*TB 9-4931-290-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR VOLTAGE CALIBRATOR, BALLANTINE MODEL 421A

Headquarters, Department of the Army, Washington, DC
15 May 2008

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 or DA Form 2028 (Recommended Changes to Publications and Blank Forms) 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 send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

*This bulletin supersedes TB 9-4931-290-50, dated 20 August 2004.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Voltage Calibrator, Ballantine Model 421A. The manufacturer's 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. None.

b. **Time and Technique.** The time required for this calibration is approximately 2 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
Dc volts	Range: 0 to 111 V Accuracy: ± (0.2% setting +0.007% range +25 μV)
Ac volts	Range: 0 to 111 V at 1 kHz Accuracy: ± (0.15% setting +0.005% range +3 μ V) Range: 0 to 100 V at 400 Hz Accuracy: ± (0.25% setting +0.005% range +3 μV) Range: 100 to 1000 V at 400 Hz Accuracy: ± (0.45% setting +0.005% range +3 μ V)
Stability	Range: 105 to 125 V Accuracy: ± 0.09%
Frequency	Range: 400 Hz or 1 kHz Accuracy: ± 3%
Distortion	Less than 0.2%

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 Sets 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. 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 required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in the calibration procedure. The following peculiar accessory is also required for this calibration: Decade resistor, Winslow, Model 336 (7907234) or Claristat, Model 240C (240C).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUDIO ANALYZER	Sensitivity: 0.25% harmonic content	Boonton, Model 1121 (1121)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ± 1%	Ridge, Model 9020A (9020A)
MULTIMETER	Range: 99.84 mV to 150 V ac Accuracy: ± 0.025% (.05%) Dc Range: 973 mV to 100 V Accuracy: ± 0.025%	Hewlett-Packard, Model 3458A (3458A)

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. Additional maintenance information is contained in the manufacturer's manual for this TI.

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

7. Equipment Setup

a. Connect autotransformer to a 115 V ac source and adjust for a 115 V output.

b. Connect TI to autotransformer.

c. Connect multimeter to TI output.

d. Set multimeter to measure dc volts.

e. Position TI controls as listed (1) through (3) below:

(1) **RANGE** switch to **10 V**.

(2) **MODE** switch to **DC POS**.

(3) **OUTPUT VOLTAGE** controls to **TEN.000**.

f. Energize TI and allow 2 hours for to warm-up and stabilize.

8. Output Stability

a. Performance Check

(1) Record multimeter indication.

(2) Vary autotransformer from 105 to 125 V and return to 115 V. Multimeter indication will remain within ± .009 V of indication recorded in (1) above throughout autotransformer variations.

b. Adjustments. No adjustments can be made.

9. Ac Voltage

a. Performance Check

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

(a) **MODE** switch to **1 kc RMS**.
(b) **RANGE** switch to **100 V**.
(c) **OUTPUT VOLTAGE** controls to **TEN0.00**.

(2) Set multimeter to measure ac volts.

(3) If multimeter does not indicate between 99.8450 and 100.1550 volts, perform **b** (1) below.

(4) Repeat technique of (1) through (3) above for each TI output listed in table 3.

Table 3. Ac Voltage

Test instrument switch setting			Multimeter indications (V)		Test instrument adjustments
MODE switch	**RANGE** switch (V)	**OUTPUT VOLTAGE** controls	Min	Max	
1 kc RMS	100	99.90	99.745	100.055	---
1 kc RMS	100	88.80	88.645	88.955	---
1 kc RMS	100	77.70	77.545	77.855	---
1 kc RMS	100	66.60	66.445	66.755	---
1 kc RMS	100	55.50	55.345	55.655	---
1 kc RMS	100	44.40	44.245	44.555	---
1 kc RMS	100	33.30	33.145	33.455	---
1 kc RMS	100	22.20	22.045	22.355	---

Table 3. Ac Voltage - Continued

Test instrument switch setting			Multimeter indications (V)		Test instrument adjustments
MODE switch	**RANGE** switch (V)	**OUTPUT VOLTAGE** controls	Min	Max	
1 kc RMS	100	11.10	10.945	11.255	---
1 kc RMS	10	TEN.000	9.9845	10.0155	---
1 kc RMS	1	.TEN0.00	0.99845	1.00155	---
0.4 kc RMS	100	TEN0.00	99.745	100.255	**b**(2)
1 kc P-P	100	TEN0.00	35.2952	35.40479	**b**(3)
0.4 kc P-P	100	TEN0.00	35.25985	35.44015	---

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

(a) **MODE** switch to **1 kc RMS**.
(b) **RANGE** switch to **100 mV**.
(c) **OUTPUT VOLTAGE** controls to **TEN0.00**.

