SPECIFICATION AND PERFORMANCE CHECK

The electrical specifications are valid only if (1) the instrument has been calibrated at an ambient temperature between +20° C and +30° C; (2) the instrument is operating at an ambient temperature between 0° C and +50° C, unless otherwise noted; (3) each plug-in must be operating (fully installed) in a calibrated system.

SPECIFICATION

TABLE 2-1
Vertical Amplifier

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential)		50 mV/division ±2%. Less than 0.5% difference between left and right vertical plug-in compartments.
Bandwidth (6-Division Reference)	Dc to at least 90 MHz with a 067-0680-00 Calibration Fixture. Dc to at least 60 MHz with a calibrated 5A48.	
Risetime (6-Division Reference)	3.9 ns or less with a 067-0680-00 Calibration Fixture. 5.8 ns or less with a calibrated 5A48.	
Aberrations (6-Division Reference)	6% or less measured with a 067-0680-00 Calibration Fixture. 3% or less measured with a calibrated 5A48.	
Position Effect on Aberrations (6-Division Reference with a 067-0680-00 Calibration Fixture)		Front corner aberrations of +step or −step response signal should not exceed ±6% when the waveform is positioned not more than 1 division beyond graticule center.
Vertical Centering		Within ±0.5 division of graticule center.
Delay Line Length		140 ns.
Modes	Chop and Alt.	
Rate		
Chop	50 kHz +50% −30%; 3 μs on, 2 μs off.	
Alt	Once every two sweeps.	

TABLE 2-2

Horizontal Amplifier

Characteristics	Performance Requirements	Supplemental Information
Bandwidth	Dc to at least 2 MHz.	8-division signal used as a reference.
Horizontal Centering		Within 0.5 division of graticule center.
X-Y Operation	Less than 2° phase shift from dc to at least 20 kHz.	

TABLE 2-3

Z-Axis Amplifier

Characteristics	Performance Requirements	Supplemental Information
External Input		
Input Voltage	+5 V turns crt beam on from off condition. −5 V turns crt beam off from on condition.	
Usable Frequency Range	Dc to 2 MHz.	
Input Impedance	Resistance: 10 kΩ. Capacitance: 40 pF.	
Maximum Safe Input	50 V (dc + peak ac).	

TABLE 2-4

Display

Characteristics	Performance Requirements	Supplemental Information
Geometry	Bowing or tilt ≤ 0.1 division.	
Orthogonality	90° ±0.7°.	
Photographic Writing Rate	90 cm/μs, using a C-59 camera and Polaroid 3000 speed film.	
Phosphor	P31 standard; P7 and P11 optional.	
Deflection	Electrostatic, with mesh magnification.	
Acceleration Potential	15 kV.	

TABLE 2-5

Power Supply and Calibrator

Characteristics	Performance Requirements	Supplemental Information
Power Line Input		
Line Voltage (RMS)	Nominal 100 V, 110 V, 120 V, 200 V, 220 V, 240 V ±10%.	
Line Frequency	50 to 400 Hz.	
Input Power	100 W maximum at 120 V ac, 60 Hz.	
Fuse Data	1.25 A slow blow (120 V ac). 0.7 A slow blow (240 V ac).	
Calibrator		
Voltage	400 mV, ±1%.	
Current	4 mA, ±1%.	
Frequency	Twice the power line frequency.	

TABLE 2-6

Readout

Characteristics	Performance Requirements	Supplemental Information
Intensity Range		Off to full brightness. Readout inoperative when READOUT INTENS fully counterclockwise in detent position.
Location		Top words are displayed in top major graticule division between left and right extreme graticule lines. Bottom words are displayed in bottom major graticule division between left and right extreme graticule lines.

TABLE 2-7

Miscellaneous

Characteristics	Performance Requirements	Supplemental Information
Graticule		
Scale	8 x 10 divisions with 1.22 cm/Div.	
Scale Color and Type		
Normal	White internal graticule lines.	
Optional	Black internal graticule lines.	
Beam Finder	Limits trace within viewing area and intensifies trace.	

