VALVE ELECTRONIC

CV4520

MINISTRY OF AVIATION - D.L.R.D.(T)

Specification MOA/CV4520 Issue 1 dated 4th May, 1960. To be read in conjunction with K.1001, B.S.448 and B.S.1409	SECURITY Specification: UNCLASSIFIED Valve: UNCLASSIFIED

→ Indicates a change

TYPE OF VALVE - Reliable Miniature Low Impedance Triode with Flying Leads

CATHODE - Indirectly - heated

ENVELOPE - Glass

PROTOTYPE - CV4038, VX3520

MARKING: See K.1001/4

BASE: See B.S.448/B9A/F.

RATING (Note A)

(All limiting values are absolute)

			Note
Heater Voltage	(V)	6.3	
Heater Current	(A)	1.1	
Max. Heater - Cathode Voltage, Cathode +ve	(V)	250	B
Cathode -ve	(V)	100	B
Max. Anode Voltage (Ia = 0)	(V)	500	
Max. Negative Grid Voltage	(V)	100	
Max. Operating Anode Voltage (pa.max)	(V)	300	
Max. Anode Dissipation	(W)	15	
Max. Cathode Current	(mA)	125	
Max. Grid Circuit Resistance (Fixed Bias)	(M)	0.1	
(Auto Bias)	(M)	0.5	
Max. Vibration (100 Hours duration Max.)	(g)	5	C
(10 Minutes duration Max.)	(g)	20	D
Max. Shock (short duration)	(g)	500	
Max. Bulb Temperature	(°C)	225	
Min. Operating Pressure	(mm. Hg)	55	
Max. Ambient Storage Temperature Range	(°C)	-60/+85	

Typical Operating Conditions

Measured at Va=150V. Ia=100mA

Mutual Conductance	(mA/V)	11
Anode Impedance	(Ω)	410
Amplification Factor		4.5
Neg. grid voltage	(V)	21.5

CAPACITANCES (pF)

C in (Nom.) Valve Shielded	7.1	F
Cout (Nom.) " "	6.0	F
Cagi (Nom.) " "	9.5	F

CONNECTIONS

Lead	Electrode	
1	Anode	a
2	Cathode	k
3	Anode	a
4	Heater	h
5	Heater	h
6	Grid	g1
7	No connection	n.c.
8	Anode	a
9	Anode	a

DIMENSIONS

See K1001/A1/D11

Dimensions (mm)	Min.	Max.
A. Seated height		66
B. Diameter	19	22.2
D. Lead length (Note E)	38	-

MOUNTING POSITION

Any

TYPE APPROVAL

See K1001/15
Minimum quantity for submission 150
See Note G.

APPLICATIONS DATA

Issue 1. - See section following Page 6.

NOTES

See next page

Z.21177.

NOTES

A. Caution to Electronic Equipment Design Engineers: Special attention should be given to the temperature of valves to be operated in Guided Weapons and Aircraft. Reliability will be seriously impaired if the maximum bulb temperature is exceeded. 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. Both reliability and performance will be jeopardized if heater voltage ratings are exceeded; life and reliability performance are directly related to the degree that regulation of the heater voltage is maintained at its centre-rated value. Under no circumstances should the heater voltage supply be allowed to deviate more than ± 5% from the rated value.

B. For greater reliability, the potential between heater and cathode should not be allowed to exceed 10 volts.

C. The maximum peak acceleration under continuous random vibration conditions specified assumes that the vibration frequency components are varying continuously over the band 10 to 1,000 cycles/sec. in a random manner.

D. The maximum peak acceleration under short term random vibration conditions specified assumes that the vibration frequency components are varying continuously over the band 10 to 1,000 cycles/sec. in a random manner.

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

F. Capacitance measured at a frequency of 1 Mc/s.

G. When submitting samples for Type Approval the manufacturer must have drawn the samples from a lot which has met the requirements of the specification. The manufacturer shall provide the test results for that particular lot; together with detailed results on the samples, as required by the Type Approval Authority.

TESTS

CV4520

TO BE PERFORMED IN ADDITION TO THOSE APPLICABLE IN K.1001

TESTS IN ANY ONE GROUP SHALL BE PERFORMED IN THE SPECIFIED ORDER

TEST CONDITIONS - UNLESS OTHERWISE SPECIFIED

Vh(V)	Va(V)	Ia(mA)
6.3	150	100

K1001	TEST	TEST CONDITIONS	AQL %	INSP. LEVEL	SYMBOL	LIMITS MIN.	LAL	BOGEY	UAL	MAX.	ALD	UNITS
AIX/2.1	GROUP A											
	Visual Inspection	Notes: 1,2. No voltages		100%								
5.14	Inoperatives			100%								
	Insulation	Va-all = -300V		100%	R	100	-	-	-	-	-	M
		Vgi-all = -100V		100%	R	100	-	-	-	-	-	M
	Reverse Grid Current(1)	Rg1 = 500k max.		100%	Ig1	-	-	-	-	2.0	-	µA
	Vibration Noise(1)	Notes: 2,3 Acceleration =20g peak min. Frequency = 50 c/s Rk = 200 Ck = 1000µ F min. Rg1 = 0 Va(b) = 200V Ra = 1K		100%	Vout	-	-	-	-	120	-	mV r.m.s.
	Vibration Noise (2)	Note: 3 Acceleration = 5g peak min. Frequency = 1000-2500 c/s Rk = 200 Ck = 1000 µF min. Rg1 = 0 Va(b) = 200V Ra = 1K		100%	Vout	-	-	-	-	350	-	mV r.m.s.
AIX/2.2		Note: 4										
AIX/2.3												
	GROUP B	Combined AQL	1.5									
5.3	Heater-Cathode Leakage Current	Vhk = ± 250V	0.65	II	Ihk	-	-	-	-	20	-	µA
				V2	Ihk	-	-	-	5	-	-	µA
	Negative Grid Voltage		0.65	II	-Vg1	17	-	-	-	26	-	V
				V2	-Vg1	-	19	21.5	24	-	5.55	V
	Mutual Conductance	Note: 5	0.65	II	gm	9	-	-	-	13	-	mA/V
				V2	gm	-	10	11	12	-	9.2	mA/V
	Negative Grid Cut-Off Voltage	Va = 100V Ia = 2mA	0.65	II	-Vg1	-	-	-	-	35	-	V
	GROUP C											
	Heater Current		1.5	I	Ih	1.0	-	1.1	-	1.2	-	A
	Change of Mutual Conductance	Vh = 5.7V Note: 6	1.5	I	Δgm	-	-	-	-	8.0	-	%
	Cathode Heating Time	Va = 170V Rg1 = 0 Rk = 170 Note: 7	1.5	I	thk	-	-	-	-	40	-	secs

K1001	TEST	TEST CONDITIONS	AQL %	INSP. Level	SYMBOL	LIMITS MIN.	LAL	BOGEY	UAL	MAX.	ALD	UNITS
	GROUP D											
	Reverse Grid Current (2)	Vh=6.9V Va=250V Ia=2mA Rg1=0.1M Note 8	4.0	Code F	Ig1	-	-	-	-	4.0	-	µA
	Amplification Factor		4.0	Code F	µ	3.5	-	4.5	-	5.5	-	
5.9	Capacitances	Measured on a 1Mc/s bridge with valve in a fully screened socket. Valve shielded Note 9	4.0	Code F	Cin Cout Cag1	5.7 4.8 7.75	- - -	7.1 6.0 9.5	- - -	8.5 7.2 11.25	- - -	pF pF pF
	GROUP E											
AIX/ 2.4.2.3.	Lead Fragility	No Voltages	4.0	Code F								
AIX/ 2.4.2.1.	Glass Strain	No Voltages Note: 10	4.0	Code F								
	Vibration Fatigue	Acceleration = 5g peak min. Time = 200 hours Note: 11 Vh = 6.6V		Code J								
	Vibration Noise (3)	Note: 12. Acceleration = 20g peak min; Rk=200; Ck = 1000µF min. Rg1 = 0, Ra = 1K Va(b) = 200V, Vh = 6.3V. Frequency = (1) 60-120 c/s			Vout	-	-	-	150	-	-	mV r.m.s
		(2) 120-250 c/s			Vout	-	-	-	150	-	-	mV r.m.s
		(3) 250-500 c/s			Vout	-	-	-	150	-	-	mV r.m.s
		(4) 500-1000 c/s			Vout	-	-	-	250	-	-	mV r.m.s
		(5) 1000-2500 c/s			Vout	-	-	-	800	-	-	mV r.m.s
	Post Vibration Noise (3) Tests:	Combined AQL	2.5									
	Vibration Noise (1)	As in Group A. Note: 3.	1.0		Vout	-	-	-	-	300	-	mV r.m.s
	Heater-Cathode Leakage Current.	Vhk = ± 250V.	1.0		Ihk	-	-	-	-	30	-	µA
	Reverse Grid Current (1)	Rg1 = 500k Max.	1.0		Ig1	-	-	-	-	2.5	-	µA
	Mutual Conductance	Note 5	1.0		gm	8.5	-	-	-	13.0	-	mA/V
	Catastrophics	Note: 13	0.65									
AIX/ 2.4.2. 4.3.	Shock	Hammer Angle = 30° No Voltages (T/A. only)										
	Post Shock Tests:	As for Post Vibration Noise (3) Tests (T/A only)										

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TESTS (Contd.)

K1001	TEST	TEST CONDITIONS	AQL %	INSP. LEVEL	SYMBOL	LIMITS MIN.	LAL	BOGEY	UAL	MAX.	AID	UNITS
	GROUP F											
AVI/5	Life	Vh = 6.3v Vhk = 200V 50 c/s Va = 120V Ia = 125 mA										
AVI/5.1	Stability Life											
	Change in Mutual Conductance	Note 5	1.5	Code H	Δgm	-	-	-	-	10	-	%
AVI/5.3	Intermittent Life											
	Test Point 200 hours	Combined AQL	4.0	Code H								
5.14	Inoperatives		1.5									
	Heater-Cathode Leakage Current	Vhk = ± 250V	2.5		Ihk	-	-	-	-	20	-	μA
	Reverse Grid Current (1)	Rg1 = 500k max.	2.5		Ig1	-	-	-	-	2.0	-	μA
	Negative Grid Voltage		2.5		-Vg1	16.5	-	-	-	26	-	V
	Average Change of Negative Grid Voltage				$\overline{\Delta Vg1}$	-	-	-	-	10	-	%
	Insulation		2.5									
		Va - all = -300V			R	50	-	-	-	-	-	M
		Vg1 - all = -100V			R	50	-	-	-	-	-	M
	Test Point 1000 hours	Combined AQL	6.5	Code F								
5.14	Inoperatives		4.0									
	Heater-Cathode Leakage Current	Vhk = ± 250V	4.0		Ihk	-	-	-	-	30	-	μA
	Reverse Grid Current (1)	Rg1 = 500k max.	4.0		Ig1	-	-	-	-	3.0	-	μA
	Negative Grid Voltage		4.0		-Vg1	15.5	-	-	-	26	-	V
	GROUP G											
AIX/2.5	Electrical re-Test after 28 days holding period			100%								
5.14	Inoperatives		0.5									
	Reverse Grid Current (1)	Rg1 = 500k max.	0.5		Ig1	-	-	-	-	2.0	-	μA
	Negative Grid Voltage				-Vg1	17	-	-	-	26	-	V

NOTES

1. The valve shall be visually inspected for good workmanship. Particular attention shall be paid to the following:- Structure quality, quality of welds, quality of lead tinning, external dimensions and shape.

2. This test may be done alternatively in Group G, at the discretion of the manufacturer.

3. The valve shall be mounted so that the direction of vibration is parallel to the minor axis of the electrode structure. The test shall be of sufficient duration to obtain a steady reading of noise output.

4. At this stage the lot shall be formed. It shall be an identifiable lot not exceeding 1,300 valves, manufactured in a period not exceeding 25 consecutive Working days. Normal Sampling (Single) shall apply.

5. This test shall be performed using a mutual conductance bridge or any other approved method.

6. The change in mutual conductance is expressed:-

$$\frac{(\text{gm at } 6.3V) - (\text{gm at } 5.7V)}{(\text{gm at } 6.3V)} \times 100\%$$

7. The valve to be cold when plugged into socket or switched on. A cold valve is one which has had its heater supply switched off for at least 2 hours. The cathode heating time to be measured is that time at which the anode current reaches 100 mA from switching on.

8. For this test, the valve shall be pre-heated for 5 minutes under the test conditions. Igi shall not be rising or out of limit after a total of 5 minutes.

9. The capacitance Test Jig connections shall be as follows:-

Test	Links to H.P.	Links to L.P.	Links to E.
Cin	6	2,4,5,7,C	1,3,8,9
Cout	1,3,8,9.	2,4,5,7,C	6
Cagi	1,3,8,9	6	2,4,5,7,C

10. This is a destructive test and valves used for this test will not be accepted for delivery.

11. The sample shall be vibrated over the frequency range 60 to 1000c/s. Duration of frequency sweep shall be 12 minutes minimum. All valves to be vibrated for 66.2/3 hours in each of three mutually perpendicular planes. The heater supply shall be switched approximately 8 minutes on and 16 minutes off throughout the duration of the test.

12. This test to be applied to the total sample previously subjected to the Vibration Fatigue test. Each valve shall be mounted so that the direction of vibration is parallel to the minor axis of the electrode structure and shall be vibrated over the frequency range 60 - 2,500 c/s. swept once only at a rate of change of frequency not greater than 1 octave per 30 secs. The voltages to be recorded shall be the values of noise output at the maximum resonance in each of the specified frequency bands, as measured on an approved equipment.

13. A valve shall be deemed to be catastrophic if it is either an inoperative as defined in K1001 Section 5.14, or has either or both the following defects:

(i) Vgi outside the range ± 50% of the bogey given in Group B.

(ii) Vibration noise output, as measured in Group A, greater than 1000 mV. r.m.s.

SPECIFICATION CV4520
ISSUE No. 1, DATED 4th MAY, 1961

AMENDMENT No. 1

Page 3. Group B. Mutual Conductance.

Under ALD column delete '2.2' and insert '1.2'

October, 1961

D.L.R.D.(T)

5.2.1962

N.4320/D

CV4520

APPLICATIONS DATA

FOR

VALVE TYPE

CV4520

This information is intended for the guidance of users and does not form part of the procurement specification

ISSUE 1 SEPTEMBER 1961

ISSUED BY:-

MINISTRY OF AVIATION T.L.S. (B)

CASTLEWOOD HOUSE.

77-91 NEW OXFORD STREET.

LONDON. W.C.1.

AMENDMENTS

No:	Date	Page

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CONTENTS

STATISTICAL ASPECTS OF CV4500 SPECIFICATIONS

These test specifications have been drawn up on a statistical basis involving the following considerations:-

1. The use of 100% testing on its own does not, with presently known methods, and with reasonable economy, result in 100% perfect items reaching the customer, because reliability cannot be tested into a product.

2. To control the average and spread of the characteristics of a batch of valves is a better guarantee that the product is under control, than to accept all of a product solely on the basis that the characteristics lie within certain limits. In general it is true to say that a valve which is just inside a limit is neither better nor more reliable than one which is just outside that limit.

3. It may be demonstrated that the main characteristics of valves fairly closely follow normal or log-normal Gaussian distributions.

The inspection of these valves when submitted for acceptance is therefore carried out in two complementary stages.

Acceptance Sampling by Attributes.

Each Attribute sampling test in the specification has two conditions which define the inspection which must be made in order to ensure that the corresponding characteristic meets the required standard. The conditions are:-

(a) The Inspection Level, which defines, directly or indirectly, the size of the sample which must be taken.

(b) The Acceptance Quality Level (AQL), which defines, indirectly, the number of rejects which can be tolerated in the sample.

These conditions also define the Operating Characteristic of the sampling scheme (Page 5), which gives the relationship between the quality of the submitted lot and the probability of its acceptance. In general the levels are so calculated that if lots containing a percentage of rejects equal to the AQL were constantly submitted, then approximately 95% of the lots would be accepted.

