



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat - Portland

14058 SW Milton Court
Portland, OR 97224

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002)

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2021
Certificate Number: AC-2489.01



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
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 April 2017).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 AND
ANSI/NCSL Z540-1-1994 (R2002)**

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800-828-1470 ext 7617

CALIBRATION

Valid to: **September 7, 2021**

Certificate Number: **AC-2489.01**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment ¹	0 µA to 220 µA		Fluke 5720A
	10 Hz to 20 Hz	0.03 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.015 % + 8 nA	
	1 kHz to 5 kHz	0.03 % + 12 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	
	0.22 mA to 2.2 mA		
	10 Hz to 20 Hz	0.03 % + 40 nA	
	20 Hz to 40 Hz	0.018 % + 35 nA	
	40 Hz to 1 kHz	0.013 % + 35 nA	
	1 kHz to 5 kHz	0.021 % + 0.11 µA	
	5 kHz to 10 kHz	0.11 % + 0.65 µA	
2.2 mA to 22 mA			
10 Hz to 20 Hz	0.039 % + 0.4 µA		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment ¹	20 Hz to 40 Hz	0.019 % + 0.35 μA	Fluke 5720A
	40 Hz to 1 kHz	0.014 % + 0.35 μA	
	1 kHz to 5 kHz	0.021 % + 0.55 μA	
	5 kHz to 10 kHz	0.11 % + 5 μA	
	22 mA to 220 mA		
	10 Hz to 20 Hz	0.033 % + 4 μA	
	20 Hz to 40 Hz	0.018 % + 3.5 μA	
	40 Hz to 1 kHz	0.014 % + 2.5 μA	
	1 kHz to 5 kHz	0.021 % + 3.5 μA	
	5 kHz to 10 kHz	0.11 % + 10 μA	
	0.22 A to 2.2 A		
	20 Hz to 1 kHz	0.027 % + 35 μA	
	1 kHz to 5 kHz	0.046 % + 80 μA	
	5 kHz to 10 kHz	0.7 % + 160 μA	
	2.2 A to 11 A		Fluke 5720A-EP with 5725A
	40 Hz to 1 kHz	0.048 % + 0.17 mA	
1 kHz to 5 kHz	0.096 % + 0.38 mA		
5 kHz to 10 kHz	0.36 % + 0.75 mA		
11 A to 20.5 A		Fluke 5520A	
45 Hz to 100 Hz	0.092 % + 3.9 mA		
100 Hz to 1 kHz	0.12 % + 3.9 mA		
1 kHz to 5 kHz	2.3 % + 3.9 mA		
20 A to 100 A		0.12 %	Ohm Labs Shunt with Current Source
10 Hz to 1 kHz			

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Extended Frequency Ranges ¹	29 μ A to 329.99 μ A 10 kHz to 30 kHz	1.2 % + 3 μ A	Fluke 5520A
	330 μ A to 3.299 mA 10 kHz to 30 kHz	0.78 % + 0.5 μ A	
	3.3 mA to 32.99 mA 10 kHz to 30 kHz	0.31 % + 3 μ A	
	33 mA to 329.99 mA 10 kHz to 30 kHz	0.31 % + 0.16 mA	
Clamp-on Ammeter Toroidal Type ¹ Transformer Type	20 A to 150 A 45 Hz to 65 Hz	0.34 % + 35 mA	Fluke 5520A with Wavetek Coil
	65 Hz to 440 Hz	0.95 % + 66 mA	
	150 A to 1000 A 45 Hz to 65 Hz	0.38 % + 0.17 A	
	65 Hz to 440 Hz	1.2 % + 0.35 A	
Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	20 A to 150 A 45 Hz to 65 Hz	0.66 % + 0.26 A	Fluke 5520A with Wavetek Coil
	65 Hz to 440 Hz	1.2 % + 0.29 A	
	150 A to 1000 A 45 Hz to 65 Hz	0.68 % + 1.0 A	
	65 Hz to 440 Hz	1.4 % + 1.2 A	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current - Measuring Equipment Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	1 000 A to 6 000 A 10 Hz to 300 Hz	0.77 %	Fluke 52120A, w/ 5520A, 3kA, 6kA coil
	1 000 A to 6 000 A 300 Hz to 440 Hz	0.77 %	
AC Current – Measure ¹	0 μA to 100 μA		Agilent 3458A opt 2
	10 Hz to 20 Hz	0.46 % + 30 nA	
	20 Hz to 45 Hz	0.17 % + 30 nA	
	45 Hz to 100 Hz	0.072 % + 30 nA	
	100 Hz to 5 kHz	0.072 % + 30 nA	
	100 μA to 1 mA		
	10 Hz to 20 Hz	0.46 % + 200 nA	
	20 Hz to 45 Hz	0.17 % + 200 nA	
	45 Hz to 100 Hz	0.071 % + 200 nA	
	100 Hz to 5 kHz	0.038 % + 200 nA	
	1 mA to 10 mA		
	10 Hz to 20 Hz	0.46 % + 2 μA	
	20 Hz to 45 Hz	0.17 % + 2 μA	
	45 Hz to 100 Hz	0.071 % + 2 μA	
	100 Hz to 5 kHz	0.038 % + 2 μA	
	10 mA to 100 mA		
10 Hz to 20 Hz	0.46 % + 20 μA		
20 Hz to 45 Hz	0.17 % + 20 μA		
45 Hz to 100 Hz	0.071 % + 20 μA		
100 Hz to 5 kHz	0.038 % + 20 μA		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measure ¹	100 mA to 1 A 10 Hz to 20 Hz	0.46 % + 200 μA	Fluke 5720A
	20 Hz to 45 Hz	0.19 % + 200 μA	
	45 Hz to 100 Hz	0.097 % + 200 μA	
	100 Hz to 5 kHz	0.12 % + 200 μA	
1 A to 3 A 10 Hz to 5 kHz	0.17 % + 1.8 mA	Fluke 8846A	
	3 A to 10 A 10 Hz to 5kHz		0.18 % + 6 mA
10 A to 100 A 10 Hz to 1 kHz	0.12 %	Ohm Labs Shunt	
DC Resistance – Measuring Equipment and Measure ¹	0 Ω to 10 Ω	18 μΩ/Ω + 58 μΩ	Agilent 3458A with Decade Resistor
	10 Ω to 100 Ω	15 μΩ/Ω + 0.58 mΩ	
	100 Ω to 1 kΩ	12 μΩ/Ω + 0.58 mΩ	
	1 kΩ to 10 kΩ	12 μΩ/Ω + 5.8 mΩ	
	10 kΩ to 100 kΩ	12 μΩ/Ω + 58 mΩ	
	100 kΩ to 1 MΩ	19 μΩ/Ω + 2.3 Ω	
	1 MΩ to 10 MΩ	62 μΩ/Ω + 120 Ω	
	10 MΩ to 100 MΩ	0.059 % + 1.2 kΩ	
	100 MΩ to 1 GΩ	0.58 % + 12 kΩ	
DC Resistance – Measuring Equipment ¹	0.33 mΩ	0.047 %	DC Current Shunt
	1 mΩ	0.037 %	
	10 mΩ	0.013 %	
	100 mΩ	0.012 %	
	10 MΩ to 100 MΩ	0.036 %	Decade Resistor

