Calibration Laboratory Assessment Service

CLAS Certificate Number 95-02

Fluke Electronics Canada L.P.
Calibration Centre
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Clients Served: All interested parties

Field of Calibration: Electrical (dc and lf).
On-site calibrations available.

SCC Accreditation: Accredited Laboratory No. 224
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This scope of capabilities is published by the CLAS program of the National Research Council of Canada (NRC) in close co-operation with the PALCAN program of the Standards Council of Canada (SCC), Canada's accreditation body for calibration and testing laboratories. The SCC accredits the capabilities of the named laboratory for performing the listed calibrations at the given level of uncertainty with traceability to the national measurement standards of Canada. The total uncertainty of the following capabilities, in each case, has a confidence level of at least 95% and includes the NRC (or other recognized national laboratory) uncertainty, and uncertainties associated with the measurements made by the accredited laboratory. The uncertainty quoted does not include the possible effects on the customer's device of transportation, long term stability or intended use. See Supplementary Notes. For clients requiring a confidence level of 99%, the laboratory is able to adjust the uncertainty accordingly.

Type I Capabilities

Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
FREQUENCY			By phase comparison. See Type II capabilities below for frequency.
0.01 Hz to 10 MHz		0.22 parts in 10^9	Measure and source capabilities. For suitably stable sources with amplitudes between 0.1 V to 5 V rms.

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Type I Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
RESISTANCE			
Specific values			
0.01 Ω		39 ppm	See Note 1
0.1 Ω		4 ppm	
1 Ω		1.5 ppm	
10 Ω		2.1 ppm	
100 Ω		1.8 ppm	
1 kΩ		1.8 ppm	
10 kΩ		1.2 ppm	
100 kΩ		1.8 ppm	
1 MΩ		2.5 ppm	
10 MΩ		5 ppm	
19 MΩ		8 ppm	
100 MΩ		22 ppm	
1 GΩ		40 ppm	
VOLTAGE, DC			
Specific values			
1 V		1 ppm	See Note 2
1.018 V		1 ppm	See Note 3
10 V		0.5 ppm	

Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
PHASE			
± 180°	5 Hz to 10 Hz	0.200°	Best measurement capability applies only to sinusoidal signals.
	10 Hz to 50 kHz	0.05°	
± 180°	10 Hz to 30 kHz	0.1° to 10°	Generate using Multifunction Calibrator.

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Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
FREQUENCY			
0.1 mHz To 2.1 GHz		1 part in 10^9	For the calibration of frequency measuring devices using sources phase locked to frequency standard.
1 μHz to 2.7 GHz		1 part in 10^9	For the calibration of frequency generating devices using counters phase locked to frequency standard.
RISE TIME			
>150 ps		9 ps	Measured rise time with digital sampling oscilloscope using external trigger. Suitable for the calibration of pulse generators.
>200 ps		14 ps	Measured rise time with digital sampling oscilloscope using external splitter and delay line to provide trigger. Suitable for the calibration of pulse generators.
>150 ps		9 ps to 1ns	Generate with pulse repetition frequencies of 1kHz, 10kHz, 100 kHz and 1 MHz. Suitable for the calibration of oscilloscope calibrators.