(6) Multimeter will indicate between 0.0998420 and 0.1001580 mV.

(7) Set **RANGE** switch to **10 mV** and **OUTPUT VOLTAGE** controls to **TEN.000**.

(8) If multimeter does not indicate between 0.0099847 and 0.01001553 V, perform **b** (4) below.

(9) Set **RANGE** switch to **1 mV** and **OUTPUT VOLTAGE** controls to **.TEN000**.

(10) If multimeter does not indicate between 0.0099847 and 0.001001553, perform **b** (4) below.

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

(a) **MODE** switch to **0.4 kc RMS**.
(b) **RANGE** switch to **100 V**.
(c) **OUTPUT VOLTAGE** controls to **TEN0.00**.

(12) Connect multimeter to TI **± 0.3% 0.4 kc ONLY** output jack and **GND**.

(13) Multimeter will indicate between 99.545 and 100.4550 V ac.

(14) Set **MODE** switch to **0.4 kc P-P**. Multimeter will indicate between 35.18915 and 35.510843 V ac.

b. Adjustments

NOTE

Adjustment of R69, R71, or R73 affects the 100 mV (millivolt), 1 V and 10 V ranges as well as the 100 V range. They should be adjusted for the best overall indication on all ranges.

(1) Adjust R69 1 kc LEVEL (fig. 1 or 2) for 100.0000 V ac (R).

(2) Adjust R71 0.4 kc LEVEL (fig. 1 or 2) for 100.0000 V ac (R).

(3) Adjust R73 P-P LEVEL (fig. 1 or 2) for 35.3500 V ac (R).

(4) Adjust R46 1 & 10 mV AC (fig. 1 or 2) for 0.0100 or 0.0010 V ac depending on range switch setting (R).

NOTE

R46 1 & 10 mV ac (fig. 1 or 2) affects the 1 mV range as well as the 10 mV range and should be adjusted for best overall indication on both ranges.

