425 Maintenance Manual OSCILLOSCOPE

DU MONT

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

TYPE

425 Maintenance Manual OSCILLOSCOPE

DU MONT

Serial No. _____

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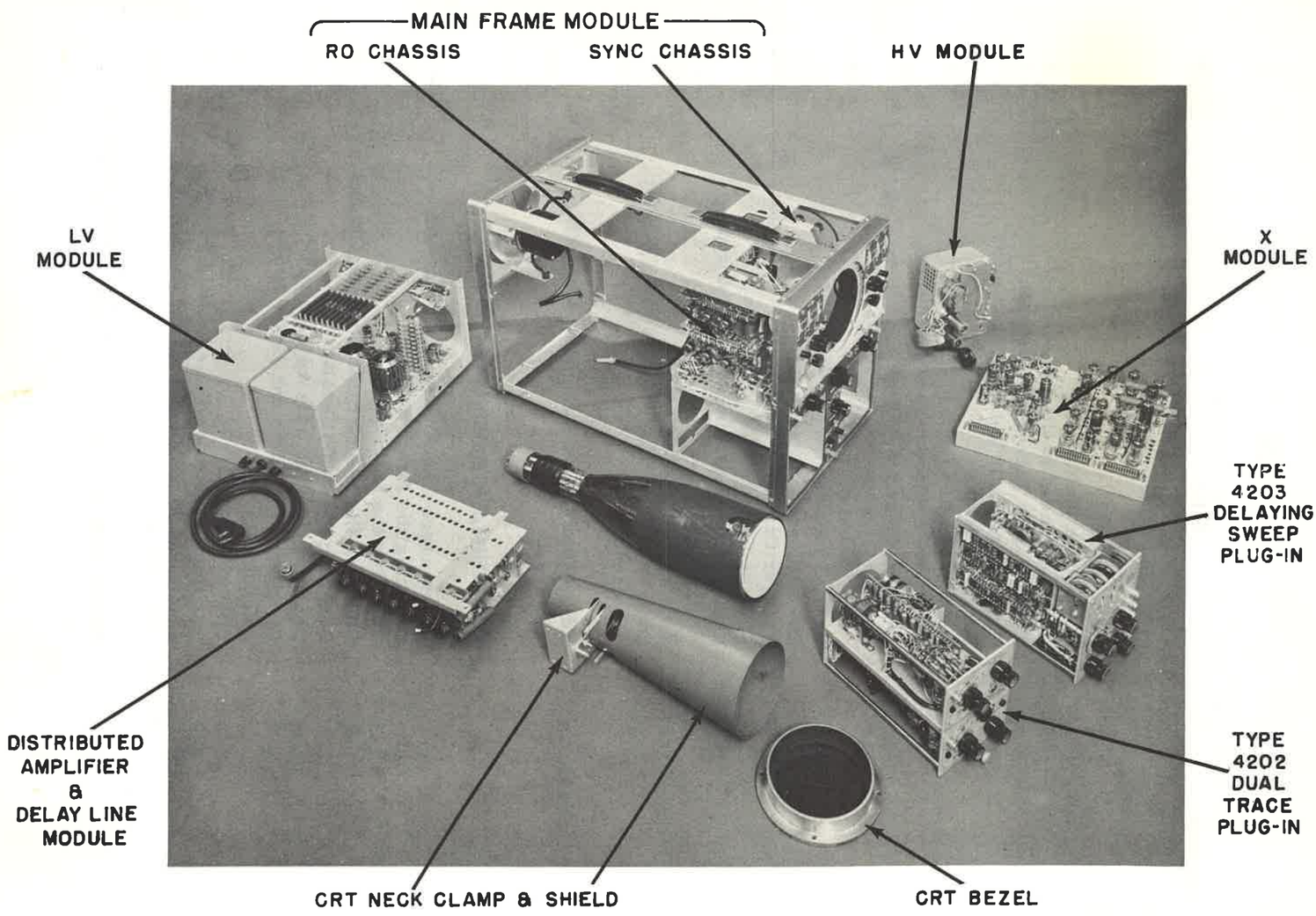


FIGURE I-1. ILLUSTRATING THE MODULE MAKE-UP OF TYPE 425 OSCILLOSCOPE

SECTION 1

MAINTENANCE

1-1. INTRODUCTION

This Maintenance Manual contains Service Information, Procedures for Internal Adjustments, Schematics, and Parts List for the Type 420 Series Oscilloscopes. The Operating Manual for these series is a separate book and it contains information on Specifications, Operating Instructions, and Applications. The Operating and Maintenance Instructions for the Plug-in Units will be found in a single manual for the respective unit.

WARNING

OBSERVE THE FOLLOWING PRECAUTIONS WHEN NECESSARY TO ENERGIZE THE EQUIPMENT WITH THE PANELS REMOVED

1) Never work alone.
2) Make sure the chassis is properly grounded.
3) Remove power cord before changing any tubes.
4) Before touching any components, short the terminals to remove any possible charge that may remain after turning off the power.

1-2. PREVENTIVE MAINTENANCE

a. AIR FILTER

The Type 420 Series Oscilloscopes are cooled by air drawn into the instruments through a washable filter constructed of rubberized dynel fiber. If the filter becomes dirty, it will restrict the flow of air and may cause the instrument to overheat. You should inspect and clean the filter every three or four months. Should the thermal relay in the instrument open up, the filter should be checked immediately. To clean the filter, first remove loose dirt from the filter by rapping it

gently on a hard surface. Then wash the filter briskly with warm water. The filter may be left in the side cover while flushing.

b. FAN MOTOR

Fan motor bearings should be lubricated every three or four months with a few drops of light machine oil. Failure to lubricate the bearings periodically will injure the fan and thereby cause instrument overheating.

c. VISUAL INSPECTION

You should visually inspect the entire Oscilloscope every few months for possible circuit defects. These defects may include such things as loose or broken connections, damaged binding posts, improperly seated tubes, scorched wires or resistors, missing tube shields, or broken terminal strips. For most visual troubles the remedy is apparent; however, particular care must be taken when heat-damaged components are detected. Overheating of components is often the consequence of other, less obvious defects in the circuit. It is essential that you determine the cause of overheating before replacing heat-damaged components in order to prevent further damage. The Type 420 Series Oscilloscopes are stable instruments that will provide many hours of trouble-free operation. However, to insure the reliability of measurements, we suggest that you recalibrate the instruments after each 500 hours of operation (or every six months if used intermittently). Complete recalibration procedures are given in this Maintenance Manual.

1-3. GAINING ACCESS TO THE CHASSIS

The panels of this instrument are held in place by spring-loaded screwhead fasteners. To remove the side panels, use a screwdriver to rotate the fasteners approximately a half-turn counterclockwise; then pull the upper portion of the panels outward from the carrying handles. This will expose most of the tubes and service adjustments for normal maintenance. To remove the bottom panel, lay the instrument on its side, remove the screws and pull of the panel. Panels are replaced by reversing the order of their removal.

1-4. CATHODE-RAY TUBE REPLACEMENT

> **CAUTION**
>
> THE CATHODE-RAY TUBE SHOULD BE HANDLED WITH CARE TO PREVENT BREAKAGE AND/OR 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.

The following step-by-step procedure is suggested for replacing the cathode-ray tube:

1) Turn off the power and remove the side panels.

2) Remove bezel held by four screws at front panel.

3) Remove the cathode-ray tube socket and the intensifier button.

