

## Product Datasheet - Technical Specifications



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# Specifications

All specifications are subject to change without notice.

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

## Thermocouple input

Table 1. Thermocouple input specifications

Parameter	Condition	Specification
A/D converters		Delta-Sigma
ADC resolution		24 bits
Number of channels		8
<i>Input isolation</i>	<i>Between any TCx channel and digital/chassis ground.</i>	<i>500 VDC absolute max</i>
Channel configuration		Software-selectable to match sensor type
Differential input voltage range (Note 1)		±0.128 V
<i>Absolute maximum input voltage</i>	<i>Between any two TCx inputs</i>	<i>±25 V (power on) ±25 V (power off)</i>
<i>Differential input impedance</i>		<i>40 MΩ</i>
<i>Input current</i>	<i>Open thermocouple detect disabled</i>	<i>1 nA</i>
	<i>Open thermocouple detect enabled</i>	<i>65 nA</i>
<i>Common mode rejection</i>	<i>f<sub>IN</sub> = 50 Hz or 60 Hz</i>	<i>100 dB</i>
<i>Noise rejection</i>	<i>f<sub>IN</sub> = 50 Hz or 60 Hz</i>	<i>75 dB</i>
Input bandwidth		10 Hz
Crosstalk	Between any two TCx inputs	-90 dB
Sample rate (Note 2)		4 Hz max (per channel)
Input noise		250 nV rms
Gain error		0.006 %
Offset error		3 μV
Measurement sensitivity (Note 3)	Thermocouple type J,K,T,E,N	0.09 °C
	Thermocouple type R,S	0.11 °C
	Thermocouple type B	0.13 °C
Warm-up time		20 minutes min
Open thermocouple detect response time		1 second
<i>CJC sensor accuracy</i>	<i>0 °C to 45 °C</i>	<i>±0.20 °C typ ±0.40 °C max</i>
Calibration method		Factory
Recommended warm-up time		20 minutes min
Calibration interval		1 year (factory calibration)

**Note 1:** Calibration is performed at ±70 mV.

**Note 2:** The enabled thermocouple inputs are continuously converted at the maximum A/D converter rate. If channels are enabled and have an open thermocouple connection the sampling rate will be lower.

**Note 3:** Measurement sensitivity is the smallest change in temperature that can be detected.

## Channel configurations

Table 2. Channel configuration specifications

Sensor Category	Condition	Specification
Thermocouple	J, K, S, R, B, E, T, or N The factory default configuration is Type J.	8 differential channels (Note 4)

**Note 4:** Channel configuration is stored on EEPROM external to the isolated microcontroller by the firmware whenever any item is modified. Modification is performed by commands issued over Ethernet from an external application, and the configuration is made non-volatile through the use of the EEPROM.

## Compatible thermocouples

Table 3. Compatible sensor type specifications

Parameter	Specification
Thermocouple	J: -210 °C to 1200 °C
	K: -270 °C to 1372 °C
	R: -50 °C to 1768 °C
	S: -50 °C to 1768 °C
	T: -270 °C to 400 °C
	N: -270 °C to 1300 °C
	E: -270 °C to 1000 °C
B: 0 °C to 1820 °C	

## Accuracy

### Thermocouple measurement accuracy

Table 4. Thermocouple accuracy specifications, including CJC measurement error (Note 5, Note 6)  
All specifications are ( $\pm$ ).

Sensor Type	Sensor Temperature (°C)	Accuracy Error Maximum (°C), 15 °C to 35 °C	Accuracy Error Typical (°C), 15 °C to 35 °C	Accuracy Error Maximum (°C), 0 °C to 45 °C	Accuracy Error Typical (°C), 0 °C to 45 °C
J	-210	1.896	0.823	2.228	0.990
	0	0.760	0.328	0.815	0.364
	1200	0.717	0.324	1.336	0.585
K	-210	2.196	0.938	2.578	1.141
	0	0.787	0.334	0.848	0.377
	1372	0.974	0.431	1.807	0.786
S	-50	2.144	0.711	2.566	1.053
	250	1.595	0.528	1.888	0.775
	1768	0.750	0.178	1.759	0.649
R	-50	2.266	0.749	2.715	1.113
	250	1.617	0.534	1.917	0.786
	1768	0.631	0.148	1.579	0.584
B	250	1.934	0.453	2.552	0.977
	700	0.740	0.179	1.128	0.439
	1820	0.482	0.137	1.213	0.492
E	-200	1.700	0.742	1.987	0.884
	0	0.752	0.327	0.806	0.360
	1000	0.629	0.285	1.142	0.500

Sensor Type	Sensor Temperature (°C)	Accuracy Error Maximum (°C), 15 °C to 35 °C	Accuracy Error Typical (°C), 15 °C to 35 °C	Accuracy Error Maximum (°C), 0 °C to 45 °C	Accuracy Error Typical (°C), 0 °C to 45 °C
T	-200	1.920	0.817	2.253	0.993
	0	0.801	0.339	0.870	0.385
	400	0.519	0.223	0.702	0.308
N	-200	2.125	0.876	2.518	1.101
	0	0.857	0.351	0.940	0.412
	1300	0.668	0.291	1.352	0.585

**Note 5:** Thermocouple measurement accuracy specifications include polynomial linearization, cold-junction compensation, and system noise. The accuracy specifications assume the device is operated within its enclosure and has been warmed up for the recommended 20 minutes. Errors shown do not include inherent thermocouple error. Contact your thermocouple supplier for details on the actual thermocouple accuracy error.

