9823 Multifunction Calibrator

Calibration Adjustment Procedure

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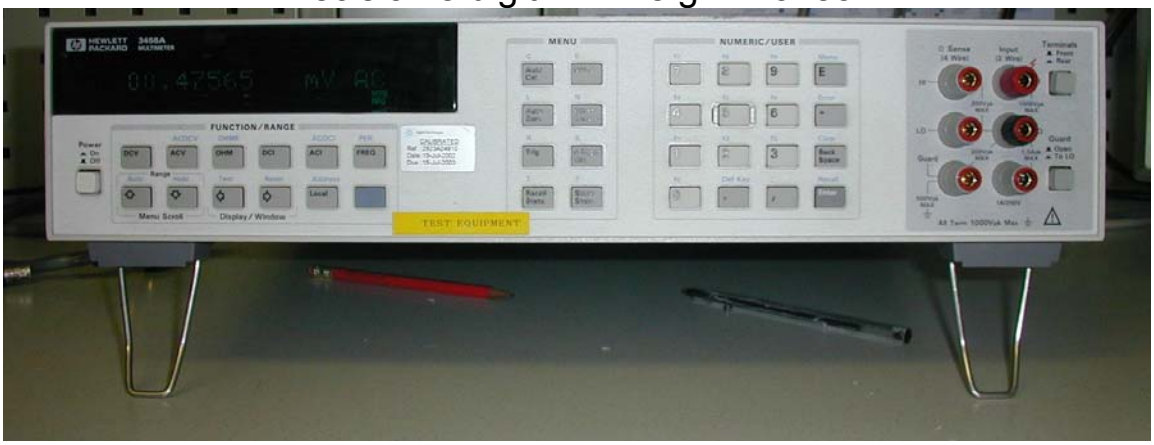
Chapter 1 General Information

Calibration equipment required to perform a calibration of the 9823:

Precision 8 digit DMM e.g. HP3485A



Low thermal e.m.f. leads

Special Time Electronics constructed precision (+/-0.05%) 4 terminal current shunt to extend the DMM measuring capability to 10 Amps if required. The shunt is in a specially sealed oil filled case. This ensures excellent temperature stability when under load. The shunt is available from Time Electronics.

Switch on the 9823 and DMM and leave to warm up for at least 2 hrs before calibration.

The temperature for calibration should be 22°C +/- 2°C.

IMPORTANT NOTE:

Some versions of the 9823 have front panels markings 100V, 10V, 1V, 100mV, 10mV, 1A, 100mA, 10mA, 1mA, 100uA. These represent the nominal value and a 100% over-range is available on each to provide full scale outputs of twice the values stated above.

Other versions have markings 200V, 20V, 2V, 200mV, 20mV, 2A, 200mA, 20mA, 2mA, 200uA. These represent the actual full scale output.

Please note the 1KV and 10A ranges are unchanged and represent the full scale output.

1.1 Before and After Calibration

It is advisable that a complete set of calibration results are taken before a calibration adjustment is started. This is known as a 'BEFORE' and it is important because it verifies that the 9823 is operating correctly on all ranges and indicates if any ranges will need adjustment. If any of the ranges are well outside specification this indicates that the 9823 may be faulty or that the calibration factors have become corrupted (see 1.3 to reset all calibration factors). Please refer to the Time Electronics example calibration certificate at the end of this document for details of the allowed error, please note these are 24 hour stability specification for zero settings and the 90 day specification for full scale settings. Time Electronics initial calibration policy is to ensure that the 9823 is well within it's one year specification to remain in calibration for a 1 year period. Generally if the 9823 is within specification and no adjustment is required then an 'AFTER' calibration certificate is not always needed. The 'AFTER' adjustment calibration run should only be done after **all** adjustments have been made as described in this document.

1.2 Calibration factors and manual adjustments

The 9823 stores most of its calibration factors (both zero and full scale) in non-volatile format in a EEPROM memory chip located on the Processor board. The calibration factors are stored twice in memory and when the unit is switched on the 2 sets are compared to check for corruption. Should an error be found, the message “Error 6” will be displayed. If this is the case, or other unexpected performance is encountered it will be necessary to reset (zero) all the calibration factors and undertake a complete recalibration (see 1.3 below).

The calibration factors can only be changed when the calibration key (supplied with unit) is inserted into the rear panel socket to activate calibration mode. When the unit is in calibration mode a ‘C’ is shown in the display’s left most digit.

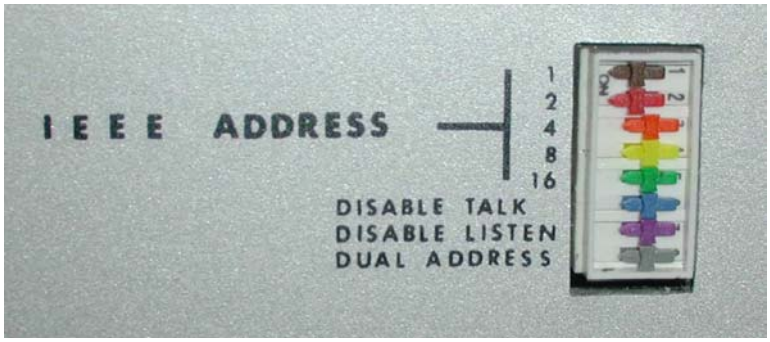
Please note that some of the calibration adjustment is still done using multi-turn trimmers which are mounted on the circuit boards. These adjustments are identified in this document as ‘MANUAL’ after the section title.

1.3 Resetting Calibration Factors

To reset **all** calibration factors, switch off the unit, set all 8 IEEE dip switches (on rear panel) to the ON position, insert the cal key, and switch on. At power up the unit will carry out a self-test sequence. Each segment of the 8-digit display will light up in turn, followed by all the front panel leds (except FS, ZERO, + & -). If no errors are detected, the word “Pass” will appear on the display. If an error occurs, the word “Error” followed by a number 1-6 will be displayed (see technical manual for details). After the self-test is completed, the unit’s calibration factors will be automatically reset to zero. The unit should be switched off and IEEE address 16 selected before switching on again to start the calibration adjustment.

Please note the IEEE address is set on the top five positions of the DIP switch which is located on the rear panel. They are in binary format i.e. 1,2,4,8,16. The address is the addition of the switches selected in the ON position e.g. to select address 3 requires positions 1 and 2 ON, see picture below.

Note: If the cal key is inserted when the unit has not been set to address ‘16’, the display will flash “Error 7” and calibration adjustment cannot proceed.



