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***TB 9-6625-149-50**

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLOSCOPE, TEKTRONIX TYPE 541A (AN/USM-164) AND CURRENT PROBE AMPLIFIER, TEKTRONIX TYPES 131-1 THROUGH -4, WITH CURRENT PROBE, TEKTRONIX TYPE P6016

Headquarters, Department of the Army, Washington, DC
4 April 1974

◆ REPORTING OF ERRORS ◆

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		Paragraph	Page
SECTION	I.	IDENTIFICATION AND DESCRIPTION	
		Test instrument identification.....	1 2
		Calibration data card, DA Form 2416.....	2 3
		Calibration description.....	3 3
	II.	EQUIPMENT REQUIREMENTS	
		Equipment required	4 4
		Accessories required	5 4
	III.	PRELIMINARY OPERATIONS FOR OSCILLOSCOPE, TEKTRONIX TYPE 541A (AN/USM-164)	
		Preliminary instructions	6 5
		Equipment Setup.....	7 5

*This bulletin supersedes TB 9-6625-149-50, 12 November 1969.

IV.	CALIBRATION PROCESS FOR OSCILLOSCOPE, TEKTRONIX TYPE 541A (AN/USM-164)		
	Calibrator accuracy	8	7
	Crt geometry	9	8
	Vertical amplifier gain and stability	10	8
	Sweep length and registration	11	10
	Triggering	12	10
	Horizontal high-frequency compensation	13	12
	Sweep amplifier	14	13
	Magnifier gain	15	14
	Sweep timing	16	14
	External dc balance	17	16
	Vertical rise time	18	16
	Low-voltage power supply	19	16
	High-voltage power supply	20	17
	Final procedure.....	21	17
V.	PRELIMINARY OPERATIONS FOR CURRENT PROBE AMPLIFIER, TEKTRONIX TYPES 131-1, THROUGH-4, WITH CURRENT PROBE, TEKTRONIX TYPE P6016		
	Preliminary instructions	22	17
	Equipment setup	23	18
VI.	CALIBRATION PROCESS FOR CURRENT PROBE AMPLIFIER, TEKTRONIX TYPES 131-1 THROUGH-4, WITH CURRENT PROBE, TEKTRONIX TYPE P6016		
	Input impedance.....	24	18
	Low-frequency compensation	25	20
	Amplifier gain.....	26	20
	Rise time and high-frequency compensation	27	21
	Power supply regulation.....	28	22
	Final procedure.....	29	23

**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Oscilloscope, Tektronix Type 541A, (AN/USM-164) Current Probe Amplifier, Tektronix Types 131-1 through -4, with Current Probe, Tektronix Type P6016. The manufacturer's instruction manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the "TI" (test instrument) throughout this bulletin.

a. Model Variations. AN/USM-164 is the same as Tektronix Type 541A.

b. Time and Technique. The time required for this calibration is approximately 2 hours, using the dc and low frequency technique.

2. Calibration Data Card, DA Form 2416

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TM 38-750. DA Form 2416 must be annotated in accordance with TM 38-750 for each calibration performed.

b. Adjustments to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) will follow the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description.

Test instrument parameters.	Performance specifications.
Oscilloscope, Tektronix Type 541A (AN/USM - 164)	
Power input requirements	117 or 234 vac \pm 10%, 50 to 60 Hz
Sweep rates	.1 μ sec/cm to 5 sec/cm in 24 calibrated steps
Accuracy	\pm 3%
Sweep magnification	Increases the sweep amplifier gain 5 times
Accuracy	\pm 5%
Triggering facilities	Provides for manual control, preset stability control, and fully automatic triggering.
Horizontal deflection system: Deflection factor	Continuously variable from approximately .2 v/cm to 15 v/cm. Dc to 240 kHz or better
Frequency response	
Amplitude calibrator: Output voltages Accuracy	0.2 mv to 100 v p-p in 18 steps \pm 3%
Current Probe Amplifier, Tektronix Types 131-1 through -4 with Current Probe, Tektronix Type P6016	
Power requirements	115 vac \pm 10 v, 50 to 60 Hz, 1 w
Sensitivity	1 ma/div to 1 amp/div in 10 calibrated steps
Accuracy	\pm 3%
Low Frequency Response	50 Hz at 3 db down
Rise time	20 nsec
Maximum current rating	15 amps p-p

**SECTION II
EQUIPMENT REQUIREMENTS**

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one accuracy ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories listed in table 3 are issued with secondary transfer calibration standards set 4931-621-7877 and are to be used in this calibration procedure. When necessary, these items may be substituted by equivalent items unless specifically prohibited.

Table 2. Minimum Specifications Required

Item	Common name	Minimum use specifications.	Manufacturer, model, and part number.
A1	AC CALIBRATOR	Range: 34.29 to 36.41 v rms Accuracy: $\pm .75\%$	Hewlett-Packard, Model 745A (MIS-10342).
A2	AC/DC VOLTMETER	Range: 0.097 to 515 vdc and 34.29 to 36.41 vac. Accuracy: $\pm .75\%$	Dana, Model 5703-S-2127 (7912606).
A3	AUTOTRANSFORMER	Range: 105 to 125 vac Accuracy: $\pm 1\%$	General Radio, Model W10MT3AS3 (7910809)
A4	CALIBRATION ADAPTER	Rise Time: 3 nsec or less	Tektronix, Type TU-7 (7912279).
A5	DC VOLTMETER	Range: -1310 to -1390 vdc Accuracy: $\pm .75\%$	EIS, Model ESV (MIS-10276).
A6	DECADE RESISTOR	Range: 24.5 kilohms	Biddle-Gray, Model 601147-1 (7910328).
A7	OSCILLOSCOPE ¹	Must be compatible with current probe.	Tektronix, Type 540 series
A8	PLUG-IN ²	Range: 0.05 v/cm p-p Rise time: 12 nsec or less	Tektronix, Type K or equivalent
A9	SQUARE WAVE GENERATOR.	Range: 500 kHz Rise time 12 nsec or less	Tektronix, Type 106 (MIS-10284)
A10	TIME-MARK GENERATOR.	Range: 5 sec to 20 nsec Accuracy: $\pm .75\%$	Tektronix, Type 184 (7910242-1).

