ELECTRONIC VALVE SPECIFICATIONS

SPECIFICATION MOA/CV4508 ISSUE 2 DATED 1ST JANUARY 1961

AMENDMENT NO. 1

Page 4 Group E Vibration Noise(3)

In the column headed "LIMITS MAX" insert the following limits against the appropriate frequency as follows:-

(1)	60 - 120 c/s	insert	"500"
(2)	120 - 250 c/s	"	"500"
(3)	250 - 500 c/s	"	"700"
(4)	500 - 1000 c/s	"	"700"
(5)	1000 - 2000 c/s	"	"700"

July 1964

TVC for R.R.E. NM.222371

VALVE ELECTRONIC

CV4508

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

Specification MOA/CV4508

Issue 2 dated 1st January, 1961

To be read in conjunction with K.1001, B.S.448 and B.S.1409

SECURITY	
Specification	Valve
UNCLASSIFIED	UNCLASSIFIED

→ Indicates a change

TYPE OF VALVE - Reliable Sub-Miniature Short Suppressor Base Pentode with Flying Leads.

CATHODE - Indirectly-heated

ENVELOPE - Glass

PROTOTYPE - CV467, VX 8240

MARKING

See K.1001/4

BASE

See B.S.448/B8D/F/1.1

RATINGS (Note A)

(All limiting values are absolute)

			Note
Heater Voltage	(V)	6.3	
Heater Current	(mA)	175	
Max. Heater - Cathode Voltage, Cathode +ve	(V)	100	
Cathode -ve	(V)	100	B
Max. Anode Voltage (Ia = 0)	(V)	350	
Max. Screen Voltage (Ig2 = 0)	(V)	350	
Max. Negative Grid Voltage	(V)	100	
Max. Positive Suppressor Voltage	(V)	0	
Max. Negative Suppressor Voltage	(V)	100	
Max. Operating Anode Voltage (pa.max)	(V)	190	
Max. Operating Screen Voltage (pg2.max)	(V)	190	
Max. Anode Dissipation	(W)	1.0	
Max. Screen Dissipation	(W)	0.4	
Max. Cathode Current	(mA)	12	
Max. Grid Circuit Resistance (Fixed Bias)	(M)	0.25	F
(Auto Bias)	(M)	0.5	F
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)	165	
Min. Operating Pressure	(mm.Hg)	55	
Max. Ambient Storage Temperature Range	(°C)	-60/+85	

Typical Operating Conditions

Measured at Va = Vg2 = 100V; Vg1 = -2V; Vg3 = 0		
Anode Current	(mA)	3.0
Screen Current	(mA)	2.25
Mutual Conductance	(mA/V)	2.5
Inner μ		34
Mutual Conductance, Grid 3 (Vg3 = -2V)	(mA/V)	0.35

CONNECTIONS

Lead	Electrode	
1	Grid	g1
2	Suppressor	g3
3	Heater	h
4	Suppressor	g3
5	Anode	a
6	Heater	h
7	Screen	g2
8	Cathode	k

DIMENSIONS

See B.S. 448/B8D/F/2.1
Size Ref. No.2

Dimensions (mm)	Min.	Max.
A. Seated height	29.0	32.0
B. Overall length	-	38.1
C. Diameter	9.3	10.16
D. Lead length (Note E)	38.1	-

MOUNTING POSITION

Any

TYPE APPROVAL

See K1001/15
Minimum quantity for submission 225
See Note G.

CAPACITANCE (pF)

C in (Nom.) Shielded	4.2
Cout (Nom.) Shielded	3.1
Cag1 (Max.) Shielded	0.015
Cag3 (Max.) Shielded	3.0
Cg3. All (Nom) Shielded	6.5

APPLICATIONS DATA

Issue 1. - See section following Page 6.

NOTES

See next page

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, when cathode is negative with respect to heater, 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. For greater reliability during use, the grid circuit resistance should be kept to a minimum.

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.

CV4508

TESTS

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)	Vg2(V)	Vg1(V)	Vg3(V)
6.3	100	100	-2	0

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	200	-	-	-	-	-	M
		Vg2-all = -300V		100%	R	200	-	-	-	-	-	M
		Vg1-all = -100V		100%	R	200	-	-	-	-	-	M
		Vg3-all = -100V		100%	R	200	-	-	-	-	-	M
	Reverse Grid Current (1)	Rg1 = 500k max.		100%	Ig1	-	-	-	-	0.3	-	µA
	Vibration Noise (1)	Notes: 2,3 Acceleration = 15g peak min. Frequency = 50 c/s Rk = 390 Ck = 1000 µF min. Rg1 = 0 Va(b) = 250V Vg2 = 100V (Note: 4) Ra = 22k		100%	Vout	-	-	-	-	60	-	mV r.m.s
AIX/2.2		Note: 5										
AIX/2.3												
	GROUP B											
5.3	Heater-Cathode Leakage Current	Vhk = ± 100V	0.4	II	Ihk	-	-	-	-	10	-	µA
				V2	Ihk	-	-	-	2	-	-	µA
	Anode Current (1)		0.4	II	Ia	2.0	-	3.0	-	4.0	-	mA
				V2	Ia	-	2.65		3.35	-	0.78	mA
	Screen Current		0.4	II	Ig2	1.0	-	2.25	-	3.5	-	mA
				V2	Ig2	-	1.81	-	2.69	-	0.98	mA
	Mutual Conductance		0.4	II	gm	1.75	-	2.5	-	3.25	-	mA/V
				V2	gm	-	2.24	-	2.76	-	0.59	mA/V
	GROUP C											
	Heater Current		1.0	I	Ih	160	-	175	-	190	-	mA
	Anode Current (2)	Vg1 = -8V Ra = 1M max.	1.0	I	Ia	-	-	-	-	50	-	µA
	Change of Mutual Conductance	Vh = 5.7V Vg1 = 0. RK = 390 Ck = 2000 µF Note: 6	2.5	I	Δgm	-	-	-	-	15	-	%

K1001	TEST	TEST CONDITIONS	AQL %	INSP. LEVEL	SYMBOL	LIMITS MIN	LAL.	BOGEY	UAL.	MAX.	ALD	UNITS
	GROUP D											
	Anode/Screen Current Ratio	Note: 7	2.5	Code G		0.75	-	-	-	2.25	-	
	Reverse Grid Current (2)	Vh = 6.9V; Va = Vg2 = 190V; Ia = 5.25mA; Vg1 or Rk adjust Rg1 = 500k max. Note: 8	2.5	Code G	Ig1	-	-	-	-	1.0	-	µA
	Mutual Conductance: Grid 3	Vg3 = -2V	2.5	Code G	gm(g3)	0.2	-	-	-	1.2	-	mA/V
	Grid 3 Cut off	Ia = 50 µA	2.5	Code G	-Vg3	5	-	-	-	12	-	V
5.9	Capacitances	Measured on 1 Mc/s bridge valve mounted in a fully screened socket. Shielded. Note: 9.	2.5	Code G	Cin Cout Cag.1	3.6 2.5	- -	- -	- -	4.8 3.7 0.015	- - -	pF pF pF
	GROUP E											
AIX/ 2.4.2.3.	Lead Fragility	No Voltages	1.0	Code I								
AIX/ 2.4.2.1	Glass Strain	No Voltages Note: 14	2.5	Code G								
	Vibration Noise (2)	Notes: 3, 10.		Code L	Vout	-	-	-	20	-	-	mV r.m.s.
	Vibration Fatigue	Acceleration = 5g peak min. Time = 200 hours Note: 11										
	Vibration Noise (3)	Note: 12. Acceleration = 20g peak min. Rk = 390; Ck = 1000 µF min. Rg1 = 0; Ra = 22k; Va(b) = 250V Vg2 = 100V (Note: 4) Frequency = (1) 60-120 c/s.			Vout	-	-	-		-	-	mV(pk-pk)
		(2) 120-250 c/s			Vout	-	-	-		-	-	mV(pk-pk)
		(3) 250-500 c/s			Vout	-	-	-		-	-	mV(pk-pk)
		(4) 500-1000 c/s			Vout	-	-	-		-	-	mV(pk-pk)
		(5) 1000-2000 c/s			Vout	-	-	-		-	-	mV(pk-pk)
	Post Vibration Noise (3) Tests:	Combined AQL	2.5									
	Heater-Cathode Leakage Current	Vhk = ± 100V	1.0		Ihk	-	-	-	-	10	-	µA
	Reverse Grid Current (1)	Rg1 = 500k Max.	0.25		Ig1	-	-	-	-	0.5	-	µA
	Mutual Conductance		1.0		gm	1.65	-	-	-	3.35	-	mA/V
	Vibration Noise (1)	As in Group A. Note: 3	1.0		Vout	-	-	-	-	200	-	mV r.m.s.
	Catastrophics	Note: 13	0.25									
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.										

K1001	TEST	TEST CONDITIONS	AQL %	INSP. LEVEL	SYMBOL	LIMITS						UNITS
						MIN	LAL	BOGEY	UAL	MAX	ALD	
	GROUP F											
AVI/5	Life	Vg1 = 0V Vhk = 135V heater positive Rg1 = 470K Rk = 390										
AVI/5.1	Stability Life											
	Change in Mutual Conductance		1.0	I	Δgm	-	-	-	-	10	-	%
AVI/5.3	Intermittent Life											
	Test Point 200 hours	Combined AQL	4.0	Code I								
5.14	Inoperatives	Note 15	0.25									
	Heater-Cathode Leakage Current	Vhk = ± 100V	1.5		Ihk	-	-	-	-	10	-	μA
	Reverse Grid Current (1)	Rg1 = 500k max.	1.0		Ig1	-	-	-	-	0.3	-	μA
	Mutual Conductance		1.0		gm	1.75	-	-	-	3.25	-	mA/V
	Average Change of Mutual Conductance				$\overline{\Delta gm}$	-	-	-	-	10	-	%
	Insulation		2.5									
		Va - all = -300V			R	100	-	-	-	-	-	M
		Vg2 - all = -300V			R	100	-	-	-	-	-	M
		Vg1 - all = -100V			R	100	-	-	-	-	-	M
		Vg3 - all = -100V			R	100	-	-	-	-	-	M
	Test Point 1000 hours	Combined AQL	6.5	Code H								
5.14	Inoperatives		1.5									
	Heater-Cathode Leakage Current	Vhk = ± 100V	4.0		Ihk	-	-	-	-	10	-	μA
	Reverse Grid Current (1)	Rg1 = 500k max.	1.5		Ig1	-	-	-	-	1.0	-	μA
	Mutual Conductance		1.5		gm	1.55	-	-	-	3.35	-	mA/V
	Insulation		4.0									
		Va - all = -300V			R	50	-	-	-	-	-	M
		Vg1 - all = -100V			R	50	-	-	-	-	-	M
	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	-	-	-	-	0.3	-	μA
	Mutual Conductance				gm	1.75	-	-	-	3.25	-	mA/V

NOTES

1. The valve shall be visually inspected for good workmanship, using a visual aid having a X10 magnification. Particular attention shall be paid to the following:-
Structure quality, quality of welds, quality of lead tinning, external dimensions and shape, and freedom from harmful loose particles.

2. This test may be done alternatively in Group C, 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. Vg2 may be obtained from the 250 volt line via a resistor of 47 k decoupled by a 2uF capacitor.

5. At this stage the lot shall be formed. It shall be an identifiable lot not exceeding 5,000 valves, manufactured in a period not exceeding 20 consecutive Working days. Normal Sampling (Single) shall apply.

6. The change in mutual conductance is expressed:

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

7. Calculated from the Anode Current (1) and Screen Current as measured in Group B.

8. For this test, the valve shall be pre-heated for 5 minutes under the test conditions. Igl 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	1	2,3,4,6,7,8 sh.	5
Cout	5	2,3,4,6,7,8 sh.	1
Cagl	1	5	2,3,4,6,7,8, sh.

10. Test conditions as for Vibration Noise (1) in Group A.

11. The valves shall be randomly mounted on a vibrator mount in such a manner that each valve experiences an acceleration of at least 5 g peak.
The frequency of vibration shall be swept continuously over the range 60-1000 c/s at a rate of change of frequency not greater than 1 octave per minute.
The heater supply shall be 6.6 V and switched approximately 8 minutes on 16 minutes off throughout the duration of the test.
No other voltages are to be applied.

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 60-2,000 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 in terms of peak to peak voltage using an approved equipment. See pages 7 and 8 of CV4504

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) Anode current outside the range ± 75% of the bogey in Group B.

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

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

15. Accept lot if 0 inoperatives in sample, reject lot if 2 or more inoperatives. If 1 inoperative, take further sample of 50 and accept if no further inoperatives.

APPLICATIONS DATA

FOR

VALVE TYPE

CV4508

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

ISSUE 1 MARCH 1962

ISSUED BY:-
MINISTRY OF AVIATION T.L.5. (B)
CASTLEWOOD HOUSE.
77-91 NEW OXFORD STREET.
LONDON. W.C.1.

AMENDMENTS

No:	Date	Page
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CV4508

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

CV4508

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.

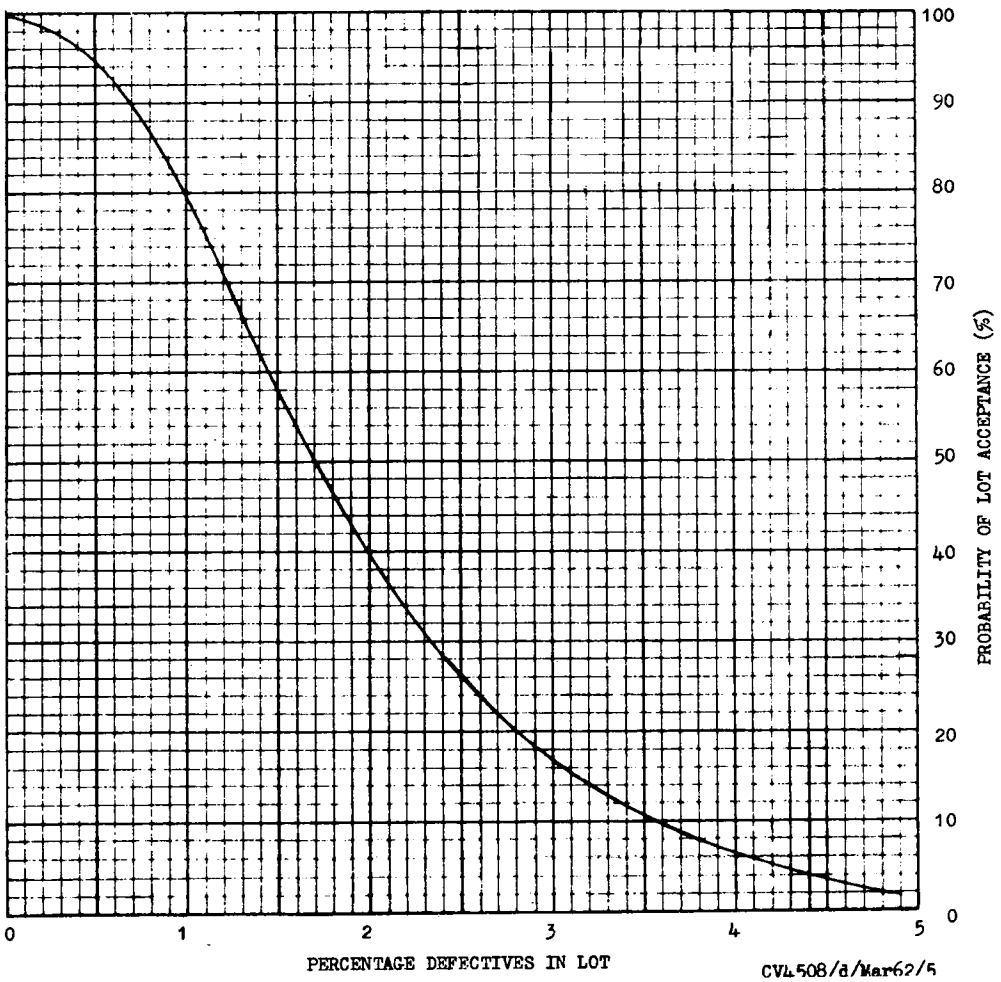
For further details of sampling inspection procedures for Attributes and Variables, reference should be made to K1001, Appendix XI, and MIL Standard 105A. Sampling Procedures and Tables for Inspection by Attributes.

