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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR STANDARD CAPACITORS FIXED AND VARIABLE (GENERAL)

Headquarters, Department of the Army, Washington, DC
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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 9-6625-1062-35, dated 7 November 1984, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Standard Capacitors, Fixed and Variable (General). The manufacturers' 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. Variations among models are described in text.

b. Time and Technique. The time required for this calibration is approximately 1 hour for fixed capacitors and 2 hours for variable capacitors, 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
General Radio, Types	
Capacitance:	
Model 1401-A	Range: 100 pF Accuracy ± 0.2%
Model 1401-B	Range: 200 pF Accuracy: ± 0.15%
Model 1401-C	Range: 500 pF Accuracy: ± 0.12%
Model 1401-D	Range: 1000 pF Accuracy: ± 0.1%
Model 1409-F	Range: 0.001 µF Accuracy: ± 0.05%
Model 1409-G	Range: 0.002 µF Accuracy: ± 0.05%
Model 1409-K	Range: 0.005 µF Accuracy: ± 0.05%
Model 1409-L	Range: 0.01 µF Accuracy: ± 0.05%

Table 1. Calibration Description - Continued

Test instrument standard capacitor	Performance specifications
General Radio, Types	
Capacitance:	
Model 1409-M	Range: 0.02 µF Accuracy: ± 0.05%
Model 1409-R	Range: 0.05 µF Accuracy: ± 0.05%
Model 1409-T	Range: 0.1 µF Accuracy: ± 0.05%
Model 1409-U	Range: 0.2 µF Accuracy: ± 0.05%
Model 1409-X	Range: 0.5 µF Accuracy: ± 0.05%
Model 1409-Y	Range: 1.0 µF Accuracy: ± 0.05%
Arco, Model SS-32 consisting of:	
Model SS-101	Range: 0.0001 µF Accuracy: ± 0.5 µµF
Model SS-201	Range: 0.0002 µF Accuracy: ± 0.5 µµF
Model SS-301	Range: 0.0003 µF Accuracy: ± 0.5 µµF
Model SS-401	Range: 0.0004 µF Accuracy: ± 0.5 µµF
Model SS-501	Range: 0.0005 µF Accuracy: ±(0.1% + 0.5 µµF)
Model SS-601	Range: 0.0006 µF Accuracy: ±(0.1% + 0.5 µµF)
Model SS-701	Range: 0.0007 µF Accuracy: ±(0.1% + 0.5 µµF)
Model SS-801	Range: 0.0008 µF Accuracy: ±(0.1% + 0.5 µµF)
Model SS-901	Range: 0.0009 µF Accuracy: ±(0.1% + 0.5 µµF)
Model SS-102	Range: 0.001 µF Accuracy: ±(0.1% + 0.5 µµF)
Models SS-202 through SS-504	Range: 0.002 through 0.5 µF Accuracy: ±(0.1% + 0.5 µµF)

Table 1. Calibration Description - Continued

Test instrument standard capacitor	Performance specifications
General Radio, Types	
Capacitance:	
Model 1422-D	
Low terminal	Range: 35 to 115 pF Accuracy: With corrections: ± 0.04 pF Direct reading: ± 0.1 pF ± 0.3 pF
High terminal	Range: 100 to 1150 pF Accuracy: With corrections: ± 0.3 pF Direct reading: ± 0.6 pF ± 1.5 pF
Model 722-D	
Low terminal	Range: 25 to 115 pF Accuracy: With corrections: ± 0.1% or ± 0.08 pF[1]
High terminal	Range: 100 to 1150 pF Accuracy: With corrections: ± 0.1% or ± 0.4 pF[1]
Cornell-Dubilier, Models	
Model CDA-5	Range: 0.0001 to 0.001 µF Accuracy: ± 5%
Model CDB-5	Range: 0.01 to 1.1 µF Accuracy: ± 5%
Model CDB-3 (MX 198/U)	Range: 0.01 to 1.1 µF Accuracy: ± 3%
Model ZM-59/U	Range: 0.001 to 1.099 µF Accuracy: ± 0.5% Zero capacitance: 30 µµF
General Radio, Types	
Model 1419B	Range: 0.0001 to 1.1110 µF Accuracy: ± 1% for 0.1, 0.01, and 0.001 µF decades ±(1% + 2 pF) for 0.0001 µF decade
Model 1419M (MX-4618/U)	Range: 0.001 to 1.110 µF Accuracy: ± 1.5% for 0.1 µF decade ± 1% for 0.01 and 0.001 µF decades Zero capacitance: 35 pF (2 terminal) 16 pF (3 terminal)
Model 1419A (MX-9266)	Range: 0.001 to 1 µF Accuracy: ± 1%

See footnote at end of table.

