

## Calibration Scope

Roos Instruments, Inc.  
2285 Martin Avenue  
Santa Clara, California 95050  
United States of America  
408-748-8589

### 1.0 Purpose/Objective

This document outlines the measurement capabilities and an estimation of measurement uncertainties and/or errors for calibration with the Roos Instruments, Inc. manufacturing and field service operations.

### 2.0 General Scope

The electronic and physical measurement limitations and characteristics of the Roos Instruments calibration transfer standards are used in all manufacturing and field service operations. Values shown represent best measurement capabilities.

### 3.0 Definitions

3.1 Calibration: A set of procedures that when executed establish under specific conditions the relationship between the values indicated by a measuring instrument and the corresponding know characteristics of a particular transfer standard.

3.2 Transfer Standard: A physical or electrical device that has its performance characteristics measured, documented and compared to a know reference at Primary calibration laboratory such as US National Institute of Science and Technology (NIST).

3.3. Measurement Uncertainty: Calculated estimation of maximum errors possible in measurement accuracy at a specific point or function for a given measuring instrument.

For more information:  
[roos.com/support](http://roos.com/support)

## 4. DC/Low Frequency Transfer Standards

### 4.1 Fluke 87IV Multimeter

Measurements	Uncertainty Label	Uncertainty Value
Voltage DC	Maximum voltage	1000 V
	Accuracy	$\pm(0.05\% + 1)$
	Maximum resolution	10 $\mu$ V
Voltage AC	Maximum voltage	1000 V
	Accuracy	$\pm(0.7\% + 2)$ True RMS
	AC bandwidth	20 kHz with low pass filter; 3 db @ 1 kHz
Current DC	Maximum resolution	0.1 mV
	Maximum amps	10 A (20 A for 30 seconds maximum)
	Amps accuracy	$\pm(0.2\% + 2)$
Current AC	Maximum resolution	0.01 $\mu$ A
	Maximum amps	10 A (20 A for 30 seconds maximum)
	Amps accuracy	$\pm(1.0\% + 2)$ True RMS
Resistance	Maximum resolution	0.1 $\mu$ A
	Maximum resistance	50 M $\Omega$
	Accuracy	$\pm(0.2\% + 1)$
Capacitance	Maximum resolution	0.1 $\Omega$
	Maximum capacitance	9,999 $\mu$ F
	accuracy	$\pm(1\% + 2)$
Frequency	Maximum resolution	0.01 nF
	Maximum frequency	200 kHz
	Accuracy	$\pm(0.005\% + 1)$
Duty cycle	Maximum resolution	0.01 Hz
	Maximum duty cycle	99.9%
	Accuracy	$\pm(0.2\%$ per khz + 0.1%)
Temperature measurement	Maximum resolution	0.1%
		-200.0°C –1090°C -328.0°F –1994.0°F excluding probe
80 BK temperature probe		-40.0°C –260°C -40.0°F –500°F, 2.2°C or 2% whichever is greater

Measurements	Uncertainty Label	Uncertainty Value
Conductance	Maximum conductance	60.00 nS
	Accuracy	$\pm(1.0\% + 10)$
	Maximum resolution	0.01 nS
Diode	Range	3 V
	Resolution	1 mV
	Accuracy	$\pm(2\% + 1)$
Duty cycle range	Accuracy	Within $\pm(0.2\%$ per kHz + 0.1%)

Environmental Specifications	
Operating temperature	-°C to + 55°C
Storage temperature	-°C to + 60°C
Humidity (without condensation)	0% – 90% (0°C – 35°C) 0% – 70% (35°C – 55°C)
Operating Altitude	2000 m

Safety Specifications	
Overvoltage category	EN 61010 to 1000 V CAT III, 600V CAT IV
Agency approvals	UL, CSA, TÜV, VDE listed

## 4.0 RF Transfer Standards up to 40 GHz

### 4.1 Gigatronics 8541C RF Power Meter with Gigatronics 80324A Power Sensor

The accuracy calculation table lists the significant uncertainties of an absolute power measurement. The accuracy of the 8541C combined with the 80324A sensor is shown at +20 dBm, 0 dBm, and -30 dBm; Frequency = 1 GHz; Source Match = 1.5:1.

Measurements	Uncertainty at 1 GHz, 1.5:1 Source Match		
	@ 20 dBm	@ 0 dBm	@ -30 dBm
8541C with 80324A			
Instrumentation Uncertainty	±5.2%	±0%	±0.925%
Sensor Power Linearity (>8 GHz)	±0%	±0%	±0%
Calibrator Uncertainty	±1.2%	±1.2%	±1.2%
Calibrator/Sensor Mismatch	±0.28%	±0.28%	±0.28%
Calibration Factor Uncertainty	±1.04%	±1.04%	±1.04%
Zero Error	±0.00000005%	±0.00000005%	±0.005%
Noise	±0.00000005%	±0.00000005%	±0.005%
Mismatch (Sensor/Source)	±2.25%	±2.25%	±2.25%
% Total Uncertainty	±9.97%	±4.77%	±5.71%
dB Total Uncertainty	±0.41 dB	±0.20 dB	±0.24 dB

## 4.2 Micronetics NS346KA RF Noise Power Source

Measurements	Uncertainty
RF Frequency	100 MHz to 40000 MHz
Noise Output	10 - 17 dB ENR
Noise Spectral Density	-160.5 dBm/Hz
VSWR	1.25:1 Max (5 - 12 GHz)
	1.30:1 Max (12 - 18 GHz)
	1.40:1 Max (18 - 26.5 GHz)
	1.50:1 Max (26.5 - 40 GHz)

## 4.3 Anritsu SC7777 Open Short Load Standards (OSL K-Connector)

Measurements	Uncertainty Label	Uncertainty Value
Reference Plane Pin Depth	FEMALE	0.207 ±0.003 inches (5.2578 ±0.0762 mm)
	MALE	-0.207 ±0.003 inches (-5.2578 ±0.0762 mm)