Certificate of Calibration

ISO/IEC 17025:2017

Certificate Number WO-00433491

Model Number	34401A
Manufacturer	Keysight Technologies
Description	Digital multimeter, 6.5 digit
Serial Number	MY41020616
Customer Asset No.	EMSG01
Date of Calibration	8 Apr 2023
Procedure	STE-50111013-D.04.05-T122B0T4
Temperature	(23 ± 5) °C
Humidity	(50 ± 20) %RH

Customer
Keysight Technologies Singapore (Sales) Pte. Ltd.
1 Yishun Ave 7
Company 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 accredited to ISO/IEC 17025:2017. 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.
This calibration report is available at Keysight Support Portal http://support.keysight.com/.

Based on the customer's request, the next calibration is due on 8 Apr 2024.

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

A.MANOHAR-Service Centre Manager

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	33250A13820	21 Apr 2023
5725A	Amplifier for 5700A or 5720A	5725A85019	15 Dec 2024
5730A	High Performance Multifunction Calibrator	5730A98501	22 Feb 2024

Traceability Table

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W,R	33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13820	1-17207370153-1-SINGLAS:LA-2014-0575-C	AC Voltage DC Voltage Frequency
W,R	5725A	Amplifier for 5700A or 5720A	5725A85019	WO-00293200-ANAB:AC-1498	AC Current AC Voltage DC Current
W,R	5730A	High Performance Multifunction Calibrator	5730A98501	WO-00353735-ANAB:AC-1498	AC Current AC Voltage DC Current DC Voltage Resistance

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.

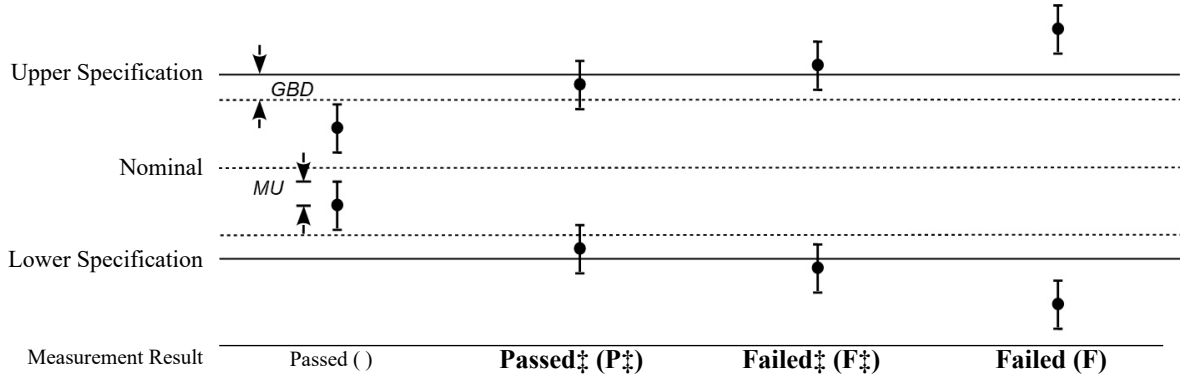
Compliance with Specification

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.

Acceptance Limit

The "Keysight Cal + Uncertainties + Guardbanding" service employs a guard band (GBD) 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.

