

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

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AMENDMENTS

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Ia	: Vg1 Va=50V to 300V (50V steps)	Nominal 8
Ia	: Vg1 Va=50V to 300V (50V steps)	Lower lmt. 9
Ia	: Vg1 Va=50V to 300V (50V steps)	Upper lmt. 10
gm	: Vg1 Va=50V to 200V (50V steps)	Nominal 11
gm	: Vg1 Va=50V to 200V (50V steps)	Lower lmt. 12
gm	: Vg1 Va=50V to 200V (50V steps)	Upper lmt. 13
μ	: Vg1 Va=50V to 200V (50V steps)	Nominal 14
μ	: Vg1 Va=50V to 200V (50V steps)	Lower lmt. 15
μ	: Vg1 Va=50V to 200V (50V steps)	Upper lmt. 16
ra	: Vg1 Va=50V to 200V (50V steps)	Nominal 17
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μ , gm, ra, Vg1	: Ia Va=150V	Nominal 26
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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

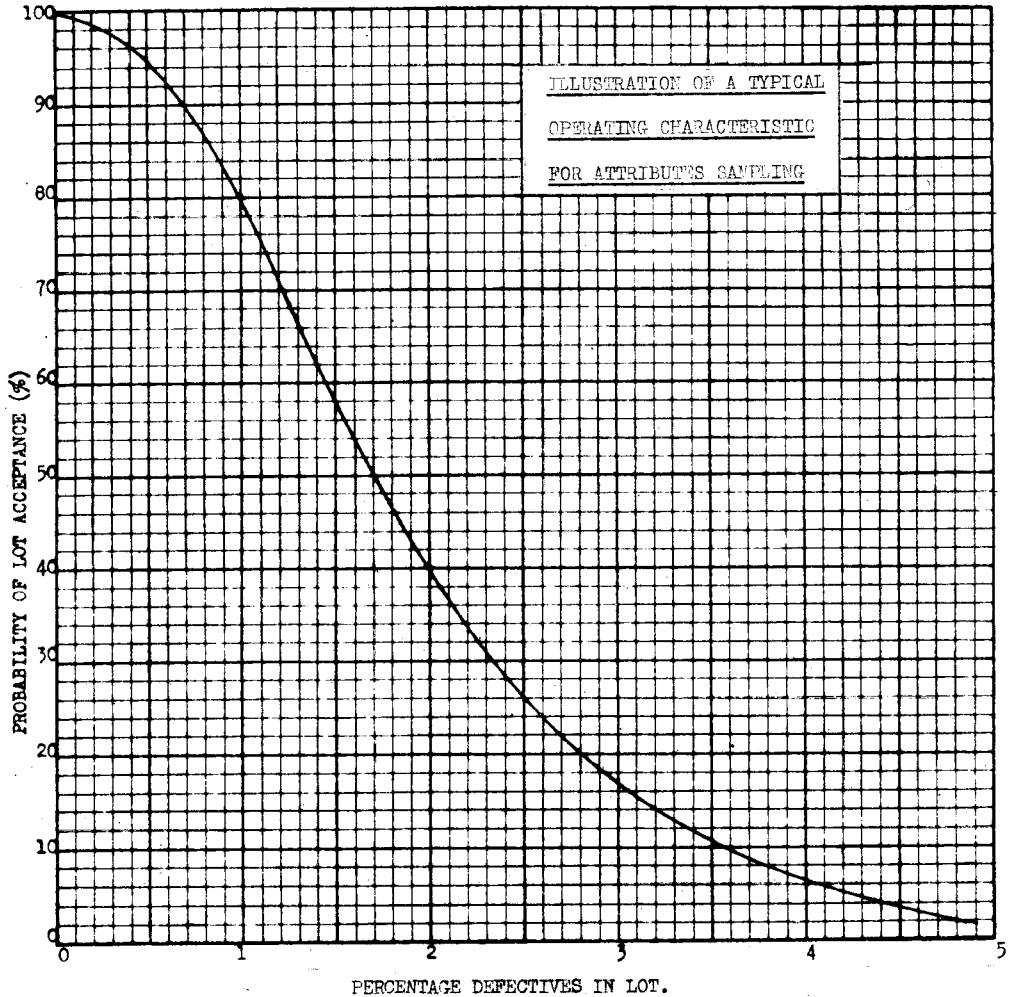
Illustrations of the limiting distributions for this valve, which would be just accepted by the above controls, are given on Pages 6 and 7. These show normal curves with the maximum permissible spread allowed by the AQL, centered on the LAL and UAL, respectively, and the maximum spread distributions,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

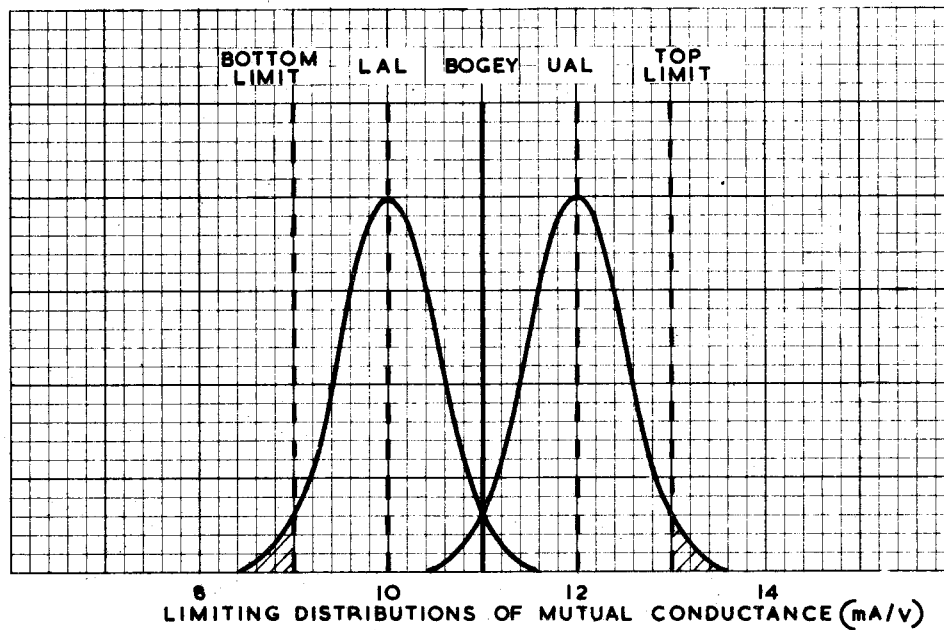
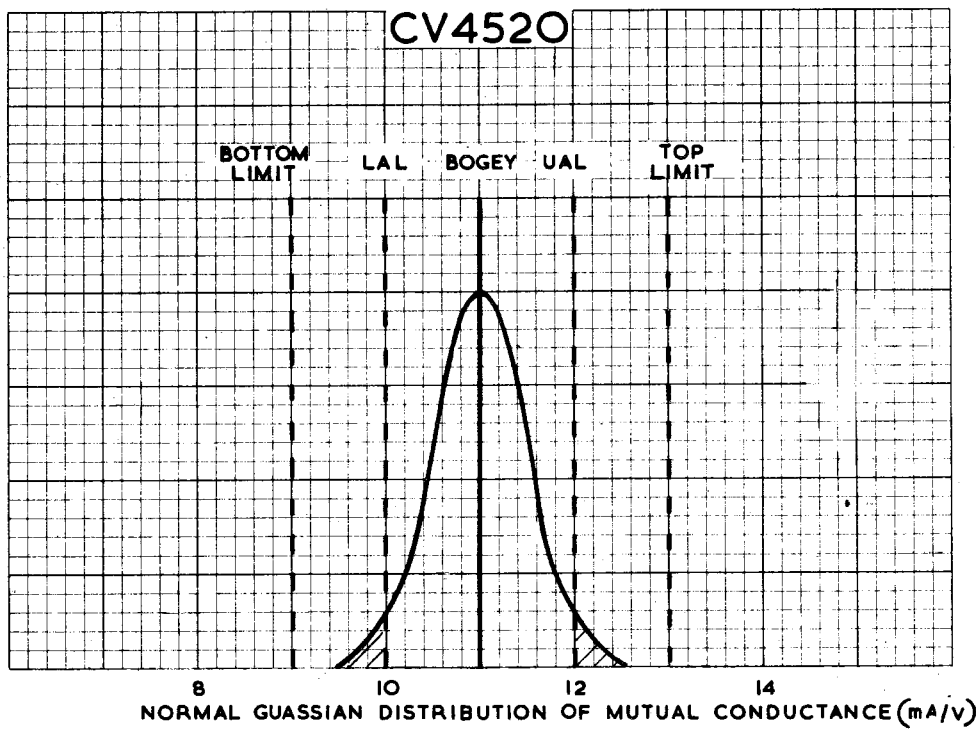
For further details of sampling inspection procedures for Attributes and Variables, reference should be made to K1001, Appendix XI, and MIL Standard 105A, Sampling Procedures and Tables for Inspection by Attributes.

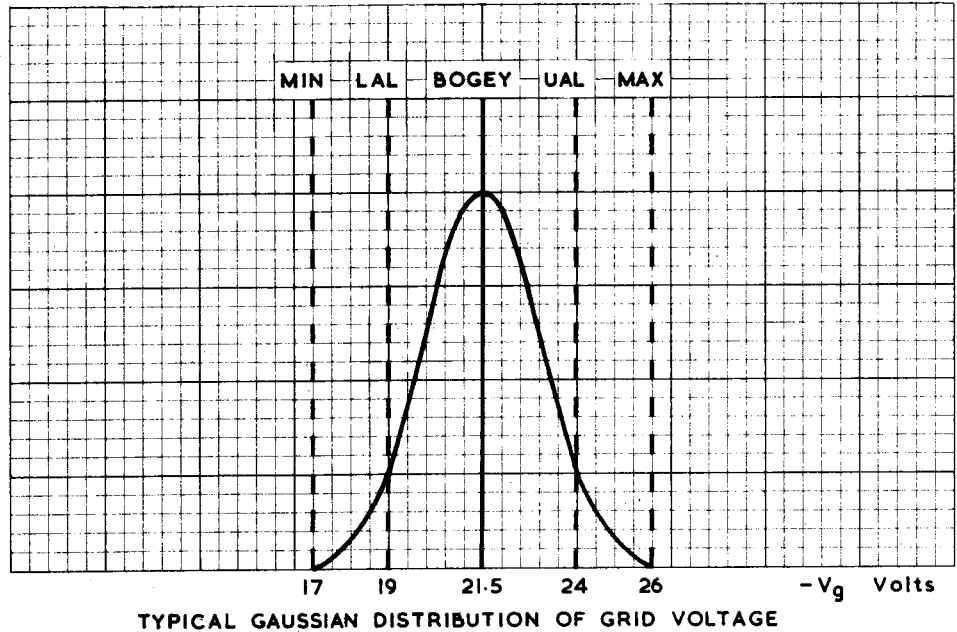
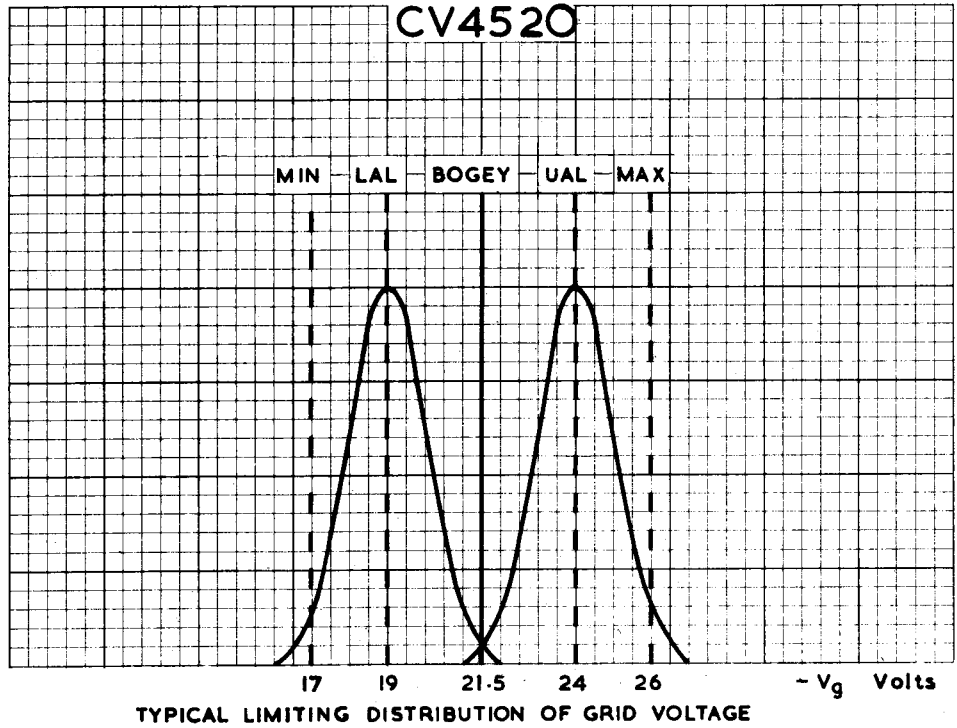
Typical Operating Characteristic

