Specifications

WEB-TEMP

MEASUREMENT COMPUTING™

Document Revision 1.2, April, 2008

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 power supply input.*
Channel configuration		Software programmable to match sensor type
Differential input voltage range for the various sensor categories	Thermocouple	±0.080 V
	RTD	0 to 0.5V
	Thermistor	0 to 2 V
	Semiconductor sensor	0 to 2.5 V
Absolute maximum input voltage	*±C0x through ±C7x relative to AGND (pins 9, 19, 28, 38)*	*±25 V (power on)* *±40 V (power off)*
Input impedance		*5 Gigohm (power on)* *1 Mohm (power off)*
Input leakage current	*Open thermocouple detect disabled*	*30 nA max.*
	Open thermocouple detect enabled	*105 nA max.*
Common mode rejection ratio	f_{IN} *= 60 Hz*	*100 dB min.*
ADC Resolution		24 bits
ADC 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 sensor. The maximum open detection time is 3 seconds.
CJC sensor accuracy	*15 °C to 35 °C*	*-0.75 °C to 0.5 °C max.*
	0 °C to 55 °C	*-1.5 °C to 1.25 °C max.*

Channel configurations

Table 2. Channel configuration specifications

Sensor Category	Conditions	Max number of sensors (all channels configured alike)
Disabled	All temperature input channels are disconnected from screw terminals and internally connected to AGND.	See Note 3
Thermocouple (Note 1)		8 differential channels
Semiconductor sensor (Note 1)		8 differential channels
RTD and Thermistor (Note 1)	2-wire input configuration with a single sensor per channel pair	4 differential channels
	2-wire input configuration with two sensors per channel pair	8 differential channels
	3-wire configuration with a single sensor per channel pair	4 differential channels
	4-wire input configuration with a single sensor per channel pair	4 differential channels
	4-wire input configuration with two sensors per channel pair	8 differential channels

Note 1: Internally, the WEB-TEMP has four, dual-channel, fully differential A/Ds providing a total of eight differential channels. The analog input channels are therefore configured in four channel pairs with CH0/CH1 sensor inputs, CH2/CH3 sensor inputs, CH4/CH5 sensor inputs, and CH6/CH7 sensor inputs paired together. This "channel-pairing" requires the analog input channel pairs be configured to monitor the same category of temperature sensor. Mixing different sensor types of the same category (such as a type J thermocouple on channel 0 and a type T thermocouple on channel 1) is permissible.

Note 2: Channel configuration information is stored on a 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.

Note 3: The factory default configuration is *Disabled*. The Disabled mode will disconnect the analog inputs from the terminal blocks and internally grounds (AGND) all of the A/D inputs. This mode also disables each of the current excitation sources.

Compatible sensors

Table 3. Compatible sensor type specifications

Parameter	Conditions
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
RTD	100 Ω PT (DIN 43760: 0.00385 ohms/ohm/°C)
	100 Ω PT (SAMA: 0.003911 ohms/ohm/°C)
	100 Ω PT (ITS-90/IEC751:0.0038505 ohms/ohm/°C)
Thermistor	Standard 2,252 Ω through 30,000 Ω
Semiconductor / IC	TMP36 or equivalent

Accuracy

Thermocouple measurement accuracy

Table 4. Thermocouple accuracy specifications, including CJC measurement error. All specifications are (±).

Sensor Type	Sensor temperature	Accuracy error maximum (°C)	Accuracy error typical (°C)	Tempco (°C/°C)
J	-210 °C	3.098	1.762	0.040
	0 °C	1.282	0.724	
	1200 °C	1.178	0.684	
K	-210 °C	3.318	1.843	0.045
	0 °C	1.292	0.730	
	1372 °C	1.495	0.799	
S	-50 °C	1.892	1.058	0.027
	250 °C	0.853	0.479	
	1768 °C	0.734	0.416	
R	-50 °C	2.010	1.124	0.025
	250 °C	0.844	0.475	
	1768 °C	0.612	0.347	
B	250 °C	2.199	2.192	0.004
	700 °C	0.824	0.821	
	1820 °C	0.471	0.469	
E	-200 °C	3.050	1.708	0.038
	0 °C	1.465	0.826	
	1000 °C	1.010	0.564	
T	-200 °C	3.226	1.797	0.045
	0 °C	1.334	0.754	
	400 °C	0.856	0.496	
N	-200 °C	3.406	1.897	0.035
	0 °C	1.300	0.735	
	1300 °C	0.978	0.571	

