CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Transcat – Portland
14058 SW Milton Court
Portland, OR 97224

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

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

AC-2489.01
Certificate Number

ANAB Approval

Certificate Valid Through: 09/07/2021
Version No. 003 Issued: 05/01/2019

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).

ANSI National Accreditation Board

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

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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 10 Hz to 1 kHz	0.12 %	Ohm Labs Shunt with Current Source

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Extended Frequency Ranges [1]	29 µA to 329.99 µA 10 kHz to 30 kHz	1.2 % + 3 µA	Fluke 5520A
	330 µA to 3.299 mA 10 kHz to 30 kHz	0.78 % + 0.5 µA	
	3.3 mA to 32.99 mA 10 kHz to 30 kHz	0.31 % + 3 µA	
	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 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	 0.46 % + 200 µA 0.19 % + 200 µA 0.097 % + 200 µA 0.12 % + 200 µA	Fluke 5720A
	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	
	1 A to 10 A	0.013 %	Guildline 9211 with Current Source
	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 µV/V + 0.12 mV	Agilent 3458A opt. 2 with Fluke 5720A-EP
	500 V to 800 V	16 µV/V + 0.12 mV	
	800 V to 1 kV	21 µV/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 µV/V + 0.71 µV	Fluke 5720A with 5725A
	0.22 V to 2.2 V	5.1 µV/V + 0.71 µV	
	2.2 V to 11 V	3.7 µV/V + 2.6 µV	
	11 V to 22 V	3.8 µV/V + 4.1 µV	
	22 V to 220 V	5.1 µV/V + 41 µV	
	220 V to 1.1 kV	7 µV/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 µV	
	1 MHz to 3 MHz	3.5 % + 2.4 µV	
	3 MHz to 10 MHz	9.3 % + 2.4 µV	
	10 MHz to 20 MHz	23 % + 2.4 µV	
	1 mV to 3 mV		
	100 kHz to 1MHz	0.97 % + 2 µV	
	1 MHz to 3 MHz	3.5 % + 2 µV	
	3 MHz to 10 MHz	9.3 % + 2 µV	
	10 MHz to 20 MHz	23 % + 2 µV	

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		Vitrek 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		Vitrek 4700A/ HVL-100
	30 Hz to 70 Hz	0.16 % + 2.6 V	
	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	
	220 V to 1100 V		
	40 Hz to 1 kHz	0.011 % + 4 mV	Fluke 5720A/5725A
	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 mF 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	 0.07 % 0.071 % 0.13 % 0.21 % 0.22 % 0.48 %	Thermal Voltage Converters

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Sine Wave Flatness [1]	50 MHz to 70 MHz 70 MHz to 80 MHz 80 MHz to 100 MHz	0.75 % 0.89 % 1 %	Thermal Voltage Converters
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	
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	
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	
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	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Devices [1]	-50 °C to -30 °C	0.65 °C	Ectron 1140A
	-30 °C to 45 °C	0.59 °C	
	45 °C to 105 °C	0.42 °C	
Type S	105 °C to 310 °C	0.35 °C	
	310 °C to 615 °C	0.31 °C	
	615 °C to 1 768 °C	0.27 °C	
	250 °C to 350 °C	1.0 °C	
	350 °C to 445 °C	0.77 °C	
	445 °C to 580 °C	0.61 °C	
Type B	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	
	-270 °C to -260 °C	5.1 °C	
	-260 °C to -200 °C	1.1 °C	
	-200 °C to -140 °C	0.25 °C	
Type N	-140 °C to -70 °C	0.16 °C	
	-70 °C to 25 °C	0.13 °C	
	25 °C to 160 °C	0.11 °C	
	160 °C to 1 300 °C	0.10 °C	
	0 °C to 250 °C	0.21 °C	
	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	
Type 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
Power – Measuring Equipment (for current range listed below) 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 %	

