FACTORY CALIBRATION PROCEDURE

CONTENTS:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

Equipment Required

Factory Test Limits - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

Main Procedure - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

This procedure is company confidential

TEST DISPLAY GENERATOR
067-0561-00

September 1968
For all serial numbers.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 39-307. (DH)

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Test Equipment

1 TYPE 547 OSCILLOSCOPE
1 TYPE W PLUG-IN UNIT
1 TYPE 76TU LINE-VOLTAGE CONTROL UNIT

b. Test Fixture and Accessories

2 50Ω cables, BNC (012-0057-00)
1 P6006 10X Passive Probe (010-0128-00)

c. Other Equipment

1 20,000Ω/V Multimeter
1 Computer Measurements Company Universal Counter-Timer Model 226BN or equivalent

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

QUALIFICATION

Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (set-ups, presets, etc.) are not listed. Instruments may not meet Factory Test Limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

4. POWER SUPPLIES

a. +12V Supply: 12V ±0.1%
b. Power Supplies Accuracy, Regulation and Ripple:

Supply	Accuracy & Regulation	Ripple
+12V	±1%	5mV, max
-12V	±3%	5mV, max
+3.6V	±5%	5mV, max
-3.6V	±5%	5mV, max

5. CLOCK PERIOD

b. Clock period: 35µs ±10%

6. X:Y STAIRCASE LEVELS

b. First step Level: Zero ±20mV
c. Last Step Level: 1V ±20mv

8. Y:X STAIRCASE LEVELS

b. First step Level: Zero ±20mV
c. Last Step Level: 1V ±20mV

10. DOTS-LINES DENSITY

b. Dot-Line Density: ±2%
c. Variable Density Control: ≤60%

11. TIME/DOT µs AND TIME/LINE ms

b. TIME/DOT µs: ±10% of position indicated
c. TIME/LINE ms: ±10% of position indicated
d. Single Sweep: Must single sweep when CONT-READY-SINGLE is depressed to SINGLE

12. AMPLITUDE VOLTS: ±5%

14. DC OFFSET

b. DC OFFSET Range: + and - 1V, min

THE END

Factory Test Limits are limits an instrument must meet before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, it is necessary to set up some circuits so their performance is better than required by Factory Test Limits. Therefore, the instructions given in the Factory Calibration Procedure may call for checks or adjustments which result in less error than that allowed by the Factory Test Limits.

1. PRELIMINARY INSPECTION

a. Check fuse for proper value
b. Make Physical Inspection

2. PRESETS

3. RESISTANCE

Check Power Supply Resistances to ground

Supply	Approx Resistance	Meter Range
+12	130Ω	X10
-12	80Ω	X10
+3.6	1kΩ	X100
-3.6	95Ω	X10

4. POWER SUPPLIES

a. Adjust +12V Supply (R335)
b. Check Accuracy Regulation and Ripple of power supplies

Supply	Accuracy & Regulation	Ripple
+12	±1%	5mV
-12	±3%	5mV
+3.6	±5%	5mV
-3.6	±5%	5mV

c. Check Line Voltage Selector Switch

5. CLOCK PERIOD

a. Setup
b. Adjust clock for a period of 35µs (R5). Check SW7 601 and 611 positions.

6. X:Y STAIRCASE LEVELS

a. Setup
b. Adjust First Step Level (R39) for Zero Volts.
c. Adjust Last Step Level (R85) for 1 Volt.

7. X:Y STAIRCASE FREQUENCY COMPENSATION

a. Setup
b. Adjust X:Y Frequency Compensations (C43, C57 and C58)

8. Y:X STAIRCASE LEVEL

a. Setup
b. Adjust First Step Level (R139) for Zero Volts
c. Adjust Last Step Level (R185) for 1 Volt

9. Y:X FREQUENCY COMPENSATION

a. Setup
b. Adjust Y:X Frequency Compensations (C143, C157 and C158)

10. DOTS - LINES DENSITY

a. Adjust Dot-Line Density

C118F	100 counts
C18D	125 counts
C118C	400 counts
C18A	300 counts

b. Check Variable Density Control

11. TIME/DOT μs AND TIME/LINE ms

a. Setup
b. Check TIME/DOT μs pulse width to be that selected ±10%
c. Check TIME/LINE ms pulse width to be that selected ±10%
d. Check Single Sweep for a single positive pulse.

12. AMPLITUDE VOLTS

Check AMPLITUDE VOLTS switch to be that selected ±5%.