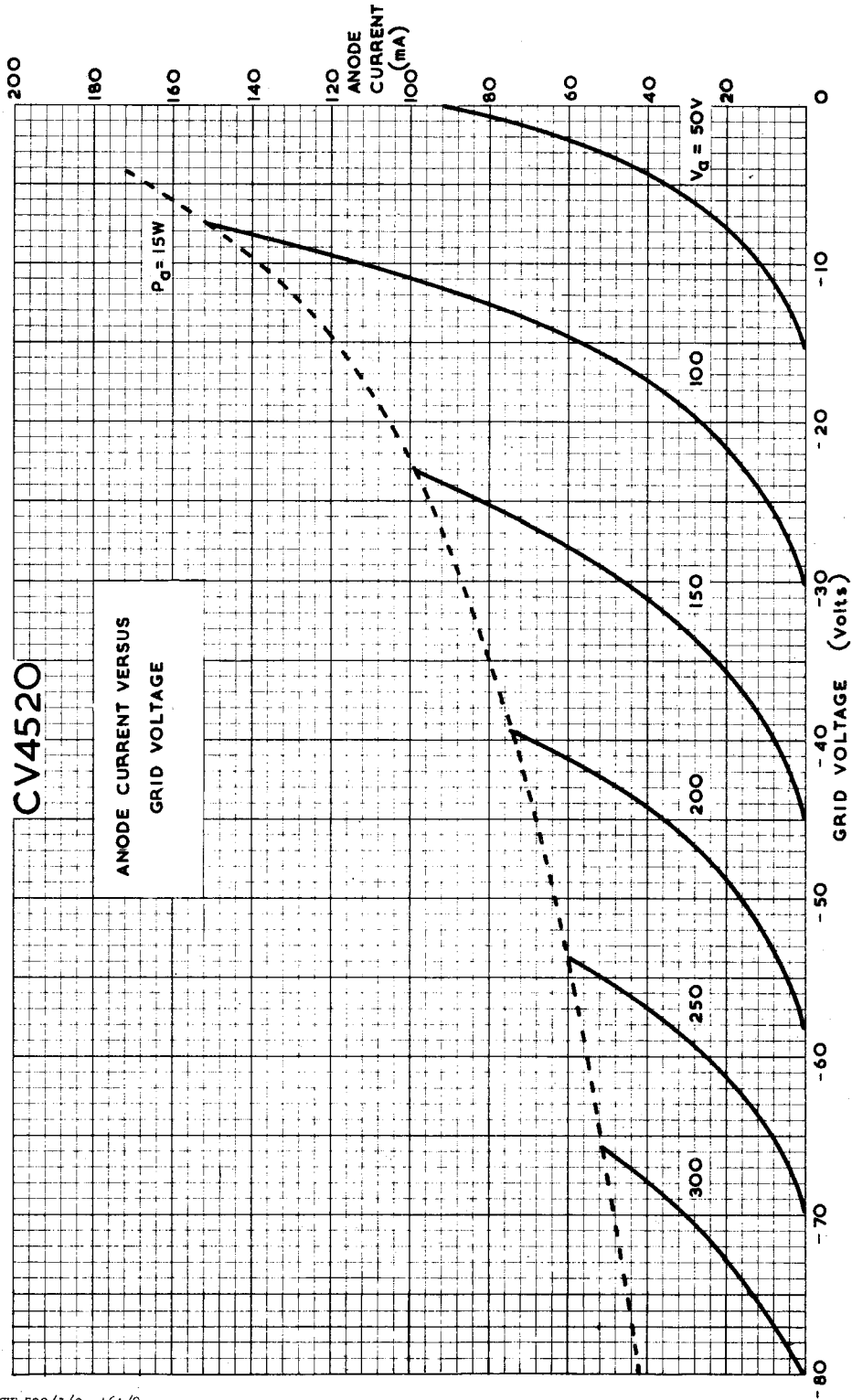
The following curve gives a typical Operating Characteristic for:-

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).

