PHILIPS

LABORATORY REPORT

ELECTRON TUBES
SEMICONDUCTORS
COMPONENTS
MATERIALS
AND THEIR APPLICATIONS

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Author : J. de Vries.
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group Electronic Application
author J. de Vries

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summary

Results of measurements concerning the variation of the output voltage of two transistorised stabilization circuits as a function of the output power and the input voltage are given.

The circuits are intended to keep the supply voltage of battery operated tiny vision receivers on a constant level of 11 volts during the discharge of the battery.

It is assumed that the battery voltage decreases from 15 volts to 11.5 volts during the discharge.

The circuits can handle output powers of 10 watts and 20 watts respectively.

Under the most unfavourable conditions approximately 6 % variation of the output voltage occurs.

A.C. Kleisma

Measurements on transistorised stabiliz ion circuits.

The voltage of a battery being in use, decreases during life.

To prevent changing of the operating conditions of a transistorised t.v. receiver, fed by a battery, the supply voltage must be stabilized.

Figure 1 shows a stabilization circuit, designed for an output of 11 V - 10 W.
The output power of this circuit is limited by Ic max. = 1 Amp. of the medium power transistor AD 139.

The series regulator transistor AD 139, the d.c. amplifier transistor A.C. 127 and the reference voltage source zenerdiode OAZ 208 were together mounted on a heat sink of 100 cm2.

The adjustment of the stabilization circuit is based on the following conditions :
a t.v. receiver has a supply voltage of 11 V.
the e.h.t. is 11 kV at an average beam current of 100/uA.
r.i. of the e.h.t. source is 10 MΩ and the battery voltage Vi. = 12 V.

The minimum power consumption of the t.v. receiver is at zero beam current. In this case the e.h.t. is 12 kV, and there is no power supply of the e.h.t. source.

The maximum power consumption of the t.v. receiver is at the maximum beam current of 250/uA.
In that case the e.h.t. is 9,5 kV and the power supply of the e.h.t. source if 3 W.

With an efficiency of about 75 % the variation of the power consumption of the t.v. receiver will approximately be 4 W.

Since the maximum power supply of the stabilization circuit is limited by Ic max. = 1 A of the regulator transistor AD 139 to approximately 10 W, the minimum power supply is 6 W.

At the assumed e.h.t. of 11 kV at a beam current of 100/uA, the power supply of the e.h.t. source is 1,2 W.
With an efficiency of 75 % the power consumption of the e.h.t. source will be 1,6 W. In this case the total power consumption of the t.v. receiver is 6 W + 1,6 W = 7,6 W. (point D in figures 3A and 3B).

Figures 3A and 3B show the output voltage (Vu) of the stabilization circuit versus the power consumption (Wu) of the t.v. receiver. The curves were measured at a battery voltage (Vi) of 15 V, 12 V and 11,5 V (curves A, B, and C respectively).

In figure 3A the stabilization circuit was adjusted referring to the foregoing calculation (point D) at an ambient temperature of 25°C. (curves A, B and C) and than, without changing the adjustments, also measured at an ambient temperature of 45° C. (curves A', B' and C').

In figure 3B the stabilization circuit was adjusted at an ambient temperature of 45°C. (curves A, B and C).
Without changing the adjustment, the curves are also taken at an ambient temperature of 25°C (curves A', B' and C').

From figure 3A it can be seen, that at an ambient temperature of 25°C, the maximum variation of the output voltage of the stabilization circuit is only 3,5 % at a certain average beam current.
For a beam current range from 0 - 250 uA, the variation of the output voltage is 5,3 %. At an ambient temperature of 45°C, the voltage variations are somewhat higher, namely 4,75 % and 6,2 % respectively.

The variations of the output voltage at constant beam current, evaluated above are the result of the decreasing battery voltage (Vi) during its life-time.

From figure 3B it can be seen that at an ambient temperature of 45°C, the maximum variation of the output voltage of the stabilization circuit is only 3,7 %, at a certain beam current adjustment.
For a beam current range from 0 - 250 uA, the output voltage variation is 5,6 %. At 25°C ambient temperature, the voltage variations of the stabilization circuit are somewhat smaller, namely 2,2 % and 4,25 % respectively.