Before calibrating the 9823, please read this section to ensure that you understand all of the following points :

a) AC Zero, Frequency response, and Linearity

The 9823 cannot be adjusted during the standard calibration adjustment in the following :

AC Volts Zero
AC Current Zero
AC Frequency response
Linearity

All of the above can be tested and recorded on the calibration certificate if required (see example certificate at the end of this document). If the 9823 is out of specification on any of the above please contact Time Electronics or local authorized agent for advice.

b) AC Ranges

All AC voltage ranges are calibrated at 200Hz.

All AC current ranges are calibrated at 60Hz.

There is **no** zero adjustment on AC ranges. Please note that performance of the 9823 at less than 10% of full scale is not specified (see specification in technical manual). In particular on 200uA AC range it is virtually impossible to eliminate the electrical noise pickup. The user must understand that a current source has a very high output resistance (greater then 10M ohms, even on the 200uA range), therefore unless very special screened leads and correct grounding techniques are used, noise pickup will occur.

If an output of less then 10% of full scale is required, the range below should be selected to ensure full performance.

c) Calibration leads and Connections

Stray thermal e.m.f generation in leads and connections can affect the calibration. The terminals of the 9823 are specifically designed to minimize this effect. However if standard leads and connectors are used errors will occur. Leads and connectors that exhibit a very low thermal e.m.f. effect should be used on voltages below 10V (suitable lead sets are available from Time Electronics). To reduce AC noise pickup due to capacitive/inductive coupling, the leads should be kept as short as practically possible and screened.

Resistance calibration up to 100kOhm must be done using the 4-wire method. The 1MOhm and 10MOhm can be calibrated using the 2-wire method and screened (shielded) leads must be used to reduce noise pickup. The screen should only be connected to the green earth terminal on the 9823. If you are unsure about this, please refer to your DMM technical manual. Please note that the gold plated shorting links must be removed for 4 terminal calibration.

d) DMM filter settings

All high performance DMM's include analogue and digital filtering functions. All calibration of the 9823 should be performed with a filter time of 1 second or greater.

We also recommend increasing this to 3 seconds (or more) for voltages of less then 200mV, and for currents less then 2mA.

A filter time of at least 3 seconds should also be used for calibration of the 1MOhm and 10MOhm.

SAFETY PRECAUTIONS

When calibrating high voltage and high current ranges observe safety precautions. This is particularly important when using the 1kV range and due attention should be paid to the high voltage warning buzzer.

Chapter 2

Calibration adjustment procedure

The calibration adjustment of the 9823 is divided into 5 parts, and should be done in the following order only :

DC Voltage ranges
AC Voltage ranges
DC Current ranges
AC Current ranges
Resistance ranges

2.1 Entering Calibration Mode

Switch unit to **LOCAL** mode

Select address 16 on the IEEE switch on the back of the unit. Please note it is necessary to switch off the unit before changing the IEEE address.

Insert cal key into the rear panel socket.

After inserting the cal key a flashing ‘C’ should appear in the left hand side of the display. If this does not happen check that the cal key has been correctly inserted.

2.2 Selecting Ranges

The front panel selection buttons are dual function. Their function is indicated by the blue and red markings above and below each one.

Primary function	-	*Keys operate as indicated by **blue** legends*
Secondary function	-	*Keys operate as indicated by **red** legends*

Which function is active is determined by the **SELECT** button which toggles (alternates) between Primary and Secondary function. The LED on the **SELECT** button indicates the active function -

i.e. OFF - Primary/blue or ON - Secondary/red:

Note: When Secondary button function is active, pressing any button will automatically change the state of all buttons back to Primary function, and the **SELECT** LED will extinguish.

For example, to select 20V DC range:

Ensure that the **SELECT** button led is off - active state is Primary
Press **SELECT** button
Press **DC** button
Press **SELECT** button
Press **20V** button

The active state is now back to Primary and the required output value can now be set. The digits are incremented or decremented as required using the buttons marked with up/down arrows.

Throughout this document, we use shorthand to describe the button press sequences. For example, we would write the above button press sequence will be :

SELECT / DC / SELECT / 20V

2.3 Output terminals

The 9823 is equipped with three sets of output terminals. The main output is via 4 terminals marked V/I/R. These are designed to allow 4 wire connections to be made and are used where effects of lead resistance must be automatically compensated. The two outer terminals of each are known as sense terminals and for most calibration should be left linked to their respective +ve/-ve terminal by the special gold plated links which are supplied. These links should be left in place for all voltage and current re-calibration, however they should be removed for the 4 wire resistance re-calibration (100kOhms and less). The main output terminals are used for voltage ranges up to 20 V, current ranges up 2A, and the resistance ranges.

The 200V and 1kV ranges have their own set of output terminals. The 10 A range also has it’s own terminal set.

