

Model Number 34401A
Manufacturer Keysight Technologies Inc
Description Digital multimeter, 6.5 digit
Serial Number 3146A29540
Customer Asset No. 34401A29540

Date of Calibration 10 Dec 2015
Procedure STE-50111013-D.01.01
Temperature (23 ± 5) °C
Humidity (45 ± 25) %RH

Customer
Keysight Technologies (China) Co Ltd
No 3 North Wangjing Rd
SSU
BEIJING 100102,
China

Location of Calibration
Keysight Technologies (China) Co., Ltd.
Beijing Calibration Laboratory
No.3 Wang Jing Bei Lu
Chao Yang Dist.
Beijing 100102,
China

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and accredited to ISO/IEC 17025:2005 with Certificate Number: CNAS L0640. 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.

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 certificate may refer to instruments manufactured by HP, Agilent and Keysight as being manufactured by Keysight Technologies, Inc.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Based on the customer's request, the next calibration is due on 10 Dec 2016.

Keysight Technologies (China) Co., Ltd.
Beijing Calibration Laboratory
No.3 Wang Jing Bei Lu
Chao Yang Dist.
Beijing 100102,
China


Cai Hong - Authorized Signatory

Traceability Information

Technician ID Number 00818290

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.

This certificate shall not be reproduced, except in full, without prior written approval of the laboratory.

Calibration Equipment Used

| Model Number | Model Description | Equipment ID | Cal Due Date | Certificate Number |
|--------------|---|--------------|--------------|--------------------|
| 33250A | Function/Arbitrary Waveform Generator, 80 MHz | 33250A25319 | 24 Mar 2016 | 1-6643169757-1 |
| 5720A | Calibrator | 5720A7335202 | 28 Aug 2016 | 1-7174546237-1 |
| 5725A | Amplifier | 5725A6805002 | 28 Aug 2016 | 1-7174546157-1 |

Traceability Table

| | Model | Model Description | Equipment ID | Certificate Number | Trace Value |
|-----|--------|---|--------------|---------------------------|--|
| W | 33250A | Function/Arbitrary Waveform Generator, 80 MHz | 33250A25319 | 1-6643169757-1 | |
| R | 53132A | Universal Counter, 225 MHz, 12 digit/s, 150 ps. GPIB, RS232 | 53132A05514 | 1-5365239070-1-CNAS:L0640 | Frequency |
| R | 5720A | CALIBRATOR | 5720A7335202 | 1-6087453048-1-CNAS:L0628 | AC Voltage DC Voltage |
| W,R | 5720A | Calibrator | 5720A7335202 | 1-7174546237-1-CNAS:L0628 | AC Current AC Voltage DC Current DC Voltage Resistance |
| W,R | 5725A | Amplifier | 5725A6805002 | 1-7174546157-1-CNAS:L0628 | 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.

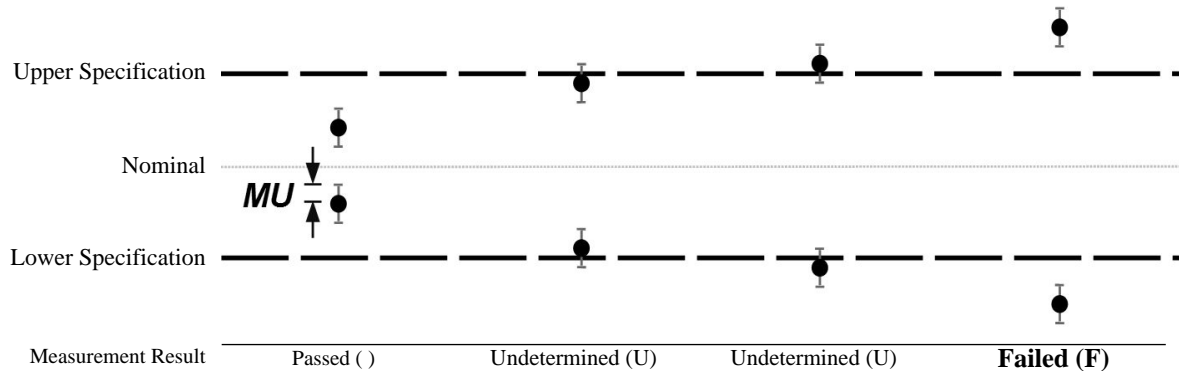
Compliance with Specification

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 measurement uncertainty, which corresponds to a coverage probability of approximately 95%, is the standard uncertainty multiplied by the coverage factor $k=2$. Where this is not the case, coverage factor (k), effective degrees of freedom (ν_{eff}) and coverage probability (p) are stated.