Figure 2 shows a stabilization circuit designed for power consumption of a t.v. receiver up to 22,5 W.
The maximum power supply of this circuit is limited by $W_{max.}$ = 280 m. W. of the amplifier transistor AC 127.

In order to increase the maximum power supply of this circuit, without exceeding W max. of the AC 127, a limiting resistor of 56Ω is inserted in the collector lead of this transistor.

The maximum permissible dissipation of the AC 127 is now reached at a power supply of 22,5 W at V battery = 15 V and of 24 W at V battery = 11,5 V.

Concerning the adjustment of this stabilization circuit, calculations can be made analogous to those of the circuit of figure 1.

Suppose a t.v. receiver has a maximum power consumption of 15 W.
The minimum power consumption of this receiver, due to the various beam current adjustments up to 250 µA will be 15 W - 4 W = 11 W.

At a beam current of 100 µA, the total power consumption of the t.v. receiver will here also be 1,6 W above minimum power consumption and is 12,6 W. (point D in figures 4A and 4B).

The same measurements as carried out on the 10 W stabilization circuit were made.
Figure 4A shows the curves, measured after adjustment of the circuit at an ambient temperature of 25°C. (For V battery (Vi) is 15 V, 12 V and 11,5 V see curves A, B and C respectively).
At 45°C ambient temperature, and unchanged adjustment of the circuit, the curves A', B' and C' apply.

At 25°C ambient temperature the maximum variation of the supply voltage at a certain beam current is 3 % and at beam current variations from 0 - 250 µA the maximum variations of the supply voltage are 3,75 %.

At an ambient temperature of 45°C the supply voltage variations increase to 3,75 % and 4,5 % respectively.

The curves in figure 4B were measured after adjustment of the circuit at an ambient temperature of 45°C (curves A, B and C for V battery is 15 V, 12 V and 11,5 V respectively).
Without changing the adjustment of the circuit, curves A', B' and C' apply at 25°C ambient temperature.

Maximum variations of the supply voltage at a certain beam current are 3,5 % during life-time of the battery and 4,3 % at various beam current adjustments.

At 25°C ambient temperature the supply voltage variation decreases to 3 % and 3,8 % respectively.

Conclusions :

The variation of the output voltage of the 10 W. stabilization circuit, owing to power consumption variations and/or obsolescence of the battery are given in the table below :

The circuit adjusted and measured at T ambient (the percentages between brackets are measured, without changing the adjustment at	25°C (45°C)	45°C (25°C)
Wu constant and battery variation maximum	3.5 % (4.35 %)	3.7 % (2.15 %)
Wu variation maximum and V battery constant (12 V)	2.5 % (2.35 %)	2.55 % (2.75 %)
Wu variation maximum and battery variation maximum	5.3 % (6.1 %)	5.6 % (4.15 %

The variation of the output voltage of the 20 W stabilization circuit, with a maximum load up to 15 W are

Wu constant and battery variation maximum	2.85 % (3.75 %)	3.5 % (2.95 %)
Wu variation maximum and V battery constant (12 V)	1.2 % (1.1 %)	1.15 % (1.3 %
Wu variation maximum and battery variation maximum	3.75 % (4.5 %)	4.35 % (3.85 %)

