AE-71

TECHNICAL MANUAL

INSTRUMENT CALIBRATION PROCEDURE

DC VOLTAGE CALIBRATORS

FLUKE
332A OR 332B

THIS PUBLICATION SUPERSEDES NAVAIR 17-20AE-71
DATED 1 NOVEMBER 2001

AE-71

PUBLISHED BY DIRECTION OF COMMANDER NAVAL AIR SYSTEMS COMMAND

1 SEPTEMBER 2004

LIST OF EFFECTIVE PAGES

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SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration of the Fluke 332A or 332B DC Voltage Calibrators. 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
Line regulation	332A: ±0.0005% of setting or 25 μV for a 10% line voltage change from nominal 332B: ±0.0002% of setting or 10 μV	A reference level is set; then variations at low and high line are measured on a stable dc voltmeter.
Load regulation	332A: ±0.0005% of setting or 25 μV for a full load change 332B: ±0.0002% of setting or 10 μV	A reference level is set; then the load is removed and any variations are measured on a stable dc voltmeter.
Ripple and noise	332A and 332B: 10 V range, 20 μV_{rms} 100 V range, 30 μV_{rms} 1000 V range, 40 μV_{rms}	Measured with an audio analyzer.
Zero output	332A: 10 V range Tolerance: ±10 μV before adj ±2 μV after adj 100 V range Tolerance: ±20 μV before adj ±2 μV after adj 1000 V range Tolerance: ±200 μV before adj ±2 μV after adj 332B: 10 V range Tolerance: ±10 μV before adj ±1 μV after adj 100 V range Tolerance: ±20 μV before adj ±1 μV after adj 1000 V range Tolerance: ±200 μV before adj ±1 μV after adj	Measuring and adjusting the output using a null detector.

TI Characteristics	Performance Specifications	Test Method
Decade linearity	332A: 3rd dial: ±200 μV 1st and 2nd dials: ±20 μV before adjust; ±2 μV after adjust 332B: 3rd dial: ±200 μV (±12 μV Serial 642 and above) 1st and 2nd dials: ±12 μV before adjust; ±2 μV after adjust	Comparison of outputs at equivalent settings for the first 3 decades; other decades tested by measuring the voltage output.
Range accuracy	332A: 10 V range Tolerance: ±310 μV before adj ±30 μV after adj 100 V range Tolerance: ±3.02 mV before adj ±100 μV after adj 1000 V range Tolerance: ±30.20 mV before adj ±1 mV after adj 332B: 10 V range Tolerance: ±210 μV before adj ±30 μV after adj 100 V range Tolerance: ±2.02 mV before adj ±100 μV after adj 1000 V range Tolerance: ±20.20 mV before adj ±1 mV after adj	Measuring and adjusting the output by a standard cell referenced direct voltage measurement system.

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 Output voltage variable from 105 to 125 V	Penril W5MT3A
2.2 DC differential voltmeter	Range: 0.1111 to 1000 V Uncertainty: ±0.025% Stability: ±0.0005% per hr on the ±1 V input ±0.0008% per hr on the ±10 V input	Fluke 895A
2.3 Load resistor	Range: 20 kΩ at 50 W, 2 kΩ at 5 W, and 200 Ω at 0.5 W, 8 kΩ at 12 W Accuracy: ±0.5% iv	Clarostat 240C set to required values
2.4 Audio analyzer	Frequency: 15 Hz to 30 kHz Voltage: 0 to 40 μV_{rms} Accuracy: NA	Hewlett-Packard 8903BOPT010
2.5 Direct voltage measurement system Required components:	Ranges: 1, 10, 100 and 1000 V Uncertainty: 1 V range ±12.8 ppm of output 10 V range ±12.8 ppm of output 100 V range ±13.2 ppm of output 1000 V range ±15.7 ppm of output	Fluke 7105A
2.5.1 DC voltage standard		Fluke 335A or 332B
2.5.2 Reference divider		Fluke 750A or 752A
2.5.3 Null detector (2 required)		Fluke 845AR or 845AB
2.6 Milliammeter	To measure 10 mA dc Uncertainty: ±5%	Simpson 260
2.7 Accessory kit, leads	Shielded cable with low thermal spade lugs	Local supply
2.8 DC reference standard	Output voltage: std cell magnitude (e.g. 1.018000) Uncertainty: Traceable to type I calibration laboratory through a certified output voltage called "Assigned Reference Output" or simply "Vref" herein	Fluke 732AAN

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 VOLTAGE

VOLTAGE TRIP switch to	1000 (332B)
VOLTAGE TRIP vernier	fully cw
CURRENT LIMIT control	fully cw
VOLTAGE RANGE switch to	1000
VOLTAGE dials to	000.0000

3.3 Ensure that all power switches are off; then connect the auxiliary equipment to the appropriate power source.

3.4 Turn all auxiliary equipment power switches on.

3.5 Set the autotransformer for 115 V ac output.

3.6 Connect the TI to the autotransformer output, and set the TI POWER switch to STDBY/RESET.

3.7 Allow one hour for the equipment to stabilize.

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 TESTS

WARNING

THIS PROCEDURE INVOLVES VOLTAGES THAT ARE HAZARDOUS TO PERSONNEL. USE EXTREME CAUTION.

4.1.1 Set the load resistor to 20 kΩ, and connect it across the TI OUTPUT terminals.

4.1.2 Set the DC differential voltmeter to measure 1000 volts, and connect it to the TI SENSE terminals.

4.1.3 Ensure that the straps between the TI SENSE and the OUTPUT jacks are in place during all tests.

4.1.4 Set the TI VOLTAGE RANGE to 1000, the voltage dials to (10)00.0000, and the TI POWER switch to OPR or ON.

4.1.5 Adjust the differential voltmeter voltage dials and NULL RANGE switch to obtain a null on the 10 mV NULL RANGE and note the indication.

4.1.6 Adjust the autotransformer for 105 V ac output, and wait one minute. Verify that the differential voltmeter indication is within ±2.0 mV for the 332B or ±5.0 mV for the 332A of the null indication of step 4.1.5.

4.1.7 Adjust the autotransformer for 125 V ac output, and wait one minute. Verify that the differential voltmeter indication is within ±2.0 mV for the 332B or ±5.0 mV for the 332A of the null indication of step 4.1.5.

4.1.8 Adjust the autotransformer for 115 V ac. Set the DC differential voltmeter null switch to TVM.

4.1.9 Set the TI POWER switch to STANDBY, disconnect the load resistor lead from the TI + OUTPUT terminal, set the TI POWER switch to OPR or ON, and verify that the differential voltmeter indication is within ±2.0 mV for the 332B or ±5.0 mV for the 332A of the null indication of step 4.1.5.

4.1.10 Set the differential voltmeter NULL range switch to TVM, the TI Voltage dials to zero and the POWER switch to STANDBY or STDBY.

