CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Keysight Technologies, Inc. Service Center
900 South Taft Avenue
Loveland, CO 80537

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994
& ANSI/NCSL Z540.3-2006

while demonstrating technical competence in the field(s) of

CALIBRATION

Refer to the accompanying Scope(s) of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1813

Certificate Number

ANAB Approval

Certificate Valid: 08/01/2014 - 10/07/2015
Version No. 001 Issued: 01/16/2015

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated January 2009*).

ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, & ANSI/NCSL Z540.3-2006

Keysight Technologies, Inc. Service Center

www.keysight.com
900 South Taft Avenue Loveland, CO 80537
Point of Contact: Ron Eastwood Email: ron_eastwood@keysight.com Phone: 916-788-5506

CALIBRATION

Valid to: October 7, 2015 Certificate Number: AC - 1813

I. Electromagnetic - DC/Low Frequency

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
DC Voltage - Source	150 µV to 10 V 0.1 V 1 V 10 V 100 V 1 kV	0.01 µV/V + 100 nV 0.67 µV/V 0.23 µV/V 0.14 µV/V 0.53 µV/V 1.3 µV/V	Josephson Junction Fluke 732 Fixed Oil Resistors	Agilent/OEM Procedures
DC Voltage - Measure	100 mV 1 V 10 V 100 V 1 kV	0.67 µV/V 0.23 µV/V 0.14 µV/V 0.53 µV/V 1.3 µV/V	Fixed Oil Resistors Josephson Junction	
DC Current - Source	100 nA 1 µA 10 µA 100 µA 1 mA 10 mA 100 mA 1 A	12 µA/A 5.2 µA/A 5.1 µA/A 1 µA/A 1.0 µA/A 1.0 µA/A 1.0 µA/A 1.7 µA/A	Fixed Resistors in Oil HP 3458A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Source	**10 mV** 1 kHz 20 kHz 100 kHz 300 kHz 1 MHz 4 MHz **100 mV** 1 kHz 20 kHz 100 kHz 300 kHz 1 MHz 4 MHz 8 MHz 10 MHz **1 V** 1 kHz 20 kHz 50 khz 100 kHz 300 kHz 500 kHz 1 MHz 4 MHz 8 MHz 10 MHz **3 V** 100 kHz 2 MHz 4 MHz 8 MHz 10 MHz	 31 µV/V 95 µV/V 0.16 mV/V 0.29 mV/V 0.90 mV/V 2.4 mV/V 26 µV/V 31 µV/V 68 µV/V 0.12 mV/V 0.51 mV/V 2.3 mV/V 3.6 mV/V 4.3 mV/V 15 µV/V 17 µV/V 20 µV/V 21 µV/V 38 µV/V 73 µV/V 0.25 mV/V 2.3 mV/V 3.6 mV/V 4.4 mV/V 23 µV/V 2.3 mV/V 2.3 mV/V 3.6 mV/V 4.3 mV/V	Datron 4700 HP 33250A Fluke 5790A	Agilent/OEM Procedures

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Source (cont.)	**10 V** 10 Hz 20 Hz 40 Hz 1 kHz 4 kHz 8 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz **100 V** 1 kHz 20 kHz 50 kHz 100 kHz **700 V** 1 kHz 20 kHz **1 kV** 1 kHz 10 kHz 20 kHz	 34 µV/V 26 µV/V 23 µV/V 15 µV/V 15 µV/V 15 µV/V 15 µV/V 15 µV/V 23 µV/V 23 µV/V 49 µV/V 86 µV/V 0.29 mV/V 18 µV/V 19 µV/V 24 µV/V 33 µV/V 21 µV/V 26 µV/V 41 µV/V 58 µV/V 62 µV/V	Datron 4700 HP 33250A Fluke 5790A	Agilent/OEM Procedures
AC Voltage - Measure	**1 mV** (10 to 20) Hz 20 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **3 mV** (10 to 20) Hz 20 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	 0.46 mV/V 0.43 mV/V 0.54 mV/V 0.67 mV/V 1.8 mV/V 2.8 mV/V 4.5 mV/V 0.10 mV/V 80 µV/V 0.12 mV/V 0.21 mV/V 0.42 mV/V 0.94 mV/V 1.9 mV/V	Fluke 5790A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Measure (cont.)	**10 mV** (10 to 20) Hz (20 100) Hz 100 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **30 mV** (10 to 20) Hz 20 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **100 mV** (10 to 20) Hz 20 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **300 mV** (10 to 20) Hz 20 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **1 V** (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **3 V** (1 to 100) kHz	 56 µV/V 46 µV/V 44 µV/V 98 µV/V 0.17 mV/V 0.38 mV/V 0.58 mV/V 1.1 mV/V 55 µV/V 43 µV/V 44 µV/V 85 µV/V 0.14 mV/V 0.31 mV/V 0.71 mV/V 45 µV/V 33 µV/V 34 µV/V 74 µV/V 0.12 mV/V 0.27 mV/V 0.60 mV/V 33 µV/V 26 µV/V 23 µV/V 30 µV/V 52 µV/V 93 µV/V 0.19 mV/V 29 µV/V 23 µV/V 16 µV/V 15 µV/V 17 µV/V 30 µV/V 51 µV/V 0.16 mV/V 16 µV/V	Fluke 5790A	Agilent/OEM Procedures