4) Remove the four deflection-plate leads located at the neck of the tube.

5) Loosen the two clamp screws at the neck of the cathode-ray tube.

6) Pull the cathode-ray tube straight out through the front panel.

7) Carefully exchange the rubber clamp strip from the old to the new cathode-ray tube.

8) Install new tube through front-panel opening, and replace the bezel.

9) Replace the tube socket, deflection-plate connectors, and the intensity button.

10) Apply power and check the sweep; if not horizontal, loosen the clamp-handle screw and rotate the tube as required.

11) Tighten the cathode-ray tube neck-clamp screws and the clamp-handle screw securely to prevent rotation of the tube.

1-5. ILLUMINATED SCALE LAMP REPLACEMENT

Defective scale lamps are removed as follows:

1. Turn off power and remove side panels.

2. Remove the cathode-ray tube as described in an earlier paragraph.

3. Remove the appropriate lamp assembly located on the rear side of the front panel by depressing the spring clip. The defective bulb may then be removed and replaced.

NOTE: The scale lamps are connected in series-parallel. One defective lamp will cause two to be out at the same time. Refer to the Schematic entitled, "Display Logic Switch and Scale Lamps" for the connection detail.

1-6. SERVICING HINTS

This is a complex electronic instrument. There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuits, you will be able to make a reasonable assumption at the general source of troubles from their symptoms.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. How often it is checked, will depend on the installation and the conditions of operation. In general, portable units moved about constantly will require more frequent service than units fastened down permanently.

For these regular checks, clean all dust and dirt from the unit, using a light air blast or soft brush. Be sure that the dust is removed from around tube socket contacts and terminal strip connections.

In the event of improper equipment performance, the following suggestions are recommended:

1) Note that all tube heaters are lit, or feel tubes for warmth.

2) If the instrument fails to operate at all, including the fan

and the pilot light, check the source of power and determine that the power cord is firmly in place. Then check the fuses at the rear of the instrument. If the instrument has been operating but has just stopped and the fan is still working, it may have overheated and tripped the thermal cutout switch. The thermal cutout switch will reset itself when the interior temperature of the instrument drops to a safe value. Possible causes of overheating are: restriction of air circulation, high room temperature, or the instrument may have been operating over an extended period with the side panels removed. Be sure that the air filters are clean.

3) If the fan and pilot light operate, but there is no spot visible, there is a possibility that the spot is positioned off the screen. Check whether the beam-position-indicator lamps are operating and if the PATTERN POSITIONING control or the Y Plug-in POSITION control produce any effect. Advance the INTENSITY control and see if there is some unfocused glow on the screen to indicate operation of the CRT circuitry.

4) Localizing the trouble is made easier by use of an oscilloscope to check waveforms. Use a high-impedance Probe while trouble shooting.

5) Replacement of certain tubes may require resetting of one or more service adjustments. Consult Table 1-1. For optimum stability, the new tube should be allowed a warmup time of at least 10 minutes before making any service adjustments.

6) Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks while soldering semiconductors.

7) When using accessory probes or adapters, be sure the trouble is not originating in the accessory, before suspecting the oscilloscope itself.

8) Troubles are usually caused by tube failure and one way to locate defective tubes, is to try replacing them

with good ones. Sometimes the aftermath of tube failure yields charred resistors or over-stresses capacitors. Obviously in these cases you will also have to find and replace the damaged components, which can be found by visual inspection. If possible, replace all suspected tubes at one time, and if the trouble is helped, return the old tubes one-at-a-time until the offending one is discovered.

9) When more than one Type 420 Series Oscilloscope is available, the subchassis may be interchanged to isolate the troubled area, thus expediting maintenance.

1-7. REPLACEMENT PARTS

a. STANDARD PARTS

Replacement for all parts used in Type 420 Series Oscilloscopes can be purchased directly from Du Mont. However, since most of the components are standard electronic parts, they can generally be obtained locally in less time than is required to obtain them from the factory.

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this Manual. The Parts List gives the values, tolerances, ratings, and Du Mont part number for all electrical components used in the instrument. This will help to expedite service.

b. SPECIAL PARTS

In addition to the standard electronic components mentioned in the previous paragraph, some special parts are also used in the assembly of the Type 420 Series Oscilloscopes. These parts, such as delay lines, special resistor values, transformers, etc., are manufactured specially for Du Mont by other companies in accordance with Du Mont specifications. These parts and most mechanical parts should be ordered directly from Du Mont since they are normally difficult or impossible to obtain from other sources. All parts may be obtained either directly from the factory or through the local Du Mont representative.

Since the production of this instrument, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from Du Mont, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered. Your local Du Mont representative has knowledge of these changes and may call you if a change in your purchase order is necessary.

1-8. LOCATIONS OF TUBES, SERVICE ADJUSTMENTS, AND TEST POINTS

The location of tubes, service adjustments, and test points are shown on the appropriate schematic drawings which will be found in the last section of this Manual.

Normally, it will not be necessary to make all of the adjustments in the paragraphs to follow. However, any adjustment that is made, should be accomplished in the indicated sequence.

> WARNING
>
> WHEN THE PANELS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

1-9. EQUIPMENT REQUIRED FOR ADJUSTMENTS AND TROUBLE SHOOTING

DESCRIPTION	CHARACTERISTICS
Volt-ohmmeter	Simpson Model 260 or equivalent; 20,000 ohms/volt sensitivity
Digital Voltmeter	John Fluke Model 800; incremental accuracy of 0.5% or better
Square Wave Generator	Tektronix Type 105 or equivalent
Autotransformer	Powerstat, Variac, or equivalent; capable of varying line voltage of the instrument being calibrated from 105 volts to 125 volts
Oscilloscope	Du Mont Type 425 and Type 403B Oscilloscopes, or equivalent
Du Mont Type 4207	Y Test Plug-in Unit used for normalizing the gain of the vertical channels
Insulated Alignment Tool	General Cement Co., Type 8271, or equivalent
Resistor (Qty 3)	Fixed, composition, 91 megohms, ±20%, 1/2 watt; Du Mont Part Number: 0204 2300
Resistor (Qty 2)	Fixed, film, 61.9K ohms, ± 1%, 1/2 watt; Du Mont Part Number: 0239 0342
Resistor (Qty 1)	Fixed, film, 100K ohms, ± 1%, 1/2 watt; Du Mont Part Number: 0239 0346
Resistor (Qty 1)	Fixed, film, 2 megohms, ± 1%, 1/2 watt; Du Mont Part Number: 0229 6140

1-10. CHECKING POWER SUPPLY VOLTAGES

Preset the Main Frame front-panel controls as follows:

Control	Setting
TRIGGER MODE	NORMAL AC
STABILITY	PRESET
DISPLAY LOGIC	MAIN SWP
LENGTH	X1
SWEEP RATE	5 MS/CM
VERNIER	Pushed in
TRIGGER SOURCE	OFF
TRIG LEVEL	Center of Range

Check to see that the time base has not been initiated. Allow 20 minutes for warmup before making any adjustments.

The following voltages in the Low Voltage Power Supply should be checked and readjusted if necessary. Use a John Fluke Model 800 or equivalent Digital Voltmeter with an incremental accuracy of ± 0.5% or better.

