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1.0 TITLE

Calibration procedure for CDT-240.

2.0 PURPOSE

To describe the CDT-240 calibration procedure.

3.0 DEFINITIONS

DMM - Digital Multimeter
CAL-BOX - Calibration Box (00-CDT-CBX)

4.0 PRECAUTIONS

4.1 The CDT-240 tester is capable of generating high voltage. Be very careful to follow all directions in the procedure.

5.0 MATERIALS/EQUIPMENT NEEDED

5.1 Calibrated DMM (Qty 2) DMM1 for voltage RMS below 50V and the DMM2 for voltages RMS 50V or greater.
5.2 Calibrated Oscilloscope (with 10x or 100x probe)
5.3 DC power supply 60V
5.4 BNC cable, 1:1 ratio
5.5 Screwdrivers

6.0 PROCEDURE

6.1 Once a technician has been trained on this procedure by an appropriate person, follow the directions listed in Appendix 1.
6.2 An appropriate person shall be any technician that has performed the calibration of a CDT-240 tester and can explain the procedure and safety concerns.

7.0 APPENDICES

7.1 Appendix 1 CDT-240 Factory Calibration Procedure.

8.0 RELATED ITEMS

8.1 CAL-Log-001-CDT 240
8.2 CBX1V Video

Appendix 1
CDT-240 Factory Calibration Procedure.

1. Software version verification.

1.1. When you turn on your CDT the version software appears at the booting screen, please verify with Compliance West the latest version and update it, if applies.

2. Power Supply Voltage.

2.1. Before starting, pull the traveler for the product being calibrated and have a copy ready of CAL-Log-001-CDT 240, use the specifications given here in the current document instead of mentioned CAL-Log.

2.2. Plug in the CDT-240 power cord, plug in the EUT power cord to the proper value (90 – 260V 50/60Hz), disconnect all the test leads attached to G, L or N outputs, disconnect any power cord attached to the front panel socket. Turn the unit ON, then perform a relay calibration pressing TEST once is prompt it on the display. Note that the EUT power source could be grounded or floated.

2.3. Adjust the $5V_{DC}$ output of the power supply to $5.1V_{DC}$ (-0/+0.04V) by turning V_{R1} (orange potentiometer) on the power supply while measuring the output voltage of the supply TP5 (+5V) to TP6 (AGND) on the main board, in order to locate V_{R1} please refer to **Figure 1**.

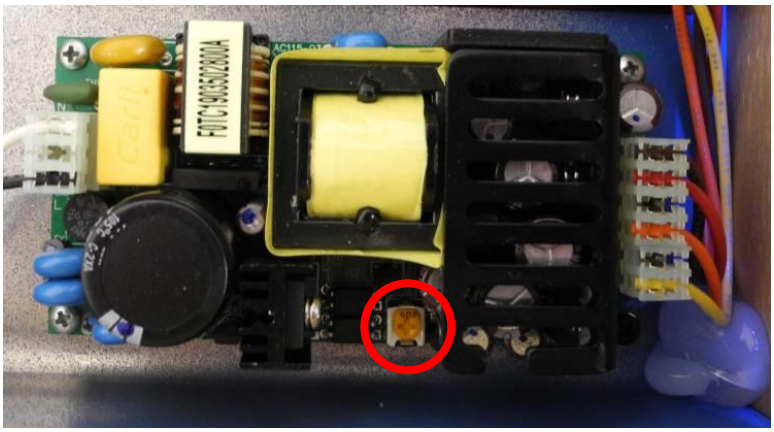

Figure 1. V_{R1} location (Red circle).

3. Zero Volt Adjustment (P3).

3.1. Connect the Oscilloscope to the BNC 100:1 output of the CDT-240.

3.2. Set the CDT for the following test:

- Trigger on POS
- Delay Test
- Delay: 3.0 s
- Line to Gnd measurement

3.3. Perform a test if necessary so that the CDT is not armed. The oscilloscope should measure 0V on the BNC connector we expect to get same as **Figure 2**, adjust P3 in order to set this value.