4.1.11 Set the load resistor to 2 kΩ, and connect it across the TI OUTPUT terminals.

4.1.12 Set the DC differential voltmeter to measure 100 volts.

4.1.13 Set the TI VOLTAGE RANGE to 100, and the voltage dials to (10)0.00000, and then set the TI POWER switch to OPR or ON.

4.1.14 Adjust the differential voltmeter voltage dials and NULL RANGE switch to obtain a null on the 1 mV NULL RANGE and note the indication.

4.1.15 Adjust the autotransformer for 105 V ac output, and wait one minute. Verify that the differential voltmeter indication is within ±0.2 mV for the 332B or ±0.5 mV for the 332A of the null indication of step 4.1.14.

4.1.16 Adjust the autotransformer for 125 V ac output, and wait one minute. Verify that the differential voltmeter indication is within ±0.2 mV for the 332B or ±0.5 mV for the 332A of the null indication of step 4.1.14.

4.1.17 Adjust the autotransformer for 115 V ac. Set the DC differential voltmeter null switch to TVM.

4.1.18 Set the TI POWER switch to STANDBY, disconnect the load resistor lead from the TI + OUTPUT TERMINAL, set the TI POWER switch to OPR or ON, and verify that the differential voltmeter indication is within ±0.2 mV for the 332B or ±0.5 mV for the 332A of the null indication of step 4.1.14.

4.1.19 Set the differential voltmeter NULL range switch to TVM, set the TI Voltage dials to zero and the POWER switch to STANDBY or STDBY.

4.1.20 Set the load resistor to 200 Ω, and connect it across the TI OUTPUT terminals.

4.1.21 Set the DC differential voltmeter to measure 10 volts.

4.1.22 Set the TI VOLTAGE RANGE switch to 10, the voltage dials to (10).000000, and the POWER switch to OPR or ON.

4.1.23 Adjust the differential voltmeter voltage dials and NULL RANGE switch to obtain a null on the 100 μV NULL RANGE and note the indication.

4.1.24 Adjust the autotransformer for 105 V ac output, and wait one minute. Verify that the differential voltmeter indication is within ±20 μV for the 332B or ±50 μV for the 332A of the null indication of step 4.1.23.

4.1.25 Adjust the autotransformer for 125 V ac output and wait one minute. Verify that the differential voltmeter indication is within ±20 μV for the 332B or ±50 μV for the 332A of the null indication of step 4.1.23.

4.1.26 Adjust the autotransformer for 115 V ac. Set the DC differential voltmeter null switch to TVM.

4.1.27 Set the TI POWER switch to STANDBY, disconnect the load resistor lead from the TI + OUTPUT terminal, set the TI POWER switch to OPR or ON, and verify that the differential voltmeter indication is within ±20 μV for the 332B or ±50 μV for the 332A of the null indication of step 4.1.23.

4.1.28 Set the differential voltmeter NULL range switch to TVM and the TI POWER switch to STDBY/RESET.

4.1.29 Disconnect the differential voltmeter and the load resistor from the TI.

4.2 10, 100, AND 1000 V DC RANGE RIPPLE TEST

4.2.1 Using shielded cables connect the audio analyzer (item 2.4), load resistor (item 2.3), and TI as shown in Figure 1. Connect all test equipment to power and allow for a sufficient warm-up time.

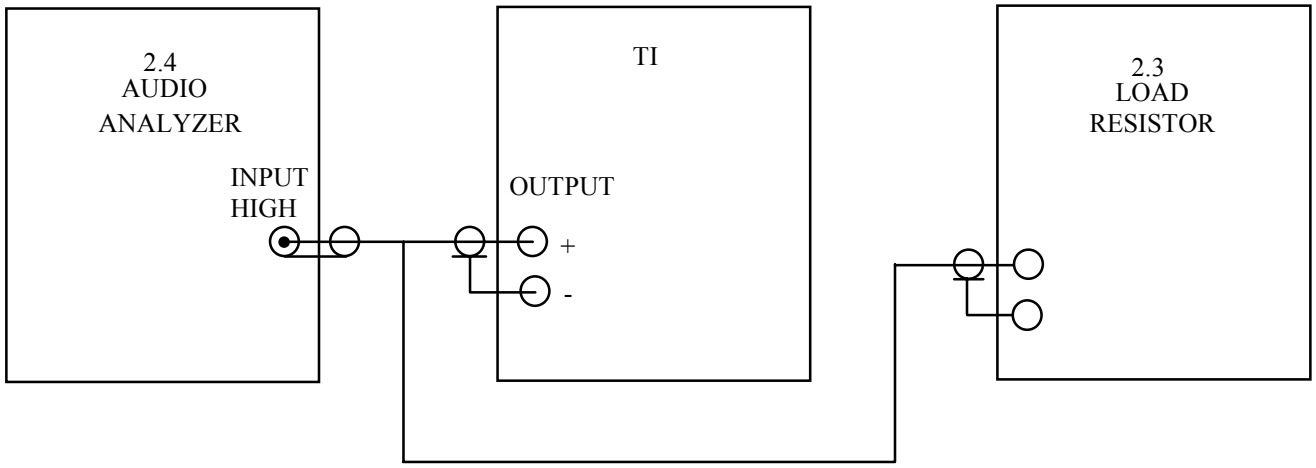


Figure 1. Ripple Test Configuration

4.2.2 Set the TI as follows:

METER	VOLTAGE	
VOLTAGE TRIP	120 (332A)	1000 (332B)
CURRENT LIMIT	60	

4.2.3 Set the audio analyzer to measure AC and set the LP filter to 30 kHz.

4.2.4 Set the load resistor to 200 Ω.

4.2.5 Set the TI output to 10.000000 Vdc on the 10 V range.

4.2.6 Verify that the audio analyzer indicates ≤ 20 μV_{rms}.

WARNING

THE FOLLOWING STEPS USE A HIGH POTENTIAL OF UP TO 400 V DC.

4.2.7 Set the load resistor to 2 kΩ.

4.2.8 Set the TI output to 100.00000 V dc on the 100 V range.

4.2.9 Verify that the audio analyzer indicates ≤ 30 μV_{rms}.

4.2.10 Set the load resistor to 8 kΩ.

4.2.11 Set the TI output to 300.0000 V dc on the 1000 V range.

4.2.12 Verify that the audio analyzer indicates ≤ 40 μV_{rms}.

4.2.13 Set the TI output to ZERO, and disconnect the equipment.

4.3 ZERO OUTPUT TESTS AND ADJUSTMENTS

4.3.1 Set the TI controls as follows:

POWER switch to	STDBY/RESET
METER switch to	VOLTAGE
VOLTAGE RANGE switch to	10 V
VOLTAGE dials to	0.000000
VOLTAGE TRIP vernier	fully cw
VOLTAGE TRIP switch to	1000 V (332B)
CURRENT LIMIT control to	Approximately 10° from max. cw

4.3.2 Turn the two large chassis locating screws on the rear of the TI one half turn ccw, and slide the TI chassis out of the case just far enough to gain access to the ZERO OUTPUT adjustment holes in the chassis cover plate (labeled R108, R110, and R112 on the 332A and 10 V, 100 V, and 1000 V on the 332B). On later models of the 332B, access to these adjustments is available through an access panel on top of the TI and the chassis does not have to be pulled out.

