Von C.

TELEVISION RECEIVER DEPARTMENT

ADVANCED ENGINEERING PROJECTS OPERATION

Materials & Processes Development Engineering

Cathode & Getter Development Engineering

THE IONIZATION GAUGE CALIBRATION OF COLOR GUNS

by: O. Nalin

SUMMARY - The ionization gauge calibration of color guns, using Building 15 method, has been made over the pressure range of 1×10^{-7} to 3×10^{-3} Torr.

The response is linear from 2×10^{-6} to 1×10^{-3} Torr. The gauge sensitivity constant is 5.

June 11, 1965

cc: G. L. Case
P. P. Coppola
G. W. Hees
L. E. Huyler
L. C. Kunz
P. J. Librizzi
E. M. Krackhardt
B. J. Smith

THE IONIZATION GAUGE CALIBRATION OF COLOR GUNS

OBJECTIVE - Color Gun Calibration for Gas Ratio

Calibration of the color tri-gun for gas ratio was accomplished by using an ultrahigh vacuum system, baked out at 400°C, which included a production color tri-gun assembly, a Veeco pressure gauge, a Shulz-Phelps pressure gauge, a gas reservoir with a palladium diaphragm attached, and hydrogen gas.

The system was baked at 400°C for two hours, and the cathodes activated and aged according to the current (low grid) color production schedules. After cathode processing, an equilibrium pressure of about 10^{-8} was attained, with the cathodes cold and of about 10^{-7} with the cathodes hot. Hydrogen was then introduced into the reservoir through the palladium diaphragm to maintain desired levels of pressure.

"Gas Ratio" readings versus hydrogen pressure were recorded and are plotted in Graph 1 for low and high pressures of hydrogen. The data was obtained, using the Building 15 method, from the center (green) gun operating at 500 µA cathode current with 370 V on G_2 and -22.5 V on both the focus (G_4) and the anode (G_3 - G_5) electrodes. The red and blue guns were biased to cutoff Curve A gives the high pressure data (Shulz-Phelps readings), and curve B the lower pressure data (Veeco readings).

The position departure of the "gas ratio" from a straight line at the high pressure end of curve A is due to each electron producing slightly more than one ionizing collision due to the decreased mean free path.

At the lower end of curve B, there is a negative departure from the straigh line caused by leakage phenomena due to the large surface area of the gun focus and anode electrodes.

The Color Engineering group gas test circuit was used for "gas ratio" readings (schematic diagram attached).

Other electrode connection configurations were also evaluated during this work:

1. G_2 as electron collector, G_4 (focus) as ion collector, G_3 and G_5 floating (per original request).

   Results: No measurable ion current. Ion collector too far from the ionization region and shielded by G_3.

2. G_1 as electron collector, G_2 as ion collector.

   Results: Non-linear, due to G_1 outgassing, and impractical, due to difficulty of maintaining constant cathode current.

3. Color Engineering group "gas ratio" equipment and method: G_2 biased at 300 V, G_1 adjusted to cause 500 µA I_k to flow into G_2 , with the anode (G_3 - G_5) floating. When the "gas ratio" button is depressed, 300 V is applied also to the anode which causes the emitted current to switch from G_2 into G_3 - G_5. The focus (G_4) electrode is the ion collector and is biased at -22.5 V.

Results: Although this method may yield lower ultimate pressures due to the smaller focus electrode (ion collector) surface area and somewhat better sensitivity since gas ionization occurs nearer G_4, it is rather unreliable due to increase in pressure caused by outgassing of the anode electrodes under electron bombardment.

Also, after the button has been depressed, an approximate 20% increase of cathode current is experienced due to the increase of field penetration, which requires readjustment of grid one bias.

Pressure and gas ratio are linearly proportional,

$$P_{Torr} = K \cdot GR$$

where K is a constant which depends upon the primary ionizing current and the gun geometry. For the green gun operating at 500 μA, this constant is

$$K = \frac{1 \times 10^{-4}}{0.48} = 2.1 \times 10^{-4}$$

The relationship between gas pressure, positive ion current and gauge sensitivity is given by

$$\frac{I+}{I-} = S \cdot P$$

where S is the sensitivity constant.

