

# FACTORY CALIBRATION PROCEDURE

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## INTRODUCTION:

This isn't a field recalibration procedure as is the procedure in your instruction manual. This is a guide in calibrating brand-new instruments, just assembled instruments that have never been turned on before. Therefore it calls out many procedures and adjustments that are rarely required for subsequent recalibration.

Even though we wrote this procedure primarily for our own factory test department, it's valuable to others also if used with some caution:

1. Special test equipment, if mentioned, is not available from Tektronix unless it's listed also in our current catalog. This special equipment is used in our test department to speed calibration. Usually you can either duplicate its function with standard equipment in your facility, devise alternate approaches, or build the special test equipment yourself.

2. Factory circuit specifications are not guaranteed unless they also appear as catalog or instruction manual specifications. Factory circuit specs usually are tighter than advertised specs. This helps insure the instrument will meet or exceed advertised specs after shipment and during subsequent field recalibrations over several years of use. Your instrument may not meet factory circuit specs but should meet catalog or instruction manual specs.

3. Presetting internal adjustments, if mentioned, usually is unnecessary. This is helpful for "first-time" calibration only. If internal adjustments are preset, you'll have to perform a 100% recalibration. So don't preset them unless you're certain a "start-from-scratch" policy is the best.

In this procedure, all front panel controls for the instrument under test are in capital letters (SENSITIVITY) and internal adjustments are capitalized only (Gain Adj).

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For 53A, 53/54A and A units,  
all serial numbers.

53A	sn 101 to 1499
53/54A	sn 1500 to 2797
A	sn 2798 up

The 53/54A and A are identical, only the nomenclature changed. Circuitry and circuit symbol numbers are different in the 53A but specifications are the same.

# A



## ABBREVIATIONS:

a	amp	mid r	midrange or centered
ac	alternating current	min	minimum
approx	approximately	mm	millimeter
b	base	mpt	metalized, paper tubular (capacitor)
bulb	light, lamp, etc.	msec	millisecond
c	collector	mt	mylar, tubular (capacitor)
ccw	counterclockwise or full counterclockwise	mv	millivolt
cer	ceramic	$\mu$	micro ( $10^{-6}$ )
cm	centimeter	$\mu$ f	microfarad
comp	composition (resistor)	$\mu$ h	microhenry
cps	cycles per second	$\mu$ sec	microsecond
crt	cathode ray tube	n	nano ( $10^{-9}$ )
cw	clockwise or full clockwise	nsec	nanosecond
db	decibel	$\Omega$	ohm
dc	direct current	p	pico ( $10^{-12}$ )
div	division	pbt	paper, "bathtub" (capacitor)
e	emitter	pcc	paper covered can (capacitor)
emc	electrolytic, metal cased (capacitor)	pf	picofarad ( $\mu\mu$ f)
emt	electrolytic, metal tubular	piv	peak inverse voltage
fil	filament	pmc	paper, metal cased (capacitor)
freq	frequency	poly	polystyrene
gmV	guaranteed minimum value (capacitor)	pot	potentiometer
gnd	chassis ground	prec	precision (resistor)
h	henry	pt	paper, tubular (capacitor)
hv	high voltage	ptm	paper, tubular molded (capacitor)
inf	infinity	ptp	peak-to-peak
int	internal	sec	second
k	kilo ( $10^3$ )	sn	serial number
k	kilohm	term	terminal
m	milli ( $10^{-3}$ )	tub	tubular (capacitor)
ma	milliamp	unreg	unregulated
max	maximum	v	volt
mc	megacycle	var	variable
meg	megohm	w	watt
mh	millihenry	WW	wire wound
		x-former	transformer

## FACTORY CIRCUIT SPECIFICATIONS

Factory circuit specifications are qualified by the conditions specified in the main body of the calibration procedure. The numbers listed beside the specs correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory circuit specs if calibration or check-out methods and test equipment differ substantially from those in this procedure.

1. EQUIPMENT REQUIRED
2. PRELIMINARY INSPECTION
3. A UNIT PRESETS
4. RESISTANCE CHECKS
5. SETUP
6. OUTPUT VOLTAGE
  - 6a. Pins 1 and 3: +65 to +70 v.
7. DC BALANCE
8. VERTICAL POSITION RANGE
9. GAS AND MICROPHONICS
  - 9a. Gas: 2 mm, max.
  - 9b. Microphonics: normal type = 2 mm, max.  
ringing type = none.
10. INPUT SELECTOR SWITCH
11. GAIN
  - 11b. Gain Adj range: 2.2 cm, min.
12. VOLTS/CM ACCURACY
  - 12a. Accuracy:  $\pm 2\%$ .

