



## Q&A: Thermal characterization of batteries using heat flux sensors

### What kind of data logger do I need for my measurements?

For high resolution measurements, you need a data logger which can resolve at least 1 $\mu$ V. For synchronized measurements (for example channel 1 cell voltage, channel 2 heat flux voltage measurement) it is often useful to plug the sensor to the A channel of the multichannel potentiostat.

### How do I mount the heat flux sensor?

Important when attaching the sensor to the battery surface is optimal thermal connection. We therefore recommend cleaning the surface of the sensor and the battery with Isopropanol. Then the sensor can be attached by either a double side sticky thermal tape, or by pressing the sensor to the surface using thermal paste or by gluing the sensor to the surface with a thermally conductive epoxy. The sensor needs to be removed carefully. Do not pull at the flex-print! It is better to remove the sensor by a blade and Isopropanol.

### Which sensor is better, the XM or the XP?

This depends on the application. The advantage of the XM sensor is its small size of 4mm x 4mm, while with the larger XP sensor a higher resolution can be obtained (below 0.09W/m<sup>2</sup>). We propose that you test both so you can find out which one is best suited for your application.

### Can the sensor be used in water?

We have done several experiments in deionized water without any problems. The highly accelerated stress tests at a humidity of 85% and a temperature 125°C for 100h do not show any sensor degradation.

### Could the sensor be used inside the battery?

We do not have any experience with this kind of experiments yet. You can try to do tests at your own risk. However the sensor is very robust against chemicals. For this kind of experiment we suggest to seal the borders and the contacts of the sensors with chemically stable glue. If you need a longer flex-print for insertion into the battery, just ask for an additional flex-print. You can attached this flex print to the flex-print of the sensor by using a solder paste, pressing the tow contacts onto each other and heating it with a solder gun from top. Please make sure that you seal the position of the connection also by chemical inert glue.

### How are the sensors calibrated?

The sensors are calibrated in a special measurement setup using NIST traceable thermal reference materials. For further information see: <http://scitation.aip.org/content/aip/journal/rsi/83/7/10.1063/1.4737880>

Please do not hesitate to contact us at [info@greenTEG.com](mailto:info@greenTEG.com) if you have any questions.