4.3.3 Set the null detector controls as follows:

RANGE switch to	1 MICROVOLT
ZERO/OPR switch to	ZERO
POWER switch to	BATT OPR

4.3.4 Connect the equipment as shown in Figure 2.

4.3.5 Set the TI POWER switch to OPR or ON.

4.3.6 Adjust the null detector ZERO control to obtain a null indication on the 1 μV range; then set the RANGE switch to 100 MICROVOLTS and the ZERO/OPR switch to OPR.

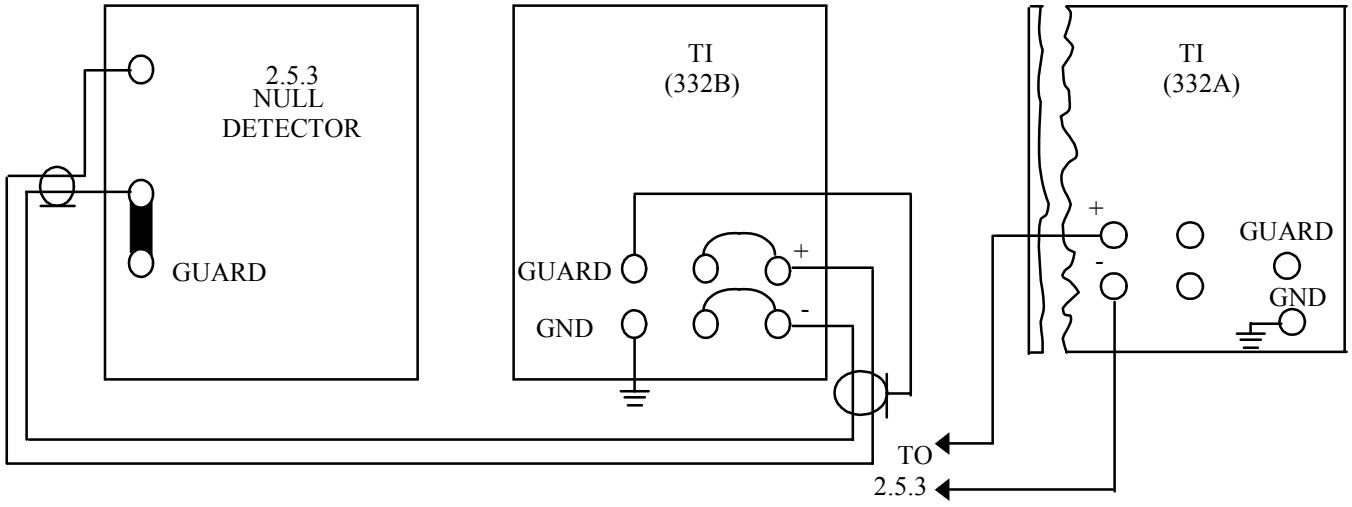


Figure 2. Zero Output Test Configuration

4.3.7 Set the TI RANGE switch to each setting listed in the following table. At each setting, measure the TI output with the null detector, verify that the TI output is within the applicable performance limits listed, and then adjust the corresponding TI ZERO OUTPUT ADJUST trimmer for a null detector indication within the applicable adjustment tolerance.

TI RANGE Switch Setting	TI	Performance Tolerance Limits (μV)	Adjustment Tolerance Limits (μV)
10 V	332A	-10 to +10	-2 to +2
”	332B	”	-1 to +1
100 V	332A	-20 to +20	-2 to +2
”	332B	”	-1 to +1
1000 V	332A	-200 to +200	-2 to +2
”	332B	”	-1 to +1

4.3.8 Set the null detector ZERO/OPR switch to ZERO, set the TI POWER switch to STDBY/RESET, and disconnect the null detector from the TI.

4.4 LINEARITY TEST AND VOLTAGE DIAL FUNCTIONAL CHECK

WARNING

THE TI CHASSIS COVER PLATE WILL BE AT A HIGH POTENTIAL IN THE FOLLOWING STEPS. USE AN INSULATED SCREWDRIVER OR PLASTIC ALIGNMENT TOOL WHEN PERFORMING INTERNAL ADJUSTMENTS.

4.4.1 Set the differential voltmeter RANGE switch to 1 V and the NULL switch to TVM.

4.4.2 Connect the equipment as shown in Figure 3. Ensure that the strap between the differential voltmeter ground and COM terminals is removed.

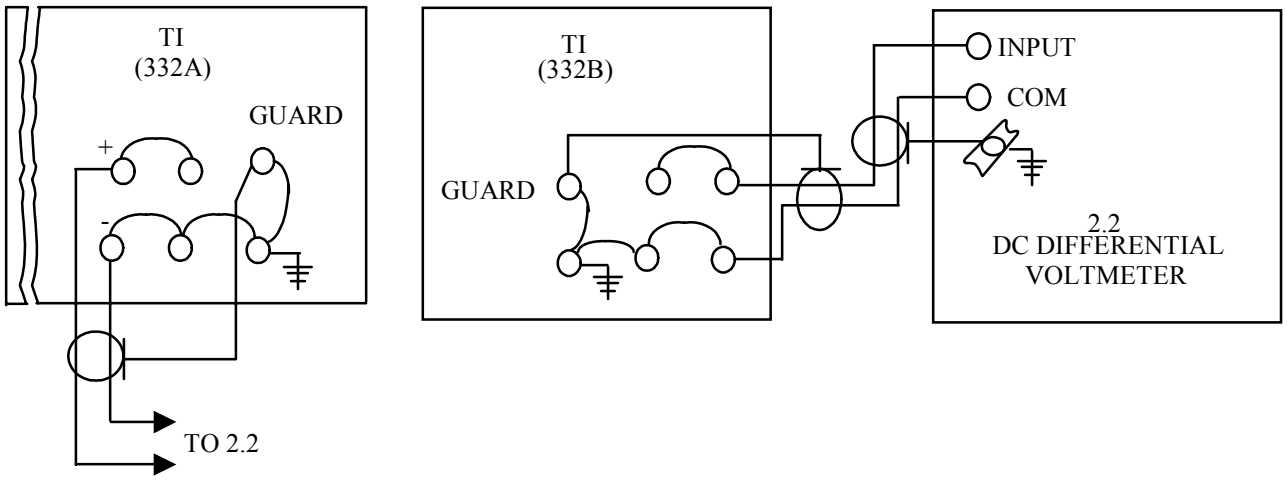


Figure 3. Linearity Test Configuration

4.4.3 Set the TI VOLTAGE RANGE switch to 1000 and set the TI POWER switch to OPR or ON.

4.4.4 Perform a measurement as follows for each TI voltage dial setting listed in the following table.

4.4.4.1 Set the TI voltage dials to the appropriate setting, and measure the TI output by obtaining a null indication on the differential voltmeter 100 μV range.

