FACTORY CALIBRATION PROCEDURE

CONTENTS:

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.

180A

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For 180A only, all serial numbers, not for 180.

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).

ABBREVIATIONS:

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

FACTORY CIRCUIT SPECIFICATIONS*

SPEC QUALIFICATION

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.

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 recalibrations. Instruments that have left our factory may not meet factory circuit specs but should meet catalog or instruction manual specs.

1. EQUIPMENT REQUIRED

2. PRELIMINARY INSPECTION

3. 180A PRESETS

4. RESISTANCE CHECKS

5. POWER SUPPLIES

5c. Value, ripple, and regulation checked from 105 to 125 vac.

supply	value error, max	max ptp ripple 105 to 125 v ac
-150 v	±2%	5 mv
+225 v	±2%	80 mv
+350 v	±3%	100 mv
- 17 v	-15.5 to 17.5 v	--
- 8 v	7.5 to 8.5 v	--

6. TIME MARKERS

6c. Marker amplitude

MARKER OUT: 3 v, min
banana jack out: 25 v, min

7. TRIGGER AMPLITUDE, FREQ

7a. Amplitude: 6 to 8 v.

8. 5, 10, AND 50 MC SINE WAVE

8b. 5 MC amplitude: 3 v, min.
8b. 1 mc modulation on 5 MC: .2 v, max.
8c. 10 MC amplitude: 3 v, min.
8d. 50 MC amplitude: 3 v, min.

9. CRYSTAL FREQ

9b. C105 range: ±3 cps at 1 mc.

10. OVEN LIGHT

11. THE END

*180A sn 5001 to 5478 calibration is essentially the same as sn 5479-up.

Exceptions:

(1) No variable C116.
(2) MARKER OUT amplitude: 1 v, min.
(3) Banana jack output amplitude: 6 v, min.
(3) Sine wave outputs: about 1 v.
(4) TRIGGER OUT amplitude: 1 v, min.

As can been seen, the extensive mod at sn 5479 was mainly aimed at boosting the output amplitudes.

CALIBRATION

NOTES

1. EQUIPMENT REQUIRED

a. Test scope

1	540 series	Tektronix type scope
1	L	Tektronix type fast-rise high-gain plug-in unit
1	10X probe	Tektronix probe

b. Test equipment

1	180A	Tektronix time-mark generator

c. Test accessories

1	012-001	52Ω cable, uhf connectors
1	011-045	50Ω termination

d. Miscellaneous equipment

1	630	Triplett meter; 20,000Ω/v dc
or	262	Simpson meter; 20,000Ω/v dc
1	--	Variable line voltage source with meter

1b. Equipment substitutes

(1) A TU-50 may be substituted for 180A.

2. PRELIMINARY INSPECTION

a. Check for unsoldered joints, rosin joints, lead dress and long leads. Check for loose hardware and protruding parts. Check controls for smooth mechanical operation.

b. Special checks

Check that 180A door swings freely. Check for lubricant on door hold-down screw.

c. fuse

117 v operation:	159-026	3.2a	mdx	slo-blo
234 v operation:	159-003	1.6a	mdx	slo-blo
CRYSTAL OVEN:	159-028	.25a	mdx	fast-blo

3. 180A PRESETS

a. Internal adjustments

Tighten link between 5 mc coils.

All internal adjustments mid r

3a. Presetting internal adjustments

(1) Presetting internal adjustments is helpful for "first-time" calibration but is usually unnecessary for 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.

NOTES

4. RESISTANCE CHECKS

a. Check resistances to ground

use	check point	approx resistance
117 vac	T701 term 1 and 4	inf
-150 v	C763 case	30 k
+225 v	at C715	10 k
+350 v	at C715	200 k

5. POWER SUPPLIES

a. Apply power

Connect 180A to variable line voltage source, set source to 117 v and turn 180A POWER ON.

b. -150 Adj

Connect meter to -150 v line. Adjust -150 Adj for -150 v.

c. Check value (voltmeter), ripple (test scope at .005 v with 10X probe) and regulation between 105 v ac and 125 v ac as follows:

supply	value error, max	max ptp ripple (neglect marker hash) 105 to 125 vac
-150 v	± 3 v, ±2%	5 mv
+225 v	± 4.5 v, ±2%	80 mv
+350 v	±10.5 v, ±3%	100 mv
- 17 v	-15.5 to -17.5 v	--
- 8 v*	7.5 to 8.5 v*	--

*Use 10X test scope probe to check -8 v value.

