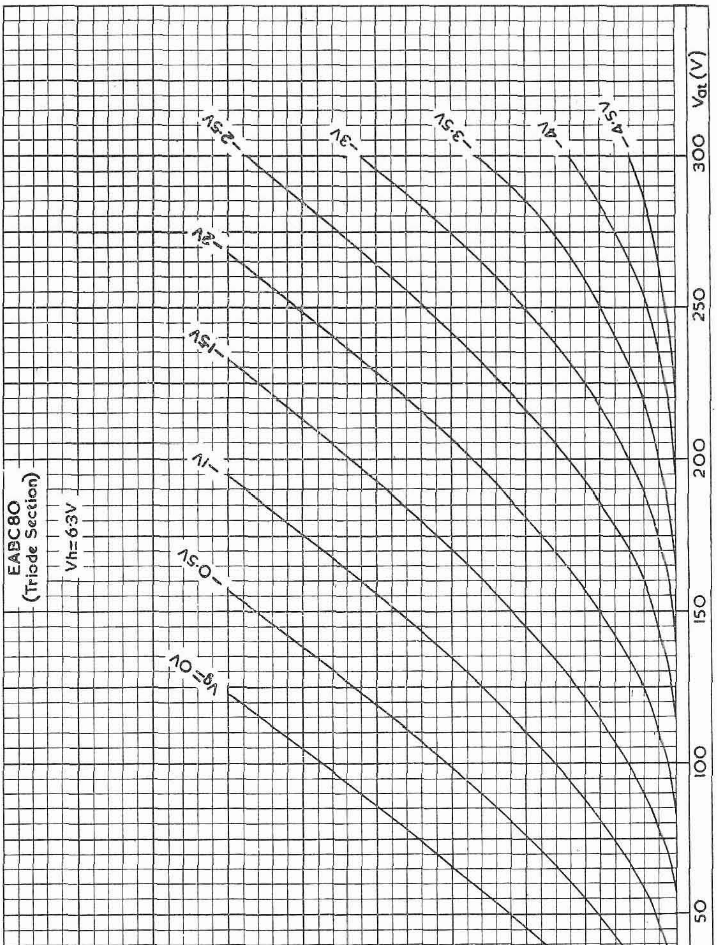




EABC80

TRIPLE DIODE TRIODE

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

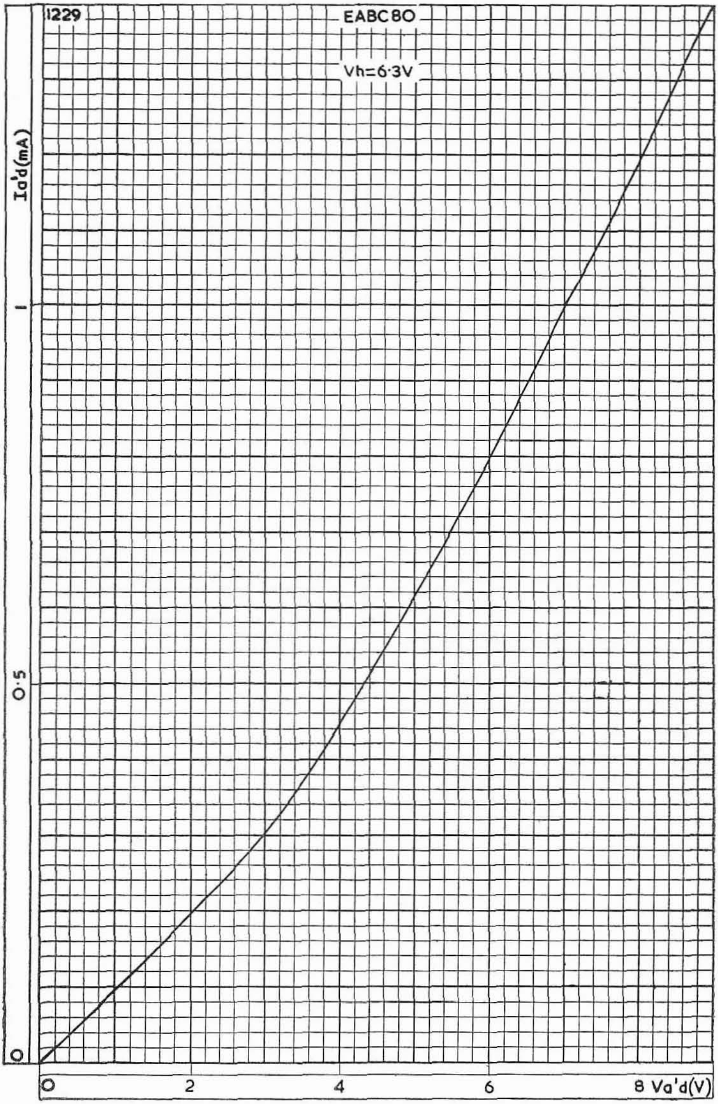


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TRIPLE DIODE TRIODE

EABC80

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

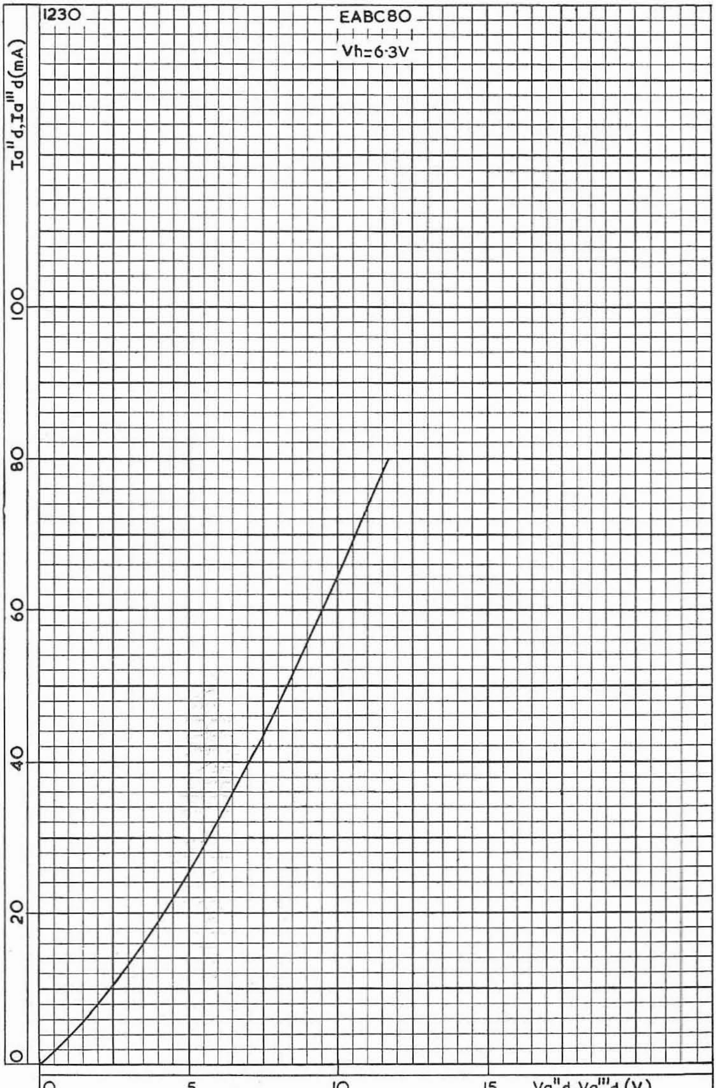


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR DIODE SECTION a′d

EABC80

TRIPLE DIODE TRIODE

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

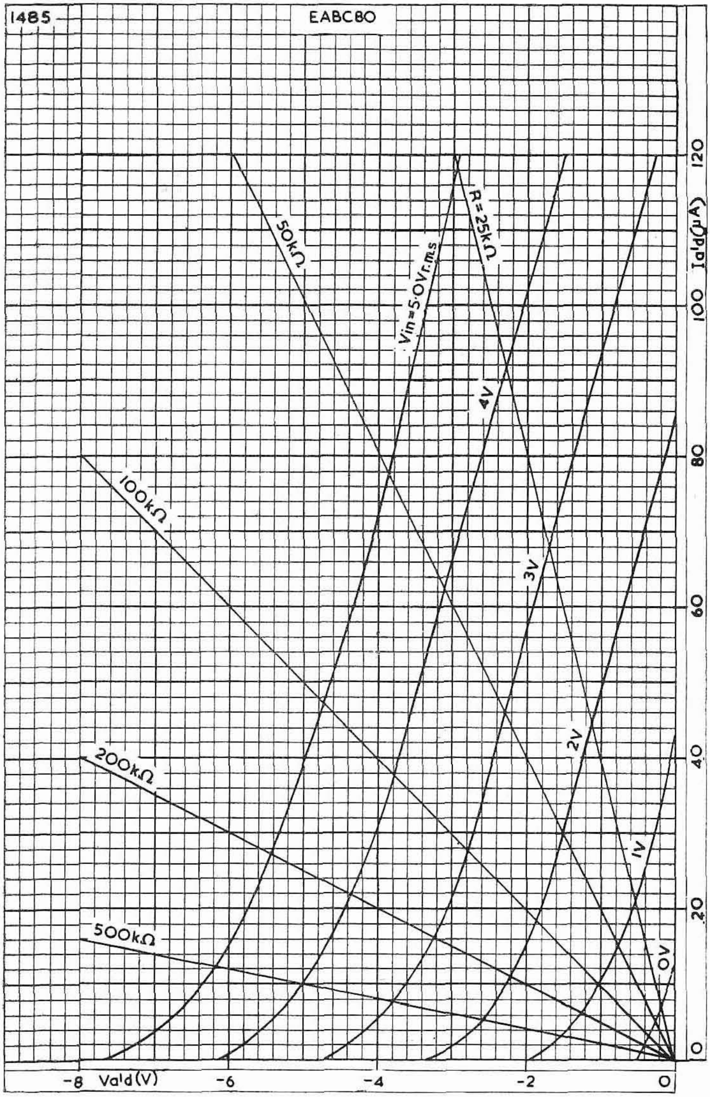


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR DIODE SECTIONS a″d AND a‴d

TRIPLE DIODE TRIODE

EABC80

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

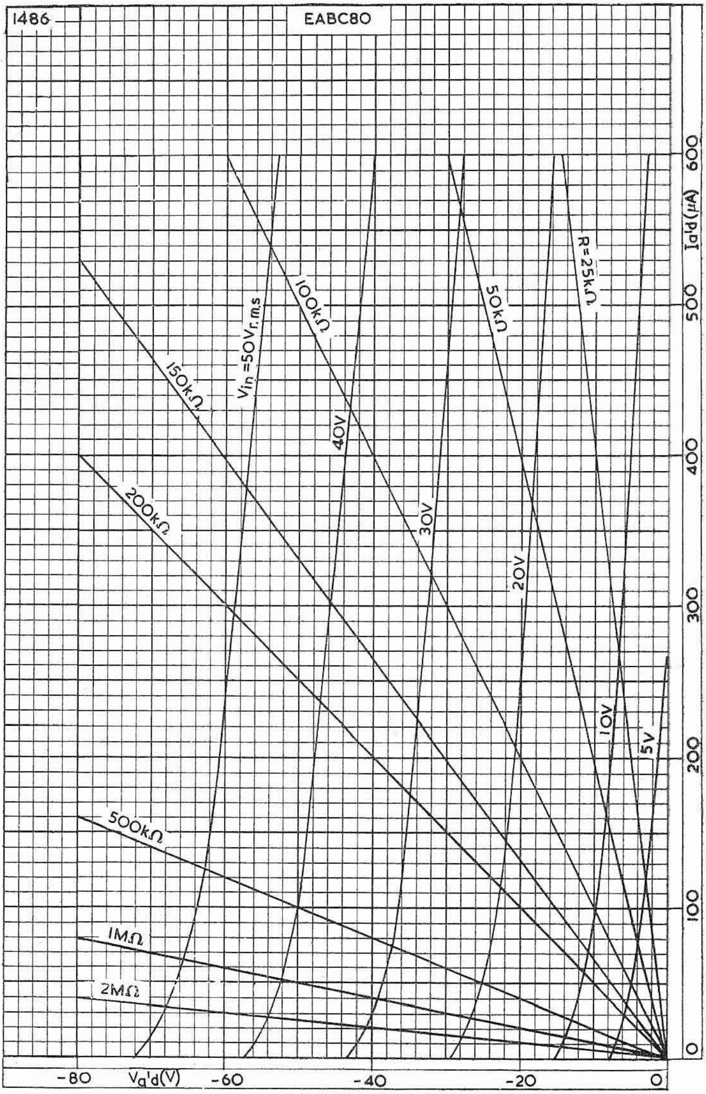


RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN 0V AND $5V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTION a'_d

EABC80

TRIPLE DIODE TRIODE

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

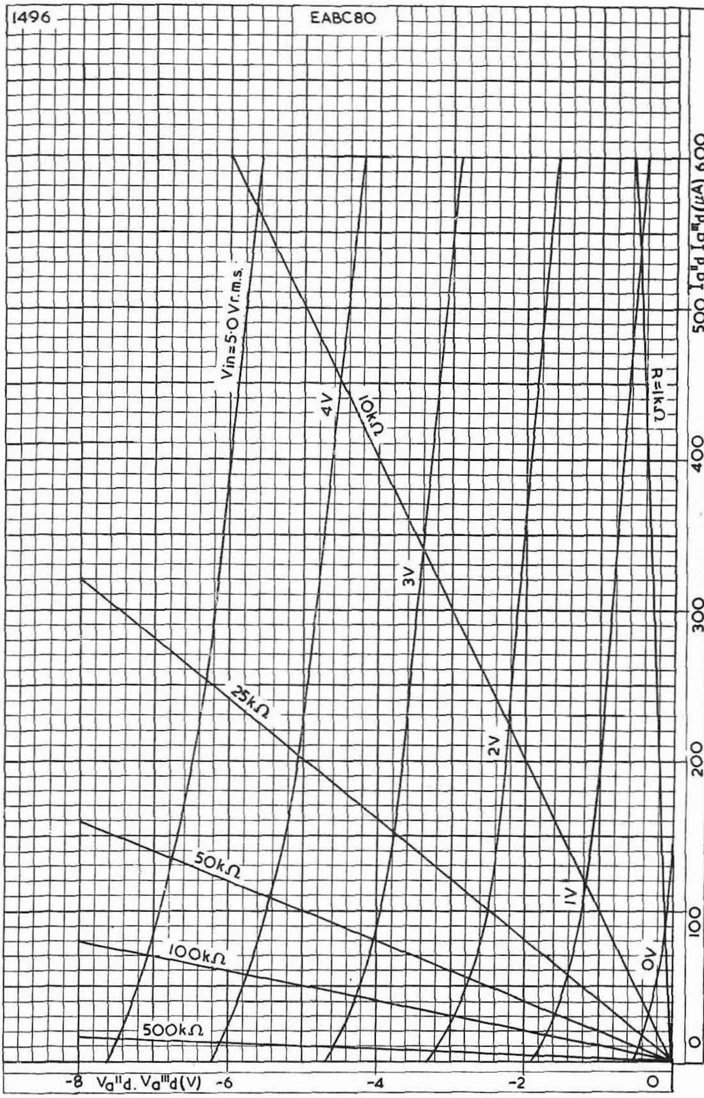


RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN $5V_{r.m.s.}$ AND $50V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTION a'_d

TRIPLE DIODE TRIODE

EABC80

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.

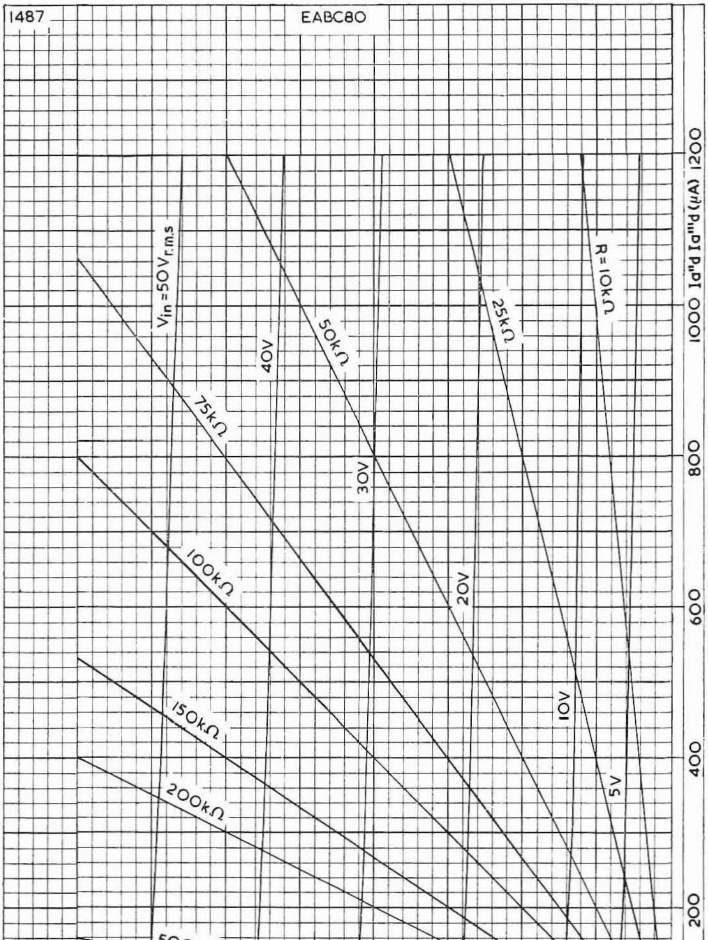


RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN 0 AND $5V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTIONS a''_d AND a'''_d

EABC80

TRIPLE DIODE TRIODE

Triple diode triode, one diode having a separate cathode. Primarily designed for use in f.m./a.m. receivers.



RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN $5V_{r.m.s.}$ AND $50V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTIONS a''_d AND a'''_d

DOUBLE DIODE

EB91

Miniature double diode with separate cathodes and internal screening between sections.

HEATER

Suitable for series or parallel operation, A.C. or D.C.

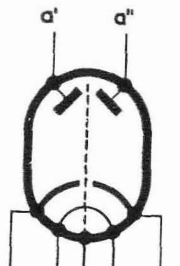
V_h	6.3	V
I_h	0.3	A

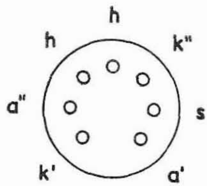
CAPACITANCES

$c_{a'-k'+h+s}$	3.0	μμF
$c_{a''-k''+h+s}$	3.0	μμF
$c_{k'-a'+h+s}$	3.4	μμF
$c_{k''-a''+h+s}$	3.4	μμF
$c_{a'-a''}$	<0.025	μμF

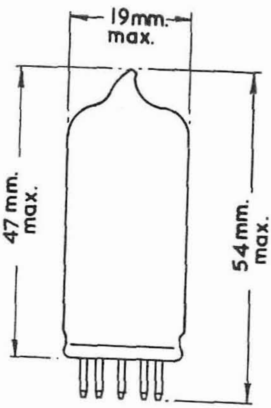
LIMITING VALUES (each section)

P.I.V. max.	420	V
I_a max.	9	mA
$i_{a(pk)}$ max.	54	mA
V_a max ($I_a = 0.3\ \mu A$)	-1.3	V
$v_{h-k(pk)}$ max.	330	V





B7G BASE

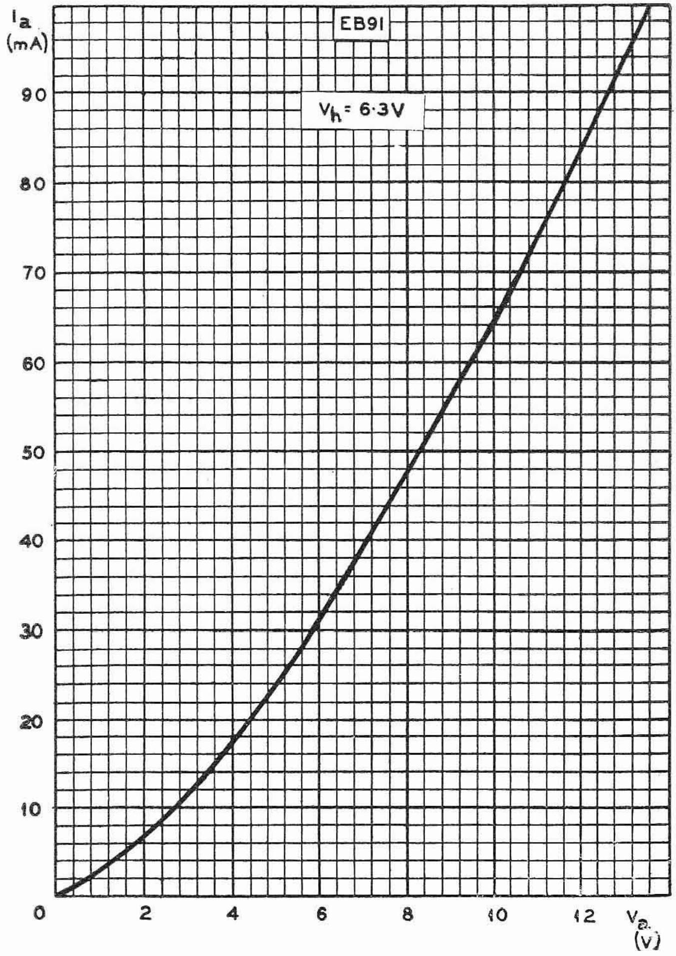


518

EB91

DOUBLE DIODE

Miniature double diode with separate cathodes and internal screening between sections.

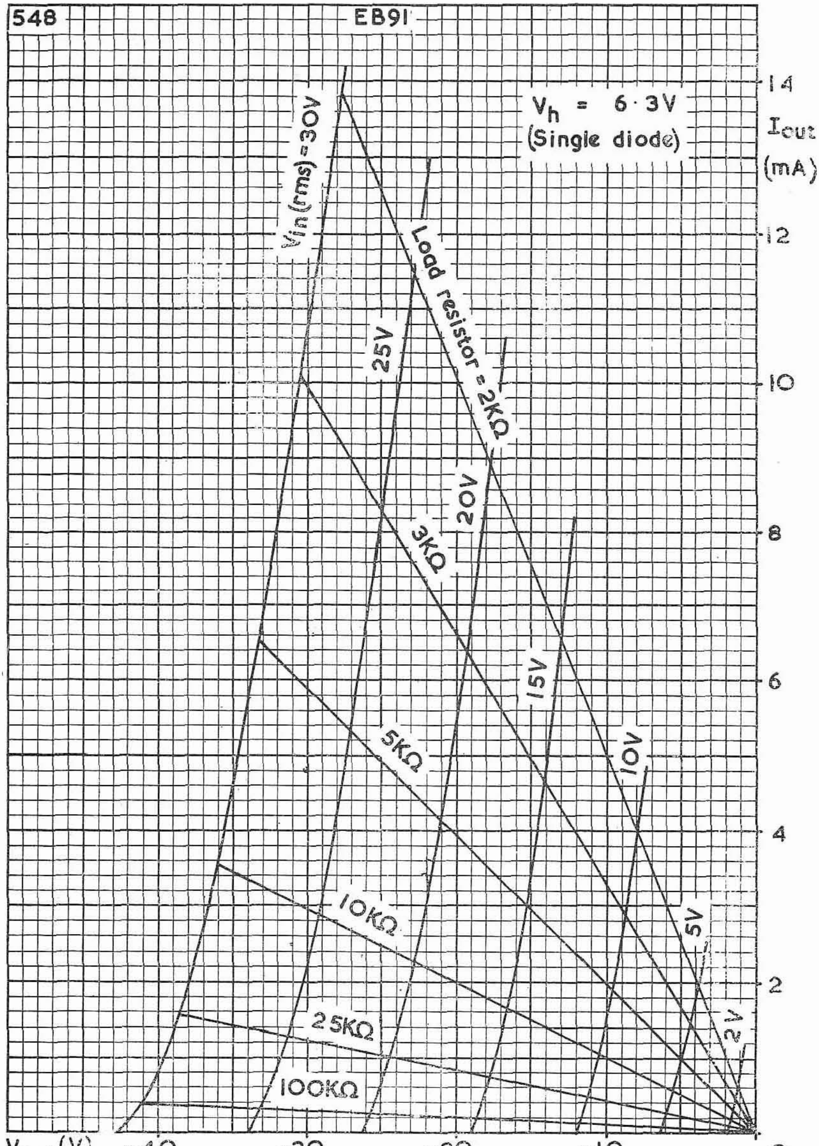


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE DIODE

EB91

Miniature double diode with separate cathodes and internal screening between sections.



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

DOUBLE DIODE TRIODE

EBC81

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

HEATER

V_h	6.3	V
I_h	230	mA

MOUNTING POSITION Any

CAPACITANCES

$c_{a'd-g}$	<0.007	pF
$c_{a''d-g}$	<0.007	pF
$c_{a'd-a}$	<0.005	pF
$c_{a''d-a}$	<0.01	pF

Triode section

c_{g-k}	2.3	pF
c_{a-k}	2.3	pF
c_{a-g}	1.2	pF
c_{g-h}	<0.05	pF

Diode sections

$c_{a'd-k}$	0.9	pF
$c_{a''d-k}$	0.9	pF
$c_{a'd-a''d}$	<0.2	pF
$c_{a'd-h}$	<0.25	pF
$c_{a''d-h}$	<0.05	pF

CHARACTERISTICS

V_a	250	V
V_g	−3.0	V
I_a	1.0	mA
g_m	1.2	mA/V
μ	70	
r_a	58	kΩ

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (with cathode bias)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) ($D_{tot}=5\%$)	V_{out} ($V_{r.m.s.}$) ($D_{tot}=10\%$)	R_{g1}† (kΩ)
400	100	1.35	2.2	43.5	35.5	62.5	330
350	100	1.18	2.2	43	30.5	54	330
300	100	1.0	2.2	42.5	25.5	46	330
250	100	0.85	2.2	42	21	38	330
200	100	0.7	2.2	41	16	28.5	330
150	100	0.5	2.2	40	12	19.5	330
100	100	0.28	3.3	33.5	6.0	10.5	330
400	220	0.76	3.9	48	40	74.5	680
350	220	0.67	3.9	47.5	34.5	64	680
300	220	0.56	3.9	47	27	54	680
250	220	0.48	3.9	46.5	24.5	44.5	680
200	220	0.4	3.9	46	19	34	680
150	220	0.32	3.9	44	16.5	24	680
100	220	0.18	5.6	38	8.0	13.5	680

EBC81

DOUBLE DIODE TRIODE

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER* (with grid current bias)

V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=2.5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	R_{g1}† (kΩ)
400	100	2.4	56.5	33	51	330
350	100	2.0	55	27	43	330
300	100	1.95	53.5	22	35	330
250	100	1.3	51	17	27	330
200	100	0.95	48.5	12	19	330
150	100	0.6	44	7.0	11	330
100	100	0.3	35.5	3.0	5.0	330
400	220	1.3	62.5	34	55.5	680
350	220	1.1	61.5	29	47	680
300	220	0.9	59.5	23	38	680
250	220	0.7	57	17	29.5	680
200	220	0.5	54	12.5	21	680
150	220	0.33	49	8.0	14	680
100	220	0.18	40	4.0	7.0	680

*Measured with grid resistor of 22MΩ and signal source impedance Z_s=0Ω. The distortion figures quoted hold good for values of Z_s not exceeding 200kΩ. At this value of Z_s, the gain will be reduced by 10%.

†R_{g1} = Grid resistor of the following valve.

LIMITING VALUES

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	500	mW
I_k max.	5.0	mA
R_{g-k} max.	3.0	MΩ
R_{g-k} max. (grid current biasing)	22	MΩ
V_g max. (I_g = +0.3μA)	–1.3	V
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Diode sections (each section)

P.I.V. max.	350	V
I_{ad} max.	800	μA
$i_{ad(pk)}$ max.	5.0	mA

MICROPHONY

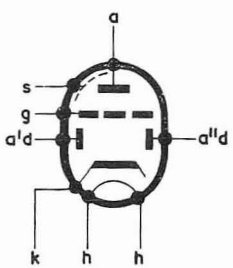
This valve can be used without special precautions against microphony in circuits in which the input voltage >10mV (r.m.s.) for an output of 50mW from the output valve.

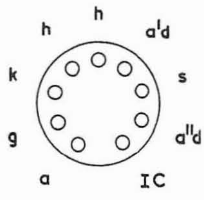
DOUBLE DIODE TRIODE

EBC81

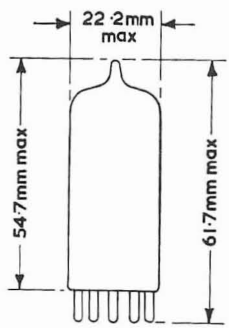
High gain triode for use as a.f. voltage amplifier combined with twin diodes.

3684





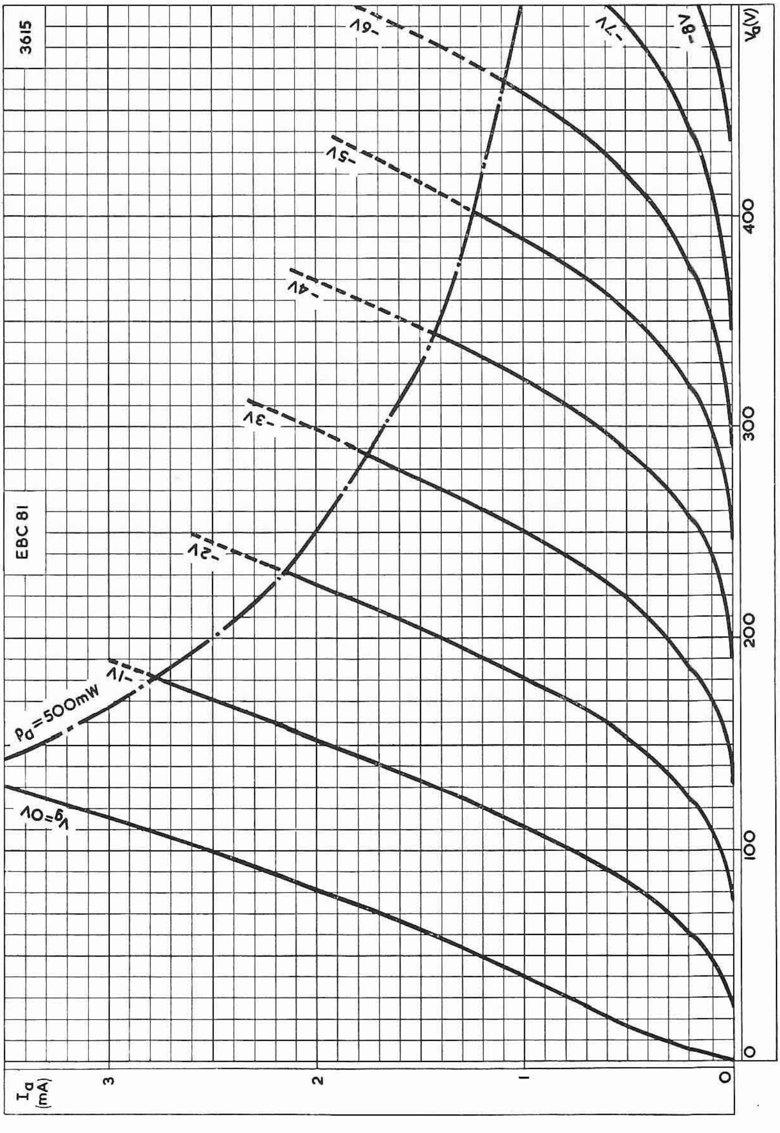
B9A Base



EBC81

DOUBLE DIODE TRIODE

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

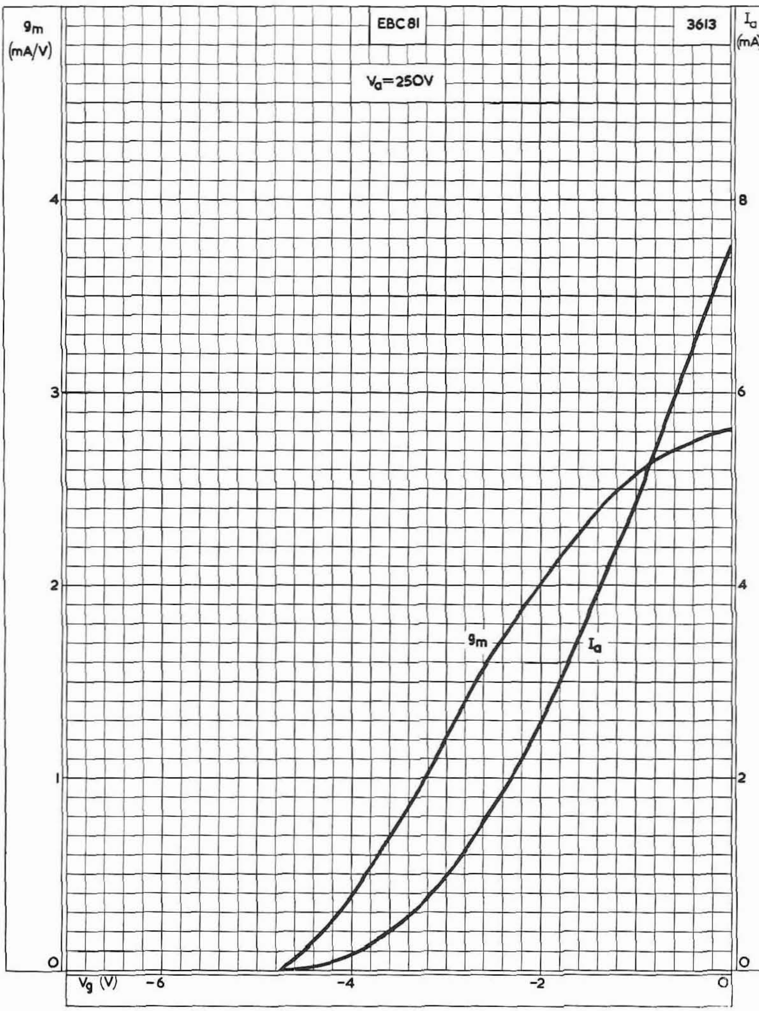


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

DOUBLE DIODE TRIODE

EBC81

High gain triode for use as a.f. voltage amplifier combined with twin diodes.



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

EBF83

Double diode variable-mu pentode primarily intended for use in equipment operating directly from a 6V, 12V or 24V battery, on or off charge.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

$c_{a'd-g1}$	<0.8	mpF
$c_{a''d-g1}$	<1.0	mpF
$c_{a'd-a}$	<150	mpF
$c_{a''d-a}$	<25	mpF

Pentode section

c_{a-g1}	<2.5	mpF
c_{out}	5.2	pF
c_{in}	5.0	pF

Diode sections

$c_{a'd-k}$	2.5	pF
$c_{a''d-k}$	2.5	pF
$c_{a'd-a''d}$	<250	mpF

CHARACTERISTICS

V_a	6.3	12.6	25	V
V_{g3}	0	0	0	V
V_{g2}	6.3	12.6	25	V
V_{g1}	†	†	†	
I_a	0.12	0.45	1.7	mA
I_{g2}	40	140	500	µA
g_m	0.45	1.0	2.1	mA/V
r_a	0.65	1.0	0.2	MΩ

†Obtained by grid current biasing with $R_{g1} = 2.2$MΩ.

LIMITING VALUES

Pentode section

V_a max.	50	V
V_{g2} max.	50	V
I_k max.	5.0	mA
R_{g1-k} max.	5.0	MΩ
V_{h-k} max.	50	V

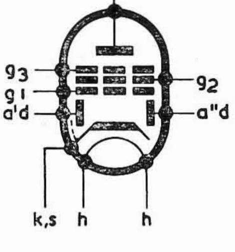
Diode sections (each section)

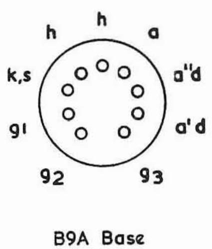
I_{ad} max.	800	µA
$i_{ad(pk)}$ max.	5.0	mA

EBF83

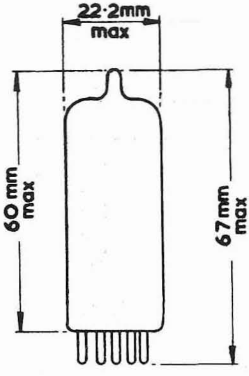
DOUBLE DIODE VARIABLE-MU R.F. PENTODE

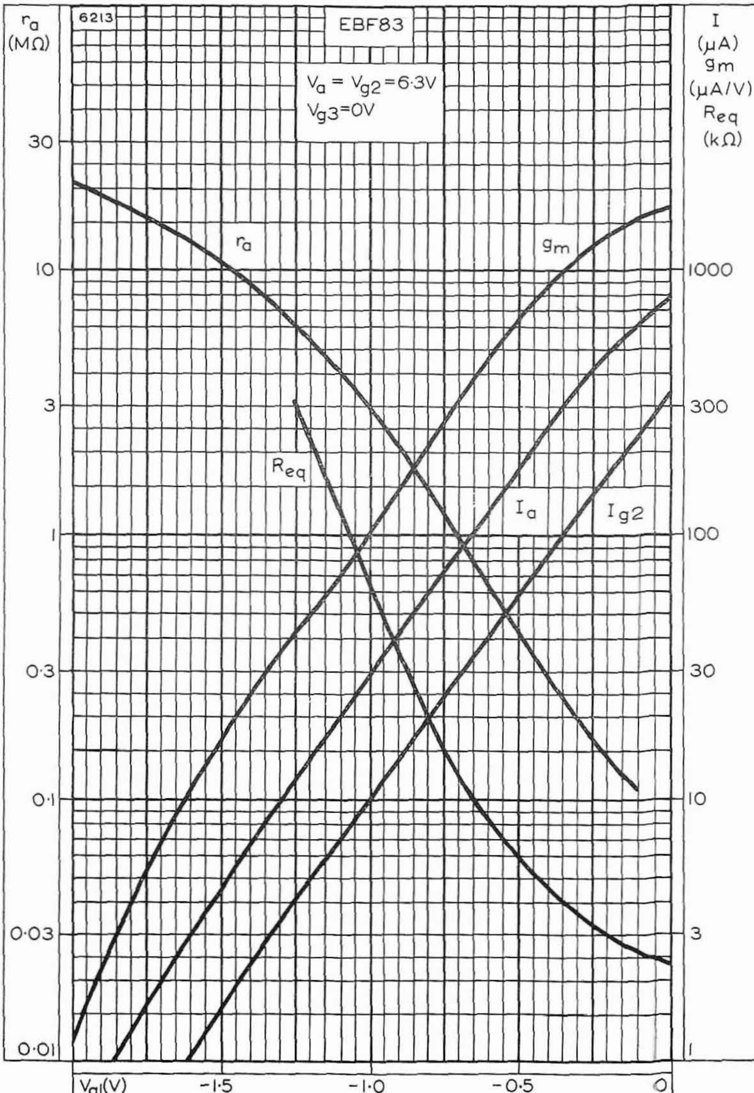
6070



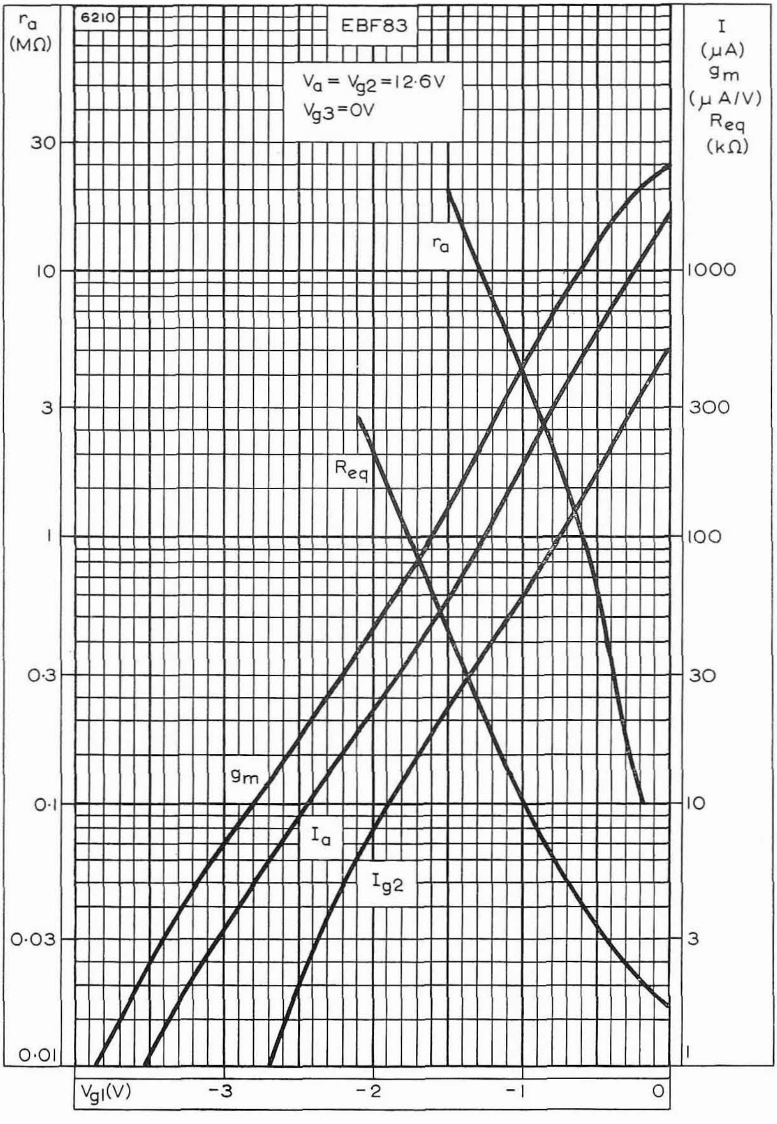


B9A Base

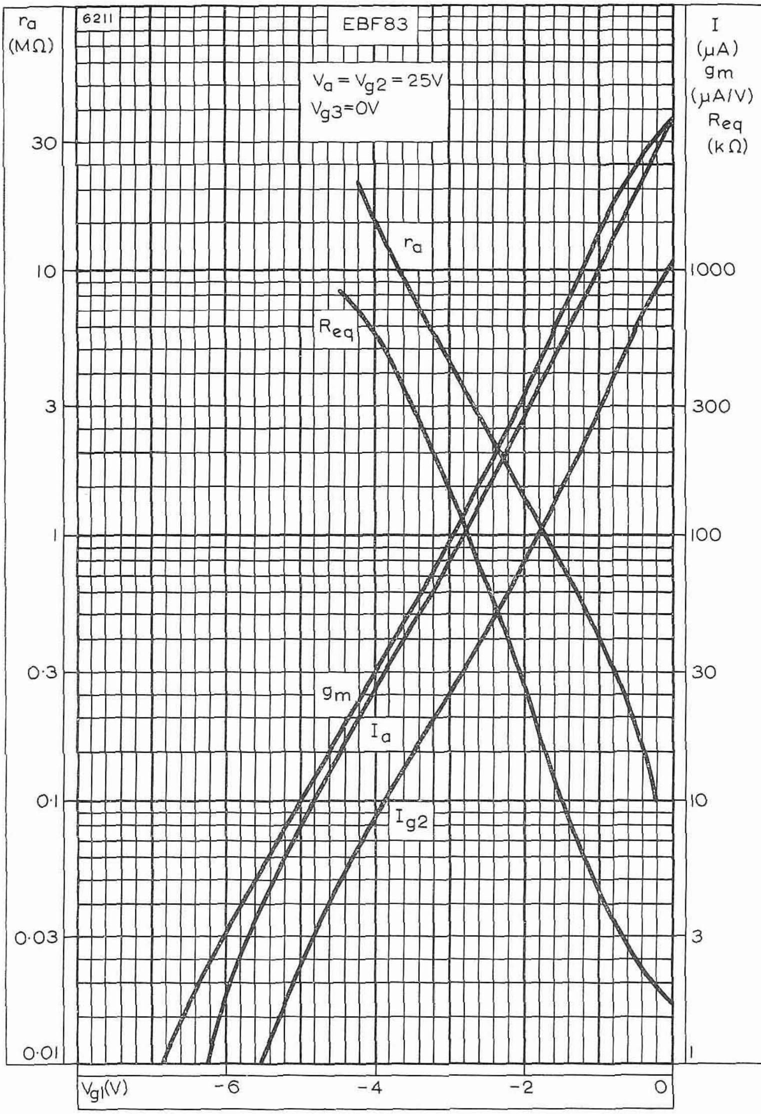




ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 6.3V$



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 12.6V$



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 25V$

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

EBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

HEATER

Suitable for series or parallel operation a.c. or d.c.

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES

$c_{a'd-g1}$	<0.0008	pF
$c_{a''d-g1}$	<0.001	pF
$c_{a'd-a}$	<0.15	pF
$c_{a''d-a}$	<0.025	pF

Pentode section

c_{a-g1}	<0.0025	pF
c_{out}	5.2	pF
c_{in}	5.0	pF
c_{g1-h}	0.05	pF

Diode sections

$c_{a'd-k}$	2.5	pF
$c_{a''d-k}$	2.5	pF
$c_{a'd-a''d}$	<0.25	pF
$c_{a'd-h}$	<0.015	pF
$c_{a''d-h}$	<0.003	pF

CHARACTERISTICS

V_a	250	250	V
V_{g3}	0	0	V
V_{g2}	80	100	V
V_{g1}	-1.0*	-2.0	V
I_a	9.0	9.0	mA
I_{g2}	2.7	2.7	mA
g_m	4.5	3.8	mA/V
r_a	0 9	1.0	MΩ
μ_{g1-g2}	20	20	

*At this voltage grid current may occur. If this is not acceptable the negative bias voltage should be increased to −2.0V.

EBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

TYPICAL OPERATING CONDITIONS

$V_a = V_b$	200	200	250	250	V
V_{g3}	—	0	0	0	V
R_{g2}	47	30	82	56	kΩ
V_{g1}	−0.5*	−1.5	−0.5*	−2.0	V
R_k	—	105	—	170	Ω
I_a	9.5	11	8.0	9.0	mA
I_{g2}	2.8	3.3	2.2	2.7	mA
g_m	5.0	4.5	4.7	3.8	mA/V
r_a	0.6	0.6	0.8	1.0	MΩ
R_{eq}	2.5	3.5	2.3	4.0	kΩ
g_m (V_{g1} = −20V)	115	120	180	200	μA/V

*This voltage is produced by the grid current flowing through the grid resistor and the steady current of the diode. If this condition is not acceptable the negative grid bias should be increased to −1.5V at V_a = 200V and −2.0V at V_a = 250V.

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
*V_a max.	300	V
p_a max.	2.25	W
$V_{g2(b)}$ max.	550	V
*V_{g2} max. (I_a<4.0mA)	300	V
V_{g2} max. (I_a>8.0mA)	125	V
p_{g2} max.	450	mW
I_k max.	16.5	mA
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V
R_{g1-k} max.	3.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
R_{g3-k} max.	10	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

EBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

Diode sections (each section)

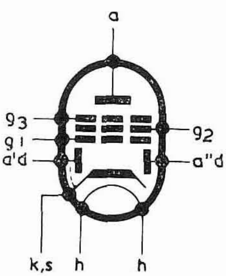
P.I.V. max.	200	V
I_{ad} max.	800	μA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

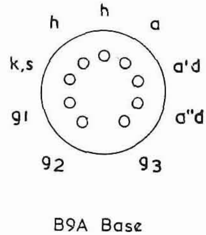
*If the heater, anode and screen-grid voltages are obtained from an accumulator by means of a vibrator, V_a max. = 250V, V_{g2} max. = 250V.

MICROPHONY

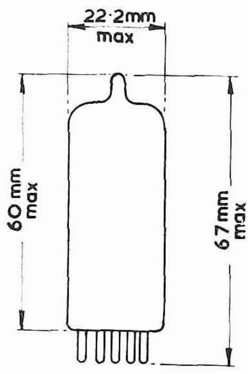
This valve can be used without special precautions against microphony in circuits in which the input voltage is >25mV (r.m.s.) for an output of 50mW from the output valve.

2845





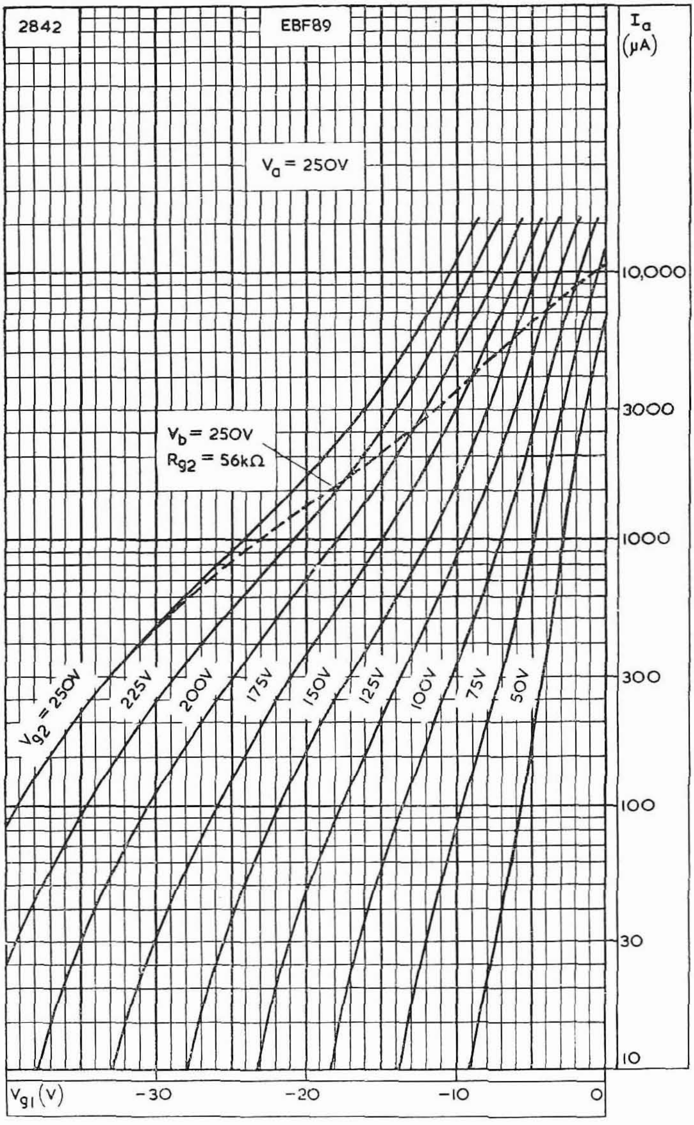
B9A Base



EBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

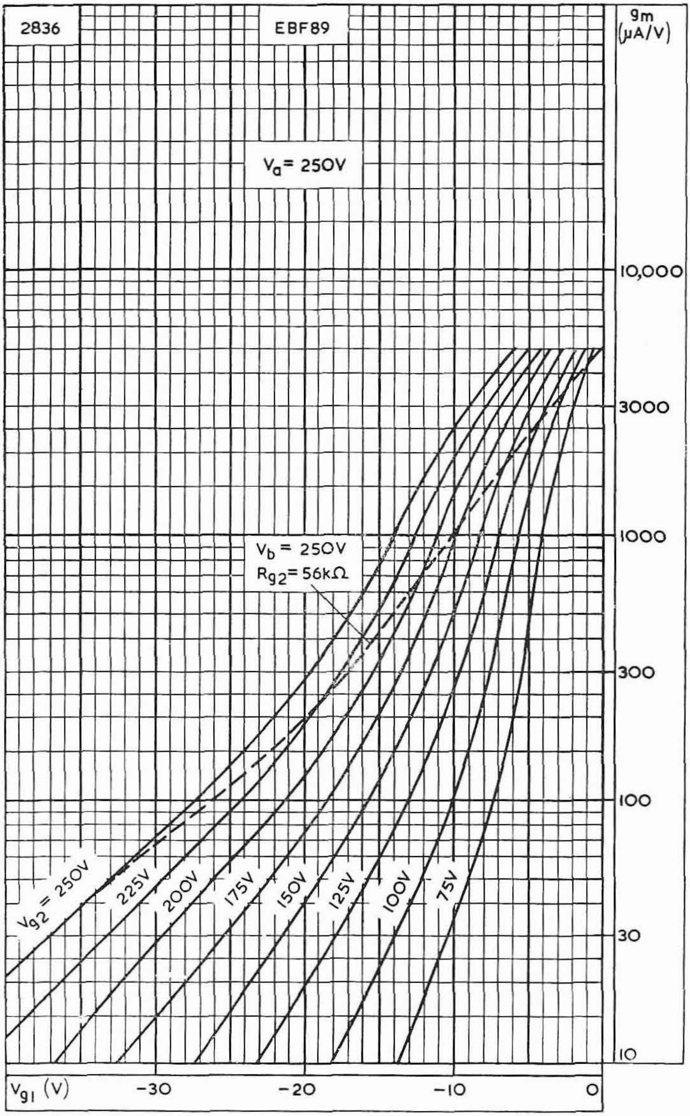


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

EBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

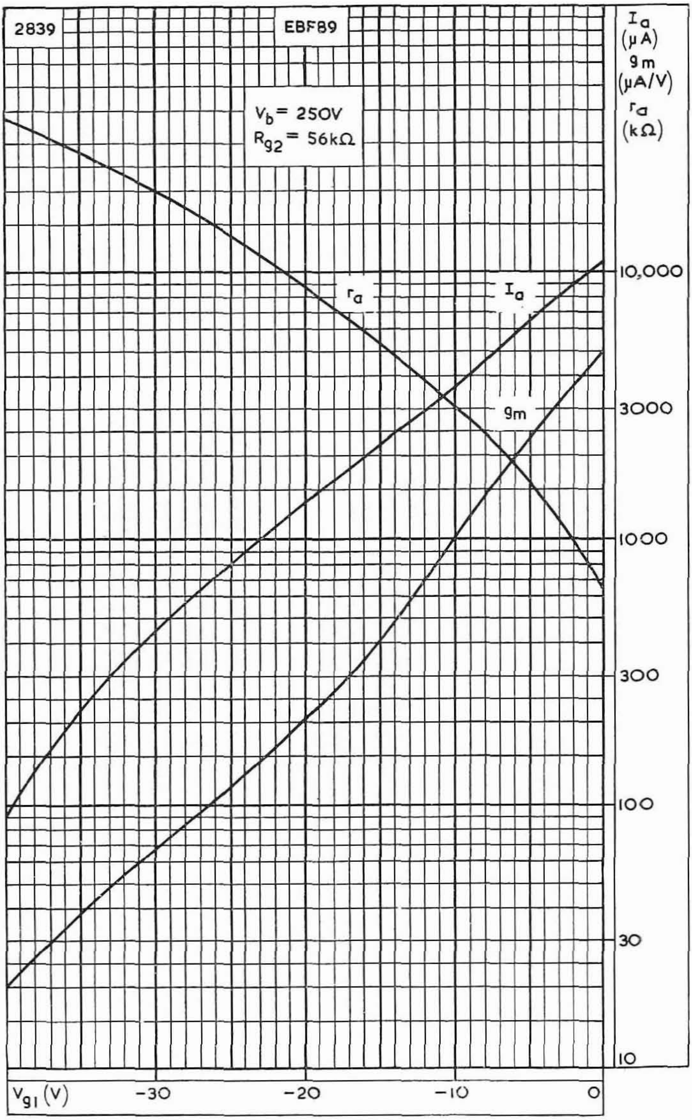


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

EBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

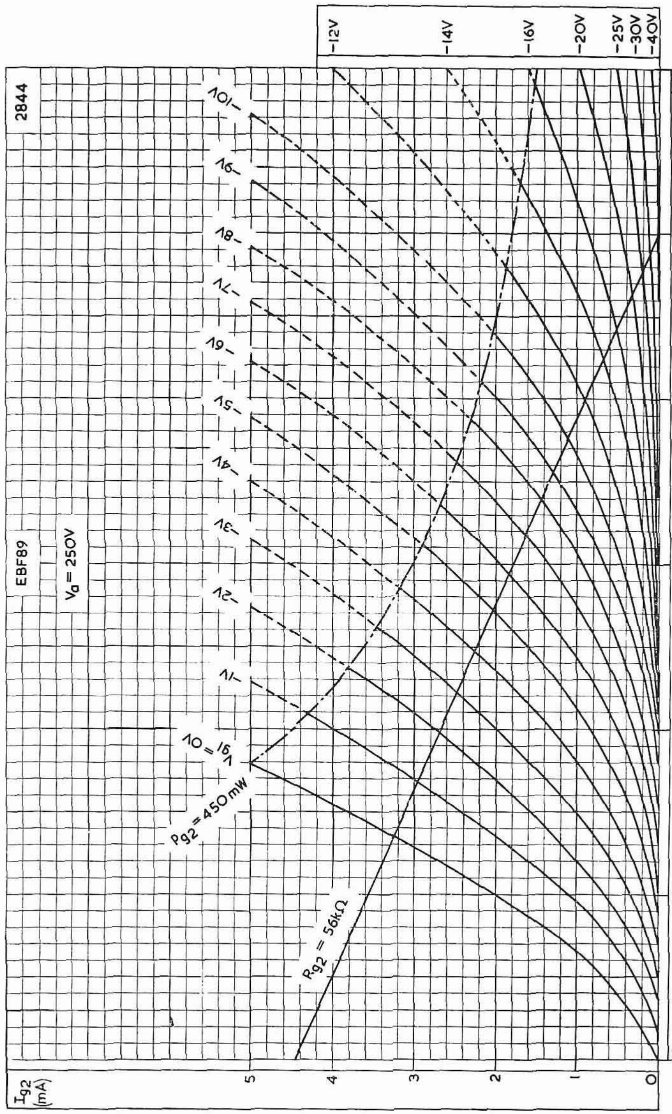


ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

EBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

12AT7
CV455

DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

The heater is centre-tapped and the two sections may be operated in series or in parallel with one another.

Series	V_h applied between pins 4 and 5
Parallel	V_h applied between pin 9 and pins 4 and 5 connected together

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	150	300	mA

CAPACITANCES

$^*c_{a-g}$	1.6	pF
$^*c_{in}$	2.3	pF
$c_{a'-k'+h}$	0.45	pF
$c_{a''-k''+h}$	0.35	pF
$^*c_{a-k}$	0.2	pF
$^*c_{h-k}$	2.5	pF
$^*c_{k-g+h}$	4.7	pF
$c_{a'-g'+h}$	1.9	pF
$c_{a''-g''+h}$	1.8	pF
$c_{a'-a''}$	<0.4	pF
c_{g-h}	<0.17	pF
$c_{g'-g''}$	<0.005	pF
$c_{a'-g''}$	<0.07	pF
$c_{a''-g'}$	<0.04	pF

*Each section

CHARACTERISTICS (each section)

V_a	100	170	200	250	V
I_a	3.0	8.5	11.5	10	mA
V_g	−1.0	−1.0	−1.0	−2.0	V
g_m	3.75	5.9	6.7	5.5	mA/V
μ	62	66	70	60	
r_a	16.5	11	10.5	11	kΩ
$^*r_{g-k}$	21	16	14	25	kΩ

*Measured at f=50Mc/s

LIMITING VALUES (each section)

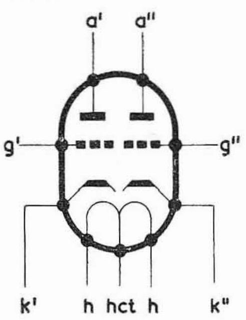
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
I_k max.	15	mA
$-V_g$ max.	50	V
V_g ($I_g = +0.3\mu A$)	−1.3	V
R_{g-k} max. (self-bias)	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

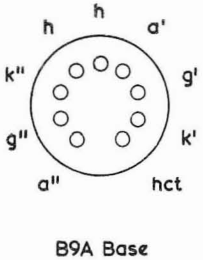
ECC81

DOUBLE TRIODE

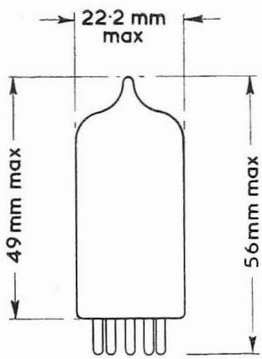
Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

2678





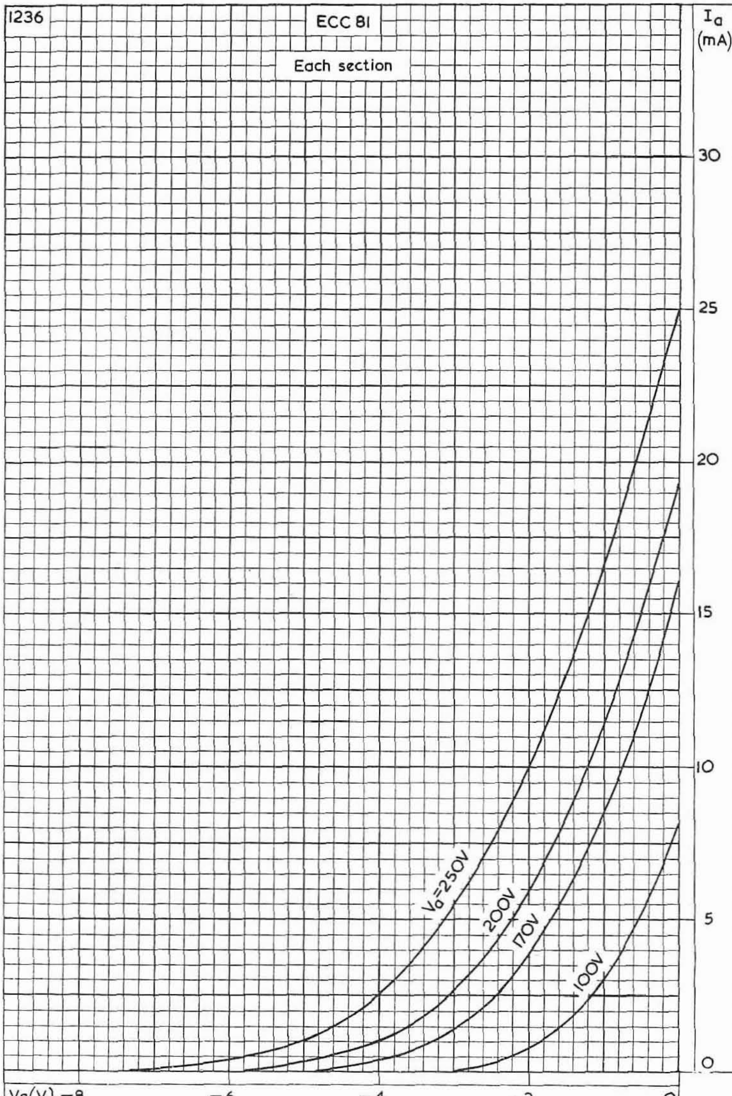
B9A Base



DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300 Mc/s.

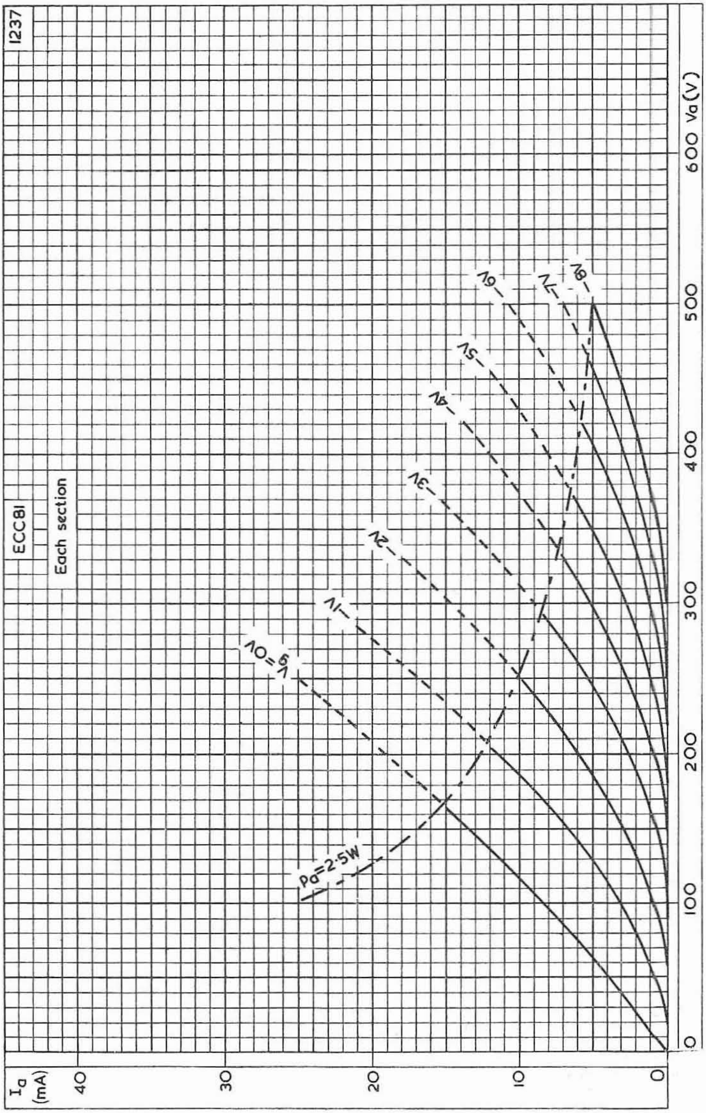


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE, WITH ANODE VOLTAGE AS PARAMETER (EACH SECTION)

ECC81

DOUBLE TRIODE

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

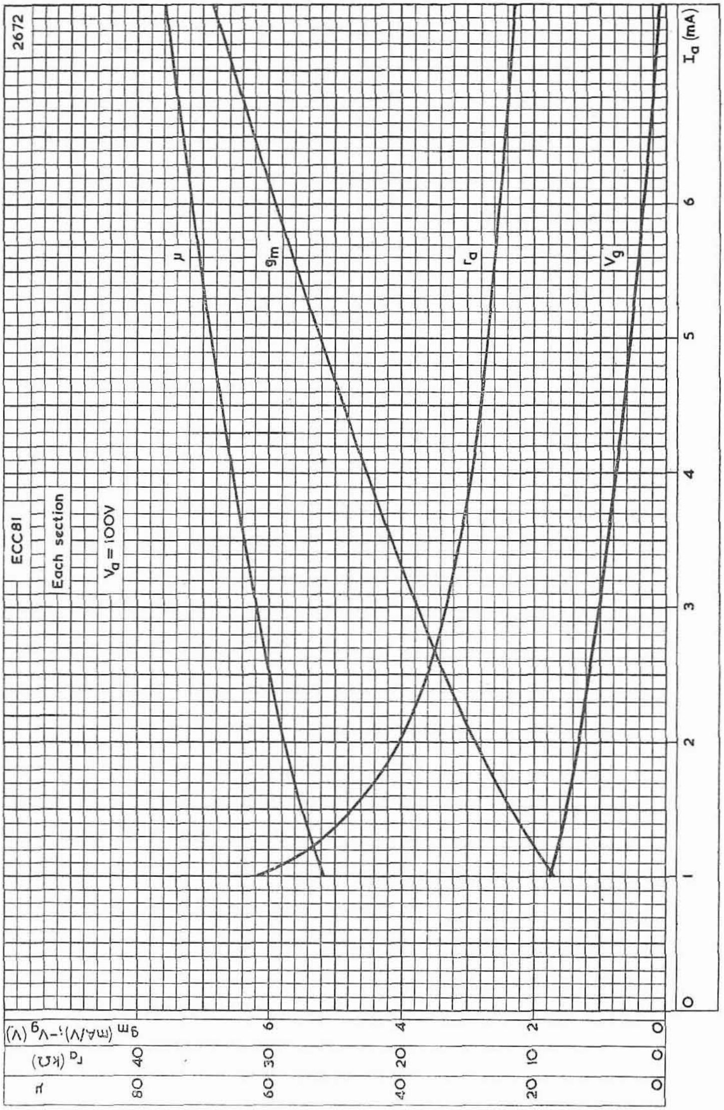


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH GRID VOLTAGE AS PARAMETER (EACH SECTION)

DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

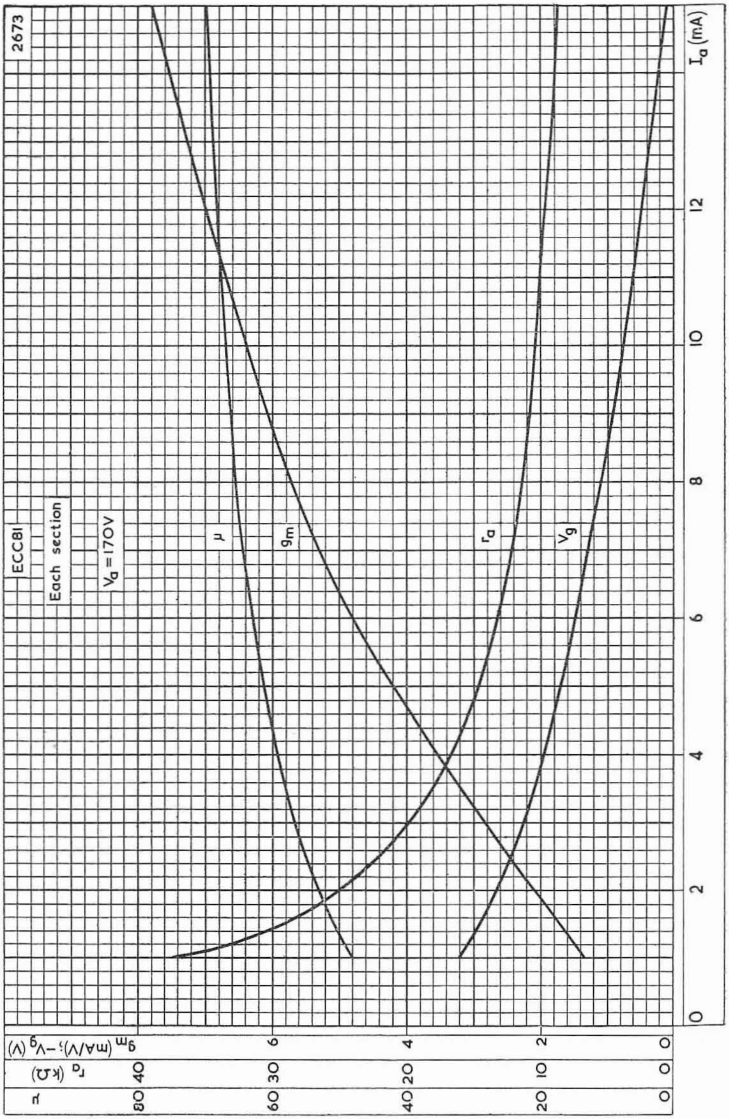


GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 100V (EACH SECTION)

ECC81

DOUBLE TRIODE

Double triode primarily intended for use as a frequency changer or r.f amplifier at frequencies up to 300Mc/s.

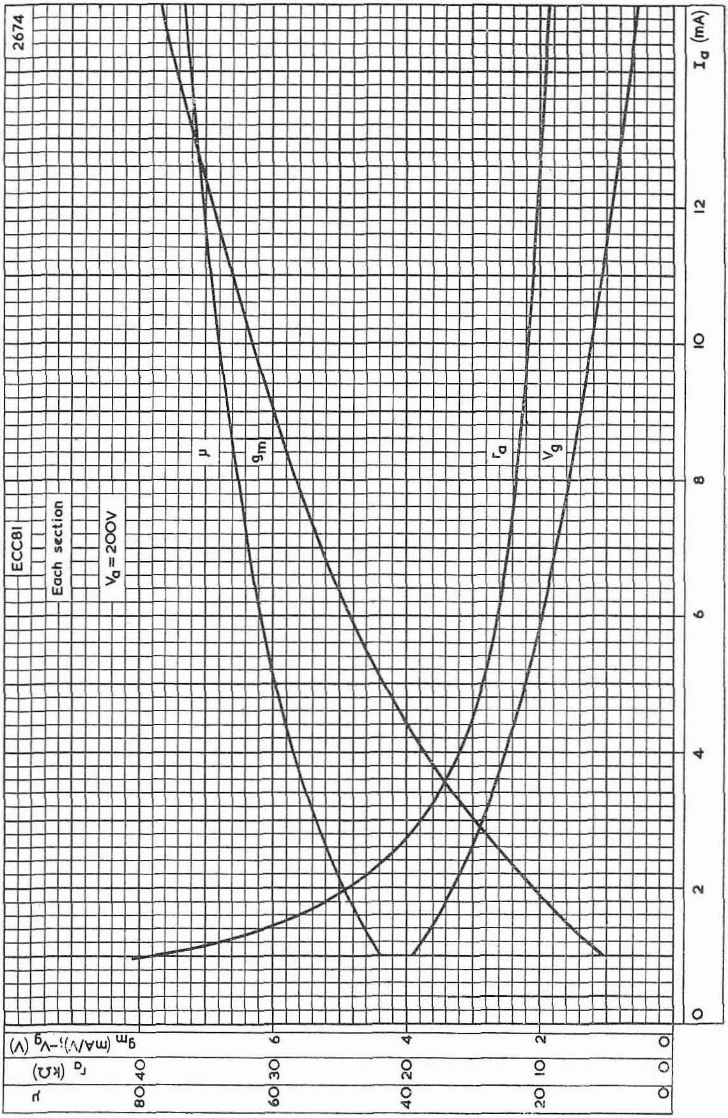


GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR, AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 170V (EACH SECTION)

DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

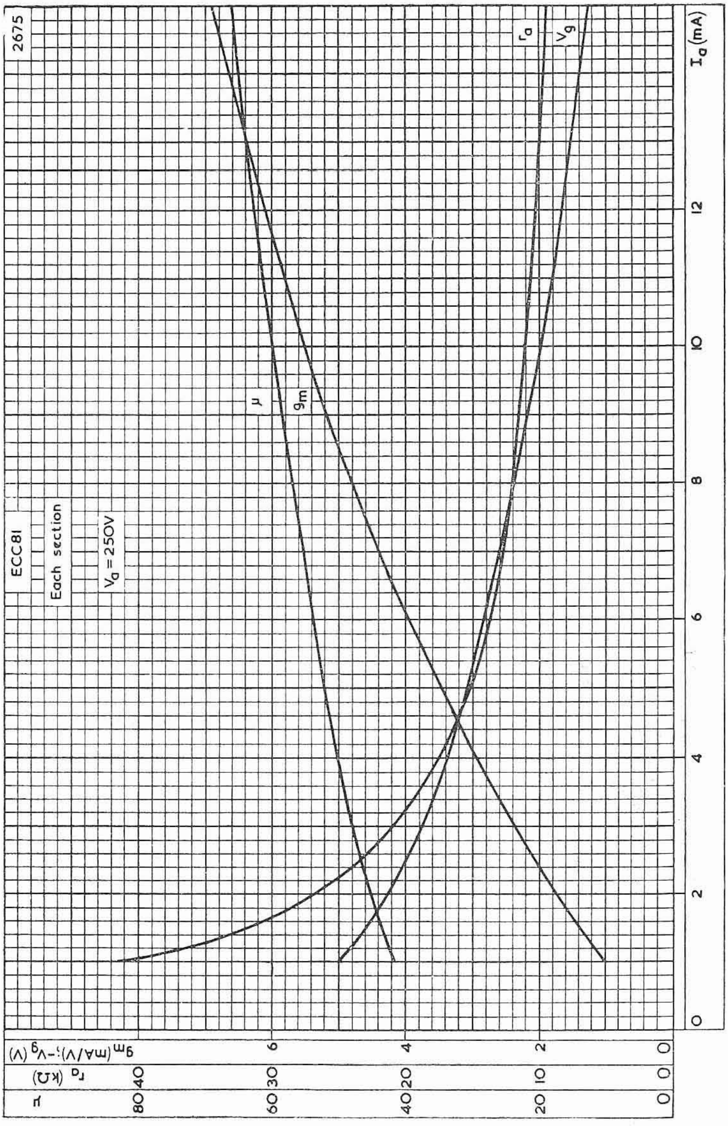


GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 200V (EACH SECTION)

ECC81

DOUBLE TRIODE

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

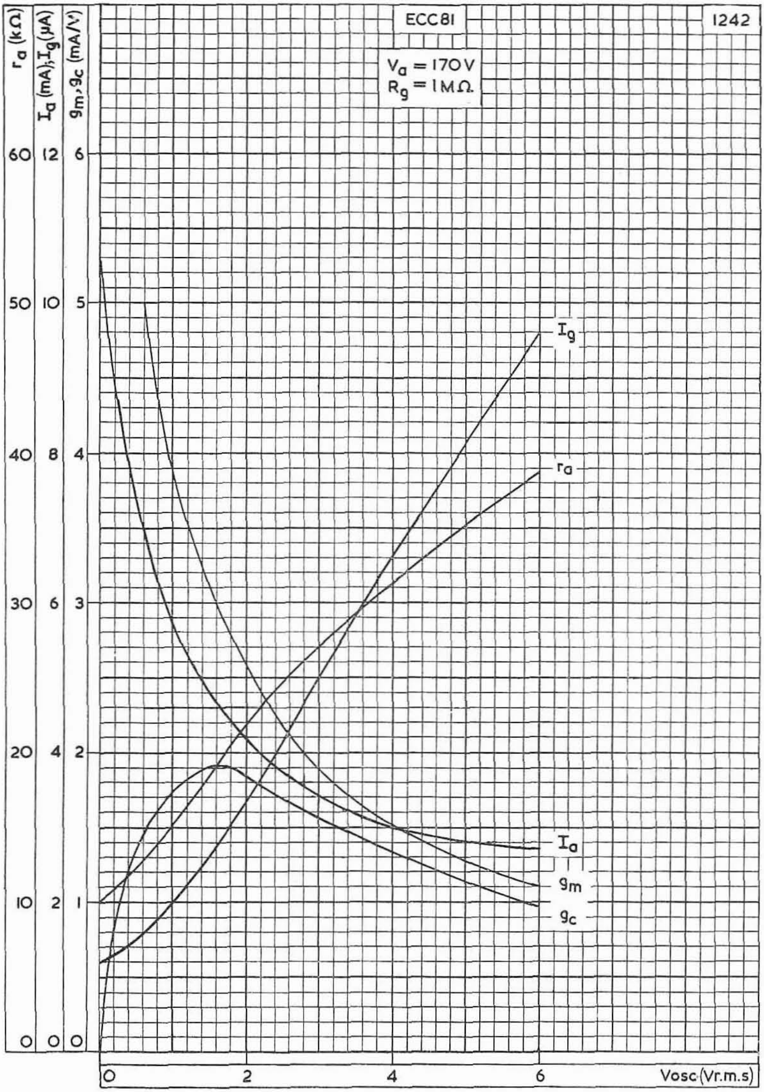


GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND INTERNAL RESISTANCE PLOTTED AGAINST ANODE CURRENT, FOR ANODE VOLTAGE OF 250V (EACH SECTION)

DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

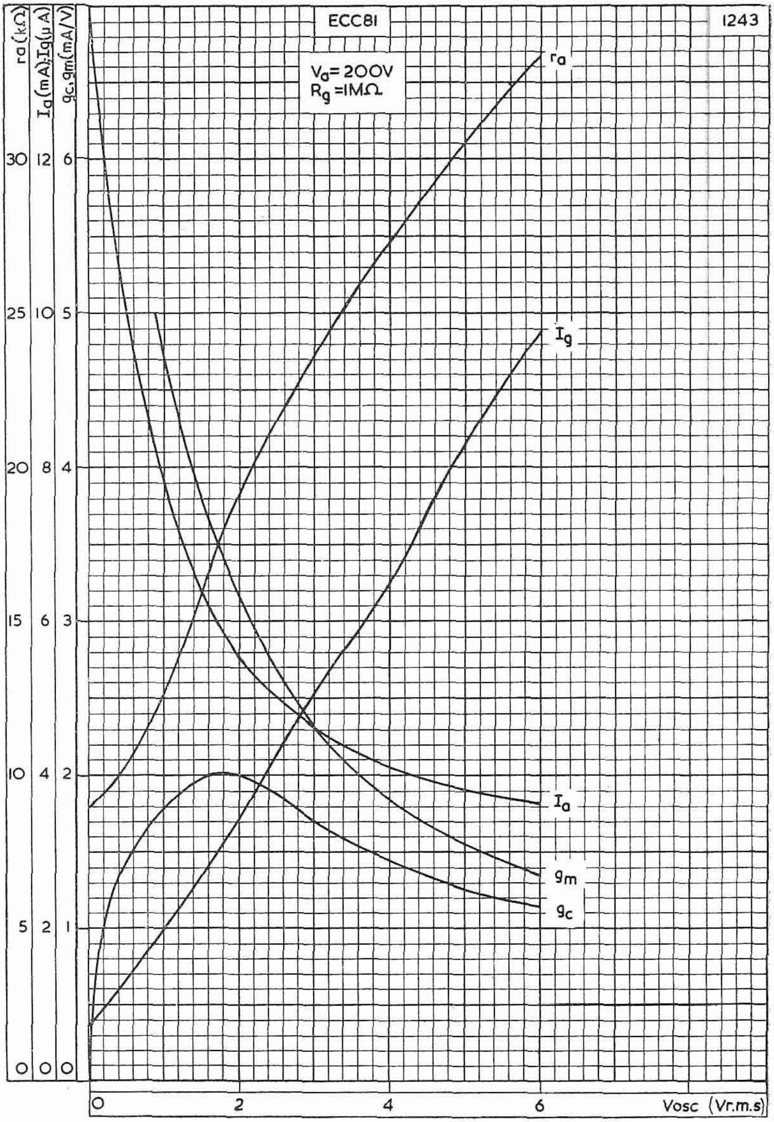


PERFORMANCE CURVES AS FREQUENCY CHANGER AT ANODE VOLTAGE OF 170V

ECC81

DOUBLE TRIODE

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.

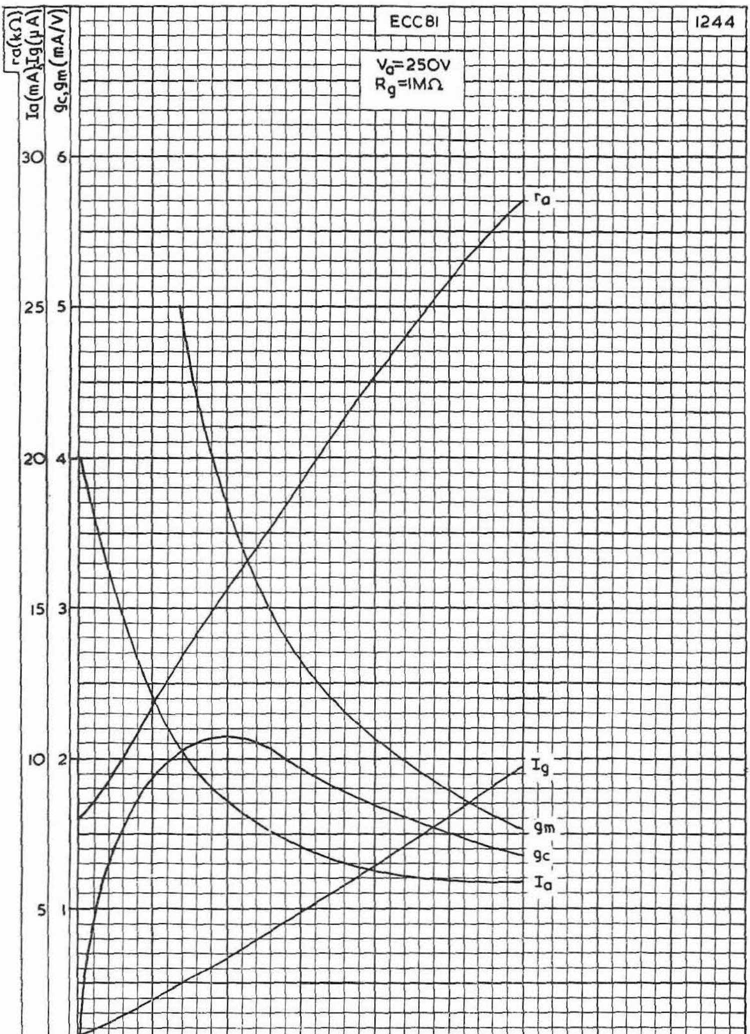


PERFORMANCE CURVES AS FREQUENCY CHANGER AT ANODE VOLTAGE OF 200V

DOUBLE TRIODE

ECC81

Double triode primarily intended for use as a frequency changer or r.f. amplifier at frequencies up to 300Mc/s.



PERFORMANCE CURVES AS FREQUENCY CHANGER AT ANODE VOLTAGE OF 250V

DOUBLE TRIODE

ECC82

Low μ double triode having separate cathodes, primarily intended for use as an amplifier or oscillator.

HEATER

Suitable for series or parallel operation, a.c. or d.c. The heater is centre-tapped and the two sections may be operated in series or in parallel with one another.

Series	V_h applied between pins 4 and 5
Parallel	V_h applied between pin 9 and pins 4 and 5 connected together

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	150	300	mA

CAPACITANCES (measured without an external shield) ←

$*c_{a-g}$	1.5	pF
$*c_{in}$	1.8	pF
$c_{out'}$	370	mpF
$c_{out''}$	250	mpF
$*c_{g-h}$	<135	mpF
$c_{a'-a''}$	<1.1	pF
$c_{a''-g'}$	<60	mpF
$c_{a'-g''}$	<110	mpF
$c_{g'-g''}$	<10	mpF

*Each section

CHARACTERISTICS (each section)

V_a	100	250	V
I_a	11.8	10.5	mA ←
V_g	0	−8.5	V
g_m	3.1	2.2	mA/V
μ	19.5	17	←
r_a	6.25	7.7	kΩ ←
V_g max. ($I_g = +0.3\mu A$)		−1.3	V ←

ECC82

DOUBLE TRIODE

OPERATING CONDITIONS (each section) ←

As an a.f. amplifier

V_b (V)	R_a (kΩ)	I_k (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_g† (kΩ)
400	47	5.0	1.2	13.5	59	6.7	150
350	47	4.3	1.2	13.5	51	6.6	150
300	47	3.7	1.2	13.5	43	6.5	150
250	47	3.0	1.2	13.5	34	6.4	150
200	47	2.4	1.2	13.5	26	6.3	150
150	47	1.8	1.2	13.5	18	6.1	150
100	47	1.2	1.2	13.5	11	5.6	150
400	100	2.6	2.2	14	57	6.2	330
350	100	2.3	2.2	14	49	6.1	330
300	100	2.0	2.2	14	41	6.0	330
250	100	1.6	2.2	14	32	5.9	330
200	100	1.3	2.2	14	25	5.8	330
150	100	1.0	2.2	14	17	5.6	330
100	100	0.7	2.2	14	10	4.8	330
400	220	1.3	3.9	14.5	50	5.1	680
350	220	1.2	3.9	14.5	43	5.0	680
300	220	1.0	3.9	14.5	36	4.9	680
250	220	0.8	3.9	14.5	28	4.8	680
200	220	0.7	3.9	14.5	22	4.7	680
150	220	0.5	3.9	14.5	15	4.4	680
100	220	0.3	3.9	14.5	8.0	4.0	680

*Output voltage and distortion at start of positive grid current. At lower output voltage, the distortion is approximately proportional to the output voltage.

†R_g = grid resistor of following valve.

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.75	W
I_k max.	20	mA
*$i_{k(pk)}$ max.	150	mA ←
$-V_g$ max.	100	V ←
$-v_{g(pk)}$ max.	250	V ←
R_{g-k} max. (fixed bias)	1.5	MΩ
V_{h-k} max.	180	V
†R_{h-k} max.	20	kΩ

†When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 150kΩ.

*Maximum pulse duration = 200μs.

DOUBLE TRIODE

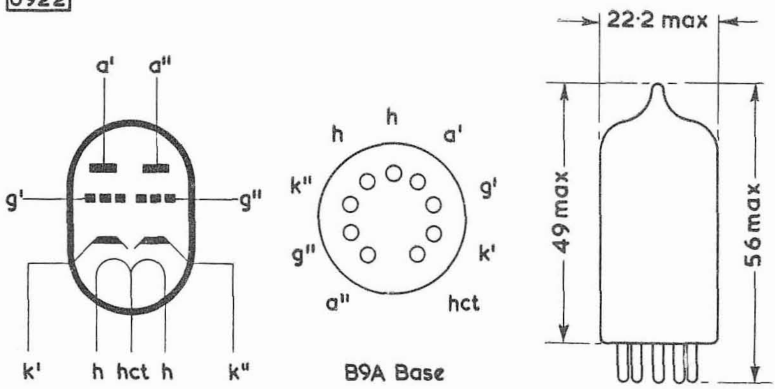
ECC82

OPERATING NOTES

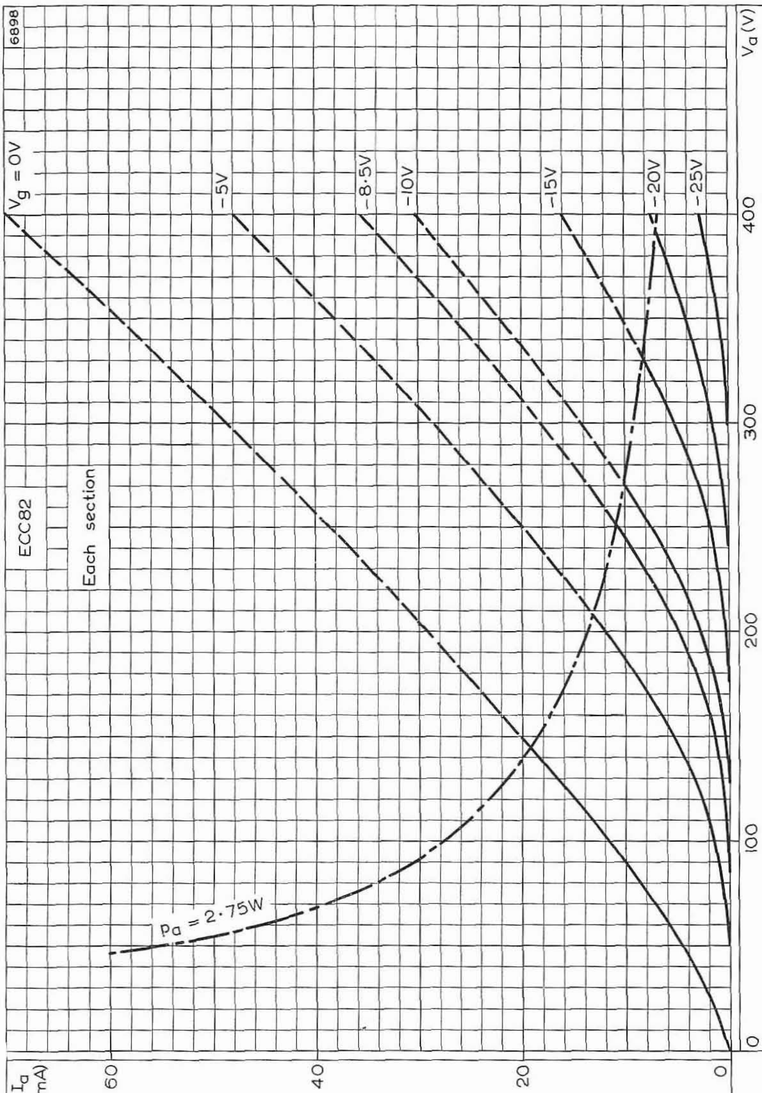
This valve can be used without special precautions against microphony in equipment where the input voltage is not less than 10mV for an output of 50mW (or 100mV for 5W output).

With V_h applied between pin 9 and pins 4 and 5 connected together, and with the centre tap of the heater transformer earthed the section connected to pins 6, 7 and 8 is the most favourable with regard to hum.

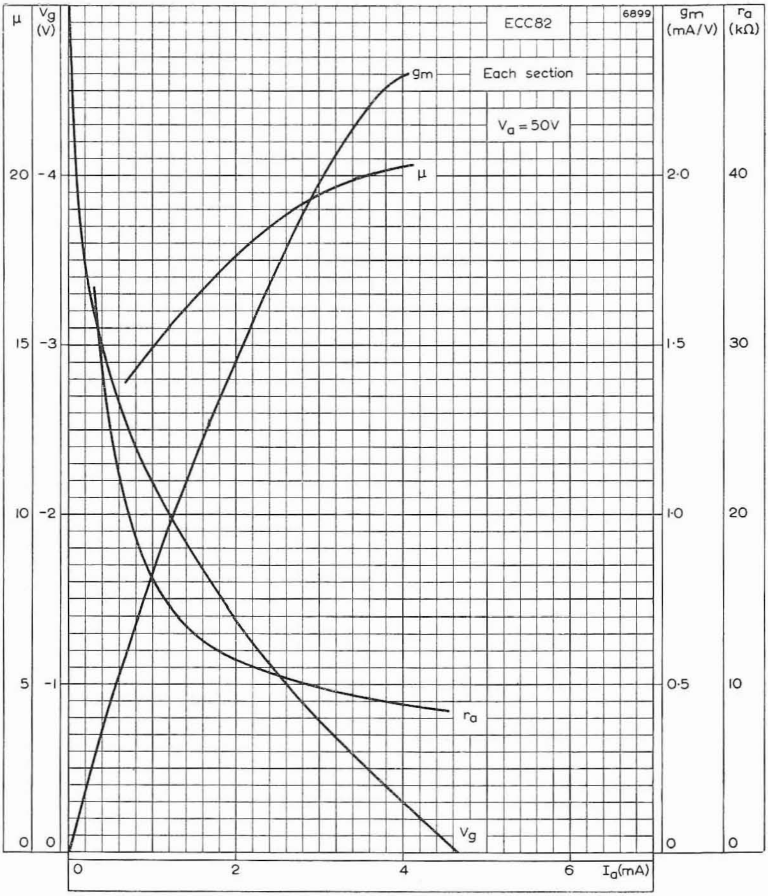
6922



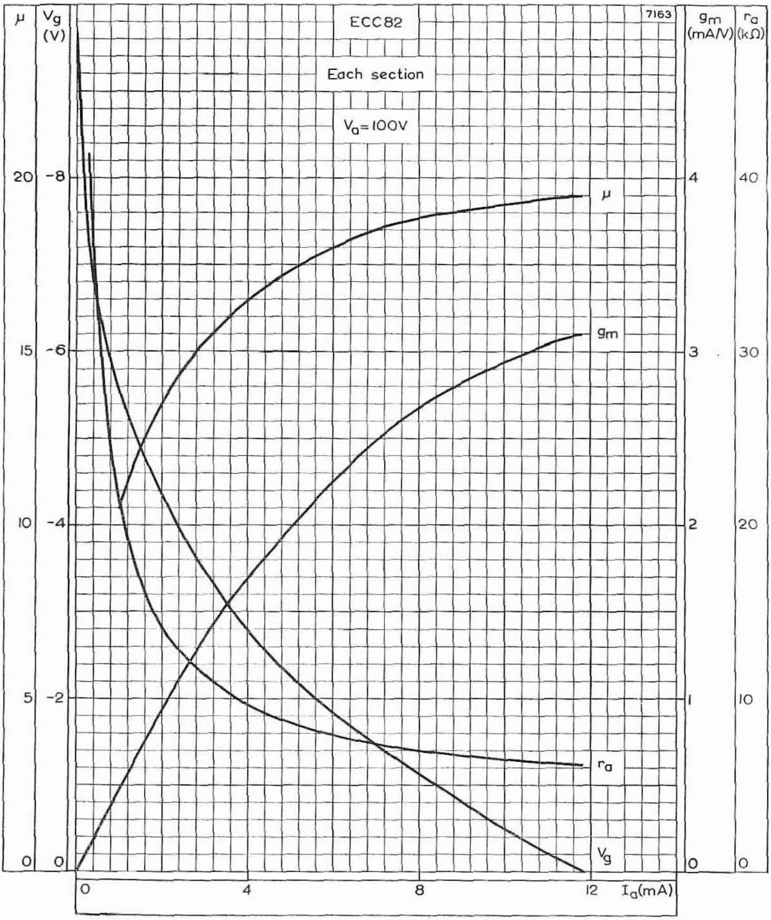
All dimensions in mm



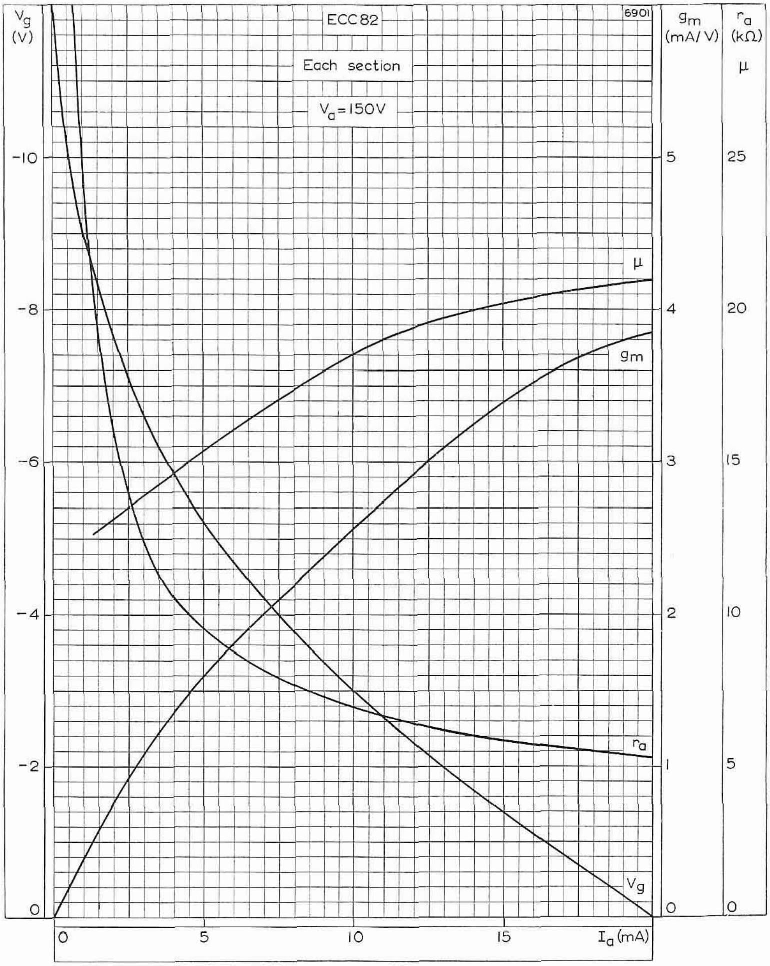
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



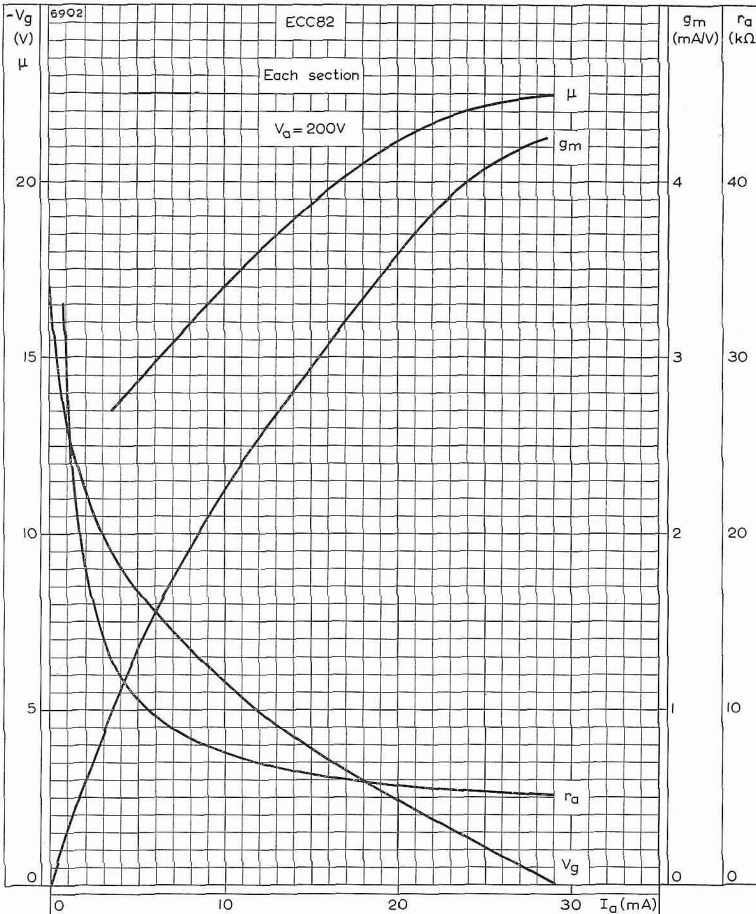
ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 50V$



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. V_a = 100V



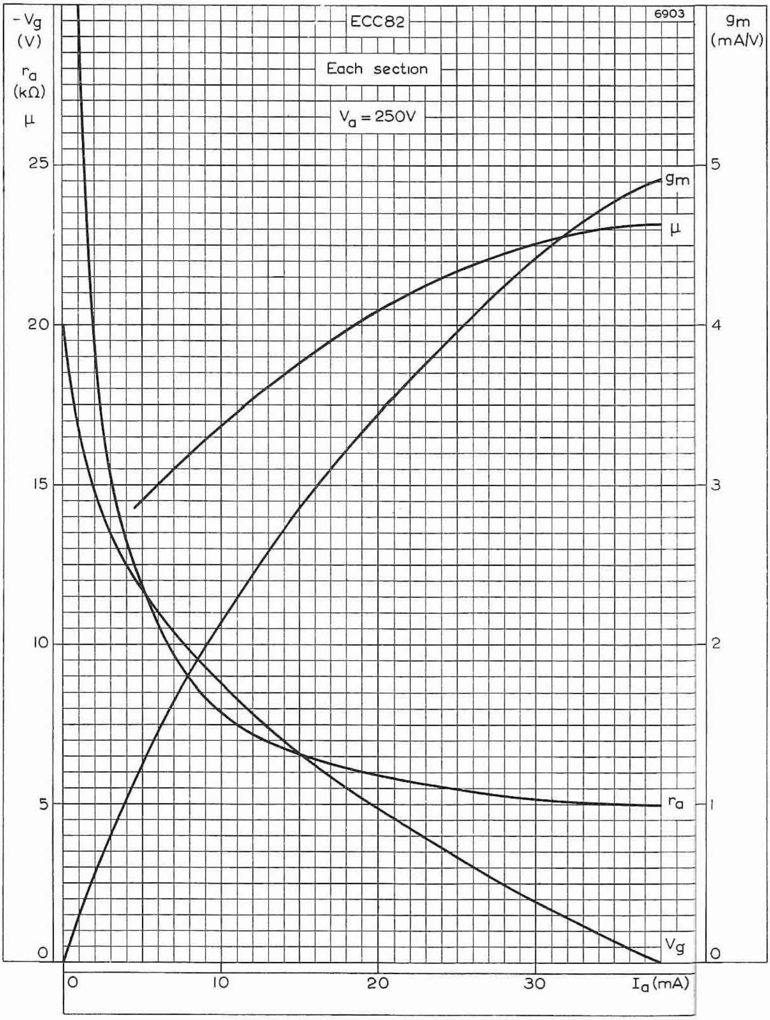
ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 150V$



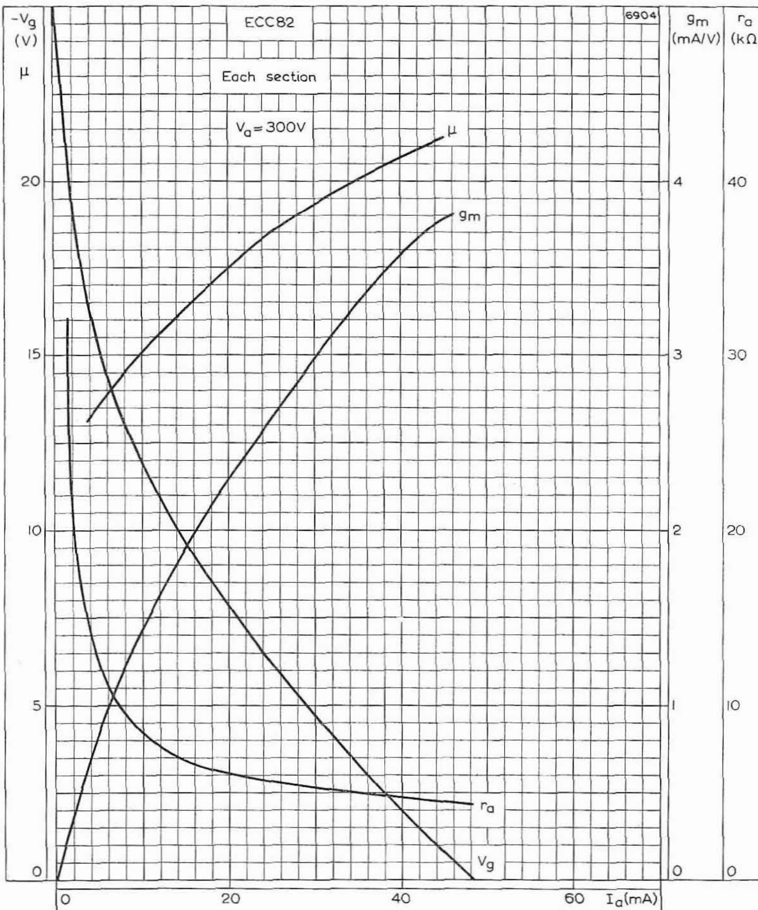
ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 200V$

ECC82

DOUBLE TRIODE



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 250V$



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 300V$

DOUBLE TRIODE

ECC83

High μ double triode, having separate cathodes, primarily intended for use as a resistance-coupled amplifier or phase inverter.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

The heater is centre-tapped and the two sections may be operated in series or in parallel with one another.

Series	V_h applied between pins 4 and 5
Parallel	V_h applied between pin 9 and pins 4 and 5 connected together

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	150	300	mA

CAPACITANCES

$c_{out'}$	330	mpF
$c_{out''}$	230	mpF
*c_{in}	1.6	pF
*c_{a-g}	1.6	pF
$c_{a'-a''}$	<1.2	pF
$c_{a''-g'}$	<100	mpF
$c_{a'-g''}$	<110	mpF
$c_{g'-g''}$	<10	mpF
*c_{g-h}	<150	mpF

*Each section

CHARACTERISTICS (each section)

V_a	100	250	V
I_a	0.5	1.2	mA
V_g	−1.0	−2.0	V
g_m	1.25	1.6	mA/V
μ	100	100	
r_a	80	62.5	kΩ
V_g max. ($I_g = +0.3\mu A$)		−0.9	V

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F.← AMPLIFIER with grid current bias (R_g = 10MΩ)

V_b (V)	R_a (kΩ)	$R_{g'}$** (kΩ)	I_a (mA)	Z_s = 0kΩ: $\frac{V_{out}}{V_{in}}$	Z_s = 0kΩ: $V_{out(r.m.s.)}$* (V)	Z_s = 220kΩ: $\frac{V_{out}}{V_{in}}$	Z_s = 220kΩ: $V_{out(r.m.s.)}$† (V)
400	47	150	3.4	47	43	38	46
350	47	150	2.8	46	36	37	38
300	47	150	2.2	44	29	36	30
250	47	150	1.7	42	22	34	24
200	47	150	1.2	39	15	32	17
400	100	330	2.1	61	59	49	62
350	100	330	1.75	60	49	48	52
300	100	330	1.4	58	39	47	42
250	100	330	1.1	56	30	46	33
200	100	330	0.8	54	21	43	23
400	220	680	1.2	73	71	58	75
350	220	680	1.0	72	59	57	63
300	220	680	0.8	70	47	56	52
250	220	680	0.6	68	36	54	40
200	220	680	0.45	65	25	52	29

*Output voltage measured at D_{tot} = 5%.

$\frac{V_{out}}{V_{in}}$ measured with $V_{in(r.m.s.)}$ = 100mV

**Grid resistor of following valve.

†When operating this valve with grid current bias and a high source impedance, the second harmonic distortion rises to a peak at quite low levels of output (about $10V_{r.m.s.}$) and then falls with increasing drive. The third harmonic then begins to rise, and D_{tot} finally reaches 5% at a much higher output level than with zero source impedance. The maximum value of this distortion peak varies inversely with the anode load, being about 5.5% with R_a = 47kΩ, 4.5% with R_a = 100kΩ and 4% with R_a = 220kΩ.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. ← AMPLIFIER with cathode bias

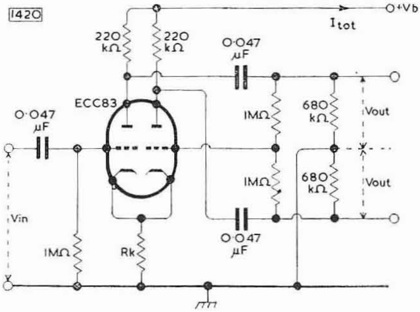
V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	$V_{out(r.m.s.)}$* (V)	D_{tot}* (%)	$R_{g'}$† (kΩ)
400	47	2.2	1.0	43	40.5	5.0	150
350	47	1.7	1.2	42	31	5.0	150
300	47	1.3	1.5	40	22	5.0	150
250	47	0.9	2.2	36	12.5	5.0	150
400	100	1.4	1.5	59	59	5.0	330
350	100	1.1	1.8	57	45	5.0	330
300	100	0.88	2.2	55	32.5	5.0	330
250	100	0.6	3.3	50	18.5	5.0	330
400	220	0.88	2.2	71	63	3.7	680
350	220	0.7	2.7	69	60	5.0	680
300	220	0.5	3.9	65	38.5	5.0	680
250	220	0.38	4.7	62	27	5.0	680

*Output voltage measured at $D_{tot} = 5\%$ or at start of positive grid current. At lower output voltages the distortion is approximately proportional to the output voltage.

†Grid resistor of following valve.

At lower values of V_b, grid current bias should be used.

OPERATING CONDITIONS AS A PHASE INVERTER



V_b (V)	I_{tot} (mA)	R_k (kΩ)	$V_{out(r.m.s.)}$* (V)	$\frac{V_{out}}{V_{in}}$
350	1.3	1.5	44	65
250	0.8	2.2	23	60

*Output voltage measured at $D_{tot}=5\%$.

LIMITING VALUES (each section)

V_a max.	300	V
p_a max.	1.0	W
I_k max.	8.0	mA
$-V_g$ max.	50	V
R_{g-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	180	V
†R_{h-k} max.	20	kΩ

†When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 150kΩ.

OPERATING NOTES

1. Microphony

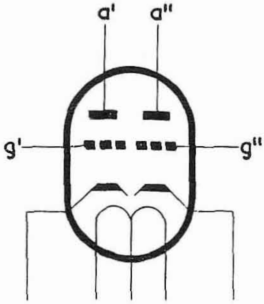
This valve may be used without special precautions against microphony in equipment where the input voltage is not less than 5mV for an output of 50mW (or 50mV for 5W output).

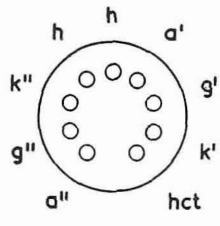
2. Hum

With V_h applied between pin 9 and pins 4 and 5 connected together and the centre tap of the heater transformer earthed, the section connected to pins 6, 7 and 8 is the most favourable with regard to hum, and should be used for the input section when the two sections are used in cascade.

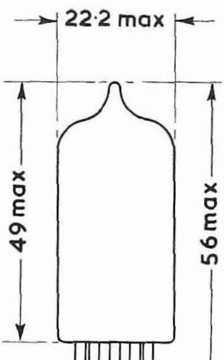
When used as a normal voltage amplifier with $V_b = 250V$, $R_a = 100k\Omega$, $R_g = 330k\Omega$, $R_k = 1.5k\Omega$ (suitably decoupled), the maximum hum level of the input triode is $10\mu V$, the average value being $6\mu V$. If one side of the heater is earthed, rather than the centre tap, it is preferable to earth pins 4 and 5. The average value of hum under these conditions may be $50\mu V$.

6922

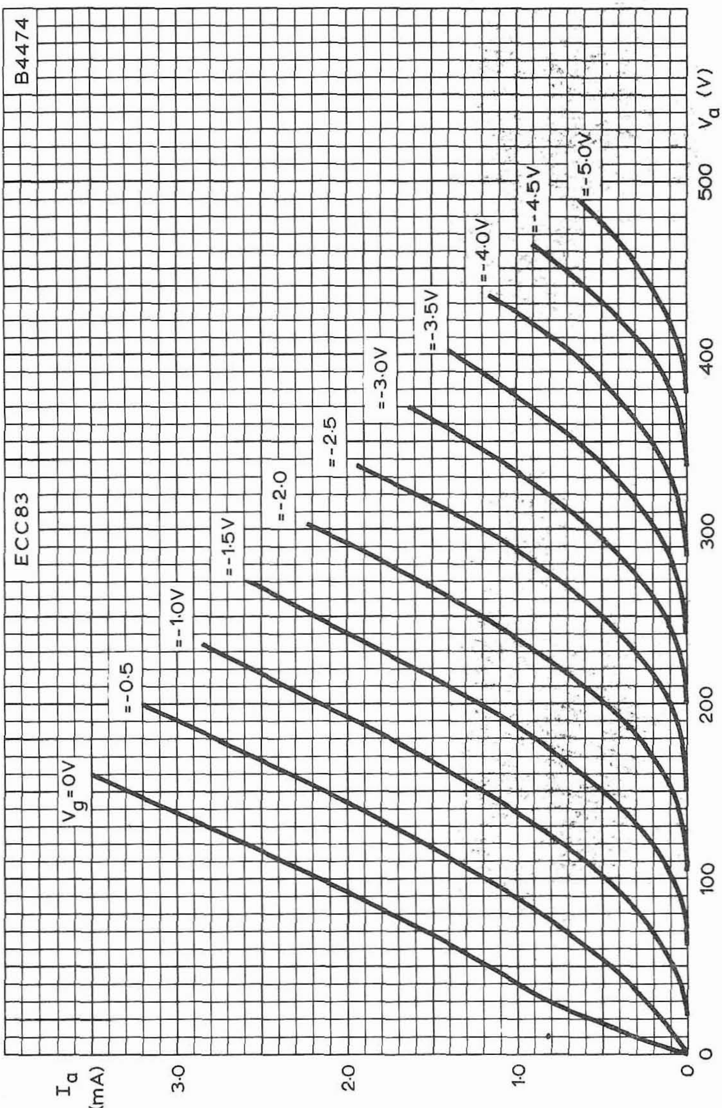




B9A Base



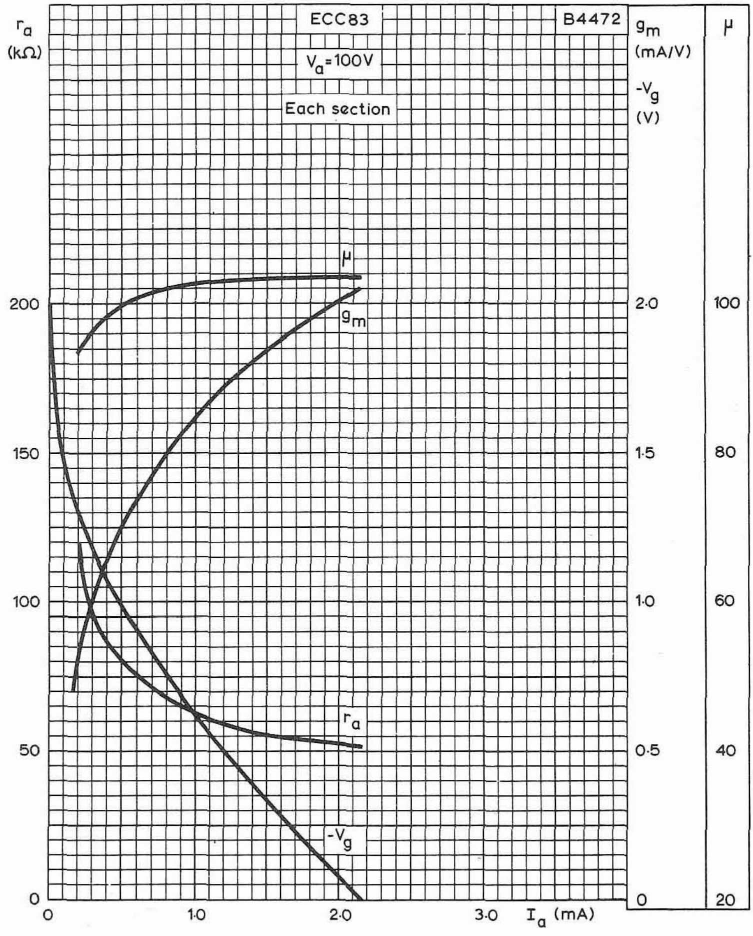
All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER (each section)

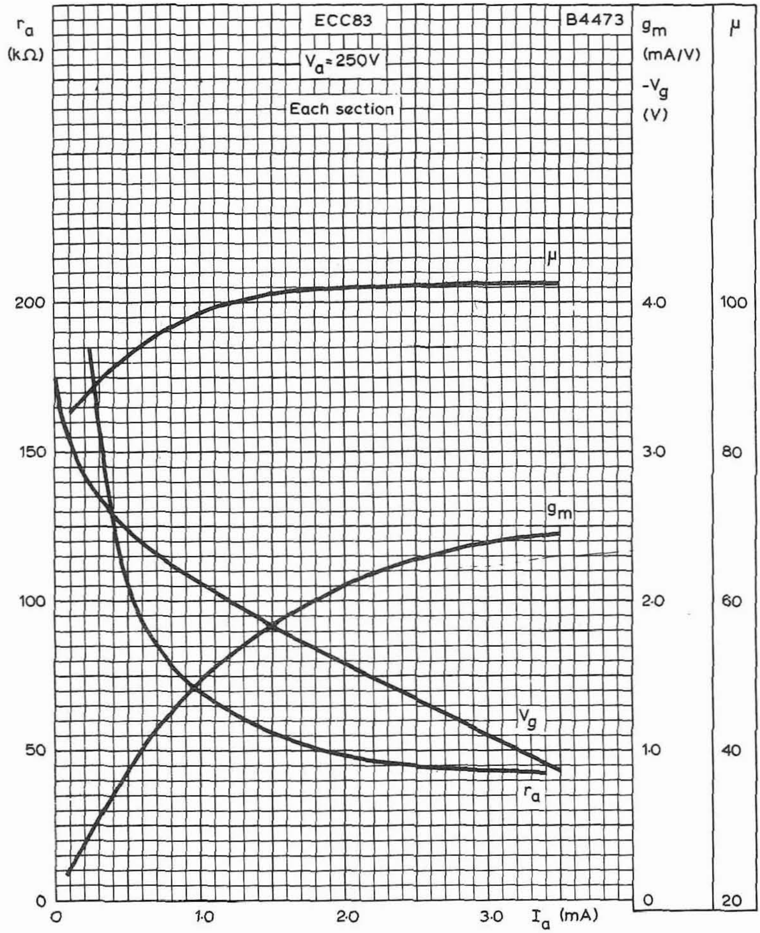
ECC83

DOUBLE TRIODE



MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT.
$V_a = 100V$

Mullard



MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT.

$V_a = 250V$

R.F. DOUBLE TRIODE

ECC85

Double triode primarily intended for use in f.m. receivers as an r.f. amplifier and self-oscillating additive mixer.

HEATER

V_h	6.3	V
I_h	435	mA

CAPACITANCES ←

$c_{a'-g'}$	1.5	pF
$c_{a'-k'}$	0.17	pF
$c_{a'-k'+h+s}$	1.2	pF
$*c_{a'-k'+h+s}$	1.8	pF
$c_{g'-k'+h+s}$	3.1	pF
$c_{a''-g''}$	1.5	pF
$c_{a''-k''}$	0.18	pF
$c_{a''-k''+h+s}$	1.2	pF
$*c_{a''-k''+h+s}$	1.8	pF
$c_{g''-k''+h+s}$	3.1	pF
$c_{a'-g''}$	<8	mpF
$c_{a'-k''}$	<8	mpF
$c_{g'-k''}$	<3	mpF
$c_{a'-a''}$	<40	mpF
$*c_{a'-a''}$	<8	mpF
$c_{a''-g'}$	<8	mpF
$c_{a''-k'}$	<8	mpF
$c_{g''-k'}$	<3	mpF
$c_{g'-g''}$	<3	mpF

*Measured with an external shield

CHARACTERISTICS (each section)

V_a	250	V
I_a	10	mA
V_g	-2.7	V ←
g_m	6.1	mA/V ←
μ	55	←
r_a	9.0	kΩ ←

OPERATING CONDITIONS AS R.F. AMPLIFIER

V_b	250	V
V_a	230	V
R_a	1.8	kΩ
I_a	10.8	mA ←
R_k	200	Ω
g_m	6.8	mA/V ←
r_a	8.3	kΩ ←
r_{g1} (f = 100Mc/s)	4.7	kΩ ←
R_{eq}	580	Ω ←

OPERATING CONDITIONS AS SELF-OSCILLATING FREQUENCY CHANGER

V_b	250	V
R_a	12	kΩ
R_{g-k}	1.0	MΩ
I_a	6.0	mA ←
V_{osc} (r.m.s.)	3.0	V
g_c	3.0	mA/V ←
r_a	18	kΩ ←

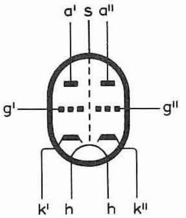
RATINGS (ABSOLUTE MAXIMUM SYSTEM)

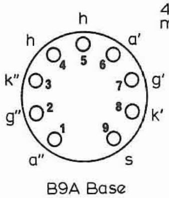
(each section unless otherwise specified)

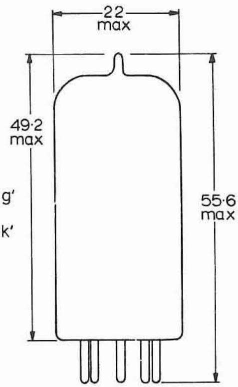
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$p_{a'} + p_{a''}$ max.	4.5	W
I_k max.	15	mA
$-V_g$ max.	100	V
R_{g-k} max.	1.0	MΩ
*V_{h-k} max.	90	V
R_{h-k} max.	20	kΩ

*When operating as an oscillator no r.f. voltage should be applied between heater and cathode. ←

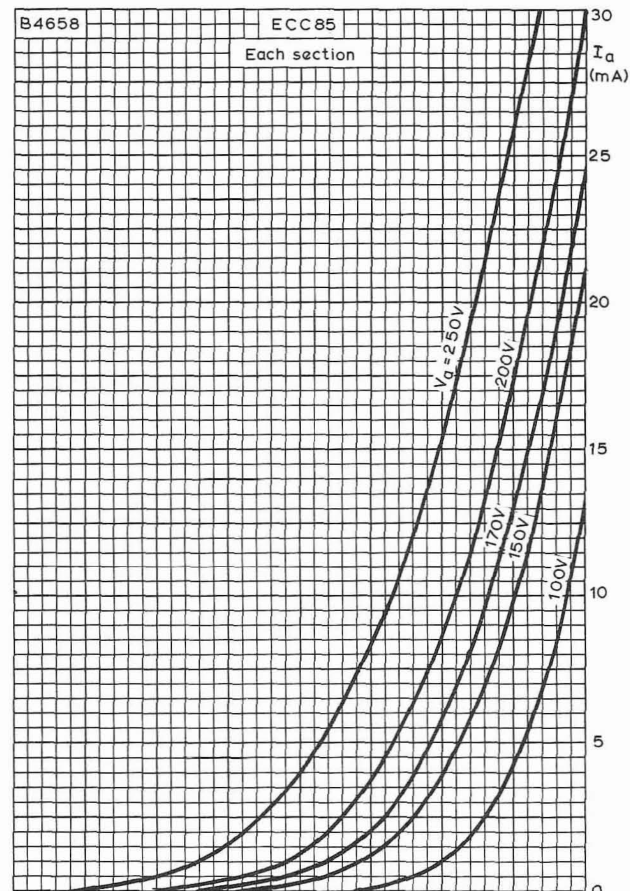
B4669



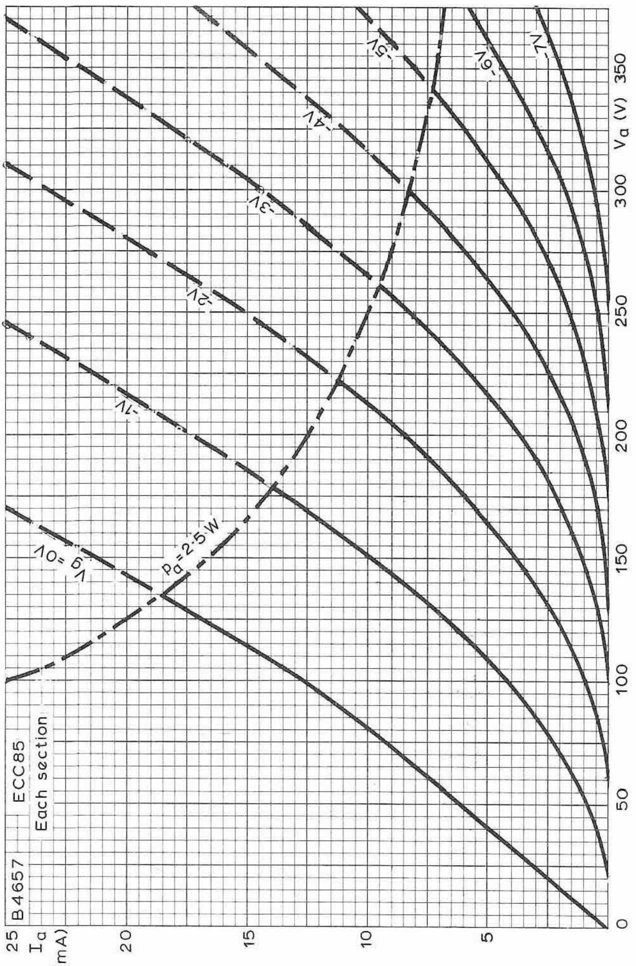




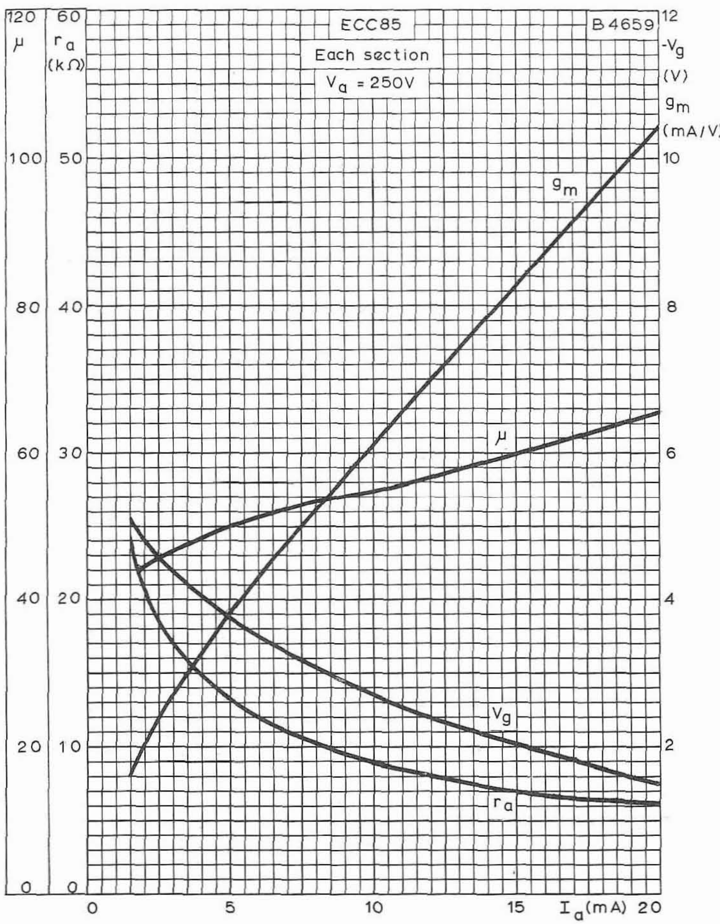
All dimensions in mm ←



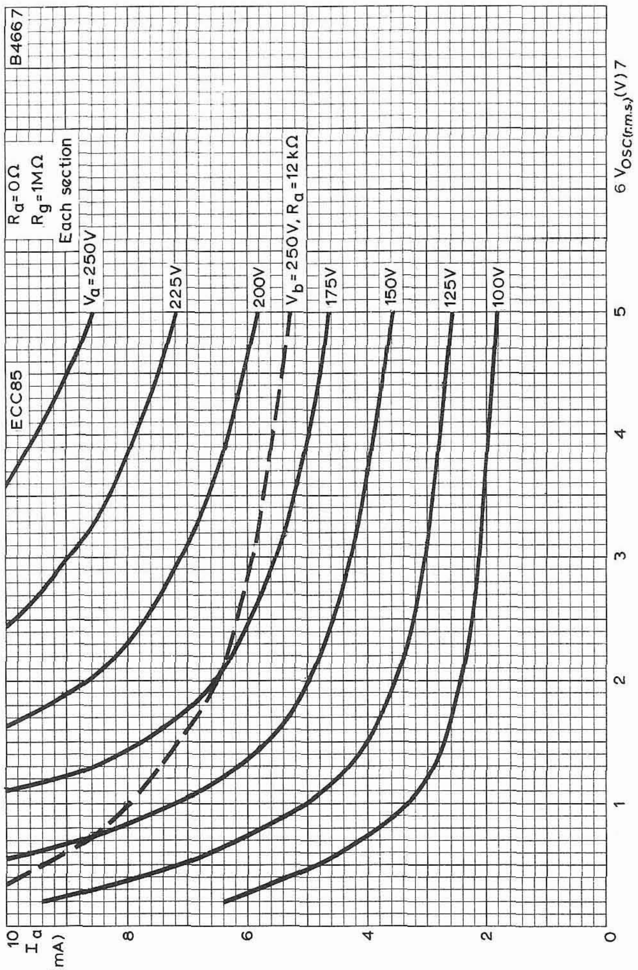
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST CURRENT. V_a = 250V



ANODE CURRENT PLOTTED AGAINST OSCILLATOR VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

V.H.F. DOUBLE TRIODE

ECC88

High slope, low noise v.h.f. frame grid double triode for use as a cascode amplifier.

HEATER

V_h	6.3	V
I_h	365	mA

CAPACITANCES

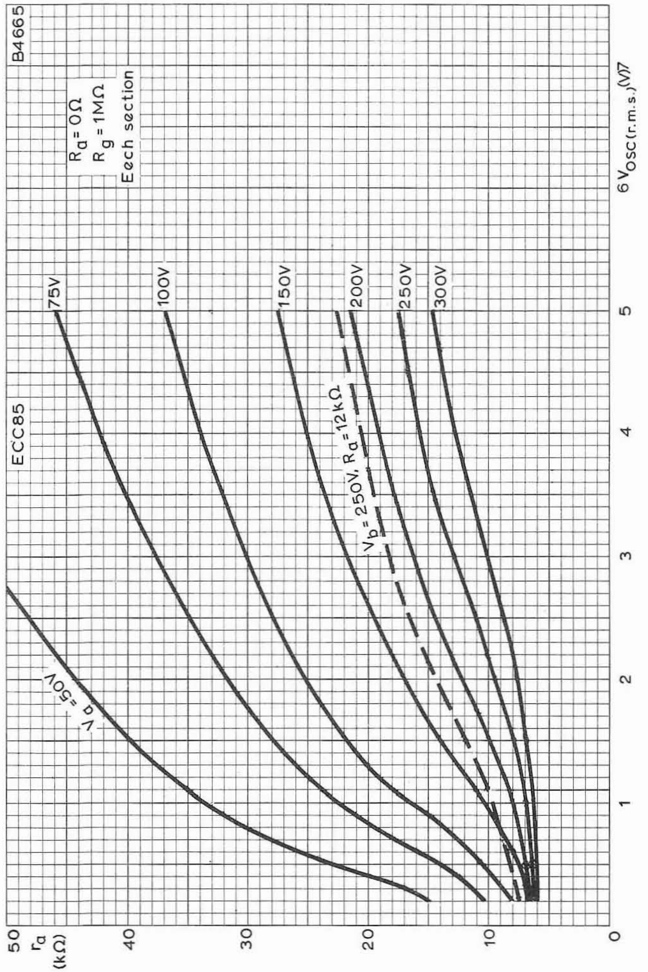
	Shielded	Unshielded	
$c_{a'-a''}$	<15	<45	mpF
$c_{g'-a''}$	<5	<5	mpF
Grounded cathode section			
$c_{a'-g'}$	1.4	1.4	pF
$c_{g'-k'+h+s}$	3.3	3.3	pF
$c_{a'-k'+h+s}$	2.5	1.8	pF
$c_{g'-h}$	130	130	mpF
Grounded grid section			
$c_{a''-g''}$	1.4	1.4	pF
$c_{k''-g''+h+s}$	6.0	6.0	pF
$c_{a''-g''+h+s}$	3.7	2.8	pF
$c_{k''-h}$	2.7	2.7	pF
$c_{a''-k''}$	160	180	mpF

CHARACTERISTICS

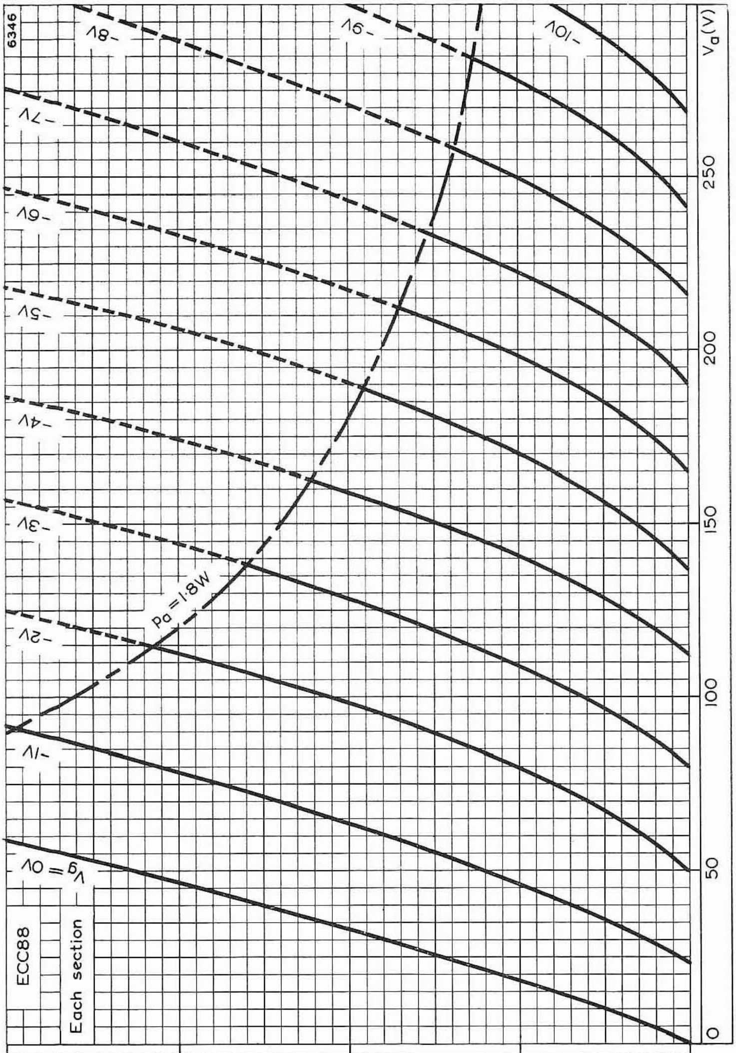
V_a	90	V
V_g	−1.3	V
I_a	15	mA
g_m	12.5	mA/V
r_a	2.6	kΩ
μ	33	
R_{eq}	300	Ω

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	130	V
p_a max.	1.8	W
I_k max.	25	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
$V_{h-k'}$ max.	50	V
$V_{h-k''}$ max. (cathode positive)	150	V
R_{h-k} max.	20	kΩ



ANODE IMPEDANCE PLOTTED AGAINST OSCILLATOR VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

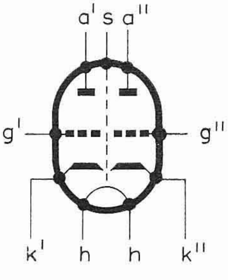


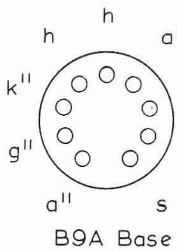
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER IN THE REGION OF THE ORIGIN

NOTES

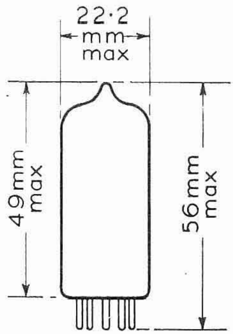
In order not to exceed the maximum permissible anode voltage when the cascode amplifier is controlled, it is necessary to use a voltage divider for the grid of the grounded grid section. With grid current biasing for the grounded cathode section, the anode voltage across this section should not be more than 75V in the non-controlled condition.

5242





B9A Base



The triode on pins 6, 7, 8, should have the grounded cathode connection and that on pins 1, 2, 3, should have the grounded grid connection.

TRIODE PENTODE

ECF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

HEATER

V_h	6.3	V
I_h	430	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

c_{ap-at}	<0.06	pF
c_{ap-gt}	<0.02	pF
c_{gp-at}	<0.16	pF
c_{gp-gt}	<0.02	pF

Pentode section

$^*c_{a-g1}$	<0.025	pF
c_{in}	5.5	pF
c_{out}	3.8	pF

*May be reduced to <0.01pF by the use of a skirted base.

Triode section

c_{a-k+h}	1.8	pF
c_{g-k+h}	2.5	pF
c_{a-g}	1.5	pF

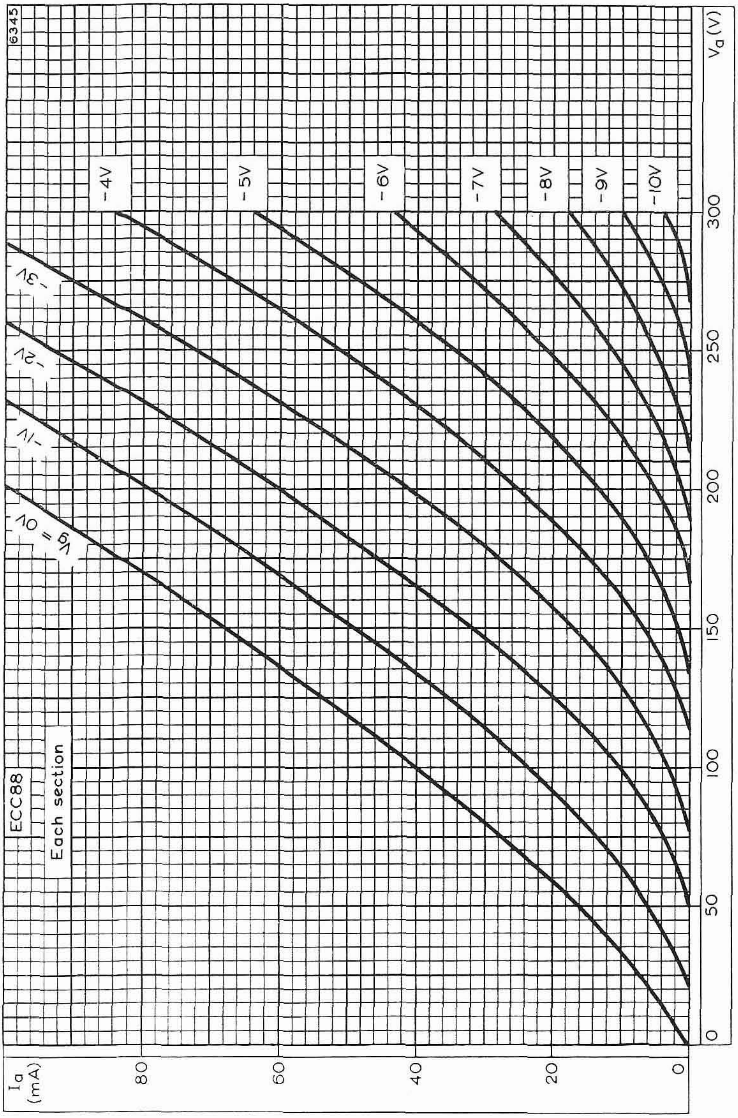
CHARACTERISTICS

Pentode section

V_a	250	V
V_{g2}	200	V
V_{g1}	–3.2	V
I_a	7.0	mA
I_{g2}	1.8	mA
g_m	5.5	mA/V
r_a	900	kΩ
μ_{g1-g2}	47	
R_{in} (f=50Mc/s)	11	kΩ
R_{eq}	1.5	kΩ

Triode section

V_a	100	V
I_a	14	mA
V_g	–2.0	V
g_m	5.0	mA/V
μ	20	
r_a	4.0	kΩ



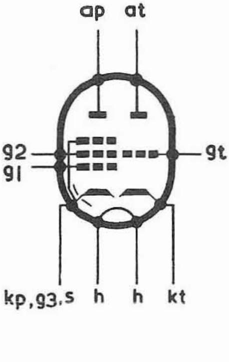
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

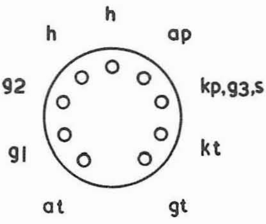
TRIODE PENTODE

ECF80

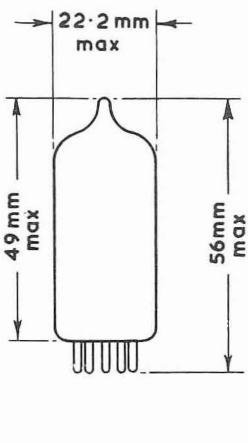
Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

3222





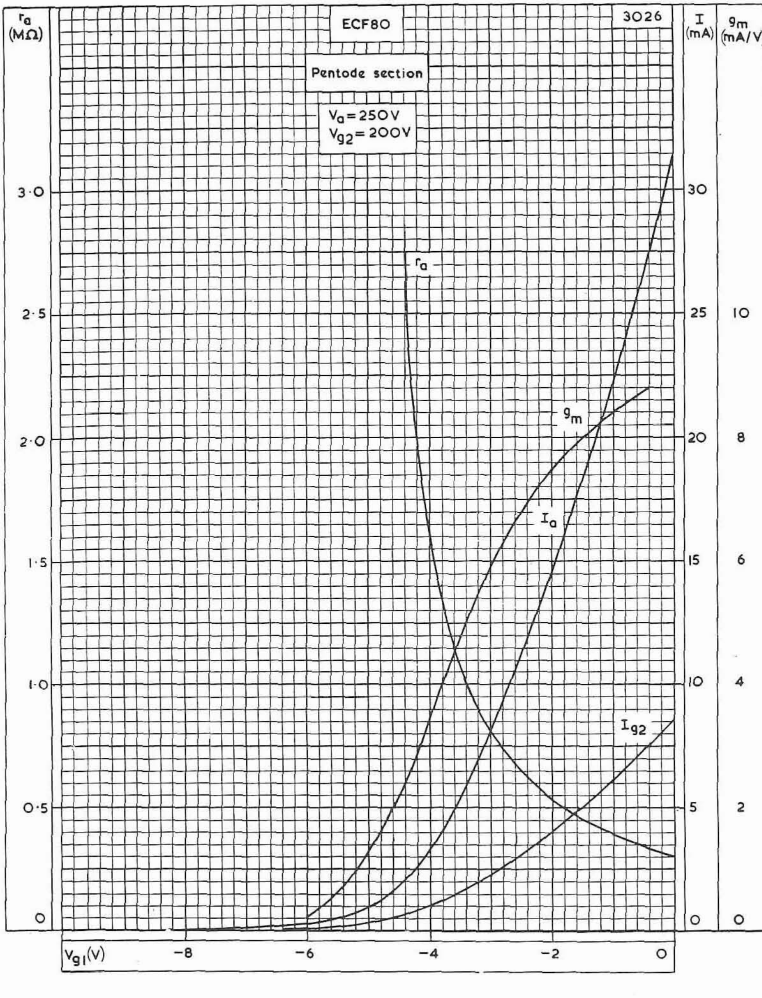
B9A Base



TRIODE PENTODE

ECF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE OF PENTODE SECTION. V_a=250V, V_{g2}=200V

ECF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

TYPICAL OPERATING CONDITIONS

As a frequency changer

$V_a = V_b$	250	250	V
R_{g2}	68	47	kΩ
R_{g1}	100	100	kΩ
R_k	0	820	Ω
I_a	5.6	5.7	mA
I_{g2}	1.52	1.4	mA
$V_{osc(r.m.s.)}$	4.0	3.5	V
I_{g1}	58	0	μA
g_c	1.95	2.1	mA/V
r_a	1.15	1.5	MΩ

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.7	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_k \leq 10$mA)	200	V
V_{g2} max. ($I_k > 10$mA)	175	V
p_{g2} max. ($p_a \leq 1.2$W)	750	mW
p_{g2} max. ($p_a > 1.2$W)	500	mW
I_k max.	14	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	-1.3	V
R_{g1-k} max. (cathode bias)	1.0	MΩ
R_{g1-k} max. (fixed bias)	500	kΩ
V_{h-k} max. (cathode positive)	150	V
V_{h-k} max. (cathode negative)	100	V

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max	1.5	W
I_k max.	14	mA
*$i_{k(pk)}$ max.	200	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	-1.3	V
$-v_{g1(pk)}$ max.	350	V
V_{h-k} max. (cathode positive)	150	V
V_{h-k} max. (cathode negative)	100	V

*Max. pulse duration 200μs

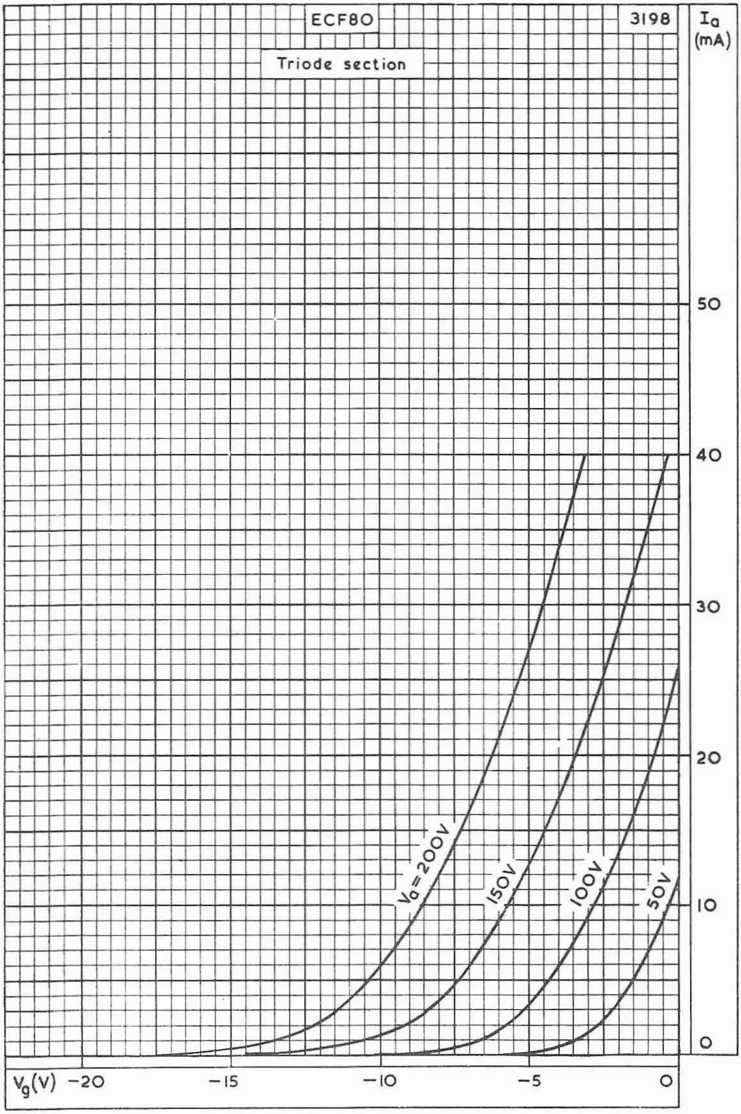
OPERATING NOTE

It is anticipated that variations in heater-to-cathode capacitance may render the valve unsuitable for use in Hartley oscillator circuits, particularly in f.m. receivers. For this reason it is recommended that a Colpitts type of circuit be employed.