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
DC Resistance – Measuring Equipment ¹	100 MΩ to 1 GΩ	0.13 %	Decade Resistor
	1 GΩ to 10 GΩ	0.25 %	
	10 GΩ to 100 GΩ	0.59 %	
	100 GΩ to 900 GΩ	0.77 %	
	1 TΩ	1.6 %	
DC Current – Measuring Equipment and Measure ¹	0 μA to 100 μA	26 μA/A + 0.92 nA	Agilent 3458A with Current Source
	100 μA to 1 mA	26 μA/A + 5.8 nA	
	1 mA to 10 mA	26 μA/A + 58 nA	
	10 mA to 100 mA	43 μA/A + 0.58 μA	
	100 mA to 1 A	0.013 % + 12 μA	Guildline 9211 with Current Source
	1 A to 10 A	0.013 %	
	10 A to 100 A	0.048 %	
	100 A to 300 A	0.062 %	
Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	20 A to 150 A	0.5 % + 0.14 A	Fluke 5520A with Wavetek Coil
	150 A to 1 000 A	0.52 % + 0.5 A	
DC Current – Measuring Equipment Clamp-on Ammeter Non-Toroidal Type ¹ Hall Sensor	1 000 A to 5 000 A	0.58 %	Fluke 52120A, w/ 5520A, 3kA or 6 kA coil
DC Voltage – Measuring Equipment and Measure ¹	0 V to 100 mV	7.1 μV/V + 0.58 μV	Agilent 3458A opt. 2 with Fluke 5720A-EP
	100 mV to 10 V	5.1 μV/V + 0.58 μV	
	10 V to 100 V	7.6 μV/V + 35 μV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
DC Voltage – Measuring Equipment and Measure ¹	100 V to 500 V	11 μ V/V + 0.12 mV	Agilent 3458A opt. 2 with Fluke 5720A-EP
	500 V to 800 V	16 μ V/V + 0.12 mV	
	800 V to 1 kV	21 μ V/V + 0.12 mV	
DC Voltage – Measure ¹	> 1 kV to 10 kV	0.04 % + 0.092 V	Vitrek 4700
	10 kV to 20 kV	0.04 % + 2.4 V	Vitrek 4700/HVL-35
	20 kV to 70 kV	0.09 % + 2.4 V	Vitrek 4700/HVL-70
	70 kV to 100 kV	0.17 % + 2.5 V	Vitrek 4700/HVL-100
DC Voltage – Measuring Equipment ¹	0 V to 0.22 V	10 μ V/V + 0.71 μ V	Fluke 5720A with 5725A
	0.22 V to 2.2 V	5.1 μ V/V + 0.71 μ V	
	2.2 V to 11 V	3.7 μ V/V + 2.6 μ V	
	11 V to 22 V	3.8 μ V/V + 4.1 μ V	
	22 V to 220 V	5.1 μ V/V + 41 μ V	
	220 V to 1.1 kV	7 μ V/V + 0.41 mV	Fluke 5700A-EP w/ 5725A
AC Voltage – Measure	0 to 1 mV		R&S URE3
	100 kHz to 1MHz	1.8 % + 2.4 μ V	
	1 MHz to 3 MHz	3.5 % + 2.4 μ V	
	3 MHz to 10 MHz	9.3 % + 2.4 μ V	
	10 MHz to 20 MHz	23 % + 2.4 μ V	
	1 mV to 3 mV		
	100 kHz to 1MHz	0.97 % + 2 μ V	
	1 MHz to 3 MHz	3.5 % + 2 μ V	
	3 MHz to 10 MHz	9.3 % + 2 μ V	
	10 MHz to 20 MHz	23 % + 2 μ V	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measure	3 mV to 100 mV		R&S URE3
	100 kHz to 1MHz	0.91 % + 3 μV	
	1 MHz to 3 MHz	1.8 % + 3 μV	
	3 MHz to 10 MHz	2.9 % + 3 μV	
	10 MHz to 20 MHz	7 % + 3 μV	
	20 MHz to 30 MHz	14 % + 3 μV	
AC Voltage – Measure ¹	0 mV to 10 mV		Agilent 3458A opt 2
	1 Hz to 40 Hz	0.039 % + 3.5 μV	
	40 Hz to 1 kHz	0.028 % + 1.2 μV	
	1 kHz to 20 kHz	0.038 % + 1.2 μV	
	20 kHz to 50 kHz	0.15 % + 1.2 μV	
	50 kHz to 100 kHz	0.59 % + 1.2 μV	
	100 kHz to 300 kHz	4.6 % + 2.3 μV	
	300 kHz to 1 MHz	1.5 % + 5.8 μV	
	1 MHz to 4 MHz	8.1 % + 8.1 μV	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.013 % + 4.6 μV	
	40 Hz to 1 kHz	0.009 4 % + 2.3 μV	
	1 kHz to 20 kHz	0.017 % + 2.3 μV	
	20 kHz to 50 kHz	0.037 % + 2.3 μV	
	50 kHz to 100 kHz	0.093 % + 2.3 μV	
100 kHz to 300 kHz	0.36 % + 12 μV		
300 kHz to 1 MHz	1.2 % + 12 μV		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	1 MHz to 2 MHz	1.9 % + 12 μV	Agilent 3458A opt 2
	2 MHz to 4 MHz	4.7 % + 81 μV	
	4 MHz to 8 MHz	4.7 % + 92 μV	
	8 MHz to 10 MHz	17 % + 120 μV	
AC Voltage – Measure ¹	100 mV to 1 V		Agilent 3458A opt 2
	1 Hz to 40 Hz	0.009 8 % + 46 μV	
	40 Hz to 1 kHz	0.009 4 % + 23 μV	
	1 kHz to 20 kHz	0.017 % + 23 μV	
	20 kHz to 50 kHz	0.036 % + 23 μV	
	50 kHz to 100 kHz	0.093 % + 23 μV	
	100 kHz to 300 kHz	0.35 % + 0.12 mV	
	300 kHz to 1 MHz	1.2 % + 0.12 mV	
	1 MHz to 2 MHz	1.9 % + 0.12 mV	
	2 MHz to 4 MHz	4.7 % + 0.81 mV	
	4 MHz to 8 MHz	4.7 % + 0.92 mV	
	8 MHz to 10 MHz	17 % + 1.2 mV	
	1 V to 10 V		
	1 Hz to 40 Hz	0.015 % + 0.46 mV	
	40 Hz to 1 kHz	0.009 5 % + 0.23 mV	
	1 kHz to 20 kHz	0.017 % + 0.23 mV	
	20 kHz to 50 kHz	0.036 % + 0.23 mV	
	50 kHz to 100 kHz	0.093 % + 0.23 mV	
	100 kHz to 300 kHz	0.35 % + 1.2 mV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	300 kHz to 1 MHz	1.2 % + 1.2 mV	Agilent 3458A opt 2
	1 MHz to 2 MHz	1.8 % + 1.2 mV	
	2 MHz to 4 MHz	4.7 % + 8.1 mV	
	4 MHz to 8 MHz	4.7 % + 9.2 mV	
	8 MHz to 10 MHz	17 % + 12 mV	
	10 V to 100 V		
	1 Hz to 40 Hz	0.024 % + 4.6 mV	
	40 Hz to 1 kHz	0.024 % + 2.3 mV	
	1 kHz to 20 kHz	0.024 % + 2.3 mV	
	20 kHz to 50 kHz	0.041 % + 2.3 mV	
	50 kHz to 100 kHz	0.14 % + 2.3 mV	
	100 kHz to 300 kHz	0.46 % + 12 mV	
	300 kHz to 1 MHz	1.7 % + 12 mV	
	100 V to 700 V		
	1 Hz to 40 Hz	0.047 % + 46 mV	
	40 Hz to 1 kHz	0.047 % + 23 mV	
	1 kHz to 20 kHz	0.071 % + 23 mV	
	20 kHz to 50 kHz	0.14 % + 23 mV	
	50 kHz to 100 kHz	0.35 % + 23 mV	
	700 V to 10 kV		Vitretek 4600A
20 Hz to 100 Hz	0.14 % + 0.37 V		
100 Hz to 400 Hz	0.48 % + 0.17 V		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment	
AC Voltage – Measure ¹	10 kV to 30 kV		Vitrek 4700A/ HVL-35	
	30 Hz to 70 Hz	0.11 % + 2.4 V		
	70 Hz to 200 Hz	0.7 % + 2.4 V	Vitrek 4700A/ HVL-35	
	200 Hz to 450 Hz	1.4 % + 2.4 V		
	30 kV to 50 kV		Vitrek 4700A/ HVL-70	
	30 Hz to 70 Hz	0.13 % + 2.5 V		
	70 Hz to 200 Hz	0.7 % + 2.5 V		
	200 Hz to 450 Hz	2.9 % + 2.5 V		
	50 kV to 70 kV	30 Hz to 70 Hz	0.16 % + 2.6 V	Vitrek 4700A/ HVL-100
		70 Hz to 200 Hz	1.2 % + 2.6 V	
AC Voltage – Measuring Equipment ¹	0 mV to 2.2 mV		Fluke 5700-EP	
	10 Hz to 20 Hz	0.16 % + 4 μV		
	20 Hz to 40 Hz	0.1 % + 4 μV		
	40 Hz to 20 kHz	0.08 % + 4 μV		
	20 kHz to 50 kHz	0.13 % + 4 μV		
	50 kHz to 100 kHz	0.17 % + 5 μV		
	100 kHz to 300 kHz	0.33 % + 10 μV		
	300 kHz to 500 kHz	0.47 % + 20 μV		
500 kHz to 1 MHz	0.58 % + 20 μV			