It can be seen that the above scheme only defines the permissible percentage of valves outside the specified test limits, and not the distribution of the values of the characteristic within those limits. Theoretically therefore, it would be possible for all the values to lie just within a limit and the product would still be accepted.

To ensure that this situation does not occur on the major electrical characteristics, Variables sampling is introduced.

Acceptance Sampling by Variables

Each Variables sampling test in the specification has one condition which defines the inspection which must be made in order to ensure that the corresponding characteristic meets the required standard. This condition is the Inspection Level, which defines the size of the sample which must be taken.

The sample is divided into groups of five and the required characteristics are recorded. From these results the average value of each characteristic for the whole sample, and the average of the individual ranges for each group of five, are calculated. These values define the location and the dispersion of the characteristic distribution, respectively. The average must lie between the Lower Acceptance Limit (LAL) and the Upper Acceptance Limit (UAL), and the average range must not exceed the Acceptance Limit for Dispersion (ALD)

/Illustrations

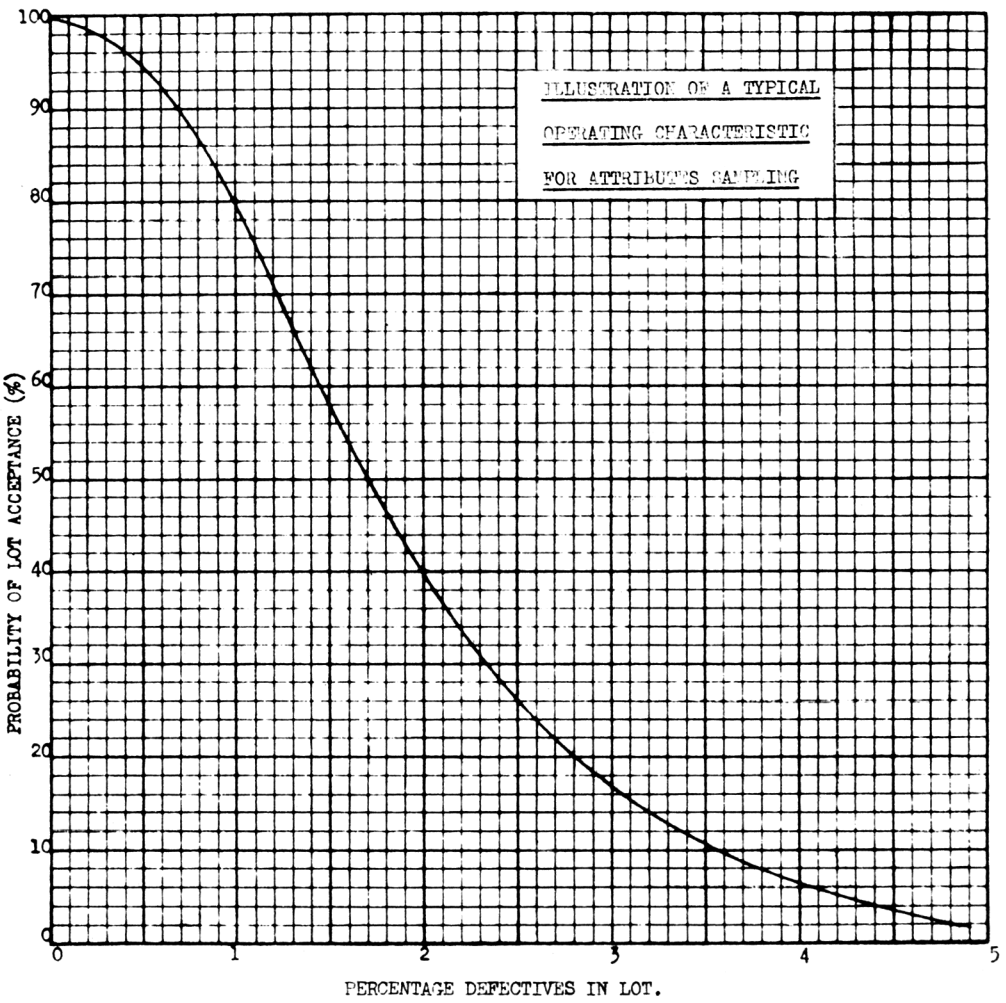
Illustrations of the limiting distributions for this valve, which would be just accepted by the above controls, are given on Pages 6 and 7. These show normal curves with the maximum permissible spread allowed by the ALD, centered on the LAL and UAL, respectively, and the maximum spread distributions, centered on the bogey value.

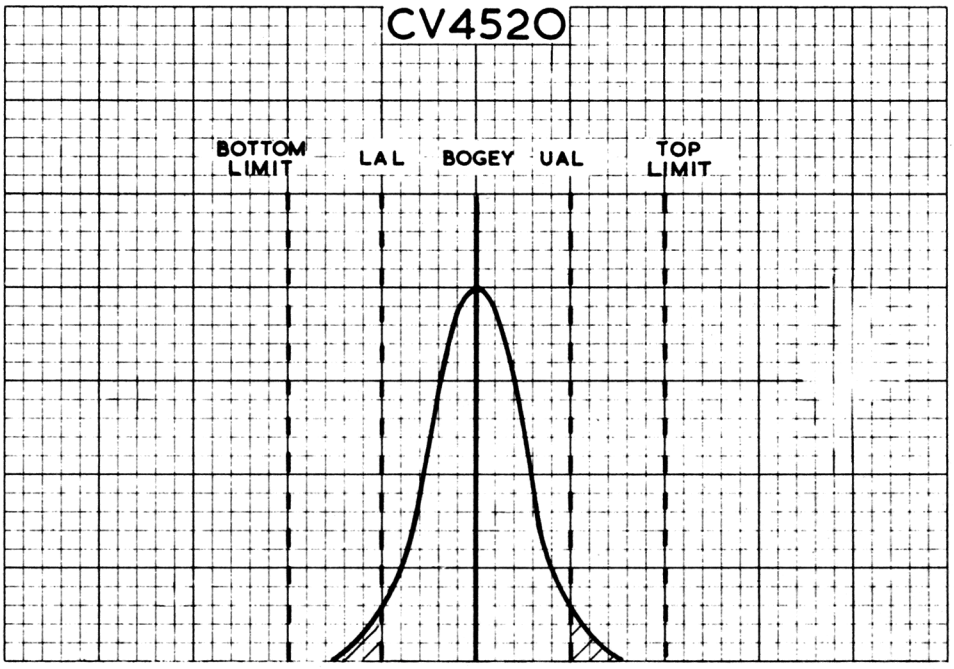
For further details of sampling inspection procedures for Attributes and Variables, reference should be made to K1001, Appendix XI, and MIL Standard 105A, Sampling Procedures and Tables for Inspection by Attributes.

Typical Operating Characteristic

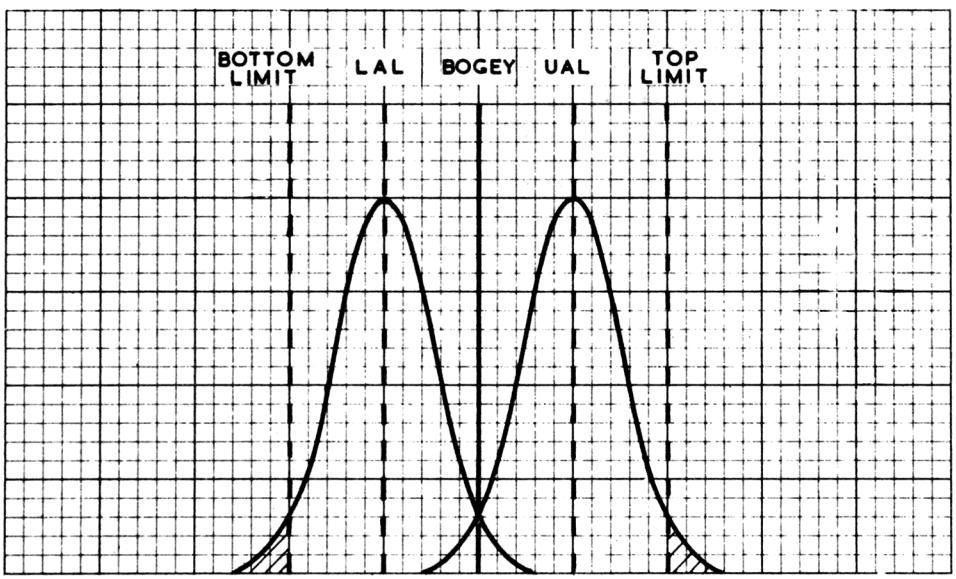
The following curve gives a typical Operating Characteristic for:-

Lot Size of between 1301 and 3200
Inspection Level II (Code Letter L, Sample size 150)
An AQL of 0.4% (Accept on 2, reject on 3).

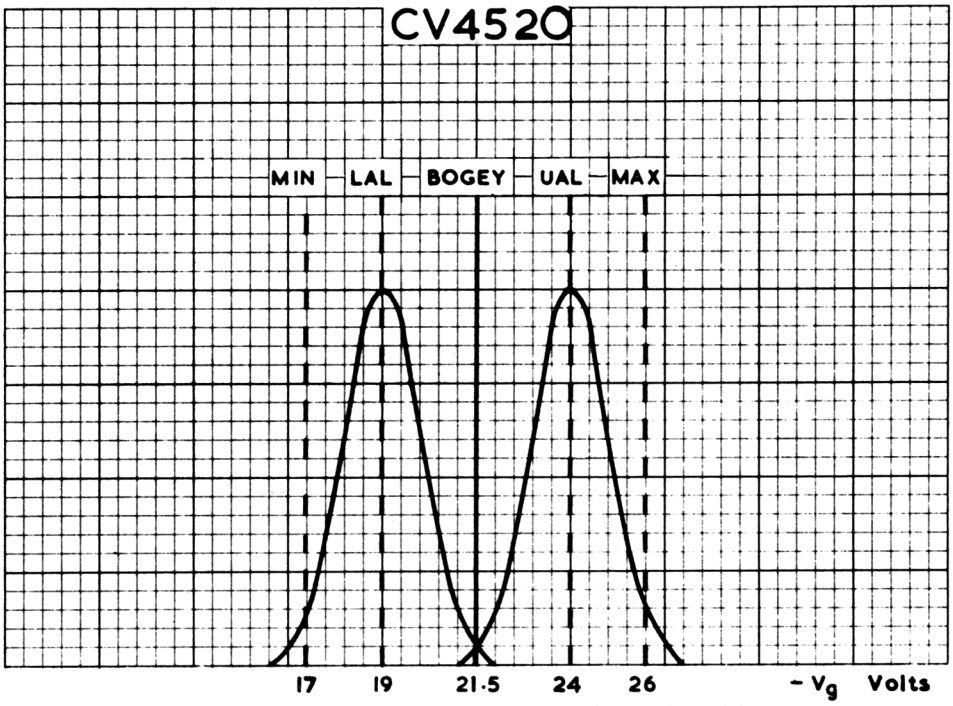




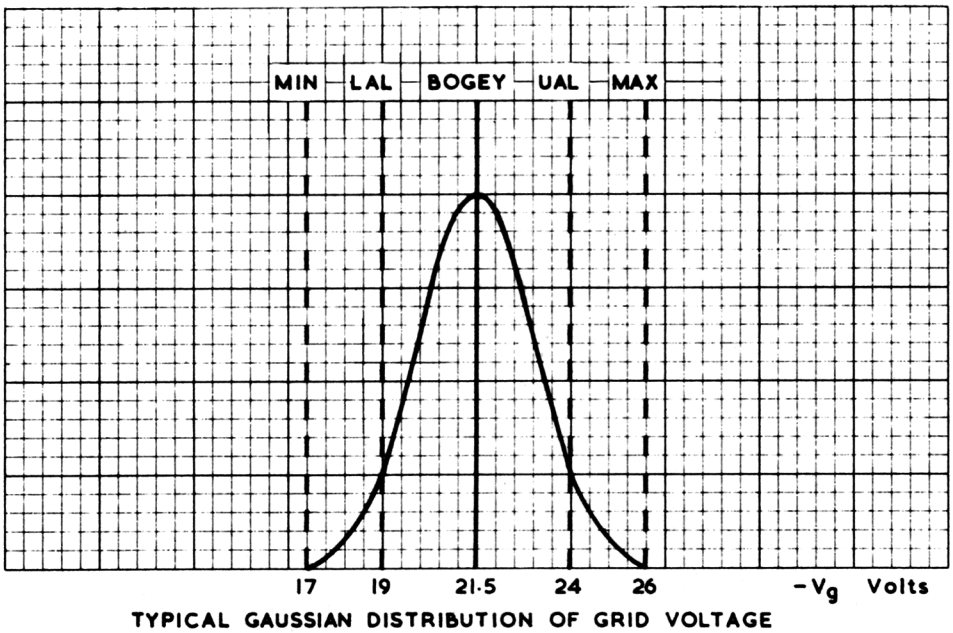
NORMAL GUASSIAN DISTRIBUTION OF MUTUAL CONDUCTANCE (mA/V)



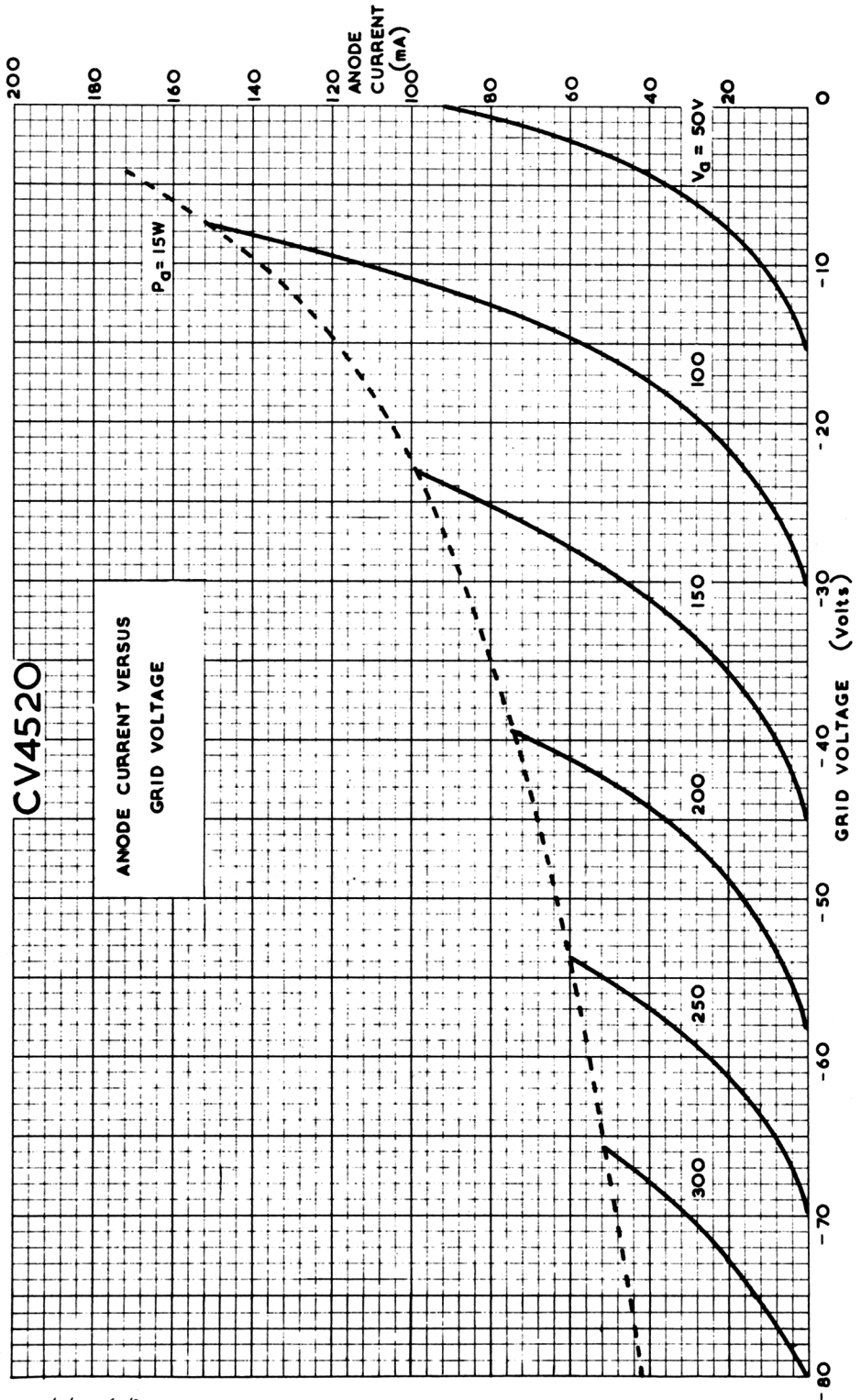
LIMITING DISTRIBUTIONS OF MUTUAL CONDUCTANCE (mA/V)



