Time Electronics
Calibration, Test and Measurement

Extended Specifications

5025E Series 2 Multifunction Calibrator

Revision: 2310-1

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5025E Series 2 Specifications

1. Specifications are stated as ± ppm or % of output + floor, unless otherwise indicated.
2. Specifications apply at 23 °C ± 5 °C.
3. For temperatures outside this range add 0.2 x specification per °C.
4. Specifications include stability, linearity, and traceability of external standards used for calibration.

DC Voltage

Range	Uncertainty 1 Year	Resolution	Output Resistance	Max. Burden
0 to 20 mV	40 ppm + 4 µV	0.1 µV	10 Ω	
20 to 200 mV	40 ppm + 4 µV	1 µV	10 Ω	
0.2 to 2 V	40 ppm + 15 µV	1 µV	0.1 Ω	20 mA
2 to 20 V	40 ppm + 75 µV	10 µV	0.1 Ω	20 mA
20 to 200 V	40 ppm + 1 mV	100 µV	0.25 Ω	10 mA
200 to 1010 V	40 ppm + 10 mV	1 mV	1 Ω	1 mA
Hi Drive Mode				
20 to 200 V	50 ppm + 15 mV	1 mV	<5 Ω	20 mA
200 to 1050 V	150 ppm + 30 mV	10 mV	<10 Ω	10 mA

Maximum capacitance 1000 pF.
1 % of full scale overrange, except for function limits.

DC Current

Range	Uncertainty 1 Year	Resolution	Compliance Voltage	Max. Inductance
0 to 200 µA	150 ppm + 25 nA	0.1 nA	10 V	50 µH
0.2 to 2 mA	120 ppm + 55 nA	1 nA	10 V	50 µH
2 to 20 mA	120 ppm + 200 nA	10 nA	10 V	50 µH
20 to 200 mA	120 ppm + 2 µA	100 nA	10 V	30 µH
0.2 to 2 A	400 ppm + 100 µA	1 µA	4 V	5 µH
2 to 22 A	600 ppm + 1 mA	10 µA	4 V	2 µH

For full accuracy the 2 A and 20 A ranges compliance is limited to 2.2 V. For settling and stabilisation, see notes
1 % of full scale overrange, except for function limits.

DC Power

Voltage Range	Uncertainty 1 Year	Resolution	Output Resistance	Max. Burden
2 to 20 mV	100 ppm + 10 µV	1 µV	10 Ω	
20 to 200 mV	100 ppm + 25 µV	1 µV	10 Ω	
0.2 to 2 V	100 ppm + 50 µV	10 µV	0.1 Ω	20 mA
2 to 20 V	100 ppm + 500 µV	100 µV	0.1 Ω	20 mA
20 to 200 V	200 ppm + 10 mV	1 mV	<5 Ω	20 mA
200 to 1050 V	500 ppm + 50 mV	10 mV	<10 Ω	10 mA
Current Range	**Uncertainty 1 Year**	**Resolution**	**Compliance Voltage**	**Max Inductance**
0.2 to 2 A	500 ppm + 500 µA	100 µA	4 V	200 µH
2 to 22 A	650 ppm + 5 mA	1 mA	4 V	150 µH

Simultaneous output of voltage and current. Output displayed in Watts or VA. Specification applies with low terminals isolated.
Additional current errors apply for use with common low terminals, see notes.

To calculate the total power uncertainty, use the following formula: $\sqrt{Vspec^2 + Ispec^2}$

Resistance

Range	Uncertainty 1 Year	Resolution	Max. Rating
1 to 20 Ω	100 ppm + 15 mΩ	1 Ω	0.1 W
20 to 100 Ω	100 ppm + 15 mΩ	10 mΩ	0.1 W
100 to 1000 Ω	100 ppm + 15 mΩ	1 mΩ	0.1 W
1 to 10 kΩ	200 ppm + 25 mΩ	1 Ω	0.1 W
10 to 100 kΩ	100 ppm + 1 Ω	1 Ω	0.1 W
0.1 to 1 MΩ	100 ppm + 10 Ω	10 Ω	0.1 W
1 to 10 MΩ	200 ppm + 100 Ω	100 Ω	200 V
10 to 100 MΩ	0.1 % + 10 kΩ	1 kΩ	200 V
0.1 to 1.1 GΩ	1 % + 1 MΩ	1 kΩ	200 V

2 wire output, calibrated at the output terminals. Specifications do not include external lead resistance.