13. X:Y HORIS - Y:X VERT SWITCHING

a. Setup
b. Check X:Y Horiz - Y:X Vert Switching

14. DC OFFSET

a. Setup
b. Check DC Offset Range for + and -1V, min
c. Check Single Sweep

15. REMOTE PROGRAM TEST

16. OUTPUT SIGNAL SOURCE

Check the OUTPUT SIGNAL SOURCE switch

THE END

1. PRELIMINARY INSPECTION

a. Check fuse for proper value

b. Make Physical Inspection

Check the component assembly of instrument; unsoldered joints, rosin joints, lead dress and unclipped wire ends. Check controls for smooth mechanical operation, proper indexing and spacing. Correct all defects found.

2. PRESETS

a. Set the Test Display Generator controls:

MODE	
CONT-READY-SINGLE	CONT
RASTER-SINGLE DOT	RASTER
DENSITY	
X:Y HORIZ - Y:X VERT	X:Y HORIZ
DOTS-LINES	DOTS 300:400
VARIABLE	CAL
TIME/DOT μs	20
AMPLITUDE VOLTS	1
TIME/LINE ms	3
DC OFFSET	OFF
OUTPUT SIGNAL SOURCE	INT
REMOTE PROGRAM TEST	
NON STORE-STORE-ERASE	NON STORE
VIEW	OFF
WRITE THROUGH	OFF
GATE OUTPUT (at rear)	
FAST-SLOW	FAST
Line Voltage Selector	115V
SW7 (internal switch)	611 position (slider toward rear)
Internal Adjustments	
C43, C58, C143 & C158	cw
all others	midr

2. (cont'd)

b. Set the TYPE 547 controls with TYPE W installed:

HORIZONTAL DISPLAY	B
MAIN TIME BASE	
TRIGGERING LEVEL	cw
TRIGGERING MODE	AUTO
TRIGGERING SLOPE	+
TRIGGERING COUPLING	AC
TRIGGERING SOURCE	NORM
TIME/CM	1mSEC

c. Set the TYPE W controls

Vc RANGE	0
COMPARISON VOLTAGE	1.20
INPUT ATTEN	1
DISPLAY	A-Vc
MILLIVOLTS/CM	2
VARIABLE	CALIB

3. RESISTANCE

Check power supply resistances to ground (-polarity meter lead grounded)

Supply	Approx Resistance	Meter Range
+12	130Ω	X10
-12	80Ω	X10
+3.6	1kΩ	X100
-3.6	95Ω	X10

4. POWER SUPPLIES

a. Adjust +12V Supply: 12V ±1%

Connect the X10 probe to the TYPE W A input. Connect the probe to the +12V supply and set the TYPE W Vc control to +11. Adjust R335 for 12V.

4. (cont'd)

b. Check Accuracy Regulation and Ripple of power supplies

Using the TYPE W at appropriate settings, check accuracy, regulation and ripple of supplies as indicated below while varying the 76TU from 104VAC to 126VAC.

Supply	Accuracy & Regulation	Ripple
+12	±1%	5mV
-12	±3%	5mV
+3.6	±5%	5mV
-3.6	±5%	5mV

c. Check Line Voltage Selector Switch

Connect a multimeter across pins 6 and 7 of the power transformer and note meter reading (approx 16VAC with TU76 set at 115VAC). Set the Line Voltage Selector switch to 230V. The meter reading should be approximately half of that noted previously. Return the Line Voltage Selector to 115V.

5. CLOCK PERIOD

a. Setup

Set the TYPE W Vc RANGE to 0, Input ATTEN to 10, MILLIVOLTS/CM to 50. Set the test scope B TIME/CM to 10μSEC. Connect the X10 probe to the collector of Q12, set the test scope B TRIGGERING MODE to TRIG and adjust the TRIGGERING LEVEL for a stable display.

b. Adjust clock for a period of 35μs ±10%

While observing the test scope display adjust R5 for a period of 35μs (3.5cm). Set the B TIME/CM to 2μSEC and note the pulse width. Set SW7 to the 601 position. The pulse width should be approximately half. Return SW7 to the 611 position. Remove the probe.

4. (cont'd)

b. Check Accuracy Regulation and Ripple of power supplies

Using the TYPE W at appropriate settings, check accuracy, regulation and ripple of supplies as indicated below while varying the 76TU from 104VAC to 126VAC.

