

MODEL 9041

EXTENDED SPECIFICATIONS



25ppm TRANSPORTABLE CALIBRATOR

(ES) Equipements Scientifiques SA - Département Tests & Mesures - 127 rue de Buzenval BP 26 - 92380 Garches
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Warm Up Time	Double the time since last used up to 20 minutes maximum	
Standard Interfaces	USB	
Optional Interfaces	RS232 (Serial)	
Temperature Performance	Storage : -5°C to +60°C Operation : 0°C to +50°C	
Relative Humidity	Operation : <80% to 30°C, <70% to 40°C, <40% to 50°C Storage : <95%, non-condensing	
Altitude	Operation : 3000m (10,000ft) Maximum Transit : 12000m (40,000ft) Maximum	
EMC & Safety	The calibrator line input plug must be earthed See D.O.C for full details	
Line Power	Line Voltage Selectable : 110V / 230V Line Frequency : 50Hz to 60Hz Line Voltage Variation : -6% +10%	
Power Consumption	28 Watts (Standby)	200 Watts (Maximum)
Low Analogue Isolation	100V	
Connections	Voltage / 2 Wire Resistance Low Current (<=2A) High current (>2A) Earth Connection Oscilloscope Functions Adapter Interface USB Interface	1x Black : 1x White 4mm Safety sockets 1x Black : 1x Red 4mm Safety sockets 1x Blue : 1x Yellow 4mm Safety sockets 1x Green 4mm Safety Socket 2x BNC terminal 1x Female 'D' type socket 1x Female 'B' type socket
Display Information	Type Viewing Area Resolution Backlight Type Brightness	Backlit blue on white STN Type 133mm * 39mm 240 x 64 dots LED 230 to 260 cd/m ²
Indicators	Voltage / Current / High Current Negative to ground Oscilloscope Feature Connector (Ext. Pod)	Red LED (between terminals) Green LED (left of Earth terminal) Green LED (right of BNC Connector) Green LED (right of 'D' type connector)
Keyboard	Rubber key	
Fuses	Mains Inlet	3.15A A/S (240 Volt) 5A A/S (110 Volt operation)
Isolation	Outputs are opto-isolated from mains earth and the USB interface Maximum common mode voltage between earth and the low terminals 30 Volts ac/dc.	
Dimensions & Weights	Calibrator Only	60cm x 50cm x 46cm : 28kgs
Warranty Period	1 Year (Parts & Labour)	
Recommended Service Interval	1 Year	
Supplied Connections	1x USB Interface Lead (Type A to Type B) 1x Adaptor Connection Lead (if at least one adaptor ordered)	1x Mains Lead
Optional Lead Set Kit	1x Voltage connection leadset 1x Low Current connection leadset 1x High current connection leadset 1x AC connection leadset	
Case Colour	Black	

1 Year Total Accuracy Specifications at TCal $\pm 5^{\circ}\text{C}$ & Range Parameters

Range	Resolution	Max. Burden Current	Typical Output Resistance ¹	Overload Protection	1 Year Total ppm set μV
0-202mV	0.1 μV	1mA ²	50 Ohms	20 V	30 + 3.6
0.2-2.02V	1 μV	50mA	0.2 Ohms	150V	30 + 5
2-20.2V	10 μV	50mA	0.2 Ohms	150V	25 + 40
20-202V	100 μV	20mA ³	0.5 Ohms	1200V	30 + 400
200-1025V	1mV	20mA ³	0.7 Ohms	1200V	30 + 4000

Stability (Accuracy relative to calibration Standards)

Range	24 Hour Stability		Noise ⁴ μV	90 day Rel		180 Day Rel		1 year Rel		2 year Rel	
	ppm Set	μV		ppm Set	μV	ppm Set	μV	ppm Set	μV	ppm Set	μV
0-202mV	7 + 1		0.3	21.6 + 3		24.3 + 3		27 + 3		37.8 + 4.2	
0.2-2.02V	7 + 2		0.7	21.6 + 4		24.3 + 4		27 + 4		37.8 + 5.6	
2-20.2V	6 + 18		5.9	17.6 + 39		19.8 + 39		22 + 39		30.8 + 54.6	
20-202V	7 + 280		92	21.6 + 400		24.3 + 400		27 + 400		37.8 + 560	
200-1025V	7 + 2100		693	21.6 + 4000		24.3 + 4000		27 + 4000		37.8 + 5600	

Notes

Note 1 : Allowance must be made for output resistance when driving into a load.

Note 2 : Limited by 50 Ohm output impedance.

Note 3 : Internally adjustable from 2mA to 30mA - Factory set to 20mA as standard.

For safety the trip is controlled by a fail-safe circuit independent of the processor which shuts the high voltage output off in the event of an overload.

Note 4 : Typical RMS noise figures at 50% of full scale, bandwidth 1 to 10Hz.

High Voltage Safety

High voltage output is ramped to allow instrument under test to auto range.

Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage.

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting.

High voltage (> 20V) output is indicated to user through an audible warning beep.

An external high voltage output/standby control switch is available as an option.

2 Wire output / Remote sensing not available.

Isolation : Floating or grounded selection available as standard.

Maximum floating voltage : 100V

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

DCV Specifications : V1.60

1 Year Total Accuracy Specifications at TCal $\pm 5^{\circ}\text{C}$ & Range Parameters

Range	Resolution	Max. Inductive Load	Compliance Voltage	Overload Protection	1 Year Total		
					% set		μA
0-202 μA	100pA	10mH	4.2 Volts	150V	0.010	+	0.03
0.2-2.02mA	1nA	10mH	4.2 Volts	150V	0.008	+	0.04
2-20.2mA	10nA	10mH	4.2 Volts	150V	0.005	+	0.3
20-202mA	100nA	10mH	4.2 Volts	150V	0.008	+	3
0.2-2.02A	1 μA	10mH	4.2 Volts	150V	0.015	+	35
2-30A	10 μA	10mH	3.9 Volts	150V	0.040	+	350

Stability (Accuracy relative to calibration Standards)

Range	Noise ¹ 0.1-1Hz	90 day Rel %Set μA	180 Day Rel %Set μA	1 year Rel %Set μA	2 year Rel %Set μA
0-202 μA	180pA	0.0064 + 0.03	0.0072 + 0.03	0.0080 + 0.03	0.0112 + 0.042
0.2-2.02mA	500pA	0.0056 + 0.04	0.0063 + 0.04	0.0070 + 0.04	0.0098 + 0.056
2-20.2mA	4nA	0.0032 + 0.3	0.0036 + 0.3	0.0040 + 0.3	0.0056 + 0.42
20-202mA	40nA	0.0040 + 3	0.0045 + 3	0.0050 + 3	0.0070 + 4.2
0.2-2.02A	1 μA	0.0064 + 35	0.0072 + 35	0.0080 + 35	0.0112 + 49
2-30A ²	20 μA	0.0240 + 350	0.0270 + 350	0.0300 + 350	0.0420 + 490

Notes

Note 1 : Typical RMS noise figures at 50% of full scale.