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	2.2 mV to 22 mV		Fluke 5720A
	10 Hz to 20 Hz	0.04 % + 4 μV	
	20 Hz to 40 Hz	0.03 % + 4 μV	
	40 Hz to 20 kHz	0.014 % + 4 μV	
	20 kHz to 50 kHz	0.03 % + 4 μV	
	50 kHz to 100 kHz	0.06 % + 5 μV	
	100 kHz to 300 kHz	0.12 % + 10 μV	
	300 kHz to 500 kHz	0.16 % + 20 μV	
	500 kHz to 1 MHz	0.27 % + 20 μV	
	22 mV to 220 mV		
	10 Hz to 20 Hz	0.028 % + 12 μV	
	20 Hz to 40 Hz	0.011 % + 7 μV	
	40 Hz to 20 kHz	0.009 % + 7 μV	
	20 kHz to 50 kHz	0.021 % + 7 μV	
	50 kHz to 100 kHz	0.047 % + 17 μV	
	100 kHz to 300 kHz	0.091 % + 20 μV	
	300 kHz to 500 kHz	0.14 % + 25 μV	
	500 kHz to 1 MHz	0.28 % + 45 μV	
	220 mV to 2.2 V		
	10 Hz to 20 Hz	0.027 % + 40 μV	
	20 Hz to 40 Hz	0.01 % + 15 μV	
	40 Hz to 20 kHz	0.005 % + 8 μV	
	20 kHz to 50 kHz	0.008 % + 10 μV	
	50 kHz to 100 kHz	0.012 % + 30 μV	
100 kHz to 300 kHz	0.044 % + 80 μV		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	300 kHz to 500 kHz	0.1 % + 200 μV	Fluke 5720A
	500 kHz to 1 MHz	0.18 % + 300 μV	
	2.2 V to 22 V		
	10 Hz to 20 Hz	0.028 % + 0.4 mV	
	20 Hz to 40 Hz	0.01 % + 0.15 mV	
	40 Hz to 20 kHz	0.005 % + 0.05 mV	
	20 kHz to 50 kHz	0.008 % + 0.1 mV	
	50 kHz to 100 kHz	0.011 % + 0.2 mV	
	100 kHz to 300 kHz	0.03 % + 0.6 mV	
	300 kHz to 500 kHz	0.1 % + 2 mV	
	500 kHz to 1 MHz	0.17 % + 3.2mV	
	22 V to 220 V		
	10 Hz to 20 Hz	0.028 % + 4 mV	
	20 Hz to 40 Hz	0.010 % + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % + 0.6 mV	
20 kHz to 50 kHz	0.009 3 % + 1 mV		
50 kHz to 100 kHz	0.016 % + 2.5 mV		
100 kHz to 300 kHz	0.09 % + 16 mV		
300 kHz to 500 kHz	0.44 % + 40 mV		
500 kHz to 1 MHz	0.8 % + 80 mV		
220 V to 750 V		Fluke 5720A/5725A	
30 kHz to 50 kHz	0.061 % + 11 mV		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	50 kHz to 100 kHz	0.23 % + 45 mV	Fluke 5720A/5725A
	220 V to 1100 V		
	40 Hz to 1 kHz	0.011 % + 4 mV	
	1 kHz to 20 kHz	0.017 % + 6 mV	
	20 kHz to 30 kHz	0.061 % + 11 mV	
Capacitance – Measuring Equipment ¹	0.19 nF to 1.1 nF		Fluke 5520A
	10 Hz to 10 kHz	0.39 % + 7.8 pF	
	1.1 nF to 3.3 nF		
	10 Hz to 3 kHz	0.39 % + 7.8 pF	
	3.3 nF to 11 nF		
	10 Hz to 1 kHz	0.21 % + 7.8 pF	
	11 nF to 33 nF		
	10 Hz to 1 kHz	0.21 % + 78 pF	
	33 nF to 110 nF		
10 Hz to 1 kHz	0.21 % + 78 pF		
	110 nF to 330 nF		
	10 Hz to 1 kHz	0.21 % + 0.23 nF	
	330 nF to 1.1 μF		
	10 Hz to 600 Hz	0.2 % + 0.78 nF	
	1.1 μF to 3.3 μF		
	10 Hz to 300 Hz	0.2 % + 2.3 nF	
	3.3 μF to 11 μF		
	10 Hz to 150 Hz	0.2 % + 7.8 nF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Capacitance – Measuring Equipment ¹	11 µF to 33 µF 10 Hz to 120 Hz	0.31 % + 23 nF	Fluke 5520A
	33 µF to 110 µF 10 Hz to 80 Hz	0.35 % + 78 nF	
	110 µF to 330 µF DC to 50 Hz	0.35 % + 0.23 µF	
	330 µF to 1.1 mF DC to 20 Hz	0.35 % + 0.78 µF	
	1.1 mF to 3.3 mF DC to 6 Hz	0.35 % + 2.3 µF	
	3.3 mF to 11 mF DC to 2 Hz	0.35 % + 7.8 µF	
	11 mF to 33 mF DC to 0.6 Hz	0.58 % + 23 µF	
	33 mF to 110 mF DC to 0.2 Hz	0.86 % + 78 µF	
Sine Wave Flatness ¹ 0 V to 3 V	10 Hz to 100 Hz 100 Hz to 300 kHz 300 kHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz 30 MHz to 50 MHz 50 MHz to 70 MHz 70 MHz to 80 MHz 80 MHz to 100 MHz	0.07 % 0.071 % 0.13 % 0.21 % 0.22 % 0.48 % 0.75 % 0.89 % 1 %	Thermal Voltage Converters

