1000 Series

Precision Multi Product Calibrator

Calibration Manual

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Preparing For Calibration

Introduction

The recommended calibration period for the 1000 series calibrators is 12 months. Extended specifications for 6, 12 and 24 month re-calibration periods are available from the 1000 series extended specifications.

Calibration can be achieved using one of two methods:
1. Manual calibration via the front panel controls.
2. Automated closed-loop calibration using ProCal calibration software.

In both instances the calibrator should be switched on and allowed to warm up for the required period as stated in the operator's manual (see "Powering up the calibrator", p15 of the 100 series operation manual). Calibration should be performed in a stable environment where the temperature is stable to within +/- 1ºC during the calibration.

Equipment Required

To calibrate the 1000 series calibrators the following equipment is required:

1. High Accuracy precision Multimeter (example Transmille 8081 / Agilent 3458A opt 002 / Fluke 8508A)
2. LCR Bridge (example Agilent)
3. DC Voltage Source (example Transmille 3000 series multiproduct calibrator, Fluke 55xx series multiproduct calibrator)
4. High Accuracy Frequency Counter / GPS Frequency Reference / Off-Air Frequency Reference

Between these four pieces of equipment it is possible to calibrate all basic functions of the 1000 series calibrators. For units fitted with additional options additional equipment is required.

Optional Equipment

To perform a full calibration of a 1000 series multiproduct calibrator additional equipment may be required dependent upon the capabilities of the multimeter being used.

For multimeters such as the Agilent 3458A with limited maximum current, a selection of current shunts are required. These current shunts should be suitable for both DC and AC current up to. Suggested current shunt values are listed below, along with the current range they will be used for :

0.1 Ohm – 1A to 10A AC/DC
1 Ohm – 100 mA to 1A AC/DC
10 Ohm – 10.2mA to 100mA AC/DC
100 Ohm –1.02mA to 10mA AC/DC

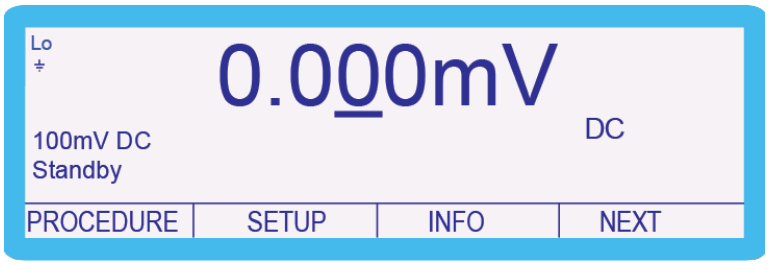
These shunts are also used for multimeters with insufficient current accuracy for low current calibration.

Calibration Password

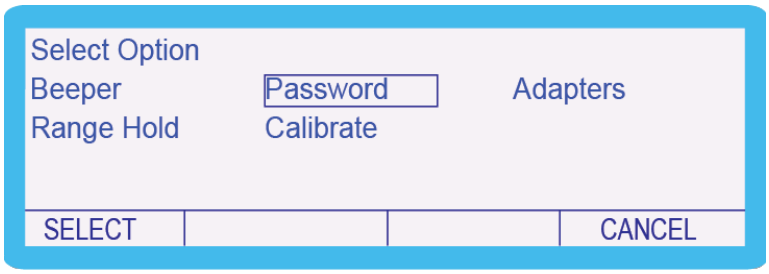
Changing the Calibration Password

To navigate to the 'Calibration Password' screen follow the procedure in the section: 'Manual Calibration' to step 3 where the following screen appears:

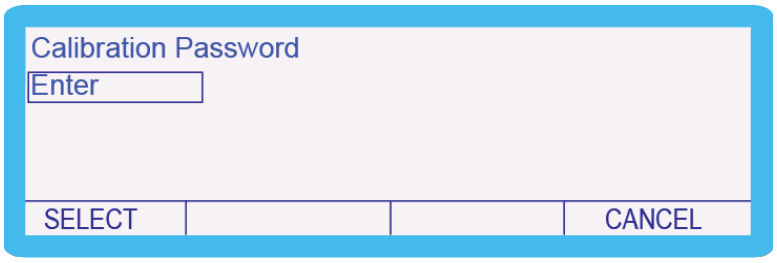
1. Press the **SETUP** soft key.



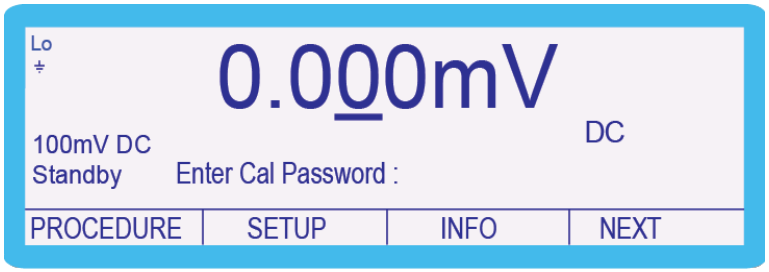
2. Use the 'Digital Control' or the 'Arrow Keys' to highlight 'Password' and then press **SELECT** soft key.



3. Press the **SELECT** soft key.

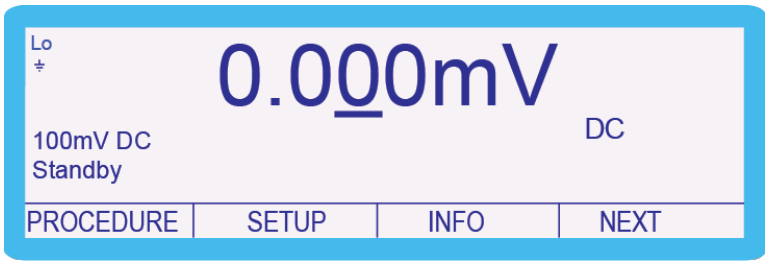


4. Enter the calibration password (default 0324).



The following screen is displayed for approximately 2 seconds:

and then reverts back to:

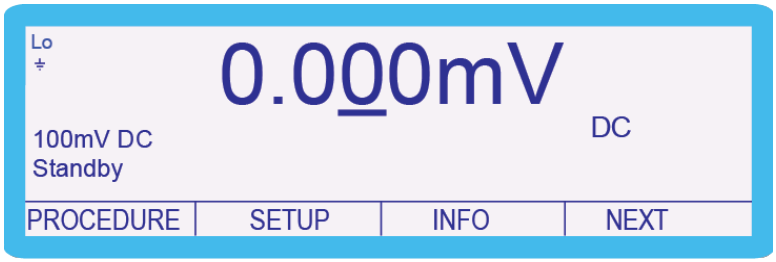


The instrument is now ready to be calibrated and the password can be changed.

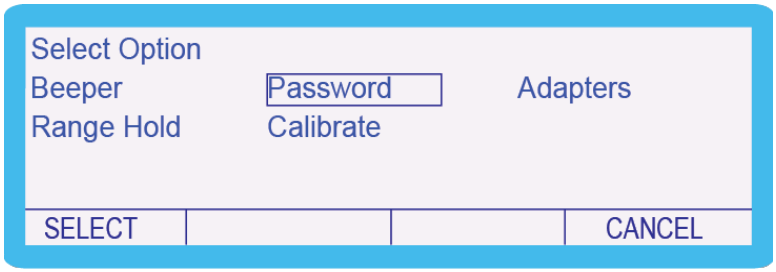
Set New Password

To change the password, complete the following procedure:

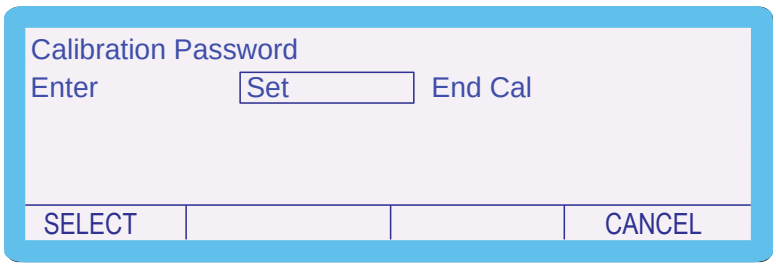
1. Press the **SETUP** soft key.



2. Use the 'Digital Control' or the 'Arrow Keys' to highlight 'Password' and then press **SELECT** soft key.



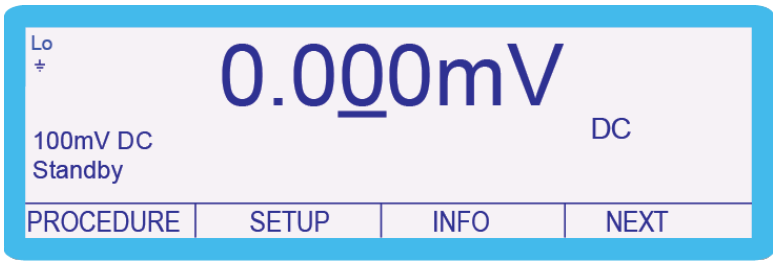
3. Highlight 'Set' and then press the **SELECT** soft key.



4. 'Enter New Cal Password' using function control keys, followed by the ENTER key e.g. 1000.

The following screen is displayed for approximately 2 seconds:

and then reverts to:



The password has now been changed.

Manual Calibration

Manual Calibration is achieved using the following front panel controls:

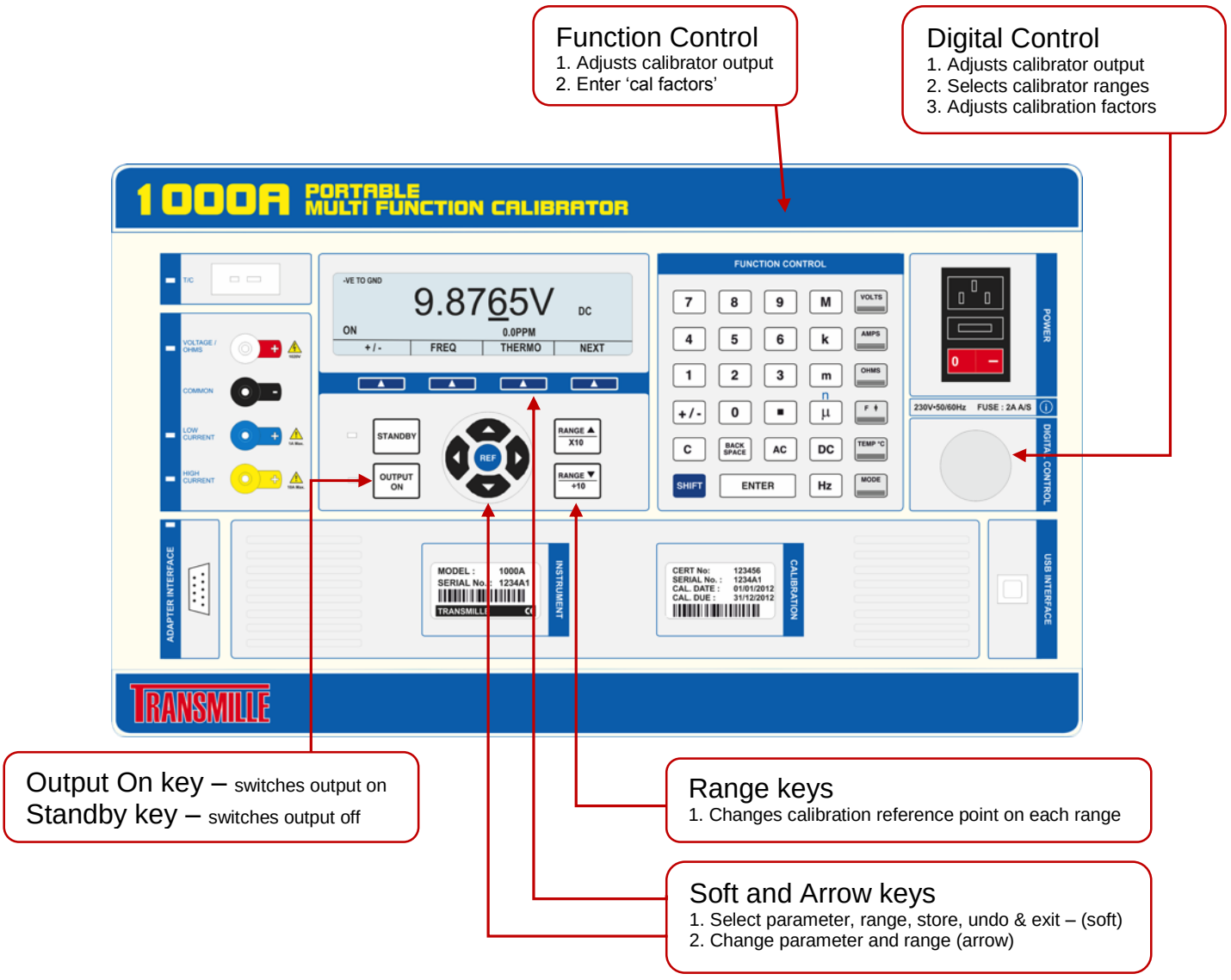
1. A digital control scroll wheel

2. Function controls

3. Soft and Arrow keys

4. Range up and Down keys

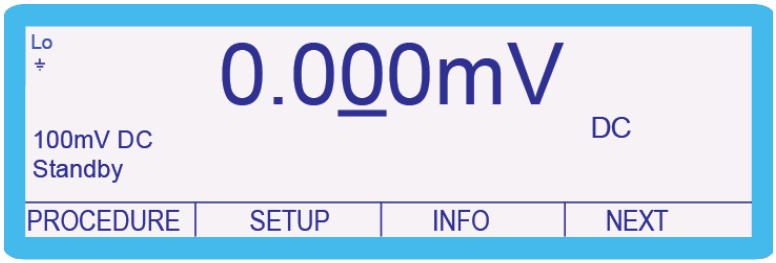
5. Output On and Standby keys



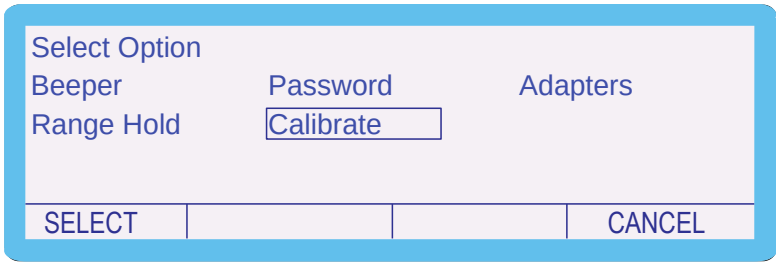
Entering Calibration Mode

To navigate to the calibration control screen, complete the following procedure:

1. Select **SETUP** using the soft key.



2. Select **CALIBRATE** using the soft key.

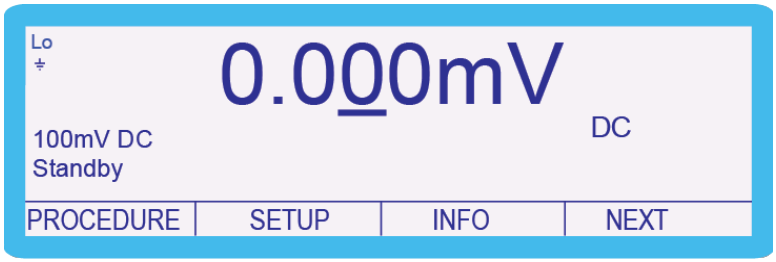


3. 'Enter Cal Password' using function control keys.