Supply	Accuracy & Regulation	Ripple
+12	±1%	5mV
-12	±3%	5mV
+3.6	±5%	5mV
-3.6	±5%	5mV

c. Check Line Voltage Selector Switch

Connect a multimeter across pins 6 and 7 of the power transformer and note meter reading (approx 16VAC with TU76 set at 115VAC). Set the Line Voltage Selector switch to 230V. The meter reading should be approximately half of that noted previously. Return the Line Voltage Selector to 115V.

5. CLOCK PERIOD

a. Setup

Set the TYPE W Vc RANGE to 0, Input ATTEN to 10, MILLIVOLTS/CM to 50. Set the test scope B TIME/CM to 10μSEC. Connect the X10 probe to the collector of Q12, set the test scope B TRIGGERING MODE to TRIG and adjust the TRIGGERING LEVEL for a stable display.

b. Adjust clock for a period of 35μs ±10%

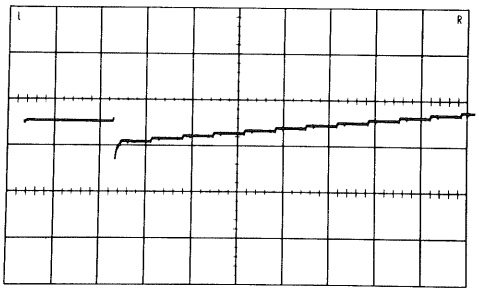
While observing the test scope display adjust R5 for a period of 35μs (3.5cm). Set the B TIME/CM to 2μSEC and note the pulse width. Set SW7 to the 601 position. The pulse width should be approximately half. Return SW7 to the 611 position. Remove the probe.

6. X:Y STAIRCASE LEVELS

a. Setup

Remove the X10 probe from the TYPE W A input. Connect a 50Ω cable from the A input to the X OUT connector on the Test Display Generator. Set the INPUT ATTEN to 1. Connect a 50Ω cable from the test scope B TRIGGER INPUT to the Test Display Generator GATE OUTPUT. Set the B TRIGGERING SOURCE to EXT and set TIME/CM to 50μsec. A staircase display like that shown in Fig 6a notes column should be obtained. (R39 and R85 may have to be adjusted to bring the display on screen).

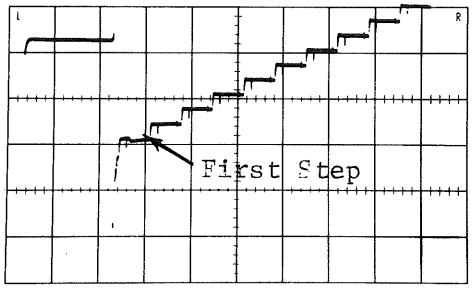
6a.



b. Adjust First Step Level: Zero ±2mV

Set the TYPE W A AC-DC-GND switch to GND and set MILLIVOLTS/CM to 10. Position the trace to the center graticule line. Return the switch to DC. Adjusting R39, place the first step of the staircase to the center graticule line (see Fig 6b).

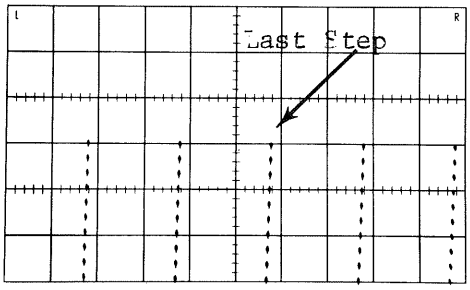
6b.



c. Adjust Last Step Level: 1V ±20mV

Set the TYPE W COMPARISON VOLTAGE control to 1.00 and the Vc RANGE to +11. Set the B TIME/CM to 5mSEC. ADjust R85 to place the last step to the center graticule line as shown in Fig 6c.

6c.



7. X:Y STAIRCASE FREQUENCY COMPENSATION

a. Setup

Set the TYPE W COMPARISON VOLTAGE to 0.50. Set the test scope HORIZONTAL DISPLAY to B INTENS by "A".

7a. (cont')

Set the A TRIGGERING MODE to AUTO STABILITY and A TIME/CM to 20μSEC. Adjust the DELAY-TIME MULTIPLIER to obtain an intensified portion of the display (see figure 7a in notes). Set the HORIZONTAL DISPLAY to A DLY'D and the TYPE W MILLIVOLTS/CM to 5 to obtain a display as shown in figure 7b.

b. Adjust X:Y Frequency Compensations:

Adjust C43, C57 and C58 for minimum aberration of the leading edge of the step waveform. See figure 7b in notes.