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Power – Measuring Equipment 0.33 mA to 330 mA	11 μW to 1.1 mW	0.024 %	Fluke 5520A
	1.1 mW to 0.11 W	0.027 %	
	0.11W to 110 W	0.024 %	
	110 W to 330 W	0.018 %	
0.33 A to 3 A	11 W to 110 mW	0.044 %	Fluke 5520A
	0.11 W to 990 W	0.053 %	
	1 W to 3 kW	0.009 6 %	
3 A to 20.5 A	99 mW to 0.99 W	0.088 %	Fluke 5520A
	0.99 W to 6.8 kW	0.07 %	
	6.8 W to 20.5 kW	0.04 %	
AC Power (PF = 1) 3.3 mA to 9 mA	0.11 mW to 3 mW 10 Hz to 65 Hz	0.13 %	Fluke 5520A
	3 mW to 9 W 10 Hz to 65 Hz	0.077 %	
9 mA to 33 mA	0.3 mW to 10 mW 10 Hz to 65 Hz	0.089 %	Fluke 5520A
	10 mW to 33 W 10 Hz to 65 Hz	0.077 %	
33 mA to 90 mA	1 mW to 30 mW 10 Hz to 65 Hz	0.071 %	Fluke 5520A
	30 mW to 90 W 10 Hz to 65 Hz	0.057 %	
90 mA to 330 mA	3 mW to 100 mW 10 Hz to 65 Hz	0.089 %	Fluke 5520A
	100 mW to 300 W 10 Hz to 65 Hz	0.078 %	
0.33 A to 0.9 A	11 mW to 0.3 W 10 Hz to 65 Hz	0.071 %	Fluke 5520A
	0.3 W to 900 W 10 Hz to 65 Hz	0.081 %	
0.9 A to 2.2 A	30 mW to 0.72 W 10 Hz to 65 Hz	0.089 %	Fluke 5520A
	0.72 W to 2 kW 10 Hz to 65 Hz	0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W 10 Hz to 65 Hz	0.088 %	Fluke 5520A

