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# USB-4065 Specifications

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## USB-4065 Specifications

These specifications apply to the USB-4065, a 6½-Digit, ±300 V, USB Digital Multimeter Device.

## Definitions

**Warranted** specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

**Characteristics** describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- **Typical** specifications describe the performance met by a majority of models.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Warranted** unless otherwise noted.

$T_{cal}$  is the device temperature at last external calibration. NI factory calibration is  $23\text{ °C} \pm 1\text{ °C}$ .

## Conditions

Specifications are valid under the following conditions unless otherwise noted.

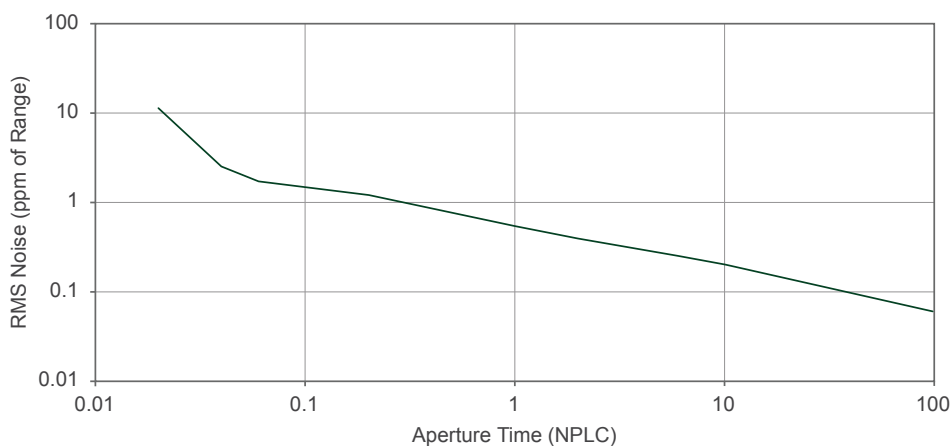
- Ambient temperature of  $T_{cal} \pm 5\text{ °C}$ .
- Calibration interval of 1 year
- Warm-up time of 50 minutes

- niDMM Digits Resolution property or NIDMM\_ATTR\_RESOLUTION\_DIGITS attribute set to 6.5
- niDMM Aperture Time Units property or NIDMM\_ATTR\_APERTURE\_TIME\_UNITS attribute set to Power Line Cycles
- niDMM Aperture Time property or NIDMM\_ATTR\_APERTURE\_TIME attribute set to 10

## DC Specifications

Resolution (digits)	Reading rate (S/s), specified for 60 Hz (and 50 Hz) operation	Aperture time (NPLC)	RMS noise (ppm of range), 10 V range
6½	0.6 (0.5)	100	0.06
	6 (5)	10	0.2
	10 (8.33)	6	0.25
5½	30 (25)	2	0.4
	60 (50)	1	0.55
	900	0.06	1.7
	1,500	0.04	2.5
4½	3,000	0.02	11.5

**Figure 1.** Noise Performance, Nominal



**Note** Noise performance is measured on the 10 V range.

## DC System Speed Characteristics

Range or function changes	10/s
Auto range time, DC V	200 ms
Auto range time, DC I	200 ms
Auto range time, resistance	250 ms
Trigger latency	<1 $\mu$ s
Maximum trigger rate	2.5 kHz

## DC Accuracy Specifications



**Note** Tempco is the temperature coefficient in ppm of range per degree Celsius.

**Table 1.** DC Voltage  $\pm$  (ppm of Reading + ppm of Range)

Range	Resolution	Input resistance (10 M $\Omega$ , default), nominal	24 hour <sup>1</sup> T <sub>cal</sub> $\pm$ 1 $^{\circ}$ C	90 day T <sub>cal</sub> $\pm$ 5 $^{\circ}$ C	1 year T <sub>cal</sub> $\pm$ 5 $^{\circ}$ C	Tempco (ppm/ $^{\circ}$ C)
100 mV <sup>2</sup>	100 nV	>10 G $\Omega$ , 10 M $\Omega$	30 + 30	65 + 35	90 + 35	5 + 2
1 V	1 $\mu$ V	>10 G $\Omega$ , 10 M $\Omega$	20 + 8	65 + 12	90 + 12	5 + 1
10 V	10 $\mu$ V	>10 G $\Omega$ , 10 M $\Omega$	15 + 7	65 + 12	90 + 12	5 + 1
100 V	100 $\mu$ V	10 M $\Omega$	20 + 8	75 + 12	110 + 12	9 + 1
300 V	1 mV	10 M $\Omega$	20 + 24	75 + 40	110 + 40	9 + 1

<sup>1</sup> Relative to external calibration source. DMM must remain powered on.