Table 1. Calibration Description - Continued

Test instrument standard capacitor	Performance specifications
Capacitance: Model 219K Model 219M	 Range: 0.001 to 1.110 μF Accuracy: ± 1% Zero capacitance: 46 μμF Range: 0.01 to 1.110 μF Accuracy: ± 2% 0.1 μF decade ± 1% all other decades Zero capacitance: 44 μμF

[1]Whichever is greater.

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-287 or AN/GSM-705 and Secondary Reference Calibration Standards Set NSN 4931-00-621-7878. 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 ratio between the standard and TI. Where the four-to-one ratio cannot be met, the four-to-one 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 this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common Name	Minimum Use Specifications	Manufacturer and Model (Part Number)
CAPACITANCE BRIDGE (SECONDARY)	Range: 0 to 1.150 μF Accuracy: ±0.125%% Range: 0 to 1151.2 pF Accuracy: ±0.012%	Andeen-Hagerling, Model 2550A
CAPACITANCE/INDUCTANCE MEASURING SYSTEM (TRANSFER)	Range: 0.1 pF to 2000 μF[1] Accuracy: ± 0.05 %	Wayne Kerr, Model 6425B (MIS-45837)

[1]Verified from 100 pF to 1 μF.

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraph **6** 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 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.

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 OUTPUT(S) to minimum after each step within the performance check where applicable.

7. Capacitors (Fixed)

a. Performance Check

(1) Adjust capacitance bridge for 1 kHz operation.

(2) Adjust capacitance bridge to obtain residual capacitance. Record the value for each range being used.

(3) Connect TI to capacitance bridge **UNKNOWN CAPACITANCE HIGH** and **LOW** terminals with TI **G** banana plug plugged into **LOW** terminal of capacitance bridge.

(4) Measure capacitance and record capacitance indication.

(5) Subtract value recorded in (2) above from value recorded in (4) above. The difference is the measured value. A test report is required for all General Radio, Types 1401, 1409, and Arco, Model SS-32 capacitors. Record this value in the calibration test report for each series of capacitors as required in paragraph 9. (See sample test reports for 1401, 1409, and SS-32).

NOTE

Perform (6) through (9) below for Arco, Model SS-32 set, using 0.0001 capacitor and four-position adapter.

(6) Connect four-position adapter and 0.0001 capacitor to capacitance bridge.

(7) Measure capacitance and record capacitance indication.

(8) Subtract value recorded in (4) above for the 0.0001 capacitor from value recorded in (6) above. Record this difference on test report as capacitance of four-position adapter.

(9) Remove adapter.

(10) Repeat (3) through (5) above for remaining General Radio, Types 1401, 1409, and Arco, Model SS-32 components.

b. Adjustments. No adjustments can be made.

8. Capacitors (Variable)

a. Performance Check

(1) Turn all TI controls to zero (for General Radio, Type 1422-D set dial to 350; for General Radio, Types 722-D set dial to 250).

NOTE

Position TI, cables, and adapters so that minimum movement is required for connections during calibration. Always approach TI setting from a lower value to a higher value.

(2) Connect TI **LOW** terminal to TI **GND** terminal, using grounding strap supplied with TI (for General Radio, Type 1422-D connect strap between **1150 pF** and **GND** terminals; for General Radio, Type 722 series connect strap between **HI** and **G** or center terminal).

NOTE

For transfer level calibration perform (3) through (9) below; for reference level calibration perform (10) through (31) below.

NOTE

Before using the capacitance/inductance measuring system the Trimming O/C and S/C procedure in the manufacturer's manual should be completed.

(3) Connect Kelvin leads (supplied with capacitance/inductance measuring system) to capacitance/inductance measuring system, observing and matching color coding on both.

(4) Perform the Trimming O/C and S/C procedure listed in the manufacturer's manual.

(5) Connect TI to capacitance/inductance measuring system.

(6) The capacitance/inductance measuring system value will not be greater than the zero capacitance value for TI model listed in table 3. For models not listed in table 3, proceed to (7) below.