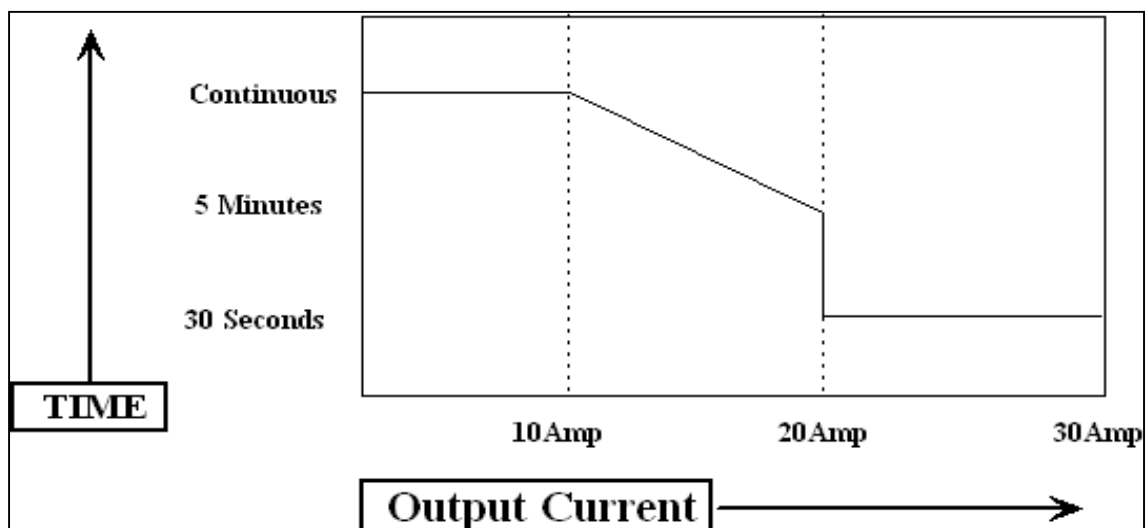
Note 2 : Power & temperature sensor on 30A range - microprocessor monitors & protects from overheating.
Higher resistance loads allow a longer ON period. See graph 1 for details.

Note 3 : Specifications apply to loads of less than 10% of the maximum burden voltage.

Note 4: Zero or floor allowance.

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.



* Note Timing is started after a minimum period of 7 minutes at zero output.
Shorter periods will reduce the output time available.

1 Year Total Accuracy Specifications at TCal $\pm 5^{\circ}\text{C}$ & Range Parameters

Range	Frequency	Resolution	Max. Burden Current	Typical Output Resistance	Overload Protection	1 year Accuracy % set uV		
0-202mV	10 to 44Hz	1uV	1mA ¹	50 Ohms	20 V	0.2000	+	50
	45 to 999Hz	1uV	1mA ¹	50 Ohms	20 V	0.0400	+	20
	1 to 19.999kHz	1uV	1mA ¹	50 Ohms	20 V	0.0900	+	35
	20 to 99.999kHz	1uV	1mA ¹	50 Ohms	20 V	0.3000	+	70
	100 to 500kHz	1uV	1mA ¹	50 Ohms	20 V	0.8000	+	380
0.2-2.02V	10 to 44Hz	10uV	50mA	0.2 Ohms	1200V	0.2000	+	350
	45 to 999Hz	10uV	50mA	0.2 Ohms	1200V	0.0400	+	90
	1 to 19.999kHz	10uV	50mA	0.2 Ohms	1200V	0.0900	+	135
	20 to 99.999kHz	10uV	50mA	0.2 Ohms	1200V	0.2500	+	2000
	100 to 500kHz	10uV	50mA	0.2 Ohms	1200V	0.4500	+	3800
2-20.2V	10 to 44Hz	100uV	50mA	0.2 Ohms	1200V	0.2000	+	3000
	45 to 999Hz	100uV	50mA	0.2 Ohms	1200V	0.0350	+	900
	1 to 19.999kHz	100uV	50mA	0.2 Ohms	1200V	0.0700	+	1350
	20 to 100kHz	100uV	50mA	0.2 Ohms	1200V	0.2200	+	33000
20-202V	30 to 44Hz	1mV	20mA ²	0.5 Ohms	1200V	0.0600	+	20mV
	45 to 999Hz	1mV	15mA ²	0.5 Ohms	1200V	0.0400	+	7.5mV
	1kHz to 20kHz	1mV	2mA ²	0.5 Ohms	1200V	0.0900	+	40mV
200-1020V ³	30 to 45Hz	10mV	20mA ²	0.7 Ohms	1200V	0.0600	+	200mV
	45 to 999Hz	10mV	15mA ²	0.7 Ohms	1200V	0.0400	+	75mV
	1kHz to 10kHz	10mV	2mA ²	0.7 Ohms	1200V	0.1500	+	400mV

Stability (Accuracy relative to calibration Standards)