Test Point	Voltage and Tolerance	Service Adjustment	Location
TP2103	-150V ± 0V	-150V ADJ (R2169R)	All adjustments are located on the Low-voltage Module, Schematic 8901 4711-4
TP2102	+110V ± 0V	+110V ADJ (R2169F)	
TP2101	+255V ± 0V	+255V ADJ (R3106F)	
TP2100	+420 +3V, -6V	No Adjustment	

NOTE: All adjustments should be made at mid-line voltage: 115V/230V, ± 2%

1-11. SWEEP-CIRCUIT ADJUSTMENTS

a. CLAMP ADJ (R5222F, X Module Schematic 8901 4731-4)

The CLAMP ADJ controls the screen voltage of the Saw Generator Clamp Tube V509 which is adjusted for nominal zero bias tube current.

1. Set a Simpson Model 260 Multimeter to 100 MICRO-AMPS. (This is equivalent to 0.25 volt full scale.)

2. Connect this meter across R5227 by connecting the positive lead to TP5200 and the negative lead to TP5201. See Sheet 4 of the Schematic listed in the heading.

3. Adjust the CLAMP ADJ for an indicated reading of 0.1 volt. outside adjustment set -.1V with respect to TP5200 on 1.5V range

b. SAW START LEVEL (R5222R, X Module Schematic 8901 4731-4)

The SAW START LEVEL provides adjustment of the dc starting level of the Main Sweep so that it may coincide with the starting point of the Delaying Sweep.

1. Connect a vacuum-tube voltmeter from pin 6 (positive) of the Saw Bootstrap Cathode Follower, V510, to ground.

2. Adjust the SAW START LEVEL for an indicated reading of 33 volts.

3. This adjustment must later be retouched to normalize the starting point of the Main and Delaying Sweeps.

c. SWEEP MODE PRESET (R6167, Main Frame Module, Schematic 8901 4741-4)

The SWEEP MODE PRESET adjustment sets the optimum point for triggering when the STABILITY control is set to PRESET.

1. On the Main Frame set TRIGGER SOURCE switch to OFF, TRIGGER MODE switch to NORMAL AC, and STABILITY control to PRESET.

2. Temporarily, connect a 2-megohm 1% resistor from the arm of the SWEEP MODE PRESET adjustment to ground. This point is readily available at pins 12 and 13 (on outside - count from left to right) of bottom Assembly Board on Sync Chassis.

3. Adjust the SWEEP MODE PRESET until a trace just appears on the screen (driven sweep).

4. Disconnect the 2-megohm resistor. The trace should now disappear.

1-12. TRIGGER CIRCUIT ADJUSTMENTS

a. TRIG SENS (R6139, Main Frame Module Schematic 8901 4741-4)

The TRIG SENS adjustment is provided in the Sync Shaper Trigger circuit to set the current of the normally conducting tube and the backlash voltage.

1. On the Main Frame, set TRIGGER SOURCE switch to OFF and rotate TRIG LEVEL control in a direction fully opposite from PRESET. The SYNC READY lamp should be on.

2. Connect a Simpson Model 260 or equivalent voltmeter across the cathode resistor R6148 in the Sync Shaper circuit, V613 and V614, pin 6 (positive). R6148 is located on the Assembly board just below the TRIG LEVEL CENT (R6125) adjustment.

3. Set TRIG SENS adjustment for an indicated reading of 2.6 volts

4. Slowly rotate the TRIG LEVEL control. When this control is rotated about one-half way, the voltage should change abruptly from 2.6 volts to approximately 0.9 volt. At this point the SYNC READY lamp should be extinguished.

5. Reset the TRIG LEVEL control to PRESET.

b. TRIG LEVEL CENT (R6125, Main Frame Module Schematic 8901 4741-4)

The TRIG LEVEL CENT adjustment sets the level of the Trigger Shaper circuit so that no readjustment of the TRIG LEVEL control is required when the TRIGGER SOURCE switch is set from plus to minus slopes or vice versa.

1. On the Main Frame, set TRIGGER MODE to NORMAL AC, TRIG LEVEL to PRESET, and TRIGGER SOURCE to OFF.

2. Adjust TRIG LEVEL CENT until the SYNC READY Lamp is "just on". Next, advance this adjustment slightly beyond the threshold level of "just on" for the final setting.

c. AUTO SYNC ADJ (R6153, Main Frame Module Schematic 8901 4741-4)

The AUTO SYNC ADJ is provided to optimize the slope of the regenerative loop of the Sync Shaper circuit in order to improve triggering ability.

1. Set TRIGGER MODE to AUTO (SLOW or FAST), TRIGGER SOURCE to OFF, and TRIG LEVEL to PRESET.

2. Connect a 273-megohm resistor from pin 2 of the Sync Buffer Cathode Follower V612A to ground. (The 273-megohm resistor is comprised of three 91-megohm resistors connected in series.)

3. Set AUTO SYNC ADJ for intermittent or threshold operation of the Main Sweep.

4. Remove the resistor. A horizontal reference trace should appear on the screen only when the TRIGGER SOURCE switch is set to AUTO (SLOW or FAST).

1-13. CATHODE-RAY TUBE ADJUSTMENTS

a. -1200V ADJ (R1000, HV Module Schematic 8901 4701-4)

The -1200V ADJ is provided to permit adjustment of the brightness level of the CRT. The control normalizes the special no-burn safety circuit against the voltage reference corona tube V110.

1. On the Main Frame, set SWEEP RATE switch to 2 SEC/CM and pull out the VERNIER control.
2. Set the DISPLAY LOGIC switch to ~~MAIN SWP~~ and FOCUS and ASTIG controls to center of range.
3. Turn the -1200V ADJ fully clockwise.
4. Connect a Simpson Model 260 or equivalent voltmeter from pin 6 of the Input Cathode Follower, V518 and V519, to ground.
5. Using the front panel INTENSITY control, adjust for an indicated reading of ~~70~~ 65 volts.
6. Set -1200V ADJ to yield a low intensity reference spot.
7. Adjust FOCUS and ASTIG for optimum spot size.

b. PATTERN ADJ (R2301F, LV Module Schematic 8901 4711-4)

The PATTERN ADJ control is provided to optimize the CRT geometry for the left and right edges of the display.

1. Apply a 1 Kc signal from a Tektronix Type 105 or an equivalent Squarewave Generator to the Y Input connector.
2. On the Main Frame, set TRIGGER SOURCE to INT and SWEEP RATE to 1 MS/CM.
3. Adjust INTENSITY control until the display approaches normal brightness.
4. Set up the Oscilloscope for a 5 by 10-centimeter pattern.

5. Optimize the FOCUS and ASTIG control settings.

6. Switch the Squarewave Generator to 10 Kc.

7. Rotate the PATTERN ADJ throughout its range and observe the vertical edge at the left and right-hand sides of the 5 by 10-centimeter display.

8. Barreling at one extreme and pincushioning at the other extreme should be obtained.

9. Set the PATTERN ADJ to optimize the display at the left and right-hand sides.

c. Y DEFL PL SHIELD ADJ (R2301R, LV Module Schematic 8901 4711-4)

The Y DEFL PL SHIELD ADJ is provided to optimize the display for a flat top and a flat bottom on a minimum 5 centimeter scan. To accomplish this, carefully set the Y DEFL PL SHIELD ADJ so that this condition is obtained.

NOTE: The PATTERN ADJ (R2301F) and the Y DEFL PL SHIELD ADJ (R2301R) service adjustments are interdependent and may have to be repeated twice for optimum geometry setting.