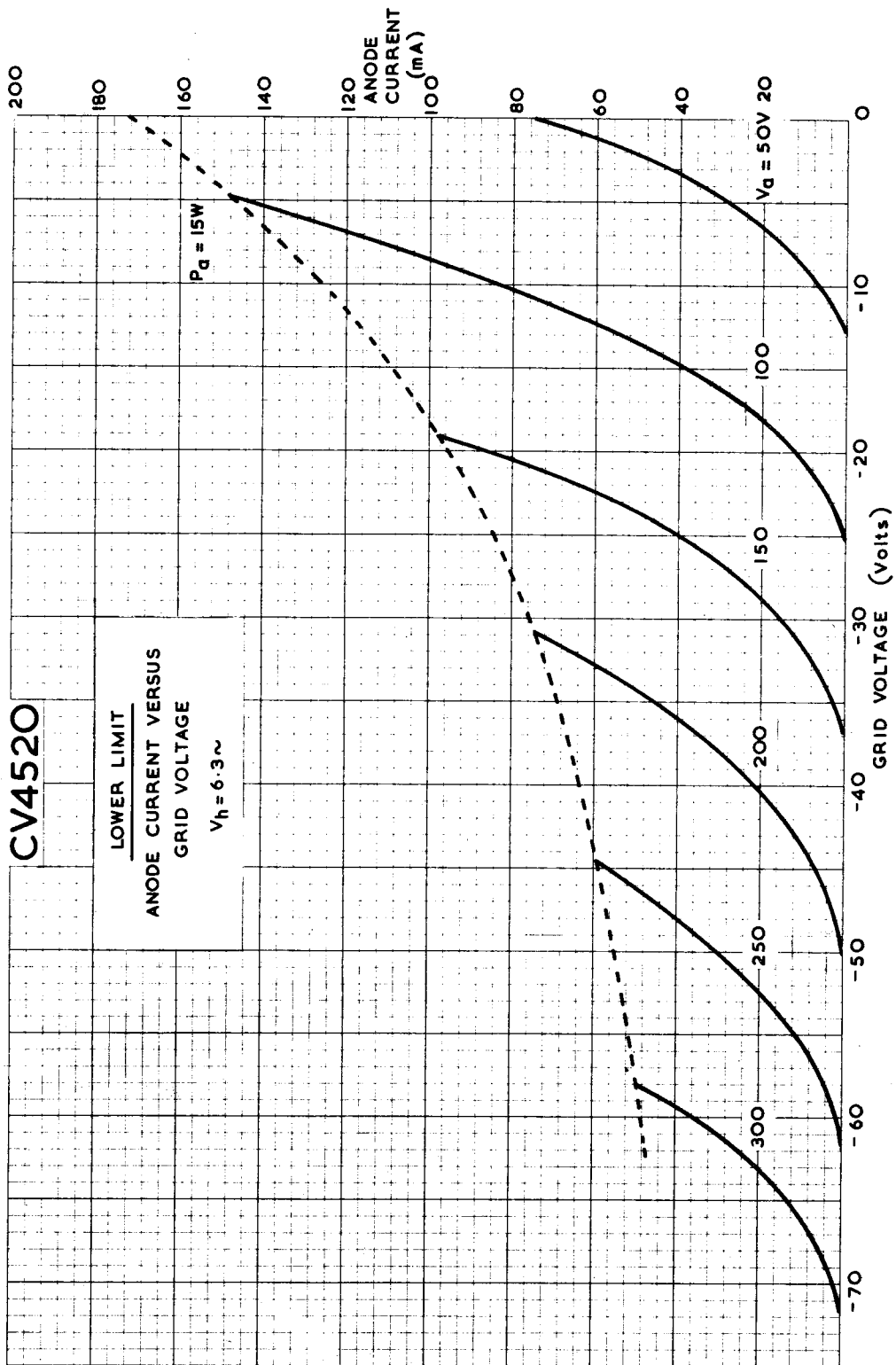


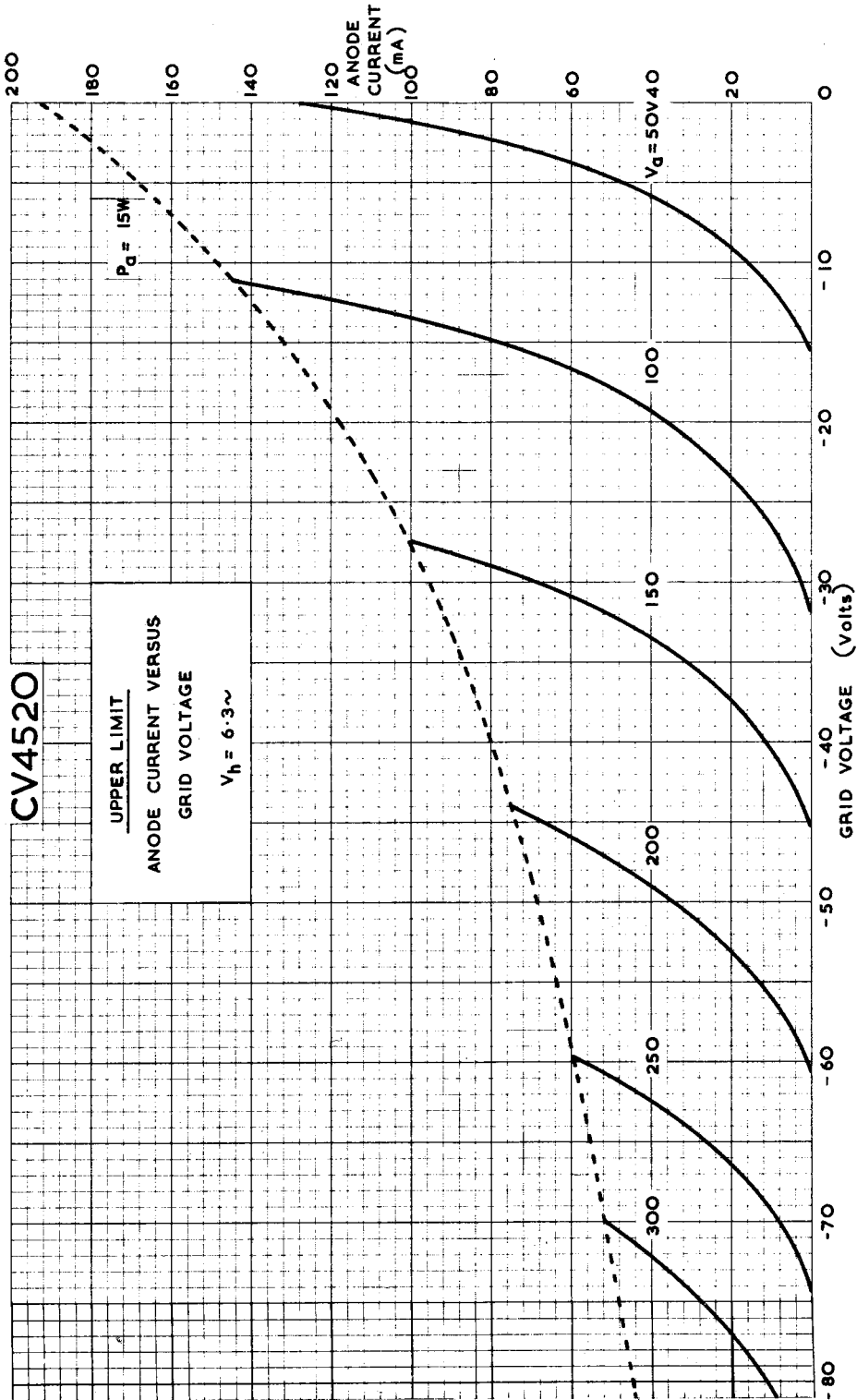


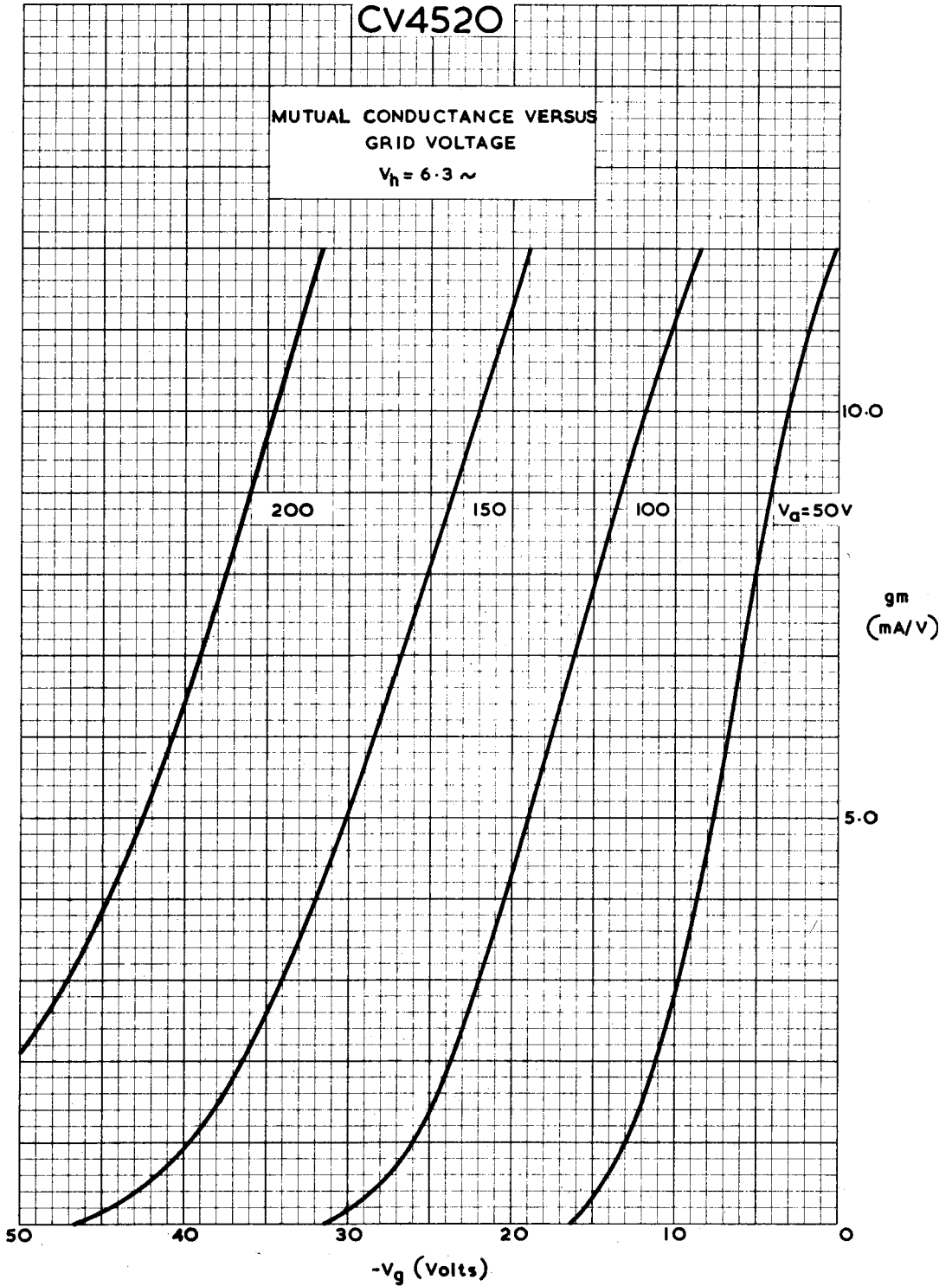


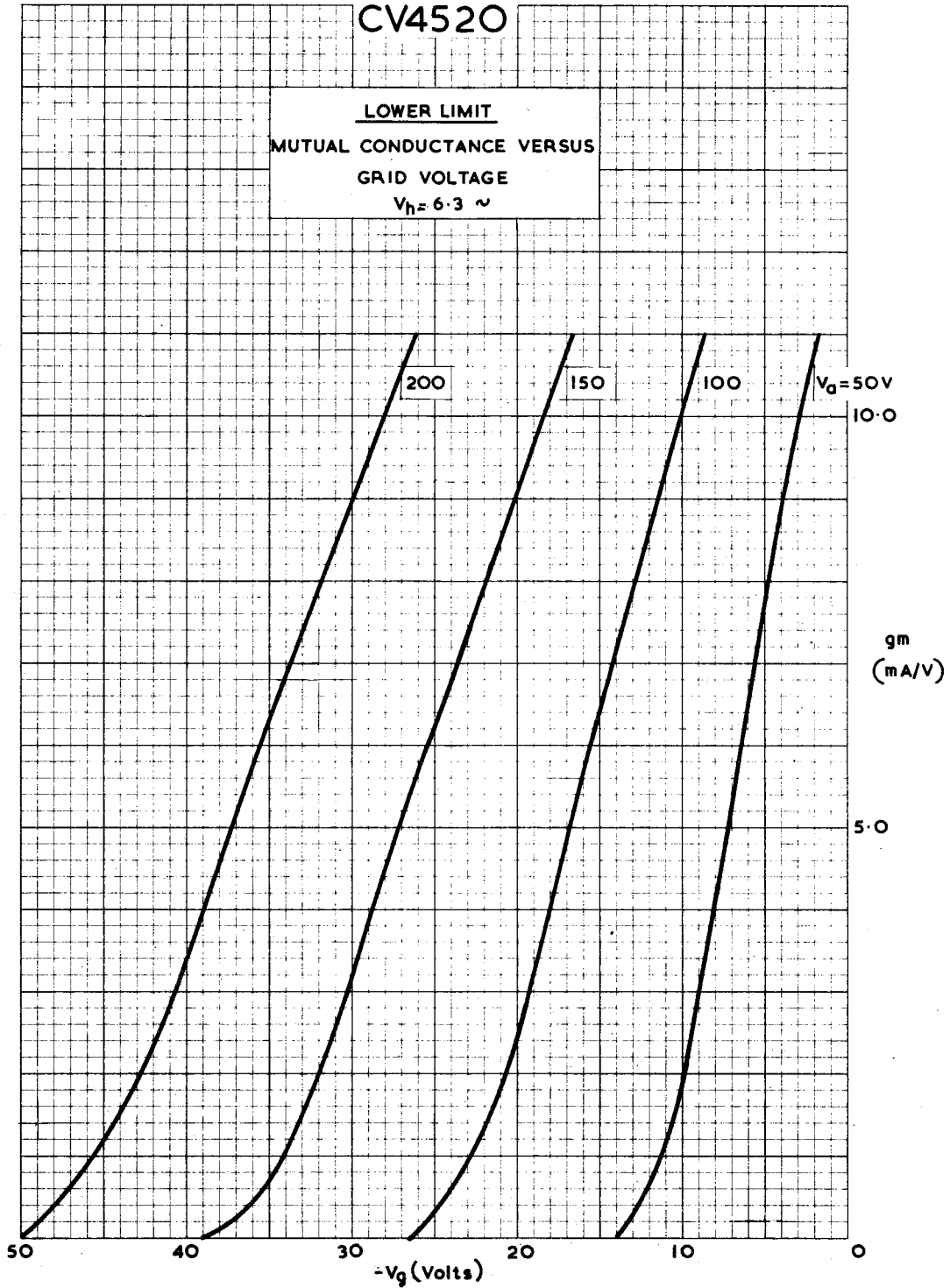