J. de Vries

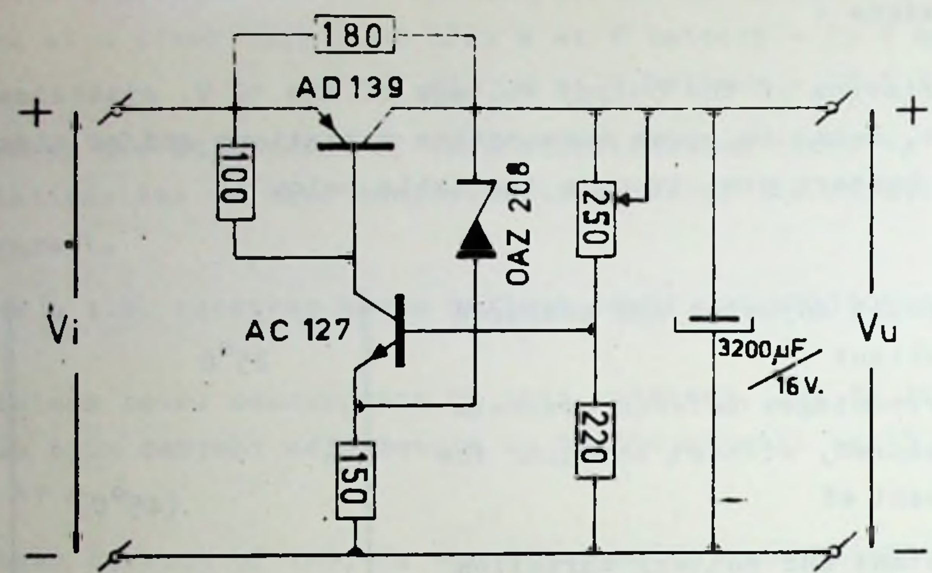

180
AD139
100
OAZ 208
250
