



Time Electronics
Calibration, Test and Measurement

Extended Specifications

5025E Series 2 Multifunction Calibrator

Revision: 0221-3

Time Electronics Ltd

Unit 5, TON Business Park, 2-8 Morley Road,
Tonbridge, Kent, TN9 1RA, United Kingdom.

T: +44 (0) 1732 355993 | F: +44 (0) 1732 350198
mail@timeelectronics.co.uk | www.timeelectronics.com

5025E Series 2 Specifications

1. Specifications are stated as $\pm$ ppm or % of output + floor, unless otherwise indicated.
2. Specifications apply at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
3. For temperatures outside this range add $0.2 \times$ specification per $^{\circ}\text{C}$.
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 mA
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	
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	200 ppm + 10 mV	1 mV	<5 Ω	20 mA
200 to 1050 V	500 ppm + 50 mV	10 mV	<10 Ω	10 mA

Specifications are between 0.1 Hz and 10 Hz bandwidth. 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 + 50 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 maximum load is 1.1 Ω for the 2 A range, and 110 m Ω for the 20A range.
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 mA
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	
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 + 250 μA	10 μA	4 V	200 μH
2 to 22 A	650 ppm + 5 mA	100 μA	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: $\sqrt{V_{spec}^2 + I_{spec}^2}$

Resistance

Range	Uncertainty 1 Year	Resolution	Max. Rating
1 to 20 Ω	100 ppm + 15 m Ω	1 Ω	0.1 W
20 to 49.99 Ω	100 ppm + 15 m Ω	10 m Ω	0.1 W
50 to 999.999 Ω	100 ppm + 15 m Ω	1 m Ω	0.1 W
1 to 9.999 k Ω	200 ppm + 25 m Ω	1 Ω	0.1 W
10 to 99.999 k Ω	100 ppm + 1 Ω	1 Ω	0.1 W
100 to 999.99 k Ω	100 ppm + 10 Ω	10 Ω	0.1 W
1 to 9.999 9 M Ω	200 ppm + 100 Ω	100 Ω	0.1 W
10 to 99.999 M Ω	0.1 % + 1 k Ω	1 k Ω	0.1 W
100 to 120.000 M Ω	1 % + 10 k Ω	1 k Ω	0.1 W

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

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	20 mA
	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			
	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	
	40 Hz to 2 kHz	0.05 % + 50 μV			
	2 kHz to 20 kHz	0.05 % + 75 μV			< 0.5 Ω
	20 kHz to 100 kHz	0.10 % + 150 μV			
	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		< 0.5 Ω	
	20 kHz to 100 kHz	0.15 % + 1.5 mV			
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.

AC Current

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

For full accuracy the maximum load is 1.1 Ω for the 2 A range, and 110 m Ω for the 20A range. 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 μ V	1 μ V	10 Ω
20 to 200 mV		0.05 % + 150 μ V	1 μ V	
0.2 to 2 V		0.05 % + 100 μ V	10 μ V	20 mA
2 to 20 V		0.05 % + 500 μ V	100 μ V	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	100 μ A	3 V
2 to 22 A		0.1 % + 15 mA	1 mA	

Frequency accuracy 0.02 %. Maximum Inductance: 2 A range 200 μ H, 20 A range 100 μ H

Specification applies with low terminals isolated. High terminals must not be connected. Additional current errors apply for use with common low terminals, see notes.

Phase Angle	Frequency	Uncertainty 1 Year	Resolution
$\pm 90^\circ$	40 to 100 Hz	0.25 $^\circ$	0.1 $^\circ$
	100 to 500 Hz	1.0 $^\circ$	0.1 $^\circ$

Power Factor	Frequency	Resolution
0.00 to 1.000	40 to 500 Hz	0.001

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

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

$$\text{Power Specification (\%)} = \sqrt{V_{\text{spec}}^2 + I_{\text{spec}}^2 + PC^2}$$

Where V_{spec} and I_{spec} is the voltage and current accuracy expressed in %. PC is a Phase Correction derived from a formula given as:

$$\text{Phase Correction (\%)} = 100 \left(1 - \frac{\cos(\text{Phase} + P_{\text{spec}})}{\cos \text{Phase}} \right)$$

