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Integrated circuits

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

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.

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Neglect of this simple task may lead to loss of data sheets, and an incomplete Handbook congested with out-of-date information.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

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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.

GENERAL INDEX TO VOLUME ONE

GENERAL INDEX TO VOLUME ONE

GENERAL INDEX TO VOLUME ONE

These general notes include definitions and general test procedures. They should be read in conjunction with the data sheets for Special Quality Valves. Where reference should be made to a specific note, this is indicated on the data sheet by an index number, e.g. Group Quality Level.[10]

1. *Heater voltage.* Life and reliability of performance are a function of the value and degree of regulation of the heater voltage. In order to achieve the maximum useful life the heater should be maintained as close as possible to its rated value, and unless specific recommendations are made on individual data sheets, designers should aim to maintain the voltage at the valve pins within $\pm 5\%$ of the published nominal value. The tolerance quoted includes variations in the supply voltage.

2. *Capacitances.* Unless otherwise stated the capacitances quoted are measured with the valve cold in a fully screened socket. The measurements are made with or without an external shield, as stated on the individual data sheets.

3. *Electrode voltages.* The reference point for electrode voltages is normally the cathode, and the symbols V_a, V_{g2} etc., are used to indicate the anode and screen-grid voltages with respect to the cathode.

   In some cases however, a cathode resistor is used when measuring characteristics, and in such cases the symbols V_{a-k}, V_{g2-k} are used when voltages are measured with respect to the cathode and V_{a-e}, V_{g2-e}, when the voltages are measured with respect to the negative end of the cathode resistor.

4. *Limiting values.* Unless otherwise stated the Limiting Values of Special Quality Valves are Absolute Ratings.

   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 of 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.

The life expectancy may be reduced if conditions other than those specified for life test are imposed on the valve and will be reduced appreciably if absolute maximum ratings are exceeded.

Heater to cathode voltage. In the interests of reliability the heater to cathode voltage should always be kept as low as possible, and it is preferable to have the cathode positive with respect to the heater.

Bulb temperature. In the interests of reliability the bulb temperature should always be kept as low as possible.

5. *The A.Q.L.* (Acceptable quality level) is the limit below which the average percentage of defectives is controlled.

6. *Maximum and minimum values for the individuals* are the limits to which valves are tested.

7. *Maximum and minimum for lot average* are the limits between which the average value of the characteristic of a lot or batch is controlled.

8. *Lot standard deviation* is the standard deviation of a single lot or batch.

9. *Bogey value* is the target value.

10. *Group quality level.* This is the A.Q.L. (Acceptable quality level) over a whole group of tests.

Sub-group quality level. The A.Q.L. over a number of tests, which do not constitute a complete group.

11. *Glass envelope strain test.*
    (*A*) This test is carried out on a sampling basis and consists of completely submerging the valves in boiling water at a temperature between 97 and 100°C for 15 seconds and then immediately plunging them in ice cold water for 5 seconds. The valves are then examined for glass cracks.
    (*B*) This test is carried out on a sampling basis and consists of completely submerging the valves in boiling water not less than 85°C for 15 seconds and then immediately plunging them in ice cold water not more than 5°C for 5 seconds. The valves are then examined for glass cracks.

12. *Base strain test.* This test is carried out on a sampling basis and consists of forcing the pins of the valves over specified cones and then completely submerging the valves and cones in boiling water at a temperature between 97 and 100°C for 10 seconds. The valves and cones are allowed to cool to room temperature before examining for glass cracks.

13. *Lead fragility test.*
    (*A*) This test is carried out on a sampling basis and consists of holding the valves vertically and having a 1-lb weight freely suspended from the lead under test. The valves are inclined slowly so as to bend the weighted lead through 45°, brought to 45° in the other direction, back again to 45° in the first direction and finally returned to the vertical, the entire action taking place in one vertical plane. The valves are examined for cracks and broken leads
    (*B*) This test is carried out on a sampling basis and consists of holding the valves vertically and having a 1-lb weight freely suspended from the lead under test. The valves are inclined slowly so as to bend the weighted lead through 90° and then returned to the vertical, the entire action taking place in one vertical plane. This cycle is repeated for the number of times shown on the data sheet. The valves are examined for broken leads.

14. This test is carried out on a sampling basis under the conditions detailed in the data.

15. *Shock test.* This test is carried out on a sampling basis and subjects the valves to 5 blows of the specified acceleration in each of 4 directions.

16. *Inoperatives.* An inoperative is defined as a valve having an open or short circuited electrode, an air leak or a broken pin.

SPECIAL QUALITY SUBMINIATURE VOLTAGE INDICATOR

DM160

Special quality, directly heated subminiature voltage indicator for use in industrial equipment such as transistorised computers.

This data should be read in conjunction with GENERAL NOTES - SPECIAL QUALITY VALVES, and the index numbers are used to indicate where reference should be made to a specific note.

FILAMENT

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

V_f (see RATINGS section)	1.0	V
I_f nom.	30	mA
I_f (initial range)	24 to 36	mA

CHARACTERISTICS, OPERATING CONDITIONS AND RANGE VALUES FOR EQUIPMENT DESIGN[3]

	Nominal value	Initial range	End of life	
V_a	50			V
R_g	100			kΩ
*$V_{g(b)}$ (max. light output)	0			V
*$V_{g(b)}$ (zero light output)	-3	-3	-3	V
I_a at $V_{g(b)}$ = 0V	585	430 to 740	>250	μA←
**I_a at $V_{g(b)}$ = -3V		<5.0	<5.0	μA
Insulation resistance between any two electrodes at 50V		>100		MΩ

*Voltage with respect to the centre tap of the filament transformer.

**The residual electron current may be concentrated on one spot which may then be visible in dark surroundings. This effect cannot be mistaken for the indicator being in the conducting condition.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)[4]

$V_{a(b)}$ max.	100	V
V_a max.	65	V
I_a max.	850	μA
$V_{g(b)}$ max. (R_g = 100kΩ ± 10%)	0	V
$V_{g(b)}$ max. (R_g = 1MΩ ± 10%)	6.0	V
$-V_g$ max.	50	V
R_g max.	1.1	MΩ
R_g min.	90	kΩ

Filament voltage

The average filament voltage should be 1.0V. Variations exceeding +0 or -10% will shorten the life of the valve.

SHOCK RESISTANCE[15]

The valve is subjected to an acceleration of 500g, 5 times in each of four positions in an NRL shock machine with the hammer lifted over an angle of 30°.

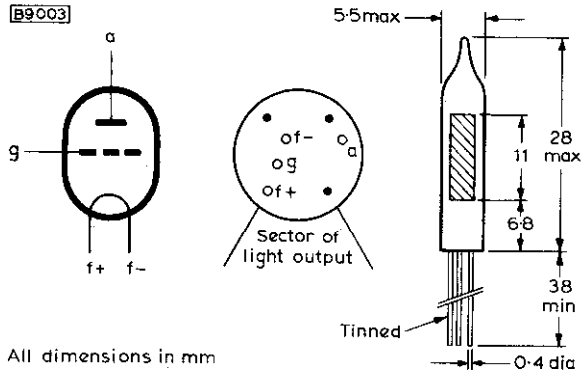
LIFE

Production samples are checked for the end of life values given on page 1 under the following conditions for 10 000 hours:

$V_{f(r.m.s.)}$	1.0	V
V_a	50	V
*$V_{g(b)}$	0	V
R_g	100	kΩ

*Voltage with respect to the centre tap of the filament transformer.

DIMENSIONS AND CONNECTIONS



All dimensions in mm

Connections should not be soldered nearer than 5mm from the seal.
The leads should not be bent nearer than 1.5mm from the seal.

APPLICATION NOTES

The visibility of the phosphorescent light produced by the anode when the indicator is conducting depends upon the grid voltage and the illumination level of the surroundings. With $V_g = -3V$ for zero light output the visibility is best when $\Delta V_g = 3V$, but an unambiguous indication is still obtained at $\Delta V_g = 1.4V$ under nominal conditions and a low level of ambient light. With still smaller values of drive voltage a pre-amplifier is required. These points being taken into account, one can use the DM160 for reading out digital information from logic circuits. Figs. 1 and 2 show typical arrangements for negative and positive logic, respectively.

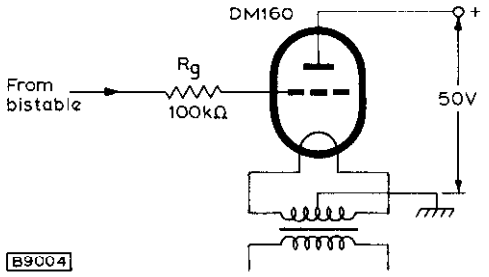


Fig. 1 Digital read-out circuit with DM160 connected to negative logic circuit which uses bistables equipped with p-n-p transistors. The 'High' output level of the bistable may vary between 0V and -0.3V, and the 'Low' level between -3V and -6.8V.

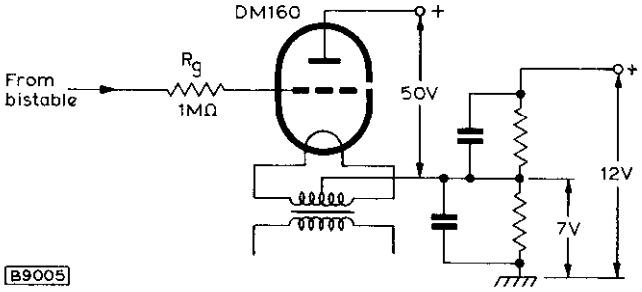


Fig. 2 Digital read-out circuit with DM160 connected to positive logic circuit which uses bistables equipped with n-p-n transistors. The 'High' output level of the bistable may vary between +7.5V and +12V, and the 'Low' level between 0V and +0.4V. R_g protects the valve against excessive anode currents and positive grid currents in case the grid voltage exceeds the cathode potential.

When the minimum ΔV_g lies below 3V the spread in the 'High' level of the bistable will give rise to an extra spread in the brightness of the phosphorescent light. If this is undesirable the spread may be reduced by clamping the grid voltage (see page 4).

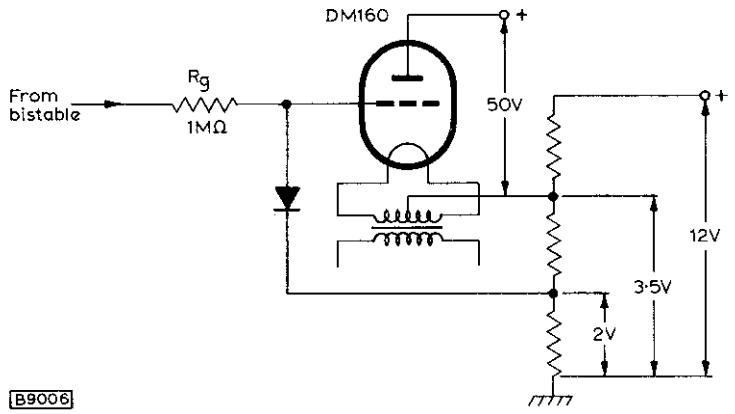
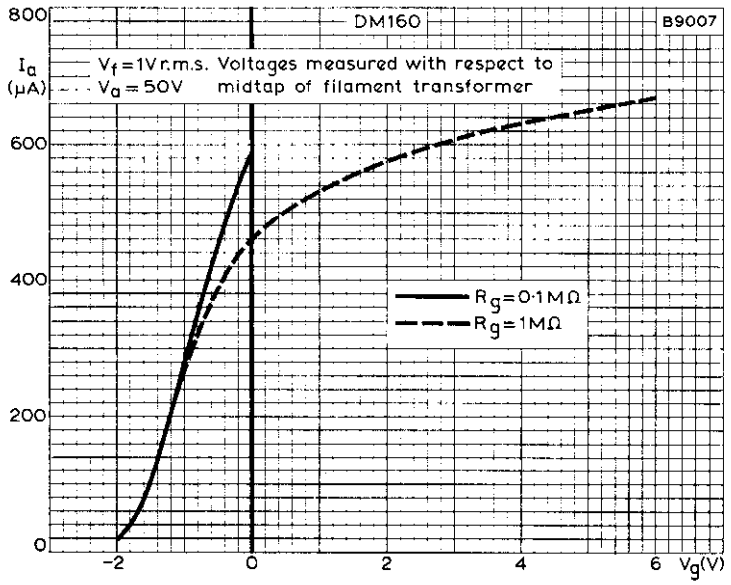
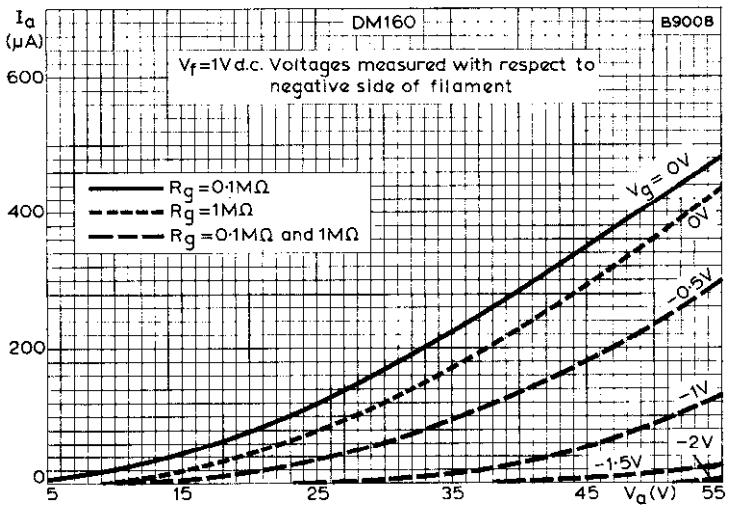
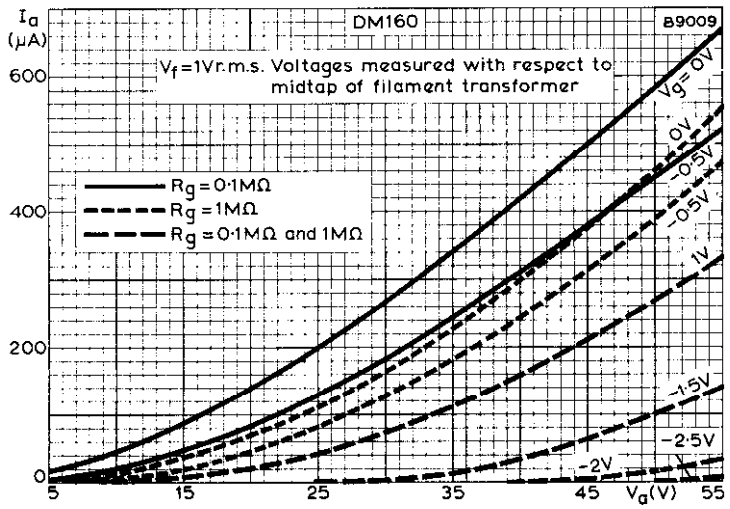


Fig.3 As Fig.2: 'High' voltage between +2V and +7V, and 'Low' level between 0V and +0.5V; grid voltage clamped.



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

E55L

Special quality high slope output pentode intended for general industrial applications where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	600	mA

CAPACITANCES[2]

Pentode connected

Shielded

	Minimum	*Average*	*Maximum*	
c_{a-g1}	—	80	120	mpF
c_{in}	15	18	21	pF
c_{in} (w) (I_k = 55.5mA)	—	28	—	pF
c_{out}	5.8	6.5	7.2	pF

Unshielded

c_{a-g1}	—	110	150	mpF
c_{in}	15	18	20	pF
c_{in} (w) (I_k = 55.5mA)	—	28	—	pF
c_{out}	3.6	4.0	4.4	pF

Triode connected

Shielded

c_{a-g}	5.5	6.2	6.9	pF
c_{in}	10	11.8	13.6	pF
c_{out}	9.4	10.5	11.6	pF
c_{h-k}	—	6.0	—	pF

Unshielded

c_{a-g}	5.6	6.3	7.0	pF
c_{in}	10	11.8	13.6	pF
c_{out}	7.0	7.8	8.6	pF
c_{h-k}	—	6.0	—	pF

E55L

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

CHARACTERISTICS[3]

Pentode connected		
V_a	125	V
V_{g2}	125	V
V_{g3}	0	V
V_{g1}	−3.0	V
R_k	0	Ω
I_a	50	mA
I_{g2}	5.5	mA
g_m	45	mA/V
r_a	20	kΩ
μ_{g1-g2}	30	
r_{g1} (f = 50Mc/s)	1.0	kΩ
Triode connected		
V_a	125	V
I_a	55.5	mA
V_g	−3.0	V
g_m	50	mA/V
μ	30	
r_a	600	Ω

OPERATING CONDITIONS

V_{a-e}	140	V
V_{g2-e}	140	V
V_{g3-k}	0	V
V_{g1-e}	+12	V
R_k	270	Ω
I_a	50	mA
I_{g2}	5.5	mA
g_m	45	mA/V

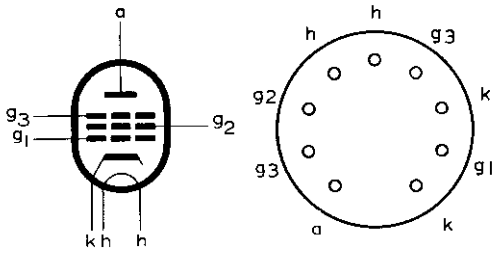
CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN ←

	Average	*Initial range*	*End of life**	
Anode Current at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	50	48 to 52	—	mA←
Grid-cathode voltage at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	−3.0	−2.3 to −3.7	−1.8	V←
Screen-grid current at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	5.5	4.5 to 6.5	—	mA←
Mutual conductance at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	45	38 to 52	Δg_m max. = 25%	mA/V←
Negative control-grid current (max.) at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	—	—	2.0	μA←

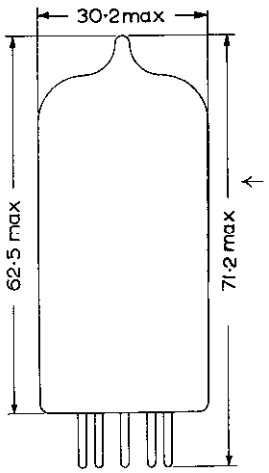
*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

E55L



B9D Base

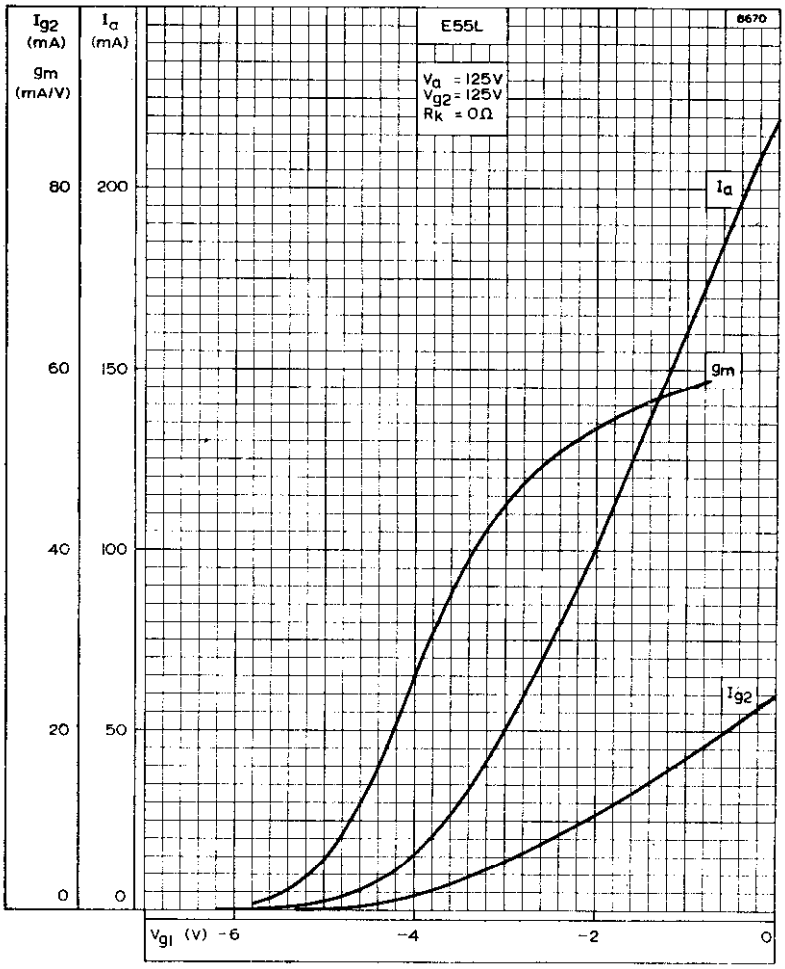


9862

All dimensions in mm

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

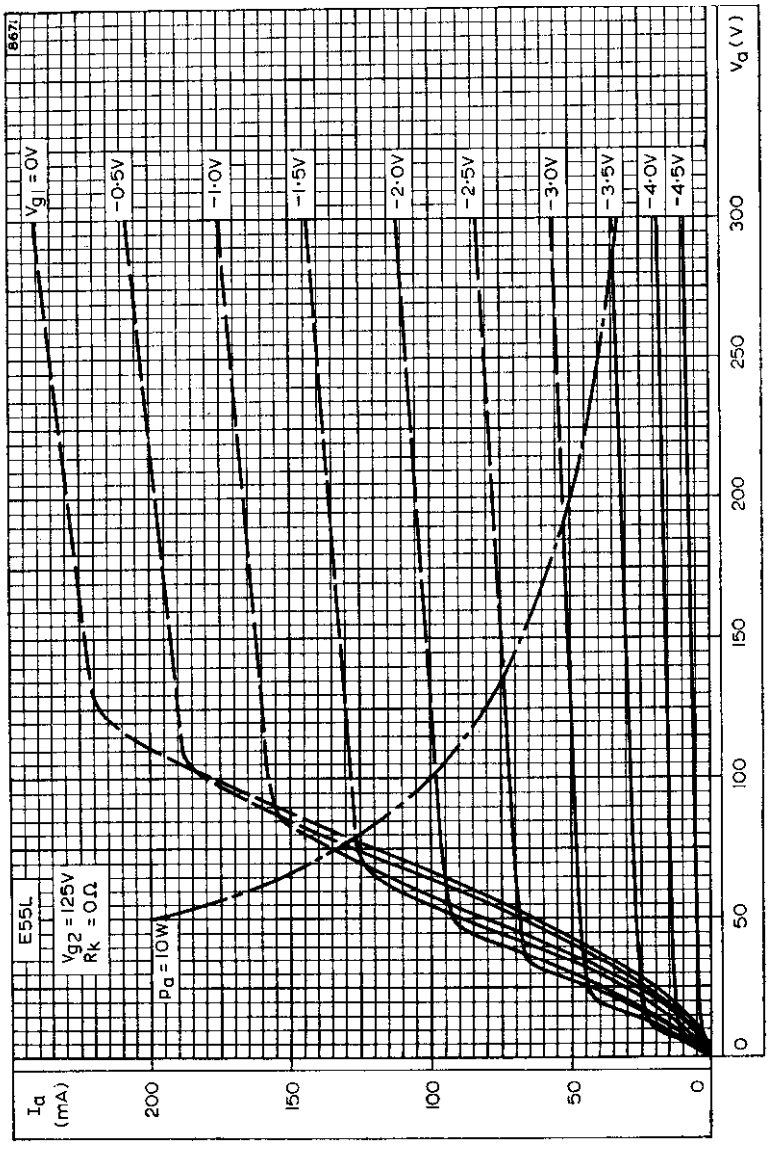
E55L



ANODE AND SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_{g2} = 125V

E55L

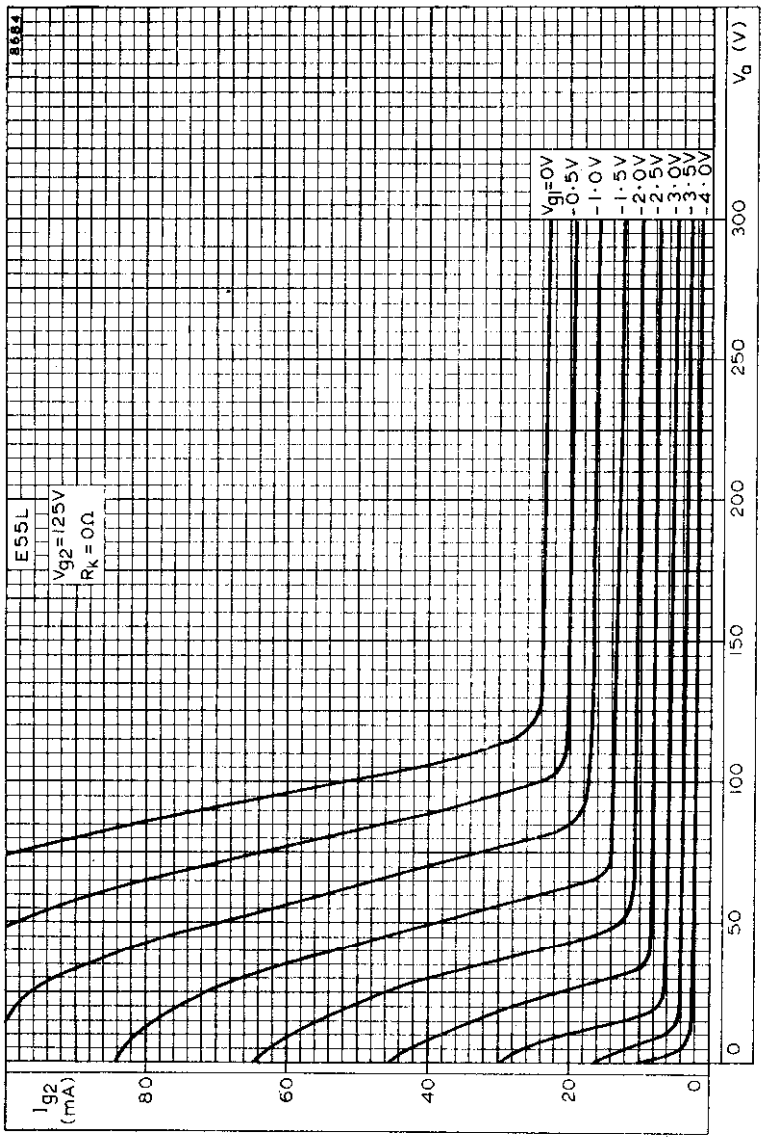
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



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

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

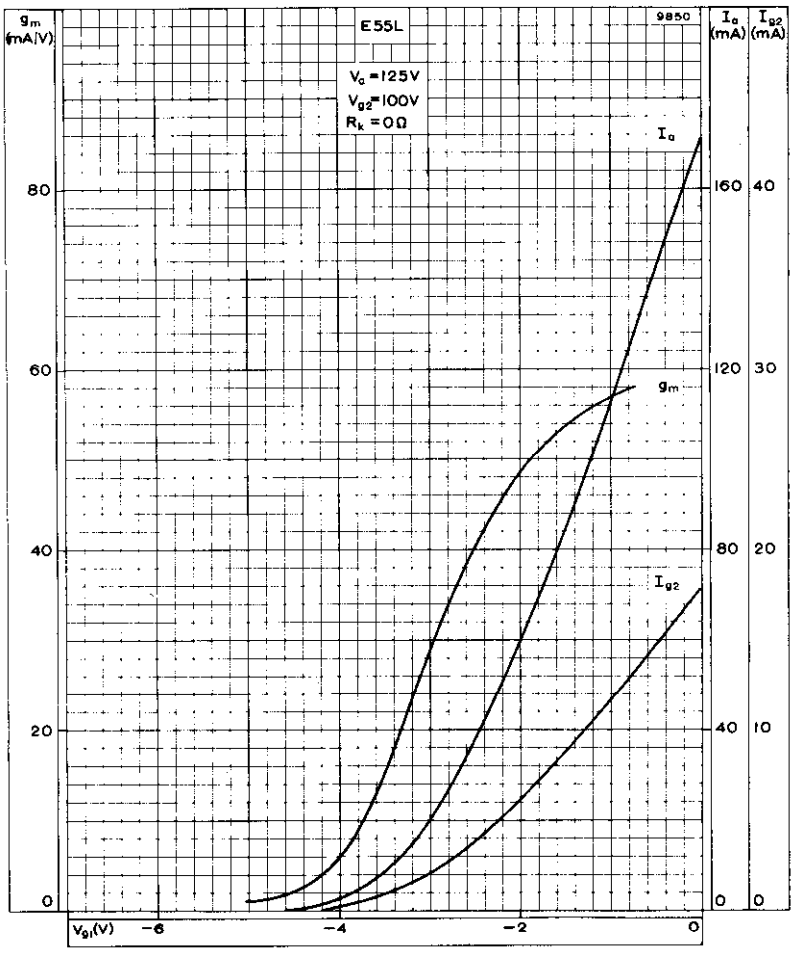
E55L



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 125V

E55L

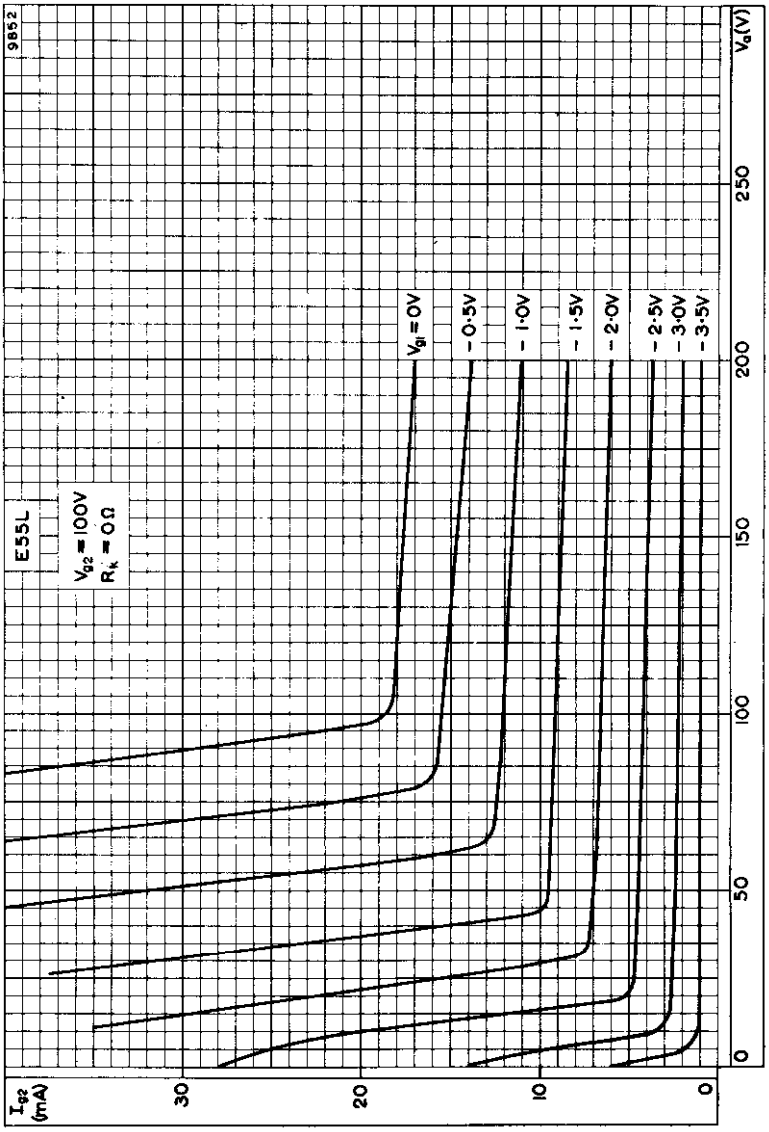
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



ANODE AND SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_{g2} = 100V

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

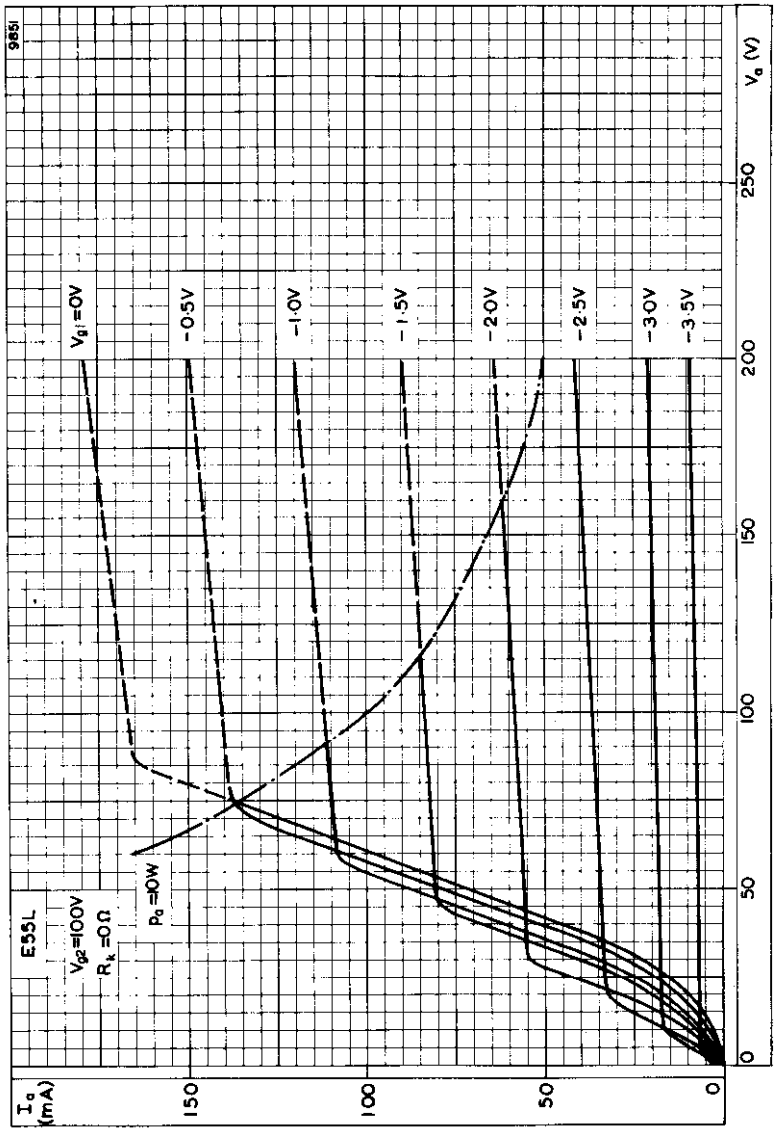
E55L



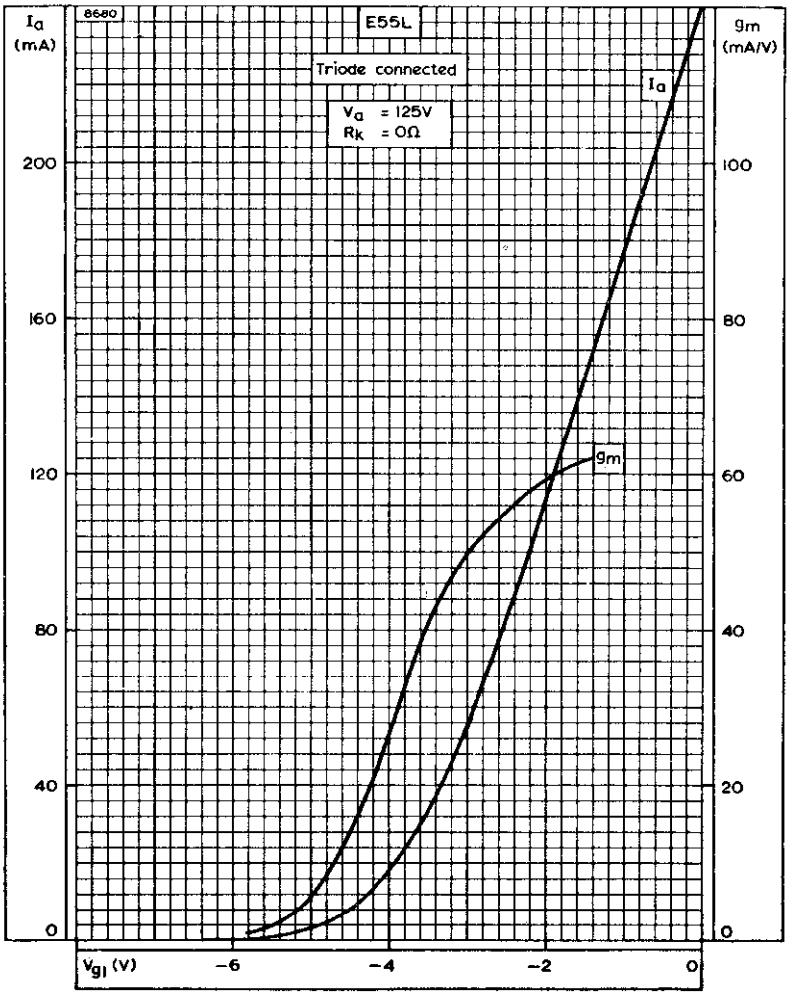
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V

E55L

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



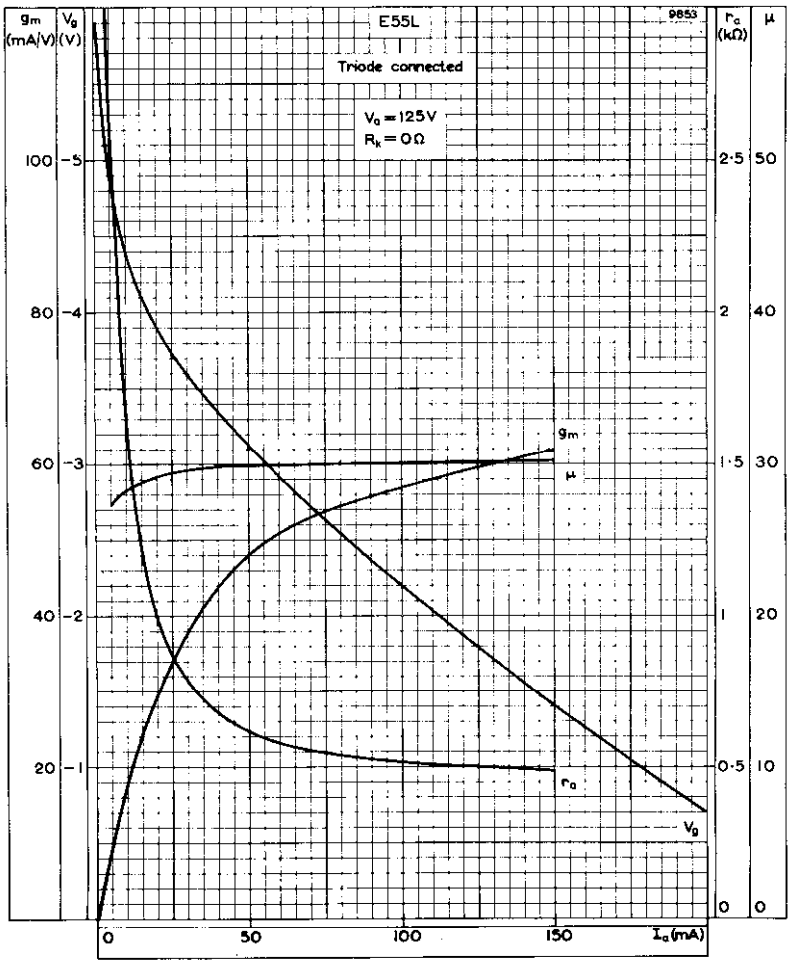
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V



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

E55L

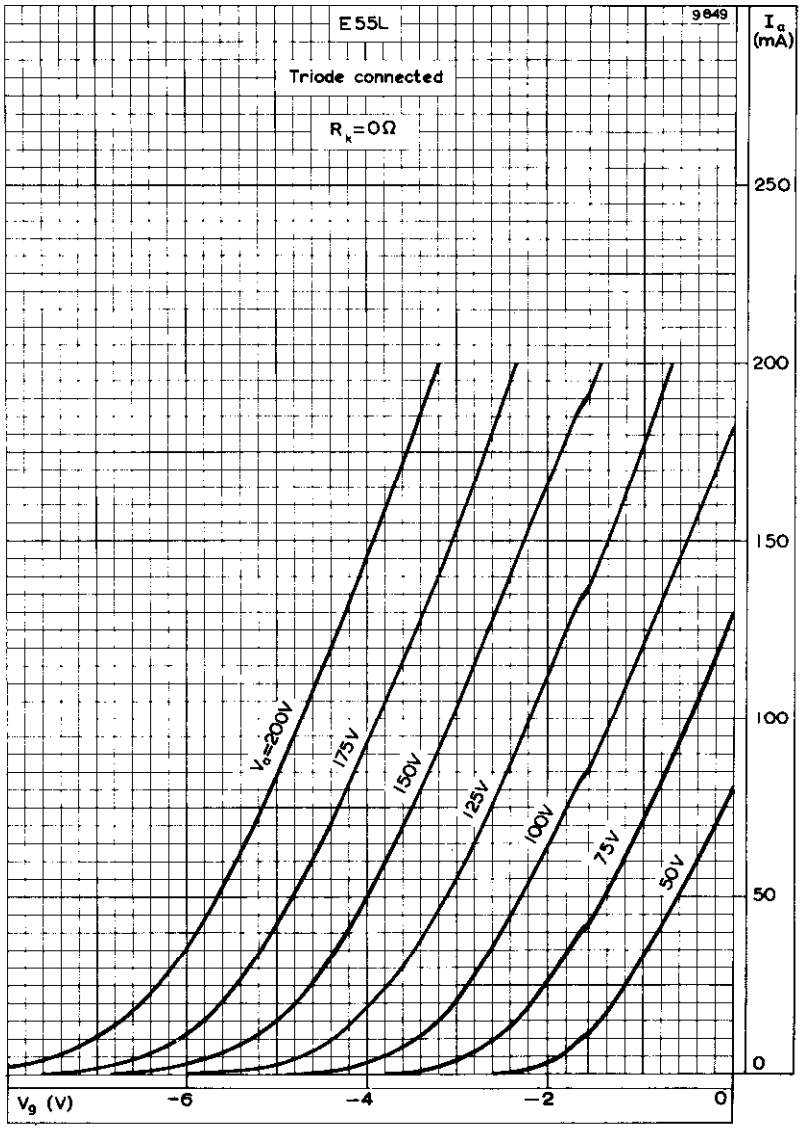
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT, WHEN TRIODE CONNECTED

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

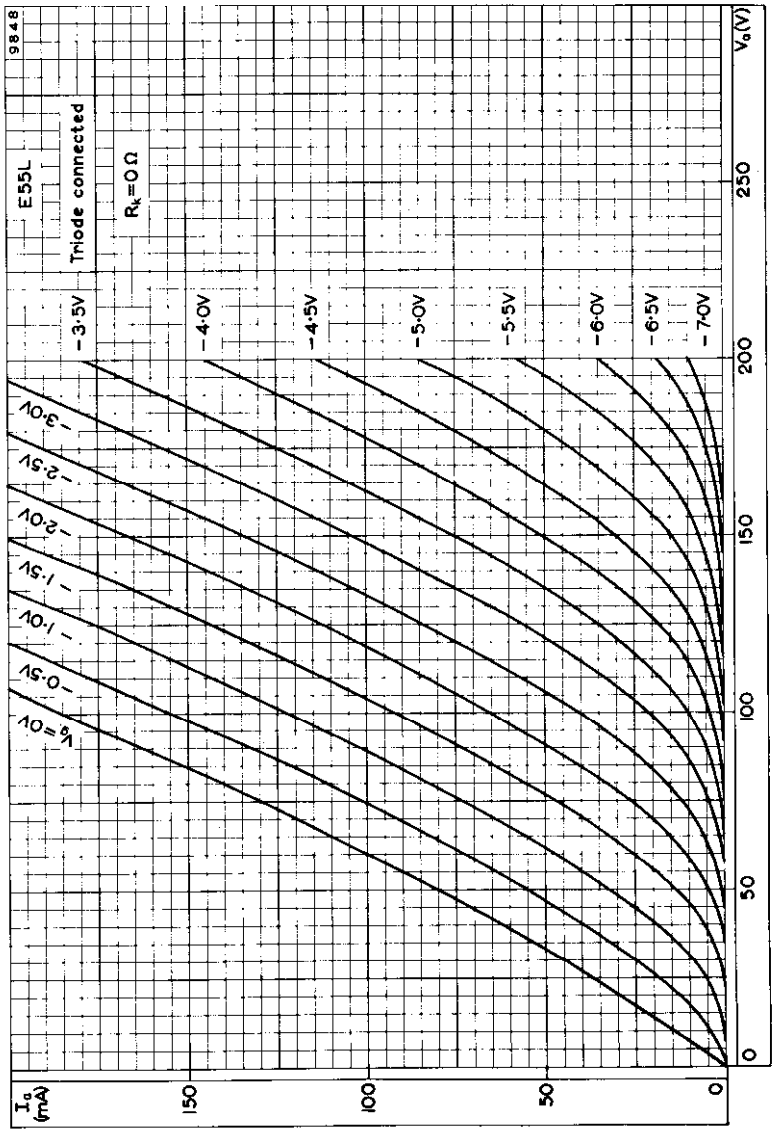
E55L



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

E55L

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



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

SPECIAL QUALITY TRIODE PENTODE

E80CF

Special quality triode pentode with separate cathodes for use in general industrial applications, where stability of characteristics and long life are required. This valve will maintain its emission capabilities after long periods of operation under cut-off conditions.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	330	mA
The maximum variation of heater current at 6.3V is	±16.5	mA←

CAPACITANCES[2] (measured without an external shield) ←

	Minimum	*Average*	*Maximum*	
C_{ap-at}	—	—	70	mpF
C_{ap-gt}	—	—	20	mpF
C_{g1-at}	—	—	160	mpF
Pentode section				
C_{a-g1}	—	—	25	mpF
C_{in}	5.2	5.6	6.0	pF
C_{out}	3.0	3.4	3.8	pF
C_{g1-h}	—	—	160	mpF
Triode section				
C_{a-k+h}	1.2	1.5	1.8	pF
C_{g-k+h}	2.2	2.5	2.8	pF
C_{a-g}	1.2	1.5	1.8	pF
C_{g-h}	—	—	220	mpF

CHARACTERISTICS[3]

Pentode section		
V_{a-e}	170	V
V_{g2-e}	170	V
R_k	155	Ω
I_a	10	mA
I_{g2}	2.8	mA
g_m	6.2	mA/V
r_a	400	kΩ
μ_{g1-g2}	40	
Triode section		
V_{a-e}	100	V
R_k	120	Ω
I_a	14	mA
g_m	5.0	mA/V
r_a	3.6	kΩ
μ	18	

E80CF SPECIAL QUALITY TRIODE PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN←

Pentode section

	Average	*Initial Range*	*End of Life**	
Anode current at $V_{a-e} = V_{g2-e} = 170V$, $R_k = 155\Omega$	10	7.5 to 12.5	6.0	mA
Screen-grid current at $V_{a-e} = V_{g-e} = 170V$, $R_k = 155\Omega$	2.8	1.55 to 4.05	—	mA
Mutual conductance at $V_{a-e} = V_{g2-e} = 170V$, $R_k = 155\Omega$	6.2	5.2 to 7.2	4.3	mA/V
Control-grid current at $V_{a-e} = V_{g2-e} = 170V$, $R_k = 155\Omega$		< 0.5	< 1.0	μA

Triode Section

Anode current at $V_{a-e} = 100V$, $R_k = 120\Omega$	14	10 to 18	8.4	mA
Mutual conductance at $V_{a-e} = 100V$, $R_k = 120\Omega$	5.0	4.0 to 6.0	3.5	mA/V
Control-grid current at $V_{a-e} = 100V$, $R_k = 120\Omega$		< 0.3	< 1.0	μA

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

OPERATING CONDITIONS

Pentode section as r.f. amplifier

V_{a-e}	170	V
V_{g2-e}	170	V
R_k	155	Ω
I_a	10	mA
I_{g2}	2.8	mA
g_m	6.2	mA/V
μ_{g1-g2}	40	
r_a	400	kΩ
r_{in} (f = 50Mc/s)	10	kΩ
R_{eq}	1.5	kΩ

Pentode section as frequency changer

V_{a-e}	170	V
V_{g2-e}	170	V
R_k	330	Ω
R_{g1}	100	kΩ
I_a	8.0	mA
I_{g2}	2.5	mA
I_{g1}	12	μA
$V_{osc\ (r.m.s.)}$	3.5	V
g_c	2.4	mA/V
r_a	500	kΩ

LIMITING VALUES[4] (absolute ratings)

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	2.15	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_k > 10mA$)	200	V
V_{g2} max. ($I_k < 10mA$)	225	V
p_{g2} max. ($p_a > 1.2W$)	700	mW
p_{g2} max. ($p_a < 1.2W$)	800	mW
$-V_{g1}$ max.	100	V
p_{g1} max.	100	mW
I_k max.	18	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

Note—If the triode is used as a v.h.f. oscillator then it is recommended that a Colpitt's circuit should be used.