TABLE 2-8

Environmental

Characteristics	Performance Requirements	Supplemental Information
Temperature		
Operating	0°C to +50°C.	
Storage	−40°C to +70°C.	
Altitude		
Operating	To 15,000 feet.	
Storage	To 50,000 feet.	
Vibration		
Operating and Non-Operating	With the instrument complete and operating, vibration frequency swept from 10 to 50 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015" total displacement. Hold 3 minutes at any major resonance, or if none, at 50 Hz. Total time, 54 minutes.	
Shock		
Operating and Non-Operating	30 g's, 1/2 sine, 11 ms duration, 2 shocks in each direction along 3 major axes for a total of 12 shocks.	
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.	

TABLE 2-9

Physical

Parameter	Information
Finish	Anodized aluminum panel with gray vinyl coated frame. Blue-vinyl coated cabinet.
Net Weight of Cabinet Version with Feet and Handle	25 lbs (11 kg).
Overall Dimensions	See Fig. 2-1.
Overall rack depth	19 inches.

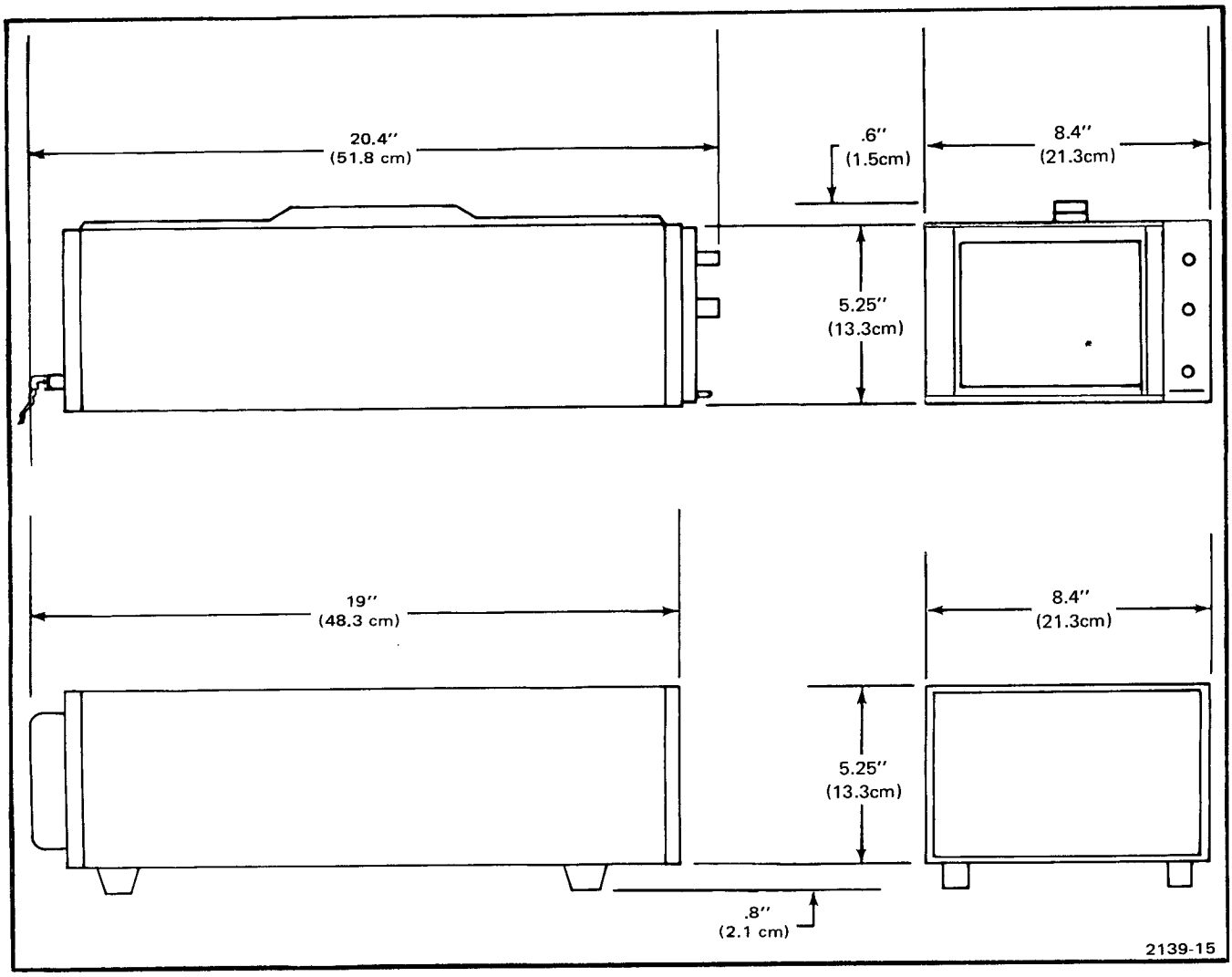

Fig. 2-1. Illustration showing dimensions of the cabinet version of the 5440.

