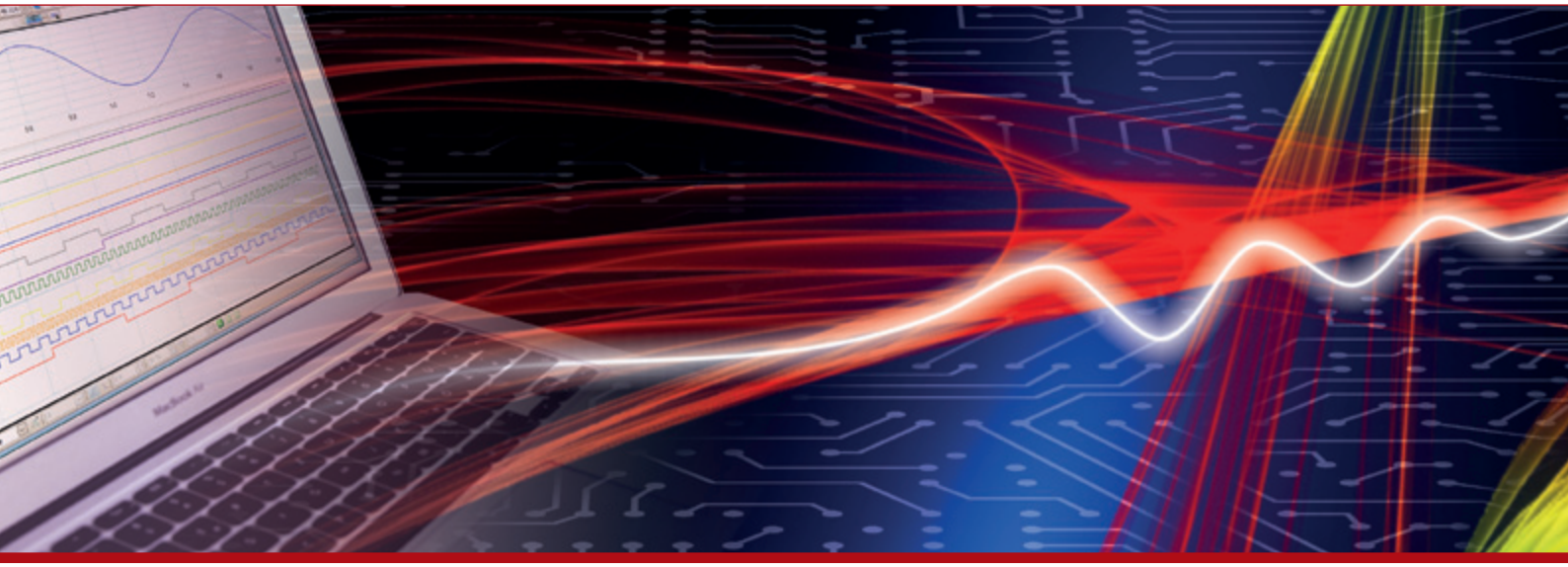
Product Datasheet - Technical Specifications



More information in our Web-Shop at ▸ **www.meilhaus.com**

Your contact

Technical and commercial sales, price information, quotations, demo/test equipment, consulting:

Tel.: **+49 - (0)81 41 - 52 71-0**

E-Mail: **sales@meilhaus.com**

Meilhaus Electronic GmbH
Am Sonnenlicht 2
82239 Alling/Germany
Tel. **+49 - (0)81 41 - 52 71-0** E-Mail **sales@meilhaus.com**

www.meilhaus.com

Specifications

Basic Module Specifications 148
Analog Input Specifications 149
Voltage Input Specifications 150
Current Specifications 152
Resistance Specifications 153
RTD Specifications 154
Thermistor Specifications 156
Thermocouple Specifications 157
Bridge and Strain Gage Specifications 162
Digital I/O Specifications 164
Isolation and Protection Specifications 165
Power, Physical, and Environmental Specifications 166
Terminal Block Specifications 167
Regulatory Specifications 168

Basic Module Specifications

Table 27 lists the basic specifications for the DT9829 Series modules.