¹Additional equipment required; available at site of TI and should be items normally used with TI.

²Additional equipment required.

Table 3. Accessories Required

Item	Common name	Description and part number
B1	ADAPTER ¹	Single banana jack to alligator clip (7907560)
B2	ADAPTER	UHF jack to BNC plug (8109698)
B3	ADAPTER	BNC plug to double banana jack (7909401)
B4	CABLE ²	36-in., RG-58(/)U; BNC plug and double banana plug terminations (7907471).
B5	CABLE	30-in., RG-58(/)U; BNC plug terminations (7907467)
B6	LEAD ¹	12-in., single banana plug terminations (7907496)

¹Two required.

²Three required.

**SECTION III
PRELIMINARY OPERATIONS FOR OSCILLOSCOPE,
TEKTRONIX TYPE 541A**

6. Preliminary Instructions

a. The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with sections I through IV of this bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

7. Equipment Setup

- a.** Remove protective covers of TI.
- b.** Insert calibration adapter (A4) into TI.
- c.** Connect TI to autotransformer (A3).
- d.** Connect autotransformer to 115-volt ac source and adjust controls for 115 volts ac.
- e.** Energize TI and allow sufficient time for equipment to warm up and stabilize.
- f.** Position TI controls as listed in (1) through (11) below:
 - (1) **HORIZONTAL DISPLAY** switch to **NORM**.
 - (2) **SCALE ILLUM** control as desired.

TB 9-6625-149-50

- (3) **TRIGGERING LEVEL** control to **0** (zero).
 - (4) **TRIGGERING MODE** switch to **AUTO**.
 - (5) **TRIGGER SLOPE** switch to **+INT**.
 - (6) **TIME/CM** switch to **.5 MILLISEC**.
 - (7) **TIME/CM VARIABLE** control to **CALIBRATED**.
 - (8) **STABILITY** control to midrange.
 - (9) **INTENSITY, FOCUS, and ASTIGMATISM** controls for sharp trace.
 - (10) **HORIZONTAL POSITION** control to center the trace.
 - (11) **AMPLITUDE CALIBRATOR** switch to **100 VOLTS**.
- g.** Turn calibration adapter **TEST FUNCTION** switch to **HIGH LOAD**.
- h.** Turn calibration adapter **VERTICAL POSITION** control to center trace on crt.

**SECTION IV
CALIBRATION PROCESS FOR OSCILLOSCOPE,
TEKTRONIX TYPE 541A**

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before continuing with the calibration.

NOTE

When indications specified in paragraphs **8** through **18** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **8** through **18**. Do not perform power supply check if all other parameters are within tolerance.

8. Calibrator Accuracy

a. Performance Check

- (1) Set TI **POWER** switch to **OFF** and remove **V875** (fig. 1) from TI.
- (2) Set TI **POWER** switch to **ON**.
- (3) Connect ac/dc voltmeter (A2) between TI **CAL OUT** connector and chassis ground, using leads supplied with ac/dc voltmeter and, if necessary, adapter (B2).
- (4) Turn TI **AMPLITUDE CALIBRATOR** switch to settings listed in table 4. If ac/dc voltmeter does not indicate within limits specified, perform **b** below.
- (5) Set TI **POWER** switch to **OFF** and replace **V875**.
- (6) Set TI **POWER** switch to **ON**.

