Product Datasheet - Technical Specifications

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Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic* text are guaranteed by design.

Analog input

Table 1. Generic analog input specifications

Parameter	Conditions	Specification
A/D converters		Four dual 24-bit, Sigma-Delta type
Number of channels		8 differential
Input isolation		*500 VDC minimum between field wiring and USB interface*
Channel configuration		Thermocouple sensor type
Differential input voltage range	Thermocouple	±0.080 V
Absolute maximum input voltage	*±C0x through ±C7x relative to GND (pins 9, 19, 28, 38)*	±25 V power on, ±40 V power off.
Input impedance		5 Gigohm, min.
Input leakage current	Open thermocouple detect enabled	105 nA max.
Normal mode rejection ratio	f_{IN} *= 60 Hz*	*90 dB min.*
Common mode rejection ratio	f_{IN} *= 50 Hz/60 Hz*	*100 dB min.*
Resolution		24 bits
No missing codes		*24 bits*
Input coupling		DC
Warm-up time		30 minutes min.
Open thermocouple detect		Automatically enabled when the channel pair is configured for thermocouple sensors. The maximum open detection time is 3 seconds.
CJC sensor accuracy	*15 °C to 35 °C*	*±0.25 °C typ., ±0.5 °C max.*
	0 °C to 70 °C	*-1.0 to +0.5 °C max*

Channel configurations

Table 2. Channel configuration specifications

Sensor Category	Conditions	Specification
Thermocouple	J, K, S, R, B, E, T, or N	8 differential channels

Note 1: Channel configuration information is stored in the EEPROM of the isolated microcontroller by the firmware whenever any item is modified. Modification is performed by commands issued over USB from an external application, and the configuration is made non-volatile through the use of the EEPROM.

Note 2: The factory default configuration is *Type J*.

Accuracy

Thermocouple measurement accuracy

Table 3. Thermocouple accuracy specifications, including CJC measurement error

Sensor Type	Maximum error	Typical error	Temperature range
J	±1.499 °C	±0.507 °C	-210 to 0 °C
	±0.643 °C	±0.312 °C	0 to 1200 °C
K	±1.761 °C	±0.538 °C	-210 to 0 °C
	±0.691 °C	±0.345 °C	0 to 1372 °C
S	±2.491°C	±0.648 °C	-50 to 250 °C
	±1.841 °C	±0.399 °C	250 to 1768.1 °C
R	±2.653 °C	±0.650 °C	-50 to 250 °C
	±1.070 °C	±0.358 °C	250 to 1768.1 °C
B	±1.779 °C	±0.581 °C	250 to 700 °C
	±0.912 °C	±0.369 °C	700 to 1820 °C
E	±1.471 °C	±0.462 °C	-200 to 0 °C
	±0.639 °C	±0.245 °C	0 to 1000 °C
T	±1.717 °C	±0.514 °C	-200 to 0 °C
	±0.713 °C	±0.256 °C	0 to 600 °C
N	±1.969 °C	±0.502 °C	-200 to 0 °C
	±0.769 °C	±0.272 °C	0 to 1300 °C

Note 3: Thermocouple specifications include linearization, cold-junction compensation and system noise. These specs are for one year, or 3000 operating hours, whichever comes first and for operation of the RedLab TC between 15 °C and 35 °C. For measurements outside this range, add ±0.5 degree to the maximum error shown. There are CJC sensors on each side of the module. The accuracy listed above assumes the screw terminals are at the same temperature as the CJC sensor. Errors shown do not include inherent thermocouple error. Please contact your thermocouple supplier for details on the actual thermocouple error.

Note 4: Thermocouples must be connected to the RedLab TC such that they are floating with respect to GND (pins 9, 19, 28, 38). The RedLab TC GND pins are isolated from earth ground, so connecting thermocouple sensors to voltages referenced to earth ground is permissible as long as the isolation between the GND pins and earth ground is maintained.

Note 5: When thermocouples are attached to conductive surfaces, the voltage differential between multiple thermocouples must remain within ±1.4V. For best results we recommend the use of ungrounded or insulated thermocouples when possible.

Throughput rate

Table 4. Throughput rate specifications

Number of input channels	Maximum throughput
1	2 Samples/second
2	2 S/s on each channel, 4 S/s total
3	2 S/s on each channel, 6 S/s total
4	2 S/s on each channel, 8 S/s total
5	2 S/s on each channel, 10 S/s total
6	2 S/s on each channel, 12 S/s total
7	2 S/s on each channel, 14 S/s total
8	2 S/s on each channel, 16 S/s total

Note 6: The analog inputs are configured to run continuously. Each channel is sampled twice per second. The maximum latency between when a sample is acquired and the temperature data is provided by the USB unit is approximately 0.5 seconds.

