Data Logger Deployment Tips

Introduction

Data loggers and data collection systems are used in countless industries, gathering information that drives informed decisions and unlocks hidden insights. In our years of experience installing and helping customers deploy thousands of these systems, we've learned a thing or two. This article lays out the 10 crucial factors you must consider before embarking on your data logger installation, ensuring your project runs smoothly and delivers the results you were looking for.

Logger Power

One of the first questions I ask when quoting a custom data logging system is how the logger will be powered. Is AC power available or will it need to run on battery? If it is to be battery powered, how long must it run and how often will it be taking a sample; these 2 factors will help determine how big of a battery will be needed. For remote applications, a package with a solar panel, charge controller, and battery may be needed to provide continuous operation. For applications that will AC line power there can be 2 options, use a regular plug-in power supply which may be provided with the logger or use an existing DC power supply which may be present in an equipment cabinet. If you plan to use an existing power supply it is important to know what other equipment is connected to the same supply. Electric motors, heaters, and relays can generate significant noise and voltage spikes which can affect the measurements or, in a worst-case scenario, even damage the data logger.

It's also important to consider if some sort of backup power will be needed. Some loggers are outfitted with internal batteries for backup but if this is not the case, it might be necessary to provide some type of uninterruptable power source (UPS) like those used with a PC to provide backup power for the data logger. Finally, you might want to make sure you have some type of power surge suppressor to protect the data logger from voltage spikes – I've seen more than one logger fried by overvoltage on the power input caused by a power fault or lightning strike.

Environmental Protection

One of the most important things to consider when setting up a logger is if there is any possibility of it being exposed to moisture. Probably the single largest cause of failure we see on units that are sent in for repair is damage due to moisture. Most data loggers are not rated for direct exposure to water or condensation. If there is a chance that the data logger will be exposed to splashing or directed water spray, it must be put in some sort of enclosure to protect it. If you are planning to use the logger outside, it is almost a given that it will need to be put in some sort of box.

Or, will the logger be used in a dusty or dirty environment? Maybe there won't be any moisture around but over time the accumulation of crud inside the logger can cause an electrical leakage path or short circuits. We sold several loggers to a dog food manufacturer and after 3 or 4 years of operation in an environment where they were continually exposed to high levels of dust and when they were sent in for service and calibration we found the circuit boards were completely coated with dirt.

Cable Routing

If you are building a system that will be measuring any low-level voltage signals like those from thermocouples and you will be running the cables any significant distance, the way those cables are routed can determine your ability to get accurate, low noise measurements. A worst-case example that comes to mind is a customer who called our support team concerned that his data logger was defective because his temperature measurements were very noisy changing by a few degrees from reading to reading. They went through the normal troubleshooting procedure and the logger itself seemed to pass its internal self-test. Then they had him connect a short thermocouple directly to the logger and the readings seemed fine. Finally, they asked him about the wiring for his thermocouples and it turns out that the thermocouple wires were several hundred feet long and they were running in conduit bundled with AC power lines.

Connecting Sensors to the Data Logger

It is always a good idea to think about the wiring considerations upfront. Is this going to be a one-time permanent installation where the logger will be connected up to the sensors and left for months or years or will it be used for short-term tests and then disconnected and reused for a different project? Most of the loggers come with screw terminals and if you have to repeat wire and unwire 50 thermocouples it can get tedious. Or maybe this will be for a portable application where it would be nice to have connectors to simplify repeatedly attaching and detaching the sensors. Something as simple as having some terminal strips to land the connections in an orderly way can make a big difference. You can't imagine some of the rat nests of wires we have seen when customers send back a system that they can't get to work.

Grounding and Shielding

If you are looking for accurate, repeatable, low-noise measurements careful attention to grounding and shielding of the signal input wires is very important. Ideally, you'll want to have a high-quality local ground point with a low-impedance connection to earth ground. From this single point, individual connections run out in a star configuration to the earth ground of the data logger and other pieces of equipment.

Try to avoid grounds configured as a tree, for example, connecting all of the shields to the data logger ground and then the data logger ground to the earth ground. Configurations like this can cause noise to be induced in the data logger ground by the currents generated in the shielding wires from external EMI and RFI. It is important to avoid having different pieces of equipment connected to the earth's ground at different points as this can lead to offset voltages and ground loops. Likewise, shields should only be connected at one end – connecting shields at both ends will almost certainly cause ground loops and strange measurement results.

Input Protection

Is there any foreseeable chance that the inputs to the data logger might be subject to a voltage beyond their specifications if a fault occurs or worst case if there is a nearby lighting strike? Some of the worst damage I have seen has been in cases where the data logger was connected to an inductive load like a relay coil, electromagnet coil, or motor, and the load was switched off abruptly. An inductor can store a significant amount of energy in its associated magnetic field when it is in operation. If the power is switched off very quickly this magnetic field will collapse and the associated stored energy has to go somewhere, taking the path of least resistance, which, if it's the data logger, can fry all sorts of components. Adding a Zener diode across the data logger input to clamp the voltage is a cheap way of protecting the input from damage.

