

## TYPE 310A OSCILLOSCOPE

### FACTORY CALIBRATION PROCEDURE

Quick check for long ends, unsoldered joints, wire dress, etc. Preset all pots and trimmers to mid-range. Check clearance of terminals on all front panel pots. Tighten set screws in TRIGGER LEVEL knob just snug enough that the knob can be turned on the shaft.

#### 1. CHECK POWER SUPPLY RESISTANCE TO GROUND

The -150 volt supply will be more than 6k to ground, the 100 v will be more than 6 k to ground, and the 300 v will be more than 10 k. Check transformer primary for infinite resistance to ground.

#### 2. CHECK VOLTAGES AND MEASURE RIPPLE AND REGULATION

Adjust -150 v supply with -150 ADJ. Check 100 v and 300 v supplies. ( $\pm 3\%$ ) Check elevated heater supplies at transformer terminals. (100 v at 9 and 10, 300 v at 13 and 14, and -HV at 17 and 18.)

Check power supplies for proper regulation with line at 105 and 125 v. The ripple should not exceed 10 mv on any of the three supplies at 117 v.

#### 3. SET CAL. ADJ.

With the SQUARE WAVE CALIBRATOR OFF, adjust CAL. ADJ. for 100 v at CAL TEST PT. Turn CALIBRATOR on. Voltage at CAL. TEST PT. must read between 40 and 60 v.

#### 4. SET HV ADJ.

Connect a meter between Power Transformer terminals #17 or #18 and ground. Adjust HV. ADJ. for a reading of -1675 v. Check regulation at high and low line voltage (105 and 125 v) with high intensity and sweep free running.

#### 5. CHECK SCALE ILLUM. AND POSITIONING CONTROLS

Check the SCALE ILLUM. controls. Check operation of positioning controls. Advance STABILITY and INTENSITY controls to obtain a trace. Align trace with horizontal graticule lines, push crt forward against graticule and tighten crt clamp.

#### 6. SET ASTIGMATISM

Using normal intensity, display about two divisions of calibrator signal. Adjust the FOCUS and ASTIG. controls for the sharpest line focus of the presentation.

#### 7. CHECK CRT GEOMETRY

Apply enough signal from the calibrator so that only the vertical parts of the square waves are visible on the graticule. Check geometry of the CRT.

#### 8. SET VERT. AMP. DC BAL.

Rotate the VARIABLE gain control from one end to the other and adjust the DC BAL. pot for no vertical shift with rotation. (R344) With vertical IN-PUT grounded and VOLTS/DIV in .1 v, check main amp for microphonics. Switch to .01 v and check preamp microphonics.

9. SET VERT AMP GAIN

Apply 0.5 v from the CALIBRATOR to the INPUT of the scope. Set the VOLTS/DIV switch to 0.1. Adjust the VERT. GAIN ADJ. for 5 divisions of deflection. Switch from AC to DC. The gain should not change more than 2%. Check the VARIABLE coverage and UNCALIBRATED neon. With the gain properly set, the VERTICAL POSITION control must have at least 5.5 major divisions of range each side of the graticule center.

10. SET PREAMP GAIN.

Switch VOLTS/DIV to .01 v. Apply .05 v from the CALIBRATOR to the input. Adjust PREAMP GAIN (R322) for 5 divisions of deflection.

11. CHECK VERTICAL DC SHIFT

With the VERTICAL VOLTS/DIV switch at 0.1 v/DIV, ground the INPUT and switch the input coupling from AC to DC. The trace should not shift more than 1 minor division vertically. With the input still grounded, switch from the 0.1 v division to the 0.05 v position. The trace should not shift more than 0.5 minor divisions. (Due to preamp output coupling cap.)

12. CHECK VERT. AMP. BALANCE

With the VERTICAL POSITION control centered, the trace must be within 1 major division of the graticule center. (Re-check vert. amp. DC bal.)

13. CHECK COMPRESSION AND EXPANSION.

With two major divisions of calibrator waveform displayed, position the presentation to the top and the bottom limits of the graticule. Compression must not be greater than 0.5 minor divisions. Expansion must not be greater than 0.75 minor divisions.

14. ADJUST HUM BAL.

Connect a 2X probe to the INPUT. Ground the probe to a front panel ground post. Switch gain to .01 v. Use a fast sweep speed and adjust the HUM BALANCE pot for minimum trace width.

15. ADJUST VOLTS/DIV SWITCH COMPENSATIONS

With the variable gain knob in the CALIBRATED position and the VOLTS/DIV switch in the 0.1 position, connect the 2X probe or a 10X probe to the output of a fast rise square wave generator and display about 4 divisions of signal. Adjust the probe for best square wave presentation. Switch to 0.2 position and adjust C310 for no spike and C309 for best level. Turn the red knob to the ccw end and adjust C413 for level. Re-check C310 and C309 as these three adjustments interact and may have to be adjusted several times. Switch to 0.5 position and adjust C307 for spike and C306 for level. Switch to 1.0 position and adjust C304 for spike and C303 for level. Switch to 10 position and adjust C301 for spike and C300 for level.