NOTE

The differential voltmeter NULL switch should be set to TVM before the TI voltage dials are changed to a different setting.

4.4.4.2 Verify that the TI output is within the tolerance limits listed in the following table.

TI Voltage Dial Setting	332B Tolerance Limits (V)	332A Tolerance Limits (V)
000.1111	0.1109 to 0.1113	0.1108 to 0.1114
000.2222	0.2220 to 0.2224	0.2219 to 0.2225
000.3333	0.3331 to 0.3335	0.3330 to 0.3336
000.4444	0.4442 to 0.4446	0.4441 to 0.4447
000.5555	0.5553 to 0.5557	0.5552 to 0.5558
000.6666	0.6664 to 0.6668	0.6663 to 0.6669
000.7777	0.7775 to 0.7779	0.7774 to 0.7780
000.8888	0.8886 to 0.8890	0.8885 to 0.8891
000.9999	0.9997 to 1.0001	0.9996 to 1.0002
000.XXXX	1.1108 to 1.1112	1.1107 to 1.1113

NOTE

If the TI is a 332B and has Deck A, B, and C adjustments (Serial number 642 and above), skip to step 4.4.8; if not, perform steps 4.4.5 through 4.4.7, and then skip to section 4.5.

4.4.5 Perform a measurement as follows for each TI voltage dial setting listed in the following table.

4.4.5.1 Set the TI voltage dials to the initial value, and obtain a null indication on the differential voltmeter 100 μV range for the 332B, and on the 1 mV range for the 332A.

4.4.5.2 Set the TI voltage dials to the secondary value, and verify that the change in the differential voltmeter indication is within the tolerance limits listed in the following table. Do not readjust the differential voltmeter.

3rd Dial Linearity Test

TI Voltage Dial		Tolerance
Initial	Secondary	
000.X000	001.0000	±200 μV
001.X000	002.0000	”
003.X000	004.0000	”
005.X000	006.0000	”
007.X000	008.0000	”
009.X000	00X.0000	”

4.4.6 Perform a measurement and adjustment as follows for each TI voltage dial setting listed in the following table.

NOTE

For the measurements in the following tables, first verify the tolerance limits for all tests to determine the as-found condition. Then repeat the tests and perform the required adjustments.

4.4.6.1 Set the TI voltage dials to the initial value, and obtain a null indication on the differential voltmeter 100 μV range.

4.4.6.2 Set the TI voltage dials to the secondary value, and verify that the change in the differential voltmeter indication is within the tolerance limits. Do not readjust the differential voltmeter.

4.4.6.3 In the following table, adjust the TI SAMPLE STRING ADJUST screw on the TI chassis cover plate for a null indication within ±2 μV on the differential voltmeter 100 μV range.

1st and 2nd Dial Linearity Test and Adjustment

TI Voltage Dials		TI Range	Tolerance		TI Sample String Adjustment	
Initial	Secondary		332B	332A	332B	332A
00.X0000	01.00000	100 V	±12 μV	±20 μV	Deck B 1	R907 1
01.X0000	02.00000	”	”	”	” 2	R908 2
03.X0000	04.00000	”	”	”	” 4	R909 4
05.X0000	06.00000	”	”	”	” 6	R910 6
07.X0000	08.00000	”	”	”	” 8	R911 8
09.X0000	0X.00000	”	”	”	” X	R912 10
0.X00000	1.000000	10 V	”	”	Deck A 1	R901 1
1.X00000	2.000000	”	”	”	” 2	R902 2
3.X00000	4.000000	”	”	”	” 4	R903 4
5.X00000	6.000000	”	”	”	” 6	R904 6
7.X00000	8.000000	”	”	”	” 8	R905 8
9.X00000	(10).000000	”	”	”	” 10	R906 10

4.4.7 Set the differential voltmeter to TVM, set the TI POWER switch to STANDBY, and disconnect the test equipment.

4.4.8 Perform a measurement and adjustment as follows for each TI voltage dial setting listed in the following table.

4.4.8.1 Set the TI voltage dials to the initial value, and obtain a null indication on the differential voltmeter 100 μV range.

4.4.8.2 Set the TI voltage dials to the secondary value, and verify that the change in the differential voltmeter indication is within the tolerance limits. Do not readjust the differential voltmeter.

4.4.8.3 In the following table, adjust the TI SAMPLE STRING ADJUST screw on the TI chassis cover plate for a null indication within ±2 μV on the differential voltmeter 100 μV range. Do not readjust the differential voltmeter.

1st, 2nd and 3rd Dial Linearity Test and Adjustment

TI Voltage Dials		TI Range	Tolerance	TI Sample String Adjustment	
Initial	Secondary				
000.X000	001.0000	1000 V	±12 μV	Deck C	1
001.X000	002.0000	”	”	”	2
003.X000	004.0000	”	”	”	4
007.X000	008.0000	”	”	”	8
00X.0000	010.0000	”	”	Deck B	1
01.X0000	02.00000	100 V	”	”	2
03.X0000	04.00000	”	”	”	4
07.X0000	08.00000	”	”	”	8
0X.00000	10.00000	”	”	Deck A	1
1.X00000	2.000000	10 V	”	”	2
3.X00000	4.000000	”	”	”	4
7.X00000	8.000000	”	”	”	8

4.4.9 Set the differential voltmeter to TVM, set the TI POWER switch to STANDBY, and disconnect the test equipment.

4.5 RANGE TESTS AND ADJUSTMENTS

NOTE

Perform section 4.5.1 if the Fluke 750A reference divider is used. Perform section 4.5.2 if the Fluke 752A reference divider is used.

4.5.1 Using the 750A reference divider

4.5.1.1 Set the TI and the DC voltage standard controls as follows:

POWER switch to	STDBY/RESET
VOLTAGE RANGE switch to	1000
VOLTAGE dials to	(10)00.0000
VOLTAGE TRIP switch to	1000 (332 B)
VOLTAGE TRIP vernier	fully cw
METER switch to	VOLTAGE
CURRENT LIMIT control	fully ccw (min)

4.5.1.2 Connect the milliammeter to the TI output terminals, set the TI POWER switch to OPR or ON, adjust the TI CURRENT LIMIT control for a milliammeter indication of 10 mA; then set the TI POWER switch to STDBY/RESET and disconnect the milliammeter.