Range	Frequency	Frequency	90 day Rel		180 Day Rel		1 year Rel			2 year Rel				
		Resolution	%Set	uV	%Set	uV	%Set	uV	%Set	uV				
0-202mV	10 to 44Hz	1Hz	0.1440	+	50	0.1620	+	50	0.1800	+	50	0.2520	+	70
	45 to 999Hz	1Hz	0.0240	+	20	0.0270	+	20	0.0300	+	20	0.0420	+	28
	1 to 19.999kHz	1Hz	0.0560	+	35	0.0630	+	35	0.0700	+	35	0.0980	+	49
	20 to 99.999kHz	1Hz	0.2240	+	70	0.2520	+	70	0.2800	+	70	0.3920	+	98
	100 to 500kHz	1Hz	0.4800	+	380	0.5400	+	380	0.6000	+	380	0.8400	+	532
0.2-2.02V	10 to 44Hz	1Hz	0.1440	+	350	0.1620	+	350	0.1800	+	350	0.2520	+	490
	45 to 999Hz	1Hz	0.0240	+	90	0.0270	+	90	0.0300	+	90	0.0420	+	126
	1 to 19.999kHz	1Hz	0.0480	+	135	0.0540	+	135	0.0600	+	135	0.0840	+	189
	20 to 99.999kHz	1Hz	0.1760	+	2000	0.1980	+	2000	0.2200	+	2000	0.3080	+	2800
	100 to 500kHz	1Hz	0.3280	+	3800	0.3690	+	3800	0.4100	+	3800	0.5740	+	5320
2-20.2V	10 to 44Hz	1Hz	0.1440	+	3000	0.1620	+	3000	0.1800	+	3000	0.2520	+	4200
	45 to 999Hz	1Hz	0.0224	+	900	0.0252	+	900	0.0280	+	900	0.0392	+	1260
	1 to 19.999kHz	1Hz	0.0400	+	1350	0.0450	+	1350	0.0500	+	1350	0.0700	+	1890
	20 to 100kHz	1Hz	0.1440	+	33000	0.1620	+	33000	0.1800	+	33000	0.2520	+	46200
20-202V	30 to 44Hz	1Hz	0.0320	+	20mV	0.0360	+	20mV	0.0400	+	20mV	0.0560	+	28mV
	45 to 999Hz	1Hz	0.0240	+	7.5mV	0.0270	+	7.5mV	0.0300	+	7.5mV	0.0420	+	11mV
	1kHz to 20kHz	1Hz	0.0560	+	40mV	0.0630	+	40mV	0.0700	+	40mV	0.0980	+	56mV
200-1020V	30 to 45Hz	1Hz	0.0320	+	200mV	0.0360	+	200mV	0.0400	+	200mV	0.0560	+	280mV
	45 to 999Hz	1Hz	0.0240	+	75mV	0.0270	+	75mV	0.0300	+	75mV	0.0420	+	105mV
	1kHz to 10kHz	1Hz	0.0960	+	400mV	0.1080	+	400mV	0.1200	+	400mV	0.1680	+	560mV

All specifications apply from 10% of full scale. ⁵

AC Frequency Accuracy : 30ppm of Setting

Notes
Note 1: Current limited by 50 ohms output resistance.
Note 2 : Internally adjustable from 2mA to 30mA - Factory set to 20mA as standard For safety the trip is controlled by a fail-safe circuit independant of the processor which shuts the high voltage output off in the event of an overload.
Note 3 : Frequency and voltage combinations are limited. See Volt-Hertz profile in Graph 3
Note 4 : Allowance must be made for output resistance when driving into a load.
Note 5 : Zero or floor allowance.

2 Wire output / Remote sensing not available. Maximum floating voltage : 100V.

THD less than .6%

Isolation : Floating or grounded selection available as standard.

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

High Voltage Safety

High voltage output is ramped to allow instruments under test to auto-range.

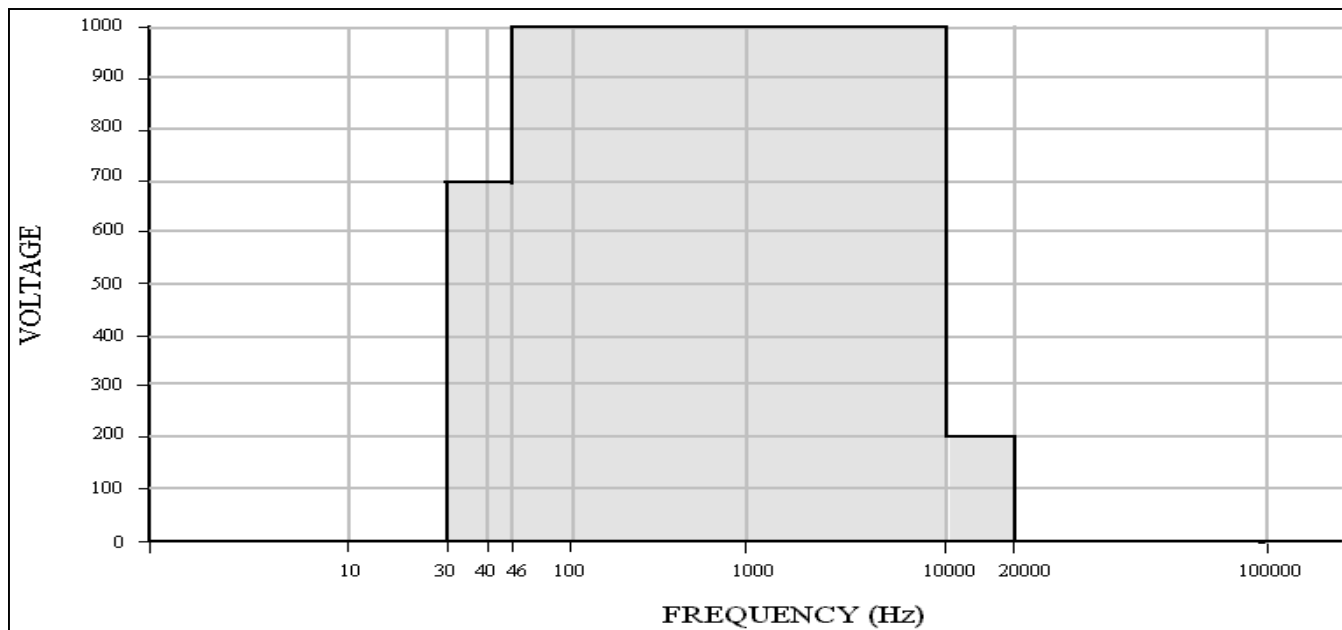
Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting for frequencies

