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The Controller

How to troubleshoot a sensor

Troubleshooting is a thought process. A way of looking at a problem, that once developed, can be applied to a wide range of problems. Once you learn to apply the steps to solve an electrical problem, you can apply the same steps and concepts to solving a mechanical problem, a refrigeration problem or a computer programming problem.

I'm going to describe some of these ideas and steps in general terms, then give specific examples to show how they are used.

1. What you observe to be the malfunctioning part may not be the problem at all! A simple example here would be a household lamp. You walk into your house one afternoon after work. You flip the switch, but no light! Your first instinct would be to determine that the lightbulb doesn't work. You would be correct most of the time, but not this time!

2. Think of your problem as a series of steps that must happen one after another in order for things to work correctly. You can think of your steps from the beginning of the process to the observed problem. Or in reverse, start at the problem and work backwards. For our problem, we'll work backwards. Lightbulb, lamp switch, lamp cord, house wiring, wall switch, more house wiring, circuit breaker box, wiring coming into the house, power substation. OK, maybe we don't need to go quite that far back! But you get the idea.

3. Divide and conquer. Pick some point (the middle maybe ?) in your process and observe/measure the input and output of that particular step. Pick a step in the process where you can GUARANTEE you have the correct input. If your input for that step is correct, but the output is not what it should be, you are a lucky man! You just found the problem.
If the output for this step is correct for the input, you are still a lucky man! You have just cut the number of possible problems in half. For our example, you have decided to look at the wall switch. Being the outstanding maintenance man that you are, you pull your screwdriver and

your voltmeter out of your back pocket and go to work pulling the cover plate off the wall switch and check the voltage. There is no voltage on the line side of the switch.

4. Start working forward or backward, one step at a time, until you find a step where your output doesn't respond properly to your input. At this point, you will be fairly safe taking things one step at a time. You go to your circuit breaker box and check the position of all your breakers. You notice that none of your breakers have tripped. You try a couple other light switches and they don't work either. A quick glance around reveals that you don't have any power in your house! You step outside to look at your neighbors houses, they have power. YOU FORGOT TO PAY THE BILL! It's Friday afternoon and you are in for a long weekend without power.

Knowledge about the system you are trouble shooting is invaluable. Obviously, the more you know, the quicker you'll become at tracking down problems. The only way to get experience is to bump your head against a few issues. Don't overlook the information in the system prints. Have your prints in one hand, your meter in the other and your eyes on the hardware when you start tracking down a problem.

Real-world example: A sensor problem

Fortunately, your refrigeration control system has an obvious starting point for tracking down problems. The point where the field wiring lands in the cabinet is a good place to start looking.

But before you break out your voltmeter, there is an easier first step to take, software. Since the focus of this article is a sensor, let's take a look at the value the computer reads from the input module. We are going to look at what is referred to as the raw value. The raw value is a number the computer sees based on the actual voltage (or current) that the sensor is generating. If the raw value is garbage, break out the voltmeter. The obvious question is: How do I know the raw value is garbage? First, let's find the raw value in the software and take a look at it.

From the main screen, press **F1, F1**. Find the analog sensor you want to troubleshoot. You may need to select page down until you find the sensor in question. Click on the sensor you are looking for and you will see the *Analog Signal Setup Utility* screen. In the upper right hand corner of the screen, you will see the words Raw Value: followed by a number. The number will be between zero and 4095. Compare the raw value of the sensor in question to the same type of sensor that is working properly. The two raw values should be close,

especially if the parameters they are reading are close, such as cooler temps or dock temps. I realize you may not always have a convienient comparison to make. A vessel pressure sensor and the discharge pressure sensors are bad examples for comparison. These two sensors are built to cover widely different ranges. Perhaps you can call another facility that has our system and ask them about the raw value for the same sensor.