(Instruments fitted with firmware version 10.x.x are limited to 120 MΩ)

AC Voltage

Range	Frequency	Uncertainty 1 Year	Resolution	Output Resistance	Max. Burden
2 to 20 mV	20 Hz to 40 Hz	0.15 % + 40 µV	1 µV	10 Ω	
	40 Hz to 2 kHz	0.10 % + 30 µV			
	2 kHz to 20 kHz	0.15 % + 30 µV			
	20 kHz to 100 kHz	0.15 % + 40 µV		50 Ω	
	100 kHz to 300 kHz	0.20 % + 75 µV			
	300 kHz to 500 kHz	1.25 % + 125 µV			
20 to 200 mV	20 Hz to 40 Hz	0.10 % + 60 µV	1 µV	10 Ω	
	40 Hz to 2 kHz	0.05 % + 50 µV			
	2 kHz to 20 kHz	0.10 % + 75 µV			
	20 kHz to 100 kHz	0.10 % + 100 µV		50 Ω	
	100 kHz to 300 kHz	0.25 % + 375 µV			
	300 kHz to 500 kHz	1.25 % + 1.25 mV			
0.2 to 2 V	20 Hz to 40 Hz	0.10 % + 60 µV	10 µV	< 0.1 Ω	20 mA
	40 Hz to 2 kHz	0.05 % + 50 µV			
	2 kHz to 20 kHz	0.05 % + 75 µV			
	20 kHz to 100 kHz	0.10 % + 150 µV		< 0.5 Ω	
	100 kHz to 300 kHz	0.25 % + 3.75 mV			
	300 kHz to 1 MHz	1.25 % + 12.5 mV			
2 to 20 V	20 Hz to 40 Hz	0.10 % + 600 µV	100 µV	< 5 Ω	20 mA
	40 Hz to 2 kHz	0.05 % + 500 µV			
	2 kHz to 20 kHz	0.10 % + 750 µV			
	20 kHz to 100 kHz	0.15 % + 1.5 mV		< 0.5 Ω	
20 to 200 V	40 Hz to 1 kHz	0.05 % + 3 mV	1 mV	< 5 Ω	20 mA
200 to 1050 V	40 Hz to 1 kHz	0.05 % + 20 mV	10 mV	< 10 Ω	10 mA

Frequency accuracy 0.01 %. Frequency resolution 1 Hz. 1 % of full scale overrange, except for function limits.
Additional noise floor uncertainties apply to settings below 5 mV, see notes.

AC Current

Range	Frequency	Uncertainty 1 Year	Resolution	Compliance Voltage (RMS)	Max. Inductance
10 to 200 µA	20 Hz to 40 Hz	0.10 % + 150 nA	10 nA	8 V	50 µH
	40 Hz to 2 kHz	0.05 % + 150 nA			
	2 kHz to 5 kHz	0.10 % + 150 nA			
0.2 to 2 mA	20 Hz to 40 Hz	0.10 % + 150 nA	10 nA	8 V	50 µH
	40 Hz to 2 kHz	0.05 % + 150 nA			
	2 kHz to 5 kHz	0.10 % + 200 nA			
2 to 20 mA	20 Hz to 40 Hz	0.10 % + 2 µA	100 nA	8 V	50 µH
	40 Hz to 2 kHz	0.05 % + 2 µA			
	2 kHz to 5 kHz	0.10 % + 2.5 µA			
20 to 200 mA	20 Hz to 40 Hz	0.10 % + 20 µA	1 µA	8 V	30 µH
	40 Hz to 2 kHz	0.05 % + 20 µA			
	2 kHz to 5 kHz	0.10 % + 25 µA			
0.2 to 2 A	20 Hz to 40 Hz	0.10 % + 100 µA	10 µA	3 V	200 µH
	40 Hz to 500 Hz	0.05 % + 100 µA			
2 to 22 A	20 Hz to 40 Hz	0.15 %+ 3 mA	100 µA	3 V	150 µH
	40 Hz to 500 Hz	0.10 %+ 3 mA			

For full accuracy the 2 A and 20 A ranges compliance is limited to 2.2 V. 1 % of full scale overrange, except for function limits.