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
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 %	
	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 %	
	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 %	
	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 %	
	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 %	
	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 %	
	1.4 W to 4.5 kW 10 Hz to 65 Hz	0.18 %	

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
4.5 A to 20.5 A	150 mW to 6.7 W 10 Hz to 65 Hz	0.17 %	
	6.7 W to 20 kW 10 Hz to 65 Hz	0.17 %	
LF Phase – Measuring Equipment [1]	0° to 90°		Fluke 5520A
	10 Hz to 65 Hz	0.11°	
	65 Hz to 500 Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	1 kHz to 5 kHz	1.9°	
	5 kHz to 10 kHz	3.9°	
	10 kHz to 30 kHz	7.8°	
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
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 Equipment [1]	250 ps nominal	51 ps NOTE 4	Fluke 5520A SC1100
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 + 3*L*) µin	Comparison to Gage Blocks
	8 in to 42 in	(13 + 4*L*) 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 + 4*L*) µin	Horizontal Comparator
Length Measurement Single Axis - Outside	0.001 in to 10 in	(3 + 4*L*) µin	Horizontal Comparator

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [5]	Reference Standard, Method and/or Equipment
Height Measuring Equipment	0 in to 4 in	(10 + 3*L*) µin	Comparison to Gage Blocks
Height Gages, Dial Gages, And Digital Indicators	4 in to 24 in	(12 + 4*L*) µin	
Dial Indicators [1]	0 in to 0.1 in	4.5 µin	Gage Blocks Surface Plate
	0.1 in to 6 in	(4 + 4*L*) µin	
Height Measure (Master 1-2-3 Blocks, Caliper Masters, Parallels)	0 in to 6 in	(10 + 3*L*) µin	Gage Blocks with Amplifier
	6 in to 24 in	(12 + 4*L*) µin	
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 µin + 1.7 √Dµin	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 + 1*L*) µin	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 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 200 mg 100 mg 50 mg 20 mg 10 mg 5 mg 2 mg 1 mg	14 mg 5.9 mg 3.1 mg 1.8 mg 1.5 mg 0.31 mg 0.14 mg 0.09 mg 0.09 mg 59 µg 41 µg 41 µg 41 µg 41 µg 41 µg 17 µg 17 µg 17 µg 17 µg 17 µg 17 µg 17 µg 17 µg 17 µg	ASTM Class 1 Weights
Balances & Scales Avoirdupois [1]	50 lb 30 lb 20 lb 10 lb 5 lb 3 lb 2 lb 1 lb	2.3 g 1.4 g 0.91 g 0.45 g 0.23 g 0.14 g 91 mg 45 mg	NIST Class F Weights
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 lfb-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 15°C to 35°C 35°C to 70°C	(10 to 75) % RH (75 to 95) % RH (10 to 95) % RH (10 to 50) % RH (50 to 70) % RH (70 to 95) % RH	0.5 % RH 0.65 % RH 0.5 % RH 0.5 % RH 0.7 % RH 0.85 % RH	Thunder Scientific 2500
Relative Humidity – Measure [1] (10 °C to 30 °C)	10 % RH to 80 % RH	1.3 % 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	-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
Sine Wave Flatness [1]	10 Hz to 100 Hz	0.069 %	Thermal Voltage Converters
	100 Hz to 300 kHz	0.069 %	
	300 kHz to 10 MHz	0.12 %	
	10 MHz to 20 MHz	0.2 %	
	20 MHz to 30 MHz	0.22 %	
	30 MHz to 50 MHz	0.44 %	
	50 MHz to 70 MHz	0.64 %	
	70 MHz to 80 MHz	0.73 %	
	80 MHz to 100 MHz	0.85 %	
Bandwidth [1]	50 kHz to 100 MHz	1.7 % + 100 µV	Fluke 5520A SC1100
	100 MHz to 300 MHz	2.2 % + 100 µV	
	300 MHz to 600 MHz	4.1 % + 100 µV	
	600 MHz to 1.1 GHz	5.1 % + 100 µV	
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.

Vice President