# NAVAIR 17-20AE-254

AE-254

TECHNICAL MANUAL

INSTRUMENT CALIBRATION PROCEDURE

# DC VOLTAGE STANDARD

FLUKE
332D

THIS PUBLICATION SUPERSEDES NAVAIR 17-20AE-254
DATED 1 AUGUST 2001



AE-254



**PUBLISHED BY DIRECTION OF COMMANDER NAVAL AIR SYSTEMS COMMAND**

# 1 APRIL 2012

# LIST OF EFFECTIVE PAGES

The purpose of this list is to identify the pages in this document affected by any technical content changes made since the previous release of the document.

NOTE: On a revised page, with the exception of the Title, the A, and the i pages, the technical changes are indicated by a vertical line in the outer margin of the page.

| Page No. ** | Revision* | Page No. ** | Revision* | Page No. ** | Revision* |
|---|---|---|---|---|---|
| Title | 0 | | | | |
| A | 0 | | | | |
| i | 0 | | | | |
| 1 to 8 | 0 | | | | |
| A-1 to A-8 | 0 | | | | |

*Zero in this column indicates an original page.
“R” in this column indicates a revised page.
**All pages not listed are blank pages.

# TABLE OF CONTENTS



# ILLUSTRATIONS



# TABLES

# SECTION 1

# INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration of Fluke 332D DC Voltage Standard. The instrument being calibrated is referred to herein as the TI (Test Instrument).

1.2 All comments concerning this procedure should be directed to the Measurement Science Department, Corona Division, Naval Surface Warfare Center, P.O. Box 5000, Corona, CA 92878-5000.

1.3 This procedure includes tests of essential performance parameters only. Any malfunction noticed during calibration, whether specifically tested for or not, should be corrected.

Table 1. Calibration Description

| TI Characteristics | Performance Specifications | Test Method |
|---|---|---|
| Load and line regulation | Tolerance: 0.0002% of setting or 10 μV for either a 10% line voltage change or a full load change. | The TI output voltage is monitored while the line voltage is changed or while the load is changed from full load to no load. |
| Voltage standard (output voltage) | Fluke 332D<br>Output voltage: 0 to 1111.1110 V dc<br>Output current: 0 to 50 mA<br>Voltage ranges: 10, 100 and 1000 V<br>Resolution: 0.1 ppm of range<br><br>Tolerance:<br>10 V range: ±(0.007% iv +85 μV)<br>100 V range: ±(0.007% iv + 325 μV)<br>1000 V range: ±(0.0075% iv + 505 μV) | The output of a standard-cell-referenced direct-voltage-measurement system is for adjusting certain circuits, and for measuring the TI output voltages. |

# SECTION 2

# EQUIPMENT REQUIREMENTS

## NOTES

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment, which may be used at the discretion of the using laboratory. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

The instruments utilized in this procedure were selected from those known to be available at Navy calibration facilities and the listing by make or model number carries no implication of preference, recommendation, or approval for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in this procedure.

Table 2.  Equipment Requirements

| Item | Minimum Use Specifications | Calibration Equipment |
|---|---|---|
| 2.1 Autotransformer | Input voltage: 115 V at 60 Hz<br>Output voltage: variable from 105 to 125 | Penril W5MT3A |
| 2.2 Digital multimeter (DMM) | Range: 105 to 125 V<br>Uncertainty: ±2% iv (used to monitor line voltage) | Hewlett-Packard 34401A |
| 2.3 Load resistor | Values: 200 Ω, ±5%, 1.25 W; 2000 Ω, ±5%, 12.5 W; 20 kΩ, ±5%, 125 W | Clarostat 240C |
| 2.4 High accuracy digital multimeter (HADMM) | Range: 9 to 1100 V dc<br>Uncertainty: ±0.0026% iv<br>Null range: 100 µV | Hewlett-Packard 3458A |
| 2.5 Null detectors (2 required) | Null range: 3 µV to 30 mV<br>Uncertainty: ±(3% end scale +0.1 µV) | Fluke 845AB |
| 2.6 Multifunction meter calibrator (MMC) | Output voltage: 10 µV to 1100 V dc<br>Uncertainty: approximately ±0.002% iv; not as important as the stability rating in this procedure<br>Stability must be within: ±(0.001% of setting +20 µV) | Fluke 5700AAN |
| 2.7 Voltage divider | Ratio range: 0.0000010 to 1.1<br>Uncertainty: 1 ppm related to input | Fluke 720A |
| 2.8 A-B switch (pinch-type, reversing switch) | Two-position switch, arbitrarily assigned positions A and B or simply A-B switch | Local supply, such as: Leeds & Northrup 3294 |
| 2.9 DC reference standard | Output voltage: Std-cell magnitude (e.g. “1.018000”)<br>Uncertainty: traceable to Type I calibration laboratory through a certified output voltage called “Assigned Reference Output” or simply “$V_{ref}$” herein | Fluke 732B, with known history |
| 2.10 Reference divider | Range: 1000 and 1100<br>Uncertainty: ±1 ppm | Fluke 752A |
| 2.11 Binding posts | Used to hold the shielded wires together | Local supply |
| 2.12 Electrical tape | Used to cover the binding post and its contents | Local supply |
| 2.13 Shielded leads | Low-thermal type with spade lugs, for example:<br>Fluke PCA -0116<br>” -0126<br>” -0227<br>” -0536<br>” -0627<br>” -0636<br>Pomona type shielded leads: #1756-24 or 1756-48 | Local supply as required |

# SECTION 3

## PRELIMINARY OPERATIONS

3.1 Ensure that all power switches are set to off, and set all auxiliary equipment controls as necessary to avoid damage to the equipment and so that dangerous voltages will not be present on output terminals when the power switches are turned on.