## NOT INTENDED FOR INCOMING INSPECTION

We initially calibrate the instrument to factory circuit specifications. These specs usually are tighter than advertised specs, thus helping to insure the instrument will meet or be within advertised specs after shipment and during subsequent field recalibrations. Instruments that have left our factory may not meet factory circuit specs but should meet catalog or instruction manual specs.

13. VOLTS/CM COMPENSATION
  - 13c. Level flat-topped 1 kc 105 waveform, with no overshoot or roll-off.
14. HIGH FREQUENCY
  - 14b. Best square corner on 107 waveform, with no overshoot or undershoot.
15. PASSBAND
  - 15b. Passband: No more than 3 db down at 20 mc.
16. THE END.

# FACTORY CALIBRATION PROCEDURE

## CALIBRATION

## NOTES

### 1. EQUIPMENT REQUIRED

- a. 1 540 series Tektronix type oscilloscope as plug-in scope
- 1 105 Tektronix type square-wave generator
- 1 107 Tektronix type square-wave generator
- 1 190B Tektronix type constant amplitude sinewave generator
- 1 011-030 47 pf input time-constant standardizer
- 1 011-045 50  $\Omega$  termination
- 2 012-001 52  $\Omega$  cables, 42"
- 1 630 Triplet type or  
262 Simpson type multimeter;  
20,000  $\Omega/v$  dc
- 1 special Standard calibrator

### 2. PRELIMINARY INSPECTION

- a. Check for unsoldered joints, rosin joints, lead dress and long ends. Check controls for smooth mechanical operation and proper indexing.

### 3. A UNIT PRESETS

- a. Front panel controls

INPUT SELECTOR	A DC
VERTICAL POSITION	mid r
VOLTS/CM	.05
VARIABLE volts/cm	CALIBRATED
DC BAL	mid r
GAIN ADJ	cw

b. Internal adjustments

NOTE: 53A nomenclature in parentheses.

Vert Pos Range R3761 (Positioning Adj R3671)	mid r mid r
L3401 and L3581  (L3801 and L3901)	slugs just below bottom of wind- ings slugs just below bottom of wind- ings
HF Peaking R3871 (not in 53A)	mid r

c. Leave controls and adjustments for any step, as they were in the step preceding unless noted otherwise.

4. RESISTANCE CHECKS

a. Use ohmmeter to check following resistances to ground:

use	Amphenol pin	approx resistance
output	1	9.5 k
gnd	2	0 Ω
output	3	9.5 k
unused	4 to 8	inf
-150 v	9	inf
+100 v	10	4 k
+225 v	11	10 k
+350 v	12	inf
(unused in 53A)	12	inf
unused	13 to 14	inf
+75 v fil	15	200 Ω
unused	16	inf

5. SETUP

a. Plug-in scope's electrical center

Determine plug-in scope's vertical amplifier electrical center by either:

- (1) Inserting a test load unit (TU-1 or TU-2), pushing PRESS TO SHORT INPUT button and noting trace vertical position (electrical center), or

3b. Presetting internal adjustments

(1) Presetting internal adjustments is helpful for "first-time" calibration but usually is unnecessary for field recalibration. If you preset, you'll have to perform a 100% recalibration. Don't preset them unless you're certain a "start-from-scratch" policy is the best.

(2) Inserting a normal letter-series plug-in, shorting Amphenol pins 1 and 3 together and noting trace vertical position (electrical center).

b. Plug-in scope presets

A sweep, 1 msec/cm, auto, +int.

c. Insert A unit in plug-in scope and turn power on.

## 6. OUTPUT VOLTAGE

a. 65 to 70 v

Use VERTICAL POSITION to place trace to electrical center. Use dc voltmeter to check output voltages, to ground, as follows:

Amphenol pin 1: +65 to +70 v

Amphenol pin 3: +65 to +70 v

## 7. DC BALANCE

a. DC BAL R4401 (R3541)

Rotate VARIABLE volts/cm back and forth and adjust DC BAL R4401 (R3541) for no trace shift.

## 8. VERTICAL POSITION RANGE

a. Vert Pos Range (R3761)  
(Positioning Adj R3671)

Set VERTICAL POSITION to mid r (white index mark straight up) and adjust Vert Pos Range R3761 (Positioning Adj R3671) to place trace to electrical center.

## 9. GAS AND MICROPHONICS

a. Gas: 2 mm

Keep INPUT SELECTOR at A DC, ground INPUT A and note trace position. Change INPUT SELECTOR to A AC and note any trace shift (gas): 2 mm, max.

b. Microphonics: normal = 2 mm, ringing = none

Keep INPUT A grounded, change INPUT SELECTOR to A DC, rap lightly on A unit front panel and check microphonics: normal type = 2 mm, max; ringing type = none.