**Note 6:** When thermocouples are attached to conductive surfaces, the voltage differential between multiple thermocouples must remain within  $\pm 1.8$  V. For best results Meilhaus Electronic recommends using electrically insulated thermocouples when possible.

## Digital input/output

Table 1. Digital input/output specifications

Parameter	Specification
Digital type	5 V TTL input / CMOS output
Number of I/O	One port of 8 bits, shared with temperature alarms
Configuration	Each bit can be independently configured for input or output
Power on conditions	Power on reset is input mode, except when bits are configured to operate as alarms.
Pull-up/pull-down configuration	The port has 47 k $\Omega$ resistors configurable as pull-up (default) or pull-down via internal jumper W1.
Digital I/O transfer rate (system paced)	100 to 5000 reads / writes per second, typical, on a local network (Note 7)
Power on and reset state	All bits are input unless the temperature alarm functionality is enabled for them.
Input high voltage threshold	2.0 V min
Input high voltage limit	5.5 V absolute max
Input low voltage threshold	0.8 V max
Input low voltage limit	-0.5 V absolute min 0 V recommended min
Output high voltage	4.4 V min (IOH = -50 $\mu$ A) 3.76 V min (IOH = -24 mA)
Output low voltage	0.1 V max (IOL = 50 $\mu$ A) 0.44 V max (IOL = 24 mA)

**Note 7:** This is the typical throughput when the device and host are both connected by Ethernet to the same local network. Throughput can vary significantly, and typical throughput is not guaranteed, if a wireless connection is involved or data is sent over the internet.

## Temperature alarms

Table 2. Temperature alarm specifications

Parameter	Specification
Number of alarms	8 (one per digital I/O line)
Alarm functionality	Each alarm controls its associated digital I/O line as an alarm output. When an alarm is enabled, its associated I/O line is set to output and driven to the appropriate state determined by the alarm options and input temperature. The alarm configurations are stored in non-volatile memory and loaded at power on.
Alarm input modes	<ul style="list-style-type: none"> <li>■ Alarm when input temperature <math>\geq T1</math>, reset alarm when input temperature <math>&lt; T2</math></li> <li>■ Alarm when input temperature <math>\leq T1</math>, reset alarm when input temperature <math>&gt; T2</math></li> <li>■ Alarm when input temperature is <math>&lt; T1</math> or <math>&gt; T2</math></li> </ul> T1 and T2 may be independently set for each alarm.
Alarm error modes	<ul style="list-style-type: none"> <li>■ Alarm on temperature reading only</li> <li>■ Alarm on temperature reading or open thermocouple error</li> <li>■ Alarm on open thermocouple error only</li> </ul>
Alarm output modes	<ul style="list-style-type: none"> <li>■ Disabled, digital I/O line may be used for normal operation</li> <li>■ Enabled, active high output (DIO line goes high when alarm condition is met)</li> <li>■ Enabled, active low output (DIO line goes low when alarm condition is met)</li> </ul>
Alarm latency (Note 8)	1 second

**Note 8:** Alarm settings are applied when changed and at power-on. Temperatures are constantly converted on enabled channels and processed for alarm conditions regardless of the communications connectivity.

## Counter

Table 3. Counter specifications

Parameter	Specification
Counter type	Event counter
Number of channels	1
Input type	Schmitt trigger; fixed 47.5 k $\Omega$ pull-down resistor
Resolution	32 bits
Schmitt trigger hysteresis	0.6 V min 1.7 V max
Input high voltage threshold	1.9 V min 3.6 V max
Input high voltage limit	5.5 V absolute max
Input low voltage threshold	1.0 V min 2.3 V max
Input low voltage limit	-0.5 V absolute min 0 V recommended min
Input frequency	10 MHz max
High pulse width	50 ns min
Low pulse width	50 ns min

## Memory

Table 4. Memory specifications

Parameter	Specification
EEPROM	4,096 bytes

## Power

Table 5. Power specifications

Parameter	Conditions	Specification
External power supply		5 V $\pm$ 5% required 5 V, 1 A supply provided (PS-5V1AEPS)
Supply current	Quiescent current	177 mA typical (Note 9)
User output voltage range	Available at +VO terminal	4.40 V min to 5.25 V max; assumes supplied AC adapter is used
User output current	Available at +VO terminal	10 mA max
Isolation	Measurement system to chassis ground	500 VDC min

**Note 9:** This is the total quiescent current requirement for the device that includes the LEDs. This value does not include any potential loading of the digital I/O bits or +VO terminal.