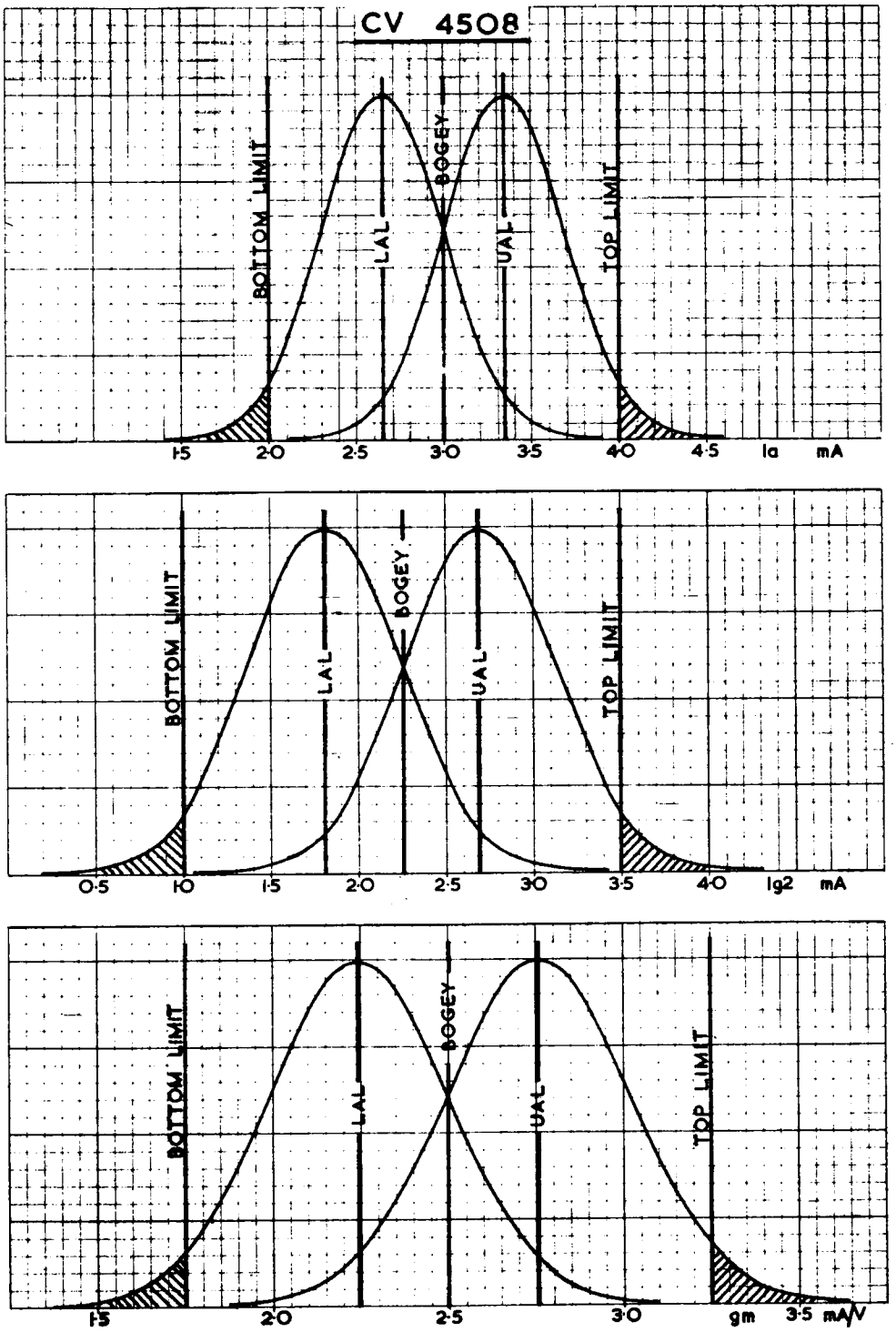
Typical Operating Characteristic

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).