Table 3. Zero Capacitance

Test instrument	Zero capacitance (Pf)
ZM-59/U (Sprague 283W2)	30
Cornell-Dubilier, Model	
CDA-5	- - -
CDB-5	- - -
CDB-3 (MX-198-U)	- - -
General Radio, Types	
1419B	- - -
1419M (MX-4618/U)	35 for two terminal 16 for three terminal
1419A (MX-9266)	- - -
219K	46
219M	44

(7) Turn TI to first position indicated in appropriate table for model being calibrated.

(8) Capacitance/inductance measuring system will indicate within limits specified in appropriate table below.

(9) Repeat technique of (7) and (8) above for remaining TI switch positions on model being calibrated.

(10) Connect TI to capacitance bridge.

(11) Set capacitance bridge for three-terminal operation and measure capacitance. Record value as lead capacitance.

NOTE

Perform (12) through (21) below for General Radio, Type 722-D and (17) and (22) through (33) below for General Radio, Type 1422-D.

(12) Connect capacitance bridge to **115** and **LO** terminals of TI.

(13) Adjust TI for indication of 250 on dial. Measure capacitance and record value.

(14) Subtract value recorded in (11) above from value in (13) above. Calculated value will be within ± 0.08 pF of previous test report value. Record value obtained on new test report (See sample test report).

NOTE

Round off corrected value to two decimal places.

(15) Repeat technique of (13) and (14) above at each remaining low range dial setting listed on the test report. Values will be within the tabulated tolerances listed in table 4 of previous test report values.

Table 4. General Radio, Type 722-D Check

Type 722-D Low Range		Type 722-D High Range	
Settings	Tolerances (pF)	Settings	Tolerances (pF)
25	±0.08	100	±0.40
30	±0.08	150	±0.40
35	±0.08	200	±0.40
40	±0.08	250	±0.40
45	±0.08	300	±0.40
50	±0.08	350	±0.40
55	±0.08	400	±0.40
60	±0.08	450	±0.45
65	±0.08	500	±0.50
70	±0.08	550	±0.55
75	±0.08	600	±0.60
80	±0.08	650	±0.65
85	±0.08	700	±0.70
90	±0.09	750	±0.75
95	±0.10	800	±0.80
100	±0.10	850	±0.85
105	±0.10	900	±0.90
110	±0.11	950	±0.95
115	±0.12	1000	±1.00
- - -	- - -	1050	±1.05
- - -	- - -	1100	±1.10
- - -	- - -	1150	±1.15

(16) Disconnect capacitance bridge from **LOW** and center terminal and move shorting bar of TI to **LOW** and center terminals.

(17) Connect capacitance bridge **UNKNOWN HIGH** and **LOW** terminals to TI **HIGH** and center terminals

(18) Adjust TI for indication of 100 on dial.

(19) Measure capacitance and record value.

(20) Subtract value recorded in (11) above from value recorded in (19) above. Calculated value will be within ±0.4 pF of previous test report value. Record value on test report.

(21) Repeat technique of (18) through (20) above at each remaining high range setting on test report. Values will be within the tabulated tolerances listed in table 4 of previous test report values. Record values on test report.

(22) Adjust TI for indication of 350 on dial.

(23) Measure capacitance and record value.

(24) Subtract value recorded in (11) above from value recorded in (23) above. Calculated value will be within ±0.04 pF of previous test report value. Record value on test report.

NOTE

If measurements exceed ±0.3 pF from nominal on the low range, or ± 1.5 pF from nominal on the high range, perform (1) through (3) below.

(25) Repeat technique of (22) through (24) above at each remaining low range setting on test report. Calculated values will be within ± 0.04 pF of previous test report values. Record values on test report.

(26) Move shoring bar of TI to **115** and **G** terminals.

(27) Connect capacitance bridge **UNKNOWN HIGH** and **LOW** terminals to TI **1150** and **G** terminals.

(28) Adjust TI for indication of 100 on dial.

(29) Measure capacitance and record value.

(30) Subtract value recorded in (13) above from value recorded in (31) above. Calculated value will be within ± 0.3 pF of previous test report value. Record value on test report.

NOTE

If measurements exceed ±0.3 pF from nominal on the low range, or ± 1.5 pF from nominal on the high range, perform (1) through (3) below.

(31) Repeat technique of (28) through (30) above at each remaining high range setting on test report. Calculated values will be within ±0.3 pF of previous test report values. Record values on test report.

b. Adjustments

(1) To adjust the low range, remove the correction chart cover and cover screws (fig. 1) and adjust C1 LOW RANGE to center the maximum positive and maximum negative error around the nominal.

