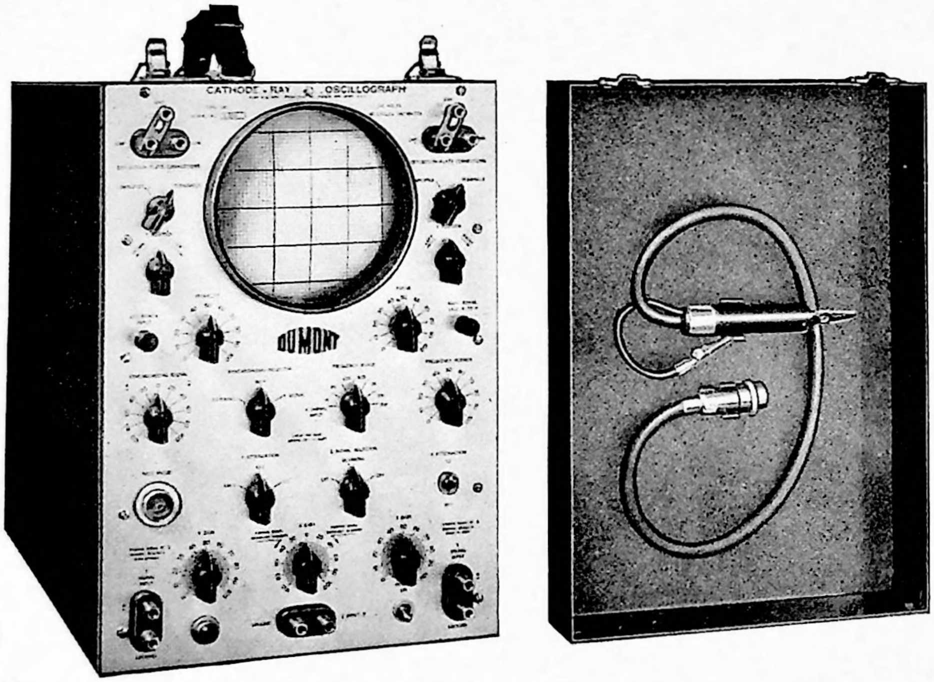
DU MONT

CATHODE-RAY OSCILLOGRAPH
TYPE 241

OPERATING INSTRUCTIONS

ALLEN B. DU MONT LABORATORIES, INC.
PASSAIC, NEW JERSEY
U. S. A.



TYPE 241 CATHODE-RAY OSCILLOGRAPH

Operating Instructions

For

DU MONT TYPE 241
CATHODE-RAY OSCILLOGRAPH

ALLEN B. DU MONT LABORATORIES, INC.
Passaic, N. J., U. S. A.

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OPERATING INSTRUCTIONS

1.00 INTRODUCTION

1.10 GENERAL SPECIFICATIONS:

Cathode-ray Tube:

Type 5JP1/2529A5
Accelerating Potential (overall) .... 1500 volts

Input Impedance:

	TERMINALS	PROBE	DIRECT (BALANCED)	DIRECT (UNBALANCED)
a. Y-Axis	2 meg. 40 uuf.	1 meg. 10 uuf.	5 meg. 20 uuf.	5 meg. 25 uuf.
b. X-Axis	2 meg. 40 uuf.		5 meg. 20 uuf.	5 meg. 25 uuf.
c. Z-Axis	1 meg. 20 uuf.			

Maximum Input Potential:

Y-Axis through amplifier .... 400 r.m.s. signal volts (600 v. d. c. max.)
Y-Axis direct to plates .... 400 r.m.s. signal volts (600 v. d. c. max.)
Y-Axis through probe........... 400 volts d.c. or peak signal
X-Axis through amplifier .... 50 r.m.s. signal volts (600 v. d. c. max.)
X-Axis direct to plates .... 400 r.m.s. signal volts (600 v. d. c. max.)
Z-Axis .... 5 r.m.s. signal volts (600 v. d. c. max.)
External synch voltage.......... 10 peak to peak signal volts (600 v. d. c. max.)

Amplifier Frequency Response:

Y-Axis............. Uniform within 3 db. from 20 cycles to 2 megacycles at any attenuator setting. Typical square-wave response is shown in Figure 2 for frequencies of 50 cycles, 500 cycles, 25 kilocycles, and 100 kilocycles per second.

X-Axis............. Uniform within 3 db. from 5 cycles to 100 kilocycles per second at any attenuator setting.

Z-Axis............. Uniform within 3 db., 30 cycles to 2 megacycles per second.

Voltage Gain of Amplifiers (approximate):

Y-Axis .... 250 times
X-Axis .... 100 times
Z-Axis .... 10 times

Deflection Factor:

a. With Amplifier:
Y-Axis (Terminals) .... 0.07 r.m.s. v/inch
Y-Axis with Probe.................................. 0.70 r.m.s. v/inch
X-Axis .... 0.70 r.m.s. v/inch

b. To Deflection Plates:
Y-Axis .... .22 r.m.s. v/inch
X-Axis .... .21 r.m.s. v/inch

Linear Time-Base:

Frequency Range .... 15 to 30,000 c.p.s.
Direction of Sweep................................... Left to Right
Synchronizing Signal Sources...................... Y-Signal (internal)
External
60 cycles

Synchronizing Polarity .... Either polarity of synch signal

Power Supply Source:

Potential	115 volts r.m.s.
Frequency	60 cycles
Power Consumption	160 watts
Fuse Protection	3 amp.

Physical Specifications:

Height	17½ inches overall
Width	10¾ inches "
Depth	21 inches "
Weight	65 pounds

1.20 DESCRIPTION

The Type 241 Cathode-ray Oscillograph is an instrument for plotting a visual curve of one electrical quantity as a function of another on the screen of a cathode-ray tube.