(0324 is the default password) followed by **ENTER**

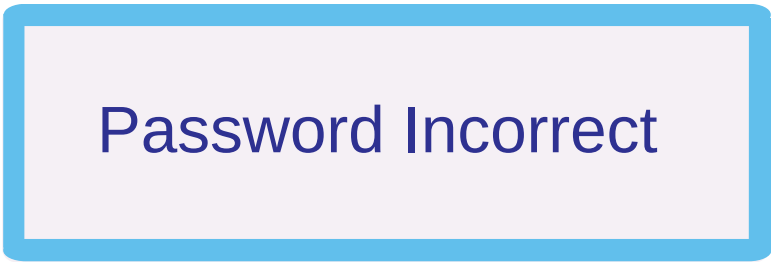
The following screen is displayed for approximately 2 seconds:

and then reverts to:



The instrument is now ready to be calibrated.

Should the password be entered incorrectly, the screen will display the following message for approximately 2 seconds:

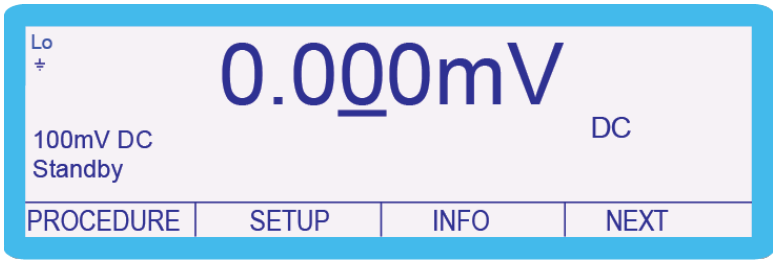


Select **SETUP** using the soft key to navigate back to ‘Enter Cal Password’ screen and re-enter the password.

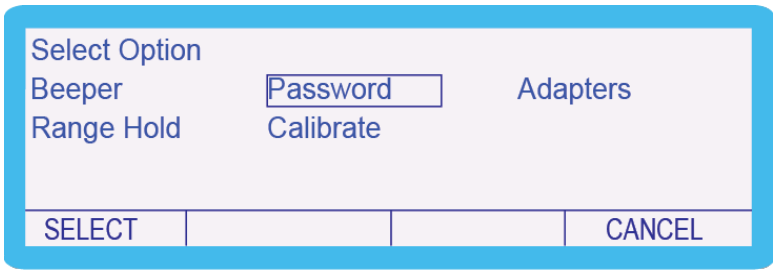
Exiting Calibration Mode

After calibration of the 1000 series is complete the calibration program should be ended to avoid any unauthorised or mistaken adjustment of the calibrator.
The following procedure should be completed.

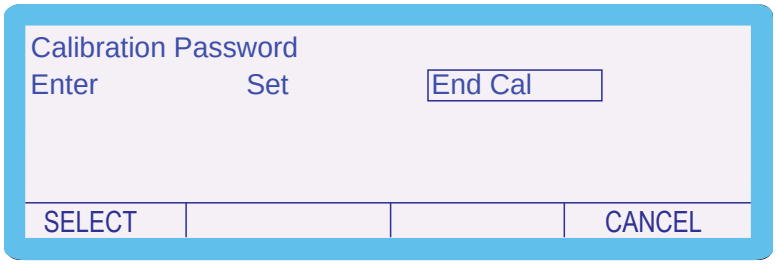
1. Press the **SETUP** soft key.



2. Use the 'Digital Control' or the 'Arrow Keys' to highlight 'Password' and then press **SELECT** soft key.



3. Highlight 'End Cal' and then press **SELECT** soft key.



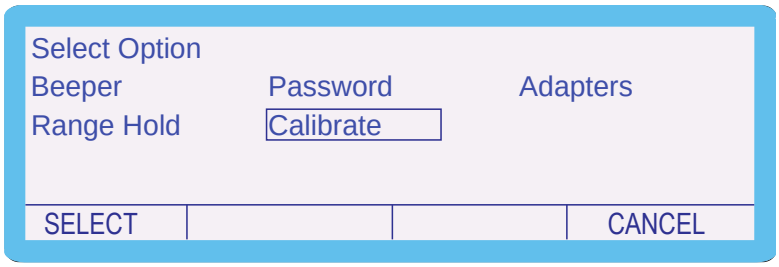
The calibrator then returns to the normal screen.

Calibration Parameters

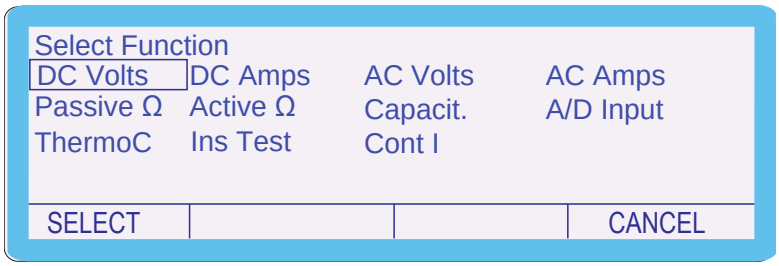
With the calibration password entered the different parameters of the instrument can be calibrated.

To enter a different parameter, complete the following procedure:

1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’.



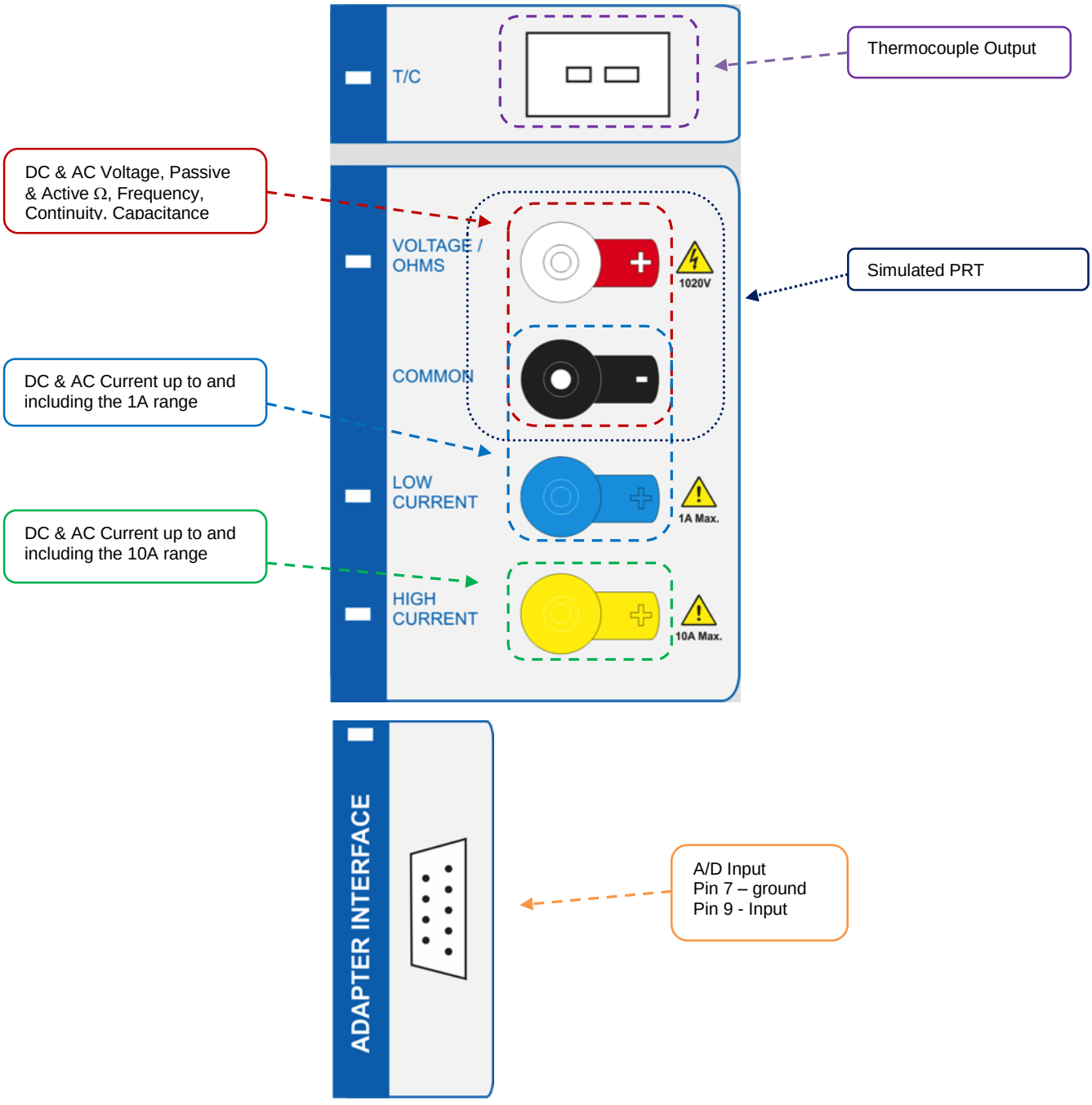
2. Highlight the required parameter e.g. ‘DC Volts’ and then press the **SELECT** soft key.



Depending upon the model and options fitted the available functions will vary.

Connections

The output of the 1000 series calibrator should be connected to the precision multimeter as below:

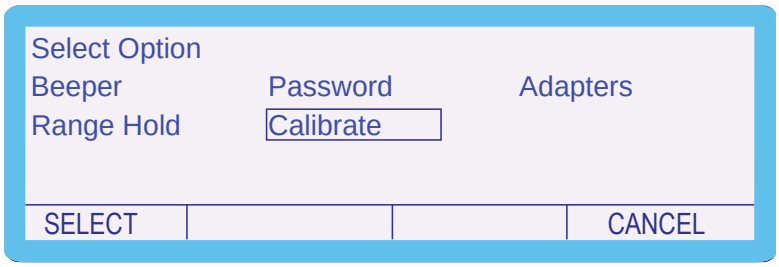


Calibration of Ranges

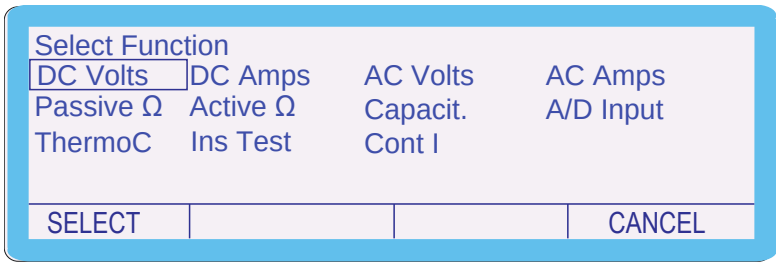
D.C. Voltage

To calibrate the D.C. Voltage parameter, complete the procedure as follows:

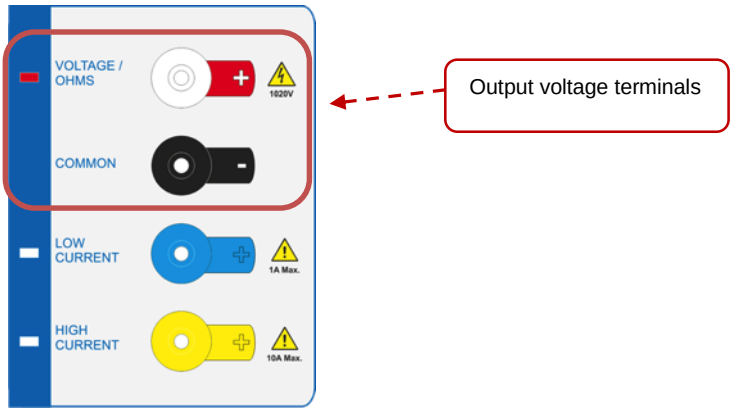
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’.



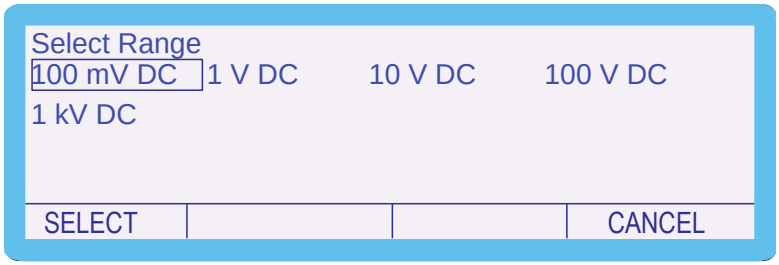
2. Highlight the required parameter; ‘DC Volts’ for example, and then press the **SELECT** soft key.



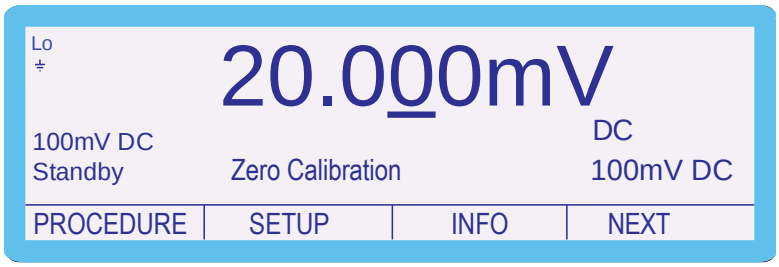
3. Connect the calibrator output voltage terminals to the precision Multimeter. Ensure that the Multimeter has been zeroed as a system by shorting out the leads and pressing the null button.



4. Select required range using the ‘Digital Control’ or the ‘Arrow Keys’ and press the **SELECT** soft key.



5. Ensure the calibration point is set to ‘Zero Calibration’. Use the ‘range up’ and ‘range down’ keys to change the calibration point if required.