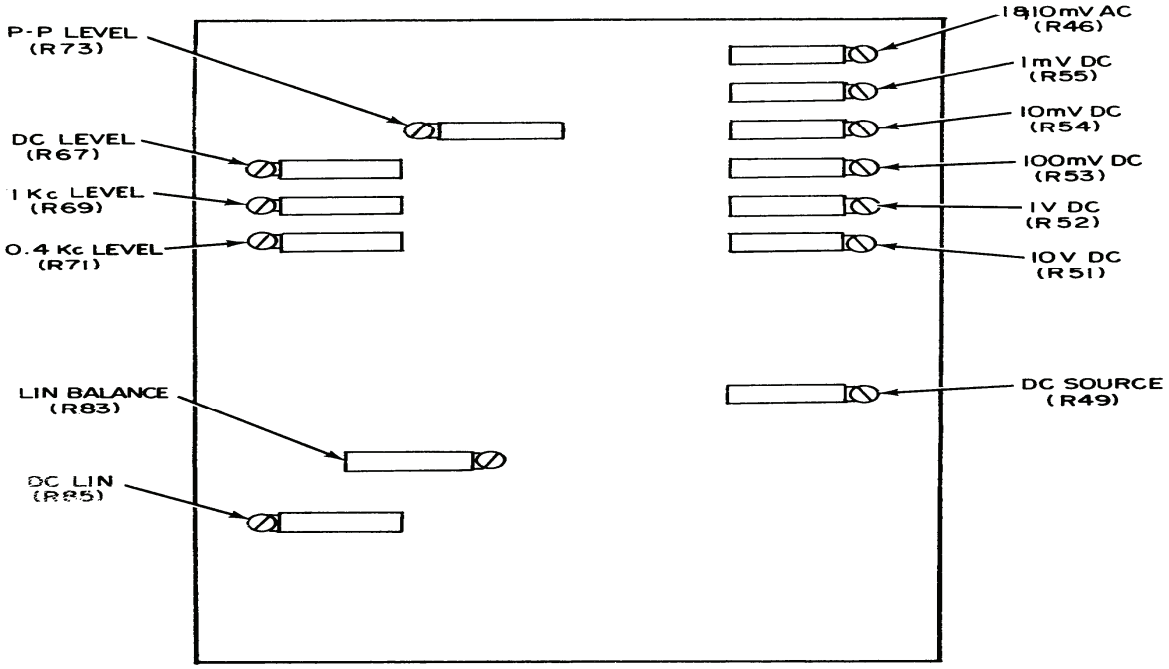

Figure 1. Model 421A (above S/N 901) adjustments.

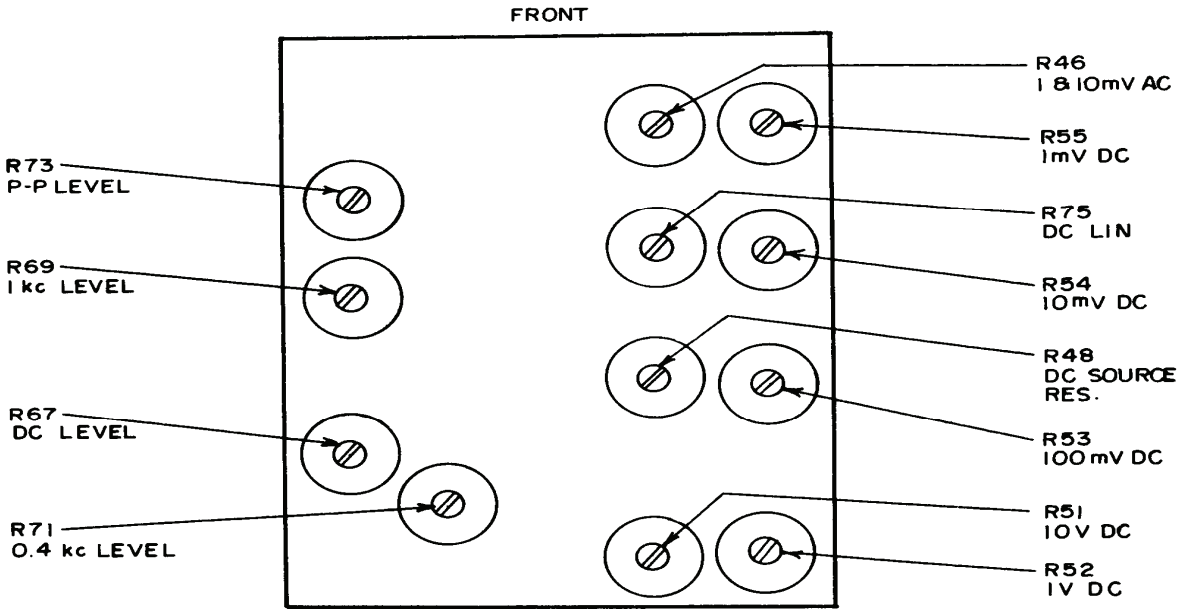

Figure 2. Model 421A (below S/N 901) adjustments.

10. Dc Voltage

a. Performance Check

(1) Adjust decade resistor to 1 megohm (999.999 ohms on model 336) and connect across TI output. This connection remains throughout the dc voltage check except where instructed specifically to change.

(2) Connect multimeter to TI output.

(3) Set multimeter to measure dc volts.

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

(a) **MODE** switch to **DC POS**.
(b) **RANGE** switch to **100 V**.
(c) **OUTPUT VOLTAGE** controls to **TEN0.00**.

(5) Measure and record TI output for each **RANGE** listed in table 4.