TRIODE PENTODE

ECF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

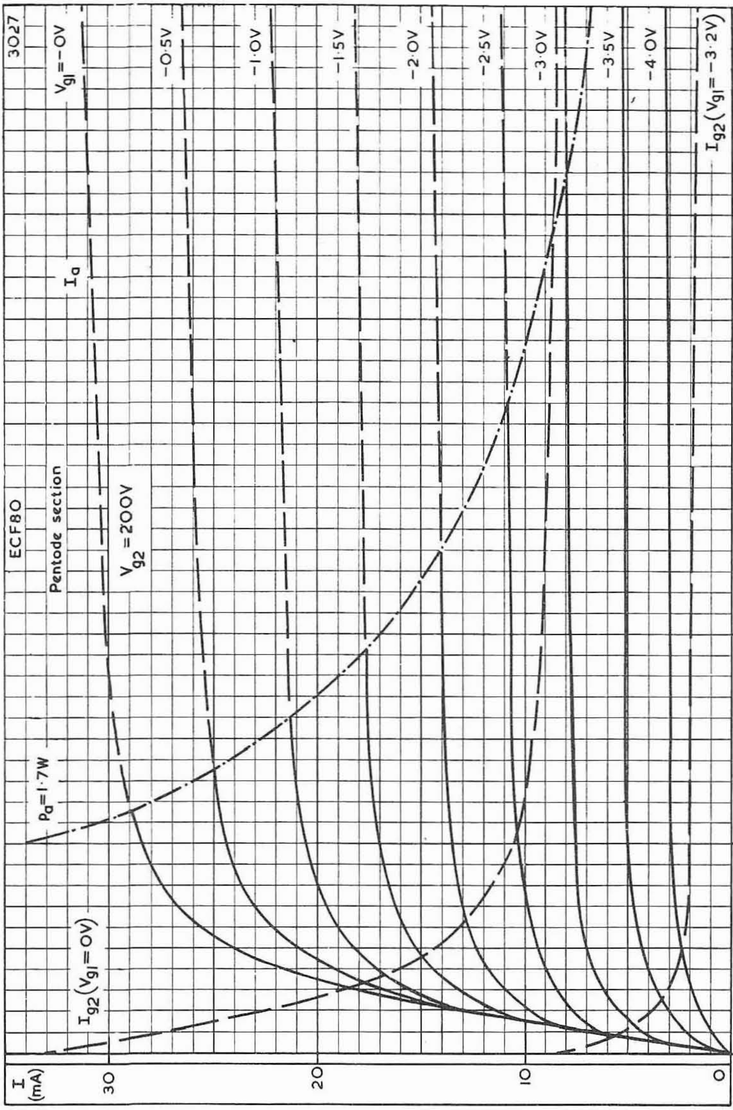


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR TRIODE SECTION FOR VARIOUS VALUES OF ANODE VOLTAGE

ECF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

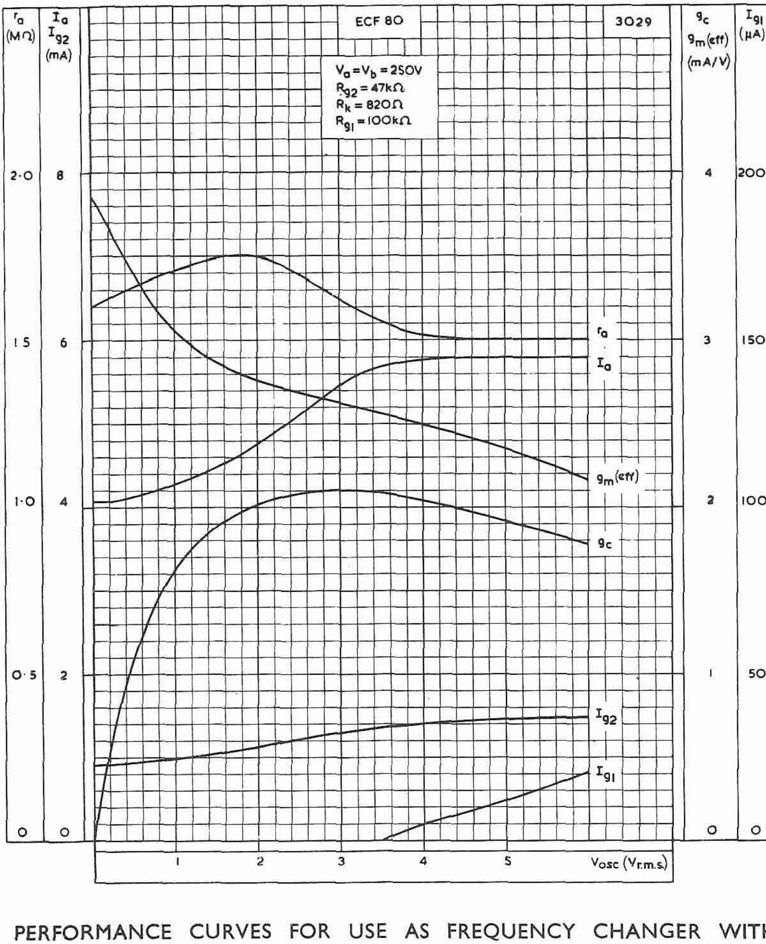


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE FOR PENTODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

TRIODE PENTODE

ECF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

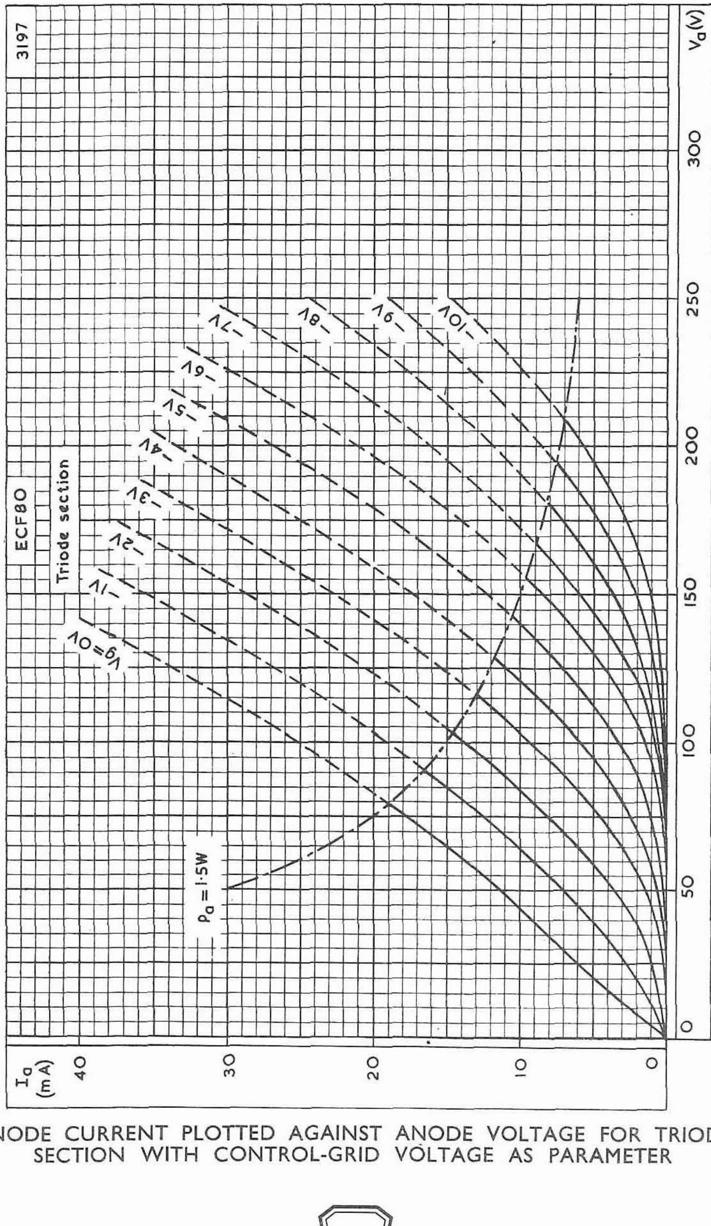


PERFORMANCE CURVES FOR USE AS FREQUENCY CHANGER WITH $R_k = 820\Omega$

ECF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR TRIODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

TRIODE HEPTODE

ECH83

Triode heptode intended for use as a frequency changer or combined r.f. and a.f. amplifier in equipment operating directly from a 6V, 12V or 24V battery, on or off charge.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{ah-at}	200	mpF
c_{ah-gt}	<90	mpF
$c_{ah-g3+gt}$	<350	mpF
c_{g1-at}	<60	mpF
c_{g1-gt}	<170	mpF
$c_{g1-g3+gt}$	<450	mpF

Heptode section

$c_{in(g1)}$	4.8	pF
$c_{in(g3)}$	6.0	pF
c_{out}	7.9	pF
c_{a-g1}	<12	mpF
c_{g1-g3}	<300	mpF

Triode section

c_{in}	2.6	pF
c_{out}	2.1	pF
c_{a-g}	1.0	pF

OPERATING CONDITIONS OF HEPTODE SECTION AS R.F. AMPLIFIER

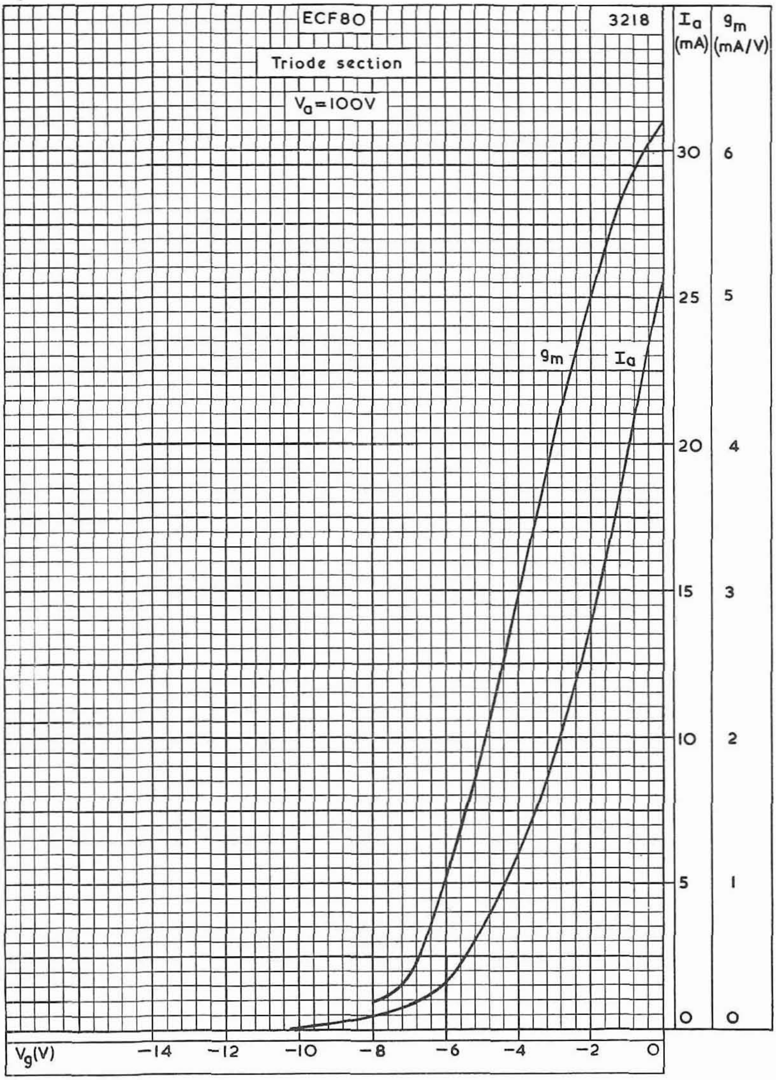
$V_a = V_b$	6.3	12.6	25	V
$V_{g2+g3+g4}$	6.3	12.6	25	V
$*V_{g1(b)}$	0	0	0	V
V_{g1}	†	†	†	
R_{g1}	1.0	1.0	1.0	MΩ
I_a	0.11	0.4	1.25	mA
$I_{g2+g3+g4}$	80	250	850	µA
g_m	0.35	0.75	1.5	mA/V
r_a	600	850	200	kΩ
R_{eq}	8.5	6.5	5.0	kΩ
V_{g1} (for 100 : 1 reduction in g_m)	−2.0	−2.8	−4.4	V

$*V_{g1(b)}$ = Voltage at earthy end of grid leak.
†Obtained by grid current biasing.

ECF80

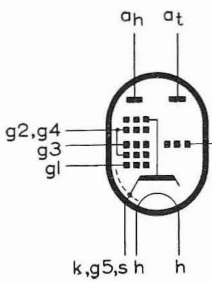
TRIODE PENTODE

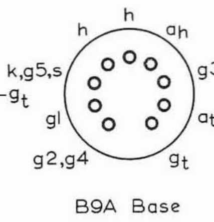
Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.



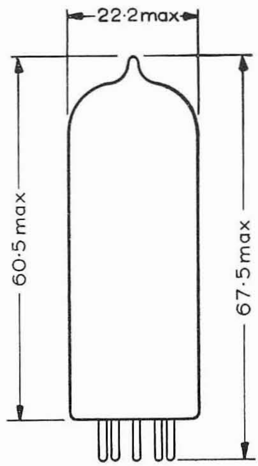
ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR TRIODE SECTION
$V_a = 100V$

TRIODE HEPTODE ECH83





B9A Base



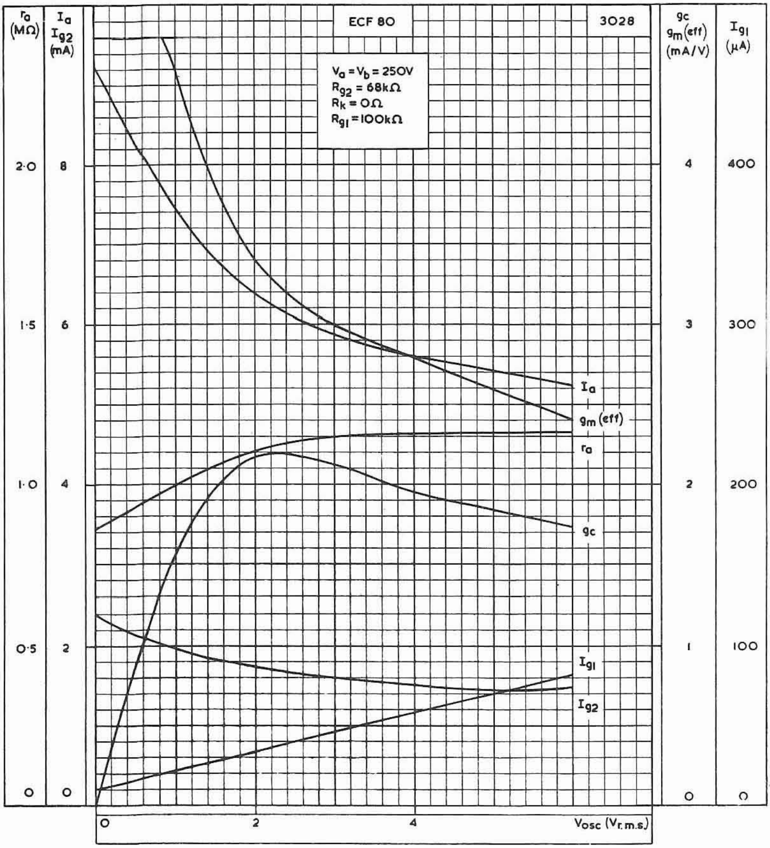
All dimensions in mm

6397

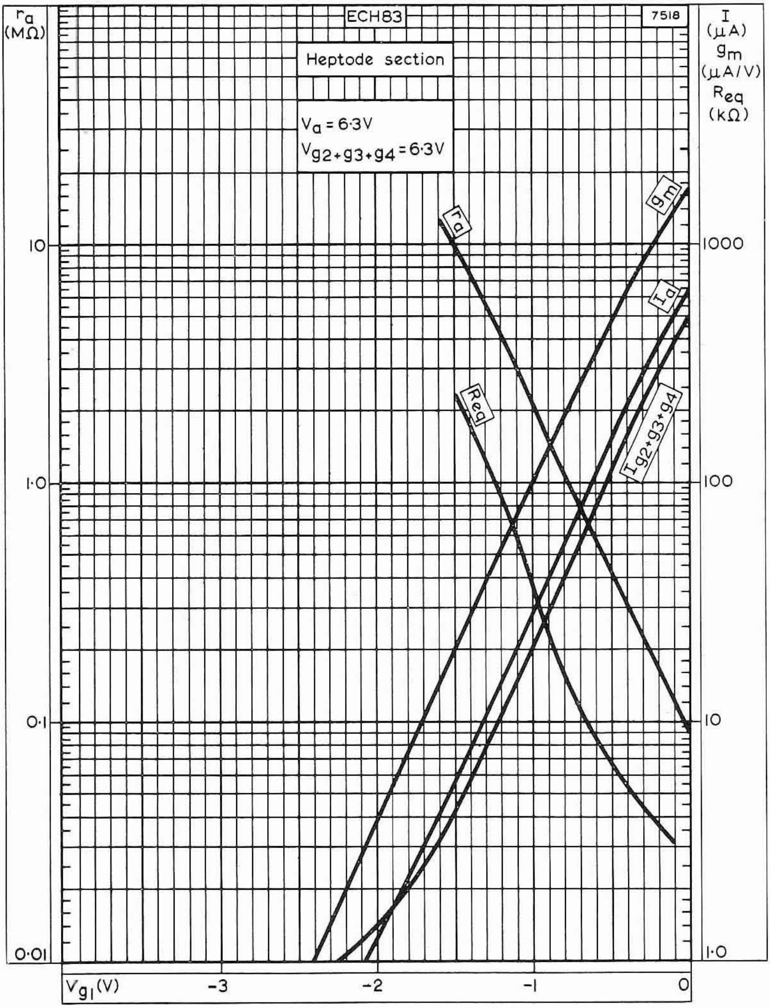
ECF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.



PERFORMANCE CURVES FOR USE AS FREQUENCY CHANGER WITH $R_k = 0\Omega$



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION

$V_a = V_{g2+g3+g4} = 6.3V$

ECH83

TRIODE HEPTODE

OPERATING CONDITIONS AS A.M. FREQUENCY CHANGER (multiplicative mixer)

Heptode section

$V_a = V_b$	6.3	12.6	25	V
V_{g2+g4}	6.3	12.6	25	V
$^*V_{g1(b)}$	0	0	0	V
V_{g1}	†	†	†	
R_{g1}	1.0	1.0	1.0	MΩ
I_a	18	100	460	μA
I_{g2+g4}	0.1	0.35	1.25	mA
I_{g3+gt}	28	32	54	μA
$V_{osc(r.m.s.)}$	0.9	1.2	2.0	V
R_{g3+gt}	47	47	47	kΩ
g_c	50	160	390	μA/V
r_a	3.75	3.8	1.1	MΩ

$^*V_{g1(b)}$ = Voltage at earthy end of grid leak.
†Obtained by grid current biasing with $R_{g1} = 1.0$MΩ.

Triode section

$V_a = V_b$	12.6	V
V_g	0	V
I_a	750	μA
g_m	1.4	mA/V
I_{gt+g3}	42	μA
R_{gt+g3}	47	kΩ
$V_{gt+g3(r.m.s.)}$	1.7	V

OPERATING CONDITIONS OF TRIODE SECTION AS A.F. AMPLIFIER

V_b	12.6	V
R_a	150	kΩ
R_g	10	MΩ
R_{g1} (of following valve)	10	MΩ
V_{out}/V_{in}	8.0	
V_{out}	1.8	V
D_{tot}	5.0	%

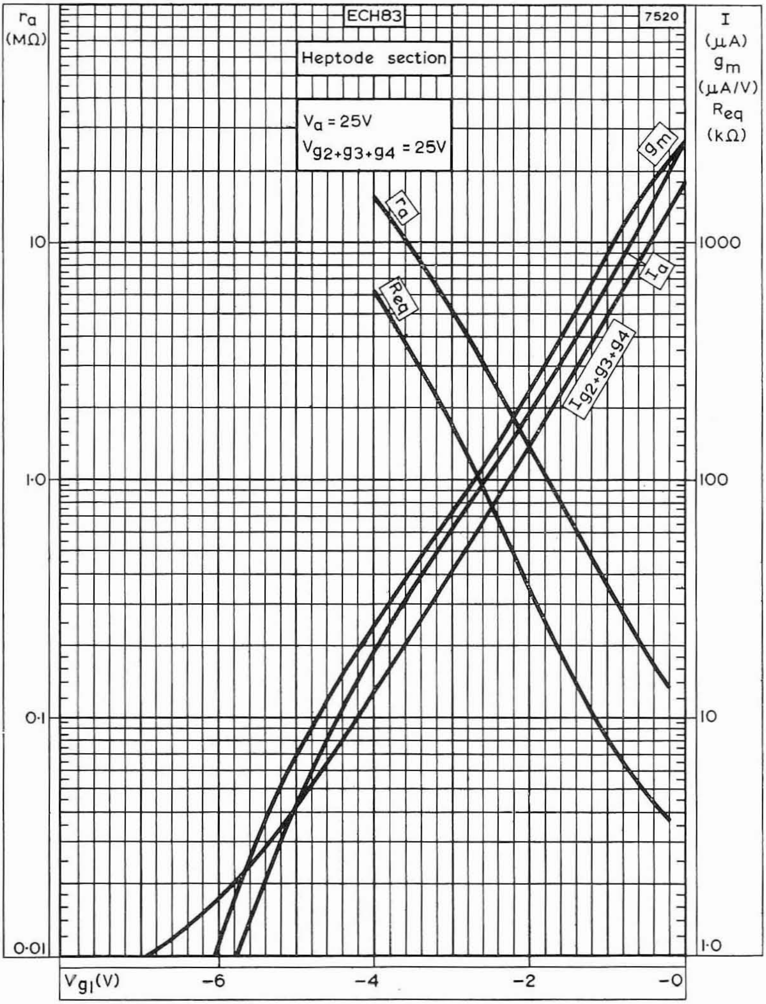
LIMITING VALUES

Heptode section

V_a max.	30	V
V_{g2+g4} max.	30	V
I_k max.	5.0	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	50	kΩ

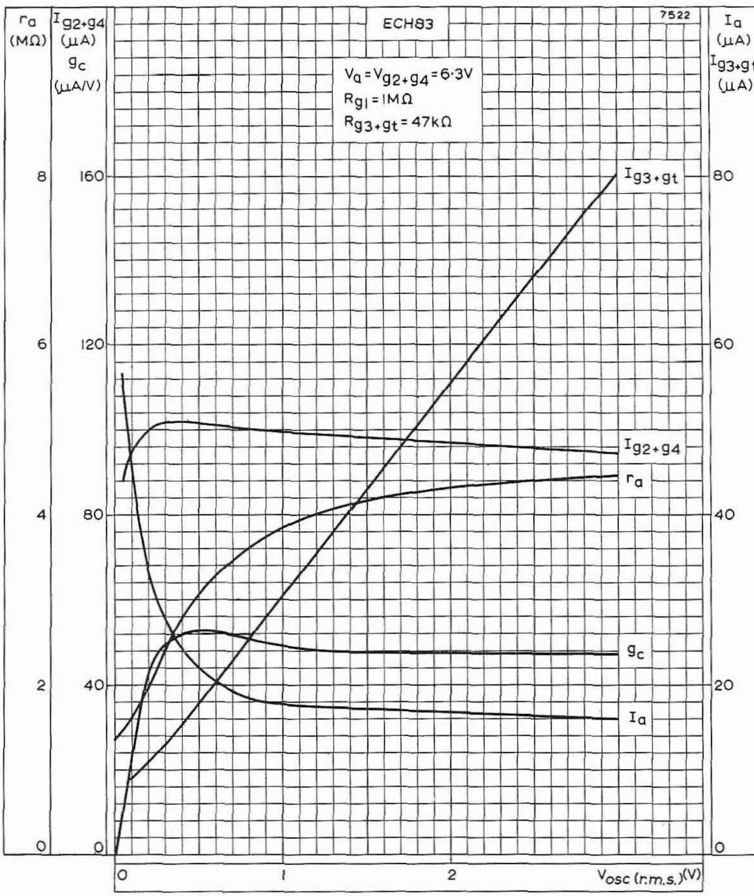
Triode section

V_a max.	30	V
I_k max.	3.0	mA



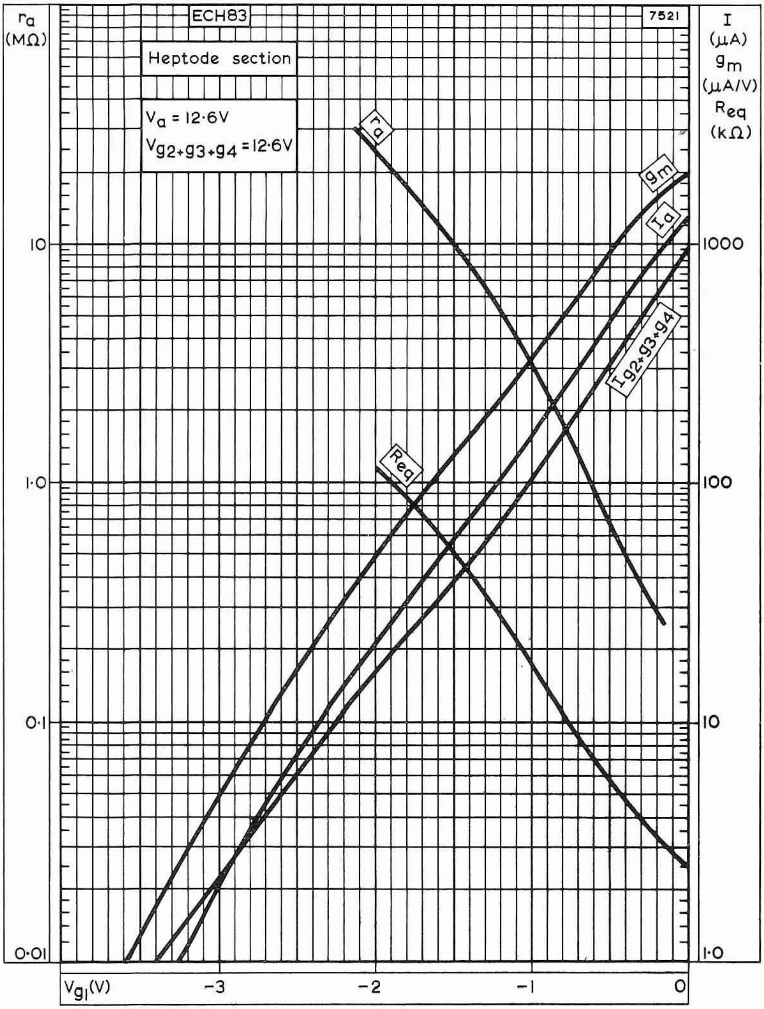
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION

$V_a = V_{g2+g3+g4} = 25V$



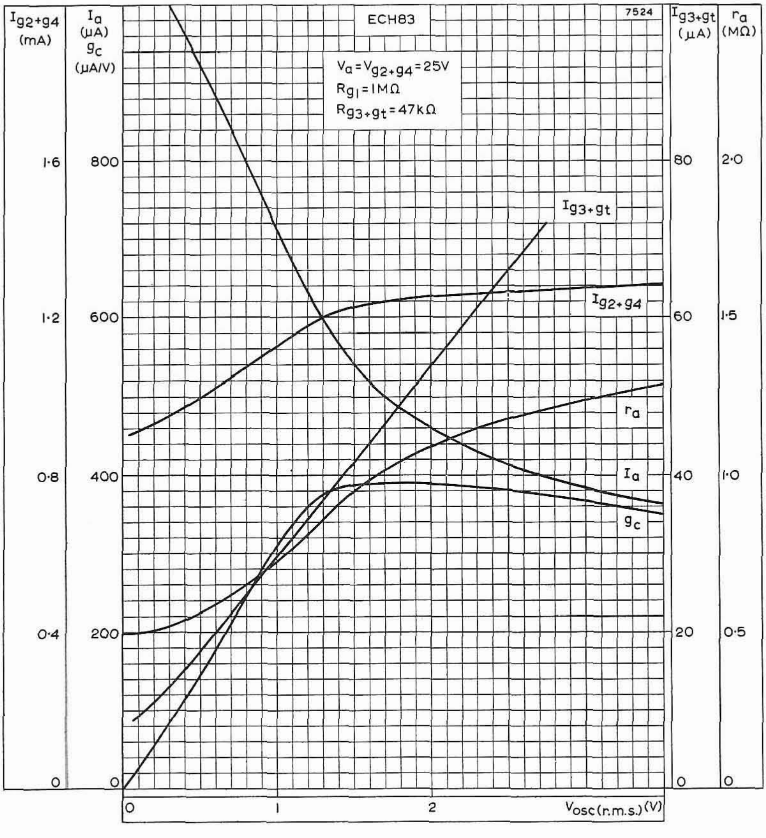
PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

$V_a = V_{g2+g4} = 6.3V$



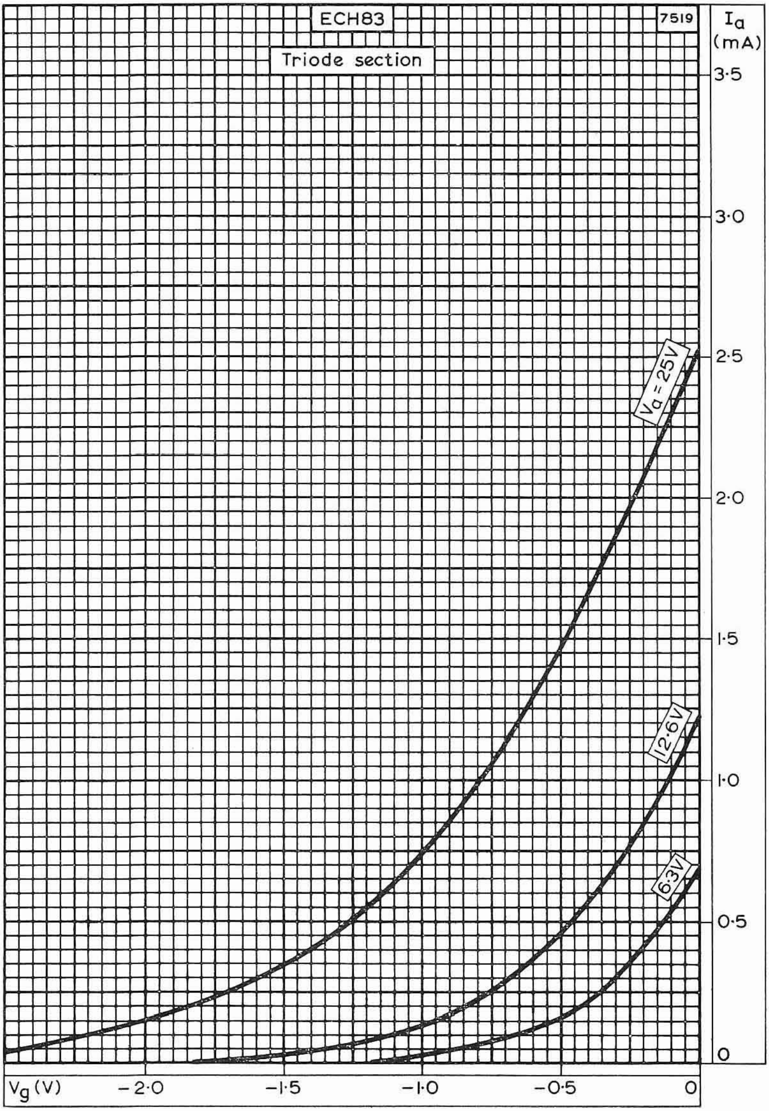
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION

$V_a = V_{g2+g3+g4} = 12.6V$



PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

$V_a = V_{g2+g4} = 25V$



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER. TRIODE SECTION

TRIODE HEPTODE

Triode heptode intended for use as a noise cancelled synchronising pulse separator and time base oscillator.

ECH84

HEATER

Suitable for series or parallel operation, a.c. or d.c.

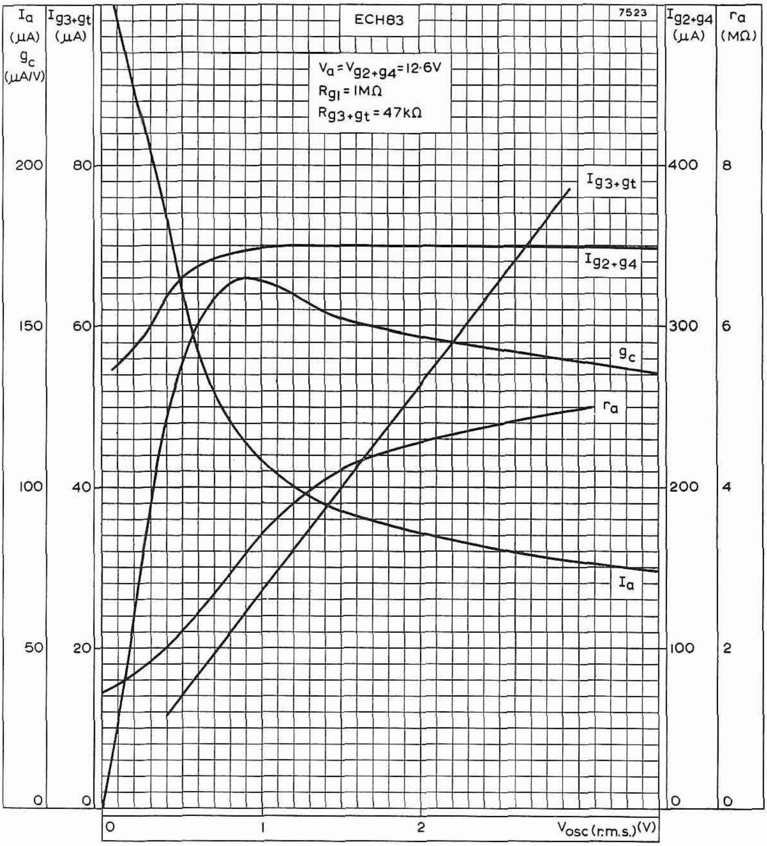
V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{ah-at}	<250	mpF
c_{ah-gt}	<90	mpF
c_{g1-at}	<80	mpF
c_{g1-gt}	<100	mpF
c_{g3-at}	<130	mpF
Heptode section		
c_{a-g1}	<9.0	mpF
Triode section		
c_{in}	3.0	pF
c_{a-g}	1.1	pF

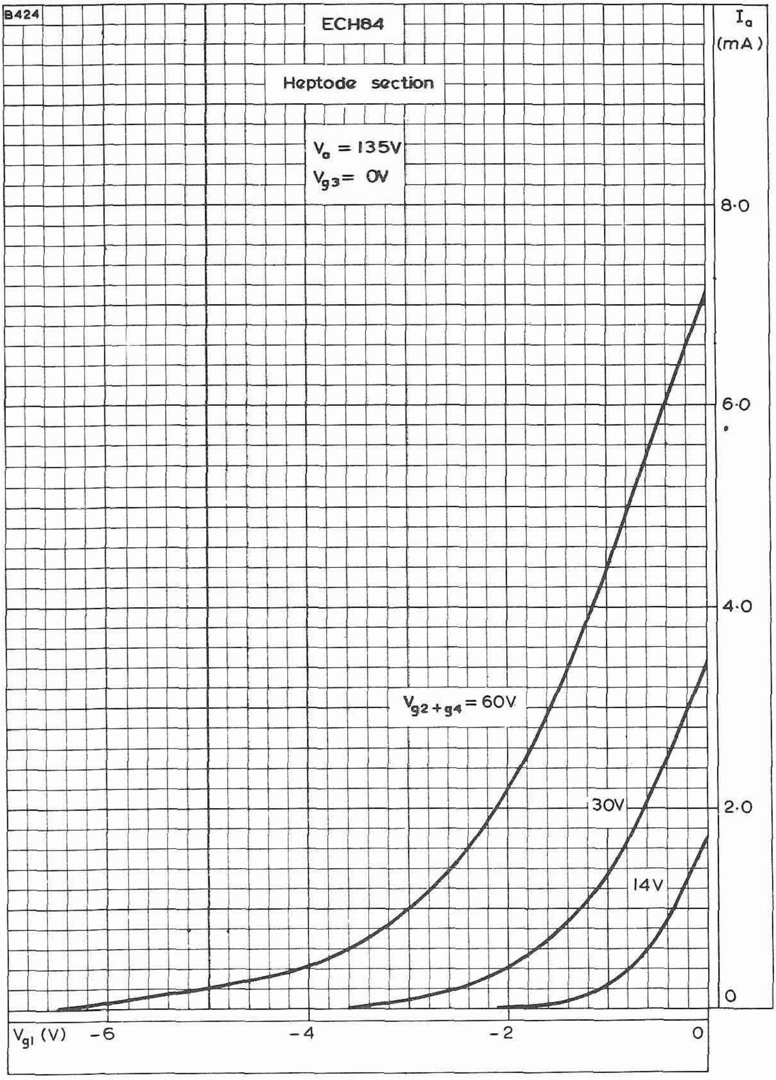
CHARACTERISTICS ←

Heptode section		
V_a	135	V
V_{g3}	0	V
V_{g2+g4}	14	V
V_{g1}	0	V
I_a	1.7	mA
I_{g2+g4}	900	µA
g_m	2.2	mA/V
V_{g3} ($Ia=20\mu A$)	-2.0	V
V_{g1} ($Ia=20\mu A$)	-1.9	V
$-V_{g3}$ max. ($I_{g1} = +0.3\mu A$)	1.3	V
$-V_{g1}$ max. ($I_{g3} = +0.3\mu A$)	1.3	V
Triode section		
V_a	50	V
V_g	0	V
I_a	3.0	mA
g_m	3.7	mA/V
μ	50	
I_a ($V_a=200V$, $V_g=-11V$)	<100	µA
$-V_g$ max. ($I_g = +0.3\mu A$)	1.3	V



PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

$V_a = V_{g2+g4} = 12.6V$



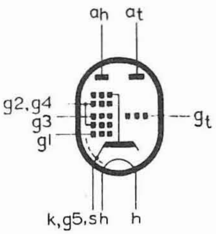
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

ECH84

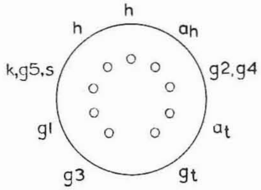
TRIODE HEPTODE

DESIGN CENTRE RATINGS

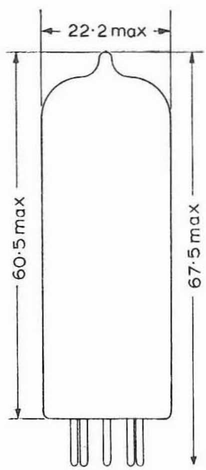
Heptode section		
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.7	W
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max.	250	V
V_{g2+g4} min.	10	V
p_{g2+g4} max.	800	mW
$-v_{g1(pk)}$ max.	150	V
$-v_{g3(pk)}$ max.	150	V
I_k max.	12.5	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	100	V
Triode section		
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.3	W
$-v_{g(pk)}$ max.	200	V
I_k max.	10	mA
R_{g-k} max.	3.0	MΩ



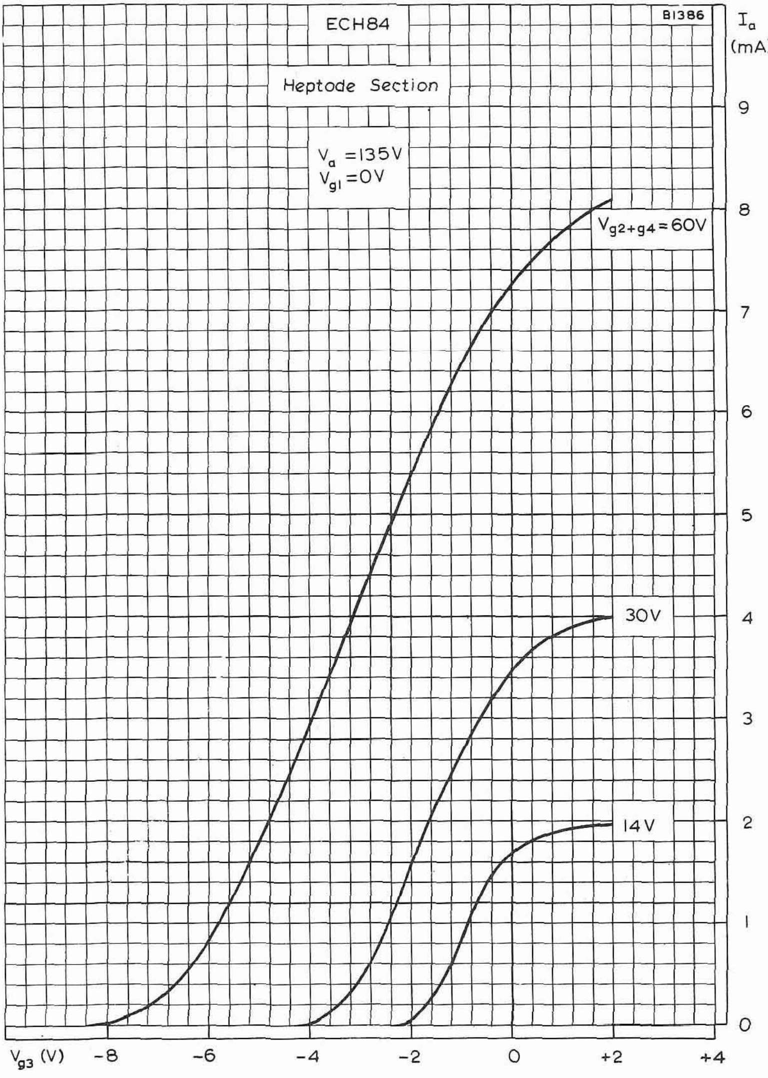
8808



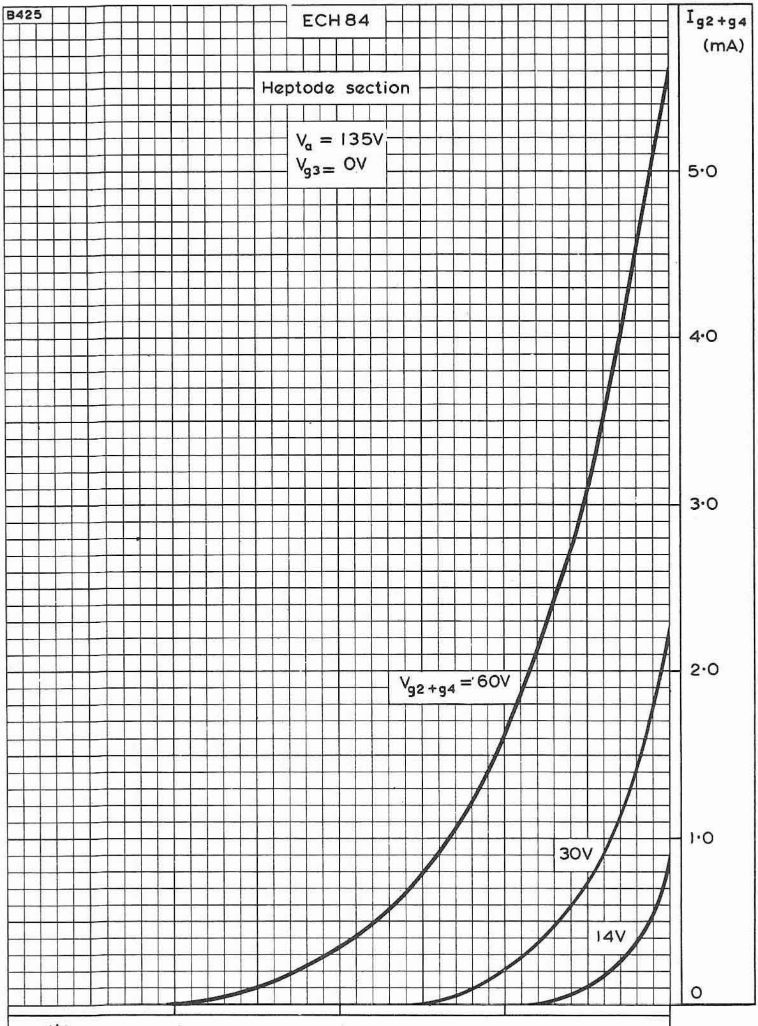
B9A Base



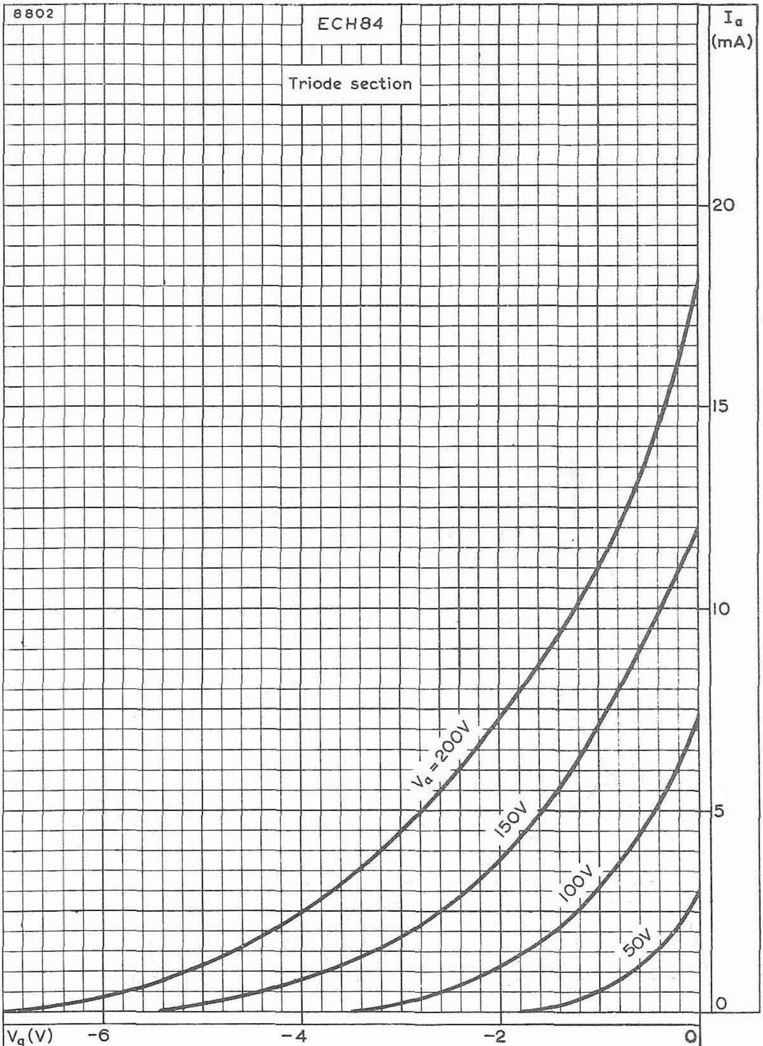
All dimensions in mm



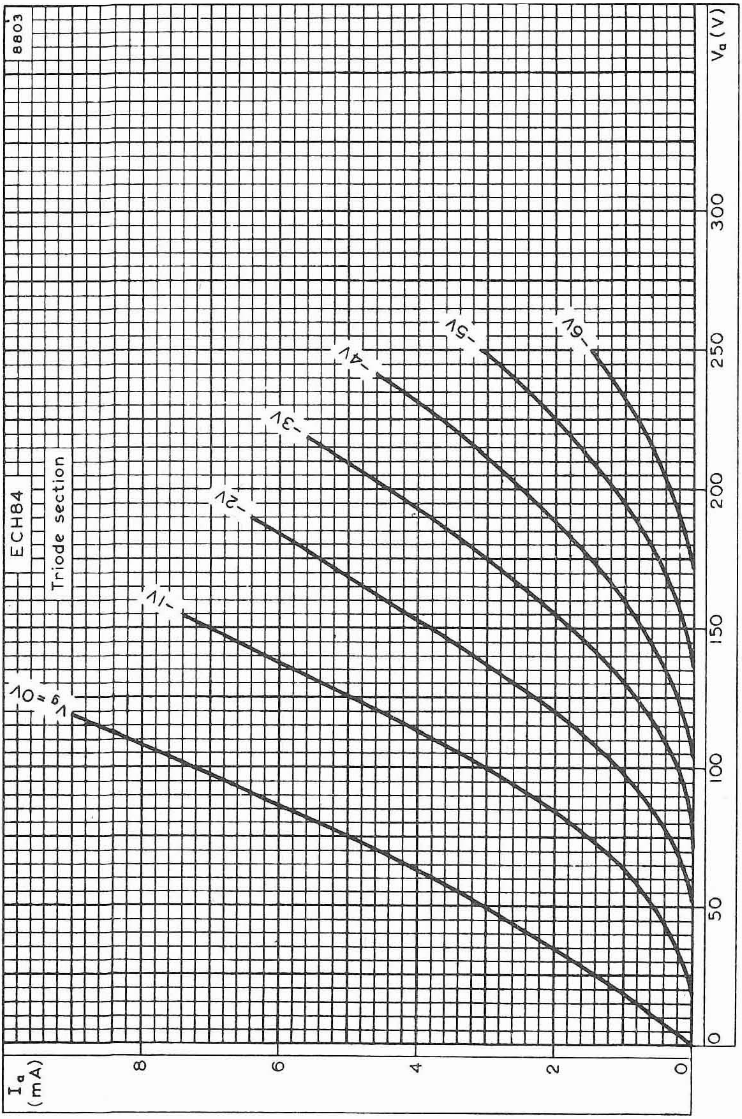
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_3) VOLTAGE.
HEPTODE SECTION



SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER. TRIODE SECTION

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

HEATER

Suitable for series or parallel operation, a.c. or d.c

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{gt-ap}	<0.12	pF
c_{at-ap}	<1.2	pF
c_{gt-g1}	<0.2	pF
c_{at-g1}	<0.2	pF
c_{h-k}	3.7	pF←

Pentode Section

c_{in}	4.5	pF
c_{out}	5.0	pF
c_{a-g1}	<0.2	pF
c_{g1-h}	<0.25	pF

Triode Section

c_{gt-k}	2.0	pF
c_{at-k}	0.3	pF
c_{at-gt}	0.9	pF
c_{gt-h}	<0.05	pF

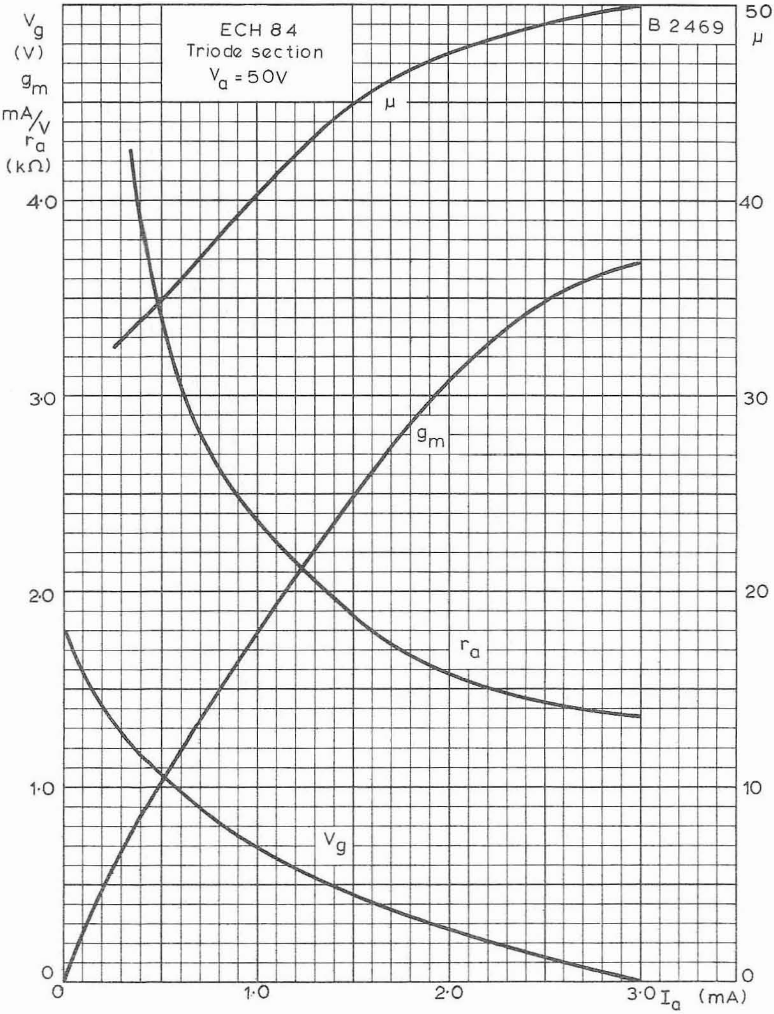
CHARACTERISTICS

Pentode Section

V_a	170	200	V
V_{g2}	170	200	V
V_{g3}	0	0	V
I_a	15	17.5	mA
I_{g2}	2.8	3.3	mA
V_{g1}	−6.7	−8.0	V
g_m	3.2	3.3	mA/V
r_a	150	150	kΩ
μ_{g1-g2}	14	14	

Triode Section

V_{at}	100	V
I_{at}	4.0	mA
V_{gt}	−2.3	V
g_m	1.4	mA/V
r_a	12.5	kΩ
μ	17.5	



AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND CONTROL-GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. V_a = 50V. TRIODE SECTION

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

Operating Conditions

V_b (V)	R_a (k Ω)	I_{at} (mA)	$-V_{gt}$ (V)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}† (k Ω)
170	47	1.8	3.5	9.5	22	8.7	150
170	400	1.0	3.5	10.5	24	7.6	330
170	220	0.5	3.5	11	24.5	6.5	680
200	47	2.2	4.2	9.5	27	9.0	150
200	100	1.2	4.2	10.5	29	8.0	330
200	220	0.6	4.2	11	30	6.5	680

* Output voltage and distortion at the start of positive grid current. At lower output voltages the distortion is approximately proportional to the voltage.

† Grid resistor of the following valve.

LIMITING VALUES

Pentode Section

$V_{a(b)}$ max.	550	V
$v_{a(pk)}$ max.	1.2	kV
V_a max.	400	V
p_a max.	3.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W←
I_k max.	25	mA
* $i_{k(pk)}$ max.	350	mA←
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max. (I_k=12 mA) (frame output valve)	2.2	M Ω
R_{g1-k} max. (I_k=20 mA) (audio output valve)	1.0	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

* Max. pulse duration 10% of one cycle, with a maximum of 2 m secs.

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

PENTODE SECTION AS FRAME OUTPUT VALVE

Typical Data

V_a	170	200	V
V_{g2}	170	200	V
V_{g3}	0	0	V
V_{g1}	−9.0	−10.6	V
$I_{a(0)}$	8.5	10	mA
$I_{g2(0)}$	1.6	1.9	mA

Circuit Design

To allow for valve spread and deterioration during life the frame output circuit should be designed around the following values of :—

V_a	50	60	V
V_{g2}	170	200	V
I_a	26	31	mA

PENTODE SECTION AS SYNCHRONISING PULSE SEPARATOR

Typical Data

V_a	20	V
V_{g2}	15	V
V_{g3}	0	V
V_{g1} ($I_a = 100\mu A$)	−1.4	V
I_a ($V_{g1} = 0$)	2.0	mA

PENTODE SECTION AS AUDIO OUTPUT VALVE

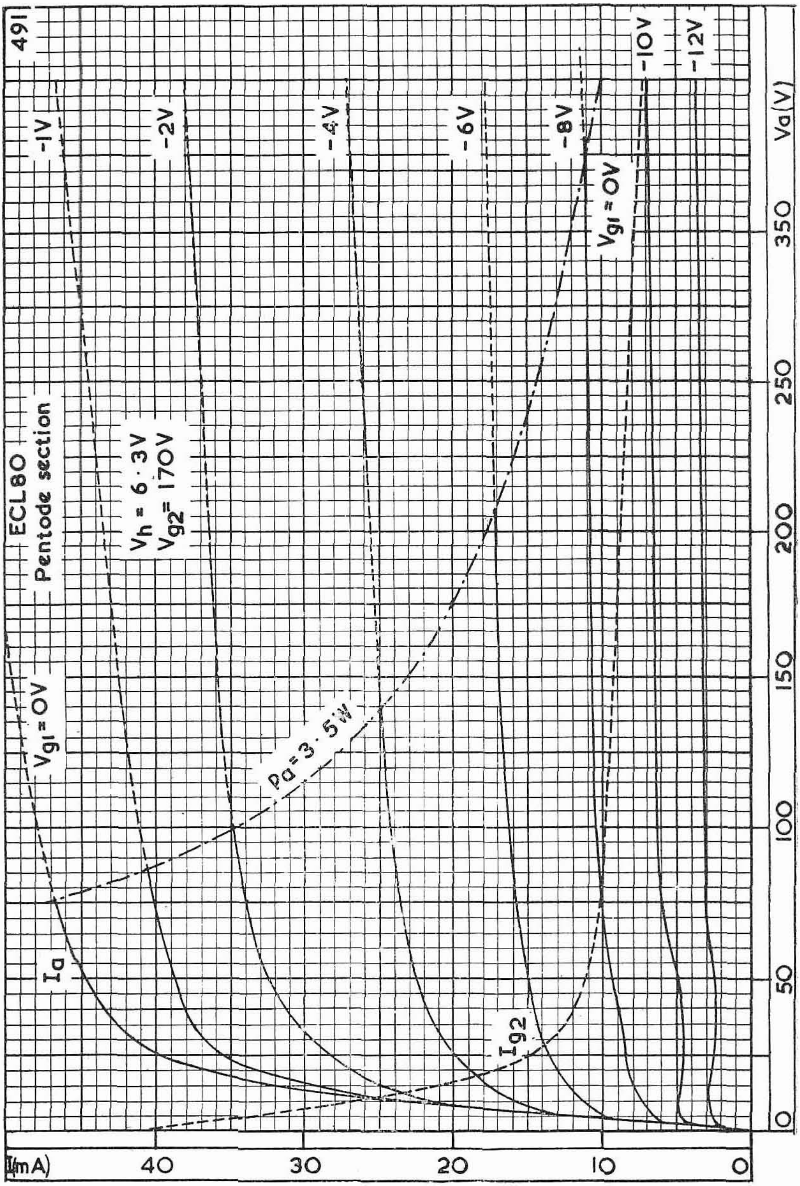
Operating Conditions

V_a	170	200	V
V_{g2}	170	200	V
V_{g3}	0	0	V
V_{g1}	−6.7	−8.0	V
R_a	11	11	k Ω
$I_{a(0)}$	15	17.5	mA
$I_{g2(0)}$	2.8	3.3	mA
$V_{in\ (r.m.s.)}$ ($P_{out} = 50$ mW)	0.7	0.7	V
$V_{in\ (r.m.s.)}$ ($D_{tot} = 10\%$)	3.5	4.0	V
P_{out} ($D_{tot} = 10\%$)	1.0	1.4	W
$V_{in\ (r.m.s.)}$ (up to $\eta = 50\%$)	4.1	4.7	V
$P_{out\ (r.m.s.)}$ (up to $\eta = 50\%$)	1.27	1.75	W
$D_{tot\ (r.m.s.)}$ (up to $\eta = 50\%$)	12	12	%

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.



ANODE CURRENT AND SCREEN-GRID CURRENT OF PENTODE SECTION PLOTTED AGAINST ANODE VOLTAGE, FOR SCREEN-GRID VOLTAGE OF 170 V

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

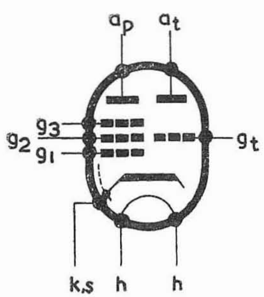
LIMITING VALUES

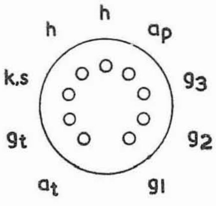
Triode Section

$V_{at(b)}$ max.	550	V
V_{at} max.	200	V
p_{at} max.	1.0	W
I_k max.	8	mA ←
* $i_{k(pk)}$ max.	200	mA
V_{gt} max. ($I_{gt}=+0.3\ \mu A$)	−1.3	V
R_{gt-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

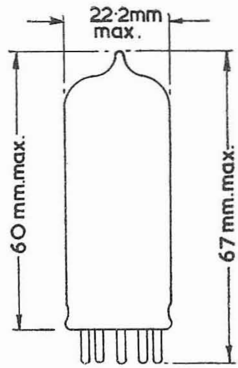
* Max pulse duration 10% of one cycle, with maximum of 2 m secs.

When the triode section is used in amplifier circuits, where the input voltage, for an output of 50 mW is less than 50 mV, no special precautions need be taken against microphonic effects.





B9A
Noval Base

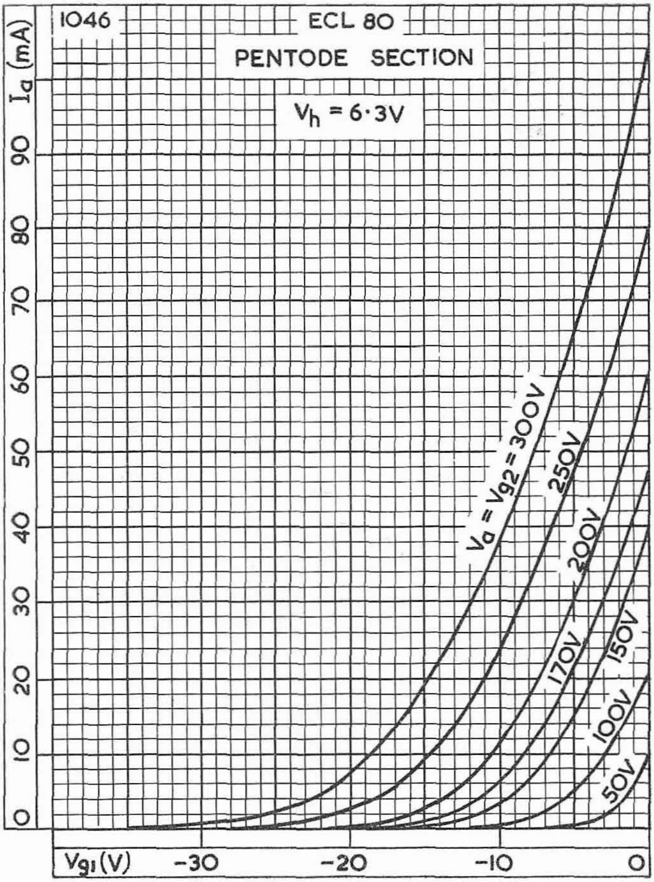


519

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

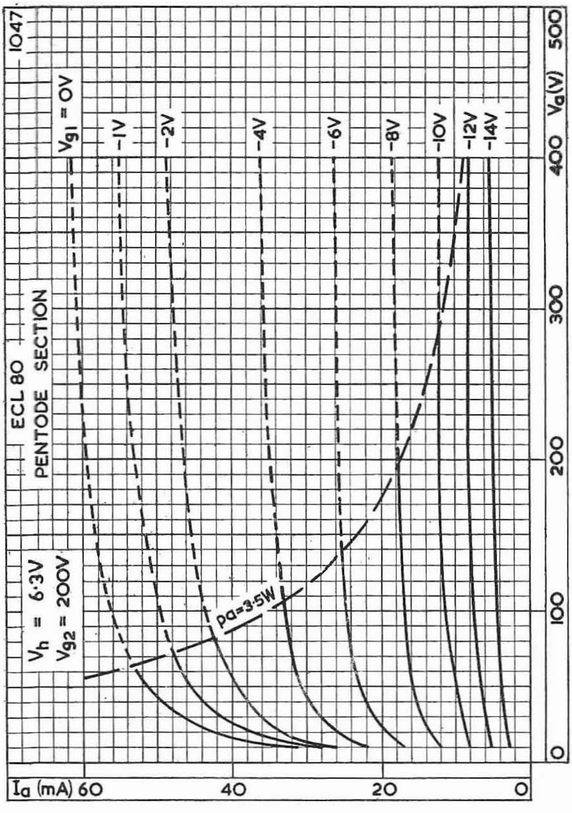


ANODE CURRENT OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE, FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 50V AND 300V

ECL80

TRIODE PENTODE

Combined triode and output pentode designed primarily for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

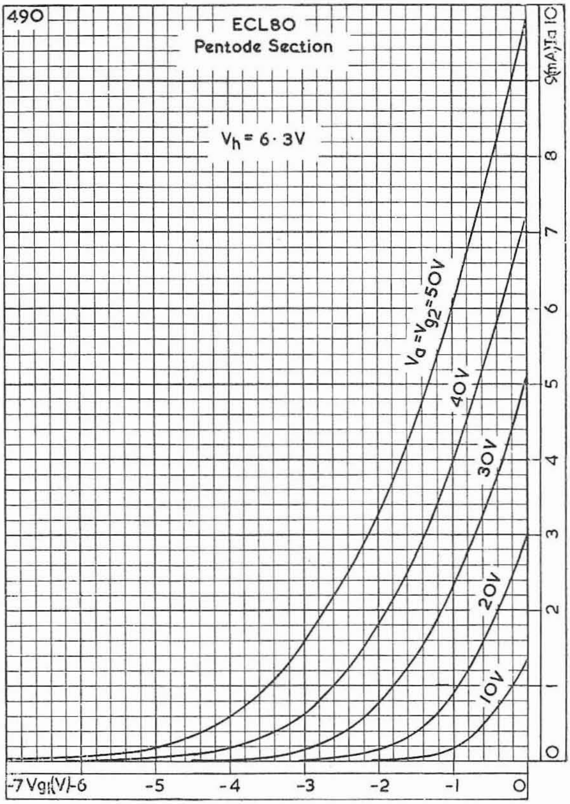


ANODE CURRENT AND SCREEN-GRID CURRENT OF PENTODE SECTION PLOTTED AGAINST ANODE VOLTAGE, FOR SCREEN-GRID VOLTAGE OF 200V

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

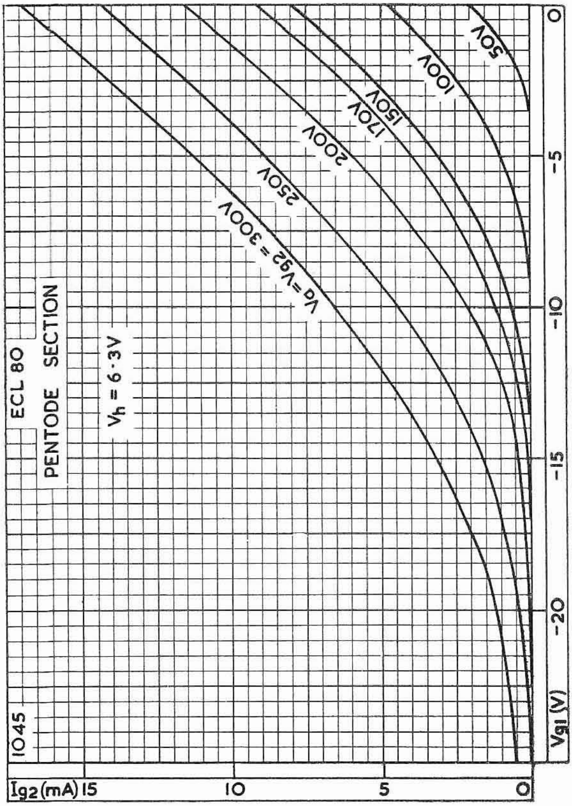


ANODE CURRENT OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE, FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 10V AND 50V

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

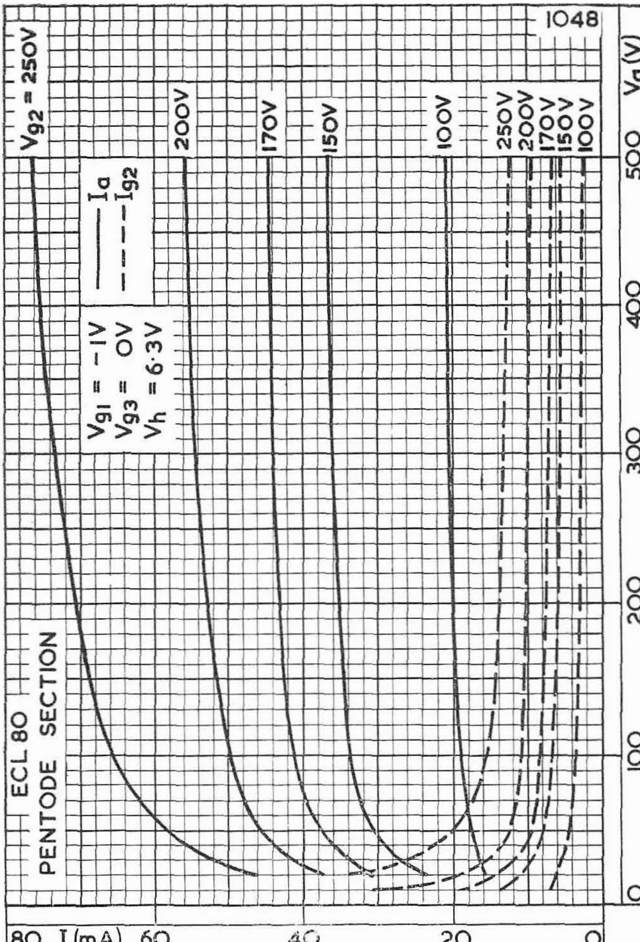


SCREEN-GRID CURRENT OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE, FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 50V AND 300V

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

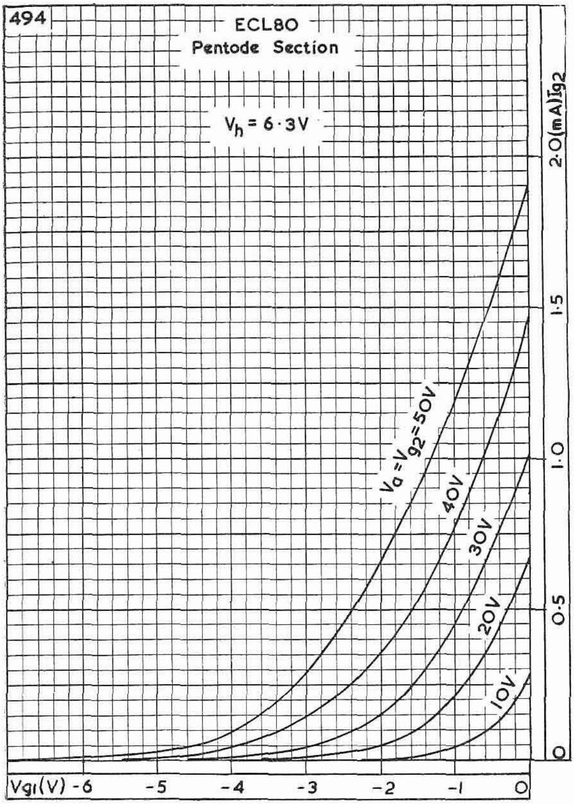


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AT —1V

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

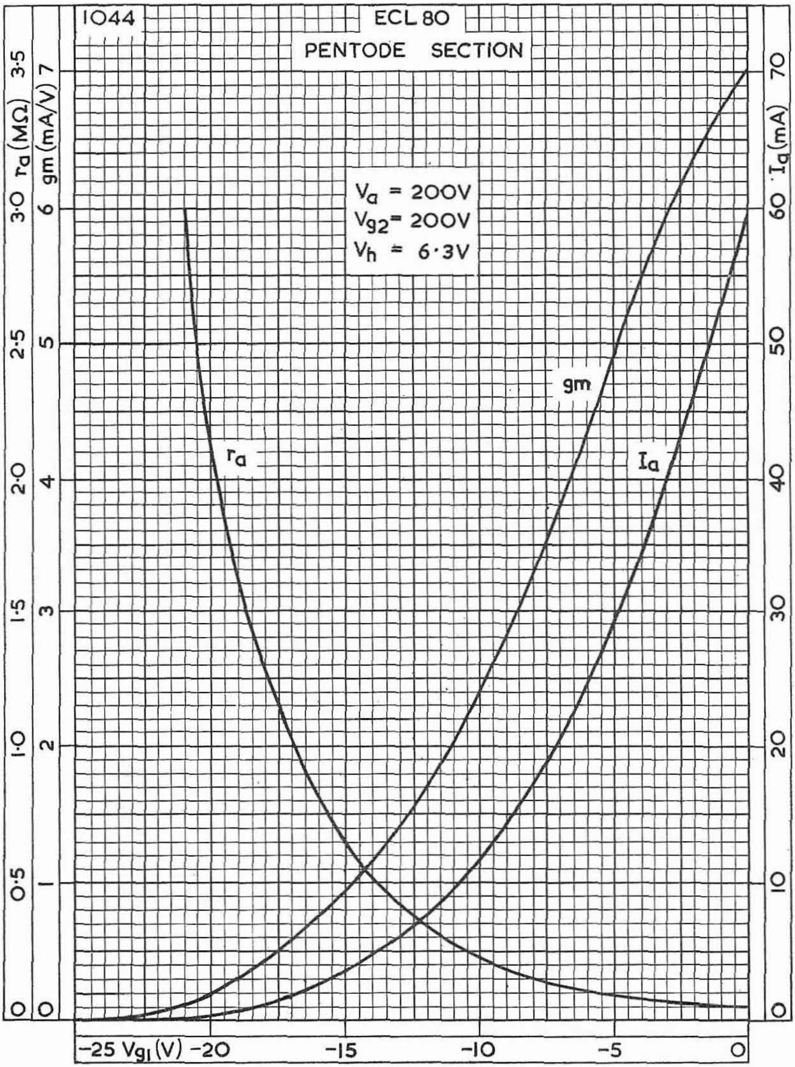


SCREEN-GRID CURRENT OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE, FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 10V AND 50V

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

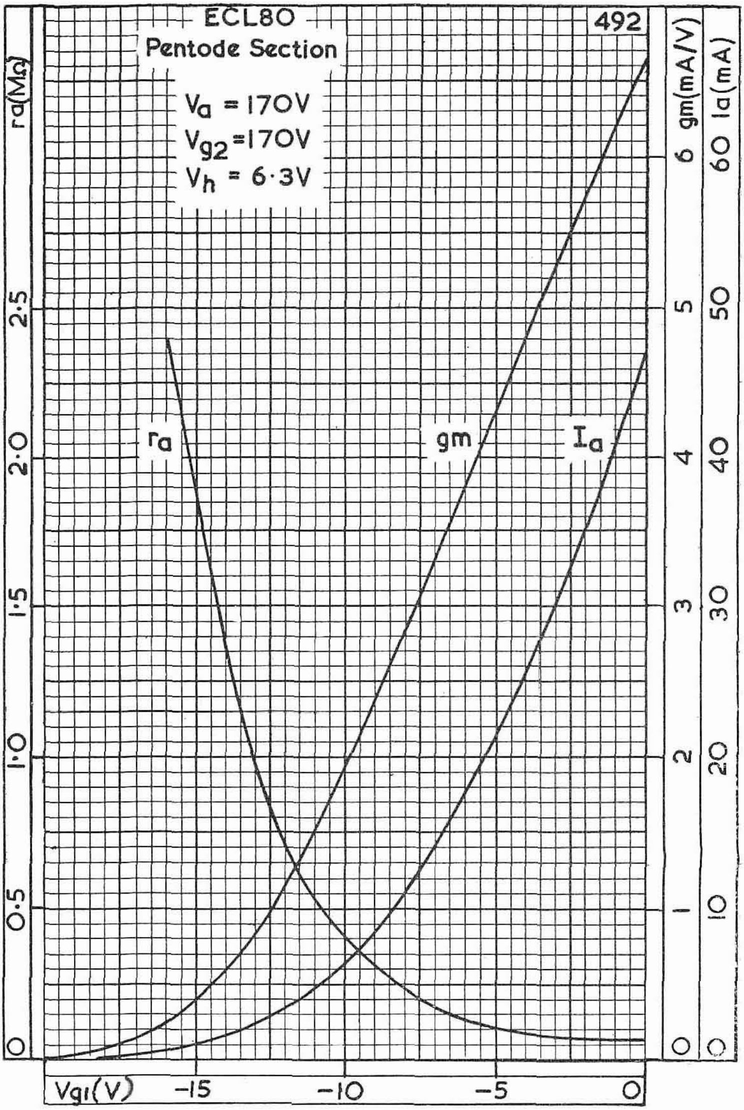


ANODE CURRENT, MUTUAL CONDUCTANCE AND INTERNAL RESISTANCE OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE, FOR SCREEN-GRID VOLTAGE OF 200V

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

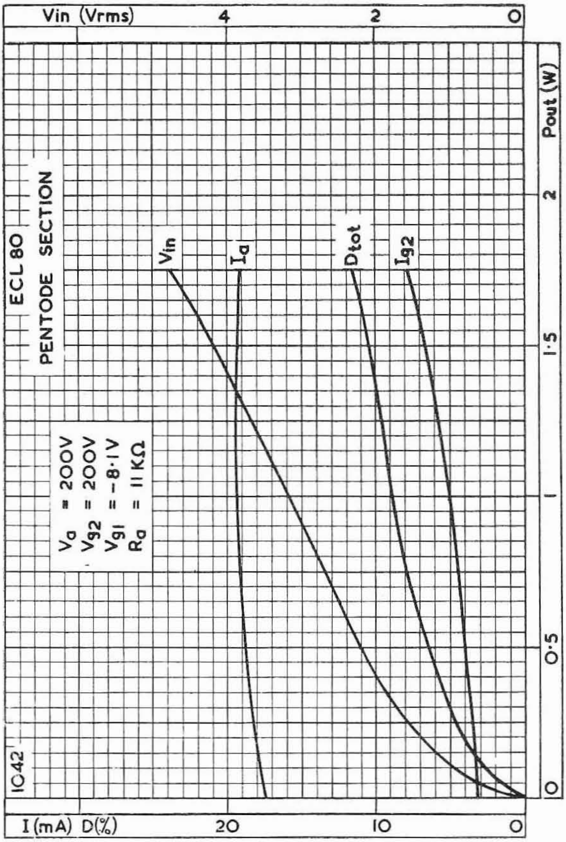


ANODE CURRENT, MUTUAL CONDUCTANCE AND INTERNAL RESISTANCE OF PENTODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR SCREEN-GRID VOLTAGE OF 170V

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

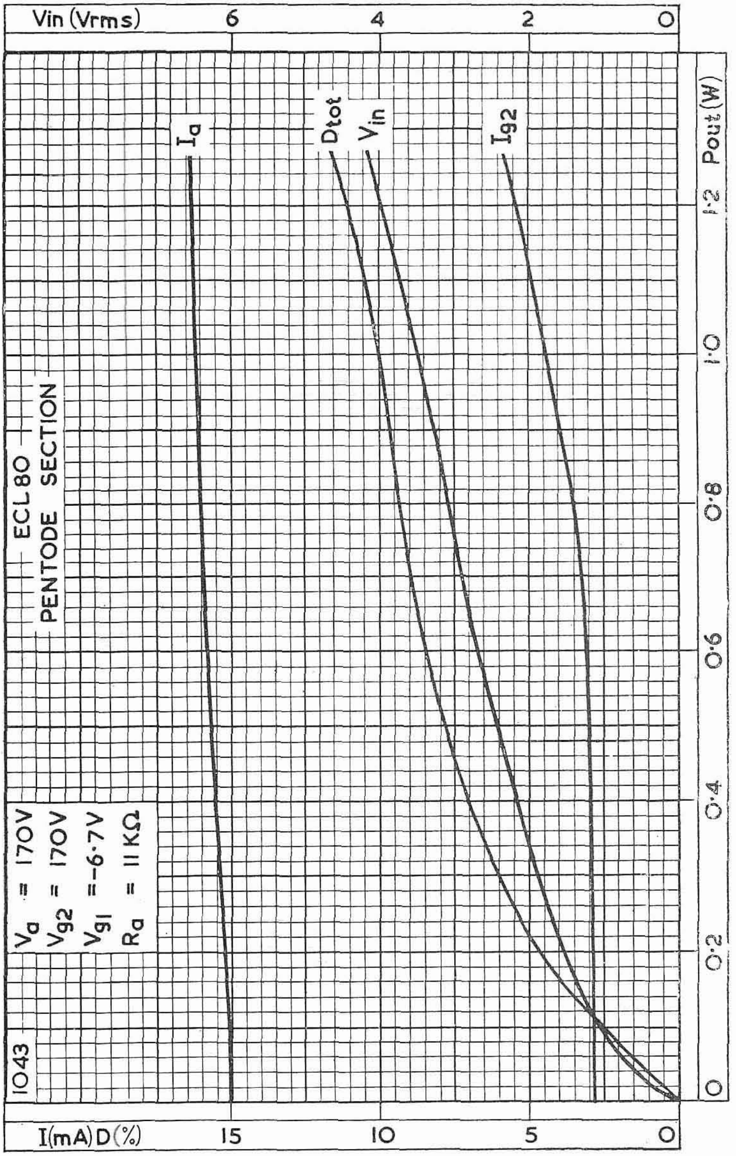


ANODE CURRENT, SCREEN-GRID CURRENT, INPUT VOLTAGE AND TOTAL DISTORTION PLOTTED AGAINST POWER OUTPUT, FOR SCREEN-GRID VOLTAGE OF 200V

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

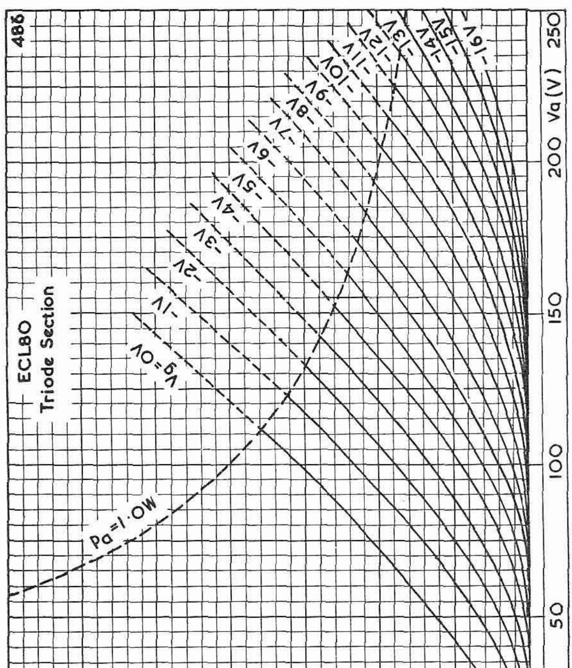


ANODE CURRENT, SCREEN-GRID CURRENT, INPUT VOLTAGE AND TOTAL DISTORTION PLOTTED AGAINST POWER OUTPUT, FOR SCREEN-GRID VOLTAGE OF 170V

TRIODE PENTODE

ECL80

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.

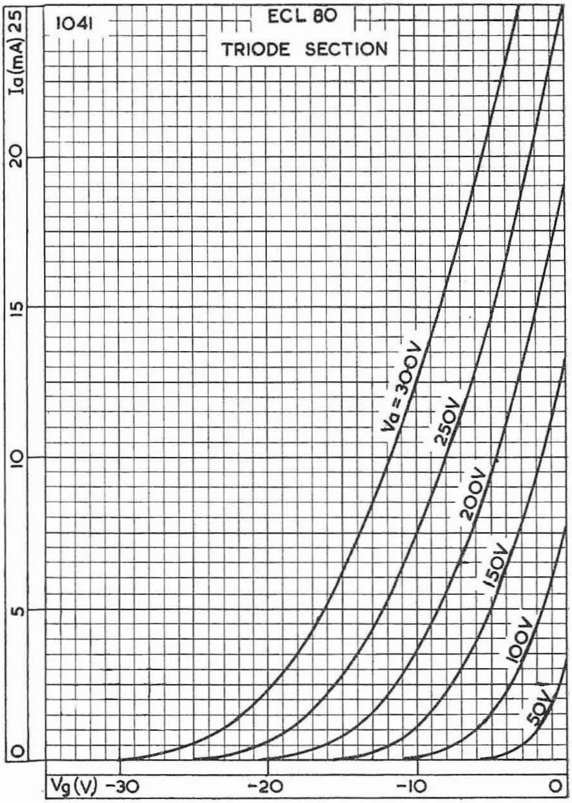


ANODE CURRENT OF TRIODE SECTION PLOTTED AGAINST ANODE VOLTAGE, WITH GRID VOLTAGE AS PARAMETER

ECL80

TRIODE PENTODE

Combined triode and output pentode primarily designed for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve. Other applications include the use of the triode as a line blocking oscillator, A.F. voltage amplifier or in multivibrator circuits and the operation of the pentode as an audio output valve or a synchronising pulse separator.



ANODE CURRENT OF TRIODE SECTION PLOTTED AGAINST GRID VOLTAGE, WITH ANODE VOLTAGE AS PARAMETER

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

HEATER

V_h	6.3	V
I_h	780	mA

MOUNTING POSITION

Any

CAPACITANCES

c_{ap-at}	<0.25	pF
c_{ap-gt}	<0.02	pF
c_{g1p-at}	<0.02	pF
c_{g1p-gt}	<0.025	pF

Pentode section

c_{a-g1}	<0.3	pF
c_{in}	9.3	pF
c_{out}	8.0	pF
c_{g1-h}	<0.3	pF

Triode section

c_{a-g}	4.2	pF
c_{in}	2.7	pF
c_{out}	4.3	pF
c_{g-h}	<0.1	pF

CHARACTERISTICS

Pentode section

V_a	200	250	V
V_{g2}	200	250	V
I_a	35	28	mA
I_{g2}	7.0	5.7	mA
V_{g1}	–16	–22.5	V
g_m	6.4	5.0	mA/V
r_a	20	25	kΩ
μ_{g1-g2}	9.5	9.5	

Triode section

V_a	100	V
I_a	3.5	mA
V_g	0	V
g_m	2.5	mA/V
r_a	28	kΩ
μ	70	

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	R_g (MΩ)	Z_{source} (kΩ)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%)	R_{g1}* (kΩ)
250	100	1.05	1.5	3.3	0	48	0.8	330
200	100	0.85	1.5	3.3	0	47	1.0	330
150	100	0.6	1.8	3.3	0	45	1.9	330
100	100	0.38	1.8	3.3	0	41	6.0	330
250	100	1.05	1.5	3.3	220	44	0.75	330
200	100	0.85	1.5	3.3	220	43	0.85	330
150	100	0.6	1.8	3.3	220	41	1.05	330
100	100	0.38	1.8	3.3	220	34	3.6	330
250	220	0.63	2.2	3.3	0	55.5	0.75	680
200	220	0.52	2.2	3.3	0	54.5	1.0	680
150	220	0.36	2.7	3.3	0	52	1.85	680
100	220	0.23	2.7	3.3	0	47	4.25	680
250	220	0.63	2.2	3.3	220	51.5	0.7	680
200	220	0.52	2.2	3.3	220	50	0.5	680
150	220	0.36	2.7	3.3	220	47	1.0	680
100	220	0.23	2.7	3.3	220	38	3.75	680
250	100	1.4	0	22	0	50	0.5	330
200	100	1.05	0	22	0	48.5	0.7	330
150	100	0.7	0	22	0	46	1.55	330
100	100	0.37	0	22	0	44	8.0	330
250	100	1.4	0	22	220	46	2.2	330
200	100	1.05	0	22	220	44	2.1	330
150	100	0.7	0	22	220	42.5	1.6	330
100	100	0.37	0	22	220	37	5.9	330
250	220	0.78	0	22	0	58	0.5	680
200	220	0.59	0	22	0	56	0.8	680
150	220	0.4	0	22	0	53	1.7	680
100	220	0.21	0	22	0	46	5.6	680
250	220	0.78	0	22	220	52.5	2.2	680
200	220	0.59	0	22	220	51	2.0	680
150	220	0.4	0	22	220	48.5	1.4	680
100	220	0.21	0	22	220	42	3.1	680

*Grid resistor of following valve

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV

D_{tot} measured for $V_{out} = 10V$

MICROPHONY AND HUM

The triode section can be used without special precautions against microphony and hum in circuits in which the input voltage is >10mV(r.m.s.) for an output of 50mW from the output stage.

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

PENTODE SECTION AS FRAME OUTPUT VALVE

Circuit design

To allow for valve spread and deterioration during life the frame output circuit should be designed around the following values

V_a	50	V
V_{g2}	170	V
$i_{a(pk)}$	85	mA

For an average new valve the following figures will apply

V_a	50	V
V_{g2}	170	V
$i_{a(pk)}$	135	mA

V_{g1} adjusted so that $I_{g1} = +0.3\mu A$

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	200	250	V
$V_{g2(b)}$	200	250	V
$*R_{g2}$	0	2.2	kΩ
$I_{a(o)}$	35	28	mA
$I_{g2(o)}$	7.0	5.5	mA
I_{g2} (max. sig.)	16	10.5	mA
V_{g1}	−16	−22.5	V
R_k	390	680	Ω
$V_{in(r.m.s.)}$ ($P_{out} = 50mW$)	600	780	mV
R_a	5.6	9.0	kΩ
$V_{in(r.m.s.)}$	6.6	9.5	V
†P_{out}	3.5	3.4	W
D_{tot}	10	10	%

Two valves in class 'AB' push-pull

V_a	200	250	V
$V_{g2(b)}$	200	250	V
$**R_{g2}$	0	2.7	kΩ
$I_{a(o)}$	2×35	2×21.5	mA
I_a (max. sig.)	2×39.5	2×27.5	mA
$I_{g2(o)}$	2×7.0	2×4.2	mA
I_{g2} (max. sig.)	2×16.5	2×9.2	mA
††R_k	190	390	Ω
$V_{in(g1-g1)r.m.s.}$	25	38	V
R_{a-a}	6.0	10	kΩ
P_{out}	9.8	9.0	W
D_{tot}	4.0	5.0	%

*Undecoupled screen-grid resistor.

†P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available duiing the reproduction of speech and music.

**Common screen-grid resistor undecoupled.

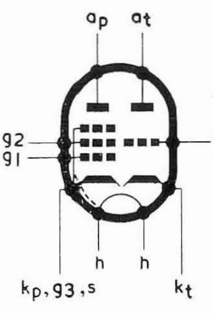
††Common cathode bias resistor.

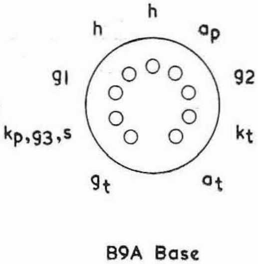
TRIODE PENTODE

ECL82

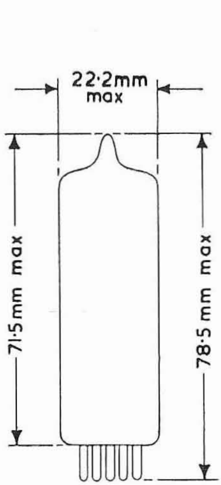
Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

2324





B9A Base



ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
‡$+v_{a(pk)}$ max.	2.5	kV
‡$-v_{a(pk)}$ max.	500	V
p_a max. (frame output)	5.0	W
p_a max. (audio applications)	7.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	1.8	W
p_{g2} max. (speech and music)	3.2	W
I_k max.	50	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (cathode bias)	2.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
‡$+v_{a(pk)}$ max.	600	V
p_a max.	1.0	W
I_k max.	15	mA
*$i_{k(pk)}$ max.	200	mA
R_{g-k} max. (fixed bias)	1.0	MΩ
R_{g-k} max. (cathode bias)	3.0	MΩ
R_{g-k} max. (grid current biasing)	22	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

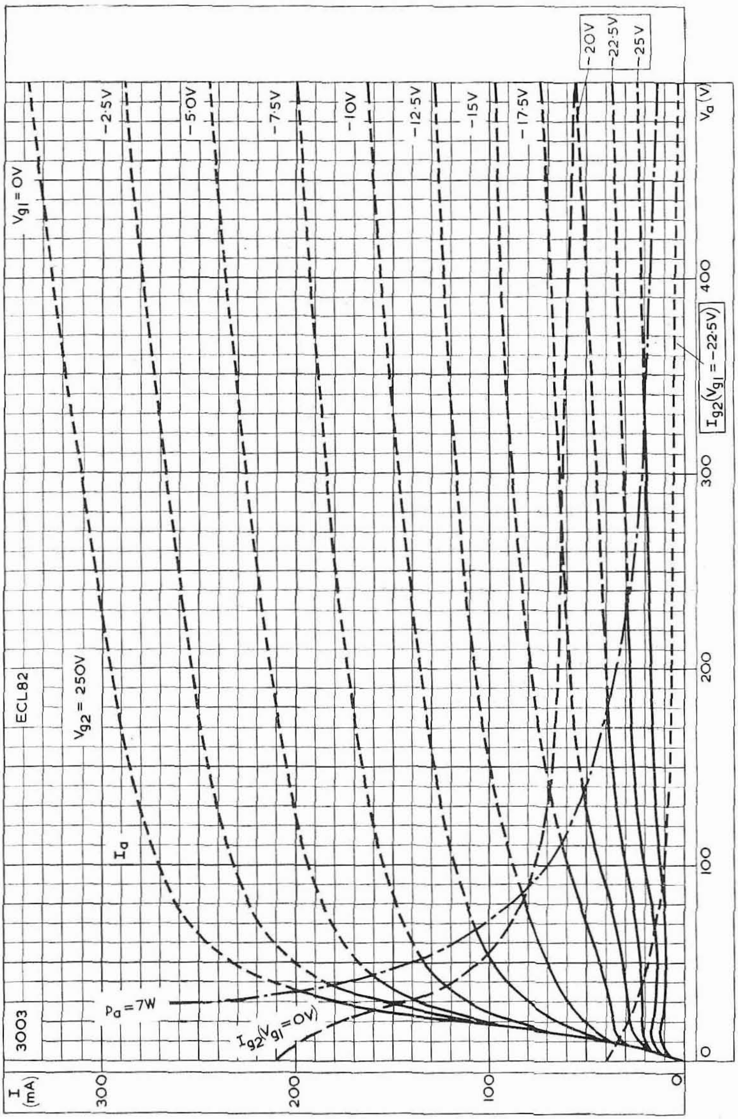
*Maximum pulse duration 200μs

‡Maximum pulse duration 4% of one cycle with a maximum of 800μs

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

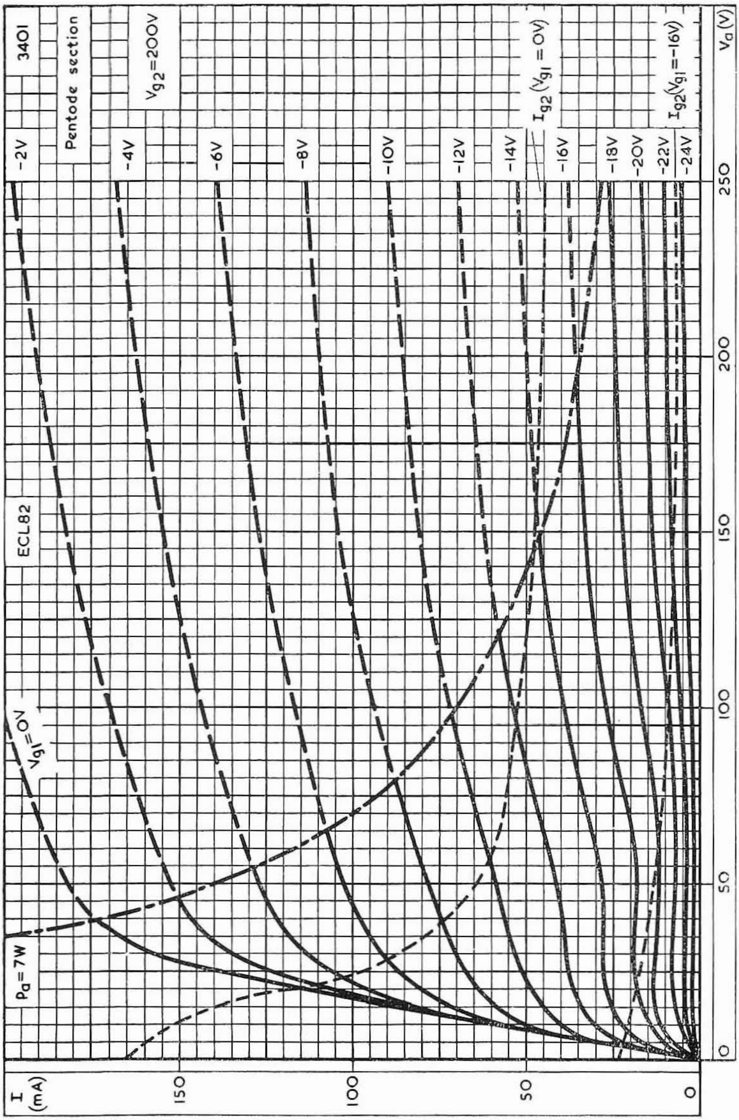


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

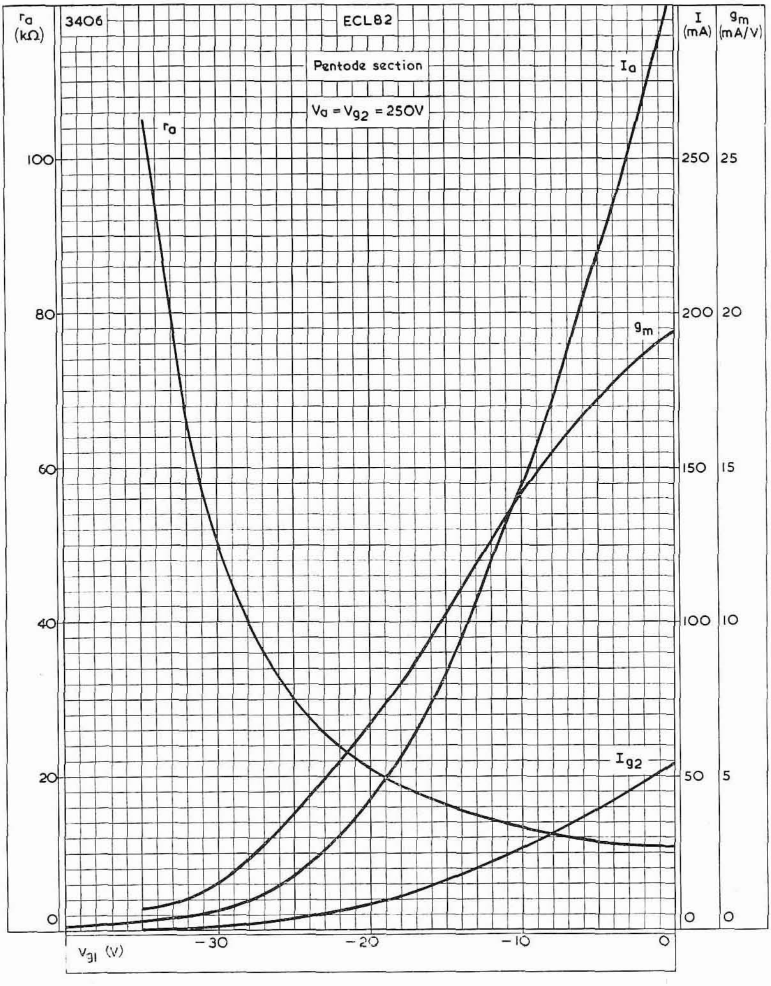


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

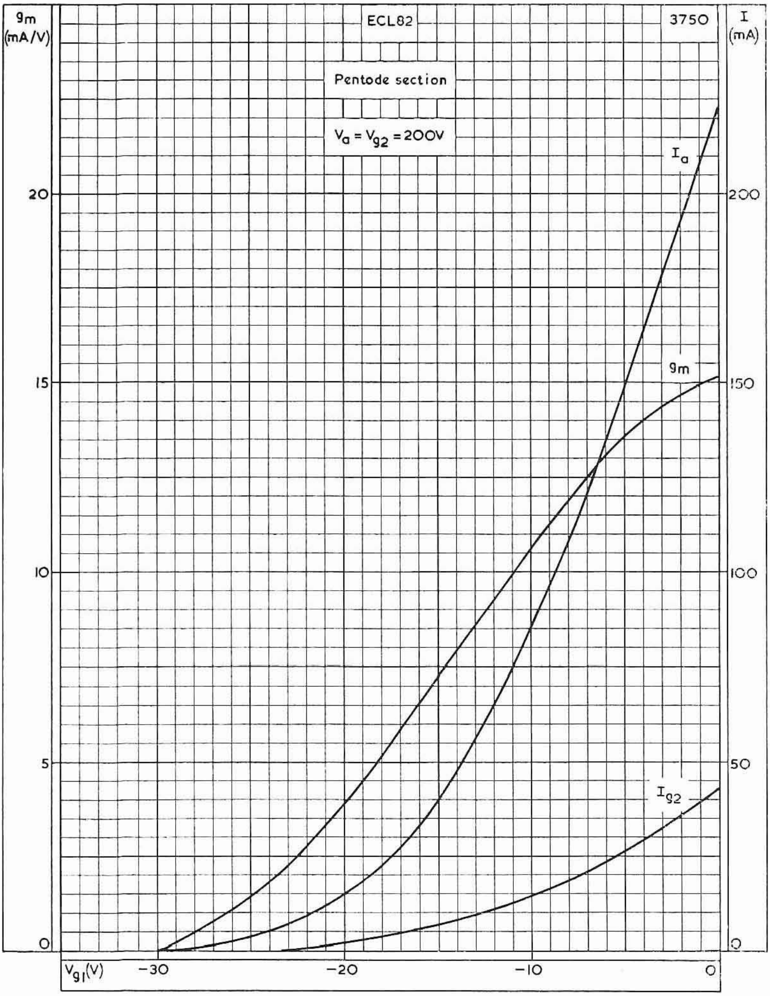


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 250V$

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

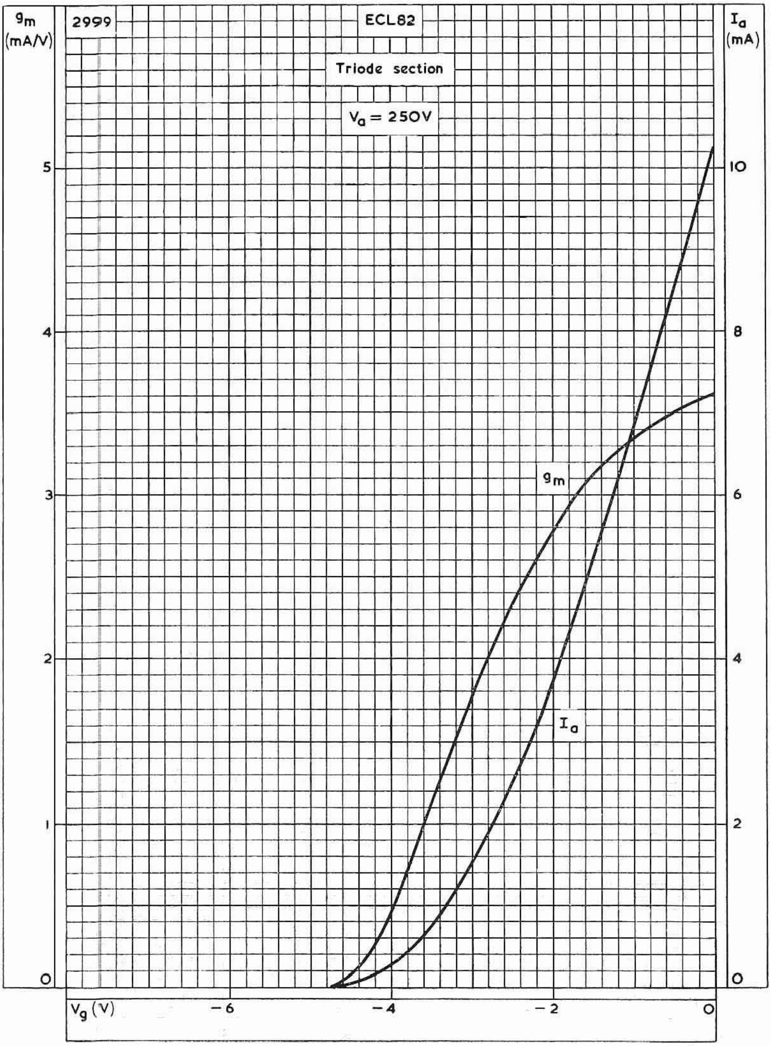


ANODE AND SCREEN-GRID CURRENTS AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

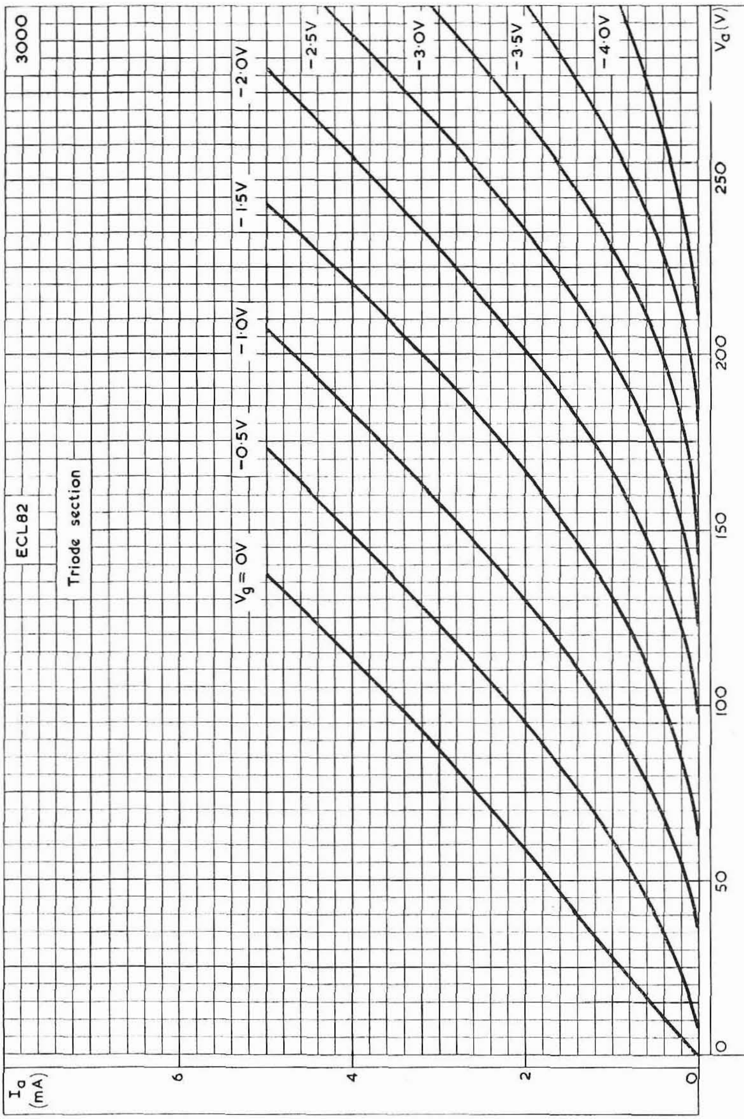


ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE FOR TRIODE SECTION. $V_a = 250V$

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

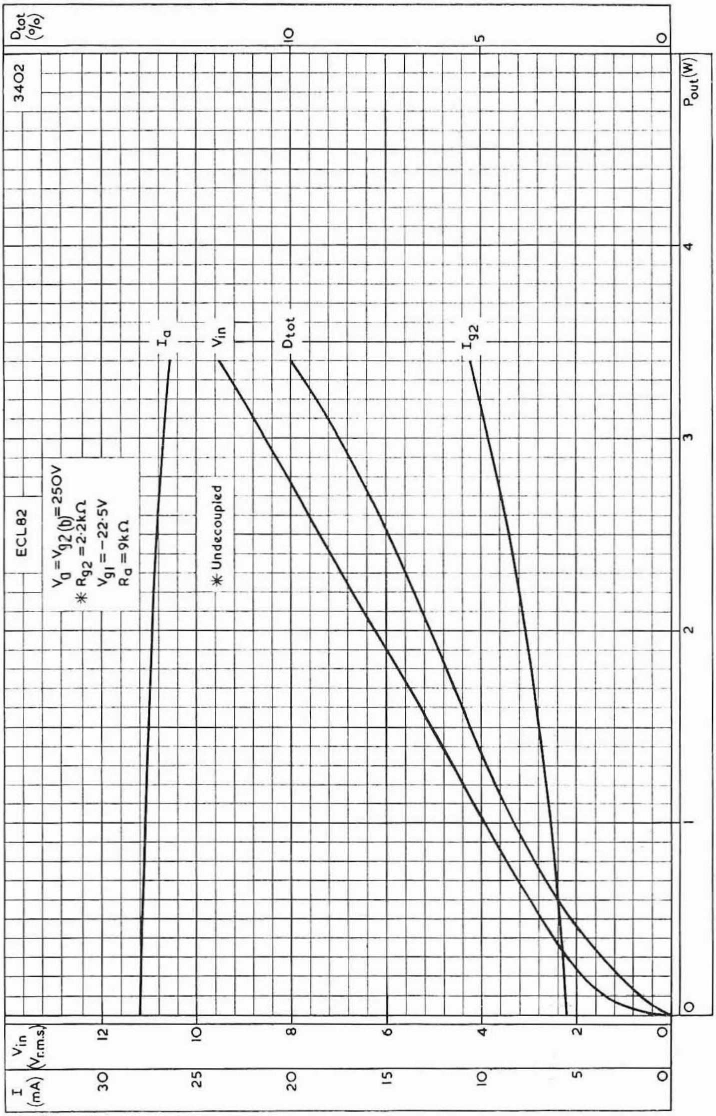


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER FOR TRIODE SECTION

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

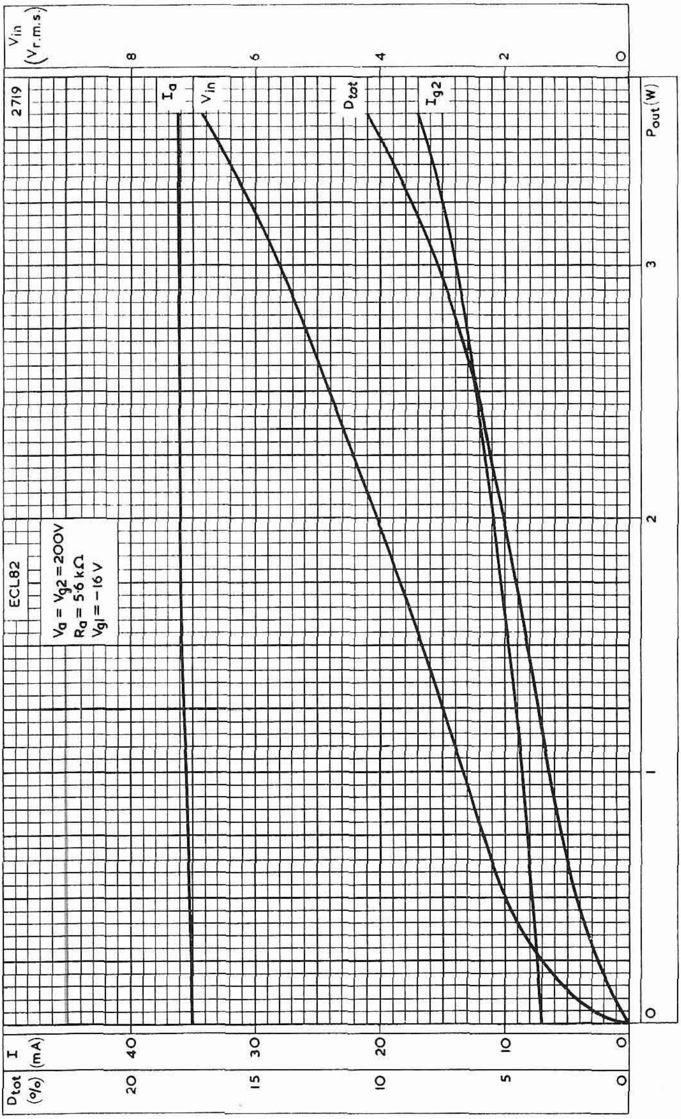


PERFORMANCE OF SINGLE ECL82 CLASS 'A' AMPLIFIER. $V_a = V_{g2(b)} = 250V$

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

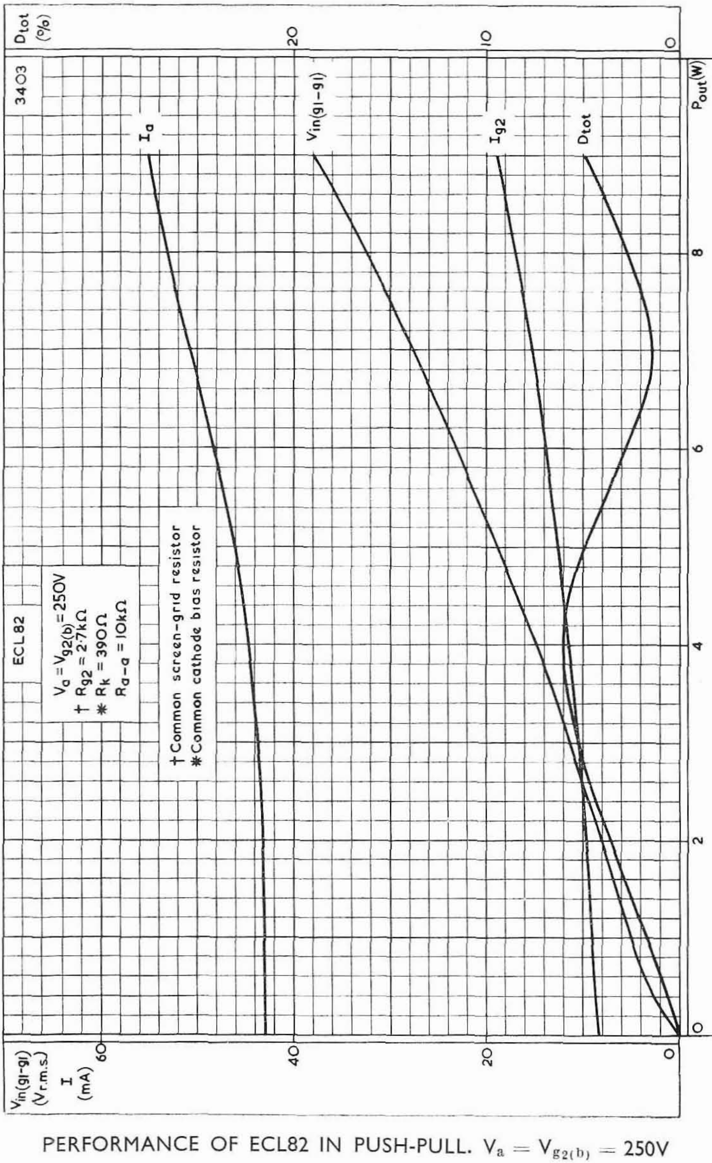


PERFORMANCE OF SINGLE ECL82 CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 200V$

TRIODE PENTODE

ECL82

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.

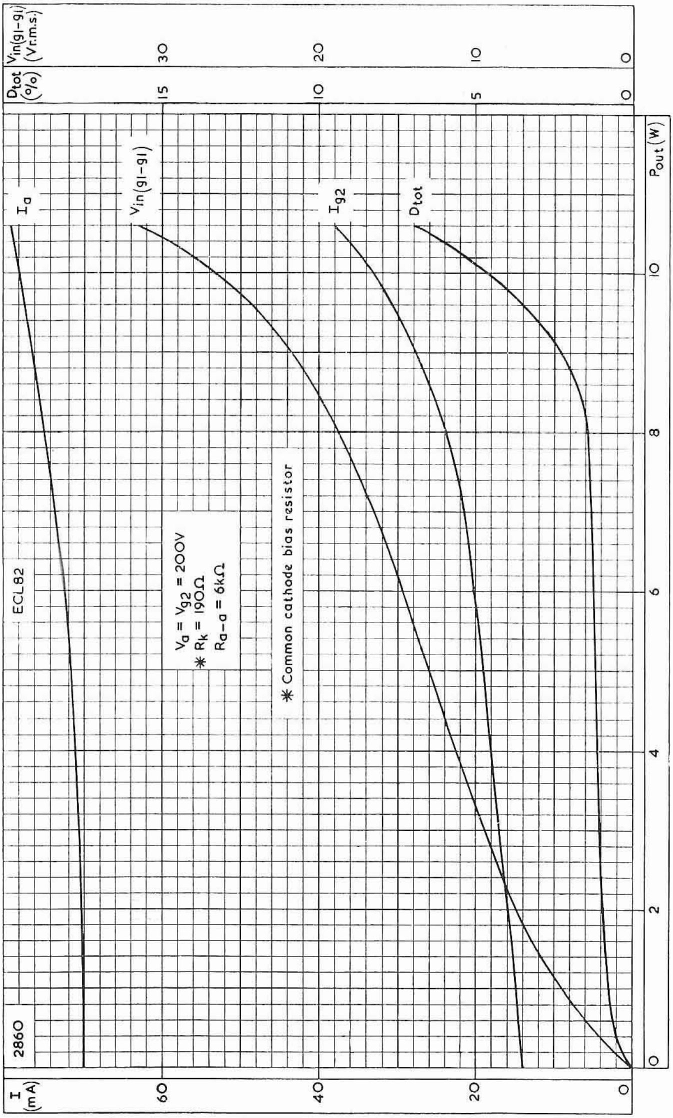


PERFORMANCE OF ECL82 IN PUSH-PULL. $V_a = V_{g2(b)} = 250V$

ECL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output valve or frame oscillator and output valve.



PERFORMANCE OF ECL82 IN PUSH-PULL. $V_a = V_{g2} = 200V$

TRIODE PENTODE ECL86

Combined high-μ triode and output pentode for use in audio amplifier circuits.

HEATER

Vh	6.3	V
Ih	660	mA

CAPACITANCES

cap - gt	< 6.0	mpF
cat - g1	< 200	mpF
cgt - g1	< 20	mpF
cat - ap	< 150	mpF

Pentode section

cin	10	pF
ca - g1	< 400	mpF
cg1 - h	< 240	mpF

Triode section

cin	2.3	pF
cout	2.5	pF
ca - g	1.4	pF
cg - h	< 6.0	mpF

CHARACTERISTICS

Pentode section

Va	250	V
Vg2	250	V
Vg1	- 7.0	V
Ia	36	mA
Ig2	6.0	mA
gm	10	mA/V
ra	48	kΩ
μg1 - g2	21	
- Vg1 max. (Ig1 = + 0.3 μA)	1.3	V

OPERATING CONDITIONS FOR TRIODE SECTION AS RESISTANCE COUPLED A.F. AMPLIFIER

Cathode bias

Vb	300	250	250	200	V
Ra	220	220	220	220	kΩ
Ia	0.8	0.6	0.6	0.42	mA
Rk	1.2	1.75	1.75	2.6	kΩ
$\frac{Vout}{Vin}$	80	75	70	66	
Vout (r.m.s.)	9.0	5.0	3.2	3.2	V
Dtot	0.4	0.4	0.4	0.6	%
* Rg	10	10	0.68	0.68	MΩ

* Grid resistor of following valve.

At lower values of Vb, grid current bias should be used.

Grid current bias (Rg = 10 MΩ) Zs = 47 kΩ

Vb (V)	Ra (kΩ)	Rg* (MΩ)	Ia (mA)	Dtot (%)	Vout/Vin	Vout(r.m.s.) (V)
300	220	10	0.8	0.4	80	9
250	220	10	0.6	0.4	75	5
250	220	0.68	0.6	0.4	70	3.2
200	220	0.68	0.42	0.6	66	3.2

* Grid resistor of following valve.

LIMITING VALUES

Pentode section

Va (b) max.	550	V
Va max.	300	V
pa max.	9.0	W
Vg2 (b) max.	550	V
Vg2 max.	300	V
pg2 max.	1.8	W
Ik max.	55	mA
Rg1 - k max.	0.5	MΩ
Vh - k max.	100	V

Triode section

Va	250	V
Vg	- 1.9	V
Ia	1.2	mA
gm	1.6	mA/V
μ	100	
ra	62	kΩ
- Vg1 max. (Ig1 = +0.3 μA)	1.3	V

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER ←

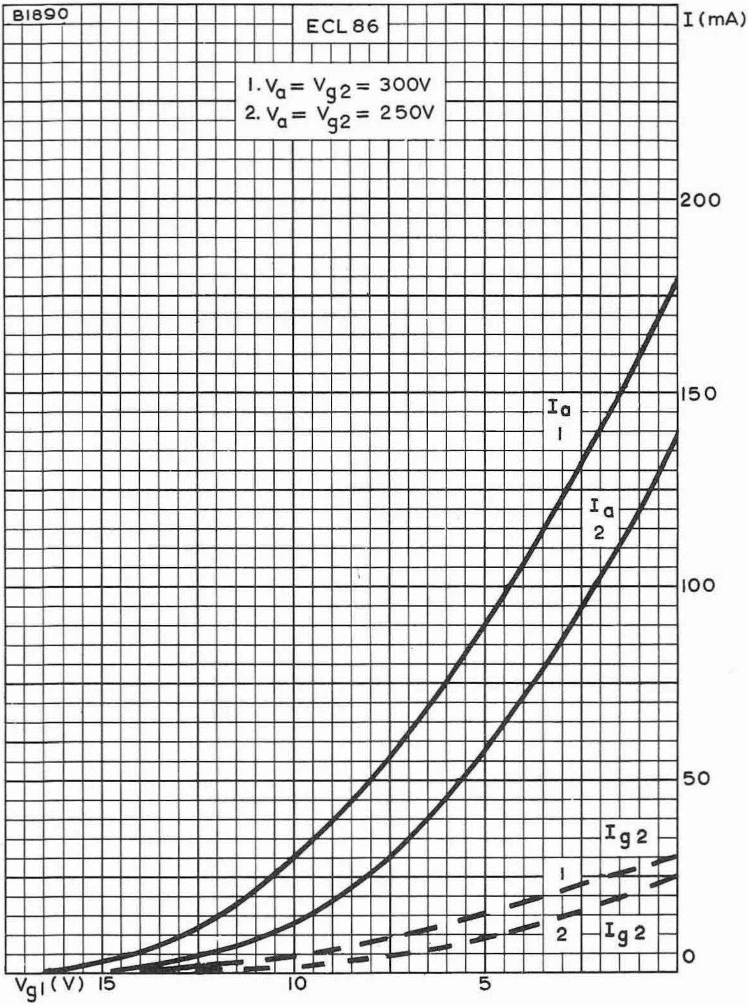
Pentode section

Va	250	250	V
Vg2	250	250	V
Rk	270	170	Ω
Ia	27	37	mA
Ig2	8.2	10	mA
Ra	10	7.0	kΩ
Pout	2.8	4.0	W
Vin (r.m.s.)	2.7	3.2	V
Dtot	10	10	%
Vin (r.m.s.) (Pout = 50 mW)	280	300	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL ←

Cathode bias

Va (b)	250	300	V
Vg2 (b)	250	300	V
Rk (per valve)	180	260	Ω
Ra - a	8.2	9.1	kΩ
Ia (o)	2 x 32.5	2 x 31	mA
Ia (max. sig.)	2 x 35.5	2 x 37	mA
Ig2 (o)	2 x 5.6	2 x 5.5	mA
Ig2 (max. sig.)	2 x 8.9	2 x 10.6	mA
Vin (g1 - g1) r.m.s.	11.0	16.8	V
Pout	10	13.6	W
Dtot	5.0	4.0	%
Vin (r.m.s.) (Pout = 50 mW)	480	520	mV



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. PENTODE SECTION.

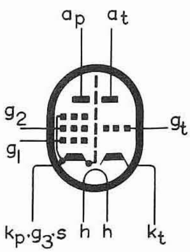
Triode section

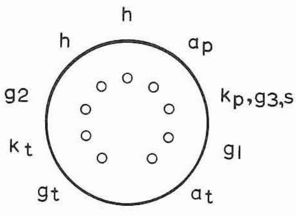
Va (b) max.	550	V
Va max.	300	V
pa max.	500	mW
Ik max.	4.0	mA
Rg - k max.	1.0	MΩ
Vh - k max.	100	V

OPERATING NOTES

1. Microphony

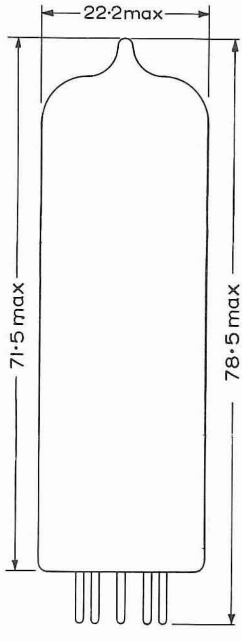
This valve may be used without special precautions against microphony in equipment where the input voltage is not less than 4 mV for an output of 50 mW.



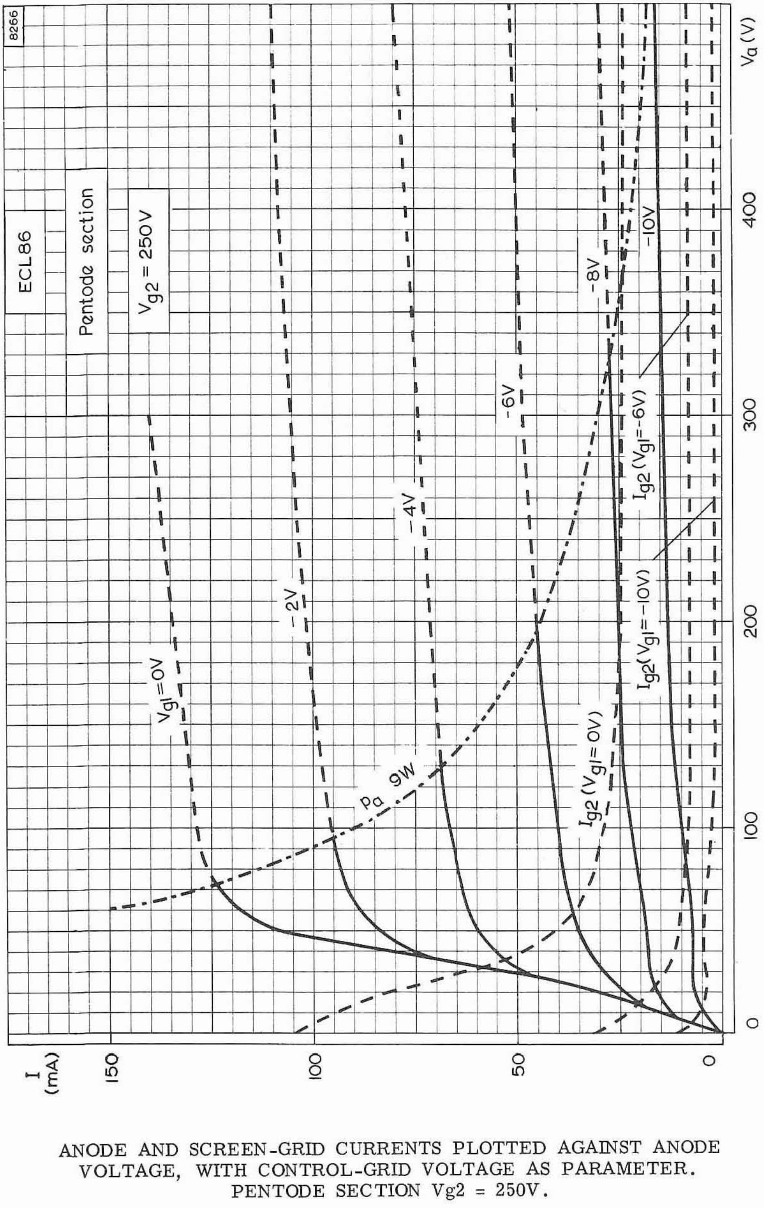


B9A Base

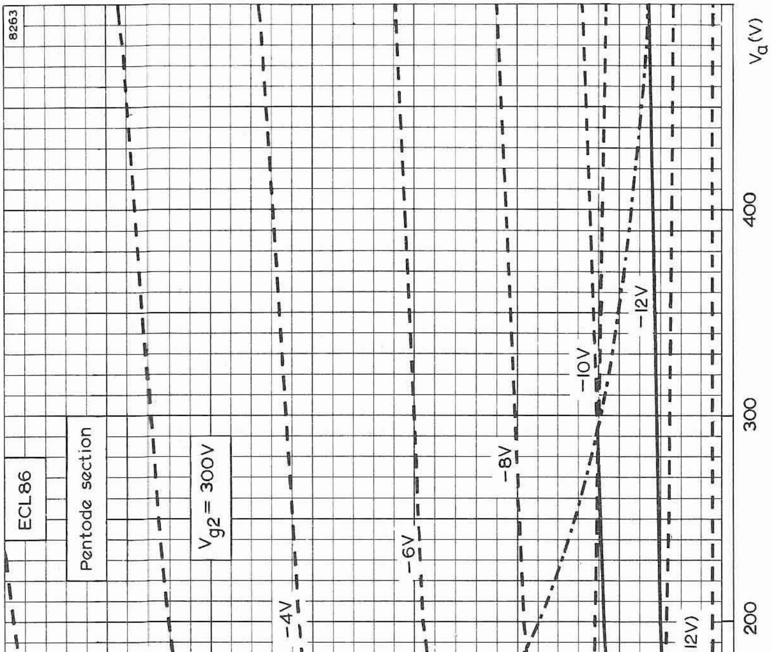
All dimensions in mm



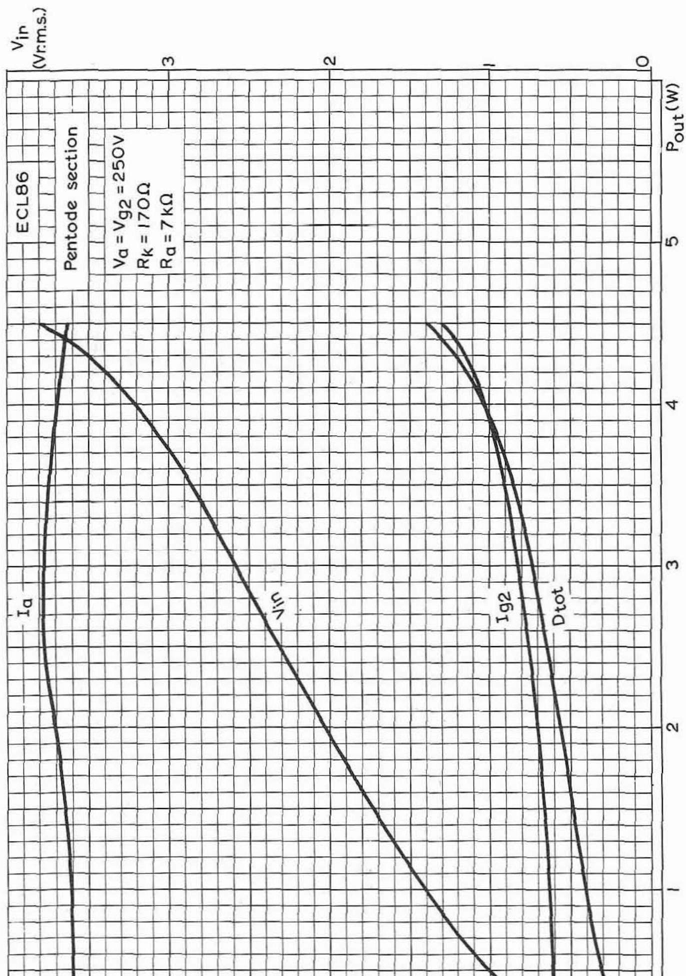
7471



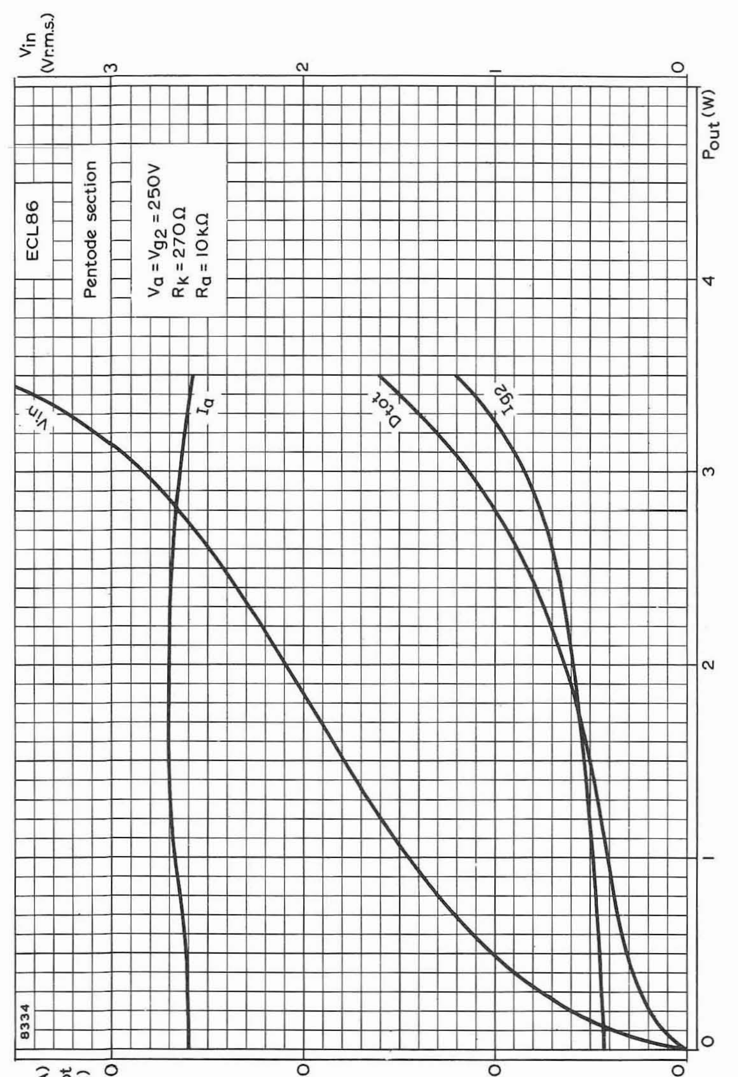
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION Vg2 = 250V.



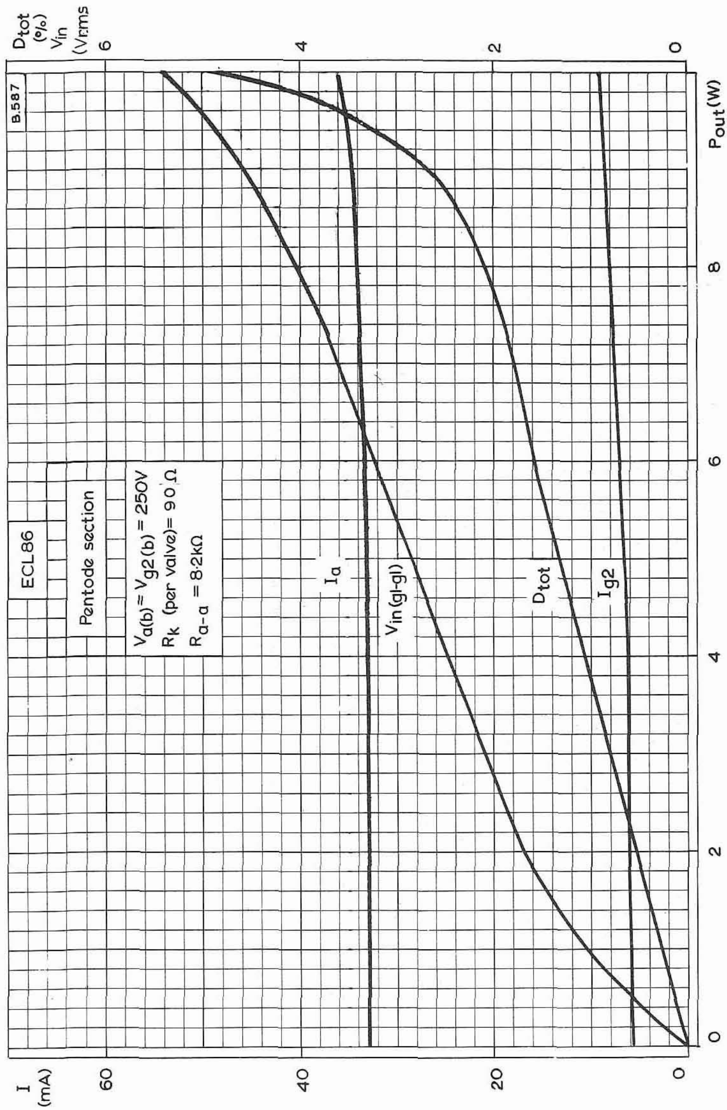
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION Vg2 = 300V.



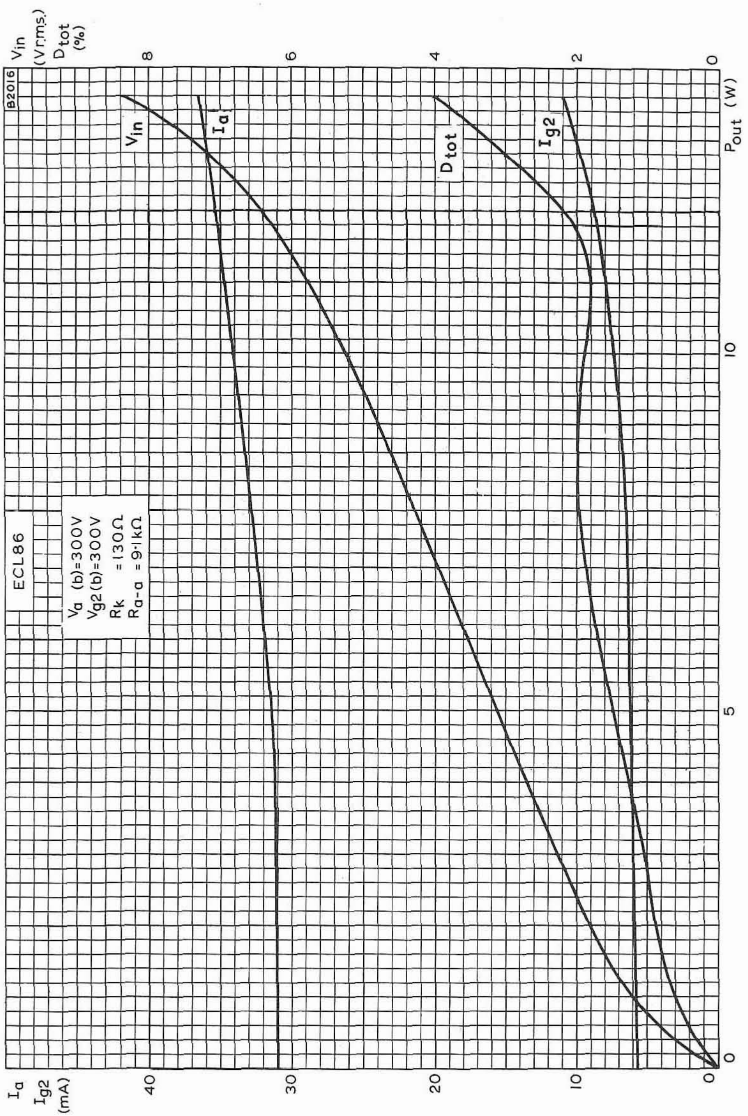
PERFORMANCE OF ECL86 AS SINGLE VALVE AMPLIFIER.
PENTODE SECTION Va = Vg2 = 250V, Rk = 170Ω.



PERFORMANCE OF ECL86 AS SINGLE VALVE AMPLIFIER.
PENTODE SECTION Va = Vg2 = 250V, Rk = 270Ω.



PERFORMANCE OF ECL86 IN PUSH-PULL
PENTODE SECTION Va(b) = Vg2(b) = 250V



PERFORMANCE OF ECL86 IN PUSH-PULL
PENTODE SECTION Va(b) = Vg2(b) = 300V

R.F. PENTODE

EF80

High slope r.f. pentode primarily intended for r.f. or i.f. amplification in television receivers. It is suitable for use as a video amplifier, mixer or synchronising pulse separator.

HEATER

Suitable for series or parallel operation a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

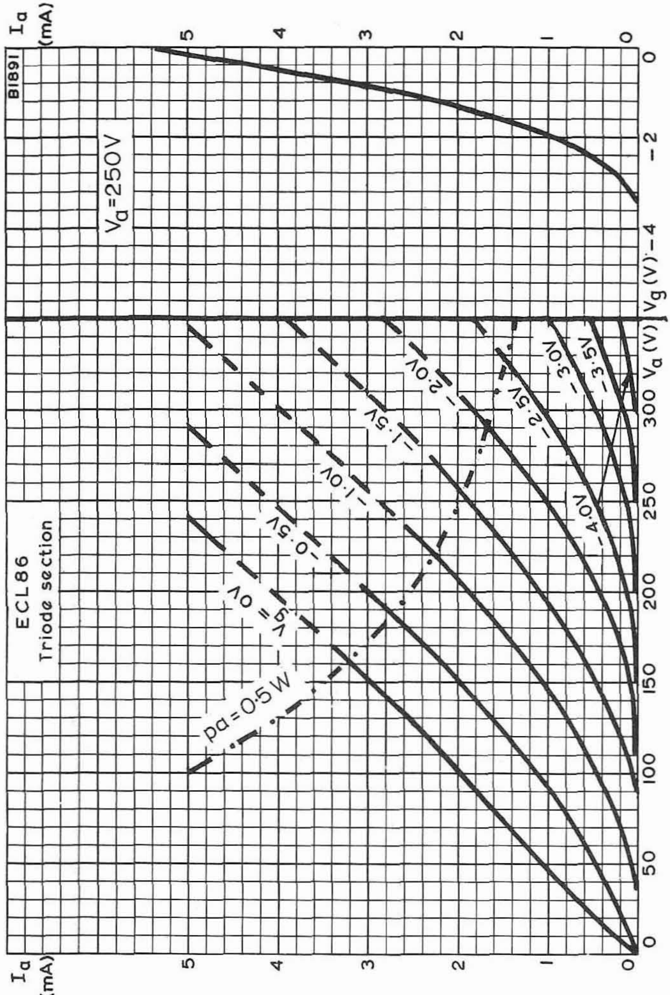
$c_{in(g1)}$	7.0	pF ←
$c_{in(g2)}$	5.4	pF
c_{out}	3.1	pF ←
c_{a-g1}	<7.0	mpF
c_{g2-g1}	2.6	pF
c_{a-k}	<10	mpF
c_{g1-h}	<150	mpF

CHARACTERISTICS

V_a	170	V
V_{g2}	170	V
V_{g3}	0	V
I_a	10	mA
I_{g2}	2.5	mA
V_{g1}	−2.0	V
g_m	7.4	mA/V
r_a	400	kΩ
μ_{g1-g2}	50	
R_{eq}	1.0	kΩ
r_{g1} (f = 50Mc/s)	10	kΩ
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V

LIMITING VALUES

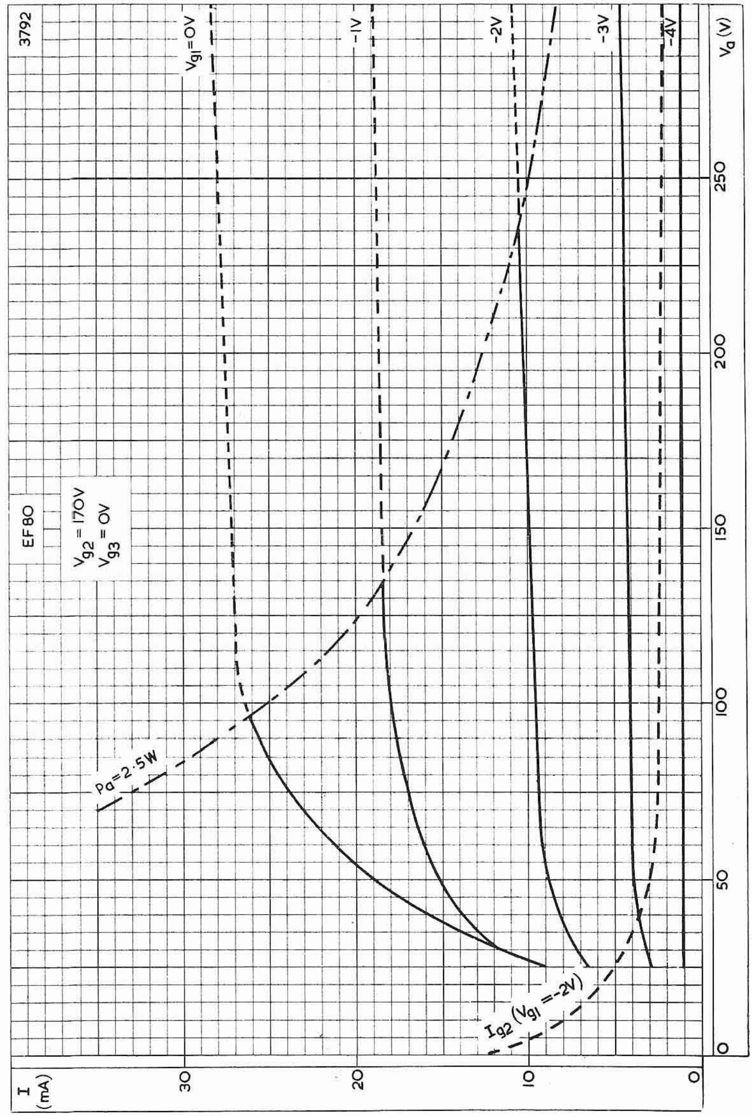
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	700	mW
I_k max.	15	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL GRID VOLTAGE AS PARAMETER.