5c. -8 v Value

(1) -8 v should be checked with 10X 10 meg test scope probe or VTVM to avoid loading problems of VOM.

6. TIME MARKERS

a. Setup

Test scope presets

Stability	preset
Triggering mode	ac slow, +ext
Time/cm	1 μsec
Magnifier	off
Input	dc
Volts/cm	.5
Variable	calibrated

Check 10X probe compensation with scope calibrator.

Connect the probe to 180A MARKER OUT and a coax cable between 180A TRIGGER OUT and the scope ext trigger jack.

b. Markers

6b. sn 5001 to 5478

Cancel and reset 1 MICROSECONDS and 5 MICROSECONDS push buttons. Use 100 KC-10μS TRIGGER RATE for external triggering.

Adjust test scope trigger level for a stable display. Adjust 5 μS (internal) for correct timing as noted on test scope.

Cancel and reset 5 MICROSECONDS button only. Note marker amplitude.

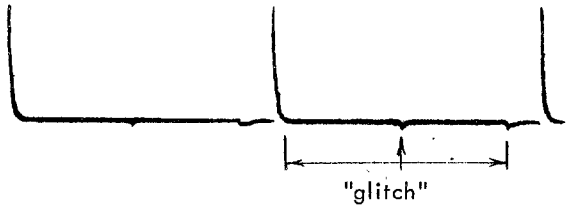
Cancel and reset 1 MICROSECONDS button only. Adjust C116 so that the 1 μsec markers are the same amplitude as the 5 μsec markers.

(1) No variable C116.

Adjust for proper timing as follows:

depressed marker buttons	test scope time/cm	TRIGGER RATE	adjust
1 and 5 MICROSECONDS	1 μsec	10 μS	5 μs*
5 and 10 MICROSECONDS	1 μsec	10 μS	10 μs**
10 and 50 MICROSECONDS	10 μsec	100 μS	50 μs*
50 and 100 MICROSECONDS	10 μsec	100 μS	100 μs**
100 and 500 MICROSECONDS	100 μsec	1 MS	500 μs*
500 MICROSECONDS and 1 MILLISECONDS	100 μsec	1 MS	1 ms**
1 and 5 MILLISECONDS	1 msec	10 MS	5 ms*
5 and 10 MILLISECONDS	1 msec	10 MS	10 ms**
10 and 50 MILLISECONDS	10 msec	100 MS	50 ms*
50 and 100 MILLISECONDS	10 msec	100 MS	100 ms**
100 and 500 MILLISECONDS	100 msec	1 SEC	500 ms*
500 MILLISECONDS and 1 SECONDS	100 msec	1 SEC	1 sec**
1 and SECONDS	1 sec	1 SEC	5 sec*

*Adjust so "glitch" is placed as shown.



**Adjust so "glitch" is placed as shown.

c. Marker amplitude MARKER OUT: 3 v, min
banana jack out: 25 v, min

Note amplitude of markers at MARKER OUT: 3 v, min. Note amplitude of markers at each banana jack: 25 v, min.

6c. sn 5001 to 5478

(1) MARKER OUT amplitude: 1 v, min
(2) Banana jack out: 6 v, min

7. TRIGGER AMPLITUDE, FREQ

a. Amplitude, frequency 6 to 8 v

Connect 10X probe to TRIGGER OUT.

Check the TRIGGER RATE outputs for freq corresponding to front panel markings and an output amplitude of 6 v, min.

7a. sn 5001 to 5478

(1) TRIGGER OUT amplitude: 1 v, min.

7a. Trigger output over 8 v

(1) Check V562 (T12-6).
(2) Check C560.
(3) Check R561, R560 divider.

8. 5, 10, AND 50 MC SINE WAVE

a. Setup

Trigger test scope externally from 180A TRIGGER OUT at 10 μS.

Connect a 50 Ω termination to 180A MARKER OUT. Connect test scope 10X probe to 50 Ω termination and connect probe gnd clip to 180A.

b. 5 MC, C123 and C129 amplitude: 3 v, min
1 mc modulation: .2 v, max

Cancel and reset 5 MC button. Set test scope to .2 μsec/cm.

