Time Electronics
Calibration, Test & Measurement

5051

Extended Specification

V1.4d

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5051 SPECIFICATIONS

1. Total accuracies are shown as ppm or % of output + floor.
2. Specifications apply for settings between 10% and 100% of range.
3. Specifications apply at ambient temp of 22°C +/- 3°C
4. For temperatures outside the above range apply 0.2 x specification per °C
5. Calibrator warm up time at least 1 hour.
6. All values are relative to calibration standards.
7. Accuracies quoted are for 1 year.

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

CALIBRATOR SECTION

DC VOLTAGE

Range	Accuracy ppm	Output Resistance	Max Output Current	Resolution
20mV [1]	100 + 4uV	10 Ω	-	100nV
200mV [1]	30 + 6uV	10 Ω	-	1uV
2V [1]	15 + 20uV	< 0.1 Ω	20mA	1uV
20V [1]	15 + 150uV	< 0.1 Ω	20mA	10uV
200V [1]	30 + 6mV	< 5 Ω	20mA	100uV
1050V	50 + 30mV	< 10 Ω	10mA	1mV

1. Over-Range 10%.

AC VOLTAGE 10Hz - 20kHz (sine-wave)

Range RMS	Frequency [2]	Accuracy %	Output Resistance	Max Output Current	Resolution
20mV [1]	10Hz-45Hz	0.05 + 250uV	10 Ω [3]		1uV
	45Hz-1kHz	0.05 + 100uV	10 Ω [3]	-	1uV
	1kHz-10kHz	0.05 + 150uV	10 Ω [3]		1uV
	10kHz-20kHz	0.05 + 250uV	10 Ω [3]		1uV
200mV [1]	10Hz-45Hz	0.05 + 250uV	10 Ω	-	1uV
	45Hz-1kHz	0.04 + 100uV	10 Ω		1uV
	1kHz-10kHz	0.04 + 150uV	10 Ω		1uV
	10kHz-20kHz	0.05 + 250uV	10 Ω		1uV
2V [1]	10Hz-45Hz	0.08 + 500uV	< 0.1 Ω	20mA	10uV
	45Hz-1kHz	0.03 + 170uV	< 0.1 Ω	20mA	10uV
	1kHz-10kHz	0.03 + 250uV	< 0.1 Ω	20mA	10uV
	10kHz-20kHz	0.08 + 500uV	< 0.1 Ω	20mA	10uV
20V [1]	10Hz-45Hz	0.08 + 4mV	< 5 Ω	20mA	100uV
	45Hz-1kHz	0.03 + 2mV	< 5 Ω	20mA	100uV
	1kHz-10kHz	0.03 + 3mV	< 5 Ω	20mA	100uV
	10kHz-20kHz	0.08 + 4mV	< 5 Ω	20mA	100uV
200V [1]	40Hz-1kHz	0.06 + 20mV	< 5Ω	20mA	1mV
1050V	40Hz-1kHz	0.08 + 90mV	< 10 Ω	10mA	10mV

1. Over-Range 10%
2. The frequency accuracy for AC ranges is 0.01% and is crystal controlled. The setting resolution is 1Hz.
3. The output resistance on the 20mV and 200mV ranges is 10 ohms. This must be taken into account when loads of 100K ohms or less are being driven. A 100K load will result in a 0.01% error.

All AC outputs exclude the DC component.

It is recommended that for very high accuracy low level AC calibration a precision attenuator with known characteristics is used. This can be driven from the 5051's 2V or 20V ranges and with proper screening of the attenuator the signal to noise ratio of the resulting output can be improved significantly. A 1000:1 screened precision attenuator is available from Time Electronics.