AC 127
Vi
Vu
3200µF
16 V.
220
150
+
−

Fig. 1

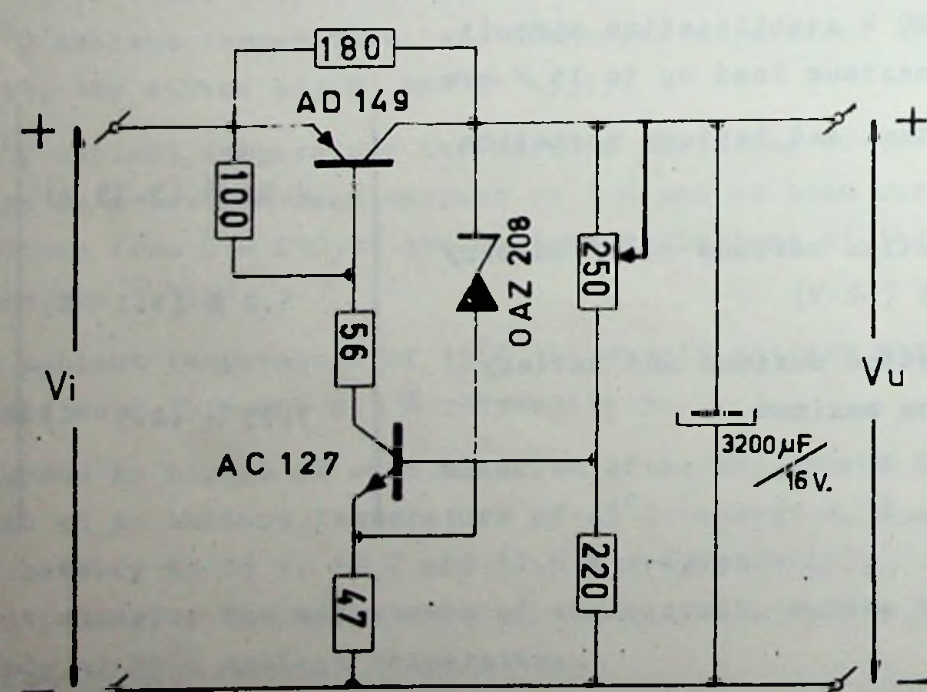
