303-AH

CATHODE-RAY OSCILLOGRAPH MANUAL

DUMONT

OSCILLOSCOPE LABORATORIES, INC.

The product described in this instruction book was formerly manufactured by the Instrumentation Division of Fairchild Camera and Instrument Corporation. It is now manufactured by DUMONT OSCILLOSCOPE LABORATORIES, INC. All references to Fairchild, and Fairchild part numbers should be interpreted as DUMONT.

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TABLE 1-1

PERFORMANCE SPECIFICATIONS

CATHODE-RAY TUBE	
Type	5YP-
Accelerating Potential	Second anode: +1600 volts Intensifier: +3000 volts
Vertical Deflection	2.5 inches (max.)
Illuminated Scale	Engraved, illuminated scale over face of tube; dimmer control provided on front panel
Y AXIS	
Deflection Factor	
Amplifier (at full gain)	0.1 peak-to-peak volt/inch, or 0.035 rms volt/inch
Direct	25 peak-to-peak volts/inch, or 9 rms volts/inch
Frequency Response	
Pulse Response	0.0333 microseconds rise time (For 0.25 μs pulse having rise time of 0.01 μs) Not more than 3% tilt and curvature on 60-cycle square wave
Sinusoidal	Down not more than 30% from 10 cycles to 10 megacycles; no positive slope above 10 kilocycles
Undistorted Deflection	
Symmetrical Signal	(Through use of vertical positioning control) 3 inches
Undirectional Signal	1.5 inches
Input Voltage	600 (d-c plus peak a-c) maximum
Attenuation	By factors of 1, 3, 10, 30, 100, 300 or 1000, as selected
Input Impedance	
Amplifier	2.0 megohms, 40μμf
Direct	
Single-ended	3.9 megohms, 10μμf
Balanced	7.8 megohms, 10μμf
Signal Delay	0.25 microseconds (to allow sweep to start before amplified signal is applied to defective plates; allows examination of full input signal without loss at leading edge).
Calibration Voltage	
Availability	To Y INPUT by front-panel switch
Wave Shape	Square waves
Frequency	Power line
Amplitude	0.1, 1, 10 or 100 volts peak-to-peak, as selected
Accuracy	±5% or better

TABLE 1-1 PERFORMANCE SPECIFICATION (CONTINUED)

X AXIS

Deflection Factor	
Amplifier (at full gain)	0.35 peak-to-peak volt/inch, or 0.12 rms volt/inch
Frequency Response	Uniform within 30% to 700 kilocycles; flat to d-c
Undistorted Deflection	5 inches
Input Voltage (max.)	Depends on attenuator setting (Adjust for no greater than full-screen deflection with X AMPLITUDE control at minimum setting)
Attenuation	By factors of 1 or 10, as selected
Linear-Sweep Time Base	
Circuit	High-vacuum tube, Driven or Recurrent
Duration	(Continuously variable) 0.1 set to 2μs
Expansion	To 6 times full-screen diameter with no appreciable distortion
Positioning	So any portion of expanded sweep may be examined on screen
Writing Rate	Capable of 10 inches/μs or better
Gating	Gate turn beam "on" during forward sweep only
Time Calibration	
Form of Markers	Damped sinusoidal oscillations
Availability	Applied to Y INPUT by means of front-panel switch in place of external signal
Interval	100μs (10 kc), 10μs (100 kc), 1μs (1 mc), or 0.1μs (10 mc), as selected
Accuracy	±3% or better

Z AXIS (Intensity-modulation Circuit)

Input Impedance	40,000 ohms, 80μμf
Sensitivity	15 volts peak (positive) will blank the beam

OUTPUT GATE SIGNAL

Availability	Front-panel terminal
Polarity	Negative
Amplitude	Approx. 75 volts
Impedance	Less than 1000 ohms

POWER SUPPLY

Primary-power Potential	115 or 230 rms volts ±10%
Frequency	50-400 cps
Power Consumption	300 Watts
Fuse Protection	
115-volt operation	3 amperes
230-volt operation	1.5 amperes

MAINTENANCE

1. GENERAL

The Type 303-A Cathode-ray Oscillograph is designed and built so that comparatively little attention should be necessary, under normal conditions, to maintain the equipment in good working order. It must be recognized, however, that trouble may be expected at some time during the life of the instrument. What follows, therefore, should provide useful information for the location and correction of such trouble as may be encountered.

The first step in correcting any trouble or failure that may occur is to isolate the section of the circuit causing the trouble. Such isolation can be accomplished by considering the circuit as composed of the basic sections shown in the over-all block diagram, Figure 1-2. Trouble ordinarily occurs in only one section at a time; thus, it is usually necessary to correct only the one trouble.

The next step after isolating the trouble to a particular section is to determine the tube circuit involved. A replacement tube should be tried before attempting any other tests. If trouble persists, voltage and resistance measurements should be made.

2. DRAWINGS

An over-all schematic of the circuit will be found at the back of this section and should be consulted while trouble shooting. A list of the component electrical parts, including descriptions, will be found on the reverse side of the schematic diagram.

- WARNING -

POTENTIALS AS HIGH AS 3000 VOLTS ARE EMPLOYED IN THIS EQUIPMENT. OBSERVE THE FOLLOWING PRECAUTIONS WHEN NECESSARY TO ENERGIZE THE EQUIPMENT WITH THE DUST COVER REMOVED.

(1) Never work alone.

(2) Make sure the chassis is properly grounded. (Do not depend upon a ground connection made by touching the chassis. Make ground connections directly to one of the ground binding posts).

(3) Remove power before changing any tube or attaching any test leads. Remove power cord from the line outlet.

(4) Before touching any component, short the terminals to remove any possible charge that may remain after turning off the power.

(5) Work with one hand in your pocket.

TABLE 4-1

VOLTAGE AND RESISTANCE MEASUREMENTS*

Preset front-panel controls according to the following chart:**

CONTROL	POSITION	CONTROL	POSITION
Y POSITION	CENTER	X SELECTOR	10
X POSITION	CENTER	X AMPLITUDE	10
SYNC SELECTOR	LINE	MULTIPLIER A	1
SWEEP MODE	RECURRENT	MULTIPLIER B	0.3
CALIBRATOR	OFF	MULTIPLIER C	10
Y AMPLITUDE	60	SYNCHRONIZATION AMPLITUDE	0
Y ATTENUATOR	1000		

TUBE			PIN NUMBERS								
SYMBOL	TYPE	FUNCTION	1	2	3	4	5	6	7	8	9
V101	6AH6V	Input Cathode Follower	2600	16K	0+	0+	16K	16K	750		
			8V 8.2	137V 138	6.3V AC	6.3V AC	137V 138	137V 138	9.5V 9.2		
V102	6AH6V	1st Y amplifier	1100	930	0+	0+	19K	18K	930		
			9.5V 9.1	10.5V 10.6	6.3V AC	6.3V AC	115V 117	143V 145	10.5V 10.6		
V103	6AH6V	Paraphase Amplifier	270K	250	0+	0+	15K	15K	250		
			4.75V 2.4	6.3V 6.0	6.3V AC	6.3V AC	145V 146	145V 150	6.3V 6.0		
V104	6AH6V	Paraphase Amplifier	110K	250	0+	0+	15K	15K	250		
			4.8V	6.3V 6.0	6.3V AC	6.3V AC	145V 145	145V 150	6.3V 6.0		
V105	6AH6V	1st Push-Pull Amplifier	200K	1100	0+	0+	200K	15K	1000		
			24.5V 19.5	25.5V 24.5	6.3V AC	6.3V AC	145V 140	150V 150	23.5V 24.5		
V106	6AH6V	1st Push-Pull Amplifier	200K	1100	0+	0+	200K	15K	1000		
			24.5V 20.5	25.5V 24.5	6.3V AC	6.3V AC	145V 140	150V 150	23.5V 24.5		
V107	5763	2nd Push-Pull Amplifier	19K		150K	140K	140K	18K	140	160K	
			300V 330		168V 160	150V 147	150V 147	420V 430	168V 160	160V 150	

* Obtained when using a vacuum-tube voltmeter. Readings are typical and nominal and may vary by as much as 20% or more in some cases. All voltages are d-c unless otherwise indicated.

** Readings taken at socket of V401 obtained with CALIBRATOR TIME and CALIBRATOR AMPLITUDE switch set at Position 1.

TABLE 4-1 (CONT'D.)

	TUBE			PIN NUMBERS								
	SYMBOL	TYPE	FUNCTION	1	2	3	4	5	6	7	8	9
X	V108	5763	2nd Push-Pull Amplifier	19K		150K	140K	140K	18K	140K	160V	
				300V		168V	150V	150V	420V	168V	160V	
X	V201	6AH6V	Internal Sync Amplifier	800 340	910	0+ 160	0+ 147	29K 142	26K 430	910 160	150	
				9.8V 9.2	11.3V 10.7	6.3V AC	6.3V AC	82V 80	150V 142	11.3K 10.7		
X	V202	6C4	Sync Phase Splitter	45K		0+	0+		2.2M	1000		
				76V 74		6.3V AC	6.3V AC		OV 0	2.7V 2.85		
X	V203	6AH6V	Sync Amplifier	47	47	0+	0+	26K	26K	150		
				0	1.7	6.3V AC	6.3V AC	130V	150V	1.7V		
X	V204	6J6	Sweep Gate Generator	28K	28K	0+	0+	200K	80K	0		
				83V	125V	6.3V AC	6.3V AC	-13V	-2.7V	OV		
X	V205	12AT7	Gate Output Cathode Follower	20K	30K	17K	0+	0+	20K	28K	18K	0+
				325V	125V	130V	6.3V AC	6.3V AC	325V	83V	88V	6.3V AC
X	V206	6AU6	Sweep Generator	200K	0	0+	0+	∞	40K	0		
				-13V	0	6.3V AC	6.3V AC	20V	53V	OV		
X	V301	12AU7	Input Cathode Follower	26K	240K	5K	0+	0+	26K	46	4700	0+
				380V	OV SW POS 16	20V	6.3V AC	6.3V AC	380V	OV SW POS 1.9	20V	6.3V AC
X	V302	6J6	Paraphase Amplifier	∞	∞	0+	0+	4900	5800	6500		
				85V	89V	6.3V AC	6.3V AC	20V	21V	22V		
X	V303	12AU7	Push-Pull Cathode Follower	140K	∞	33K	0+	0+	140K	∞	33K	0+
				150V	86V	86V	6.3V AC	6.3V AC	150V	90V	91V	6.3V AC
X	V304	6J6	Push-Pull Amplifier	33K	33K	0+	0+	33K	33K	6500		
				245V 275	245V 275	6.3V AC 3.1	6.3V AC 2.4	91V 105	91V 105	94V 110		
X	V305	6J6	Push-Pull Amplifier	37K	37K	0+	0+	33K	33K	6500		
				310V	310V	6.3V AC	6.3V AC	87V	87V	93V		

TABLE 4-1 (CONT'D.)