2.4 Calibration of DC Voltage Ranges

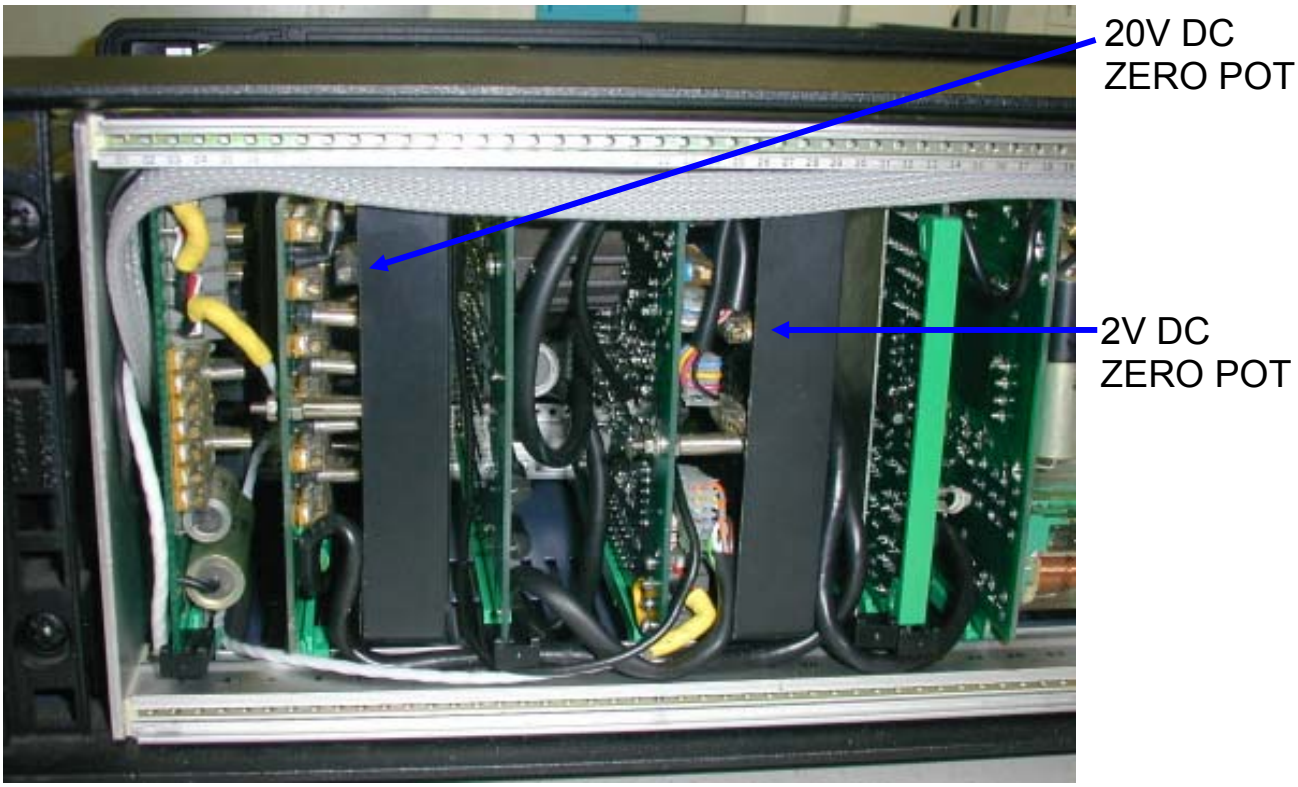
Remove the left hand rear panel, which is retained by 6 captive screws.

Connect low thermal leads from 9823 main terminals to voltage terminals on the DMM.

Select the appropriate range on the DMM for each range to be calibrated.

20 Volt Range Zero (MANUAL)
Press SELECT / DC / SELECT / 20V / ZERO.
Adjust 20 Volt zero pot indicated in the picture below for a reading of 0V +/- 40uV on the DMM.

2 Volt Range Zero (MANUAL)
Press SELECT / 2V / ZERO.
Adjust 2 Volt zero pot indicated in the picture below for a reading of 0V +/- 7uV on the DMM.
Go back and check 20 Volt zero and adjust if necessary.



+2 Volt Full-Scale

Press SELECT / 2V / FS. A 2V output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 2V +/- 17uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-2 Volt Full-Scale

Press SELECT / 2V / FS / -. A -2V output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -2V +/- 17uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

+20 Volt Full-Scale

Press SELECT / 20V / FS. A 20V output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 20V +/- 140uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-20 Volt Full-Scale

Press SELECT / 20V / FS / -. A -20V output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -20V +/- 140uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

200mV Range Zero

Press SELECT / 200mV / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0V +/- 3uV.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+200mV Full-Scale

Press SELECT / 200mV / FS. A 200mV output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 200mV +/- 4uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-200mV Full-Scale

Press SELECT / 200mV / FS / -. A -200mV output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -200mV +/- 4uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

20mV Range Zero

Press SELECT / 20mV / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0V +/- 3uV.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

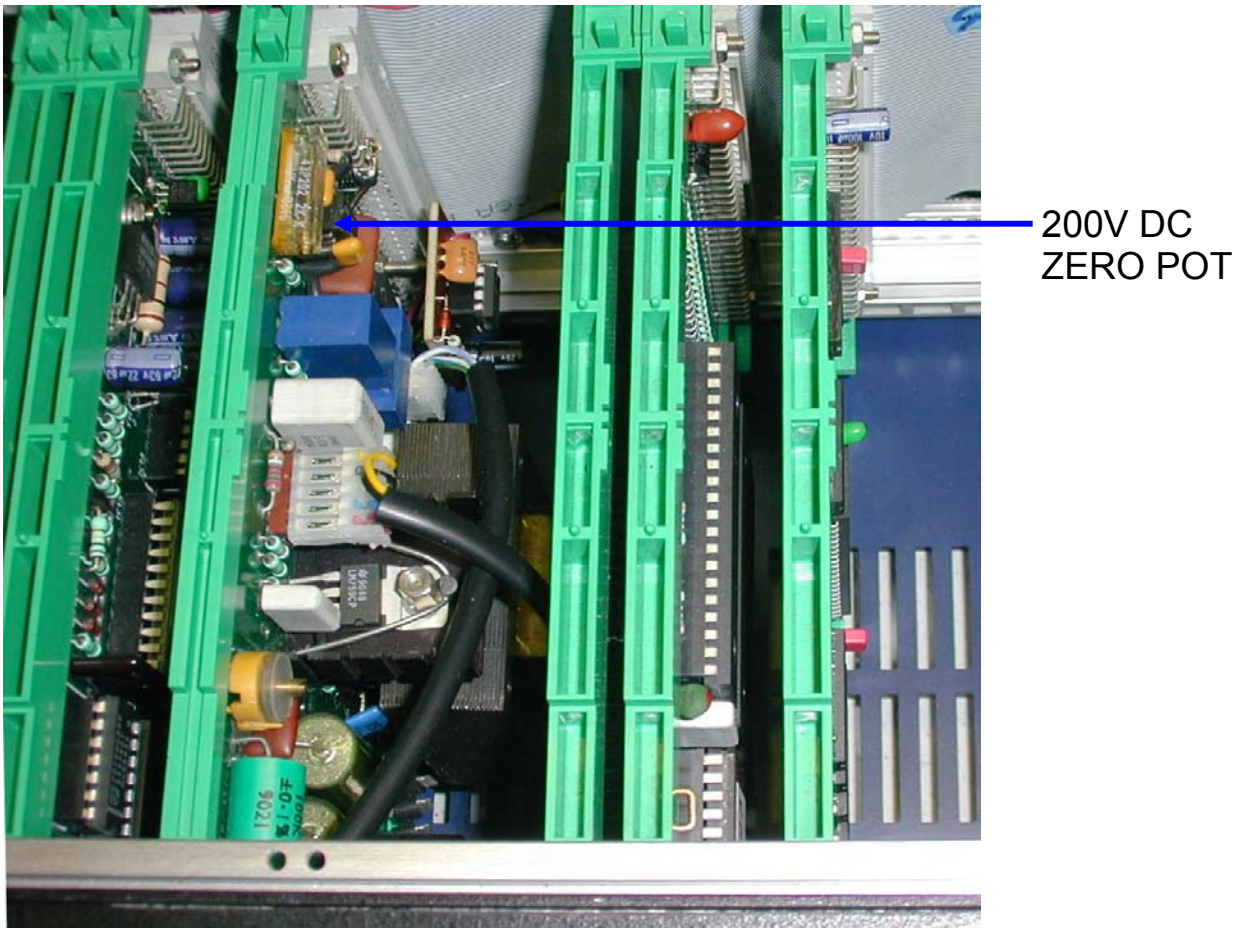
+20mV Full-Scale

Press SELECT / 20mV / FS. A 20mV output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 20mV +/- 3uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-20mV Full-Scale