6. Press **OUTPUT ON** and measure the output ‘Zero Calibration’.

7. To adjust the output, type in the measured value using the keyboard, followed by the ‘ENTER’ key i.e. 0.00028mV.

0 **•** **0** **0** **0** **2** **8** **ENTER**

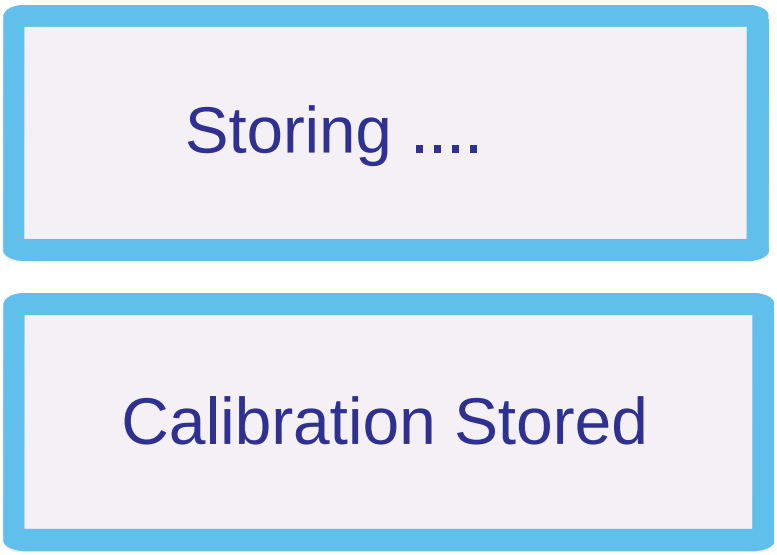
8. The output can also be adjusted by moving the ‘cursor’ to the required digit and adjusting the output using the up and down arrow keys or the digital control.

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

11. Once the output has been adjusted to within specification, the changes can be stored to long term memory. To store the changes permanently, press the **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

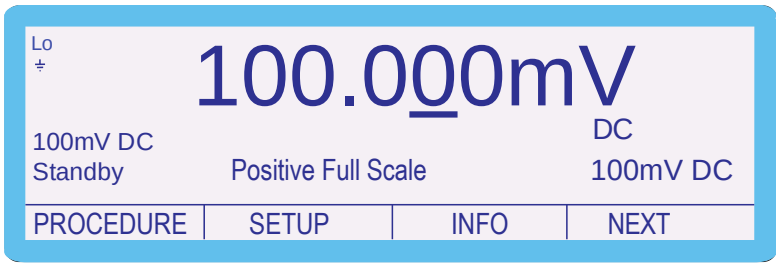


After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

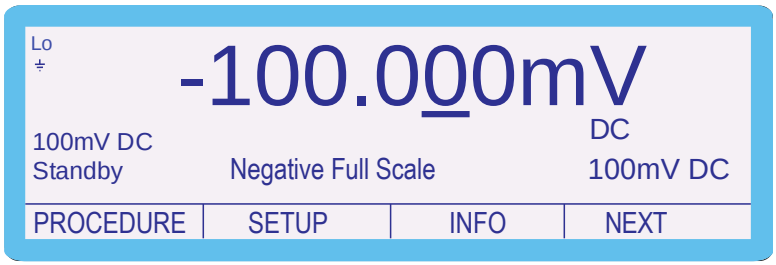
NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

12. Using the Range up / Range down' keys, change the output to 'Positive Full Scale'



13. Measure the output, and adjust as required using the process described in steps **6 – 10**.

14. Use the Range up / Range down keys to change the calibration point to 'Negative Full Scale'.



15. Measure the output, and adjust as required using the process described in steps **6 – 10.**

16. When calibration of this range is complete press the **RANGE** soft key.

17. To continue adjusting other ranges in the DC Voltage function, select 'DC Volts' and select the required range.

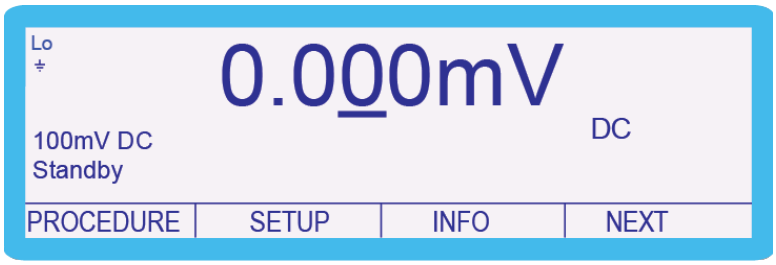
18. All DC volts ranges are calibrated in the same manner.

NOTE: The 'Zero Calibration' points for both the 200V DC and 1kV DC Ranges do not occur at 0V. They take place at 5V and 50V respectively.

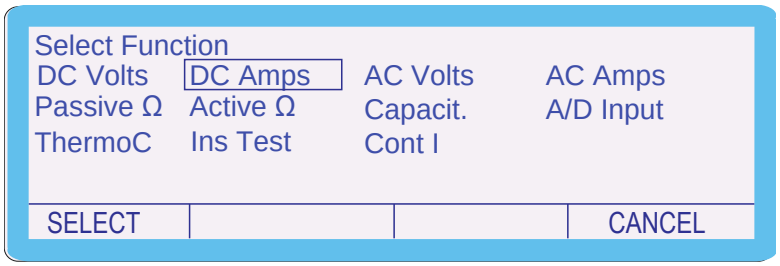
D.C. Current

To calibrate the D.C. Current parameter, complete the procedure as follows:

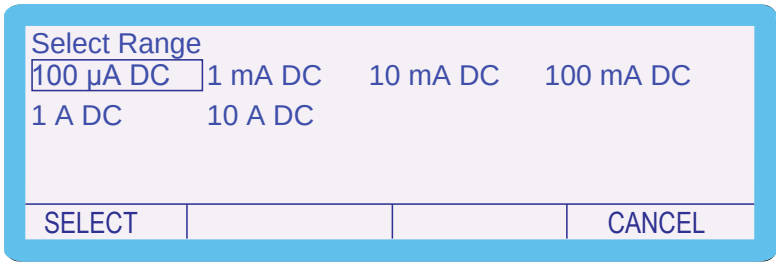
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’.



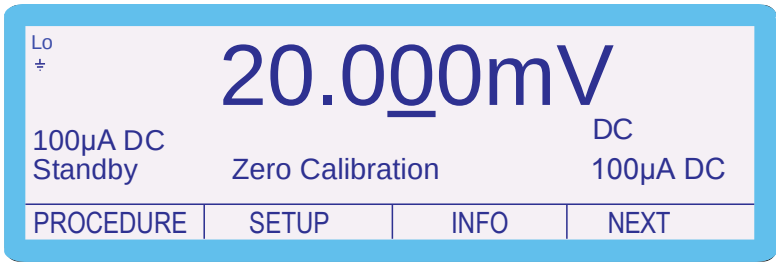
2. Highlight the required parameter ‘DC Amps’ and then press **SELECT** soft key.



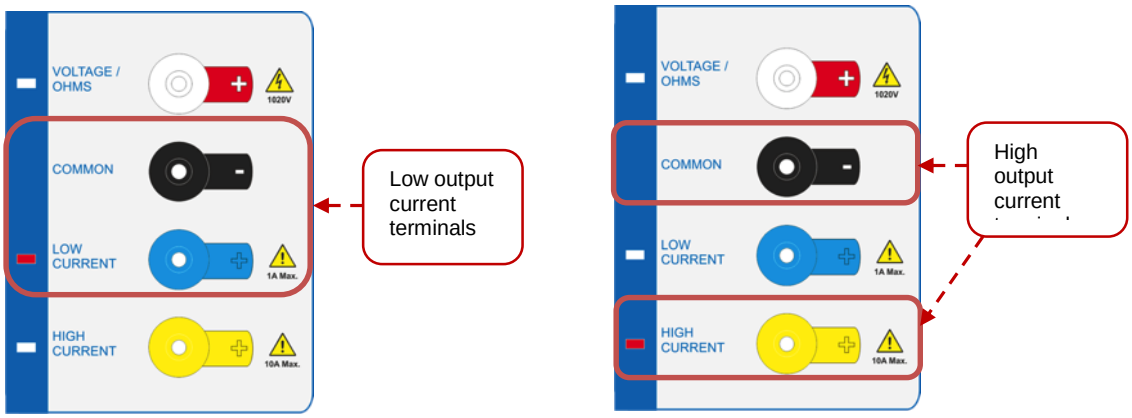
3. Highlight the required range e.g. ‘100µA’ and then press **SELECT** soft key.



4. The Calibrator will now change to the 100µA AC range. Use the Range Up / Range Down keys to select the ‘Zero Calibration’ adjustment point.



5. Connect the calibrator output voltage terminals to the precision multimeter. Ensure that the multimeter is in AC Current on the appropriate range.



NOTE: Ensure that the correct terminals / current shunts are used for the various current outputs. The 1000 calibrators can output up to 10A DC current, which can blow the fuse / cause damage if the incorrect input is used.

6. Press **OUTPUT ON** and measure the output.

7. To adjust the output, type in the measured value using the keyboard, followed by the 'ENTER' key i.e. 0.00028uA.

0 **.** **0** **0** **0** **2** **8** **ENTER**

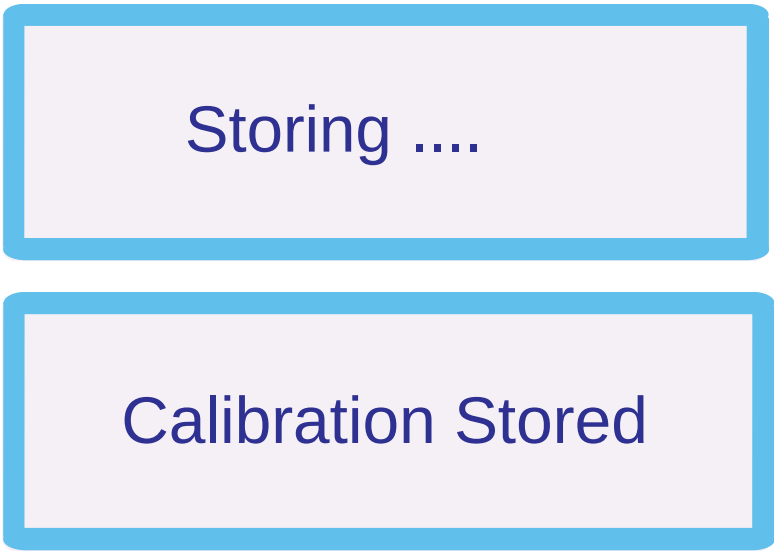
8. The output can also be adjusted by moving the 'cursor' to the required digit and adjusting the output using the up / down arrows or the digital control.

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

11. Measure and check the output again and then press **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

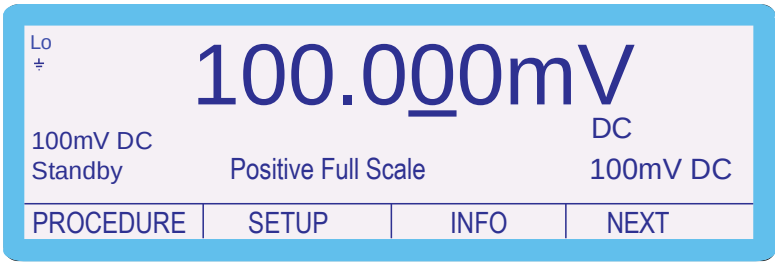


After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

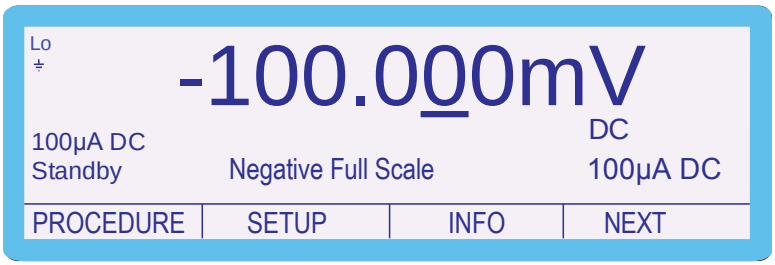
NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

12. Use the ‘range up’ and ‘range down’ keys to change the calibration point to ‘Positive Full Scale’.



13. Measure the output as before; if necessary adjust as previously described above (steps 5-11).

14. Use the ‘range up’ and ‘range down’ keys to change the calibration point to ‘Negative Full Scale’.



15. Measure the output as before; if necessary adjust as previously described above (steps 5-11).

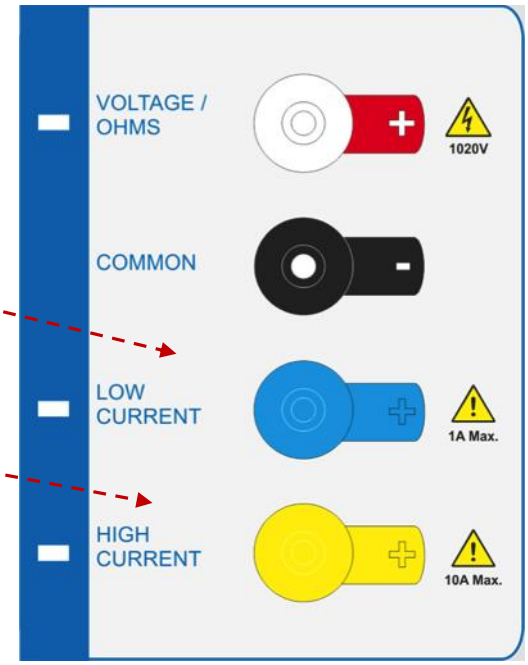
16. When calibration of this range is complete press the **RANGE** soft key. To continue adjusting other ranges in the DC Amps function, select ‘DC Amps’ and select the required range.