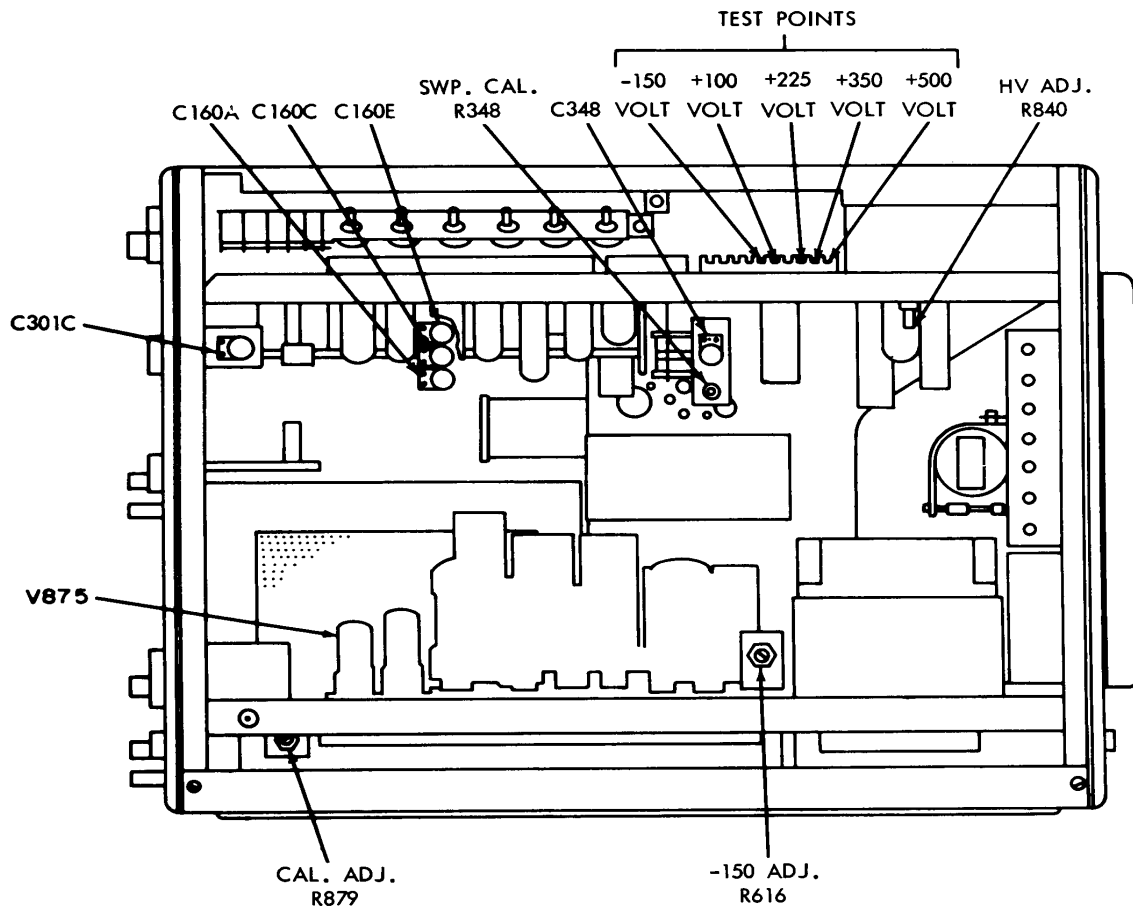


Figure 1. Oscilloscope - right-side view.

Table 4. Calibrator Accuracy

Test instrument AMPLITUDE CALIBRATOR switch settings	Ac/dc voltmeter indication (+ V dc)	
	Min	Max
100 VOLTS	97	103
50 VOLTS	48.5	51.5
20 VOLTS	19.4	20.6
10 VOLTS	9.7	10.3
5 VOLTS	4.85	5.15
2 VOLTS	1.94	2.06
1 VOLT	0.97	1.03
.5 VOLT	0.485	0.515
.2 VOLT	0.194	0.206
.1 VOLT	0.097	0.103

b. Adjustments

- (1) Turn **AMPLITUDE CALIBRATOR** switch to **100 VOLTS**.
- (2) Adjust **CAL ADJ R879** (fig. 1) until ac/dc voltmeter indicates 100 volts.

9. Crt Geometry

a. Performance Check

- (1) Connect TI **CAL OUT** to calibration adapter (A4) **EXT INPUT**, using cable (B5) and, if necessary, adapter (B2).
- (2) Set **AMPLITUDE CALIBRATOR** switch to **5 VOLTS**.
- (3) Adjust calibration adapter **VERTICAL POSITION** control until only the rising and falling portion of display are visible on TI crt. If vertical curvature of display is observed, perform **b** below.

b. Adjustments. Adjust **GEOMETRY R861** (fig. 2) for no vertical curvature of crt display.

10. Vertical Amplifier Gain and Stability

a. Performance Check

- (1) Connect ac calibrator (A1) to calibration adapter (A4) **EXT INPUT**, using cable (B4).
- (2) Turn calibration adapter **TEST FUNCTION** switch to **GAIN SET**.
- (3) Adjust ac calibrator controls for 1 kHz and amplitude for 4 major divisions of vertical deflection on TI crt. If ac calibrator does not indicate between 34.29 and 36.41 volts rms, perform **b** below.

(4) While maintaining a 4-major division vertical display, vary autotransformer (A3) from 105 to 125 volts and then back to 115 volts. Ac calibrator indication will remain between 34.29 and 36.41 volts.

b. Adjustments

(1) Adjust output of ac calibrator for 35.35 volts rms.

(2) Adjust **GAIN ADJ R570** (fig. 2, not shown) for 4 major divisions of vertical deflection on TI crt. (R)