3.2 Set the TI controls as follows:

| | |
|---|---|
| POWER switch to | OFF |
| METER switch to | CURRENT |
| VOLTAGE TRIP to1000: VERNIER | fully clockwise |
| CURRENT LIMIT to | fully clockwise |
| VOLTAGE RANGE to | 10 |
| READOUT DIALS (Output-Voltage Controls) to | all zeros |

3.3 Set all other equipment controls as necessary to avoid damage to the equipment, and so that dangerous voltages will not be present on the output terminals when the power switches are turned on.

3.4 Connect the TI and all line-powered test equipment to the appropriate power source.

3.5 Turn all power switches on and allow sufficient warm-up time for the equipment (the TI requires 1 hour warm-up time).

3.6 Perform the self-calibration procedure for the Fluke 720A Voltage (Kelvin-Varley) Divider, if it has not been calibrated within the past few weeks.

# SECTION 4

## CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before proceeding.

### 4.1 LINE AND LOAD REGULATION TEST

WARNING

VOLTAGES HAZARDOUS TO LIFE MAY BE PRESENT. USE EXTREME CAUTION.

4.1.1 Connect the equipment as shown in Figure 1.

4.1.2 Adjust the AUTOTRANSFORMER for 115 V output as monitored on the DMM (item 2.2).

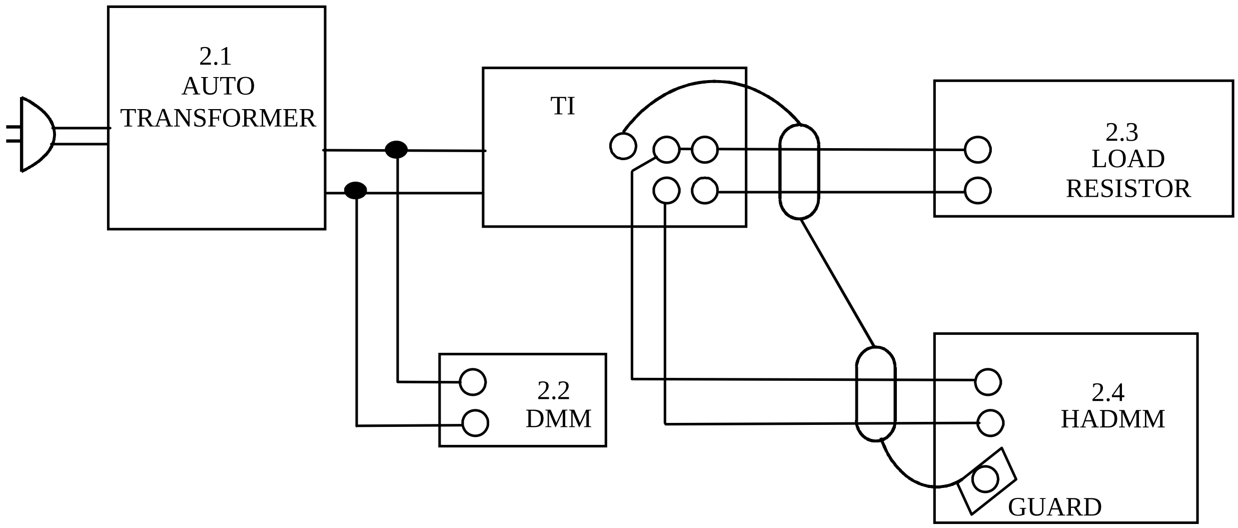



Figure 1. Line and Load Regulation Test Configuration

4.1.3 Set the TI front panel controls as follows:

| | |
|---|---|
| POWER switch to | STANDBY |
| METER switch to | CURRENT |
| RANGE switch to | 10 |
| Output-Voltage (READOUT) DIALS to | ALL ZEROS |
| VOLTAGE TRIP switch to | 1000 |
| VERNIER control to | fully clockwise |
| CURRENT LIMIT | fully clockwise (60) |

4.1.4 Set the HADMM (item 2.4) to measure dc voltage.

4.1.5 Perform each of the measurements listed below as follows:

4.1.5.1 Set the equipment controls to obtain the settings for each measurement listed in the following table. Use the High Accuracy Digital Multimeter (HADMM) (item 2.4) to note the TIs response.

| TI Settings | | | |
|---|---|---|---|
| Load Resistor (Ω) | Range (V) | Output-Voltage Dials (V) | Tolerance Limits |
| 200 | 10 | 10.000000 | +20 μV |
| 2000 | 100 | 100.00000 | +200 μV |
| 20000 | 1000 | 1000.0000 | +2.0 mV |

4.1.5.2 Set the autotransformer for 115 V output. Measure the dc voltage with the HADMM (item 2.4) and verify that the voltage indication as the 1st indication for reference.

4.1.5.3 Adjust the autotransformer for a 105 volt output. Wait one minute; then measure the dc voltage and note the voltage indication as the 2nd indication. Verify that the difference between the 1st and the 2nd indications is within the tolerance limits listed.

4.1.5.4 Adjust the autotransformer for a 125 volt output. Wait 1 minute; then measure the dc voltage and note the indication. Verify that the difference between the indications of steps 4.1.5.2 and 4.1.5.4 are within the tolerance limits listed.