1-14. X AMPLIFIER CENTERING AND PRE-CLIPPING ADJUSTMENTS

a. LENGTH (R5153, X Module Schematic 8901 4731-4)

The LENGTH control sets the Main Sweep length so that it occupies the width of the calibrator scale without hitting the sides of the cathode-ray tube with attendant electron scattering.

1. On the Main Frame, set the DISPLAY LOGIC switch to MAIN SWP and the SWEEP RATE to 5 MS/CM.

2. On the Y Plug-in Unit, set the VOLTS/CM switch to CAL and push in the VERNIER control.

3. Set the LENGTH adjustment so that 3 cycles of the calibrator pattern are displayed in 10.5 centimeters of the CRT scale.

b. X POS CENT (R5616, X Module Schematic 8901 4731-4)

The X POS CENT adjustment is provided so that the PATTERN POSITIONING control may be set to its electrical horizontal center when the trace is horizontally centered on the screen.

1. Remove V525.

2. Connect pin 3 of the Upper Level Cathode Follower, V525A, to +110 volts.

3. Connect pin 6 of the Lower Level Cathode Follower, V525B, to ground.

4. Set the Main TRIGGER SOURCE switch to OFF.

5. Connect the arms of the Horizontal Section of the PATTERN POSITIONING control (R6620F and R6620R) together. This may be conveniently accomplished by temporarily connecting a jumper across pins 4 and 16 of P5200.

6. Set the Horizontal Section of the PATTERN POSITIONING control to its electrical center. This is accomplished by connecting a Simpson Model 260 or an equivalent voltmeter from the jumper wire on pins 4 and 16 of P5200 (negative) to the plate pin 1, and then to the cathode pin 2, of the X Position Reference Diode, V526. Then adjust the PATTERN POSITIONING control so that equal voltages are obtained from these points.

7. Adjust X POS CENT to bring the start of the sweep to the left-hand edge of the CRT scale.

8. Remove the jumper across pins 4 and 16 of P5200. At this point, do not disturb the conditions outlined in steps 1, 2, and 3. They are needed for the X5 REG adjustment described in the next paragraph.

c. X5 REG (R5617 X Module Schematic 8901 4731-4)

The X5 REG adjustment is provided so that equal expansion of the display from left and right of center will occur when the EXPAND switch is set from X1 to X5.

1. On the Main Frame, set SWEEP RATE switch to 2 SEC/CM and the DISPLAY LOGIC switch to R.O.

2. Pull out the Main VERNIER control and turn it fully counterclockwise.

3. Set the X and Y Read-Out switches to 000. This is done so that the scaling and index dots coincide, thus only one dot appears.

4. Use the INDEX POSITIONING control to move the read-out dot to the exact center of the calibrator scale.

5. Set the EXPAND switch to X5 and adjust the X5 REG to bring the dot back to the exact center of the scale.

6. Restore V525 to its socket and remove the jumpers connected on pins 3 and 6.

NOTE: Time sharing will cause the display of dots and sweep to be seen only on a half-time basis. In other words, you alternately see first the dots, then the trace, etc.

d. WINDOW-LEVEL ADJUSTMENTS: X1 ADJ AND X5 ADJ (R6503 and R6502, X Module Schematic 8901 4731-4)

The window-level adjustments (X1 ADJ and X5 ADJ) are provided to set the voltages of the diode clippers (CR5502 and V523) which prevent excessive input to the X amplifier. These clipping diodes are necessitated by the feedback circuits employed in the X amplifier and prevent time distortion when signals of varying repetition rates are displayed.

1. Insert the network shown in Figure 1-2 in series with the horizontal deflection plate and the X amplifier output.

2. On the Main Frame, set the DISPLAY LOGIC switch to MAIN SWP, SWEEP RATE switch to 10 MS/CM, and push in the VERNIER control.

3. Set EXPAND switch to X1 and adjust the Window-Level X1 ADJ to produce a pattern which is symmetrically

clipped at either end of the CRT scale. In other words, distance A in Figure 1-3a will be equal to distance B in Figure 1-3b. It will be necessary to move the PATTERN POSITIONING control to locate the left and right-end clipping levels.

4. Repeat the procedure described in step 3 by setting the EXPAND switch to X5, and note the following exception. The X5 ADJ is set so that the pattern starts 0.4 centimeter closer to the left edge of the CRT scale than the right edge. In other words, distance A in Figure 1-3a is shortened by 0.4 centimeter.

5. After the Window-Level adjustments are made, remove the network installed in step 1.

e. SETTING X AMPLIFIER TRIMMER CAPACITORS

(X1 Trimmer C5602, X5 Trimmer C5605, and HF Feedback Compensation C5628; X Module Schematic 8901 4731-4)

The X amplifier employs voltage feedback for linearization and gain stability. The feedback networks must give the same feedback at low and high frequencies to avoid distortion. Trimmer capacitors are provided to normalize the high frequency feedback with the feedback at low frequencies.

1. Set the Main Frame controls as follows:

DISPLAY LOGIC	R.O.
TRIGGER SOURCE	+ LINE
VOLTS/CM	CAL
SWEEP RATE	10 MS/CM
Vertical Readout	000
Horizontal Readout	999
SWITCH MODE	CHOP
EXPAND	X1

2. With INDEX POSITIONING control, move the index dot to the left edge of the scale. The scaling dot should now be at the right edge of the scale.

3. Simulate for stray capacity by placing a metal cover near the chassis.

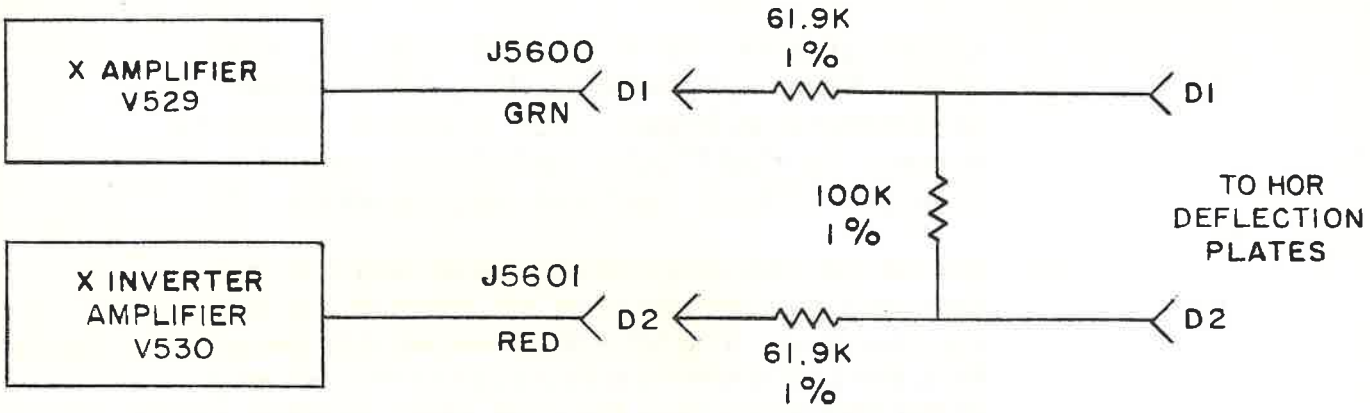
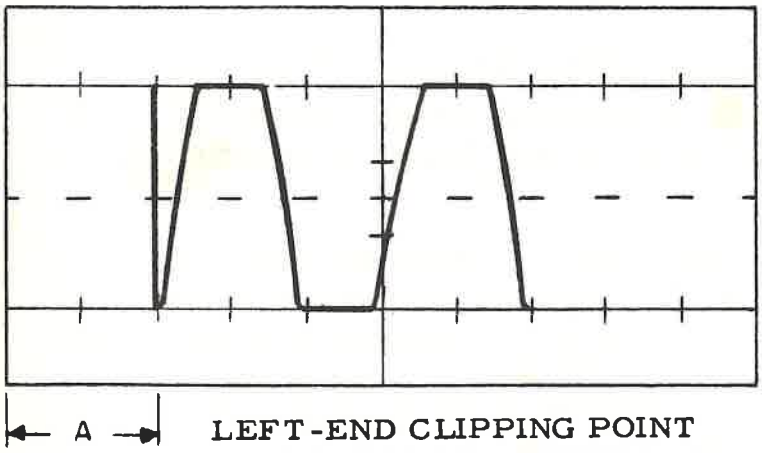