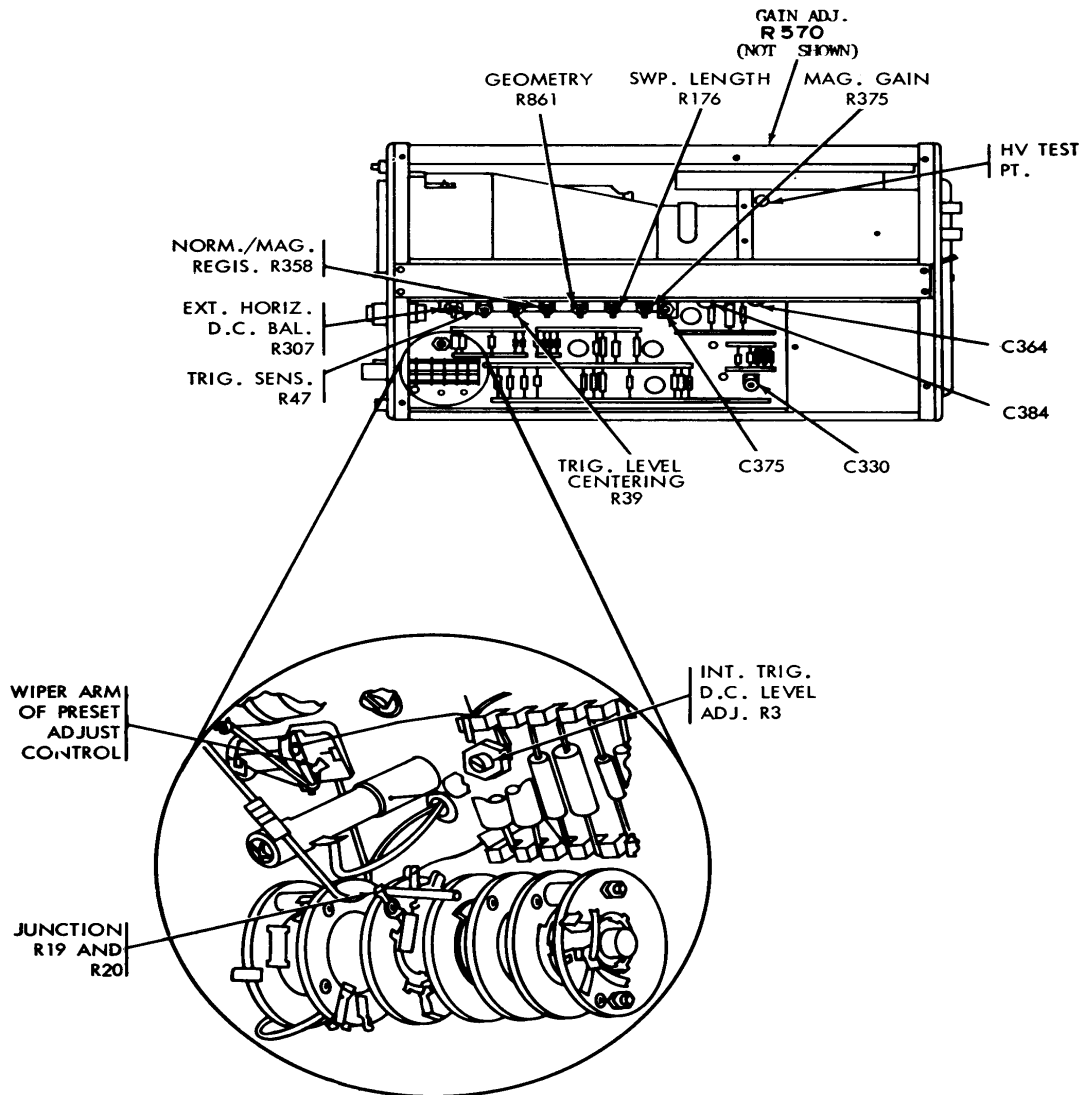


Figure 2. Oscilloscope - top view.

11. Sweep Length and Registration

a. Performance Check

- (1) Turn calibration adapter (A4) **TEST FUNCTION** switch to **HIGH LOAD**.
- (2) Turn TI **TRIGGERING MODE** switch to **AC** and **STABILITY** control fully clockwise. If sweep is not approximately 10.5 centimeters long, perform **b(1)** below.
- (3) Connect time-mark generator (A10) to calibration adapter **EXT INPUT**, using cable (B5).
- (4) Set time-mark generator to .5 mS markers.
- (5) Adjust TI **STABILITY** and **TRIGGERING LEVEL** controls for a stable display.
- (6) Turn TI **HORIZONTAL DISPLAY** switch to **5X MAG** and position first time marker behind center graticule line with **HORIZONTAL POSITION** control.
- (7) Turn TI **HORIZONTAL DISPLAY** to **NORM**. If marker does not remain behind center graticule line, perform **b(2)** below.

b. Adjustments

- (1) Adjust **SWP LENGTH R176** (fig. 2) until sweep is approximately 10.5 centimeters long. (R)
- (2) Adjust **NORM. MAG. REGIS. R358** (fig. 2) until marker is centered behind center graticule line. (R)

12. Triggering

a. Performance Check

- (1) Connect TI **CAL OUT** to calibration adapter (A4) **EXT INPUT**, using cable (B5) and, if necessary, adapter (B2).
- (2) Position TI controls as listed in (a) through (c) below:
 - (a) **AMPLITUDE CALIBRATOR** switch to **5 VOLTS**.
 - (b) **TIME/CM** switch to **.5 MILLISEC**.
 - (c) **STABILITY** control fully clockwise.
- (3) Adjust calibration adapter **VARIABLE** control for 1 minor division of vertical deflection on TI crt.

(4) Adjust TI **STABILITY** control for stable waveform and center waveform vertically with **VERTICAL POSITION** control. Adjust **INTENSITY**, **FOCUS**, and **ASTIGMATISM** controls for best display.

(5) Connect junction of **R19** and **R20** (fig. 2) to chassis ground, using lead and two adapters (B6 and B1).

(6) While observing waveform, turn **TRIGGER SLOPE** switch from **+INT** to **-INT**. Waveform will invert and remain stable.

(7) If necessary, turn **TRIG. SENS.** control **R47** (fig. 2) fully counterclockwise and **TRIG. LEVEL CENTERING R39** (fig. 2) fully clockwise.

(8) From clockwise position, turn **STABILITY** control counterclockwise until waveform just disappears, then 2 or 3 degrees further.

(9) Turn **TRIG. LEVEL CENTERING R39** counterclockwise until waveform appears. If waveform does not reappear, turn **TRIG. SENS. R47** clockwise a few degrees and repeat the step.

(10) Turn TI **TRIGGER SLOPE** switch from **-INT** to **+INT** and back to **-INT**, while adjusting **TRIG. LEVEL CENTERING R39** and **TRIG. SENS. R47** to obtain a stable waveform, with respective polarity in both positions.

(11) Turn TI **TRIGGERING MODE** switch to **DC** and adjust calibration adapter **VARIABLE** control for 3 minor divisions of vertical deflection on TI crt.

(12) While observing TI crt, turn **TRIGGER SLOPE** switch from **-INT** to **+INT**. Waveform will invert and remain stable in both positions. If waveform will not invert and remain stable in both positions, adjust **INT. TRIG. D.C. LEVEL R3** (fig. 2) until stable waveform is obtained with respective polarity in both positions.

(13) Remove lead and adapter from junction of R19 and R20.

(14) Adjust **TRIGGERING LEVEL** control until waveform is stable. White dot on **TRIGGERING LEVEL** control will point to **0** (zero). If zero indication is not shown, loosen setscrew on **TRIGGERING LEVEL** control and turn knob until white dot points to **0** (zero).

(15) Tighten setscrew and remove connection from calibration adapter **EXT INPUT**.

(16) Position TI controls as listed in (a) through (d) below:

TB 9-6625-149-50

- (a) **TRIGGERING MODE** switch to **AUTO**.
- (b) **TRIGGER SLOPE** switch to **+LINE**.
- (c) **STABILITY** control to **PRESET**.
- (d) **TIME/CM** switch to **50 μSEC**.

(17) Connect ac/dc voltmeter (A2) between wiper arm of TI **PRESET ADJUST** control (fig. 2) and chassis ground.

(18) Turn **PRESET ADJUST** control fully counterclockwise; then, turn clockwise until trace appears on TI crt. Record ac/dc voltmeter indication.

(19) Slowly turn **PRESET ADJUST** control clockwise until trace brightens. Record ac/dc voltmeter indication.

(20) Turn **PRESET ADJUST** control to obtain an indication on ac/dc voltmeter midway between indications recorded in (18) and (19) above.

b. Adjustments. No further adjustments can be made.