It consists essentially of a cathode-ray tube, amplifiers for producing the deflection voltages, a linear-time-base generator, and associated power supplies.

In addition to being deflected vertically and horizontally, the electron beam may be modulated in intensity. This feature permits the use of timing signals or blanking pulses.

Provision is made to connect signals directly to the deflection plates when the frequencies to be observed are outside the useful limits of the amplifiers.

The Y-axis or vertical deflection amplifier has uniform frequency response from 20 c.p.s. to more than 2 mc. The X-axis or horizontal deflection amplifier has uniform response to 100 kc. Both amplifiers have input attenuators and distortionless gain controls. The Y-amplifier has an input connection for a test probe which reduces the input capacitance, with a loss of gain. The X-axis amplifier can be used to amplify the linear time-base or to amplify an external signal.

The Z-axis amplifier modulates the electron beam with any signal applied to its input terminal post or with a return trace blanking pulse produced by the linear-time-base generator. Either polarity of the signal amplified can be used to increase the beam intensity.

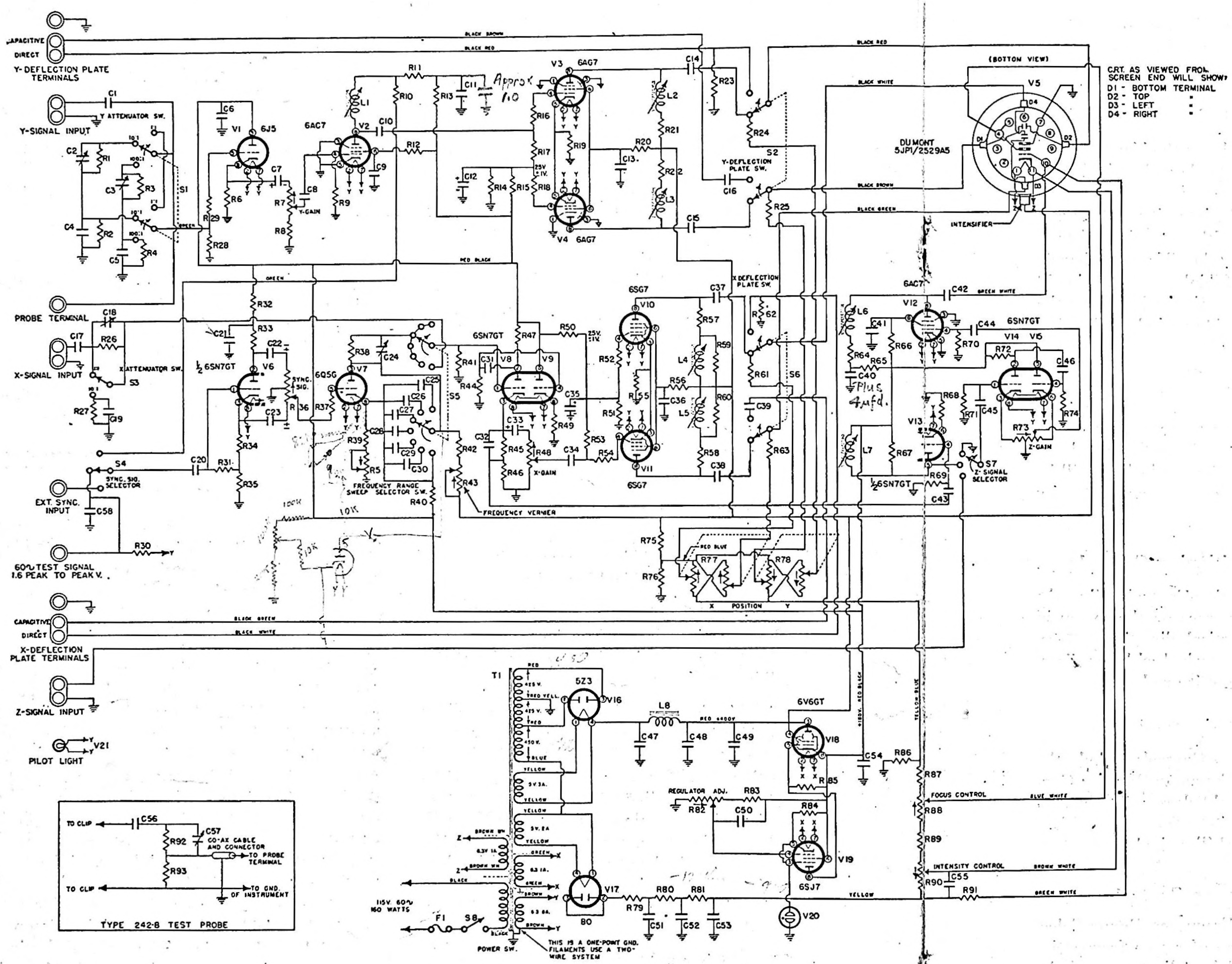
The unit is housed in a black wrinkle-finished case having a removable front cover which serves to protect the front panel when the equipment is not in use. The removable test probe can be held inside the cover by clips that are provided. A power source of approximately 160 watts at 115 volts, 60 cycles, is required, and this supply is protected by a three-ampere fuse.

2.00 OPERATING INSTRUCTIONS

2.10 INSTALLATION

The Type 241 Cathode-ray Oscillograph is shipped with all tubes in place and ready for operation with the exception of the cathode-ray tube, which may be packed separately.