Performance Test Results Summary

| <u>Test Name</u> | <u>As Received Status</u> |
|-------------------------------|---------------------------|
| ZERO OFFSET - FRONT TERMINALS | Passed |
| ZERO OFFSET - REAR TERMINALS | Passed |
| DC VOLTS | Passed |
| AC VOLTS | Passed |
| FREQUENCY | Passed |
| OHMS | Passed |
| DC CURRENT | Passed |
| AC CURRENT | Passed |

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 | 0.1 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 | | | | | |
| ----- | (Front) | | | | | |
| 4-Wire Ohms Zero Offset | | | | | | |
| 100 Ohm | 0 Ohm | -4.0 mOhm | 2.6 mOhm | 4.0 mOhm | 1.2 mOhm | |
| 1 kOhm | 0 Ohm | -10 mOhm | 3 mOhm | 10 mOhm | 1.2 mOhm | |
| 10 kOhm | 0 Ohm | -0.10 Ohm | 0.02 Ohm | 0.10 Ohm | 0.014 Ohm | |
| 100 kOhm | 0 Ohm | -1.0 Ohm | 0.2 Ohm | 1.0 Ohm | 0.13 Ohm | |
| 1 MOhm | 0 Ohm | -10 Ohm | 0 Ohm | 10 Ohm | 0.68 Ohm | |
| 10 MOhm | 0 Ohm | -0.10 kOhm | 0.00 kOhm | 0.10 kOhm | 0.011 kOhm | |
| 100 MOhm | 0 Ohm | -10.0 kOhm | 0.0 kOhm | 10.0 kOhm | 0.058 kOhm | |
| Range | Input | | | | | |
| ----- | (Front) | | | | | |
| 2-Wire Ohms Zero Offset | | | | | | |
| 100 Ohm | 0 Ohm | -204.0 mOhm | -39.9 mOhm | 204.0 mOhm | 3.0 mOhm | |
| 1 kOhm | 0 Ohm | -210 mOhm | -40 mOhm | 210 mOhm | 3.3 mOhm | |
| 10 kOhm | 0 Ohm | -0.30 Ohm | -0.04 Ohm | 0.30 Ohm | 8.4 mOhm | |
| 100 kOhm | 0 Ohm | -1.2 Ohm | -0.1 Ohm | 1.2 Ohm | 0.068 Ohm | |
| 1 MOhm | 0 Ohm | -10 Ohm | 0 Ohm | 10 Ohm | 1.3 Ohm | |
| 10 MOhm | 0 Ohm | -0.10 kOhm | 0.00 kOhm | 0.10 kOhm | 7.8 Ohm | |
| 100 MOhm | 0 Ohm | -10.0 kOhm | 0.0 kOhm | 10.0 kOhm | 0.058 kOhm | |
| 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 | 1 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. | Sts |
|-------------------------|--------|-------------|-----------|------------|-------------|-----|
| Range | Input | | | | | |
| ----- | (Rear) | | | | | |
| DC Volts Zero Offset | | | | | | |
| 100 mV | 0 V | -3.5 uV | 1.1 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 Ohm | 0 Ohm | -4.0 mOhm | 0.1 mOhm | 4.0 mOhm | 1.1 mOhm | |
| 1 kOhm | 0 Ohm | -10 mOhm | 0 mOhm | 10 mOhm | 0.82 mOhm | |
| 10 kOhm | 0 Ohm | -0.10 Ohm | 0.00 Ohm | 0.10 Ohm | 8.3 mOhm | |
| 100 kOhm | 0 Ohm | -1.0 Ohm | 0.0 Ohm | 1.0 Ohm | 0.16 Ohm | |
| 1 MOhm | 0 Ohm | -10 Ohm | 0 Ohm | 10 Ohm | 0.98 Ohm | |
| 10 MOhm | 0 Ohm | -0.10 kOhm | 0.00 kOhm | 0.10 kOhm | 6.3 Ohm | |
| 100 MOhm | 0 Ohm | -10.0 kOhm | 0.4 kOhm | 10.0 kOhm | 0.058 kOhm | |
| Range | Input | | | | | |
| ----- | (Rear) | | | | | |
| 2-Wire Ohms Zero Offset | | | | | | |
| 100 Ohm | 0 Ohm | -204.0 mOhm | 5.8 mOhm | 204.0 mOhm | 6.1 mOhm | |
| 1 kOhm | 0 Ohm | -210 mOhm | 6 mOhm | 210 mOhm | 5.8 mOhm | |
| 10 kOhm | 0 Ohm | -0.30 Ohm | 0.02 Ohm | 0.30 Ohm | 7.2 mOhm | |
| 100 kOhm | 0 Ohm | -1.2 Ohm | 0.1 Ohm | 1.2 Ohm | 0.068 Ohm | |
| 1 MOhm | 0 Ohm | -10 Ohm | 0 Ohm | 10 Ohm | 0.60 Ohm | |
| 10 MOhm | 0 Ohm | -0.10 kOhm | 0.00 kOhm | 0.10 kOhm | 0.0097 kOhm | |
| 100 MOhm | 0 Ohm | -10.0 kOhm | 0.3 kOhm | 10.0 kOhm | 0.058 kOhm | |
| Range | Input | | | | | |
| ----- | (Rear) | | | | | |
| DC Current Zero Offset | | | | | | |
| 10 mA | 0 A | -2.00 uA | 0.03 uA | 2.00 uA | 5.8 nA | |
| 100 mA | 0 A | -5.0 uA | 0.0 uA | 5.0 uA | 0.21 uA | |
| 1 A | 0 A | -100 uA | 3 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 | 99.9947 mV | 100.0085 mV | 0.0029 mV | |
| 1 V | 1 V | 0.999953 V | 0.999996 V | 1.000047 V | 0.000070 V | |