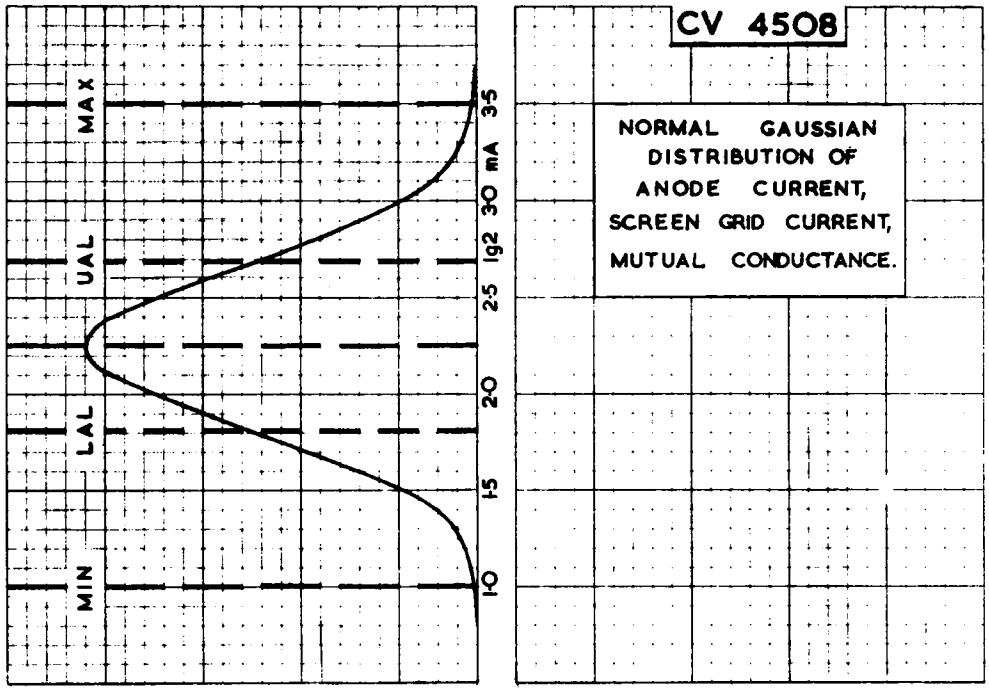
ILLUSTRATION OF A TYPICAL OPERATING CHARACTERISTIC FOR ATTRIBUTES SAMPLING

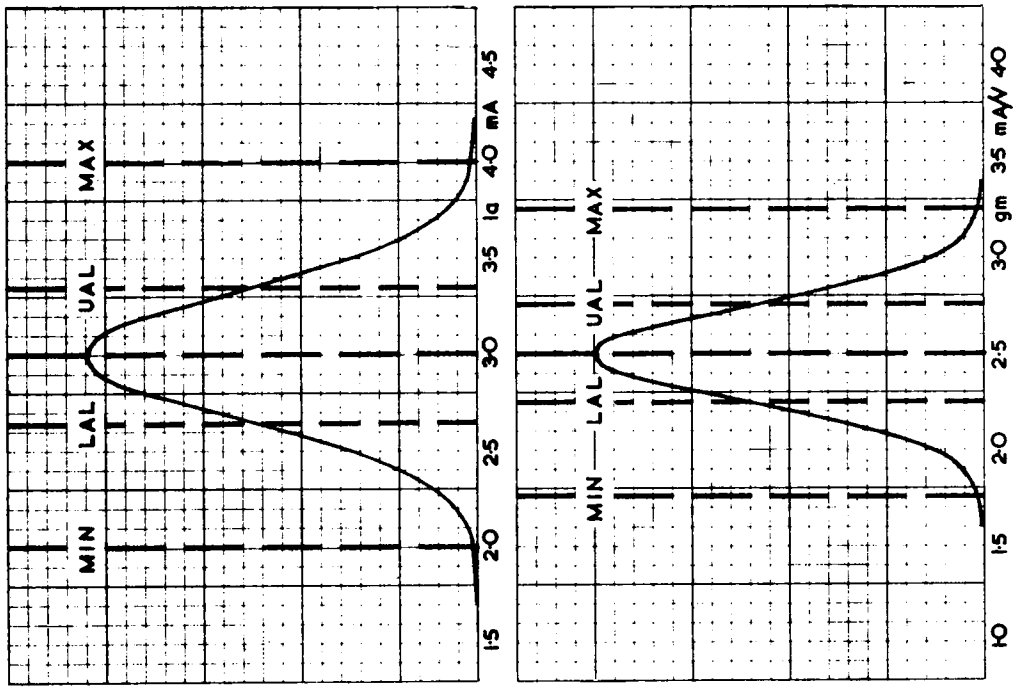


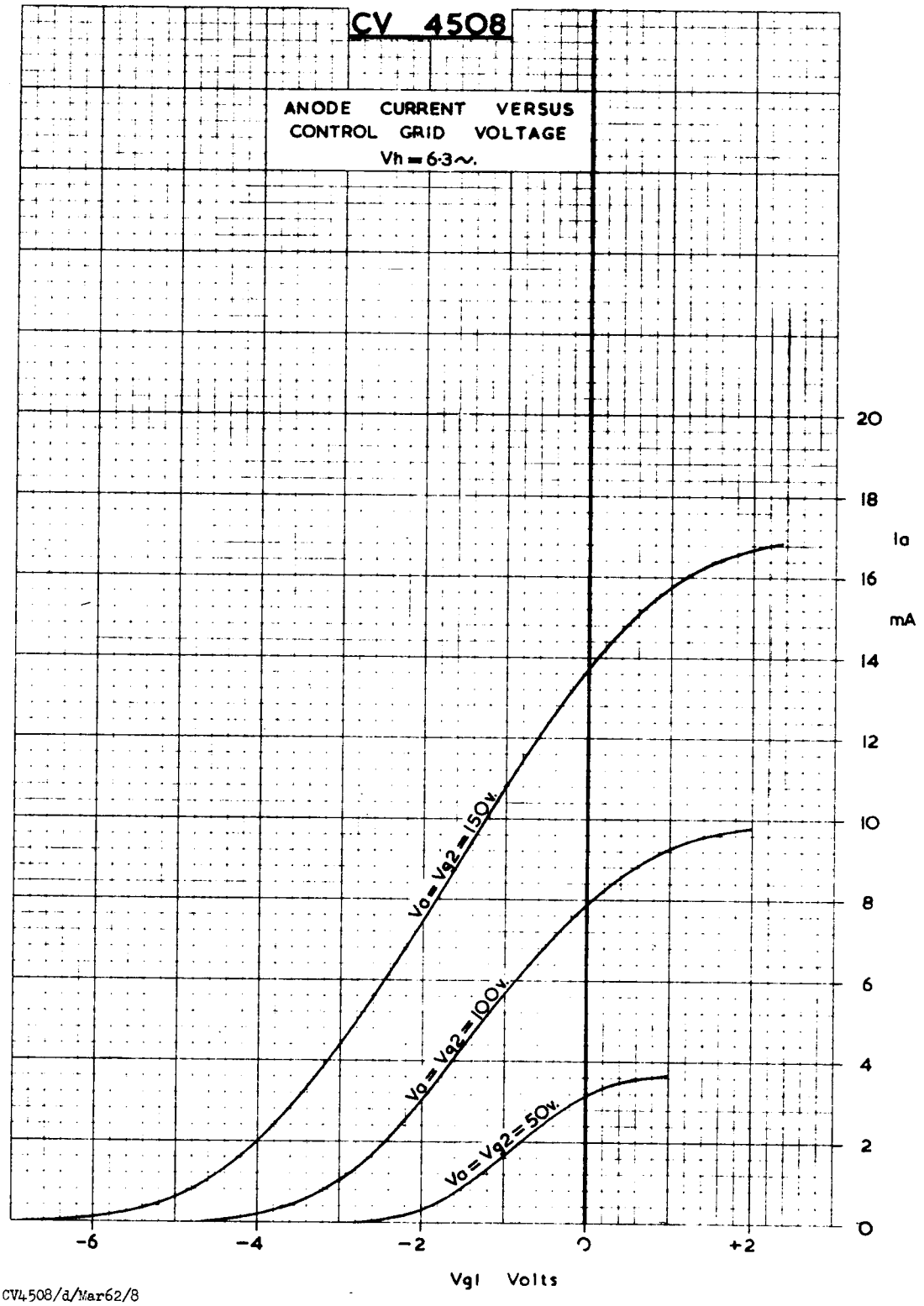


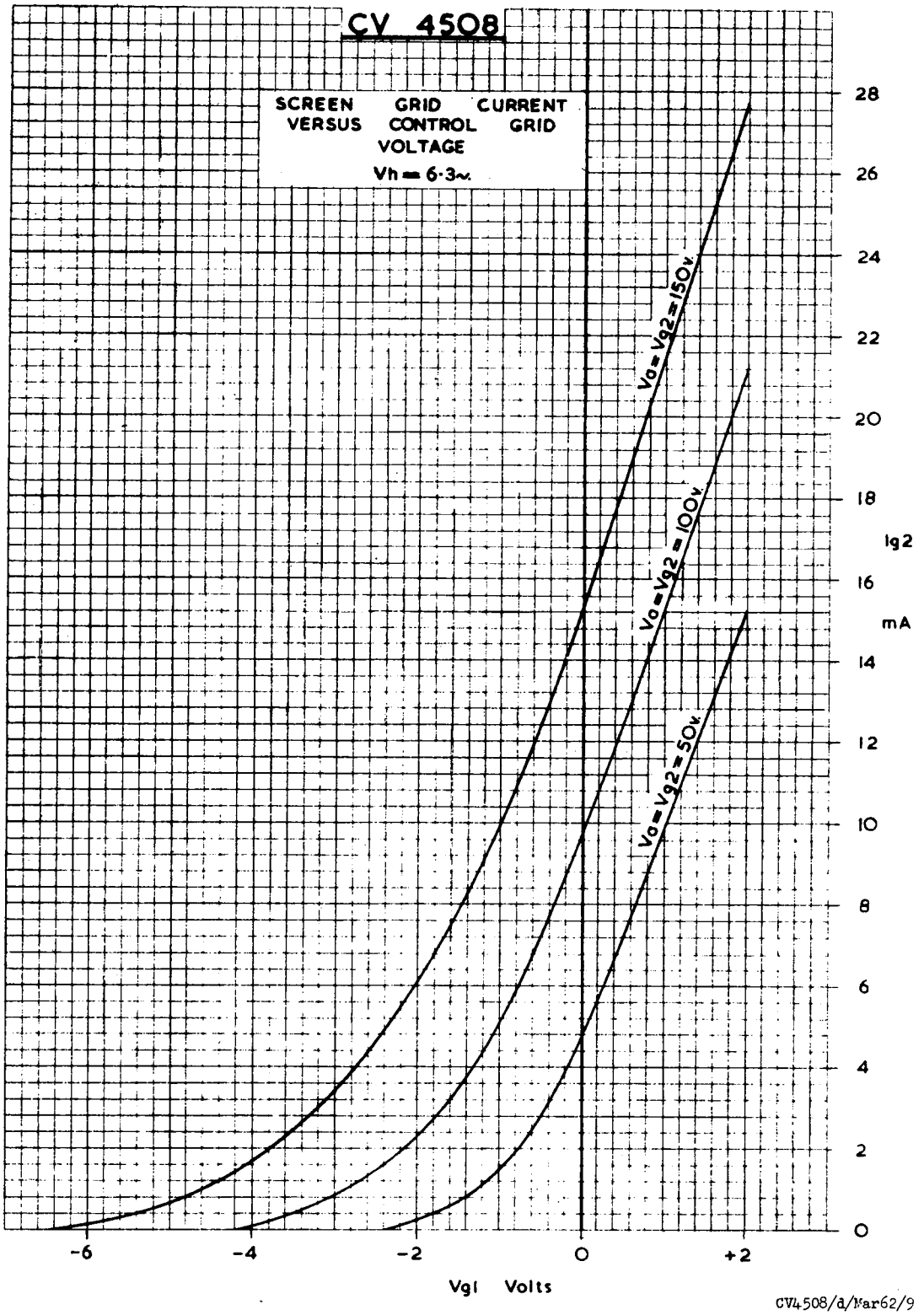
LIMITING DISTRIBUTIONS OF MAJOR CHARACTERISTICS

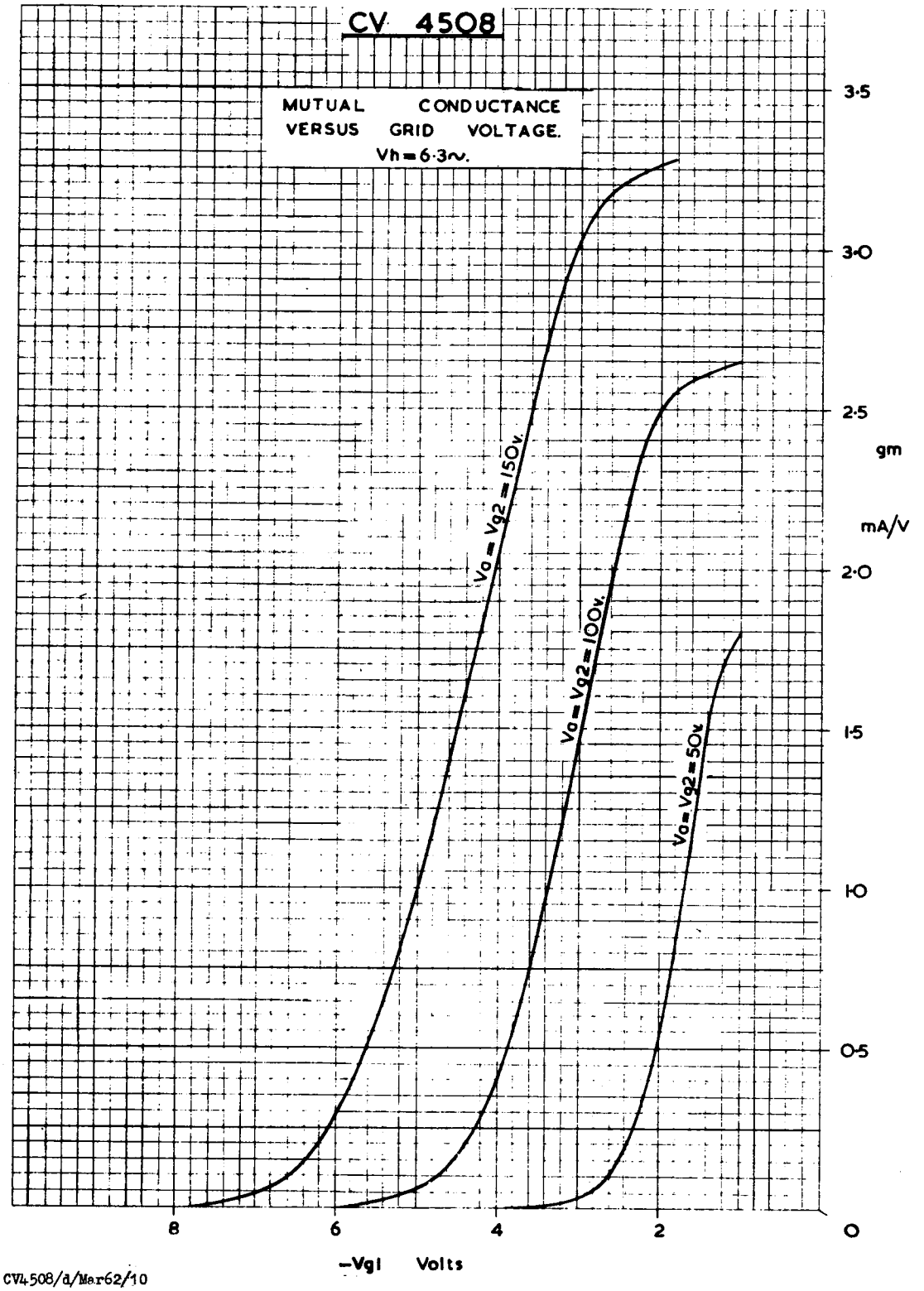
CV4508


CV 4508
NORMAL GAUSSIAN DISTRIBUTION OF ANODE CURRENT, SCREEN GRID CURRENT, MUTUAL CONDUCTANCE.
MAX
UAL
LAL
MIN
Ig2 mA
1·0
1·5
2·0
2·5
3·0
3·5

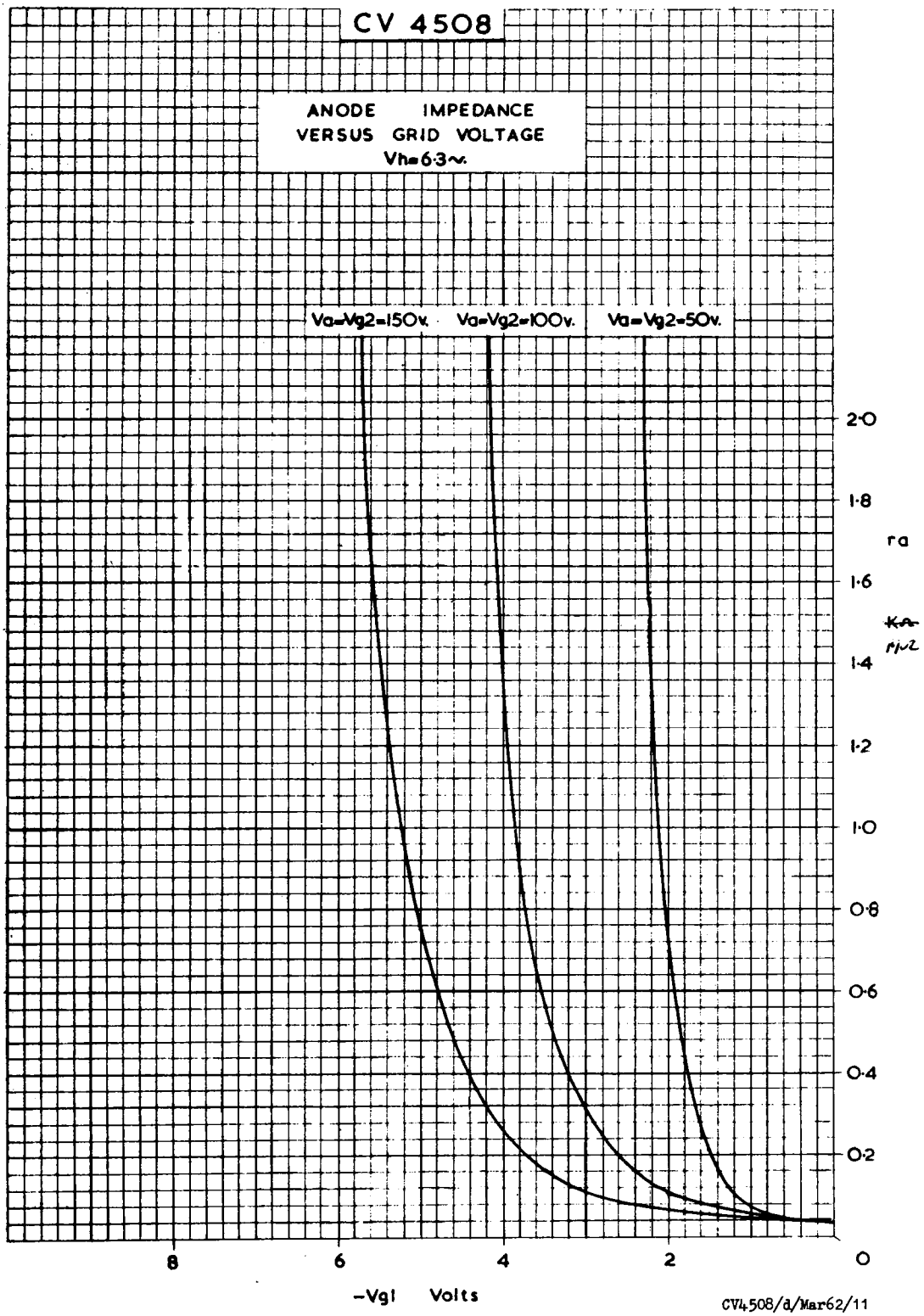

MAX
UAL
LAL
MIN
Ia mA
2·0
2·5
3·0
3·5
4·0
4·5
MAX
UAL
LAL
MIN
gm mA/V
1·0
1·5
2·0
2·5
3·0
3·5
4·0

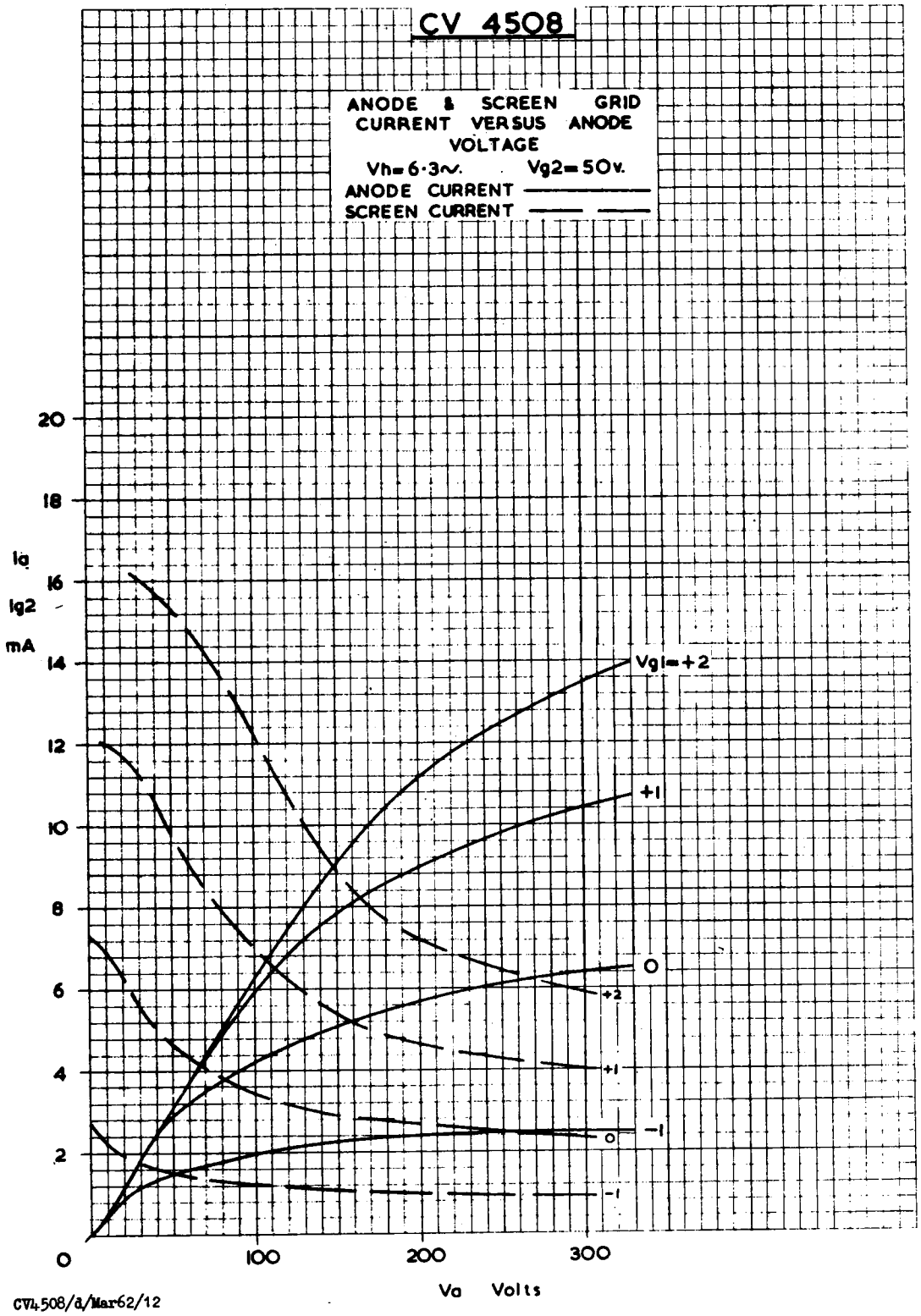

CV 4508
ANODE CURRENT VERSUS
CONTROL GRID VOLTAGE
Vh = 6·3~.
20
18
16
14
12
10
8
6
4
2
0
Ia
mA
Va = Vg2 = 150v.
Va = Vg2 = 100v.
Va = Vg2 = 50v.
-6
-4
-2
0
+2
Vg1 Volts