To install the cathode-ray tube, the chassis must be removed from the cabinet by first removing the three retaining screws at the top front of the cabinet and the two located at the rear of the cabinet. It may then be removed by sliding the chassis and front panel forward. The cathode-ray tube is inserted through the front panel, care being taken not to shear off the deflection-plate or intensifier caps. The tube is pushed back until the screen end is flush with the front panel and the socket end projects through the rear retaining clamp. The tube is then rotated until the deflection plate and intensifier caps center on their respective cutouts in the shield. The rear retaining clamp is then tightened firmly. The four deflection-plate connections are made and the intensifier cap connected. The socket is now firmly seated on the tube base. Before replacing the cabinet, it is well to check that all tubes are firmly in their sockets. All vacuum-tube locations are plainly marked on the chassis label. The Type CD2005 ¼ watt neon bulb fits into a socket mounted under the chassis.



SCHEMATIC OF CIRCUIT

TYPE 241

CATHODE-RAY OSCILLOGRAPH

. DW-205-D-9

COMPONENT PARTS LIST

C1	0.5 μf. 600V.
C2	3-12 μμf.
C3	3-12 μμf.
C4	70 μμf. 500V.
C5	.001 μf. 500V.
C6	0.5 μf. 600V.
C7	100 μf. 50V.
C8	0.1 μf. 1000V.
*C9	1 μf. 600V.
C10	0.5 μf. 200V.
*C11	4 μf. 600V. + app 1.0 μfd
C12	25 μf. 50V.
C13	0.5 μf. 600V.
C14	0.1 μf. 1000V.
C15	0.1 μf. 1000V.
C16	.05 μf. 400V.
C17	0.5 μf. 600V.
C18	3-12 μμf.
C19	70 μμf. 500V.
C20	.05 μf. 400V.
C21	1 μf. 200V.
C22	0.1 μf. 1000V.
C23	0.1 μf. 1000V.
C24	3-12 μμf.
C25	150 μμf. 500V.
C26	600 μμf. 500V.
C27	.0025 μμf. 500V.
C28	.01 μf. 400V.
C29	.04 μf. 400V.
C30	0.15 μf. 400V.
C31	0.1 μf. 1000V.
C32	200 μμf. 500V.
C33	100 μf. 50V.
C34	0.5 μf. 600V.
C35	25 μf. 50V.
C36	0.5 μf. 600V.
C37	0.1 μf. 1000V.
C38	0.1 μf. 1000V.
C39	.05 μf. 400V.
*C40	0.5 μf. 600V. + 4.0 μfd
C41	0.5 μf. 600V.
C42	.05 μf. 1600V.
C43	.05 μf. 400V.
C44	0.1 μf. 1000V.
C45	0.1 μf. 1000V.
C46	0.1 μf. 1000V.
C47	4 μf. 600V.
C48	4 μf. 600V.
C49	4 μf. 600V.
C50	1 μf. 200V.
C51	0.5 μf. 1500V.
C52	0.5 μf. 1500V.
C53	0.5 μf. 1500V.
C54	1 μf. 400V.
C55	0.5 μf. 600V.
C56	.05 μf. 400V.
C57	3-12 μμf.
C58	0.25 μf. 400V.
F1	3 Amp. Fuse
L1	70-250 μh.
L2	130-500 μh.
L3	130-500 μh.
L4	7-19 mh.
L5	7-19 mh.
L6	33-100 μh.
L7	90-195 mh.
L8	19 h. 150 ma.
R1	2 meg. ½W. ±5%
R2	250 K. ½W. ±5%
R3	2 meg. ½W. ±5%
R4	20 K. ½W. ±5%
R5	1 K pot.
R6	1 K ½W.
R7	1 K. pot.
R8	110 ohms ½W.
R9	25 meg. 1W.
R10	100 K ½W.
R11	2 K. 1W.
R12	75 K. 1W.
R13	10 K. 3W.
R14	10 K. ½W.
R15	75 K. 1W.
R16	50 ohms ½W.
R17	50 K ½W.
R18	50 ohms ½W.
R19	470 ohms 3 W.
R20	15 K. 10W.
R21	4 K. 10W. non. ind.
R22	4 K. 10W. non. ind.
R23	500 K. ½W.
R24	5 meg. ½W.
R25	5 meg. ½W.
R26	2 meg. ½W. ±5%
R27	250 K. ½W. ±5%
R28	2 meg. ½W.
R29	50 ohms ½W.
R30	100 K ½W.
R31	500 K ½W.
R32	100 K 1W.
R33	10 K 1W.
R34	2 K ½W.
R35	8 K 1W.
R36	200 K pot. C. T.
R37	20 K ½W.
R38	3 meg. ½W.
R39	1 K 1W.
R40	82 K 3 W.
R41	2 meg. ½W.
R42	500 K 1W.
R43	4 meg. pot. ±10%
R44	2 meg. ½W.
R45	10 K 1W.
R46	1 K ½W.
R47	1 K ½W.
R48	10 K pot.
R49	1 K ½W.
R50	75 K 1W.
R51	10 K ½W.
R52	50 ohms ½W.
R53	2 meg. ½W.
R54	50 ohms ½W.
R55	2.5 K 1W.
R56	82 K 3 W.
R57	39 K 3 W.
R58	39 K 3 W.
R59	10 K ½W.
R60	10 K ½W.
R61	5 meg. ½W.
R62	500 K ½W.
R63	5 meg. ½W.
R64	2 K 1W.
R65	10 K 1W.
R66	75 K 1W.
R67	10 K ½W.
R68	2.5 K 1W.
R69	1 meg. ½W.
R70	25 meg. 1W.
R71	1 meg. ½W.
R72	1 K ½W.
R73	2 K pot. C.T.
R74	1 meg. ½W.
R75	200 K 1W.
R76	100 K 1W.
R77	4 meg. } dual
R78	4 meg. } pot.
R79	2 K 1W.
R80	100 K 1W.
R81	100 K 1W.
R82	500 K pot.
R83	500 K 1W.
R84	100 K 1W.
R85	500 K 1W.
R86	250 K 1W.
R87	750 K 1W.
R88	500 K pot.
R89	100 K 1W.
R90	200 K pot.
R91	500 K 1W.
R92	1 meg. ½W. ±5%
R93	120 K. ½W. ±5%
S1	D.P. 3T.
S2	D.P. D.T.
S3	S.P. D.T.
S4	S.P. 3T.
S5	D.P. 7T.
S6	D.P. D.T.
S7	S.P. 3T.
S8	Toggle S.P. S.T power SW.
T1	Power Trans. Stock #20—178
V1	6J5
V2	6AC7
V3	6AG7
V4	6AG7
V5	Du Mont 5JP1/2529A5
V6 & 13	6SN7GT
V7	6Q5G
V8 & 9	6SN7GT
V10	6SG7
V11	6SG7
V12	6AC7
V14 & 15	6SN7GT
V16	5Z3
V17	80
V18	6V6GT
V19	6SJ7
V20	¼W. neon CD—2005 C.L.
V21	6.3 V. 0.15A. Brown bead