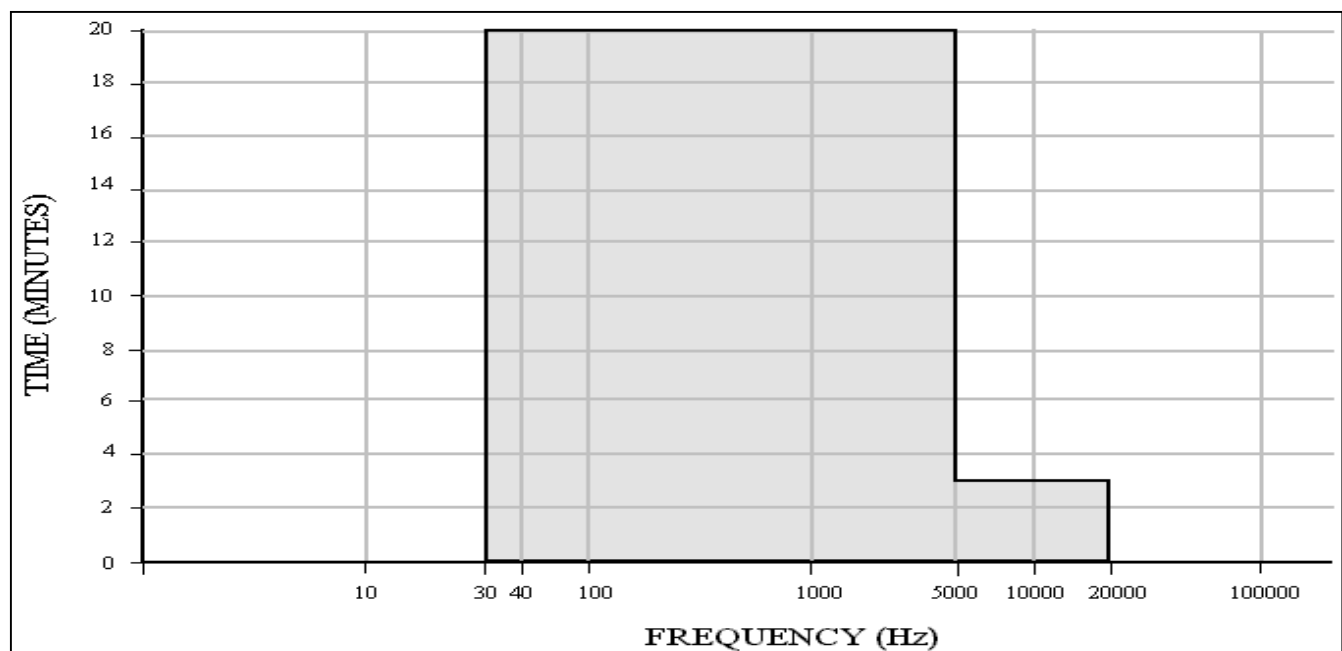
up to 5kHz or 3 mins for frequencies above 5kHz.

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option



Graph 3 : Volt-Hertz profile for 1000V AC range



Graph 4 : Time-Hertz profile for voltages above 20V

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

ACV Specifications : V1.60

1 Year Total Accuracy Specifications at TCal $\pm 5^{\circ}\text{C}$ & Range Parameters

Range	Frequency	Resolution	Maximum Burden Voltage (Peak)	Overload Protection	1 year Accuracy		
					%Set		μA
20-202 μA	10Hz to 44Hz	1nA	3 Volts	150V	0.20	+	0.25
	45Hz to 999Hz				0.07	+	0.25
	1kHz to 10kHz				0.80	+	0.25
0.2-2.02mA	10Hz to 44Hz	10nA	3 Volts	150V	0.20	+	0.5
	45Hz to 999Hz				0.06	+	0.4
	1kHz to 10kHz				0.70	+	0.7
2-20.2mA	10Hz to 44Hz	100nA	3 Volts	150V	0.20	+	5
	45Hz to 999Hz				0.06	+	4
	1kHz to 10kHz				0.50	+	7
20-202mA	10Hz to 44Hz	1 μA	3 Volts	150V	0.20	+	50
	45Hz to 999Hz				0.06	+	40
	1kHz to 10kHz				0.60	+	70
0.2-2.02A	10Hz to 44Hz	10 μA	3 Volts	150V	0.20	+	500
	45Hz to 999Hz				0.09	+	400
	1kHz to 5kHz				0.60	+	700
2-30.0A	30Hz to 44Hz	100 μA	2.8 Volts	150V	0.20	+	5000
	45Hz to 99Hz				0.09	+	2000
	100Hz to 1kHz				0.30	+	4000

All specifications apply from 10% of full scale.

AC Frequency Accuracy : 30ppm

Settling Time: For 50% change in output: Less than 3 second from standby to within spec

Inductive Loads : Up to 1H may be connected without additional protection providing the frequency / inductance combination does not exceed the maximum burden voltage.

Stability (Accuracy relative to calibration Standards)

Range	Frequency	Frequency Resolution	90 day Rel		180 Day Rel		1 year Rel		2 year Rel	
			%Set	μA	%Set	μA	%Set	μA	%Set	μA
20-202 μA	10Hz to 44Hz	1Hz	0.1360	+ 0.25	0.1530	+ 0.25	0.1700	+ 0.25	0.2380	+ 0.35
	45Hz to 999Hz	1Hz	0.0400	+ 0.25	0.0450	+ 0.25	0.0500	+ 0.25	0.0700	+ 0.35
	1kHz to 10kHz	1Hz	0.8800	+ 0.25	0.9900	+ 0.25	1.1000	+ 0.25	1.5400	+ 0.35
0.2-2.02mA	10Hz to 44Hz	1Hz	0.1360	+ 0.5	0.1530	+ 0.5	0.1700	+ 0.5	0.2380	+ 0.7
	45Hz to 999Hz	1Hz	0.0320	+ 0.4	0.0360	+ 0.4	0.0400	+ 0.4	0.0560	+ 0.56
	1kHz to 10kHz	1Hz	0.4800	+ 0.7	0.5400	+ 0.7	0.6000	+ 0.7	0.8400	+ 0.98
2mA-20.2mA	10Hz to 44Hz	1Hz	0.1360	+ 5	0.1530	+ 5	0.1700	+ 5	0.2380	+ 7
	45Hz to 999Hz	1Hz	0.0320	+ 4	0.0360	+ 4	0.0400	+ 4	0.0560	+ 5.6
	1kHz to 10kHz	1Hz	0.3200	+ 7	0.3600	+ 7	0.4000	+ 7	0.5600	+ 9.8
20-202mA	10Hz to 44Hz	1Hz	0.1360	+ 50	0.1530	+ 50	0.1700	+ 50	0.2380	+ 70
	45Hz to 999Hz	1Hz	0.0320	+ 40	0.0360	+ 40	0.0400	+ 40	0.0560	+ 56
	1kHz to 10kHz	1Hz	0.3200	+ 70	0.3600	+ 70	0.4000	+ 70	0.5600	+ 98
0.2 -2.02A	10Hz to 44Hz	1Hz	0.1360	+ 500	0.1530	+ 500	0.1700	+ 500	0.2380	+ 700
	45Hz to 999Hz	1Hz	0.0400	+ 400	0.0450	+ 400	0.0500	+ 400	0.0700	+ 560
	1kHz to 5kHz	1Hz	0.4000	+ 700	0.4500	+ 700	0.5000	+ 700	0.7000	+ 980
2-30.0A ¹	30Hz to 44Hz	1Hz	0.1200	+ 5000	0.1350	+ 5000	0.1500	+ 5000	0.2100	+ 7000
	45Hz to 99Hz	1Hz	0.0400	+ 2500	0.0450	+ 2500	0.0500	+ 2500	0.0700	+ 3500
	100Hz to 1kHz	1Hz	0.2000	+ 4000	0.2250	+ 4000	0.2500	+ 4000	0.3500	+ 5600