<sup>2</sup> With offset nulling.

**Table 2.** DC Current  $\pm$  (ppm of Reading + ppm of Range)

Range	Resolution	Burden voltage, typical	24 hour <sup>3</sup> $T_{cal} \pm 1^\circ\text{C}$	90 day $T_{cal} \pm 5^\circ\text{C}$	1 year $T_{cal}$ $\pm 5^\circ\text{C}$	Tempco (ppm/ $^\circ\text{C}$ )
10 mA	10 nA	<60 mV	50 + 100	300 + 200	500 + 200	30 + 20
100 mA	100 nA	<0.6 V	100 + 40	300 + 50	500 + 50	30 + 5
1 A	1 $\mu\text{A}$	<0.35 V	500 + 60	800 + 100	1,000 + 100	65 + 10
3 A	3 $\mu\text{A}$	<1 V	1,000 <sup>4</sup> + 200	1,200 <sup>5</sup> + 200	1,200 <sup>6</sup> + 200	65 + 20

**Table 3.** Resistance (4-Wire and 2-Wire)  $\pm$  (ppm of Reading + ppm of Range)

Range	Resolution	Test current, nominal	Max test voltage <sup>7</sup>	Open circuit voltage <sup>8</sup>	24 hour <sup>9</sup> $T_{cal} \pm 1^\circ\text{C}$	90 day $T_{cal} \pm 5^\circ\text{C}$	1 year $T_{cal} \pm 5^\circ\text{C}$	Tempco (ppm/ $^\circ\text{C}$ )
100 $\Omega$	100 $\mu\Omega$	1 mA	100 mV	6.3	30 + 30	95 + 40	110 + 40	8 + 3
1 k $\Omega$	1 m $\Omega$	1 mA	1 V	6.3	20 + 8	95 + 20	110 + 20	8 + 1
10 k $\Omega$	10 m $\Omega$	100 $\mu\text{A}$	1 V	11.9	20 + 8	95 + 20	110 + 20	8 + 1
100 k $\Omega$	100 m $\Omega$	10 $\mu\text{A}$	1 V	6.3	20 + 8	95 + 20	110 + 20	8 + 1
1 M $\Omega$	1 $\Omega$	5 $\mu\text{A}$	10 V	6.3	20 + 12	110 + 24	125 + 24	10 + 1
10 M $\Omega$ <sup>10</sup>	10 $\Omega$	500 nA	10 V	11.9	150 + 12	400 + 24	500 + 24	30 + 2
100 M $\Omega$ <sup>11</sup>	100 $\Omega$	500 nA   10 M $\Omega$	10 V	4.9	2,000 + 24	6,000 + 60	8,000 + 60	400 + 4



**Note** Resistance specifications are for 4-wire measurements. For 2-wire measurements, perform offset nulling or add 200 m $\Omega$  to specification. For relative humidity >80%, add 100 ppm/M $\Omega$ .

<sup>3</sup> Relative to external calibration source. DMM must remain powered on.

<sup>4</sup> Add 650 ppm/A of reading for currents above 1.5 A.

<sup>5</sup> Add 650 ppm/A of reading for currents above 1.5 A.

<sup>6</sup> Add 650 ppm/A of reading for currents above 1.5 A.

<sup>7</sup> Highest nominal voltage present with highest range resistance applied.

<sup>8</sup> Nominal voltage present at output with no resistance load.

<sup>9</sup> Relative to external calibration source. DMM must remain powered on.

<sup>10</sup> 2-wire resistance measurement only.

<sup>11</sup> 2-wire resistance measurement only.

Table 4. Diode Test

Range	Resolution	Test current, nominal	Accuracy
10 V	10 $\mu$ V	100 $\mu$ A, 1 mA (up to 3.5 V measurement for 1 mA test current)	Add 50 ppm of range and 50 ppm of reading to 10 V DC voltage specifications.