Adjust C123 and C129 for 1 cycle per cm, max amplitude (3 v, min), and min 1 mc modulation (.2 v, max).

Set test scope to 2 μsec/cm. Note 1 mc modulation on 5 mc sine wave: .2 v, max.

QC will secure 5 mc link with Q dope.

8b,c,d.
sn 5001 to 5478

(1) Amplitude of 5, 10, 50 MC: 1 v, approx.

c. 10 MC, C133 and C139 amplitude: 3 v, min

Cancel and reset 10 MC button. Set test scope to .1 μsec/cm.

Adjust C133 and C139 for 1 cycle per cm and for max amplitude (3 v, min).

d. 50 MC, C143 and C147 amplitude: 3 v, min

Cancel and reset 50 MC button. Set test scope to .1 μsec/cm, X5 magnifier.

Adjust C143 and C147 for 1 cycle per cm and for max amplitude (1.4 v indicated, min). On the 50 MC range the output will be an indicated 1.4 v due to the bandpass of the 540 series scope.

8d. Double traces on 50 mc waveform

(1) Slightly readjust 5 μsec markers.
(2) Slightly readjust 10 μsec markers.
(3) Check following stages, if necessary.
(4) Check tubes.
(5) Check for open LR combinations in the 5, 10, or 50 μsec stages.

9. CRYSTAL FREQ

a. Setup

Test scope will remain externally triggered. Connect 10X test scope probe to another 180A or any source of accurate frequency.

Set test scope to 1 μsec/cm.

b. C105 range: ±3 cps at 1 mc

The crystal oven should be allowed to warm for 5 min before adjustment.

There must be enough range left at either side of C105 final adjustment to make the signal drift at rate of 3 cm per sec.

Adjust C105 to stop drift.

10. OVEN LIGHT

a. Oven light operation

Check the oven pilot light for turn off and on about every 20 to 30 sec.

The oven heater is not connected through the power switch and will continue to operate if the instrument is turned off but still connected to the line.

10a. Erratic oven light operation

(1) Check thermostat.

11. THE END

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 180A TIME MARK GENERATOR

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

Recommended Equipment:

Tektronix type 541 or 543. Tektronix type "L" plug in.
10X probe
DC voltmeter of at least 20,000Ω/V calibrated for an accuracy of ±1% at 150 volts and 300 volts.
An autotransformer for varying the line voltage to the instrument from 105 to 125 volts.
A type B52-R 52Ω terminating resistor.

PRELIMINARY INSPECTION

Check for unsoldered joints, rosin joints, poor wire dress, check that the door swings freely, check resistance of transformer primaries and power supplies to ground. The fuse should be 3.2 amp slo blo for 117V and 0.25 amp fast blo for the oven transformer.

1. POWER SUPPLY VOLTAGE ADJUSTMENT.

To adjust the output voltages of the supplies, connect the instrument to the output of the autotransformer and adjust it for 117 volts. Turn the power switch to ON.

To adjust the -150 volt supply, connect the meter between ground and the -150 volt supply. The connection to the -150 volt supply may be made at the top of the 18k resistor attached to pins 3 and 9 of v744. Adjust -150 for exactly that amount.

Check the output voltage of the +225 supply by connecting the meter between ground and pin 3 of v707. The voltage of this supply should be within ±2% of 225 volts.

Check the voltage of the +350 volt supply by connecting the meter between ground and pin 6 of v707. The voltage of this supply should be within 3% of 350 volts.

To check the -17 volt bias supply, connect the meter between ground and the negative side of C770 located on lower front side of the power chassis. The -17 volt supply should be between -17½ and -15½ volts. Measure between ground and the junction of R774 and R776 to check the -8 volt supply. The -8 volt supply should be ±½ volt of 8 volts.

2. POWER SUPPLY RIPPLE AND REGULATION CHECK.

The power supply regulating circuits of the type 180A are capable of holding ripple to a very low level between 105 and 125 line volts. (connected for 117 volt operation) The line voltage should be varied from 105 to 125 volts with the 50MC button pushed in at low line.

The ripple on the supplies should not exceed: -150-5 millivolts, +225-80 millivolts, +350-100 mv. These measurements are made neglecting hash due to the markers operation.

3. ADJUSTMENT OF TIME MARKERS.

Use the following front panel control settings of the Scope and "L" unit.

