



# TRANSMILLE 4015 ADVANCED MULTIPRODUCT CALIBRATOR

**EXTENDED SPECIFICATIONS**

# Interpreting Specifications

Transmille have taken great care over presenting the extended specifications in a manner that is easy to read while including high levels of details

Transmille specify specifications as both Absolute and Relative Specification, with varying calibration intervals, from 24 Hours to 2 Years

By 'Absolute Uncertainties', this means that all internal components of the calibrator have been compensated for. This includes stability, line voltage variations, temperature, humidity as well as the uncertainty of calibration as performed by Transmille Ltd.

This does NOT include external sources of uncertainty, such as the leads that are used to connect to the calibrator, and resolution of the UUT

Relative Accuracy' refers to the stability of the instrument itself, without any external factors except temperature variation.

During re-calibration, the 'Absolute Uncertainties' should be used for verification of the instrument. If the calibration laboratory offers better uncertainties than those offered by Transmille, new uncertainties can be calculated by combining the relative specification and the new imported uncertainties.

All of Transmilles Absolute uncertainties are presented to 95% confidence,  $k=2$ .

This is for ease of use in a 17025 accredited laboratory, where other contributions will likely also be calculated for  $k=2$ , minimising the need for re-calibration of uncertainties.

Warm Up Time	Double the time since last used up to 20 minutes maximum	
Standard Interfaces	USB, GPIB	
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 (100V Option Available) Line Frequency : 50Hz to 60Hz Line Voltage Variation : -6% +10%	
Power Consumption	28 Watts (Standby)	200 Watts (Maximum)
Low Analogue Isolation	100V	
Front Panel Connections	Voltage / 2 Wire Resistance Low Current (<=2A) High current (>2A) Earth Connection Oscilloscope Functions Adapter Interface USB Interface High Bandwidth Output	1x Black : 1x Red 4mm Binding Posts 1x Black : 1x Red 4mm Binding Posts 1x Blue : 1x Yellow 4mm Binding Posts 1x Green 4mm Binding Posts 2x BNC terminal 1x Female 'D' type socket 1x Female 'B' type socket 1 x Female Type 'N' socket
Display Information	Type Viewing Area Resolution Backlight Type	Touchscreen LCD 7" 800 * 480 LED
Indicators	Voltage / Current / High Current Negative to ground Oscilloscope RF Frequency Output Standby Indicator Output Indicator Adapter Interface	Red LED (left of terminals) Green LED (left of Earth terminal) Green LED (right of BNC Connector) Green LED (right of Type N Connector) Red LED (left of Standby Key) Green LED (left of Operate Key) 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 Calibrator in Shipping Box Calibrator in Hard Transit case	19cm x 43cm x 46cm : 15kgs 65cm x 56cm x 37cm : 18kgs 65cm x 56cm x 26cm : 25kgs
Warranty Period	1 Years (Parts & Labour)	
Recommended Service Interval	1 Year	
Supplied Connections	1x USB Interface Connection 1x Adaptor Connection Lead (if at least one adaptor ordered)	1x Mains Lead
Optional Lead Set Kit	1x Voltage connection lead set 1x Low Current connection lead set 1x High current connection lead set 1x AC connection lead set	
Mounting Kit (optional)	4U rack mount kit	
Case Colour	Grey	

Due to continuous development specifications may be subject to change.

**1 year Total Accuracy Specifications at Tcal  $\pm 5^{\circ}\text{C}$** 

Range	Resolution	Max. Burden Current	Typical Output Resistance <sup>1</sup>	Overload Protection	1 Year Total	
					ppm set	$\mu\text{V}$
0-202mV	0.01 $\mu\text{V}$	1mA <sup>2</sup>	50 Ohms	20 V	25	+ 3
0.2-2.02V	0.1 $\mu\text{V}$	50mA	0.2 Ohms	150V	15	+ 3
2-20.2V	1 $\mu\text{V}$	50mA	0.2 Ohms	150V	15	+ 30
20-202V	10 $\mu\text{V}$	20mA <sup>3</sup>	0.5 Ohms	1200V	20	+ 300
200-1025V	100 $\mu\text{V}$	20mA <sup>3</sup>	0.7 Ohms	1200V	20	+ 3000

**Stability (Accuracy relative to calibration Standards)**

Range	24 Hour Stability		Noise <sup>4</sup> $\mu\text{V}$	90 day Rel		180 Day Rel		1 year Rel		2 year Rel	
	ppm Set	$\mu\text{V}$		ppm Set	$\mu\text{V}$	ppm Set	$\mu\text{V}$	ppm Set	$\mu\text{V}$	ppm Set	$\mu\text{V}$
0-202mV	6	+ 1	0.3	17.6	+ 3	19.8	+ 3	22	+ 3	30.8	+ 4.2
0.2-2.02V	3	+ 2	0.7	10.4	+ 3	11.7	+ 3	13	+ 3	18.2	+ 4.2
2-20.2V	3	+ 18	5.9	10.4	+ 30	11.7	+ 30	13	+ 30	18.2	+ 42
20-202V	3	+ 280	92	10.4	+ 30	11.7	+ 30	13	+ 30	18.2	+ 42
200-1025V	5	+ 2100	693	14.4	+ 3000	16.2	+ 3000	18	+ 3000	25.2	+ 4200

**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 1Hz 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. This function can be disabled

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.

