Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 1-14027285905-1

Model Number	34401A
Manufacturer	Keysight Technologies Inc
Description	Digital multimeter, 6.5 digit
Serial Number	MY41027712
Customer Asset No.	EMSG03
Date of Calibration	11 Feb 2021
Procedure	STE-50111013-D.03.05-T119Q8Q
Temperature	(23 ± 5) °C
Humidity	(50 ± 20) %RH

Customer
Keysight Technologies Singapore (Sales) Pte Ltd
1 Yishun Ave 7
Registration No:201400782D
SINGAPORE 768923
Singapore

Location of Calibration
Keysight Technologies Singapore (Sales) Pte. Ltd.
1 Yishun Avenue 7
Registration No:201400782D
Singapore 768923
SINGAPORE

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2015.

As Received Conditions
The measured values of the equipment were observed in specification at the points tested. Additionally, the expanded measurement uncertainty intervals about the measured values were in specification.

Action Taken
- No corrective actions were necessary.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested. Additionally, the expanded measurement uncertainty intervals about the measured values were in specification.

Remarks or Special Requirements

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.
This calibration report may refer to equipment manufactured by HP, Agilent and Keysight as being manufactured by Keysight Technologies.

Based on the customer's request, the next calibration is due on 11 Feb 2022.

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Traceability Information

Technician ID N5249752

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Model Number	Model Description	Equipment ID	Cal Due Date
33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13628	25 Nov 2021
5720A	Multifunction Calibrator - No Options	5720A85203	2 Mar 2021
5725A	Amplifier for 5700A or 5720A	5725A30002	24 Jul 2022

Traceability Table

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W,R	33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13628	1-13541390639-1-SINGLAS:LA-2014-0575-C	AC Voltage DC Voltage Frequency
W,R	5720A	Multifunction Calibrator - No Options	5720A85203	1-12162383892-1-A2LA:2166.01	AC Current AC Voltage DC Current DC Voltage Resistance
W,R	5725A	Amplifier for 5700A or 5720A	5725A30002	1-12902338694-1-NVLAP:105016-0	AC Current AC Voltage DC Current

Legend

W - Working Standard The calibration equipment used for the calibration of the Model indicated on the first page of the Certificate of calibration.

R - Reference Standard The Reference Standard (Accredited or NMI-calibrated ETE) used to provide traceability to the SI-Units for the calibration parameters listed.

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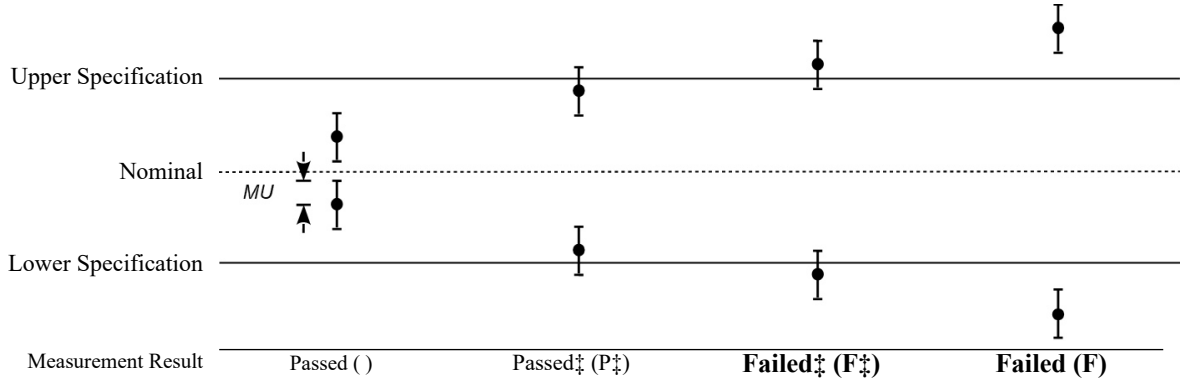
Compliance with Specification

The uncertainty of measurement has been taken into account when determining compliance with specification, as per ILAC-G8:09/2019. If the expanded measurement uncertainty intervals centered about one or more measured values were both in as well as out of specification (upper or lower), it is not possible to state compliance or non-compliance based on a 95% coverage probability for the expanded measurement uncertainty.

An overall statement of compliance for all tests performed as received, and as completed (if any adjustments / repairs were performed) is included at the beginning of this report. Statements of compliance apply only to warranted specifications. When functional verification tests are performed, results are reported in the “Functional Test” section, and do not affect these statements of compliance.
The status summaries relate to the tested item only. A final decision about whether the item's performance actually satisfies requirements of the user can only be made by the user.