	TUBE			PIN NUMBERS										
	SYMBOL	TYPE	FUNCTION	1	2	3	4	5	6	7	8	9		
X	V401**	6AL5	Voltage Calibrator (Time)	11K	0	0+	0+	0		0				
				150V ok	0V	6.3V AC 3.0	6.3V AC 3.0	0V ok		0V ok				
			Voltage Calibrator (Amplitude)	12K	0	0+	0+	260K		260K				
				150V ok	0V	6.3V AC 3.0	6.3V AC 3.0	76V ok		76V ok				
	V502	6AL5	Gate D-C Restorer	1.2M	1.2M	1.2M	1.2M	3.5M		3.5M				
				-1400 V	-1500 V	-1500 V	-1500 V	-1500 V		-1500 V				
X	V601	6AQ5	152V Series Regulator		22K	0+	0+	15K	15K	65K				
					150V	150V	150V	400V	400V	135V				
X	V602	12AU7	(a) 115V Series Regulator (b) 150V Series Regulator	15K	85K	∞	0+	0+	15K	150K	∞	0+		
				400V 420	100V 100	120V 115	6.3V AC 3.	6.3V AC 3.	400V 420	150V 150	160V 160	6.3V AC 3.0		
X	V603	6AH6V	Error-Detecting Amplifier	700K	0	0+	0+	65K	14K	0				
				-4.1V -3	0V	6.3V AC 3.	6.3V AC 3.	135V 125	150V 150	0V				
X	V604	OB2	-108V Voltage Regulator	0	250K									
				0V	-110V									
X	V605	6AQ5	150V Series Regulator	65K	14K	0+	0+	15K	15K					
				135V	150V	150V	150V	400V	400V					
X	V606	6X4	-108V Rectifier	250K		0+	0+		250K	0				
				-190 ok V		6.3V AC 3.0	6.3V AC 3.0	1V	-190 V ok	-0.9 V				
	V607	1X2A	+1700V Rectifier		9.5M			9.5M				9.5M	Cap	
					1800V			1800V				1800V	110K Cap 150V	
X	V608	1X2A	-1300V Rectifier	110K			120K	120K				110K	Cap	
				150V			6.7V	6.7V				150V	1.3M Cap -170M	
X	V609	5U4G	+150V Rectifier		120K	120K	13		13	120K				
					160V	160V	-0.9V		-0.9V	160V				

TABLE 4-1 (CONT'D)

TUBE			PIN NUMBERS										
SYMBOL	TYPE	FUNCTION	1	2	3	4	5	6	7	8	9		
V610	5Y3GT	+415V Rectifier		16K	16K	110K		110K		16K			
				420V	420V	140V		140V		420V			
V611	5Y3GT	+415V Rectifier		16K		140K		140K		16K			
				420V		140V		140V		420V			
V501	5YP-	Cathode-ray Tube	1	2	3	14	5	D1	D2	D3	D4	A2	A1
			1.2M	1.2M	3.5M	1.2M	7.5M	37K	33K	4.5M	4.5M	38K	10 Meg
			-1550 V	-1450 V	-1500 V	-1550 V	-1000 V	310V	245V	285V	285V	290V	+1800V

TABLE 4-2

ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES

Tube Reference Symbol	Tube Type	Factory Adjustment
V102	6AH6V	DELAY LINE COMP (R164) Delay-line Filter Peaking Coil (L103 and L104)
V103	6AH6V	1ST BAL ADJ (R124) Delay-line Filter Peaking Coil (L105 and L106) LOW FREQ ADJ (R129) Y Peaking Coil (L107)
V104	6AH6V	1ST BAL ADJ (R124) Y Peaking Coil (L108)
V105	6AH6V	2ND BAL ADJ (R136)
V106	6AH6V	2ND BAL ADJ (R136)
V107	5763	Y Peaking Coil (L109)
V108	5763	Y Peaking Coil (L110)
V204	6J6	Beam Gate Adjustment (L203)
V301	12AU7	X D-C BAL (R307)
V302	6J6	EXPANDED SW LIN (R313)
V304	6J6	X Peaking Coil (L301) X LIN ADJ (R332)
V305	6J6	X Peaking Coil (L302) X LIN ADJ (R332)
V401	6AL5	VOLT CAL ADJ (R401)
V603	6AH6V	150 V REG ADJ (R604)

3. CIRCUIT VOLTAGES

Table 4-1 lists voltages and resistances from tube pins to ground. Voltage measurements shown were taken using a vacuum-tube voltmeter. With one or two exceptions, however, a test meter having an internal resistance of 20,000 ohms per volt should give the same readings. Voltages measured with a meter having a lower internal resistance may in some cases be lower than the values shown in the table.

It should be remembered that all values are nominal, and considerable variations may be experienced due to various line-voltage conditions and component tolerances. Generally, a variation of ±10% is to be expected and ±20% may not be uncommon. Good judgment is often required to determine if a particular deviation is indicative of trouble.

4. FACTORY ADJUSTMENTS

a. GENERAL

In order to avoid component pre-selection, a number of factory adjustments have been included in this instrument. Before making any adjustments, a 10-minute warm-up period should be allowed. Certain factory adjustments may need to be reset when replacing tubes; Table 4-2 lists these adjustments. For identification and location of the back-of-panel controls, see Figures 4-1 through 4-3.

b. TEST EQUIPMENT REQUIRED

Description	Range or Characteristics
General-purpose Oscillograph	Du Mont Type 304-H or equivalent
Volt-ohmmeter	20,000 ohms/volt test meter or VTVM
Voltage Calibrator	Du Mont Type 264-B or equivalent
Square-wave Generator	60 cycles to one megacycle
R-F Signal Generator	10 kilocycles to 10 megacycle
Line Control Unit (Powerstat)	3 amperes at 115 volts
2 Batteries	90 volts, "B" or "C" type
250K ohm Resistor	2 watts ±10%

c. FACTORY ADJUSTMENTS FOR Y AMPLIFIER

(1) Y attenuator Compensation Capacitors--The trimmer capacitors C103, C110, C104 and C106 are used for compensating the Y ATTENUATOR in the 3, 10, 30 and 100 positions, respectively. C107 and C111 are loops of wire which simulate the behavior of a capacitor thereby serving as compensation for the Y ATTENUATOR in the 300 and 1000 positions, respectively. Compensation should be adjusted by applying a 10-kc square wave to the Y-INPUT terminals and adjusting the appropriate trimmer to pass the square wave with minimum distortion. In Figure 4-4, "A" represents proper adjustment, while "B" and "C" represent conditions of overcompensation and undercompensations, respectively.

FIGURE 4-4 - WAVEFORMS ENCOUNTERED IN ADJUSTING THE Y ATTENUATOR

(2) Delay-line Compensator (DELAY LINE COMP) - R164 - The leading edge of square-wave signal passing through the delay line tends to "droop." Compensation is effected by the application of a 100-kc square wave to the Y amplifier and adjusting R164 until the "droop" is eliminated.

(3) Low-frequency Compensation (LOW FREQ ADJ) - R129 - Compensation should be adjusted by applying a 60-cycle square wave to the Y-INPUT terminal and adjusting R129 to pass a flat-top square wave.

(4) Push-pull Balance Adjustments (1ST AND 2ND BAL ADJ) - R214 and R136 - These adjustments should be made with no input signal to the amplifier. To make these adjustments, correct a 20,000 ohms-per-volt voltmeter between the plates of V103 and V104. Adjust R124 for "zero" volts as indicated on the meter. Next, connect the meter between the plates of V107 and V108. Adjust R136 for "zero" volts as indicated on the meter.

(5) Peaking Coil Adjustments (L107 through L110)--To make these adjustments apply a one-megacycle square wave to the Y-INPUT terminals and adjust the peaking coils initially for a slight overpeaking; next, back off the adjustment just enough to eliminate the overpeaking.

(6) Delay-line Filter Peaking Coil Adjustments (L103 through L106)--To make these adjustments apply one-megacycle square-wave signal to the Y-INPUT terminals and slide the two input filter peaking coils (L103 and L104) in the direction of increasing inductance until bumps are observed in the square wave pattern; next, slide the coils back just enough to eliminate the bumps. The output filter peaking coils (L105 and L106) are adjusted in a similar manner.

d. FACTORY ADJUSTMENTS FOR X AMPLIFIER

(1) X Attenuator Compensation Capacitor - C302 - This adjustment is made by applying the 10-kc square-wave signal to the X-INPUT terminals and setting the X-SELECTOR switch at 10. It is not necessary to apply a signal to the Y INPUT. Proper adjustment of the X attenuator is obtained when the dots at each end of the horizontal trace are of maximum relative intensity and in sharpest focus.

(2) Linearity Adjustment (X LIN ADJ) - R332 - To set this adjustment, obtain a one-inch sweep in the horizontal center of the screen. Position the pattern 1-1/2 inches to the left and 1-1/2 inches to the right of center; observe whether horizontal amplitude of the pattern is greater at the left side or the right side of center. Then adjust R332 until the pattern has the same amplitude on both sides of center.

(3) D-C Balance Adjustments (X D-C BAL) - R307 - When this control is properly adjusted, there will be no shifting in the zero position (left and right) with changes in the setting of the X-AMPLITUDE control. To make the D-C Balance adjustment, set the X-SELECTOR switch at 10 and the X-AMPLITUDE control full counterclockwise. Position the trace in the horizontal center of the cathode-ray tube screen. Increase the X-AMPLITUDE control to 100 (fully clockwise) and adjust the D-C Balance to return the trace to its previous position. It should now be possible to move the X-AMPLITUDE control over its full range without any horizontal displacement taking place. Repeat the adjustment procedure if any horizontal displacement is observed.

(4) Sweep Clamp Adjustment (SW CLAMP) - R312 - To make this adjustment, set MULTIPLIER A at its mechanical center, MULTIPLIER B at 1000, and X SELECTOR to SWEEP. Proper adjustment is obtained when the sweep clamp control is set to maintain the starting point of the sweep fixed irrespective of the changes in the setting of the MULTIPLIER C (or X AMPLITUDE) control.

(5) Expanded Sweep Linearity (EXPANDED SW LIN) - R313 - To make this adjustment, set the CALIBRATOR switch to one of the AMPLITUDE positions and adjust the sweep controls until seven cycles of the voltage calibrator pattern is obtained. Next turn the X-POSITION control fully counterclockwise and increase the X-AMPLITUDE control until the last complete cycle, at the right end of the trace appears approximately in the center of the screen. Measure the horizontal displacement produced by this cycle. Position the first complete cycle, at the extreme left end of the trace, to the center of the screen; compare the horizontal displacement with that previously obtained. Proper adjustment of the expanded sweep linearity control is obtained when the displacement are identical.

(6) X-Amplifier Peaking Coil Adjustments - L301 and L302 - To make these adjustments, apply a 100-kc square-wave signal to the X-INPUT terminals. Set X-SELECTOR switch at 1, CALIBRATOR switch at OFF, SYNC SELECTOR at EXT, and SWEEP MODE at RECURRENT. Connect a jumper from the plate of V206 (pin 5) to the Y-INPUT terminals; also, a test lead from the square-wave generator to the EXTERNAL SYNC terminals. Adjust the peaking coils initally for a slight overpeaking of the wave appearing on screen; then back off the adjustment just enough to eliminate the overpeaking.

e. FACTORY ADJUSTMENT FOR SWEEP CIRCUIT

(1) Beam Gate Adjustment - L203 - This adjustment is made to give a trace of uniform brightness at the highest-frequency sweep (MULTIPLIER B set at 0.3).

f. FACTORY ADJUSTMENT FOR THE CALIBRATOR

(1) Time Calibration Oscillators - L401, L402, L403 and C405 - These adjustments are made by comparison of the internal calibration signals with known signal frequencies obtained from a high-frequency signal generator. For example: The 100-μs range must be adjusted to give the same

number of cycles between two fixed points along the sweep as the 10-kc signal from the signal generator produces. For accurate comparisons, the settings of MULTIPLIER A, B and C must not be changed when switching from the internal marker signals to the external standard source and vice versa.

On the 10-μs range, the internal marker frequency should correspond to a 100-kc signal from the standard source; on the 1-μs range, to a 1-Mc standard signal; and on the 0.1-μs range, to a 10-Mc standard signal.

