

FACTORY CALIBRATION PROCEDURE

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INTRODUCTION:

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

June 1966

For all serial numbers.



191

FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

QUALIFICATION:

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

ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261.



EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- * 1 TYPE 547 OSCILLOSCOPE
- * 1 TYPE 1A1 DUAL TRACE PLUG-IN
- 1 TYPE 661 OSCILLOSCOPE
- * 1 TYPE 5T3 TIMING UNIT
- 1 TYPE 4S3 SAMPLING PROBE UNIT
- * 1 TYPE 184 TIME MARK GENERATOR

b. Test Fixtures and Accessories

- * 1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
- 1 P6035 100X Probe
- 1 P6038 1X Probe
- 1 Harmonic analyzer (See Prod. Mfg. Tooling Drawing No 1434-A)
- 1 DC Voltage Bridge (016-0543-99)
- * 1 50 Ω Precision Termination (017-0083-00)
(selected to be within .2%)
- 1 50 Ω cable, BNC (012-0057-00)
- 1 50 Ω 5nsec RG8 cable (017-0502-00)
- 1 GR to BNC adapter (017-0063-00)
- 1 VP-2 Voltage Pickoff Tee (017-0077-00)

c. Other Equipment

- 1 20,000 Ω /VDC.
- 1 Set earphones

* This equipment must be traceable to NBS for instrument certification. 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.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

FACTORY TEST LIMITS

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1. PRELIMINARY INSPECTION

2. PRESET CONTROLS

3. RESISTANCE CHECKS

4. SETUP

5. POWER SUPPLIES

<u>Supply</u>	<u>Regulation</u>	<u>Ripple</u>
-11 volts	±30mV	3mV
+6.2 volts		3mV

* 6. AMPLITUDE

- b. Variable Range: 1 volt min
- c. AMPLITUDE RANGE accuracy:

<u>AMPLITUDE RANGE</u>	<u>Accuracy</u>
.5 - 5V	±2.0%
50 - 500mV	±3.0%
5 - 50mV	±4.0%

* 7. FREQUENCY

- b. Accuracy: ±1.0%
- c. Linearity: ±1.0%

* 8. AMPLITUDE REGULATION

b. Regulation

<u>Frequency</u>	<u>Amplitude Range</u>	<u>Regulation</u>
50kHz to 42MHz	5mV-5.5V	±3%
42MHz to 100MHz	50mV-5.5V	±3%
42MHz to 100MHz	5-55mV	+3% -5%

9. HARMONIC CONTENT

Content: 5% P to P max

THE END

* Indicates measurement characteristic; test equipment used must be traceable to NBS for instrument certification.

1. PRELIMINARY INSPECTION

Check for unsoldered joints, rosin joints, lead dress and long ends. Check for protruding parts, loose hardware and foreign material. Check for loose knobs, sufficient clearance of knobs from the front panel and each other, and smooth rotation of the FREQUENCY dial and controls. Correct all defects founds.

Check to see that the plates of the variable air capacitor, C-10, are parallel and straighten those that are not.

The solder lugs on the bottom of the variable air capacitor should be bent nearly vertical so as to provide good clearance from the edges of their access holes.

Wires leading to the AMPLITUDE RANGE switch should have maximum clearance from adjacent wires.

The one inch grey-orange-white shielded cable between wafers of the AMPLITUDE RANGE switch should have maximum clearance from the switch. The white secondary coil of T38 should be wound tightly close to the chassis between the bare wire.

C8 from pin 2 and the bare wire from pin 1 of V10 should be $\frac{1}{4}$ inch or more from the chassis.

2. PRESET CONTROLSTYPE 191

POWER	off
FREQUENCY dial	.5MHz
FREQUENCY RANGE	50kHz
AMPLITUDE	50
VARIABLE	CAL
AMPLITUDE RANGE	.5-5V
115V/230V	115V
internal adjustments	midr

Leave controls for any step as they were in the preceding step unless otherwise noted.

3. RESISTANCE CHECKS

a. +450 unregulated

Measure the resistance from the +450 volt supply to chassis ground. It should read 4.7k. Turn POWER switch on, resistance should be approx 120k. Turn POWER switch off.

b. +6.2 volts

Measure the resistance across C127. It should be approx 6.2k.

c. -11 volts

Measure the resistance across C118. It should be 1.8k.

3a. CAUTION! Do not plug the TYPE 191 line cord into a power outlet until instructed to do so in step 4.

4. SETUP

Plug the TYPE 191 into a variable line voltage source and turn POWER switch on. Turn all test equipment on. Set variable line voltage source to 115V out as read on its meter.

5. POWER SUPPLIES

a. +450 unregulated

Measure the +450 volt supply to chassis ground using the multimeter. Read approximately 435 volts.

*b. Preset -11 volts and check regulation
Regulation: $\pm 20mV$*

Place negative lead of multimeter on the -11 volt supply. Place positive lead on chassis ground and adjust R122 to read 11 volts on meter.

