*TB 9-6625-1200-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLOSCOPE TEKTRONIX, TYPES 422 AND 422MOD125B

Headquarters, Department of the Army, Washington, DC
14 March 2003

Approved for public release; distribution is unlimited.

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028, directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our FAX number is: DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use: https://amcom2028.redstone.army.mil.

_____

*This bulletin supersedes TB 9-6625-1200-35, 22 September 1983 including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This provides bulletin instructions for the calibration of Oscilloscope, Tektronix, Types 422 and 422MOD125B. The manufacturer's manuals were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None that effects calibration.

b. Time and Technique. The time required for this calibration is approximately 3 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows 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
Power input requirement	115 V ac ± 10% at 50 to 400 Hz
Vertical sensitivity	Range: 0 to 20 V/div Accuracy: ± 3%, X1 ± 4% for channel 2 in X10 GAIN position (±7.5% for S/N below 20,000)
Calibrator: Internal	 Range: 0.2 V square wave Accuracy: ± 1.6% for S/N below 20,000 ± 2.5% for S/N above 20,000
Calibrator jack	Range: 2 V square wave Accuracy: ± 3.6% for S/N below 20,000 ± 1.5% for S/N above 20,000
Risetime	24 ns or less with aberrations of ± 0.15 div or less
Sweep timing	Range: 0.5 µs to 0.5 s/div Accuracy: ± 3% ± 5% in X10 MAG

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286, AN/GSM-287, or AN/GSM-705. Alternate items may be used by the calibrating activity. 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 ratio between the standard and TI.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
OSCILLOSCOPE CALIBRATOR	Voltage output: Range: 10 mV to 5 V Accuracy: ±0.25% Time markers: 0.5 ns to .5 s Leveled sine wave: Range: 10 mV to 3 V p-p Frequency: 10 Hz to 150 MHz Accuracy: ±0.25%	(MIS38938) John Fluke, Model 5820A (5820A-5C-GHz)
MULTIMETER	Range: 0V to -12V Accuracy: ±0.25%	John Fluke, Model 8840A/AF-05/09 (AN/GSM-64D)

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** 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 as listed in table 2

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure.

d. Unless otherwise specified, all control and control settings refer to the TI.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUPUT(S) to minimum after each step within the performance check where applicable.

a. Remove TI protective cover only when necessary to perform adjustments.

b. Position controls as listed in (1) through (9) below:

(1) Both **VOLTS/DIV** switches to .1 and **VARIABLE** controls to **CAL**.

(2) **CH1-CH2** mode switch to **CH1**.

(3) Both **AC-GND-DC** switches to **AC**.

(4) Both vertical **POSITION** controls to mid-range.

(5) Push in **INVERT PULL** (CH2 only) switch.

(6) Push in **X10 GAIN AC** (CH2 only) switch.

(7) **TIME/DIV** switch to **1 mSEC** and **VARIABLE** control to **CAL**.

(8) Push in **X10 MAG** switch.

(9) **TRIGGERING** controls as listed in (a) through (c) below:

(a) **SOURCE** switch to **CH1 & 2**.
(b) **COUPLING** switch to **AC**.
(c) **SLOPE** switch to up position.

c. Connect TI to appropriate power source.

d. Pull **POWER** switch to **ON** and allow at least 20 minutes for warm-up.

8. Vertical Sensitivity and Stability

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to TI **CH 1** input connector, oscilloscope calibrator **SOURCE/MEASURE CHAN2** output to TI **CH 2** input connector.

(2) Set oscilloscope calibrator to a **VOLTAGE** output of 400 mV and frequency of 1 kHz.

(3) Adjust oscilloscope calibrator knob located below the **EDIT FIELD** key for 4 divisions displayed on TI crt. If **Err** displayed on oscilloscope calibrator is not within limits shown in the first row of table 3 , perform **b** (1) and (2) below.

(4) Repeat technique of (2) and(3) above for **CH1** with settings listed in table 3 below. **Err** displayed on calibration generator will be within tolerance listed.