Example I:

- **a**. Maximum positive error - + 0.12 pF
- **b**. Maximum negative error - - 0.04 pF
- **c**. Algebraic difference (a-b) - 0.16 pF
- **d**. a - b ÷ 2 = New maximum and minimum error values - ± 0.08

Example II:

- **a**. Maximum positive error - +0.12 pF
- **b**. Maximum negative error - +0.04 pF
- **c**. Algebraic difference (a-b) - 0.08 pF
- **d**. a - b ÷ 2 = New maximum and minimum error values - ± 0.04

(2) Set dial to the point where the maximum positive error was recorded and adjust C1 LOW RANGE (fig. 1) to obtain the maximum positive value calculated in (1) above. Check at the maximum negative error point, and repeat adjustments as required.

(3) To adjust the high range, adjust C2 HIGH RANGE (fig. 1) using method provided in (1) and (2) above.

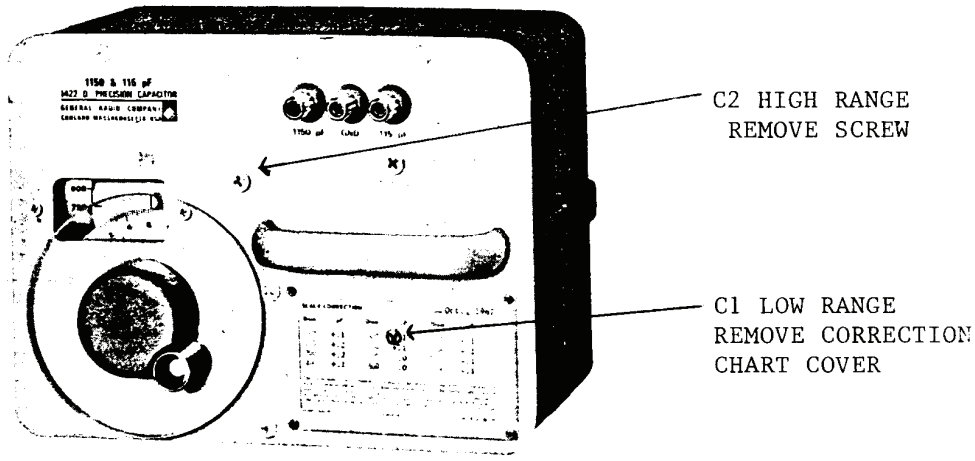

Figure 1. 1422D adjustments.

(4) Repeat **8** (a) (13) and (24) through (33) above until no adjustment is required.

NOTE

Adjustments of C1 or C2 cancels historical drift rate data and tolerance criteria referenced in previous test report. After adjustments, drift rate data and tolerance criteria will be referred to the nominal value set above and a new test report prepared. When a new test report is prepared, the date should be noted.

9. Calibration Test Report. A calibration test report is required for the General Radio, Types 1401 series, 1409 series, 722 series, 1422-D, and Arco, Model SS-32 capacitors.

a. Instruments whose value has drifted outside manufacturer's specifications when referenced to nominal values, yet the drift rate is sufficiently low to allow use within manufacturer's specified accuracy of the previous test report value.

b. Instruments that have values and stability better than the manufacturer's specifications may be utilized at greater accuracies when test report values are used.

The performance specifications will be ascertained by referencing present measured values to previous measured values in lieu of present to nominal values. If present measured values are not within manufacturer's accuracy specification of last measured value, the TI must be red-tagged. Calibration activities will maintain a case history file of test reports for the TI. The file will contain an accumulation of at least six of the most recent test reports. If in four successive calibrations the measured value drifts from the nominal value

as much as three times the manufacturer's accuracy specification, the instrument must be red-tagged. An example of calibration data to be annotated on the test report is shown on the sample test report.

Table 5. Cornell-Dubilier, Model CDA-5 Capacitance

Test instrument		Capacitance/inductance measurement system indications (μF)	
Left Switch	Right Switch	Min	Max
0	0.0001	0.000095	0.000105
0	0.0002	0.000190	0.000210
0	0.0003	0.000285	0.000315
0	0.0004	0.000380	0.000420
0	0.0005	0.000475	0.000525
0	0.0006	0.000570	0.000630
0	0.0007	0.000665	0.000735
0	0.0008	0.000760	0.000840
0	0.0009	0.000855	0.000945
0	0.001	0.00095	0.00105
0.001	0	0.00095	0.00105
0.002	0	0.00190	0.00210
0.003	0	0.00285	0.00315
0.004	0	0.00380	0.00420
0.005	0	0.00475	0.00525
0.006	0	0.00570	0.00630
0.007	0	0.00665	0.00735
0.008	0	0.00760	0.00840
0.009	0	0.00855	0.00945
0.01	0	0.00950	0.01050

