# Data Logger Optimization for SCH Magnet

**Noah Fuentes**
University of North Florida, Jacksonville, FL 32224

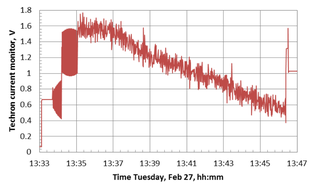
## Introduction

At the National High Magnetic Field Laboratory, there is a Series-Connected Hybrid magnet that can be used for NMR spectroscopy. This magnet contains a superconducting coil outer layer that is connected in series to a resistive magnet inner layer. Through testing of the drift of the magnetic field, the magnet would periodically trip due to power equipment related switching.

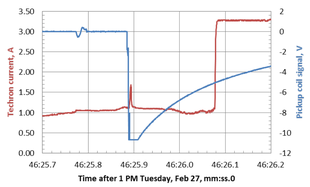
In order to record the data to monitor this issue, they used a data logger programmed in LabVIEW. Overtime they found that if the logger was left running for a period of time, it would sometimes crash.

## SCH Magnet Trips

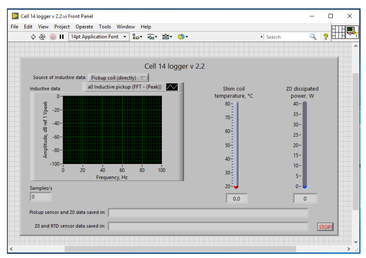
One of the sensors on the original logger was used to record Techron current monitor. On February 27th, the original logger was able to record this data (Figure 1) from a trip related to switching on power equipment at a slow rate.




The logger was also able to record the trip at a faster rate from the Techron current monitor sensor and the pick-up coil sensor (Figure 2).




This trip at time 13:46:25.8 was a good representation of a typical trip. In order to better analyze these trips the logger needed to be better equipped to monitor the drift and the trips without crashing.




Pictured above is the original logger used to record this trip on February 27th (Figure 3).

## Original Logger

The original logger had two main functions: reading data and recording it to previously named files. For reading the data, the logger had four different sensors and could read and display the data at a high samples per second rate. Although, if the logger was running for an extended period of time, it would eventually crash without showing a reason and would lose any data that was picked up after the crash.

Needed:

- An additional trigger sensor for timed recording
- Control over what to name the files
- A way to back up the files while recording to ensure no loss of data
- A fix for the crashing bug
- Rearranging of the program to make it more user friendly

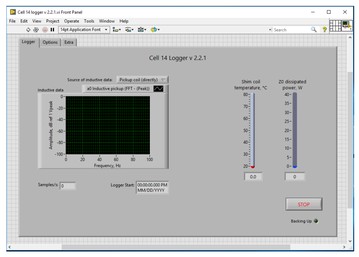
## Error Handling

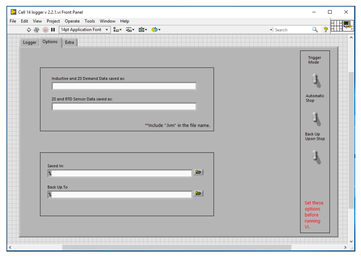
After analyzing the code associated with reading data I noticed that the program had a buffer between reading data and recording it. Because the logger was reading at such a fast pace, it couldn't record enough data to keep up so the buffer would slowly grow overtime. Once the buffer got too big, the logger would crash.

To fix this buffer error, I wrote code to adjust where in the buffer the logger should record data from based on how large it was that moment. This way, if the buffer started getting too big it would record more recent data that was read and catch up.

## Final Logger

Once finished, the logger was used with the SCH magnet and ran without errors (Figure 4 & 5).

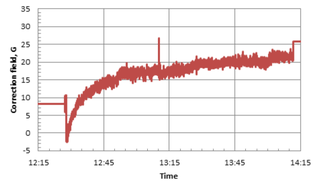


## Results

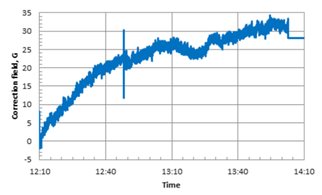
On July 3rd, data was able to be captured by the final logger regarding the drift of the magnet (Figure 5).

July 3, Temperature Regulation On Sensing Resistor is On




On July 5th, more data was recorded of the drift (Figure 6).

July 5, Temperature Regulation On Sensing Resistor is Off




In addition to better monitoring the drift without crashing, if there were anymore trips related to switching on of power equipment, the final version of the logger would be able to monitor that as well.

## Conclusion

The SCH magnet that can be used for NMR spectroscopy had a data logger to monitor the drift of the magnetic field. While recording data, there were unexpected trips not due to NMR equipment and the logger would crash after a certain period of time. The logger was then optimized to better monitor the drift and any unexpected trips without error. In addition, the logger has an easier interface for the user.

## Acknowledgements

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