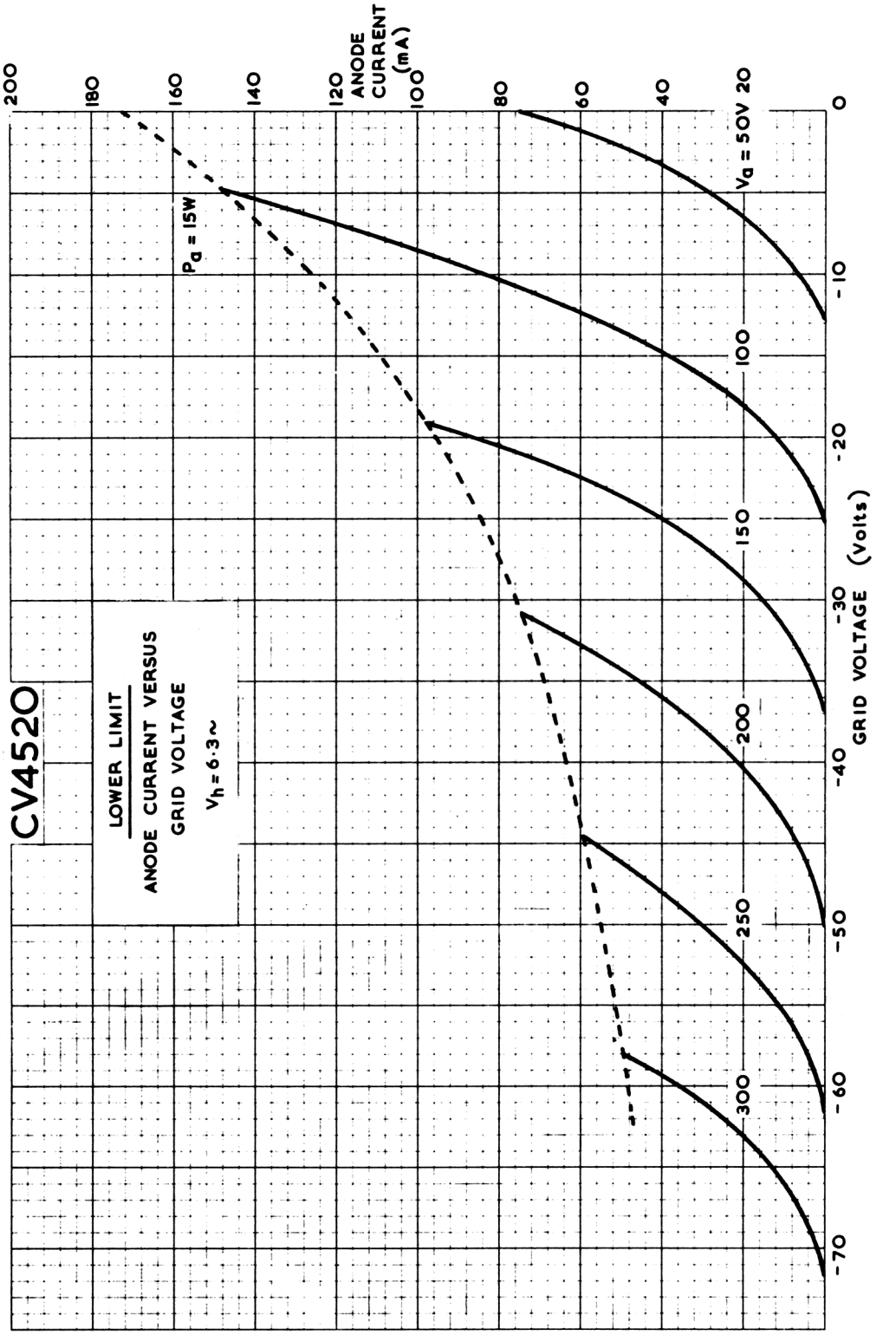
TYPICAL LIMITING DISTRIBUTION OF GRID VOLTAGE

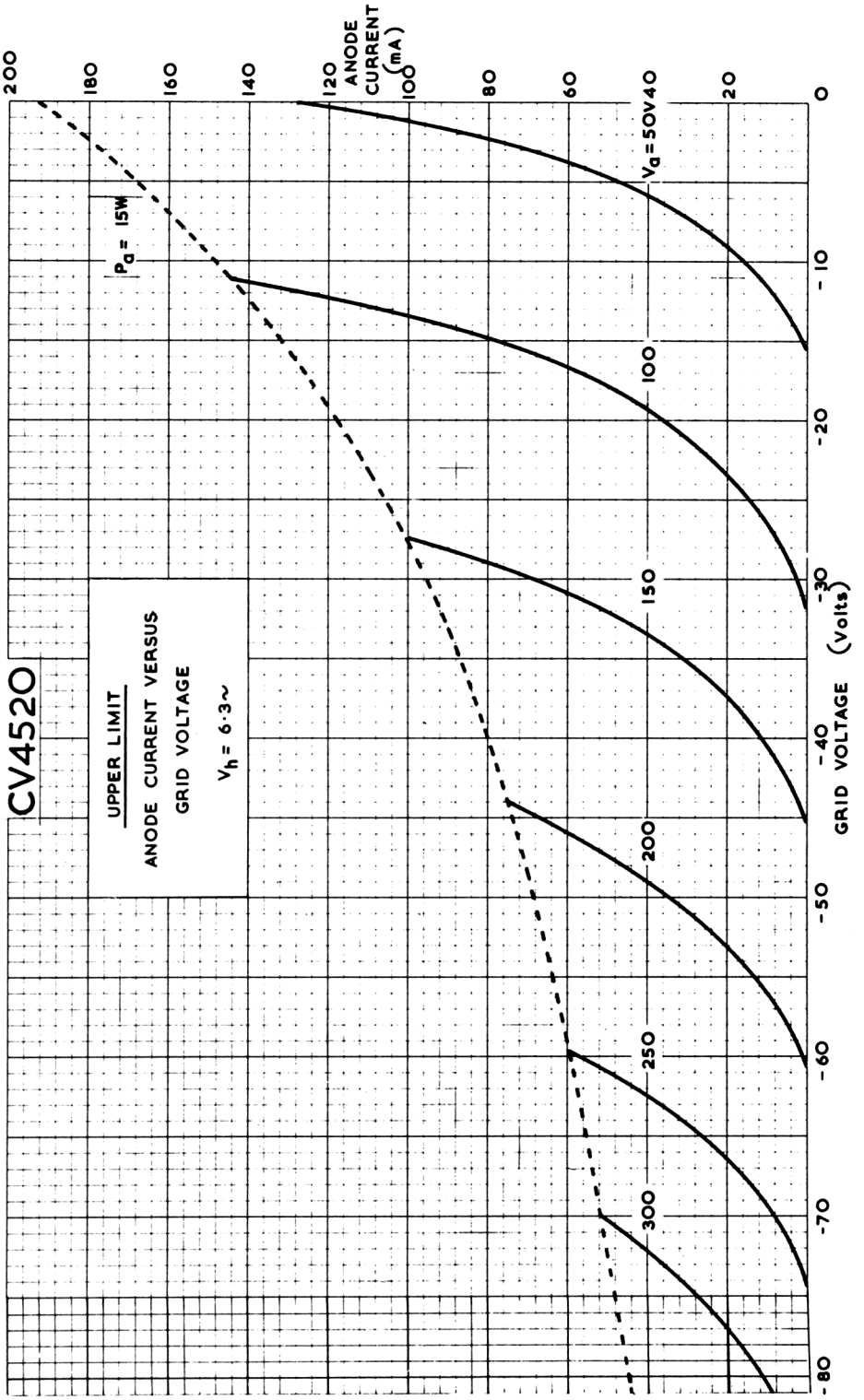


TYPICAL GAUSSIAN DISTRIBUTION OF GRID VOLTAGE

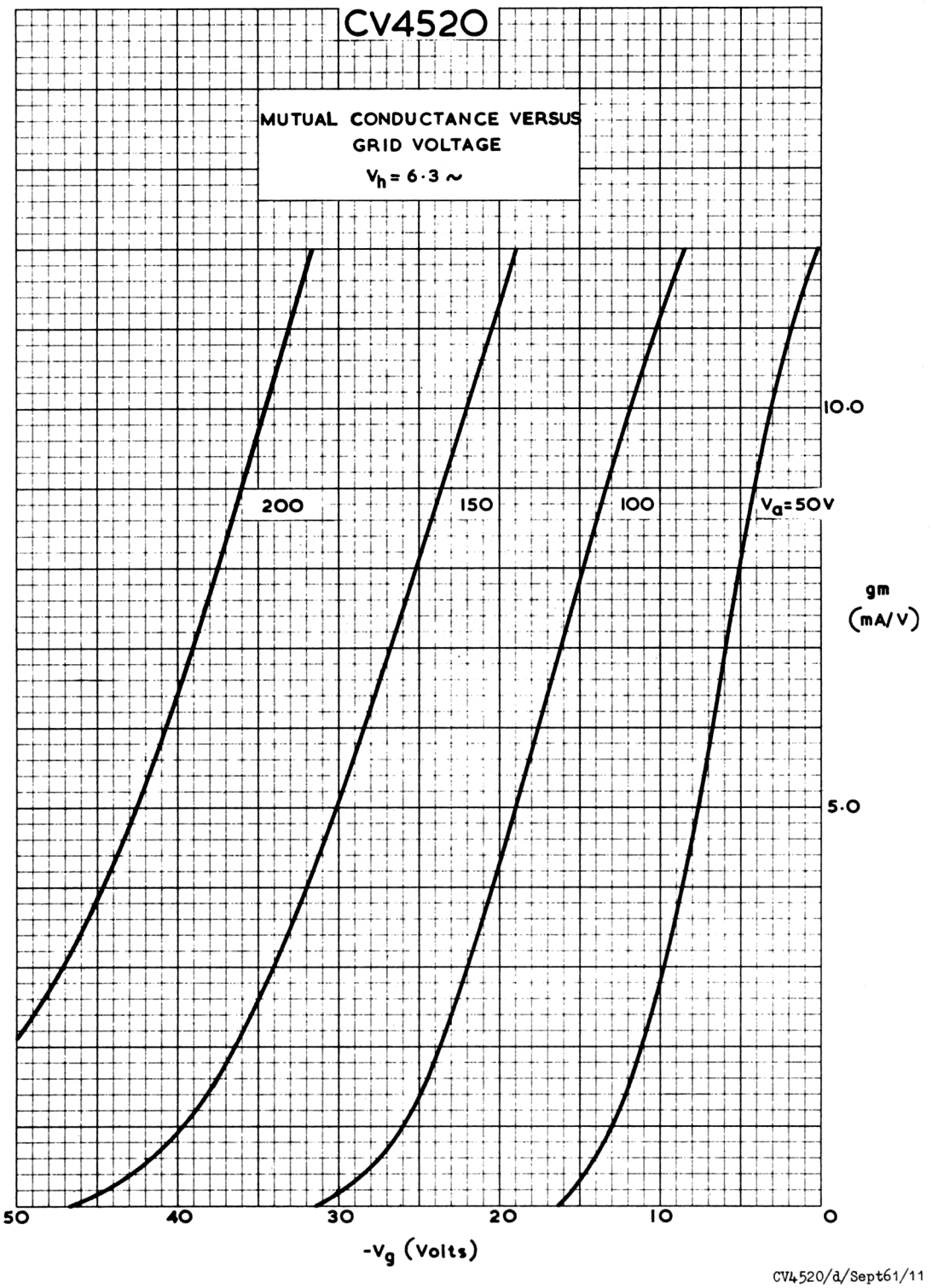

CV4520
ANODE CURRENT VERSUS GRID VOLTAGE
ANODE CURRENT (mA)
200
180
160
140
120
100
80
60
40
20
0
P_g = 15W
V_g = 50V
100
150
200
250
300
-10
-20
-30
-40
-50
-60
-70
-80
GRID VOLTAGE (Volts)

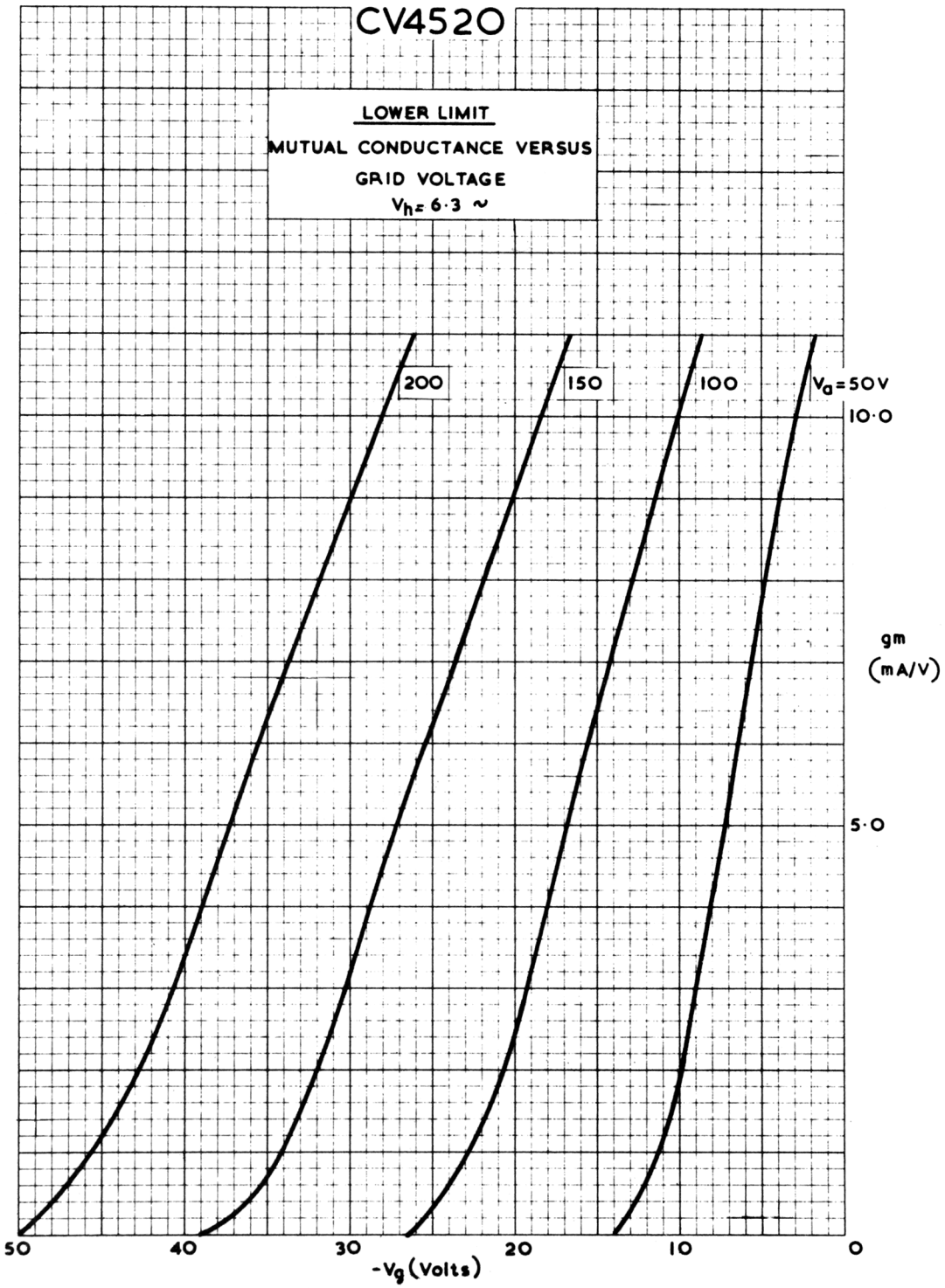
CV4520


CV4520
LOWER LIMIT
ANODE CURRENT VERSUS
GRID VOLTAGE
V_h = 6·3~
P_a = 15W
V_a = 50V
ANODE CURRENT (mA)
GRID VOLTAGE (Volts)
200
180
160
140
120
100
80
60
40
20
0
-10
-20
-30
-40
-50
-60
-70
100
150
200
250
300

