

***TB 9-6625-147-35**

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR PLUG-IN UNIT AM-3174/USM AND TEKTRONIX TYPES L AND 53/54L

Headquarters, Department of the Army, Washington, DC
12 June 1973

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*This bulletin supersedes TB 9-6625-147-50, 9 December 1969.

**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the A and C level calibration of Plug-in Unit AM-3174/USM, and Tektronix Types L and 53/54L. The manufacturer's instruction manual was used as the prime data source in compiling these instructions. The plug-in unit will be referred to as the "TI" (test instrument) throughout this bulletin.

a. Model Variations. The TI may have BNC or UHF connectors. Where a BNC connector is used, adapter (B1, table 3) is required.

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). Maintenance forms, records, and reports which are to be used by calibration personnel at all calibration levels are listed in and prescribed by TM 38-750.

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 |
|---|--|
| Frequency response: Range Accuracy | 0.05 to 40 v/cm, dc to 30 MHz; 0.005 to 4 v/cm, 3 Hz to 24 MHz. 3 db \pm 1/2 db |
| Step attenuator: Accuracy | \pm 3% of front-panel reading for all positions of VOLTS/CM switch. |
| Transient response and bandpass: Oscilloscopes: 532 | Bandpass: dc to 5 MHz; ac: 3 Hz to 5 MHz; X10 gain ac: 3 Hz to 5 MHz. Rise time: ac-dc: 70 nsec; X10 gain ac: 70 nsec |
| 541/541A 543/543A 545/545A,555 | Bandpass: dc to 30 MHz; ac: 3 Hz to 30 MHz; X10 gain ac: 3 Hz to 24 MHz. Rise time: ac-dc: 12 nsec; X10 gain ac: 14 nsec |
| 531/531A 533/533A 535/535A | Bandpass: dc to 15 MHz; ac: 3 Hz to 15 MHz; X10 gain ac: 3 Hz to 15 MHz. Rise time: ac-dc: 23 nsec; X10 gain ac: 32 nsec |
| 581, 585 ¹ | Bandpass: dc to 30 MHz; ac: 3 Hz to 30 MHz; X10 gain ac: 3 Hz to 24 MHz. Rise time: ac-dc: 12 nsec; X10 gain ac: 14 nsec |

See footnote at end of table.

Table 1. Calibration Description - Continued.

| Test instrument parameters. | Performance specifications |
|-----------------------------|---|
| 551 | Bandpass: dc to 25 MHz; ac: 3 Hz to 25 MHz; X10 gain ac: 3 Hz to 22 MHz. Rise time: ac-dc: 14 nsec; X10 gain ac: 16 nsec |
| 536 | Bandpass: dc to 11 MHz; ac: 3 Hz to 11 MHz; X10 gain ac: 3 Hz to 10 MHz. Rise time: ac-dc: 32 nsec; X10 gain ac: 35 nsec |

¹Type 81 plug-in adapter must be used with the 580 series oscilloscope.

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. The equipment used for the C-level calibration was selected from that known to be available in AN/TSM-55(v)5 4940-454-8710. 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 of Equipment Required

| Item | Common Name | Minimum Use Specifications | Manufacturer, Model And Part Number. |
|------|---------------------------|---|--|
| A1 | VOLTAGE STANDARD | Range: 0.0194 to 8.24 V p-p, 400 Hz Accuracy: $\pm 0.75\%$ | Ballantine, Model 420 (8205523) (Meter Calibrator, TS-2734/U; John Fluke, Model 760A w/ Ratio Transformer TF-515/U, Gertsch, Model RT-60) ¹ |
| A2 | SQUARE-WAVE GENERATOR. | Range: 50 Hz to 1 MHz Rise Time: See table 1 | Tektronix, Type 106 (MIS-10284) (Signal Generator AN/USM-256, Fairchild, Model 791) ¹ |
| A3 | OSCILLOSCOPE ² | Must be calibrated and be compatible with the TI | See table 1. |
| A4 | DC VOLTMETER | Range: 54.45 to 55.55 V Accuracy: $\pm 0.25\%$ | Dana, Model 5703-S-2127 (7912606) John Fluke, Model 760A) ¹ |

¹C-level equipment

²Additional equipment required. See table 1.

