CONTENTS:

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

Equipment Required

<u>Factory Test Limits</u> - 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.

<u>Main Procedure</u> - 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).

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.

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This procedure is company confidential

S-51

March 1969 For all serial



PMSE

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EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

TEKTRONIX Instruments α.

TYPE	560	SERIES OSCILLOSCOPE
TYPE	3T2	RANDOM SAMPLING SWEEP
TYPE	3S2	SAMPLING UNIT
TYPE	S-3	SAMPLING HEAD
TYPE	S-4	SAMPLING HEAD
TYPE	285	POWER SUPPLY
TYPE	113	DELAY CABLE
	TYPE TYPE TYPE TYPE TYPE TYPE TYPE	TYPE 560 TYPE 3T2 TYPE 3S2 TYPE S-3 TYPE S-4 TYPE 285 TYPE 113

b. Test Fixtures and Accessories

1	Sampling Head Extender (012-0124-00)
2	50Ω cable, BNC/BSM (012-0127-00)
1	50 Ω 5X Attenuator, 3mm (015-1002-00)
2	50Ω 2ns cable, 3mm (015-1005-00)
1	50Ω 5ns cable, 3mm (015-1006-00)
1	Adapter, 3mm male to GR (015-1007-00)
1	Adapter, 3mm female to GR (015-1008-00)
1	Adapter, 3mm male to male (015-1011-00)
1	50Ω power divider, 3mm (015-1014-00)
1	Adapter, GR to N male (017-0021-00)
1	Adapter, GR to BNC female (017-0063-00)

c. Other equipment

- 1 Generator, hp 8614B (850MHz to 2.4GHz)
- 1
- Generator, hp 628A (15GHz to 21GHZ) Adapter, WR51 to WR42 (hp NK-292A furnished with hp 628A) 1
- 1 Adapter, WR42 to 3mm female (Omni Spectra #20188J)
- 1 20,000Ω/VDC multimeter

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.

FACTORY TEST LIMITS

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 (setups, 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.

2. TD BIAS ADJUSTMENTS

c. Oscillator period: variable from no less than 3.5ns to no more than 6.0ns

> SYNC range: must vary the oscillator period at least lns and no more than 2ns

- KICKOUT AT INPUT: amplitude; no more than 400mV peak
- 4. OSCILLATOR FEED-THRU
- b. Duration of oscillator feed-thru: must cease within 30ns after the start of the TRIG OUT pulse; must start between 600ns and 1000ns before the TRIG OUT pulse
- 5. TRIG OUT PULSE AMPLITUDE, WIDTH, RISETIME, AND PERIOD
- a. TRIG OUT and internal Trig Out pulse amplitude: at least 200mV into 50Ω
 b. TRIG OUT and internal Trig Out pulse width: at least lns at +100mV amplitude level
- c. TRIG OUT pulse risetime: 400ps or less
- d. TRIG OUT pulse period: 15µs ±3µs, max

6. JITTER

b. Jitter at 18,5GHz: 10ps or less with input of 100mV as measured into 50Ω
c. Jitter at 1GHz: 15ps or less with input of 100mV as measured into 50Ω

THE END

This instrument must meet Factory Test Limits 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, this procedure may require that some checks and adjustments be made so that performance is better than that required by Factory Test Limits.

1. SYNC TD BIAS PULSE

a. Setup

- b. Check sync TD bias pulse
- 2. TD BIAS ADJUSTMENTS
- a. Setup
- b. Adjust Output TD Bias (R21)
- c. Adjust Sync TD Bias (R48): Oscillator period; variable from no less than 3.5ns to no more than 6.0ns

SYNC range: must vary the oscillator period at least lns and no more than 2ns

3. CHECK KICKOUT AT INPUT:

amplitude; no more than 400mV peak

4. OSCILLATOR FEED-THRU

- a. Setup
- b. Check duration of oscillator feed-thru: must cease within 30ns after the start of the TRIG OUT pulse; must start between 600ns and 1000ns before the TRIG OUT pulse
- 5. TRIG OUT PULSE AMPLITUDE, WIDTH, RISETIME, AND PERIOD
- a. Check TRIG OUT and internal Trig Out pulse amplitude: at least 200mV into 50Ω
- b. Check TRIG OUT and internal Trig Out pulse width: at least lns at +100mV amplitude level
- c. Check TRIG OUT pulse risetime: 400ps or less
- d. Check TRIG OUT pulse period: 15µs ±3µs, max