8. Y:X STAIRCASE LEVEL

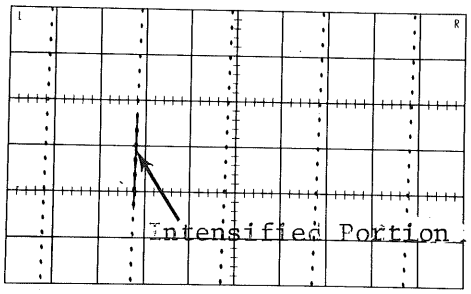
a. Setup

Set the scope HORIZONTAL DISPLAY to B and the B TIME/CM to .1mSEC. Set the TYPE W Vc RANGE to 0 and COMPARISON VOLTAGE to 1.00. Set MILLIVOLTS/CM to 10. Set the Test Display Generator X:Y HORIZ - Y:X VERT to Y:X VERT and the GATE OUTPUT (in rear) to SLOW. Set DOT/LINES to LINES and TIME/LINE ms to .1. A display like that shown in Fig 8a in notes column should be obtained (R139 may have to be adjusted to bring the display on screen).

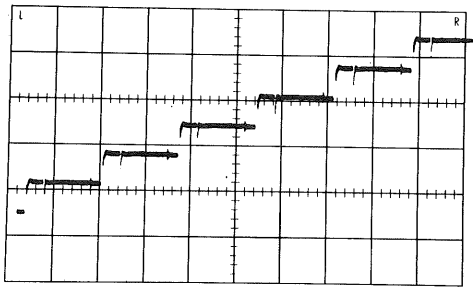
b. Adjust First Step Level: Zero ±20mV

Set the TYPE W A AC-DC-GND switch to GND and position the trace to the center graticule line. Return the switch to DC. Adjust R139 to place the first step of the staircase to the center graticule line (see Fig 8a).

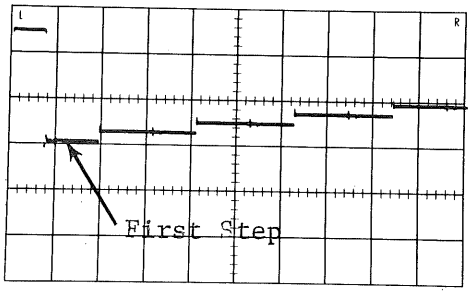
7a. The display will vary slightly depending upon the preset settings of the frequency compensations.



7b.



8a.

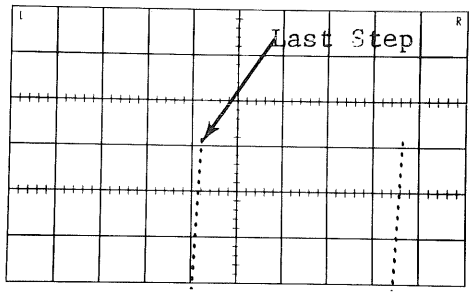


8. (cont'd)

c. Adjust Last Step Level: 1V ±20mV

Set the TYPE W Vc RANGE to +11 and the scope B TIME/CM to 20mSEC. Adjust R185 to place the last step to the center graticule line (see Fig 8c).

8c.

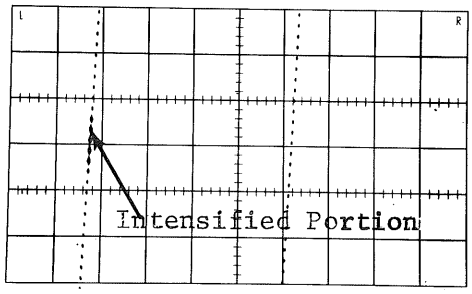


9. Y:X FREQUENCY COMPENSATION

a. Setup

Set the TYPE W COMPARISON VOLTAGE to 0.50. Set the scope HORIZONTAL DISPLAY to B INTENS by "A". Set the A TIME/CM to .1mSEC. Adjust the DELAY-TIME MULTIPLIER to obtaine an intensified portion of the display (see notes, figure 9a). Set the HORIZONTAL DISPLAY to A DLY'D and the TYPE W MILLIVOLTS/CM to 2 to obtain a display as shown in figure 9b.

9a.

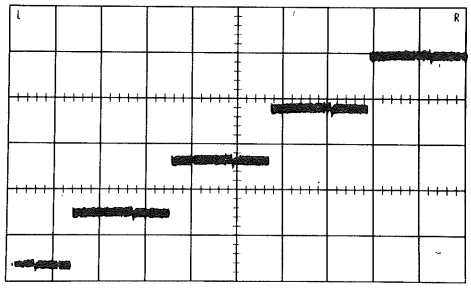


b. Adjust Y:X Frequency Compensations:

Adjust C143, C157 and C158 for minimum aberration of the leading edge of the step waveform (see notes, figure 9b).