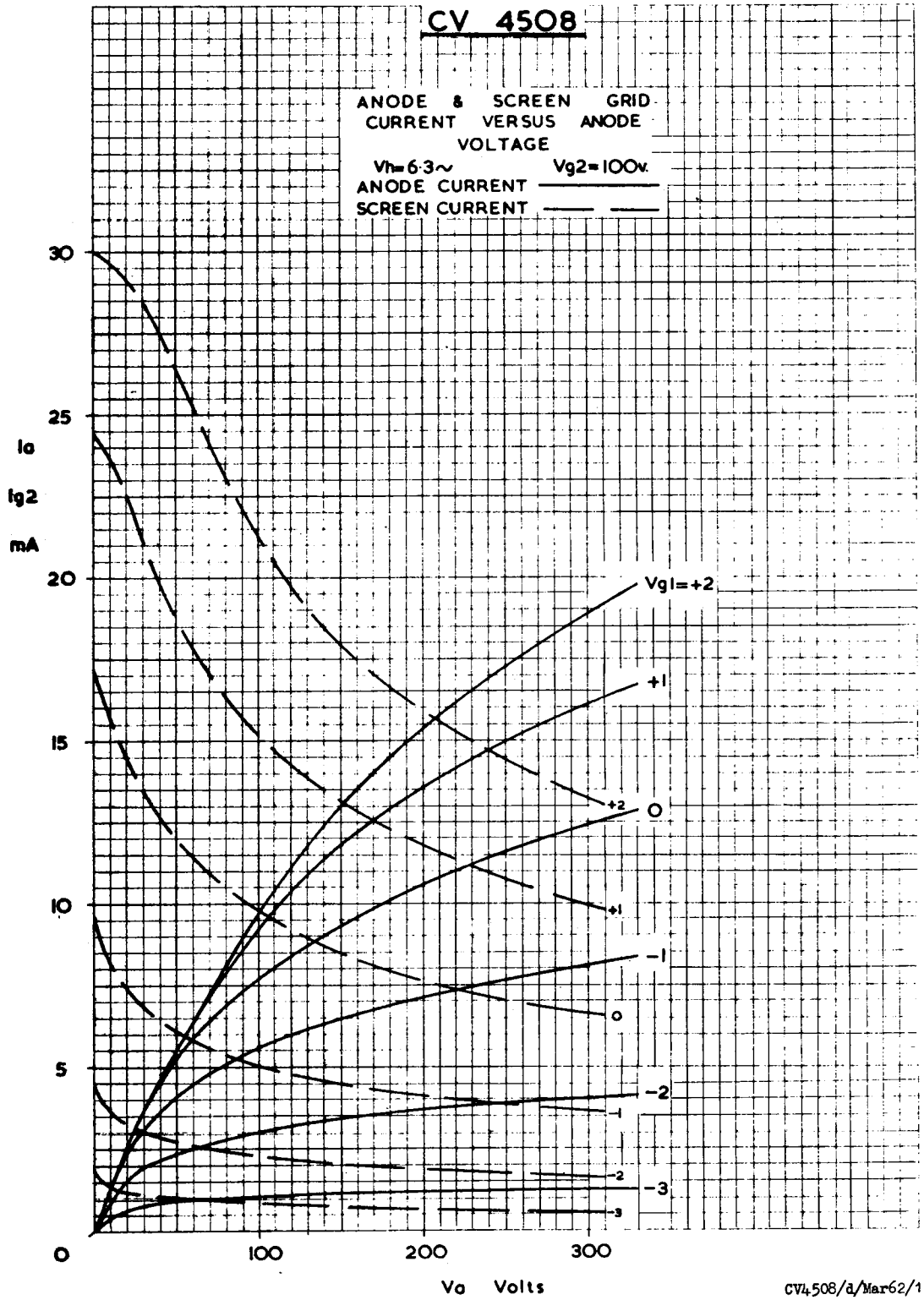

CV 4508
SCREEN GRID CURRENT
VERSUS CONTROL GRID
VOLTAGE
Vh = 6·3~
Vo = Vg2 = 150v
Vo = Vg2 = 100v
Vo = Vg2 = 50v
Ig2
mA
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-6
-4
-2
0
+2
Vg1 Volts

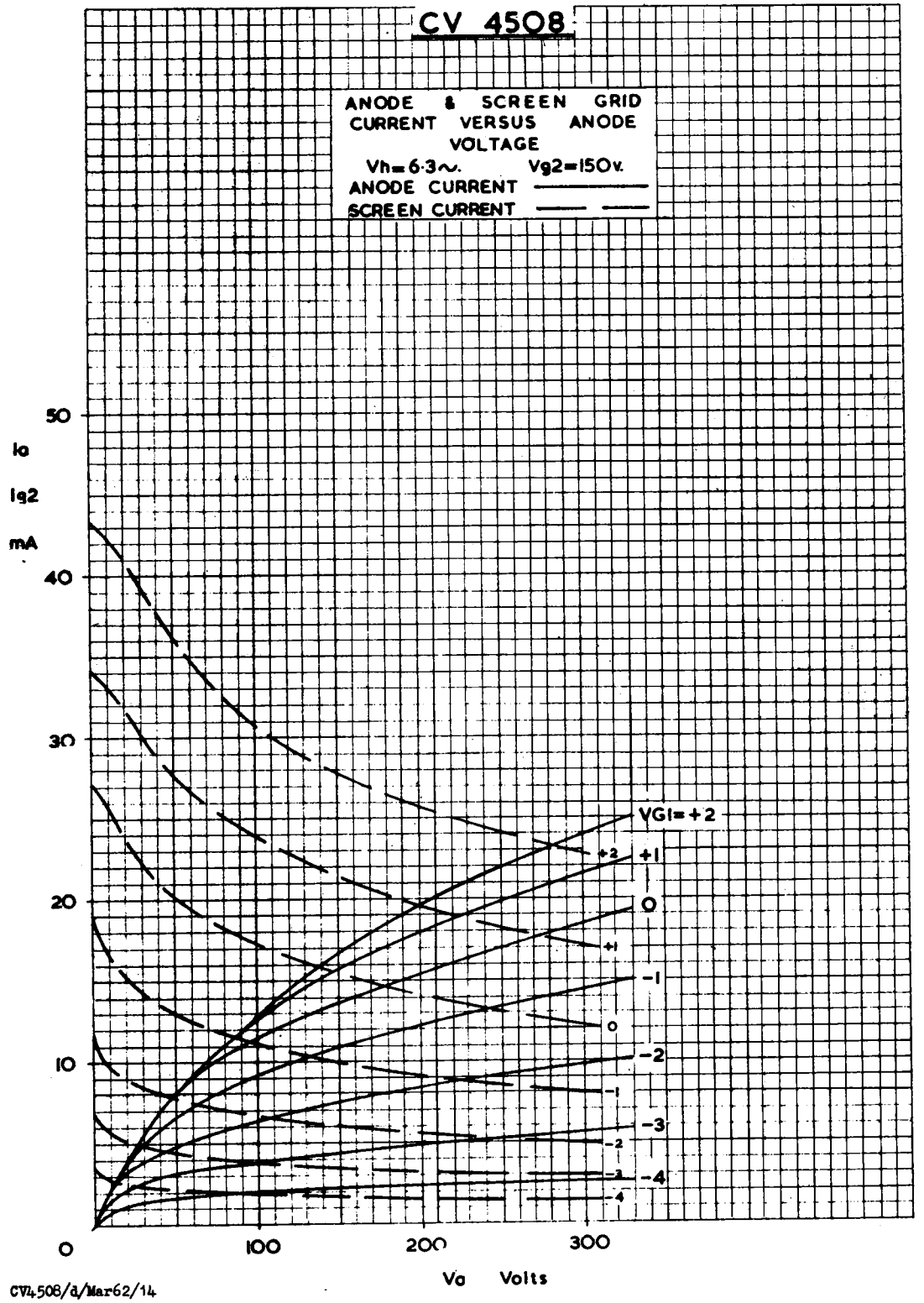

CV 4508
MUTUAL CONDUCTANCE
VERSUS GRID VOLTAGE.
Vh = 6·3v.
Vo = Vg2 = 150v.
Vo = Vg2 = 100v.
Vo = Vg2 = 50v.
3·5
3·0
2·5
gm
mA/V
2·0
1·5
1·0
0·5
0
8
6
4
2
-Vg1 Volts

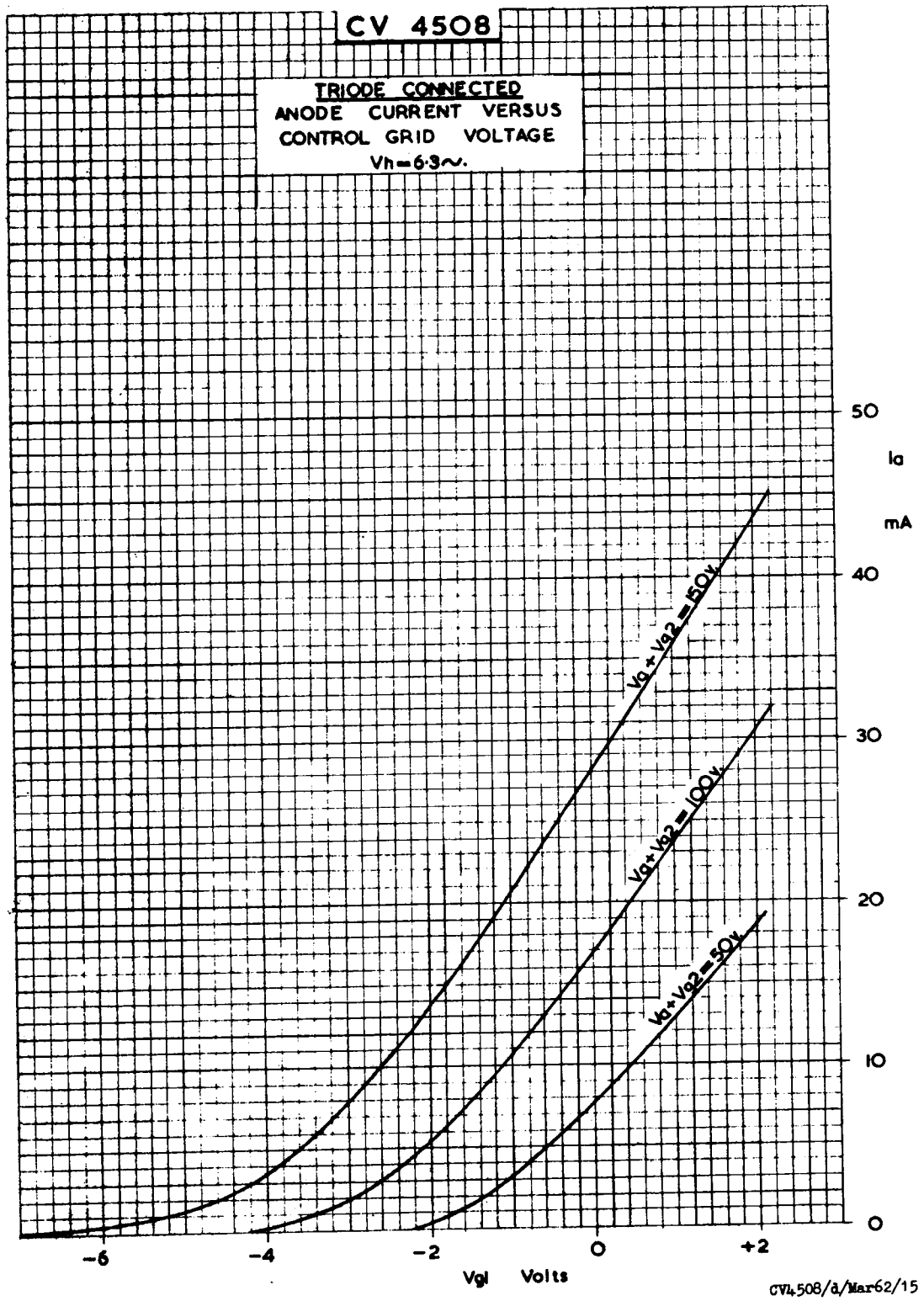
CV4508

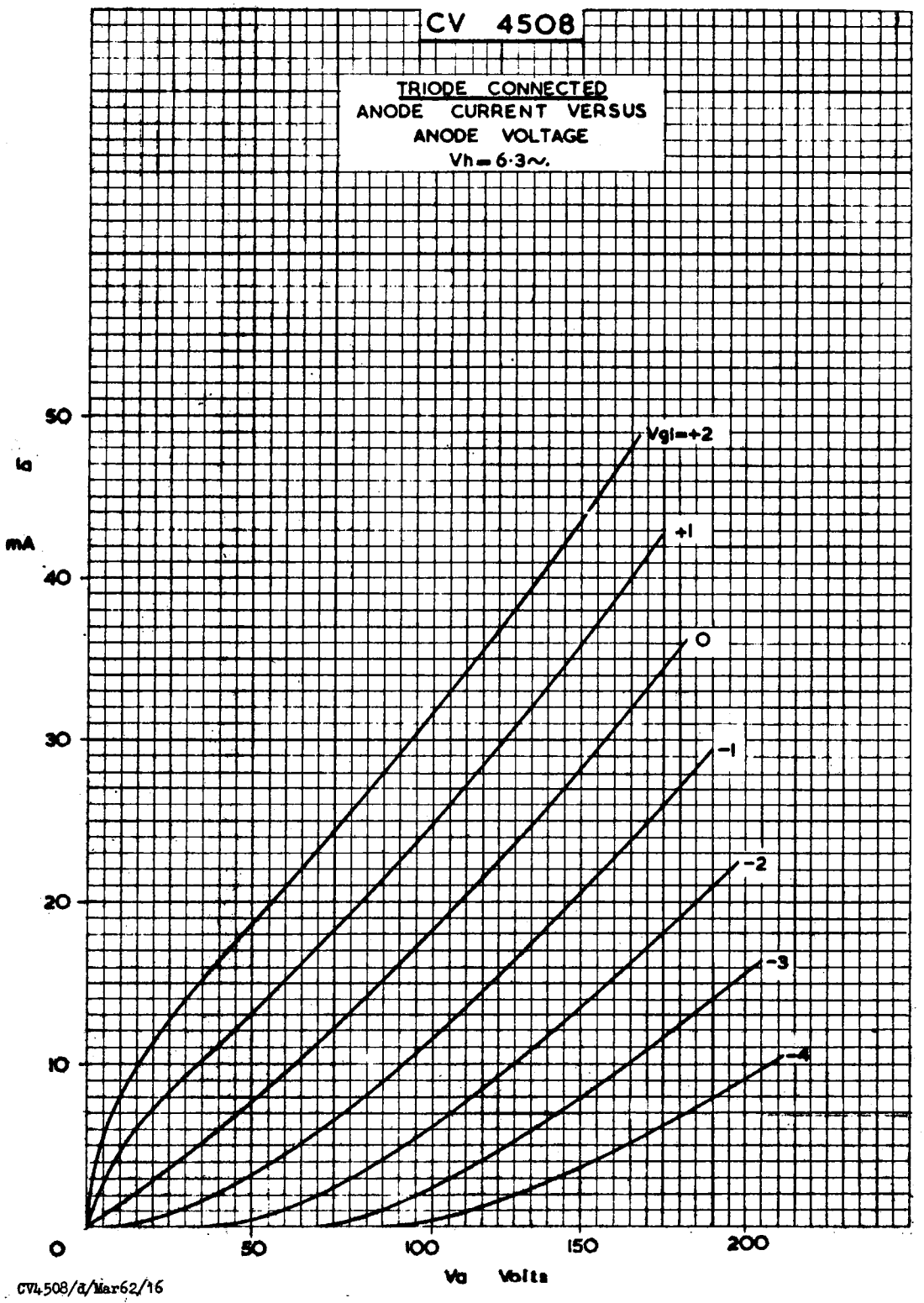

CV 4508
ANODE IMPEDANCE
VERSUS GRID VOLTAGE
Vh=6·3~.
Va=Vg2=150v.
Va=Vg2=100v.
Va=Vg2=50v.
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
ra
KΩ
8
6
4
2
0
-Vg1 Volts