Triode section

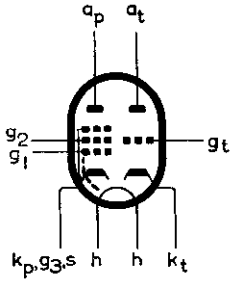
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	1.75	W
$-V_g$ max.	100	V
‡$v_{g(pk)}$ max.	30	V
p_g max.	100	mW
I_k max.	18	mA
‡$i_{k(pk)}$ max.	100	mA
R_{g-k} max.	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

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

SHOCK AND VIBRATION

The E80CF can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

E80CF SPECIAL QUALITY TRIODE PENTODE



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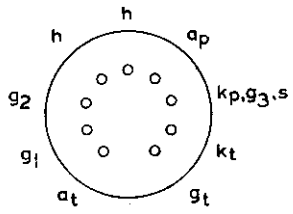
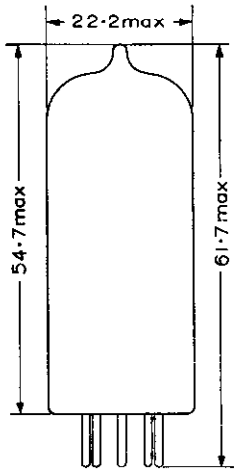
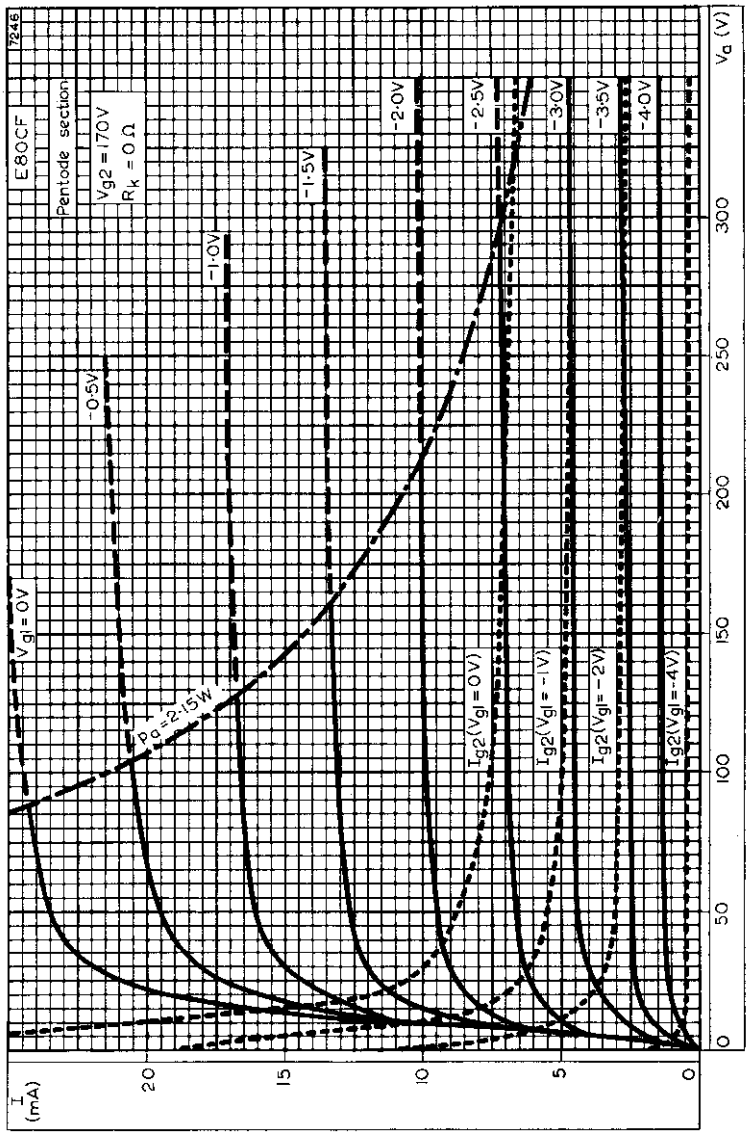


B9A Base

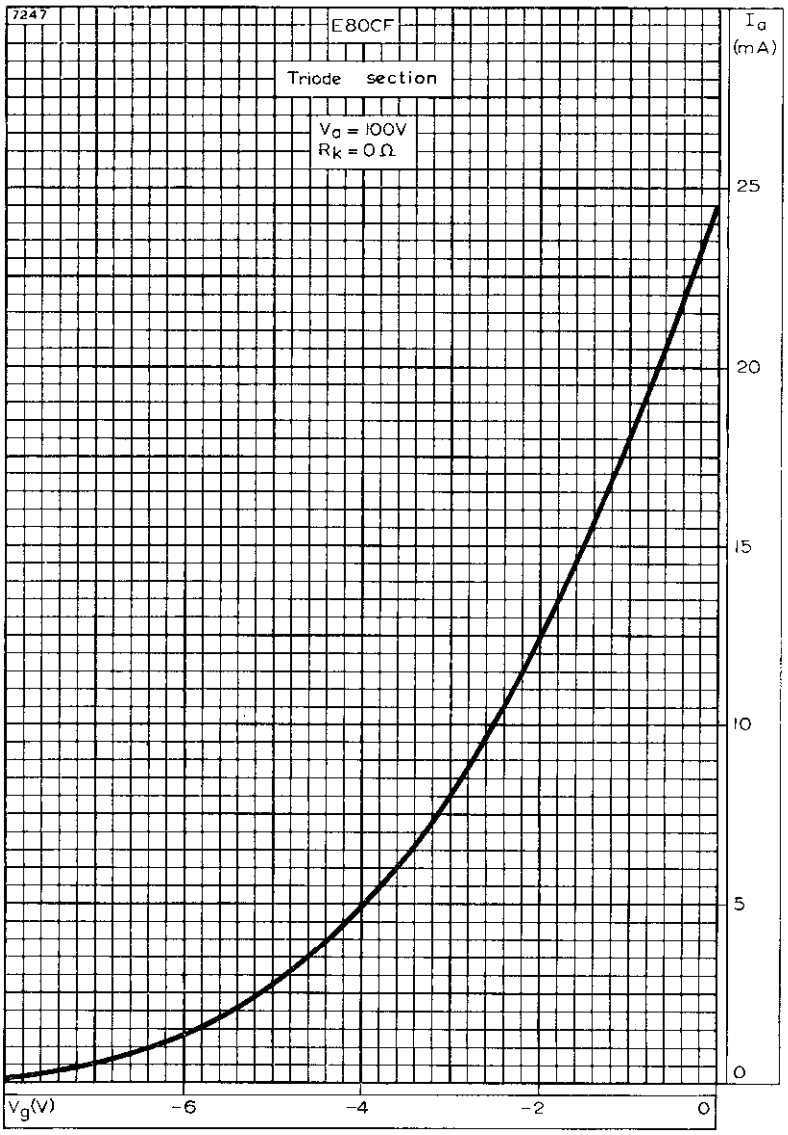


All dimensions in mm

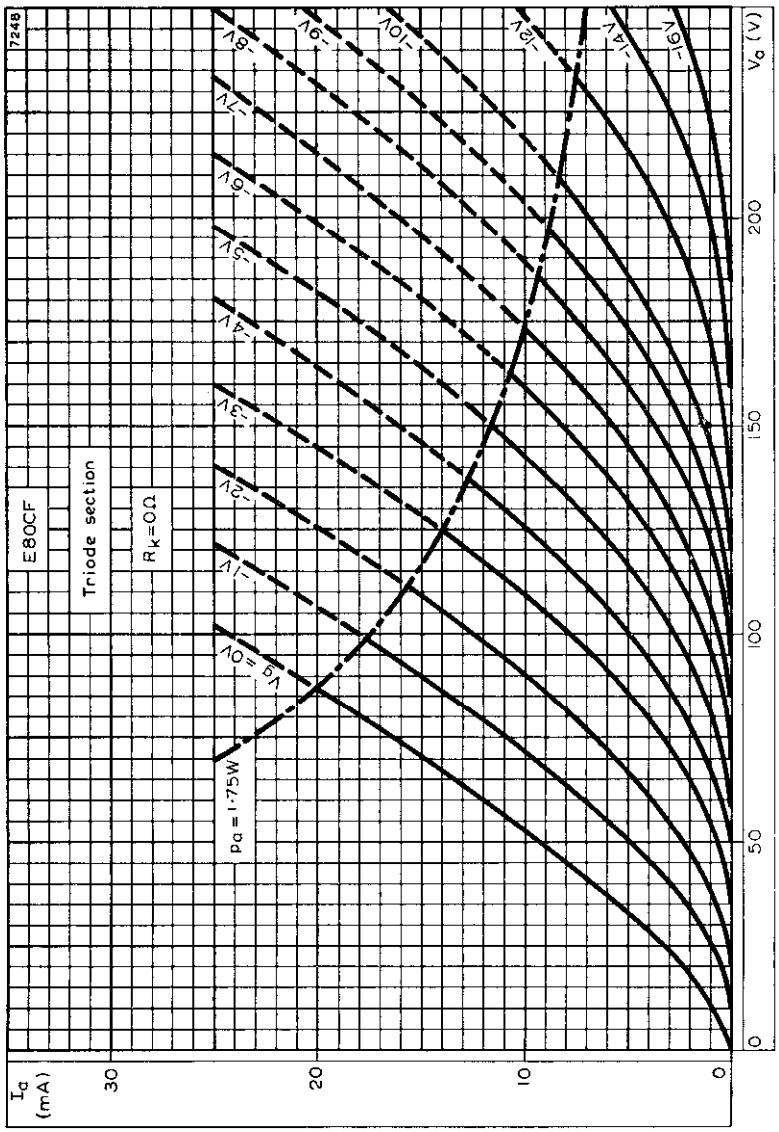


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE FOR PENTODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

E80CF SPECIAL QUALITY TRIODE PENTODE

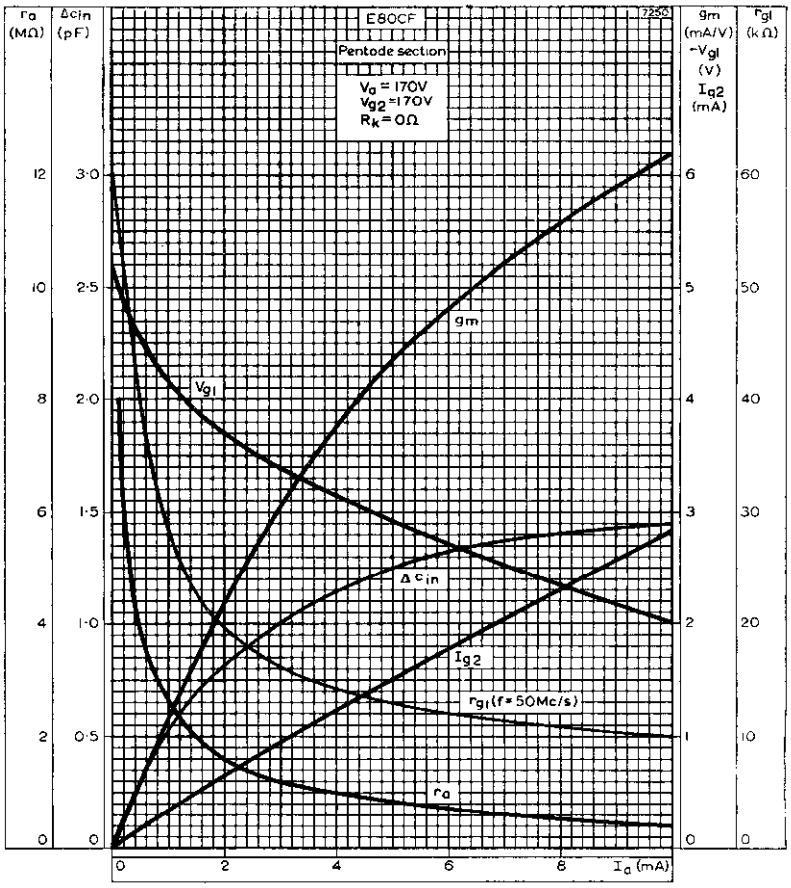


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE FOR TRIODE SECTION

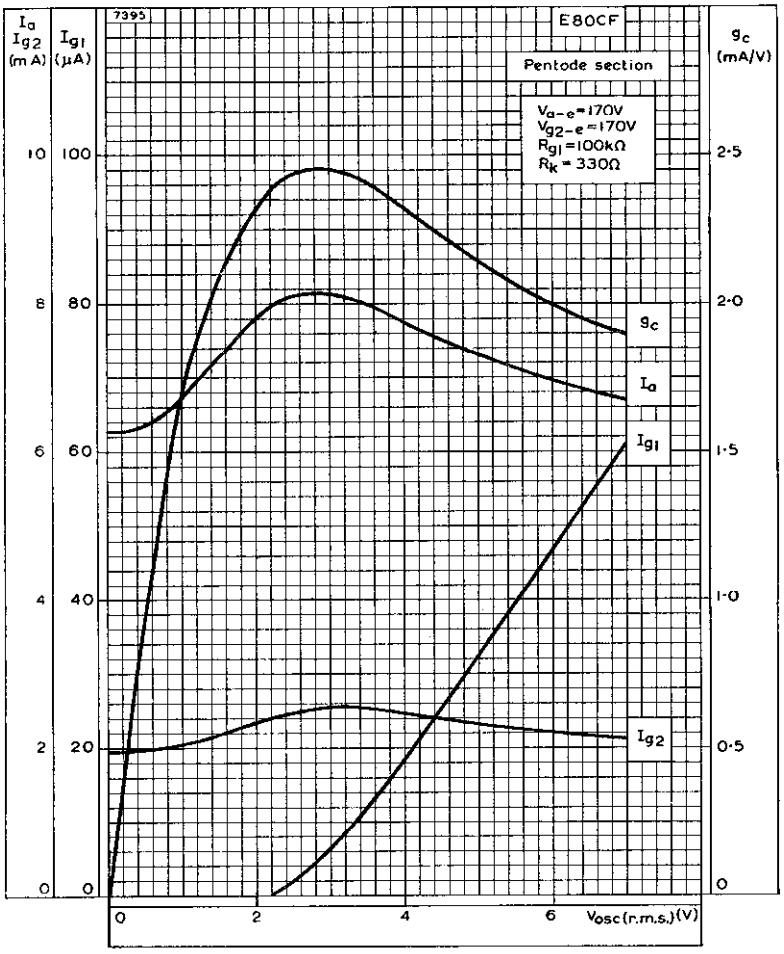


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR TRIODE SECTION WITH GRID VOLTAGE AS PARAMETER

E80CF SPECIAL QUALITY TRIODE PENTODE

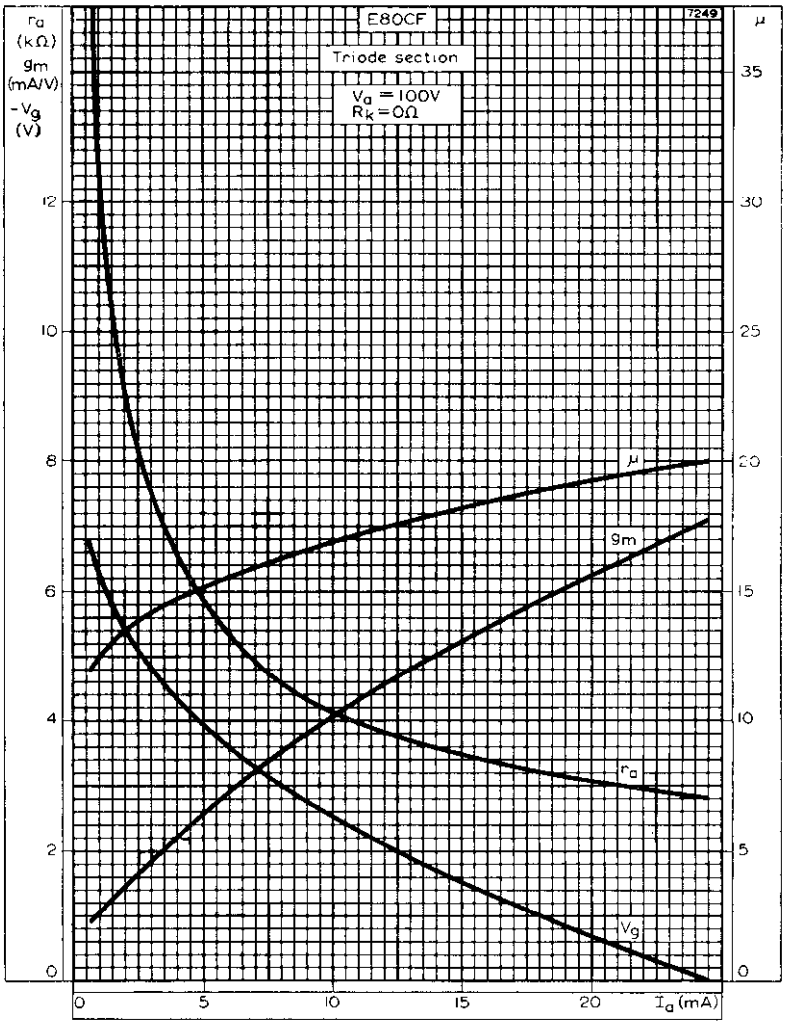


ANODE IMPEDANCE, CHANGE IN INPUT CAPACITANCE, MUTUAL CONDUCTANCE, CONTROL-GRID VOLTAGE, SCREEN-GRID CURRENT AND INPUT RESISTANCE PLOTTED AGAINST ANODE CURRENT FOR PENTODE SECTION



PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

E80CF SPECIAL QUALITY TRIODE PENTODE



ANODE IMPEDANCE, MUTUAL CONDUCTANCE, GRID VOLTAGE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT FOR TRIODE SECTION

SPECIAL QUALITY TRIODE

E88C

Special quality U.H.F. triode for use as a grounded grid r.f. amplifier or mixer at frequencies up to 1000Mc/s where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	155	mA

CAPACITANCES[2]

	Min.	*Av.*	*Max.*	
Unshielded				
c_{a-g}	0.9	1.1	1.3	pF
Shielded (shield connected to grid)				
c_{a-g+s}	1.4	1.7	2.0	pF
$c_{k+h-g+s}$	3.2	3.8	4.4	pF
c_{a-k+h}	35	50	65	mpF

CHARACTERISTICS[3]

V_a	160	V
I_a	12.5	mA
V_g	−1.25	V
g_m	13.5	mA/V
μ	70	
r_a	5.2	kΩ
$-V_g$ max. ($I_g = +0.3\mu A$)	1.3	V

OPERATING CONDITIONS

Grounded-grid r.f. amplifier

V_{a-c}	160	170	V
V_{g-c}	0	+9.0	V
R_k	100	820	Ω
I_a	12.5	12.5	mA
g_m	13.5	13.5	mA/V
R_{eq} (r.f.)	240	—	Ω
N.F. (f = 850Mc/s)	10	—	dB

E88C

SPECIAL QUALITY TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN←

	Min.	Av.	Max.	
Anode current				
V_{a-e} = 170V, V_{g-e} = 9V, R_k = 820Ω	—	12.5	—	mA
V_{a-e} = 160V, V_{g-e} = 0V, R_k = 100Ω	9.5	12.5	16.1	mA
Mutual conductance				
V_{a-e} = 170V, V_{g-e} = 9V, R_k = 820Ω	10.5	13.5	16.5	mA/V
V_{a-e} = 160V, V_{g-e} = 0V, R_k = 100Ω	—	13.5	—	mA/V
Negative grid current				
V_{a-e} = 160V, V_{g-e} = 0V, R_k = 100Ω	—	—	0.1	μA
Heater-cathode insulation				
V_{h-k} = 125V	—	—	15	μA
Heater current				
V_h = 6.3V	147	155	163	mA

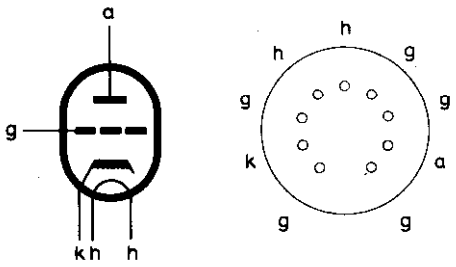
SHOCK AND VIBRATION ←

The E88C can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

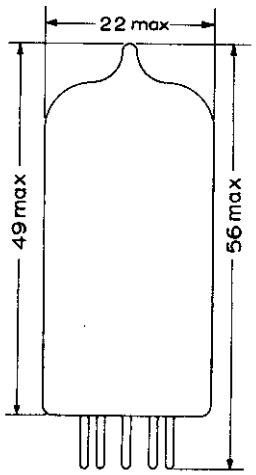
ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	400	V
V_a max.	200	V
p_a max.	2.6	W ←
$-V_{g1}$ max.	50	V
I_k max.	16.5	mA ←
R_{g-k} max.	0.5	MΩ
V_{h-k} max. (k positive)	125	V
V_{h-k} max. (k negative)	60	V
T_{bulb} max.	170	°C
V_h max.	6.6	V
V_h min.	6.0	V

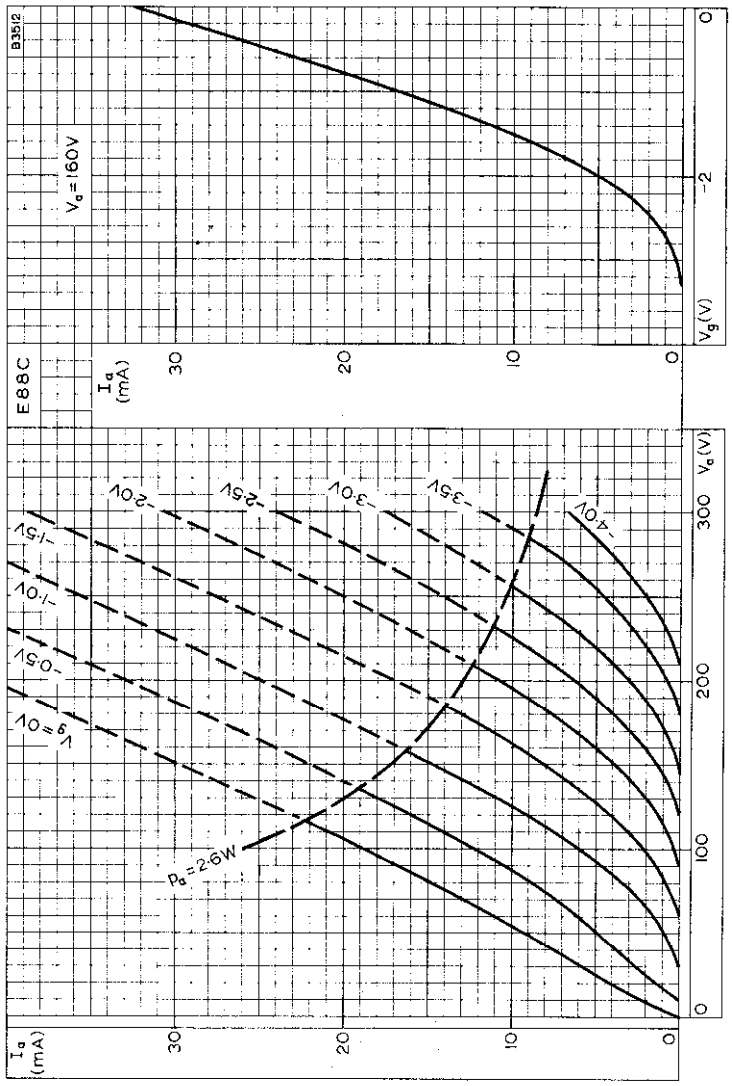
B38I



B9A Base



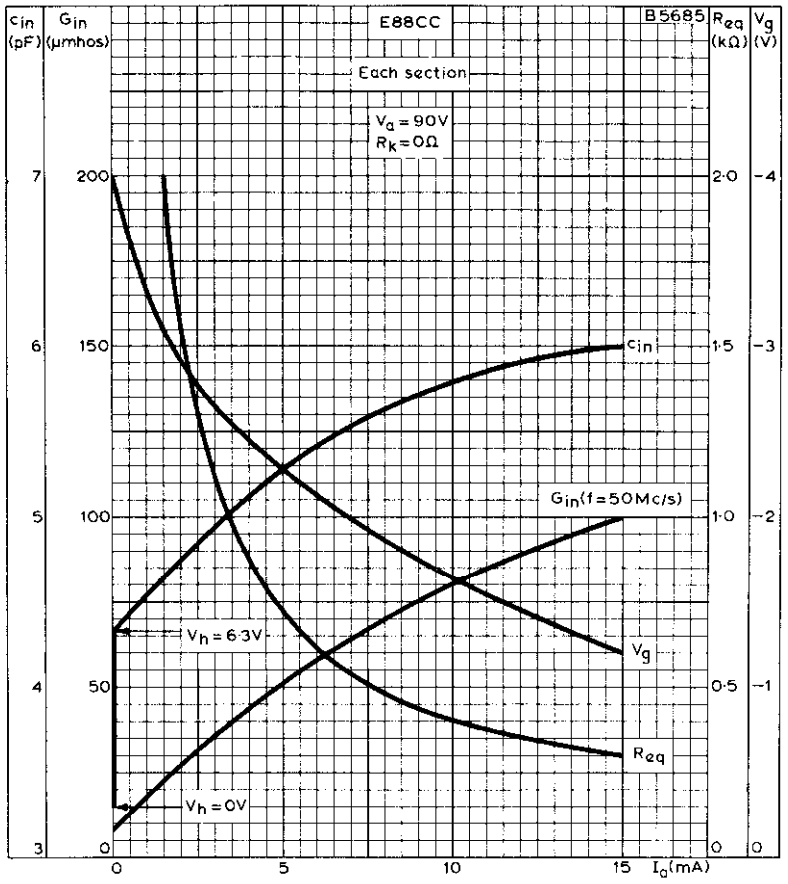
All dimensions in mm



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE AT V_a = 160V.
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY
DOUBLE TRIODE

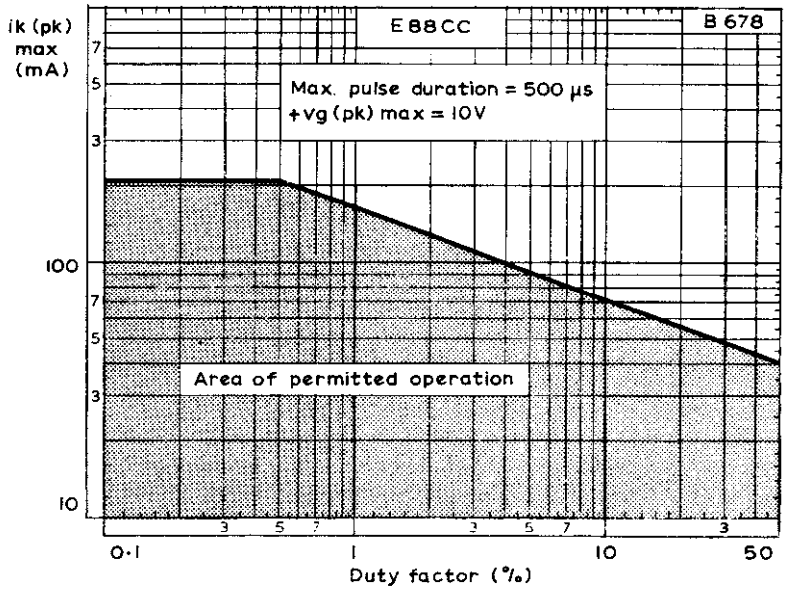
E88CC



INPUT CAPACITANCE, INPUT CONDUCTANCE, EQUIVALENT NOISE RESISTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT.

E88CC

SPECIAL QUALITY
DOUBLE TRIODE



PULSE RATING CHART

Negative grid voltage V_a = 150V, I_a = 100μA	6.5	5.0 to 8.5	—	V
Grid voltage difference (between sections) $V_{a'} = V_{a''}$ = 150V, $I_{a'} = I_{a''}$ = 100μA	—	< 2.0	< 2.0	V
Insulation resistance (between any two electrodes) $V_{d.c.}$ = 200V	—	> 100	> 20	MΩ
Heater-cathode insulation (I_{h-k}) V_{h-k} (120V k positive) (60V k negative)	—	< 6.0	< 12	μA
Heater current V_h = 6.3V	300	285 to 315	285 to 315	mA

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

SHOCK AND VIBRATION

The E88CC can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

DESIGN CENTRE RATINGS[4] (unless otherwise stated) each section

$V_{a(b)}$ max.	400	V
V_a max.	220	V
V_a max. (p_a < 800mW)	250	V
p_a max.	1.5	W
p_a max. ($p_{a'}+p_{a''}$ < 2W)	1.8	W
$p_{a'}+p_{a''}$ max.	3.0	W
p_g max.	30	mW
$-V_g$ max.	100	V
$-v_{g(pk)}$ max.	200	V
I_k max.	20	mA
*$i_{k(pk)}$ max.	100	mA
V_{h-k} max. (k positive)	150	V
(k negative)	100	V
**R_{g-k} max.	1.0	MΩ
T_{bulb} max. (absolute)	170	°C
V_h max. (absolute)	6.6	V
V_h min. (absolute)	6.0	V

*Maximum duty factor 0.1 maximum pulse duration = 200μs.

**Operation with fixed bias is only permitted for I_a < 5mA.

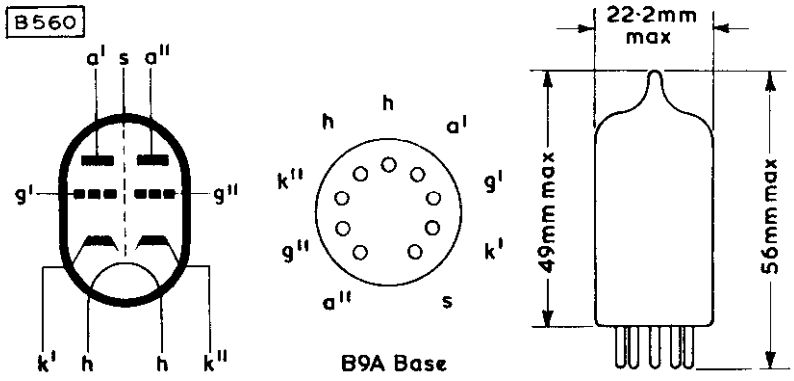
E88CC

SPECIAL QUALITY DOUBLE TRIODE

OPERATING NOTES

The hum voltage referred to g has a maximum value of 50μV and is measured with the centre tap of the heater winding earthed, at a supply frequency of 50c/s (including 3% at 500c/s), with a fully screened valve holder and a linear band-pass characteristic under the following conditions:

V_b	90	V
I_a	15	mA
R_k	80	Ω
C_k	1000	μF
R_{g-k}	500	kΩ



SPECIAL QUALITY PENTODE E180F

Special quality high slope r.f. pentode intended for general industrial applications where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES - SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

The maximum variation of heater current at V_h = 6.3V is ± 15 mA.

MOUNTING POSITION Any

CAPACITANCES (measured with an external shield)

	Minimum	Average	Maximum	
ca - g1	-	18	30	mpF
ca - k	-	-	100	mpF
* cin	6.6	7.5	8.4	pF
cin (I_k = 16.3 mA)	-	11.1	-	pF
* cout	2.5	3.0	3.5	pF
cg1 - h	-	-	0.1	pF

* Pin 6 is left floating during the capacitance measurements.

CHARACTERISTICS

	Pentode connected		Triode connected g2 to a, g3 to k		
Va	180	V	Va	150	V
Vg3	0	V	Vg1	- 1.25	V
Vg2	150	V	Ia	16.5	mA
Vg1	- 1.25	V	gm	21	mA/V
Ia	13	mA	μ	50	
Ig2	3.3	mA	ra	2.4	kΩ
gm	16.5	mA/V			
ra	90	kΩ			
μg1-g2	50				
- Vg1 max., (Ig1 = 0.3 μA)	500	mV			

OPERATING CONDITIONS AS R.F. AMPLIFIER

	Pentode connected			Triode connected		
Va - e	180	190	V	Va - e	160	V
Vg3 - k	0	0	V	Vg3	0	V
Vg2 - e	150	160	V	Vg1 - e	+ 9.0	V
Vg1 - e	0	+ 9.0	V	Rk	620	Ω
Rk	100	630	Ω	Ia	16.5	mA
Ia	11.5	13	mA	gm	21	mA/V
Ig2	2.9	3.3	mA	Req(r.f.)	225	Ω
gm	15.5	16.5	mA/V			
Vg1 max., (Ia=800μA)	- 4.5	-	V			
Req(r.f.)	-	460	Ω			
* rg1(f=50Mc/s)	-	6.0	kΩ			
* Øgm(f=50Mc/s)	-	9.0	deg			

* Cathode connections strapped together

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	Initial range	End of life*	
Anode current	13	12.2 to 13.8	11.5	mA

Va-e = 190V, Vg2-e = 160V

Vg1-e = +9V, Rk = 630Ω

SPECIAL QUALITY PENTODE E180F

	Average	Initial range	End of life*	
Screen-grid current Va-e=190V, Vg2-e=160V Vg1-e=+9V, Rk = 630Ω	3.3	2.9 to 3.7	-	mA
Mutual conductance Va-e=190V, Vg2-e=160V Vg1-e=+9V, Rk = 630Ω	16.5	14.2 to 18.8	11	mA/V
Negative control-grid current Va-e=190V, Vg2-e=160V Vg1-e=+9V, Rk = 78Ω Rg1-k = 100 kΩ	-	< 0.5	< 1.0	μA
Insulation resistance Between any two electrodes Vd.c.=100V	-	> 20	-	MΩ
Heater cathode insulation Vh-k = 60V	-	> 4.0	-	MΩ
Heater current	300	285 to 315	285 to 315	mA

* To allow for valve deterioration during life, circuits should be designed to function with a valve on which one or more of the characteristics have changed to the values stated.

SHOCK AND VIBRATION RATINGS

The E180F can withstand vibrations of 2.5 g and 50 c/s for 96 hours and is proof against impact accelerations of approximately 300 g.

ABSOLUTE MAXIMUM RATINGS[4]

Va(b) max.	400	V
Va max.	210	V
pa max.	3.0	W
Vg2 (b) max.	400	V
Vg2 max.	175	V
pg2 max.	0.9	W

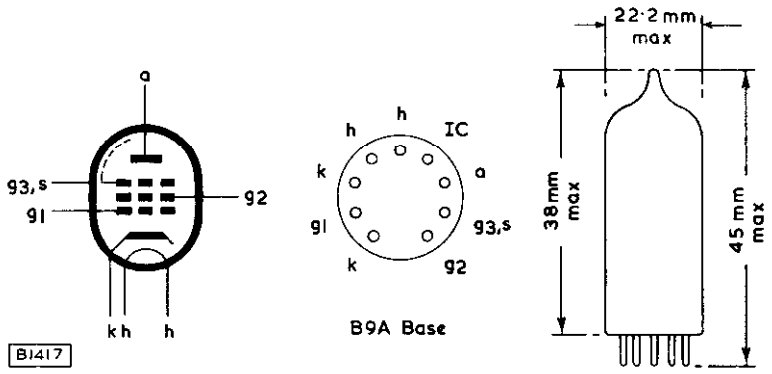
Ik max.	25	mA
+ Vg1 max.	0	V
- Vg1 max.	50	V
- vg1 (pk) max.	100	V
Rg1-k max. (fixed bias)	250	kΩ
Vh-k max.	60	V
Rh-k max.	20	kΩ
Tbulb max.	155	°C
Vh min.	6.0	V
Vh max.	6.6	V

OPERATING NOTE

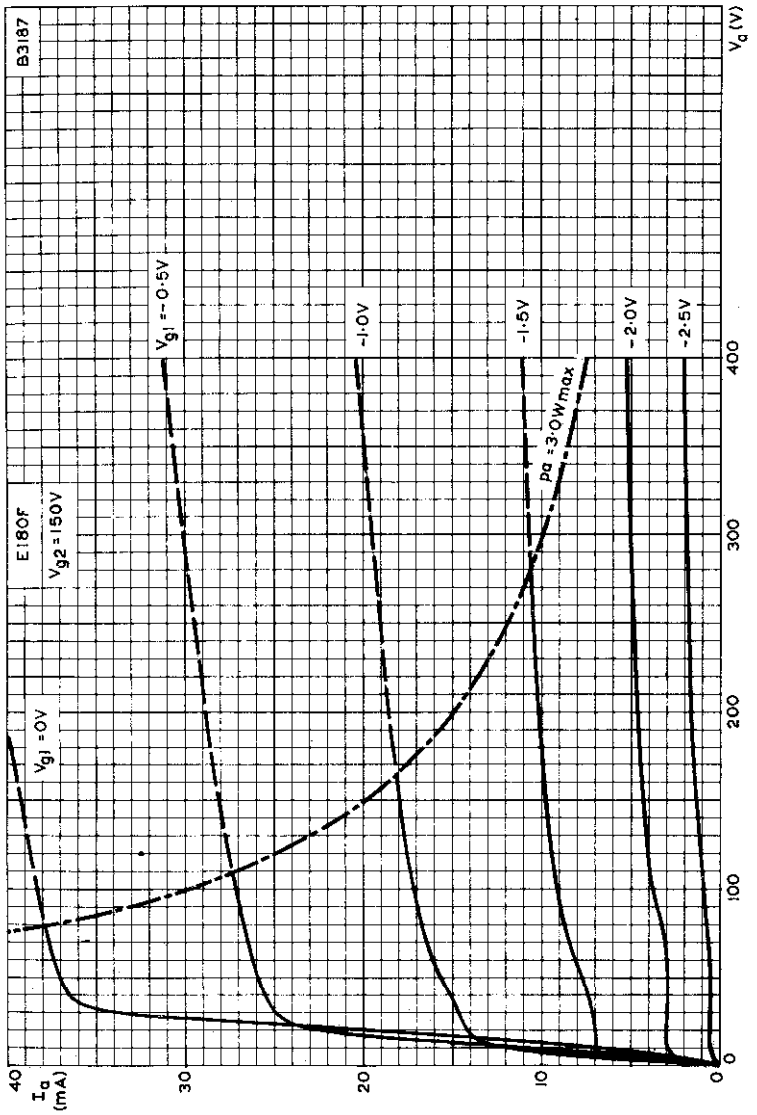
Hum

The hum voltage referred to g1 has a maximum value of 100 μV and is measured with centre tap of the heater winding earthed, a supply frequency of 50 c/s (including 3 % at 500 c/s) and a linear band-pass characteristic under the following conditions.