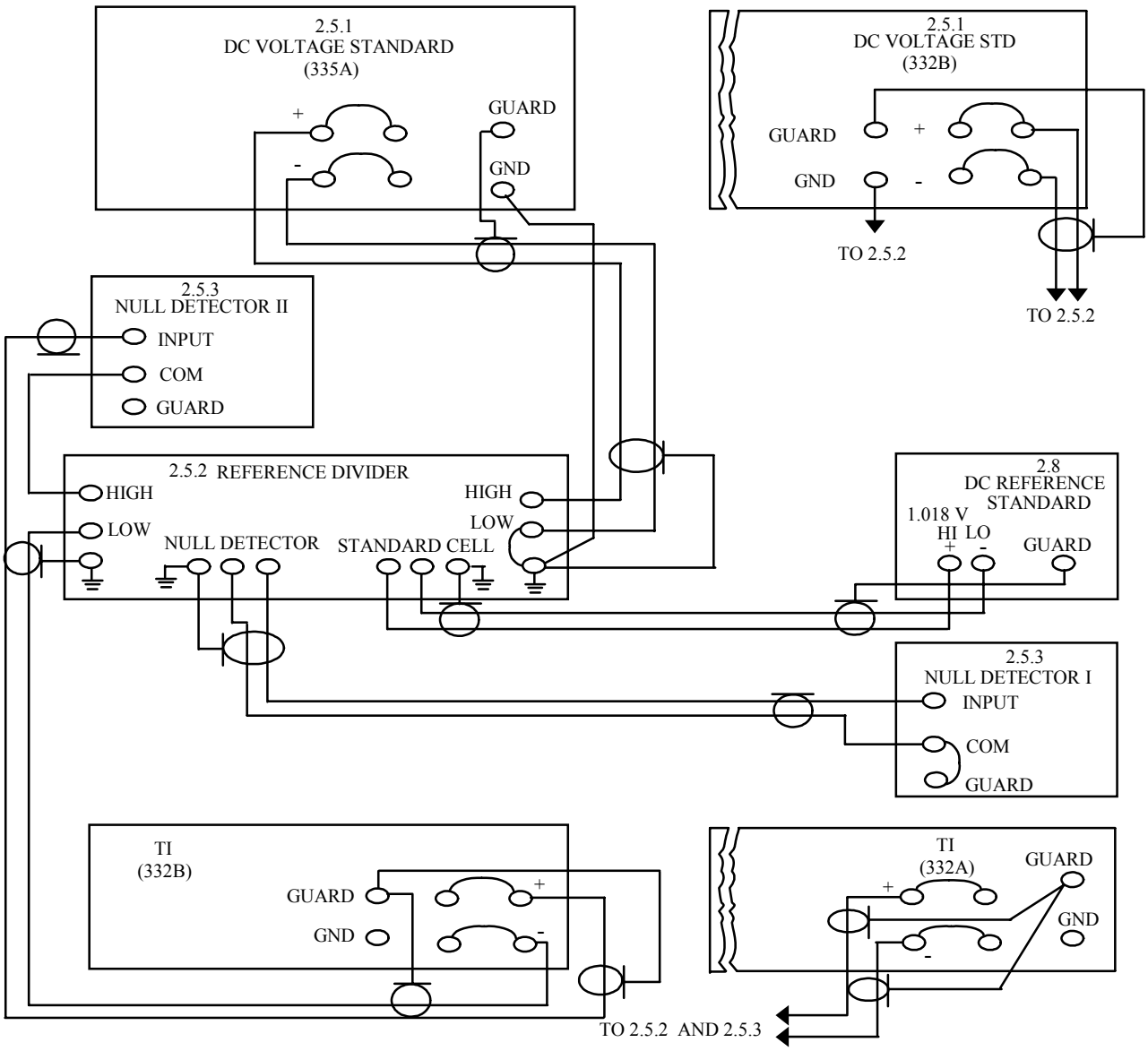
4.5.1.3 Set the reference divider controls as follows:

STD CELL CIRCUIT switch to	OPEN
INPUT VOLTAGE switch to	1000
OUTPUT VOLTAGE switch to	1000

4.5.1.4 Set the controls on both null detectors as follows:

OPR-Zero switch to	ZERO
RANGE switch to	10 microvolts

4.5.1.5 Connect the equipment as shown in Figure 4.



NOTE

Use copper conductor shielded cable, not nickel plated wire or coaxial cable.

Figure 4. Range Accuracy Test Configuration Using the 750A Reference Divider

4.5.1.6 Set the reference divider STANDARD CELL VOLTAGE switches to the certified value of the DC reference standard (Item 2.8).

4.5.1.7 Set the DC voltage standard POWER switch to OPR and the reference divider STD CELL CIRCUIT switch to LOCKED.

4.5.1.8 Adjust null detectors I and II ZERO controls to obtain a null indication on the 10 μV range; then set the RANGE switch to 30 MILLIVOLTS.

4.5.1.9 Set null detector I ZERO/OPR switch to OPR, and note the null detector meter deflection.

4.5.1.10 Adjust the reference divider INPUT VOLTAGE ADJUST COARSE and FINE controls, the DC voltage standard voltage controls, and the null detector I RANGE switch to obtain a null indication on the null detector I 10 μV range.

4.5.1.11 Set null detector I RANGE switch to the 300 μV range and the ZERO/OPR switch to ZERO. Set the reference divider STD CELL CIRCUIT switch to OPEN.

4.5.1.12 Set the TI POWER switch to OPR or ON.

4.5.1.13 Set null detector II ZERO/OPR switch to OPR.

4.5.1.14 Set the null detector II RANGE switch to measure the voltage at the null detector input terminals, verify that the voltage is between -30.2 and then +30.2 mV (332A) or -20.2 mV and then +20.2 mV (332B), and then adjust the TI 1000 V CAL ADJUST screw for a null indication within ±1 mV on the null detector 3 mV range.

4.5.1.15 Set null detector II ZERO/OPR switch to ZERO and the TI POWER switch to STDBY/RESET.

4.5.1.16 Turn the DC voltage standard to STDBY/RESET. Set the DC voltage standard range switch and the reference divider input and output switches to 100 V. Turn the DC voltage standard to OPR.

4.5.1.17 Set the TI VOLTAGE RANGE switch to 100.

4.5.1.18 Set the reference divider STD CELL CIRCUIT switch to LOCKED. Set the null detector I ZERO/OPR switch to OPR and, if necessary adjust the reference voltage divider COARSE and FINE controls, or the DC voltage standard voltage controls for a null indication on the 10 μV range.