Press SELECT / 20mV / FS / -. A -20mV output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -20mV +/- 3uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

Remove the lid from the case by unscrewing the top two screws on ether side of the case, then lift off the lid.
Connect DMM voltage terminals to the 9823 high voltage terminals.
Press SELECT / 200V / ZERO.
Leave for 1 minute to settle.
Adjust trimmer as shown in the picture below for a reading of 0V +/- 2mV.



+200 Volt Full Scale

Ensure that the DMM will accept an input of 200V.
Press SELECT / 200V / FS. 200V will then be shown on the display.
Press HV ON. A 200V output will be produced on the high voltage terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 200V +/- 6mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.
Press ZERO.

Please note *that for performance reasons the 9823 uses slow ramping for large changes in output voltages, approximately > 50V.*

-200 Volt Full-Scale

Ensure that the DMM will accept an input of 200V.
Press SELECT / 200V / FS / -. -200V will then be shown on the display.
Press HV ON. A -200V output will be produced on the high voltage terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -200V +/- 6mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.
Press ZERO. The output is ramped down to zero.

+1kV Full-Scale

Ensure that the DMM will accept an input of 1000V.
Press SELECT / 1kV / FS. 1000V will then be shown on the display.
Press HV ON. A 1000V output will be produced on the high voltage terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 1000V +/- 35mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.
Press ZERO. The output is ramped down to zero.

-1kV Full-Scale

Ensure that the DMM will accept an input of -1000V.
Press SELECT / 1kV / FS / -. -1000V will then be shown on the display.
Press HV ON. A -1000V output will be produced on the high voltage terminals.
Press DEV%
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for -1000V +/- 35mV.
When the correct output voltage has been achieved, press DEV%**.** The DEV% button led goes out and the cal factor is then stored.
Press ZERO**.** The output is ramped down to zero.

2.5 Calibration of AC Voltage Ranges

Connect the 9823 main output terminals and select the appropriate range on the DMM.
All AC voltage ranges should be calibrated at 200Hz sine wave.
Press SELECT / AC / SELECT / FREQWAVE.
Select 200Hz by using only the up/down buttons for the three digits at the right hand side of the display.

20V AC Full-Scale
Press SELECT / 20V / FS. A 20V AC output will be produced on the main output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 20V +/- 5mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2V AC Full-Scale
Press SELECT / 2V / FS. A 2V AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 2V +/- 0.5mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

200mV AC Full-Scale
Press SELECT / 200mV / FS. A 200mV AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 200mV +/- 80uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

20mV AC Full-Scale
Press SELECT / 20mV / FS. A 20mV AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 20mV +/- 35uV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

200V AC Full-Scale

Ensure that the DMM will accept an input of 200V AC.
Press SELECT / 200V / FS. 200V AC will then be shown on the display.
Press HV ON. A 200V AC output will be produced on the high voltage output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 200V +/- 60mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.
Press ZERO. The output is ramped down to zero.

1kV AC

Ensure that the DMM will accept an input of 1000V AC.
Press SELECT / 1kV / FS. 1000V AC will then be shown on the display.
Press HV ON. A 1kV AC output will be produced on the high voltage output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output voltage for 1kV +/- 320mV.
When the correct output voltage has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.
Press ZERO. The output is ramped down to zero.

2.6 Calibration of DC Current Ranges

Select the appropriate range on the DMM.

200uA Range Zero

Press SELECT / DC / SELECT / 200uA / ZERO.
By using the + and - button and the up and down buttons, adjust the output to read 0A +/- 30nA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+200uA Full-Scale

Press SELECT / 200uA / FS. A 200uA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 200uA +/- 38nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-200uA Full-Scale

Press SELECT / 200uA / FS / -. A -200uA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -200uA +/- 38nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2mA Range Zero

Press SELECT / 2mA / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0A +/- 50nA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+2mA Full-Scale

Press SELECT / 2mA / FS. A 2mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 2mA +/- 100nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-2mA Full-Scale

Press SELECT / 2mA / FS / -. A -2mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -2mA +/- 100nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

20mA Range Zero
Press SELECT / 20mA / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0A +/- 200nA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+20mA Full-Scale
Press SELECT / 20mA / FS. A 20mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 20mA +/- 800nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-20mA Full-Scale
Press SELECT / 20mA / FS / -. A -20mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -20mA +/- 800nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

200mA Range Zero
Press SELECT / 200mA / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0 +/- 2uA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+200mA Full-Scale
Press SELECT / 200mA / FS. A 200mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 200mA +/- 8uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-200mA Full-Scale
Press SELECT / 200mA / FS / -. A -200mA output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -200mA +/- 8uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2A Range Zero

Press SELECT / 2A / ZERO.
By using the + and - buttons and the up and down buttons, adjust the output to read 0A +/- 60uA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+2A Full-Scale

Check if the DMM will measure 2A. If not, use a 4 terminal current shunt.
Press SELECT / 2A / FS. A 2A output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 2A +/- 180uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-2A Full-Scale

Check if the DMM will measure 2A. If not, use a 4 terminal current shunt.
Press SELECT / 2A / FS / -. A -2A output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -2A +/- 180uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

10A Range Zero

Press SELECT / 10A / ZERO
Connect 9823 10 amp output terminals to DMM current input
By using the + and - buttons and the up and down buttons, adjust the output to read 0A +/- 3mA.
When the o/p has been adjusted correctly, press SELECT / ZERO / ZERO.

+10A Full-Scale

Check if the DMM will measure 10A. If not, use a 4 terminal current shunt.
Press SELECT / 10A / FS. A 10A output will be produced on the high current output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 10A +/- 7mA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

-10A Full-Scale

Press SELECT / 10A / FS / -. A -10A output will be produced on the high current output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for -10A +/- 7mA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

Connect the 9823 main output terminals to the AC current terminals on the DMM.
Select an appropriate manual range on the DMM.
All AC current ranges should be calibrated at 60Hz sine wave.
Press SELECT / AC / SELECT / FREQWAVE.
Select 60Hz by using only the up/down buttons for the three digits at the right hand side of the display.