Table 3. Channel 1 Vertical Deflection

CH1 VOLTS/DIV settings	Oscilloscope calibrator	
	VOLTAGE settings	**Err** display (%)
.1	.4 V	±3.0
.01	40 mV	±3.0
.02	80 mV	±3.0
.05	200 mV	±3.0
.2	.8 V	±3.0
.5	2.0 V	±3.0
1	4 V	±3.0
2	8 V	±3.0
5	20 V	±3.0
10	40 V	±3.0
20	80 V	±3.0

(5) Set oscilloscope calibrator to standby and select oscilloscope calibrator **CHAN 2**.

(6) Set **CH1-CH2** mode switch to **CH2** and repeat technique of (2), (3), and (4) above, using table 4 If not in tolerance in (4) above, perform **b**(1) and (3) below.

Table 4. Channel 2 Vertical Deflection

CH1 VOLTS/DIV settings	Oscilloscope calibrator	
	VOLTAGE settings	**Err** display (%)
.1	.4 V	±3.0
.01	40 mV	±3.0
.02	80 mV	±3.0
.05	200 mV	±3.0
.2	.8 V	±3.0
.5	2.0 V	±3.0
1	4 V	±3.0
2	8 V	±3.0
5	20 V	±3.0
10	40 V	±3.0
20	80 V	±3.0

(7) Set oscilloscope calibrator to standby.

(8) Set **CH 2 VOLTS/DIV** switch to .05.

(9) Set oscilloscope calibrator for a **VOLTAGE** output of 20 mV and frequency of 1 kHz.

(10) Pullout **X10 GAIN AC** switch.

(11) Adjust oscilloscope calibrator knob located below the **EDIT FIELD** key for 4 divisions displayed on TI crt. **Err** displayed on oscilloscope calibrator will be within ±4.0 percent (± 7.5 percent for S/N below 20,000).

(12) Push in **X10 GAIN AC** switch.

(13) Set oscilloscope calibrator to standby.

b. Adjustments

(1) Set oscilloscope calibrator **VOLTAGE** output for an **Err** display of ± 0.0 percent.

(2) Adjust **CH 1 GAIN** for a 4 division display on TI.

(3) Adjust **CH 2 GAIN** for a 4 division display on TI.

9. Volts/Div Compensation

a. Performance Check

(1) Set **CH1-CH2** mode switch to **CH1** and **CH1 VOLTS/DIV** switch to .05.

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to TI **CH 1** input connector, using cable and standardizer. Select oscilloscope calibrator channel 1 output.

(3) Set **TIME/DIV** switch to **.2 mSEC**.

(4) Set oscilloscope calibrator **EDGE** mode for an output of 200 mV at 1 kHz and adjust amplitude for 4 divisions of vertical display on TI.

(5) Adjust TI **TRIGGERING LEVEL** control for a stable display.

(6) For **CH 1** only, adjust standardizer for optimum square wave (square corners and flat tops).

NOTE

If standardizer cannot be properly adjusted, adjust C12 (fig. 1) to midrange and readjust standardizer for optimum waveform (R).

(7) Repeat technique of (4) and (5) above for **CH 1 VOLTS/DIV** switch settings listed in table 5. If display does not have square corners and flat tops, perform corresponding adjustments.

Table 5. Volts/Div Compensation

Test instrument	Oscilloscope calibrator	Test instrument adjustments (fig. 1)			
		CH 1		CH 2	
CH1/CH2 VOLTS/DIV settings	**VOLTAGE** settings	Square corner (R)	Flat top (R)	Square corner (R)	Flat top (R)
.05	200 mV	---	---	---	C112
.1	400 mV	C3C	C3B	C103C	C103B
.2	800 mV	C4C	C4B	C104C	C104B
.5	2 V	C5C	C5B	C105C	C105B
5	20 V	C6C	C6B	C106C	C106B