**1 year Total Accuracy Specifications at TCal  $\pm 5^{\circ}\text{C}$** 

Range	Resolution	Max. Inductive Load	Compliance Voltage	Overload Protection	1 Year Total % set	uA
0-202uA	10pA	10mH	4.2 Volts	150V	0.01	+ 0.03
0.2-2.02mA	100pA	10mH	4.2 Volts	150V	0.008	+ 0.04
2-20.2mA	1nA	10mH	4.2 Volts	150V	0.005	+ 0.3
20-202mA	10nA	10mH	4.2 Volts	150V	0.008	+ 3
0.2-2.02A	100nA	10mH	4.2 Volts	150V	0.015	+ 35
2-30A	1uA	10mH	3.9 Volts	150V	0.04	+ 350

**Stability (Accuracy relative to calibration Standards)**

Range	Noise <sup>1</sup> 0.1-1Hz	90 Day Rel %Set uA	180 Day Rel %Set uA	1 Year Rel %Set uA	2 Year Rel %Set uA
0-202uA	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	1uA	0.0064 + 35	0.0072 + 35	0.0080 + 35	0.0112 + 49
2-30A <sup>2</sup>	20uA	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.

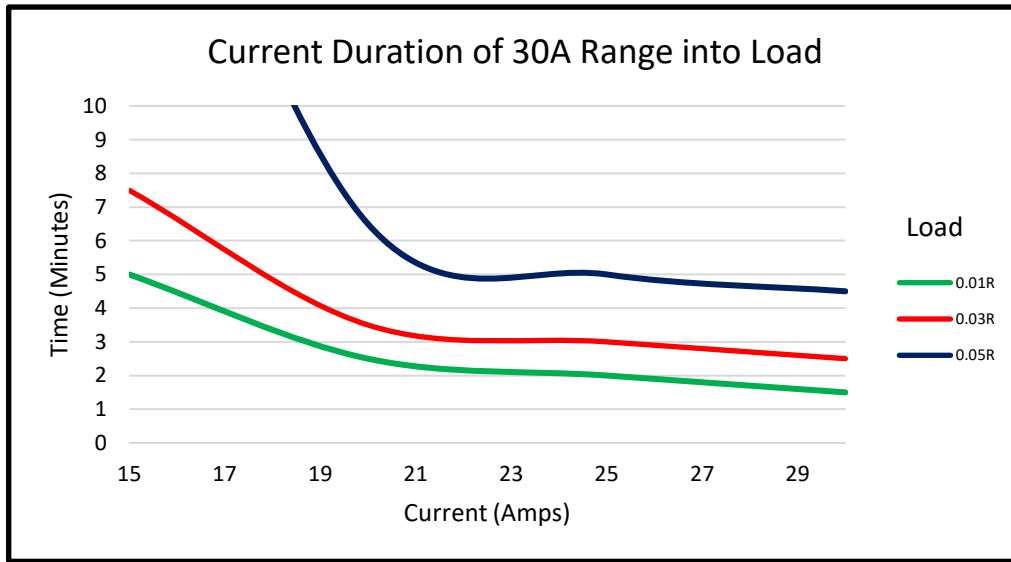
Higher resistance loads allow a longer ON period. See graphs 1 and 2 for details.

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.



Measurement Conditions : Ambient Temperature 20°C, Mains Voltage 230V, Mains Frequency 50Hz  
 Allow at least 7 minutes 'off' period between current output

Shorter periods will reduce the output time available.

A higher ohmic value load (for example, a 0.1R Shunt) allows greater output time as more heat is dissipated within the shunt / load. With lower loads more heat is dissipated within the instrument, reducing output time

Into a 0.1R Load outputs of up to 20A are available for periods of greater than 30 minutes continuously, considerations of self heating of the external load/Uut should be considered due to the power being dissipated

