TB 9-6625-2045-35

22 DECEMBER 1985 CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR IMPEDANCE BRIDGE GENERAL RADIO, MODELS 1650A AND 1650B

TB 9-6625-2045-35, 29 April 1983, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
1 and 2	1 and 2
7 through 10	7 through 10

2. File this change sheet in front of the publication for reference purposes.

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Distribution:

To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

PIN: 052861-001

*TB 9-6625-2045-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR IMPEDANCE BRIDGE GENERAL RADIO MODELS 1650A AND 1650B

Headquarters, Department of the Army, Washington, DC
29 April 1983

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*This bulletin supersedes TB 11-6625-2702-35, 5 October 1977, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for calibration of Impedance Bridge, General Radio Models 1650A and 1650B. 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. Differences among models are listed within the text. Adjustments and switch setting differences for model 1650B are shown in parentheses.

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

2. DA Form 2416 (Calibration Data Card)

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25. DA Form 2416 must be annotated in accordance with TB 750-25 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) 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
Model 1650A	
Resistance	Range: 1 mΩ to 11 MΩ in 8 ranges, ac or dc Accuracy: ±1% ±mΩ (residual R ≈ 1 mΩ for ac) ±1% from 1Ω to 100 kΩ for dc An external dc supply is required for ± 1% accuracy above 100 kΩ and below 1Ω
Capacitance	Range: 1 pF to 1100 μF in 7 ranges, series or parallel Accuracy: ± 1% ± pF (residual C ≈ 0.5 pF)
Internal oscillator frequency	Range: 1 kHz Accuracy: ± 2%
Model 1650B	
Resistance	Range: 1 mΩ to 1.1 MΩ in 7 ranges, ac or dc Accuracy: ± 1% ± 1mΩ (residual R ≈ 1 mΩ) for ac ± 1% from 1Ω to 100 kΩ for dc And external dc supply is required for ± 1% accuracy above 100 kΩ and below 1Ω
Capacitance	Range: 1 pF to 1100 μF in 7 ranges, series of parallel Accuracy: ± 1% ± 1 pF (residual C ≈ 0.5 pF)
Internal oscillator frequency	Range: 1 kHz Accuracy: ± 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 Set AN/GSM-286. 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 provide a four-to-one ratio between the standard and TI.

5. Accessories Required. The accessories listed in table 3 are issued as indicated in paragraph **4** above and are 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 and model (part number)
A1	CAPACITANCE STANDARD	Range: 0.0002 to 0.2 µF Accuracy: ±0.3%	Arco, Model SS32 (7907233)
A2	FREQUENCY COUNTER	Range: 980 to 1020 Hz Accuracy: ± 0.7%	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1)
A3	RESISTANCE BRIDGE	Range: 30Ω to 17 kΩ Accuracy: ± 0.33%	ESI, Model 230B (7912150-2) w/generator detector, ESI Model 860A (791215-2)
A4	RESISTANCE STANDARD	Range: 9Ω to 810 kΩ Accuracy: ± 0.33%	Biddle-Gray, Model 601147-1 (7910328)

Table 3. Accessories Required

Item	Common name (official nomenclature)	Description (part number)
B1	CABLE[1]	30-in., RG-58/U; double banana plug terminations (7907470)
B2	CABLE (TEST LEAD)	36-in., RG-58/U; BNC plug to double banana plug terminations (7907471)
B3	LEAD	18-in., spade lug terminations (red) (7911292-10)
B4	LEAD	18-in., spade lug terminations (black) (7911292-9)

[1] Two required.

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 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.

NOTE

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 manuals for this TI.

NOTE

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

7. Equipment Setup

a. Remove TI from protective case only to gain access to adjustments.

b. Set function (GENERATOR) switch to OFF (POWER OFF).

c. Mechanically zero NULL meter on TI.

d. Set ORTHONULL NORMAL switch to ORTHONULL (IN).

e. Install 4 D cell batteries into TI.

8. DQ Dial

a. Performance Check

(1) Connect ground strap between BIAS + and BIAS - terminals on TI.