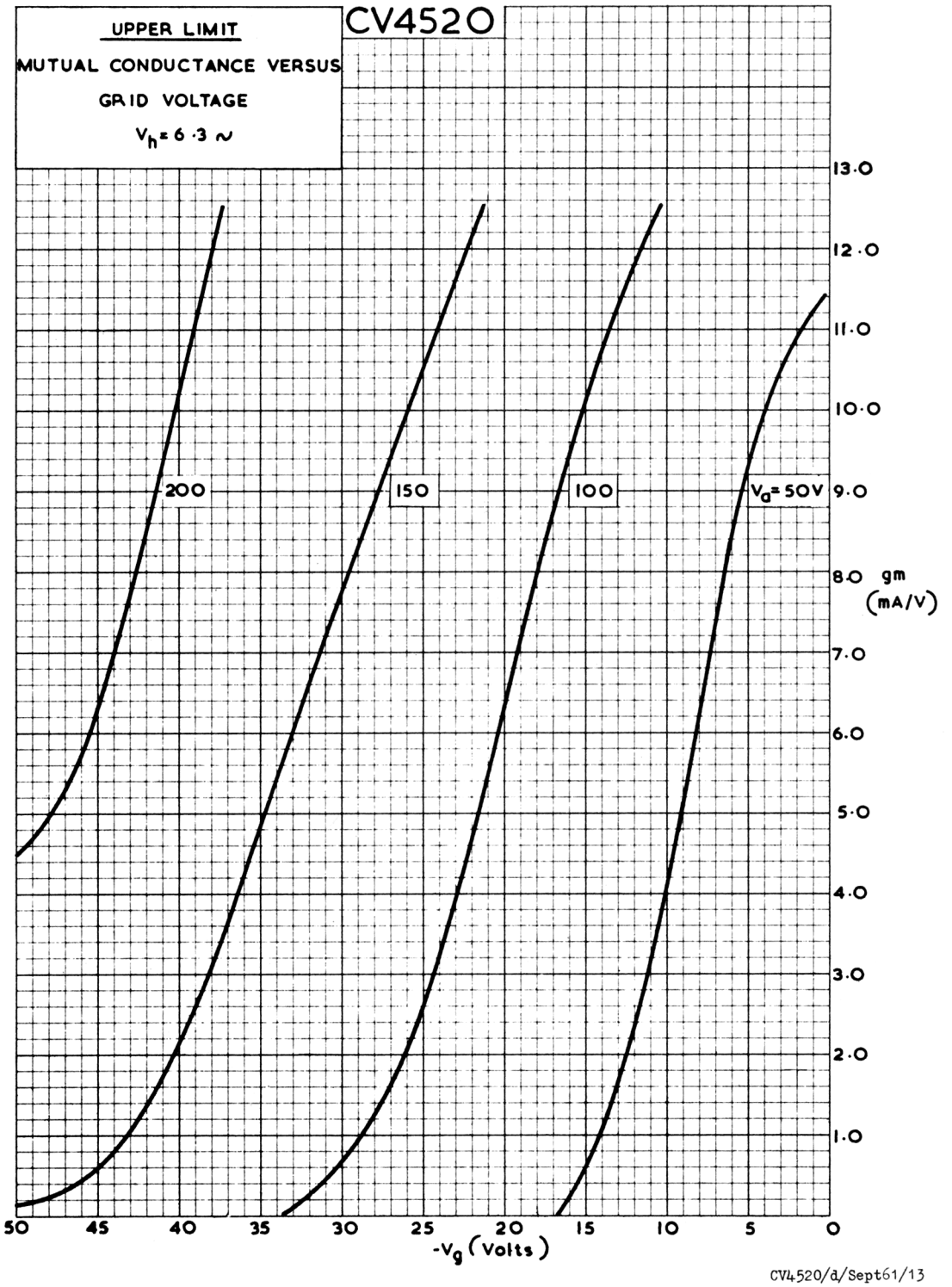

CV4520
UPPER LIMIT
ANODE CURRENT VERSUS
GRID VOLTAGE
V_h = 6·3~
P_a = 15W
V_a = 50V
40
ANODE CURRENT (mA)
GRID VOLTAGE (Volts)
200
180
160
140
120
100
80
60
40
20
0
-10
-20
-30
-40
-50
-60
-70
-80
100
150
200
250
300

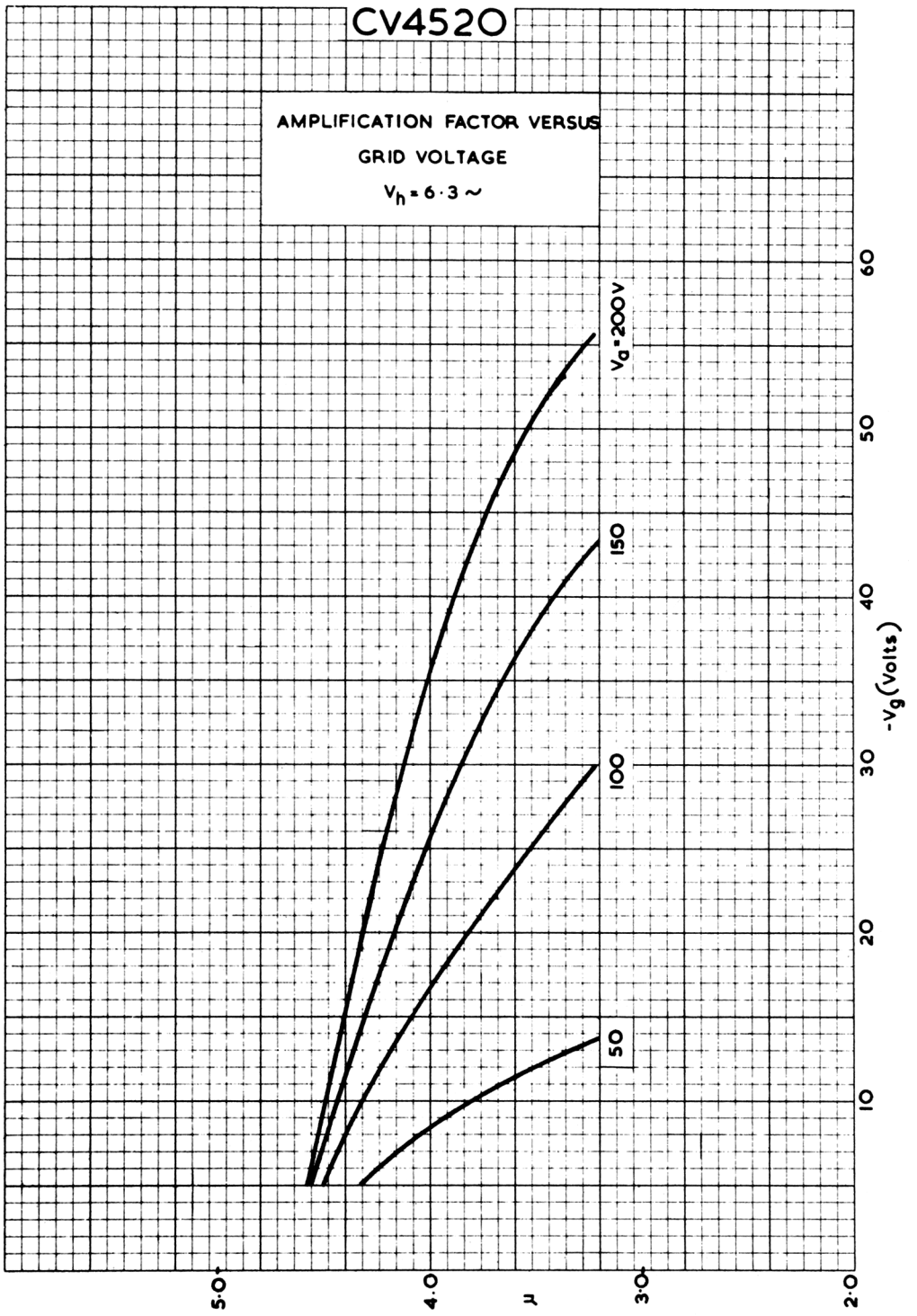
CV4520


CV4520
MUTUAL CONDUCTANCE VERSUS GRID VOLTAGE
V_h = 6·3 ~
200
150
100
V_a=50V
10·0
5·0
gm (mA/V)
50
40
30
20
10
0
$-V_g$ (Volts)

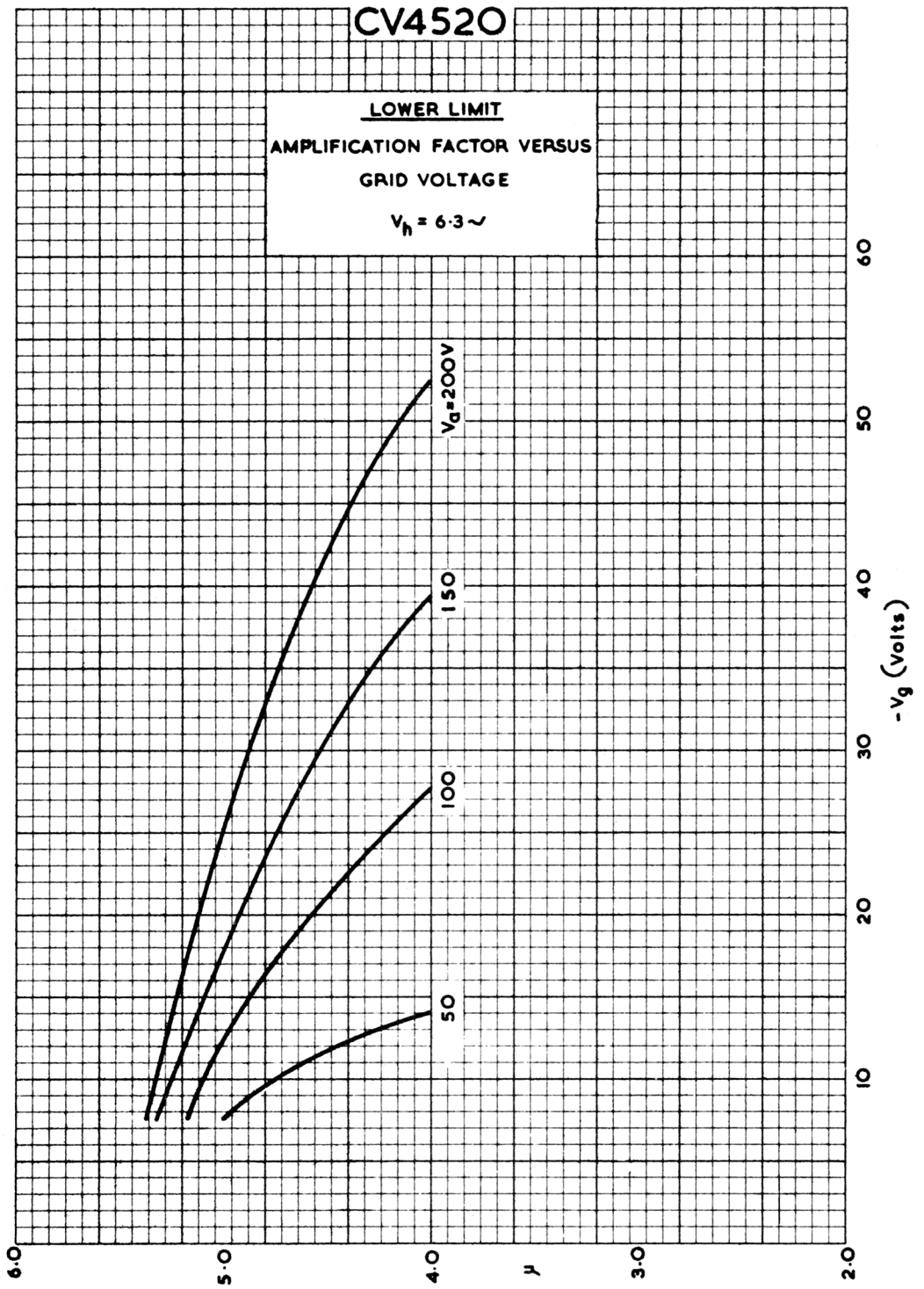

CV4520
LOWER LIMIT
MUTUAL CONDUCTANCE VERSUS
GRID VOLTAGE
V_h= 6·3 ~
200
150
100
V_a=50V
10·0
gm
(mA/V)
5·0
50
40
30
20
10
0
-V_g (Volts)