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

ACI Specifications : V1.60

Notes

Note 1 : Temperature sensor on 30A range - microprocessor monitors & protects from overheating.

Higher resistance loads allow a longer ON period. See graph 5 for details.

Note 2 : Specifications apply to loads of less than 10% of the maximum burden voltage.

Driving Coils and Inductive Loads

When driving any load exceeding the maximum compliance voltage will cause the calibrator to trip into standby

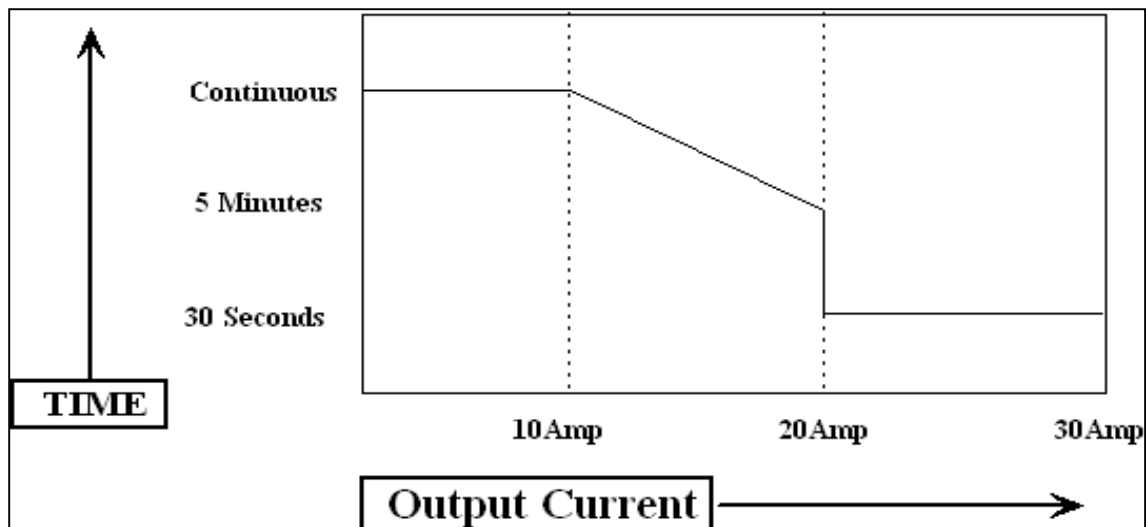
The maximum compliance voltage on the 10Amp range is specified at a max 2.8V RMS, 7.8V Peak to Peak at 220V supply

Slightly higher compliances are available when powered from a 240V supply.

When using EA002 with leads supplied it is possible to drive 30Amps/50Hz from a 230V supply, falling to 10Amps at 400Hz

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.



Graph 5* : Operating time on 30A range with current into a short circuit at 20°C

Continuous current is available up to 10A output.

- * Note Timing is started after a minimum period of 7 minutes at zero output.
Shorter periods will reduce the output time available.

Total Accuracy - Standard Accuracy

Range	90 day ppm	180 Day ppm	1 year ppm	2 year ppm
1Hz	16	18	20	28
10Hz	16	18	20	28
100Hz	16	18	20	28
1kHz	16	18	20	28
10kHz	16	18	20	28
100kHz	16	18	20	28
1MHz	16	18	20	28
10MHz	16	18	20	28

Total Accuracy - High Accuracy (Option)

Range	90 day ppm	180 Day ppm	1 year ppm	2 year ppm
1Hz	0.8	0.9	1	1.4
10Hz	0.8	0.9	1	1.4
100Hz	0.8	0.9	1	1.4
1kHz	0.8	0.9	1	1.4
10kHz	0.8	0.9	1	1.4
100kHz	0.8	0.9	1	1.4
1MHz	0.8	0.9	1	1.4
10MHz	0.8	0.9	1	1.4

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

PWM (%) - Frequency Range 5Hz to 10kHz	
5% to 95%	Better than 0.001%

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

Frequency Specifications : V1.60

For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 3000 Series calibrators use passive standard resistors, the calibrated value of which is displayed when selected.