13. All D.C. current ranges are calibrated in the same manner.

Remember to change the connections when calibrating the 10A range

Current connections - 100µA, 1mA, 10mA, 100mA and 1A ranges

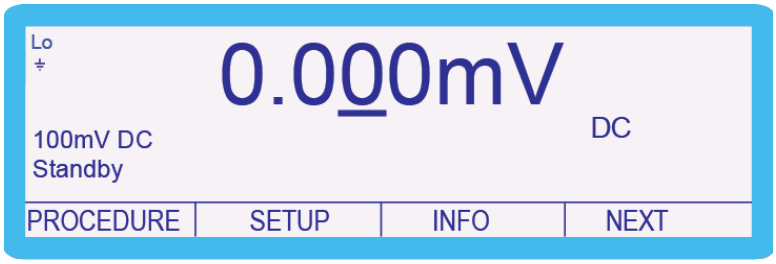
High current connections 10A range



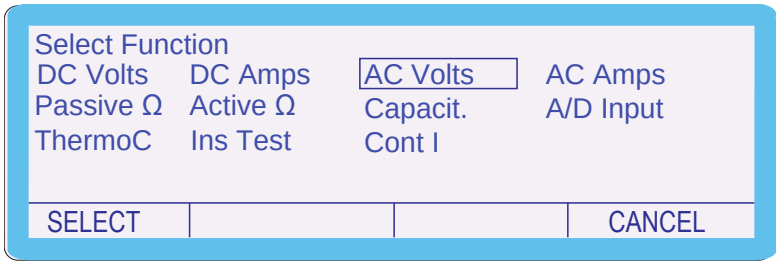
A.C. Voltage

To calibrate the A.C. Voltage parameter, complete the procedure as follows:

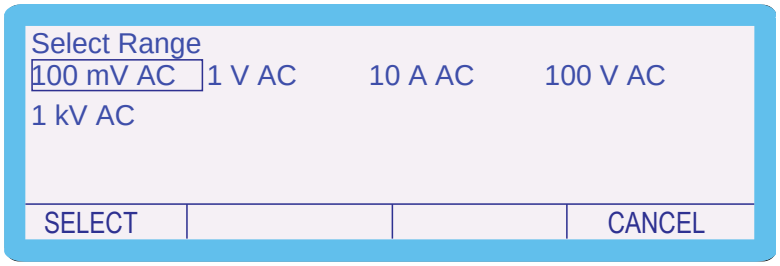
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’.



2. Highlight the required parameter ‘AC Volts’ and then press **SELECT** soft key.

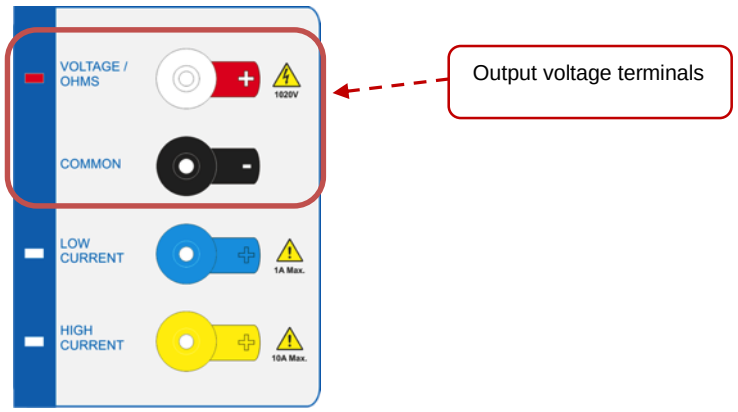


3. Use the ‘Digital Control’ or the ‘Arrow Keys’ to highlight the required range e.g. ‘100mV AC’ and then press **SELECT** soft key.



4. The Calibrator will now change to the 100mV AC range. Use the Range Up / Range Down keys to select the 206Hz Positive Full Scale adjustment point.

5. Connect the calibrator output voltage terminals to the precision multimeter. Ensure that the multimeter is set to A.C. Voltage on the appropriate range.



6. Press **OUTPUT ON** and measure the output.

7. To adjust the output, type in the measured value using the keyboard, followed by the 'ENTER' key i.e. 99.990mV.

0 **9** **9** **•** **9** **9** **0** **ENTER**

8. The output can also be adjusted by moving the 'cursor' to the required digit and adjusting the output using the up / down arrows or the digital control

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

11. Measure and check the output again and then press **STORE** soft key.

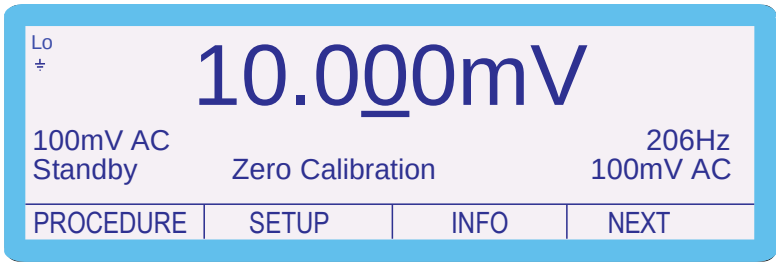
The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

After displaying these messages, the shift key will also cease to be illuminated

SHIFT

NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

12. Use the ‘range up’ and ‘range down’ keys to change the calibration point to 206Hz ‘Zero Calibration’.



NOTE: The ‘Zero Calibration’ of the AC Voltage ranges is performed at 20% of full scale.

13. Measure the output as before; if necessary adjust as previously describe above (steps 6-10).

14. The AC Voltage frequency response is only adjusted at the Full Scale points at different frequencies. A list of the frequencies that each model is adjusted at can be found at the end of this calibration manual.

15. Use the range up / range down keys to select the AC 10Hz Calibration Point.

NOTE: In many cases only the 206Hz full scale and zero calibration points require adjustment. The Frequency Response of the 1000 series calibrator may not change.

16. Measure the output as before; if necessary adjust as previously described above (steps 6-10).

17. Using the Range up / Range down keys, measure and adjust (if required) all available frequency points for each range. Depending upon the Range selected the available frequency points will differ. For a list of available frequency adjustment points, please refer to the section at the end of this manual.

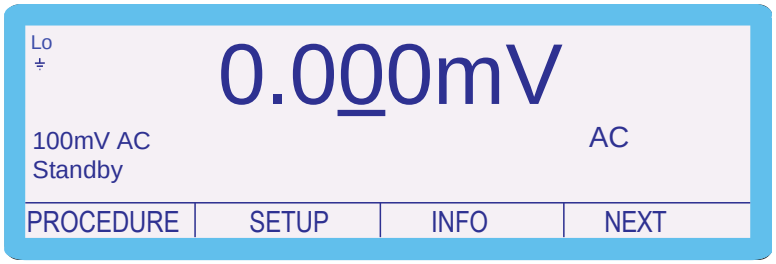
18. When calibration of this range is complete press the **RANGE** soft key. To continue adjusting other ranges in the AC Voltage function, select 'AC Volts' and select the required range.

19. All A.C. volts ranges are calibrated in the same manner.

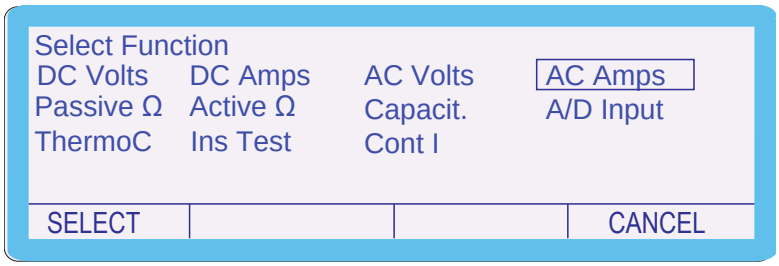
A.C. Current

To calibrate the A.C. Current parameter, complete the procedure as follows:

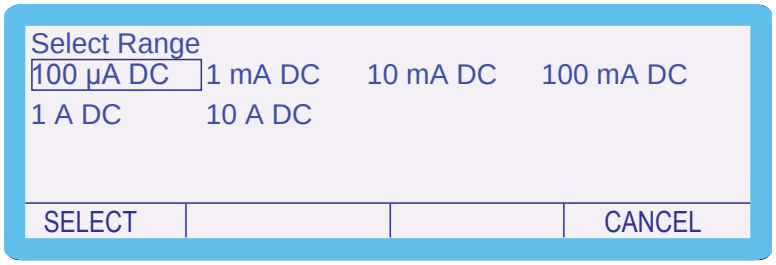
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’.



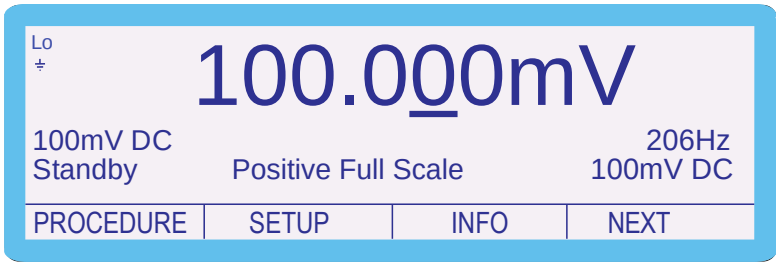
2. Highlight the required parameter ‘AC Amps’ and then press **SELECT** soft key.



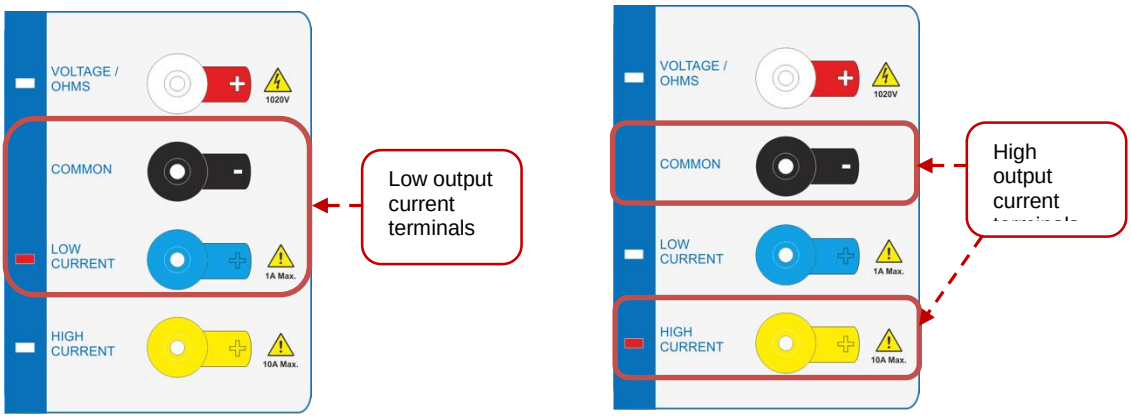
3. Highlight the required range e.g. ‘100µA’ and then press **SELECT** soft key.



4. The Calibrator will now change to the 100uA AC range. Use the Range Up / Range Down keys to select the 206Hz Positive Full Scale adjustment point.



5. Connect the calibrator output voltage terminals to the precision multimeter. Ensure that the multimeter is in AC Current on the appropriate range.



NOTE: Ensure that the correct terminals / current shunts are used for the various current outputs. The 1000 calibrators can output up to 10A AC current, which can blow the fuse / cause damage if the incorrect input is used.

6. Press **OUTPUT ON** and measure the output.

7. To adjust the output, type in the measured value using the keyboard, followed by the 'ENTER' key i.e. 99.990uA

0 **9** **9** **•** **9** **9** **0** **ENTER**

8. The output can also be adjusted by moving the 'cursor' to the required digit and adjusting the output using the up / down arrows or the digital contro

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

11. Measure and check the output again and then press **STORE** soft key.

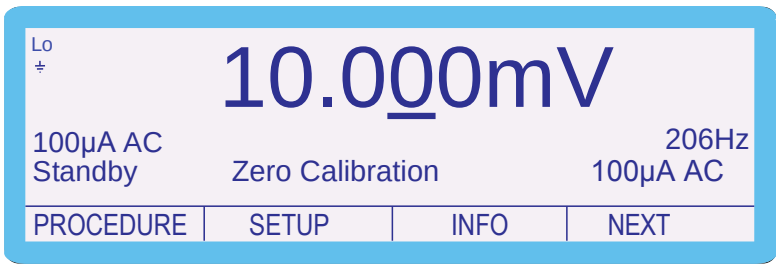
The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

NOTE: In many cases only the 206Hz full scale and zero calibration points require adjustment. The Frequency Response of the 1000 series calibrator may not change.

12. Use the ‘range up’ and ‘range down’ keys to change the calibration point to 206Hz ‘Zero Calibration’.

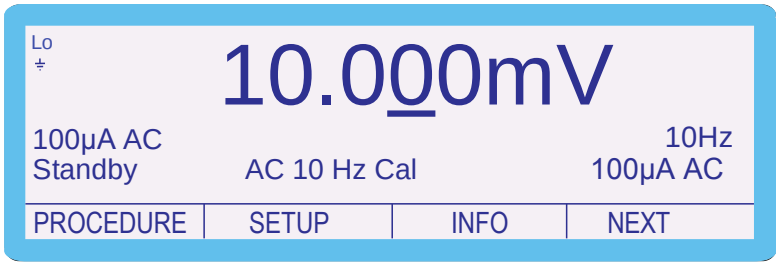


NOTE: The ‘Zero Calibration’ of the AC Current ranges is performed at 20% of full scale.

13. Measure the output as before; if necessary adjust as previously described above (steps 5-11).

14. The AC Current frequency response is only adjusted at the Full Scale points at different frequencies. A list of the frequencies that each model is adjusted at can be found at the end of this calibration manual.

15. Use the range up / range down keys to select the AC 10Hz Calibration Point.



NOTE: In many cases only the 206Hz full scale and zero calibration points require adjustment. The Frequency Response of the 1000 series calibrator may not change.

16. Measure the output as before; if necessary adjust as previously described above (steps 5-11).

17. Using the range up / range down keys, measure and adjust (if required) all available frequency points for each range. Depending upon the Range selected the available frequency points will differ. For a list of available frequency adjustment points, please refer to the section at the end of this manual.

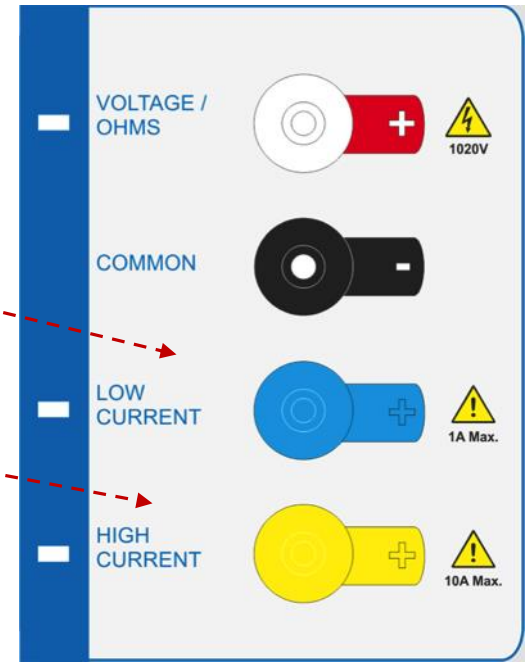
18. When calibration of this range is complete press the **RANGE** soft key. To continue adjusting other ranges in the AC Amps function, select 'AC Amps' and select the required range.