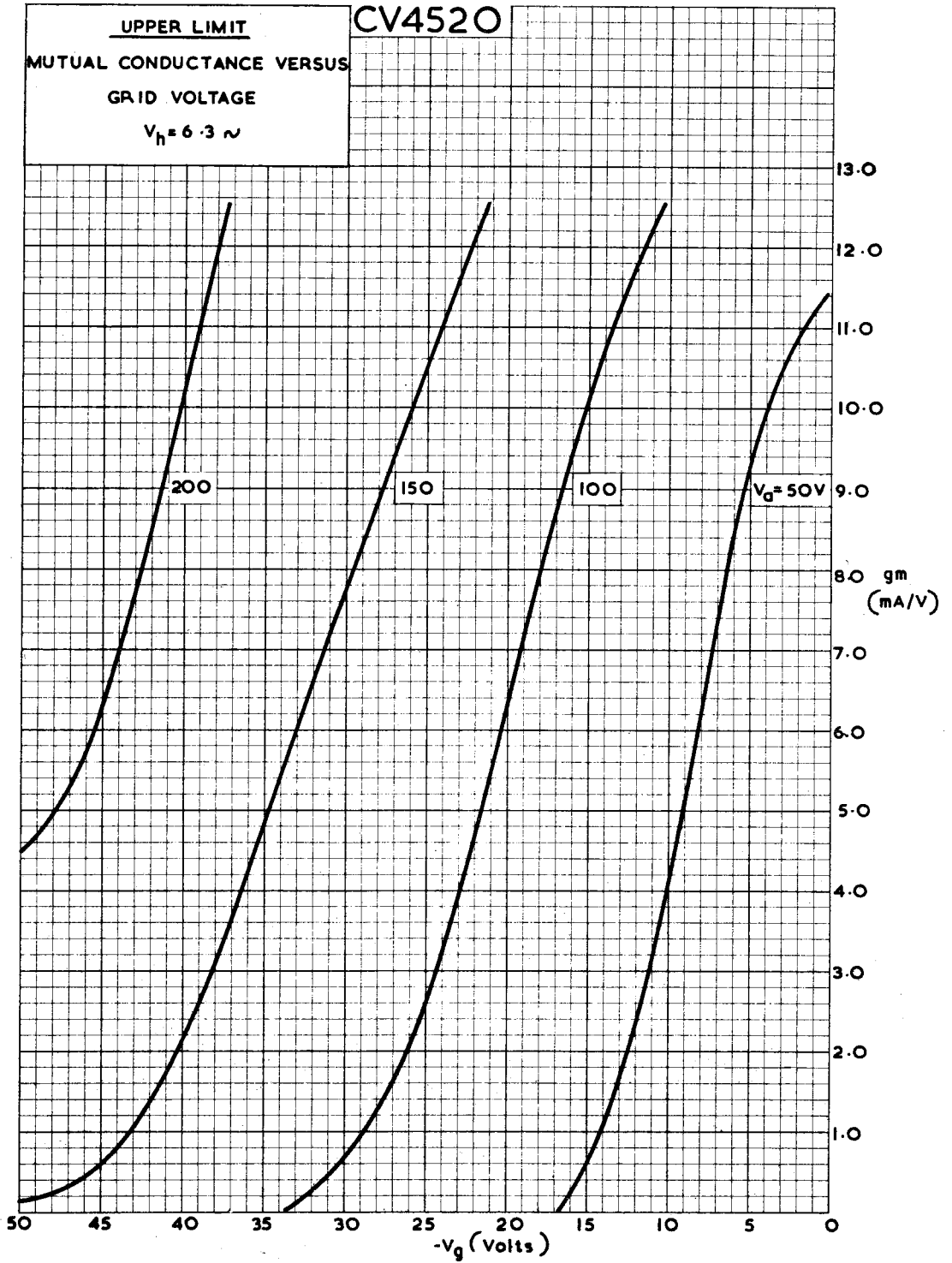
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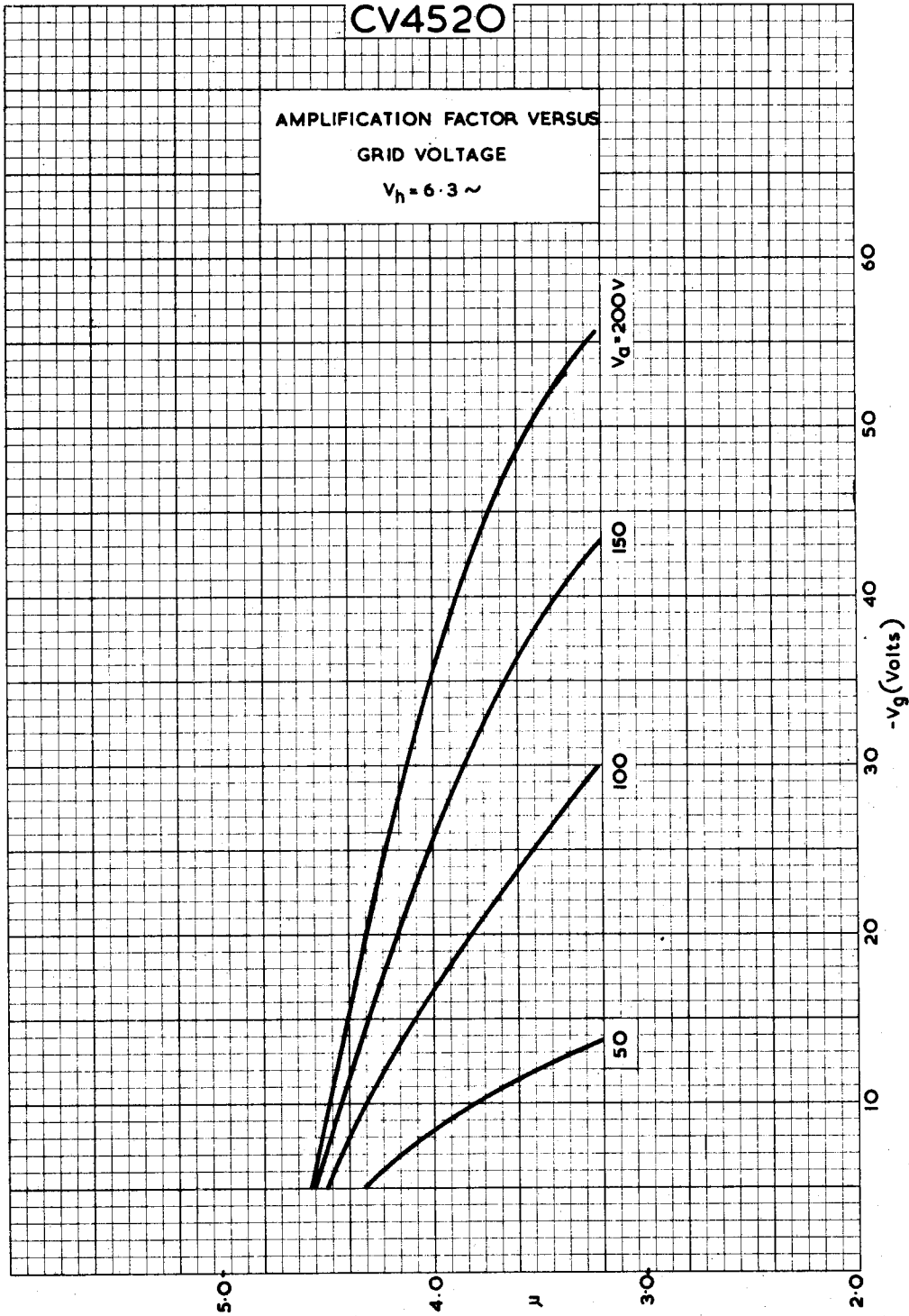


