

TYPE 321 OSCILLOSCOPE

F A C T O R Y

C A L I B R A T I O N P R O C E D U R E

Quick check for long ends, unsoldered joints, wire dress, etc. Preset all pots and trimmers to mid-range. Check front panel controls for position and operation.

1. CHECK POWER SUPPLY RESISTANCES TO GROUND

Primary of Power Transformer --- Infinite
10 Volts. Regulated to Converter --- Infinite

The following readings taken with Com. Lead of Ohmmeter on ground:

* +45	200 Ω
* +45 Dec.	600 Ω
* +10	80 Ω
* +6.3	8 Ω
* +6.3 Dec.	8 Ω
* -10	1000 Ω
* -10 Dec.	1400 Ω
* -45	4000 Ω
-720	5 Meg Ω

*NOTE: These readings will vary depending on range used. Use lowest possible range.

1A. CHECK RESISTANCE ACROSS BATTERY TERMINALS

With common lead of ohmmeter on Neg. terminal read 300 Ω , reverse leads and read infinite. Power switch off.

2. CHECK VOLTAGES AND REGULATION

Adjust 10 Volts regulated, (Check D.C. regulation.) 105-125. Measure voltages from converter.

TYPICAL MEASUREMENTS

		Ripple
+45	45.5	5 mv
+45 Dec.	47	2 mv
+10	9.3	3 mv
+6.3	6.3	150 mv
+6.3 Dec.	6.3	100 mv
-10	-10	3 mv
-10 Dec.	-11	2 mv
-45	-44	5 mv
-720	-720	750 mv

3. CHECK HI VOLTAGE (Accelerating) at cathode of V832 measure +3330 Volts.

4. CHECK SCALE ILLUM. AND POSITIONING CONTROLS

Check the SCALE ILLUMINATION control. Check operation of the POSITIONING CONTROLS. Free run trace and align trace with horizontal graticule lines. Push CRT forward against graticule and tighten CRT clamp.

5. CHECK FOCUS AND ASTIGMATISM

Using normal intensity, display about 2 major divisions of calibrator signal. Adjust FOCUS and ASTIGMATISM for sharpest focus of the display.

6. SET GEOM. ADJUST

Display only the rising and falling portion of the calibrator waveform. Adjust GEOMETRY for straightest vertical lines.

7. SET VERTICAL AMPLIFIER DC BALANCE

Adjust the DC BAL. pot so that there is no vertical shifting of the trace as the VARIABLE sensitivity control is rotated from one extreme to the other.

8. DC SHIFT COMP.

9. SET VERTICAL AMPLIFIER GAIN

Apply .05 V to the vertical INPUT jack on the 321 from the calibrator in the test scope. Set the VOLTS/DIV switch to .01. Set the VERT. GAIN ADJ. for 5 major divisions of signal display. Switch from AC to DC. There should be no change in gain. Check the VARIABLE sensitivity control for sufficient range.

10. CHECK VERTICAL AMPLIFIER BALANCE

With the VERTICAL POSITION control centered, the trace should be within 1 major division of the graticule center.

11. SET CAL AMP

12. CHECK COMPRESSION AND EXPANSION

With 2 major divisions of calibrator waveform displayed, position the presentation to the top and bottom limits of the graticule. Compression or expansion must not be greater than .5 minor divisions. Check for microphonics and hum.

13. ADJUST VOLTS/DIV SWITCH COMPENSATIONS

With the VARIABLE sensitivity control turned completely CW, and the VOLTS/DIV switch in the .01 position, connect a 10X probe to the output of the test scope calibrator and display about 4 major divisions of signal. Compensate probe. Adjust the attenuator compensation as follows:

<u>VOLTS/DIV</u>	PEAKING ADJ.	LEVEL ADJ.
<u>.02</u>	C418C	C418A
<u>.05</u>	C416C	C416A
<u>.1</u>	C414C	C414A
<u>1</u>	C412C	C412A
<u>10</u>	C410C	C410A

14. CHECK ACCURACY OF VOLTS/DIV STEPS

Begin with the VOLTS/DIV switch in the .01 position and the calibrator in the test scope set to .05 V. Check each range of the VOLTS/DIV switch for the proper deflection. ($\pm 2\%$) NOTE: The accuracy of the vertical calibration of the 321 is dependent upon the accuracy of the test scope calibrator.

15. ADJUST HIGH FREQUENCY COMPENSATION

From the type 105 square wave generator apply a signal of approximately 250 KC to the vertical INPUT of the 321. Set the VOLTS/DIV switch to the straight through (.01) position. Adjust C508 for the best square wave response.

16. SET STABILITY

Remove any signal from the vertical INPUT jack. Turn the TRIG. LEVEL control to AUTO. Rotate the STABILITY control CW until the sweep triggers. Further CW rotation will cause the sweep to free run. The STABILITY control should be positioned approximately mid-way between the point at which the sweep triggers and the point at which it free runs.

17. CHECK VERTICAL FREQUENCY RESPONSE

With the VOLTS/DIV switch on the .01 position, feed enough 50 KC signal from the 190 into the vertical INPUT to obtain 4 major divisions of deflection. Switch the 190 to 5 MC. The vertical deflection should now be not less than 2.9 major divisions.