6. JITTER

a. Setup

- b. Check jitter at 18.5GHz: 10ps or less with input of 100mV as measured into 50Ω
- c. Check jitter at 1GHz: 15ps or less with input of 100mV as measured into 50Ω

THE END

1. SYNC TD BIAS PULSE

a. Setup

Install the TYPE S-3 in channel A of the TYPE 3S2 and the TYPE S-4 in channel B. With D2 *removed*, install the TYPE S-51 in the TYPE 285 with a Sampling Head Extender. Turn the TYPE 285 on. Connect a BNC/BSM cable from the TYPE 285 TRIGGER OUT to the TYPE 3T2 50Ω TRIGGER INPUT.

Preset as follows:

TYPE 3S2

A POSITION	midr
DC OFFSET	midr
DOT RESPONSE	midr
units/div	100
VARIABLE	CAL
mode	CH A
NORMAL-SMOOTH	NORMAL

TYPE 3T2

TIME POSITION	midr
FINE	midr
RANGE	10µs
START POINT	BEFORE TRIGGER
DISPLAY MAG	X1
TIME MAGNIFIER	X5
VARIABLE	CAL
DISPLAY MODE	NORMAL
TRIG POLARITY	+
SOURCE	EXT

TYPE S-51

SYNCfull cwR21 (Output TD Bias)30° from full cw

b. Check sync TD bias pulse

Connect the TYPE S-3 probe tip to ground on the TYPE S-51 control board, adjust the TYPE 3T2 for a triggered sweep and place the trace at the bottom graticule line with the TYPE 3S2 DC OFFSET.

Move the probe tip to point E on the TYPE S-51 control board. Adjust the TYPE 3T2 TIME POSITION controls to display the sync TD bias pulse. Adjust R48 (Sync TD Bias from one end to the other and check that the top of the pulse is always between 200my and 530mV above ground.



NOTES



1b. (CONT)

Remove the TYPE S-51 from the Sampling Head Extender, install D2 and reinstall the TYPE S-51 on the Extender.

2. TD BIAS ADJUSTMENTS

a. Setup

TYPE S-51 INPUT--5ns cable--male to male adapter--TYPE S-4 input

TYPE 285 TRIGGER OUT--BNC/BSM cable--TYPE 3T2 50Ω TRIGGER INPUT

Preset as follows:

TYPE 3S2

midr
midr
midr
midr
100
CAL
CH B
NORMAL

TYPE 3T2

TIME POSITION	full cw
FINE	full cw
RANGE	100ns
START POINT	BEFORE TRIGGER
DISPLAY MAG	X1
TIME MAGNIFIER	X10
VARIABLE	CAL
DISPLAY MODE	NORMAL
TRIG POLARITY	+
SOURCE	EXT

b. Adjust Output TD Bias

Adjust the TYPE 3T2 TRIG SENSITIVITY and TYPE 3S2 DC OFFSET for a stable display. Set the TYPE S-51 SYNC full ccw. Set R21 (Output TD Bias) and R48 (Sync TD Bias) full cw. Adjust R21 ccw until the trace disappears. Adjust R48 ccw until a trace with oscillator kickout pulses appears. Note the position of R21, adjust it ccw from this position until the trace disappears again and note this position. Leave R21 adjusted to the point halfway between these two positions. a. Connectors on all cables, attenuators, adapters, etc. called for in this procedure are 3mm unless otherwise specified.

b, Oscillator kickout pulses



- 2. (CONT)
 - c. Adjust Sync TD Bias: Oscillator period; variable from no less than 3.5ns to no more than 6.0ns

SYNC range; must vary the oscillator period at least Ins and no more than 2ns

Adjust the TYPE 3S2 B DELAY control to locate the pulse that does not shift when R48 is adjusted back and forth. With the TYPE S-51 SYNC control full ccw, adjust R48 for about a 5,2ns period between the positive pulse that remains stationary and the positive pulse to the left of it. (Ignore the negative pulses.) Rotate the SYNC full cw and check that the time between the two pulses is no less than 3.5ns. Check that the change in the period, from one end of the SYNC control to the other, is at least lns and no more than 2ns. Final adjustment of R48 must be made with the TYPE S-51 installed in a housing.