Table 27: Basic Module Specifications

Feature	Specifications
Number of analog input channels DT9829-2: DT9829-4: DT9829-8:	 2 Differential (0 and 1) 4 Differential (0 to 3) 8 Differential (0 to 7)
Number of digital input lines	4 Isolated, TTL, 12 V and 24 V compliant
Number of digital output lines	4 Isolated, open-collector outputs
Data coding Analog input: Digital I/O:	 32-Bit floating point Binary
PC interface	USB 2.0 high speed
Power	Supplied by USB interface
Isolation	±500 V galvanic isolation to PC

Analog Input Specifications

Table 28 lists the analog input specifications for the DT9829 Series modules.

Table 28: Analog Input Specifications

Feature	Specifications
Number of analog input channels DT9829-2: DT9829-4: DT9829-8:	 Up to 2, individually configurable Up to 4, individually configurable Up to 8, individually configurable
Input modes	Voltage Current Resistance (2-, 3-, and 4-wire) RTD (2-, 3-, and 4-wire) Thermistor (2-, 3-, and 4-wire) Thermocouple Bridge (Full, Half, and Quarter) Strain gage
A/D converter type	24-bit Sigma-Delta
Sampling mode	Multiplexed
Aggregate sample rate (throughput)	960 Samples per second, maximum[a]

a. Divide the aggregate sample rate by the number of channels used to determine the per channel throughput rate. For example, if you are using eight channels, the maximum throughput is 120 Samples per second.

Voltage Input Specifications

Table 29 lists the voltage measurement specifications for the analog input subsystem on the DT9829 Series modules.

Table 29: Voltage Measurement Specifications

Feature	Specifications
Input ranges (software-selectable)	±10 V (gain of 1), ±2 V (gain of 5), or ±200 mV (gain of 50)
Input impedance	100 MΩ
Input bias current	150 nA
Input common mode voltage range (all ranges)	±12 V
Common mode rejection @50 Hz and 60 Hz	100 dB
Analog filter bandwidth, –3 dB [a]	425 Hz
Overvoltage protection	±24 V
Offset error Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±100 µV typical; ±200 µV maximum ±15 µV typical; ±30 µV maximum ±5 µV typical; ±8 µV maximum
Gain error (all ranges)	±0.02% of reading typical; ±0.1% of reading maximum
Offset error Tempco Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±10 µV/° C ±2 µV/° C ±1 µV/° C
Gain error Tempco Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±60 ppm of reading/° C ±10 ppm of reading/° C ±70 ppm of reading/° C

a. The input signal bandwidth is due to the combined responses of the 425 Hz analog filter and the ADC filter bandwidth. The ADC filter bandwidth is equal to 1.15 x the sampling frequency, in Hz. For example, with eight channels enabled and running at the maximum throughput of 960 Samples/s (120 Samples/second per channel), the ADC filter bandwidth is 1.15 x 960 Hz or 1.1 kHz. In this case, the input signal bandwidth is approximately equal to 425 Hz.

Table 30: Typical Voltage Noise

Throughput (Samples/s)	Noise (μVrms)		
	Gain = 50	Gain = 5	Gain = 1
960	1.2	10.0	40.0
120	0.4	2.5	12.0
60	0.3	2.0	10.0
10	0.2	1.0	5.0

Current Specifications

Table 33 lists the specifications for current measurement channels on the DT9829 Series modules.

Table 31: Current Specifications

Feature	Specifications
Input range	±25 mA
Sensor compliance voltage	5 V maximum @ 20 mA
Input terminal voltage (with respect to Agnd)	±12 V maximum
Common-mode rejection @ 50 Hz and 60 Hz	100 dB
Analog filter bandwidth, –3 dB [a]	425 Hz
Differential overvoltage protection	±15 V
Offset error	±0.5 µA typical; ±1 µA maximum
Gain error	±0.1% of reading typical; ±0.2% of reading maximum
Offset error Tempco	±0.025 µA/° C
Gain error Tempco	±10 ppm of reading/° C

a. The input signal bandwidth is due to the combined responses of the 425 Hz analog filter and the ADC filter bandwidth. The ADC filter bandwidth is equal to 1.15 x the throughput. For example, with eight channels enabled and running at the maximum throughput of 960 Samples/s (120 Samples/second per channel), the ADC filter bandwidth is 1.15 x 960 Samples/s or 1.1 kSamples/s. In this case, the input signal bandwidth is approximately equal to 425 Hz.

Resistance Specifications

Table 33 lists the specifications for resistance measurement channels on the DT9829 Series modules.

