

## Formula Hybrid 2016 Program

### Linear Technology BMS Product Overview

Linear Technology is a manufacturer of high performance analog semiconductors. Included in this portfolio is the LTC6804 Battery Stack Monitor, an analog front-end for high performance Battery Management Systems. An LTC6804 can measure up to 12 series connected battery cells at voltages up to 4.2V with 16 bit resolution and better than 0.04% accuracy.

When stacked in series, the LTC6804 enables the measurement of every battery cell voltage in large high voltage systems. Six operating modes are available to optimize update rate, resolution and the low pass response of the built-in 3rd order noise filter. In the fastest mode, all cells can be measured within 290µsec. Multiple LTC6804s can be interconnected over long distances and operated simultaneously, using Linear Technology's proprietary 2-wire isoSPI™ interface.

Every LTC6804 includes an integrated isoSPI interface to provide high RF noise immunity up to 1Mbps. The isoSPI interface support transmission of distances up to 100meters, using only twisted pair and a simple pulse transformer. Drive currents and signal thresholds are configured with two resistors, allowing the system to be optimized for cable length and signal-to-noise performance. To interface isoSPI with an external SPI device, such as a microprocessor, use Linear Technology's LTC6820 isoSPI transceiver. The LTC6820 is a companion to the LTC6804 that translates between isoSPI and SPI (Serial Peripheral Interface bus).

Two communication options are available. Using the LTC6804-1, multiple devices are connected in an isoSPI daisy chain with one host processor connection for all devices. Using the LTC6804-2, multiple devices are connected in parallel to the host processor with each device individually addressed. The LTC6804 was designed to minimize power consumption, especially during long-term storage where battery drain is unacceptable. In sleep mode, the LTC6804 draws less than 4µA from the batteries. General purpose I/O pins are available to monitor analog signals, such as current and temperature, and can be captured simultaneously with the cell voltage measurements. Additional features include passive balancing for each cell with a programmable balancing timer for up to 2 hours, even when the LTC6804 is in sleep mode. The LTC6804 interfaces with external I2C devices such as temperature sensors, ADCs, DACs and EEPROM. Local EEPROM can be used to store serialization and calibration data, enabling modular systems.

The LTC6804 is fully specified for operation from -40°C to 125°C and includes a full set of self-tests to ensure that there are no latent fault conditions. To accomplish this, the LTC6804 includes a redundant voltage reference, extensive logic test circuitry, open wire detection capability, a watchdog timer and packet error checking on the serial interface. The LTC6804 is offered in a small 8mm x 12mm surface mount device and the LTC6820 is offered in an MSOP and tiny QFN package

[www.linear.com/product/LTC6804](http://www.linear.com/product/LTC6804)

[www.linear.com/product/LTC6820](http://www.linear.com/product/LTC6820)

## Linear Technology Demo Systems

Linear Technology will provide Formula Hybrid teams with LTC6804-1 or LTC6804-2 demo-systems for their test and evaluation. Since each LTC6804 demo board can be monitor up to 12 cells, the total number that you require will depend on the number of battery cells in your system. The following overview can be used to determine your requirements:

<b>Part Number</b>	<b>Description</b>
<b>DC1894B</b>	<p>LTC6804-1 Demo Board. Each DC1894B can monitor up to 12 series battery cells. Multiple DC1894B can be daisy-chained using isoSPI, a 2-wire isolated serial interface. The interconnections are made using simple RJ45 terminated Ethernet patch cables. Communication to a PC is accomplished via the DC1941C (isoSPI translator) and the DC2026B (Linduino One). Descriptions of these boards are provided below. A PC-based Graphical User Interface (GUI) is available online.</p> <p>For demo board and GUI information: <a href="http://www.linear.com/solutions/4074">http://www.linear.com/solutions/4074</a></p>
<b>DC1942C</b>	<p>LTC6804-2 Demo Board. Each DC1942C can monitor up to 12 series battery cells. Multiple DC1942C can be connected in parallel using isoSPI, a 2-wire isolated serial interface. The interconnections are made using simple RJ45 terminated Ethernet patch cables. Communication to a PC is accomplished via the DC1941C (isoSPI translator) and the DC2026B (Linduino One). Descriptions of these boards are provided below. A PC-based Graphical User Interface (GUI) is available online.</p> <p>For demo board and GUI information: <a href="http://www.linear.com/solutions/4751">http://www.linear.com/solutions/4751</a></p>
<b>DC1941C</b>	<p>LTC6820 isoSPI Demo Board. The DC1941C is an isoSPI to SPI translation board that allows a SPI based device to interface to the LTC6804 stack. Typically, the SPI is provided by a microprocessor, such as the DC2026B Linduino One.</p> <p>For demo board and GUI information: <a href="http://www.linear.com/solutions/4407">http://www.linear.com/solutions/4407</a></p>
<b>DC2026B</b>	<p>Linduino One. An isolated Arduino-Compatible Demonstration Board that can act as the microprocessor interface to an LTC6804 stack. The Linduino One can be used to control the LTC6804 stack and can be interfaced to a PC for code development. Linduino One support and LTC6804 code is online:</p> <p>For demo board and Linduino information: <a href="http://www.linear.com/linduino">http://www.linear.com/linduino</a></p>

Support material for these Demo Boards, such as software, source code, bill of materials, schematics, and PCB design files can be downloaded from the Linear Technology website.

## **Linear Technology Integrated Circuits**

Linear Technology will provide Formula Hybrid teams with LTC6804 and LTC6820 ICs for their final BMS design. Linear Technology may provide other ICs upon request, at their discretion.

As a producer of high performance analog Integrated Circuits, Linear Technology offers a broad range of products for automotive applications. This includes active balancing, current sensing, power regulation, isolation, and more. See the Linear Technology Automotive Products brochure for a complete overview:

<http://www.linear.com/docs/5206>

### **Requesting Demo Boards / Parts**

Each request must be accompanied with a UPS or FEDEX account number to cover shipment costs. Each team has a demo board and part quantity limitation. For more information and to request parts, please contact:

**Greg Zimmer**

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Email: [gzimmer@linear.com](mailto:gzimmer@linear.com)