Table 6. Cornell-Dubilier, Model CDB-3 (MX-198/U), Capacitance

Test instrument		Capacitance/inductance measurement system Indications (μF)	
Left Switch	Right Switch	Min	Max
0	0.01	0.0097	0.0103
0	0.02	0.0194	0.0206
0	0.03	0.0291	0.0309
0	0.04	0.0388	0.0412
0	0.05	0.0485	0.0515
0	0.06	0.0582	0.0618
0	0.07	0.0679	0.0721
0	0.08	0.0776	0.0824
0	0.09	0.0873	0.0927
0	0.1	0.0970	0.1030
0.1	0	0.0970	0.1030
0.2	0	0.1940	0.2060
0.3	0	0.2910	0.3090
0.4	0	0.3880	0.4120
0.5	0	0.4850	0.5150
0.6	0	0.5820	0.6180
0.7	0	0.6790	0.7210
0.8	0	0.7760	0.8240

Table 7. Cornell-Dubilier, Model CDB-5 Capacitance

Test instrument		Capacitance/inductance measurement system indications (μF)	
Left Switch	Right Switch	Min	Max
0.9	0	0.8730	0.9270
1.0	0	0.9700	1.0300
0	0.01	0.0095	0.0105
0	0.02	0.0190	0.0210
0	0.03	0.0285	0.0315
0	0.04	0.0380	0.0420
0	0.05	0.0475	0.0525
0	0.06	0.0570	0.0630
0	0.07	0.0665	0.0735
0	0.08	0.0760	0.0840
0	0.09	0.0855	0.0945
0	0.1	0.0950	0.1050
0.1	0	0.0950	0.1050
0.2	0	0.1900	0.2100
0.3	0	0.2850	0.3150
0.4	0	0.3800	0.4200
0.5	0	0.4750	0.5250
0.6	0	0.5700	0.6300
0.7	0	0.6650	0.7350
0.8	0	0.7600	0.8400
0.9	0	0.8550	0.9450
1.0	0	0.9500	1.0500

Table 8. 1419A (MX-9266) and General Radio, Type 219K Capacitance

Test instrument decade switch settings			Capacitance measurement system indications (μF)	
0.001 μF/STEP decade	0.01 μF/STEP decade	0.1 μF/STEP decade	Min	Max
1	0	0	0.00099	0.00101
2	0	0	0.00198	0.00202
3	0	0	0.00297	0.00303
4	0	0	0.00396	0.00404
5	0	0	0.00495	0.00505
6	0	0	0.00594	0.00606
7	0	0	0.00693	0.00707
8	0	0	0.00792	0.00808
9	0	0	0.00891	0.00909
10	0	0	0.0099	0.0101
0	1	0	0.0099	0.0101
0	2	0	0.0198	0.0202
0	3	0	0.0297	0.0303
0	4	0	0.0396	0.0404
0	5	0	0.0496	0.0505
0	6	0	0.0594	0.0606
0	7	0	0.0693	0.0707
0	8	0	0.0792	0.0808
0	9	0	0.0891	0.0909

Table 8. 1419A (MX-9266) and General Radio, Type 219K Capacitance - Continued

Test instrument decade switch settings			Capacitance measurement system indications (μF)	
0.001 μF/STEP decade	0.01 μF/STEP decade	0.1 μF/STEP decade	Min	Max
0	10	0	0.099	0.101
0	0	1	0.099	0.101
0	0	2	0.198	0.202
0	0	3	0.297	0.303
0	0	4	0.396	0.404
0	0	5	0.495	0.505
0	0	6	0.594	0.606
0	0	7	0.693	0.707
0	0	8	0.792	0.808
0	0	9	0.891	0.909
0	0	10	0.99	1.01

