

NOTE REGARDING FACTORY CALIBRATION PROCEDURES

AND TEST SPECIFICATIONS

Factory Calibration Procedures and Test Specifications are intended for use at the factory as a general guide for calibrators and quality control men. Most of the tolerances listed in these sheets are closer than advertised specifications. This is done purposely in order to insure that the instrument will meet or exceed advertised specifications when it reaches the customer.

These calibration procedures and test specifications should be used, therefore, as a guide only.

Some of the test equipment referred to in the calibration procedures is not available commercially; the Tektronix field engineer will be glad to suggest alternate approaches.

Type 53C CALIBRATION PROCEDURE

The 530 series oscilloscope used should have been previously checked for power supply outputs, power supply ripple and regulation, vertical amplifier gain, vertical amplifier band pass, and calibrator accuracy.

The EP53 plug-in extension is necessary to allow access to the input attenuators and the peaking coils.

1. Determine zero input vertical level of scope (jumper plug-in outputs together and observe the vertical level of the trace).

2. Adjust "vert pos range"

Jumper pin 5 of V4553 to pin 5 of V4563 and adj. "vert pos range" to level determined in step 1.

Remove jumper.

3. Adjust "multi stability."

OPERATING MODE to alternate sweeps.

Free run the main sweep and adjust "multi stability" for stable switching at the end of each sweep. Check all sweep ranges.

4. Adjust DC BAL

OPERATING MODE to alternate sweeps.

Free run the sweep and adjust AMPL A DC BAL so the VARIABLE ATTEN for the A section does not shift the A trace. Adjust AMPL B DC BAL so the VARIABLE ATTEN for the B section does not shift the B trace.

With front panel VERT POSITION controls between 3 and 9 o'clock both traces should be in the graticule with the A trace on top. If not, select 6BQ7's and/or 12AU7's and repeat this complete step.

5. Adjust "chopping rate."

OPERATING MODE switch to chopped.

Set the TIME/CM to 1 microsec/cm and adjust "chopping rate" for 10 cm/cycle. Chopping square wave must be symmetrical within 10%, if not select V3803.

Set TIME/CM to 10 μ sec/cm and adjust C3613 and C3653 for best square wave. Adjust C3583 and C4583 for minimum spiking. Use no more than 1 cm vertical defl for these adjustments.

Type 53C Calibration Procedure, continued

Adjustment of C3583 and C4583 will be different when the 1 cm is positioned at the top of the graticule or at the bottom, compromise between the two positions.

6. Check for hum and microphonics.

With the VARIABLE ATTEN control to its most sensitive position there should be no noticeable hum on the trace. Microphonics should not exceed 2 mm.

7. Adjust the vertical gain.

OPERATING MODE to A only

VOLTS/CM to .05

VARIABLE ATTEN clockwise.

With .2 volts in from the calibrator adjust R3563 ("Ampl A gain adj") for 4 cm.

8. Check attenuation ratios.

VOLTS/CM to .05

CALIBRATOR to .5 volts

Adj VARIABLE ATTEN control for 5 cm deflection

Rotate the VOLTS/CM control counter clockwise and at the same time rotate the CALIBRATOR switch clockwise. 5 cm deflection should result from each pair of switch positions within 3%.

9. Repeat steps 7 and 8 for the B amplifier.

Adjust R4563 ("ampl B gain adj")

10. Standardize the input capacitance of the A channel.

OPERATING MODE to A only.

VOLTS/CM to .05

VARIABLE ATTEN clockwise

1 kc from 105 to INPUT A through a 530 standards probe.

With POLARITY on normal dc adjust C3223 for best square wave.

Switch POLARITY to inverted dc and adjust C3273 for best square wave.