3. KICKOUT AT INPUT: amplitude; no more than 400mV peak

Check that the amplitude of the positive oscillator kickout pulses is not more than 400mV peak.

Disconnect the 5ns cable and male to male adapter from the TYPE S-51 and TYPE S-4.

4. OSCILLATOR FEED THRU

a. Setup

TYPE S-51 TRIG OUT--BNC/BSM cable--BNC female to GR adapter--GR to 3mm male adapter--TYPE S-4 input

TYPE 285 TRIGGER OUT--BNC/BSM cable--TYPE 3T2 50Ω TRIGGER INPUT

Change the TYPE 3T2 TIME POSITION RANGE to 1μ s, the TIME MAGNIFIER to X20 and the TYPE 3S2 units/div to 50.

c. Adjusting R48 to increase the period between pulses will also increase the change in the period produced by adjustment of the SYNC control.

NOTES

b, Duration of oscillator feed thru

- 4. (CONT)
 - b. Check duration of oscillator feed thru: must cease within 30ns after the start of the TRIG OUT Pulse; must start between 600ns and 1000ns before the TRIG OUT pulse

Adjust the TYPE 3T2 TIME POSITION controls to display the TRIG OUT pulse and check that the oscillator feed thru pulses cease within 30ns after the start of the TRIG OUT pulse,

Change the TYPE 3T2 TIME POSITION RANGE to 10µs, the TIME MAGNIFIER to X5 and check that the oscillator feed thru pulses start between 600ns and 1000ns before the TRIG OUT pulse.

TRIG OUT PULSE AMPLITUDE, WIDTH, 5. RISETIME, AND PERIOD

Check TRIG OUT and internal Trig Out pulse amplitude: at least 200mV into 500

Change the TYPE 3T2 TIME POSITION RANGE to 100ns and the TIME MAGNIFIER to X10. Adjust the TIME POSITION controls to display the TRIG OUT pulse and check that the amplitude of the pulse is at least 200mV. Interchange the connections to the TYPE S-4 input and the TYPE 3T2 500 TRIGGER INPUT, readjust the TYPE 3T2 TIME POSITION to display the internal Trig Out pulse and check that its amplitude is at least 200mV.

b. Check TRIG OUT and internal Trig Out pulse width: at least Ins at +100mV amplitude level

Using the average level of the trace during the lns preceeding the pulse as a 0 reference level, check that the width of the pulse at the 100mV level is at least lns. Return the connections to the TYPE S-4 input and the TYPE 3T2 50 Ω TRIGGER INPUT to the original setup and repeat this check for the front panel TRIG OUT pulse.









- 5, (cont'd)
 - c. Check TRIG OUT pulse risetime: 400ps or less

Change the TYPE 3T2 TIME MAGNIFIER to X50. Adjust the TYPE 3S2 POSITION and VARIABLE controls and the TYPE 3T2 TIME POSITION controls for a 5 division display of the TRIG OUT pulse. Check that the 10% to 90% rise-time of the pulse is no more than 400ps.

Return the TYPE 3S2 VARIABLE to CAL.

d. Check TRIG OUT pulse period: 15µs ±3µs, max

Change the TYPE 3T2 TIME POSITION RANGE to 100μ s, the START POINT to WITH TRIGGER, the TIME MAGNIFIER to X5 and set the SAMPLES/DIV near full ccw. (The TYPE 3T2 internal Samples/ Div switch must be in the Variable position.) Check for at least 12μ s and no more than 18μ s **bet**ween the positive TRIG OUT pulses.