Table 3. Accessories Required

| Item | Common name | Description and part number ¹ |
|------|--------------------|---|
| B1 | ADAPTER | BNC jack. to UHF plug (10519439) |
| B2 | ADAPTER | UHF jack to BNC plug (8109698) |
| B3 | CABLE | 36-in., RG-58/U; BNC plug and double banana plug terminations (7907471) |
| B4 | CAPACITOR STANDARD | Variable from 5 to 80 pF (SKD 4850-44) |
| B5 | PLUG-IN EXTENDER | Tektronix, Type 013-0055-00 (FSN: 5935-759-6614). |

¹For C-level calibration use accessories as required for equipment hookup.

**SECTION III
PRELIMINARY OPERATIONS**

6. Preliminary Instructions

a. The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with the entire 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 left-side and bottom panels from oscilloscope (A3) and insert TI into left-side compartment.

b. Position TI controls is listed in (1) through (3) below:

(1) AC-DC switch to DC.

(2) VOLTS/CM switch to 0.05.

(3) VARIABLE VOLTS/CM control fully clockwise to CALIBRATED (detent) position.

c. Energize equipment and allow sufficient time for equipment to warm up and stabilize.

SECTION IV CALIBRATION PROCESS

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.

8. Variable Attenuator and X10 Variable Attenuator Balance

a. Performance Check

- (1) Adjust TI VERTICAL POSITION control to center the trace on horizontal axis.
- (2) Turn TI VARIABLE VOLTS/CM control fully clockwise and then counterclockwise. Trace displayed on oscilloscope (A3) will not shift. If trace shifts, perform **b**(1) below.
- (3) Turn TI AC-DC switch to X10 GAIN AC and turn VARIABLE VOLTS/CM control clockwise and then counterclockwise. Oscilloscope display will not shift from horizontal axis. If trace shifts, perform **b**(2) and (3) below.
- (4) Turn VARIABLE VOLTS/CM switch to CALIBRATED position.

b. Adjustments

- (1) Adjust VARIABLE ATTEN BAL control to eliminate shifting of trace from horizontal axis as VARIABLE VOLTS/CM control is turned clockwise and counterclockwise.
- (2) Adjust X10 VARIABLE ATTEN BAL control to eliminate shifting of trace.
- (3) Repeat (1) and (2) above until no further adjustment can be made.

9. Cathode Current

a. Performance Check

- (1) Remove TI from oscilloscope (A3) and reconnect, using plug-in extender (B5).
- (2) Connect dc voltmeter (A4) across R6072 (fig. 1), using cables supplied with dc voltmeter. Dc voltmeter will indicate between 54.45 and 55.55 volts dc. If not, perform **b** below.
- (3) Remove plug-in extender and reinstall TI in oscilloscope.

b. Adjustments. Adjust CATHODE CURRENT ADJ R5922 (fig. 2) for 55 volts dc as indicated on dc voltmeter.

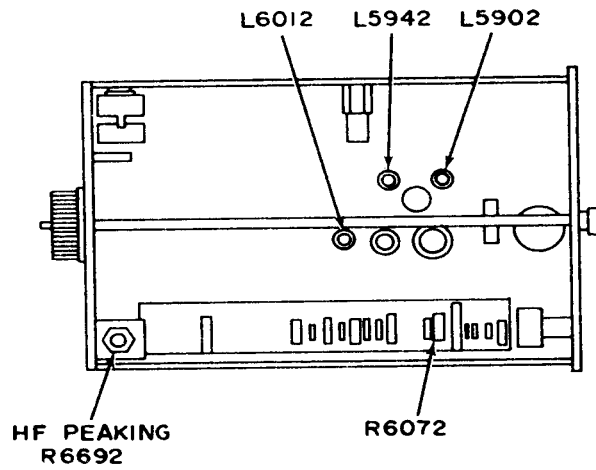


Figure 1. Plug-in unit - bottom interior view.