CV 4508
ANODE & SCREEN GRID CURRENT VERSUS ANODE VOLTAGE
Vh=6·3~. Vg2=50v.
ANODE CURRENT
SCREEN CURRENT
Ia
Ig2
mA
20
18
16
14
12
10
8
6
4
2
0
100
200
300
Va Volts
Vg1=+2
+1
0
-1
+2
+1
0
-1

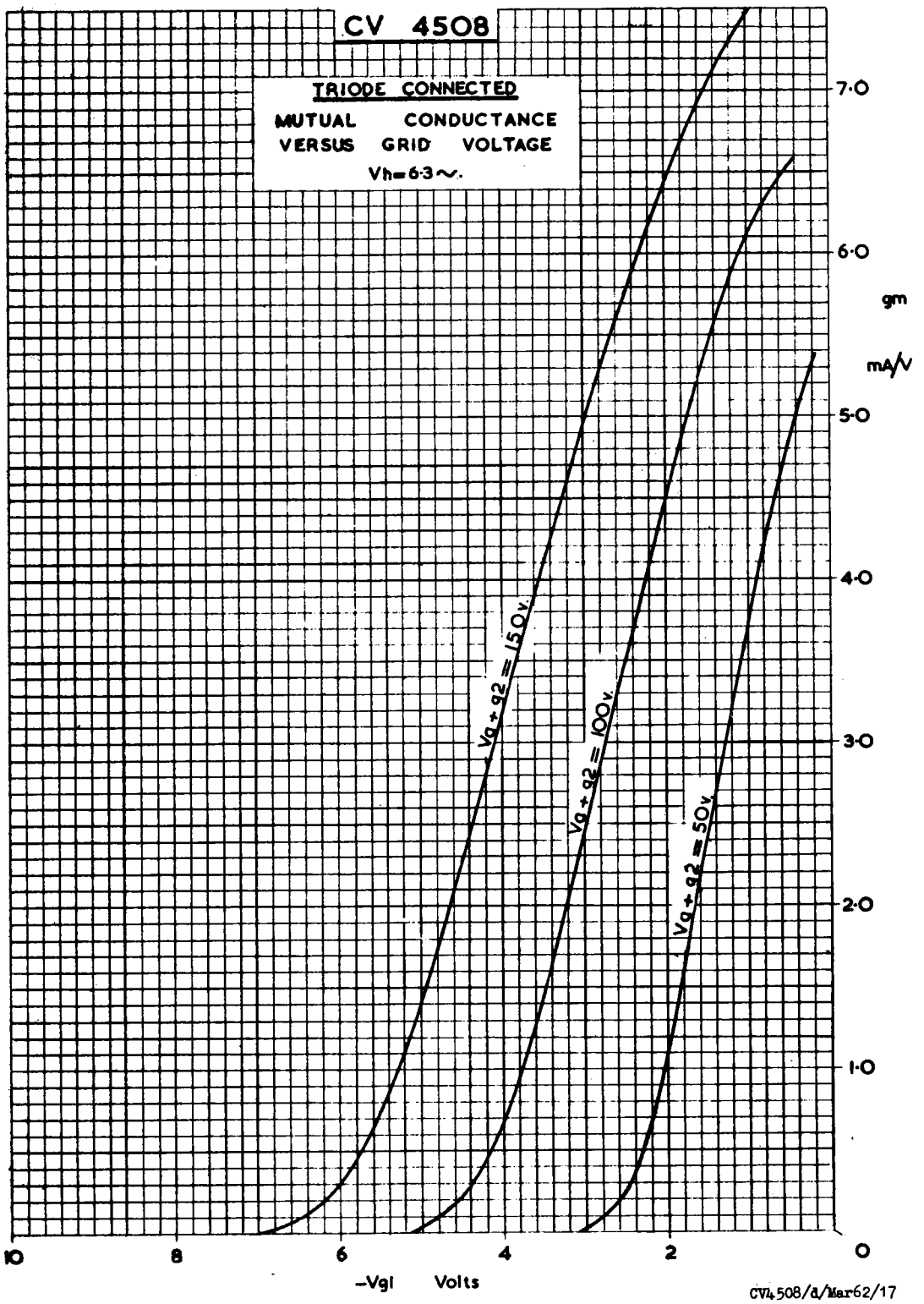

CV 4508
ANODE & SCREEN GRID CURRENT VERSUS ANODE VOLTAGE
Vh=6·3~
Vg2=100v.
ANODE CURRENT
SCREEN CURRENT
Ia
Ig2
mA
30
25
20
15
10
5
0
100
200
300
Va Volts
Vg1=+2
+1
0
-1
-2
-3
+2
+1
0
-1
-2
-3

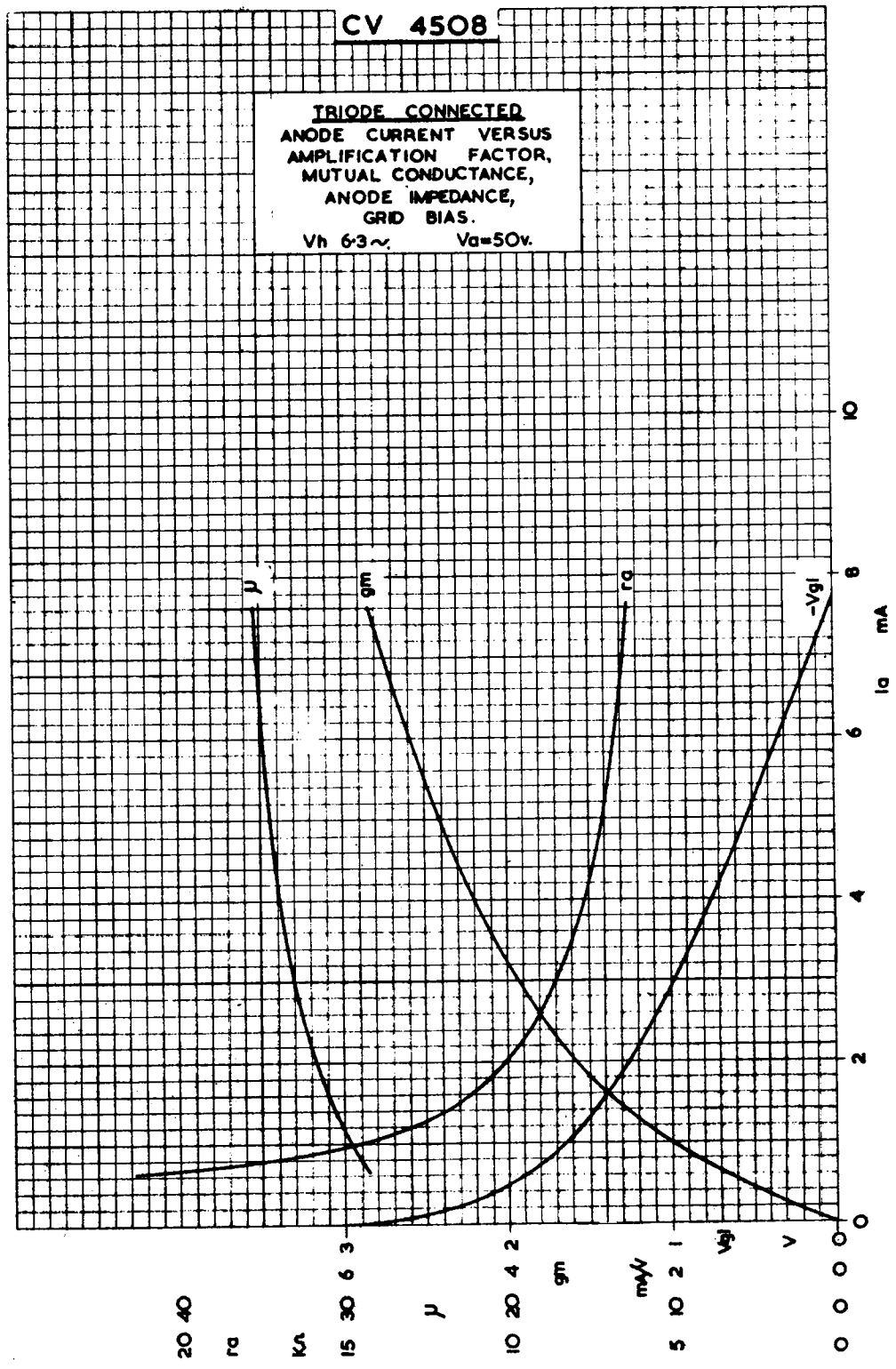

CV 4508
ANODE & SCREEN GRID CURRENT VERSUS ANODE VOLTAGE
Vh = 6·3~.
Vg2 = 150v.
ANODE CURRENT
SCREEN CURRENT
Ia
Ig2
mA
50
40
30
20
10
0
100
200
300
Va Volts
VG1 = +2
+1
0
-1
-2
-3
-4

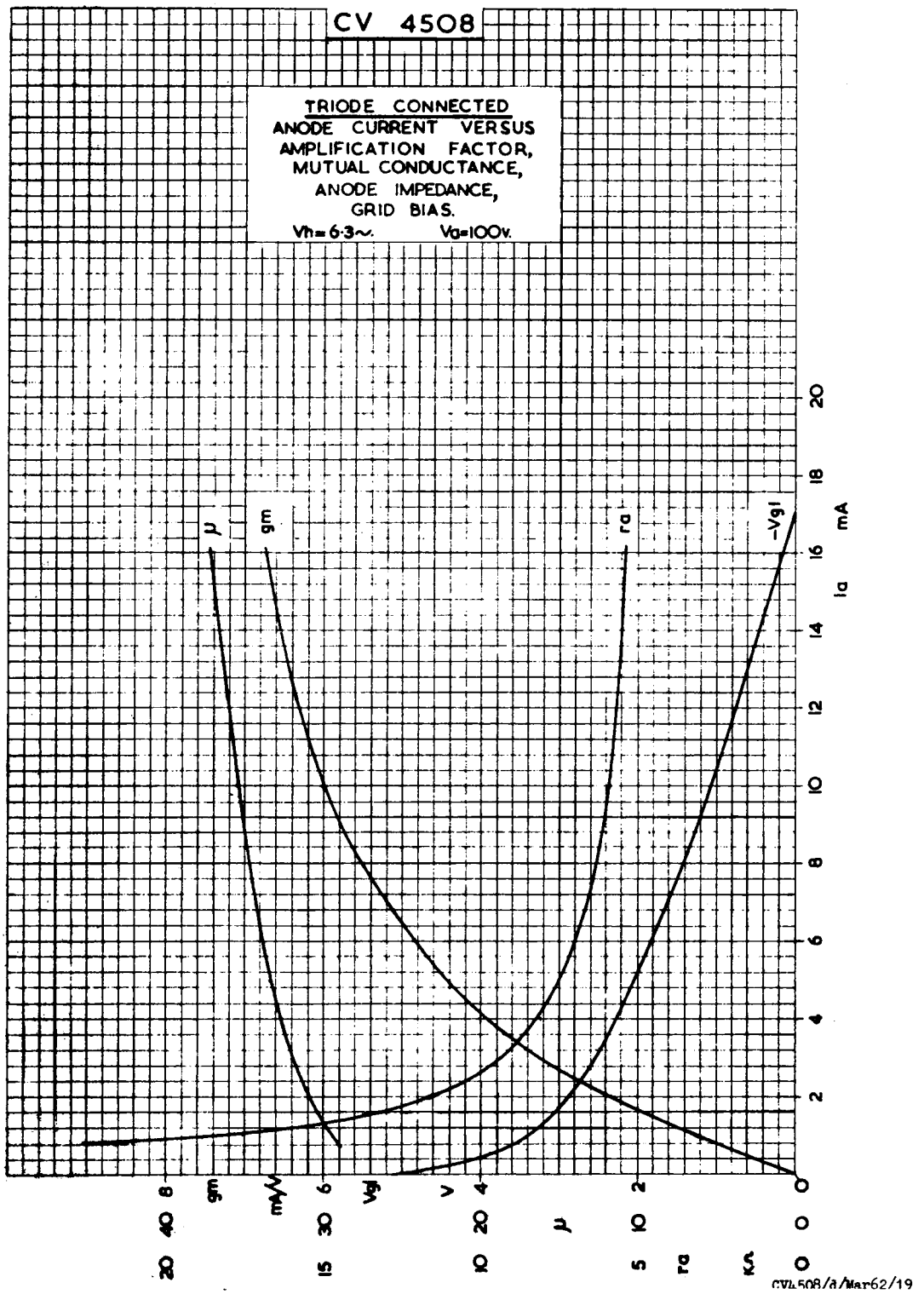

CV 4508
TRIODE CONNECTED
ANODE CURRENT VERSUS
CONTROL GRID VOLTAGE
Vh=6·3~.
50
40
30
20
10
0
Ia
mA
Va+Vg2=150v.
Va+Vg2=100v.
Va+Vg2=50v.
-6
-4
-2
0
+2
Vg1 Volts