13. Horizontal High-Frequency Compensation

a. Performance Check

(1) Connect TI **CAL OUT** to **HORIZ INPUT** and **TRIG INPUT**, using cable, adapter, and leads (B4, B2, and B6). Connect TI **SAWTOOTH OUT** to calibration adapter (A4) external **INPUT**, using cable and adapter (B5 and B3).

(2) Position TI controls as in (a) through (e) below:

- (a) **TRIGGER SLOPE** switch to **+EXT**.
- (b) **TIME/CM** switch to **1 MILLISEC**.
- (c) **AMPLITUDE CALIBRATOR** switch to **1 VOLT**.
- (d) **HORIZONTAL DISPLAY** switch to **EXT HORIZ ATTEN X1**.

(e) **EXTERNAL HORIZ ATTENUATOR 10-1** control for 4 divisions of horizontal deflection on TI crt.

(3) Adjust calibration adapter (A4) **VARIABLE** control for 4 major divisions of vertical deflection on TI crt. If square-wave display does not have flat tops and square corners, perform **b(1)** below.

(4) Turn TI **HORIZONTAL DISPLAY** switch to **EXT HORIZ ATTEN X10** and turn **CALIBRATOR** to **10 VOLTS**.

(5) Repeat (2)(e) above. If the indication is not same as in (3) above, perform **b(2)** below.

b. Adjustments

(1) Adjust **C330** (fig. 2) for optimum square wave. (R)

(2) Adjust **C301C** (fig. 1) for optimum square wave. (R)

14. Sweep Amplifier

a. Performance Check

(1) Connect time-mark generator (A10) to calibration adapter (A4) **EXT INPUT**, using cable (B4).

(2) Position TI controls as listed in (a) through (e) below:

(a) **TRIGGER SLOPE** switch to **+INT**.

(b) **TRIGGERING MODE** switch to **AC**.

(c) **TIME/CM** switch to **1 MILLISEC**.

(d) **HORIZONTAL DISPLAY** switch to **NORM**.

(e) **STABILITY** control as necessary.

(3) Adjust calibration adapter **VARIABLE** control for 2 major divisions of vertical deflection on TI crt.

(4) Set time-mark generator to 1 mS markers.

(5) Adjust **HORIZONTAL POSITION** control to align second marker behind second vertical graticule line. If 10th or 19th markers are not within ± 1.5 minor divisions of 10th vertical graticule line, perform **b** below.

b. Adjustments. Adjust **SWP. CAL R348** (fig. 1) to align 10th marker 8 centimeters from second marker. (R)

TB 9-6625-149-50

15. Magnifier Gain

a. Performance Check

(1) Set time-mark generator (A10) to .1 mS markers.

(2) Turn TI **HORIZONTAL DISPLAY** switch to **5X MAG** and align third marker with second graticule line. If 19th marker does not display between 7.76 and 8.24 centimeters from third marker. perform **b** below.

b. Adjustments. Adjust **MAG. GAIN R375** (fig. 2) to align 19th marker 8 centimeters from third marker. (R)

16. Sweep Timing

a. Performance Check

(1) Turn **HORIZONTAL DISPLAY** switch on TI to **NORM**.

(2) Adjust **STABILITY** control as necessary.

(3) Adjust time-mark generator (A10) to outputs listed in table 5. At each setting, adjust **HORIZONTAL POSITION** control to align second (or third) marker behind second vertical graticule line. At each setting, if 10th or 19th markers are not displayed within ± 1.5 minor divisions of 10th vertical graticule line, perform **b(1)** below.

NOTE

When displaying one marker per centimeter, always align second marker behind second vertical graticule line. When displaying two markers per centimeter, align third marker behind second vertical graticule line.

Table 5. Sweep Timing

Test instrument TIME/CM switch setting	Time-mark generator setting.	Markers Per/cm.
.1 μ SEC	.1 μ S	1 ¹
.2 μ SEC	.1 μ S	2
.5 μ SEC	.5 μ S	1 ²
1 μ SEC	1 μ S	1 ³
2 μ SEC	1 μ S	2
5 μ SEC	5 μ S	1
10 μ SEC	10 μ S	1 ⁴
20 μ SEC	10 μ S	2
50 μ SEC	50 μ S	1
.1 MILLISEC	.1 mS	1
.2 MILLISEC	.1 mS	2
.5 MILLISEC	.5 mS	1
1 MILLISEC	1 mS	1
2 MILLISEC	1 mS	2

Table 5. Sweep Timing - Continued

Test instrument TIME/CM switch setting	Time-mark generator setting.	Markers Per/cm.
5 MILLISEC	5 mS	1
10 MILLISEC	10 mS	1
20 MILLISEC	10 mS	2
50 MILLISEC	50 mS	1
.1 SEC	.1 S	1
.2 SEC	.1 S	2
.5 SEC	.5 S	1
1 SEC	1 S	1
2 SEC	1 S	2
5 SEC	5 S	1

¹Adjust C375 (fig. 2) and C348 (fig. 1). (R)

²Adjust C160 A (fig. 1). (R)

³Adjust C160C (fig 1). (R)

⁴Adjust C160E (fig 1). (R)

(4) Position TI controls as listed in (a) through (c) below:

- (a) **TIME/CM** switch to **.1 μSEC**.
- (b) **HORIZONTAL DISPLAY** switch to **5X MAG**.
- (c) **TRIGGER SLOPE** switch to **+EXT**.

(5) Connect **TRIGGER OUTPUT** of time-mark generator to TI **TRIGGER INPUT**, using cable (B4 or B5) and if necessary, adapter (B2).

(6) Set time-mark generator to 20 nS output.

(7) Position second cycle behind second vertical graticule line with **HORIZONTAL POSITION** control. If ninth cycle is not between 7.6 and 8.4 centimeters from second cycle, perform **b(2)** below.