* 2-.5μf. 600V.

2.110 Power Supply

The Type 241 Cathode-ray Oscillograph is designed to operate on 115 volts, 60 cycles only. For operation on other supply voltages a suitable voltage changing transformer is necessary. **Satisfactory operation may be had with supply frequencies up to 400 c.p.s.**

When external voltage or frequency changing or regulating devices are used in connection with the oscillograph, such devices should be located at least six feet from the oscillograph to avoid magnetic deflection distortion as discussed in Section 3.10.

The high voltage section of the power supply delivers approximately 1100 volts negative with respect to ground. The low voltage supply delivers approximately 400 volts positive with respect to ground for the amplifiers and sweep oscillator.

In addition, an electronic voltage regulator delivers 180 volts positive for the operation of all low-level stages. Its regulation and output voltages are determined by a factory adjustment of a potentiometer, R82, mounted on the chassis in front of the 6V6GT tube.

The regulated voltage has been factory adjusted to a value of 180 volts, and its adjustment should not be changed except to compensate for variations in regulator tubes. A voltmeter should always be used when this adjustment is made to return the output to 180 volts.

2.20 CONTROLS

All controls and terminals of the Type 241 are located on the front panel. Related controls are grouped together where possible. In general, the X-axis controls occupy the right side of the panel and the Y-axis controls the left side. Each group of controls will be considered separately.

2.210 Beam Controls

The Beam Controls comprise those which adjust the intensity, focus, and position of the fluorescent spot.

2.211 Power Switch

The Power Switch is located on the front panel to control the power supply to the instrument. When thrown to the "power on" position, the pilot light should come on. This switch should always be thrown to the "off" position before the instrument is removed from the cabinet.

2.212 Intensity Control

The Intensity Control sets the bias potential between the control electrode and cathode and thus determines the beam current. In general, it is desirable to keep the intensity of the trace as low as is consistent with convenience in use in order to conserve tube life. A sharply focused line or spot of high intensity should never be permitted to remain stationary on the screen for any considerable period. (See Section 3.30.)

2.213 Focus Control

The Focus Control serves to set the potential of the focusing electrode or first anode of the cathode-ray tube. In general, there will be a setting for optimum focus at each intensity level.

2.214 X- and Y-Positioning Controls

The X- and Y-Positioning Controls adjust the location of the spot or trace on the screen in the horizontal and vertical direction respectively. Each control is marked with the direction of motion of the spot it produces.

2.220 Linear-Time-Base Controls

The Linear-Time-Base Controls include the Frequency Range and Frequency Vernier Controls, Sychronizing Signal Selector, Synchronizing Signal Amplitude Control, and an External Synchronizing Signal Terminal.

2.221 Frequency Range Control

The setting of the Frequency Range Selector determines the range of sweep frequencies which can be produced by adjustment of the Frequency Vernier Control. The limits of each of the six ranges are given by the numbers to either side of the dial pointer and are as follows: 15, 60, 220, 900, 3K, 10K, 30K. The letter "K" represents kilo or one thousand; thus, 30K represents 30,000 cycles per second.

In the extreme counter-clockwise position marked "X-signal Input," the sweep circuit is prevented from oscillating and the input of the X-axis Amplifier is connected to the "X-signal Input" terminals.

2.222 Frequency Vernier Control

When the proper frequency range has been selected with the Frequency Range Control (Section 2.221), the exact frequency necessary to stabilize the pattern on the screen can be obtained by means of the Frequency Vernier Control.

2.223 Synchronizing Selector Switch

The source of signal to which the sweep oscillator is synchronized is determined by the setting of the Sychronizing Selector. The following sources of synchronization are available: External Signal, 60 Cycle, and Y-amplifier Signal.

In the External position the switch permits synchronizing the oscillator with a signal connected between ground and the "External Synchronizing Signal" input post. The amount of signal necessary is discussed in Section 2.225.

When the switch is thrown to the 60 cycle position, the sweep may be synchronized with the frequency of the power line supplying the instrument.

When the selector is in the "Y Signal" position, a signal is selected from a suitable point in the Y-axis amplifier and used to synchronize the sweep.