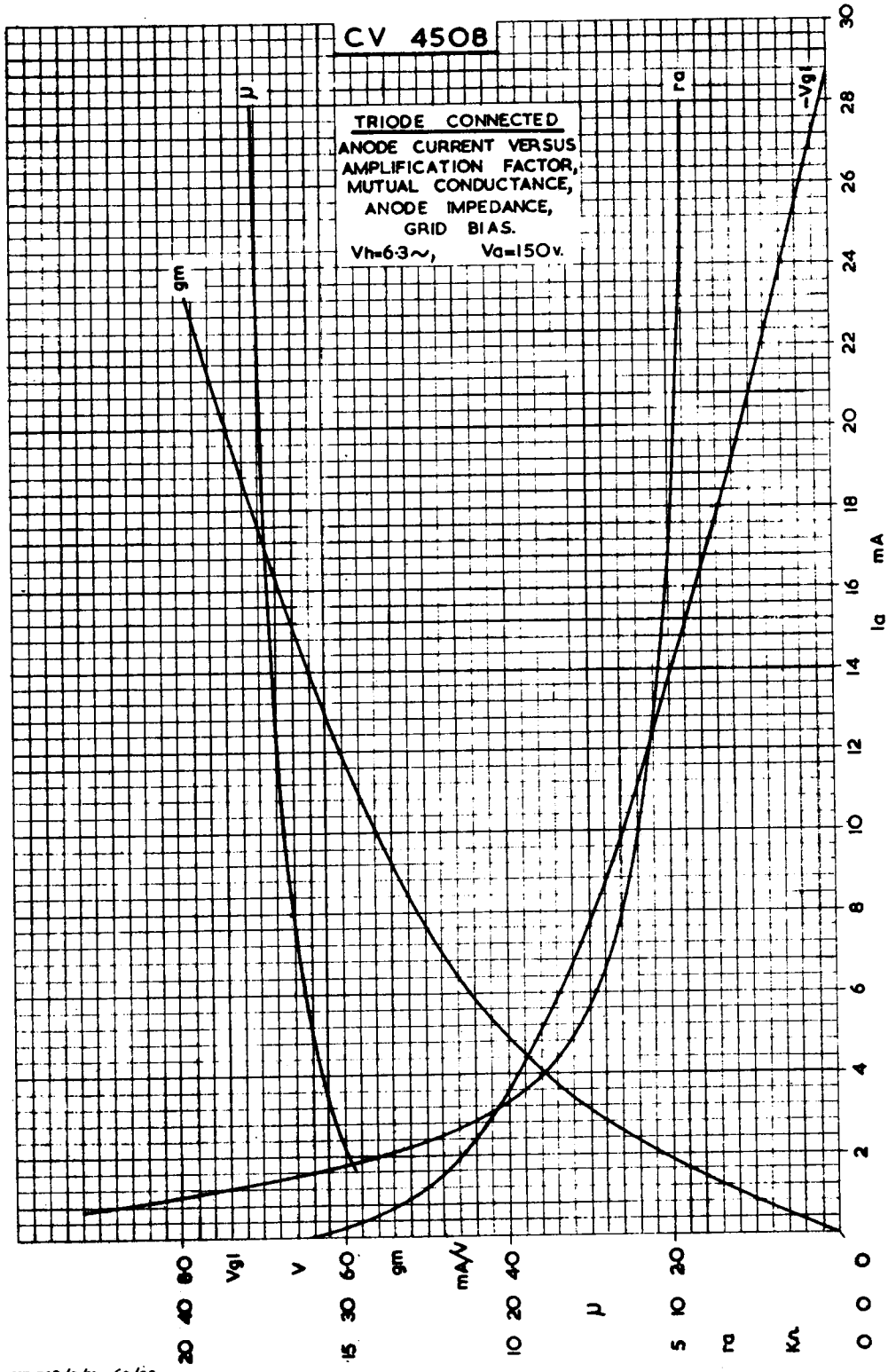

CV 4508
TRIODE CONNECTED
ANODE CURRENT VERSUS
ANODE VOLTAGE
Vh = 6·3~.
Ia
mA
50
40
30
20
10
0
Vgi=+2
+1
0
-1
-2
-3
-4
0
50
100
150
200
Va Volts

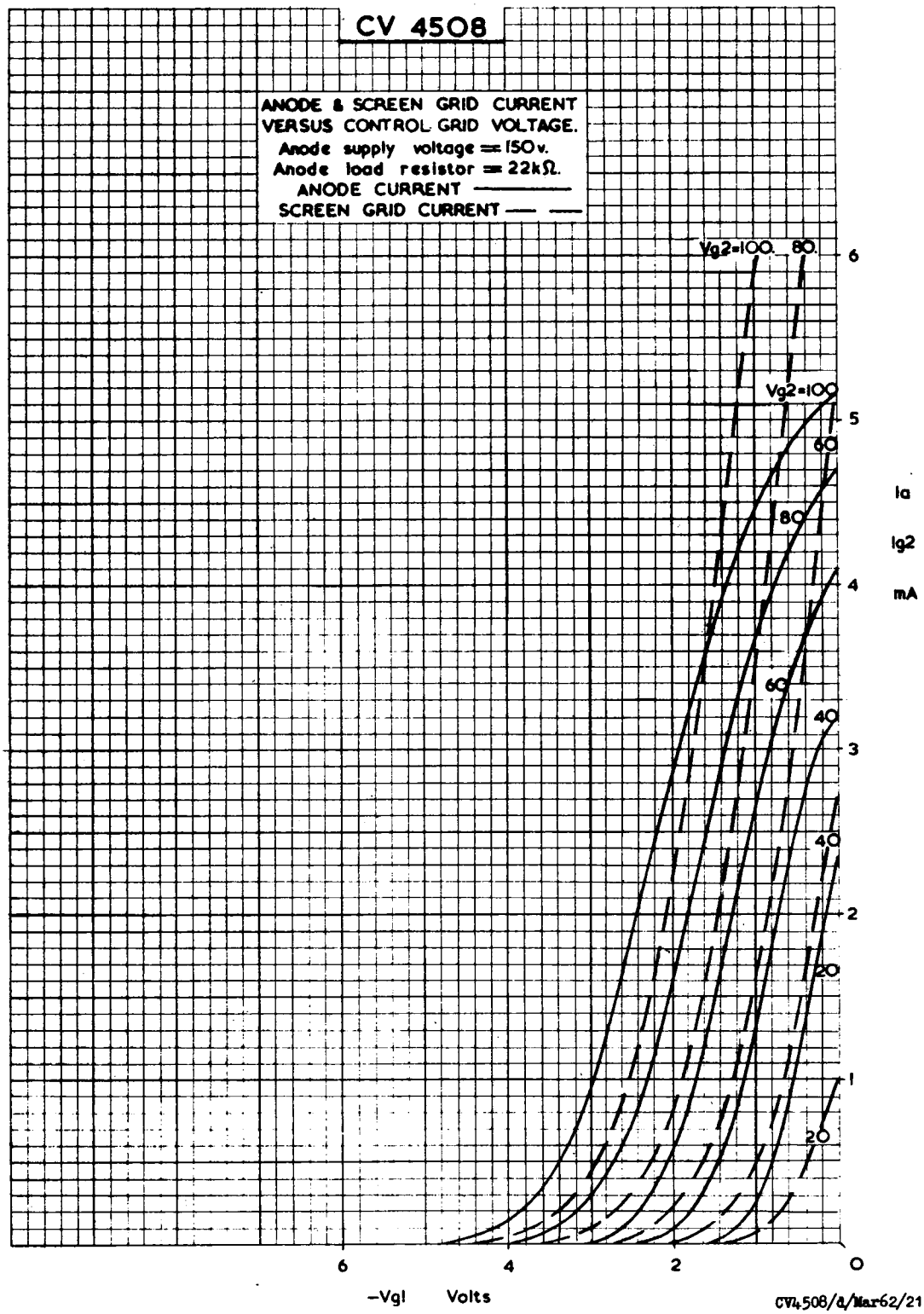
CV4508

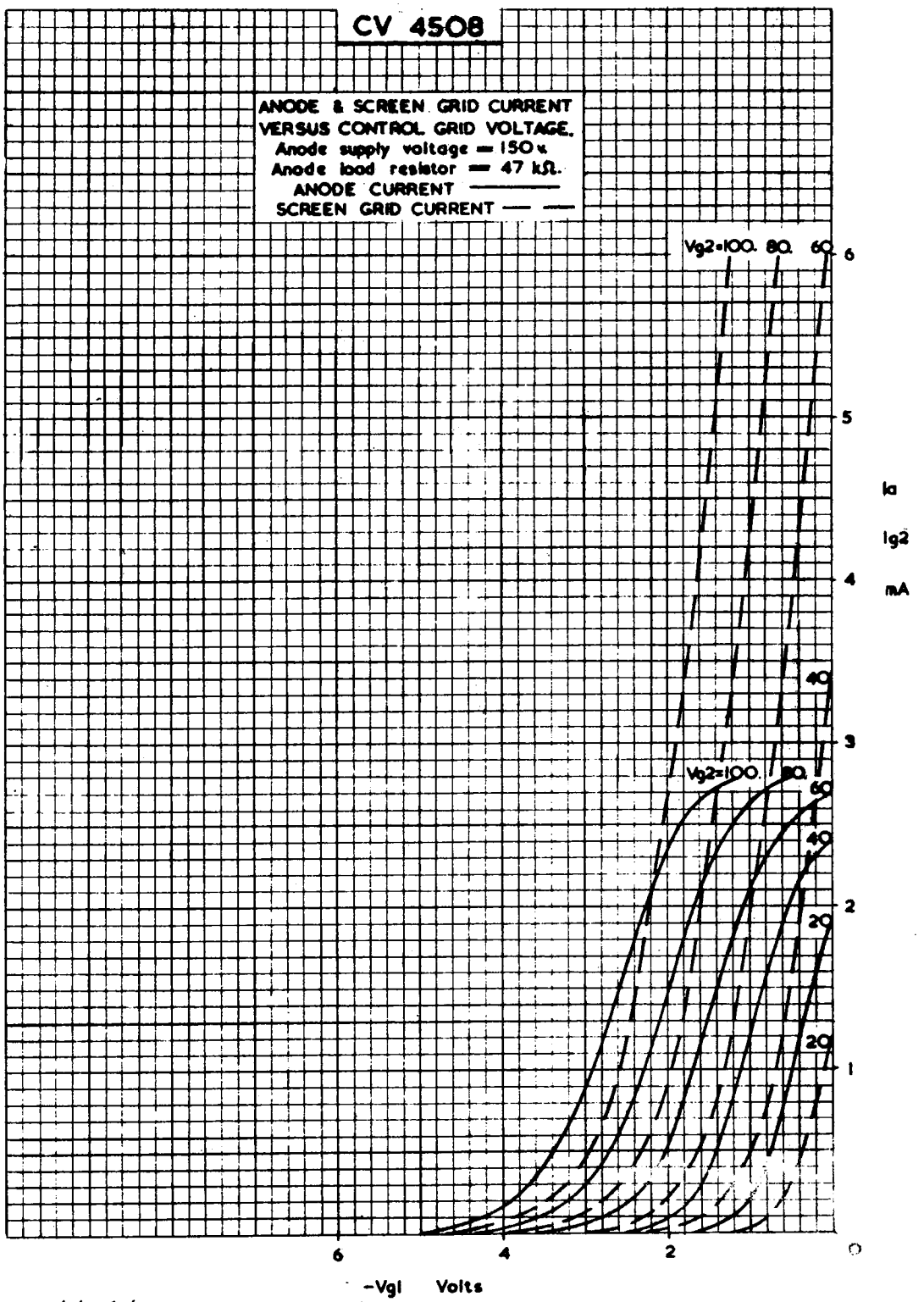

CV 4508
TRIODE CONNECTED
MUTUAL CONDUCTANCE
VERSUS GRID VOLTAGE
Vh=6·3~.
Vg+g2 = 150v.
Vg+g2 = 100v.
Vg+g2 = 50v.
7·0
6·0
5·0
4·0
3·0
2·0
1·0
0
gm
mA/V
10
8
6
4
2
0
-Vg1 Volts

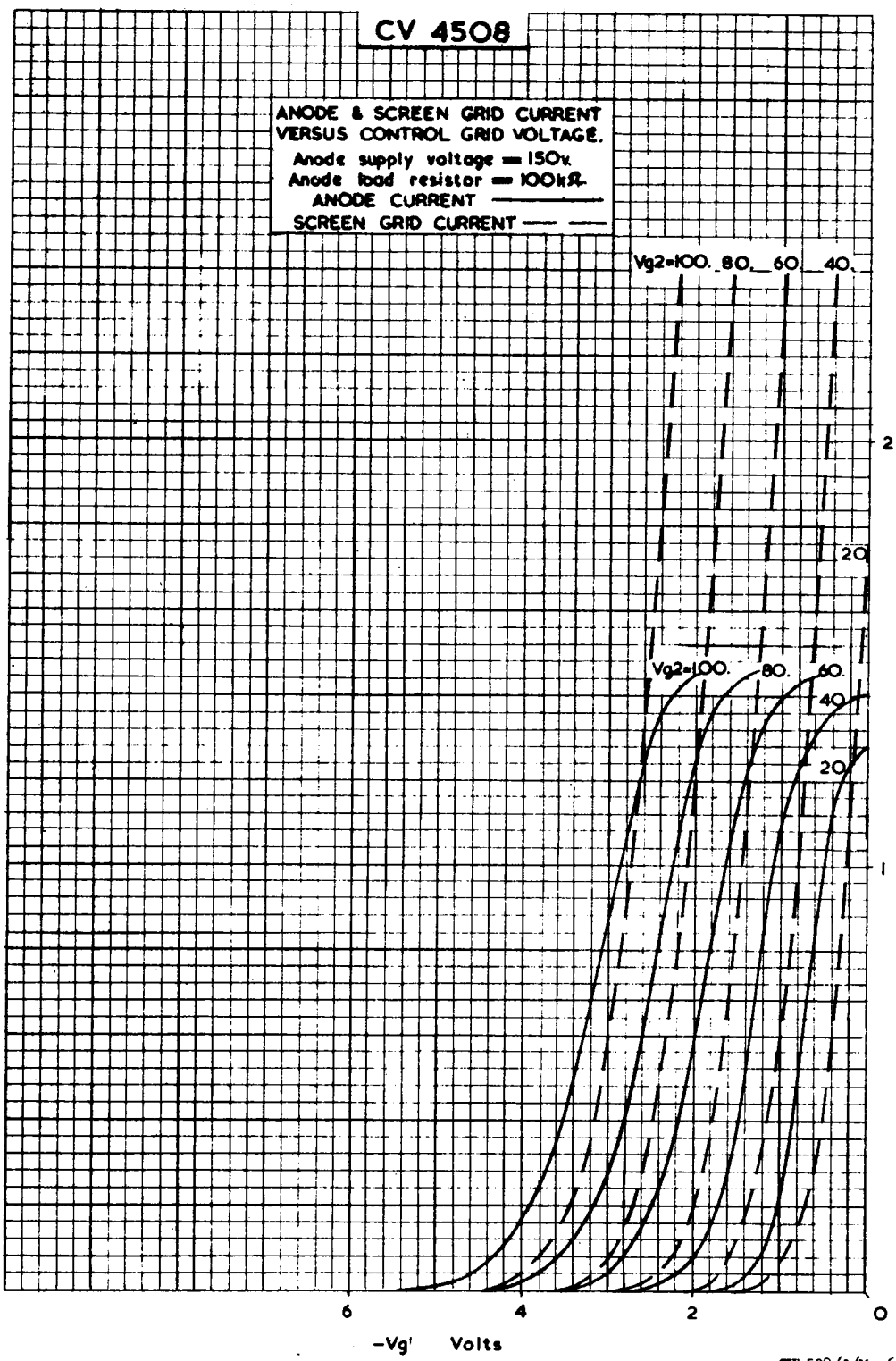

CV 4508
TRIODE CONNECTED
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR,
MUTUAL CONDUCTANCE,
ANODE IMPEDANCE,
GRID BIAS.
Vh 6·3~.
Va=50v.
μ
gm
ra
-Vg1
Ia mA
0
2
4
6
8
10
Vg1 V
0 0 0
1 0 0
2 0 0
gm mA/V
3 6 3
4 2 0
μ
30 15
20 10
40 20
ra KΩ

