

V603 is also connected in a half-wave rectifier circuit, the output from which is filtered by a single section R-C type filter. Potential at the output of this filter is approximately +1600 volts and supplies the necessary potential to the intensifier electrode of the cathode-ray tube.

e. REGULATED HEATER SUPPLY

A regulated heater supply on the first and second stages of the Y-axis amplifier provides good vertical stability. A series-connected thermal regulator (V606) controls the heater temperature to stabilize cathode emission over a  $\pm 10\%$  range of variation in supply voltage. In addition, a HUM BALANCE potentiometer (R144) is included in the filament circuit of V101 and V102 to reduce line-frequency modulation to a minimum.

## SECTION IV MAINTENANCE

**WARNING!**

This equipment employs high voltages that are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working on the equipment.

### 1. GENERAL SYSTEM TROUBLE SHOOTING

It is assumed that maintenance personnel are thoroughly familiar with the physical make-up of the equipment, the installation and operating procedures, and the detailed theory of operation given elsewhere in this handbook.

Maintenance personnel must be prepared to repair and adjust the equipment should it fail in operation. The trouble must be located; and after repairs have been made, the equipment must be tested and adjusted to conform to the original specifications. Maintenance personnel must endeavor to find the source of the trouble that causes each equipment failure, particularly when the trouble is a recurrent one. The recurrence of a fault usually indicates the effect, not the cause, has been remedied. No back-of-panel adjustment should be undertaken except where evidence points to trouble in the particular section of the instrument affected by the control.

### 2. THEORY OF LOCALIZATION

The first step in correcting any trouble or failure that may occur is to isolate the section of the circuit that is 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. As an aid in servicing, Trouble Shooting Chart, Table 4-1, indicates causes and remedies for certain specific troubles.

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.

An over-all schematic of the circuit, together with a tube location diagram (Figure 4-5), will be found at the back of this section and should be consulted while trouble shooting. A list of component electrical parts, including descriptions, will be found following the tube location diagram.

TABLE 4-1  
TROUBLE SHOOTING CHART

POWER SUPPLY AND CRT CIRCUITS		
Symptom	Probable Cause	Remedy
POWER indicator lamp fails to light.	SCALE switch in OFF position. No a-c line voltage. POWER indicator lamp open. Power cable defective. Filament transformer defective. (Check by measuring voltage across POWER indicator lamp, terminals 7 and 8, which should measure 6.3 volts a-c). Fuse defective. 115-230 Voltage Selector Switch (S601) defective.	Turn SCALE (POWER) switch on. Trace line failure. Replace I405. Repair or replace cable. Replace T601. Replace F601. Make certain the 115/230 voltage selector switch is set at the proper voltage. Check continuity of switch with POWER at OFF. Replace switch if found defective. CAUTION: S601 must be wired in accordance with the overall schematic drawing to insure the proper phase relationship of primary transformer T601.
Line fuse blows instantly when POWER switch is turned "on".	Defective rectifier tube or filter capacitor.	Check filter capacitors C606-A, C606-B, C606-C, C606-D, C601 and C602 for low resistance or short. If found OK, replace rectifier tubes V603, V604 and V605. NOTE: If a filter capacitor is shorted, quite probably a rectifier tube may also be defective.
Some filaments fail to light.	Defective tube or tubes. Broken lead from filament transformer. (Check filament voltage at tube socket and continuity to filament transformer T601). Filament transformer, T601, defective. (Check filament voltage at each winding of T601).	Replace burned out tubes. Repair. Replace.
Vertical displacement of trace with no input to Y amplifier.	No +110V regulated supply.	Replace Voltage Regulator V601.
Low beam intensity; increased deflection sensitivity of cathode-ray tube. (No voltage on intensifier, A3.)	Positive high voltage rectifier defective. R604 open circuited. C603 or R605 shorted.	Replace V603. Replace. Replace.

TABLE 4-1  
TROUBLE SHOOTING CHART (Continued)

Symptom	Probable Cause	Remedy
No spot on cathode-ray tube screen.	Defective negative high voltage rectifier V604. (Check voltage on cathode-ray tube--cathode (pin 2), grid (pin 3), first anode (pin 5). If voltage appears on any of these electrodes, as per Table 4-2, this is probably not the cause.) C605 shorted. R606 open-circuited. C604 shorted.	Replace V604. Replace. Replace. Replace.
No spot on cathode-ray tube screen. (All CRT voltages normal.)	Defective cathode-ray tube (V401).	Replace V401.*
No sweep. Horizontal deflection circuit (X axis) checks OK.	X SELECTOR switch is not set at RECURRENT SWEEP. Inadequate amplitude of sync signal when X SELECTOR is set at DRIVEN. INTENSITY control set too low. Sweep generator (V303) inoperative. Sweep output cathode follower (V304-B) inoperative. Sweep charging capacitors defective (C306, C307, C308, C310 and C311).	Rotate switch to RECURRENT SWEEP. Adjust SYNC AMPLITUDE control for the proper phase and amplitude of the synchronization signal. Increase INTENSITY. Check tube.* Check pin voltages and continuity to ground per Table 4-2. Check tube.* Check pin voltages and continuity to ground per Table 4-2. Replace defective capacitors.
No sweep. X SELECTOR switch set at RECURRENT	DRIVEN SWEEP BIAS out of adjustment (R319).	Readjust bias so that sweep starts operating. (Refer to the paragraph entitled, "Factory Adjustment for the Sweep Circuit" in this Section).
Sweep fails to expand equally in both directions as the AMPLITUDE control is advanced.	Sweep DC LEVEL control out of adjustment (R403).	Readjust R403.
Nonlinearity of sweep observed at a frequency of approximately 300 cycles per second.	Sweep-output attenuator trimmer requires adjustment (C313).	Refer to the paragraph entitled, "Factory Adjustment for the Sweep Circuit" in this Section.
No sweep available at SAW-TOOTH or EXTERNAL CAPACITOR terminal when X SELECTOR switch is set at RECURRENT SWEEP; sweep is present on cathode-ray tube screen.	Sweep coupling capacitor open (C505). R512 open. R513 shorted.	Replace. Replace. Replace. Check continuity of SWEEP RANGE switch (Section S302-1R).

TABLE 4-1  
TROUBLE SHOOTING CHART (Continued)

Symptom	Probable Cause	Remedy
Horizontal trace present on cathode-ray tube screen when X SELECTOR switch is set at DRIVEN SWEEP. SYNC AMPLITUDE control is set at "Q."	Driven sweep limiter diode (V304-A) inoperative.	Check tube.* Check pin voltages and continuity to ground per Table 4-2. If V304-A checks OK, the Driven Sweep BIAS is out of adjustment. Refer to the paragraph entitled, "Factory Adjustment for the Sweep Circuit" for the proper adjustment procedure.
Loss of synchronization	Sync amplifier and phase splitter (V301) inoperative.  SYNC SELECTOR switch is not in the proper position for the desired mode of operation.  SYNC AMPLITUDE control is not set to the proper polarity.  Defective coupling capacitors: C302, C303, C304 or C301.	Check tube.* Check pin voltages and continuity to ground per Table 4-2.  Set SYNC SELECTOR switch at INTERNAL when X SELECTOR switch is set at either DRIVEN or RECURRENT SWEEP. External sync signals may be employed if SYNC SELECTOR is set at EXTERNAL.  If X SELECTOR is set at AMPLIFIER (AC or DC), SYNC SELECTOR must be set at EXTERNAL. If line frequency excitation is employed, SYNC SELECTOR should be set at LINE.  Change polarity.  Replace defective capacitor.
Return trace is visible with normal INTENSITY control setting.	Differentiating network C314 and R325 defective.  Return trace blanking amplifier (V305-A) inoperative.  Return trace blanking coupling capacitor open (C401).	Replace.  Check tube.* Check pin voltages and continuity to ground per Table 4-2.  Replace defective capacitor.
No sync of vertical deflection signals when SYNC SELECTOR switch is set at INTERNAL.	SYNC AMPLITUDE control defective (R308).  Sync coupling capacitor open (C302).  Sync amplifier and phase splitter (V301) inoperative.	Replace.  Replace.  Check tube.* Check pin voltages and continuity to ground per Table 4-2.
X SELECTOR switch is set at either DRIVEN or RECURRENT SWEEP. Sweep is distorted at the maximum setting of the SYNC AMPLITUDE control.	Sync limiter diode (V302) inoperative.	Replace defective diode.

