USB-5104

4-channel thermocouple logger

User's Guide

MEASUREMENT COMPUTING™

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About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-5104 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information related to the subject matter.

Caution!   Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

bold text   **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

italic text   *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

Additional information about USB-5104 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Introducing the USB-5104

The USB-5104 is a 4-channel thermocouple data logger that records temperature in indoor environments using up to four J, K, T, E, R, S, B, or N type thermocouple sensors (sold separately).

Using USB-5100 Series Data Logger Software, you can easily perform the following tasks:

- Record the ambient temperature with its internal temperature thermistor
- Configure the logger alarm to trip for specific high or low temperatures
- Set up burst logging in which the logger records data at a different interval during certain conditions
- Calculate minimum, maximum, average, and standard deviation statistics

Use the built-in LCD screen to monitor temperature, logging status, battery use, and memory consumption between readouts.

Installing the USB-5104

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

Contact us immediately if any components are missing or damaged.

Installing the software

Note: Before connecting the USB-5104 logger, first install the USB-5100 Series Data Logger Software.

Perform the following steps to install the USB-5100 Series Data Logger Software:

1. Download the software from www.mccdaq.com/daq-software/usb-5100-series-software.aspx.
2. Follow the onscreen instructions.

In addition to the software, the executable also installs electronic copies of the *USB-5100 Series Getting Started Guide* and *USB-5100 Series Software Help*.

Installing the hardware

> **Install the software before you install your device**
>
> The driver needed to run the USB-5104 device is installed when you install the software. Therefore, you need to install the USB-5100 Series Data Logger Software before you install the hardware.
>
> For operation on a Windows operating system, we recommend that you run Windows Update to update your operating system with the latest USB drivers.

Perform the following steps to connect a USB-5100 Series data logger:

1. Launch the USB-5100 Series Data Logger Software.
2. Plug the large end of the mini-USB cable into a USB port on the computer.
3. Plug the small end of the mini-USB cable into the USB port on the data logger.

Windows: When connecting a device for the first time, it may take several seconds to detect the new hardware and report that it has connected successfully. A message may display indicating that you need to reboot before you can use the device – this is optional; you do not need to reboot at this time.

The device name appears in the status bar once it is recognized by the software. The status bar also lists the total number of devices connected. At this point, you can access the device using the software.

Functional Details

Logger components

The external components on the USB-5104 are shown in Figure 1.
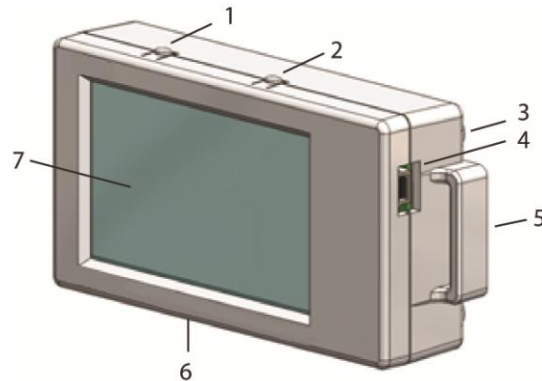
1	Start/Stop button	5	Mounting loops (one on each side)
2	Alarm/Stats button	6	Thermocouple ports (not shown)
3	Logger rear (not shown): Mounting magnets (×4) and battery compartment	7	LCD screen
4	USB port		

Figure 1. USB-5104 components

Start/Stop button

Press this button for 3 seconds to start or stop logging data, or to resume logging. This requires configuring the logger with a push button start or stop, and with "Resume logging on next button push" selected; see *Setting up the logger* on page 9 for more information.

You can also press this button for 1 second to record an internal event (see *Recording internal logger events* on page 12), or to turn on the LCD screen on if it is configured to be off.

Alarm/Stats button

Use this button to clear a tripped alarm (see *Setting up alarms* on page 10) or to cycle between statistics, alarm readings, the current sensor reading, and the internal temperature reading, if enabled in the software.

Mounting magnets

Four built-in mounting magnets on the rear of the device are used to mount the logger to a magnetic surface.

Battery compartment

The battery compartment houses the two AAA 1.5 volt alkaline batteries. Refer to *Battery information* on page 12 for information about the logger batteries.