ANODE CURRENT PLOTTED AGAINST CONTROL GRID VOLTAGE. Va = 250V

TRIODE SECTION

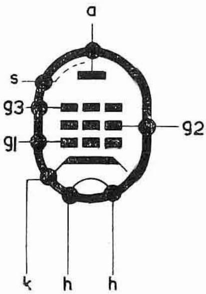


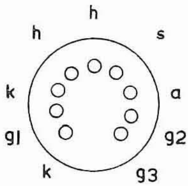
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE, WITH SCREEN-GRID VOLTAGE AS PARAMETER. $V_{g2} = 170V$

EF80

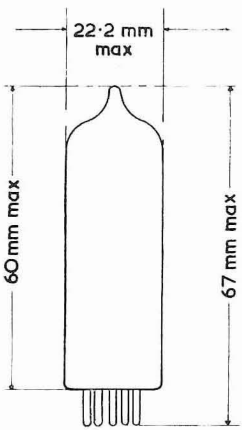
R.F. PENTODE

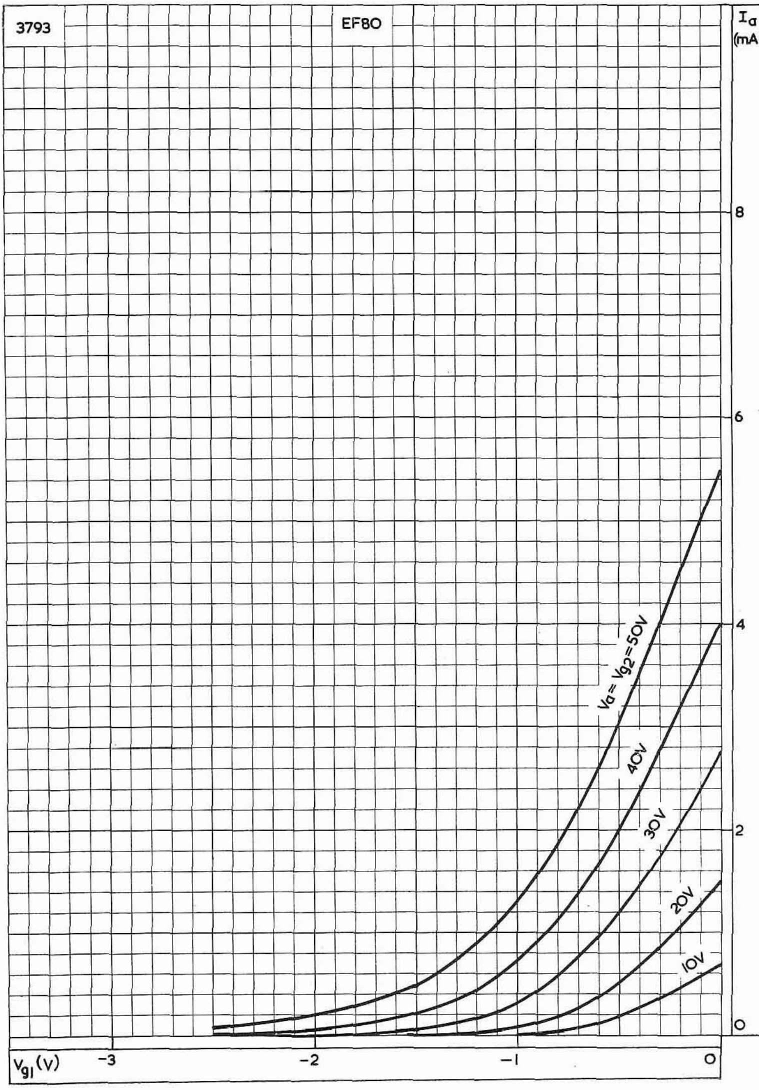
3785



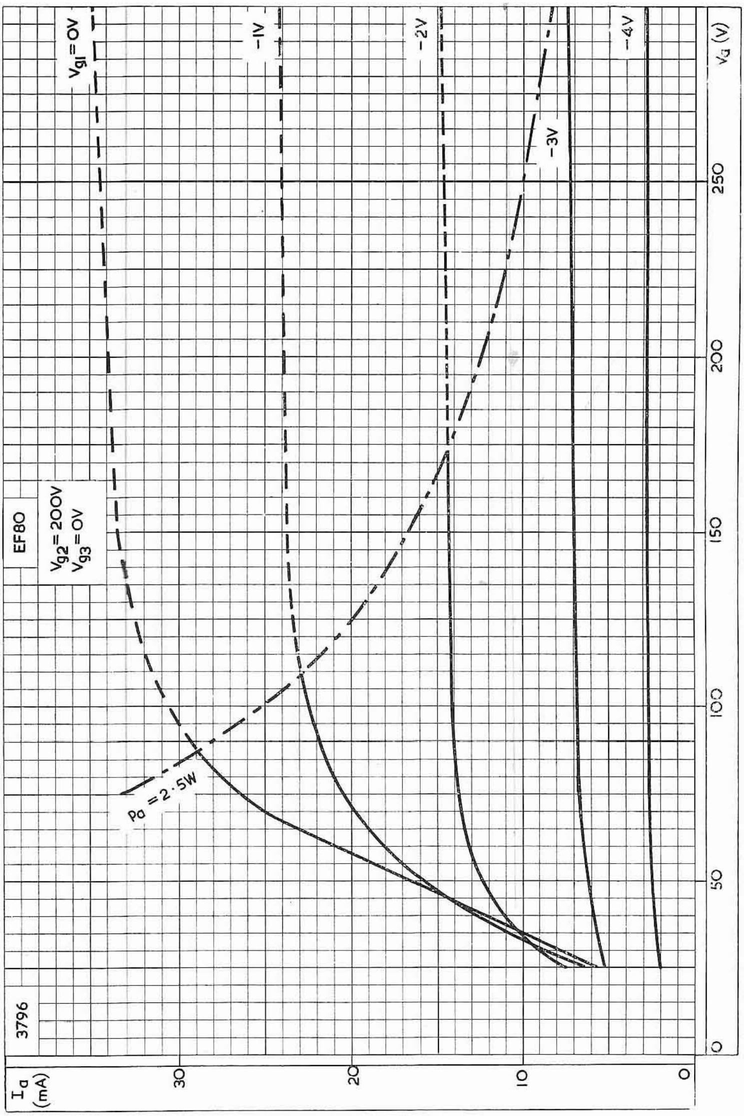


B9A Base

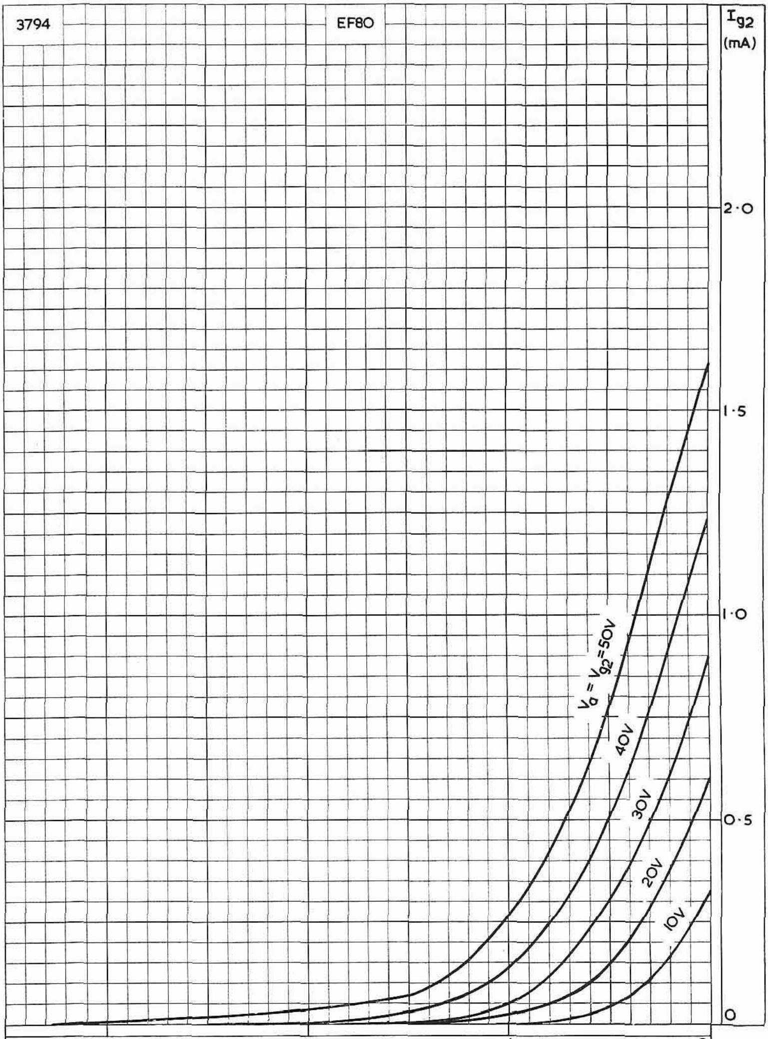




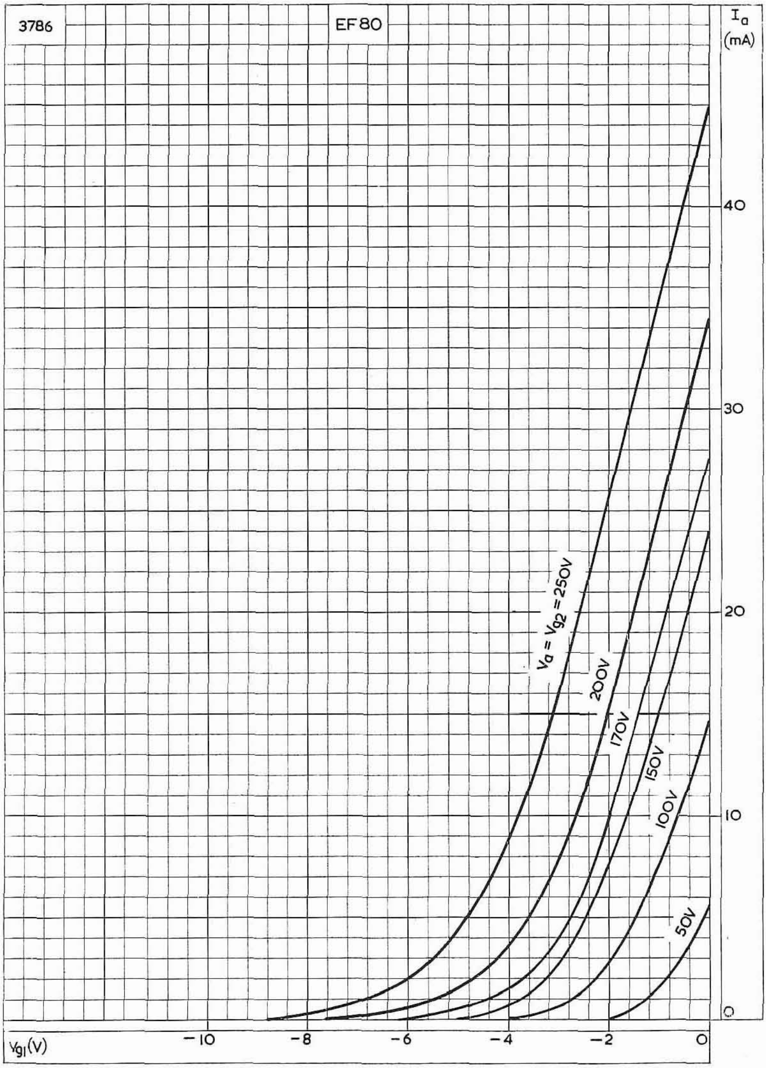
ANODE CURRENT IN THE REGION OF THE ORIGIN PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER



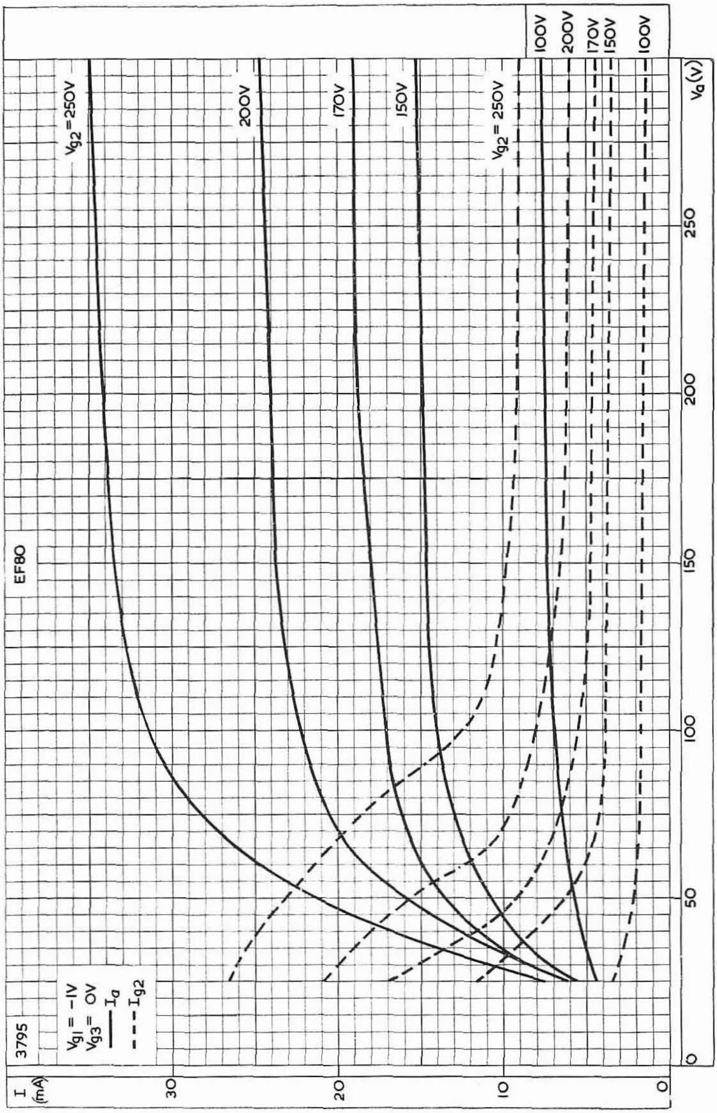
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



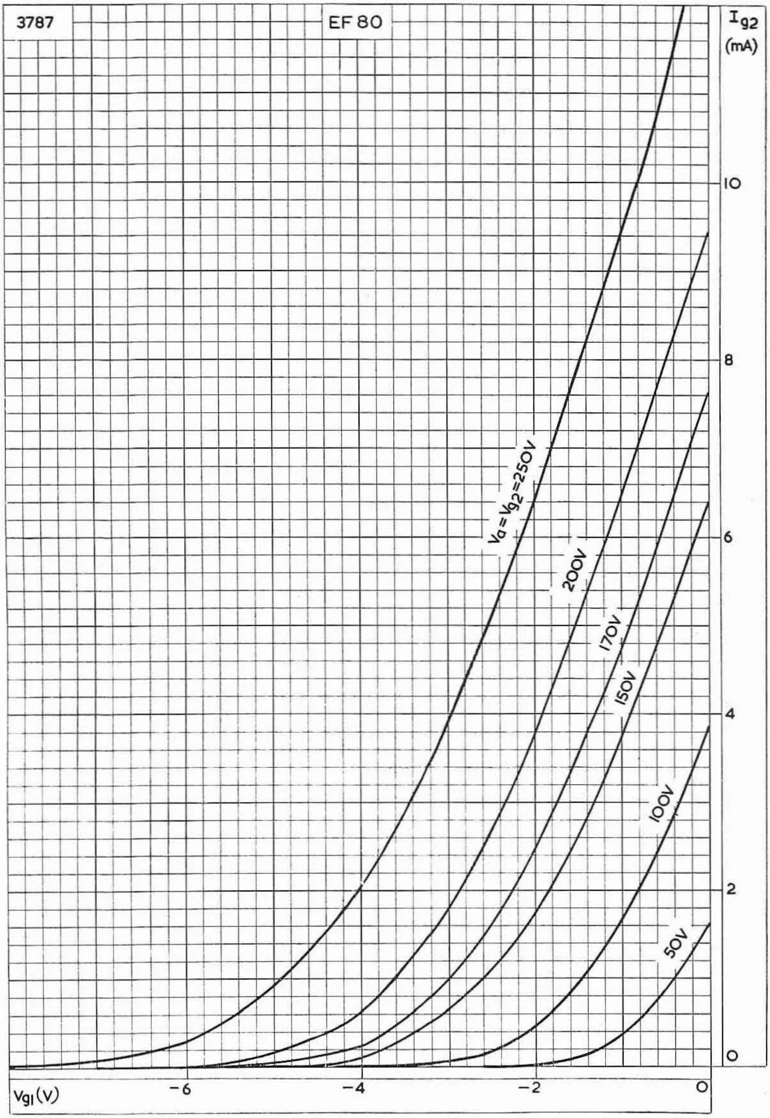
SCREEN-GRID CURRENT IN THE REGION OF THE ORIGIN PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER



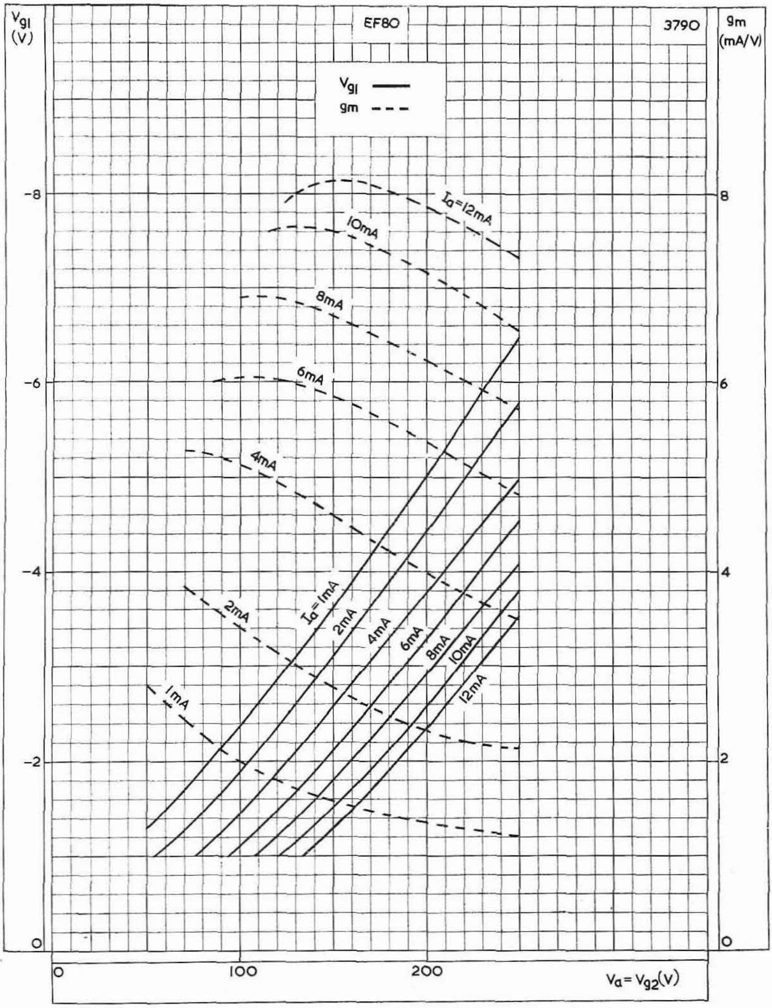
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER



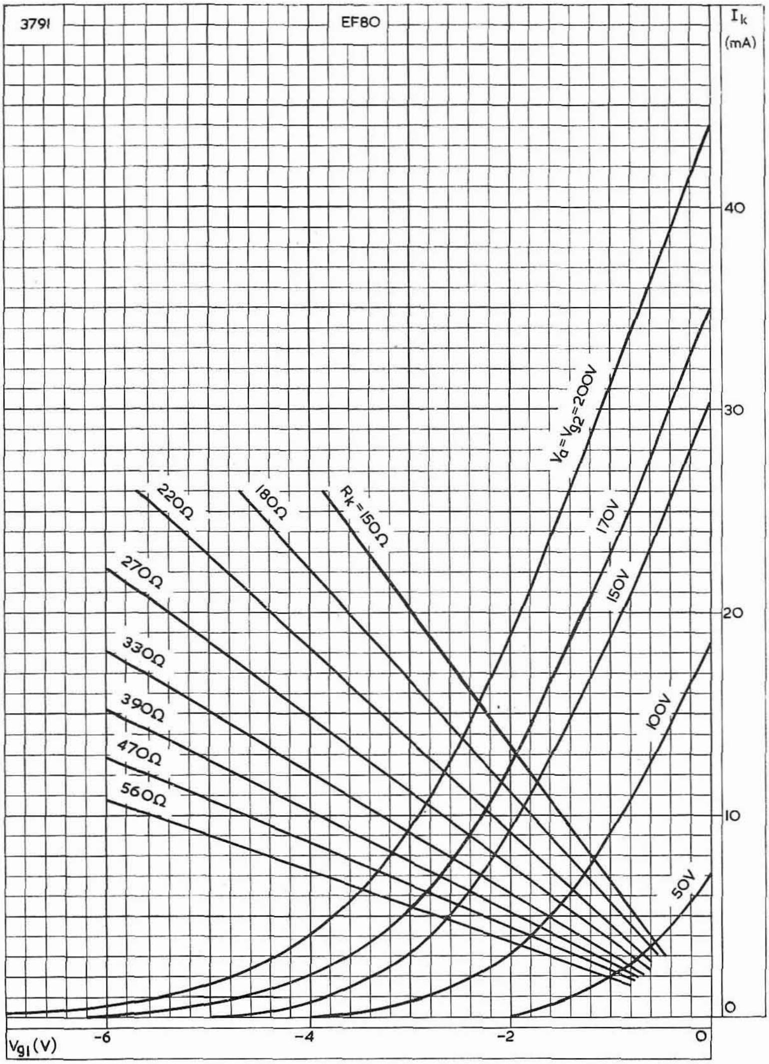
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



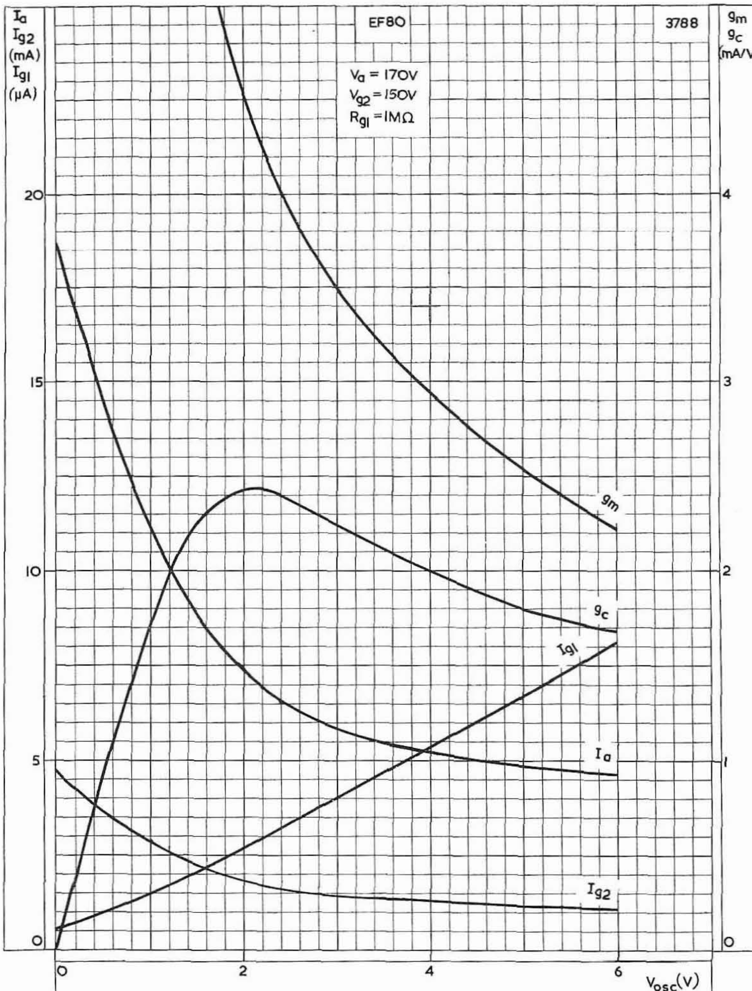
SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER



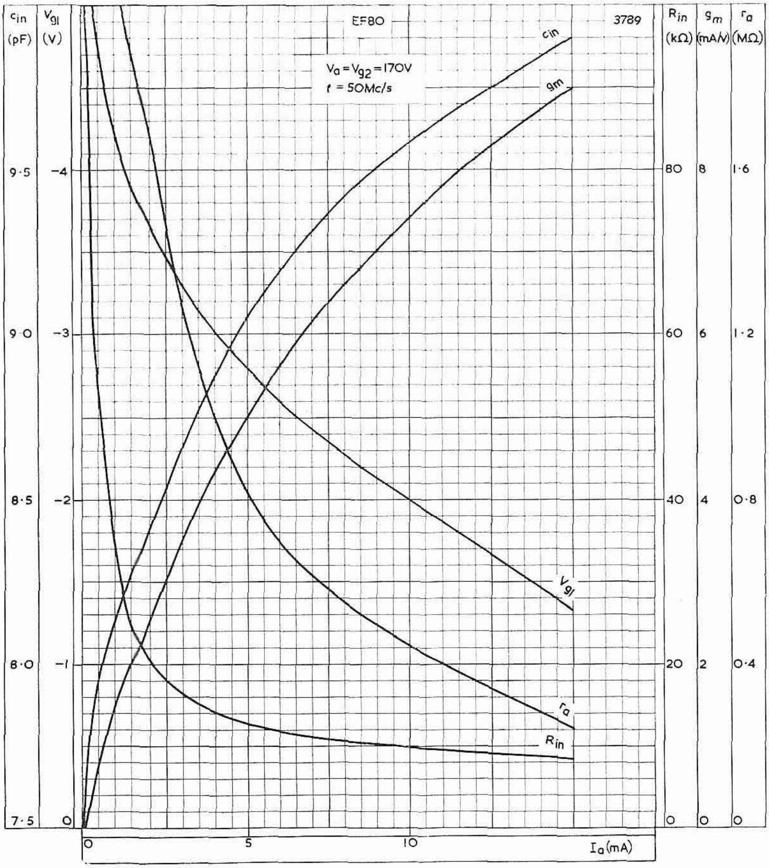
RELATION BETWEEN CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE AND ANODE AND SCREEN-GRID VOLTAGES, WITH ANODE CURRENT AS PARAMETER



CATHODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER



PERFORMANCE CURVES AS FREQUENCY CHANGER. $V_a = 170V$, $V_{g2} = 150V$



CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, ANODE IMPEDANCE, INPUT CAPACITANCE AND INPUT DAMPING PLOTTED AGAINST ANODE CURRENT

VARIABLE-MU R.F. PENTODE

EF85

High slope variable-mu r.f. pentode, primarily intended for use in television receivers.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES (measured without an external shield)

c_{in}	7.2	pF
c_{out}	3.7	pF
c_{a-g1}	$<$ 7.0	mpF
c_{g1-h}	$<$ 150	mpF

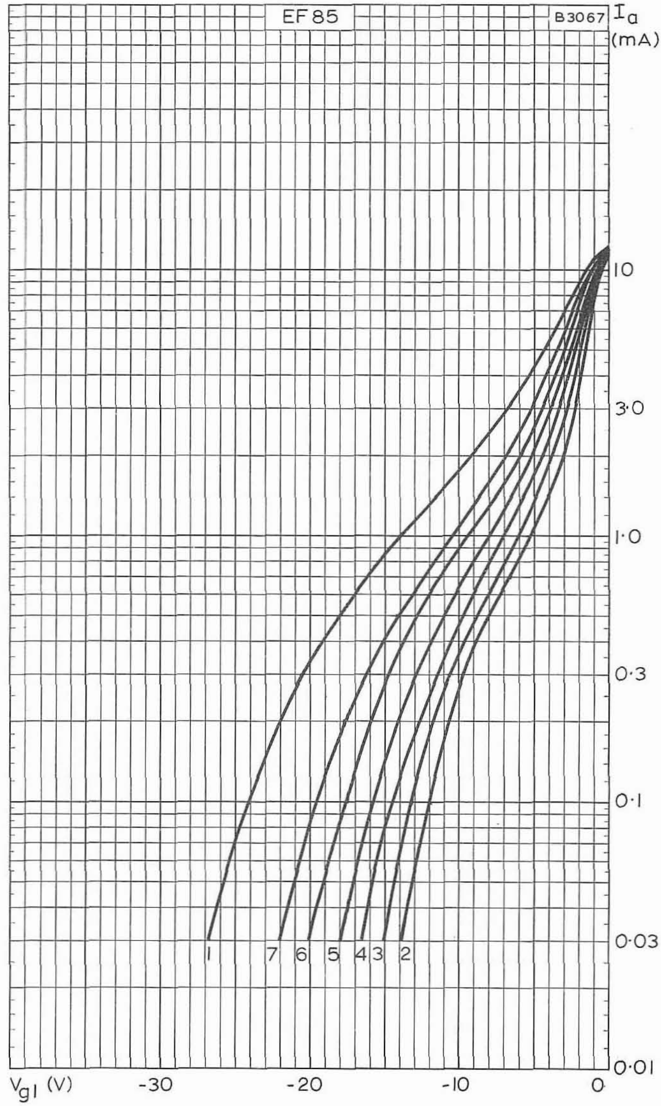
CHARACTERISTICS

$V_b = V_a$	250	V
V_{g3}	0	V
R_{g2}	60	kΩ
V_{g2}	100	V
I_a	10	mA
I_{g2}	2.5	mA
V_{g1}	−2.0	V
g_m	6.0	mA/V
r_a	500	kΩ
R_{eq}	1.5	kΩ

OPERATING CONDITIONS (See circuit on page D2)

Condition	*1*	*2*	*3*	*4*	
V_b	190	190	190	190	V
R_{g2}	22	6.8	8.2	10	kΩ
$R_{g2-c'}$	—	8.2	12	18	kΩ
R_{k1}	47	47	47	47	Ω
R_{k2}	100	56	68	82	Ω
I_a	11.8	9.2	9.6	10	mA
I_{g2}	3.0	2.2	2.2	2.5	mA
g_m	6.0	5.7	5.8	6.0	mA/V
V_{g1} for 60 : 1 reduction in g_m	−18.5	−9.0	−10	−11	V
I_{total}	15	23.5	20.5	18.5	mA

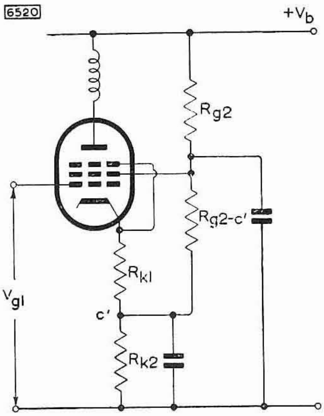
Condition	*5*	*6*	*7*	
V_b	190	190	190	V
R_{g2}	12	15	18	kΩ
$R_{g2-c'}$	27	47	82	kΩ
R_{k1}	47	47	47	Ω
R_{k2}	82	82	82	Ω
I_a	10.7	11.3	11.7	mA
I_{g2}	2.5	2.7	2.8	mA
g_m	6.0	6.2	6.0	mA/V
V_{g1} for 60 : 1 reduction in g_m	−12	−13.5	−15	V
I_{total}	17.5	16.5	16	mA



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE UNDER CONDITIONS 1 to 7 (See page D1)

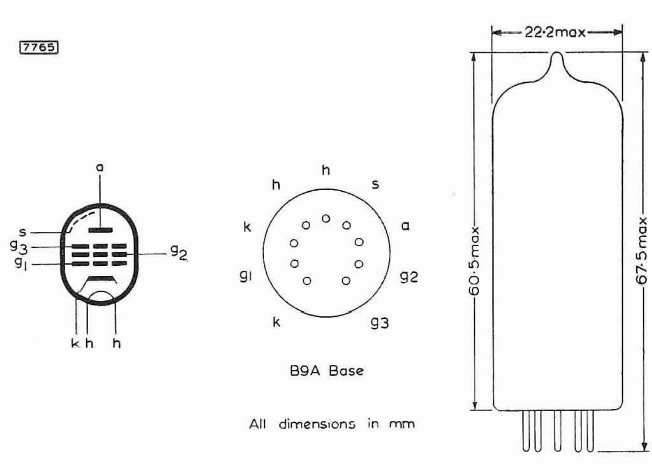
EF85

VARIABLE-MU R.F. PENTODE

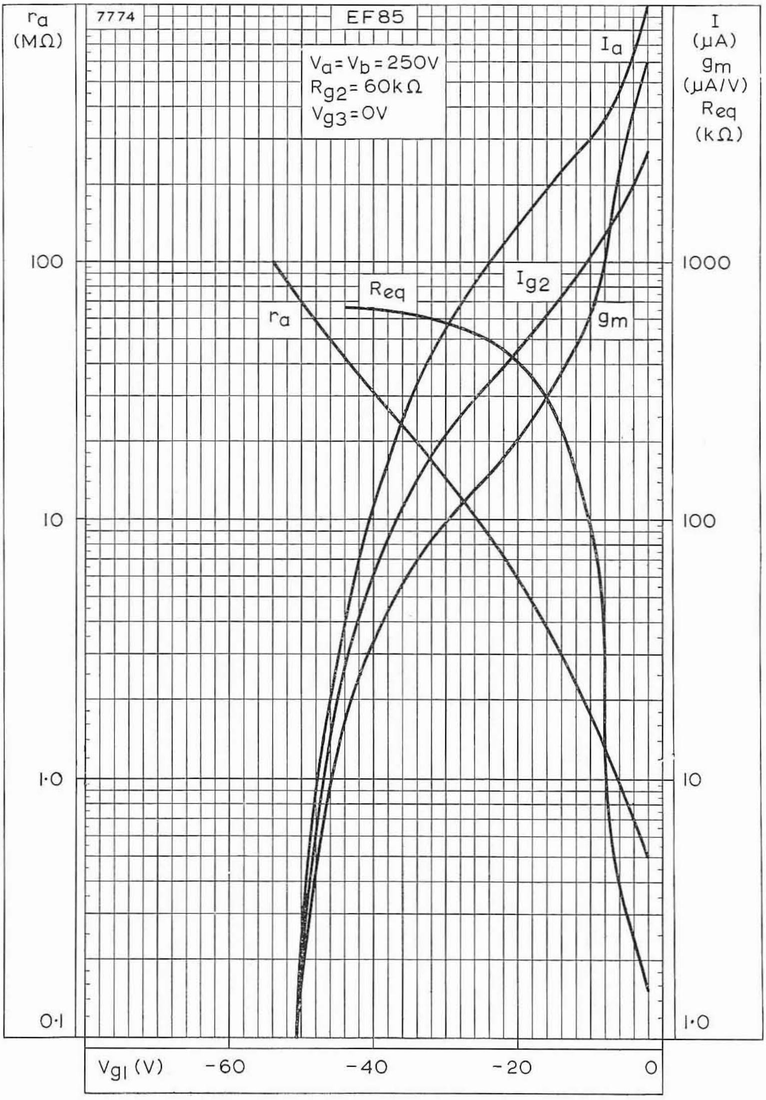


LIMITING VALUES

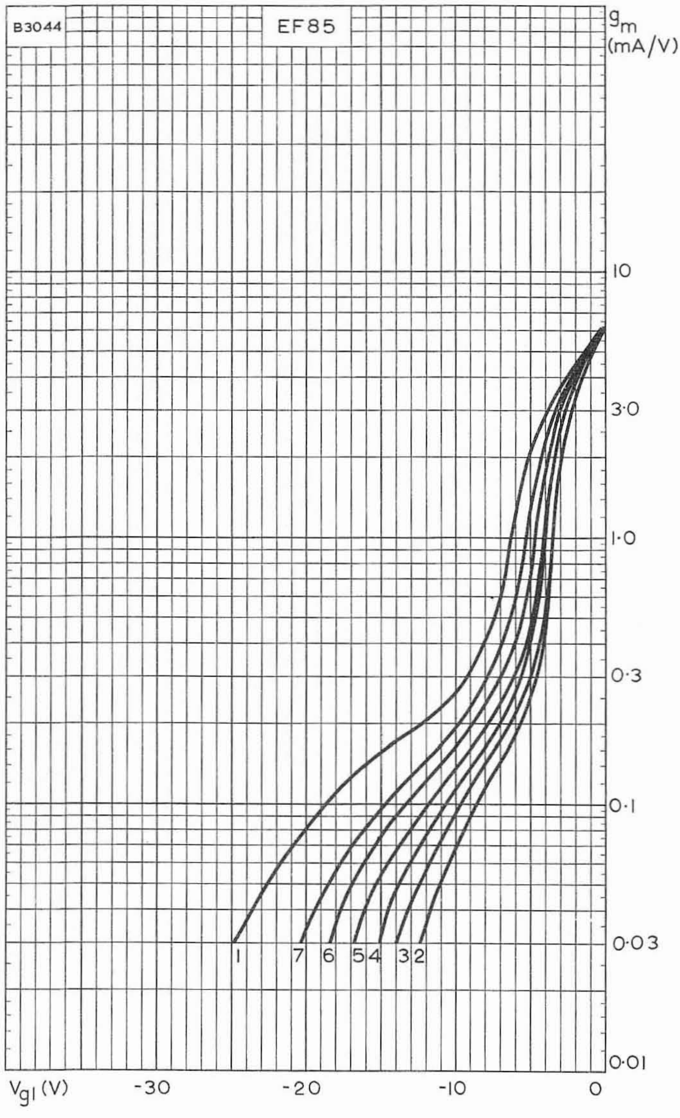
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	650	mW
I_k max.	15	mA
R_{g1-k} max.	3.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ



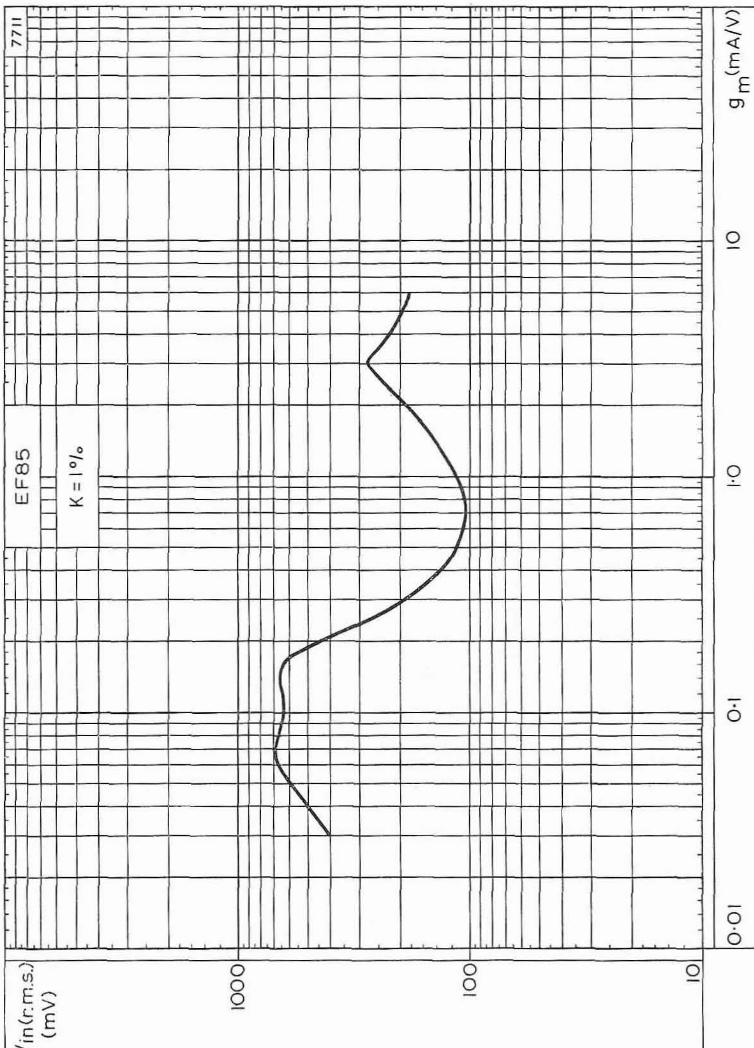
All dimensions in mm



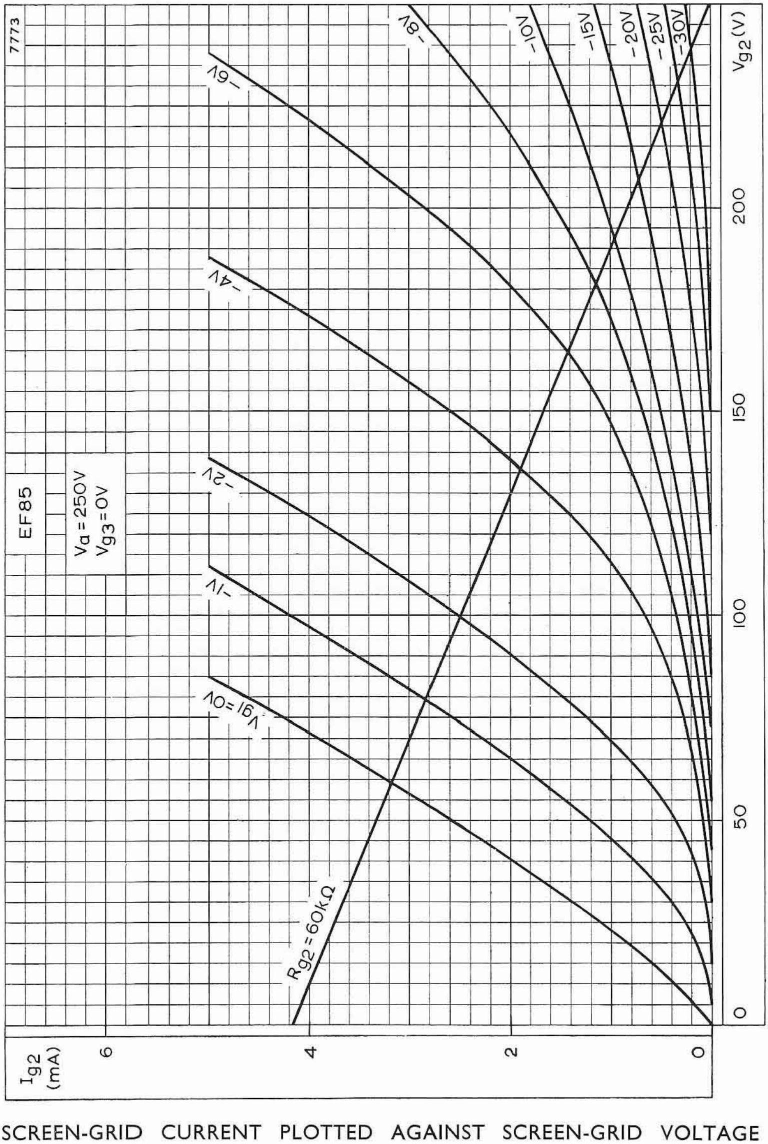
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE ANODE IMPEDANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE UNDER CONDITIONS 1 to 7 (See page D1)



CROSS MODULATION CURVE



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

VOLTAGE AMPLIFYING PENTODE

EF86

Low-noise pentode for use as r.c. coupled a.f. voltage amplifier, particularly suitable for the early stages of high-gain audio amplifiers, microphone pre-amplifiers and tape recorders.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	200	mA

CAPACITANCES (measured without an external shield)

c_{out}	5.1	pF←
c_{in}	3.8	pF
c_{a-g1}	<50	mpF
c_{g1-h}	<2.5	mpF

CHARACTERISTICS

V_a	250	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	600	μA
V_{g1}	−2.2	V←
g_m	2.2	mA/V←
r_a	2.0	MΩ←
μ_{g1-g2}	38	
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER ←

Pentode connection

V_b (V)	R_a (kΩ)	R_{g2} (MΩ)	R_k (kΩ)	I_k (mA)	$\frac{V_{out}}{V_{in}}$†	V_{out}* ($V_{r.m.s.}$)	R_{g1}** (kΩ)
400	100	0.39	1.0	3.2	140	85	330
350	100	0.39	1.0	2.75	134	74	330
300	100	0.39	1.0	2.4	129	62	330
250	100	0.39	1.0	2.0	123	50	330
200	100	0.39	1.0	1.55	117	38	330
150	100	0.39	1.0	1.05	110	27	330
400	220	1.0	2.2	1.45	210	72	680
350	220	1.0	2.2	1.3	205	62	680
300	220	1.0	2.2	1.1	194	53	680
250	220	1.0	2.2	0.9	185	44	680
200	220	1.0	2.2	0.75	173	35	680
150	220	1.0	2.2	0.5	147	22	680

*Output voltage at $D_{tot} = 5\%$.
**Grid resistor of following valve.

† $\frac{V_{out}}{V_{in}}$ measured with V_{in} = 100mV r.m.s.

OPERATING NOTES

1. Hum

When used as a normal voltage amplifier with a line voltage of 250V, an anode load of 100kΩ and a grid resistor of 470kΩ the maximum hum level of the valve alone is 5μV, the average value being about 3μV when operated with one side of the heater earthed. This can be further reduced by centre-tapping the heater to earth. Under these conditions the nominal hum level is 1μV. The low level of hum attained with this valve can be completely masked by that due to an unsuitable valveholder, in which excessive leakage and capacitive coupling between pins will introduce considerable hum.

2. Noise

The low-frequency noise generated by a valve is most conveniently specified as an equivalent voltage on the control grid for a specific bandwidth. For the EF86 under normal conditions, i.e. line voltage of 250V and an anode load of 100kΩ, the equivalent noise voltage is approximately 2μV for the frequency range of 25 to 10,000c/s.

3. Microphony

Care in the design of the valve to ensure that the electrode structure and its mounting are as rigid as possible has reduced the microphony of the EF86 to a very low level. There are no appreciable internal resonances at frequencies below 1,000c/s. At higher frequencies the effect of vibration is usually negligible on account of the damping provided by the chassis and the valveholder. In high-gain applications such as tape recording care should be taken in siting the valve, particularly when a loudspeaker is present in the same cabinet or when a motor is mounted on the same chassis. In such cases a flexible mounting for the valveholder or a separate weighted sub-chassis is advisable.

EF86

VOLTAGE AMPLIFYING PENTODE

Triode connection (g_2 connected to a, g_3 to k)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$‡	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}† (kΩ)
400	47	3.6	1.2	26	68	5.2	150
350	47	3.15	1.2	25	58	5.0	150
300	47	2.7	1.2	25	46	4.6	150
250	47	2.25	1.2	25	36	4.3	150
200	47	1.8	1.2	24	24	3.9	150
400	100	2.0	2.2	28	75	4.8	330
350	100	1.8	2.2	28	63	4.7	330
300	100	1.5	2.2	27.5	51	4.6	330
250	100	1.25	2.2	27.5	42	4.2	330
200	100	1.0	2.2	27	30	4.0	330
400	220	1.1	3.9	29	71	4.3	680
350	220	0.95	3.9	29	60	4.3	680
300	220	0.8	3.9	29	52	4.2	680
250	220	0.7	3.9	28	42	3.9	680
200	220	0.55	3.9	28	30	3.7	680

*Output voltage and distortion at the start of positive grid current. At lower output voltages the distortion is approximately proportional to the voltage.

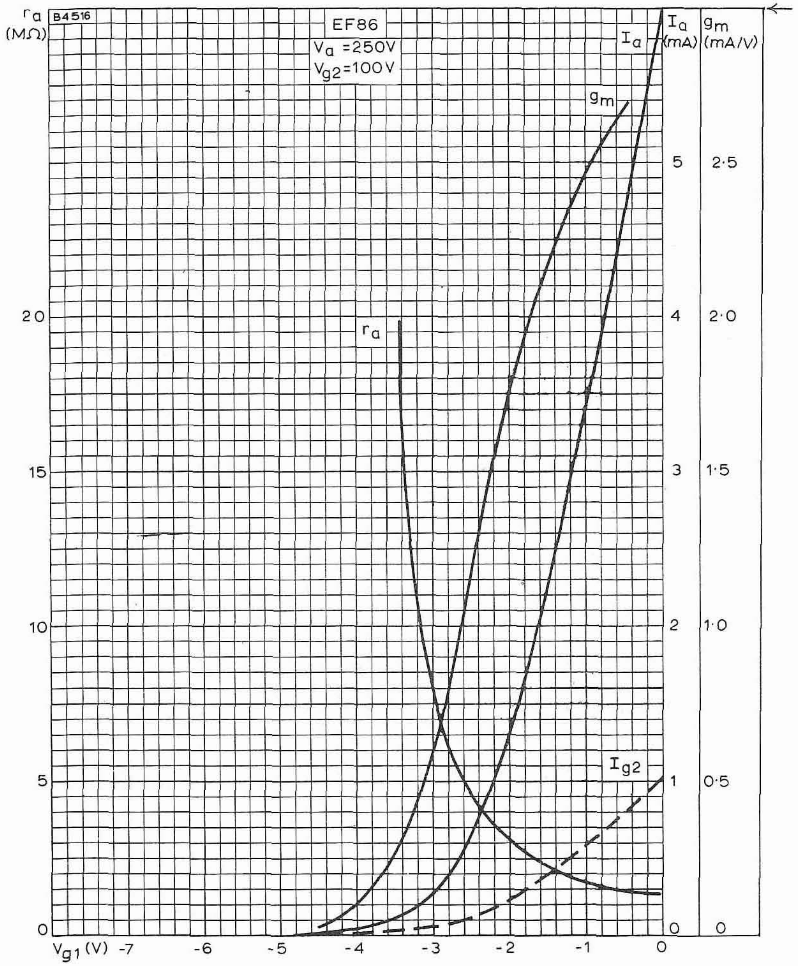
†Grid resistor of the following valve.

‡ $\frac{V_{out}}{V_{in}}$ measured with $V_{in} = 100$mV r.m.s.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g1-k} max. ($p_a > 200$mW)	3.0	MΩ
R_{g1-k} max. ($p_a < 200$mW)	10	MΩ
V_{h-k} max. (cathode positive)	100	V
V_{h-k} max. (cathode negative)	50	V
*R_{h-k} max.	20	kΩ

*When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 120kΩ.

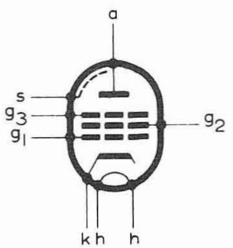


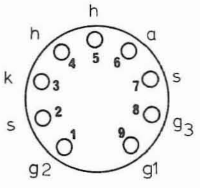
ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_{g2} = 100V$

EF86

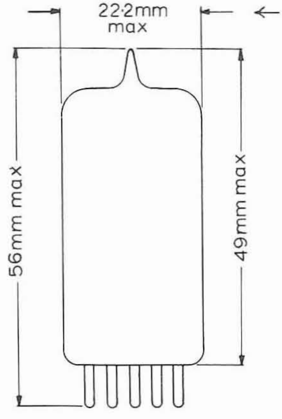
VOLTAGE AMPLIFYING PENTODE

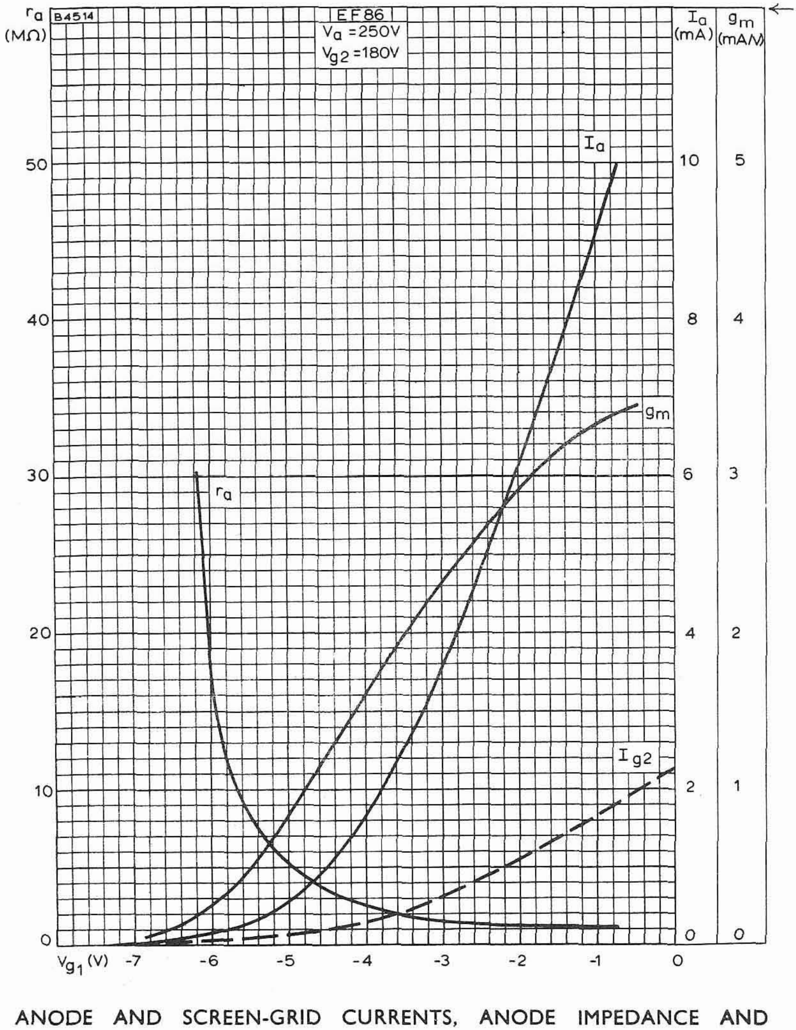
B4522



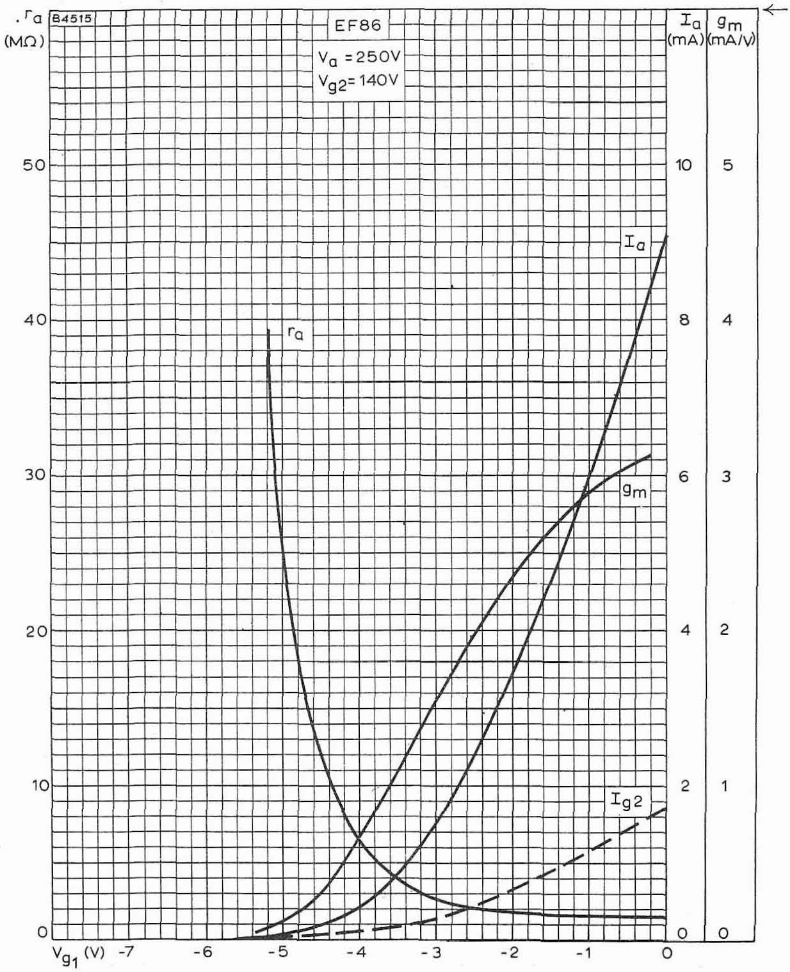


B9A Base



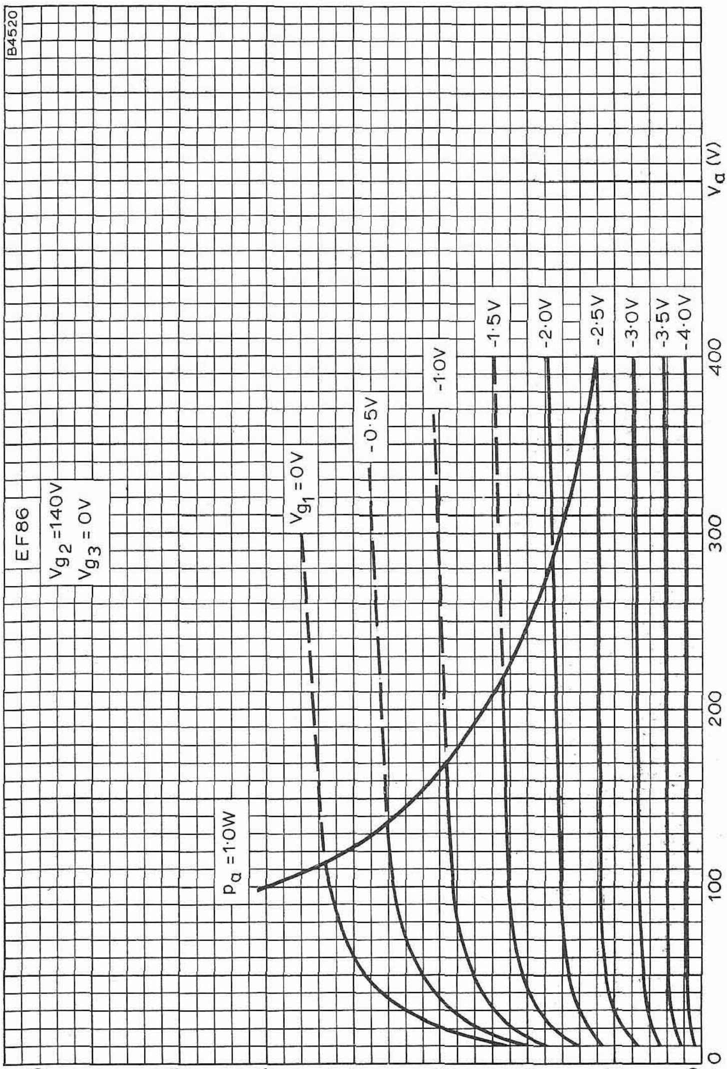


ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_{g2} = 180V$

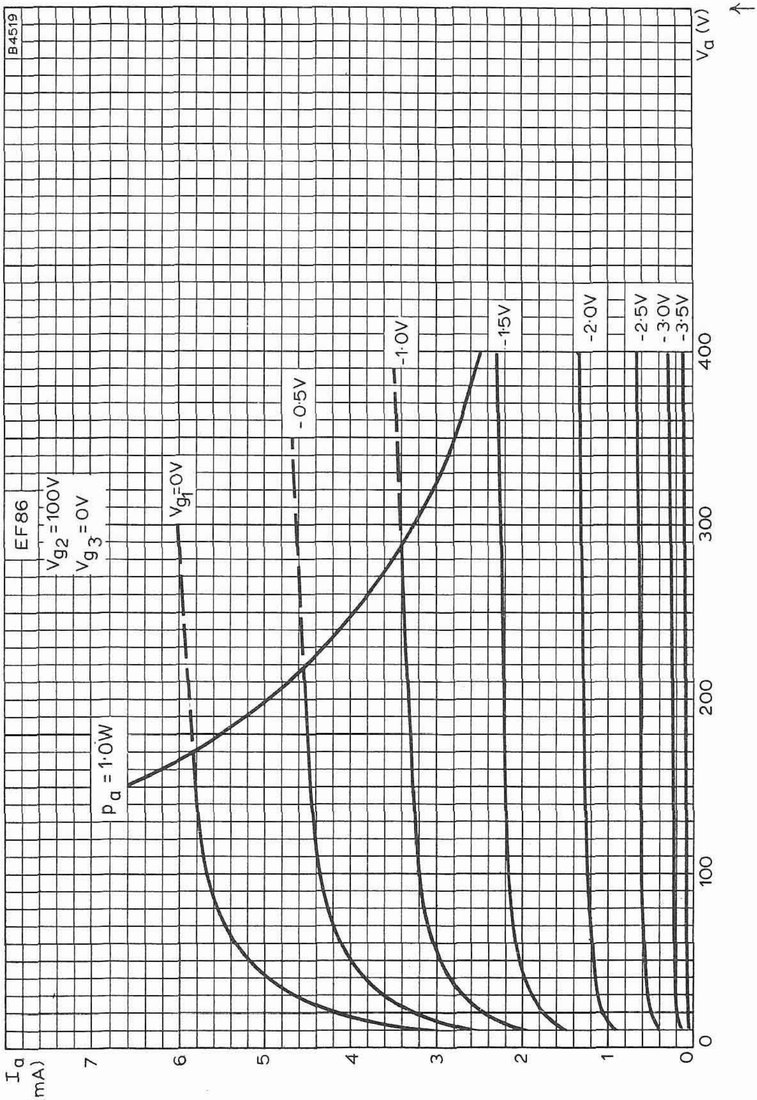


ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.

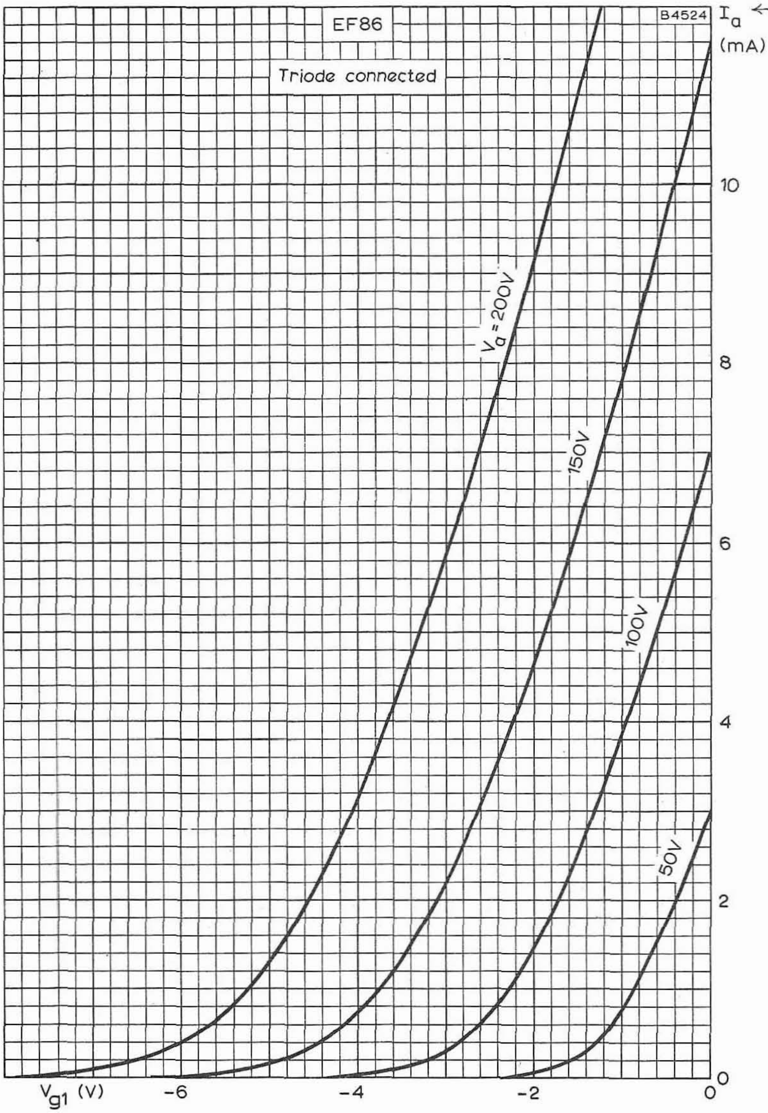
V_{g2} = 140V



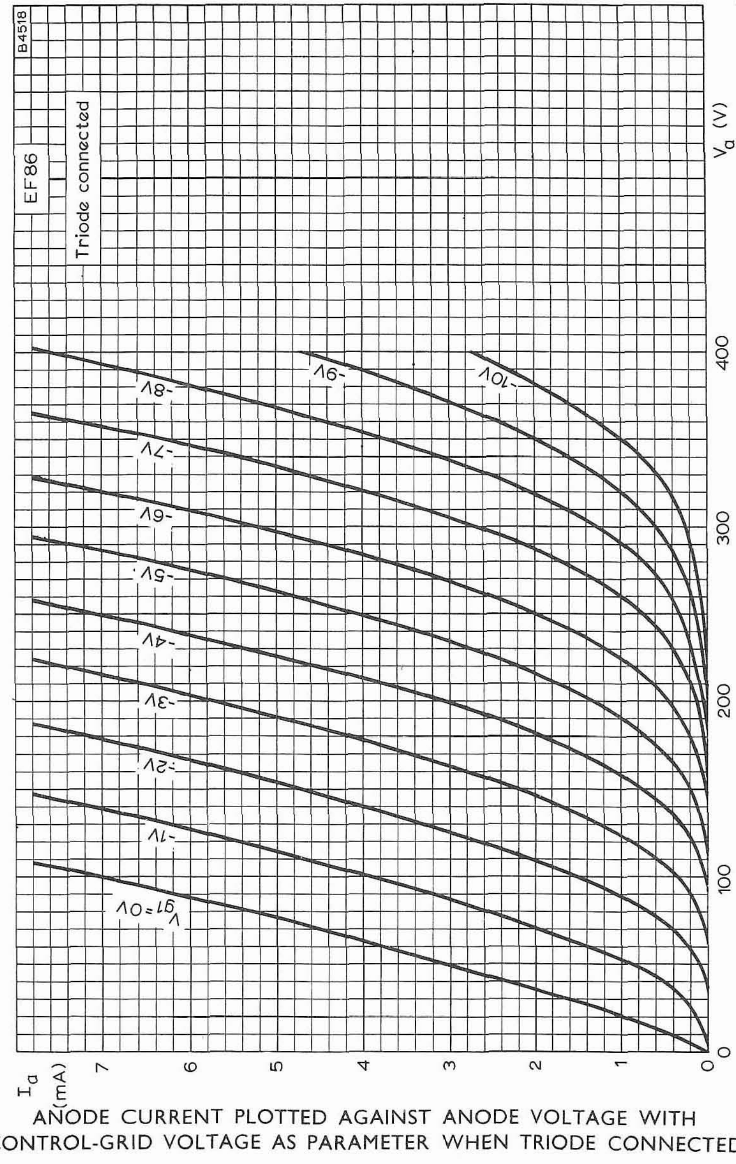
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 140V$



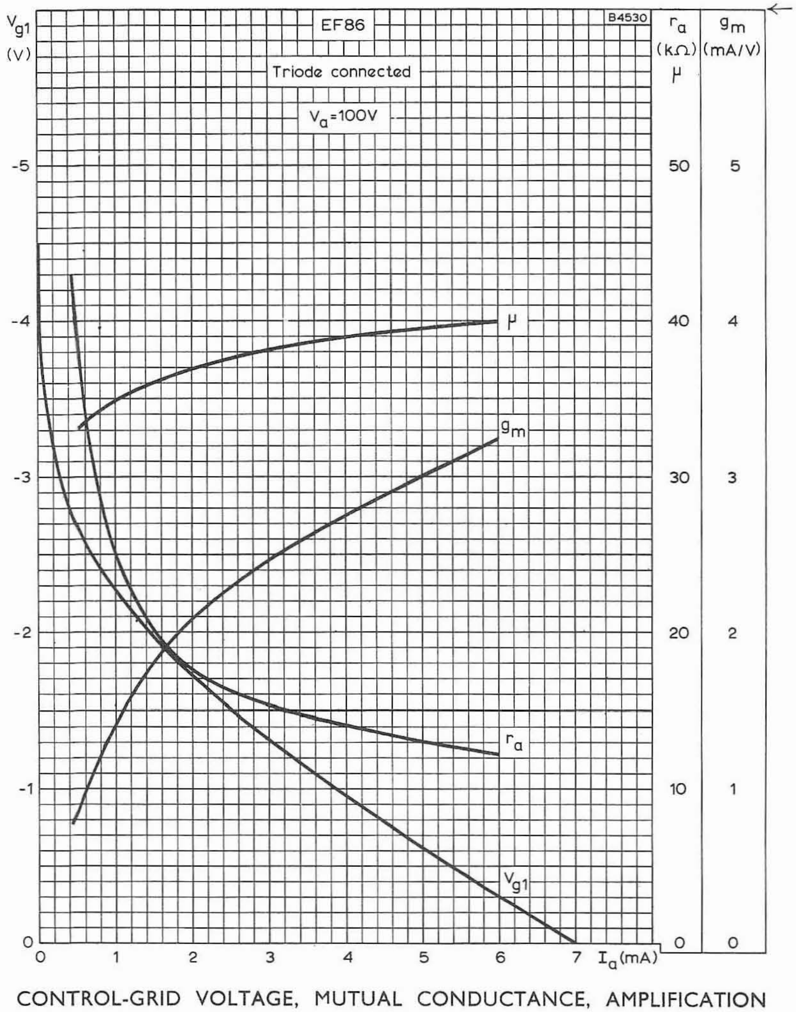
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V



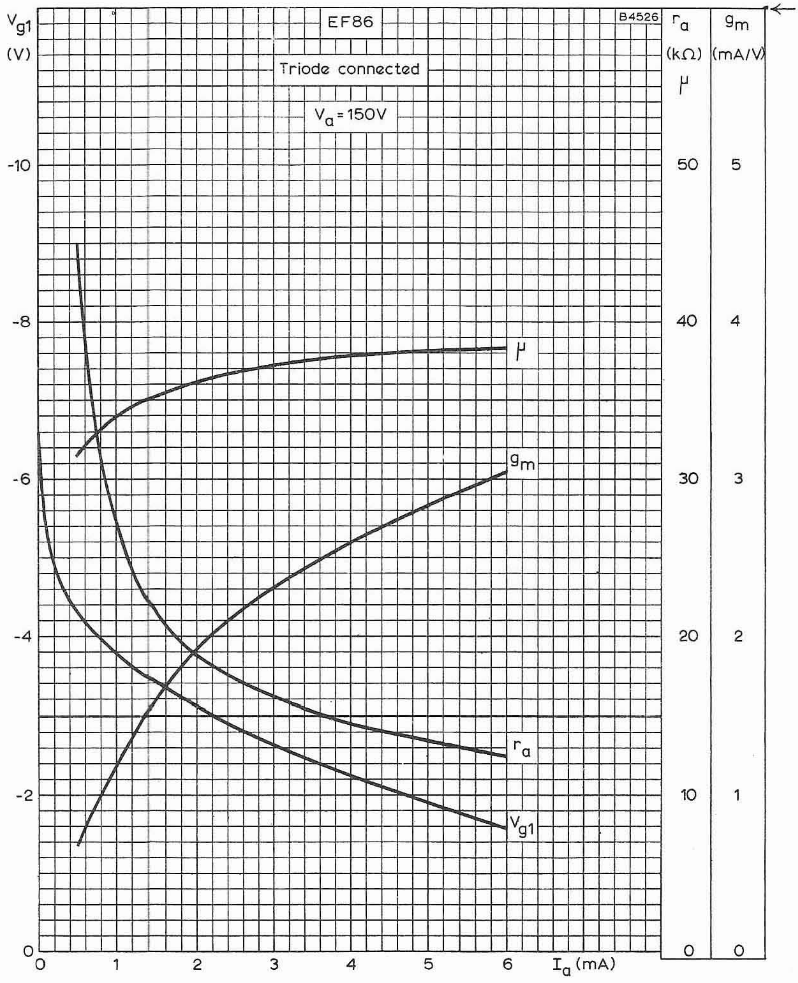
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



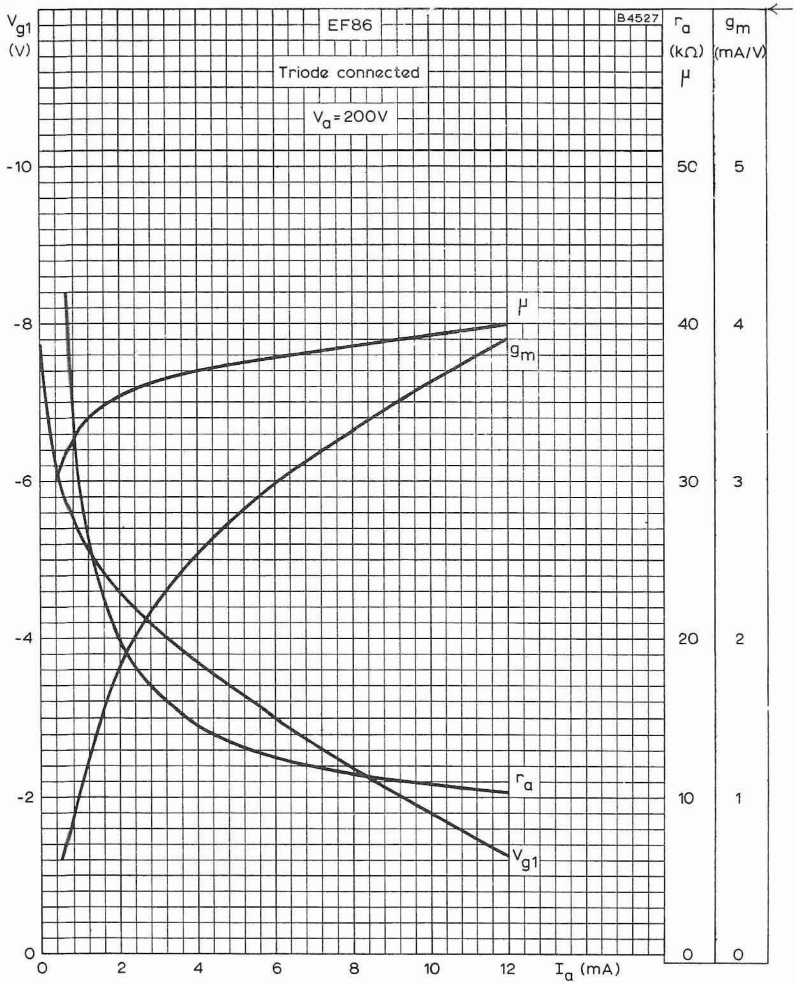
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH
CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT WHEN TRIODE CONNECTED. $V_a = 100V$



CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT WHEN TRIODE CONNECTED. $V_a = 150V$



CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT WHEN TRIODE CONNECTED. $V_a = 200V$

R.F. PENTODE

EF91

High slope pentode primarily intended for use as r.f. and i.f. amplifier or mixer valve.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

	Unshielded	*Shielded*	
c_{in}	7.1	7.1	pF
c_{out}	2.1	3.1	pF
c_{a-g1}	<20	<10	mpF

CHARACTERISTICS

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
V_{g1}	−2.0	V
I_a	10	mA
I_{g2}	2.6	mA
g_m	7.6	mA/V
r_a	>500	kΩ
μ_{g1-g2}	70	
R_{eq}	1.2	kΩ
r_{g1} (f = 50Mc/s)	6.5	kΩ
V_{g3} for cut-off ($I_a < 50\mu A$)	−120	V

OPERATING CONDITIONS AS MIXER

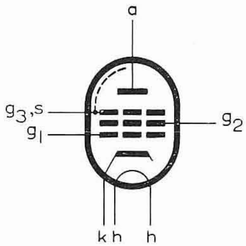
V_b	250	V
V_{g3}	0	V
R_k	470	Ω
R_{g1}	1.0	MΩ
I_a	6.0	mA
I_{g2}	1.5	mA
I_{g1}	2.0	μA
$V_{osc\ (r.m.s.)}$	4.0	V
g_c	2.5	mA/V
$g_{m(eff.)}$	3.2	mA/V
r_a	880	kΩ

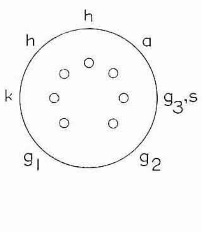
EF91

R.F. PENTODE

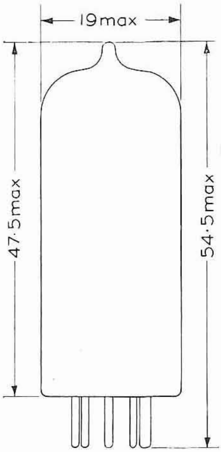
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	650	mW
$-V_{g1}$ max.	50	V
I_k max.	15	mA
R_{g1-k} max.	250	kΩ←
V_{h-k} max.	150	V
T_{bulb} max.	210	°C



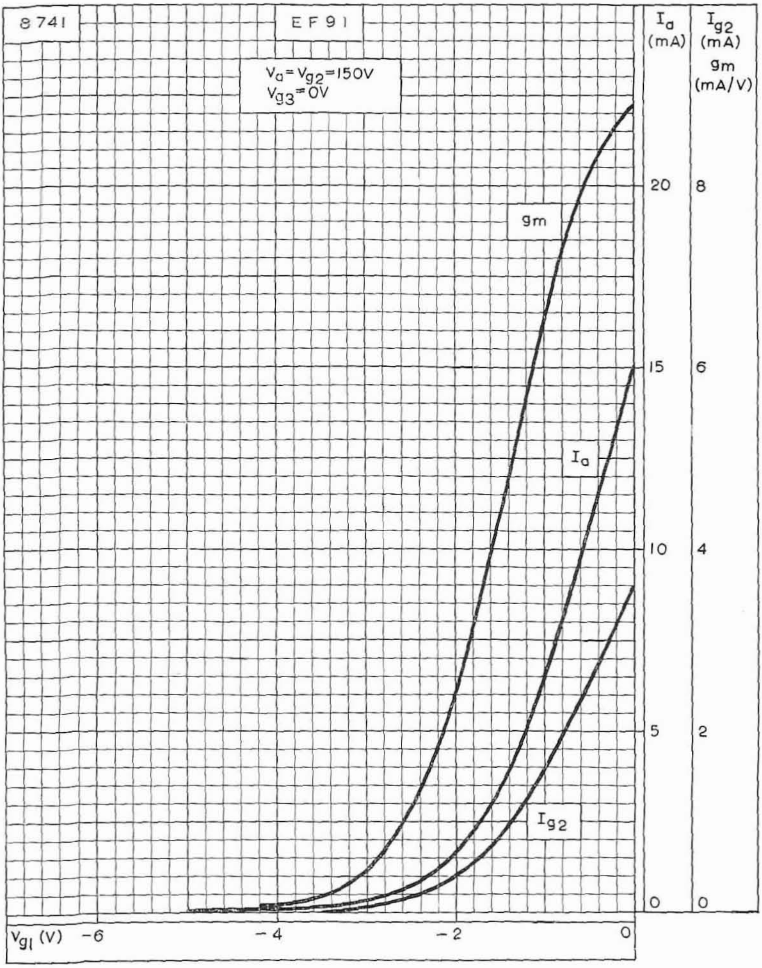


B7G Base

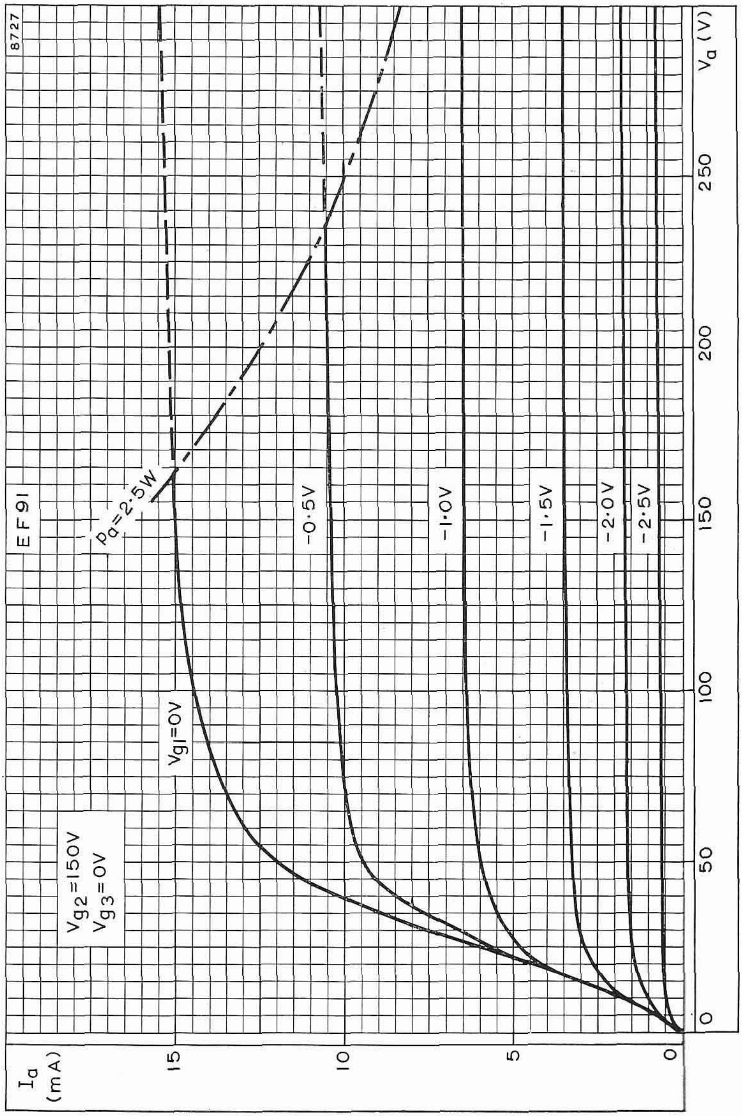


All dimensions in mm

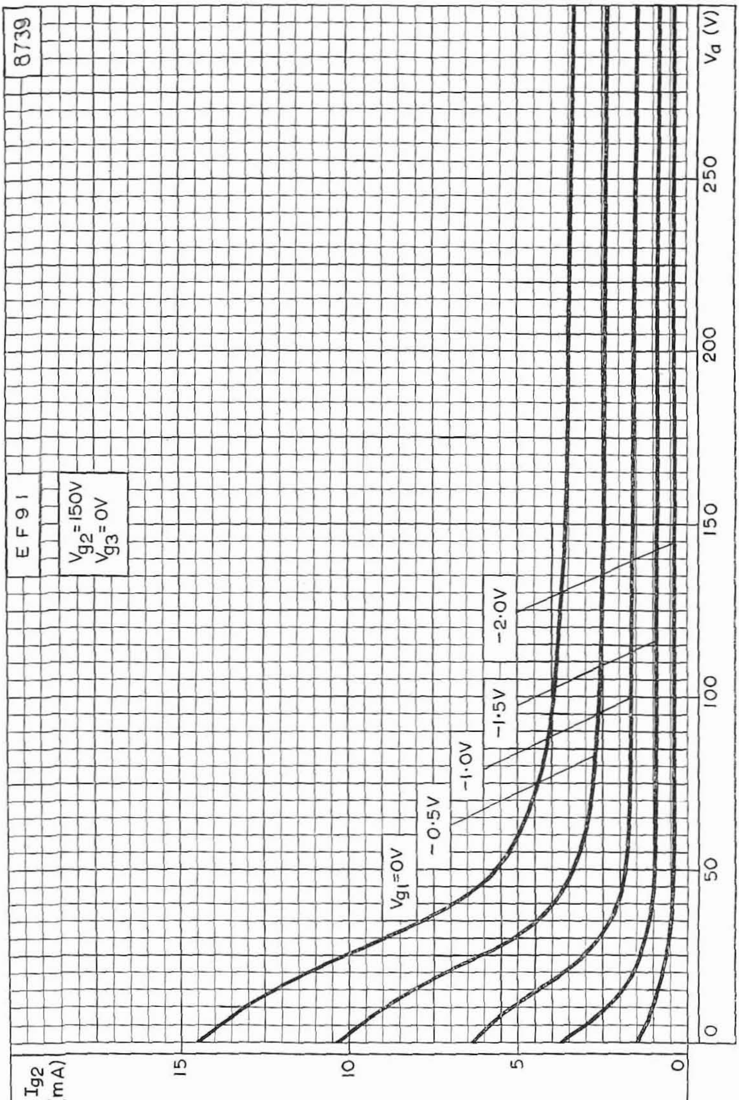
8723



ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 150V$



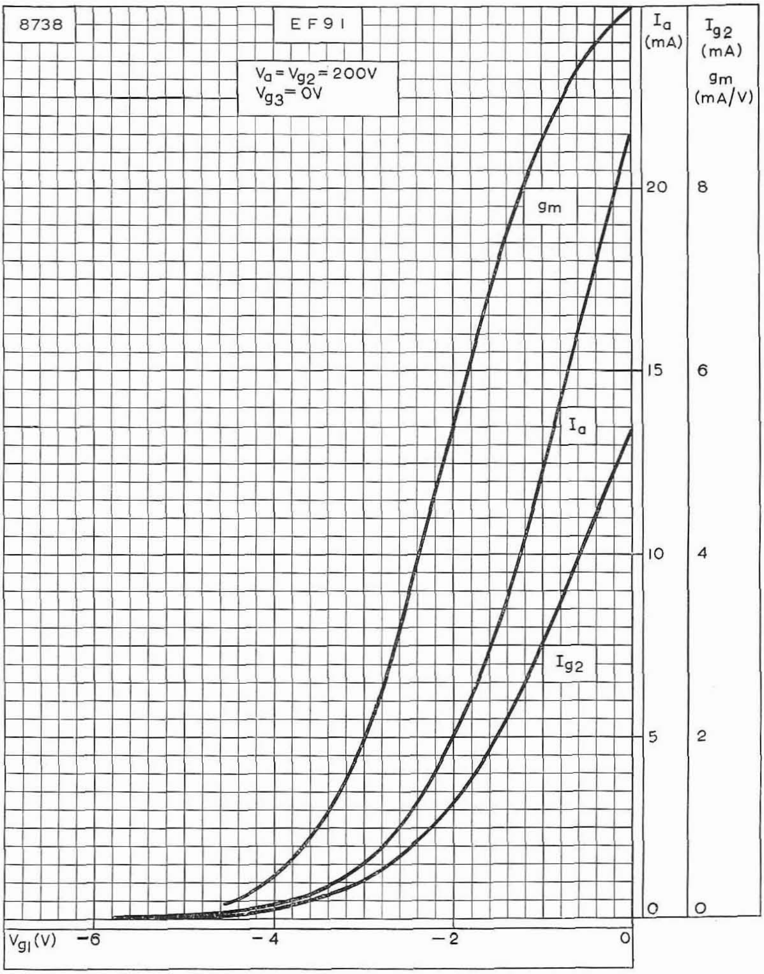
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



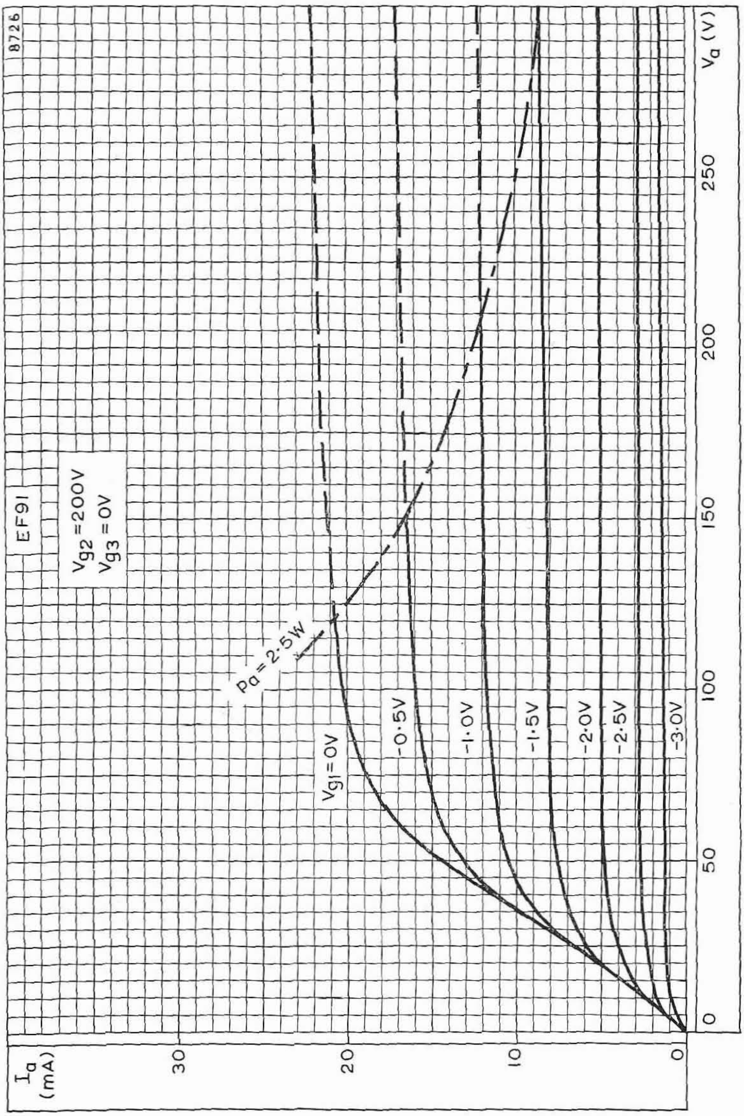
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$

EF91

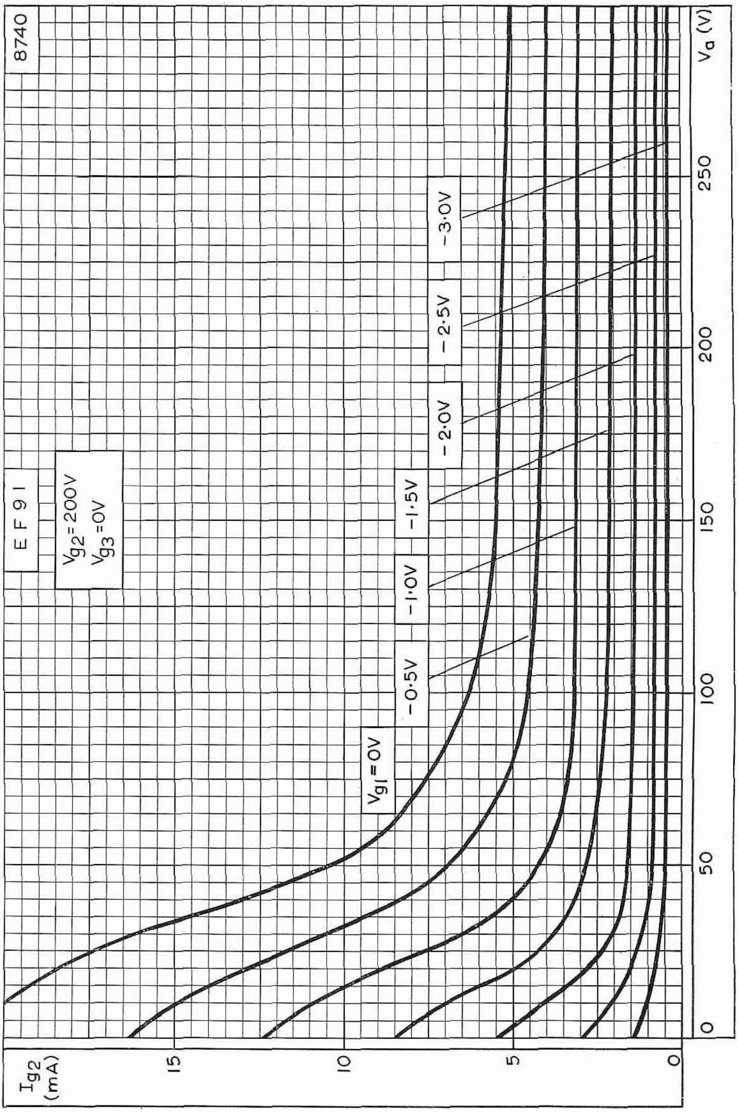
R.F. PENTODE



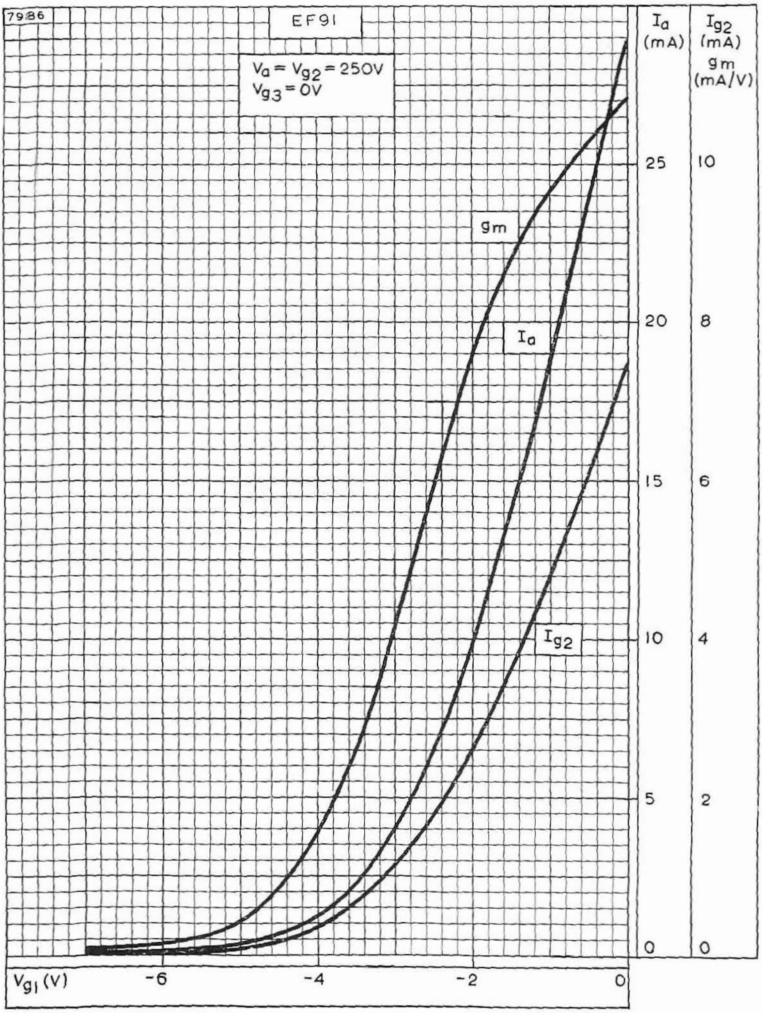
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$



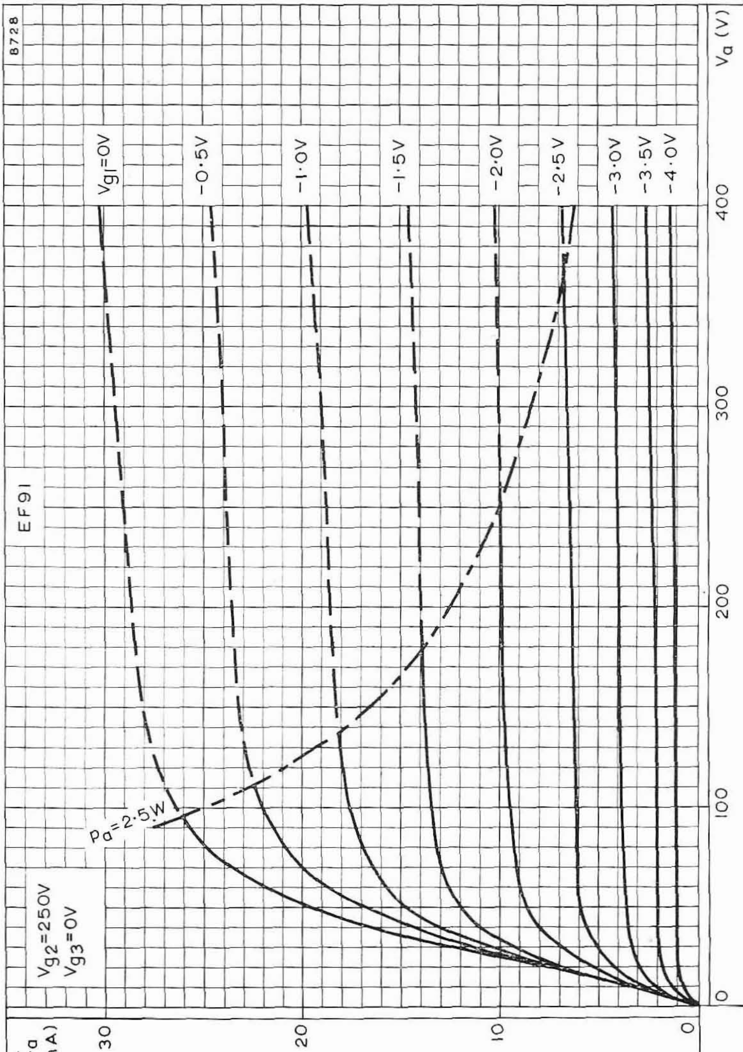
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



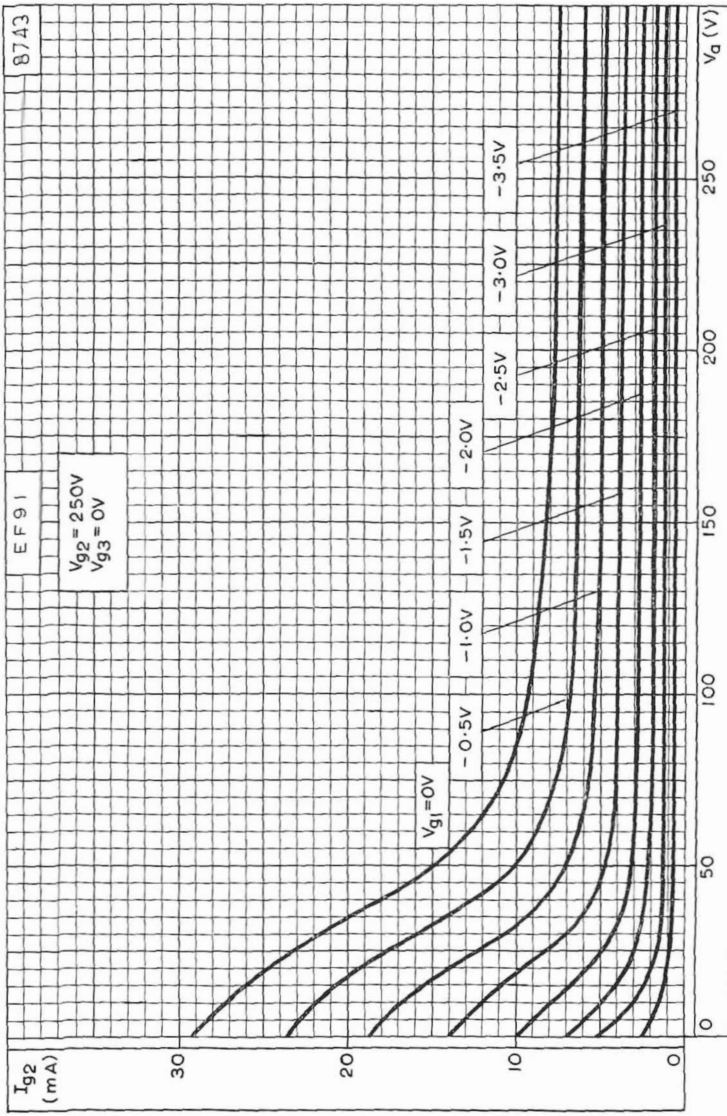
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 250V$



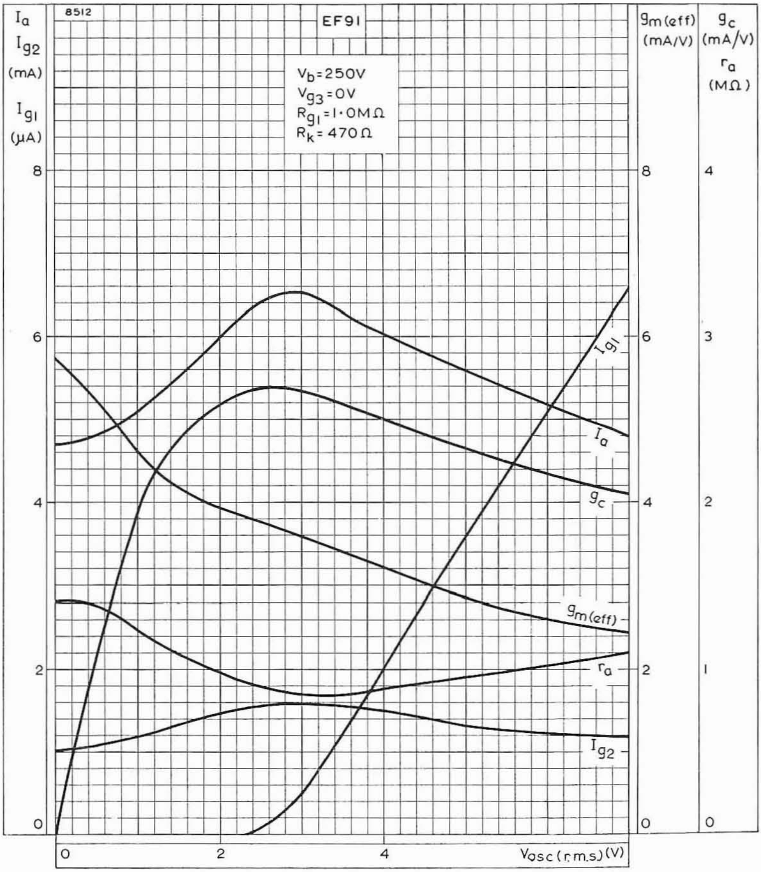
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



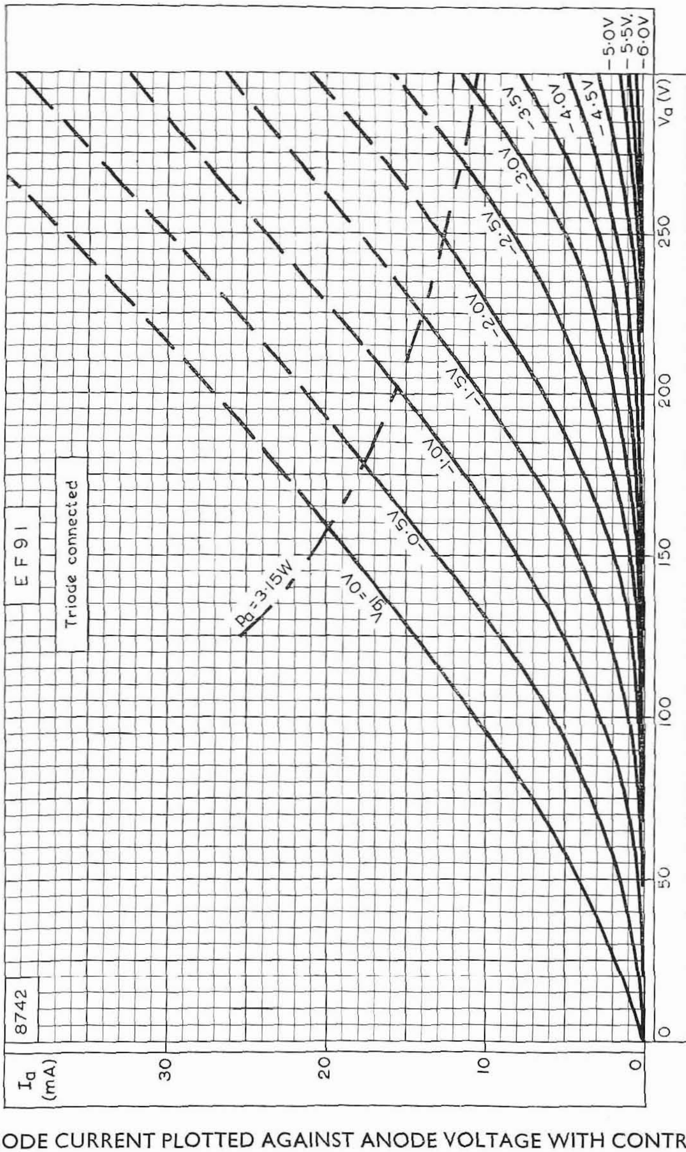
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

EF91

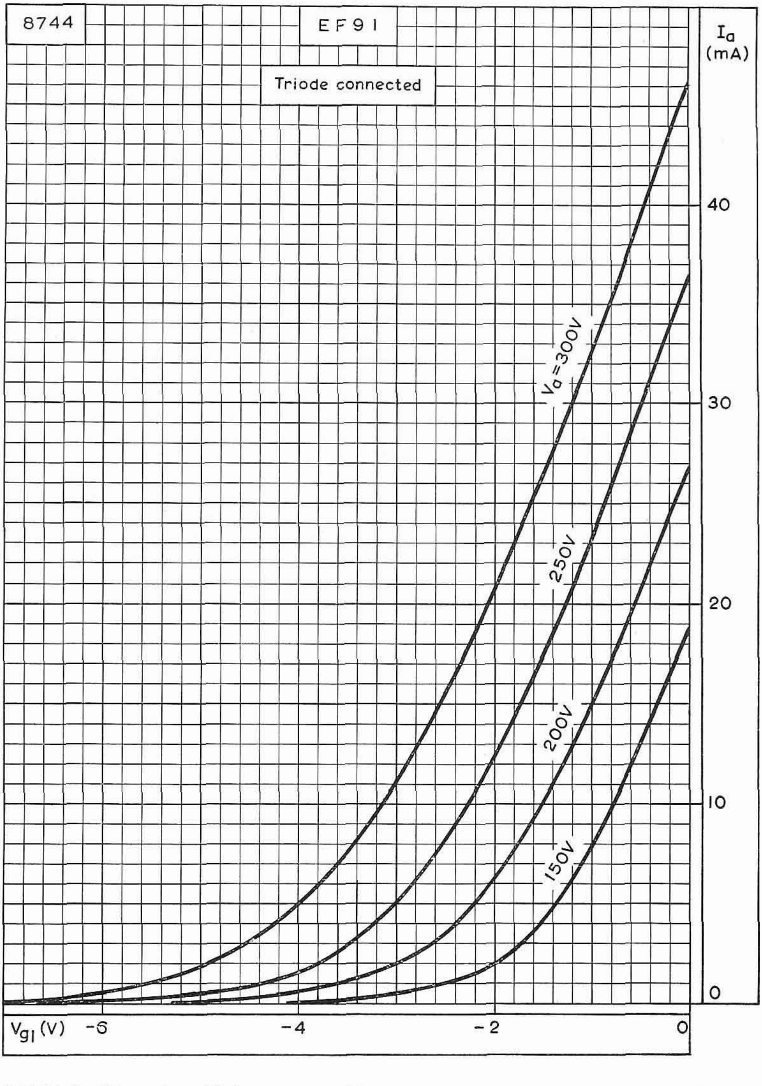
R.F. PENTODE



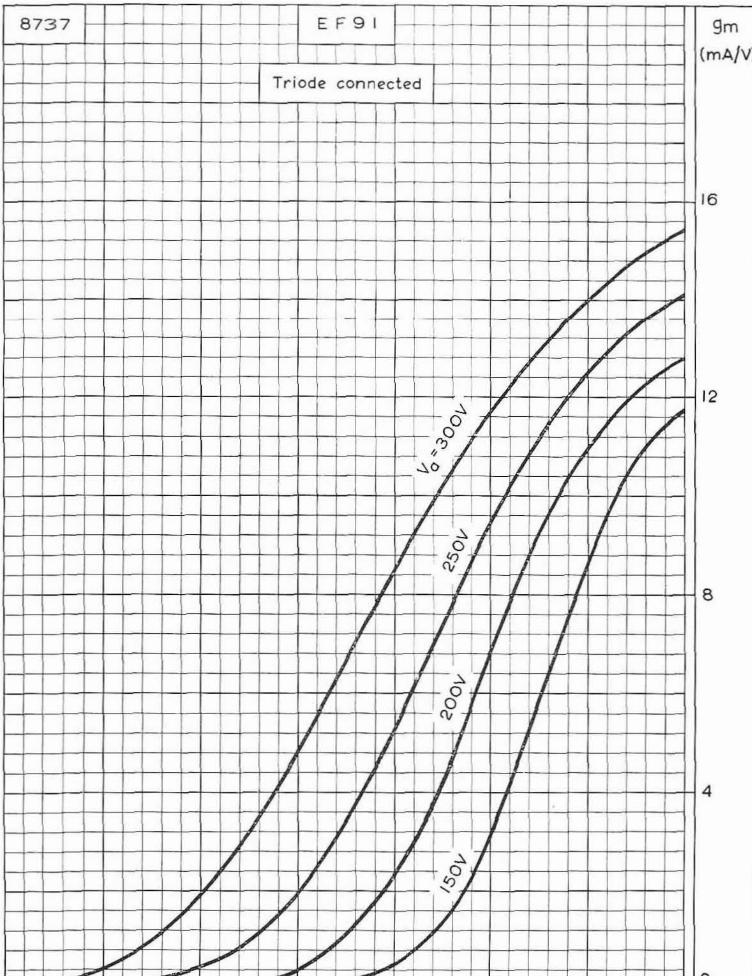
PERFORMANCE CURVES WHEN USED AS FREQUENCY CHANGER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED

VARIABLE-MU R.F. PENTODE

EF92

Variable-mu r.f. pentode for use as a controlled r.f. or i.f. amplifier.

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

	Unshielded	Shielded	
c_{in}	4.8	5.0	pF
c_{out}	6.3	6.5	pF
c_{a-g1}	<15	<10	mpF
c_{h-k}	2.3	2.3	pF

CHARACTERISTICS

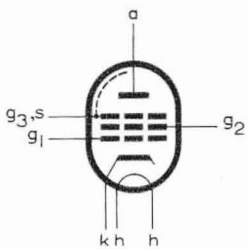
V_a	200	V
V_{g2}	200	V
V_{g3}	0	V
I_a	8.25	mA
I_{g2}	2.1	mA
V_{g1}	–2.5	V
g_m	2.45	mA/V
r_a	900	kΩ
μ_{g1-g2}	30	
V_{g1} (for 100 : 1 reduction in g_m)	–27	V

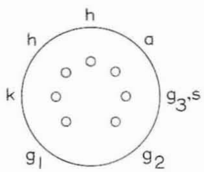
LIMITING VALUES

$V_{a(b)}$ max.	500	V
V_a max.	250	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	500	V
V_{g2} max.	250	V
p_{g2} max.	600	mW
$-V_{g1}$ max.	50	V
I_k max.	12	mA
R_{g1-k} max.	100	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

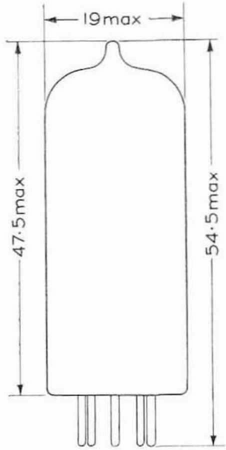
EF92

VARIABLE-MU R.F. PENTODE



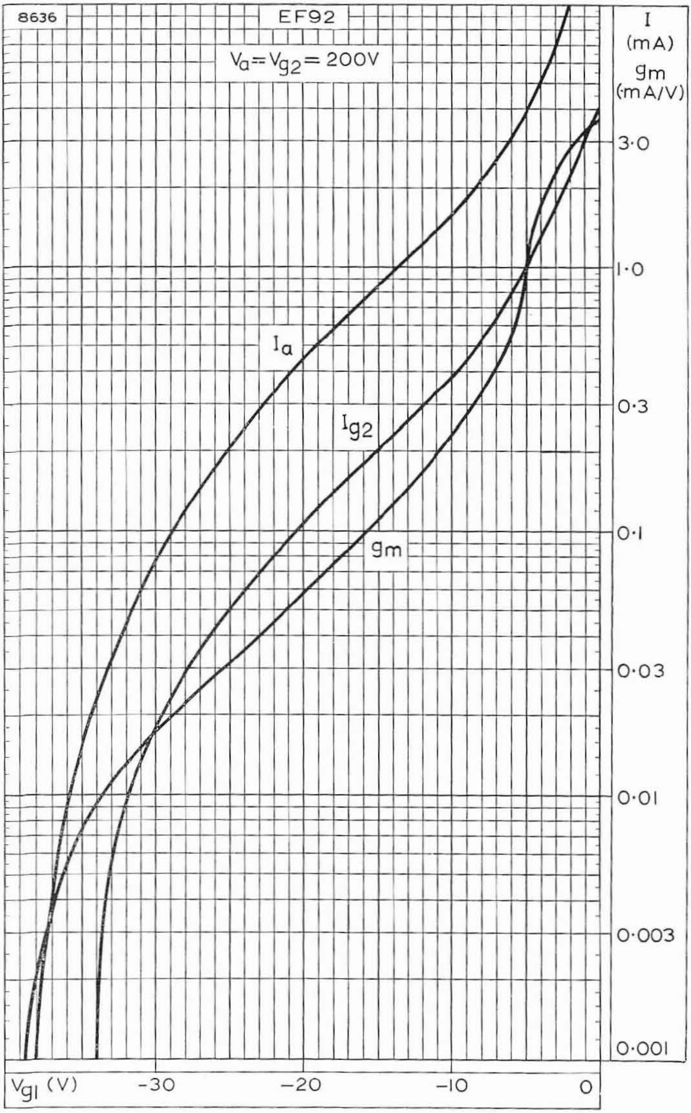


B7G Base

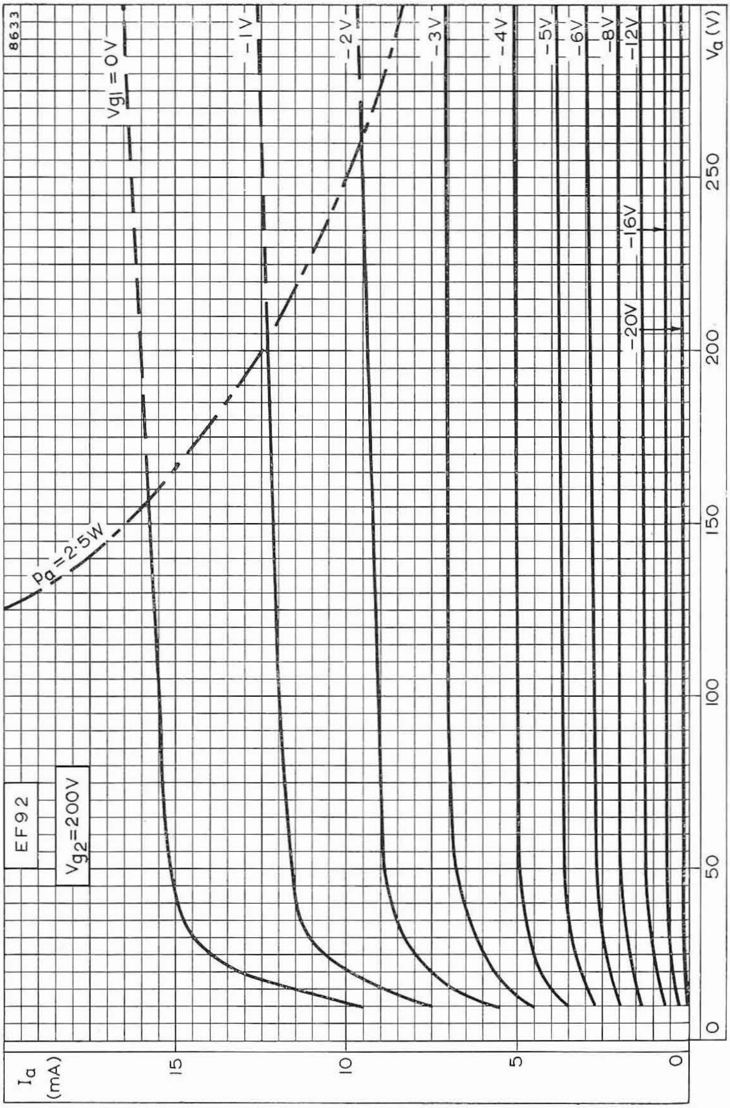


All dimensions in mm

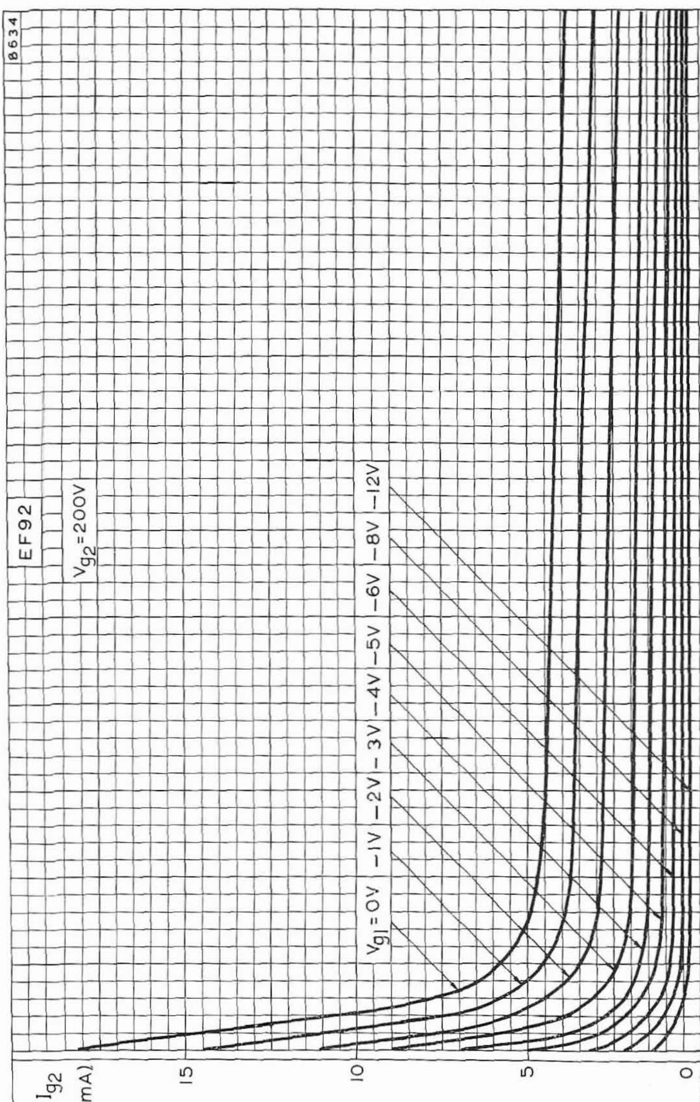
8723



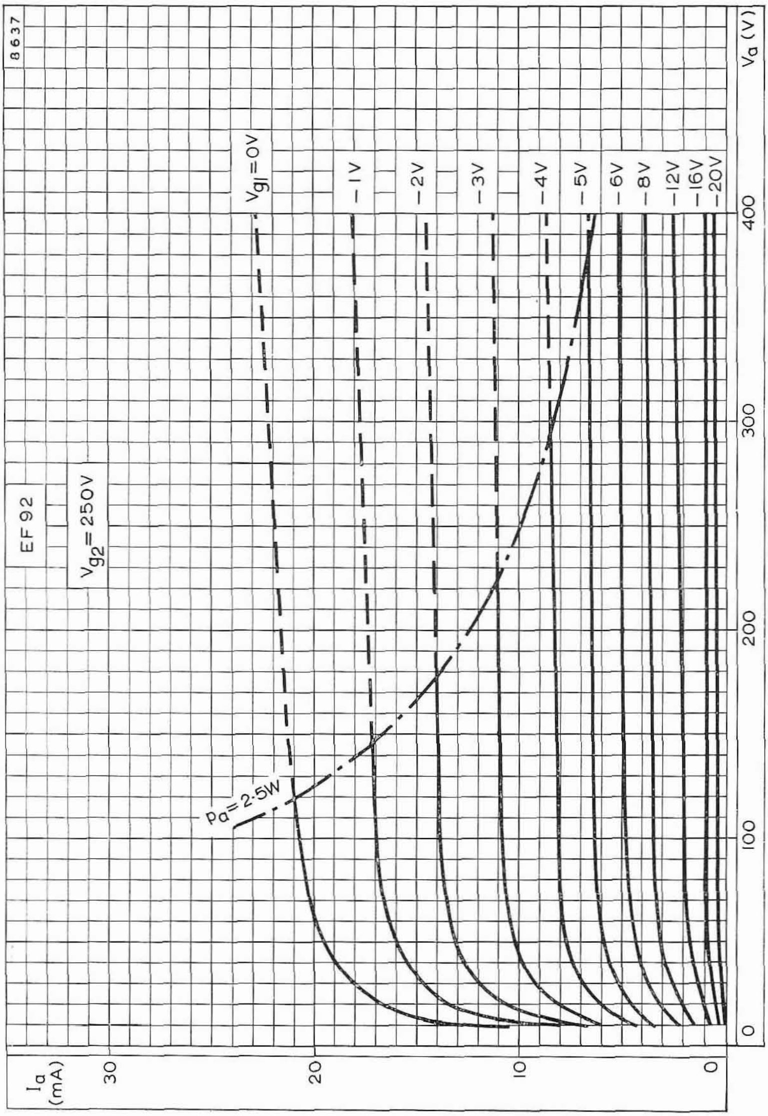
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 200V$



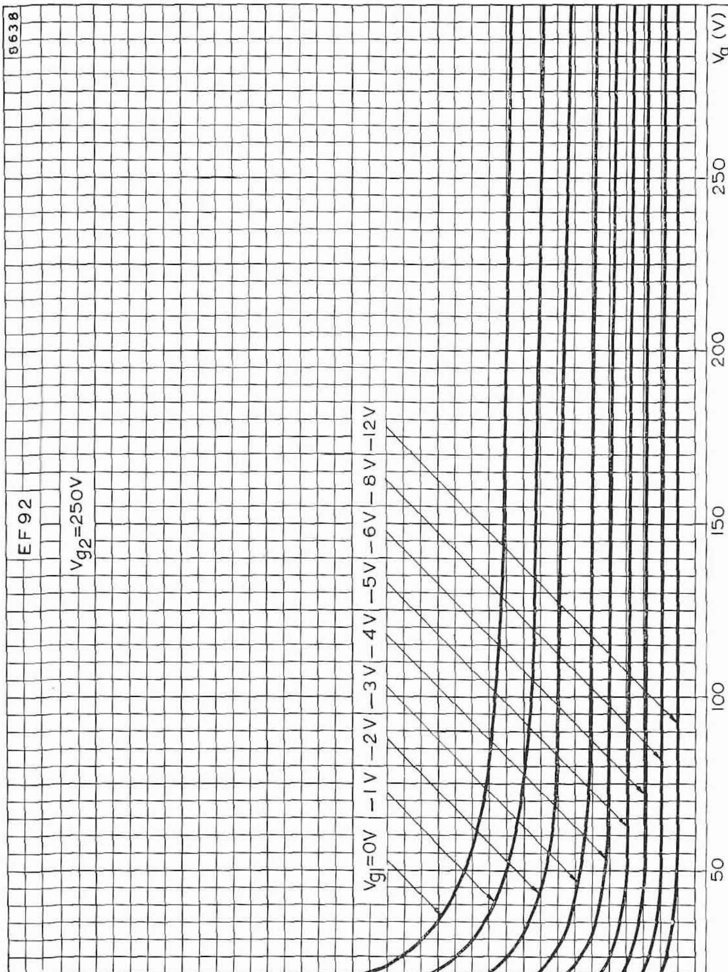
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_{g2} = 200V$



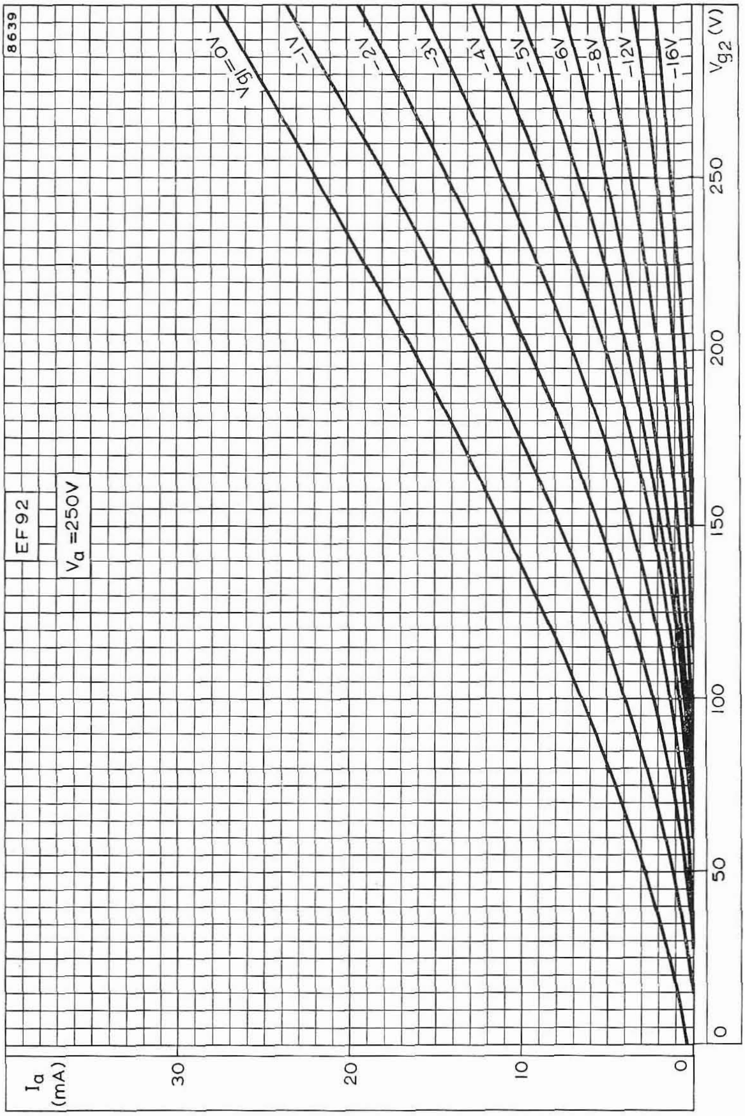
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_{g2} = 200V$



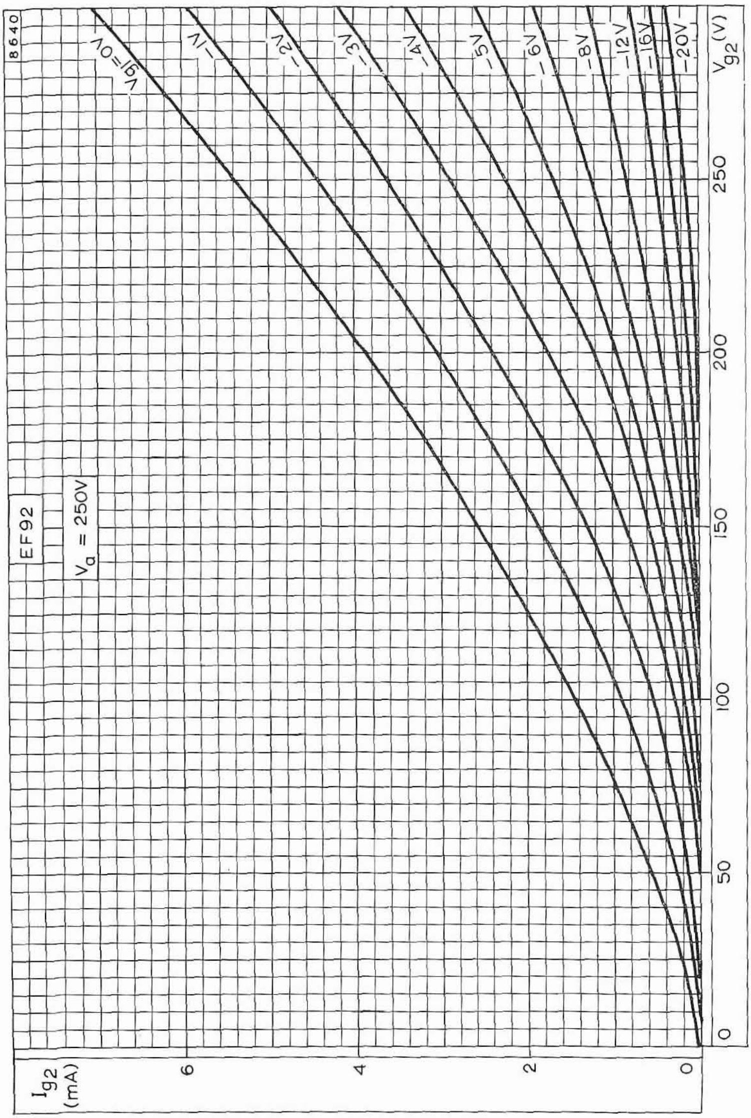
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_{g2} = 250V$



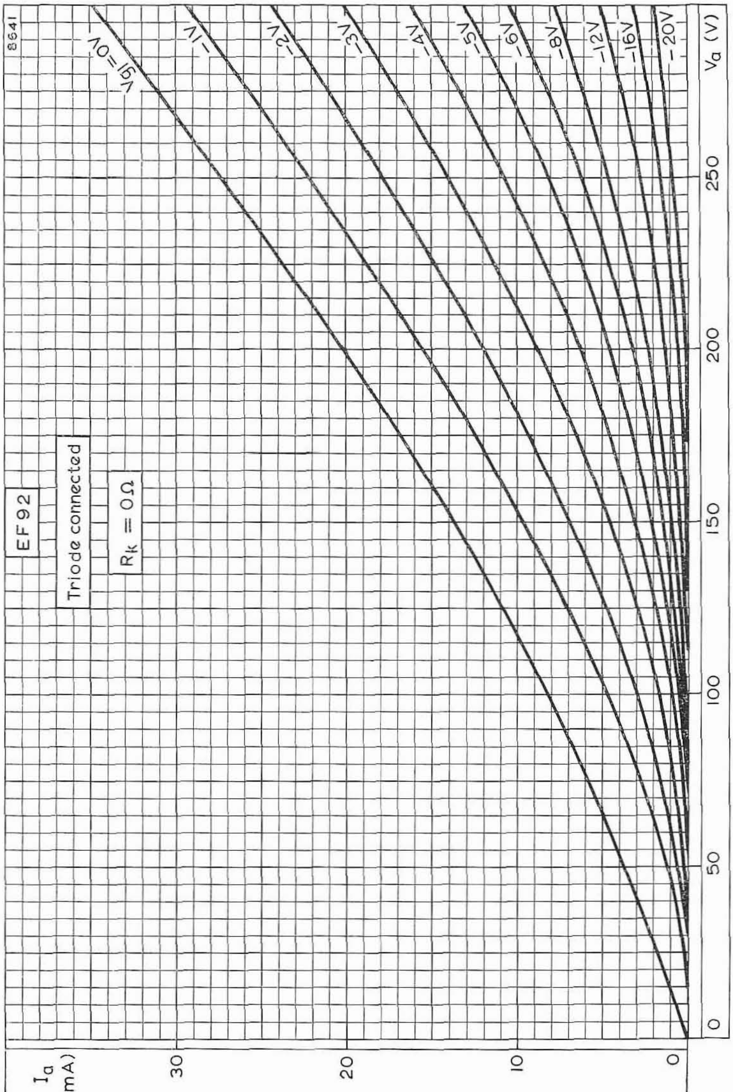
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_{g2} = 250V$



ANODE CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_a = 250V$



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_a = 250V$



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER,
WHEN TRIODE CONNECTED

V.H.F. PENTODE

EF95

Low noise, high slope pentode primarily intended for use as an r.f. and i.f. amplifier.

HEATER

V_h	6.3	V
I_h	175	mA

CAPACITANCES

Pentode connection

	Unshielded	*Shielded*	
c_{in}	4.0	4.0	pF
c_{out}	2.2	3.1	pF
c_{a-g1}	23	$<$ 20	mpF
c_{h-k}	2	2	pF

Triode connection

c_{in}	2.7	2.8	pF
c_{out}	4.2	5.1	pF
c_{a-g}	1.4	1.4	pF

CHARACTERISTICS

Pentode connection

V_a	120	180	V
V_{g2}	120	120	V
I_a	7.5	7.7	mA
I_{g2}	2.5	2.4	mA
V_{g1}	−2.0	−2.0	V
g_m	5.0	5.1	mA/V
r_a	250	400	kΩ
μ_{g1-g2}	35	35	
R_{eq}	2	2	kΩ
r_{g1} (f = 50Mc/s)	25	25	kΩ

Triode connection

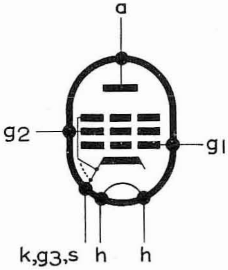
V_a	120	V
I_a	10	mA
V_g	−2	V
g_m	6.8	mA/V
r_a	5.2	kΩ
μ	35	
R_{eq}	900	Ω

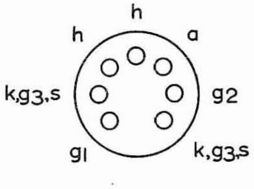
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	300	V
V_a max.	180	V
p_a max.	1.7	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	140	V
p_{g2} max.	500	mW
$-V_{g1}$ max.	50	V
R_{g1-k} max.	3.0	MΩ←
I_k max.	18	mA
V_{h-k} max.	120	V
T_{bulb} max.	170	°C

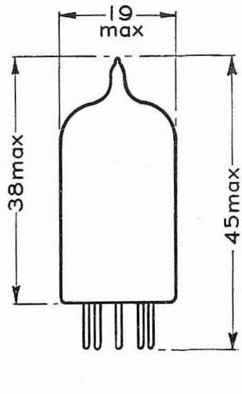
EF95

V.H.F. PENTODE



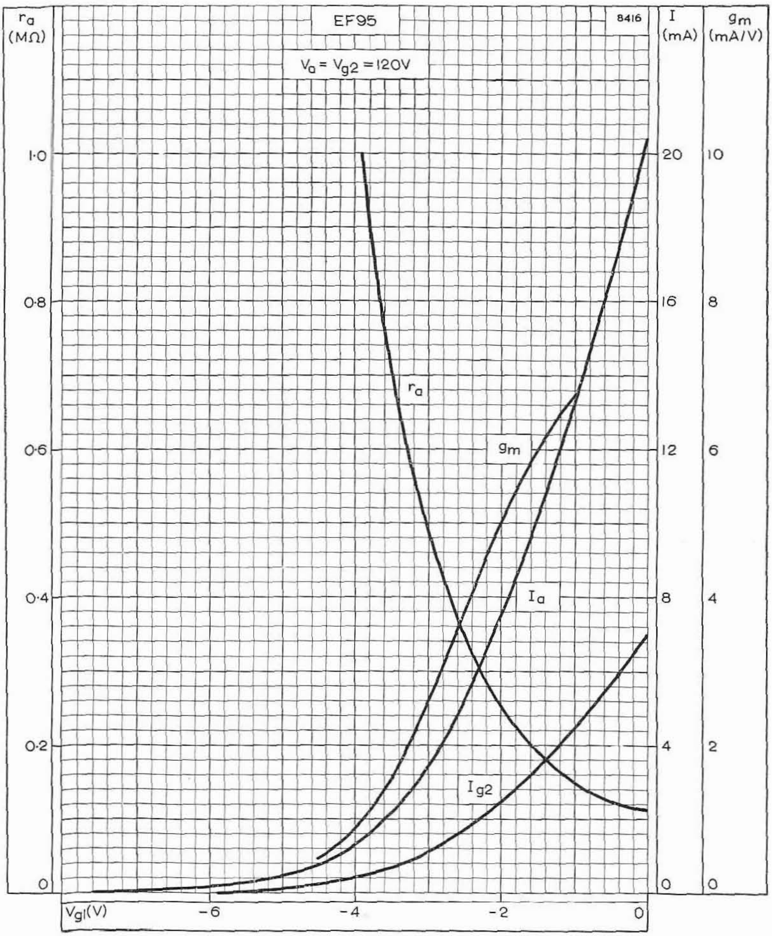


B7G Base

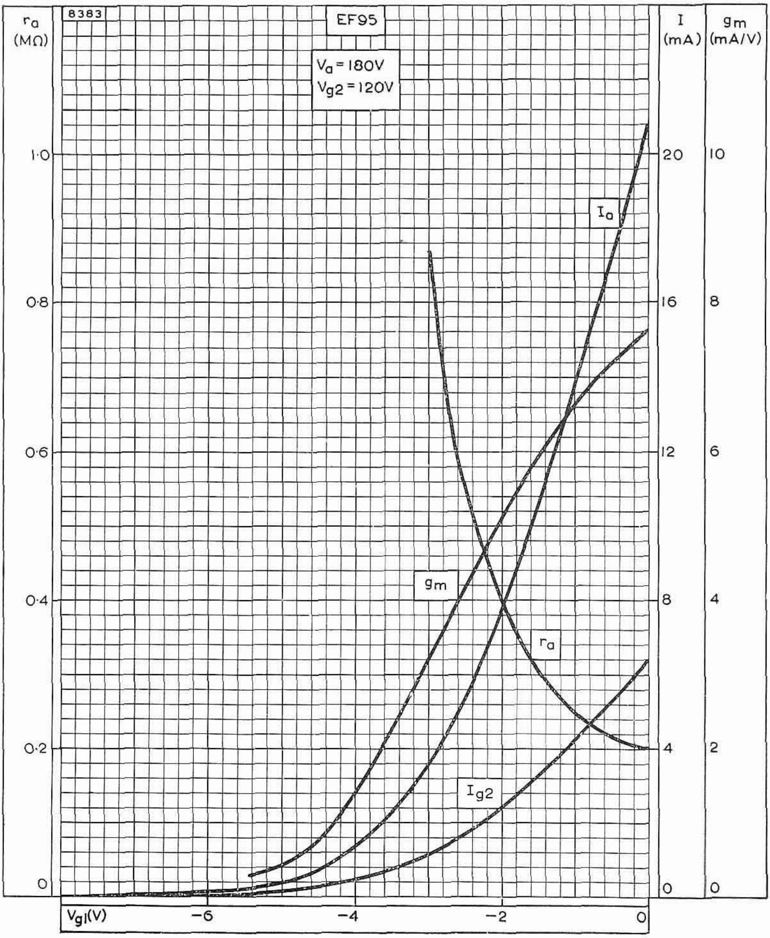


4748

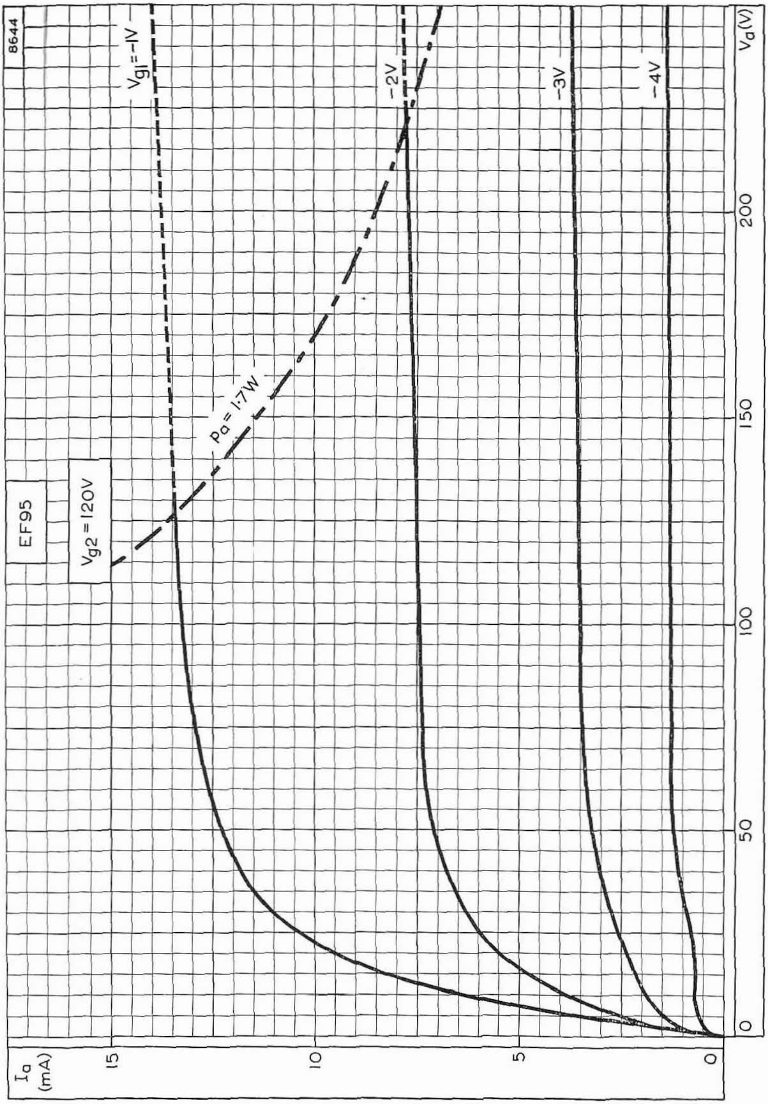
All dimensions in mm



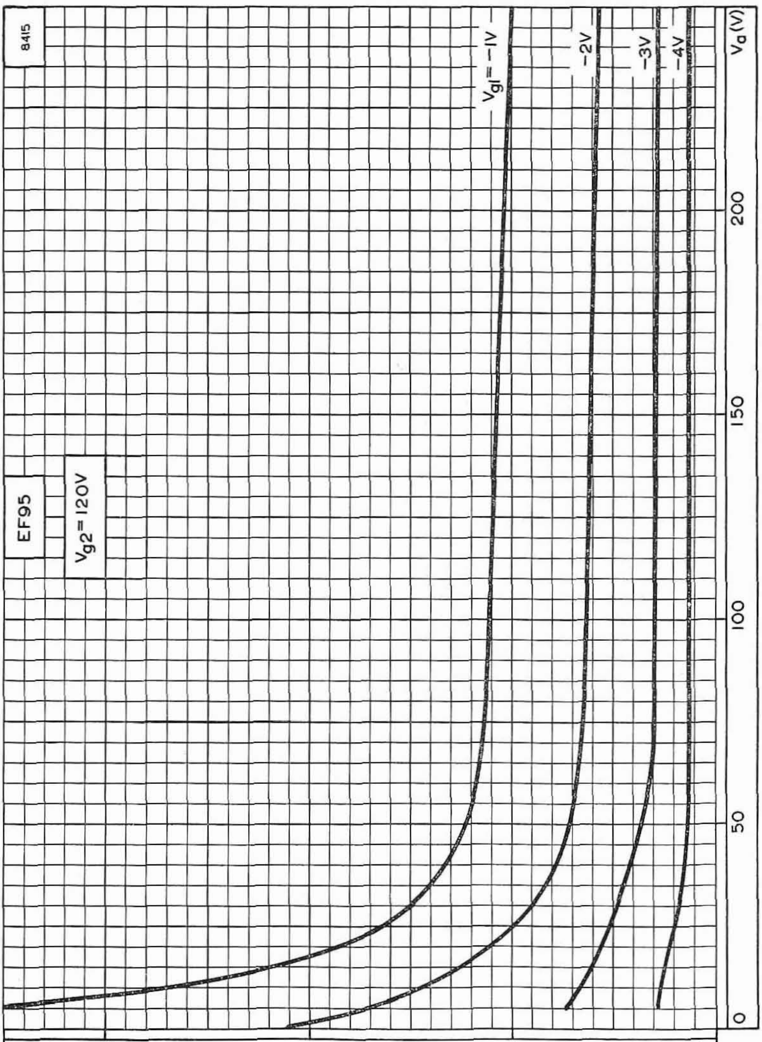
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 120V$



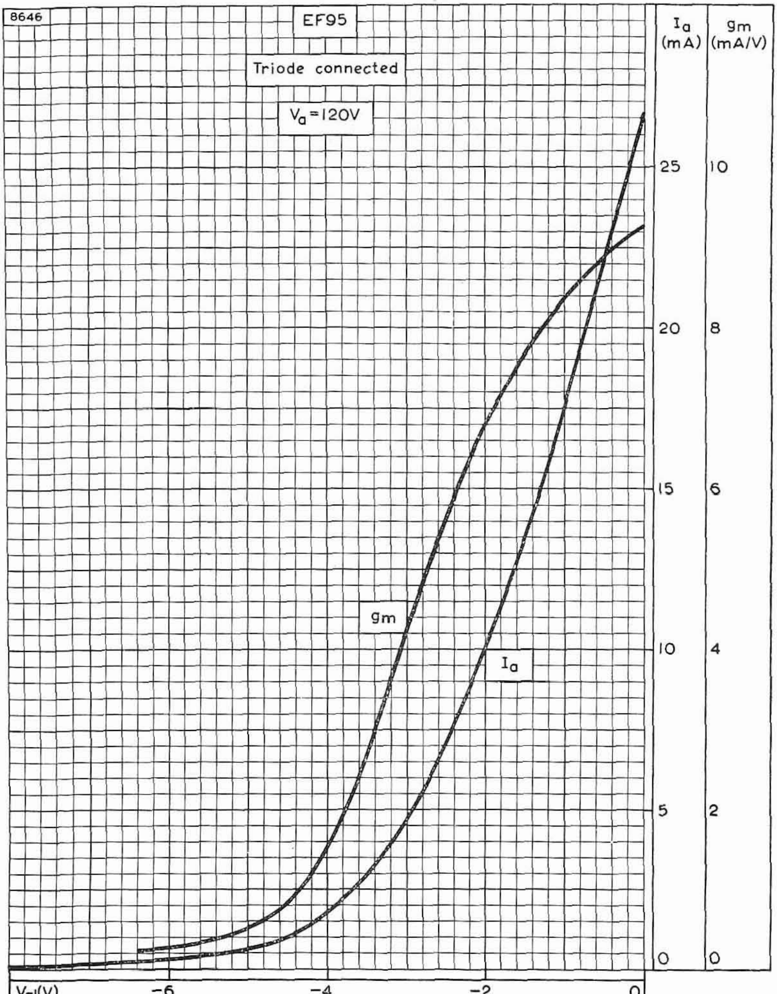
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Va = 180V



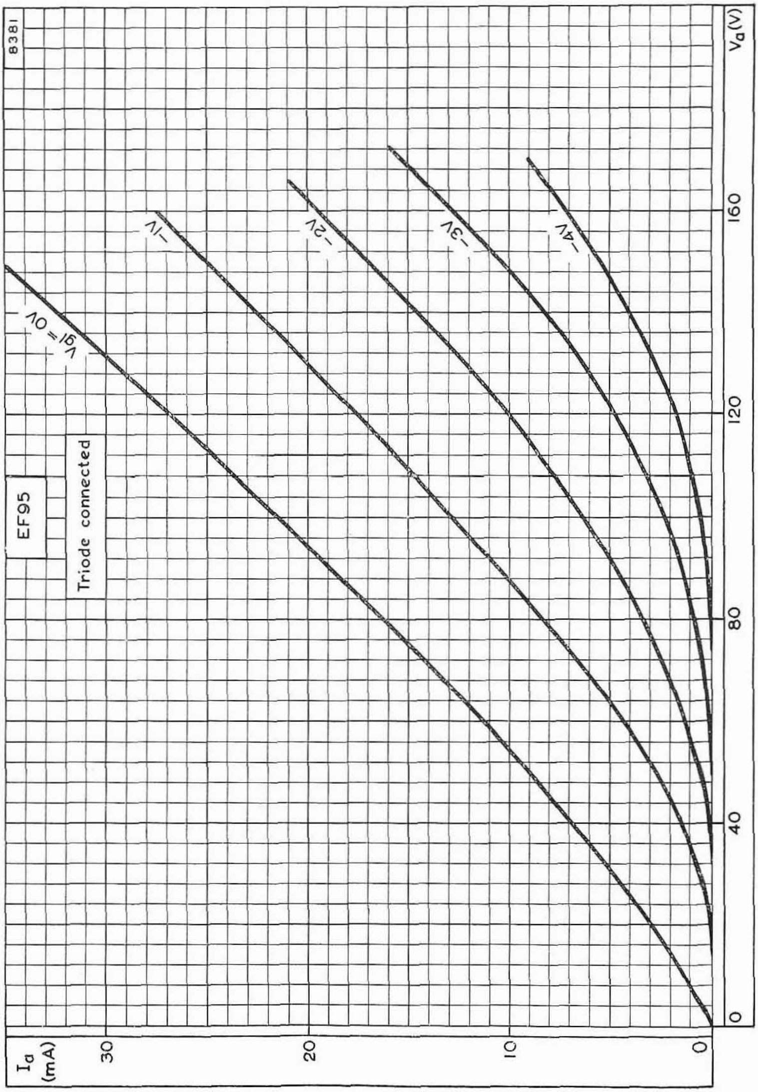
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER,
WHEN TRIODE CONNECTED

VARIABLE-MU R.F. PENTODE

EF183

Frame-grid variable-mu r.f. pentode for use as an automatic gain controlled i.f. amplifier in television receivers.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{in}	9.5	pF
c_{out}	3.0	pF
c_{a-g1}	5.5	mpF←
c_{g1-g2}	2.8	pF

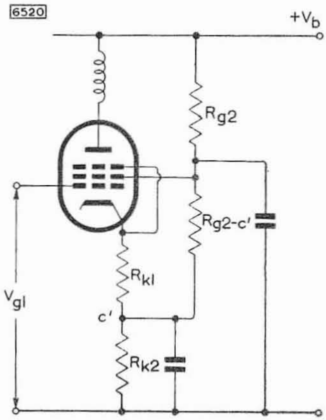
CHARACTERISTICS

V_a	170	200	230	V
V_{g2}	90	90	90	V
V_{g3}	0	0	0	V
I_a	14	12	10.5	mA
I_{g2}	5.3	4.5	3.6	mA
V_{g1}	−1.8	−2.0	−2.1	V
g_m	14	12.5	10.6	mA/V
r_a	350	500	650	kΩ
r_{g1} (f = 40Mc/s)	11.6	13	15.3	kΩ
R_{eq} (f = 40Mc/s)	—	490	—	Ω←

EF183

VARIABLE-MU R.F. PENTODE

OPERATING CONDITIONS

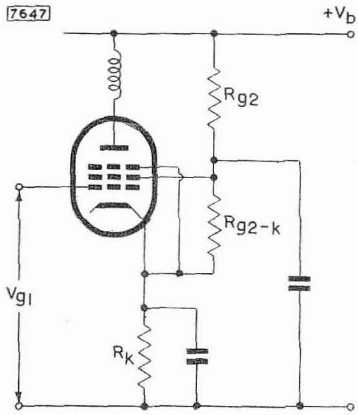


With compensating resistor R_{k1} (e.g. vision i.f. amplifier)

Condition	*1*	*2*	*3*	*4*	
*V_b	190	190	190	190	V
R_{g2}	22	6.8	8.2	10	kΩ
$R_{g2-c'}$	—	8.2	12	18	kΩ
R_{k1}	22	22	22	22	Ω
R_{k2}	100	56	68	82	Ω
R_{g1}	—	—	—	—	kΩ
I_a	11.6	11.8	11.7	11.4	mA
I_{g2}	4.3	4.4	4.4	4.3	mA
g_m	12.3	12.4	12.2	12	mA/V
V_{g1} for 100 : 1 reduction in g_m	–18.5	–9.0	–10	–11	V
I_{total}	16	27	24	21	mA

Condition	*5*	*6*	*7*	*8*	
*V_b	190	190	190	190	V
R_{g2}	12	15	18	33	kΩ
$R_{g2-c'}$	27	47	82	—	kΩ
R_{k1}	22	22	22	22	Ω
R_{k2}	82	82	82	0	Ω
R_{g1}	—	—	—	470	kΩ
I_a	11.8	11.9	12	11.6	mA
I_{g2}	4.4	4.5	4.5	4.4	mA
g_m	12.3	12.5	12.5	15.5	mA/V
V_{g1} for 100 : 1 reduction in g_m	–12	–13.5	–14.5	–17	V
I_{total}	19.7	18.5	14.7	16	mA

*For other values of V_b up to 210V, the above conditions can be used providing the values of R_{g2} are changed to keep V_{g2} at approx. 90V.



Without compensating resistor (e.g. sound i.f. amplifier)

Condition	*1*	*2*	*3*	*4*	
*V_b	190	190	190	190	V
R_{g2}	22	6.8	8.2	10	kΩ
R_{g2-k}	—	8.2	12	18	kΩ
R_k	120	68	82	100	Ω
I_a	11.7	12	11.8	11.4	mA
I_{g2}	4.3	4.5	4.4	4.3	mA
g_m	12.4	13	12.3	12	mA/V
V_{g1} for 10 : 1 reduction in g_m	−5.0	−3.0	−3.25	−3.5	V
V_{g1} for 100 : 1 reduction in g_m	−18.5	−9.0	−10	−11	V
I_{total}	16	27	24	21	mA

Condition	*5*	*6*	*7*	
*V_b	190	190	190	V
R_{g2}	12	15	18	kΩ
R_{g2-k}	27	47	82	kΩ
R_k	100	100	100	Ω
I_a	11.8	12	12	mA
I_{g2}	4.4	4.5	4.5	mA
g_m	12.4	12.5	12.5	mA/V
V_{g1} for 10 : 1 reduction in g_m	−4.0	−4.4	−4.6	V
V_{g1} for 100 : 1 reduction in g_m	−12	−13.5	−14.5	V
I_{total}	19.7	18.5	17.5	mA

*For other values of V_b up to 210V, the above conditions can be used providing the values of R_{g2} are changed to keep V_{g2} at approx. 90V.