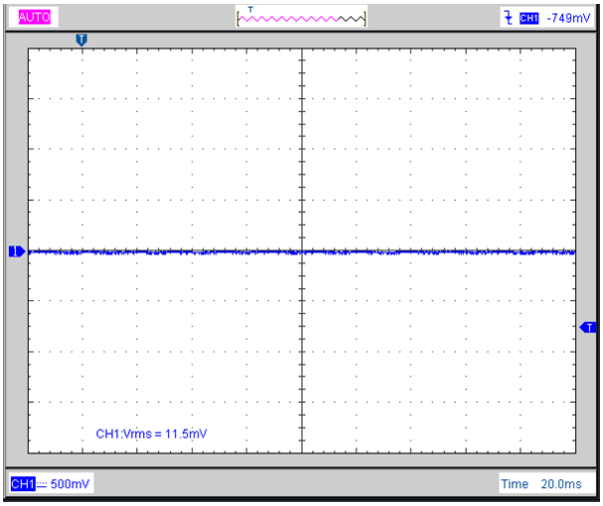

Figure 2. Zero output on BNC connector with CDT-240 not armed.

3.4. Disconnect the oscilloscope and connect DMM1 to the BNC connector, as it shows it in **Figure 3**.

Figure 3. BNC – Center (+) , Outside (-).

3.5. Adjust P3 so that the output is $0.000V_{DC}$ +/- $2mV_{DC}$ on DMM1, in order to get an accurate measurement.

3.6. Record the result on section 1 of CAL-Log-001-CDT 240.

4. Time Constant Adjustment (P4).

4.1. Connect the L and G front panel test jacks across the RC time constant CAL-BOX, 0.1s terminals "C" and "D" as shown in **Figure 4**.

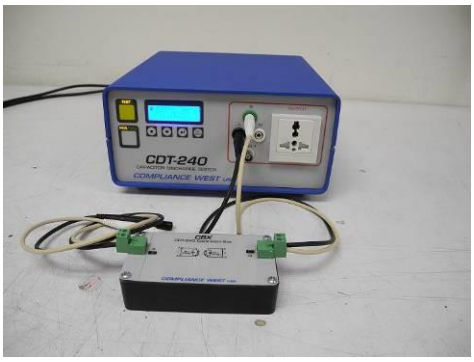

Figure 4. CDT-240 with CAL-BOX attached.

4.2. Set the CDT for the following test (same as previous test):
- Trigger on POS
- Delay Test
- Delay: 3.0 s
- Line to Gnd measurement

4.3. Press TEST once to ARM, and again to perform the test. The test result should be 0.0V (because the voltage decayed to zero in 3s). Adjust P4 as needed so that the measured voltage is 0.0V (turning the potentiometer clockwise makes the reading lower, i.e. more negative. Repeat the test multiple times to verify. The reading may fluctuate +/- 0.8V.

4.4. Edit the test parameters for a negative polarity test:
- **Trigger on NEG**
- Delay Test
- Delay: 3.0 s
- Line to Gnd measurement

4.5. Verify that the voltage measurement is 0V +/- 0.8V. Adjust P4 as needed.

4.6. Repeat steps 4.2 – 4.5 as needed so that the test result is always as close to 0.0V as possible.

4.7. Record both positive (as 4.3) and negative (as 4.5) results on section 3 of CAL-Log-001-CDT 240.

4.8. Disconnect the CAL-BOX.

5. Internal Voltage Measurement Accuracy (P5 & P2).

5.1. Line to Ground (P5)

5.1.1. Connect the Oscilloscope to the BNC 100:1 output of the CDT-240.

5.1.2. Edit the test parameters for a Voltage test:
- Trigger on NEG
- **Voltage Test**
- **Voltage setting: 50.0 V**
- Line to Gnd measurement

5.1.3. Press the test button once to ARM the CDT. You should see a sine wave signal on the oscilloscope as it shows it in **Figure 5**.