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Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
CURRENT, DC			On-site calibrations available. See note 11.
10 μA to 20 A		40 to 3 ppm	For the calibration of current sources
10 nA to 20 A		100 ppm to 3 ppm	For the calibration of current measuring devices.
CURRENT, AC/DC TRANSFER			
200 μA to 2 A	10 Hz to 30 kHz	60 ppm to 200 ppm	For the calibration of current sources using an AC/DC transfer standard, and for characterizing AC current sources.
5 mA to 20 A	40 Hz to 10 kHz	100 ppm to 150 ppm	
20 mA and 200 mA	10 Hz to 10 kHz	60 ppm to 300 ppm	
2 A and 10 A	10 Hz to 10 kHz	100 ppm to 150 ppm	
CURRENT, AC			On-site calibrations available. See note 11.
10 μA to 11 A	10 Hz to 10 kHz	160 ppm to 1%	See Note 4
10 μA to 1 A	10 Hz to 10 kHz	300 ppm to 0.3%	See Note 5
VOLTAGE, AC			On-site calibrations available. See Note 11.
0.3 mV to 22 V	10 Hz to 1 MHz	80 ppm to 0.28%	See Note 8
22 V to 220 V	10 Hz to 1 MHz	80 ppm to 1.3%	
220 V to 1100 V	40 Hz to 30 kHz	80 ppm to 360 ppm	
220 V to 750 V	30 kHz to 100 kHz	360 ppm to 0.13%	
1 mV to 10 mV	10 Hz to 300 kHz	0.02% to 4%	See Note 9
10 mV to 100 V	10 Hz to 1 MHz	90 ppm to 1.5%	
100 V to 700 V	10 Hz to 100 kHz	420 ppm to 0.3%	
0.3 mV to 70 V	10 Hz to 1 MHz	24 ppm to 1.2%	See Note 10
70 V to 220 V	10 Hz to 500 kHz	31 ppm to 500 ppm	
200 V to 1000 V	10 Hz to 100 kHz	38 ppm to 500 ppm	

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Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
VOLTAGE, AC (continued)			
Triangular waveform			See note 10
5 mVpp to 60 Vpp	10 Hz to 100 kHz	52ppm to 870ppm	
Square waveform			
5 mVpp to 60 Vpp	10 Hz to 10 kHz	52ppm to 870ppm	
5 mVpp to 60 Vpp	10 kHz to 100 kHz	232ppm to 1050ppm	
1 mVpp to 100 Vpp	10 Hz to 1 kHz	25ppm +1uV	Using a sampling technique. See note 10.
0.1 Vpp to 100 Vpp	1 kHz to 10 kHz	125ppm +5uV	
VOLTAGE, DC			On-site calibrations available. See note 11.
Specific Values			For the calibration of high accuracy digital meters, multi-function calibrators, and similar devices using a combination of multi-function calibrators, voltage reference standards, and voltage ratio standards
100 mV		4 ppm	
1 V		1 ppm	
10 V		0.5 ppm	
100 V		0.7 ppm	
1000 V		1 ppm	
Other Values			See Note 8
1 mV to 22 V		0.05% to 3 ppm	
22 V to 1.1 kV		3 ppm to 9 ppm	
10 mV to 10 V		100 ppm to 4 ppm	
10 V to 1000 V		4 ppm to 15 ppm	
VOLTAGE, AC/DC TRANSFER			For the calibration of voltage sources using an AC/DC transfer standard. See Annex A for details.
2 mV	10 Hz to 1 MHz	600 ppm to 2200 ppm	
10 mV to 0.2 V		26 ppm to 800 ppm	
0.6 V to 20 V		7 ppm to 150 ppm	
60 V	10 Hz to 300 kHz	15 ppm to 150 ppm	
100 V to 1000 V	10 Hz to 100 kHz	16 ppm to 150 ppm	

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Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
RESISTANCE			On-site calibrations available. See note 11.
1 Ω to 1 GΩ		3 ppm to 70 ppm	See Note 6.
0.01 Ω to 1 GΩ		2 ppm to 70 ppm	See Note 7.
CAPACITANCE			Measure using an LCR meter. Suitable for the calibration of capacitors and the capacitance function of multifunction calibrators (such as the Fluke 5500 series of calibrators).
5 pF to 300 μF	50 Hz to 10 kHz	0.05% to 5%	
200 μF to 110 mF		0.05%	Measure using a constant current source and a DMM. Suitable for the calibration of the capacitance function of multifunction calibrators (such as the Fluke 5500 series of calibrators).
0.19 nF to 1 μF	10 Hz to 10 kHz	1.4% to 5.8%	On-site calibrations available. See note 11.
1 μF to 110 μF	10 Hz to 80 Hz	0.34% to 1.4%	Source synthesized capacitance using a multifunction calibrator.
110 μF to 110 mF	DC to 50 Hz	0.55% to 1.2%	
Specific Values			
10 nF	1 kHz	0.01%	Calibration of 10 nF, 0.1 μF and 1.0 μF capacitors by substitution method using LCR meter. Suitable for the calibration of LCR meters.
0.1 μF	1 kHz	0.01%	
1.0 μF	1 kHz	0.01%	