(2) Connect EXT GEN AC-DC ground terminal and BIAS + terminal on TI (UNKNOWN HIGH AND LOW terminals) to unknown 1 and 2 on resistance bridge (A3), using leads (B3 and B4).

(3) Adjust CRL (CGRL) dial to 0.

(4) Set CRL MULTIPLIER (MULTIPLIER) switch to k Ω100 (k Ω x 100).

(5) Set CRL SELECTOR (PARAMETER) switch to Cp.

(6) Adjust DQ dial to 50 on high D scale. If resistance bridge does not indicate between 31.04 and 32.96 (31.44 and 33.36) ohms, perform **b** below.

(7) Repeat technique of (6) above, for settings and indications listed in table 4. Resistance bridge indications will be within limits specified.

Table 4. DQ Dial Accuracy

Test instrument DQ dial settings (high D scale)	Resistance bridge indications (Ω)	
	Min	Max
20	77.115	81.885
10	154.40	163.98
5	308.90	327.9
2	772.10	819.9
1	1544	1640
0.5	3089	3279
0.2	7721	8199
0.1	15,440	16,400

b. Adjustments

(1) Adjust DQ dial until resistance bridge indicates 79.5 Ω.

(2) Loosen set screws on DQ dial. Reposition DQ dial for 20 on high D scale and retighten set screws.

9. CRL (CGRL) Dial

a. Performance Check

(1) Set CRL SELECTOR (PARAMETER) switch to Lp, and adjust SENSITIVITY (DET SENS) control fully ccw. Remove BIAS strap.

(2) Adjust CRL (CGRL) dial to 0.4. If resistance bridge (A3) does not indicate between 396 and 404 ohms, perform **b** below.

(3) Repeat technique of (2) above for settings and indications listed in table 5. Resistance bridge indications will be within limits specified.

Table 5. CRL (CGRL) Dial Accuracy

Test instrument CRL (CGRL) dial settings	Resistance bridge indication (Ω)	
	Min	Max
0.6	594	606
0.8	792	808
1.0	990	1010
1.2	1188	1212
1.4	1386	1414
1.6	1584	1616
1.8	1782	1818
2.0	1980	2020
2.5	2475	2525
3.0	2970	3030
3.5	3465	3535

Table 5. CRL (CGRL) Dial Accuracy - Continued

Test instrument CRL (CGRL) dial settings	Resistance bridge indications (Ω)	
	Min	Max
4.0	3960	4040
4.5	4455	4545
5	4950	5050
6	5940	6060
7	6930	7070
8	7920	8080
9	8910	9090
10	9900	10,100
11	10,890	11,110

b. Adjustments

(1) Set resistance bridge for 4300 ohms.

(2) Adjust CRL (CGRL) dial to 4.3.

(3) Adjust cam screw 6 (fig. 1) for a null indication on resistance bridge.