POWER TO EXTERNAL EQUIPMENT

With the plug-in units removed from the Oscilloscope, the unused power capability of the Oscilloscope power supplies may be used to operate external electronic equipment. The recommended access to the power supplies is through the Main Interface circuit board. Special equipment is available from Tektronix, Inc. to facilitate connection to the individual power supply voltages. Order the equipment through your local Tektronix Field Office or representative.

Table 2-10 lists the maximum current draw and Main Interface pin assignment for only those power supply voltages recommended for operating external electronic equipment.

TABLE 2-10
Power Available to External Equipment

Power Supply Voltage	Maximum Current	Main Interface Pin Number
+200 V	30 mA	A1
+30 V	240 mA	A5
+15 V	600 mA	A6
+5 V	1.5 A	B2
−15 V	600 mA	B6
−30 V	240 mA	B5

PERFORMANCE CHECK

Introduction

This procedure checks the 5440 electrical characteristics against the performance requirements that appear in the Specification section of this manual. If the instrument fails to meet the requirements given in this performance check, the adjustment procedure should be performed. This procedure can also be used by an incoming inspection facility to determine acceptability of performance.

Tolerances that are specified in this performance check procedure apply to the instrument under test and do not include test equipment error.

Test Equipment Required

The following test equipment, or equivalent, is required to perform the performance check and adjustment procedure. Test equipment characteristics listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerance.

Special test devices are used where necessary to facilitate the procedure. Most of these are available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

TABLE 2-11

List of Test Equipment Requirements

Description	Performance Requirements	Application	Examples
Oscilloscope	Bandwidth dc to 1 MHz; minimum deflection factor, 1 mV/div; sweep rate, 1 ms/div.	LV power supply ripple check.	a. Tektronix 5110, 5A13N, 5B10N.
Digital voltmeter[1]	Range, zero to 200 volts; accuracy, within 0.1%.	LV power supply check and adjustment.	a. Tektronix DM 501 Digital Multimeter.[2]
DC voltmeter (vom)[1]	Range, zero to 3000 volts; accuracy, checked to within 1% at 3000 volts.	HV power supply check.	a. Triplett Model 630NA. b. Simpson Model 262
Calibration generator	Amplitude calibration, 10 mV to 1 V; accuracy, ±0.25% into 1 MΩ output, square wave at approximately 1 kHz.	Vert and Horiz gain check and adjustment.	a. Tektronix PG 506 Calibration Generator.[2]
Time-mark generator	Marker outputs, 5 ns and 10 ns; accuracy, within 1%.	Sweep timing checks and adjustment at 5 and 10 ns.	a. Tektronix TG 501 Time-Mark Generator.[2]
Pulse generator	Pulse duration, 10 ns or less; pulse amplitude, .5 V to at least 5 V into 50 Ω load.	Vert compensation check and adjustment.	a. Tektronix PG 501 Pulse Generator.[2]
Medium-frequency signal generator	Sinewave output, to at least 60 MHz, leveled; output amplitude 5 V p-p; accuracy, 2%.	Vertical bandwidth check.	a. Tektronix SG 503 Signal Generator.[2]

TABLE 2-11 (cont.)

List of Test Equipment Requirements

Description	Performance Requirements	Application	Examples
Amplifier plug-in unit[3]	Bandwidth, dc to 60 MHz; display mode, CH 1 and dual-trace; deflection factor, 5 mV to 10 V/div.	Vert and Horiz gain check and adjustment.	a. Tektronix 5A48 Amplifier plug-in unit.
Time-base unit	Sweep rate, at least 5 ns/div.	Sweep timing check and adjustment. Used to provide sweep throughout procedure.	a. Tektronix 5B44 Time-Base unit.
Calibration fixture	Produces gain-check and pulse-response waveforms.	Vert and Horiz gain check and adjustment.	a. Tektronix Calibration Fixture 067-0680-00.
Coaxial cable (2 required)	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Provides signal interconnection.	a. Tektronix part 012-0057-01.
1X passive probe	Compatible with 5A-series amplifiers used in the oscilloscope.	Calibrator signal check.	a. Tektronix P6028 Probe.
Termination	Impedance, 50 Ω; accuracy, within 2%; connectors, bnc.	Vert check and adjustment.	a. Tektronix part 011-0049-01.
T-connector	Connectors, bnc.	External Z-axis amplifier check.	a. Tektronix part 103-0030-00.
Screwdriver	3-inch shaft, 3/32 inch bit.	Adjustments.	a. Xcelite R3323.