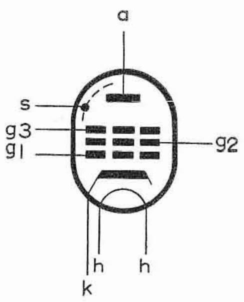
EF183

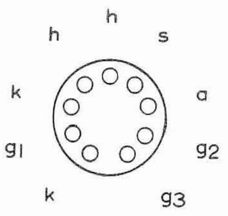
VARIABLE-MU R.F. PENTODE

DESIGN CENTRE RATINGS

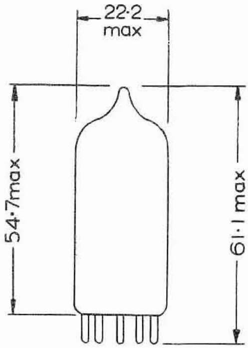
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	650	mW
$-v_{g1(pk)}$ max.	50	V
I_k max.	20	mA
R_{g1-k} max.	1.0	MΩ
R_{g3-k} max.	50	kΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	180	°C

6688

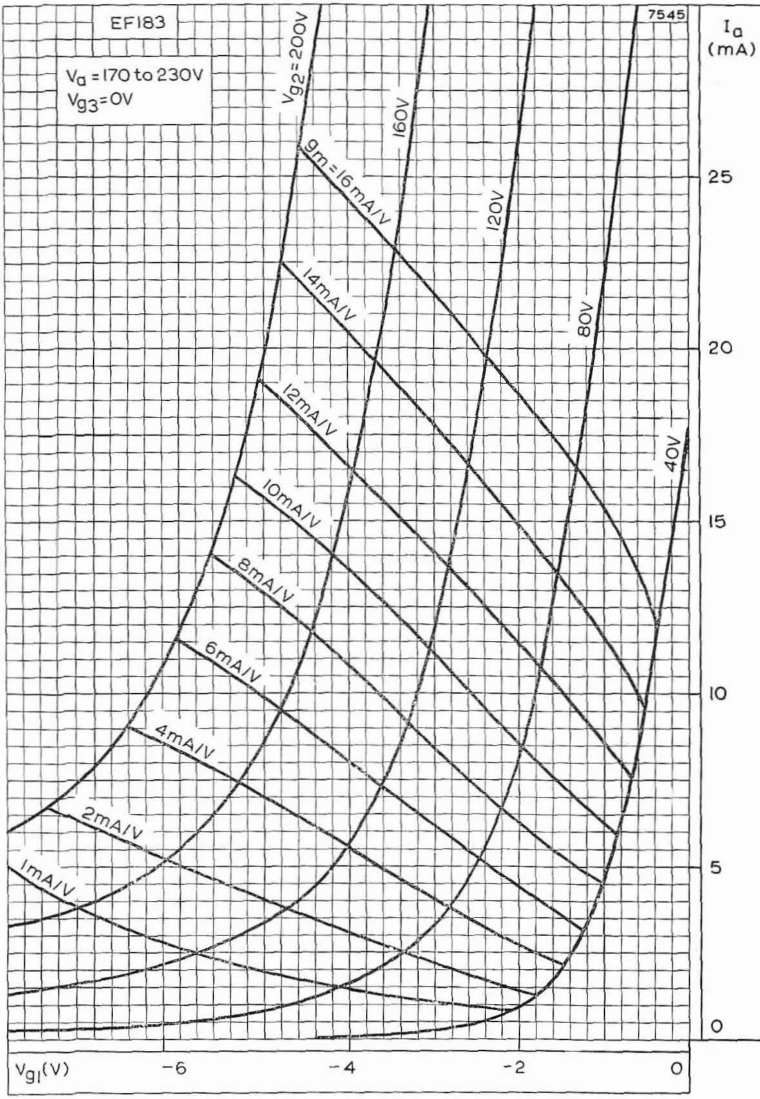




B9A Base



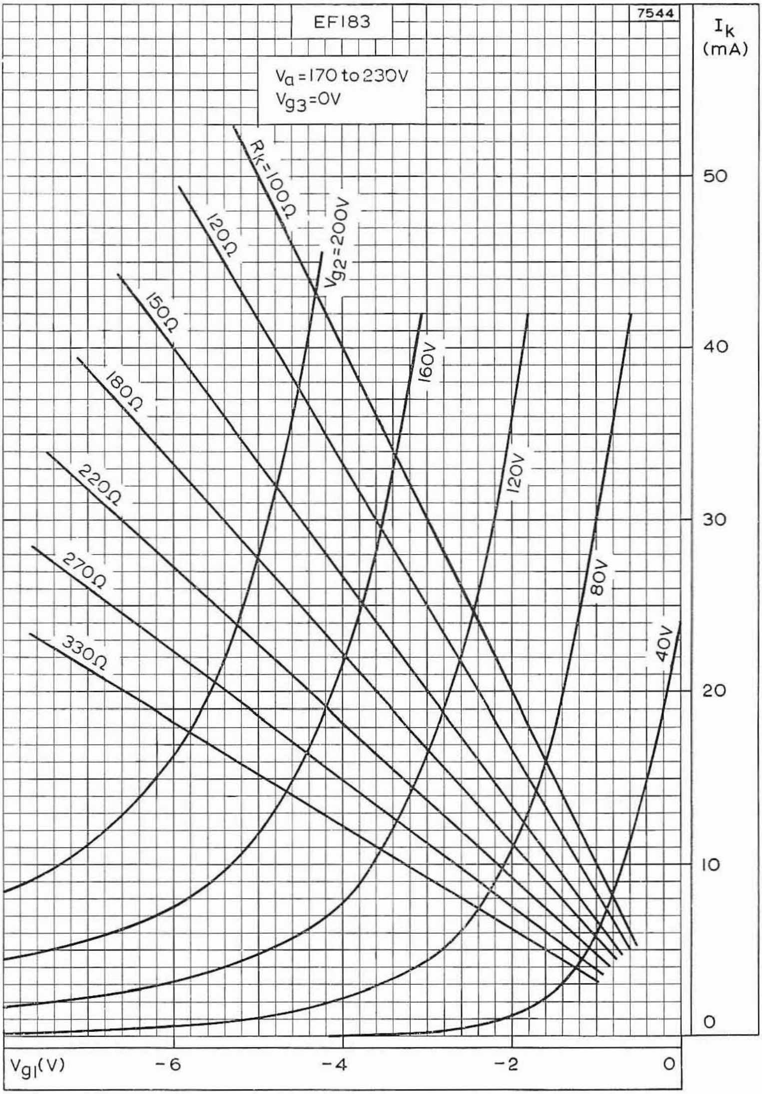
All dimensions in mm



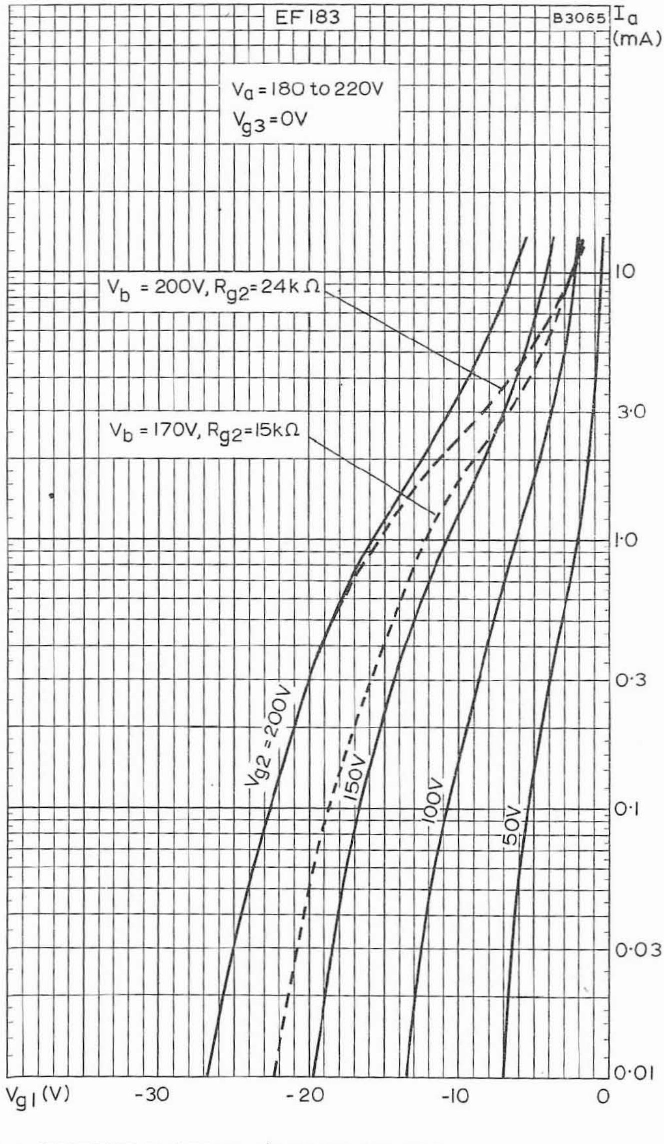
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER AND WITH MUTUAL CONDUCTANCE CONTOURS

EF183

VARIABLE-MU R.F. PENTODE



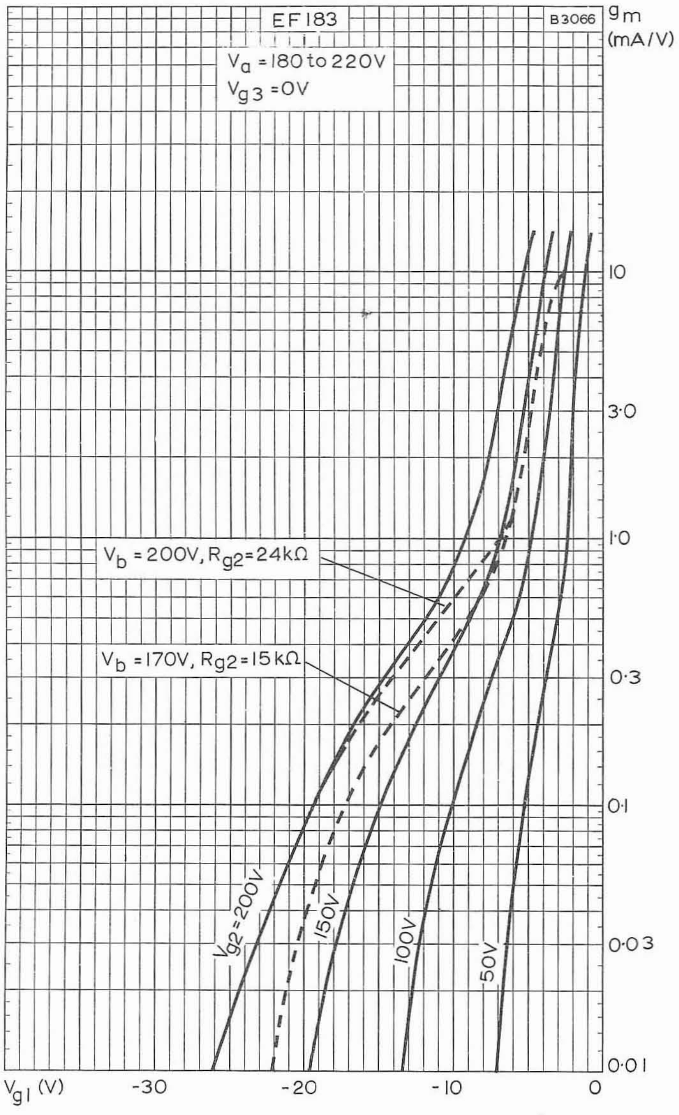
CATHODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



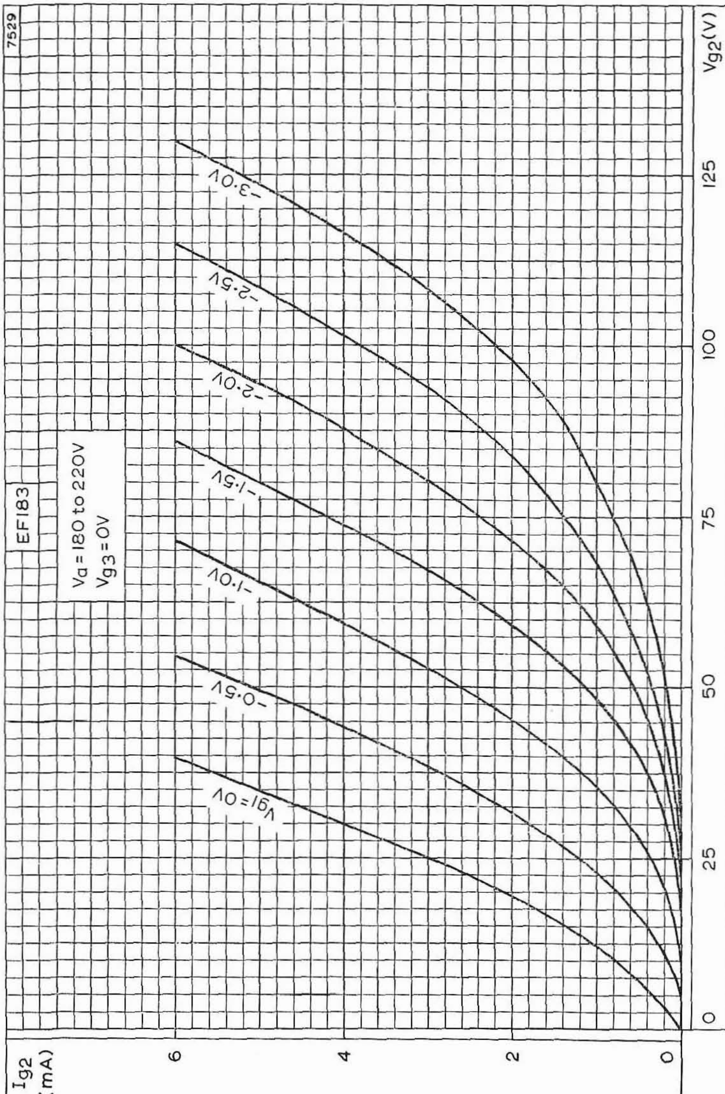
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

EF183

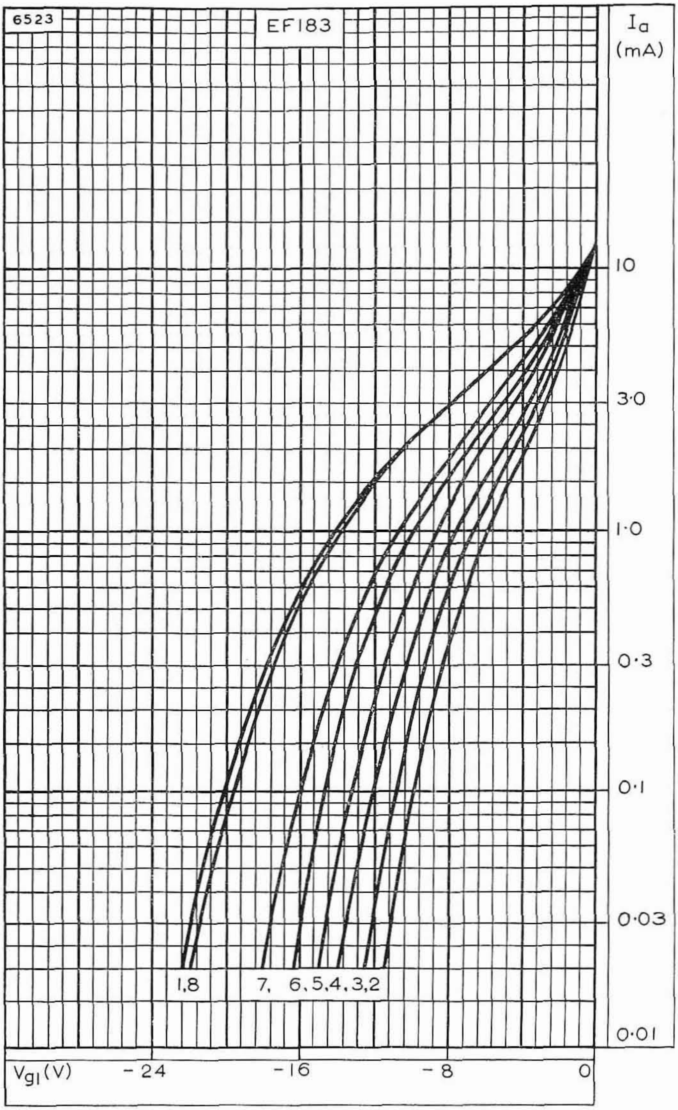
VARIABLE-MU R.F. PENTODE



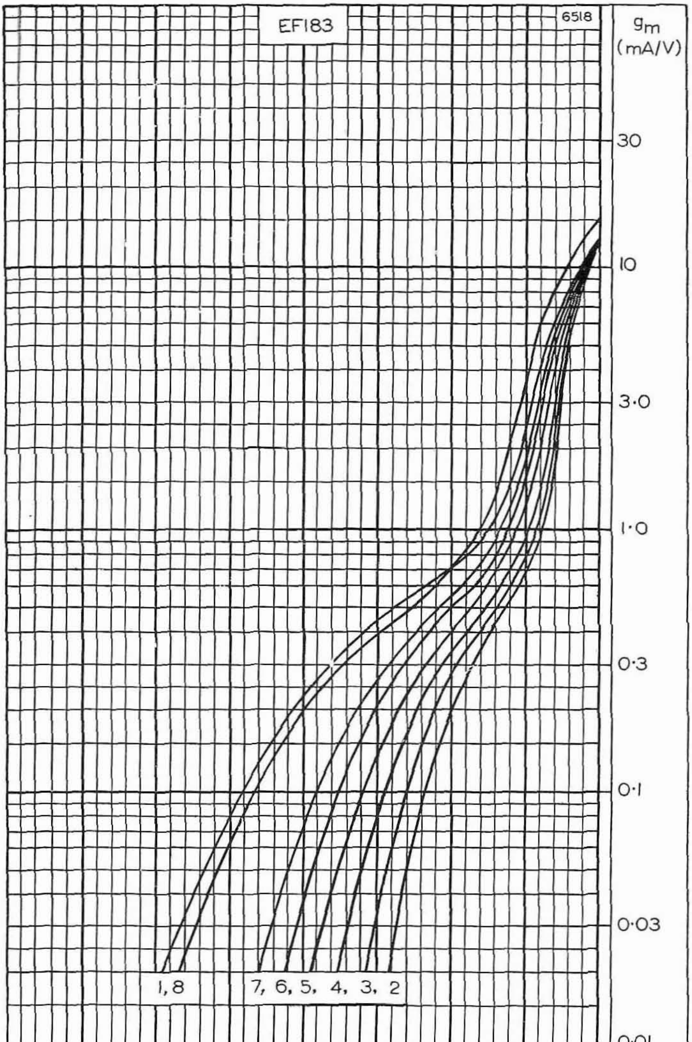
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



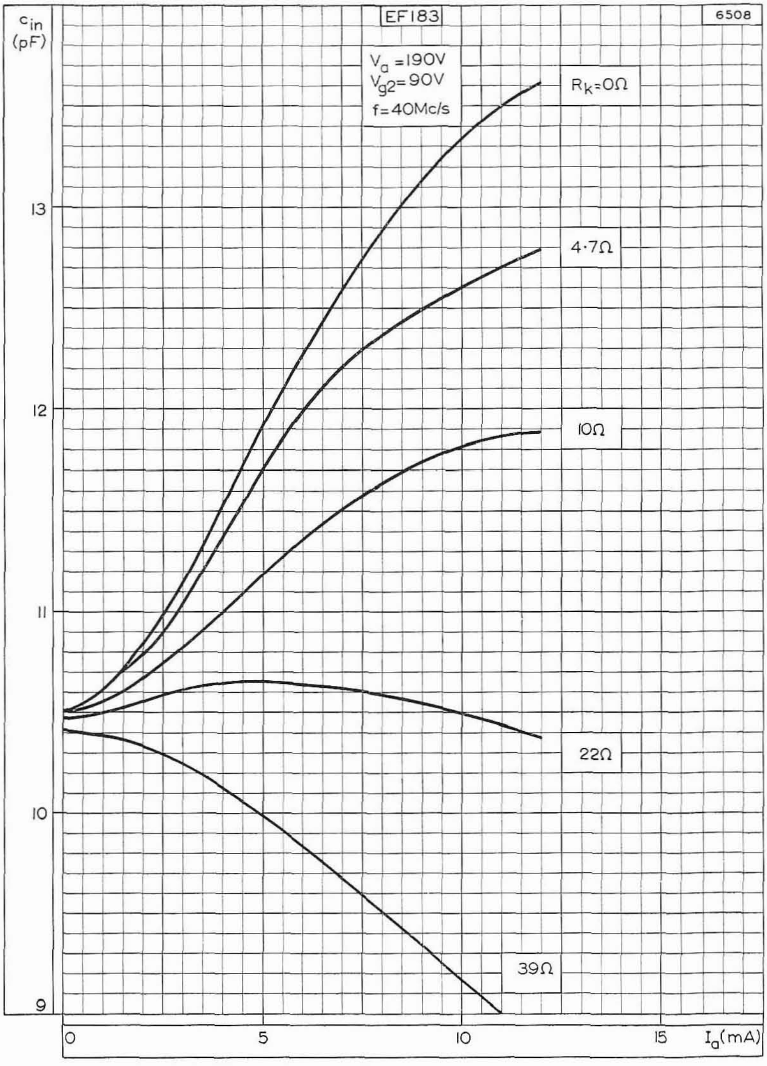
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Curve numbers refer to operating conditions on pages D2, D3



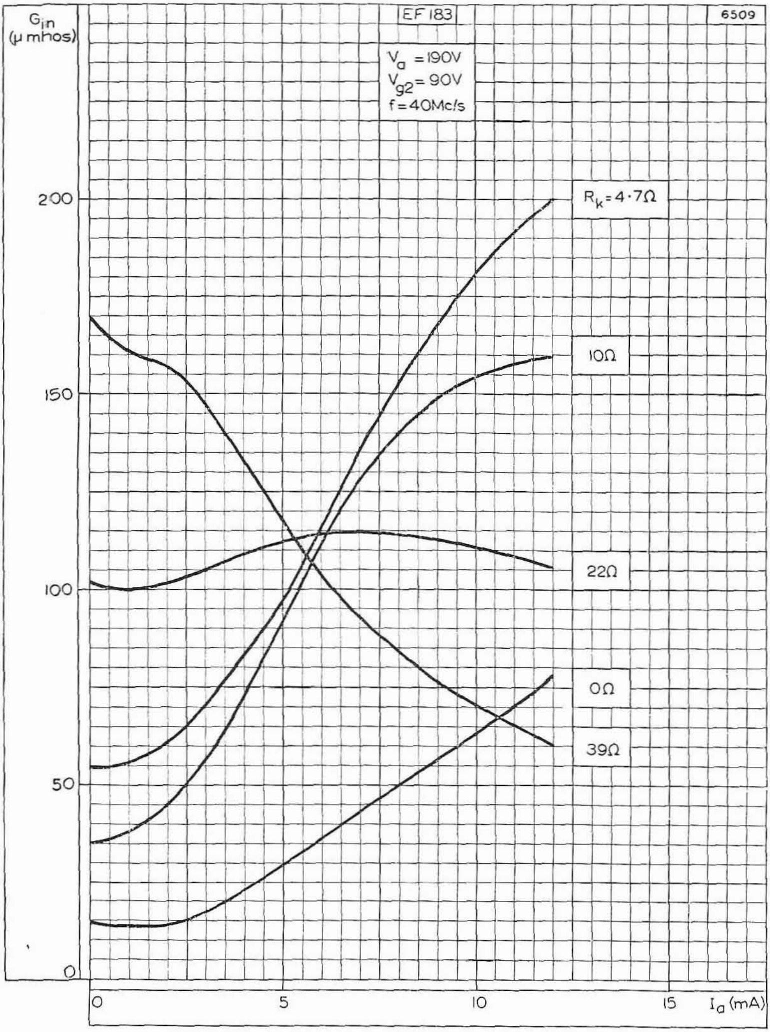
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Curve numbers refer to operating conditions on pages D2, D3

EF183

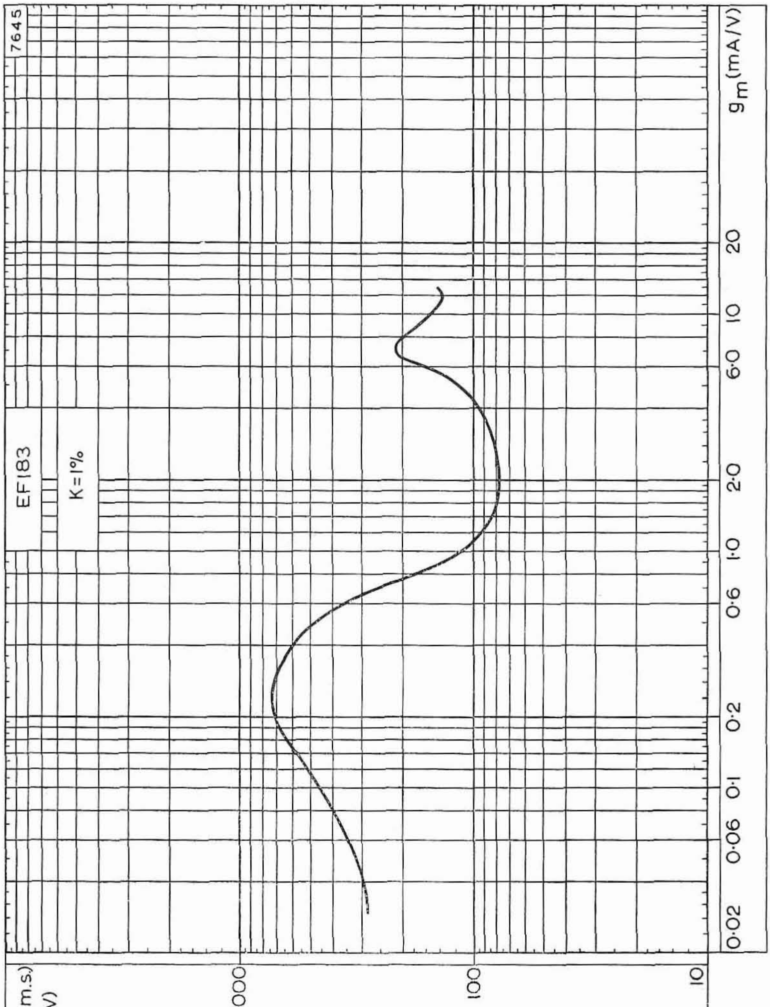
VARIABLE-MU R.F. PENTODE



INPUT CAPACITANCE PLOTTED AGAINST ANODE CURRENT FOR VARIOUS VALUES OF CATHODE RESISTOR



INPUT CONDUCTANCE PLOTTED AGAINST ANODE CURRENT FOR VARIOUS VALUES OF CATHODE RESISTOR



CROSS-MODULATION CURVE

R.F. PENTODE

EF184

Frame-grid sharp cut-off pentode for use as an i.f. amplifier in television receivers.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{in}	10	pF
c_{out}	3.0	pF
c_{a-g1}	5.5	mpF←
c_{g1-g2}	2.8	pF

CHARACTERISTICS

V_a	170	200	V
V_{g2}	170	200	V
V_{g3}	0	0	V
I_a	10	10	mA
I_{g2}	4.1	4.1	mA
V_{g1}	−2.0	−2.5	V
g_m	15.6	15	mA/V
r_a	330	380	kΩ
μ_{g1-g2}	60	60	
r_{g1} (f = 40Mc/s)	9.5	11	kΩ
R_{eq} (f = 40Mc/s)	—	330	Ω←

OPERATING CONDITIONS ←

$V_{a(b)}$	170	200	230	V
$V_{g3(b)}$	0	0	0	V
$V_{g2(b)}$	170	200	230	V
R_k	140	140	140	Ω
R_{g2}	0	7.5	15	kΩ
I_a	10	10	10	mA
I_{g2}	4.1	4.1	4·1	mA
g_m	15.6	15.6	15.6	mA/V
r_a	330	510	680	kΩ
r_{g1} (f = 40Mc/s)	10	10	10	kΩ
R_{eq} (f = 40Mc/s)	300	300	300	Ω

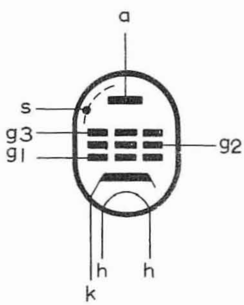
EF184

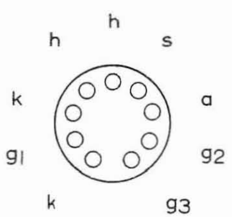
R.F. PENTODE

DESIGN CENTRE RATINGS

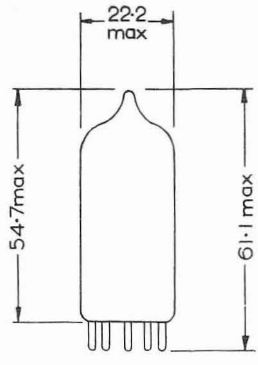
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	900	mW
$-v_{g1(pk)}$ max.	50	V
I_k max.	25	mA
R_{g1-k} max.	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	180	°C

6688

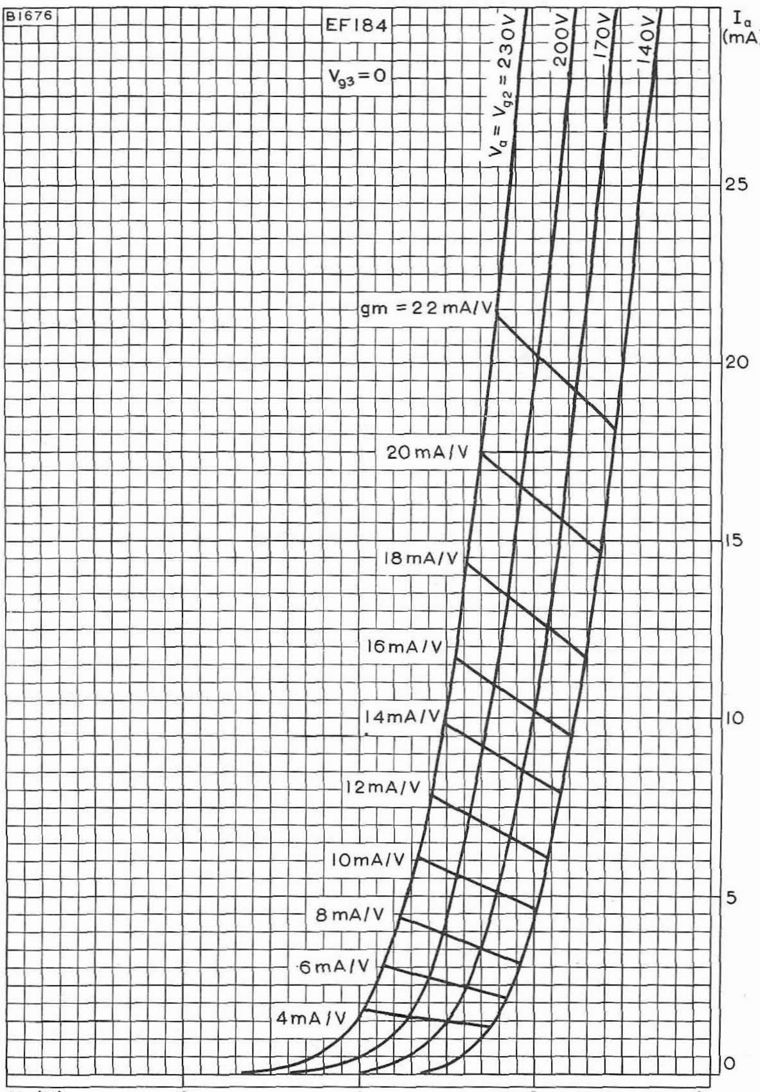




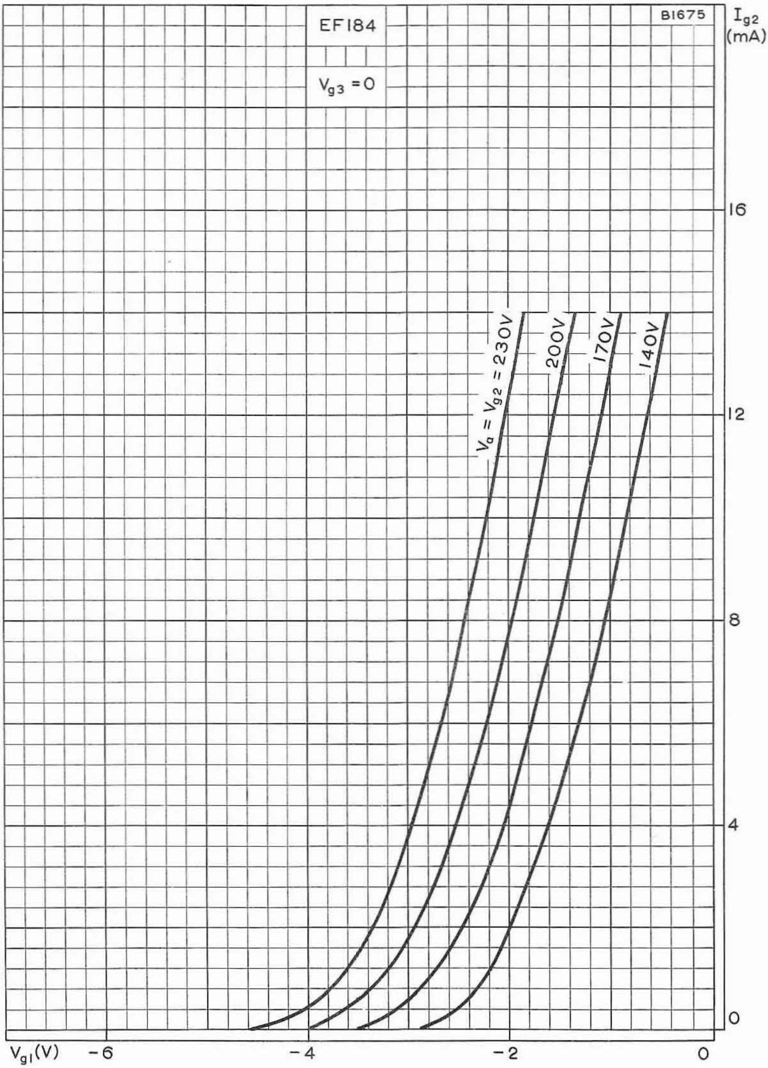
B9A Base



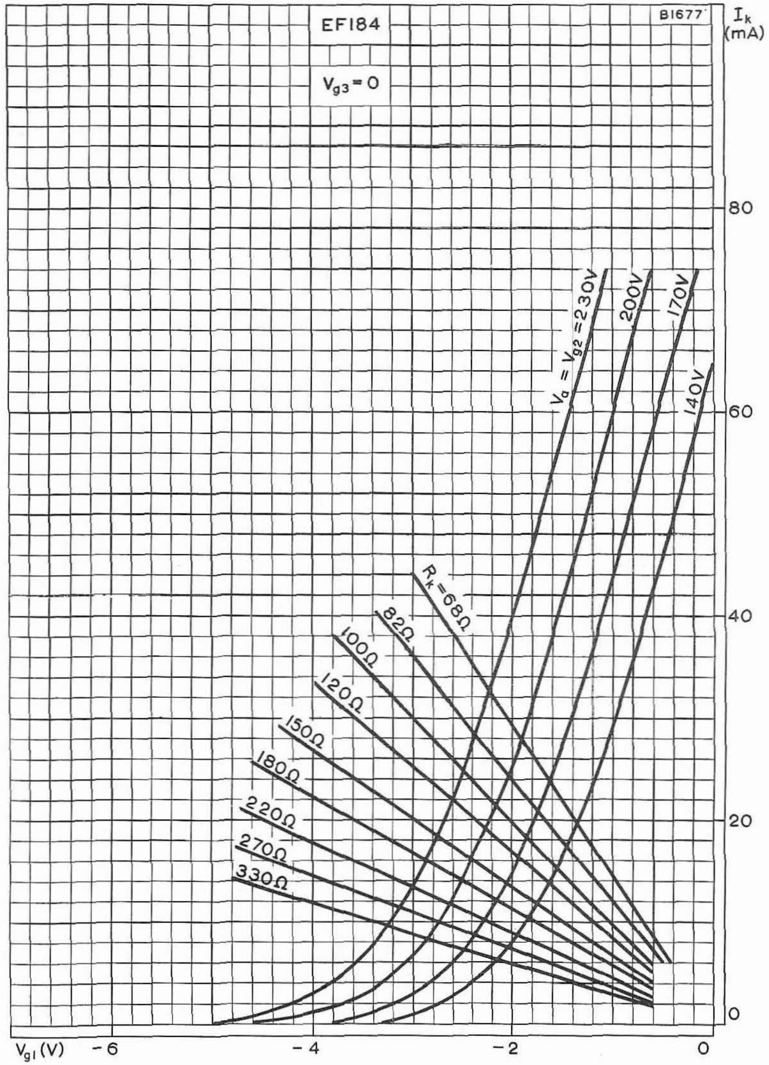
All dimensions in mm



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER AND WITH MUTUAL CONDUCTANCE CONTOURS

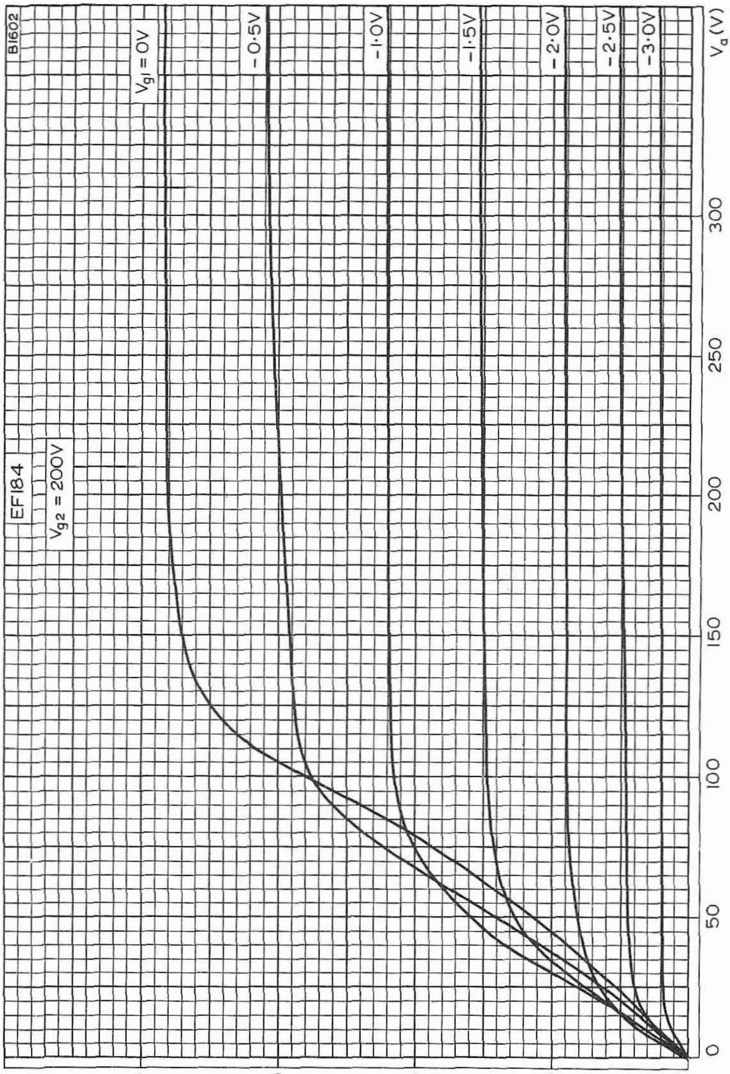


SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER

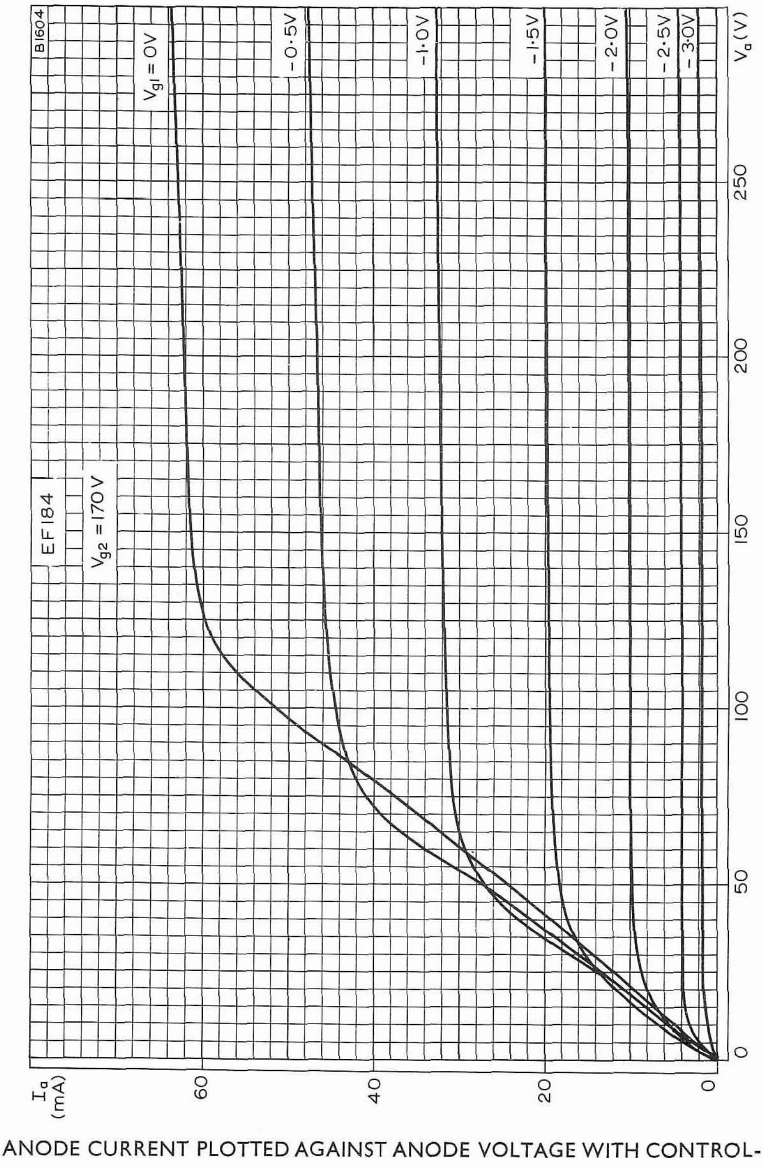


CATHODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER

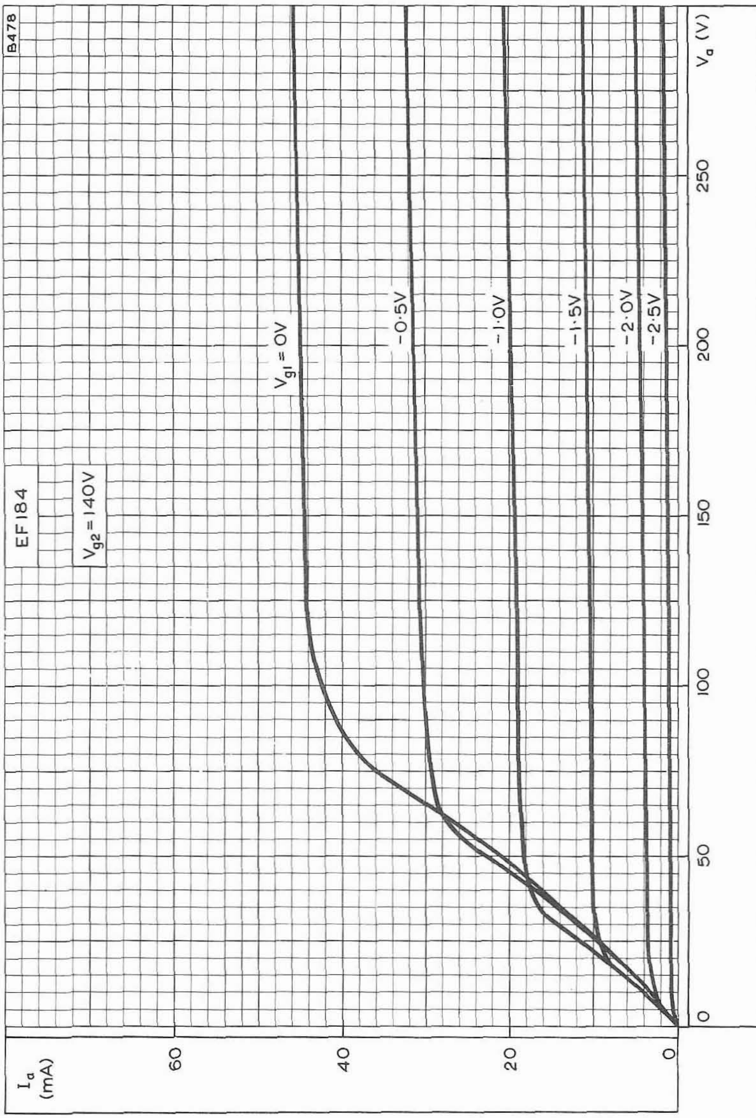
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 230V$



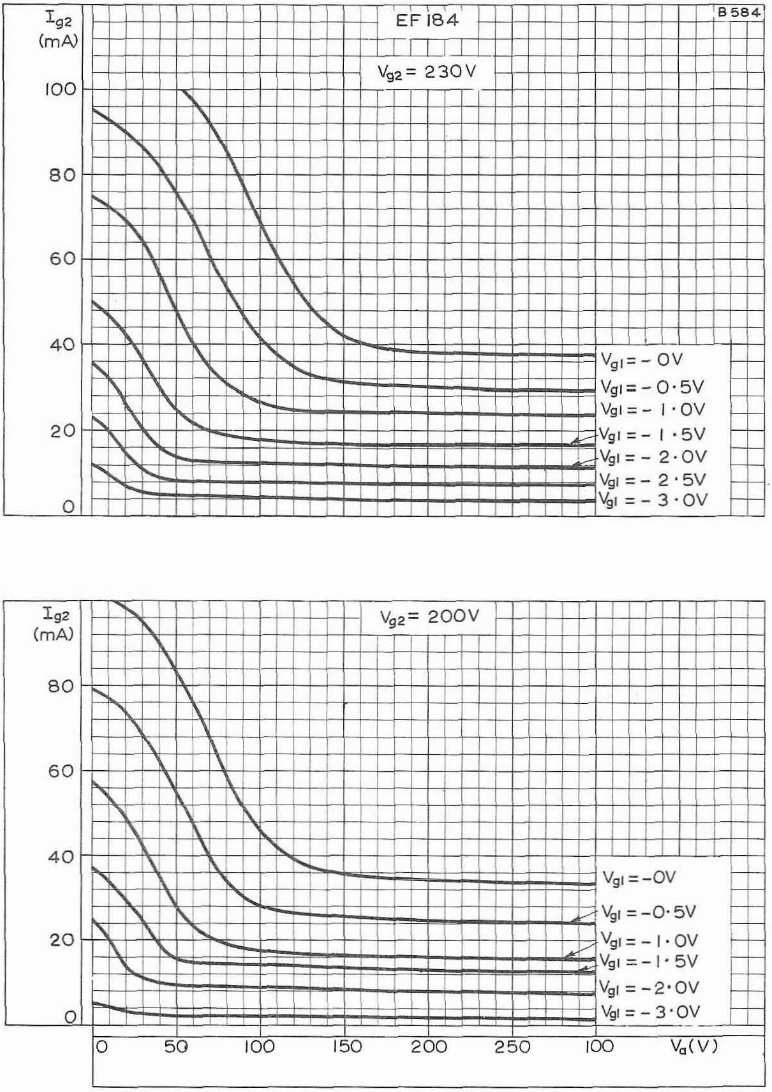
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



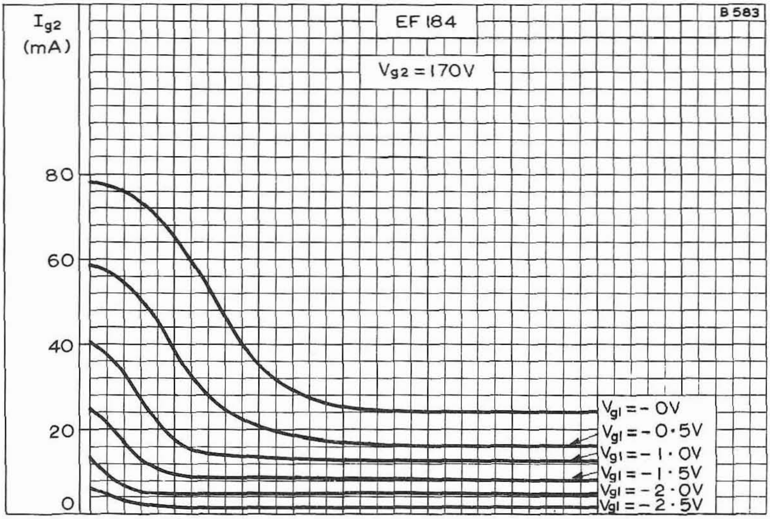
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 170V$

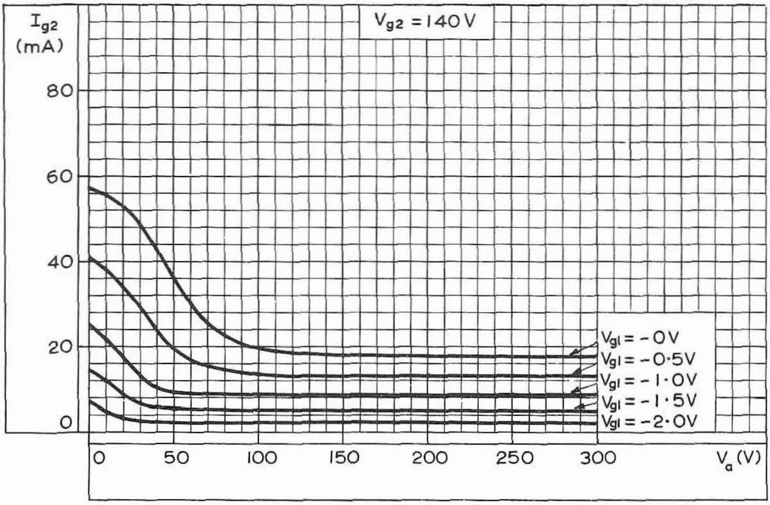


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 140V$

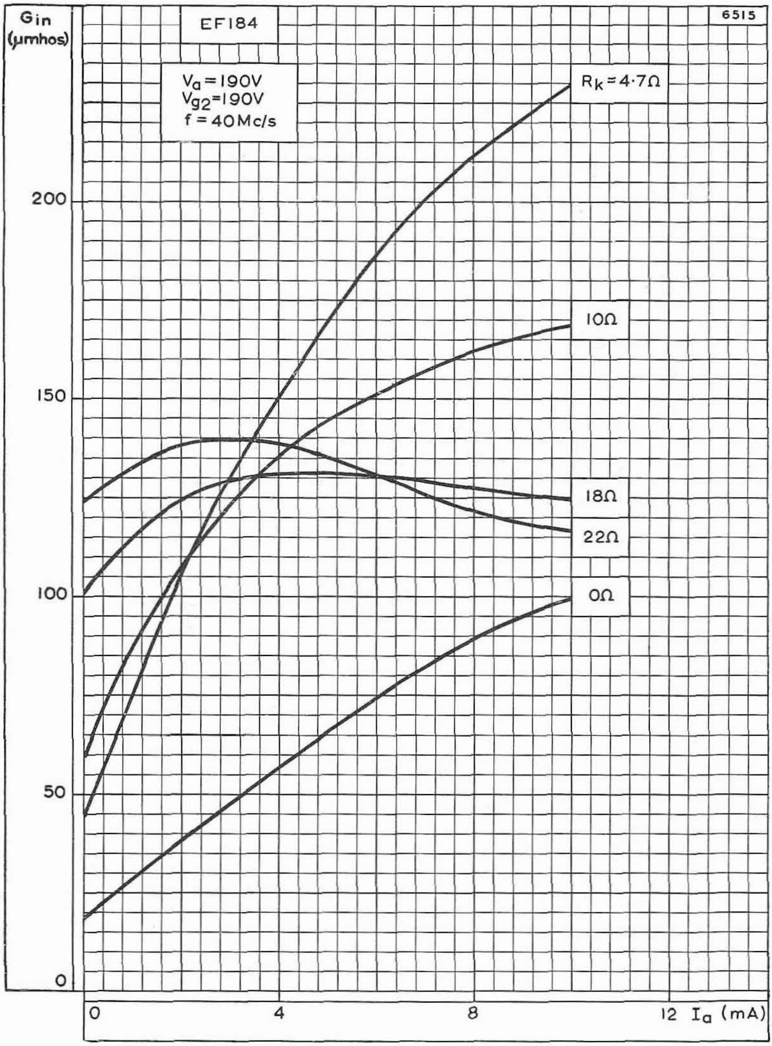


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

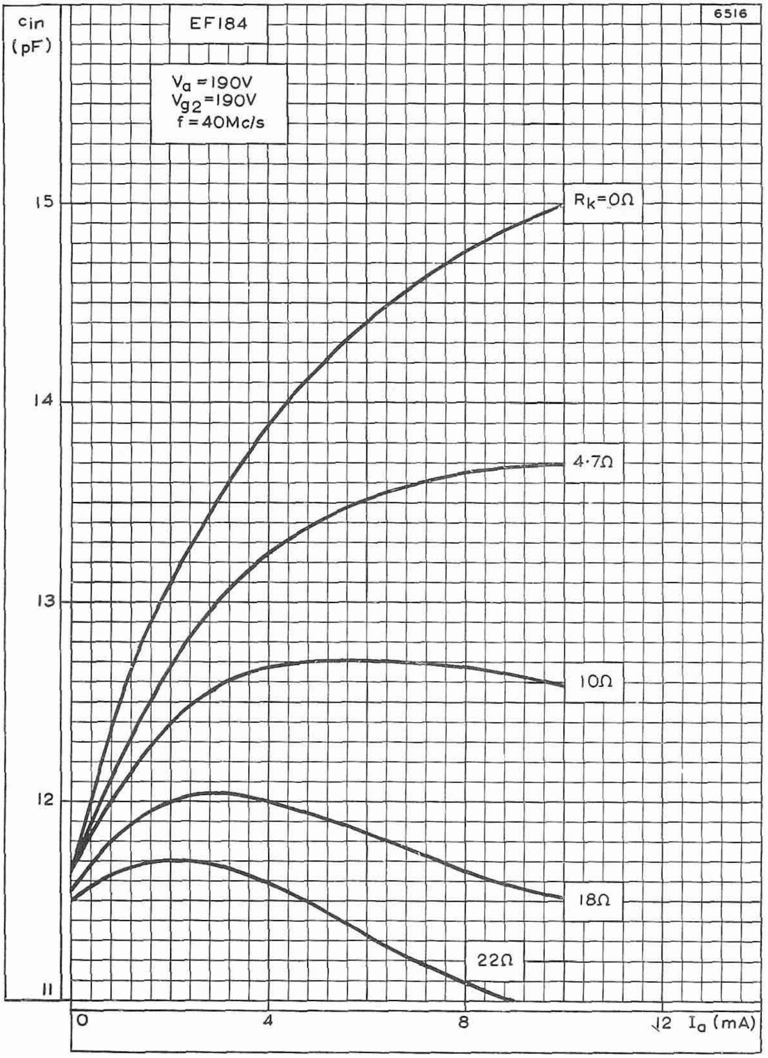




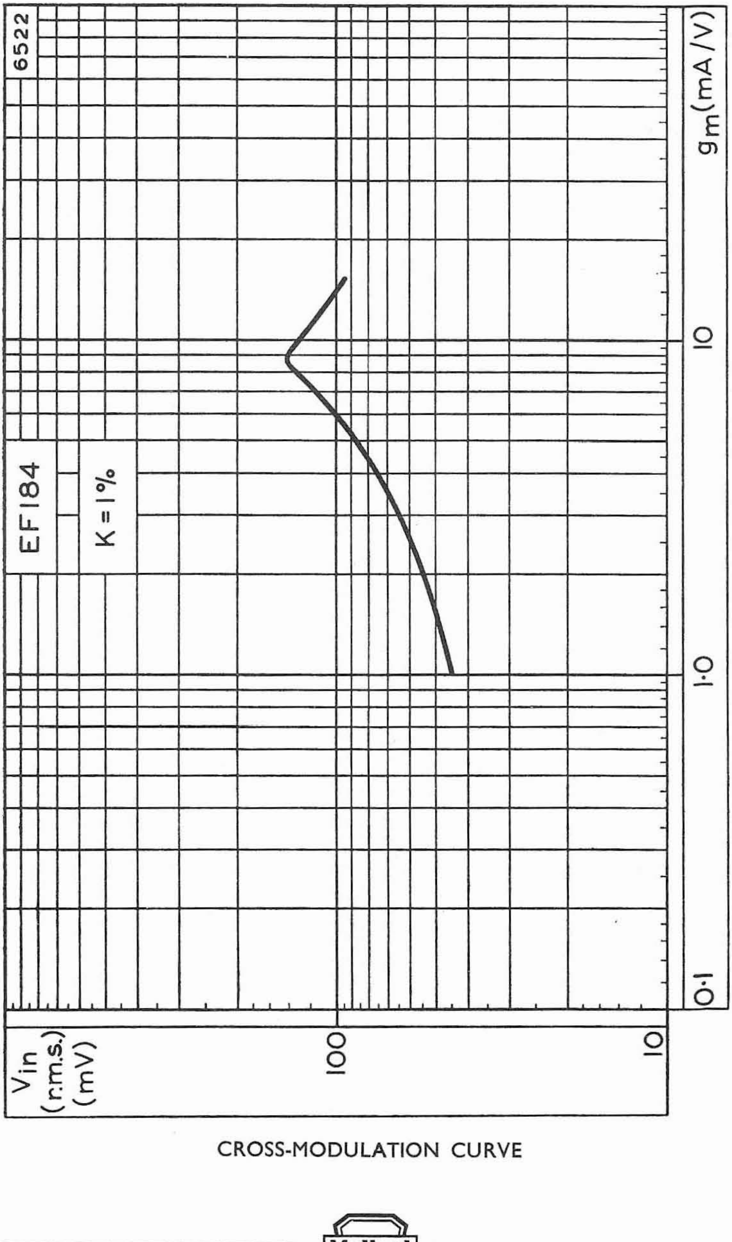
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



INPUT CONDUCTANCE PLOTTED AGAINST ANODE CURRENT WITH VARIOUS VALUES OF CATHODE RESISTOR



INPUT CAPACITANCE PLOTTED AGAINST ANODE CURRENT WITH VARIOUS VALUES OF CATHODE RESISTOR



CROSS-MODULATION CURVE

OUTPUT PENTODE

EL360

Output pentode for use in radar scanning, series regulator and similar applications and in pulse modulator applications.

HEATER

V_h	6.3	V
I_h	1.27	A

CAPACITANCES

c_{out}	7.7	pF
c_{in}	17.5	pF
c_{a-g1}	<1.1	pF

CHARACTERISTICS

Pentode connection

V_a	100	250	V
V_{g2}	100	250	V
V_{g1}	–6.3	–46	V
I_a	120	48	mA
I_{g2}	8.3	5.5	mA
g_m	16.5	6.9	mA/V
r_a	3.7	13.5	kΩ
μ_{g1-g2}	6.0	5.0	

←

Triode connection (g_2 connected to a)

V_a	100	V
I_a	100	mA
V_{g1}	–8.0	V
g_m	14.5	mA/V
r_a	380	Ω
μ	5.5	

EL360

OUTPUT PENTODE

DESIGN CENTRE RATINGS (unless otherwise stated)

Scanning, low voltage series regulator, and similar applications

$V_{a(b)}$ max.	1.0	kV
$v_{a(pk)}$ max.	7.0	kV
$-v_{a(pk)}$ max. ($p_a = 15W$)	1.0	kV
$-v_{a(pk)}$ max. ($p_a = 10W$)	1.5	kV
V_a max.	800	V
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
$-v_{g1(pk)}$ max.	1.0	kV
p_a max.	15	W
p_{g2} max.	5.0	W
V_{a+g2} max.	400	V
p_{a+g2} max.	18	W
I_k max.	200	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V

High voltage series regulator applications

$V_{a(b)}$ max.	4.0	kV
$V_{g2(b)}$ max.	550	V
V_a max.	2.0	kV
V_{g2} max.	400	V
p_a max.	6.0	W
p_{g2} max.	2.0	W
I_k max.	5.0	mA

Pulse modulator applications

V_a max. (absolute)	5.0	kV
p_a max.	10	W
*$i_{k(pulse)}$ max. (absolute)	4.0	A
V_{g2} max.	550	V
p_{g2} max.	3.0	W
$-V_{g1}$ max.	300	V
$+v_{g1(pulse)}$ max.	60	V

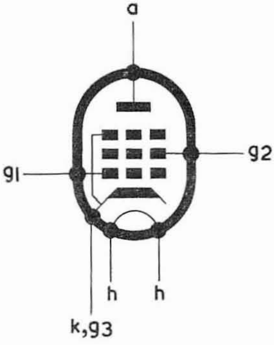
*Max. pulse duration 1μs, duty factor 0.001

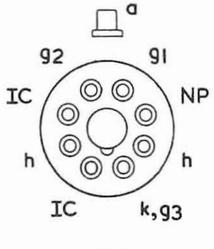
OUTPUT PENTODE

EL360

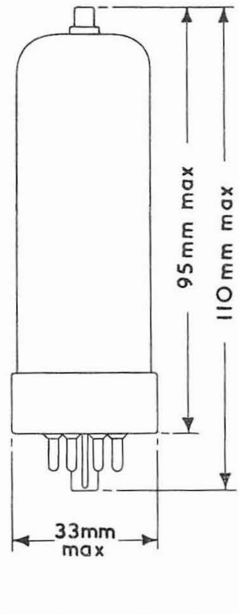
Output pentode for use in radar scanning, series regulator and similar applications and in pulse modulator applications.

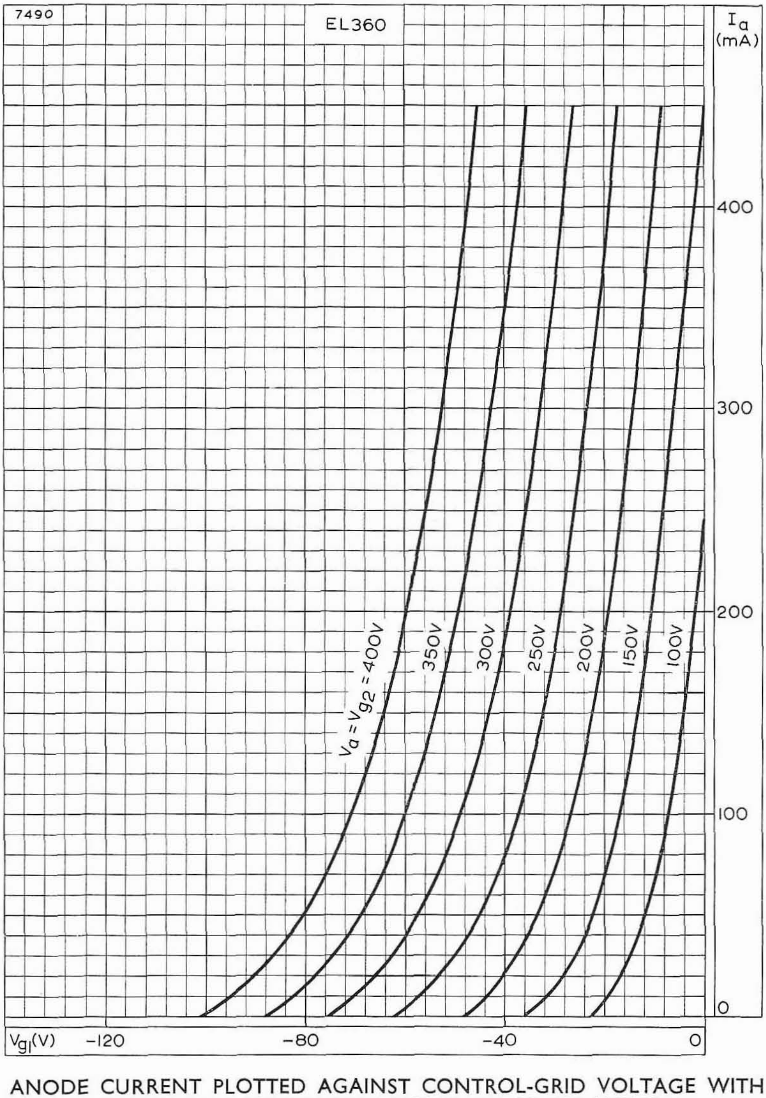
2277





Octal Base

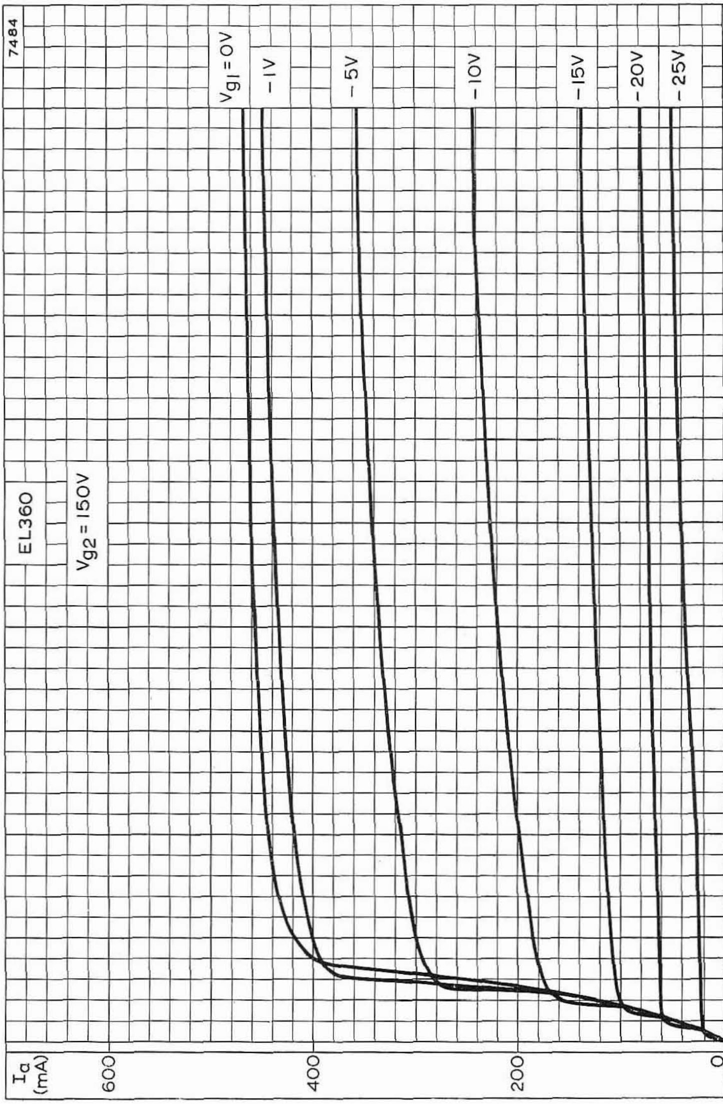




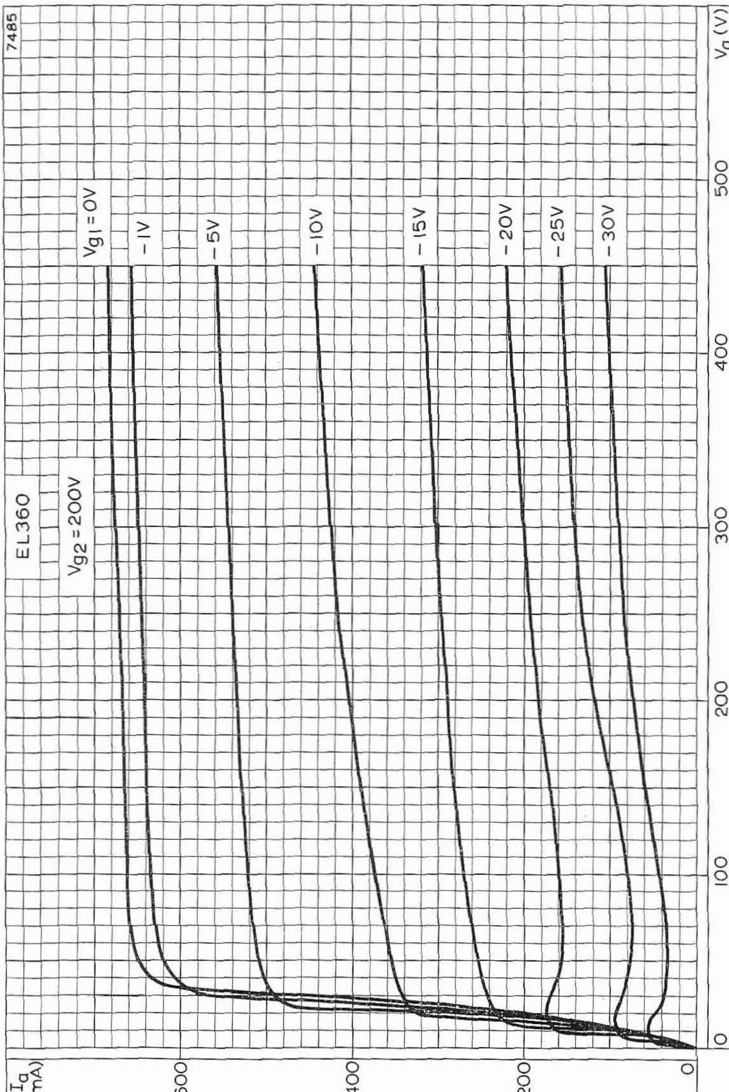
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS

EL360

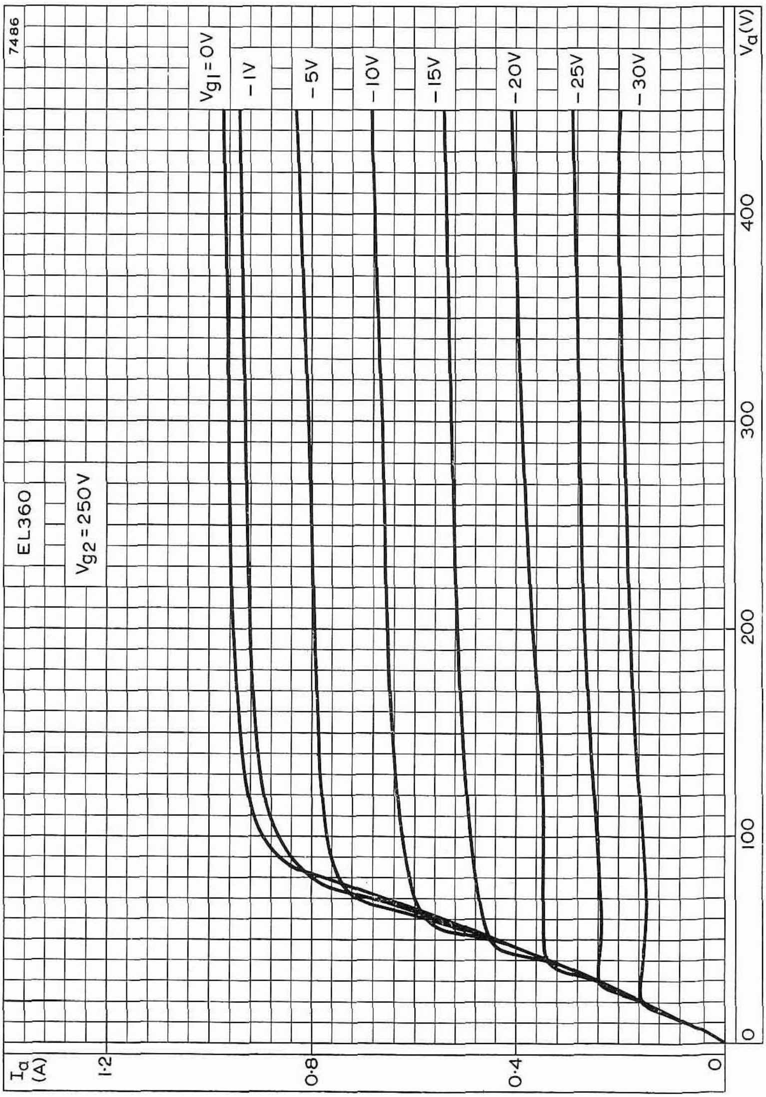
OUTPUT PENTODE



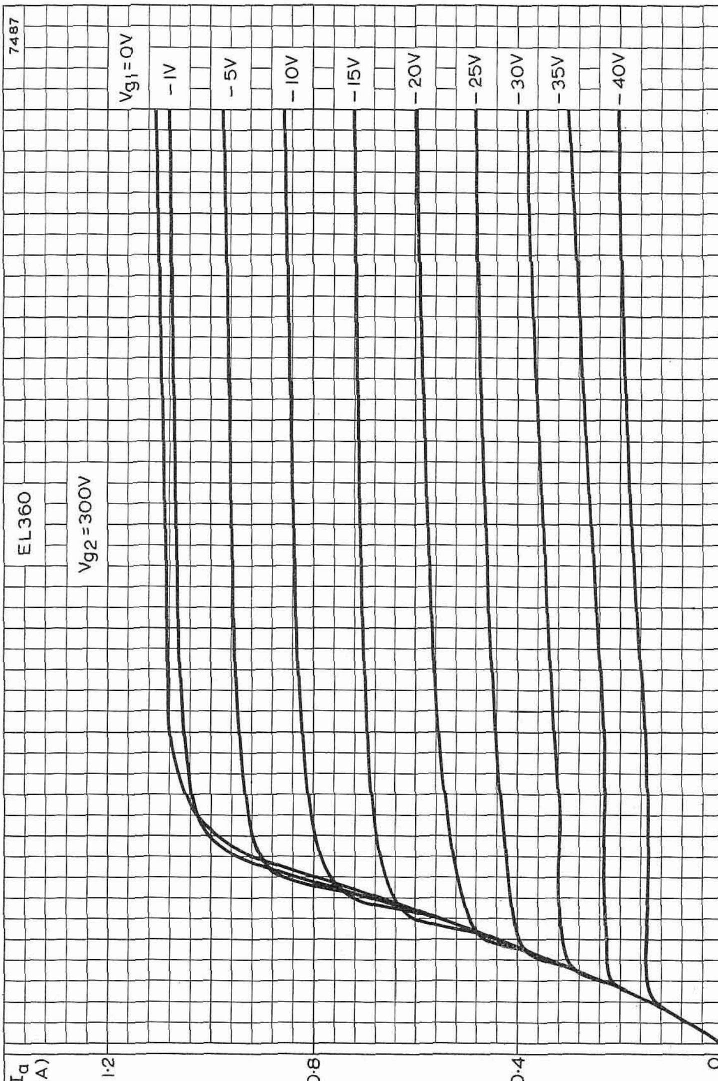
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

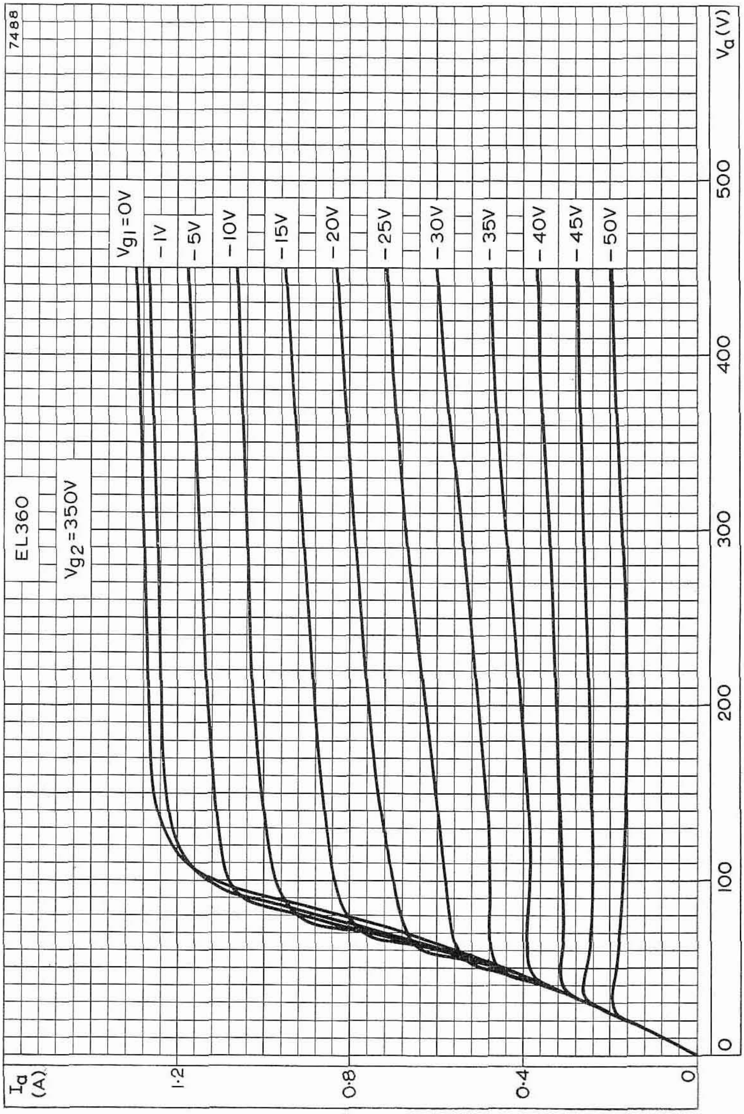


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

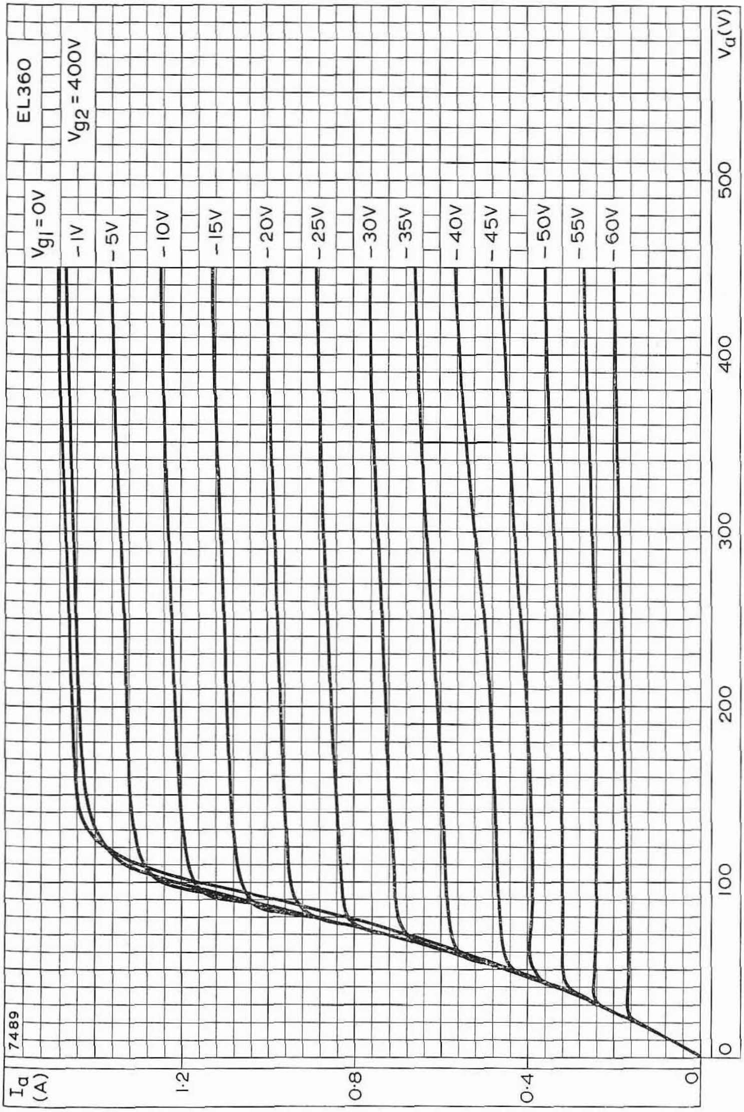


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$

Mullard



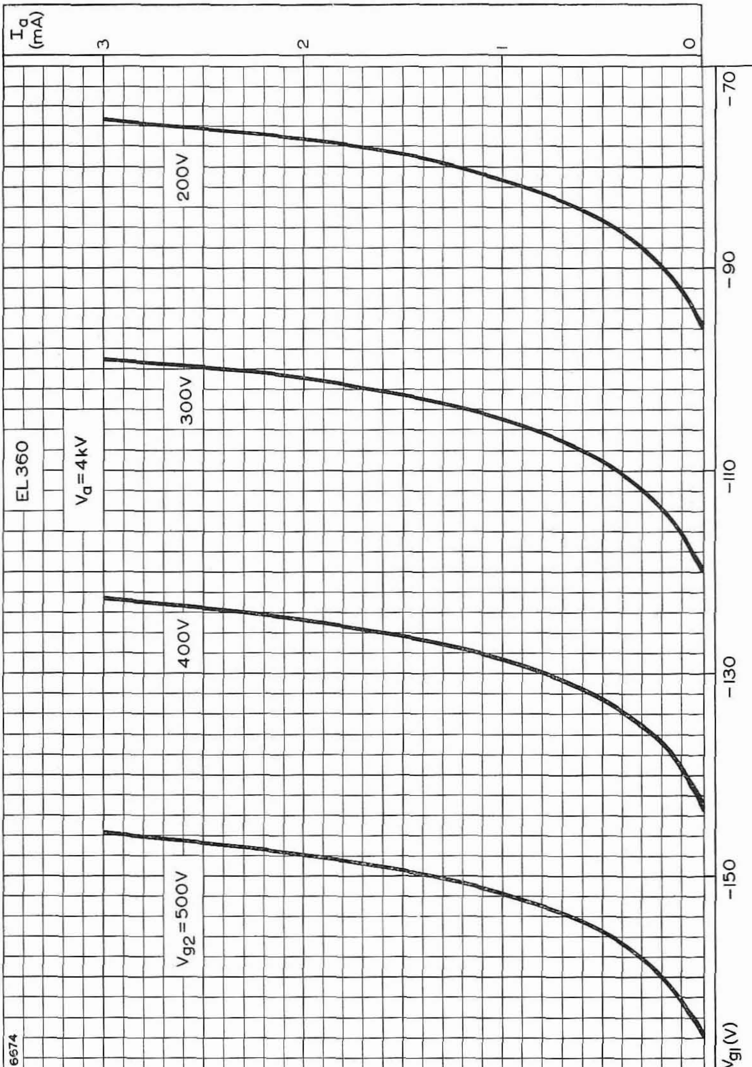
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V



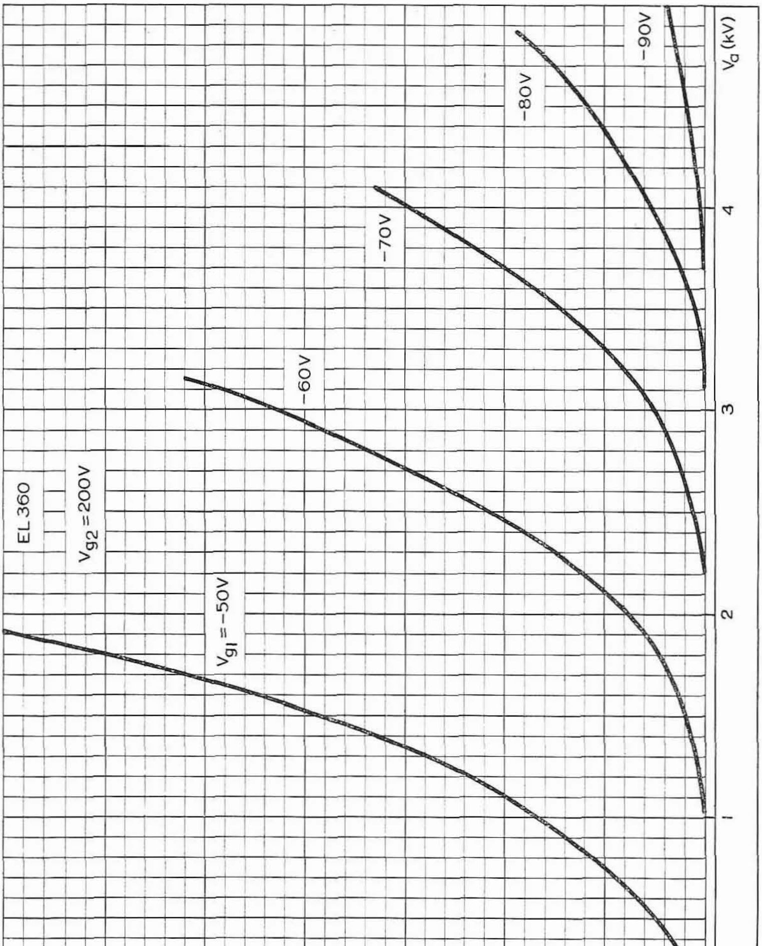
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 400V$

EL360

OUTPUT PENTODE



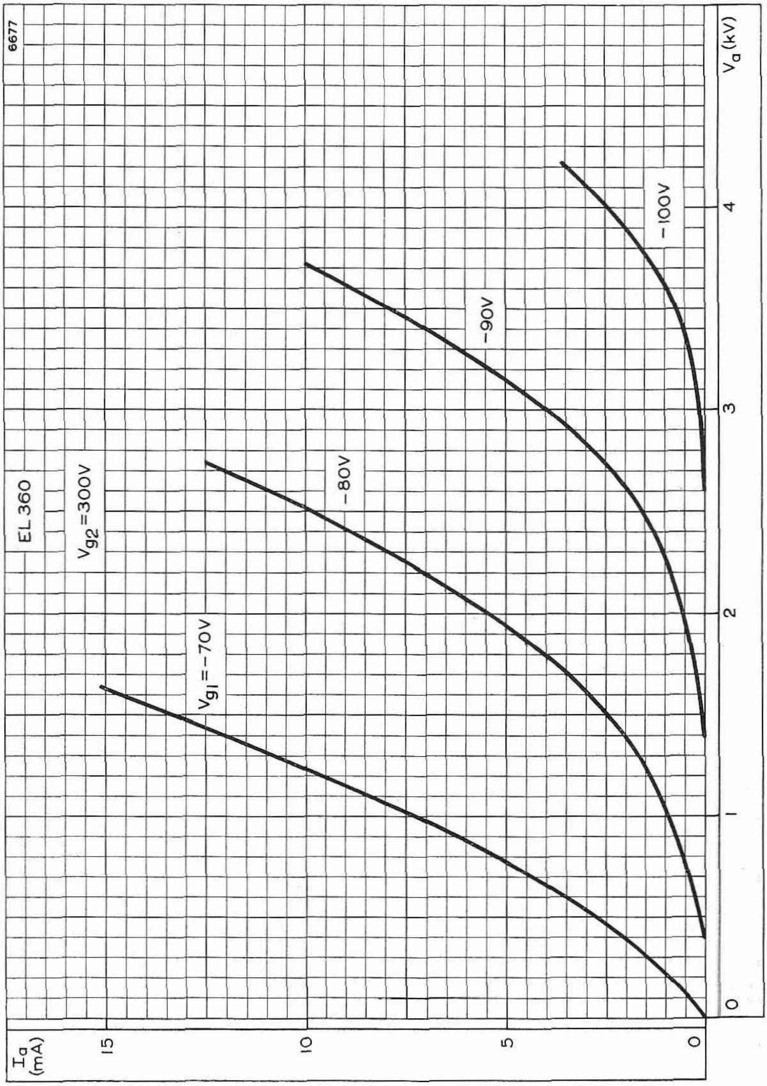
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. $V_a = 4kV$



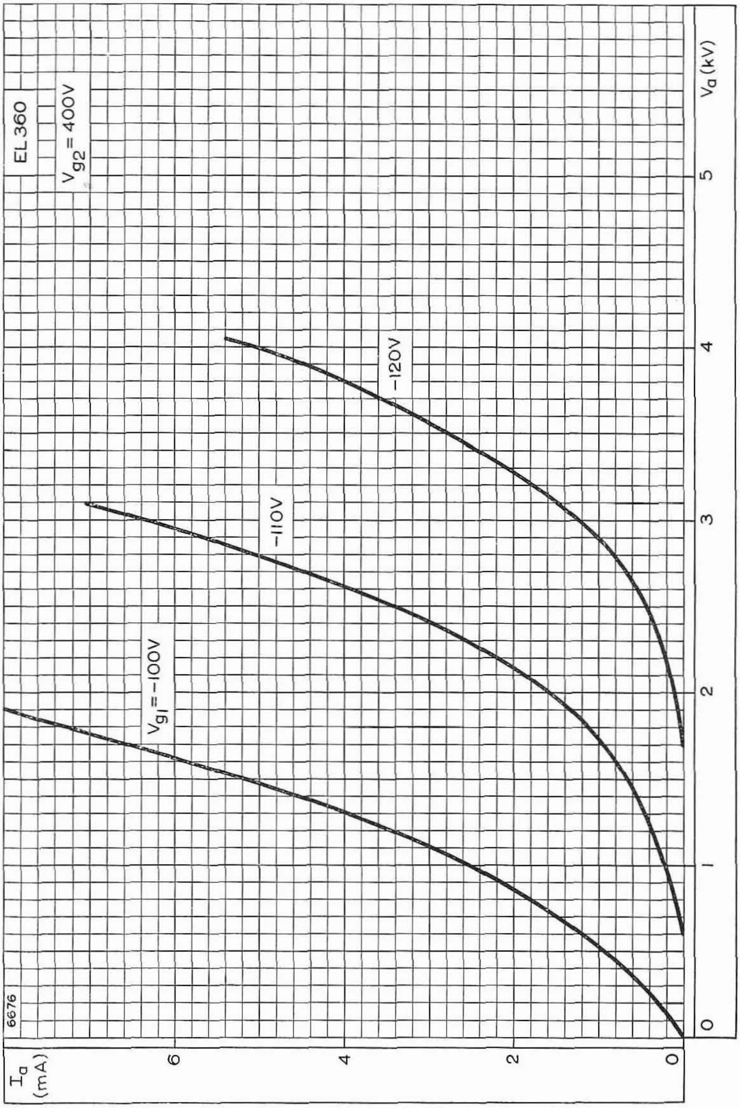
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 5kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

EL360

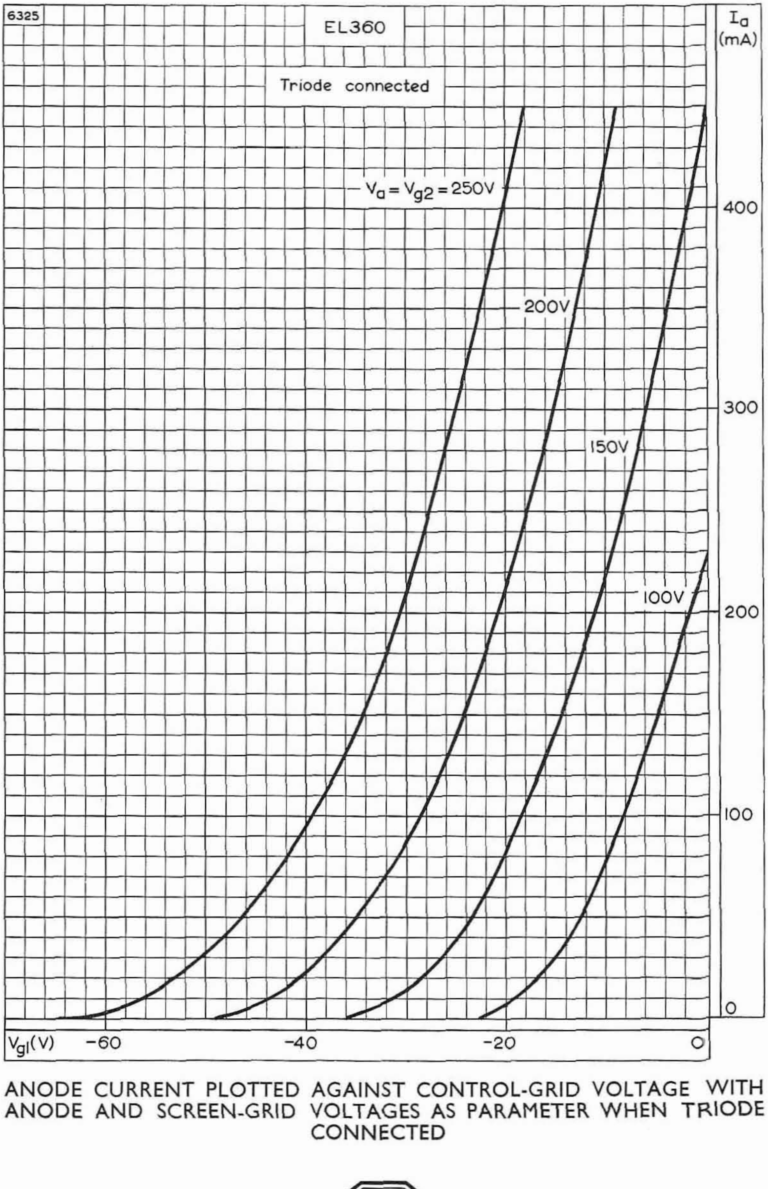
OUTPUT PENTODE



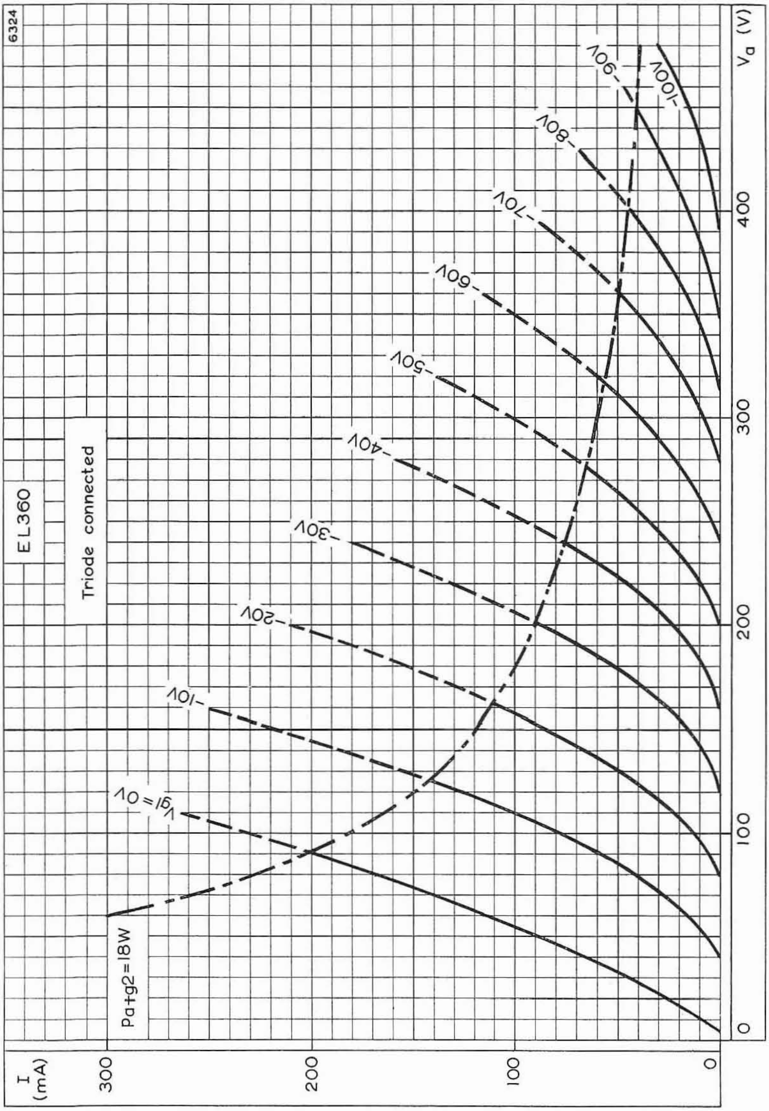
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 4kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



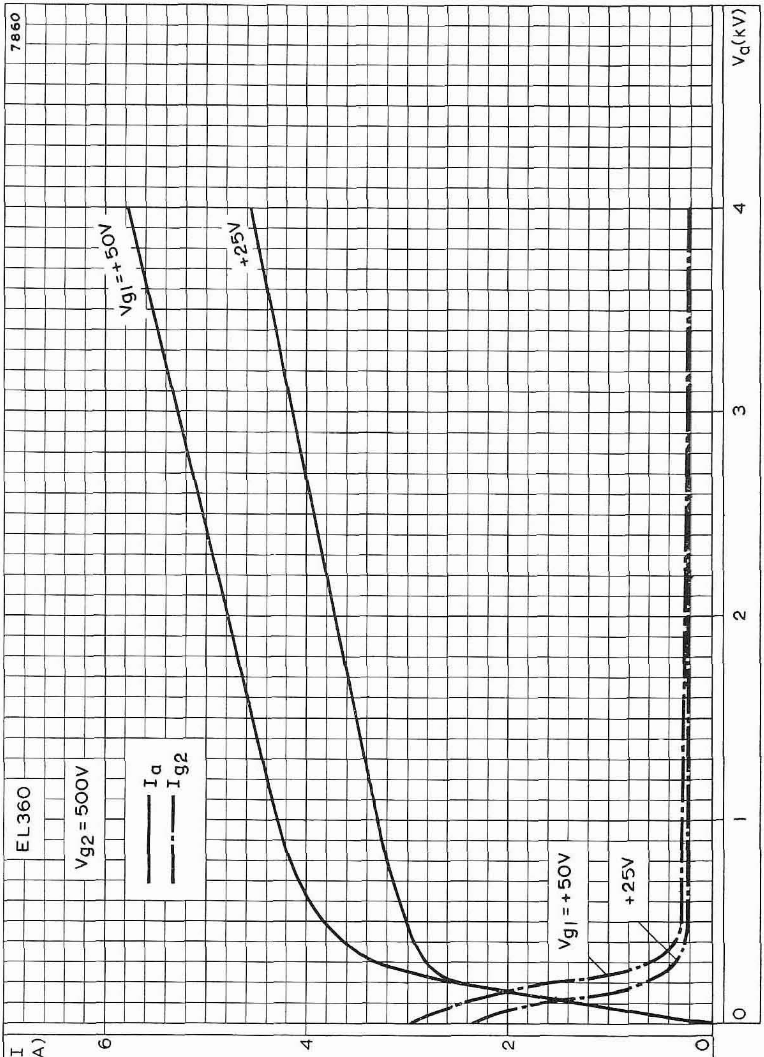
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 4kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 400V$



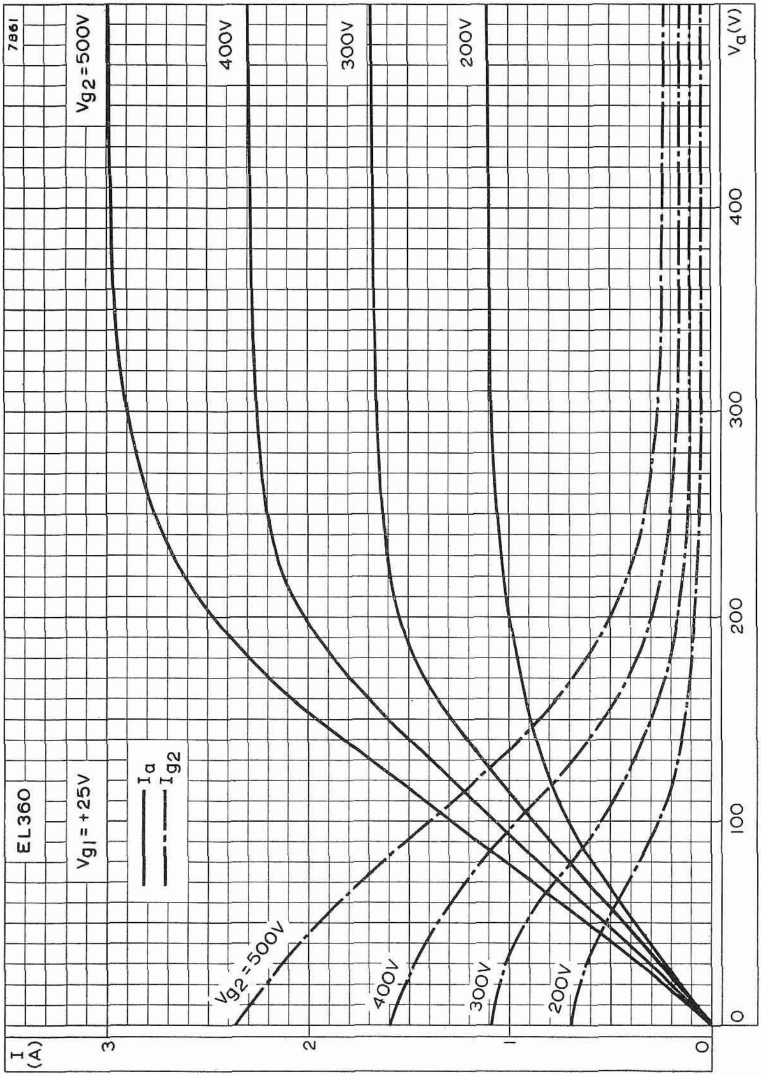
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER WHEN TRIODE CONNECTED



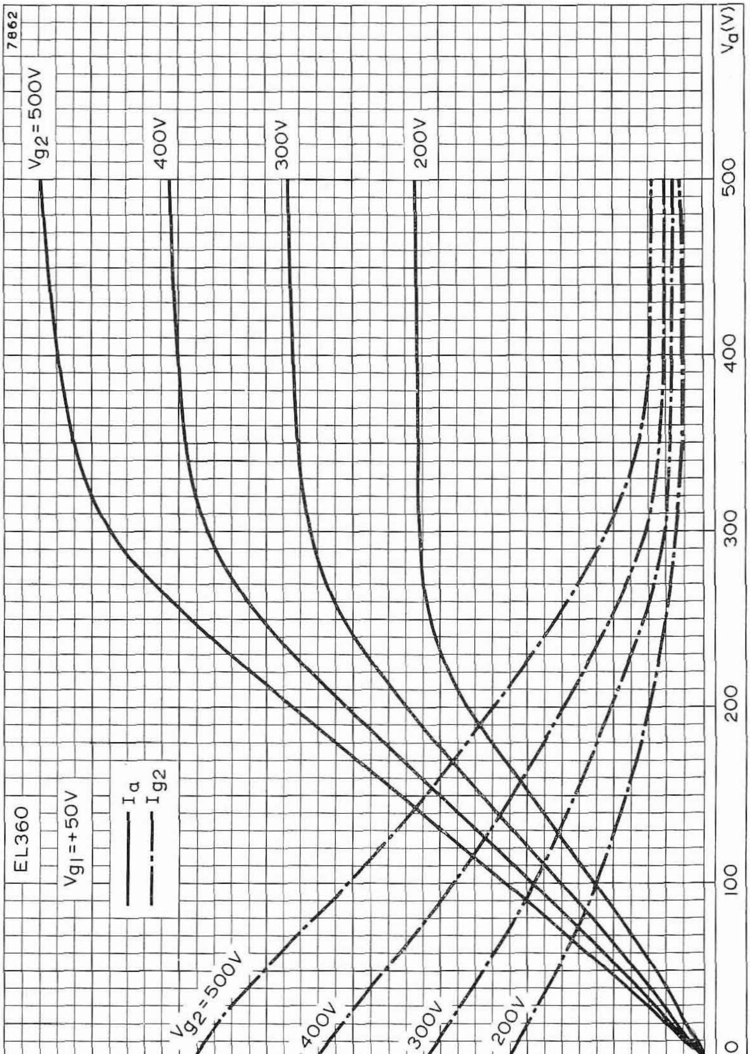
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



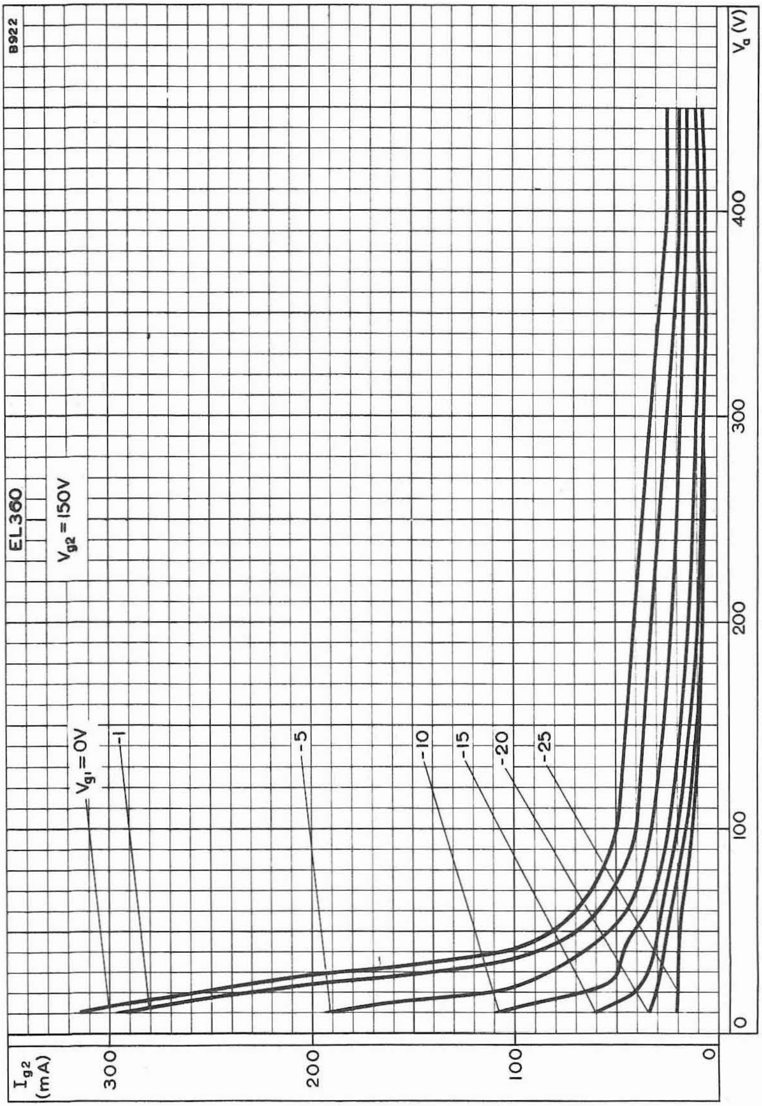
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



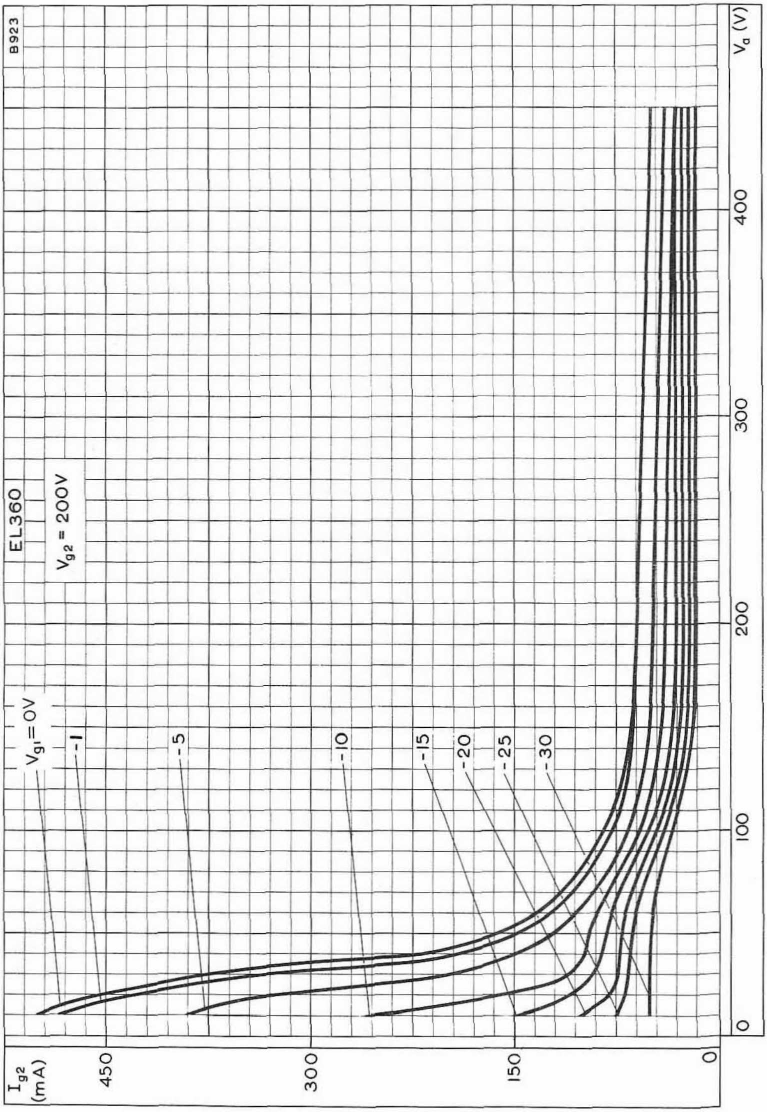
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. $V_{g1} = +25V$



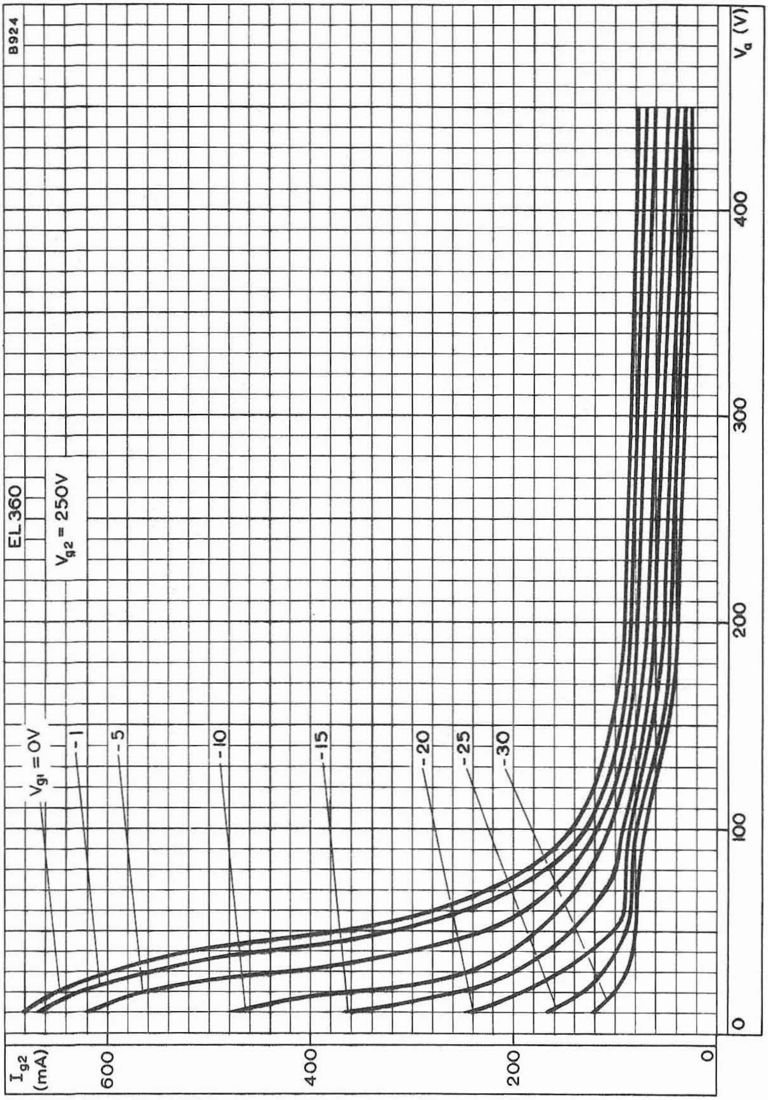
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. $V_{g1} = +50V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$



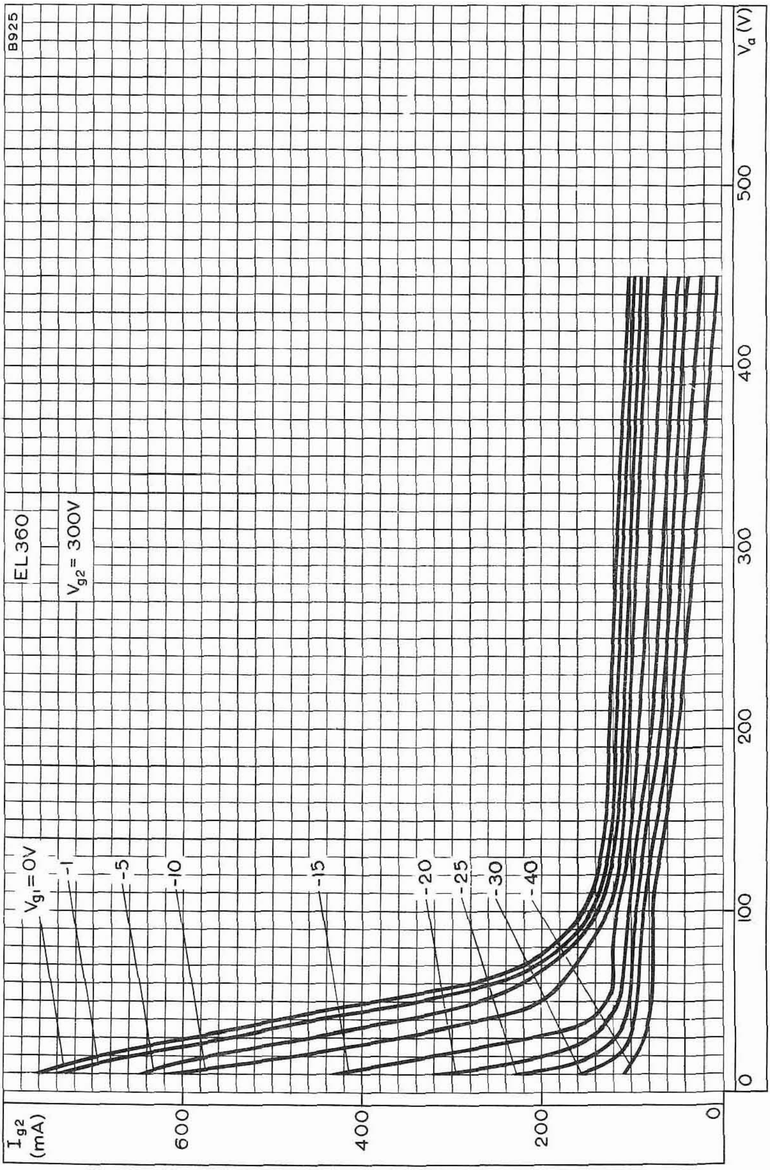
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



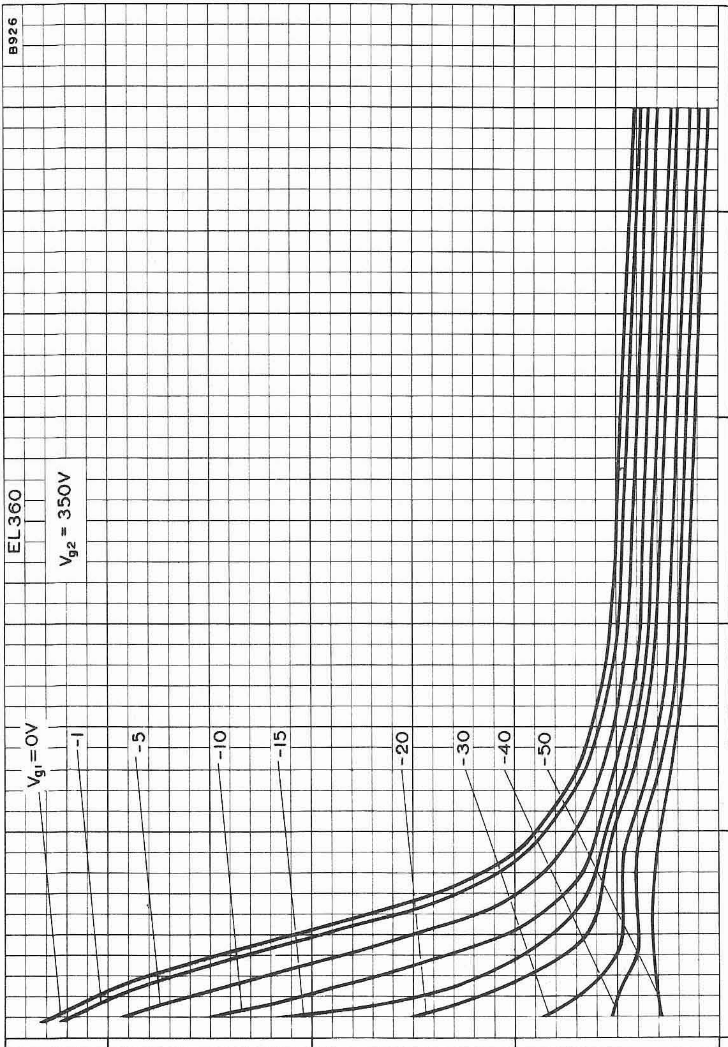
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

EL360

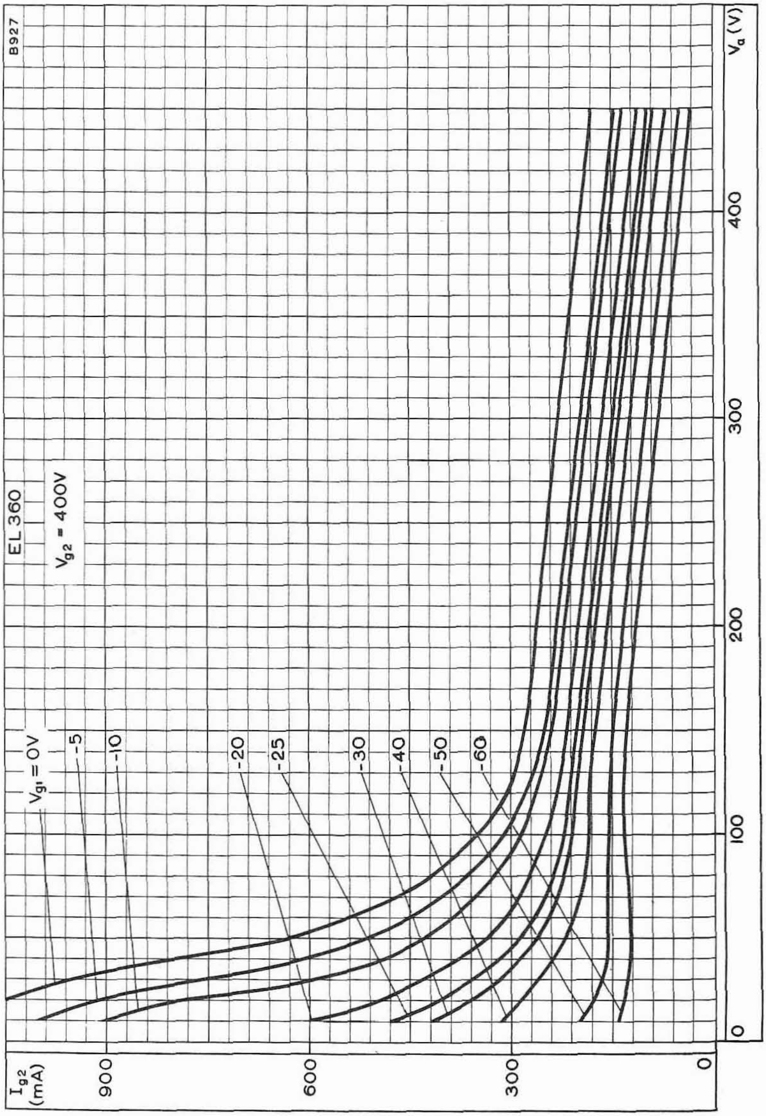
OUTPUT PENTODE



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 350V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 400V$

TUNING INDICATOR

EM81

Electron beam tube for use as a tuning indicator in f.m. or a.m. receivers or as a level indicator in tape recorders.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

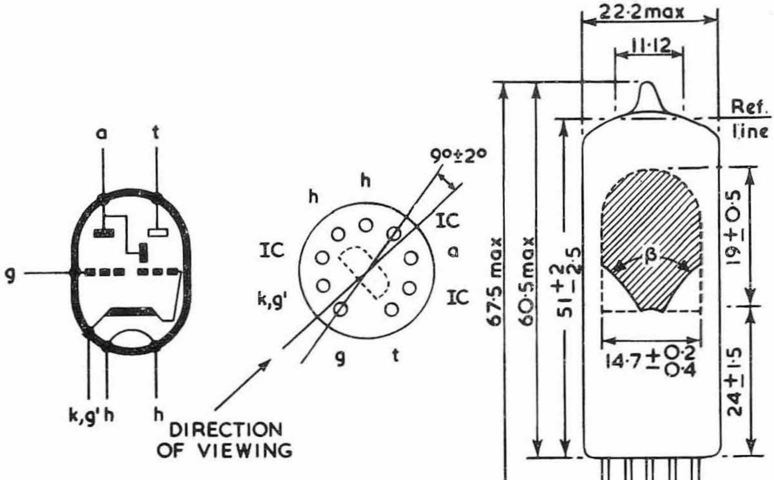
V_b		250		V
V_t		250		V
R_a		500		kΩ
R_{g-k}		3.0		MΩ
V_g	−1.0		−10.5	V
I_a	370		20	μA
I_t	2.0		2.3	mA
β	65		5.0	deg.
V_g max. ($I_g = +0.3\mu A$)			−1.3	V

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	200	mW
$V_{t(b)}$ max.	550	V
V_t max.	300	V
V_t min.	165	V
I_k max.	3.0	mA
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

EM81

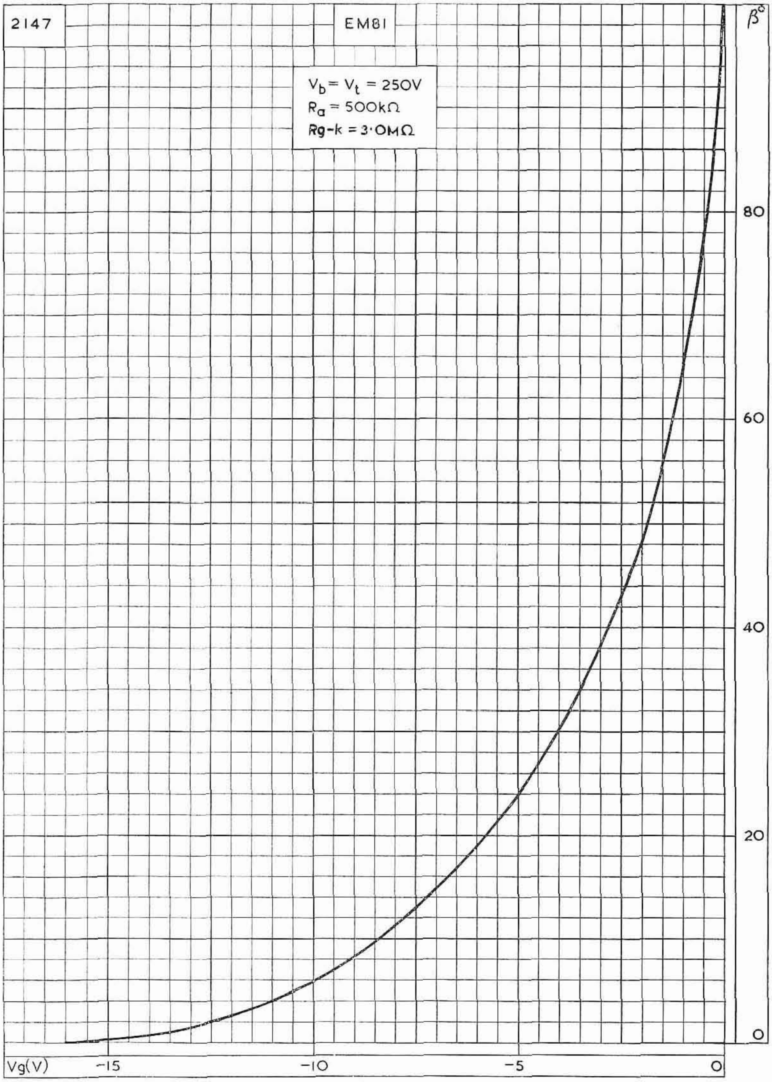
TUNING INDICATOR



B9A
Noval Base

2149

All dimensions in mm



LIGHT ANGLE PLOTTED AGAINST CONTROL-GRID VOLTAGE

VOLTAGE INDICATOR

EM87

Short grid-base electron beam tube for use as a voltage indicator in tape recorders. The pattern consists of a vertical column with a fluorescent area at the top and bottom. As the grid is driven negative these fluorescent areas converge, until they meet at $V_g = -10V$. At $V_g = -15V$ there is a 1.5mm cross-over which can be utilised to indicate overloading.

HEATER

V_h	6.3	V
I_h	300	mA

TYPICAL OPERATING CONDITIONS

(deflection electrode connected to anode)

V_b		250		V
V_t		250		V
R_a		100		kΩ
R_{g-k}		3.0		MΩ
V_g	0	–10	–15	V
I_a	2.0	0.5	0.2	mA
I_t	1.0	1.8	2.0	mA
*L	21	0	–1.5	mm

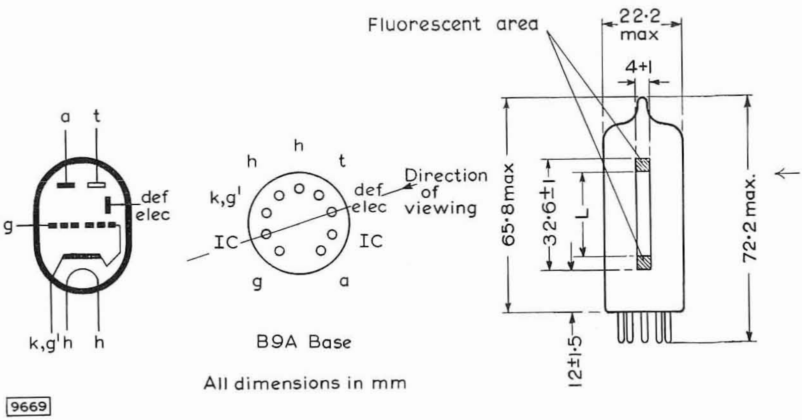
*Length of column. A negative value of L indicates overlapping.

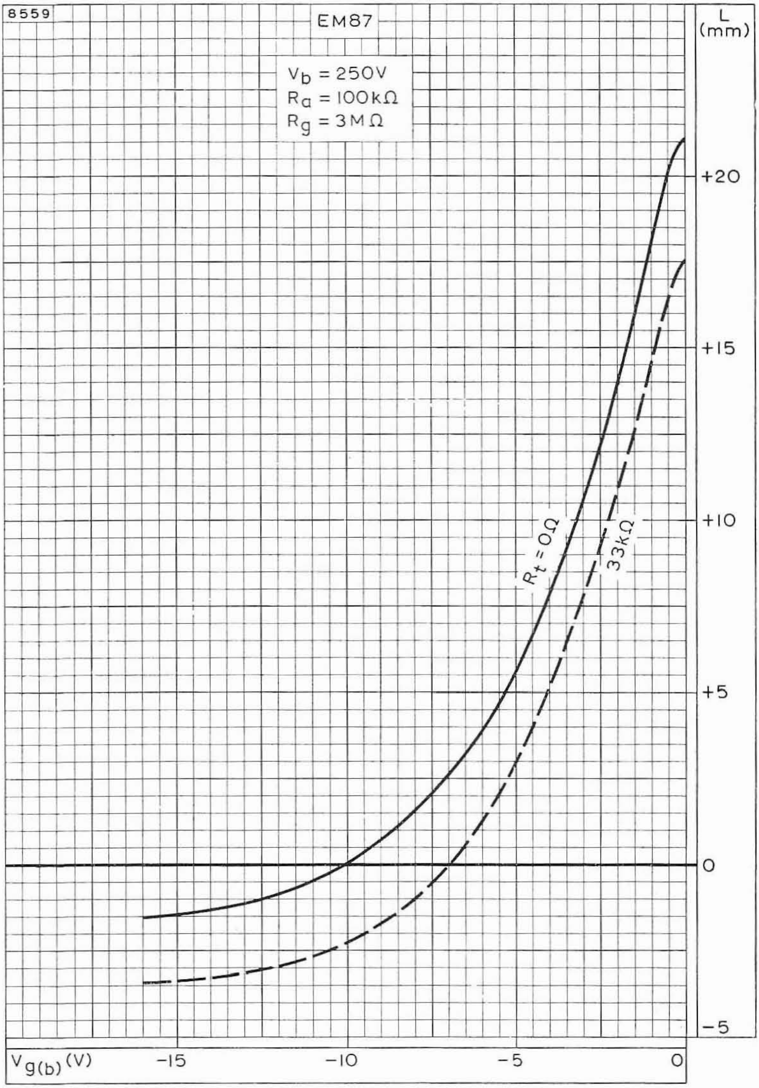
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	600	mW
$V_{def.elec.(b)}$ max.	550	V
$V_{def.elec.}$ max.	300	V
$V_{t(b)}$ max.	550	V
V_t max.	300	V
V_t min.	170	V
I_k max.	5.0	mA
R_{g-k} max.	3.0	MΩ
R_{h-k} max.	100	kΩ
V_{h-k} max.	250	V
T_{bulb} max.	120	°C

EM87

VOLTAGE INDICATOR





LENGTH OF COLUMN PLOTTED AGAINST CONTROL-GRID VOLTAGE

HALF-WAVE RECTIFIERS

EY86
EY87

High voltage half-wave rectifiers particularly suitable for use in cathode ray tube e.h.t. supply units. The EY87 is electrically identical to the EY86 but has a chemically treated bulb to prevent flash-over under conditions of high humidity.

HEATER

V_h	6.3	V
I_h	90	mA
Heater voltage tolerances $I_{out} \leqq 200\mu A$	±15*	%
$I_{out} > 200\mu A$	±7*	%

*These tolerances apply when the power supply voltage is at its nominal value and when a valve having bogey heater characteristics is employed. In addition, fluctuations in the mains supply voltage not exceeding ±10% are permissible.

CAPACITANCE

$c_{a-(h+k+s)}$	1.7	pF

LIMITING VALUES

Pulsed input

†P.I.V. max.	22	kV
I_{out} max.	800	μA
††$i_{a(pk)}$ max.	40	mA
C max.	2000	pF

†Max. duration 18% of a line scanning cycle with a max. of 18μs.

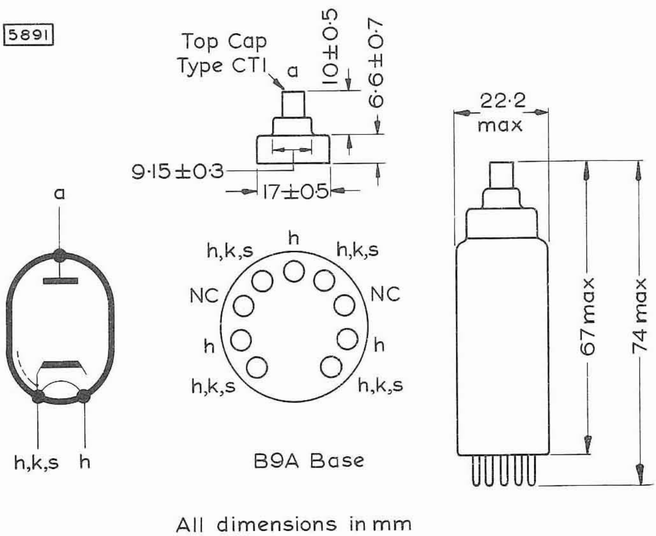
††Max. duration 10% of a line scanning cycle with a max. of 10μs.

Sinusoidal input (50c/s)

$V_{in(r.m.s.)}$ max.	5.0	kV
I_{out} max.	3.0	mA
C max.	0.2	μF
R_{lim} min.	100	kΩ

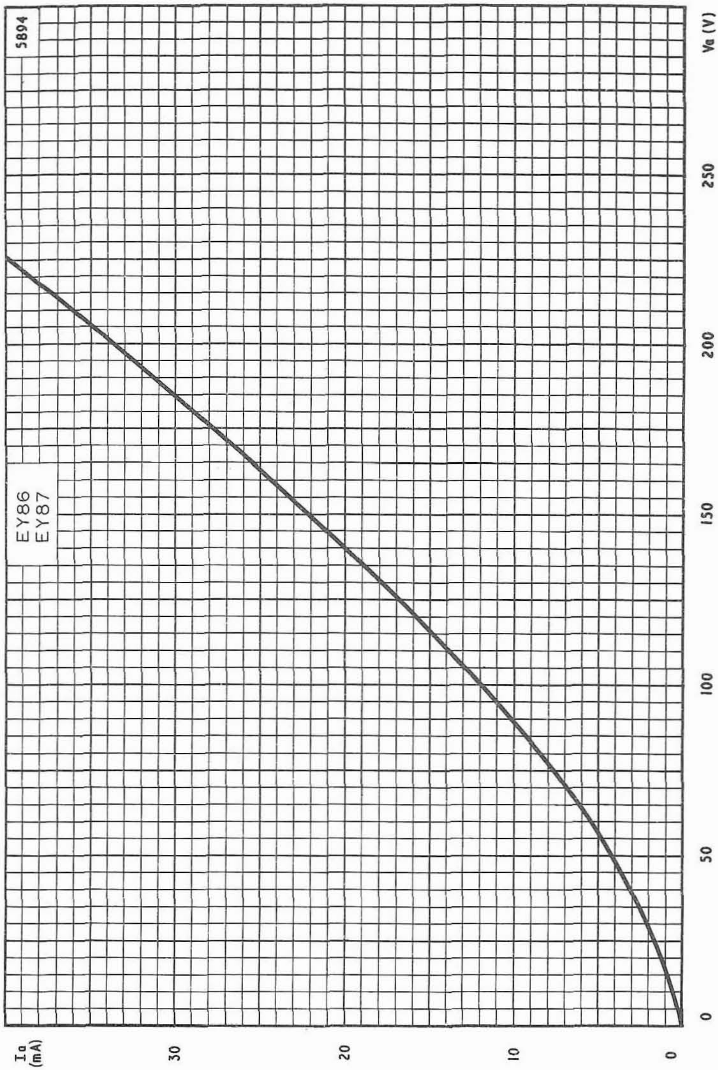
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16kV. The level of X-radiation is likely to be considerably higher when the heater circuit of the tube is open.



Pins 1, 4, 6 and 9 may be used for fixing an anti-corona shield.

Pins 3 and 7 may only be connected to points in the heater circuit and must not be earthed.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

FULL-WAVE RECTIFIER

EZ80

Indirectly-heated full-wave rectifier, primarily intended for use in a.c. mains-operated equipment.

HEATER

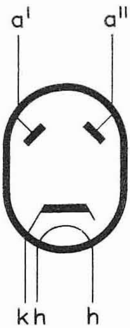
V_h	6.3	V
I_h	600	mA

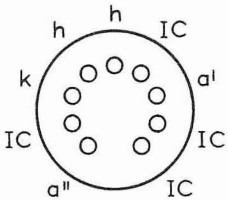
LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2 × 350	V
I_{out} max.	90	mA
C max.	50	μF
$i_{a(pk)}$ max. (per anode)	270	mA
$v_{h-k(pk)}$ max.	500	V

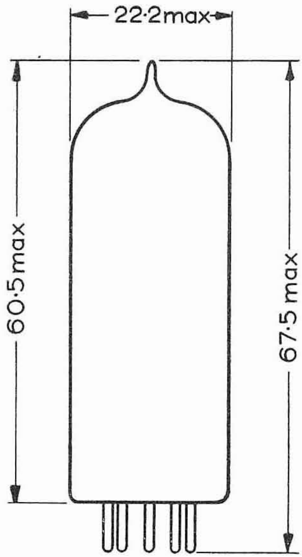
OPERATING CONDITIONS

$V_{in(r.m.s.)}$	2 × 250	2 × 275	2 × 300	2 × 350	V
R_{lim} min. (per anode)	125	175	215	300	Ω
C	50	50	50	50	μF
I_{out}	90	90	90	90	mA
V_{out}	265	285	310	360	V



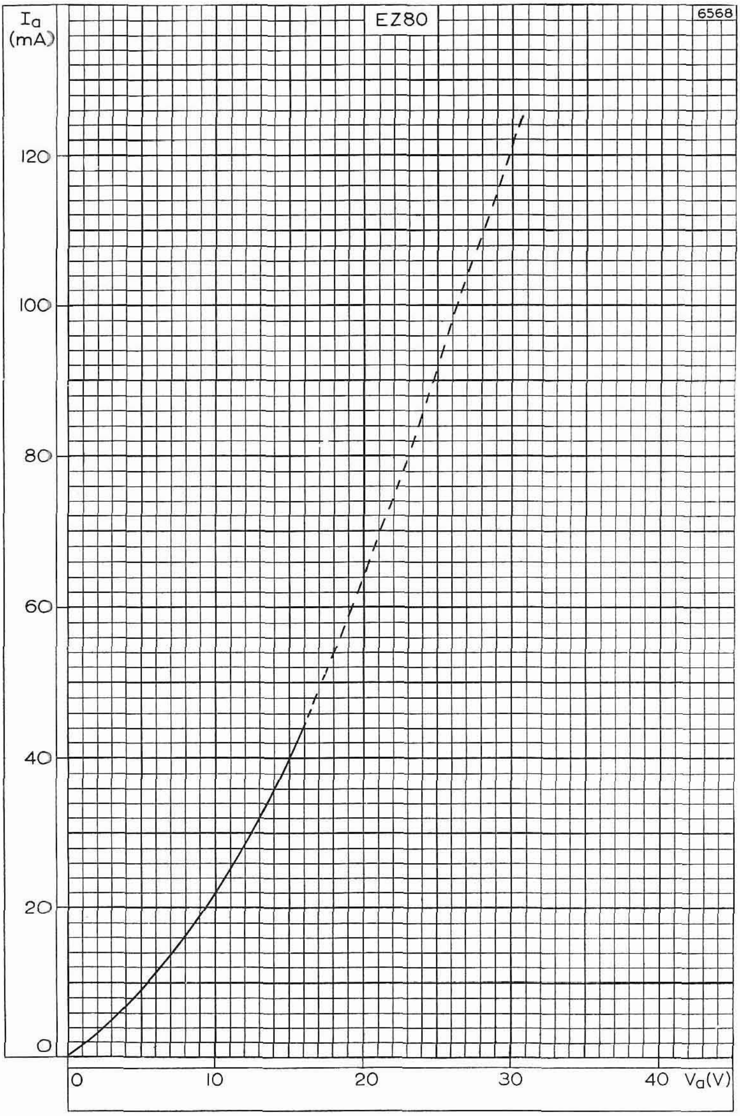


B9A Base

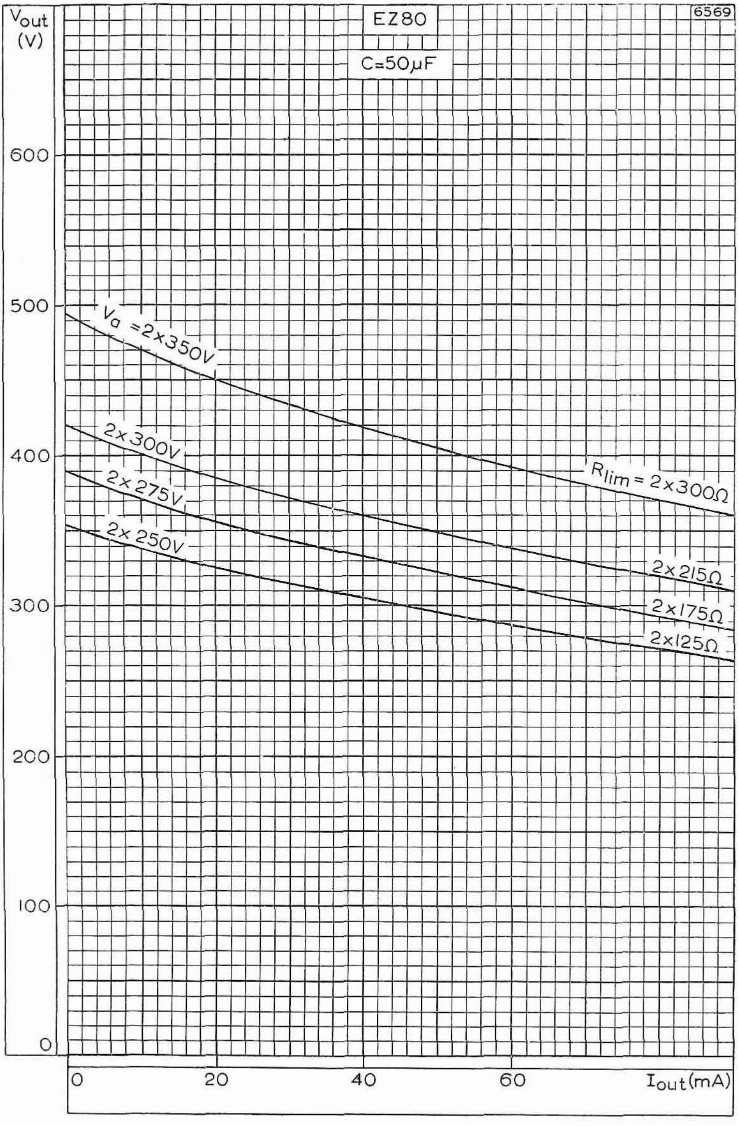


6401

All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



REGULATION CURVES

HALF-WAVE RECTIFIER GY501

E.H.T. rectifier for colour television receivers. This valve has a chemically treated envelope to avoid flashover under conditions of high humidity and low atmospheric pressure (450mm of mercury).

HEATER

V_h (see note 1)	3.15	V
I_h	400	mA

CAPACITANCES

c_{a-h+k}	1.2	pF ←

OPERATING CONDITIONS

I_{out}	1.5	mA
V_{out}	25	kV

RATINGS (DESIGN CENTRE SYSTEM)

P.I.V. max. (see note 2)	31	kV
V_{out} max.	25	kV
$I_{a(out)}$ max.	1.7	mA

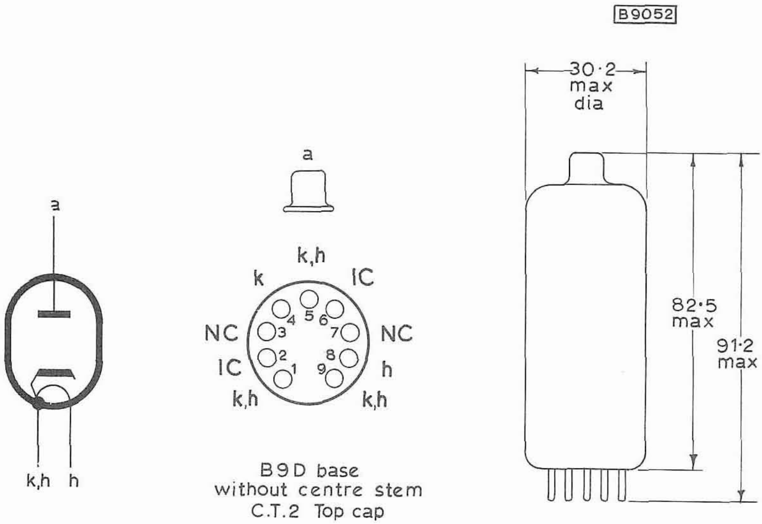
OPERATING NOTES

1. The nominal heater voltage value applies to operation with the average beam current to be expected in practice. Heater voltage variations up to max. ±15% are permitted for a nominal tube under the worst probable conditions.

2. Maximum pulse duration 22% of one cycle with a maximum of 18μs. The negative peak due to ringing in the line output transformer should be taken into account.

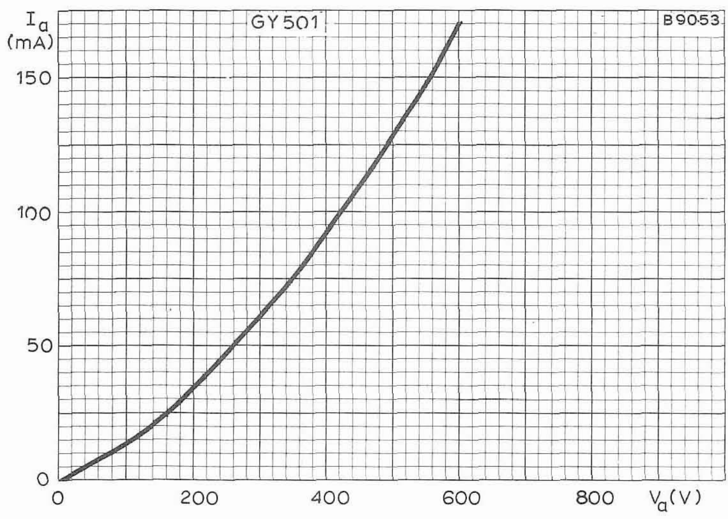
3. When operated in a television receiver this valve will produce X-radiation in excess of permissible dosage and a suitable screen should be incorporated.

OUTLINE DRAWING OF GY501

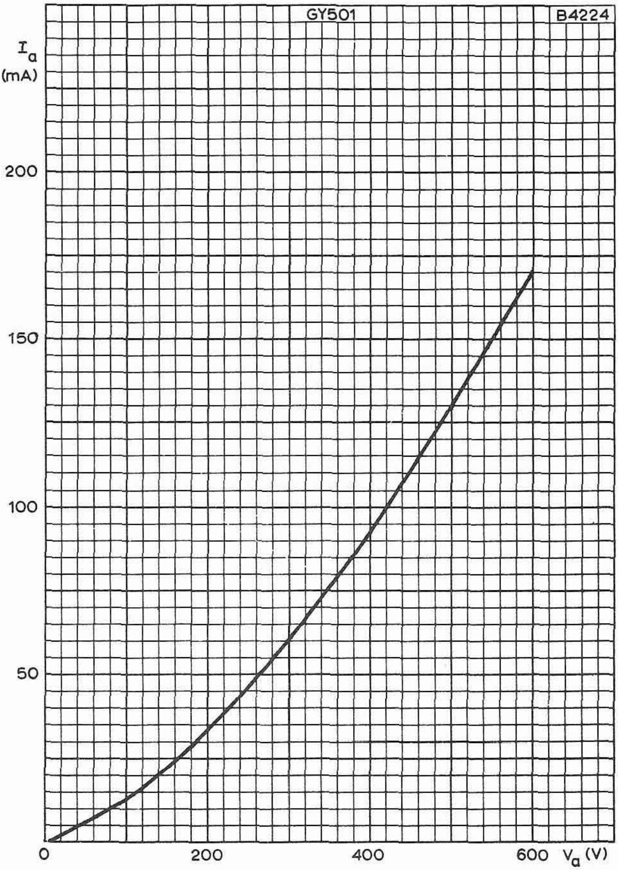


All dimensions in mm

Pins 1, 5 and 9 may be used to connect an anti-corona ring. Circuit elements having the same potential as the heater, eg. series resistor, may be connected to pins 3 and 7. These pins must not be earthed



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

U.H.F. TRIODE

PC86

Frame-grid triode for use as grounded-grid amplifier or self-oscillating mixer in Bands IV and V.

HEATER

I_h	300	mA
V_h	4.0	V ←

CAPACITANCES ←

Unshielded

c_{a-g}	2.2	pF
c_{a-k}	240	mpF
c_{a-k+h}	350	mpF
c_{a-g+h}	2.3	pF
c_{g-k}	3.5	pF
c_{g-k} (I_a = 12mA)	5.6	pF
c_{g-k+h}	3.8	pF
c_{g-h}	300	mpF
c_{k-g+h}	6.3	pF

Shielded

$c_{h+k-g+s}$	4.1	pF
c_{a-g+s}	3.3	pF
c_{a-k+h}	300	mpF

CHARACTERISTICS

V_a	175	V
V_g	-1.5	V
I_a	12	mA
g_m	14	mA/V
r_a	4.85	kΩ
μ	68	
R_{eq}	230	Ω

OPERATING CONDITIONS

As grounded-grid amplifier

V_a	175	V
I_a	12	mA
R_k	125	Ω
g_m	14	mA/V

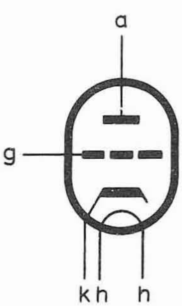
As self-oscillating mixer

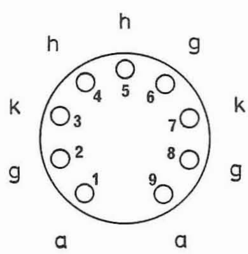
$V_{a\ (b)}$	220	V
R_a	5.6	kΩ
R_g	47	kΩ
I_a	12	mA
I_g	50	µA
v_{osc} (r.m.s.)	2.5	V
g_c	5.5	mA/V

DESIGN CENTRE RATINGS

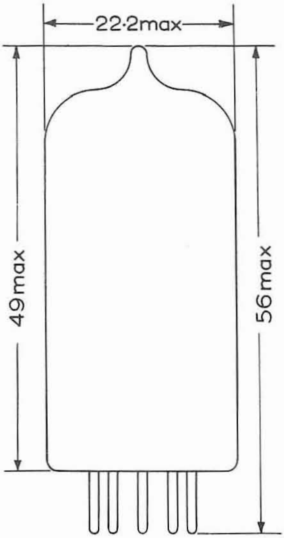
$V_{a\ (b)}$ max.	550	V
V_a max.	220	V
p_a max.	2.2	W
I_k max.	20	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	100	V

B4187

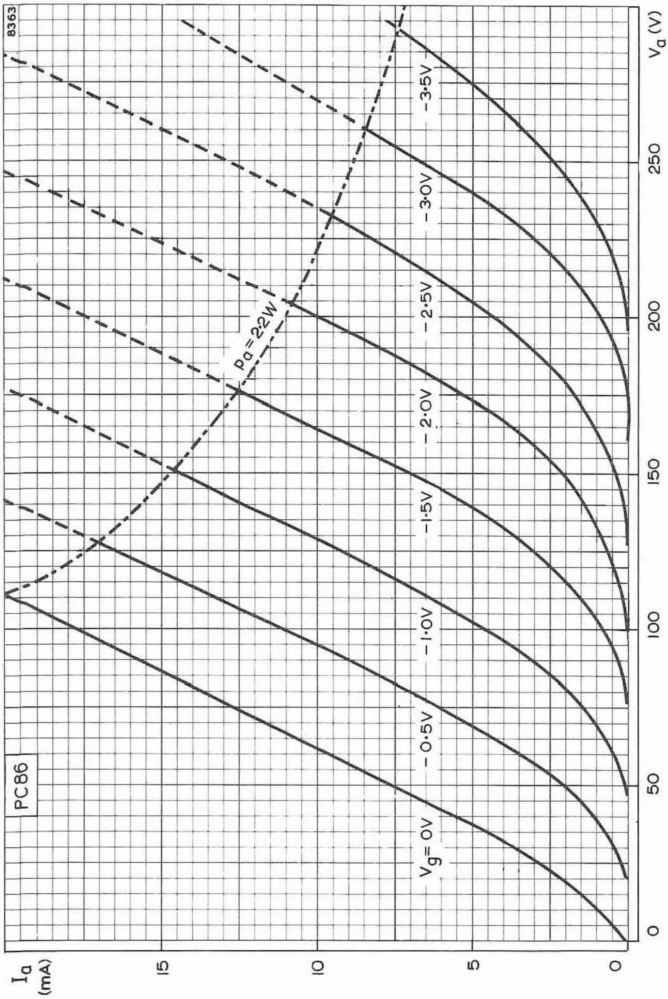




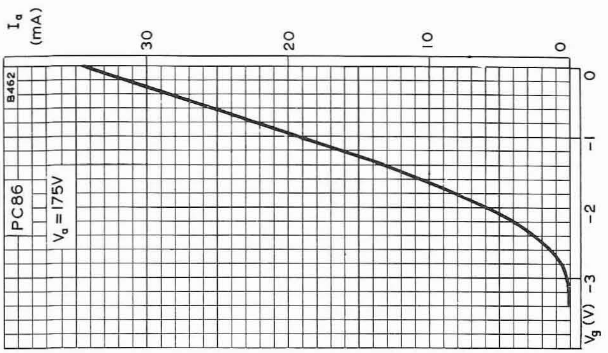
B9A Base

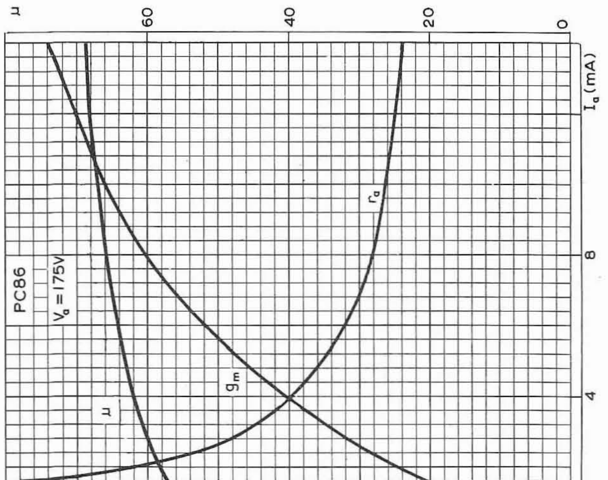


All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.





ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE. Va = 175V

MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT. Va = 175 V

U.H.F. TRIODE

PC88

Frame-grid triode for use as grounded-grid amplifier in Bands IV and V.

HEATER

I_h	300	mA
V_h	3.8	V

CAPACITANCES (*measured with close fitting shield connected to the grid*)

$c_{h+k-g+s}$	3.8	pF
c_{a-g+s}	1.7	pF
c_{a-k+h}	55	mpF
	Unshielded	
c_{a-g}	1.2	pF

CHARACTERISTICS

V_a	160	V
I_a	12.5	mA
V_g	−1.25	V
g_m	13.5	mA/V
r_a	4.8	kΩ
μ	65	
R_{eq}	240	Ω

OPERATING CONDITIONS

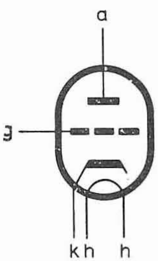
V_a	160	V
R_k	100	Ω
I_a	12.5	mA
g_m	13.5	mA/V
r_a	4.8	kΩ
μ	65	
Noise factor	10	dB

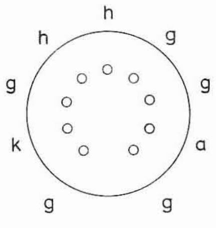
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	2.0	W
I_k max.	13	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	100	V

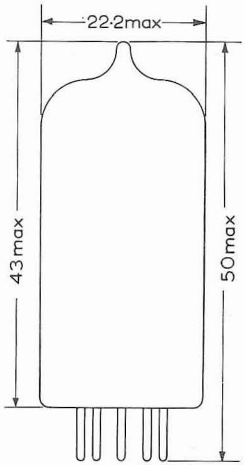
PC88

U.H.F. TRIODE



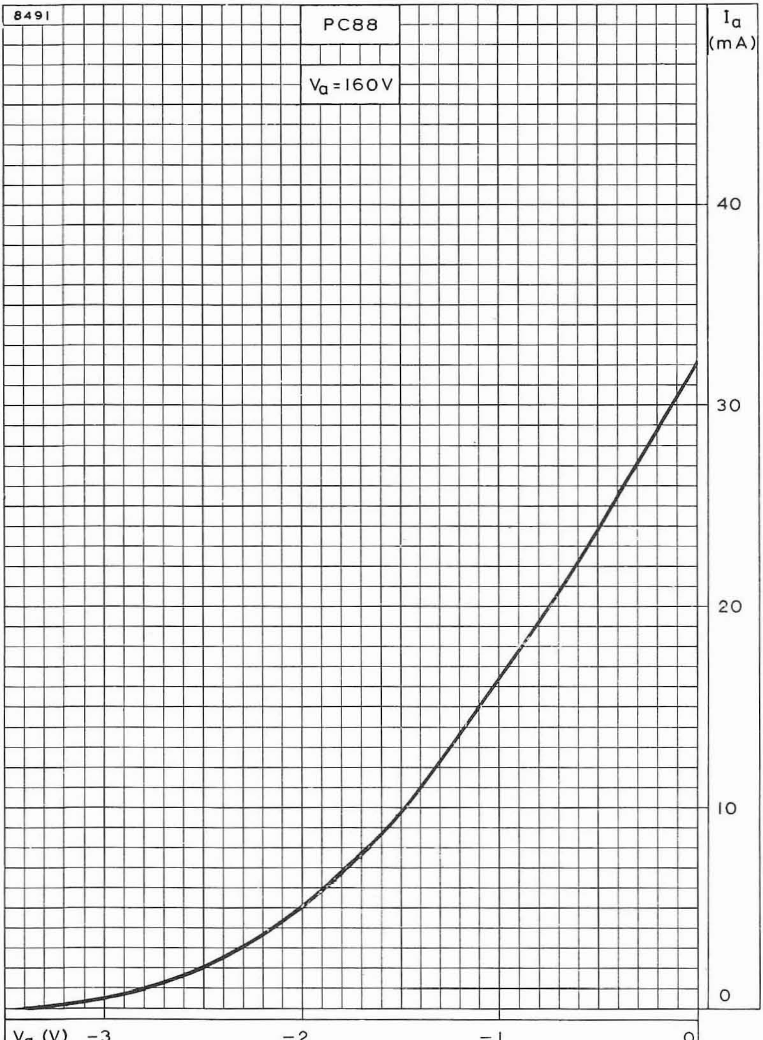


B9A Base

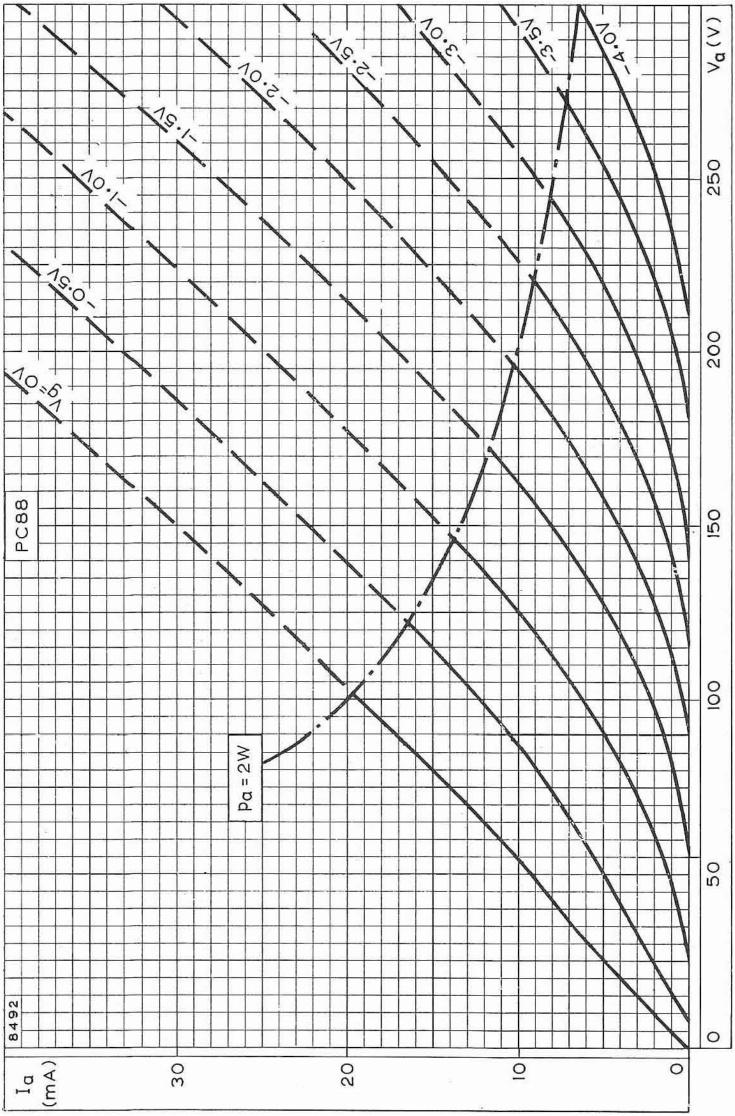


All dimensions in mm

8371



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

R.F. TRIODE

PC900

Triode with low anode-to-grid capacitance intended for use as an r.f. amplifier in v.h.f. television receivers.

HEATER

Suitable for series operation a.c. or d.c.

I_h	300	mA
V_h	3.9	V ←

CAPACITANCES (with external shield)

c_{a-g}	350	mpF
$c_{a-k+h+s}$	3.0	pF
$c_{g-k+h+s}$	4.5	pF
c_{a-k}	80	mpF
c_{g-k}	3.3	pF
c_{g-h}	$<$70	mpF
c_{k-h}	2.3	pF

CHARACTERISTICS

V_a	135	V
I_a	11.5	mA
V_g	-1.0	V
g_m	14.5	mA/V
μ	76	←
r_a	5.25	kΩ ←

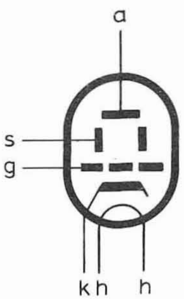
OPERATING CONDITIONS	1	2	3	
V_b	200	200	135	V
R_a	5.6	5.6	1.5	kΩ ←
R_k	0	87	0	Ω ←
I_a	16.5	11.5	16.5	mA ←
I_g	20	0	20	μA ←
V_g	-0.5	1.0	-0.5	V
g_m	20	14.5	20	mA/V
μ	84	76	84	←
V_g for 10:1 reduction in g_m	-3.2	-3.8	-2.3	V ←
V_g for 100:1 reduction in g_m	-7.7	-8.3	-5.3	V ←

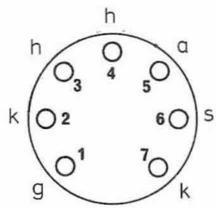
RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	550	V
V_a max.	200	V
p_a max.	2.2	W
I_k max.	20	mA
$-V_g$ max.	50	V
Rg-k max.	1.0	MΩ
R_{g-k} max. (a.g.c. circuits)	3.0	MΩ
$^*V_{h-k}$ max.	100	V

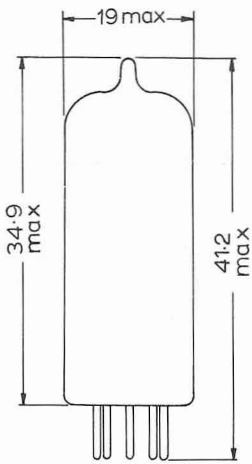
*To fulfil modulation hum requirement, V_{h-k} should not exceed 55V r.m.s. ←

B4370

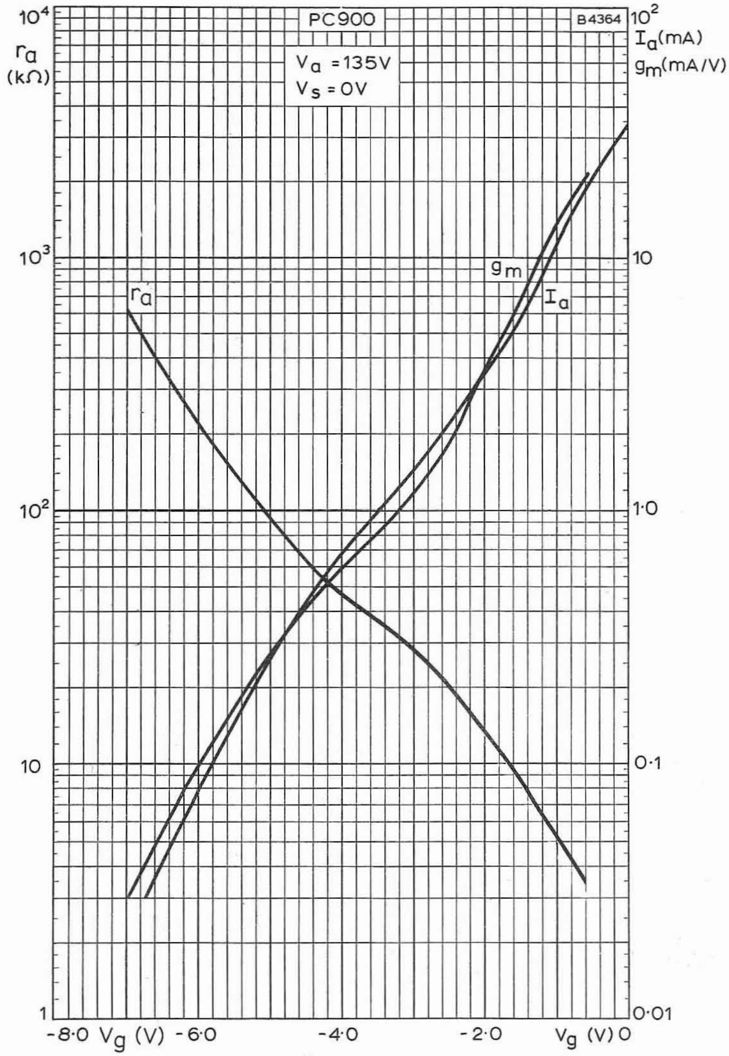




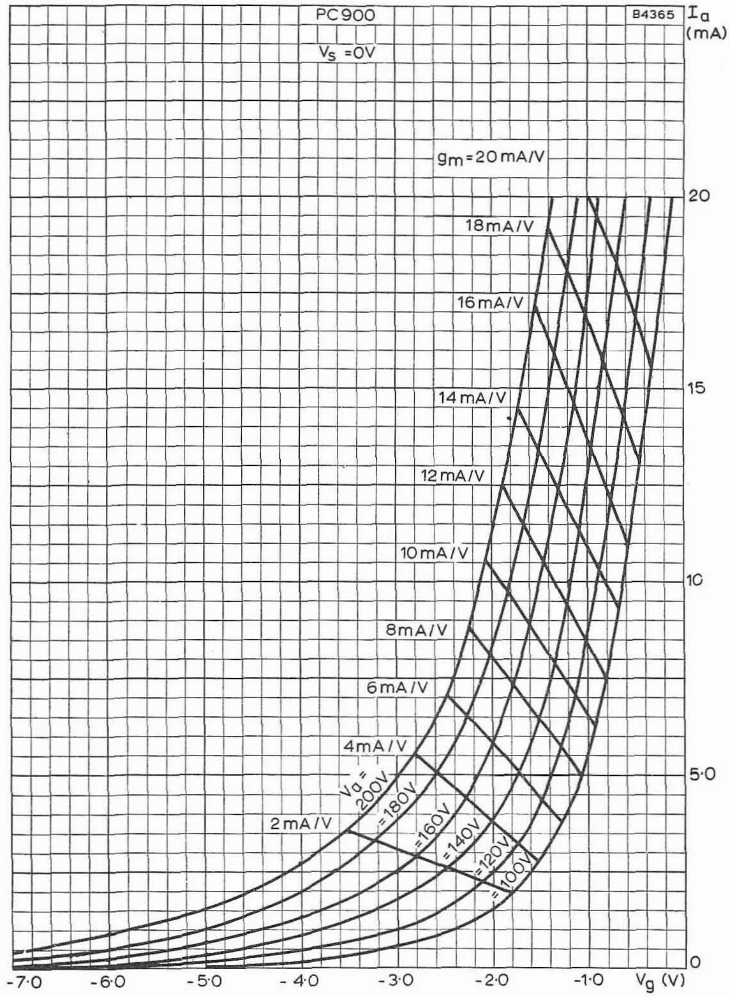
B7G Base



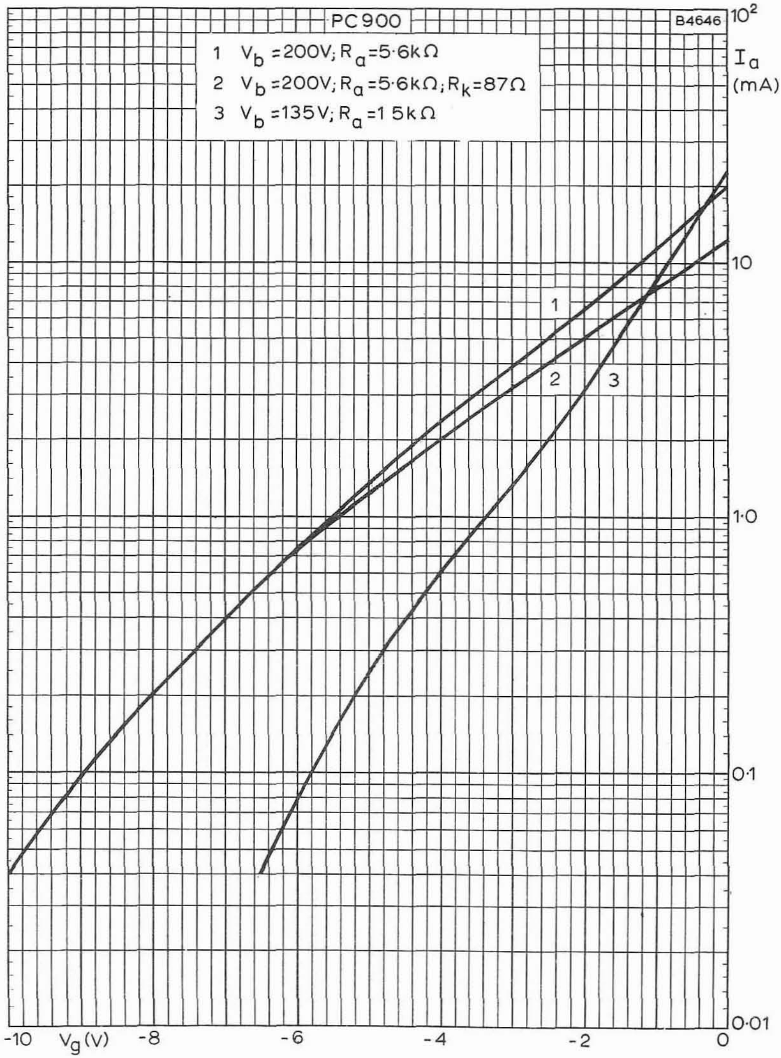
All dimensions in mm



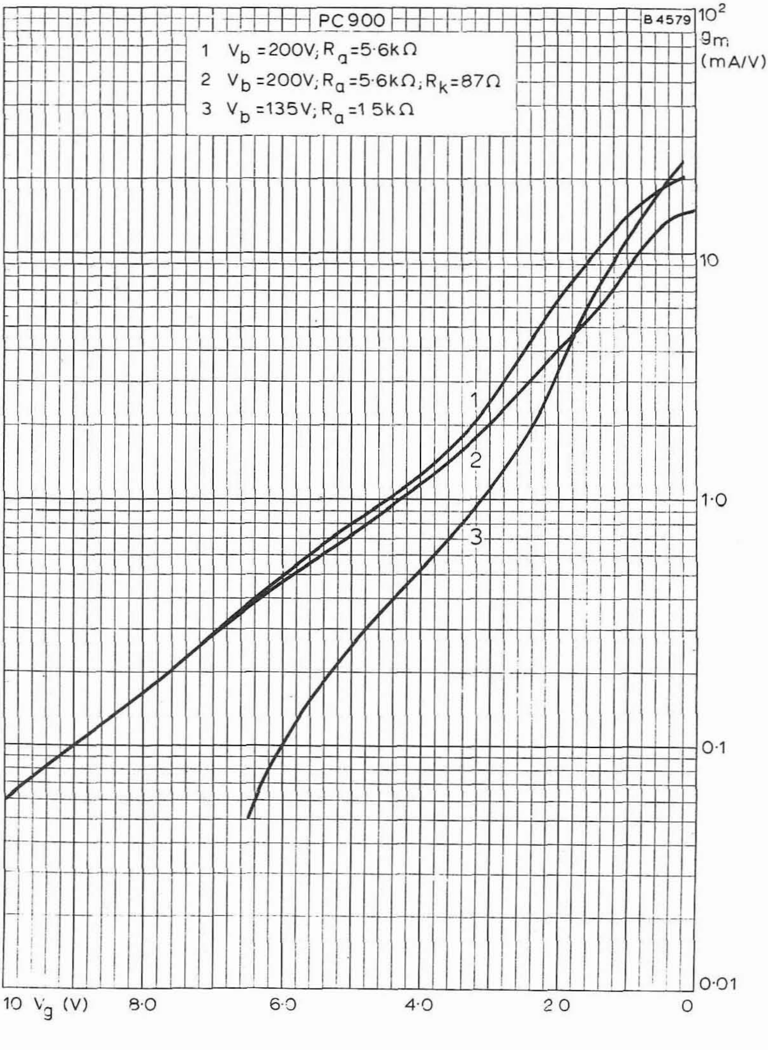
ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE



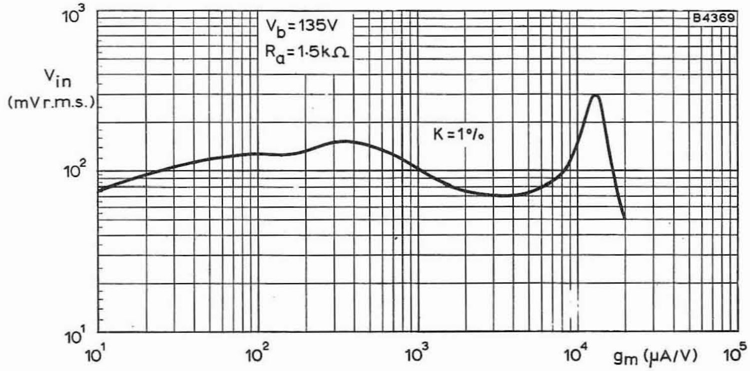
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AND MUTUAL CONDUCTANCE AS PARAMETERS

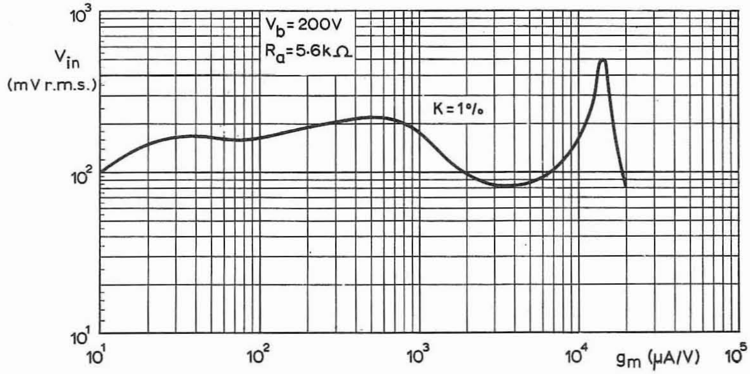


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE





CROSS MODULATION CURVE

R. F. DOUBLE TRIODE

PCC85

Double triode primarily intended for use as an oscillator and mixer at frequencies up to 200Mc/s in television receivers.