4.1.6 Set the autotransformer for a 115 V output.

4.1.7 Perform each of the load-regulation measurements tabulated below (using Figure 1 as the test setup).

4.1.7.1 Set the equipment controls as necessary to obtain the settings for each measurement listed in the following table.

| TI Settings | | | |
|---|---|---|---|
| Load Resistor (Ω) | Range (V) | Output-Voltage Dials (V) | Tolerance Limits |
| 20000 | 1000 | 1000.0000 | ±2.0 mV |
| 2000 | 100 | 100.00000 | ±200 µV |
| 200 | 10 | 10.000000 | ±20 µV |

4.1.7.2 With the load resistance connected as shown in Figure 1, measure the dc voltage with the HADMM (item 2.4) for each range, and verify that the voltage indication as the 1st indication for reference.

4.1.7.3 Set the TI power switch to STDBY/RESET, disconnect the load resistance, and then set the TI power switch to OPR.

4.1.7.4 Measure the dc voltage with no load for each range and note the 2nd indication. Verify that the difference between the 1st and 2nd indications is within the tolerance limits listed.

4.1.8 Disconnect the Test configuration, setting the equipment controls as required for safeguard.

## 4.2 ACCURACY TEST

4.2.1 Connect the HADMM to the TI output terminals. Set the TI to the settings listed in the following table and verify that the HADMN is within the following listed tolerance limits.

| TI Settings | | |
|---|---|---|
| Range (V) | Output-Voltage Dials (V) | HADMM Tolerance Limits |
| 10 | 1.0000 | 0.99984 to 1.00016 |
| | 3.3333 | 3.33307 to 3.33353 |
| | 5.5555 | 5.55503 to 5.55597 |
| | 7.7777 | 7.77707 to 7.77833 |
| | 9.9999 | 9.99912 to 10.00068 |
| 100 | 10.000 | 9.9990 to 10.0010 |
| | 50.000 | 49.9962 to 50.0038 |
| | 100.000 | 99.9927 to 100.0073 |
| 1000 | 100.00 | 99.9920 to 100.0080 |
| | 500.00 | 499.9620 to 500.0380 |
| | 1000.00 | 999.92645 to 1000.0755 |

4.2.2 If the TI fails any of the previous points, mark the TI as being received in an out of tolerance condition, and proceed to Appendix A to adjust the TI.

4.2.3 Unless other measurements are to be performed, turn all power switches to off or standby and disconnect the equipment from the TI.

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332D DC Voltage Standard

PROC. NO. NA 17-20AE-254 MFR MODEL SER. NO.

| PROCEDURE STEP NO (1) | FUNCTION TESTED (2) | | NOMINAL (3) | MEASURED VALUES FIRST RUN (4) | MEASURED VALUES SECOND RUN (5) | OUT OF TOL (6) | CALIBRATION TOLERANCES (7) |
|---|---|---|---|---|---|---|---|
| 4.1 | Line and Load Regulation Test | | | | | | |
| | 10 V - Range Test (Line Regulation) | | | | | | |
| | Load | Line | | | | | |
| 4.1.5.2 | 200 Ω | 115 V | -- | (μV) | | | Ref: |
| 4.1.5.3 | 200 Ω | 105 V | -- | | | | Ref: |
| ” | | | | | | | ±20 μ V |
| 4.1.5.4 | 200 Ω | 125 V | -- | (μV) | | | Ref: |
| ” | | | | | | | Ref: |
| ” | | | | | | | ±20 μV |
| | 100 V - Range Test | | | | | | |
| | Load | Line | | | | | |
| 4.1.5.2 | 2000 Ω | 115 V | -- | (μV) | | | Ref: |
| 4.1.5.3 | 2000 Ω | 105 V | -- | | | | Ref: |
| ” | | | | | | | ±200 μV |
| 4.1.5.4 | 2000 Ω | 125 V | -- | (μV) | | | Ref: |
| ” | | | | | | | Ref: |
| ” | | | | | | | ±200 μV |
| | 1000 V - Range Test | | | | | | |
| | Load | Line | | | | | |
| 4.1.5.2 | 20000 Ω | 115 V | -- | (μV) | | | Ref: |
| 4.1.5.3 | 20000 Ω | 105 V | -- | | | | Ref: |
| ” | | | | | | | ±2 mV |
| 4.1.5.4 | 20000 Ω | 125 V | -- | (μV) | | | Ref: |
| ” | | | | | | | Ref: |
| ” | | | | | | | ±2 mV |
| 4.1.7.2 | 1000 V | 20000 Ω | -- | (mV) | | | 1st (ref): |
| ” | | | | | | | 2nd (ref): |
| 4.1.7.4 | 1000 V | None | -- | | | | ±2.0 mV |
| 4.1.7.2 | 100 V | 2000 Ω | -- | (mV) | | | 1st (ref): |
| ” | | | | | | | 2nd (ref): |
| 4.1.7.4 | 100 V | None | -- | | | | ±200 μ V |
| | | | | | | | |