[1]**Required only for Adjustment procedure. A high-voltage probe can be used with the DM501 in lieu of the DC voltmeter. Order 010-0277-00.**
[2]**Requires TM 500-Series Power Module.**
[3]**Additional amplifier, such as 5A24N, required to check dual amplifier operation.**

Preliminary Procedure

1. Ensure that the line voltage selector block has been installed on the correct line selector pins on the Low Voltage and Calibrator circuit board and that the regulating range includes the applied line voltage. Refer to the Operating Voltage section of this manual.

2. Ensure that all test equipment is suitably adapted to the applied line voltage.

3. If applicable, install the TM 500-series test equipment into the test equipment Power Module.

4. Install a vertical amplifier unit into the left vertical compartment of the 5440.

5. Install a time-base unit in the horizontal compartment of the 5440.

6. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to stabilize.

Initial Control Settings

Set the following controls during warm-up time:

Oscilloscope

Intensity, Focus	Set for well-defined trace and normal brightness.

Amplifier Plug-In

Display	On.
Position	Centered.
CH 1 Volts/Div	.1.
CH 1 Cal	Fully clockwise.
CH 1 Input coupling	Dc.
Trigger	CH 1.
Mode	CH 1.

Time Base Plug-In

Display	Alternate.
Position	Centered.
Main Sec/Div	1 ms.
Main Variable	Cal.
Swp Mag	Off.
Triggering	+ Slope, Auto Trig, AC Coupl.
Trig Source	Left.

PERFORMANCE CHECK PROCEDURE

1. Check Trace Alignment

a. Position the horizontal trace over the center horizontal graticule line.

b. CHECK—For alignment error of .1 division or less.

c. Press the POWER switch to turn off the Oscilloscope.

d. Interchange the amplifier and time-base units in their respective compartments. Pull the POWER switch to on.

e. Position the vertical trace over the center vertical graticule line.

f. CHECK—For alignment error of .1 division or less.

2. Check Geometry

a. Set the FOCUS and INTENSITY controls for a well-defined trace, extending vertically above and below the graticule area.

b. CHECK—Vertical bowing and tilt of the trace display is less than .1 division when positioned horizontally across the entire graticule area.

c. Press the POWER switch to turn off the Oscilloscope and interchange the amplifier and time-base units.

d. Pull the POWER switch to on.

3. Check Beam Finder

a. Press the BEAM FINDER switch.

b. CHECK—The display is compressed within the graticule area and is intensified.

c. Press and hold the BEAM FINDER switch in, then rotate the position control of the vertical amplifier and the time-base unit fully clockwise and counterclockwise.

d. CHECK—The display is compressed within the graticule area and is intensified.

4. Check Trigger Amplifier

a. Connect a 60 MHz sine-wave signal from the MF (Medium Frequency) generator to the vertical amplifier input, using a 42 inch bnc cable and a 50 ohm termination.

b. Set the vertical amplifier and generator controls to obtain a signal amplitude of 1 major division.

c. Set the time-base unit for 20 ns/div (SWP MAG on) and adjust the trig level control for a stable display.

d. CHECK—That a stable display can be obtained.

e. Press the POWER switch to turn off the Oscilloscope and change the amplifier from the left vertical compartment to the center compartment.

f. Pull the POWER switch to on, select the right trigger source, and repeat parts b through d of this step.

g. Disconnect the bnc cable and termination from the vertical amplifier input connector and release the SWP MAG pushbutton.

5. Check Alternate Operation

a. Push both CH 1 and CH 2 pushbuttons in.

b. Set the time-base unit for 10 ms/div and position the traces about two divisions apart.

c. Turn the time-base Sec/Div switch throughout its range.

d. CHECK—Trace alternation at all sweep rates (except AMP position). At faster sweep rates, alternation is not apparent; instead, display appears as two traces on the screen.

e. Press the POWER switch to turn off the Oscilloscope and change the amplifier from the center vertical compartment to the left compartment.

f. Pull the POWER switch on and repeat parts a through d of this step.