2.224 Synchronizing Signal Amplitude Control

This control allows the amount of synchronizing voltage applied to the grid of the 6Q5G gas triode to be adjusted to the optimum value to insure good synchronization. In addition, the polarity of the synchronizing signal upon which the synchronization occurs may be selected. In the sector of the Synchronizing Signal Control marked ±, the sweep synchronizes on the negative half cycle of an external synchronizing signal or the positive half cycle of an internal synchronizing signal. In the sector of the control marked ∓, the reverse is true. Thus, synchronization from non-symmetrical wave forms such as short pulses, etc., is assured.

The minimum amount of synchronizing voltage which gives good synchronization should always be used. Excess synchronizing voltage at the grid of the 6Q5G gas triode may introduce non-linearity in the sweep.

2.225 External Synchronizing Signal Input

When synchronization is desired with a signal other than the power line or that amplified by the Y-axis Amplifier, it should be connected to the terminal marked "Ext. Synch. Input." Under such conditions, the Synchronizing Selector (Section 2.223) should be thrown to the "External" position.

Excess synchronizing voltages fed to this terminal may couple to the X- and Y-amplifiers and cause distortion. Ten volts (peak to peak) should be the maximum external synch signal ever employed. The impedance of the External Synchronizing Signal Input is 500,000 ohms. If large values of external synchronizing voltage are available, a suitable series resistor should be connected to the External Synchronizing Signal Input to reduce this to the maximum value given above.

2.230 Y-Axis Amplifier

The Y-axis Amplifier consists of an input attenuator, a cathode-loaded input stage, a stage of amplification, and a balanced phase-inverter deflection amplifier. The amplifier has uniform frequency response in the range of 20 c.p.s. to more than 2 mc. This response is maintained for any setting of the gain control or input attenuator. The overall gain of the amplifier is more than 250 times.

A typical response curve is shown in Figure 1. Figure 2 shows typical square wave response at 50 cycles, 500 cycles, 25 kilocycles, and 100 kilocycles.

The Y-axis Amplifier Controls consist of the Y-signal Input Terminal Post, the Test Probe Terminal, the Y-attenuation Control, and the Y-gain Control.

2.231 Y-Signal Input Terminal

The signal used to provide Y-axis or vertical deflection may be connected either to the Y

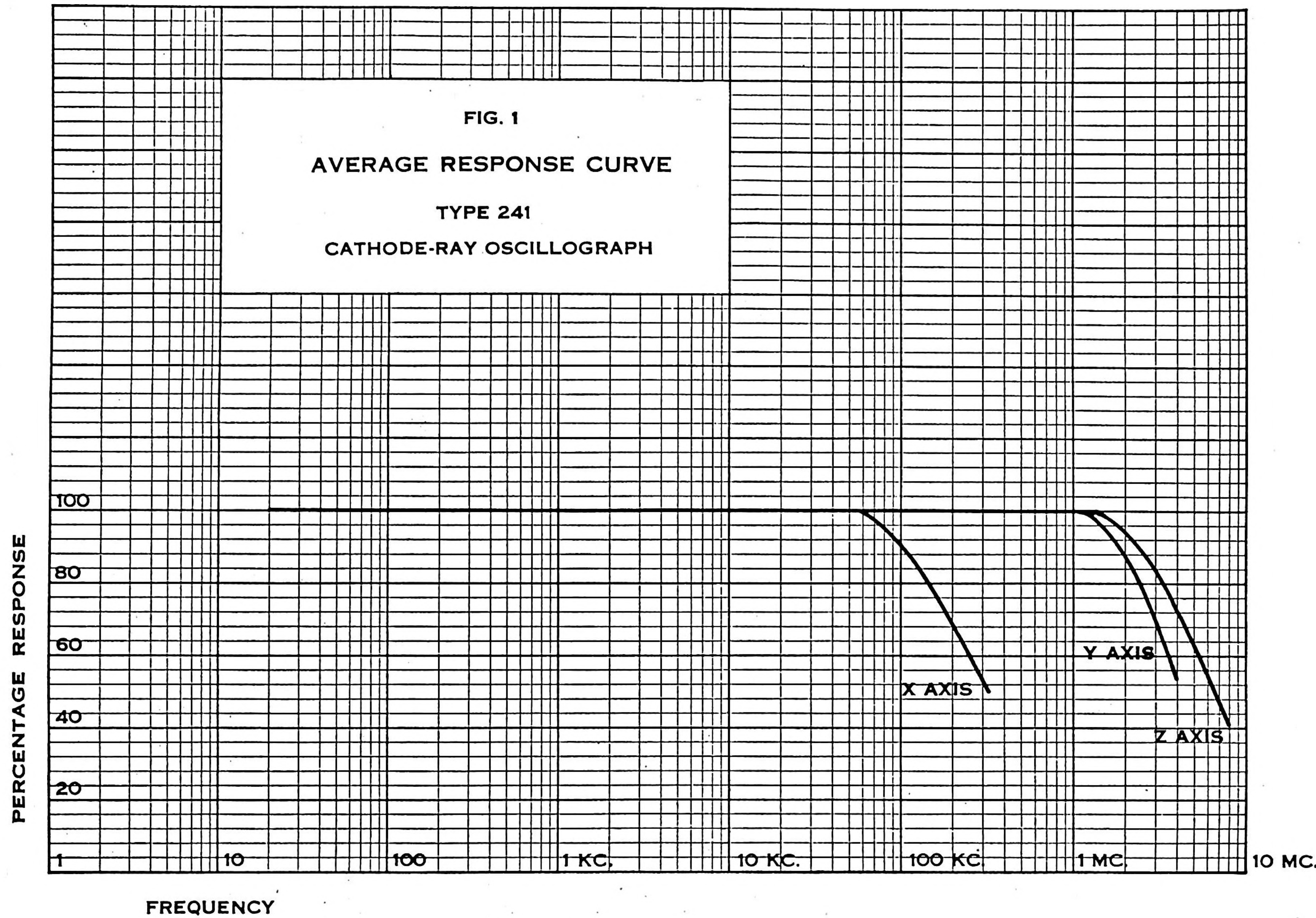


FIG. 1
AVERAGE RESPONSE CURVE
TYPE 241
CATHODE-RAY OSCILLOGRAPH
PERCENTAGE RESPONSE
100
80
60
40
20
1
10
100
1 KC.
10 KC.
100 KC.
1 MC.
10 MC.
FREQUENCY
X AXIS
Y AXIS
Z AXIS

Signal Input Terminal or to the Test Probe Terminal (Section 2.234) and ground.

