

TYPE 21 and (22)

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

PRELIMINARY INSPECTION:

Check for long ends, unsoldered joints, loose hardware, and fit of plug-in in scope. Bend down loose components on top.

PRESET:

<u>Level</u>	<u>0</u>	<u>Slope</u>	<u>+</u>	<u>Sweep Function</u>	<u>NORMAL</u>
<u>Coupling</u>	<u>AC</u>	<u>Time/CM</u>	<u>1 millisecc</u>	<u>Source</u>	<u>Line</u>
Stability	CW	All caps	mid-range		

1. CHECK RESISTANCE TO GROUND

Check at interconnecting plug. ()-indicates extra connections for 22.

1. 28k	11. 90k	21. infinity
2. 0	12. - (infinity)	22. 1.5 m
3. 13k	13. -	23. - (infinity)
4. -	14. 26k	24. 1.5 m
5. 26k	15. -	25. -
6. 42k	16. -(infinity)	26. -
7. -	17. 0	27. -
8. infinity	18. .3	28. -
9. -	19. infinity	29. -
10. -	20. infinity	30. -

2. SET TRIGGER LEVEL CENTERING AND TRIG. SENSITIVITY

Plug the unit into the right-hand compartment of the 555 using an extension. Connect a meter lead to the front end of the 470 k resistor going to the center of the LEVEL pot. Adjust the level for a 0 voltage reading. Loosen the knob on the shaft and turn it so that with the spot pointed at the zero level mark; the voltage reading will be zero. Connect a jumper to ground from the front of the 470k resistor to maintain the zero reference. Set the SOURCE switch to LINE. Connect a 10X probe from the test scope to pin #6 of V45. Set the test scope for +line, Auto trigger, 2 milliseconds/cm, and .5V/cm. Adjust TRIGGER LEVEL CENTERING so that the waveform on the test scope is symmetrical. For a finer adjustment, switch test scope MAG ON and horizontally center a switching portion of the multi-waveform. Now switch the SLOPE switch of the unit under calibration back and forth from + to - and at the same time readjust TRIGGER LEVEL CENTERING until there is no horizontal shifting of the switching portion of the waveform observed on the test scope. Advance the SENSITIVITY pot until oscillations occur on the multi-waveform. Retard the control until the oscillations cease and the small spike on the negative side of the waveform is about one-half of its maximum amplitude.

3. ADJUST STABILITY

Turn the unit under calibration to AC AUTO and LOWER BEAM. Connect a meter to the left side of the 470 K resistor just above V114. Set the stability control half-way between the point where the sweep first starts and the point where it free runs (The trace will brighten when it free runs).

4. ADJUST DC LEVEL TRIGGERING

With the LEVEL control still at ground, switch both beams to B X1. Feed 3 mm of cal. signal into both verticals. Center both traces on their center lines. Switch to DC COUPLING, +SLOPE, and set SOURCE to LOWER BEAM. Adjust LOWER INT. TRIG. DC for stable triggering in both \pm SLOPE positions. Switch SOURCE to upper beam and adjust UPPER INT. TRIG. D.C. LEVEL ADJ. the same way. Remove the ground from the level control.

5. ADJUST LOCKOUT LEVEL

Connect a meter to the cathodes of V133. Set the meter on the 60 v scale. Turn to single sweep and ext. trig. Push button to light ready light. Observe the meter reading. Connect a signal to the Vertical input of sufficient amplitude to trigger the sweep or turn the LEVEL knob to trigger the sweep. Set the LOCK OUT LEVEL ADJ. for an 11-volt difference in the readings.

6. ADJUST MAG GAIN (R372 and R472 of A and B Horiz. Amps.)

Apply 100 μ sec, 1 msec, and 5 msec time marks to both Vertical Amplifiers.

Set HORIZ. DISPLAY, both UB and LB, to TIME BASE A X.2. Set Time Base A (Type 21) SWEEP FUNCTION to NORMAL, VARIABLE to CALIBRATED and TIME/CM to 1 ms. The trigger should be set to UPPER BEAM, AC, +, and +LEVEL. (Time Base B SWEEP FUNCTION to NORMAL.)