DC VOLTS (cont.)

| TEST CONDITIONS | | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Status |
|-----------------|--------|-------------|-------------|------------|------------|--------|
| 10 V | 10 V | 9.99960 V | 10.00000 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 | 1000.001 V | 1000.055 V | 0.0084 V | |

AC VOLTS

Passed

| TEST CONDITIONS | | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Status |
|-----------------|---------|------------|-------------|-------------|------------|--------|
| Input | Freq. | | | | | |
| (Front) | | | | | | |
| ----- | | | | | | |
| 100 mV Range | | | | | | |
| 10 mV | 1 kHz | 9.9540 mV | 10.0009 mV | 10.0460 mV | 0.0056 mV | |
| 100 mV | 1 kHz | 99.9000 mV | 99.9977 mV | 100.1000 mV | 0.021 mV | |
| 100 mV | 50 kHz | 99.8300 mV | 100.0045 mV | 100.1700 mV | 0.035 mV | |
| | | | | | | |
| Input | Freq. | | | | | |
| (Front) | | | | | | |
| ----- | | | | | | |
| 1 V Range | | | | | | |
| 1 V | 20 Hz | 0.999100 V | 0.999789 V | 1.000900 V | 0.00012 V | |
| 1 V | 1 kHz | 0.999100 V | 0.999969 V | 1.000900 V | 0.000063 V | |
| 1 V | 20 kHz | 0.999100 V | 0.999950 V | 1.000900 V | 0.000065 V | |
| 1 V | 50 kHz | 0.998300 V | 0.999642 V | 1.001700 V | 0.00016 V | |
| 1 V | 100 kHz | 0.993200 V | 0.999094 V | 1.006800 V | 0.00030 V | |
| 1 V | 300 kHz | 0.955000 V | 1.001391 V | 1.045000 V | 0.00063 V | |
| | | | | | | |
| Input | Freq. | | | | | |
| (Front) | | | | | | |
| ----- | | | | | | |
| 10 V Range | | | | | | |
| 100 mV | 1 kHz | 86.94 mV | 100.90 mV | 113.06 mV | 0.20 mV | |
| 1 V | 1 kHz | 0.99640 V | 0.99995 V | 1.00360 V | 0.00019 V | |
| 10 V | 10 Hz | 9.99100 V | 9.99978 V | 10.00900 V | 0.0029 V | |
| 10 V | 1 kHz | 9.99100 V | 9.99986 V | 10.00900 V | 0.00059 V | |
| 10 V | 50 kHz | 9.98300 V | 9.99777 V | 10.01700 V | 0.0016 V | |
| | | | | | | |
| Input | Freq. | | | | | |
| (Front) | | | | | | |
| ----- | | | | | | |
| 100 V Range | | | | | | |
| 100 V | 1 kHz | 99.9100 V | 99.9942 V | 100.0900 V | 0.0079 V | |
| 100 V | 50 kHz | 99.8300 V | 100.0128 V | 100.1700 V | 0.015 V | |
| | | | | | | |
| Input | Freq. | | | | | |
| (Front) | | | | | | |
| ----- | | | | | | |
| 750 V Range | | | | | | |
| 700 V | 1 kHz | 699.355 V | 699.945 V | 700.645 V | 0.073 V | |
| 700 V | 50 kHz | 698.785 V | 699.553 V | 701.215 V | 0.45 V | |
| 700 V | 45 Hz | 699.355 V | 699.883 V | 700.645 V | 0.12 V | |