USB port

Use this port to connect the logger to the computer with the mini-USB cable.

Mounting loops

Use the two mounting loops (only one is visible in the diagram) to mount the logger with the hook-and-loop strap; see *Mounting the logger* on page 12 for more information about using the mounting loops.

Thermocouple ports

Use these ports to connect thermocouple sensor subminiature connectors; see *Connecting thermocouple sensors* on page 10 for more information.

LCD Screen

The logger LCD screen displays details about the current status. Figure 2 shows all of the symbols that display on the LCD screen. The table below lists a description for each symbol.
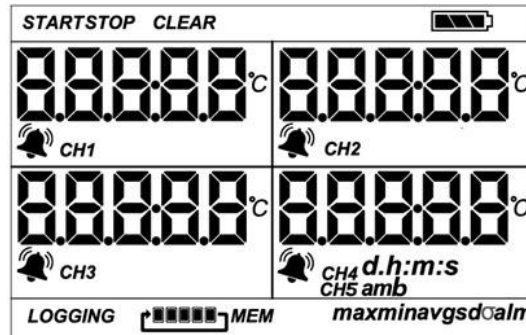

Figure 2. LCD screen symbols

Symbol	Description
START	The logger is waiting to be launched. Press and hold the Start/Stop button for 3 seconds to launch the logger.
STOP	The logger was launched with push button stop enabled; press and hold the Start/Stop button for 3 seconds to stop the logger. **Note**: If you also launched the logger with a push button start, this symbol does not appear on the display for 30 seconds.
CLEAR	An alarm is ready to be cleared. This symbol appears when **Cleared with button press** is selected in the alarm settings. Press the Alarm/Stats button for 3 seconds to clear the alarm.
	The battery indicator shows the approximate battery power remaining.
	This is an example of a temperature reading. Temperature units are set with the software. You cannot change the temperature unit after the logger is launched.
	A sensor reading is above or below the configured high or low alarm. Press and release the Alarm/Stats button until **alm** displays (explained below). The alarm symbol clears depending on how alarms are configured. If the alarm is configured to clear when the logger is relaunched, this symbol remains on the LCD. Otherwise, it clears when the sensor reading is back within the alarm limits or you press the Alarm/Stats button for 3 seconds.
CH1	The channel number associated with the thermocouple reading. Up to four channels are visible at one time. Press the Alarm/Stats button for 1 second to cycle through any available statistics and then to fifth channel, which is the temperature being logged by the internal thermistor (if enabled in the software).
m:s	The logger is configured to start logging on a particular date/time. The display counts down in days, hours, minutes, and seconds until logging begins. In this example, 5 minutes and 38 seconds remain until logging begins.
LOGGING	Displays when the logger is currently logging.
MEM	The logger is configured to stop logging when memory fills. The memory bar indicates the approximate space remaining in the logger to record data. When first launched, all five segments in the bar are empty. In this example, the logger memory is almost full (only one segment in the memory bar is empty).
MEM	The logger is configured to never stop logging (wrapping). The logger continues recording data indefinitely, with newest data overwriting the oldest data. When first launched, all five segments in the memory bar will be empty. In this example, the memory is full (all five segments are filled in) and new data is overwriting the oldest data. This continues until the logger is stopped or the battery runs out.

Symbol	Description
max **min** **avg** **sd**σ	These symbols show the maximum, minimum, average, and standard deviation values most recently calculated by the logger. The logging mode must be set in the software to *Statistics*. Press the Alarm/Stats button for 1 second to cycle through each of the available statistics and then to the channel 5 thermistor reading (if enabled), and then back to the current thermocouple readings, or to the alarm value, if applicable.
alm	The sensor reading that tripped the alarm. Press the Alarm/Stats button to view this reading. Press the Alarm/Stats button again to cycle through any statistics, then to the channel 5 thermistor reading (if enabled), and back to the current thermocouple readings.
LoAd	The launch settings are being loaded onto the logger. Do not disconnect the USB cable during this process.
Err	An error occurred while loading the launch configurations onto the logger. Verify that the USB cable is connected to both the logger and the computer and try launching again.
StoP	The logger is stopped or the memory is full.