19. All AC current ranges are calibrated in the same manner.

Remember to change the connections when calibrating the 10A range

Current connections - 100μA, 1mA, 10mA, 100mA and 1A ranges

High current connections 10A range

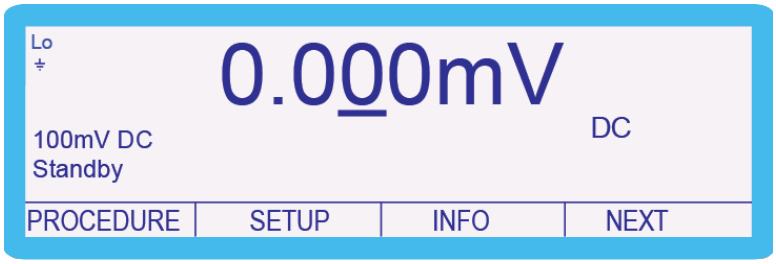


Passive Ω

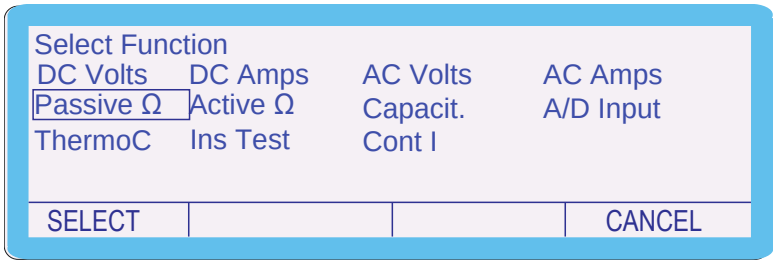
To calibrate the Passive Ω parameter, complete the procedure as follows:

NOTE: This output from the 1000 series calibrator is a passive output. This means that the value on the display is the resistance value generated at the terminals.
The resistance cannot be 'altered' to a different output; the value stored is simply the value of the resistor and the connections to the terminal.
For a variable resistance output, simulated resistance output (Active Ω) must be used.

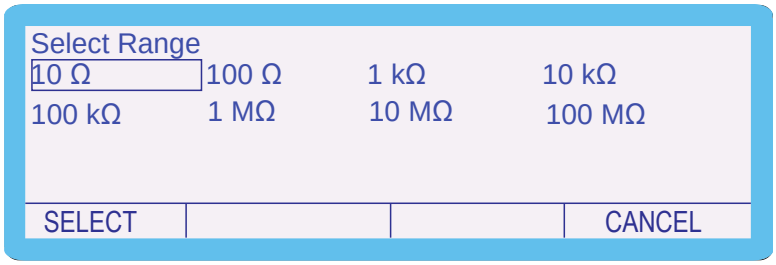
1. Enter the setup menu and use the 'Digital Control' or the 'Arrow Keys' to select 'Calibrate' and then press **SELECT** soft key.



2. Highlight the required parameter 'Passive Ω' and then press **SELECT** soft key.

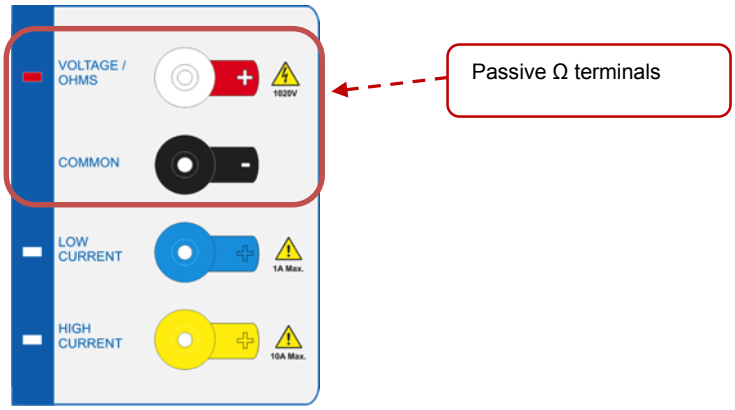


3. Highlight the required range e.g. '10 Ω' and then press **SELECT** soft key.



4. The Calibrator will now change to the 10 Ω range.

5. Connect the calibrator Voltage (2 Wire output) terminals to the precision multimeter. To ensure an accurate measurement connect as a 4 wire measurement, with both positive leads connected together. Ensure that the multimeter is nulled as a system, including the leads.



6. Press **OUTPUT ON** and measure the output.

7. To adjust the output, enter the value as measured on the multimeter. E.g. measured output = 10.00045Ω.

1 **0** **•** **0** **0** **0** **4** **5** **ENTER**

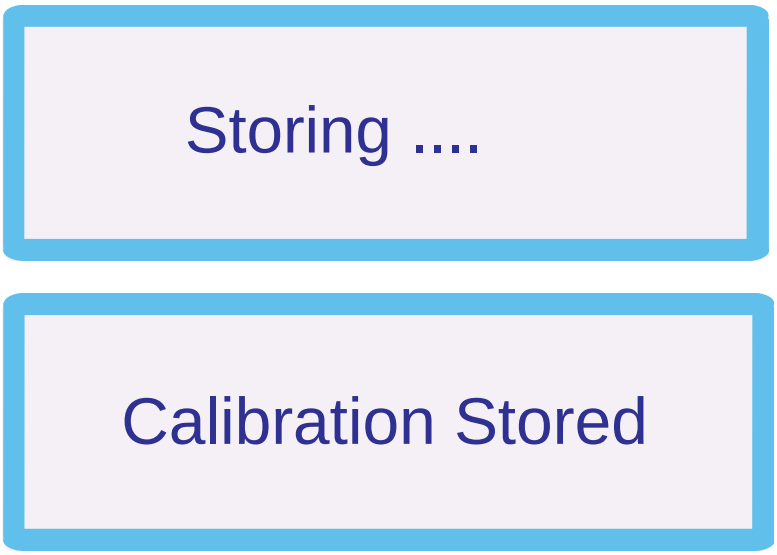
8. The output can also be adjusted by moving the 'cursor' to the required digit and adjusting the output using the up / down arrows or the digital control.

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

11. Measure and check the output again and then press **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.



After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

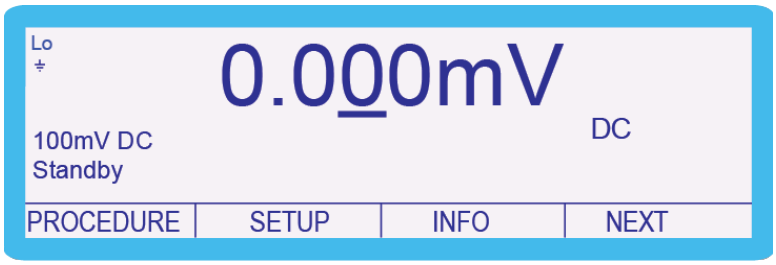
12. When calibration of this range is complete press the **RANGE** soft key, select 'Passive Ω' and then select the required range.

13. All Passive Ω ranges are calibrated in the same manner.

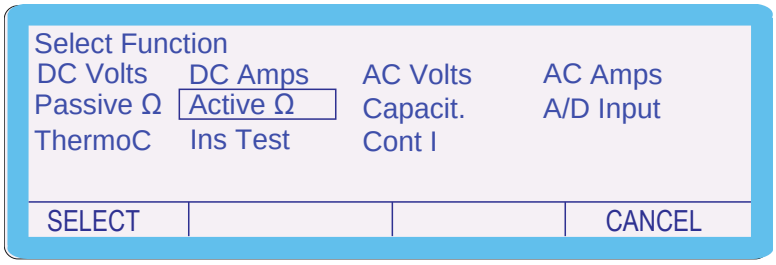
Active Ω

To calibrate the Active Ω parameter, complete the procedure as follows:

1. Enter the setup menu and use the 'Digital Control' or the 'Arrow Keys' to select 'Calibrate' and then press **SELECT** soft key.

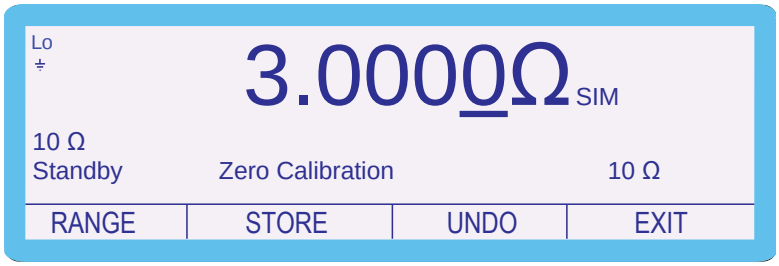


2. Highlight the required parameter 'Active Ω' and then press **SELECT** soft key.

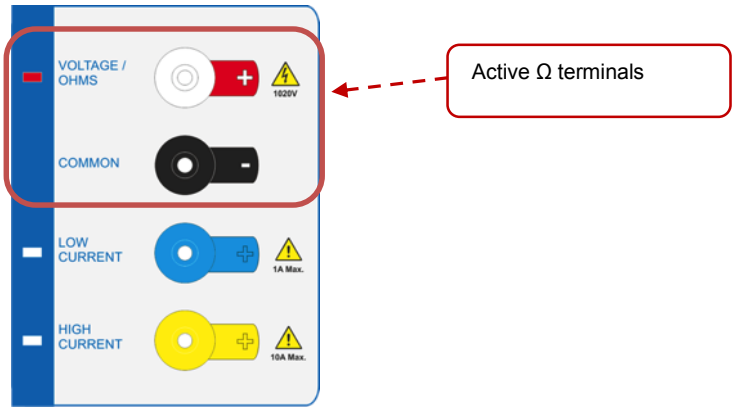


3. Highlight the required range e.g. '10 Ω' and then press **SELECT** soft key.

4. The Calibrator will now change to the 10 Ω Active Ω range. Using the Range up / Range Down keys, select the 'Zero Calibration' adjustment point.



5. Connect the calibrator Voltage output terminals (2 Wire output) to the precision multimeter.



6. Ensure that the multimeter has been zeroed with the leads shorted. If applicable use low current resistance (Low I) measurement modes. This is because active resistance is a lower accuracy output typically used for calibration of 3 ½ and 4 ½ digit multimeters that use lower measurement currents.

7. Press **OUTPUT ON** and measure the output.

8. To adjust the output enter the value as measured on the multimeter e.g. measured output = 29.95Ω.

2 **9** **•** **9** **5** **ENTER**

9. The output can also be adjusted by moving the 'cursor' to the required digit and adjusting the output using the up / down arrows or the digital control.

10. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

11. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

12. Measure and check the output again and then press **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

13. Press the Range Up / Range Down keys until ‘ Positive Full Scale’ is displayed.

14. Measure the output, and adjust as required using the steps previously described (steps 5-12).

NOTE: If the 'Positive Full Scale' has been adjusted, ensure that the 'Zero Calibration' point is still in calibration. It may require more than one cycle of adjusting the Zero and Positive Full Scale calibration points to bring both points into specification.

15. When calibration of this range is complete press the **RANGE** soft key, select 'Active Ω', and then select the required range.

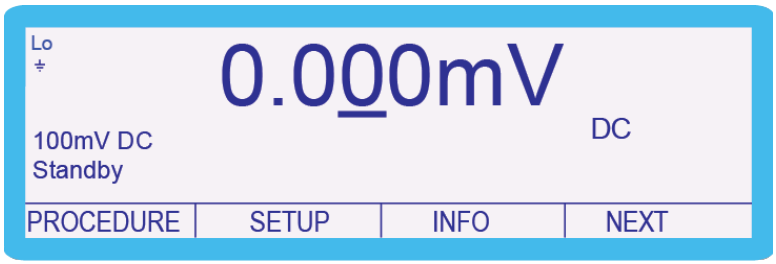
16. All Active Ω ranges are calibrated in the same manner.

Capacitance

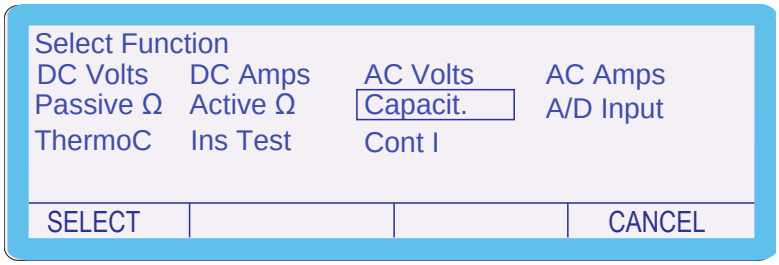
To calibrate the Capacitance parameter, complete the procedure as follows:

NOTE: The Capacitance output from the 1000 series calibrator is a passive output. This means that the value on the display is the capacitance value generated at the terminals.
The capacitance cannot be 'altered' to a different output, the value stored is simply the value of the capacitor and the connections to the terminal.

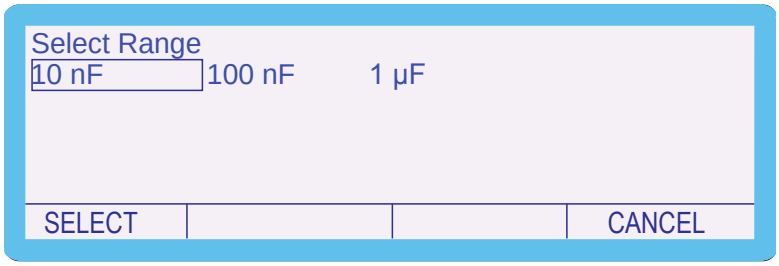
1. Enter the setup menu and use the 'Digital Control' or the 'Arrow Keys' to select 'Calibrate' and then press **SELECT** soft key.



2. Highlight the required parameter 'Capacit.' and then press **SELECT** soft key.

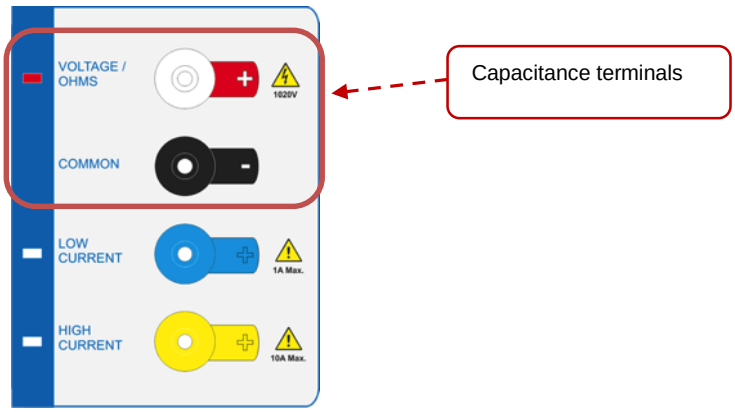


3. Highlight the required range e.g. '1uF ' and then press **SELECT** soft key.



4. The Calibrator will now change to the 1µF Capacitance range.

5. Connect the calibrator Voltage (Capacitance) terminals to the LCR Bridge Ensure that the LCR Bridge is nulled before connecting to the Calibrator.