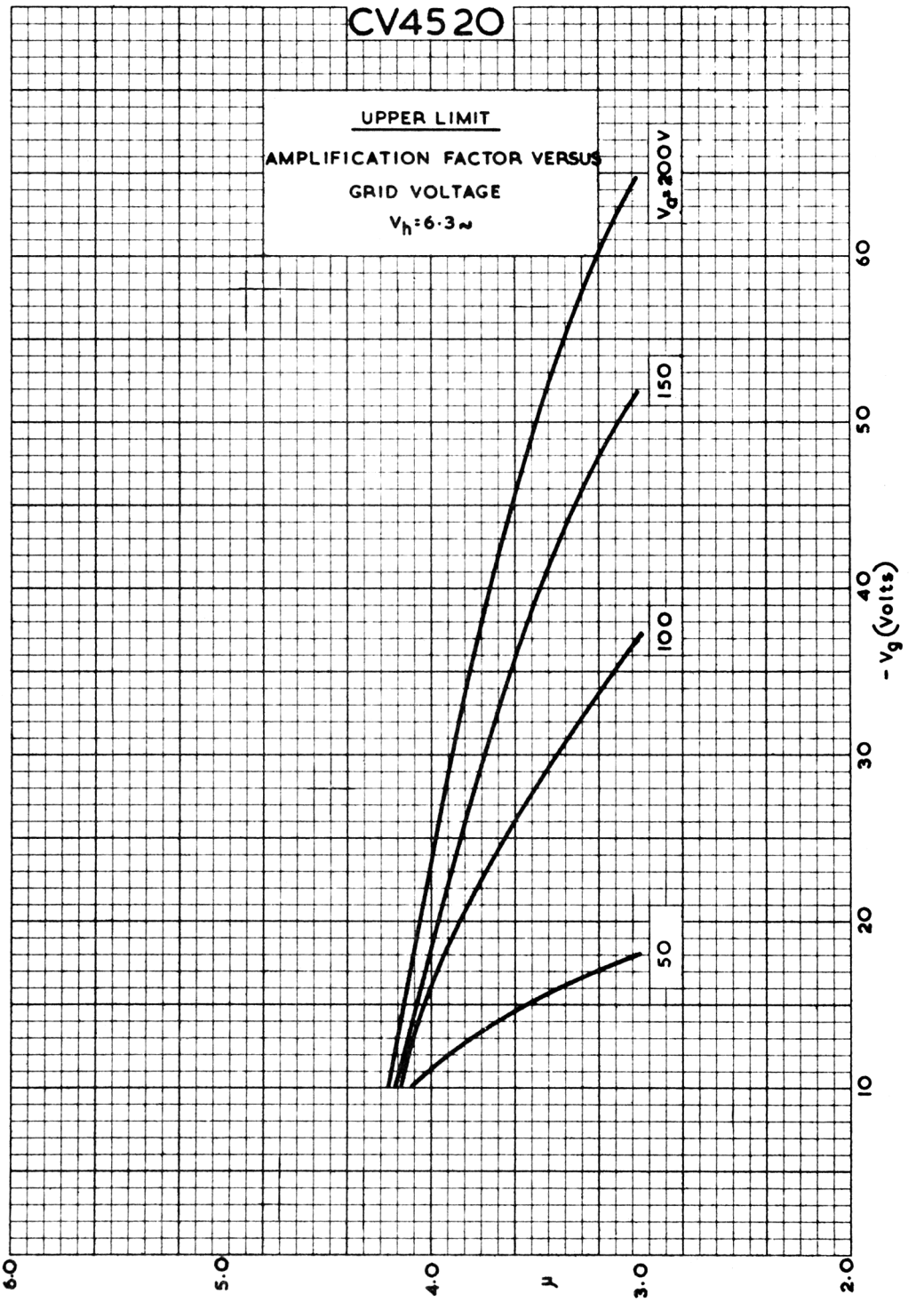
CV4520

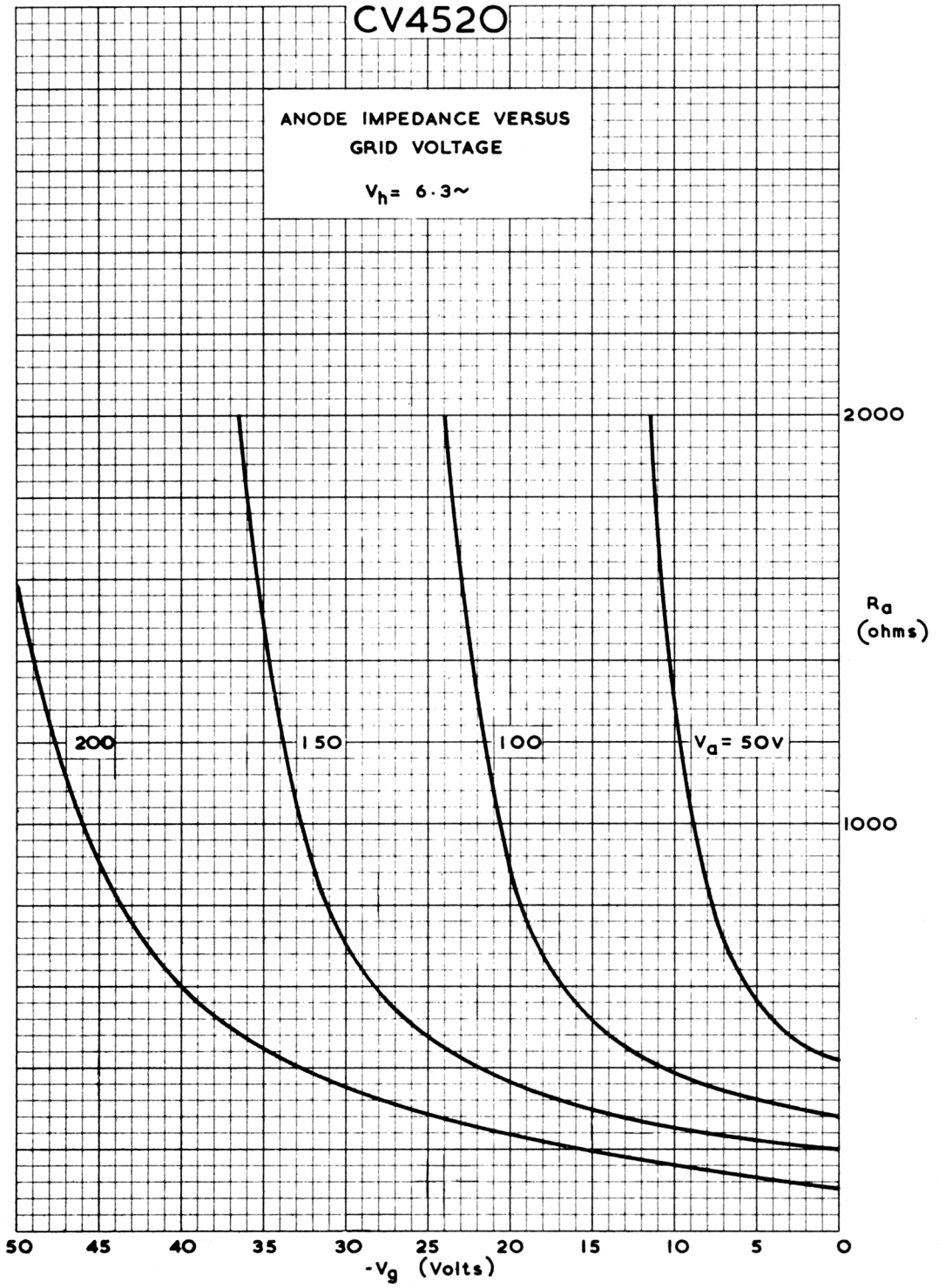

UPPER LIMIT
MUTUAL CONDUCTANCE VERSUS
GRID VOLTAGE
V_h = 6·3 ~
CV4520
200
150
100
V_a = 50V
13·0
12·0
11·0
10·0
9·0
8·0
7·0
6·0
5·0
4·0
3·0
2·0
1·0
gm
(mA/V)
50
45
40
35
30
25
20
15
10
5
0
-V_g (Volts)

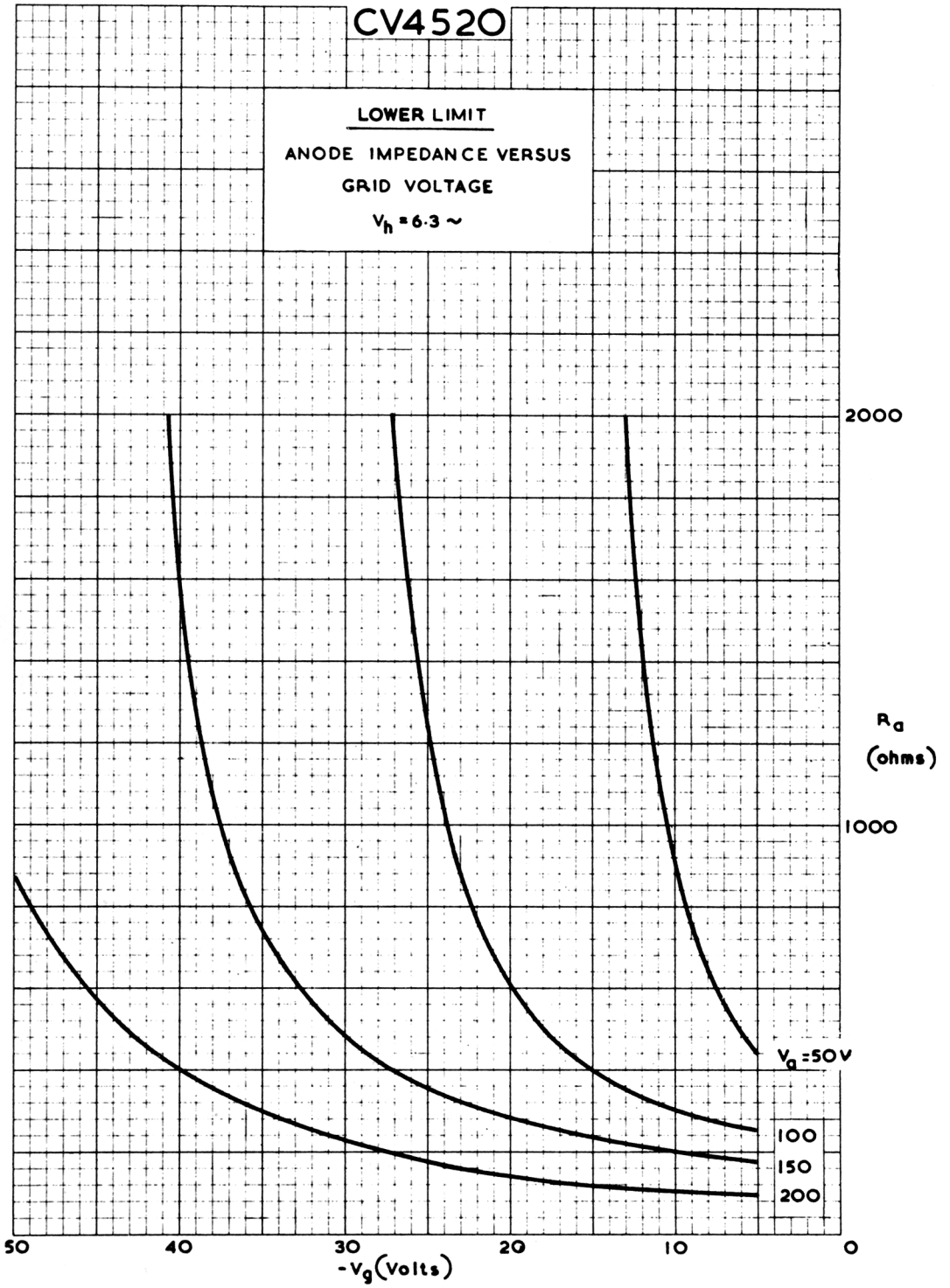

CV4520
AMPLIFICATION FACTOR VERSUS
GRID VOLTAGE
$V_h = 6.3 \sim$
V_a = 200V
150
100
50
60
50
40
30
20
10
$-V_g$ (Volts)
5·0
4·0
μ
3·0
2·0

CV4520

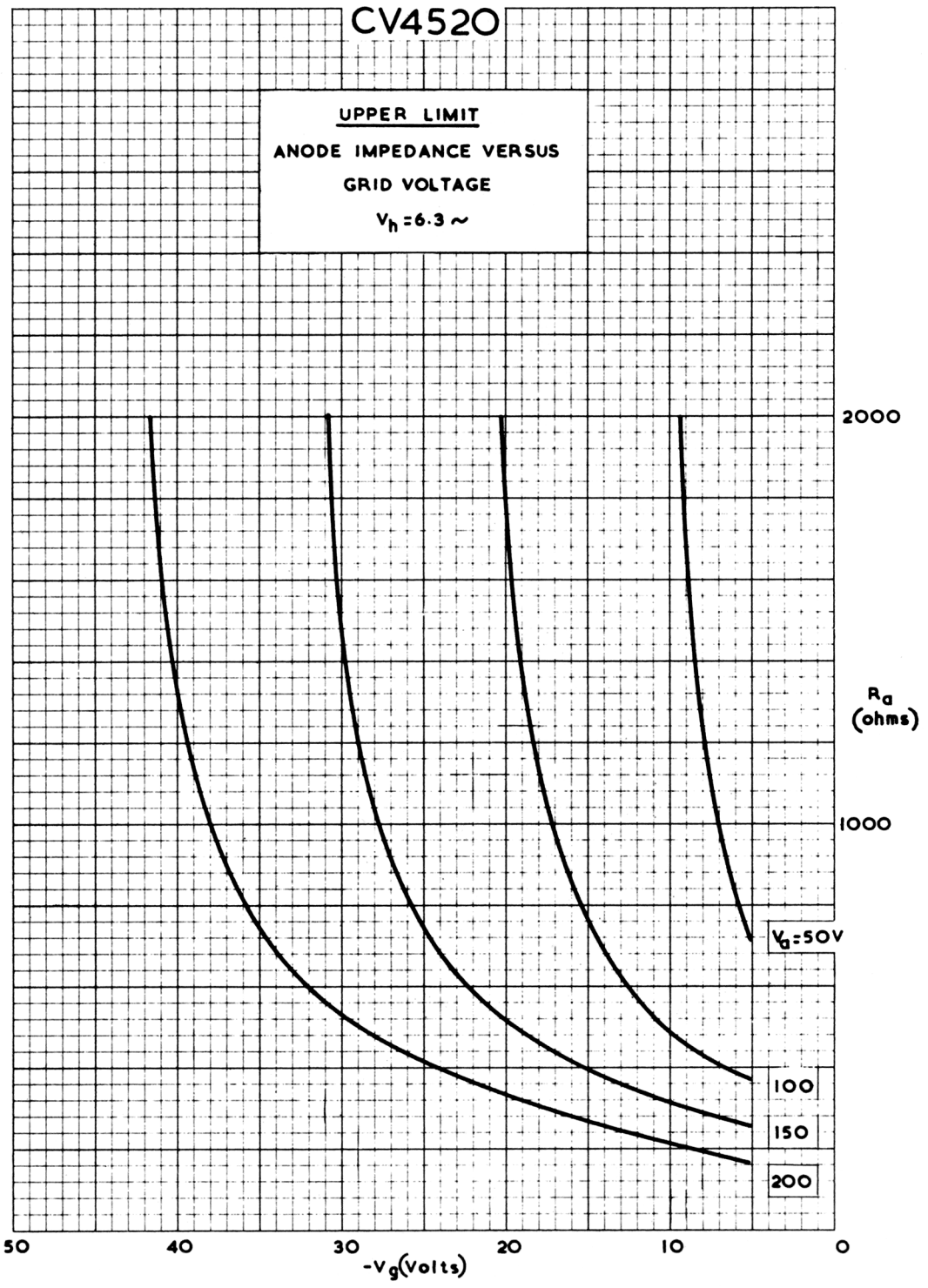

CV4520
LOWER LIMIT
AMPLIFICATION FACTOR VERSUS
GRID VOLTAGE
V_h = 6·3 ~
V_a=200V
150
100
50
6·0
5·0
4·0
3·0
2·0
μ
10
20
30
40
50
60
-V_g (Volts)