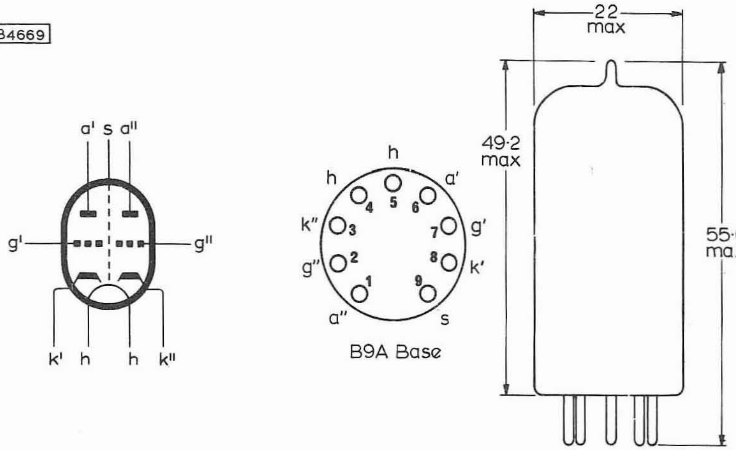
HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	9.0	V

For characteristics, operating conditions and limiting values see type UCC85.

B4669



All dimensions in mm

The triode on pins 6, 7 and 8 should be used as the r.f. amplifier and that on pins 1, 2 and 3 as the self-oscillating additive mixer.

R.F. DOUBLE TRIODE

PCC89

Variable-mu frame grid double triode primarily intended for use as a cascode amplifier at frequencies up to 220Mc/s in television receivers with series connected heaters.

HEATER

Suitable for series operation a.c. or d.c.

I_h	300	mA
V_h	7.5	V←

CAPACITANCES (measured with an external shield)

$c_{a'-a''}$	<15	mpF
$c_{g'-a''}$	<5	mpF

Grounded cathode section

$c_{a'-g'}$	1.9	pF
$c_{g'-k'+h+g''+s}$	3.8	pF
$c_{a'-k'+h+g''+s}$	2.5	pF
$c_{g'-h}$	<300	mpF

Grounded grid section

$c_{a''-g''}$	4.1	pF
$c_{a''-k''}$	<200	mpF
$c_{k''-g''+h+s}$	6.3	pF
$c_{a''-g''+h+s}$	4.5	pF
$c_{k''-h}$	2.9	pF

CHARACTERISTICS (each section)

V_a	90	V
I_a	15	mA
V_g	–1.2	V
g_m	12.3	mA/V
r_a	2.9	kΩ
μ	36	

PCC89

R.F. DOUBLE TRIODE

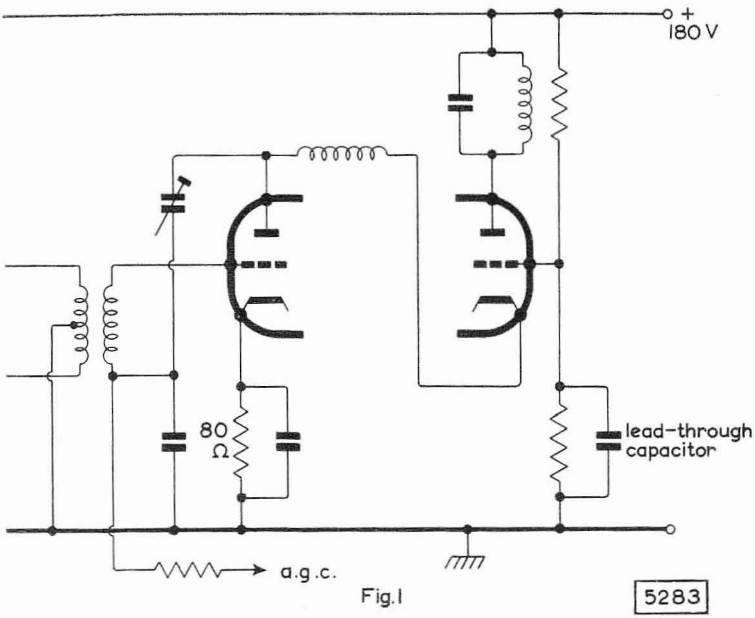
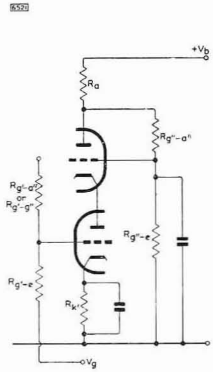


Fig. 1

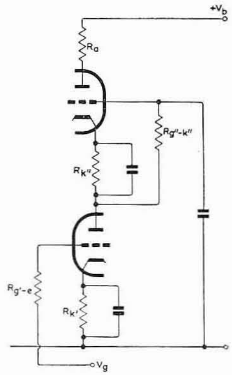
CHARACTERISTICS (cascode—see Fig. 1)

V_b	180	V
I_a	15	mA
g_m	12	mA/V
*$V_{g'}$	-9.0	V
Noise factor	5.5	dB

*For 100 : 1 reduction in cascode slope.



Circuit A



Circuit B

OPERATING CONDITIONS

←

Condition	1	2	3	4	
Circuit	A	A	A	A	
V_b	190	190	190	190	V
$R_{a''}$	1.5	3.3	3.9	3.9	kΩ
$R_{g''-a''}$	100	100	100	100	kΩ
$R_{g''-e}$	100	100	100	100	kΩ
$R_{g'-e}$	—	470	470	470	kΩ
$R_{g'-g''}$	—	—	22	15	MΩ
$R_{k'}$	68	0	0	0	Ω
I_a	15	14.8	14.7	14.9	mA
g_m	13	14.4	14.7	14.8	mA/V
V_g for 100 : 1 reduction in g_m	−9.3	−9.0	−11	−12	V

Condition	5	6	7	8	9	
Circuit	A	A	A	B	B	
V_b	190	190	190	190	190	V
$R_{a''}$	3.9	3.9	4.7	1.5	3.3	kΩ
$R_{g''-a''}$	100	100	100	—	—	kΩ
$R_{g''-e}$	100	100	100	—	—	kΩ
$R_{g''-k''}$	—	—	—	—	470	kΩ
$R_{k''}$	0	0	0	68	0	Ω
$R_{g'-e}$	470	470	470	470	470	kΩ
$R_{g'-g''}$	—	10	—	—	—	MΩ
$R_{g'-a''}$	22	—	15	—	—	MΩ
$R_{k'}$	0	0	0	68	0	Ω
I_a	15	15.1	14	15	14.4	mA
g_m	14.9	15	14.7	13	14.3	mA/V
V_g for 100 : 1 reduction in g_m	−12.5	−13.5	−15	−16.5	−16	V

The gain/slope ratio depends upon the circuit and will differ at high and low frequencies.

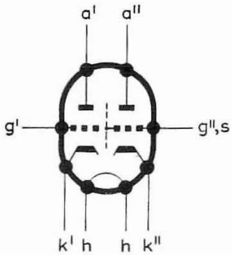
PCC89

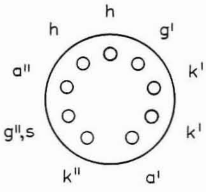
R.F. DOUBLE TRIODE

LIMITING VALUES (each section, unless otherwise stated)

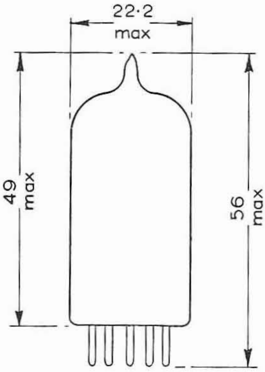
V_a max.	130	V
p_a max.	1.8	W
I_k max.	18	mA ←
$-V_g$ max.	50	V
$R_{g'-k'}$ max.	1.0	MΩ
$R_{g''-k''}$ max.	500	kΩ
$V_{h-k''}$ max. (cathode positive)	200	V ←
R_{h-k} max.	20	kΩ

To fulfil hum requirements, $V_{h-k'}$ must be less than $50V_{r.m.s.}$





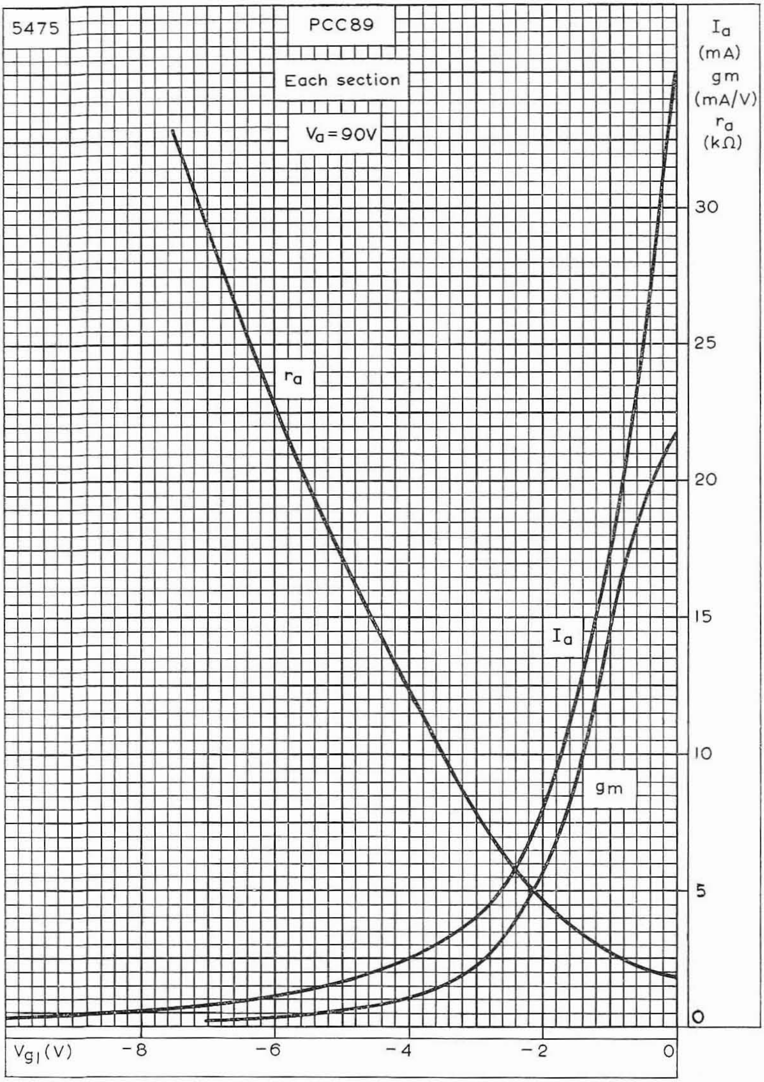
B9A Base



4473

All dimensions in mm

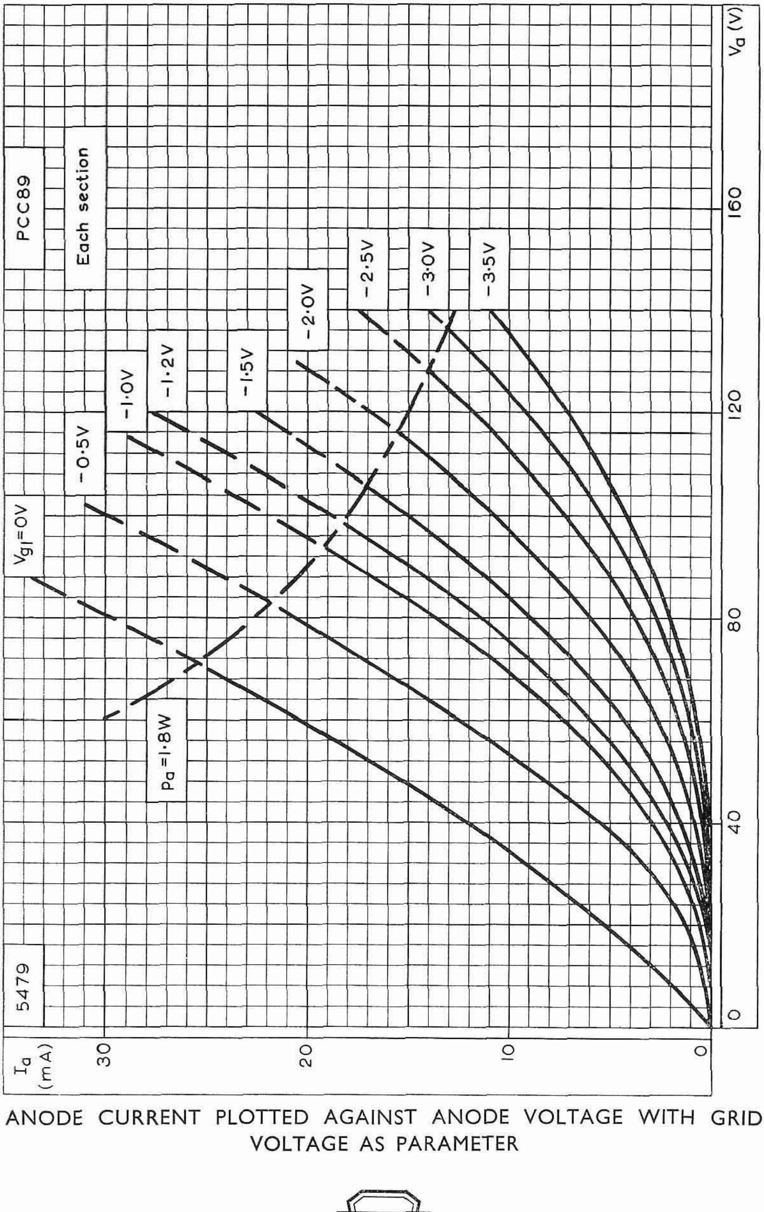
The triode on pins 6, 7, 8 and 9 should have the grounded cathode connection, and that on pins 1, 2 and 3 should have the grounded grid connection. It is recommended that pins 7 and 8 be strapped.



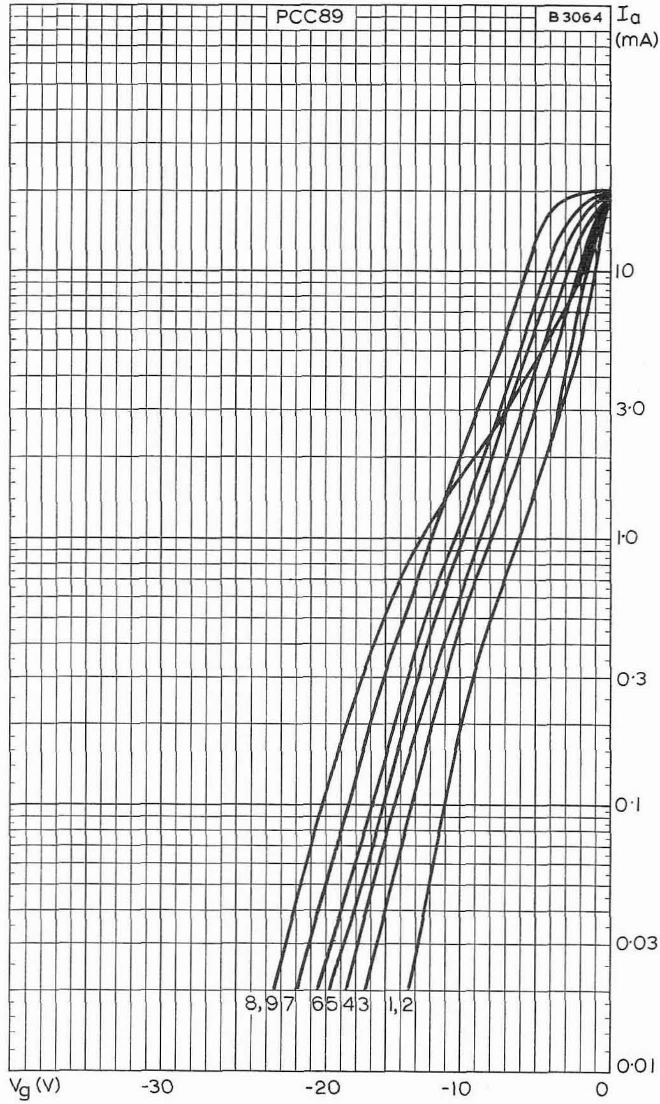
ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE

PCC89

R.F. DOUBLE TRIODE



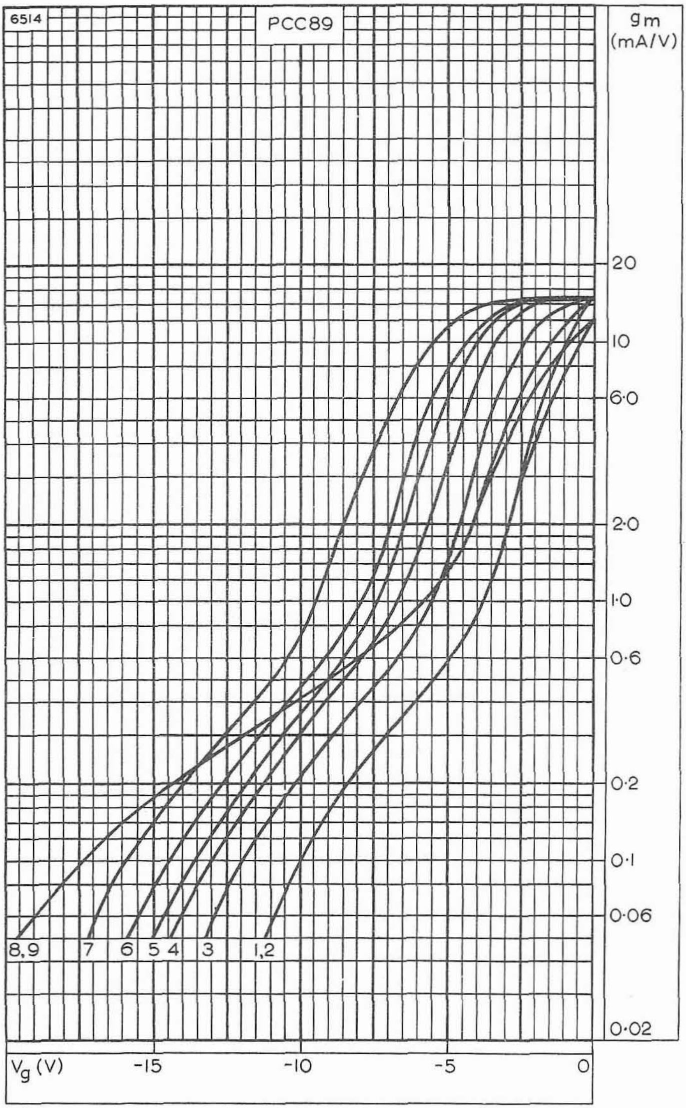
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE
UNDER CONDITIONS 1 to 9 (See page D3)

PCC89

R.F. DOUBLE TRIODE



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE UNDER CONDITIONS 1 to 9 (See page D3)

V.H.F. DOUBLE TRIODE

PCC189

Variable-mu, low noise v.h.f. frame grid double triode with high mutual conductance for use as a cascode amplifier.

HEATER

I_h	300	mA
V_h	7.6	V

CAPACITANCES

	Shielded	Unshielded	
$c_{a'-a''}$	< 15	< 45	mpF
$c_{g'-a''}$	< 4.0	< 4.0	mpF
Grounded cathode section			
$c_{a'-g'}$	1.9	1.9	pF
$c_{g'-k'+h+s}$	3.5	3.5	pF
$c_{a'-k'+h+s}$	2.3	1.7	pF
$c_{g'-h}$	< 280	< 280	mpF
Grounded grid section			
$c_{a''-g''}$	1.9	1.9	pF
$c_{k''-g''+h+s}$	6.0	6.0	pF
$c_{a''-g''+h+s}$	4.0	3.4	pF
$c_{k''-h}$	3.0	3.0	pF
$c_{a''-k''}$	170	180	mpF

CHARACTERISTICS (each section)

V_a	90	V
V_g	−1.4	V
I_a	15	mA
g_m	12.5	mA/V
r_a	2.5	kΩ
μ	34	
V_g (for 20 : 1 reduction in g_m)	−5.0	V
V_g (for 100 : 1 reduction in g_m)	−9.0	V

DESIGN CENTRE RATINGS (each section)

$V_{a(b)}$ max.	550	V
V_a max.	130	V
p_a max.	1.8	W
I_k max.	22	mA
$-V_g$ max.	50	V
$R_{g'-k}$ max.	1.0	MΩ
$R_{g''-k}$ max.	500	kΩ
$V_{h-k'}$ max.	80	V
$V_{h-k''}$ max. (cathode positive)	180	V
R_{h-k} max.	20	kΩ

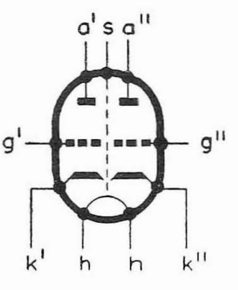
PCC189

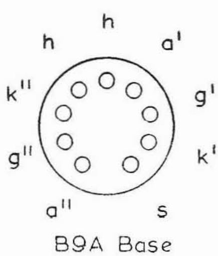
V.H.F. DOUBLE TRIODE

NOTE

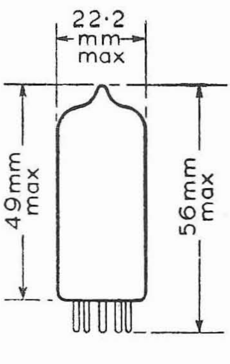
In order not to exceed the maximum permissible anode voltage when the cascode amplifier is controlled, it is necessary to use a voltage divider for the grid of the grounded grid section.

5242

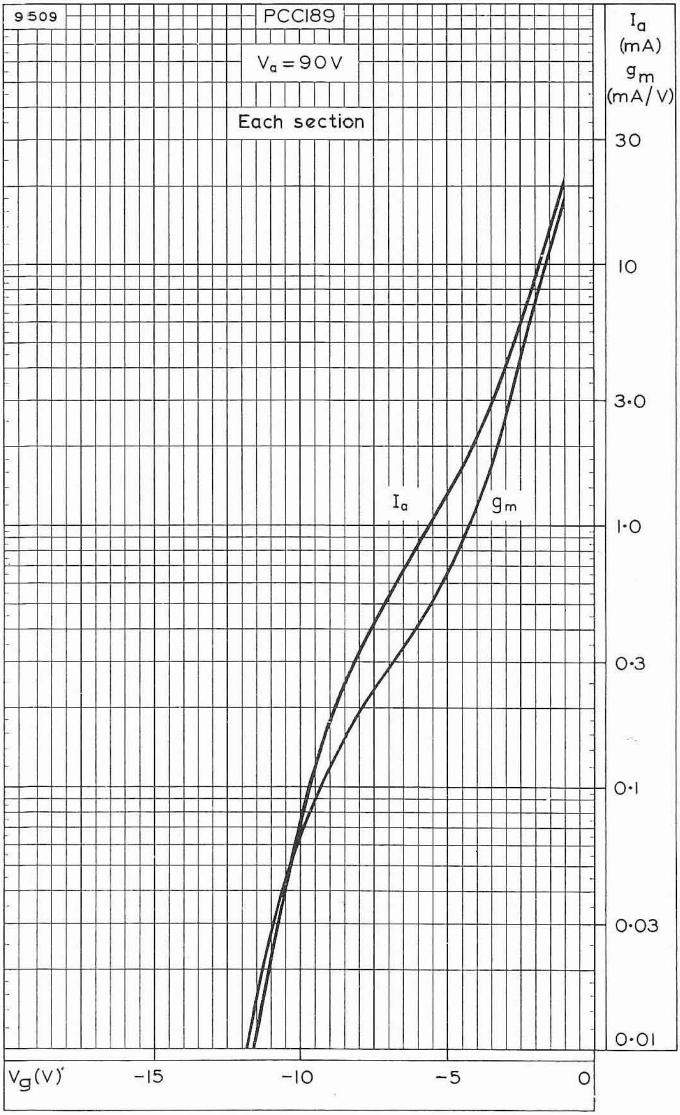




B9A Base



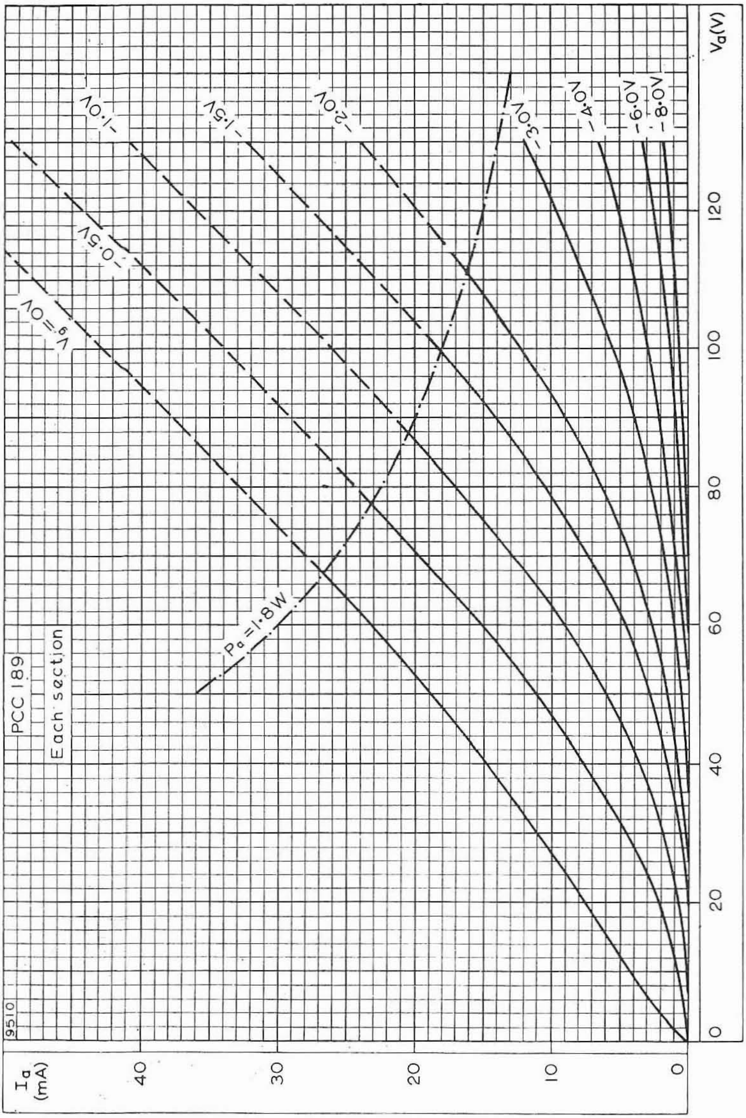
The triode on pins 6, 7, 8, should have the grounded cathode connection and that on pins 1, 2, 3, should have the grounded grid connection.



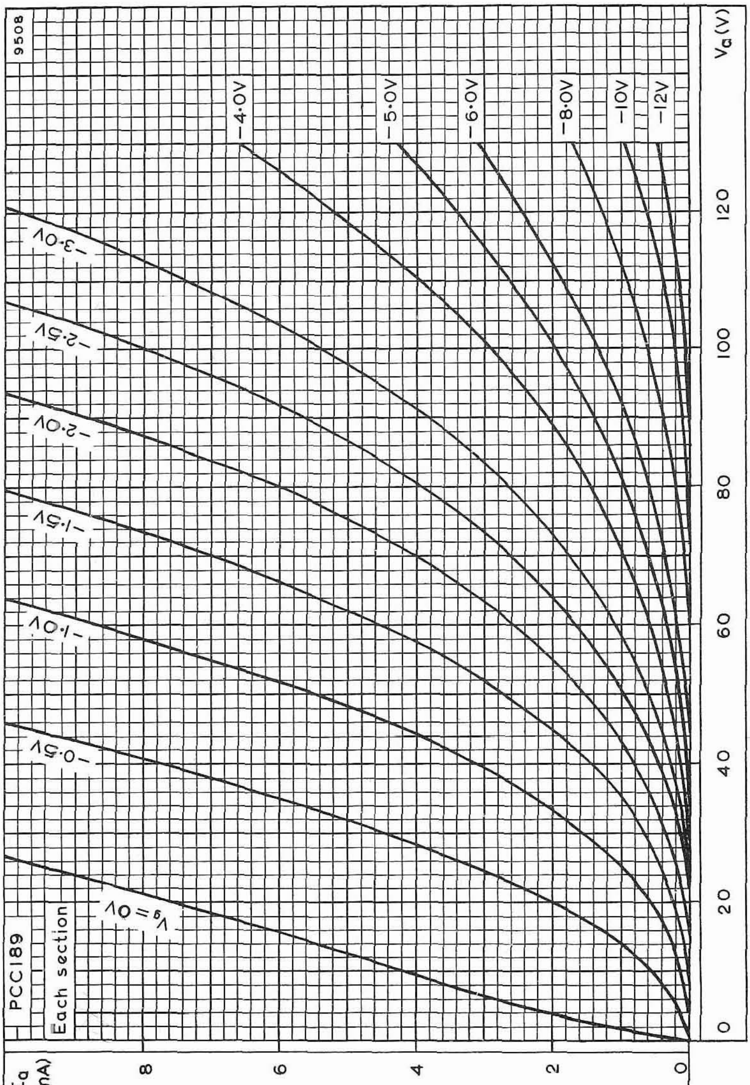
ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE

PCC189

V.H.F. DOUBLE TRIODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER IN THE REGION OF THE ORIGIN

TRIODE PENTODE

PCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	9.0	V

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

c_{ap-at}	<0.06	pF
c_{ap-gt}	<0.02	pF
c_{gp-at}	<0.16	pF
c_{gp-gt}	<0.02	pF

Pentode section

*c_{a-g1}	<0.025	pF
c_{in}	5.5	pF
c_{out}	3.8	pF

*May be reduced to <0.01pF by the use of a skirted base.

Triode section

c_{g-k+h}	2.5	pF
c_{a-k+h}	1.8	pF
c_{a-g}	1.5	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	170	V
I_a	10	mA
V_{g1}	−2.0	V
I_{g2}	2.8	mA
g_m	6.2	mA/V
μ_{g1-g2}	47	
r_a	400	kΩ
R_{in} (f = 50Mc/s)	10	kΩ
R_{eq}	1.5	kΩ

Triode section

V_a	100	V
I_a	14	mA
V_g	−2.0	V
g_m	5.0	mA/V
μ	20	
r_a	4.0	kΩ

PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

TYPICAL OPERATING CONDITIONS

As a frequency changer

V_a	170	170	V
V_{g2}	170	170	V
R_{g1}	100	100	kΩ
R_k	820	0	Ω
I_a	5.2	6.3	mA
I_{g2}	1.5	2.5	mA
$V_{osc(r.m.s.)}$	3.5	4.0	V
I_{g1}	0	53	μA
g_c	2.1	2.05	mA/V
r_a	870	720	kΩ

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.7	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_k \leq 10mA$)	200	V
V_{g2} max. ($I_k > 10mA$)	175	V
p_{g2} max. ($p_a \leq 1.2W$)	750	mW←
p_{g2} max. ($p_a > 1.2W$)	500	mW←
I_k max.	17	mA←
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max. (cathode bias)	1.0	MΩ
R_{g1-k} max. (fixed bias)	500	kΩ
*V_{h-k} max. (cathode positive)	225	V←
V_{h-k} max. (cathode negative)	100	V←

*Max. d.c. component 150V

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.5	W
I_k max.	17	mA←
†$i_{k(pk)}$ max.	200	mA
R_{g-k} max.	500	kΩ
V_g max. ($I_{g1} = +0.3\mu A$)	−1.3	V
$-v_{g(pk)}$ max.	350	V←
*V_{h-k} max. (cathode positive)	225	V←
V_{h-k} max. (cathode negative)	100	V←

*Max. d.c. component 150V
†Max. pulse duration 200μs ←

OPERATING NOTE

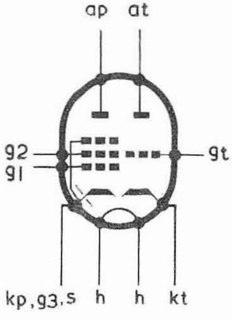
It is anticipated that variations in heater-to-cathode capacitance may render this valve unsuitable for use in Hartley oscillator circuits, particularly in f.m. receivers. For this reason it is recommended that a Colpitts type of circuit be employed.

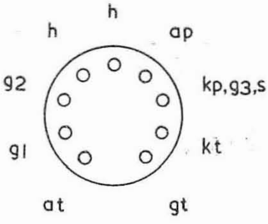
TRIODE PENTODE

PCF80

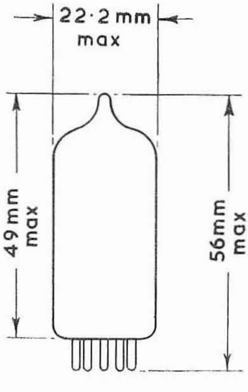
Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

3222





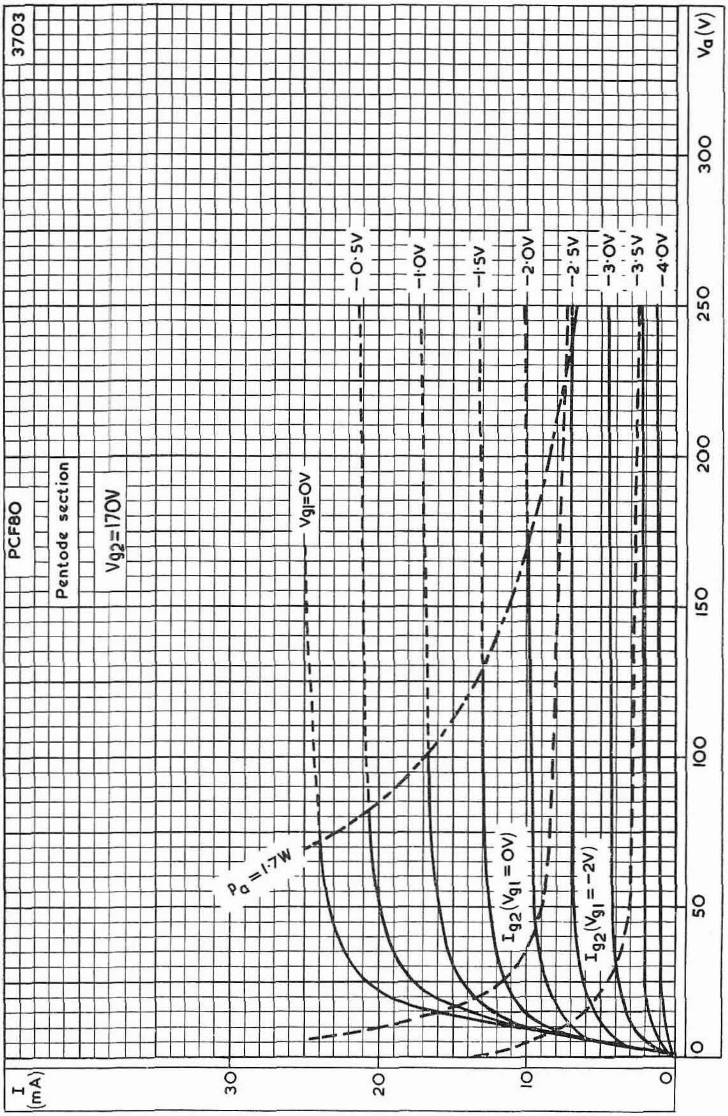
B9A Base



PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

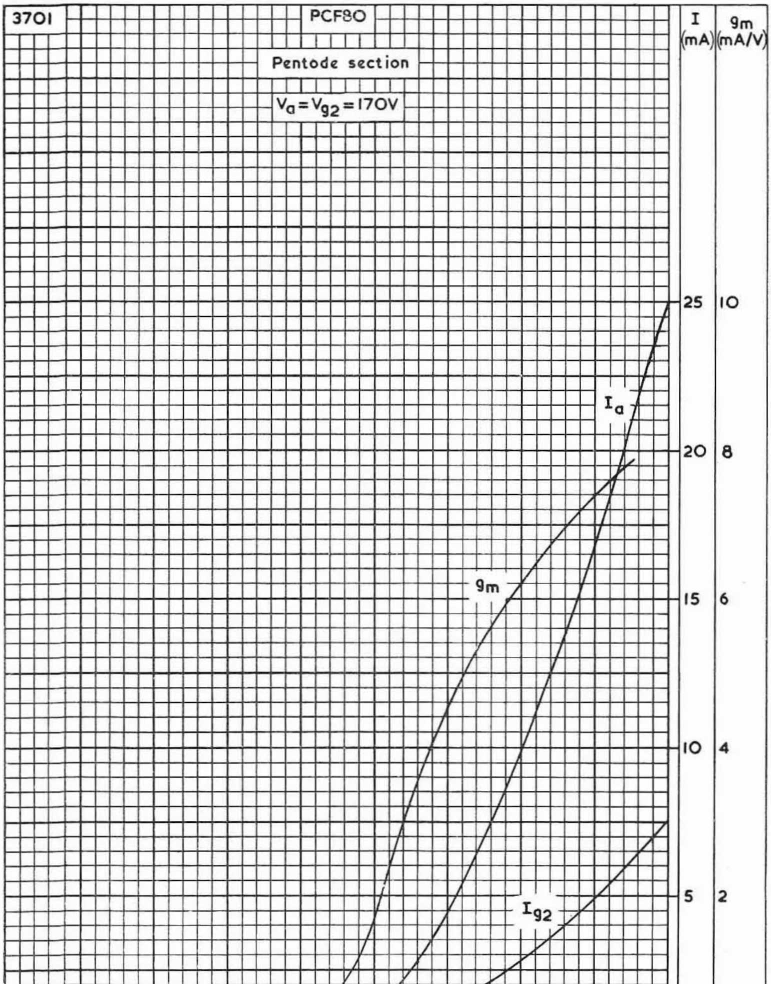


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE FOR PENTODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

TRIODE PENTODE

PCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

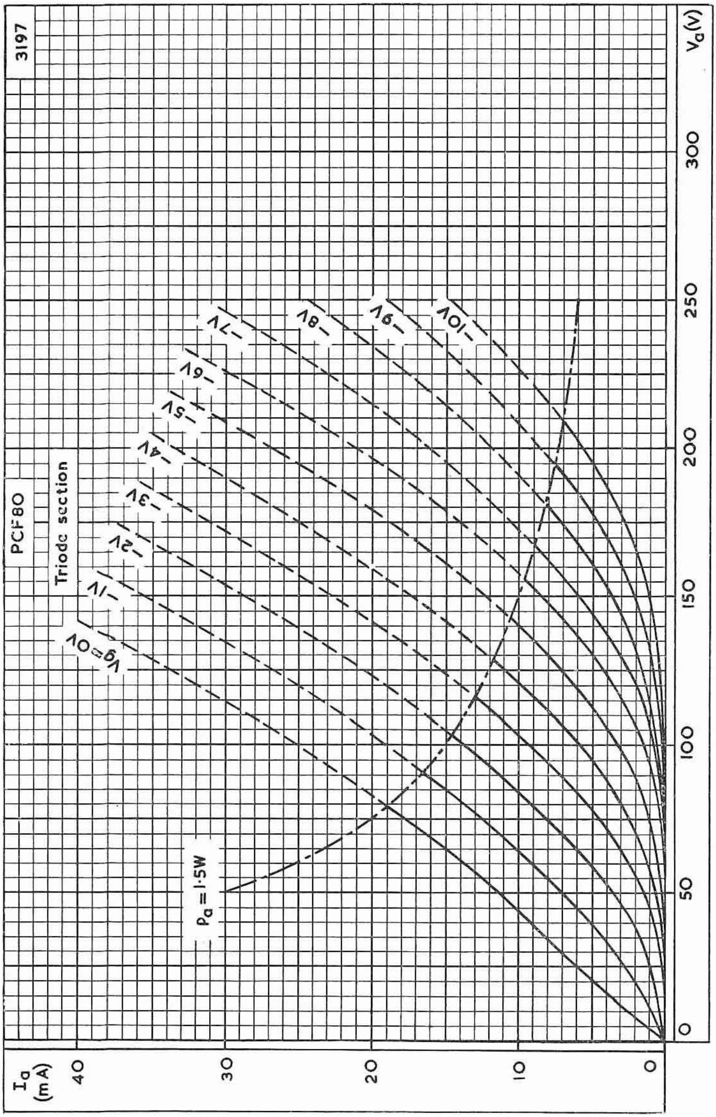


ANODE AND SCREEN-GRID CURRENTS AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE OF PENTODE SECTION. $V_a = V_{g2} = 170V$

PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

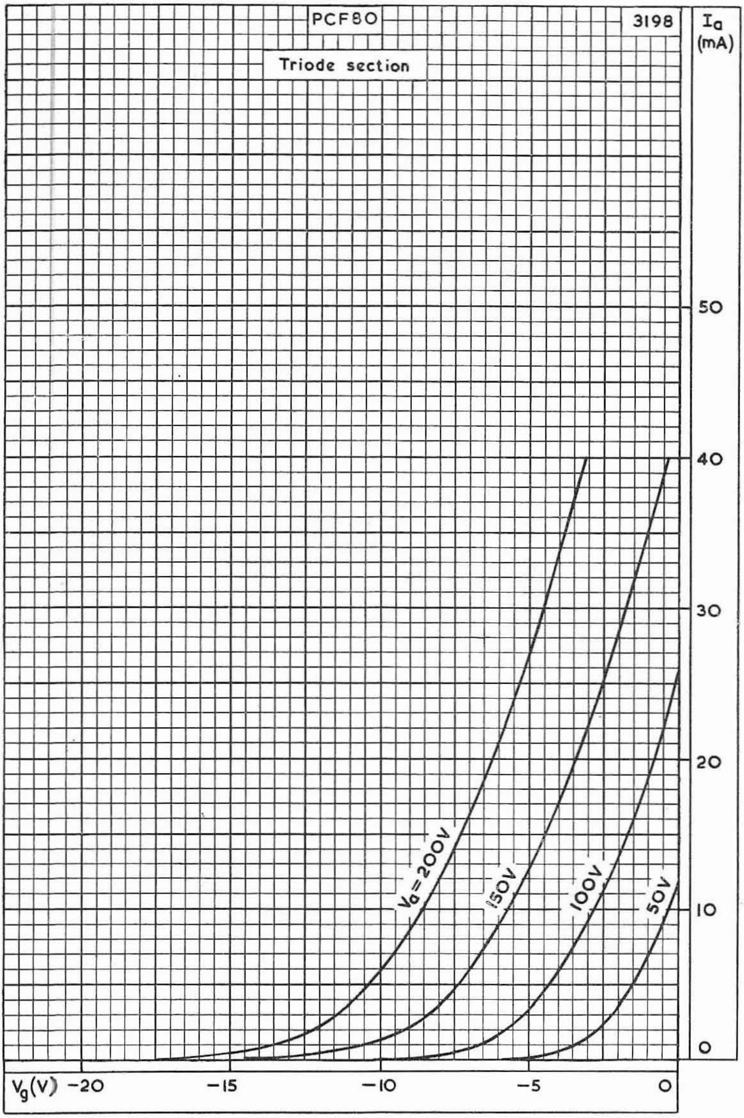


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR TRIODE SECTION WITH GRID VOLTAGE AS PARAMETER

TRIODE PENTODE

PCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

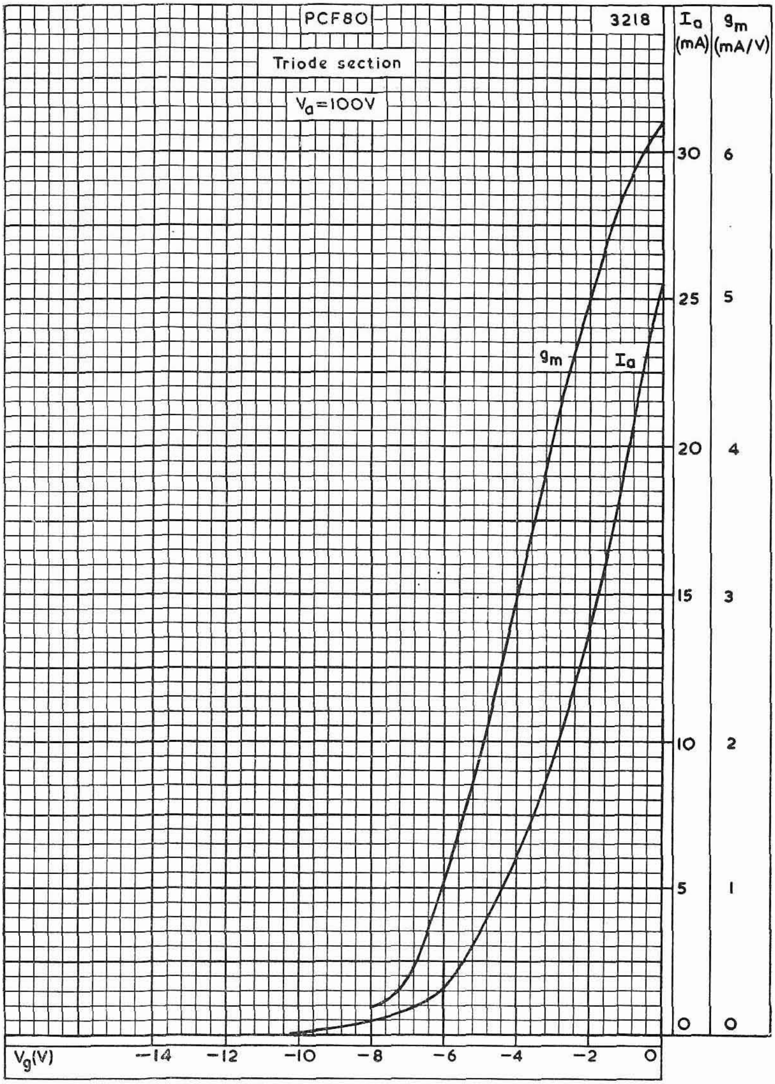


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR TRIODE SECTION FOR VARIOUS VALUES OF ANODE VOLTAGE

PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

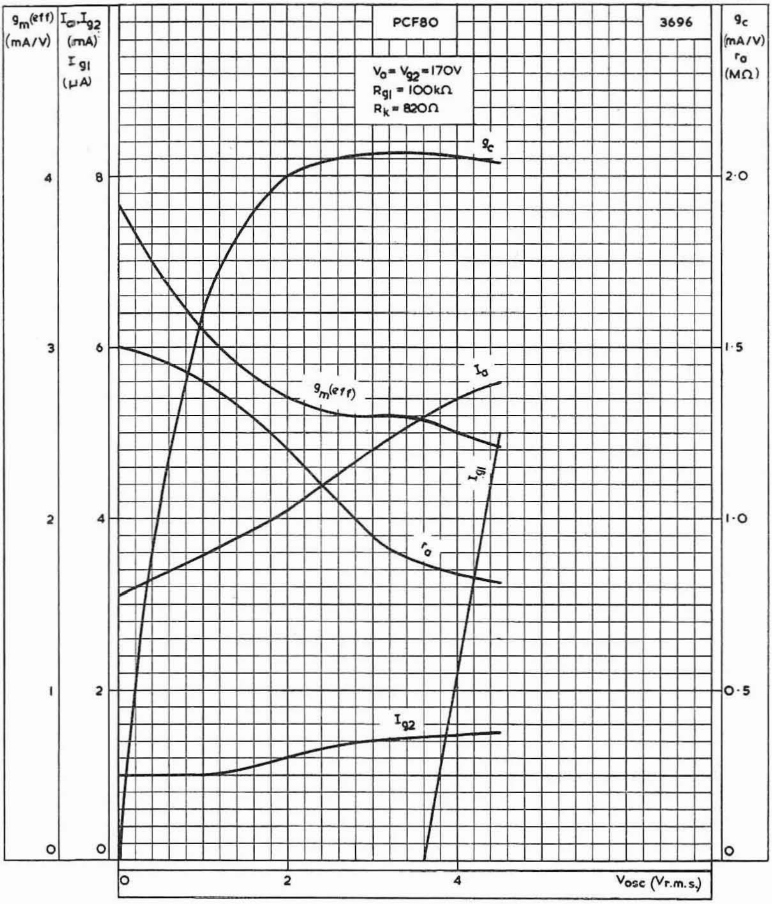


ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE FOR TRIODE SECTION. $V_a = 100V$

TRIODE PENTODE

PCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

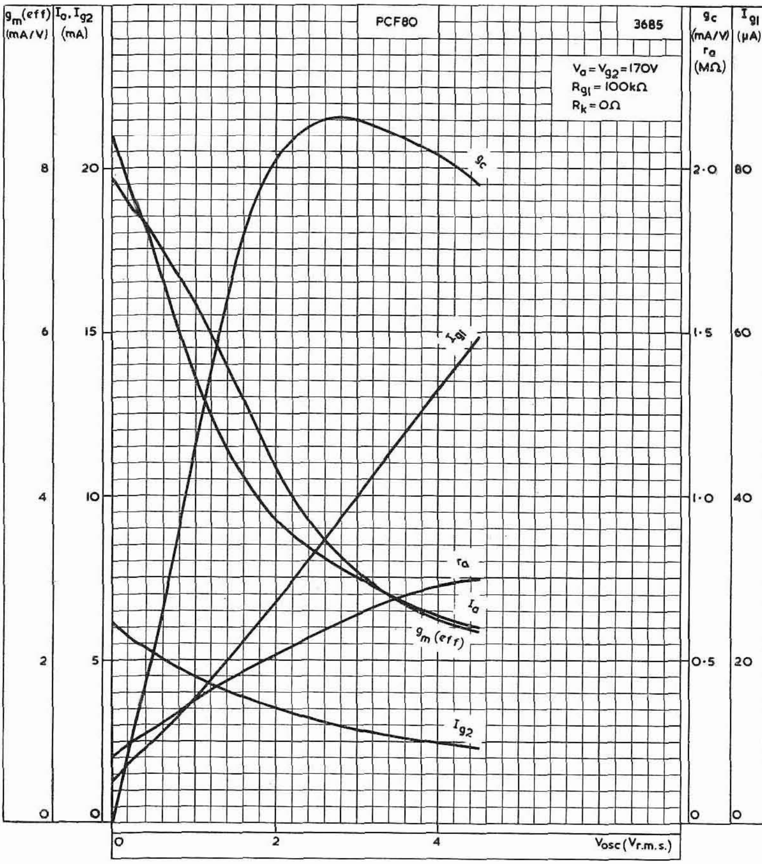


PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER WITH $R_k = 820\Omega$

PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.

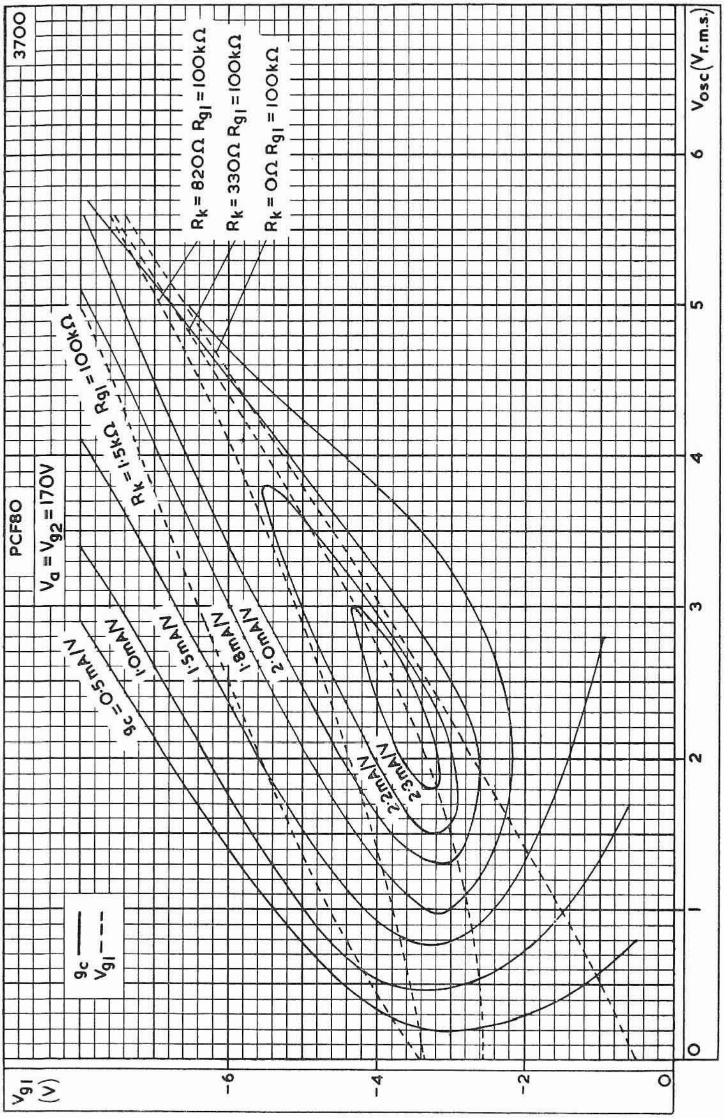


PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER WITH $R_k = 0\Omega$

TRIODE PENTODE

PCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220Mc/s in television equipment with series connected heaters.



CONTROL-GRID BIAS PLOTTED AGAINST OSCILLATOR VOLTAGE FOR VARIOUS VALUES OF CATHODE RESISTOR AND GRID RESISTOR, TOGETHER WITH 'CONTOUR LINES' OF CONSTANT CONVERSION CONDUCTANCE

TRIODE PENTODE

PCF86

Combined triode and high slope frame grid r.f. pentode for use as a frequency changer at frequencies up to 220Mc/s in television tuners.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	8.0	V

CAPACITANCES (measured without an external shield)

c_{ap-at}	125	mpF←
c_{ap-gt}	14	mpF
c_{g1-at}	<10	mpF
c_{g1-gt}	<10	mpF

Pentode section

c_{a-g1}	12	mpF
c_{g1-g2}	1.7	pF
c_{in}	5.8	pF←
c_{out}	3.5	pF

Triode section

c_{g-k+h}	2.4	pF
c_{a-k+h}	1.1	pF
c_{a-g}	2.0	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	150	V
I_a	10	mA
I_{g2}	3.3	mA
g_m	12	mA/V
r_a	>350	kΩ
μ_{g1-g2}	70	
V_{g1}	−1.2	V
R_{eq}	1.0	kΩ

Triode section

V_a	100	V
I_a	14	mA
g_m	5.7	mA/V←
μ	17	
V_g	−3.0	V

PCF86

TRIODE PENTODE

OPERATING CONDITIONS AS A FREQUENCY CHANGER

Pentode section

V_a	190	V
$V_{g2(b)}$	190	V
R_{g2}	18	kΩ
R_{g1}	100	kΩ
I_a	8.5	mA
I_{g2}	2.7	mA
$V_{osc(r.m.s.)}$	2.3	V
g_c	4.5	mA/V

LIMITING VALUES

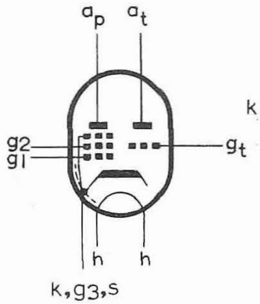
Pentode section

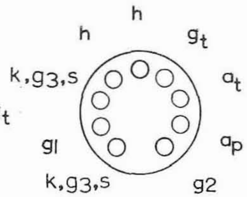
V_a max.	250	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	500	mW
I_k max.	18	mA
R_{g1-k} max.	250	kΩ

Triode section

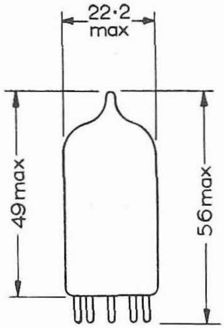
V_a max.	125	V
p_a max.	1.5	W
I_k max.	15	mA
R_{g-k} max.	500	kΩ
*V_{h-k} max.	100	V

*To fulfil hum requirements on a.m. sound, it will be necessary for V_{h-k} to be less than 50$V_{r.m.s.}$ For intercarrier receivers V_{h-k} should not exceed 75$V_{r.m.s.}$

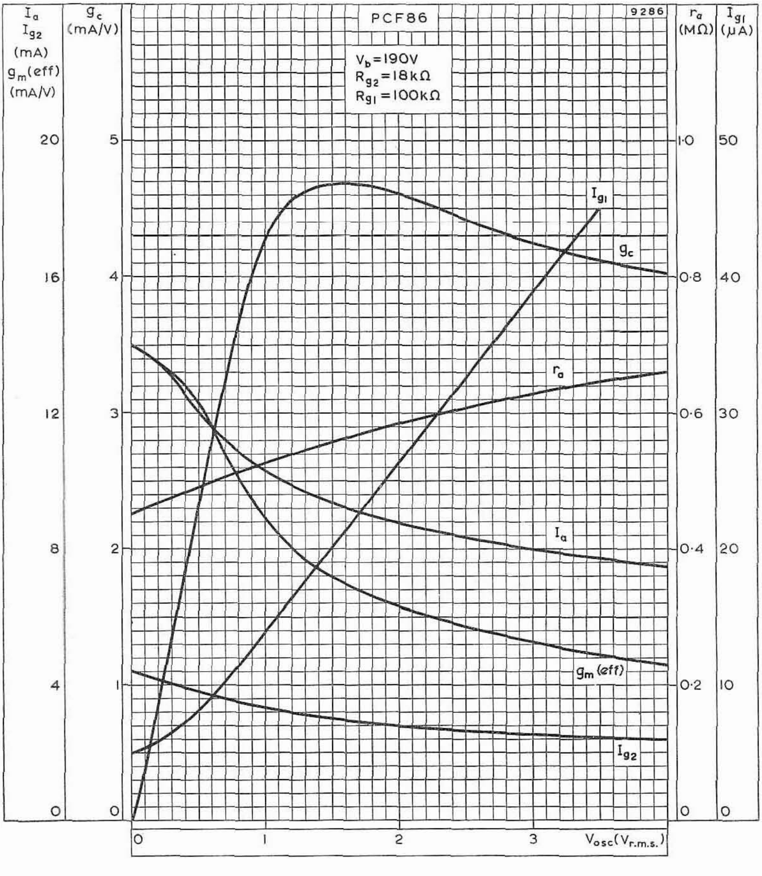




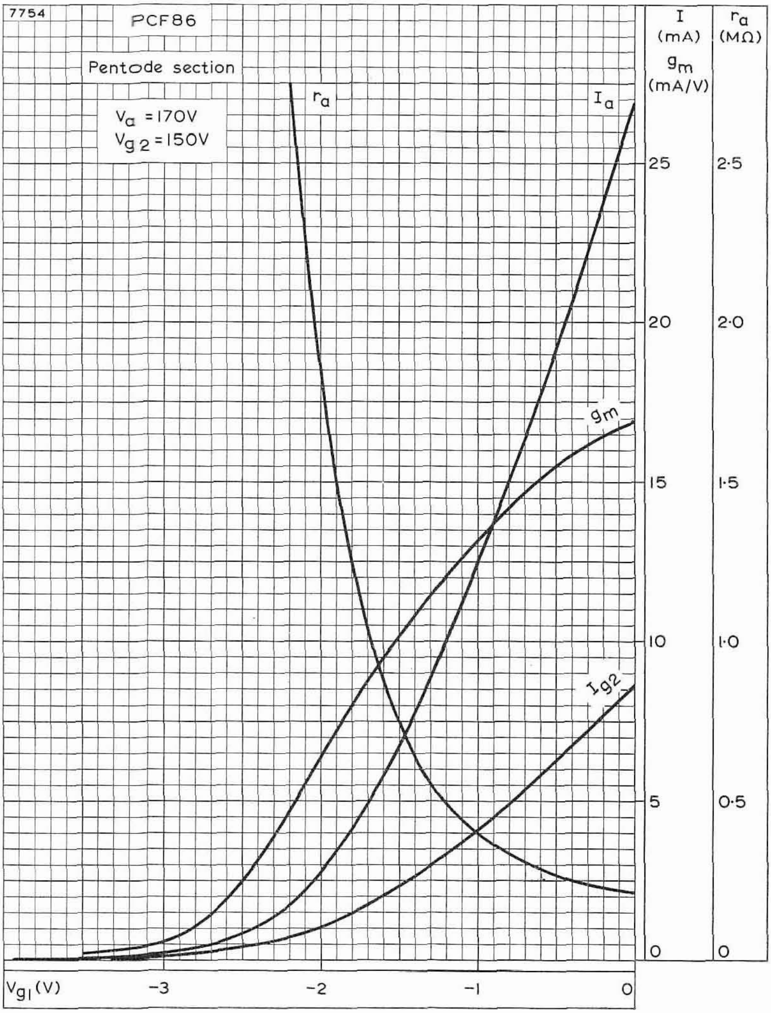
B9A Base
All dimensions in mm



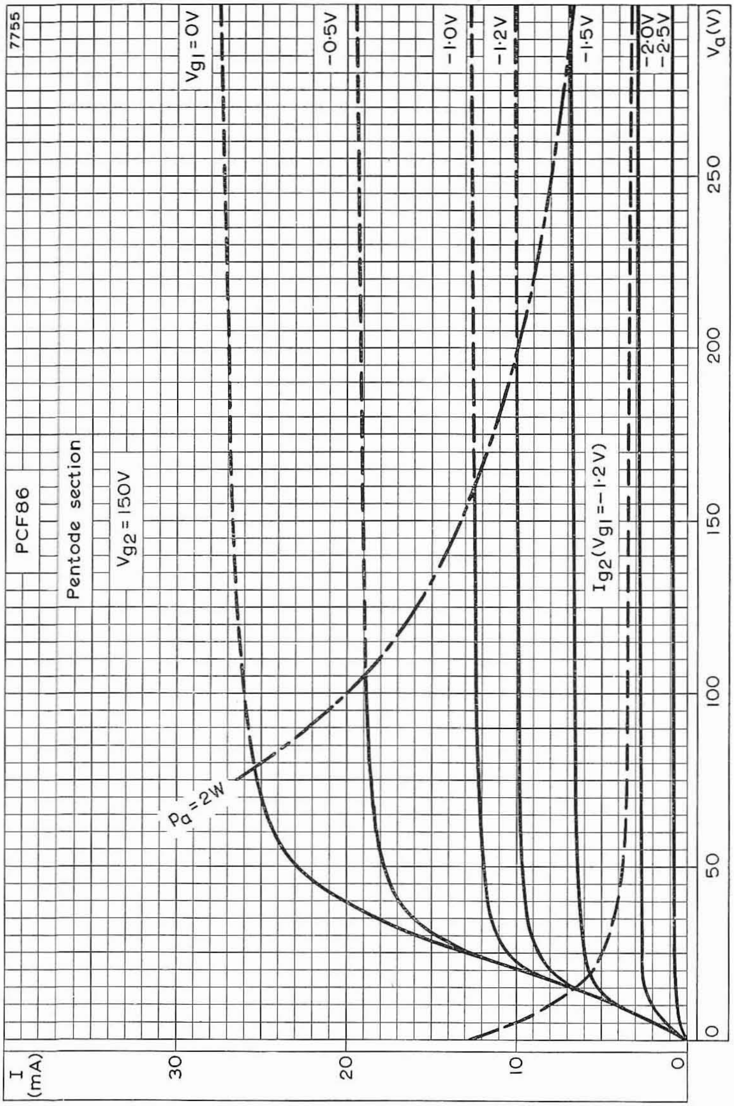
7408



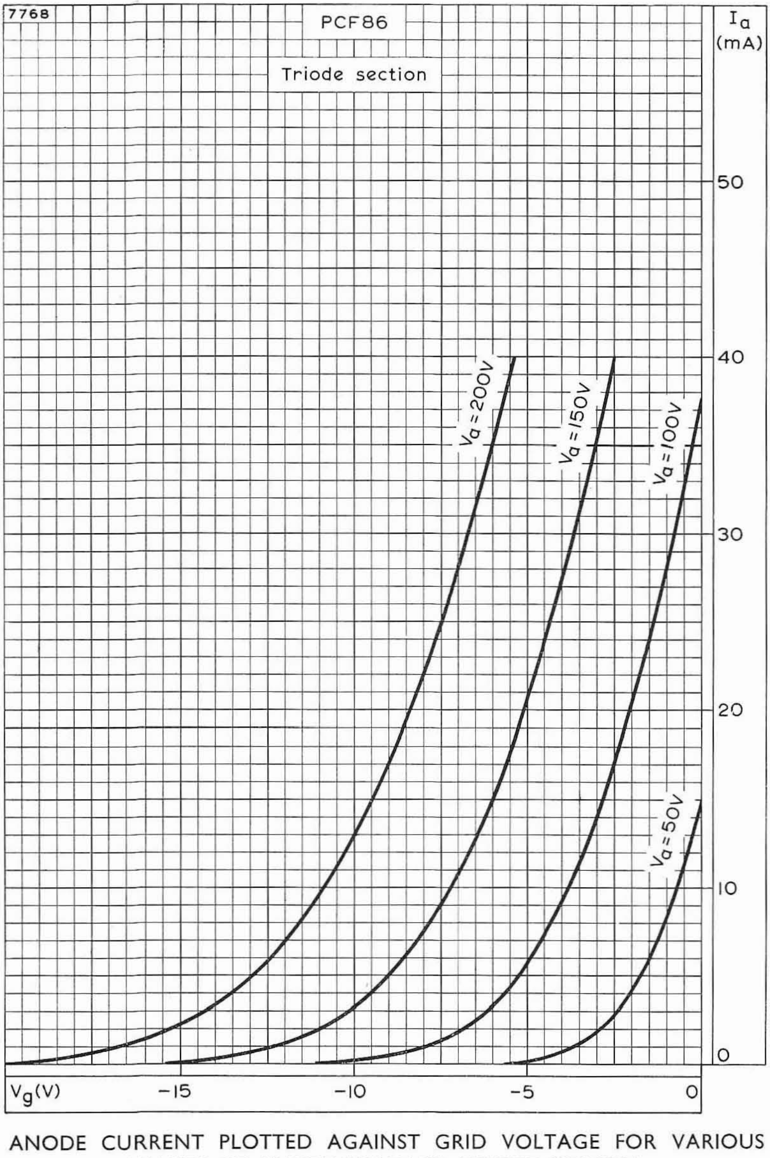
PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER



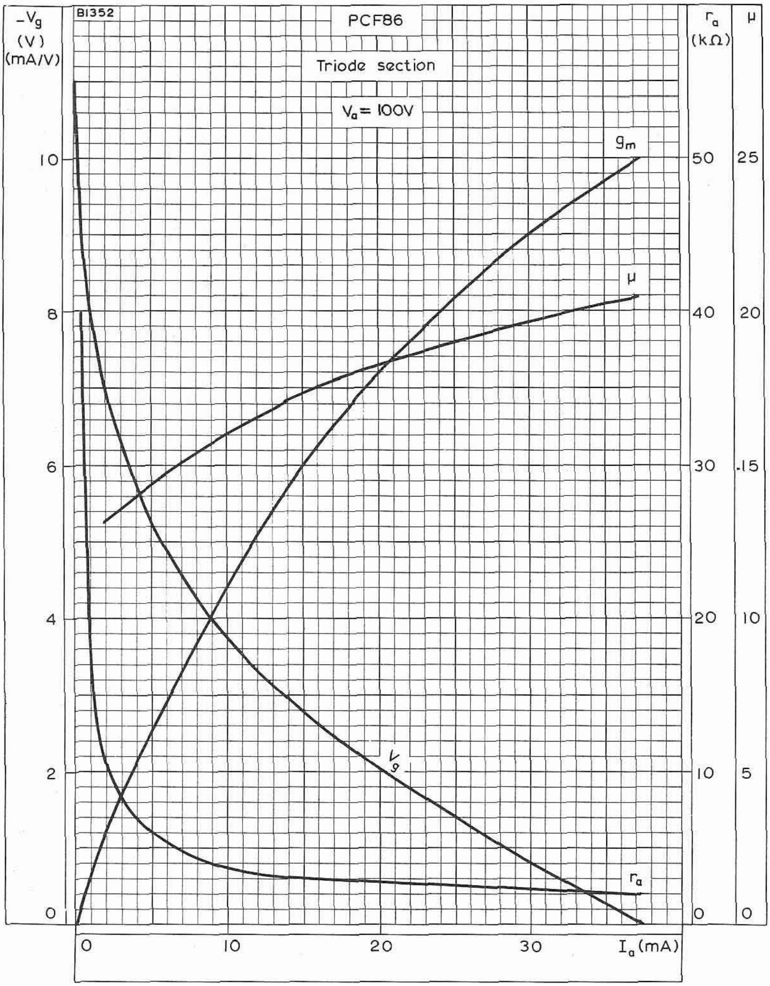
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. PENTODE SECTION



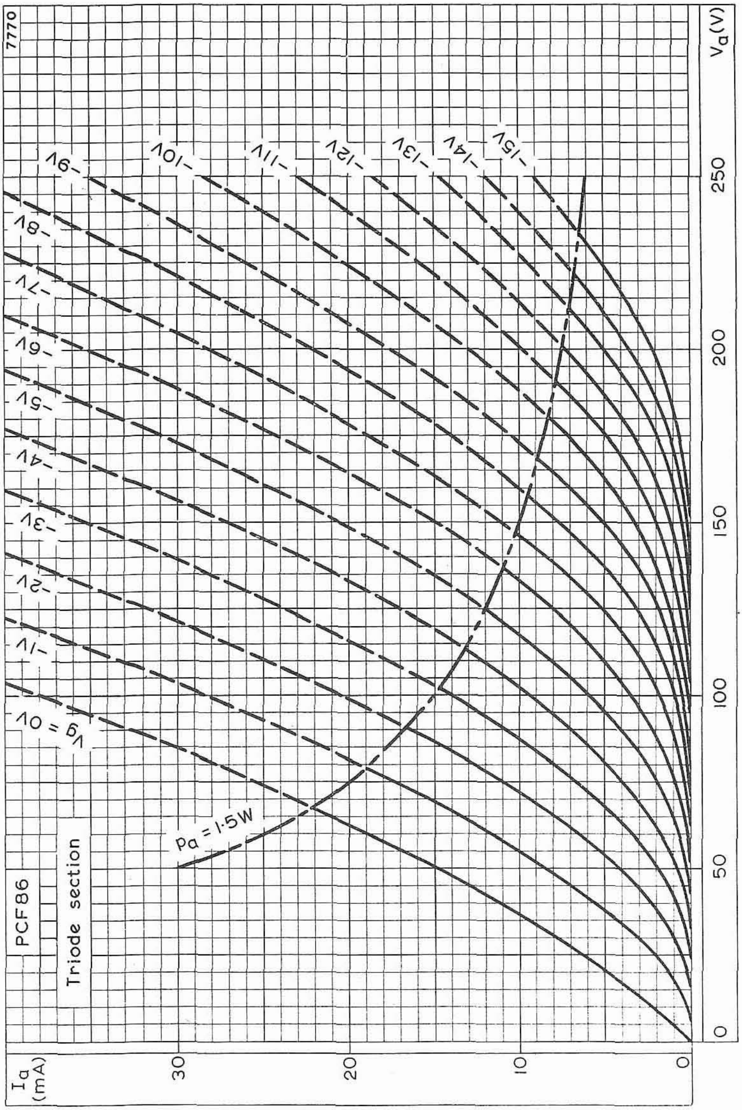
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION



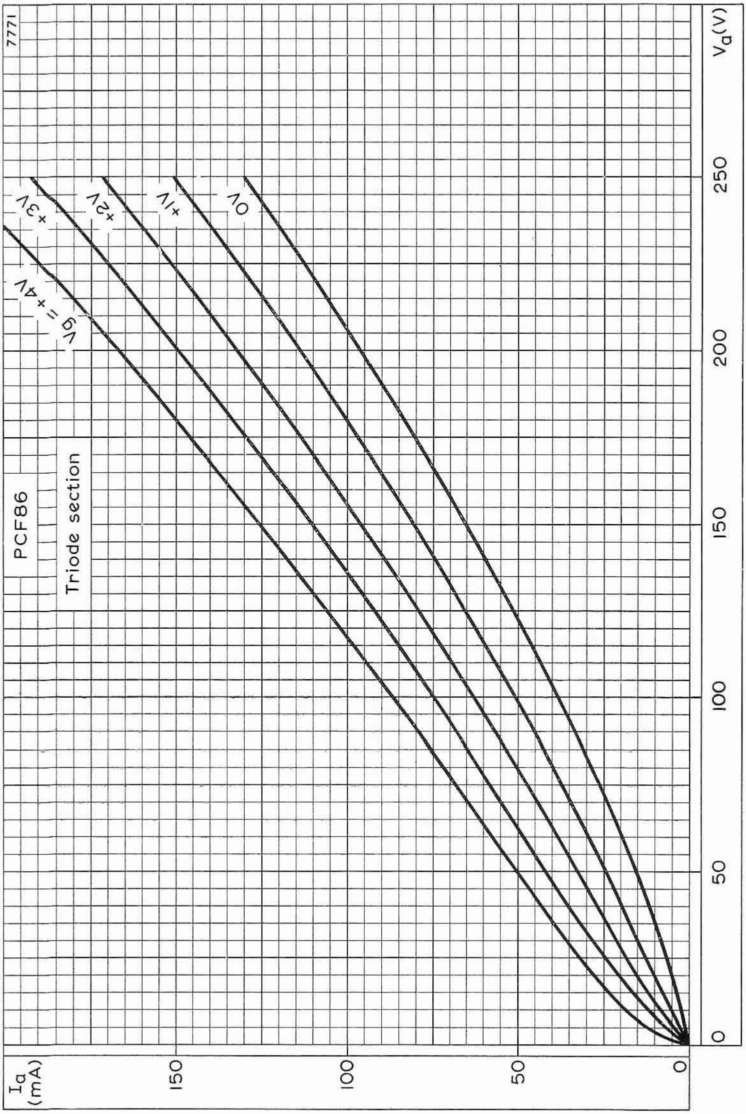
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE FOR VARIOUS VALUES OF ANODE VOLTAGE. TRIODE SECTION



GRID VOLTAGE, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH POSITIVE GRID VOLTAGE AS PARAMETER. TRIODE SECTION

TRIODE PENTODE

PCF801

Combined triode and frame-grid, variable-mu pentode for use as a frequency changer and i.f. amplifier at frequencies up to 200Mc/s in television receivers.

HEATER		
Suitable for series operation a.c. or d.c.		
Ih	300	mA
Vh	8.5	V
CAPACITANCES (shielded)		
cap-at	< 25	mpF
cap-gt	< 10	mpF
cg1-at	< 10	mpF
cg1-gt	< 10	mpF
Pentode section		
ca-g1	9.0	mpF
ca-g1 max.	12	mpF
cg1-g2	1.6	pF
cin	6.2	pF
cout	3.7	pF
Triode section		
ca-g	1.8	pF
cin	3.3	pF
cout	1.7	pF
CHARACTERISTICS		
Pentode section		
Va	170	V
Vg2	120	V
Ia	10	mA
Ig2	3.0	mA
Vg1	- 1.4	V
gm	11	mA/V
ra	> 350	kΩ
μg1-g2	55	
Req	1.5	kΩ

Triode section

Va	100	V
Ia	15	mA
Vg	- 3.0	V
gm	9.0	mA/V
μ	20	

OPERATING CONDITIONS AS FREQUENCY CHANGER

Pentode section

Vb	200	200	V
Ra	2.7	4.7	kΩ
Rg2	27	27	kΩ
Rg1	0.1	1.0	MΩ
Ia	10	9.3	mA
Ig2	3.0	2.9	mA
Ig1	8.0	2.3	μA
Vg1	- 1.4	*	V
Vosc (r.m.s.)	1.6	1.6	V
gc	5.0	4.7	mA/V

* With grid current bias.

OPERATING CONDITIONS AS I.F. AMPLIFIER

Pentode section

Vb	200	200	V
Ra	2.7	4.7	kΩ
Rg2	27	27	kΩ
Rg1	0.1	1.0	MΩ
Ia	10	13	mA
Ig2	3.0	3.9	mA
Vg1	- 1.4	*	V
gm	11	14.5	mA/V
Vg1 for 100 : 1 reduction in gm	- 12		V
Rin (f = 50 Mc/s)	10	10	kΩ

* With grid current bias.

OPERATING CONDITIONS AS OSCILLATOR

Triode section

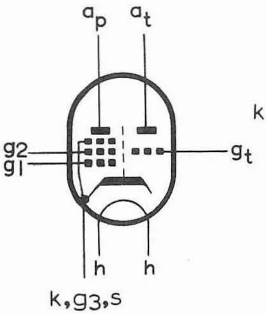
Va	200	200	V
Ra	8.2	12	kΩ

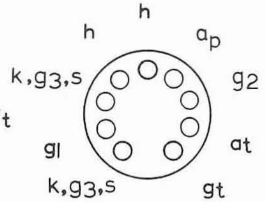
Rg	10	10	kΩ
Vosc	4.5	3.3	Vr.m.s.
Ia	16	12	mA
gm	3.7	3.7	mA/V

DESIGN CENTRE RATINGS

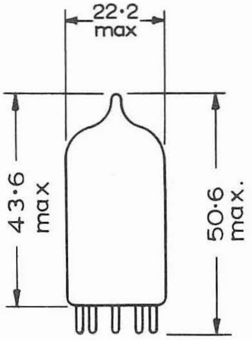
Pentode section		
Va(b) max.	550	V
Va max.	250	V
pa max.	2.0	W
Vg2(b) max.	550	V
Vg2 max.	250	V
pg2 max.	see page C4	
Ik max.	18	mA
- Vg1 max.	50	V
Rg1-k max.	1.0	MΩ
Triode section		
Va(b) max.	550	V
pa max.	1.5	W
Ik max.	20	mA
- Vg max.	50	V
Rg-k max.	500	kΩ
* Vh-k max.	100	V

* To fulfil hum requirements on a.m. sound, it will be necessary for Vh-k to be less than 50 Vr.m.s.

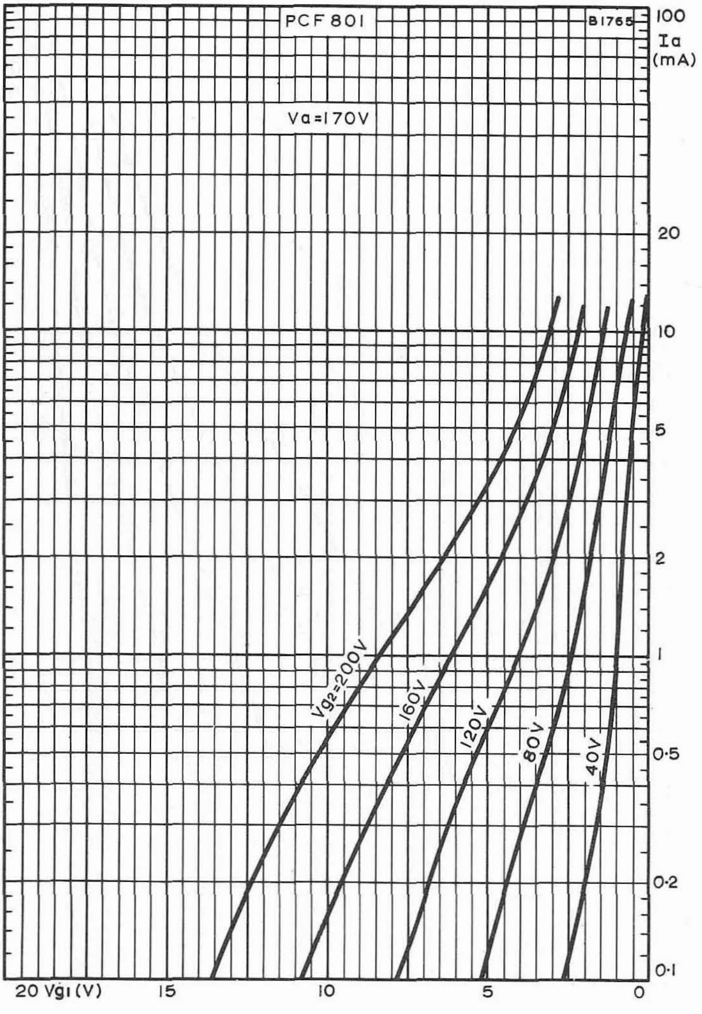




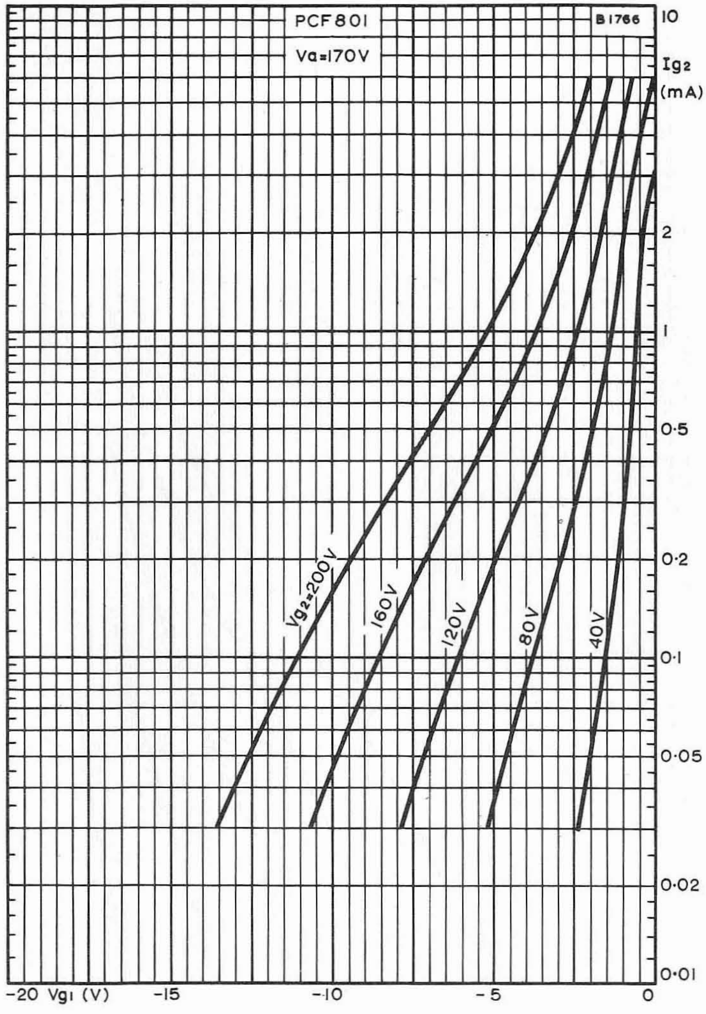
B9A Base
All dimensions in mm



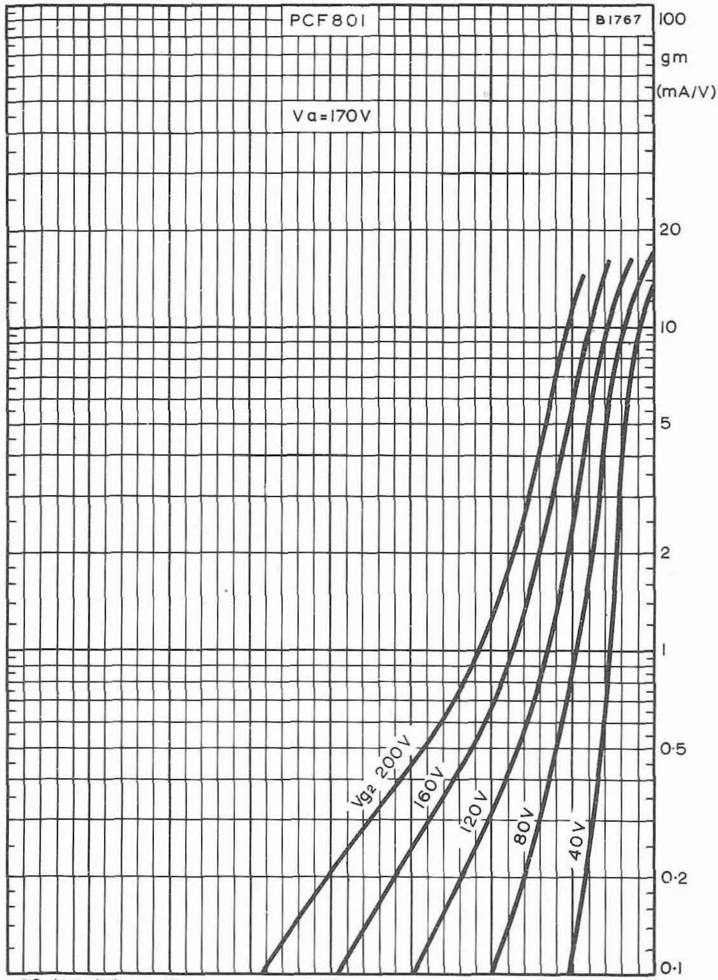
9823



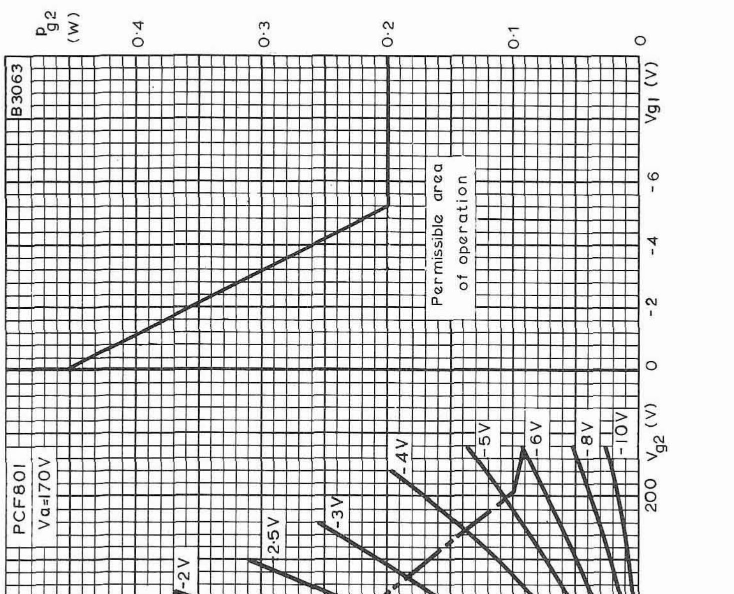
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER Va = 170V



SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER Va = 170V

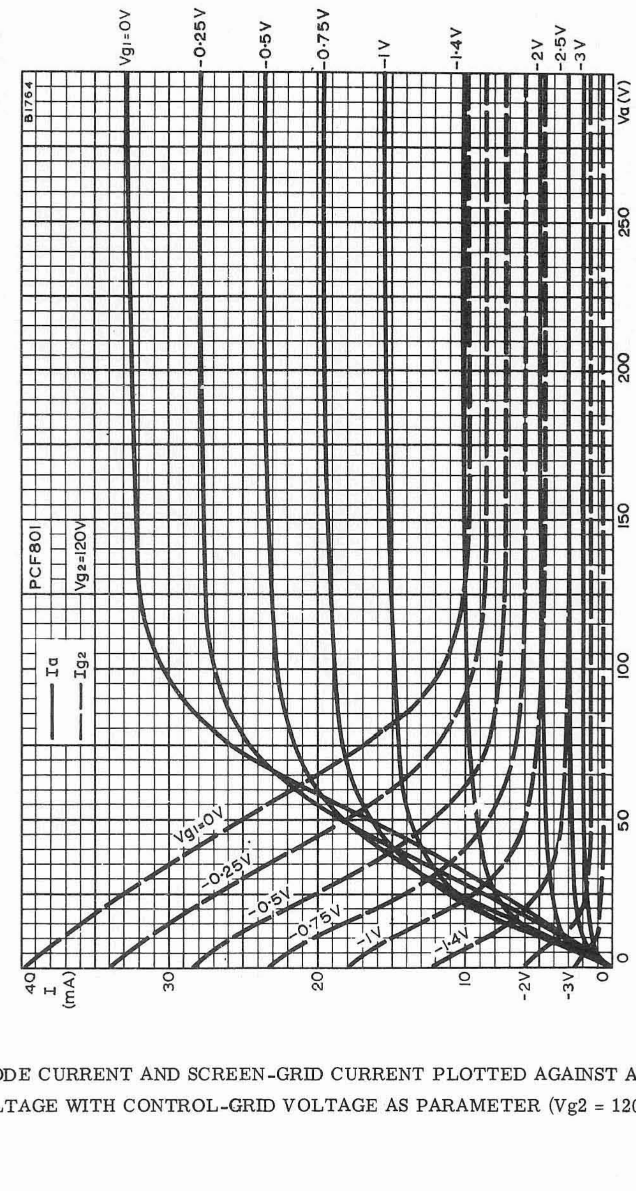


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID AS PARAMETER, Va = 170V.

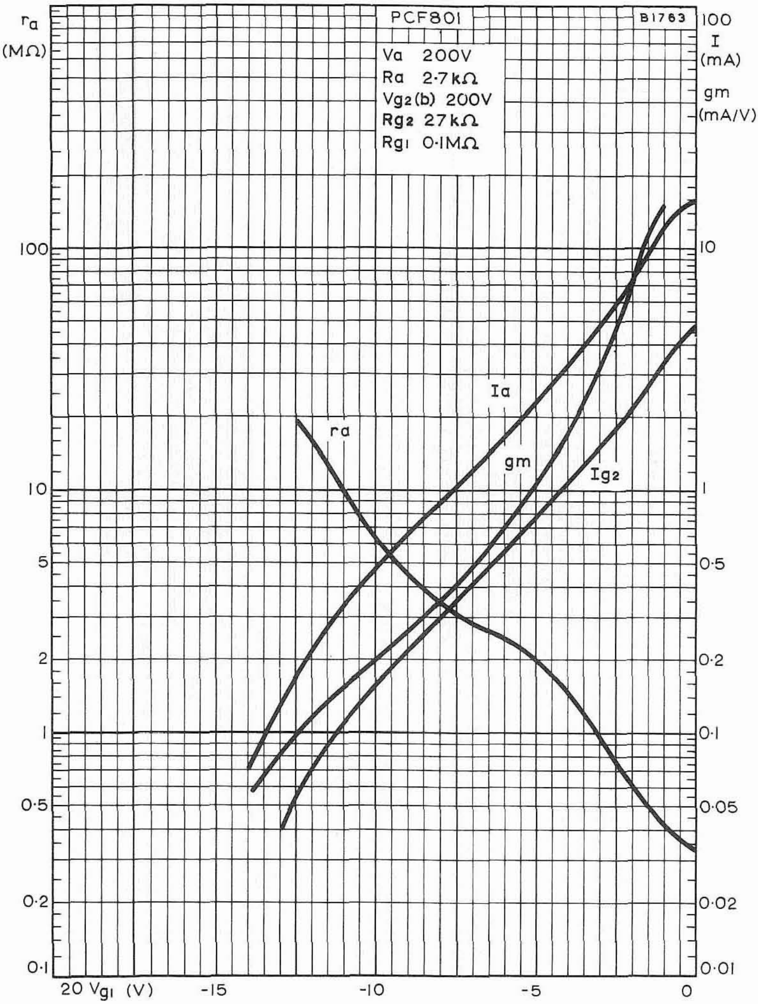


LIMITS OF SCREEN-GRID DISSIPATION

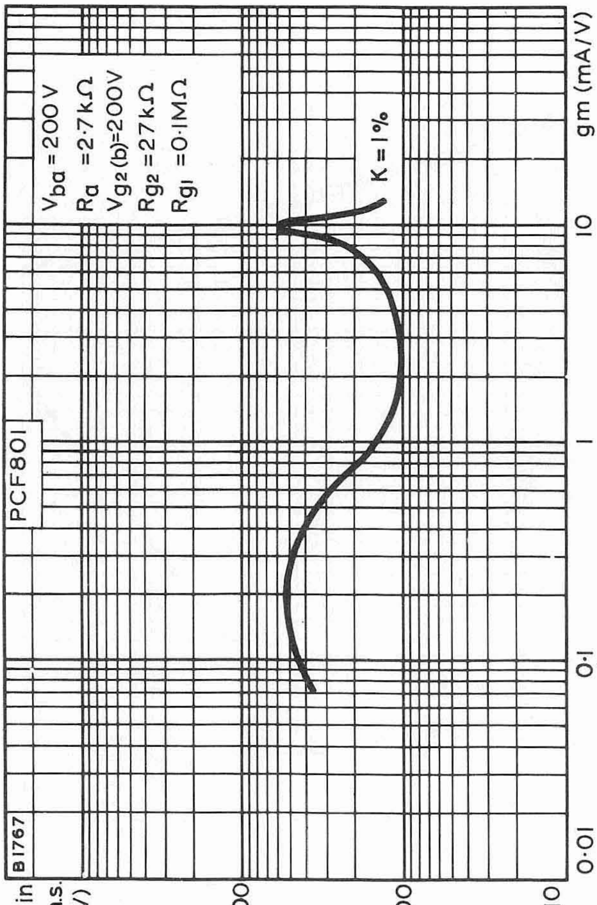
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, Va = 170V.



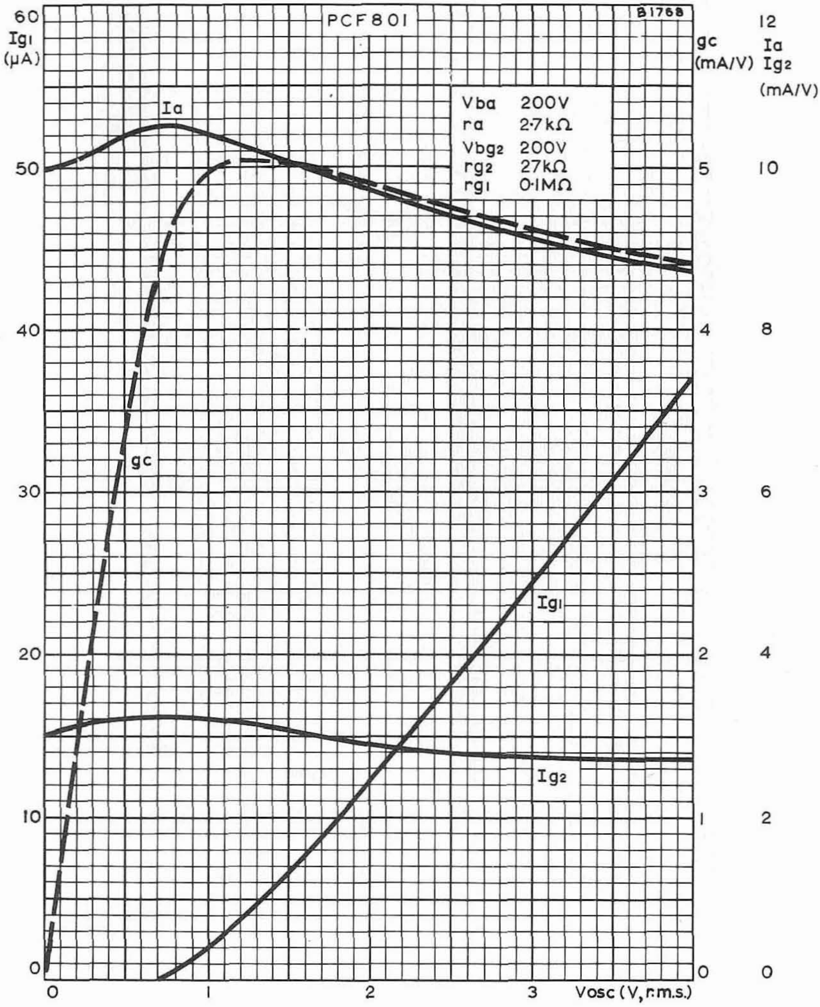
ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER (Vg2 = 120 V)



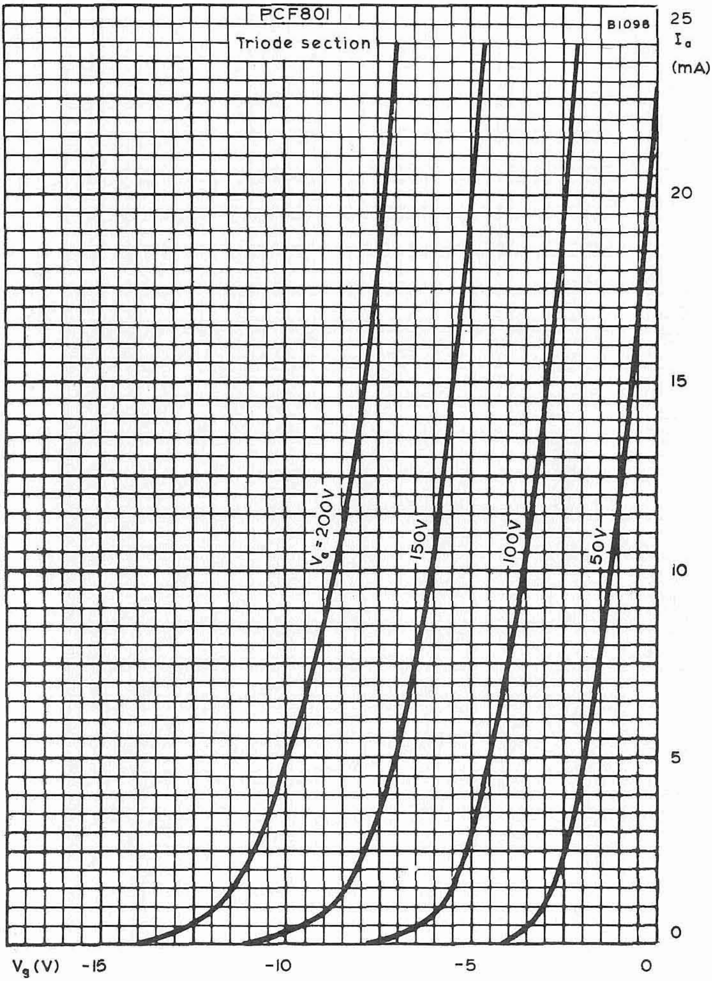
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.



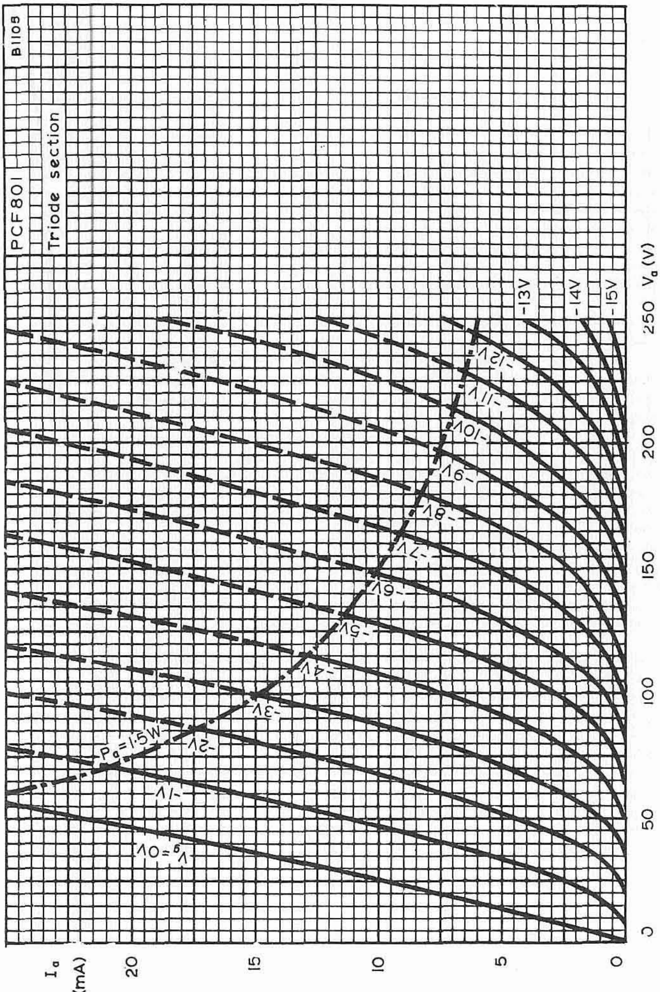
CROSS MODULATION CURVE



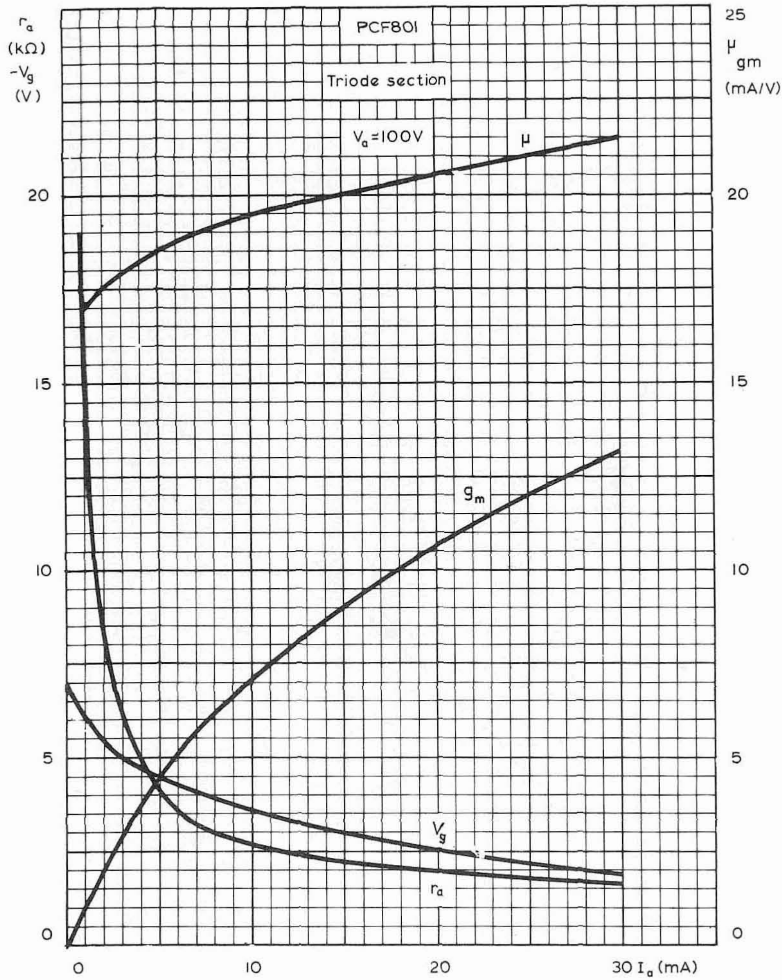
PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER.



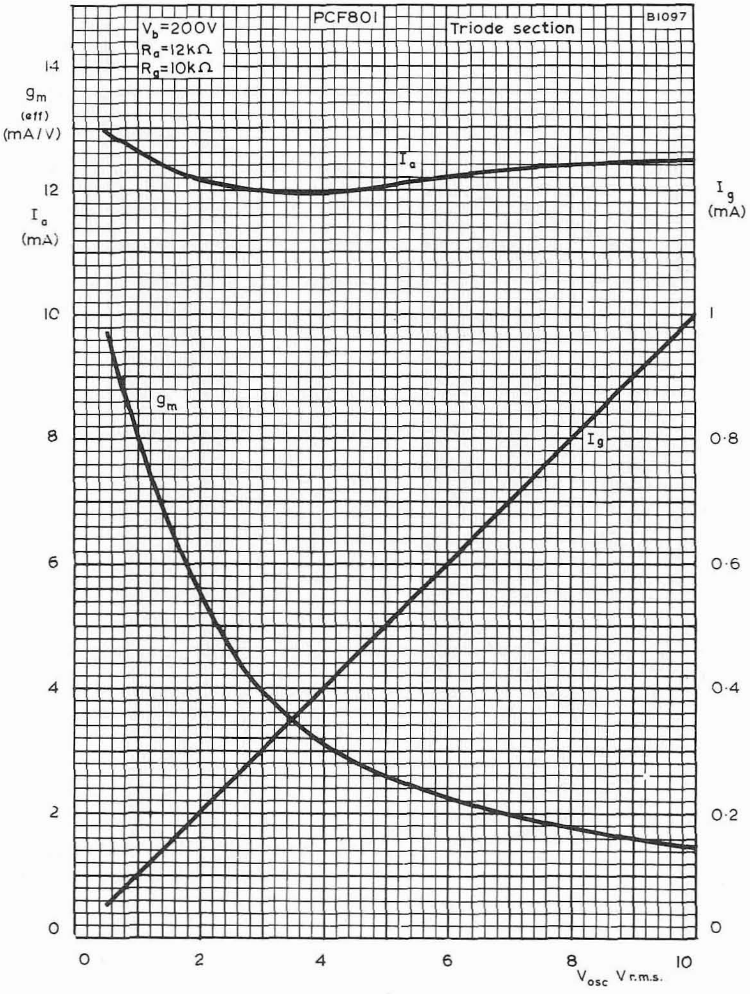
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETERS. TRIODE SECTION.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETERS. TRIODE SECTION.



ANODE IMPEDANCE, MUTUAL CONDUCTANCE, GRID VOLTAGE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT. Va = 100V. TRIODE SECTION.



PERFORMANCE CURVES FOR USE AS OSCILLATOR. TRIODE SECTION.

TRIODE PENTODE

PCF806

Combined triode and high slope frame grid r.f. pentode for use as a frequency changer at frequencies up to 220Mc/s in television tuners.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	8.0	V

CAPACITANCES (measured without an external shield)

c_{ap-at}	<30	mpF
c_{ap-gt}	<10	mpF
c_{g1-at}	<10	mpF
c_{g1-gt}	<10	mpF

Pentode section

c_{a-g1}	12	mpF
c_{g1-g2}	1.6	pF ←
c_{in}	6.0	pF
c_{out}	3.3	pF ←

Triode section

c_{g-k+h}	2.2	pF ←
c_{a-k+h}	1.2	pF ←
c_{a-g}	2.0	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	150	V
I_a	10	mA
I_{g2}	3.3	mA
g_m	12	mA/V
r_a	>350	kΩ
μ_{g1-g2}	70	
V_{g1}	−1.2	V
R_{eq}	1.0	kΩ

Triode section

V_a	100	V
I_a	14	mA
g_m	5.5	mA/V
μ	17	
V_g	−3.0	V

PCF806

TRIODE PENTODE

OPERATING CONDITIONS AS A FREQUENCY CHANGER

Pentode section

V_b	190	V
$V_{g2(b)}$	190	V
R_{g2}	18	kΩ
R_{g1}	100	kΩ
I_a	8.5	mA
I_{g2}	2.7	mA
$V_{osc(r.m.s.)}$	2.3	V
g_c	4.5	mA/V

DESIGN CENTRE RATINGS

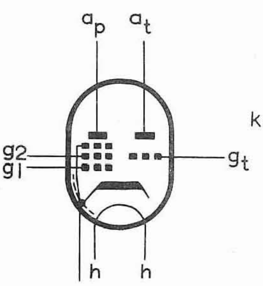
Pentode section

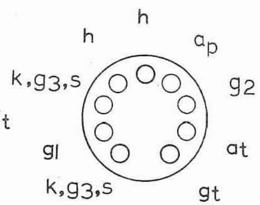
V_a max.	250	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	500	mW
I_k max.	18	mA
R_{g1-k} max.	250	kΩ

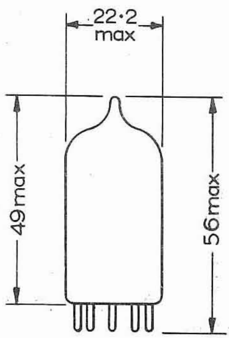
Triode section

V_a max.	125	V
p_a max.	1.5	W
I_k max.	15	mA
R_{g-k} max.	500	kΩ
*V_{h-k} max.	100	V

*To fulfil hum requirements on a.m. sound, it will be necessary for V_{h-k} to be less than $50V_{r.m.s.}$

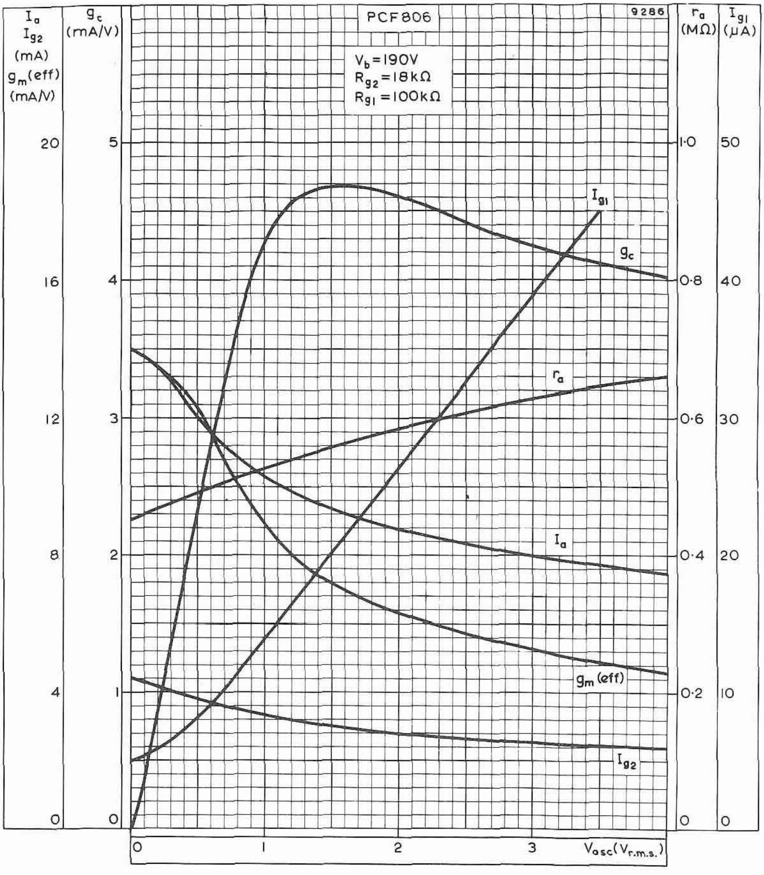




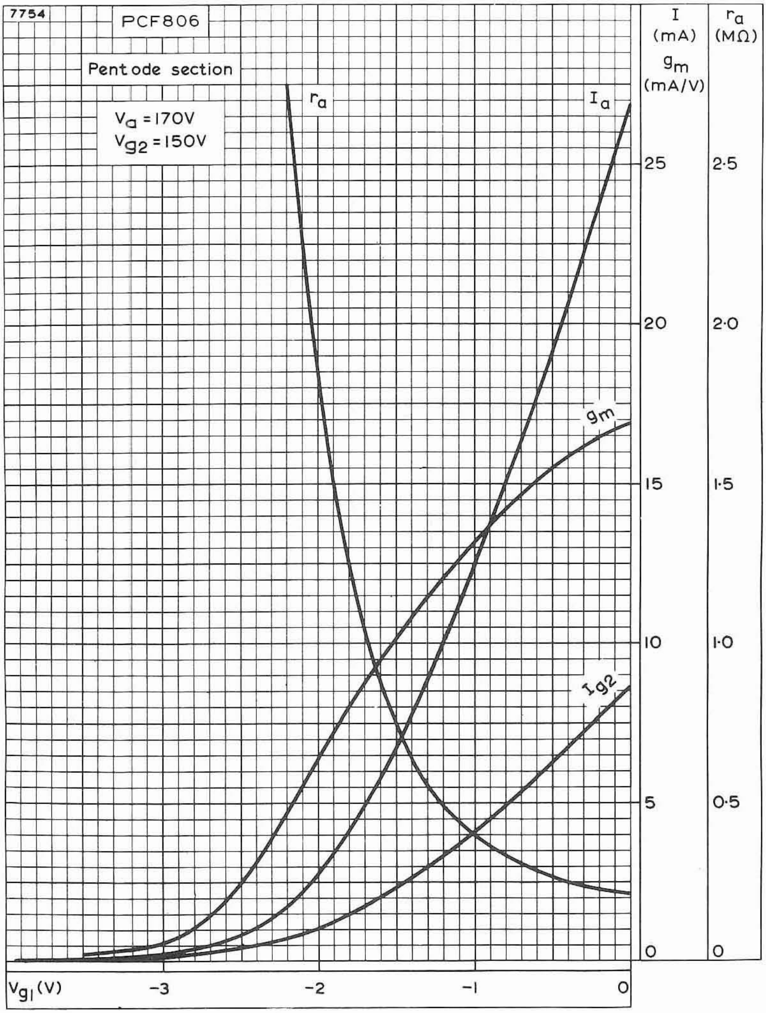


B9A Base
All dimensions in mm

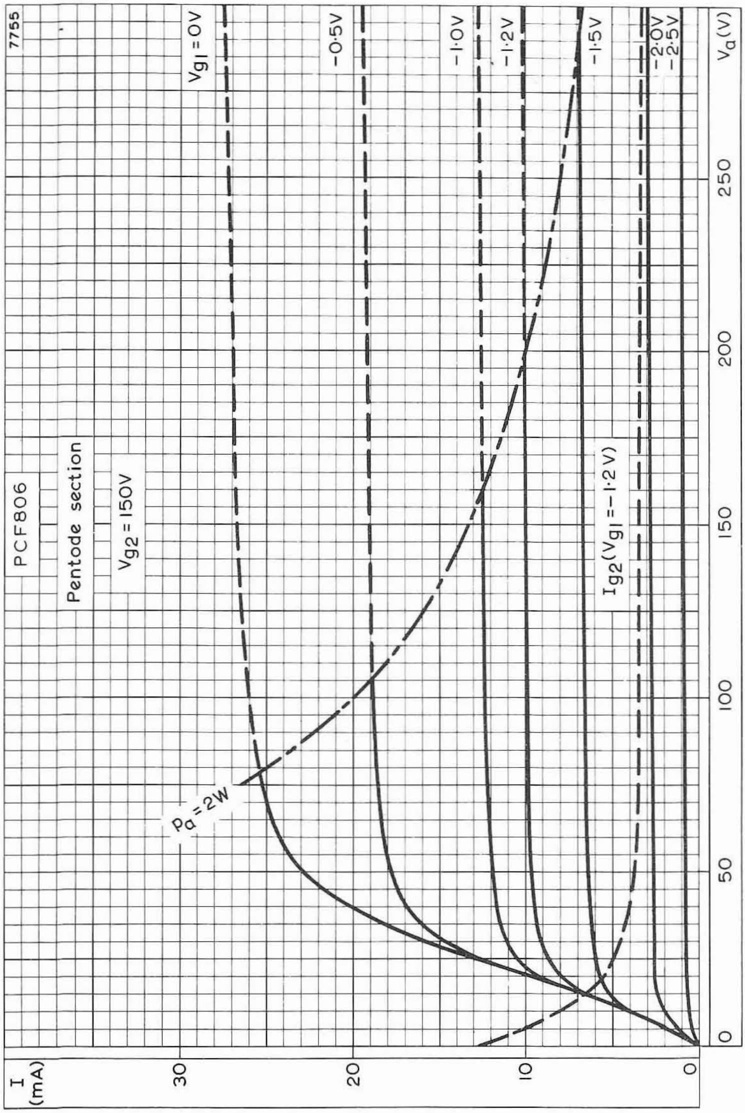
9111



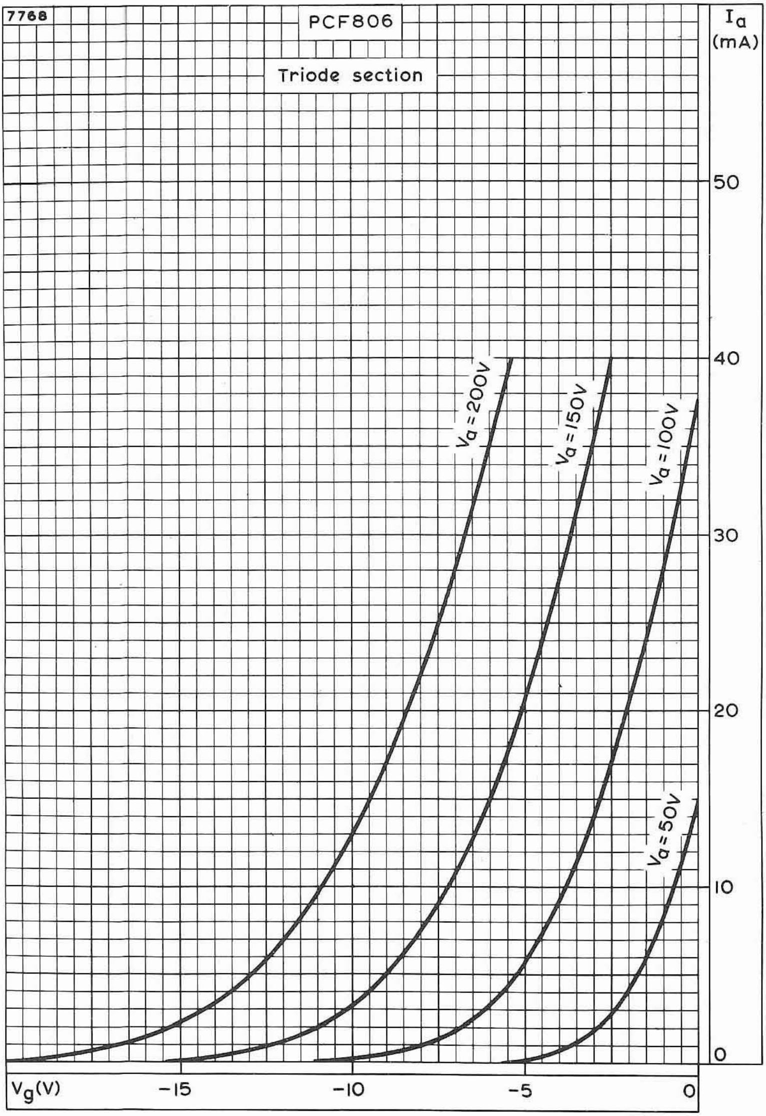
PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER



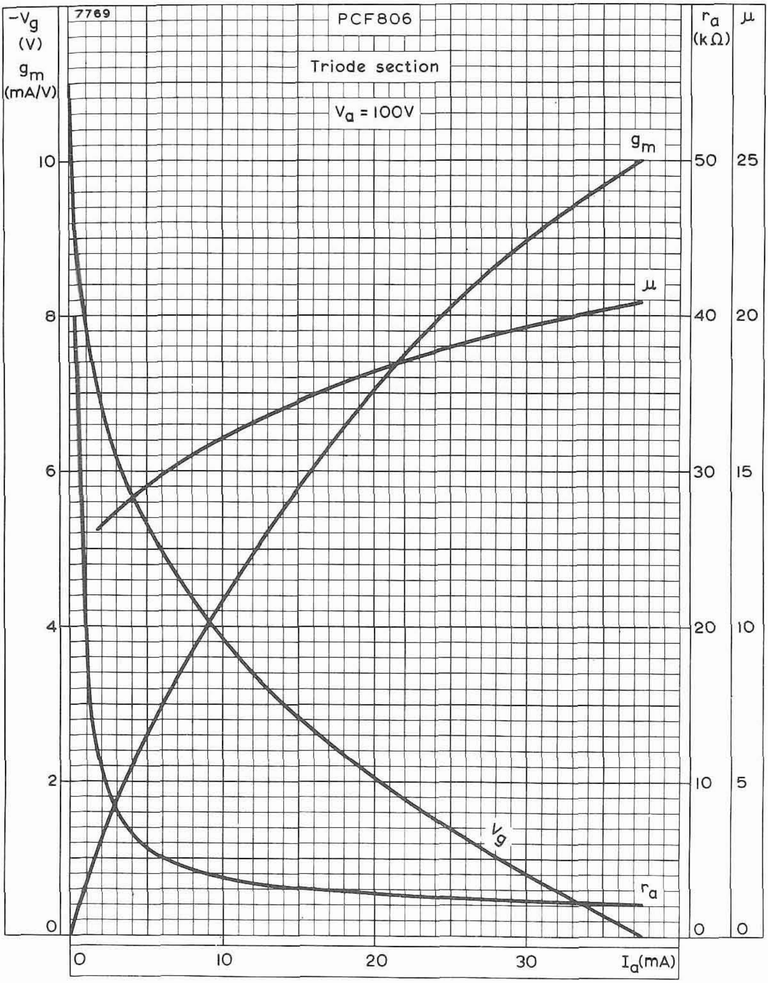
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. PENTODE SECTION



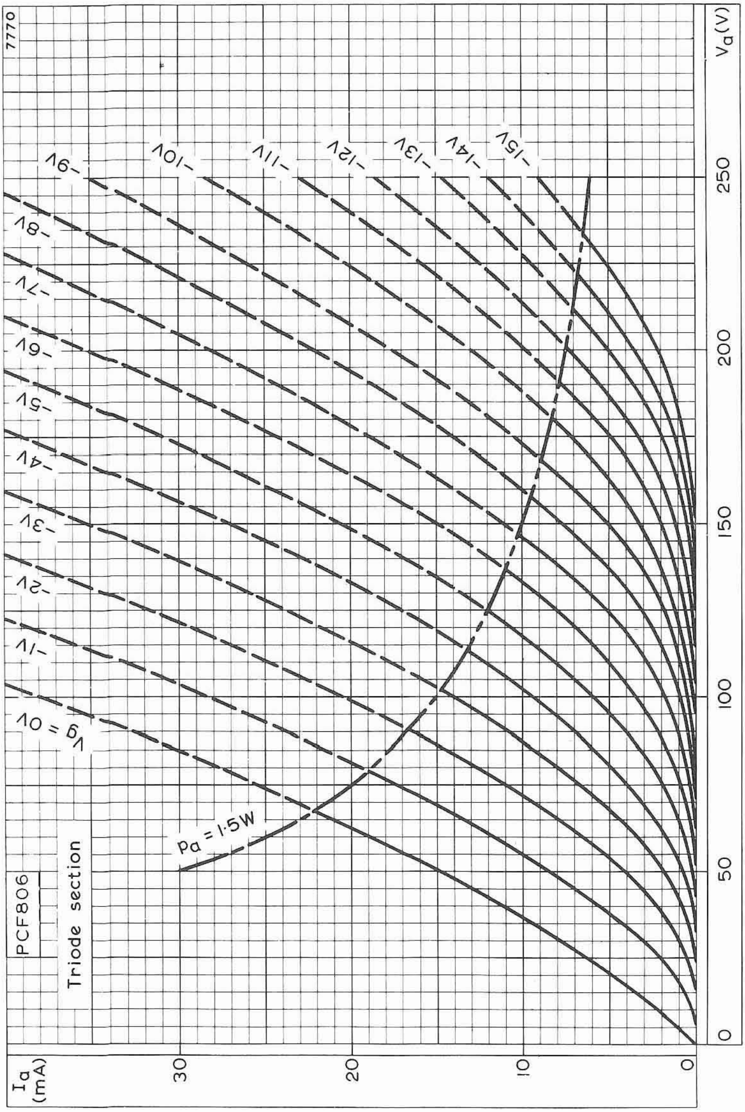
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
PENTODE SECTION



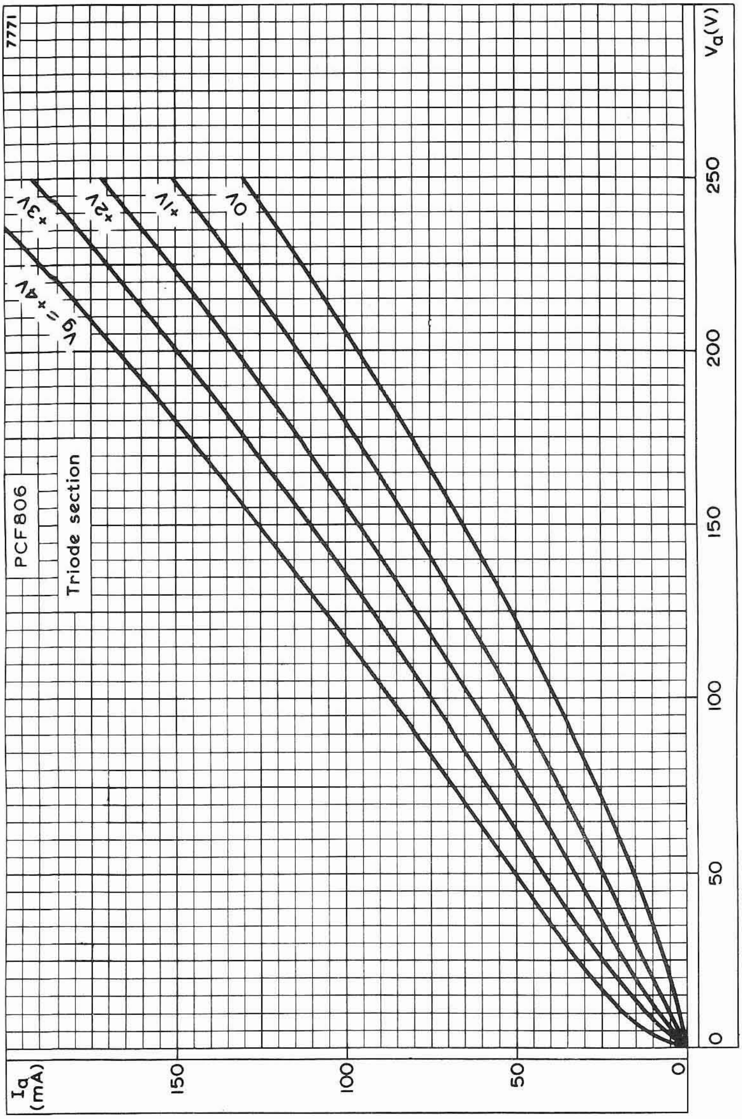
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE FOR VARIOUS VALUES OF ANODE VOLTAGE. TRIODE SECTION



GRID VOLTAGE, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH POSITIVE GRID VOLTAGE AS PARAMETER. TRIODE SECTION

TRIODE HEPTODE

PCH200

TENTATIVE DATA

Triode heptode intended for use as a noise cancelled synchronising pulse separator and clipper.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

I_h	300	mA
V_h	8.5	V ←

CAPACITANCES

$c_{ah\text{-}at}$	<150	mpF
$c_{g1\text{-}at}$	<10	mpF
$c_{g1\text{-}gt}$	<5.0	mpF ←
$c_{g3\text{-}gt}$	<20	mpF
Heptode section		
c_{in}	4.4	pF
c_{out}	5.4	pF ←
$c_{a\text{-}g1}$	<100	mpF
$c_{a\text{-}g3}$	<250	mpF
$c_{g1\text{-}g3}$	300	mpF
Triode section		
c_{in}	3.3	pF ←
c_{out}	1.7	pF ←
$c_{a\text{-}g}$	1.8	pF

CHARACTERISTICS

Heptode section

V_a	14	V
V_{g2+g4}	14	V
I_a	1.5	mA ←
I_{g2+g4}	1.3	mA ←
I_{g3}	1.0	μA
V_{g3}	0	V
V_{g1}	0	V
V_{g3} max. ($I_{g3} = 0.3\mu A$)	<-1.3	V
V_{g1} max. ($I_{g1} = 0.3\mu A$)	<-1.3	V

Triode section

V_a	100	V
I_a	9.0	mA ←
V_g	-1.0	V
g_m	8.8	mA/V ←
μ	50	←

OPERATING CONDITIONS

Heptode section

V_{ah}	1.0	14	V
V_{g2+g4}	14	14	V
I_{ah}	>300	750	μA
I_{g3}	1.0	1.0	μA
I_{g1}	100	100	μA

RATINGS (DESIGN CENTRE SYSTEM)

Heptode section

$V_{a(b)}$ max.	550	V
V_a max.	100	V ←
p_a max.	500	mW ←
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max. (see note 1)	50	V
p_{g2+g4} max.	500	mW
$-v_g$ (pk) max.	100	V ←
$-v_{g3}$ (pk) max.	150	V
I_k max.	8.0	mA ←
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	100	V

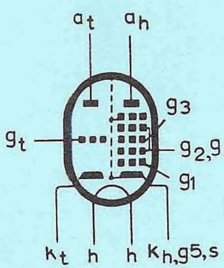
Triode section

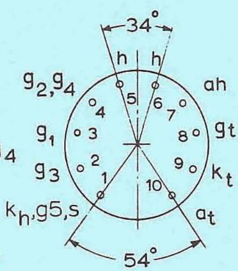
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.5	W
$-v_{g1}$ (pk) max.	200	V
I_k max.	20	mA
R_{g-k} max.	2.0	MΩ
V_{h-k} max. (cathode positive)	70V d.c. + 100V r.m.s. ←	

NOTES

1. The minimum $V_{g2 + g4}$ is 6V under design maximum conditions.

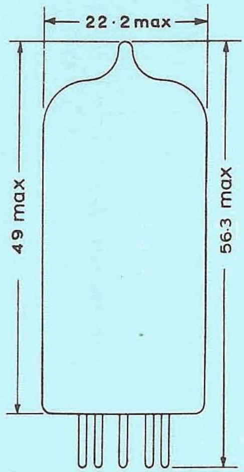
B4461



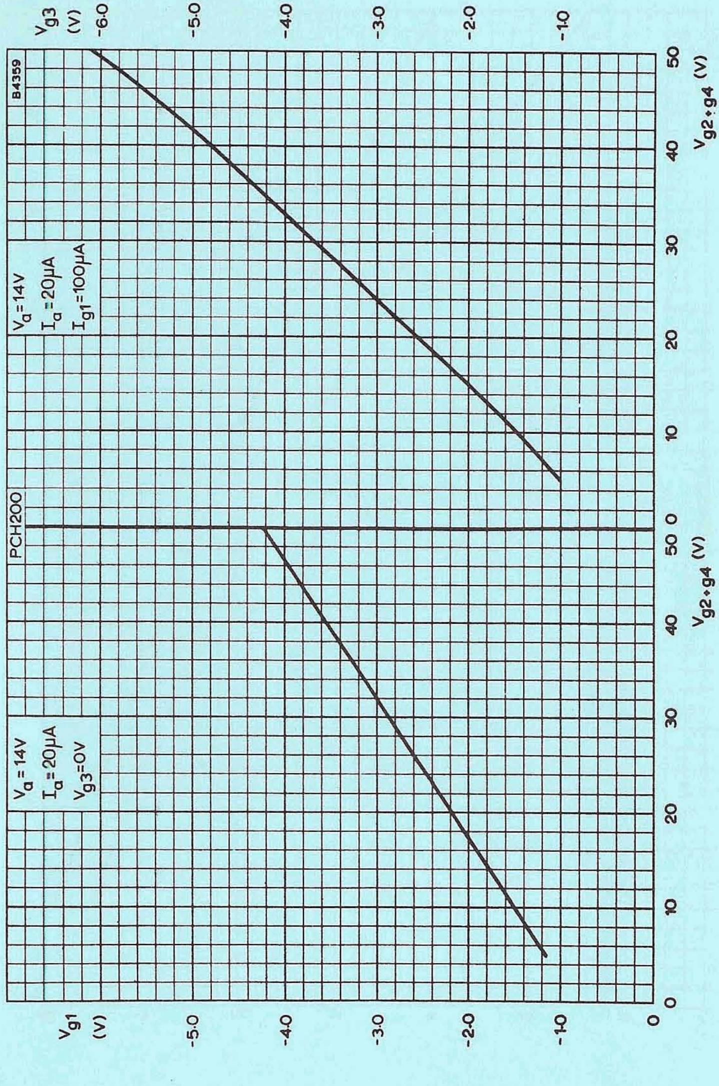


Pin circle diameter = 11·9mm
Pin diameter = 1·0mm

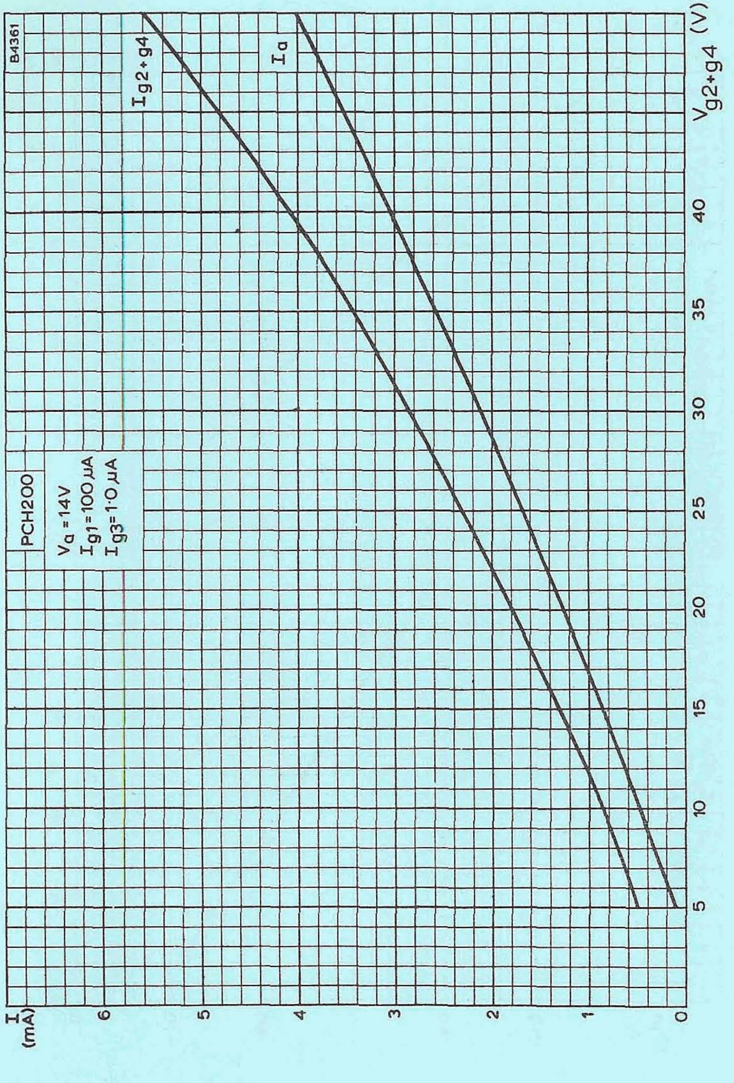
B10B base



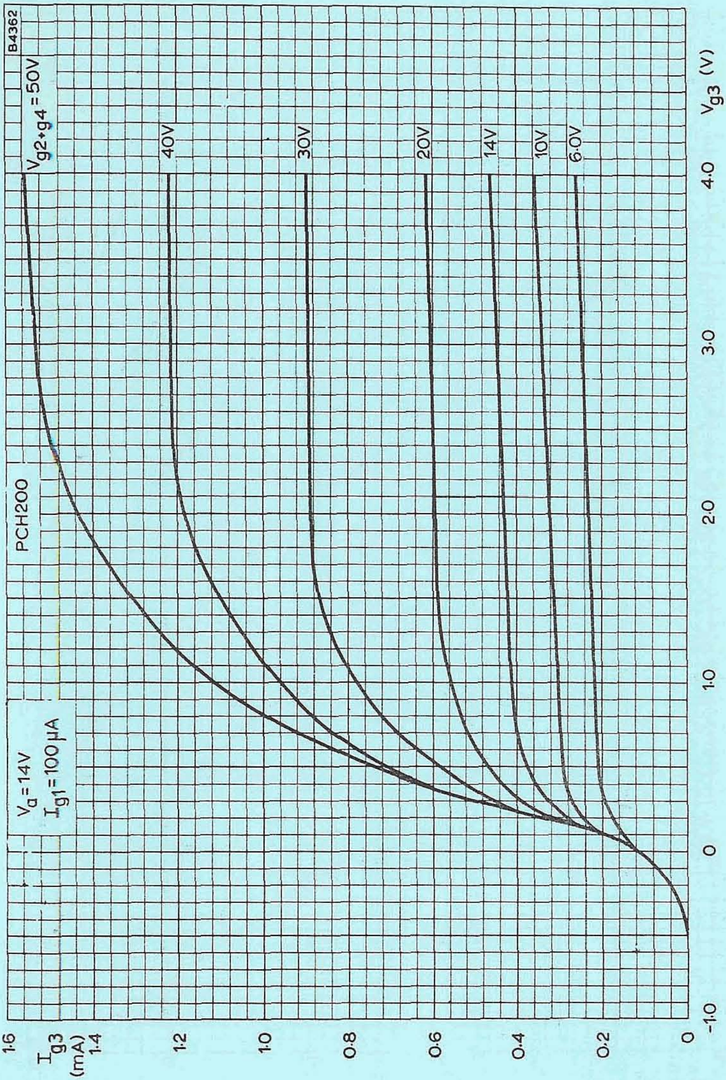
All dimensions in mm



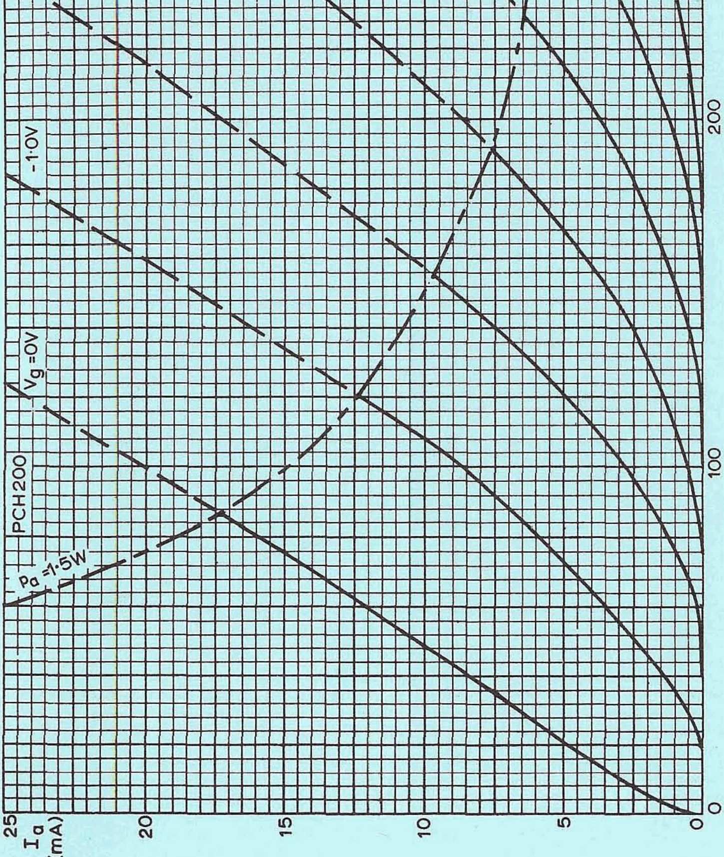
FIRST-GRID AND THIRD-GRID VOLTAGES PLOTTED
AGAINST SCREEN-GRID VOLTAGE
HEPTODE SECTION



ANODE AND SCREEN-GRID CURRENTS PLOTTED
AGAINST SCREEN-GRID VOLTAGE
HEPTODE SECTION



THIRD-GRID CURRENT PLOTTED AGAINST THIRD-GRID VOLTAGE
WITH SCREEN-GRID VOLTAGE AS PARAMETER
HEPTODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
TRIODE SECTION

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	16	V

CAPACITANCES (measured without an external shield)

c_{at-g1p}	<20	mpF
c_{gt-ap}	<20	mpF
c_{gt-g1p}	<25	mpF
c_{at-ap}	<250	mpF

Pentode section

c_{in}	9.3	pF
c_{out}	8.0	pF
c_{a-g1}	<300	mpF
c_{g1-h}	<300	mpF

Triode section

c_{a-k+h}	4.3	pF ←
c_{g-k+h}	2.7	pF
c_{a-g}	4.0	pF
c_{g-h}	<20	mpF

CHARACTERISTICS

Pentode section

V_a	170	200	V
V_{g2}	170	200	V
I_a	41	35	mA
I_{g2}	9.0	8.0	mA ←
V_{g1}	−11.5	−16	V
g_m	7.5	6.4	mA/V
r_a	16	20	kΩ
μ_{g1-g2}	9.5	9.5	

Triode section

V_a	100	V
I_a	3.5	mA
V_g	0	V
g_m	2.2	mA/V ←
r_a	32	kΩ ←
μ	70	

PENTODE SECTION AS FRAME OUTPUT VALVE

See nomogram on page C1 and notes on page D4.

PCL82

TRIODE PENTODE

TRIODE SECTION AS A.F. AMPLIFIER

Measured using grid current bias. $R_g = 10M\Omega$

V_b	R_a	I_a	R_{source}	$\frac{V_{out}}{V_{in}}$*	$V_{out(r.m.s.)}$†	R_{g1}‡
(V)	(kΩ)	(mA)	(kΩ)		(V)	(kΩ)
200	47	1.83	0	41	23	150
170	47	1.40	0	39	18.3	150
150	47	1.18	0	38	14.8	150
100	47	0.60	0	34	6.7	150
200	47	1.83	220	31	25.5	150
170	47	1.40	220	30	20.5	150
150	47	1.18	220	29	17.1	150
100	47	0.60	220	27	9.0	150
200	100	1.08	0	51	28.5	330
170	100	0.83	0	50	22	330
150	100	0.72	0	49	18.2	330
100	100	0.38	0	44	8.7	330
200	100	1.08	220	39	33	330
170	100	0.83	220	38	26.5	330
150	100	0.72	220	37	22	330
100	100	0.38	220	34	12.2	330
200	220	0.60	0	58	30.5	680
170	220	0.47	0	56	24	680
150	220	0.40	0	55	20	680
100	220	0.23	0	50	10.3	680
200	220	0.60	220	44	38.5	680
170	220	0.47	220	42	31	680
150	220	0.40	220	41	26	680
100	220	0.23	220	38	14.9	680

*V_{out}/V_{in} measured with an input voltage of 100mV.

†V_{out} measured for $D_{tot} = 5\%$.

‡Grid resistor of following valve.

MICROPHONY

The triode section can be used without special precautions against microphony and hum in circuits in which the input voltage is $\geqq$ 10mV for an output of 50mW from the output stage. The a.c. voltage between pin 4 and triode cathode should not exceed 6.3V.

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_{a-k}	170	170	200	200	V
V_{g2-k}	170	170	200	200	V
R_k	450	230	650	380	Ω
R_a	7.0	3.9	9.0	5.6	kΩ
$I_{a(o)}$	25	41	22	35	mA
$I_{g2(o)}$	4.8	8.0	4.3	7.0	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	660	590	690	600	mV
$V_{in(r.m.s.)}$	5.3	6.0	5.7	6.6	V
*P_{out}	2.0	3.3	2.0	3.5	W
*D_{tot}	9.2	10	8.5	10	%

*P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control grid, the bias voltage developed across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in a reduction in P_{out} of approximately 10%

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
*+$v_{a(pk)}$ max.	2.5	kV
$-v_{a(pk)}$ max.	500	V
p_a max. (audio applications)	7.0	W
p_a max. (frame output)	5.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2.2	W ←
I_k max.	50	mA
R_{g1-k} max.	1.0	MΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

*Maximum pulse duration is 4% of one cycle with a maximum of 800μs

Triode section

V_a max.	250	V
*+$v_{a(pk)}$ max.	600	V
p_a max.	1.0	W
I_k max.	15	mA
*$i_{k(pk)}$ max.	200	mA
R_{g-k} max.	1.0	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

*Maximum pulse duration = 200μs

PCL82

TRIODE PENTODE

PEAK ANODE CURRENT NOMOGRAM

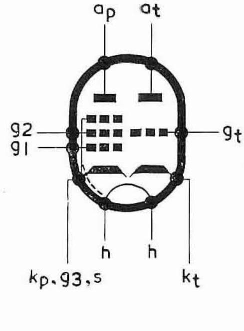
The nomogram shown on the following page gives directly the values of peak anode current and corresponding values of anode voltage at end of scan for various values of screen-grid voltage.

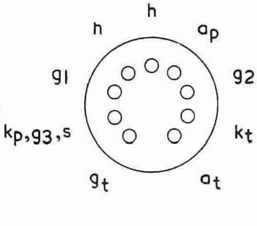
No indication of anode and screen-grid dissipation limits is given in the nomogram: these must be checked independently.

Example

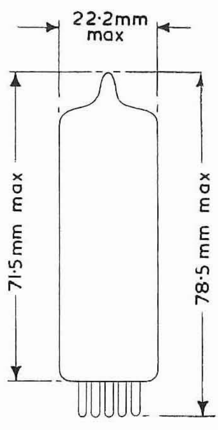
Suppose the screen-grid voltage is 170V. From the nomogram, the optimum working conditions at V_{g2} = 170V are $i_{a(pk)}$ = 90mA, and v_a at end of scan = 70V.