Remove the connections from the TYPE S-4 input and the 3T2 50 Ω TRIGGER INPUT.

d, TRIG OUT pulse period



6. JITTER

a. Setup

hp 628A RF OUTPUT--WR51 to WR42 adapter--WR42 to 3mm adapter--

power divider -- 2ns cable--TYPE S-4 input -- 2ns cable--5X atten--TYPE S-51 INPUT

TYPE S-51 TRIG OUT--BNC/BSM cable--TYPE 3T2 50Ω TRIGGER INPUT

Preset as follows:

TYPE 3S2

B POSITION DC OFFSET DOT RESPONSE	midr midr set for unity loop gain
unites/arv	50
mode	CH B
NORMAL-SMOOTH	NORMAL
TRIG OUT	В

TYPE 3T2

TIME POSITION	midr
FINE	midr
RANGE	100 ns
START POINT	WITH TRIGGER
DISPLAY MAG	X10
TIME MAGNIFIER	X50
VARIABLE	CAL

6a. (CONT)

DISPLAY MODE	NORMAL
TRIG POLARITY	+
SOURCE	EXT

hp 628A

power switch	ON
frequency dial	18.5GHz
MOD SELECTOR	OFF

b. Check jitter at 18.5GHz:
 10ps or less with input of
 100mV as measured into 50Ω

After the hp 628A has been on for at least 5 minutes, adjust the ZERO SET to obtain a power-monitor meter indication exactly on the ZERO SET index. Change the MOD SELECTOR to CW and adjust the POWER SET to obtain a meter indication exactly on the POWER SET index. Set the OUTPUT ATTEN for a 100mV signal as measured into $50\Omega_{\star}$ (If the correct setting of the OUTPUT ATTEN for 100mV into 50Ω is not known it will be necessary to determine this setting with a power meter.) Adjust the TYPE S-51 SYNC and TYPE 3T2 TRIG SENSITIVITY controls to obtain a stable display of the 18.5GHz signal with the least possible trace width. If the trace width exceeds 0.5 division (10ps), determine the jitter contributed by the TYPE 3T2 using the method described in the notes column and then find the jitter contributed by the TYPE S-51 using the following formula:

TYPE S-51 jitter =

 $\sqrt{(displayed jitter)^2 - (TYPE 3T2 jitter)^2}$

c. Check jitter at 1GHz: 15ps or less with input of 100mV as measured into 50Ω

Disconnect the power divider from the WR42 to 3mm adapter and connect it through a 3mm female to GR adapter and a GR to N male adapter to the hp 8614A CAL RF POWER OUTPUT.

b. To determine the jitter contributed by the TYPE 3T2, complete the following:

TYPE S-51 TRIG OUT--BNC/BSM cable--TYPE 3T2 50Ω TRIGGER INPUT

TYPE 285 TRIGGER OUT--BNC/BSM cable--GR to BNC female adapter--TYPE 113--GR to 3mm male adapter--5ns cable--TYPE S-4 input

With the TYPE 3T2 TIME POSITION RANGE at 100ns, the DISPLAY MAG at X1, the TIME MAGNIFIER AT X10 and the TYPE 3S2 units/div at 50, obtain a stable display of the leading edge of the TRIG OUT pulse. Change the TYPE 3T2 DISPLAY MAG to X10, the TIME MAGNIFIER to X50 and the TYPE 3S2 units/div to 10. Adjust the TYPE 3T2 TIME POSITION controls and the TYPE 3S2 VARIABLE to obtain a display of the leading edge of the pulse at a 45° angle to the graticule lines.



Measure the horizontal width of the trace in graticule divisions. (This is a combination of jitter and noise.) Disconnect the 5ns cable from the TYPE S-4 input, return the trace to the graticule center and measure the vertical noise on the trace. Calculate the TYPE 3T2 jitter using the following formula:

TYPE 3T2 jitter =

 $\sqrt{(\text{combined jitter & noise})^2 - (\text{noise})^2}$

6c. (CONT)

Depress the hp 8614A LINE and RF switches, set the FREQUENCY to 1000 and the ΔF to 0. Change the TYPE 3S2 units/div to 100 and the TYPE 3T2 DISPLAY MAG to X1. Adjust the hp 8614A ATTENUATION and the TYPE S-51 SYNC for a stable 5 division display. Change the TYPE 3T2 DISPLAY MAG to X10 and the TYPE 3S2 units/div to 10. Adjust the TYPE 3S2 DC OFFSET and TYPE 3T2 TIME POSITION controls to display the center of one of the positive going transitions of the waveform. Adjust the TYPE S-51 SYNC for the minimum trace width. If the width is greater than 0.75div (15ps), determine the jitter contributed by the TYPE S-51 by the method described in part b of this step.

THE END