4.5.1.19 Set the null detector I ZERO/OPR switch to ZERO. Set the reference divider STD CELL CIRCUIT switch to OPEN.

4.5.1.20 Set the TI POWER switch to OPR or ON. Set the null detector II ZERO/OPR switch to OPR.

4.5.1.21 Set the null detector II RANGE switch to measure the voltage at the null detector input terminals, verify that the voltage is between -3.02 and +3.02 mV (332A) or -2.02 and +2.02 mV (332B), and then adjust the TI 100 V CAL ADJUST screw for a null indication within ±100 μV on the null detector 300 μV range.

4.5.1.22 Set the null detector II ZERO/OPR switch to ZERO and the TI POWER switch to STDBY/RESET.

4.5.1.23 Turn the DC voltage standard to STDBY/RESET. Set the DC voltage standard range switch and the reference divider input and output switches to 10 V. Turn the DC voltage standard to OPR.

4.5.1.24 Set the TI VOLTAGE RANGE switch to 10.

4.5.1.25 Set the reference divider STD CELL CIRCUIT switch to LOCKED. Set the null detector I ZERO/OPR switch to OPR and, if necessary, adjust the reference voltage divider COARSE and FINE controls for a null indication on the 10 μV range.

4.5.1.26 Set null detector I ZERO/OPR switch to ZERO. Set the reference divider STD CELL CIRCUIT switch to OPEN.

4.5.1.27 Set the TI POWER switch to OPR or ON. Set null detector II ZERO/OPR switch to OPR.

4.5.1.28 Set the null detector II RANGE switch to measure the voltage at the null detector input terminals, verify that the voltage is between -310 and +310 μV (332A) or -210 and +210 μV (332B), and then adjust the TI 10 V CAL ADJUST screw for a null indication within ±30 μV on the null detector 100 μV range.

4.5.1.29 Set the null detector II ZERO/OPR switch to ZERO, and TI and dc voltage standard POWER switches to STDBY/RESET, and the VOLTAGE dials to 0.00000. Disconnect the equipment. Skip to step 4.5.2.12.

4.5.2 Using the 752A reference divider

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

4.5.2.2 Connect the equipment as shown in Figure 5.

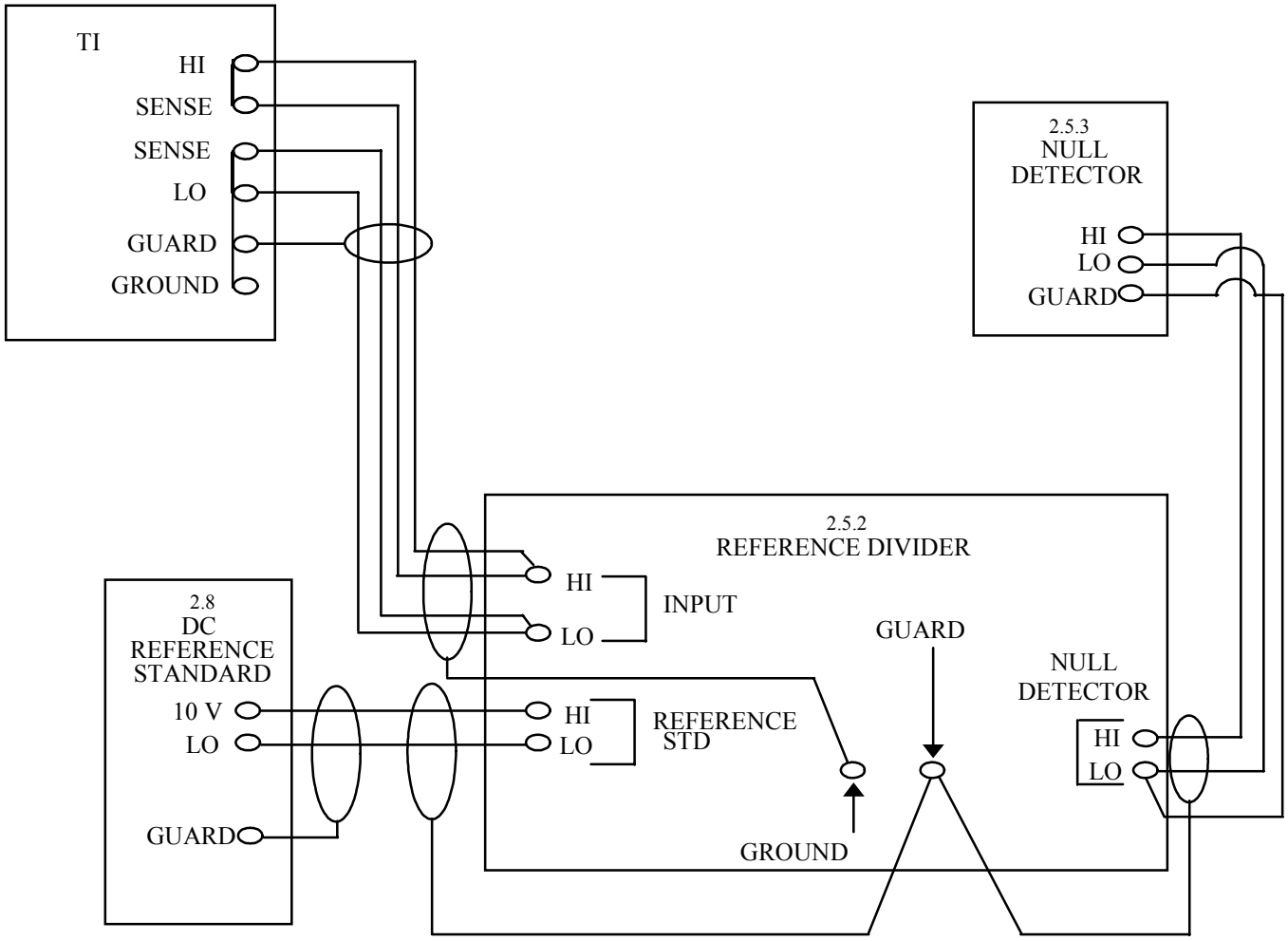


Figure 5. Range Accuracy Test Configuration Using the 752A Reference Divider

4.5.2.3 Set the TI POWER switch to STDBY/RESET and the null detector ZERO/OPR switch to ZERO.

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

4.5.2.5 Set the reference divider CALIBRATE switch to operate and MODE switch to 10.

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

4.5.2.7 Select a null detector sensitivity setting to avoid meter pegging and set the ZERO/OPR switch to OPR.

4.5.2.8 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.

4.5.2.9 Verify that the TI Output Voltage dial setting is equal to the reference voltage on the DC reference standard Report of Calibration ±0.000210.

4.5.2.10 Set the null detector RANGE switch to avoid meter pegging and ZERO/OPR switch to ZERO and set the TI RANGE switch to STDBY/RESET.

4.5.2.11 Using the methods described in steps 4.5.2.4 through 4.5.2.10, repeat the measurement for each of the following TI and reference divider settings. At each setting, verify that the TI Output Voltage dial setting is within the tolerance limits listed in the following table.