Calibration Test Results Summary

Calibration test results of warranted specifications

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	11-5-3
(As Rec)	11-5-3

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 µV	0.0 µV	3.5 µV	1.1 µV	
1 V	0 V	−7.0 µV	0.1 µV	7.0 µV	1.2 µV	
10 V	0 V	−0.0500 mV	0.0010 mV	0.0500 mV	0.0066 mV	
100 V	0 V	−0.60 mV	0.00 mV	0.60 mV	0.17 mV	
1000 V	0 V	−10.00 mV	0.31 mV	10.00 mV	0.74 mV	
Range	*Input (Front)*					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	−0.8 mΩ	4.0 mΩ	1.2 mΩ	
1 kΩ	0 Ω	−10.0 mΩ	−0.6 mΩ	10.0 mΩ	1.2 mΩ	
10 kΩ	0 Ω	−0.100 Ω	−0.009 Ω	0.100 Ω	0.014 Ω	
100 kΩ	0 Ω	−1.00 Ω	−0.06 Ω	1.00 Ω	0.16 Ω	
1 MΩ	0 Ω	−10.00 Ω	−0.21 Ω	10.00 Ω	0.98 Ω	
10 MΩ	0 Ω	−0.100 kΩ	0.001 kΩ	0.100 kΩ	0.011 kΩ	
100 MΩ	0 Ω	−10.000 kΩ	0.000 kΩ	10.000 kΩ	0.058 kΩ	
Range	*Input (Front)*					
2-Wire Ohms Zero Offset						
100 Ω	0 Ω	−204.0 mΩ	−106.9 mΩ	204.0 mΩ	6.1 mΩ	
1 kΩ	0 Ω	−210.0 mΩ	−105.6 mΩ	210.0 mΩ	5.8 mΩ	
10 kΩ	0 Ω	−0.3000 Ω	−0.1007 Ω	0.3000 Ω	0.0084 Ω	
100 kΩ	0 Ω	−1.200 Ω	−0.111 Ω	1.200 Ω	0.068 Ω	
1 MΩ	0 Ω	−10.0 Ω	0.0 Ω	10.0 Ω	1.3 Ω	
10 MΩ	0 Ω	−0.1000 kΩ	0.0014 kΩ	0.1000 kΩ	0.0097 kΩ	
100 MΩ	0 Ω	−10.000 kΩ	0.000 kΩ	10.000 kΩ	0.058 kΩ	
Range	*Input (Front)*					
DC Current Zero Offset						
10 mA	0 A	−2.00 µA	0.01 µA	2.00 µA	0.16 µA	
100 mA	0 A	−5.00 µA	0.05 µA	5.00 µA	0.21 µA	
1 A	0 A	−100.0 µA	2.8 µA	100.0 µA	7.0 µA	
3 A	0 A	−600 µA	2 µA	600 µA	11 µA	

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 µV	0.1 µV	3.5 µV	1.1 µV	
1 V	0 V	−7.0 µV	0.0 µV	7.0 µV	1.2 µV	
10 V	0 V	−0.0500 mV	0.0000 mV	0.0500 mV	0.0066 mV	
100 V	0 V	−0.60 mV	−0.02 mV	0.60 mV	0.17 mV	
1000 V	0 V	−10.00 mV	0.07 mV	10.00 mV	0.74 mV	
Range	*Input (Rear)*					
4-Wire Ohms Zero Offset						
100 Ω	0 Ω	−4.0 mΩ	0.7 mΩ	4.0 mΩ	1.2 mΩ	
1 kΩ	0 Ω	−10.0 mΩ	0.6 mΩ	10.0 mΩ	1.2 mΩ	
10 kΩ	0 Ω	−0.100 Ω	0.007 Ω	0.100 Ω	0.014 Ω	
100 kΩ	0 Ω	−1.00 Ω	0.07 Ω	1.00 Ω	0.16 Ω	
1 MΩ	0 Ω	−10.00 Ω	0.00 Ω	10.00 Ω	0.98 Ω	
10 MΩ	0 Ω	−0.100 kΩ	−0.001 kΩ	0.100 kΩ	0.011 kΩ	
100 MΩ	0 Ω	−10.000 kΩ	0.033 kΩ	10.000 kΩ	0.058 kΩ	
Range	*Input (Rear)*					
2-Wire Ohms Zero Offset						
100 Ω	0 Ω	−204.0 mΩ	4.4 mΩ	204.0 mΩ	6.1 mΩ	
1 kΩ	0 Ω	−210.0 mΩ	4.4 mΩ	210.0 mΩ	5.8 mΩ	
10 kΩ	0 Ω	−0.3000 Ω	0.0028 Ω	0.3000 Ω	0.0084 Ω	
100 kΩ	0 Ω	−1.200 Ω	0.003 Ω	1.200 Ω	0.068 Ω	
1 MΩ	0 Ω	−10.0 Ω	0.2 Ω	10.0 Ω	1.3 Ω	
10 MΩ	0 Ω	−0.1000 kΩ	0.0000 kΩ	0.1000 kΩ	0.0097 kΩ	
100 MΩ	0 Ω	−10.000 kΩ	0.000 kΩ	10.000 kΩ	0.058 kΩ	
Range	*Input (Rear)*					
DC Current Zero Offset						
10 mA	0 A	−2.00 µA	−0.04 µA	2.00 µA	0.16 µA	
100 mA	0 A	−5.00 µA	0.01 µA	5.00 µA	0.21 µA	
1 A	0 A	−100.0 µA	−1.0 µA	100.0 µA	7.0 µA	
3 A	0 A	−600 µA	0 µA	600 µA	11 µA	

