Temperature Data Logging
Making the right choice with a Data Acquisition System

There are many ways to make temperature measurements. The simplest method is to insert a temperature probe into a device under test (DUT) to measure the temperature at that point in time. What if you want to do more than that?

- What if you want to **measure the temperature at multiple locations** in your DUT?
- What if you want to **measure the temperature at regular intervals**, such as every minute for 10 hours?
- What if you want a **temperature measurement accuracy** of 0.05°C?
- What if you want to **set up alarm systems** to trigger on temperature deviations exceeding certain thresholds?
- What if you want to **make voltage, current or resistance measurements simultaneously with temperature measurements**?
- What if you want to **configure your measurement setup and automate all your testing** without the complexity of programming?

The DAQ970A data acquisition system has high quality switching and an advanced 6 ½ digit DMM built-in that allows you to measure accurately.

- Fast reading measurements up to 5000 readings/sec and scan rates up to 450 channels/sec
- Ability to measure high voltages up to 300 Volts
- Ability to measure wide temperature range (from -200 °C to 1800 °C) for many high-performance applications
What is a Temperature Data Logger?

As described in Wikipedia, “temperature data logger, also called temperature monitor, is a portable measurement instrument that is capable of autonomously recording temperature over a defined period of time. The digital data is retrieved, viewed, and evaluated after it has been recorded.”

However, not all temperature data loggers can meet all the needs highlighted in the six questions above. You do not have to settle for less and risk missing your project deadlines.

Figure 1. An example of an analog temperature data logger with limited functions
Perhaps the data acquisition (DAQ) system is a new concept for you. DAQ uses a process of sampling signals that measure real world physical conditions (such as temperature, pressure, or current), and then converts those analog signals to digital signals with the analog-to-digital conversion (ADC) system. You can then use a computer to analyze the data to solve the problems you are working on to resolve. So, how do you choose the right DAQ for temperature data logging?

Measuring Temperature at Multiple Locations

It is common to make temperature measurements at multiple locations, especially when monitoring for temperature variations between several critical locations. For example, during product development, engineers need to characterize product performance and monitor temperature on critical components. Reliability and operating performance are impacted if electronic components exceed specification guidelines.

Generally, DAQ instruments have multiplexer modules with many temperature input channels. For example, a single module may have 40 temperature input channels, and if that DAQ instrument can accommodate up to 3 module slots, you can measure up to 120 temperature points simultaneously. Consider this type of versatility even if you do not need it for your current project, it will allow you to scale up for future needs easily.

Making Temperature Measurements at Regular Intervals

When you are doing temperature data logging, the flexibility to set the interval time between scans is useful. You will likely want the capability to set the time interval in seconds, minutes or even hours (see Figure 2).

![Figure 2. Front panel time interval setting between scans, using DAQ970A](image-url)
A useful capability of a modern DAQ instrument is the ability to log data and save it directly to a USB thumb drive. The stored data is available to playback for post analysis work. Figure 3 shows an example of Log to USB settings on a DAQ instrument and the saved file exported to Excel for post analysis work.

Figure 3. Log to USB and then export the file to Excel for post analysis work, using DAQ970A

Make High Accuracy Temperature Measurements

Some DAQ systems can accommodate several types of temperature sensors. The most common types of temperature sensors are thermocouples, resistance temperature detectors (RTD), and thermistors. Some DAQs can accommodate all the various temperature sensor types with high resolution down to 0.05°C, depending on the accuracy of the sensor used. If you need very high accuracy, choose an RTD sensor. RTDs has a 4-wire measurement capability which removes long cable errors. The RTD is the most stable of all the sensor types, but it is also the most expensive. Most engineers can settle for 0.1-0.5°C accuracy and tend to choose thermocouple or thermistor sensors. Figure 4 shows a DAQ displaying not only the numerical temperature but also a real-time statistical display, so you can see how much the temperature is varying over time.

Figure 4: Numerical display with real-time statistics, using DAQ970
Setup Alarms to Trigger on Temperature Variations

Some DAQ systems have alarm settings. You can set the *high and/or low limits* for the alarm to trigger. You can also set TTL digital logic alarm outputs to trigger external alarm lights, sirens, or control systems to take corrective action when triggered.

![Figure 5. Temperature exceeding the high limit trigger of an alarm, using DAQ970A](image)

Configure Your Setup and Automate Tests Without Programming

What if you want to configure 120-channels to measure temperature using a specific sensor type, and it takes 30 seconds to set up each channel? It will take you an hour to complete your channel configurations. Some DAQ systems also require external signal conditioning, software drivers, and more. All these demands add up, and the manual effort required can increase the risk of mistakes.

Some DAQs allow you to configure a few channels and then copy the configurations to other channels that are similar. This saves you a lot of time. Based on the above example of configuring 120-channels, you will shave off almost an hour of set up time. By copying the configurations, it will probably take only 5 minutes. Many DAQ systems require textual programming to automate the test. You need programming experience to understand all the input and output channels, driver setups, signal conditioning operations, non-linear sensor corrections, and test sequence programs to generate results in the right format.

Some new DAQ systems can configure inputs and require no external signal conditioning or error correction setup. They also allow scanning procedures and graphical output setup to be done directly on the front panel without any programming required.
Making Non-Temperature Measurements

Whether you choose a dedicated temperature meter, a temperature recorder or a data acquisition system, not all of them come with built-in signal conditioning. Signal conditioning amplifies, attenuates, shapes, or isolates signals from transducers before sending to the measurement hardware. Signal conditioning converts the signal to a form that is better measured by the system, or in some cases, makes it possible to measure the signal at all. Examples of signal conditioning include:

- Amplification of small signals
- Attenuation of large signals
- Thermocouple compensation for temperature measurements
- Filtering to remove system noise

Conclusion

There are many types of temperature measuring instruments. Consider using a DAQ-based temperature data logger that provides

- The flexibility for a considerable number of input channels to make temperature measurements
- The ability to choose the right sensor for your accuracy requirements
- The ability to measure many other types of signals
- Graphical output or export file capability to help you perform post processing and analysis work, without any programming.

Keysight recently introduced the next generation DAQ970A data acquisition system. It provides precision measurements across the widest range of signal types. Speed your development process by providing your engineers test automation without programming and the broadest range of measurement options with industry leading scan and reading rates.

To learn more about the DAQ970A, please visit our website at www.keysight.com/find/DAQ

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