Type 53C Calibration Procedure, continued

11. Compensate the attenuators for A channel

VARIABLE ATTEN clockwise

1 kc from 105 through a 530 standards probe

Adjust for best square wave as follows:

VOLTS/CM	Adjust
.1	C3143B C3153B
.2	C3113B C3123B
.5	C3083 C3093
5.0	C3053 C3063

Check all other attenuator ranges for proper "stacking" of attenuators. There should be no more than 1 mm of spike on a 6 cm square wave. If excessive spiking is present, check the dc value of the input resistance. R3203 should be 1 meg $\pm 1\%$.

12. Standardize the input capacitance of the B channel.

OPERATING MODE to B only

VOLTS/CM to .05

VARIABLE ATTEN clockwise

1 kc from 105 to INPUT B through a 530 standards probe.

With POLARITY on normal dc adjust C4223 for best square wave.

Switch POLARITY to inverted dc and adjust C4273 for best square wave.

13. Compensate the attenuators for B channel.

VARIABLE ATTEN clockwise.

1 kc from 105 through a 530 standards probe.

Adjust for best square wave as follows:

Type 53C Calibration Procedure, continued

VOLTS/CM	Adjust
.1	C4113B C4153B
.2	C4113B C4123B
.5	C4083 C4093
5.0	C4053 C4063

Check all other attenuator ranges for proper "stacking" of attenuators. There should be no more than 1 mm of spike on a 6 cm square wave. If excessive spiking is present, check the dc value of the input resistance. R4203 should be 1 meg $\pm 1\%$.

14. Adjust high-frequency compensation.

350 kc from 105 properly terminated (termination to match the cable used) into either input and adjust C3613, C3653, L3603, and L4603 for best square wave.

15. Check bandpass.

Remove EP53 extension and plug unit directly into scope. Should be no more than 3 db down at 8.5 mc through either channel.

16. Check dc output level.

The voltage at pin 1 and 3 of the amphenol connector must be between 65 and 70 volts with the trace centered.

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TYPE 53/54C PLUG-IN UNIT

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

The following instruments and equipment are needed:

- 1 540-Series oscilloscope
- 1 TYPE 190 CONSTANT-AMPLITUDE SIGNAL GENERATOR
- 1 TYPE 105 SQUARE-WAVE GENERATOR
- 1 TYPE 107 SQUARE-WAVE GENERATOR
- 1 INPUT CAPACITANCE STANDARDIZER (CS 20)
- 1 5:1 L Pad (B52-L5)
- 1 52-Ω TERMINATING RESISTOR (B52-R)
- 3 52-Ω Cables

The 540-Series oscilloscope should be set up as follows unless otherwise stated:

<u>HORIZONTAL DISPLAY</u>	<u>INTERNAL SWEEP (Type 541)</u> <u>MAIN SWEEP NORMAL (Type 545)</u>
<u>TRIGGERING MODE</u>	<u>AUTOMATIC</u>
<u>TRIGGER SLOPE</u>	<u>-INT.</u>
<u>STABILITY</u>	<u>PRESET</u>
<u>TIME/CM</u>	<u>1 MILLISEC</u>
<u>MULTIPLIER</u>	<u>1</u>
<u>TYPE 105</u>	Use a 52-Ω cable, terminated with an <u>INPUT CAPACITANCE STANDARDIZER (CS 20)</u>
<u>TYPE 107</u>	Use a 52-Ω cable terminated with the <u>TERMINATING RESISTOR (B52-R)</u>
<u>TYPE 190</u>	Terminate <u>ATTENUATOR</u> box with the <u>5:1 L PAD (B52-L5)</u>

The vertical-system electrical center of the 540-Series oscilloscope should be determined in the following manner:

Using a TEST LOAD UNIT, depress the PRESS TO SHORT INPUT button and observe the vertical level of the trace. If you use a Type 53/54 plug-in unit,

jumper between pins 1 and 3 on the 16-pin connector and observe the vertical level of the trace. This level will be referred to later in the calibration procedure.