(2) Voltage Calibrator Adjustment (VOLT CAL ADJ) - R401 - The voltage calibrator adjustment is set by comparison with a Du Mont Type 264-B Voltage Calibrator or equivalent, connected to the Y-INPUT terminals. The 0.1-volt range is set by adjustment of R401 to produce the same vertical displacement of the beam as the 0.1-volt signal from the standard voltage calibrator produces. The other range should be checked for accuracy by comparison with the standard calibrator source; however, no further adjustment should be necessary.

g. FACTORY ADJUSTMENT FOR THE POWER SUPPLY

(1) Regulator Voltage Adjustment (150 V REG ADJ) - R604- Insert the line cord of the Type 303-A into a line voltage control unit. Adjust the voltage to 115 volts. Connect a d-c voltmeter between pin 2 of V605 and chassis. Adjust the 150 V REG control (See Figure 4-2) for a reading of 150 volts on the meter.

5. REPLACEMENT OF CATHODE-RAY TUBE

- CAUTION -

The cathode-ray tube should be handled with great care to prevent breakage which might result in serious personal injury from flying glass. Do not employ force at any time. As an added precaution, it is advisable to wear safety goggles and gloves.

To replace the Type 5YP- Cathode-ray Tube, removal of the old tube may be accomplished as follows: Disconnect the power cord from the line; remove the two screws holding the chassis to the rear of the cabinet, and carefully slide the instrument forward until it is clear of the cabinet. Detach the circular ring (bezel), calibrated scale and color filter from the front panel by removing the four screws which hold them in place. Next, loosen the screw holding the tube-base clamp. Remove the cathode-ray tube socket, the five caps to the deflection-plate and second-anode terminals and the intensifier button. The tube may now be removed through the front-panel opening.

Insert the new cathode-ray tube through the front-panel opening and the tube shield. When inserting the tube the intensifier pin should be on the left side of the tube as viewed from the front of the front of the instrument. Push the tube in far enough so that the base goes into the base clamp provided. Connect the base socket to the tube. Connect the tensifier button to the intensifier pin. Connect the four deflection plate and second anode caps to the neck terminals. Replace the calibrated scale, color filter and bezel; move the tube forward so that it just touches the filter. Plug the power cord into the line outlet; turn on the instrument, and adjust for horizontal sweep. If the resulting trace is not horizontal, rotate the tube as required. Tighten the tube-base clamp, being careful not to rotate the tube in so doing.

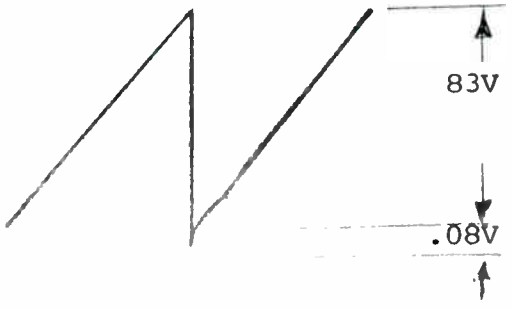
Slide the instrument back into its cabinet and replace the two screws at the rear which hold the chassis in place.

6. WAVEFORM DATA

As an aid in trouble shooting, sketches of typical critical waveforms, obtained from tube pin sockets in the Type 303-A are shown in Figure 4-5. Identification of the tube pins at which these waveforms are obtained and in the peak-to-peak voltage amplitudes are given in each sketch. The built-in Voltage Calibrator, set at 0.1 volt, serves as the test signal for the Y INPUT.

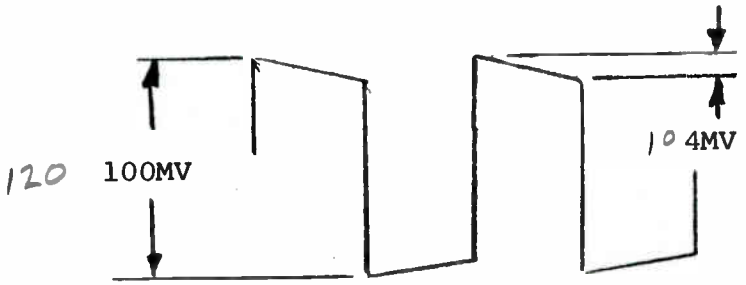
7. ILLUMINATED CALIBRATED SCALE

As an aid in amplitude and time calibration, both for visual measurements and for permanent records by photographic recording, an illuminated scale over the face of the cathode-ray tube, provided with a dimmer control, is a part of the Type 303-A. The illumination lamps are located behind the front panel. To replace a defective lamp, remove the cabinet as indicated in paragraph 5 above. Slide the lamp assembly from the tongue support and replace the defective bulb. To insure proper illumination, when replacing the lamp assembly, make certain that the bulb is tight against the panel.

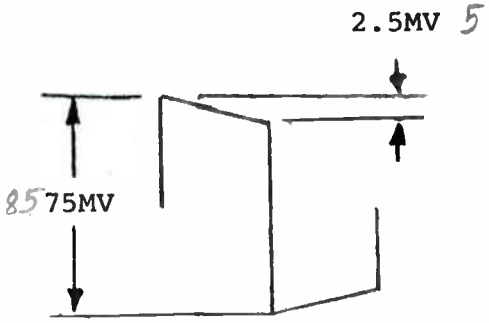


V204-B, Grid (pin 5)

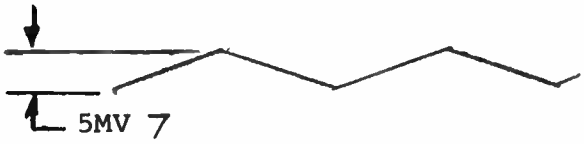
FIGURE 4-5 - TYPICAL CRITICAL WAVEFORMS



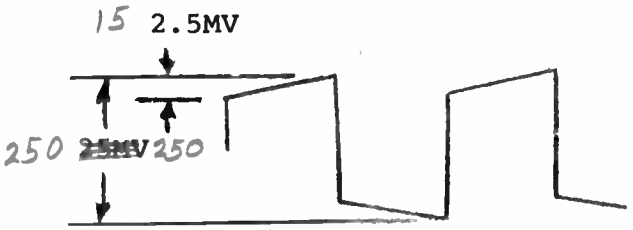
V101, Grid (pin 1)



V101, Cathode (pin 7)
V102, Grid (pin 1)

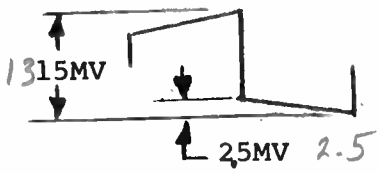


V101, Plate (pin 5)

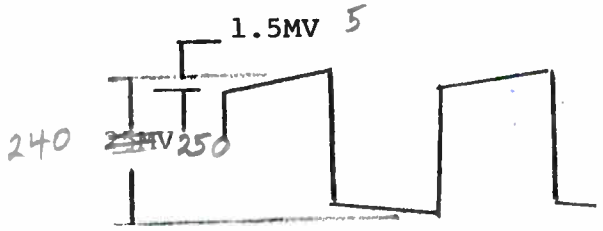


V102, Plate (pin 5)

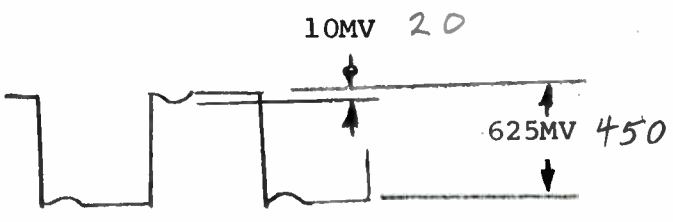
V102, Screen Grid (pin 6)



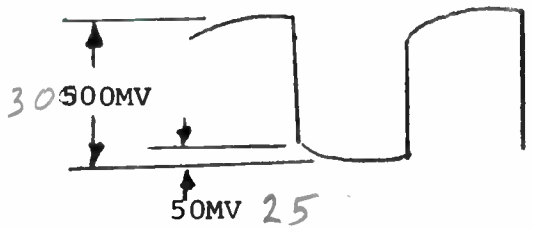
V102, Cathode (pin 7)



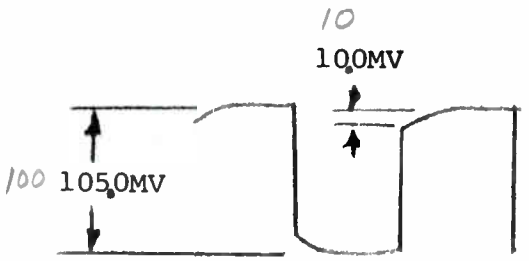
V103, Grid (pin 1)



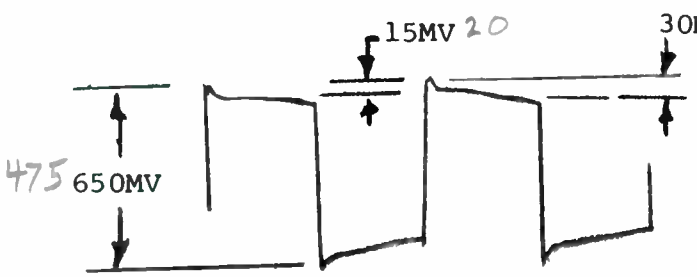
V103, Plate (pin 5)



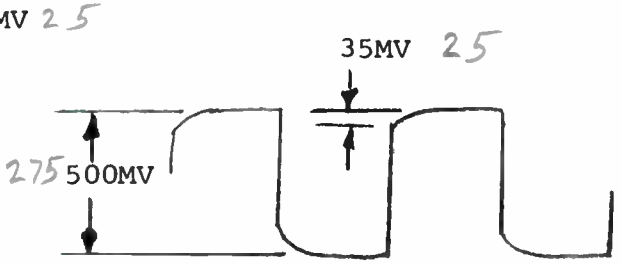
V104, Plate (pin 5)



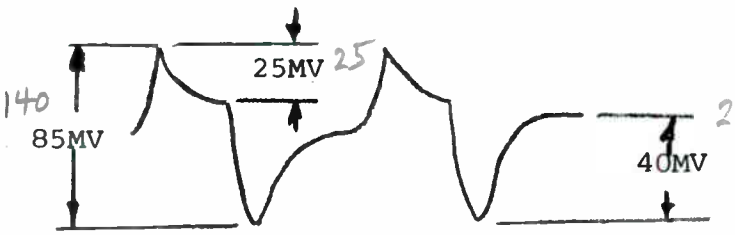
V103 and V104, Cathode (pin 7)



V105, Grid (pin 1)

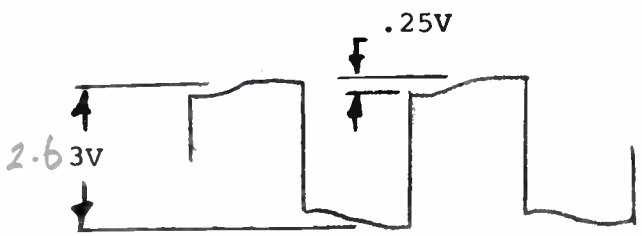


V106, Grid (pin 1)

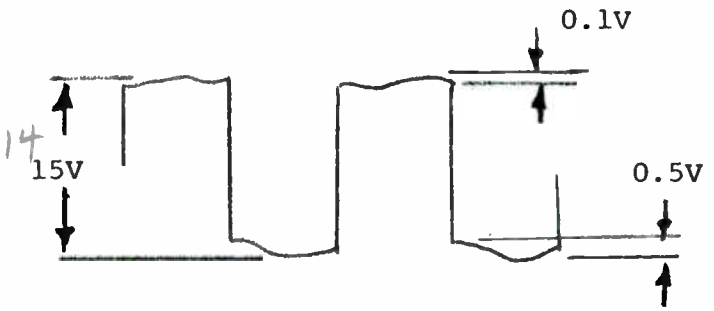


V105 and V106, Cathode (pin 7)