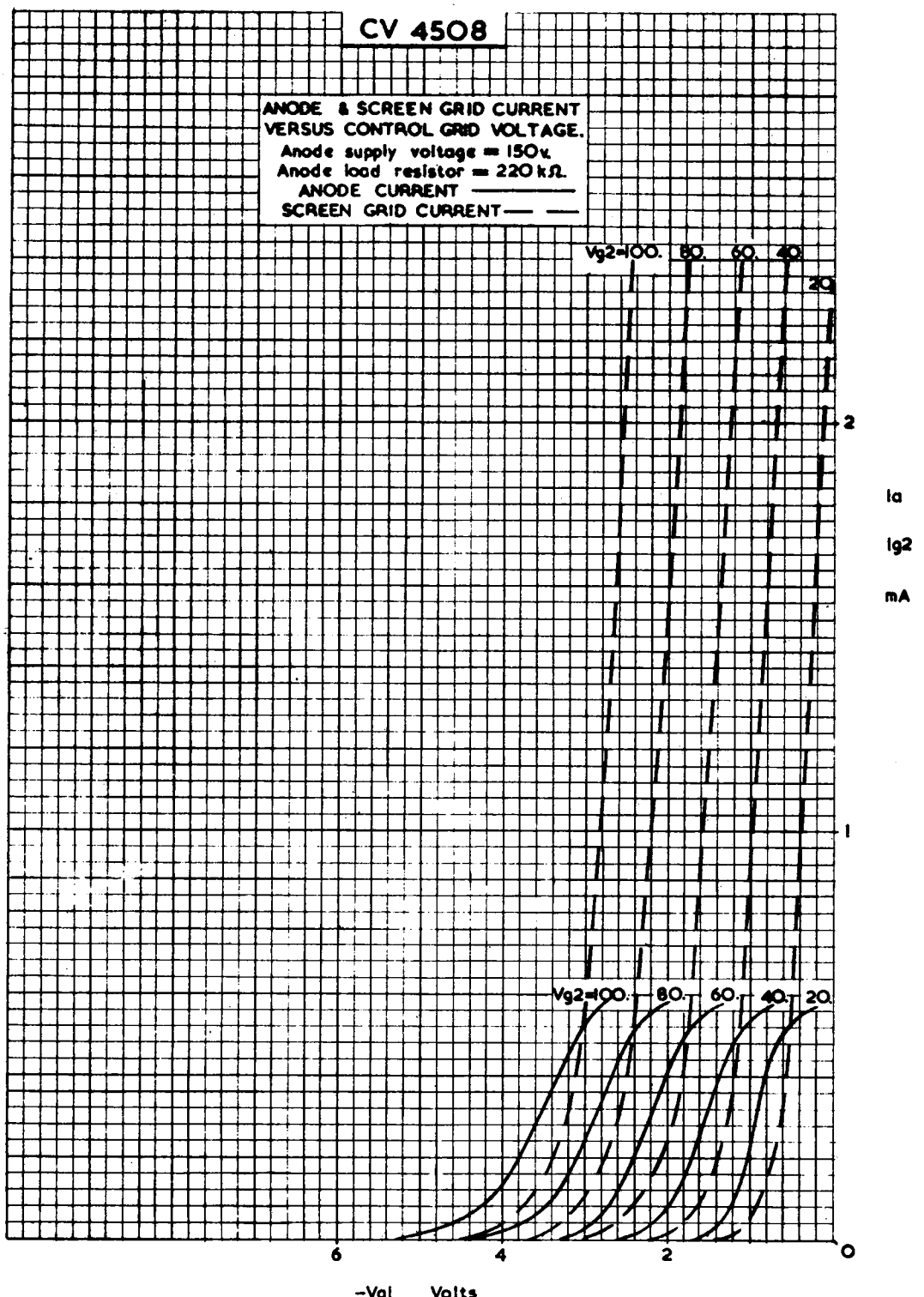

CV 4508
TRIODE CONNECTED
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR,
MUTUAL CONDUCTANCE,
ANODE IMPEDANCE,
GRID BIAS.
Vh = 6·3~.
Vg = 100v.
μ
gm
ra
-Vgl
Ia mA
20
18
16
14
12
10
8
6
4
2
0
gm mA/V
Vgl V
μ
ra KΩ
8 6 4 2 0
40 30 20 10 0
20 15 10 5 0


CV 4508
TRIODE CONNECTED
ANODE CURRENT VERSUS
AMPLIFICATION FACTOR,
MUTUAL CONDUCTANCE,
ANODE IMPEDANCE,
GRID BIAS.
Vh=6·3~,
Va=150v.
μ
gm
ra
-Vg1
Ia mA
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-Vg1 V
80
40
20
60
30
15
gm mA/V
40
20
10
μ
20
10
5
ra KΩ
0
0
0

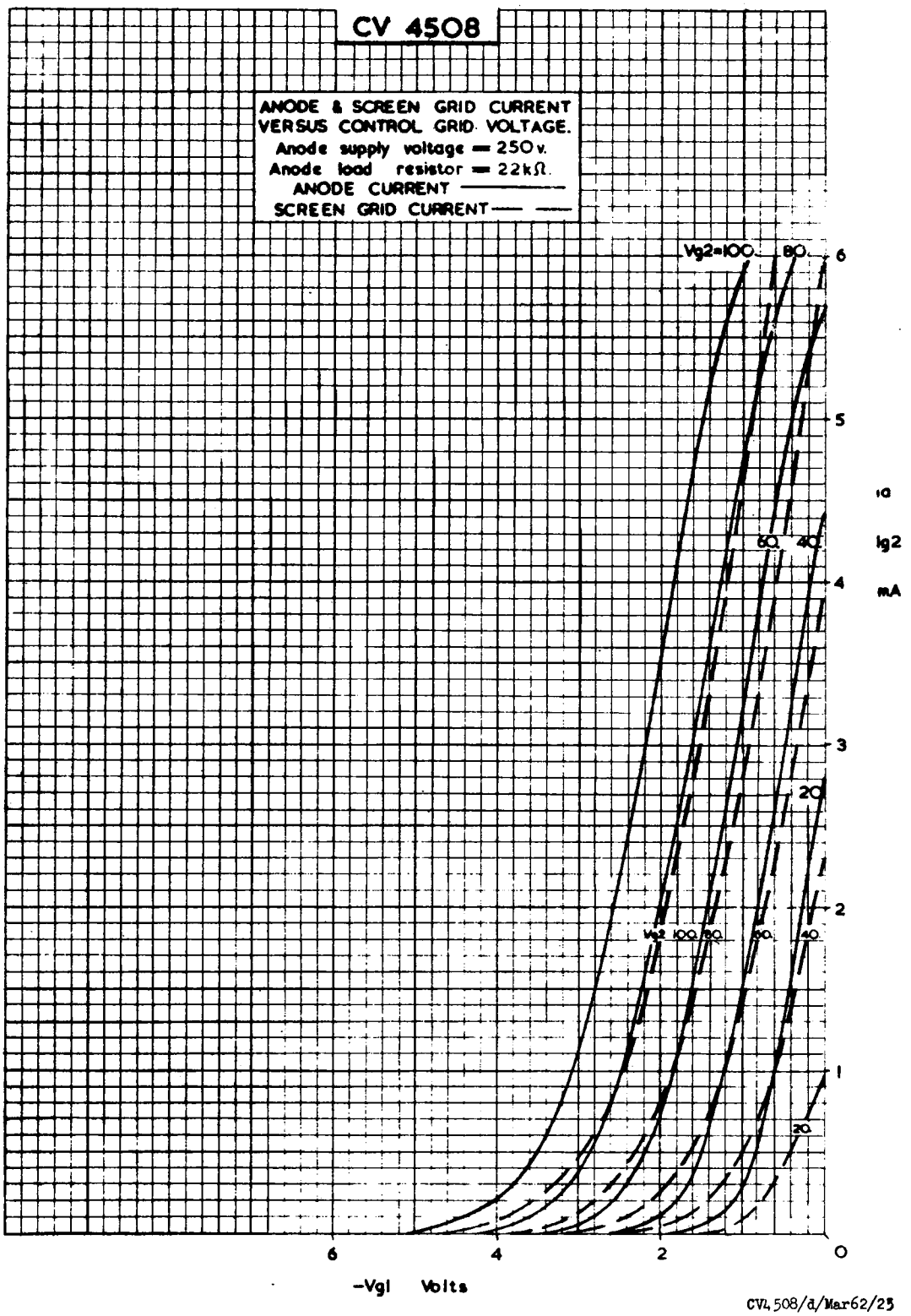

CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 150 v.
Anode load resistor = 22kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100
80
60
40
20
Ia
Ig2
mA
6
5
4
3
2
1
0
6
4
2
0
-Vg1 Volts

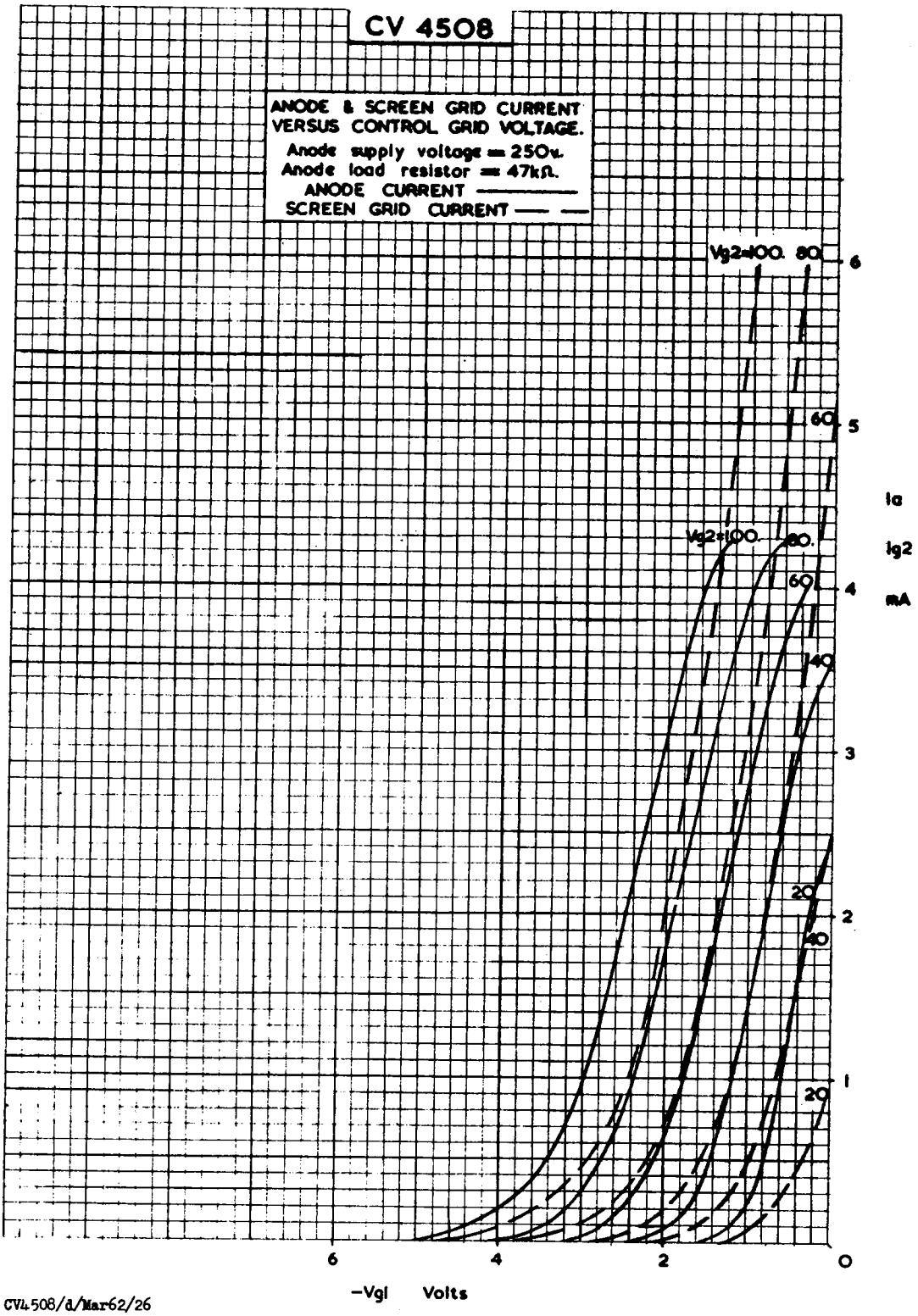

CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 150 v.
Anode load resistor = 47 kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100. 80. 60.
Vg2=100.
80.
60
40
20
20
6
5
4
3
2
1
0
Ia
Ig2
mA
6
4
2
-Vg1 Volts


CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 150v.
Anode load resistor = 100kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100. 80. 60. 40.
Vg2=100. 80. 60. 40. 20.
2
1
Ia
Ig2
mA
6
4
2
0
-Vg' Volts

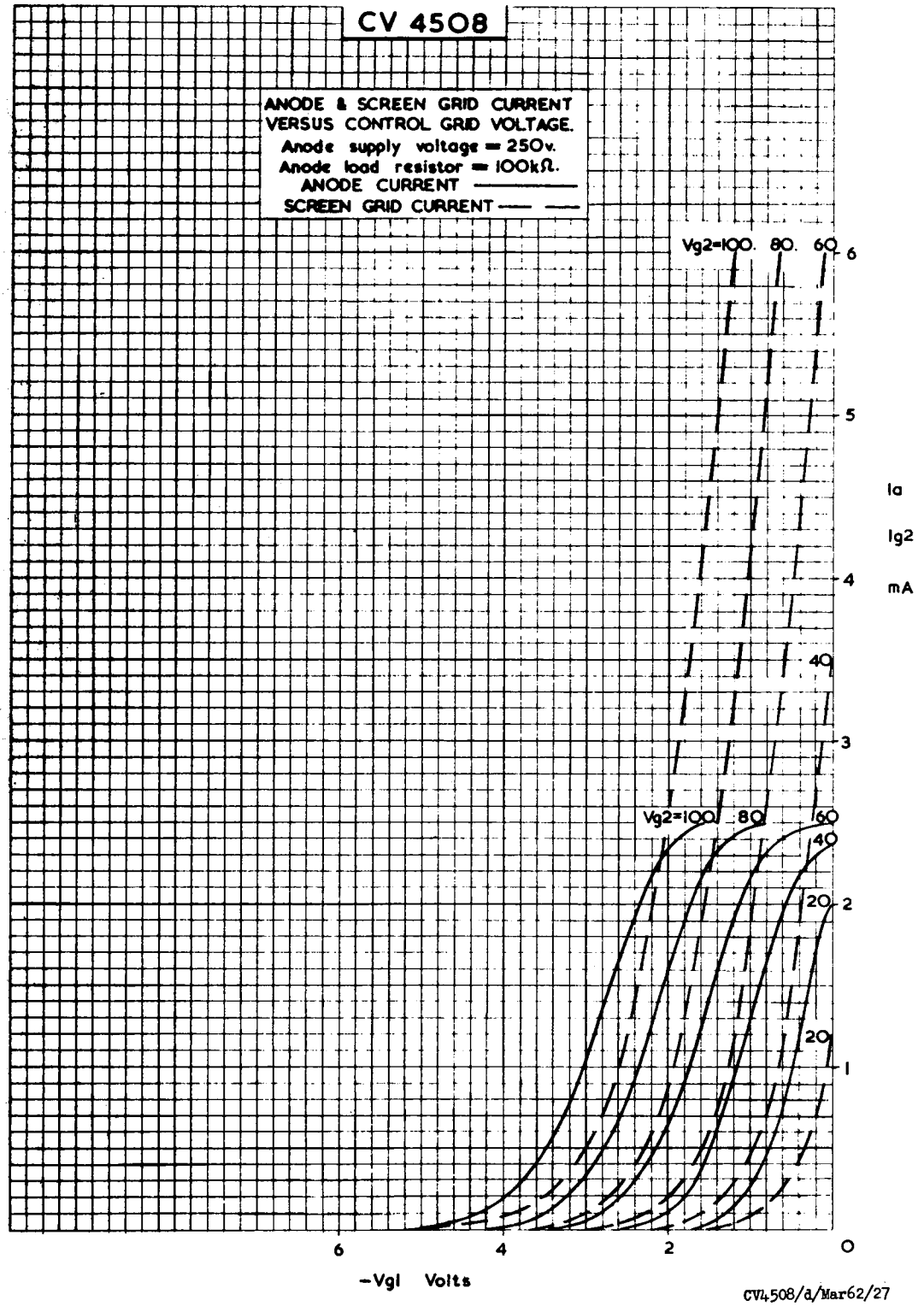

CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 150v.
Anode load resistor = 220 kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100. 80. 60. 40. 20.
2
1
Ia
Ig2
mA
Vg2=100. 80. 60. 40. 20.
6
4
2
0
-Vg1 Volts