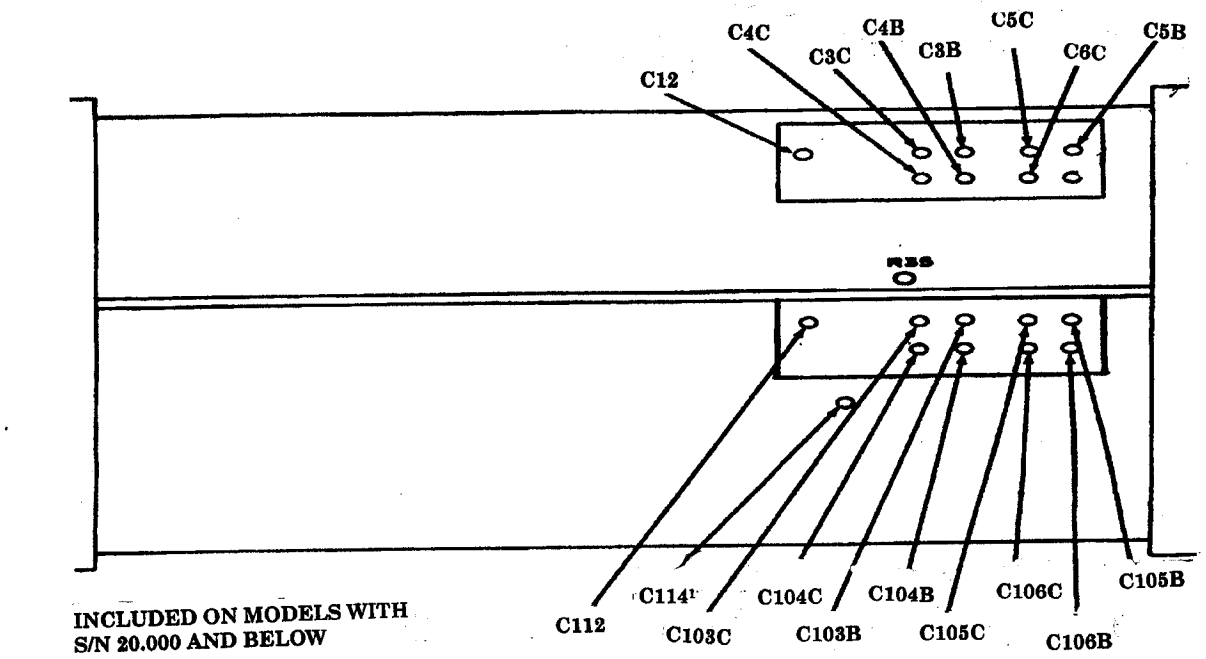

Figure 1. Test instrument – bottom view.

(8) Repeat technique of (1) through (5) and (7) above for **CH 2 VOLTS/DIV** switch settings and adjustments listed in table 5.

(9) Set oscilloscope calibrator to standby.

b. Adjustments. No further adjustments can be made.

10. Magnifier Registration

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to TI **CH 1** input.

(2) Set oscilloscope calibrator **MARKER** output to .5 ms.

(3) Position controls as listed in (a) through (h) below.

(a) **CH1-CH2** mode switch to **CH1**.
(b) **CH 1 VOLTS/DIV** switch to **.5**
(c) **TRIGGERING** source switch to **CH1**.
(d) **TRIGGERING** coupling switch to **AC**.
(e) **TIME/DIV** switch to **1 mSEC** and **VARIABLE** control to **CAL**.
(f) **TRIGGERING LEVEL** control for stable display.
(g) Pull out **X10 MAG** switch.
(h) Adjust horizontal **POSITION** control to align first time marker to center vertical graticule line.

(4) Push in **X10 MAG** switch. If first marker does not remain aligned behind center vertical graticule line within ±1 minor division, perform **b** below.

b. Adjustments. Adjust R535 (fig. 2) until first marker is positioned to center vertical graticule line for both **X10** and **X1 MAG** switch positions (R).