Measurement Report

Certificate Number WO-00433491

Model 34401A **Serial** MY41020616 **Firmware Rev** 11-5-3 **Test Date** 8 Apr 2023
Options Tested **Condition** As Received

DC VOLTS

Passed

The test limits correspond to the published 1 year specifications.

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	*Input(Front)*					
100 mV	100 mV	99.9915 mV	99.9980 mV	100.0085 mV	0.0029 mV	
1 V	1 V	0.9999530 V	0.9999936 V	1.0000470 V	0.0000070 V	
10 V	10 V	9.999600 V	9.999998 V	10.000400 V	0.000043 V	
10 V	-10 V	−10.000400 V	−10.000001 V	−9.999600 V	0.000041 V	
100 V	100 V	99.99490 V	99.99769 V	100.00510 V	0.00058 V	
1000 V	1000 V	999.9450 V	999.9828 V	1000.0550 V	0.0084 V	

AC VOLTS

Passed

The test limits correspond to the published 1 year specifications.

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	*Freq.*					
100 mV Range						
10 mV	1 kHz	9.9540 mV	9.9980 mV	10.0460 mV	0.0056 mV	
100 mV	1 kHz	99.900 mV	99.985 mV	100.100 mV	0.021 mV	
100 mV	50 kHz	99.830 mV	99.945 mV	100.170 mV	0.035 mV	
Input (Front)	*Freq.*					
1 V Range						
1 V	20 Hz	0.99910 V	0.99947 V	1.00090 V	0.00012 V	
1 V	1 kHz	0.999100 V	0.999878 V	1.000900 V	0.000063 V	
1 V	20 kHz	0.999100 V	0.999863 V	1.000900 V	0.000065 V	
1 V	50 kHz	0.99830 V	0.99952 V	1.00170 V	0.00016 V	
1 V	100 kHz	0.99320 V	0.99832 V	1.00680 V	0.00030 V	
1 V	300 kHz	0.95500 V	0.99288 V	1.04500 V	0.00063 V	
Input (Front)	*Freq.*					
10 V Range						
100 mV	1 kHz	86.94 mV	100.60 mV	113.06 mV	0.20 mV	
1 V	1 kHz	0.99640 V	0.99981 V	1.00360 V	0.00019 V	
10 V	10 Hz	9.9910 V	9.9941 V	10.0090 V	0.0029 V	
10 V	1 kHz	9.99100 V	9.99862 V	10.00900 V	0.00059 V	
10 V	50 kHz	9.9830 V	9.9971 V	10.0170 V	0.0016 V	

AC VOLTS (cont.)

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	*Freq.*					
100 V Range						
100 V	1 kHz	99.9100 V	99.9857 V	100.0900 V	0.0079 V	
100 V	50 kHz	99.830 V	99.976 V	100.170 V	0.015 V	
Input (Front)	*Freq.*					
750 V Range						
700 V	1 kHz	699.355 V	699.884 V	700.645 V	0.073 V	
700 V	50 kHz	698.79 V	700.37 V	701.21 V	0.45 V	
700 V	45 Hz	699.36 V	699.78 V	700.64 V	0.12 V	

FREQUENCY

Passed

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Input (Front)	*Freq.*					
100 mV Range						
10 mV	100 Hz	99.9000 Hz	99.9993 Hz	100.1000 Hz	0.0049 Hz	
1 V Range						
1 V	100 kHz	99.99000 kHz	100.00013 kHz	100.01000 kHz	0.00073 kHz	

4-WIRE OHMS

Passed

The test limits correspond to the published 1 year specifications.