Switch to 0.01 position, (preamp) and adjust C320 for best square wave. Check all intermediate ranges for proper stacking of dividers.

16. CHECK ACCURACY OF CALIBRATOR AND VOLTS/DIV STEPS

Begin with the VOLTS/DIV switch in the 0.01 position and the CALIBRATOR set to 0.05 v. Check each range of the two switches for the proper deflection. ( $\pm 2\%$ ) If any range is borderline, check it against the test scope.

17. CHECK TRIG. LEVEL AC

Position the TRIG. LEVEL knob on the shaft so the scope will trigger + or - on 1 major division of calibrator signal when the dot is centered. (Between . and L on TRIG. LEVEL.) By adjusting the trigger level, it should be possible to trigger on  $\frac{1}{4}$  major division of signal.

18. CHECK TRIG. LEVEL DC

The scope must trigger on one major division of signal within 2 major divisions of graticule center on either + or - internal trigger.

19. ADJUST AUTO AND PRESET

Set the test scope to .5 v/DIV DC vertical sensitivity and trigger on LINE with both scopes. Using a 10X probe, connect it to the purple wires at the back end of the STABILITY pot. Set the scope under test to AUTO and adjust the PRESET control for half way between the point where the sweep triggers and the point where it free runs. The scope should now trigger on 0.25 major division amplitude, + or -.

20. CHECK EXTERNAL TRIGGER

The scope should trigger on EXTERNAL AC, DC, or AUTO with 0.2 v of signal.

21. CHECK LINE TRIGGER POLARITY

Connect a 2X probe from the scope input to the fuse holder. Check to see that the scope triggers on the proper polarity. If it does not, reverse the leads to terminals 29 and 30 on the power transformer.

22. SET LF ADJ.

Set the scope on the .1 range AC coupled, insert a 50 cps square wave and note the resulting waveshape with 8 major divisions of deflection. Switch to the preamp (.01) and adjust the LOW FREQ ADJ. for the same presentation as obtained in the main amp.

23. SET HF ADJ.

Set the scope on the .1 range and insert 400 kc from a properly terminated square wave generator. Adjust for about 5 major divisions of deflection. Center the waveform on the graticule. Preset L418 and L409 three turns from minimum inductance. Adjust L450 and L451 for best level keeping the adjustments balanced. Touch up L418 and L409 if needed to bring up the corner spike. Switch to the .01 preamp position and adjust L341 and L325 for the best square wave shape.

24. CHECK VERTICAL FREQUENCY RESPONSE

With the scope on the .01 position, feed enough 50 kc signal from the 190 into the scope to obtain 6 major divisions of deflection. Switch the frequency to 5 mc. There must be at least 2.8 divisions of deflection remaining if both amplifiers have the correct frequency response.

25. CHECK HF SYNC

The scope must sync on a 5 mc signal

26. ADJUST SWEEP CAL. AND SWEEP LENGTH

Set the scope for: 1 millisec/div, +INT, AC, with MAG. OFF. Insert 100  $\mu$ sec and 1 millise

c markers from a time mark generator. Adjust the SWEEP CAL. FOR exactly 1 large marker per large division. Adjust the SWEEP LENGTH for 10.5 divisions with the sweep free running. Check the coverage, non-cal neon, and operation of the variable control.

27. CHECK MAG GAIN AND SET MAG CENTERING

Position the left hand marker on the sweep under the center line of the graticule with 5X mag on. Switch to MAG X1 and again position the left hand marker under the center line with the MAG CENTERING pot. Check the timing with the MAG X5. ( $\pm 2\%$  on all ranges except 0.5  $\mu$ sec/div which is 5%) Check timing from 100  $\mu$ sec to 0.2 sec.

28. ADJUST HF TIMING

Check the timing on the 100  $\mu$ sec range. Neglect the first division. Set the scope for 10  $\mu$ sec/div, MAG X5 and insert 10  $\mu$ sec markers. Adjust C205 for linearity and C175B for timing. Switch the MAG X1, and adjust C213 for linearity using 10  $\mu$ sec markers. On the 1  $\mu$ sec range, set the timing with C175A. For the 0.5  $\mu$ sec range, trigger externally and with the MAG X5 apply 10 mc to the INPUT. Adjust C250 for timing. Re-check all of the last adjustments for interaction. Check timing of all intermediate ranges.

29. CHECK CRT CATHODE INPUT

Remove the grounding strap and apply 10 volts from the CALIBRATOR to the CRT CATHODE. With normal intensity, 10 volts will modulate the trace.

30. CHECK EXTERNAL DEFLECTION FACTOR

Switch to EXT. HORIZONTAL and feed 10 v of CALIBRATOR signal into the EXTERNAL connection. There should be at least 6.75 major divisions of deflection with EXT. HORIZ. variable pot full CW.

31. CHECK HOLD-OFF

Connect a 10X probe from the test scope to the center of C205. Turn the STABILITY control cw and check all ranges for sufficient hold-off.