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FACTORY CALIBRATION PROCEDURE

CONTENTS:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

Equipment Required

Factory Test Limits - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

Main Procedure - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

This procedure is company confidential

067-0610-99
CURRENT
CALIBRATOR

June 1970

For all serial numbers.

CHANGE INFORMATION:

This procedure has been prepared by Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact Staff Engineering, 39-307.

EQUIPMENT REQUIRED

All TEKTRONIX test equipment must be calibrated to Factory Test Limits using methods specified in the applicable TEKTRONIX Factory Calibration Procedure. Other test equipment should be calibrated to its manufacturer's specifications. Exceptions to calibration procedures, which are necessary to improve the measurement capability of some test equipment, e.g. calibrated to ±0.5% accuracy at some specific setting, are noted on this Equipment Required List.

Equivalent test equipment may be used. A Test-Final Staff Engineer must approve any substitutions.

a. TEKTRONIX Instruments

1 TYPE 547 OSCILLOSCOPE
1 TYPE 1A1 DUAL-TRACE PLUG-IN UNIT

b. Test Fixtures and Accessories

1	P6042 Current Probe	(010-0207-00)
2	P6006 10X Probes	(010-0160-00)
1	BNC 50Ω coax cable	(012-0057-01)
1	BNC 50Ω Termination	(011-0049-00)

c. Other Manufacturer's Equipment

1 20,000Ω/VDC Multimeter (VOM)
1 Potentiometric DC Voltmeter (ESI Model PVB 300 or equivalent)
1 TRYGON HH15-3 power supply or equivalent

1. PRELIMINARY INSPECTION

a. Preset controls

FREQUENCY-Hz	50K
CURRENT	.5mA

All internal adjustments to midrange.

b. Resistance checks

Using the multimeter (VOM) check the following resistances:

Test point	reading	Meter Scale
T-1 pin 9 to GND	inf	X1kΩ
Across 6000μF cap (C10)	15kΩ	X1kΩ
T-1 pin 9 to C10 neg lead	260Ω	X100Ω
+ to -terminal of CR15	4kΩ	X1kΩ
BIAS WINDING + & - (both)	0Ω	X1Ω

c. Divider resistance

Remove leads from G & F. Remove (8-4) wire from negative terminal of C10 (6000μF). Solder two heavy (#16) short wires to the CURRENT switch (8-4) and (8-6) wires (opposite end of terminals G and F on the circuit board).

Connect the DC Voltmeter (PVB300) to the two short wires just installed. Set the PVB300 for resistance readings and measure all of the divider resistors.

Using the following table as a guide, draft another with similar format. Several computations will be necessary using the table information.

Table explanation:

Column A: computed resistance.
Column B: measured resistance.
Column C: measured divided by computed R.
Column D: record only digits past decimal if number exceeds 1.000.
Column E: add the D & E columns where applicable.
Column F: record the sum of D & E here.
Column G: compute the reciprocal of column F.
Column H: multiply column G by column A, giving size of resistance needed (in parallel) to properly compensate dividers.

1c. (Cont.)

The table below is for reference only.

	A	B	C	D	E	F	G	H	
POS	NOMINAL VALUE	Measured Value	$\frac{B}{A}$	Digits After Decimal	Temp Compen	Sum of D & E	$\frac{1}{F}$	A X G	
.5	40kΩ	39.790	.99475	N/A					The 40k resistor and 10k resistor must be replaced to obtain the described tolerance.
1	20kΩ	19.984	.99920	N/A					
2	10kΩ	9.941	.9941	N/A					
5	4kΩ	3.9995	.9998	N/A					
10	2kΩ	1.9993	.99965	N/A					
20	1kΩ	1.0006	1.0006	N/A					
50	400Ω	400.07	1.00017	N/A					
100	200Ω	200.06	1.00030	N/A					
200	100Ω	99.91	.9991	N/A					
500	40Ω	39.789	.99475	N/A	0.001	One of the 20Ω resistors needs to be replaced.			
.8	25Ω	25.698	1.02792	.02792	0.001	.02892	34.578	864.45	
1	20Ω	20.403	1.02015	.02015	0.002	.02215	45.146	902.9	
1.6	12.5Ω	12.837	1.02696	.02696	0.0	.02696	37.0919	463.7	
2	10Ω	10.322	1.0322	.0322	0.001	.0332	30.120	301.2	
3	6.667Ω	6.826	1.02384	.02384	0.001	.02484	40.258	268.4	
4	5Ω	4.979	0.9958		0.002	add about 0.3Ω in series with one leg.			
5	4Ω	3.993	0.99825		0.002	nothing needs to be added here (column B is in tolerance).			

Column B (measured value) must not exceed 0.5% of A.

Values in column C that are less than 1 (one) must have resistance added in series. Contact resistance can have a decided difference in the readings. Make certain when installing any of the shunts good joints are made.