1 Year Total Accuracy Specifications at TCal $\pm 5^{\circ}\text{C}$ & Range Parameters

Range	Maximum Current	Maximum Voltage	Display Resolution	1 Year Total Accuracy	
				% set	Ohms
0 Ω	0.5A	-	10u Ω	-	0.005
0.1 Ω	0.5A	-	10u Ω	0.015 +	0.005
1 Ω	0.4A	-	10u Ω	0.01 +	0.005
10 Ω	0.3A	-	10u Ω	0.01 +	0.005
100 Ω	0.1A	-	100u Ω	0.005 +	0.005
1k Ω	-	10V	1m Ω	0.004 +	0.04
10k Ω	-	50V	10m Ω	0.004 +	0.4
100k Ω	-	100V	100m Ω	0.004 +	4
1M Ω *	-	100V	1 Ω	0.01 +	40
10M Ω *	-	100V	10 Ω	0.035 +	400
100M Ω *	-	100V	1k Ω	0.5 +	4000
1G Ω *	-	100V	100k Ω	1 +	40000

* 2-Wire only

Stability (Accuracy relative to calibration Standards)

Range	90 day Rel			180 Day Rel			1 year Rel			2 year Rel		
	%		Ohms	%		Ohms	%		Ohms	%		Ohms
0 Ω	-		0.005	-		0.005	-		0.005	-		
0.1 Ω	0.0112	+	0.005	0.0126	+	0.005	0.014	+	0.005	0.0196	+	0.005
1 Ω	0.0072	+	0.005	0.0081	+	0.005	0.009	+	0.005	0.0126	+	0.005
10 Ω	0.0072	+	0.005	0.0081	+	0.005	0.009	+	0.005	0.0126	+	0.005
100 Ω	0.0036	+	0.005	0.00405	+	0.005	0.0045	+	0.005	0.0063	+	0.005
1k Ω	0.0028	+	0.04	0.00315	+	0.04	0.0035	+	0.04	0.0049	+	0.04
10k Ω	0.0028	+	0.4	0.00315	+	0.4	0.0035	+	0.4	0.0049	+	0.4
100k Ω	0.0024	+	4	0.0027	+	4	0.003	+	4	0.0042	+	4
1M Ω	0.0072	+	40	0.0081	+	40	0.009	+	40	0.0126	+	40
10M Ω	0.024	+	400	0.027	+	400	0.03	+	400	0.042	+	400
100M Ω	0.32	+	4000	0.36	+	4000	0.4	+	4000	0.56	+	4000
1000M Ω	0.72	+	40000	0.81	+	40000	0.9	+	40000	1.26	+	40000

For 2-Wire connection allow 35m Ω on all resistance specifications.

The 2 and 4 Wire value for each resistor is calibrated. The 2-Wire value is measured at the terminals

The 4-Wire values are taken using the zero position to NULL the measuring system.

Specifications apply at TCal $\pm 5^{\circ}\text{C}$. Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 3000 Series calibrators use passive standard capacitors, the calibrated value of which is displayed when selected.

General Specifications

Range	Maximum Voltage	Display Resolution	D	R _s
1nF	50V	0.1pF	0.006	N/A
10nF	50V	0.1pF	0.006	N/A
20nF	50V	0.1pF	0.006	N/A
50nF	50V	1pF	0.006	N/A
100nF	50V	10pF	0.006	N/A
1uF	30V	100pF	0.002	N/A
10uF	20V	1nF	0.014	0.2Ω

Specifications apply at 1kHz. Allow 20pF for lead effects.

No appreciable variation is noticable at frequencies below 1kHz.

Total Accuracy

Range	90 day %	180 Day %	1 year %	2 year %
1nF	0.2	0.225	0.25	0.35
10nF	0.2	0.225	0.25	0.35
20nF	0.2	0.225	0.25	0.35
50nF	0.2	0.225	0.25	0.35
100nF	0.2	0.225	0.25	0.35
1uF	0.32	0.36	0.4	0.56
10uF	0.48	0.54	0.6	0.84

Measurement methods

C_p up to 1uF
C_s above 1uF

Capacitance is calibrated as value at the terminals

ie. displayed value incorporates capacitance of circuit up to and including the terminals

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications

Range	Maximum Voltage	Display Resolution
100uF	8V	10nF
1mF	8V	100nF
10mF	8V	1uF

Total Accuracy

Range	90 day %	180 Day %	1 year %	2 year %
100uF	0.48	0.54	0.6	0.84
1mF	0.8	0.9	1	1.4
10mF	0.8	0.9	1	1.4

Capacitance is calibrated as value at the terminals

ie. displayed value incorporates capacitance of circuit up to and including the terminals

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

Minimum terminal voltage = 80mV

Maximum terminal voltage = 8V

Maximum current input = 20mA

Performance/compatibility may be affected using other measurement methods/techniques for the simulated capacitance function in which case passive capacitance functionality may be employed.

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

Simulated Capacitance Option : V1.60

Total Accuracy

Range	Display Resolution	Measurement Current (Max.)	1 year	
			% (Rng)	Zero
10R to 100R	10m Ω	20mA	0.03	50m Ω
101R to 1kR	100m Ω	2mA	0.03	50m Ω
1.01kR to 10kR	1 Ω	300uA	0.03	50m Ω
10.1kR to 100kR	10 Ω	40uA	0.03	50m Ω
101kR to 1MR	100 Ω	4uA	0.03	50m Ω
1.01MR to 10MR	1k Ω	0.4uA	0.03	50m Ω

Minimum terminal voltage = 80mV

Maximum current input = 20mA

Input measurement current must be a constant DC current isolated from earth

Performance/compatibility may be affected using other measurement methods/techniques for the simulated resistance function eg. AC or pulsed, in which case passive resistance functionality may be employed.

Current must be stable for a period of 1s - it is therefore recommended the UUT range is selected manually

Specifications apply at TCal $\pm$ 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

Simulated Resistance Option : V1.60

General Specifications

Range	Maximum Current	DC Resistance	Q	Display Resolution
1mH	30mA	7.8Ω	1	100mH
10mH	25mA	24Ω	2.8	1uH
19mH	20mA	33Ω	3.8	1uH
29mH	20mA	41Ω	4.7	1uH
50mH	20mA	54Ω	6.1	1uH
100mH	20mA	78Ω	8.6	10uH
1H	10mA	260Ω	29	100uH
10H	1mA	950Ω	110	1mH

All Inductance specifications $\pm 50\mu\text{H}$.

Accuracy Relative to Calibration Standards Specifications

Range	90 day Rel %	180 Day Rel %	1 year Rel %	2 year Rel %
1mH	0.4	0.45	0.5	0.7
10mH	0.4	0.45	0.5	0.7
19mH	0.4	0.45	0.5	0.7
29mH	0.4	0.45	0.5	0.7
50mH	0.4	0.45	0.5	0.7
100mH	0.4	0.45	0.5	0.7
1H	0.4	0.45	0.5	0.7
10H	0.4	0.45	0.5	0.7

Measurement methods

L_s up to 1H

L_p from 1H to 10H

Specifications apply at TCal $\pm 5^\circ\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^\circ\text{C}$ should be added.