Page 1 of 2

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332D DC Voltage Standard

| PROC. NO. NA 17-20AE-254 | | MFR | MODEL | | | SER. NO. |
|---|---|---|---|---|---|---|
| PROCEDURE STEP NO (1) | FUNCTION TESTED (2) | NOMINAL (3) | MEASURED VALUES FIRST RUN (4) | SECOND RUN (5) | OUT OF TOL (6) | CALIBRATION TOLERANCES (7) |
| 4.1.7.2 | 10 V 200 Ω | -- | (mV) | | | 1st (ref): |
| ” | | | | | | 2nd (ref): |
| 4.1.7.4 | 10 V None | -- | | | | ±20 μV |
| | | | | | | |
| 4.2.1 | Accuracy Test (V) | (V) | | | | (V) |
| ” | 10 V 1.000 | 1.000 | | | | 0.99984 to 1.00016 |
| ” | 3.3333 | 3.3333 | | | | 3.33307 to 3.33353 |
| ” | 5.5555 | 5.5555 | | | | 5.55503 to 5.55597 |
| ” | 7.7777 | 7.7777 | | | | 7.77707 to 7.77833 |
| ” | 9.9999 | 9.9999 | | | | 9.99912 to 10.00068 |
| ” | 100 V 10.000 | 10.000 | | | | 9.9990 to 10.0010 |
| ” | 50.000 | 50.000 | | | | 49.9962 to 50.0038 |
| ” | 100.000 | 100.000 | | | | 99.9927 to 100.0073 |
| ” | 1000 V 100.00 | 100.00 | | | | 99.9920 to 100.0078 |
| ” | 500.00 | 500.00 | | | | 499.9620 to 500.0380 |
| ” | 1000.00 | 1000.00 | | | | 999.9245 to 1000.0755 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Page 2 of 2

# APPENDIX A

## ADJUSTMENTS

A.1 Adjustments Access: Certain adjustments are necessary during the calibration process while the TI is in operation. Remove the covers from the TI just far enough, as required, to gain access for: the Range-Zero-Output-, the Sample-String-, and the Range-Cal adjustments. Refer to Figure A-1 for the location of adjustments.

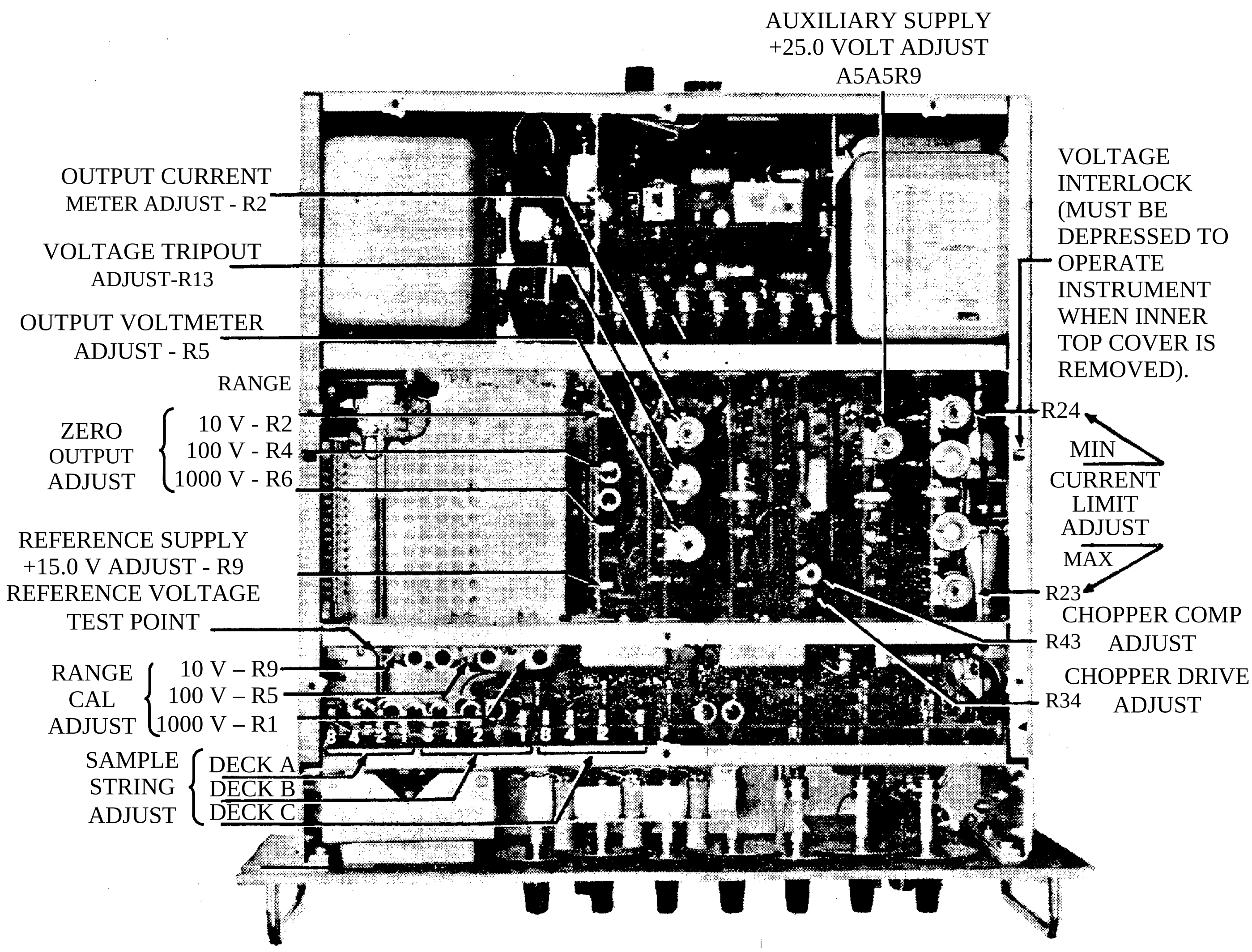



Figure A-1. Location of Adjustments

A.2 ZERO OUTPUT ADJUSTMENTS

A.2.1 Set the Null Detector (item 2.5) OPR-ZERO switch to ZERO. Perform the mechanical or electrical zero adjustments for the Null Detector as required. Electrically zero adjust the Null Detector up to its 3 μV position.