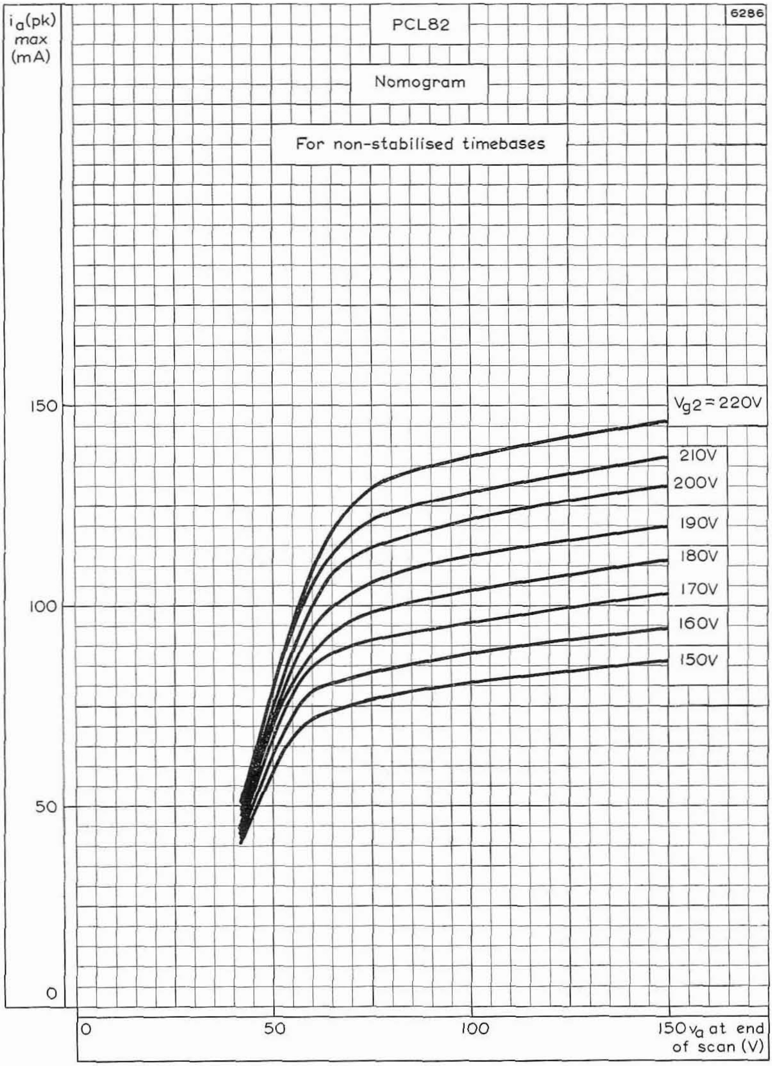
2324



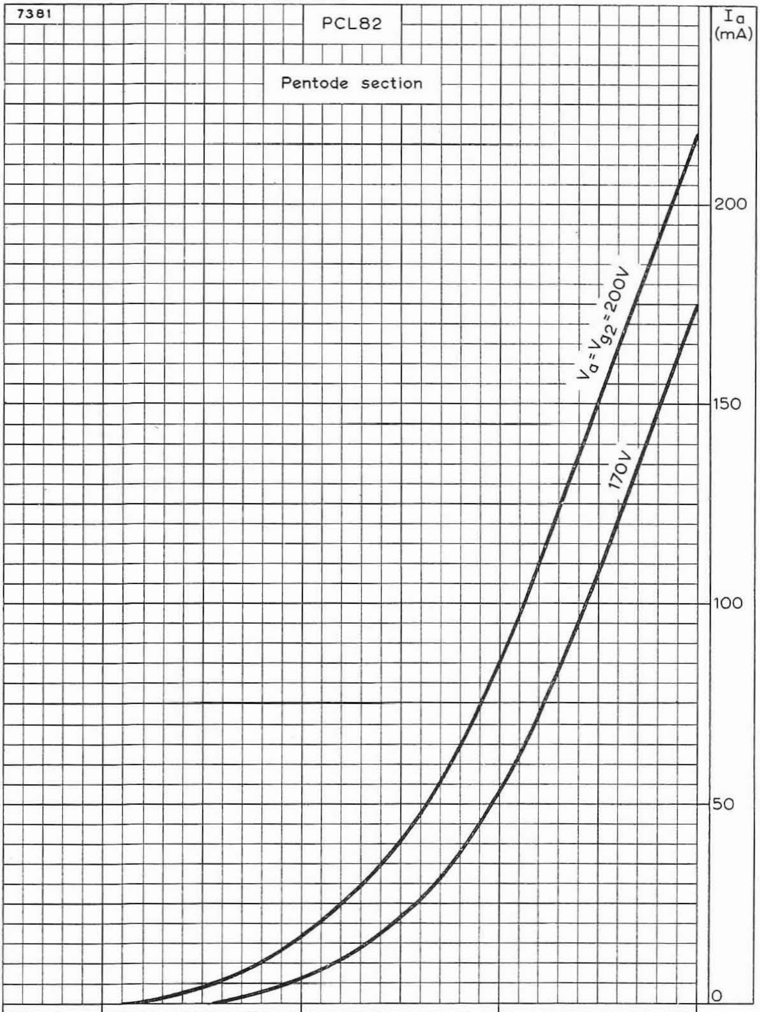


B9A Base

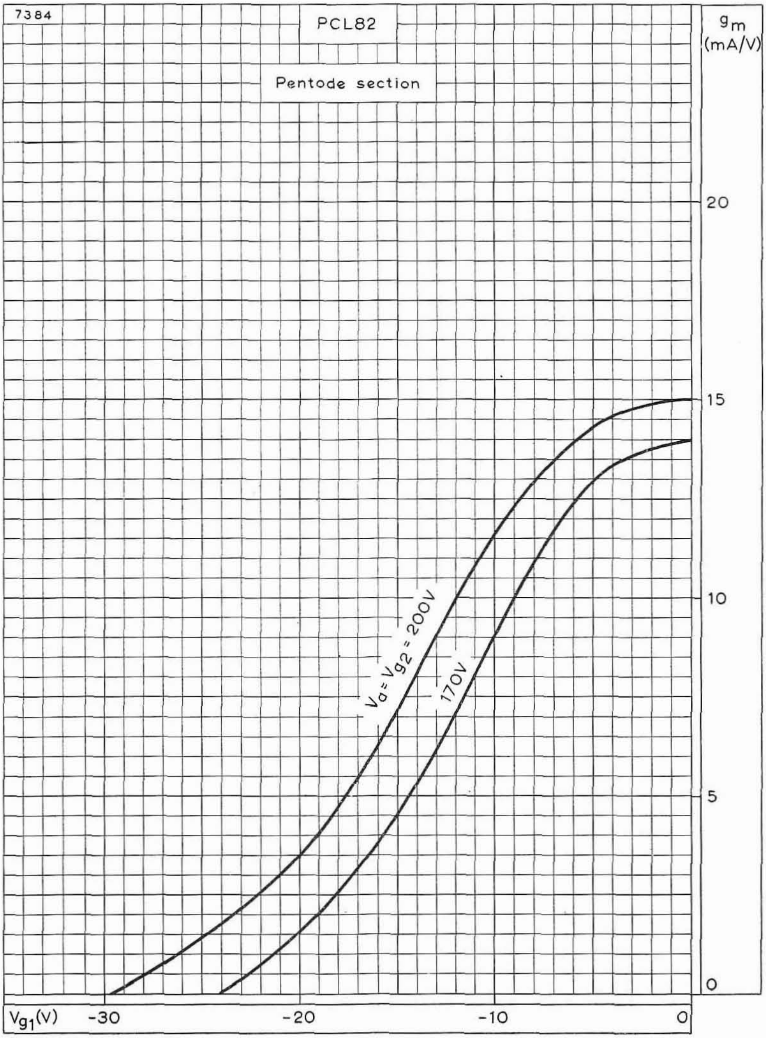




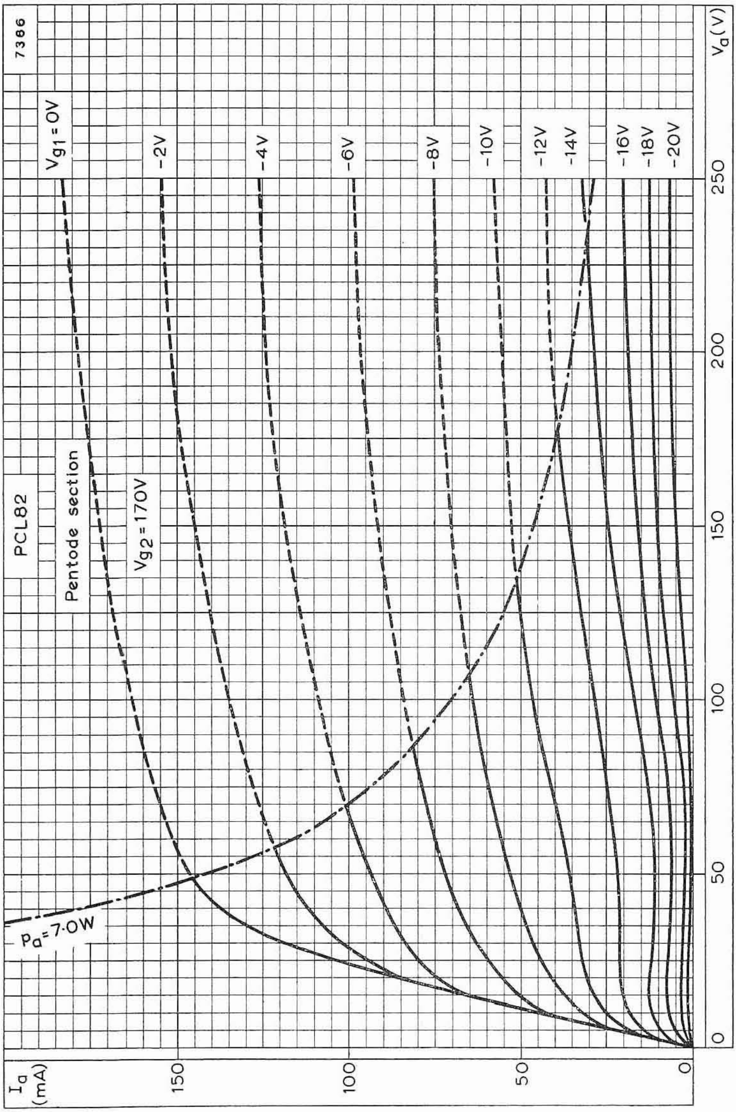
PEAK ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE AT THE END OF SCAN



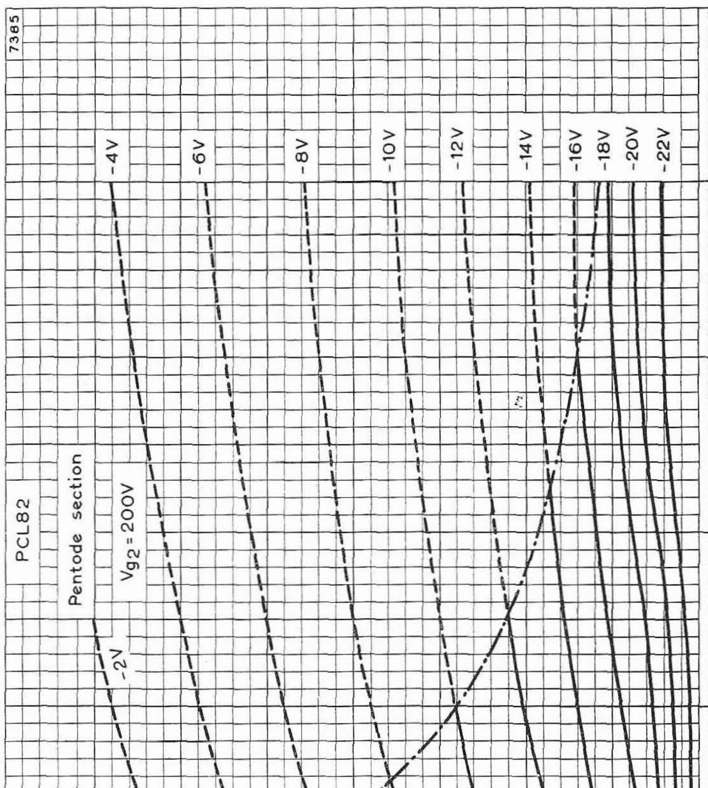
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER. PENTODE SECTION



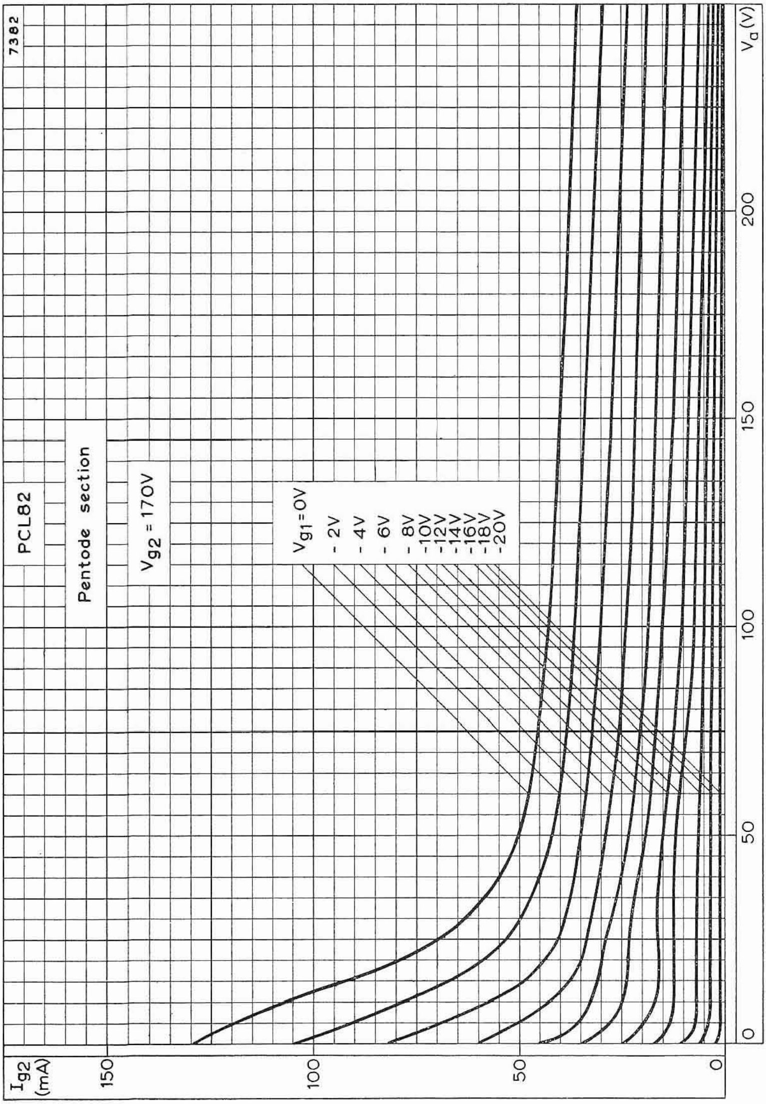
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER. PENTODE SECTION



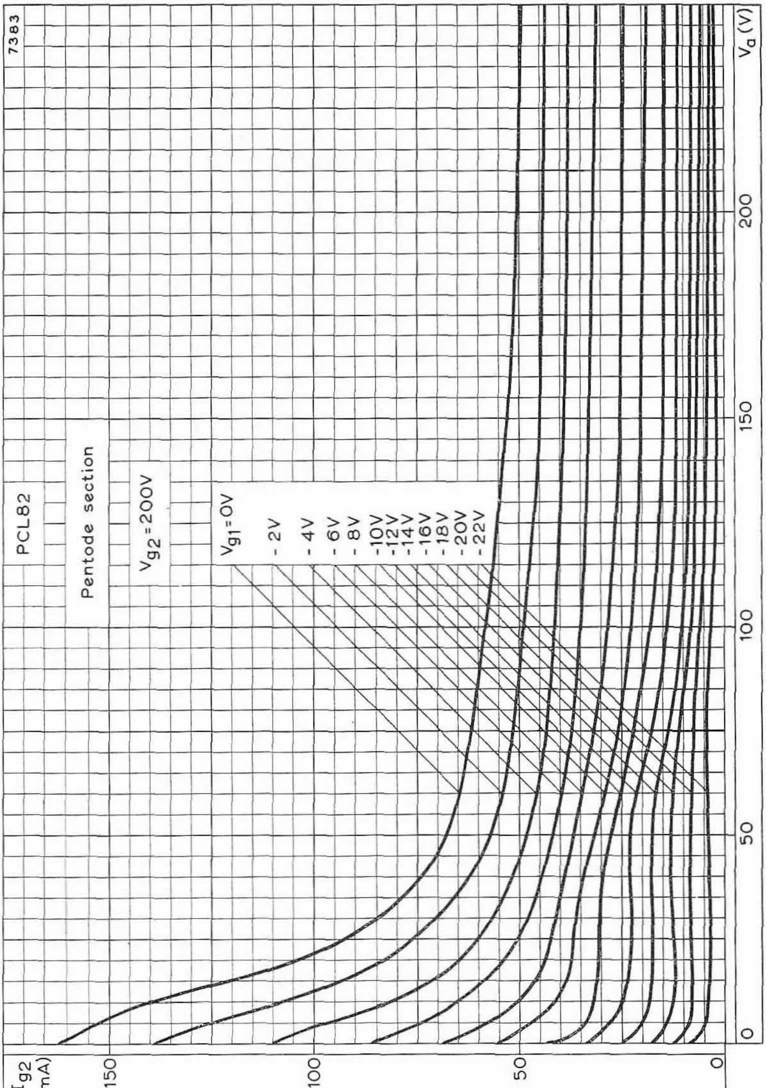
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION. $V_{g2} = 170V$



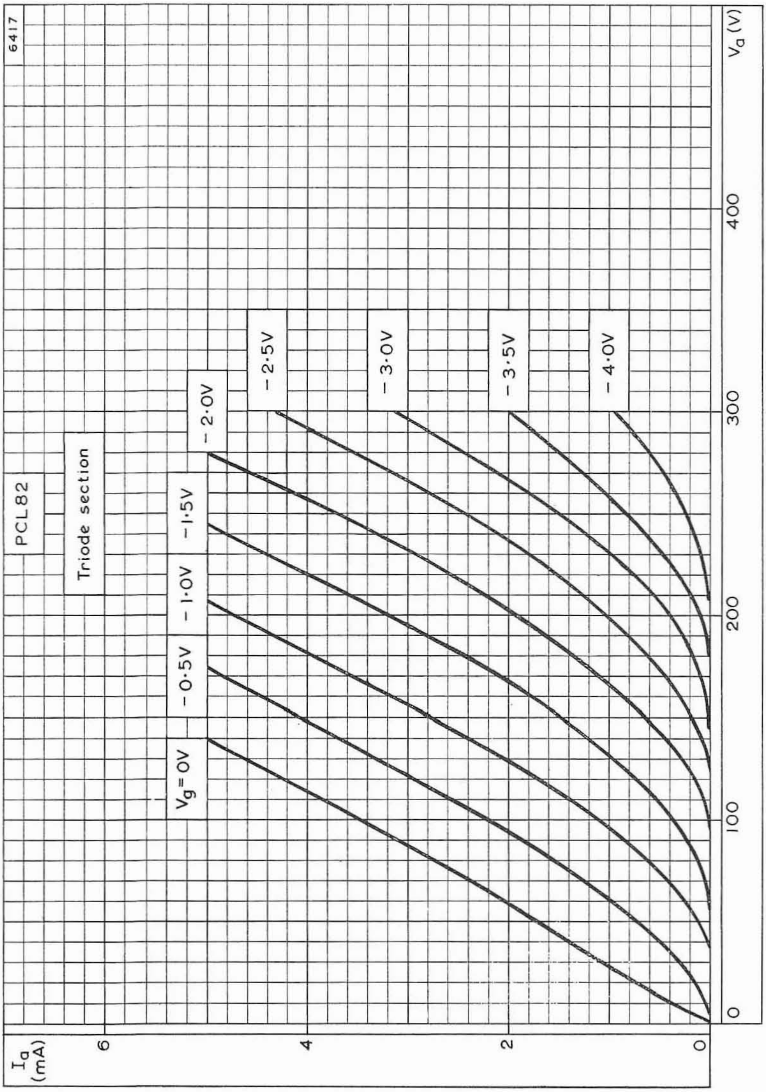
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION. $V_{g2} = 200V$



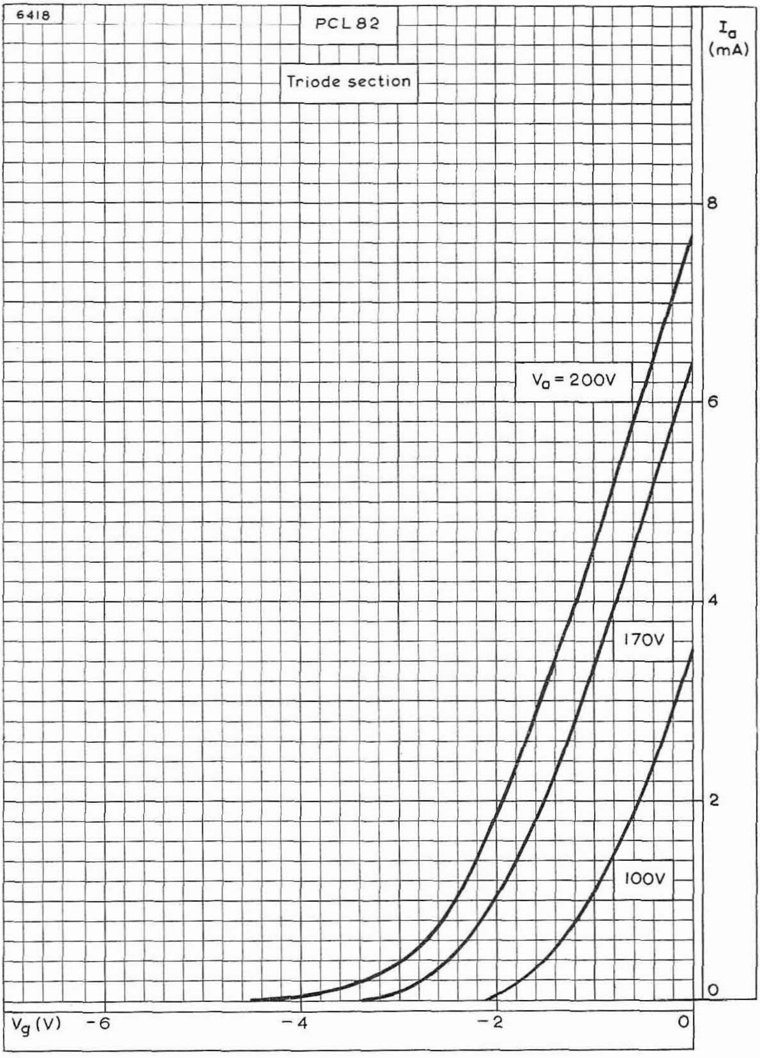
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION. $V_{g2} = 170V$



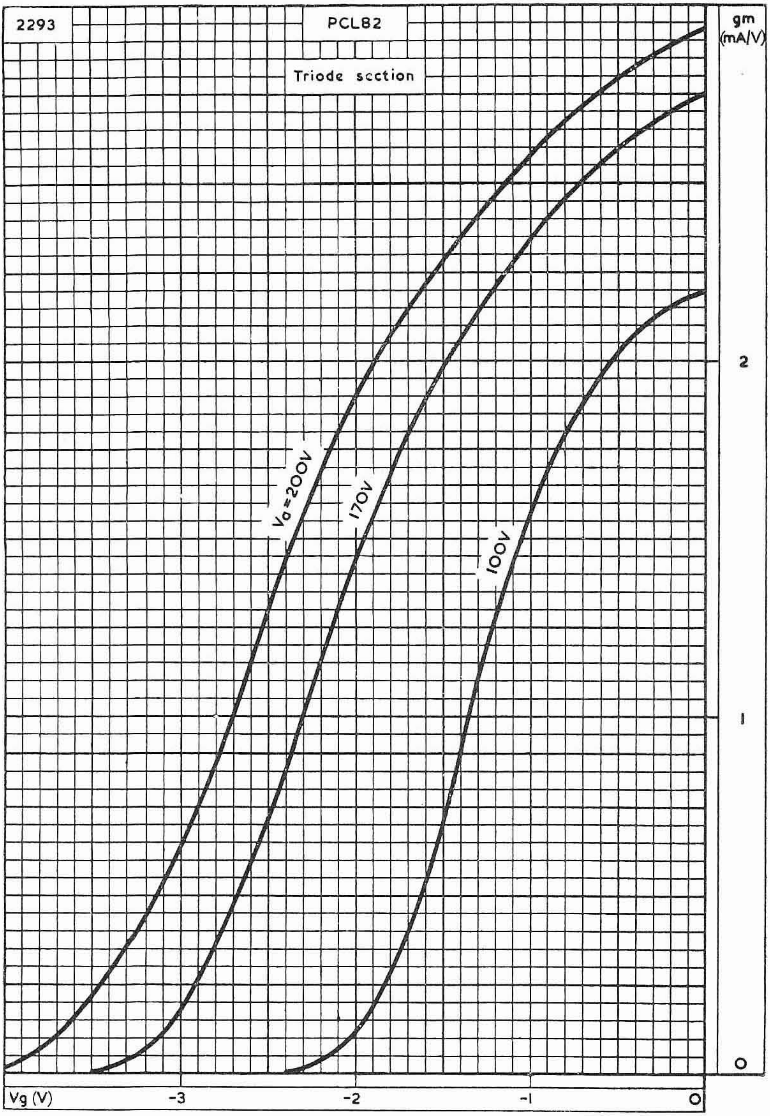
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION. $V_{g2} = 200V$



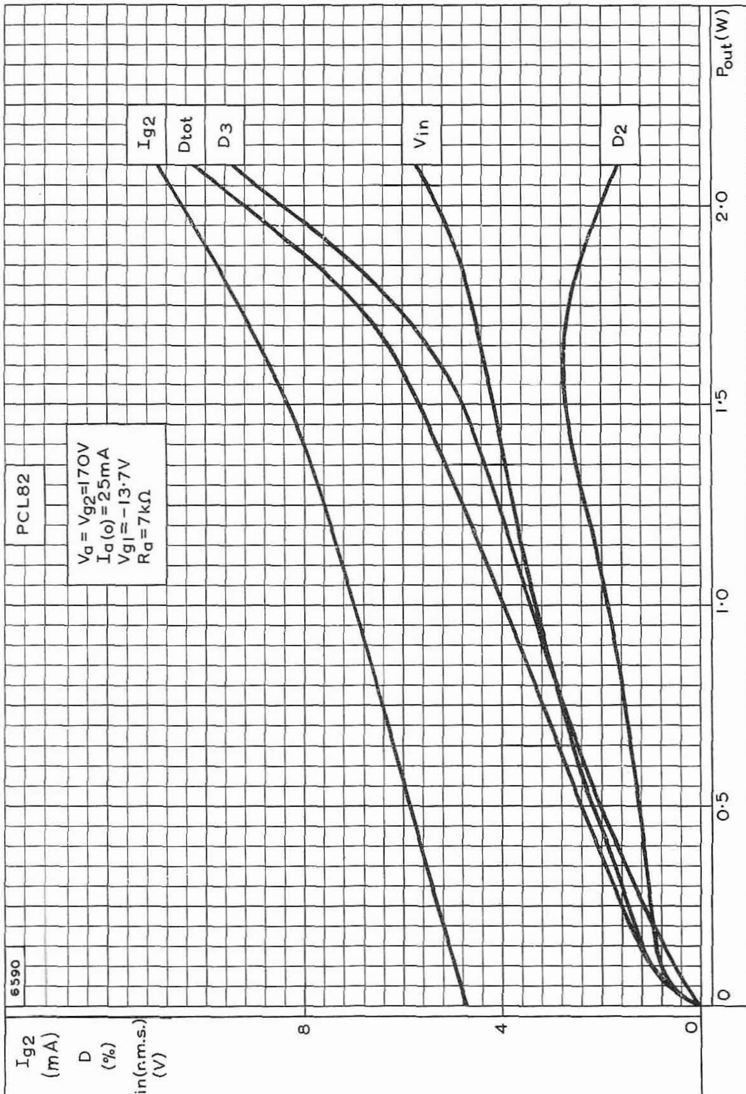
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE.
TRIODE SECTION



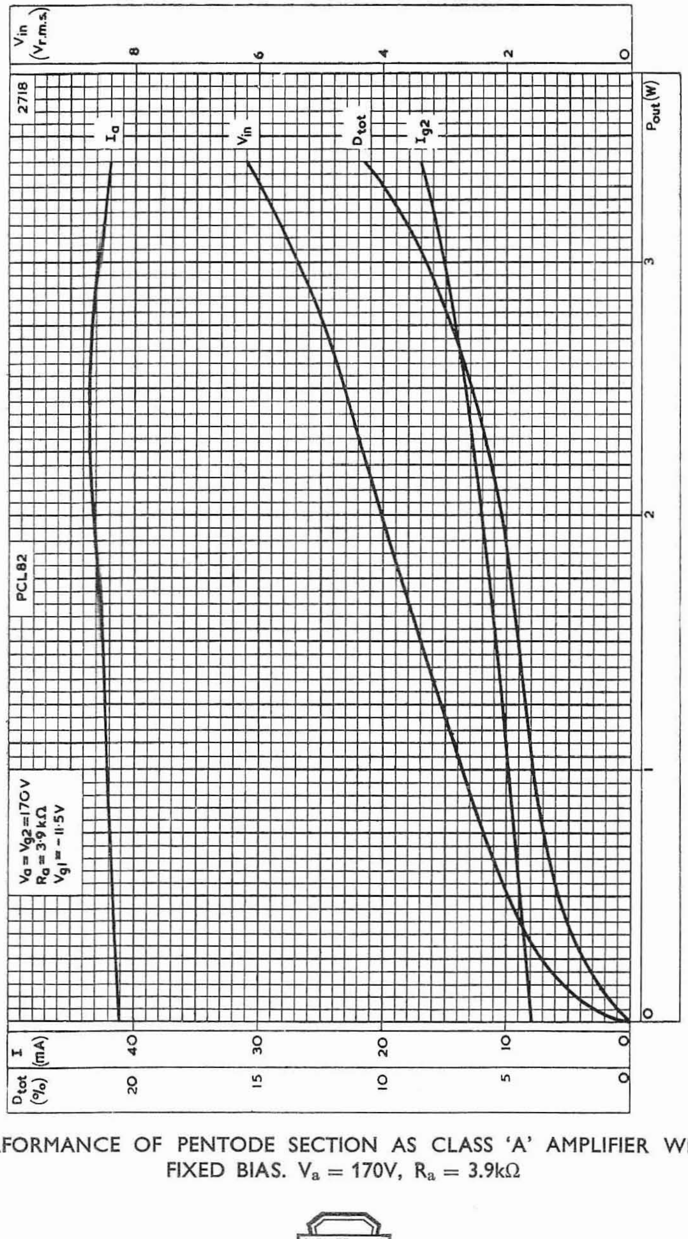
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
TRIODE SECTION



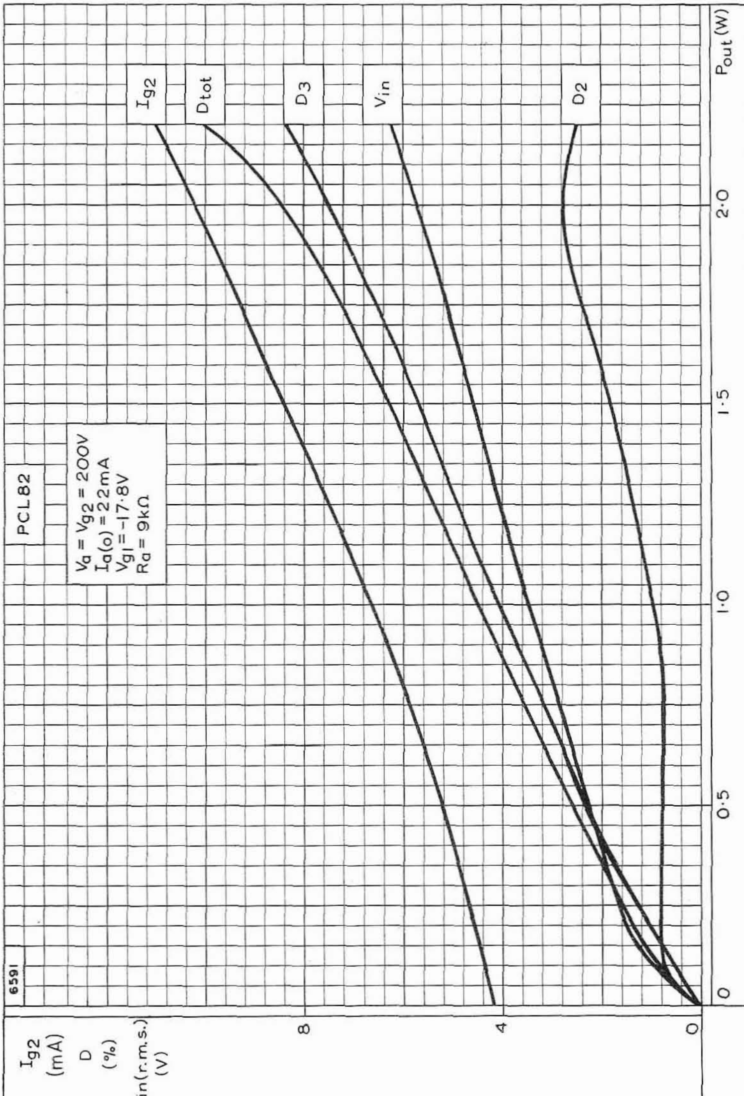
MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE.
TRIODE SECTION



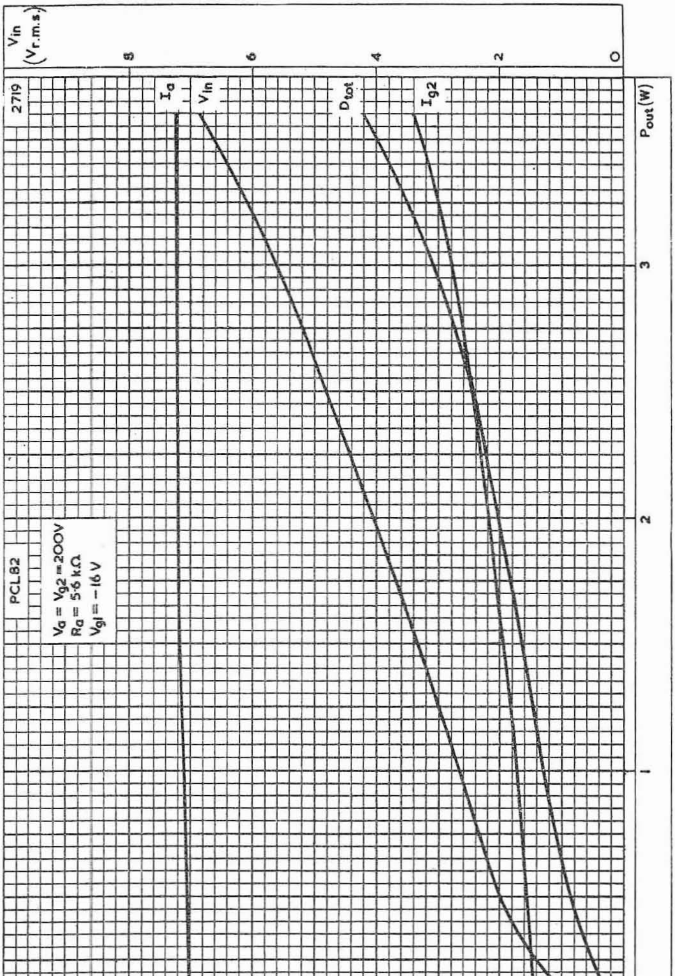
PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 170V$, $R_a = 7k\Omega$



PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 170V$, $R_a = 3.9k\Omega$



PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 200V$, $R_a = 9k\Omega$

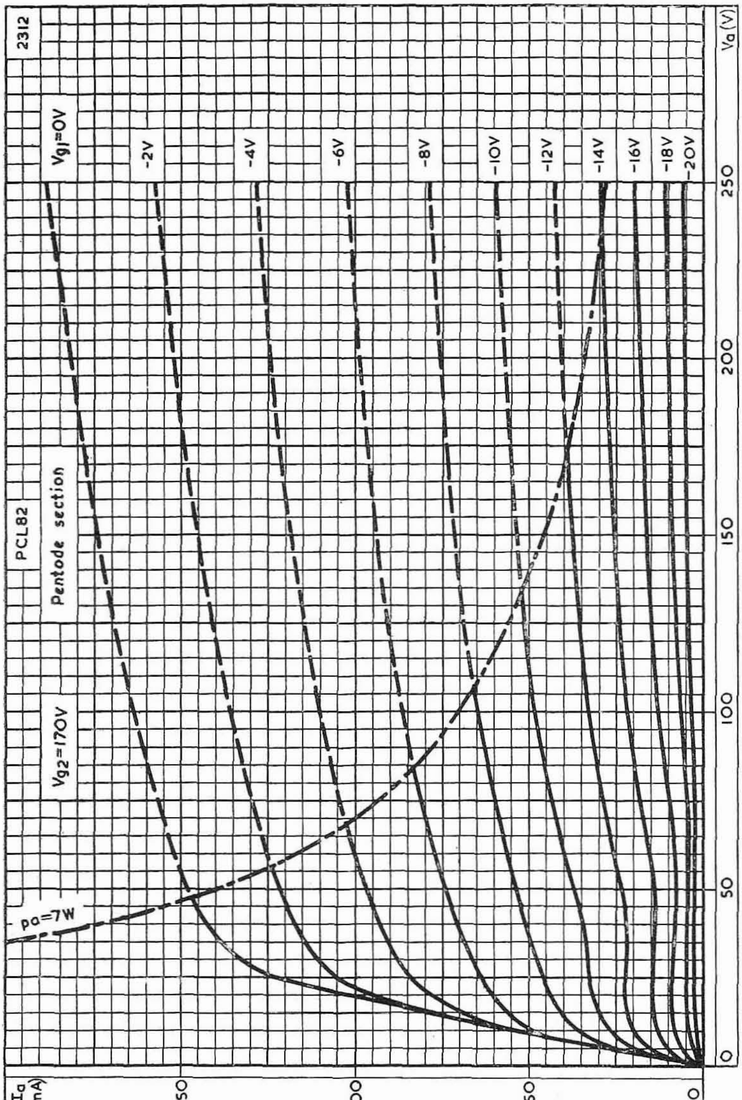


PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 200V$, $R_a = 5.6k\Omega$

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

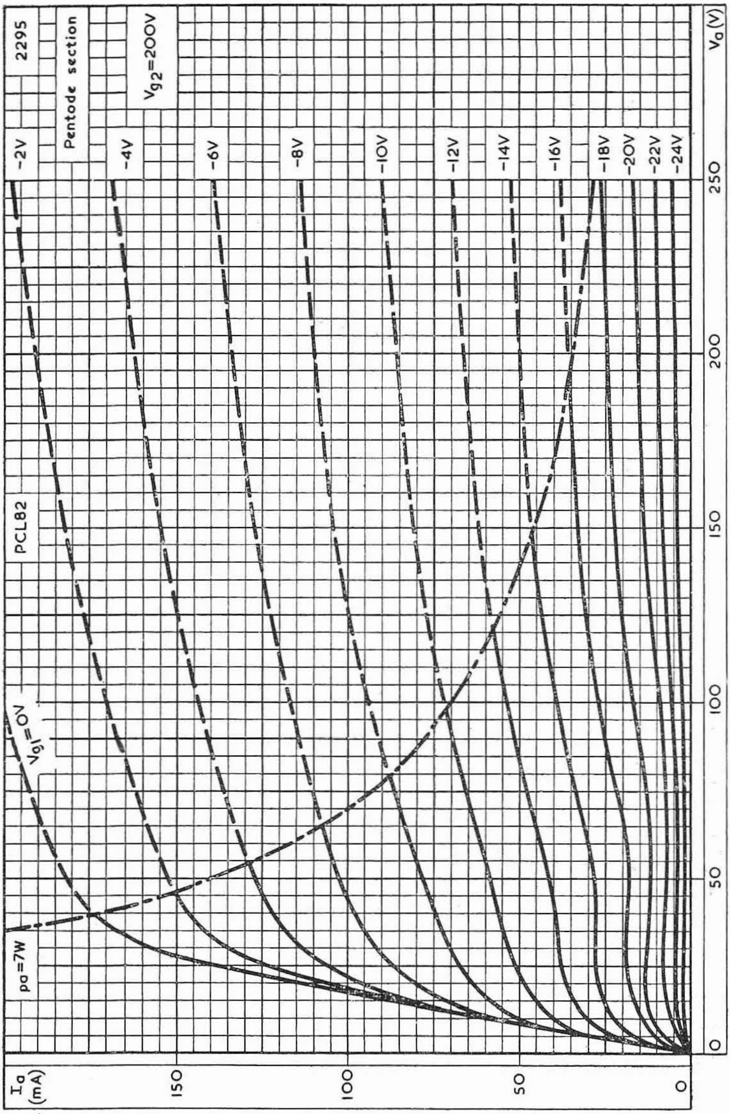


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=170V

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

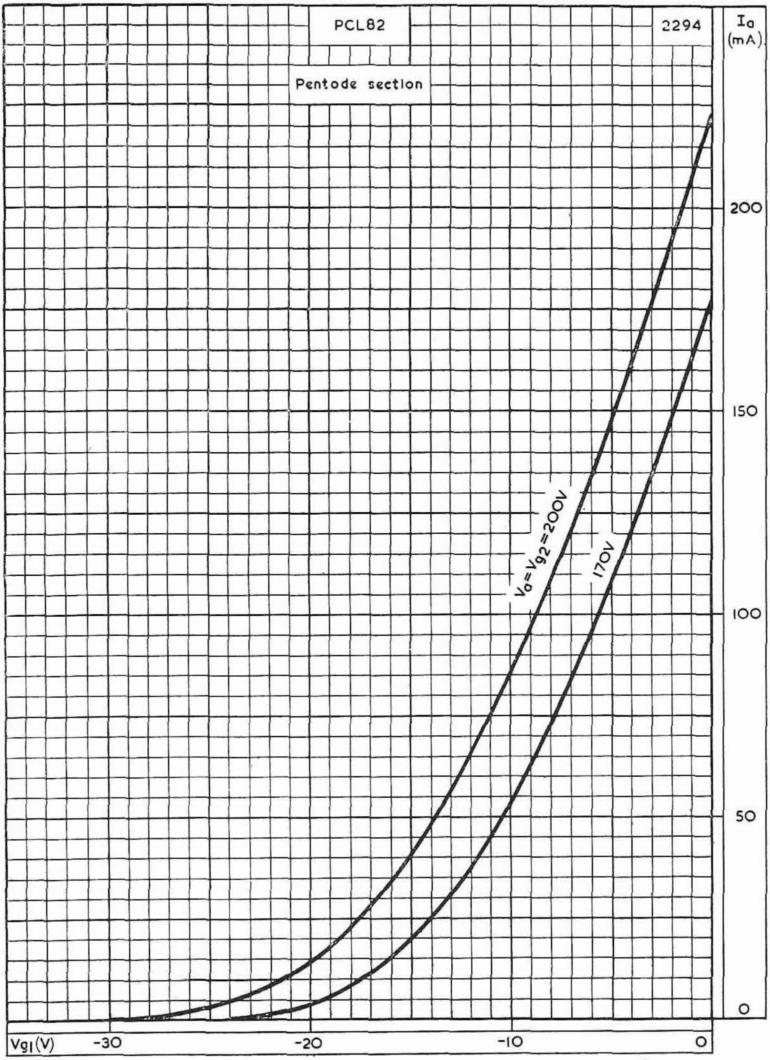


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=200V

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

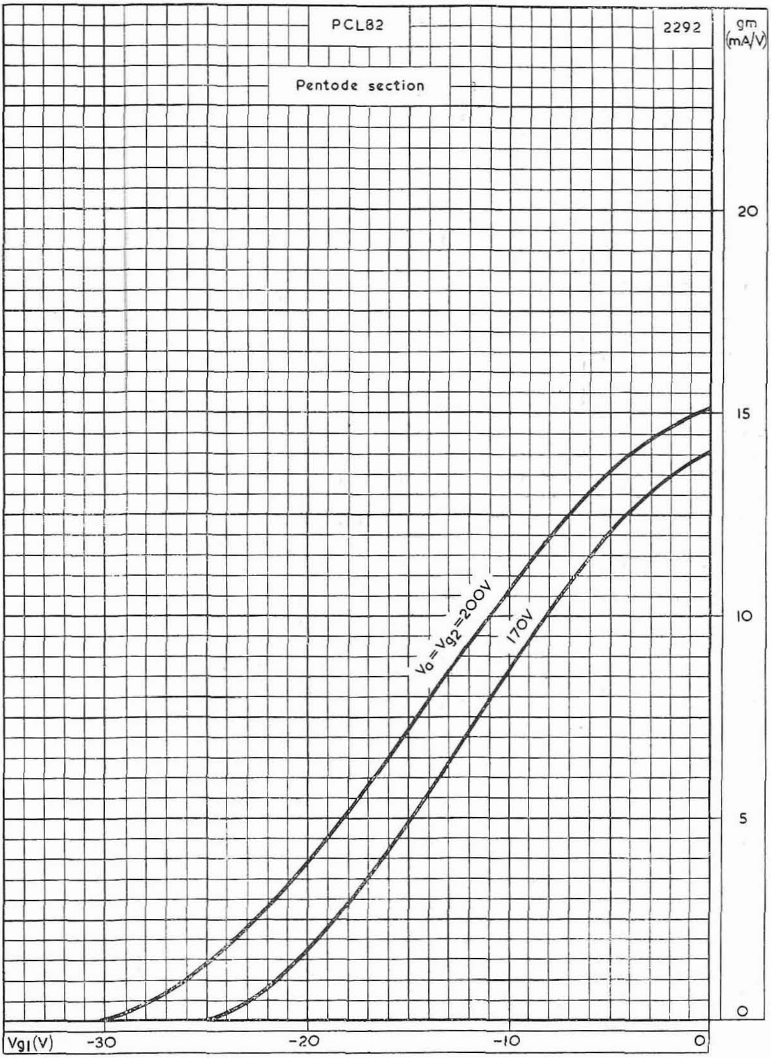


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

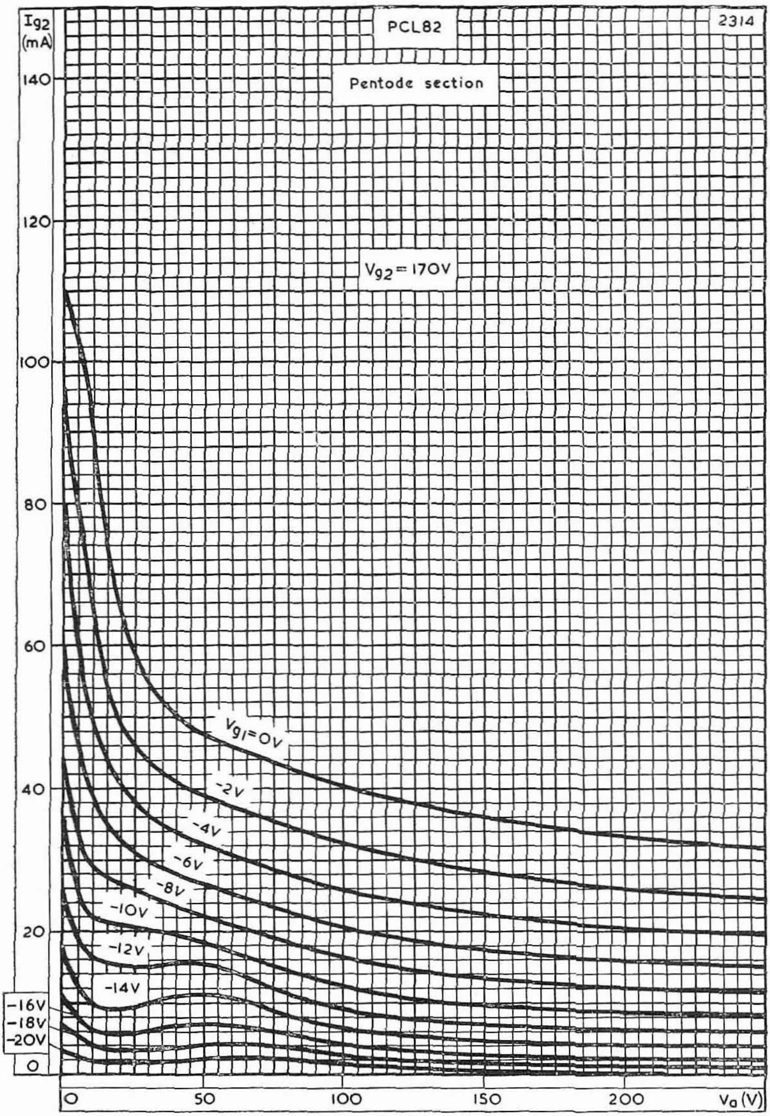


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

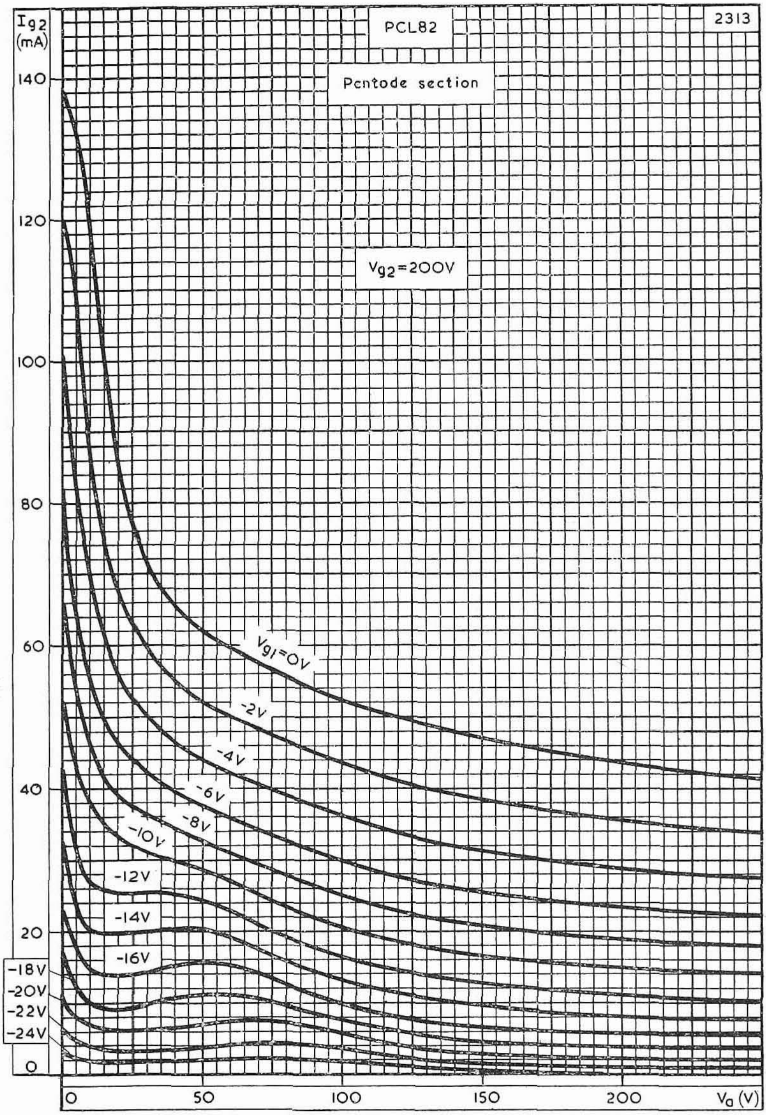


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=170V

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

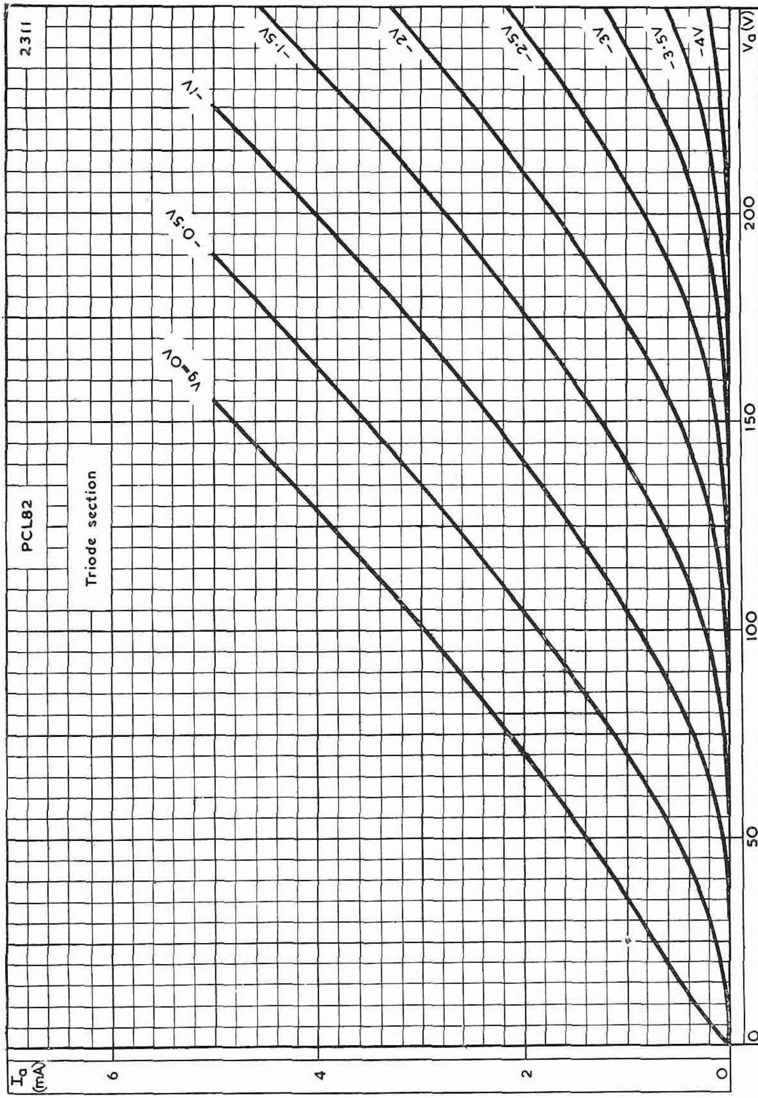


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=200V

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

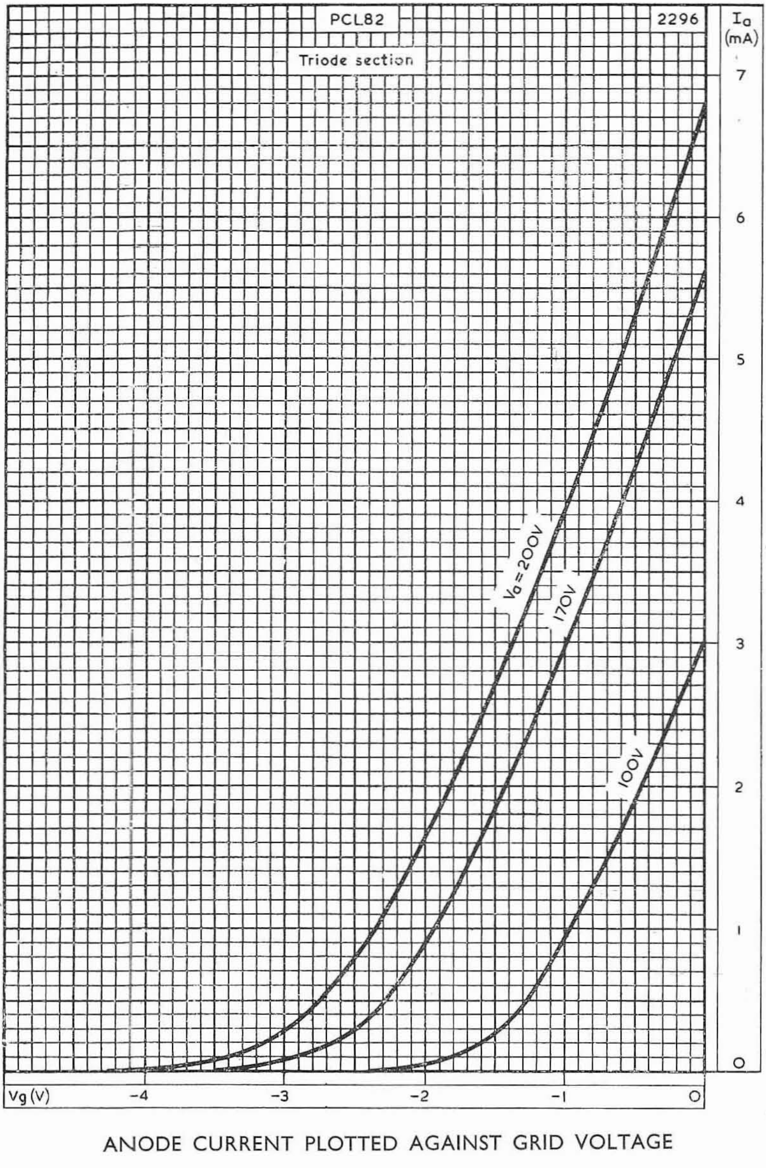


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

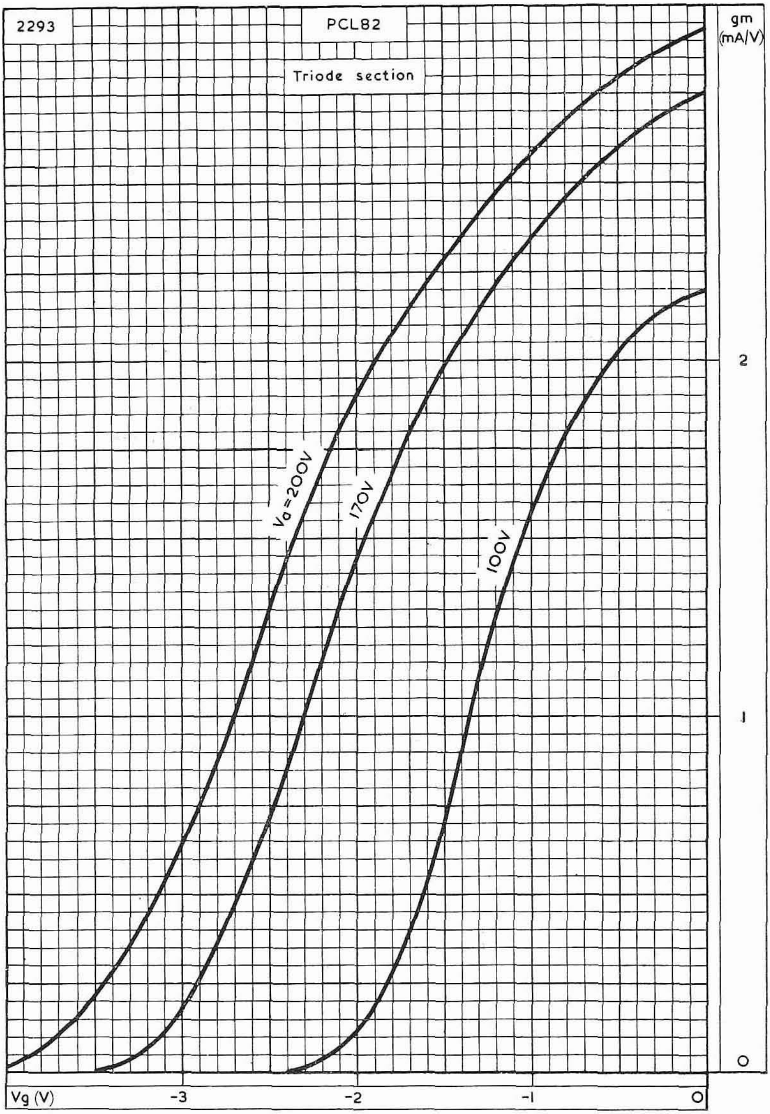


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

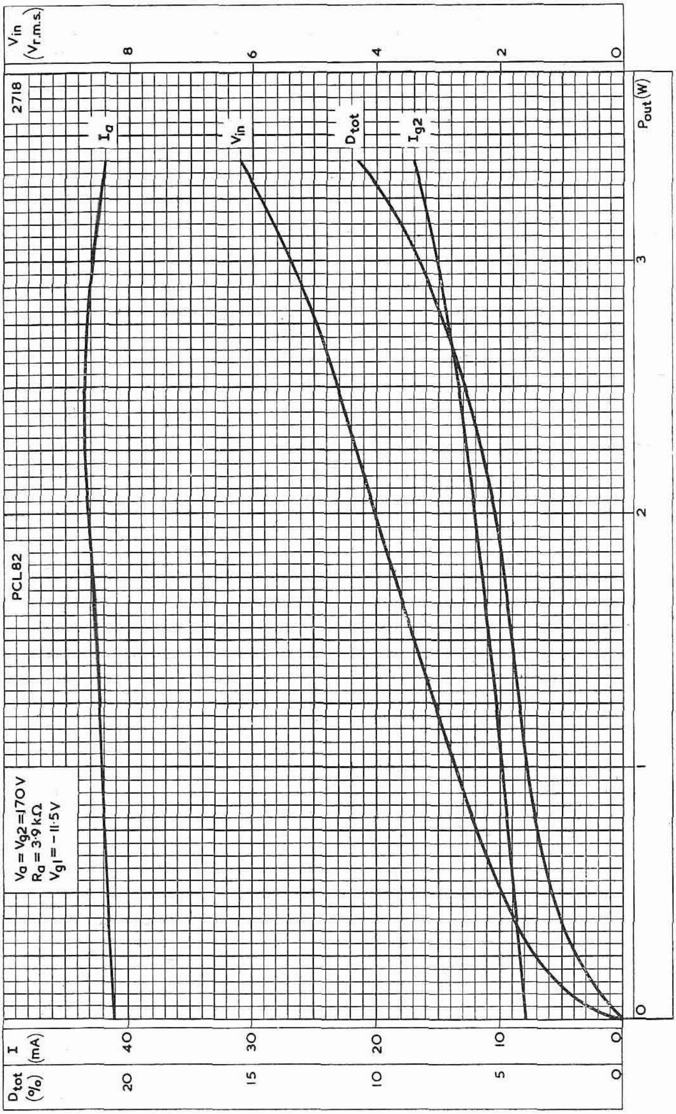


MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

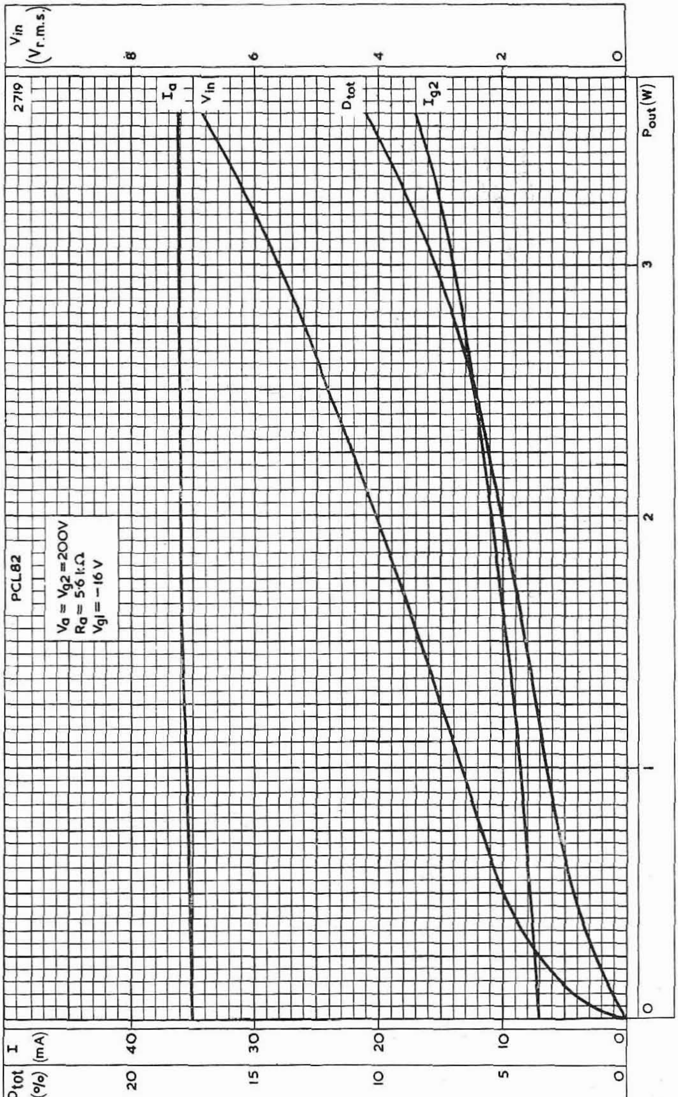


PERFORMANCE OF PENTODE SECTION AS CLASS "A" AMPLIFIER WITH FIXED BIAS $V_a = 170V$

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.

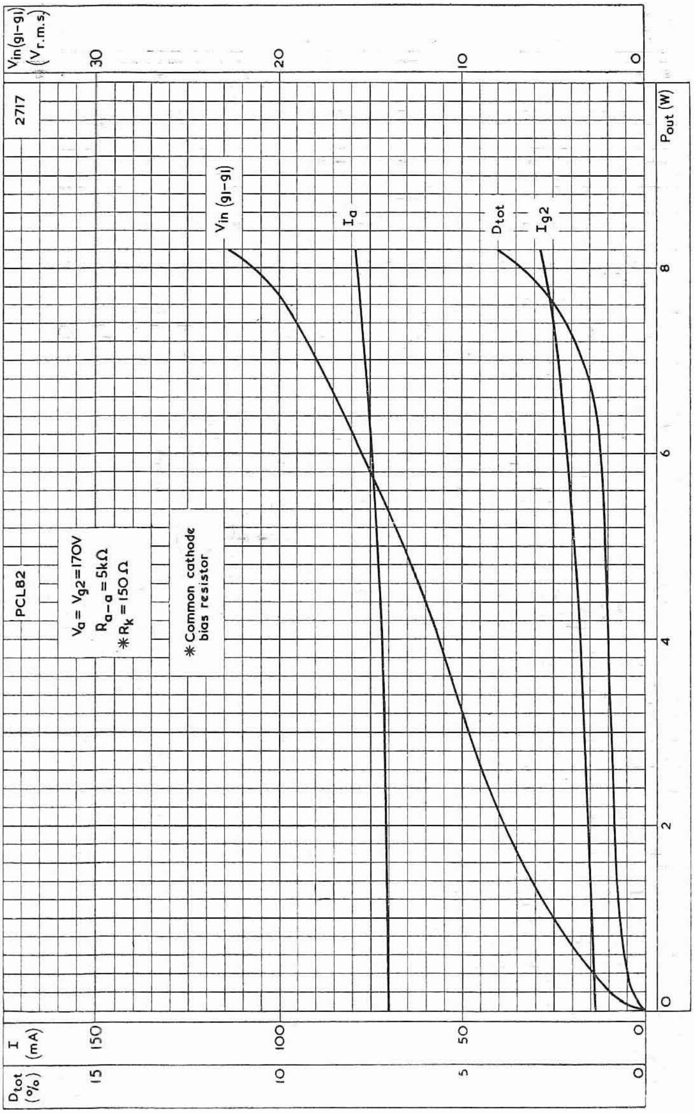


PERFORMANCE OF PENTODE SECTION AS CLASS "A" AMPLIFIER WITH FIXED BIAS $V_a = 200V$

PCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.



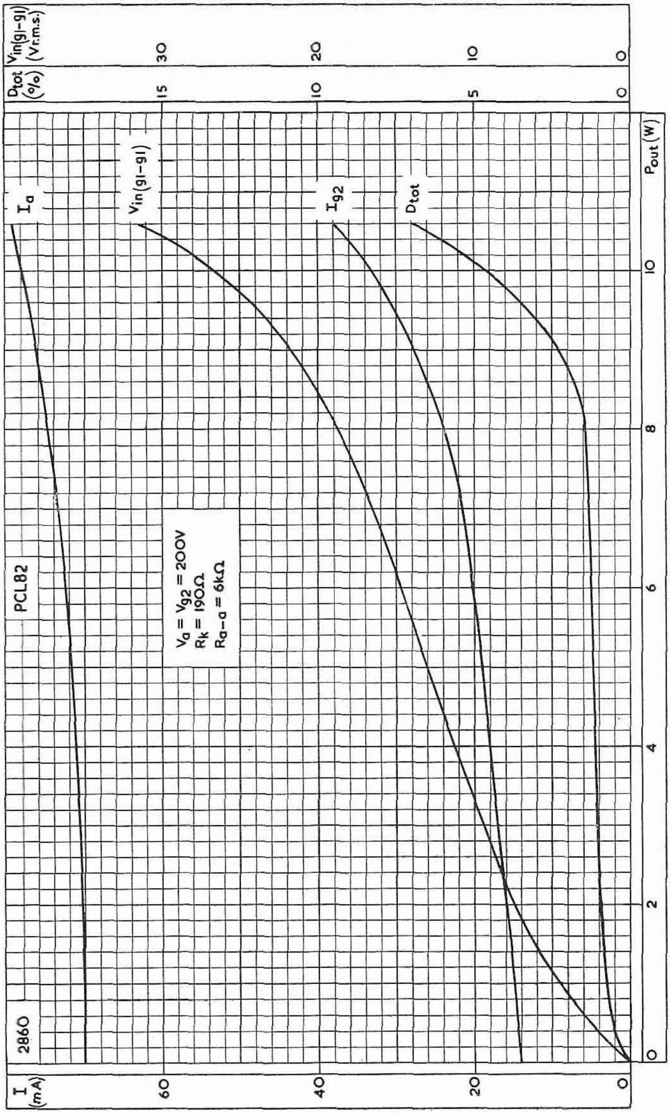
PERFORMANCE OF PCL82 IN PUSH-PULL $V_a = 170V$

Mullard

TRIODE PENTODE

PCL82

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as an a.f. amplifier or frame blocking oscillator and the pentode as frame or audio output valve.



PERFORMANCE OF PCL82 IN PUSH-PULL Va = 200V

TRIODE PENTODE

PCL84

Triode pentode for use in television circuits as keyed a.g.c. valve, sync-separator, sync-amplifier or in noise suppression circuits. Pentode section for use as video output valve.

HEATER

I_h	300	mA
V_h	15	V

CAPACITANCES

c_{at-g1}	<10	mpF
c_{gt-g1}	<10	mpF
Pentode section		
c_{in}	8.7	pF
c_{out}	4.2	pF
c_{a-g1}	<100	mpF
Triode section		
c_{g-k}	3.8	pF
c_{a-k}	2.3	pF
c_{a-g}	2.7	pF
c_{g-h}	<100	mpF

CHARACTERISTICS

Pentode section

V_a	170	200	220	V
V_{g2}	170	200	220	V
V_{g1}	−2.1	−2.9	−3.4	V
I_a	18	18	18	mA
I_{g2}	3.0	3.0	3.0	mA
g_m	11	10.4	10	mA/V
r_a	100	130	150	kΩ
μ_{g1-g2}	36	36	36	
V_{g1} max. ($I_{g1} = +0.3\mu A$)			−1.3	V

Triode section

V_a	200	V
V_g	−1.7	V
I_a	3.0	mA
g_m	4.0	mA/V
r_a	16.2	kΩ
μ	65	
V_g max. ($I_g = +0.3\mu A$)	−1.3	V

PCL84

TRIODE PENTODE

PENTODE SECTION AS VIDEO OUTPUT VALVE

$V_b = V_{g2}$	170	200	220	V
V_{g1}	−2.0	−2.8	−3.3	V
R_a	3.0	3.0	3.0	kΩ
I_a	18	18	18	mA
I_{g2}	3.2	3.1	3.1	mA
g_m	10.4	10	9.7	mA/V

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	4.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.7	W
I_k max.	40	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (self bias)	2.0	MΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
$v_{a(pk)}$ max.	600	V
p_a max.	1.0	W
*$i_{k(pk)}$ max.	160	mA
I_k max.	12	mA
R_{g-k} max. (fixed bias)	1.0	MΩ
R_{g-k} max. (self bias)	3.0	MΩ
V_{h-k} max. (cathode negative)	150	V
†V_{h-k} max. (cathode positive)	350	V
R_{h-k} max.	20	kΩ

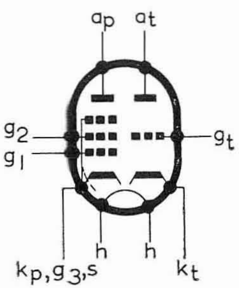
*Maximum pulse duration = 800μs.

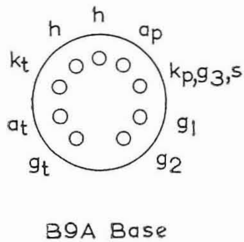
†Maximum d.c. component = 200V.

TRIODE PENTODE

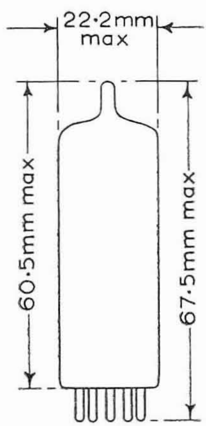
PCL84

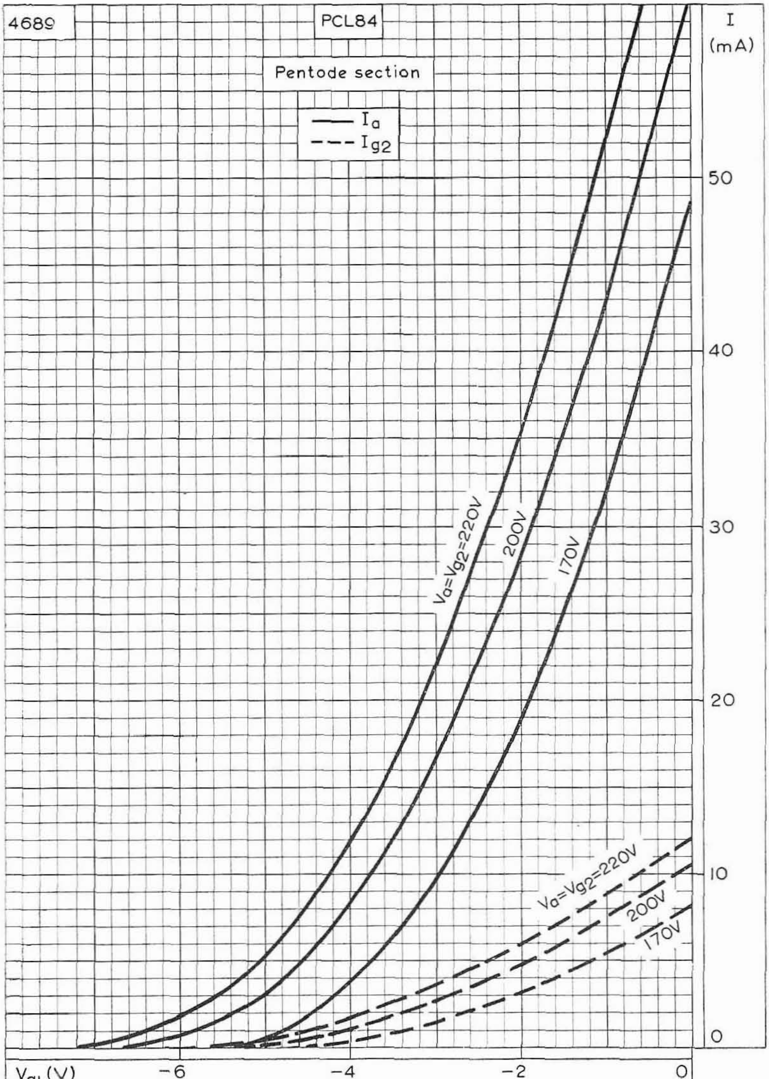
4690





B9A Base

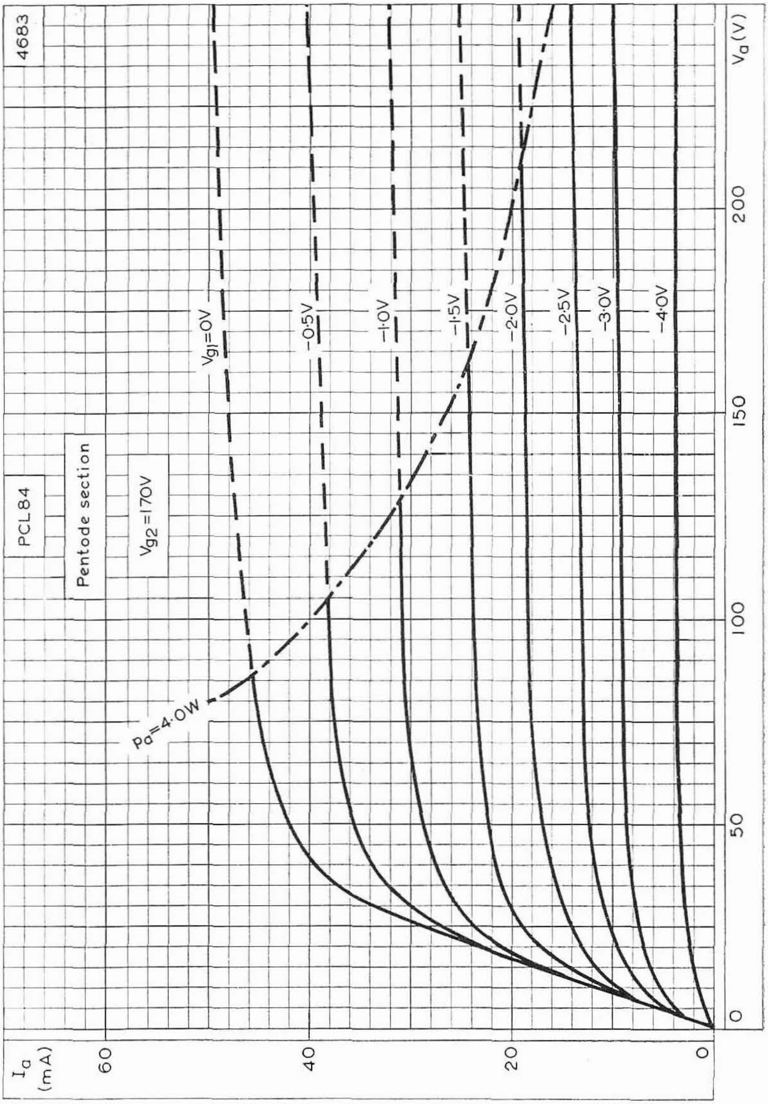




ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS ANODE AND SCREEN-GRID VOLTAGES

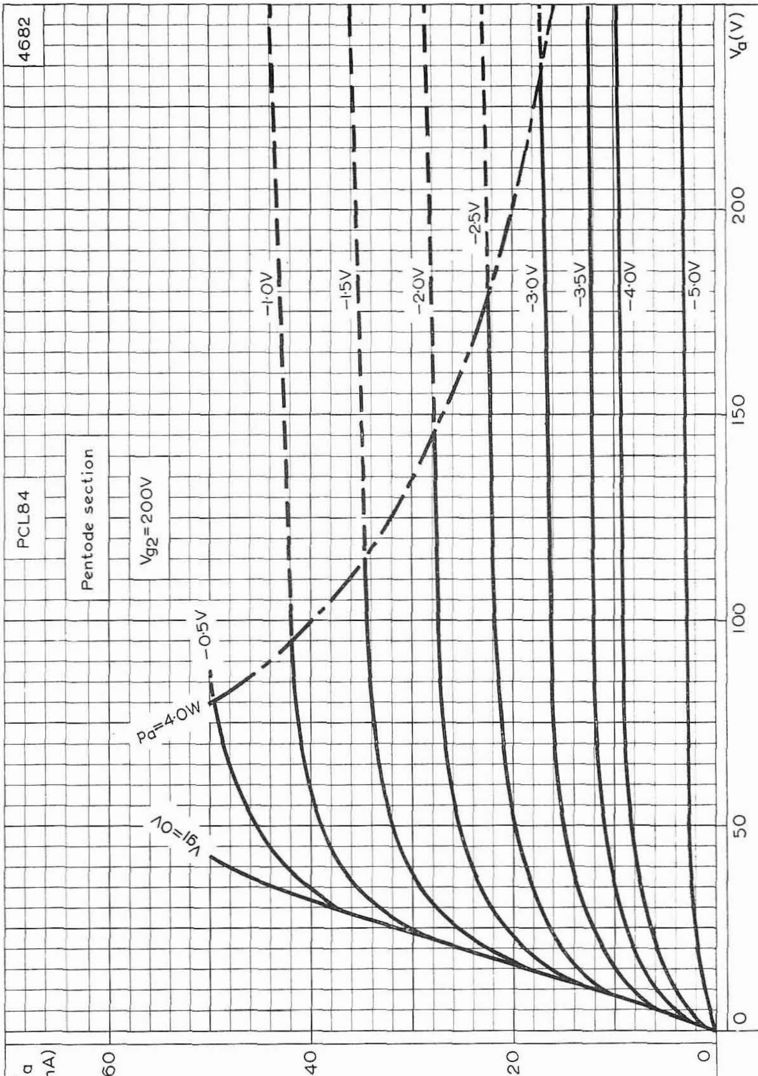
PCL84

TRIODE PENTODE

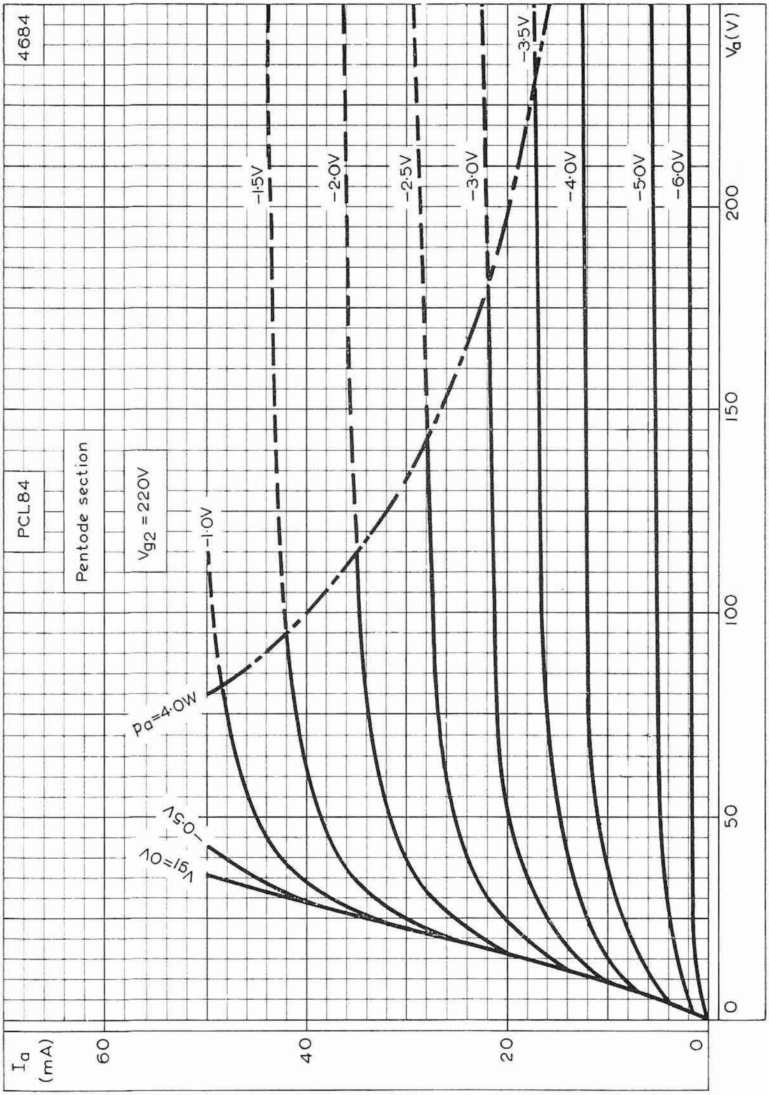


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER.
$V_{g2} = 170V$

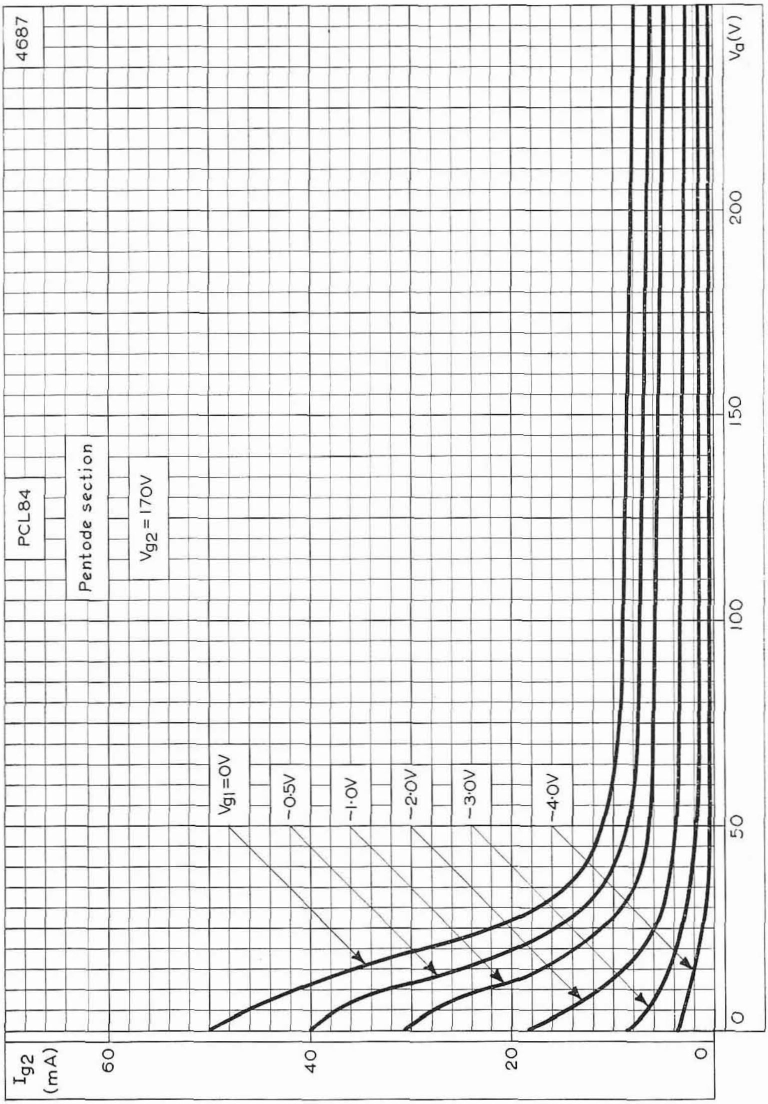
Mullard



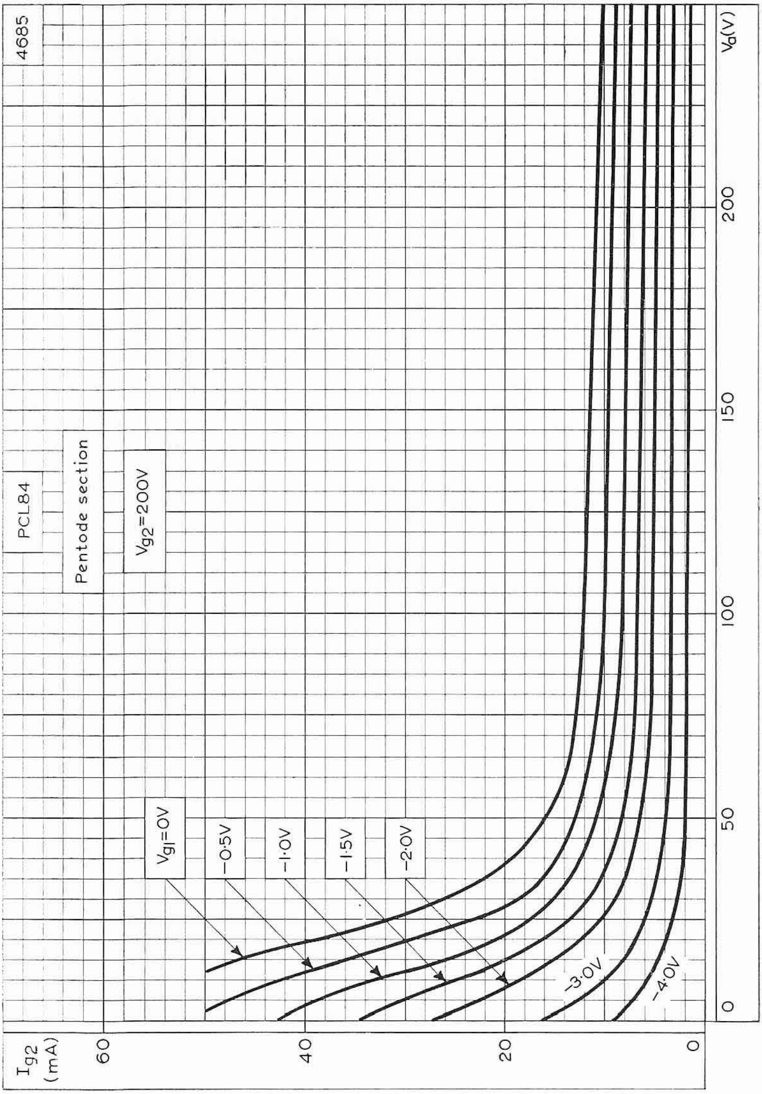
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 200V$



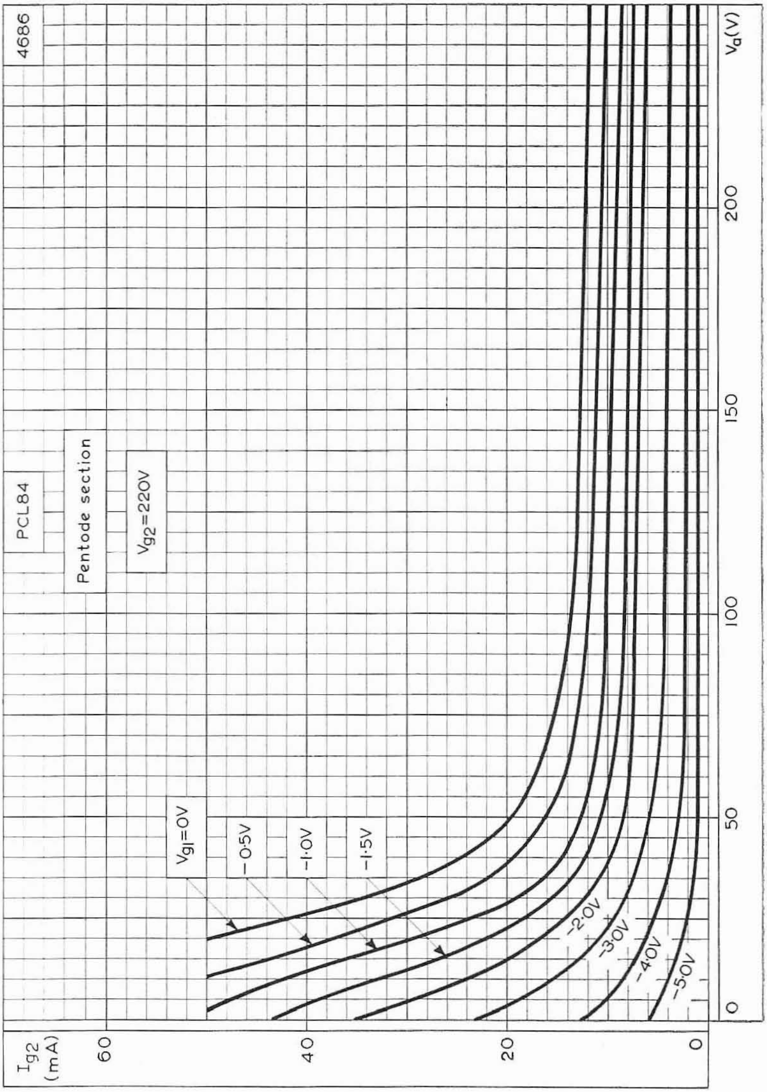
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 220V$



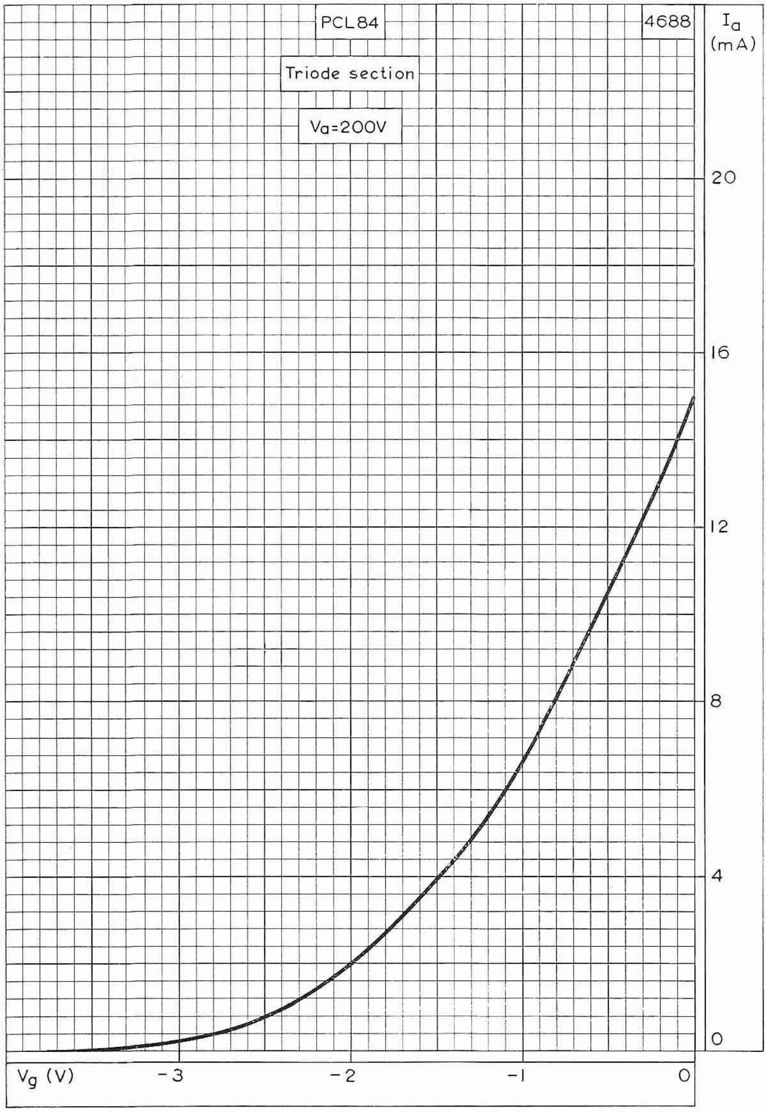
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 170V$



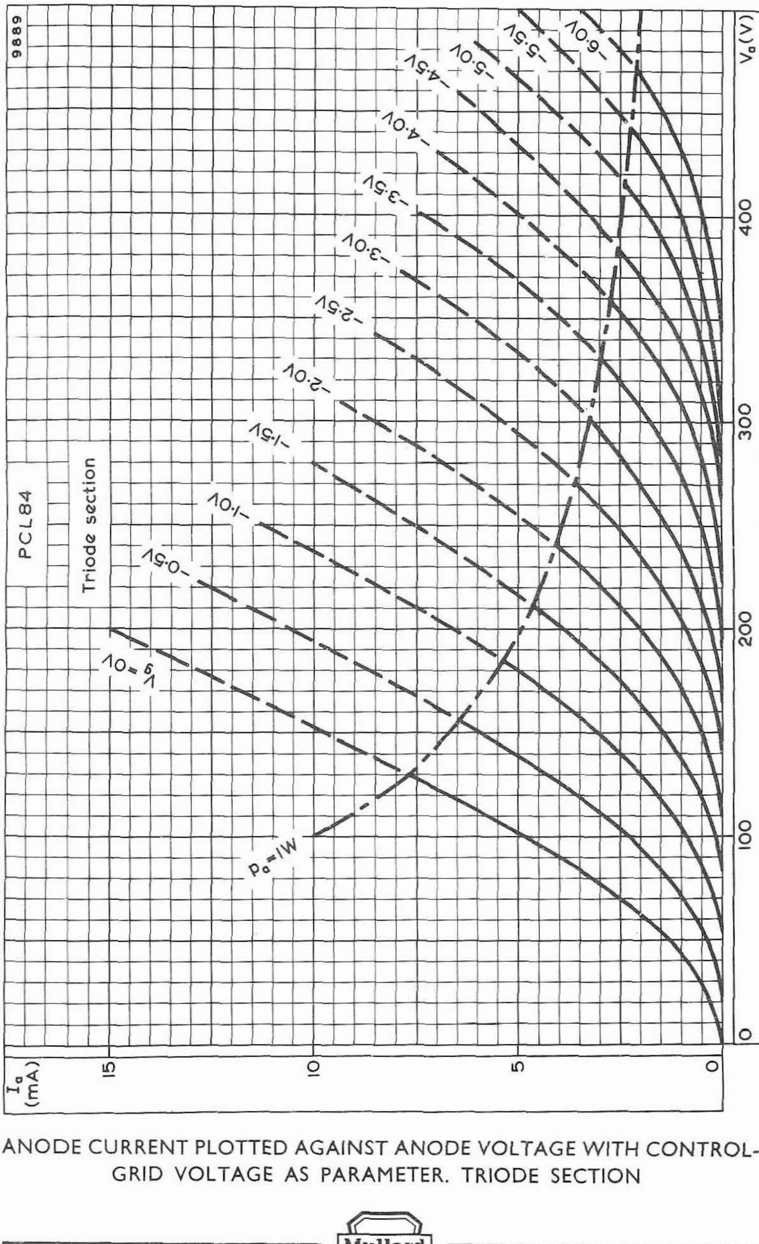
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 200V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 220V$



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
FOR TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. TRIODE SECTION

SHUNT STABILISER TRIODE

PD500

High voltage triode for use as a shunt stabiliser in colour television receivers.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	7.3	V

CHARACTERISTICS

V_a	25	kV
V_s	0	V
$-V_g$ at $I_a = 1.5$mA	7 to 30	V
$-V_g$ max. at $I_a = 0.1$mA	40	V
ΔV_g max. between $I_a = 0.1$mA and $I_a = 1.5$mA	10	V

RATINGS (DESIGN CENTRE SYSTEM)

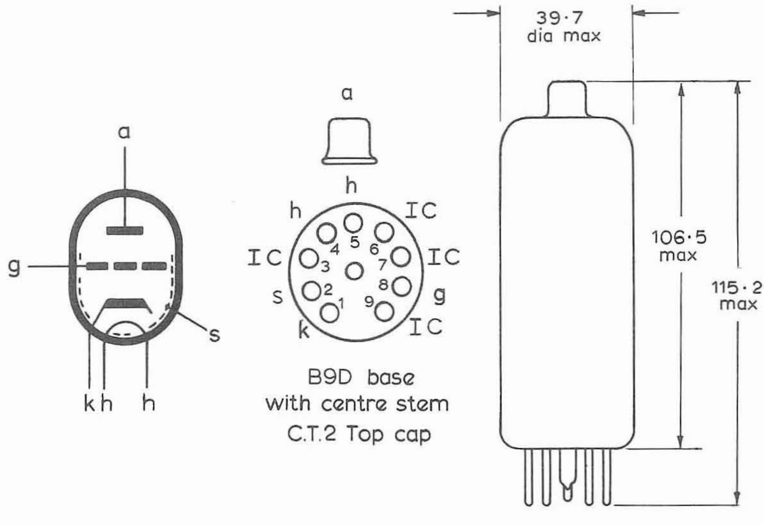
V_a max.	25	kV
V_a (absolute max. see note 1)	27.5	kV
$-V_g$ max. (see note 2)	150	V
p_a	30	W
p_a max. (intermittent rating t.v. shunt stabiliser - see note 3)	40	W
I_a max.	1.6	mA ←
R_{g-k} max.	5.0	MΩ
V_{h-k} max. (cathode positive)	400V d.c.+250V a.c.	
V_{h-k} max. (cathode negative)	250	V
V_{s-k} max. (shield negative - see note 4)	400	V
$T_{anode\ seal}$ (absolute max.)	200	°C

NOTES

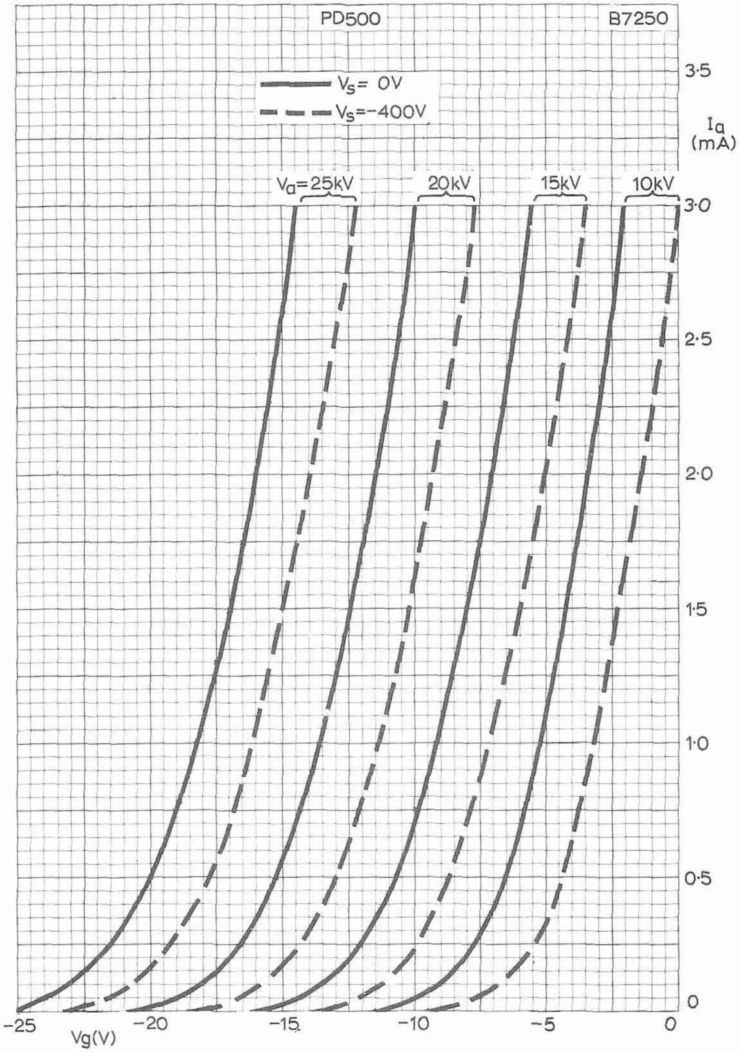
1. If due to a circuit failure the anode current becomes zero, the anode voltage should never exceed 45kV (abs. max.).
2. During equipment warm-up period and for brief intervals during equipment adjustment only, the grid voltage may rise to 440V maximum.
3. This rating applies to operation for a maximum of 10% of the time.
4. Operation with the shield positive with respect to cathode is not recommended. The shield may function as a spark trap and should have a low impedance return path to the external coating of the picture tube. A.C. potential between the shield and cathode can modulate the anode current; the maximum sensitivity is 2.5μA/V.
5. Additional support is required at the top of the valve. To prevent corona ← effects, any metal screening around the valve should be at least 50mm from the nearest point of the bulb. Adequate ventilation should be provided for.

X-RAYS

When operated in a television receiver this valve will produce X-radiation in excess of permissible dosage, and a suitable screen should be incorporated.



All dimensions in mm



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

DOUBLE PENTODE

PFL200

Double pentode for video output plus sync, separator, a.g.c. amplifier or i.f. amplifier applications.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	17	V ←

CAPACITANCES (unshielded) ←

$c_{a'-a''}$	<150	mpF
$c_{g1'-g1''}$	<10	mpF
$c_{a'-g1''}$	<100	mpF
$c_{a''-g1'}$	<5.0	mpF
L Section		
$c_{in'}$	12.5	pF
$c_{out'}$	6.5	pF
$c_{a'-g1'}$	100	mpF
F Section		
$c_{in''}$	10.5	pF
$c_{a''-g2''+k''g3''+h+k'g3',s}$	10.5	pF
$c_{a''-g1''}$	150	mpF
$c_{g1''-h}$	<150	mpF

CHARACTERISTICS ←

	Amplifier section		Output section	
V_a	150	50	170	V
V_{g2}	150	75	170	V
I_a	10	5.0	30	mA
I_{g2}	3.0	1.6	7.0	mA
V_{g1}	-2.1	-0.65	-2.7	V
g_m	8.5	6.8	22	mA/V
μ_{g1-g2}	38	34	38	
r_a	150	110	33	kΩ

RATINGS (DESIGN CENTRE SYSTEM)

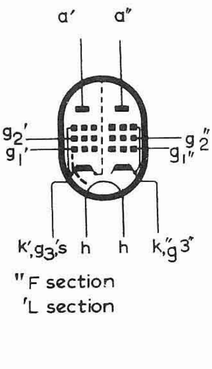
Output section

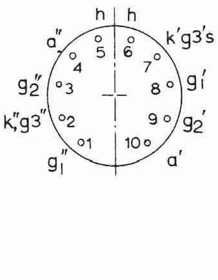
V_a max.	250	V
V_{g2} max.	250	V
p_a max.	5.0	W
p_{g2} max.	2.5	W
p_{g2} max. (intermittent rating, short duration)	3.2	W
I_k max.	60	mA
I_k max. (intermittent rating, short duration)	85	mA
R_{g1-k} max.	1.0	MΩ
V_{h-k} max.	200	V

Amplifier section

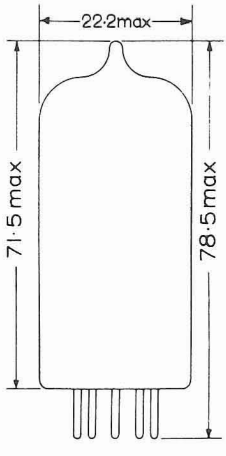
$V_{a(b)}$ max.	550	V
$V_{g2(b)}$ max.	550	V
V_a max.	250	V
V_{g2} max.	250	V
p_a max.	1.5	W
p_{g2} max.	0.5	W
I_k max.	15	mA
R_{g1-k} max.	1.0	MΩ
V_{h-k} max.	200	V

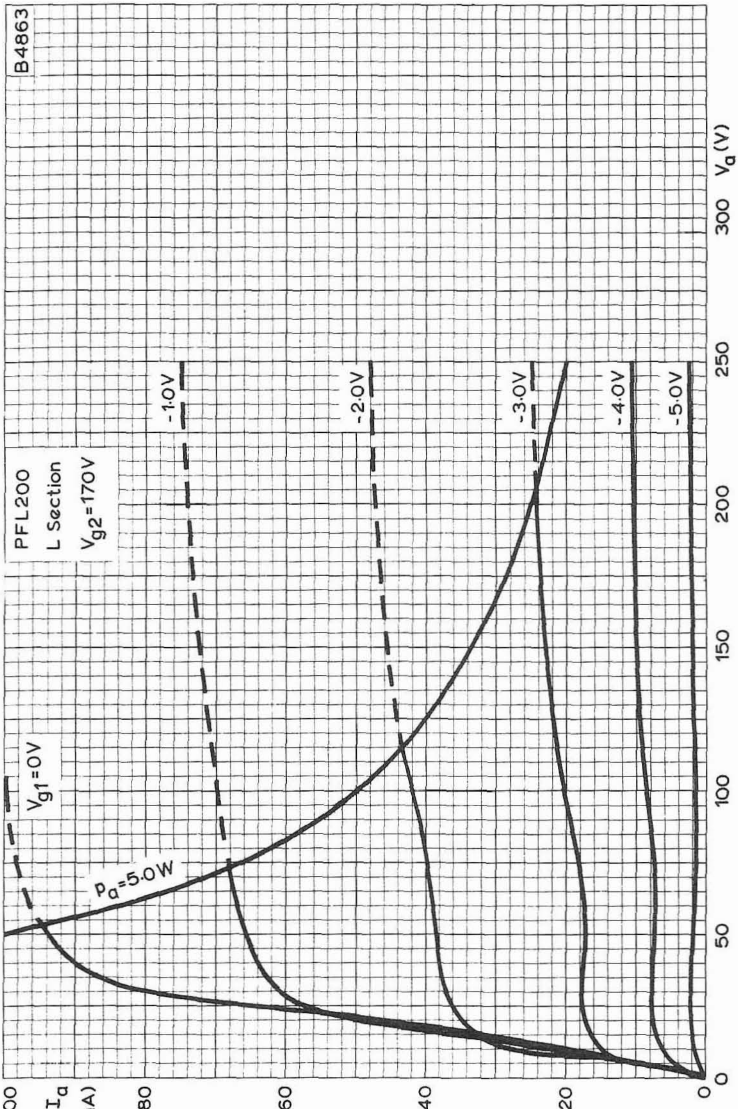
B4679



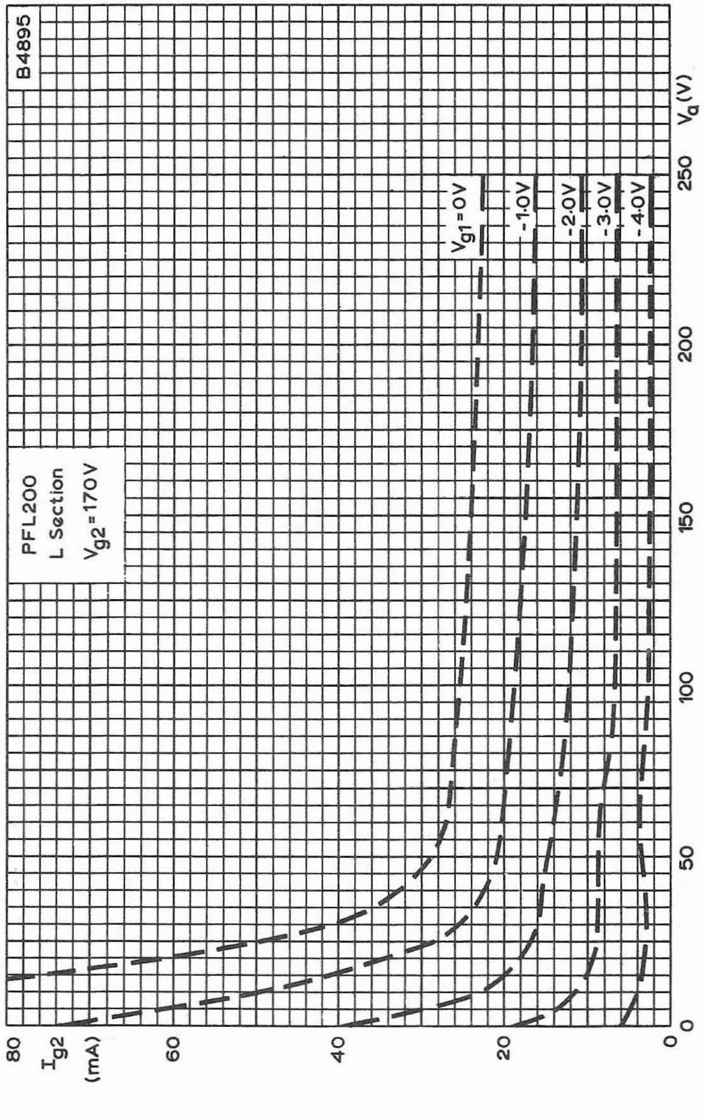


B10B base

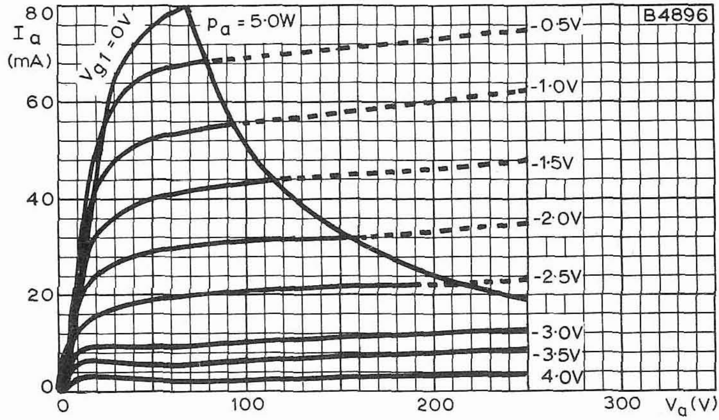


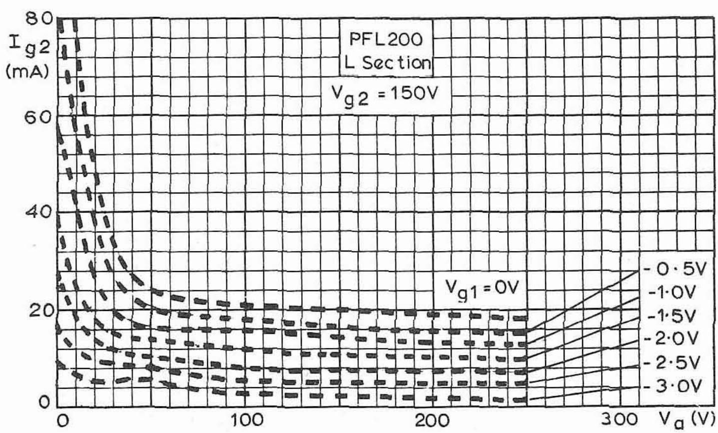


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 170V. L SECTION

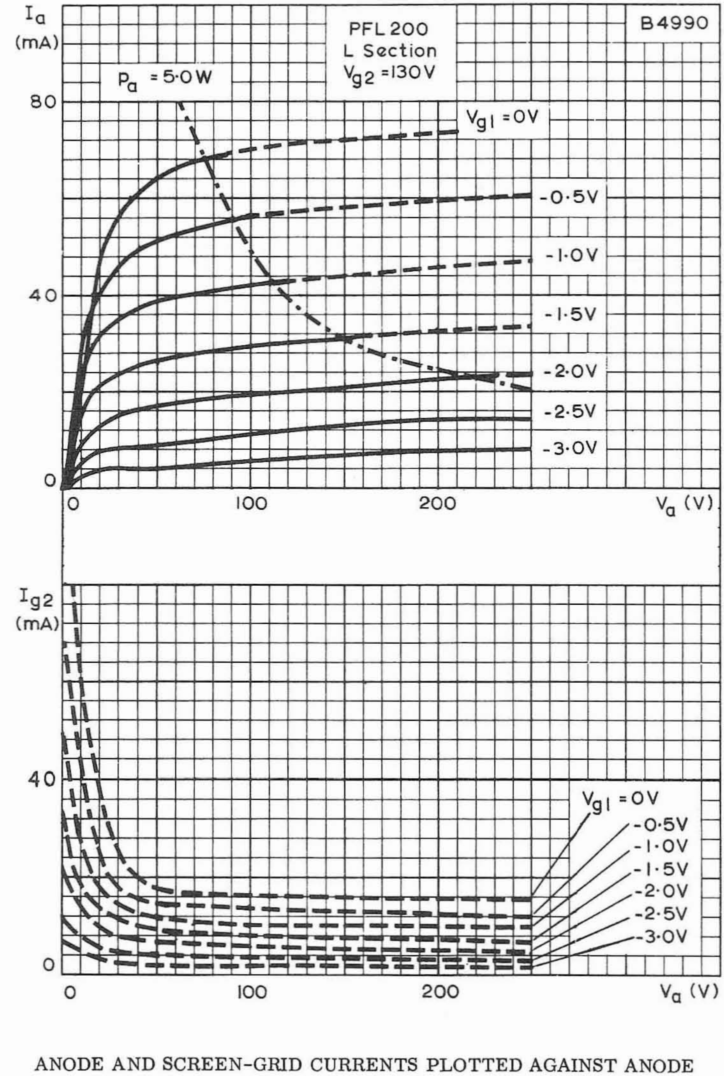


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 170V.
L SECTION

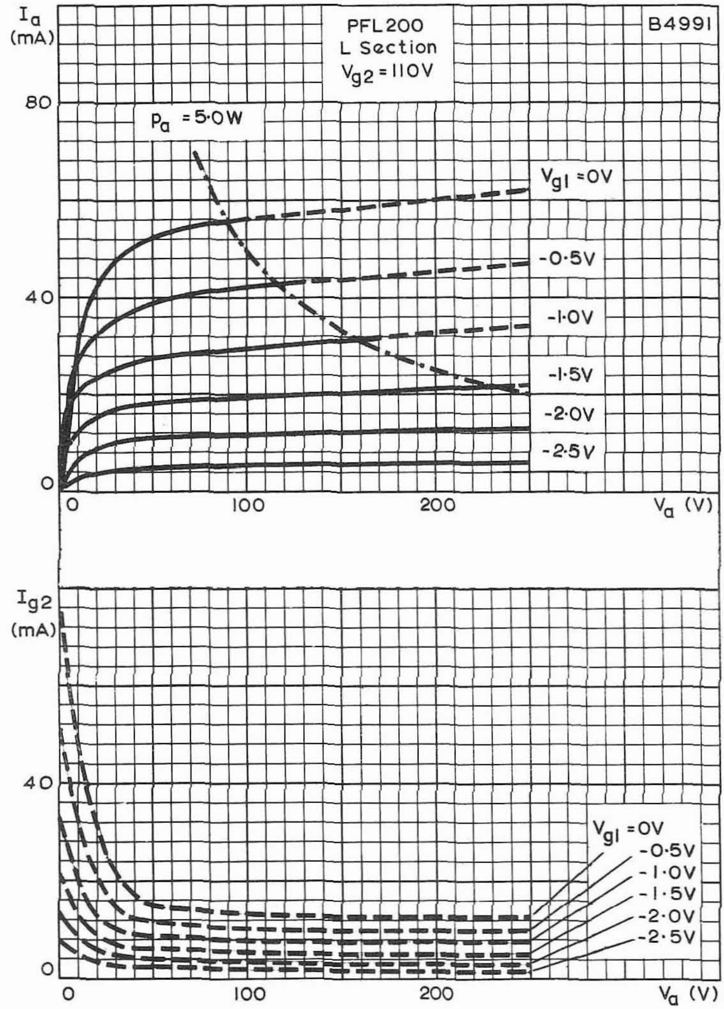




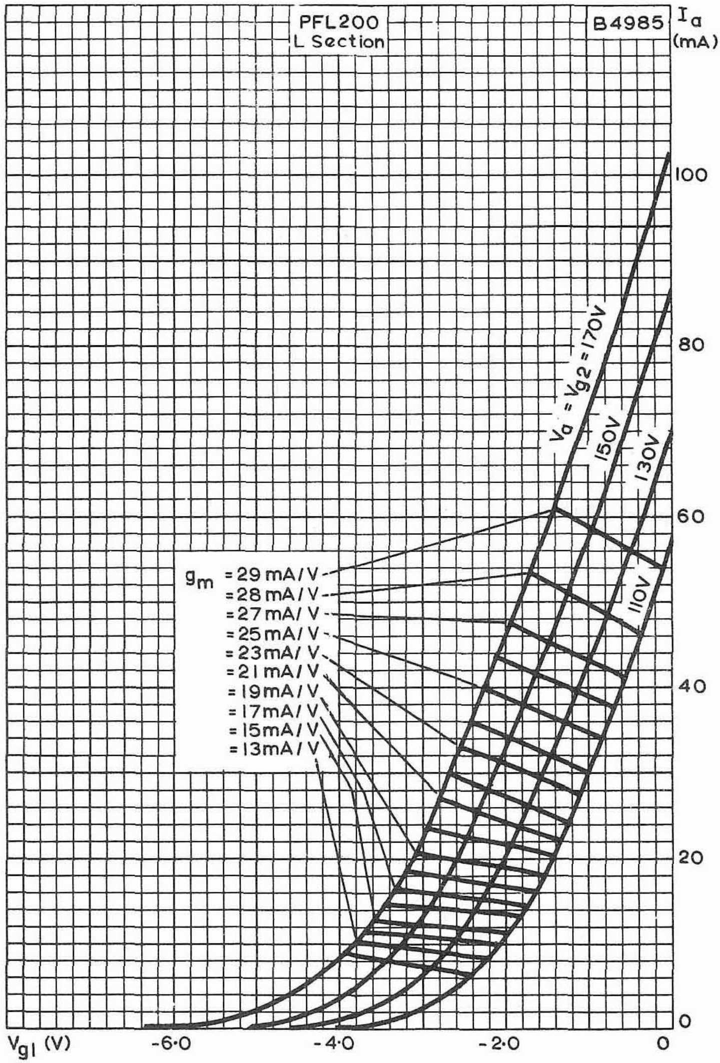
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V. L SECTION



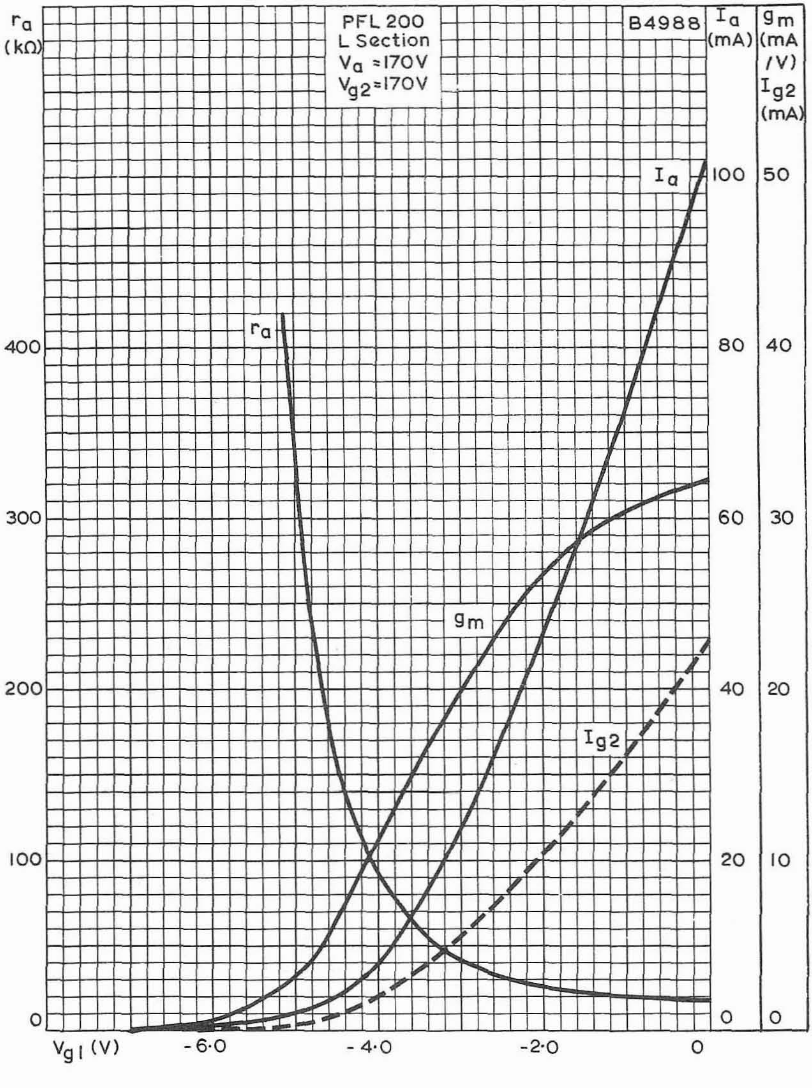
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 130V. L SECTION



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 110V. L SECTION



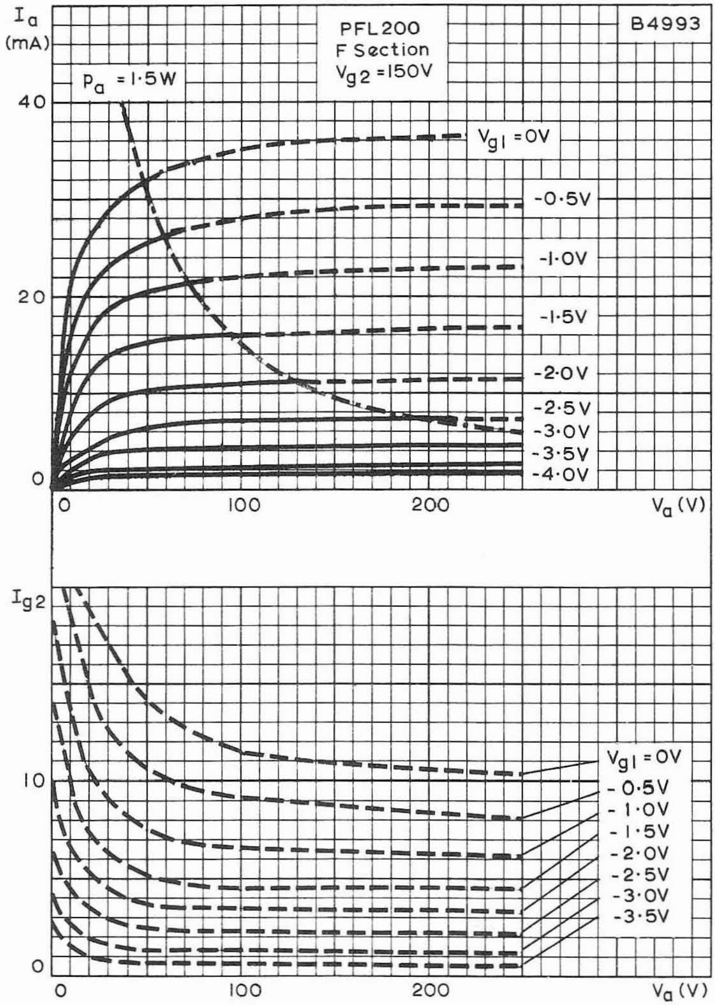
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS AND WITH MUTUAL CONDUCTANCE CONTOURS.
L SECTION



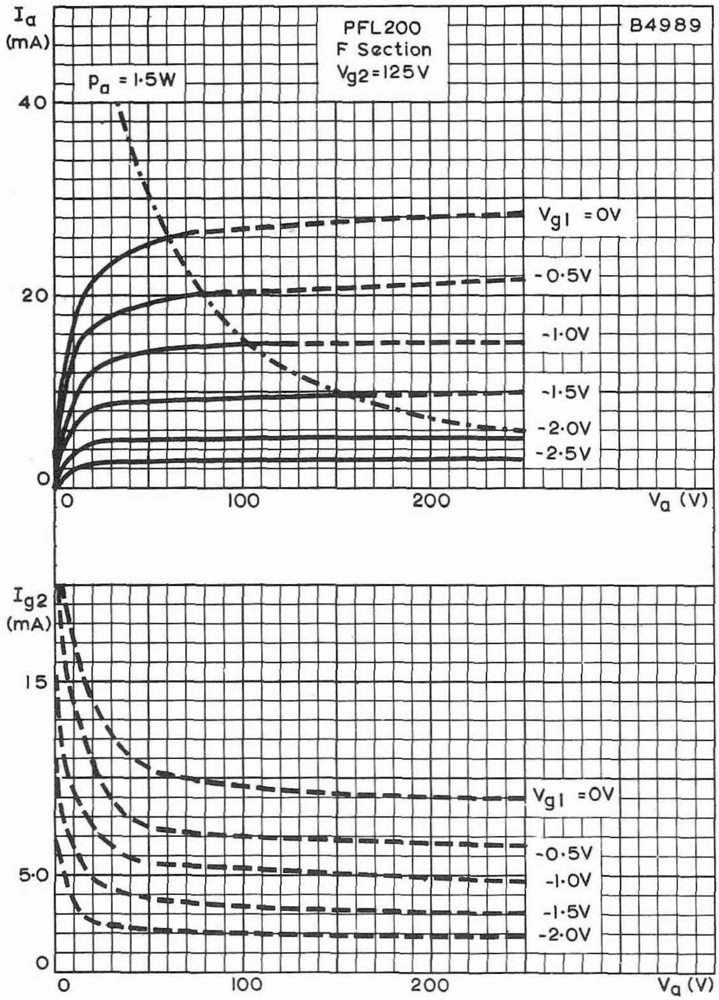
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.

$V_a = V_{g2} = 170V.$

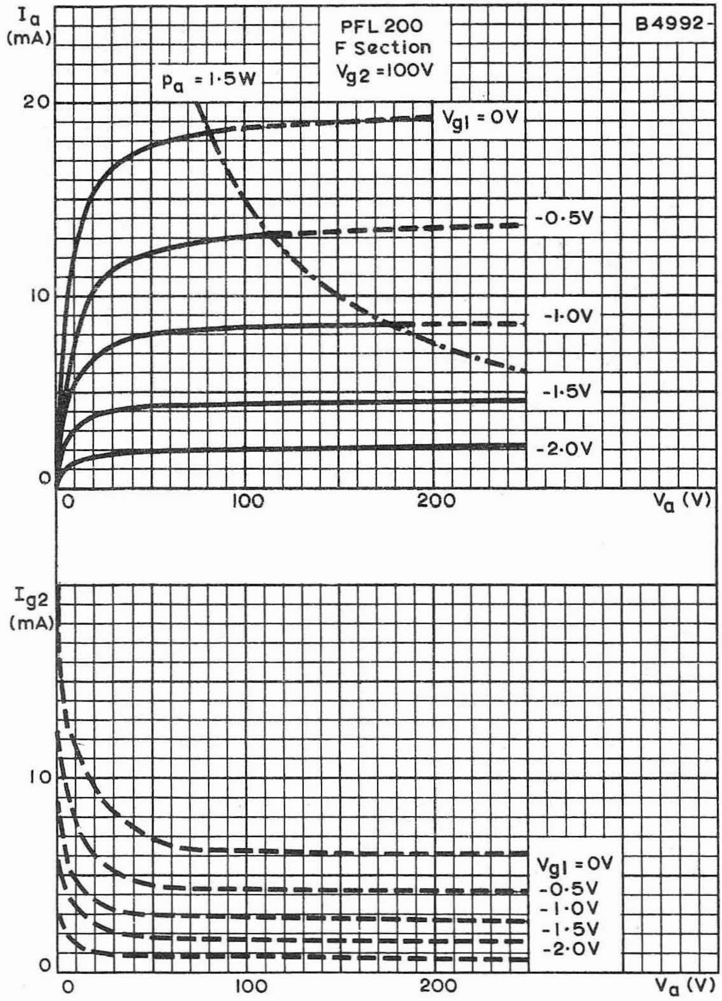
L SECTION



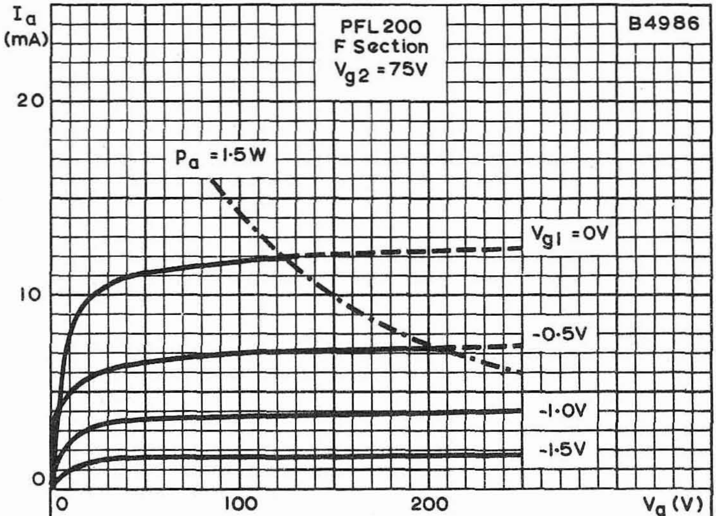
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V. F SECTION

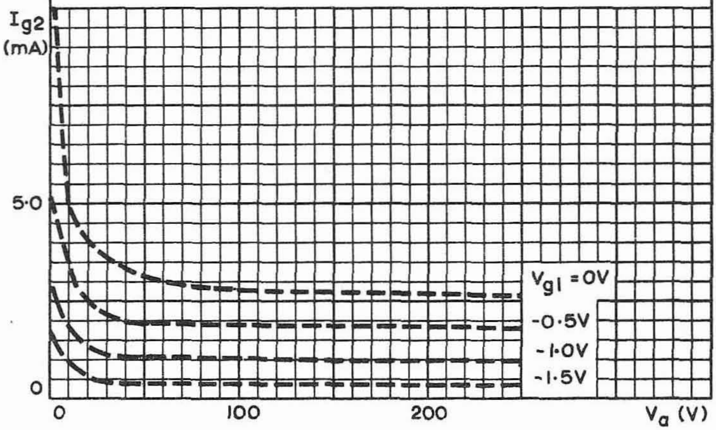


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 125V. F SECTION

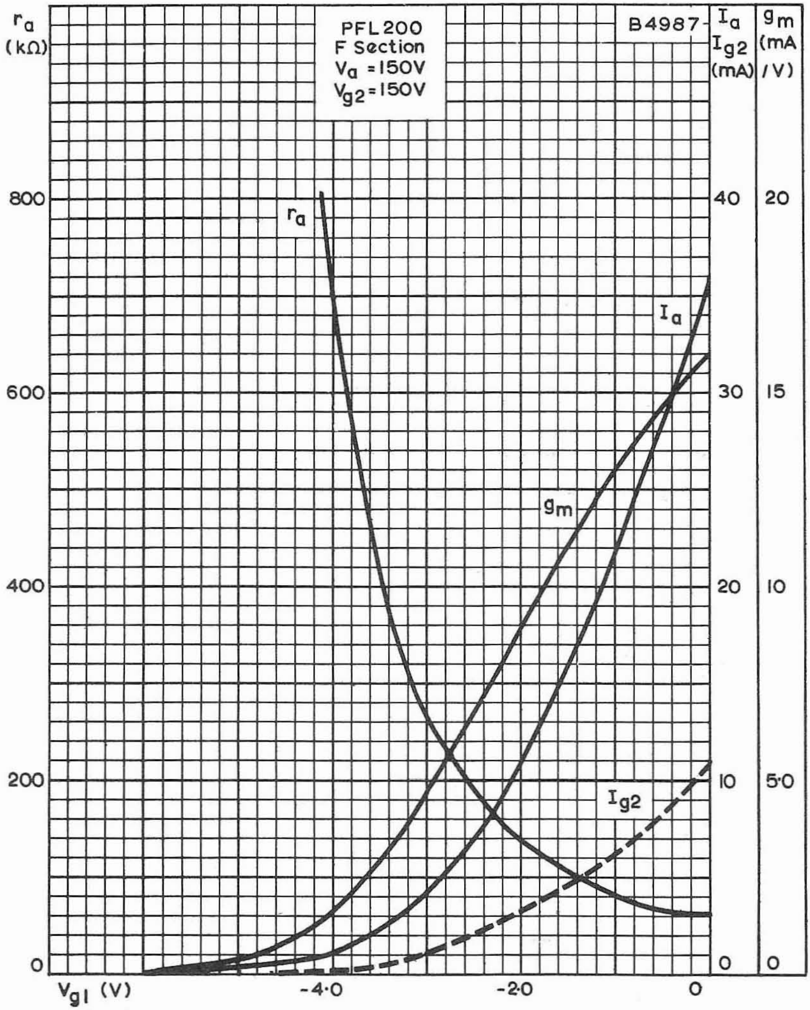


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V. F SECTION





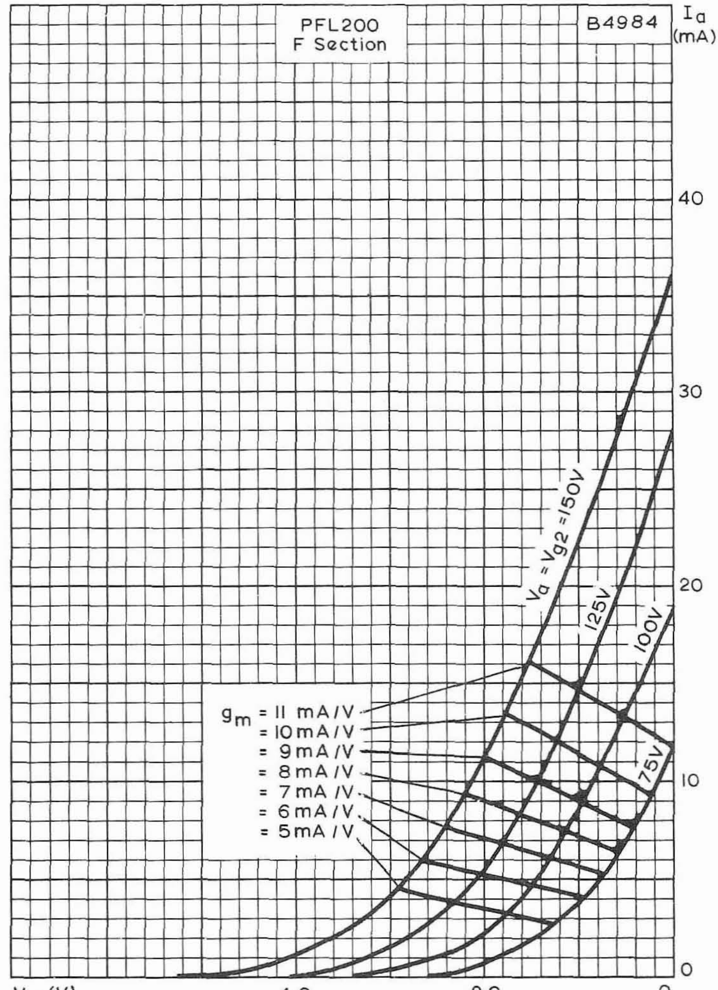
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 75V$.
F SECTION



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.

$V_a = V_{g2} = 150V$.

F SECTION



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS AND WITH MUTUAL CONDUCTANCE CONTOURS.
F SECTION

LINE OUTPUT PENTODE

PL36

Output pentode primarily intended for use in the line timebase of television receivers.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	25	V

CAPACITANCES

c_{in}	17.5	pF
c_{out}	8.0	pF
c_{a-g1}	$<$ 1.1	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	-8.2	V
I_a	100	mA
I_{g2}	7.0	mA
g_m	14	mA/V
r_a	5.0	kΩ
μ_{g1-g2}	5.6	

OPERATION AS LINE OUTPUT PENTODE

Circuit design

In calculating the peak anode current for circuit design purposes the knee is taken as the reference point. Operation so that the anode potential of the output valve at the end of scan is above the knee of the anode characteristic is only recommended when an effective feedback stabilising circuit is employed. A nomogram is given on page C1.

For operation below the knee of the characteristic the nomogram on page C2 should be used.

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
*$+v_{a(pk)}$ max.	7.0	kV
*$-v_{a(pk)}$ max.	1.5	kV
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
*$-v_{g1(pk)}$ max.	1.0	kV
†p_{g2} max.	5.0	W
$p_{a}+p_{g2}$ max.	13	W
I_k max.	200	mA
V_{h-k} max. (cathode negative)	200	V
V_{h-k} max. (cathode positive)	250	V
R_{g1-k} max. (fixed bias)	500	kΩ
R_{g1-k} max. (line timebase applications)	3.3	MΩ
Min. drive at $v_{a(pk)}$ = 5kV	100	V
Min. drive at $v_{a(pk)}$ = 7kV	120	V
T_{bulb} max.	250	°C←

*Max. duration 22% of one cycle with a maximum of 18μs.

†Max. average p_{g2} is 7W during the period between the commencement of I_{g2} and the instant when I_a attains one half of its normal operating value.

PEAK ANODE CURRENT NOMOGRAMS

Stabilised timebases

The nomogram shown on page C1 gives directly the values of peak anode current and end-of-scan anode voltage which should be used in designing a stabilised line timebase. The nomogram is based on an h.t. line voltage of 200V, and a correction factor is included for other h.t. voltages.

Non-stabilised timebases

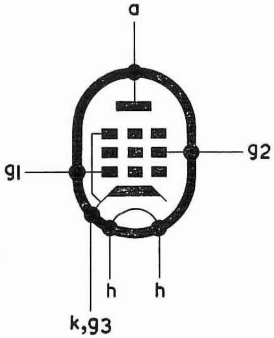
The nomogram shown on page C2 gives directly the values of peak anode current and end-of-scan anode voltage which should be used in designing a non-stabilised line timebase. It assumes 'below-the-knee' operation, undecoupled screen-grid resistor (excluding capacitors of a few hundred microfarad), and control-grid potential of +1V.

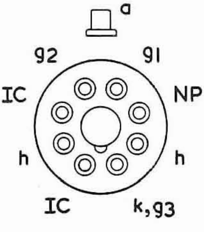
Measurements

When measurements are made specifically for the purpose of comparison with the nomogram, all the components comprising the timebase, including the valves, should be nominal. The h.t. line should also be nominal. In receivers designed for a range of declared values of mains voltage, measurements should be made at the nominal declared value of mains voltage producing the lowest nominal h.t. voltage. The timebase should be synchronised and the raster adjusted to nominal scan. The beam current drawn from the e.h.t. supply should be 300μA.

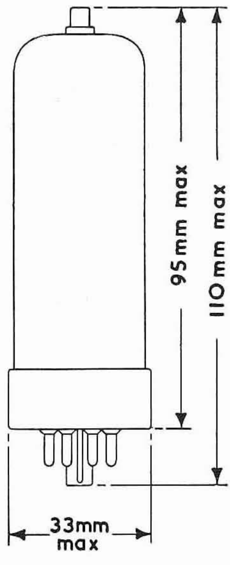
The use of the nomogram does not exempt the designer from checking that the valve is operating within its limiting values.

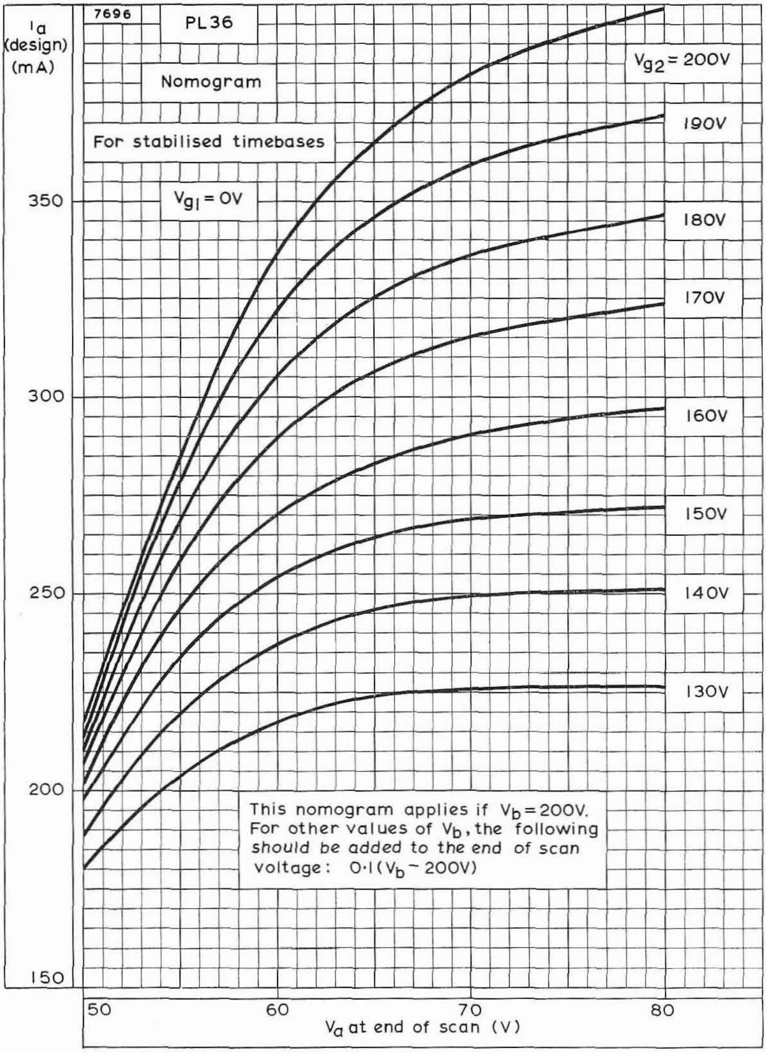
2277



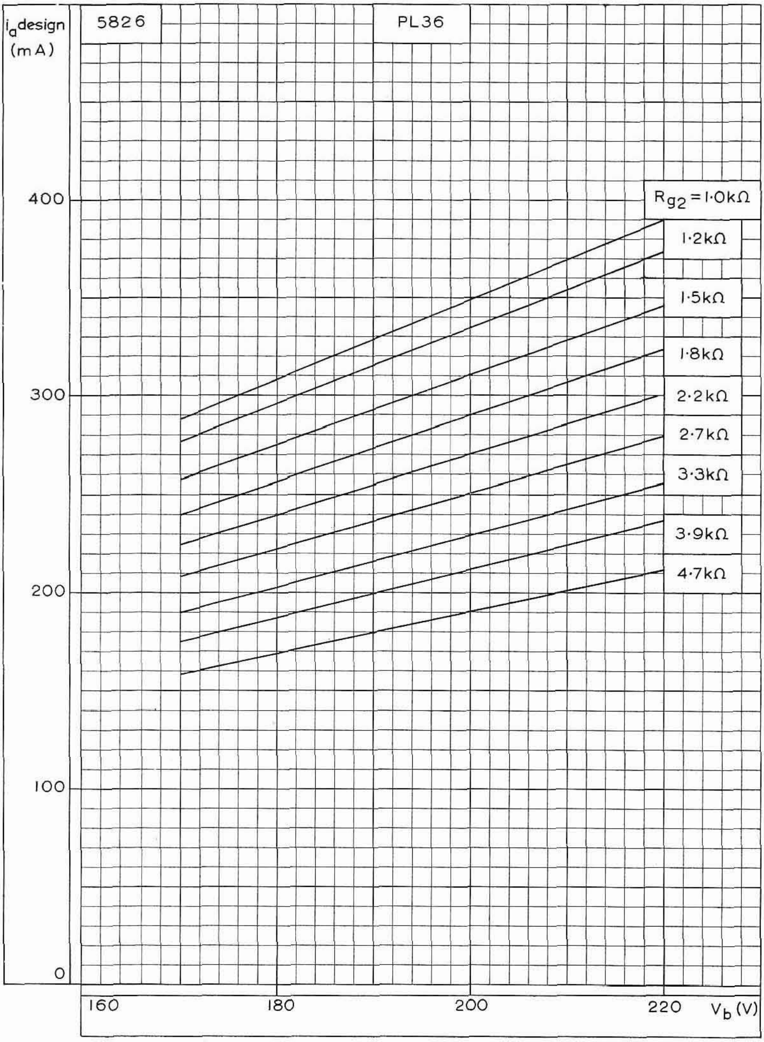


Octal Base

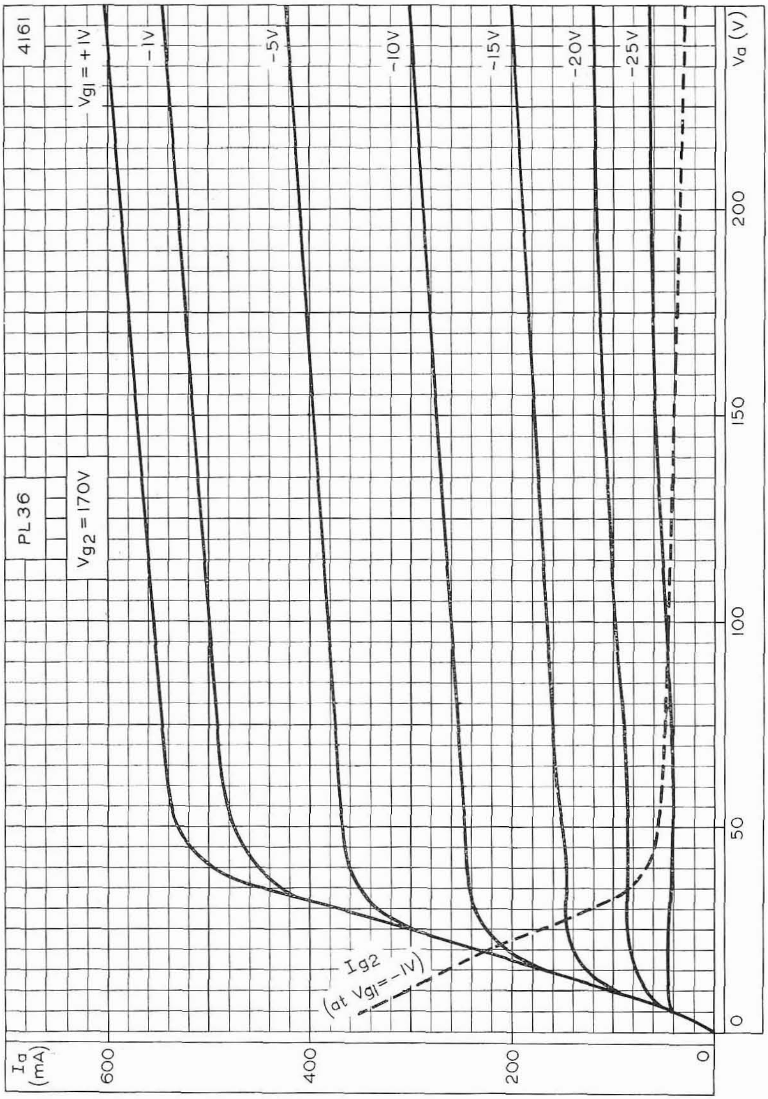




NOMOGRAM FOR STABILISED TIMEBASES



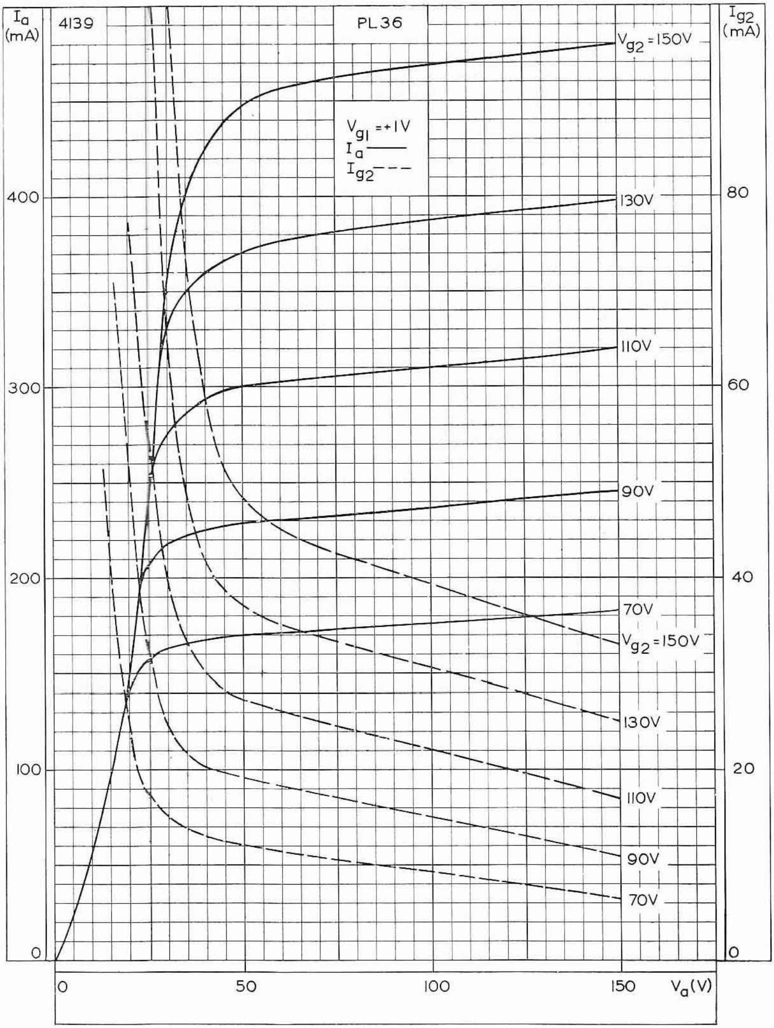
NOMOGRAM FOR NON-STABILISED TIMEBASES



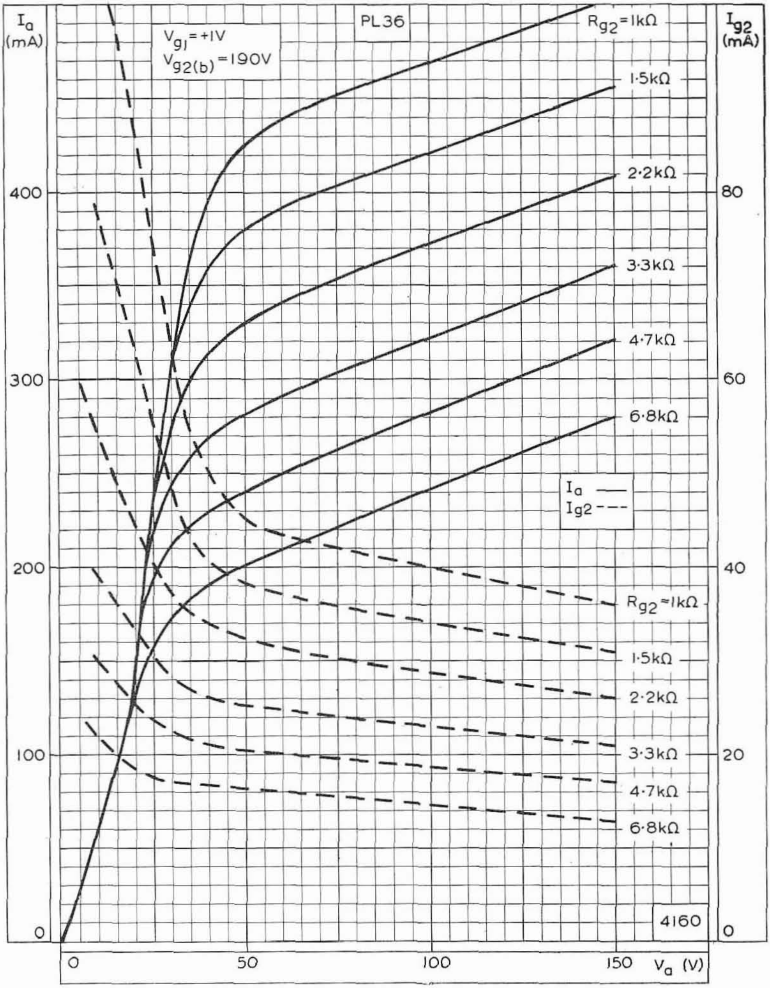
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

PL36

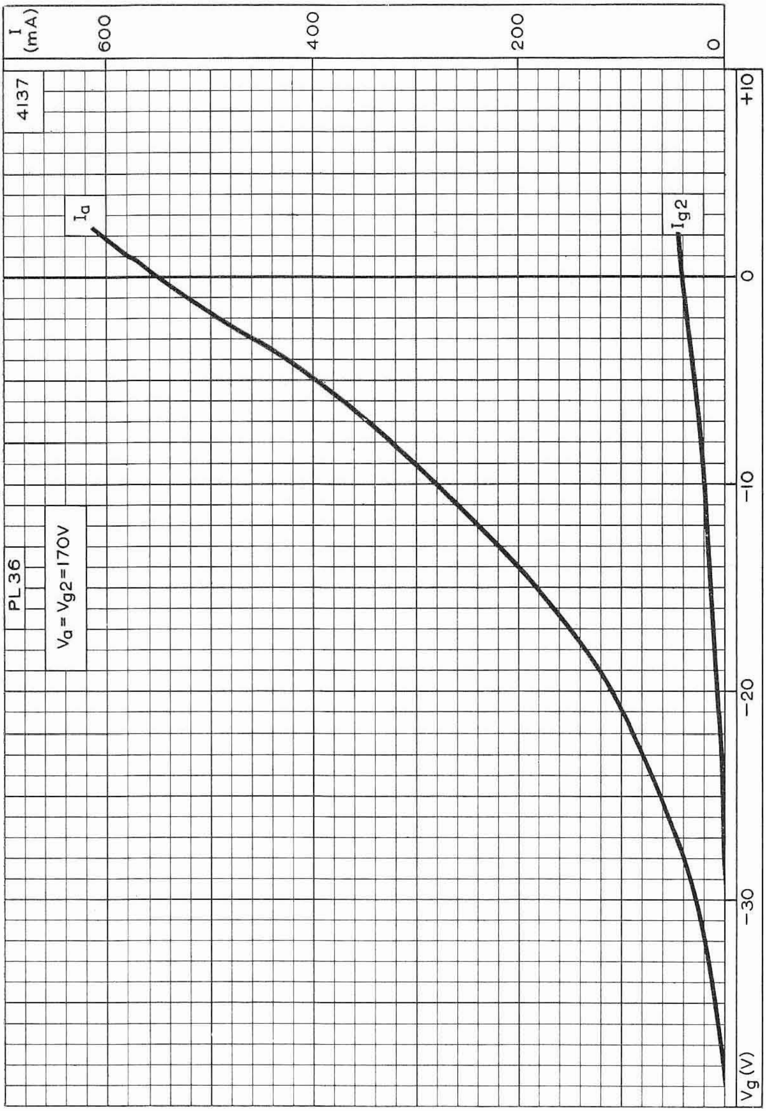
LINE OUTPUT PENTODE



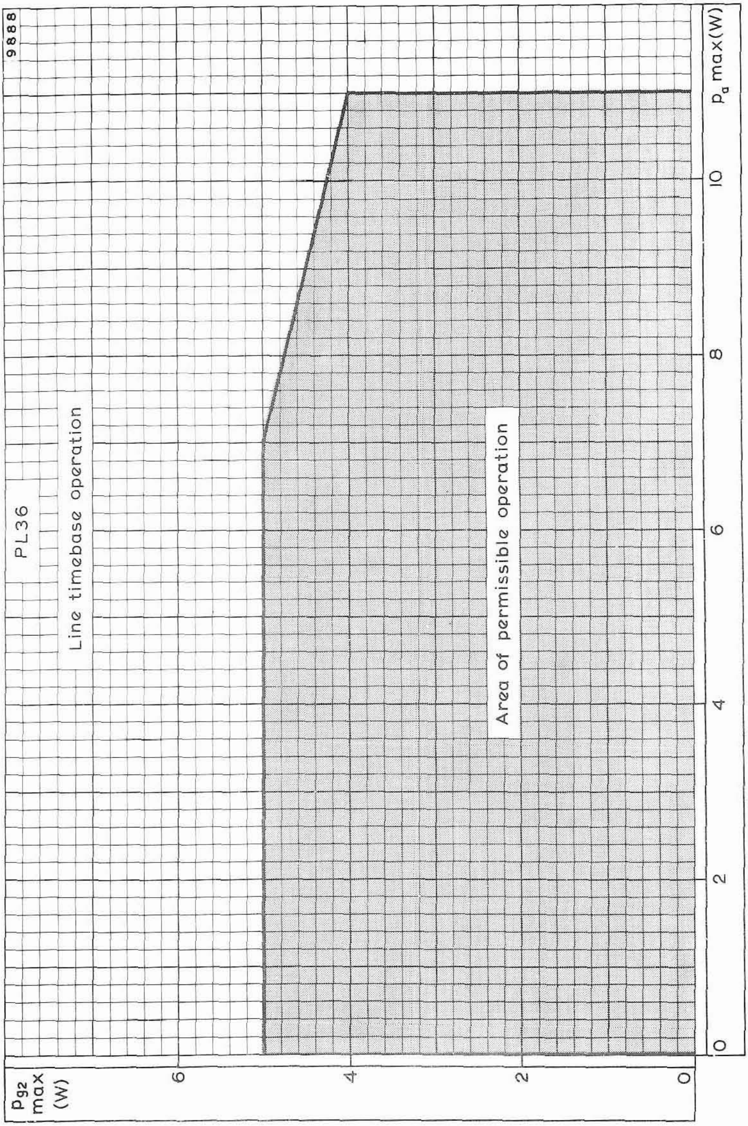
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID RESISTANCE AS PARAMETER



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE



BOUNDARY OF OPERATION FOR LINE TIMEBASE APPLICATIONS

Line output pentode for use in portable television receivers.