Measurement results are reported as:

- Passed ( ) - The measured values of the equipment were observed in specification at the points tested. Additionally, the expanded measurement uncertainty intervals about the measured values were in specification.
- Passed‡ (P‡) - The measured values of the equipment were observed in specification at the points tested. However, a portion of the expanded measurement uncertainty intervals about one or more measured values exceeded specification. Consequently, compliance with specification cannot be declared based on the stated coverage probability.
- Failed‡ (F‡) - One or more measured values of the equipment were observed out of specification at the points tested. However, a portion of the expanded measurement uncertainty intervals about one or more measured values were in specification. Consequently, non-compliance with specification cannot be declared based on the stated coverage probability.
- Failed (F) - One or more measured values of the equipment were observed out of specification at the points tested. Additionally, the expanded measurement uncertainty intervals about one or more measured values were entirely outside the specification.



MU = 95% expanded measurement uncertainty.
( ) This result is indicated on the measurement report as a blank space in the column labeled “Status” or “Sts”.
Note: For more information on the level of risk such as false accept and false reject and statistical assumptions of these statements of conformity, please visit: www.keysight.com/find/decisionrules.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

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Calibration Test Results Summary

Test Name	As Received Status
ZERO OFFSET - FRONT TERMINALS	Passed
ZERO OFFSET - REAR TERMINALS	Passed
DC VOLTS	Passed
AC VOLTS	Passed
FREQUENCY	Passed
4-WIRE OHMS	Passed
2-WIRE OHMS MATH NULL ON	Passed
2-WIRE OHMS MATH NULL OFF	Passed
DC CURRENT	Passed
AC CURRENT	Passed

Tested Configuration

Firmware Version	11-5-2
(As Rec)	11-5-2

Measurement Report

Certificate Number 1-14027285905-1

Model 34401A **Serial** MY41027712 **Firmware Rev** 11-5-2 **Test Date** 11 Feb 2021
Options Tested **Condition** As Received

ZERO OFFSET - FRONT TERMINALS — Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	*Input (Front)*					
DC Volts Zero Offset						
100 mV	0 V	−3.5 uV	1.1 uV	3.5 uV	1.1 uV	
1 V	0 V	−7 uV	1 uV	7 uV	1.2 uV	
10 V	0 V	−0.05 mV	0.00 mV	0.05 mV	6.6 uV	
100 V	0 V	−0.6 mV	0.0 mV	0.6 mV	0.17 mV	
1000 V	0 V	−10 mV	0 mV	10 mV	0.74 mV	
Range	*Input (Front)*					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	−2.0 mΩ	4.0 mΩ	1.2 mΩ	
1 kΩ	0 Ω	−10 mΩ	−2 mΩ	10 mΩ	1.2 mΩ	
10 kΩ	0 Ω	−0.10 Ω	−0.02 Ω	0.10 Ω	0.014 Ω	
100 kΩ	0 Ω	−1.0 Ω	−0.2 Ω	1.0 Ω	0.16 Ω	
1 MΩ	0 Ω	−10 Ω	−1 Ω	10 Ω	0.98 Ω	
10 MΩ	0 Ω	−0.10 kΩ	−0.01 kΩ	0.10 kΩ	0.011 kΩ	
100 MΩ	0 Ω	−10.0 kΩ	0.0 kΩ	10.0 kΩ	0.058 kΩ	
Range	*Input (Front)*					
2-Wire Ohms Zero Offset						
100 Ω	0 Ω	−204.0 mΩ	4.5 mΩ	204.0 mΩ	6.1 mΩ	
1 kΩ	0 Ω	−210 mΩ	4 mΩ	210 mΩ	5.8 mΩ	
10 kΩ	0 Ω	−0.30 Ω	0.01 Ω	0.30 Ω	8.4 mΩ	
100 kΩ	0 Ω	−1.2 Ω	0.1 Ω	1.2 Ω	0.068 Ω	
1 MΩ	0 Ω	−10 Ω	0 Ω	10 Ω	1.3 Ω	
10 MΩ	0 Ω	−0.10 kΩ	0.00 kΩ	0.10 kΩ	0.0097 kΩ	
100 MΩ	0 Ω	−10.0 kΩ	0.0 kΩ	10.0 kΩ	0.058 kΩ	
Range	*Input (Front)*					
DC Current Zero Offset						
10 mA	0 A	−2.00 uA	0.01 uA	2.00 uA	0.16 uA	
100 mA	0 A	−5.0 uA	0.0 uA	5.0 uA	0.21 uA	
1 A	0 A	−100 uA	0 uA	100 uA	7.0 uA	
3 A	0 A	−600 uA	1 uA	600 uA	11 uA	