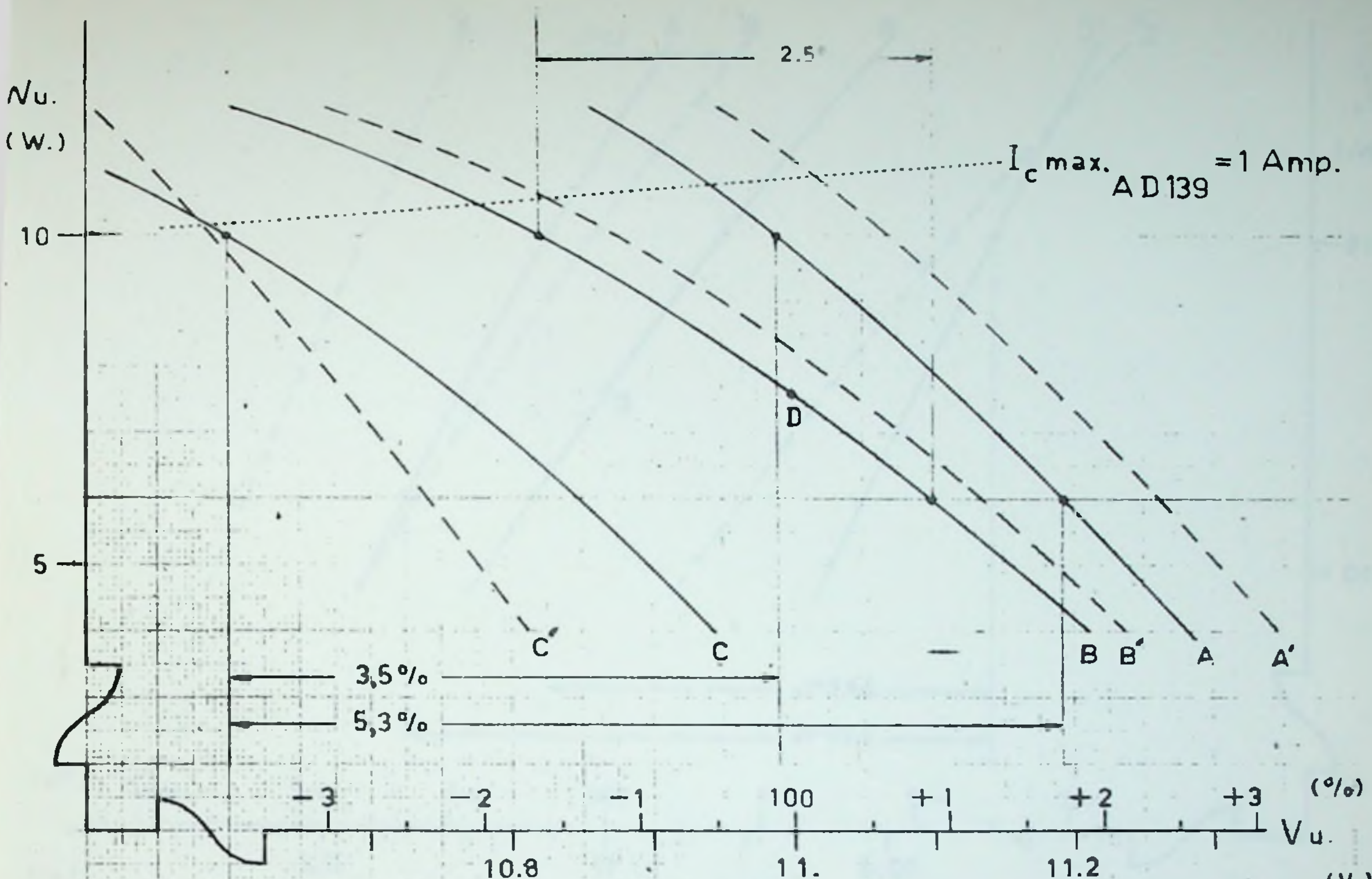
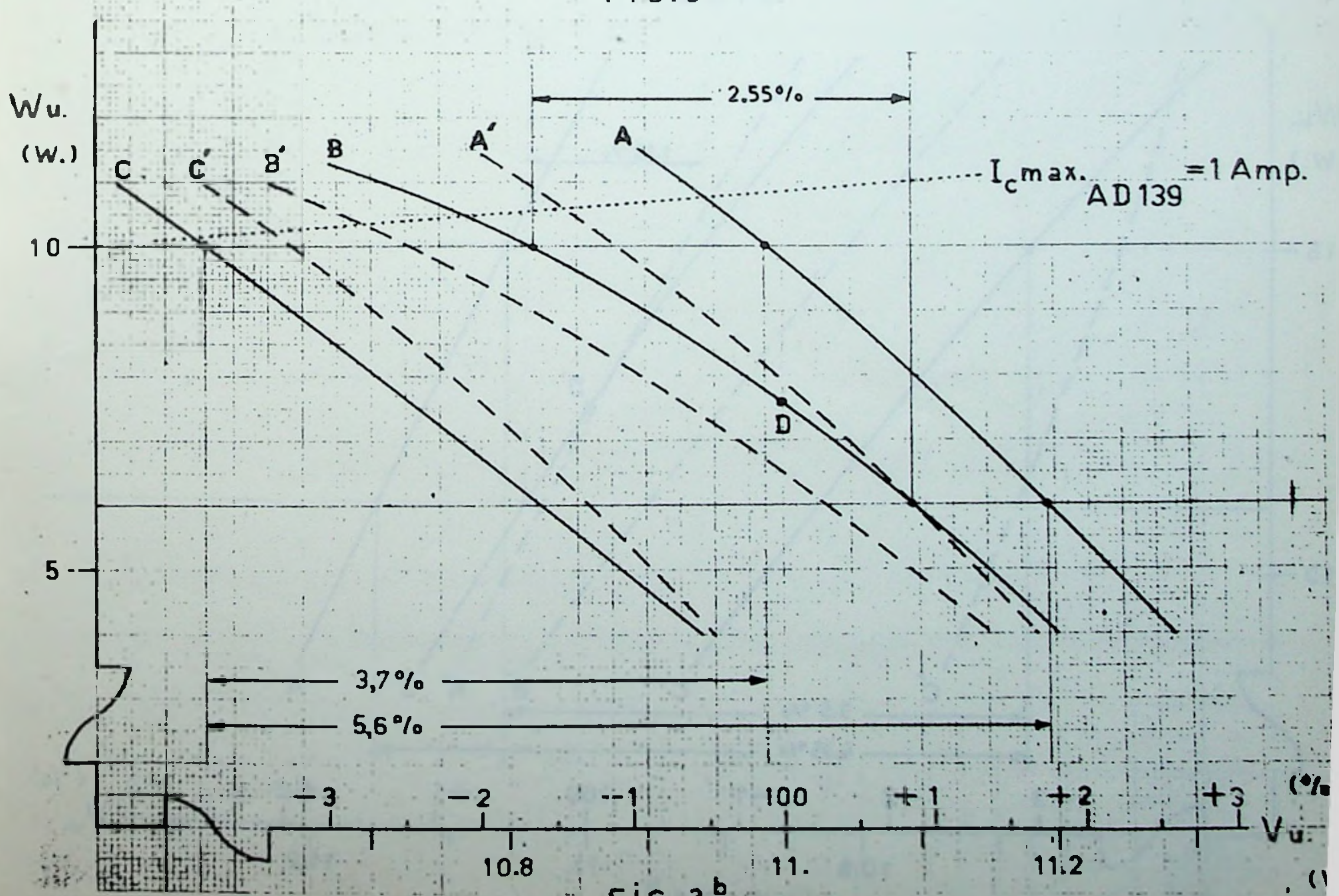