6. Press **OUTPUT ON** and measure the output.

7. To adjust the output enter the value as measured on the multimeter e.g. measured output = 1.0016uF, use the function control keys.

1 **•** **0** **0** **1** **6** **ENTER**

8. The output can also be adjusted by moving the ‘cursor’ to the required digit and adjusting the output using the up / down arrows or the digital control.

9. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

10. To undo the adjustment before storing the changes, press the **UNDO** soft key.This will remove any changes that have been made to the output of the calibrator.

11. Measure and check the output again and then press **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

After displaying these messages, the shift key will also cease to be illuminated

SHIFT

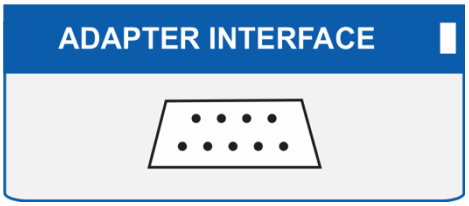
NOTE: If the 'Positive Full Scale' has been adjusted, ensure that the 'Zero Calibration' point is still in calibration. It may require more than one cycle of adjusting the Zero and Positive Full Scale calibration points to bring both points into specification.

12. When calibration of this range is complete press the **RANGE** soft key, select 'Capacit.' and then select the required range.

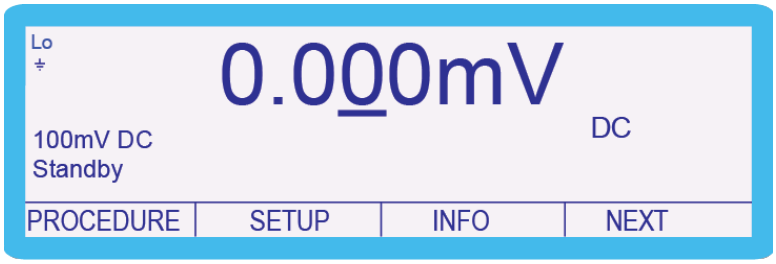
13. All capacitance ranges are calibrated in the same manner.

A/D Input

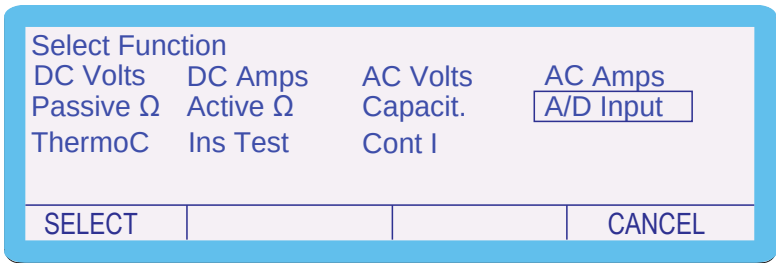
Injecting voltage between Pins 7 (Ground) and 9 (Input), the 1000A series calibrator can measure voltage. This is used for adapters with readback (such as EA001A, EA015 etc) as well as Pressure and Torque Modules.



1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’ and then press **SELECT** soft key.



2. Highlight the required parameter ‘A/D Input’ and then press **SELECT** soft key.

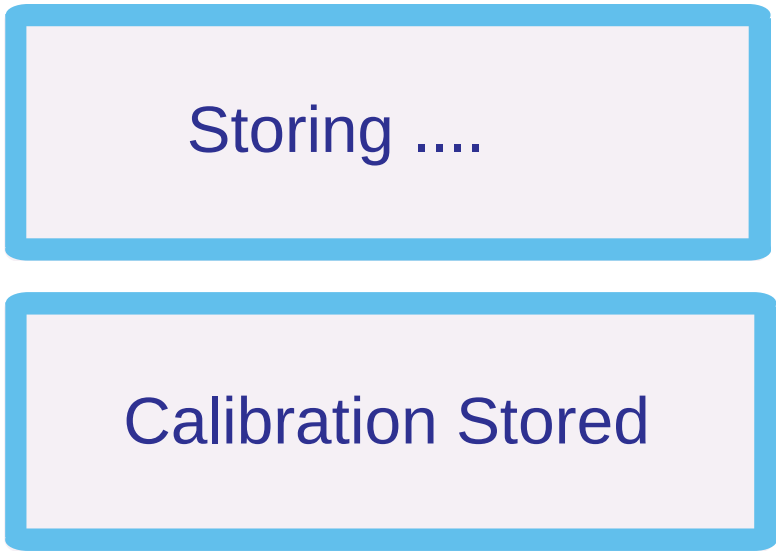


3. The Calibrator will now change to the A/D Input Screen. Use the Range Up / Range Down keys to select the Zero Calibration adjustment point.

4. Apply an output of 0 V from your voltage source to the adapter interface, using Pin 7 as the Ground or Negative connection, and Pin 9 as the Signal or Positive connection.

5. Wait for the reading to stabilise on the screen of the 1000. After achieving a stable reading, press the **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration has been saved.



The screen of the 3000A will now display 0V. If the reading is different, repeat the previous stages.

6. Using the Range Up / Range Down keys to select the Positive Full Scale adjustment point.

7. Apply an output of 10 V from your voltage source to the adapter interface, using Pin 7 as the Ground or Negative connection, and Pin 9 as the Signal or Positive connection.

8. Wait for the reading to stabilise on the screen of the 1000. After achieving a stable reading, press the **STORE** button.

9. Using the Range Up / Range Down keys select the Negative Full Scale point.

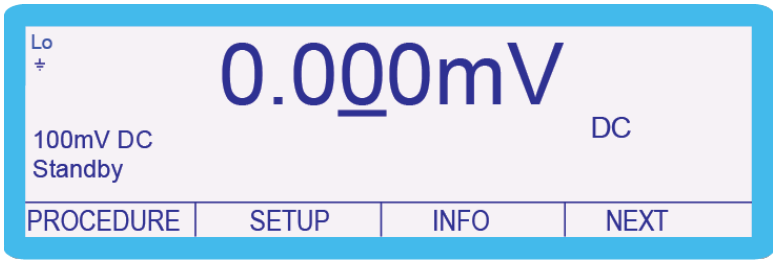
10. Apply an output of 10 V from your voltage source to the adapter interface, using Pin 7 as the Ground or Negative connection, and Pin 9 as the Signal or Positive connection.

11. Wait for the reading to stabilise on the screen of the 1000. After achieving a stable reading, press the **STORE** button.

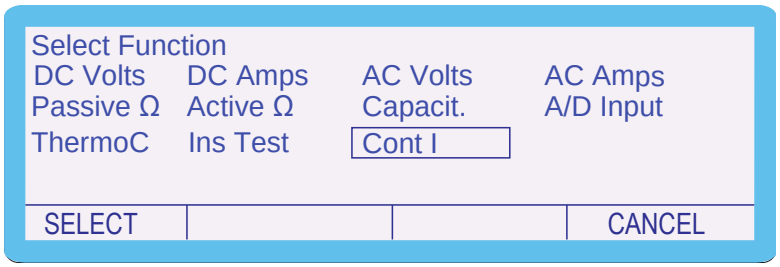
Continuity Resistance Current

To perform a continuity test, complete the procedure as follows:

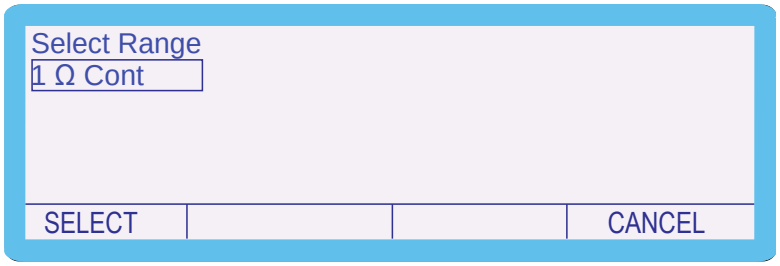
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’ and then press **SELECT** soft key.



2. Highlight the required parameter ‘Cont I’ and then press **SELECT** soft key.

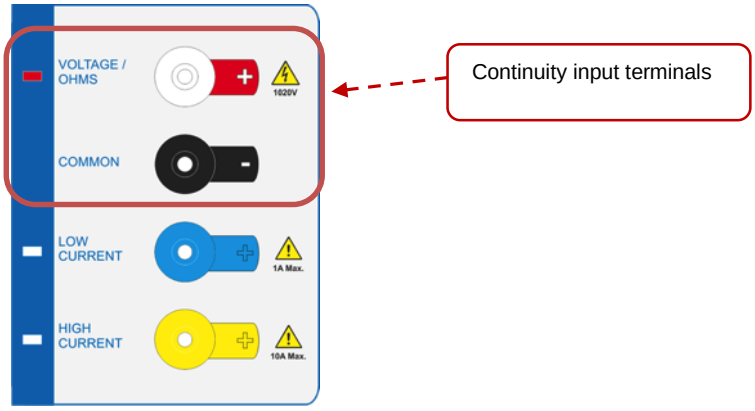


3. Highlight the range ’1 Ω Cont’ and then press **SELECT** soft key.



4. The Calibrator will now change to the 1Ω Continuity Input Screen. Use the Range Up / Range Down keys to select Zero Calibration: Apply 30mA.

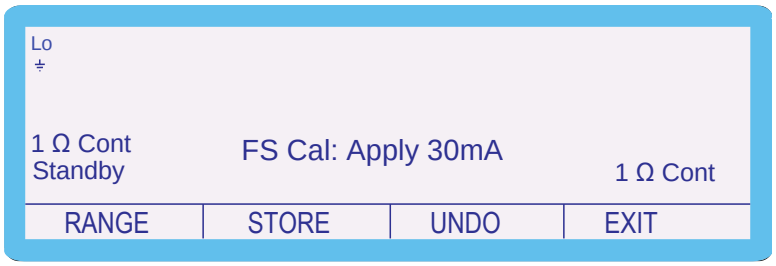
5. Connect leads from the current terminals of your current source to the voltage terminals of the 1000 series.



6. Press **OUTPUT ON** on the 1000 series.

7. Apply an output of 30mA from your current source and measure the input on your 1000 series.

8. Use the ‘range up’ and ‘range down’ keys to change the measurement point to Full Scale Calibration: Apply 300mA.



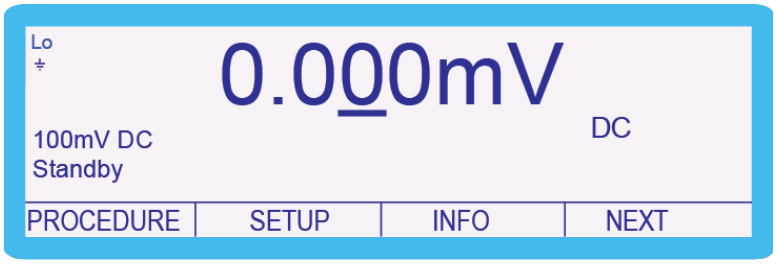
9. Press **OUTPUT ON** on the 1000 series.

10. Apply an output of 300mA from your current source and measure the input on your 1000 series.

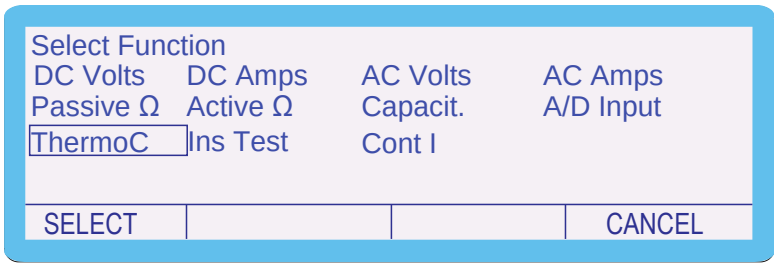
Thermocouple

For thermocouple calibration, complete the procedure as follows:

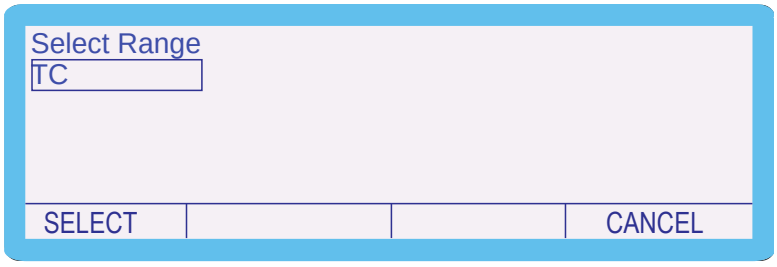
1. Enter the setup menu and use the ‘Digital Control’ or the ‘Arrow Keys’ to select ‘Calibrate’ and then press **SELECT** soft key.



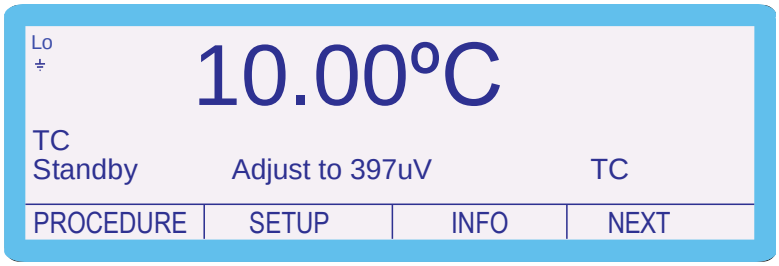
2. Highlight the required parameter ‘ThermoC’ and then press **SELECT** soft key.



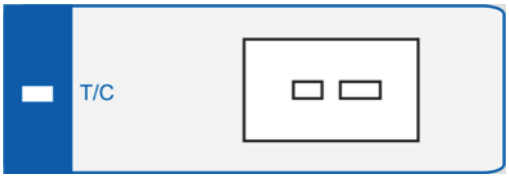
3. Highlight the range ’TC’ and then press **SELECT** soft key.



4. The Calibrator will now change to the Thermocouple Input Screen. Use the Range Up / Range Down keys to select 'Adjust to 397uV’.



5. Connect the thermocouple adapter into thermocouple input of the 1000 series Calibrator. Connect this to the voltage terminals of your precision Multimeter.



6. Press **OUTPUT ON** on the 1000 series.

7. Adjust the temperature reading until a measurement of 397µV is displayed on the Multimeter. The temperature reading is adjusted by moving the 'cursor' to the required digit and adjusting the output using the up and down arrow keys or the digital control.