**1 year Total Accuracy Specifications at TCal ±5°C**

Range	Frequency	Resolution	Max. Burden Current	Typical Output Resistance	Overload Protection	1 Year Accuracy % set	uV
0-202mV	10 to 45Hz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.0700	+ 25
	45Hz to 10kHz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.0250	+ 28
	10kHz to 20kHz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.0600	+ 35
	20kHz to 50kHz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.1000	+ 40
	50kHz to 100kHz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.3200	+ 50
	100kHz to 500kHz	1uV	1mA <sup>1</sup>	50 Ohms	20 V	0.5000	+ 300
0.2-2.02V <sup>6</sup>	10 to 45Hz	10uV	50mA	0.2 Ohms	1200V	0.0500	+ 70
	45Hz to 10kHz	10uV	50mA	0.2 Ohms	1200V	0.0250	+ 80
	10 to 20kHz	10uV	50mA	0.2 Ohms	1200V	0.0650	+ 80
	20 to 50kHz	10uV	50mA	0.2 Ohms	1200V	0.0900	+ 150
	50 to 100kHz	10uV	50mA	0.2 Ohms	1200V	0.2100	+ 500
	100kHz to 500kHz	10uV	50mA	0.2 Ohms	1200V	0.4500	+ 800
2-20.2V	10 to 45Hz	100uV	50mA	0.2 Ohms	1200V	0.0500	+ 800
	45Hz to 10kHz	100uV	50mA	0.2 Ohms	1200V	0.0250	+ 700
	10 to 20kHz	100uV	50mA	0.2 Ohms	1200V	0.0650	+ 800
	20 to 50kHz	100uV	50mA	0.2 Ohms	1200V	0.0900	+ 800
	50 to 100kHz	100uV	50mA	0.2 Ohms	1200V	0.2100	+ 1800
20 - 202V <sup>7</sup>	30Hz to 45Hz	1mV	20mA <sup>2</sup>	0.5 Ohms	1200V	0.0500	+ 5000
	45Hz to 10kHz	1mV	15mA <sup>2</sup>	0.5 Ohms	1200V	0.0550	+ 7500
	10 to 20kHz	1mV	15mA <sup>2</sup>	0.5 Ohms	1200V	0.0750	+ 10000
	20 to 40kHz	1mV	2mA <sup>2</sup>	0.5 Ohms	1200V	0.0900	+ 10000
	40 to 100kHz	1mV	2mA <sup>2</sup>	0.5 Ohms	1200V	0.2100	+ 70000
200-1020V <sup>3</sup>	30 to 45Hz	10mV	20mA <sup>2</sup>	0.7 Ohms	1200V	0.0550	+ 100000
	45Hz to 1kHz	10mV	15mA <sup>2</sup>	0.7 Ohms	1200V	0.0550	+ 20000
	1kHz to 5kHz	10mV	15mA <sup>2</sup>	0.7 Ohms	1200V	0.0800	+ 20000
	5kHz to 10kHz	10mV	2mA <sup>2</sup>	0.7 Ohms	1200V	0.0950	+ 40000

**Stability (Accuracy relative to calibration Standards)**

Range	Frequency	Frequency Resolution	90 day Rel		180 Day Rel		1 year Rel		2 year Rel	
			%Set	uV	%Set	uV	%Set	uV	%Set	uV
0-202mV	10 to 45Hz	1Hz	0.0480	+ 20	0.0540	+ 22.5	0.0600	+ 25	0.0840	+ 35
	45Hz to 10kHz	1Hz	0.0160	+ 22.4	0.0180	+ 28	0.0200	+ 28	0.0280	+ 39
	10kHz to 20kHz	1Hz	0.0400	+ 28	0.0450	+ 35	0.0500	+ 35	0.0700	+ 49
	20kHz to 50kHz	1Hz	0.0640	+ 32	0.0720	+ 40	0.0800	+ 40	0.1120	+ 56
	50kHz to 100kHz	1Hz	0.2176	+ 40	0.2448	+ 50	0.2720	+ 50	0.3808	+ 70
	100kHz to 500kHz	1Hz	0.3400	+ 240	0.3825	+ 300	0.4250	+ 300	0.5950	+ 420
0.2-2.02V <sup>6</sup>	10 to 45Hz	1Hz	0.0296	+ 56	0.0333	+ 70	0.0370	+ 70	0.0518	+ 98
	45Hz to 10kHz	1Hz	0.0152	+ 64	0.0171	+ 80	0.0190	+ 80	0.0266	+ 112
	10 to 20kHz	1Hz	0.0440	+ 64	0.0495	+ 80	0.0550	+ 80	0.0770	+ 112
	20 to 50kHz	1Hz	0.0600	+ 120	0.0675	+ 150	0.0750	+ 150	0.1050	+ 210
	50 to 100kHz	1Hz	0.1440	+ 400	0.1620	+ 500	0.1800	+ 500	0.2520	+ 700
	100kHz to 500kHz	1Hz	0.3040	+ 640	0.3420	+ 800	0.3800	+ 800	0.5320	+ 1120
2-20.2V	10 to 45Hz	1Hz	0.0296	+ 640	0.0333	+ 800	0.0370	+ 800	0.0518	+ 1120
	45Hz to 10kHz	1Hz	0.0152	+ 560	0.0171	+ 700	0.0190	+ 700	0.0266	+ 980
	10 to 20kHz	1Hz	0.0440	+ 640	0.0495	+ 800	0.0550	+ 800	0.0770	+ 1120
	20 to 50kHz	1Hz	0.0600	+ 640	0.0675	+ 800	0.0750	+ 800	0.1050	+ 1120
	50 to 100kHz	1Hz	0.1440	+ 1440	0.1620	+ 1800	0.1800	+ 1800	0.2520	+ 2520
20 - 202V <sup>7</sup>	30Hz to 45Hz	1Hz	0.0296	+ 4000	0.0333	+ 5000	0.0370	+ 5000	0.0518	+ 7000
	45Hz to 10kHz	1Hz	0.0368	+ 6000	0.0414	+ 7500	0.0460	+ 7500	0.0644	+ 10500
	10 to 20kHz	1Hz	0.0512	+ 8000	0.0576	+ 10000	0.0640	+ 10000	0.0896	+ 14000
	20 to 40kHz	1Hz	0.0600	+ 8000	0.0675	+ 10000	0.0750	+ 10000	0.1050	+ 14000
	40 to 100kHz	1Hz	0.1440	+ 56000	0.1620	+ 70000	0.1800	+ 70000	0.2520	+ 98000
200-1020V <sup>3</sup>	30 to 45Hz	1Hz	0.0336	+ 80000	0.0378	+ 100000	0.0420	+ 100000	0.0588	+ 140000
	45Hz to 1kHz	1Hz	0.0368	+ 16000	0.0414	+ 20000	0.0460	+ 20000	0.0644	+ 28000
	1kHz to 5kHz	1Hz	0.0544	+ 16000	0.0612	+ 20000	0.0680	+ 20000	0.0952	+ 28000
	5kHz to 10kHz	1Hz	0.0640	+ 32000	0.0720	+ 40000	0.0800	+ 40000	0.1120	+ 56000

All specifications apply from 10% of full scale.