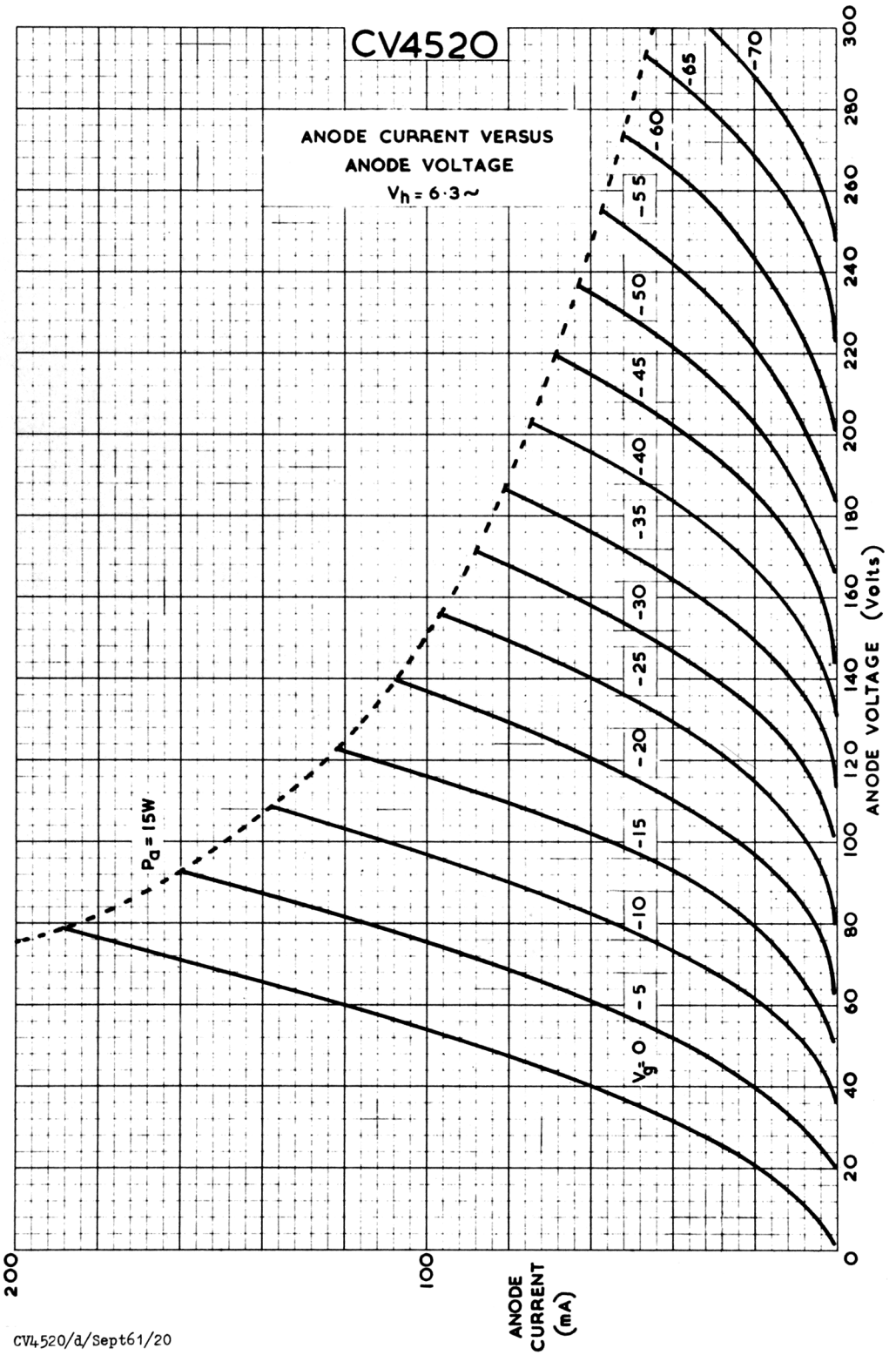

CV4520
UPPER LIMIT
AMPLIFICATION FACTOR VERSUS
GRID VOLTAGE
V_h=6·3 ~
V_a=200V
150
100
50
6·0
5·0
4·0
3·0
2·0
μ
10
20
30
40
50
60
$-V_g$ (Volts)


CV4520
ANODE IMPEDANCE VERSUS
GRID VOLTAGE
V_h= 6.3~
2000
1000
R_a
(ohms)
200
150
100
V_a= 50V
50
45
40
35
30
25
20
15
10
5
0
-V_g (Volts)

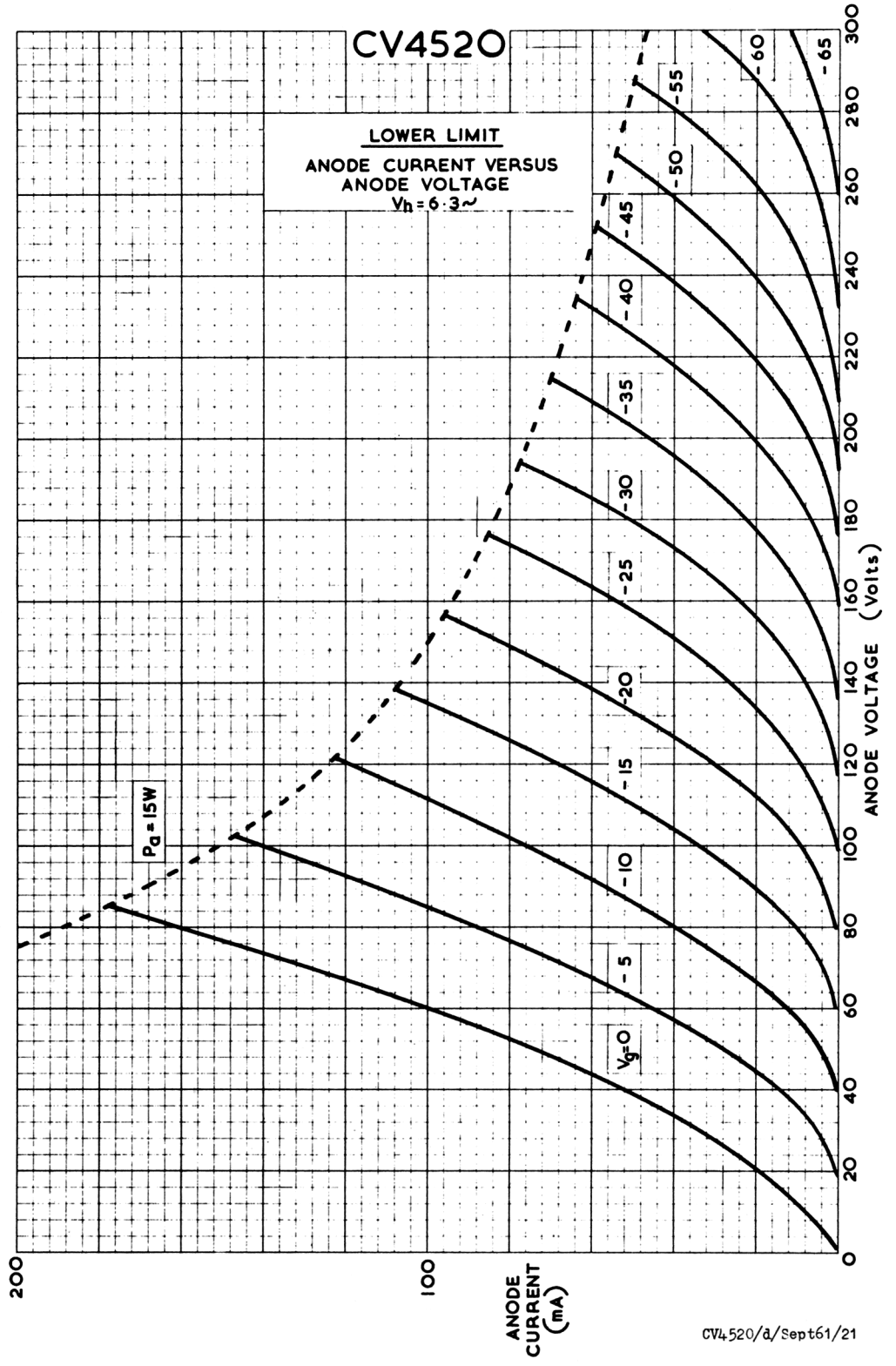

CV4520
LOWER LIMIT
ANODE IMPEDANCE VERSUS
GRID VOLTAGE
V_h = 6·3 ~
2000
1000
R_a
(ohms)
V_a = 50V
100
150
200
50
40
30
20
10
0
$-V_g$ (Volts)

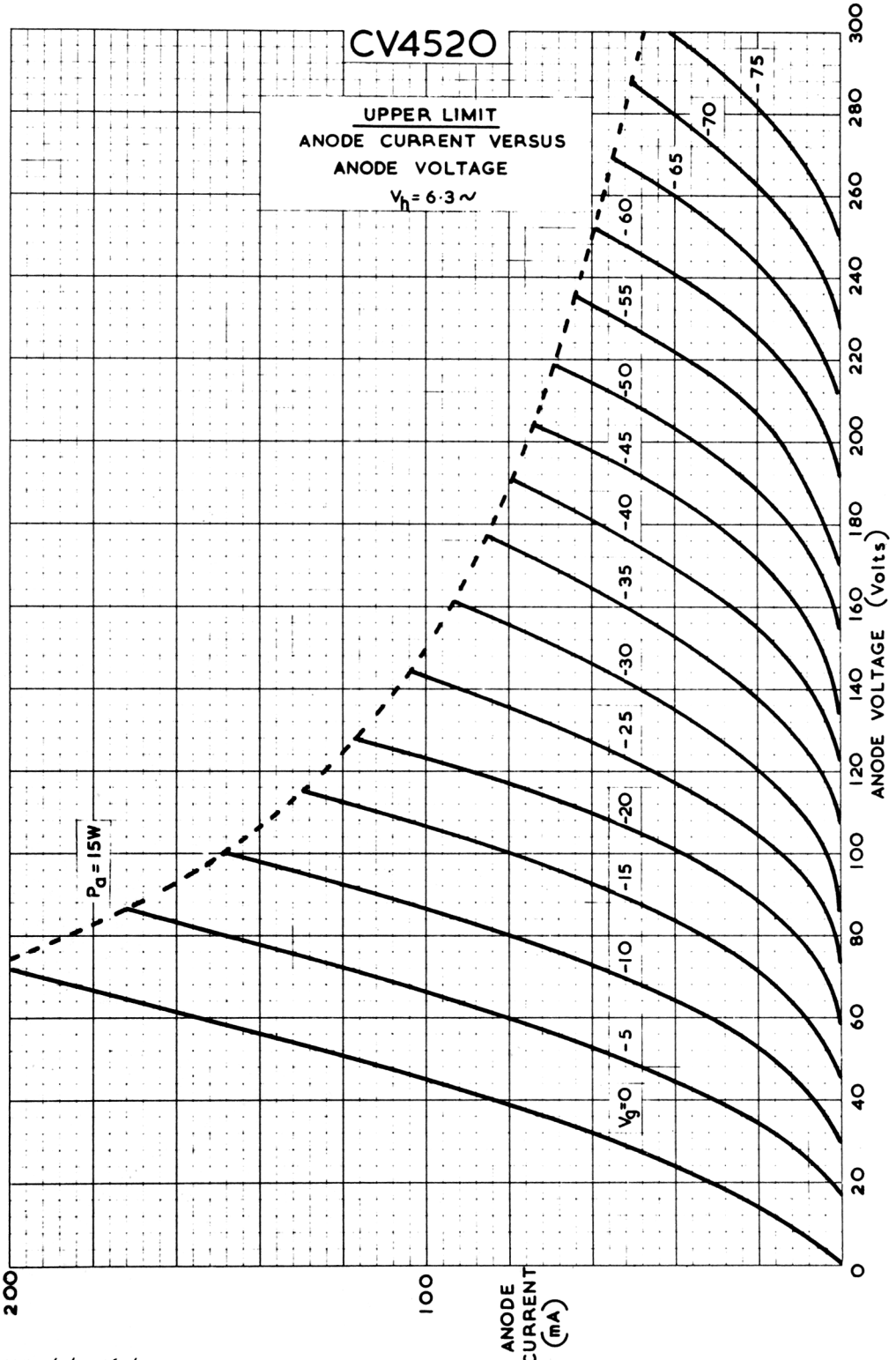
CV4520

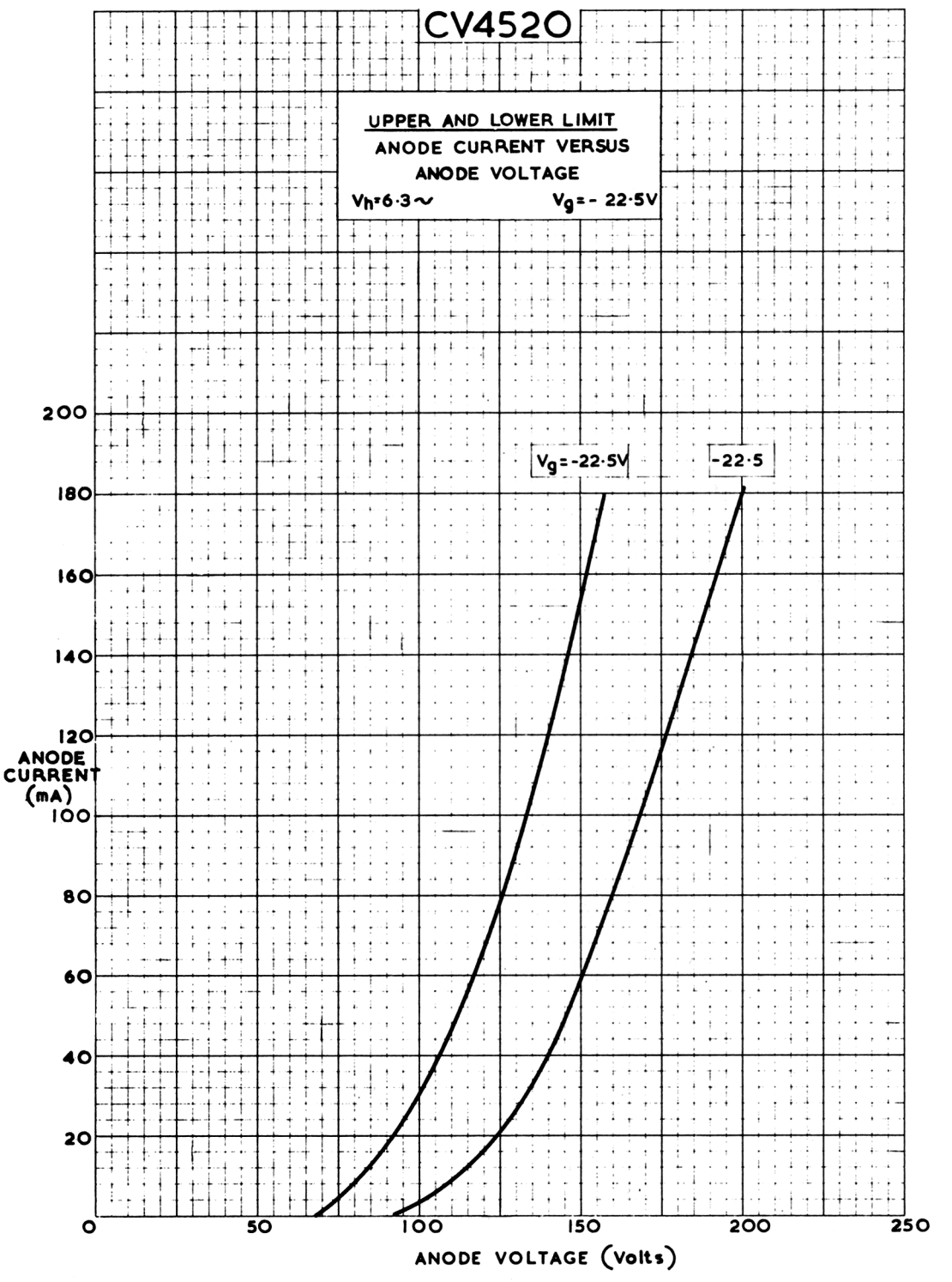

CV4520
UPPER LIMIT
ANODE IMPEDANCE VERSUS
GRID VOLTAGE
V_h = 6.3 ~
2000
1000
R_a (ohms)
V_a = 50V
100
150
200
50
40
30
20
10
0
-V_g (Volts)