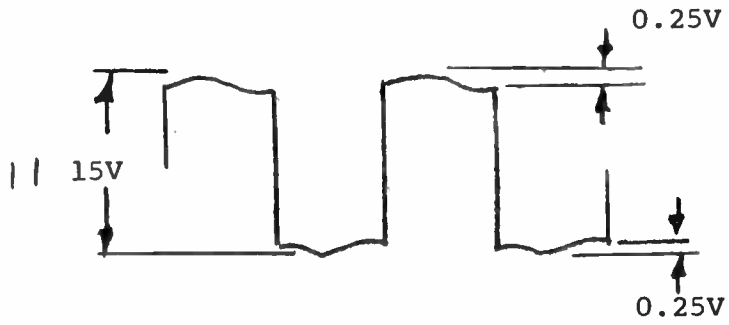
V107, Grid (pin 8)



V108, Grid (pin 8)

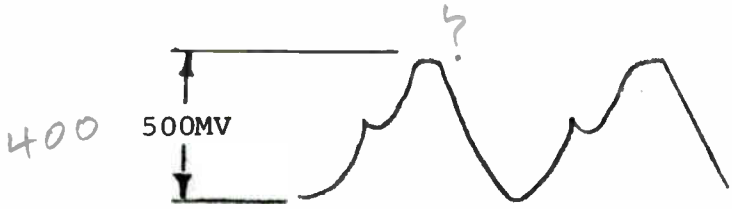


V107, Plate (pin 1)



V108, Plate (pin 1)

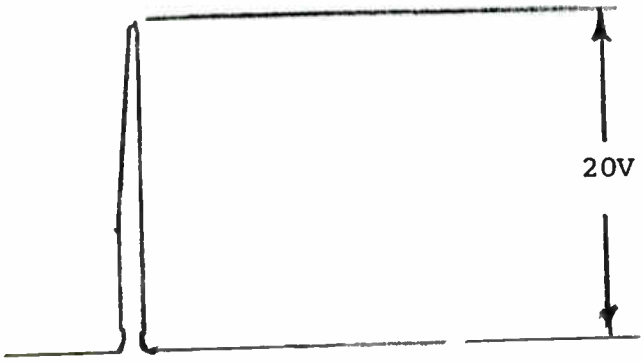
V107, Cathode (pin 7)



V108, Cathode (pin 7)

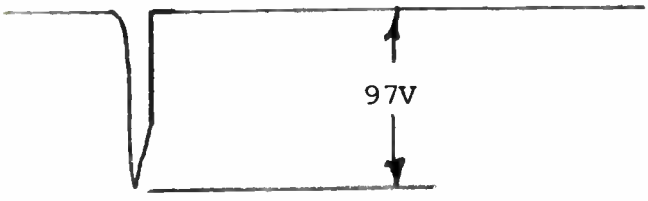
Square Wave As Seen on Face of Cathode-ray Tube Screen

60 CYCLE SWEEP-FREQUENCY WAVEFORMS; NO SYNC INPUT:

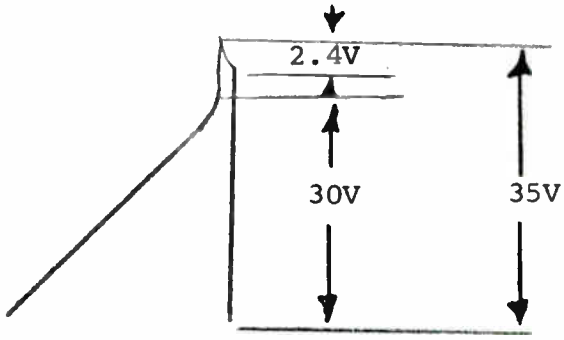


V203, Plate (pin 5)
V204-A, Plate (pin 4)

V204-B, Plate (pin 2)



V206, Plate (pin 5)



V204-A, Grid (pin 6)

8. SELECTING 115-)R 230-VOLT LINE

Provision is made in the Type 303-A for changing from 115 to 230-volt line operation or vice versa. To accomplish this, remove the chassis from the cabinet; turn it upside down. Set the 115/230 volt selector switch (S601) at the desired voltage. Replace fuses in accordance with the appropriate note on the over-all schematic located at the back of this section.

9. DU MONT WARRANTY

All instruments produced by the Instrument Division of Du Mont Laboratories Divisions of Fairchild Camera and Instrument Corporation, are sold under the Du Mont Fairchild Warranty. For the provisions of this warranty, see the Warranty and Service Notice on the inside cover.

10. SERVICE

The Instrument Division maintains complete facilities for servicing Du Mont equipment. For details of the Instrument Service policies, see the Warranty and Service Notice on the inside back cover.

TYPE 303-A CATHODE-RAY OSCILLOGRAPH

COMPONENT PARTS LIST

Symbol	Part No.	Description
		MOTOR
B601	81000320	Motor
		CAPACITORS
C101	03128410	3/12 µµf 350 Volts Variable Ceramic
C102	Same as C101	
C103	03129330	1800 µµf ±5% 500 Volt Mica
C104	Same as C103	
C105	Same as C101	
C106	Same as C101	
C107	03129310	1200 µµf ±5% 500 Volt Mica
C108	Same as C101	
C109	Same as C101	
C110	03129130	510 µµf ±5% 300 Volt Mica
C111	Same as C101	
C112	Same as C101	
C113	03129120	150 µµf ±5% 500 Volt Mica
C114	Same as C101	
C115A,B,C	03014240	20/20/30/30 µf Elect
C116	03115470	80 µf 300 Volt Elect
C117	03013030	500 µf 25 Volt Elect
C118	Same as C114	
C119	03015340	1 µf 200 Volt Paper
C120	Same as C117	
C121	Same as C119	
C122A,B,C,D	03002350	10/10/10/10/µf Elect
C124	03126250	0.47 µf ±10% 200 Volt Paper
C125	03019650	0.01 µf 450 Volt Ceramic
C126	Same as C124	
C128	Same as C124	
C131	Same as C119	
C132	03021090	330 µµf ±5% 500 Volt Mica
C133	Same as C132	
C134	03021120	430 µµf ±5% 500 Volt Mica
C135	03127600	0.47 µf ±20% 400 Volt Paper
C136	Same as C135	
C137	03029450	1200 µµf ±10% 500 Volt Mica
C138	Same as C125	
C139	Same as C101	
C140	03129110	43 µµf ±5% 500 Volt Mica
C141	Same as C101	
C142	Same as C101	
C143	03129100	10 µµf ±5% 500 Volt Mica
C144	03126260	100 µf 12 Volt Elect
C145	Same as C125	
C201A,B,C,D	Same as C122	
C202	Same as C135	
C203	Same as C125	
C204	03000220	4 µf 450 Volt Elect
C205	Same as C125	
C206	Same as C125	
C207	03000040	25 µf 50V Elect
C208A,B,C,D	03018200	30/10/10/10 µf Elect
C209	03002720	2.5 µµf ±5% 500V Ceramic
C210	Same as C105	
C212A,B	03003820	0.25/0.25 µf 600V Paper
C213	03115460	0.024 µf ±5% 400V Paper
C214	03033350	5100 µµf ±5% 500V Mica
C215	03030010	1300 µµf ±5% 500V Mica
C216	03021060	240 µµf ±5% 500V Mica
C217	03020860	36 µµf ±5% 500V Mica
C218	Same as C114	
C219	03029490	2700 µµf ±10% 500V Mica
C220	03013740	0.01 µf ±10% 400V Paper
C221	03126580	0.047 µf ±10% 200V Paper
C222A,B	03115480	0.5/0.5 µf ±10% 600V Paper
C223	03016360	0.05 µf 2000V Paper
C224	03018040	1 µf ±10% 2000V Paper
C225	03100510	400 µµf ±20% 2000V Mica
C226	03020880	43 µµf ±5% 500V Mica
C301	03020430	100 µµf ±10% 500V Mica
C302	Same as C103	
C303	Same as C125	
C304	03033610	3900 µµf ±10% 500V Mica
C305	Same as C112	
C306	03020450	150 µµf ±10% 500V Mica
C401	Same as C113	
C402	03014820	0.1 µf ±20% 600V Paper
C403	03012340	0.02 µf ±20% 200V Paper
C404	Same as C112	
C405	Same as C103	
C501	Same as C223	
C601	Same as C125	
C602	03003840	2 µf 600V Paper
C603	Same as C125	
C604	03002000	24 µf 350V Elect
C605	Same as C604	
C606	03017750	0.5 µf 2000V Paper
C607	Same as C606	
C608	Same as C606	
C609	Same as C606	
C610	03012470	80 µf 475V Elect
C611	03013770	15 µf 450V Elect
C612	Same as C610	
C613	Same as C611	
C614	Same as C611	
C615	Same as C125	
C616	Same as C125	
		CRYSTALS
CR201	26000630	Crystal Unit 1N34
		FUSES
F601	11001000	3 Amp.Cart.
	11000980	1.6 Amp.Cart. (For 230 V Operation)
		LAMPS
I601	12001310	0.15 Amp.Inc.
I602	Same as I601	
I603	Same as I601	
I604	Same as I601	
I605	Same as I601	
		BINDING POSTS
J101	09033250	Connector Female, 1 Contact
J102	51001290	Binding Post
J201	Same as J102	
J202	Same as J102	
J203	Same as J102	
J204	Same as J102	
J301	Same as J102	
J302	Same as J102	
J501	Same as J102	
J502	Same as J102	
		INDUCTORS
L103	21006101	2.5/5.50 µh Variable
L104	Same as L103	
L105	21006141	4/8 µh Variable
L106	Same as L105	
L107	21007911	1.7/3.0 µh Variable
L108	Same as L107	
L109	21004541	5/11 µh Variable
L110	Same as L109	
L111	21006510	3.9 µh
L112	Same as L111	
L201	21006151	120/220 µh Variable
L202	Same as L201	
L203	21A-12489	70/250 µh Variable
L301	21A-12820	996/2916 µh Variable
L302	Same as L301	
L401	21009221	7.5/19 mh Variable
L402	Same as L401	
L403	21009231	335/900 µh Variable
L404	Same as L111	
L601	21000550	5H 250 ma
L602	Same as L601	
		RESISTORS
R101	02041270	2 megohms ±5% 1/2W
R102	02040550	2,000 ohms ±5% 1/2W
R103	Same as R101	
R104	02040680	6,800 ohms ±5% 1/2W
R105	Same as R101	
R106	02040790	20,000 ohms ±5% 1/2W
R107	Same as R101	
R108	Same as R101	
R109	02040560	2200 ohms ±5% 1/2W
R110	02043860	39,000 ohms ±5% 1W
R111	02031610	47 ohms ±10% 1/2W
R112	02031770	1000 ohms ±10% 1/2W
R113	02030450	750 ohms ±5% 1/2W
R114	01011160	500 ohms ±20% 1/2W, Variable

TYPE 303-A CATHODE-RAY OSCILLOGRAPH

COMPONENT PARTS LIST (Continued)