**AC Frequency Accuracy : 30ppm**

Due to continuous development specifications may be subject to change.

**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 independent of the processor which shuts the high voltage output off in the event of an overload.
Note 3:	Frequency and voltage combinations are limited.
Note 4:	Specifications apply up to 10% of maximum load current. Above this level, allowance must be made for output resistance.
Note 5:	Zero or floor allowance.
Note 6:	THD less than 0.39% of output - 10Hz to 1MHz bandwidth at frequencies up to 50kHz
Note 7:	Voltage above 40kHz limited to 100V

2 Wire output / Remote sensing not available.

Maximum floating voltage : 100V.

Isolation : Floating or grounded selection available as standard.

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

Outside this range an allowance of 0.18 x 1 Year Spec. per °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. This function can be disabled by the user

High voltage (> 20V) output is indicated to user through an audible warning beep. This can be disabled by the user

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



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

Range	Frequency	Resolution	Max. Burden Voltage (peak)	Overload Protection	1 year Accuracy	
					%Set	$\mu\text{A}$
20-202 $\mu\text{A}$	10Hz to 20Hz	1nA	3 Volts	150V	0.20	+ 0.1
	20 to 45Hz				0.15	+ 0.1
	45Hz to 1kHz				0.13	+ 0.1
	1kHz to 5kHz				0.30	+ 0.15
	5kHz to 10kHz				0.80	+ 0.25
	10kHz to 30kHz				1.60	+ 0.4
0.2-2.02mA	10Hz to 20Hz	10nA	3 Volts	150V	0.20	+ 0.15
	20Hz to 45Hz				0.12	+ 0.15
	45Hz to 1kHz				0.06	+ 0.15
	1kHz to 5kHz				0.20	+ 0.2
	5kHz to 10kHz				0.50	+ 0.3
	10kHz to 30kHz				1.00	+ 0.4
2-20.2mA	10Hz to 20Hz	100nA	3 Volts	150V	0.18	+ 2
	20Hz to 45Hz				0.09	+ 2
	45Hz to 1kHz				0.04	+ 2
	1kHz to 5kHz				0.08	+ 2
	5kHz to 10kHz				0.20	+ 3
	10kHz to 30kHz				0.40	+ 4
20-202mA	10Hz to 20Hz	1 $\mu\text{A}$	3 Volts	150V	0.18	+ 20
	20Hz to 45Hz				0.09	+ 20
	45Hz to 1kHz				0.04	+ 20
	1kHz to 5kHz				0.10	+ 50
	5kHz to 10kHz				0.25	+ 50
	10kHz to 30kHz				0.40	+ 200
0.2-2.02A	10Hz to 20Hz	10 $\mu\text{A}$	3 Volts	150V	0.18	+ 100
	20Hz to 45Hz				0.17	+ 150
	45Hz to 1kHz				0.05	+ 100
	1kHz to 5kHz				0.60	+ 1000
	5kHz to 10kHz				1.50	+ 1000
2-30.0A <sup>1,4</sup>	10Hz to 20Hz	100 $\mu\text{A}$	2.8 Volts	150V	0.20	+ 3000
	20Hz to 45Hz				0.20	+ 3000
	45Hz to 1kHz				0.09	+ 2000
	1kHz to 5kHz				0.60	+ 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	uA	%Set	uA	%Set	uA	%Set	uA
20-202uA	10Hz to 45Hz	1Hz	0.128	+ 0.25	0.144	+ 0.25	0.160	+ 0.25	0.224	+ 0.35
	45Hz to 1kHz		0.040	+ 0.15	0.045	+ 0.15	0.050	+ 0.15	0.070	+ 0.21
	1kHz to 10kHz		0.640	+ 0.2	0.720	+ 0.2	0.800	+ 0.2	1.120	+ 0.28
	10kHz to 30kHz		1.200	+ 0.4	1.350	+ 0.4	1.500	+ 0.4	2.100	+ 0.56
0.2-2.02mA	10Hz to 45Hz	1Hz	0.120	+ 0.25	0.135	+ 0.25	0.150	+ 0.25	0.210	+ 0.35
	45Hz to 1kHz		0.032	+ 0.2	0.036	+ 0.2	0.040	+ 0.2	0.056	+ 0.28
	1kHz to 10kHz		0.320	+ 0.3	0.360	+ 0.3	0.400	+ 0.3	0.560	+ 0.42
	10kHz to 30kHz		0.640	+ 0.6	0.720	+ 0.6	0.800	+ 0.6	1.120	+ 0.84
2mA-20.2mA	10Hz to 45Hz	1Hz	0.120	+ 3	0.135	+ 3	0.150	+ 3	0.210	+ 4.2
	45Hz to 1kHz		0.028	+ 2	0.032	+ 2	0.035	+ 2	0.049	+ 2.8
	1kHz to 10kHz		0.160	+ 3	0.180	+ 3	0.200	+ 3	0.280	+ 4.2
	10kHz to 30kHz		0.320	+ 4	0.360	+ 4	0.400	+ 4	0.560	+ 5.6
20-202mA	10Hz to 45Hz	1Hz	0.120	+ 30	0.135	+ 30	0.150	+ 30	0.210	+ 42
	45Hz to 1kHz		0.028	+ 20	0.032	+ 20	0.035	+ 20	0.049	+ 28
	1kHz to 10kHz		0.320	+ 40	0.360	+ 40	0.400	+ 40	0.560	+ 56
	10kHz to 30kHz		0.400	+ 40	0.450	+ 40	0.500	+ 40	0.700	+ 56
0.2-2.02A <sup>3</sup>	10Hz to 45Hz	1Hz	0.120	+ 300	0.135	+ 300	0.150	+ 300	0.210	+ 420
	45Hz to 1kHz		0.032	+ 200	0.036	+ 200	0.040	+ 200	0.056	+ 280
	1kHz to 5kHz		0.320	+ 400	0.360	+ 400	0.400	+ 400	0.560	+ 560
	5kHz to 10kHz		1.120	+ 1000	1.260	+ 1000	1.400	+ 1000	1.960	+ 1400
	10kHz to 30kHz		1.920	+ 5000	2.160	+ 5000	2.400	+ 5000	3.360	+ 7000
2-30.0A <sup>1,4</sup>	30Hz to 45Hz	1Hz	0.120	+ 3000	0.135	+ 3000	0.150	+ 3000	0.210	+ 4200
	45Hz to 100Hz		0.032	+ 2000	0.036	+ 2000	0.040	+ 2000	0.056	+ 2800
	100Hz to 1kHz		0.320	+ 4000	0.360	+ 4000	0.400	+ 4000	0.560	+ 5600
	1kHz to 5kHz		0.400	+ 4000	0.450	+ 4000	0.500	+ 4000	0.700	+ 5600
	5kHz to 10kHz		2.240	+ 5000	2.520	+ 5000	2.800	+ 5000	3.920	+ 7000