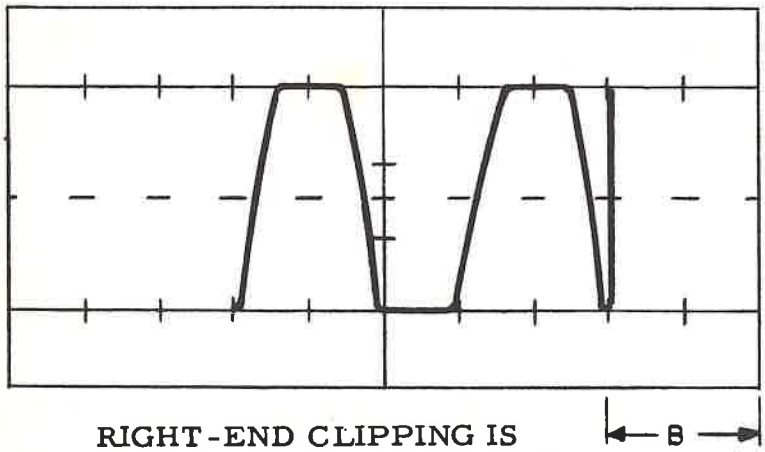
FIGURE 1-2. NETWORK FOR WINDOW-LEVEL ADJUSTMENTS



LEFT-END CLIPPING POINT IS LOCATED BY MOVING PATTERN POSITIONING CONTROL TO THE LEFT

FIGURE 1-3a.

DISPLAY ILLUSTRATING LEFT-END CLIPPING OF THE PATTERN



RIGHT-END CLIPPING IS LOCATED BY MOVING PATTERN POSITIONING CONTROL TO THE RIGHT

FIGURE 1-3b.

DISPLAY ILLUSTRATING RIGHT-END CLIPPING OF THE PATTERN

4. Adjust the X1 trimmer until the pattern obtained in Figure 1-4a appears.

5. Set the EXPAND switch to X5 and adjust the X5 trimmer for the same condition in step 4. Figure 1-4b indicates improper adjustment of either the X1 or X5 trimmer.

6. The High-Frequency Feedback Compensation is adjusted for the cleanest display on both ranges (EXPAND switch is set to X1 or X5). Figure 1-4c indicates the improper adjustment of this trimmer.

7. Reset EXPAND switch to X1.

f. Y RO BAL ADJ (R7029, Main Frame Module Schematic 8901 4741-4)

A POLARITY switch is provided for the Vertical Read-Out signal. The Y RO BAL ADJ is set to maintain the dc level of the indexing dot at the same point at either polarity position.

1. Set DISPLAY LOGIC switch to R.O. and with the INDEX POSITIONING control, move the index dot to the bottom of the CRT scale.

2. Using the Vertical Read-Out switches, position the scaling dot to the top of the CRT scale.

3. Set the Y RO BAL ADJ so that there is no depositioning of the index dot when the POLARITY switch is set from (+) to (-).

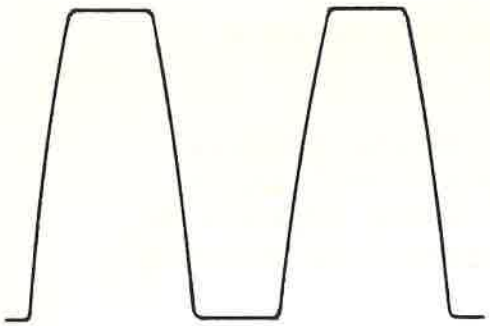


FIGURE 1-4a

NORMAL DISPLAY ILLUSTRATING PROPER ADJUSTMENT OF C5602, C5605 & C5628

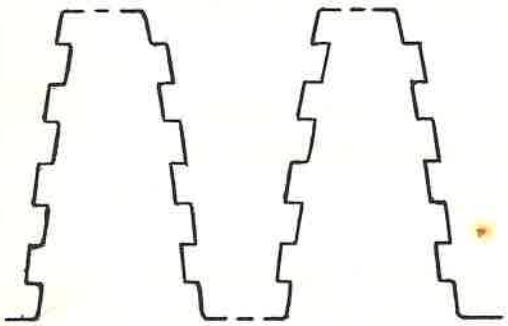


FIGURE 1-4b

DISPLAY ILLUSTRATING IMPROPER ADJUSTMENT OF C5602 ON X1 SCALE OR C5605 ON X5 SCALE

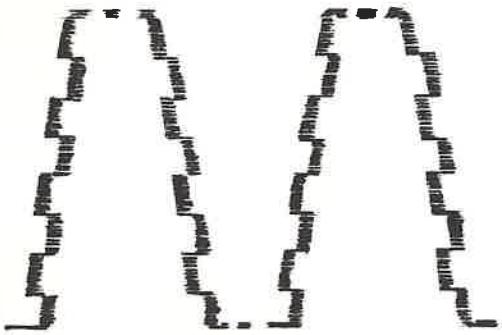


FIGURE 1-4c

DISPLAY ILLUSTRATING IMPROPER ADJUSTMENT OF THE HF FEEDBACK TRIMMER, C5628

g. X RO CAL ADJ (R7127, Main Frame Module Schematic 8901 4741-4)

The X RO CAL ADJ is provided in the horizontal Read Out channel to (1) calibrate the Read-Out signal using the CRT scale or (2) to normalize the Read-Out signal with an external standard.

1. Set Main Frame controls as follows:

DISPLAY LOGIC	R.O.
SWEEP RATE	5 MS/CM
Vertical Readout	000
Horizontal Readout	49.9 MS
VOLTS/CM	CAL

2. Center the display with the PATTERN POSITIONING control.

3. Using the INDEX POSITIONING control, move the index dot so that it starts at the beginning of the first cycle.

4. Set the X RO CAL ADJ so that the scaling dot starts exactly at the beginning of the fourth cycle.

1-15. Y SENSITIVITY ADJUSTMENTS

a. GENERAL

Sensitivity adjustments are provided for each vertical channel in the Main Frame of the Type 425 Oscilloscope. The Type 4207 Y Test Plug-in Unit may be used to normalize the gain of both channels to 125 millivolts/centimeter. When the Type 4207 Y Test Plug-in Unit is not available, the AMPL A GAIN may be adjusted by normalizing the read-out to the scale. It is then advisable to set AMPL B GAIN in a similar position to that of AMPL A GAIN. A check of the Main Frame sensitivity may be made by using a Du Mont Type 4201, 4202, or 4205 Plug-in Unit and testing to see whether the calibrator signal will occupy 4 centimeters of vertical deflection without setting the VERNIER control for maximum gain.