8. The **SHIFT** key will illuminate to indicate that a change has been made to the calibration of the instrument, however has not yet been stored.

9. To undo the adjustment before storing the changes, press the **UNDO** soft key. This will remove any changes that have been made to the output of the calibrator.

10. Once the output has been adjusted the changes can be stored to long term memory. To store the changes permanently, press the **STORE** soft key.

The following 2 screens are displayed briefly to confirm that the calibration factors have been saved.

Calibration Stored

After displaying these messages, the shift key will also cease to be illuminated:

SHIFT

NOTE: All calibration points can be adjusted prior to storing the calibration factors. However, if the calibration routine is ended before the STORE button has been pressed, due to a power failure for example, the new calibration factors will not be saved.

11. Use the Range Up / Range Down keys to select ‘Adjust to -392µV’.

12. Measure the output, and adjust as required using the process described in steps **6 – 10.**

Verification of Ranges

In this section the procedure for verification of ranges is described. These procedures are mutually exclusive (for example, if required only the DC voltage portion can be verified) however we would advise that all ranges are verified at the user determined calibration interval. Transmille recommend that a recalibration / verification is performed every 12 months for optimal performance.

The recommended verification points for the 1000 series calibrator are listed below, as well as the calculated tolerance to 1 year specifications based upon TCal ± 5 specifications. These specifications apply if the unit is re-calibrated by Transmille within the UK and include both the tolerance of the 1000 as well as the uncertainty of calibration.

When calibrated by another laboratory new absolute accuracies will apply, as the uncertainty of calibration will be different than that of Transmille. In this case a new specification must be calculated. This can improve or degrade the specifications depending upon the uncertainty of calibration.

DC Voltage

WARNING: During these tests the voltage source will output up to 1000V during the adjustment procedure.

To avoid electric shock while performing steps of the following procedure please observe the following warnings:

If using non touch safe leads, ensure that any exposed elements of the lead are not touched when the output of the voltage source is active.

Make sure that leads used are rated for the output voltage and in good condition, with no damaged insulation.

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards)
2. Press the DC key.
3. Select the required test voltage using functional control keys followed by the ENTER key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter as illustrated in point 3, page 15.

Verification Points

Table 1 - DC Voltage Verification Points

Test Range	Test Voltage	Lower Limit	Upper Limit
100 mV	0 mV	-0.010000 mV	0.010000 mV
	20 mV	19.988400 mV	20.011600 mV
	100 mV	99.982000 mV	100.018000 mV
	-20 mV	-20.011600 mV	-19.988400 mV
	-100 mV	-100.018000 mV	-99.982000 mV
1 V	0.2 V	0.199954 V	0.200046 V
	1 V	0.999890 V	1.000110 V
	-0.2 V	-0.200046 V	-0.199954 V
	-1 V	-1.000110 V	-0.999890 V
10 V	2 V	1.999540 V	2.000460 V
	10 V	9.998900 V	10.001100 V
	-5 V	-5.000700 V	-4.999300 V
	-10 V	-10.001100 V	-9.998900 V
100 V	50 V	49.993000 V	50.007000 V
	100 V	99.998900 V	100.001100 V
	-100 V	-100.001100 V	-99.998900 V
	-50 V	-50.007000 V	-49.993000 V
1 kV	200 V	199.954000 V	200.046000 V
	1000 V	999.890000 V	1000.110000 V
	-1000 V	-1000.110000 V	-999.890000 V
	-200 V	-200.046000 V	-199.954000 V

The points listed in Table 1 provide the recommended DC voltage test points and

tolerance for 1000 series calibrator.

After performing verification of the Full scale and Zero values, a linearity check should be performed.

Table 2 - DC Voltage Linearity Verification

Test Range	Test Voltage	Lower Limit	Upper Limit
10 V	9 V	8.999000 V	9.001000 V
	8 V	7.999060 V	8.000940 V
	7 V	6.999140 V	7.000860 V
	6 V	5.999220 V	6.000780 V
	5 V	4.999300 V	5.000700 V
	4 V	3.999380 V	4.000620 V
	3 V	2.999460 V	3.000540 V
	2 V	1.999540 V	2.000460 V
	1 V	0.999620 V	1.000380 V
	-9 V	-9.001000 V	-8.999000 V
	-8 V	-8.000940 V	-7.999060 V
	-7 V	-7.000860 V	-6.999140 V
	-6 V	-6.000780 V	-5.999220 V
	-5 V	-5.000700 V	-4.999300 V
	-4 V	-4.000620 V	-3.999380 V
	-3 V	-3.000540 V	-2.999460 V
	-2 V	-2.000460 V	-1.999540 V
	-1 V	-1.000380 V	-0.999620 V

AC Voltage

WARNING: During these tests the voltage source will output up to 1000V during the adjustment procedure.

To avoid electric shock while performing steps of the following procedure please observe the following warnings:

If using non touch safe leads, ensure that any exposed elements of the lead are not touched when the output of the voltage source is active.

Make sure that leads used are rated for the output voltage and in good condition, with no damaged insulation.

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards)
2. Press the AC key.
3. Select the required test voltage using functional control keys followed by the ENTER key.
4. Select the required test frequency using functional control keys followed by the ENTER key.
5. Ensure the correct test range has been selected.
6. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 25.

Verification Points

The points listed in Table 3 provide the recommended AC voltage test points and tolerance for 1000 series calibrator.

Test Range	Test Frequency	Test Voltage	Lower Limit	Upper Limit

	(AC)			
100 mV	206 Hz	20 mV	19.954000 mV	20.046000 mV
	206 Hz	50 mV	49.930000 mV	50.070000 mV
	10 Hz	100 mV	99.890000 mV	100.110000 mV
	40 Hz	100 mV	99.890000 mV	100.110000 mV
	56 Hz	100 mV	99.890000 mV	100.110000 mV
	206 Hz	100 mV	99.890000 mV	100.110000 mV
	1 kHz	100 mV	99.890000 mV	100.110000 mV
	10 kHz	100 mV	99.780000 mV	100.220000 mV
	20 kHz	100 mV	99.780000 mV	100.220000 mV
1 V	206 Hz	0.2 V	0.199540 V	0.200460 V
	10 Hz	1 V	0.998900 V	1.001100 V
	40 Hz	1 V	0.998900 V	1.001100 V
	56 Hz	1 V	0.998900 V	1.001100 V
	206 Hz	1 V	0.998900 V	1.001100 V
	1 kHz	1 V	0.998900 V	1.001100 V
	5 kHz	1 V	0.997800 V	1.002200 V
	10 kHz	1 V	0.997800 V	1.002200 V
	20 kHz	1 V	0.997800 V	1.002200 V
10 V	206 Hz	2 V	1.995400 V	2.004600 V
	206 Hz	6 V	5.992200 V	6.007800 V
	10 Hz	10 V	9.989000 V	10.011000 V
	40 Hz	10 V	9.989000 V	10.011000 V
	56 Hz	10 V	9.989000 V	10.011000 V
	206 Hz	10 V	9.989000 V	10.011000 V
	1 kHz	10 V	9.989000 V	10.011000 V
	5 kHz	10 V	9.978000 V	10.022000 V
	10 kHz	10 V	9.978000 V	10.022000 V
	20 kHz	10 V	9.978000 V	10.022000 V
100 V	40 Hz	20 V	19.954000 V	20.046000 V
	206 Hz	20 V	19.954000 V	20.046000 V
	1 kHz	20 V	19.954000 V	20.046000 V
	40 Hz	100 V	99.890000 V	100.110000 V
	56 Hz	100 V	99.890000 V	100.110000 V
	206 Hz	100 V	99.890000 V	100.110000 V
	1000 Hz	100 V	99.890000 V	100.110000 V
1 kV	40 Hz	200 V	199.720000 V	200.280000 V
	206 Hz	200 V	199.720000 V	200.280000 V
	1 kHz	200 V	199.550000 V	200.450000 V
	40 Hz	700 V	699.320000 V	700.680000 V
	56 Hz	700 V	699.320000 V	700.680000 V
	1 kHz	700 V	699.320000 V	700.680000 V
	56 Hz	1000 V	999.125000 V	1000.875000 V

Table 3 - AC Voltage Verification Points

DC Current

WARNING: During these tests the current source will output currents of up to 10A

Make sure that leads used are rated for the output current and in good condition, with no damaged insulation

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards)
2. Press the DC key.
3. Select the required test current using functional control keys followed by the ENTER key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 20.

Verification Points

The points listed in Table 4 provide the recommended DC current test points and tolerance for 1000 series calibrator.

Table 4 – DC Current Verification Points

Test Range	Test Current	Lower Limit	Upper Limit
100 uA	0 µA	-0.030000 µA	0.030000 µA
	20 µA	19.964000 µA	20.036000 µA
	100 µA	99.940000 µA	100.060000 µA
	-100 µA	-100.060000 µA	-99.940000 µA
	-20 µA	-20.036000 µA	-19.964000 µA
1 mA	0.2 mA	0.199840 mA	0.200160 mA
	1 mA	0.999600 mA	1.000400 mA
	-0.2 mA	-0.200160 mA	-0.199840 mA
	-1 mA	-1.000400 mA	-0.999600 mA
10 mA	2 mA	1.998400 mA	2.001600 mA
	10 mA	9.996000 mA	10.004000 mA
	-2 mA	-2.001600 mA	-1.998400 mA
	-10 mA	-10.004000 mA	-9.996000 mA
100 mA	20 mA	19.998400 mA	20.001600 mA
	100 mA	99.960000 mA	100.040000 mA
	-20 mA	-20.016000 mA	-19.984000 mA
	-100 mA	-100.040000 mA	-99.960000 mA
1 A	0.2 A	0.199790 A	0.200210 A
	1 A	0.999550 A	1.000450 A
	-0.2 A	-0.200210 A	-0.199790 A
	-1 A	-1.000450 A	-0.999550 A
10 A	2 A	1.996500 A	2.003500 A
	10 A	9.992500 A	10.007500 A
	-2 A	-2.003500 A	-1.996500 A
	-10 A	-10.007500 A	-9.992500 A

AC Current

WARNING: During these tests the current source will output currents of up to 10A

Make sure that leads used are rated for the output current and in good condition, with no damaged insulation

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the AC key.
3. Select the required test current using functional control keys followed by the ENTER key.
4. Select the required test frequency using functional control keys followed by the ENTER key.
5. Ensure the correct test range has been selected.
6. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 29.

Verification Points

The points listed in Table 5 provide the recommended AC current test points and tolerance for 1000 series calibrator.

Table 5 – AC Current Verification Points

Test Range	Test Frequency (AC)	Test Voltage	Lower Limit	Upper Limit
100 µA	206 Hz	20 µA	19.580000 µA	20.420000 µA
100 µA	10 Hz	100 µA	99.500000 µA	100.500000 µA
100 µA	40 Hz	100 µA	99.500000 µA	100.500000 µA
100 µA	56 Hz	100 µA	99.500000 µA	100.500000 µA
100 µA	1 kHz	100 µA	99.500000 µA	100.500000 µA
100 µA	2 kHz	100 µA	99.500000 µA	100.500000 µA
1 mA	206 Hz	0.2 mA	0.199000 mA	0.201000 mA
1 mA	10 Hz	1 mA	0.998200 mA	1.001800 mA
1 mA	40 Hz	1 mA	0.998200 mA	1.001800 mA
1 mA	56 Hz	1 mA	0.998200 mA	1.001800 mA
1 mA	1 kHz	1 mA	0.998200 mA	1.001800 mA
1 mA	2 kHz	1 mA	0.998200 mA	1.001800 mA
10 mA	206 Hz	2 mA	1.990000 mA	2.010000 mA
10 mA	56 Hz	10 mA	9.982000 mA	10.018000 mA
10 mA	40 Hz	10 mA	9.982000 mA	10.018000 mA
10 mA	1 kHz	10 mA	9.982000 mA	10.018000 mA
10 mA	2 kHz	10 mA	9.982000 mA	10.018000 mA
100 mA	206 Hz	20 mA	19.900000 mA	20.100000 mA
100 mA	10 Hz	100 mA	99.820000 mA	100.180000 mA
100 mA	40 Hz	100 mA	99.820000 mA	100.180000 mA
100 mA	56 Hz	100 mA	99.820000 mA	100.180000 mA
100 mA	1 kHz	100 mA	99.820000 mA	100.180000 mA
100 mA	2 kHz	100 mA	99.820000 mA	100.180000 mA
1 A	206 Hz	0.2 A	0.199000 A	0.201000 A
1 A	10 Hz	1 A	0.998200 A	1.001800 A
1 A	40 Hz	1 A	0.998200 A	1.001800 A
1 A	56 Hz	1 A	0.998200 A	1.001800 A
1 A	1 kHz	1 A	0.998200 A	1.001800 A
1 A	2 kHz	1 A	0.998200 A	1.001800 A
10 A	206 Hz	2 A	1.983000 A	2.017000 A
10 A	10 Hz	10 A	9.975000 A	10.025000 A
10 A	40 Hz	10 A	9.975000 A	10.025000 A
10 A	56 Hz	10 A	9.975000 A	10.025000 A
10 A	100 Hz	10 A	9.975000 A	10.025000 A
10 A	1 kHz	10 A	9.975000 A	10.025000 A
10 A	2 kHz	10 A	9.975000 A	10.025000 A

Passive Resistance

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards)
2. Press the OHMS key followed by the ENTER key.
3. Press the PASSIVE soft key to enter passive Ω mode. Select the required test value using functional control keys followed by the ENTER key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 34.

Verification Points

A zero should be performed prior to making measurements on resistance functions. Appropriate leads and connectors should be used to minimise the resistance of connections for optimal performance.

NOTE: The tolerances below are based upon nominal value resistance (i.e. 100 ohms)

If values are deviating more than 10 ppm from Nominal the tolerance should be re-calculated.

Table 6 – Passive Resistance Verification Points

Test Range	Test Resistance	Lower Limit	Upper Limit
10 Ω	10 Ω	9.940000 Ω	10.060000 Ω
100 Ω	100 Ω	99.937000 Ω	100.063000 Ω
1 kΩ	1 kΩ	0.999895 kΩ	1.000105 kΩ
10 kΩ	10 kΩ	9.999445 kΩ	10.000555 kΩ
100 kΩ	100 kΩ	99.995000 kΩ	100.005000 kΩ
1 MΩ	1 MΩ	0.999900 MΩ	1.000100 MΩ
10 MΩ	10 MΩ	9.995000 MΩ	10.005000 MΩ
100 MΩ	100 MΩ	99.800000 MΩ	100.200000 MΩ

Active Resistance

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the OHMS key followed by the ENTER key.
3. Press the SIMULATED soft key to enter simulated Ω mode. Select the required test value using functional control keys followed by the ENTER key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 37.