A.2.2 Set the TI output-voltage dials to indicate all zeroes, connect the equipment as shown in Figure A-2; and set the TI power switch to OPR.

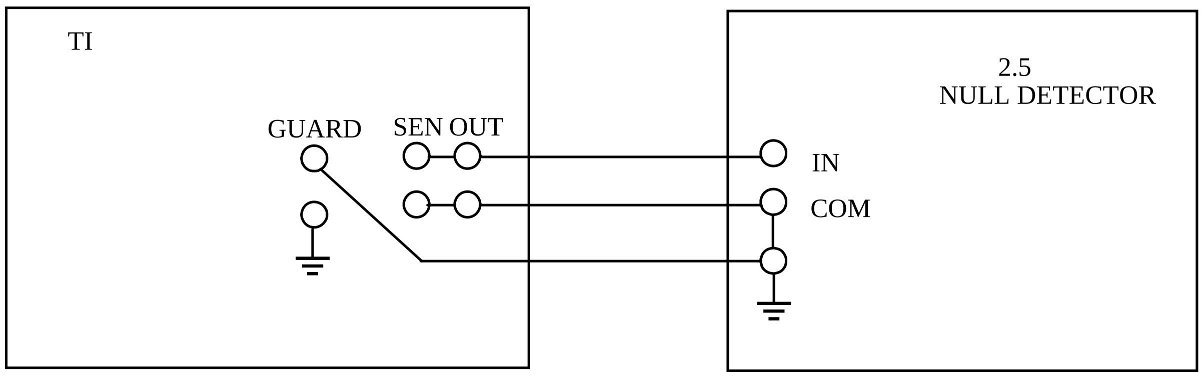



Figure A-2. Zero Output Adjust Configuration

A.2.3 Set the null detector OPR-ZERO switch to OPR position.

A.2.4 Set the TI range switch to each of the TI voltage ranges. At each TI voltage-range position, adjust the TI corresponding ZERO-OUTPUT-ADJUST range control to establish a null indication within ±1 μV on the null detector. Use only insulated screwdrivers or plastic alignment tools when performing the adjustments. Refer to Figure A-l for location of the adjustments.

A.2.5 Set the null detector OPR-ZERO switch to ZERO, the TI power switch to STDBY/RESET; and disconnect the equipment setup.

A.3 SAMPLE STRING LINEARIZATION

A.3.1 Connect the equipment as shown in Figure A-3.

A.3.2 Make the connections shown in Figure A-3 to the Assigned-Reference-Output voltage terminals. For simplification, the DC Reference Standard-Output voltage will be referred to herein simply as $V_{ref}$.

A.3.3 Set the voltage divider (item 2.7) controls to indicate a setting equal to 1/10th of $V_{ref}$. For example, if $V_{ref}$ is equal to 1.018000, the divider controls would be set for a 0.101800 indication.

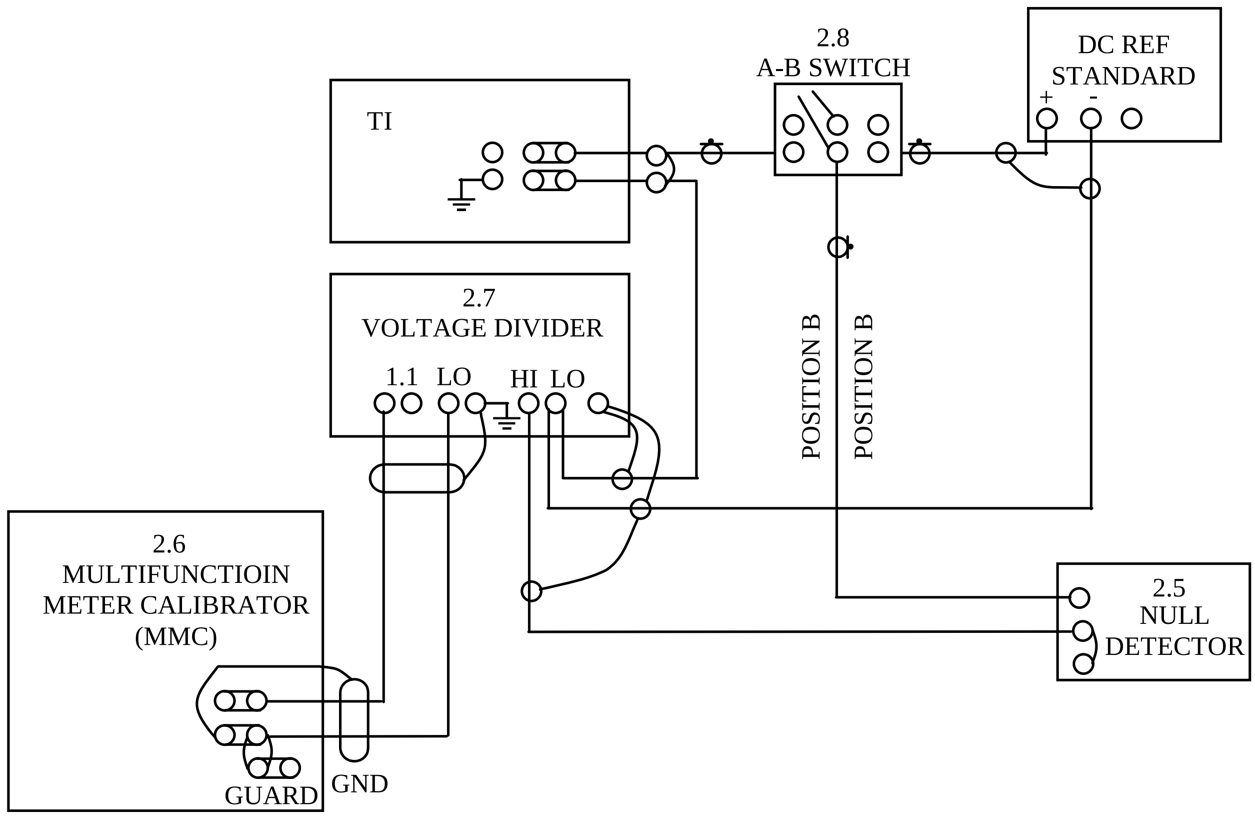
A.3.4 Set the A-B switch (item 2.8) to position A. Set the MMC (item 2.6) to 11 V.