b. AMPL B GAIN ADJUSTMENT FOR MAIN FRAME SIGNAL CHANNEL

(R3012, Y Switch and Driver, LV Module Schematic 8901 4711-4)

1. Return DISPLAY LOGIC switch to MAIN SWP.

2. Set CHANNEL SELECTOR switch to B.

3. Adjust AMPL B GAIN for four centimeters of vertical deflection.

4. Set CHANNEL SELECTOR switch to A and B. Compare both signals; they should both displace four centimeters of vertical deflection.

c. AMPL A GAIN ADJUSTMENT FOR MAIN FRAME READ OUT CHANNEL

(R3011, Y Switch and Driver, LV Module Schematic 8901 4711-4)

1. Install a Type 4207 Y Test Unit.

2. Set CHANNEL SELECTOR switch to A and the RELAY toggle switch to ON.

3. Set DISPLAY LOGIC switch to MAIN SWP.

4. Adjust AMPL A GAIN for four centimeters of vertical deflection.

5. Set DISPLAY LOGIC switch to R.O. and the Vertical Read-Out switches to 200. The Read Out dots should now be spaced four centimeters apart.

d. INT SYNC DC ZERO (R3116F, Y Switch and Driver, LV Module Schematic 8901 4711-4)

The INT SYNC DC ZERO adjustment sets the triggering level in the dc position of the TRIGGER MODE switch. It is set so that the Main Sweep will trigger in the PRESET position of the TRIG LEVEL control when the trace is centered vertically.

1. With signal input, center the trace in the horizontal center of the screen using the PATTERN POSITIONING control.

2. Connect a Simpson Model 260 or an equivalent voltmeter from P6400, pin 24 (positive) to ground.

3. Adjust for an indicated reading of zero volts. J6400, pin 24 returns to the cathode of the Internal Sync Cathode Follower, V307.

1-16. DISTRIBUTED AMPLIFIER TEST AND ALIGNMENT PROCEDURE

The adjustments of the Trimmers in the Distributed Amplifier and Delay Line, have been carefully set at the factory and do not normally require readjustment. If a complete alignment procedure is desired, it is suggested that the instrument be returned to the factory. Minor adjustments may be made as follows:

1. Check to see that all Delay Line Trimmers have been set 9/32" from the fibre washers and the Amplifier Trimmers 7/16" from the fibre washers. Set peaking coils L4100 and L4101 to maximum counterclockwise position.

2. Install a Du Mont Type 4207 Y Test Plug-in Unit in the Main Frame.

3. Apply power to the Main Frame and allow five minutes for the instrument to warm up. Meanwhile, preset front-panel controls as follows:

Control	Setting
EXPAND	X5
SWEEP RATE	0.05 us/cm
DISPLAY LOGIC	MAIN SWP
TRIGGER SOURCE	+ INT
TRIGGER MODE	NORMAL AC
STABILITY AND TRIG LEVEL	PRESET

4. On the Y Plug-in Unit, set the CHANNEL SELECTOR switch to A, and the RELAY toggle switch to ON.

NOTE

Do not turn any one trimmer more than one-half turn at a time.

5. Start with the trimmer nearest the 590-ohm reverse termination resistor and adjust the Distributed Amplifier Trimmers counterclockwise until approximate alignment of this section is obtained.

6. Continue alignment along the delay line until the top of the displayed test pulse is a straight line. Decrease the sweep rates occasionally to check for tilt in the alignment.

TABLE 1-1. ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES

NOTE: If the tube is replaced with an unaged tube, some of the adjustments may need to be reset after 50 hours of operation. The table below indicates which adjustments should be reset at that time.

SYMBOL	TYPE	SERVICE ADJUSTMENTS	RESET AFTER 50 HOURS
	HIGH VOLTAGE POWER SUPPLY MODULE (Schematic 8901 4701-4)		
V101	K1736P (CRT)	-1200V ADJ (R1000), PATTERN ADJ (R2301F), Y DEFL PL SHIELD (R2301R), SWP CAL (R6603), AMP A GAIN (R3011), AMP B GAIN (R3012), and LENGTH (R5153)	No for all adjustments
V102	12AU7	-1200V ADJ (R1000)	Yes
V103	6CZ5	None	No
V104 thru V106	5642	SWP CAL (R6603), AMP A GAIN (R3011), AMP B GAIN (R3012), and LENGTH (R6153)	No for all adjustments
V107	5642	None	No
V108 & V109	5642	SWP CAL (R6603), AMP A GAIN (R3011), AMP B GAIN (R3012), and LENGTH (R6153)	No for all adjustments

TABLE 1-1. ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES
(Continued)

SYMBOL	TYPE	SERVICE ADJUSTMENTS	RESET AFTER 50 HOURS
LOW VOLTAGE POWER SUPPLY MODULE (Schematic 8901 4711-4)			
V201	6BJ8	None	No
V202	6336	None	No
V203	6BR8-A	None	No
V204	6336	None	No
V205	6BR8-A	None	No
V206	ECC83/12AX7	+255 ADJ (R3106R)	Yes
V207	6336	None	No
V208	6BR8-A	None	No
V209	ECC83/12AX7	+110 ADJ (R2169F)	Yes
V211	6BR8-A	None	No
V212	ECC83/12AX7	-150 ADJ (R2169R)	Yes
V213	OG3	-1250 ADJ (R2169R)	No
Y SWITCH AND DRIVER, LV MODULE (Schematic 8901 4711-4)			
V301 thru V307:	No Adjustment Required		
Y DISTRIBUTED AMPLIFIER AND DELAY LINE MODULE (Schematic 8901 4721-4)			
V401 thru V407:	No Adjustment Required		

TABLE 1-1. ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES
(Continued)

SYMBOL	TYPE	SERVICE ADJUSTMENTS	RESET AFTER 50 HOURS
	X MODULE (Schematic 8901 4731-4)		
V501	6922	SWP MODE PRESET (R6167)	Yes
V502	6BC7	SAW START LEVEL (R5222R)	Yes
V503	6BA8-A	None	No
V504	6BA8-A	None	No
V505	7119	None	No
V506	6922	SWP MODE PRESET (R6167), and SAW START LEVEL (R5222R)	Yes
V507	6922	LENGTH (R5153)	Yes
V508	6922	None	No
V509	6BA8-A	CLAMP ADJ (R5222F)	Yes
V510	6BA8-A	SAW START LEVEL (R5222R), SWP CAL (R6603)	Yes
V511	OG3	SWP MODE PRESET (R6167), and SWP CAL (R6603)	Yes
V512	6BA8-A	None	No
V513	6BR8-A	SWP CAL (R6603)	Yes
V514	6DJ8	None	No
V515	6922	None	No
V516	6BK7-B	None	No

TABLE 1-1. ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES
(Continued)

SYMBOL	TYPE	SERVICE ADJUSTMENTS	RESET AFTER 50 HOURS
	X MODULE (continued) (Schematic 6901 4731-4)		
V518 & V519	6BA8-A	SAW START LEVEL (R5222R)	Yes
V520	6AW8-A	None	No
V521 & V522	6BA8-A	None	No
V523	6BJ8	X5 ADJ (R6502) and X1 ADJ (R6503)	Yes
V524	6AW8-A	X5 ADJ (R6502) and X1 ADJ (R6503)	Yes
V525	7119	X5 ADJ (R6502) and X1 ADJ (R6503)	Yes
V526	OG3	None	No
V527	6DJ8	X5 ADJ (R6502) and X1 ADJ (R6503)	Yes
V528	6922	None	No
V529	6BQ5/EL84	X5 ADJ (R6502) and X1 ADJ (R6503)	Yes
V530	6CW5/EL86	None	No