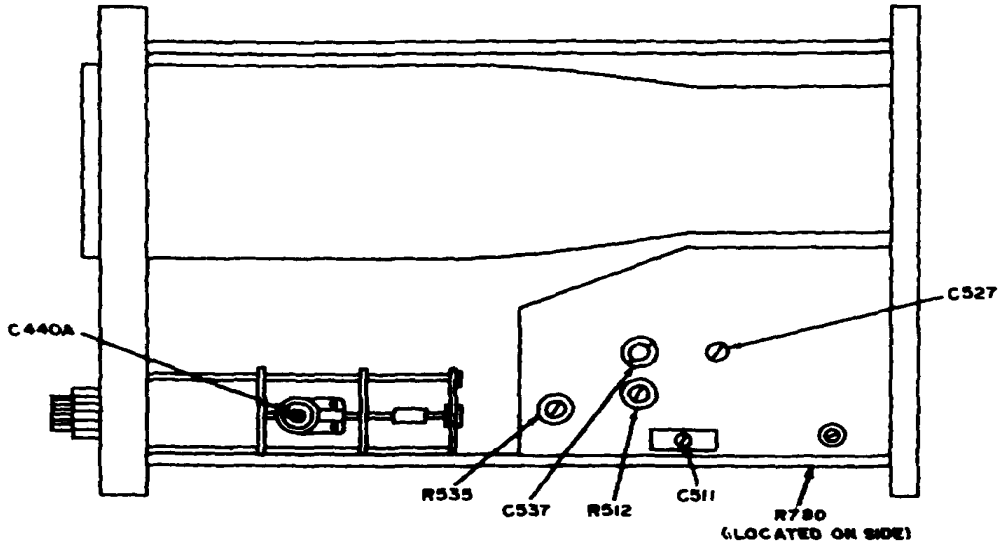

Figure 2. Test instrument - top view.

11. Sweep Timing

a. Performance Check

(1) Set oscilloscope calibrator **MARKER** output to 1 ms, and set TI **VOLTS/DIV** switch for approximately 4 divisions of vertical display.

(2) Adjust **TRIGGERING LEVEL** control for a stable display and horizontal **POSITION** control to align 2nd marker behind 2nd vertical graticule line. Adjust oscilloscope calibrator knob located under the **EDIT FIELD** key to align 10th marker behind 10th vertical graticule line. If **Err** displayed on oscilloscope calibrator does not indicate within limits shown in the first row of table 6, perform **b**(1) below.

(3) Repeat technique of (1) and (2) above for **TIME/DIV** and oscilloscope calibrator **MARKER** outputs listed in table 6. If oscilloscope calibrator **Err** displayed does not indicate within limits shown in table 6 at each setting, perform **b**(1) through (3) below.

Table 6. Sweep Timing

Oscilloscope calibrator		Test instrument		
MARKER output		Test instrument **TIME/DIV** switch settings		**Err** display (%)
1	ms/div	1	ms/div	±3.0
0.5	?s/div	500	ns/div	±3.0
1	ms/div	1	ms/div	±3.0
2	ms/div	2	ms/div	±3.0
5	?s/div	5	µs/div	±3.0
10	?s/div	10	µs/div	±3.0
20	?s/div	20	µs/div	±3.0
50	?s/div	50	µs/div	±3.0
.1	ms/div	100	µs/div	±3.0
.2	ms/div	200	µs/div	±3.0
.5	ms/div	500	µs/div	±3.0
2	ms/div	2	ms/div	±3.0
5	ms/div	5	ms/div	±3.0
10	ms/div	10	ms/div	±3.0
20	ms/div	20	ms/div	±3.0
50	ms/div	50	ms/div	±3.0
.1	s/div	100	ms/div	±3.0
.2	s/div	200	ms/div	±3.0
.5	s/div	500	ms/div	±3.0

(4) Set **TIME/DIV** switch to **.5 µSEC** and pullout **X10 MAG** switch. Set oscilloscope calibrator **MARKER** output to 50 ns.

(5) Repeat technique of (1) and (2) above. If oscilloscope calibrator **Err** displayed does not indicate within ±5 percent, perform **b**(4) below.

(6) Turn horizontal **POSITION** control until center portion of magnified sweep has marker aligned behind 2nd vertical graticule line. If 8th marker from 2nd vertical line is not aligned behind 10th vertical graticule line within ±2.5 minor divisions, perform **b**(5) below.

(7) Set oscilloscope calibrator to standby.

b. Adjustments (fig. 2)

(1) Adjust R512 for best compromise of **TIME/DIV** switch positions from **1 mSEC** through **20** m**SEC** (R).

(2) Adjust C440A for best compromise of **TIME/DIV** switch positions from **10** m**SEC** through **1** m**SEC** (R).