PRE-CHECK

Make a careful visual inspection of the unit for proper wire dress and check controls for smooth mechanical operation. Make the following resistance-to-ground checks at the amphenol 16-pin connector:

AMPHENOL CONNECTOR PIN NUMBER	RESISTANCE TO GROUND IN Ω
1	8.5 K
2	0
3	8.5 K
4	infinite
5	"
6	"
7	"
8	0 (MODE switch <u>ALTERNATE</u>)
9	200 K
10	2 K
11	7 K
12	infinite
13	"
14	"
15	110
16	infinite

PRESET CONTROLS

<u>VERTICAL POSITION</u>	mid-range
<u>VOLTS C/M</u>	.05
<u>VARIABLE VOLTS/CM</u>	full right (cw)
<u>POLARITY</u>	<u>NORMAL</u>
<u>AC-DC</u>	<u>DC</u>
<u>GAIN ADJ.</u>	full right (cw)
<u>DC BAL.</u>	mid-range
<u>MODE switch</u>	<u>ALTERNATE</u>
VERT. POS. RANGE	mid-range

Preset all coil slugs below the windings.

Plug 53/54 C Unit into scope.

1. CHECK DC OUTPUT LEVEL

Measure between pin 1 and ground and pin 3 and ground of the 16-pin amphenol plug (65-70 v).

2. ADJUST DC BAL. (same procedure for both A and B channels)

Position trace to about the center horizontal graticule line with the VERTICAL POSITION knob. Adjust DC BAL. so that the trace remains stationary on the screen as the VARIABLE VOLTS/CM knob is varied throughout its range.

3. ADJUST VERT. POS. RANGE

Set both VERTICAL POSITION knobs to mid-range. Adjust VERT. POS. RANGE control so that the two traces are equidistant above and below the "vertical-system electrical center".

4. CHECK GAS AND MICROPHONICS (same procedure for both A and B channels)

Gas check: Switch the VOLTS/CM switch from .05 to .1 and observe vertical shift in trace (2 mm maximum).

Microphonics check: Rap lightly on the front panel of the plug-in unit and watch for excessive-ringing type of microphonics.

5. CHECK ALTERNATE-SWEEP OPERATION

Reset scope as follows:

TIME/CM 100 MILLISEC

Set up plug-in as follows:

MODE switch ALTERNATE

Position the two traces about 2 cm apart and see that each time the sweep is triggered the trace alternates between A and B channel.

6. CHECK CHOPPED OPERATION

Reset the scope as follows:

TIME/CM 10 MICROSEC

Set up plug-in as follows:

MODE switch CHOPPED

Position the two traces about 2 cm apart and check to see that the chopped waveform is flat on top and bottom.

7. SET GAIN ADJ. (same procedure for both A and B channels)

Reset scope as follows:

TIME/CM 1 MILLISEC

7. (Continued)

Set up plug-in as follows:

VOLTS/CM .05
VARIABLE VOLTS/CM full right (cw)
AC-DC DC

From SQUARE-WAVE CALIBRATOR apply .2 volts to input and set GAIN ADJ. for 4 cm of vertical deflection.

8. CHECK AC DC SWITCH (same procedure for both A and B channels)

Set up plug-in as follows:

VOLTS/CM .05
AC DC DC

From the SQUARE-WAVE CALIBRATOR apply 100 millivolts to input. Position the base line of the calibrator waveform to the center graticule line. Set AC DC switch to AC. The waveform should shift down so that the center graticule line is now approximately through the center of the display.

9. CHECK VOLTS/CM SWITCH STEPS (same procedure for both A and B channels)

Set up plug-in as follows:

AC DC DC
VARIABLE VOLTS/CM full right (cw)

From SQUARE-WAVE CALIBRATOR apply signal to input and check for proper deflection.

<u>SQUARE-WAVE CALIBRATOR</u>	<u>VOLTS/CM SWITCH</u>	<u>DEFLECTION</u>
.2	.05	4 cm
.2	.1	2 cm
.5	.2	2.5 cm
2	.5	4 cm
2	1	2 cm
5	2	2.5 cm
20	5	4 cm
20	10	2 cm
50	20	2.5 cm

10. CHECK POLARITY SWITCH (same procedure for both A and B channels)

Position trace to center of screen and switch POLARITY switch from NORMAL to INVERTED. The trace must not shift more than 3 cm.