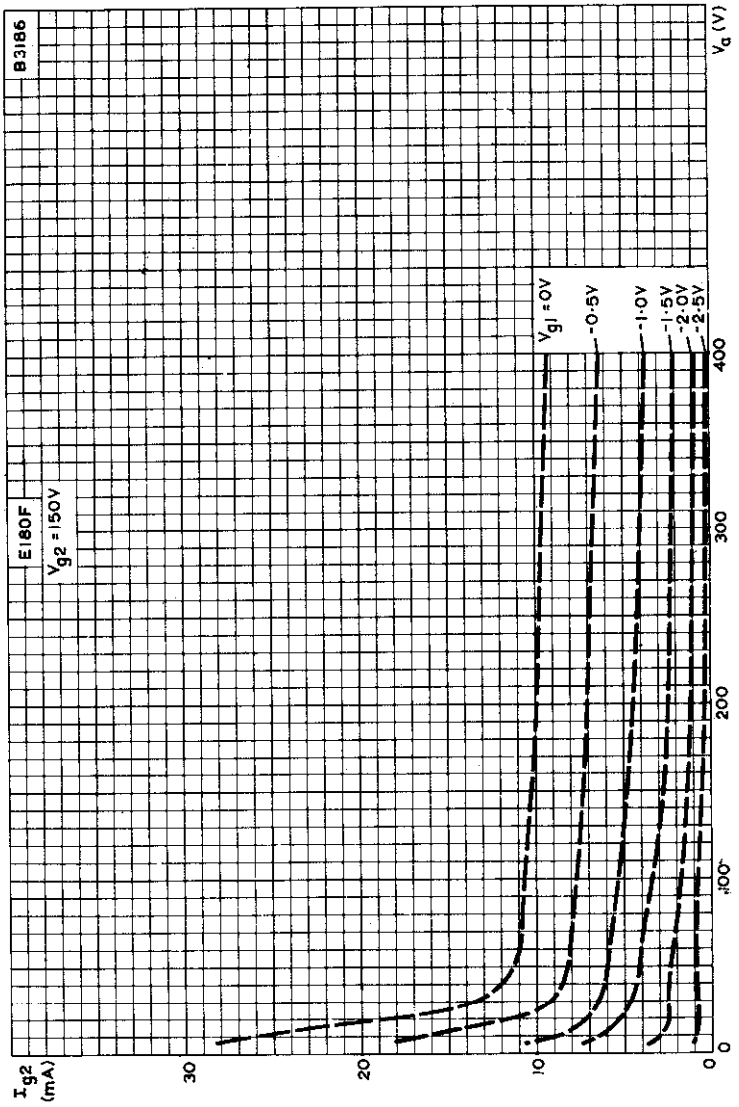
Vh	6.3	V
Ck	1000	μF
Rg1-k	500	kΩ



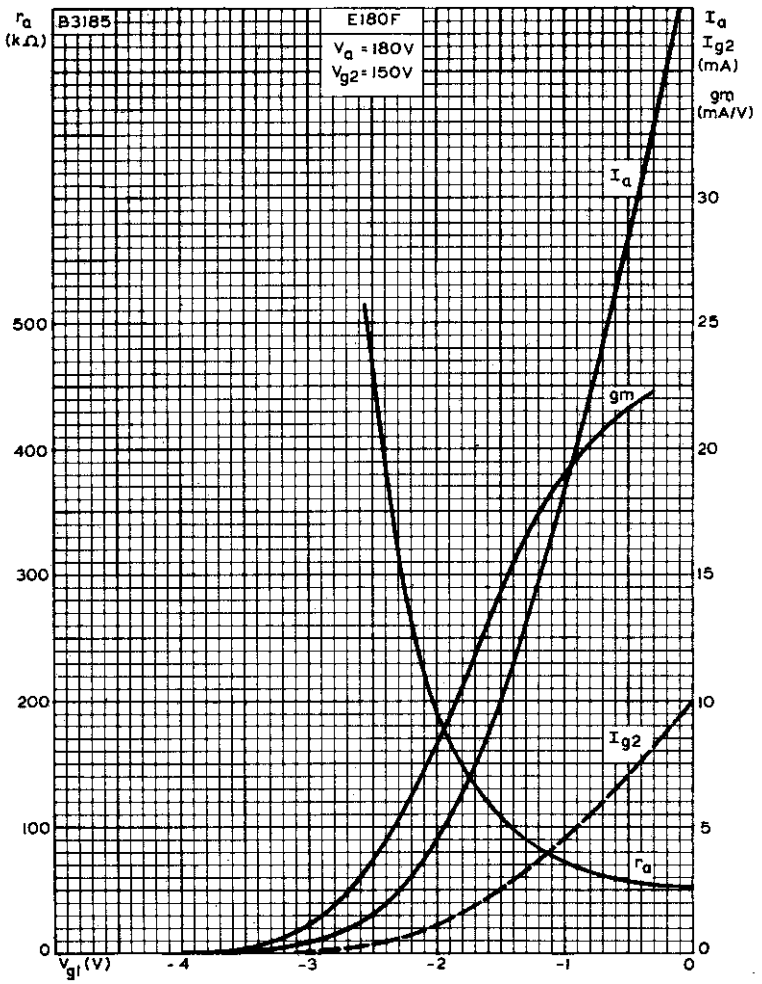
SPECIAL QUALITY PENTODE E180F



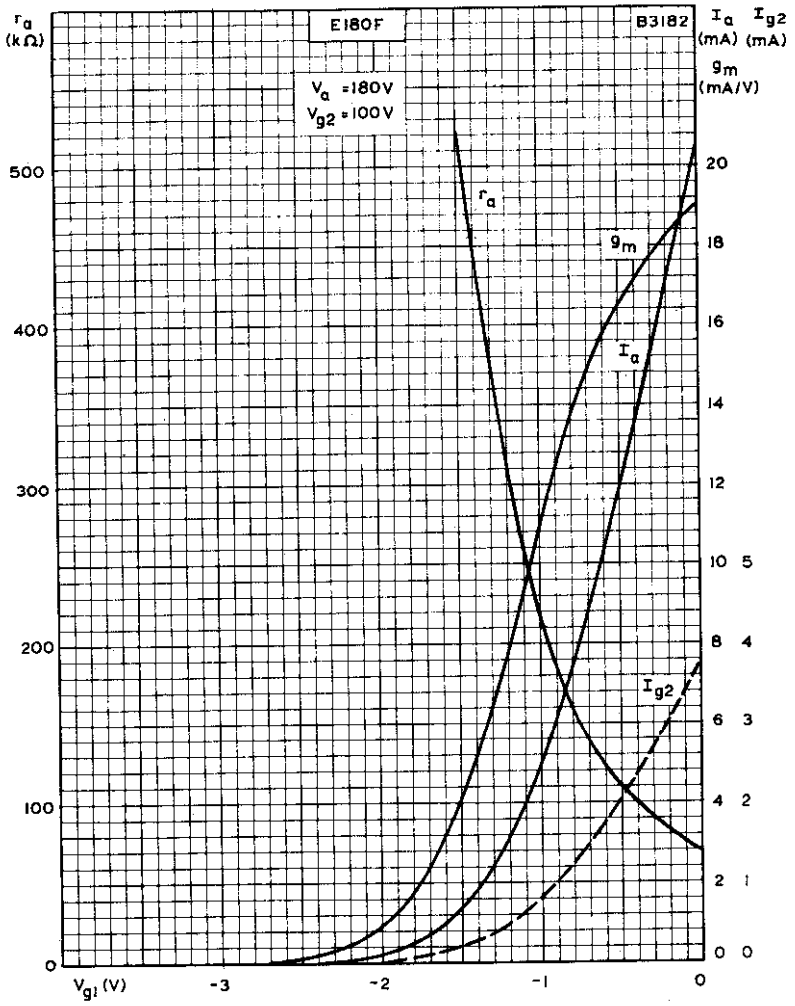
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 150V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 150V



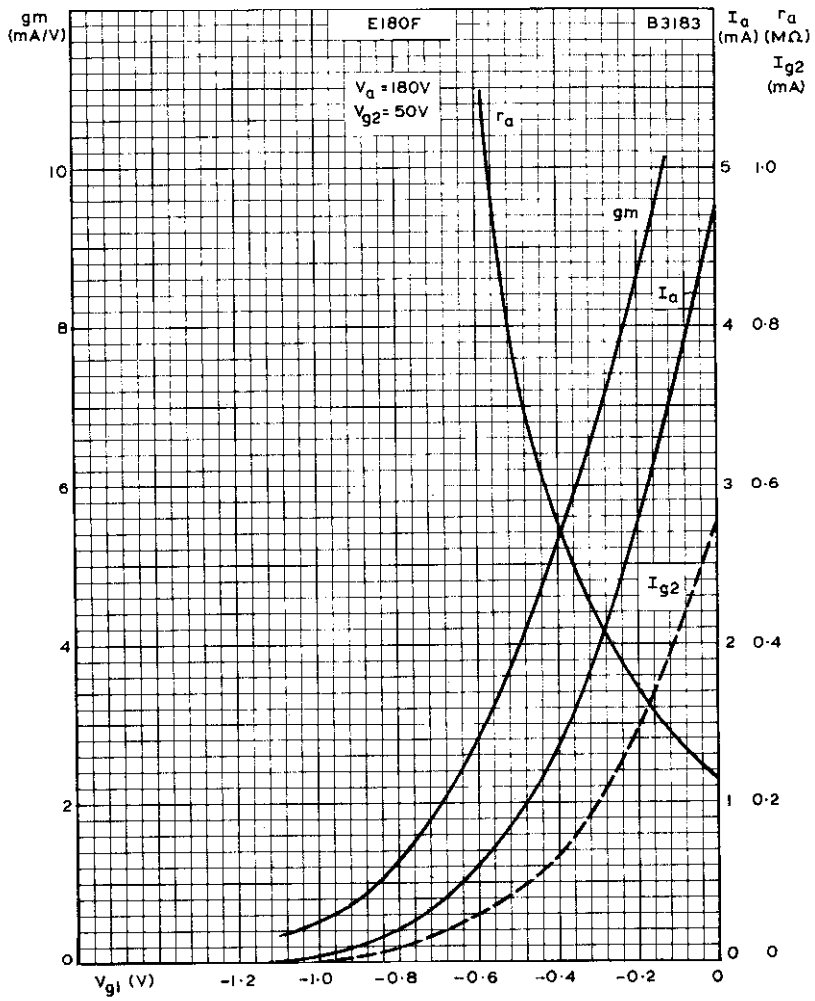
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Va = 180V, Vg2 = 150V.



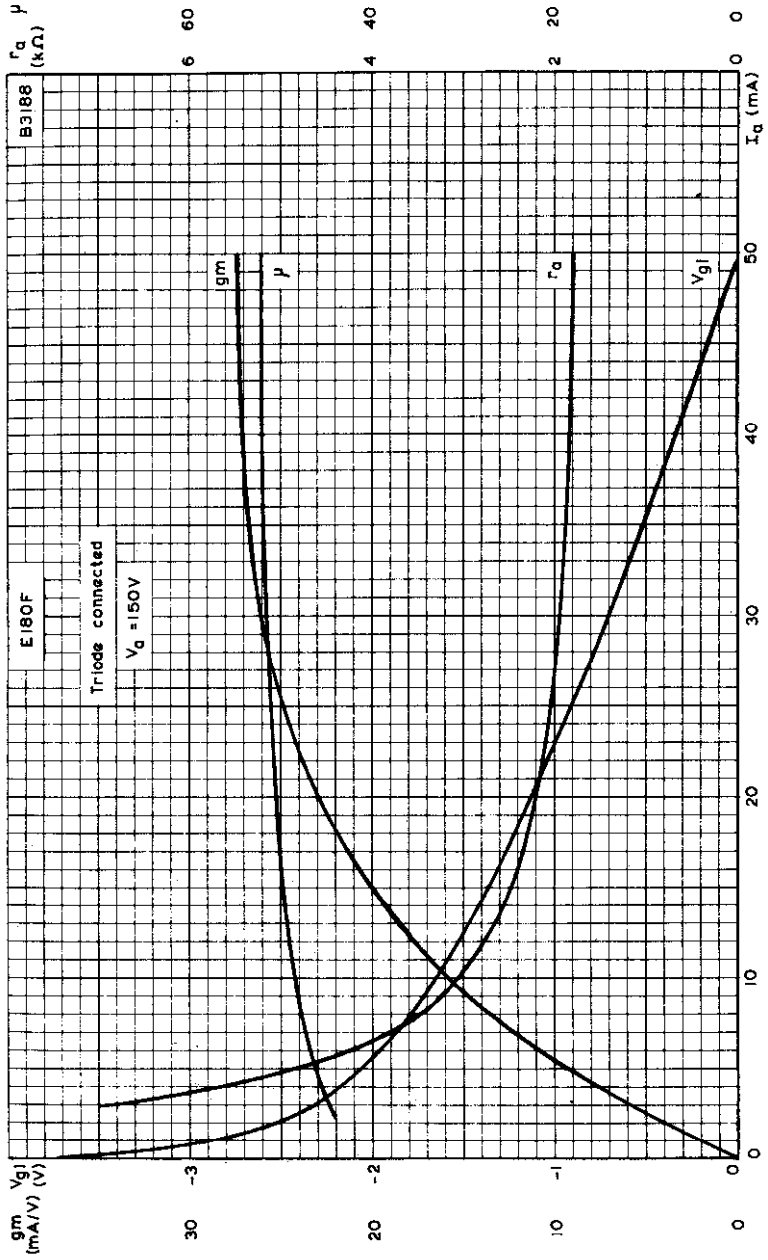
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST COLTROL-GRID VOLTAGE.

Va = 180V, Vg2 = 100V

SPECIAL QUALITY PENTODE E180F

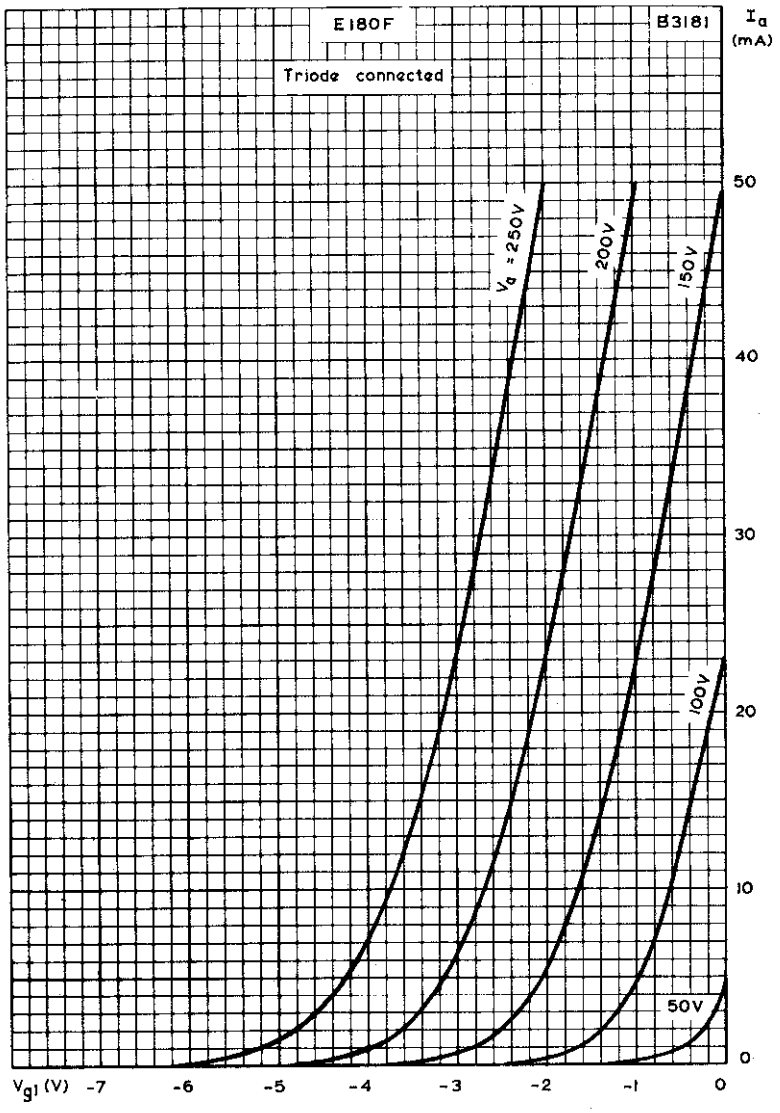


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Va = 180V, Vg2 = 50V

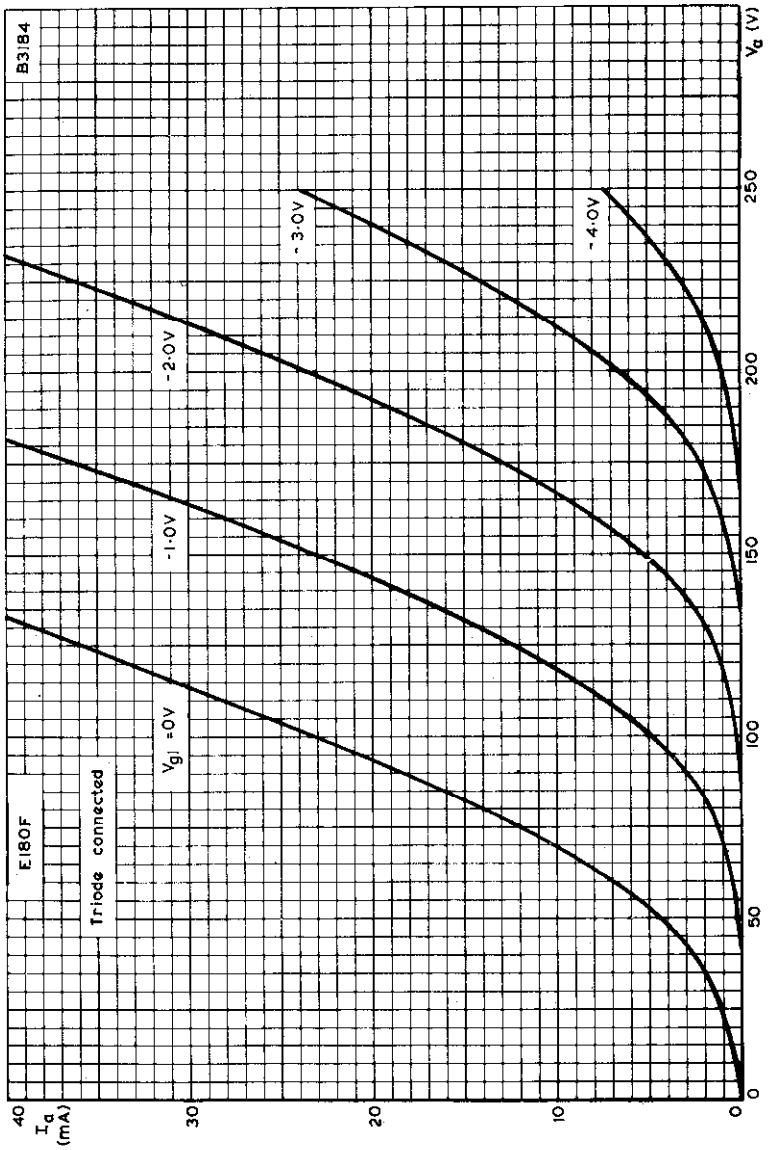


MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR, ANODE IMPEDANCE, AND CONTROL-GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT TRIODE CONNECTED.

SPECIAL QUALITY PENTODE E180F



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



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

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F

Special quality high slope pentode designed for use in industrial equipment where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES - SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h [1]	6.3	V
I_h	340	mA

The maximum variation of heater current at 6.3V is ±20mA.

CAPACITANCES[2]

Heptode connected

Shielded	Min.	Av.	Max.	
c_{a-g1}	-	-	32	mpF
c_{in}	13	14.5	16	pF
$c_{in(w)}$ (I_k = 40mA)	22	24	26	pF
c_{out}	3.9	4.1	4.3	pF
c_{a-k}	26	33	40	mpF
c_{g1-h}	35	55	75	mpF
c_{a-h}	12	20	28	mpF
c_{h-k}	4.2	5.2	6.2	pF
Unshielded				
c_{a-g1}	-	-	36	mpF
c_{in}	13	14.5	16	pF
$c_{in(w)}$ (I_k = 40mA)	22	24	26	pF
c_{out}	3.2	3.5	3.8	pF
c_{a-k}	53	60	67	mpF
c_{g1-h}	40	60	80	mpF
c_{a-h}	26	31	36	mpF

Triode connected

	Unshielded	Shielded	
c_{in}	10	10	pF
c_{out}	7.2	8.2	pF
c_{a-g}	4.7	4.6	pF

CHARACTERISTICS[3]

Pentode connected

V_a	120	V
V_{g3}	0	V
V_{g2}	150	V
V_{g1}	-1.9	V
R_k	0	Ω
I_a	35	mA
I_{g2}	5.0	mA
g_m	50	mA/V
r_a	42	kΩ
μ_{g1-g2}	57	
r_{g1} (f = 100MHz)	420	Ω
R_{eq} (f = 40MHz)	110	Ω

Triode connected (g_2 to a, g_3 to k)

V_a	150	V
V_{g1}	-2	V
I_a	35	mA
g_m	53	mA/V
r_a	1.1	kΩ ←
μ	57	

CHARACTERISTIC RANGE VALUE FOR EQUIPMENT DESIGN

	Average	Initial range	End of Life*	
Anode current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = 0V, R_k = 47Ω	35	31 to 39	25	mA
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	35	34 to 36	-	mA
Screen-grid current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	5	4.4 to 5.6	-	mA
Mutual conductance				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	50	42 to 58	35	mA/V
Negative control-grid current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	-	<0.1	<0.2	μA

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F

Insulation

	Initial Range	End of Life	
Between heater and cathode measured at V_{h-k} = 100V			
Leakage current	<10	<20	μA
Between any two arbitrary electrodes except k-g1 measured at 250V	>100	>40	MΩ

OPERATING CONDITIONS

V_{a-e}	135	V
V_{g3-e}	0	V
V_{g2-e}	165	V
V_{g1-e}	+12.5	V
R_k	360	Ω
I_a	35	mA
I_{g2}	5.0	mA
g_m	50	mA/V

SHOCK AND VIBRATION

The E810F can withstand vibrations of 2.5g at 50Hz for 32 hours and is proof against impact accelerations of approximately 500g.[4]

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$V_{a(b)}$ max.	400	V
V_a max.	250	V
p_a max.	5.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	200	V
p_{g2} max.	1.0	W
$-v_{g1(pk)}$ max.	50	V
$-V_{g1}$ max.	25	V
$+V_{g1}$ max.	0	V
*I_k max.	50	mA
R_{g1-k} max.	200	kΩ
V_{h-k} max.	100	V
*T_{bulb} max.	200	°C

*In applications where a long life is not required, I_k max. can be increased to 65mA and T_{bulb} max. to 220°C.

OPERATING NOTES

1. Hum

The hum referred to g_1 has a maximum value of 150μVr.m.s. measured under the following conditions:

V_h (centre tap earthed)	6.3	V
V_{a-k}	120	V
V_{g2-k}	150	V
V_{g3-k}	0	V
R_{g1-k}	500	kΩ
R_k	47	Ω
C_k	1000	pF

2. Microphony

The microphonic noise voltage has a maximum value of 25mVr.m.s. at 50Hz and a maximum value of 500mVr.m.s. over the frequency range 50 to 2000Hz measured at the anode, under the following conditions:

V_h	6.3	V
$V_{a(b)}$	155	V
V_{g2-e}	160	V
V_{g3-k}	0	V
V_{g1-e}	+7	V
R_a	680	Ω
R_k	220	Ω
C_k	0	μF
peak acceleration	10	g

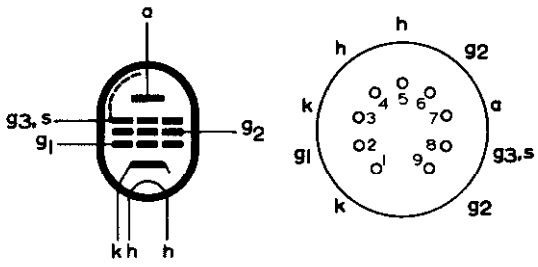
3. Distortion

The average value of harmonic distortion is 7.5% when $i_{a(pk)}$ = 40mA measured under the following conditions:

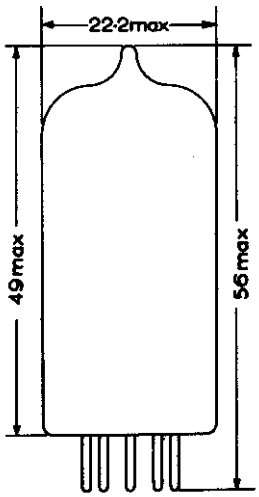
V_h	6.3	V
$V_{a(b)}$	155	V
V_{g2-e}	165	V
V_{g3-k}	0	V
V_{g1-e}	+12.5	V
I_a	35	mA
R_a	560	Ω
R_k	360	Ω
C_k	1000	μF

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F



B9A Base



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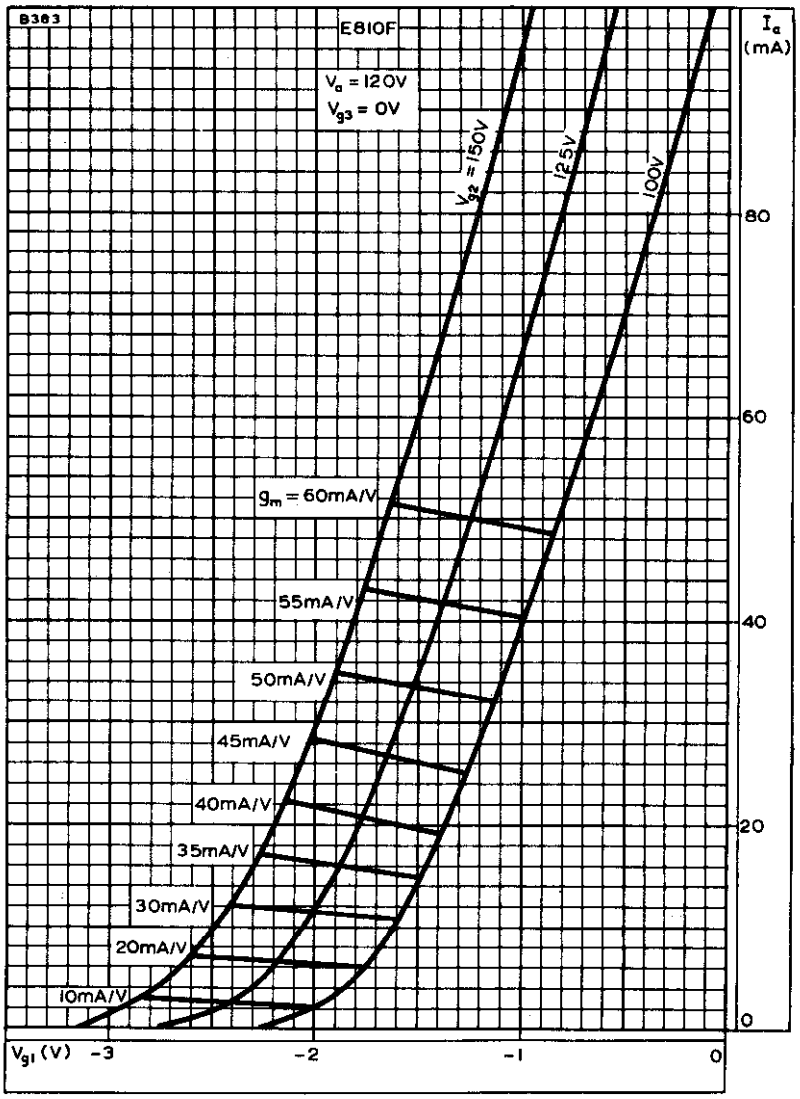
All dimensions in mm

SPECIAL QUALITY
WIDEBAND R.F. PENTODE

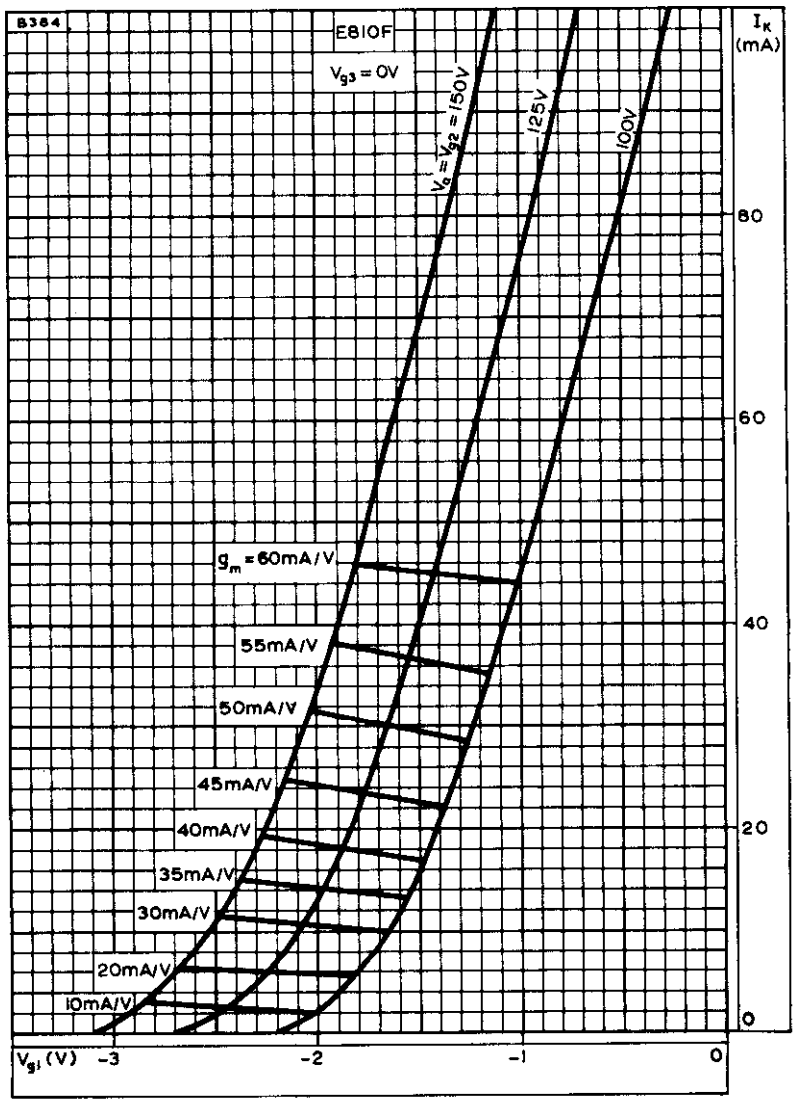
E810F



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

E810F

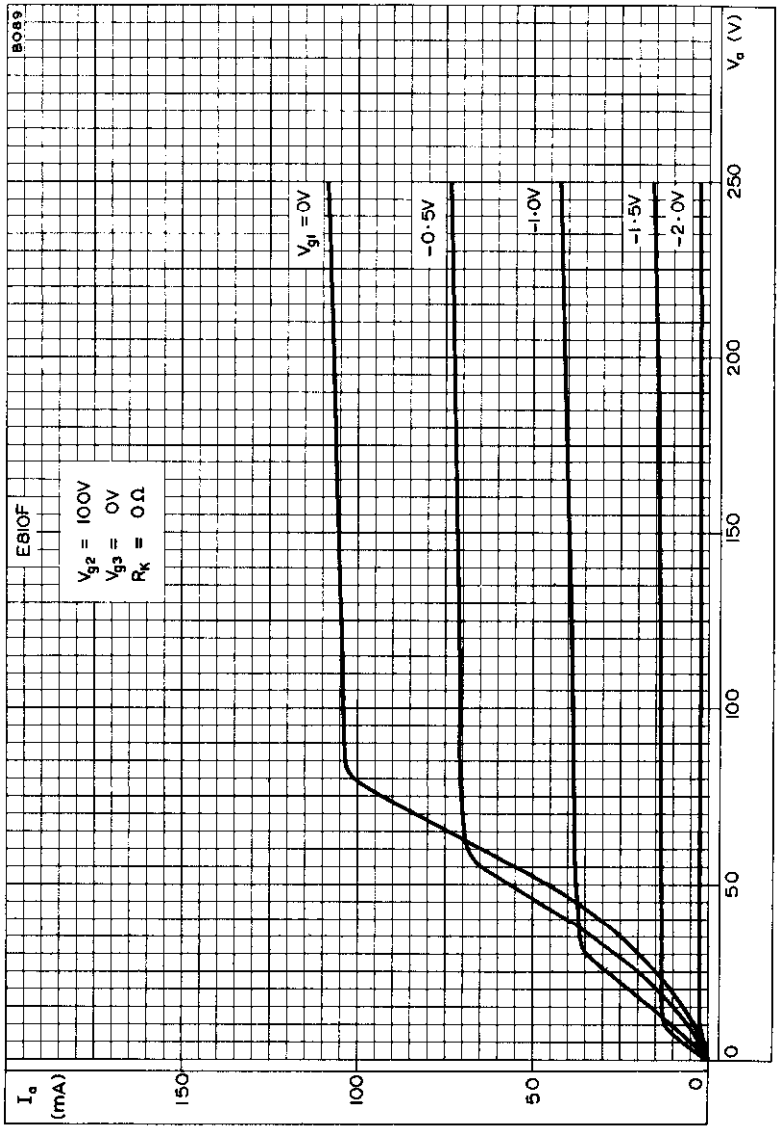
SPECIAL QUALITY WIDEBAND R.F. PENTODE



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

SPECIAL QUALITY
WIDEBAND R.F. PENTODE

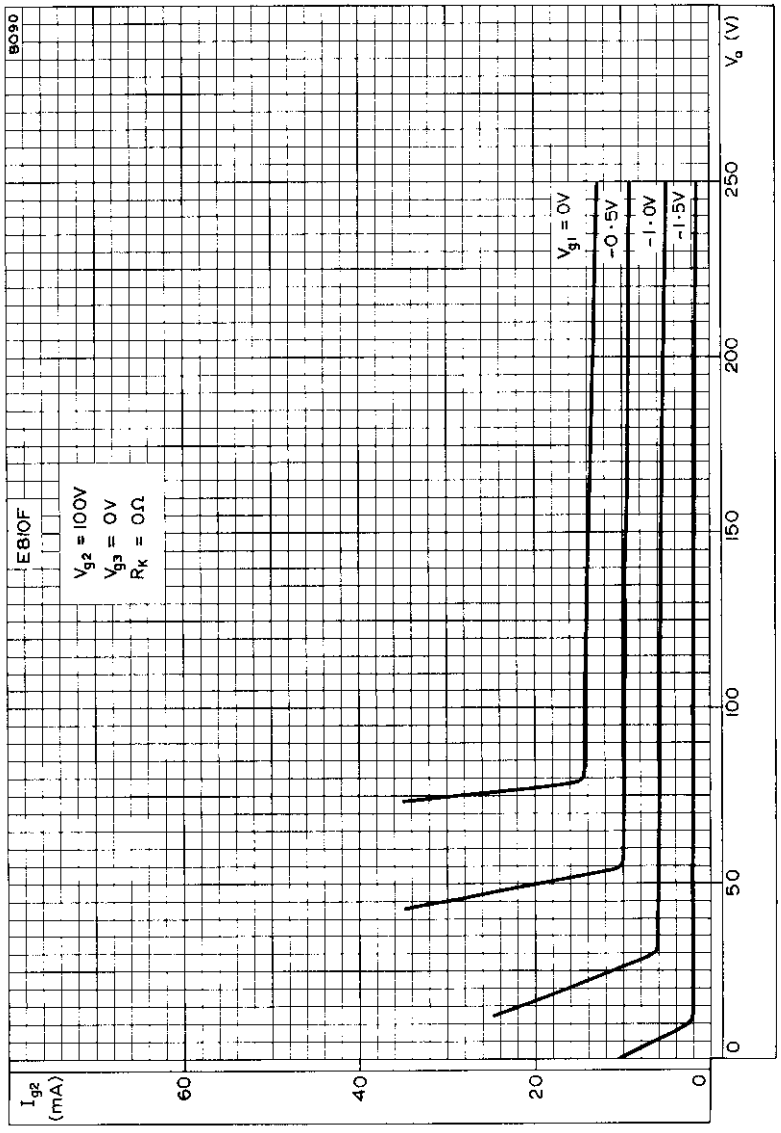
E810F



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

E810F

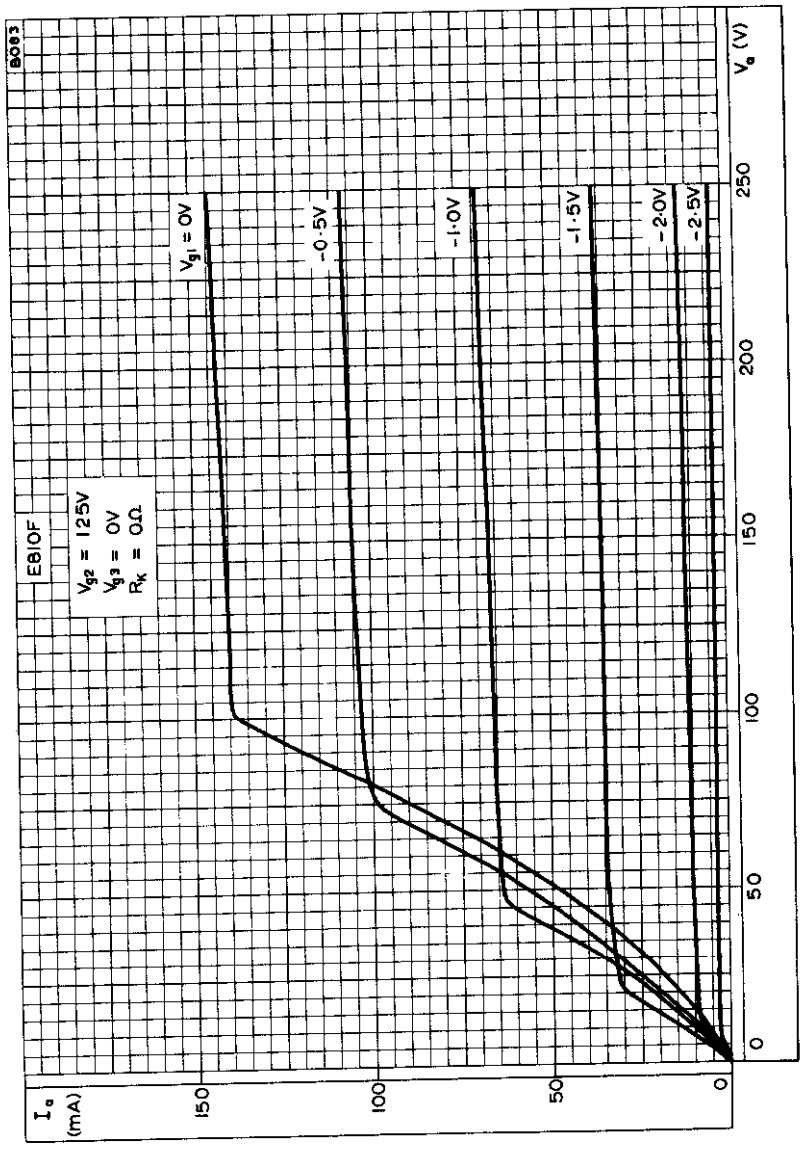
SPECIAL QUALITY WIDEBAND R.F. PENTODE



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

SPECIAL QUALITY
WIDEBAND R.F. PENTODE

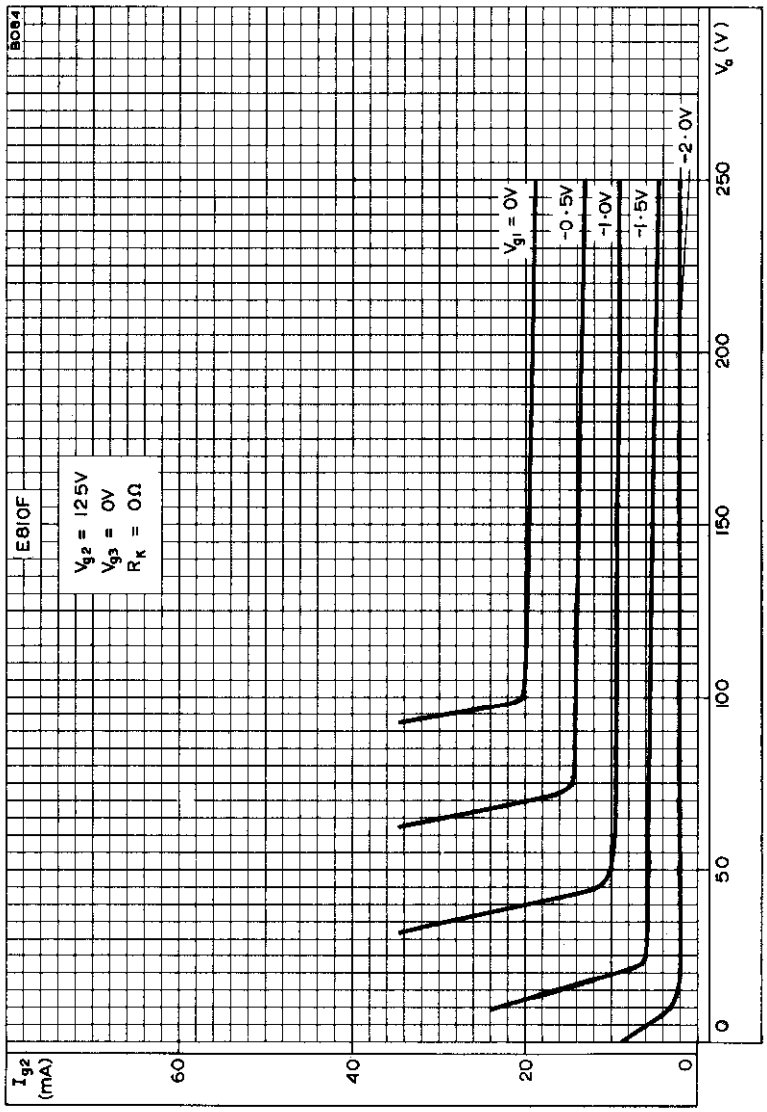
E810F



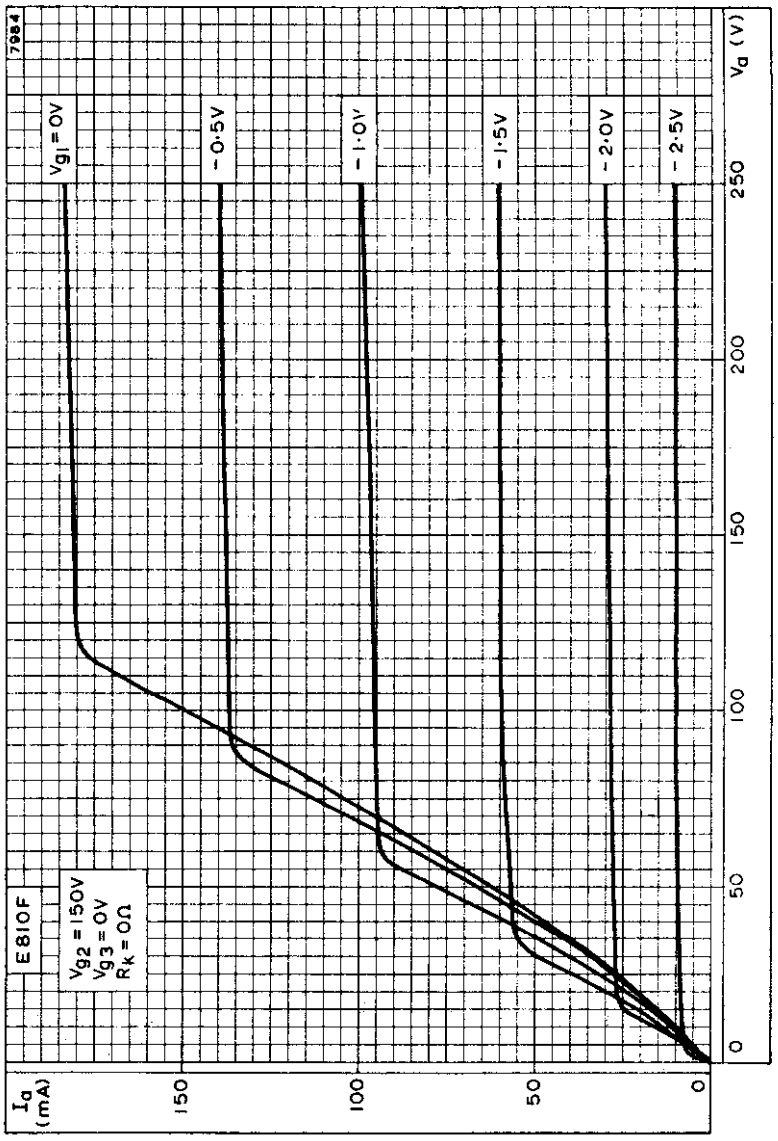
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 125V

E810F

SPECIAL QUALITY WIDEBAND R.F. PENTODE



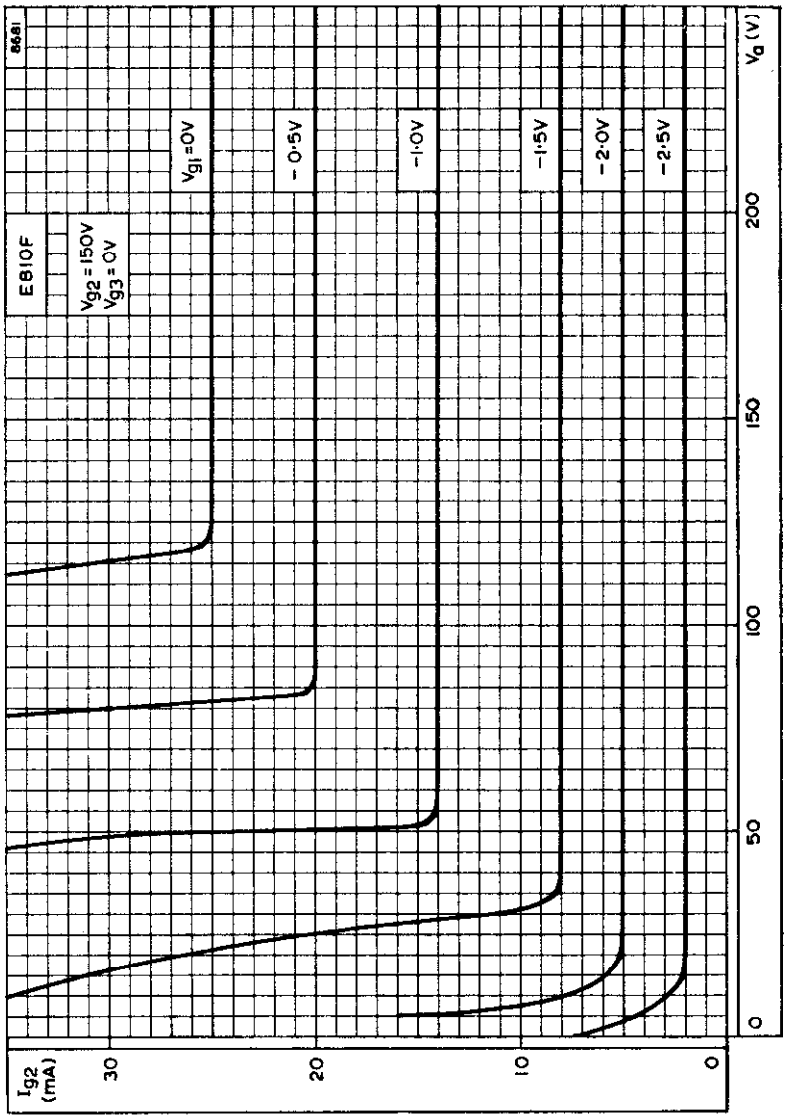
SCREEN GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 125V



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

E810F

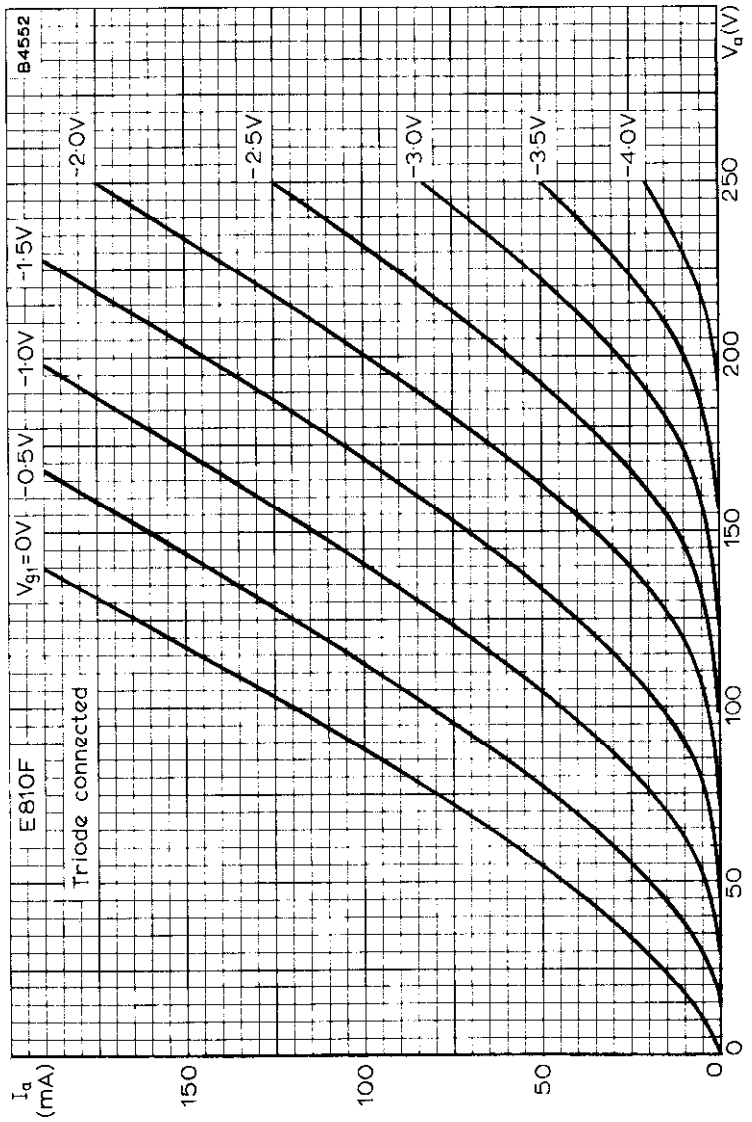
SPECIAL QUALITY WIDEBAND R.F. PENTODE



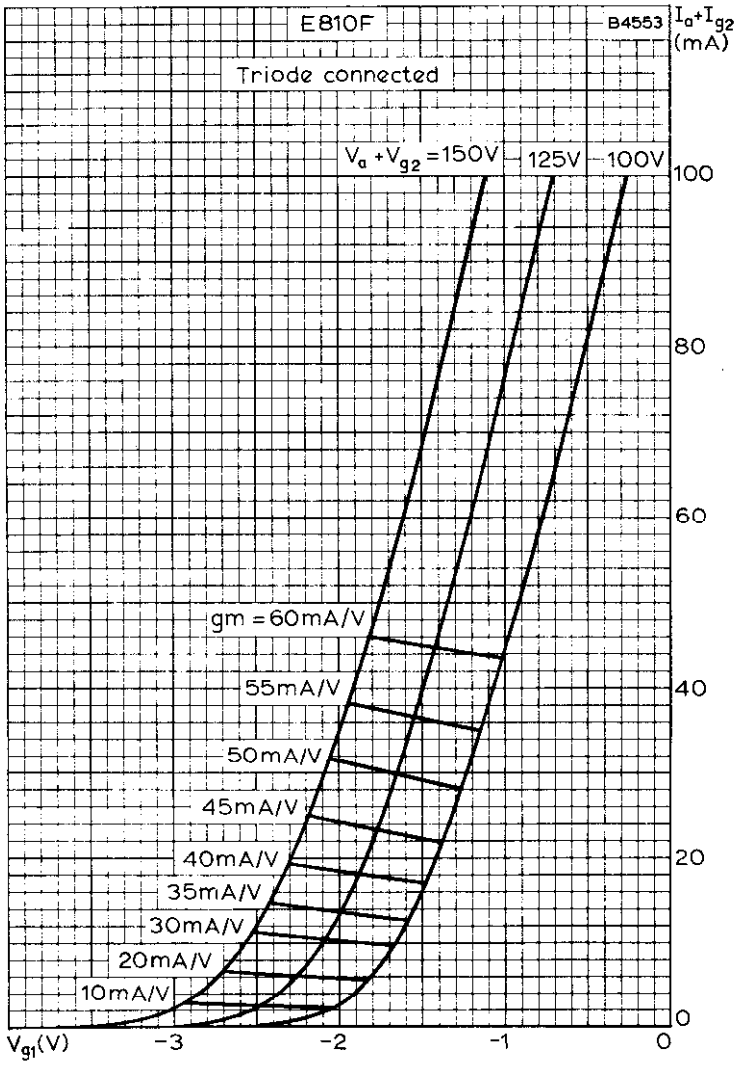
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F



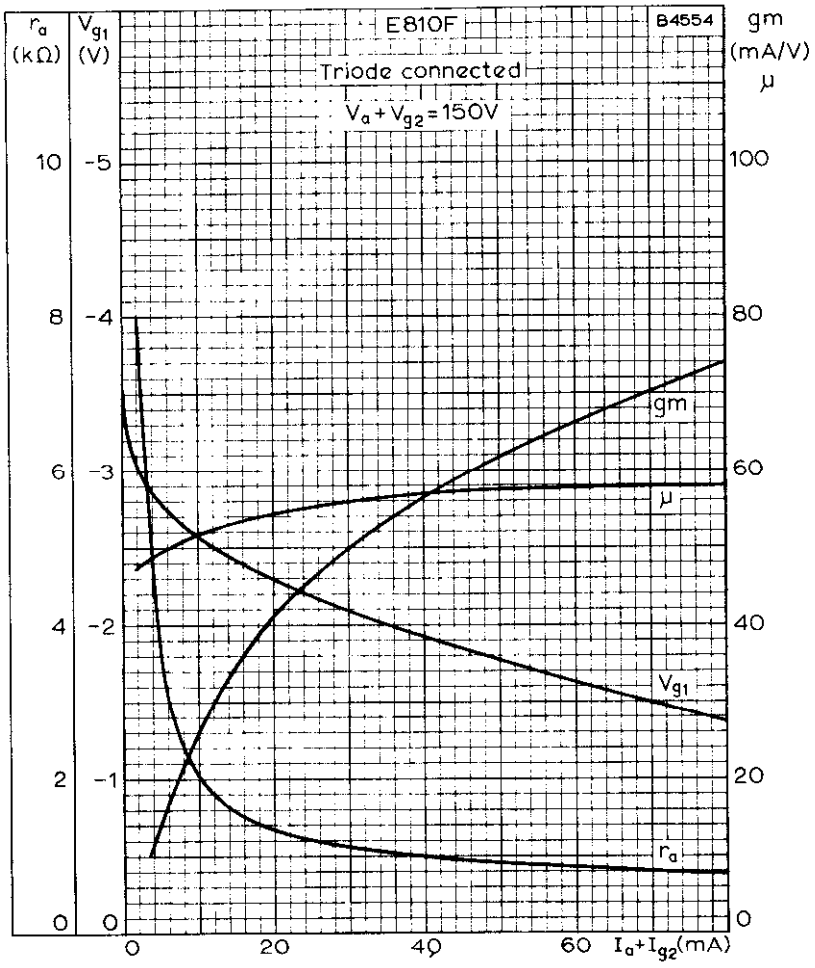
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL GRID VOLTAGE AS PARAMETER



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

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F



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

SPECIAL QUALITY V.H.F. TRIODE

EC1000

Special quality subminiature triode primarily intended for use as an input valve in measurement probes.

