

# LTC6801

## Multicell Li-Ion Battery Monitor

### DESCRIPTION

Demonstration circuit 1469 is a Multicell Li-Ion Battery Monitor featuring the LTC6801. This circuit autonomously detects individual over- and under-voltage conditions on up to twelve series connected Lithium-Ion cells and two temperature limits using suitable sensors. Pin-strapping establishes the cell-count to monitor, the threshold for OV, threshold for UV, alarm hysteresis, and measurement interval. A square-wave is used to excite the alarm circuit, and a returned signal duplicates this if no alarms are present, but returns a static signal when a fault condition is present. The circuit also provides a means of cascading numerous monitors together so that very large series connected arrays of cells can be monitored simultaneously.

Additional support features are provided on the demo circuit, including a digital excitation source and an alarm indicator LED, so that stand-alone evaluations can be performed. Jumpers are provided to provide for local signal loop-back and to activate the desired support circuits.

The following table indicates the performance and control ranges of the LTC6801.

**Design files for this circuit board are available. Call the LTC factory.**

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### PERFORMANCE SUMMARY

Specifications are at TA = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V <sub>IN</sub>	Total Input Supply Range	Total potential of series-connected cells	10		60	V
I <sub>QS</sub>	Supply Current, Idle	Current into V+ pin when idle			20	μA
I <sub>M</sub>	Supply Current, Measuring	15ms (Continuous)		1000		uA
		130ms		300		
		500ms		90		
N	Number of cells monitored	9 strappable choices	4		12	Cells
V <sub>UV</sub>	Individual cell under-voltage threshold	9 strappable choices	1.34		2.88	V
V <sub>OV</sub>	Individual cell over-voltage threshold	9 strappable choices	3.74		4.51	V
HYS <sub>UV</sub>	Individual cell under-voltage alarm hysteresis	3 strappable choices	0		500	mV
HYS <sub>OV</sub>	Individual cell over-voltage alarm hysteresis		0		200	mV
T <sub>CYCLE</sub>	Measurement Cycle Time	3 strappable choices	15		500	ms
VERR	Measurement Error		-1		+1	%
TEMP <sub>OP</sub>	Operational Temperature Range		-40	+25	+85	°C
TEMP <sub>LIM</sub>	Temperature Alarm Limit	Set by on-board thermistors	-20	+25	+60	°C
F <sub>IN</sub>	Alarm Enable Input Frequency	Digital Square-wave	1	10	50	kHz

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## OPERATING PRINCIPLES

The LTC6801 accepts a differential logic enable input EIN and duplicates it on EOUT to drive a cascaded LTC6801 EIN port. A differential logic sense input SIN receives a signal the same as EOUT (but usually from a cascaded LTC6801) and performs a phase detection function. When the phase detection finds a good correlation AND no alarms are detected, the EIN signal propagates to the SOUT of the LTC6801 and can drive the SIN port of an LTC6801 lower in the cascade. For a single LTC6801, the EOUT signals are simply looped-back to the SIN port and the SOUT signal is used to determine the alarm state. Logic signals passing between cascaded LTC6802 devices are ac-coupled to provide dielectric isolation. On the DC1469A, the coupling is performed by 500V-rated capacitors.

DC1469A provides an on-board 10kHz oscillator that can be jumper configured to activate and drive the local EIN.

In a cascaded arrangement of demo circuits, only the bottom-of-stack unit would be so configured, and only in the event that an external stimulus wasn't available. The oscillator must be disabled to demonstrate minimum power (i.e. in the idle condition).

An LED indicator circuit is also provided to allow visual indication of the alarm condition. If activated by the jumper configuration, the green indication shows that all measurements are within normal limits. Since the LED consumes a few milliamperes, the feature should be disabled to demonstrate lowest battery drain.

Connectors are provided to interconnect multiple DC1469A boards in cascade. Ribbon cables perform the "daisy-chain", and jumpers allow configuring the cascade connection as a loop-back for the top-of-stack unit.

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## QUICK START PROCEDURE

Demonstration circuit 1469 is easy to set up to evaluate the performance of the LTC6801. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions:

**JP1-5** GND position (horizontally)

**JP6,7** VREG position (horizontally)

**JP8** GND position (horizontally)

**JP9** Both shunts in LOOP position (horizontally)

**JP10** DIFF position

**JP11** ON position

**JP12** Both shunts in OFF position (horizontally)

2. J1 is a two-piece connector. The removable section has the screw-clamp array, and may have been shipped either mated, loose, or parked on the pass-through fingers at the right edge of the board. This

connector allows for quick assembly of a wire-harness to a cell array (or cell array simulator). If such harnessing or cell-simulator has already been set up to work with other Linear battery monitor demo circuits (DC1331 for example), the movable part may be clamped to the DC1469 battery pass-through fingers to form a simple "extender" assembly. The harness connects to taps in the cell array, supporting 4 to 12 cells of monitoring. For cell-counts less than 12, the topmost contact must share a connection with the uppermost cell potential of the group to properly power the LTC6801, and JP6 and JP7 reconfigured accordingly.

