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BUFFALO TUBE WORKS

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GENERAL ELECTRIC COMPANY
SCHENECTADY, N. Y., U. S. A.

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Title Certain Points of View to be Considered in the Building of a Pulse Peak Emission and Characteristic Set

By

Electronic Tube Engineering Div.

Information prepared for

Tests made by

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Date Nov. 26, 1945

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CERTAIN POINTS OF VIEW TO BE CONSIDERED IN THE BUILDING OF A PULSE PEAK EMISSION & CHARACTERISTIC SET

The major components of the system will be separately discussed. Included are:

A. Positive grid characteristic measurement
   1. Pulser
   2. Power Supply
   3. Energy Storage Capacitors
   4. Grid Voltage Measurement
   5. Grid Current Measurement
   6. Plate & Screen Current Measurement

B. Emission Characteristics
   1. Pulser
   2. Peak Drive Measurement
   3. Current Viewing

Insofar as time permits, drawings will be prepared which illustrate the points mentioned.

A. Positive Grid Characteristic Measurements

1. Pulser

A 4C35 should be used. The ordinary 6SN7 synchronized driver can be used. The pulser plate supply should be capable of delivering 3.0 kv d-c @ 100 ma approximately. With a 50 ohm pulse former (sinusoidal) this will develop about 8.0 kv maximum at the thyratron and approximately 3 kv peak at the load at a peak load current up to about 50 amperes. If it ever becomes necessary to deliver more current at this voltage, decrease the fixed loading.

A 1:1 inverting pulse transformer should be connected in series with the pulse forming circuit. The use of the transformer minimizes stray current effects, improving readings. The secondary should be loaded as shown on sketch #1 attached. The use of the split load resistor permits finer adjustment of drive at low levels (otherwise finest adjustment is limited by the volts per turn of the variac.

2. Plate and Screen Power Supplies

The supplies should be capable of delivering the average current required without a noticeable reduction in voltage from the no-load value. The average current is related to the peak value by

(1) I_b or $I_{c2} = \frac{2}{\pi} I_{peak} \times$ pulse duration

If there is supply regulation, there will be an error in voltage reading. All supplies should be ungrounded.

3. The Energy Storage Capacitors

The plate voltage at the time of maximum plate current must be known. If the energy storage capacitor is large enough, the voltage will not drop off greatly during the pulse. Since $Q = CV$, it is easily shown that

$$(2)\quad C\Delta V = \frac{I_{peak} \times \text{pulse duration}}{2\pi}$$

4. Grid Voltage Measurement

Two alternative methods of measuring drive are feasible: synchroscopic measurement and peak voltmeter measurement. In D.F. # 77876 the synchroscopic measuring method is described. It is not a continuous reading instrument, therefore it is more difficult to adjust for particular conditions. This is particularly true when data for $e_c = e_b$ is desired. (With the synchroscopic method it is necessary to guess at $e_b = E_{bb} - E_{ib}$, set e_c, readjust e_b, check e_c, then read.)

A combination circuit is recommended, consisting of a synchroscope connection and a peak reading voltmeter. For low values of e_c the synchroscope should be used because it does not load the system. At low voltages, assuming scales are switched by changing the meter multiplier, the peak meter may load the system unnecessarily. In any event it would be well to observe grid drive pulse shape so that phase shifts can be noted (an indication of trouble). The recommended circuit is shown in sketch #2. An advantage of this system is that it reads e_c directly without separate measurement of bias.

5. Grid Current Measurement

D.F. #77876 discusses the method recommended. Synchroscopic measurement should be used to separate positive and negative currents, enabling reading of data at the proper phase.

6. Plate and Screen Current Measurement

Multigrid tubes can produce very non-sinusoidal current functions if a sinusoidal grid voltage pulse is applied. Therefore, it is necessary to be certain that E_{ib} and E_{ic2} are read at the proper phase. Whether or not amplifiers are used, it is well to measure the currents synchroscopically.

When direct viewing, the voltage developed across the viewing resistor may be an appreciable part of the supply voltage. Generally it cannot be neglected. If amplifiers were used, it would be possible to neglect this drop, resulting in direct reading of e_b and e_c. It is recommended that a d-c amplifier be connected to the circuit, see sketch #3. The amplifier need not necessarily be linear, but the actual measurement is done on a comparative basis in the grid circuit of the amplifier.