This data should be read in conjunction with GENERAL NOTES - SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

Suitable for parallel supply a.c. or d.c.

V_h[1]	6.3	V
I_h	185	mA

MOUNTING POSITION

Note - Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 2mm from the seal.

CAPACITANCES[2] (unshielded)

	Min.	Av.	Max.	
c_{a-g}	1.4	1.7	2.0	pF
c_{a-h}	185	270	355	mpF
c_{a-k}	325	450	575	mpF
c_{g-k}	2.9	3.5	4.1	pF
c_{g-h}	23	33	43	mpF
c_{h-k}	2.3	2.8	3.3	pF

CHARACTERISTICS[3]

V_a	80	V
I_a	14	mA
V_g	-2.0	V
g_m	14.5	mA/V
μ	27.5	
r_{g1} (f = 250Mc/s)	300	Ω

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Av.	Initial range	End of life	
Anode current				
$V_{a\ (b)} = 90V$ $R_k = 680\Omega$ $V_{g\ (b)} = 7.5V$	14	-	-	mA
$V_{a\ (b)} = 82V$ $R_k = 143\Omega$ $V_{g\ (b)} = 0V$	14	11.2 to 16.8	8.2	mA
Mutual conductance				
$V_{a\ (b)} = 90V$ $R_k = 680\Omega$ $V_{g\ (b)} = 7.5V$	14.5	12.9 to 16.1	9.2	mA/V
$V_{a\ (b)} = 82V$ $R_k = 143\Omega$ $V_{g\ (b)} = 0V$	14.5	-	-	mA/V
Negative grid current				
$V_{a\ (b)} = 92V$ $R_k = 680\Omega$ $V_{g\ (b)} = 7.5V$	-	<10	<10	nA ←
Heater current				
$V_h = 6.3V$	185	175 to 195	-	mA
Heater-cathode insulation				
$V_{h-k} = 55V$	-	<5.0	<10	μA

SHOCK AND VIBRATION

The EC1000 can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a\ (b)}$ max.	275	V
V_a max.	110	V
p_a max.	1.5	W
I_k max.	22	mA
$-V_g$ max.	55	V
$^*R_{g-k}$ max.	48	MΩ
V_{h-k} max.	55	V
V_h max.	6.6	V

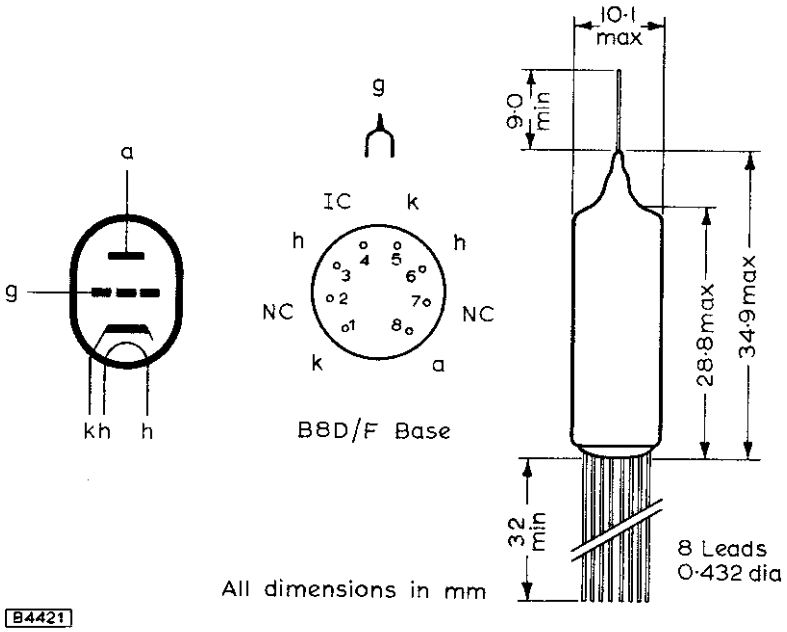
SPECIAL QUALITY V.H.F. TRIODE

EC1000

V_h min.	6.0	V
T_{bulb} max.	170	°C

*R_{g-k} max. should be restricted to that value at which no absolute maximum rating is exceeded at $-I_g$ = 10nA. In practice the maximum R_{g-k} will also be determined by the required current stability and the permissible hum level.

In calculating the maximum permissible R_{g-k} to be safe from thermal run-away, the d.c. feedback factor of the circuit should be taken into account.



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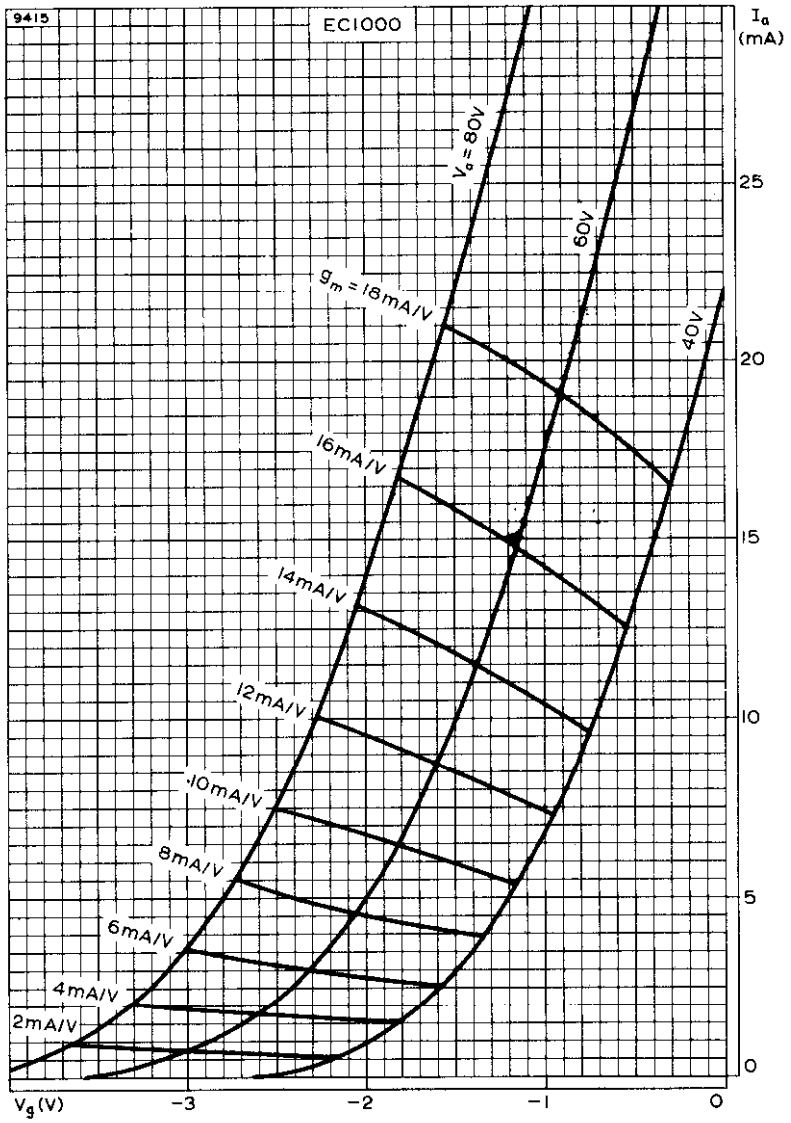
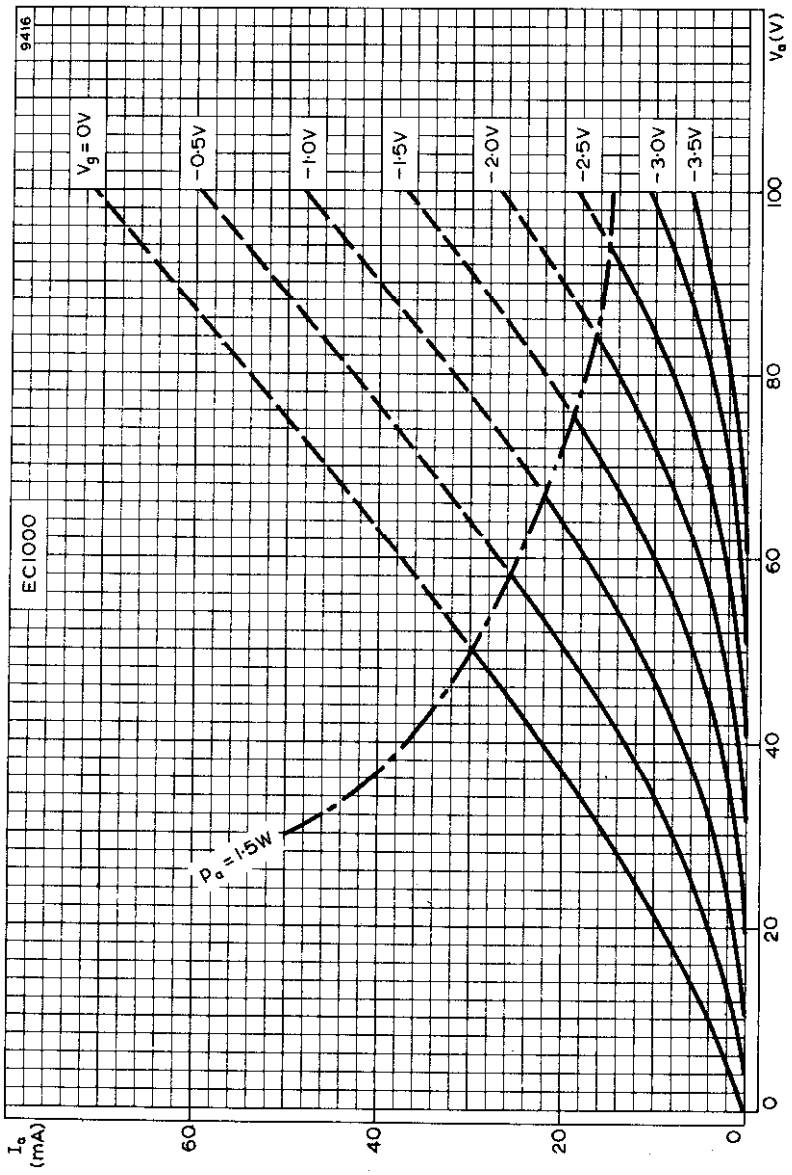
SPECIAL QUALITY V.H.F. TRIODE

EC1000



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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY DOUBLE TRIODE

ECC2000

Special quality double triode for use as cascode amplifier without external neutralisation at frequencies up to 300Mc/s, where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES - SPECIAL QUALITY VALVES, which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h [1]	6.3	V
I_h	335	mA

CAPACITANCES (without external shield)

Input triode

$c_{a''-k''+sn''+h+s}$	5.0	pF
$c_{g''-k''+sn''+h+s}$	5.1	pF
$c_{a''-g''}$	450	mpF
$c_{a''-sn''}$	3.4	pF ←
$c_{g''-sn''}$	1.4	pF
$c_{g''-k''+sn''+h+s}$ (I_a = 15.5mA)	10	pF ←

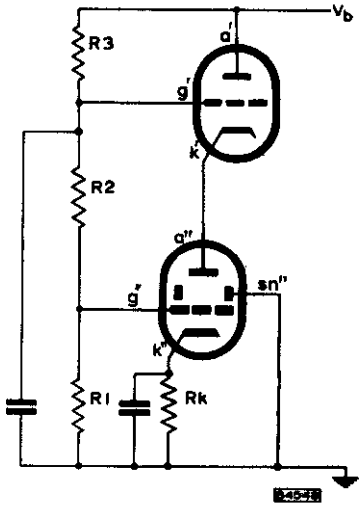
Output triode

$c_{a'-g'+h+s}$	3.2	pF ←
$c_{k'-g'+h+s}$	6.5	pF ←
$c_{a'-k'}$	180	mpF ←
$c_{a'-g'}$	1.5	pF
$c_{a'-a''}$	≤45	mpF

CHARACTERISTICS

	Input Triode Pins 2, 3, 4 and 10		Output Triode Pins 7, 8 and 9		
V_a	90	90	90	90	V
I_a	27	15	27	15	mA
$-V_g$	1.2	2.0	1.2	1.8	V ←
g_m	16.5	12	22	16	mA/V
μ	28	-	32	-	←
R_{eq}	225	400	150	250	Ω ←

OPERATING CONDITIONS



V_b	200	200	V
I_a	26.8	15.5	mA ←
R_1	18	18	kΩ
R_2	100	100	kΩ
R_3	100	100	kΩ
R_k	680	1200	Ω
$*r_{g1}$	570	750	Ω
Noise factor			
*N.F. min.	4.0	4.0	dB

*f = 200Mc/s

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN (each section unless otherwise stated)

	Initial Range	End of Life	
Anode current $V_{a(b)}$ = 110V, R_k = 680Ω, $V_{g(b)}$ = 17V	26 to 28	-	mA
Mutual conductance $V_{a(b)}$ = 110V, R_k = 680Ω, $V_{g(b)}$ = 17V			
$g_{m''}$	13.5 to 19.5	>11	mA/V
$g_{m'}$	18 to 26	>14	mA/V
Negative grid current $V_{a(b)}$ = 110V, R_k = 680Ω, $V_{g(b)}$ = 17V	<0.1	<1.0	μA
Anode current $V_{a(b)}$ = 91V, R_k = 46Ω	21.6 to 32.4	>15	mA
Insulation			
Between grid and other electrodes. $V_{d.c.}$ = 50V	>100	>20	MΩ
Between anode and any other electrode except grid. $V_{d.c.}$ = 250V	>100	>20	MΩ
Heater - cathode insulation (I_{h-k}) V_{h-k} = 150V (cathode positive) V_{h-k} = 50V (cathode negative)	<15	<20	μA

SHOCK AND VIBRATION

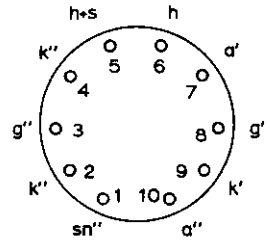
The ECC2000 can withstand vibrations of 2.5g at 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (each section)

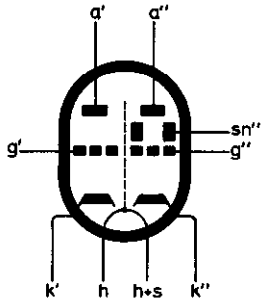
$V_{a(b)}$ max.	450	v
V_a max.	250	V
p_a max.	2.7	W
*$-v_{g(pk)}$ max.	150	V
$-V_g$ max.	50	V
I_k max.	40	mA
**$i_{k(pk)}$ max.	400	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
V_{h-k} max. (k positive)	150	V
(k negative)	50	V
T_{bulb} max.	225	°C

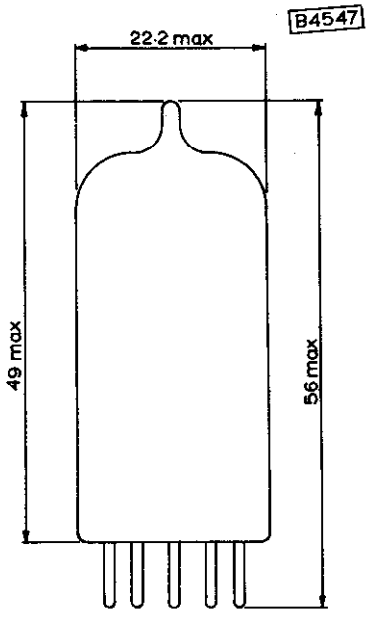
*Duty cycle max. 1%, t_p max. =10μs.

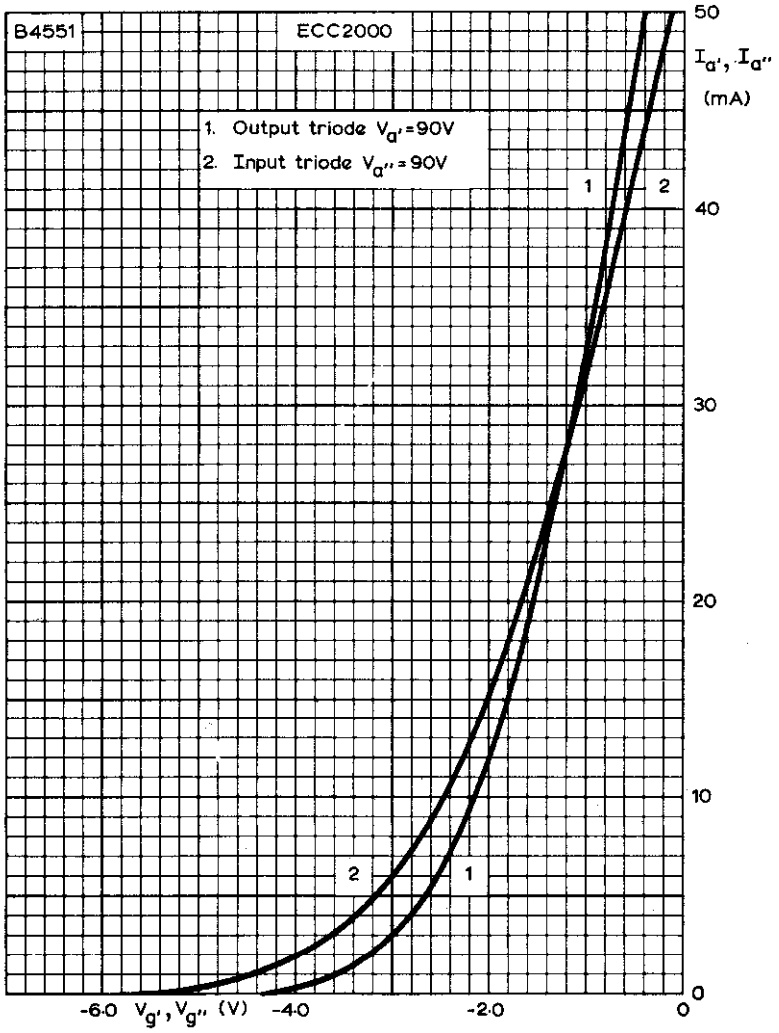
**Duty cycle max. 10%, t_p max. =200μs.



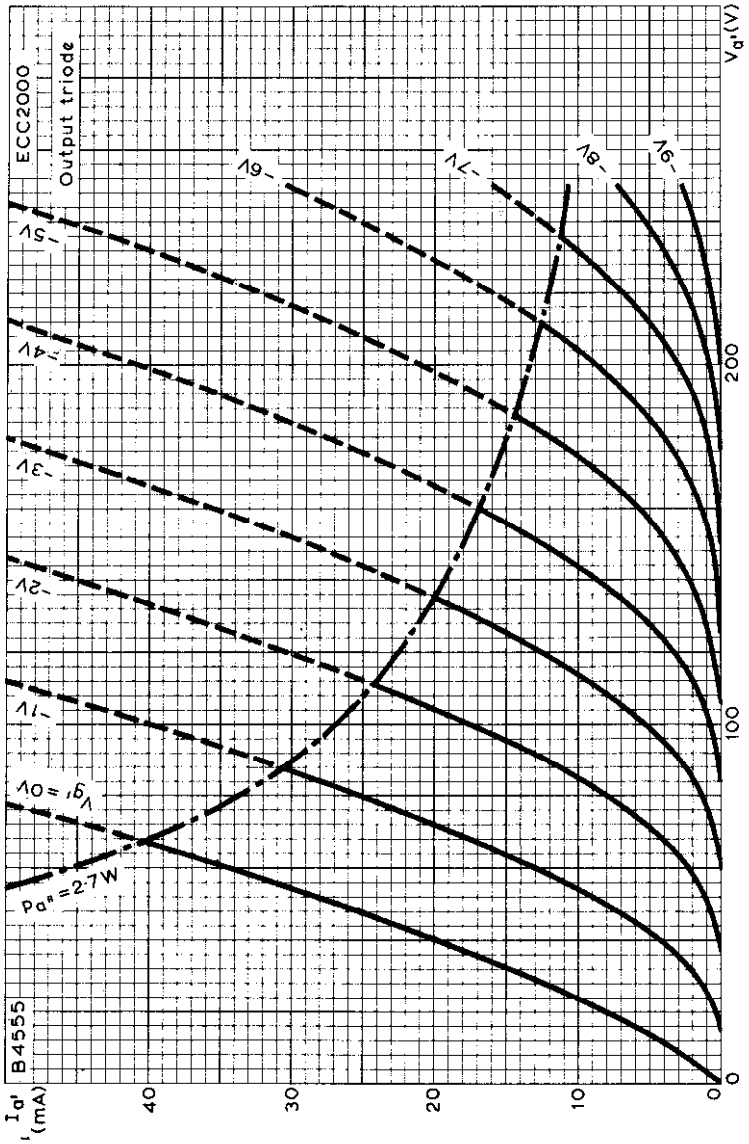
B10B Base



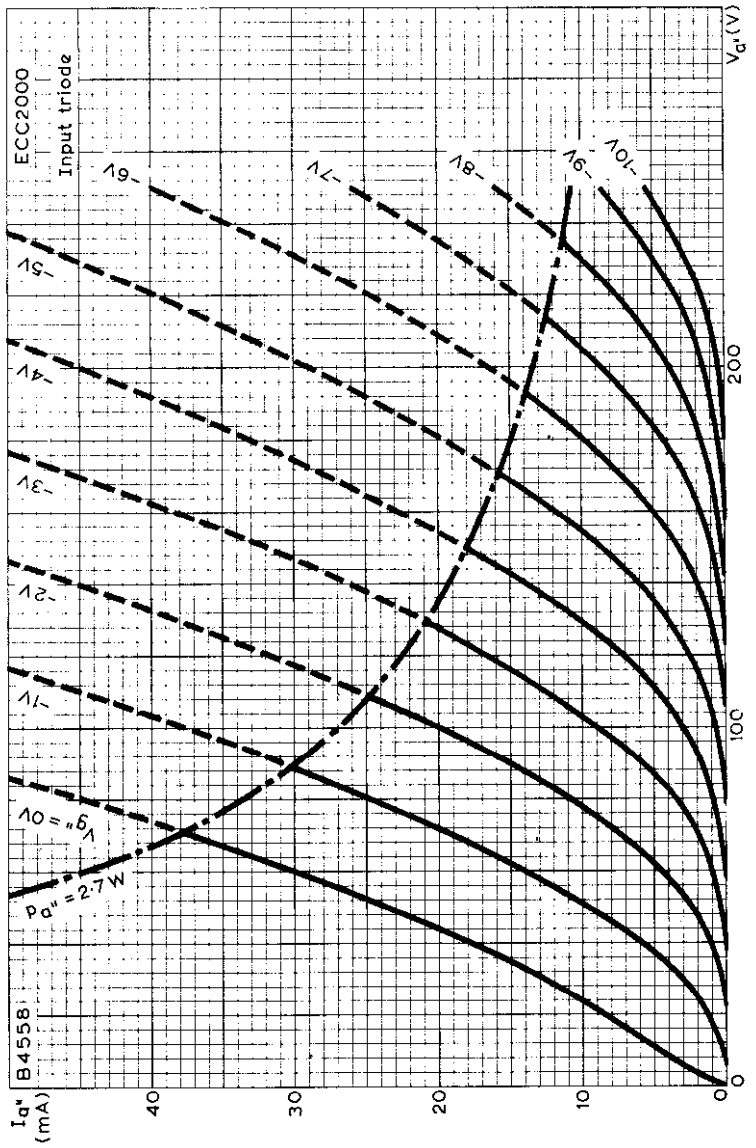




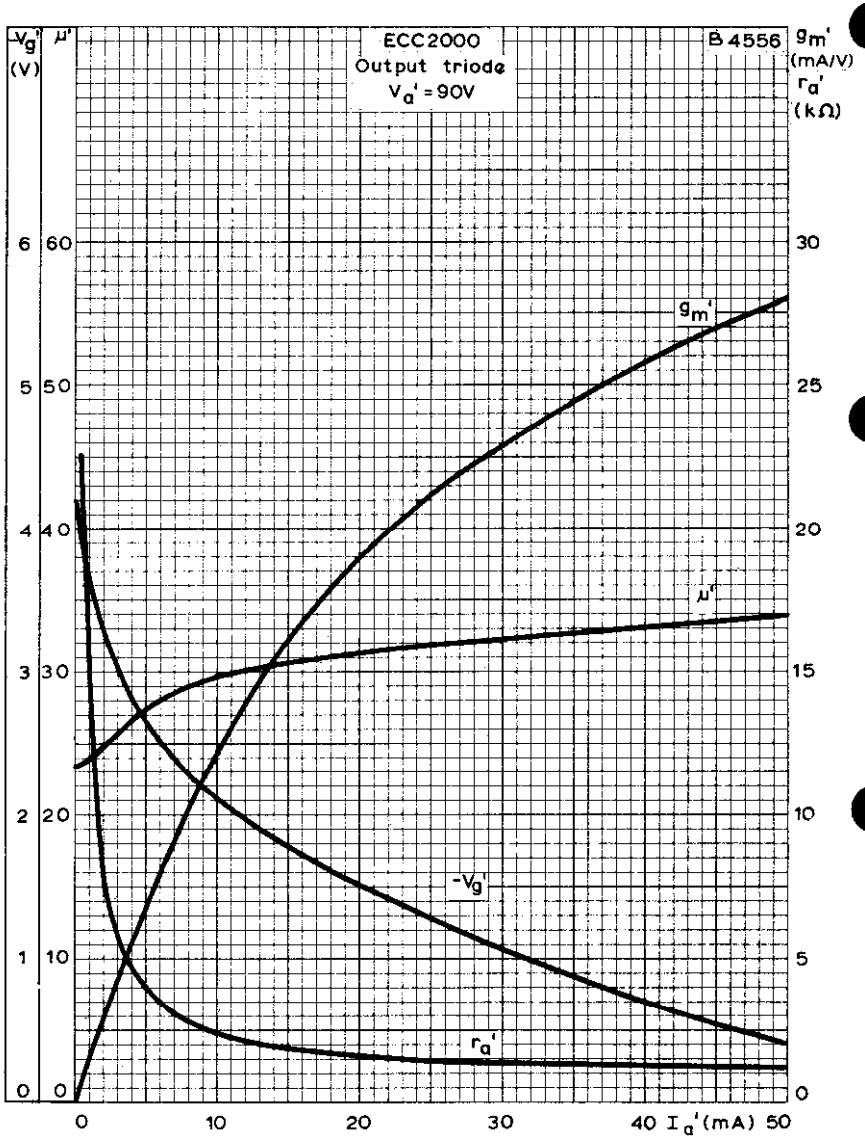
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
- INPUT AND OUTPUT TRIODES



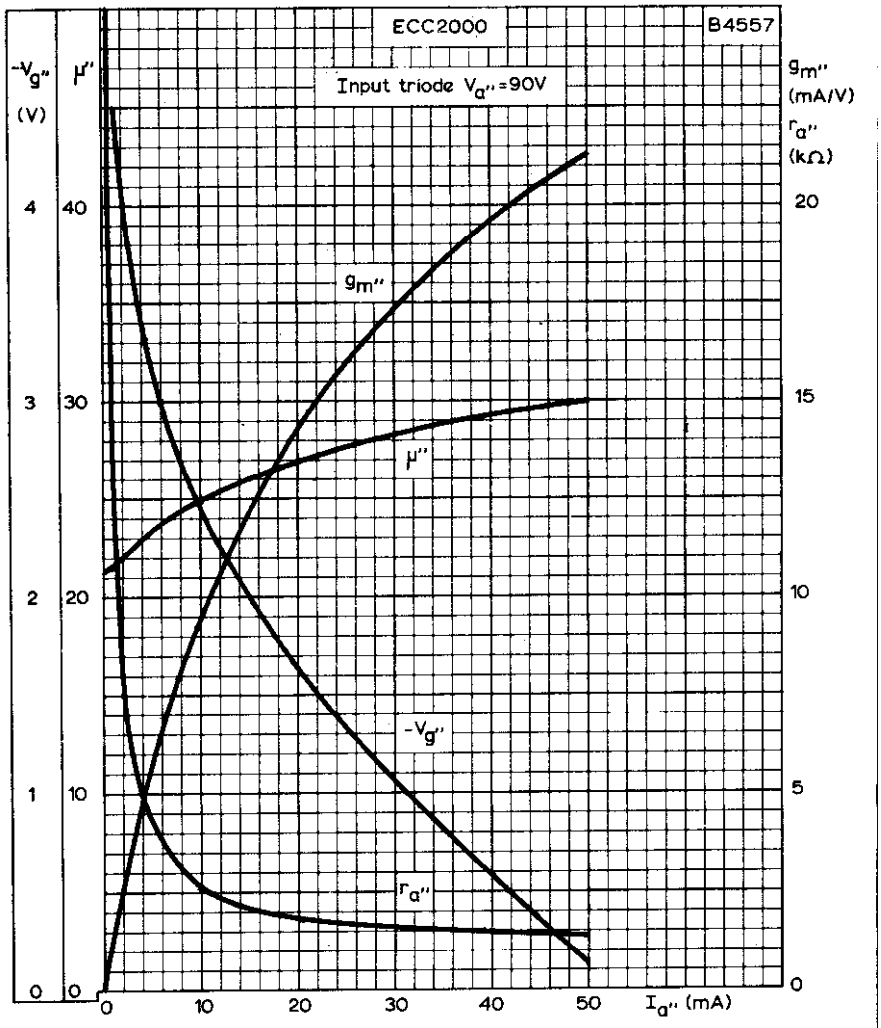
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER - OUTPUT TRIODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER - INPUT TRIODE



MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT - OUTPUT TRIODE



MUTUAL CONDUCTANCE, ANODE IMPEDANCE, AMPLIFICATION FACTOR AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT - INPUT TRIODE

SPECIAL QUALITY DOUBLE DIODE

M8079

Special quality miniature double diode with separate cathodes and internal screening between sections for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

CAPACITANCES[2] (measured with an external shield)

$C_{a'-k'+h+s+S}$	3.2	pF
$C_{a''-k''+h+s+S}$	3.2	pF
$C_{k'-a'+h+s+S}$	3.9	pF
$C_{k''-a''+h+s+S}$	3.9	pF
$C_{a'-a''}$	<26	mpF

LIMITING VALUES[4] (absolute ratings) each section

P.I.V. max.	460	V
I_a max.	10	mA
$i_{a(pk)}$ max.	60	mA
V_{h-k} max.	360	V
$V_{in(r.m.s.)}$ max.	165	V
R_{lim} min. (per anode)	600	Ω
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

M8079

SPECIAL QUALITY DOUBLE DIODE

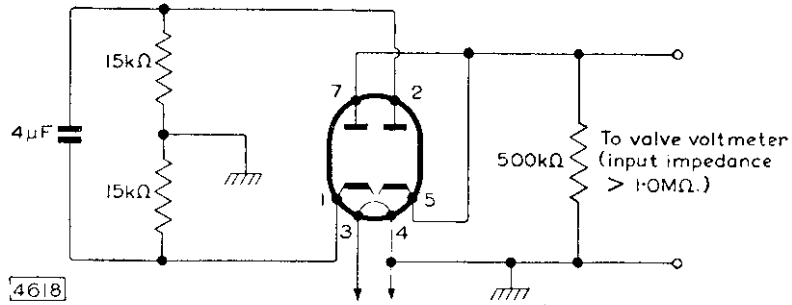
TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	165	11	8.0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, screen-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	5.0	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	5.0	—	—	—	μA
Output current	0.65	18	16	—	—	—	—	mA
Emission V_a = 10V	0.65	—	40	—	—	—	—	mA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. V_a = 0V, R_a = 40kΩ	2.5	—	2.0	20	—	—	—	μA
Anode current difference between sections V_a = 0V, R_a = 40kΩ	2.5	—	—	5.0	—	—	—	μA
Change in emission V_h = 5.7V, V_a = 7.0V	2.5	—	—	15	—	—	—	%
Hum V_h = 7.0V Tested in circuit shown below	2.5	—	—	10	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	



GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
$C_{a'-a''}$	—	—	—	26	—	—	—	mpF
$C_{a'-k'+h+s+g}$	—	—	2.4	4.0	—	—	—	pF
$C_{a''-k''+h+s+g}$	—	—	2.4	4.0	—	—	—	pF
$C_{k'-a'+h+s+g}$	—	—	2.5	5.0	—	—	—	pF ←
$C_{k''-a''+h+s+g}$	—	—	2.5	5.0	—	—	—	pF ←

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Microphonic noise measured at the cathode with both sections in parallel. 50c/s, 2.0g min. peak acceleration, $R_k = 4.7k\Omega$, $I_a = 20mA$	2.5	—	—	5.0	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Microphonic noise (conditions as above)	—	—	—	5.0	—	—	—	mV (r.m.s.)

GROUP F

Intermittent life test

The valve is connected in a full-wave rectifier circuit with a load resistor of 11kΩ and a reservoir capacitor of 8μF. The supply impedance is adjusted so that the peak anode current is not less than 60mA for a nominal valve, the total output current being approximately 18mA.

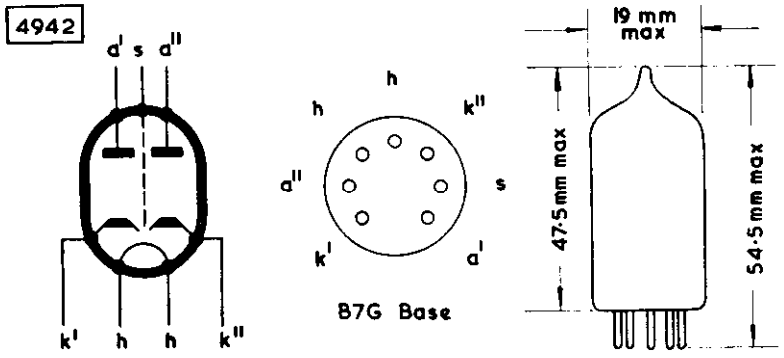
The cathode to heater voltage is provided by the output voltage in series with 117Vr.m.s.