6. Check Chop Operation

a. Push the CHOP button in on the time-base unit.

b. Turn the time-base Sec/Div switch throughout its range.

c. CHECK—For dual-trace display at all sweep rates, without alteration (except AMP position).

d. Press the POWER switch to turn off the Oscilloscope and change the amplifier from the left vertical compartment to the center compartment.

e. Pull the POWER switch to on and repeat parts a, b, and c of this step.

7. Check Alternate Operation Between Amplifiers

a. Install a second vertical dual-trace plug-in unit in the left plug-in compartment and set its controls for dual-trace operation.

b. Set the time-base Chop pushbutton to its out position and the Sec/Div switch to 20 ms/div.

c. CHECK—For two traces for the left amplifier (one for each channel), then two traces for the center amplifier, alternately. (If a single-channel amplifier is used instead of the second dual-trace amplifier, the single-channel trace will appear twice for each alternation.)

d. Press the POWER switch to turn off the Oscilloscope and interchange the two vertical amplifiers in their respective compartments. Remove the vertical amplifier from the center compartment. Pull the POWER switch to on.

NOTE

The 5A48 is used for the vertical system performance procedure. When a different amplifier plug-in is used to verify vertical specifications, the oscilloscope system frequency response may be degraded.

8. Check Vertical Gain

a. Connect a 1 kHz square-wave signal from the calibration Generator to the amplifier input, using a 42-inch bnc cable. Set the time-base Sec/Div to 1 ms.

b. Set the amplifier and generator controls to obtain a five-volt reference signal. Center the display.

c. CHECK—The crt display for a vertical deflection of 5 divisions ±0.15 division (±3%).

d. Press the POWER switch to turn off the Oscilloscope and remove the amplifier from the left vertical compartment and install it in the center compartment. Pull the POWER switch to on.

e. CHECK—The crt display for a vertical deflection of 5 divisions ±0.15 division (±3%).

f. Disconnect the bnc cable from the 5A48 input connector.

9. Check Vertical Compensation

a. Set the amplifier CH 1 VOLTS/DIV switch to .1. Connect the pulse generator to the CH 1 input connector with the 42 inch cable and a 50 ohm termination.

b. Set the time-base unit for a calibrated sweep rate of 20 ns/div and triggering for auto mode, ac coupled, and RIGHT trigger source. Adjust the trigger level control for a stable display, triggered on the rising portion of a 1 MHz pulse. Center the pulse horizontally on the graticule.

c. CHECK—For optimum square leading corner and flat top on a 5-division displayed pulse with aberrations not to exceed +0.15 or −0.15 division, with total peak-to-peak aberrations not to exceed 0.15 division.

d. Press the POWER switch to turn off the Oscilloscope and install the amplifier in the left compartment. Pull the POWER switch to on.

e. Push in the LEFT Trigger Source button. Adjust trigger level control for a stable display, triggered on the rising portion of the pulse. Center the pulse horizontally on the graticule.

f. CHECK—For optimum square leading corner and flat top on a 5-division displayed pulse with aberrations not to exceed +0.15 or −0.15 division, with total peak-to-peak aberrations not to exceed 0.15 division.

10. Check Vertical Bandwidth

a. Disconnect the bnc cable from the pulse generator and connect it to the output connector of the MF generator.

b. Set the amplifier VOLTS/DIV switch to .1 and adjust the MF generator controls for a 6-division display, at a frequency of 50 kHz. Center the display on the graticule.

c. Set the time-base unit for a sweep rate of 10 μs/div.

d. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

e. CHECK—The generator for a reading of at least 60 megahertz.

f. Press the POWER switch to turn off the Oscilloscope and install the amplifier in the center compartment. Pull the POWER switch to on.

g. Repeat parts b through e for the center vertical compartment.

h. Disconnect the bnc cable and termination from the amplifier input connector.

NOTE

The 5A48 amplifier is used for the horizontal system adjustment procedure. When a different amplifier plug-in is used to verify horizontal specifications, the amplifier frequency must be considered.

11. Check Horizontal Gain

a. Press the POWER switch to turn off the Oscilloscope and interchange the amplifier and the time-base units in their respective compartments. Pull the POWER switch to on.

b. Connect a 1 kHz square-wave signal from the Calibration Generator to the amplifier input connector, using a 42 inch bnc cable.

c. Set the amplifier and generator controls to obtain a five-volt reference signal. Center the display between the second and seventh vertical graticule lines.

d. CHECK—The crt display for a horizontal deflection of 5 divisions ±0.15 division.

e. Disconnect the bnc cable from the amplifier input donnector.