**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.

Note 3 : Limited to 1A above 5kHz

Note 4 : Limited to 10A above 5kHz

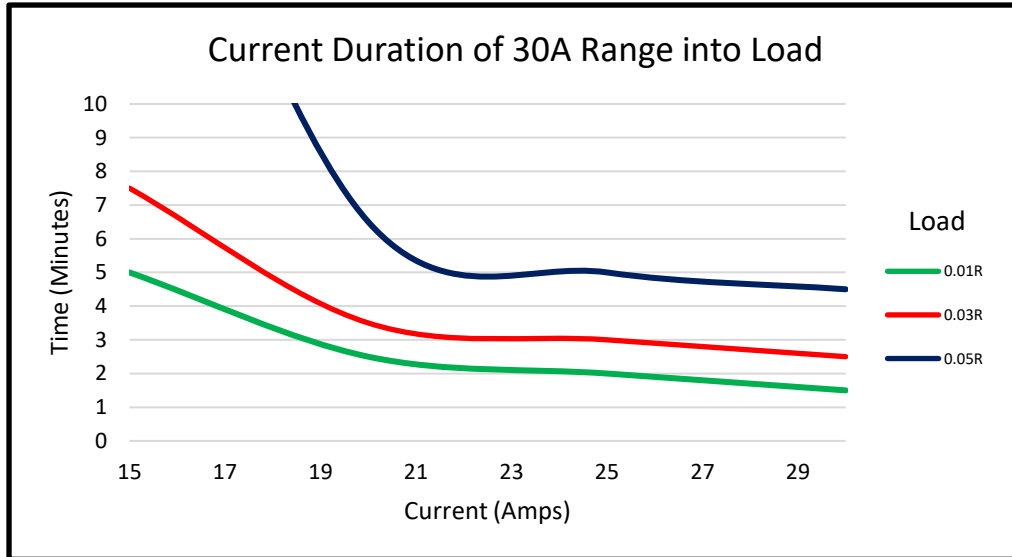
**Driving Coils and Inductive Loads**

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

The maximum compliance voltage on the 30Amp 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 ± 5°C

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



Measurement Conditions : Ambient Temperature 20°C, Mains Voltage 230V, Mains Frequency 50Hz  
Allow at least 7 minutes 'off' period between current output

Shorter periods will reduce the output time available.

A higher ohmic value load (for example, a 0.1R Shunt) allows greater output time as more heat is dissipated within the shunt / load. With lower loads more heat is dissipated within the instrument, reducing output time

Into a 0.1R Load outputs of up to 20A are available for periods of greater than 30 minutes continuously, considerations of self heating of the external load/Uut should be considered due to the power being dissipated

**Total Accuracy - Standard Accuracy**

Range	Resolution	90 day ppm	180 Day ppm	1 year ppm	2 year ppm
1Hz - 1MHz*	1Hz	16	18	20	28
10MHz	1Hz	16	18	20	28

**Total Accuracy - Option FRQ (1ppm)**

Range	Resolution	90 day ppm	180 Day ppm	1 year ppm	2 year ppm
1Hz - 1MHz*	1Hz	0.8	0.9	1	1.4
10MHz	1Hz	0.8	0.9	1	1.4

\* Frequency continuously variable.