18. CHECK HIGH FREQUENCY TRIGGER

The scope must trigger on a 2MC signal.

19. CHECK TRIG. LEVEL, AC, INT.

Position the TRIG. LEVEL knob on the shaft so that the scope will trigger \pm on .5 major division of calibrator signal when the dot on the knob is centered. (at zero). By adjusting the TRIG. LEVEL control, it should be possible to trigger on 1 minor division of signal.

20. CHECK AUTO. TRIGGERING, INT.

When the TRIG. LEVEL control is turned to AUTO. the scope will trigger \pm on .5 major divisions of calibrator signal.

21. CHECK TRIG. LEVEL, DC, INT.

The scope must trigger on .5 major divisions of signal within 2 major divisions of the graticule center on \pm INT.

22. CHECK EXT. TRIGGERING

The scope should trigger on EXT. AC, DC, or AUTO with .5 V og signal.

23. SET HORIZONTAL GAIN

Apply 10 μ sec markers from the 180 to the vertical INPUT. Set the sweep speed at 10 μ SEC/DIV. Adjust R338, HORIZONTAL GAIN to give 1 marker per major division.

24. SET SWEEP LENGTH

Adjust the SWEEP LENGTH control (R176) for 10.5 major divisions of horizontal deflection at 1 MILLISEC/DIV sweep speed with 1 millisecc markers from the 180.

25. ADJUST MAG GAIN

Set the TIME/DIV switch to 10 μ SEC. Apply 1 μ sec markers to the vertical INPUT. Pull VARIABLE TIME/DIV control to give 5X MAG. Adjust the MAG. GAIN control (R348) to give 2 markers per major division. Check sweep timing in all ranges. ($\pm 2\%$)

26. SET .5 μ SEC DIV/TIMING

Apply 1 μ sec markers to the vertical INPUT. Set the TIME/DIV switch to .5 μ SEC. Adjust C160L for 1 marker per 2 major divisions.

27. SET SLOW SWEEP ADJ.

Using 1 sec markers from the 180, switch the TIME/DIV to the .5 SEC position. Adjust SLOW SWEEP ADJ. (R167) to give 1 marker per 2 major division.

28. CHECK Z-AXIS INPUT

Remove the grounding strap from the Z-AXIS INPUT and apply 10 V from the test scope calibrator. At normal INTENSITY setting the 10 V should intensify the trace.

29. CHECK EXTERNAL DEFLECTION FACTOR

Switch the TIME/DIV switch to EXT. HORIZ. and feed 10 V from the test scope calibrator to the EXT. HORIZ. INPUT jack on the 321. There should be 6.7 or more major divisions of deflection.

30. CHECK HOLD-OFF

Connect a 10X probe to the ungrounded side of C312. Free run the 321 sweep and check for sufficient hold-off on all sweep ranges.

<u>RANGE</u>	<u>HOLD-OFF</u>	<u>RANGE</u>	<u>HOLD-OFF</u>
.5 μ sec	13 μ sec	10 μ sec	130 μ sec
1 μ sec	13 μ sec	20 μ sec	130 μ sec
2 μ sec	13 μ sec	50 μ sec	130 μ sec
5 μ sec	13 μ sec		
.1 Millisec	.8 Millisec	10 Millisec	150 Millisec
.2 Millisec	.8 Millisec	20 Millisec	150 Millisec
.5 Millisec	.8 Millisec	50 Millisec	150 Millisec
1 Millisec	8 Millisec	.1 Sec	150 Millisec
2 Millisec	8 Millisec	.2 Sec	150 Millisec
5 Millisec	8 Millisec	.5 Sec.	150 Millisec

31. MAKE NOTE OF CRT TYPE AND SERIAL NUMBER AND RECORD ON CALIBRATION RECORD.

32. CHECK OPERATION OF BATTERY CHARGER CIRCUIT.

Connect the scope to 117V with the power switch off. With the battery pack in place, connect the negative lead of the voltmeter to the -10V regulated supply. Connect the + lead of the voltmeter to the front end of the 117 Ω 10W resistor on the left side of the scope. (viewed from the front) With the switch in the DRY CELLS position, the reading will be 0 volts. Switch to the 2.5AH position and the meter should read 37-40V. Switch to the 4.3AH position and the meter should read 34-36V.

Now switch the scope ON and the meter should read 14-16V in the 4.3AH position, 16-18V in the 2.5AH position and 0 V in the DRY CELL position if the charger is working properly.

33. CHECK BATTERY OPERATION

Remove the AC cord. Insert the battery pack. The scope should function normally as long as the battery voltage under load is higher than 11.5 v.

34. CHECK DC OPERATION

Remove the battery pack from the scope and insert the DC cord. Connect the battery pack to the black and white leads. (Negative to the white lead.) The scope should operate normally. Check between the black and green leads for a resistance of 13 Ω .

Connect a DC supply to the black and white leads. The scope should regulate from 11.5 v to 23 volts.

Connect the DC supply to the white and green leads. The scope should regulate from 22 to 35 volts.