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Measure (cont.)	**6 V** 1 kHz **10 V** (10 to 20) Hz (20 to 100) Hz 100 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz **19 V** 1 kHz **100 V** (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 200) kHz **300 V** 40 to 1 kHz (1 to 20) kHz (20 to 30) kHz (30 to 50) kHz (50 to 100) kHz **500 V** 40 to 1 kHz (1 to 20) kHz (20 to 30) kHz (30 to 50) kHz (50 to 100) kHz **700 V** 40 to 1 kHz (1 to 20) kHz (20 to 30) kHz (30 to 50) kHz (50 to 100) kHz **1 kV** 40 to 1 kHz (1 to 20) kHz (20 to 30) kHz	 18 µV/V 28 µV/V 23 µV/V 13 µV/V 14 µV/V 17 µV/V 40 µV/V 65 µV/V 0.19 mV/V 15 µV/V 34 µV/V 22 µV/V 18 µV/V 19 µV/V 28 µV/V 47 µV/V 22 µV/V 25 µV/V 25 µV/V 39 µV/V 65 µV/V 20 µV/V 22 µV/V 26 µV/V 39 µV/V 77 µV/V 22 µV/V 33 µV/V 40 µV/V 54 µV/V 92 µV/V 27 µV/V 25 µV/V 38 µV/V	Fluke 5790A	Agilent/OEM Procedures