TABLE 4-1  
TROUBLE SHOOTING CHART (Continued)

Symptom	Probable Cause	Remedy
An appropriate negative signal applied to Z INPUT does not blank the trace.	Intensity modulation coupling capacitor open (C402).  R401 shorted.  Z INPUT coaxial cable open.	An appropriate negative signal of approximately 15 volts peak is necessary to blank the trace. If no result is experienced when this amplitude of signal is applied to Z Input, replace C402.  Replace.  Check continuity of cable with SCALE switch at OFF. Repair or replace if found defective.
VERTICAL DEFLECTION CIRCUIT (Y AXIS)		
An appropriate signal is applied to Y INPUT. No vertical displacement of the trace results.	VOLTS FULL SCALE (attenuator) switch is set at OFF.  One or more of the vertical deflection circuit tubes are inoperative (V101 through V106 inclusive).	Set VOLTS FULL SCALE (attenuator) to either A-C or D-C AMPLIFIER.  Check tubes.* Check pin voltages and continuity to ground per Table 4-2.
No vertical signal when VOLTS FULL SCALE is set at A-C AMPLIFIER; signal is present when VOLTS FULL SCALE is switched to D-C AMPLIFIER.	Input coupling capacitor open (C101).	Replace.
A 10-kc square wave, applied to Y INPUT, is distorted at 1V, 10V, 100V, positions of the VOLTS FULL SCALE (attenuator) switch.	Y attenuator compensation capacitors out of adjustment (C102, C104 and C106).	Refer to the paragraph entitled, "Factory Adjustments for the Y Amplifier" for the proper adjustment procedure.
Y POSITION control is set at center of its range; trace is not centered vertically on cathode-ray tube screen.	Position centering adjustment (Y CTR) out of adjustment (R121).	Set VOLTS FULL SCALE at OFF and Y POSITION control at the mechanical center of its range; adjust R121 to bring the trace on the cathode-ray tube to the vertical center of the screen.
VOLTS FULL SCALE is set at OFF; CRT trace shifts (up and down) with changes in the setting of the MULTIPLIER (amplitude) control.	D-C BALANCE control out of adjustment (R110)	Refer to the paragraph entitled, "Factory Adjustments for the Y Amplifier" in this section for the proper adjustment procedure.
Size of pattern changes as it is positioned vertically on CRT screen.	Y LINEarity out of adjustment (R136).	Refer to the paragraph entitled, "Factory Adjustment for the Y Amplifier" in this section for the proper adjustment procedure.
No vertical displacement of CRT trace when a signal is applied to the appropriate vertical deflection-plate input terminals. (Jumpers are connected for direct input).	Direct input coupling capacitor(s) open (C110 and/or C111).	Replace.

TABLE 4-1

## TROUBLE SHOOTING CHART (Continued)

Symptom	Probable Cause	Remedy
HORIZONTAL DEFLECTION CIRCUIT (X AXIS)		
No sweep. Sweep circuit checks OK; X SELECTOR is set at RECURRENT SWEEP.	Check continuity of X SELECTOR Switch (Section S501-2R). Horizontal deflection circuit (X axis) inoperative.	Repair or replace if found defective.  Check horizontal deflection circuit (X axis) as outlined in this chart below.
An appropriate signal is applied to X INPUT. No horizontal displacement of the trace results. (X SELECTOR is set at either A-C or D-C AMPLIFIER).	One or more of the horizontal deflection circuit tubes are inoperative (V305-B and V501 through V503).	Check Tubes.* Check pin voltages and continuity to ground per Table 4-2.
No horizontal signal when X SELECTOR is set at A-C AMPLIFIER; signal is present when X SELECTOR is switched to D-C AMPLIFIER.	Input coupling capacitor open (C501).	Replace.
X POSITION control is set at center of its range; trace is not centered horizontally on the cathode-ray tube screen.	Position centering adjustment (X CTR) out of adjustment (R508).	Set X SELECTOR at OFF and X POSITION control at the mechanical center of its range; adjust R508 to bring the trace on the cathode-ray tube to the horizontal center of the screen.
X SELECTOR is set at OFF; CRT trace shifts (left and right) with changes in the setting of the AMPLITUDE control.	D-C BALANCE control out of adjustment (R506).	Refer to the paragraph entitled "Factory Adjustments for the X Amplifier" in this section for the proper adjustment procedure.
Size of pattern changes as it is positioned horizontally on CRT screen.	X LINEarity out of adjustment (R526).	Refer to the paragraph entitled "Factory Adjustments for the X Amplifier" in this section for the proper adjustment procedure.
No horizontal displacement of CRT trace when a signal is applied to the appropriate horizontal deflection-plate input terminals. (Jumpers are connected for direct input.)	Direct input coupling capacitor(s) open (C510 and/or C511).	Replace.
*If tube replacement is necessary, refer to "Adjustments to be Made When Replacing Tubes," Table 4-3.		

## 3. CIRCUIT VOLTAGES AND RESISTANCES

Table 4-2 lists voltages and resistances from tube pins to ground. Unless otherwise specified, voltage measurements are made with a meter having an internal resistance of 20,000 ohms per volt. Voltages measured with a meter having a lower internal resistance may in some cases be lower than the values shown in the table.

TABLE 4-2

## VOLTAGE AND RESISTANCE MEASUREMENTS\*

Preset front-panel controls according to the following chart:			
CONTROL	POSITION	CONTROL	POSITION
Y POSITION	CENTER	VOLTS FULL SCALE	OFF
X POSITION	CENTER	X SELECTOR	RECUR
INTENSITY	MAX CCW	SWEEP RANGE	50-250
FOCUS	MAX CW	MULTIPLIER	4
SYNC SELECTOR	LINE	(X) AMPLITUDE	MAX CCW
SWEEP VERNIER	CENTER	CALIBRATOR	OFF
SYNC AMPLITUDE	MAX CCW		

TABLE 4-2

## VOLTAGE AND RESISTANCE MEASUREMENTS

Symbol	TUBE Type	Function	PIN NUMBERS								
			1	2	3	4/	5/	6	7	8	9/
V101	5963	Input Cathode Follower	20K	220K	4.4K	0-250 -0	0-250 -0	20K	220K	4.4K	0-250 -0
			110V	0V	5V	0-6.3 Volts AC	0-6.3 Volts AC	110V	0V	5V	6.3-0 Volts AC
V102	5963	Paraphase Amplifier	20K	5K	1.5K	0-250 -0	0-250 -0	20K	4.4K	1.5K	0-250 -0
			62V	5.5V	7V	12.6 -6.3V AC	12.6 -6.3 AC	62V	5.5V	7V	6.3-0 Volts AC
V103	12AU7	1st Push-Pull Amplifier	30K	17.5K	8.2K	0	0	30K	17.5K	8.2K	0
			65V	32V	33V	3.2V AC	3.2V AC	65V	32V	33V	3.2V AC
V104	12AU7	2nd Push-Pull Amplifier	20K	30K	28K	0	0	22K	30K	28K	0
			100V	65V	65V	3VAC	3VAC	100V	65V	65V	3VAC
V105	6AQ5	3rd Push-Pull Amplifier		18K	0	0	44K	140K	24K		
				107V	3VAC	3VAC	180V	218V	100V		
V106	6AQ5	3rd Push-Pull Amplifier		18K	0	0	44K	140K	24K		
				107V	3VAC	3VAC	180V	218V	100V		
V301	12AU7	(a) Sync Amplifier (b) Sync Phase Splitter	90K	2.2 Meg.	10K	0	0	280K	100K	1.8K	0
			100V	**10V	19V	3VAC	3VAC	20V	0V	0.8V	3VAC
V302	6AL5	Sync Limiter Diode		100K	0	0	0				
				-0.5V	3VAC	3VAC	0V				
V303	6Q5G	Sweep Generator		0	330K	1K	120K		0	2K	
				3VAC	30V	4.2V	-0.4 V		3VAC	3.6V	
V304	12AU7	(a) Driven Sweep Limiter (b) Sweep Output Cathode Follower	350K	350K	20K	0	0	35K	350K	175K	0
			30V	30V	55V	3VAC	3VAC	340V	30V	60V	3VAC

\*Obtained when using a 20,000 ohms/volt test meter. 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.

TABLE 4-2

VOLTAGE AND RESISTANCE MEASUREMENTS (Continued)

TUBE			PIN NUMBERS										
Symbol	Type	Function	1	2	3	4/	5/	6	7	8	9/		
V305	12AU7	(a) Return Trace Blanking Amplifier (b) Series Dropping Triode	125K	15K	0	0	0	20K	125K	18K	0		
			35V	-0.3V	0V	3VAC	3VAC	340V	65V	75V	3VAC		
V501	12AU7	Input Cathode Follower	30K	200K	8K	0	0	30K	0	6K	0		
			310V	0V	18V	3.1V AC	3.1V AC	310V	0V	18V	3.1V AC		
V502	6J6	Paraphase Amplifier	28K	28K	0	0	7K	10K	5.6K				
			58V	58V	3VAC	3VAC	18V	18V	19V				
V503	6J6	Push-Pull Amplifier	83K	83K	0	0	28K	28K	12K				
			200V	200V	3VAC	3VAC	58V	58V	75V				
V601	OB2	+110V Voltage Regulator					20K	0					
							110V	0V					
V602	6AL5	Voltage Calibrator	65K	0	0	0	200K		200K				
			128V	0V	3VAC	3VAC	65V		65V				
V603	1X2A	+1600 V Rectifier	10 Meg	10 Meg									
			1600V DC	1600V DC								CAP 1380VAC	
V604	1X2A	-1400 V Rectifier	2K	2K									
			1380V AC	1380V AC								CAP -1400 VDC	
V605	5Y3GT	+360 V Rectifier		20K		175		175		20K			
				370V		400V AC		400V AC		370V			
V606	3-14	Amperite Regulator		5.5					6.5	5.5			
				5.6V AC					24.5V AC	5.8V AC			
V401	5ADP-	Cathode-ray Tube	1	2	3	5	7	8	9	10	11	14	A3
			1 Meg	1 Meg	1.2 Meg	700K	45K	45K	44K	100K	70K	1 Meg	10 Meg
			-1400 V	-1400 V	-1400 V	-900 V	+180 V	+180 V	190V	200V	200V	-1400 V	+1600 V

\*\*Obtained when using a vacuum-tube voltmeter.

/Values on V101 and V102 depend upon setting of grounded arm HUM BALANCE potentiometer (R144)

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

#### 4. SELECTING 115- OR 230-VOLT LINE

Provision is made in the Types 304-A and 304-AR for changing from 115- to 230-volt line operation or vice versa. To accomplish this, remove the chassis or dust cover and set the 115/230-volt selector switch (S601), located at the rear of the chassis, at the desired voltage. Replace fuses in accordance with the appropriate note on the over-all schematic at the back of this section.