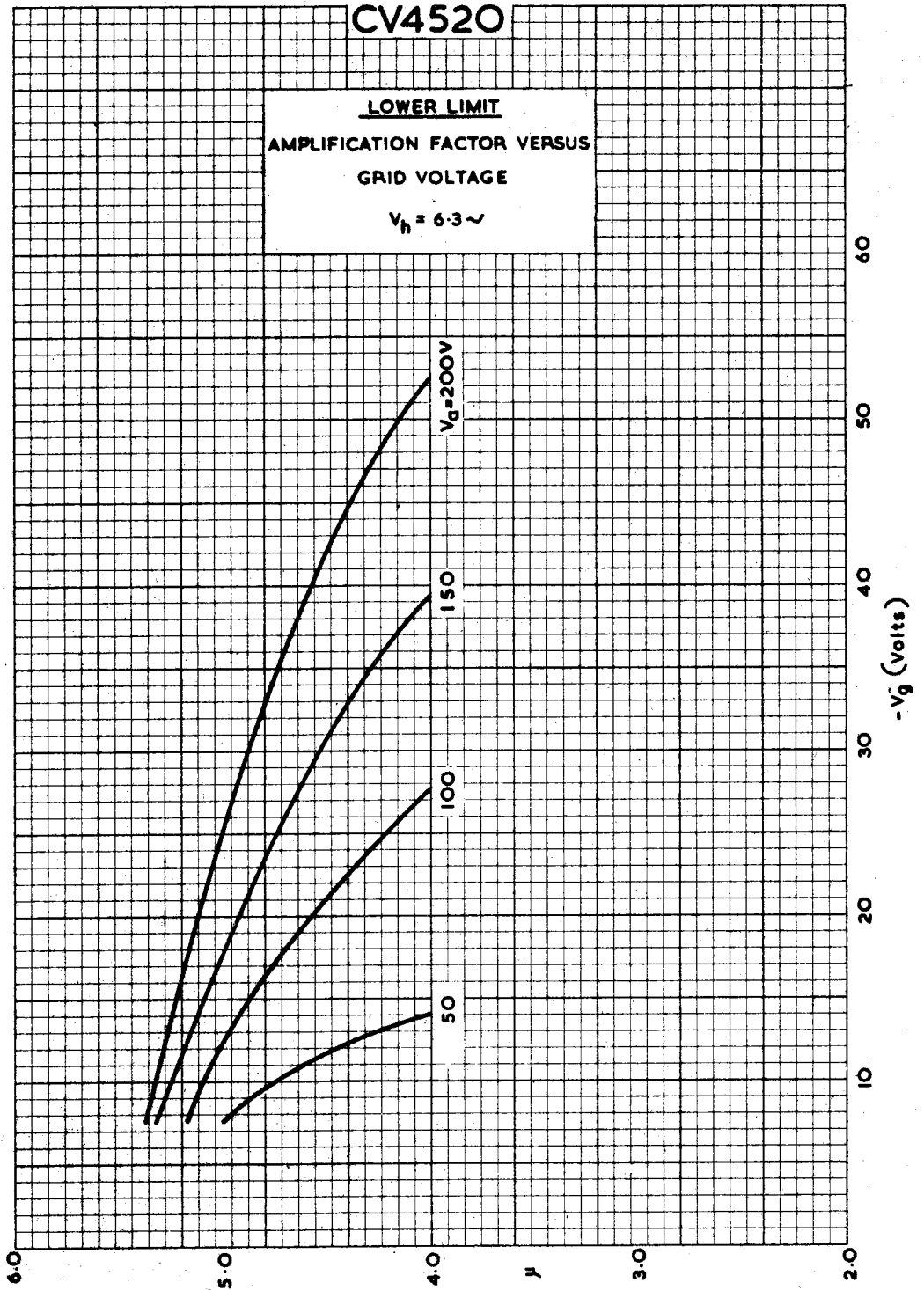


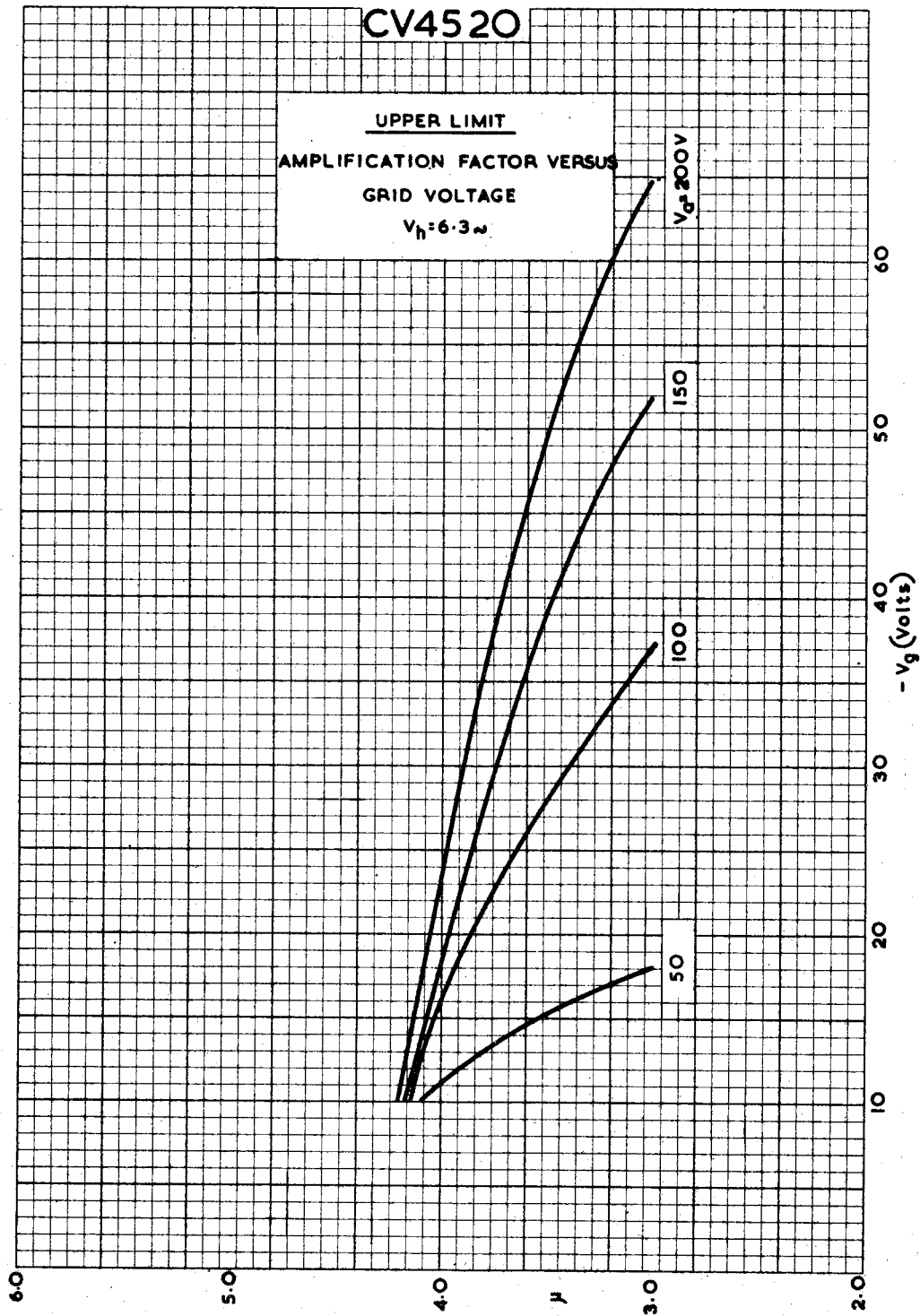


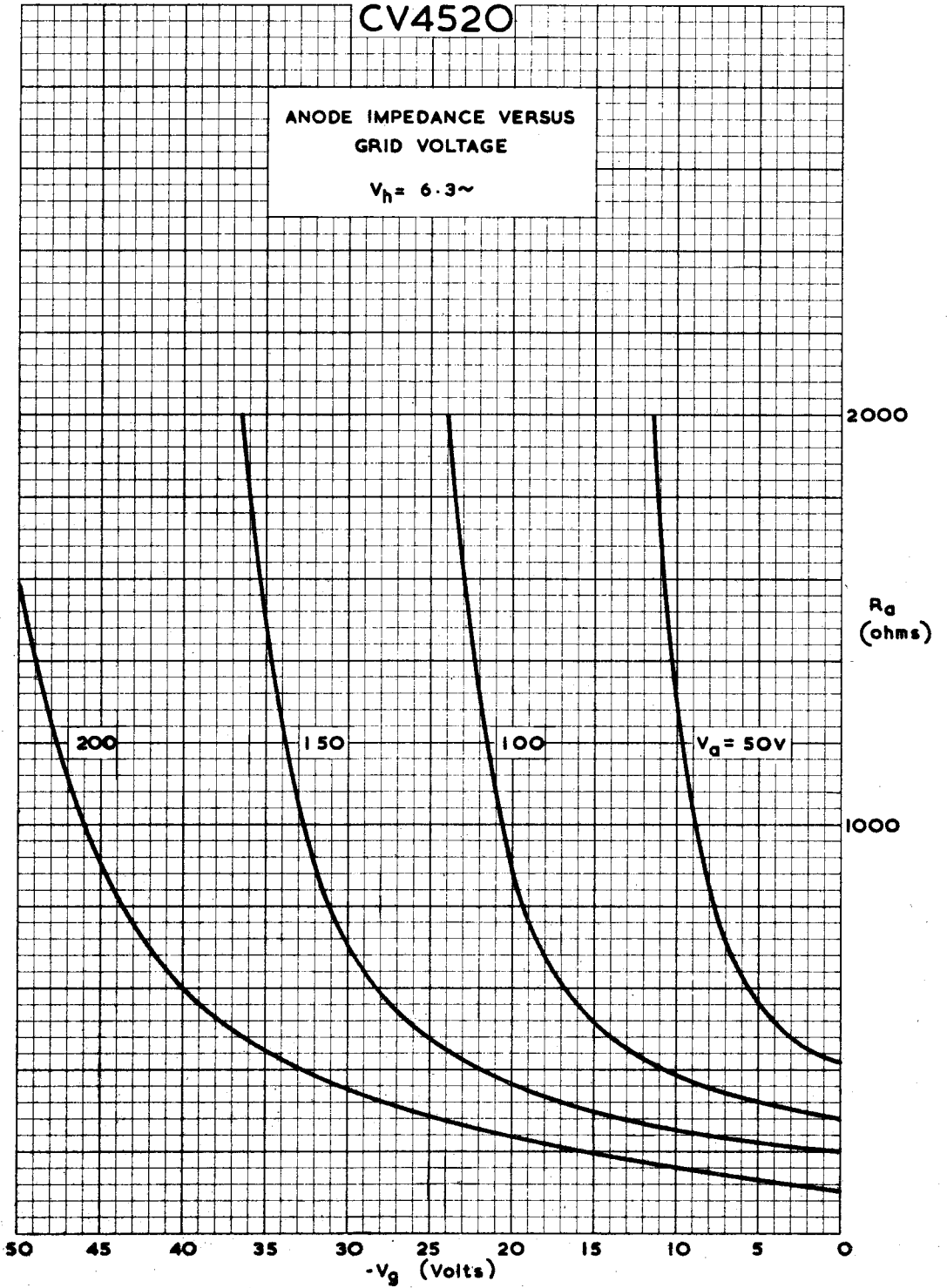


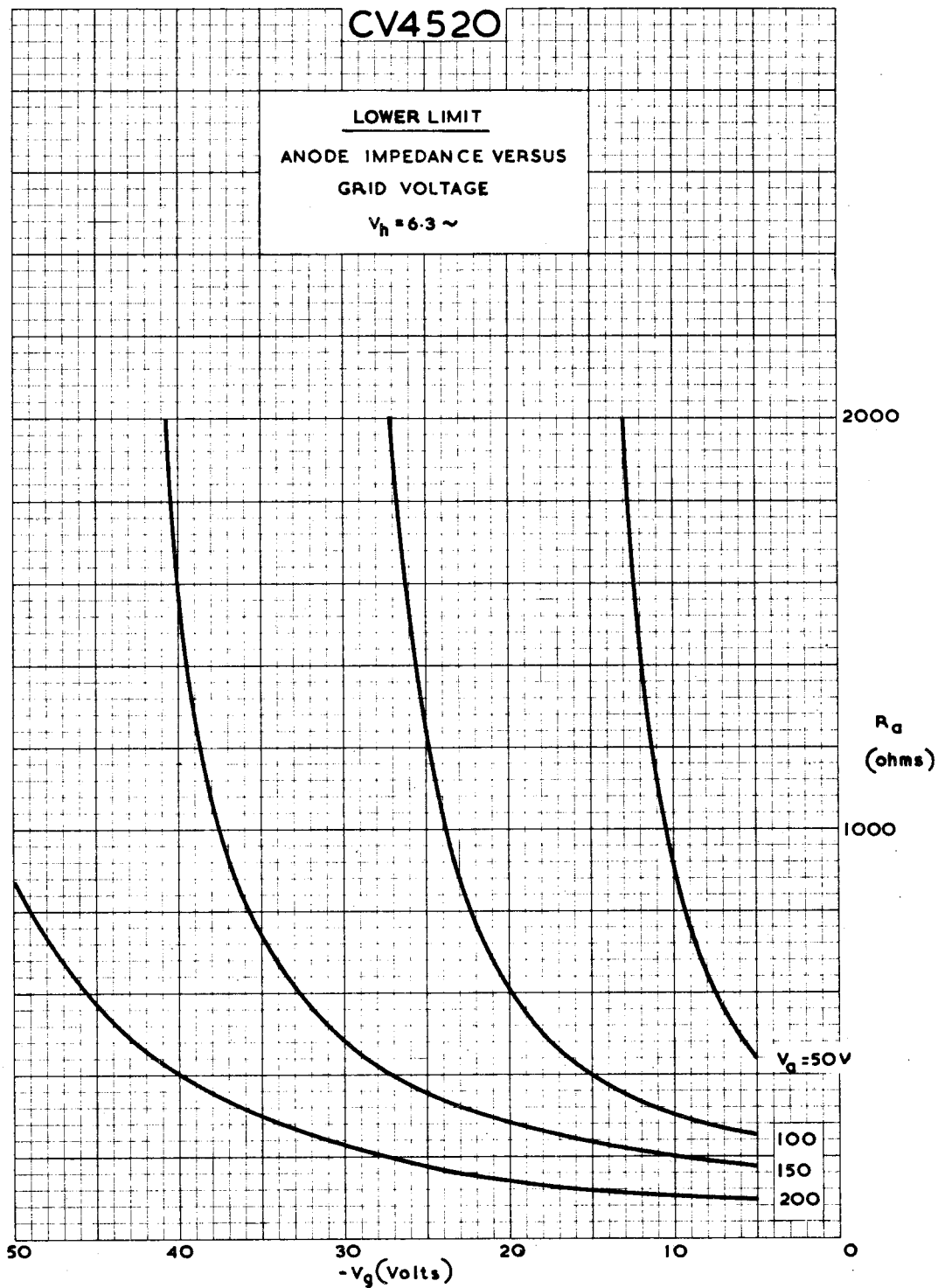


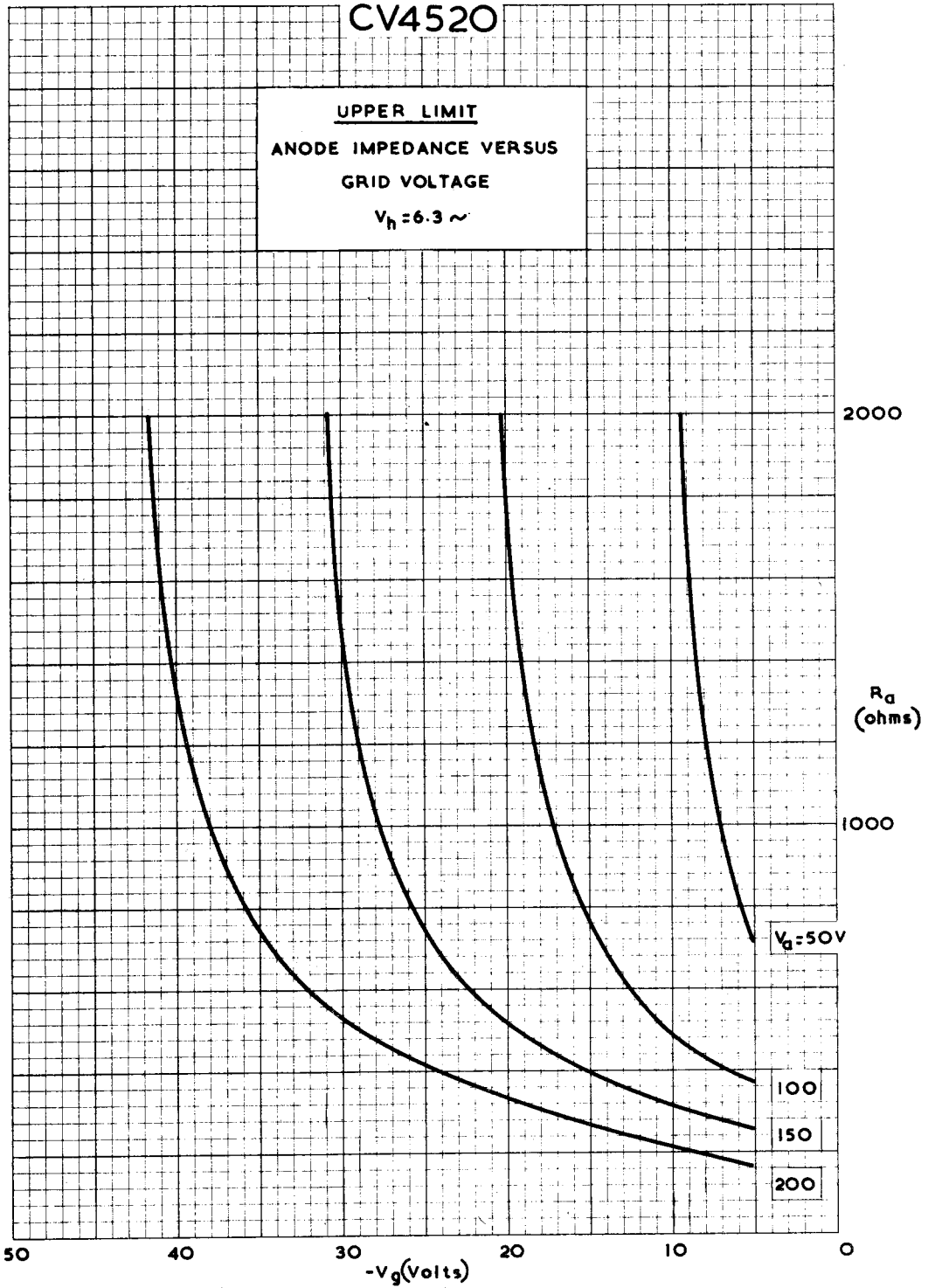


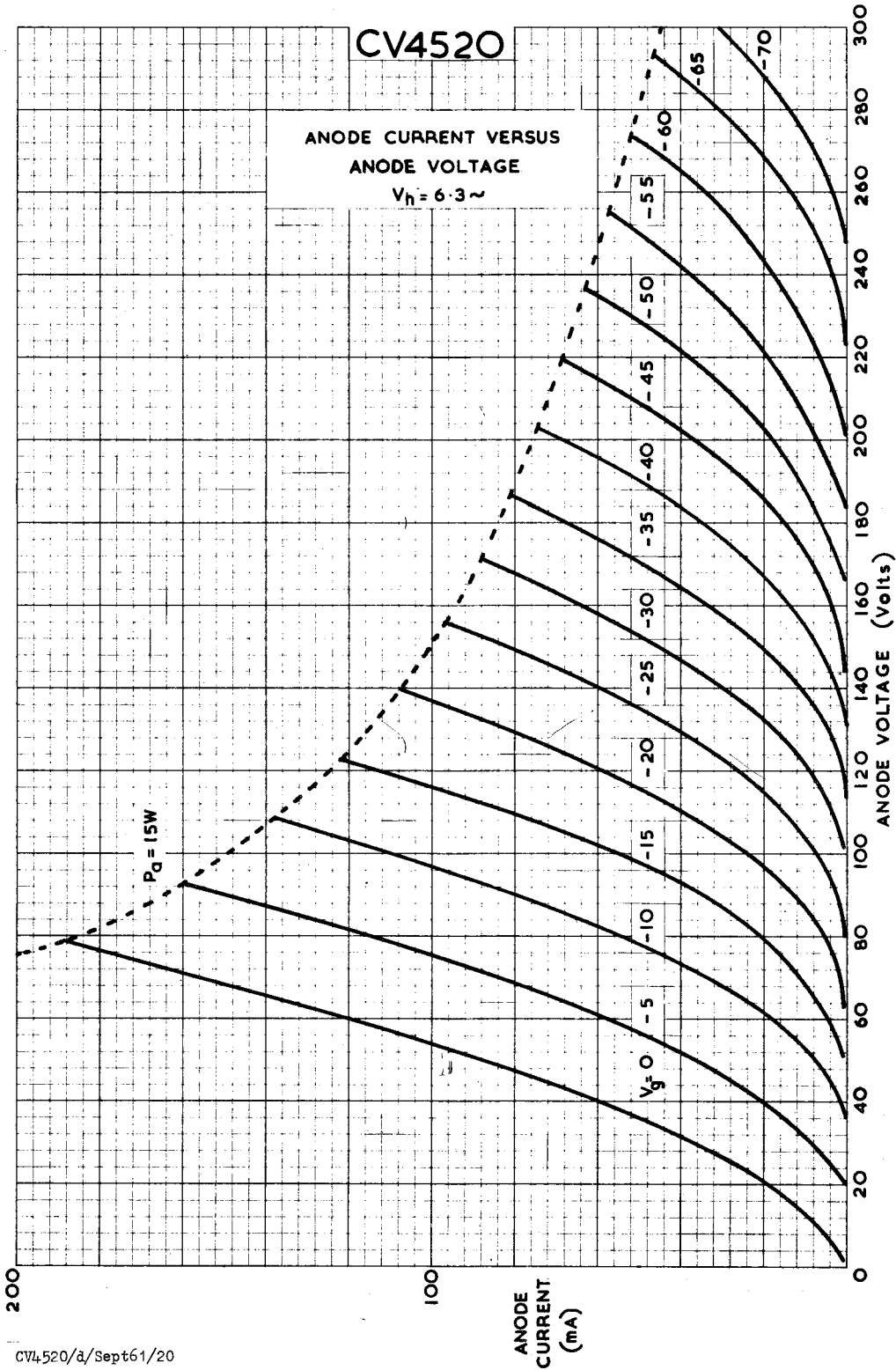


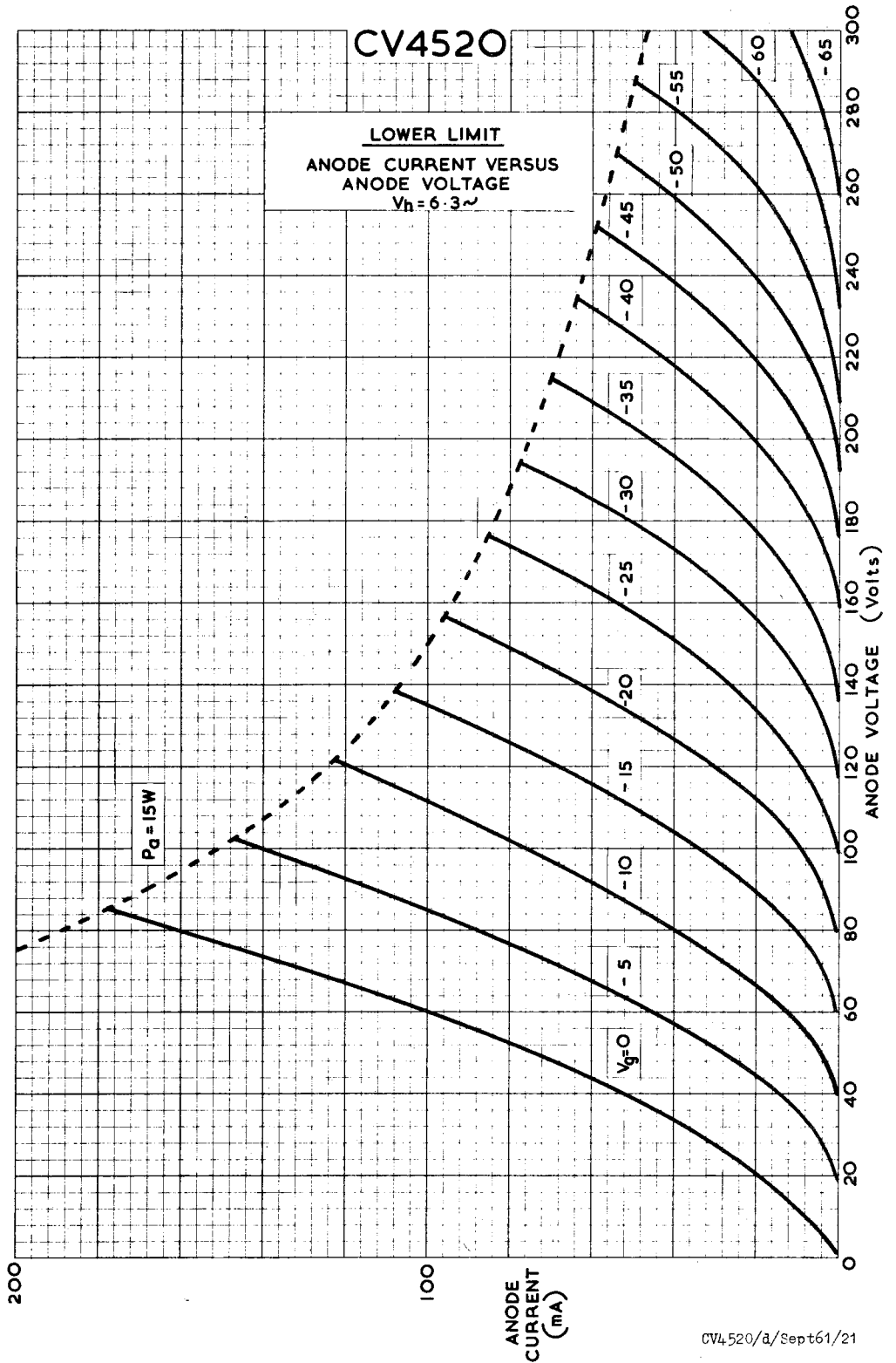


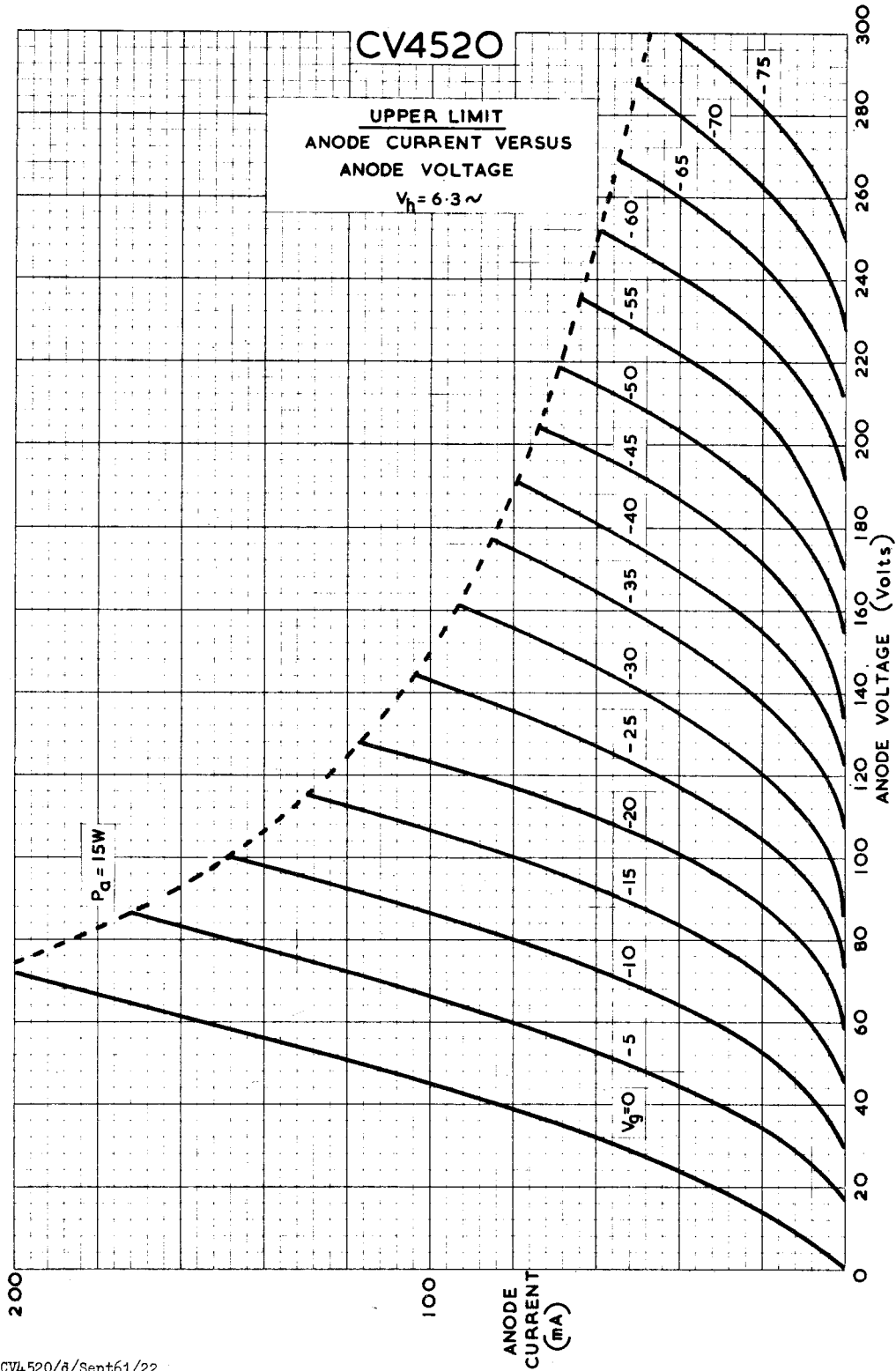


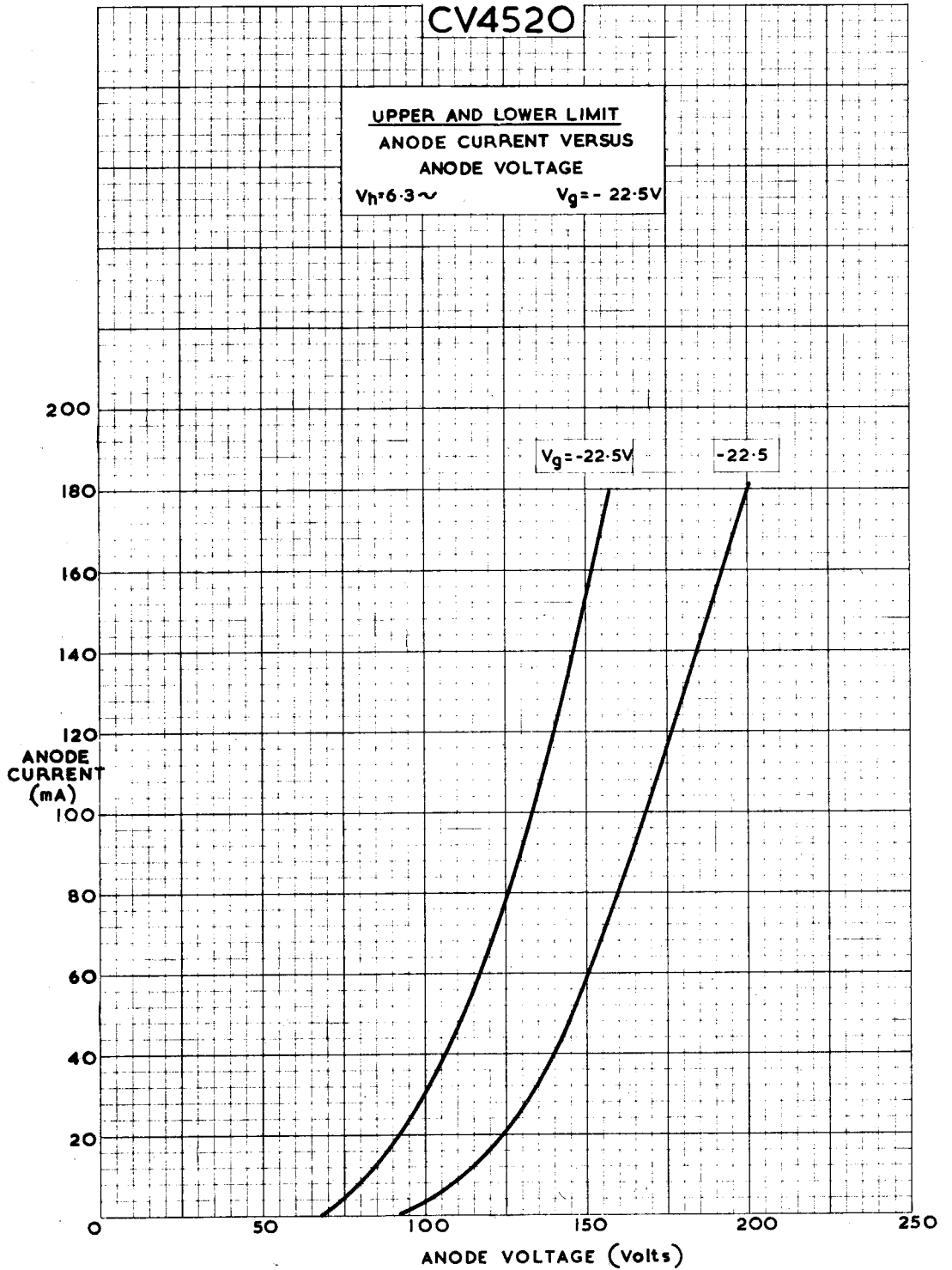


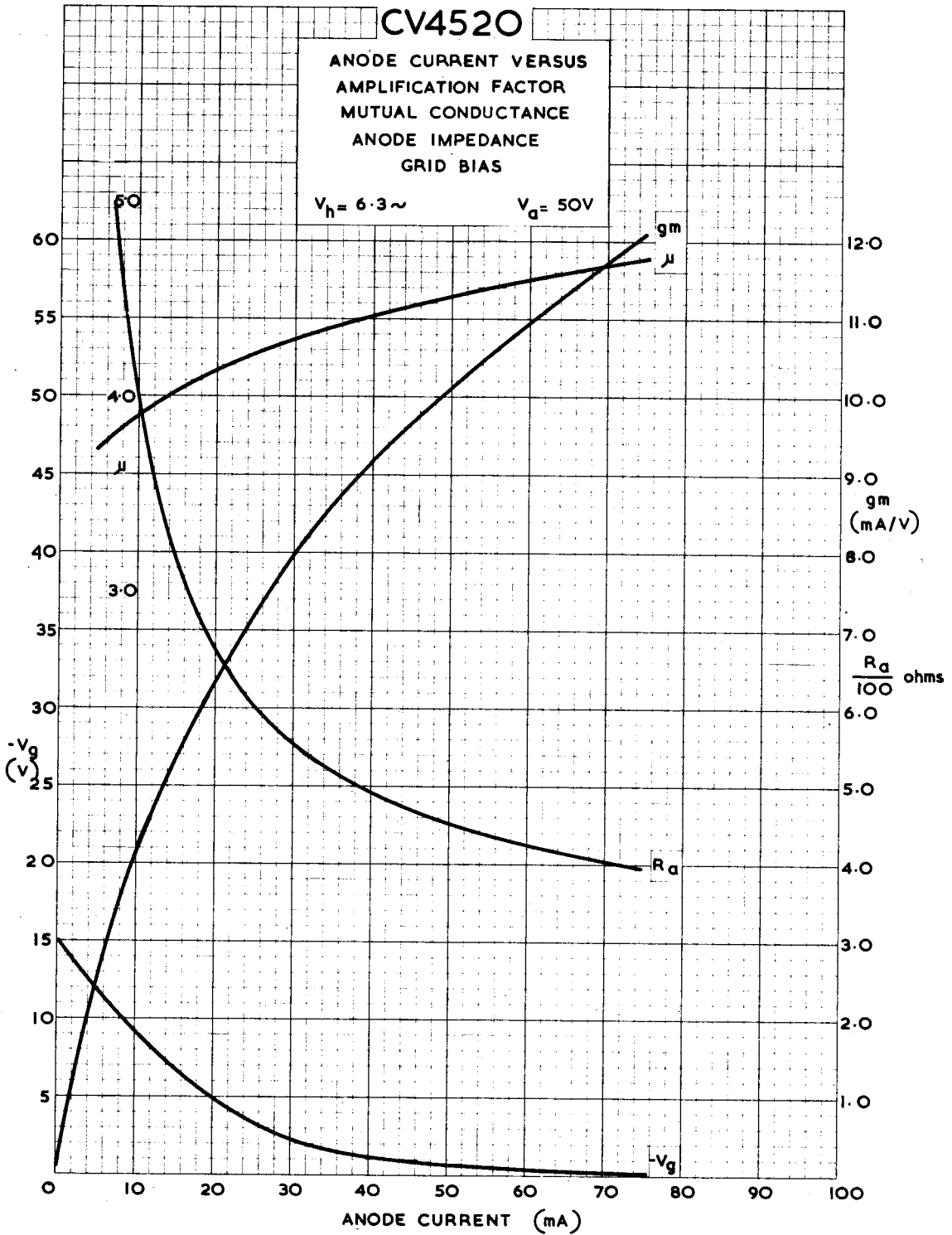


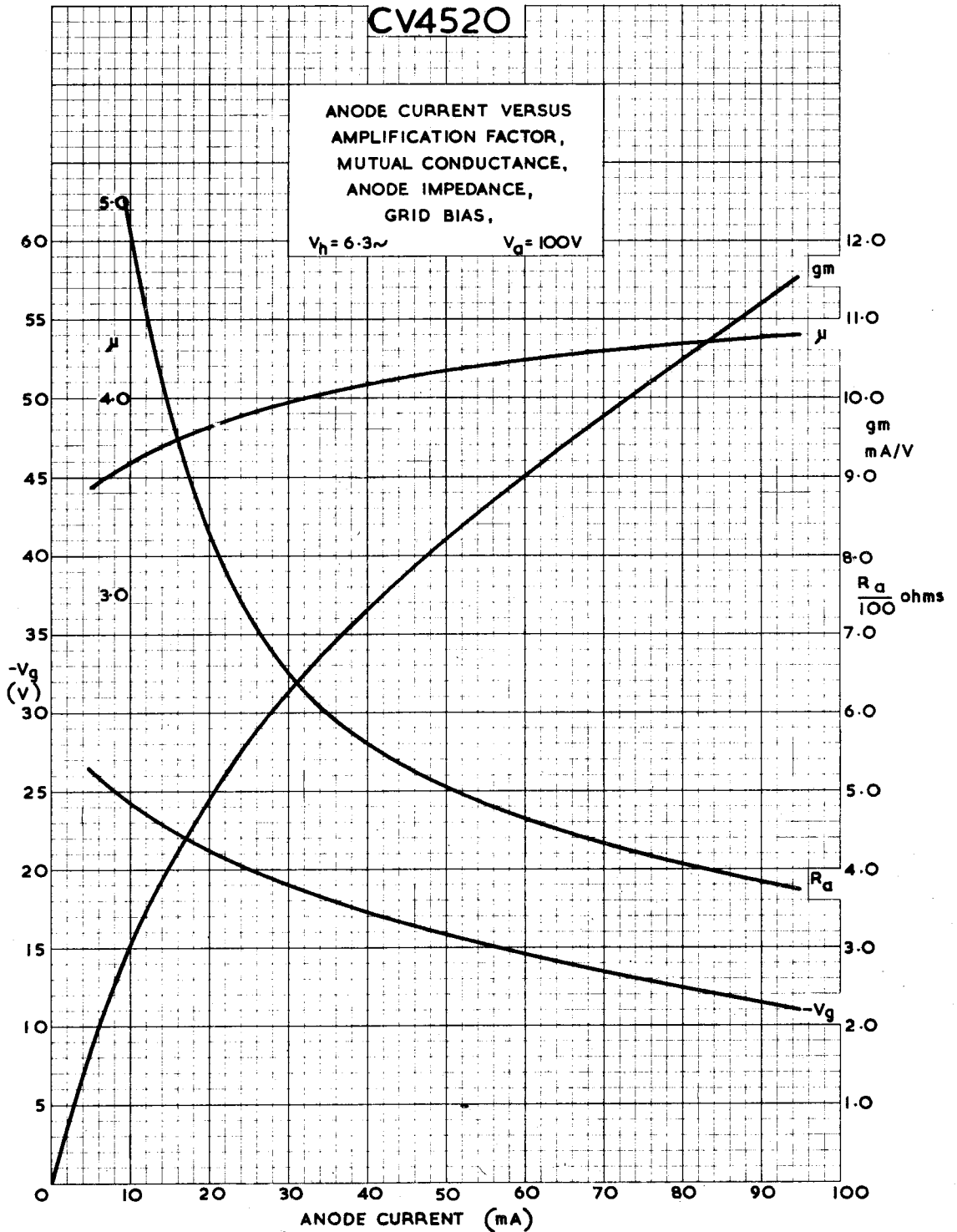


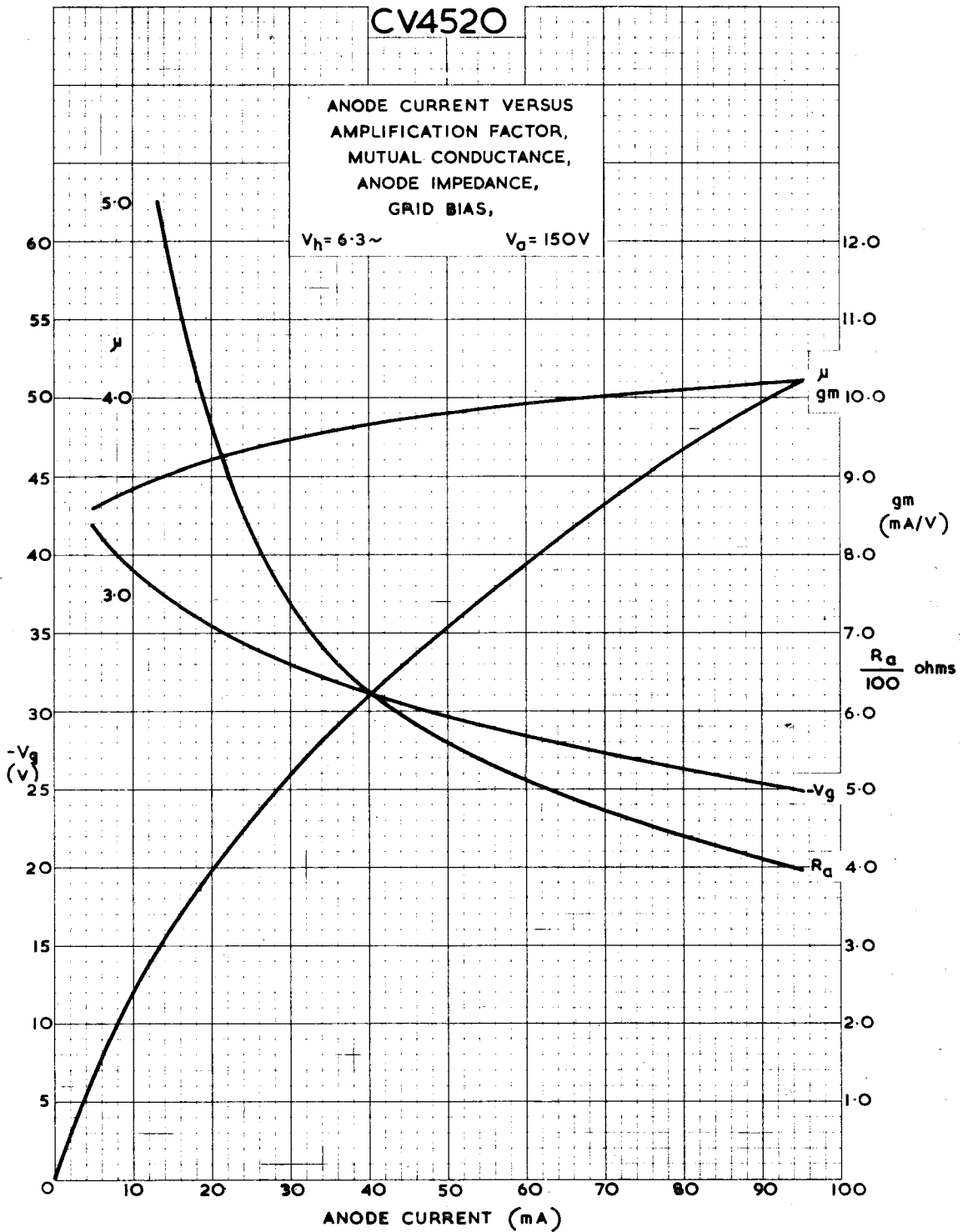