Reference Divider Mode Switch Setting	TI Initial Settings		TI Output Voltage Dial Tolerance Limits	
	Range	Output Voltage Dials		
10	100	10.00000	REF VOLTAGE	±0.00022
100	100	100.00000	REF VOLTAGE X 10	±0.00202
10	1000	010.0000	REF VOLTAGE	±0.0004
100	1000	100.0000	REF VOLTAGE X 10	±0.0022
1000	1000	1000.0000	REF VOLTAGE X 100	±0.0202

4.5.2.12 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 332A DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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 Tests					
4.1.5	Full load 115 V ac	--				Reference
4.1.6	1000 V range 105 V ac	--				±5.0 mV of step 4.1.5
4.1.7	1000 V range 125 V ac	--				±5.0 mV of step 4.1.5
4.1.9	Full load/no load	--				±5.0 mV of step 4.1.5
4.1.14	Full load 115 V ac	--				Reference
4.1.15	100 V range 105 V ac	--				±0.5 mV of step 4.1.14
4.1.16	100 V range 125 V ac	--				±0.5 mV of step 4.1.14
4.1.18	Full load/no load	--				±0.5 mV of step 4.1.14
4.1.23	Full load 115 V ac	--				Reference
4.1.24	10 V range 105 V ac	--				±50 μV of step 4.1.23
4.1.25	10 V range 125 V ac	--				±50 μV of step 4.1.23
4.1.27	Full load/no load	--				±50 μV of step 4.1.23
4.2	10, 100 and 1000 V dc Range Ripple Test					
4.2.6	10.000000 V dc	--	ck ( )			≤ 20μV_{rms}
4.2.9	100.00000 V dc	--	ck ( )			≤ 30μV_{rms}
4.2.12	300.0000 V dc	--	ck ( )			≤ 40μV_{rms}
4.3	Zero Output Tests and Adjustments*					
4.3.7	10 V measurement	0 V				-10 to +10 μV
”	10 V adjust	--	ck ( )			Adjust within ±2 μV
”	100 V measurement	0 V				-20 to +20 μV
”	100 V adjust	--	ck ( )			Adjust within ±2 μV
”	1000 V measurement	0 V				-200 to +200 μV
”	1000 V adjust	--	ck ( )			Adjust within ±2 μV

*Any out of tolerance indications for 10 V, 100 V, and 1000 V measurements are corrected in step 4.3.7.

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332A DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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)
4.4	Linearity Test and Voltage Dial Functional Check					
4.4.4.2	Linearity Tests	(V)				(V)
”	TI Volt Dial .1111	.1111				0.1108 to 0.1114
”	” .2222	.2222				0.2219 to 0.2225
”	” .3333	.3333				0.3330 to 0.3336
”	” .4444	.4444				0.4441 to 0.4447
”	” .5555	.5555				0.5552 to 0.5558
”	” .6666	.6666				0.6663 to 0.6669
”	” .7777	.7777				0.7774 to 0.7780
”	” .8888	.8888				0.8885 to 0.8891
”	” .9999	.9999				0.9996 to 1.0002
”	” .XXXX	1.1110				1.1107 to 1.1113
4.4.5.2	3rd Dial Linearity Test					
”	TI Volt Dial 001.0	0 V				±200 µV
”	” 002.0	”				”
”	” 004.0	”				”
	” 006.0	”				”
”	” 008.0	”				”
”	” 00X.0	”				”
4.4.6	1st and 2nd Dial Linearity Tests and Adjustments*					
4.4.6.2	TI Volt Dial 01.00	0 V				±20 µV
4.4.6.3	Adjust R907	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 02.00	”				±20 µV
4.4.6.3	Adjust R908	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 04.00	”				±20 µV
4.4.6.3	Adjust R909	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 06.00	”				±20 µV
4.4.6.3	Adjust R910	”	ck ( )			±2 µV

*Any out of tolerance indication in step 4.4.6.2 are corrected in step 4.4.6.3.

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332A DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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)
4.4.6.2	TI Volt Dial 08.00	0 V				±20 µV
4.4.6.3	Adjust R911	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 0X.00	”				±20 µV
4.4.6.3	Adjust R912	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 1.000	”				±20 µV
4.4.6.3	Adjust R901	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 2.000	”				±20 µV
4.4.6.3	Adjust R902	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 4.000	”				±20 µV
4.4.6.3	Adjust R903	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 6.000	”				±20 µV
4.4.6.3	Adjust R904	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 8.000	”				±20 µV
4.4.6.3	Adjust R905	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 10.000	”				±20 µV
4.4.6.3	Adjust R906	”	ck ( )			±2 µV
4.5	Range Tests and Adjustments*					
4.5.1.14	1000 V measurement*	0 V				-30.20 to +30.20 mV
”	1000 V adjust	--	ck ( )			Within ±1 mV
4.5.1.21	100 V measurement*	0 V				-3.02 to +3.02 mV
”	100 V adjust	--	ck ( )			Within ±100 µV
4.5.1.28	10 V measurement*	0 V				-310 to +310 µV
”	10 V adjust	--	ck ( )			Within ±30 µV
4.5.2.1	Self Calibration	--	ck ( )			NA
4.5.2.9	TI Output Voltage	REF VOLT**	ck ( )			Ref Volts ±0.000210 V
4.5.2.11		REF VOLT**	ck ( )			Ref Volts ±0.00022 V
”	” ” ”	REF VOLTX10**	ck ( )			Ref Volts X10 ±0.00202 V
”	” ” ”	REF VOLT**	ck ( )			Ref Volts ±0.0004 V
”	” ” ”	REF VOLTX10**	ck ( )			Ref Volts X10 ±0.0022 V
”	” ” ”	REF VOLTX100**	ck ( )			Ref Volts X100 ±0.0202 V

* Any out of tolerance indications are corrected on the following line.