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage Wideband - Measure	**Absolute Voltage** **(1 to 3) V** 10 Hz to 500 kHz 500 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz **Voltage Flatness** **(1 to 3) mV** 10 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz **(10 to 300) mV** 10 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz **(1 to 3) V** 10 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 0.4 mV/V + 3 µV 0.41 mV/V + 1.4 µV 2 mV/V + 1.5 µV 2 mV/V + 3.9 µV 2.3 mV/V + 1.1 µV 0.20 mV/V 0.26 mV/V 0.9 mV/V 1.2 mV/V 1.4 mV/V 0.17 mV/V 0.24 mV/V 0.8 mV/V 1.2 mV/V 1.6 mV/V 0.12 mV/V 0.20 mV/V 0.5 mV/V 0.8 mV/V 1.1 mV/V	Fluke 5790A	Agilent/OEM Procedures
AC Current - Source	**40 Hz to 10 kHz** 10 mA 50 mA 100 mA 0.5 A, 1 A 5 A **10 A** 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 11 µA/A 13 µA/A 12 µA/A 17 µA/A 37 µA/A 53 µA/A 64 µA/A 73 µA/A	Fluke 5720A Holt HCS-1	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Current - Measure	**10 µA** 10 Hz to 1 kHz (1 to 10) kHz **100 µA** (10 to 20) Hz 20 Hz to 10 kHz **(1 to 100) mA** (10 to 20) Hz 20 Hz to 10 kHz **1 A** (10 to 20) Hz 20 Hz to 10 kHz **10 A** 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.11 mA/A 0.32 mA/A 88 µA/A 0.12 mA/A 76 µA/A 0.12 mA/A 0.11 mA/A 0.14 mA/A 0.15 mA/A 0.32 mA/A 0.43 mA/A	Fluke 5790A with Agilent ET22703 Shunt Box HP 3458A with 0.001 Ω Shunt	Agilent/OEM Procedures
Thermal Voltage Converters - Measure	**(0.5 to 3) V** 10 Hz 100 Hz 10, 30 kHz 100 kHz 300 kHz 1 MHz **(3 to 10) V** 10 Hz 1, 20 kHz 100 kHz 300 kHz 1 MHz **(10 to 100) V** 10 Hz 1, 20 kHz 100 kHz 200 kHz **(100 to 700) V** 40 Hz, 1kHz 20 kHz 100 kHz **1 000 V** 40 Hz 1 kHz 10, 20 kHz 30 kHz	 0.0016 % 0.0013 % 0.0007 % 0.0011 % 0.0022 % 0.0035 % 0.0013 % 0.0005 % 0.0008 % 0.0018 % 0.003 % 0.0014 % 0.0008 % 0.0011 % 0.0023 % 0.0012 % 0.0014 % 0.0029 % 0.0021 % 0.0014 % 0.0022 % 0.0024 %	Holt 11 TVC	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Thermal Voltage Converters – Measure (cont.)	**(0.5 to 3) V** (3, 8, 10) MHz (20, 30) MHz 50 MHz 70 MHz 80 MHz 100 MHz	 0.12 % 0.25 % 0.62 % 0.93 % 1.1 % 1.3 %	Ballantine 1395A TVC	
Ratio Transformer – Magnitude Only	(1 to 100) V input, 1 kHz	0.52 parts in 10^6 of input	ESI-DT72A Ratio Transformer	
Inductance (Series) - Measure	**1 MHz** 0.1 Ω 1 Ω 10 Ω 100 Ω	 1.0 nH 0.30 nH 1.0 nH 7.0 nH	HP 4284A, 16074A	
Capacitance (Parallel)	**1 MHz** 100 Ω 1 kΩ 10 kΩ 100 kΩ	 0.7 pF 0.07 pF 0.02 pF 0.004 pF	HP 4284A, 16074A, 16380A	
DC Resistance - Measure	1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ	0.38 μΩ/Ω 0.38 μΩ/Ω 0.38 μΩ/Ω 0.38 μΩ/Ω 0.44 μΩ/Ω 0.47 μΩ/Ω 0.43 μΩ/Ω 0.46 μΩ/Ω 1.2 μΩ/Ω 1.7 μΩ/Ω 5.4 μΩ/Ω 60 μΩ/Ω 0.19 mΩ/Ω 0.24 mΩ/Ω 0.21 mΩ/Ω	Resistance Bridge Resistance Shunts in Oil, HP 3458A, 4339B	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Capacitance - Measure	**2/3 Terminal Pair - 1 kHz**		AH2500a Bridge, HP8753C, 85046A, 4284A, 16074A, 16380C	Agilent/OEM Procedures
	1 pF to 40 nF	3 µF/F		
	(40 to 100) nF	4 µF/F		
	(100 to 400) nF	5 µF/F		
	400 nF to 1.2 µF	8 µF/F		
	Dissipation Factor - 1kHz			
	1 pF to 1 nF	0.000003		
	(1 to 10) nF	0.000005		
	(10 to 40) nF	0.00001		
	(40 to 70) nF	0.000015		
	(70 to 100) nF	0.00002		
	(100 to 200) nF	0.00004		
	(200 to 300) nF	0.000055		
	(300 to 400) nF	0.000075		
	(400 to 500) nF	0.000095		
	(500 to 600) nF	0.00011		
	(600 to 700) nF	0.000125		
	(700 to 800) nF	0.000145		
	(800 to 900) nF	0.00016		
	900 nF to 1 µF	0.000175		
	(1 to 1.1) µF	0.000195		
	(1.1 to 1.2) µF	0.00021		
	4 Terminal Pair Dissipation Factor			
	1 pF			
	0.00002, 1 kHz	44 µF/F		
	0.00003, 1 MHz	90 µF/F		
	0.00006, 2 MHz	0.23 mF/F		
	0.00009, 3 MHz	0.41 mF/F		
	0.00014, 4 MHz	0.63 mF/F		
	0.0002, 5 MHz	0.88 mF/F		
	0.00057, 10 MHz	2.5. mF/F		
	0.00083, 13 MHz	3.7 mF/F		
	10 pF			
	0.00002, 1 kHz	39 µF/F		
	0.00002, 1 MHz	39 µF/F		
	0.00002, 2 MHz	40 µF/F		
	0.00002, 3 MHz	43 µF/F		
	0.00002, 4 MHz	47 µF/F		
	0.00003, 5 MHz	54 µF/F		
	0.00007, 10 MHz	0.12 mF/F		
	0.00009, 13 MHz	0.16 mF/F		