Verification Points

A zero should be performed prior to making measurements on resistance functions. Appropriate leads and connectors should be used to minimise the resistance of connections for optimal performance.

NOTE: The tolerances below are based upon nominal value resistance (i.e. 100 ohms)

If values are deviating more than 10 ppm from Nominal the tolerance should be re-calculated.

Table 7 – Active Resistance Verification Points

Test Range	Test Value	Lower Limit	Upper Limit
10 Ω	0 Ω	-0.052000 Ω	0.052000 Ω
	3 Ω	2.948000 Ω	3.052000 Ω
	10 Ω	9.948000 Ω	10.052000 Ω
100 Ω	20 Ω	19.930000 Ω	20.070000 Ω
	30 Ω	29.930000 Ω	30.070000 Ω
	100 Ω	99.930000 Ω	100.070000 Ω
1 kΩ	200 Ω	199.750000 Ω	200.250000 Ω
	300 Ω	299.750000 Ω	300.250000 Ω
	1000 Ω	999.750000 Ω	1000.250000 Ω
10 kΩ	1 kΩ	0.997900 kΩ	1.002100 kΩ
	2 kΩ	1.997900 kΩ	2.002100 kΩ
	3 kΩ	2.997900 kΩ	3.002100 kΩ
	4 kΩ	3.997900 kΩ	4.002100 kΩ
	5 kΩ	4.997900 kΩ	5.002100 kΩ
	6 kΩ	5.997900 kΩ	6.002100 kΩ
	7 kΩ	6.997900 kΩ	7.002100 kΩ
	8 kΩ	7.997900 kΩ	8.002100 kΩ
	9 kΩ	8.997900 kΩ	9.002100 kΩ
	10 kΩ	9.997900 kΩ	10.002100 kΩ
100 kΩ	20 kΩ	19.979900 kΩ	20.020100 kΩ
	30 kΩ	29.979900 kΩ	30.020100 kΩ
	100 kΩ	99.979900 kΩ	100.020100 kΩ
1 MΩ	200 kΩ	199.799900 kΩ	200.200100 kΩ
	300 kΩ	299.799900 kΩ	300.200100 kΩ
	1000 kΩ	999.799900 kΩ	1000.200100 kΩ
10 MΩ	2 MΩ	1.997000 MΩ	2.003000 MΩ
	3 MΩ	2.997000 MΩ	3.003000 MΩ
	10 MΩ	9.997000 MΩ	10.003000 MΩ

Capacitance (Measured at 1 kHz)

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the F key followed by the ENTER key.
3. Select the required test value using the functional control keys followed by the ENTER key. For nF values press the SHIFT key followed by the µ key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter as illustrated in point 5, page 41.

Verification Points

Table 8 – Capacitance Verification Points

Test Range	Test Value	Lower Limit	Upper Limit
10 nF	10 nF	9.890000 nF	10.110000 nF
100 nF	100 nF	99.998200 nF	100.001800 nF
1 µF	1 µF	0.991900 µF	1.008100 µF

Frequency Output

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the FREQ soft key.
3. Select the required test value using the functional control keys followed by the ENTER key.
4. Ensure the correct test range has been selected.
5. Connect the Calibrator to the precision Multimeter.

Verification Points

Table 9 –Frequency Verification Points

Test Range	Test Value	Lower Limit	Upper Limit
100 kHz	100 kHz	99.998000 kHz	100.002000 kHz
50 kHz	50 kHz	49.999000 kHz	50.001000 kHz
20 kHz	20 kHz	19.999600 kHz	20.000400 kHz
10 kHz	10 kHz	9.999800 kHz	10.000200 kHz
1 kHz	1 kHz	0.999980 kHz	1.000020 kHz
100 Hz	100 Hz	99.980000 Hz	100.020000 Hz

A/D Input

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Inject voltage between Pins 7 (Ground) and 9 (Input) for measurement.

Verification Points

Table 10 – A/D Input Verification Point

Test Range	Test Value	Lower Limit	Upper Limit
10 V A/D Input	10 V	9.999600 V	10.000400 V

Thermocouple Cold Junction Measurement

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the THERMO soft key.
3. Press the AUTO CJ soft key.
4. Compare values against another thermocouple source.

Verification Points

Table 11 – Thermocouple Output Verification Point

Thermocouple Output	Test Value	Lower Limit	Upper Limit
CJC Temp Measurement	23 °C	22.85 °C	23.15 °C

Temperature Simulation

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the THERMO soft key.
3. Press the TYPE soft key.
4. Select the required thermocouple output using the arrow keys are digital control followed by the ENTER key.
5. Connect the Calibrator to the precision Multimeter as illustrated in point _, page _.

Verification Points

Table 12 – Temperature Simulation - Type K.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type K - CJC at 0°C - ITS90	-5.891 mV (-200°C)	-5.9002 mV	-5.8818 mV
	-4.669 mV (-140°C)	-4.6779 mV	-4.6601 mV
	-3.554 mV (-100°C)	-3.562700 mV	-3.5453 mV
	-1.889 mV (-50°C)	-1.897400 mV	-1.8806 mV
	-0.968 mV (-25°C)	-0.976200 mV	-0.9590 mV
	0.000 mV (0°C)	-0.008000 mV	0.008 mV
	4.096 mV (100°C)	4.087200 mV	4.1048 mV
	2.023 mV (122°F)	2.014600 mV	2.0314 mV
	4.096 mV (212°F)	4.087200 mV	4.104800 mV
	4.920 mV (120°C)	4.911000 mV	4.929000 mV
	8.138 mV (200°C)	8.128400 mV	8.147600 mV
	20.644 mV (500°C)	20.631900 mV	20.656100 mV
	29.129 mV (700°C)	29.115200 mV	29.142800 mV
	41.276 mV (1000°C)	41.259700 mV	41.292300 mV
	54.819 mV (1370°C)	54.800000 mV	54.838000 mV

Table 13 – Temperature Simulation - Type J.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type J - CJC at 0°C - ITS90	-8.095 mV (-210°C)	-8.104600 mV	-8.085400 mV
	0.000 mV (0°C)	-0.008000 mV	0.008000 mV
	21.848 mV (400°C)	21.835600 mV	21.860400 mV
	69.553 mV (1200°C)	69.531100 mV	69.574900 mV

Table 14 – Temperature Simulation - Type T.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type T - CJC at 0°C - ITS90	-6.180 mV (-250°C)	-8.104600 mV	-8.085400 mV
	0.000 mV (0°C)	-0.008000 mV	0.008000 mV
	20.872 mV (400°C)	21.835600 mV	21.860400 mV

Table 15 – Temperature Simulation - Type R.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type R - CJC at 0°C - ITS90	0.000 mV (0°C)	-0.008000 mV	0.008000 mV
	3.408 mV (400°C)	3.399300 mV	3.416700 mV
	21.003 mV (1760°C)	20.990800 mV	21.015200 mV

Table 16 – Temperature Simulation - Type S.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type S - CJC at 0°C - ITS90	0.000 mV (0°C)	-0.008000 mV	0.008000 mV
	3.259 mV (400°C)	3.250300 mV	3.267700 mV
	18.609 mV (1760°C)	18.597300 mV	18.620700 mV

Table 17 – Temperature Simulation - Type N.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type N - CJC at 0°C - ITS90	-3.990 mV (-200°C)	-3.998800 mV	-3.981200 mV
	-0.646 mV (-25°C)	-0.654100 mV	-0.637900 mV
	3.374 mV (120°C)	3.365300 mV	3.382700 mV
	47.513 mV (1300°C)	47.495500 mV	47.530500 mV

Table 18 – Temperature Simulation - Type B.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type B - CJC at 0°C - ITS90	1.792 mV (600°C)	1.783600 mV	1.800400 mV
	4.834 mV (1000°C)	4.825000 mV	4.843000 mV
	13.820 mV (1820°C)	13.809200 mV	13.830800 mV

Table 19 – Temperature Simulation - Type E.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type E - CJC at 0°C - ITS90	-9.718 mV (-250°C)	-9.727900 mV	-9.708100 mV
	-1.432 mV (-25°C)	-1.440300 mV	-1.423700 mV
	24.964 mV (350°C)	24.951000 mV	24.977000 mV
	76.373 mV (1000°C)	76.349700 mV	76.396300 mV

Table 20 – Temperature Simulation - Type L.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type L - CJC at 0°C - ITS90	-8.158 mV (-200°C)	-8.175600 mV	-8.140400 mV
	0.000 mV (0°C)	-0.028000 mV	0.028000 mV
	53.140 mV (900°C)	53.093400 mV	53.186600 mV

Table 21 – Temperature Simulation - Type U.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type U - CJC at 0°C - ITS90	-5.696 mV (-200°C)	-5.713100 mV	-5.678900 mV
	0.000 mV (0°C)	-0.024000 mV	0.024000 mV
	34.309 mV (600°C)	34.280100 mV	34.337900 mV

Table 22 – Temperature Simulation - Type C.
Figures in brackets ( ) are the equivalent temperature for the mV output.

Temperature Simulation	Test Value	Lower Limit	Upper Limit
Type C - CJC at 0°C - ITS90	0.000 mV (0°C)	-0.008000 mV	0.008000 mV
	11.583 mV (650°C)	11.572700 mV	11.593300 mV
	18.257 mV (1000°C)	18.245300 mV	18.268700 mV
	37.070 mV (2316°C)	37.054600 mV	37.085400 mV

Simulated PRT

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the NEXT soft key followed by the PRT soft key.
3. Press the R0 soft key and select the required R0 by using the arrows keys or digital control.
4. Connect the Calibrator to a precision Multimeter.

Verification Points

Table 23 – Simulated PRT Verification Points

Test value	Lower Limit	Upper Limit
-100 °C	-100.300000 °C	-99.700000 °C
0 °C	-0.300000 °C	0.300000 °C
30 °C	29.100000 °C	30.900000 °C
100 °C	99.100000 °C	100.900000 °C
200 °C	199.100000 °C	200.900000 °C
400 °C	399.100000 °C	400.900000 °C
800 °C	799.100000 °C	800.900000 °C

Continuity Resistance (Optional)

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the NEXT soft key followed by the CONT. soft key.
3. Press the RESIST. soft key and select the required test value by using the arrows keys or digital control.
4. Connect the Calibrator to a precision Multimeter.

Verification Points

Table 24 – Continuity Resistance Verification Points

Test Range	Test Value	Lower Limit	Upper Limit
10 Ω	0 Ω	-0.045000 Ω	0.045000 Ω
	3 Ω	2.955000 Ω	3.045000 Ω
	10 Ω	9.955000 Ω	10.045000 Ω
50 Ω	20 Ω	19.875000 Ω	20.125000 Ω
	30 Ω	29.875000 Ω	30.125000 Ω
	50 Ω	49.875000 Ω	50.125000 Ω
500 Ω	100 Ω	99.000000 Ω	101.000000 Ω
	200 Ω	199.000000 Ω	201.000000 Ω
	500 Ω	499.000000 Ω	501.000000 Ω
5 kΩ	1000 Ω	990.000000 Ω	1010.000000 Ω
	2000 Ω	1990.000000 Ω	2010.000000 Ω
	5000 Ω	4990.000000 Ω	5010.000000 Ω

Continuity Current (Optional)

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the NEXT soft key followed by the CONT. soft key.
3. Press the CURRENT soft key and select the required test value by using the arrows keys or digital control.
4. Connect the Calibrator to the current source as illustrated in point 5, page 47.

Verification Points

Table 25 – Continuity Resistance Verification Points

Test Range	Test Value	Lower Limit	Upper Limit
300 mA	50 mA	48.600000 mA	51.400000 mA
	100 mA	98.600000 mA	101.400000 mA
	200 mA	198.600000 mA	201.400000 mA
	300 mA	298.600000 mA	301.400000 mA

Insulation Test Function (Optional)

Configuring the Calibrator for Verification

1. Press SHIFT key followed by the C key. This will reset the unit (this applies from firmware version 12.0.20 onwards).
2. Press the NEXT soft key followed by the INS TEST soft key.
3. Use V up and V down soft keys to set the required voltage. Then use the function control keys to input the required Ω values followed by the ENTER key.

Verification Points

Table 26 –Insulation Test Function Verification Points

Test Range	Test value	Lower Limit	Upper Limit
100V – 250 kΩ	250 kΩ	0.248700 kΩ	0.251300 kΩ
100V – 500 kΩ	500 kΩ	0.497500 kΩ	0.502500 kΩ
100V – 1 MΩ	1 MΩ	0.995000 MΩ	1.005000 MΩ
100V – 2 MΩ	2 MΩ	1.990000 MΩ	2.010000 MΩ
100V – 5 MΩ	5 MΩ	4.975000 MΩ	5.025000 MΩ
100V – 10 MΩ	10 MΩ	9.950000 MΩ	10.050000 MΩ
100V – 50 MΩ	50 MΩ	49.750000 MΩ	50.250000 MΩ
100V – 100 MΩ	100 MΩ	99.500000 MΩ	100.500000 MΩ
250V – 250 kΩ	250 kΩ	0.248700 kΩ	0.251300 kΩ
250V – 1 MΩ	1 MΩ	0.995000 MΩ	1.005000 MΩ
250V – 10 MΩ	10 MΩ	9.950000 MΩ	10.050000 MΩ
250V – 100 MΩ	100 MΩ	99.500000 MΩ	100.500000 MΩ
250V – 250 MΩ	250 MΩ	248.700000 MΩ	251.300000 MΩ
500V – 500 kΩ	500 kΩ	0.497500 kΩ	0.502500 kΩ
500V – 1 MΩ	1 MΩ	0.995000 MΩ	1.005000 MΩ
500V – 10 MΩ	10 MΩ	9.950000 MΩ	10.050000 MΩ
500V – 500 MΩ	500 MΩ	497.500000 MΩ	502.500000 MΩ
1000V – 1 MΩ	1 MΩ	0.995000 MΩ	1.005000 MΩ
1000V – 10 MΩ	10 MΩ	9.950000 MΩ	10.050000 MΩ
1000V – 100 MΩ	100 MΩ	99.500000 MΩ	100.500000 MΩ
1000V – 1 GΩ	1 GΩ	995.000000 GΩ	1005.000000 GΩ