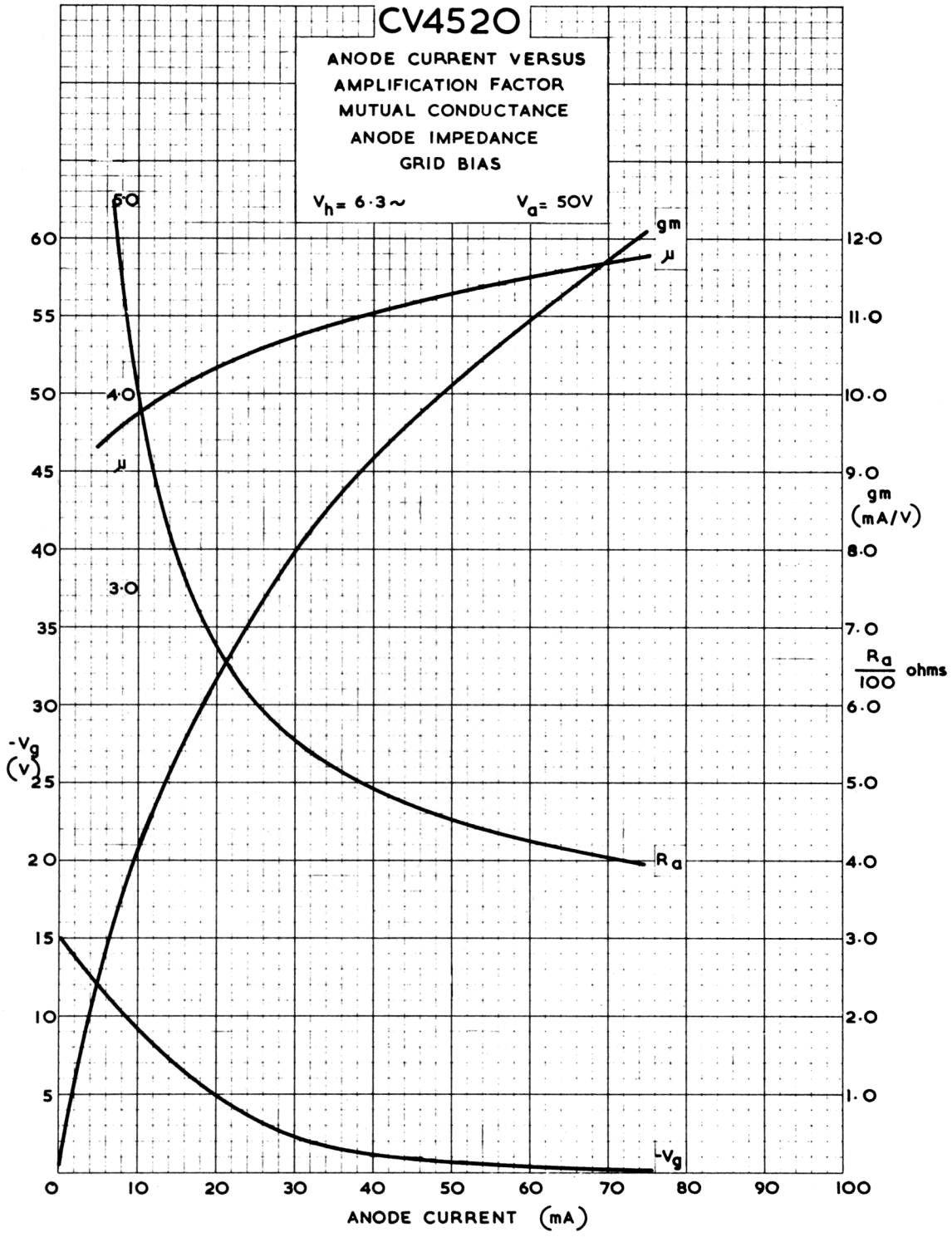

CV4520
ANODE CURRENT VERSUS
ANODE VOLTAGE
$V_h = 6{\cdot}3\sim$
$P_a = 15W$
$V_g = 0$
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
ANODE VOLTAGE (Volts)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ANODE CURRENT (mA)
200
100

CV4520

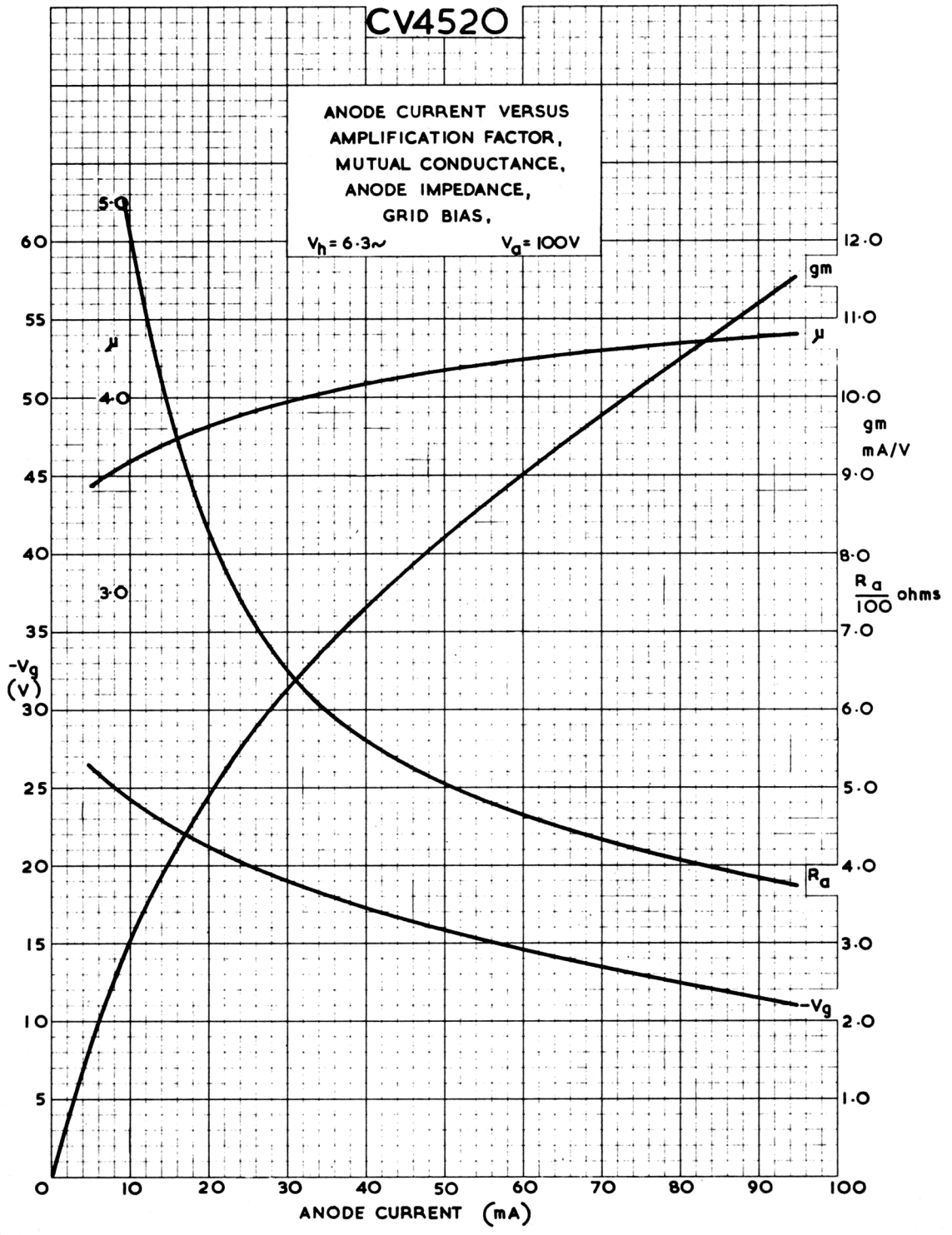

CV4520
LOWER LIMIT
ANODE CURRENT VERSUS
ANODE VOLTAGE
Vh = 6·3~
Pa = 15W
Vg=0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
ANODE VOLTAGE (Volts)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ANODE CURRENT (mA)
200
100

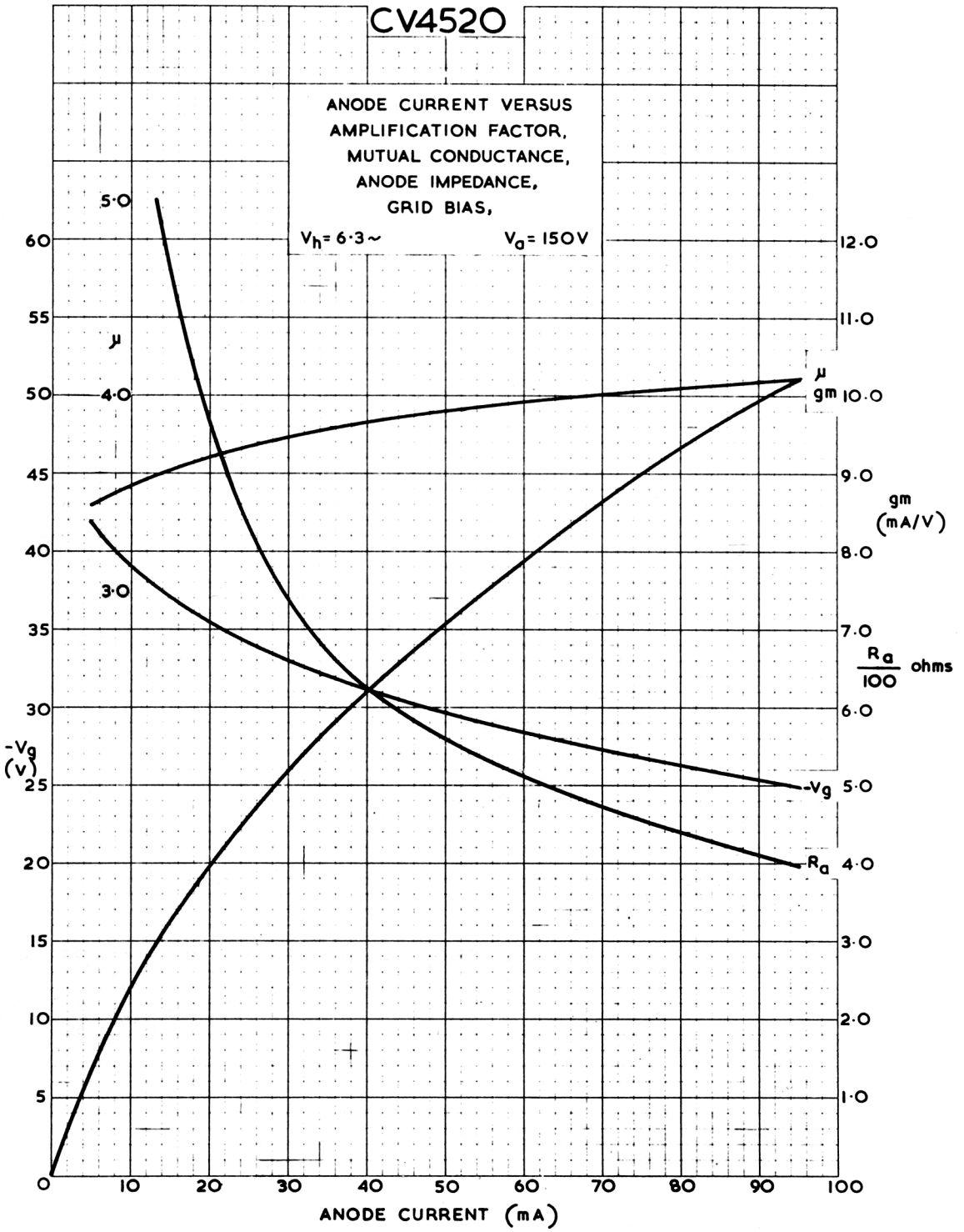

CV4520
UPPER LIMIT
ANODE CURRENT VERSUS
ANODE VOLTAGE
V_h = 6·3 ~
P_a = 15W
V_g=0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ANODE VOLTAGE (Volts)
200
100
ANODE CURRENT (mA)


CV4520
UPPER AND LOWER LIMIT
ANODE CURRENT VERSUS
ANODE VOLTAGE
Vh=6·3~
Vg=- 22·5V
Vg=-22·5V
-22·5
200
180
160
140
120
100
80
60
40
20
0
ANODE CURRENT (mA)
50
100
150
200
250
ANODE VOLTAGE (Volts)

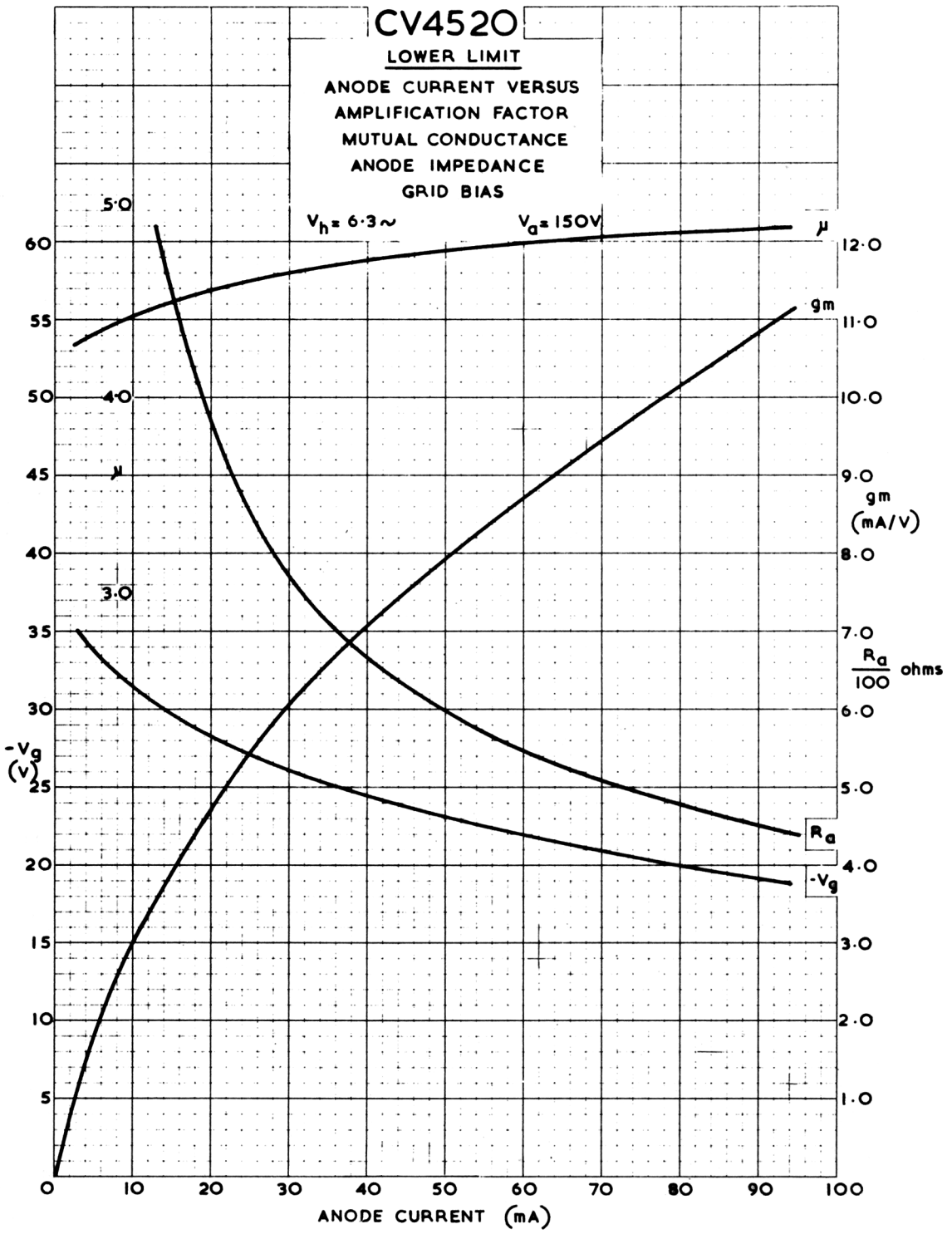

CV4520
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR
MUTUAL CONDUCTANCE
ANODE IMPEDANCE
GRID BIAS
V_h= 6·3~
V_a= 50V
6·0
4·0
3·0
μ
gm
μ
R_a
$-V_g$
$-V_g$ (V)
gm (mA/V)
$\frac{R_a}{100}$ ohms
ANODE CURRENT (mA)
0
10
20
30
40
50
60
70
80
90
100
5
10
15
20
25
30
35
40
45
50
55
60
1·0
2·0
3·0
4·0
5·0
6·0
7·0
8·0
9·0
10·0
11·0
12·0