(3) Adjust C537 for **.5** m**SEC** position of **TIME/DIV** switch (R).

NOTE

If C537 was adjusted, recheck **10** m**SEC** through **1** m**SEC** **TIME/DIV** switch positions.

(4) Adjust C511 for eight major divisions between 2nd and 10th markers (R).

NOTE

If **b**(2) and (3) above are performed, repeat **a**(4) through (6) above.

(5) Adjust C527 until 8th marker from 2nd vertical graticule line is aligned behind 10th vertical graticule line (R).

12. High Frequency Compensation and Risetime

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to TI **CH 1** input, using cable and 50? termination.

(2) Set both **VOLTS/DIV** switches to **.05** and variable control to **CAL**.

(3) Pull out **X10 MAG** switch and set **TIME/DIV** switch to **.5** m**SEC**.

(4) Select oscilloscope calibrator **FAST EDGE** function and set to 100 kHz. Center displayed pulse vertically on crt.

(5) Adjust **LEVEL** control for a stable display triggered on rising portion of pulse. If displayed pulse does not have a square leading corner and a flat top with aberrations within ±1.5 minor divisions, perform **b**(1) below.

(6) Measure risetime, using standard risetime technique. Risetime will be 24 ns or less.

(7) Move connection from TI **CH 1** input to TI **CH 2** input.

(8) Set **CH1-CH2** mode switch to **CH2**.

(9) Set **TRIGGERING CH1 & 2, CH1, EXT** switch to **CH1 & 2**.

(10) Repeat technique of (3) through (5) above. If displayed pulse does not have a square leading corner and a flat top with aberrations within ±1.5 minor divisions, perform **b**(2) below.

(11) Repeat (6) above.

(12) Push in **X10 MAG** switch.

(13) Set oscilloscope calibrator to standby.

b. Adjustments

(1) Adjust R237, C237, L245, and L255 (fig. 3) in order, for optimum square wave.

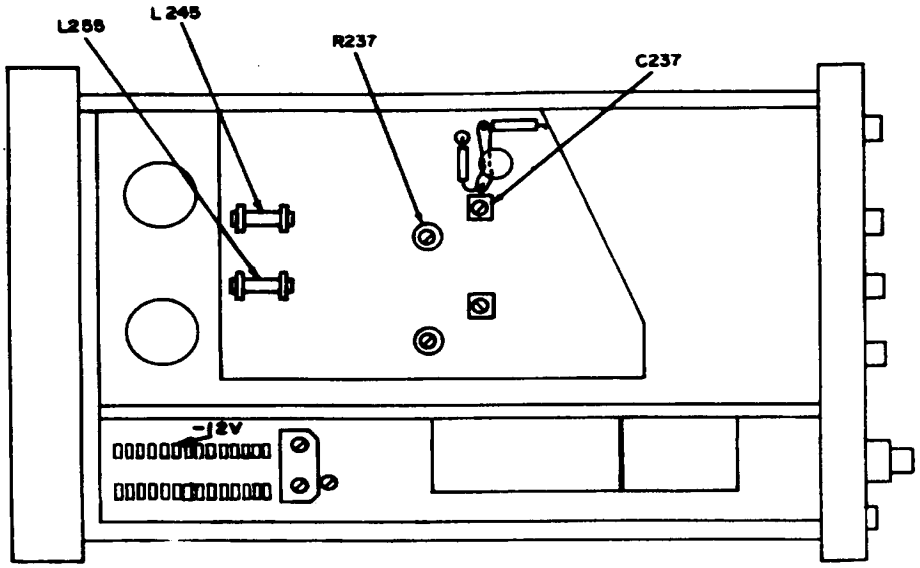

Figure 3. Test instrument - left view.

(2) Adjust C114 (fig. 1) (for S/N below 20,000) for optimum square wave. Adjust R237, C237, L245, and L255 (fig. 3) (for S/N 20,000 and above). Compromise the adjustments for optimum square wave (R).

13. Calibrator

a. Performance Check

(1) Set **TIME/DIV** switch to **.5 mSEC**.

