

LTC4009-2
Multicell Li-Ion Battery
Charger Board

DESCRIPTION

Demonstration circuit 1104B is a single-battery stand-alone charge controller with built-in charge termination featuring the LTC[®]4009-2. The input voltage is 13.5V to 20V. The charger output voltage is programmed by jumpers to support 1-, 2-, 3- and 4-cell Li-Ion batteries with a cell voltage of 4.2V/cell. The maximum charge current is 2A. The demo board is initially configured for 12.6V Li-Ion batteries. The board will automatically charge a battery as soon as input power is applied with a battery connected prior to power up. Status LEDs are provided for CHG, ACP, C/10, and ICL although this charger is not a smart battery charger, a popular smart battery connector is provided that can be used for data-logging with the optional DC410

demo board and software. To be clear, you do not need a smart battery to use this board. The optional DC410 SMBus-to-Serial port adapter and associated software is to monitor a smart battery for demonstration purposes only. Contact your Analog Devices representative for ordering a DC410.

This demo board is capable of supporting the LTC4009 and LTC4009-1 with a simple IC swap out. See schematic.

Design files for this circuit board are available at
<http://www.linear.com/demo/DC1104B>

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PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

| PARAMETER | CONDITIONS/NOTES | VALUE |
|--------------------------------|---|--|
| Maximum Input Voltage | Limited by Input Capacitor Volt Ratings | $20\text{V} \pm 10\text{ \%}$ |
| Default Battery Charge Voltage | Jumper Selectable: 4.2V, 8.4V, 12.6V and 16.8V | 12.6V |
| Minimum Input Voltage | $V_{IN} > V_{BAT}$ Termination Voltage and DCDIV > 1.2V | 13.5V When Using a 12.6V Li-ion Battery Recommend 15V |
| Shutdown Configuration | $V_{IN} > V_{BATMAX} > 6\text{V}$, Jumper Selectable: OFF, THM and ON | ON |
| Input Current Limit | Set by Value of R2 at 100mV | 2A Using a 0.05Ω Resistor |
| Maximum Charge Current | $V_{IN} > V_{BAT} > 6\text{V}$ and DCDIV > 1.2V | $2\text{A} \pm 5\%$ |

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QUICK START PROCEDURE

1. Connect the input power source to V_{IN} terminals J1 or V_{IN} and GND using a power supply capable of handling 2.5A of current within a 13.5V to 20V range. The input supply voltage must be greater than the full voltage value of the battery to allow a full charge to take place.
2. Connect the load to V_{OUT} and GND terminals.
3. Configure the jumpers for your specific battery.
4. Plug in the battery. Industry-standard 5-pin AMP smart battery connector is provided as well as generic soldering test points for hard-wire connections.
5. Turn on the input power supply.
6. Optionally use the provided DC410 demonstration software to configure and communicate with the DC1104B.