Remove meter leads and connect the DCVB to the 11 volt supply. Vary line voltage source between 103 and 126 volts. Check for regulation within specified limits.

*c. Check -11 volt and +6.2 volt ripple
Ripple: $3mV P$ to $P max$*

Switch the DCVB to RIPPLE and check the -11 volt and +6.2 volt supplies for ripple within specified limits while varying line voltage source from 103 to 126 volts. Ignore spikes and high frequency hash.

6. AMPLITUDE*a. Adjust -11 volts, Tracking, and Ampl Cal*

Since these three adjustments are interacting, the following sequence of steps are to be repeated until all three pots are accurately adjusted. For the first time through, the test scope amplitudes need not be calibrated.

Accurately calibrate the test scope at 2V/cm ($\pm 0.25\%$) using a SAC.

Connect the TYPE 191 OUTPUT to test scope using the 5nsec RG 8 A/U GR cable and a GR to BNC male adapter. Adjust the -11 volts pot for exactly 10 volts peak to peak output (5cm at 2V/cm). Disconnect the TYPE 191 from test scope.

Use the DCVB to measure the voltage from the -11 volts supply at R53L of the AMPLITUDE switch and ground. Connect the DCVB to the junction of R53J and R53K. Adjust the Tracking Adj (R55) so that the voltage measured is one volt $\pm 5\text{mV}$ from the previous voltage. Disconnect the DCVB.

Accurately calibrate the test scope at .2V/cm ($\pm 0.25\%$) using the SAC.

Switch AMPLITUDE to 5 and reconnect TYPE 191 to test scope. Adjust the Ampl Cal (R51) for exactly 1 volt peak to peak output (5cm on .2V/cm). Disconnect TYPE 191.

Repeat steps until adjustments listed above are attained.

b. Check Variable Range: $\pm 3\%$

Set AMPLITUDE to 50 and set test scope to 2V/cm accurately calibrated. Rotate the VARIABLE cw to the end of its range and observe an increase in amplitude to 5.5cm $\pm 3\%$ on the test scope. Return VARIABLE to CAL.

c. Check AMPLITUDE RANGE accuracy:

5-500mV, $\pm 3\%$

5-50mV, $\pm 4\%$

Accurately calibrate the test scope at 1V/cm. Set AMPLITUDE of TYPE 191 to 50 and terminate the OUTPUT with a selected $50\Omega \pm .2\%$ feed through termination. Connect the terminated

c. Check AMPLITUDE RANGE

Use a slow sweep time to observe a change in amplitude more readily.

6c. (cont'd)

TYPE 191 to the test scope. The peak to peak amplitude should be exactly 5cm.

Set the AMPLITUDE RANGE to 50-500mV and check the amplitude of the terminated OUTPUT on an accurately calibrated .1V/cm range. The peak to peak amplitude should be 5cm $\pm 1/3$ minor division.

Set the AMPLITUDE RANGE to 5-50mV and check the amplitude of the terminated OUTPUT on an accurately calibrated 10mV/cm range. The peak to peak amplitude should be 5cm $\pm 1/2$ minor division.

d. Check AMPLITUDE step accuracy: $\pm 4\%$

Check the AMPLITUDE positions as follows:

<u>AMPLITUDE</u>	Display <u>Amplitude $\pm 4\%$</u>
50	5cm
45	4.5cm
40	4.0cm
35	3.5cm
30	3cm
25	2.5cm

Remove the TYPE 191 cable from the test scope INPUT. Set the test scope to .005 VOLTS/CM and accurately set the gain using the SAC. Connect the TYPE 191 to the test scope and check as follows:

<u>AMPLITUDE</u>	Display <u>Amplitude $\pm 4\%$</u>
20	4cm
15	3cm
10	2cm
5	1cm

7. FREQUENCY

a. Preadjust frequency

Set AMPLITUDE RANGE to 50-500mV and the test scope to .010 VOLTS/CM. Adjust the variable inductor for the following display on the test scope.

7a. (cont'd)

<u>FREQUENCY RANGE</u>	<u>FREQUENCY</u>	<u>test scope TIME/CM</u>	<u>Adjust</u>	<u>Display</u>
42-100 MHz	50 MHz	.1 μ s X5	T-38	1 cycle/cm
18-42	20	.1 μ s Mag Off	T-34	2 cycles/cm
8-18	10	.1 μ s	T-30	1 cycle/cm
3.6-8	5	.2 μ s	T-26	1 cycle/cm
1.6-3.6	2	.5 μ s	T-22	1 cycle/cm
.75-1.6	1.0	1 μ s	T-18	1 cycle/cm
.35-.75	.5	2 μ s	T-14	1 cycle/cm
50 kHz	50 kHz	20 μ s	T-20	1 cycle/cm

NOTE: Adjust T-38 so tuning slug will be at a position nearest the chassis.

b. Adjust Frequency and check Accuracy: 1%

Connect the output of the TYPE 180A to CHANNEL 2 INPUT on the TYPE 1A1. Switch TYPE 1A1 MODE to ADD, CHANNEL 1 and CHANNEL 2 V/CM to .005 and connect earphones to test scope VERT SIG OUT. Attach the punched cabinets to the TYPE 191 and adjust TYPE 191 tuning coils and capacitors for a zero beat as follows:

b. Coil and capacitor adjustments interact. It will be necessary to go back and forth to obtain desired results.