180
AD 149
100
OAZ 208
250
56
Vi
Vu
AC 127
3200µF
16 V.
220
47
+
−

Fig.2



Nu.
(W.)
10
5
2.5
I_c max. AD139 = 1 Amp.
D
C'
C
B
B'
A
A'
3,5 %
5,3 %
−3
−2
−1
100
+1
+2
+3
(%)
Vu.
10.8
11.
11.2
(V.)

FIG. 3 a



Wu.
(W.)
10
5
2.55%
I_c max. AD139 = 1 Amp.
C
C'
B'
B
A'
A
D
3,7 %
5,6 %
−3
−2
−1
100
+1
+2
+3
Vu.
10.8
11.
11.2

FIG. 3 b

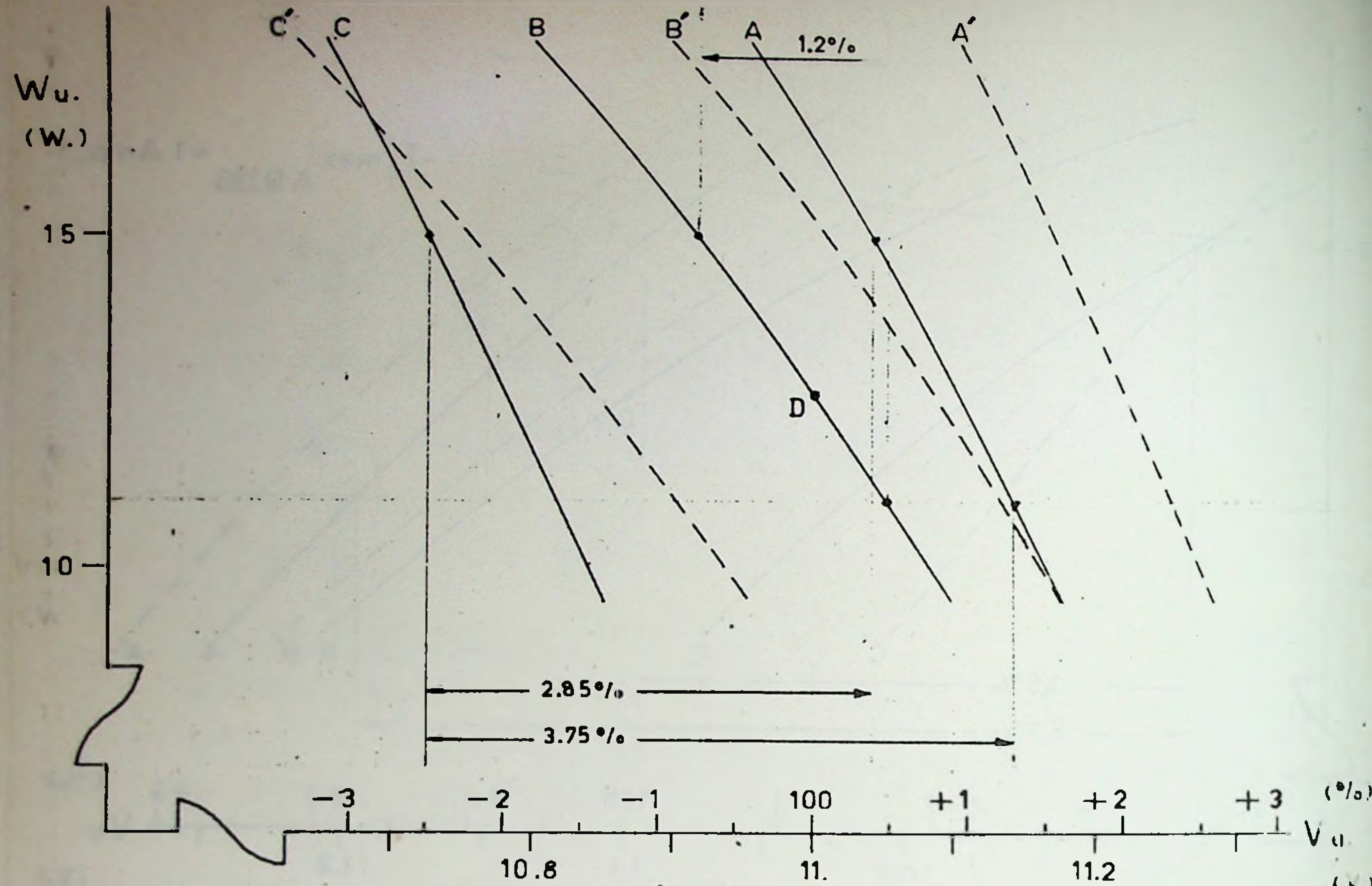

C'
C
B
B'
A
A'
1.2°/o
Wu.
(W.)
15
10
D
2.85°/o
3.75°/o
−3
−2
−1
100
+1
+2
+3
(°/o)
Vu
10.8
11.
11.2
(V)

