Report on the Calibration of a Hewlett-Packard 3458A Multimeter, Serial Number 2823A11212

Report No. Electrical/2014/S21937, 01 May 2014

ISSUED BY THE

Measurement Standards Laboratory of New Zealand

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All results quoted in this report are directly traceable to the national measurement standards held by the Measurement Standards Laboratory of New Zealand (MSL). MSL is New Zealand's national metrology institute and operates within Callaghan Innovation Research Limited.

CIPM MRA

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org).

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ACCREDITATION NUMBER 1

All measurements reported herein have been performed in accordance with the laboratory's scope of accreditation.
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Description

A Hewlett-Packard model 3458A Multimeter.

Identification

Serial number: 2823A11212.

Client

Light Standards, Measurement Standards Laboratory of New Zealand,
69 Gracefield Rd, Lower Hutt.

Date of Calibration

01 May 2014.

Conditions of Calibration

The ambient temperature during the measurements was 20.1 °C ± 1.0 °C and the relative humidity was 49 % ± 15 %.

The internal temperature reported by the instrument prior to the measurements described here was 33.8 °C. This value was obtained by executing the command TEMP? with no signal applied.

Method

The instrument power was switched on for a period of at least 4 hours before measurements were taken using the front terminals only. All measurements were made following procedure MSLT.E.025.003.

The internal calibration temperatures reported by the instrument provide a means to ensure the instrument has not been adjusted since this report. The calibration temperatures reported during these measurements are:

Input Offset Adjustment (CAL? 58)	36.2663158 °C
DC Gain Adjustment (CAL? 59)	37.1292459 °C
Resistance and DC Current Adjustment (CAL? 60)	36.3736867 °C

The command ACAL ALL, 3458 was executed prior to performing the measurements.

All instrument readings quoted are the mean of 10 or more individual readings taken using the IEEE bus. The instrument was reset before taking the readings.

Results

DC Voltage

The instrument was configured by executing the commands DCV, NPLC 100 and TRIG AUTO.

1 DC Voltage Offset

The DCV function offset was measured for each range using a low thermal short consisting of freshly scraped copper connected between the HI and LO terminals. The expanded uncertainty in the results includes a contribution for small deviations from 0 V associated with the low thermal short.

Measurements were made in the order given in the table of results. The 100 mV range measurements were made following a delay of at least 5 minutes after making the connection to the low thermal short and setting the range. The results were:

Instrument Range	Instrument Readout	Expanded Uncertainty
100 mV	0.001 68 mV	0.000 26 mV
1 V	0.000 001 42 V	0.000 000 26 V
10 V	0.000 000 91 V	0.000 000 30 V
100 V	0.000 014 V	0.000 005 V
1000 V	0.000 001 V	0.000 015 V

The expanded uncertainties quoted above are calculated using a coverage factor of 2.2.

2 DC Voltage Gain

For each range, the change in DC voltage required to go from a reading of zero volts to the indicated instrument reading was determined.

Instrument Range	Instrument Readout	Voltage +	Voltage -	Expanded Uncertainty
100 mV	± 0.100 00 mV	0.100 01 mV	0.099 98 mV	0.000 25 mV
	± 10.000 00 mV	10.000 00 mV	9.999 96 mV	0.000 27 mV
	± 50.000 00 mV	49.999 91 mV	49.999 92 mV	0.000 36 mV
	± 100.000 00 mV	99.999 9 mV	99.999 8 mV	0.000 5 mV
1 V	± 0.500 000 0 V	0.499 998 9 V	0.499 999 0 V	0.000 001 3 V
	± 1.000 000 0 V	0.999 997 8 V	0.999 998 2 V	0.000 002 0 V
10 V	± 1.000 000 0 V	0.999 997 8 V	0.999 998 2 V	0.000 002 3 V
	± 5.000 000 0 V	4.999 989 V	4.999 990 V	0.000 005 V
	± 10.000 000 0 V	9.999 978 V	9.999 980 V	0.000 008 V
100 V	± 50.000 000 V	49.999 89 V	49.999 89 V	0.000 12 V
	± 100.000 000 V	99.999 79 V	99.999 82 V	0.000 20 V
1000 V	± 100.000 00 V	99.999 8 V	99.999 9 V	0.000 5 V
	± 500.000 00 V	499.999 4 V	499.999 8 V	0.001 8 V
	± 1000.000 00 V	1000.004 1 V	1000.004 3 V	0.003 5 V
				Note 1

Note 1: The 1000 V measurements were made at least 3 minutes after application of the voltage.

The expanded uncertainties quoted above are calculated using a coverage factor of 2.0.

3 DC Voltage Linearity

The DCV linearity was determined by applying known voltages to the instrument on the 10 V range.

The true voltages required to produce the following readouts were determined. The relative values are calculated by linearly scaling the true voltages so that the relative values corresponding to readouts of 0.000 000 0 and 10.000 000 0 are exactly 0.000 000 0 and 10.000 000 0.

Instrument Readout	Relative Value +	Relative Value -	Expanded Uncertainty
±10.000 000 0 V	10.000 000 0	10.000 000 0	-
±9.000 000 0 V	8.999 998 8	8.999 998 2	0.000 003 5
±8.000 000 0 V	7.999 999 5	7.999 998 4	0.000 003 3
±7.000 000 0 V	6.999 999 1	6.999 998 3	0.000 003 1
±6.000 000 0 V	5.999 999 4	5.999 998 9	0.000 002 9
±5.000 000 0 V	4.999 999 5	4.999 999 0	0.000 002 7
±4.000 000 0 V	3.999 999 4	3.999 998 4	0.000 002 5
±3.000 000 0 V	2.999 999 8	2.999 998 7	0.000 002 2
±2.000 000 0 V	1.999 999 8	1.999 998 8	0.000 002 0
±1.000 000 0 V	1.000 000 1	0.999 999 2	0.000 001 7
0.000 000 0 V	0.000 000 0	0.000 000 0	-

The expanded uncertainties quoted above are calculated using a coverage factor of 2.1.

Uncertainties

The uncertainties quoted are at a 95% level of confidence. See the "Guide to the Expression of Uncertainty in Measurement" (ISO, 1995) for an explanation of terms.

All uncertainties are estimated by combining the uncertainties in the reference standards of this laboratory together with the uncertainties associated with the short- term behaviour of the instrument.

The uncertainties quoted do not include a contribution from the resolution of the front panel display that would be necessary for measurements that are manually recorded.

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