Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.3-2006

Certificate Number 1-11640972827-1

Model Number	34401A
Manufacturer	Keysight Technologies Inc
Description	Digital multimeter, 6.5 digit
Serial Number	3146A31122
Customer Asset No.	34401A31122
Date of Calibration	28 Aug 2019
Procedure	STE-50111013-D.03.03
Temperature	(23 ± 5) °C
Humidity	(50 ± 20) %RH

Customer
Keysight Technologies Korea Ltd
25-12 Yeouido-dong
Yeongdeungpo-gu
SEOUL 150-711
Korea, Republic of

Location of Calibration
Keysight Technologies Korea Ltd.
Singsong Center Bldg. #57,Yeouinaru-ro,
Youngdeungpo-gu
Seoul 07327
KOREA, REPUBLIC OF

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2005 and ANSI/NCSL Z540.3-2006. The quality management system is registered to ISO 9001:2015.
This calibration report is composed of a certificate of calibration, performance test results and/or certificate appendices. Each report section is numbered separately. This report is NOT an accredited report by Korea Laboratory Accreditation Scheme, a ILAC MRA signatory.

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 28 Aug 2021.

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.3-2006

Certificate Number 1-11640972827-1

Traceability Information

Technician ID Number N5256374

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	33250A13852	8 Aug 2021
5700A	AC DC Calibrator	5700A90019	17 Jul 2020
5725A	Amplifier	5725A95007	17 Jul 2020

Traceability Table

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W	33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13852	1-11570110119-1	
R	5730A	High Performance Multifunction Calibrator	5730A80501	1-11031492806-1-NVLAP:105016-0	AC Voltage DC Voltage
R	910R	GPS Controlled Frequency Std	910R87948	1-10208593779-1-KOLAS:KC01-028	Frequency
W,R	5700A	AC DC Calibrator	5700A90019	1-11425455936-1-KOLAS:KC01-028	AC Current AC Voltage DC Current DC Voltage Resistance
W,R	5725A	Amplifier	5725A95007	1-11425455989-1-KOLAS:KC01-028	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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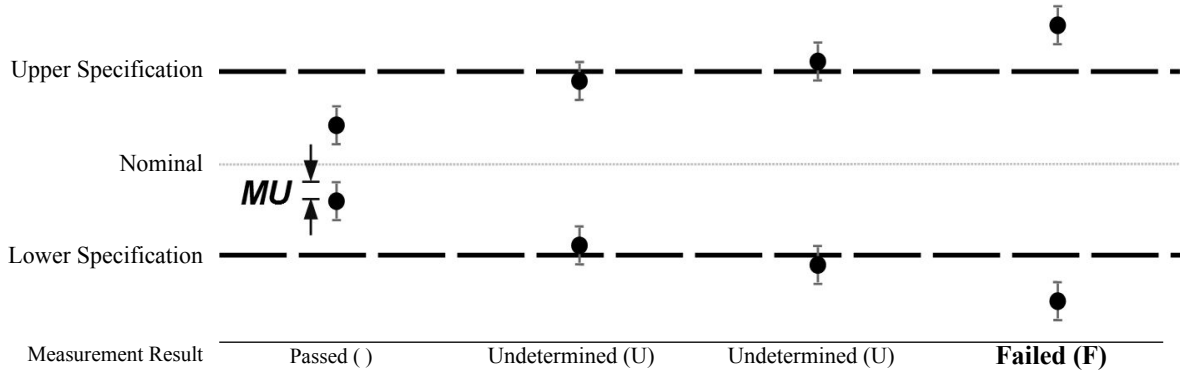
Compliance with Specification

The uncertainty of measurement has been taken into account when determining compliance with specification, as per ILAC-G8:03/2009. 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.
- Undetermined (U) - The expanded measurement uncertainty intervals about one or more measured values were in as well as out of specification. Consequently, neither compliance nor non-compliance with specification can 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.



( ) This result is indicated on the measurement report as a blank space in the column labeled “Status” or “Sts”.
MU = 95% expanded measurement uncertainty.

Acceptance Limit

The "Keysight Cal + Uncertainties + Guardbanding" service employs a guard band in the amount of the 95% expanded measurement uncertainty (MU). The resulting acceptance limit applied for Pass or Fail decisions, and for performing adjustments, is the difference of the specification and the guard band.