AC Power

Voltage Ranges	Frequency	Uncertainty 1 Year	Resolution	Max. Burden
2 to 20 mV	40 to 500 Hz	0.10 % + 150 µV	1 µV	10 Ω
20 to 200 mV		0.05 % + 150 µV	1 µV	
0.2 to 2 V		0.05 % + 100 µV	10 µV	20 mA
2 to 20 V		0.05 % + 500 µV	100 µV	20 mA
20 to 200 V		0.10 % + 3 mV	1 mV	20 mA
200 to 1050 V		0.10 % + 20 mV	10 mV	10 mA
Current Ranges	**Frequency**	**Uncertainty 1 Year**	**Resolution**	**Compliance Voltage (RMS)**
0.2 to 2 A	40 to 500 Hz	0.1 % + 1.5 mA	10 µA	3 V
2 to 22 A		0.1 % + 15 mA	100 µA	

Frequency accuracy 0.02 %. Maximum Inductance: 2 A range 200 µH, 20 A range 150 µH
Specification applies with low terminals isolated. High terminals must not be connected. Additional current errors apply for use with common low terminals, see notes.
Additional noise floor uncertainties apply to settings below 5 mV, see notes.

Phase Angle	Frequency	Uncertainty 1 Year	Resolution
± 90 °	40 to 100 Hz	0.25 °	0.1 °
	100 to 500 Hz	1.0 °	0.1 °

Power Factor	Frequency	Resolution
0.00 to 1.00	40 to 500 Hz	0.01

Accredited measurements are not available for phase angle or power factor.

To calculate the total power uncertainty, use the following formulas:

$$Power\ Specification\ (\%) = \sqrt{Vspec^2 + Ispec^2 + PC^2}$$

Where *Vspec* and *Ispec* is the voltage and current accuracy expressed in %. PC is a Phase Correction derived from a formula given as:

$$Phase\ Correction\ (\%) = 100\left(1 - \frac{Cos(Phase + Pspec)}{Cos\ Phase}\right)$$

Phase Correction Table

Phase Watts	Power Factor	Uncertainty 1 Year	
		40 to 100 Hz	100 to 500 Hz
0 °	1.00	0.00 %	0.02 %
10 °	0.99	0.08 %	0.32 %
20 °	0.94	0.16 %	0.65 %
30 °	0.87	0.25 %	1.02 %
40 °	0.77	0.37 %	1.48 %
50 °	0.64	0.52 %	2.10 %
60 °	0.50	0.76 %	3.04 %
70 °	0.34	1.20 %	4.81 %
80 °	0.17	2.48 %	9.91 %

Capacitance

Nominal Value	Frequency	Uncertainty 1 Year	Resolution	Max. Voltage
1 nF	1 kHz	0.2 % + 10 pF	0.1 pF	25 V
10 nF	1 kHz	0.2 % + 10 pF	1 pF	25 V
20 nF	1 kHz	0.2 % + 10 pF	1 pF	25 V
50 nF	1 kHz	0.2 % + 10 pF	1 pF	25 V
100 nF	1 kHz	0.2 %	10 pF	25 V
200 nF	1 kHz	0.2 %	10 pF	25 V
500 nF	1 kHz	0.2 %	10 pF	25 V
1 µF	1 kHz	0.2 %	100 pF	25 V
10 µF	1 kHz	0.5 %	1 nF	25 V
20 µF	1 kHz	0.5 %	1 nF	25 V
50 µF	1 kHz	0.5 %	1 nF	25 V
100 µF	1 kHz	0.5 %	10 nF	25 V

Specifications apply to the displayed value, calibrated at the output terminals and does not include residual lead capacitance. Output impedance > 100 MΩ.
1 kHz specifications are based on 4 wire sinusoidal measurement technique.