DC CURRENT

Range	Accuracy ppm	Compliance Voltage	Resolution
200uA [1]	150 + 15nA	11V	1 nA
2mA [1]	100 + 40nA	11V	10 nA
20mA [1]	80 + 200nA	11V	10 nA
200mA [1]	80 + 3uA	11V	100 nA
2A [1]	250 + 40uA	5V	1 uA
20A [1]	600 + 2mA	4V	10 uA

1. Over-Range 10%.

AC CURRENT (sine-wave)

Range	Frequency	Accuracy %	Compliance Voltage rms	Resolution
200uA [1]	20Hz – 1kHz	0.07 + 300nA	8V	10nA
2mA [1]	20Hz – 1kHz	0.05 + 300nA	8V	10nA
20mA [1]	20Hz – 1kHz	0.05 + 3uA	8V	100nA
200mA [1]	20Hz – 1kHz	0.05 + 30uA	8V	1uA
2A [1]	20Hz – 500Hz	0.1 + 0.5mA	3.5V	10uA
20A [1]	20Hz – 500Hz	0.2 + 5mA	3V	100uA

1. Over-Range 10%.

THERMOCOUPLE SIMULATION

Thermocouple Type	Temperature Range ºC	Accuracy ºC
J	-210 to 150 150 to 1200	0.15 0.3
K	-270 to 190 190 to 1250	0.5 0.6
T	-200 to 150 150 to 400	0.4 0.5
R	-50 to 800 800 to 1750	0.8 2.0
S	-50 to 850 850 to 1750	0.9 2.0
B	100 to 1200 1200 to 1800	1.0 2.0
N	-270 to 260 260 to 1300	0.5 0.4
E	-50 to 1000	0.3

Cold Junction Compensation +/- 0.5ºC (applies to ambient changes of +/- 1ºC)

The accuracy of the thermocouple simulation is determined by the accuracy of the 5051's DC Voltage function and the accuracy of the standard thermocouple tables (BS EN 60584-1) published by the British Standards Institute.
The 5051 uses precise digital interpretation of the tables to output voltage levels that are within the accuracies specified in the table above.

RESISTANCE [1]		
Value	**Accuracy**	**Max Rating**
1 Ω	800 ppm	0.1W
10 Ω	70 ppm	0.1W
100 Ω	30 ppm	0.1W
1K Ω	20 ppm	0.1W
10K Ω	20 ppm	0.1W
100k Ω	30 ppm	0.1W
1M Ω	150 ppm	200V
10M Ω	0.1%	200V
100M Ω	1%	200V
1G Ω	10%	200V

1. Resistance specifications are +/- 5mΩ.

CONDUCTANCE		
Value	**Accuracy**	**Max Rating**
1 S	800 ppm	0.1W
100m S	70 ppm	0.1W
10m S	30 ppm	0.1W
1m S	20 ppm	0.1W
100u S	20 ppm	0.1W
10u S	30 ppm	0.1W
1u S	150 ppm	200V
100n S	0.1%	200V
10n S	1%	200V
1n S	10%	200V

1.Conductance specifications are +/- 5mΩ

10MHz DIGITAL FREQUENCY
Variable Values 0.1Hz to 10MHz, ~2V pk-pk square wave. Accuracy 20ppm

PERIOD
Variable Values 100nS to 10S, ~2V pk-pk square wave. Accuracy 20ppm

DMM SECTION

6.5 Digits RDG = Reading. RNG = Range.

DC VOLTAGE			
Range	**Accuracy PPM** (RDG+RNG)	**Input Impedance**	**Resolution**
100 mV	50 + 40	10MΩ	1uV
1 V	40 + 8	10MΩ	1uV
10 V	35 + 6	10MΩ	10uV
100 V	45 + 7	10MΩ	100uV
1 kV	45 + 10	10MΩ	1mV

AC VOLTAGE			
Range RMS	**Frequency**	**Accuracy %** (RDG+RNG)	**Resolution**
100 mV	5 Hz – 10 Hz	0.4 + 0.04	10uV
	10 Hz – 20 kHz	0.06 + 0.04	10uV
	20 Hz – 50 kHz	0.12 + 0.05	10uV
	50 kHz – 100 kHz	0.6 + 0.1	10uV
	100 kHz – 300 kHz	5.0 + 0.5	100uV
1V – 750V	5 Hz – 10 Hz	0.4 + 0.03	0.01% of f.s.
	10 Hz – 20 kHz	0.15 + 0.05	0.01% of f.s.
	20 kHz – 50 kHz	0.6 + 0.1	0.01% of f.s.
	50 kHz – 100 kHz	5.0 + 0.5	0.01% of f.s.