Note 4: Thermocouple measurement accuracy specifications include polynomial 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 WEB-TEMP between 15 °C and 35 °C after 30 minute warm-up. The tempco should be applied to the accuracy specifications for operation at an ambient temperature outside of the 15 °C and 35 °C range. There are total of four CJC sensors, two per side of the module. Each CJC sensor is dedicated to one of the four channel pairs. 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. Contact your thermocouple supplier for details on the actual thermocouple accuracy error.

Note 5: Thermocouples must be connected to the WEB-TEMP such that they are floating with respect to AGND (pins 9, 19, 28, 38, 48). The WEB-TEMP AGND pins are isolated from earth ground. You can connect thermocouple sensors to voltages referenced to earth ground as long as the isolation between the AGND pins and earth ground is maintained.

Note 6: When thermocouples are attached to conductive surfaces, the voltage differential between multiple thermocouples must remain within ±1.4V. For best results, we recommend using insulated or ungrounded thermocouples when possible.

Semiconductor sensor measurement accuracy

Table 5. Semiconductor sensor accuracy specifications

Sensor Type	Temperature Range (°C)	Maximum Accuracy Error
TMP36 or equivalent	-40 to 150 °C	±0.50 °C

Note 7: Error shown does not include errors of the sensor itself. These specs are for one year while operation of the WEB-TEMP unit is between 15 °C and 35 °C. Contact your sensor supplier for details on the actual sensor error limitations.

RTD measurement accuracy

Table 6. RTD measurement accuracy specifications

RTD	Sensor temperature	Accuracy error (°C) maximum	Accuracy error (°C) typical	Tempco (°C/°C)
PT100, DIN, US or ITS-90	-200 °C	2.913	2.784	0.001
	-150 °C	1.201	1.070	0.001
	-100 °C	0.482	0.349	0.001
	0 °C	0.261	0.124	0.001
	100 °C	0.269	0.127	0.001
	300 °C	0.287	0.136	0.001
	600 °C	0.318	0.150	0.001

Note 8: Error shown does not include errors of the sensor itself. The sensor linearization is performed using a Callendar-Van Dusen linearization algorithm. These specs are for one year while operation of the WEB-TEMP unit is between 15 °C and 35 °C. The accuracy and tempco specifications *include* the accuracy of the Callendar-Van Dusen linearization algorithm. The specification does not include lead resistance errors for 2-wire RTD connections. Contact your sensor supplier for details on the actual sensor error limitations.

Note 9: Resistance values greater than 660Ω cannot be measured by the WEB-TEMP in the RTD mode. The 660Ω resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the RTD resistance and the lead resistances.

Note 10: For accurate three wire compensation, the individual lead resistances connected to the ±Ix pins must be of equal ohmic value. To ensure this, use connection leads of equal lengths.

Thermistor measurement accuracy

Table 7. Thermistor measurement accuracy specifications

Thermistor	Sensor temperature	Accuracy error maximum (°C)	Accuracy error typical (°C)	Tempco (°C/°C)
2252 Ω	-40 °C	0.001	0.0007	0.001
	0 °C	0.021	0.008	0.001
	50 °C	0.263	0.130	0.001
	120 °C	3.473	1.750	0.001
5000 Ω	-35 °C	0.001	0.0006	0.001
	0 °C	0.009	0.004	0.001
	50 °C	0.115	0.049	0.001
	120 °C	1.535	0.658	0.001
10000 Ω	-25 °C	0.001	0.0005	0.001
	0 °C	0.005	0.002	0.001
	50 °C	0.060	0.028	0.001
	120 °C	0.771	0.328	0.001
30000 Ω	-10 °C	0.001	0.0005	0.001
	0 °C	0.002	0.001	0.001
	50 °C	0.019	0.009	0.001
	120 °C	0.267	0.128	0.001