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	4-1-1
(As Rec)	4-1-1

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	0.5 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	1 mV	10 mV	0.74 mV	
Range	Input (Front)					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	1.6 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	0.13 Ω	
1 MΩ	0 Ω	−10 Ω	1 Ω	10 Ω	0.68 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 (Front)					
2-Wire Ohms Zero Offset						
100 Ω	0 Ω	−204.0 mΩ	32.0 mΩ	204.0 mΩ	3.0 mΩ	
1 kΩ	0 Ω	−210 mΩ	32 mΩ	210 mΩ	3.3 mΩ	
10 kΩ	0 Ω	−0.30 Ω	0.04 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	0.01 kΩ	0.10 kΩ	7.8 Ω	
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	0.04 uA	2.00 uA	0.16 uA	
100 mA	0 A	−5.0 uA	0.1 uA	5.0 uA	0.21 uA	
1 A	0 A	−100 uA	3 uA	100 uA	7.0 uA	
3 A	0 A	−600 uA	3 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	0.7 uV	3.5 uV	0.88 uV	
1 V	0 V	−7 uV	1 uV	7 uV	0.91 uV	
10 V	0 V	−0.05 mV	0.00 mV	0.05 mV	6.1 uV	
100 V	0 V	−0.6 mV	0.0 mV	0.6 mV	0.074 mV	
1000 V	0 V	−10 mV	0 mV	10 mV	0.61 mV	
Range	Input (Rear)					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	0.0 mΩ	4.0 mΩ	1.1 mΩ	
1 kΩ	0 Ω	−10 mΩ	0 mΩ	10 mΩ	0.82 mΩ	
10 kΩ	0 Ω	−0.10 Ω	0.00 Ω	0.10 Ω	8.3 mΩ	
100 kΩ	0 Ω	−1.0 Ω	0.0 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	0.00 kΩ	0.10 kΩ	6.3 Ω	
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	−4.9 mΩ	204.0 mΩ	6.1 mΩ	
1 kΩ	0 Ω	−210 mΩ	−5 mΩ	210 mΩ	5.8 mΩ	
10 kΩ	0 Ω	−0.30 Ω	0.00 Ω	0.30 Ω	7.2 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	0.60 Ω	
10 MΩ	0 Ω	−0.10 kΩ	0.01 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	0.05 uA	2.00 uA	5.8 nA	
100 mA	0 A	−5.0 uA	0.1 uA	5.0 uA	0.21 uA	
1 A	0 A	−100 uA	1 uA	100 uA	4.7 uA	
3 A	0 A	−600 uA	1 uA	600 uA	8.7 uA	

DC VOLTS

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	Input(Front)					
100 mV	100 mV	99.9915 mV	99.9973 mV	100.0085 mV	0.0028 mV	
1 V	1 V	0.999953 V	0.999997 V	1.000047 V	0.0000087 V	
10 V	10 V	9.99960 V	9.99997 V	10.00040 V	0.000076 V	
10 V	-10 V	−10.00040 V	−9.99996 V	−9.99960 V	0.000076 V	
100 V	100 V	99.9949 V	99.9997 V	100.0051 V	0.00092 V	
1000 V	1000 V	999.945 V	999.995 V	1000.055 V	0.0099 V	

AC VOLTS

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	Freq.					
100 mV Range						
10 mV	1 kHz	9.9540 mV	10.0043 mV	10.0460 mV	0.0067 mV	
100 mV	1 kHz	99.9000 mV	100.0052 mV	100.1000 mV	0.022 mV	
100 mV	50 kHz	99.8300 mV	99.9929 mV	100.1700 mV	0.046 mV	
Input (Front)	Freq.					
1 V Range						
1 V	20 Hz	0.999100 V	0.999926 V	1.000900 V	0.00020 V	
1 V	1 kHz	0.999100 V	1.000146 V	1.000900 V	0.000088 V	
1 V	20 kHz	0.999100 V	1.000068 V	1.000900 V	0.000089 V	
1 V	50 kHz	0.998300 V	0.999534 V	1.001700 V	0.00016 V	
1 V	100 kHz	0.993200 V	0.998695 V	1.006800 V	0.00035 V	
1 V	300 kHz	0.955000 V	1.001644 V	1.045000 V	0.00062 V	
Input (Front)	Freq.					
10 V Range						
100 mV	1 kHz	86.94 mV	100.67 mV	113.06 mV	0.11 mV	
1 V	1 kHz	0.99640 V	1.00002 V	1.00360 V	0.00012 V	
10 V	10 Hz	9.99100 V	10.00095 V	10.00900 V	0.0060 V	
10 V	1 kHz	9.99100 V	10.00038 V	10.00900 V	0.00089 V	
10 V	50 kHz	9.98300 V	9.99550 V	10.01700 V	0.0016 V	
Input (Front)	Freq.					
100 V Range						
100 V	1 kHz	99.9100 V	99.9713 V	100.0900 V	0.0097 V	
100 V	50 kHz	99.8300 V	100.0017 V	100.1700 V	0.028 V	

AC VOLTS (cont.)

