

Draft MSL Proficiency Test MSL-PT-E01-2019

6.5 Digit Multimeter

Technical Protocol

1. Introduction

The purpose of the proficiency test is to verify the calibration capabilities of participants with respect to a widely-used multifunction 6.5 digit multimeter. This instrument can measure dc voltage, dc current, ac voltage, ac current, and resistance. Only a limited selection of possible points will be used to keep the process manageable.

Following initial calibration at MSL, the digital multimeter will be circulated to each participating laboratory. After measurement at two or three laboratories, the multimeter will be returned to MSL for a stability and damage check before being dispatched to the next participant. Finally, the multimeter will be recalibrated by MSL to determine any possible drift.

2. Equipment and handling

Artefact: Hewlett Packard 34401A Digital Multimeter, serial number tbc.

After arrival of the instrument, it should be checked for any physical damage. Check that the instrument is functioning correctly. Report any problems immediately to MSL.

The multimeter should be allowed to stabilise in a temperature and, if possible, humidity-controlled environment for at least 24 hours before commencing measurements.

Each laboratory is allowed two weeks to complete the measurements. Once measurements are completed, repack the artefact in the original packaging and return by courier to:

Cheng Yang,
Measurement Standards Laboratory
Callaghan Innovation
69 Gracefield Road,
Lower Hutt 5010

3. Quantities to be Measured

- **Participants must NOT attempt to perform any maintenance of the instrument or calibration adjustments.**
- **Participants must NOT discuss results with other participants before the final report is issued.**

In this proficiency test only a subset of the measurement points described in the Service Manual of the 34401A will be evaluated together with some power frequency points at 53 Hz. Each participant should

calibrate the digital multimeter at least at the points given in the table below (the meter range will be specified for each point). You may use your own standard (automated) procedures that cover additional points but these will not be used for analysis in this proficiency test.

Parameter	Nominal value
DC Voltage	100 mV, 1 V, 10 V, -10 V, 100 V and 1000 V
DC Current	10 mA and 1 A
DC Resistance	100 Ω , 100 k Ω and 100 M Ω (using 4-wire)
AC Voltage	53 Hz: ^{Note 1} 10 V, 100 V and 700 V 1 kHz: 100 mV, 1 V, 10 V, 100 V and 700 V 50 kHz: 100 mV, 1 V, 10 V, 100 V
AC Current	53 Hz: ^{Note 1} 10 mA and 1 A 1 kHz: 10 mA and 1 A

Note 1: 53 Hz is not specified in the Service Manual set of points but is important to support electrical power measurements. If 53 Hz is not in your scope these measurements may be omitted.

For the purposes of this proficiency test, it is acceptable to report results outside the range of the measurand on your scope of accreditation.

Setting Up

In general:

- Reset the instrument to default settings before starting measurements.
- The front input terminals must be used for all measurements.
- Manual range selection must be made for all measurements. Select the range before applying the test signal to the multimeter.

More specific instructions and instrument settings will be provided in the final version of this protocol.

Measurement Conditions

It is expected the measurements will be carried out in the following range of environmental conditions:

- Temperature: 20 °C to 23 °C (± 1 °C)
- Relative humidity: 40 % to 60 % (± 10 %)

The environmental conditions during the measurements must be reported with the results.

4. Documents to be submitted

Within two weeks of completion of the measurements, participating laboratories are required to submit their results to MSL in the form of a calibration report as routinely provided to customers. Results should also be reported in a Results Sheet provide by MSL and submitted with the calibration report (these documents can be sent by email – see *Contact Information* below).

Uncertainties should be calculated using your usual method, which should be consistent with the method in the ISO *Guide to the Expression of Uncertainty in Measurement*. Uncertainties must be reported as expanded uncertainties at the 95% level of confidence.

Note: *It is acceptable for the purposes of this proficiency test to report an uncertainty below that on your scope of accreditation or to report results outside the range of the measurand on your scope of accreditation, but such points should be clearly identified.*

5. Further Information

Schedule

The proficiency test is scheduled to start in early 2020. A travelling schedule will be proposed after consultation with participating laboratories.

Analysis

If required, some correction for environmental conditions may be applied to bring all results to a common basis.

Results from all participating laboratories will be compared to the values measured by MSL. The results will be reported as a table of normalised error (E_n) values, which are given by

$$E_n = \frac{LAB-REF}{\sqrt{U_{LAB}^2 + U_{REF}^2}},$$

where: LAB = participating laboratory's value, REF = reference laboratory's value, U_{LAB} = participating laboratory's expanded uncertainty, U_{REF} = reference laboratory's expanded uncertainty.

Reporting

A draft final report will be compiled once all participating laboratories have completed their calibrations. The report will list all participants but will identify results only by a laboratory number which will be communicated to each participant when registrations are complete. The same report will be issued to all participants. Laboratories will be given two weeks to comment on the draft final report, after which a final report will be issued.

Note: If any participant makes changes to submitted data between the interim and final reports, this will be noted in the final report.

Contact information

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MSL Proficiency Test-E1-2019

RESULTS SHEET
HP 34401A 6.5 Digit Multimeter, serial number tbc.

Laboratory Name:

Report Number:

Calibrated Date:

Calibrated By:

Ambient Temperature and Humidity:

Nominal Value	Applied Value	DMM Reading	DMM Range	Reported ⁽¹⁾ Uncertainty	Least ⁽²⁾ Uncertainty
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DC Voltage

100 mV					
1 V					
10 V					
-10 V					
100 V					
1000 V					

DC Current

10 mA					
1 A					

DC Resistance (4-wire)

100 Ω					
100 k Ω					
100 M Ω					

AC Voltage @ 53 Hz

10 V					
100 V					
700 V					

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RESULTS SHEET
HP 34401A 6.5 Digit Multimeter, serial number tbc.

Laboratory Name:

Report Number:

Calibrated Date:

Calibrated By:

Ambient Temperature and Humidity:

Nominal Value	Applied Value	DMM Reading	DMM Range	Reported ⁽¹⁾ Uncertainty	Least ⁽²⁾ Uncertainty
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AC Voltage @ 1 kHz

100 mV					
1 V					
10 V					
100 V					
700 V					

AC Voltage @ 50 kHz

100 mV					
1 V					
10 V					
100 V					

AC Current @ 53 Hz

10 mA					
1 A					

AC Current @ 1 kHz

10 mA					
1 A					

Notes:

1. The reported uncertainty is the calculated uncertainty for this calibration. It is acceptable for the purposes of a measurement audit to report an uncertainty below that on your Scope of Accreditation.
2. The least uncertainty is the laboratory's accredited least uncertainty of measurement (from Scope of Accreditation).