Notes:

- You can disable the LCD screen when logging. Select "Turn LCD off" when setting up the logger as described in the next section. When this option is enabled, you can still temporarily view the LCD screen by pushing the Start/Stop button for 1 second. The LCD will then remain on for 10 minutes.
- The LCD screen refreshes every 15 seconds regardless of the logging interval selected in the software. If you choose a logging interval less than 15 seconds, the data will be recorded at the faster interval, but the temperature readings will only be updated on the screen every 15 seconds.
- When the logger has stopped logging, the LCD screen remains on until the logger is offloaded to a computer, unless launched with the "Turn LCD off" option. Once the logger is offloaded and disconnected from the computer, the LCD turns off automatically after 2 hours. The LCD turns back on the next time the logger is connected to the computer.
- If a thermocouple is disconnected during logging, erroneous values will display on the LCD for that sensor, and return to normal readings once reconnected. See *Connecting thermocouple sensors* on page 10 for more details.

Setting up the logger

All hardware configuration options on the USB-5104 are programmable with USB-5100 Series Data Logger Software.

Data logging options

You can configure the following logger options:

- thermocouple sensors to log
- thermocouple type
- logging rate
- logging mode
- start/stop/restart modes
- alarm modes
- filter options
- LCD off

For detailed information on all software features, refer to the *USB-5100 Series Software Help* located at www.mccdaq.com/PDFs/Manuals/USB-5100-Series-Help.pdf.

Connecting thermocouple sensors

The logger can accept up to four standard thermocouple sensors of the appropriate type with standard thermocouple subminiature connectors.

ANSI Standard Thermocouple Color Coding		
Type-J	Iron-Constantan	Black
Type-K	Chromel-Alumel	Yellow
Type-S	Platinum-Rhodium	Green
Type-T	Copper-Constantan	Blue
Type-E	Chromel-Constantan	Purple
Type-R	Platinum-Rhodium	Green
Type-B	Platinum-Rhodium	Gray
Type-N	Nicrosil-Nisil	Orange

If the thermocouple has stripped-wire ends, male subminiature connectors with screw terminals are available. You must use the matching type of subminiature connector for the thermocouple you are using.

Note that the negative terminal on the subminiature connector is wider than the positive terminal. Make sure the plug is inserted into the jack correctly as shown.
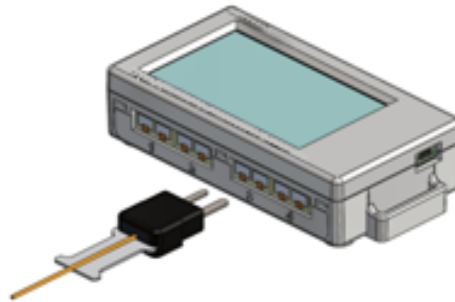

Figure 3. Thermocouple inputs

If you disconnect a thermocouple while the device is logging, an erroneous reading can appear on the LCD for that channel. In addition, erroneous readings will be logged and saved in the data file depending on the logging interval. For example, if a thermocouple is disconnected for 5 minutes and the logging interval is set to 1 minute, 5 erroneous data points are logged while the thermocouple was disconnected. If you reconnect it, the correct values will display on the LCD again and will be logged and saved in the data file.

Setting up alarms

All alarm options are software configurable. You can set an alarm to trip when a sensor reading rises above or falls below a specified value on any of the thermocouple channels.

The alarm symbol displays on the LCD screen when an alarm is tripped. Alarm limits are checked when the LCD screen refreshes (every 15 seconds).

The logging mode must be set to *Normal* or *Statistics* in order to enable an alarm.

Alarm modes

Set the alarm mode to cumulative to raise an alarm if the thermocouple sensor is out of range for a specific number to channels.

- **Cumulative** – raises an alarm when the TC sensor is out-of-range for a specified number of samples.
- **Consecutive** – raises an alarm when the TC sensor is out-of-range consecutively for a specified number of samples.

You can configure a tripped alarm to clear on the next launch, when sensor readings are within specified limits, or when the **Alarm/Stats** button is pressed.