A.3.5 Set the null detector OPR-ZERO switch to OPR, and adjust the MMC to establish a null indication to within ±1 μV on the null detector 10 μV range, adjusting the null detector null sensitivity control as required. Set the TI power switch to OPR.

A.3.6 Set the null detector OPR-ZERO switch to ZERO, and set the A-B switch to position B.

A.3.7 Perform each of the adjustments tabulated below, using only insulated screwdrivers or plastic alignment tools as follows:

A.3.7.1 Set the null detector OPR-ZERO switch to ZERO to avoid meter pegging in preparation for the upcoming circuit changes.




NOTE: USE PURE COPPER CONDUCTORS SHIELDED CABLE, NOT COATED OR PLATED WIRE NOT COAXIAL CABLE.

THROUGHOUT THIS PROCEDURE SHEILDS MAY BE HELD TOGETHER WITH BINDING POSTS, ITEM 2.11; THEN THEY MAY BE COVERED WITH AN ELECTRICAL TAPE, ITEM 2.12.

Figure A-3. Sample-String-Linearization Adjustment Setup

A.3.7.2 Set the equipment controls to the settings listed for each required adjustment in the following table.

| | TI | | | |
|---|---|---|---|---|
| Voltage Divider (Dials) | Range | Voltage Dials | Required Adjustments | Tolerance Limits |
| 0000000 | 1000 V | 000.0000 | Detector* | ±1 µV |
| .1000000 | 1000 V | 000.X00 | 1000 V CAL | ±1 µV |
| .1000000 | 1000 V | 001.0000 | DECK C - 1 | ±1 µV |
| .2000000 | 1000 V | 002.0000 | DECK C - 2 | ±1 µV |
| .4000000 | 1000 V | 004.0000 | DECK C - 4 | ±2 µV |
| .8000000 | 1000 V | 008.0000 | DECK C - 8 | ±4 µV |

| | TI | | | |
|---|---|---|---|---|
| Voltage Divider (Dials) | Range | Voltage Dials | Required Adjustments | Tolerance Limits |
| 1.0000000 | 1000 V | 00X.0000 | Divider** | ±5 µV |
| Retained setting | 1000 V | 010.0000 | DECK B - l | ±5 µV |
| 0000000 | 100 V | 00.00000 | Detector* | ±1 µV |
| .1000000 | 100 V | 01.00000 | 100 V CAL | ±1 µV |
| .2000000 | 100 V | 02.00000 | DECK B - 2 | ±1 µV |
| .4000000 | 100 V | 04.00000 | DECK B - 4 | ±2 µV |
| .8000000 | 100 V | 08.00000 | DECK B - 8 | ±4 µV |
| 1.0000000 | 100 V | 0X.00000 | Divider** | ±5 µV |
| Retained setting | 100 V | 10.00000 | DECK A - l | ±5 µV |
| 0000000 | 10 V | 0.00000 | Detector* | ±1 µV |
| .1000000 | 10 V | 1.00000 | 10 V CAL | ±1 µV |
| .2000000 | 10 V | 2.00000 | DECK A - 2 | ±1 µV |
| .4000000 | 10 V | 4.00000 | DECK A - 4 | ±2 µV |
| .8000000 | 10 V | 8.00000 | DECK A - 8 | ±4 µV |

* Adjust the null detector ZERO ADJ to obtain a system zero.

**Adjust the voltage divider readout dials for a null on the null detector. Retain this setting for the next measurement step marked “Retained setting.”

A.3.7.3 Set the null detector OPR-ZERO switch to OPR. Make the indicated adjustment to establish a detector null indication within the tolerance limits listed, increasing the detector null-range sensitivity as required. Refer to Figure A-1 for the locations of the TI RANGE-CAL or the TI SIMPLE-STRING-ADJUST potentiometers.

A.3.8 Set the null detector OPR-ZERO switch to ZERO. Adjust the null detector zero control for a zero meter deflection on the 3 µV range; then, set the detector range switch to the 30 µV range position.

A.3.9 Set the TI range control to its 1000 V position, and set the TI output-voltage dials (READOUT DIALS) to 010.0000 V.

A.3.10 Set the A-B switch (item 2.8) to position A, repeat steps A.3.2 and A.3.3; then, set the null detector OPR-ZERO switch to OPR.

A.3.11 Adjust the MMC as required to establish a null indication to within ±1 µV on the null detector 10 µV range while adjusting the null detector null sensitivity control as required.

A.3.12 Set the null detector OPR-ZERO switch to ZERO. Set the A-B switch to position B, and set the voltage divider controls to 1.0000000.

WARNING

ALL TI ADJUSTMENTS MUST BE MADE ONLY WITH INSULATED SCREWDRIVERS OR PLASTIC ALIGNMENT TOOLS.

A.3.13 Set the null detector OPR-ZERO switch to OPR. Adjust the TI internal 1000 V CAL potentiometer to establish a null indication on the null detector to within ±5 mV while switching the null detector range sensitivity as required.