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	Freq.					
750 V Range						
700 V	1 kHz	699.355 V	699.761 V	700.645 V	0.068 V	
700 V	50 kHz	698.785 V	699.654 V	701.215 V	0.45 V	
700 V	45 Hz	699.355 V	699.628 V	700.645 V	0.083 V	

FREQUENCY

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	Freq.					
100 mV Range						
10 mV	100 Hz	99.9000 Hz	99.9994 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	100.0010 Ω	100.0140 Ω	0.0031 Ω	
1 kΩ	1 kΩ	0.999890 kΩ	1.000003 kΩ	1.000110 kΩ	0.000014 kΩ	
10 kΩ	10 kΩ	9.99890 kΩ	10.00003 kΩ	10.00110 kΩ	0.00013 kΩ	
100 kΩ	100 kΩ	99.9890 kΩ	100.0003 kΩ	100.0110 kΩ	0.0015 kΩ	
1 MΩ	1 MΩ	0.999890 MΩ	0.999998 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ	10 MΩ	9.99590 MΩ	9.99989 MΩ	10.00410 MΩ	0.00044 MΩ	
100 MΩ	100 MΩ	99.1900 MΩ	100.0159 MΩ	100.8100 MΩ	0.074 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	99.9911 Ω	100.0140 Ω	0.0029 Ω	
1 kΩ	1 kΩ	0.999890 kΩ	0.999988 kΩ	1.000110 kΩ	0.000014 kΩ	
10 kΩ	10 kΩ	9.99890 kΩ	9.99991 kΩ	10.00110 kΩ	0.00013 kΩ	
100 kΩ	100 kΩ	99.9890 kΩ	99.9999 kΩ	100.0110 kΩ	0.0015 kΩ	
1 MΩ	1 MΩ	0.999890 MΩ	0.999997 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ	10 MΩ	9.99590 MΩ	9.99992 MΩ	10.00410 MΩ	0.00042 MΩ	

2-WIRE OHMS MATH NULL ON (cont.)

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
100 MΩ 100 MΩ	99.1900 MΩ	99.9873 MΩ	100.8100 MΩ	0.016 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	100.0427 Ω	100.2140 Ω	0.014 Ω	
1 kΩ 1 kΩ	0.999690 kΩ	1.000046 kΩ	1.000310 kΩ	0.000029 kΩ	
10 kΩ 10 kΩ	9.99870 kΩ	10.00002 kΩ	10.00130 kΩ	0.00019 kΩ	
100 kΩ 100 kΩ	99.9888 kΩ	100.0004 kΩ	100.0112 kΩ	0.0015 kΩ	
1 MΩ 1 MΩ	0.999890 MΩ	1.000000 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ 10 MΩ	9.99590 MΩ	9.99994 MΩ	10.00410 MΩ	0.00042 MΩ	
100 MΩ 100 MΩ	99.1900 MΩ	99.9638 MΩ	100.8100 MΩ	0.014 MΩ	

DC CURRENT

Passed

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range Input(Front)					
10 mA 10 mA	9.99300 mA	9.99896 mA	10.00700 mA	0.00060 mA	
100 mA 100 mA	99.9450 mA	99.9873 mA	100.0550 mA	0.0070 mA	
1 A 1 A	0.998900 A	1.000423 A	1.001100 A	0.00011 A	
3 A 2 A	1.99700 A	2.00084 A	2.00300 A	0.00028 A	

AC CURRENT

Passed

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front) Freq.					
1 Amp Range					
10 mA 1 kHz	8.590 mA	9.971 mA	11.410 mA	0.012 mA	
1 A 1 kHz	0.998600 A	1.000515 A	1.001400 A	0.00071 A	
3 Amp Range					
2 A 1 kHz	1.99520 A	2.00000 A	2.00480 A	0.0014 A	