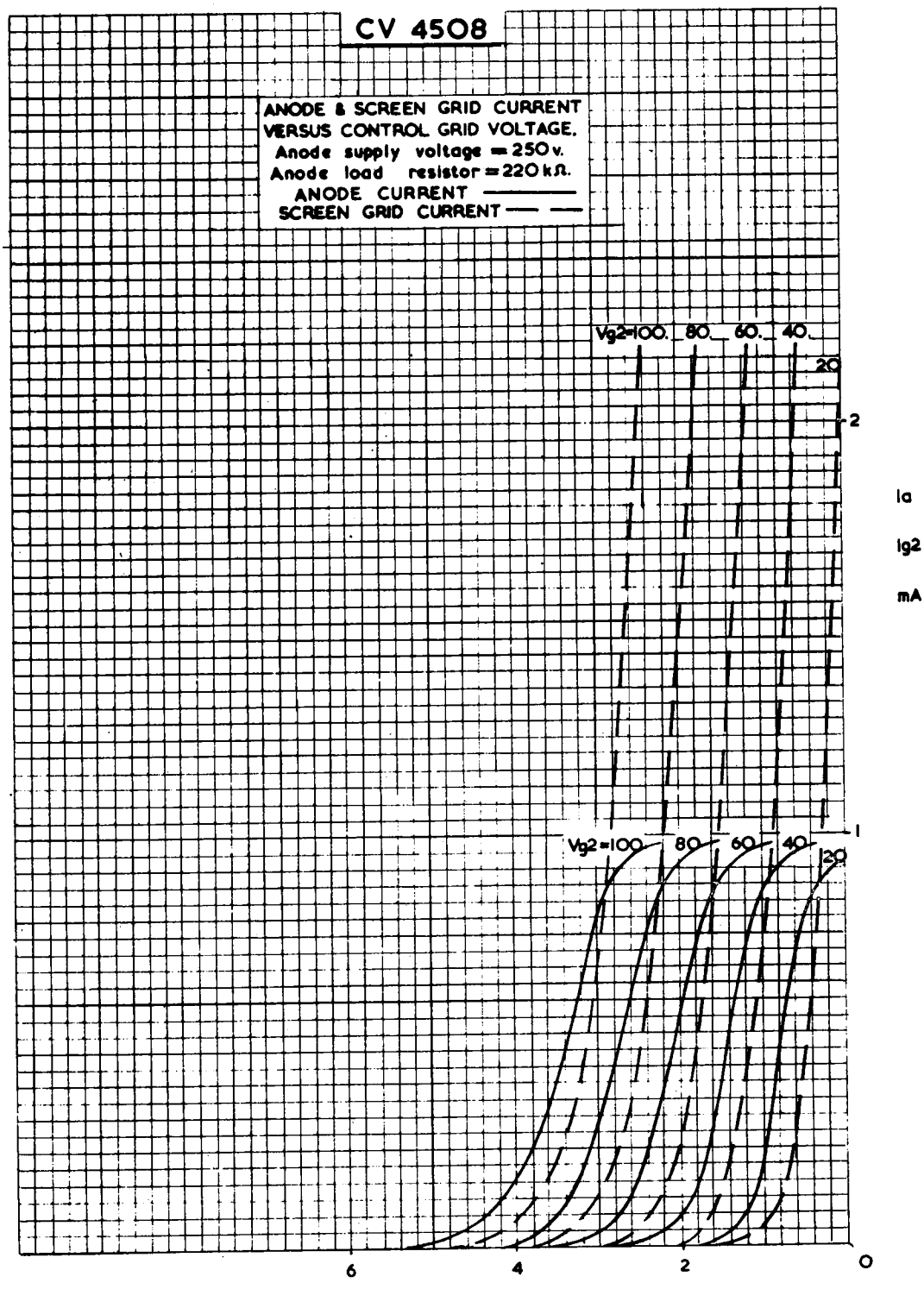
CV4508

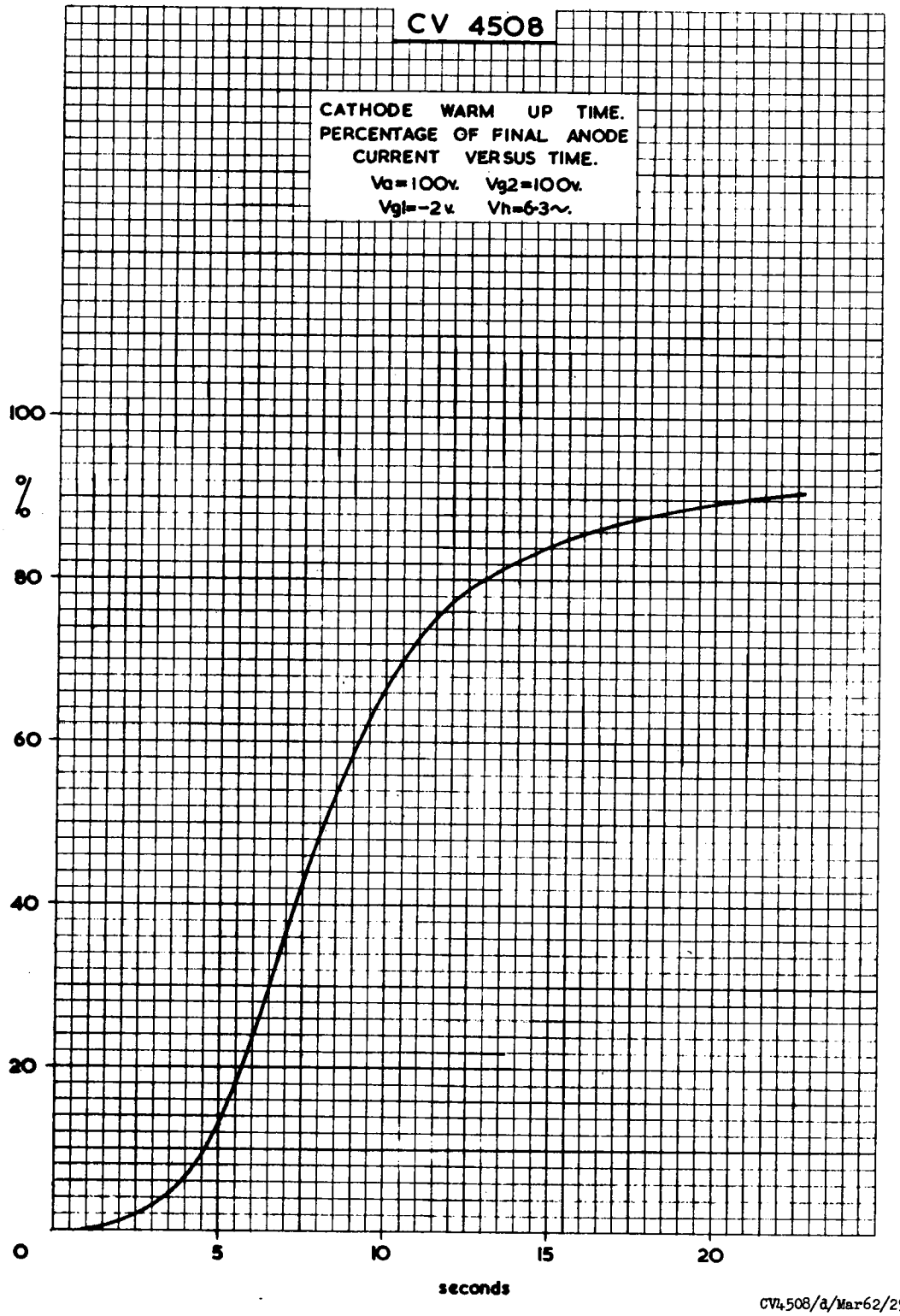

CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 250 v.
Anode load resistor = 22kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100
80
60
40
20
Vg2 100 80 60 40
20
6
5
4
3
2
1
0
Ia
Ig2
mA
6
4
2
0
-Vg1 Volts


CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 250v.
Anode load resistor = 47kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100.
80.
60.
40.
20.
Ia
Ig2
mA
6
5
4
3
2
1
0
6
4
2
-Vg1 Volts

CV4508


CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 250v.
Anode load resistor = 100kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100. 80. 60
Vg2=100 80 60 40 20
20
Ia
Ig2
mA
6
5
4
3
2
1
0
6
4
2
0
-Vg1 Volts


CV 4508
ANODE & SCREEN GRID CURRENT
VERSUS CONTROL GRID VOLTAGE.
Anode supply voltage = 250 v.
Anode load resistor = 220 kΩ.
ANODE CURRENT
SCREEN GRID CURRENT
Vg2=100
80
60
40
20
2
1
Ia
Ig2
mA
6
4
2
0
-Vg1 Volts


CV 4508
CATHODE WARM UP TIME.
PERCENTAGE OF FINAL ANODE CURRENT VERSUS TIME.
Va=100v. Vg2=100v.
Vg1=-2v. Vh=6·3~.
100
%
80
60
40
20
0
5
10
15
20
seconds

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:- $Rk\ eff. = Rk + \frac{Ra}{\mu}$

For Pentodes:- $Rk\ eff. = \frac{Ik \times Rk}{Ia} + \frac{Ig2 \times Rg2}{Ia \times \mu(g1 - g2)}$

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

$= 4715$ ohms.

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

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

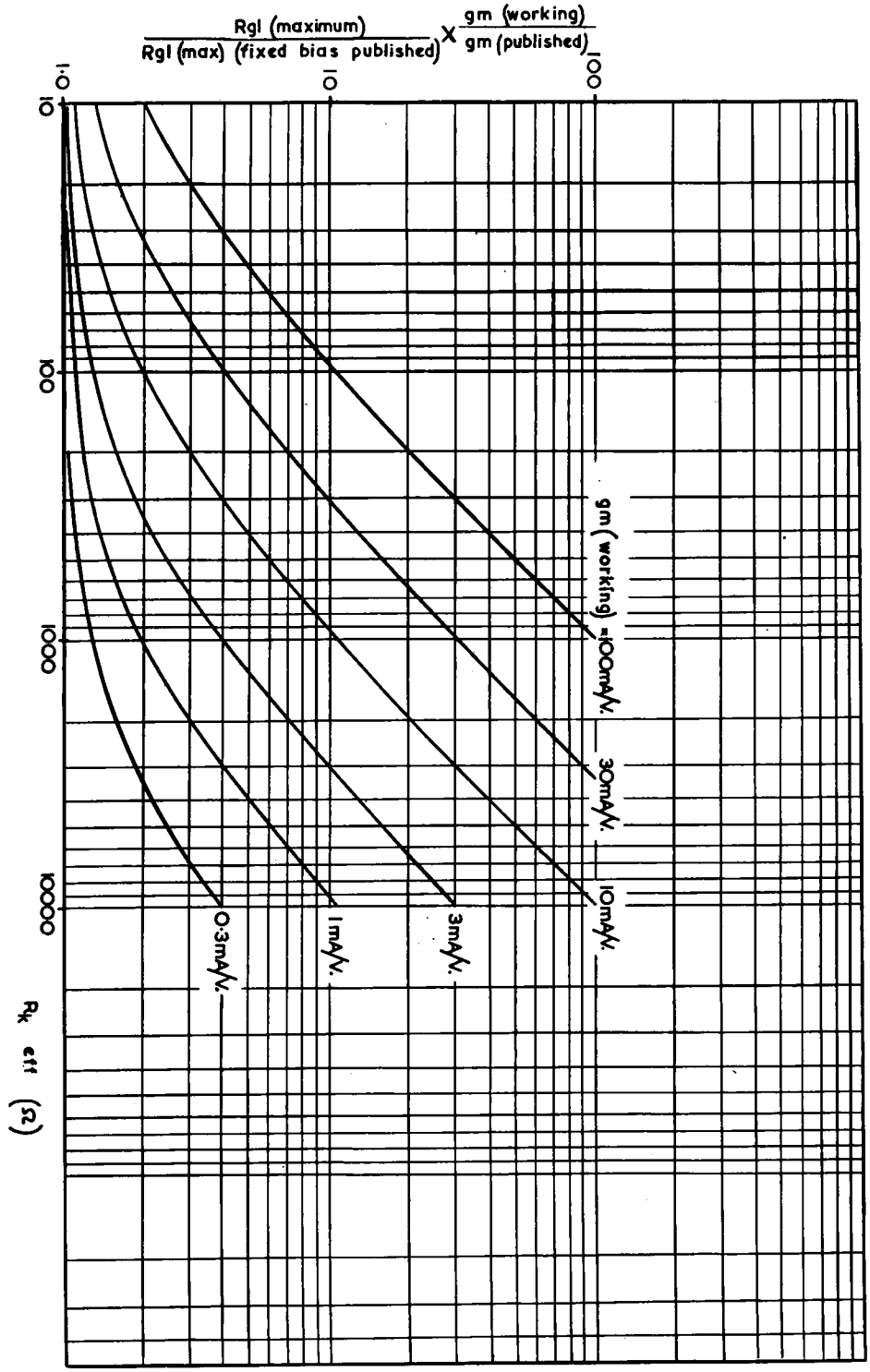
Therefore Rg1 maximum $= 16 \times 0.25 \times 10^6 \times \frac{5.2}{3.5} = 6M$.

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:-

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

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.

CV4508


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