FIG. 4a

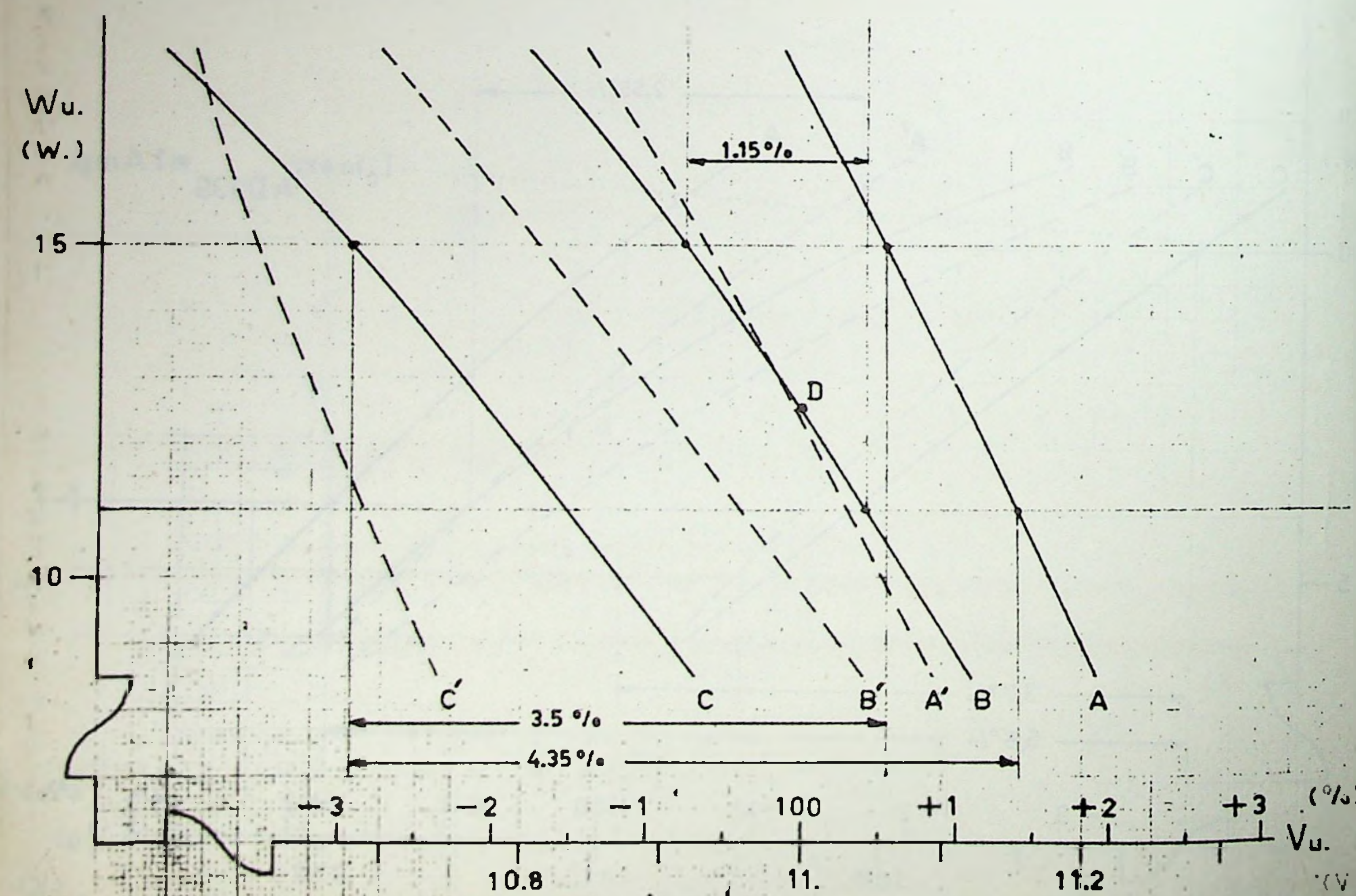

Wu.
(W.)
1.15°/o
15
10
D
C'
C
B'
A'
B
A
3.5°/o
4.35°/o
−3
−2
−1
100
+1
+2
+3
(°/o)
Vu.
10.8
11.
11.2
(V)

FIG. 4b