Notes:

- The actual values for the high and low alarm limits are set to the closest values supported by the logger based on the thermocouple type. In addition, alarms can trip or clear when the sensor reading is within the resolution specification for each thermocouple type. This means the value that triggers the alarm may differ slightly than the value entered.
- When you read out the logger, high and low alarm levels display on the plot along with "Chan <#> Alarm Tripped" and "Chan <#> Alarm Cleared" events showing when the temperature alarm tripped and cleared. The "Chan <#> Alarm Cleared" event contains the value that was furthest out of range for the sensor before the alarm cleared (see the Points table for the actual value).

Refer to the *USB-5100 Series Software Help* for detailed information about alarm modes.

Logging modes

Use software to configure the logging mode for *Normal*, *Burst*, or *Statistics*. Burst logging and statistics are available on thermocouple channels but not on the internal temperature channel. Refer to the *USB-5100 Series Software Help* for detailed information about logging modes.

Burst logging

Burst logging mode allows you to set up more frequent logging when a specified condition is met, such as when sensor readings fall outside of a specified range.

When the plot is configured for events, a *New Interval* event appears each time the logger enters or exits burst logging mode.

Burst mode does not support alarm settings.

Statistics

In Statistics logging mode, the logger calculates maximum, minimum, average, and standard deviation statistics during logging. The results are recorded at each logging interval based on samples taken at a specified rate. This results in up to four additional series per sensor that record the following information at each logging interval:

- The maximum, or highest, sampled value.
- The minimum, or lowest, sampled value.
- An average of all sampled values.
- The standard deviation from the average for all sampled values.

Once logging begins, click the Alarm/Stats button on the logger to cycle through the current maximum, minimum, average, and standard deviation data on the LCD screen. You can plot the statistics series once you read out the logger.

Normal logging mode

Set the logging mode to *Normal* when you don't need the additional data generated by Burst or Statistics logging.

Reading out the logger

To read out data logged by the USB-5104, connect it to the computer with the mini-USB cable and read out it with USB-5100 Series Data Logger Software.

Refer to the *USB-5100 Series Software Help* for detailed information about reading out logged data.

Recording internal logger events

The logger records the following internal events to track logger operation and status. You can plot these events after reading out the logger and opening the data file.

Internal Event Name	Definition
Host Connected	The logger is connected to the computer.
Started	The Start/Stop button was pressed to begin logging.
Stopped	The logger received a command to stop recording data (from either the USB-5100 Series Data Logger Software or by pushing the **Start/Stop** button).
Button Up/Button Down	The **Start/Stop** button was pressed for 1 second.
Bad Battery	The battery level dropped below 2.7 V (recorded even when the battery channel is disabled).
Good Battery	The battery level rose to 2.9 V or above after a **Bad Battery event** was marked.
Chan <#> Alarm Tripped	A temperature alarm is tripped on the specified channel.
Chan <#> Alarm Cleared	A temperature alarm cleared on the specified channel. This event also contains the value that is furthest out of range for the sensor before the alarm cleared.
New Interval	The logger has entered or exited burst logging mode.
Safe Shutdown	The battery level dropped below 1.85 V; the logger performs a safe shutdown.

Mounting the logger

There are several ways to mount the USB-5104 using the materials included:

- Use the four built-in magnets on the back of the logger to mount it to a magnetic surface.
- Attach the Command strip to the back of the logger to mount it a wall or other flat surface. The Command strip is included in the accessory kit that shipped with the logger.
- Use the double-sided tape to affix the logger to a surface. The tape is included in the accessory kit that shipped with the logger.
- Insert the hook-and-loop strap through the mounting loops on both sides of the logger for mounting to a curved surface, such as a pipe or tubing. The strap is included in the accessory kit that shipped with the logger.

Protecting the logger

The USB-5104is designed for indoor use and can be permanently damaged by corrosion if it gets wet. Protect it from condensation. If the message **FAIL CLK** appears on the LCD screen, a failure occurred with the internal logger clock, possibly due to condensation. Remove the battery immediately and dry the circuit board. It is possible to dry the logger with a hair dryer, but do not let the board get too hot. You should be able to comfortably hold the board in your hand while drying it.

Static electricity may cause the logger to stop logging

The logger is tested to 8 kV. Avoid electrostatic discharge by grounding yourself using a wrist strap or touch the computer chassis or other grounded object to eliminate any stored static charge.