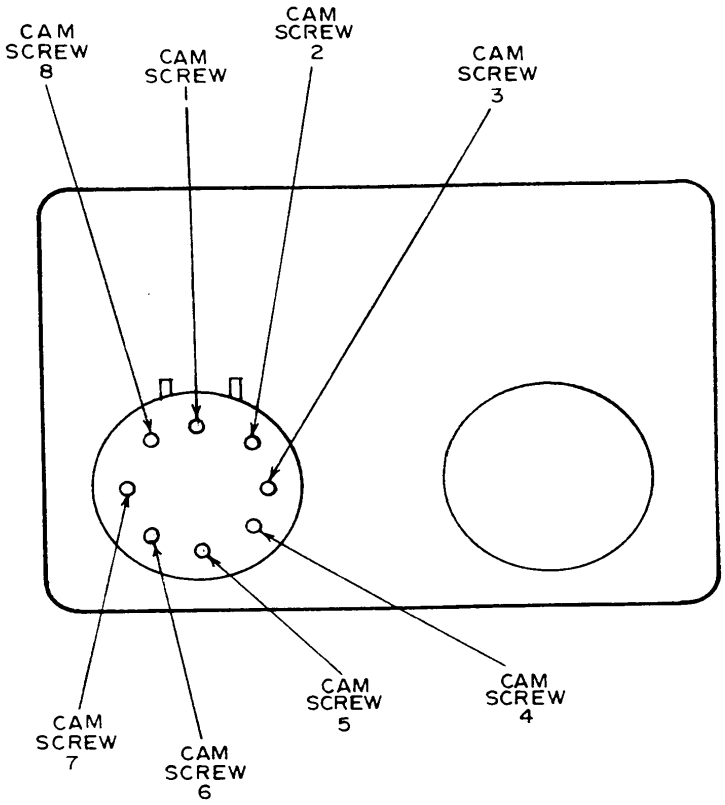

Figure 1. Impedance bridge – rear view.

(4) Repeat technique of (1) through (3) above for settings and adjustments listed in table 6.

Table 6. CRL (CGRL) Dial Accuracy

Resistance bridge settings (Ω)	Test Instrument	
	CRL (CGRL) dial settings	Cam screw adjustments (fig. 1) (R)
2700	2.7	5
1660	1.66	4
1000	1.0	3
540	0.54	2
100	0.1	1
7000	7.0	7
11000	11.0	8

10. Oscillator Frequency

a. Performance Check

(1) Connect frequency counter (A2) to TI DET OUTPUT (UNKNOWN HIGH and LOW) terminals, using cable (B2).

(2) Connect ground strap between BIAS + and BIAS - terminals on TI.

(3) Set function (GENERATOR) switch to INT 1 KC (AC INTERNAL 1 kHz) and ORTHONULL NORMAL switch to NORMAL (OUT). Adjust SENSITIVITY (OSC LEVEL) control to near midrange. Frequency counter will indicate between 980 and 1020 Hz.

b. Adjustments. No adjustments can be made.

11. Capacitance

a. Performance Check

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

(a) SENSITIVITY (DET SENS) control fully ccw.

(b) CRL SELECTOR (PARAMETER) switch to Cs.

(c) CRL MULTIPLIER (MULTIPLIER) switch to PF 100 (PF x 100).

(d) DQ dial fully cw.

(e) CRL (CGRL) dial to 2.

(f) OSC LEVEL control fully cw.

(2) Connect 0.0002 µf standard capacitor from capacitance standard set (A1) to UNKNOWN terminals.

(3) Adjust SENSITIVITY (DET SENS) control and CRL (CGRL) dial for most sensitive null indication on NULL meter. CRL (CGRL) will indicate between 1.98 and 2.02.

(4) Repeat technique of (2) and (3) above for standard capacitors settings and TI indications listed in table 7. CRL (CGRL) dial indications will be within limits specified.

Table 7. Capacitance

Standard capacitor value (µF)	Test Instrument		
	CRL MULTIPLIER (MULTIPLIER) switch position	CRL (CGRL) dial indications	
		Min	Max
0.0002	nf1 (nf x 1)	0.18	0.22
0.02	nf10 (nf x 10)	1.98	2.02
0.02	nf100 (nf x 100)	0.18	0.22
0.2	µf1 (µf x 1)	0.18	0.22

b. Adjustments. No adjustments can be made.

12. Ratio Resistors

a. Performance Check

(1) Connect equipment as shown in figure 2.

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

(a) CRL SELECTOR (PARAMETER) switch to R.

(b) Function switch to INT 6V (AC INTERNAL 1 kHz).

(c) CRL MULTIPLIER (MULTIPLIER switch to Ω1(Ω x 1).

(d) CRL (CGRL) dial to 10.

(3) Adjust resistance standard (A4) (and DET SENS) for null on null detector of resistance bridge (A3) (for null on TI). Resistance standard will indicate between 9.9 and 10.1Ω.

(4) Repeat technique of (2)(c), (d), and (3) above for settings and indicators listed in table 8. Resistance standard indications will be within limits specified.