Adjust MAG GAIN of both A and B Horiz. Amps. for two time marks/CM. Always time between the 1st and 9th centimeter (CM) graticule mark. (See specification sheet for all timing tolerances.)

7. ADJUST SWEEP CAL (R351 and R451 of A and B Horiz. Amps.)

Switch HORIZ. DISPLAY, both UB and LB, to TIME BASE A X1. Adjust SWP CAL of both A and B Horiz. Amps. for one 1msec time mark/CM.

8. ADJUST SWP MAG REG (R358 and R458 of A and B Horiz. Amps.)

Return HORIZ DISPLAY, both UB and LB, to TIME BASE A X.2. Position both UB and LB displays so the middle 5 msec time mark falls at the graticule center. Switch both HORIZ DISPLAY to A X1. Adjust UB and LB SWP MAG REG so the time mark again falls at the graticule center.

9. ADJUST TIME BASE A SWEEP LENGTH

Adjust SWEEP LENGTH for 10.5 cm of horizontal deflection.

10. CHECK VARIABLE TIME/CM (Time Base A).

Check VARIABLE TIME/CM for smooth operation and a complete range of control between the TIME/CM steps. The UNCALIBRATED neon must light whenever the VARIABLE TIME/CM is rotated away from full clockwise.

11. ADJUST TIME BASE B SWEEP LENGTH

Set HORIZ DISPLAY, both UB and LB, to TIME BASE B X1 and TIME/CM to 1 msec/cm. The trigger should be set to LOWER BEAM, AC, +, and +LEVEL. Adjust SWEEP LENGTH for 10.5 cm of horizontal deflection.

Remove time base extensions and insert the Type 21 and Type 22 sweep generators into their compartments.

12. CHECK VARIABLE TIME/CM (Time Base B.)

Set TIME/CM to 1 ms and apply 5 ms time marks. Check VARIABLE TIME/CM and UN-CALIBRATED neon as in Step 5.

13. CHECK TIME BASE B SWEEP RATES (.1 msec to 5 sec/cm)

Apply 100 µsec time marks. Set TIME/CM to .1 msec. Readjust +LEVEL if necessary. Check the sweep rates as follows:

<u>TIME/CM</u>	<u>TIME-MARK GEN.</u>	<u>OBSERVE</u>
.1 msec	100 µsec	1 mark/cm
.2 msec	100 µsec	2 mark/cm
.5 msec	500 µsec	1 mark/cm
1 msec	1 msec	1 mark/cm
2 msec	1 msec	2 mark/cm
5 msec	5 msec	1 mark/cm
10 msec	10 msec	1 mark/cm
20 msec	10 msec	2 mark/cm
50 msec	50 msec	1 mark/cm
.1 sec	100 msec	1 mark/cm
.2 sec	100 msec	2 mark/cm
.5 sec	500 msec	1 mark/cm
1 sec	1 sec	1 mark/cm
2 sec	1 sec	2 mark/cm
5 sec	5 sec	1 mark/cm

14. ADJUST C330 and C430 (A and B Horiz. Amps.)

Set HORIZ. DISPLAY, both UB and LB, to TIME BASE B X.2. Set Time Base B TIME/CM to .1 msec. Apply 10 µsec time marks. Readjust +LEVEL. Adjust separately C330 and C430, A and B Horiz. Amps., for minimum shift of the sweep start while switching TIME/CM alternately between 50 µsec and .1 msec.

15. ADJUST TIME BASE B, HORIZ. AMP. A, & HORIZ. AMP B HIGH-FREQUENCY TIMING.

Apply 10 µsec trigger pulses to Time Base B INPUT and 1 µsec time marks to each vertical. Set trigger to EXT, AC, +, and +LEVEL.