A revision of the deflecting plates circuit should make it possible to introduce directly viewed signals to one electrode and amplified signals to the other. The amplifier should be made in accordance with accepted video practice. It should be physically located alongside the deflector terminal, reducing reactive loading of the amplifier. No cables or shielding should be used in the output circuit. The grid circuit of the amplifier should be cable connected to the viewing resistor in the conventional way. The amplifier should receive essentially positive pulses and be biased off so that no saturation ever occurs, comparison being in the grid circuit. Comparative circuits for direct and amplified viewing should be independent and switched along with signal circuits (see sketch #1).

The use of current viewing amplifiers is to be recommended whenever e_b = 2000 v or less. Above 2000 v the error introduced by neglecting the viewed voltage is small. However, special care must be exercised in designing viewing resistors to avoid self-inductance in the resistor. In very high current cases direct viewing, with correction for resistor drop, is more accurate.

B. Emission Characteristics

1. Pulser

The 4035 pulser described above should be used to drive a 1R21 pulser when peak drive above 50 amperes is required. The 1R21 should be supplied with 4000 Vdc. It has been used at currents up to 400 amperes, and it is possible to run above this value if the tube is adequately cooled. The 1R21 current will probably be about twice the useful load current. Use a 1:1 inverting transformer.

2. Peak Drive Measurement

The combination of peak voltmeter and synchroscope should be used.

3. Current Viewing

Direct synchroscopic measurement is recommended here. The situation is much like that in the grid circuit of the characteristic set. More accuracy can be obtained.

Procedure for the use of Direct Viewing and Amplifying Circuit

The circuit shown on sketch #3 provides direct viewing and amplified viewing. Two vertical centering controls are supplied, assuming that it will be expedient to switch centering controls along with the signal circuits. The two calibrating controls are not switched though it would be desirable to short out the bias (amplifier calibrator) when direct reading and to switch the present calibrator to "off" when reading with the amplifier.

The synchroscope is centered for each use by the separate centering controls, both calibrating voltages being zero at the time of centering. When a pulse is applied to the amplifier, its magnitude is determined by increasing the bias until the peak of the trace has returned to the centered position. When direct reading use present practice.