Table 32: Resistance Measurement Specifications

Feature	Specifications
Nominal input ranges	200 kΩ, 4 kΩ
Maximum readable values	200 kΩ, 4.7 kΩ
Measurement configuration	2-, 3-, or 4-wire
Offset error 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 25 ppm of range, ±0.1 Ω, typical; 50 ppm of range, ±0.2 Ω maximum; 25 ppm of range, ±5 Ω, typical; 50 ppm of range, ±10 Ω, maximum
Gain error 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±0.02% of reading typical; ±0.10% of reading maximum ±0.02% of reading typical; ±0.10% of reading maximum
Offset error Tempco 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±0.005 Ω/° C ±0.20 Ω/° C
Gain error Tempco 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±25 ppm of reading/° C ±25 ppm of reading/° C

RTD Specifications

Table 33 lists the specifications for RTD channels on the DT9829 Series modules.

Table 33: RTD Specifications

Feature	Specifications
RTD types (software-selectable)[a]	100 Ω, 500 Ω, and 1000 Ω, Pt 0.00385 Ω/Ω/° C, IEC 60751, ASTM-E1137 100 Ω,Pt 0.003911 Ω/Ω/° C, US Industrial Standard 100 Ω, Pt 0.003916 Ω/Ω/° C, JISC 1604-1989 100 Ω, Pt 0.003928 Ω/Ω/° C, ITS-90 1000 Ω, Pt 0.00375 Ω/Ω/° C, Low Cost 98.129 Ω, Pt 0.00392 Ω/Ω/° C, SAMA RC21-4-1966
Input ranges 100 Ω RTDs: 500 Ω and 1000 Ω RTDs:	 470 Ω 4700 Ω
Measurement configuration	2-, 3-, or 4-wire
Current source	425 µA ±0.5%
Warm-up time	10 minutes

a. Non-standard RTD types are supported with user-supplied Callendar-Van Dusen coefficients.

Table 34 lists the accuracy specifications for measured resistance for all RTD types.

Table 34: Accuracy Specifications for Measured Resistance for All RTD Types

Range	Gain Error (% of reading)		Offset Error (ppm of Range)		Gain Error Tempco (% of Reading/° C)	Offset Error Tempco (ppm of Range/° C)
	Typical	Maximum	Typical	Maximum		
470 Ω	±0.03	±0.10	±25	±40	±0.0075	±5
4700 Ω	±0.02	±0.10	±7.5	±15	±0.0027	±1

Table 35 lists the accuracy specifications for the Pt100, IEC60751.

Table 35: Accuracy Specifications for the Pt100, IEC60751[a]

Sensor Temperature (° C)	Accuracy Error (° C, Typical)	Accuracy Error (° C, Maximum)	Tempco (° C/C)
–200	±0.04	±0.08	±0.008
–100	±0.07	±0.19	±0.008
0	±0.11	±0.30	±0.008
100	±0.14	±0.41	±0.008
200	±0.17	±0.53	±0.008
400	±0.25	±0.76	±0.008
600	±0.33	±1.04	±0.008
800	±0.41	±1.32	±0.008

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Callendar-Van Dusen equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire RTD measurements.

Table 36 lists the accuracy specifications for the Pt1000, IEC60751.

Table 36: Accuracy Specifications for the Pt1000, IEC60751[a]

Sensor Temperature (° C)	Accuracy Error (° C, Typical)	Accuracy Error (° C, Maximum)	Tempco (° C/C)
–200	±0.02	±0.06	±0.004
–100	±0.04	±0.16	±0.004
0	±0.06	±0.27	±0.004
100	±0.08	±0.38	±0.004
200	±0.10	±0.49	±0.004
400	±0.15	±0.73	±0.004
600	±0.21	±1.00	±0.004
800	±0.26	±1.28	±0.004

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Callendar-Van Dusen equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire RTD measurements.

Thermistor Specifications

Table 33 lists the specifications for thermistor channels on the DT9829 Series modules.

Table 37: Thermistor Specifications

Feature	Specifications
Input range	200 kΩ
Maximum readable value	200 kΩ
Measurement configuration	2-, 3-, or 4-wire
Current source	10 µA, ±0.5%
Warm-up time	10 minutes

Table 38 lists the accuracy specifications for measured resistance for all thermistors.