<u>TIME/CM</u>	<u>TIME MARK GEN.</u>	<u>LOCATION</u>	<u>ADJ.</u>	<u>OBSERVE</u>
(Set <u>HORIZ. DISPLAY</u> , UB and LB, to <u>TIME BASE B X1</u>)				
.5 µsec	1 µsec	Time Base B	C160A	1 mark/2cm
.1 µsec	10 MC	Horiz. Amp. A	C350	1 cycle/cm
			C372	Linearity
		Horiz. Amp. B	C450	1 cycle/cm
			C472	Linearity

15. (Continued)

TIME/CM	TIME MARK GEN.	LOCATION	ADJ.	OBSERVE
(Set <u>HORIZ. DISPLAY</u> , UB and LB, to <u>TIME BASE B X.2</u>)				
.1 μ sec	50 MC	Horiz. Amp. A	C364	Linearity and timing.
			C384	
		Horiz. Amp. B	C464	Linearity and timing.
			C484	

Recheck all above positions for interaction.

Set HORIZ. DISPLAY, UB and LB, to TIME BASE B X1.
Apply 100 μ sec trigger pulses.

1 μ sec	1 μ sec	Time Base B	C160C	1 mark/cm
2 μ sec	1 μ sec			2 mark/cm
5 μ sec	5 μ sec			1 mark/cm
10 μ sec	10 μ sec		C160E	1 mark/cm
20 μ sec	10 μ sec			2 mark/cm
50 μ sec	50 μ sec			1 mark/cm

16. ADJUST SWEEP DELAY START AND DELAY STOP (R576, R572)

Apply 1 msec time marks to each vertical. Set UB HORIZ DISPLAY to TIME BASE A X1. Set Time Base A TIME/CM to 1 msec and Time Base B TIME/CM to 10 μ sec. Switch SWEEP FUNCTION to SWEEPS ONCE FOR EACH "A" DEL'D. TRIG.

The 1-10 MULTIPLIER should be set to 1.00. At this point, Time Base A + LEVEL may require slight readjustment. Also position both UB and LB sweeps for normal display. Adjust DELAY START so the leading edge of the second UB marker is brightened and the LB marker occurs at the sweep start.

Now set the 1-10 MULTIPLIER to 9.00. Adjust DELAY STOP so the leading edge of the tenth UB marker is brightened and the LB marker occurs at the sweep start. Interaction may require re-adjustment of DELAY START and DELAY STOP. Check linearity of the 1-10 MULTIPLIER at all major divisions. (See spec. sheet.)

17. CHECK DELAY SWEEP JITTER:

Set Time Base B TIME/CM to 1 μ sec. Check horizontal jitter of LB pulse at 1.00, and 9.00 settings of the 1-10 MULTIPLIER.

18. CHECK TIME BASE A SWEEP RATES USING 1-10 MULTIPLIER. (.1 ms to 5 sec.)

Check each of the following positions between 1.00 and 9.00 on the 1-10 MULTIPLIER. At 1.00, note error in delay start due to the trigger circuit; add or subtract this error at 9.00. (See Chart on Following Page).

18.	TIME BASE A	TIME BASE B	TIME-MARK GEN.
	.1 ms/cm	1 μ sec/cm	100 μ sec
	.2 ms/cm	1 μ sec/cm	100 μ sec
	.5 ms/cm	1 μ sec/cm	500 μ sec
	1 ms/cm	10 μ sec/cm	1 msec
	2 ms/cm	10 μ sec/cm	1 msec
	5 ms/cm	10 μ sec/cm	5 msec
	10 ms/cm	.1 msec/cm	10 msec
	20 ms/cm	.1 msec/cm	10 msec
	50 ms/cm	.1 msec/cm	50 msec
	.1 sec/cm	1 msec/cm	100 msec
	.2 sec/cm	1 msec/cm	100 msec
	.5 sec/cm	1 msec/cm	500 msec
	1 sec/cm	20 msec/cm	1 sec
	2 sec/cm	20 msec/cm	1 sec
	5 sec/cm	20 msec/cm	5 sec

19. ADJUST TIME BASE A H.F. SWEEP RATES:

Apply 10 μ sec time marks to both verticals. Set Time Base A TIME/CM to 10 μ sec and Time Base B TIME/CM to .5 μ sec/cm. Readjust Time Base A +LEVEL. Adjust C160E and C160C using 1-10 MULTIPLIER for timing between 1.00 and 9.00. At 1.00, note error in delay start due to trigger circuit; add or subtract this error at 9.00.