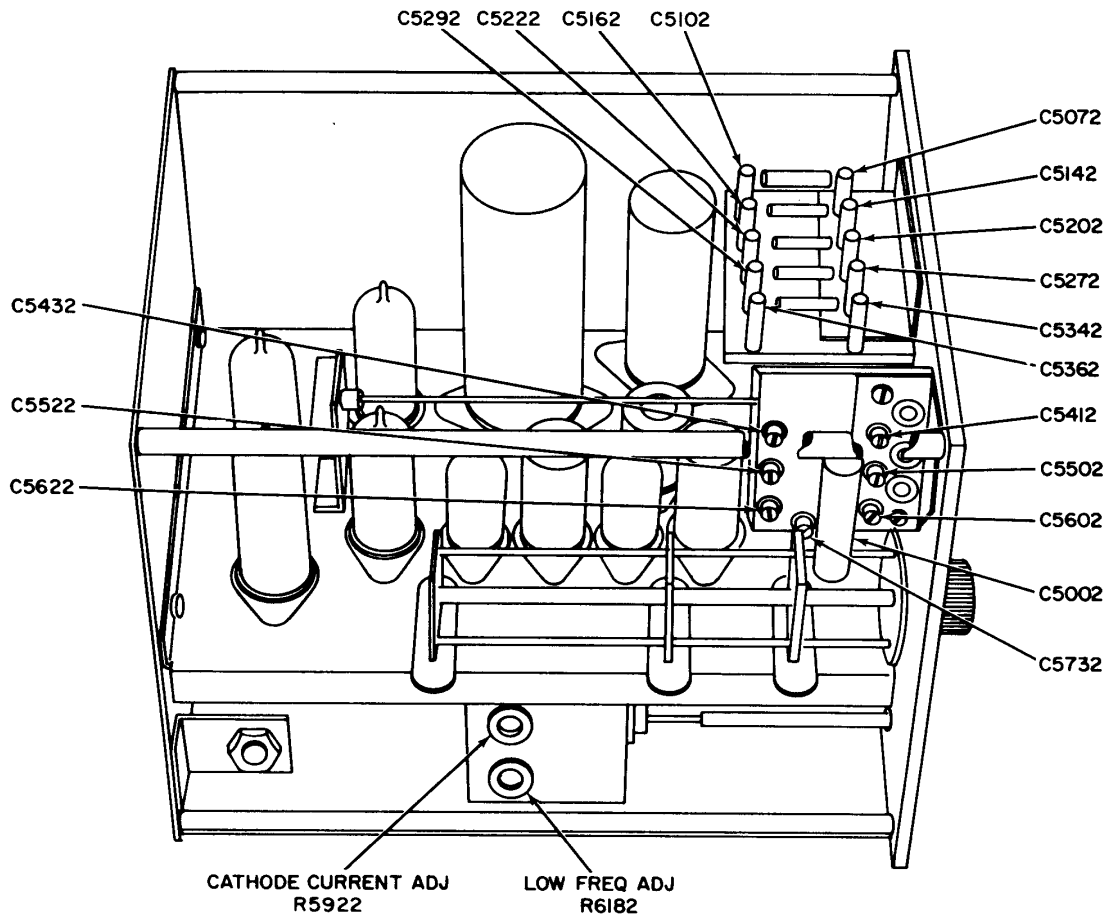


Figure 2. Plug-in unit - bottom interior view.

10. Main Amplifier Gain

a. Performance Check

- (1) Turn TI AC-DC switch to AC.
- (2) Connect voltage standard (A1) to TI INPUT connector, using cable (B3) and, if required, adapter (B1).
- (3) Turn oscilloscope (A3) TIME/CM switch to .5 mSEC.
- (4) Adjust output of voltage standard for a 4-cm vertical deflection on oscilloscope. Voltage standard will indicate between 194 and 206 millivolts peak-to-peak. If not, perform **b** below.

b. Adjustments

- (1) Adjust output of voltage standard for 200 millivolts peak-to-peak.
- (2) Adjust upper GAIN ADJUST for a 4-cm vertical deflection on oscilloscope.

11. X10 Gain and Attenuator Accuracy

a. Performance Check

- (1) Turn TI AC-DC switch to X10 GAIN AC position.
- (2) Adjust output of voltage standard (A1) for 4-cm vertical deflection on oscilloscope (A3). Voltage standard will indicate between 0.0194 and 0.0206 volt peak-to-peak. If not, perform **b** below.
- (3) Turn TI VOLTS/CM switch to positions listed in table 4 and at each position adjust voltage standard for a 4-cm vertical deflection on oscilloscope. Voltage standard will indicate within limits specified. If not, perform **b** below.