Intermittent life test end points		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Emission $V_a = 10V$	500 hours	2.5	35	—	mA
	1000 hours	4.0	30	—	mA
Sub-group (b)					
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	500 hours	4.0	—	20	%
Anode current $V_a = 0V$, $R_a = 40k\Omega$	500 hours	4.0	1.0	20	μA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	50	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

GROUP G

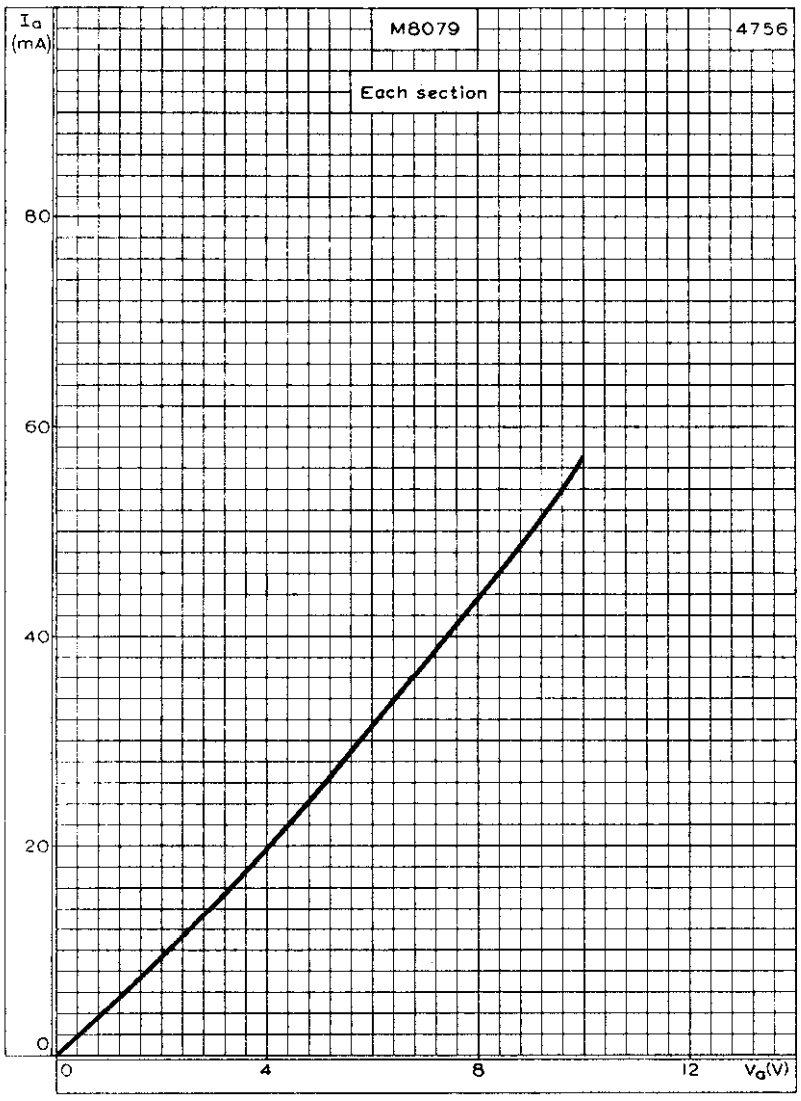
Valves are held for 28 days and retested for Inoperatives[14]	0.5	—	—	

M8079 SPECIAL QUALITY DOUBLE DIODE



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

SPECIAL QUALITY DOUBLE DIODE M8079



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SPECIAL QUALITY R.F. PENTODE

M8083

Special quality r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

c_{in}	7.1	pF ←
c_{out}	3.4	pF ←
c_{a-g1}	<10	mpF

CHARACTERISTICS[3]

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
I_a	10	mA
I_{g2}	2.6	mA
V_{g1}	−2.0	V
g_m	7.6	mA/V
r_a	>500	kΩ
$\mu_{g1\ g2}$	70	
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	450	V ←
V_{g2} max.	300	V
p_{g2} max.	900	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	500	kΩ ←
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

M8083

SPECIAL QUALITY R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g3-k} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	R_{g1} (Ω)	C_k (μF)
6.3	250	0	250	0	160	0	1000

TESTS	A.Q.L.[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, g_2-rest measured at –300V g_1-rest measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse control-grid current R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current V_{h-k} = 100V cathode negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	0.65	—	—	10	—	—	—	μA
	—	—	—	—	—	2.0	—	μA
Anode current	0.65	9.85	7.5	12.2	—	—	—	mA
	—	—	—	—	8.7	11	0.91	mA
Screen-grid current	0.65	2.6	1.8	3.4	—	—	—	mA
	—	—	—	—	—	3.0	—	mA
Mutual conductance	0.65	7.6	6.0	9.25	—	—	—	mA/V ←
	—	—	—	—	6.81	8.43	0.63	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. V_{g1-e} = –8.0V	2.5	—	—	100	—	—	—	μA
Reverse control-grid current. V_{g1-e} = –50V	2.5	—	—	1.0	—	—	—	μA
Change in mutual conductance. V_h = 5.7V	2.5	—	—	15	—	—	—	%
Reverse control-grid current. V_h = 6.9V, V_{a-e} = 300V, V_{g2-e} = 300V, R_k = 250Ω	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration. V_b = 250V, R_a = 2kΩ, R_k = 0Ω, V_{g1} = –2V	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	6.5	8.7	—	—	—	pF
C_{out}	—	—	2.75	3.75	—	—	—	pF
C_{a-g1}	—	—	—	10	—	—	—	mpF
Grid 3 cut-off voltage V_{g1-e} = –3.5V, I_a = 50μA	6.5	—	–70	–120	—	—	—	V
Amplification factor (μ_{g1-g2})	—	—	60	89	—	—	—	

M8083

SPECIAL QUALITY R.F. PENTODE

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current. R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	5.5	9.25	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	5.5	9.25	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 180\Omega \pm 10\%$, $V_{h-k} = 100V$ (cathode negative)

Stability life test end point

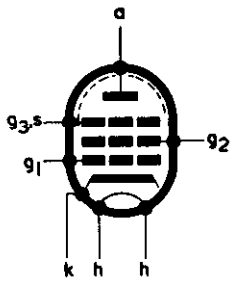
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

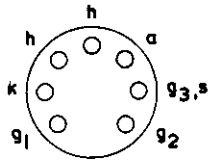
Intermittent life test			A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)						
Inoperatives[16]	500 hours		2.5	—	—	
	1000 hours		4.0	—	—	
Heater current	500 hours		2.5	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours		2.5	—	20	μA
	1000 hours		4.0	—	20	μA
Reverse coutrol-grid current. R_{g1} max = 500kΩ	500 hours		2.5	—	0.75	μA
	1000 hours		4.0	—	1.0	μA
Mutual conductance	500 hours		2.5	5.2	9.25	mA/V
	1000 hours		4.0	4.9	9.25	mA/V
Average change in mutual conductance	500 hours		—	—	10	%
Sub-group (b)						
Anode current	500 hours		4.0	6.8	12.2	mA
	1000 hours		6.5	5.25	—	mA
Insulation as in group A	500 hours		4.0	50	—	MΩ
	1000 hours		6.5	30	—	MΩ
Group quality level[10]	500 hours		6.5	—	—	
	1000 hours		10	—	—	

M8083 SPECIAL QUALITY R.F. PENTODE

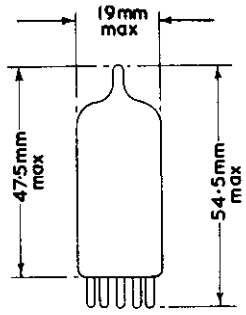
GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse control-grid current. R_{g1}max = 500kΩ	0.5	—	0.75	μA

3594





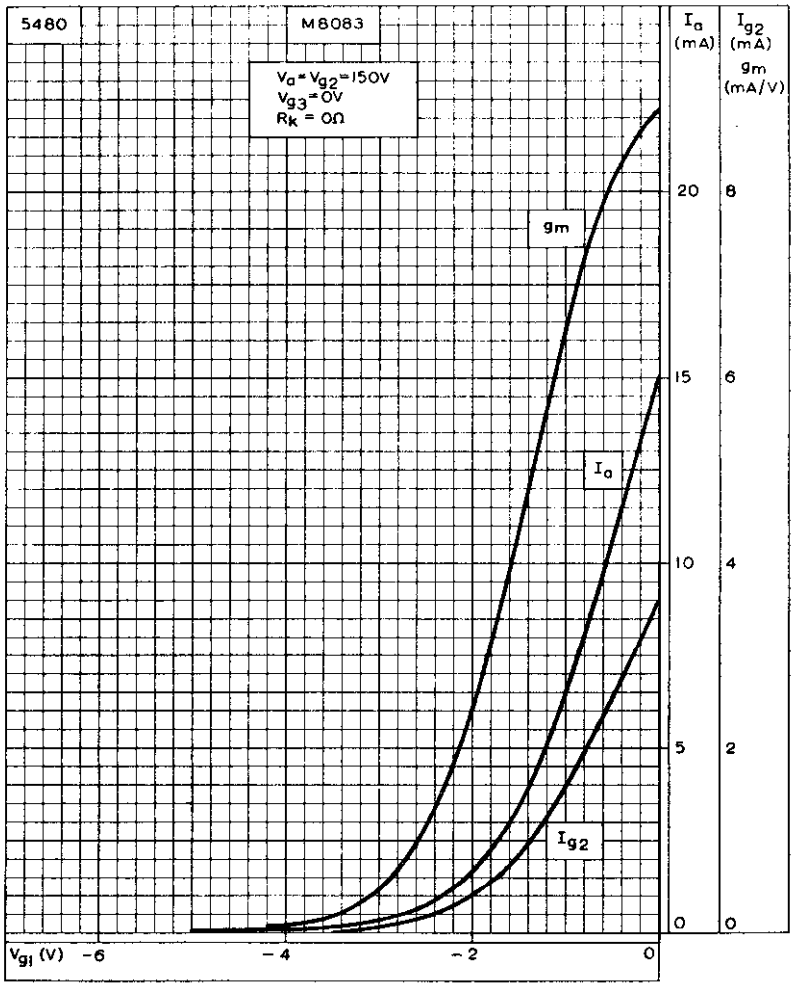
B7G Base



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

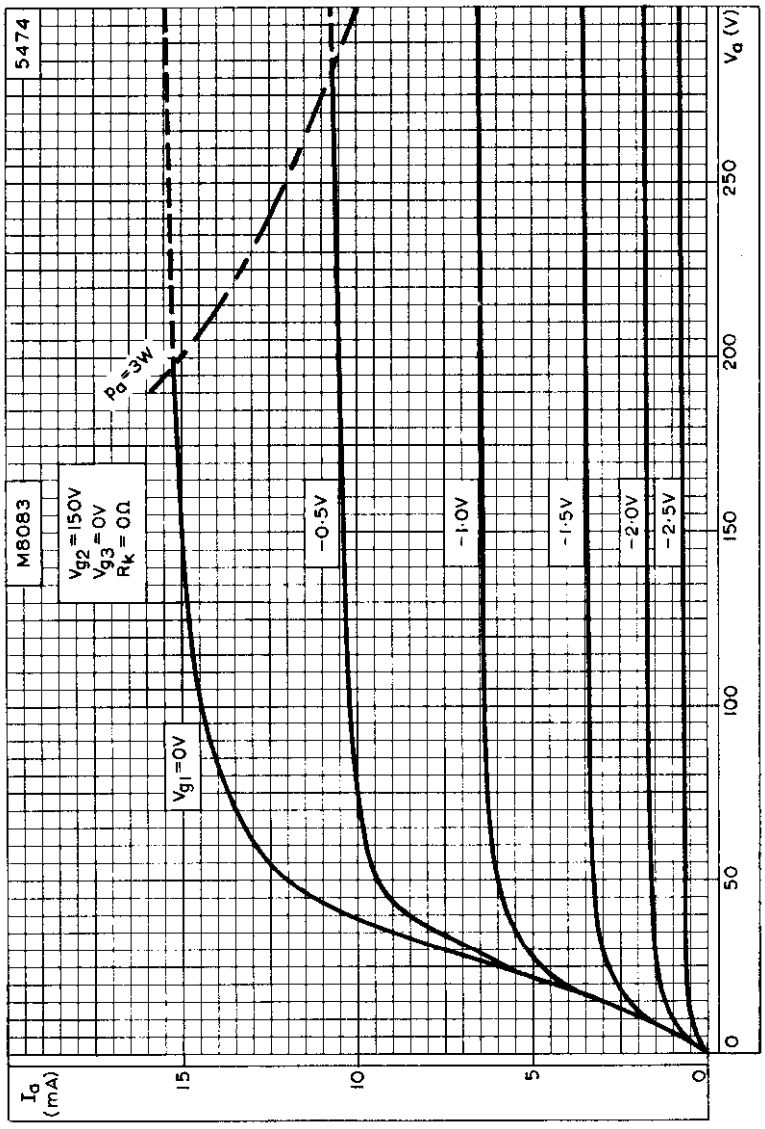
SPECIAL QUALITY R.F. PENTODE

M8083

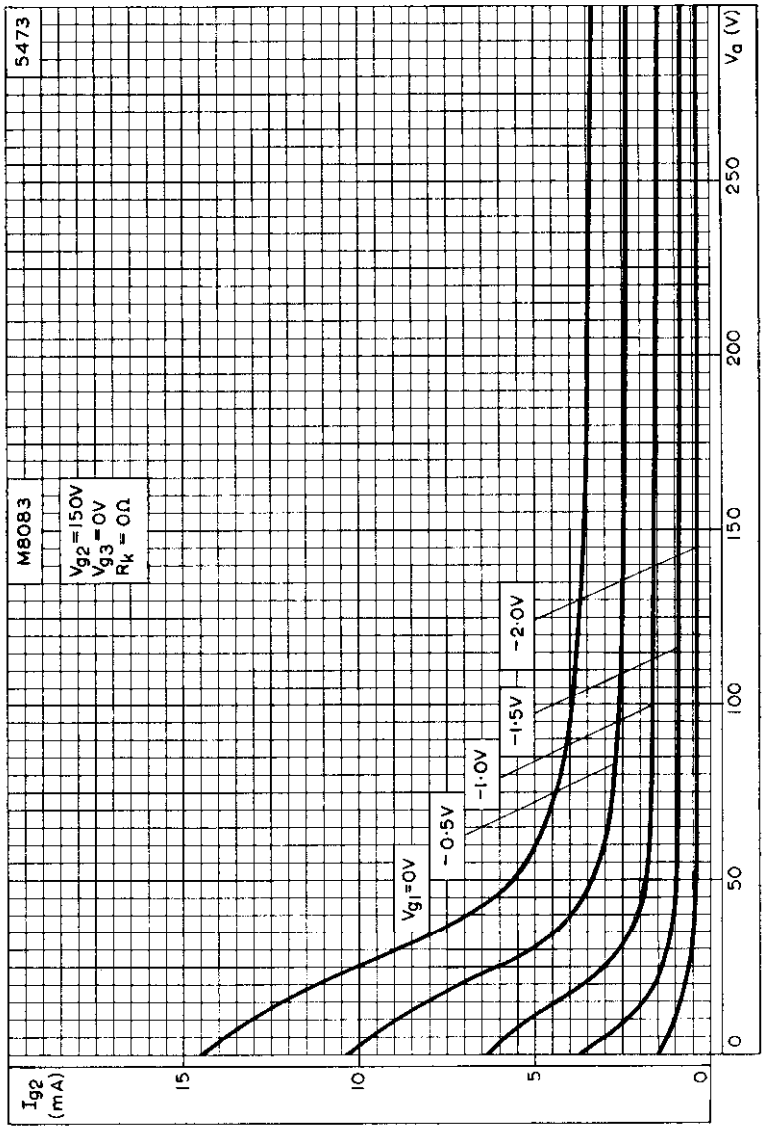


ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 150V$

M8083 SPECIAL QUALITY R.F. PENTODE

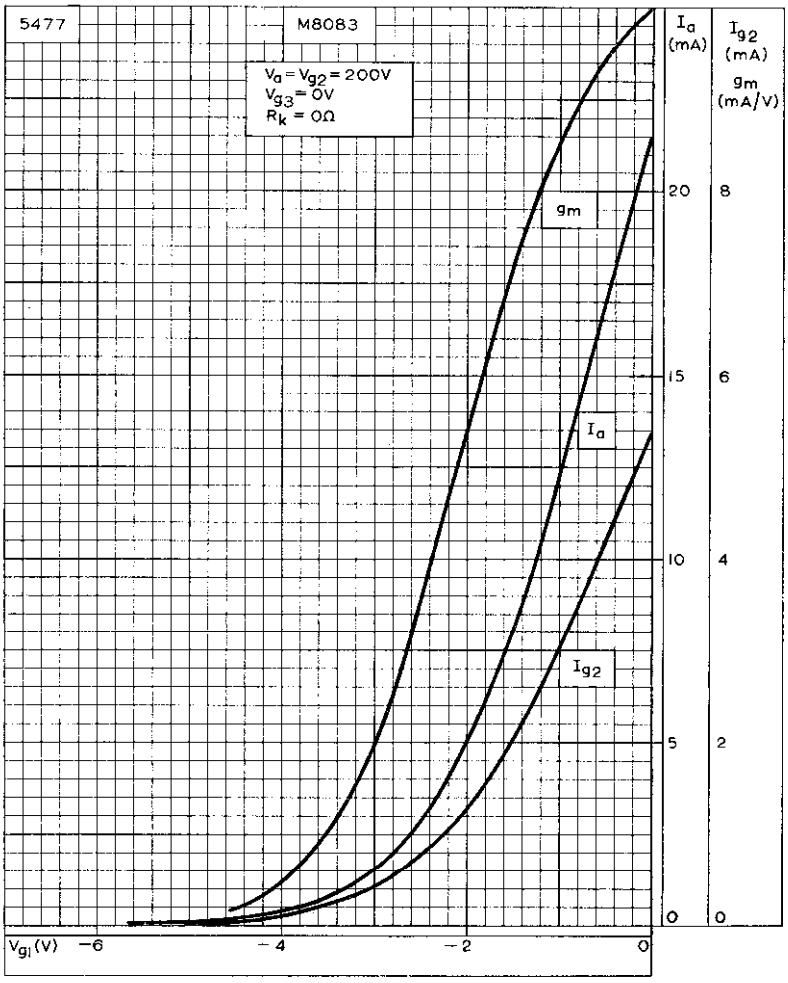


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



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

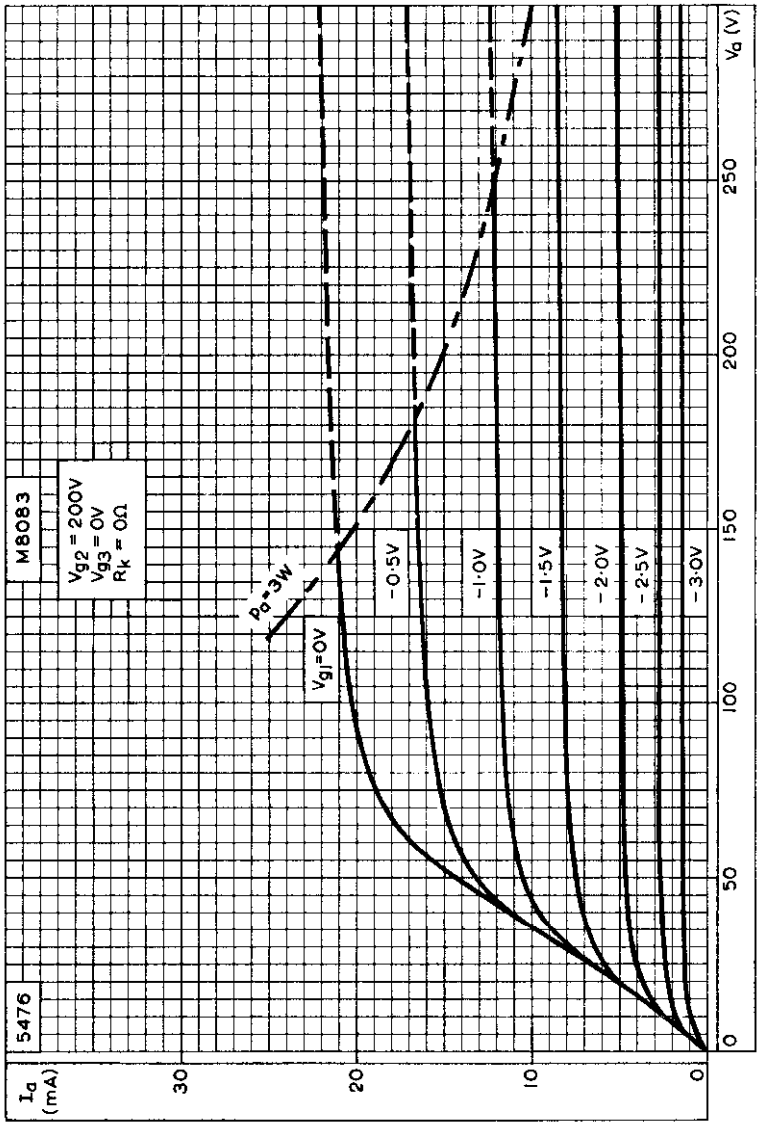
M8083 SPECIAL QUALITY R.F. PENTODE



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

SPECIAL QUALITY R.F. PENTODE

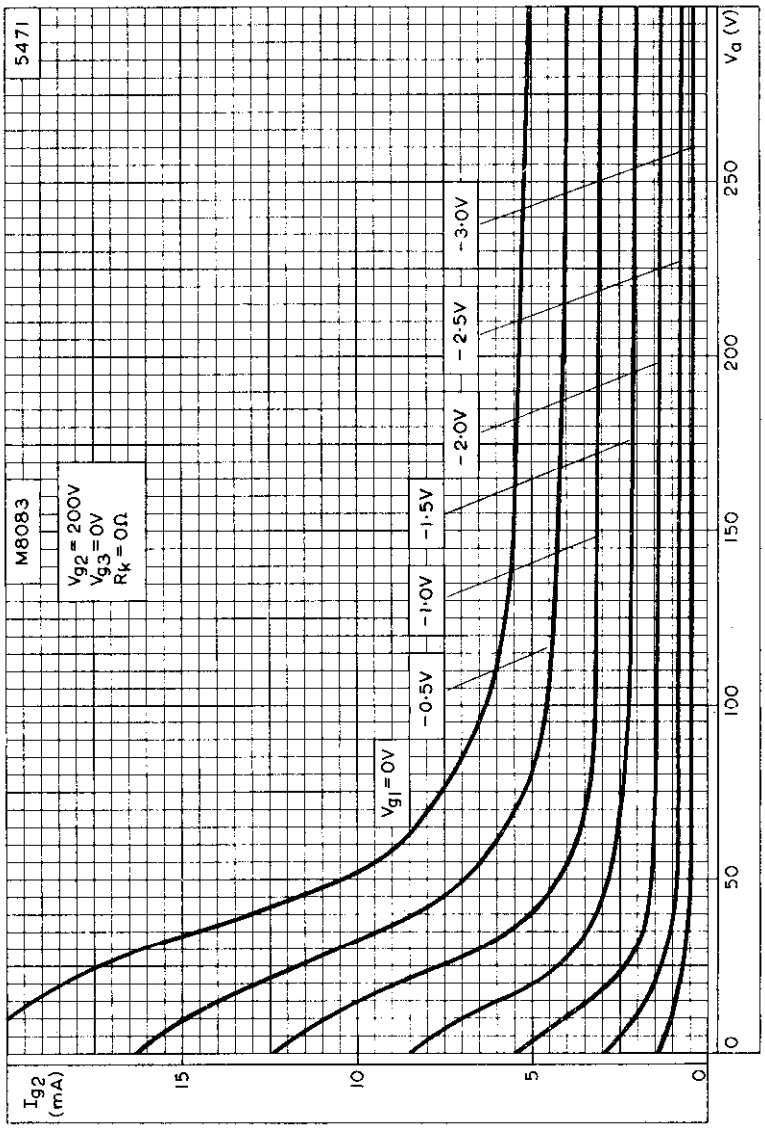
M8083



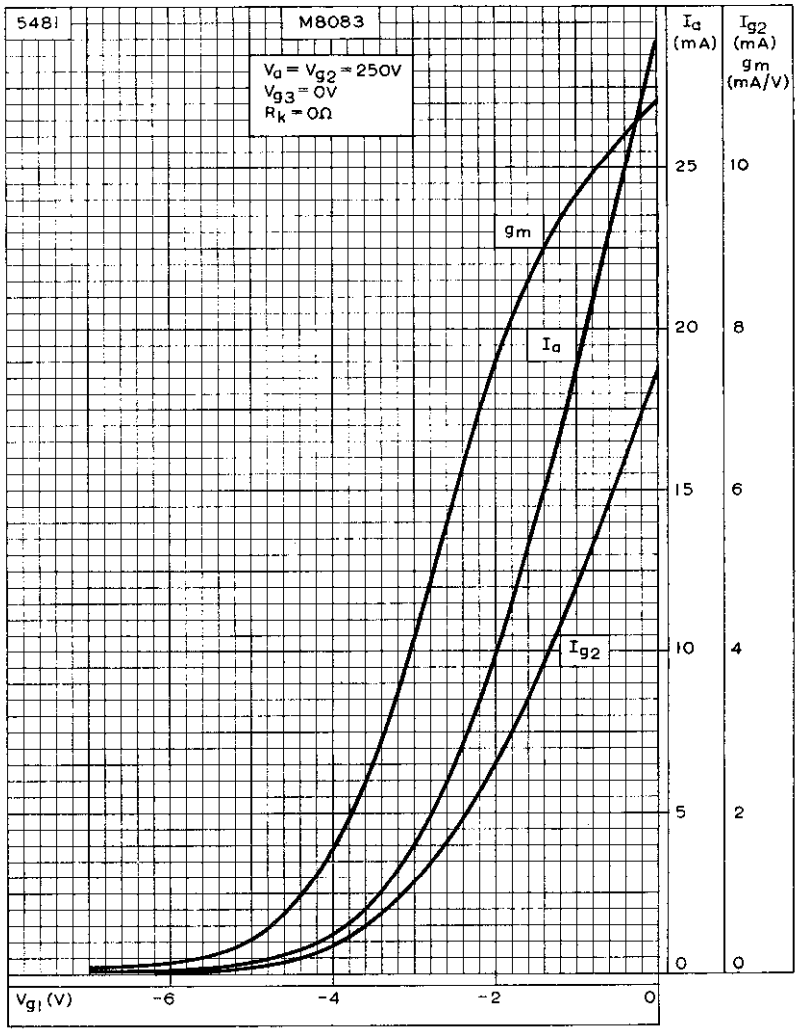
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

M8083

SPECIAL QUALITY R.F. PENTODE

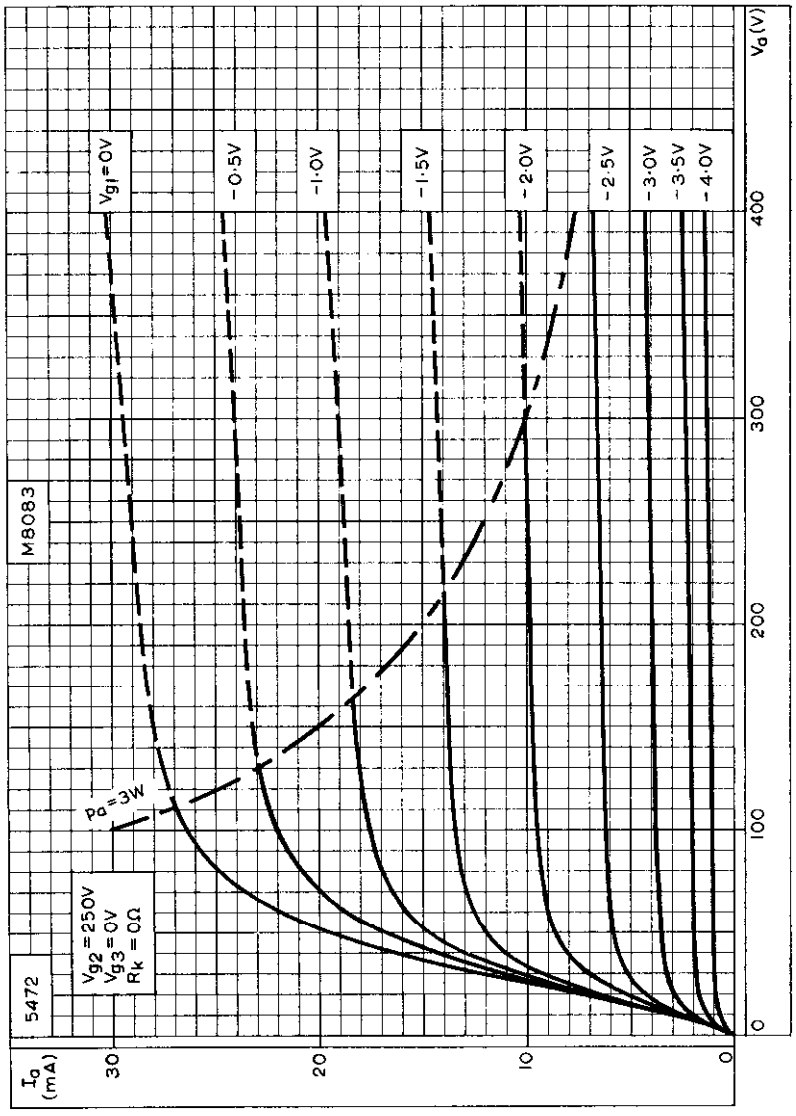


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

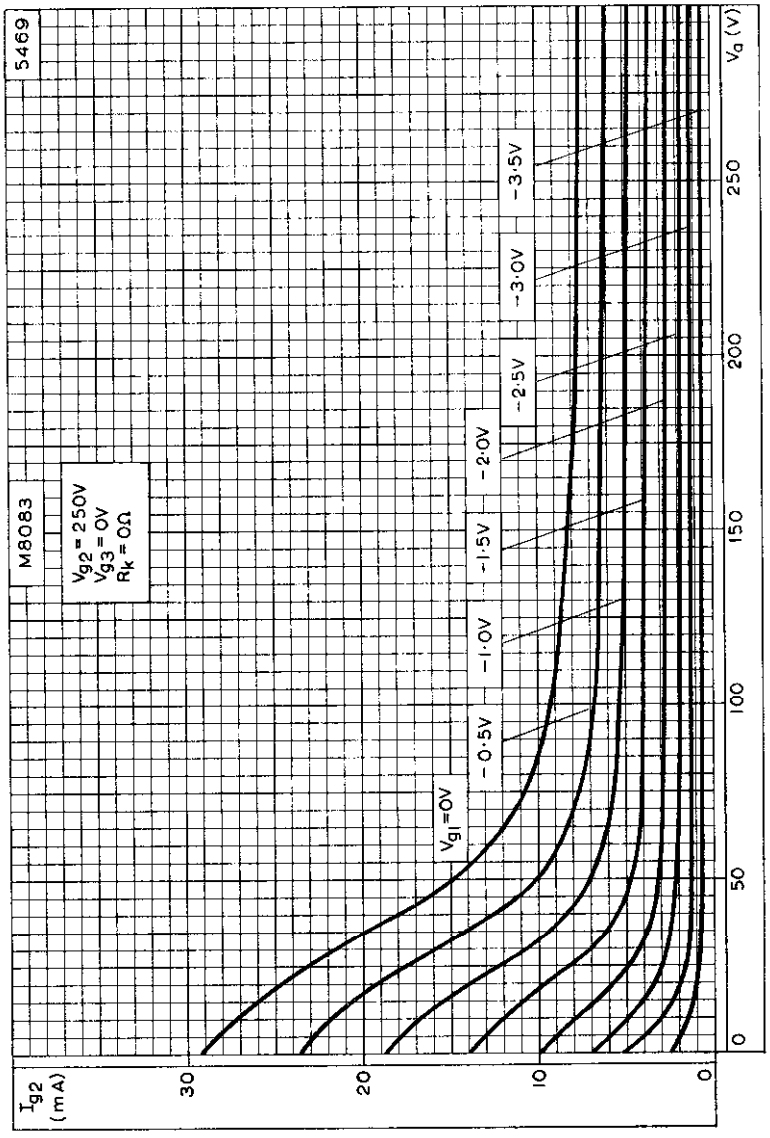


ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 250V$

M8083 SPECIAL QUALITY R.F. PENTODE

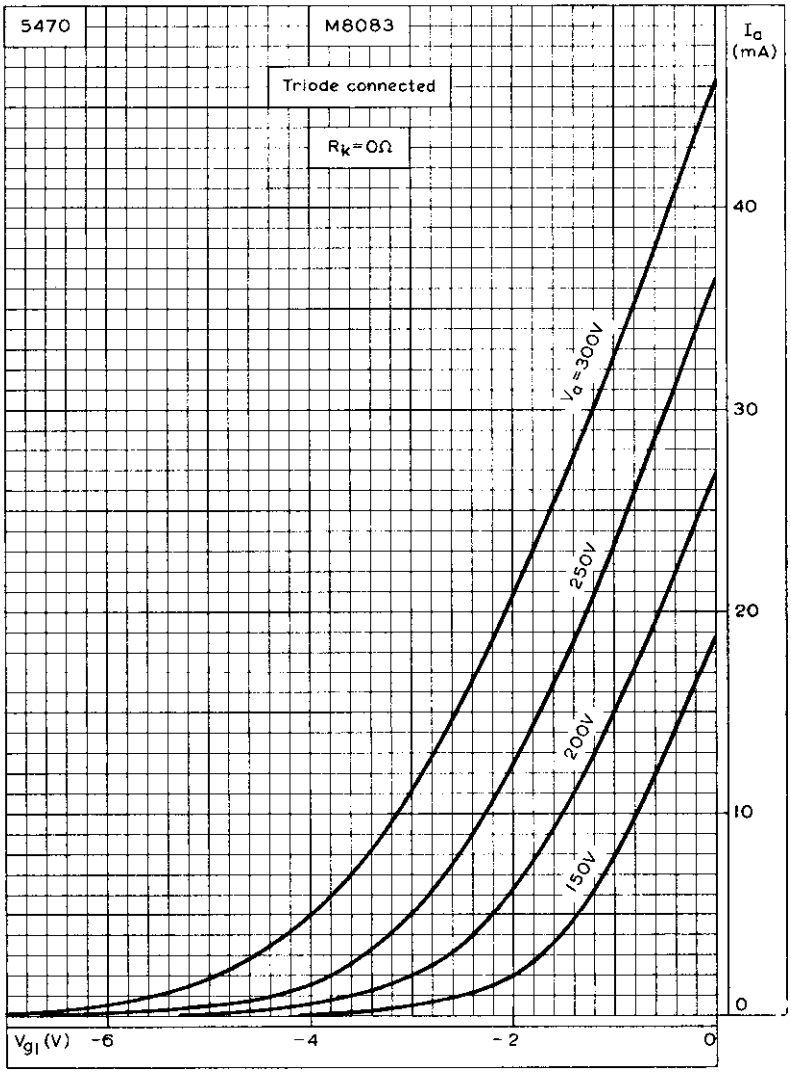


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



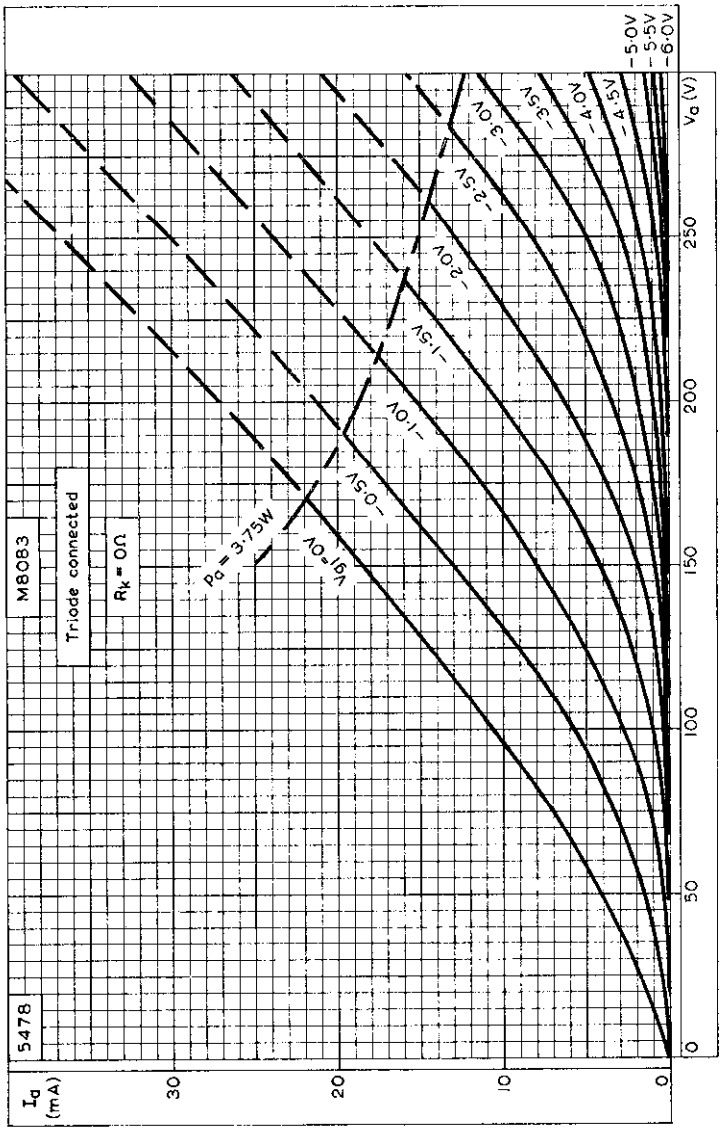
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

M8083 SPECIAL QUALITY R.F. PENTODE



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

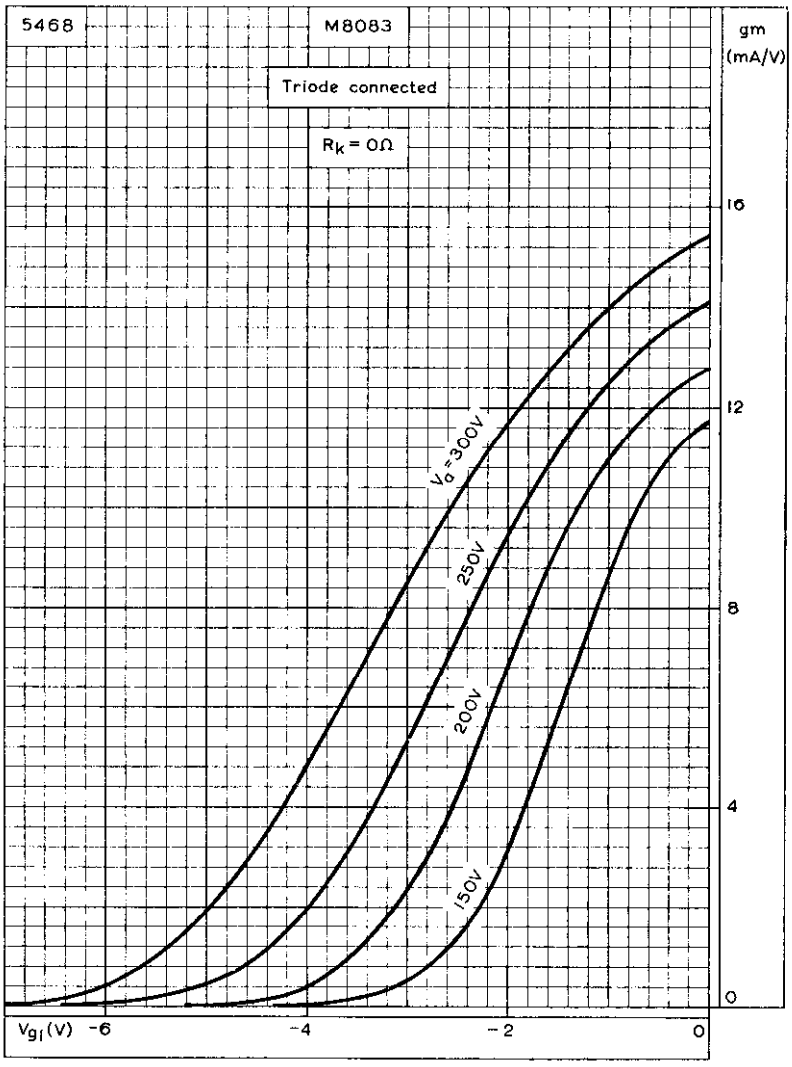
SPECIAL QUALITY R.F. PENTODE **M8083**



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

M8083

SPECIAL QUALITY R.F. PENTODE



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

SPECIAL QUALITY V.H.F. POWER TETRODE

M8096

Special quality r.f. beam power tetrode for use at frequencies up to 175Mc/s in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.0	V
I_h	750	mA

CAPACITANCES[2] (measured without an external shield)

c_{a-g1}	<300	mpF
c_{in}	9.5	pF
c_{out}	4.5	pF

CHARACTERISTICS[3]

V_a	250	V
V_{bp}	0	V
V_{g2}	250	V
V_{g1}	−7.5	V
I_a	45	mA
I_{g2}	4.5	mA
g_m	7.0	mA/V
μ_{g1-g2}	16	
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

f max.	175	Mc/s
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	500	V
V_{g2} max.	250	V
$-V_{g1}$ max.	125	V
p_a max.	12	W
p_{g2} max.	2.0	W
I_k max.	60	mA
$i_{k(pk)}$ max.	550	mA
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	250	°C

M8096

SPECIAL QUALITY V.H.F. POWER TETRODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{bp} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.0	250	0	250	−7.5	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid-current								
R_{g1} max. = 100kΩ	0.25	—	—	2.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	690	810	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	20	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	20	—	—	—	μA
†Anode current	0.65	45	33	57	—	—	—	mA
	—	—	—	—	39	51	4.6	mA
Screen-grid current	0.65	—	—	7.0	—	—	—	mA
Mutual conductance	0.65	7.0	5.6	9.0	—	—	—	mA/V
	—	—	—	—	6.3	7.7	0.54	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

When V_{g1} is applied in turn to pins 8 and 9,

†no change in anode current should result.

GROUP C								
Anode current. V_{g1} = –15V	2.5	—	—	15	—	—	—	mA
Change in mutual conductance. V_h = 5.7V	2.5	—	—	15	—	—	—	%
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, V_b = 250V, R_a = 2.0kΩ, V_g = –15V.	2.5	—	—	250	—	—	—	mV (r.m.s.)
Amplification factor (μ_{g1-g2})	2.5	—	13	20	—	—	—	
*Beam plate continuity test. V_{bp} = 250V	2.5	—	—	—	—	—	—	
Group quality level[10]	6.5	—	—	—	—	—	—	
*The anode and screen-grid currents should change from the values obtained in group B								
GROUP D								
Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{a-g}	—	—	—	300	—	—	—	mpF
c_{in}	—	—	7.9	11.1	—	—	—	pF
c_{out}	—	—	3.0	6.0	—	—	—	pF
Reverse grid current. V_h = 6.6V, V_a = 300V, V_{g2} = 250V, I_a = 40mA	6.5	—	—	2.5	—	—	—	μA
Power oscillation. $V_{a(b)}$ = 300V, I_a = 50mA, R_{g1} = 16kΩ, f = 135Mc/s	6.5	—	1.5	—	—	—	—	W
Reverse screen-grid current. V_a = 0V, I_{g2} = 10mA, V_{g2} = 170$V_{r.m.s.}$	6.5	—	—	500	—	—	—	μA
*Peak cathode current. $v_{a(pk)} = v_{g1(pk)} = v_{bp(pk)}$ = 200V	6.5	—	4.5	—	—	—	—	A
*The voltage waveform should be a half-sine wave. P.R.F. = 50p/s., t_p max. = 12.5μs.								

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.6V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	40	—	—	—	μA
Reverse grid current. R_{g1} max. = 100kΩ	2.5	—	—	5.0	—	—	—	μA
Power oscillation as in group D	2.5	—	1.0	—	—	—	—	W
Microphonic noise as in group C	2.5	—	—	500	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	40	—	—	—	μA
Reverse grid current. R_{g1} max. = 100kΩ	2.5	—	—	5.0	—	—	—	μA
Power oscillation as in group D	2.5	—	1.0	—	—	—	—	W
Microphonic noise as in group C	2.5	—	—	500	—	—	—	mV (r.m.s.)

GROUP F

Stability life test[14]

Running conditions. R_{g1} = 100kΩ±20%, R_k = 150Ω±10%, V_{h-k} = 100V (cathode negative), C_k = 1000μF

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

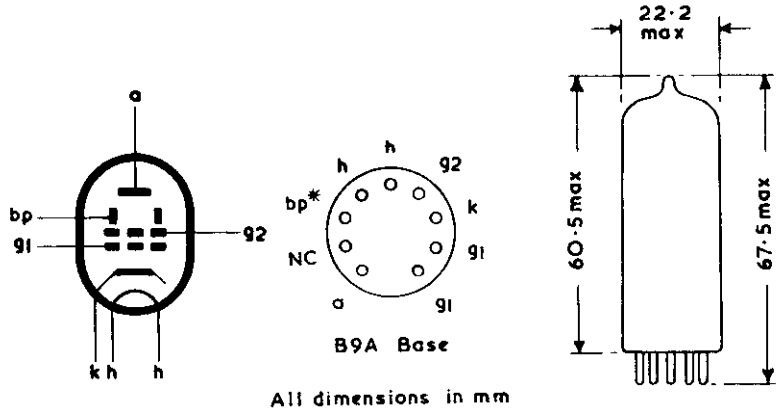
Running conditions. R_{g1} = 100kΩ±20%, R_k = 150Ω±10%, V_{h-k} = 100V (cathode negative) C_k = 1000μF

Intermittent life test end points		*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	640	810	mA
Heater to cathode leakage current. V_{h-k} = ±100V	500 hours	2.5	—	30	μA
	1000 hours	4.0	—	40	μA
Reverse grid current. R_{g1} max. = 100kΩ	500 hours	2.5	—	3.0	μA
	1000 hours	4.0	—	4.0	μA
Mutual conductance	500 hours	2.5	4.8	—	mA/V
	1000 hours	4.0	4.5	—	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	28	57	mA
	1000 hours	6.5	25	—	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Power oscillation as in group D	500 hours	4.0	1.0	—	W
	1000 hours	6.5	0.8	—	W
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8096

SPECIAL QUALITY V.H.F. POWER TETRODE

GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current. R_{g1} max. = 100kΩ	0.5	—	2.5	μA



All dimensions in mm

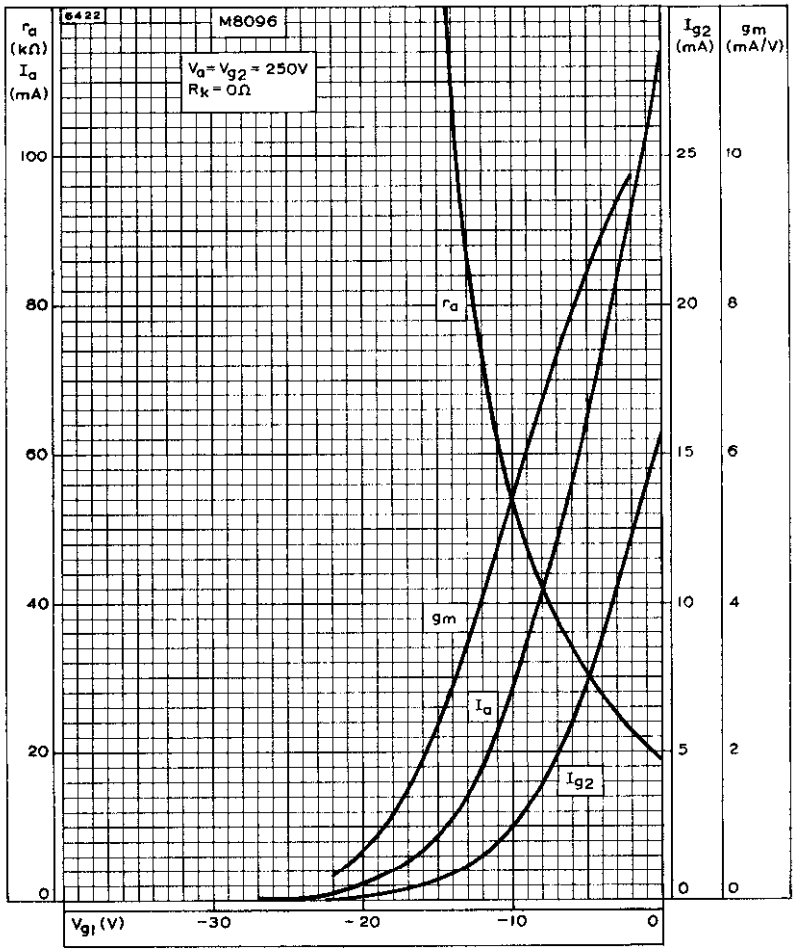
* Connect contact 3 to contact 7 at socket. Contacts 8 and 9 should be connected to external circuit with leads of equal length.