TIME BASE A	TIME BASE B	TIME BASE GEN.	ADJUST
10 μ sec/cm	.5 μ sec/cm	10 μ sec marker	C160E
20 μ sec/cm	.5 μ sec/cm	10 μ sec marker	
50 μ sec/cm	.5 μ sec/cm	50 μ sec marker	
1 μ sec/cm	.1 μ sec/cm	1 μ sec marker	C160C
2 μ sec/cm	.1 μ sec/cm	1 μ sec marker	
5 μ sec/cm	.1 μ sec/cm	5 μ sec/marker	

Because of the very fast sweep rate of .1 μ sec/cm, the 1-10 MULTIPLIER cannot be used when adjusting C160A. Therefore, the following procedure is necessary.

Switch LB HORIZ. DISPLAY to TIME BASE A X1. Apply 10 μ sec trigger pulses to Time Base INPUT and set trigger to EXT, AC, +, and +LEVEL. Set Time Base B SWEEP FUNCTION to NORMAL.

TIME BASE A	TIME-MARK GEN.	ADJUST	OBSERVE
.1 μ sec/cm	10 mc	C160A	1 cycle/cm
.2 μ sec/cm	10 mc		2 cycle/cm
.5 μ sec/cm	1 μ sec		1 marker/2cm

Set HORIZ. DISPLAY, UB and LB, to TIME BASE A X.2.

1 μ sec/cm	50 mc	1 cycle/cm
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Replacing the Cabinet sides will affect the H.F. timing so this should be checked in order to make compensation for the change in timing.

20. CHECK SINGLE SWEEP CIRCUIT:

Switch SWEEP FUNCTION switch to SINGLE SWEEP. Push the small red button in the center of the FUNCTION knob. The READY light should now come on. Turning the LEVEL knob to either AUTO or RECURRENT will trigger the sweep and going past the Zero point will also trigger the sweep but in one direction only, the direction being determined by the setting of the SLOPE switch. With the ready light on, apply enough signal to the INPUT to trigger the sweep. The READY light should now go out and one trace should be produced.

21. CHECK DELAYED SWEEP AND TRIGGER (TYPE 22 ONLY).

Switch the Type 22 to SWEEPS ONCE. (SWEEP FUNCTION SWITCH) Apply 100 and 1000 microsecond pulses to the inputs of both channels. Set the UPPER BEAM HORIZONTAL DISPLAY to A. Set the LOWER BEAM HORIZONTAL DISPLAY to B. Set TIME BASE A at 1 MILLISEC/CM and TIME BASE B at 2 μSEC/CM. Obtain a stable display by adjusting TIME BASE A TRIGGER LEVEL. Turn VARIABLE TIME DELAY to position the marker at the 1 cm mark on the center of the B trace. There should be less than 2 mm of jitter here. Now position the marker at the 9 cm mark on the B trace. There should be less than 4 mm of jitter at the 9 cm mark. Check TIME BASE B at 50 μsec for smooth operation all the way across the upper trace. (Time BASE B trigger is out of the circuit.)

Switch FUNCTION to TRIGGERABLE ONCE. Time base B trigger is now in the circuit. Use the TRIGGER LEVEL control and with DC coupling; check for triggering on 1 millisecc and .1 millisecc pulses.

22. CHECK HOLD-OFF:

Connect a 10X probe from the test scope to the SAWTOOTH OUT post. The sawtooth waveform will be about 150 V in amplitude. Check for sufficient hold-off on all ranges. The three highest sweep speeds will not have much hold-off.

23. CHECK GATE OUT:

Check for over 20 v gate on all sweep ranges from the GATE OUT jack.

24. CHECK ALTERNATE SWEEP OPERATION:

Install a TEST LOAD UNIT or a CA plug-in in the right hand plug-in compartment. Switch the plug-in to DUAL TRACE operation and check operation at high and low sweep speeds.