P. W. Crapuchettes Nov 26, 1945.

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ENGINEERING
TUBE DIVISION

Countersigned: K C DeWalt
Nov 26, 1945

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TA Elder
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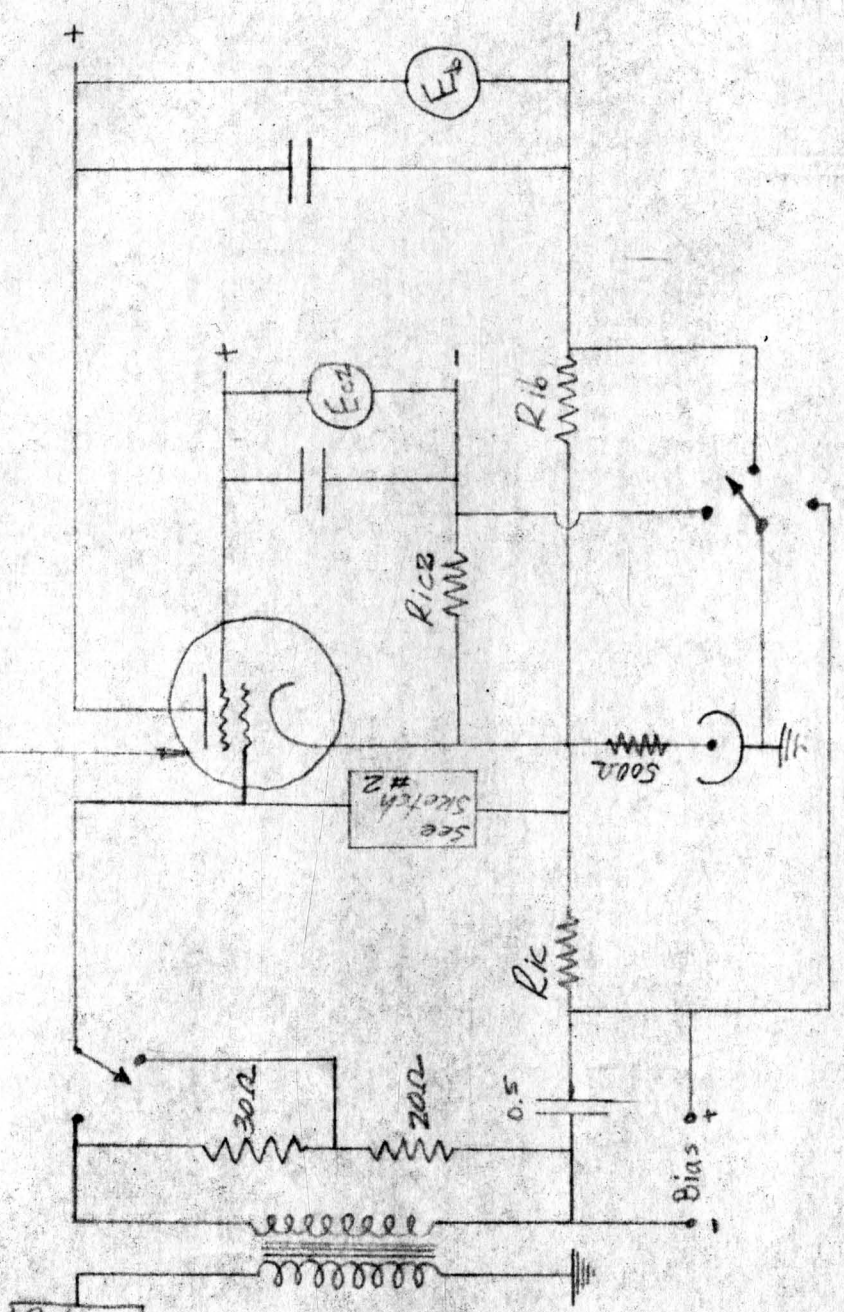
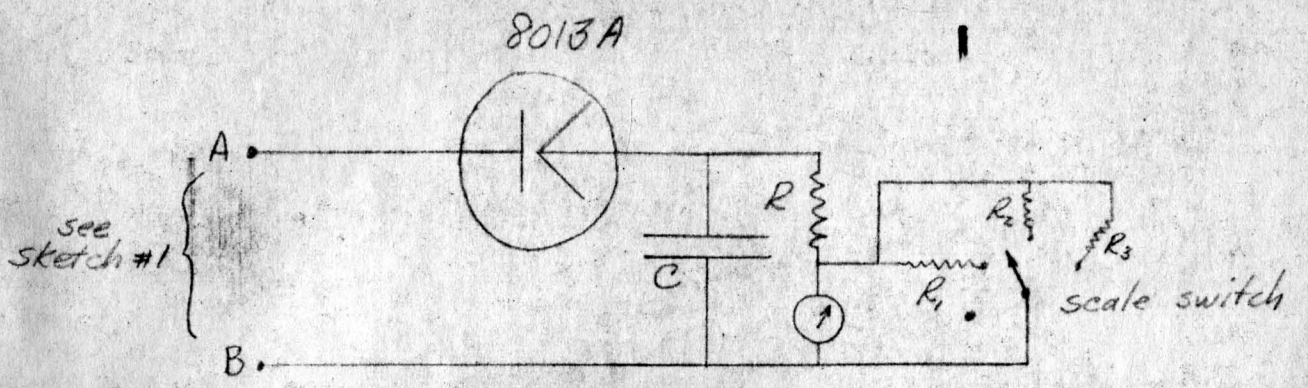
(AC Gable



SCHEMATIC FOR POSITIVE GRID CHARACTERISTIC SET using peak voltmeter for e_c

DF 77879 REVISIONS	MADE BY Phil Coppedette	INSPECTED BY Nov. 23, 1945	PRINTS TO
	GENERAL ELECTRIC WORKS Schenectady	K- SKETCH #1 SHEET NO. ____ CONT. ON SHEET ____	
FF-449-A (1-41)	PRINTED IN U.S.A.		



NOTE 1: This circuit reads actual peak grid volts, including bias.

NOTE 2: RC product should be nearly unity.