200uA AC Full-Scale
Press SELECT / 200uA / FS. A 200uA AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 200uA +/- 120nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2mA AC Full-Scale
Press SELECT / 2mA / FS. A 2mA AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 2mA +/- 800nA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

20mA AC Full-Scale
Press SELECT / 20mA / FS. A 20mA AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 20mA +/- 8uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

200mA AC Full-Scale
Press SELECT / 200mA / FS. A 200mA AC output will be produced.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 200mA +/- 80uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2A AC Full-Scale

Check if the DMM will measure 2A. If not, use a 4 terminal current shunt.

Press SELECT / 2A / FS. A 2A AC output will be produced on the main terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 2A +/- 900uA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

10A AC Full-Scale

Check if the DMM will measure 10A. If not, use a 4 terminal current shunt.

Press SELECT / 10A / FS.
A 10A AC output will be produced on the 10 amp output terminals.
Press DEV%.
Use the top row of buttons to increase the output or the bottom row to decrease it, adjust the output current for 10A +/- 10mA.
When the correct output current has been achieved, press DEV%. The DEV% button led goes out and the cal factor is then stored.

2.8 Calibration of Resistance Ranges

Connect a 4-wire lead set to DMM, then short all 4 leads at the opposite end. Then null (zero) the DMM. Remove the two gold links from the 9823's main terminals, then connect the 4 wire lead set to the 9823.
The 7 resistance values are individually adjusted using a multi-turn trimmer for each – see diagram following.

10 Ohm Calibration (MANUAL)
Press SELECT / Res(KΩ). 0.01 will be shown on the display.
Adjust 10R trimmer pot (R21) on the back of the 9823 resistance board for a DMM reading of 10 Ohm +/- 0.0002 Ohm.

100 Ohm Calibration (MANUAL)
Press 20mV. 0.10 will then be shown on the display.
Adjust 100R trimmer pot (R19) on the back of the 9823 resistance board for a DMM reading of 100R +/- 0.001 Ohm.

1k Ohm Calibration (MANUAL)
Press 200mV. 1.0 will be shown on the display.
Adjust 1K trimmer pot (R17) on the back of the 9823 resistance board for a DMM reading of 1k Ohm +/- 0.008 Ohm.

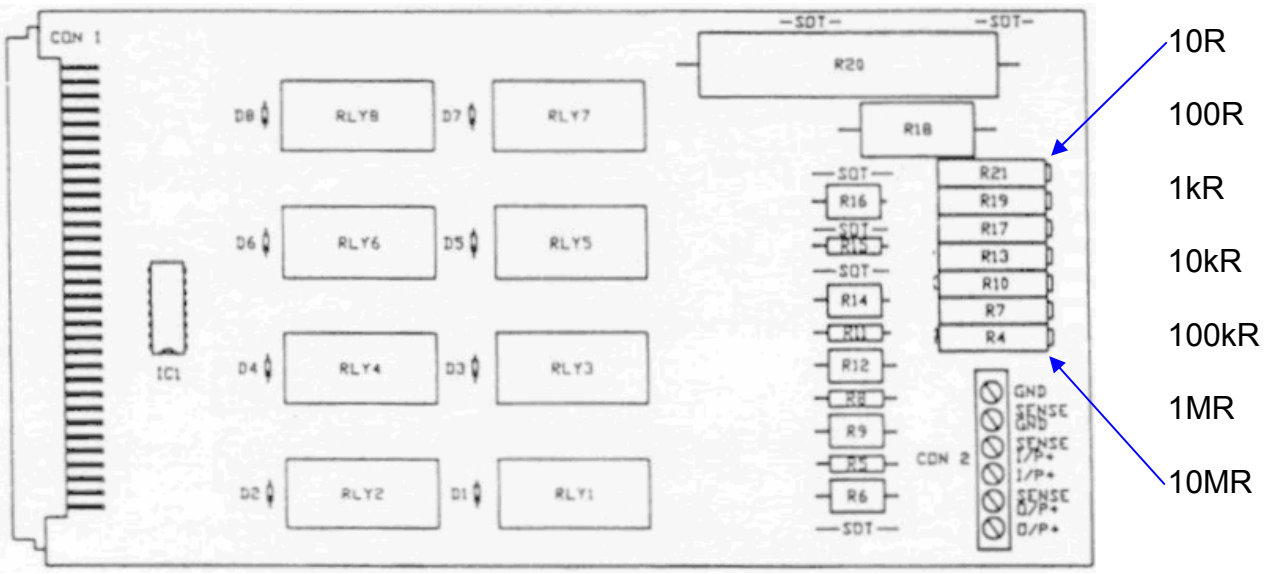
10k Ohm Calibration (MANUAL)
Press 2V. 10.00 will then be shown on the display.
Adjust 10K trimmer pot (R13) on the back of the 9823 resistance board for a DMM reading of 10k Ohm +/- 0.08 Ohm.

100k Ohm Calibration (MANUAL)
Press 20V. 100.00 will then be shown on the display.
Adjust 100K trimmer pot (R10) on the back of the 9823 resistance board for a DMM reading of 100k Ohm +/- 0.8 Ohm.

1M Ohm Calibration (MANUAL)
Use 2-wire resistance measurement for the 1MOhm and the 10MOhm.
Replace gold links on 9823 main terminals and use DMM 2-wire mode.

Press 100V. 1000.0 will then be shown on the display.
Adjust 1M trimmer pot (R7) on the back of the 9823 resistance board for a DMM reading of 1M Ohm +/- 20 Ohm.

10M Ohm Calibration (MANUAL)
Press 1kV. 10000.0 will then be shown on the display.
Adjust 10M trimmer pot (R4) on the back of the 9823 resistance board for a DMM reading of 10M Ohm +/- 500 Ohm.



2.9 Calibration completion details

The calibration adjustment is now complete. Switch the unit off, remove the cal key, replace the rear panel cover, and reset the IEEE address as required (not 0,16 or 32).
If a full calibration certificate is required test with the required calibration procedure (without the cal key in) and record the results.

Please note that the complete set of calibration results will include measurements at many points that are not calibration adjustment procedure. Refer to the Time Electronics example calibration certificate following.
Full traceability and environmental information should always be recorded on a calibration certificate.