TABLE 1-1. ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES
(Concluded)

SYMBOL	TYPE	SERVICE ADJUSTMENTS	RESET AFTER 50 HOURS
		MASTER CLOCK AND SYNC AMPLIFIER, MAIN FRAME MODULE (Schematic 8901 4741-4)	
V601	6922	None	No
V602	7119	None	No
V610	6922	None	No
V611	6922	TRIG LEVEL CENT (R6125)	Yes
V612	6922	TRIG LEVEL CENT (R6125), SWP MODE PRESET (R6167), and AUTO SYNC ADJ (R6153)	Yes for all
V613	6BA8-A	AUTO SYNC ADJ (R6153) and TRIG LEVEL CENT (R6125)	Yes
V614	6BA8-A	TRIG SENS (R6139) and AUTO SYNC ADJ (R6153)	Yes
		READOUT GENERATOR, MAIN FRAME MODULE (Schematic 8901 4741-4)	
V701	6922	None	No
V702	6BC7	None	No
V703	6922	None	No
V704 & V705	6BC7	None	No
V706	6922	None	No
V707	6922	Y RO BAL ADJ (R7029)	Yes
V708	6BK7-B	None	No

SECTION 2

PERFORMANCE ASSURANCE TEST

2-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance of the Type 425 Oscilloscope. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available.

NOTE

If this oscilloscope is checked by a receiving inspection laboratory, the tests outlined below are recommended to certify performance. The Type 425 Oscilloscope has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined below, the instrument will not perform to specifications, the assistance of the local Du Mont Field Engineering Representative should be requested.

2-2. CHECKING THE POWER SUPPLY

1. Check fuses for proper value.

2. Check and clean air filters.

3. Oil the fan motor with a few drops of light oil every few months.

4. Examine the instrument for charred or mechanically damaged components, loose connectors, and improperly seated tubes; correct all defects.

5. Install Y Plug-in Unit (Types 4201, 4202, or 4205).

6. Install the Type 4203 Delaying Sweep Plug-in Unit. If this unit is not available, use the Type 4204 or any other X Plug-in Unit.

   Note: Only a limited number of tests may be made without the Type 4203 Plug-in Unit. The performance of the Delaying Sweep, Main and Delaying Sweep, and Independent Display positions of the DISPLAY LOGIC switch can not be checked adequately without the Type 4203 Delaying Sweep Plug-in Unit.

7. Apply power to the Type 425 Oscilloscope through a variable voltage source (Variac or an equivalent). Set the line voltage to 115 volts. (Double this value for 230-volt operation.)

8. Apply the calibration signal to the vertical system and display the Main Sweep at a rate of 10 milliseconds/cm.

9. Set Main TRIGGER MODE switch to NORMAL AC, STABILITY and TRIG LEVEL controls to PRESET, and TRIGGER SOURCE switch to +LINE.

10. Allow 20 minutes for warmup before making any adjustments. Replace the covers while waiting to avoid overheating the instrument.

11. Lower the line voltage until the display starts to drift, or becomes erratic. The line voltage must be less than 105 volts (210 volts for 230-volt operation). If instability is noted, check operation of the low-voltage power supplies.

12. Raise the line voltage to 125 volts (250 volts for 230-volt operation). The display should remain stable and must not be erratic. If instability is noted, check operation of the low-voltage power supplies.

13. Reset the line voltage to 115 volts (230 volts for 230-volt operation).

2-3. CHECKING THE MAIN SWEEP

1. Check that the Main Sweep occupies a minimum horizontal scan of 10 centimeters. If necessary, set the LENGTH (R5153) service adjustment for 10.5 centimeters.

2. Adjust the front panel screwdriver SWP CAL control until exactly six cycles of the calibrator waveform (60-cycle line) occupies 10 centimeters of the horizontal scan. Exercise care to avoid parallax errors when making this measurement.

3. Pull out the Main Sweep VERNIER control, and adjust the sweep rate until two cycles of the calibrator display exactly fills the center two centimeters of the scale. Set the EXPAND switch to X5. The two cycles about the center should now occupy the entire screen. If equal expansion of the display from left and right of center does not occur when the EXPAND switch is set from X1 to X5, then adjust the X5 REG (R5617) located on X Module. Reset the EXPAND switch to X1 and push in the Main Sweep VERNIER control to obtain calibrated sweep.

4. Set the DISPLAY LOGIC switch to R.O., the Y Read-Out thumbswitches to 000, and the X Read-Out thumbswitches to 999. Center the Read-Out dots vertically on screen, and adjust the index dot (left dot) to fall on the extreme left-hand edge of the scale. If the scaling dot (right dot) does not fall on the extreme right-hand edge of the scale, set the X RO CAL ADJ (R7127) on the R.O. chassis until both dots are exactly 10 centimeters apart. When properly adjusted, they should include 6 cycles of the calibrator display.

5. Set the POLARITY switch from (+) to (-). If the index dot moves, set the Y RO BAL ADJ (R7029) so that there is no depositioning of the index dot when the POLARITY switch is set from (+) to (-).

6. Push in the SWITCH MODE push button to obtain CHOPped electronic switch operation. If the calibrator waveform becomes serrated, adjust the X1 Trimmer, C5602, on the X Module to clear up this condition.

7. Set the EXPAND switch to X5 and repeat step 6 with the X5 Trimmer (C5605). Next, adjust the High-Frequency Feedback Compensation Trimmer (C5628) for the cleanest display on both ranges (EXPAND switch is set to X1 or X5). Refer to Section 1 of this Manual for precise instructions.

8. Reset the EXPAND switch to X1.

9. On the Main Frame, set the TRIGGER MODE switch to ARMED AC, the STABILITY control for Recurrent Sweep, and the DISPLAY LOGIC switch to R.O. Make sure that the PICK-OFF SOURCE switch on the Delaying Sweep unit is set to OFF. The display should now disappear. Push the ARMED SWP RESET button. A single trace of the time base complete with Read-Out dots should appear. Repeat this operation several times to test the single sweep. After completing these tests, reset the STABILITY control to PRESET and the SWITCH MODE push-button to ALTERNATE.

2-4. CHECKING THE MAIN FRAME TRIGGER CIRCUIT

1. On the Main Frame, set the TRIGGER SOURCE switch to +EXT/10, the TRIG LEVEL control to PRESET, and the TRIGGER MODE switch to ARMED AC. The SYNC READY indicator should be lit. Turn the TRIGGER SOURCE switch to -EXT/10. The SYNC READY lamp should remain on. If it does not, the TRIG LEVEL CENT adjustment (R6125), located on the sync chassis will have to be reset.

2. Push in the ARMED SWP RESET button to rearm the sweep. The SWP READY indicator should now be lit.

3. Rotate the Main TRIG LEVEL control throughout its range. Somewhere near the center range of this control, the SYNC READY indicator will go out, the sweep will fire once, and the SWP READY indicator will also extinguish. Reset the TRIG LEVEL control to PRESET and repeat this test several times.