Table 38: Accuracy Specifications for Measured Resistance for All Thermistors

Gain Error (% of reading)		Offset Error (ppm of Range)		Gain Error Tempco (% of Reading/° C)	Offset Error Tempco (ppm of Range/° C)
Typical	Maximum	Typical	Maximum		
±0.02	±0.10	±25.0	±50.0	±0.0027	±1

Table 39 lists the accuracy specifications for typical thermistor elements.

Table 39: Accuracy Specifications for Typical Thermistor Elements (Omega 44000 Series Thermistor Beads)[a]

Sensor Temperature (° C)	R25° C 3000 Ω		R25° C 10000 Ω		R25° C 30000 Ω	
	Typical (° C)	Maximum (° C)	Typical (° C)	Maximum (° C)	Typical (° C)	Maximum (° C)
–40	±0.004	±0.016	_[b]	_[b]	_[b]	_[b]
0	±0.014	±0.039	±0.008	±0.029	±0.005	±0.203
25	±0.042	±0.098	±0.017	±0.050	±0.009	±0.239
50	±0.126	±0.268	±0.042	±0.101	±0.017	±0.288
120	±1.580	±3.106	±0.418	±0.853	±0.165	±0.679

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Steinhart-Hart equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire thermistor measurements.

b. Resistance at these temperatures exceed the 200 kΩ measurement range.

Thermocouple Specifications

Table 40 lists the specifications for thermocouple channels on the DT9829 Series modules.

Table 40: Thermocouple Specifications

Feature	Specifications
Thermocouple types (software-selectable)	J, K, T, B, E, N, R, S
Full-scale input range	±200 mV
DC differential input impedance	100 MΩ
Open thermocouple detect current	150 nA
Input common-mode voltage (referenced to Agnd)	±10 V
Channel-to-channel common-mode voltage	±15 V
Warm-up time	10 minutes

System Temperature Error for the DT9829 Series

Table 41 lists the typical accuracy errors and Table 42 lists the maximum accuracy errors of the DT9829 Series module for each thermocouple type at several thermocouple measurement values.

The values in Table 41 are the typical errors expected when the module is operating at 23° C ±5° C ambient. The values in Table 42 are the maximum errors expected when operating the module is operating at 23° C ±5° C ambient.

Table 41: Typical Thermocouple Measurement Accuracy of the DT9829 Series at 23° C ±5° C

Thermocouple Temperature	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.12° C	±0.16° C	±0.16° C	±0.10° C	–	–	–	±0.25° C
0° C	±0.10° C	±0.14° C	±0.16° C	±0.10° C	±1.06° C	±1.10° C	–	±0.22° C
100° C	±0.15° C	±0.16° C	±0.15° C	±0.12° C	±0.77° C	±0.75° C	–	±0.21° C
300° C	±0.18° C	±0.25° C	±0.19° C	±0.16° C	±0.65° C	±0.62° C	±1.82° C	±0.24° C
500° C	±0.25° C	±0.28° C	–	±0.22° C	±0.66° C	±0.61° C	±1.14° C	±0.28° C
700° C	±0.31° C	±0.33° C	–	±0.29° C	±0.68° C	±0.62° C	±0.89° C	±0.34° C
900° C	±0.33° C	±0.45° C	–	±0.36° C	±0.70° C	±0.64° C	±0.78° C	±0.40° C
1100° C	±0.42° C	±0.50° C	–	–	±0.73° C	±0.66° C	±0.72° C	±0.47° C
1400° C	–	–	–	–	±0.79° C	±0.72° C	±0.71° C	–

a. **Conditions for accuracy measurements:**
Module has been calibrated and warmed up for 10 minutes.
Module is calibrated at 23° C.
CJC offset is nulled using the CJC calibration process.
The module is operated in a stable environment within the specified limits.
Inclusive of CJC error and input offset, gain, linearity, and long-term stability errors.
Exclusive of thermocouple errors.
Exclusive of noise.
Specifications are valid for 1 year from calibration.