** Reference voltage on the DC reference standard Report of Calibration.

CALIBRATION CHECKLIST

TEST INST (S) Fluke 332B DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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 Tests					
4.1.5	Full load 115 V ac	--				Reference
4.1.6	1000 V range 105 V ac	--				±2.0 mV of step 4.1.5
4.1.7	1000 V range 125 V ac	--				±2.0 mV of step 4.1.5
4.1.9	Full load/no load	--				±2.0 mV of step 4.1.5
4.1.14	Full load 115 V ac	--				Reference
4.1.15	100 V range 105 V ac	--				±0.2 mV of step 4.1.4
4.1.16	100 V range 125 V ac	--				±0.2 mV of step 4.1.4
4.1.18	Full load/no load	--				±0.2 mV of step 4.1.4
4.1.23	Full load 115 V ac	--				Reference
4.1.24	10 V range 105 V ac	--				±20 μV of step 4.1.23
4.1.25	10 V range 125 V ac	--				±20 μV of step 4.1.23
4.1.27	Full load/no load	--				±20 μV of step 4.1.23
4.2	10, 100, AND 1000 V dc Range Ripple Test					
4.2.6	10.000000 V dc	--	ck ( )			≤20 μV_{rms}
4.2.9	100.00000 V dc	--	ck ( )			≤30 μV_{rms}
4.2.12	300.0000 V dc	--	ck ( )			≤40 μV_{rms}
4.3	Zero Output Test and Adjustments*					
4.3.7	10 V measurement	0 V				-10 to +10 μV
”	10 V adjust	--	ck ( )			Adjust within ±1 μV
”	100 V measurement	0 V				-20 to +20 μV
”	100 V adjust	--	ck ( )			Adjust within ±1 μV
”	1000 V measurement	0 V				-200 to +200 μV
”	1000 V adjust	--	ck ( )			Adjust within ±1 μV

*Any out of tolerance indications for 10 V, 100 V, and 1000 V measurements are corrected in step 4.3.7.

CALIBRATION CHECKLIST

TEST INST(S) Fluke 332B DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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)
4.4	Linearity Test and Voltage Dial Functional Check					
4.4.4.2	Linearity Tests	(V)				(V)
”	TI Volt Dial .1111	.1111				0.1109 to 0.1113
”	” .2222	.2222				0.2220 to 0.2224
”	” .3333	.3333				0.3331 to 0.3335
”	” .4444	.4444				0.4442 to 0.4446
”	” .5555	.5555				0.5553 to 0.5557
”	” .6666	.6666				0.6664 to 0.6668
”	” .7777	.7777				0.7775 to 0.7779
”	” .8888	.8888				0.8886 to 0.8890
”	” .9999	.9999				0.9997 to 1.0001
”	” .XXXX	1.1110				1.1108 to 1.1112
4.4.5.2	3rd Dial Linearity Test (Serial number 641 and below)					
”	TI Volt Dial 001.0	0 V				±200 µV
”	” 002.0	”				”
”	” 004.0	”				”
	” 006.0	”				”
”	” 008.0	”				”
”	” 00X.0	”				”
4.4.6	1st and 2nd Dial Linearity Tests and Adjustments* (Serial number 641 and below)					
4.4.6.2	TI Volt Dial 01.00	0 V				±12 µV
4.4.6.3	Adjust Deck B 1	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 02.00	”				±12 µV
4.4.6.3	Adjust Deck B 2	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 04.00	”				±12 µV
4.4.6.3	Adjust Deck B 4	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 06.00	”				±12 µV
4.4.6.3	Adjust Deck B 6	”	ck ( )			±2 µV
*Any out of tolerance indication in step 4.4.6.2 are corrected in step 4.4.6.3.						

NOTE: Perform steps 4.4.5.2, 4.4.6.2 and 4.4.6.3 (for SNs 641 and below) or 4.4.8.2 and 4.4.8.3 (for SNs 642 and higher).

CALIBRATION CHECKLIST

TEST INST (S) Fluke 332B DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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)
4.4.6.2	TI Volt Dial 08.00	0 V				±12 µV
4.4.6.3	Adjust Deck B 8	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 0X.00	”				±12 µV
4.4.6.3	Adjust Deck B X	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 1.000	”				±12 µV
4.4.6.3	Adjust Deck A 1	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 2.00	”				±12 µV
4.4.6.3	Adjust Deck A 2	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 4.000	”				±12 µV
4.4.6.3	Adjust Deck A 4	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 6.000	”				±12 µV
4.4.6.3	Adjust Deck A 6	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial 8.000	”				±12 µV
4.4.6.3	Adjust Deck A 8	”	ck ( )			±2 µV
4.4.6.2	TI Volt Dial (10).000	”				±12 µV
4.4.6.3	Adjust Deck A 10	”	ck ( )			±2 µV
4.4.8	1st, 2nd and 3rd Dial Linearity Tests and Adjustments* (Serial number 642 and above)					
4.4.8.2	TI Volt Dial 001.0	0 V				±12 µV
4.4.8.3	Adjust Deck C 1	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 002.0	”				±12 µV
4.4.8.3	Adjust Deck C 2	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 004.0	”				±12 µV
4.4.8.3	Adjust Deck C 4	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 008.0	”				±12 µV
4.4.8.3	Adjust Deck C 8	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 010.0	”				±12 µV
4.4.8.3	Adjust Deck B 1	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 02.00	”				±12 µV
4.4.8.3	Adjust Deck B 2	”	ck ( )			±2 µV

*Any out of tolerance indication in step 4.4.8.2 are corrected in step 4.4.8.3.

CALIBRATION CHECKLIST

TEST INST (S) Fluke 332B DC Voltage Calibrator

PROC. NO. NA 17-20AE-71		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)
4.4.8.2	TI Volt Dial 04.00	0 V				±12 µV
4.4.8.3	Adjust Deck B 4	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 08.00	”				±12 µV
4.4.8.3	Adjust Deck B 8	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 10.00	”				±12 µV
4.4.8.3	Adjust Deck A 1	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 2.000	”				±12 µV
4.4.8.3	Adjust Deck A 2	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 4.000	”				±12 µV
4.4.8.3	Adjust Deck A 4	”	ck ( )			±2 µV
4.4.8.2	TI Volt Dial 8.000	”				±12 µV
4.4.8.3	Adjust Deck A 8	”	ck ( )			±2 µV
4.5	Range Tests and Adjustments					
4.5.1.14	1000 V measurement*	0 V				-20.20 to +20.20 mV
”	1000 V adjust	--	ck ( )			Within ±1 mV
4.5.1.21	100 V measurement*	0 V				-2.02 to +2.02 mV
”	100 V adjust	--	ck ( )			Within ±100 µV
4.5.1.28	10 V measurement*	0 V				-210 to +210 µV
”	10 V adjust	--	ck ( )			Within ±30 µV
4.5.2.1	Self Calibration	--	ck ( )			NA
4.5.2.9	TI Output Voltage	REF VOLT**	ck ( )			Ref Volts ±0.000210 V
4.5.2.11	TI Output Voltage	REF VOLT**	ck ( )			Ref Volts ±0.00022 V
”	” ” ”	REF VOLTX10**	ck ( )			Ref Volts X10 ±0.00202 V
”	” ” ”	REF VOLT**	ck ( )			Ref Volts ±0.0004 V
”	” ” ”	REF VOLTX10**	ck ( )			Ref Volts X10 ±0.0022 V
”	” ” ”	REF VOLTX100**	ck ( )			Ref Volts X100 ±0.0202 V

* Any out of tolerance indications are corrected on the following line.

** Reference voltage on the DC reference standard Report of Calibration.