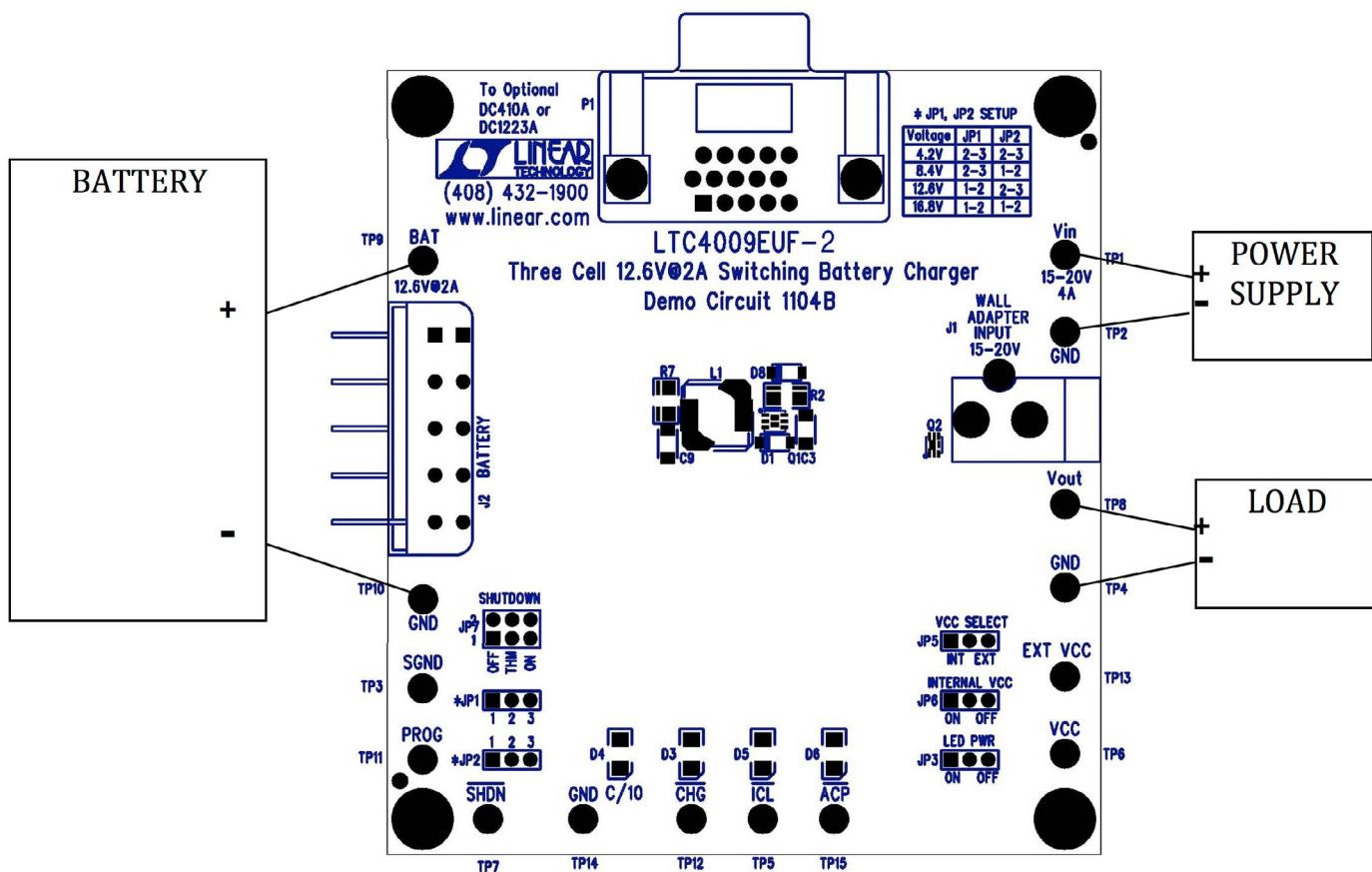


Figure 1. Optional DC410 SMBUS to Serial Adapter, Provides Data Logging and Control Battery