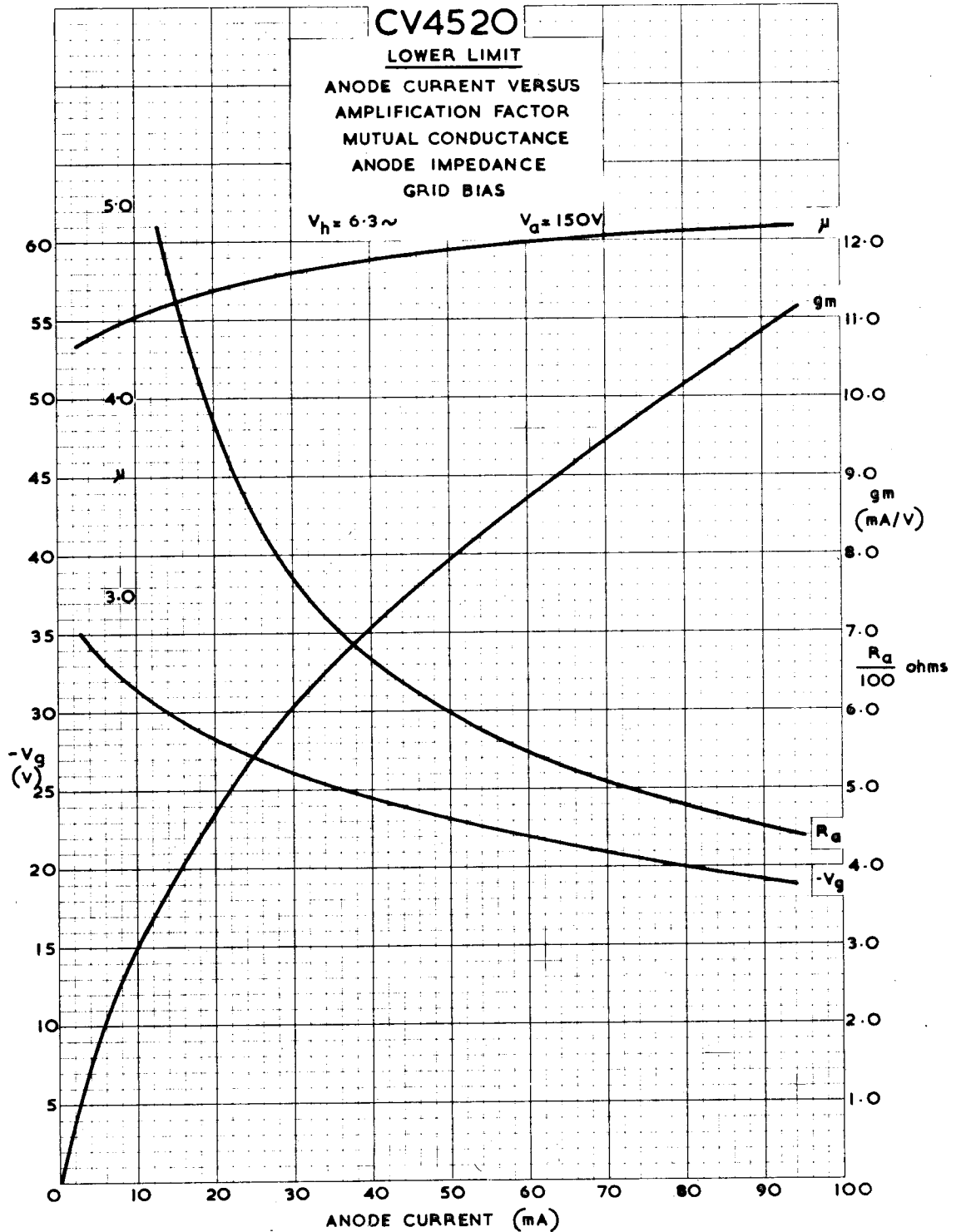


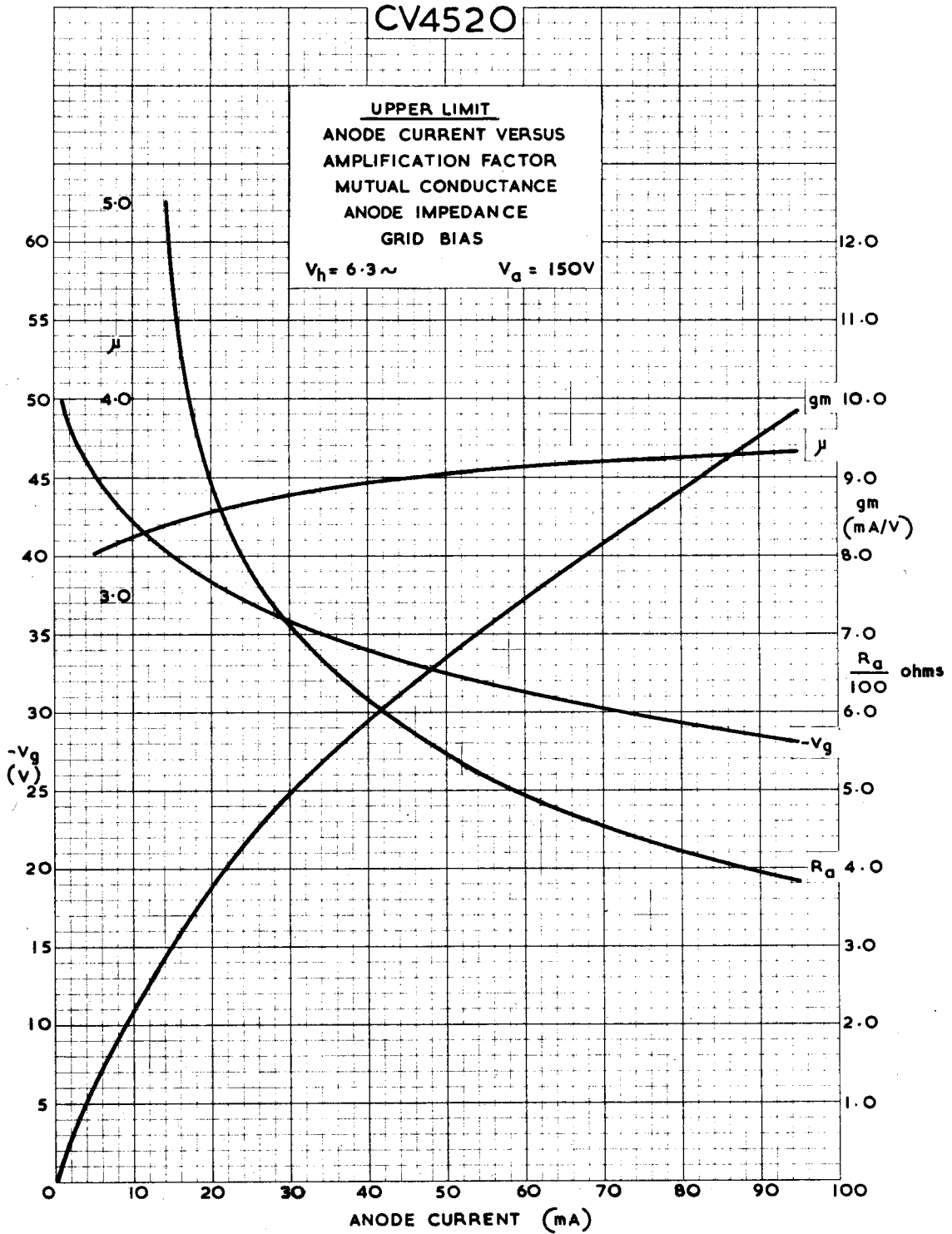


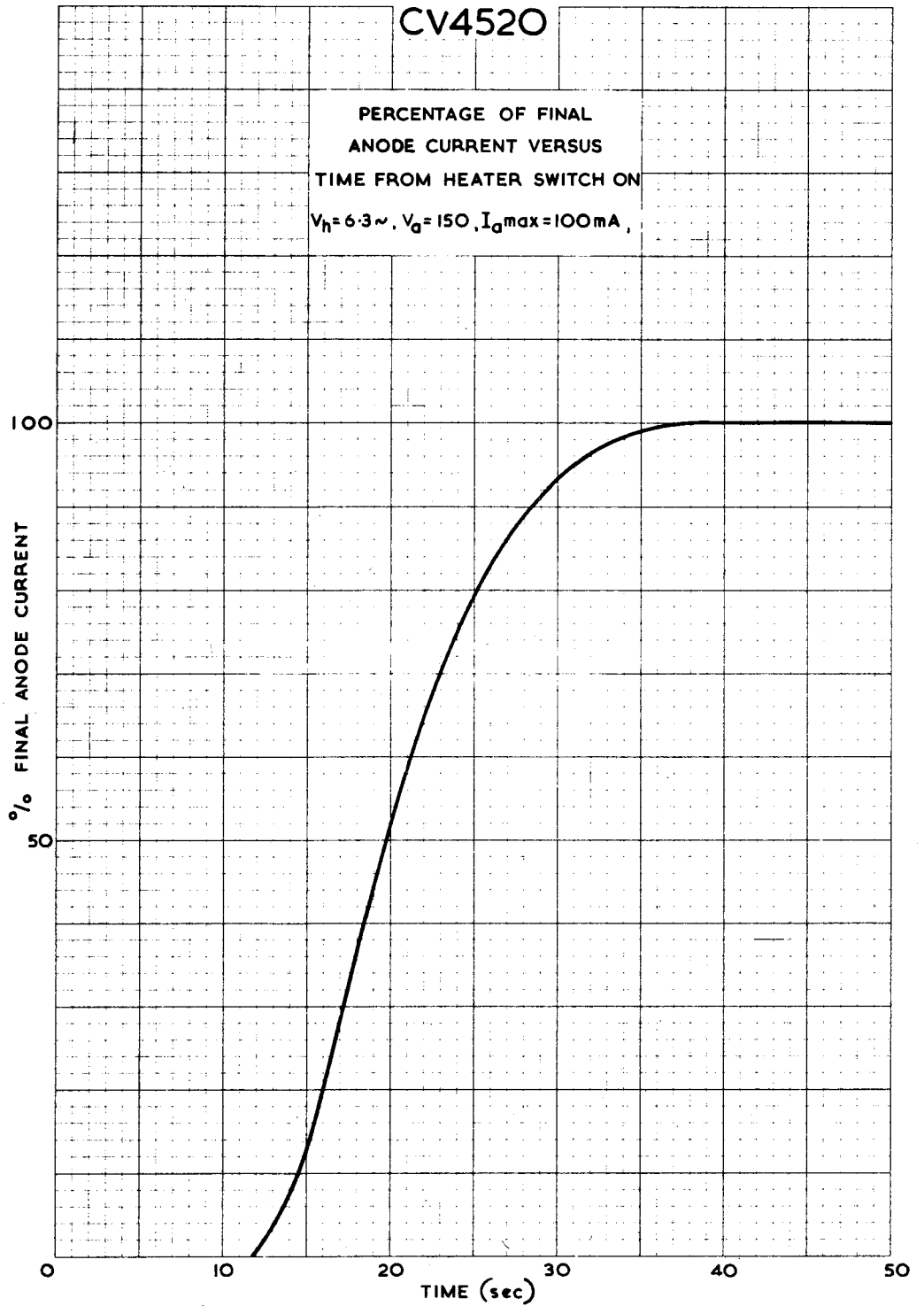




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MAXIMUM VALUE OF GRID-TO-CATHODE RESISTOR

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:-

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

$$\text{For Pentodes:- } R_k \text{ eff.} = \frac{I_k \times R_k}{I_a} + \frac{I_{g2} \times R_{g2}}{I_a \times \mu(g_1 - g_2)}$$

Example