## Network

### Ethernet connection

Table 6. Ethernet connection specifications

Parameter	Specification
<i>Ethernet type</i>	100 Base-TX 10 Base-T
<i>Communication rates</i>	10/100 Mbps, auto-negotiated
<i>Connector</i>	RJ-45, 8 position
<i>Cable length</i>	100 meters (328 feet) max
<i>Additional parameters</i>	HP Auto-MDIX support

### Network interface

Table 7. Factory default specifications

Parameter	Specification
Protocols used	TCP (IPv4 only) and UDP
Network ports used	UDP: 54211 (discovery) UDP: 6234 (bootloader only) TCP: 54211 (commands)
Network IP configuration	DHCP + link-local, DHCP, static, link-local
Network name	E-TC-xxxxxxx, where xxxxxx are the lower 6 digits of the device MAC address
Network name publication	By NBNS; responds to b-node broadcasts, therefore only available on the local subnet

### Network factory default settings

Table 8. Factory default specifications

Parameter	Specification
Factory default IP address	192.168.0.101
Factory default subnet mask	255.255.255.0
Factory default Gateway	192.168.0.1
Factory default DHCP setting	DHCP + link-local enabled

## Network security

Table 9. Factory default specifications

Parameter	Specification
Security implementation	TCP sockets are not opened unless application sends the correct PIN connection code; stored in non-volatile memory; may be changed by user; default value is 0000
Number of concurrent sessions	1
Vulnerabilities	TCP Sequence Number Approximation Vulnerability

## LED displays and the factory reset button

Table 10. LED and button configurations

Parameter	Specification
Power LED (top)	<ul style="list-style-type: none"> <li>■ On: <math>4.2\text{ V} &lt; V_{\text{ext}} &lt; 5.6\text{ V}</math></li> <li>■ Off: <math>V_{\text{ext}} &lt; 4.2\text{ V}, V_{\text{ext}} &gt; 5.6\text{ V}</math> (power fault)</li> </ul> <b>Power</b> and <b>Activity</b> LEDs blink continuously in firmware update mode
Activity LED (bottom)	<ul style="list-style-type: none"> <li>■ On: A valid host connection is established.</li> <li>■ Blinks: A command is received.</li> </ul> <b>Power</b> and <b>Activity</b> LEDs blink continuously in firmware update mode
Ethernet connector LEDS	<ul style="list-style-type: none"> <li>■ Left (green): Link/activity indicator; on when there is a valid Ethernet link, and blinks when network activity is detected.</li> <li>■ Right (yellow): Speed indicator; on for 100 Mbps, off for 10 Mbps or no link.</li> </ul>
Factory reset button	Resets network and alarm configuration settings to factory default values. <ul style="list-style-type: none"> <li>■ Press and hold for 4 seconds. The Power and Activity LEDs will both blink twice and turn off to indicate that network settings have been restored to default values. Release the button to allow the device to reset and use the default settings. If the reset button is released before the two LEDs blink, settings are not affected.</li> <li>■ Holding the reset button at power on forces the device into firmware update mode in case of a failed firmware update. In this mode, both LEDs blink together constantly. The device may be returned to normal operation by cycling the power.</li> </ul>

## Environment

Table 11. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 55 °C
Storage temperature range	-40 °C to 85 °C
Humidity	0 °C to 90% non-condensing

## Mechanical

Table 12. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	117.9 × 82.8 × 29.0 mm (4.64 × 3.26 × 1.14 in.)

## Screw terminal connector

Table 13. Screw terminal connector specifications

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

Table 14. Screw terminal pinout

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
1	CH0H	CH0 sensor input (+)	17	DIO0	DIO channel 0
2	CH0L	CH0 sensor input (-)	18	DIO1	DIO channel 1
3	CH1H	CH1 sensor input (+)	19	DIO2	DIO channel 2
4	CH1L	CH1 sensor input (-)	20	DIO3	DIO channel 3
5	CH2H	CH2 sensor input (+)	21	GND	Digital ground
6	CH2L	CH2 sensor input (-)	22	DIO4	DIO channel 4
7	CH3H	CH3 sensor input (+)	23	DIO5	DIO channel 5
8	CH3L	CH3 sensor input (-)	24	DIO6	DIO channel 6
9	CH4H	CH4 sensor input (+)	25	DIO7	DIO channel 7
10	CH4L	CH4 sensor input (-)	26	+VO	User voltage output
11	CH5H	CH5 sensor input (+)	27	GND	Digital ground
12	CH5L	CH5 sensor input (-)	28	GND	Digital ground
13	CH6H	CH6 sensor input (+)	29	GND	Digital ground
14	CH6L	CH6 sensor input (-)	30	CTR	Counter input
15	CH7H	CH7 sensor input (+)	31	GND	Digital ground
16	CH7L	CH7 sensor input (-)	32	CHGND	Chassis ground