Symbol	Part No.	Description
R115	02031650	100 ohms ±10% 1/2W
R116		
R117	02031810	2200 ohms ±10% 1/2W
R118	02034830	3300 ohms ±10% 1W
R119	02030400	470 ohms ±5% 1/2W
R120	Same as R119	
R121	02031560	18 ohms ±10% 1/2W
R122	02030470	910 ohms ±5% 1/2W
R123	02032030	150,000 ohms ±10% 1/2W
R124	01052600	2000 ohms ±30% 1/2W, Variable
R125	02031840	3900 ohms ±10% 1/2W
R126	02032010	100,000 ohms ±10% 1/2W
R127	Same as R119	
R128	Same as R119	
R129	01014100	500,000 ohms ±20% 1/2W, Variable
R130	02031670	150 ohms ±10% 1/2W
R131	02030910	62,000 ohms ±5% 1/2W
R132	Same as R119	
R133	Same as R115	
R134	Same as R119	
R135	02030930	75,000 ohms ±5% 1/2W
R136	Same as R124	
R137	02032040	180,000 ohms ±10% 1/2W
R138	Same as R137	
R139	02030750	13,000 ohms ±5% 1/2W
R140	02040920	68,000 ohms ±5% 1/2W
R141	02041260	1.8 megohms ±5% 1/2W
R142	02034770	1000 ohms ±10% 1W
R143	Same as R113	
R144	Same as R113	
R145	02030840	33,000 ohms ±5% 1/2W
R146	02036270	130 ohms ±5% 2W
R147	Same as R145	
R148	02031140	560,000 ohms ±5% 1/2W
R149	02030040	15 ohms ±5% 1/2W
R150	Same as R149	
R151	Same as R148	
R152	02112930	750 ohms ±10% 10W, Wire Wound
R153	02036360	330 ohms ±5% 2W
R154	Same as R153	
R155	Same as R153	
R156	Same as R153	
R157	Same as R153	
R158	Same as R153	
R159	Same as R126	
R160	02032210	4.7 megohms ±10% 1/2W
R161	01013200	100,000/100,000 ohms ±20% 1/2W, Variable
R162	Same as R160	
R163	02032050	220,000 ohms ±10% 1/2W
R164	01013800	500 ohms ±20% 1/2W, Variable
R165	02041040	220,000 ohms ±5% 1/2W
R166	02041230	1.3 megohms ±5% 1/2W
R167	02041200	1.0 megohms ±5% 1/2W
R168	Same as R111	
R201	Same as R122	
R202	Same as R117	
R203	02034850	4700 ohms ±10% 1W
R204	Same as R106	
R205	Same as R117	
R206	02032170	2.2 megohms ±10% 1/2W
R207	Same as R106	
R208	02031940	27,000 ohms ±10% 1/2W
R209	Same as R112	
R210	Same as R112	
R211	01014220	10,000 ohms ±20% 1/2W, Variable
R212	Same as R106	
R213	02031730	470 ohms ±10% 1/2W
R214	02034810	2200 ohms ±10% 1W
R215	Same as R130	
R216	Same as R126	
R217	02034990	68,000 ohms ±10% 1W
R218	Same as R106	
R219	02031950	33,000 ohms ±10% 1/2W
R220	01011090	200,000 ohms ±20% 1/2W, Variable
R221	Same as R106	
R222	02037870	6800 ohms ±10% 2W
R223	Same as R222	
R224	02037920	18,000 ohms ±10% 2W
R225	Same as R106	
R226	Same as R224	
R228	01013340	1 megohm/1 megohm 2W, Variable
R229	Same as R123	
R230	Same as R106	
R231	02031900	12,000 ohms ±10% 1/2W
R232	02036650	5100 ohms ±5% 2W
R233	Same as R123	
R234	Same as R219	
R235	02032020	120,000 ohms ±10% 1/2W
R236	02032240	8.2 megohms ±10% 1/2W
R237	Same as R236	
R238	Same as R236	
R239	02032180	2.7 megohms ±10% 1/2W
R240	Same as R239	
R241	Same as R236	
R242	Same as R236	
R243	Same as R236	
R244	02030330	240 ohms ±5% 1/2W
R245	02030140	39 ohms ±5% 1/2W
R246	02030180	56 ohms ±5% 1/2W
R247	02030600	3300 ohms ±5% 1/2W
R301	Same as R163	
R302	Same as R101	
R303	02031760	820 ohms ±10% 1/2W
R304	Same as R106	
R305	02034880	8200 ohms ±10% 1W
R306	02030610	3600 ohms ±5% 1/2W
R307	01014000	5000 ohms ±20% 1/2W, Variable
R308	Same as R106	
R309	01020530	10,000 ohms ±20% 2W, Variable
R310	Same as R106	
R311	Same as R123	
R312	Same as R307	
R313	Same as R307	
R314	Same as R106	
R315	02031850	4700 ohms ±10% 1/2W
R316	02030350	300 ohms ±5% 1/2W
R317	Same as R315	
R318	02030800	22,000 ohms ±5% 1/2W
R319	01038400	10,000 ohms ±30% 1/4W, Variable
R320	Same as R318	
R321	Same as R106	
R322	02034140	560,000 ohms ±5% 1W
R323	02032190	3.3 megohms ±10% 1/2W
R324	Same as R106	
R325	Same as R106	
R326	02034950	33,000 ohms ±10% 1W
R327	Same as R326	
R328	Same as R208	
R329	02036850	36,000 ohms ±5% 2W
R330	Same as R329	
R331	Same as R106	
R332	01014830	5000 ohms ±20% 2W, Variable
R333	02036750	13,000 ohms ±5% 2W
R334	Same as R333	
R335	Same as R208	
R336	Same as R329	
R337	Same as R329	
R338	Same as R106	
R401	01014050	200,000 ohms ±20% 1/2W, Variable
R402	02060100	180,000 ohms ±1% 1/2W
R403	02060080	18,000 ohms ±1% 1/2W
R404	02060060	1800 ohms ±1% 1/2W
R405	02060040	200 ohms ±1% 1/2W
R501	Same as R148	
R502	01008860	200,000 ohms ±20% 1/2W, Variable
R503	02035050	220,000 ohms ±10% 1W
R504	Same as R502	
R505	Same as R503	
R506	02034940	27,000 ohms ±10% 1W
R507	01024240	100,000 ohms ±20% 2W, Variable
R508	Same as R231	
R509	02035040	180,000 ohms ±10% 1W
R510	Same as R206	
R511	Same as R509	
R601	02032070	330,000 ohms ±10% 1/2W
R602	02030970	110,000 ohms ±5% 1/2W
R603	Same as R112	
R604	Same as R129	
R605	02032150	1.5 megohms ±10% 1/2W
R606	02032130	1 megohms ±10% 1/2W
R607	02106800	10,000 ohms ±5% 20W, Wire-wound
R609	Same as R163	
R610	Same as R601	
R611	02031980	56,000 ohms ±10% 1/2W
R612	Same as R112	
R613	Same as R125	
R614	Same as R125	
R615	02031800	1800 ohms ±10% 1/2W
R616	02038250	10 megohms ±10% 2W
R617	02037990	68,000 ohms ±10% 2W
R618	Same as R617	
R619	Same as R503	
R620	02038070	330,000 ohms ±10% 2W
R621	Same as R112	
R623	01044421	6 ohms ±10% 2W, Variable, Wire-wound
R625	02108110	25,000 ohms ±5% 10W, Wire-wound

TYPE 303-A CATHODE-RAY OSCILLOGRAPH

COMPONENT PARTS LIST (Continued)

Symbol	Part No.	Description
		SWITCHES
S101	05005711	Rotary 2P7T
S201	05004271	Rotary DP3T
S202	05005601	Rotary 7P7T
S301	05005611	Rotary 3P3T
S401	05004281	Rotary 3P9T
S601	05000420	Slide DPDT
S602	05001130	Toggle SPST
S603	05000510	Push SPST
		TRANSFORMERS
T601	20007011	Plate, Filament
		TUBES
V101	25002750	6AH6V
V102	Same as V101	
V103	Same as V101	
V104	Same as V101	
V105	Same as V101	
V106	Same as V101	
V107	25001860	5763
V108	Same as V107	
V201	Same as V101	
V202	25000790	6C4
V203	Same as V101	
V204	25000190	6J6
V205	25001530	12AT7
V206	25000050	6AU6
V301	25000130	12AU7
V302	Same as V204	
V303	Same as V301	
V304	Same as V204	
V305	Same as V204	
V401	25000020	6AL5
V501	25003900*	5YP1
	25003930*	5YP11
V502	Same as V401	
V601	25000340	6AQ5
V602	Same as V301	
V603	Same as V101	
V604	25000360	OB2
V605	Same as V601	
V606	25000170	6X4
V607	25006490	1X2A
V608	Same as V607	
V609	25000060	5U4G
V610	25000220	5Y3GT
V611	Same as V610	
		CABLES
W601	50015040	Cable, Assembly, Power

* Depending on Sales Order.

ADDENDUM

DU MONT TYPE 303-AH CATHODE-RAY OSCILLOGRAPH

1. PURPOSE

In the Du Mont Type 303-AH, a higher voltage intensifier supply and a different type cathode-ray tube (5XP-) are employed than in either the Type 303 or the Type 303-A. The result is a greater range of applications owing to greater light output from the cathode-ray tube. Thus, with the Type 303-AH, high-frequency patterns are more easily observed and photographed; signals of low repetition rate persist on the screen for a longer period of time, facilitating visual observation; leading and trailing edges of pulses having fast rise and fall times are more easily observed; single transits and repetitive pulse signals having a low-duty cycle may be more readily observed and photographed.

2. PHYSICAL DESCRIPTION

In appearance, the Type 303-AH resembles the Type 303-A with the exception of a voltage selector switch which is accessible through an opening on the right side of the cabinet. Either HIGH (10.3 KV) or LOW (7.3 KV) accelerating potential may be selected by this switch.

3. ELECTRICAL DESCRIPTION

Electrically, the circuit of the Type 303-AH is the same as that of the Type 303-A, except for the addition of the high-voltage power supply circuit for providing the greater accelerating potential. The complete Type 303-AH schematic is a part of this addendum and may be referred to in place of the schematic found at the back of the Type 303-A Operating and Maintenance Manual.

Since some of the Performance Specifications vary with accelerating potentials, the following table provides such specifications which are in variance with those given in Table 1-1 of the Type 303-A Manual.

TYPE 303-AH

PERFORMANCE SPECIFICATIONS*

CATHODE-RAY TUBE

Type	5XP-
Accelerating Potentials	Second Anode (A2): +1600 volts Intensifier (A3): +3000 volts; +7300 volts; +10,300 volts
Vertical Deflection (Max)	2.5 inches (A3 at 3KV) 1.5 inches (A3 at 7.3 KV) 1.6 inches (A3 at 10.3KV)

*See Table 1-1 of the Type 303-A Operating and Maintenance Manual for additional specifications.

Y AXIS

Deflection Factor

Total Accelerating Voltage	Y-Axis Deflection Factor (Volts /inch)			
	Amplifier at Full Gain		Direct To Deflection Plates	
	P-p	RMS	P-p	RMS
3.0 KV	0.1	0.035	28	10
7.3 KV	0.14	0.050	40	14
10.3 KV	0.16	0.057	46	16

Undistorted Deflection (Using Amplifier)

Symmetrical Signal..... (Through use of vertical positioning control)

3 inches (A3 at 3KV)
2.1 inches (A3 at 7.3 KV)
1.9 inches (A3 at 10.3KV)

Unidirectional Signal..... 1.5 inches (A3 at 3KV)
1.05 inches (A3 at 7.3 KV)
0.95 inches (A3 at 10.3KV)

X AXIS

Deflection Factor
(Amplifier at full gain)..... 0.35 peak-to-peak volt/inch or
0.12 rms volt/inch (A3 at 3KV)

0.5 peak-to-peak volt/inch or
0.18 rms volt/inch (A3 at 7.3KV)

0.6 peak-to-peak volt/inch or
0.21 rms volt/inch (A3 at 10.3KV)

Undistorted Deflection (Max)..... 4.25 inches (A3 at 3KV)
3.6 inches (A3 at 7.3 KV)
3.0 inches (A3 at 10.3KV)

Linear-sweep Time Base
Expansion To 6 times maximum undistorted screen deflection with no appreciable distortion

POWER SUPPLY

Fuse Protection
115-volt operation ..... 4 amperes (slow blow)
230-volt operation ..... 2 amperes (slow blow)

WEIGHT ..... 84 lbs.