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
	1.4 W to 4.5 kW 10 Hz to 65 Hz	0.18 %	
4.5 A to 20.5 A	150 mW to 6.7 W 10 Hz to 65 Hz 6.7 W to 20 kW 10 Hz to 65 Hz	0.17 % 0.17 %	
LF Phase – Measuring Equipment ¹	0° to 90° 10 Hz to 65 Hz 65 Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	0.11° 0.20° 0.39° 1.9° 3.9° 7.8°	Fluke 5520A
Oscilloscopes ¹ Amplitude DC ¹ into 50 Ω Load into 1 MΩ Load Amplitude Square Wave ¹ into 50 Ω Load Rate: 10 Hz to 10 kHz into 1 MΩ Load Rate: 10 Hz to 1 kHz Rate: 1 kHz to 10 kHz	 (-6.6 to 6.6) V (-130 to 130) V 1 mV _(pk-pk) to 6.6 V _(pk-pk) 1 mV _(pk-pk) to 6.6 V _(pk-pk) 1 mV _(pk-pk) to 6.6 V _(pk-pk)	 0.20% + 31 μV 0.039% + 31 μV 0.19% + 31 μV 0.078% + 31 μV 0.19% + 31 μV	 Fluke 5520A/SC1100
Timing - Generate ¹ 50 Ω Load	5 s 2 s 1 s 500 ms 200 ms 100 ms 50 ms 20 mS to 1 nS	0.30 % 0.12 % 0.062 % 0.032 % 0.014 % 0.0076 % 0.0046 % 0.00022 %	Fluke 5520A/SC1100