## 5. FACTORY ADJUSTMENTS

### a. GENERAL

#### - WARNING -

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

In order to avoid component pre-selection, a number of factory adjustments have been included in this instrument. Only two such adjustments are necessary if the instrument is operating normally. These are the D-C BALANCE adjustments for the X and Y amplifiers, located on the front panel of the instrument. Certain factory adjustments may need to be reset when replacing tubes; Table 4-3 lists these adjustments. Before making any adjustments, a 10-minute warm-up period should be allowed. For identification and location of the back-of-panel controls, see Figures 4-1 through 4-3.

### b. TEST EQUIPMENT REQUIRED

Description	Range of Characteristics
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 10kc

### c. FACTORY ADJUSTMENTS FOR Y AMPLIFIER

(1) Position Centering Adjustment (Y CTR) - R121 - This adjustment is set to bring the trace on the cathode-ray tube to the center of the screen vertically with no signal input (VOLTS FULL SCALE) at OFF and Y POSITION control at the mechanical center of its range (pointing up).

(2) Sensitivity Adjustment (Y SEN) - R128 - This control should be set to give the amplifier a sensitivity of 9 millivolts per inch rms or 25 millivolts per inch d-c at full gain. To make this adjustment, refer to the paragraph entitled "Factory Adjustments for the Voltage Calibrator" in this section.

TABLE 4-3

## ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES

Tube Reference Symbol	Type	1st Readjustment	2nd Readjustment	3rd Readjustment
V101**	5963	(Y) D-C BAL (R110)	HUM BAL (R144)	
V102**	5963	Y CTR (R121)	Y SEN (R128)	*Y CTR (R121)
V103	12AU7+	Y SEN (R128)	Y CTR (R121)	
V104	12AU7+	Y LIN (R136)	Y SEN (R128)	Y CTR (R121)
V105	6AQ5	Y LIN (R136)	Y SEN (R128)	Y CTR (R121)
V106	6AQ5	Y LIN (R136)	Y SEN (R128)	Y CTR (R121)
V301	12AU7+			
V302	6Q5G	DR SW BIAS (R319)	SW D-C LEVEL (R403)	LF ADJ (R315)
V303	12AU7+			
V304	12AU7+			
V401	5ADP-	Y SEN (R128)	Y CTR (R121)	
V501**	12AU7+	(X) D-C BAL (R506)	X CTR (R508)	
V502	6J6	X CTR (R508)		
V503	6J6	X LIN (R526)		
V601	OB2			
V602	6AL5	CAL ADJ (R602)	Y SEN (R128)	Y CTR (R121)
V603	1X2A			
V604	1X2A			
V605	5Y3GT			
V606	3-14			

\*The Y CTR control needs readjustment at this point because the Y POSITION control is dependent on Y SEN. The latter control cannot be listed as the second readjustment when replacing V102 because in doing so may result in displacing the pattern so far off the screen that the Y POSITION control has no effect on the pattern.

\*\*V101, V102, and V501 are preselected tubes and may prove critical in replacement. The Du Mont Instrument Service Department can supply tubes specifically selected for these positions.

+Type 5963 tubes may be substituted for Type 12AU7 with no loss in performance, provided balanced tubes are selected where necessary.

(3) Hum Balance Adjustment (HUM BAL) - R144 - This control should be adjusted to give minimum ripple on the trace. To make this adjustment, shield the Y INPUT terminals and the bottom of the chassis (under the Y attenuator), and set the VOLTS FULL SCALE switch and MULTIPLIER to give maximum amplifier sensitivity. Then adjust HUM BALANCE potentiometer (R144) to give minimum residual ripple (0.02" max.).

(4) Linearity Adjustment (Y LIN) - R136 - To make this adjustment, apply a square-wave signal to the Y INPUT and adjust for 1 inch vertical deflection at the center of the screen. Position pattern 1-1/2 inches up and 1-1/2 inches down and observe whether vertical size of pattern becomes greater, or smaller, away from the center of the screen. If the size changes, adjust the Y LIN control until a minimum change in size with positioning occurs. When this adjustment is made, reset the Y CTR adjustment (R121). It may also be necessary to recheck the Y SEN adjustment (R128).

(5) D-C Balance Adjustment (D-C BAL) - R110 - In addition to the back-of-panel factory adjustments, the amplifier is supplied with a D-C Balance control, which may be adjusted by means of a screwdriver at the front panel. See Figure 2-1 for location. When this adjustment is properly set, there will be no shifting in the zero position (up and