Specifications apply at TCal  $\pm$  5°C

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

PWM (%) - Frequency Range 5Hz to 50kHz	Duty Cycle Accuracy
5% to 95%	Better than 0.001%

PWM (Level)	Level Accuracy
2V to 10V	Better than 0.05V

PWM (DC Offset)	Level Accuracy
+0V to +5V	Better than 0.1V

**PWM Output provides a square wave output with variable level, duty cycle and DC offset**

*For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 4000 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 $\Omega$	0.5A	-	1 $\mu\Omega$	-	0.005
0.1 $\Omega$	0.5A	-	1 $\mu\Omega$	0.015 +	0.005
1 $\Omega$	0.4A	-	1 $\mu\Omega$	0.01 +	0.005
10 $\Omega$	0.3A	-	1 $\mu\Omega$	0.01 +	0.005
100 $\Omega$	0.1A	-	10 $\mu\Omega$	0.005 +	0.005
1k $\Omega$	-	10V	100 $\mu\Omega$	0.004 +	0.04
10k $\Omega$	-	50V	1m $\Omega$	0.004 +	0.4
100k $\Omega$	-	100V	10m $\Omega$	0.004 +	4
1M $\Omega^*$	-	100V	100m $\Omega$	0.01 +	40
10M $\Omega^*$	-	100V	1 $\Omega$	0.035 +	400
100M $\Omega^*$	-	100V	1k $\Omega$	0.5 +	4000
1000M $\Omega^*$	-	100V	10k $\Omega$	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 $\Omega$	-	0.005	-	0.005	-	0.005	-	0.005
0.1 $\Omega$	0.0112	+ 0.005	0.0126	+ 0.005	0.014	+ 0.005	0.0196	+ 0.005
1 $\Omega$	0.0072	+ 0.005	0.0081	+ 0.005	0.009	+ 0.005	0.0126	+ 0.005
10 $\Omega$	0.0072	+ 0.005	0.0081	+ 0.005	0.009	+ 0.005	0.0126	+ 0.005
100 $\Omega$	0.0036	+ 0.005	0.00405	+ 0.005	0.0045	+ 0.005	0.0063	+ 0.005
1k $\Omega$	0.0028	+ 0.04	0.00315	+ 0.04	0.0035	+ 0.04	0.0049	+ 0.04
10k $\Omega$	0.0028	+ 0.4	0.00315	+ 0.4	0.0035	+ 0.4	0.0049	+ 0.4
100k $\Omega$	0.0024	+ 4	0.0027	+ 4	0.003	+ 4	0.0042	+ 4
1M $\Omega$	0.0072	+ 40	0.0081	+ 40	0.009	+ 40	0.0126	+ 40
10M $\Omega$	0.024	+ 400	0.027	+ 400	0.03	+ 400	0.042	+ 400
100M $\Omega$	0.32	+ 4000	0.36	+ 4000	0.4	+ 4000	0.56	+ 4000
1000M $\Omega$	0.72	+ 40000	0.81	+ 40000	0.9	+ 40000	1.26	+ 40000

**For 2-Wire connection allow 35mW 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.

**Total Accuracy**

Range	Display Resolution	Measurement Current (Max.)	1 year	
			% of Range	Zero
0Ω to 100Ω	10mΩ	20mA	0.01	50mΩ
100Ω to 330Ω	10mΩ	20mA	0.01	50mΩ
330Ω to 1kΩ	100mΩ	2mA	0.01	50mΩ
1kΩ to 3.3kΩ	100mΩ	2mA	0.01	50mΩ
3.3kΩ to 10kΩ	1Ω	300uA	0.01	50mΩ
10kΩ to 33kΩ	1Ω	300uA	0.01	50mΩ
33kΩ to 100kΩ	10Ω	40uA	0.01	50mΩ
100kΩ to 330kΩ	10Ω	40uA	0.01	50mΩ
330kΩ to 1MΩ	100Ω	4uA	0.01	50mΩ
1MΩ to 3.3MΩ	100Ω	4uA	0.01	50mΩ
3.3MΩ to 10MΩ	1kΩ	0.4uA	0.01	50Ω
10MΩ to 33MΩ	1kΩ	0.4uA	0.01	2.5kΩ
33MΩ to 100MΩ	10kΩ	0.2uA	0.05	100kΩ
110MΩ to 330MΩ	10kΩ	0.2uA	1	100kΩ
330MΩ to 1GΩ	100kΩ	10nA	2	500kΩ

Note : Specifications apply for 12 hours from 'Zero' operation

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 ± 5°C.