If fully automated calibration of the 9823 is required, use Time Electronics' EasyCal calibration software. A complete system can be configured using EasyCal running on a PC with a GPIB interface card fitted. A procedure is available from Time Electronics that will automatically drive both an HP3485A DMM and the 9823. This allows the correct ranges on the DMM and the 9823 to be automatically selected and also sets up the correct outputs on the 9823. The calibration run will then proceed automatically. This is in effect a 'BEFORE' calibration and will identify any ranges that need adjustment. Adjustments should be made as described in this document before the whole EasyCal calibration run is repeated to produce an 'AFTER' (final calibration) certificate. Please contact Time Electronics for further information on the EasyCal system.

Time Electronics Ltd
Botany Industrial Estate, Tonbridge, Kent, TN9 1RH, UK
Tel: 01732 355993 Fax: 01732 770312
Email: mail@TimeElectronics.co.uk Website: www.TimeElectronics.co.uk

Certificate of Calibration

Certificate No. HP 10094

Cover Sheet - 5 results sheets to follow

Issued on: 03 Apr 2002

Lab Details

Time Electronics

Botany Ind. Est.
Tonbridge
Kent
England
Tel: 01732 355993 Fax: 01732 770312

Approved Signatories
Steve Taylor Lewis Crowhurst

Instrument Details

Type: **V/I/R CALIBRATOR**

Manuf. : **TIME ELECTRONICS**

Model: **9823**

Serial No.: **1595 J7**

Customer Details

Tel:
Fax:

Lab Conditions

Temperature: **23.0** +/-2.0degC *Humidity: 50% +/- 10%*

Supply Voltage: **230** +/-15 Volts *Supply Frequency: 50Hz +/- 0.3Hz*

Comments

Calibrated to manufacturer's specifications.

Calibrating Instruments

5mR CURRENT SHUNT Serial No:112473 Cert No:18372 Cal Date:06/Mar/2002 Cal Due:05/Mar/2003

100mR CURRENT SHUNT Serial No:136697 Cert No:18420 Cal Date:14/Mar/2002 Cal Due:13/Mar/2003

HP 3458A Serial No:2823A24910 Cert No:8065Z857701A Cal Date:06/Jul/2001 Cal Due:05/Jul/2002

Procedure: *9823-TIME-CAL*

Calibrated by: *Steve Taylor*

Date of Calibration: *03 Apr 2002*

Signed .....

Certificate of Calibration

V/I/R CALIBRATOR
TIME ELECTRONICS
9823

Issued on 03 Apr 2002

Result Sheet 1 of 5

Serial No.:1595 J7

Cust/Owner:

Certificate No. HP 10094

Test Name	Rqd Value	Actual Value	Allowed Error	% of Spec	Pass/Fail
D.C VOLTAGE					
20mV RANGE	0.00 uV	-0.05 uV	3.00 uV	-2 %	Pass
20mV RANGE	20.0000 mV	19.9999 mV	3.10 uV	-4 %	Pass
20mV RANGE	-20.0000 mV	-20.0001 mV	3.10 uV	3 %	Pass
---					
200 mV RANGE	0.00 uV	0.57 uV	3.40 uV	17 %	Pass
200mV RANGE	200.0000 mV	200.0014 mV	4.40 uV	32 %	Pass
200mV RANGE	-200.0000 mV	-200.0006 mV	4.40 uV	13 %	Pass

2V RANGE	0.00 uV	0.21 uV	7.00 uV	3 %	Pass
2V RANGE	2.000000 V	2.000004 V	17.00 uV	22 %	Pass
2V RANGE	-2.000000 V	-2.000001 V	17.00 uV	4 %	Pass

20V RANGE	0.00 uV	1.52 uV	40.00 uV	4 %	Pass
20V RANGE	20.000000 V	19.999987 V	140.00 uV	-10 %	Pass
20V RANGE	-20.000000 V	-20.000023 V	140.00 uV	16 %	Pass

200V RANGE	0.00 mV	-0.93 mV	2.00 mV	-47 %	Pass
200V RANGE	200.00000 V	199.99934 V	6.00 mV	-11 %	Pass
200V RANGE	-200.00000 V	-199.99982 V	6.00 mV	-3 %	Pass

1KV RANGE	0.00 mV	-3.75 mV	20.00 mV	-19 %	Pass
1KV RANGE	1000.000 V	999.992 V	35.00 mV	-22 %	Pass
1KV RANGE	-1000.000 V	-999.991 V	35.00 mV	-25 %	Pass
A.C VOLTAGE					
20mV RANGE: 200Hz	20.000 mV	19.993 mV	0.0350 mV	-20 %	Pass

200mV RANGE: 200Hz	200.000 mV	199.984 mV	0.0800 mV	-20 %	Pass
---					
2V RANGE: 60Hz	2.00000 V	1.99987 V	0.530 mV	-24 %	Pass
2V RANGE: 200Hz	2.00000 V	1.99989 V	0.530 mV	-21 %	Pass
2V RANGE: 1KHz	2.00000 V	2.00024 V	0.530 mV	46 %	Pass
2V RANGE: 5KHz	2.00000 V	2.00039 V	5.00 mV	8 %	Pass
2V RANGE: 10KHz	2.00000 V	1.99852 V	5.00 mV	-30 %	Pass
2V RANGE: 20KHz	2.00000 V	2.00209 V	5.00 mV	42 %	Pass

Procedure: *9823-TIME-CAL*
Calibrated by: *Steve Taylor*
Date of Calibration: *03 Apr 2002*
Signed .....

Certificate of Calibration

V/I/R CALIBRATOR
TIME ELECTRONICS
9823

Issued on 03 Apr 2002

Result Sheet 2 of 5

Serial No.:1595 J7

Cust/Owner:

Certificate No. HP 10094

Test Name	Rqd Value	Actual Value	Allowed Error	% of Spec	Pass/Fail
20V RANGE: 60Hz	20.00000 V	19.99958 V	5.00 mV	-8 %	Pass
20V RANGE: 200Hz	20.00000 V	20.00105 V	5.00 mV	21 %	Pass
20V RANGE: 500Hz	20.00000 V	20.00169 V	5.00 mV	34 %	Pass
20V RANGE: 1KHz	20.00000 V	20.00274 V	5.00 mV	55 %	Pass
20V RANGE: 2KHz	20.00000 V	20.00469 V	14.00 mV	34 %	Pass
20V RANGE: 5KHz	20.00000 V	20.00046 V	50.00 mV	1 %	Pass
20V RANGE: 10KHz	20.00000 V	19.97750 V	50.00 mV	-45 %	Pass
20V RANGE: 15KHz	20.00000 V	19.97147 V	50.00 mV	-57 %	Pass
20V RANGE: 20KHz	20.00000 V	19.98523 V	50.00 mV	-30 %	Pass