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	0.0028 Ω	
1 kΩ	1 kΩ	0.999890 kΩ	1.000007 kΩ	1.000110 kΩ	0.000012 kΩ	
10 kΩ	10 kΩ	9.99890 kΩ	10.00000 kΩ	10.00110 kΩ	0.00011 kΩ	
100 kΩ	100 kΩ	99.9890 kΩ	100.0016 kΩ	100.0110 kΩ	0.0014 kΩ	
1 MΩ	1 MΩ	0.999890 MΩ	1.000035 MΩ	1.000110 MΩ	0.000022 MΩ	
10 MΩ	10 MΩ	9.99590 MΩ	9.99973 MΩ	10.00410 MΩ	0.00043 MΩ	
100 MΩ	100 MΩ	99.19 MΩ	100.04 MΩ	100.81 MΩ	0.14 MΩ	

2-WIRE OHMS MATH NULL ON — Passed

The test limits correspond to the published 1 year specifications.

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
2-Wire Ohms Math Null ON						
Range	*Input(Front)*					
100 Ω	100 Ω	99.9860 Ω	100.0014 Ω	100.0140 Ω	0.0028 Ω	
1 kΩ	1 kΩ	0.9998900 kΩ	1.0000091 kΩ	1.0001100 kΩ	0.0000095 kΩ	
10 kΩ	10 kΩ	9.99890 kΩ	9.99997 kΩ	10.00110 kΩ	0.00018 kΩ	
100 kΩ	100 kΩ	99.9890 kΩ	100.0018 kΩ	100.0110 kΩ	0.0012 kΩ	
1 MΩ	1 MΩ	0.999890 MΩ	1.000038 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ	10 MΩ	9.99590 MΩ	9.99990 MΩ	10.00410 MΩ	0.00044 MΩ	
100 MΩ	100 MΩ	99.19 MΩ	99.95 MΩ	100.81 MΩ	0.13 MΩ	

2-WIRE OHMS MATH NULL OFF — Passed

The test limits correspond to the published 1 year specifications.

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
2-Wire Ohms Math Null OFF						
Range	*Input(Front)*					
100 Ω	100 Ω	99.786 Ω	99.934 Ω	100.214 Ω	0.021 Ω	
1 kΩ	1 kΩ	0.999690 kΩ	0.999942 kΩ	1.000310 kΩ	0.000028 kΩ	
10 kΩ	10 kΩ	9.99870 kΩ	9.99990 kΩ	10.00130 kΩ	0.00016 kΩ	
100 kΩ	100 kΩ	99.9888 kΩ	100.0018 kΩ	100.0112 kΩ	0.0012 kΩ	
1 MΩ	1 MΩ	0.999890 MΩ	1.000039 MΩ	1.000110 MΩ	0.000021 MΩ	
10 MΩ	10 MΩ	9.99590 MΩ	9.99986 MΩ	10.00410 MΩ	0.00043 MΩ	
100 MΩ	100 MΩ	99.19 MΩ	99.95 MΩ	100.81 MΩ	0.13 MΩ	

DC CURRENT — Passed

The test limits correspond to the published 1 year specifications.

TEST CONDITIONS		MINIMUM	MEASURED	MAXIMUM	UNCERT.	Status
Range	*Input(Front)*					
10 mA	10 mA	9.99300 mA	9.99979 mA	10.00700 mA	0.00042 mA	
100 mA	100 mA	99.9450 mA	100.0016 mA	100.0550 mA	0.0054 mA	
1 A	1 A	0.998900 A	0.999941 A	1.001100 A	0.000097 A	
3 A	2 A	1.99700 A	1.99987 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	9.973 mA	11.410 mA	0.032 mA	
1 A	1 kHz	0.99860 A	0.99992 A	1.00140 A	0.00033 A	
3 Amp Range						
2 A	1 kHz	1.99520 A	1.99923 A	2.00480 A	0.00065 A	