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Type II Capabilities			
Measured Quantity & Range or Instrument	Frequency	Best Measurement Capability expressed as an Uncertainty (±) (see Supplementary Notes)	Remarks
ELECTRICAL CALIBRATION OF TEMPERATURE INDICATORS AND SIMULATORS -250 °C to 2316 °C		0.05 °C to 0.6 °C	On-site calibrations available. See note 11. Source for types B, E, J, K, N, R, S, and T thermocouples using multifunction calibrators. Suitable for the calibration of temperature indicators, process calibrators and multi-product calibrators (such as the Fluke 5500 series) by electrical simulation of temperature. ITS-90 or IPTS-68 temperature scales available.
TEMPERATURE **Resistance Temperature Devices** 0 to 100 °C		0.03 °C	For the calibration of resistance temperature devices in a liquid bath. See note 12.

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Notes

1. For the calibration of high accuracy multi-function calibrators, digital multimeters, and standard resistors. Standard resistors are calibrated in air at a nominal temperature of 23 °C and must have a relatively low temperature coefficient to achieve this uncertainty. Calibration in oil at a nominal temperature of 25 °C is also available.

2. For the calibration of high accuracy voltage standards including solid-state devices.

3. For the calibration of high accuracy solid-state voltage standards, multi-function calibrators, and digital multimeters.

4. For the calibration of current measuring devices.

5. For the calibration of current generating devices and equipment.

6. For the calibration of resistance measuring devices over a wide range of resistance using fixed resistors in 1.0 Ω and 1.9 Ω decades.

7. For the calibration of resistors and resistance devices over a wide range of resistance and conditions.

8. For the calibration of voltage measuring devices using multi-function calibrators.

9. For the calibration of voltage sources using high accuracy digital multimeters.

10. For the calibration of voltage sources using an AC measurement standard.

11. The range of uncertainties for the best measurement capability may be larger for on-site calibrations.

12. Individual RTDs are calibrated using the laboratory's measuring devices. It is the client's responsibility to evaluate any additional uncertainties introduced by the client's measurement system. RTD thermometers consisting of a temperature indicator and RTD(s) are calibrated as a system.

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Supplementary Notes

A. Calibration capabilities are traceable to the national measurement standards of Canada held or accepted by the National Research Council (NRC) or, with the agreement of NRC, to the national measurement standards of other countries and are thus traceable to the internationally accepted representation of the appropriate SI (Système International) unit.

B. Laboratories are certified by the NRC's Calibration Laboratory Assessment Service (CLAS) for one or more of the following capabilities:

Type I: A capability of which the primary purpose is the calibration of measurement standards for other calibration laboratories. A laboratory with this type of capability has the appropriate reference standards, working standards, check standards, and calibration systems to be able to assess dynamically and to quantify its measurement uncertainty, and is able to monitor its measurement processes continually. The environmental conditions that affect the laboratory's measurements are closely monitored and controlled. A laboratory with this type of capability usually reports a measurement value accompanied by a comprehensive statement of uncertainty. A laboratory with this type of capability is often referred to as a standards or standards calibration laboratory.

Type II: A capability of which the main purpose is the calibration and adjustment of test, measurement and diagnostic equipment for use in product testing, manufacturing, servicing, etc. A laboratory with this type of capability has the appropriate working standards and calibration systems to be able to calibrate to a manufacturer's specification and tolerance or calibrate to a written standard, using appropriate test uncertainty ratios (TUR). A laboratory with this type of capability usually reports a measurement value and indicates if the test equipment complies with a specification, tolerance or a written standard. It will, usually, base its capabilities on the specifications and tolerances of the working standards being used. It also has, normally, the means to check its working standards between calibrations and has available the appropriate environment(s). A laboratory with this type of capability is often referred to as a test equipment calibration laboratory.

Type III: A calibration capability, within a laboratory, mobile or fixed, with the appropriate reference or working standards, of which the main purpose is to provide a reference. A laboratory with this type of capability usually has minimal means to monitor its calibration system. It relies mainly on the values assigned by higher echelon laboratories to its standards and uses these values with few other considerations to assign values or verify the compliance of equipment being calibrated to their specifications and tolerances or to written standards. This could be an on-site service subject to a wide range of environmental factors.

