DU MONT

VOL. 5, NO. 11 & 12 JAN. - FEB., 1943

OSCILLOGRAPHER

NOTES ON REPLACING DU MONT GAS TRIODE TUBES

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Considerable confusion has existed with regard to the gas triode or thyratron tubes used for sweep oscillator service in Du Mont cathode-ray oscillographs. As a measure which would provide greater assurance that Du Mont oscillographs would operate at peak performance when the tube complement was replaced, the Du Mont Laboratories registered their gas triodes with the Radio Manufacturers Association under the type numbers 6Q5G and 2B4.

The Du Mont Type 6Q5G was formerly known as the Du Mont Type 884. The Type 2B4 was formerly known as the Du Mont Type 885. The operating characteristics of the Type 6Q5G are not the same as those of tubes produced by other manufacturers under the 884 type number, and the same holds true for the Type 2B4. A brief outline of the essential differences follows.

The Type 2B4 is identical to the Type 6Q5G except for heater voltage (2B4 — 2.5 volts, 6Q5G — 6.3 volts), heater current (2B4 — 1.4 amp., 6Q5G — 0.6 amp.), and basing (2B4 — 5A, 6Q5G — 6Q). The Type 885 and 884 of other manufacturers are also identical with the same exceptions. Reference will be made only to the Type 6Q5G and 884 in this article, and it should be understood that all references to the 6Q5G apply equally as well to the 2B4. The same holds true of the 884 and 885 as produced by other manufacturers.

Gas triodes may readily be compared by comparison of their *Average Control Characteristics*. The average control characteristic of a gas triode is a plot of the plate voltage for starting the discharge, versus the negative grid voltage. The control ratio is the slope of this curve. The average control characteristics for the Types 6Q5G and 884 as produced by other manufacturers are shown in Fig. 1.

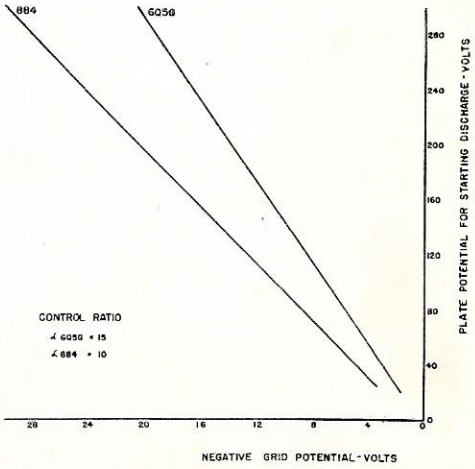


Fig. 1—Average control characteristics for Type 6Q5G and 884 Gas Triodes.

In the region shown on these curves, the equation of the average control characteristic may be written as

$$E_{bk} = \alpha E_g \qquad (1)$$

where E_{bk} = breakdown potential (plate potential for starting the discharge)

α = control ratio

E_g = negative grid potential

From Fig. 1 the following values for α are obtained:

$$\alpha_{6Q5G} = 15$$

$$\alpha_{884} = 10$$

It can be shown that, to a first approximatation, the frequency of oscillation of a gas-triode relaxation oscillator, such as is commonly used in oscillograph sweep circuits, can be expressed as

$$f = \frac{E_{bb}}{RC}\left(\frac{1}{E_{bk} - E_{ex}}\right) \qquad (2)$$

where f = frequency in cycles per second

E_{bb} = plate or battery supply potential in volts

R = total charging resistance in megohms

C = total charging capacitance in microfarads

E_{ex} = Extinction potential in volts.

E_{bk} in equation (2) may be replaced by equation (1), and if the other parameters remain constant:

$$f = k\frac{1}{\alpha}$$

whence $$\frac{f_{884}}{f_{6Q5G}} = \frac{\alpha_{6Q5G}}{\alpha_{884}} = 1.5$$

or $$f_{884} = 1.5\, f_{6Q5G}$$

The correction factor 1.5 does not strictly hold true under conditions of actual practice because of additional factors which are beyond the intended scope of this discussion. This correction factor varies with grid potential and it has been found experimentally that the frequency ratio factor lies between 1.0 and 3.0 within the range of grid potential shown in Figure 1.

Likewise, from equations (1) it can be seen that the output voltage amplitude from a sweep oscillator using a 6Q5G will be approximately 1.5 times the amplitude from an 884 when used in the same conventional circuit since for a given grid potential, the difference between breakdown and extinction plate potentials is greater in the case of the 6Q5G.

In actual practice in Du Mont oscillograph circuits, it will be found that the linearity of the sawtooth oscillator output voltage when using a Type 884 will be poor compared to the 6Q5G as evidenced by a tendency toward nonlinear distortion at the beginning of the sweep resulting in an apparent "packing" of recurrent signal. this is noticeable at the higher sweep frequencies.

The "flyback" or return time or discharge time, of either the 6Q5G or 884 is approximately 5 microseconds at a sweep frequency of 30 kilocycles.

The amplitude of synchronizing signal required for either type of tube is approximately the same.

As a practical matter it will be found that substitution of an 884 in the Du Mont Type 208 Oscillograph will result in a sweep frequency in the lowest frequency range of approximately 2.3 times the minimum obtained with the 6Q5G regardless of charging resistance (fine frequency control). At the high frequency range this ratio will be approximately 2.1 with maximum charging

resistance (minimum fine frequency setting) and 1.0 at minimum charging resistance.

In the case of the new Du Mont Type 224-A instrument the ratio at minimum sweep frequency and maximum charging resistance is 2.1 and at minimum charging resistance 1.55. At the highest frequency range the ratios are 1.9 and 1.0 respectively.