Signals up to 400 volts r.m.s. amplitude may be connected to the Y-signal Input Terminal, and the Y-attenuator Control (Section 2.232) and Y-gain Control (Section 2.233) adjusted to give suitable deflection.

2.232 Y-Attenuation Control

A high impedance attenuator is provided at the input of the Y-amplifier to reduce the input signal, if necessary, to a value which will not overload the amplifier. The attenuation ratios provided are 100:1, 10:1, 1:1. The three steps of attenuation in addition to that in the probe itself (Section 2.235) are also provided when the test probe is used.

2.233 Y-Gain Control

A low-impedance continuously-variable attenuator supplies a fine adjustment of the amplitude of deflection. The operator will notice that the signal amplitude can never be reduced to zero with this control, but that the amplitude in the extreme counter-clockwise position is about 10 per cent of the "full gain" amplitude. This feature, in conjunction with the Y-attenuation Control, prevents the overloading of the input stage of the amplifier as long as the pattern is no larger than full screen size. Thus, the operator will not be deceived by overload in the amplifier distorting the wave form he is examining as long as the pattern is kept entirely on the screen.

2.234 Test Probe Terminal

The Test Probe Terminal provides a means for connecting a coaxial test probe such as the Du Mont Type 242-B, to the Y-amplifier. The probe, so connected, will be in parallel with the Y-signal Input Terminal, and uses the same input attenuator.

2.235 Test Probe

One Du Mont Type 242-B Test Probe is supplied with every Type 241 Oscillograph. The Type 242-B Test Probe consists of a compensated 10:1 attenuator mounted in an insulated probe and supplied with a three foot length of low-capacitance coaxial cable and connector.

The input capacitance of the test probe to ground is 10 uuf. This makes it possible to connect the probe to relatively high impedance circuits without serious loading effects.

2.240 X-Axis Amplifier

The X-axis Amplifier consists of an input attenuator, a cathode-loaded input stage, and a phase-inverter deflection amplifier. The X-axis Amplifier Controls consist of the X-signal Input Terminal, the X-gain Control, and the X-axis Attenuation Control.

Figure 1 shows a typical response curve for the X-Axis Amplifier.

2.241 X-Signal Input Terminal

An external signal to be amplified along the X or horizontal axis should be connected between the X-signal Input Terminal and ground. This terminal is connected to the input of the amplifier only when the frequency range switch is in the "X Signal Input" position. (See Section 2.221.)

2.242 X-Amplifier Gain Control

The X-amplifier Gain Control is a continuously variable low-impedance attenuator which operates in conjunction with the X-attenuation Control to determine the amount of deflection along the X-axis.