4. INSTALLATION AND OPERATION

For installation and operating instructions, refer to the Type 303-A Operating and Maintenance Manual (Section II). The only additional information required is the procedure for selecting the cathode-ray tube accelerating potential (See paragraph 5).

5. SELECTION OF ACCELERATING POTENTIAL

It should be noted that certain advantages result from increased accelerating potential as follows:

1. Greater trace intensity. 2. Opportunity to observe faster writing-rate signals. 3. Ability to photograph signals of higher frequency or pulses with faster rise time.

Along with the above advantages, certain other effects result and should be considered when increasing accelerating potentials. These are:

1. Decreased deflection sensitivity. 2 Decreased undistorted deflection on screen. 3. Decreased maximum deflection. 4. Decreased maximum undistorted expansion both vertically and horizontally.

In many applications, these latter effects are not disadvantages; however, in some cases they may be limiting factors and should be examined for the effect produced. Refer to the table of Performance Specifications for details.

Figure 1 identifies the high-voltage selector switch and the high-voltage selector plug. When the Voltage Selector Switch is at HIGH, the over-all accelerating potential is 10.3 KV; when at LOW, 7.3 KV.

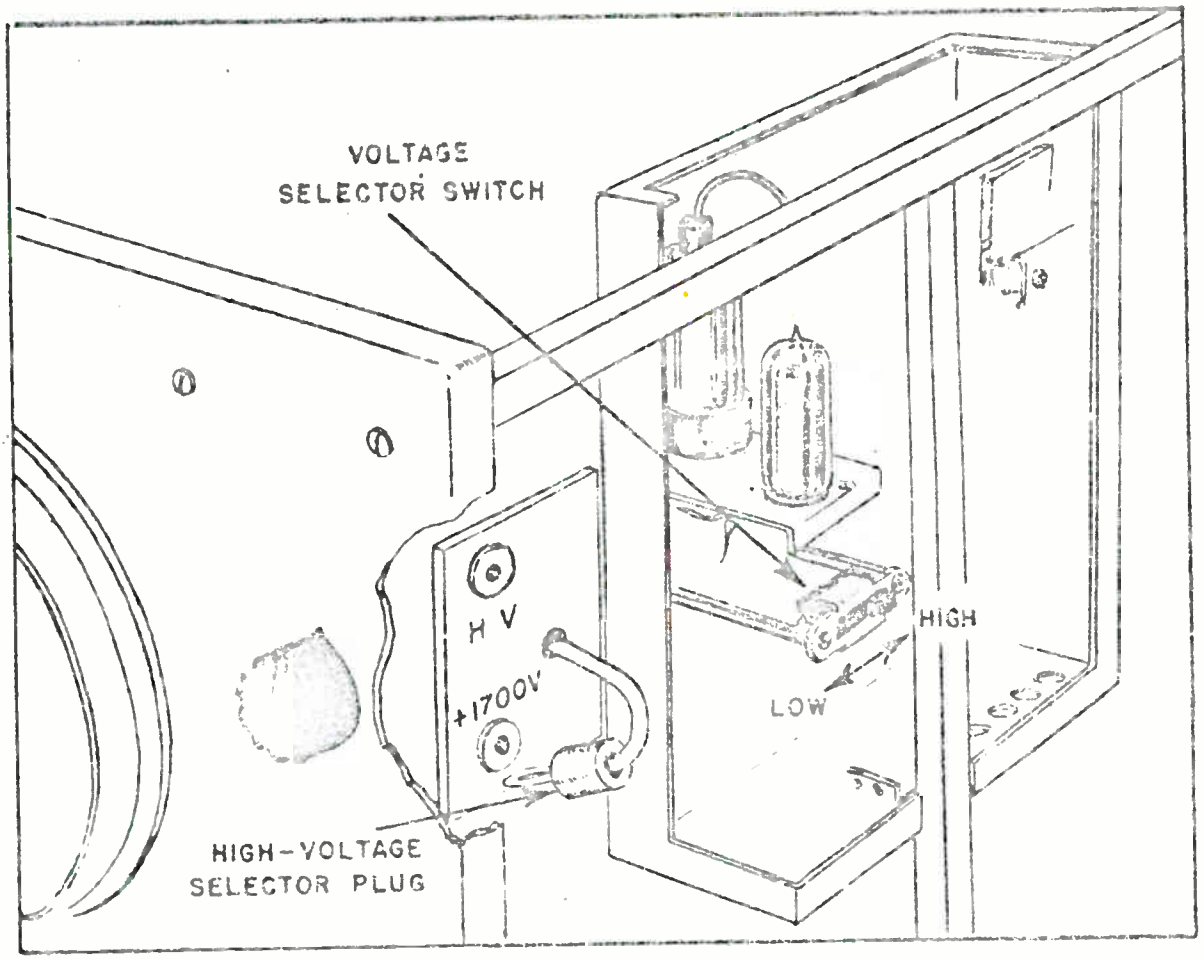


FIGURE 1

HIGH-VOLTAGE SELECTORS IDENTIFIED

If desired to reduce the over-all accelerating potential to 3 KV, proceed as follows: Disconnect the power cord from the line; remove the two screws holding the chassis to the rear of the cabinet and carefully slide the chassis out sufficiently to reach the small High-voltage Selector Plug (See Figure 1). Remove this plug from the HV jack and place it in the +1700-volt jack. (When the plug is in this position, the special high-voltage power supply output is not connected to the cathode-ray tube.)

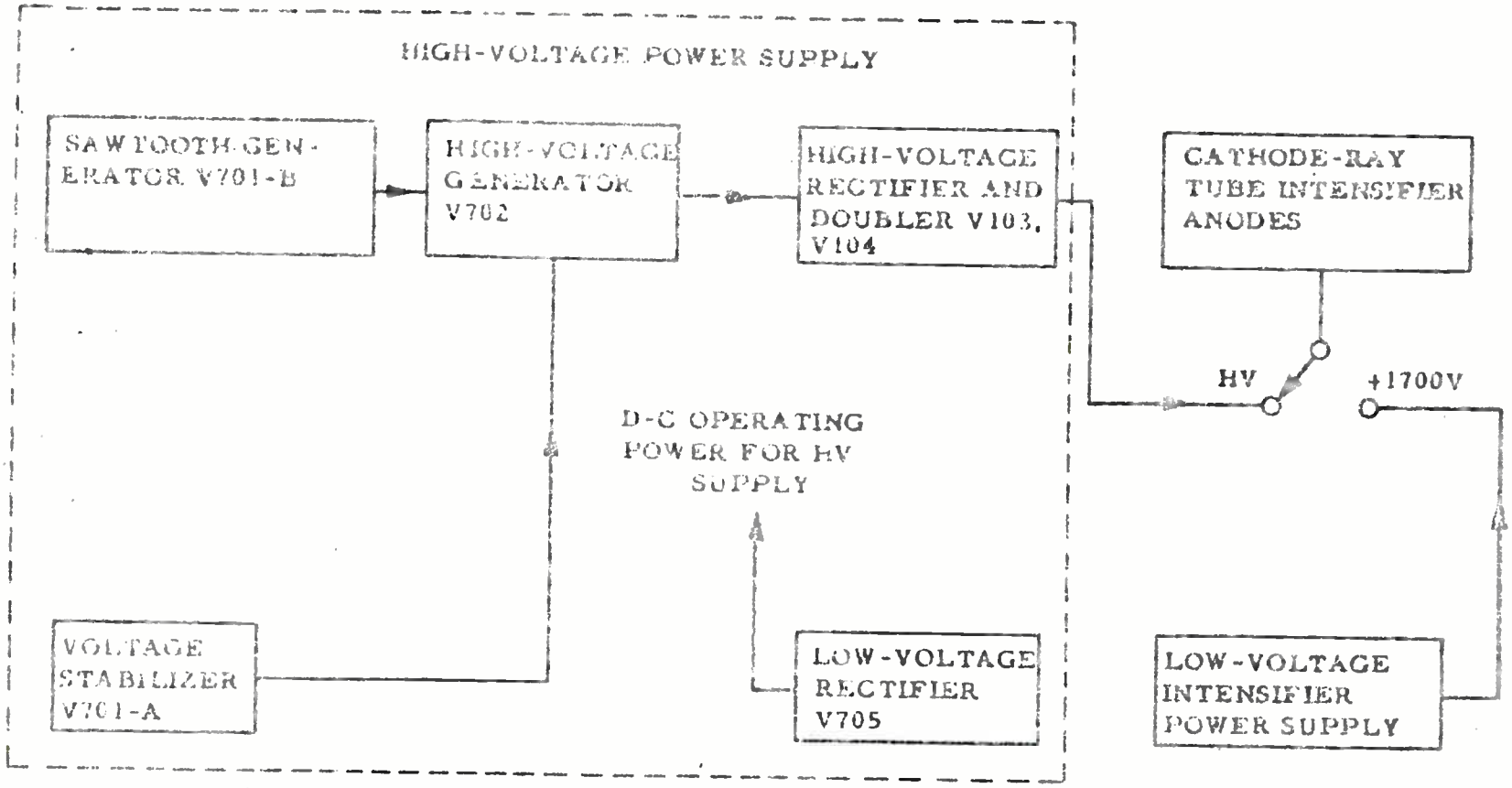


FIGURE 2. 303-AH HIGH-VOLTAGE POWER SUPPLY, SIMPLIFIED BLOCK DIAGRAM

Slide the chassis back in the cabinet and replace the two rear screws.

6. THEORY OF TYPE 303-AH HIGH-VOLTAGE POWER SUPPLY

a. GENERAL

The simplified block diagram (Figure 2) and the Type 303-AH schematic furnished with this addendum will be found useful in analyzing the power supply circuit.

b. BLOCK DIAGRAM

This supply is composed of: (1) a sawtooth generator, (2) a high-voltage generator, (3) a high-voltage rectifier and doubler, (4) a voltage stabilizier, and (5) a low-voltage rectifier.

c. CIRCUIT ANALYSIS

(1) SAWTOOTH GENERATOR

V701-B is a free-running blocking oscillator with R702 and C705 constituting the frequency-determining elements. Operation of the circuit is as follows: Assume plate current increases through the primary winding of T701; voltage is induced in the secondary winding in such a way as to increase the bias on the grid of V701-B. Due to regenerative action of the circuit, V701-B is quickly driven to cutoff permitting C705 to charge from the positive supply through R702. When the charging voltage across C705 reaches the necessary potential for "turning on" V701-B, the resulting low-impedance path to ground through V701-B rapidly discharges C705. This cycle is repetitive resulting in the generation of sawtooth waveforms at a frequency of approximately 20 kc.

(2) HIGH-VOLTAGE GENERATOR

The sawtooth waveform, generated at V701-B, is coupled to V702 through C704. V702 is driven to cutoff by the return portion of the sawtooth signal, producing a rapid plate-current change which shocks T702 into producing damped sinusoidal oscillations. The auto-transformer action of the T702 primary steps up the peak pulse voltage to approximately 3.5 or 5 kilovolts depending upon the setting of the voltage selector switch, S701, which determines the bias applied to V702. The high-voltage output from the supply is thus determined by the bias applied to V702.