Digital input/output

Table 5. Digital input/output specifications

Digital type	CMOS
Number of I/O	8 (DIO0 through DIO7)
Configuration	Independently configured for input or output. Power on reset is input mode.
Pull-up/pull-down configuration	All pins pulled up to +5 V via 47 K resistors (default). Pull-down to ground (GND) also available.
Digital I/O transfer rate (software paced)	**1.** Digital input – 50 port reads or single bit reads per second typ. **2.** Digital output – 100 port writes or single bit writes per second typ.
Input high voltage	2.0 V min., 5.5 V absolute max.
Input low voltage	0.8 V max., –0.5 V absolute min.
Output low voltage (IOL = 2.5 mA)	0.7 V max
Output high voltage (IOH = -2.5 mA)	3.8 V min.

Note 7: All ground pins on the RedLab TC (pins 9, 19, 28, 38) are isolated from earth ground. If a connection is made to earth ground when using digital I/O and conductive thermocouples, the thermocouples are no longer isolated. In this case, thermocouples must not be connected to any conductive surfaces that may be referenced to earth ground.

Memory

Table 6. Memory specifications

EEPROM	1,024 bytes isolated micro reserved for sensor configuration 256 bytes USB micro for external application use

Microcontroller

Table 7. Microcontroller specifications

Type	Two high performance 8-bit RISC microcontrollers

USB +5V voltage

Table 8. USB +5V voltage specifications

Parameter	Conditions	Specification
USB +5V (VBUS) input voltage range		4.75 V min. to 5.25 V max.

Power

Table 9. Power specifications

Parameter	Conditions	Specification
Supply current	USB enumeration	<100 mA
Supply current (Note 8)	Continuous mode	140 mA typ.
User +5V output voltage range (terminal block pin 21 and 47)	Connected to self-powered hub. (Note 9)	4.75 V min. to 5.25 V max.
User +5V output current (terminal block pin 21 and pin 47)	Bus-powered and connected to a self-powered hub. (Note 9)	10 mA max.
Isolation	Measurement system to PC	500 VDC min.

Note 8: This is the total current requirement for the RedLab TC which includes up to 10 mA for the status LED.

Note 9: Self-Powered Hub refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA.

Root Port Hubs reside in the PC's USB Host Controller. The USB port(s) on your PC are root port hubs. All externally powered root port hubs (desktop PC's) provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub.

USB specifications

Table 10. USB specifications

USB device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0
	Self-powered, 100 mA consumption max
USB cable type	*A-B cable, UL type AWM 2527 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D–)*
USB cable length	3 meters max.

Environmental

Table 11. Environmental specifications

Operating temperature range	0 to 70 ° C
Storage temperature range	-40 to 85 ° C
Humidity	0 to 90% non-condensing

Mechanical

Table 12. Mechanical specifications

Dimensions	127 mm (L) x 88.9 mm (W) x 35.56 (H)
User connection length	3 meters max.

Screw terminal connector type and pin out

Table 13. Screw terminal connector specifications

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Screw terminal pin out

Table 14. Screw terminal pin out

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
1	RSVD	Reserved, Do Not Use	27	RSVD	Reserved, Do Not Use
2	NC		28	GND	
3	C0H	CH0 sensor input (+)	29	C7L	CH7 sensor input (-)
4	C0L	CH0 sensor input (-)	30	C7H	CH7 sensor input (+)
5	NC		31	RSVD	Reserved, Do Not Use
6	RSVD	Reserved, Do Not Use	32	NC	
7	C1H	CH1 sensor input (+)	33	C6L	CH6 sensor input (-)
8	C1L	CH1 sensor input (-)	34	C6H	CH6 sensor input (+)
9	GND		35	NC	
10	RSVD	Reserved, Do Not Use	36	RSVD	Reserved, Do Not Use
	CJC sensor			CJC sensor	
11	RSVD	Reserved, Do Not Use	37	RSVD	Reserved, Do Not Use
12	NC		38	GND	
13	C2H	CH2 sensor input (+)	39	C5L	CH5 sensor input (-)
14	C2L	CH2 sensor input (-)	40	C5H	CH5 sensor input (+)
15	NC		41	RSVD	Reserved, Do Not Use
16	RSVD	Reserved, Do Not Use	42	NC	
17	C3H	CH3 sensor input (+)	43	C4L	CH4 sensor input (-)
18	C3L	CH3 sensor input (-)	44	C4H	CH4 sensor input (+)
19	GND		45	NC	
20	RSVD	Reserved, Do Not Use	46	RSVD	Reserved, Do Not Use
21	+5V	+5V output	47	+5V	+5V output
22	GND		48	GND	
23	DIO0	Digital Input/Output	49	DIO7	Digital Input/Output
24	DIO1	Digital Input/Output	50	DIO6	Digital Input/Output
25	DIO2	Digital Input/Output	51	DIO5	Digital Input/Output
26	DIO3	Digital Input/Output	52	DIO4	Digital Input/Output