FREQUENCY

Passed

| TEST CONDITIONS | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Status |
|------------------------|-------------|--------------|--------------|-------------|--------|
| Input Freq. (Front) | | | | | |
| ----- | | | | | |
| 100 mV Range | | | | | |
| 10 mV 100 Hz | 99.9000 Hz | 100.0004 Hz | 100.1000 Hz | 0.0048 Hz | |
| 1 V Range | | | | | |
| 1 V 100 kHz | 99.9900 kHz | 100.0003 kHz | 100.0100 kHz | 0.00065 kHz | |

OHMS

Passed

| TEST CONDITIONS | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Sts |
|--------------------|---------------|---------------|---------------|---------------|-----|
| 4-Wire Ohms | | | | | |
| Range Input(Front) | | | | | |
| 100 Ohm 100 Ohm | 99.9860 Ohm | 100.0068 Ohm | 100.0140 Ohm | 0.0028 Ohm | |
| 1 kOhm 1 kOhm | 0.999890 kOhm | 0.999968 kOhm | 1.000110 kOhm | 0.000012 kOhm | |
| 10 kOhm 10 kOhm | 9.99890 kOhm | 9.99971 kOhm | 10.00110 kOhm | 0.00011 kOhm | |
| 100 kOhm 100 kOhm | 99.9890 kOhm | 99.9970 kOhm | 100.0110 kOhm | 0.0014 kOhm | |
| 1 MOhm 1 MOhm | 0.999890 MOhm | 0.999958 MOhm | 1.000110 MOhm | 0.000022 MOhm | |
| 10 MOhm 10 MOhm | 9.99590 MOhm | 9.99948 MOhm | 10.00410 MOhm | 0.00043 MOhm | |
| 100 MOhm 100 MOhm | 99.1900 MOhm | 99.9844 MOhm | 100.8100 MOhm | 0.14 MOhm | |

DC CURRENT

Passed

| TEST CONDITIONS | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Status |
|--------------------|------------|-------------|-------------|------------|--------|
| Range Input(Front) | | | | | |
| 10 mA 10 mA | 9.99300 mA | 10.00009 mA | 10.00700 mA | 0.00042 mA | |
| 100 mA 100 mA | 99.9450 mA | 99.9982 mA | 100.0550 mA | 0.0054 mA | |
| 1 A 1 A | 0.998900 A | 1.000001 A | 1.001100 A | 0.000097 A | |
| 3 A 2 A | 1.99700 A | 2.00002 A | 2.00300 A | 0.00026 A | |

AC CURRENT

Passed

| TEST CONDITIONS | MINIMUM | MEASURED | MAXIMUM | UNCERT. | Status |
|------------------------|------------|------------|------------|-----------|--------|
| Input Freq. (Front) | | | | | |
| ----- | | | | | |
| 1 Amp Range | | | | | |
| 10 mA 1 kHz | 8.590 mA | 9.967 mA | 11.410 mA | 0.032 mA | |
| 1 A 1 kHz | 0.998600 A | 1.000185 A | 1.001400 A | 0.00033 A | |

Model 34401A Serial 3146A29540 Firmware Rev
Options TestedTest Date 10 Dec 2015
Condition As Received

AC CURRENT (cont.)

| <u>TEST CONDITIONS</u> | <u>MINIMUM</u> | <u>MEASURED</u> | <u>MAXIMUM</u> | <u>UNCERT.</u> | <u>Status</u> |
|-----------------------------|----------------|-----------------|----------------|----------------|---------------|
| 3 Amp Range 2 A 1 kHz | 1.99520 A | 1.99967 A | 2.00480 A | 0.00065 A | |