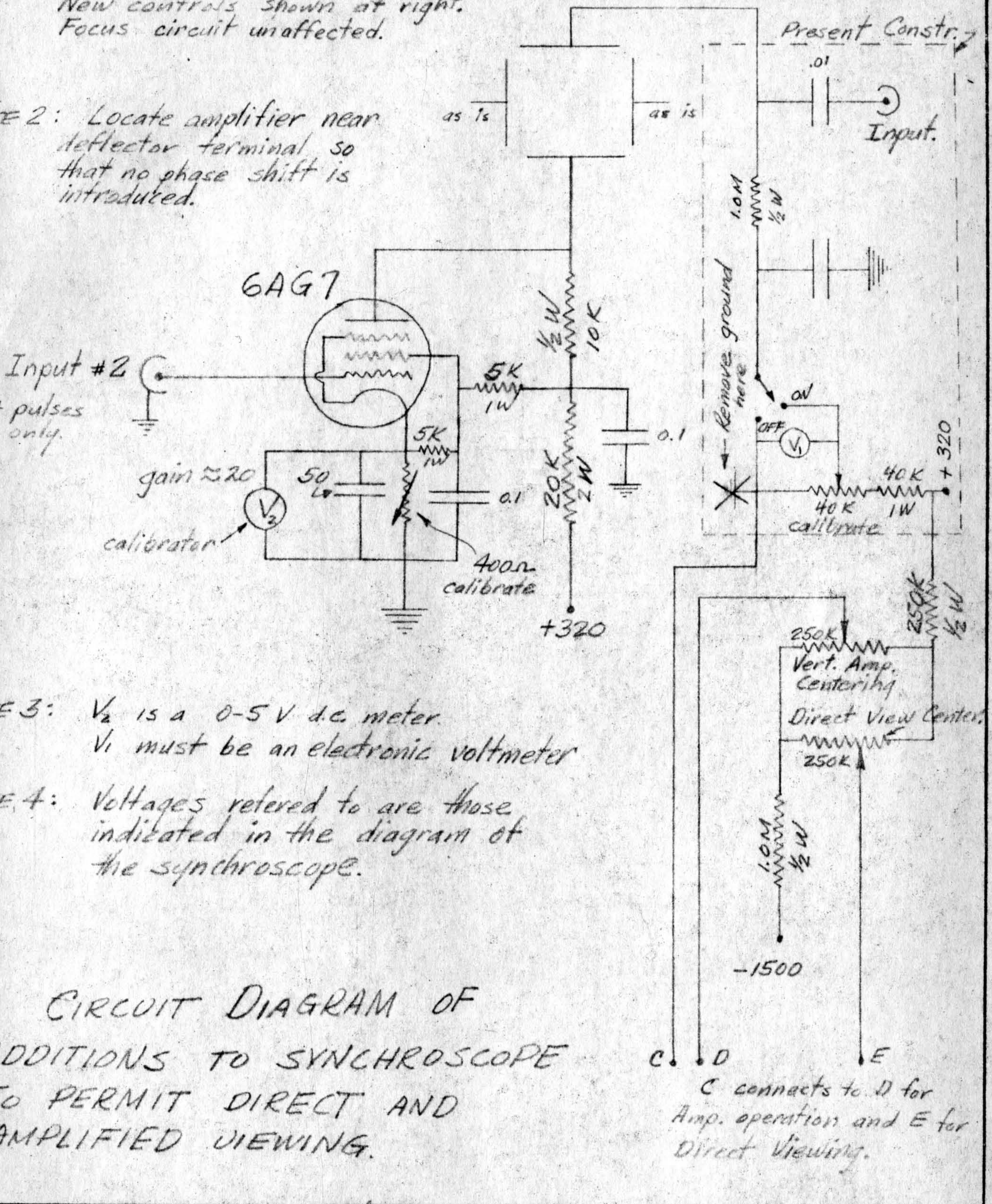
NOTE 3: R_1, R_2, and R_3 should be adjusted to read 150 v, 500 v, 1500 v and 5000 v full scale.

NOTE 4: K-69087-1A117 gives the capacity dividing circuit. See D.F. 77876.

NOTE 5: 8016 or 8013A are good diodes to use. 8013A is better because of less impedance.

NOTE 1: Disconnect present vertical centering control. Replace pot. with fixed 250K resistor. New controls shown at right. Focus circuit unaffected.

NOTE 2: Locate amplifier near deflector terminal so that no phase shift is introduced.



NOTE 3: V_2 is a 0-5 V d.c. meter. V_1 must be an electronic voltmeter

NOTE 4: Voltages refered to are those indicated in the diagram of the synchroscope.

CIRCUIT DIAGRAM OF ADDITIONS TO SYNCHROSCOPE TO PERMIT DIRECT AND AMPLIFIED VIEWING.