Battery information

The logger requires two user-replaceable AAA 1.5 volt alkaline batteries. Non-rechargeable lithium batteries can be used for operation at the extreme ends of the logger operating range.

Expected battery life varies based on the ambient temperature where the logger is deployed, the logging or sampling interval, frequency of offloading to the computer, number of channels that are active, if burst or statistics logging modes are active, and battery performance. New batteries typically last 1 year with a logging interval set greater than 1 minute. Deployments in extremely cold or hot temperatures, with a logging interval faster than 1 minute, or a sampling interval faster than 15 seconds can impact battery life. Estimates are not guaranteed due to uncertainties in initial battery conditions and operating environment.

The logger can also be powered by the mini-USB cable when the remaining battery voltage is too low for it to continue logging. Connect the logger to the computer, click the **Readout device** icon on the software toolbar, and save the data as prompted. Replace the battery before launching the logger again.

Perform the following procedure to replace the batteries:

1. Open the battery door on the back of the logger.
2. Remove the old batteries.
3. Insert two new batteries with the correct polarity.
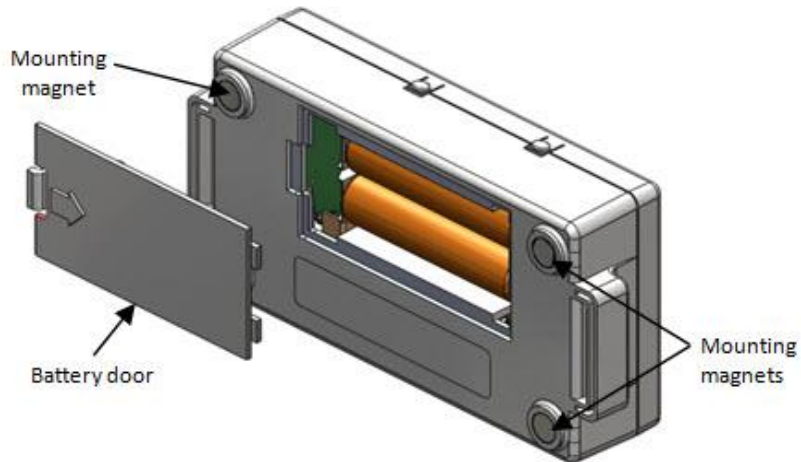4. Reinsert the battery door and snap it back into place.

Figure 4. Logger rear

Caution! Do not cut open, incinerate, heat above 85 °C (185 °F), or recharge the batteries. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations.

The USB-5100 Series Data Logger Software lets you record the current battery voltage at each logging interval; this option is disabled by default. Recording battery life at each logging interval takes up memory and therefore reduces logging duration. It is recommended you only record battery voltage for diagnostic purposes. Even with the channel disabled, a bad battery event will still be recorded.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.

Thermocouple accuracy

Table 1. Accuracy specifications

Type	Range	Accuracy	Resolution (20-bit)
J	–210 °C to 760 °C (–346 °F to 1,400°F)	±0.6 °C (±1.08 °F) ± thermocouple probe accuracy	0.03 °C (0.06 °F)
K	–260 °C to 1,370 °C (–436 °F to 2,498 °F)	±0.7 °C (±1.26 °F) ± thermocouple probe accuracy	0.04 °C (0.07 °F)
T	–260 °C to 400 °C (–436 °F to 752 °F)	±0.6 °C (±1.08 °F) ± thermocouple probe accuracy	0.02 °C (0.03 °F)
E	–260 °C to 950 °C (–436 °F to 1,742 °F)	±0.6 °C (±1.08 °F) ± thermocouple probe accuracy	0.03 °C (0.05 °F)
R	–50 °C to 1,550 °C (–58 °F to 2,822 °F)	±2.2 °C (±3.96 °F) ± thermocouple probe accuracy	0.08 °C (0.15 °F)
S	–50 °C to 1,720 °C (–58 F° to 3,128 °F)	±2.2 °C (±3.96 °F) ± thermocouple probe accuracy	0.08 °C (0.15 °F)
B	550 °C to 1,820 °C (1,022 °F to 3,308 °F)	±2.5 °C (±4.5 °F) ± thermocouple probe accuracy	0.1 °C (0.18 °F)
N	–260 °C to 1,300 °C (–436 °F to 2,372 °F)	±1.0 °C (±1.8 °F) ± thermocouple probe accuracy	0.06 °C (0.11 °F)