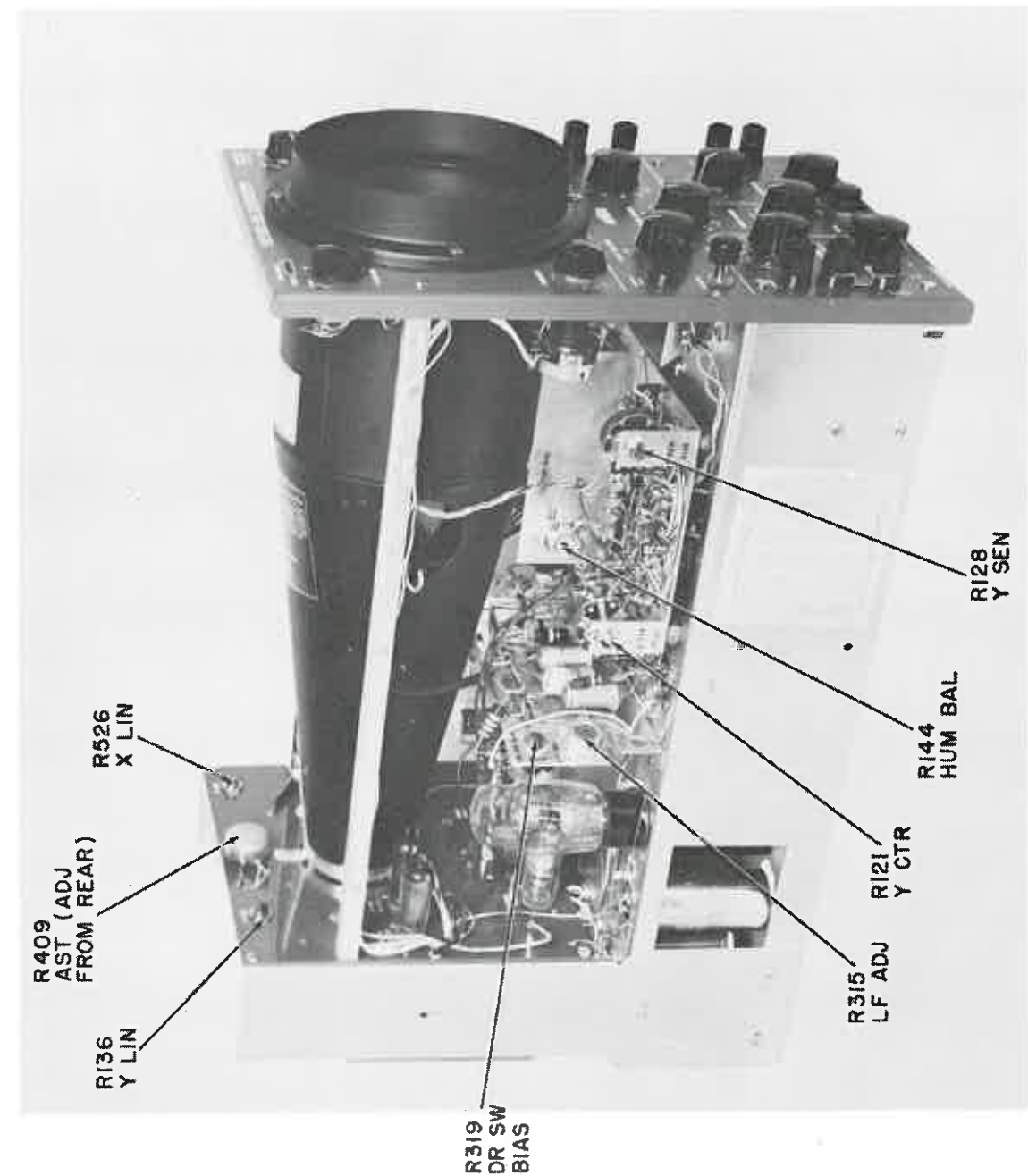


FIGURE 4-1a - IDENTIFICATION OF BACK-OF-PANEL CONTROLS, LEFT SIDE, TYPE 304-A

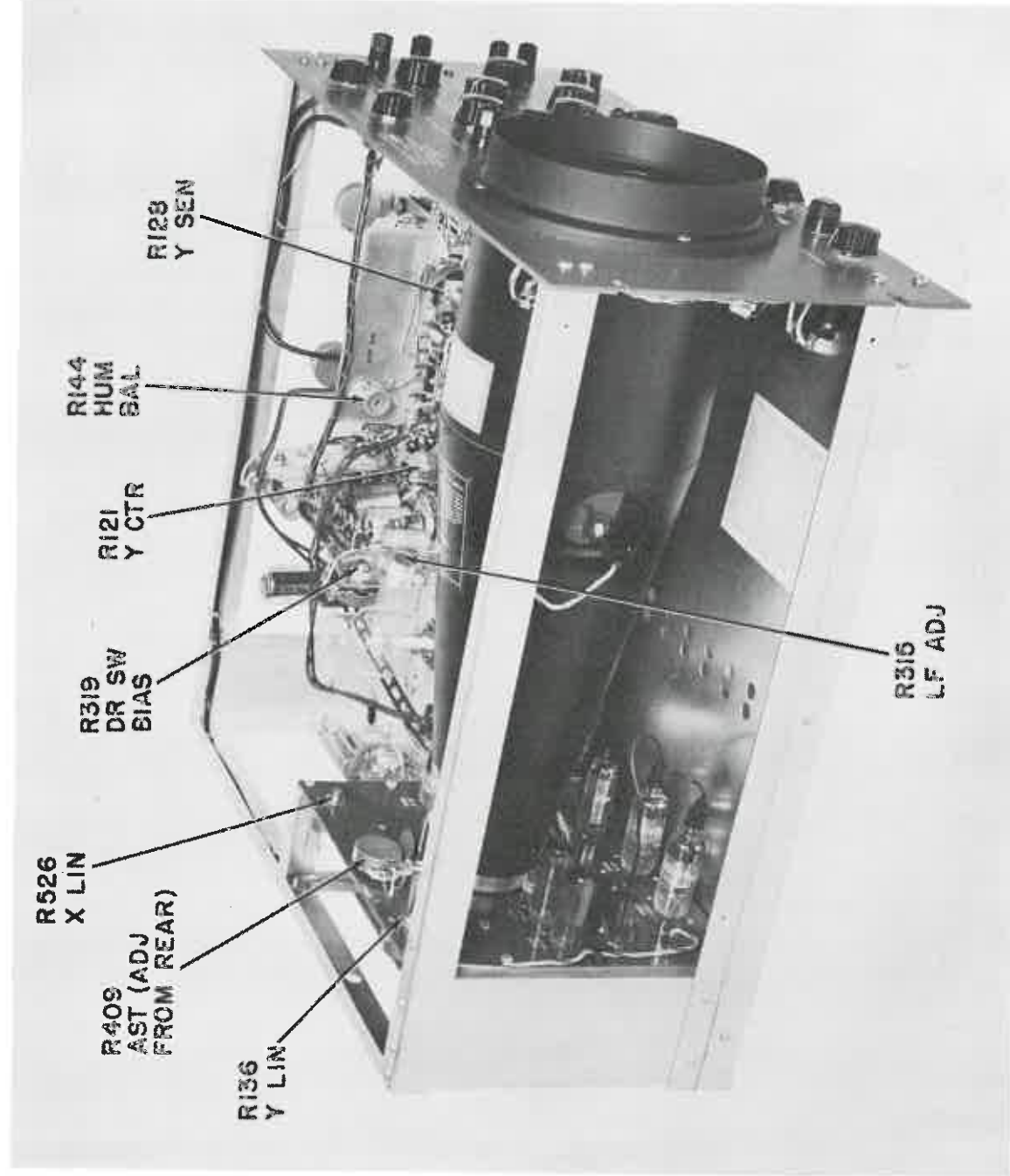


FIGURE 4-1b - IDENTIFICATION OF BACK-OF-PANEL CONTROLS, LEFT SIDE, TYPE 304-AR

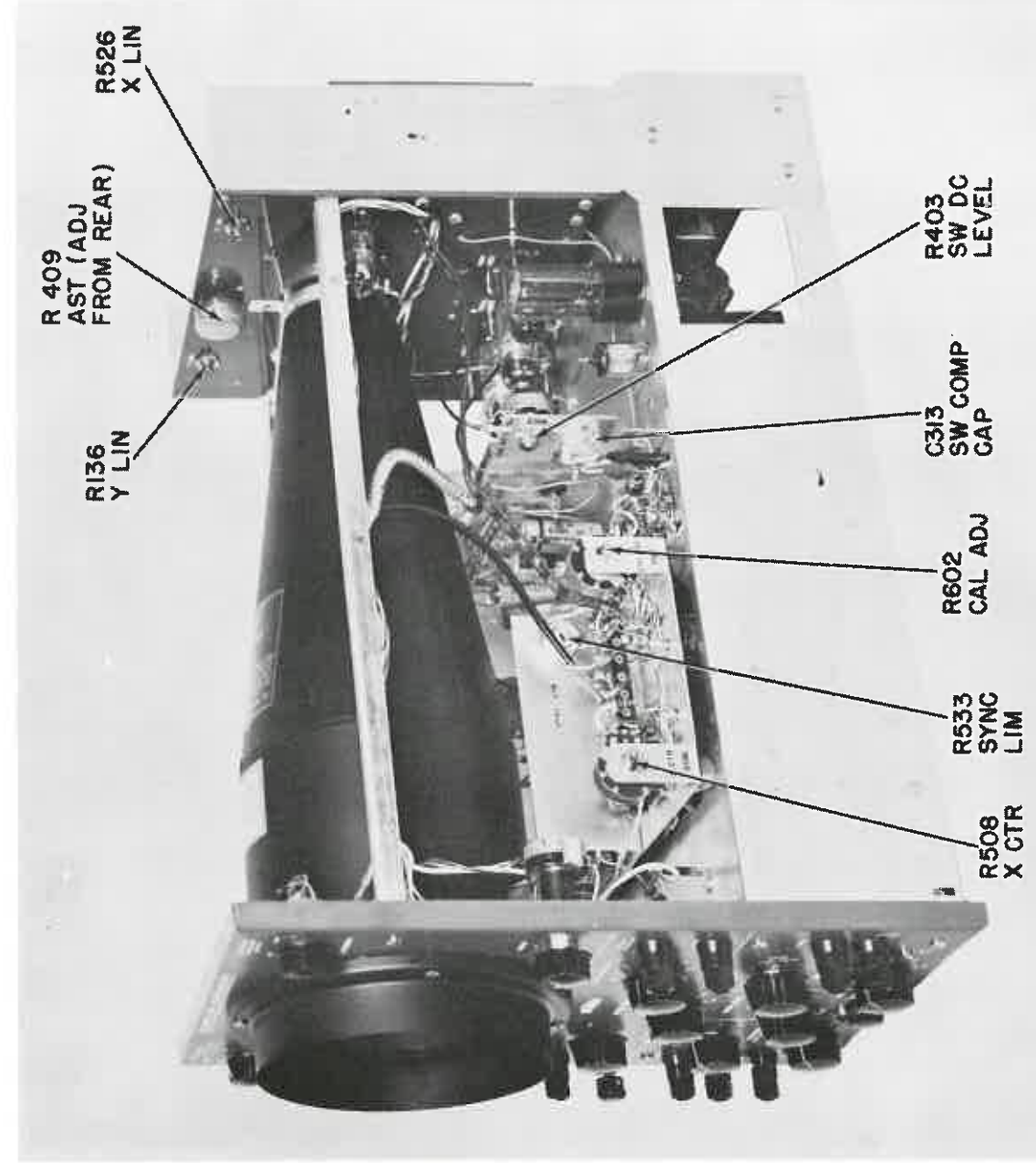


FIGURE 4-2a - IDENTIFICATION OF BACK-OF-PANEL CONTROLS, RIGHT SIDE, TYPE 304-A

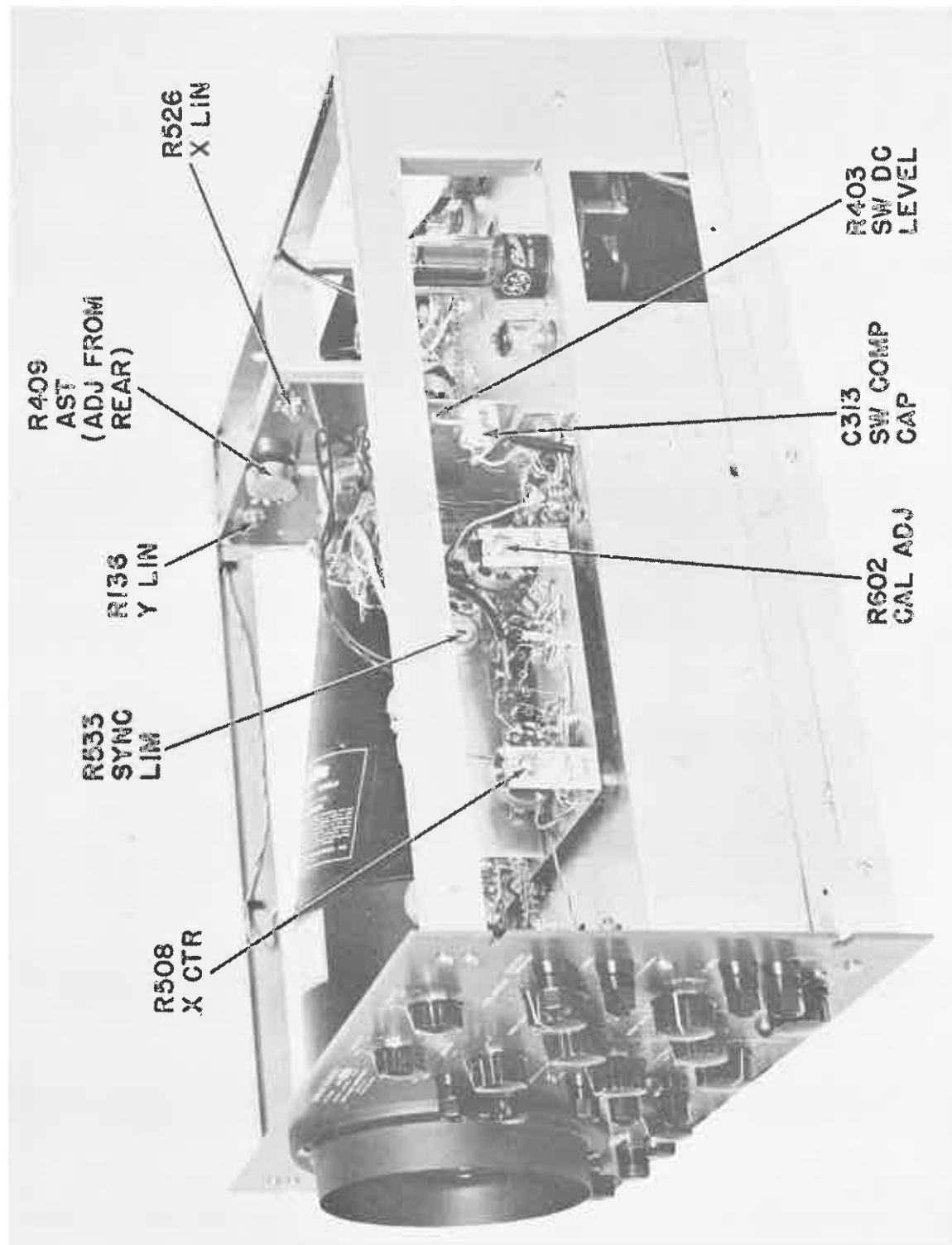


FIGURE 4-2b - IDENTIFICATION OF BACK-OF-PANEL CONTROLS, RIGHT SIDE, TYPE 304-AR

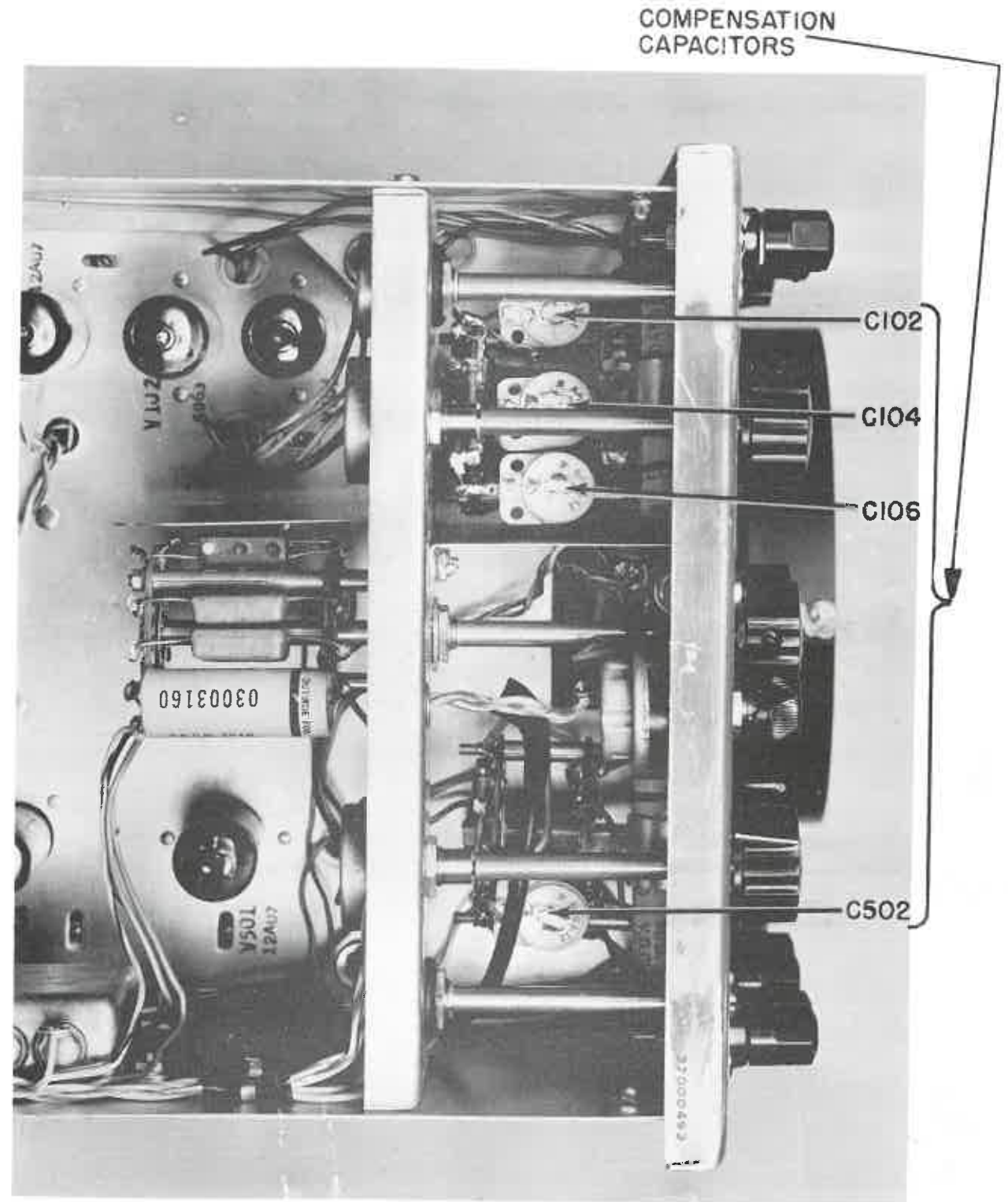


FIGURE 4-3 - IDENTIFICATION OF BACK-OF-PANEL CONTROLS, BOTTOM FRONT



down) with changes in the setting of the MULTIPLIER control. Since this adjustment requires occasional resetting, owing to aging of components, it is made readily accessible to the operator. To set the D-C Balance adjustment, set the VOLTS FULL SCALE switch to the OFF position and the MULTIPLIER control at the extreme left. Position the trace to the vertical center of the cathode-ray tube. Set the MULTIPLIER control to 1, and adjust D-C Balance to return the trace to its previous position. It should now be possible to move the MULTIPLIER control from 10 to 1 without any vertical displacement resulting. Repeat the adjustment procedure if any vertical displacement is observed.

(6) Input Attenuator Compensation Capacitors - The trimmer capacitors C102, C104 and C106 are used for compensating the input attenuator (VOLTS FULL SCALE) in the 1V, 10V, and 100V 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 of distortion. In Figure 4-4 "A" represents proper adjustments, while "B" and "C" represent conditions of over-compensation and undercompensation, respectively.

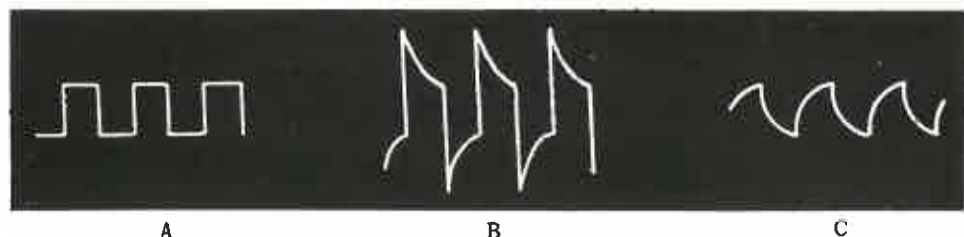


FIGURE 4-4 - WAVEFORMS ENCOUNTERED IN ADJUSTING THE Y ATTENUATOR

#### d. FACTORY ADJUSTMENTS FOR X AMPLIFIER

(1) Linearity Adjustment (X LIN) - R526 - 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 the horizontal amplitude of the pattern is greater at the left side or the right side of center. Then adjust R526 until the pattern has the same amplitude on both sides of center.

(2) D-C Balance Adjustment (D-C BAL) - R506 - 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. Position the trace in the horizontal center of the cathode-ray tube screen. Increase the 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 AMPLITUDE control over its full range without any horizontal displacement taking place. Repeat the adjustment procedure if any horizontal displacement is observed.