Conductance

Value	Resolution	Uncertainty 1 Year
1.000 00 S	0.000 01 S	1.51 %
100.000 mS	0.001 mS	0.16 %
10.000 00 mS	0.000 01 mS	250 ppm
1.000 000 mS	0.000 001 mS	225 ppm
100.000 0 µS	0.000 1 µS	200 ppm
10.000 00 µS	0.000 01 µS	200 ppm
1.000 00 µS	0.000 01 µS	300 ppm
100.000 nS	0.001 nS	0.11 %
10.000 0 nS	0.000 1 nS	1 %

2 wire only. Does not include external lead conductance. Conductance is a mathematical calculation of the resistance function and therefore does not require calibration.

Thermocouple Simulation

Type	Range °C	Uncertainty 1 Year	Type	Range °C	Uncertainty 1 Year
J	-210 to -50 -50 to 1200	± 0.15 °C ± 0.2 °C	B	300 to 800 800 to 1820	± 1.5 °C ± 0.8 °C
K	-200 to -100 -100 to 1372	± 0.25 °C ± 0.18 °C	N	-200 to 0 0 to 600 600 to 1300	± 0.4 °C ± 0.15 °C ± 0.2 °C
T	-200 to 100 100 to 400	± 0.2 °C ± 0.15 °C	E	-200 to 0 0 to 1000	± 0.20 °C ± 0.12 °C
R	-50 to 50 50 to 250 250 to 1768	± 1.0 °C ± 0.7 °C ± 0.6 °C	S	-50 to 500 500 to 1768	± 0.9 °C ± 0.6 °C
U	-200 to 100 100 to 600	± 0.25 °C ± 0.1 °C	C	0 to 1740 1740 to 2315	± 0.30 °C ± 0.50 °C
L	-200 to 900	±0.2 °C			

Resolution 0.1 °C. Selectable units: °C, °F and °K. Switchable CJ reference: Internal, Manual and OFF. Additional errors apply for Internal and Manual CJ reference modes. Internal CJ reference mode accuracy ± 0.5 °C and applies to ambient changes less than ± 1 °C.

The accuracy of the thermocouple simulation is determined by the accuracy of the 20 and 200 mV DC ranges using tables published in EN 60584-1:2013 (ITS-90). Type U & L based on tables published in DIN 43710 (ITPS68). Type C based on tables published in ASTM E230/E230M–12 (ITS-90). Accredited measurements are not available for Types B, U, C, L & the internal CJ reference.

RTD Simulation

Range	Uncertainty 1 Year	Resolution
Pt100		
-180 to 50 °C	± 0.07 °C	0.01 °C
50 to 250 °C	100 ppm + 0.07 °C	
250 to 850 °C	100 ppm + 0.10 °C	
Pt200		
-180 to 50 °C	± 0.05 °C	0.01 °C
50 to 250 °C	100 ppm + 0.05 °C	
250 to 850 °C	100 ppm + 0.08 °C	
Pt500		
-180 to 50 °C	± 0.04 °C	0.01 °C
50 to 250 °C	100 ppm + 0.04 °C	
250 to 850 °C	400 ppm + 0.3 °C	1 °C
Pt1000		
-180 to 0 °C	± 0.05 °C	0.01 °C
0 to 850 °C	400 ppm + 0.3 °C	1 °C

2-wire output calibrated at the output terminals. Specifications do not include external lead resistance. The accuracy of the RTD simulation function is determined using tables published in IEC 60751(ITS-90, alpha = 0.00385).

Digital Frequency

Range	Resolution	Uncertainty 1 Year
0.1 Hz to 1 kHz	0.01 Hz	20 ppm
1 kHz to 1 MHz	1 Hz	
1 MHz to 10 MHz	10 Hz	

Digital Period

Range	Resolution	Uncertainty 1 Year
100 ns to 10 s	Fixed Values 1,2,5 Sequence	20 ppm

Square wave output. Amplitude approximately 2 Vp-p. Period is a mathematical calculation of the Frequency function and therefore does not require calibration.