This article is going to focus on troubleshooting a field wiring problem, so you have determined the raw value is not what it should be.
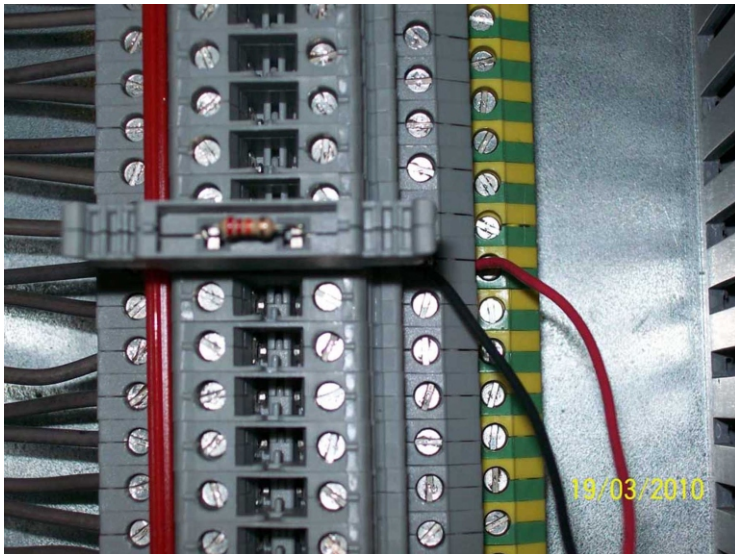
Now that we know there is an issue with the data being fed to the computer, let's start from there and work our way from the computer to the sensor. The problem could be the sensor itself, the transmitter (if applicable) the wiring, the power supply, the fuse (or resistor)... The point is, once you have made a first guess at where to start looking for the problem, you need to re-apply steps **2**, **3**, and **4**.

A little bit of knowledge helps

The system sends out a 24VDC signal (in almost all cases) to each sensor. The sensor sends this signal back to the computer AFTER it has changed the voltage according to the parameter it is reading, such as tempertaure or pressure.

Technically, the sensor is altering the current, but we will focus on voltage, because voltage is easier to measure. Measure the voltage going out

to your sensor. Is it 24VDC? If you don't know where to take this measurement, I'm not going to tell you! Get out your meter, study your prints, look at the wire and equipment in your panel. You'll learn much more than if I just tell you. Here's a hint, look at the picture above. Unfortunately, the fuse, or resistor in this case, is going to make it difficult to measure the 24VDC supply to the sensor. You'll have to pull the fuse and land a jumper wire with the DC supply wire, re-insert the fuse and take your measurement. Are you supplying 24VDC to your sensor? If not, start working backwards to your DC power supply.

If you are sending 24VDC to the sensor, measure the voltage on the return wire. The return wire is landed underneath (middle layer) the signal return wire. The voltage there should be similar to the voltage on a similar sensor, but less than 24 VDC. If you don't see voltage on the signal wire, divide and conquer.

You don't measure any voltage on the signal return wire. By this point, you have an open circuit somewhere. Either the field wiring or the sensor has gone bad. You could go to the sensor, cut the wiring and do a continuity test. Wiring can go bad after a few years, especially if the junction boxes leak and take on water. You could also replace the sensor.

I've mentioned a couple of times through out this article to compare what you are troubleshooting to something you know is working. This is an important idea, and really quite a luxury you don't often have when troubleshooting. When you are troubleshooting something you are not familiar with, look for something similar for comparison. If there are too many unknowns, you won't be able to troubleshoot anything! If you have something to compare with, or have some known good voltage readings, you have some information to help you troubleshoot.

In fact, you may want to take some voltage readings now, while things are working properly. Record what you find and tape your voltage measurements on the inside panel door of your cabinet, right next to your channel assignments. The Controller June 2009.

The idea for this article came from Barry Henderson at Wal-Mart DC 6095 in Opelika Alabama. For Barry's winning suggestion, he will receive, on behalf of Wal-Mart, a MOA switch and a temperature sensor, saving his company $70.00.

A side note to our Wal-Mart Customers. These newsletters should be available on SharePoint.

Troubleshooting Quick Hits

*If you see **err** in the right most column on your valve group screen*. You have a valve group that has not returned to refrigeraton status after a defrost cycle. Click on that valve group and <T>erminate the defrost. That should clear up the issue.

A lag compressor won't start even though the lead compressor before it is loaded up to 100% and the pressure in the vessel is still rising. Go to F5, F4, F7 and select the compressor that is behaving badly. Look in the lower right hand section of the screen. Look at the value on the line that says: Discharge Start Inhibit. Is that value too high for the system that compressor is discharging into?

Access code Update

The section in the software manual explaining the user access codes needs to be updated. The new codes are as follows:

0 - **All access rights** (admin)

1 - **View Only**

2 - **Technical**, application access without programming or users ID and Password access.

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Never trust a computer you can't throw out a window.
Steve Wozniak   Co-founder of Apple Computer
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