DC CURRENT			
Range	**Accuracy PPM** (RDG+RNG)	**Burden Voltage**	**Resolution**
10 mA	500 + 200	<0.1V	100nA
100 mA	500 + 50	<0.7V	1uA
1 A	1000 + 100	<1V	10uA
3 A	1200 + 200	<2V	100uA

AC CURRENT			
Range RMS	**Frequency**	**Accuracy %** (RDG+RNG)	**Resolution**
1 A	10Hz – 5kHz	0.15 + 0.05	100uA
3 A	10Hz – 5kHz	0.25 + 0.1	100uA

RESISTANCE		
Range	**Test Current**	**Accuracy PPM** (RDG+RNG)
100Ω	1mA	100 + 40
1kΩ	1mA	100 + 10
10kΩ	100uA	100 + 10
100kΩ	10uA	100 + 10
1 MΩ	5uA	100 + 10
10 MΩ	0.5uA	400 + 10
100 MΩ	0.1uA	9000 + 10

FREQUENCY/PERIOD (100mV – 750V)	
Range	**Accuracy %** (RDG)
3Hz to 10Hz	0.1
10Hz to 40Hz	0.03
40Hz to 300kHz	0.01

Calibrator Options

(Option code shown in brackets)

CAPACITANCE AND INDUCTANCE (9798)			
Value	**Frequency**	**Accuracy %**	**Max volts**
1 nF	1kHz	0.5 +/-10pf	100V
10 nF	1kHz	0.5 +/-10pf	
100 nF	1kHz	0.5	
1 uF	1kHz	0.25	
10 uF	1kHz	0.5	
100 uF	100Hz	0.5	
Value	**Frequency**	**Accuracy**	**Max current**
1 mH	1kHz	1% of nominal OR 0.1% of previous calibration value	10mA
1.9 mH	1kHz		
5 mH	1kHz		
10 mH	1kHz		
19 mH	1kHz		
50 mH	1kHz		
100 mH	1kHz		
190 mH	1kHz		
500 mH	1kHz		
1H	1kHz		
10H	100Hz		

Specifications are shown after subtraction of residual capacitance / inductance.
Specification based on 4 wire sine-wave measurement technique.

OSCILLOSCOPE (9770)	
FREQUENCY Fixed Values 1, 2, 5 steps 0.1Hz to 10MHz accuracy 0.1ppm* 20, 50, 100MHz accuracy 20ppm	**PERIOD** Fixed Values 1, 2, 5 steps 100nS to 10S accuracy 0.1ppm* 50, 20, & 10nS accuracy 20ppm
* Fitted with Oven-Controlled Frequency Reference. Otherwise - 20ppm. 1.5V pk-pk - 0.1Hz to 100kHz. 1V pk-pk - 100kHz to 100MHz (sine-wave at 100MHz)	
DUTY CYCLE 3 frequencies, 100Hz, 1kHz, 10kHz. Duty cycle settable from 0 to 100% Setting resolution 0.01% at 100Hz, 0.1% at 1 kHz, 1% at 10 kHz Deviation function is not available.	
AMPLITUDE	
Output per div	1mV to 50V in 1, 2, 5 sequence. 1kHz square wave or DC.
Graticule X	1, 2, 4, 6, 8. Max output 200V pk-pk [1]
Range	**Accuracy**
1mV to 200mV	0.2% +/- 4uV
200mV to 200V	0.05%
1mV to 20mV 50Ω	0.5% +/- 10uV
20mV to 2V 50Ω	0.25%
FAST RISE	< 300ps. Bandwidth Checking up to 600 MHz