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PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|-----|----------------------------|---|-------------------------------|
| Required Circuit Components | | | | |
| 1 | 1 | C1 | CAP, ALUM 10 μ F, 35V, 5X6.0 SIZE | SUNCON, 35CE10AX |
| 2 | 5 | C2, C8, C11, C14, C16 | CAP, X7R, 0.1 μ F, 50V, 10% 0603 | TDK, C1608X7R1H104K |
| 3 | 1 | C12 | CAP, X7R, 0.1 μ F, 16V, 10% 0402 | TDK, C1005X7R1C104K |
| 4 | 2 | C3, C9 | CAP, X5R, 10 μ F, 25V, 20% 1206 | TAIYO YUDEN, TMK316BJ106ML |
| 5 | 1 | C6 | CAP, X7R, 4.7nF, 50V, 10% 0402 | TDK, C1005X7R1H472K |
| 6 | 1 | C7 | CAP, X5R, 2.2 μ F, 16V, 20% 0805 | TDK, C2012X5R1C225M |
| 7 | 1 | C13 | CAP, TANT 10 μ F 16V 20% 3828 | AVX TAJB106M016 |
| 8 | 1 | C15 | CAP, X7R 1 μ F 25V 10% 1206 | AVX 12063C105KAT |
| 9 | 2 | D1, D8 | SCHOTTKY RECT, MBR230LSFT1 SOD-123FL | ON SEMI, MBR230LSFT1G |
| 10 | 2 | D3, D5 | LED, AMBER | ROHM SEMI, SML-010DTT86M |
| 11 | 2 | D4, D6 | LED, GREEN | ROHM SEMI, SML-010FTT86L |
| 12 | 1 | D7 | DIODE, CMDSH-3, SOD-323 | CENTRAL SEMI, CMDSH-3TR (PBF) |
| 13 | 1 | L1 | INDUCTOR, 10 μ H, CDR7D28MN SERIES | SUMIDA, CDR7D28MNNP-100 NC |
| 14 | 1 | Q1 | DUAL-N-CH FET, SiA914ADJ, POWERPAK SC-70-6 | VISHAY, SIA914ADJ-T1-GE3 |
| 15 | 1 | R1 | RES, CHIP, 5.11k, 1/16W, 1% 0603 | VISHAY, CRCW06035K11FKEA |
| 16 | 2 | R2, R7 | SENSE RES, LRC, 0.05, 0.25W, 1% 1206 | VISHAY, WSL1206R0500FEA |
| 17 | 2 | R5, R15 | RES, CHIP, 100k, 1/16W, 5% 0402 e3 | VISHAY, CRCW0402100KJNED |
| 18 | 2 | R8, R9 | RES, CHIP, 3.01k, 1/16W, 1% 0402 | VISHAY, CRCW04023K01FKED |
| 19 | 1 | R12 | RES, CHIP, 6.04k, 1/16W, 1% 0402 | VISHAY, CRCW04026K04FKED |
| 20 | 1 | R16 | RES, CHIP, 165k, 1/16W, 1% 0402 e3 | VISHAY, CRCW0402165KFKED |
| 21 | 1 | R26 | RES, CHIP, 26.7k, 1/16W, 1% 0402 | VISHAY, CRCW040226K7FKED |
| 22 | 2 | R27, R31 | RES, CHIP, 10, 1/16W, 5% 0603 | VISHAY, CRCW060310R0JNEA |
| 23 | 1 | R29 | RES, CHIP, 12.4k, 1/16W, 1% 0402 | VISHAY, CRCW040212K4FKED |
| 24 | 1 | R30 | RES, CHIP, 10k, 1/16W, 5% 0603 e3 | VISHAY, CRCW060310K0JNEA |
| 25 | 1 | R33 | RES, CHIP, 1.21k, 1/16W, 1% 0402 e3 | VISHAY, CRCW04021K21FKED |
| 26 | 1 | U1 | IC LTC4009CUF-2, QFN-20(4x4) | LINEAR TECH, LTC4009CUF-2#PBF |
| 27 | 1 | U2 | IC LT1129CS8-5 SOS | LINEAR TECH, LT1129CS8-5#PBF |
| Additional Demo Board Circuit Components | | | | |
| 1 | 1 | D2 | DIODE, MMSZ5248BS, SOD-323 | DIODES INC, MMSZ5248BS-7-F |
| 2 | 1 | Q2 | P-CH, 60V, Si4431CDY-T1-GE3, S08 | VISHAY, Si4431CDY-T1-GE3 |
| 3 | 1 | R25 | RES, CHIP, 100k, 1/16W, 5% 0402 e3 | VISHAY, CRCW0402100KJNED |
| 4 | 0 | (U1 OPTION) | IC LTC4009CUF-1, QFN-20(4x4) | LINEAR TECH, LTC4009CUF-1#PBF |
| 5 | 0 | (U1 OPTION) | IC LTC4009CUF, QFN-20(4x4) | LINEAR TECH, LTC4009CUF#PBF |
| 6 | 0 | R17 (FOR 4009CUF ONLY) | RES, CHIP, 31.2k, 1/16W, 025% 0402 e3 | |
| 7 | 0 | R18 (FOR 4009CUF ONLY) | RES, CHIP, 0, 0402 e3 | |
| 8 | 0 | R19 (FOR 4009CUF ONLY) | RES, CHIP, 294k, 1/16W, 0.25% 0402 e3 | |
| 9 | 0 | L1 (OPTION) | INDUCTOR, 10 μ H, IHLP-2525CZ-01 SERIES | VISHAY, IHLP2525CZER100M01 |
| 10 | 0 | C5 (FOR U1 = 4009CUF ONLY) | CAP, COG, 10pF, 50V, \pm 0.5pF 0402 | |