Stability	Preset
Triggering level	As appropriate
Triggering mode	AC slow, external, positive
Time/CM	1 microsecond
Magnifier	Off
"L"	
Input	DC
Volts Cm	0.5
Variable	Calibrated

Check the 10X probe compensation with the scope calibrator. Connect the probe to the marker out jack of the 180A and a coax cable between the 180A trigger out and the scope external trigger jack. Depress the 1µsec and 5µsec pushbuttons and the 10µsec trigger button. Adjust the test scope trigger level for proper display and adjust the 5µsec pot on the 180A. Adjust C116 so that the 1µsec markers are approximately the same amplitude as the 5µsec markers when viewed alone.

180A	Test Scope Sweep	Adjust	180A Trigger
1&5µsec	1µsec	5µsec	10µsec
5&10µsec	1µsec	10µsec	10µsec
10&50µsec	10µsec	50µsec	100µsec
50&100µsec	50µsec	100µsec	100µsec
100&500µsec	100µsec	500µsec	1millisec
500µsec&1ms	500µsec	1ms	1ms
1&5ms	1ms	5ms	10ms
5&10ms	5ms	10ms	10ms
10&50ms	10ms	50ms	100ms
50&100ms	50ms	100ms	100ms
100&500ms	100ms	500ms	1second
500ms&1sec	500ms	1sec	1sec
1&5sec	1sec	5sec	1sec

4. CHECK MARKER AMPLITUDE

The amplitude of the markers at the output jack should be 3 volts or more. Generally they are about 5 volts. The amplitude out at the banana jacks must be 25 volts or more.

5. SET FREQUENCY AND AMPLITUDE OF THE 5, 10 and 50 MC MARKERS

Trigger the scope externally from the 180 trigger at the 10µsec rate. Connect the 52Ω terminator to the output jack of the 180. Connect the 10X probe to the terminator. Adjust the coupling link on the 5MC coils to the extreme upper end. (QC will secure this with Q dope)

Set C123 and C129 for maximum output at 5MC. (It is possible to set this range at 6 mc also) Set C133 and C139 for maximum output at 10MC. Set C143 and C147 for maximum output at 50MC. This range can be set at 40 MC so care should be exercised in checking the frequency. To check the frequency of the 5, 10, and 50MC output: for 5MC with the scope sweep set at 0.2μsec/CM. There should be 1 cycle per CM. For 10MC set the scope sweep to 0.1μsec/CM and there should be 1 cycle per CM. With the scope still triggered externally at 10μsec switch to 5x magnifier with the main sweep control set at 0.1μsec/CM. There should be one cycle per centimeter if the frequency is properly set at 50MC. The minimum output of all the sinewave outputs (5, 10 and 50MC) is 3 volts. On the 50MC range the output will be an indicated 1.4 volts due to the bandpass of the 540 series scope. If there are double traces on the 50mc waveform (trigger pulling) generally a slight readjustment of the 5μsec and 10μsec markers will cure this although it may be due to stages out of count, bad tubes, open LR combinations in the 5, 10 or 50μsec stages. There should be no appreciable trigger pulling at any trigger rate. The 1MC modulation on the 5MC sinewave should not exceed 0.2 volts.

5. CHECK TRIGGER AMPLITUDE AND FREQUENCY

Connect the 10X probe to the trigger output and check the amplitude. The amplitude of the triggers must be at least 6 volts and if it is over 8 volts, generally there is some defective component, V562 or C560. The trigger rates must correspond to the switch label on the front panel.

6. SET CRYSTAL FREQUENCY

With the scope triggered externally from the 180 under calibration, connect the 10X probe from the plug-in to another calibrated 180 or any source of accurate frequency. Set the scope sweep to 1μsec/CM and stop the drift to one side or the other by adjusting C105. There should be enough range left at either side of the adjustment to make the signal drift at the rate of 3CM per second which corresponds to 3 cycles per second at 1 megacycle. The crystal oven should be allowed to heat for at least 5 minutes before this adjustment is made.

7. CHECK OVEN LIGHT FOR OPERATION

Check the oven pilot light to see that it turns on and off about one time in 20-30 seconds. If the action is erratic it may be due to a poor thermostat. The oven heater is not connected through the power switch and will continue to operate if the instrument is turned off but is still connected to the line.