Table 4. Dc Voltage

RANGE switch setting	**OUTPUT VOLTAGE** control setting	Multimeter indications (V)		Adjustments
		Min	Max	
100 v	TEN0.00	99.7929	100.2070	**b**(10) through (15)
10 v	TEN.000	9.97928	10.02073	**b**(16) and (17)
1 v	.TEN000	.997905	1.00210	**b**(18) and (19)
100 mV	TEN0.00	.099768	.100232	**b**(20) and (21)
10 mV	TEN.000	.009954	.010046	**b**(22) and (23)
1 mV	.TEN000	.000973	.001027	**b**(24) and (25)

(6) Analyze recorded indications. If all indications are within specified limits, proceed to paragraph **11**. If error is approximately the same magnitude and polarity on all ranges, perform **b** (1) through (10) below. If error is only on individual ranges, perform adjustments as specified in table 4.

b. Adjustments

(1) Set **RANGE** switch to **100 V** and **OUTPUT VOLTAGE** controls to **TEN0.00**.

(2) Adjust R67 DC LEVEL (fig. 1 or 2) for a 100.0-V dc indication on multimeter (R).

(3) Set **OUTPUT VOLTAGE** controls to **10.00**.

(4) Adjust R85 DC LIN (fig. 1) [R75 DC LIN (fig. 2) for TI with S/N below 900] for a 10.0 V dc indication on multimeter (R).

NOTE

Omit steps (5) through (9) for TI's with serial numbers below 900.

(5) Set **MODE** switch to **DC NEG**.

(6) Note multimeter indication and adjust R83 LIN BALANCE (fig. 1) to eliminate half the error from 10 V (R).

(7) Adjust R85 DC LIN (fig. 1) for a 10 V indication on multimeter (R).

(8) Set **MODE** switch to **DC POS**.

(9) Repeat technique of (1) through (8) above as necessary for best overall indications.

(10) Set **RANGE** switch to **100 V** and **OUTPUT VOLTAGE** controls to **TEN0.00**.

(11) Disconnect resistant decade from TI.

(12) Measure and record TI output.

(13) Adjust resistance decade to 20 kilohms and reconnect to TI output.

(14) Adjust R48 DC RESOURCE RES (fig. 2) [R49 DC SOURCE (fig. 1) for TI with S/N below 900] to obtain multimeter indication of value recorded in (12) above, minus 4.762 V (R).

(15) Adjust resistance decade to 1 megohm.

(16) Set **RANGE** switch to **10 V** and **OUTPUT VOLTAGE** controls to **TEN.000**.

(17) Adjust R51 10 V DC (fig. 1 or 2) for a 10.0 V indication on multimeter (R).

(18) Set **RANGE** switch to **1 V** and **OUTPUT VOLTAGE** controls to **.TEN000**.

(19) Adjust R52 1 V DC (fig. 1 or 2) for a 1.0 V indication on multimeter (R).

(20) Set **RANGE** switch to **100 mV** and **OUTPUT VOLTAGE** controls to **TEN0.00**.

(21) Adjust R53 100 mV DC (fig. 1 or 2) for a l00 mV (millivolt) indication on multimeter (R).

(22) Set **RANGE** switch to **10 mV** and **OUTPUT VOLTAGE** controls to **TEN.000**.

(23) Adjust R54 10 mV DC (fig. 1 or 2) for a 10.0 mV indication on multimeter (R).

(24) Set **RANGE** switch to **1 mV** and **OUTPUT VOLTAGE** controls to **.TEN000**.

(25) Adjust R55 1 mV DC (fig. 1 or 2) for a 1.0 mV indication on multimeter (R).

11. Distortion and Frequency

a. Performance Check

(1) Connect audio analyzer to TI **OUTPUT** terminals.

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

(a) **MODE** switch to **1 kc RMS**.
(b) **RANGE** switch to **10 V**.
(c) **OUTPUT VOLTAGE** controls to **TEN.000**.

(3) Measure distortion. Distortion will be less than 0.2 percent.

(4) Set **MODE** switch to **0.4 kc RMS**.

(5) Measure distortion. Distortion will be less than 0.2 percent.

(6) Measure frequency. Frequency will be between 388 and 412 Hz.

(7) Set **MODE** switch to **1 kc RMS**. Measure frequency. Frequency will be between 970 and 1030 Hz.

b. Adjustments. No adjustments can be made.

12. Final Procedure

a. Deenergize and disconnect all equipment.

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

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army

0808504

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342062, requirements for calibration procedure TB 9-4931-290-24.

Instructions for Submitting 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@redstone.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:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter 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.

PIN: 084774-000