ZERO OFFSET - REAR TERMINALS — Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	*Input (Rear)*					
DC Volts Zero Offset						
100 mV	0 V	−3.5 uV	−0.3 uV	3.5 uV	1.1 uV	
1 V	0 V	−7 uV	0 uV	7 uV	1.2 uV	
10 V	0 V	−0.05 mV	0.00 mV	0.05 mV	6.6 uV	
100 V	0 V	−0.6 mV	0.0 mV	0.6 mV	0.17 mV	
1000 V	0 V	−10 mV	0 mV	10 mV	0.74 mV	
Range	*Input (Rear)*					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	−1.3 mΩ	4.0 mΩ	1.2 mΩ	
1 kΩ	0 Ω	−10 mΩ	−1 mΩ	10 mΩ	1.2 mΩ	
10 kΩ	0 Ω	−0.10 Ω	−0.01 Ω	0.10 Ω	0.014 Ω	
100 kΩ	0 Ω	−1.0 Ω	−0.1 Ω	1.0 Ω	0.16 Ω	
1 MΩ	0 Ω	−10 Ω	0 Ω	10 Ω	0.98 Ω	
10 MΩ	0 Ω	−0.10 kΩ	0.00 kΩ	0.10 kΩ	0.011 kΩ	
100 MΩ	0 Ω	−10.0 kΩ	0.0 kΩ	10.0 kΩ	0.058 kΩ	
Range	*Input (Rear)*					
2-Wire Ohms Zero Offset						
100 Ω	0 Ω	−204.0 mΩ	−146.1 mΩ	204.0 mΩ	6.1 mΩ	
1 kΩ	0 Ω	−210 mΩ	−146 mΩ	210 mΩ	5.8 mΩ	
10 kΩ	0 Ω	−0.30 Ω	−0.15 Ω	0.30 Ω	8.4 mΩ	
100 kΩ	0 Ω	−1.2 Ω	−0.2 Ω	1.2 Ω	0.068 Ω	
1 MΩ	0 Ω	−10 Ω	0 Ω	10 Ω	1.3 Ω	
10 MΩ	0 Ω	−0.10 kΩ	0.00 kΩ	0.10 kΩ	0.0097 kΩ	
100 MΩ	0 Ω	−10.0 kΩ	−0.2 kΩ	10.0 kΩ	0.058 kΩ	
Range	*Input (Rear)*					
DC Current Zero Offset						
10 mA	0 A	−2.00 uA	0.00 uA	2.00 uA	0.16 uA	
100 mA	0 A	−5.0 uA	0.0 uA	5.0 uA	0.21 uA	
1 A	0 A	−100 uA	−1 uA	100 uA	7.0 uA	
3 A	0 A	−600 uA	3 uA	600 uA	11 uA	

DC VOLTS

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	*Input(Front)*					
100 mV	100 mV	99.9915 mV	99.9998 mV	100.0085 mV	0.0029 mV	
1 V	1 V	0.999953 V	1.000004 V	1.000047 V	0.0000070 V	
10 V	10 V	9.99960 V	9.99999 V	10.00040 V	0.000043 V	
10 V	-10 V	−10.00040 V	−10.00000 V	−9.99960 V	0.000041 V	
100 V	100 V	99.9949 V	100.0001 V	100.0051 V	0.00058 V	
1000 V	1000 V	999.945 V	999.998 V	1000.055 V	0.0084 V	

AC VOLTS

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	*Freq.*					
100 mV Range						
10 mV	1 kHz	9.9540 mV	9.9987 mV	10.0460 mV	0.0056 mV	
100 mV	1 kHz	99.9000 mV	100.0001 mV	100.1000 mV	0.021 mV	
100 mV	50 kHz	99.8300 mV	99.9972 mV	100.1700 mV	0.035 mV	
Input (Front)	*Freq.*					
1 V Range						
1 V	20 Hz	0.999100 V	0.999761 V	1.000900 V	0.00012 V	
1 V	1 kHz	0.999100 V	1.000004 V	1.000900 V	0.000063 V	
1 V	20 kHz	0.999100 V	1.000067 V	1.000900 V	0.000065 V	
1 V	50 kHz	0.998300 V	1.000250 V	1.001700 V	0.00016 V	
1 V	100 kHz	0.993200 V	1.000367 V	1.006800 V	0.00030 V	
1 V	300 kHz	0.955000 V	1.000059 V	1.045000 V	0.00063 V	
Input (Front)	*Freq.*					
10 V Range						
100 mV	1 kHz	86.94 mV	100.32 mV	113.06 mV	0.20 mV	
1 V	1 kHz	0.99640 V	0.99976 V	1.00360 V	0.00019 V	
10 V	10 Hz	9.99100 V	10.00021 V	10.00900 V	0.0029 V	
10 V	1 kHz	9.99100 V	10.00004 V	10.00900 V	0.00059 V	
10 V	50 kHz	9.98300 V	10.00476 V	10.01700 V	0.0016 V	
Input (Front)	*Freq.*					
100 V Range						
100 V	1 kHz	99.9100 V	99.9845 V	100.0900 V	0.0079 V	

AC VOLTS (cont.)