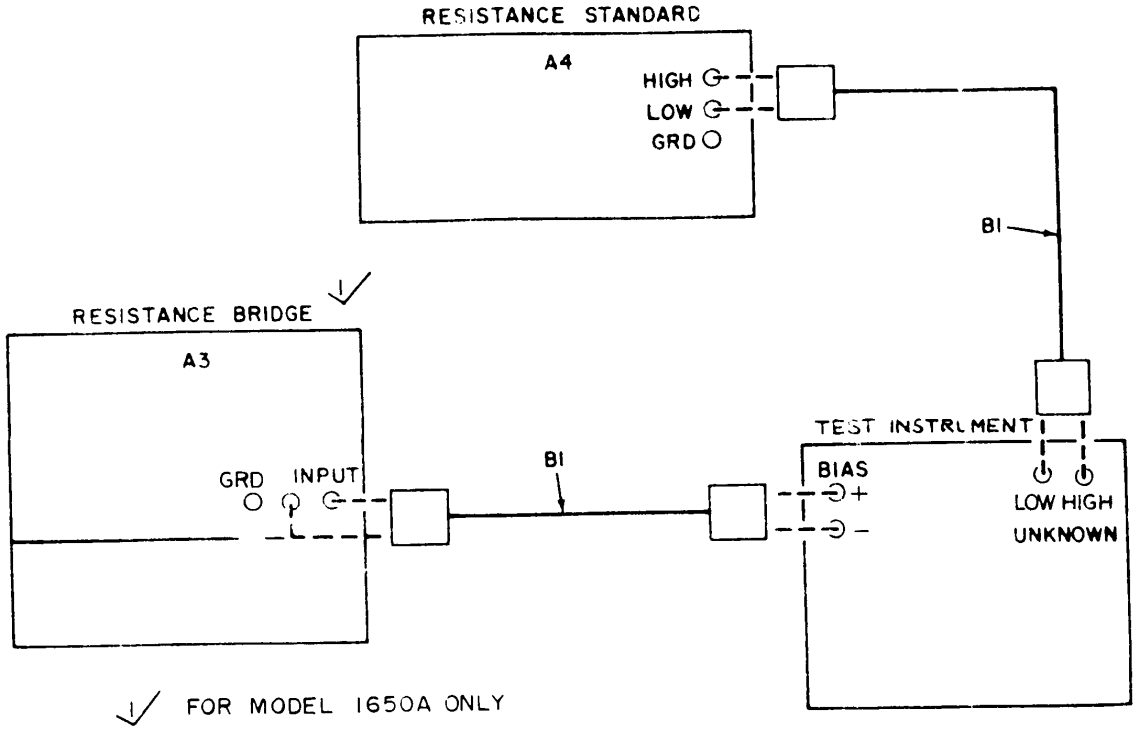

Figure 2. Ratio resistors check – equipment setup.

Table 8. Ratio Resistors

Test Instrument		Resistance standard indications (Ω)	
CRL MULTIPLIER (MULTIPLIER) switch	CRL (CGRL) dial	Min	Max
Ω10 (Ω x 10)	10	99	101
Ω100 (Ω x 100)	10	990	1010
kΩ1 (Ω x 1k)	10	9900	10,100
kΩ10 (kΩ x 10)	10	99,000	101,000
kΩ100 (kΩ x 100)	2.5	247,500	252,500
MΩ1[1]	0.8	792,000	808,000

[1]For model 1650A only.

b. Adjustments. No adjustments can be made.

13. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

b. When all parameters are within tolerance, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, repair the TI in accordance with the maintenance manual. When repair is delayed for any reason or the TI cannot be repaired with local resources annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument) and inform the owner/user accordingly, in accordance with TB 750-25.

TB 9-6625-2045-35

By Order of the Secretary of the Army:

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Distribution:

To be distributed in accordance with DA Form 12-34C, Block 319, requirements for calibration procedures publications.

US GOVERNMENT PRINTING OFFICE: 1985 - 544-007/20177

PIN: 052861-000