3. Connect a complementary differential logic-signal pair to EIN and EIN/. The signals should be 0-5V swings at 1kHz to 50kHz, referred to the V- turret. For ac-coupling the inputs, the connections can alternatively be made at J2 pins 6 & 7 (or the nearby vias for C15 & C16). For production LTC6801, it is

also possible to provide single-ended signaling to EIN by setting EIN/ to a mid-level voltage by placing the JP10 jumper to the SE position. Additionally, a single-ended 10kHz oscillator is provided that can be powered and connected to EIN by placing the two JP12 jumpers to the ON position.

4. Turn on the power at the cell simulator, and adjust to about 3V per cell (i.e. 36V for 12 cells).

**NOTE.** Make sure that the total input potential does not exceed 60V. Individual cell potentials must not exceed 6V or protective Zener diodes will conduct.

5. The LED should illuminate, indicating that the monitor is detecting nominal operating conditions. SOUT will be a square wave like that furnished to EIN (SOUT/ is the complement of SOUT).

6. Vary the cell simulator supply to see the alarm condition occur (LED dark and SOUT low). For the settings given, thresholds are at about 16V and 45V for the total 12-cell potential. Refer to the datasheet and schematic diagram (see Figure 2) for specific configurations of other thresholds and parameters that may be of interest.
7. If multiple DC1469 assemblies are being evaluated, they may be cascaded by attaching a ribbon from J3 to the J2 of another board. Board(s) with a ribbon attached to J3 must have JP9 jumpers relocated to the LINK position (horizontally). Board(s) with a ribbon attached to J2 must have JP10 set to DIFF and JP12 jumpers in the OFF position (vertically) or removed.