Remove the 50Ω cable from the TYPE W and Test Display Generator X OUT connector. Remove the GATE OUTPUT from the scope TRIGGER INPUT. Set TIME/LINE ms to 3.

9b.



10. DOTS - LINES DENSITY

a. Steup

Connect a 50Ω cable from the Test Display Generator Z OUT to the A connector on the Universal Counter-Timer. Connect a 50Ω cable from the GATE OUTPUT to the B connecter. Set DOTS-LINES to LINES and X:Y HORIZ-Y:X VERT to X:Y HORIZ. Set TIME/LINE ms to 3 and DENSITY to 100.

Set the counter controls as follows: TRIGGER LEVEL controls, ccw; START B, -50; FREQ A, -50; B SLOPE + -, to -; GATE ON - AUTOMATIC, GATE ON; DISPLAY, midr; FUNCTION, $\frac{A}{B}$. Rotate the A TRIGGER LEVEL cw until the counter starts counting and note the setting. Continue rotating cw until the counter stops counting. Set the control halfway between the two levels. Set GATE ON - AUTOMATIC to AUTOMATIC. The counter should stop counting. Rotate the B TRIGGER LEVEL cw until the counter again begins to count. The counter should now count, display for a short duration, reset and repeat.

b. Adjust Dot-Line Density: ±2%

Adjust C118F for a counter indication of 100. Set DOTS-LINES to DOTS and GATE OUTPUT to FAST. Adjust C18D for an indication of 125. Set DOTS-LINES to LINES, DENSITY to 400 and GATE OUTPUT to SLOW. Adjust C118C for an indication of 400. Set DOTS -LINES to DOTS, GATE OUTPUT to FAST and adjust C18A for an indication of 300.

Set DOTS-LINES to LINES, DENSITY to 25 and GATE OUTPUT to SLOW. Check for an indication of 25 ±2 counts.

10. (cont'd)

c. Check Variable Density Control: ≤60%

Rotate the VARIABLE DENSITY control full ccw. Check the counter for an indication of equal to or less than 15. Set DENSITY to 100 and check for 60 or less. Set DENSITY to 400 and check for 240 or less. Set DOTS-LINES to DOTS and GATE OUTPUT to FAST. Check for an indication of 180 or less. Set DENSITY to 125:100 and check for 75 or less. Return VARIABLE DENSITY to CAL. Remove the Z OUT and GATE OUTPUT cables from the counter.

11. TIME/DOT μs AND TIME/LINE ms

a. Setup

Set the TYPE W Vc RANGE to 0, INPUT ATTEN to 10 and MILLIVOLTS/CM to 50. Connect a 50Ω cable from the Test Display Generator Z OUT to the TYPE W A input. Set the scope B TIME/CM to 10μSEC, TRIGGERING SOURCE to NORM and adjust TRIGGERING LEVEL for a stable display.

b. Check TIME/DOT μs: ±10%

Check the displayed pulse width to be 20μs (2cm) ±10%. Set TIME/DOT μs to 9 and the scope B TIME/CM to 5μSEC. Check the pulse width to be 9μs (1.8cm) ±10%. Set TIME/DOT μs to 5 and the scope B TIME/CM to 1μSEC. Check the pulse width to be 1μs (5cm) ±5%. Set TIME/DOT μs to 20.

c. Check TIME/LINE ms: ±10%

Set the Test Display Generator DOTS-LINES to LINES and the test scope B TIME/CM to 1mSEC. Check for a pulse width of 3mS (3cm) ±5%. Set TIME/LINE ms to 4 and check for a pulse width of 4ms (4cm) ±10%.

11c. (cont'd)

Set TIME/LINE ms to 10 and check for a pulse width of 10ms (10cm) ±10%. Set TIME/LINE ms to 2 and test scope B TIME/CM to .5mSEC. Check for a pulse width of 2ms (4cm) ±10%. Set TIME/LINE ms to .1 and test scope B TIME/CM to 20μSEC. Check for a pulse width of .1ms (5cm) ±10%. Set TIME/LINE ms to 3.

d. Check Single Sweep

Set RASTER-SINGLE DOT to SINGLE DOT and CONT-READY-SINGLE to READY. Depress to SINGLE and note that display consists of a single positive pulse of approximately 20μs. Set RASTER-SINGLE DOT to RASTER and CONT-READY-SINGLE to CONT.