(3) VOLTAGE STABILIZER

The voltage-stabilizer circuit consists of V701-A and the feedback winding of T702. Any output-voltage change results in induced voltage in this feedback winding, which is subsequently rectified by V701-A and applied as bias to the grid of V702. This "automatic" bias in turn controls the amplitude of the first cycle of the transient oscillation. The high-voltage output is thus [illegible] for [illegible] variations.

(4) [illegible]

[illegible] is coupled to [illegible] through V701.

(5) [illegible]

V705 is connected in a full-wave rectifier circuit [illegible] choke-input filter. The output [illegible] supplies the necessary d-c power for the proper operation of [illegible] power supply.

[illegible]

[illegible]

WARNING!

POTENTIALS AS HIGH AS 10,000 VOLTS ARE EMPLOYED IN THIS EQUIPMENT. OBSERVE THE FOLLOWING PRECAUTIONS WHEN NECESSARY TO ENERGIZE THE EQUIPMENT WITH DUST COVERS REMOVED.

(1) Never work alone.

(2) Remove power before changing any tube or [illegible]

(3) [illegible]

(4) [illegible]

VOLTAGE MEASUREMENTS[1]

TUBE			PIN NUMBER									
SYMBOL	TYPE	FUNCTION	1	2	3	4	5	6	7	8	9	CAP
V701	12AV7	(a) Voltage Stabilizer (b) Sawtooth Generator	-67V	-67V	65V	↑		250V	-70V	0V	↑	
						6.3VAC						
V702	6BQ6GT	High-voltage Generator	155V	↑	-70V	160V	-70V	-85V	↑	0V		DO NOT MEASURE
						6.3 VAC						
V703	5642	High-voltage Rectifier and Doubler	9KVAC	9KVAC								4.5 KV
			1.2VAC									
			(See Note 2)									
V704	5642	High-voltage Rectifier	9 KV	9 KV								0V
			1.2VAC									
			(See Note 2)									
V705	6X4	Low-voltage Rectifier	375VAC		350V	350V		375VAC				
					6.3VAC							
					(See Note 1)							

NOTE:

1. All d-c voltages measured from tube pins to chassis using a 20,000 ohms/volt test meter. All readings taken with voltage selector switch (HIGH-LOW) set at HIGH. All voltages are positive d-c unless otherwise indicated.
2. Measurement not recommended. Proper filament operation can generally be ascertained by noting filament glow.

b. TROUBLE SHOOTING DATA FOR THE HIGH-VOLTAGE POWER SUPPLY

(1) CIRCUIT VOLTAGES

The following table indicates the proper operating voltage from each effective tube pin to chassis. All values are nominal, and considerable variation may be experienced due to various line-voltage conditions and component tolerances. Generally, a variation of ±10% is to be expected and ±20% may not be uncommon. Good judgment is often required to determine if a particular deviation is indicative of trouble.

(2) WAVEFORM DATA

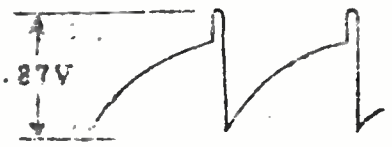
Checking with an oscillograph* for the presence of correct waveforms often aids in the diagnosis of component or circuit failure. Sketches showing typical waveforms at critical points are shown in Figure 3. Identification of the tube pins at which these waveforms are obtained and the peak-to-peak voltage amplitudes are given with each waveform. The peak-to-peak amplitudes shown are nominal and may vary by as much as 20% or more in some cases.

(3) PREVENTATIVE MAINTENANCE

The high-voltage power supply unit should be dusted frequently since electrostatically charged particles of dust will accumulate in the unit and create leakage paths.

If soldering is required in the repair of the supply, it will be necessary to "ball" the solder joint to minimize the possibility of corona discharge.

Care should be exercised in the installation of V703 and V704 to avoid damaging the element leads or chipping the bulb.



V701-B, Grid (pin 7)

V701-B, Plate (pin 8)

V702, Grid (pin 5)

V702, Plate (CAP)

FIGURE 3: TYPICAL WAVEFORMS AT CRITICAL POINTS

*The Type 303-AH itself may be used to check waveforms in the high-voltage supply, provided of course that all other circuits are operating properly.

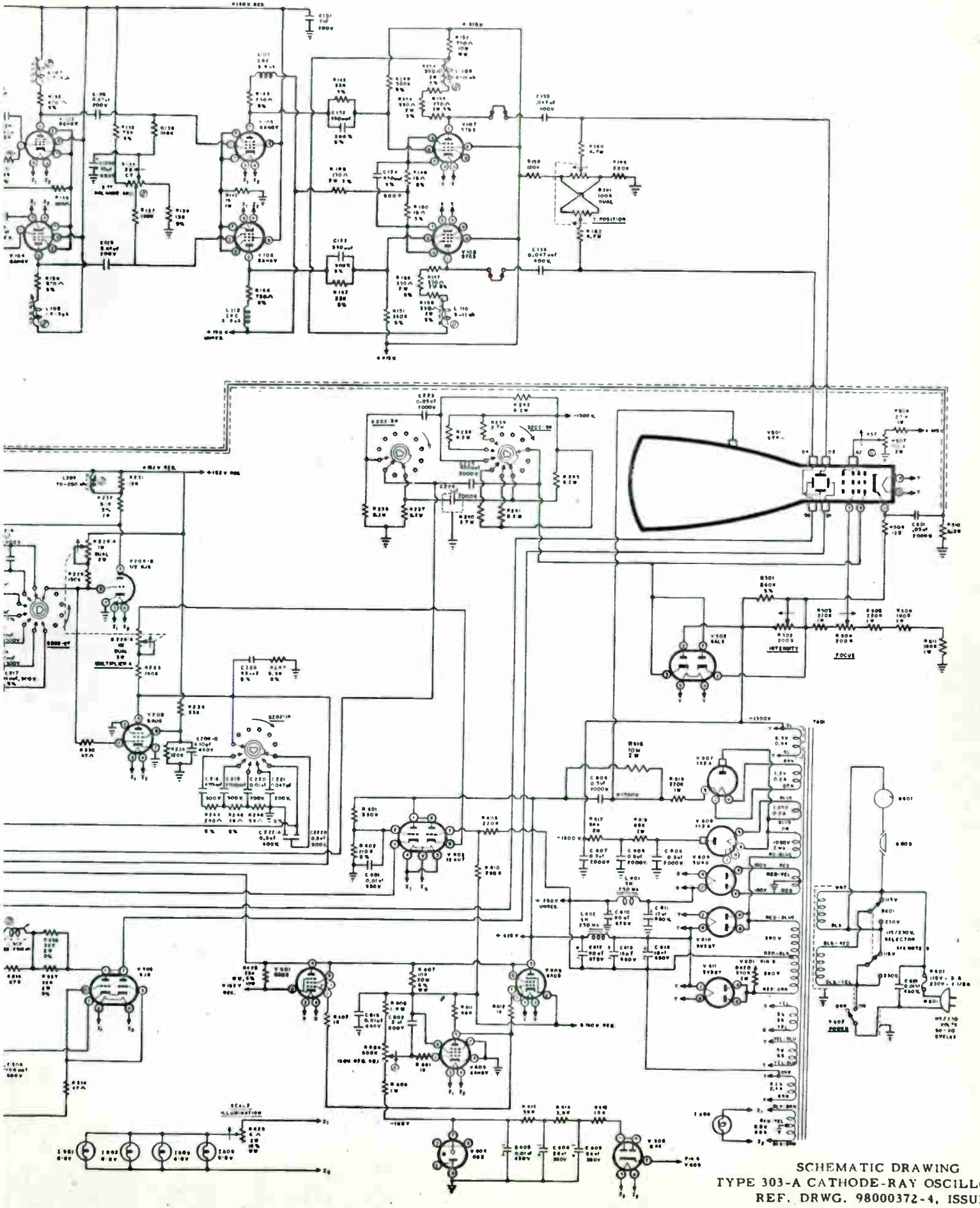
COMPONENT PARTS LIST

Symbol	Part Number	Description
Transformers		
T701	20005591	Block Oscillator Transformer
T702	20007092	High Voltage Transformer
T703	20007081	Power Transformer
Tubes		
V701	25000130	12AU7
V702	25001830	6BQ6GT
V703	25005740	5642
V704	Same as V703	
V705	25000170	6X4

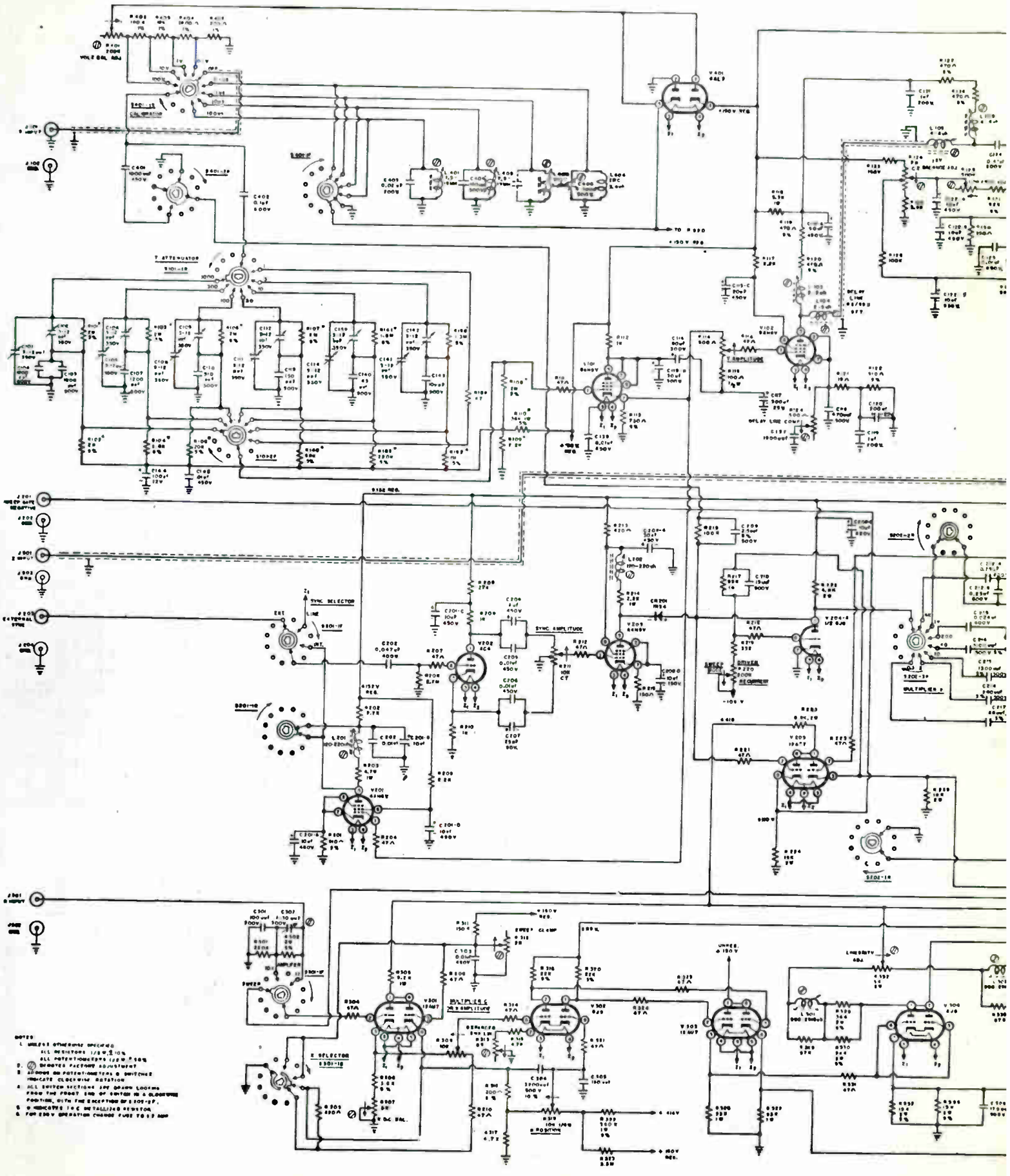
COMPONENT PARTS LIST - HIGH VOLTAGE POWER SUPPLY

