

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 M PLUG-IN
 FACTORY CALIBRATION PROCEDURE
 (Tentative)

The following instruments and equipment are needed for a complete calibration of the Type M Plug-In:

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|---|--|--------------------|
| 1 | <u>Type 545A Oscilloscope</u> | (or equivalent) |
| 1 | <u>Type 105 Square-Wave Generator</u> | (or equivalent) |
| 1 | <u>Type 107 Square-Wave Generator</u> | (or equivalent) |
| 1 | Input Capacitance Standardizer (CS47) | <u>TEK 011-021</u> |
| 2 | 52 Ω Cable | <u>TEK 012-001</u> |
| 1 | Plug-In Extension (EP54) | <u>TEK 013-019</u> |
| 3 | 5:1 T Attenuators (B52-T5) | <u>TEK 011-027</u> |
| 2 | 52 Ω Terminating Resistors (B52R) | <u>TEK 011-001</u> |
| 1 | X10 Probe | |

The Type 545A should be set up as follows unless otherwise stated:

<u>HORIZONTAL DISPLAY</u>	<u>A</u>
<u>TRIGGERING MODE</u>	<u>AC</u>
<u>TRIGGERING SLOPE</u>	<u>+INT</u>
<u>STABILITY</u>	<u>FREE RUN</u>
<u>TIME/CM</u>	<u>1 μSEC</u>
<u>HORIZONTAL POSITION</u>	Mid-Range

Type 105: Connect a 52 Ω coaxial cable to the OUTPUT and terminate the other end of the cable with an INPUT CAPACITANCE STANDARDIZER.(CS47)

Type 107: Connect a 52 Ω coaxial cable to the OUTPUT terminal and terminate the other end of the cable with a B52R TERMINATING RESISTOR.

The vertical-system electrical center of the Type 545A Scope should be determined by one of the following steps:

1. Using a TEST LOAD UNIT, depress the PRESS TO SHORT INPUT button and observe the vertical level of the trace.
2. Using a lettered type plug-in unit, connect a short jumper between pins 1 and 3 on the 16-pin Amphenol connector and observe the vertical level of the trace.

This level is the vertical-system electrical center which will be referred to later in the calibration procedure.

PRELIMINARY INSPECTION:

Make a careful visual inspection of a unit for unsoldered joints, rosin joints, long wire ends and wire dress.

Check controls for smooth mechanical operation.

Make the following resistance-to-ground checks at the 16-pin Amphenol connector:

AMPHENOL CONNECTOR PIN NUMBER	DC RESISTANCE- TO-GROUND IN OHMS	AMPHENOL CONNECTOR PIN NUMBER	DC RESISTANCE- TO-GROUND IN OHMS
1	11.1 k	9	3.5 k
2	0	10	2 k
3	11.1 k	11	80 k
4	Infinite	12	Infinite
5	Infinite	13	Infinite
6	Infinite	14	Infinite
7	Infinite	15	150 Ω
8	at least 1 M (<u>ALT-CHOP</u> at <u>CHOPPED</u>)	16	80 k
8	0 (<u>ALT-CHOP</u> at <u>ALTERNATE</u>)		

PRESET CONTROLS (All channels):

<u>POSITION</u>	Mid-range
<u>VOLTS/CM</u>	.02
<u>VAR GAIN</u>	<u>CALIB</u>
<u>MODE</u>	<u>OFF</u>
<u>GAIN ADJ</u>	Maximum clockwise
<u>DC BAL</u>	Mid-range
<u>ALTERNATE-CHOPPED</u>	<u>ALTERNATE</u>
<u>VERT. POS. RANGE</u>	Mid-range
<u>HF PEAKING</u>	Mid-range
<u>OUTPUT DC LEVEL</u>	Mid-range

Preset coil slugs of L5363 and L5373 at the center of the windings.

Preset all variable capacitors of the input attenuators at mid-range.

Plug Type M Unit into scope, using a plug-in extension (EP54).

1. CHECK ZENER REGULATED VOLTAGE:

Using a DC voltmeter, check +12.6 zener regulated voltage (+12.6v \pm .6v) and +6.3 zener regulated voltage (+6.3v \pm .6v).

2. ADJUST DC BAL: (All channels)

Place MODE switch at NORM. AC. Position the trace to about the center horizontal graticule line with the POSITION control. Adjust DC BAL so that the trace remains stationary on the screen as the VAR. GAIN control is varied throughout its range.

3. ADJUST VERT. POS. RANGE:

Set all POSITION controls to mid-range. Place all MODE switches at NORM. AC. Adjust VERT. POS. RANGE control so that all traces are within one major division of the vertical electrical-system center.