1. At 1mV/div 1,2,4X not available

2.2GHz-LEVELLED SWEEP (9769) 0.5V, 1V, 1.5V pk-pk Sine-Wave, 50Ω Output.	
Range	**Amplitude Accuracy**
100 MHz to 200 MHz	1%
200 MHz to 500 MHz	4%
500 MHz to 1 GHz	10%
2.2 GHz to 2.2 GHz	20%

Calibrator Options (continued)

FULL RANGE RESISTANCE (9787)			
Range	**Accuracy[1]**	**Resolution**	**Max Rating**
1Ω – 20Ω	0.01% +/- 7mΩ	1Ω	0.1W
20Ω – 99.999Ω	0.01% +/- 7mΩ	1mΩ/5mΩ*	0.1W
100Ω – 999.999Ω	0.01% +/- 5mΩ	1mΩ	0.1W
1kΩ – 9.999kΩ	0.02% +/- 20mΩ	1Ω	0.1W
10kΩ – 99.999kΩ	0.01% +/- 1Ω	1Ω	0.1W
100kΩ – 999.99kΩ	0.01% +/- 10Ω	10Ω	0.1W
1MΩ – 9.9999MΩ	0.02% +/- 100Ω	100Ω	0.1W
10MΩ – 120MΩ	0.1% +/- 1kΩ	1kΩ	0.1W

1.After subtraction of lead resistance. Add end resistance variation +/- 2.5mΩ
* Output resolution is 5mΩ below 50Ω

PRT SIMULATION (Uses Full Range Resistance option)			
Pt100 DIN	Alpha Coeff 0.003850	Range -180 to 850ºC	Accuracy 0.1ºC

It should be notes that the accuracy of the PRT simulation is determined by the accuracy of the PRT tables (BS EN 60751) published by the British Standards Institute. The 5025 uses precise digital interpretation of the tables to output resistance values that are within the accuracies specified in the table above.

SIMULATED RESISTANCE (9774)	
RANGE	**ACCURACY**
2 Wire[1]	
40 ohms (min 10 ohms)	0.15% of setting +/- 20 milliohms
400 ohms	0.05% of setting +/- 0.05% of range
4K ohms	0.02% of setting +/- 0.05% of range
40K ohms	0.02% of setting +/- 0.05% of range
400K ohms	0.02% of setting +/- 0.05% of range
4M ohms	0.05% of setting +/- 0.05% of range
40M ohms	0.2% of setting +/- 0.05% of range

1. After subtraction of lead resistance.
Maximum measure current allowed in simulated resistance mode is 20mA. Simulated resistance mode is suitable for DC only, i.e. only DC current may be passed through the active resistance.
Simulated resistance limitations
It should be noted that the 5051's simulated resistance circuitry has a 2V voltage compliance. This means that the simulation is only valid if the measure current multiplied by required resistance is less than 2V. For example, if the measure current is 1mA, the maximum simulated resistance will be 2K ohms. The user should be aware of the measure currents being used by the instrument being calibrated in order to prevent incorrect simulated resistance being output by the 5051.
It should also be noted that some DMMs use measuring currents which are outside the 5051 simulated resistance limits. If in doubt over the validity of the 5051's output it is recommended that the voltage across the output terminals is checked – it should be less than 2V for correct operation.

PRT SIMULATION (Uses Simulated Resistance option)			
Pt100 DIN	Alpha Coeff 0.003850	Range -250 to 850ºC	Accuracy 0.1ºC

It should be notes that the accuracy of the PRT simulation is determined by the accuracy of the 5051's simulated (active) resistance function and the accuracy of the PRT tables (BS EN 60751) published by the British Standards Institute. The 5051 uses precise digital interpretation of the tables to output resistance values that are within the accuracies specified in the table above.