(3) Position Centering Adjustment (X CTR) - R508 - With no signal input (X SELECTOR at OFF) and the X POSITION control at the mechanical center of its range (pointing up), adjust R508 to bring the trace on the cathode-ray tube to the center of the screen horizontally.

(4) X Attenuator Compensation Capacitor - C502 - 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.

#### e. FACTORY ADJUSTMENTS FOR THE SWEEPS

(1) Driven Sweep Bias (DR SW BIAS) - R319 - To properly adjust for normal operation of the driven sweep, set the SWEEP RANGE switch at the 2-10 cps position; set the SYNC AMPLITUDE control at zero, the SWEEP VERNIER fully clockwise and the SYNC LIMITING (screw-driver) adjustment fully counterclockwise. Push in the CALIBRATOR button, and adjust the MULTIPLIER control for about 0.5 inch vertical deflection. Set the X SELECTOR switch to DRIVEN SWEEP and adjust the driven sweep bias potentiometer until the sweep just stops and a vertical bar appears. Check this setting with the SWEEP VERNIER turned completely counterclockwise also making certain that this adjustment in no way affects normal operation of the sweep on RECURRENT. Set the SYNC SELECTOR switch at INT. It should now be possible to trigger the "driven sweep" by rotating the SYNC AMPLITUDE control either way from "0." Check for proper triggering of the "driven sweep" with the SWEEP VERNIER control turned completely counterclockwise. If the sweep fails to trigger in this case, increase the vertical amplitude of the signal to a maximum of 0.6 inches. If the SYNC AMPLITUDE control, when fully advanced, still does not trigger the "driven sweep," the sweep thyratron (V303) may be defective.

(2) SYNC LIMITER (SYNC LIM) - R533 - Adjust the Driven Sweep BIAS control as outlined in paragraph e (1) above. Adjust pattern for 0.5 inch vertical deflection and advance the SYNC AMPLITUDE control just enough to trigger the sweep. Proper adjustment of the SYNC LIMITER control is obtained by advancing it from its extremely counterclockwise position to a point where the sweep stops and then "backing it off" to a point where the sweep just starts again and is stable.

(3) Sweep DC Level Adjustment (SW DC LEVEL) - R403 - This adjustment should be made so as to allow the sweep to expand equally in both directions as the (X) AMPLITUDE control is advanced.