6309

The bulb and base dimensions of this valve are in accordance with BS448, Section B9A

SPECIAL QUALITY
V.H.F. POWER TETRODE

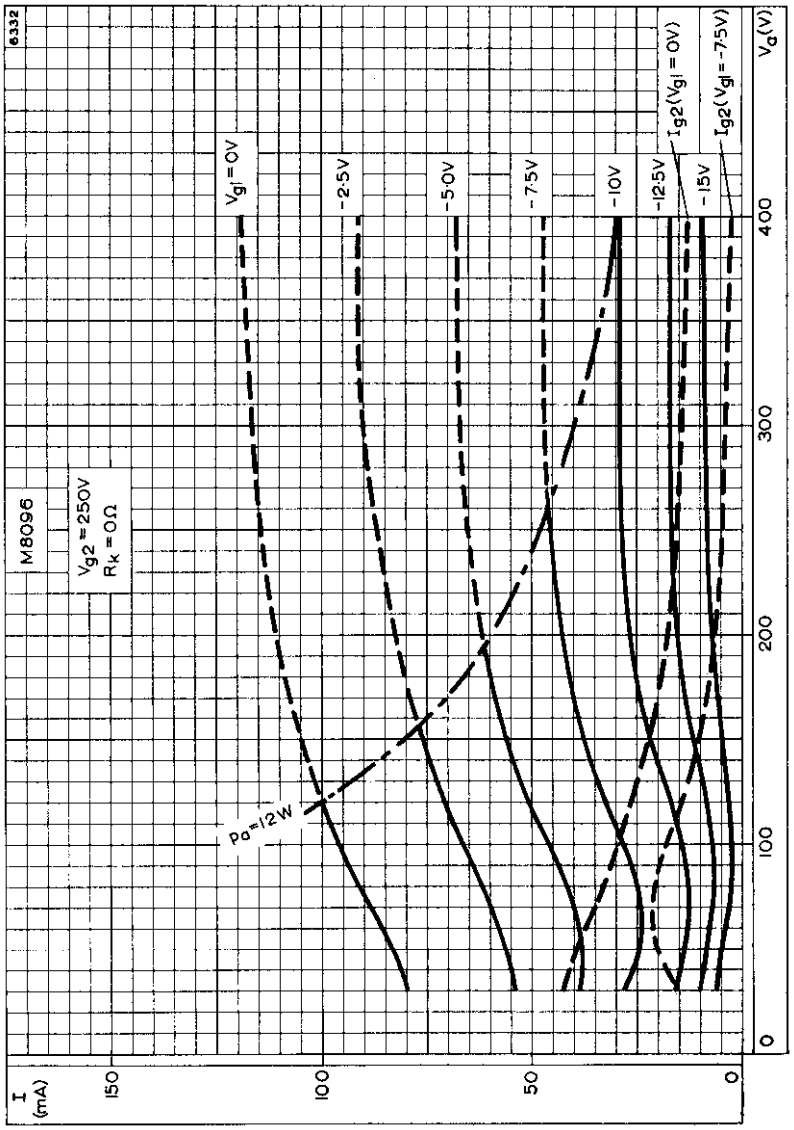
M8096



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

M8096

SPECIAL QUALITY
V.H.F. POWER TETRODE



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

SPECIAL QUALITY V.H.F. PENTODE

M8100

Special quality low noise, high slope r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	175	mA

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<20	mpF
c_{in}	4.0	pF
c_{out}	3.1	pF

CHARACTERISTICS[3]

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_k	0	0	Ω

ABSOLUTE MAXIMUM RATINGS[4]

f max.	400	Mc/s
$V_{a(b)}$ max.	400	V
V_a max.	200	V
p_a max.	1.65	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_{g1} max.	4.0	mA
R_{g1-k} max.	3.0	MΩ←
I_k max.	20	mA
V_{h-k} max.	130	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	120	120	−2.0	0	0

TESTS	A.Q.L.[5] (%)	*Individuals*[6] Bogey[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
R_{g1} max. = 500kΩ	0.25	—	—	0.1	—	—	—	μA
GROUP B								
Heater current	0.65	—	160	190	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	—	—	μA
Anode current	0.65	7.5	5.0	11	—	—	—	mA
	—	—	—	—	6.5	8.5	0.87	mA
Screen-grid current	0.65	2.5	0.8	4.0	—	—	—	mA
	—	—	—	—	1.8	3.2	0.52	mA
Mutual conductance	0.65	5.0	4.0	6.25	—	—	—	mA/V
	—	—	—	—	4.525	5.475	0.357	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_{g1} = -10V$	2.5	—	—	200	—	—	—	μA
Anode current. $V_{g1} = -5.5V$	2.5	—	5.0	—	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current. $V_h = 7.0V$, $R_{g1} = 100k\Omega$	2.5	—	—	0.5	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration, $V_b = 135V$, $R_a = 2k\Omega$, $R_{g2} = 10k\Omega$, $C_{g2} = 2\mu F$, $R_{g1} = 100k\Omega$	2.5	—	—	45	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

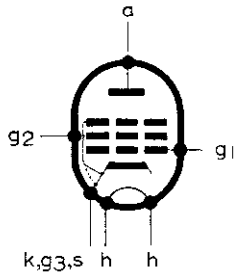
GROUP D

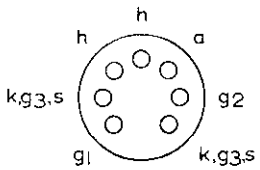
Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.4	4.6	—	—	—	pF
c_{out}	—	—	2.45	3.25	—	—	—	pF
c_{a-g1}	—	—	—	20	—	—	—	mpF
Noise factor	4.0	—	—	2.5	—	—	—	dB

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.3V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current.								
V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current.								
R_{g1} max. = 500kΩ	2.5	—	—	0.2	—	—	—	μA
Mutual conductance	2.5	—	3.5	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	90	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current.								
V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current.								
R_{g1} max. = 500kΩ	2.5	—	—	0.2	—	—	—	μA
Mutual conductance	2.5	—	3.5	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	90	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
GROUP F								
Stability life test[14]								
Running conditions. V_a = 150V, V_{g2} = 125V, R_{g1} = 100kΩ, R_k = 130Ω, V_{h-k} = 135V (cathode negative).								

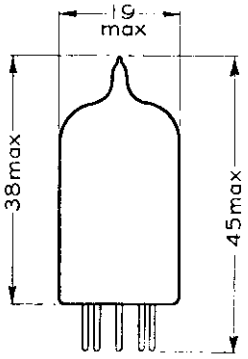
Stability life test end points									
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%	
Intermittent life test									
Running conditions. $V_a = 150V$, $V_{g2} = 125V$, $R_{g1} = 100k\Omega$, $R_k = 130\Omega$, $V_{h-k} = 135V$ (cathode negative).									
Intermittent life test end points					A.Q.L.[5] (%)	*Min.*	*Max.*		
Sub-group (a)									
Inoperatives[16]				500 hours	2.5	—	—		
				1000 hours	4.0	—	—		
Heater current				500 hours	2.5	160	190	mA	
				1000 hours	4.0	160	190	mA	
Heater to cathode leakage current. $V_{h-k} = \pm 100V$				500 hours	2.5	—	10	μA	
				1000 hours	4.0	—	10	μA	
Reverse grid current. R_{g1} max. = 500kΩ				500 hours	2.5	—	0.1	μA	
				1000 hours	4.0	—	0.1	μA	
Mutual conductance				500 hours	2.5	3.75	6.25	mA/V	
				1000 hours	4.0	3.5	6.25	mA/V	
Average change in mutual conductance				500 hours	—	—	15	%	
Sub-group (b)									
Anode current				500 hours	4.0	4.5	11	mA	
				1000 hours	6.5	4.0	11	mA	
Insulation as in group A				500 hours	4.0	50	—	MΩ	
				1000 hours	6.5	30	—	MΩ	
Noise factor				500 hours	4.0	—	2.7	dB	
				1000 hours	6.5	—	2.8	dB	
Group quality level[10]				500 hours	6.5	—	—		
				1000 hours	10	—	—		
GROUP G									
Valves are held for 28 days and retested for									
Inoperatives[16]					0.5	—	—		
Reverse grid current. R_{g1} max. = 500kΩ					0.5	—	0.15	μA	

M8100 SPECIAL QUALITY V.H.F. PENTODE





B7G Base



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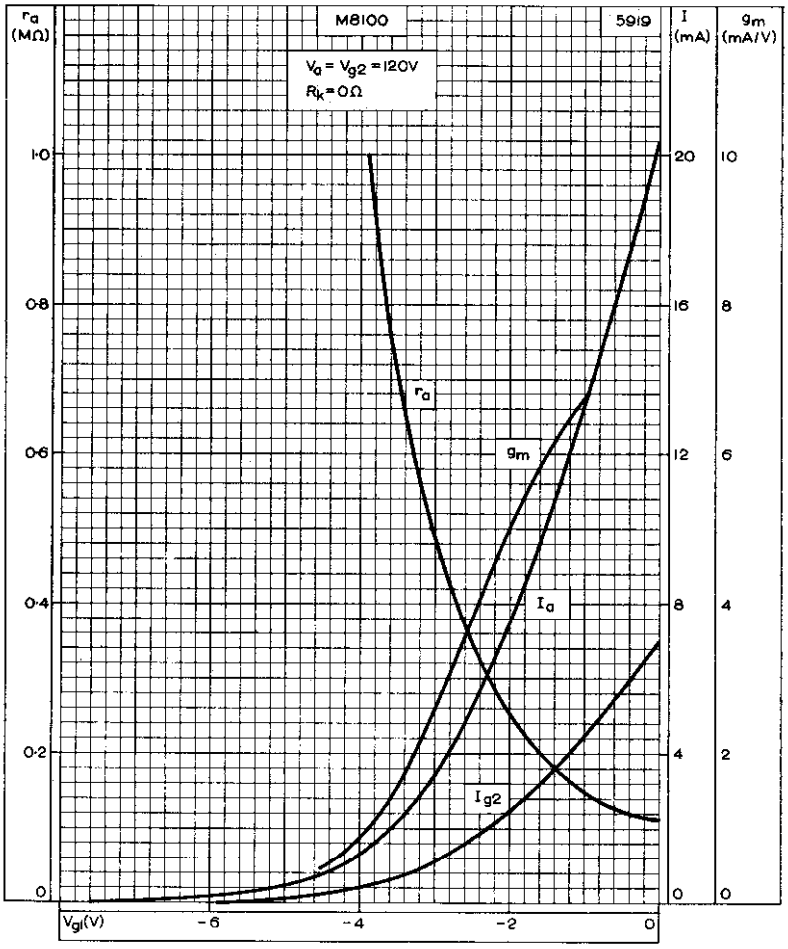
All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

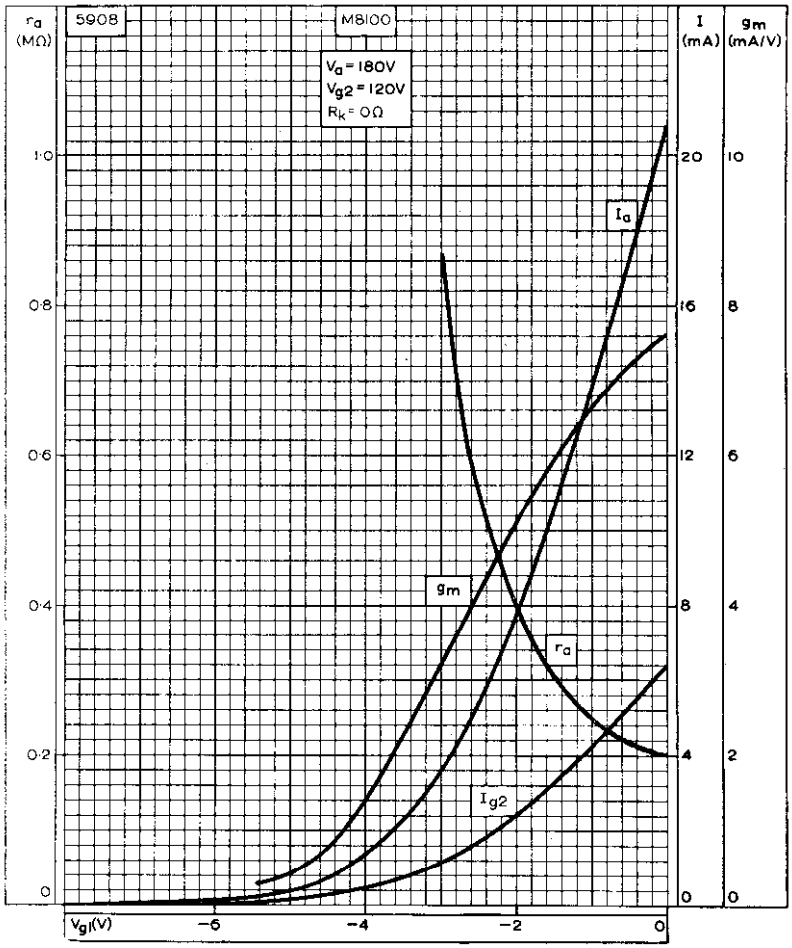
SPECIAL QUALITY V.H.F. PENTODE

M8100

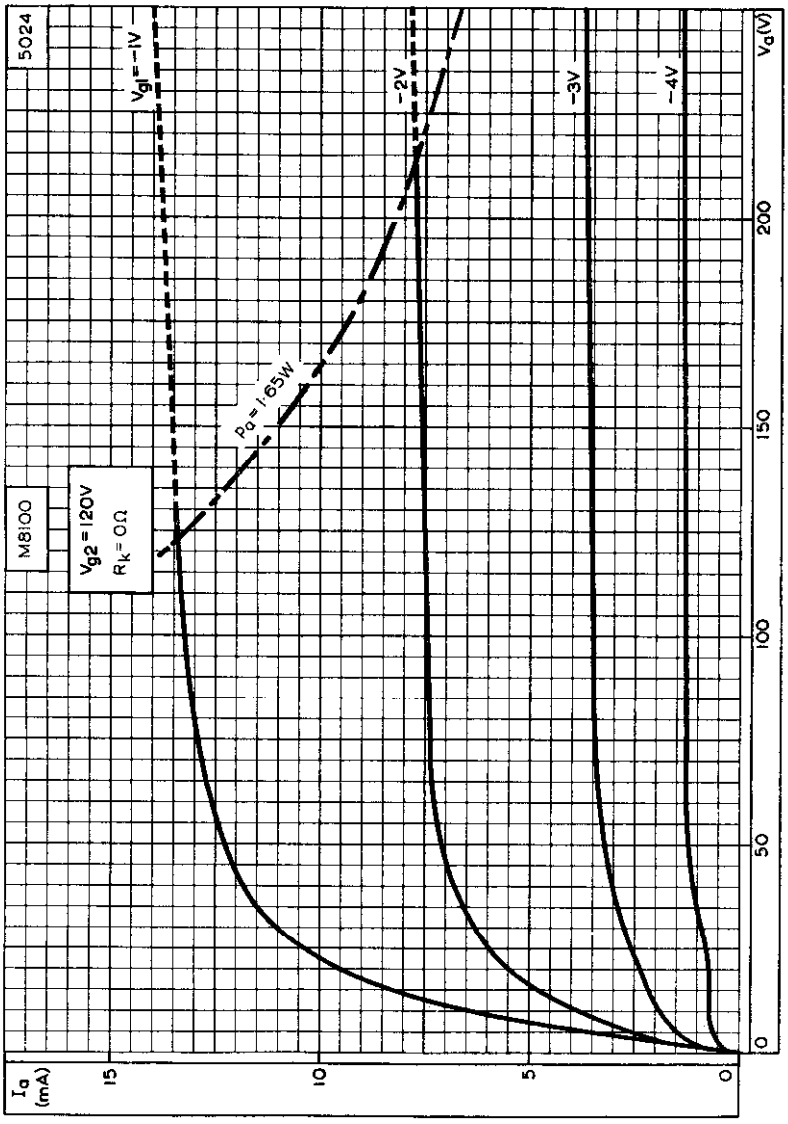


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = 120V$

M8100 SPECIAL QUALITY V.H.F. PENTODE

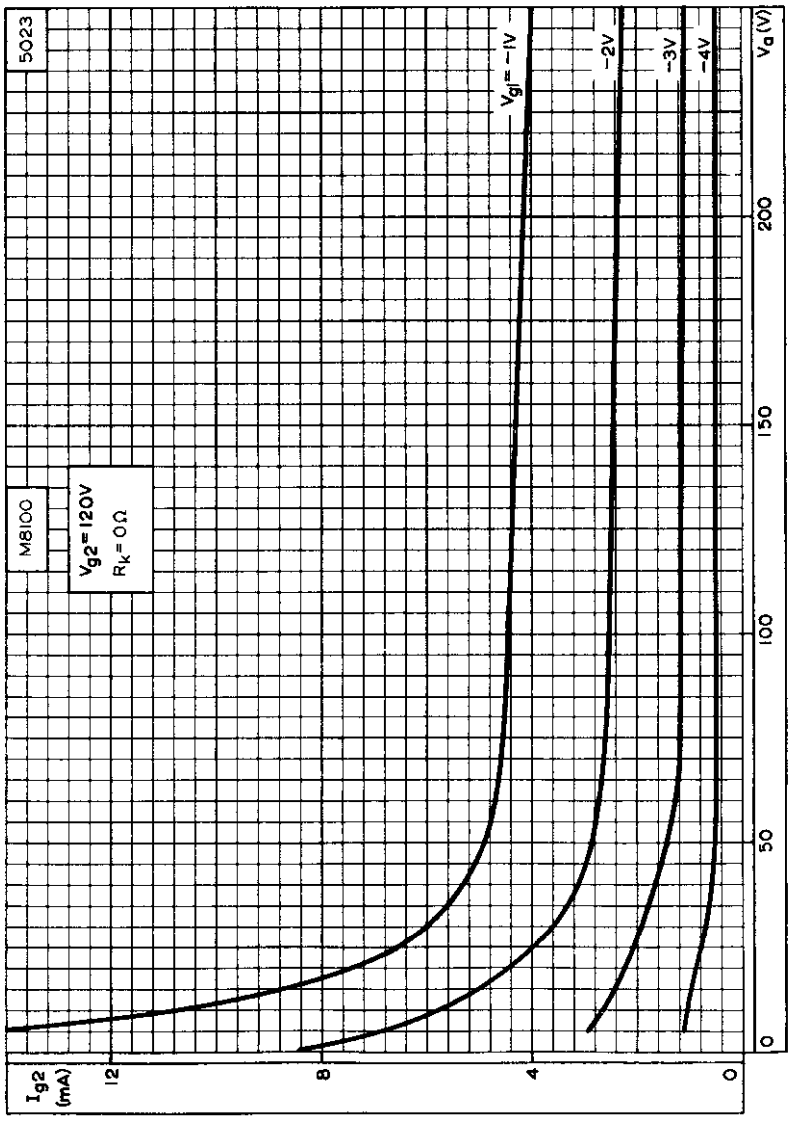


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = 180V$

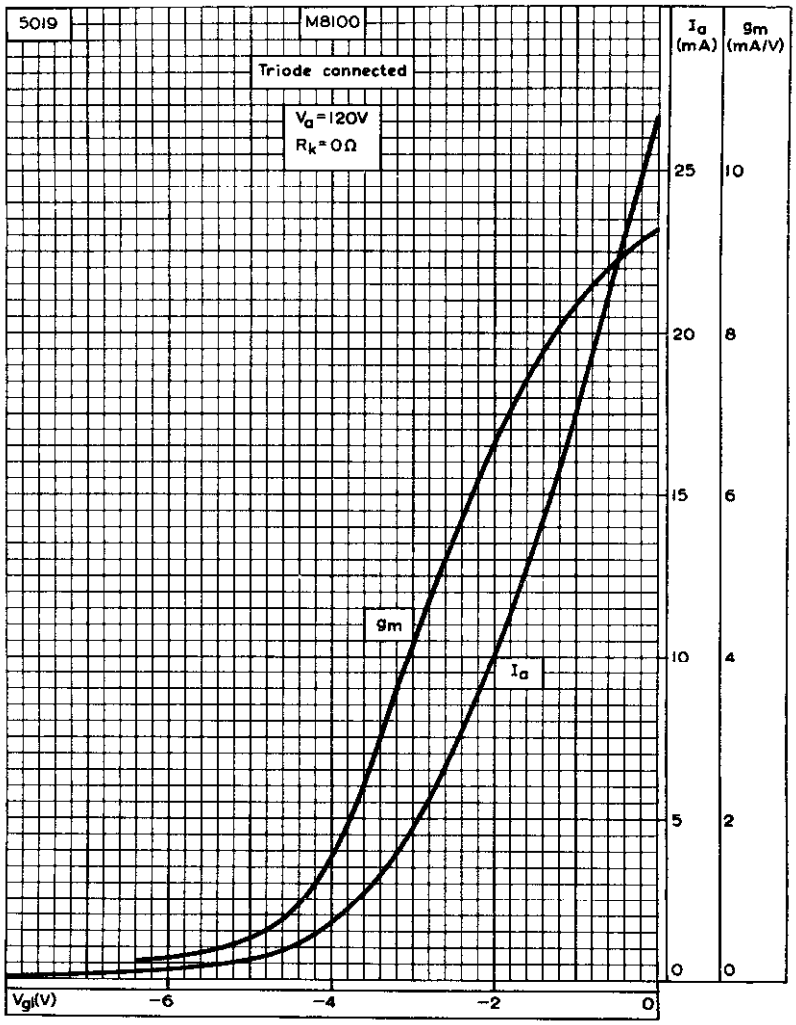


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.

M8100 SPECIAL QUALITY V.H.F. PENTODE

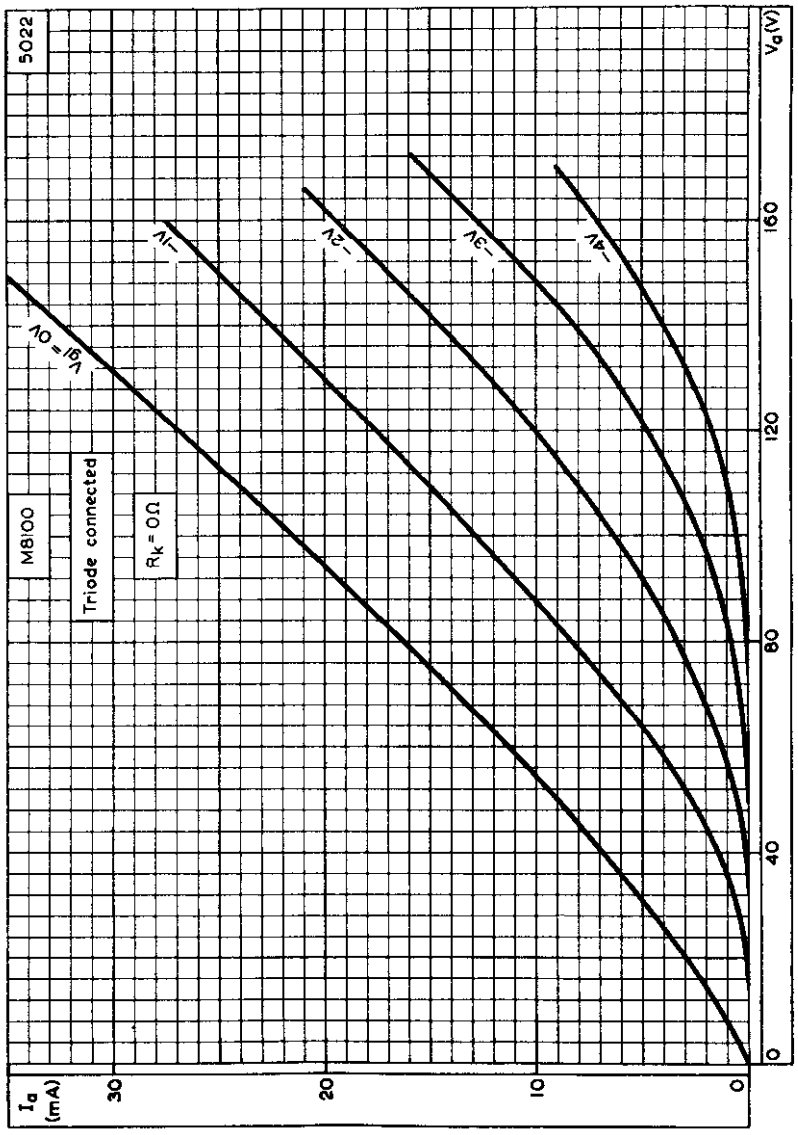


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.



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

M8100 SPECIAL QUALITY V.H.F. PENTODE



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

SPECIAL QUALITY DOUBLE TRIODE

M8136

Special quality low μ double triode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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[1]	12.6	6.3	V
I_h	150	300	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured without an external shield)

$*c_{a-g}$	1.5	pF
$*c_{in}$	1.6	pF
$c_{out'}$	550	mpF
$c_{out''}$	450	mpF

*Each section

CHARACTERISTICS[3] (each section)

V_a	250	V
I_a	10.5	mA
V_g	–8.5	V
g_m	2.2	mA/V
r_a	7.7	kΩ
μ	17	
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings) each section

V_a max.	330	V
p_a max.	3.0	W
I_k max.	20	mA
$-V_g$ max.	110	V
$*-V_{g(pulse)}$ max.	200	V ←
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

$*t_p$ = 800μs, duty factor (max.) = 0.05

M8136

SPECIAL QUALITY DOUBLE TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_g (V)	R_k (Ω)	V_{h-k} (V)
12.6	250	–8.5	0	0

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
g-rest measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current R_g max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	2.0	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	2.0	—	μA
Anode current	0.65	10.5	6.5	14.5	—	—	—	mA
	—	—	—	—	9.0	12	1.22	mA
Mutual conductance	0.65	2.2	1.75	2.65	—	—	—	mA/V
	—	—	—	—	2.0	2.4	0.157	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current.								
V_g = –25V	2.5	—	—	20	—	—	—	μA
V_g = –18V	2.5	—	5.0	—	—	—	—	μA
Anode current difference between sections	2.5	—	—	3.5	—	—	—	mA
Change in mutual conductance. V_h = 11.4V	2.5	—	—	15	—	—	—	%
Reverse grid current. V_h = 14V, R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, V_b = 250V, R_a = 2kΩ, R_k = 410Ω, V_{g-e} = 0V, C_k = 1000μF. Both sections connected in parallel	2.5	—	—	100	—	—	—	mV (r.m.s.)
Group quality level [10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
*C_{a-g}	—	—	1.1	1.9	—	—	—	pF
*C_{in}	—	—	1.2	2.0	—	—	—	pF
C_{out}'	—	—	300	700	—	—	—	mpF
C_{out}''	—	—	300	600	—	—	—	mpF
*Each section								
Mutual conductance. V_a = 100V, V_g = 0V	6.5	3.25	2.5	4.0	—	—	—	mA/V
	—	—	—	—	2.85	3.65	0.31	mA/V
Amplification factor	6.5	17	15.5	18.5	—	—	—	
	—	—	—	—	16.2	17.8	0.63	

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 14V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f= 170c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Mutual conductance	2.5	—	1.6	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	150	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Mutual conductance	2.5	—	1.6	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	150	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions. R_g = 500kΩ,
V_{h-k} = 175V (cathode negative)

Stability life test end point

Change in mututal conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions, R_g = 500kΩ
V_{h-k} = 175V (cathode negative)

Intermittent life test end points

		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	138	162	mA
Heater to cathode leakage current. V_{h-k} = ±100V	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current. R_g max. = 500kΩ	500 hours	2.5	—	0.5	μA
	1000 hours	4.0	—	0.5	μA
Mutual conductance	500 hours	2.5	1.6	2.65	mA/V
	1000 hours	4.0	1.5	2.65	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	5.5	14.5	mA
	1000 hours	6.5	5.0	14.5	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8136 SPECIAL QUALITY DOUBLE TRIODE

GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse grid current. R_g max. = 500kΩ	0.5	—	0.5	μA

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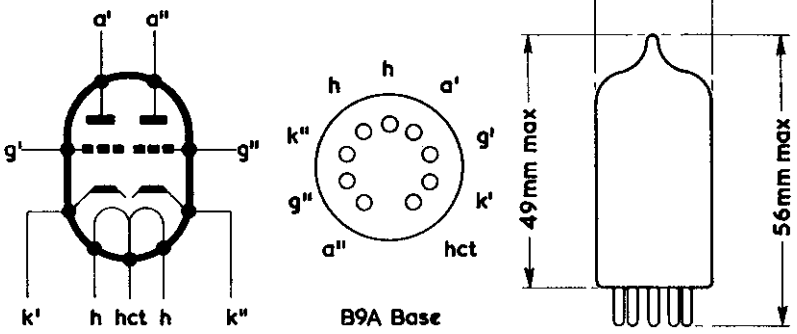
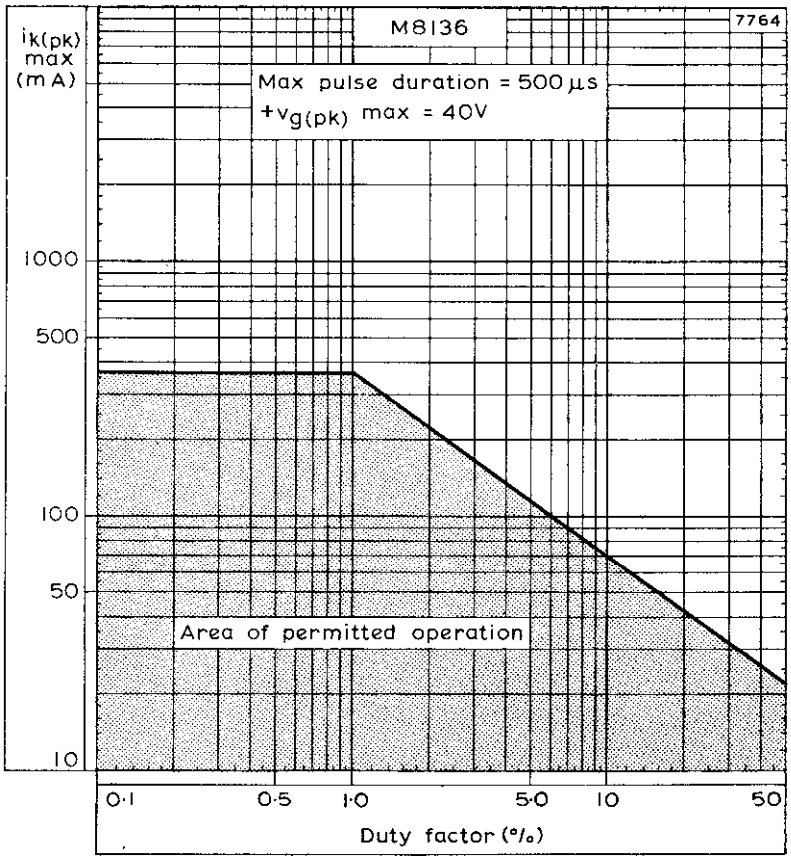
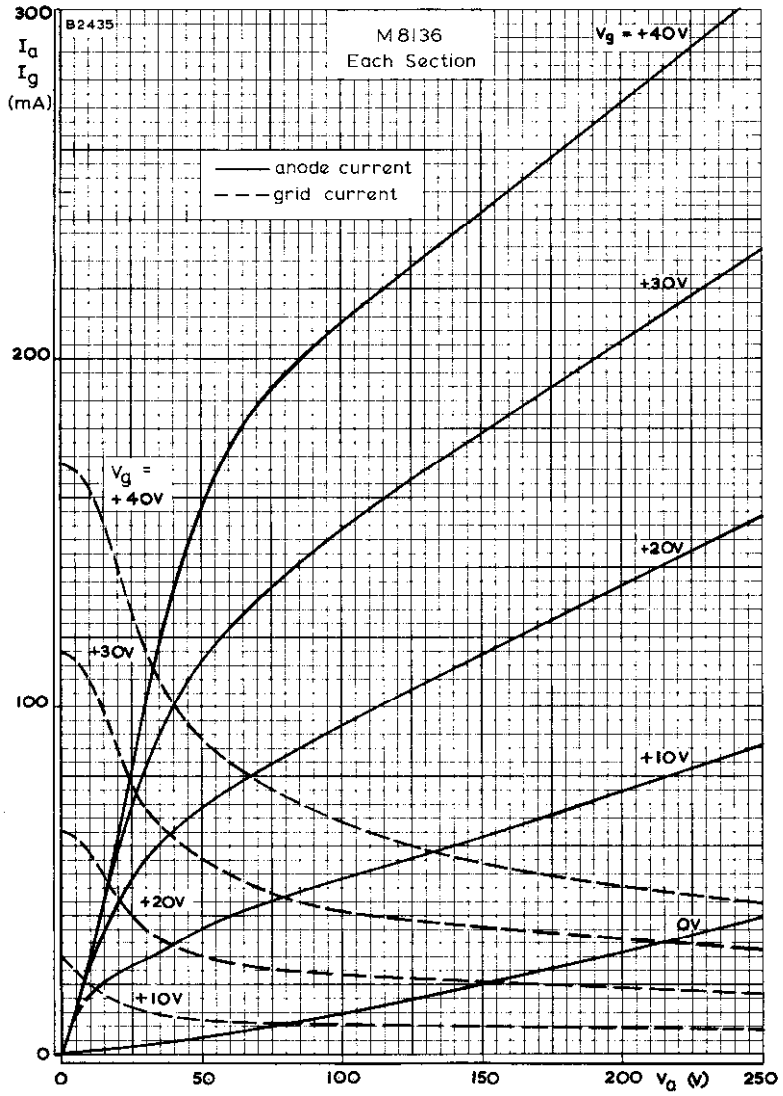


The bulb and base dimensions of this valve are in accordance with BS448, Section B9A



PULSE RATING CHART

M8136 SPECIAL QUALITY DOUBLE TRIODE



ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE
WITH POSITIVE GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY DOUBLE TRIODE

M8137

Special quality high-μ double triode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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[1]	12.6	6.3	V
I_h	150	300	mA

CAPACITANCES[2] (measured without an external shield)

$*C_{a\cdot g}$	1.7	pF
$*C_{in}$	1.6	pF
$C_{out'}$	520	mpF
$C_{out''}$	400	mpF

*Each section

CHARACTERISTICS[3] (each section)

V_a	250	V
I_a	1.25	mA
V_g	−2.0	V
g_m	1.6	mA/V
μ	90	
r_a	56	kΩ
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings) each section

$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	1.1	W
I_k max.	20	mA
$-V_g$ max.	55	V
$*-V_{g(pulse)}$ max.	200	V ←
R_{g-k} max. (cathode bias)	2.2	MΩ
R_{g-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

$*t_p = 800\mu s$, Duty factor (max.) = 0.05

M8137 SPECIAL QUALITY DOUBLE TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_g (V)	R_k (Ω)	V_{h-k} (V)
12.6	250	−2.0	0	0

TESTS	*A.Q.L.*[5]	*Individuals*[6]			*Lot average*[7]		*Lot standard deviation*[8]	
	(%)	*Bogey*[9]	*Min.*	*Max.*	*Min.*	*Max.*	*Max.*	
GROUP A								
Insulation								
a-rest, measured at −300V	0.25	—	100	—	—	—	—	MΩ
g-rest, measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current. R_g max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater to cathode leakage current								
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	2.0	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	2.0	—	μA
Anode current	0.65	1.25	0.75	1.75	—	—	—	mA
	—	—	—	—	1.0	1.5	0.19	mA
Mutual conductance	0.65	1.6	1.25	2.05	—	—	—	mA/V
	—	—	—	—	1.425	1.775	0.136	mA/V
Anode current V_g = −4.0V	0.65	—	—	35	—	—	—	μA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current difference between sections	2.5	—	—	600	—	—	—	μA
Change in mutual conductance. $V_h = 11.4V$	2.5	—	—	15	—	—	—	%
Microphonic noise at the anode at 50c/s and 2g min. peak acceleration, $V_b = 250V$, $R_a = 2k\Omega$, $R_k = 1.5k\Omega$, $C_k = 1000\mu F$, $V_{g-e} = 0V$, both sections connected in parallel	2.5	—	—	25	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	1.2	2.0	—	—	—	pF
$C_{out'}$	—	—	220	700	—	—	—	mpF
$C_{out''}$	—	—	180	600	—	—	—	mpF
C_{a-g}	—	—	1.27	2.12	—	—	—	pF
Amplification factor	6.5	—	75	115	—	—	—	
Grid emission $V_h = 14V$, $R_g = 500k\Omega$	6.5	—	—	1.5	—	—	—	μA

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 14V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration. f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Microphonic noise as in group C	2.5	—	—	40	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Microphonic noise as in group C	2.5	—	—	40	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
GROUP F								
Stability life test[14]								
Running conditions. R_g = 500kΩ, V_{h-k} = 135V (cathode negative)								

Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions R_g = 500kΩ,
V_{h-k} = 135V (cathode negative)

Intermittent life test end points				A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)							
Inoperatives[16]	500 hours			2.5	—	—	
	1000 hours			4.0	—	—	
Heater current	500 hours			2.5	138	162	mA
Heater to cathode leakage. V_{h-k} = ±100V	500 hours			2.5	—	20	μA
	1000 hours			4.0	—	20	μA
Reverse grid current. R_g max. = 500kΩ	500 hours			2.5	—	0.5	μA
	1000 hours			4.0	—	0.5	μA
Mutual conductance	500 hours			2.5	1.15	2.05	mA/V
	1000 hours			4.0	1.12	2.05	mA/V
Average change in mutual conductance	500 hours			—	—	15	%
Sub-group (b)							
Anode current	500 hours			4.0	0.65	1.75	mA
	1000 hours			6.5	0.6	1.75	mA
Insulation as in group A	500 hours			4.0	50	—	MΩ
	1000 hours			6.5	30	—	MΩ
Group quality level[10]	500 hours			6.5	—	—	
	1000 hours			10	—	—	

M8137 SPECIAL QUALITY DOUBLE TRIODE

	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current. R_g max. = 500kΩ	0.5	—	0.5	μA

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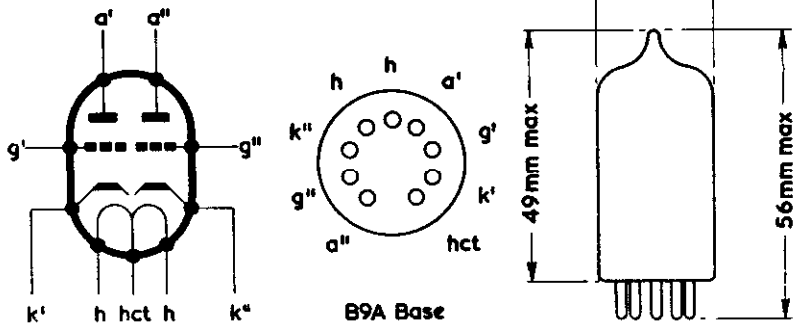
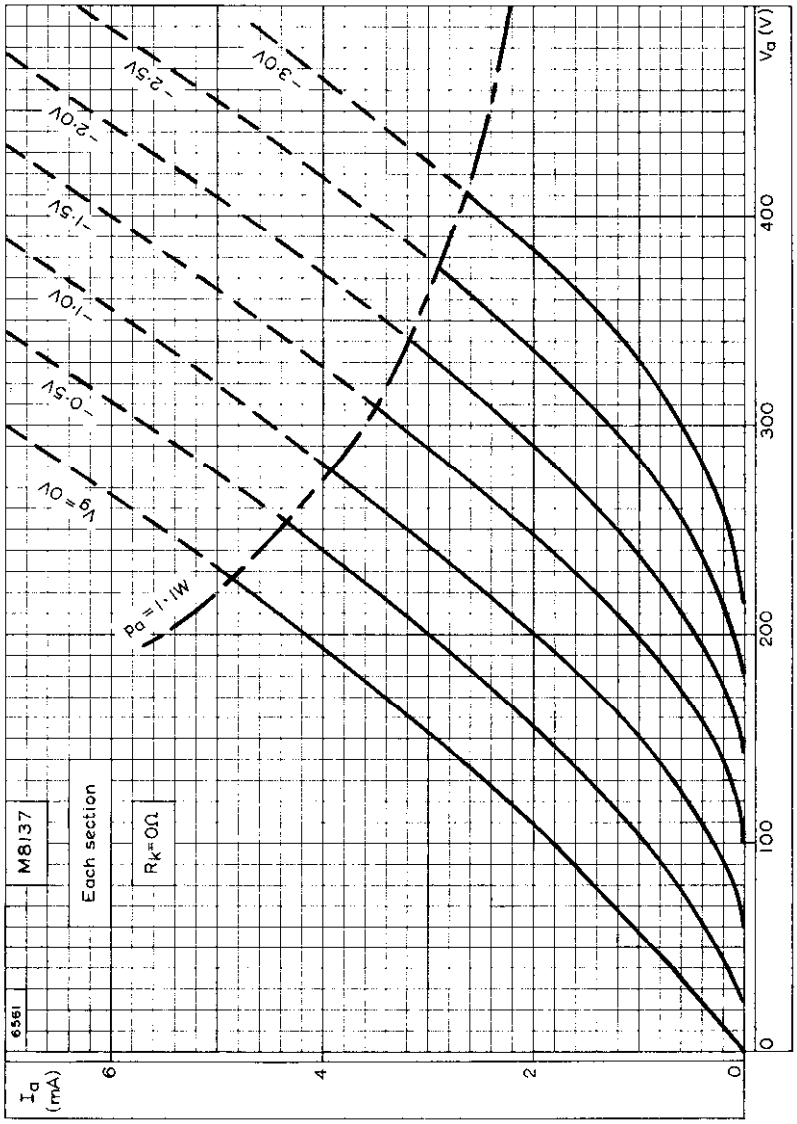


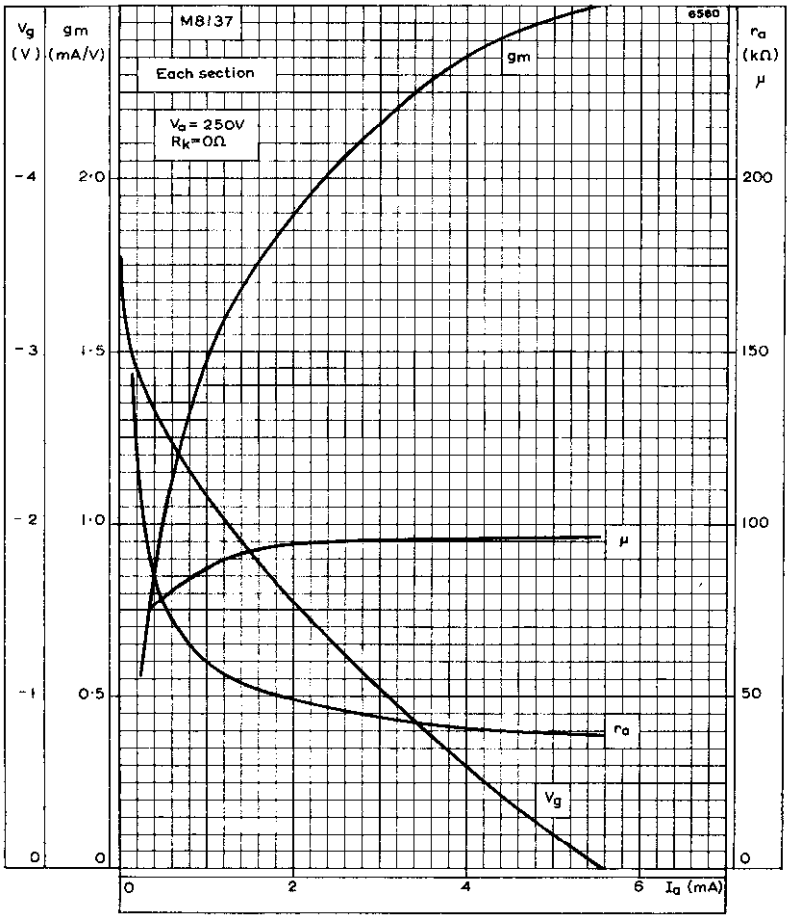
The bulb and base dimensions of this valve are in accordance with BS448, Section B9A

SPECIAL QUALITY DOUBLE TRIODE **M8137**



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

M8137 SPECIAL QUALITY DOUBLE TRIODE



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

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161

Special quality variable-mu r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES[2]

	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[3]

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	
R_k	0	Ω
V_{g1} (for 100 : 1 reduction in g_m)	−27	V

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	300	V
p_{g2} max.	700	mW
$-V_g$ max.	55	V←
I_k max.	14	mA
R_{g1-k} max. (cathode bias)	500	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
V_{h-k} max.	150	V
Maximum fatigue (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

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SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	200	0	200	−2.5	*0	0

TESTS

GROUP A	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
Insulation								
a-rest, g_2-rest, g_3-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	184	216	—	—	—	mA
Heater-to-cathode leakage current								
V_{h-k} = 100V cathode positive, cathode negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	—	—	3.0	—	μA
Anode current	0.65	8.25	6.0	10.5	—	—	—	mA
	—	—	—	—	7.6	8.9	0.77	mA
Screen-grid current	0.65	—	1.2	3.0	—	—	—	mA
	—	—	—	—	—	2.4	—	mA
Mutual conductance	0.65	2.45	1.8	3.1	—	—	—	mA/V
	—	—	—	—	2.25	2.65	0.23	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Mutual conductance. $V_{g1} = -26V$	2.5	—	4.0	60	—	—	—	μA/V
Reverse grid current. $V_{g1} = -50V$	2.5	—	—	1.0	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current. $V_h = 6.9V$, $V_{a-e} = 300V$, $V_{g2-e} = 200V$, $R_k = 240\Omega$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, $V_{a(b)} = 200V$, $R_a = 2.0k\Omega$	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.8	5.2	—	—	—	pF
c_{out}	—	—	5.0	7.4	—	—	—	pF ←
c_{a-g1}	—	—	—	10	—	—	—	mpF
Grid 3 cut-off voltage. $V_{g1} = -7.0V$, $I_a = 50\mu A$	6.5	—	−55	−125	—	—	—	V
Amplification factor (μ_{g1-g2})	6.5	—	23	39	—	—	—	

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SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170 ± 5c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater-to-cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	3.1	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater-to-cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	3.1	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)

GROUP F

Stability life test[14]

Running conditions. R_{g1} = 100kΩ, V_a = 250V, V_{h-k} = 135V (cathode negative), R_k = 160Ω, V_{g1-e} = 0V

Stability life test end point

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions. R_{g1} = 100kΩ, V_a = 250V, V_{h-k} = 135V (cathode negative), R_k = 160Ω

Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	184	216	mA
Heater-to-cathode leakage current. V_{h-k} = ±100V	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	30	μA
Reverse grid current. R_{g1} max. = 500kΩ	500 hours	2.5	—	0.75	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	1.6	3.1	mA/V
	1000 hours	4.0	1.5	3.1	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

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SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse grid current. R_{g1} max. = 500kΩ	0.5	—	0.75	μA