AC VOLTAGE HI FREQUENCY (9771)			
Range	**20 kHz – 100 kHz**	**100 kHz to 300 kHz**	**300kHz to 1MHz**
20mV	0.05% + 0.1mV	0.1% + 0.5mV	-
200mV	0.05% + 0.1mV	0.1% + 0.5mV	-
2V	0.05% + 1mV	0.1% + 5mV	1% + 10mV
20V	0.1% + 10mV	-	-

Frequency Accuracy 0.01%

Calibrator Options (continued)

POWER (5077)				
DC Voltage				
Range	Accuracy ppm	Output Resistance	Max Output Current	Resolution
2V	80 + 100uV	< 0.5 ohm	20mA	1uV
20V	80 + 300uV	< 0.5 ohm	20mA	10uV
300V	100 + 20mV	< 5 ohm	20mA	100uV
1kV	250 + 50mV	< 10 ohm	10mA	1mV

AC Voltage (45Hz to 400Hz Accuracy 0.02%, Resolution 0.1Hz)				
2V	0.03 + 200uV	< 0.5 ohm	20mA	100uV
20V	0.03 + 2mV	< 1 ohm	20mA	1mV
300V	0.06 + 30mV	< 5 ohm	20mA	10mV
1kV	0.08 + 90mV	< 10 ohm	10mA	100mV

DC Current			
Range	Accuracy ppm	Compliance Voltage	Resolution
200mA	400 + 200uA	5V	100uA
2A	250 + 200uA	5V	100uA
20A	600 + 2mA	4V	1mA

AC Current (45Hz to 400Hz Accuracy 0.02%, Resolution 0.1Hz)			
Range	Accuracy %	Compliance Voltage	Resolution
200mA	0.1 + 1mA	3.5V	100uA
2A	0.1 + 1mA	3.5V	100uA
20A	0.2 + 10mA	3V	1mA

Phase (10% to 100% of range V & I)			
Frequency	Range	Accuracy	Resolution
40 to 95Hz	-90.0 to +90.0deg	0.3deg	0.1deg
100Hz to 400Hz	-90.0 to +90.0deg	1deg	0.1deg

Power Factor [1]		
Frequency	Range	Accuracy
40 to 400Hz	0.00 to 1.00 lead/lag	0.01

General	
Form Factor	External option connected via USB
Dimensions	W 447 x D 470mm x H 152mm
Weight	13kg

1. The accuracy of the power is complex and is determined by using a formula which combines the errors due to Voltage, Current, and Phase.
Power Acc (%) = SqrRt (Vacc^2 + Iacc^2 + Phase Correction^2)
Where Phase Correction (%) = 100x(1-Cos(Phase+PhaseAcc)/Cos Phase))

PC SPECIFICATION

Processor	2 GHz
RAM	512MB
Hard Drive	40 GB
Ports	4 x USB, 1 x Fast Ethernet.
Display	10.5in LCD, (Touch Screen)
Operating System	Windows XP Embedded

GENERAL

POWER SUPPLY	
Mains Voltage	100 - 230V AC 50/60 Hz.
Fuse Ratings	3.15A anti-surge
Connector	IEC Plug
Power Consumption	125W typical, 220W Max.
MAXIMUM ALLOWABLE VOLTAGE BETWEEN TERMINALS	
Source	
Between V+ and V- terminals	< 1500V Peak
Between V- and Earth	< 75V Peak
Between Main, Aux and Earth	< 75V Peak
Measure	
Between V+ and V- terminals	<1000V Peak
Between V- and Earth < 75V Peak	<75V Peak
ENVIRONMENTAL	
Operating Temperature	15 - 25 ^{0}C, Full Spec: 22 ^{0}C +/- 3^{0}C.
Storage Temperature	-10 ^{0}C to 50 ^{0}C
Humidity	Operating < 80%
Altitude	0 - 3km. Non Operating 3Km - 12km
Warm Up Time	1 hour to full accuracy
MECHANICAL	
Dimensions	Width 430mm, Height 202, Depth 538mm
Weight	23kg