(4) Sweep-output Attenuator Trimmer - C313 - The sweep-output attenuator is adjusted for optimum linearity and minimum "tail" of the sawtooth waveform, using a frequency of approximately 300 cps. To adjust, set the X SELECTOR at RECURRENT SWEEP, SWEEP RANGE switch at 250-1250; connect a test lead from the SAWTOOTH TEST SIGNAL terminal to the Y INPUT terminal and adjust to two-inch vertical deflection. Observe the waveform on the cathode-ray tube screen of the Type 304-A while adjusting the trimmer for minimum "tail" on the sawtooth wave.

(5) Sweep Low-frequency Adjustment (LF ADJ) - R315 - Feed a four-cycle sine-wave signal to the Y INPUT terminal. With SWEEP RANGE set at the 2-10 position and SWEEP VERNIER set at 10, adjust R315 for a two-cycle pattern on the screen.

#### f. FACTORY ADJUSTMENTS FOR THE VOLTAGE CALIBRATOR

(1) Voltage Calibrator Adjustment (CAL ADJ) - R602 - 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. Set front-panel controls as follows:

CONTROL	POSITION
VOLTS FULL SCALE	0.1
MULTIPLIER	1
X SELECTOR	RECURRENT SWEEP
SWEEP RANGE	50-250
SYNC SELECTOR	LINE

Push the CALIBRATOR switch and adjust the SYNC AMPLITUDE and SWEEP VERNIER controls for several cycles display on the cathode-ray tube screen. The proper adjustment is obtained when CAL ADJ (R602) is adjusted to produce the same vertical displacement of the beam (CALIBRATOR switch pushed in) as a 0.1 volt signal from the standard voltage calibrator produces (CALIBRATOR switch released .... e.g. out).

#### (2) Amplitude Calibration of Y Amplifier

Adjust the front-panel controls as indicated in the preceding paragraph to obtain several cycles display on the screen. Adjust R128 (Y SENSitivity adjustment) for a vertical deflection of four inches. The Y amplifier is now adjusted for a sensitivity of 25 millivolts peak-to-peak per inch at full gain. To release the CALIBRATOR switch, push in.

#### g. OTHER FACTORY ADJUSTMENTS

(1) Astigmatism Control (AST) - R409 - Apply a 60-cycle sine-wave test signal to the Y INPUT terminal. Synchronize one or two cycles of this signal on the screen, and expand the trace to full-screen diameter. Adjust the FOCUS control for sharpest trace. Then ad-

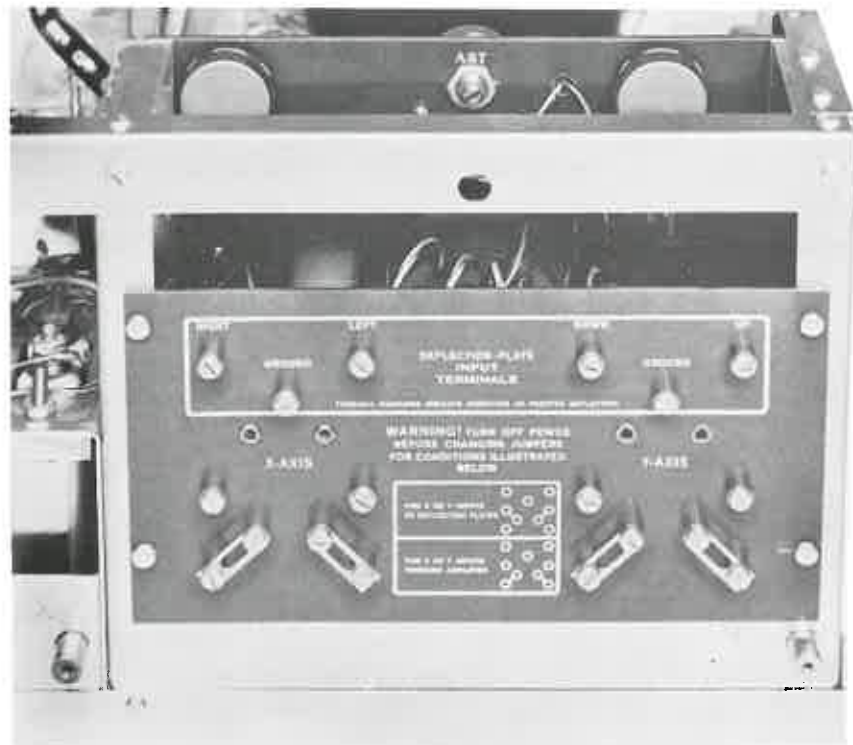


FIGURE 4-5 - REAR PANEL VIEW OF TYPE 304-AR SHOWING AST CONTROL (R409)

just the ASTigmatism control (by means of a screwdriver inserted through the hole provided in the rear of the cabinet) for uniform width of trace from start to finish. It will probably be necessary to readjust the FOCUS control simultaneously with the ASTigmatism potentiometer to maintain best focus. Once properly adjusted, the ASTigmatism control should require no further attention under normal conditions.

#### 6. REPLACEMENT OF CATHODE-RAY TUBE

##### a. TYPE 304-A

To replace the Type 5ADP - Cathode-ray Tube in the Type 304-A, removal of the old tube may be accomplished as follows: Disconnect the power cord from the line; remove the two screws holding the rear of the cabinet; and carefully slide the instrument forward until it is clear of the cabinet. Detach the circular ring (bezel) and calibrated scale 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, 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 instrument. Push the tube in far enough so that the base goes into the base clamp provided. Connect the base socket to the tube.

#### CAUTION

The cathode-ray tube should be inserted with great care to prevent damage which might result in personal injury. Do not employ force at any time. As an added precaution, wear safety goggles and gloves.

Connect the intensifier button to the intensifier pin. Replace the calibrated scale and the bezel; move the tube forward so that it just touches the scale. Connect the power cord to the line; turn on the instrument and set X SELECTOR to RECURRENT SWEEP. If the resulting trace is not horizontal, rotate the tube slightly until it is. Disconnect the power cord from the line and tighten the tube-base clamp.

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

##### b. TYPE 304-AR

To replace the Type 5ADP - Cathode-ray Tube in the Type 304-AR, first remove the dust cover by loosening the screws on either side and rear that hold the dust cover to the chassis. In all other respects, removal and replacement of the cathode-ray tube is accomplished in the manner described for the Type 304-A.

#### 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 304-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 enters the front-panel aperture provided for it as far as it will go.

#### 8. DU MONT "OSCILLOGRAPHER"

The Du Mont "Oscillographer," a quarterly publication, is published regularly by the Allen B. Du Mont Laboratories, Inc. It is sent free of charge to engineers, research workers, and those engaged in the use and application of cathode-ray equipment. When requesting this publication or when sending notification of change of address, please supply the following information: name, company name, company address, type of business, and title of individual.

#### 9. DU MONT WARRANTY

All instruments produced by the Instrument Division of Allen B. Du Mont Laboratories, Inc., are sold under the Du Mont Warranty. For the provisions of this warranty, see the Warranty and Service Notice on the inside back 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.