12. AMPLITUDE VOLTS ±5%

Set DOTS-LINES to DOTS and adjust test scope TRIGGERING LEVEL for a stable display. Using the TYPE W POSITION control, place the bottom of the display to the center graticule line. Set Vc RANGE to +11 and COMPARISON VOLTAGE to 1.00. Set the INPUT ATTEN to 1 and check that top of waveform is within 1cm of center graticule line.

Set Vc RANGE to 0, COMPARISON VOLTAGE to 0.75 and INPUT ATTEN to 10. Set the Test Display Generator AMPLITUDE VOLTS to .75. Set the bottom of the waveform to the center graticule line. Set Vc RANGE to +11 and INPUT ATTEN to 1. Check that top of waveform is within .75cm of graticule center. Set Vc RANGE to 0, COMPARISON VOLTAGE to 0.50, INPUT ATTEN to 10. Set the Test Display Generator AMPLTIUDE VOLTS to .5. Set the bottom of the waveform to the graticule center. Set Vc RANGE to +11, INPUT ATTEN to 1 and MILLIVOLTS/CM to 10. Check that top of waveform

12. (cont'd)

is within 2.5cm of graticule center. Set Vc RANGE to 0 and AMPLITUDE VOLTS to 1. Remove the cable from the TYPE W and Z OUT connector.

13. X:Y HORIZ - Y:X VERT SWITCHING

a. Setup

Connect a 50Ω cable from the TYPE W A input to the Test Display Generator X OUT. Set the TYPE W INPUT ATTEN to 10 and MILLIVOLTS/CM to 50. Set the scope B TIME/CM to 1mSEC. Adjust TRIGGERING LEVEL for a stable display.

b. Check X:Y Horiz - Y:X Vert Switching

Note several cycles of a 1 volt sawtooth display. Set X:Y HORIZ-Y:X VERT to Y:X VERT and set the test scope B TIME/CM to .1 SEC. Again note several cycles of a 1 volt sawtooth display.

Connect the 50Ω cable to the Y OUT connector and repeat.

c. Check Single Sweep

Set X:Y HORIZ - Y:X VERT to X:Y HORIZ and CONT-READY-SINGLE to READY. Set scope B TIME/CM to .2 SEC and TRIGGERING MODE to AUTO. Depress to SINGLE and note a single sawtooth display.

14. DC OFFSET

a. Setup

Set the test scope B TIME/CM to 1mSEC and free-run the sweep. Set the TYPE W A AC-DC-GND switch to GND and position the trace to the center graticule line.

14. (cont'd)

b. Check DC Offset Range: + and - 1V, min

Set the TYPE W AC-DC-GND switch to DC. Rotate the Y DC OFFSET control full cw and note that the trace moves in the positive direction a minimum of 2cm from the graticule center. Rotate the control full ccw and note that trace moves in the negative direction a minimum of 2cm from the graticule center.

Connect the 50Ω cable to the X OUT connector and repeat using the X DC OFFSET control. Remove the 50Ω cable from the X OUT connector.

15. REMOTE PROGRAM TEST

Using the multimeter, check for continuity between pins 4, 5 & 17 of the Remote Program Test connector and Z OUT. Check continuity between pins 3, 15, & 16, and Y OUT. Check continuity between pins 1, 2, 14, and X OUT.

Connect the negative meter lead to gnd and positive lead to pin 6. Check for approximately 150Ω. Set the NON STORE-STORE-ERASE switch to STORE and note that the meter reads infinity. Connect the positive lead to pin 18, depress the switch to ERASE and again note a meter reading of approximately 150Ω. Return the switch to NON STORE.

Connect the meter lead to pin 8. The meter should indicate infinity. Set the WRITE THROUGH-OFF switch to WRITE THROUGH. The meter should indicate approximately 150Ω. Set WRITE THROUGH-OFF to OFF

15. (cont'd)

Connect the meter lead to pin 20. The meter should indicate infinity. Set the VIEW-OFF switch to VIEW. The meter should indicate approximately 150Ω. Set VIEW-OFF to OFF.

16. OUTPUT SIGNAL SOURCE

Shut the Test Display Generator power off. Set the OUTPUT SIGNAL SOURCE switch to EXT. With the multimeter, check continuity between the X OUT, Y OUT, Z OUT and the X IN, Y IN, and Z IN connectors. Set the OUTPUT SIGNAL SOURCE switch to INT and check for loss of continuity.

THE END