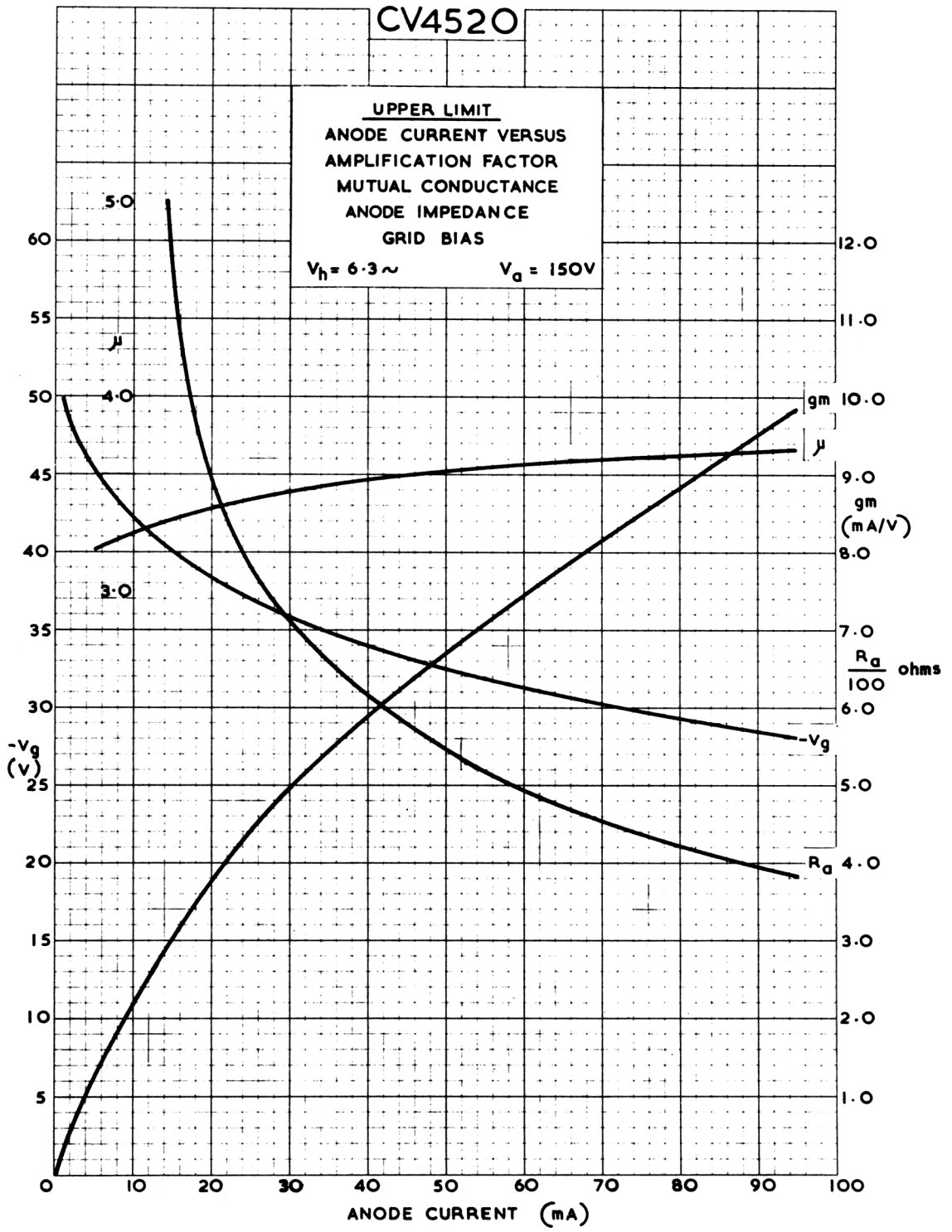
CV4520


CV4520
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR,
MUTUAL CONDUCTANCE,
ANODE IMPEDANCE,
GRID BIAS,
V_h = 6·3~
V_a = 100V
5·0
4·0
3·0
μ
gm
R_a
-V_g
-V_g (V)
gm mA/V
$\frac{R_a}{100}$ ohms
ANODE CURRENT (mA)
0
10
20
30
40
50
60
70
80
90
100
5
10
15
20
25
30
35
40
45
50
55
60
1·0
2·0
3·0
4·0
5·0
6·0
7·0
8·0
9·0
10·0
11·0
12·0

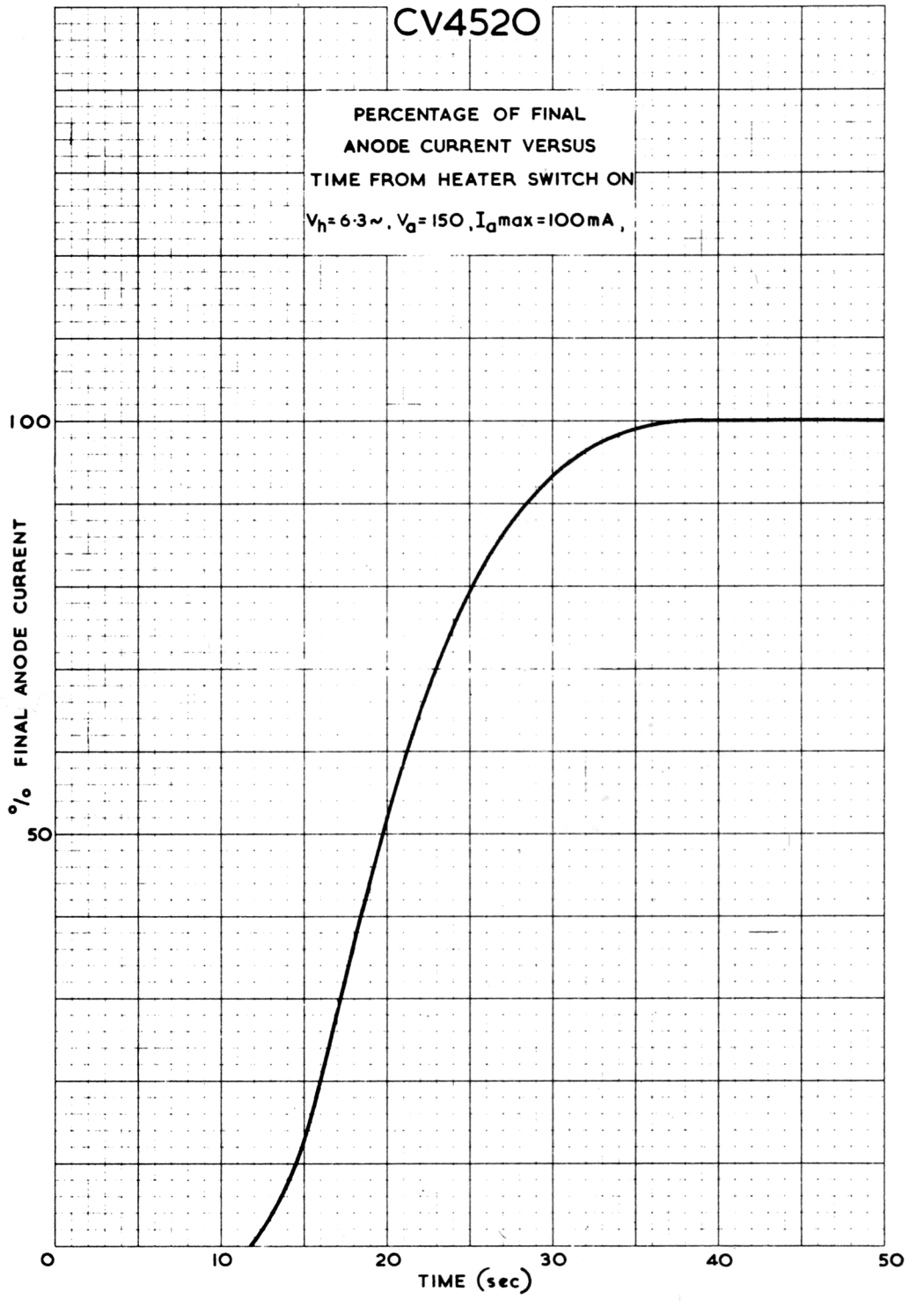

CV4520
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR,
MUTUAL CONDUCTANCE,
ANODE IMPEDANCE,
GRID BIAS,
Vh= 6·3~
Va= 150V
5·0
μ
4·0
3·0
μ
gm
-Vg
Ra
-Vg (V)
gm (mA/V)
Ra/100 ohms
ANODE CURRENT (mA)
0
5
10
15
20
25
30
35
40
45
50
55
60
10
20
30
40
50
60
70
80
90
100
1·0
2·0
3·0
4·0
5·0
6·0
7·0
8·0
9·0
10·0
11·0
12·0

CV4520


CV4520
LOWER LIMIT
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR
MUTUAL CONDUCTANCE
ANODE IMPEDANCE
GRID BIAS
V_h = 6·3 ~
V_a = 150V
5·0
4·0
3·0
μ
gm
R_a
$-V_g$
-V_g (V)
gm (mA/V)
$\frac{R_a}{100}$ ohms
ANODE CURRENT (mA)
0 10 20 30 40 50 60 70 80 90 100
60 55 50 45 40 35 30 25 20 15 10 5
12·0 11·0 10·0 9·0 8·0 7·0 6·0 5·0 4·0 3·0 2·0 1·0


CV4520
UPPER LIMIT
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR
MUTUAL CONDUCTANCE
ANODE IMPEDANCE
GRID BIAS
Vh = 6·3 ~
Va = 150V
5·0
μ
4·0
3·0
gm
μ
-Vg
Ra
-Vg (V)
gm (mA/V)
Ra/100 ohms
ANODE CURRENT (mA)
0
10
20
30
40
50
60
70
80
90
100
5
10
15
20
25
30
35
40
45
50
55
60
1·0
2·0
3·0
4·0
5·0
6·0
7·0
8·0
9·0
10·0
11·0
12·0

CV4520


CV4520
PERCENTAGE OF FINAL
ANODE CURRENT VERSUS
TIME FROM HEATER SWITCH ON
V_h=6·3~, V_a=150, $I_a$max=100mA,
100
50
0
% FINAL ANODE CURRENT
10
20
30
40
50
TIME (sec)

MAXIMUM VALUE OF GRID-TO-CATHODE RESISTOR

The value of the external grid to cathode resistor which can be used with a valve in circuit is limited by the negative grid current of the valve and the D.C. effective mutual conductance of the valve in the circuit.

In simple circuits, the maximum safe value of grid to cathode resistor can be obtained with the aid of the curves given on the next page, by taking the working slope from characteristic curves and calculating the value of the effective cathode resistor from the following equations:-

For Triodes:- $R_k \text{ eff.} = R_k + \frac{R_a}{\mu}$

For Pentodes:- $R_k \text{ eff.} = \frac{I_k \times R_k}{I_a} + \frac{I_{g2} \times R_{g2}}{I_a \times \mu(g1 - g2)}$

Example

CV4502 operating as a voltage amplifier with Va(b)=250V, Ra=100K, Rg2=330K, Rk=560. Ia=2.0mA, Ig2=0.67mA, gm working=3.5mA/V.

Then $R_k \text{ eff.} = \frac{2.67 \times 560}{2.0} + \left(\frac{0.67}{2.0} \times \frac{330,000}{28}\right)$

$= 4715$ ohms.

From the curves for these values of Rk eff. and gm working:-

$$\frac{Rg1 \text{ (maximum)}}{Rg1(max) \text{ (Fixed bias published)}} \times \frac{gm \text{ (working)}}{gm \text{ (published)}} = 16$$

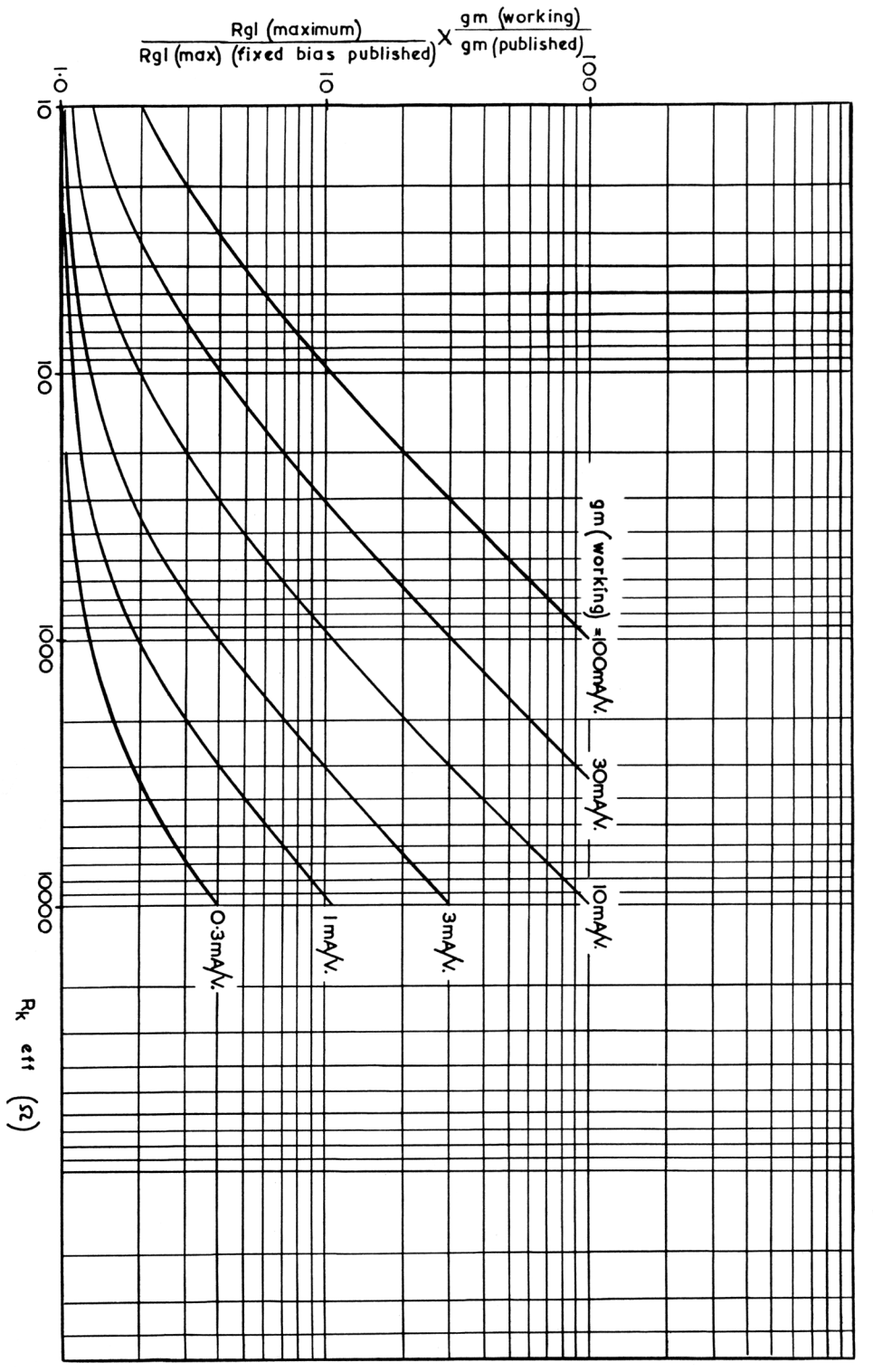
Therefore Rg1 maximum $= 16 \times 0.25 \times 10^6 \times \frac{5.2}{3.5} = 6M$.

In more complex circuits, for example, those employing feedback additional to that given by a cathode, anode or screen grid resistor, or those having large signals and driven into positive grid current, the working slope and effective cathode resistor are difficult to assess. For these cases the maximum value of grid to cathode resistor in circuit is given by the following relationship:-

$$\frac{Rg1 \text{ (maximum)}}{Rg1 \text{ (max) (fixed bias published)}} = \frac{gm \text{ (published)}}{gm \text{ (w: eff.)}}$$

where the effective working mutual conductance gm (w: eff:) is obtained by measurement in the circuit and is the change of anode current that would occur in that circuit for unit change of grid voltage, where this change of voltage is that which would be caused by a change of negative grid current within the valve.

CV4520


Rgl (maximum) / Rgl (max) (fixed bias published) X gm (working) / gm (published)
1·0
10
100
gm (working) = 100mA/V.
30mA/V.
10mA/V.
3mA/V.
1mA/V.
0·3mA/V.
1000
10000
Rk eff (Ω)