Shunt resistors in parallel: (column H)
- any over 800 ohms use 1/4 watt 5%
- any over 400Ω to 800Ω use 1/2 watt 5%
- any over 200Ω to 400Ω use 1 watt 5%
- any less than 200Ω, do not use. Add some resistance, very small, in series with one leg of the divider, then remeasure and compute the needed shunt resistor. The values and tolerances needed for shunt resistance less than 200 ohms are too cumbersome.

Install resistance (column H) in parallel with corresponding divider. Connect the leads back on G & F.

Remove the small leads previously soldered to the divider switch.

2. DC POWER SUPPLIES

a. Preset 10V (R26)

Apply 115VAC from Line Voltage Control Unit 76TU. Using the VOM across G and F (+) adjust R26 for 10V.

b. Check power supplies operation

Check across C15 and C16 for ≈35VDC.
Check across C10 (6000μF) for ≈24VDC.
Check across VR100 (oscillator board) for ≈12VDC.

3. OSCILLATOR

a. Adjust Lo Amp drive

Connect test scope, 10X probe to R145, R141, R144 junction, gnd clip to pin G. Connect test scope other 10X probe to R155, R156, R153 junction.
Set CURRENT to 500mA.
Adjust TYPE 1A1, in ALT, for both traces to 0VDC at center in .05V/cm.

Set INPUT to DC.

Adjust R144 for equal negative swing of display.

Adjust R151 for 0V DC of negative swing. Connect one probe to pin F. Readjust R144 for a null signal at 100mA P-P. Check for good null .5mA to 500mA ≤30mV.

NOTE

If oscillator is not operating, adjust R103 near midr for oscillator to run.

b. Adjust Hi Amp drive

Set CURRENT Divider to 5A.

Connect probe to junction R175, R171, R174.

Connect probe to junction R185, R186, R183, R184.

Adjust R174 for equal negative swing.

Adjust R181 for 0V negative swing.

Connect one probe to pin F. Readjust R174 for a null signal at 2A P-P. Check for good null .8A to 5A P-P ≤30mV.

c. Check current step.

Connect the P6042 to the current loops. Check for nominal display in all current steps.

4. 10VOLTS

Use the PVB300 and adjust the voltage from G to F for exactly 10V.

Check power supply regulator from 105 to 125VAC on all current ranges.

5. CURRENT DIVIDER

Turn POWER ON to OFF. Remove Pin K lead from the power supply board. Install the PVB300 with (+) red lead to the board, the (-) black lead to the lead that was attached to Pin K.

NOTE

CAUTION: removing the PVB300 leads with POWER ON could easily damage the output transistors. Be certain power is off before removing the leads.

Using the following table check the current up to 500mA.

mA	reading	max deviation
.5	0.2500	0.2488 to 0.2512
1	0.5000	0.4975 to 0.5025
2	1.000	0.9950 to 1.005
5	2.500	2.488 to 2.512
10	5.000	4.975 to 5.025
20	10.000	9.950 to 10.050
50	25.00	24.88 to 25.12
100	50.00	49.75 to 50.25
200	100.00	99.50 to 100.5
500	250.00	248.8 to 251.2

Turn POWER OFF then remove PVB300. Resolder the lead to Pin K of the board.

Remove both leads from pin L and connect the leads with solder. Install the PVB300 in the same manner as before (+ to board, - to the leads).

A	reading	max deviation
.8	0.400	0.398 to 0.402
1	0.500	0.4975 to 0.5025
1.6	0.800	0.796 to 0.804
2	1.000	0.995 to 1.005
3	1.500	1.4925 to 1.5075
4	2.000	1.990 to 2.010
5	2.500	2.488 to 2.512

Turn POWER OFF and resolder the leads to Pin L on the board.

6. OPERATION

a. AC Divider

Connect the P6042, set to 10mA, TYPE 1A1 set to .05V/cm, TYPE 547 to 5μSEC/cm to unit. Set 067-0610-99 to 50kHz, AC, 50mA, FREQUENCY to CAL.

Adjust R103 for 2 cycles in 8div.

Check range for 5kHz, 500Hz and 50Hz ±20% and that the variable has a range of 10:1 minimum in each position of the range switch, from CAL.

Check in AUTO trigger that +DC and -DC are of correct polarity.

b. Bias Winding

Turn 067-0610-99 POWER OFF. Connect TRYGON 15-3 + and - to mA BIAS WINDING and P6042 to mA loop. Set TRYGON CURRENT LIMIT to minimum voltage limit to max.

Increase CURRENT LIMIT check for positive polarity of current.

Repeat the above using A BIAS WINDING.

	A	B	C	D	E	F	G	H
POS	NOMINAL VALUE	Measured Value	$\frac{B}{A}$	Digits after Decimal	Temp Compensation	Sum of D & E	$\frac{1}{F}$	A X G
.5	40kΩ							
1	20kΩ							
2	10kΩ							
5	4kΩ							
10	2kΩ							
20	1kΩ							
50	400Ω							
100	200Ω							
200	100Ω							
500	40Ω				0.001			
.8	25Ω				0.001			
1	20Ω				0.002			
1.6	12.5Ω				0.0			
2	10Ω				0.001			
3	6.667Ω				0.001			
4	5Ω				0.002			
5	4Ω				0.002			