**Note** Diode test specifications can be used to test p-n junctions, LEDs, or zener diodes up to 10 V.

## DC Functions General Specifications

Overrange	105% of range except 300 V and 3 A range
Maximum 4-wire lead resistance	Use the lesser of 10% of range or 1 k $\Omega$
DC voltage input bias current	<40 pA at 23 °C, typical
Effective Common-Mode Rejection Ratio (CMRR) (1 k $\Omega$ resistance in LO lead)	>150 dB second order DC noise rejection (for power-line frequency $\pm$ 0.1%), 12 PLC aperture

Table 5. Normal Mode Rejection Ratio (NMRR)

Aperture time (NPLC)	DC noise rejection	Normal mode rejection (for power-line frequency $\pm$ 0.1%)
1	Normal	60 dB
2	Second-order	>85 dB
10		

## AC Specifications

Desired bandwidth	Recommended reading rate	Resolution (digits)
10 Hz to 100 kHz	1 S/s	6½
100 Hz to 100 kHz	10 S/s	5½
500 Hz to 100 kHz	100 S/s	4½

## AC System Speed Characteristics

Range or function changes	10/s
Trigger latency	<1 $\mu$ s
Maximum trigger rate	2.5 kHz

## AC Accuracy Specifications

All AC accuracy specifications apply to signal amplitudes greater than 2% of range.



**Note** Tempco is the temperature coefficient. Tempco values are valid within the device's ambient temperature range.

**Table 6.** AC Voltage (% of Reading + % of Range)

Range (peak voltage)	Frequency	24 hour $T_{cal} \pm 1^\circ C$	1 year <sup>12</sup> $T_{cal} \pm 5^\circ C$	Tempco(%/ $^\circ C$ )
200 mV ( $\pm 320$ mV), 2 V ( $\pm 3.2$ V), 20 V ( $\pm 32$ V), 300 V ( $\pm 425$ V)	10 Hz to 40 Hz	1.5 + 0.04	2 + 0.05	0.01 + 0.003
	>40 Hz to 20 kHz	0.2 + 0.04	0.2 + 0.05	0.01 + 0.003
	>20 kHz to 50 kHz	0.3 + 0.04	0.3 + 0.05	0.01 + 0.003
	>50 kHz to 100 kHz	1.5 + 0.08	1.5 + 0.08	0.02 + 0.005

**Table 7.** AC Current (% of Reading + % of Range)

Range (peak current)	Frequency	24 hour $T_{cal} \pm 1^\circ C$	1 year <sup>13</sup> $T_{cal} \pm 5^\circ C$	Tempco(%/ $^\circ C$ )
10 mA ( $\pm 16$ mA), 100 mA ( $\pm 160$ mA), 500 mA ( $\pm 780$ mA), 3 A ( $\pm 4.25$ A)	10 Hz to 40 Hz	1.6 to 0.05	2.1 + 0.05	0.015 + 0.03
	>40 Hz to 5 kHz	0.3 + 0.05	0.3 + 0.06	0.015 + 0.03

**Table 8.** High Crest Factor Additional Error

Crest factor	Additional error (% of reading)
1 to 3	0.05%

<sup>12</sup> Use the 1 Year specification to calibrate on a 90-day cycle.

<sup>13</sup> Use the 1 Year specification to calibrate on a 90-day cycle.



Crest factor	Additional error (% of reading)
3 to 4	0.1%
4 to 5	1% (for frequencies above 2 kHz)



**Note** High crest factor additional error is applicable for non-sinewave signals up to the rated peak voltage, current, or bandwidth.

## AC Functions General Specifications

Input impedance	10 M $\Omega$ in parallel with 200 pF, nominal
Input coupling	AC coupling
Maximum Voltz-Hertz product	$3 \times 10^7$ V-Hz
Maximum DC voltage component	250 V
CMRR, 1 k $\Omega$ resistance in LO lead	70 dB (DC to 60 Hz)
Overrange	105% of range except 300 V, 3 A range

## Temperature Accuracy Specifications



### Note

$T_{cal}$  is the device temperature at last external calibration. NI factory calibration is  $23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ . For total measurement accuracy, add temperature probe error.

Tempco is the temperature coefficient, expressed in degrees of measurement uncertainty per degree change in DMM instrument operating temperature.