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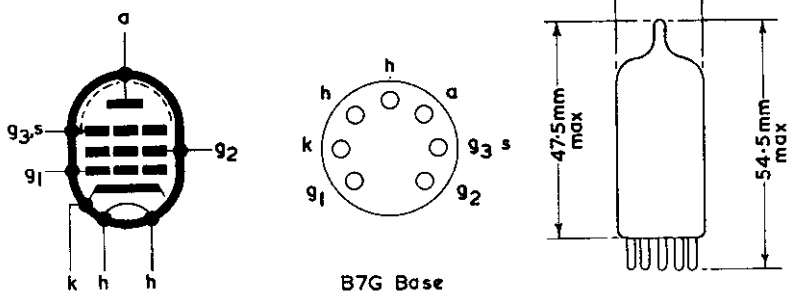
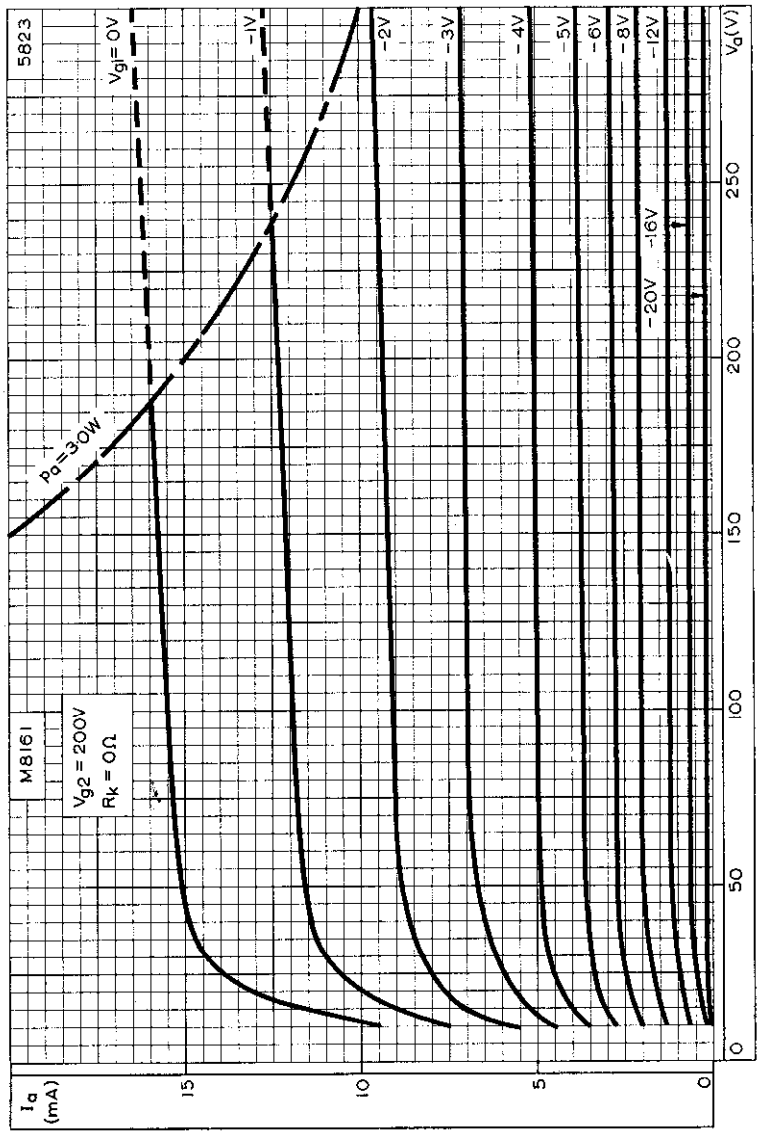


B7G Base

The bulb and base dimensions of this valve are in accordance with BS448 Section B7G

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161



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

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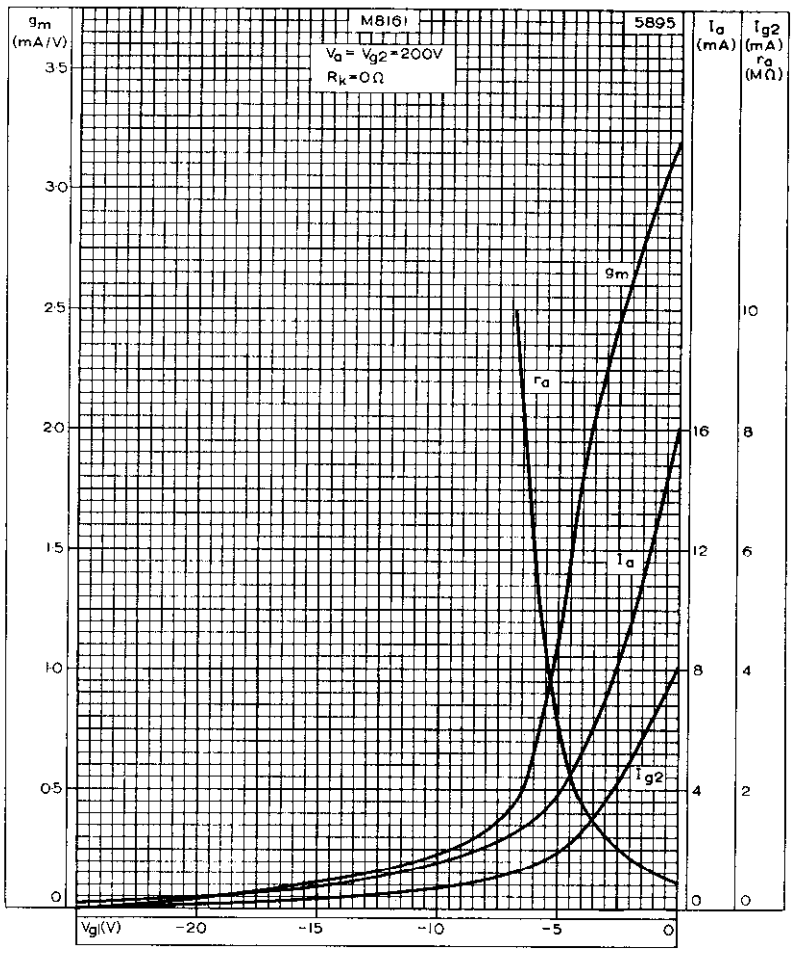
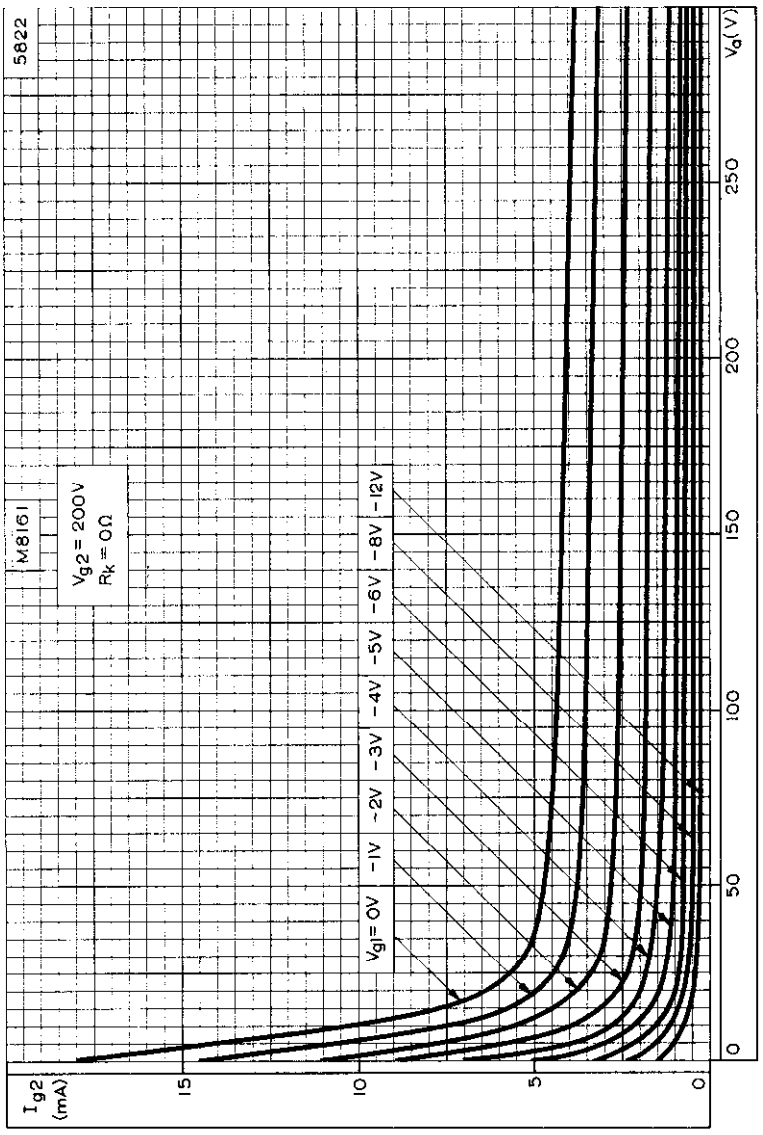
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



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

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

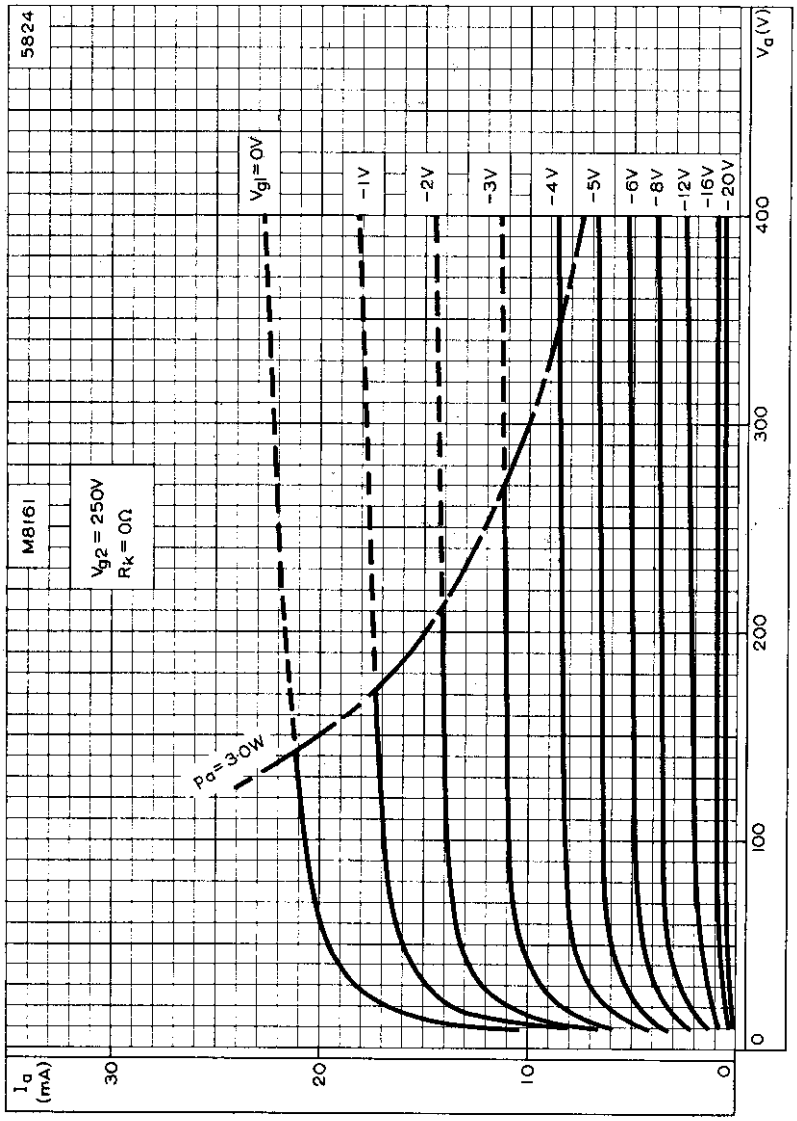
M8161



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

M8161

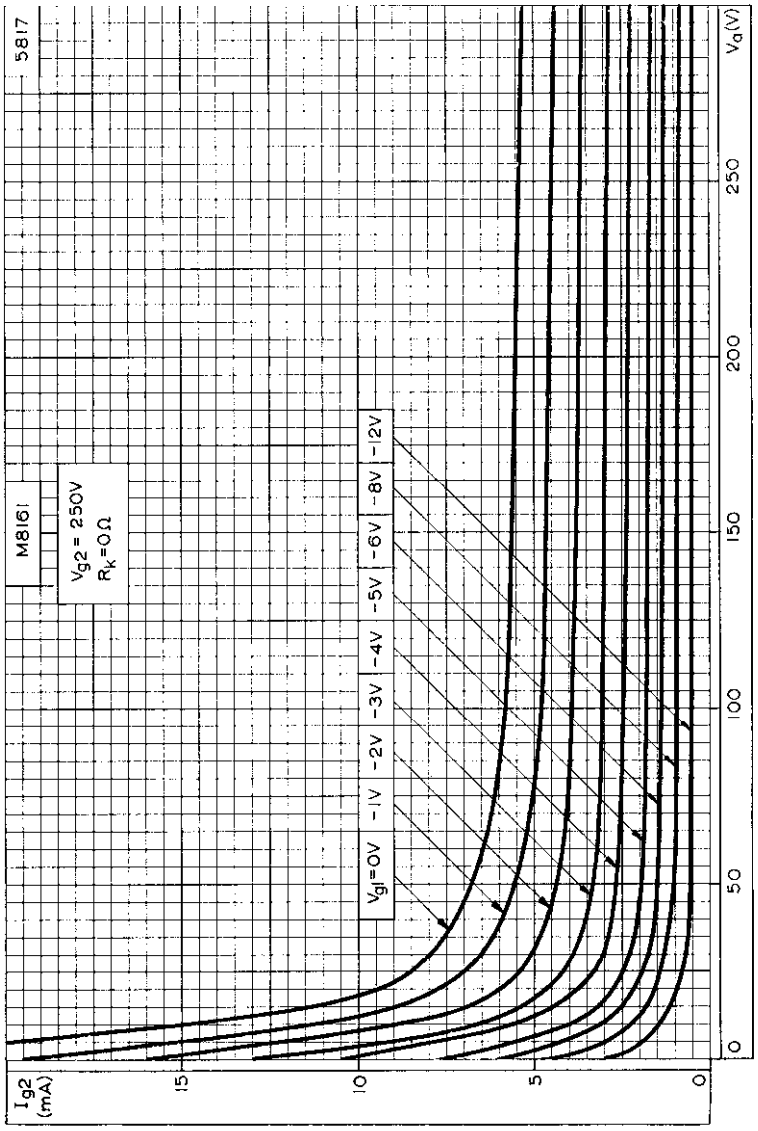
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



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

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161



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

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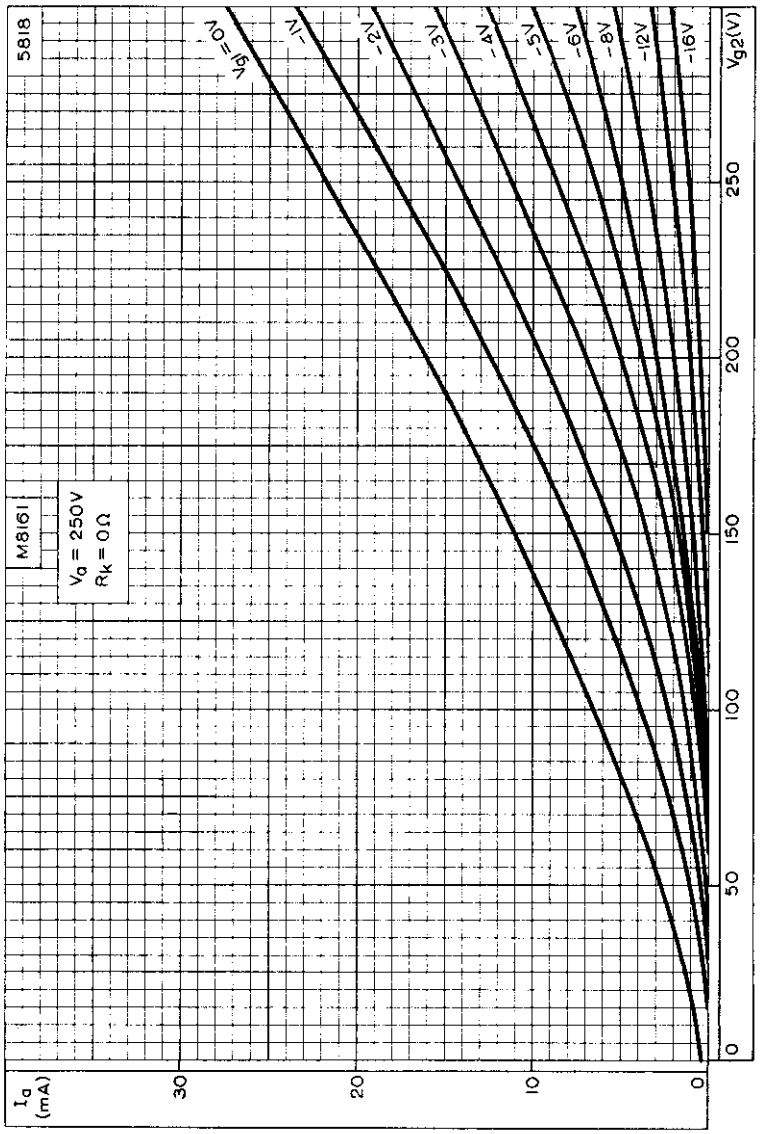
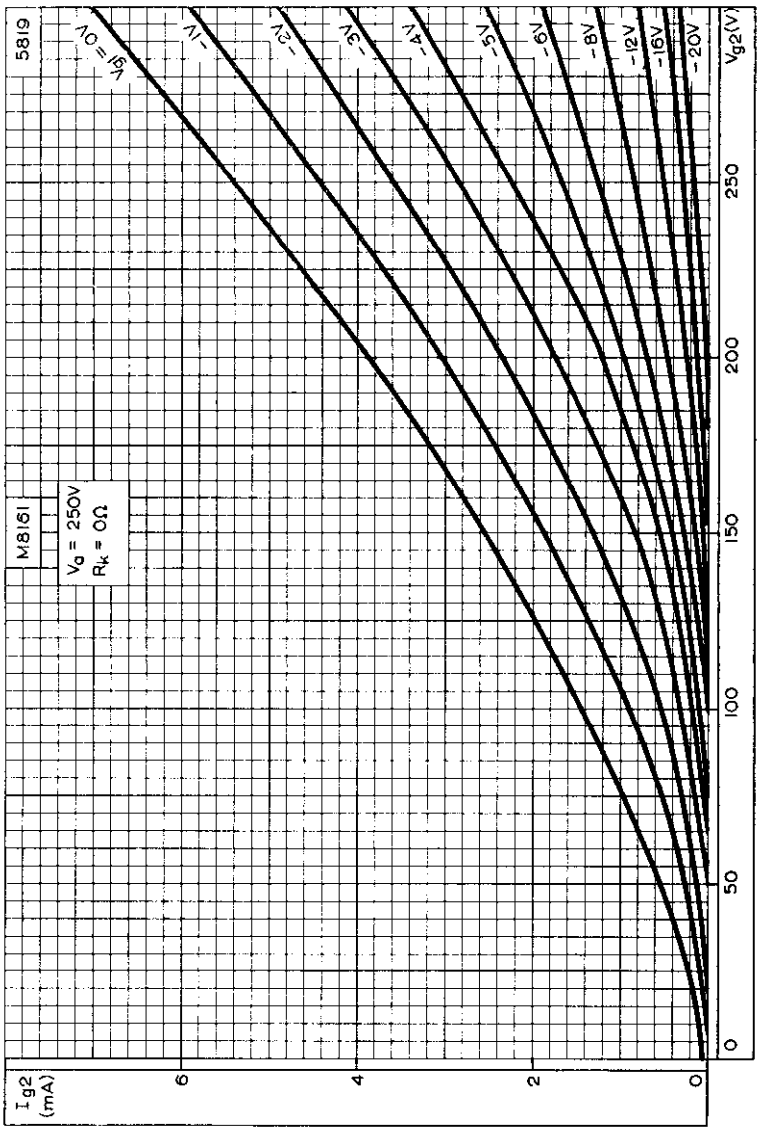
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



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

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161



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

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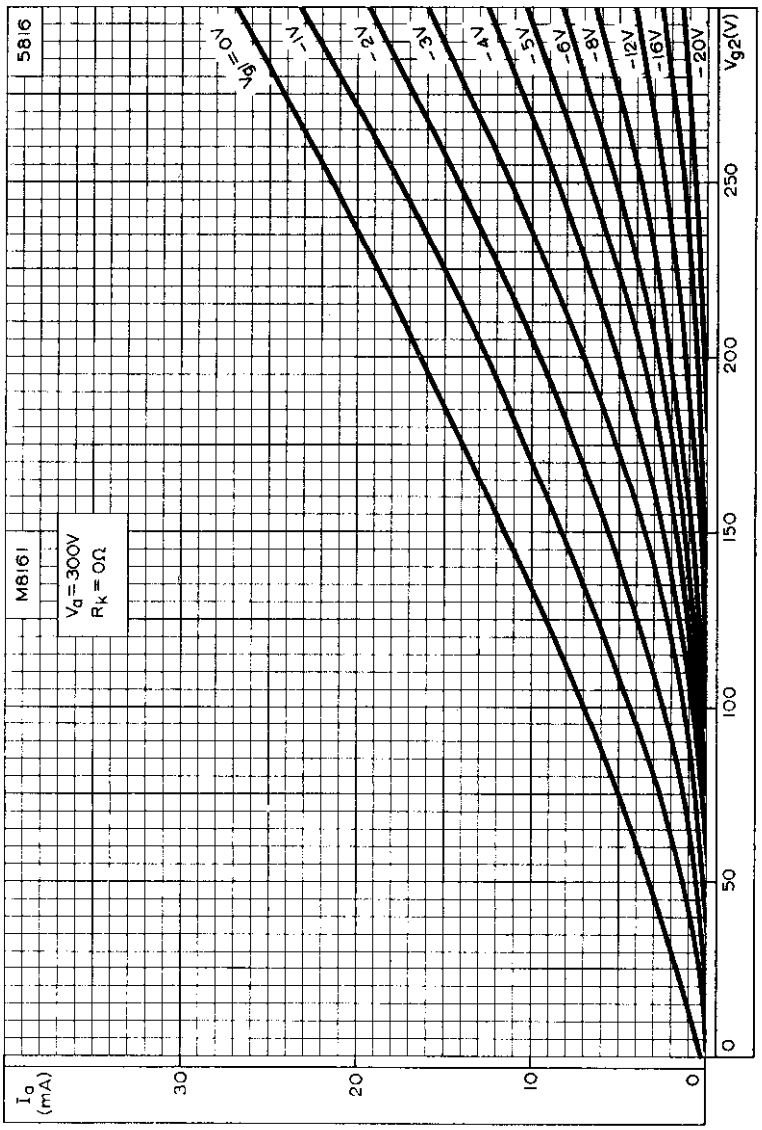
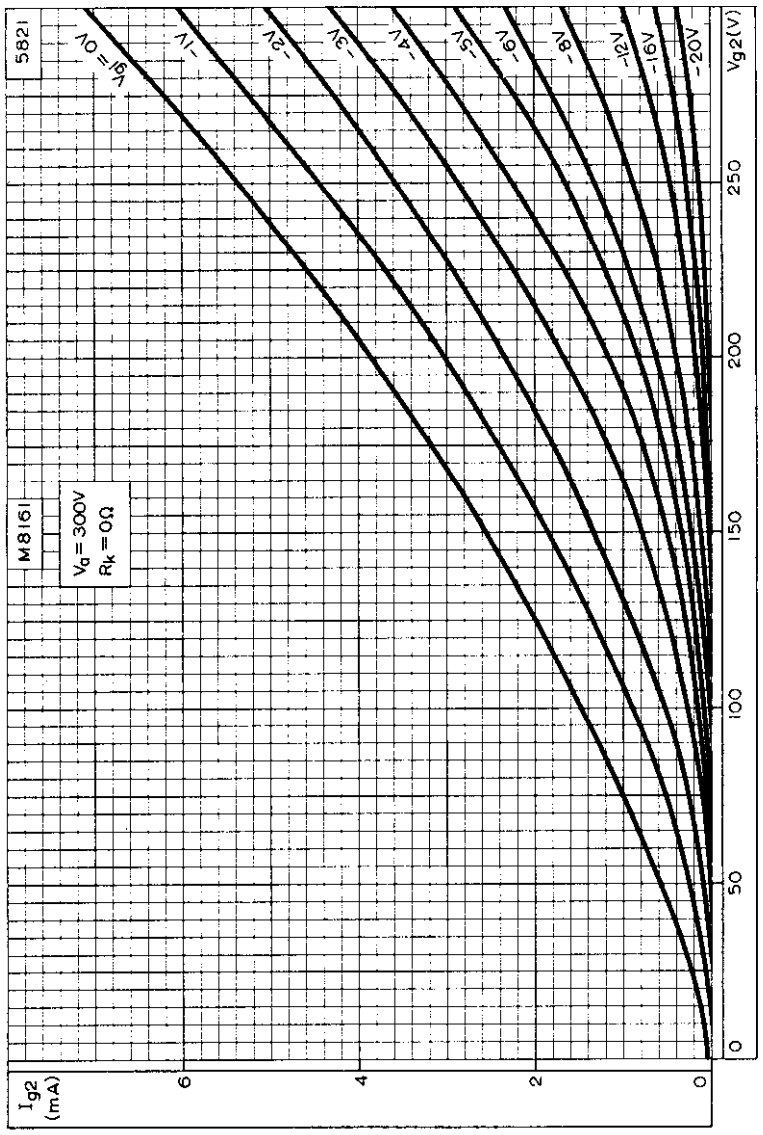
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



ANODE CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 300V.

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 300V.

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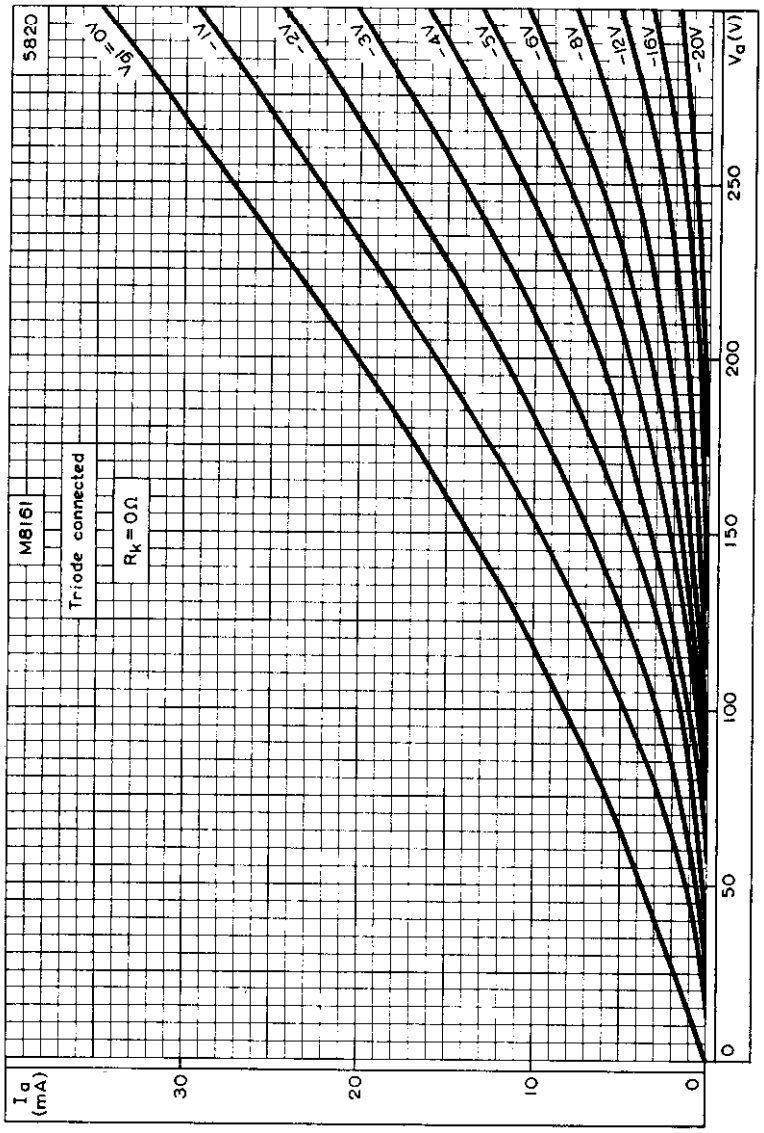
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



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

SPECIAL QUALITY DOUBLE TRIODE

M8162

Special quality double triode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

The heater is centre-tapped and the two sections may be operated in series or 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[1]	12.6	6.3	V
I_h	150	300	mA

CAPACITANCES[2] (measured without an external shield)

*c_{a-g}	1.6	pF
*c_{in}	2.2	pF
$c_{out'}$	470	mpF
$c_{out''}$	400	mpF
$c_{h-k'+k''}$	4.75	pF
$c_{a'-a''}$	240	mpF

*Each section

CHARACTERISTICS[3] (each section)

V_a	250	V
I_a	10	mA
V_g	−2.0	V
g_m	5.5	mA/V
μ	60	
r_a	11	kΩ
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings) each section

$V_{a(b)}$ max.	550	V
V_a max.	380	V
p_a max.	2.8	W
I_k max.	15	mA
$-V_g$ max.	55	V
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

M8162

SPECIAL QUALITY DOUBLE TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
12.6	250	0	200	1000	0

TESTS	A.Q.L.[5]	*Individuals*[6]			*Lot average*[7]		*Lot standard deviation*[8]	
	(%)	*Bogey*[9]	*Min.*	*Max.*	*Min.*	*Max.*	*Max.*	
GROUP A								
Insulation								
a-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
g-rest measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current. R_g max. = 500kΩ	0.25	—	—	0.7	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater to cathode leakage current								
V_{h-k} = 100V cathode negative	—	—	—	10	—	2.0	—	μA
V_{h-k} = 100V cathode positive	—	—	—	10	—	2.0	—	μA
Anode current	0.65	10	7.0	14	—	—	—	mA
	—	—	—	—	8.6	11.4	1.24	mA
Anode current V_{g-e} = –20V	0.65	—	—	10	—	—	—	μA
Mutual conductance	0.65	5.5	4.5	6.5	—	—	—	mA/V
	—	—	—	—	4.9	6.1	0.46	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current difference between sections	2.5	—	—	3.2	—	—	—	mA
Change in mutual conductance. $V_h = 11.4V$	2.5	—	4.0	—	—	—	—	mA/V
	—	—	—	—	—	4.4	—	mA/V
Microphonic noise at the anode at 50c/s and 2g min. peak acceleration, $V_b = 250V$, $R_a = 2k\Omega$, $R_k = 100\Omega$. Both sections connected in parallel	2.5	—	—	25	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	2.0	3.0	—	—	—	pF
$C_{out'}$	—	—	200	700	—	—	—	mpF
$C_{out''}$	—	—	160	600	—	—	—	mpF
C_{a-g}	—	—	1.3	1.9	—	—	—	pF
$C_{a'-a''}$	—	—	150	330	—	—	—	mpF
$C_{h-k'+k''}$	—	—	2.7	5.5	—	—	—	pF
Amplification factor	6.5	—	50	70	—	—	—	
Grid emission $V_h = 15V$, $V_g = -20V$ $R_g = 500k\Omega$, $R_k = 0\Omega$	6.5	—	—	1.5	—	—	—	μA

M8162

SPECIAL QUALITY DOUBLE TRIODE

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 14V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Mutual conductance	2.5	—	3.8	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	100	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current. R_g max. = 500kΩ	2.5	—	—	1.5	—	—	—	μA
Mutual conductance	2.5	—	3.8	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	100	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions. R_g = 500kΩ, C_k = 0μF
V_{h-k} = 135V (cathode negative)

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions R_g = 500kΩ, C_k = 0μF
V_{h-k} = 135V (cathode negative)

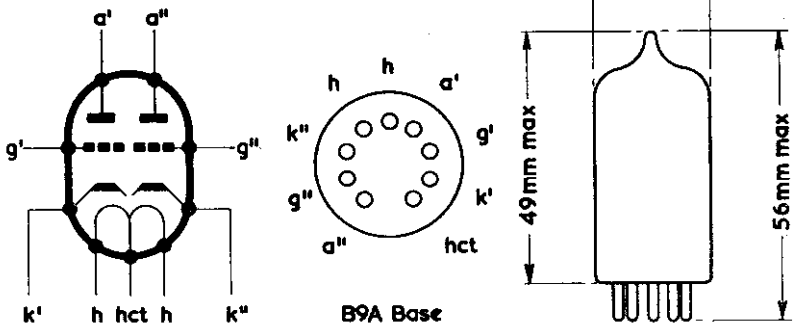
Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	138	162	mA
Heater to cathode leakage current. V_{h-k} = ±100V	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Reverse grid current. R_g max. = 500kΩ	500 hours	2.5	—	1.0	μA
	1000 hours	4.0	—	1.5	μA
Mutual conductance	500 hours	2.5	3.8	6.5	mA/V
	1000 hours	4.0	3.55	6.5	mA/V
Average change in mutual conductance	500 hours	—	—	15	% ←
Sub-group (b)					
Anode current	500 hours	4.0	6.0	14	mA
	1000 hours	6.5	5.35	14	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ ←
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8162 SPECIAL QUALITY DOUBLE TRIODE

GROUP G

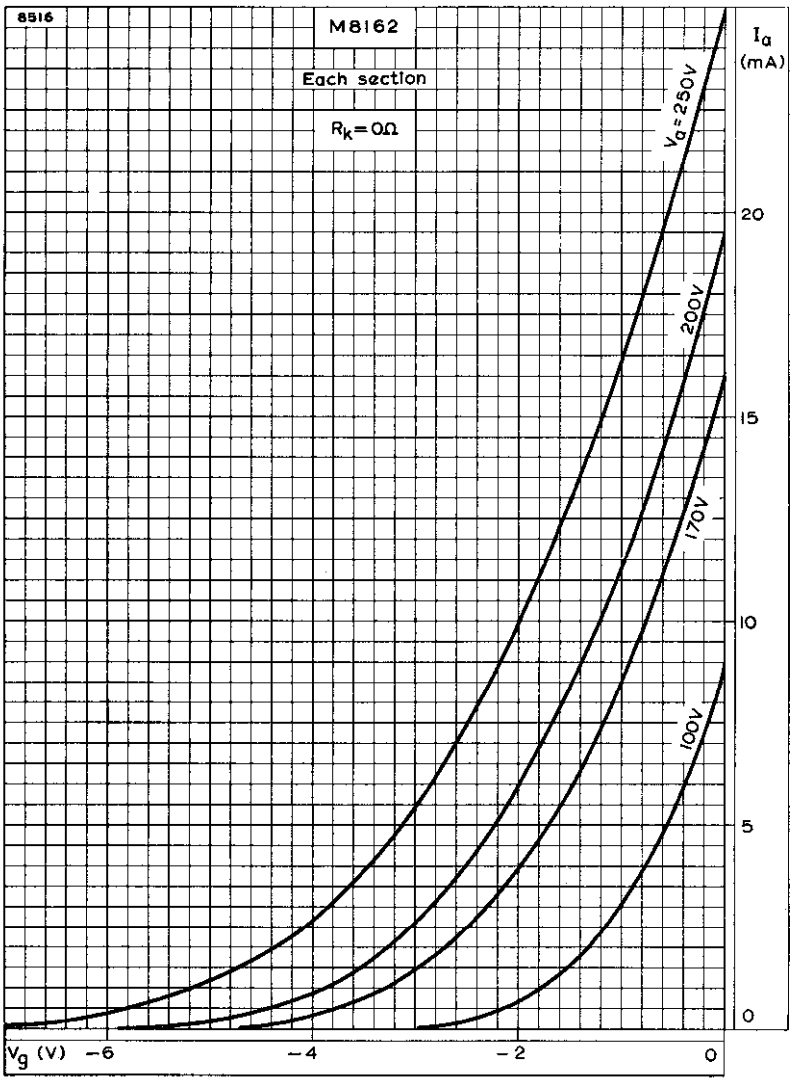
	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current. R_g max. = 500kΩ	0.5	—	0.7	μA

2678



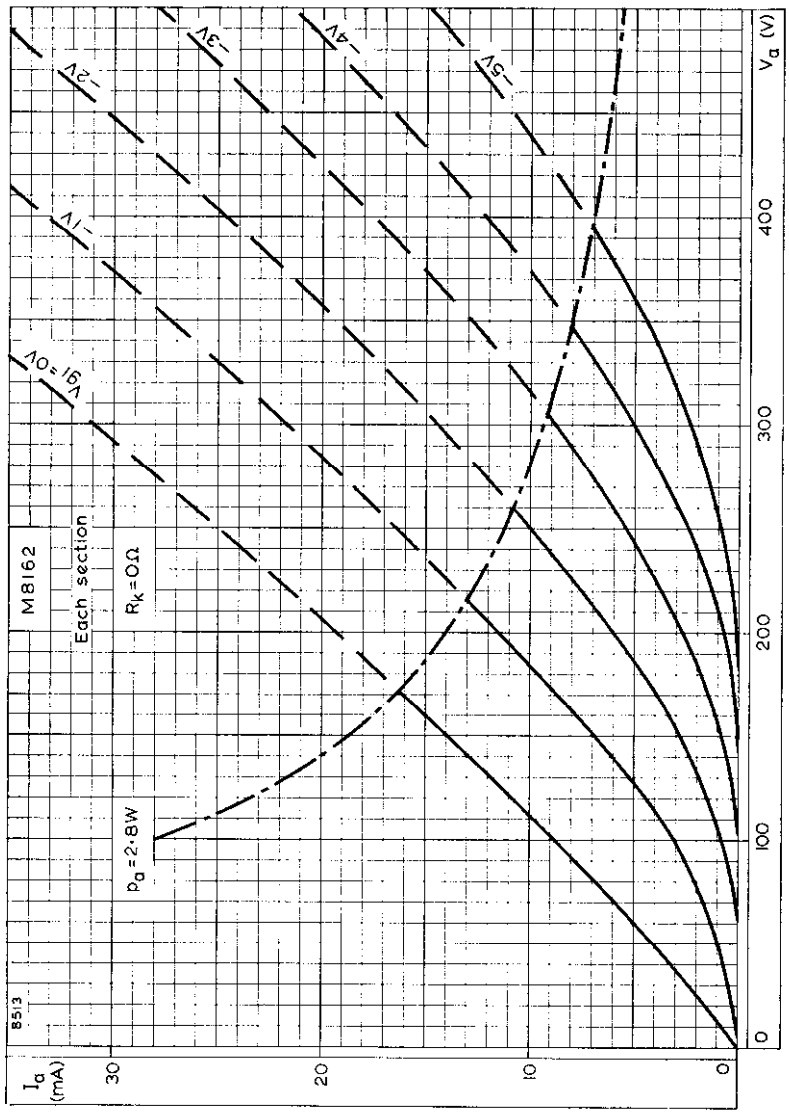
The bulb and base dimensions of this valve are in accordance with BS448, Section B9A

SPECIAL QUALITY DOUBLE TRIODE **M8162**



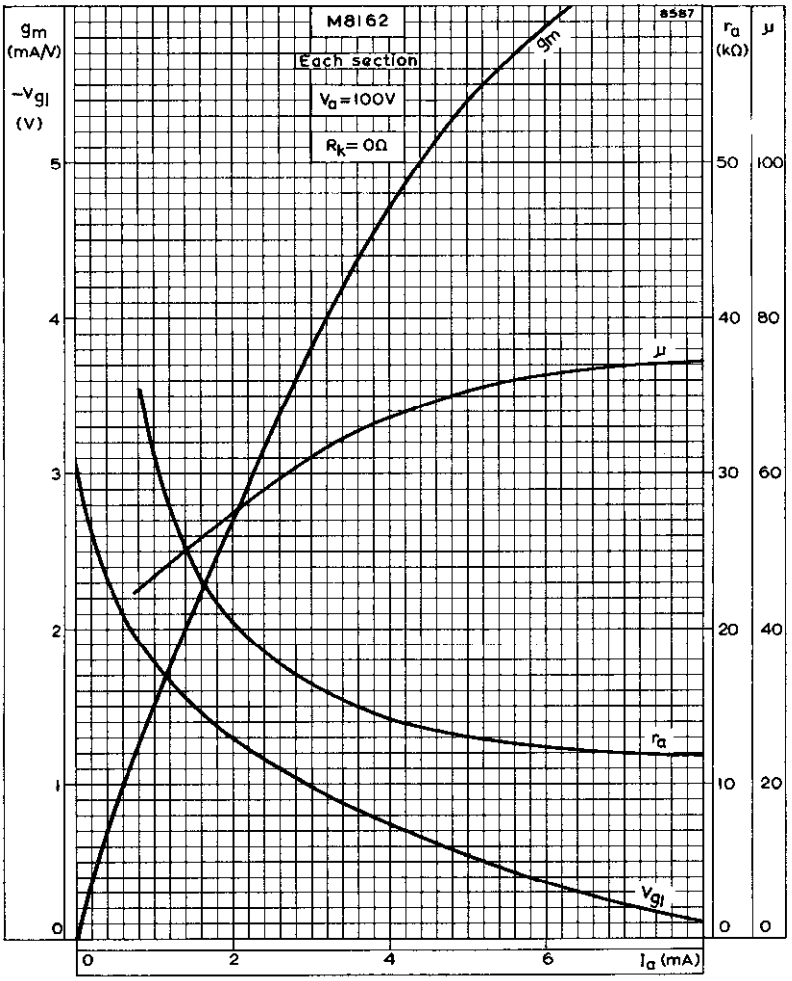
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

M8162 SPECIAL QUALITY DOUBLE TRIODE



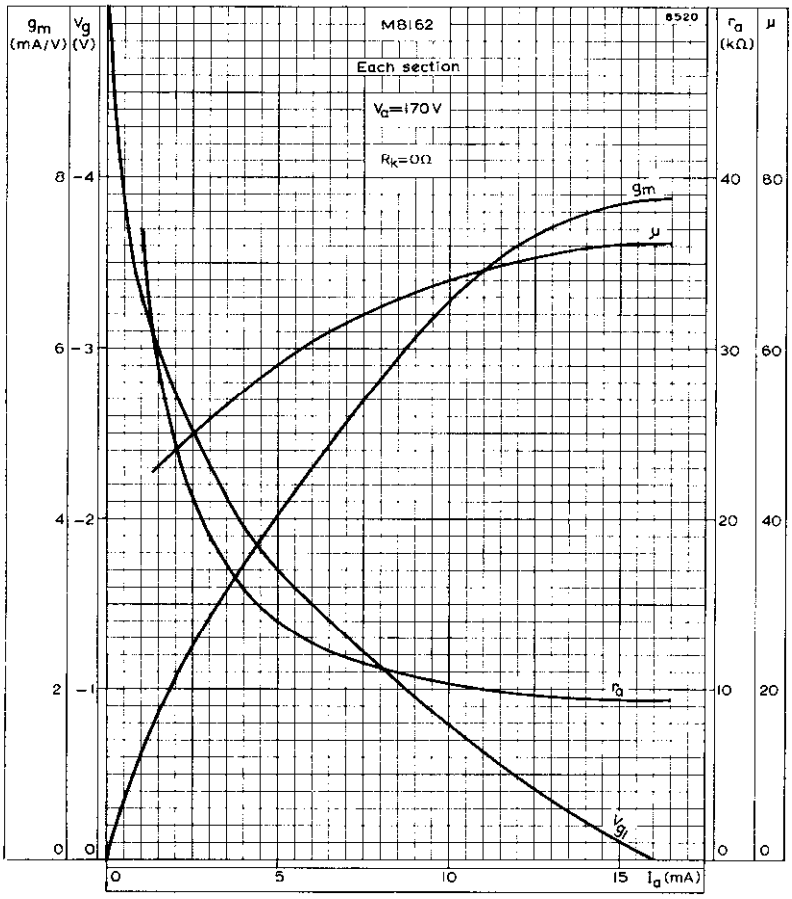
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY DOUBLE TRIODE M8162

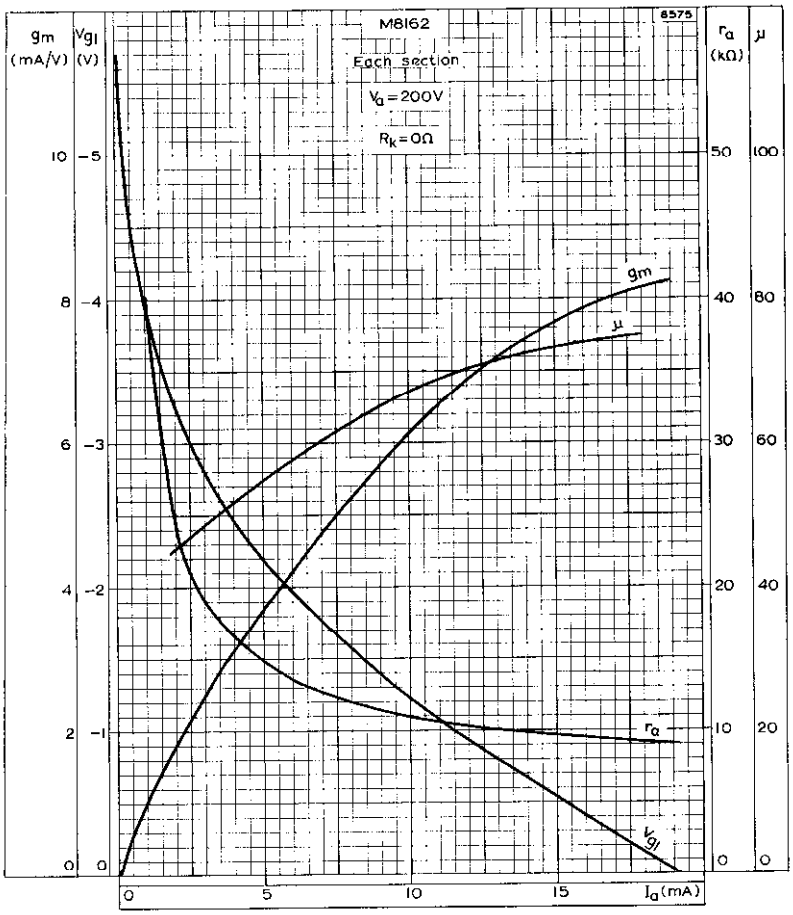


ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT.
V_a = 100V

M8162 SPECIAL QUALITY DOUBLE TRIODE

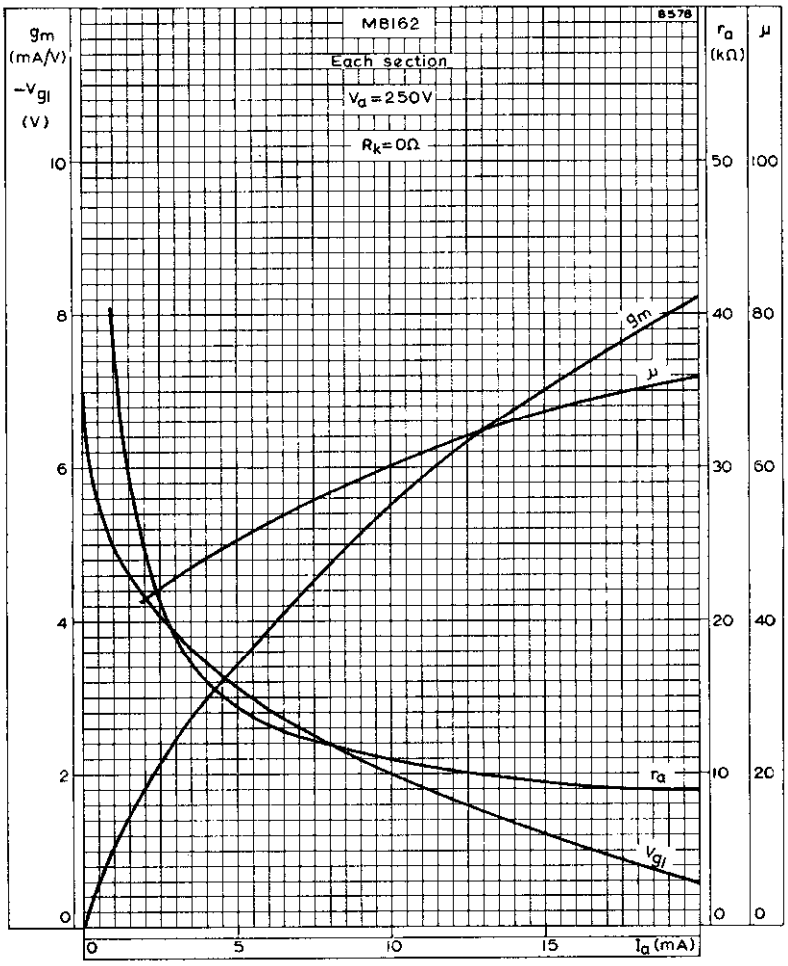


ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT.
V_a = 170V



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

M8162 SPECIAL QUALITY DOUBLE TRIODE



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

SPECIAL QUALITY PENTODE

M8196

Special quality dual control pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	175	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shiel

c_{a-g1}	<20	mpF
c_{in}	4.2	pF
c_{out}	3.2	pF

CHARACTERISTICS[3]