(8) Position 13th cycle from end of trace behind second vertical graticule line with **HORIZONTAL POSITION** control. If fourth cycle from end of trace is not between 7.6 and 8.4 centimeters from 13th cycle, perform **b(3)** below.

b. Adjustments

- (1) Adjust the respective adjustments listed in table 5 footnotes.
- (2) Adjust **C364** (fig. 2) for 1 cycle/cm over middle 8 centimeter. (R)
- (3) Adjust **C384** (fig. 2) for 1 cycle/cm over middle 8 centimeter. (R)

17. External Dc Balance

TB 9-6625-149-50

a. Performance Check

(1) Turn TI **HORIZONTAL DISPLAY** switch to **EXT HORIZ ATTEN X10**.

(2) Position spot in center of TI crt.

(3) Turn TI **EXTERNAL HORIZ ATTENUATOR** control from fully clockwise to fully counterclockwise. If spot does not remain stationary, perform **b** below.

b. Adjustments. Adjust **EXT. HORIZ. D.C. BAL R307** (fig. 2) until spot remains stationary. (R)

18. Vertical Rise Time

a. Performance Check

(1) Turn calibration adapter (A4) **TEST FUNCTION** switch to **+PULSE**.

(2) Turn TI **TIME/CM** switch to **.1 μSEC** and **HORIZONTAL DISPLAY** switch to **5X MAG**.

(3) Turn TI **TRIGGER SLOPE** switch to **+INT**.

(4) Measure rise time, using standard rise-time technique. Rise time will be less than 12 nanoseconds.

b. Adjustments. No adjustments can be made.

NOTE

Do not perform power supply checks if all other parameters are within tolerance.

19. Low-Voltage Power Supply

a. Performance Check

(1) Connect ac/dc voltmeter (A2) between -150-volt test point (fig. 1) and ground. Ac/dc voltmeter will indicate between -147 and -153 volts.

(2) Connect ac/dc voltmeter between test points (fig. 1) listed in table 6 and chassis ground. Voltages at each test point will be within limits specified.

Table 6. Low Voltage Power Supply Accuracy

Test instrument test point (fig. 1)	Ac/dc voltmeter indication (V dc)	
	Min	Max
+ 100	97	103
+ 225	218.25	231.75
+ 350	339.5	360.5
+ 500	485	515

b. Adjustments. Repeat **a**(1) above and adjust **-150 ADJ. R616** (fig. 1) for a -150 volt indication on ac/dc voltmeter. (R)

20. High-Voltage Power Supply

a. Performance Check. Connect dc voltmeter (A5) between **HV** test point (fig. 2) and chassis ground. If dc voltmeter does not indicate between -1310 and -1390 volts, perform **b** below.

b. Adjustments. Adjust **HV ADJ. R840** (fig. 1) until dc voltmeter indicates -1350 volts. (R)

21. Final Procedure

a. Deenergize and disconnect all equipment and replace TI within protective cover.

b. In accordance with TM 38-750, annotate and affix DA Label 80 (U.S. Army Calibration System). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited Use tag).

SECTION V

PRELIMINARY OPERATIONS FOR CURRENT PROBE AMPLIFIER, TEKTRONIX TYPES 131-1 THROUGH -4, WITH CURRENT PROBE, TEKTRONIX TYPE P6016.

22. Preliminary Instructions

a. The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with sections I, II, V, and VI of this bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

23. Equipment Setup

- a. Remove covers from TI.
- b. Insert plug-in (A8) into vertical compartment of oscilloscope (A7).
- c. Connect autotransformer (A3) to ac power source and adjust for 115 volts output.

NOTE

If TI is type 131-4, use 117-volt transformer housing current probe amplifier for this calibration.

- d. Connect TI to autotransformer.
- e. Energize equipment and allow sufficient time for equipment to warm up and stabilize.

SECTION VI

CALIBRATION PROCESS FOR CURRENT PROBE AMPLIFIER, TEKTRONIX TYPES 131-1 THROUGH -4, WITH CURRENT PROBE, TEKTRONIX TYPE P6016.

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before continuing with the calibration.

NOTE

When indications specified in paragraphs **24** through **27** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **24** through **27**. Do not perform power supply check if all other parameters are within tolerance.

24. Input Impedance

a. Performance Check

- (1) Connect equipment as shown in figure 3.
- (2) Turn oscilloscope (A7) **CALIBRATOR** switch to **100 VOLTS**.

NOTE

When measuring high currents, do not leave current probe connected around conductor while connecting or disconnecting probe from TI.

- (3) Clamp TI around one lead (B6).

NOTE

Be sure that slide probe is all the way forward.