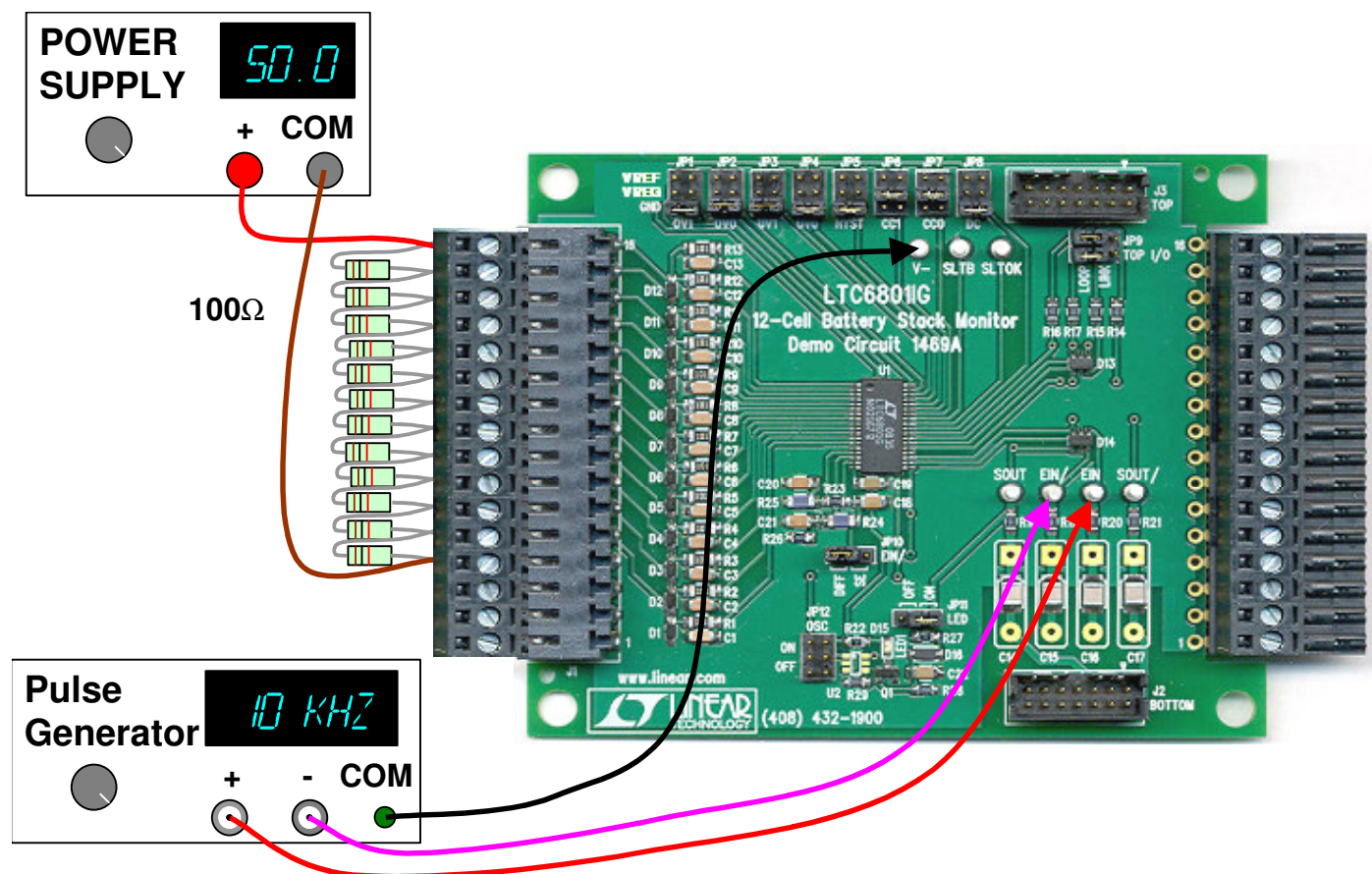
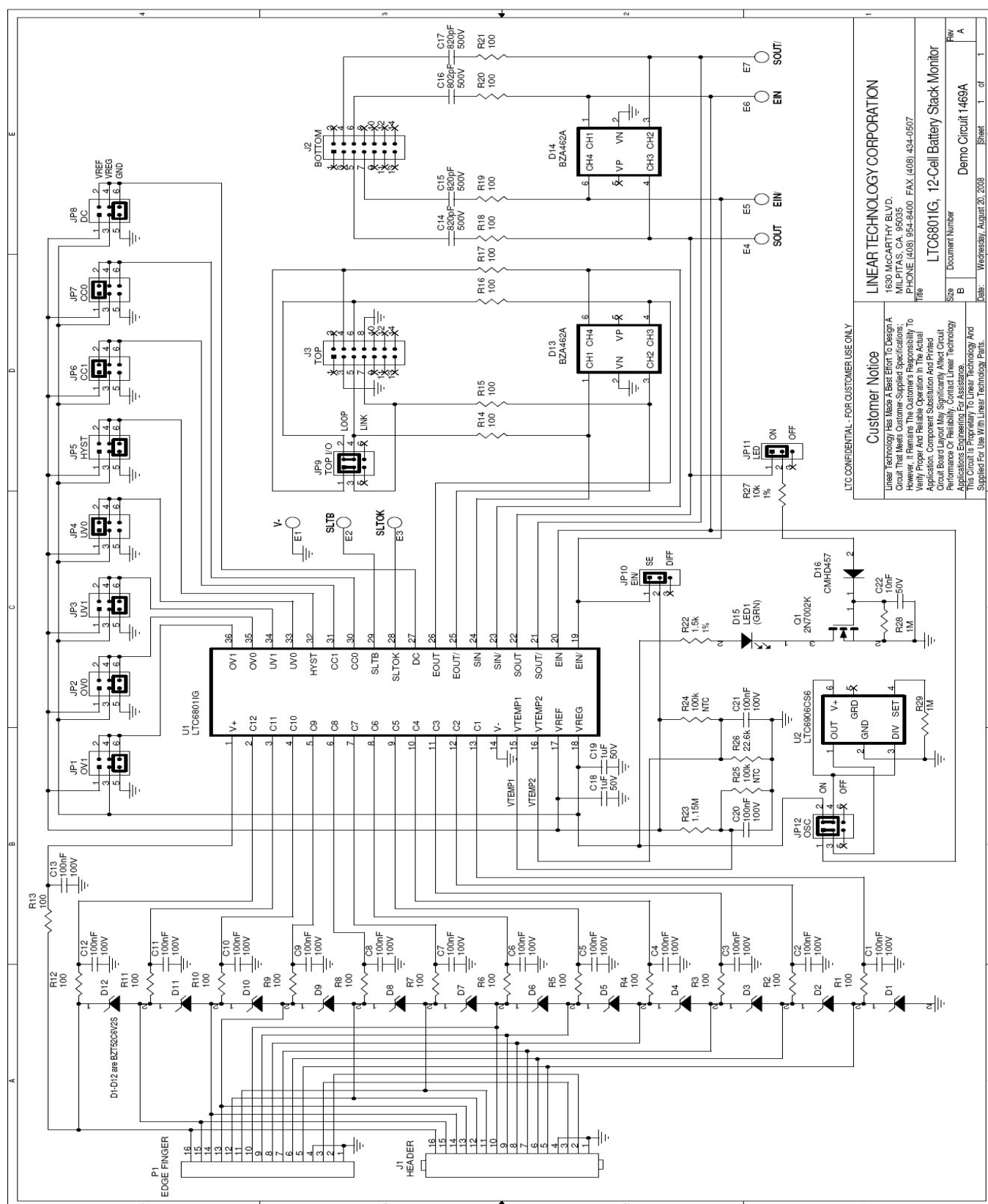


Figure 1. Proper Evaluation Equipment Setup.



**Figure 2. Schematic of DC1469A.**