# TEMPERATURE DATA LOGGING USING LARVA

This application note describes a production problem and a lab automation solution using Arduino, LArVa and an RTD as a thermal logging solution that costs under $35.

## THE MYSTERY OF THE DENDRIC GROWTH

An Angstrom Designs consulting client experienced a surge in returns of a custom, micro-machined nanostructural component they sold to their customers. Further inspection showed unexpected dendritic growth of a metal portion of the nanostructures during storage. The shelf-life of the nanostructures was radically reduced from just a few months prior and the growth was threatening to halt the company's ability to distribute this critical component.

As happens far too often, many things had changed over the previous several months. The possible culprits included a change to the cases used for storage, multiple iterations of the manufacturing process and storage of the devices in a different part of the warehouse than before.

## SOLVING THE PROBLEM: LOOK AT EVERYTHING

Desperate to track down the problem the company decided to try as many approaches as possible. Because the growth took several weeks to detect, the root cause would have to be determined in as few iterations as possible.

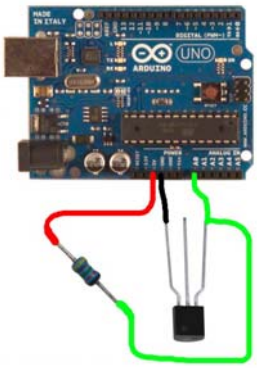
Most of the effort was focused on changes in the final few steps of the nanofabrication and cleaning process. In addition, several of the old-style storage cases were produced so side by side storage tests to could be undertaken to see if the new cases were causing the problem. Finally, knowing the growth occurs faster at high temperatures, the investigation team decided to add storage temperature to its test matrix.

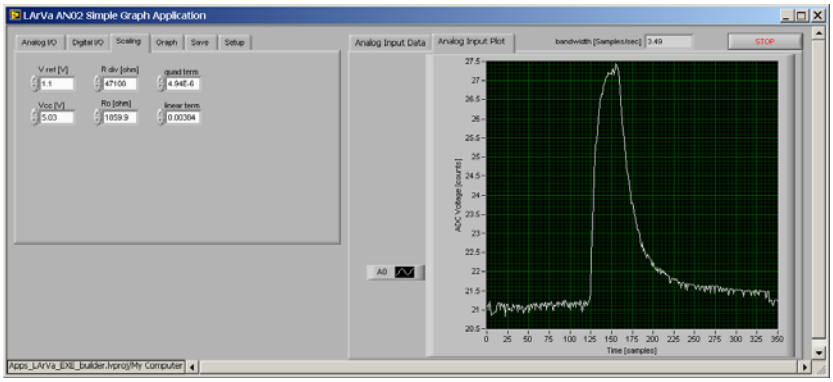
## TEMPERATURE TEST SET-UP

The investigation team decided to do side-by-side testing of the new and old-style storage cases in three different locations: the old storage location, the new storage location and inside a refrigerator.

Because the locations were not close to one another, the team needed three temperature logging stations. Wanting to save money and move quickly, the team decided to use LArVa running on an Arduino with an RTD for sensing temperature. The total cost was less than $100 for all three stations combined and the parts were procured in under a week.

Using the LArVa simple graph application the team monitored all 3 locations at 20 data samples per minute continuously.






## TEMPERATURE TEST RESULTS

The temperature test data showed very interesting results right away. The refrigerator temperature was stable and cold, the old storage location showed slightly elevated temperature readings at night and the new storage location was getting very hot at night.

The team explored why the non-refrigerated location were getting out of the bounds of the warehouse temperature controller and traced the cause back to a change made by the facilities department to disable the controller at night in order to save on heating and cooling. Because the warehouse contained a number of machines that ran at night, the warehouse was heating up without the temperature controller cooling those areas.

The team did not correct the temperature controller issue right away. It was important that the nanofabrication/ cleaning process studies finish as well as the comparison of the new and old-style cases.

## TEST RESULTS

After 3 weeks the team had ample dedritic growth to make some conclusions. The nanofabrication and cleaning process study did not show any substantial contribution to the growth even though the team thought that was the most likely cause. The change to the cases did show some additional growth for the new-style cases, but this effect was significantly smaller than the effect of temperature. The warm temperatures were the most significant cause of the problem.

To deal with the problem immediately, the company decided to store all of the nanostructures in the refrigerator until a follow-on test in a controlled warehouse could be completed. This solved the problem and made production stable again. Longer term studies into the storage cases and storage temperature now had time to proceed because the immediate crisis was solved.

## CONCLUSIONS

This study showed that the initial suspicions of the investigation team are not always correct. The cleaning process and the change in the cases were not the primary causes of the unexpected growth. Using simple and inexpensive data acquisition the team was able to determine and correct the root of the issue and trace it back to something completely unexpected, a facilities policy change in this case. Additionally, the temperature logging systems remain in place so all future temperature deviations will be detected by the production team immediately.

## MORE ON THIS APPLICATION

For all of the technical details on this application, see User Guide UG04: Measuring Temperature For Under $35 Using LArVa at www.AngstromDesigns.com/larva/user-guides.

LArVa is a free driver that turns an under $30 Arduino microcontroller into an ultra-low cost data acquisition system. While spending hundreds, thousands or more dollars on data acquisition system is necessary in some cases, inexpensive data acquisition can do a lot for very little. In this case, Arduino, LArVa and a basic RTD were enough to find a very illusive problem.

For more applications, user guides, help, questions or to download LArVa for free, go to www.AngstromDesigns.com. If you have an application that you would like to share, please contact us at www.AngstromDesigns.com/contact and we would gladly partner with you.

For corporate security reasons, the Angstrom Designs client company name, product information, photographs and data have been intentionally omitted.