12. Check Horizontal Bandwidth

a. Connect a 50 kHz sine-wave signal from the MF generator to the amplifier input, using a 42 inch bnc cable and 50 ohm termination.

b. Set the amplifier and generator controls to obtain a 6-division display. Center the display between the second and eighth vertical graticule lines.

c. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

d. CHECK—The generator for a reading of at least 2 megahertz.

e. Press the POWER switch to turn off the Oscilloscope and interchange the amplifier and the time-base units in their respective compartments. Pull the POWER switch to on.

13. Check 10 ns Timing

NOTE

A 5B42 time-base or a time-base having a 10 ns sweep must be used.

a. Disconnect the bnc cable and 50 ohm termination from the amplifier input connector and connect the time-mark generator signal to the input connector.

b. Set the time-mark generator for 10 nanosecond markers. Set the deflection factor of the amplifier so the markers are at least five divisions in amplitude.

c. Set the time-base unit for a sweep rate of 10 ns/div. Adjust the time-base triggering control for a stable display.

d. CHECK—For one 10 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary). Sweep accuracy is ±5% over the entire sweep, excluding the first 30 and the last 100 ns of the magnified sweep.

14. Check 5 ns Timing

NOTE

This step can be performed only with a time-base unit having a 5 ns sweep rate, such as Tektronix 5B44.

a. Press the POWER switch to turn off the Oscilloscope and install an appropriate time-base unit in the horizontal compartment. Pull the POWER switch to on.

b. Set the time-base unit for a sweep rate of 5 ns/div. Adjust the time-base triggering control for a stable display.

c. CHECK—For one 5 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary). Sweep accuracy is ±6% over the entire sweep, excluding the first 30 and the last 100 ns of the magnified sweep.

d. Disconnect all cables.

NOTE

If the Readout System was deleted from the instrument (Option 1), omit step 15.

15. Check Readout Modes

a. Set the time-base unit for a free-running sweep.

b. Set the READOUT INTENSITY control for a visible readout display.

c. Select dual-trace operation on the amplifier.

d. CHECK—That the characters are displayed at the top and bottom of the crt. Characters do not touch or overlap and they correlate to the respective volts/div dial settings.

e. Rotate both CH 1 and CH 2 CAL controls counterclockwise.

f. CHECK—That a > symbol is displayed at the left of the readout character. Return the CAL controls to the calibrated position (fully clockwise).

g. Rotate the time-base MAIN SEC/DIV control throughout its range.

h. CHECK—That the characters are displayed at the top-center of the crt. Characters do not touch or overlap and they correlate to the respective s/div dial settings.

i. Rotate the MAIN VARIABLE control counterclockwise.

j. CHECK—That a > symbol is displayed at the left of the readout character. Return the control to the calibrated position (fully clockwise).

k. Push the DLY'D SWP pushbutton in on the time-base unit.

l. CHECK—That characters are displayed at the top-right of the crt and that characters do not touch or overlap and they correlate to the dly'd swp s/div dial settings.

m. Push the Display Mode button to MAIN SWP.

16. Check Calibrator Signal

a. Connect the 1X probe to the CH 1 input of the amplifier. Connect the probe tip to the calibrator loop.

b. Set the amplifier CH 1 Volts/Div switch to .1, and select CH 1.

c. Set the time-base sweep rate to 5 ms/div.

d. CHECK—The crt display for a vertical deflection of 4 divisions ±0.04 division.

e. Disconnect the 1X probe.

17. Check Z Axis Amplifier

a. Connect a 50 kHz sine-wave signal from the generator to the amplifier input connector (use a bnc T connector at the amplifier input), using a 42 inch bnc cable.

b. Set the amplifier and generator controls to obtain a calibrated five volt reference display.

c. Set the time-base unit for auto, internal triggering at a sweep rate of 10 μs/div.

d. Connect the signal from the output of the T connector at the amplifier input to the EXT INTENSITY INPUT connector on the rear panel.

e. CHECK—The bottom portion of the waveform is blanked out (reduce trace brightness to observe Z axis modulation).

f. Turn off all equipment and remove all plug-ins and cables.

This completes the Performance Check of the 5440 Oscilloscope.