Note 11: Error shown does not include errors of the sensor itself. The sensor linearization is performed using a Steinhart-Hart linearization algorithm. The accuracy and tempco specifications *include* the accuracy of the Callendar-Van Dusen linearization algorithm. These specifications are for one year while operation of the WEB-TEMP unit is between 15 °C and 35 °C. The specification does not include lead resistance errors for 2-wire thermistor connections. Contact your sensor supplier for details on the actual sensor error limitations. Total thermistor resistance on any given channel pair must not exceed 180 k ohms. Typical resistance values at various temperatures for supported thermistors are shown in Table 8.

Table 8. Typical thermistor resistance specifications

Temp	2252 Ω thermistor	3000 Ω thermistor	5 kΩ thermistor	10 kΩ thermistor	30 kΩ thermistor
-40 °C	76 kΩ	101 kΩ	168 kΩ	240 kΩ (Note 12)	885 kΩ (Note 12)
-35 °C	55 kΩ	73 kΩ	121 kΩ	179 kΩ	649 kΩ (Note 12)
-30 °C	40 kΩ	53 kΩ	88 kΩ	135 kΩ	481 kΩ (Note 12)
-25 °C	29 kΩ	39 kΩ	65 kΩ	103 kΩ	360 kΩ (Note 12)
-20 °C	22 kΩ	29 kΩ	49 kΩ	79 kΩ	271 kΩ (Note 12)
-15 °C	16 kΩ	22 kΩ	36 kΩ	61 kΩ	206 kΩ (Note 12)
-10 °C	12 kΩ	17 kΩ	28 kΩ	48 kΩ	158 kΩ
-5 °C	9.5 kΩ	13 kΩ	21 kΩ	37 kΩ	122 kΩ
0 °C	7.4 kΩ	9.8 kΩ	16 kΩ	29 kΩ	95 kΩ

Note 12: Resistance values greater than 180 kΩ cannot be measured by the WEB-TEMP in the thermistor mode. The 180kΩ resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the thermistor resistance and the lead resistances.

Note 13: For accurate three wire compensation, the individual lead resistances connected to the ±Ix pins must be of equal ohmic value. To ensure this, use connection leads of equal lengths.

Throughput rate

Table 9. 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 14: 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 Ethernet unit is approximately 0.5 seconds.

Digital input/output

Table 10. Digital input/output specifications

Digital type	CMOS
Number of I/O	8 (DIO0 through DIO7)
Configuration	Independently configured for input or output. Switch selectable output voltages: +5 V and +3.3 V
Power on conditions	Power on reset is Input mode except when bits are configured to operate as alarms.
Pull-up/pull-down configuration	All pins are connected to 47 kOhm resistors that share a common point accessible at Pin 22 of the device (PU/D). This pin is floating by default and is user-configurable via external connection. For pull-up mode, connect this pin to Pin 21 (+5V). For pull-down mode, connect this pin to Pin 48 (GND).
Digital I/O transfer rate (software paced)	▪ Digital input – 50 port reads or single bit reads per second typical. ▪ Digital output – 100 port writes or single bit writes per second typical.
Input high voltage (+5 V mode)	4 V min, 5.5 V absolute max.
Input high voltage (+3.3 V mode)	2.64 V min, 5.5 V absolute max.
Input low voltage (+5 V mode)	1 V max., -0.3 V absolute min.
Input low voltage (+3.3 V mode)	0.66 V max., -0.3 V absolute min.
Output low voltage (IOL = 2.5 mA)	0.6 V max.
Output high voltage (IOH=-2.5 mA)	4.3 V min. (+5 V mode), 2.7 V (+3.3 V mode)

Note 15: Ground pins on the WEB-TEMP labeled GND are isolated from AGND pins and from earth ground.