C. The best measurement capability includes the uncertainty associated with the calibration of the accredited laboratory's reference or transfer standard by NRC, or by a laboratory acceptable to CLAS, uncertainties caused by the transportation of the calibrated reference standard from NRC (or other laboratories) to the accredited laboratory, uncertainties of the calibration process in the accredited laboratory, and uncertainties due to the behaviour of a typical measurement device during its calibration. These uncertainties include components which could have been evaluated by statistical methods on a series of repeated measurements and which can be characterised by experimental standard deviations. The other components, which can also be characterised by standard deviations, are evaluated from assumed probability distributions based on experience or other information. These have been combined to form an expanded uncertainty $U = ku_c$ with U determined from a combined standard uncertainty u_c and a coverage factor $k = 2$. Since it can be assumed that the probability distribution characterised by the reported result and u_c is approximately normal, the value of a calibrated device can be asserted to lie in the interval represented by the expanded uncertainty U with a level of confidence of approximately 95 percent. The uncertainties quoted do not include the possible effects on the calibrated device of transportation, long term stability or intended use. For clients requiring a confidence level of 99%, the laboratory is able to adjust the uncertainty accordingly.

D. The uncertainty of a specific calibration by an accredited laboratory can be greater than the best measurement capability because it will include uncertainties due to the actual condition and behaviour of the customer's device during its calibration.

E. As a rule, the smaller the uncertainty sought the greater the cost. Users should not demand uncertainties inappropriate to the device being calibrated or its intended use.

F. SCC accreditation and CLAS certification is the formal recognition of specific calibration capabilities. Neither the NRC nor the SCC guarantee the accuracy of individual calibrations by recognised laboratories.

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Annex A
Uncertainty (± ppm) of AC/DC Transfer of Voltage

Voltage		Frequency												
Range	Input	10 Hz	20 Hz	40 Hz	100 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	300 kHz	500 kHz	800 kHz	1 MHz
22 mV	0.002	940	740	600	740	600	730	740	600	860	1200	1900	2100	2200
	0.006	350	220	200	200	200	200	200	280	500	720	910	650	740
	0.010	280	150	100	150	160	150	150	200	300	400	590	600	600
	0.020	200	120	100	100	100	100	100	150	300	500	600	800	800
220 mV	0.020	180	120	120	110	110	110	110	150	300	500	600	800	800
	0.060	200	62	60	42	44	43	45	80	120	260	340	400	410
	0.100	120	50	35	35	35	30	30	60	120	180	250	325	325
	0.200	100	60	39	26	26	26	26	40	80	130	200	280	280
700 mV	0.200	100	60	40	30	30	30	30	45	100	130	220	270	270
	0.600	150	40	28	20	20	20	20	35	55	100	110	110	110
2.2 V	0.600	150	40	28	20	20	20	20	35	55	100	110	110	110
	1.000	150	40	28	10	11	11	10	35	45	100	110	110	110
	2.000	150	40	20	7	7	7	7	35	45	100	110	110	110
7 V	2.000	150	40	25	15	13	13	14	37	45	100	110	110	110
	6.000	150	40	20	8	8	8	8	35	45	100	110	110	110
22 V	6.000	150	40	25	10	13	12	14	40	45	100	110	110	110
	10.000	150	40	25	13	13	13	13	35	45	100	110	110	130
	20.000	150	40	20	13	13	13	13	35	45	100	110	110	110
70 V	20.000	150	40	25	20	20	20	20	40	52	100			
	60.000	150	40	20	15	15	15	15	40	55	100			
220 V	60.000	150	40	25	22	20	22	23	41	55	100			
	100.000	150	40	27	17	17	17	17	40	55				
	200.000	150	40	26	16	16	16	16	45	65				
1000 V	200.000	150	50	33	20	20	25	30	50	65				
	600.000	150	50	30	26	26	26	26	45	65				
	1000.000	150	50	26	20	20	26	26	45	65				