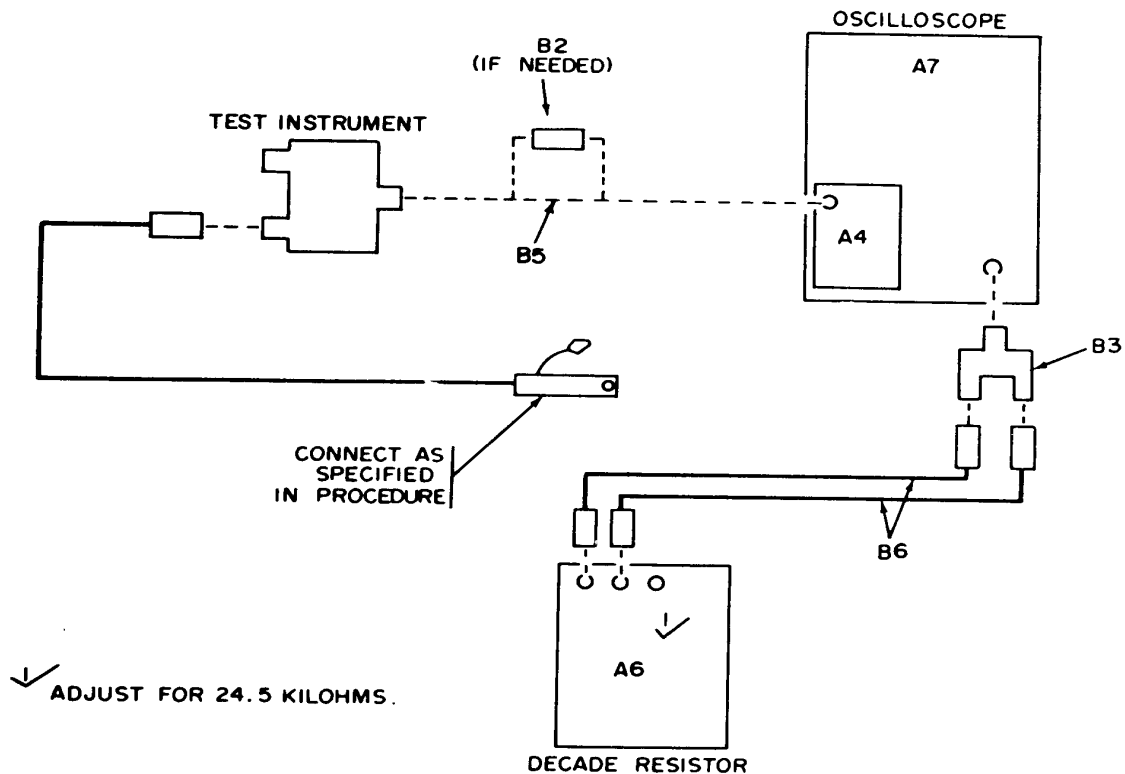


Figure 3. Input impedance and low frequency - equipment setup.

- (4) Turn TI **CURRENT/DIV.** switch to **1 mAMP.**
- (5) Turn oscilloscope **VOLTS/CM** switch to **.1.**
- (6) Record amplitude of waveform displayed on oscilloscope.
- (7) Turn TI **CURRENT DIV.** switch to **2 mAMP.**
- (8) Turn oscilloscope **VOLTS/CM** switch to **.05.** If amplitude of waveform is not the same as recorded in (6) above, perform **b** below.

TB 9-6625-149-50

b. Adjustments. Adjust **Z-IN ADJ. R452** (fig. 4) until amplitude of waveform is equal to amplitude recorded in **a(6)** above. ®

25. Low-Frequency Compensation

a. Performance Check. Adjust controls of oscilloscope (A7) and TI for 4 centimeters of vertical deflection. If leading and trailing edges of waveform are unequal in amplitude, perform **b** below.

b. Adjustments. Adjust **L.F. ADJ. R481** (fig. 4) until leading and trailing edges of waveform displayed on oscilloscope are of equal amplitude. (R)

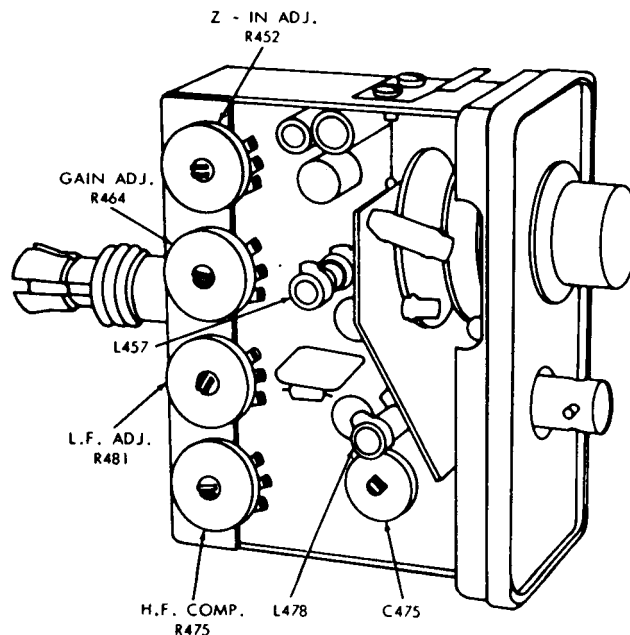


Figure 4. Current probe amplifier - typical left - interior view (types 131-1 through -4).

26. Amplifier Gain

a. Performance Check

(1) Turn TI **CURRENT/DIV.** switch to **1 mAMP.**

(2) Turn plug-in (A8) **VARIABLE VOLTS/CM** control to **CALIBRATED.** If oscilloscope (A7) does not indicate 4 centimeters of vertical deflection, perform **b** below.

b. Adjustments. Adjust **GAIN ADJ. R464** (fig. 4) for 4 centimeters of vertical deflection on oscilloscope. (R)

27. Rise Time and High Frequency Compensation

a. Performance Check

- (1) Replace left side cover on TI.
- (2) Connect equipment as shown in figure 5.
- (3) Turn TI **CURRENT/DIV.** switch to **5 mAMP.**
- (4) Turn oscilloscope (A7) **VOLTS/CM** switch to **.05.**
- (5) Adjust square-wave generator (A9) until oscilloscope displays waveform 2 centimeters high at approximately 500 kHz.