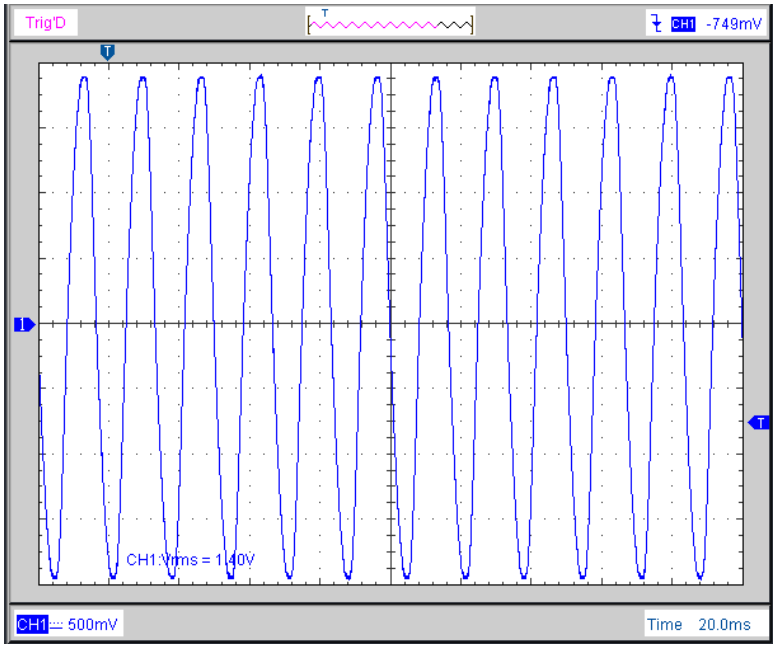

Figure 5. Sine Wave Output on CDT-240 BNC.

5.1.4. Unplug the EUT power cord and connect a $60V_{DC}$ power supply to "L" and "G", confirm the voltage with DMM2.

5.1.5. Using DMM1, adjust P5 so that the voltage at TP8 to AGND "TP6" is -1/39 of the Power supply voltage (-1.5385 V_{DC} if the voltage is $60V_{DC}$ for example). You can see both TP8 & TP6 test points on Figure 6.

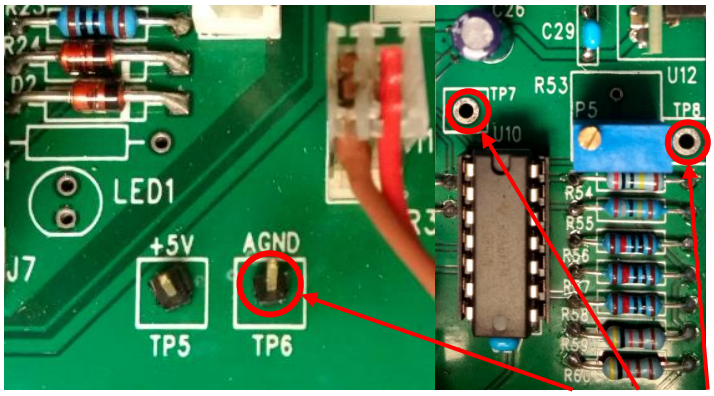

Figure 6. Internal Voltage Measurement Test Points TP6, TP7 y TP8.

5.1.6. Record the result on section 4 (L-G) of CAL-Log-001-CDT 240.
5.1.6.1. EUT Test Voltage: DMM2 Line to Ground voltage readout.
5.1.6.2. Expected Value:

$$Expected\_value = -\frac{EUT\_Test\_Voltage}{39}$$

5.1.6.3. Tolerance: Expected Value +/-1 % of reading.

5.2. Neutral to Ground (P2)

5.2.1. Connect the $60V_{DC}$ power supply to "N" and "G", confirm the voltage with DMM2.

5.2.2. Using DMM1, Adjust P2 so that the voltage at TP7 to AGND "TP6" is -1/39 of the Power supply voltage (-1.5385V_{DC} if the voltage is $60V_{DC}$ for example). You can see both TP7 & TP6 test points on Figure 6.

5.2.3. Record the Neutral to Ground voltage on section 3 (N-G) of CAL-Log-001-CDT 240.
5.2.3.1. EUT Test Voltage: DMM2 Neutral to Ground voltage readout.
5.2.3.2. Expected Value:

$$Expected\_value = -\frac{EUT\_Test\_Voltage}{39}$$

5.2.3.3. Tolerance: Expected Value +/-1 % of reading.

5.3. Line to Neutral (no adjustment - verification only)

5.3.1. Disconnect the DC power supply and plug back the EUT power cord.

5.3.2. Edit the test parameters for a Voltage test:
- Trigger on NEG
- Voltage Test
- Voltage setting: 50.0 V
- **Line to Neutral measurement**

5.3.3. Press the test button once to ARM the CDT. You should see clean AC on the oscilloscope as it shows it in **Figure 5**.

5.3.4. Circle Pass on 3 of CAL-Log-001-CDT 240 if verification was successful.

6. BNC 100:1 Calibration (P1)

6.1. Line to Ground Calibration.

6.1.1. Disconnect the scope and connect DMM1 Volts AC to the BNC 100:1 connector and DMM2 Volts AC to "L" and "G".

6.1.2. Edit the test parameters for a Voltage test:
- Trigger on NEG
- Voltage Test
- Voltage setting: 50.0V
- **Line to Ground measurement**

6.1.3. Press TEST once to ARM the CDT.

6.1.4. Adjust P1 so that the voltage on the BNC connector is 1/100 of the EUT test voltage +/- 1% (input voltage), 1.20V~ if the EUT voltage is 120V~ for example. To read both meters simultaneously press the "HOLD" button on both meters at the same time (if available).

6.1.5. Record both input voltage and L-G BNC voltage on section 4 of CAL-Log-001-CDT 240.
6.1.5.1. EUT Test Voltage: EUT input voltage at moment you are performing the test.
6.1.5.2. Expected Value:

$$Expected\_value = \frac{EUT\_Test\_Voltage}{100}$$

6.1.5.3. Tolerance: Expected Value +/-1 % of reading.

6.2. Neutral to Ground - No adjustment, verification only.

6.2.1. Reverse the polarity of the EUT voltage by unplugging the EUT power cord, swap the Line and Neutral spade lugs on the power connector, and reconnect EUT power, as it shows it in **Figure 7**.

Figure 7. Normal connection (Left), Reverse connection (Right).

6.2.2. Edit the test parameters for a Voltage test:
- Trigger on NEG
- Voltage Test
- Voltage setting: 50.0V
- **Neutral to Ground measurement**

6.2.3. Press TEST once to ARM the CDT.

6.2.4. Record both input voltage and N-G BNC voltage on section 4 of CAL-Log-001-CDT 240.
6.2.4.1. EUT Test Voltage: DMM2 Neutral to Ground voltage readout.
6.2.4.2. Expected Value:

$$Expected\_value = \frac{EUT\_Test\_Voltage}{100}$$

6.2.4.3. Tolerance: Expected Value +/-1 % of reading.

6.3. Line to Neutral - No adjustment, verification only.

6.3.1. If the EUT connection is reverse, connect as normal **Figure 7**.

6.3.2. Edit the test parameters for a Voltage test:
- Trigger on NEG
- Voltage Test
- Voltage setting: 50.0 V
- **Line to Neutral measurement**

6.3.3. Press TEST once to ARM the CDT.

6.3.4. Record both input voltage and L-N BNC voltage on section 4 of CAL-Log-001-CDT 240.
6.3.4.1. EUT Test Voltage: DMM2 Line to Neutral voltage readout.
6.3.4.2. Expected Value:

$$Expected\_value = \frac{EUT\_Test\_Voltage}{100}$$

6.3.4.3. Tolerance: Expected Value +/-1 % of reading.

7. Main Relay (off-board): Disconnect at Peak

7.1. All measurements within +5% of maximum (peak) voltage
+5% = + 18.2° from peak ($\cos^{-1}(.95)$)
equates to + 0.84 ms for 60 Hz, + 1.01 ms for 50 Hz

7.2. All measurements are positive peak disconnect (POS) unless otherwise specified. An example of a very accurate disconnect is shown below in **Figure 8**.

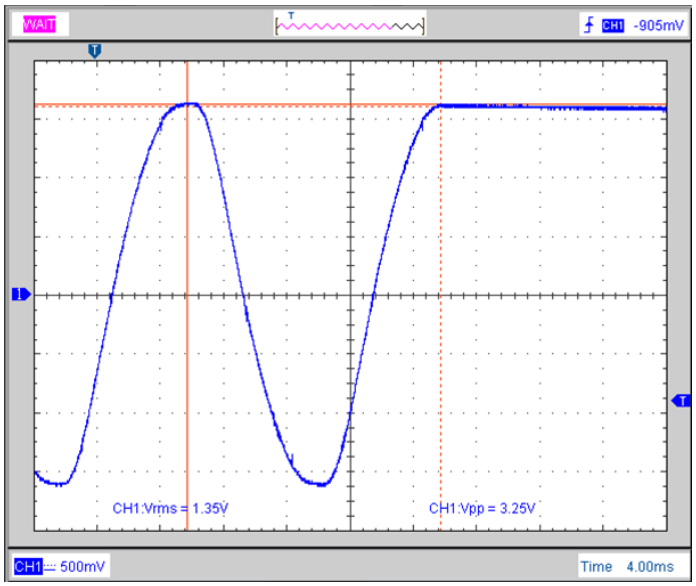

Figure 8. Example of Sine Wave disconnected on peak.

7.3. To be within 5% of the peak, the disconnect needs to occur in the time between the two vertical red lines shown below in **Figure 9** .

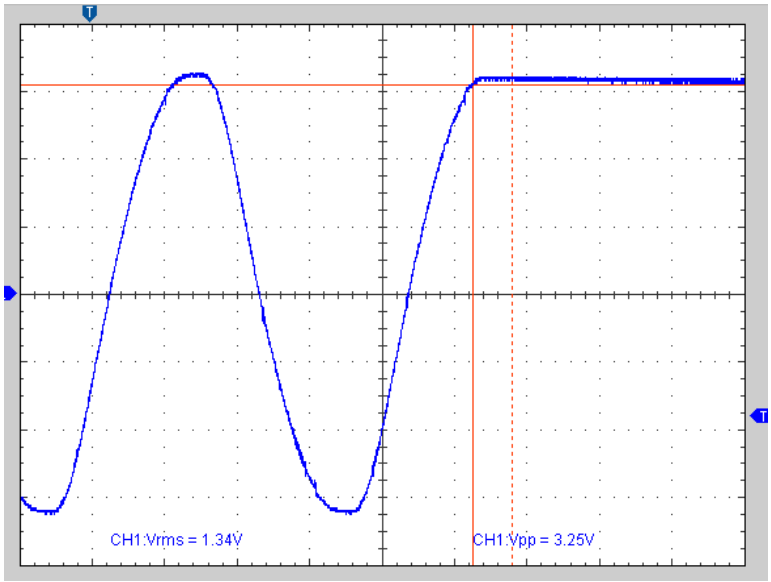

Figure 9. Range accepted for disconnect.

7.4. Accuracy at 120V, 60 Hz input, POS peak.

7.4.1. Connect an oscilloscope to the 100:1 BNC connector on the front panel of the CDT.

7.4.2. Connect the L and G front panel test jacks across the RC time constant CAL-BOX, 1s terminals "A' and "B".

7.4.3. Set the CDT for the following test:
- **Trigger on POS**
- Voltage Test
- Voltage setting: 50.0 V
- **Line to Gnd measurement**

7.4.4. Perform three tests and confirm that it disconnects within -5% /+0% of the peak voltage as specified in section 7.1.

7.4.5. Circle PASS on section 5 of CAL-Log-001-CDT 240 if the verification was successful.
7.4.5.1. Expected Value: Value of previous Positive Sine Wave Peak.
7.4.5.2. Tolerance: Expected Value -5%/+0% of reading.

7.5. Accuracy at 120V, 60Hz input, NEG peak.

7.5.1. Connect a scope to the BNC connector on the front panel of the CDT.

7.5.2. Connect the L and G front panel test jacks across the RC time constant CAL-BOX, 1s terminals "A' and "B".

7.5.3. Set the CDT for the following test:
- **Trigger on NEG**
- Voltage Test
- Voltage setting: 50.0 V
- Line to Gnd measurement

7.5.4. Perform three tests and confirm that it disconnects within -5%/+0% of peak voltage as specified in section 7.1.

7.5.5. Circle PASS on section 5 of CAL-Log-001-CDT 240 if the verification was successful.
7.5.5.1. Expected Value: Value of previous positive Sine Wave Peak, as it shown it in **Figure 8**.
7.5.5.2. Tolerance: Expected Value -5% /+0% of reading.

8. CBX 1 Second RC Time Constant - Voltage Test.

8.1. Line to Ground: Time Accuracy.

8.1.1. Edit the test parameters for a Voltage test:

- **Trigger on POS**
- Voltage Test
- Voltage setting: 50.0 V
- Line to Ground measurement

8.1.2. Connect L-G to 1s time constant terminals “A” and “B” of CAL-BOX and also connect an oscilloscope using a 10X or 100X probe.

8.1.3. Perform a test and disconnect one end of the CAL-BOX after 0.7 – 0.9 seconds, see video CBX1V, confirm the oscilloscope time measurement correspond to the CDT-240 (within +/- 0.01s).

8.1.4. Record on section 6 of CAL-Log-001-CDT 240.

8.1.4.1. Waveform value time: Oscilloscope time measurement from Main relay disconnection until CBX is unplugged “fast decay”.

8.1.4.2. Tolerance time: Waveform value time +/- 0.01s.

8.1.4.3. As left time: This is the value of the test time result on the CDT-240.

8.2. Neutral to Ground: Voltage Accuracy.

8.2.1. Edit the test parameters for a Voltage test:

- **Trigger on NEG**
- Voltage Test
- Voltage setting: 50.0 V
- **Neutral to Ground measurement**

8.2.2. Reverse the polarity of the EUT voltage by unplugging the EUT power cord, swap the Line and Neutral spade lugs on the power connector, and reconnect EUT power, as it shows it in **Figure 7**.

8.2.3. Connect N-G to 1s time constant terminals “A” and “B” of CAL-BOX and also connect an oscilloscope using a 10X or 100X probe.

8.2.4. Perform a test without disconnecting the CAL-BOX, confirm the voltage on the waveform corresponds to CDT-240 Voltage within ±2% of reading ±0.8V.

8.2.5. Record on section 6 of CAL-Log-001-CDT 240.

8.2.5.1. Waveform value voltage: Voltage level at CDT-240 time result. Note: Compensate for oscilloscope offset.

8.2.5.2. Tolerance voltage: Waveform value voltage ±2% of reading ±0.8V.

8.2.5.3. As left voltage: This is the value of the voltage result on the CDT-240 (50V +0V -0.8V).

8.2.6. Return back the polarity of the EUT to normal connection.

9. CBX 1 Second RC Time Constant - Delay Test.

9.1. Line to Ground: Voltage Accuracy.

9.1.1. Edit the test parameters for a Delay test:
- **Trigger on POS**
- **Delay Test**
- **Delay setting: 1 second**
- **Line to Ground measurement**

9.1.2. Connect L-G to 1s time constant terminals “A” and “B” of CAL-BOX and an oscilloscope using a 10X or 100X probe.

9.1.3. Perform a test and confirm the oscilloscope voltage waveform after 1s of Main relay disconnection measurement corresponds to the CDT-240 (within ±2% of reading ±0.8V).

9.1.4. Record on section 7 of CAL-Log-001-CDT 240.
9.1.4.1. Expected value: Voltage level at 1s. **Note:** Compensate for oscilloscope offset.
9.1.4.2. Tolerance voltage: Waveform value voltage ±2% of reading ±0.8V.
9.1.4.3. As left voltage: This is the value of the voltage result on the CDT-240.

9.2. Line to Neutral: Voltage Accuracy.

9.2.1. Edit the test parameters for a Delay test:
- Trigger on POS
- Delay Test
- Delay setting: 1 second
- **Line to Neutral measurement**

9.2.2. Connect L-N to 1s time constant terminals “A” and “B” of CAL-BOX and an oscilloscope using a 10X or 100X probe.

9.2.3. Perform a test and confirm the oscilloscope voltage waveform after 1 second of Main relay disconnection measurement corresponds to the CDT-240 (within ±2% of reading ±0.8V).

9.2.4. Record on section 7 of CAL-Log-001-CDT 240.
9.2.4.1. Expected value: Voltage level at 1 second. **Note:** Compensate for oscilloscope offset.
9.2.4.2. Tolerance voltage: Waveform value voltage ±2% of reading ±0.8V.
9.2.4.3. As left voltage: This is the value of the voltage result on the CDT-240.

9.3. Neutral to Ground: Time and Voltage Accuracy.

9.3.1. Edit the test parameters for a Delay test:
- **Trigger on NEG**
- Delay Test
- Delay setting: 1 second
- **Neutral to Ground measurement**

9.3.2. Reverse the polarity of the EUT voltage by unplugging the EUT power cord, swap the Line and Neutral spade lugs on the power connector, and reconnect EUT power, as it shows it in **Figure 7**.

9.3.3. Connect N-G to 1s time constant terminals “A” and “B” of CAL-BOX and the 100:1 BNC output to the oscilloscope.

9.3.4. Perform a test and confirm the oscilloscope time measurement corresponds to the CDT-240 (within +/- 0.01s).

9.3.5. Remove the BNC cable and connect to N-G an oscilloscope using a 10X or 100X probe.

9.3.6. Perform a test and confirm the oscilloscope voltage waveform after 1 second of Main relay disconnection measurement corresponds to the CDT-240 (within ±2% of reading ±0.8V).

9.3.7. Record on section 7 of CAL-Log-001-CDT 240.

9.3.7.1. As left time: Oscilloscope time measurement from BNC start of square pulse until voltage decay signal appears.

9.3.7.2. Expected value: Voltage level at 1 second. Note: Compensate for oscilloscope offset.

9.3.7.3. Tolerance voltage: Waveform value voltage ±2% of reading ±0.8V.

9.3.7.4. As left voltage: This is the value of the voltage result on the CDT-240.

9.3.8. Return the polarity of the EUT to normal connection.