Temperature alarms

Table 11. Temperature alarm specifications

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. The input to each alarm may be any of the analog temperature input channels. 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 are loaded at power on.
Alarm input modes	▪ Alarm when input temperature > T1 ▪ Alarm when input temperature > T1, reset alarm when input temperature goes below T2 ▪ Alarm when input temperature < T1 ▪ Alarm when input temperature < T1, reset alarm when input temperature goes above T2 ▪ Alarm when input temperature is < T1 or > T2 Note: T1 and T2 may be independently set for each alarm.
Alarm output modes	▪ Disabled, digital I/O line may be used for normal operation ▪ Enabled, active high output (digital I/O line goes high when alarm condition is met) ▪ Enabled, active low output (digital I/O line goes low when alarm condition is met)
Alarm update rate	1 second

Memory

Table 12. Memory specifications

EEPROM	512 bytes for sensor configuration
FLASH	2 MB for device configuration and website storage

Microcontroller

Table 13. Microcontroller specifications

Type	One high-performance 8-bit RISC microcontroller (isolated) One high-performance 16-bit RISC microcontroller (non-isolated)

Power

Table 14. Power specifications

Parameter	Conditions	Specification
Supply current (Note 17)	Continuous mode	440 mA max.
External power input (Note 16)		+5 VDC ± 5% (+5 VDC power supply provided)
External power supply (included)	MCC p/n PS-5V2AEPS	+5VDC, 10 W, 5% regulation
Voltage supervisor limits	4.75 V > V_{ext} or V_{ext} > 5.25 V	PWR LED = Off; (power fault)
	4.75 V < V_{ext} < 5.25 V	PWR LED = On
User output voltage range	Available at +5V screw terminal	4.65 V min., 5.25 V max.
User output current available	Available at +5V screw terminal	10 mA max

Note 16: Voltage specification applies at barrel plug power input. The power supply provided with the board meets this specification at the rated total power supply current. If a different power supply is used, small line resistances could cause significant voltage drop between the power supply and the barrel plug input.

Note 17: This is the total current requirement for the WEB-TEMP which includes up to 20 mA for the LEDs and 10 mA for the user voltage output.

Network

Ethernet compliance

Table 15. Ethernet compliance specifications

Device type	*IEEE 802.3 Ethernet 10Base-T*
Device compatibility	*IEEE 802.3-2003 10 Mpbs Media Access Control*

Ethernet connection

Table 16. Ethernet connection specifications

Ethernet type	*10Base-T*
Connector	*RJ-45, 8 position*
Cable	*CAT-5 shielded, unshielded twisted pair*
Length	*100 meters max.*
MAC address	00:12:71:Cx:xx:xx, where xxxxx is the device's serial number

Network factory default settings

Table 17. Factory default specifications

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	Enabled
Factory default user name	"webtemp"
Factory default password	"mccdaq"
Web Server	Enabled

Network protocols

Table 18. Factory default specifications

Protocols implemented	IP, ARP, ICMP, DHCP, UDP, TCP, NBNS, HTTP Protocols using UDP or TCP for transport communicate on their IETF assigned ports (for example HTTP on TCP port 80).
UDP messaging protocol	UDP port 54211
TCP downloading protocol	TCP port 54267
HTTP 1.0 alternate port	TCP port 49152-65535 (not including 54267)
Network name	"webtemp_xxxxx", where xxxxx is the device's serial number
Network name publication	via NBNS (responds to b-node broadcasts, therefore only available on the local subnet)
Max number of simultaneous HTTP connections	3
Max number of non-HTTP TCP sockets	5

Network security

Table 19. Factory default specifications

Security implementation	IP address based session manager with user-name/password login for configuration and control transactions (data is not secured.)
Session timeout	5 minutes with no activity
User-name/password encryption	Base64 (The default web page does not support encryption if Javascript is disabled in the web browser.)
Vulnerabilities	Denial of service attacks, user-name/password spoofing, script probing and simple decryption

LED displays and the factory reset button

Table 20. LED and button configurations

POWER/COMM LED (top)	4.75 V < V_{ext} < 5.25 V On V_{ext} < 4.75 V, V_{ext} > 5.25 V Off (power fault) Blinks during microcontroller communications.
LINK/ACTTIVITY LED (bottom)	On when there is a valid Ethernet connection and blinks when an Ethernet packet is sent or received.
Factory reset button	When held for 3 seconds, the POWER LED will turn off for a short time, indicating a reset is in process. When the POWER LED turns back on, reset is complete and the factory default network settings have been restored.