A.3.14 Set the null detector OPR-ZERO switch to ZERO. Set the TI voltage range selector to the 100 V position, and the voltage dials to 10.00000 V. Set the detector OPR-ZERO switch to OPR, and adjust the TI 100 V CAL potentiometer to establish a null indication to within ±5 µV.

A.3.15 Using the TI 10 V range setting and the TI 10 V CAL potentiometer, repeat step A.3.14, with the TI voltage dials set for 10.000000 V.

A.3.16 Set the detector OPR-ZERO switch to ZERO, set all voltage-source equipment for minimum output, and disconnect the equipment setup.

A.4 OUTPUT VOLTAGE MEASUREMENTS

A.4.1 Prior to using the 752A reference divider, perform the self-calibration procedure in accordance with the manufacturer's manual.

A.4.2 Connect the equipment as shown in Figure A-4.

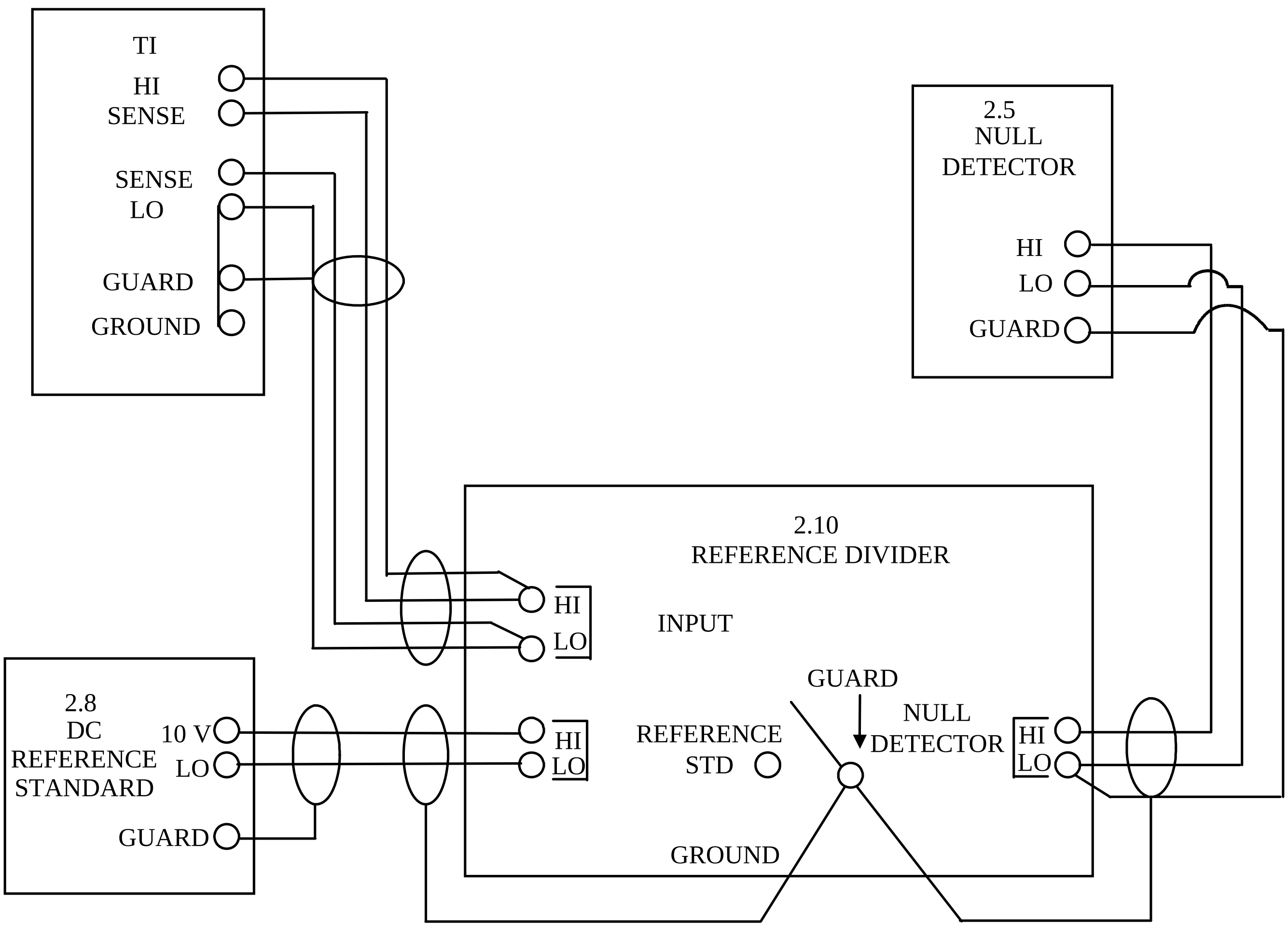



Figure A-4. Output Voltage Test Configuration

A.4.3 Set the TI POWER switch to STDBY/RESET and the null detector Opr-Zero switch to Zero.

A.4.4 Adjust the null detector zero control to obtain a null detector null indication, progressively increasing the null detector sensitivity to the 10 µV range.

A.4.5 Set the reference divider calibrate switch to operate and mode switch to 10.

A.4.6 Set the TI RANGE switch to 10 and Output Voltage dials to 10.000000.

A.4.7 Select a null detector sensitivity setting to avoid meter pegging and set the Opr-Zero switch to opr.

A.4.8 Set the TI POWER switch to OPR and Output Voltage dials for a null detector null indication, progressively increasing the null detector sensitivity to the 10 µV range.