Configuring and Programming

It may seem obvious, but spending a little time upfront to plan out exactly what you want to do and taking a few minutes to read the manual to familiarize yourself with the data logger can greatly simplify the task of configuring or programming the data logger. I like to start with a spreadsheet that contains a list of all of the parameters that need to be measured, the sensor type, sensor output signal, wiring, and any scaling that needs to be made. Do any of these measurements need to trigger an alarm that it's out of range? What does the alarm need to do; send an email, trigger a relay, etc.? It's also a good idea to get a handle on how fast you want to sample the different sensors and how much data you want to keep around.

Once you have written down what you are trying to accomplish you can start the programming process. If it's a simple application to just record data from a few inputs with no alarms you can probably configure the logger straight away. However, if it's more involved with lots of inputs with different signal types and maybe some alarms it's best to start small, configure a few inputs, test them out, and make sure they are working as you expect, and then add more testing as you go.

It's a lot easier to debug the program in chunks than to write the whole thing and then find out an assumption about the sensor that you made at the start is incorrect and then have to start over again. For example, maybe the sensor outputs a 4-20 mA signal but it turns out that the data logger needs an external shunt resistor for this measurement. Configuring and testing as you go can immediately reveal problems like this.

On the subject of sample rate, faster is not always better. You want to sample fast enough to capture the changes you are looking for but sampling the temperature of a 500-gallon tank of water every second probably doesn't make any sense; there's no way the temperature could ever change that fast! All this does is end up generating a ton of redundant data that makes it harder to download, analyze, and manage. It's also important to take a look at the specifications of the sensor when deciding on the sample rate. A good example is a humidity sensor which may have a typical time constant (response time) of 30 seconds. Again, why would you sample it every second; there's no way it could respond that fast.

Communication with the Data Logger

It's always a good idea to do a full end-to-end test while setting up the system to make sure you know how to download data and open the file in the analysis tool of your choice, whether it's the one provided with the logger or good old Microsoft Excel. Many loggers will store data in a proprietary format to maximize what can be stored locally but they usually offer some sort of conversion tool to get it into a CSV or text format that can be read by other programs. Make sure you know how you're going to download data, what tool you are going to use to analyze it, and if any special software will be needed to connect these 2. Also, some of the more advanced devices offer different options and formats for how the data is logged.

More advanced data loggers may offer multiple communications options such as USB, Wi-Fi, and Ethernet. A typical issue we routinely run into is a customer that is setting up a system in their shop which will eventually be deployed to the field. While the system is in the shop, they plug the data logger into their Ethernet get the IP address, and do all of the configuration. Then the system is deployed to the field and when they plug in the network cable they can't figure out how to connect to it. The difference is that when the system was in the shop there was a local DCHP server to assign it a network address but once it's in the field there's no server to give it an address. The fix is pretty simple, but if they had considered this upfront the logger could have easily been assigned a static IP address to simplify connection to it in the field. Again, a little thought and planning beforehand can solve a lot of frustration and calls to tech support.

Data Download & Analysis

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Don’t wait until you have weeks’ worth of data stored in the logger and then find that format is missing a critical piece of information that is needed as part of the analysis. Going through the whole process to the point where you have a chart or data table with all of the required information and documenting the procedure will make it much easier down the road, especially if the person doing the download is not the person who set up the data logger.

Commissioning/Testing

The last step in the process is usually the commission set where the data logger is installed in the final location with all of the sensors and “real” data is collected and compared with the expected values. Hopefully, by the time you reach this point, you will have already connected the sensors and done some testing to verify the measurements are working correctly and done a test data download to take a look a the data. Our biggest piece of advice is to make sure that you allow yourself enough time to work through the issues that always seem to arise. Remember Murphy’s Law – what can go wrong will go wrong and always at the worst possible time! I usually try to estimate how long it will take and then double it.

Also, make sure you have whatever documentation (data logger, sensor, etc.) and other equipment you think you might need. A small handheld digital multi-meter (DMM) to measure voltage and current is one of the handiest tools you can have around.

One of the worst experiences I ever had was a call I got late in the day one Friday. This particular customer was in Alaska working on a data logger that was going on a skid with a pump. He had just cracked open the box with his brand new data logger …and the skid had to be on a boat headed to the North Slope on Monday morning. I guess he was an optimist, but waiting until the 11th hour to start the process is just asking for a lot of trouble and frustration.

Summary

I presented a bunch of information on common suggestions we provide to customers installing a data logger for the first time. Here's a brief infographic that summarizes our Do's and Don'ts: