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VALHALLA SCIENTIFIC, INC.
2701C PRECISION VOLTAGE STANDARD

CALIBRATION PROCEDURE

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1. General

This section provides general maintenance information and a procedure for calibrating the 2701C. The Model 2701C DC Voltage Calibrator should be calibrated on a routine basis (every 12 months is recommended) to ensure continued accuracy.

For best results, the 2701C should be warmed-up with the covers in place at the calibration temperature for at least 2 hours before performing the calibration procedure that follows.

2. Required Test Equipment

The following test equipment is required to calibrate the Model 2701C DC Voltage Calibrator:

1) A DC voltage measuring device capable of measuring the following ranges:

0 volts	±0.5µV
0.1 volts	±0.5µV
1 volt	±1µV
10 volts	±10µV
100 volts	±100µV
1000 volts	±1mV

2) A high quality low-thermal lead set must be used for maximum accuracy. The recommended lead set is Valhalla Option SL-48 or its equivalent.

3) If the 2701C is equipped with the optional 120mA output, a 10Ω ±0.005% precision resistor is required. Valhalla lead set "Option C" may be used to connect to the resistor.

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3. Calibration Procedure

The 2701C offers 100% covers-on calibration that may be performed manually or via the IEEE interface bus, if installed. See Section 5 for the remote calibration procedure.

The 2701C provides 10 voltage calibration points that are always calibrated in the same sequence using the same adjustment procedure. Two additional points are provided if the 120mA option is installed. The 1200V range points are skipped in instruments equipped with Option LNF. The following section describes calibration using manual adjustments.

4. Manual Calibration

The following procedure should be used to perform a routine calibration on the 2701C. Readings should be allowed to settle for a minimum of 30 seconds before making any adjustment.

1) Make connections from the 2701C SENSE terminals to the voltmeter using the low-thermal lead set.

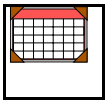
2) The calibration is initiated by turning the key-switch on the 2701C rear panel to the CALIBRATE position. Cal mode is confirmed by a "**C**" in the far right digit of the display.

3) **200mV Range, .000000C displays.** Adjustments to the output are made using the rightmost three knobs on the 2701C front panel. The knob on the far right provides the least amount of change. The second from the right provides a medium amount of change while the third from the right provides the greatest amount of change. Clockwise rotation of the knobs will increase the output while counter-clockwise rotation decreases the output.

   Adjust the necessary combination of knobs to bring the output level to 0 ±1μV. The 2701C display will not change as the knobs are adjusted. The adjustment is entered into memory by pressing the STANDBY/OPERATE Mode key once. The 2701C will proceed to the next step.

NOTE: If a particular range requires no adjustment, it may be skipped without changing its value by pressing the STANDBY/OPERATE switch before any adjustment of the knobs is made.

NOTE: If a particular range is too far out of adjustment for the microprocessor to compensate for it, the words "**FAIL CAL**" may flash on the display. In this case, a problem with the instrument or the test setup is indicated.



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4) **2V Range, 0.00000C displays.** Adjust the three knobs as required to bring the output to 0 ±3μV. Enter the adjustment by pressing the STANDBY/OPERATE key.

5) **20V Range, 00.0000C displays.** Make the required adjustments to bring the output to 0 ±20μV and enter the change.

6) **120V Range, 000.000C displays.** Make the required adjustments to bring the output to 0 ±150μV and enter the change.

7) **1200V Range, 0000.00C displays.** Make the required adjustment to bring the output to 0 ±1.5mV and enter the change. Note: This step is automatically skipped if the instrument is equipped with Option LNF.

8) If Option IT-2 is installed, the 2701C proceeds to the 120mA Mode and the display indicates 000.000C. If this option is not installed or if it will be calibrated separately, skip this step.

120mA Mode, 000.000C displays. Connect the 10Ω resistor to the 2701C OUTPUT terminals. Monitor the voltage drop across the resistor with the voltmeter. Adjust the 2701C knobs as described above until the voltmeter reads 0 ∀5μV. Enter the adjustment and remove the connections.

9) **200mV Range, .100000C displays.** Reconnect the voltmeter to the 2701C SENSE terminals, if required. The knobs are weighted to affect the output as indicated below:

1 0 0 0 0 0 C . 0.25 ppm of range
▲

1 0 0 0 0 0 C . 4 ppm of range
▲

1 0 0 0 0 0 C . 64 ppm of range
▲

Make the required adjustments to bring the reading on the voltmeter to .1000000 volts ±0.5μV. Enter the adjustment by pressing the STANDBY/OPERATE key.

10) **2V Range, 1.00000C displays.** Make the required adjustments to bring the output to 1.000000 volts ±5μV. Enter the adjustment.

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11) **20V Range, 10.0000C displays.** Make the required adjustments to bring the output to 10.00000 volts ±30µV. Enter the adjustment.

12) **120V Range, 100.000C displays.** Make the required adjustments to bring the output to 100.0000 volts ±500µV. Enter the adjustment.

13) **1200V Range, 1000.00C displays.** Make the required adjustments to bring the output to 1000.000 volts ±5mV. Enter the adjustment. Note: This step is automatically skipped if the instrument is equipped with Option LNF.

14) **"End CAL" displays.** If the instrument is not equipped with Option IT-2, the 2701C proceeds to this display indicating that a successful calibration has been completed. Turn the rear panel key switch to OPERATE. This concludes the calibration procedure.

15) **120mA Mode, 100.000C displays.** If the 2701C is equipped with Option IT-2, connect the 10Ω resistor to the OUTPUT terminals. Monitor the voltage drop across the resistor with the voltmeter. Adjust the output as necessary to bring the voltmeter reading to 1.00000 volts ±10µV. Enter the adjustment. The display should indicate "**End CAL**". Return the rear panel key- switch to the OPERATE position. This concludes the procedure.

5. Remote (IEEE-488) Calibration

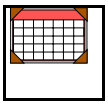
The 2701C may also be calibrated via the IEEE-488 interface, if installed. The calibration procedure must be enabled by turning the rear panel key switch to the CALIBRATE position. At the completion of the procedure, the key switch must be returned to the OPERATE position.

The sequence of calibration points is the same for both the remote calibration procedure and the manual calibration procedure, and the tolerances discussed in the preceding section apply as well. The method for making adjustments to the output is the only difference.

5-1. Increasing the Output

The output level at each calibration point is increased through use of the "U" command. This command, followed by the desired variable, determines the amount of increase. The variables are:

U0 . 0.25 ppm of range
U1 . 4 ppm of range
U2 . 64 ppm of range



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A sample command is shown below in HP Basic. If you are not using HP Basic, consult your operator's manual for the correct command syntax.

OUTPUT 715;"U1" = tells 2701C to increase the output by 4 ppm

5-2. Decreasing Output

The output level at each calibration point is decreased through use of the "D" command. This command, followed by the desired variable, determines the amount of decrease. The variables are:

D0 . 0.25 ppm of range
D1 . 4 ppm of range
D2 . 64 ppm of range

A sample command is shown below in HP Basic. If you are not using HP Basic, consult your operator's manual for the correct command syntax.

OUTPUT 715;"D0" = tells 2701C to decrease the output by 0.25 ppm

5-3. Entering the Data

The "N" command tells the 2701C to place the adjustment into non-volatile memory and move on to the next step. The "N" command may be used to skip a step without changing the calibration data.

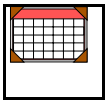
A sample command is shown below in HP Basic. If you are not using HP Basic, consult your operator's manual for the correct command syntax.

OUTPUT 715;"N" = tells 2701C to store the adjusted data and move on to the next step. If no adjustment has been made, the existing data remains in memory and the 2701C moves on to the next step.

5-6. Periodic Maintenance

It is recommended that the 2701C be operated in a clean environment. If the environment is dusty, periodic cleaning of the unit will be required.

Loose dirt or dust which has collected on the exterior surfaces of the 2701C may be removed with a soft cloth or brush. Any remaining dirt may be removed with a soft cloth dampened in a mild soap and water solution. **Do not use abrasive cleaners**. The front panel may be cleaned with a soft cloth and a "Windex" type cleaner. **Do not use petroleum based cleaners on the front panel.**



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If required, the 2701C interior may be cleaned by blowing with dry compressed air.

If the 2701C has become heavily contaminated with dirt or by other contaminants then it is recommended that the unit be completely overhauled at a Valhalla Scientific Service Center.

Valhalla Scientific, Inc.
Service Center
8318 Miramar Mall
San Diego CA 92121
858/457-5576
Fax: 858/457-0127

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