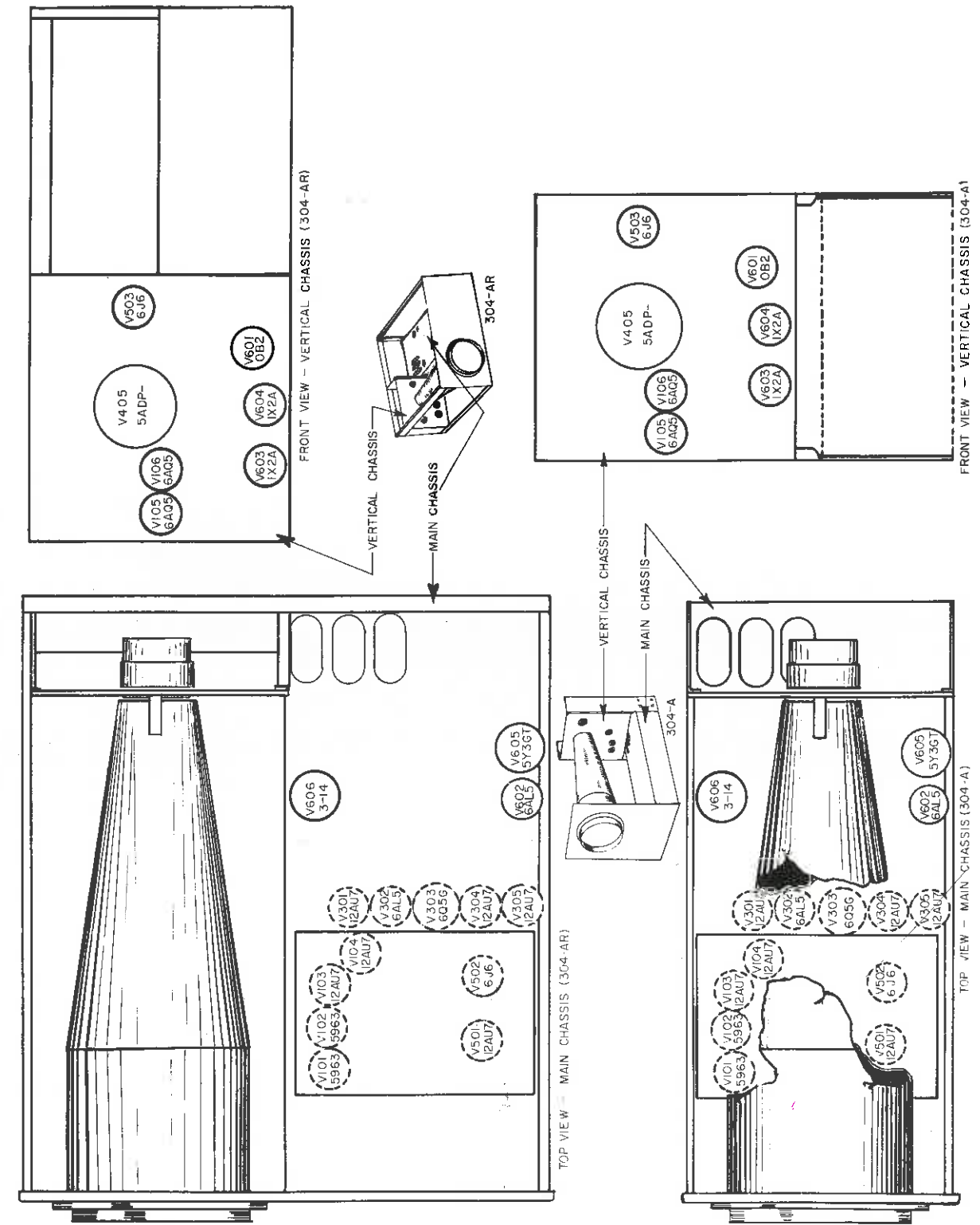


FIGURE 4-6 - TUBE LOCATION DIAGRAM, TYPES 304-A AND 304-AR

TYPES 304-A AND 304-AR CATHODE-RAY OSCILLOGRAPHS

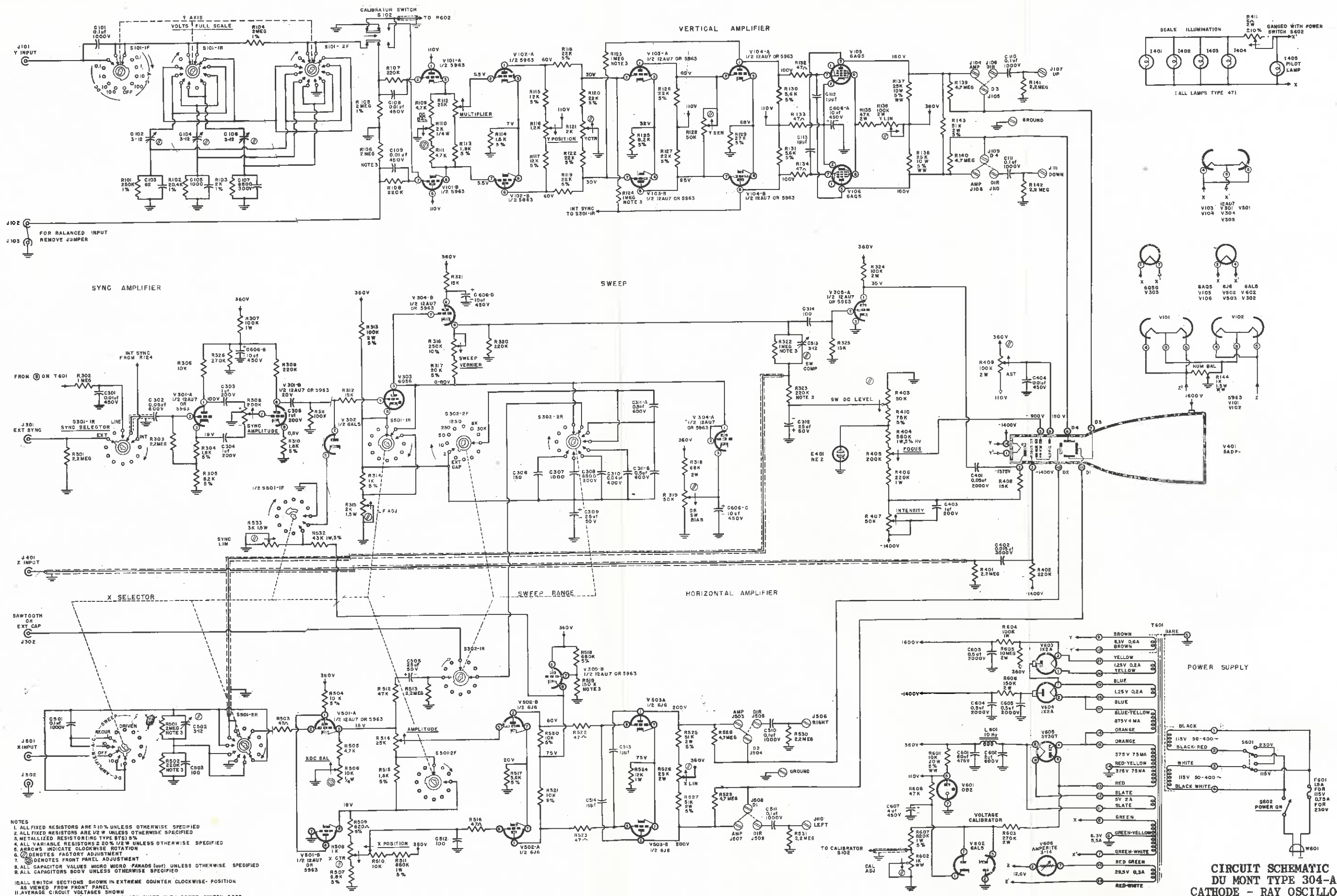
COMPONENT PARTS LIST

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>
<u>Capacitors</u>		
C101	03000460	0.1 $\mu$ f 1000 Volt Paper
C102	03003040	3-12 $\mu$ mf 500 Volt Variable Ceramic
C103	03020420	82 $\mu$ mf $\pm$ 10% 500 Volt Mica
C104	Same as C102	
C105	03029440	1000 $\mu$ mf $\pm$ 10% 500 Volt Mica
C106	Same as C102	
C107	03033640	6800 $\mu$ mf $\pm$ 10% 300 Volt Mica
C108	03015920	0.01 $\mu$ f 450 Volt Ceramic
C109	Same as C108	
C110	Same as C101	
C111	Same as C101	
C112	03012150	1 $\mu$ mf $\pm$ 20% 500 V Composition
C113	Same as C112	
C301	Same as C108	
C302	03004170	0.05 $\mu$ f 600 Volt Paper
C303	03017100	0.47 $\mu$ f 200 Volt Paper
C304	Same as C303	
C305	Same as C303	
C306	03020450	150 $\mu$ mf $\pm$ 10% 500 Volt Mica
C307	Same as C105	
C308	Same as C107	
C309	03000040	25 $\mu$ f 50 Volt Elect.
C310	03003160	0.04 $\mu$ f $\pm$ 10% 400 Volt Paper
C311 A,B	03003910	0.5/0.5 $\mu$ f 600 Volt Paper
C312	Same as C309	
C313	Same as C102	
C314	03020430	100 $\mu$ mf $\pm$ 10% 500 Volt Mica
C401	03016360	0.05 $\mu$ f 2000 Volt Paper
C402	03145590	0.015 $\mu$ f 3000 Volt Paper
C403	Same as C303	
C404	Same as C108	
C501	Same as C101	
C502	Same as C102	
C503	Same as C314	
C505	Same as C309	
C510	Same as C101	
C511	Same as C101	
C512	Same as C314	
C513	Same as C112	
C514	Same as C112	
C601	03012470	80 $\mu$ f 475 Volt Elect.
C602	03003840	2 $\mu$ f 600 Volt Paper
C603	03017750	0.5 $\mu$ f 2000 Volt Paper
C604	Same as C603	
C605	Same as C603	
C606A,B,C,D	03002350	10/10/10/10 $\mu$ f 450 Volt Elect.
C607	03000220	4 $\mu$ f 450 Volt Elect.
<u>Neon Regulator</u>		
E401	12003960	NE2 Neon Glow Lamp
<u>Fuses</u>		
F601	11000770 or 11000750	1.5 Amp. for 115 V operation 0.75 Amp. for 230 V operation
<u>Lamps</u>		
I401	12001310	0.15 Bay Inc.
I402	Same as I401	
I403	Same as I401	
I404	Same as I401	
I405	Same as I401	

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>
<u>Binding Post</u>		
J101	51001290	Binding Post
J102	Same as J101	
J103	51007080	Binding Post
J301	Same as J101	
J302	Same as J101	
J401	Same as J101	
J501	Same as J101	
J502	Same as J101	
<u>Inductors</u>		
L601	21004301	10 hy Fixed
<u>Resistors</u>		
R101	02218440	250,000 ohms $\pm$ 1% 1/2 W
R102	02218430	20,400 ohms $\pm$ 1% 1/2 W
R103	02218420	2000 ohms $\pm$ 1% 1/2 W
R104	02218450	2 megohms $\pm$ 1% 1/2 W
R105	Same as R104	
R106	02041270	2 megohms $\pm$ 5% 1/2 W
R107	0203250	220,000 ohms $\pm$ 10% 1/2 W
R108	Same as R107	
R109	02031850	4700 ohms $\pm$ 10% 1/2 W
R110	01053500	2000 ohms $\pm$ 20% 1/4 W Variable
R111	Same as R109	
R112	01018600	25,000 ohms $\pm$ 20% 1/2 W Variable
R113	02030540	1800 ohms $\pm$ 5% 1/2 W
R114	02030520	1500 ohms $\pm$ 5% 1/2 W
R115	02030740	12,000 ohms $\pm$ 5% 1/2 W
R116	01011150	1200 ohms $\pm$ 20% 1/2 W Variable
R117	Same as R115	
R118	02030800	22,000 ohms $\pm$ 5% 1/2 W
R119	Same as R118	
R120	Same as R118	
R121	01014090	2000 ohms $\pm$ 20% 1/2 W Variable
R122	Same as R118	
R123	02041200	1 megohm $\pm$ 5% 1/2 W
R124	Same as R123	
R125	02030700	8200 ohms $\pm$ 5% 1/2 W
R126	Same as R118	
R127	Same as R118	
R128	01014030	50,000 ohms $\pm$ 20% 1/2 W Variable
R129	02030820	27,000 ohms $\pm$ 5% 1/2 W
R130	02030660	5600 ohms $\pm$ 5% 1/2 W
R131	Same as R130	
R132	02031610	47 ohms $\pm$ 10% 1/2 W
R133	Same as R132	
R134	Same as R132	
R135	02037970	47,000 ohms $\pm$ 10% 2 W
R136	01053990	100,000 ohms $\pm$ 20% 2 W Variable
R137	02108110	25,000 ohms $\pm$ 5% 10 W WW
R138	Same as R137	
R139	02032210	4.7 megohms $\pm$ 10% 1/2 W
R140	Same as R139	
R141	02032170	2.2 megohms $\pm$ 10% 1/2 W
R142	Same as R141	
R143	02036890	51,000 ohms $\pm$ 5% 2 W
R144	01053600	1000 ohms $\pm$ 20% 1-1/2 W, Variable, WW
R301	Same as R141	
R302	02032130	1 megohm $\pm$ 10% 1/2 W
R303	Same as R141	
R304	Same as R113	
R305	Same as R125	
R306	02031890	10,000 ohms $\pm$ 10% 1/2 W
R307	02035010	100,000 ohms $\pm$ 10% 1 W
R308	01014200	200,000 ohms $\pm$ 20% 1/2 W Variable
R309	Same as R107	
R310	Same as R113	
R311	02032010	100,000 ohms $\pm$ 10% 1/2 W
R312	02031910	15,000 ohms $\pm$ 10% 1/2 W