HEATER

Suitable for series operation a.c. or d.c.

I_h	300	mA
V_h	21.5	V

CAPACITANCES

c_{in}	14	pF
c_{out}	6.0	pF
c_{a-g1}	<800	mpF
c_{g1-h}	<200	mpF
c_{a-k}	<100	mpF

CHARACTERISTICS

V_a	170	V
V_{g2}	170	V
V_{g1}	-24.5	V
I_a	45	mA
I_{g2}	2.2	mA
g_m	6.0	mA/V
r_a	11.5	kΩ
μ_{g1-g2}	4.9	

OPERATION AS LINE OUTPUT VALVE

Circuit design

Operation so that the anode potential of the output valve at the end of the scan is above the knee of the anode characteristic is recommended. An effective feedback stabilising circuit should be employed. A design chart is given on page C5.

Minimum values of R_{g2} required to prevent excessive screen-grid dissipation during the warming-up period.

V_b	170	200	230	V
R_{g2} min.	1.2	1.8	2.2	kΩ

High voltage cut-off

The minimum value of V_{g1} for cut-off during the fly-back period, when $v_{a(pk)}$ = 7.0kV, is -120V.

PEAK ANODE CURRENT DESIGN CHARTS

Stabilised timebases

The design chart shown on page C5 gives directly the values of peak anode current and end-of-scan anode voltage which should be used in designing a stabilised line timebase. The design chart is based on an h.t. line voltage of 200V, and a correction factor is included for other h.t. voltages.

Measurements

When measurements are made specifically for the purpose of comparison with the design chart, all the components comprising the timebase, including the valves, should be nominal. The h.t. line should also be nominal. In receivers designed for a range of declared values of mains voltage, measurements should be made at the nominal declared value of mains voltage producing the lowest nominal h.t. voltage. The timebase should be synchronised and the raster adjusted to nominal scan. The beam current drawn from the e.h.t. supply should be 300μA.

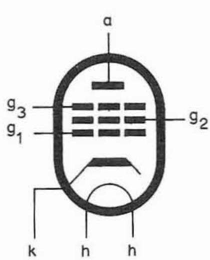
The use of the design chart does not exempt the designer from checking that the valve is operating within its limiting values.

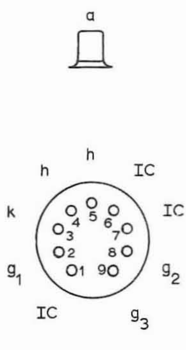
RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	650	V
V_a	250	V
* $v_{a(pk)}$ max.	7.0	kV
p_a max.	see page C6	
$p_a + p_{g2}$	see page C6	
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	250	V
$v_{g1\ (pk)}$ max.	1.0	kV
p_{g2} max.	see page C6	
I_k max.	180	mA
R_{g1-k} max.	500	kΩ
R_{g1-k} max. (line timebase applications)	2.2	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max. (cathode negative)	200	V
V_{h-k} max. (cathode positive)	200	V
T_{bulb} max.	240	°C

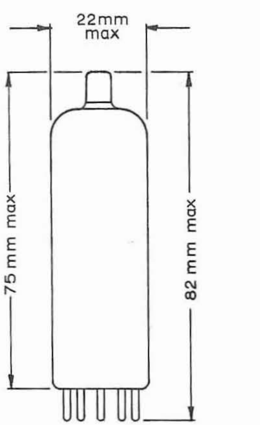
*Maximum pulse duration 22% of one cycle with a maximum of 18μs.

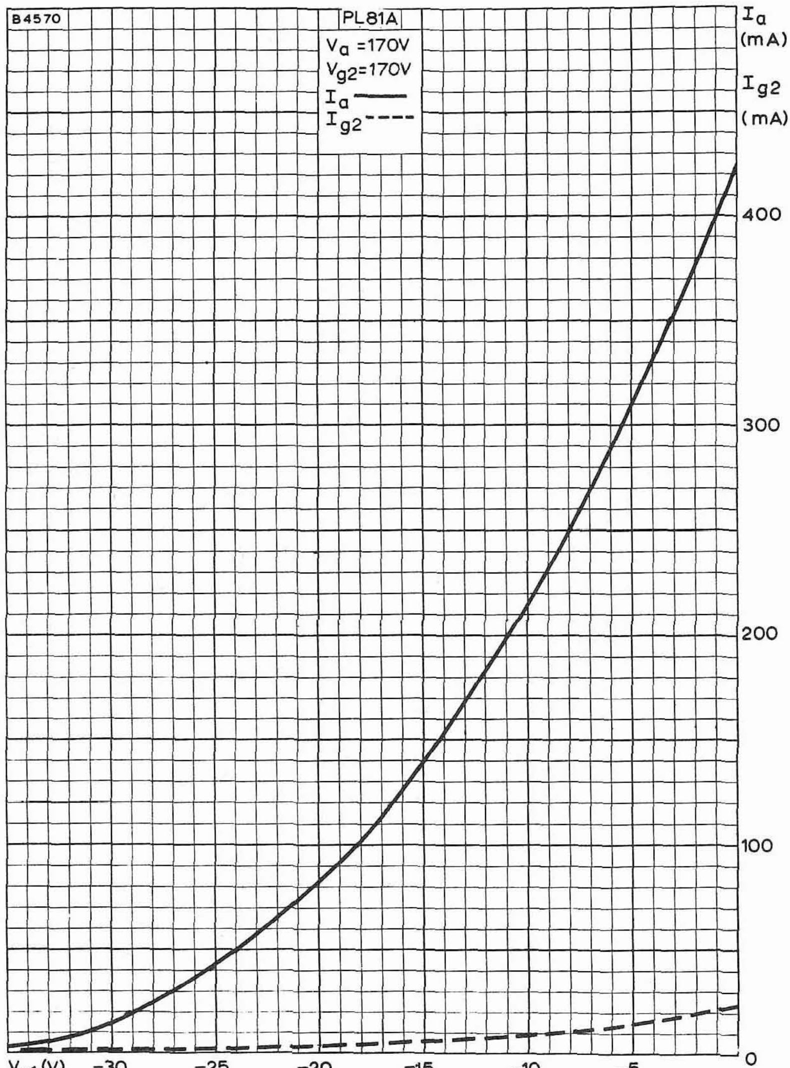
B4300



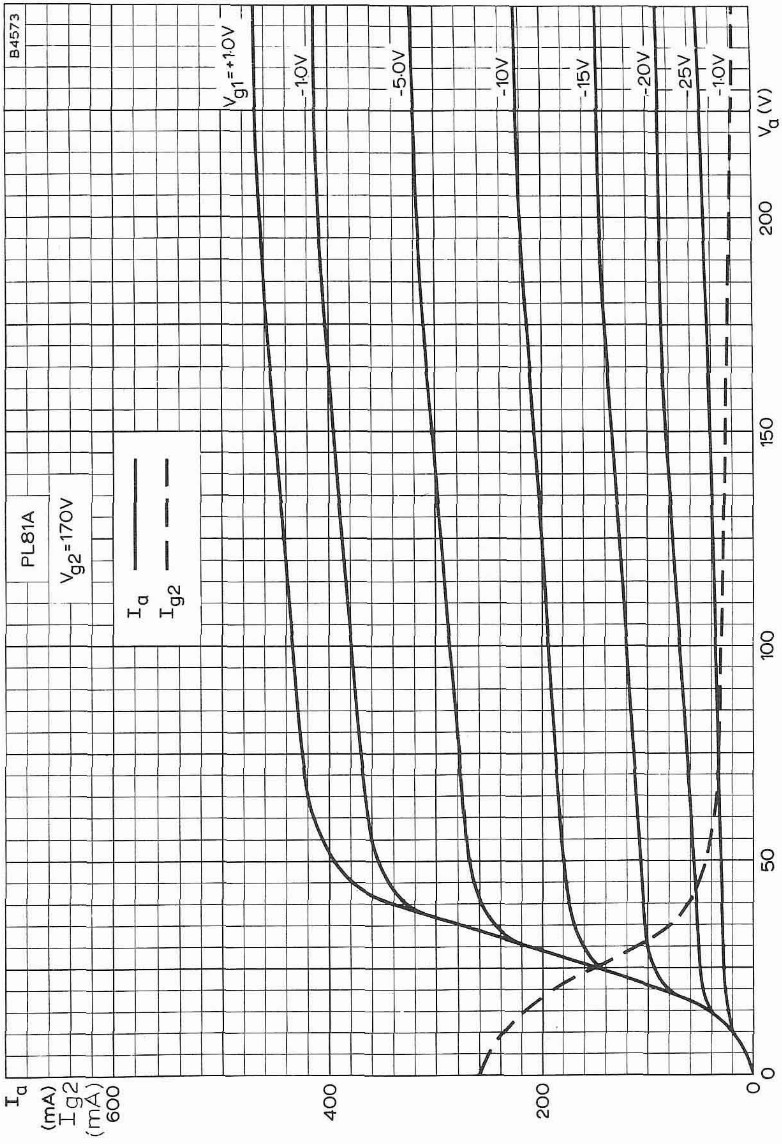


B9A Base

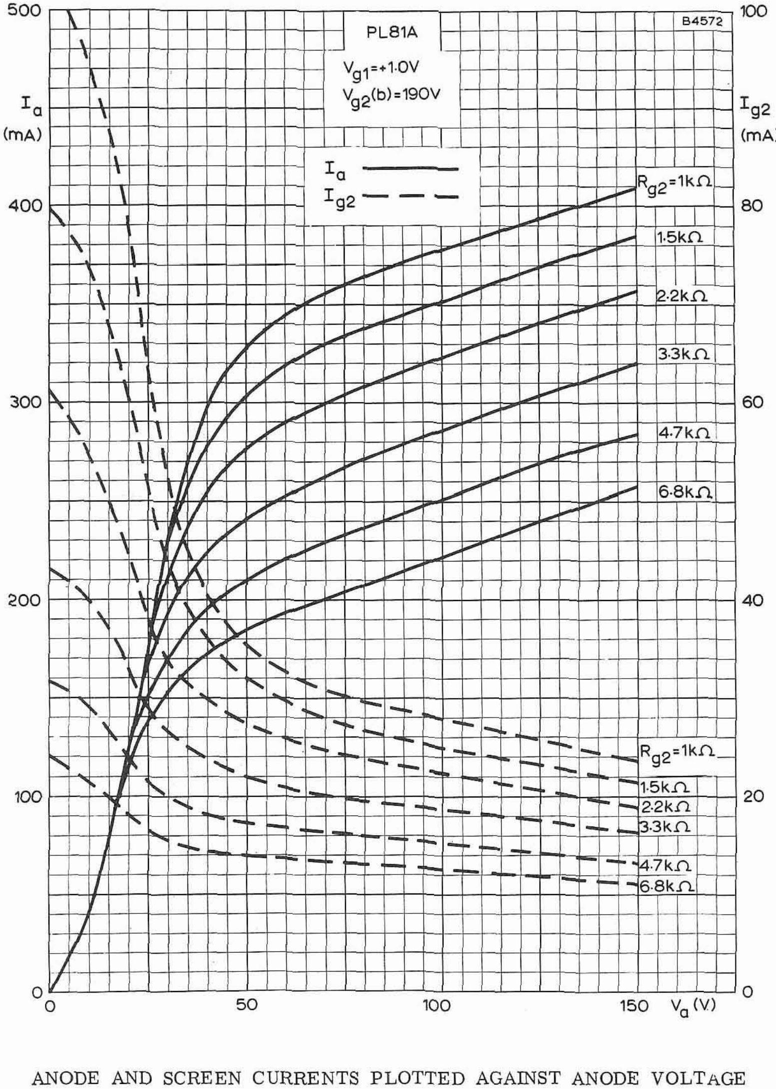




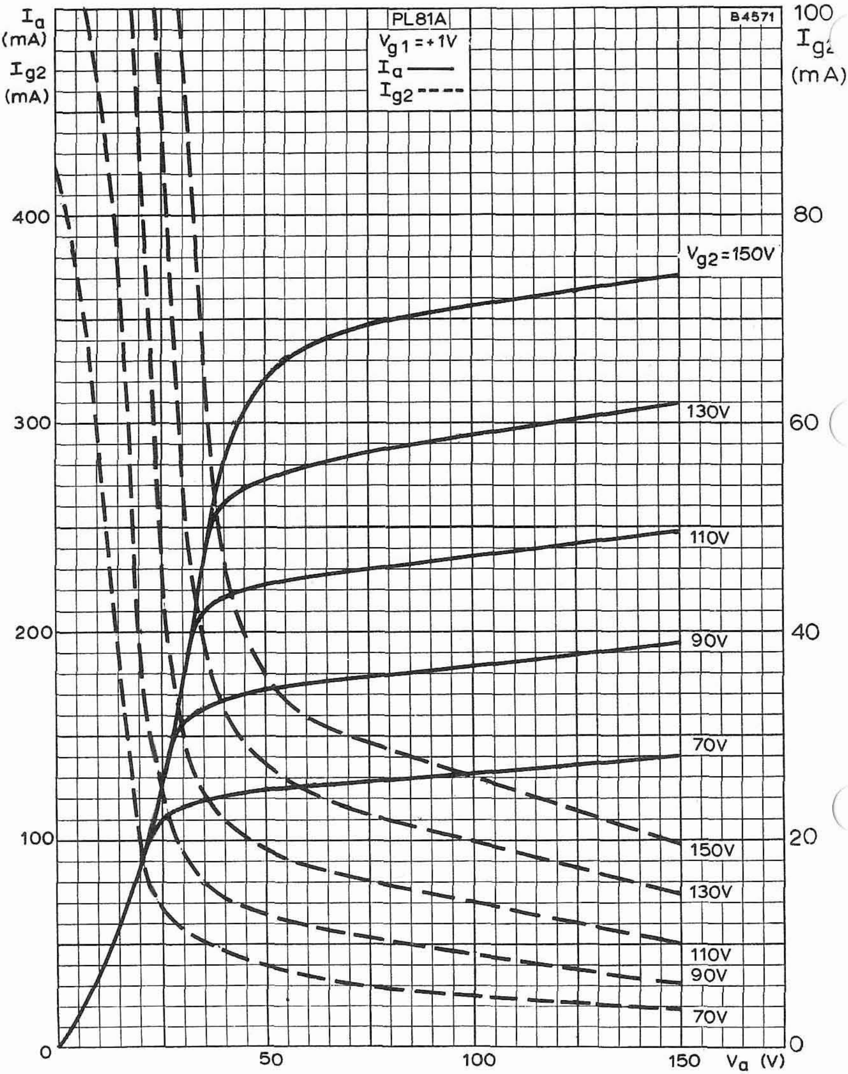
ANODE AND SCREEN CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE



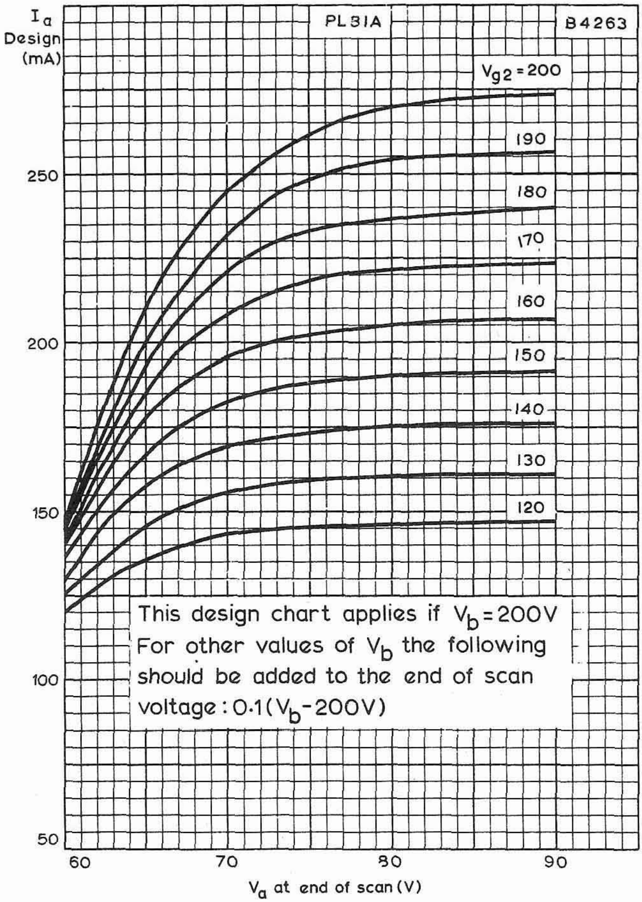
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



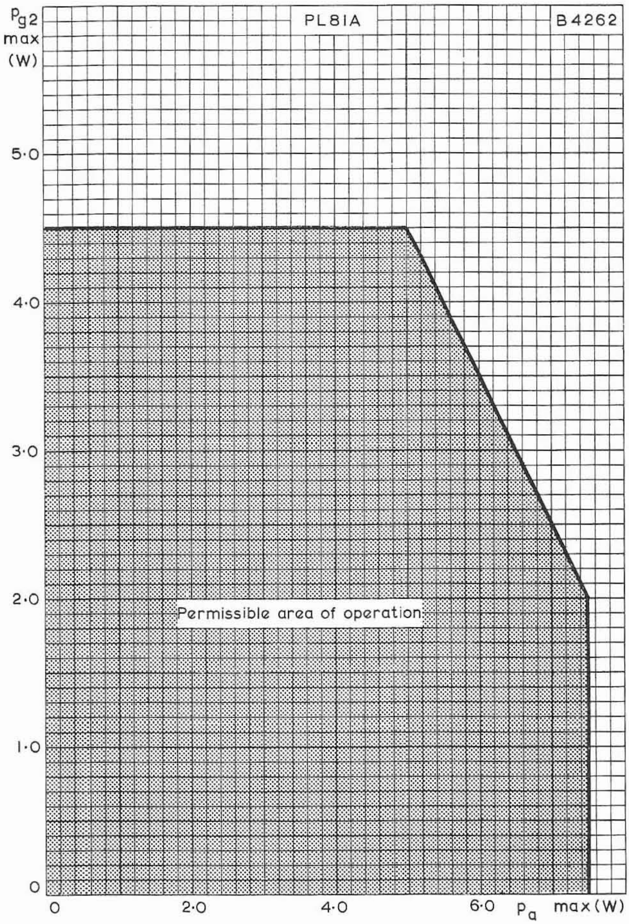
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID RESISTOR AS PARAMETER



ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE
WITH SCREEN-GRID VOLTAGE AS PARAMETER



DESIGN CHART FOR STABILISED TIMEBASES



DESIGN CENTRE RATINGS FOR p_a max. AND p_{g2} max.

VIDEO OUTPUT PENTODE

PL83

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.

HEATER

Suitable for series operation, A.C. or D.C.

I_h	0.3	A
V_h	15	V

CAPACITANCES

c_{in}	10.4	μμF
c_{out}	6.6	μμF
c_{a-g1}	<0.06	μμF
c_{g1-h}	<0.15	μμF

CHARACTERISTICS

V_a	170	200	V
V_{g2}	170	200	V
V_{g3}	0	0	V
I_a	36	36	mA
I_{g2}	5	5	mA
V_{g1}	−2.3	−3.5	V
g_m	10	10	mA/V
r_a	0.1	0.1	MΩ
μ_{g1-g2}	24	24	

TYPICAL OPERATING CONDITIONS FOR DRIVING A CATHODE RAY TUBE WITH CATHODE INJECTION

V_b	170	V
V_{g2}	170	V
V_{g3}	0	V
I_a	4	mA
I_{g2}	0.25	mA
V_{g1}	−6.7	V
R_a	2,200	Ω
$V_{out\ (pk)}$	>70	V

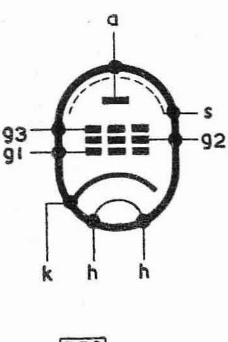
PL83

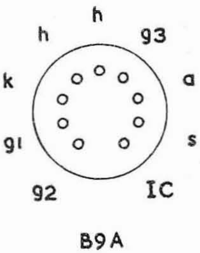
VIDEO OUTPUT PENTODE

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.

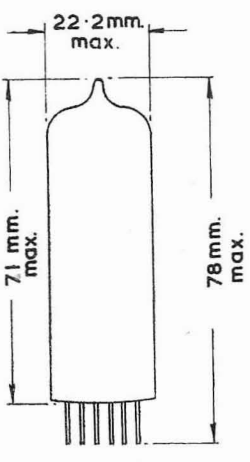
LIMITING VALUES

$V_{a\,(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9	W
$V_{g2\,(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2	W
I_k max.	70	mA
V_{g1} max. ($I_{g1}=+0.3\ \mu A$)	−1.3	V
R_{g1-k} max. (self bias)	1.0	MΩ
R_{g1-k} max. (fixed bias)	0.5	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	KΩ





B9A
Noval Base

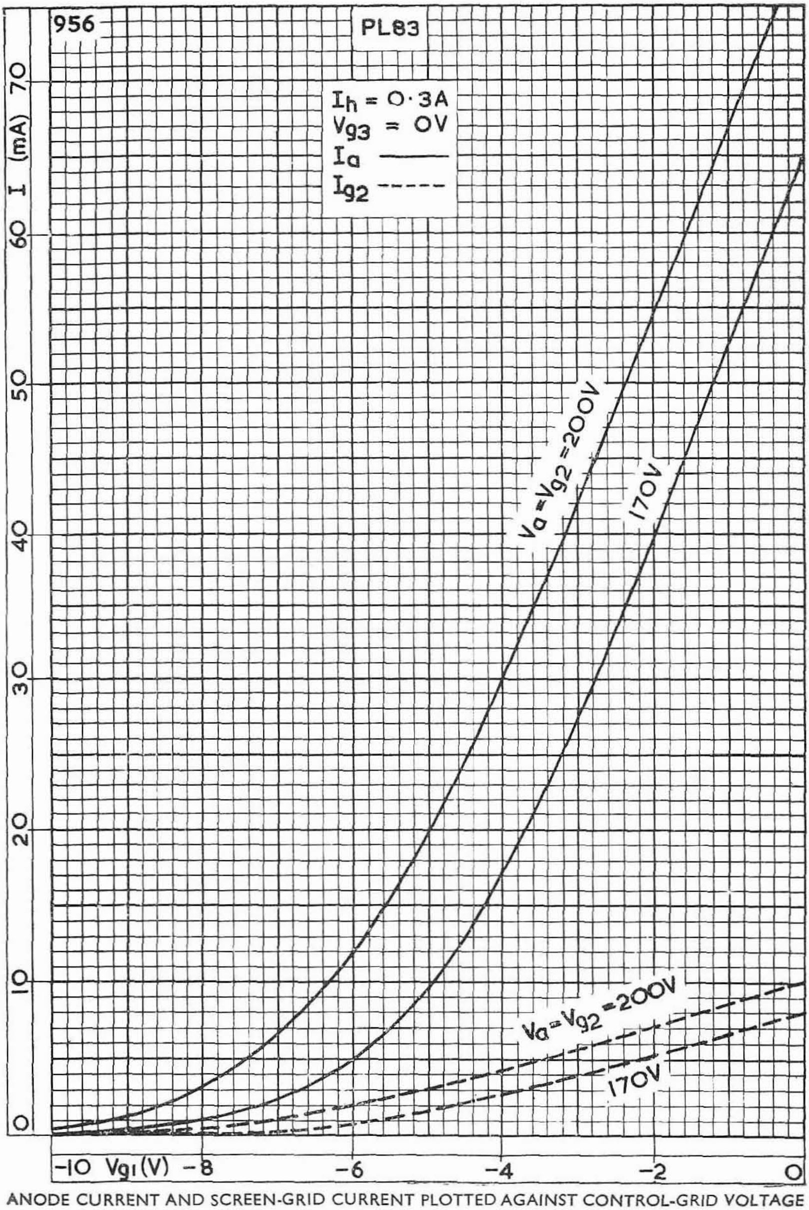


559

VIDEO OUTPUT PENTODE

PL83

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.

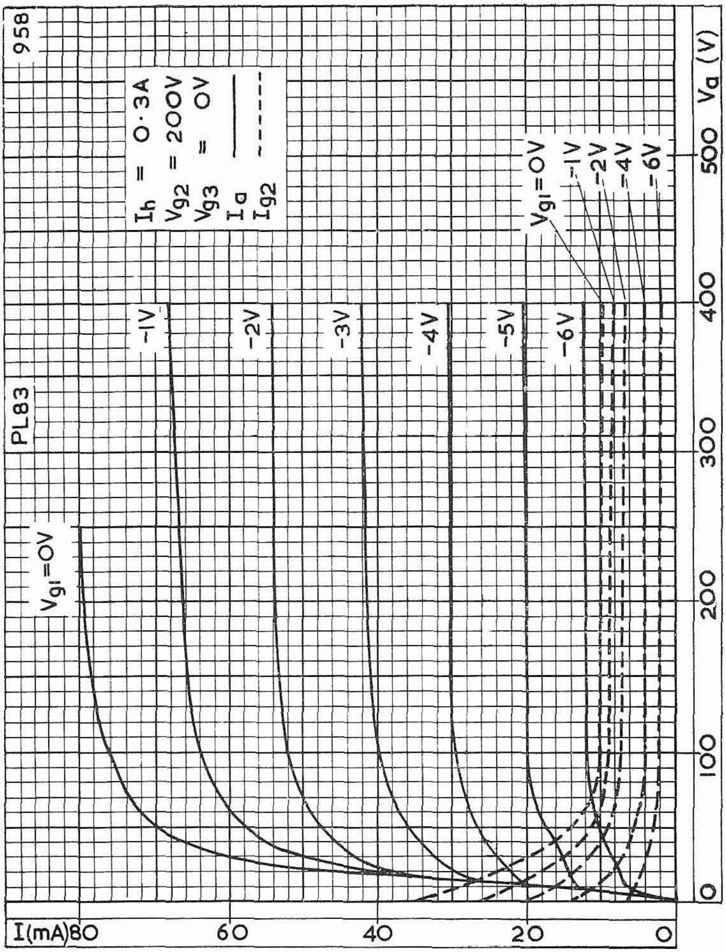


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

PL83

VIDEO OUTPUT PENTODE

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.

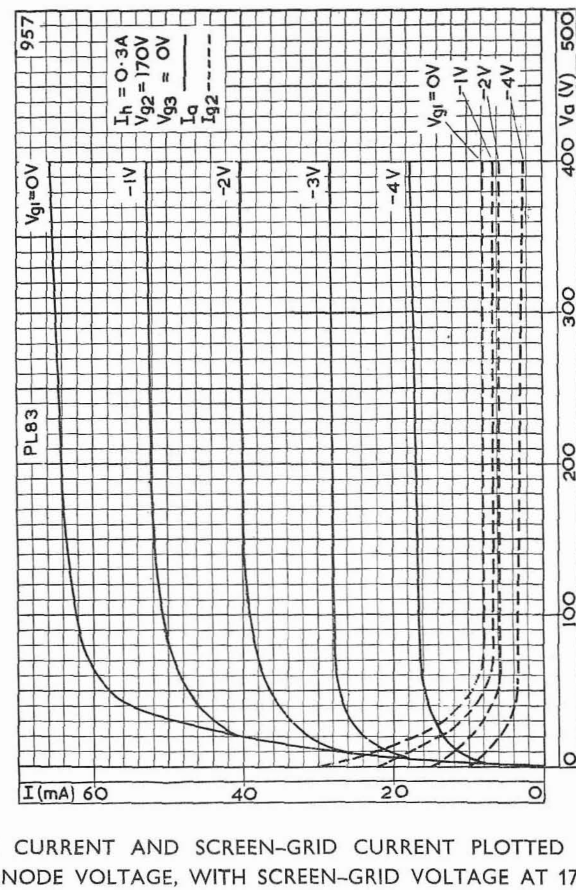


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH SCREEN-GRID VOLTAGE AT 200V

VIDEO OUTPUT PENTODE

PL83

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.



ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, WITH SCREEN-GRID VOLTAGE AT 170V

OUTPUT PENTODE

PL84

Output pentode rated for 12W anode dissipation with 300mA heater for use as a frame output valve in television receivers.

HEATER

I_h	300	mA
V_h	15	V

CAPACITANCES

c_{in}	11.8	pF
c_{out}	6.0	pF
c_{a-g1}	<0.6	pF
c_{g1-h}	<0.25	pF

CHARACTERISTICS

V_a	170	200	V
V_{g2}	170	200	V
I_a	70	60	mA
I_{g2}	3.5	3.0	mA
V_{g1}	−12.5	−17.3	V
g_m	11	8.8	mA/V
r_a	26	28	kΩ
μ_{g1-g2}	8.0	8.0	

OPERATION AS FRAME OUTPUT VALVE

See nomogram on page C1 and notes on page D2.

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
*$+v_{a(pk)}$ max.	2.0	kV
$-v_{a(pk)}$ max.	500	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	1.75	W
I_k max.	100	mA
R_{g1-k} max. (fixed bias)	500	kΩ
R_{g1-k} max. (cathode bias)	1.0	MΩ
R_{g1-k} max. (frame output)	3.3	MΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

*Max. pulse duration 4% of one cycle with a maximum of 800μs.

PL84

OUTPUT PENTODE

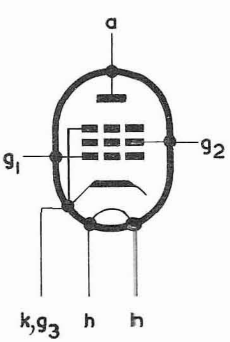
PEAK ANODE CURRENT NOMOGRAM

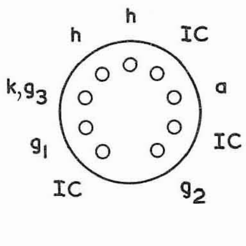
The nomogram shown on the following page gives directly the values of peak anode current and corresponding values of anode voltage at end of scan for various values of screen-grid voltage.
No indication of anode and screen-grid dissipation limits is given in the nomogram: these must be checked independently.

Example

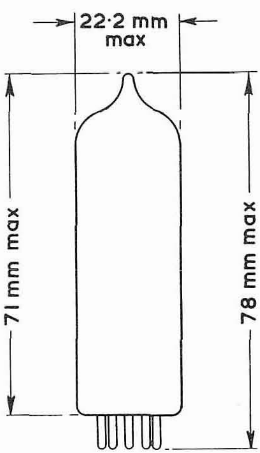
Suppose the screen-grid voltage is 170V. From the nomogram, the optimum working conditions at $V_{g2} = 170V$ are $i_{a(pk)} = 140mA$, and v_a at end of scan = 70V. If the designer requires a peak current of 160mA, the corresponding v_a at end of scan is 100V.

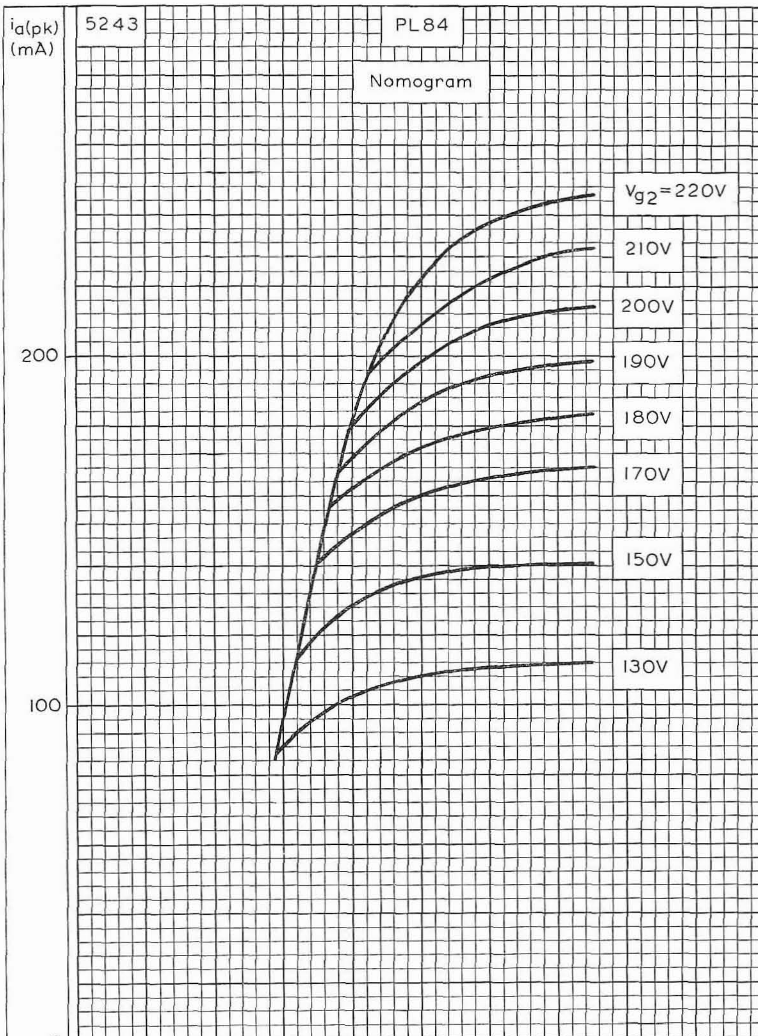
2834



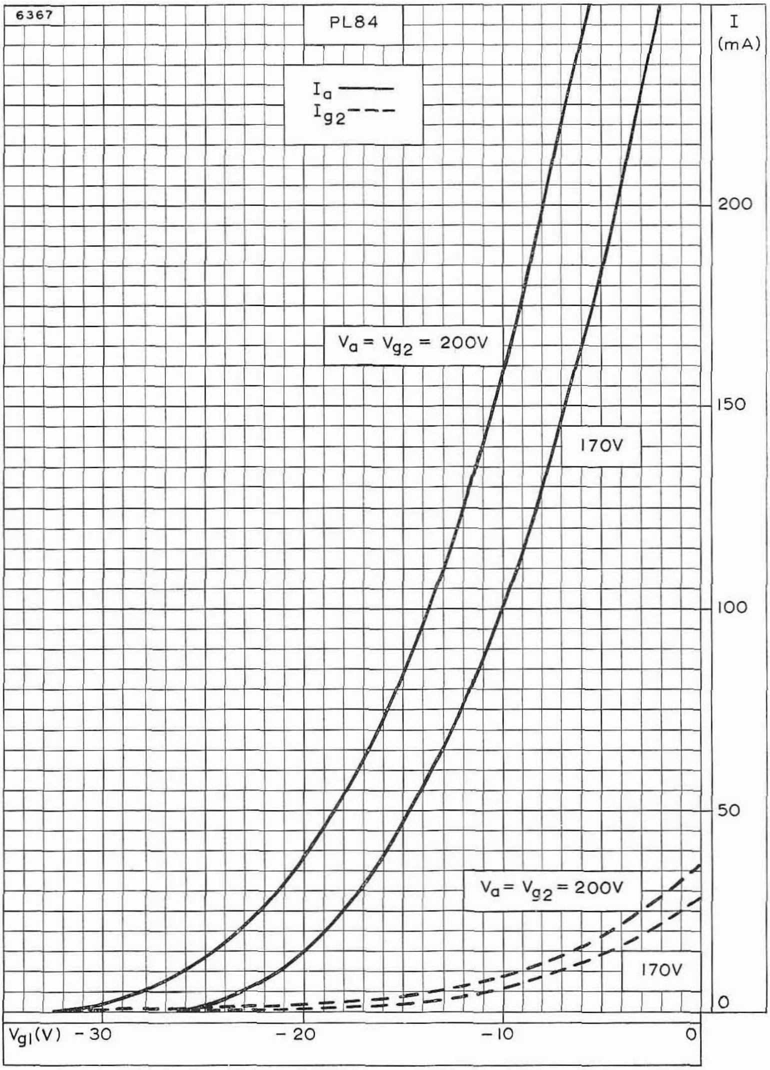


B9A Base

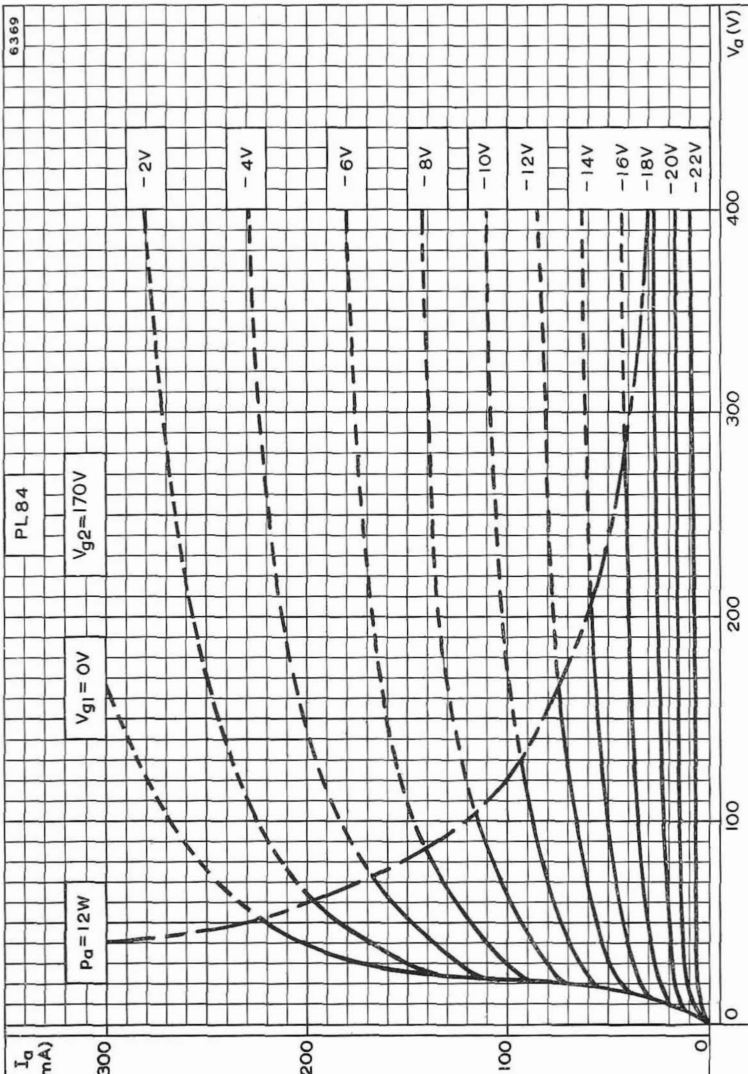




PEAK ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE AT THE END OF SCAN



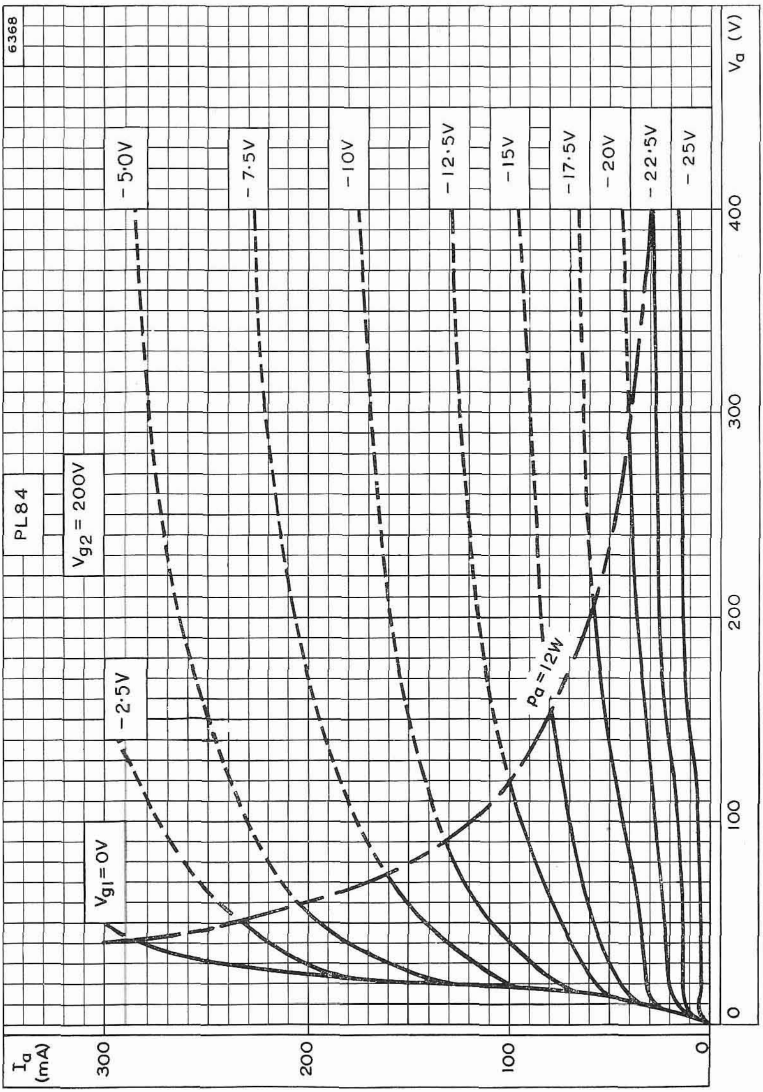
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS ANODE AND SCREEN-GRID VOLTAGES



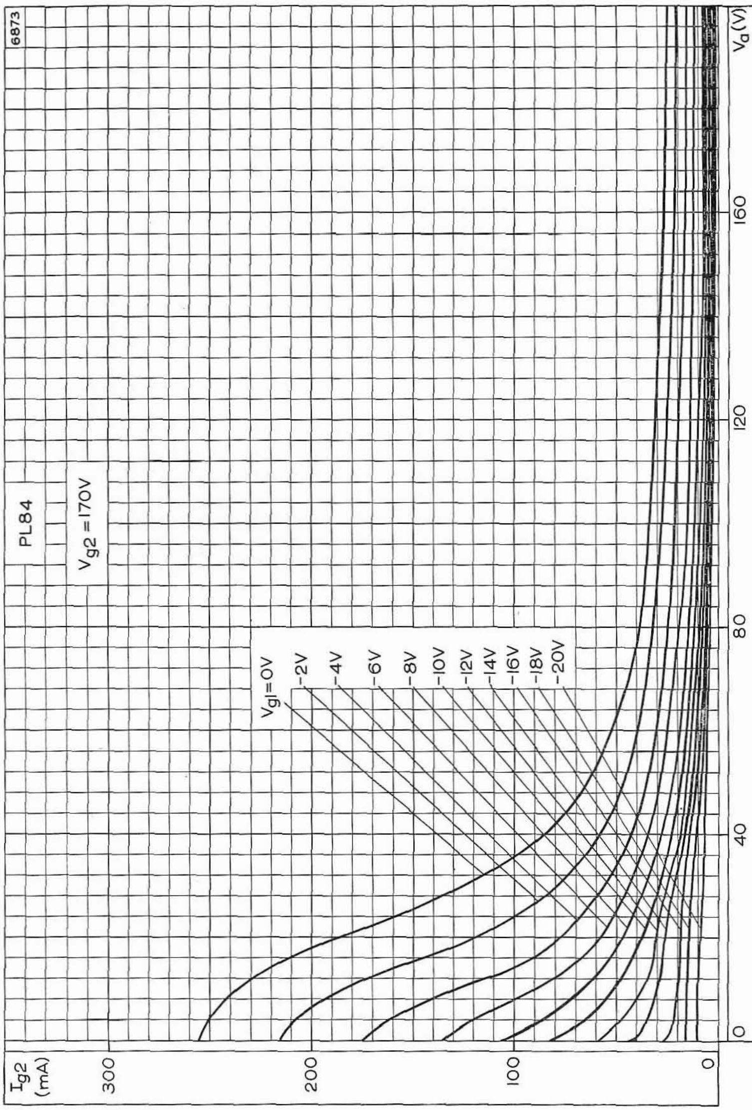
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 170V$

PL84

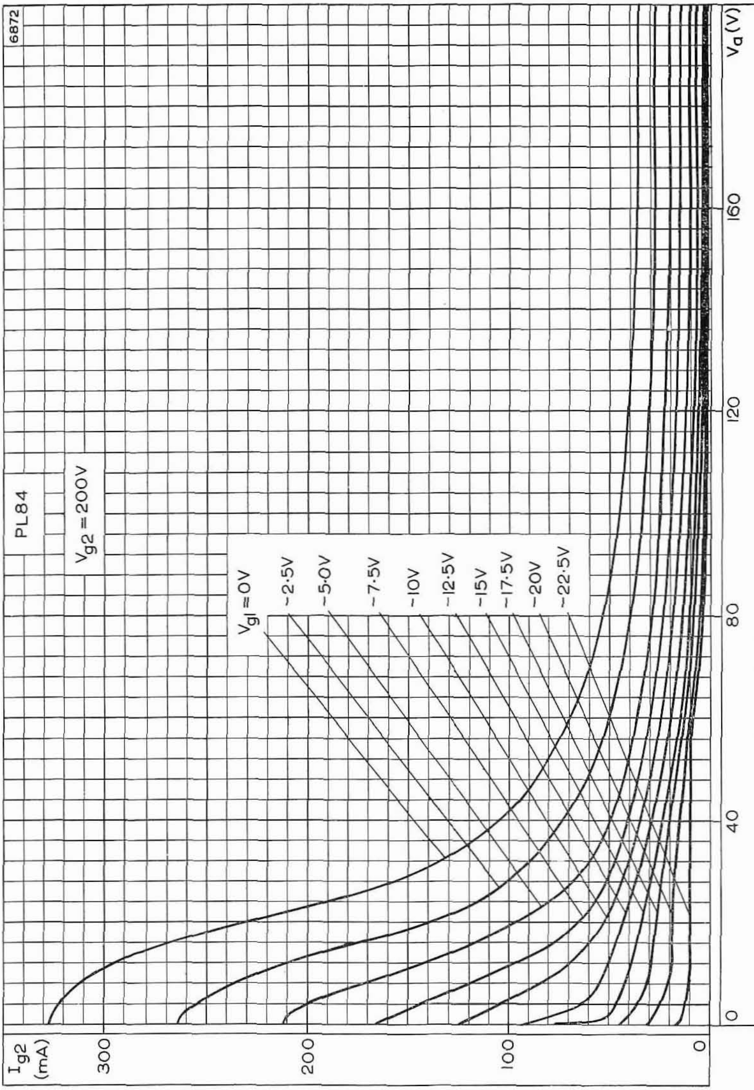
OUTPUT PENTODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 170V$



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

OUTPUT PENTODE

PL508

Field output pentode for colour television

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	17	V

CAPACITANCES (unshielded)

c_{a-g1}	1.4	pF
c_{g1-h}	<0.2	pF

CHARACTERISTICS ←

V_a	50	190	V
V_{g2}	190	190	V
I_a	320 pk	60	mA
I_{g2}	approx. 60	5.0	mA
V_{g1}	-1.0	-17	V
g_m		9.0	mA/V
μ_{g1-g2}		8.0	
r_a		10	kΩ

OPERATING CONDITIONS

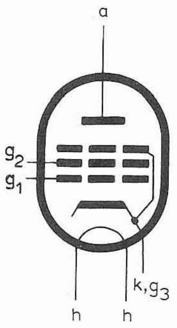
For operating conditions when used as a field output valve in stabilised timebases, see graph on page 5.

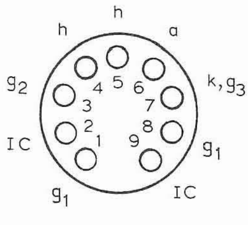
RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	700	V
V_a max.	400	V
$^*v_{a(pk)}$ max.	2.5	kV
p_a max.	12	W
$V_{g2(b)}$ max.	700	V
V_{g2} max.	275	V
p_{g2} max.	3.0	W
I_k max.	100	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (automatic bias)	2.2	MΩ
V_{h-k} max.	220	V

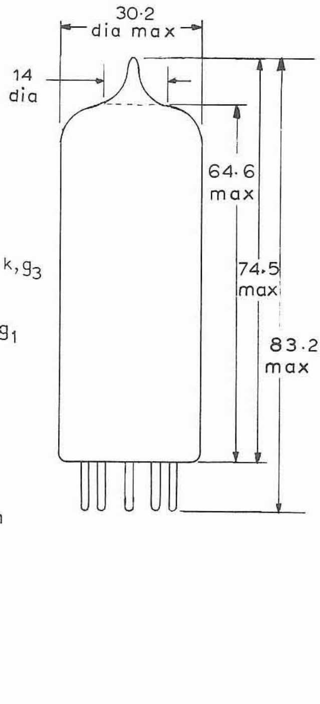
*Maximum pulse duration 5% of one cycle with a maximum of 1ms.

B8877 ←

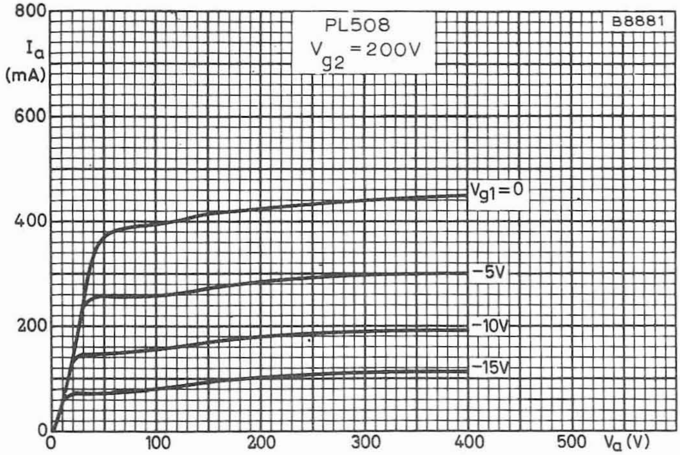


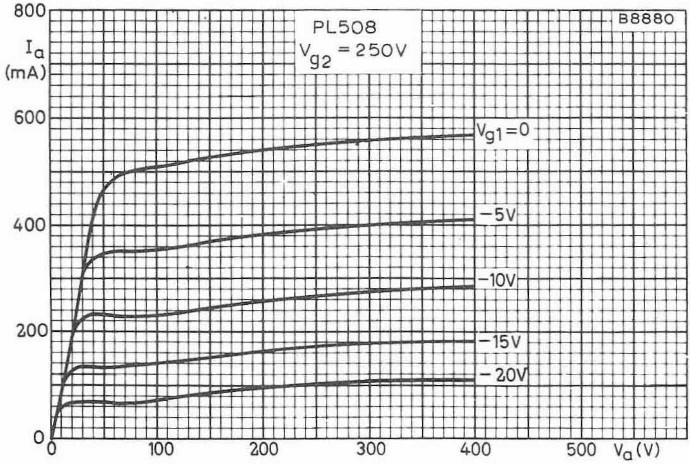


B9D Base
without centre stem

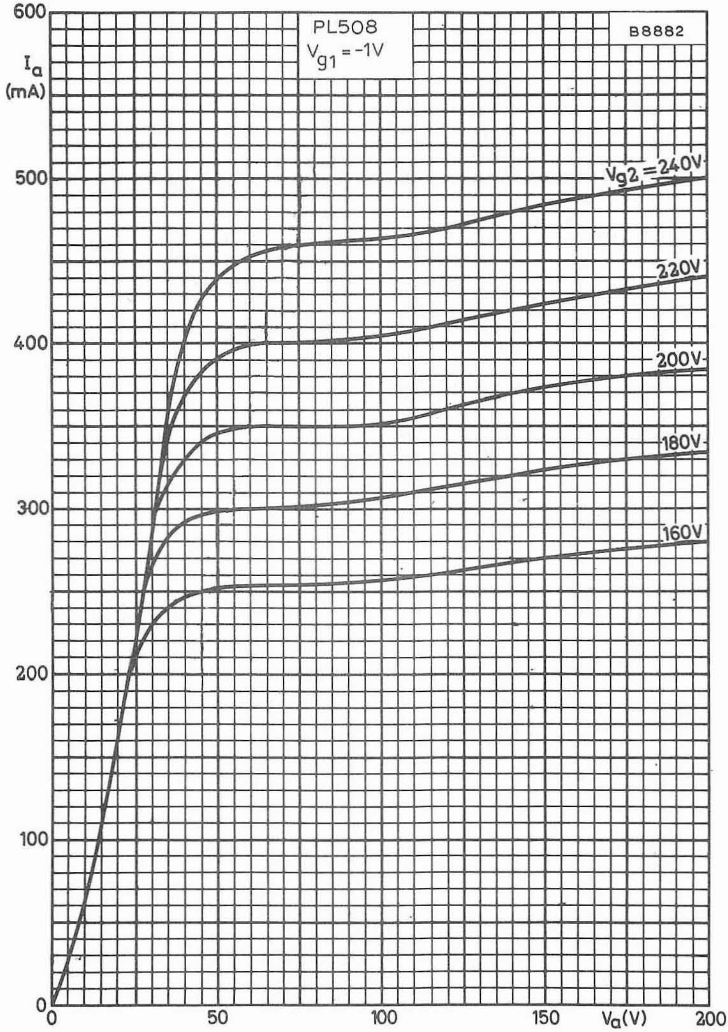


All dimensions in mm

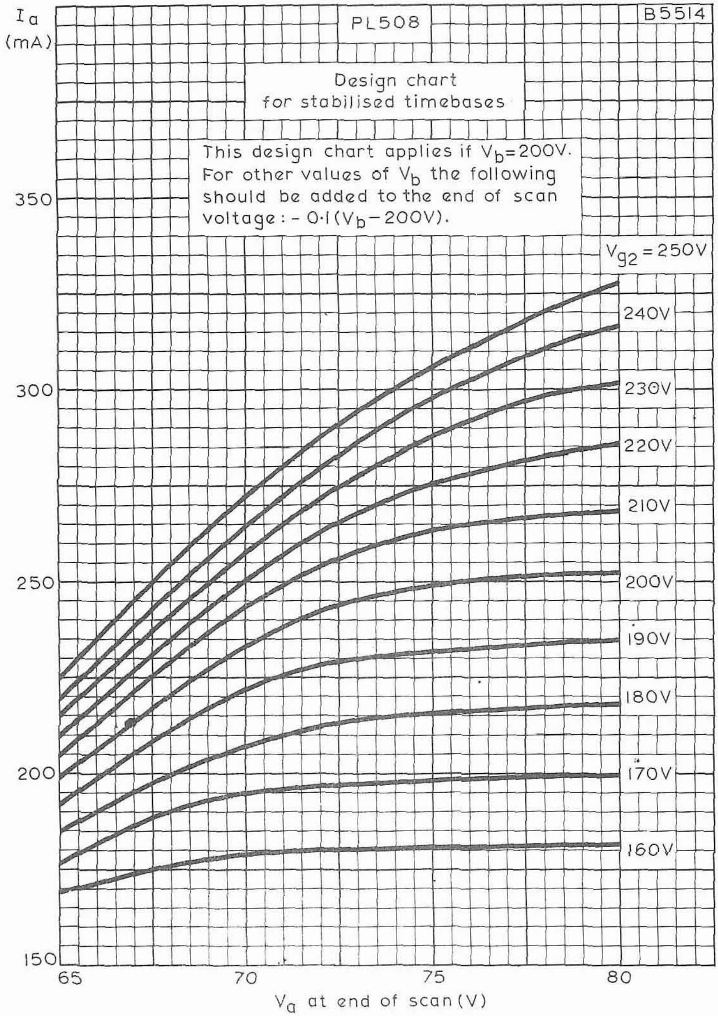




ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH SCREEN GRID VOLTAGE AS PARAMETER



DESIGN CHART FOR STABILISED TIMEBASES

OUTPUT PENTODE PL509

Output pentode for colour television line deflection circuits

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	40	V

CAPACITANCES

c_{a-g1}	2.5	pF
c_{a-g1} max.	3.0	pF ←
c_{g1-h} max.	0.2	pF

DYNAMIC CHARACTERISTICS ←

V_a	160	50	V
V_{g3}	0	0	V
V_{g2}	160	175	V
V_{g1}	0	-10	V
I_a	1.4	0.8	A
I_{g2}	45	70	mA

OPERATING CONDITIONS ←

Stabilised circuits (d.c. feedback)

The minimum required cut-off voltage ($-V_{g1}$) during flyback at Va=7.0kV and Z_{g1} = 1.0kΩ at line frequency is:-

V_{g2} = 150V: V_{g1} = -175V
V_{g2} = 200V: V_{g1} = -195V
V_{g2} = 250V: V_{g1} = -215V

Design chart for stabilised timebases See page 4

In order to prevent Barkhausen interference and loss of stabilisation, care should be taken to ensure that the anode voltage never drops below the specified minimum value during the scanning period.

When optimum suppression of Barkhausen oscillations is required, g3 may be connected to a positive voltage of approximately 20V.

Hum

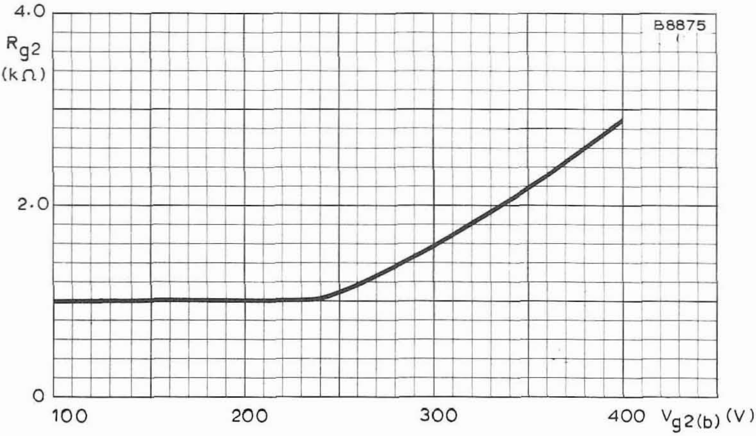
At Z_{g1} = 200kΩ (f = 50Hz), V_{h-k} = 220Vr.m.s. and without wiring and socket capacitances, the equivalent grid hum voltage is less than 5.0mV.

RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	700	V
$v_{a(pk)}$ max. (see note 1)	7.0	kV
V_{g3} max.	50	V
$V_{g2(b)}$ max.	700	V
V_{g2} max.	275	V
$-v_{g1(pk)}$ max. (design maximum system) (see note 1)	550	V
p_a max.	30	W
p_{a+g2} max. (triode connected)	31	W
p_{g2} max. (see note 2)	7.0	W
I_k max.	500	mA
R_{g1} max. (fixed bias) (see note 3)	0.5	MΩ
R_{g1} max. (stabilised line timebases) (see note 3)	2.2	MΩ
R_{g3} max. (see note 4)	10	kΩ
V_{h-k} max.	250	V
T_{bulb} max. (absolute maximum rating)	300	°C

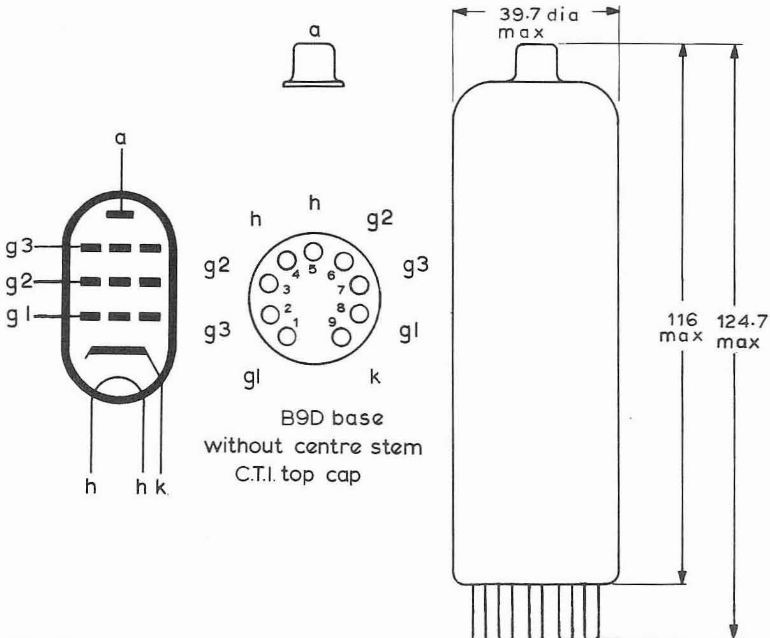
NOTES

1. Maximum pulse duration 22% of one cycle with a maximum of 18μs.
2. To prevent an excessive value of p_{g2} the minimum values of series resistance are given below.

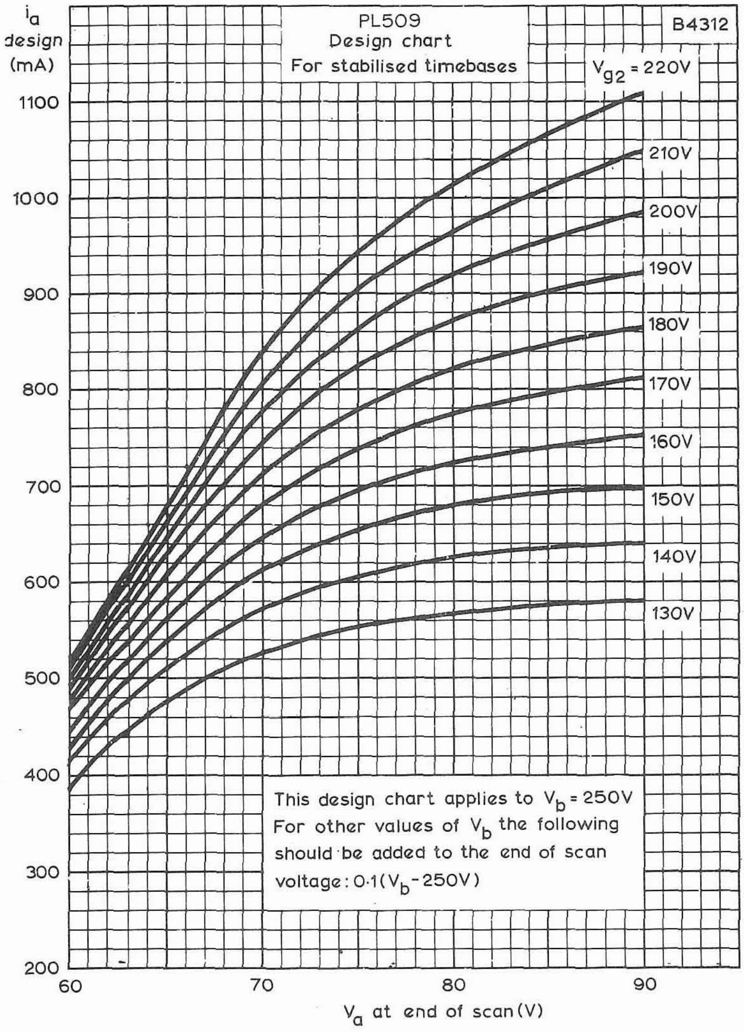


3. The circuit design must be such that negative control grid currents up to 5μA do not have any detrimental effect upon performance. Care should be taken that with 5μA grid current the limiting values for I_k, p_a and p_{g2} are not exceeded.
4. With $R_{g3} \leq 10k\Omega$ capacitive decoupling of g3 is not required.

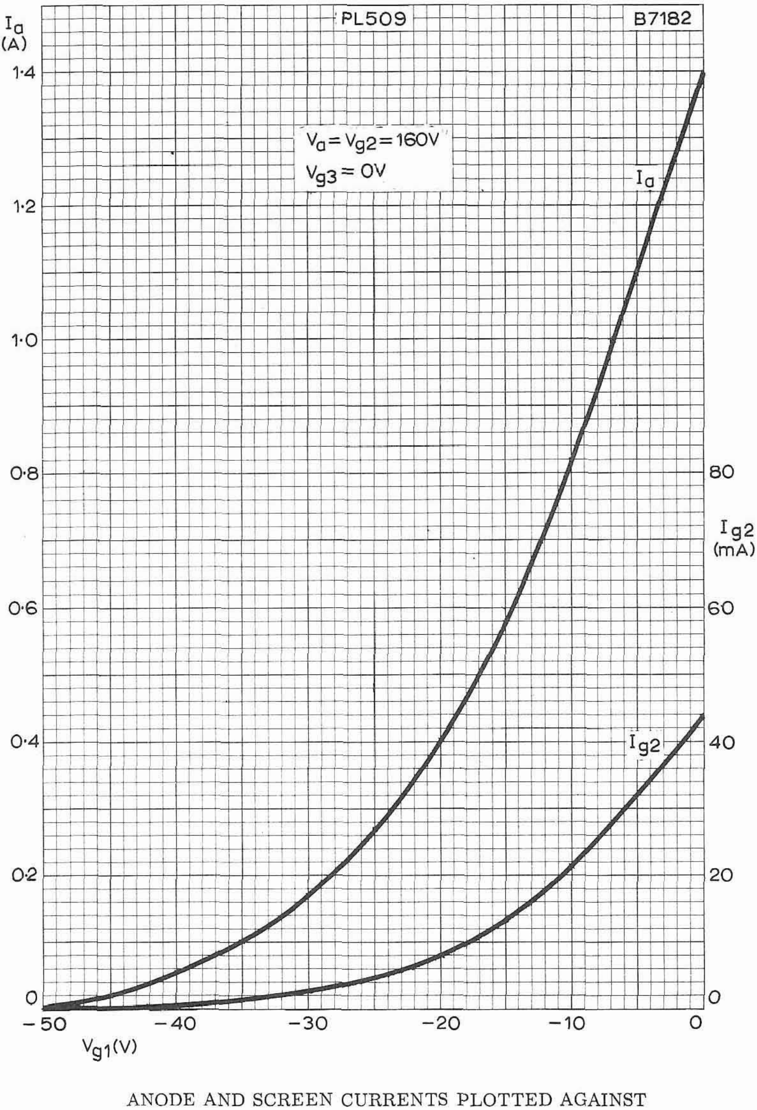
OUTPUT PENTODE PL509



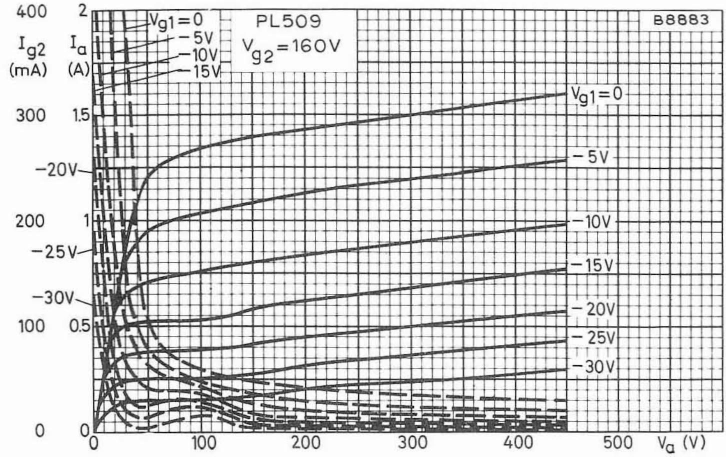
B3533 All dimensions in mm



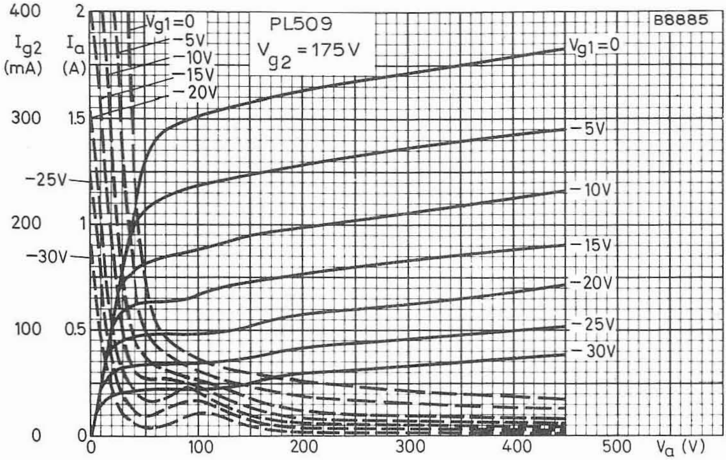
DESIGN CHART FOR STABILISED TIMEBASES



ANODE AND SCREEN CURRENTS PLOTTED AGAINST CONTROL GRID VOLTAGE

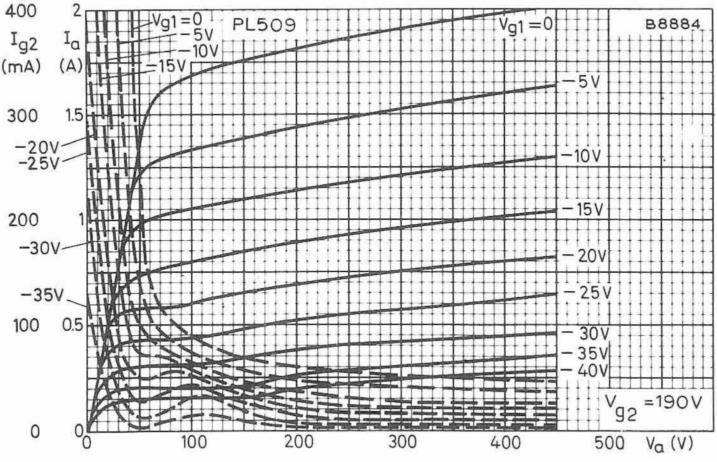


ANODE AND SCREEN GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE: V_{g2} = 160V



ANODE AND SCREEN GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE: V_{g2} = 175V

←



ANODE AND SCREEN GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE: V_{g2} = 190V

VIDEO OUTPUT PENTODE PL802

Video output pentode for colour television receivers

HEATER

Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	16	V

CAPACITANCES

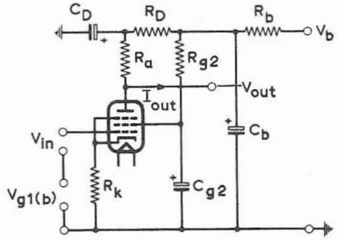
c_{in}	20	pF
c_{out}	4.0	pF
c_{a-g1}	0.075	pF
c_{a-g1} max.	0.1	pF ←

CHARACTERISTICS

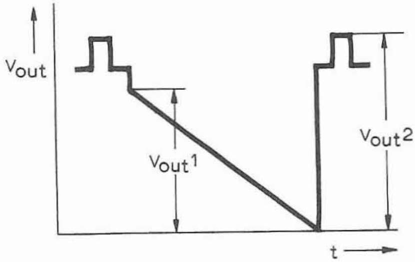
V_a	170	V
V_{g3}	0	V
V_{g2}	170	V
V_{g1}	-1.3	V ←
I_a	30	mA
I_{g2}	6.5	mA
g_m	40	mA/V
μ_{g1-g2}	70	

OPERATING CONDITIONS (negative modulation)

V_b	250V
R_b	330Ω
R_D	560Ω
C_D	16μF
R_a	2.7kΩ
R_{g2}	5.6kΩ
C_{g2}	2.0μF
R_k	39Ω
(no bypass capacitor)	
$V_{g1(b)}$	+4.0V



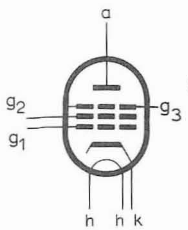
$V_{out(1)}$	100V
$V_{out(2)}$ p-p	≥140V
Video linearity	≥0.8
V_{in} p-p	approx. 5.0V
I_{out} max.	7.0mA

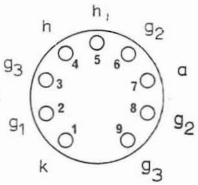


VIDEO OUTPUT PENTODE PL802

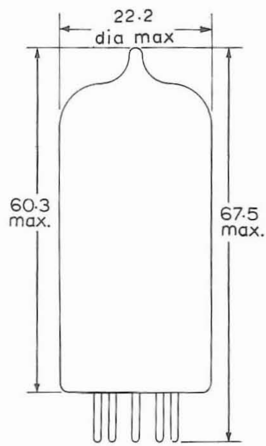
RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max. (supply)	400	V
V_a max. (long term average)	300	V
V_a max. ($I_k = 0$)	550	V
p_a max.	6.0	W
V_{g2} max.	300	V
V_{g2} max. ($I_k = 0$)	550	V
p_{g2} max.	2.5	W
p_{g2} max. (intermittent rating, short duration)	3.0	W
I_k max.	100	mA
R_{g1-k} max.	100	kΩ
R_{g1-k} max. ($R_k \geq 39\Omega$)	500	kΩ
V_{h-k} max.	200	V

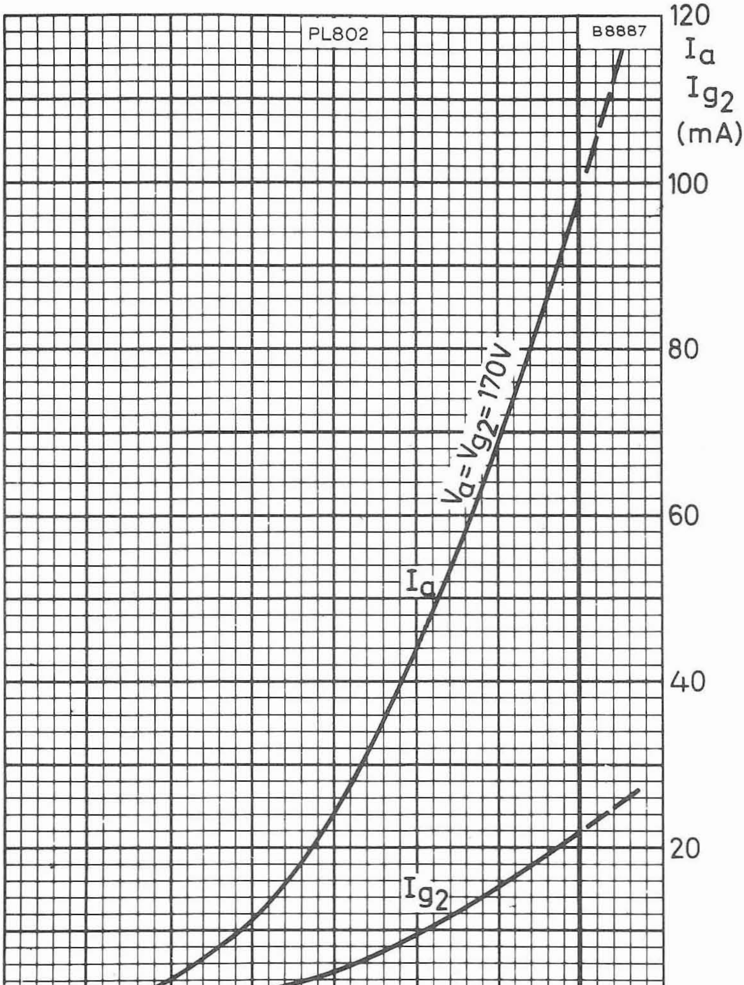




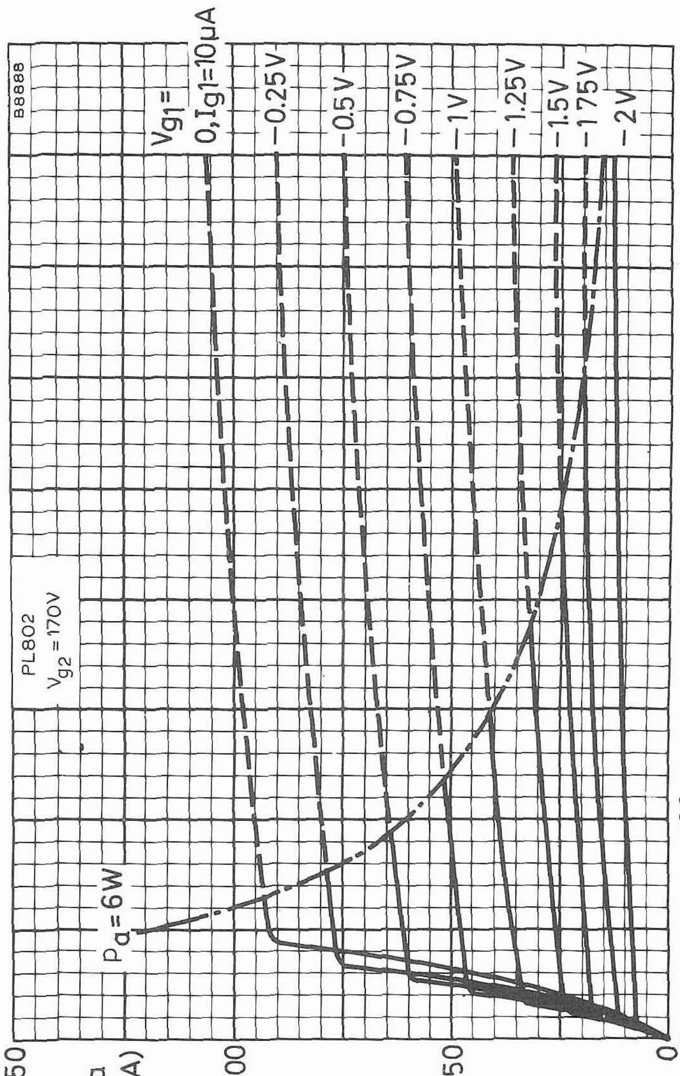
B9A Base



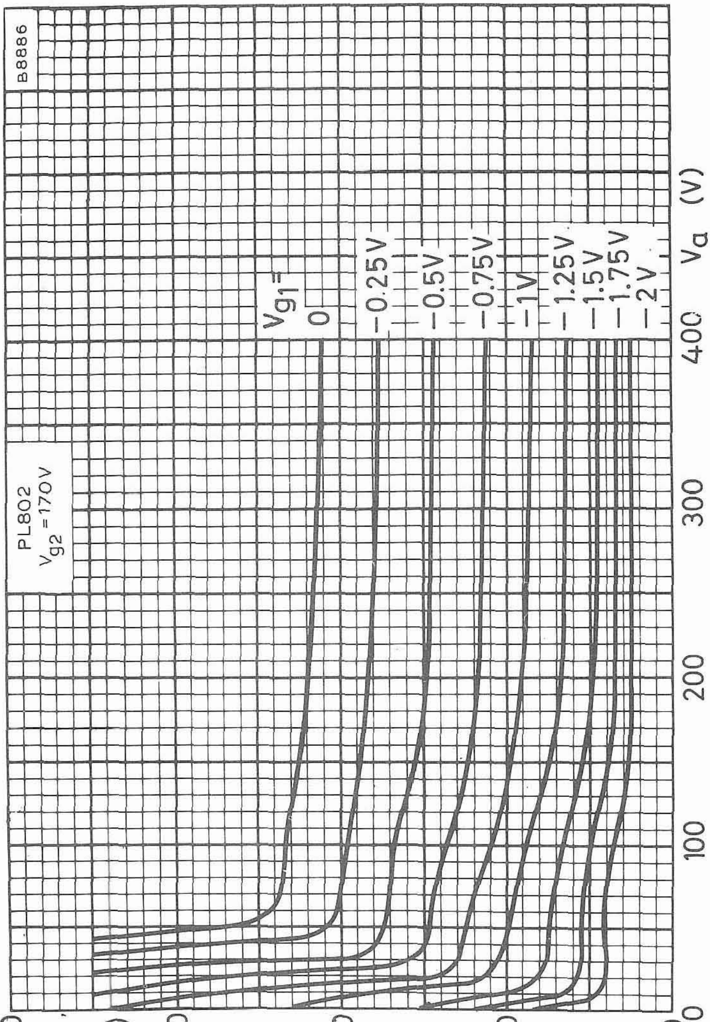
All dimensions in mm



ANODE AND SCREEN GRID CURRENTS PLOTTED AGAINST CONTROL GRID VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL GRID VOLTAGE AS PARAMETER



SCREEN GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL GRID VOLTAGE AS PARAMETER

BOOSTER DIODE

PY81

Booster diode with a maximum peak inverse voltage of 4.75kV intended for use in television receivers with series connected heaters.

HEATER

Suitable for series operation a.c. or d.c.

I_h	300	mA
V_h	17	V

CAPACITANCES

c_{a-k}	6.4	pF
c_{h-k}	2.8	pF ←

LIMITING VALUES

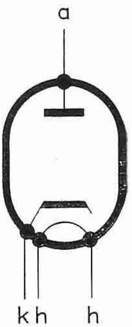
*P.I.V. max.	4.75	kV ←
*$i_{a(pk)}$ max.	450	mA
$I_{a(av)}$ max.	150	mA
C max.	4.0	μF
$V_{h-e(r.m.s.)}$ max.	220	V
*$v_{h-k(pk)}$ max. (cathode positive)	4.75	kV ←
*$v_{a-h(pk)}$ max. (anode negative)	3.0	kV

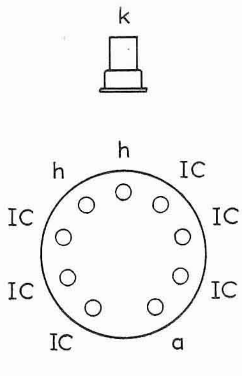
*Maximum pulse duration 22% of one cycle with a maximum of 18μs.

PY81

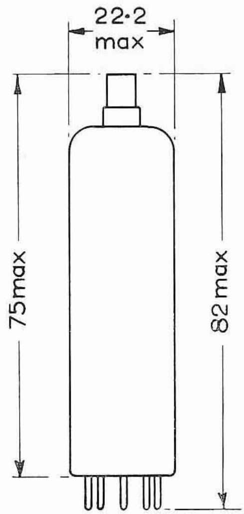
BOOSTER DIODE

6151

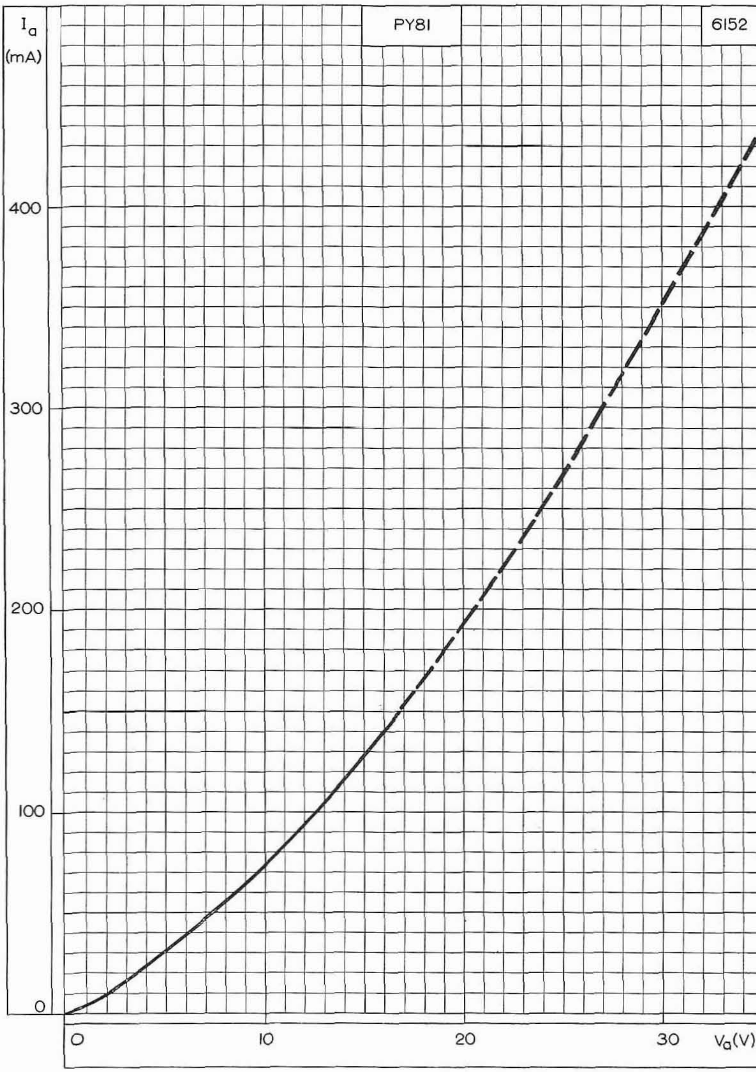




B9A Base



All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

BOOSTER DIODE

PY88

Booster diode with a maximum peak inverse voltage of 6.6kV intended for use in transformerless television receivers with 110° deflection angle cathode ray tubes.

HEATER

Suitable for series operation a.c. or d.c.

I_h	300	mA
V_h	30	V

CAPACITANCES

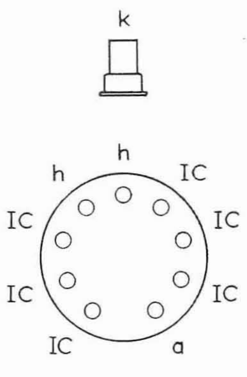
c_{a-k}	8.6	pF
c_{h-k}	2.0	pF

LIMITING VALUES

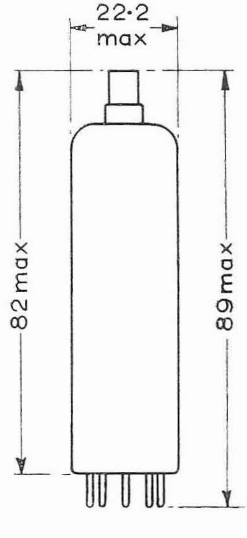
*P.I.V. max.	6.6	kV
*$i_{a(pk)}$ max.	550	mA
$I_{a(av)}$ max.	220	mA
$V_{h-e(r.m.s.)}$ max.	220	V
*$v_{h-k(pk)}$ max. (cathode positive)	6.6	kV

*Maximum pulse duration 22% of a cycle with a maximum of 18μs.

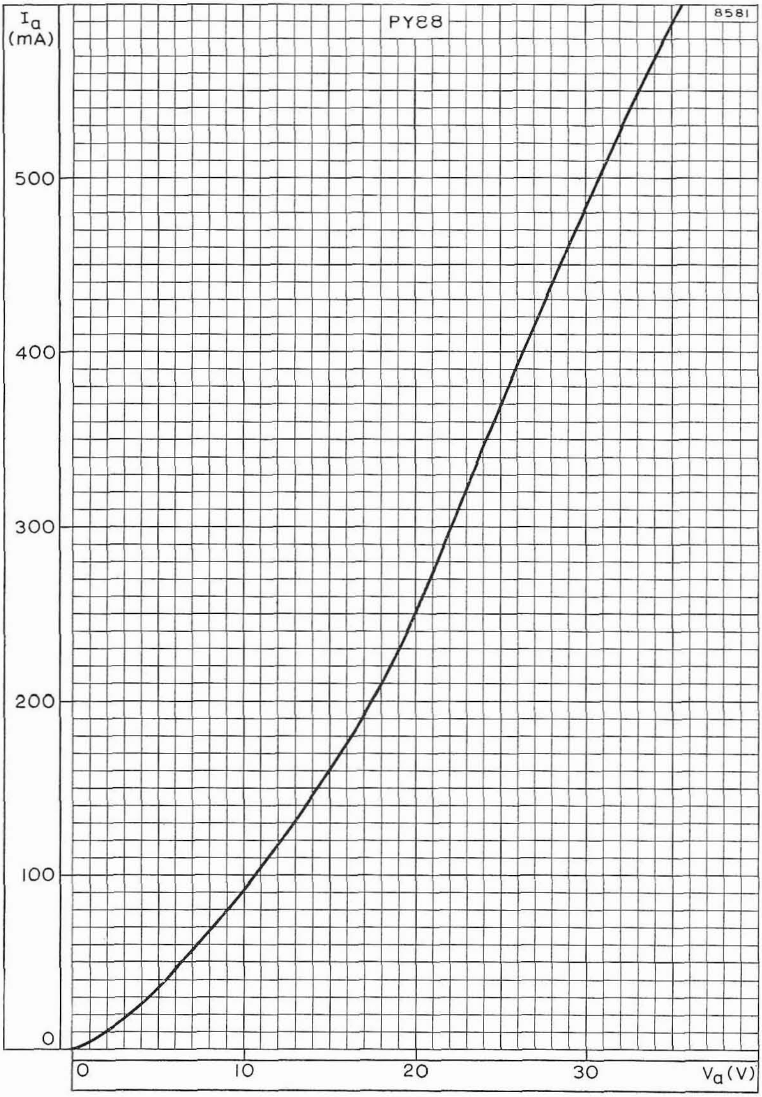
4947



B9A Base



All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

BOOSTER DIODE PY500

TENTATIVE DATA

Booster diode for colour television timebase circuits

HEATER : Suitable for series a.c. or d.c. operation

I_h	300	mA
V_h	42	V

During operation the minimum resistance between any heater pin and any mains terminal for the heater chain should be 100Ω. The hot heater resistances of the other valves in the chain can serve for this resistance.

CAPACITANCES

c_{a-k}	13.5	pF
c_{h-k}	3.7	pF

CHARACTERISTICS

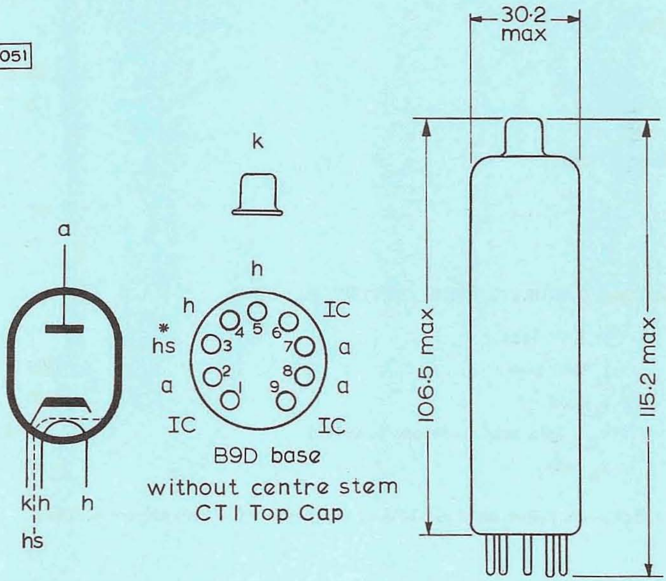
I_a	440	mA
r_i	42	Ω

LIMITING VALUES (DESIGN CENTRE RATINGS)

*P.I.V. max.	5.6	kV
i_a (pk) max.	800	mA
I_a max.	440	mA
*v_{h-k} (pk) max. (cathode positive)	6.3	kV
p_a max.	11	W

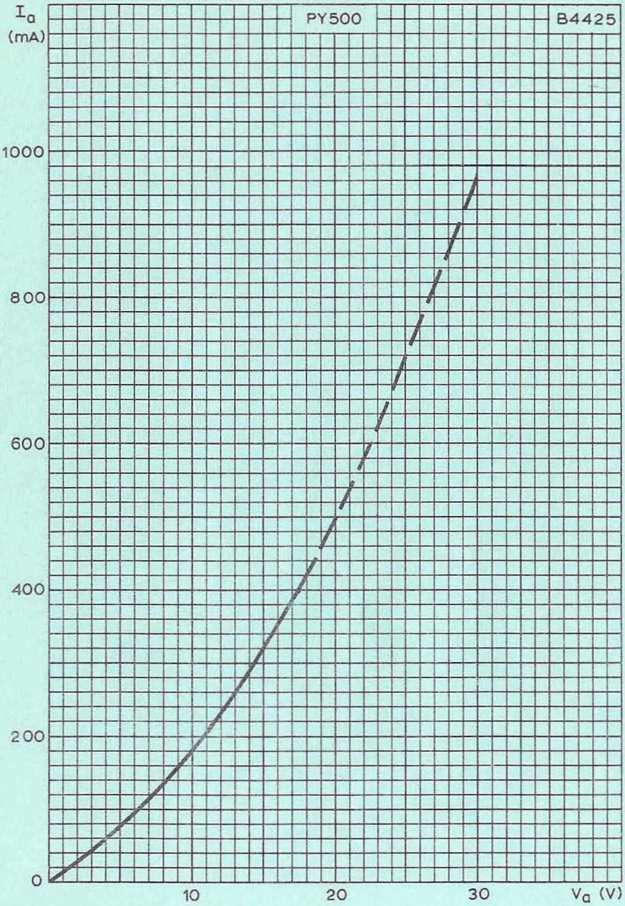
*Maximum pulse duration 22% of one cycle with a maximum of 18μs.

B3051



All dimensions in millimetres

*Insertion of a 1.0W non-inductive 330Ω carbon resistor between pins 3 and 4 is recommended to improve the high-tension properties of the tube. If no resistor is used, pins 3 and 4 should be interconnected.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

BOOSTER DIODE PY500A

Booster diode for colour television timebase circuits. In existing equipment the PY500A is a direct replacement for the PY500. In new equipment designs the 300Ω protection resistance from pin 3 to pin 4 or 5 is not required with the PY500A.

HEATER: Suitable for series operation, a.c. or d.c.

I_h	300	mA
V_h	42	V

During operation the minimum resistance between any heater pin and any mains terminal for the heater chain should be 100Ω. The hot heater resistances of the other valves in the chain can serve for this resistance.

CAPACITANCES

c_{a-k}	13	pF
c_{h-k}	3.7	pF

CHARACTERISTICS

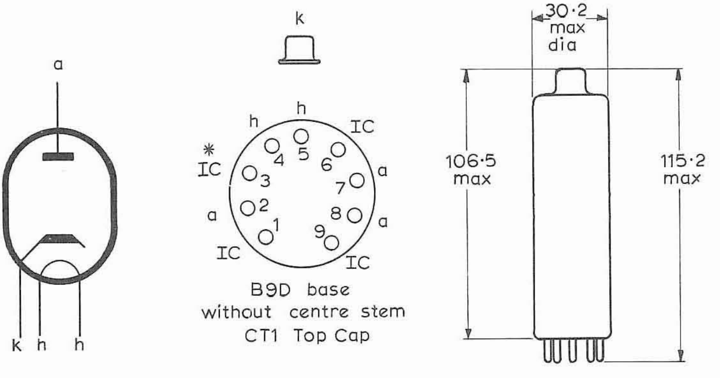
I_a	440	mA
r_i	45.5	Ω

RATINGS (DESIGN CENTRE SYSTEM)

*P.I.V. max.	5.6	kV
*P.I.V. max. (absolute rating)	7.0	kV
$i_{a(pk)}$ max.	800	mA
I_a max.	440	mA
*$v_{h-k(pk)}$ max. (cathode positive)	6.3	kV
p_a max.	11	W

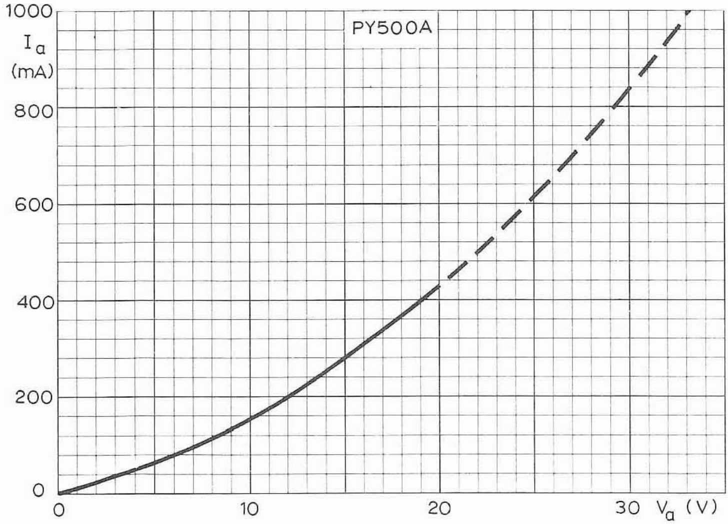
*Maximum pulse duration 22% of one cycle with a maximum of 18μs.

OUTLINE DRAWING



All dimensions in mm

*In existing equipment using the PY500 a resistor may be wired from pin 3 to pin 4 or 5, or pins 3 and 4 may be interconnected. When replacing the PY500 with the PY500A the resistor or interconnection need not be removed. In new equipment designs using the PY500A pin 3 should be left unconnected.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TRIPLE DIODE TRIODE

UABC80

Triple diode triode with 100mA heater and one diode having a separate cathode. Primarily intended for use in f.m./a.m. receivers.

HEATER

Suitable for series operation a.c. or d.c.

I_h	100	mA
V_h	28	V

CAPACITANCES

$c_{g-a'd}$	<70	mpF
$c_{at-a'd}$	<120	mpF
$c_{at-a'''d}$	<100	mpF
$c_{at-k''d}$	<10	mpF
$c_{g-a'''d}$	<20	mpF
$c_{g-k''d}$	<5.0	mpF

Triode section

c_{in}	1.9	pF
c_{out}	1.4	pF
c_{a-g}	2.0	pF
c_{g-h}	<40	mpF

Diode sections

$c_{a'd-(h+kt,k'd,k'''d,s)}$	800	mpF
$c_{a''d-(h+k''d+kt,k'd,k'''d,s)}$	4.8	pF
$c_{a'''d-(h+kt,k'd,k'''d,s)}$	4.8	pF
$c_{k''d-all}$	5.0	pF
$c_{a'd-h}$	<250	mpF
$c_{a'''d-h}$	<200	mpF
$c_{k''d-h}$	2.5	pF

CHARACTERISTICS

Triode section

V_a	170	200	V
V_g	−1.85	−2.3	V
I_a	1.0	1.0	mA
g_m	1.45	1.4	mA/V
μ	70	70	
r_a	48	50	kΩ
V_g max. ($I_g = +0.3\mu A$)		−1.3	V

Diode sections

$r_{a'd}$ ($V_{a'd} = +10V$)	5.0	kΩ
$r_{a''d}$ ($V_{a''d} = +5V$)	200	Ω
$r_{a'''d}$ ($V_{a'''d} = +5V$)	200	Ω
$r_{a''d}/r_{a'''d}$	0.65 to 1.5	

UABC80

TRIPLE DIODE TRIODE

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER* *(with grid current biasing)*

V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%) for $V_{out(r.m.s.)}$ =3V	=5V	=8V	R_g† (kΩ)
170	47	1.25	32	0.6	1.1	2.0	150
170	100	0.82	42	0.5	0.8	1.3	330
170	220	0.46	51	0.4	0.5	1.1	680
200	47	1.6	34	0.5	0.9	1.5	150
200	100	1.0	44	0.4	0.6	1.0	330
200	220	0.56	53	0.3	0.4	0.9	680
250	47	2.2	36	0.3	0.6	1.0	150
250	100	1.4	47	0.25	0.5	0.8	330
250	220	0.76	54	0.2	0.25	0.6	680

*Measured with a grid resistor of 10MΩ.

†R_g = grid resistor of following value.

LIMITING VALUES

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.0	W
I_k max.	5.0	mA
R_{g-k} max.	3.0	MΩ
†V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

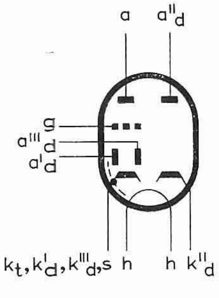
†In order to avoid excessive hum the a.c. component should be as low as possible (<30$V_{r.m.s.}$)

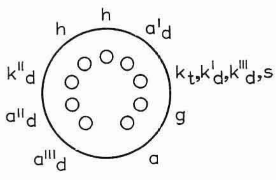
Diode sections

P.I.V.$_{(a'd)}$ max.	350	V
P.I.V.$_{(a''d)}$ max.	350	V
P.I.V.$_{(a'''d)}$ max.	350	V
$I_{a'd}$ max.	1.0	mA
$I_{a''d}$ max.	10	mA
$I_{a'''d}$ max.	10	mA
$i_{a'd(pk)}$ max.	6.0	mA
$i_{a''d(pk)}$ max.	75	mA
$i_{a'''d(pk)}$ max.	75	mA

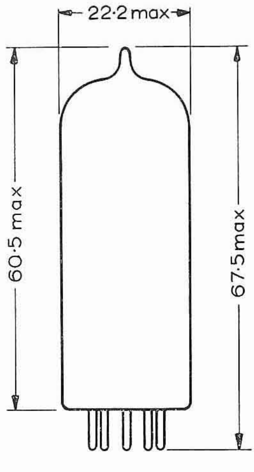
MICROPHONY

This valve can be used without special precautions against microphony in circuits in which the input voltage is not less than 10mV for an output of 50mW from the output stage at 800c/s and higher frequencies.





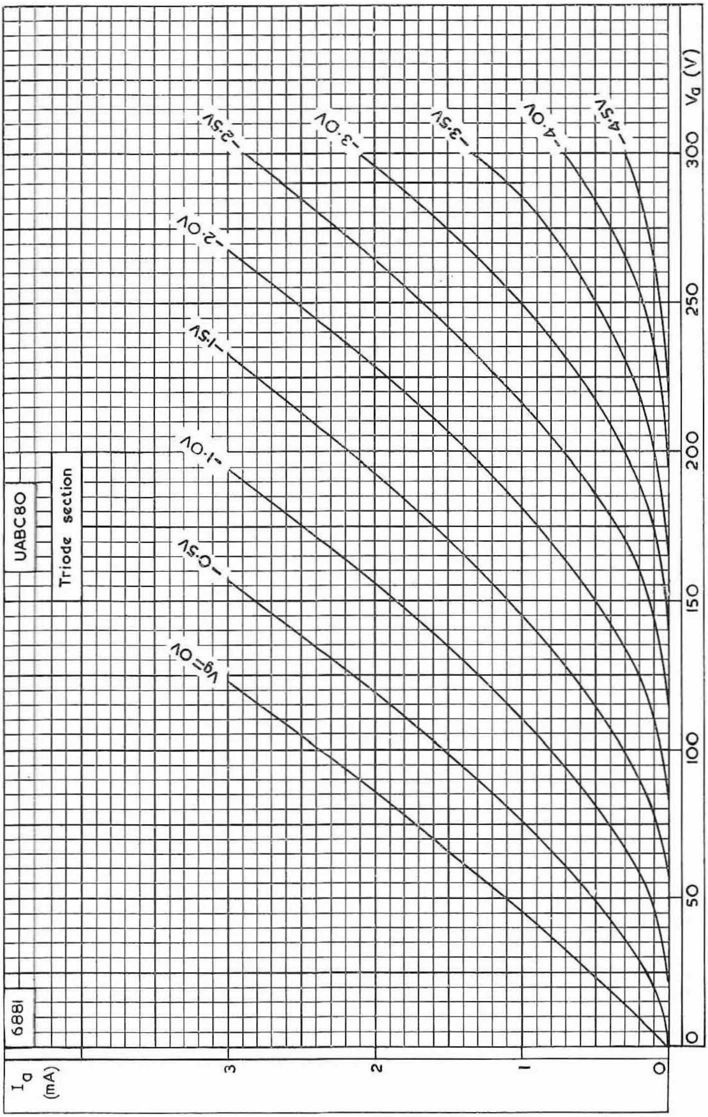
B9A Base



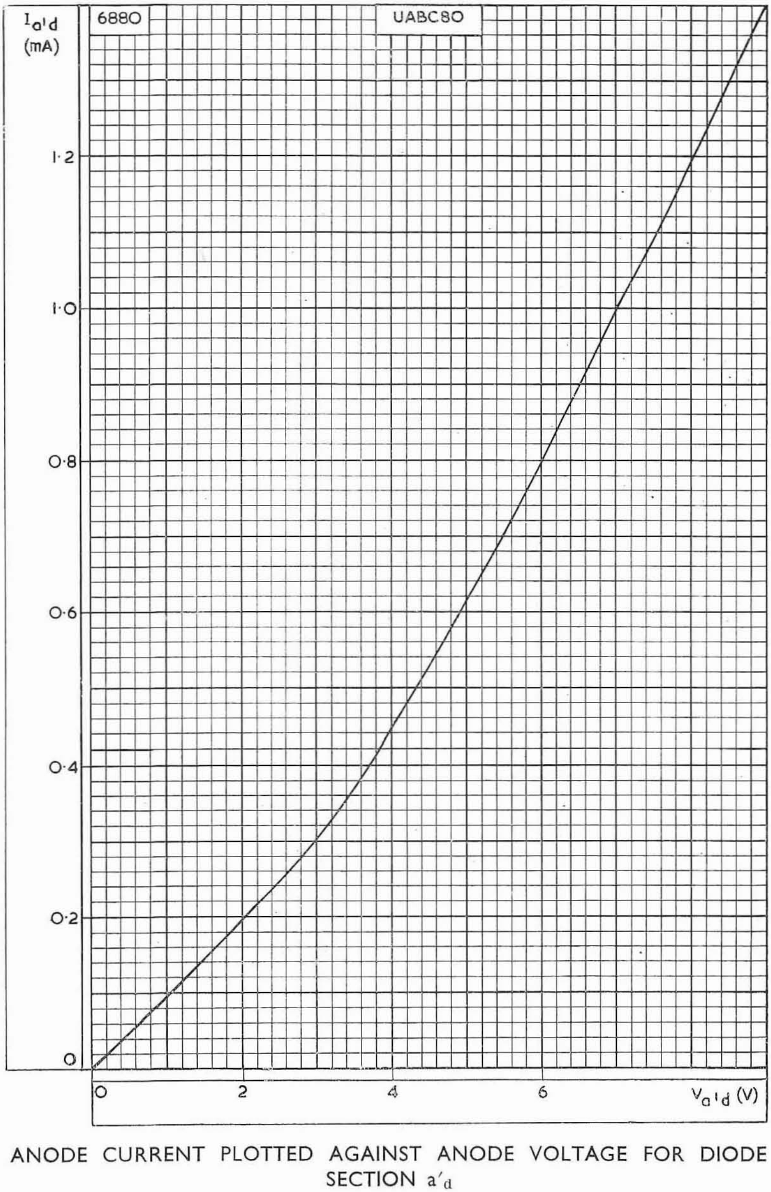
6402

All dimensions in mm

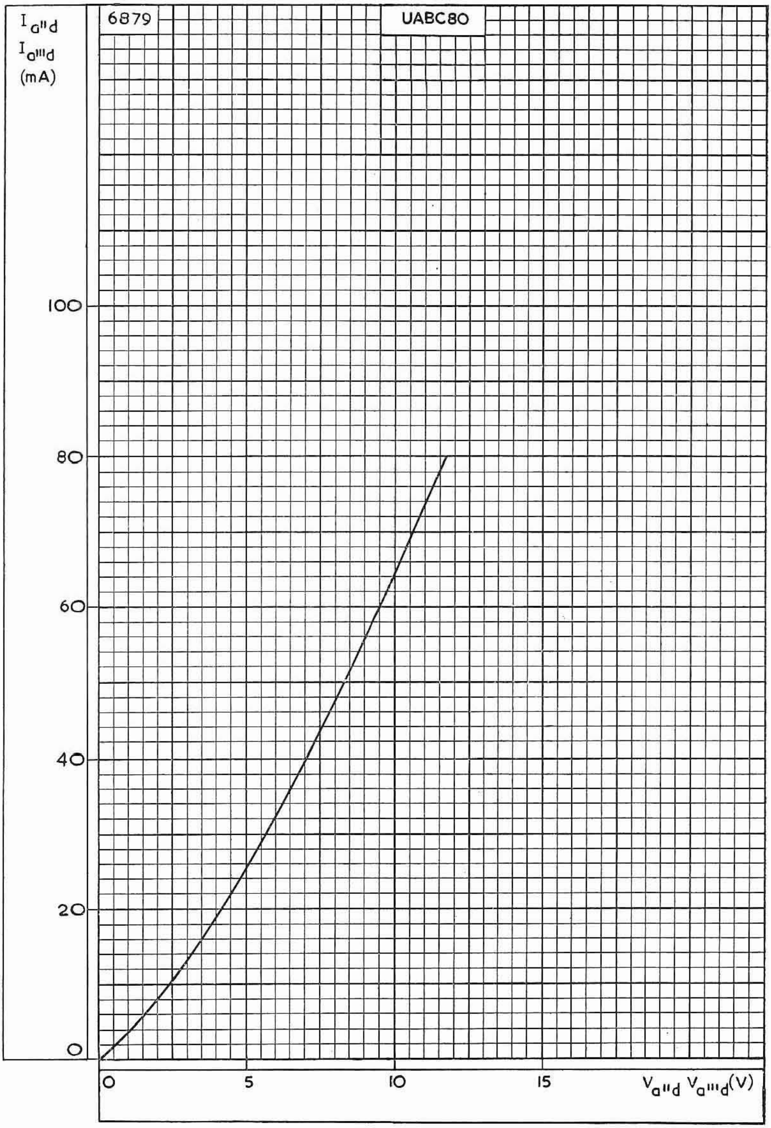
It is recommended that pin 5 be earthed.



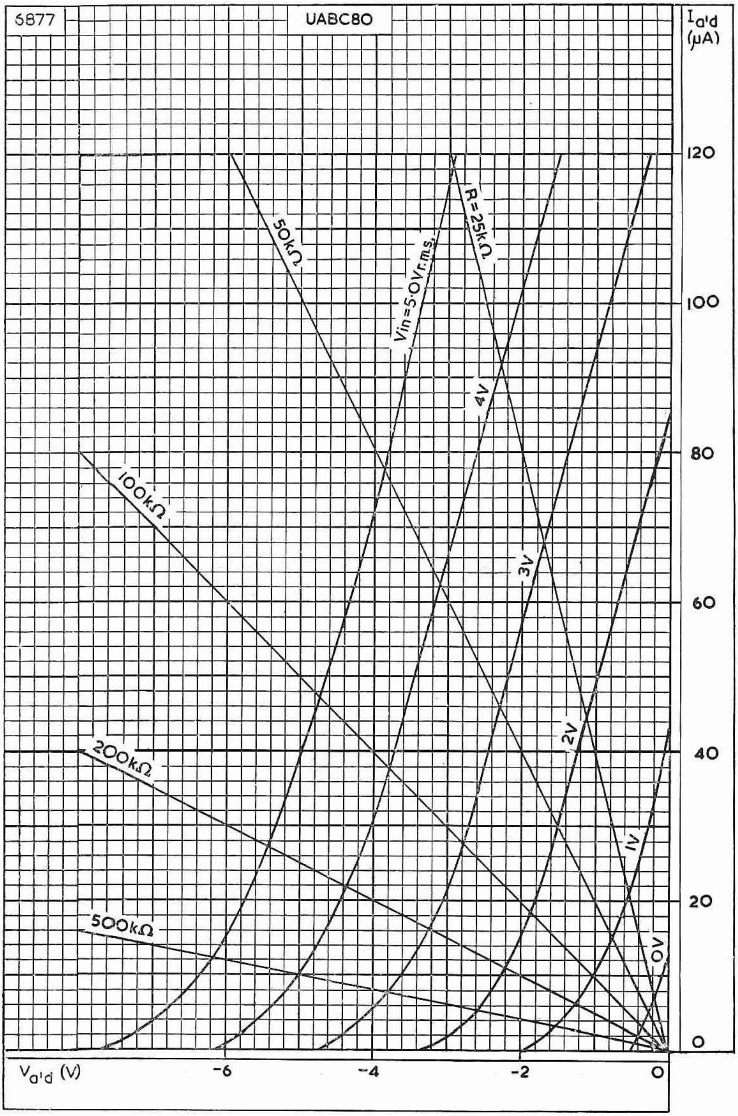
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



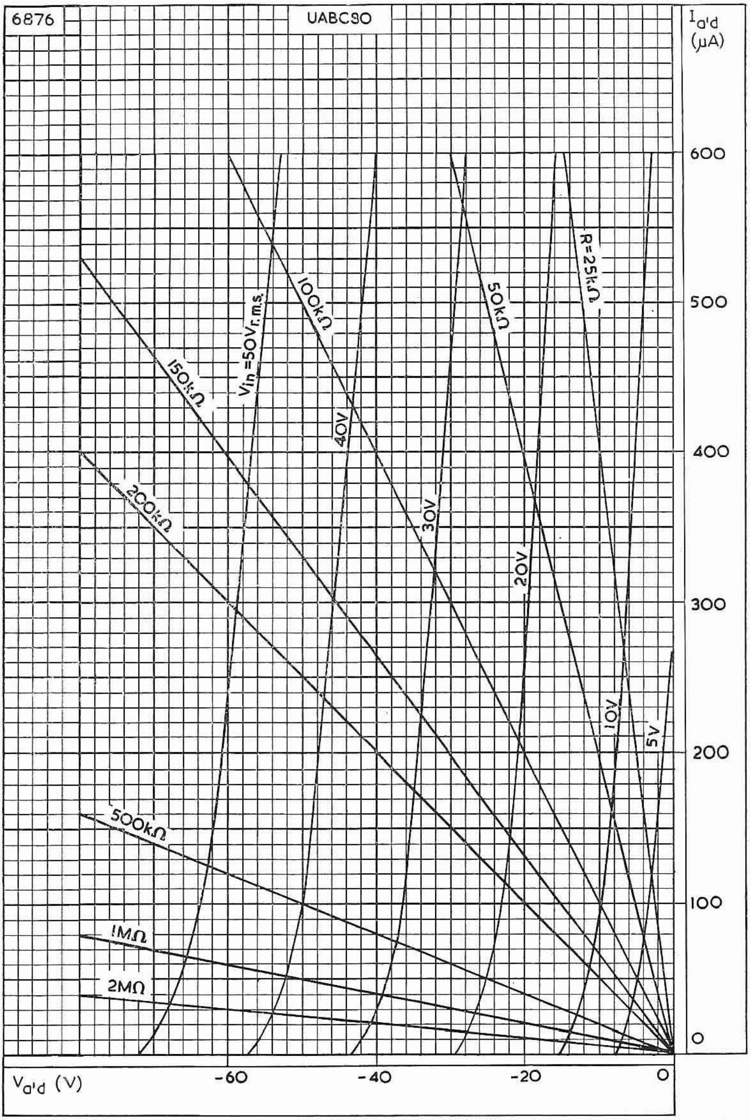
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR DIODE SECTION a'_d



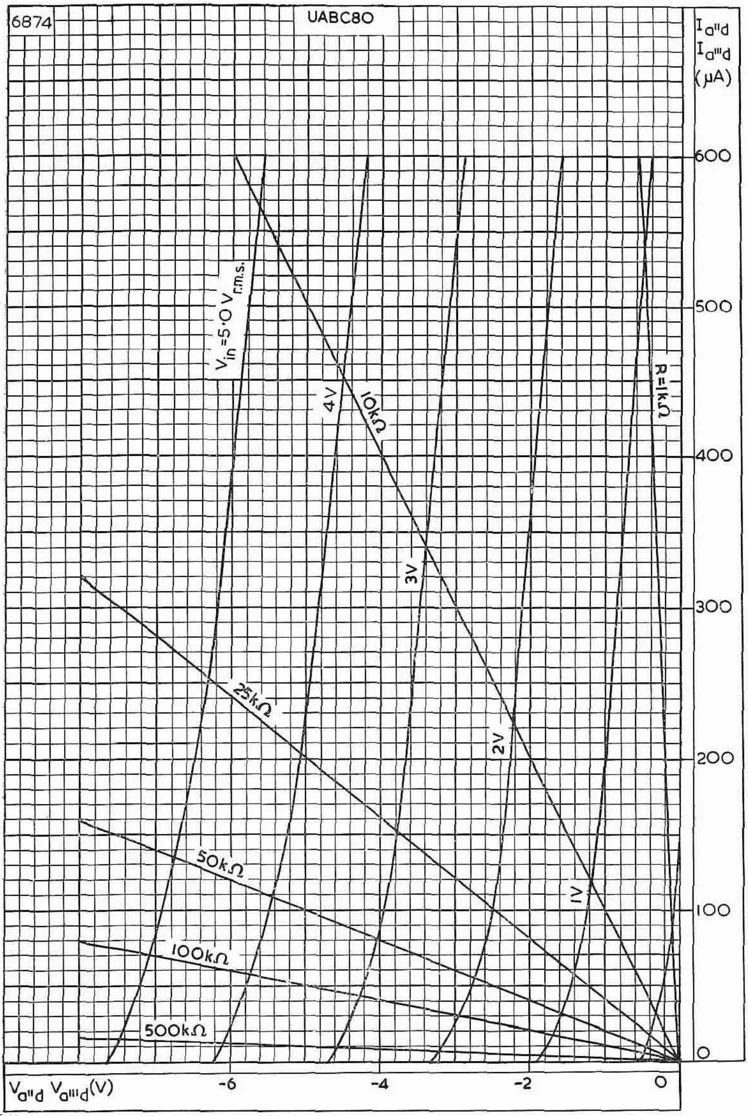
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR DIODE SECTIONS a''_d and a'''_d



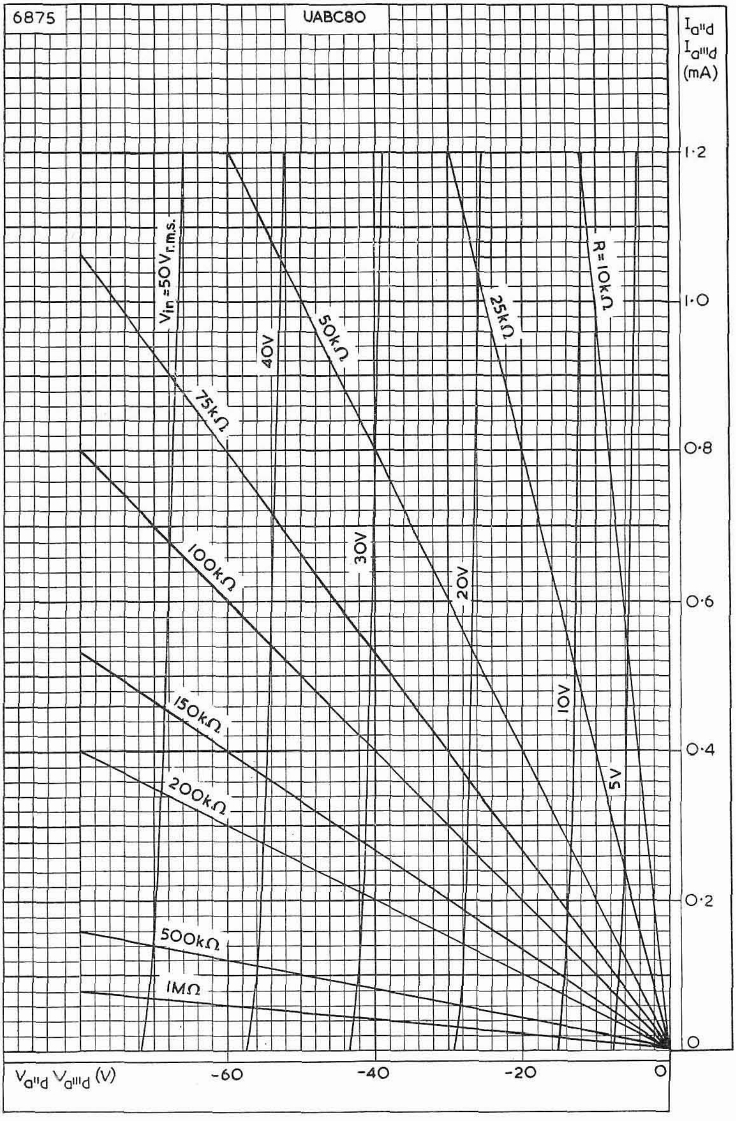
RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN 0V AND $5V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTION a'_d



RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN $5V_{r.m.s.}$ AND $50V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTION a'_d



RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN 0V AND $5V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTIONS a''_d AND a'''_d



RECTIFIED CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE BETWEEN $5V_{r.m.s.}$ AND $50V_{r.m.s.}$ AS PARAMETER FOR DIODE SECTIONS a''_d AND a'''_d

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

UBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

HEATER

Suitable for series operation a.c. or d.c.

I_h	100	mA
V_h	19	V

MOUNTING POSITION

Any

CAPACITANCES

$c_{a'd-g1}$	<0.0008	pF
$c_{a''d-g1}$	<0.001	pF
$c_{a'd-a}$	<0.15	pF
$c_{a''d-a}$	<0.025	pF

Pentode section

c_{a-g1}	<0.0025	pF
c_{out}	5.2	pF
c_{in}	5.0	pF
c_{g1-h}	0.05	pF

Diode sections

$c_{a'd-k}$	2.5	pF
$c_{a''d-k}$	2.5	pF
$c_{a'd-a''d}$	<0.25	pF
$c_{a'd-h}$	<0.015	pF
$c_{a''d-h}$	<0.003	pF

CHARACTERISTICS

V_a	100	200	V
V_{g3}	0	0	V
V_{g2}	100	100	V
V_{g1}	–2.0	–1.5	V
I_a	8.5	11	mA
I_{g2}	2.8	3.3	mA
g_m	3.5	4.5	mA/V
r_a	300	600	kΩ
μ_{g1-g2}	—	20	
V_{g1} ($g_m = 120\mu$A/V)	–10	–20	V

UBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f amplifier. The diode sections are only suitable for a.m. detection.

TYPICAL OPERATING CONDITIONS

$V_a = V_b$	170	170	200	200	V
V_{g3}	0	0	0	0	V
R_{g2}	27	21	47	30	kΩ
V_{g1}	–0.5*	–1.5	–0.5*	–1.5	V
R_k	—	105	—	105	Ω
I_a	11	11	9.5	11	mA
I_{g2}	3.4	3.4	2.8	3.3	mA
g_m	5.0	4.5	5.0	4.5	mA/V
r_a	450	450	600	600	kΩ
R_{eq}	2.5	3.5	2.5	3.5	kΩ
g_m (V_{g1} = –20V)	65	65	115	120	μA/V

*This voltage is produced by the grid current flowing through the grid resistor and the steady current of the diode. If this condition is not acceptable the negative grid bias should be increased to –1.5V.

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.25	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. (I_a<4.0mA)	250	V
V_{g2} max. (I_a>8.0mA)	125	V
p_{g2} max.	450	mW
I_k max.	16.5	mA
V_{g1} max. (I_{g1} = +0.3μA)	–1.3	V
R_{g1-k} max.	3.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
R_{g3-k} max.	10	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

UBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

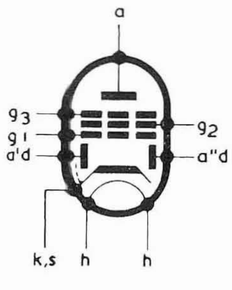
Diode sections (each section)

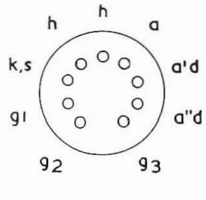
P.I.V. max.	200	V
I_{ad} max.	800	μA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

MICROPHONY

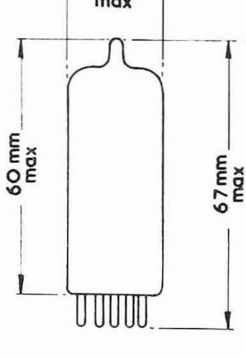
This valve can be used without special precautions against microphony in circuits in which the input voltage is >25mV (r.m.s) for an output of 50mW from the output valve.

2845





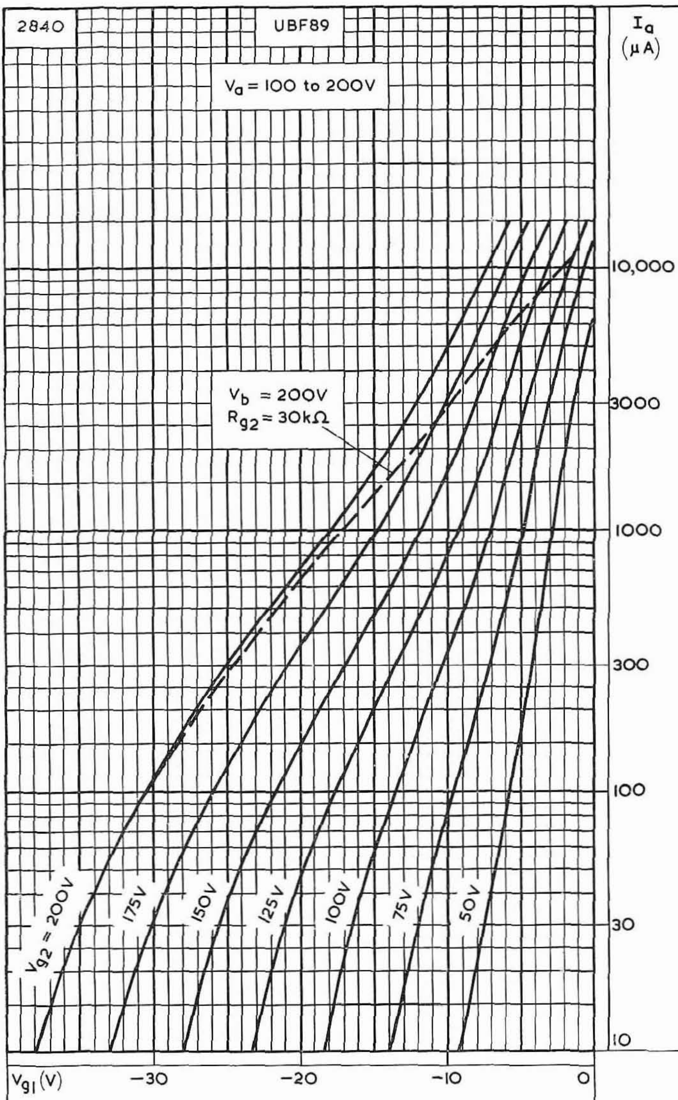
B9A Base



UBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

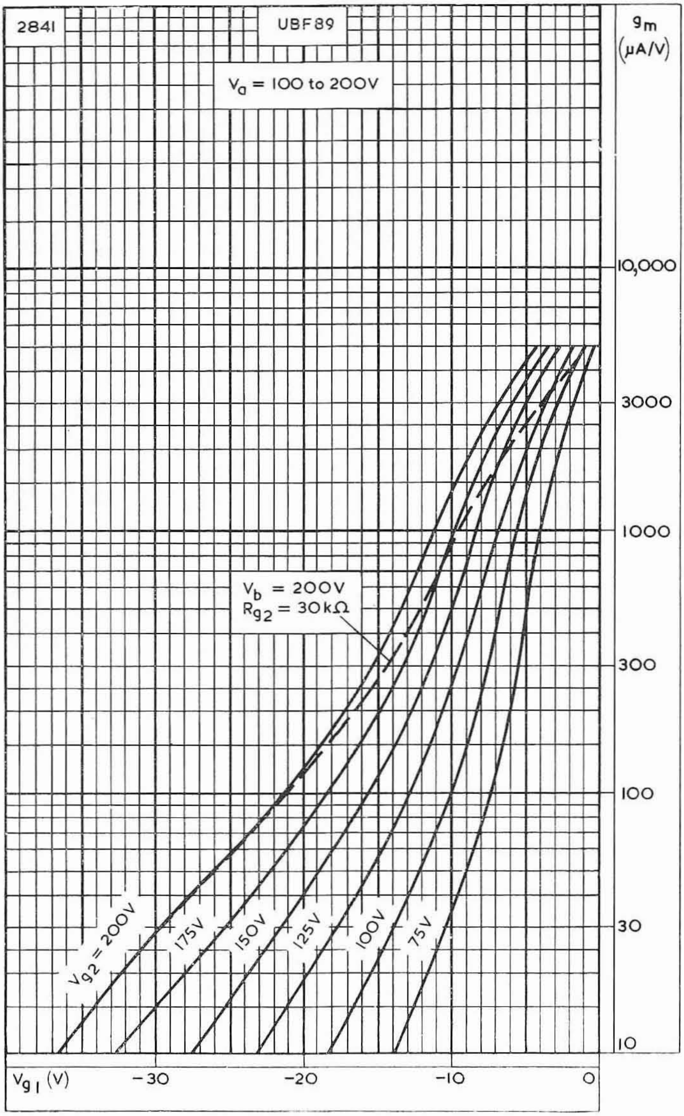


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

UBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

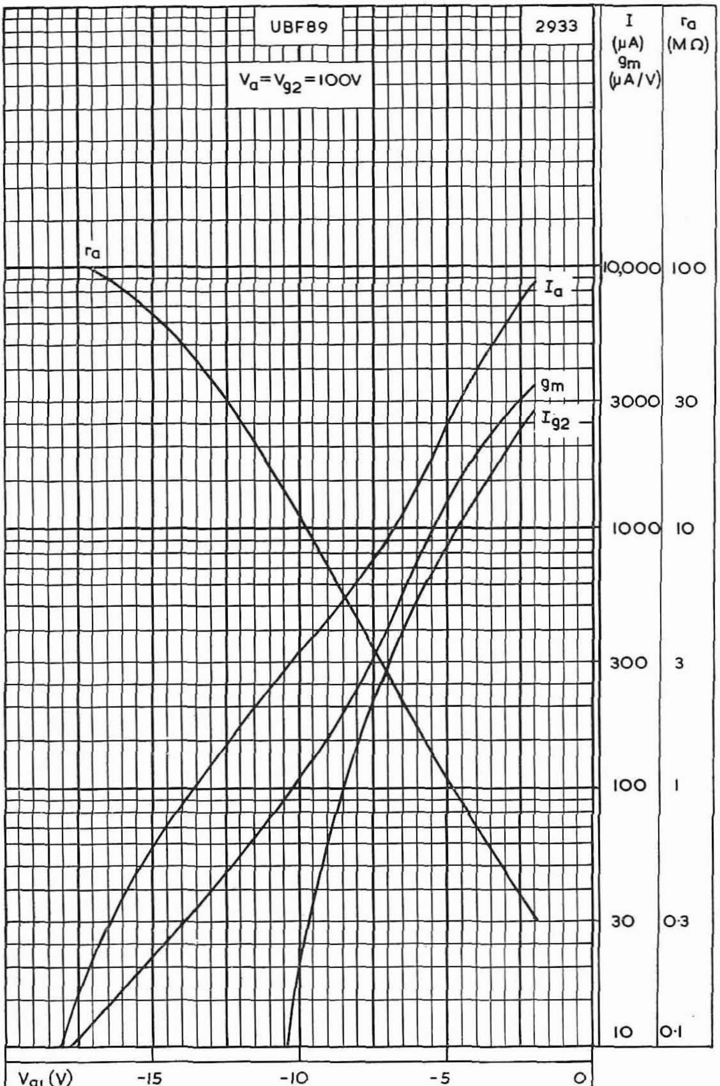


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

UBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

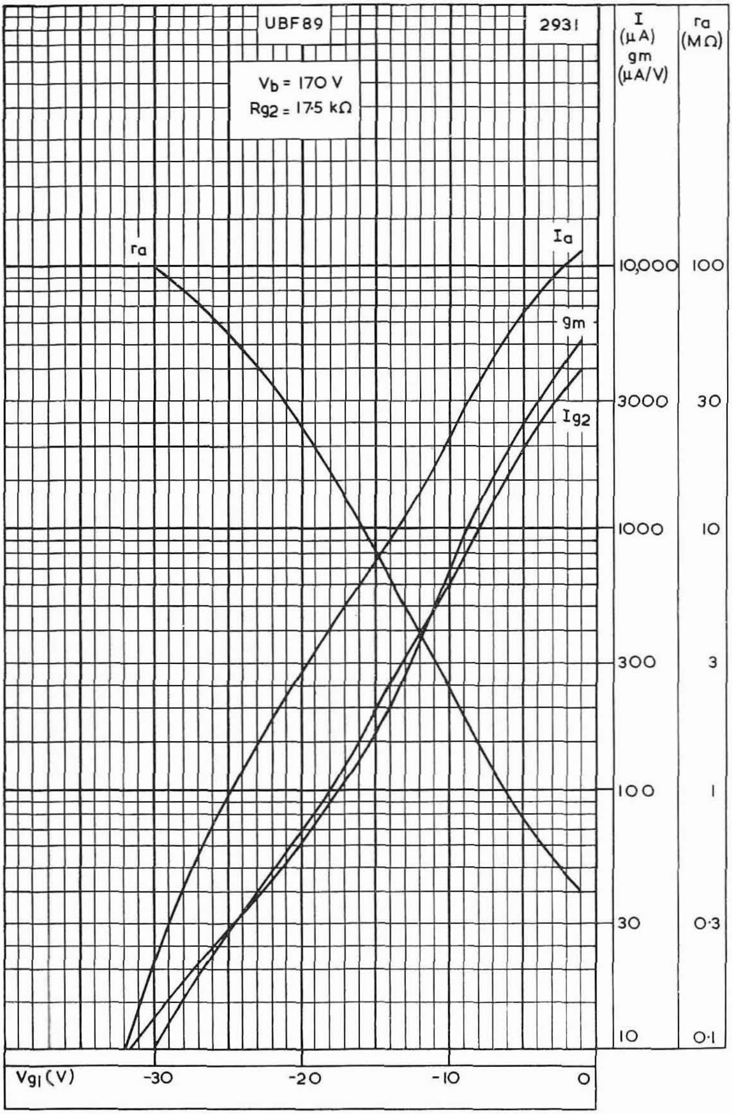


ANODE AND SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE
$V_a = V_{g2} = 100V$

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

UBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.

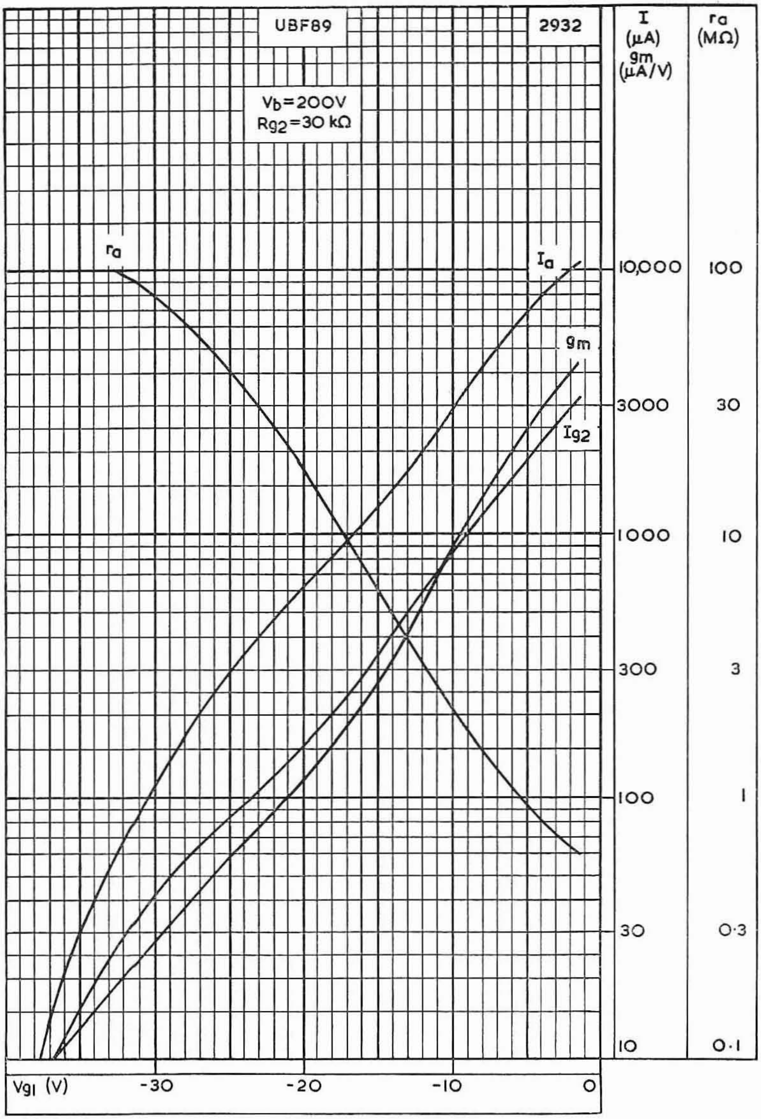


ANODE AND SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE
V_b = 170V

UBF89

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f amplifier. The diode sections are only suitable for a.m. detection.

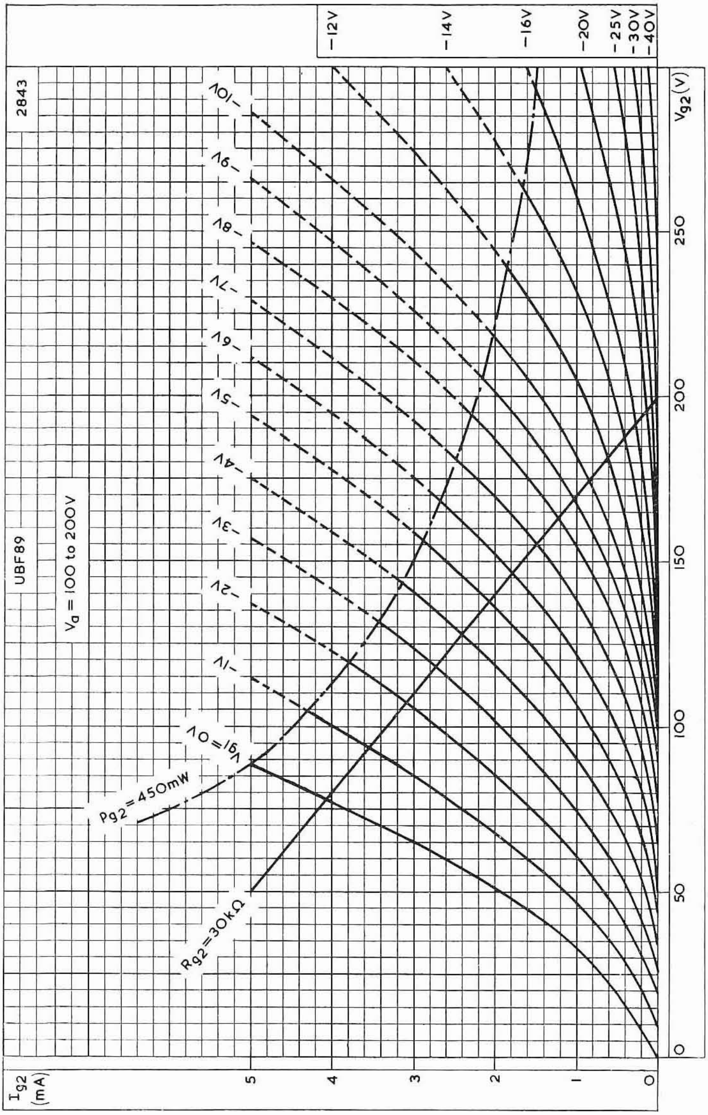


ANODE AND SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE
$V_b = 200V$

DOUBLE DIODE VARIABLE-MU R.F. PENTODE

UBF89

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f. or i.f. amplifier. The diode sections are only suitable for a.m. detection.



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

R.F. DOUBLE TRIODE UCC85

Double triode with 100mA heater primarily intended for use in f.m./a.m. receivers as an r.f. amplifier and self-oscillating additive mixer.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	100	mA
V_h	26	V

CAPACITANCES

$*c_{a-g}$	1.5	pF
$*c_{g-k+h+s}$	3.1	pF ←
$*c_{a-k}$	180	mpF
$*c_{a-k+h+s}$	1.2	pF
$*†c_{a-k+h+s}$	1.8	pF ←
$c_{a'-a''}$	<40	mpF
$†c_{a'-a''}$	<8.0	mpF
$c_{g'-g''}$	<3.0	mpF
$c_{a''-g'}$	<8.0	mpF
$c_{a'-g''}$	<8.0	mpF
$c_{a''-k'}$	<8.0	mpF
$c_{a'-k''}$	<8.0	mpF
$c_{g''-k'}$	<3.0	mpF
$c_{g'-k''}$	<3.0	mpF

*Each section

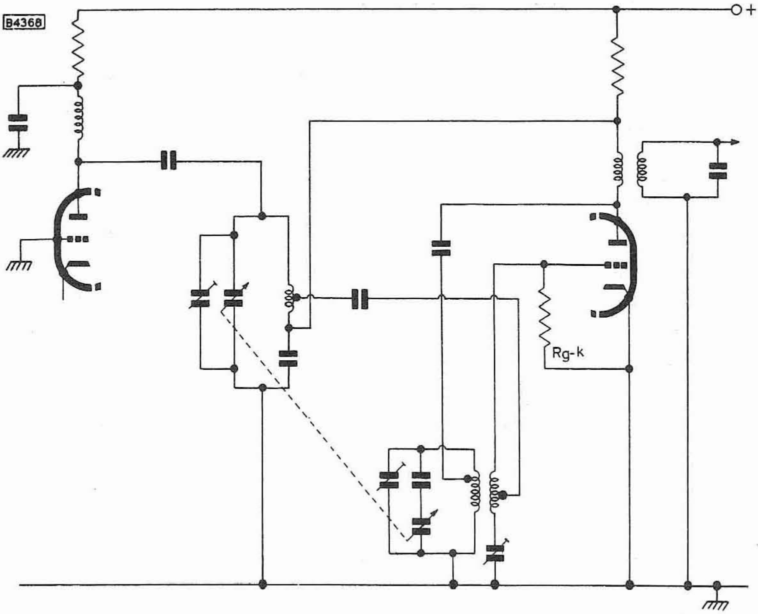
†Measured with an external shield.

CHARACTERISTICS (each section)

V_a	170	200	V
I_a	10	10	mA
V_g	-1.75	-2.4	V ←
g_m	6.7	6.0	mA/V ←
μ	48	46	←
r_a	7.1	7.7	kΩ ←

OPERATING CONDITIONS AS R.F. AMPLIFIER

V_a	155	161	V
V_b	170	170	V
R_a	1.5	1.3	kΩ
I_a	9.8	6.6	mA ←
R_k	150	330	Ω ←
g_m	6.7	5.1	mA/V ←
r_a	7.0	8.5	kΩ ←
r_{gl} (f = 100Mc/s)	3.8	5.2	kΩ ←
R_{eq}	550	820	Ω



OPERATING CONDITIONS AS SELF-OSCILLATING ADDITIVE MIXER (with i.f. feedback, see basic circuit in fig.1.)

V_b	170	200	V
R_a	4.7	8.2	kΩ
$^*R_{g-k}$	1.0	1.0	MΩ
I_a	5.5	6.0	mA ←
V_{osc} (r.m.s.)	2.8	2.8	V
g_c	2.8	2.9	mA/V ←
r_a	15	14	kΩ

*The presence of the i.f. feedback voltage tends to stabilise the performance of the oscillator and hence permits this relatively high value to be used for the grid leak.

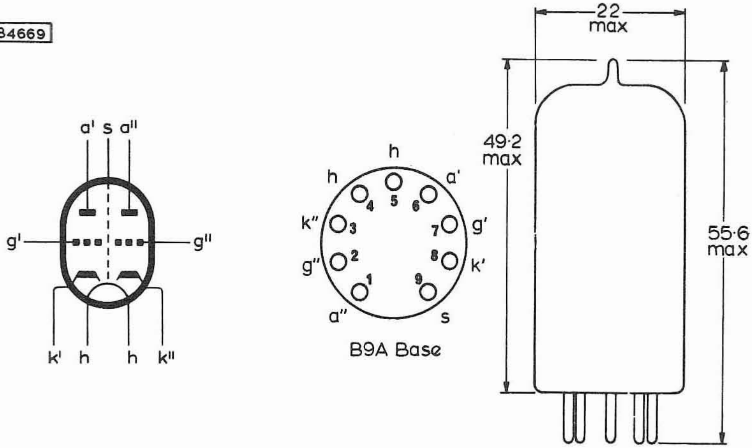
R.F. DOUBLE TRIODE UCC85

RATINGS (ABSOLUTE MAXIMUM SYSTEM)
(each section unless otherwise specified)

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.5	W
$p_{a'} + p_{a''}$ max.	4.5	W
I_k max.	15	mA
$-V_g$ max.	100	V
R_{g-k} max.	1.0	MΩ
*V_{h-k} max.	90	V
R_{h-k} max.	20	kΩ

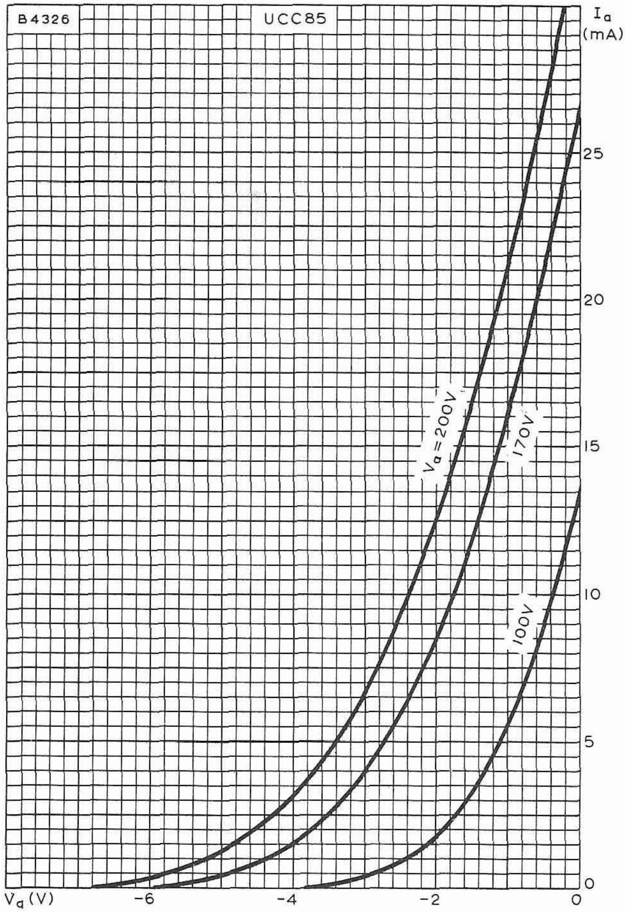
*When operating as an oscillator no r.f. voltage should be applied between heater and cathode.

B4669

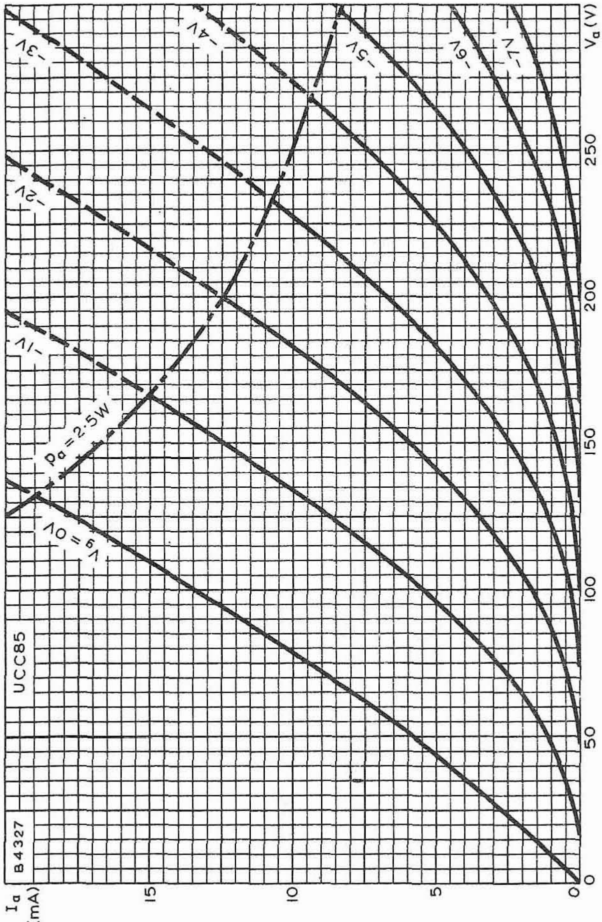


All dimensions in mm

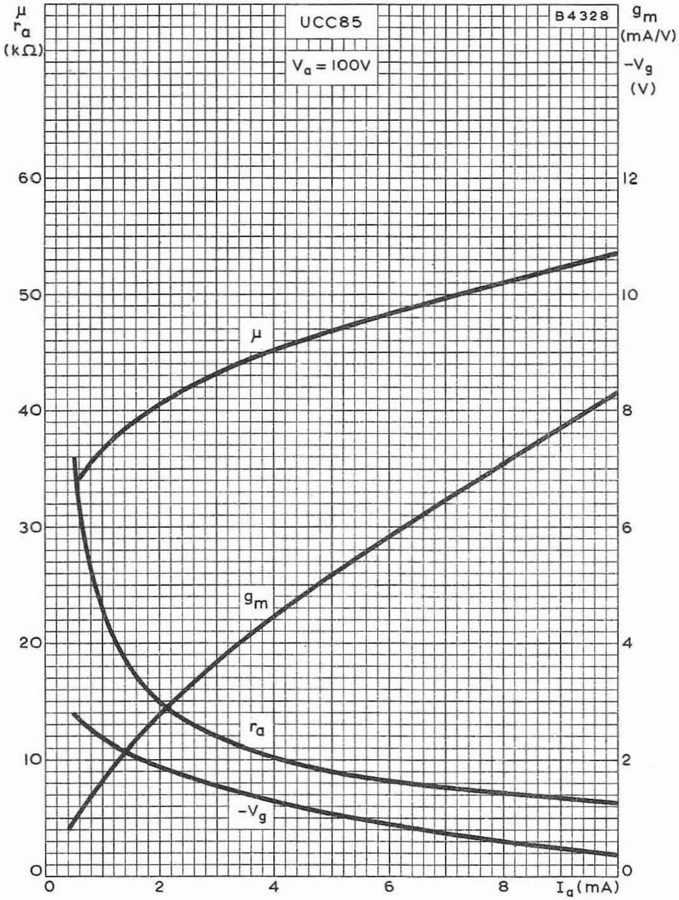
The triode on pins 6, 7, 8 should be used as the r.f. amplifier and that on pins 1, 2, 3 as the self-oscillating additive mixer.



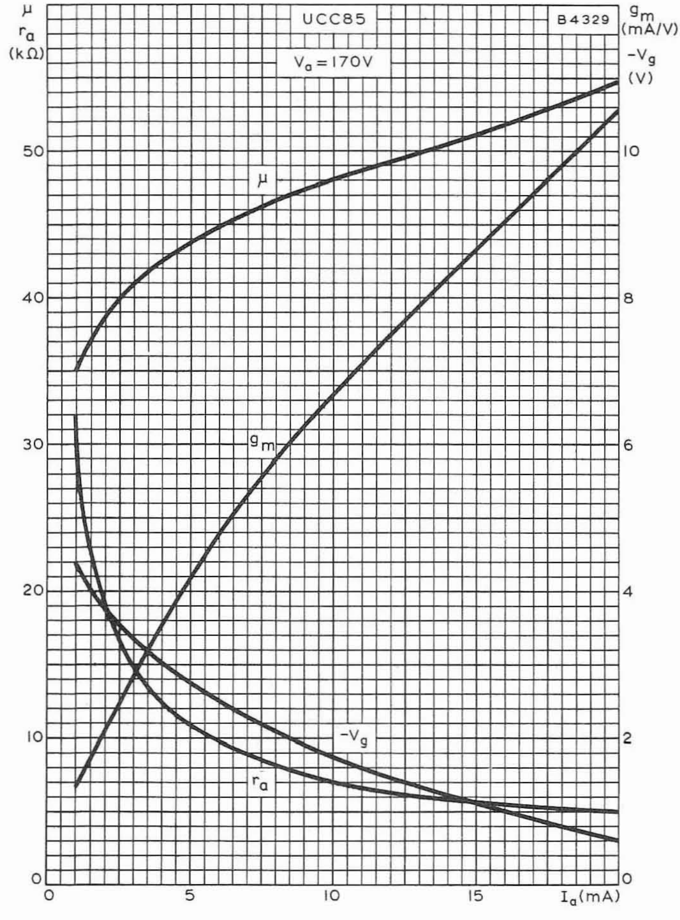
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



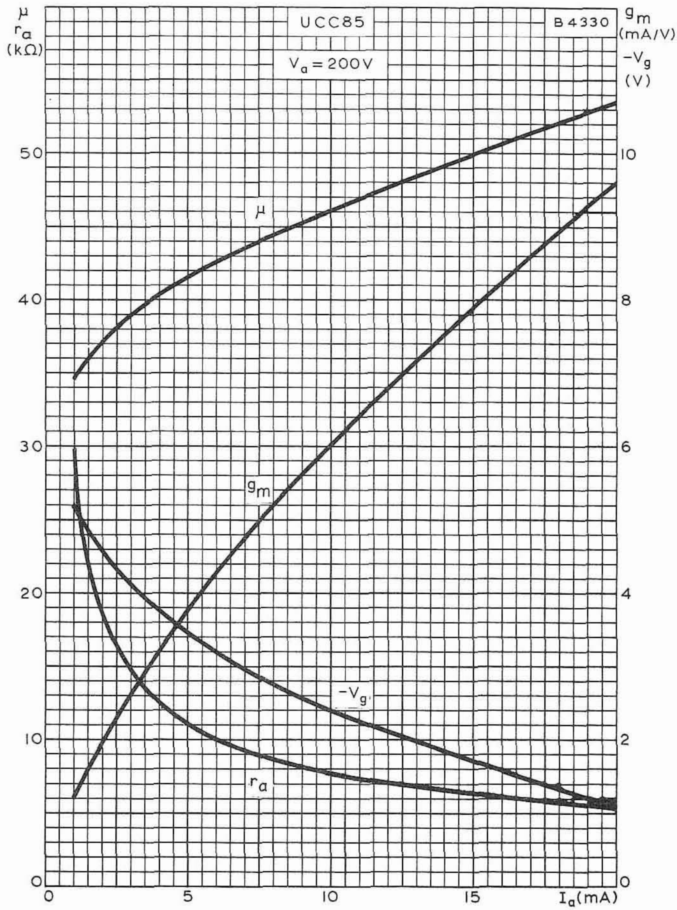
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



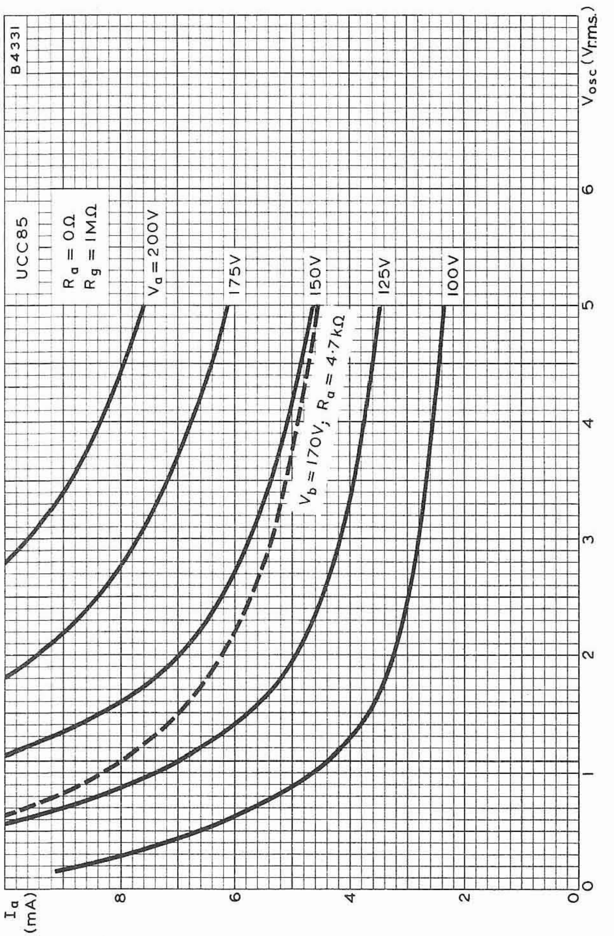
MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT, V_a = 100V



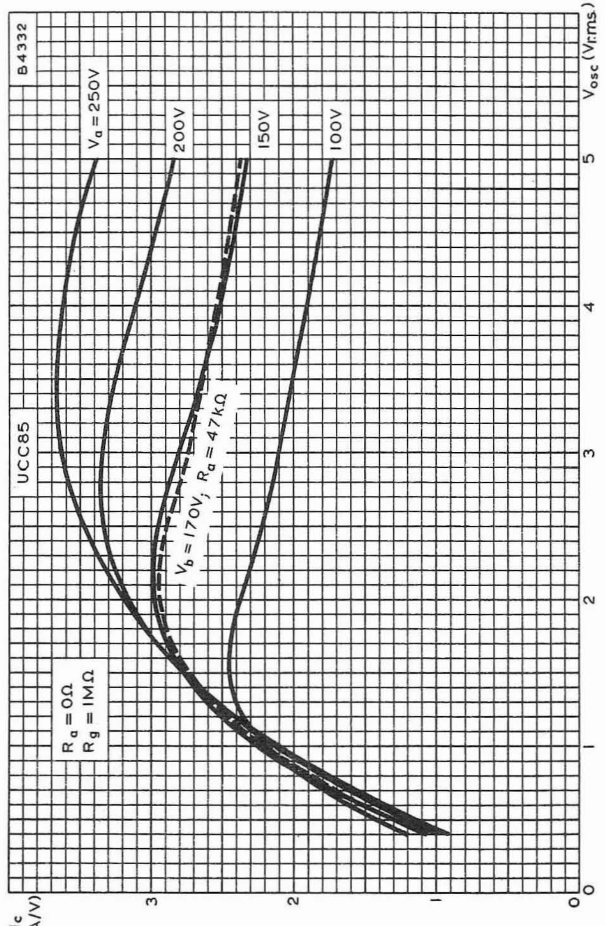
MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT, V_a = 170V



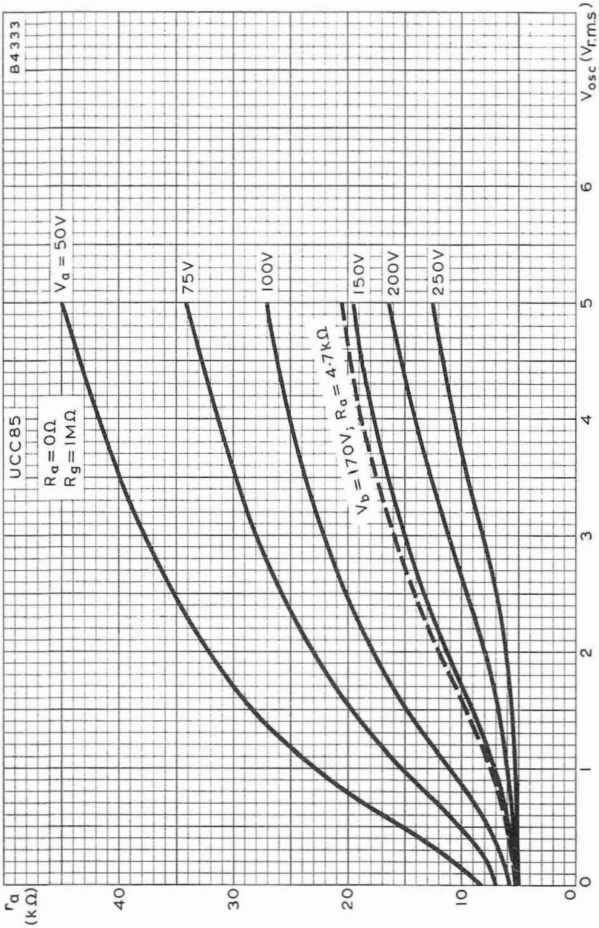
MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT, $V_a = 200V$



ANODE CURRENT PLOTTED AGAINST OSCILLATOR VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



CONVERSION CONDUCTANCE PLOTTED AGAINST OSCILLATOR VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



ANODE IMPEDANCE PLOTTED AGAINST OSCILLATOR VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

TRIODE HEPTODE

UCH81

Triode heptode with 100mA heater primarily intended for use as a frequency changer.