Table 9. General Radio, Type 219M Capacitance

Test instrument decade switch settings			Capacitance measurement system indications (μF)	
0.001 μF/STEP decade	0.01 μF/STEP decade	0.1 μF/STEP decade	Min	Max
1	0	0	0.00099	0.00101
2	0	0	0.00198	0.00202
3	0	0	0.00297	0.00303
4	0	0	0.00396	0.00404
5	0	0	0.00495	0.00505
6	0	0	0.00594	0.00606
7	0	0	0.00693	0.00707
8	0	0	0.00792	0.00808
9	0	0	0.00891	0.00909
10	0	0	0.0099	0.0101
0	1	0	0.0099	0.0101
0	2	0	0.0198	0.0202
0	3	0	0.0297	0.0303
0	4	0	0.0396	0.0404
0	5	0	0.0495	0.0505
0	6	0	0.0594	0.0606
0	7	0	0.0693	0.0707
0	8	0	0.0792	0.0808
0	9	0	0.0891	0.0909
0	10	0	0.099	0.101
0	0	1	0.098	0.102
0	0	2	0.196	0.204
0	0	3	0.294	0.306
0	0	4	0.392	0.408
0	0	5	0.490	0.510
0	0	6	0.588	0.612
0	0	7	0.686	0.714
0	0	8	0.784	0.816

Table 10. General Radio, Type 1419B Capacitance

Test instrument decade switch settings				Capacitance measurement system indications (μF)	
0.0001 μF/ STEP decade	0.001 μF/ STEP decade	0.01 μF/ STEP decade	0.1 μF/ STEP decade	Min	Max
0	0	9	0.882	0.918	
0	0	10	0.980	1.020	
1	0	0	0	0.000097	0.000103
2	0	0	0	0.000196	0.000204
3	0	0	0	0.000295	0.000305
4	0	0	0	0.000394	0.000406
5	0	0	0	0.000493	0.000507
6	0	0	0	0.000592	0.000608
7	0	0	0	0.000691	0.000709
8	0	0	0	0.000790	0.000810
9	0	0	0	0.000889	0.000911
10	0	0	0	0.000988	0.001012
0	1	0	0	0.00099	0.00101
0	2	0	0	0.00198	0.00202
0	3	0	0	0.00297	0.00303
0	4	0	0	0.00396	0.00404
0	5	0	0	0.00495	0.00505
0	6	0	0	0.00594	0.00606
0	7	0	0	0.00693	0.00707
0	8	0	0	0.00792	0.00808
0	9	0	0	0.00891	0.00909
0	10	0	0	0.0099	0.0101
0	0	1	0	0.0099	0.0101
0	0	2	0	0.0198	0.0202
0	0	3	0	0.0297	0.0303
0	0	4	0	0.0396	0.0404
0	0	5	0	0.0495	0.0505
0	0	6	0	0.0594	0.0606
0	0	7	0	0.0693	0.0707
0	0	8	0	0.0792	0.0808
0	0	9	0	0.0891	0.0909
0	0	10	0	0.099	0.101
0	0	0	1	0.099	0.101
0	0	0	2	0.198	0.202
0	0	0	3	0.297	0.303
0	0	0	4	0.396	0.404
0	0	0	5	0.495	0.505
0	0	0	6	0.594	0.606
0	0	0	7	0.693	0.707
0	0	0	8	0.792	0.808
0	0	0	9	0.891	0.909
0	0	0	10	0.99	1.01

Table 11. General Radio, Type 1419M (MX-4618/U) Capacitance

Test instrument decade switch settings			Capacitance measurement system indications (μF)	
0.001 μF/STEP decade	0.01 μF/STEP decade	0.1 μF/STEP decade	Min	Max
1	0	0	0.00099	0.00101
2	0	0	0.00198	0.00202
3	0	0	0.00297	0.00303
4	0	0	0.00396	0.00404
5	0	0	0.00495	0.00505
6	0	0	0.00594	0.00606
7	0	0	0.00693	0.00707
8	0	0	0.00792	0.00808
9	0	0	0.00891	0.00909
10	0	0	0.0099	0.0101
0	1	0	0.0099	0.0101
0	2	0	0.0198	0.0202
0	3	0	0.0297	0.0303
0	4	0	0.0396	0.0404
0	5	0	0.0495	0.0505
0	6	0	0.0594	0.0606
0	7	0	0.0693	0.0707
0	8	0	0.0792	0.0808
0	9	0	0.0891	0.0909
0	10	0	0.099	0.101
0	0	1	0.0985	0.1015
0	0	2	0.1970	0.2030
0	0	3	0.2955	0.3045
0	0	4	0.3940	0.4060
0	0	5	0.4925	0.5075
0	0	6	0.5910	0.6090
0	0	7	0.6895	0.7105
0	0	8	0.7880	0.8120
0	0	9	0.8865	0.9135
0	0	10	0.9850	1.0150

Table 12. ZM-59/U Capacitance

Test instrument		Capacitance measurement system Indications (μF)	
Selector switch setting	Capacitance value (μF)	Min	Max
1	0.1	0.0995	0.1005
2	0.2	0.1990	0.2010
3	0.3	0.2985	0.3015
4	0.4	0.3980	0.4020
5	0.5	0.4975	0.5025
6	0.6	0.5970	0.6030
7	0.7	0.6965	0.7035
8	0.8	0.7960	0.8040
9	0.9	0.8955	0.9045
10	1.0	0.9950	1.0050
1[1]	0.01	0.00995	0.01005

See footnote at end of table.