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

**For the highest possible accuracy and dependability of the measured value, regardless of the measurement technique used, the 4000 Series calibrators use passive standard capacitors, the calibrated value of which is displayed when selected.**

### General Specifications

Range	Maximum Voltage	Display Resolution	D	R <sub>s</sub>
1nF	50V	0.1pF	0.006	N/A
2nF	50V	0.1pF	0.006	N/A
5nF	50V	0.1pF	0.006	N/A
10nF	50V	0.1pF	0.006	N/A
100nF	50V	10pF	0.006	N/A
1uF	30V	100pF	0.002	N/A
10uF	20V	1nF	0.014	0.2mΩ

**Specifications apply at 1kHz. Allow 20pF for lead effects.  
No appreciable variation is noticeable at frequencies below 1kHz.**

### Total Accuracy

Range	90 day %	180 Day %	1 year %	2 year %
1nF	0.2	0.225	0.25	0.35
2nF	0.2	0.225	0.25	0.35
5nF	0.2	0.225	0.25	0.35
10nF	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<sub>p</sub> up to 1uF  
C<sub>s</sub> 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
0.95uF to 9.5uF	8V	1nF
9.5uF to 95uF	8V	10nF
95uF to 0.95mF	8V	100nF
0.95mF to 9.5mF	8V	1uF
9.5mF to 100mF	8V	1uF

**Total Accuracy**

Range	90 day %	180 Day %	1 year %	2 year %
0.95uF to 9.5uF	0.56	0.63	0.7	0.98
9.5uF to 95uF	0.56	0.63	0.7	0.98
95uF to 0.95mF	0.56	0.63	0.7	0.98
0.95mF to 9.5mF	0.56	0.63	0.7	0.98
9.5mF to 100mF	0.56	0.63	0.7	0.98

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.

A constant charging current is required for specifications to apply. AC measurement techniques will fall outside of the specification



### General Specifications

Range	Maximum Current	DC Resistance	Q	Display Resolution
1mH	30mA	7.8Ω	1	100nH
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  $\pm 50\mu\text{H}$ .  
Specifications apply at 1kHz

### 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%	40uA
0.3A to 2A	0.1mA	0.015%	400uA
2.01A to 30A	1mA	0.04%	4mA

### 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. This function can be disabled  
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.

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 200mA 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 0.2A	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 into loads of 100mOhms and greater

4010 calibrators **automatically correct for any errors in the phase** caused by inductive loading, for example when using the clamp coil adaptor.

Note that when in Power output mode the Voltage and Current negative terminals are internally tied together, and as default negative to ground is selected. Phase specifications apply only when the UUT current and voltage measurement channels are isolated from each other. Ground loops caused by externally earthing or tying low's together will cause phase errors

**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. This function can be disabled  
 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.

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

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

<b>DDS Harmonic Power Simulation - Pre Loaded Waveforms</b>
<b>3rd 5%</b>
<b>3rd 10%</b>
<b>5th 10%</b>
<b>12th 10%</b>
<b>21st 10%</b>
<b>USER+SINE</b>
<b>USER</b>

Due to continuous development specifications may be subject to change.

**Amplitude**

Range	Resolution
2mV/Div. to 10mV/Div.	10nV
20mV/Div. to 100mV/Div.	100nV
200mV/Div. to 2V/Div.	1uV
5V/Div. to 20V/Div.	10uV
50V/Div.	100uV

Sequence	1, 2, 5
Waveshapes	Square Wave (positive going from ground), DC
Square Wave Frequency	1kHz
Frequency Accuracy	30ppm
Graticule Height	6 Graticules
Rise Time	2us
Fall Time	2us
Output Terminal	Front BNC (Green LED indicates terminal active)

**DC Level**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.009	± 20	0.01	± 20	0.01	± 20	0.014	± 20

**AC Square Wave**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.09	± 40	0.08	± 40	0.1	± 40	0.14	± 40

**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  
 Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting. This function can be disabled  
 An external high voltage output/standby control switch is available as an option

**Amplitude Deviation**

Deviation Range	±10%							
Deviation Resolution	3010 : Better than 10ppm							
Range	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
-10% to +10%	0.008	± 20	0.01	± 20	0.01	± 20	0.014	± 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. ppm	180 Day Rel. ppm	1 Year Rel. ppm	2 Year Rel. ppm
2ns/Div. to 5s/Div.	4.5	4.75	5	6

Timebase Deviation				
Deviation Range	±10% in 0.001% Steps			
Deviation Resolution	0.001%			
Range	90 Day Rel. %	180 Day Rel. %	1 Year Rel. %	2 Year Rel. %
-9.5% to +9.5%	0.01	0.01	0.01	0.01

Levelled Sweep				
Sweep Range	5MHz to 350MHz			
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

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, Maximum 1.5ns*

\*Note : Rise time can be affected by leads and impedance mismatch. 1.5ns should be used for certification  
 Specifications apply at TCal ± 5°C.  
 Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

**Amplitude**

Range	Resolution
2mV/Div. to 10mV/Div.	10nV
20mV/Div. to 100mV/Div.	100nV
200mV/Div. to 2V/Div.	1uV
5V/Div. to 20V/Div.	10uV
50V/Div.	100uV

Sequence	1, 2, 5
Waveshapes	Square Wave (positive going from ground), DC
Square Wave Frequency	1kHz
Frequency Accuracy	30ppm
Graticule Height	6 Graticules
Rise Time	2us
Fall Time	2us
Output Terminal	Front BNC (Green LED indicates terminal active)

**DC Level**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.009	± 20	0.01	± 20	0.01	± 20	0.014	± 20

**AC Square Wave**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.09	± 40	0.08	± 40	0.1	± 40	0.14	± 40

**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  
 Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting. This function can be disabled  
 An external high voltage output/standby control switch is available as an option

**Amplitude Deviation**

Deviation Range	±10%							
Deviation Resolution	4010 : Better than 10ppm							
Range	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
-10% to +10%	0.008	± 20	0.01	± 20	0.01	± 20	0.014	± 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. ppm	180 Day Rel. ppm	1 Year Rel. ppm	2 Year Rel. ppm
2ns/Div. to 5s/Div.	4.5	4.75	5	6