(2) Set **CH2 VOLTS/DIV** switch to **CALIBRATE 4 DIVISIONS** position and record amplitude of waveform.

(3) Set **CH2 VOLTS/DIV** switch to **.5**.

(4) Connect TI **2 VOLT PROBE CALIBRATOR** jack to TI **CH2** input, using lead and adapters.

(5) Record amplitude of waveform.

(6) Connect oscilloscope calibrator **SOURCE/MEASURE** output to TI **CH2** input, using cable.

(7) Set oscilloscope calibrator **VOLTAGE** output for 1 kHz, 2 V and adjust variable for same value recorded in (2) above. If oscilloscope calibrator **Err** readout does not indicate within ±1.6% (±2.5% for S/N 20,000 and above) of reading recorded in (2) above, perform **b** below.

(8) Adjust oscilloscope calibrator variable control for same value recorded in (5) above. Oscilloscope calibrator **Err** readout will indicate within ±3.6% (±1.5% for S/N 20,000 and above) of value recorded in (5) above.

b. Adjustments

(1) Adjust oscilloscope calibrator variable control for a 0.0 indication on **Err** readout. Record the amplitude of waveform on TI.

(2) Set TI **VOLTS/DIV** switch to **CALIBRATE 4 DIVISIONS** and adjust R780 (fig. 2) for value recorded in (1) above (R).

14. Power Supply

a. Performance Check

NOTE

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

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

(a) **TIME/DIV** switch to **1 mSEC**.
(b) **INTENSITY** control maximum ccw.
(c) **TRIGGERING LEVEL** control ccw, but not to **AUTO**.

(2) Connect multimeter to -12V test point (fig. 3) and chassis ground, using lead. If multimeter does not indicate between -11.88 and -12.12 V, perform **b** below.

b. Adjustments.

(1) Adjust R639 or (R1130 on ac-dc power supply) (fig. 4) until multimeter indicates -12 V (R).

(2) Reinstall protective cover on TI.

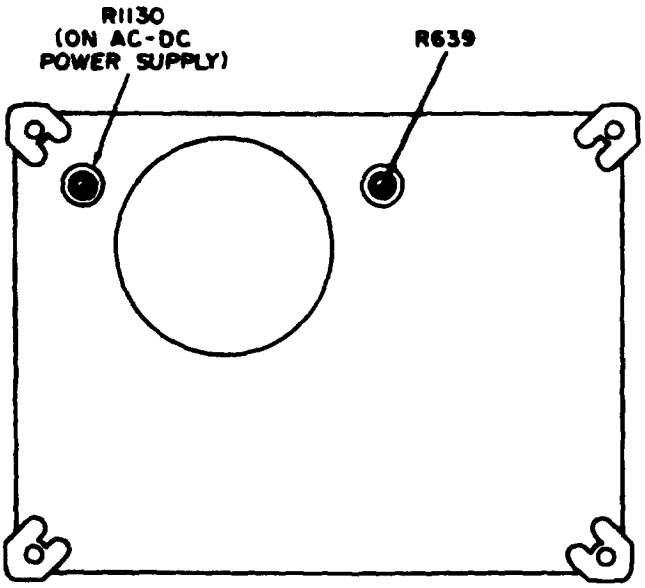

Figure 4. Test instrument - interior view.

15. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

THESE ARE THE INSTRUCTIONS FOR SENDING AN ELECTRONIC 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@avma27.army.mil

To: 2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: Home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-Oct-93
8. **Pub No**: TB 9-6625-xxxx-35
9. **Pub Title**: Calibration Procedure for …
10. **Publication Date**:
11. Change Number:
12. **Submitted Rank**: MSG
13. **Sumitter Fname**: Joe
14. **Submitter Mname**: T
15. **Submitter Lname**: Smith
16. **Submitter Phone**: (123) 123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3

20 Line: 4

21. NSN: 5
22. Reference: 6
23. Figure : 7
24. Table: 8
25. Item: 9
26. Total: 123

27: **Text**:

This is the text for the problem below line 27.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0302104

To be distributed in accordance with IDN 342992 requirements for calibration procedure TB 9-6625-1200-35.

PIN: 054267-000