11. ADJUST INPUT CAPACITORS (same procedure for both A and B channels)

Set up plug-in as follows:

<u>VOLTS/CM</u>	<u>.05</u>
<u>POLARITY</u>	<u>NORMAL</u>
<u>AC DC</u>	<u>DC</u>

From TYPE 105 apply 1-kc signal to input. Adjust 105 OUTPUT AMPLITUDE control to produce 3.5 cm of vertical deflection. Adjust input capacitor for optimum flat top. (Channel A, C3023; Channel B, C4023)

12. ADJUST VOLTS/CM SWITCH COMPENSATIONS (same procedure for both A and B channels)

Set up plug-in as follows:

<u>AC DC</u>	<u>DC</u>
<u>POLARITY</u>	<u>NORMAL</u>
<u>TYPE 105</u>	Terminate output cable with an <u>INPUT CAPACITANCE STANDARDIZER (CS 20)</u>

From TYPE 105 apply 1-kc signal to input. Adjust TYPE 105 OUTPUT AMPLITUDE control to produce 3.5 cm of vertical deflection.

<u>VOLTS/CM</u> <u>SWITCH</u>	ADJ. FOR OPTIMUM SQUARE CORNER		ADJ. FOR OPTIMUM FLAT TOP	
	<u>CHANNEL A</u>	<u>CHANNEL B</u>	<u>CHANNEL A</u>	<u>CHANNEL B</u>
<u>.1</u>	C4823C	C4923C	C4823B	C4923B
<u>.2</u>	C4833C	C4933C	C4833B	C4933B
<u>.5</u>	C4843C	C4943C	C4843B	C4943B
<u>1</u>	C4853C	C4953C	C4853B	C4953B
<u>2</u>	C4863C	C4963C	C4863B	C4963B
<u>5</u>	C4873C	C4973C	C4873B	C4973B
<u>10</u>	C4883C	C4983C	C4883B	C4983B
<u>20</u>	C4893C	C4993C	C4893B	C4993B

13. ADJUST HF COMPENSATIONS

Reset scope as follows:

<u>TIME/CM</u>	<u>.1 MICROSEC</u>
<u>MULTIPLIER</u>	<u>2</u>

Set up plug-in as follows:

<u>VOLTS/CM</u>	<u>.05</u>
<u>VARIABLE VOLTS/CM</u>	full right (cw)
<u>MODE switch</u>	<u>A ONLY</u>
<u>POLARITY</u>	<u>NORMAL</u>
<u>AC DC</u>	<u>DC</u>

13. (Continued)

From TYPE 107 apply approximately 450 kc to CHANNEL A input. Adjust TYPE 107 APPROXIMATE AMPLITUDE control for 3 cm of vertical deflection. Adjust L3523, L4413, L3313, L3353, L3073 and L3253 for optimum square corner with no overshoot. Set MODE switch to B ONLY. Now apply signal to CHANNEL B input and adjust L4313, L4353, L4073, and L4253 for optimum square corner with no overshoot. If one channel seems to have better response than the other, try a slightly different setting of L3523 and L4413 which are common to both channels.

14. CHECK FREQUENCY RESPONSE (same procedure for both A and B channels)

Reset scope as follows:

<u>TRIGGERING MODE</u>	AC SLOW
<u>TIME/CM</u>	<u>100 MICROSEC</u>
<u>STABILITY</u>	full right (cw)

Set up plug-in as follows:

<u>VOLTS/CM</u>	.05
<u>VARIABLE VOLTS/CM</u>	full right (cw)
<u>AC DC</u>	<u>DC</u>

From TYPE 190 apply 4 cm of signal at 50 kc to input. Now adjust TYPE 190 to obtain a frequency of 24 mc (do not change TYPE 190 OUTPUT AMPLITUDE) and see that there is at least 2.8 cm of vertical deflection remaining (3 db point).