10. INPUT SELECTOR SWITCH

a. Connect standard calibrator

standard calibrator, cal in--52 Ω cable--accurate +100 v  
 standard calibrator, output--52 Ω cable--A INPUT, A unit

Set standard calibrator to .1 volt.

b. Use VERTICAL POSITION to place bottom of calibrator waveform to center graticule line. Change INPUT SELECTOR to A AC; display must shift so center graticule line runs approximately through the center of the waveform. Repeat for B INPUT.

11. GAIN

a. Keep calibrator connected to INPUT B and set to .1 volt. Keep VOLTS/CM at .05 and VARIABLE at CALIBRATED. Change INPUT SELECTOR to B DC.

b. GAIN ADJ: range = 2.2 cm, set = 2 cm

Keep GAIN ADJ full cw and note deflection: at least 2.2 cm. Adjust GAIN ADJ for exactly 2 cm.

12. VOLTS/CM ACCURACY

a. Check VOLTS/CM accuracy as follows:

VOLTS/CM	calibrator	deflection
* .05	* .2 v	*4 cm, adjusted
.1	.2 v	2 cm, ±.4 mm
.2	.5 v	2.5 cm, ±.5 mm
.5	2	4 cm, ±.8 mm
1	2	2 cm, ±.4 mm
2	5	2.5 cm, ±.5 mm
5	20	4 cm, ±.8 mm
10	20	2 cm, ±.4 mm
20	50	2.5 cm, ±.5 mm

\*Adjusted, step 11.

10a. Known accurate +100 v:

(1) A good source is the plug-in scope:

(2) Remove the output section of the plug-in scope's amplitude calibrator's multivibrator (not the output cathode follower) and set the amplitude calibrator control to 100 volts.

(3) Connect an accurate voltmeter, such as a John Fluke type 803 differential voltmeter, to the plug-in scope's cal out connector and adjust the Cal Adj for exactly +100v on the voltmeter.

(4) Remove the meter and connect the standard calibrator cal in to the plug-in scope cal out.

- b. Remove standard calibrator.

**13. VOLTS/CM COMPENSATION**

- a. Connect 105

105, output--50 Ω term--52 Ω cable--47 pf standardizer--INPUT B, A unit

Set A unit VOLTS/CM to .05. Set 105 for 1 kc and about 3 cm.

- b. Adjust as follows:

VOLTS/CM	adjust spike	adjust level
.05	-- --	C3261 ( * )

\*For 53A: Set VOLTS/CM to .05 and adjust C3011 for level. Then turn VARIABLE volts/cm full ccw and adjust C3321 for level. Adjustments interact, repeat; leave VARIABLE at CALIBRATED for remaining adjustments.

.1	C3231 (C3191)	C3221 (C3181)
.2	C3171 (C3161)	C3161 (C3151)
.5	C3111 (C3131)	C3101 (C3121)
5	C3071 (C3101)	C3061 (C3091)

- c. Check all VOLTS/CM settings

Check all VOLTS/CM settings for level flat-topped waveform with no overshoot or roll-off. Remove 105.

**14. HIGH FREQUENCY**

- a. Connect 107

107 output--52 Ω cable--50 Ω term--INPUT B, A unit

Set A unit VOLTS/CM to .05. Set 107 for approximately 450 kc and about 3 cm. Set plug-in scope to display about 1 cycle of 107 waveform with the rising portion at about the second or third graticule line (plug-in scope at .2 μsec/cm, -int).

- b. L3401, L3581, HF Peaking R3871 (L3801, L3901)

Adjust L3401 and L3581 (L3801 and L3901) for best leading edge and best level just back of the leading edge. Adjust HF Peaking R3871 (not in 53A) for best square corner with no overshoot or undershoot. Adjustments interact, repeat. Remove 107.



## 15. PASSBAND

a. Connect 190B

190B attenuator--INPUT B, A unit

Set A unit VOLTS/CM to .05. Set 190B for 50 kc and exactly 3 cm.

b. Passband; 2.1 cm at 20 mc

Change 190B to 20 mc and note deflection: at least 2.1 cm, indicating A unit is no more than 3 db down at 20 mc. Remove 190B.