<u>FREQUENCY RANGE</u>	<u>TYPE 180A</u>	<u>FREQUENCY</u>	<u>Adjust</u>
42-100 MHz	50 MC	50 MHz	T-38
42-100 MHz	50 MC	100 MHz	C-38
18-42 MHz	5 MC	20 MHz	T-34
18-42 MHz	5 MC	40 MHz	C-34
8-18 MHz	1 μ s	8 MHz	T-30
8-18 MHz	1 μ s	18 MHz	C-30
3.6-8 MHz	1 μ s	4 MHz	T-26
3.6-8 MHz	1 μ s	8 MHz	C-26
1.6-3.6 MHz	5 μ s	1.6 MHz	T-22
1.6-3.6 MHz	5 μ s	3.6 MHz	C-22
.75-1.6 MHz	5 μ s	.8 MHz	T-18
.75-1.6 MHz	5 μ s	1.6 MHz	C-18
.35-.75 MHz	10 μ s	.4 MHz	T-14
.35-.75 MHz	10 μ s	.7 MHz	C-14
50 kHz	100 μ s	.45 MHz	T-10

c. Check Linearity: $\pm 1\%$ of selected frequency

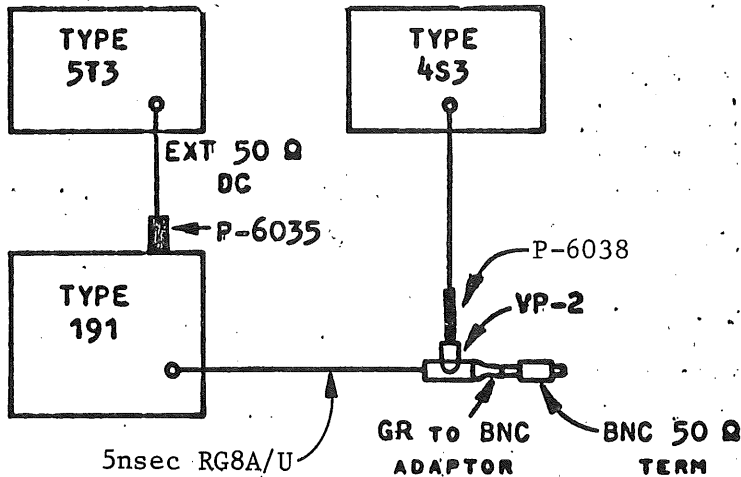
Using appropriate TYPE 184 settings and using the method described in step 7b., check a convenient center frequency of each range and check the dial reading accuracy. Readjust frequency settings if necessary.

8. AMPLITUDE REGULATION

a. Setup

Connect equipment as shown:

Connect the P6035 probe to frequency range switch, contact 1R8.



b. Check Regulation

<u>Frequency</u>	<u>AMPLITUDE RANGE</u>	<u>Regulation</u>
50 kHz to 42 MHz	5mV-5.5V	±3%
42 MHz to 100 MHz	50mV-500mV	±3%
42 MHz to 100 MHz	5-55mV	+3% -5%

Set TYPE 191 AMPLITUDE RANGE to .5-5V. Set AMPLITUDE, VARIABLE, and TYPE 4S3 MILLIVOLTS/CM for 7cm deflection on the TYPE 661. Vary the TYPE 191 FREQUENCY from 50 kHz to 100 kHz and check amplitude regulation, ±2mm.

Set AMPLITUDE RANGE to 50-500mV, FREQUENCY RANGE to 50 kHz and adjust AMPLITUDE, VARIABLE and TYPE 4S3 MILLIVOLTS/CM for 7cm deflection. Vary TYPE 191 frequency from 50 kHz to 100 MHz and check regulation, ±2mm.

Set AMPLITUDE RANGE to 5-50mV. Set AMPLITUDE, VARIABLE and TYPE 4S3 MILLIVOLTS/CM for 7cm deflection. Vary TYPE 191 frequency from 50 kHz to 100 MHz and again check regulation, +2mm to -3.5mm.

8b. (cont'd)

Vary line voltage source from 103 to 126 volts and check regulation.

Set FREQUENCY RANGE to 50 kHz and vary line voltage source from 103 to 126 volts. Check regulation.

9. HARMONIC CONTENT

Check harmonics: 5% P to P max

Set the TYPE 1A1 CHANNEL ONE VOLTS/CM switch to .01 and free run the TYPE 547 sweep. Apply 5V of 50 kHz signal to the input of the harmonic analyzer and connect the output of the analyzer to the CHANNEL 1 INPUT. Turn the analyzer 50 kHz switch on and observe the CRT display. It must be less than 2.5cm. Repeat step for .75 MHz, 1.7 MHz and 4 MHz.

THE END