Symbol	Part Number	Description
R313	02036960	100,000 ohms + 5% 2 W
R314	02030480	1000 ohms + 5% 1/2 W
R315	01023910	2000 ohms ± 20% 1-1/2 W Variable ww
R316	01014390	250,000 ohms + 10% 1/2 W Variable
R317	02030790	20,000 ohms + 5% 1/2 W
R318	02037990	68,000 ohms ± 10% 2 W
R319	Same as R128	
R320	Same as R107	
R321	Same as R312	
R322	Same as R123	
R323	02041040	220,000 ohms + 5% 1/2 W
R324	02038010	100,000 ohms ± 10% 2 W
R325	Same as R312	
R326	02032060	270,000 ohms ± 10% 1/2 W
R401	Same as R141	
R402	Same as R107	
R403	Same as R128	
R404	02063790	560,000 ohms + 5% 1 W
R405	01008860	200,000 ohms ± 20% 1/2 W Variable
R406	02035050	220,000 ohms ± 10% 1 W
R407	01008770	50,000 ohms ± 20% 1/2 W Variable
R408	Same as R312	
R409	Same as R136	
R410	02030930	75,000 ohms + 5% 1/2 W
R411	01044422	6 ohms ± 10% 2 W Variable ww
R501	Same as R106	
R502	Same as R323	
R503	Same as R132	
R504	02030720	10,000 ohms ± 5% 1/2 W
R505	Same as R109	
R506	01053510	10,000 ohms + 20% 1/4 W Variable
R507	02030680	6800 ohms + 5% 1/2 W
R508	01014080	1000 ohms ± 20% 1/2 W Variable
R509	02030480	1000 ohms ± 5% 1/2 W
R510	01014500	10,000 ohms + 20% 1/2 W Variable
R511	02034160	680,000 ohms + 5% 1 W
R512	02031970	47,000 ohms ± 10% 1/2 W
R513	Same as R141	
R514	Same as R112	
R515	Same as R113	
R516	Same as R132	
R517	Same as R130	
R518	02031160	680,000 ohms + 5% 1/2 W
R519	02041000	150,000 ohms ± 5% 1/2 W
R520	Same as R504	
R521	Same as R504	
R522	Same as R132	
R523	Same as R132	
R524	02034900	12,000 ohms ± 10% 1 W
R525	Same as R143	
R526	01053960	25,000 ohms ± 20% 2 W Variable
R527	Same as R143	
R528	Same as R139	
R529	Same as R139	
R530	Same as R141	
R531	Same as R141	
R532	02033870	43,000 ohms + 5% 1 W
R533	01023920	3000 ohms + 20% 1 -1/2 W Variable ww
R601	02106800	10,000 ohms + 5% 20 W ww
R602	01053700	1000 ohms + 10% 2 W Variable ww
R603	02038060	270,000 ohms ± 10% 2 W
R604	Same as R307	
R605	02038250	10 megohms + 10% 2 W
R606	02038030	150,000 ohms ± 10% 2 W
R607	02063810	820,000 ohms ± 5% 1 W
R608	Same as R512	
<u>Switches</u>		
S101	05003232	3P9T Rotary
S102	05006793	2P2T Push
S301	05006541	1P3T Rotary
S302	05006571	3P7T Rotary

Symbol	Part Number	Description
S501	05006561	4P7T Rotary
S601	05000420	DPDT Slide
S602	Part of R411	
<u>Transformers</u>		
T601	20007792	Transformer Power
<u>Tubes</u>		
V101	15000130	12AU7
V102	Same as V101	
V103	Same as V101	
V104	Same as V101	
V105	25000340	6AQ5
V106	Same as V101	
V301	Same as V101	
V302	25000020	6AL5
V303	25000640	6Q5G
V304	Same as V101	
V305	Same as V101	
V401	25007390	5ADP1
	or	
	25007400	5ADP2
	or	
	25007410	5ADP4
	or	
	25007420	5ADP7
	or	
	25007430	5ADP11
V501	Same as V101	
V502	25000190	6J6
V503	Same as V502	
V601	25000360	OB2
V602	Same as V302	
V603	25006490	1X2A
V604	Same as V603	
V605	25000220	5Y3GT
V606	02142600	Resistor Thermal
<u>Cable</u>		
W601	50015040	Cable Power



NOTES  
 1. ALL FIXED RESISTORS ARE 5% UNLESS OTHERWISE SPECIFIED  
 2. ALL FIXED RESISTORS ARE 1/2 W UNLESS OTHERWISE SPECIFIED  
 3. METALLIZED RESISTOR (TYPE 87S) 5%  
 4. ALL VARIABLE RESISTORS 20% 1/2 W UNLESS OTHERWISE SPECIFIED  
 5. ARROWS INDICATE CLOCKWISE ROTATION  
 6. DENOTES FACTORY ADJUSTMENT  
 7. DENOTES FRONT PANEL ADJUSTMENT  
 8. ALL CAPACITOR VALUES MICRO MICRO FARADS (uF) UNLESS OTHERWISE SPECIFIED  
 9. ALL CAPACITORS 50V UNLESS OTHERWISE SPECIFIED  
 10. ALL SWITCH SECTIONS SHOWN IN EXTREME COUNTER CLOCKWISE POSITION AS VIEWED FROM FRONT PANEL  
 11. AVERAGE CIRCUIT VOLTAGES SHOWN  
 12. (SCALE ILLUMINATION) R411 ON A COMMON SHAFT WITH POWER SWITCH S402  
 13. UNDERLINED CONTROL TITLES INDICATE FRONT PANEL LOCATION  
 V101 AND V102 ARE NOW TYPE 12 AU7 WHICH ARE INTERCHANGEABLE WITH TYPE 5963.  
 R509 is now 1K, 1/2W, ±5%, Part No. Q2030480

CIRCUIT SCHEMATIC  
 DU MONT TYPE 304-A  
 CATHODE - RAY OSCILLOGRAPH

# WARRANTY AND SERVICE NOTICE

for

## Industrial Type Cathode-ray Tubes and Instruments

### DU MONT INSTRUMENTS

Each instrument manufactured by the Instrument Division of Allen B. Du Mont Laboratories, Inc., is guaranteed to equal or exceed its published performance specifications. It is further guaranteed against defective materials (other than the cathode-ray tube) and workmanship for a period of one year from date of delivery. Any defective instrument or an instrument that does not meet or exceed our specifications will, upon inspection by us, be repaired or replaced at our discretion should such defect appear within the guarantee period.

To register this guarantee, the enclosed guarantee card must be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. **BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD.**

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

### DU MONT CATHODE-RAY TUBES

Industrial type cathode-ray tubes manufactured by Allen B. Du Mont Laboratories, Inc., are guaranteed for 1000 hours of operation or for a six-month period of installation, whichever shall first expire. The right is reserved, however, to limit claims to a period of nine months after shipment from the factory. Adjustments will be made on the merit of each individual claim because of the widely varying applications to which such tubes are subjected, and a tube which becomes defective during the guarantee period will be replaced **ONLY AFTER INSPECTION AT THE FACTORY.** Cathode-ray tubes which are sent in under the guarantee, must be sent with transportation paid.

### BURNED OUT HEATERS AND BROKEN GLASS ARE NOT COVERED BY THE TUBE GUARANTEE

To register a tube guarantee, the guarantee card enclosed with the tube must be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. **TYPE NUMBER AND SERIAL NUMBER OF THE CATHODE-RAY TUBE MUST BE IN-**

**CLUDED.** The serial number of the tube will be found either on the glass stem of the electron-gun structure or on the bulb near the Du Mont brand. Tubes must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

### CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

### SERVICE

In order to insure factory service under our guarantees, the guarantee cards enclosed with all instruments and tubes must be properly filled out and returned. In all cases where service or adjustment is requested, please write first to the factory giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. **THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given.** In this way, much time can be saved and unnecessary inconvenience often avoided. When writing in this respect, address:

Allen B. Du Mont Laboratories, Inc.  
Instrument Service Department  
760 Bloomfield Ave., Clifton, New Jersey

The Instrument Service Department will then send to the customer, the written procedure for sending the instrument back to the factory. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

### REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the type number and serial number of the instrument and refer to the component by its symbol designation and description on the circuit schematic. This will help to expedite service.