Table 12. ZM-59/U Capacitance - Continued

Test instrument		Capacitance measurement system Indications (μF)	
Selector switch setting	Capacitance value (μF)	Min	Max
2	0.02	0.01990	0.02010
3	0.03	0.02985	0.03015
4	0.04	0.03980	0.04020
5	0.05	0.04975	0.05025
6	0.06	0.05970	0.06030
7	0.07	0.06965	0.07035
8	0.08	0.07960	0.08040
9	0.09	0.08955	0.09045
1[2]	0.001	0.000995	0.001005
2	0.002	0.001990	0.002010
3	0.003	0.002985	0.003015
4	0.004	0.003980	0.004020
5	0.005	0.004975	0.005025
6	0.006	0.005970	0.006030
7	0.007	0.006965	0.007035
8	0.008	0.007960	0.008040
9	0.009	0.008955	0.009045

[1]Turn outer dial to 0.
[2]Turn center dial to 0.

10. 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 750-25-1.

NOTE

For fixed value, non adjustable capacitors: If the TI has not drifted more than the allowable tolerance from the previous test report, the TI will be considered within tolerance.

CALIBRATION TEST REPORT FOR VARIABLE AIR CAPACITOR

_____

(ORGANIZATION)

_____

REPORT OF CALIBRATION FOR
VARIABLE AIR CAPACITOR

_____

(NOMENCLATURE)
GENERAL RADIO COMPANY

_____

(MANUFACTURER)

_____

(IDENTIFICATION)
(MODEL AND SERIAL NO.)

SUBMITTED BY

(ACTIVITY AND UIC) _____

HIGH RANGE 100-1150 pF

Setting	**MEASURED VALUE**	*Setting*	**MEASURED VALUE**
100		550	
150		600	
200		650	
250		700	
300		750	
350		800	
400		850	
450		900	
500		950	
510		1000	
520		1050	
530		1100	
540		1150	

LOW RANGE 25-115 pF

Setting	**MEASURED VALUE**	*Setting*	**MEASURED VALUE**
25*		65	
30*		70	
35		75	
40		80	
45		85	
50		90	
51		95	
52		100	
53		105	
54		110	
55		115	
60			

*Model 722-D only.

UNDER THE CONDITIONS STATED, THE ABOVE MEASURED VALUES ARE IN ERROR BY NO MORE THAN ** THIS CALIBRATION IS TRACEABLE TO AND COMPATIBLE WITH NATIONAL BUREAU OF STANDARDS MEASUREMENTS.

CALIBRATION REPORT NO._____
TEMPERATURE: _____
REL HUMIDITY: _____
FREQUENCY: 1 kHz

DATE: _____

_____
CALIBRATION TECHNICIAN

_____
FACILITY CHIEF

**722-D ± 0.1% or ± 0.4 pF whichever is greater for the 100 to 1150 pF range.
± 0.1% or ± 0.08 pF whichever is greater for the 25 to 115 pF range.

1422-D ± 0.3 pF for the 100 to 1150 pF range.
± 0.4 pF for the 35 to 115 pF range.

CALIBRATION TEST REPORT FOR STANDARD CAPACITOR

_____

(ORGANIZATION) _____

REPORT OF CALIBRATION FOR

STANDARD CAPACITOR

_____

(NOMENCLATURE)

GENERAL RADIO COMPANY

_____

(IDENTIFICATION)
(MODEL AND SERIAL NO.)

SUBMITTED BY

(ACTIVITY _____
AND _____
UIC) _____

CALIBRATION MEASUREMENT VALUES

_____

MODEL 1401 SERIES			
MODEL	**SERIAL NUMBER**	**NOMINAL VALUE (MICROMICROFARADS).**	**MEASURED VALUE (MICROMICROFARADS).**

UNDER THE CONDITIONS STATED, THE ABOVE MEASURED VALUES ARE IN ERROR BY NO MORE THAN ± 0.2% FOR 1401AP, ± 0.15% FOR 1401B, ± 0.12% FOR 1401C, AND ± 0.1% FOR 1401D. THIS CALIBRATION IS TRACEABLE TO AND COMPATIBLE WITH NATIONAL BUREAU OF STANDARDS MEASUREMENTS.