CV4502 operating as a voltage amplifier with $V_a(b)=250V$, $R_a=100K$, $R_{g2}=330K$, $R_k=560$. $I_a=2.0mA$, $I_{g2}=0.67mA$, $g_m \text{ working}=3.5mA/V$.

$$\begin{aligned} \text{Then } R_k \text{ eff.} &= \frac{2.67 \times 560}{2.0} + \left(\frac{0.67}{2.0} \times \frac{330,000}{28} \right) \\ &= 4715 \text{ ohms.} \end{aligned}$$

From the curves for these values of $R_k \text{ eff.}$ and $g_m \text{ working}$:-

$$\frac{R_{g1} \text{ (maximum)}}{R_{g1} \text{ (max) (fixed bias published)}} \times \frac{g_m \text{ (working)}}{g_m \text{ (published)}} = 16$$

$$\text{Therefore } R_{g1} \text{ maximum} = 16 \times 0.25 \times 10^6 \times \frac{5.2}{3.5} = 6M.$$

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:-

$$\frac{R_{g1} \text{ (maximum)}}{R_{g1} \text{ (max) (fixed bias published)}} = \frac{g_m \text{ (published)}}{g_m \text{ (w: eff.)}}$$

where the effective working mutual conductance $g_m \text{ (w: eff.)}$ 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.