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Rise Time – Generate ^{1,4} 50 Ω Load 5.0 mV _(pk-pk) to 2.5 V _(pk-pk) Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	250 ps (nominal) 250 ps (nominal)	50 ps 50 ps	Fluke 5520A/SC1100
Leveled Sine Wave Generate ¹ 50 Ω Load 5.0 mV _(pk-pk) to 5.5 V _(pk-pk)	50 kHz 50 kHz to 100 MHz 100 MHz to 300 MHz 300 MHz to 600 MHz	1.8 % + 230 μV 2.8 % + 230 μV 3.2 % + 230 μV 4.0 % + 230 μV	Fluke 5520A/SC1100
Bandwidth/Flatness Measure ¹ 50 Ω (50 kHz Reference) 5.0 mV _(pk-pk) to 5.5 V _(pk-pk)	50 kHz to 100 MHz 100 MHz to 300 MHz 300 MHz to 600 MHz	1.4 % + 78 μV 1.8 % + 78 μV 3.2 % + 78 μV	Fluke 5520A/SC1100
Input Impedance Measure ¹ 50 Ω 1 MΩ	40 Ω to 60 Ω 500 kΩ to 1.5 MΩ	0.082 % 0.081 %	Fluke 5520A/SC1100
Input Capacitance Measure ¹	5.0 pF to 50 pF	3.9 % + 0.39 pF	Fluke 5520A/SC1100
Wave Generator – Source ¹ Amplitude (10 Hz to 10 kHz) Sine, Square, Triangle 50 Ω Load 1 MΩ Load	1.8 mV _(pk-pk) to 2.5 V _(pk-pk) 1.8 mV _(pk-pk) to 55 V _(pk-pk)	2.3 % + 78 μV _(pk-pk) 2.3 % + 78 μV _(pk-pk)	Fluke 5520A/SC1100
Wave Generator – Source ¹ Frequency Sine, Square, Triangle	10 Hz to 10 kHz	0.001 9% + 0.012 Hz	Fluke 5520A/SC1100

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Devices ¹ Type J	-210 °C to -180 °C -180 °C to -120 °C -120 °C to -50 °C -50 °C to 990 °C 990 °C to 1 200 °C	0.13 °C 0.11 °C 0.09 °C 0.08 °C 0.08 °C	Ectron 1140A
Type K	-270 °C to -255 °C -255 °C to -195 °C -195 °C to -115 °C -115 °C to -55 °C -55 °C to 1 000 °C 1 000 °C to 1 372 °C	2.3 °C 0.73 °C 0.14 °C 0.1 °C 0.08 °C 0.09 °C	Ectron 1140A
Type T	-270 °C to -255 °C -255 °C to -240 °C -240 °C to -210 °C -210 °C to -150 °C -150 °C to -40 °C -40 °C to 100 °C 100 °C to 400 °C	1.8 °C 0.52 °C 0.32 °C 0.19 °C 0.13 °C 0.09 °C 0.08 °C	Ectron 1140A
Type E	-270 °C to -245 °C -245 °C to -195 °C -195 °C to -155 °C -155 °C to -90 °C -90 °C to 0 °C 0 °C to 15 °C 15 °C to 890 °C 890 °C to 1 000 °C	2.1 °C 0.2 °C 0.11 °C 0.09 °C 0.08 °C 0.08 °C 0.07 °C 0.08 °C	Ectron 1140A
Type R	-50 °C to -30 °C -30 °C to 45 °C 45 °C to 160 °C 160 °C to 380 °C 380 °C to 775 °C 775 °C to 1 768 °C	0.68 °C 0.58 °C 0.42 °C 0.31 °C 0.28 °C 0.23 °C	Ectron 1140A
Type S	-50 °C to -30 °C -30 °C to 45 °C 45 °C to 105 °C 105 °C to 310 °C 310 °C to 615 °C 615 °C to 1 768 °C	0.65 °C 0.59 °C 0.42 °C 0.35 °C 0.31 °C 0.27 °C	Ectron 1140A