4. CHECK INPUT CAPACITOR FOR LEAKAGE: (All channels)

Set VOLTS/CM to .02. Apply 500 v to the input. Switch the 500v on and observe the trace shift after it returns to the screen. There should be less than one major division of displacement from the original position.

5. CHECK MODE SWITCH: (All channels)
Set POSITION control at mid-range and switch MODE switch from NORM. AC to INV. AC. The trace must not shift more than two major divisions from the original position. Return MODE switch to NORM. AC and position the trace to the electrical center. Measure the voltage between pin (1 or 3) of the 16-pin Amphenol connector and ground (65 - 70 v). Remove the plug-in extension and re-install the plug-in unit into scope.

6. CHECK GAS AND MICROPHONICS: (All channels)
Gas check: With input connector grounded, turn MODE switch from DC to AC and observe the vertical shift in the trace (1/2 minor division maximum).
Microphonics check: Rap lightly on the front panel of the plug-in unit and check for excessive ringing type of microphonics (no more than 1/2 major division).

7. CHECK ALTERNATE-SWEEP OPERATION:
Set 2, 3 and 4 MODE switches at NORM. AC one step at a time. Position the traces about one major division apart. Check that each time the sweep is triggered, the trace runs sequentially with various settings of the scope TIME/CM switch. Set MODE switches to INV. AC and repeat the same procedure. Repeat this procedure for B sweep operation and return HORIZONTAL DISPLAY to A.

8. CHECK CHOPPED OPERATION:
Set TIME/CM switch of the scope to 1 μsec and ALTERNATE-CHOPPED to CHOPPED. Check the CHOPPED waveform for approximate chopping rates 250 kc, 330 kc, and 500 kc with 4, 3 and 2 channels on respectively. Check for a continuous sweep with one channel on. Place TIME/CM switch at 1 msec. Check the width of all traces at normal intensity for NORM & INV operation (1/2 minor division maximum).

9. SET GAIN ADJ: (All channels)
Set VOLTS/CM switch at .02, ALTERNATE-CHOPPED switch at ALTERNATE, VAR. GAIN at CALIB and MODE switch at NORM. DC. With the scope TIME/CM switch at .2 msec and TRIGGERING MODE at AUTO, apply a 20 mv signal from AMPLITUDE CALIBRATOR to the input and set GAIN ADJ one major division of vertical deflection.

10. CHECK VAR. GAIN: (All channels)
Apply a 50 mv signal from AMPLITUDE CALIBRATOR to the input. Set the VAR.GAIN at minimum gain position (ccw) and the gain ratio should be at least 2.5 to 1. Check for smooth electrical operation. Reset VAR. GAIN to CALIB.

11. CHECK AC-DC OPERATION OF MODE SWITCH: (All channels)
Set MODE switch to NORM. DC and position the base line of the calibrator waveform to the center graticule line. Set MODE switch to NORM. AC. The waveform should shift down so that the center graticule line is now approximately through the center of the waveform. Repeat the same procedure for INV. operation. (Except when switching from DC-AC, the waveform should shift upward.)

12. CHECK VOLTS/CM SWITCH STEPS: (All channels)
Set MODE switch to NORM. DC. Apply AMPLITUDE CALIBRATOR signal to input and check for proper deflection as follows:

12. CHECK VOLTS/CM SWITCH STEPS, Cont.:

<u>VOLTS/CM</u>	<u>CALIBRATOR</u>	<u>DEFLECTION</u>
.02	50 mv	2.5 major divisions
.05	.2 v	4 " "
.1	.2 v	2 " "
.2	.5 v	2.5 " "
.5	2 v	4 " "
1	2 v	2 " "
2	5 v	2.5 " "
5	20 v	4 " "
10	20 v	2 " "

13. ADJUST INPUT CAPACITOR: (All channels)

Set the VOLTS/CM switch to .02. From Type 105 apply a 1 kc signal to the appropriate input through a B52T5, a 52 Ω cable and a 47 pf standardizer (CS47). Adjust input capacitor for optimum flat-topped waveform (Channel A, C5317; Channel B, C5317; Channel C, C5317; Channel D, C5317).

14. ADJUST VOLTS/CM SWITCH COMPENSATIONS: (All channels)

Using set up as in previous step, set Type 105 OUTPUT AMPLITUDE control to produce approximately three major divisions of vertical deflection for the following VOLTS/CM settings. Adjust the appropriate variable capacitors for optimum waveform.