C connects to D for Amp. operation and E for Direct Viewing.

DF 77829	MADE BY P.W. Crapuchettes	INSPECTED BY Nov. 23, 1945
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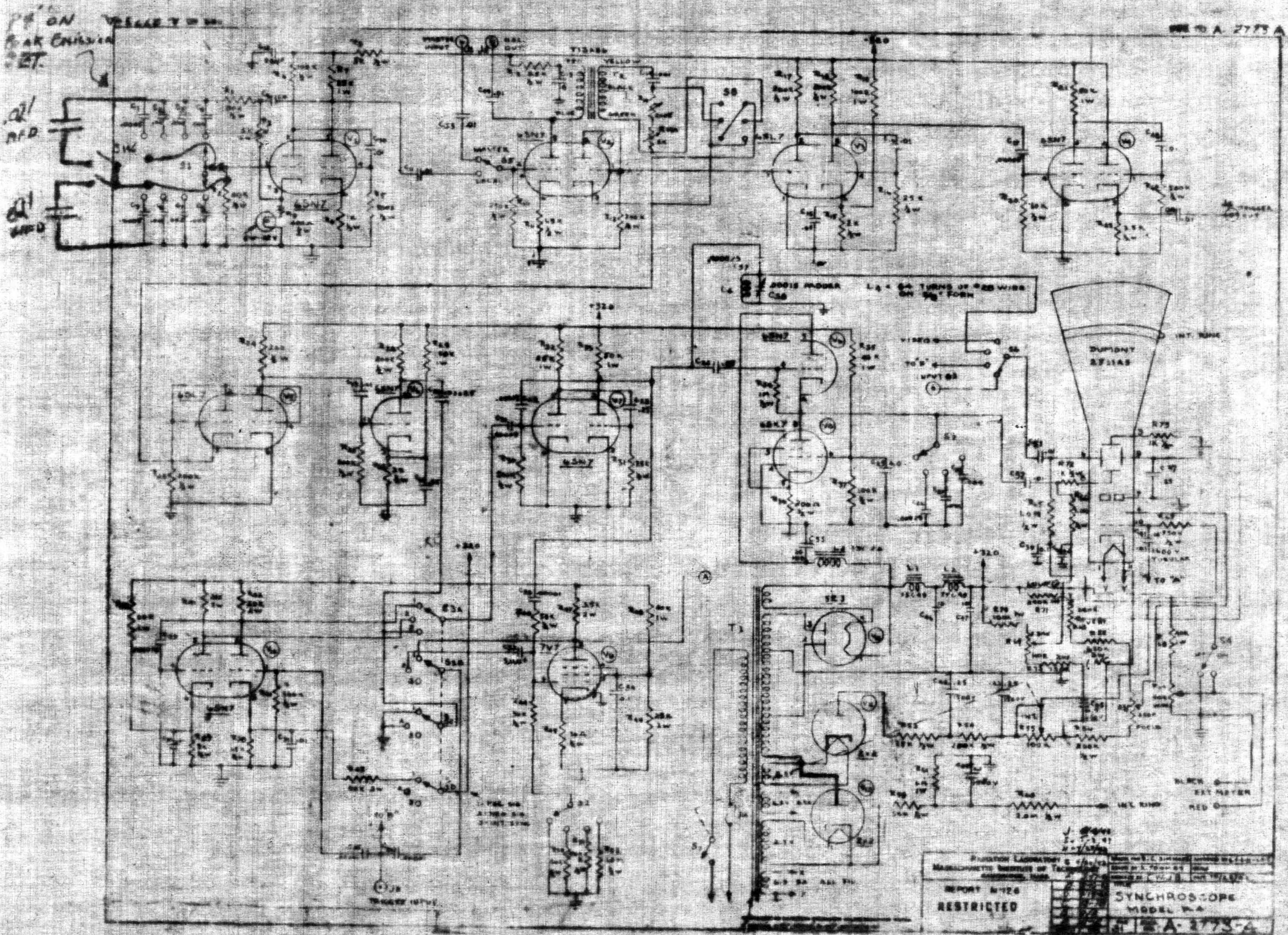
RESTRICTED
SYNCHROSCOPE
A-2773-A
DUMONT
INT. SYNC
TRIGGER INPUT
EXT. METER
RED
BLACK
.01 MFD
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