Table 4. Attenuator Accuracy

| Test instrument VOLTS/CM switch setting | Voltage standard indication (V p-p) | |
|--|-------------------------------------|--------|
| | Min | Max |
| .01 | 0.0388 | 0.0412 |
| .02 | 0.0776 | 0.0824 |
| .05 | 0.194 | 0.206 |
| .1 | 0.388 | 0.412 |
| .2 | 0.776 | 0.824 |
| .5 | 1.94 | 2.06 |
| 1 | 3.88 | 4.12 |
| 2 | 7.76 | 8.24 |

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b. Adjustments

(1) Turn VOLTS/CM switch to .005 and adjust controls of voltage standard for 0.020 volt peak-to-peak.

(2) Adjust X10 GAIN ADJUST for a 4-cm vertical deflection on oscilloscope. Repeat **a** above.

12. Attenuator Compensation

a. Performance Check

(1) Turn TI AC-DC switch to DC and VOLTS/CM switch to .05.

(2) Connect square-wave generator (A2) to TI INPUT, using cable and termination supplied with square-wave generator, adapter (B1), and capacitor standard (B4).

NOTE

Connect TI to oscilloscope, using plug-in extender (B5) when performing the adjustments in table 5.

Table 5. Input Capacitance Standardization Check

| VOLTS/CM switch setting | Adjustments (fig 2) | |
|----------------------------|---------------------|----------------------------------|
| | Optimum flat top | Optimum square leading corner |
| .1 | C5072 | C5102 |
| .2 | C5142 | C5162 |
| .5 | C5202 | C5222 |
| 1 | C5272 | C5292 |
| 2 | C5342 | C5362 |
| 5 | C5412 | C5432 |
| 10 | C5502 | C5522 |
| 20 | C5602 | C5622 |

(3) Adjust square-wave generator for a 1-kHz output and for a convenient display on oscilloscope (A3) crt.

(4) Adjust capacitor standard for optimum square-wave display on crt. If capacitor range is insufficient, adjust C5732 (fig. 2) to midrange and readjust capacitor standard.

(5) Turn TI VOLTS/CM switch to positions listed in table 5. Flat-top square wave will be displayed. If not, perform adjustments listed in table 5.

13. X10 Amplifier Low Frequency

a. Performance Check

(1) Turn oscilloscope (A3) TIME/CM switch to 10 MILLISEC.

(2) Turn TI AC-DC switch to X10 GAIN AC and VOLTS/CM switch to .005.

(3) Adjust output of square-wave generator (A2) for 50 Hz and amplitude control for a 3-cm deflection on oscilloscope crt. Waveform displayed will have flat tops. If not, perform **b** below.

b. Adjustments. Adjust LOW FREQ ADJ R6182 (fig. 2) for square waves with flat tops.

14. High-Frequency Peaking

a. Performance Check

(1) Turn oscilloscope (A3) TIME/CM switch to .5 μ SEC.

(2) Turn TI AC-DC switch to DC and VOLTS/CM switch to .05.

(3) Adjust square-wave generator (A2) output for approximately 500 kHz and amplitude control for a 3-cm vertical deflection on oscilloscope crt. Oscilloscope will display square waveform with no overshoot. If not, perform **b** below.

b. Adjustments. Adjust HF PEAKING R6692 (fig. 1) for square wave with no overshoot.

15. X10 Amplifier High Frequency

a. Performance Check

(1) Turn TI AC-DC switch to X10 GAIN AC.

(2) Adjust output of square-wave generator (A2) to 450 kHz and amplitude control for a 3-cm deflection on oscilloscope (A3). Oscilloscope will display square-cornered waveform with no overshoot. If not, perform **b** below.

b. Adjustments. Adjust L5902, L5942, and L6012 (fig. 1) for square leading corner on displayed waveform with fastest rise time, but no overshoot.

16. Rise Time

a. Performance Check

(1) Adjust output of square-wave generator (A2) for 1 MHz.

(2) Measure rise time, using standard rise time techniques.

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NOTE

Rise time depends on oscilloscope used. See table 1 for rise time specifications.

b. Adjustments. No adjustments can be made.

17. Final Procedure

a. Deenergize and disconnect all equipment and remove TI from oscilloscope.

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).

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U.S. GOVERNMENT PRINTING OFFICE: 1973-746143/5082

PIN: 011173-000