<u>VOLTS/CM</u>	<u>ADJUST FOR OPTIMUM SQUARE CORNER</u>				<u>ADJUST FOR OPTIMUM FLAT TOP</u>			
	<u>Channel</u>				<u>Channel</u>			
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
.05	C5308C				C5308B			
.1	C5309C				C5309B			
.2	C5310C				C5310B			
2	C5313C				C5313B			

Check all ranges of the VOLTS/CM switches for optimum flat-topped waveform.

15. CHECK LOW FREQUENCY RESPONSE: (All channels)

Set VOLTS/CM switch to .02 and the scope TIME/CM switch to .05 msec. From Type 105 apply a signal to the appropriate input through a B52T5, a 52 Ω cable and a 52 Ω terminating resistor. Adjust the Type 105 OUTPUT AMPLITUDE for three major divisions of vertical deflection. Set the Type 105 FREQUENCY and RANGE controls to 100 cps, 250 cps, 1 kc, 2.5 kc and 10 kc, one step at a time, and simultaneously check for a flat-topped waveform.

16. ADJUST HF COMPENSATION:

Set the scope TIME/CM switch at .1 μ sec. Place Channel A VOLTS/CM switch at .02 and MODE switch at NORM. DC. From Type 107, apply a signal of approximately 450 kc to Channel A input. Adjust Type 107 APPROXIMATE AMPLITUDE for three major divisions of vertical deflection. Set the scope STABILITY and TRIGGERING LEVEL for a stable display. Adjust L5363, L5373 and HF peaking for optimum square corner without appreciable overshoot and ringing. Check the risetime (15 nsec). Apply the Type 107 signal to other channels and check the waveform and risetime. Note: L5363, L5373 and HF peaking must be adjusted so that all channels have approximately the same transient response.

17. CHECK "A" SIGNAL OUT:

Set the Scope TIME/CM switch at 1 msec. Place Channel A VOLTS/CM switch at .02 and MODE switch at NORM. DC. Set Channel B VOLTS/CM switch at 2 and MODE switch at NORM. DC. Connect "A" SIGNAL OUT to Channel B input and adjust OUTPUT DC LEVEL for zero dc output voltage. From Type 105 apply a signal of 1 kc to Channel A input. Adjust Type 105 OUTPUT AMPLITUDE for one major division (20 mv) of vertical deflection. Using a X10 Probe, check "A" SIGNAL OUT for at least 2 volts output and for a risetime of .35 μ sec.

TYPE M PLUG-IN

TEST SPECIFICATIONS

(Tentative)

1. Output DC voltage above ground must be 65-70 v.
2. With GAIN ADJ set at maximum, the gain must be at least 10% more than the proper setting and with GAIN ADJ set at minimum, the gain must be 10% less than the proper setting (all channels).
3. Maximum trace shift on all channels must not exceed one-half minor division when MODE switch is being switched from DC to AC with the input grounded.
4. Microphonic effect (ringing type) from operation of front panel controls should be no more than one minor division, and no more than one-half major division when striking lightly on the front panel of the plug-in unit.
5. VERT POS. RANGE should adjust within $\pm 90^\circ$ of the center of rotation.
6. With vertical position controls centered and VERT. POS. RANGE properly adjusted, all traces should be within one major division of the vertical-system electrical center.
7. DC BAL. on all channels should adjust within $\pm 90^\circ$ of the center of rotation.
8. OUTPUT DC LEVEL of A SIGNAL OUT should adjust within $\pm 90^\circ$ of the center of rotation.
9. When operating MODE switch from NORM to INV on all channels, the trace must not shift more than two major divisions from the original position with POSITION controls centered and VERT. POS. RANGE properly adjusted.
10. VAR GAIN ratio must be at least 2.5 to 1.
11. The attenuator ratio (VOLTS/CM) must be within $\pm 2\%$ on all ranges.
12. In CHOPPED mode operation, the chopping rate should be approximately as follows:
 - 250 kc with 4 channels on
 - 333 kc with 3 channels on
 - 500 kc with 2 channels on
 - A continuous sweep with 1 channel on
- The flat top distortion should not exceed one-half minor division at normal intensity.
13. The bandwidth of all channels must be no more than 3 db down at 23 mc (risetime faster than 15 nanosec.)
14. The overshoot and ringing of the output waveform of all channels must be no more than one-half minor division when the output amplifier is properly adjusted for transient response.
15. The amplitude of "A" SIGNAL OUT must be at least 2 V/CM for one major division of vertical deflection in CHANNEL A.
16. The bandwidth of "A" SIGNAL OUT must be no more than 3 db down at 1 mc (risetime faster than .35 μ sec).
17. +12.6 v zener regulated voltage should be measured between +11.9 volts and +13.1 volts.
18. +6.3 v zener regulated voltage should be measured between +5.7 volts and +6.9 volts.

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