Current excitation outputs (Ix+)

Table 21. Current excitation output specifications

Parameter	**Conditions**	**Specification**
Configuration		4 dedicated pairs: ±IA - CH0/CH1 ±IB - CH2/CH3 ±IC - CH4/CH5 ±ID - CH6/CH7
Current excitation output ranges	Thermistor	10 µA typ.
	RTD	210 µA typ.
Tolerance		±5% typ.
Drift		200 ppm/°C
Line regulation		*2.1 ppm/V max.*
Load regulation		*0.3 ppm/V typ.*
Output compliance voltage (relative to AGND pins 9, 19, 28, 38)		3.90 V max. -0.03 V min.

Note 18: The WEB-TEMP has four current excitation outputs, with ±IA dedicated to the CH0/CH1 analog inputs, ±IB dedicated to CH2/CH3, ±IC dedicated to CH4/CH5, and ±ID dedicated to CH6/CH7. The excitation output currents should always be used in this dedicated configuration.

Note 19: The current excitation outputs are automatically configured based on the sensor (thermistor or RTD) selected.

Environmental

Table 22. Environmental specifications

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

Mechanical

Table 23. Mechanical specifications

Dimensions	127 mm (L) x 88.9 mm (W) x 35.56 (H)

Screw terminal connector type and pin out

Table 24. Screw terminal connector specifications

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

Table 25. Screw terminal pin out

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
1	IA+	CH0/CH1 current excitation source	27	ID-	CH6/CH7 current excitation return
2	NC	No connect - see Note 20	28	AGND	Analog ground
3	C0H	CH0 sensor input (+)	29	C7L	CH7 sensor input (-)
4	C0L	CH0 sensor input (-)	30	C7H	CH7 sensor input (+)
5	4W01	CH0/CH1 4-wire, 2 sensor common	31	IC67	CH6/CH7 2 sensor common
6	IC01	CH0/CH1 2-sensor common	32	4W67	CH6/CH7 4-wire, 2 sensor common
7	C1H	CH1 sensor input (+)	33	C6L	CH6 sensor input (-)
8	C1L	CH1 sensor input (-)	34	C6H	CH6 sensor input (+)
9	AGND	Analog ground	35	NC	No connect - see Note 20
10	IA-	CH0/CH1 current excitation return	36	ID+	CH6/CH7 current excitation source
11	IB+	CH2/CH3 current excitation source	37	IC-	CH4/CH5 current excitation return
12	NC	No connect - see Note 20	38	AGND	Analog ground
13	C2H	CH2 sensor input (+)	39	C5L	CH5 sensor input (-)
14	C2L	CH2 sensor input (-)	40	C5H	CH5 sensor input (+)
15	4W23	CH2/CH3 4-wire, 2 sensor common	41	IC45	CH4/CH5 2 sensor common
16	IC23	CH2/CH3 2 sensor common	42	4W45	CH4/CH5 4-wire, 2 sensor common
17	C3H	CH3 sensor input (+)	43	C4L	CH4 sensor input (-)
18	C3L	CH3 sensor input (-)	44	C4H	CH4 sensor input (+)
19	AGND	Analog ground	45	NC	No connect - see Note 20
20	IB-	CH2/CH3 current excitation return	46	IC+	CH4/CH5 current excitation source
21	+5V	+5V output	47	NC	No connect - see Note 20
22	PU/D	Pull-up/down for digital outputs	48	GND	Digital ground
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

Note 20: Do not make connections to pins marked "NC".

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