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Capacitance - Measure (cont.)	**100 pF** 0.00002, 1 kHz 0.00002, 1 MHz 0.00002., 2 MHz 0.00003, 3 MHz 0.00005, 4 MHz 0.00006, 5 MHz 0.00016, 10 MHz 0.00024, 13 MHz **1000 pF** 0.00002, 1 kHz 0.00003, 1 MHz 0.00006, 2 MHz 0.0001, 3 MHz 0.00015, 4 MHz 0.00021, 5 MHz 0.00058 10 MHz 0.00085 13 MHz **0.01 µF** 0.00002, 120 Hz 1 kHz, 10 kHz 0.00002, 100 kHz **0.1 µF** 0.00003, 120 Hz 0.00002, 1 kHz, 10 kHz 0.00003, 100 kHz **1 µF** 0.00004, 120 Hz 0.00002, 1 kHz 0.00003, 10 kHz 0.00004, 100 kHz **10 µF** 0.00004, 120 Hz 0.00003, 1 kHz 0.00028, 10 kHz 0.0007, 100 kHz	 38 µF/F 40 µF/F 48 µF/F 66 µF/F 91 µF/F 0.13 mF/F 0.33 mF/F 0.49 mF/F 41 µF/F 64 µF/F 0.15 mF/F 0.28 mF/F 0.44 mF/F 0.62 mF/F 1.9 mF/F 2.8 mF/F 40 µF/F 40 µF/F 40 µF/F 40 µF/F 40 µF/F 50 µF/F 40 µF/F 40 µF/F 70 µF/F 50 µF/F 50 µF/F 0.16 mF/F 0.70 mF/F	AH2500a Bridge, HP8753C, 85046A, 4284A, 16074A, 16380C	Agilent/OEM Procedures

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
HF Resistance - Measure	**4 Terminal Pair** **10 Ω** 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz **100 Ω** 1 MHz 2 MHz 3,4,5 MHz 10 MHz 13 MHz **1 kΩ** 100 kHz 1,2,3 MHz 4 MHz 5 MHz 10 MHz 13 MHz **10 kΩ** 100 kHz 1 MHz **100 kΩ** 100 kHz 1 MHz	 0.3 mΩ/Ω 0.5 mΩ/Ω 0.6 mΩ/Ω 0.7 mΩ/Ω 1.0 mΩ/Ω 4.0 mΩ/Ω 6.0 mΩ/Ω 0.3 mΩ/Ω 0.3 mΩ/Ω 0.5 mΩ/Ω 2.0 mΩ/Ω 3.0 mΩ/Ω 0.3 mΩ/Ω 0.3 mΩ/Ω 0.4 mΩ/Ω 0.5 mΩ/Ω 2.0 mΩ/Ω 3.0 mΩ/Ω 0.2 mΩ/Ω 0.3 mΩ/Ω 0.3 mΩ/Ω 0.3 mΩ/Ω	HP 4285A, 16074A, 16380A	Agilent/OEM Procedures
HF Reactance - Measure	**10 Ω** 1 MHz 2,3 MHz 4 MHz 5 MHz 10 MHz 13 MHz **100 Ω** 1,2,3,4,5 MHz 10 MHz 13 MHz	 4 mΩ 5 mΩ 6 mΩ 7 mΩ 20 mΩ 40 mΩ 40 mΩ 80 mΩ 90 mΩ	HP 4285A, 16074A, 16380A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
HF Susceptance - Measure	**1 kΩ** 100 kHz 1,2,3,4,5 MHz 10,13 MHz **10 kΩ** 100 kHz 1 MHz **100 kΩ** 100 kHz 1 MHz	 0.4 µS 0.4 µS 0.7 µS 0.04 µS 0.04 µS 4 nS 4 nS	HP 4285A, 16074A, 16380A	Agilent/OEM Procedures
Frequency	10 MHz	1.33×10^{-9} Hz	58503 GPS Receiver (signal tracked and compared with NIST)	

Notes:

1. Calibration and Measurement Capabilities (CMC) (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of k=2.
2. *This scope is formatted as part of a single document including the Certificate of Accreditation No* AC – 1813.

Vice-President