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Type B	250 °C to 350 °C	1.0 °C	Ectron 1140A
	350 °C to 445 °C	0.77 °C	
	445 °C to 580 °C	0.61 °C	
	580 °C to 750 °C	0.47 °C	
	750 °C to 1 000 °C	0.39 °C	
	1 000 °C to 1 820 °C	0.31 °C	
Type N	-270 °C to -260 °C	5.1 °C	Ectron 1140A
	-260 °C to -200 °C	1.1 °C	
	-200 °C to -140 °C	0.25 °C	
	-140 °C to -70 °C	0.16 °C	
	-70 °C to 25 °C	0.13 °C	
	25 °C to 160 °C	0.11 °C	
Type C	0 °C to 250 °C	0.21 °C	Ectron 1140A
	250 °C to 1 000 °C	0.17 °C	
	1 000 °C to 1 500 °C	0.19 °C	
	1 500 °C to 1 800 °C	0.22 °C	
	1 800 °C to 2 000 °C	0.24 °C	
	2 000 °C to 2 250 °C	0.30 °C	
2 250 °C to 2 315 °C	0.33 °C		

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Total Harmonic Distortion 5 Hz to 600 Hz Input Voltage Range <30 V 100 % to 0.3 %	10 Hz to 1 MHz	3%	Agilent 8592L
	1 MHz to 3 MHz	6%	
0.1 %	10 Hz to 20 Hz	12 %	Agilent 334A
	20 Hz to 30 Hz	6 %	
	30 Hz to 300 kHz	3 %	
	300 kHz to 500 kHz	6 %	
	500 kHz to 1.2 MHz	12 %	

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Input Voltage Range >30 V 100 % to 0.3 %	10 Hz to 300 kHz	3 %	Agilent 334A
	300 kHz to 500 kHz	6 %	
	500 kHz to 3 MHz	12 %	
0.1 %	20 Hz to 30 Hz	12 %	
	30 Hz to 300 kHz	3 %	
	300 kHz to 500 kHz	6 %	
	500 kHz to 1.2 MHz	12 %	
Harmonic Distortion	100 kHz to 100 MHz	1.7 dB	Agilent 8592L
Rise time - Measuring ¹	≥700 ps	0.81 ns	TDS3052

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁵	Reference Standard, Method and/or Equipment
Angles	0° to 75°	5.1 “	Sine Plate w/Gage Blocks
	90°	6.8 “	Master Square
Micrometers and Calipers– Outside, Inside, Depth ¹	0.05 in to 8 in	(15 + 3L) μin	Comparison to Gage Blocks
	8 in to 42 in	(13 + 4L) μin	
Anvil Flatness ¹	0 in to 1 in	4.7 μin	Optical Flats
Anvil Parallelism ¹	0 in to 1 in	6.1 μin	Optical Parallel
Length Measurement Single Axis - Inside	0.24 in to 12 in	(3 + 4L) μin	Horizontal Comparator
Length Measurement Single Axis - Outside	0.001 in to 10 in	(3 + 4L) μin	Horizontal Comparator
Height Measuring Equipment	0 in to 4 in	(10 + 3L) μin	Comparison to Gage Blocks

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁵	Reference Standard, Method and/or Equipment
Height Gages, Dial Gages, And Digital Indicators	4 in to 24 in	$(12 + 4L) \mu\text{in}$	
Dial Indicators ¹	0 in to 0.1 in	4.5 μin	Gage Blocks Surface Plate
	0.1 in to 6 in	$(4 + 4L) \mu\text{in}$	
Height Measure (Master 1-2-3 Blocks, Caliper Masters, Parallels)	0 in to 6 in	$(10 + 3L) \mu\text{in}$	Gage Blocks with Amplifier
	6 in to 24 in	$(12 + 4L) \mu\text{in}$	
Parallelism and Straightness	0 in to 12 in	20 μin	Gage amp and Surface Plate
Surface Plates ¹	12 in to 168 in	$5.5 \mu\text{in} + 1.7 \sqrt{D} \mu\text{in}$	Optodyne LDDM
Surface Plate Repeatability ¹	+/- 0.001	32 μin	Supramess
Steel Rules	0 in to 12 in	320 μin	Vision System
Thread Rings Inner Pitch Diameter	0 in to 6 in	150 μin	Comparison to Master Setting Plugs
Thread Plugs Outer Pitch Diameter	0 in to 6 in	$(79 + 1L) \mu\text{in}$	Comparator with Thread Wires
Linear Dimension – Two Axis (X-Y)	12 in x 12 in	320 μin	Vision System

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Force	10 gf to 100 gf	0.04 %	ASTM Class 2 Weights
	0.2 lbf to 500 lbf	0.025 % + 0.001 lbf	NIST Class F Weights
	500 lbf to 1 000 lbf	0.58 lbf	Load Cell