Turn Coil Ranges

Range	Frequency	Uncertainty 1 Year	Resolution	Compliance Voltage	Max. Inductance
2 A x1	DC	0.05 % + 500 µA	100 µA	4 V	200 µH
	20 Hz to 40 Hz	0.10 % + 100 µA	10 µA	3 V RMS	
	40 Hz to 100 Hz	0.05 % + 100 µA			
2 A x5 (10 A)	DC	0.05 % + 500 µA	1 mA	4 V	
	20 Hz to 40 Hz	0.10 % + 100 µA	100 µA	3 V RMS	
	40 Hz to 100 Hz	0.05 % + 100 µA			
2 A x50 (100 A)	DC	0.05 % + 500 µA	10 mA	4 V	
	20 Hz to 40 Hz	0.10 % + 100 µA	1 mA	3 V RMS	
	40 Hz to 100 Hz	0.05 % + 100 µA			
20 A x1	DC	0.065 % + 5 mA	1 mA	4 V	150 µH
	20 Hz to 40 Hz	0.15 % + 3 mA	100 µA	3 V RMS	
	40 Hz to 100 Hz	0.10 % + 3 mA			
20 A x5 (100 A)	DC	0.065 % + 5 mA	10 mA	4 V	
	20 Hz to 40 Hz	0.15 % + 3 mA	1 mA	3 V RMS	
	40 Hz to 100 Hz	0.10 % + 3 mA			
20 A x50 (1100 A)	DC	0.065 % + 5 mA	100 mA	4 V	
	20 Hz to 40 Hz	0.15 % + 3 mA	10 mA	3 V RMS	
	40 Hz to 100 Hz	0.10 % + 3 mA			

The turn coil ranges are a mathematical calculation of the DCI Power and ACI current functions and therefore do not require calibration.
1 % of full scale overrange, except for function limits. The uncertainty refers to the output terminals and does not include clamp coil accuracy.

Oscilloscope Calibration Option

Amplitude

Range	Uncertainty 1 Year		Resolution
	DC Signal	Square Wave Signal	
2 to 200 mV (1 MΩ)	0.20 % + 10 uV	0.25 % + 20 uV	10 µV
0.2 to 20 V (1 MΩ)	0.05 % + 25 uV	0.25 % + 50 uV	1 mV
20 to 200 V (1 MΩ)	0.05 % + 10 mV	0.25 % + 20 mV	10 mV
1 to 200 mV (50 Ω)	0.25 % + 20 uV	0.25 % + 40 uV	100 µV
0.2 to 2 V (50 Ω)	0.25 % + 20 uV	0.25 % + 40 uV	1 mV

Selectable DC and 1 kHz square wave signal.
The square wave signal is a chopped DC voltage, and the accuracy applies to the top line measurement relative to ground.
Calibration is performed using the DC signal.

Frequency

Range	Resolution	Uncertainty 1 Year
0.1 Hz to 10 MHz	Fixed values 1,2,5 sequence	0.1 ppm
20, 50, 100 MHz		20 ppm

Period

Range	Resolution	Uncertainty 1 Year
100 ns to 10 s	Fixed values 1,2,5 sequence	0.1 ppm
50, 20, 10 ns		20 ppm

Deviation function is not available. 1.5V pk-pk - 0.1Hz to 100kHz. 1V pk-pk - 100kHz to 100MHz (sine wave at 100MHz).
Period is a mathematical calculation of the Frequency function and therefore does not require calibration.

Duty Cycle

3 frequencies, 100 Hz, 1 kHz, 10 kHz.
Duty cycle settable from 0 to 100 %
Setting resolution 0.01 % at 100 Hz, 0.1 % at 1 kHz, 1 % at 10 kHz
Deviation function is not available.

Fast Rise

Into 50 Ω Load	Uncertainty 1 Year
400 ps	± 150 ps

Accredited measurements are not available for Duty Cycle and Fast Rise. Fast Rise specifications apply to the displayed value.

Levelled Sinewave

Amplitude Ranges: 0.35, 0.4, 0.5, 0.6, 1, 1.5, 2, 2.5, 3 and 3.5 Vp-p. Deviation ± 5 % except for function limits.

Amplitude Ranges (50 Ω)	0.35 to 3.5 Vp-p			
Reference Low Frequency Range	50 kHz	50 to 100 kHz	100 to 300 kHz	300 to 1000 kHz
Absolute Uncertainty 1 Year	0.5 % + 400 µVp-p	1 % + 400 µVp-p	1 % + 10 mVp-p	1.5 % + 35 mVp-p

Low Frequency Accuracy 100 ppm. Resolution 0.1 kHz. Settling time up to 10 seconds.

