



## Books & Reports

### **Battery Cell Voltage Sensing and Balancing Using Addressable Transformers**

A document discusses the use of saturating transformers in a matrix arrangement to address individual cells in a high-voltage battery. This arrangement is able to monitor and charge individual cells while limiting the complexity of circuitry in the battery. The arrangement has inherent galvanic isolation, low cell leakage currents, and allows a single bad cell in a battery of several hundred cells to be easily spotted.

The system is divided up into the battery cell array, the monitoring array, and the battery voltage sensing and balancing system. The battery cell array is the parallel/series connection of cells that store electrical energy. The monitoring array is the set of diodes, transformer cores, and interconnecting wires that allow the voltages of individual cells to be measured, and for the small amounts of charge to be put in individual cells as desired. In the battery voltage sensing and balancing system, the circuitry connects to the monitoring array and provides the pulses to do sensing and charging. It is separate from any main charge system. Electrical isolation is intrinsic to the design and there is no fusing necessary on sense wires.

Maximum array size is set by wire resistance and parasitic inductances in the sense winding loop that would cause

waveform degradation. In practice, an array of several hundred cells could be monitored. Charge current is limited to a few hundred milliamperes, suitable for balancing cells after a main charge system is complete. Measurement accuracy is limited by leakage inductance in the cell/diode/core loop as well as in the sense winding loop. The length of the cable between the battery and the control electronics is limited by series resistance in the cable as well as inductance that degrades the shape of the measurement pulses.

*This work was done by Francis Davies of Johnson Space Center. Further information is contained in a TSP (see page 1).*

*This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-1003. Refer to MSC-24466-1.*

### **Gaussian and Lognormal Models of Hurricane Gust Factors**

A document describes a tool that predicts the likelihood of land-falling tropical storms and hurricanes exceeding specified peak speeds, given the mean wind speed at various heights of up to 500 feet (150 meters) above ground level. Empirical models to calculate mean and standard deviation of the gust

factor as a function of height and mean wind speed were developed in Excel based on data from previous hurricanes. Separate models were developed for Gaussian and offset lognormal distributions for the gust factor. Rather than forecasting a single, specific peak wind speed, this tool provides a probability of exceeding a specified value. This probability is provided as a function of height, allowing it to be applied at a height appropriate for tall structures.

The user inputs the mean wind speed, height, and operational threshold. The tool produces the probability from each model that the given threshold will be exceeded. This application does have its limits. They were tested only in tropical storm conditions associated with the periphery of hurricanes. Winds of similar speed produced by non-tropical system may have different turbulence dynamics and stability, which may change those winds' statistical characteristics.

These models were developed along the Central Florida seacoast, and their results may not accurately extrapolate to inland areas, or even to coastal sites that are different from those used to build the models. Although this tool cannot be generalized for use in different environments, its methodology could be applied to those locations to develop a similar tool tuned to local conditions.

*This work was done by Frank Mercet of Kennedy Space Center. Further information is contained in a TSP (see page 1).KSC-13347*