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
R_k	0	0	Ω

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	400	V
V_a max.	200	V
V_{g3} max.	30	V
$-V_{g3}$ max.	55	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_a max.	1.65	W
p_{g2} max.	550	mW
R_{g1-k} max.	4.0	MΩ←
I_k max.	20	mA
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	450	g
T_{bulb} max.	165	°C

M8196

SPECIAL QUALITY PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	120	0	120	−2.0	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	175	160	190	—	—	—	mA
	—	—	—	—	168	182	4.87	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	10	—	—	—	μA
Reverse grid current, $R_{g1} = 100k\Omega$	0.65	—	0	0.1	—	—	—	μA
Anode current	0.65	5.2	2.5	9.0	—	—	—	mA
	—	—	—	—	4.2	6.2	0.8	mA
Mutual conductance	0.65	3.2	2.5	4.5	—	—	—	mA/V
	—	—	—	—	2.9	3.5	0.26	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[10]	0.4	—	—	—	—	—	—	
GROUP B								
Insulation								
a-rest, measured at −300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at −100V		—	100	—	—	—	—	MΩ
g_3-rest, measured at −300V		—	100	—	—	—	—	MΩ

M8196

Anode current								
$V_{g1} = -3V$, $V_{g3} = -10V$	2.5	—	—	200	—	—	—	μA
$V_{g1} = -3V$, $V_{g3} = -6V$	2.5	—	5.0	—	—	—	—	μA
$V_{g1} = -8V$	2.5	—	—	200	—	—	—	μA
$V_{g1} = -6V$	2.5	—	5.0	—	—	—	—	μA
Screen-grid current	2.5	—	1.5	5.5	—	—	—	mA
Change in mutual conductance, $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current								
$V_h = 7.5V$, $V_{g1} = -10V$, $R_{g1} = 100k\Omega$	2.5	—	0	1.0	—	—	—	μA
†R.F. noise at anode, $V_{g1} = 0V$, $R_k = 200\Omega$, $V_{sig} = 15mV$, $C_k = 0.2\mu F$	2.5	—	—	—	—	—	—	
Vibration, 2.5g min. peak acceleration, f = 50c/s, $R_a = 10k\Omega$	6.5	—	—	150	—	—	—	mV
Mutual conductance (g_{3-a}), $V_{g3} = -3V$	6.5	—	0.35	1.05	—	—	—	mA/V
Mutual conductance (g_{1-a}), $V_{g3} = -5V$	6.5	—	0.7	1.7	—	—	—	mA/V
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	4.5	—	—	—	pF
c_{out}	—	—	2.6	3.4	—	—	—	pF
c_{a-g1}	—	—	—	20	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55 ± 5mm Hg Voltage = $500V_{r.m.s.}$. No other applied voltages.	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $V_{a(b)} = V_{g2(b)} = 200V$, $R_a = 100k\Omega$, $R_{g2} = 500k\Omega$, $C_{g2} = 2\mu F$, $V_{g1} = 0V$, $R_k = 1k\Omega$, $C_k = 1000\mu F$, $V_{g(sig)} = 175mV$	2.5	—	—	—	—	—	—	

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

M8196

SPECIAL QUALITY PENTODE

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Base strain test[12]	—	—	—	—	—	—	—	
Glass strain test[11B]. No applied voltages	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltage applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	—	—	—	30	—	—	—	μA
Mutual conductance	—	—	2.2	—	—	—	—	mA/V
Reverse grid current, R_{g1} = 100kΩ	—	—	0	0.4	—	—	—	μA
Vibration as in group B	—	—	—	300	—	—	—	mV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
V_{h-k} = 100V, No other applied voltages, 500g.								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	—	—	—	30	—	—	—	μA
Mutual conductance	—	—	2.2	—	—	—	—	mA/V
Reverse grid current, R_{g1} = 100kΩ	—	—	0	0.4	—	—	—	μA
Vibration as in group B	—	—	—	300	—	—	—	mV

GROUP D

Heater cycling life test

V_h = 7.5V 1 minute on 4 minutes off
V_{h-k} = 135V. No other applied voltages

Heater cycling life test end point

Heater to cathode leakage current V_{h-k} = ±100V	—	—	—	20	—	—	—	μA

Stability life test[14]

Running conditions. R_{g1} = 100kΩ, R_k = 130Ω, V_{a-e} = 180V, V_{g2-e} = 125V, V_{g1-e} = 0V, V_{h-k} = 135V, $T_{ambient}$ = Room temperature.

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions. R_{g1} = 100kΩ, R_k = 130Ω, V_{a-e} = 180V, V_{g2-e} = 125V, V_{g1-e} = 0V, V_{h-k} = 135V, T_{bulb} min. = 165°C.

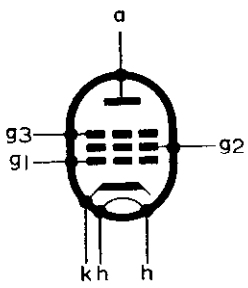
Intermittent life test end points

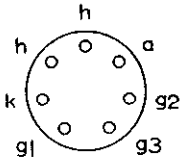
		A.Q.L.[5] (%)	*Min.*	*Max.*	
Inoperatives[6]	500 hours	—	—	—	
	1000 hours	—	—	—	
Heater current	500 hours	4.0	160	190	mA
	1000 hours	6.5	160	190	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	500 hours	4.0	—	10	μA
	1000 hours	6.5	—	10	μA
Reverse grid current, R_{g1} = 100kΩ	500 hours	4.0	0	0.1	μA
	1000 hours	6.5	0	0.1	μA
Change in mutual conductance (individuals)	500 hours	4.0	—	20	%
	1000 hours	6.5	—	25	%
Change in mutual conductance, V_h = 5.7V	500 hours	6.5	—	15	%
Insulation as in group B	500 hours	6.5	50	—	MΩ
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group quality level[10]	500 hours	10	—	—	
	1000 hours	15	—	—	

M8196

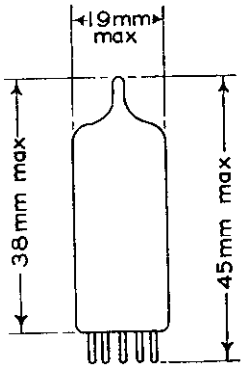
SPECIAL QUALITY PENTODE

4491





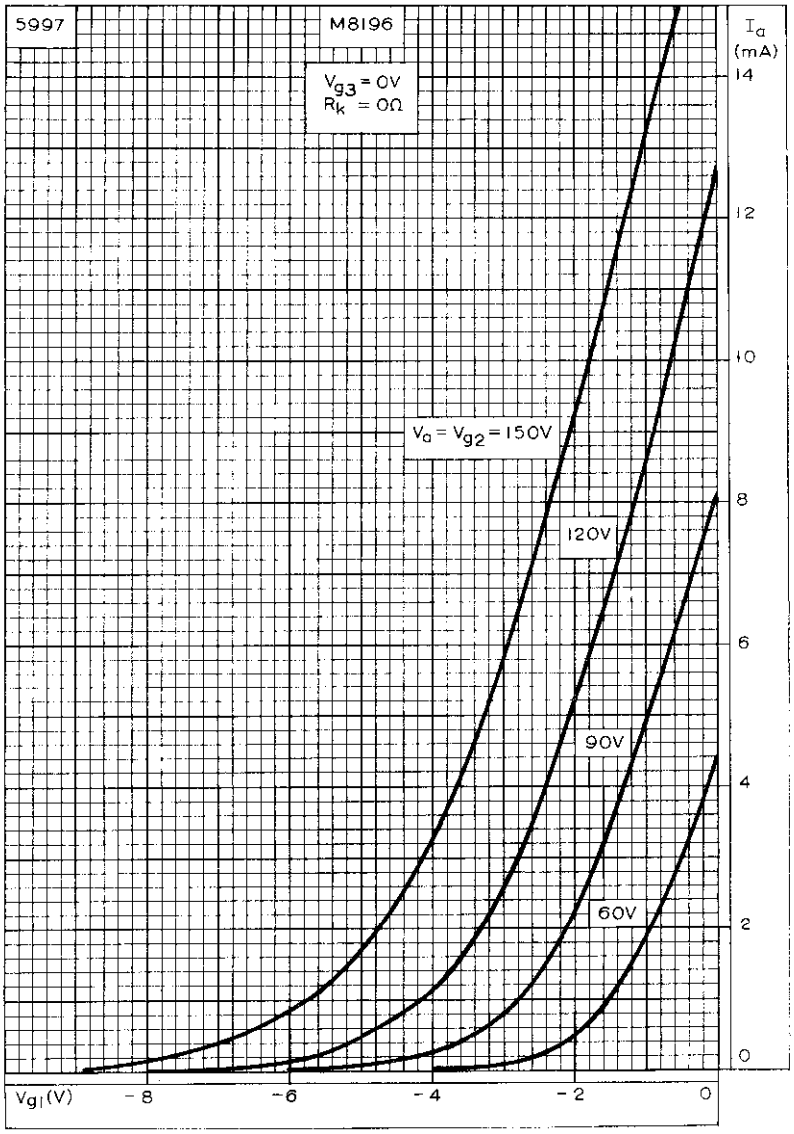
B7G Base



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G.

SPECIAL QUALITY
PENTODE

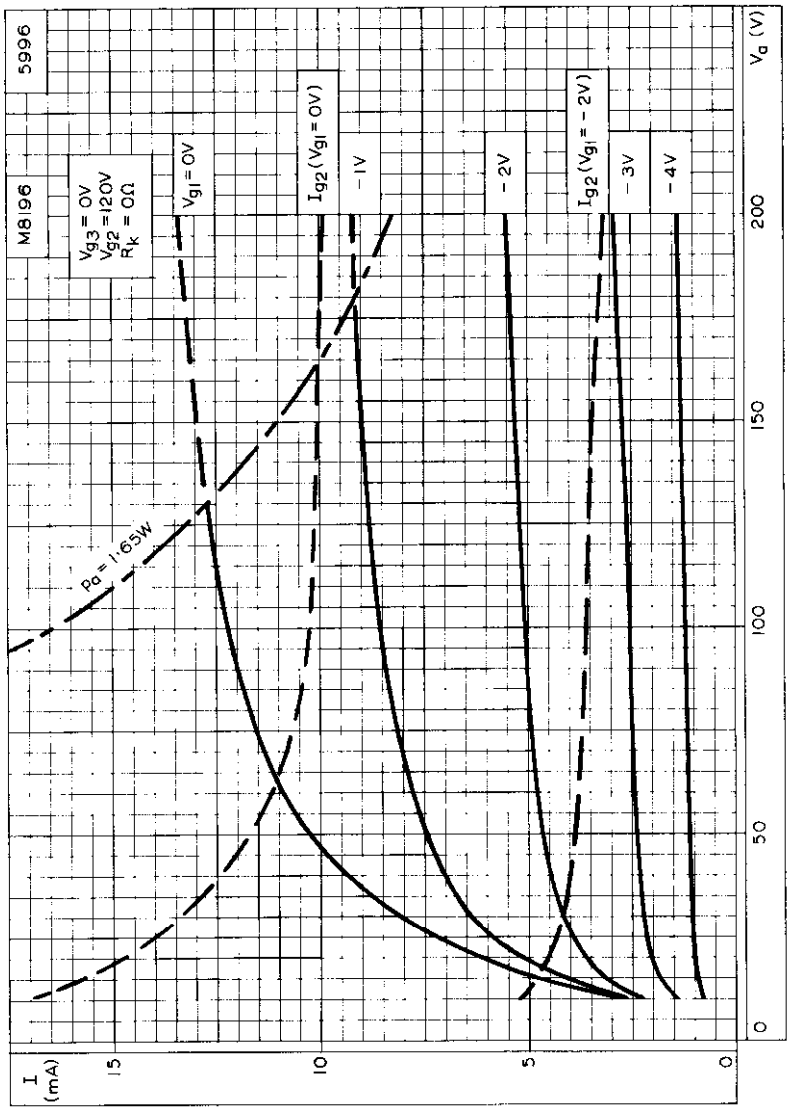
M8196



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

M8196

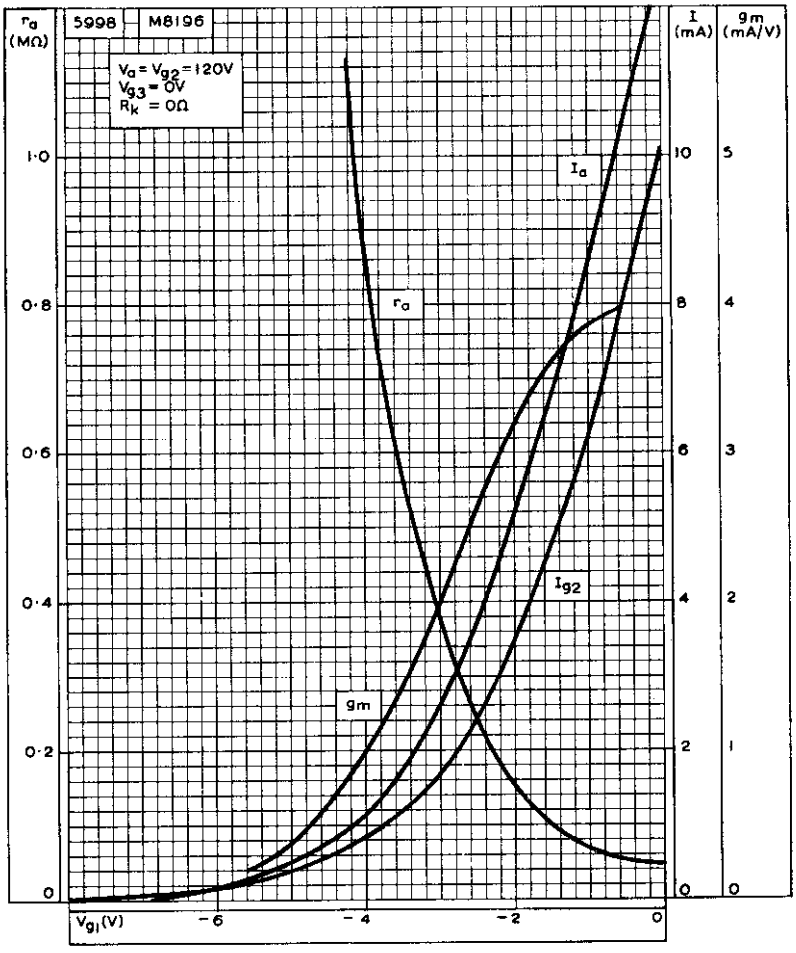
SPECIAL QUALITY PENTODE



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

SPECIAL QUALITY PENTODE

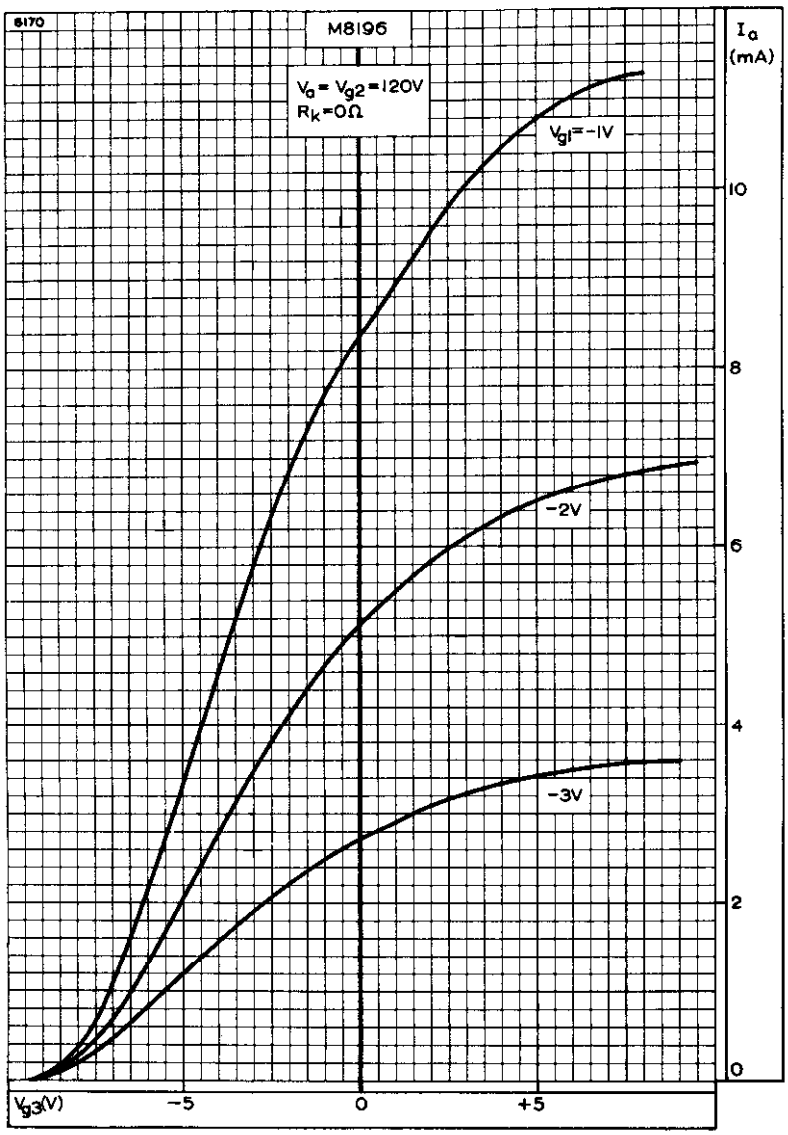
M8196



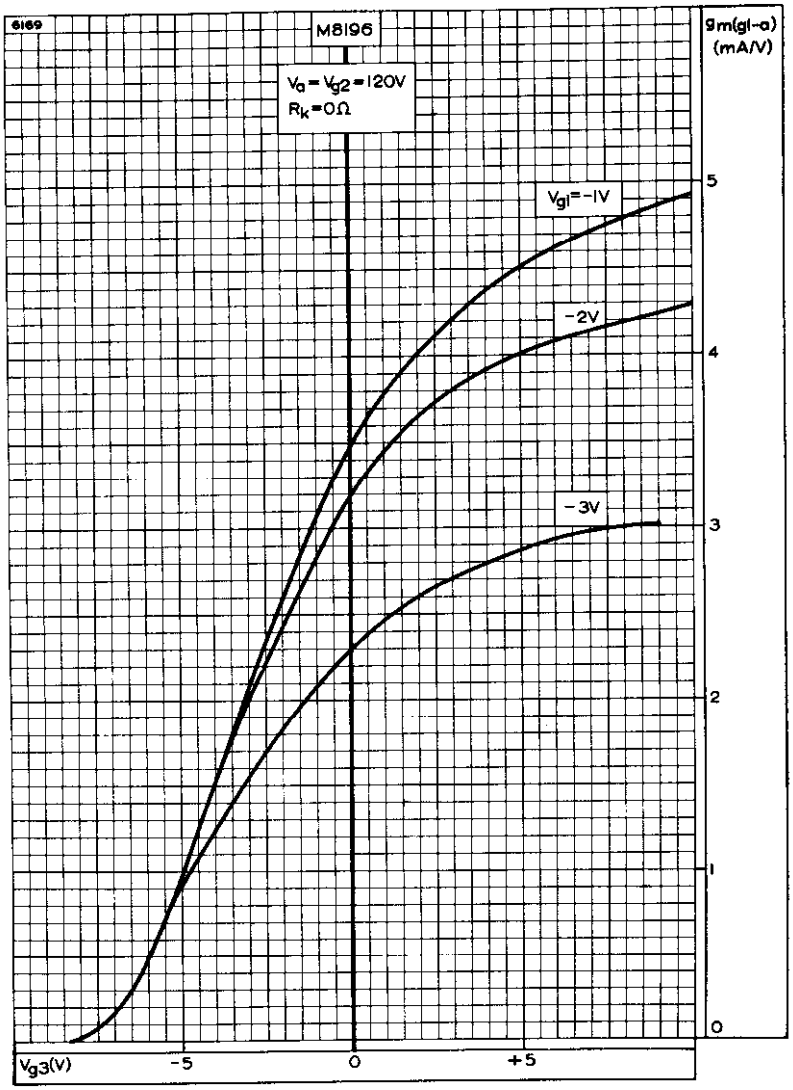
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

M8196

SPECIAL QUALITY PENTODE



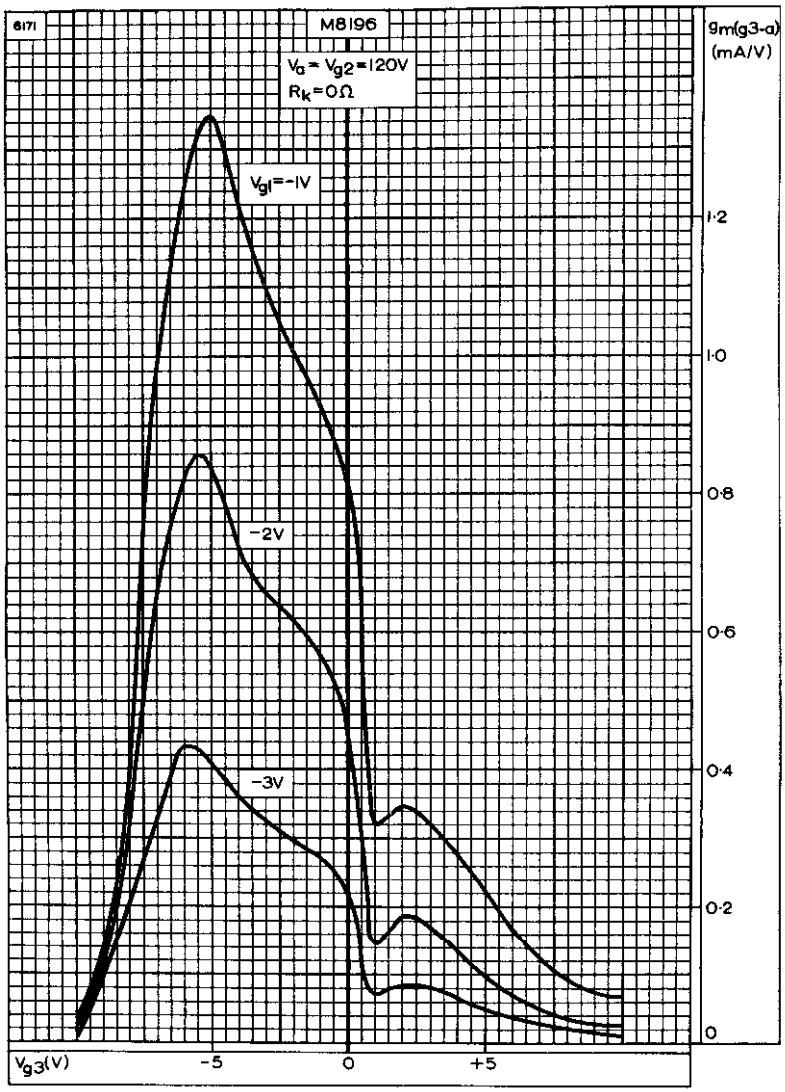
ANODE CURRENT PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE (g_{1-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

M8196

SPECIAL QUALITY PENTODE



MUTUAL CONDUCTANCE (g_{3-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY R.F. PENTODE

5840

Special quality r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES[2] (measured with external shield)

c_{a-g1}	<15	mpF
c_{in}	4.2	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	>175	kΩ
R_k	0	Ω
V_{g1} (I_a <50μA)	−9.0	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	800	mW
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	350	mW
$+V_{g1}$ max.	0	V←
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

5840

SPECIAL QUALITY R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g2-e} (V)	V_{g1-c} (V)	R_k (Ω)	C_k (μF)
6.3	100	100	0	150	1000

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	0.65	—	—	5.0	—	—	—	μA
Reverse grid current R_{g1} = 1.0MΩ	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	7.5	5.5	9.5	—	—	—	mA
	—	—	—	—	6.7	8.3	0.8	mA
Anode current V_{g1} = −9.0V, R_k = 0Ω	0.65	—	—	50	—	—	—	μA
Screen-grid current	0.65	—	1.5	3.3	—	—	—	mA
Mutual conductance	0.65	5.0	4.2	5.8	—	—	—	mA/V
	—	—	—	—	4.7	5.3	0.31	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	10	—	—	—	%
Reverse grid current $V_h = 7.5V$, $V_{g1} = -9.0V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under standard test conditions, except $V_h = 7.5V$, $R_{g1} = 1.0M\Omega$	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, $V_{g2-e} = 19V$, $R_{g1} = 100k\Omega$, $R_{g2} = 1.0k\Omega$, $R_a = 200k\Omega$, $C_k = 1000\mu F$	2.5	—	—	70	—	—	—	mV
Anode impedance	6.5	—	175	—	—	—	—	kΩ
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	4.9	—	—	—	pF
c_{out}	—	—	2.9	3.9	—	—	—	pF
c_{a-g1}	—	—	—	15	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mm Hg Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min peak acceleration, $R_a = 10k\Omega$	—	—	—	60	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B]. 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative) R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

Heater cycling life test

V_h = 7.0V. 1 minute on, 4 minutes off, 2000 switchings. V_{h-k} = 140$V_{r.m.s.}$ (continuous)

No other applied voltages

	2.5	—	—	—	—	—	—	

Stability life[14]

Running conditions: R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature

Stability life end points

Change in mutual conductance after 1 hour

	1.0	—	—	10	—	—	—	%

Survival rate life test[14]

Running conditions R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature

Survival rate life test end points (100 hours)

Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.75	—	—	—	—	mA/V

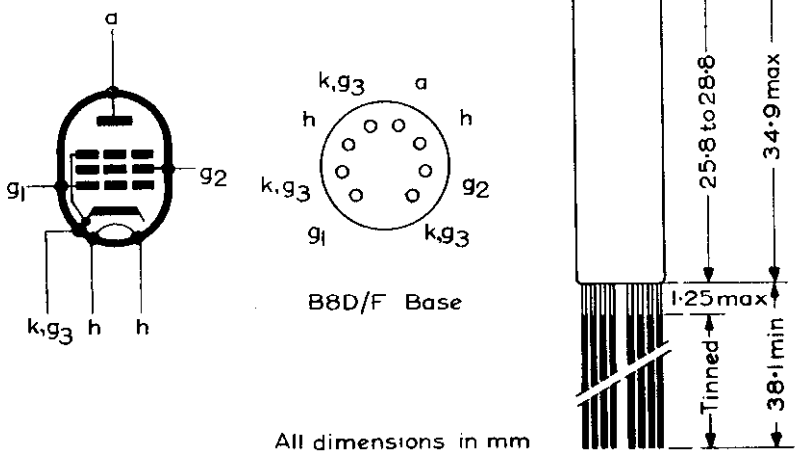
Intermittent life test

Running conditions: R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), T_{bulb} min = 220°C

Intermittent life test end points (500 hours)	A.Q.L.[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	2.5	—	—	
Heater current	4.0	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	4.0	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ	2.5	0	0.8	μA
Change in mutual conductance (individuals)	2.5	—	20	%
Change in mutual conductance V_h = 5.7V	4.0	—	15	%
Insulation as in group B	4.0	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

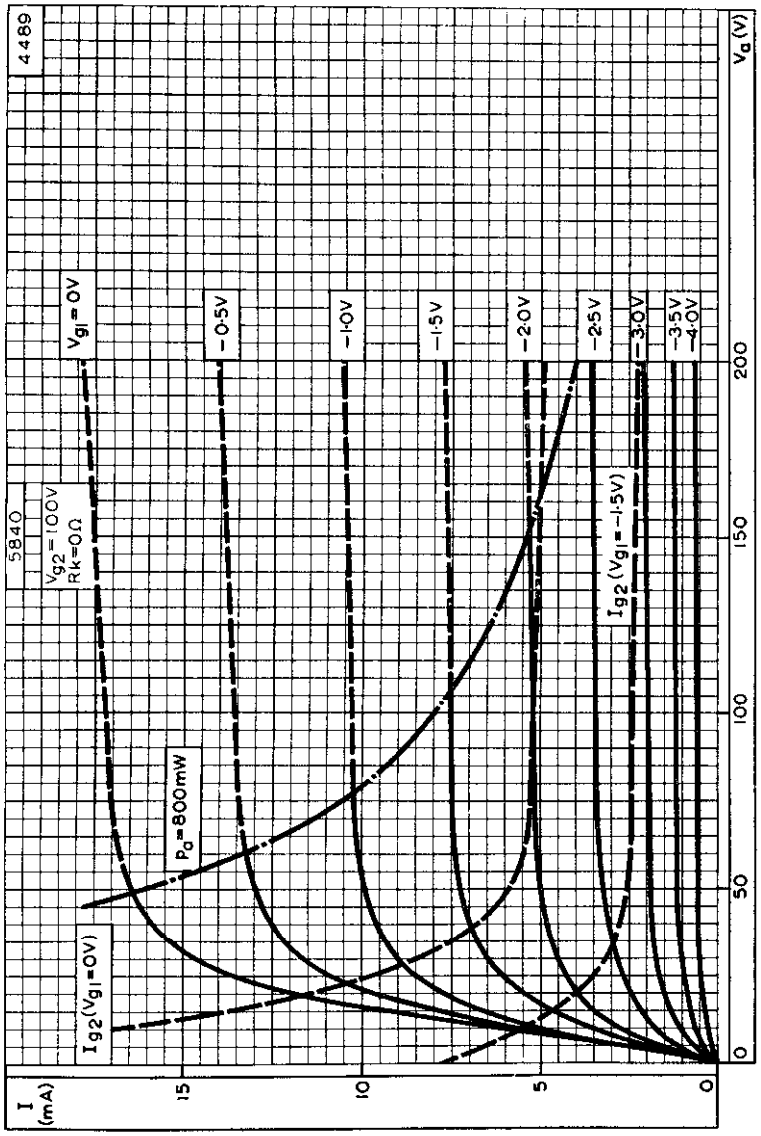
5840 SPECIAL QUALITY R.F. PENTODE

5494



The bulb and base dimensions of this valve are in accordance with BS448, Section B8D/F.

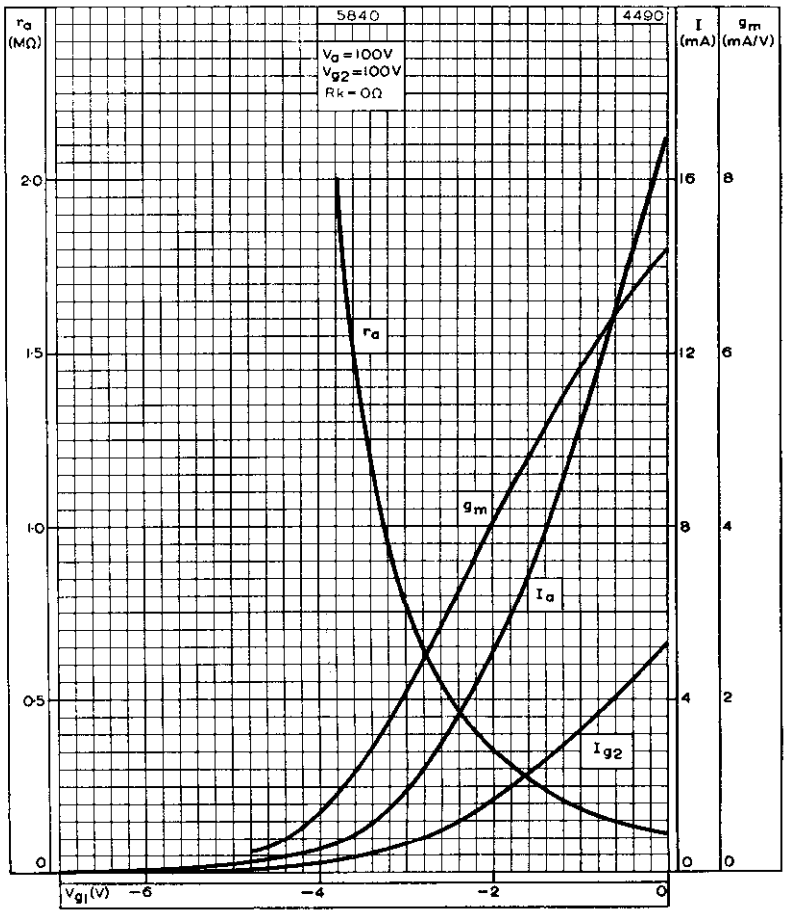
SPECIAL QUALITY R.F. PENTODE 5840



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

5840

SPECIAL QUALITY R.F. PENTODE



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

SPECIAL QUALITY DOUBLE TRIODE

6021

Special quality subminiature medium-μ double triode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

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

CAPACITANCES[3] (measured without an external shield)

$c_{a'-a''}$	<520	mpF
*c_{a-g}	1.6	pF
$c_{g'\ g''}$	<15	mpF
*c_{in}	2.4	pF
$c_{out'}$	300	mpF
$c_{out''}$	350	mpF

*Each section

CHARACTERISTICS[3] (each section)

V_a	100	V
V_g	−1.0	V
I_a	6.5	mA
g_m	5.4	mA/V
r_a	6.5	kΩ
μ	35	
R_k	0	Ω
V_g (I_a<100μA)	−6.5	V

LIMITING VALUES[4] (absolute ratings) each section

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	700	mW
I_a max.	22	mA
$+V_g$ max.	0	V←
$-V_g$ max.	55	V
I_g max.	5.5	mA
R_{g-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	0	150	1000	0

TESTS The measurements apply to each section unless otherwise stated.

	A.Q.L.[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Heater current	0.65	300	280	320	—	—	—	mA
	—	—	—	—	288	312	8.4	mA
Heater-to-cathode leakage current. $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current. $R_g = 1.0M\Omega$, $R_k = 300\Omega$, $V_{a-e} = 150V$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	6.5	4.5	8.5	—	—	—	mA
	—	—	—	—	5.6	7.3	0.8	mA
Anode current. $V_g = -6.5V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Mutual conductance	0.65	5.4	4.45	6.35	—	—	—	mA/V
	—	—	—	—	5.0	5.8	0.38	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at −300V	2.5	—	100	—	—	—	—	MΩ
g-rest, measured at −100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current. $V_h = 7.5V$, $V_g = -7.5V$, $V_a = 150V$, $R_g = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under these conditions but $R_k = 500\Omega$, $V_{g-e} = 0V$	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, both sections connected in parallel $R_g = 100k\Omega$, $R_a = 10k\Omega$, $R_k = 75\Omega$	2.5	—	—	65	—	—	—	mV
Anode current difference between sections	2.5	—	—	1.6	—	—	—	mA
Capacitances[3] (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
*c_{in}	—	—	1.8	3.0	—	—	—	pF
$c_{out'}$	—	—	200	360	—	—	—	mpF
$c_{out''}$	—	—	220	420	—	—	—	mpF
*c_{a-g}	—	—	1.2	1.8	—	—	—	pF
$c_{a'-a''}$	—	—	—	520	—	—	—	mpF
$c_{g'-g''}$	—	—	—	13	—	—	—	mpF
*Each section								
Low pressure voltage breakdown Pressure = 55±5mmHg, Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $R_a = 10k\Omega$	2.5	—	—	50	—	—	—	mV (r.m.s.)
Pulse, cathode current $V_h = 6.0V$, $V_{a+g(pulse)} = 50V$, $t_p = 25\mu s$, p.r.f. = 200p.p.s.	6.5	—	300	—	—	—	—	mA
Amplification factor	6.5	—	30	40	—	—	—	

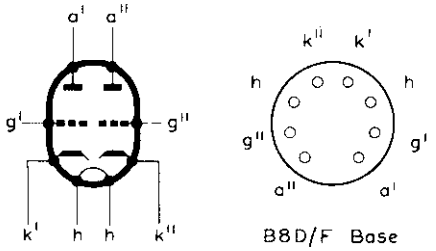
†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B]. 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV
Shock[15]								
V_{h-k} = 100V (cathode negative), R_g = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

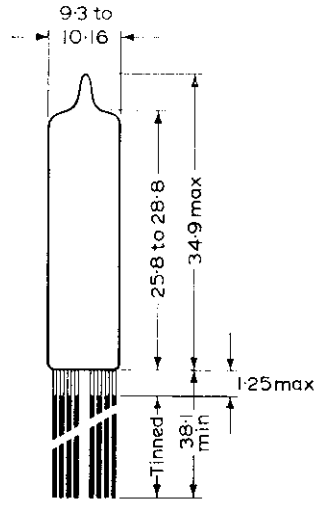
GROUP D

Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off.								
V_{h-k} = 140$V_{r.m.s.}$ (continuous).								
No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions: R_g = 1.0MΩ,								
V_{h-k} = 200V (cathode negative),								
$T_{ambient}$ = Room temperature								
Stability life test end point								
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%
Survival rate life test[14]								
Running conditions R_g = 1.0MΩ,								
V_{h-k} = 200V (cathode negative),								
$T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	4.0	—	—	—	—	mA/V
Intermittent life test								
Running conditions: R_g = 1.0MΩ,								
V_{h-k} = 200V (cathode negative), T_{bulb} min = 220°C								
Intermittent life test end points (500 hours)					*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]					2.5	—	—	
Heater current					4.0	276	328	mA
Heater-to-cathode leakage current. V_{h-k} = ±100V					4.0	—	10	μA
Reverse grid current. R_g = 1.0MΩ					2.5	0	0.9	μA
Change in mutual conductance (individuals)					2.5	—	25	%
Change in mutual conductance, V_h = 5.7V					4.0	—	15	%
Insulation as in group B					4.0	50	—	MΩ
Average change in mutual conductance					—	—	15	%
Sub-group quality level[10]					10	—	—	

6021 SPECIAL QUALITY DOUBLE TRIODE



B8D/F Base



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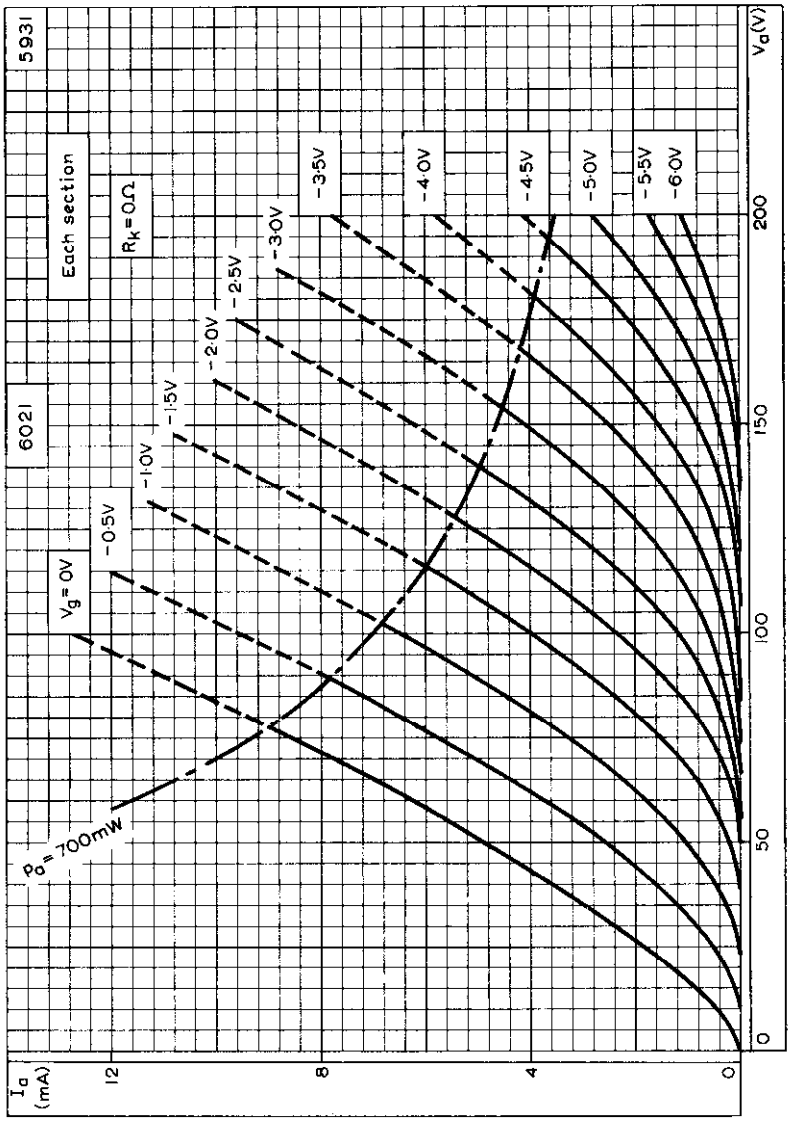
All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B8D/F

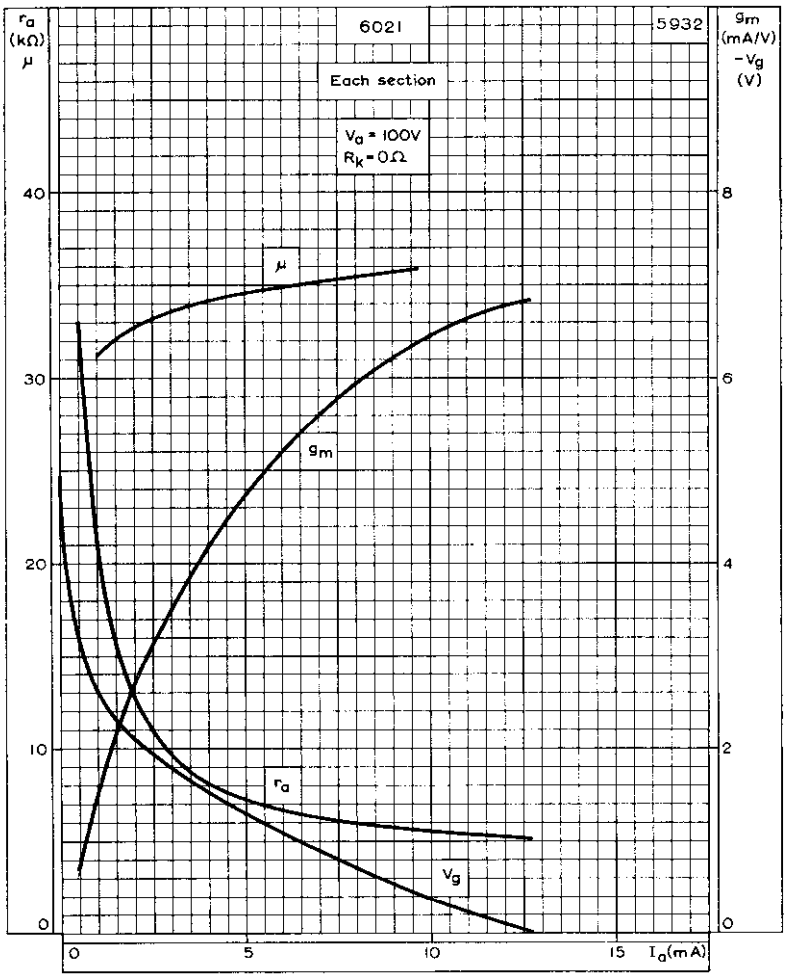
SPECIAL QUALITY DOUBLE TRIODE

6021



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

6021 SPECIAL QUALITY DOUBLE TRIODE



ANODE IMPEDANCE, MUTUAL CONDUCTANCE, GRID VOLTAGE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT FOR EACH SECTION