Phase Correction Table

Phase Watts	Power Factor	Uncertainty 1 Year	
		40 to 100 Hz	100 to 500 Hz
0 $^\circ$	1.000	0.00 %	0.02 %
10 $^\circ$	0.985	0.08 %	0.32 %
20 $^\circ$	0.940	0.16 %	0.65 %
30 $^\circ$	0.866	0.25 %	1.02 %
40 $^\circ$	0.766	0.37 %	1.48 %
50 $^\circ$	0.643	0.52 %	2.10 %
60 $^\circ$	0.500	0.76 %	3.04 %
70 $^\circ$	0.342	1.20 %	4.81 %
80 $^\circ$	0.174	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 μ F	1 kHz	0.2 %	100 pF	25 V
10 μ F	1 kHz	0.5 %	1 nF	25 V
20 μ F	1 kHz	0.5 %	1 nF	25 V
50 μ F	1 kHz	0.5 %	1 nF	25 V
100 μ F	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 M Ω .

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	1.5 %
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 μ S	0.000 1 μ S	200 ppm
10.000 00 μ S	0.000 01 μ S	200 ppm
1.000 00 μ S	0.000 01 μ S	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 -100 380 to 600	± 0.25 °C ± 0.1 °C	C	0 to 1750 1740 to 2315	± 0.30 °C ± 0.35 °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	
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 % + 250 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 % + 250 µA	1 mA	4 V	
	20 Hz to 40 Hz	0.10 % + 500 µA	100 µA	3 V RMS	
	40 Hz to 100 Hz	0.05 % + 500 µA			
2 A x50 (100 A)	DC	0.05 % + 250 µA	10 mA	4 V	
	20 Hz to 40 Hz	0.10 % + 500 mA	1 mA	3 V RMS	
	40 Hz to 100 Hz	0.05 % + 500 mA			
20 A x1	DC	0.65 % + 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	0.65 % + 25 mA	10 mA	4 V	
	20 Hz to 40 Hz	0.15 % + 15 mA	1 mA	3 V RMS	
	40 Hz to 100 Hz	0.10 % + 15 mA			
20 A x50 (1100 A)	DC	0.65 % + 250 mA	100 mA	4 V	
	20 Hz to 40 Hz	0.15 % + 150 mA	10 mA	3 V RMS	
	40 Hz to 100 Hz	0.10 % + 150 mA			

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

Oscilloscope Calibration Option

Amplitude

Range	Uncertainty 1 Year	Resolution
2 to 200 mV	0.20 % + 10 μ V	10 μ V
0.2 to 20 V	0.05 % + 25 μ V	1 mV
1 to 200 V	0.05 % + 100 μ V	10 mV
1 to 200 mV (50 Ω)	0.25 % + 20 μ V	100 μ V
0.2 to 2 V (50 Ω)	0.25 % + 20 μ V	1 mV

Selectable DC and 1kHz square wave signals. Calibration is performed using the DC signal.

Frequency

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

Period

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

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.
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Fast Rise

Into 50 Ω Load	Uncertainty 1 Year
400 ps	$\pm$ 150 ps

Accredited measurements are not available for Duty Cycle and Fast Rise.

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 $\pm$ 5 % except for function limits.

Amplitude Ranges (50 Ω)	0.35 to 3.5 Vp-p		
Reference Low Frequency Range	50 to 100 kHz	100 to 300 kHz	300 to 1000 kHz
Absolute Uncertainty 1 Year	0.5 % + 400 μ Vp-p	0.25 % + 10 mVp-p	1.25 % + 35 mVp-p

Low Frequency Accuracy 100 ppm. Resolution 0.1 kHz

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 °C.
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 Functions

Additional AC and DC current errors for use with common low terminals: 2 A Ranges: 500 ppm + 800 μ A. 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 k Ω or less are being driven. A 100 k Ω load will result in a 0.01% error.

For the normal (non-Hi Drive mode) high voltage ranges a minimum loading is required: 20 k Ω for the 200 V range, 1 M Ω for the 1000 V range.

Due to continuous development Time Electronics reserves the right to change specifications without prior notice.