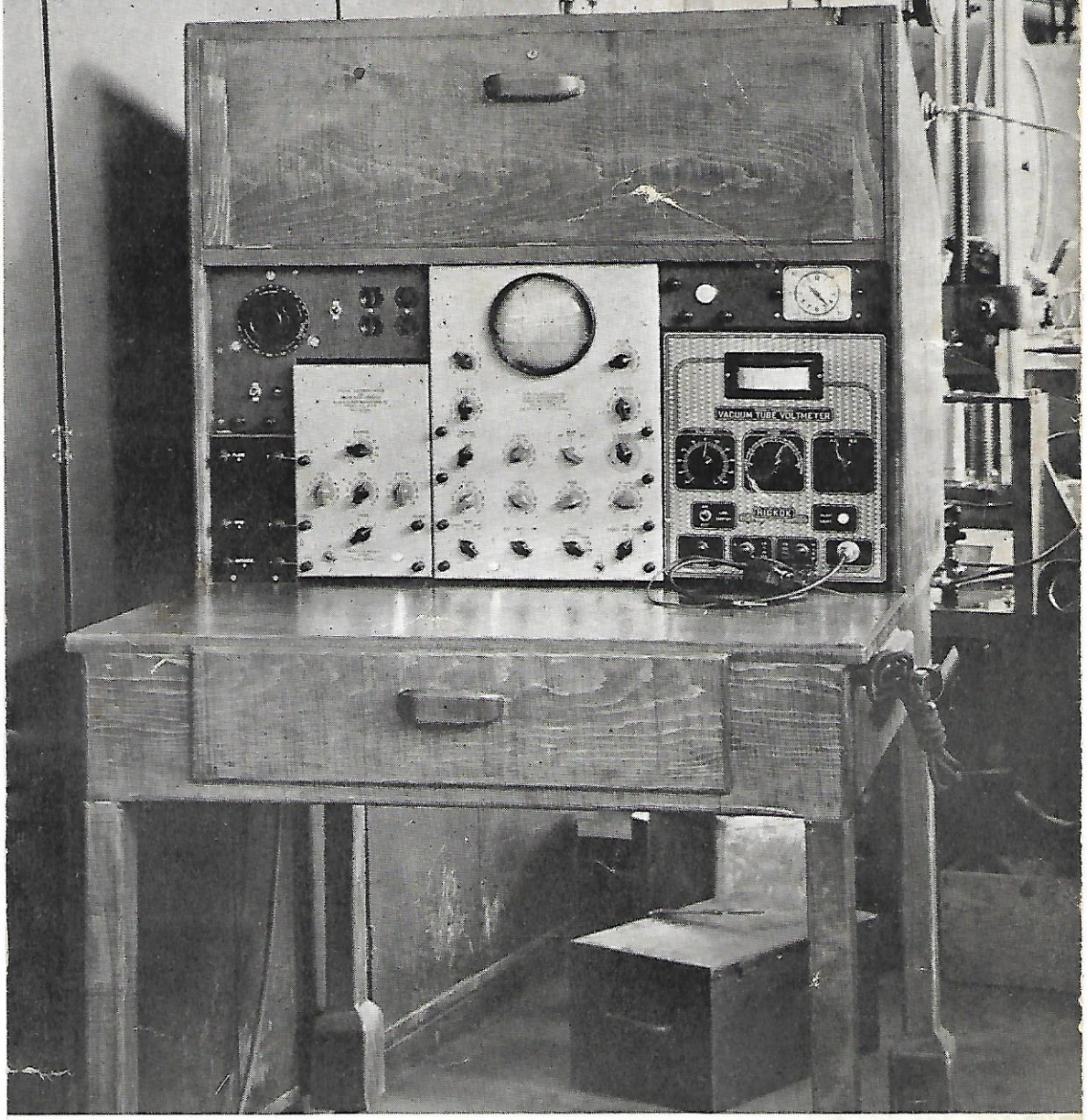
GENERAL SCHEDULING ORDER M-293

Effective May 1, 1943, orders placed for electronic test equipment must be accompanied by a WPB authorization on Form PD 556 under General Scheduling Order M 293. Exceptions to the rule are the Type 185-A Electronic Switch and the Type 215 Low-Frequency Linear-Time-Base Generator. Detailed instructions and a limited number of forms PD556 are available upon request.

Briefly stated, the ultimate purchaser of Du Mont cathode-ray oscillographs must make application in quadruplicate on the prescribed forms for each specific purchase, stating why the instrument is required, what type he wishes to obtain, the purpose for which the equipment is to be used, and when delivery is required, as well as other sundry information. This order *does not apply to cathode-ray tubes.*

Many of the operational details have not yet been officially announced but it is believed that it is not necessary to secure a preferance rating prior to submission of the PD 556 application.

Please do not forward purchase orders unless the approved authorization is attached.



TEST EQUIPMENT BENCH

Above is shown a neat measurement table assembly for use in observing the performance of welding machines and associated rectifiers at Taylor Winfield Corporation, Warren, Ohio Plant.

At the extreme left is seen a dual high voltage multiplier assembly used for connecting grid and anode voltages of a thyratron rectifier to the Du Mont Type 185-A Electronic Switch. The switch feeds into the Du Mont Type 175-A Cathode-ray Oscillograph. To the right of the oscillograph is a vacuum tube voltmeter. Above the multiplier is mounted a Variac, controlled by the switch below it. The output from the Variac is an extremely useful source of calibration voltages. A variety of terminals are provided as sources of various voltages and the locked hinged cabinet above the instruments contains test leads, cables, other accessories and tools. Note the convenient soldering iron bracket mounted on the right side of the table.

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