CALIBRATION REPORT NO:
TEMPERATURE:
REL HUMIDITY:
FREQUENCY: 1 kHz
PAGE 1 OF 1
DATE:

_____
CALIBRATION TECHNICIAN

_____
FACILITY CHIEF

CALIBRATION TEST REPORT FOR STANDARD CAPACITOR

_____

(ORGANIZATION)_____

_____

REPORT OF CALIBRATION FOR
STANDARD CAPACITOR

_____

(NOMENCLATURE)
GENERAL RADIO COMPANY

_____

(MANUFACTURER)
1409 SERIES

_____

(IDENTIFICATION)
(MODEL)
SUBMITTED BY:

(ACTIVITY _____
AND _____
UIC) _____

CALIBRATION MEASUREMENT VALUES

MODEL 1409 SERIES			
MODEL	**SERIAL NUMBER**	**NOMINAL VALUE (MICROFARADS).**	**MEASURED VALUE (MICROFARADS).**

UNDER THE CONDITIONS STATED, THE ABOVE MEASURED VALUES ARE IN ERROR BY NO MORE THAN ±0.05 THIS CALIBRATION IS TRACEABLE TO AND COMPATIBLE WITH NATIONAL BUREAU OF STANDARDS MEASUREMENTS.

CALIBRATION REPORT NO:
TEMPERATURE:
REL HUMIDITY:
FREQUENCY: 1 kHz
PAGE 1 OF 1 PAGE
RATE:

_____
CALIBRATION TECHNICIAN

_____
FACILITY CHIEF

CALIBRATION TEST REPORT FOR CAPACITANCE STANDARD SET

_____

(ORGANIZATION) _____

_____

REPORT OF CALIBRATION FOR
CAPACITANCE STANDARD SET

_____

(NOMENCLATURE)
ARCO ELECTRONICS INC.

_____

(MANUFACTURER)
SS-32

_____

(IDENTIFICATION)
(MODEL AND SERIAL NO.)
SUBMITTED BY

(ACTIVITY _____
AND _____
UIC) _____

CALIBRATION MEASUREMENT VALUES

PART NUMBER	NOMINAL VALUE (MICROFARAD)	MEASURED VALUE (MICROFARAD)	PART NUMBER	NOMINAL VALUE (MICROFARAD)	MEASURED VALUE (MICROFARAD)
SS-101	0.0001		SS-203	0.02	
SS-201	0.0002		SS-303	0.03	
SS-301	0.0003		SS-403	0.04	
SS-401	0.0004		SS-503	0.05	
SS-501	0.0005		SS-603	0.06	
SS-601	0.0006		SS-703	0.07	
SS-701	0.0007		SS-803	0.08	
SS-801	0.0008		SS-903	0.09	
SS-901	0.0009		SS-104	0.1	
SS-102	0.001		SS-204	0.2	

CALIBRATION MEASUREMENT VALUES - CONTINUED

PART NUMBER	NOMINAL VALUE (MICROFARAD)	MEASURED VALUE (MICROFARAD)	PART NUMBER	NOMINAL VALUE (MICROFARAD)	MEASURED VALUE (MICROFARAD)
SS-202	0.002		SS-304	0.3	
SS-302	0.003		SS-404	0.4	
SS-402	0.004		SS-504	0.5	
SS-502	0.005				
SS-602	0.006				
SS-702	0.007				
SS-802	0.008				
SS-902	0.009				
SS-103	0.01				

UNDER THE CONDITIONS STATED, THE ABOVE MEASURED VALUES ARE IN ERROR BY NO MORE THAN ± * %. THIS CALIBRATION IS TRACEABLE TO AND COMPATIBLE WITH NATIONAL BUREAU OF STANDARDS MEASUREMENTS. MEASURED VALUE OF THE 4.5 μμf ADAPTER WAS_____ μμF.

CALIBRATION REPORT NO:
TEMPERATURE:
REL HUMIDITY:
FREQUENCY: 1 kHz
PAGE 2 of 2 PAGES
DATE:

_____
CALIBRATION TECHNICIAN

_____
FACILITY CHIEF

_____
± 0.5 μμF FROM 100 TO 400 μμF AND ± (0.1% + 0.5 μμF) FROM 500 μμF TO 0.5 μF.

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

0729701

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342115, requirements for calibration procedure TB9-6625-1062-24.

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: 084392-000