Amplitude Ranges (50 Ω)	0.35 to 1.5 Vp-p			
High Frequency Range	10 to 199.9 MHz	200 to 499.9 MHz	500 to 999.9 MHz	1 to 2.2 GHz
Accuracy relative to 50 kHz	1.5 %	2.5 %	4 %	5 %
Absolute Uncertainty 1 Year	3 %	4 %	5.5 %	6.5 %

Amplitude Ranges (50 Ω)	2, 2.5, 3 Vp-p			
High Frequency Range	10 to 199.9 MHz	200 to 499.9 MHz	500 to 999.9 MHz	1 to 1.6 GHz
Accuracy relative to 10 MHz	1.5 %	2.5 %	4 %	5 %
Absolute Uncertainty 1 Year	3 %	4 %	5.5 %	6.5 %

Amplitude Range (50 Ω)	3.5 Vp-p			
High Frequency Range	10 to 199.9 MHz	200 to 499.9 MHz	500 to 999.9 MHz	1 to 1.3 GHz
Accuracy relative to 50 kHz	1.5 %	2.5 %	4 %	5 %
Absolute Uncertainty 1 Year	3 %	4 %	5.5 %	6.5 %

High Frequency accuracy 50 ppm, resolution 0.1 MHz.

The Levelled Sweep option is calibrated with the SMA to BNC lead supplied. Any additional losses or gains must be accounted for.
Accredited measurements are not available for levelled sinewave amplitude.

General Specifications

Mains Voltage	100 to 260 V AC 50/60 Hz.
Fuse Ratings	3.15 A anti-surge.
Power Consumption	120 W typical, 200 W Max.
Operating Temperature	10 to 40 ºC.
Storage Temperature	–10 to 50 °C.
Operating Humidity	< 80 %.
Altitude	0 to 3 km. Non-operating 3 to 12 km.
Warm Up Time	30 minutes to full accuracy.
Dimensions	Width 447 mm, Height 152 mm, Depth 470 mm.
Weight	16.5 kg.
Interfaces	RS-232, GPIB & USB (via RS232 adaptor).
Command Set	Standard SCPI.

Notes

Absolute Uncertainties
Specified at a 95 % confidence level, coverage factor k=2.

Overrange and Function Limits
These are the minimum and maximum values for the function. Where stated, over or under these values cannot be set.

Mathematical Functions
These functions are mathematical calculations performed by the instrument's internal processors and have been designed and validated by Time Electronics. Calibration of these functions can be performed upon request.

Accredited Measurements
Certain functions or ranges are indicated as 'accredited measurements not available'. On an accredited calibration certificate, these measurements will be marked as 'not accredited' or will not be included. Traceable measurements can be provided upon request. For further information please contact Time Electronics.

Power Function Information and Additional Uncertainties
Additional AC and DC current errors for use with common low terminals: 2 A Ranges: 500 ppm + 800 µA. 22 A Range: 0.25 % + 50 mA
Calibration is performed as separate voltage and current measurements.

Output Resistance and Loading
The output resistance of the 20 and 200 mV ranges is 10 Ω. This must be considered when loads of 100 kΩ or less are being driven. A 100 kΩ load will result in a 0.01% error.

The normal (non-Hi Drive) DC high voltage ranges have been designed to operate with loads of 10 MΩ. Specifications apply to loads above 100 kΩ on the 200 V range and 2 MΩ on the 1000 V.

Noise Information and Additional Uncertainties
Additional ACV noise floor uncertainties apply between 1 and 5 mV: 20 Hz to 20 kHz, add 20 µV. 20 kHz to 300 kHz, add 50 µV.
DC specifications apply between 0.1 and 1 Hz bandwidth.

Settling and Stabilisation
DC Current 2 A Range: Full accuracy applies after the momentary setting of full scale allowing for thermal stabilisation throughout the range. Settling time 30 seconds.
2 Wire Resistance: Specifications apply after 15 seconds of settling time. Above 1 MΩ the settling time increases to 30 seconds.

For further information about settling and stabilisation please contact Time Electronics.