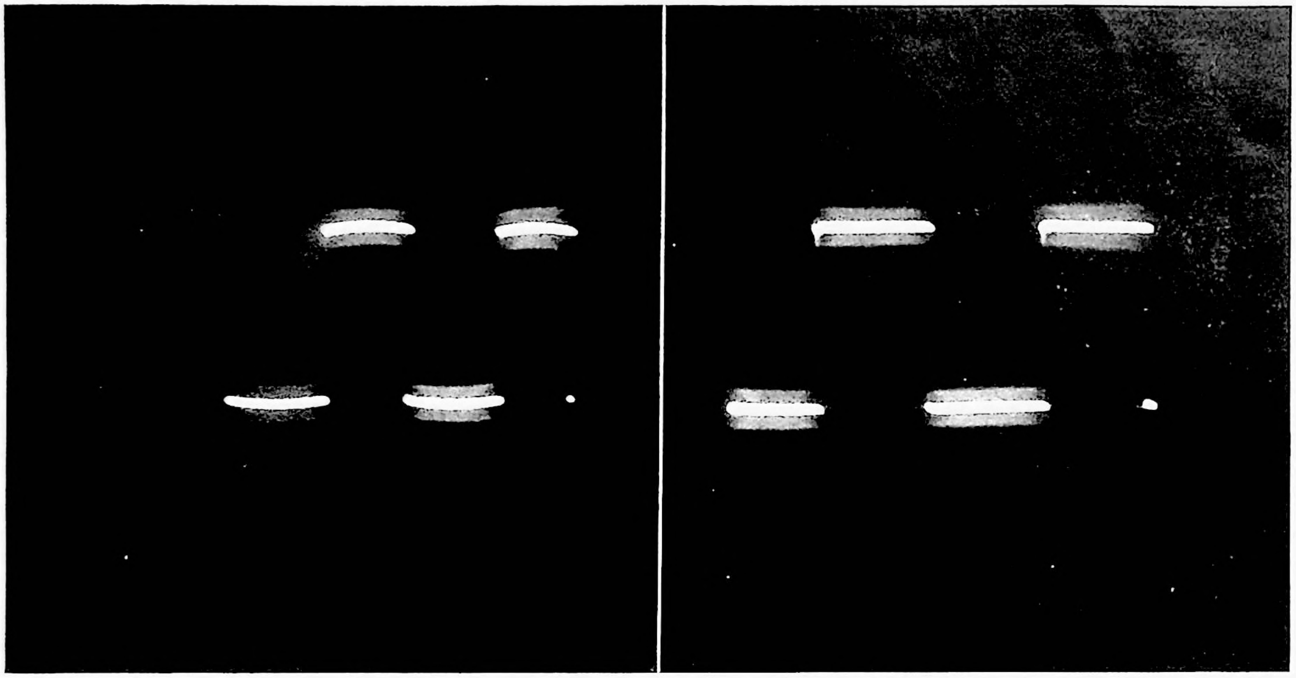
2.243 X-Attenuation Control

The input circuit of the X-axis Amplifier incorporates a two-position high-impedance attenuator with attenuations of 10:1 and 1:1. If the input voltage is over 5 volts r.m.s., the attenuator should be set in the 10:1 position. For input voltages over 50 r.m.s. an external attenuator should be used as voltages in excess of this value will overload the input stage.

2.250 Z-Axis Amplifier

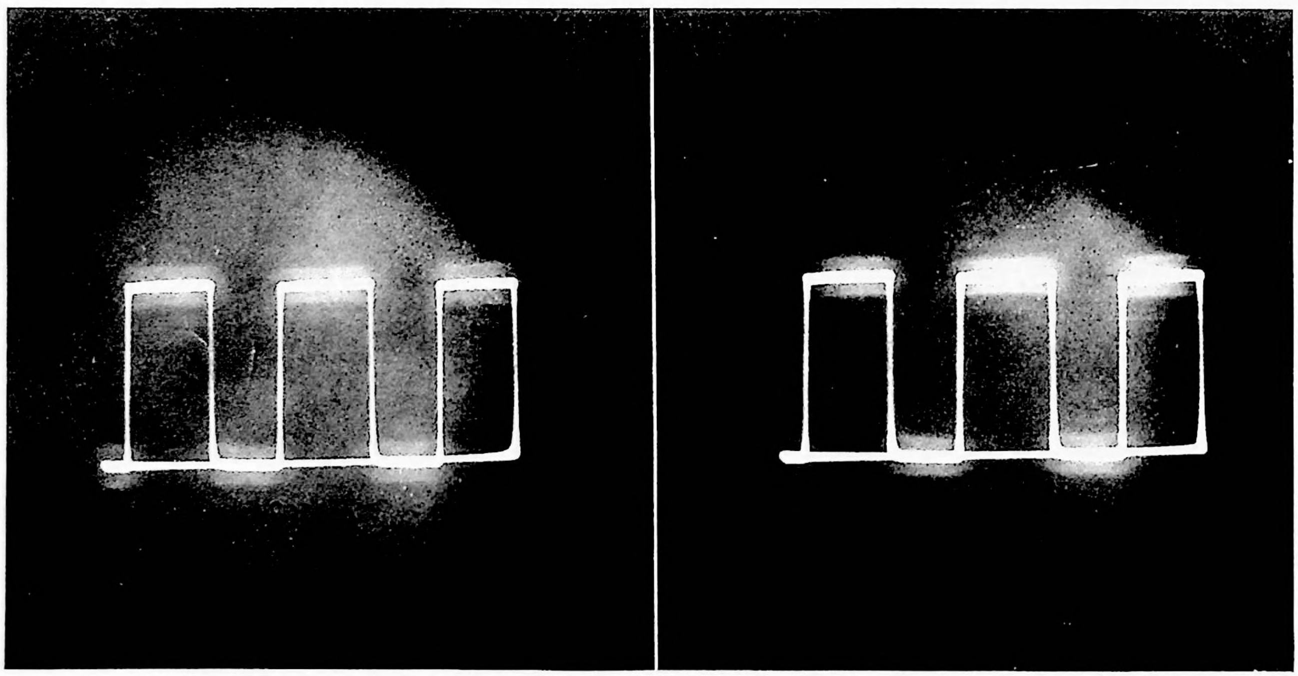
The Z-axis Amplifier amplifies signals used to modulate the intensity of the beam in the cathode-ray tube. The signal may be either an external timing signal or the return trace eliminator pulse as selected by the Z-signal Selector (Section 2.252.)

The Z-axis Amplifier controls are the Z-input Terminal, the Z-signal Selector, and the Z-gain Control.



(a)—50 Cycles Per Second (b)—500 Cycles Per Second

Sweep—Left to Right



(c)—25 Kilocycles Per Second (d)—100 Kilocycles Per Second

Sweep—Left to Right

Figure 2

TYPICAL SQUARE-WAVE RESPONSE

2.251 Z-Input Terminal

When it is desired to modulate the cathode-ray tube beam with an external signal, it should be connected between this terminal and ground. The Z-signal Selector should be in the "External" position. (Section 2.252.)

2.252 Z-Signal Selector

The Z-signal Selector switches the input of the Z-amplifier from the Z-input post to the output of the return trace pulse. In a third position it grounds the input grid of the Z-axis Amplifier and thus prevents any modulation of the electron beam.

2.253 Z-Gain Control

The Z-gain Control adjusts the amplitude and polarity of signals applied to the Z-axis Amplifier. Either the positive or negative polarity of an applied signal can be made to produce an increase of intensity of the beam. If a negative signal is applied to the Z-input terminal, the beam will increase in intensity as the Z-gain Control is rotated clockwise from the center-zero position. Counter-clockwise rotation from the zero position will produce the opposite effect.

In the same manner, the return trace may be either extinguished or intensified depending on the position of the Z-gain Control. The return trace should disappear as the control is rotated counter-clockwise.