**Table 9.** Thermocouple Temperature Accuracy Specifications (°C)

Type	Range	1 year $T_{cal} \pm 5$ °C		Tempco (°C <sub>reading</sub> /°C <sub>DMM</sub> )	Resolution
		With Simulated Ref. Junction <sup>14</sup>	With PXI-2527 <sup>15</sup>		
J	-150 to 1200	0.3	1.0	0.03	0.1
	-210 to -150	0.4	1.2	0.03	0.1
K	-100 to 1200	0.4	1.0	0.03	0.1
	-200 to -100	0.4	1.5	0.03	0.1
N	-100 to 1300	0.3	1.0	0.03	0.1
	-200 to -100	0.6	1.5	0.03	0.1
T	-100 to 400	0.3	1.0	0.03	0.1
	-200 to -100	0.4	1.5	0.03	0.1
E	-150 to 1000	0.2	1.0	0.03	0.1
	-200 to -150	0.3	1.5	0.03	0.1
R	300 to 1760	0.6	1.8	0.06	0.1
	-50 to 300	1.4	1.9	0.06	0.1
S	400 to 1760	0.7	1.8	0.06	0.1
	-50 to 400	1.3	1.8	0.06	0.1
B	1100 to 1820	0.6	1.8	0.09	0.1
	400 to 1100	1.4	1.9	0.09	0.1

**Table 10.** RTD Temperature Accuracy Specifications (°C)

Range	1 year $T_{cal} \pm 5$ °C	Tempco/°C	Resolution
-200 to 600	0.17	0.011	0.01



**Note** RTD with  $R_0 = 100 \Omega$  Pt3851 RTD in a 4-wire configuration, using lowest possible resistance range for each temperature.

<sup>14</sup> Using simulated reference junction.

<sup>15</sup> Includes PXI-2527 with TB-2627 with a typical 0.5 °C CJC error and a typical thermal EMF offset of 2.5  $\mu$ V for CJC temperatures between 15 °C and 35 °C. Add an additional 0.5 °C uncertainty when CJC is in the range 0 °C to 15 °C or 35 °C to 50 °C.

<sup>16</sup> Using simulated reference junction.

**Table 11.** Thermistor Temperature Accuracy Specifications (°C)

Range	1 year $T_{cal}^{17} \pm 5$ °C	Tempco/°C	Resolution
-80 to 150	0.08	0.002	0.01

## General Specifications

Maximum common-mode voltage	300 VAC <sub>rms</sub> or VDC
Measurement category	II



**Caution** Do not connect the product to signals or use for measurements within Measurement Categories III or IV.

## Current Ratings

<b>Input protection</b>	
Current mode fuse	4.0 Amp, fused F 4 A H 300 V, fast-acting user-replaceable fuse
Resistance, diode	Up to 300 VDC
DC V, AC V	Up to 300 VDC, 300 VAC <sub>rms</sub> , 450 VAC peak
<b>Maximum continuous current</b>	
I to LO	3 A

## Calibration Interval

Calibration interval	1 year recommended
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<sup>17</sup> Using simulated reference junction.

## Warm-Up Time Characteristics

Warm-up time	50 minutes to rated accuracy
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## Trigger Characteristics

Table 12. Input Triggers

Types	Trigger, Sample Trigger (programmable edge)
Sources	Auxiliary connector (AUX I/O connector)
Minimum pulse width	200 ns
Max samples per trigger	$2.1 \times 10^9$
Trigger delay	0 to 149 s
Logic level	5 V TTL, LVTTTL

Table 13. Output Triggers

Types	Measurement Complete (programmable edge)
Destinations	Auxiliary connector (AUX I/O connector)
Pulse width	1 $\mu$ s
Logic level	3.3 V



**Note** The AUX I/O connector is not isolated. It is not referenced to your measurement circuit. The connector is referenced to the ground of your chassis. The digital signals on this connector should not operate beyond -0.5 V to 5.5 V of your chassis ground. The trigger signals are TTL-compatible.

## Power Consumption Characteristics

Input voltage at USB device	4.5 V to 5.25 V
Maximum inrush current	500 mA
Operating current	400 mA maximum

Suspend current	500 $\mu$ A typical average current, 1 sec averaging interval
USB standard	USB 2.0 hi-speed or full-speed



**Note** The USB-4065 draws power directly from the USB port, so you do not need to connect external power.

## Physical Characteristics

Dimensions	17.8 cm x 10.4 cm x 3.3 cm (7.0 in. x 4.1 in. x 1.3 in.)
Weight	281 g (9.9 oz)

### Cleaning Statement



**Notice** Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

## Environment

Maximum altitude	2,000 m (at 25 °C ambient temperature)
Pollution degree	2
Indoor use only	

## Operating Environment

Ambient temperature range	0 °C to 45 °C
Relative humidity range	10% RH to 90% RH, noncondensing

## Storage Environment

Ambient temperature range	-40 °C to 70 °C
Relative humidity range	5% RH to 95% RH, noncondensing