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Balances & Scales – Metric ¹	5 kg	14 mg	ASTM Class 1 Weights
	2 kg	5.9 mg	
	1 kg	3.1 mg	
	500 g	1.8 mg	
	300 g	1.5 mg	
	200 g	0.31 mg	
	100 g	0.14 mg	
	50 g	0.09 mg	
	30 g	0.09 mg	
	20 g	59 µg	
	10 g	41 µg	
	5 g	41 µg	
	3 g	41 µg	
	2 g	41 µg	
	1 g	41 µg	
	500 mg	17 µg	
	200 mg	17 µg	
	100 mg	17 µg	
	50 mg	17 µg	
	20 mg	17 µg	
10 mg	17 µg		
5 mg	17 µg		
2 mg	17 µg		
1 mg	17 µg		
Balances & Scales Avoirdupois ¹	50 lb	2.3 g	NIST Class F Weights
	30 lb	1.4 g	
	20 lb	0.91 g	
	10 lb	0.45 g	
	5 lb	0.23 g	
	3 lb	0.14 g	
	2 lb	91 mg	
	1 lb	45 mg	
Mass Measure	1 g to 1 kg	18 mg	Mettler PR5003 DR
	1 kg to 5.1 kg	180 mg	
Torque – Measure ¹	15 ozf·in to 200 ozf·in	0.44 % + 0.3 ozf·in	Torque calibrator
	1 lbf·ft to 12.5 lbf·ft	0.44 %	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Torque – Measure ¹	12.5 lbf·ft to 600 lbf·ft	0.34 %	Torque calibrator
	600 lbf·ft to 2 000 lbf·ft	1.3 %	
Torque – Measuring Equipment ¹	15 ozf·in to 80 ozf·in	0.06 %	Torque Wheels with Weight
	0.42 lbf·ft to 50 lbf·ft	0.06 %	
	50 lbf·ft to 2 000 lbf·ft	0.06 %	Torque Arm with Weight
Pneumatic Absolute Pressure Source	0 psi to 30 psi	0.002 4 psig	DHI RPM 4
	30 psi to 1 000 psi	0.006 6 % + 0.000 1 psig	
Gage Pressure Source ¹	0 psi to 0.072 psi	43 µpsi	Micro tektor
	0.14 psi to 25 psi	0.017 % + 44 µpsi	Ametek RK-1100 WC
	-15 psi to 30 psi	0.002 1 psig	DHI RPM 4
	30 psi to 1 000 psi	0.006 6 % + 0.000 1 psig	
Hydraulic Gage Pressure Source ¹	5 psi to 15 000 psi	0.018 %	Fluke P3125-PSI

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Relative Humidity – Generate -10°C to 15°C	(10 to 75) % RH	0.5 % RH	Thunder Scientific 2500
	(75 to 95) % RH	0.65 % RH	
	15°C to 35°C	(10 to 95) % RH	
(10 to 50) % RH		0.5 % RH	
35°C to 70°C	(50 to 70) % RH	0.7 % RH	
	(70 to 95) % RH	0.85 % RH	

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Relative Humidity–Measure ¹ (10 °C to 30 °C)	10 % RH to 90 % RH 90 % RH to 99 % RH	1.3 % RH 2.3 % RH	Vaisala HMI41/HMP46
Temperature – Measuring Equipment	-20 °C to 120 °C	0.028 °C	Liquid Bath with RTD Dry Block Calibrator
	120 °C to 600 °C	0.13 °C	
	600 °C to 1 200 °C	3.1 °C	Accu-Mac AM1210 w/Furnace
Temperature – Measure	-196 °C to 0 °C 0 °C to 420 °C 420 °C to 660 °C 660 °C to 1 000 °C 1 000 °C to 1 200 °C	0.011 °C 0.026 °C 0.035 °C 0.93 °C 1.2 °C	AM1760 with Black Stack Accu-Mac AM1210
Infrared Temperature – Measuring Equipment $\lambda = (8 \text{ to } 14) \mu\text{m}$ $\epsilon = (0.1 \text{ to } 1)$	-15 °C to 0 °C	0.98 °C	Hart Black Body
	0 °C to 50 °C	0.67 °C	
	50 °C to 100 °C	0.71 °C	
	100 °C to 120 °C	0.77 °C	
	120 °C to 200 °C	0.94 °C	
	200 °C to 350 °C	1.7 °C	
	350 °C to 500 °C	2.1 °C	
	500 °C to 1 000 °C	4.8 °C	Omega Black Body

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency – Measuring Equipment and Measure ³ In – Lab	10 MHz	6.4×10^{-10} Hz/Hz	SRS FS725
Field Service ¹	10 MHz	2.1×10^{-7} Hz/Hz	HP 53131A (010) Counter

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Time- Measure ¹	Up to 599 sec/month	0.058 sec/day	Vibrograf 4500 Timometer

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
3. Uncertainty values of derivatives of 10 MHz will differ due to resolution, noise and gating errors.
4. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
5. D = diagonal in inches of device under test, L = Length in inches.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.01.



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