A.4.9 Verify that the TI output Voltage dials setting is equal to the DC Reference Standards certified output voltage ±0.00011.

A.4.10 Set the null detector range switch to avoid meter pegging and Opr-Zero switch to Zero and set the TI RANGE switch to STDBY/RESET.

A.4.11 Using the methods described in steps A.4.4 through A.4.10, repeat the measurement for each of the TI and reference divider settings listed in the following table. At each setting, verify that the TI Output Voltage dials' setting is within the tolerance limits listed.

| Reference Divider Mode Switch Setting | TI Initial Settings | | TI Output Voltage Dial Tolerance Limits | |
|---|---|---|---|---|
| | Range | Output Voltage Dials | | |
| 10 | 100 | 10.00000 | Ref Standard | ±000012 |
| 100 | 100 | 100.00000 | Ref Standard X10 | ±0.00102 |
| 10 | 1000 | 010.0000 | Ref Standard | ±0.0004 |
| 100 | 1000 | 100.0000 | Ref Standard X10 | ±0.0017 |
| 1000 | 1000 | 1000.0000 | Ref Standard X100 | ±0.0152 |

A.4.12 Unless other measurements are to be performed, set all equipment controls as required to avoid damage to the equipment and injury to personnel; then disconnect the test configuration.

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332D DC Voltage Standard

PROC. NO. NA 17-20AE-254 MFR MODEL SER. NO.

| PROCEDURE STEP NO (1) | FUNCTION TESTED (2) | NOMINAL (3) | MEASURED VALUES FIRST RUN (4) | MEASURED VALUES SECOND RUN (5) | OUT OF TOL (6) | CALIBRATION TOLERANCES (7) |
|---|---|---|---|---|---|---|
| A.2 | Zero Output Adjustments | | | | | |
| | Range Adjust | (μV) | | | | ±1 μV |
| A.2.4 | 10 V 10 V-zero pot | 0 | ck ( ) | | | ±1 μV |
| ” | 100 V 10 ” | 0 | ck ( ) | | | ±1 μV |
| ” | 1000 V 10 ” | 0 | ck ( ) | | | |
| | | | | | | |
| A.3 | Sample String Linearization | | | | | |
| | Required Adjustments | (μV) | (μV) | | | |
| A.3.7.3 | Null-Detector ZERO adjustment | 0 | ck ( ) | | | ±1 μV |
| ” | 1000 V CAL | 0 | ck ( ) | | | ±1 μV |
| ” | DECK C-1 | 0 | ck ( ) | | | ±1 μV |
| ” | ” C-2 | 0 | ck ( ) | | | ±1 μV |
| ” | ” C-4 | 0 | ck ( ) | | | ±2 μV |
| ” | ” C-8 | 0 | ck ( ) | | | ±4 μV |
| ” | Voltage-Divider dials | 0 | ck ( ) | | | ±5 μV |
| ” | DECK B-1 | 0 | ck ( ) | | | ±5 μV |
| ” | Null-Detector ZERO adjustment | 0 | ck ( ) | | | ±1 μV |
| ” | 100 V CAL | 0 | ck ( ) | | | ±1 μV |
| ” | DECK B-2 | 0 | ck ( ) | | | ±1 μV |
| ” | ” B-4 | 0 | ck ( ) | | | ±2 μV |
| ” | ” B-8 | 0 | ck ( ) | | | ±4 μV |
| ” | Voltage-Divider dials | 0 | ck ( ) | | | ±5 μV |
| ” | DECK A-1 | 0 | ck ( ) | | | ±5 μV |
| ” | Null-Detector ZERO adjustment | 0 | ck ( ) | | | ±1 μV |
| ” | 100 V CAL | 0 | ck ( ) | | | ±1 μV |
| ” | DECK A-2 | 0 | ck ( ) | | | ±1 μV |
| ” | ” A-4 | 0 | ck ( ) | | | ±2 μV |
| ” | ” A-8 | 0 | ck ( ) | | | ±4 μV |
| A.3.13 | 1000 V CAL | 0 | ck ( ) | | | ±5 μV |
| A.3.14 | 100 V CAL | 0 | ck ( ) | | | ±5 μV |
| A.3.15 | 10 V CAL | 0 | ck ( ) | | | ±5 μV |
| | | | | | | |

Page 1 of 2

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332D DC Voltage Standard

| PROC. NO. NA 17-20AE-254 | | | MFR | MODEL | | | SER. NO. |
|---|---|---|---|---|---|---|---|
| PROCEDURE STEP NO (1) | FUNCTION TESTED (2) | | NOMINAL (3) | MEASURED VALUES FIRST RUN (4) | MEASURED VALUES SECOND RUN (5) | OUT OF TOL (6) | CALIBRATION TOLERANCES (7) |
| A.4 | Output Voltage Measurements: Using the 752A Reference Divider | | | | | | |
| A.4.9 | Range | Voltage Dials | | | | | |
| | (V) | (V) | (V) | | | | (V) |
| ” | 10 | Ref Std Voltage | 10 | | | | ±0.00011 |
| A.4.11 | 100 | 10.00000 | 10 | | | | Ref Std ±0.00012 |
| ” | 100 | 100.00000 | 100 | | | | Ref Std X10 ±0.00102 |
| ” | 1000 | 010.0000 | 10 | | | | Ref Std ±0.0004 |
| ” | 1000 | 100.0000 | 100 | | | | Ref Std X10 ±0.0017 |
| ” | 1000 | 1000.0000 | 1000 | | | | Ref Std X100 ±0.0152 |

Page 2 of 2