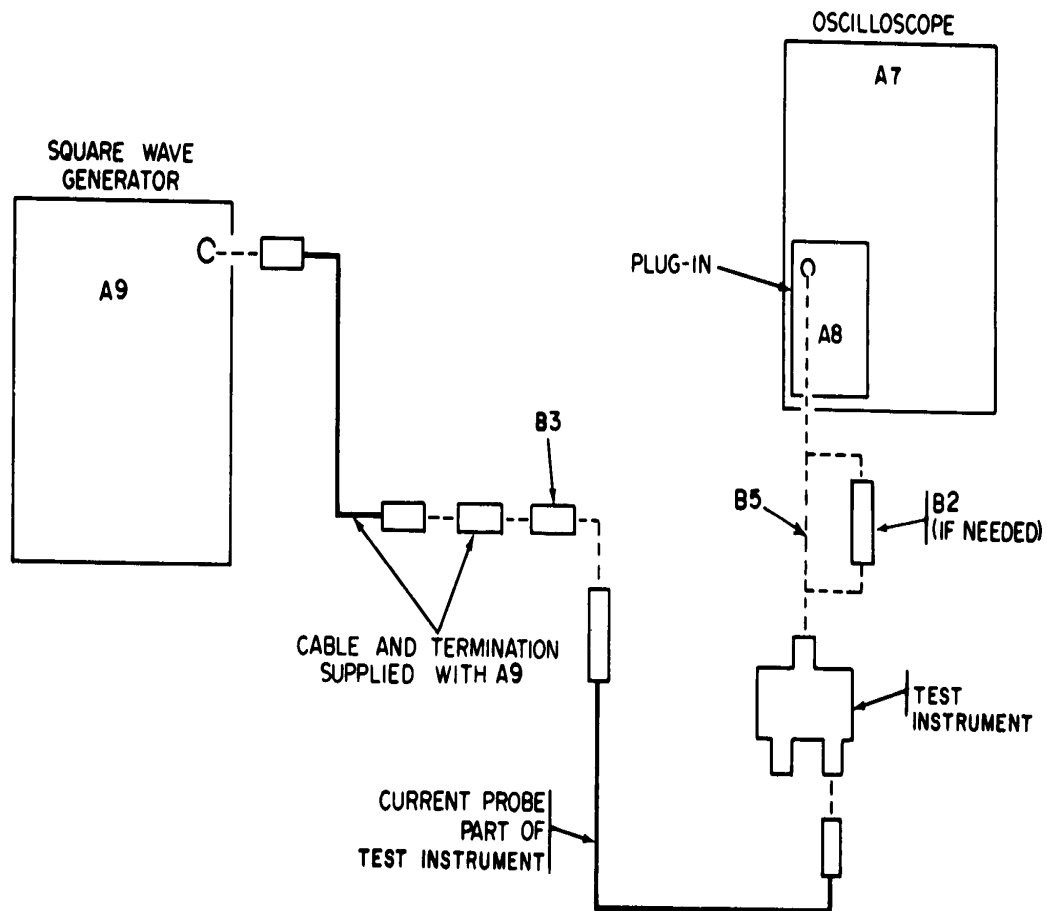


Figure 5. Rise time and high frequency - equipment setup.

TB 9-6625-149-50

(6) Adjust oscilloscope controls to display one positive half cycle of square-wave pattern. If oscilloscope does not display an optimum square wave with rise time less than 20 nanoseconds, perform **b** below.

b. Adjustments

- (1) Remove left-side cover from TI.

NOTE

In the following adjustments, it will be necessary to replace left side cover on TI after each adjustment to properly note the effects on waveform.

(2) Adjust **H.F. COMP. R475, C475, L457, and L478** (fig. 4) to obtain waveforms specified in **a(6)** above for TI current probe amplifier, types 131-1, -2, and -3. (R)

NOTE

L457 affects a wider portion of the front cover, while **L478** affects a narrower portion. Ringing, present in the waveform, will not exceed 2 percent from nominal top of square wave.

(3) Adjust **H.F. COMP. R475, C475, L457, L478** (fig. 4) and C468 (not shown) to obtain waveform specified in **a(6)** above for TI current probe amplifier, type 131-4. (R)

NOTE

Do not perform power supply check if all other parameters are within tolerance.

28. Power Supply Regulation

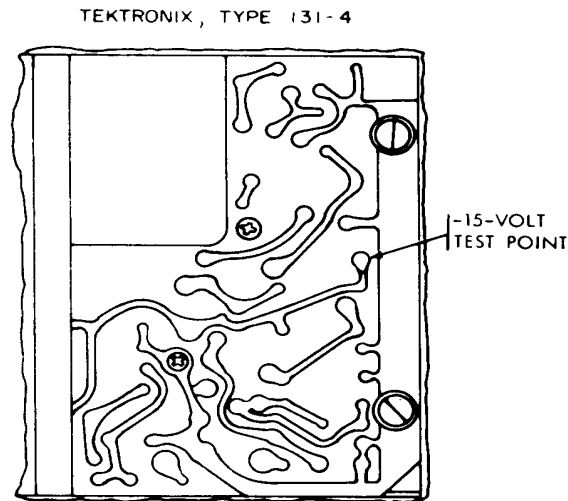
a. Performance Check

(1) Connect ac/dc voltmeter (A2) between -15-volt test point (fig. 6) and chassis ground. Ac/dc voltmeter will indicate between -13.5 and -16.5 volts.

(2) Vary autotransformer (A3) output between 105 and 125 volts. Ac/dc voltmeter indication will remain within limits of (1) above.

- (3) Adjust transformer for 115 volts ac.

b. Adjustments. No adjustments can be made.



TEKTRONIX, TYPES 131-1, -2, AND 3

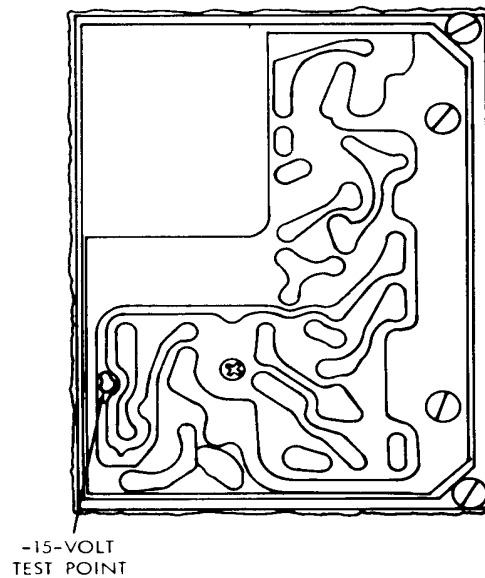


Figure 6. Current probe amplifier - right-interior view (types 131-1 through -4).

29. Final Procedure

- a. Deenergize and disconnect all equipment and replace TI within protective cover.
- b. In accordance with TM 38-750, annotate and affix DA Label 80 (U.S. Army Calibration System). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited Use tag).

TB 9-6625-149-50

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US GOVERNMENT PRINTING OFFICE: 1978 - - 740157/95

PIN NO: 011174-000