200V RANGE: 60Hz	200.0000 V	199.9934 V	60.00 mV	-11 %	Pass
200V RANGE: 200Hz	200.0000 V	200.0002 V	60.00 mV	0 %	Pass
200V RANGE: 400Hz	200.0000 V	200.0112 V	60.00 mV	19 %	Pass
200V RANGE: 1kHz	200.0000 V	199.9976 V	60.00 mV	-4 %	Pass

700V RANGE: 60Hz	700.000 V	699.916 V	320.00 mV	-26 %	Pass
700V RANGE: 200Hz	700.000 V	699.971 V	320.00 mV	-9 %	Pass
700V RANGE: 400Hz	700.000 V	699.979 V	320.00 mV	-6 %	Pass
D.C CURRENT					
200uA RANGE	0.000 uA	0.003 uA	0.0300 uA	11 %	Pass
200uA RANGE	200.0000 uA	200.0017 uA	0.0380 uA	4 %	Pass
200uA RANGE	-200.0000 uA	-199.9972 uA	0.0380 uA	-7 %	Pass

2mA RANGE	0.00 uA	0.00 uA	0.0500 uA	4 %	Pass
2mA RANGE	2.00000 mA	2.00002 mA	0.110 uA	18 %	Pass
2mA RANGE	-2.00000 mA	-1.99996 mA	0.110 mA	0 %	Pass

20mA RANGE	0.00 uA	0.04 uA	0.230 uA	18 %	Pass
20mA RANGE	20.00000 mA	20.00011 mA	0.830 uA	13 %	Pass
20mA RANGE	-20.00000 mA	-19.99998 mA	0.830 uA	-3 %	Pass

200mA RANGE	0.00 uA	0.14 uA	2.00 uA	7 %	Pass
200mA RANGE	200.0000 mA	200.0011 mA	8.00 uA	13 %	Pass
200mA RANGE	-200.0000 mA	-199.9987 mA	8.00 uA	-16 %	Pass

2A RANGE	0.00 uA	5.95 uA	60.00 uA	10 %	Pass
2A RANGE	2.000000 A	2.000012 A	0.00018 A	7 %	Pass
2A RANGE	-2.000000 A	-1.999995 A	0.00018 A	-3 %	Pass

Procedure: *9823-TIME-CAL*
Calibrated by: *Steve Taylor*
Date of Calibration: *03 Apr 2002*
Signed .....

Certificate of Calibration

V/I/R CALIBRATOR
TIME ELECTRONICS
9823

Issued on 03 Apr 2002

Result Sheet 3 of 5

Serial No.:1595 J7

Cust/Owner:

Certificate No. HP 10094

Test Name	Rqd Value	Actual Value	Allowed Error	% of Spec	Pass/Fail
10A RANGE	0.00 mA	-0.37 mA	3.00 mA	-12 %	Pass
10A RANGE	10.00000 A	9.99830 A	0.00700 A	-24 %	Pass
10A RANGE	-10.00000 A	-9.99867 A	0.00700 A	-19 %	Pass
A.C CURRENT					
200uA RANGE: 60Hz	200.000 uA	200.004 uA	0.130 uA	3 %	Pass
2mA RANGE: 60Hz	2.00000 mA	2.00022 mA	0.850 uA	26 %	Pass
20mA RANGE: 60Hz	20.0000 mA	20.0005 mA	8.10 uA	6 %	Pass
200mA RANGE: 60Hz	200.000 mA	199.995 mA	80.00 uA	-6 %	Pass
2A RANGE: 60Hz	2.00000 A	1.99982 A	0.00090 A	-20 %	Pass
10A RANGE: 60Hz.	10.0000 A	10.0008 A	0.0100 A	8 %	Pass
RESISTANCE					
10 OHMS	10.00000 R	10.00000 R	0.00020 R	-1 %	Pass
100 OHMS	100.00000 R	100.00024 R	0.00100 R	24 %	Pass
1k OHMS	1.0000000 kR	0.9999995 kR	0.00800 R	-7 %	Pass
10 KILO OHMS	10.000000 kR	9.999983 kR	0.0800 R	-21 %	Pass
100 KILO OHMS	100.00000 kR	99.99991 kR	0.800 R	-11 %	Pass
1 MEGA OHMS	1.0000000 MR	0.9999946 MR	20.00 R	-27 %	Pass
10 MEGA OHMS	10.000000 MR	9.999884 MR	500.00 R	-23 %	Pass
FREQUENCY					
100Hz	100.000 Hz	100.004 Hz	0.0100 Hz	35 %	Pass
500Hz	500.000 Hz	500.015 Hz	0.0500 Hz	30 %	Pass
1KHz	1.0000 kHz	1.0000 kHz	0.100 Hz	28 %	Pass
2KHz	2.0000 kHz	2.0001 kHz	0.200 Hz	32 %	Pass
5KHz	5.0000 kHz	5.0002 kHz	0.500 Hz	32 %	Pass
10KHz	10.0000 kHz	10.0003 kHz	1.000 Hz	33 %	Pass
20KHz	20.0000 kHz	20.0007 kHz	2.00 Hz	33 %	Pass
LINEARITY: 20V RANGE					
LINEARITY:	19.00000 V	18.99999 V	138.00 uV	-6 %	Pass
LINEARITY:	18.00000 V	18.00000 V	133.00 uV	-1 %	Pass
LINEARITY:	17.00000 V	17.00000 V	128.00 uV	3 %	Pass
LINEARITY:	16.00000 V	16.00000 V	123.00 uV	2 %	Pass
LINEARITY:	15.00000 V	15.00002 V	118.00 uV	16 %	Pass
LINEARITY:	14.00000 V	14.00000 V	113.00 uV	0 %	Pass
LINEARITY:	13.00000 V	12.99999 V	108.00 uV	-7 %	Pass
LINEARITY:	12.00000 V	11.99998 V	103.00 uV	-17 %	Pass
LINEARITY:	11.00000 V	11.00001 V	98.00 uV	15 %	Pass
LINEARITY:	10.00000 V	10.00006 V	93.00 uV	70 %	Pass
LINEARITY:	9.00000 V	9.00004 V	88.00 uV	49 %	Pass
LINEARITY:	8.00000 V	8.00004 V	83.00 uV	52 %	Pass

Procedure: *9823-TIME-CAL*
Calibrated by: *Steve Taylor*
Date of Calibration: *03 Apr 2002*
Signed .....