On the gas ratio equipment used, full scale deflection current for a 0.1 gas ratio (2×10^{-5} Torr) is 5×10^{-8} A.

$$\frac{5 \times 10^{-8}}{5 \times 10^{-4}} = S \cdot 2 \times 10^{-4}$$

$$\therefore \quad S = 5$$

For all practical purposes, the color gun "gas ratio" measuring method presently used by the Color Productinn group of Building 15 is considered satisfactory. However, because of errors at both low and high pressures, its response is linear in the range 0.02 - 6.0 (4×10^{-6} to 1×10^{-3} Torr).

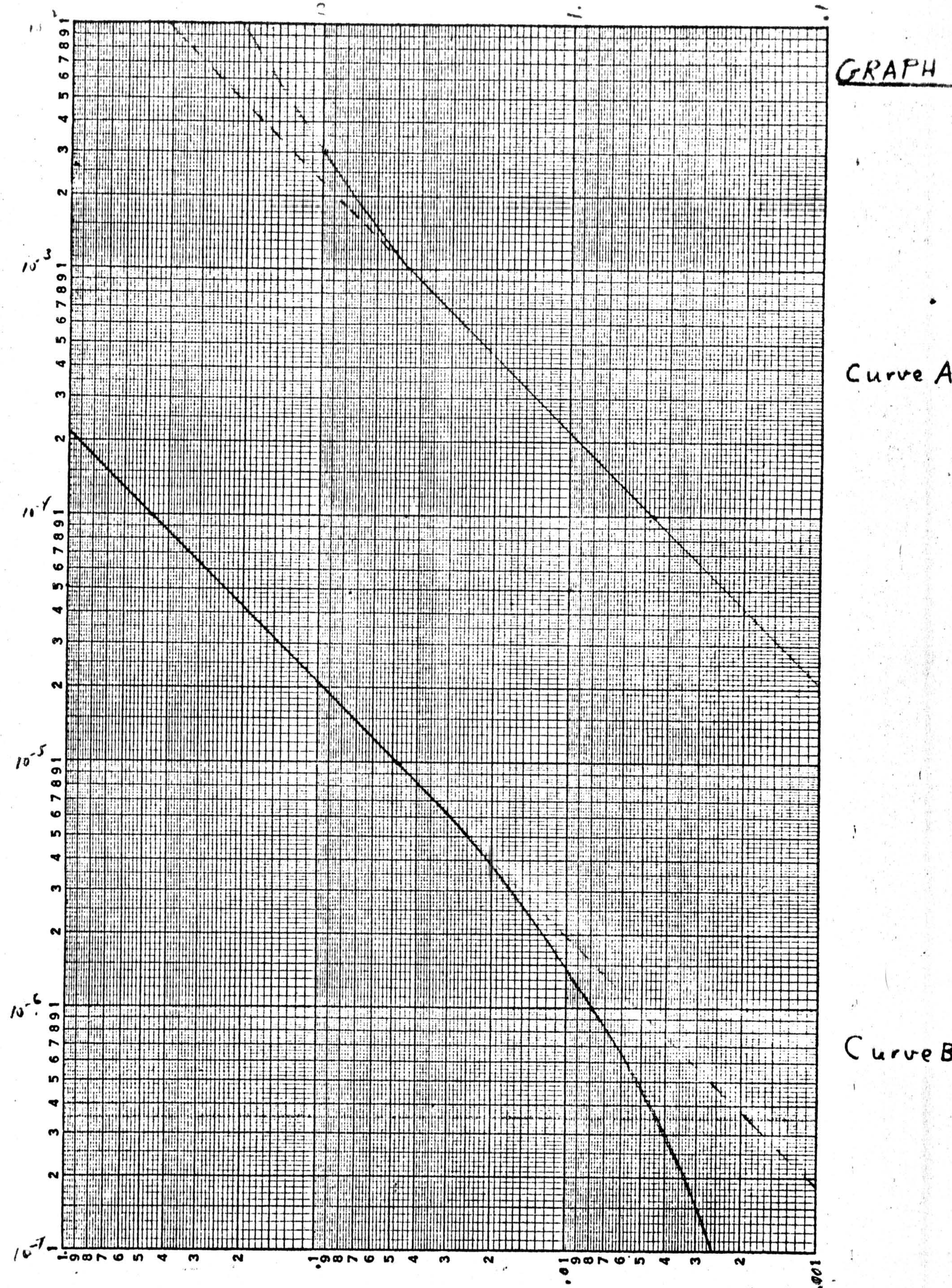
O. NALIN

ON:am

APPROVED BY: G. W. Hees

GAS RATIO (0.1 to 100.0 scale, curve A)