This feature allows the use of the intensified return trace as a high frequency sweep. The return trace time becomes a maximum of about 10 per cent of the sweep period for the highest sweep frequency.

2.260 Direct Deflection Controls

When frequencies above or below the useful limits of the amplifiers are to be observed (from 20 c.p.s. to about 5 megacycles and 500 kc. for the Y- and X-amplifiers respectively), direct connections to the deflection plates are available to extend this range.

The Direct Deflection Controls consist of the X- and Y-deflection Plate Switches and the X- and Y-deflection Plate Terminals. Since the action of these controls is the same for either X- or Y-axis, they will be considered together.

2.261 X- and Y-Deflection Plate Switches

The X- and Y-deflection Plate Switches control the connections of their respective deflection plates. When thrown to the "Amplifier" position, the plates are connected to their respective amplifiers to provide amplified deflection. When in the "Terminals" position, the plates are connected to the front panel Deflection Plate Posts. (Section 2.262.) One plate of each pair is conductively connected to a post marked "dir." This plate is connected to ground through a 500,000 ohm resistor.

The other plate of each pair is connected capacitively to the terminal marked "Cap." The time constant of the coupling circuit is one-half second, allowing the observation of fairly low frequencies without distortion.

Positioning of the spot or trace is possible, when the Deflection Plate Switches are in the "Terminals" position, by the use of the X- and Y-positioning Controls (Section 2.214.)

2.262 Deflection-Plate Terminals

The Deflection-Plate Terminals for the X- and Y-deflection plates are located near the upper right and left of the front panel respectively. Each set of terminals has a ground post associated with it. This post is provided with a jumper which can be used to ground either of the two deflection plates.

When the deflection plates are used "unbalanced," the terminal marked "Dir." should ordinarily be the grounded one. If exceptionally low frequency response is wanted, however, the "Cap." terminal may be grounded.

2.270 60 Cycle Test Signal Terminal Post

A signal of power line frequency having an amplitude of approximately 1.6 volts peak to peak is provided at a front panel terminal as a convenient source of test signal.

3.00 PRECAUTIONS

WARNING—It is inadvisable to operate this cathode-ray oscillograph with the case removed. There are potential differences as high as 1500 volts in this instrument, and it should be treated with proper caution.

3.10 MAGNETIC AND ELECTRIC FIELDS

Magnetic and electrostatic shielding has been provided for in the design of this instrument. However, operation of the instrument in strong fields such as are found near transmitters, transformers, etc., may introduce spurious deflection.

Electrostatic pick-up by the wide range amplifiers may be minimized by the use of shielded input cables and connections with a good electrical ground. Magnetic deflection may be eliminated by removing the instrument from the immediate vicinity of the source of the magnetic field, or by orienting the instrument in the field so that the spurious deflection is at a minimum.

3.20 POWER LINE REGULATION

Variations of ± 10 per cent from the nominal value of 115 volts should cause little change in the operating characteristics of the instrument. Greater changes than the above may cause the regulated power supply to cease regulating and the operation of the instrument to become erratic.

If a primary voltage regulator is employed, the precautions of Section 3.10 should be observed.

3.30 SCREEN BURNING

A fine trace or spot of high intensity should not be allowed to remain stationary on the screen for long periods. Burning or discoloration of the screen may result from concentrating the entire energy of the beam on a small area.

4.00 MAINTENANCE

The components of the Type 241 Cathode-ray Oscillograph have been selected and tested to provide long, trouble-free operating life, and the only service necessary should be the replacement of vacuum tubes; the locations of the vacuum tubes are plainly marked on the chassis label.

4.10 REPAIRS

Should any trouble develop in this instrument, it may be serviced with the aid of the schematic diagram and its accompanying parts list. Major repairs, however, are usually handled by the factory.

Under no circumstances should the instrument or cathode-ray tube be returned to the factory without proper return authorization and shipping instructions. In any correspondence with the factory concerning repairs, the type and serial numbers of the instrument and cathode-ray tube must be given, together with a description of the trouble encountered.

It should be borne in mind that, while optimum performance of this instrument requires components with values in close agreement with the schematic, satisfactory performance may often be had by emergency repairs with available components. A list of vacuum tube types which, in emergency, may be substituted for the standard types used in this instrument is given below. In most cases when a substitution is made, the instrument will no longer meet all performance specifications, but will still have some utility.

EMERGENCY TUBE REPLACEMENT DATA

Type Used in 241	*Emergency Replacement*
6J5	6C5, 6P5-G
6AC7	6AB7, 6SJ7, 6SG7
6AG7	No replacement
6SN7	6SL7
6Q5G	884
6SG7	6AC7, 6AB7, 6SJ7
6SJ7	6AB7, 6AC7, 6SG7
6V6GT	6V6, 6L6, 6Y6, 6F6
5Z3	80, 83
80	5Z3
¼ Watt Neon	991
5JP1	No replacement

PATENT NOTICE

The product described herein is manufactured under one or more of the following U. S. patents:

1,844,117	1,960,333	1,999,407	2,000,014	2,014,106	2,067,382	2,082,327
2,085,576	2,087,280	2,098,231	2,153,800	2,157,749	2,162,009	2,163,256
2,164,176	2,185,705	2,186,634	2,186,635	2,190,020	RE.21,326	2,201,309
2,207,048	2,208,254	2,209,507	2,221,398	2,225,099	2,227,822	2,229,556
2,245,409	2,245,428	2,249,942	2,249,943	2,269,115	2,269,129	2,280,700
2,280,738	2,290,592	2,297,742	2,297,752	2,299,471	2,299,510	2,315,848
2,319,691	2,321,149	2,328,259		Other patents pending		