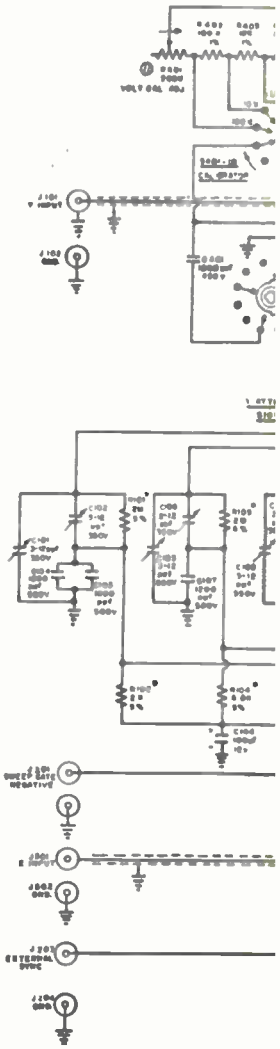
Symbol	Part Number	Description
Capacitors		
C701	0-019-50	0.01 µf 4kV Volt Ceramic
C702	Same as C701	
C703	Same as C701	
C704	Same as C701	
C705	0-021-60	240 µµf ±5% 500 Volt Mica
C706	0-119-70	0.1 µf ±20% 400 Volt Paper
C707	0-115-60	4700 µµf ±20% 5000 Volt Paper
C708	0-111-390	500 µµf ±10% 20 Volt Ceramic
C709	Same as C708	
C710	0-120-59	10 µf 450 Volt Dual
Inductors		
L701	21010-20	1.5 µh Axial
Resistors		
R701	0-034-65	49,900 ohms ±1% 1W
R702	0-203-30	100,000 ohms ±5% 1/2W
R703	Same as R702	
R704	Same as R702	
R705	0-203-30	68 ohms ±10% 1 2W
R706	0-203-40	27,000 ohms ±5% 2W
R707	Same as R705	
R708	Same as R706	
R709	0-210-5	4.7 ohms ±10% 1/2W ww
R710	Same as R709	
R711	0-203-50	390,000 ohms ±5% 1/2W
R712	0-203-50	200,000 ohms ±5% 1/2W
R713	0-203-30	100,000 ohms ±10% 1W
R714	0-202-20	50 ohms ±5% 2W
R715	Same as R711	
R716	Same as R711	
Switches		
S701	0-500-1	SPDT Slide

* Order type 307-A and the Tube Parts List for Type 307-A Operating & Maintenance Manual



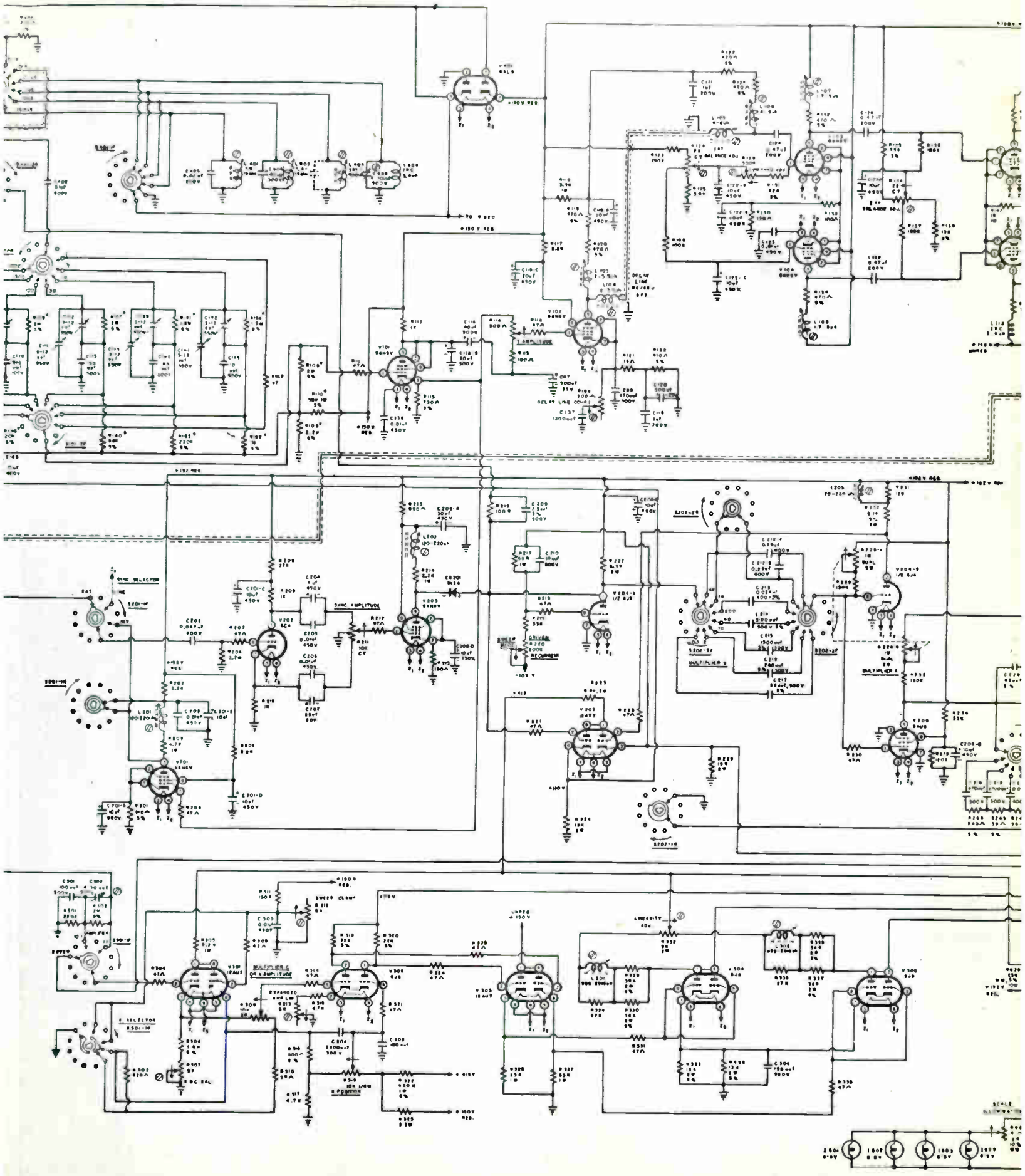
SCHEMATIC DRAWING
TYPE 303-A CATHODE-RAY OSCILLOGRAPH
REF. DRWG. 98000372-4, ISSUE 11

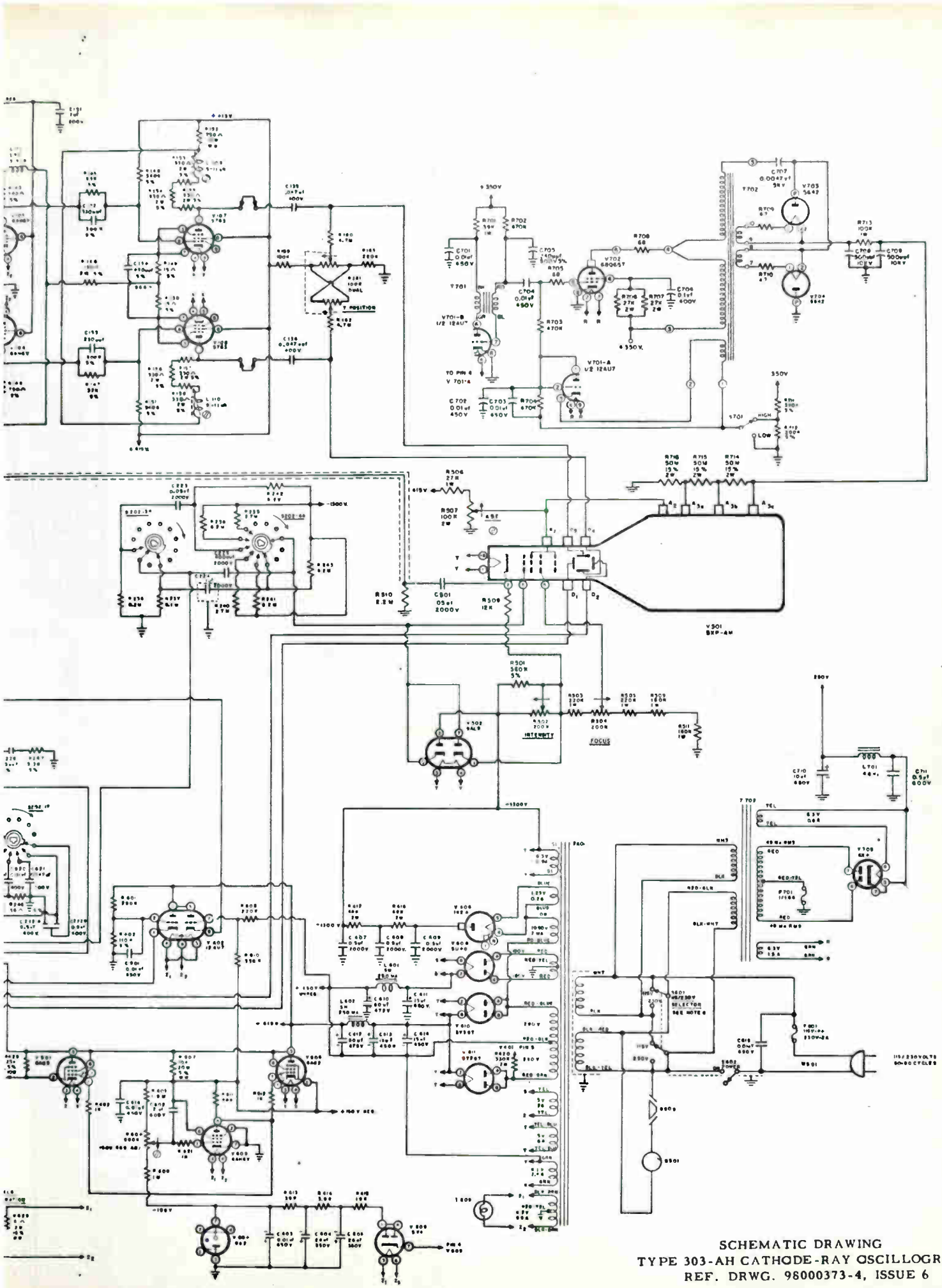




NOTES

1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS 1/2 W ±10%
   ALL POTENTIOMETERS 1/2 W ±20%
2. ○ INDICATES FACTORY ADJUSTMENT
3. SHADED ON POTENTIOMETERS & SWITCHES INDICATES CLOCKWISE ROTATION
4. ALL SWITCH SECTIONS ARE SHOWN LOOKING FROM THE FRONT END OF SWITCH IN A COUNTERCLOCKWISE POSITION, WITH THE EXCEPTION OF S202-B.
5. ⊙ INDICATES NON METALLIZED RESISTOR.
6. FOR 230 V OPERATION CHANGE FUSE TO 0.6 AM





SCHEMATIC DRAWING
TYPE 303-AH CATHODE-RAY OSCILLOGRAPH
REF. DRWG. 98000373-4, ISSUE 6

Date Last Calibration Sept 7, 1960

Calibrated By CM&S Inst Repair

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