HEATER

Suitable for series operation, a.c. or d.c.

I_h	100	mA
V_h	19	V

CAPACITANCES

c_{ah-at}	200	mpF
c_{ah-gt}	<90	mpF
$c_{ah-g3+gt}$	<350	mpF
c_{g1-at}	<60	mpF
c_{g1-gt}	<170	mpF
$c_{g1-g3+gt}$	<450	mpF

Heptode section

$c_{in(g1)}$	4.8	pF
$c_{in(g3)}$	6.0	pF
c_{out}	7.9	pF
c_{a-g1}	<6.0	mpF
c_{g1-g3}	<300	mpF
c_{g1-h}	<170	mpF
c_{g3-h}	<60	mpF

Triode section

c_{in}	2.6	pF
c_{out}	2.1	pF
c_{a-g}	1.0	pF
c_{g-h}	<20	mpF

OPERATING CONDITIONS FOR HEPTODE SECTION AS R.F. OR I.F. AMPLIFIER

$V_a = V_b$	170	200	V
V_{g3}	0	0	V
R_{g2+g4}	18	18	kΩ
V_{g1}	−2.2	−2.6	V
R_k	220	220	Ω
V_{g2+g4}	102	123	V
I_a	6.2	7.6	mA
I_{g2+g4}	3.8	4.3	mA
g_m	2.3	2.4	mA/V
r_a	600	600	kΩ
$\mu_{g1-(g2+g4)}$	20	20	
R_{eq}	8.8	9.7	kΩ
V_{g1} (for 100 : 1 reduction in g_m)	−28	−33	V
V_{g1} max. ($I_{g1} = +0.3\mu A$)		−1.3	V
V_{g3} max. ($I_{g3} = +0.3\mu A$)		−1.3	V

UCH81

TRIODE HEPTODE

OPERATING CONDITIONS OF HEPTODE SECTION AS A.M. FREQUENCY CHANGER

$V_a = V_b$	170	200	V
R_{g2+g4}	10	10	kΩ
R_{g3+gt}	47	47	kΩ
V_{g1}	–2.2	–2.6	V
V_{g2+g4}	102	119	V
I_a	3.2	3.7	mA
I_{g2+g4}	6.8	8.1	mA
I_{g3+gt}	200	230	μA
g_c	750	775	μA/V
r_a	0.9	1.0	MΩ
R_{eq}	70	75	kΩ
V_{g1} (for 100 : 1 reduction in g_c)	–24	–28	V

CHARACTERISTICS

Triode section

V_a	100	V
I_a	13.5	mA
V_g	0	V
g_m	3.7	mA/V
μ	22	
V_g max. ($I_g = +0.3\mu A$)	–1.3	V

OPERATING CONDITIONS OF TRIODE SECTION AS R.F. OSCILLATOR

V_b	170	200	V
R_{at}	15	15	kΩ
R_{gt+g3}	47	47	kΩ
I_{g3+gt}	200	240	μA
I_{at}	4.5	5.4	mA
g_m (eff)	580	580	μA/V

LIMITING VALUES

Heptode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.7	W
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max. (I_a = 7.6mA)	125	V
V_{g2+g4} max. (I_a < 1mA)	250	V
p_{g2+g4} max.	1.0	W
I_k max.	12.5	mA
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

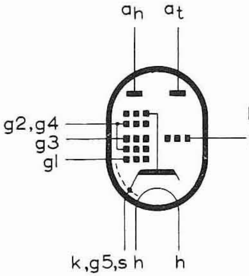
*If the two sections of the valve are switched during operation so that there is no direct connection between g_3 and g_t, as may occur in f.m./a.m. receivers, then R_{g3-k} max. = 20kΩ.

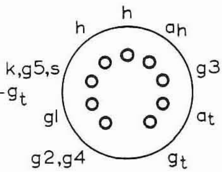
UCH81

Triode section

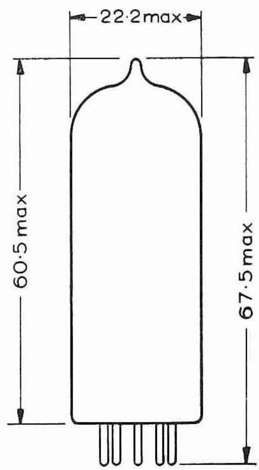
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	800	mW
I_k max.	6.5	mA
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

The heptode section of this valve can be used without special precautions against microphony in circuits in which the input voltage is not less than 50mV for an output of 50mW from the output stage. The corresponding figure for the triode section is 25mV.



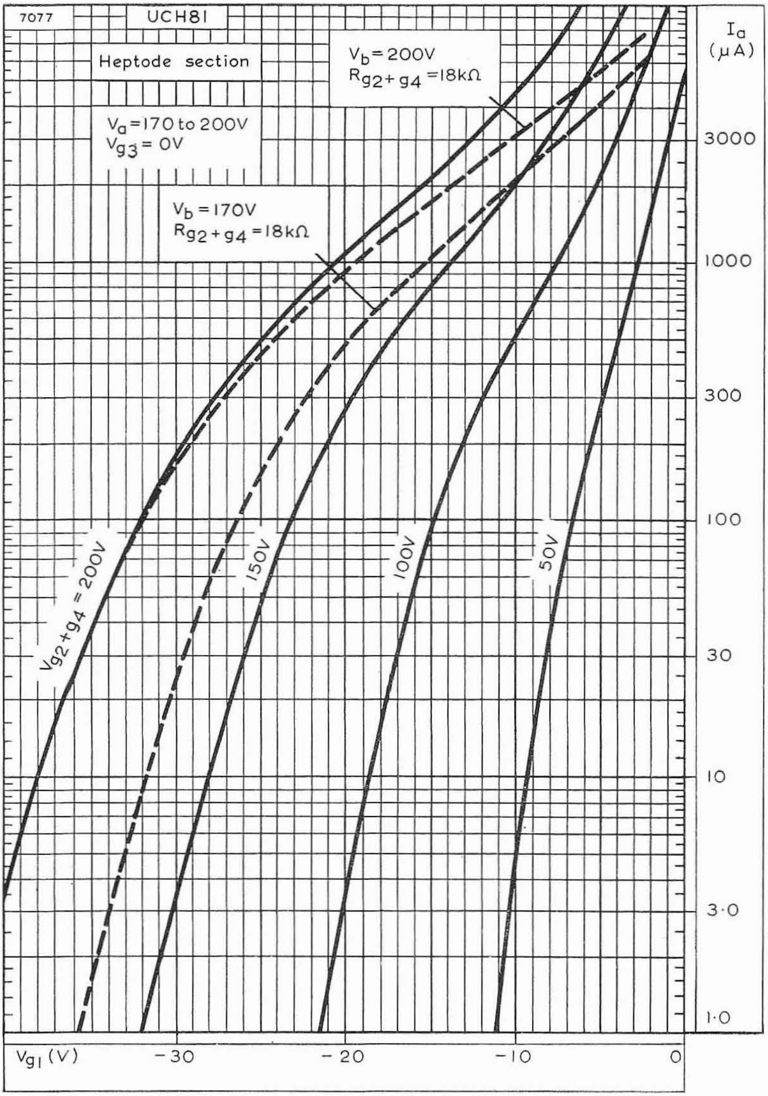


B9A Base

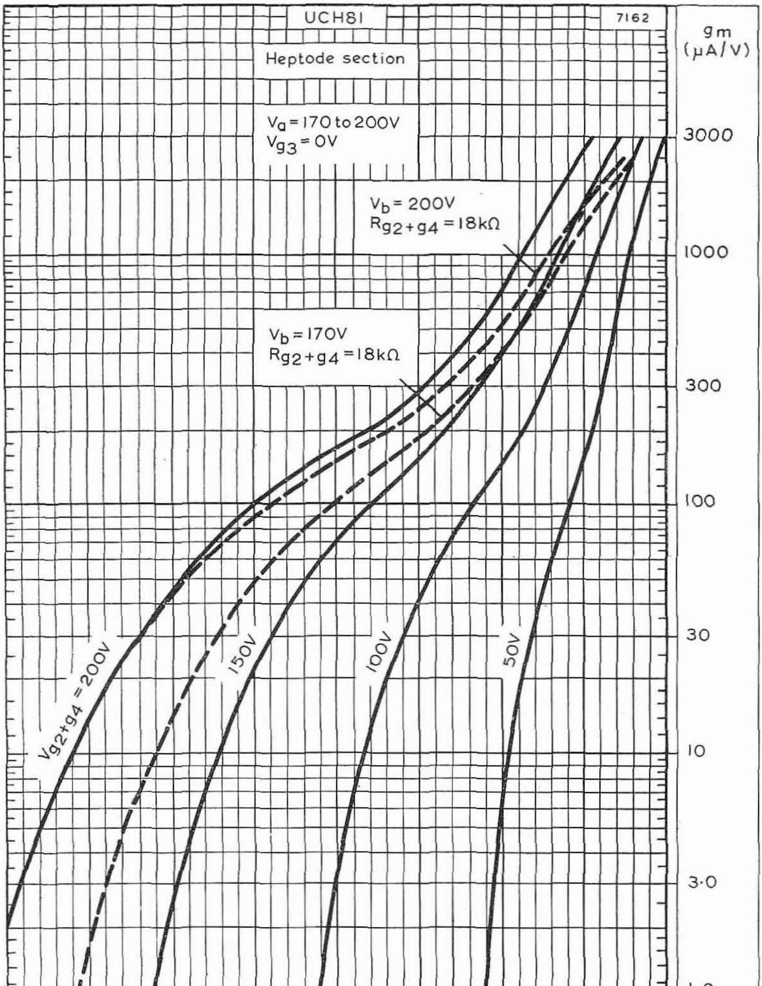


All dimensions in mm

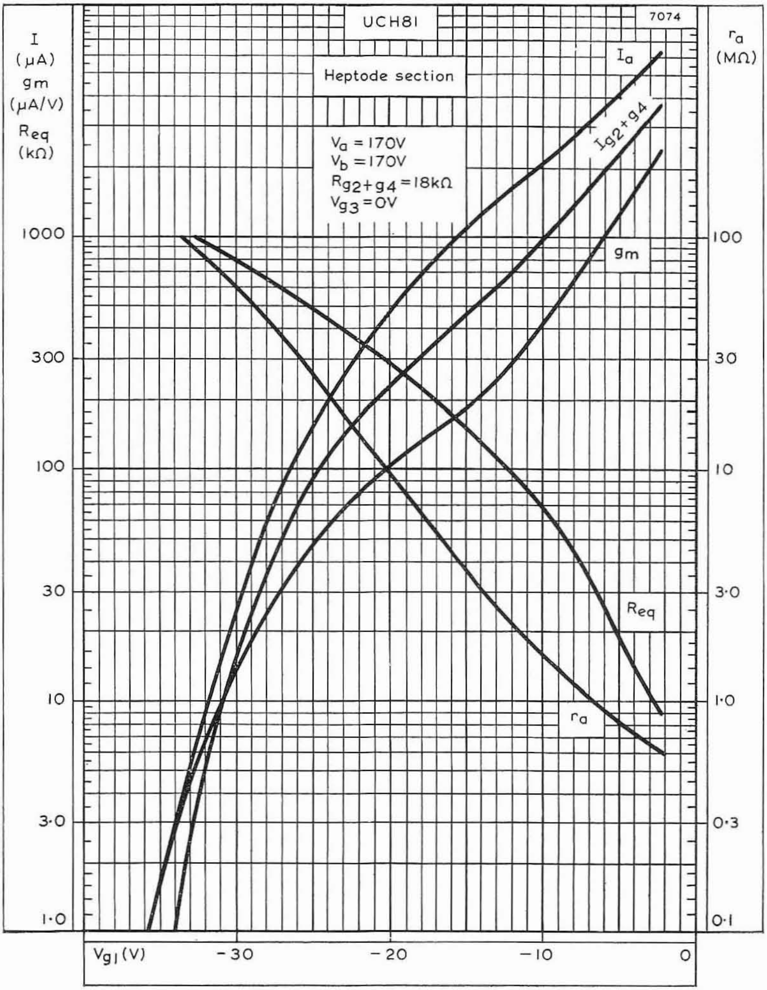
6397



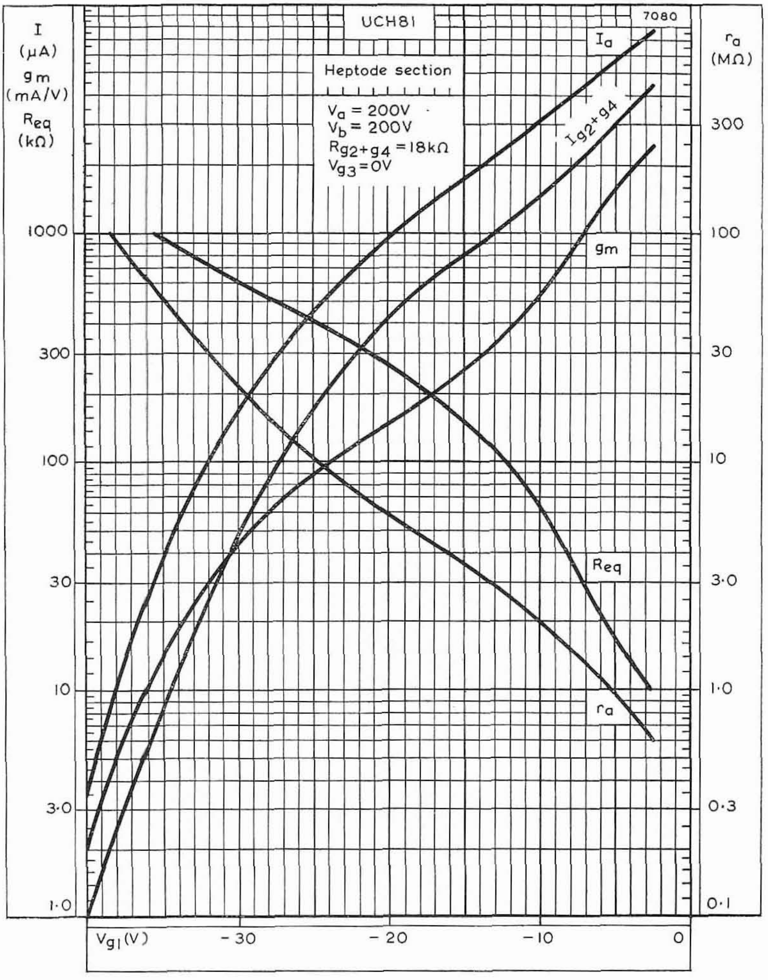
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION

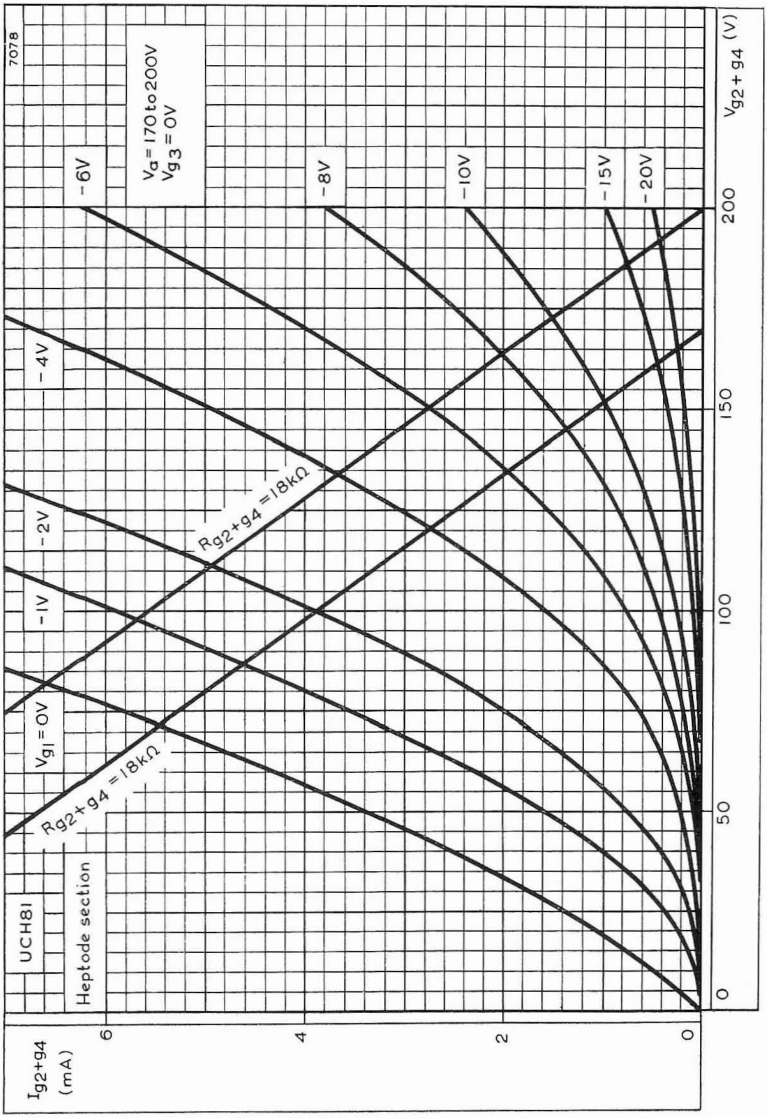


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION.
$V_a = 170V$

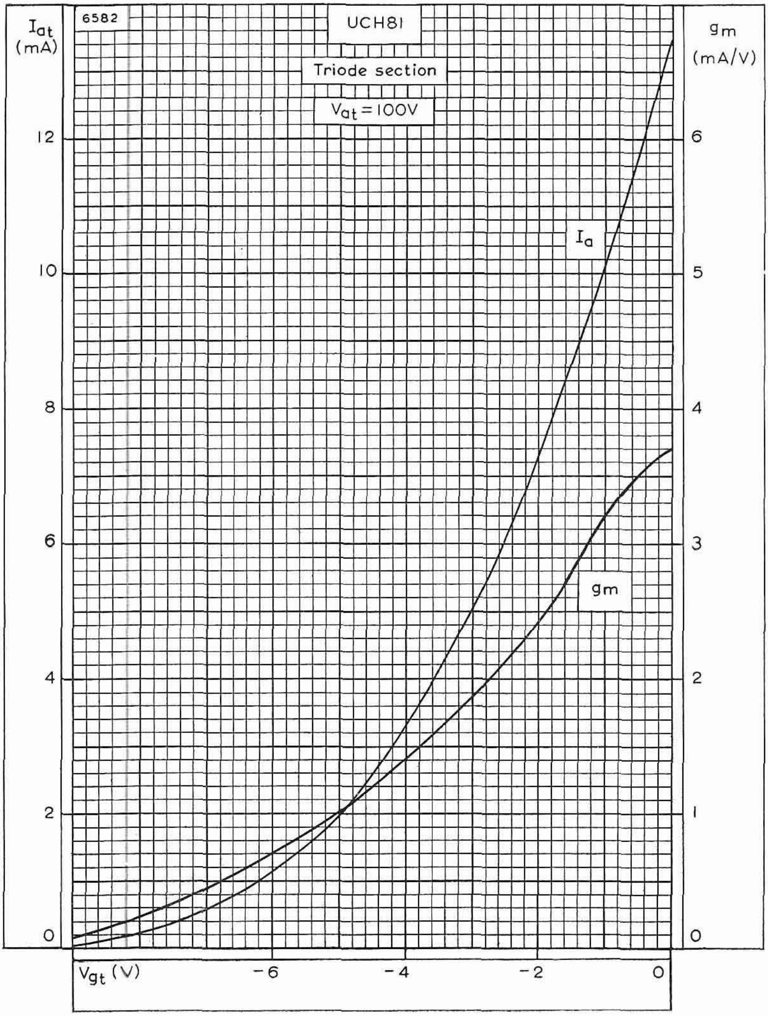


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION

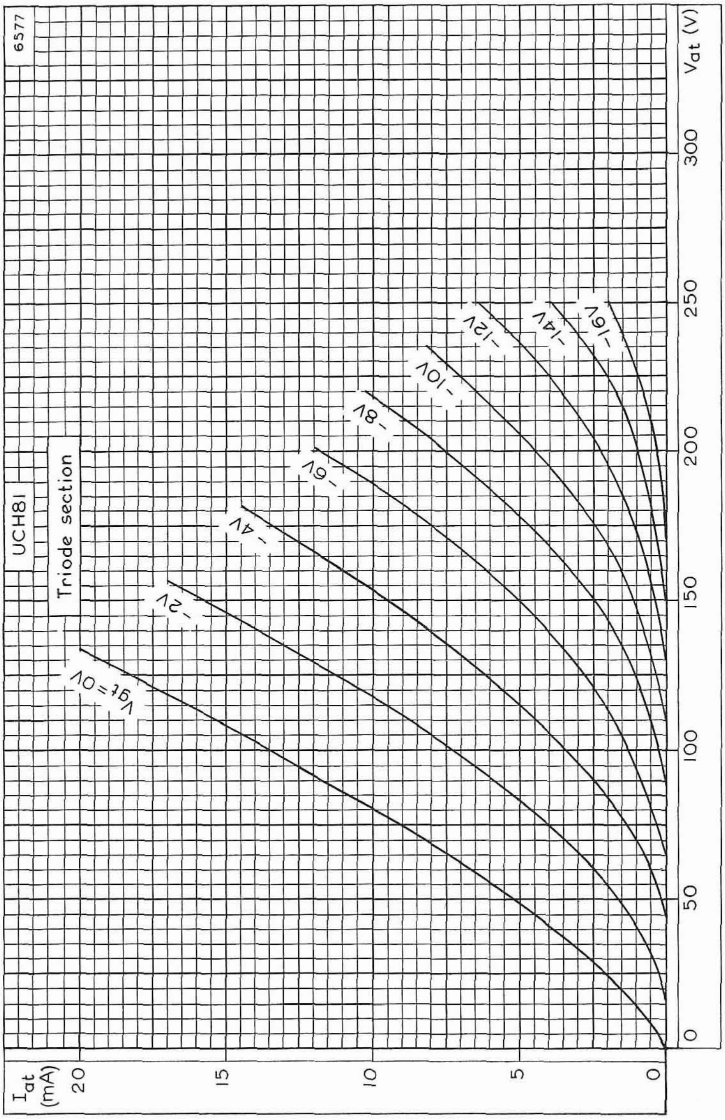
$V_a = 200V$



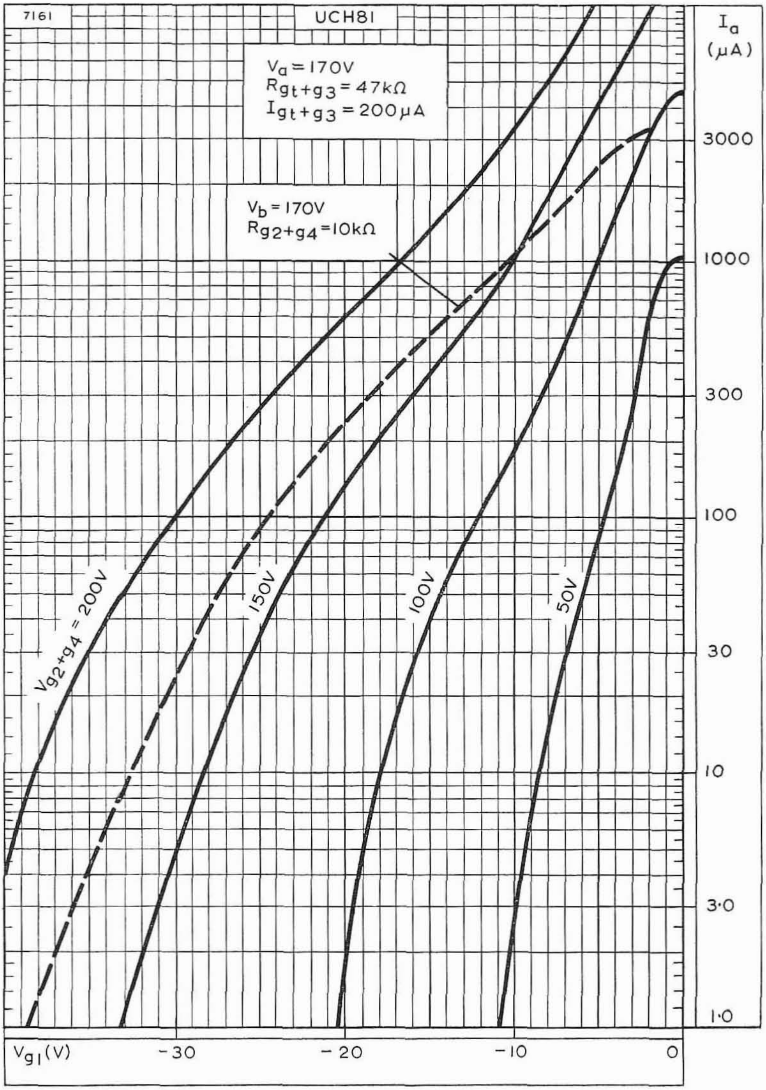
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR HEPTODE SECTION



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE FOR TRIODE SECTION

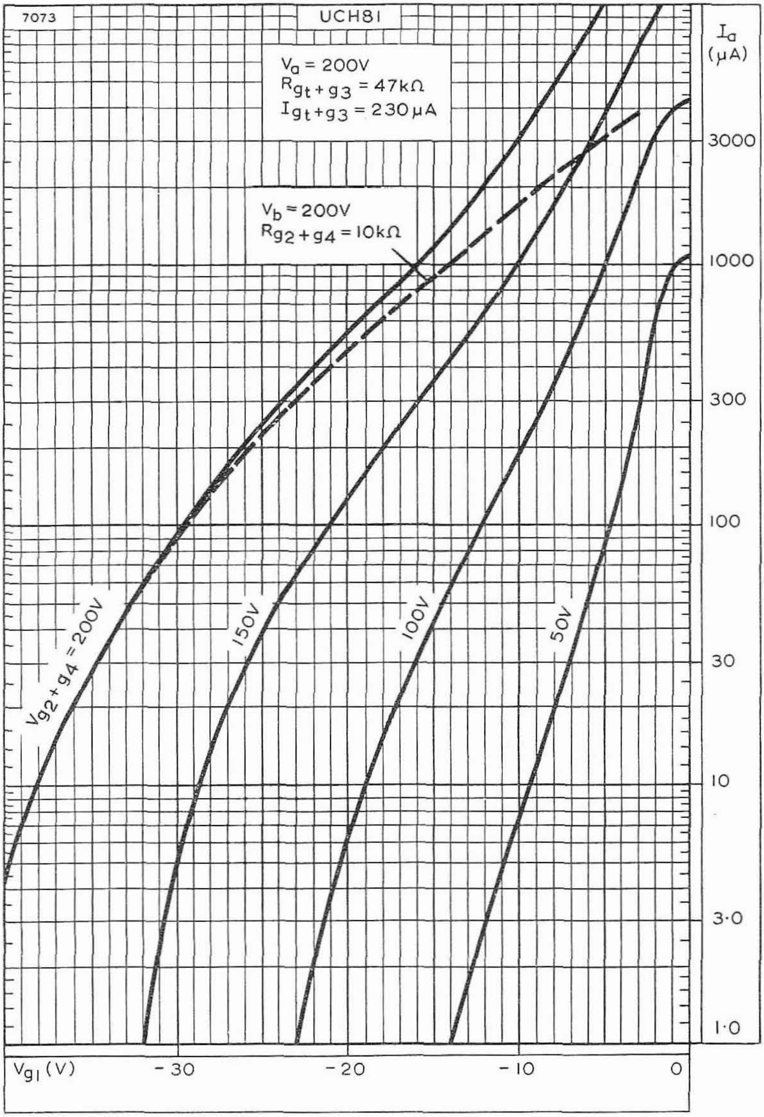


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR TRIODE SECTION

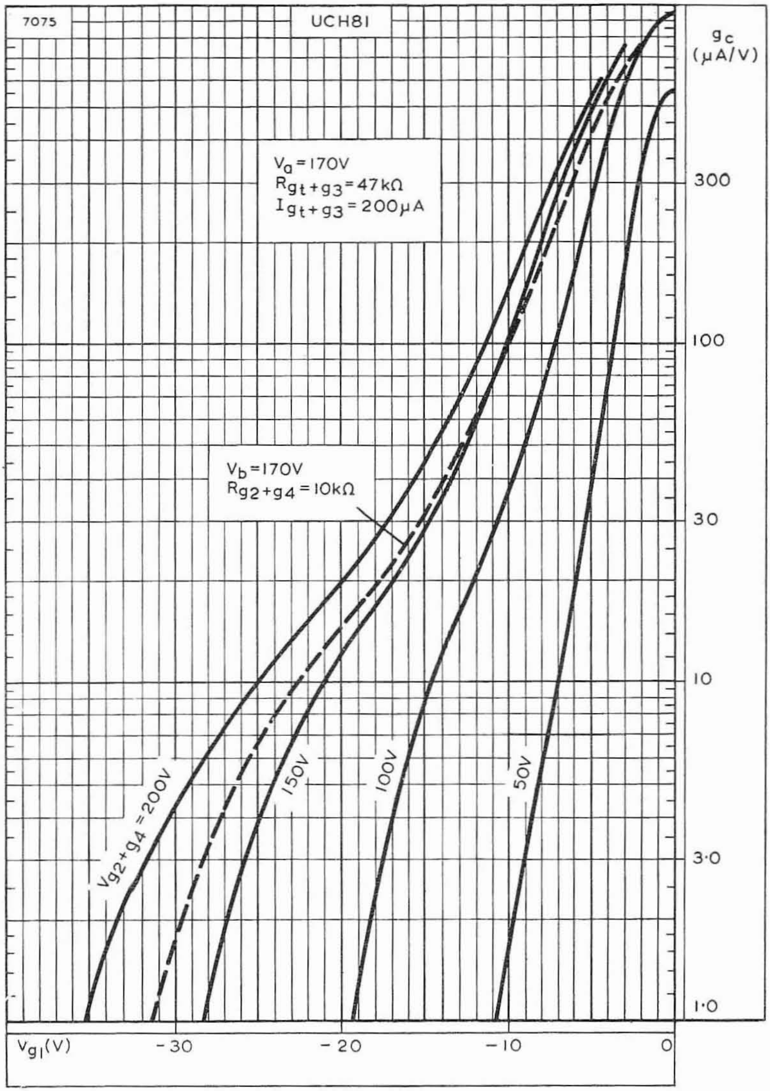


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER.

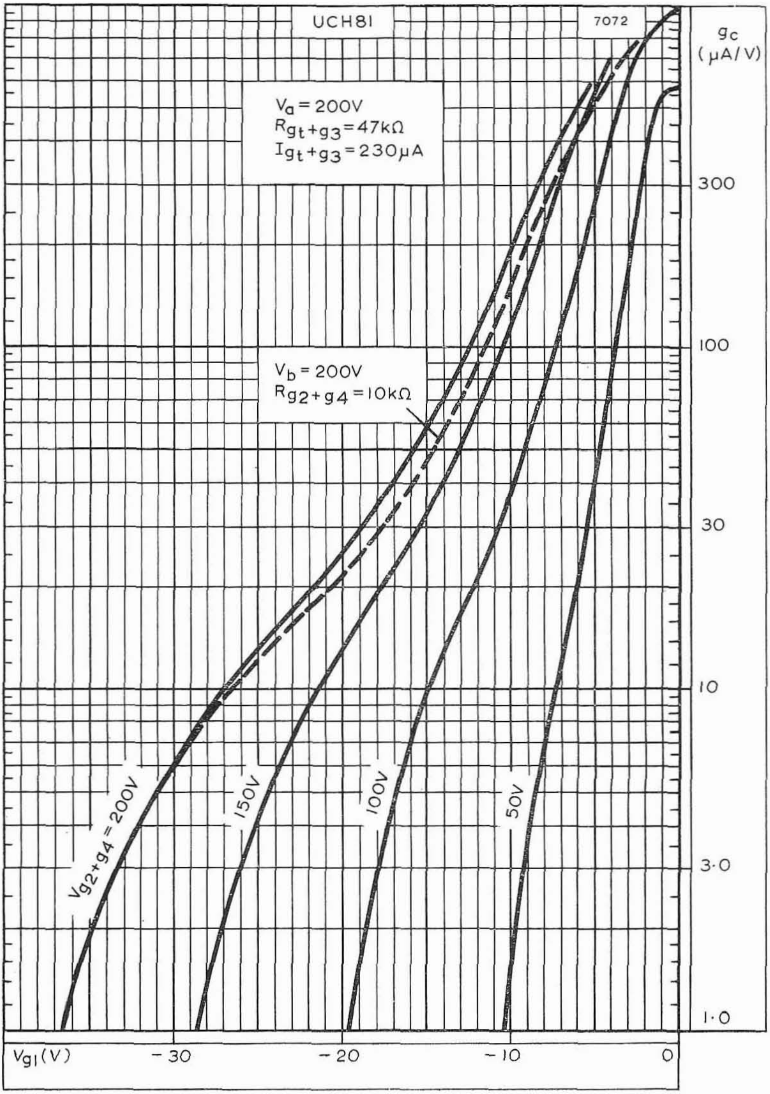
V_a = 170V



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS FREQUENCY CHANGER.
$V_a = 200V$

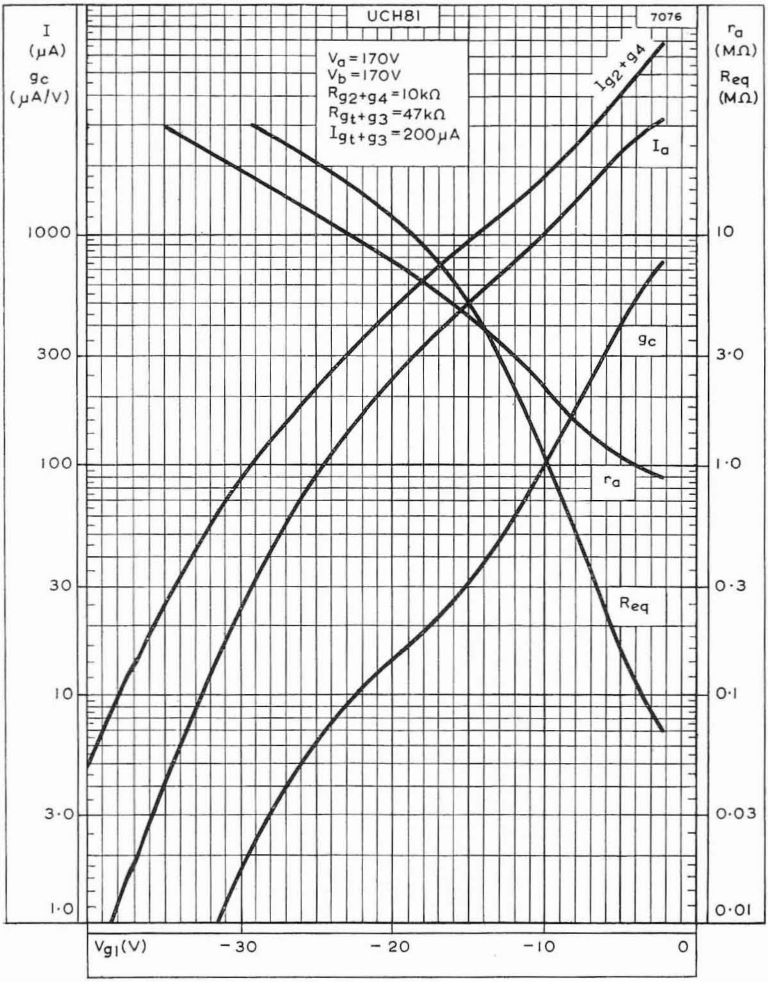


CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER.
$V_a = 170V$

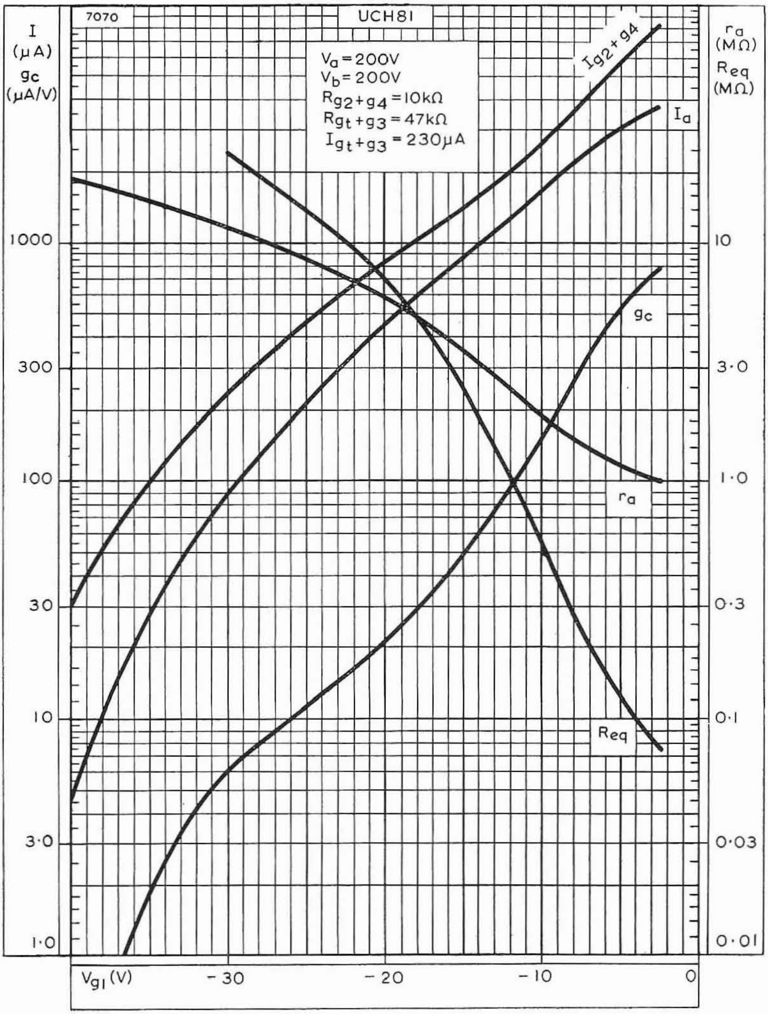


CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER.
$V_a = 200V$

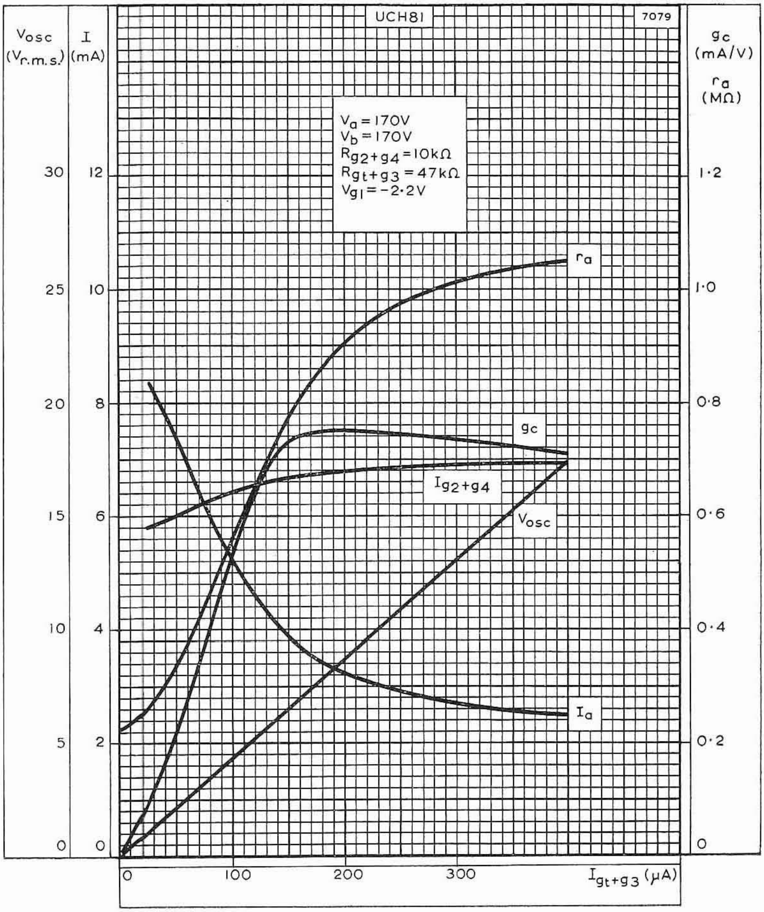
UCH81



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER. $V_a = 170V$

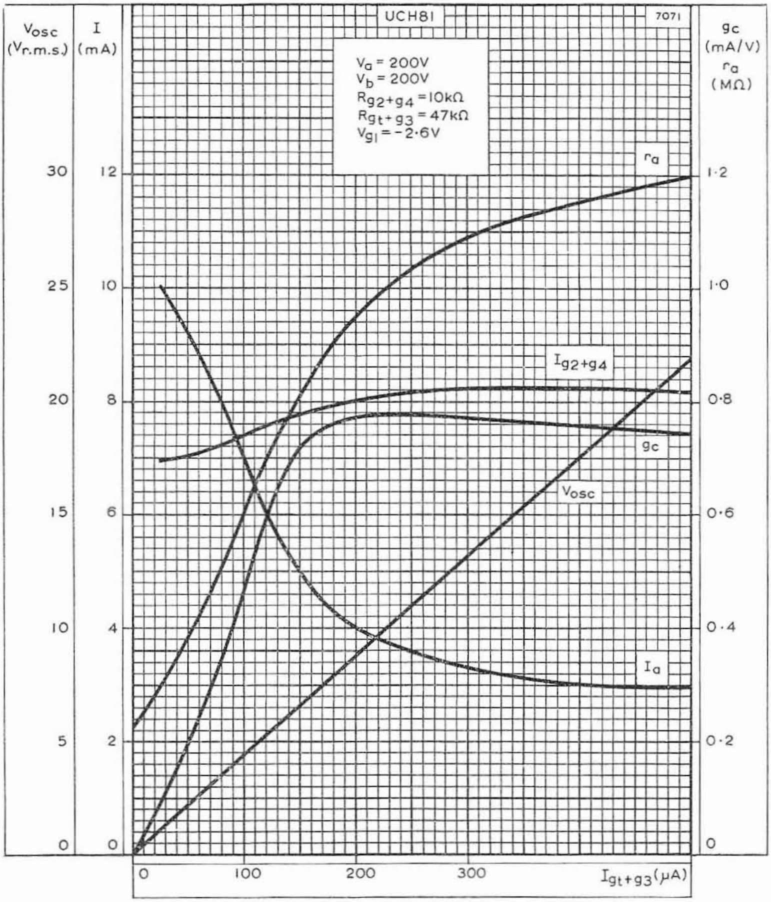


ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER. $V_a = 200V$



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR–GRID CURRENT.

$V_a = 170V$



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR–GRID CURRENT.

$V_a = 200V$

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

HEATER

Suitable for series operation a.c. or d.c.

I_h	100	mA
V_h	50	V

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

c_{at-g1p}	<0.02	pF
c_{gt-ap}	<0.02	pF
c_{gt-g1p}	<0.025	pF
c_{at-ap}	<0.25	pF

Pentode section

c_{in}	9.3	pF
c_{out}	8.0	pF
c_{a-g1}	<0.3	pF
c_{g1-h}	<0.3	pF

Triode section

c_{a-k+h}	4.3	pF
c_{g-k+h}	2.7	pF
c_{a-g}	4.2	pF
c_{g-h}	<0.02	pF

CHARACTERISTICS

Pentode section

V_a	100	200	V
V_{g2}	100	200	V
I_a	26	35	mA
I_{g2}	5.0	7.0	mA
V_{g1}	−6.0	−16	V
g_m	6.8	6.4	mA/V
r_a	15	20	kΩ
μ_{g1-g2}	10	9.5	

Triode section

V_a	100	V
I_a	3.5	mA
V_g	0	V
g_m	2.5	mA/V
r_a	28	kΩ
μ	70	

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	100	200	V
V_{g2}	100	200	V
V_{g1}	−6.0	−16	V
$I_{a(0)}$	26	35	mA
$I_{g2(0)}$	5.0	7.0	mA
$V_{in(r.m.s.)}$ P_{out}=50mW	650	600	mV
R_a	3.9	5.6	kΩ
$V_{in(r.m.s.)}$	3.8	6.6	V
*P_{out}	1.0	3.5	W
D_{tot}	9.0	10	%

Two valves in class 'AB' push-pull

V_a	100	200	V
V_{g2}	100	200	V
†R_k	150	190	Ω
$I_{a(0)}$	2×20	2×35	mA
I_a (max. sig.)	2×22.5	2×39.5	mA
$I_{g2(0)}$	2×4.0	2×7.0	mA
I_{g2} (max. sig.)	2×7.0	2×16.5	mA
R_{a-a}	5.0	6.0	kΩ
$V_{in(g1-g1)r.m.s.}$	12.4	25	V
P_{out}	2.3	9.8	W
D_{tot}	4.0	4.0	%

†Common cathode bias resistor.

*P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music.

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

TRIODE SECTION AS A.F. AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	R_g (MΩ)	Z_{source} (kΩ)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%)	R_{g1}* (kΩ)
200	100	0.85	1.5	3.3	0	47	1.0	330
150	100	0.6	1.8	3.3	0	45	1.9	330
100	100	0.38	1.8	3.3	0	41	6.0	330
200	100	0.85	1.5	3.3	220	43	0.85	330
150	100	0.6	1.8	3.3	220	41	1.05	330
100	100	0.38	1.8	3.3	220	34	3.6	330
200	220	0.52	2.2	3.3	0	54.5	1.0	680
150	220	0.36	2.7	3.3	0	52	1.85	680
100	220	0.23	2.7	3.3	0	47	4.25	680
200	220	0.52	2.2	3.3	220	50	0.5	680
150	220	0.36	2.7	3.3	220	47	1.0	680
100	220	0.23	2.7	3.3	220	38	3.75	680
200	100	1.05	0	22	0	48.5	0.7	330
150	100	0.7	0	22	0	46	1.55	330
100	100	0.37	0	22	0	44	8.0	330
200	100	1.05	0	22	220	44	2.1	330
150	100	0.7	0	22	220	42.5	1.6	330
100	100	0.37	0	22	220	37	5.9	330
200	220	0.59	0	22	0	56	0.8	680
150	220	0.4	0	22	0	53	1.7	680
100	220	0.21	0	22	0	46	5.6	680
200	220	0.59	0	22	220	51	2.0	680
150	220	0.4	0	22	220	48.5	1.4	680
100	200	0.21	0	22	220	42	3.1	680

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV

D_{tot} measured for $V_{out}=10V$

*Grid resistor of following valve.

MICROPHONY

The triode section can be used without special precautions against microphony in circuits in which the input voltage is $\geqq 10mV_{(r.m.s.)}$ for an output of 50mW from the output stage.

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

LIMITING VALUES

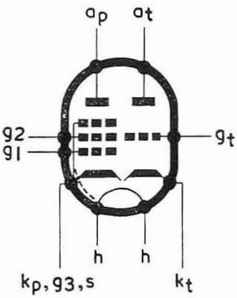
Pentode Section

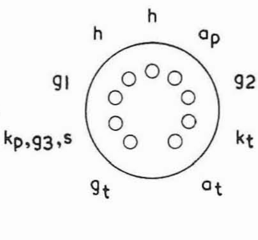
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	7.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.8	W
p_{g2} max. (max. sig. speech and music)	3.2	W
I_k max.	50	mA
R_{g1-k} max. (self bias)	2.0	MΩ
R_{g1-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

Triode Section

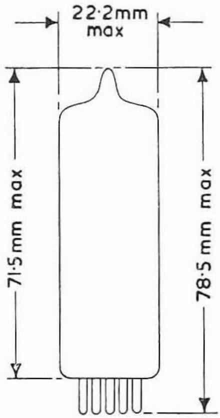
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.0	W
I_k max.	15	mA
R_{g-k} max. (self bias)	3.0	MΩ
R_{g-k} max. (fixed bias)	1.0	MΩ
R_{g-k} max. (grid current biasing)	22	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

2324





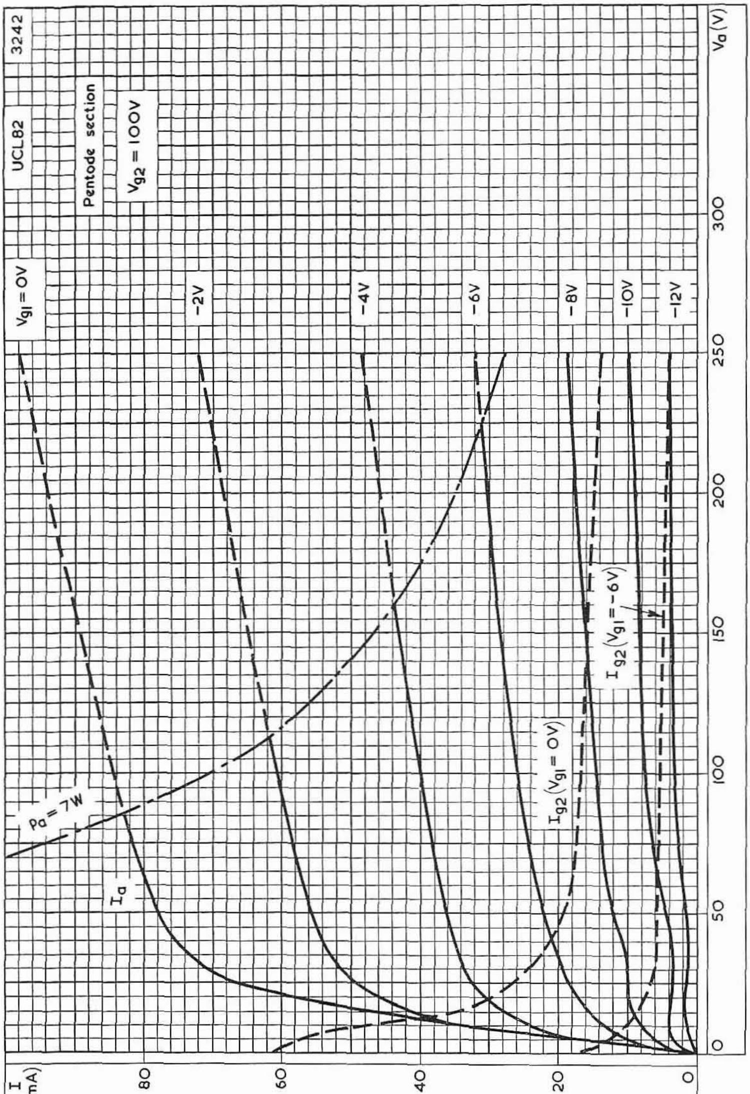
B9A Base



TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

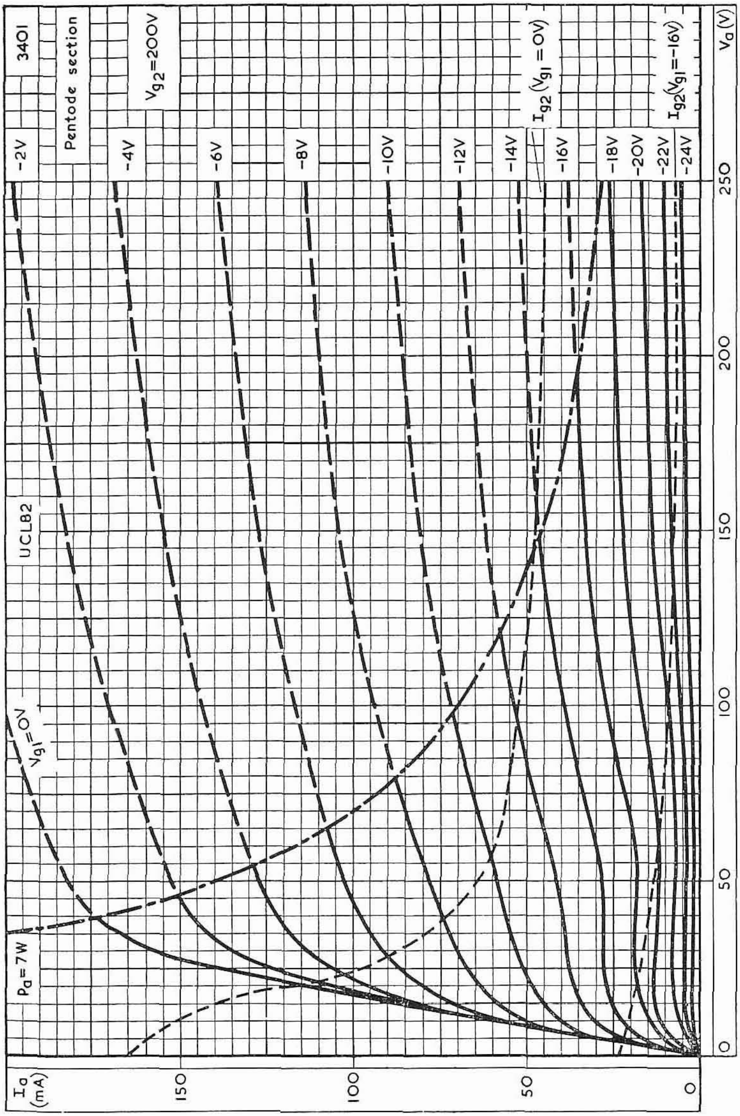


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g_2}=100V

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

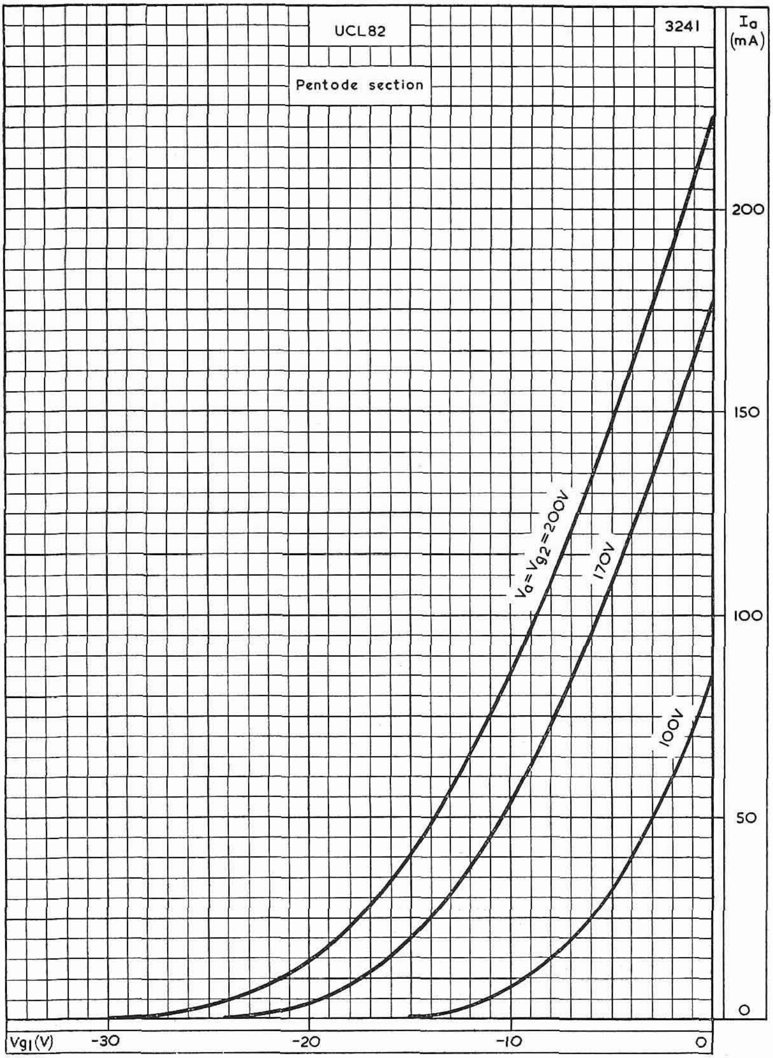


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=200V

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

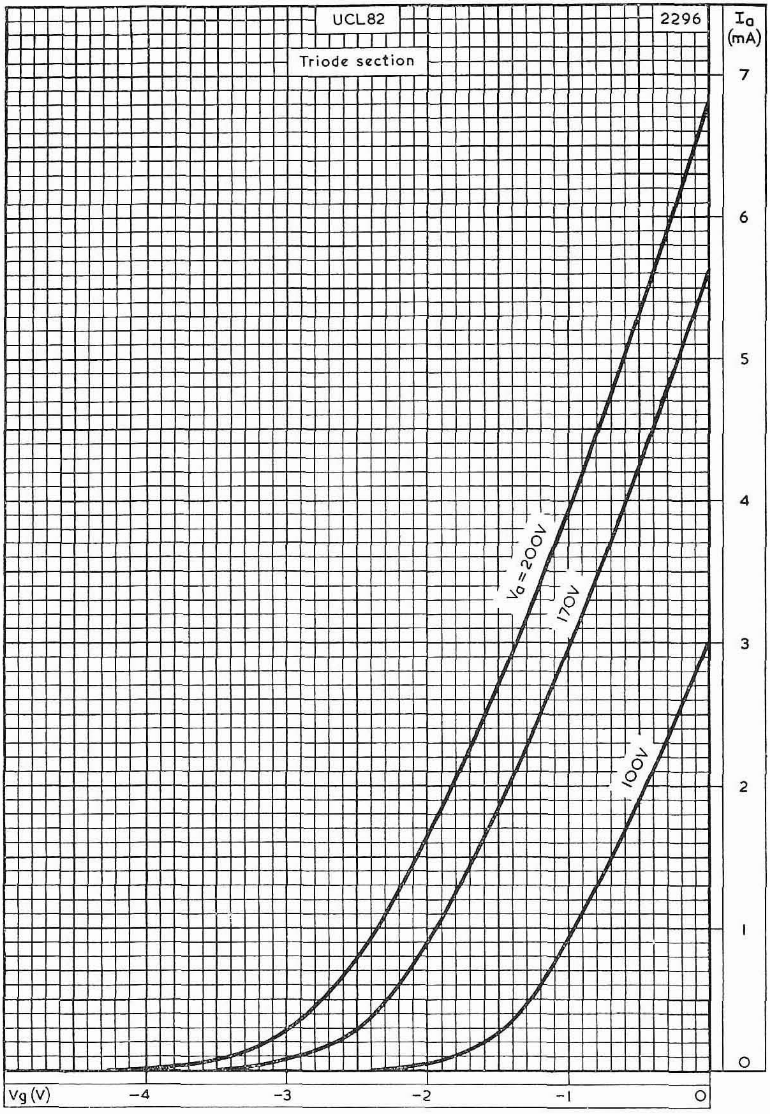


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS VALUES OF ANODE AND SCREEN-GRID VOLTAGE

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

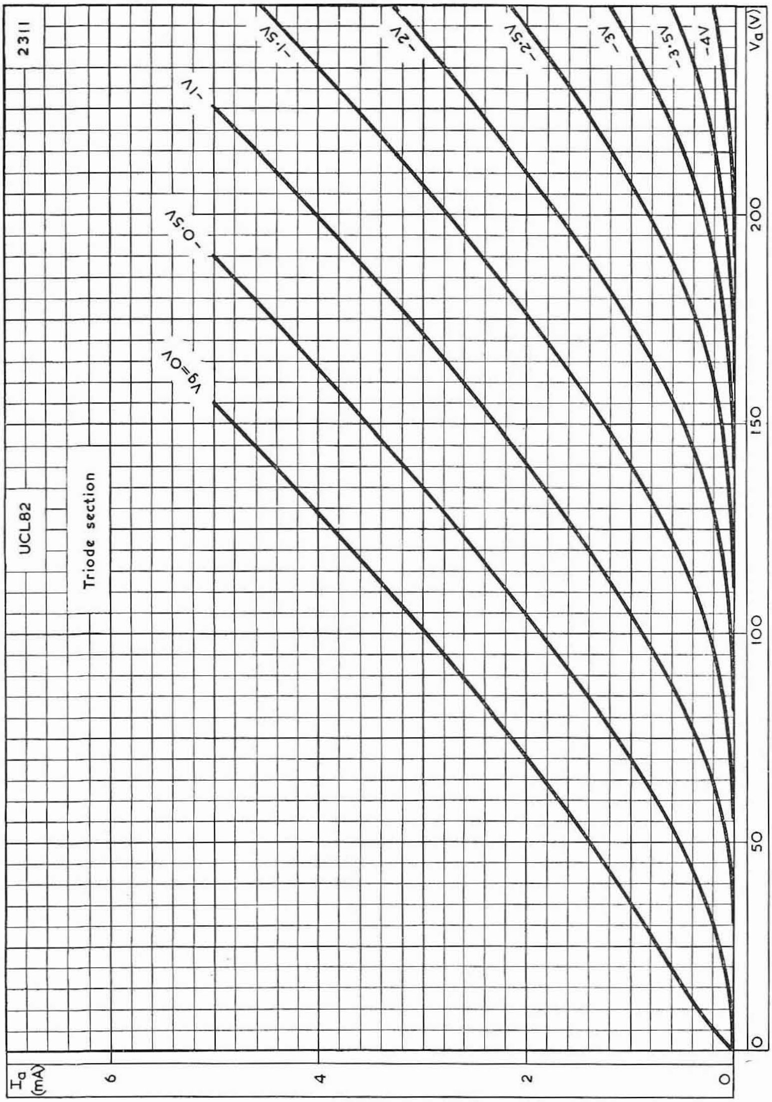


ANODE CURRENT OF THE TRIODE SECTION PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS VALUES OF ANODE VOLTAGE

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

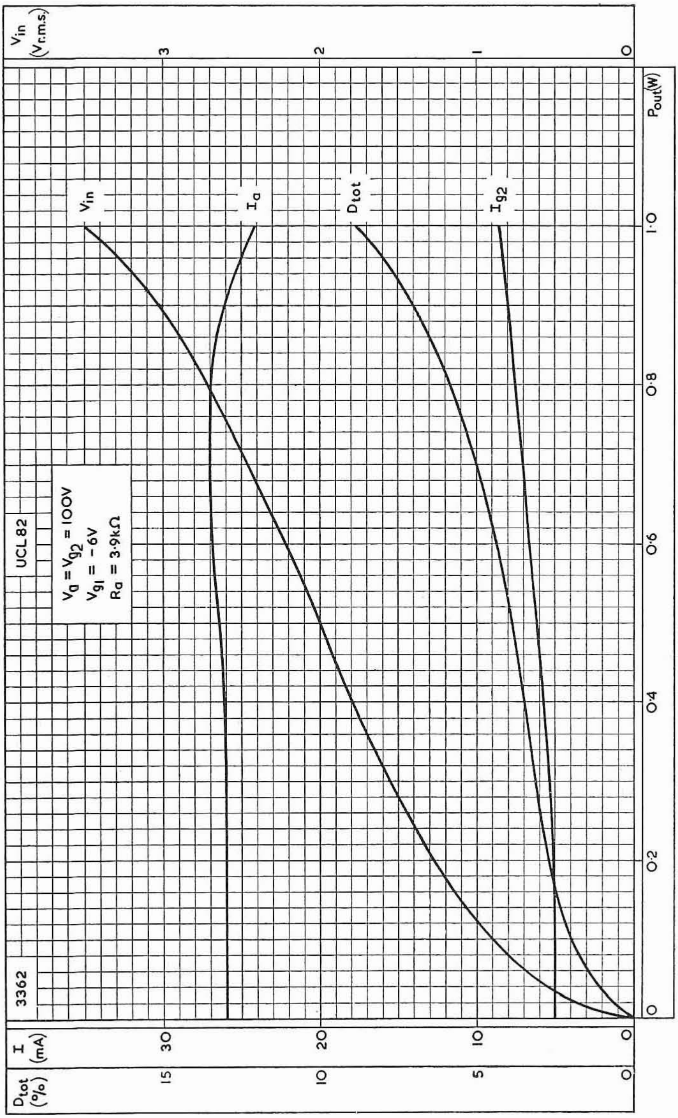


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR VARIOUS VALUES OF GRID VOLTAGE

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

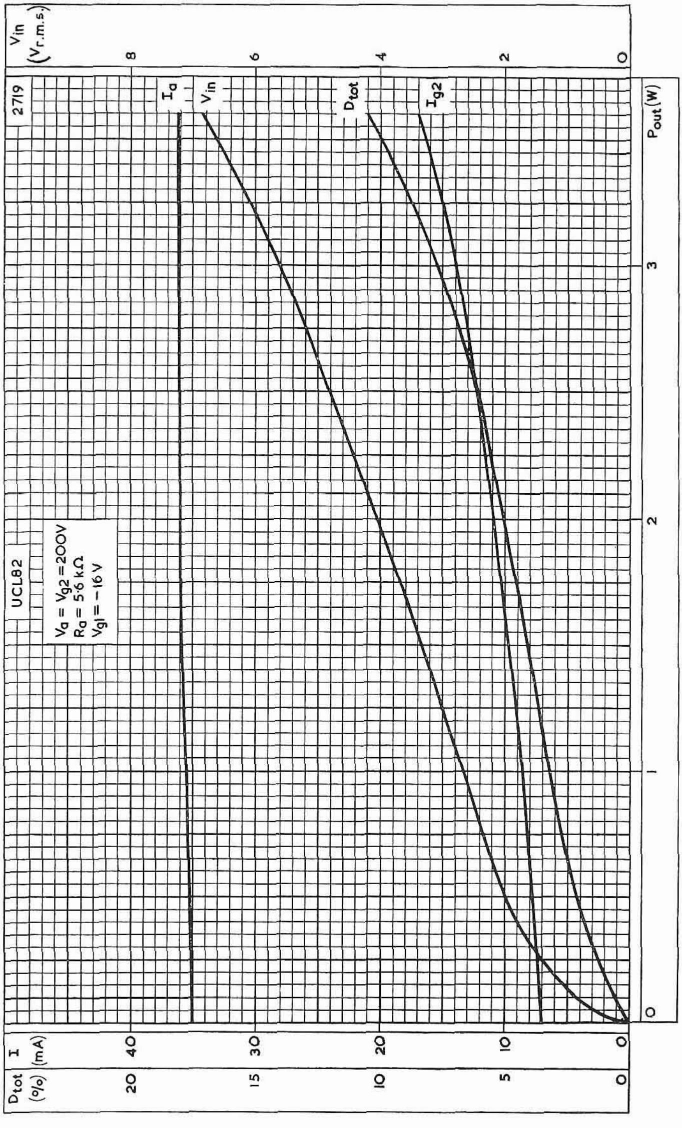


PERFORMANCE OF SINGLE UCL82 CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 100V$

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

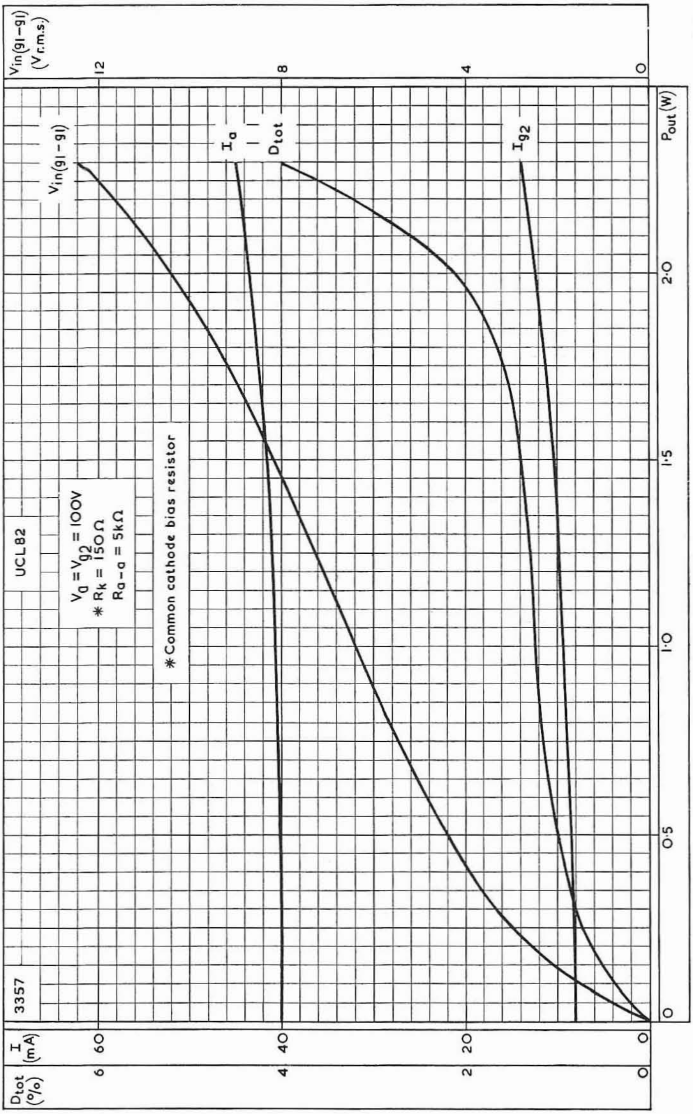


PERFORMANCE OF SINGLE UCL82 CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 200V$

UCL82

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

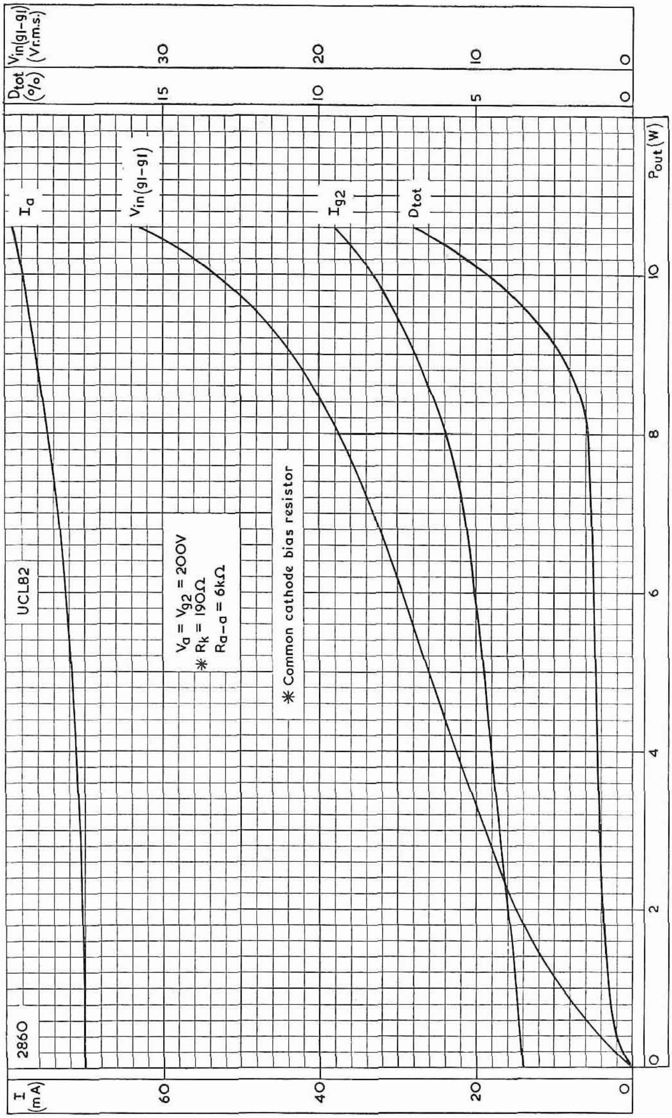


PERFORMANCE OF UCL82 IN PUSH-PULL. $V_a = V_{g2} = 100V$

TRIODE PENTODE

UCL82

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.



PERFORMANCE OF UCL82 IN PUSH-PULL. $V_a = V_{g2} = 200V$

VARIABLE-MU R.F. PENTODE

UF89

Variable-mu pentode for use as r.f. or i.f. amplifier in f.m./a.m. receivers with series connected heaters.

HEATER

I_h	100	mA
V_h	12.6	V

CAPACITANCES

c_{in}	5.5	pF
c_{out}	5.1	pF
c_{a-g1}	<2.0	mpF
c_{g1-h}	50	mpF
c_{g1-g2}	2.1	pF

CHARACTERISTICS

V_a	170	170	V
V_{g3}	0	0	V
V_{g2}	100	110	V
V_{g1}	−1.2*	−2.0	V
I_a	12	12	mA
I_{g2}	4.4	3.9	mA
g_m	4.4	3.8	mA/V
r_a	400	525	kΩ
μ_{g1-g2}	21	—	

*At this voltage, grid current may occur. If this is not acceptable the negative bias should be increased to −2.0V.

OPERATING CONDITIONS

$V_a=V_b$	170	170	200	200	V
V_{g3}	0	0	0	0	V
R_{g2}	22	15	33	24	kΩ
V_{g1}	−0.5*	−2.0	−0.5*	−2.0	V
R_k	—	130	—	130	Ω
R_{g1}	10	—	10	—	MΩ
I_a	11.8	11	11.3	11.1	mA
I_{g2}	4.3	3.9	3.9	3.8	mA
g_m	5.2	3.8	5.15	3.85	mA/V
r_a	400	450	475	550	kΩ
R_{eq}	2.6	4.5	2.5	4.2	kΩ
g_m ($V_{g1}=-20V$)	110	110	150	160	μA/V
r_g (f=50Mc/s)	—	10	—	10	kΩ

*This voltage is produced by the grid current flowing through the grid resistor and the steady current of the diode. If this condition is not acceptable the negative grid bias should be increased to −2.0V.

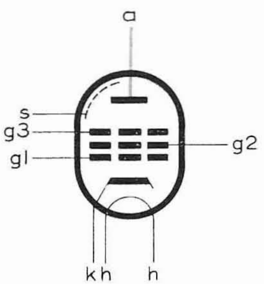
UF89

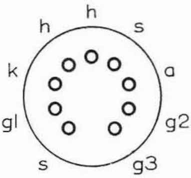
VARIABLE-MU R.F. PENTODE

LIMITING VALUES

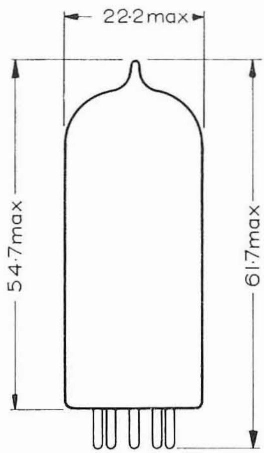
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.25	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	450	mW
I_k max.	16.5	mA
*R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	10	kΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

*With grid current biasing R_{g1-k} max. = 22MΩ.



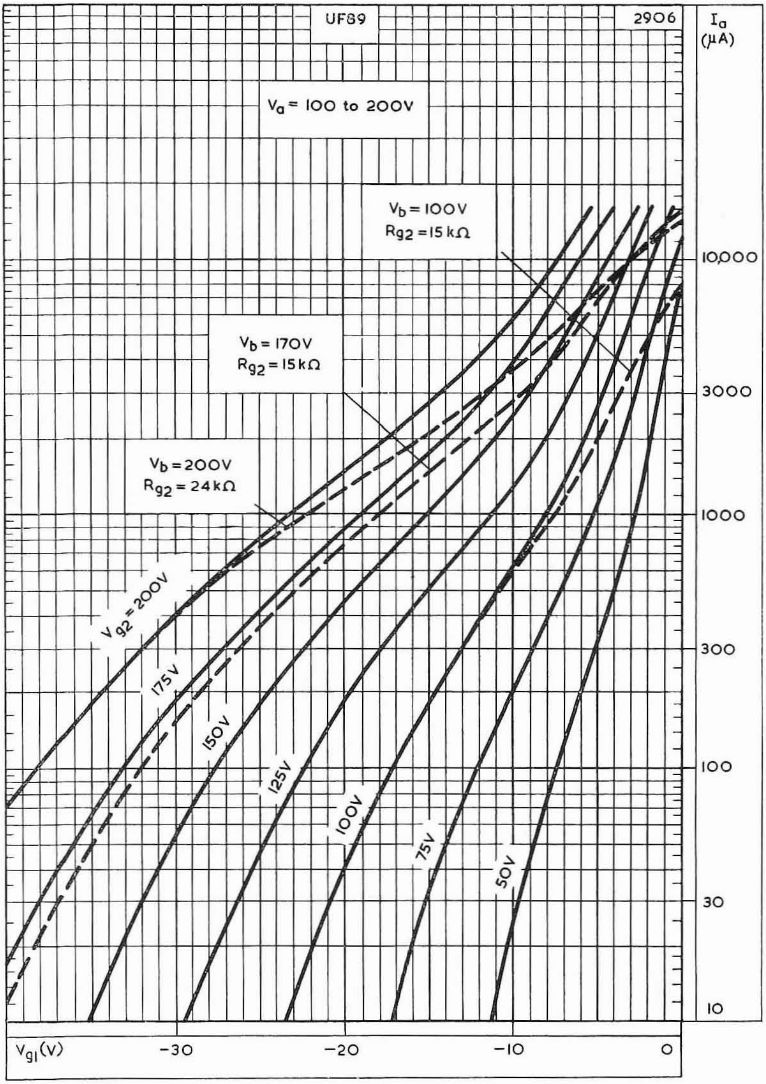


B9A Base



6394

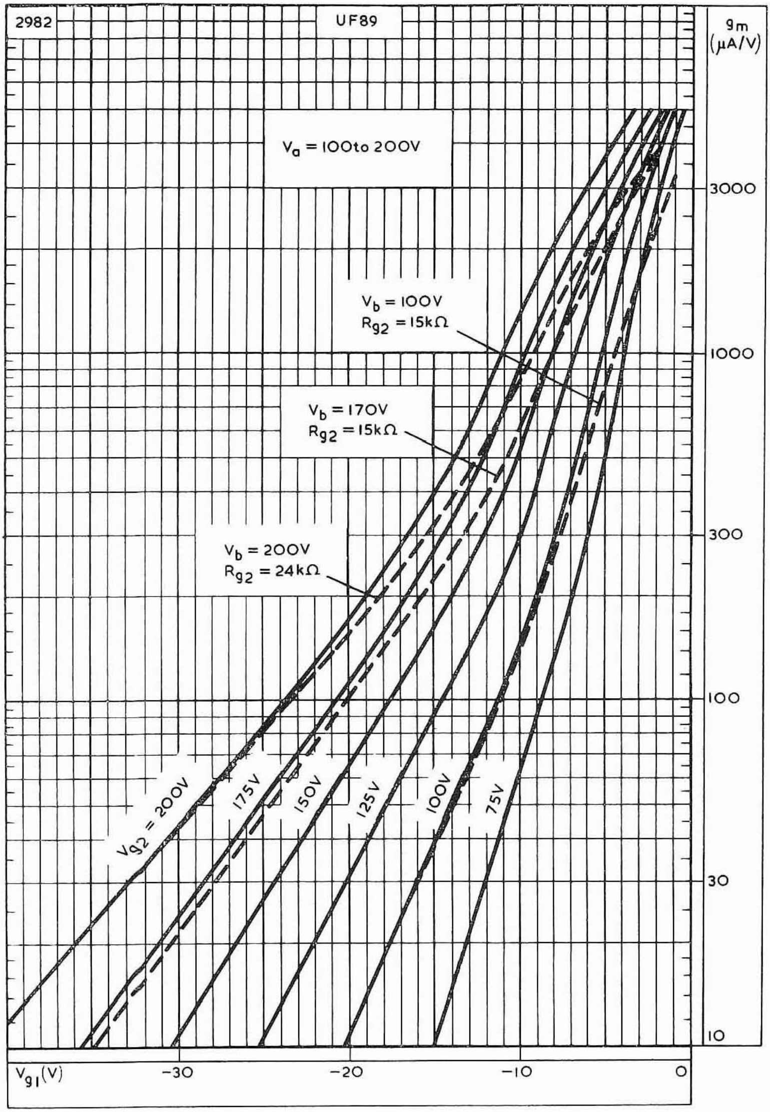
All dimensions in mm



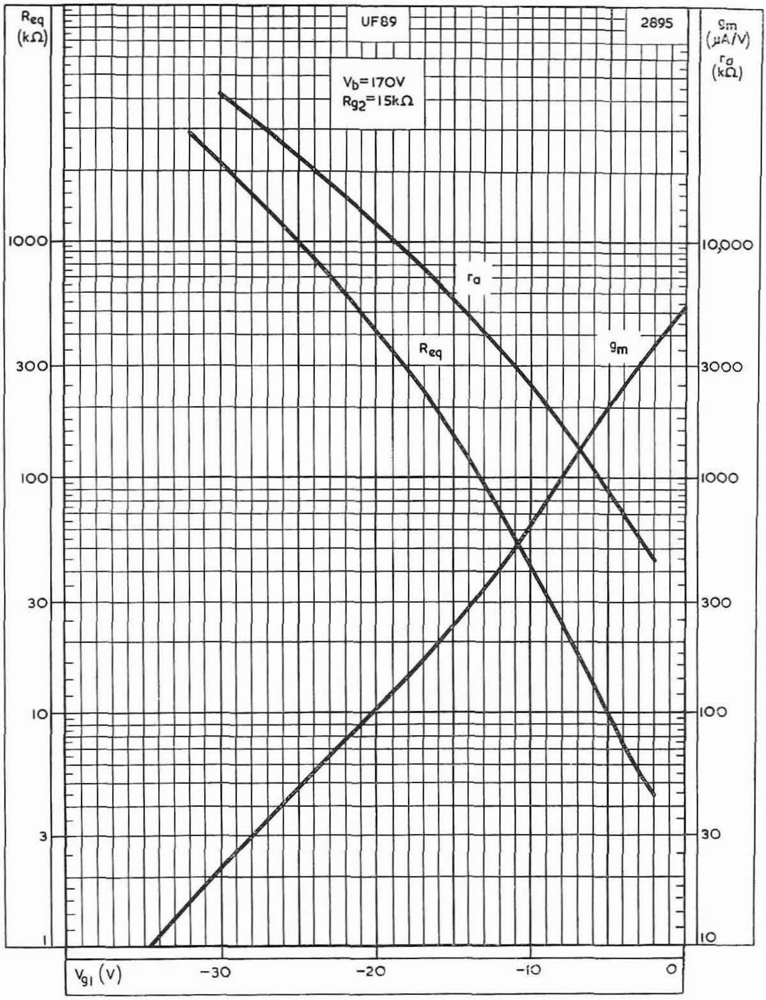
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE
WITH SCREEN-GRID VOLTAGE AS PARAMETER

UF89

VARIABLE-MU R.F. PENTODE



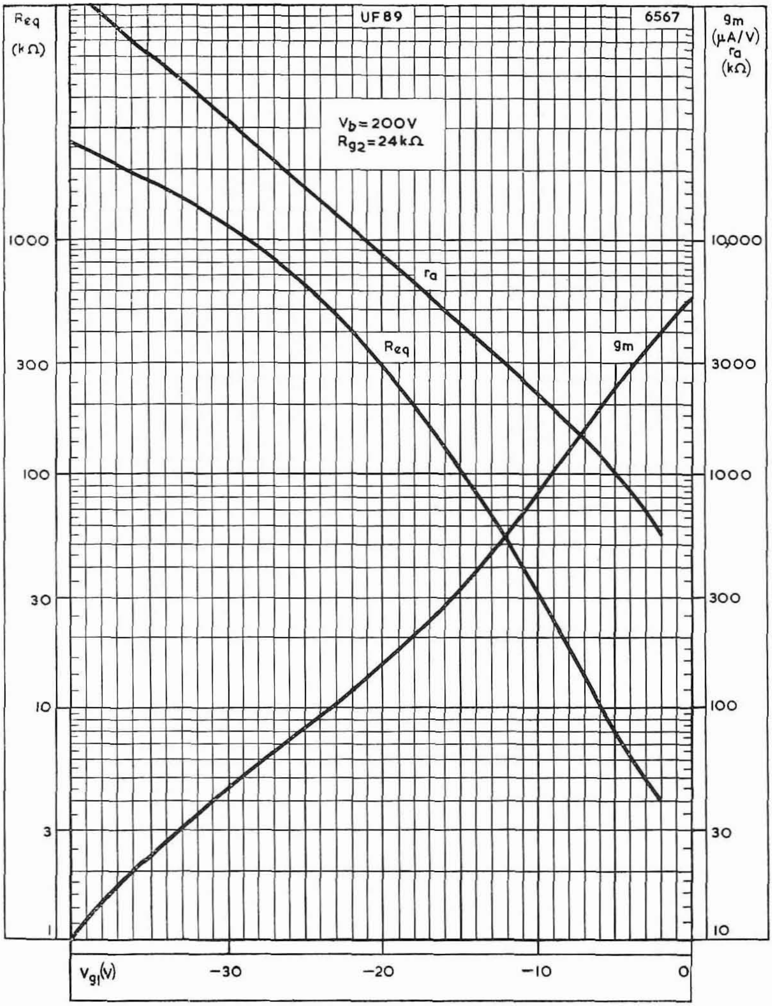
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



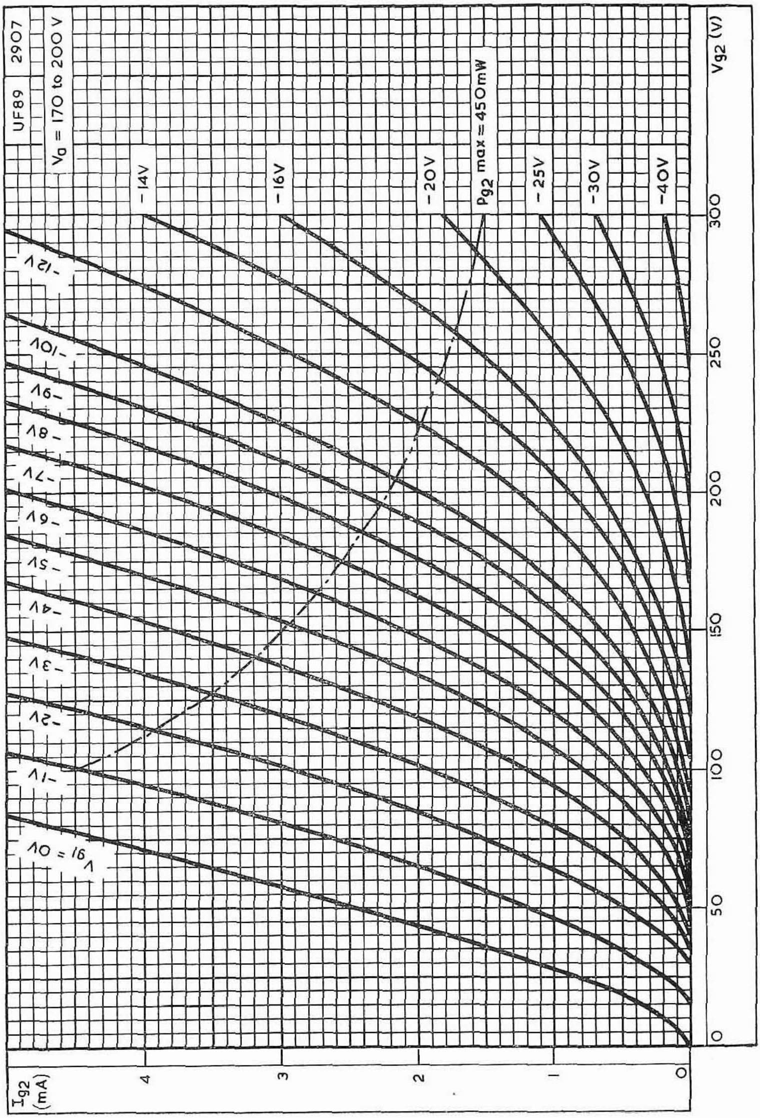
MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE $V_b = 170V$

UF89

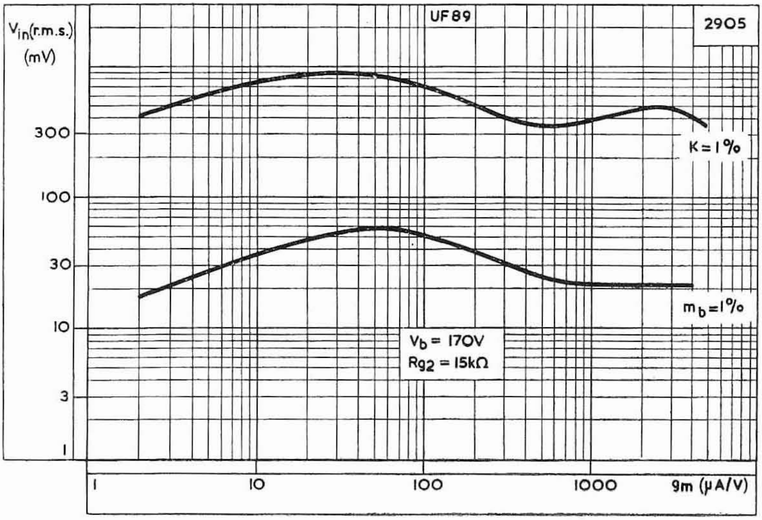
VARIABLE-MU R.F. PENTODE

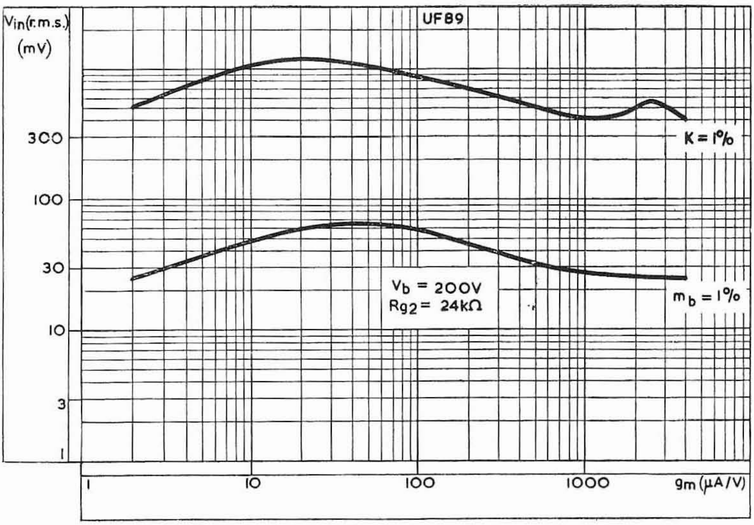


MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE $V_b = 200V$



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER





CROSS MODULATION AND MODULATION HUM CURVES

OUTPUT PENTODE

UL84

Output pentode rated for 12W anode dissipation and with 100mA heater for use in equipment with series connected heaters.

HEATER

I_h	100	mA
V_h	45	V

CAPACITANCES

c_{in}	12	pF
c_{out}	6.5	pF←
c_{a-g1}	<600	mpF
c_{g1-h}	<250	mpF

CHARACTERISTICS

V_a	100	170	200	V
V_{g2}	100	170	*	V
I_a	43	70	60	mA
I_{g2}	3.0	5.0	4.1	mA
V_{g1}	−6.7	−12.5	−17.3	V
g_m	9.0	10	8.8	mA/V
r_a	23	23	28	kΩ
μ_{g1-g2}	8.0	8.0	8.0	

$*V_{g2(b)} = 200V$, $R_{g2} = 470\Omega$

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER

V_a	100	170	200	V
V_{g2}	100	170	*	V
R_k	145	170	270	Ω
R_a	2.4	2.4	2.4	kΩ
I_a	43	70	60	mA
$I_{g2\ (0)}$	3.0	5.0	4.1	mA
$V_{in(r.m.s.)}$ (P_{out}=50mW)	500	500	550	mV
$V_{in(r.m.s.)}$	4.3	7.0	7.8	V
P_{out}	1.9	5.6	5.2	W
D_{tot}	10	10	10	%
$I_{g2\ (max.\ sig.)}$	11	22	12.5	mA

$*V_{g2(b)} = 200V$, $R_{g2} = 470\Omega$ undecoupled.

P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control grid the bias across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in approximately 10% reduction in power output.

UL84

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Pentode connection

V_a	100	170	200	V
V_{g2}	100	170	200	V
R_k (per valve)	270	240	300	Ω
R_{a-a}	3.5	3.5	3.5	kΩ
$I_{a(o)}$	2×29	2×56.5	2×55	mA
$I_{g2(o)}$	2×1.6	2×3.0	2×2.8	mA
$V_{in(g1-g1)r.m.s.}$	14	26	29	V
P_{out}	3.6	13	15	W
D_{tot}	3.0	4.5	3.5	%
$I_{a(max.\ sig.)}$	2×31	2×57.5	2×60	mA
$I_{g2(max.\ sig.)}$	2×7.0	2×20.5	2×15	mA

Distributed load conditions with screen-grid tapping at 20% of primary turns

$V_a + V_{Rk}$	200	V
$V_{g2} + V_{Rk}$	200	V
R_k (per valve)	300	Ω
R_{a-a}	3.5	kΩ
$I_{k(o)}$	2×56.5	mA
$V_{in(g1-g1)r.m.s.}$	23	V
P_{out}	10	W
D_{tot}	0.8	%
$I_{k(max.\ sig.)}$	2×65	mA

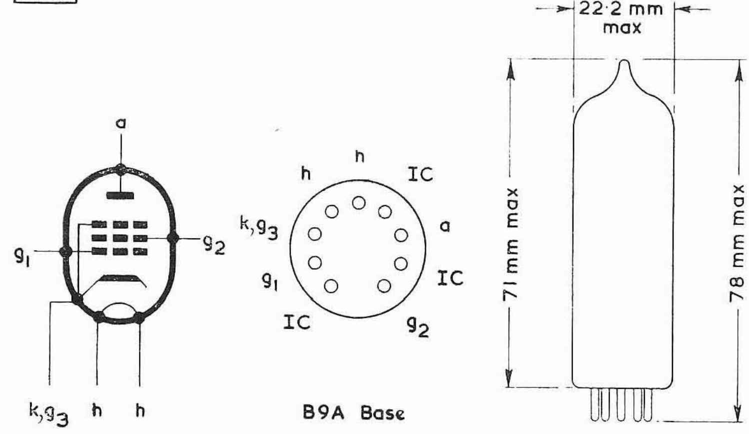
LIMITING VALUES

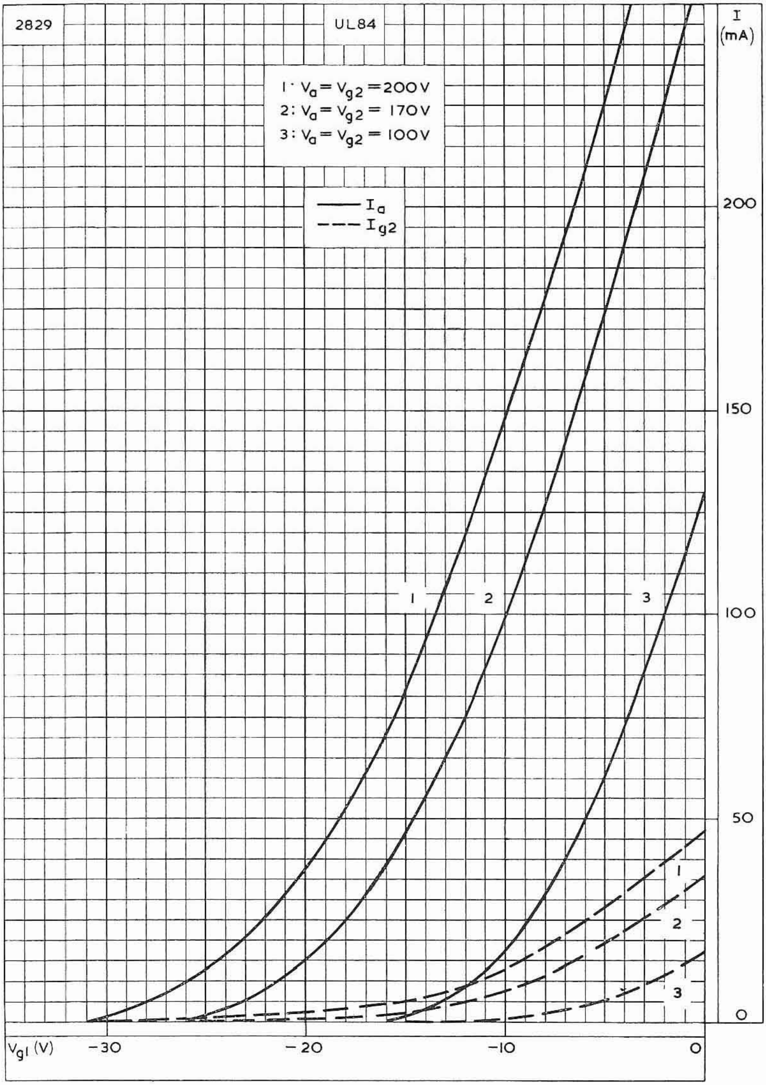
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	1.75	W
I_k max.	100	mA
R_{g1-k} max.	300	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

OUTPUT PENTODE

UL84

2834



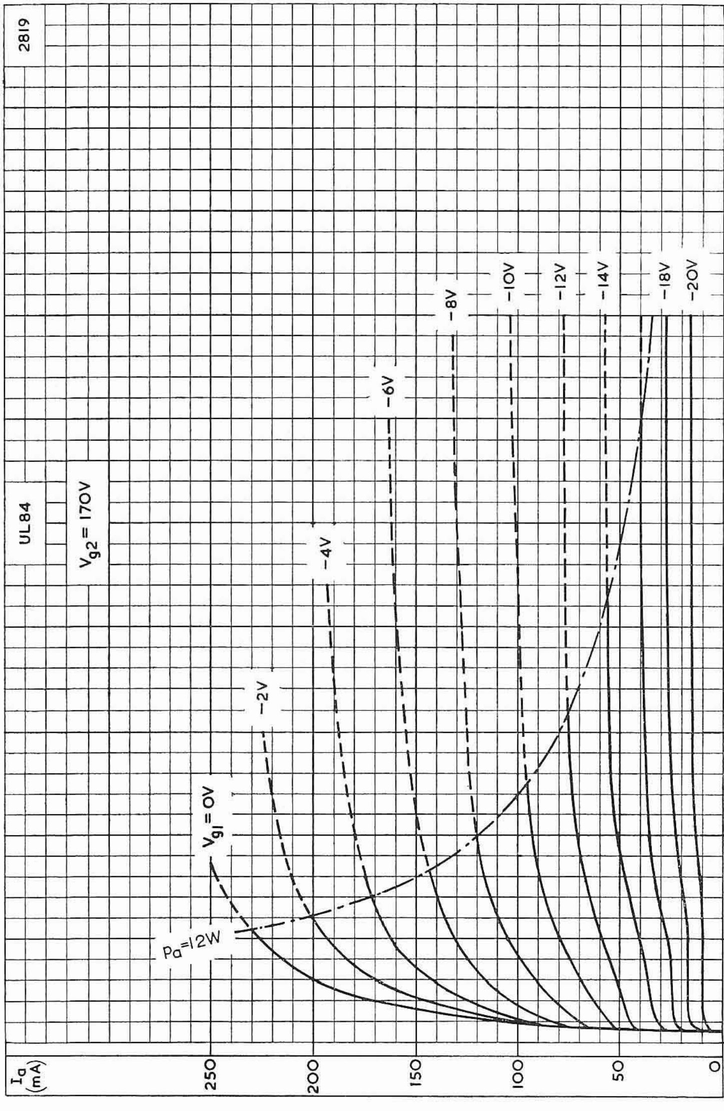


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS ANODE AND SCREEN-GRID VOLTAGES

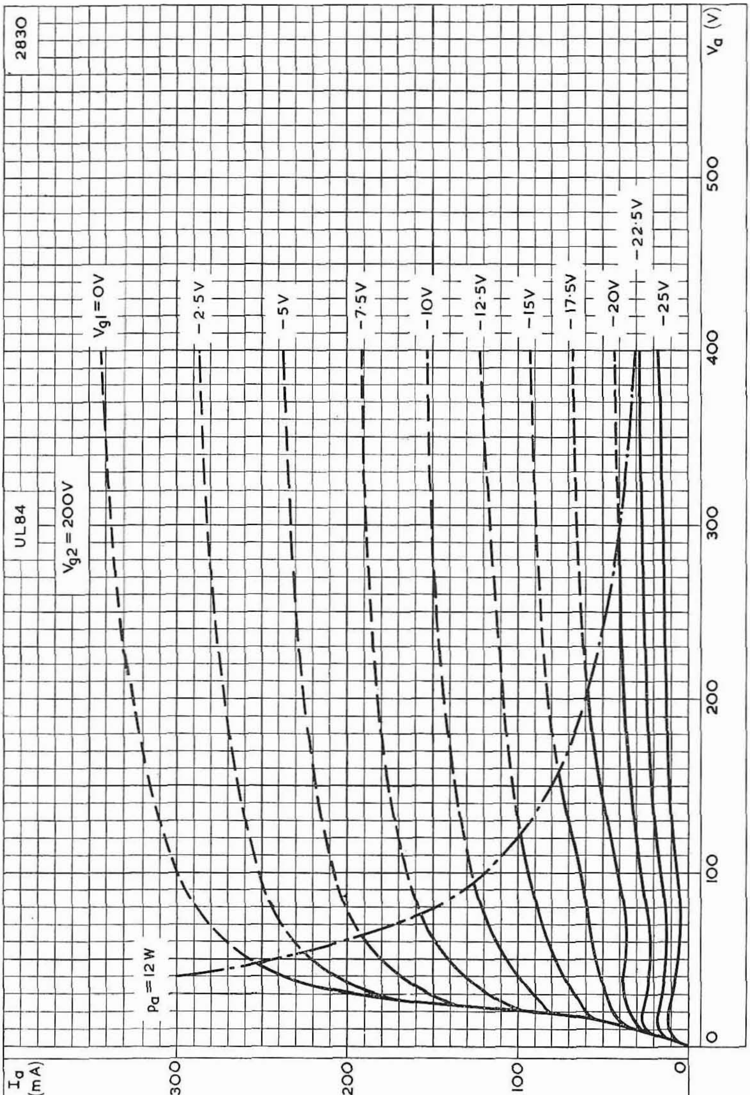
UL84

OUTPUT PENTODE

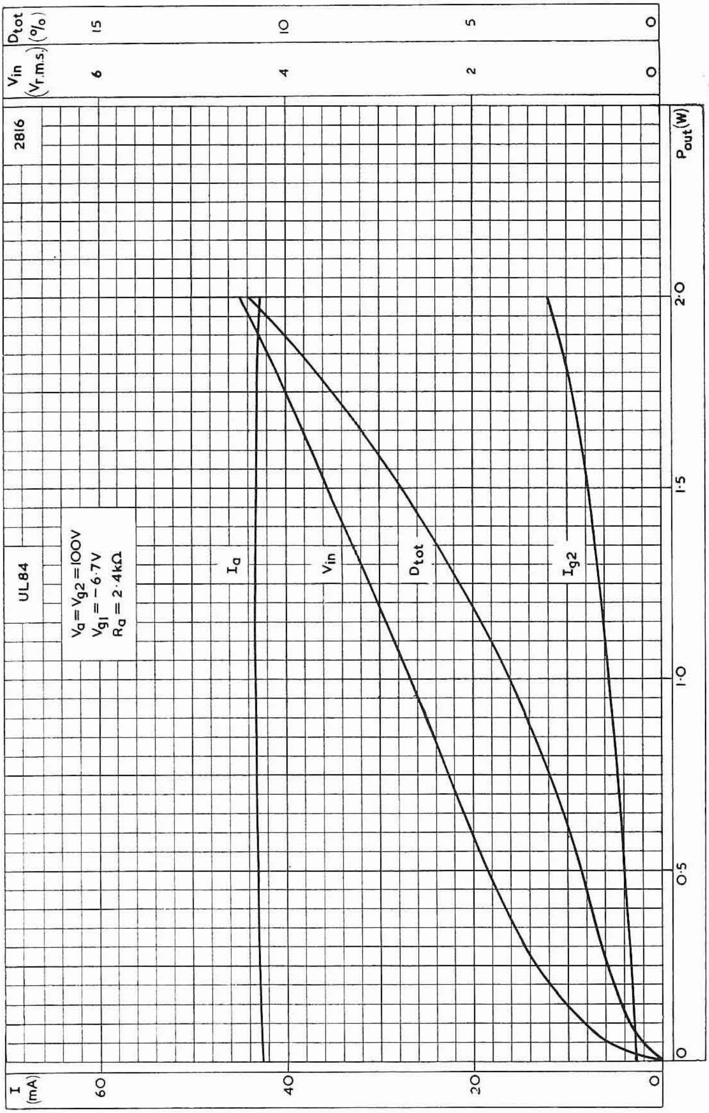
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 100V$



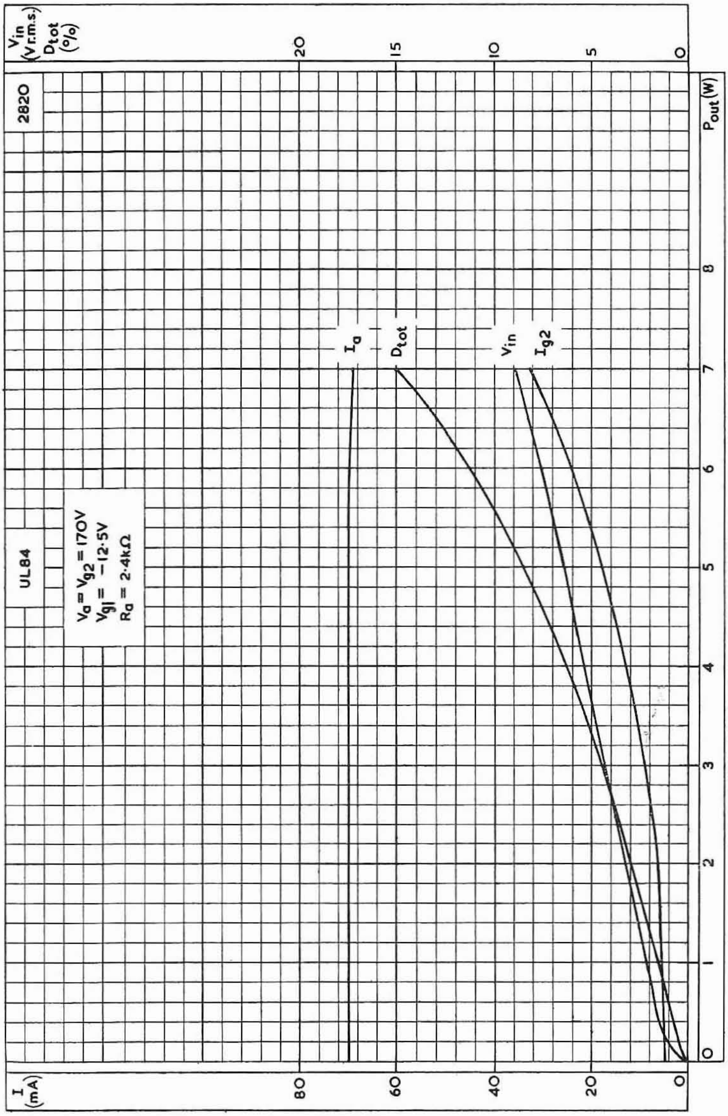
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 170V



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

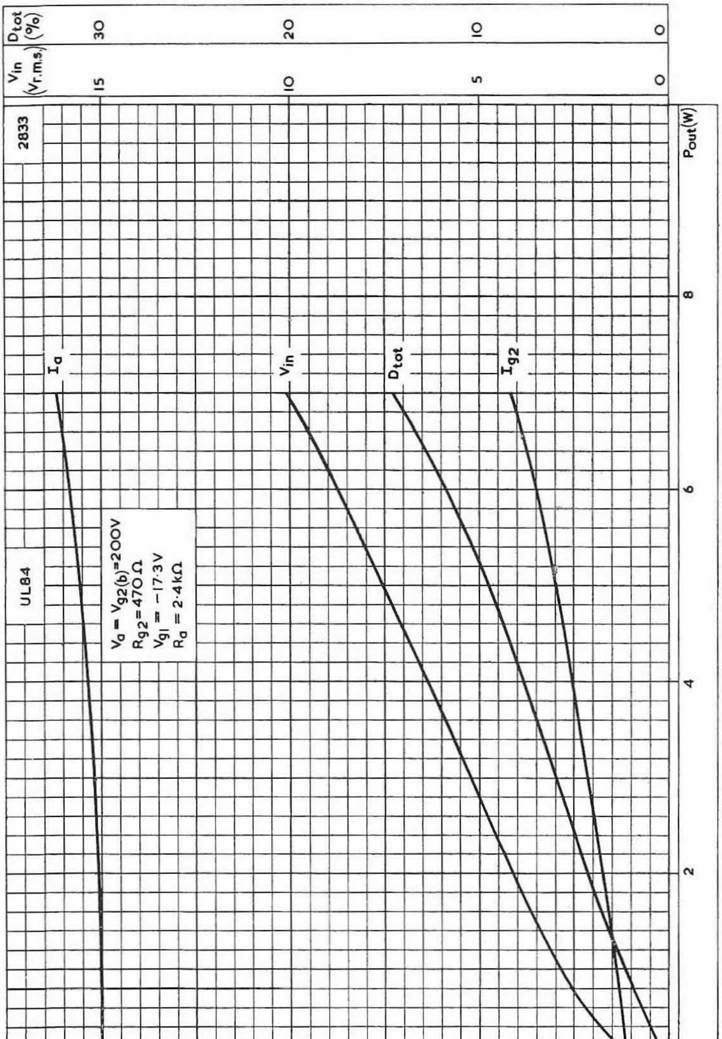


PERFORMANCE OF UL84 WHEN USED AS SINGLE VALVE AMPLIFIER
$V_a = V_{g2} = 100V$



PERFORMANCE OF UL84 WHEN USED AS SINGLE VALVE AMPLIFIER

$V_a = V_{g2} = 170V$

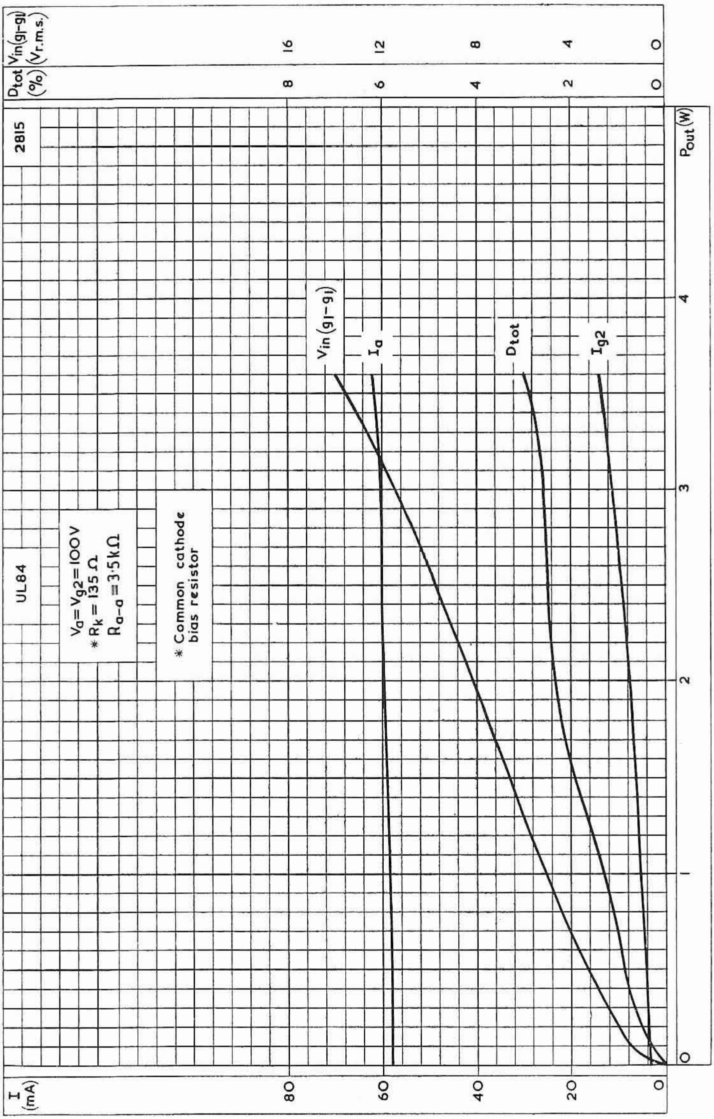


PERFORMANCE OF UL84 WHEN USED AS SINGLE VALVE AMPLIFIER

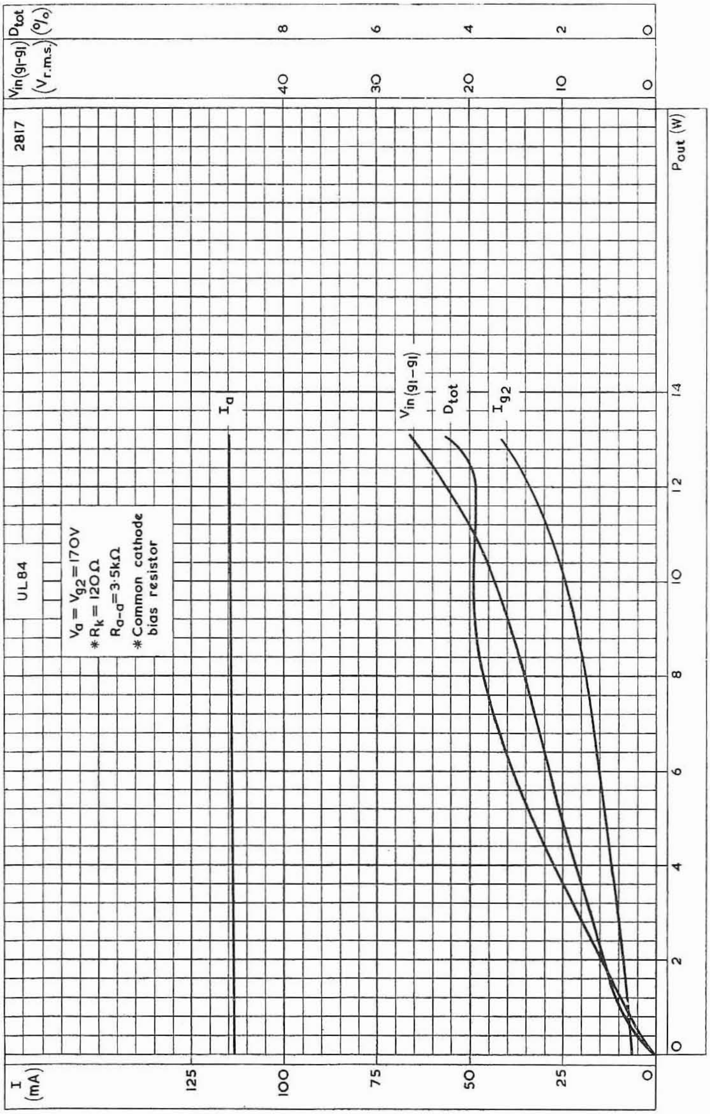
$V_a = V_{g2(b)} = 200V$

UL84

OUTPUT PENTODE



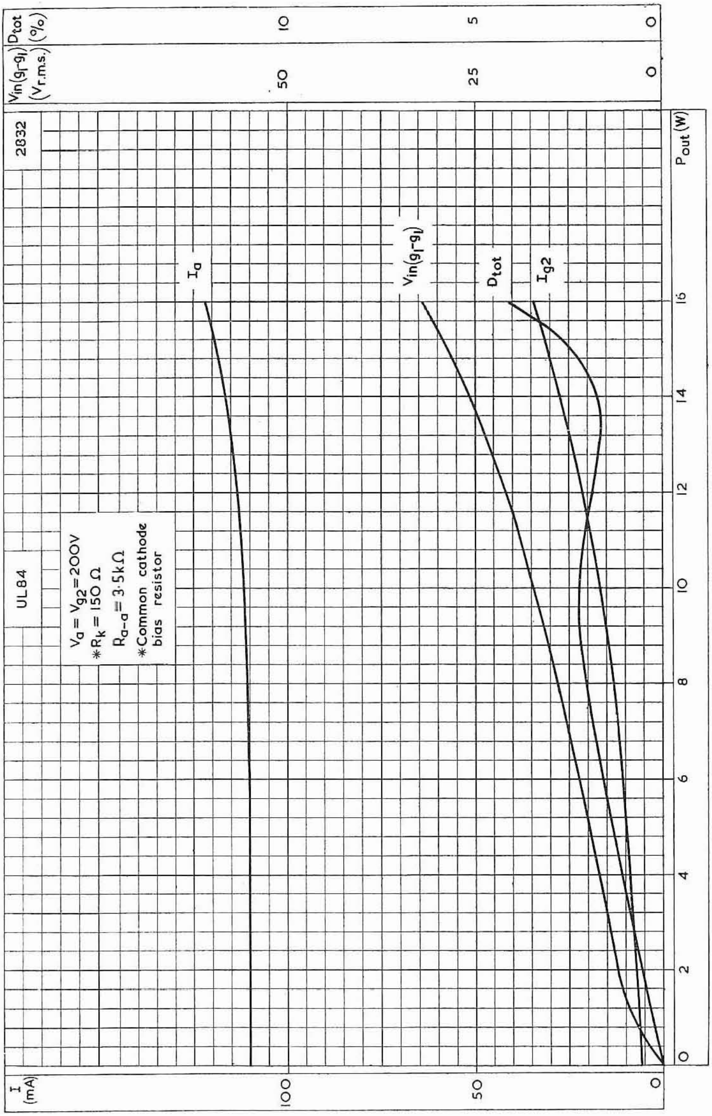
PERFORMANCE OF TWO UL84 IN PUSH-PULL. $V_a = V_{g2} = 100V$



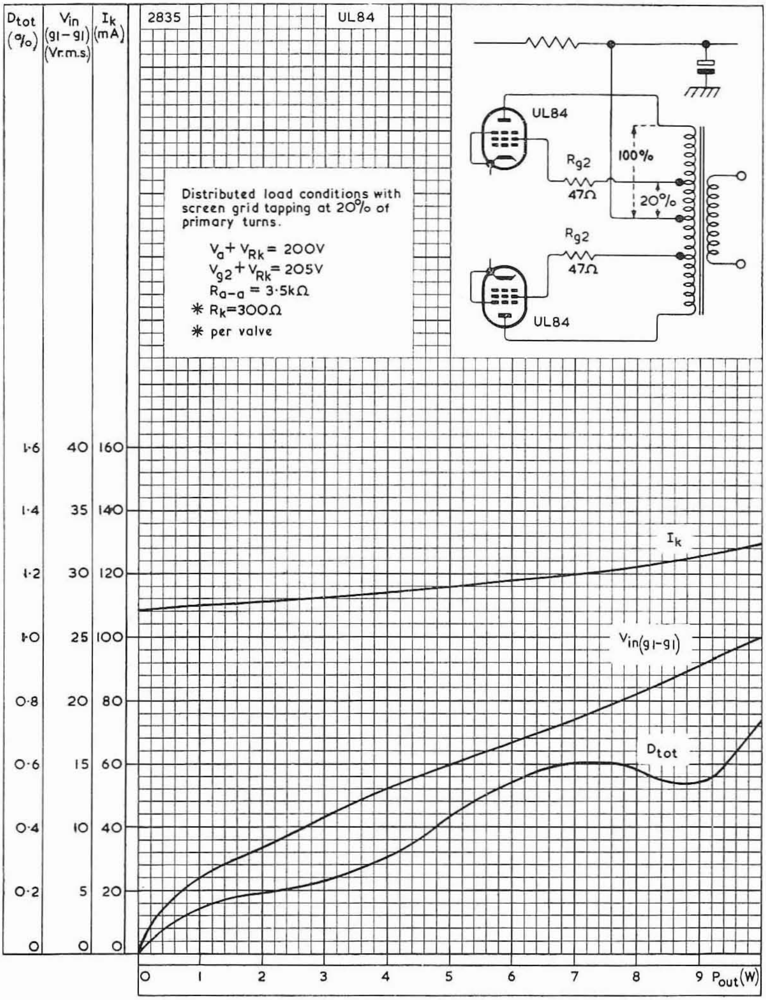
PERFORMANCE OF TWO UL84 IN PUSH-PULL. $V_a = V_{g2} = 170V$

UL84

OUTPUT PENTODE



PERFORMANCE OF TWO UL84 IN PUSH-PULL. $V_a = V_{g2} = 200V$



PERFORMANCE OF TWO UL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS

HALF-WAVE RECTIFIER

UY85

Indirectly heated half-wave rectifier with 100mA heater for use in equipment with series connected heaters.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

I_h	100	mA
V_h	38	V

LIMITING VALUES

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	110	mA
$i_{a(pk)}$ max.	660	mA
$v_{h-k(pk)}$ max. (cathode positive)	550	V

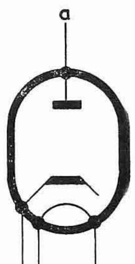
OPERATING CONDITIONS

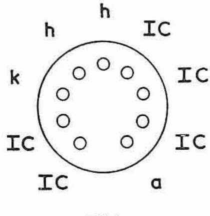
$V_{in(r.m.s.)}$	110	220	250	V
V_{out}	112	215	245	V
R_{lim} min.	0	90	100	Ω
I_{out}	110	110	110	mA
C	100	100	100	μF

UY85

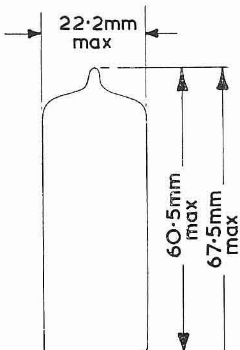
HALF-WAVE RECTIFIER

2442

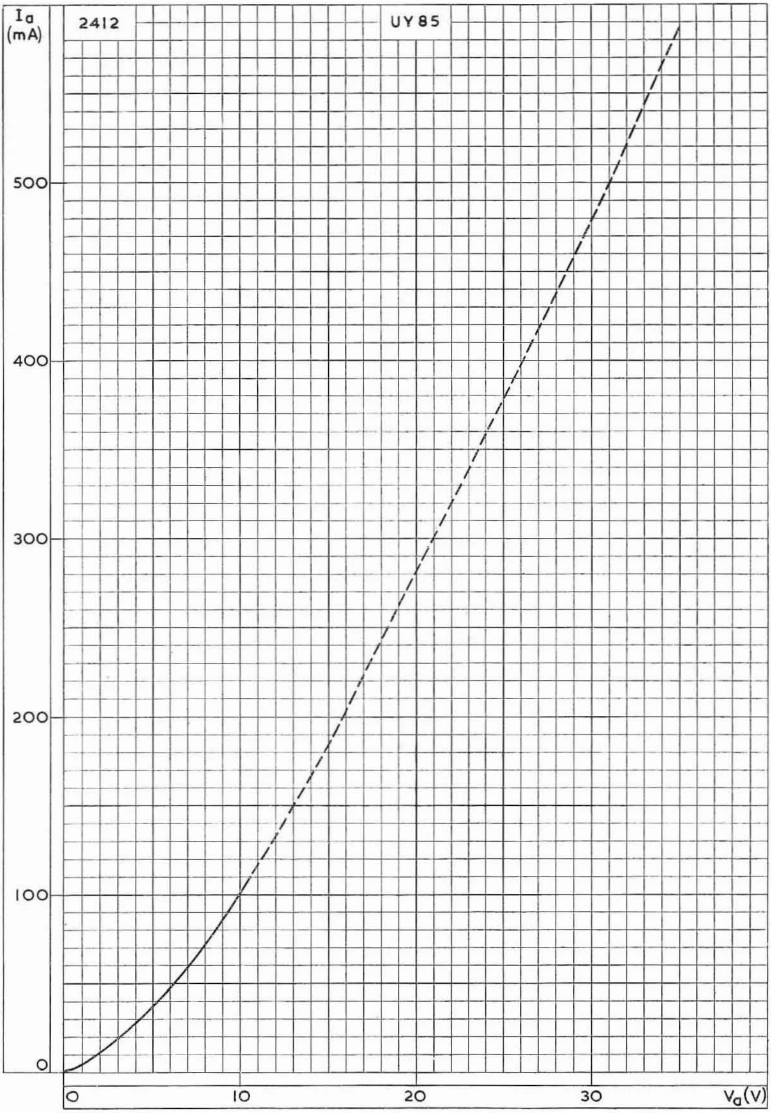




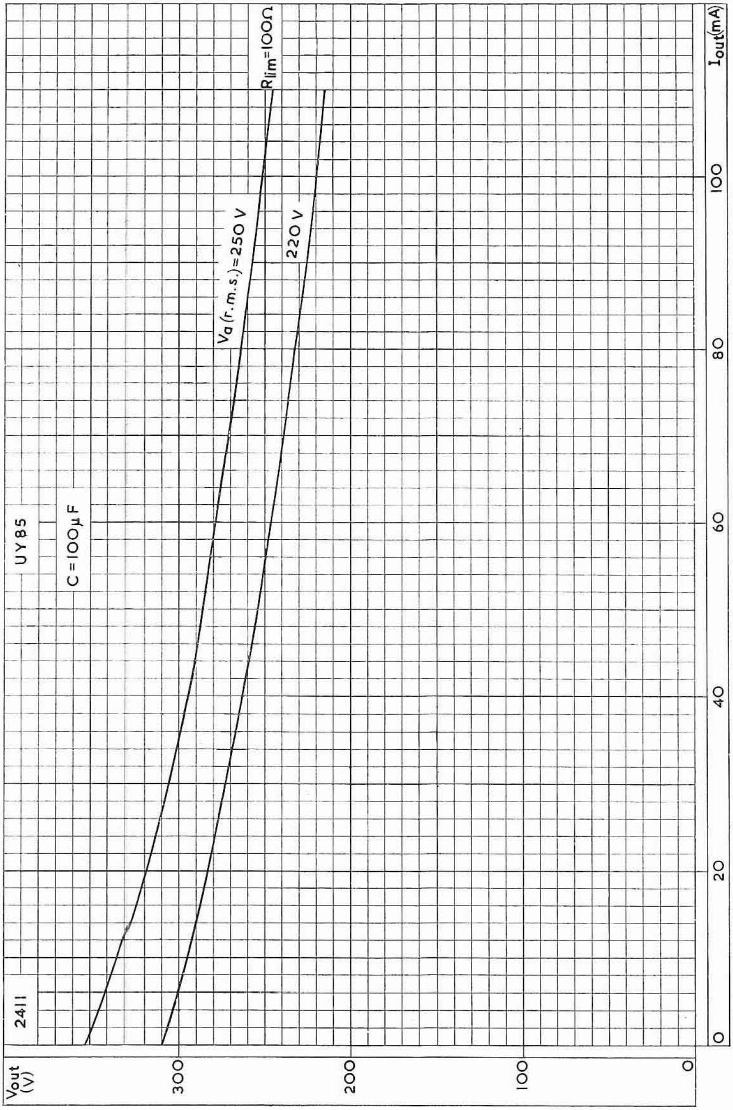
B9A
Noval Base



HALF-WAVE RECTIFIER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



REGULATION CURVES

PENTODE

6AS6

Dual control pentode for switching or gating control or for use as a frequency changer.

HEATER

V_h	6.3	V
I_h	175	mA

MOUNTING POSITION

Any

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<20	<25	mpF
c_{a-g3}	700	700	mpF
c_{in}	4.0	3.9	pF
c_{g3-all}	3.4	3.3	pF
c_{out}	3.0	2.2	pF
c_{g1-g3}	<150	<150	mpF

CHARACTERISTICS

V_a	120	120	V
V_{g2}	120	120	V
V_{g3}	−3.0	0	V
I_a	3.5	5.1	mA
I_{g2}	4.8	3.5	mA
V_{g1}	−2.0	−2.0	V
$g_{m(g1-a)}$	2.0	3.2	mA/V
$g_{m(g3-a)}$	660	450	μA/V
r_a	—	150	kΩ
$V_{g1}(I_a = 100\mu A)$	—	<−7.5	V
$V_{g3}(I_a = 20\mu A)$	−10	<−15	V

OPERATING CONDITIONS

Frequency changer with oscillator voltage on g_3

V_a	120	V
V_{g2}	120	V
V_{g1}	−2.0	V
I_a	2.1	mA
I_{g2}	5.8	mA
$V_{osc(r.m.s.)}$	6.0	V
I_{g3}	70	μA
R_{g3}	100	kΩ
g_c	1.0	mA/V
r_a	130	kΩ
R_{eq}	12	kΩ

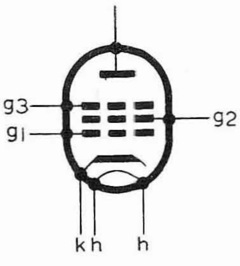
DESIGN CENTRE RATINGS

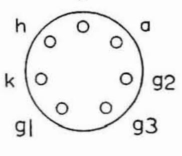
$V_{a(b)}$ max.	300	V
V_a max.	180	V
p_a max.	1.7	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	140	V
p_{g2} max.	750	mW
V_{g3} max.	27	V
R_{g1-k} max.	4.0	MΩ←
I_k max.	18	mA
V_{h-k} max.	90	V

6AS6

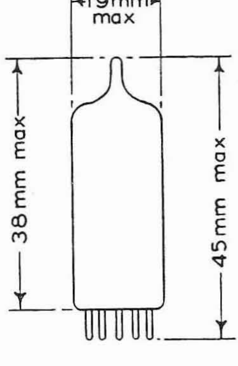
PENTODE

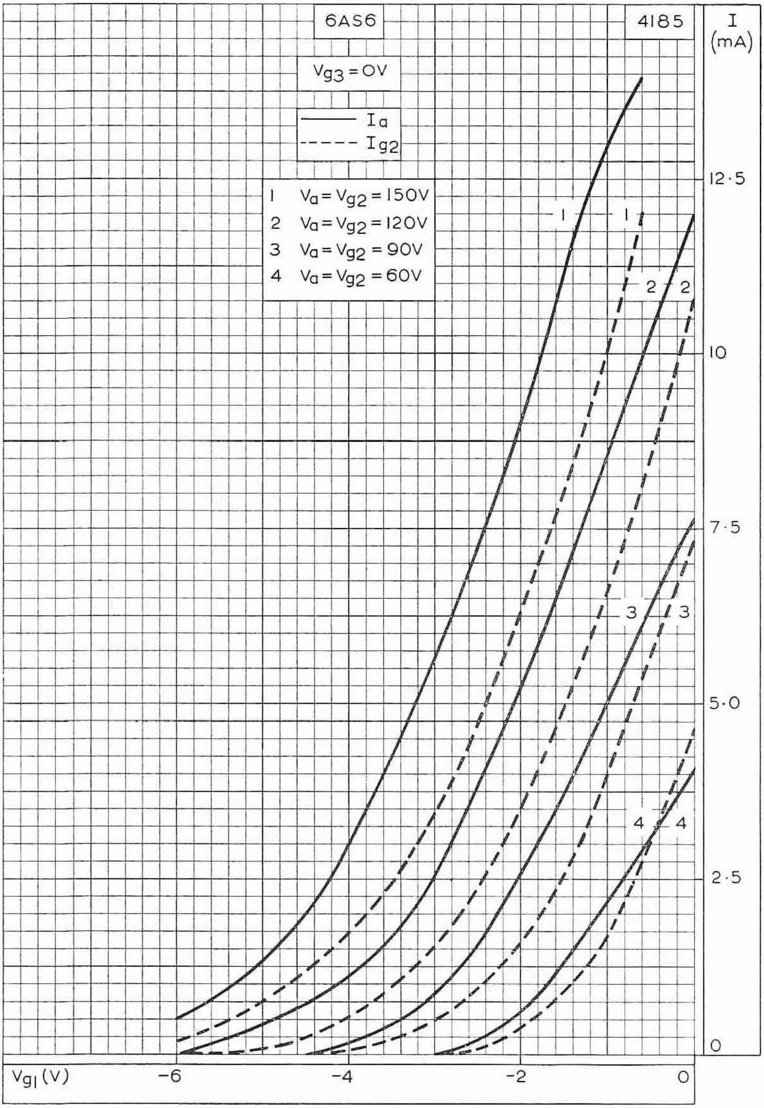
4491





B7G Base

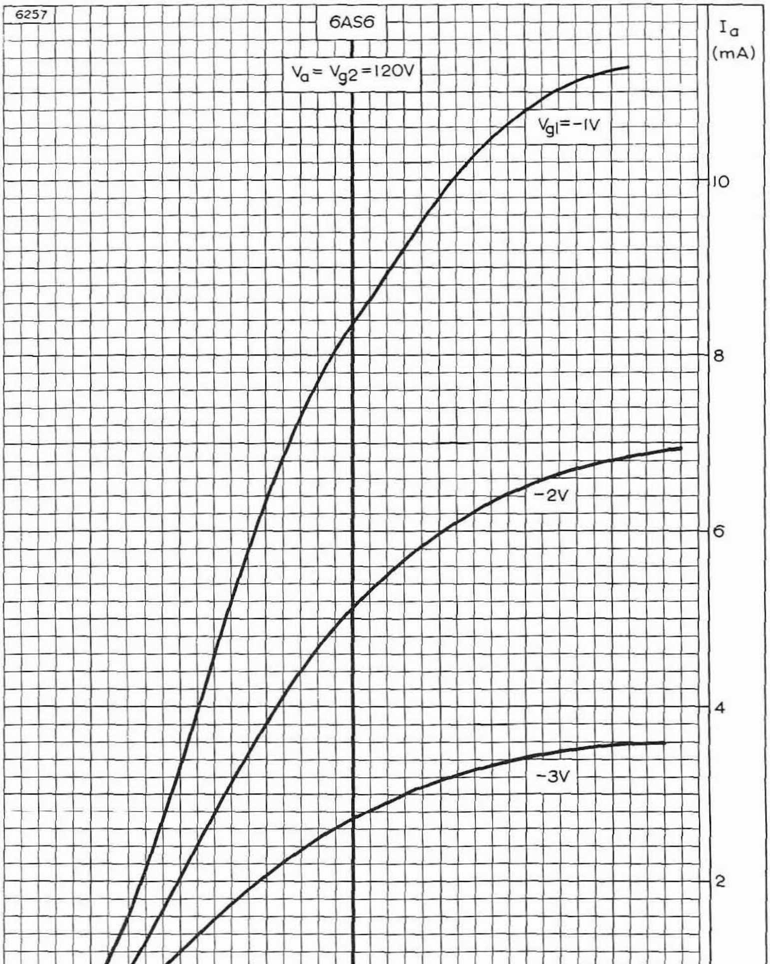




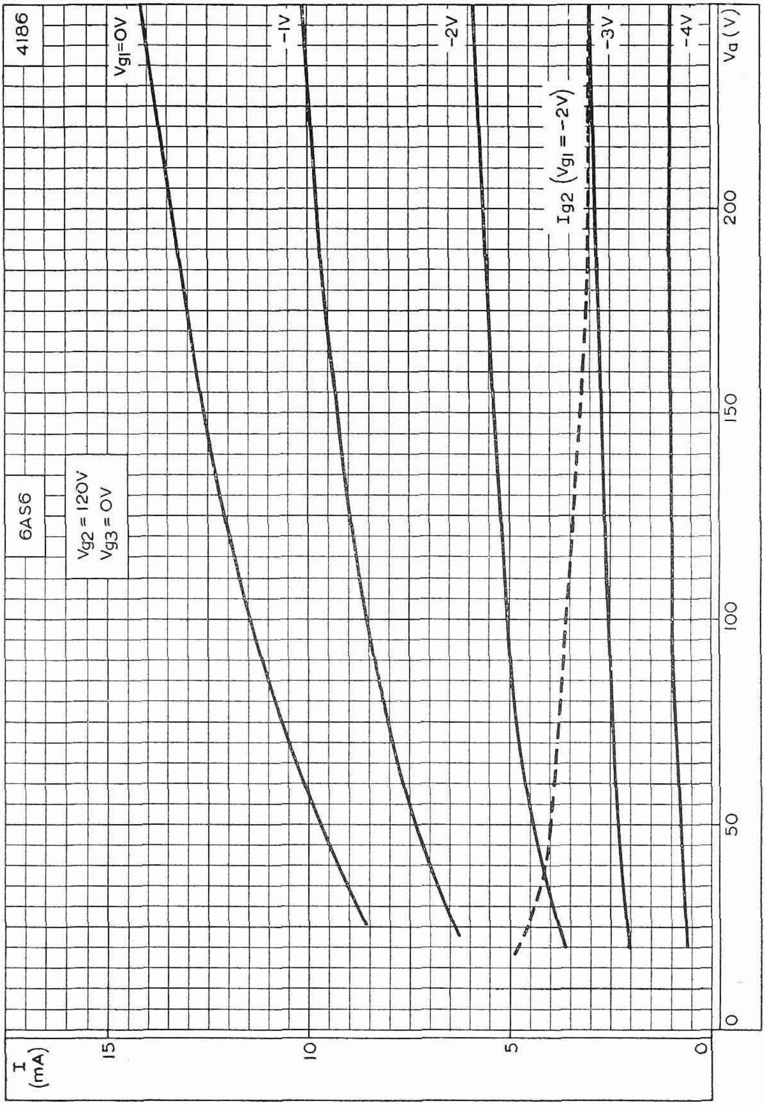
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS

6AS6

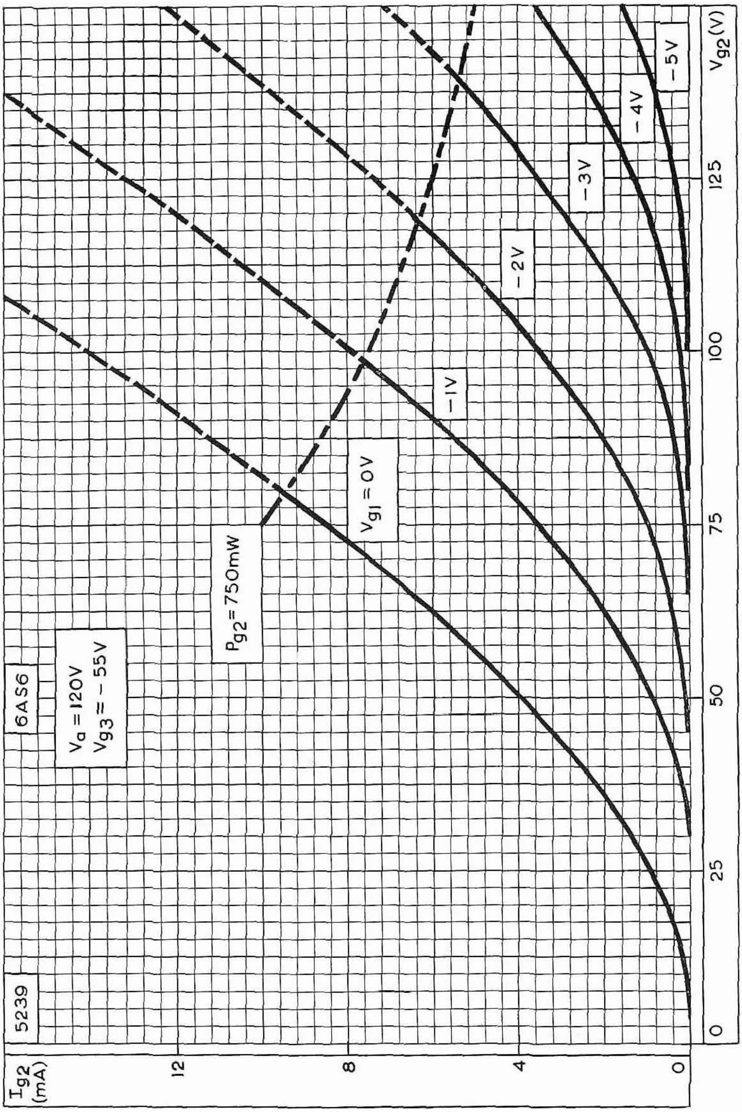
PENTODE



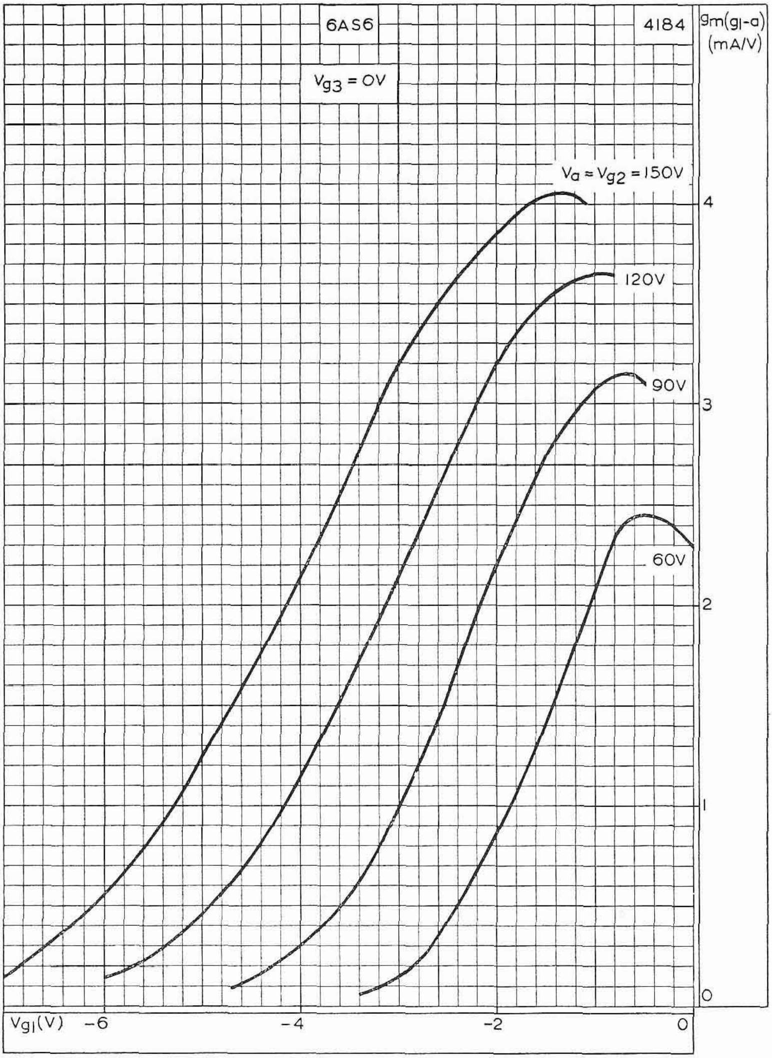
ANODE CURRENT PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



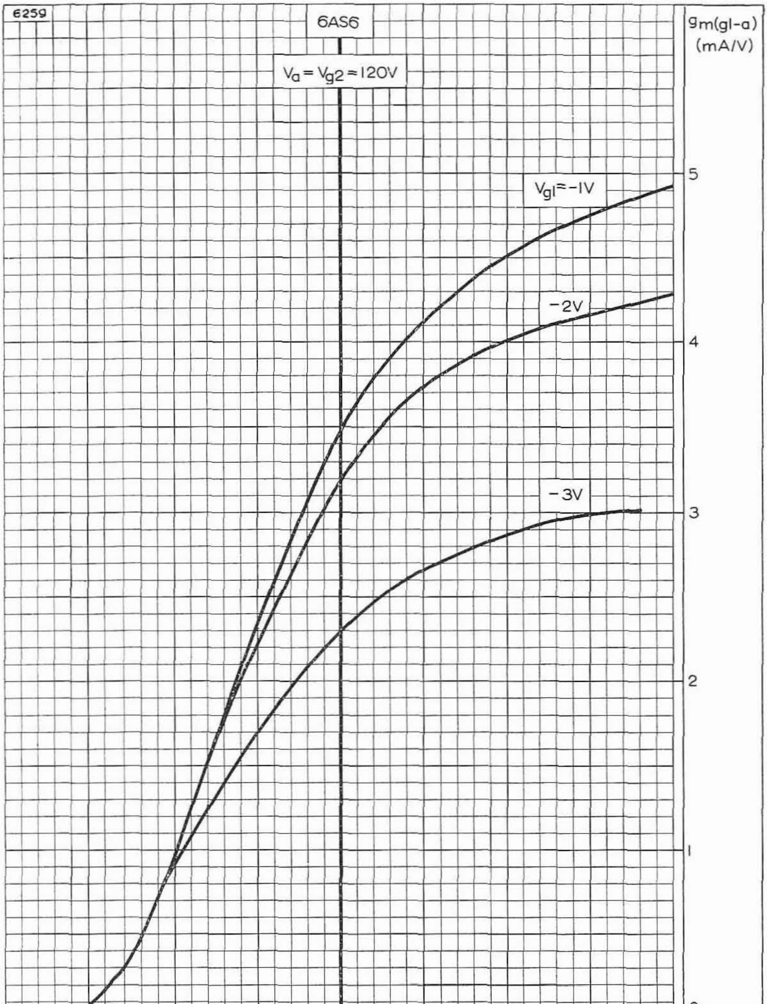
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



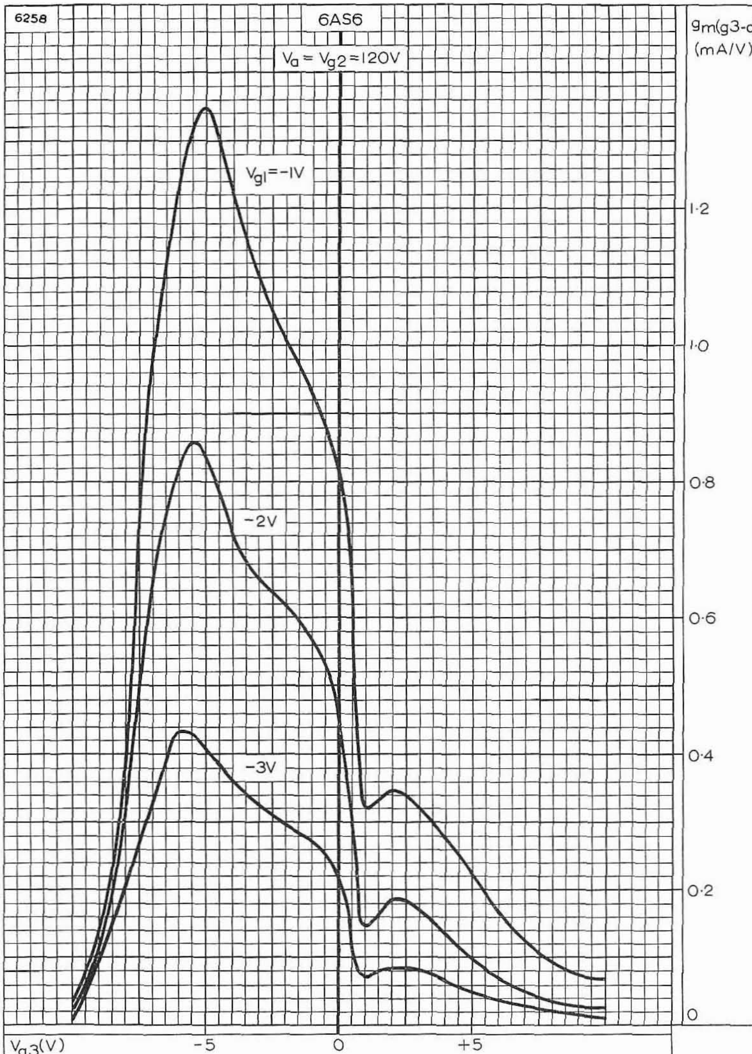
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE (g_{1-a}) PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS



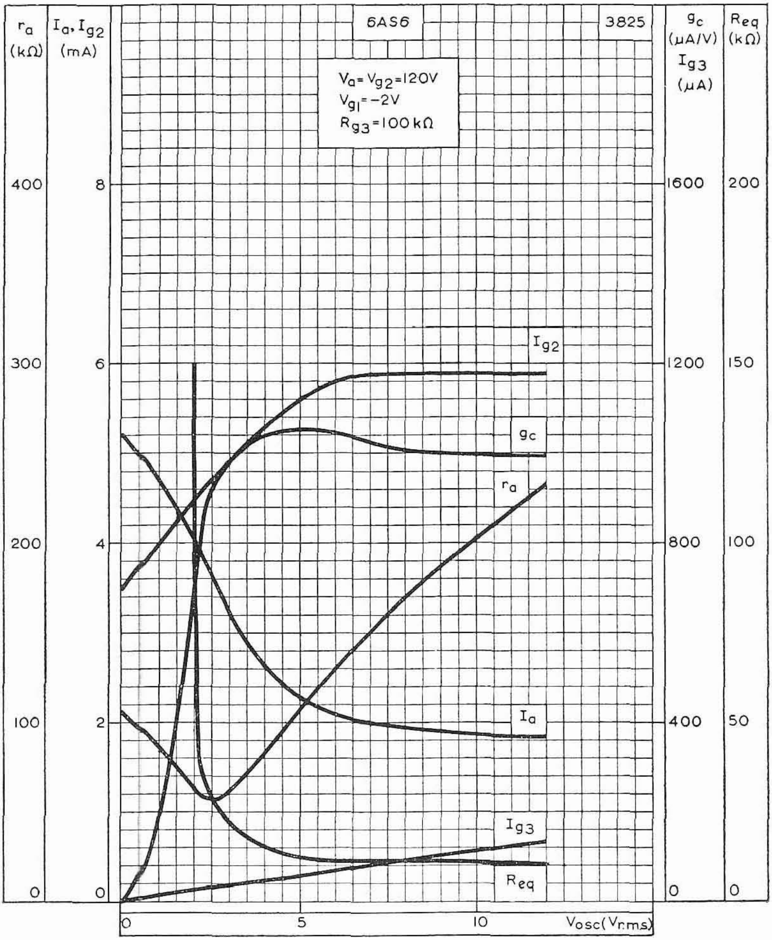
MUTUAL CONDUCTANCE (g_{1-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE (g_{3-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

6AS6

PENTODE



PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

Mullard

RECEIVING VALVES AND TELEVISION PICTURE TUBES

1