General Specifications

Voltage Range	1V to 1000V DC
Current Range	0.5mA to 30A DC
Output Terminals	Voltage output from top (Black & White) terminals 0.5mA to 2A current output from middle 2A (Black & Red) terminals 2.01A to 30A current output from bottom 30A (Blue & Yellow) terminals Note : Indicator LEDs for both sets of terminals will illuminate to indicate DC Power mode

1 Year Accuracy Relative to Calibration standards

Current Range	Resolution	Setting	Zero
0.5mA to 300mA	10uA	0.100%	60uA
0.3A to 2A	0.1mA	0.025%	600uA
2.01A to 30A	1mA	0.04%	6mA

1 Year Accuracy Relative to Calibration standards

Voltage Range	Resolution	Setting	Zero
20V	1uV	0.0025%	40uV
200V	10uV	0.0030%	400uV
1000V	100uV	0.0030%	4000uV

High Voltage Safety

High voltage output is ramped to allow instruments to auto range

Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option

30A available as standard - external amplifier **not** required

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

DC Power Option Specifications : V1.60

General Specifications

Voltage Range	1V to 1000V AC
Current Range	0.5mA to 30A AC
Frequency Range	10Hz to 400Hz
Output Terminals	Voltage output from top (Black & White) terminals 0.5mA to 2A current output from middle 2A (Black & Red) terminals 2.01A to 30A current output from bottom 30A (Blue & Yellow) terminals Note : Indicator LEDs for both sets of terminals will illuminate to indicate AC Power mode

1 Year Accuracy Relative to Calibration standards

Current Range	Resolution	Setting	Zero
0.5mA to 200mA	10uA	0.2%	40uA
0.2A to 2A	0.1mA	0.1%	400uA
2.01A to 30A	1mA	0.05%	4mA

1 Year Accuracy Relative to Calibration standards

Voltage Range	Resolution	Setting	Zero
20V	1uV	0.035%	900uV
200V	10uV	0.04%	7.5mV
1000V	100uV	0.04%	75mV

Frequency Specifications

Frequency
Range
40 to 400Hz (1V to 699V) : 46 to 400Hz (700V to 1000V)

Phase Specifications

Phase Angle	Resolution	Accuracy
0° to 359.9°	0.1°	0.1° + 6us*

*6us represents 0.109° at 50Hz or 0.87° at 400Hz

Note : Phase accuracy specification applies for levels above 10V/5A

3041 calibrators **automatically correct for any errors in the phase** caused by inductive loading, for example when using the clamp coil adaptor.

High Voltage Safety

High voltage output is ramped to allow instruments to auto range

Standby is automatically activated when setting voltages greater than 20V or 200V from a lower voltage

Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option

30A available as standard - external amplifier **not** required

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

AC Power Option Specifications : V1.60

DDS Harmonic Specifications (in addition to AC Power Specifications) (apply only if Power DDS Option fitted)

DDS Harmonic Power Simulation - General Specifications	
Harmonics in a User Defined Waveform ProWave PC software required to upload waveform data - supplied when PWRDDS option fitted	48 from 2nd to 49th Harmonic
Fundamental Frequency	40Hz to 400Hz
Harmonic Frequency Range	Up to 20kHz
Harmonic Frequency Accuracy	0.1% + (N x 0.08%) Where N is the Harmonic number
Harmonic Amplitude Resolution	0.10% of Fundamental
Harmonic Phase Range (relative to fundamental)	0 to 360°
Harmonic Phase Resolution	0.1° Relative to Fundamental
Composite Voltage Waveform Range	2V to 1000V
Composite Current Waveform Range	300mA to 30A

DDS Harmonic Power Simulation - Pre Loaded Waveforms
3rd 10%
5th 10%
21st 10%
Plus user definable waveforms (USER+SINE & USER)

Amplitude				
Ranges	2mV/Div : 5mV/Div : 10mV/Div : 20mV/Div : 50mV/Div : 100mV/Div 200mV/Div : 500mV/Div : 1V/Div : 2V/Div : 5V/Div : 10V/Div : 20V/Div : 50V/Div			
Sequence	1, 2, 5			
Waveshapes	Square Wave (positive going from ground) : DC			
Frequency	1kHz			
Frequency Accuracy	30ppm			
Graticule Height	6 Graticules			
Rise Time	2us			
Fall Time	2us			
Output Terminal	Front BNC (Green LED indicates terminal active)			
Range @ 1Mega Ohm load	90 Day Rel.		180 Day Rel.	
	%	uV	%	uV
2mV to 50V/Div	0.009	± 20	0.01	± 20

High Voltage Safety

High voltage output is ramped to allow instruments to auto range

Auto standby is activated when passing through 20V or 200V output values

High voltage (> 20V) output is indicated to user through an audible warning beep

An external high voltage output/standby control switch is available as an option

Amplitude Deviation				
Deviation Range	±10%			
Deviation Resolution	Better than 1ppm			
Range	90 Day Rel.		180 Day Rel.	
	%	uV	%	uV
-10% to +10%	0.008	± 20	0.01	± 20

Timebase				
Ranges	2ns/Div : 5ns/Div : 10ns/Div : 20ns/Div : 50ns/Div : 100ns/Div : 200ns/Div 500ns/Div : 1ms/Div : 2ms/Div : 5ms/Div : 10ms/Div : 20ms/Div : 50ms/Div 100ms/Div : 200ms/Div : 500ms/Div : 1s/Div : 2s/Div : 5s/Div			
Sequence	1, 2, 5			
Waveshape	Comb below 100ns Sine Wave above 100ns			
Oscillator	Internal Crystal TCXO			
Output Terminal	Front BNC (Green LED indicates terminal active)			
Range	90 Day Rel.		180 Day Rel.	
	ppm		ppm	
2ns/Div to 5s/Div	4.5		4.75	

Timebase Deviation				
Deviation Range	±10% in 0.05% Steps			
Deviation Resolution	Better than 0.05%			
Range	90 Day Rel.		180 Day Rel.	
	%		%	
-9.5% to +9.5%	0.01		0.01	

Due to continuous development specifications may be subject to change.