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
100 V 50 kHz	99.8300 V	100.0072 V	100.1700 V	0.015 V	
Input Freq. (Front)					
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750 V Range					
700 V 1 kHz	699.355 V	700.036 V	700.645 V	0.073 V	
700 V 50 kHz	698.785 V	700.345 V	701.215 V	0.45 V	
700 V 45 Hz	699.355 V	699.875 V	700.645 V	0.12 V	

FREQUENCY

Passed

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input Freq. (Front)					
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100 mV Range					
10 mV 100 Hz	99.9000 Hz	99.9972 Hz	100.1000 Hz	0.0048 Hz	
1 V Range					
1 V 100 kHz	99.9900 kHz	100.0000 kHz	100.0100 kHz	0.00065 kHz	

4-WIRE OHMS

Passed

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
4-Wire Ohms Range Input(Front)					
100 Ω 100 Ω	99.9860 Ω	100.0028 Ω	100.0140 Ω	0.0028 Ω	
1 kΩ 1 kΩ	0.999890 kΩ	1.000008 kΩ	1.000110 kΩ	0.000012 kΩ	
10 kΩ 10 kΩ	9.99890 kΩ	10.00008 kΩ	10.00110 kΩ	0.00011 kΩ	
100 kΩ 100 kΩ	99.9890 kΩ	100.0010 kΩ	100.0110 kΩ	0.0014 kΩ	
1 MΩ 1 MΩ	0.999890 MΩ	1.000002 MΩ	1.000110 MΩ	0.000022 MΩ	
10 MΩ 10 MΩ	9.99590 MΩ	9.99940 MΩ	10.00410 MΩ	0.00043 MΩ	
100 MΩ 100 MΩ	99.1900 MΩ	99.8389 MΩ	100.8100 MΩ	0.14 MΩ	

2-WIRE OHMS MATH NULL ON

Passed

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
2-Wire Ohms Math Null ON Range Input(Front)					
100 Ω 100 Ω	99.9860 Ω	100.0027 Ω	100.0140 Ω	0.0028 Ω	
1 kΩ 1 kΩ	0.999890 kΩ	1.000008 kΩ	1.000110 kΩ	0.0000095 kΩ	
10 kΩ 10 kΩ	9.99890 kΩ	10.00004 kΩ	10.00110 kΩ	0.00018 kΩ	
100 kΩ 100 kΩ	99.9890 kΩ	100.0013 kΩ	100.0110 kΩ	0.0012 kΩ	
1 MΩ 1 MΩ	0.999890 MΩ	1.000004 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ 10 MΩ	9.99590 MΩ	9.99950 MΩ	10.00410 MΩ	0.00044 MΩ	

2-WIRE OHMS MATH NULL ON (cont.)

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
100 MΩ 100 MΩ	99.1900 MΩ	99.7834 MΩ	100.8100 MΩ	0.13 MΩ	

2-WIRE OHMS MATH NULL OFF **Passed**

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
2-Wire Ohms Math Null OFF					
Range Input(Front)					
100 Ω 100 Ω	99.7860 Ω	100.0515 Ω	100.2140 Ω	0.021 Ω	
1 kΩ 1 kΩ	0.999690 kΩ	1.000057 kΩ	1.000310 kΩ	0.000028 kΩ	
10 kΩ 10 kΩ	9.99870 kΩ	10.00010 kΩ	10.00130 kΩ	0.00016 kΩ	
100 kΩ 100 kΩ	99.9888 kΩ	100.0014 kΩ	100.0112 kΩ	0.0012 kΩ	
1 MΩ 1 MΩ	0.999890 MΩ	1.000003 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ 10 MΩ	9.99590 MΩ	9.99950 MΩ	10.00410 MΩ	0.00043 MΩ	
100 MΩ 100 MΩ	99.1900 MΩ	99.7864 MΩ	100.8100 MΩ	0.13 MΩ	

DC CURRENT **Passed**

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range Input(Front)					
10 mA 10 mA	9.99300 mA	9.99991 mA	10.00700 mA	0.00042 mA	
100 mA 100 mA	99.9450 mA	99.9990 mA	100.0550 mA	0.0054 mA	
1 A 1 A	0.998900 A	1.000064 A	1.001100 A	0.000097 A	
3 A 2 A	1.99700 A	2.00020 A	2.00300 A	0.00026 A	

AC CURRENT **Passed**

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front) Freq.					
-------- --------					
1 Amp Range					
10 mA 1 kHz	8.590 mA	10.073 mA	11.410 mA	0.032 mA	
1 A 1 kHz	0.998600 A	1.000140 A	1.001400 A	0.00033 A	
3 Amp Range					
2 A 1 kHz	1.99520 A	1.99993 A	2.00480 A	0.00065 A	