Certificate of Calibration

V/I/R CALIBRATOR
TIME ELECTRONICS
9823

Issued on 03 Apr 2002

Result Sheet 4 of 5

Serial No.:1595 J7

Cust/Owner:

Certificate No. HP 10094

Test Name	Rqd Value	Actual Value	Allowed Error	% of Spec	Pass/Fail
LINEARITY:	7.00000 V	7.00003 V	78.00 uV	42 %	Pass
LINEARITY:	6.00000 V	6.00003 V	73.00 uV	47 %	Pass
LINEARITY:	5.00000 V	5.00004 V	68.00 uV	64 %	Pass
LINEARITY:	4.00000 V	4.00002 V	63.00 uV	30 %	Pass
LINEARITY:	3.00000 V	3.00002 V	58.00 uV	32 %	Pass
LINEARITY:	2.00000 V	1.99999 V	53.00 uV	-25 %	Pass
LINEARITY:	1.00000 V	1.00000 V	48.00 uV	9 %	Pass

LINEARITY:	-19.00000 V	-19.00004 V	138.00 uV	26 %	Pass
LINEARITY:	-18.00000 V	-18.00004 V	133.00 uV	32 %	Pass
LINEARITY:	-17.00000 V	-17.00002 V	128.00 uV	18 %	Pass
LINEARITY:	-16.00000 V	-16.00003 V	123.00 uV	22 %	Pass
LINEARITY:	-15.00000 V	-15.00005 V	118.00 uV	42 %	Pass
LINEARITY:	-14.00000 V	-14.00004 V	113.00 uV	35 %	Pass
LINEARITY:	-13.00000 V	-13.00003 V	108.00 uV	25 %	Pass
LINEARITY:	-12.00000 V	-12.00004 V	103.00 uV	34 %	Pass
LINEARITY:	-11.00000 V	-11.00001 V	98.00 uV	15 %	Pass
LINEARITY:	-10.00000 V	-10.00004 V	93.00 uV	40 %	Pass
LINEARITY:	-9.00000 V	-9.00004 V	88.00 uV	50 %	Pass
LINEARITY:	-8.00000 V	-8.00003 V	83.00 uV	31 %	Pass
LINEARITY:	-7.00000 V	-7.00004 V	78.00 uV	46 %	Pass
LINEARITY:	-6.00000 V	-6.00002 V	73.00 uV	27 %	Pass
LINEARITY:	-5.00000 V	-5.00001 V	68.00 uV	17 %	Pass
LINEARITY:	-4.00000 V	-4.00001 V	63.00 uV	14 %	Pass
LINEARITY:	-3.00000 V	-3.00001 V	58.00 uV	19 %	Pass
LINEARITY:	-2.00000 V	-1.99998 V	53.00 uV	-36 %	Pass
LINEARITY:	-1.00000 V	-0.99998 V	48.00 uV	-38 %	Pass

LINEARITY:	0.90000 V	0.90000 V	48.00 uV	-1 %	Pass
LINEARITY:	0.80000 V	0.80000 V	47.00 uV	7 %	Pass
LINEARITY:	0.70000 V	0.70000 V	47.00 uV	2 %	Pass
LINEARITY:	0.60000 V	0.60001 V	46.00 uV	24 %	Pass
LINEARITY:	0.50000 V	0.50001 V	46.00 uV	23 %	Pass
LINEARITY:	0.40000 V	0.39999 V	45.00 uV	-24 %	Pass
LINEARITY:	0.30000 V	0.30000 V	45.00 uV	3 %	Pass
LINEARITY:	0.20000 V	0.20000 V	44.00 uV	11 %	Pass
LINEARITY:	0.10000 V	0.10001 V	44.00 uV	13 %	Pass

Procedure: *9823-TIME-CAL*
Calibrated by: *Steve Taylor*

Date of Calibration: *03 Apr 2002*

Signed .....

Certificate of Calibration

V/I/R CALIBRATOR
TIME ELECTRONICS
9823

Issued on 03 Apr 2002

Result Sheet 5 of 5

Serial No.:1595 J7

Cust/Owner:

Certificate No. HP 10094

Test Name	Rqd Value	Actual Value	Allowed Error	% of Spec	Pass/Fail
LINEARITY:	-0.90000 V	-0.90004 V	48.00 uV	78 %	Pass
LINEARITY:	-0.80000 V	-0.79999 V	47.00 uV	-14 %	Pass
LINEARITY:	-0.70000 V	-0.69998 V	47.00 uV	-42 %	Pass
LINEARITY:	-0.60000 V	-0.60001 V	46.00 uV	27 %	Pass
LINEARITY:	-0.50000 V	-0.50001 V	46.00 uV	12 %	Pass
LINEARITY:	-0.40000 V	-0.39998 V	45.00 uV	-54 %	Pass
LINEARITY:	-0.30000 V	-0.30001 V	45.00 uV	14 %	Pass
LINEARITY:	-0.20000 V	-0.20000 V	44.00 uV	8 %	Pass
LINEARITY:	-0.10000 V	-0.10000 V	44.00 uV	-11 %	Pass

LINEARITY:	50.00 mV	50.00 mV	44.00 uV	10 %	Pass
LINEARITY:	10.00 mV	10.00 mV	44.00 uV	9 %	Pass
LINEARITY:	500.00 uV	502.13 uV	44.00 uV	5 %	Pass
LINEARITY:	100.00 uV	101.59 uV	44.00 uV	4 %	Pass
LINEARITY:	40.00 uV	41.33 uV	44.00 uV	3 %	Pass
LINEARITY:	20.00 uV	21.19 uV	44.00 uV	3 %	Pass

LINEARITY:	-50.00 mV	-49.99 mV	44.00 uV	-26 %	Pass
LINEARITY:	-10.00 mV	-9.98 mV	44.00 uV	-36 %	Pass
LINEARITY:	-500.00 uV	-481.54 uV	44.00 uV	-42 %	Pass
LINEARITY:	-100.00 uV	-80.74 uV	44.00 uV	-44 %	Pass
LINEARITY:	-40.00 uV	-22.03 uV	44.00 uV	-41 %	Pass
LINEARITY:	-20.00 uV	-1.25 uV	44.00 uV	-43 %	Pass

Procedure: *9823-TIME-CAL*
Calibrated by: *Steve Taylor*

Date of Calibration: *03 Apr 2002*

Signed .....