Timebase Deviation				
Deviation Range	±10% in 0.001% Steps			
Deviation Resolution	0.001%			
Range	90 Day Rel. %	180 Day Rel. %	1 Year Rel. %	2 Year Rel. %
-9.5% to +9.5%	0.01	0.01	0.01	0.01

Levelled Sweep				
Sweep Range	5MHz to 600MHz			
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 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, Maximum 1.5ns*

\*Note : Rise time can be affected by leads and impedance mismatch. 1.5ns should be used for certification Specifications apply at TCal ± 5°C.  
Outside this range an allowance of 0.18 x 1 Year Spec. per °C should be added.

**Amplitude**

Range	Resolution
2mV/Div. to 10mV/Div.	10nV
20mV/Div. to 100mV/Div.	100nV
200mV/Div. to 2V/Div.	1uV
5V/Div. to 20V/Div.	10uV
50V/Div.	100uV

Sequence	1, 2, 5
Waveshapes	Square Wave (positive going from ground), DC
Square Wave Frequency	1kHz
Frequency Accuracy	30ppm
Graticule Height	6 Graticules
Rise Time	2us
Fall Time	2us
Output Terminal	Front BNC (Green LED indicates terminal active)

**DC Level**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.009	± 20	0.01	± 20	0.01	± 20	0.014	± 20

**AC Square Wave**

Range @ 1MOhm load	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
2mV to 50V/Div.	0.09	± 40	0.08	± 40	0.1	± 40	0.14	± 40

**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  
 Standby is automatically selected for high voltage (>20V) after 20 minutes on the same setting. This function can be disabled  
 An external high voltage output/standby control switch is available as an option

Amplitude Deviation								
Deviation Range	±10%							
Deviation Resolution	4010 : Better than 10ppm							
Range	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%	uV	%	uV	%	uV	%	uV
-10% to +10%	0.008	± 20	0.01	± 20	0.01	± 20	0.014	± 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.		1 Year Rel.		2 Year Rel.	
	ppm		ppm		ppm		ppm	
2ns/Div. to 5s/Div.	4.5		4.75		5		6	

Timebase Deviation								
Deviation Range	±10% in 0.001% Steps							
Deviation Resolution	0.001%							
Range	90 Day Rel.		180 Day Rel.		1 Year Rel.		2 Year Rel.	
	%		%		%		%	
-9.5% to +9.5%	0.01		0.01		0.01		0.01	

Due to continuous development specifications may be subject to change.

4015 Extended Specifications

SCP 6GHz Option : V1.1

Variable Level Output				
Sweep Range	250kHz to 6.4GHz			
Frequency Accuracy	2ppm			
Frequency Resolution	10 kHz			
Waveform	Sine Wave			
Level	Variable from -50dBm to +10 dBm			
Level Resolution	0.01 dBm			
Output Terminal	Front Type N (Green LED indicates terminal active)			
Range	90 Day Rel. db	180 Day Rel. db	1 Year Rel. db	2 Year Rel. db
-50 to -30dBm				
0.25 - 10MHz	0.8	0.90	1	1.4
10 - 35MHz	0.8	0.90	1	1.4
35 - 4000MHz	0.8	0.90	1	1.4
35 - 4000MHz	0.8	0.90	1	1.4
-30 to 0dBm				
0.25 - 10MHz	0.8	0.90	1	1.4
10 - 35MHz	0.8	0.90	1	1.4
35 - 4000MHz	0.8	0.90	1	1.4
35 - 4000MHz	0.8	0.90	1	1.4
0dBm - 10dBm				
35 - 4000MHz	0.8	0.90	1	1.4
4 - 6.4 GHz	0.8	0.90	1	1.4

Fast Rise Output	
Rise/Fall Time	Typically 1ns, Maximum 1.5ns*

\*Note : Rise time can be affected by leads and impedance mismatch. 1.5ns should be used for certification  
 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	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
+300°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 1mW on all resistance specifications.

**Accuracy Relative to Calibration Standards Specifications**

Range	Actual Value (Ohms)	90 day Rel %	180 Day Rel %	1 year Rel %	2 year Rel %
-100°C	60.25	0.008	0.009	0.01	0.014
0°C	100.00	0.008	0.009	0.01	0.014
+30°C	111.67	0.008	0.009	0.01	0.014
+60°C	123.24	0.008	0.009	0.01	0.014
+100°C	138.50	0.008	0.009	0.01	0.014
+200°C	175.84	0.008	0.009	0.01	0.014
+300°C	247.04	0.008	0.009	0.01	0.014
+800°C	375.51	0.008	0.009	0.01	0.014

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

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

## General Specifications

PRT Type	Range °C	1 Year * ± °C
PT25	-200 to 0	0.50
	0 to 800	0.60
PT100	-200 to 0	0.13
	0 to 800	0.55
PT250	-200 to 0	0.25
	0 to 800	0.30
PT500	-200 to 260	0.10
	260 to 500	0.90
PT1000	-200 to 0	0.08
	0 to 800	0.45

### 2-Wire connection only

Display resolution : 10m°C

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 variable PRT function

e.g.. 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 ± 5°C.

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

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