9041A Extended Specifications

Oscilloscope Calibration Option : V1.60

Levelled Sweep				
Sweep Range	5MHz to 350MHz or 5MHz to 600MHz (depending on option fitted)			
Waveform	Sine Wave			
Levelled Sweep	600mV pk-pk into 50 Ohms			
Reference Level	50kHz			
Output Terminal	Front BNC (Green LED indicates terminal active)			
Range	90 Day Rel. db	180 Day Rel. db	1 Year Rel. db	2 Year Rel. db
5MHz to 350MHz	0.8	0.90	1	1.4
5MHz to 600MHz	0.8	0.90	1	1.4

Levelled Sweep	
Frequency Accuracy	See Time markers

50kHz Reference				
Accuracy	90 Day Rel.	180 Day Rel.	1 Year Rel.	2 Year Rel.
Frequency Accuracy	27 ppm	29 ppm	30 ppm	36 ppm
Level Accuracy	0.4 %	0.45 %	0.5 %	0.7 %

Fast Rise Output	
Rise/Fall Time	Typically 1ns

Specifications apply at TCal $\pm 5^{\circ}\text{C}$.

Outside this range an allowance of 0.18 x 1 Year Spec. per $^{\circ}\text{C}$ should be added.

Simulated PRT (Option)

General Specifications

Range	Actual Value (Ohms)	Max. Power Rating (Watts)	Maximum Voltage (V)	Maximum Current (mA)	Display Resolution
-100°C	60.25	0.2	3.47	57.62	1m°C
0°C	100.00	0.2	4.47	44.72	1m°C
+30°C	111.67	0.2	4.73	42.32	1m°C
+60°C	123.24	0.2	4.96	40.28	1m°C
+100°C	138.50	0.2	5.26	38.00	1m°C
+200°C	175.84	0.2	5.93	33.73	10m°C
+400°C	247.04	0.2	7.03	28.45	10m°C
+800°C	375.51	0.2	8.67	23.08	10m°C

4-Wire connection. Allow 1mΩ on all resistance specifications.

Accuracy Relative to Calibration Standards Specifications

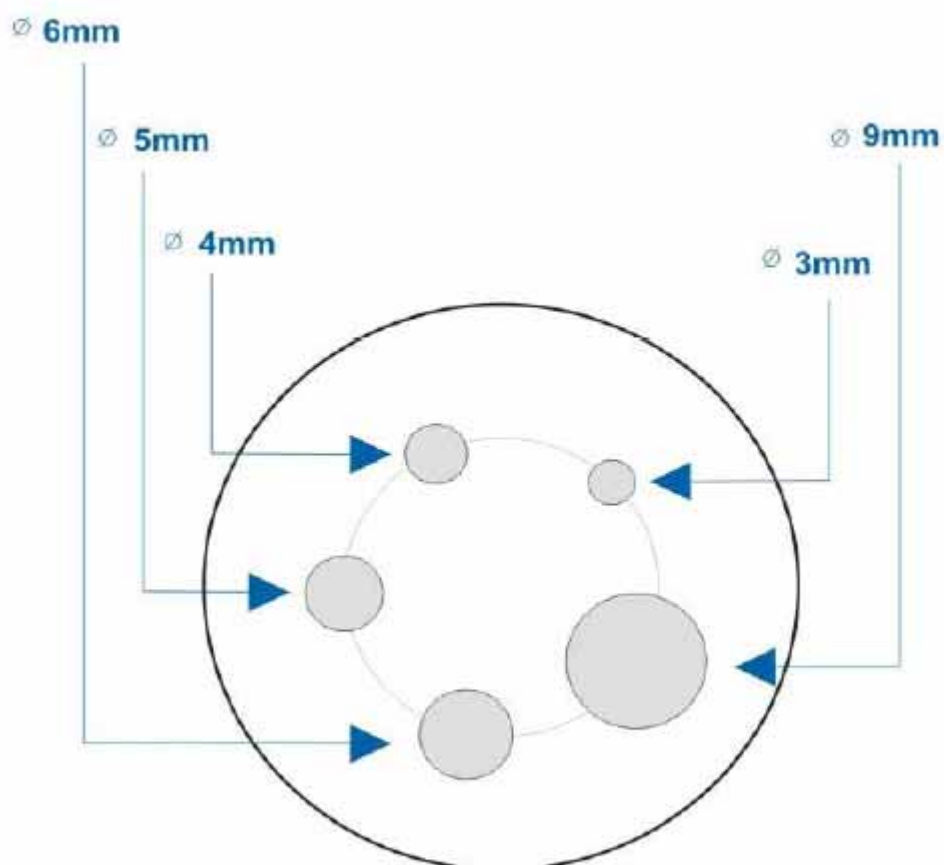
Range	Actual Value (Ohms)	90 day Rel °C	180 Day Rel °C	1 year Rel °C	2 year Rel °C
-100°C	60.25	0.040	0.045	0.050	0.070
0°C	100.00	0.016	0.018	0.020	0.028
+30°C	111.67	0.024	0.027	0.030	0.042
+60°C	123.24	0.032	0.036	0.040	0.056
+100°C	138.50	0.040	0.045	0.050	0.070
+200°C	175.84	0.048	0.054	0.060	0.084
+400°C	247.04	0.056	0.063	0.070	0.098
+800°C	375.51	0.064	0.072	0.080	0.112

Specifications apply at TCal ± 5°C.

Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

General Specifications

Temperature Range @ Ambient (20°C / 68°F)	25°C (77°F) - 200°C (392°F)
Resolution	0.1°C
Heating Time	Ambient to Maximum (200°C) - 10 minutes
Stability (10 minutes)	0.1°C
Accuracy (1 Year)	1°C
Probe Insert Diameter	3mm (0.11") , 4mm (0.25") , 5mm (0.19") , 6mm (0.23") , 9mm (0.34")



General Specifications

Temperature Range @ Ambient (20°C / 68°F)	25°C (77°F) - 200°C (392°F)
Resolution	0.1°C
Heating Time	Ambient to Maximum (200°C) - 10 minutes
Stability (10 minutes)	0.2°C
Accuracy (1 Year)	1°C
Target Plate Diameter	40mm (1.5")