16. THE END.

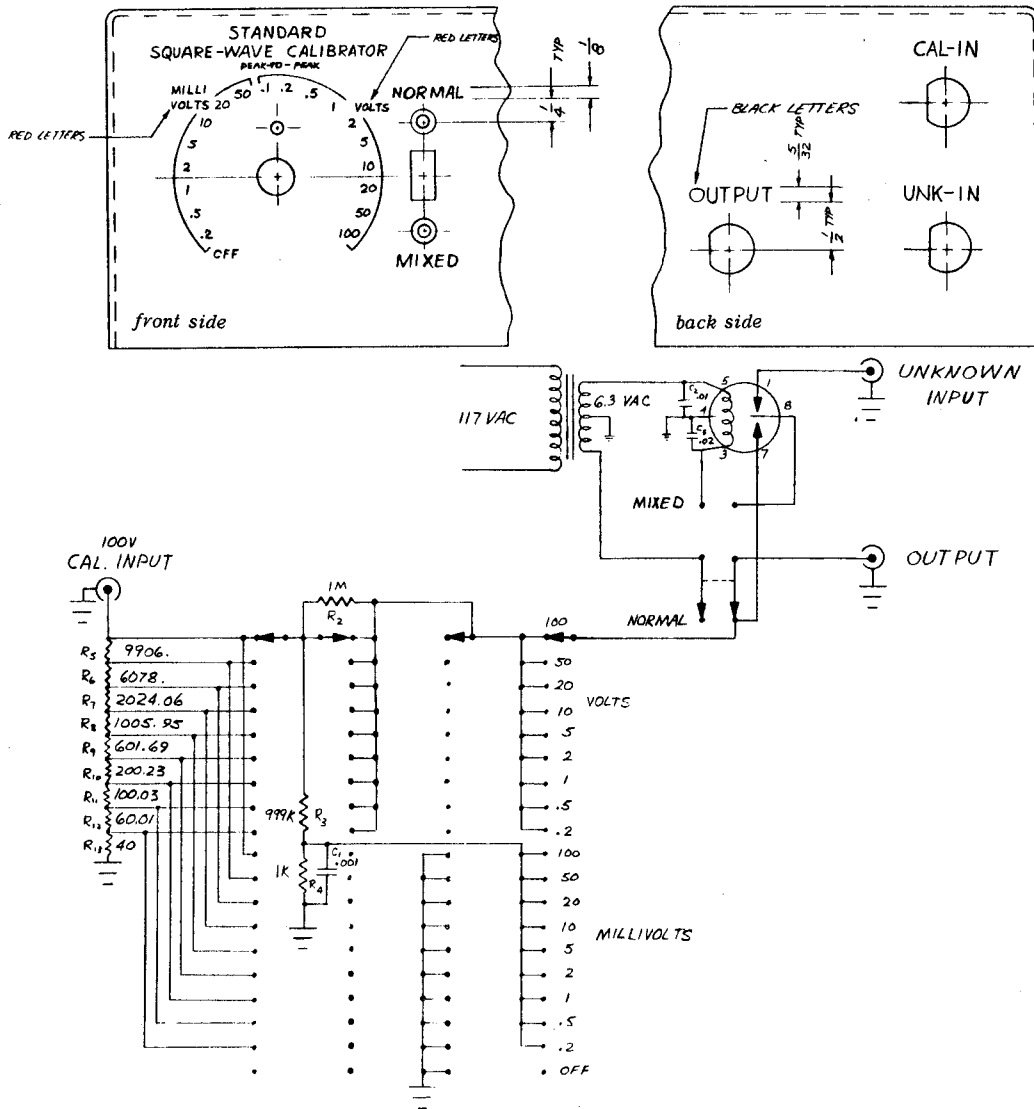
## SPECIAL TEST EQUIPMENT

Special test equipment, if mentioned, is not available from Tektronix unless it's listed also in our current catalog. This special equipment is used in our test department to speed calibration.

Usually you can either duplicate its function with standard equipment in your facility, devise alternate approaches, or build the special test equipment yourself.

### STANDARD CALIBRATOR:

Dwgs 600-B, 7-10-61 (front and rear panels); 601-B, 7-10-61 (schematic); 918-A, (parts).



3	131-081	Jacks, Amphenol	1	260-253	Switch, 19 pos. 3 sec. rotary
1	131-093	Receptacle, plug	1	283-003	Capacitor, .01 $\mu$ fd Discap
1	136-011	Socket, octal	1	309-115	Resistor, 1k 1/2w 1%
2	210-406	Screws, 4-40 1/4"	1	309-014	Resistor, 1meg 1/2w 1%
6	210-457	Nuts, 6-32 Kep-type	1	310-100	Resistor, 1meg 1w 1%
2	211-023	Nuts, 4-40	1	366-057	Knob, large black
9	211-507	Screws, 6-32	1	283-004	Capacitor, .02 Hi-Kap 150v
1	260-228	Switch, dpdt slide	1	283-000	Capacitor, .001 $\mu$ fd Discap 500v