Thermistor

Table 2. Internal 10K thermistor (temperature) specifications

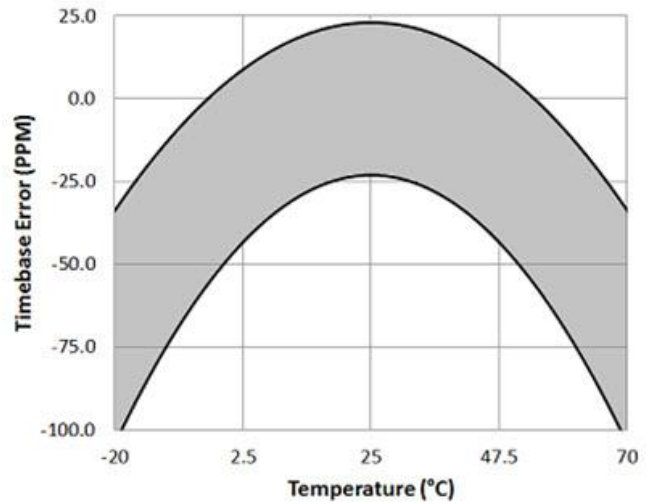| Parameter	Specification
Range	–20 °C to 70 °C (–4 °F to 158 °F)
Accuracy	±0.21 °C from 0 °C to 50 °C (±0.38 °F from 32 °F to 122 °F, see *Plot A* on page 15
Resolution	12-bit:0.024 °C at 25°C (0.04° F at 77°F), see *Plot A* on page 15
Drift	<0.1 °C (0.18 °F) per year

Logger

Table 3. Logger specifications

Parameter	Specification
Operating range	■ Logging: –20 °C to 70°C (–4 °F to 158°F); 0 to 95% RH (non-condensing) ■ Launch/readout: 0 °C to 50 °C (32 °F to 122 °F) per USB specification
Logging rate	1 second to 18 hours, 12 minutes, 15 seconds
Logging modes	Normal, burst, or statistics
Memory modes	Wrap when full or stop when full
Start modes	Immediate, push button, date & time, or next interval
Stop modes	When memory full, push button, or date & time
Restart mode	Push button
Time accuracy	±1 minute per month at 25 °C (77 °F), see *Plot B* on page 15
Battery life	1 year, typical with logging rate of 1 minute and sampling interval of 15 seconds or greater

Parameter	Specification
Battery type	Two AAA batteries or non-rechargeable lithium batteries
Memory	4 MB (1.6 million measurements, max)
Download type	USB 2.0 interface
Full memory download time	Approximately 1.5 minutes
LCD	LCD is visible from 0 °C to 50 °C (32 °F to 122 °F); the LCD may react slowly or go blank in temperatures outside this range
Size (L × W × H)	10.8 × 5.41 × 2.54 cm (4.25 × 2.13 × 1 in.)
Weight	107.5 g (3.79 oz)
Environmental Rating	IP50
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).
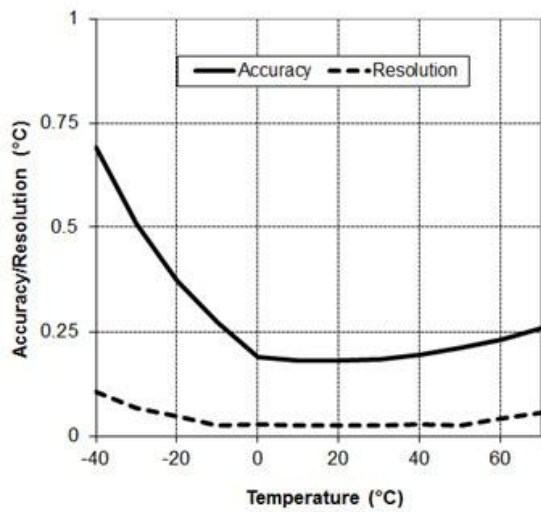
Plot A: Internal Temperature Accuracy & Resolution   Plot B: Time Accuracy