Table 42: Maximum Thermocouple Measurement Accuracy of the DT9829 Series at 23° C ±5° C

Thermocouple Temperature	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.17° C	±0.23° C	±0.24° C	±0.14° C	–	–	–	±0.37° C
0° C	±0.17° C	±0.23° C	±0.25° C	±0.16° C	±1.69° C	±1.76° C	–	±0.34° C
100° C	±0.24° C	±0.26° C	±0.25° C	±0.20° C	±1.23° C	±1.21° C	–	±0.35° C
300° C	±0.33° C	±0.41° C	±0.33° C	±0.29° C	±1.06° C	±1.01° C	±2.93° C	±0.41° C
500° C	±0.46° C	±0.50° C	–	±0.40° C	±1.10° C	±1.02° C	±1.85° C	±0.50° C
700° C	±0.55° C	±0.61° C	–	±0.53° C	±1.15° C	±1.05° C	±1.46° C	±0.61° C
900° C	±0.63° C	±0.80° C	–	±0.67° C	±1.20° C	±1.09° C	±1.29° C	±0.72° C
1100° C	±0.81° C	±0.93° C	–	–	±1.26° C	±1.14° C	±1.21° C	±0.87° C
1400° C	–	–	–	–	±1.40 C	±1.28° C	±1.22° C	–

a. **Conditions for accuracy measurements:**
Module has been calibrated and warmed up for 10 minutes.
Module is calibrated at 23° C.
CJC offset is nulled using the CJC calibration process.
The module is operated in a stable environment within the specified limits.
Inclusive of CJC error and input offset, gain, linearity, and long-term stability errors.
Exclusive of thermocouple errors.
Exclusive of noise.
Specifications are valid for 1 year from calibration.

Thermocouple Measurement Noise

The total temperature measurement noise (short term variation) is the sum of the following two components:

- The equivalent temperature noise due to the noise of the analog input circuitry.
- The CJC sensor noise in degrees C.

The noise due to the analog input circuitry (volts) is converted to temperature by dividing the noise voltage by the sensitivity of the thermocouple type being used at the particular measurement temperature. Thermocouple sensitivities can be derived from commonly available NIST (National Institute of Standards and Technology) Thermocouple Reference Tables. The voltage noise from the analog input circuitry is a function of the programmed throughput rates.

Table 43 provides the typical expected voltage noise values for a DT9829 Series module. Also listed are the typical CJC sensor temperature noise values for a selection of throughput rates.

Table 43: Input Voltage Noise and CJC Sensor Noise for the DT9829 Series

Throughput (Samples/s)	Input Voltage Noise (µV pk-pk, typical)	CJC Noise (°C pk-pk, typical)
960	10.0	0.025
120	3.0	0.025
60	2.0	0.025
10	1.0	0.025

Thermocouple Noise Calculation Example

Assume that you are using a type K thermocouple to measure a temperature of approximately 100° C, and the DT9829 Series module is configured to use a throughput rate of 960 Samples/s. The steps to determine the expected measurement noise are as follows:

1. Determine the CJC noise at the stated throughput rate and filter setting. From Table 43, the CJC noise is 0.025°C pk-pk for a throughput rate of 960 Samples/s.
2. Determine the input voltage noise at the stated throughput rate and filter setting. From Table 43, the voltage noise is 10 µV pk-pk for a throughput rate of 960 Samples/s.
3. Determine the sensitivity of the specified thermocouple type at the measurement temperature. From the NIST Thermocouple Reference Tables, the sensitivity of a Type K thermocouple at 100°C is 41.5 µV/°C.

4. Calculate the equivalent temperature noise by dividing the input voltage noise by the sensitivity of the thermocouple:

   10 µV pk-pk / 41.5 µV/°C = 0.24°C pk-pk

5. To determine the total noise, add the CJC sensor noise to the equivalent temperature noise of the input voltage noise. The total temperature noise is as follows:

   0.025°C pk-pk + 0.24°C pk-pk = 0.265°C pk-pk

Bridge and Strain Gage Specifications

Table 44 lists the bridge and strain gage specifications for the DT9829 Series modules.

Table 44: Bridge and Strain Gage Specifications

Feature	DT9829 Series Specifications
Supported bridge configurations	Full Bridge, Half Bridge, Quarter Bridge (external completion resistor required for quarter bridge configurations)
Input range	±200 mV
Internal Half-Bridge completion resistors	Internal, 10 kΩ divider, 0.1% matching, 2 ppm/° C, tracking
Gain error	±0.05% of reading typical; 0.1% of reading maximum
Offset error	±5 µV typical; ±8 µV maximum

Table 45 lists the bridge compliance voltage specifications for the DT9829 Series modules.