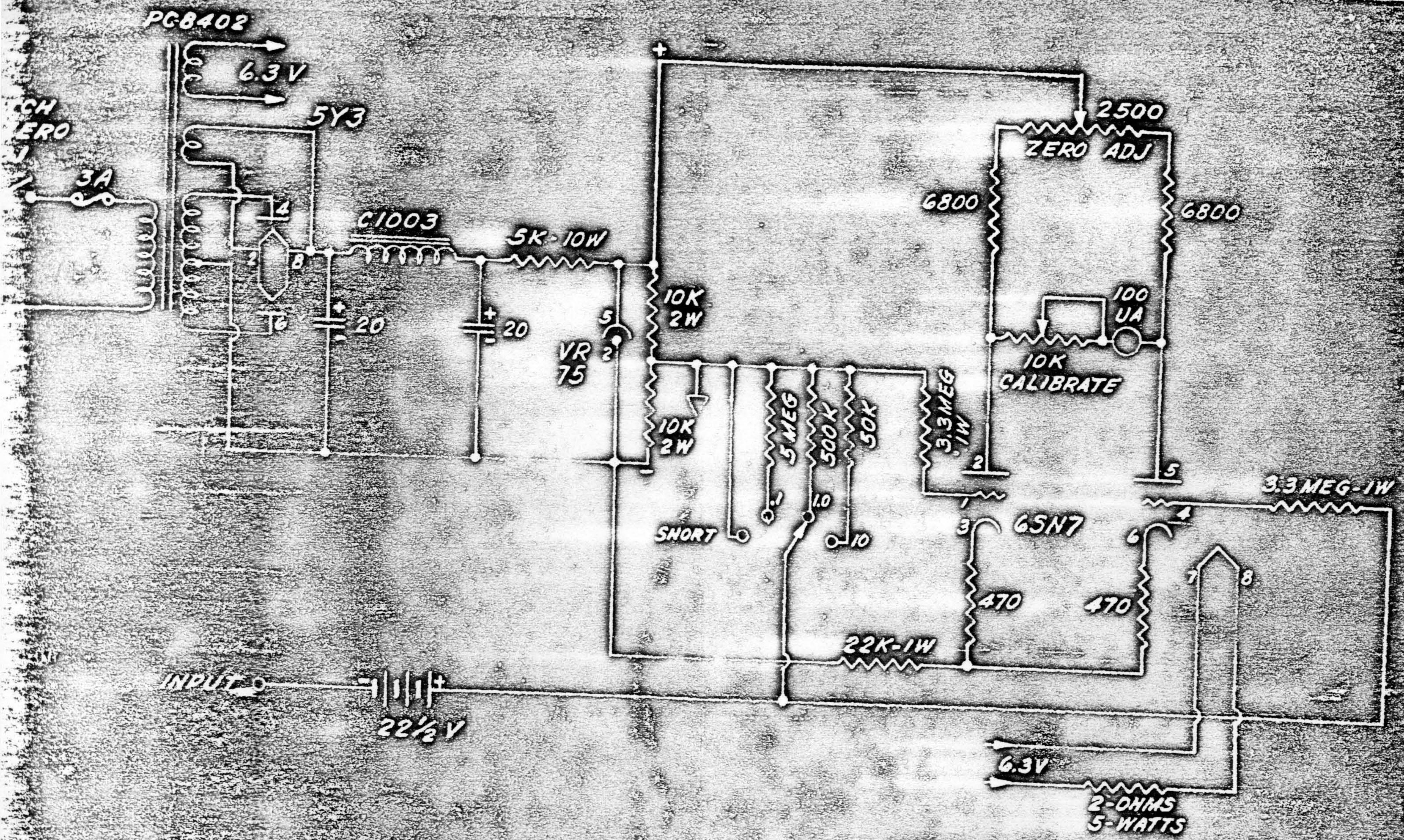
GRAPH



K&E LOGARITHMIC 358-125 KEUFFEL & ESSER CO. MADE IN U.S.A. 3 X 5 CYCLES

GAS RATIO (.001 to 1.0 scale, curve B)

E_{G_2} = 370V I_k = 500μa E_{F3C} + AVOUT = -22.5V E_f = 4.8V



COLOR PRODUCTION SE

GAS TEST MICROAMMETER

H. DeRYDER

FEB. 9, 195