4. On the Y Plug-in Unit, set the VOLTS/CM switch to OFF. Turn the Main Sweep STABILITY control from the PRESET position until the sweep runs recurrently and

displays a base line with the Read-Out dots. Twenty to fifty degrees rotation of the STABILITY control should produce no sweep action. If a trace should occur during the rotation interval mentioned, then the SWEEP MODE PRESET adjustment (R6167) should be reset according to the instructions given in Section 1 of this Manual. Return the STABILITY control to PRESET.

5. Turn the Main TRIGGER MODE control to AUTO SLOW and then to AUTO FAST. A base line with Read-Out dots should be displayed in each case. Note that the base line and Read-Out dots will appear to alternate.

2-5. CHECKING SWEEP CALIBRATION

If it is desired to check all sweep rate calibrations, a very accurate (± 1/2%) time standard such as the Tektronix Type 180A Time Marker Generator, or equivalent, should be available. Use the front panel screwdriver SWP CAL control for setting the 10 MS/CM range. If large errors are noted on the higher sweep rates, refer to the paragraph entitled "Checking the Main Sweep" in this Section.

1. Set the EXPAND switch to X1.

2. Set up the Time Marker Generator so that 10 pulses are displayed on the oscilloscope on every range of the SWEEP RATE control.

3. If the second pulse of the display is positioned to fall one centimeter from the left edge of the scale, then the ninth pulse should be spaced 8 centimeters (± 4 mm) apart from this pulse. In other words, time calibration checks are made within an 8-centimeter centered portion of the scale.

   NOTE: When making these checks, exercise care to avoid errors in scale parallax. On the slower SWEEP RATE ranges, use a stop watch or other appropriate device; the time duration is still measured between the 1 and 9-centimeter marks on the scale.

4. The above sweep calibration checks may be repeated when the EXPAND switch is set to X5, thereby increasing the effective sweep length to 50 centimeters. The maximum tolerance now becomes 7.5 millimeters, averaged over the 8-centimeter centered portion of the scale. On the

10 nanoseconds/cm and 20 nanoseconds/cm ranges, an additional 20% crowding of the display is permissible, averaged over the first 4.5 centimeters of the trace starting from the left.

5. Disconnect the Time Marker Generator from the Oscilloscope.

2-6. CHECKING Y SENSITIVITY ADJUSTMENTS

1. On the Main Frame, set the TRIGGER MODE control to NORMAL AC, TRIGGER SOURCE switch to +LINE, DISPLAY LOGIC switch to R.O., and the TRIG LEVEL and STABILITY controls to PRESET.

2. On the Y Plug-in, set the VOLTS/CM switch to CAL. The calibrator display should now appear on the screen with the Read-Out dots.

3. Set the X Read-Out switch to 000 and the Y Read Out switch to 200.

4. Using the INDEX POSITIONING control, center the Read-Out dots to the middle of the screen.

5. If the Read-Out dots are not spaced exactly 4 centimeters apart, reset AMPL B GAIN (R3012) adjustment, located on the Low-Voltage Power Supply Module, until this condition is obtained.

6. Remove the vertical amplifier Plug-in Unit and install the Type 4207 Y Test Unit Plug-in Unit.

7. Set the Main TRIGGER SOURCE switch to +INT.

8. On the Y Test Plug-in Unit, set the CHANNEL SELECTOR switch to A and the RELAY toggle switch to ON.

9. Adjust AMPL A GAIN (R3011), located on the Low-Voltage Power Supply Module, for exactly four centimeters of vertical deflection. If the Type 4207 Y Test Unit is not available, see instructions in Section 1 of this Manual.

2-7. CHECKING RISE TIME AND DELAY-LINE REGULARITY

1. If a check of rise time, peaking or delay line regularity is desired, use the Du Mont Type 4207 Y Test Unit. To observe rise time of the displayed signal, sweep rates in the range of 10 nanoseconds/cm to 0.10 usec/cm should be used.

2. At a sweep rate of 10 nanoseconds/cm, the base line of the signal pulse should extend for 3 or more centimeters from the left endoof the sweep. Starting from the initial 10% rise of the pulse, the length of the rise-time interval should extend from 0.85 to 1.1 centimeters. The Main Frame 10-90% push-button control may be used for rise-time measurements.

3. If the slower sweep rates show irregularities exceeding 1-1/2—line width over the first 400 nanoseconds of the signal pulse, the delay line trimmers require adjustment as outlined in Section 1 of this Manual.

   NOTE: The delay lines normally do not require readjustment. Do not tamper with or adjust the delay line trimmers since their adjustment is exacting and requires the tools and techniques specified in Section 1 of this Manual.

4. On the 0.10 usec/cm sweep range, the overshoot and preswing of the display should not exceed 6% of the normal amplitude of the waveform.

2-8. CHECKING BANDWIDTH

Do not attempt bandwidth certification of this Oscilloscope without checked and standardized test equipment.

1. To check the bandwidth of this Oscilloscope, procure the following equipment:

   a. Du Mont Type 4285 50-ohm Termination Adapter.

   b. Measurements Corp. Model 80 calibrated standard Signal Generator or equivalent.

   c. A short length of RG-8A/U cable with connectors in good condition.

2. Install the Du Mont Type 4201 Dual Trace Y Plug-in Unit and set the VOLTS/CM switch to 0.05 V/CM.

3. On the Main Frame, set the STABILITY control to RECURrent, the SWEEP RATE to 1 MS/CM, and the DISPLAY LOGIC switch to MAIN SWP.

4. Set the Signal Generator to 100 Kc and connect its output to the Y Input connector through the 50-ohm Terminal Adapter.

5. Adjust the output of the Signal Generator to give five centimeters of vertical deflection on the screen. Note the standardized output attenuator settings of the Signal Generator.

6. Increase the frequency of the Signal Generator to 35 Mc and reset the output attenuators to exactly the same settings used at 100 Kc.

7. The vertical bar should now have shrunk so that it occupies more than 3.25 cm and less than 3.80 cm.

NOTE: Be sure the output attenuator, measuring bolometer, and frequency settings of the Signal Generator are checked before testing bandwidth. Beware of parallax errors in reading the CRT scale.
Recheck the test setup and all equipment to make certain that the oscilloscope is being checked accurately.

2-9. ADDITIONAL TESTS FOR TIME-SHARED DISPLAYS

If further tests are desired, it is suggested that the Test Engineer follows the procedures in the Operator' s Manual for obtaining Delayed Sweep, Dual-trace operation, Main and Delayed Sweeps, and Independent Displays (time-shared dual-beam displays). Should these operation modes prove unstable or inoperative, and the procedure has been carefully followed, check the detailed maintenance procedure in Section 1 of this Manual for instructions.

2-10. ADDITIONAL CHECKS FOR VERTICAL READ-OUT ACCURACY

If a dc voltage standard is available, it is advisable to double check the vertical Read-Out calibration by applying a known signal to the Y Input connector on the Plug-in Unit. Make sure that the Y Plug-in Unit has initially been calibrated with the internal calibrator signal. The vertical Read-Out will then measure the dc voltage standard within an accuracy of 30 parts/1000 (full scale). Normally the error will be less than ±25 parts/1000 and may be reset by the AMPL B GAIN (R3012) adjustment to any desired value. The reset accuracy will then be ±5 parts/1000.

A double check of the -150-volt and +110-volt power supplies may also be made if a ±0.5% (incremental) voltmeter such as the John Fluke Model 800 or equivalent is available. These two supply busses will adversely affect calibration if they are not properly set.