Table 45: Bridge Compliance Voltage Specifications

Feature	DT9829 Series Specifications
Type	Internal. Supplied by the module through the USB connection.
Number	One common supply for up to eight analog input channels
Nominal voltage	3.0 VDC ±0.2%
Stability	35 ppm/° C
Power	225 mW, maximum
Short circuit limit	75 mA, maximum

Bridge Supply Capability

The bridge supply can be used to power up to eight connected bridge circuits (one for each channel). The number and type of bridges that the module can support is limited by the 225 mW power capability of the bridge supply. Table 46 shows the possible channel and bridge configurations.

Table 46: Number of Bridge Channels that Can Be Powered By the USB Host Port

Bridge Configuration	Total Number of Bridge Channels	Number of Channels Based on Bridge Resistance		
		120 Ω Bridge Resistance	350 Ω Bridge Resistance	1 kΩ Bridge Resistance
Full Bridge	8	0	0	8
	8	0	8	0
	3	3	0	0
	6	2	2	2
Half Bridge or Quarter Bridge	8	0	0	8
	8	0	8	0
	6	6	0	0
	8	4	Any	Any

Digital I/O Specifications

Table 47 lists the specifications for the digital I/O subsystems on the DT9829 Series modules.

Table 47: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	8 (4 in, 4 out)
Number of ports	2 (4 bits each)
Digital Inputs Input characteristics: Input type: Input high voltage: Input low voltage: Input voltage limits:	 Level-sensitive Optocoupler, 2.2 kΩ in series with LED 2.0 V minimum 0.8 V maximum −5 V to +30 V (relative to Digital Input Return)
Digital Outputs Output characteristics: Current sink capability: Output voltage range: V_{ext} range: Off state leakage:	 Open collector, 100 kΩ pull-up to V_{ext} input 2 mA minimum, V_{CE} (sat) = 0.35 V maximum 30 V maximum 30 V maximum 1 µA maximum
Interrupt on change	No
Inputs clocked with sample clock	Yes
Software I/O selectable	No

Isolation and Protection Specifications

Table 48 lists the isolation and protection specifications for the analog input subsystem on the DT9829 Series modules.

Table 48: Isolation and Protection Specifications

Feature	Specifications
ESD protection per standard EN6100-4-2:2009 (see page 168 for more) Arc: Contact:	 8 kV 4 kV
Isolation voltage from analog input and digital I/O to the host computer	±500 V operational

Power, Physical, and Environmental Specifications

Table 49 lists the power, physical, and environmental specifications for the DT9829 Series modules.

Table 49: Power, Physical, and Environmental Specifications

Feature	Specifications
Power[a]	+5 V ±5% from USB host; 500 mA maximum
Physical Dimensions In enclosure: OEM version (no enclosure):	 Length: 8.667 inches (220.14 mm) Width: 4.170 inches (105.92 mm) Height: 1.575 inches (40 mm) Length: 8.577 inches (217.86 mm) Width: 3.937 inches (100 mm) Height: 0.843 inches (21.41 mm)
Weight In enclosure: OEM version (no enclosure):	 20.63 oz (585 g) 4.71 oz (133.4 g)
Environmental Operating temperature range: Storage temperature range: Relative humidity:	 0° C to 55° C –25° C to 85° C To 95%, noncondensing

a. The number and types of bridges that can be powered from the DT9829 Series module is limited by the 500 mA maximum current that may be drawn from the host USB port. Table 46 on page 163 shows the number of bridge channels that are supported given different bridge configurations.

Terminal Block Specifications

Table 50 lists the screw terminal block specifications for the DT9829 Series modules.

Table 50: Terminal Block Specifications

Feature	Specifications
Analog Input Screw Terminal Block (TB1)	32-position, dual row, 3.5 mm Phoenix Contact 1751536
Digital I/O Screw Terminal Block (TB2)	14-position, dual row, 3.5 mm Phoenix Contact 1751442

Note: Phoenix Contact specifies a wire insulation strip length of 0.197 inches (5 mm) and a wire size of 26 AWG minimum and 16 AWG maximum.

Regulatory Specifications

DT9829 Series modules are CE-compliant. Table 51 lists the regulatory specifications for the DT9829 Series module.

Table 51: Regulatory Specifications

Feature	Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use EMC Requirements EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)