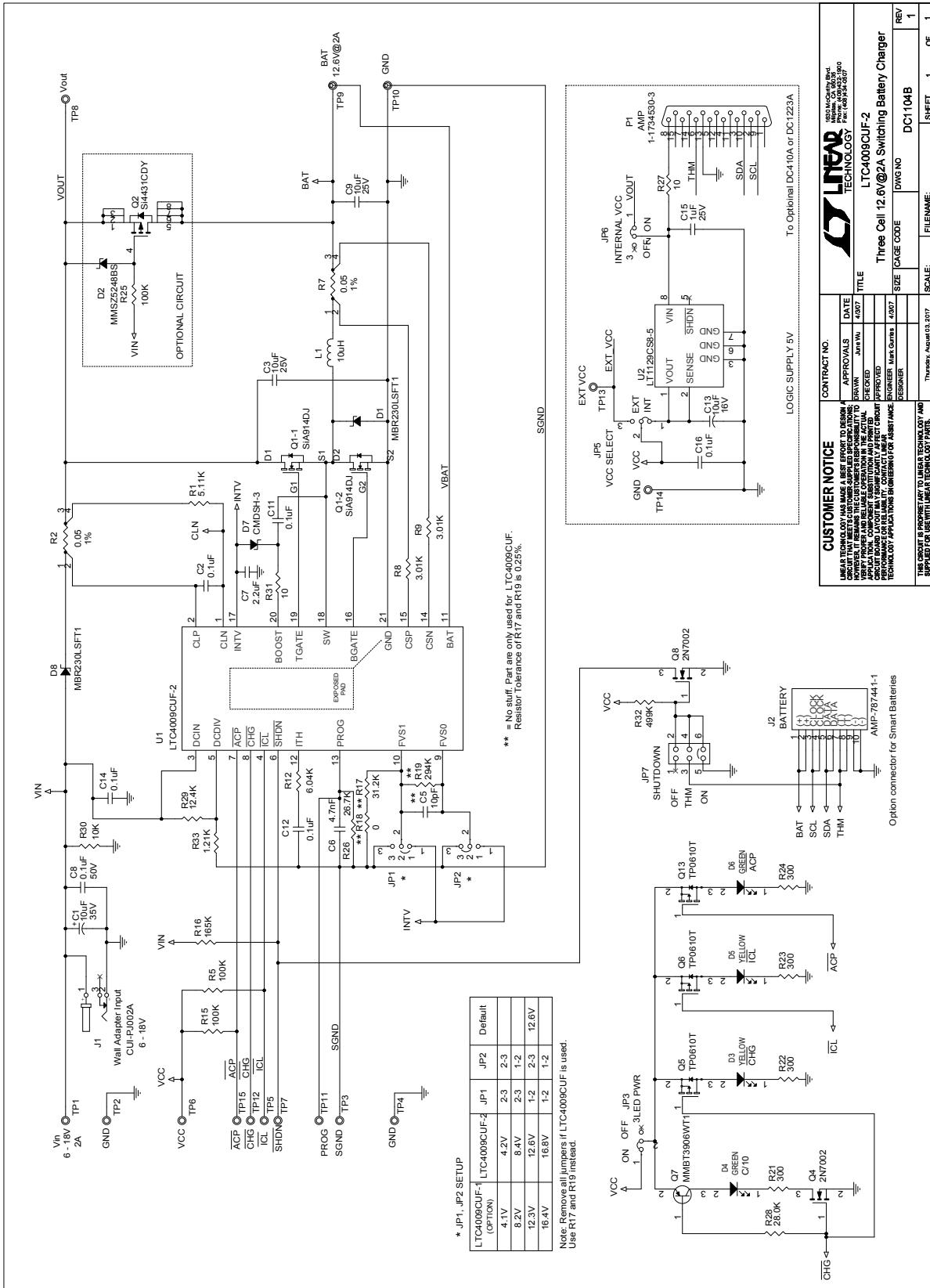
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PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|--------------------------------------|-----|------------------------|------------------------------------|-----------------------------------|
| Hardware: For Demo Board Only | | | | |
| 1 | 15 | TP1 TO TP15 | TESTPOINT, TURRET, 0.061" | MILL-MAX, 2308-2-00-80-00-00-07-0 |
| 2 | 1 | J1 | CONNECTOR | CUI-STACK, CUI-PJ002A(PBF) |
| 3 | 1 | J2 | HDR ASY, RA, NO KEY, STR TAIL | TYCO ELC, 5787441 |
| 4 | 5 | JP1 TO JP3, JP5, JP6 | HEADER 3 PIN 0.079 SINGLE ROW | SAMTEC, TMM103-02-L-S |
| 5 | 6 | JP1 TO JP3, JP5 TO JP7 | SHUNT, 0.079" CENTER | SAMTEC, 2SN-BK-G |
| 6 | 1 | JP7 | 2X3, 0.079 DOUBLE ROW HEADER | SAMTEC, TMM103-02-L-D |
| 7 | 3 | Q6, Q5, Q13 | P-CHAN, TP0610T SOT-23 | VISHAY, TP0610K-T1-E3 |
| 8 | 1 | Q7 | TRANSISTOR, MMBT3906WT1 SOT-323 | ON SEMI, MMBT3906WT1G |
| 9 | 2 | Q4, Q8 | N-CH MOSFET, 2N7002 | ZETEX, 2N7002 (PBF) |
| 10 | 1 | R32 | RES, CHIP, 499k, 1/16W, 1% 0603 e3 | VISHAY, CRCW0603499KFKEA |
| 11 | 1 | R28 | RES, CHIP, 28k, 1/16W, 1% 0603 | VISHAY, CRCW060328K0FKEA |
| 12 | 4 | R21, R22, R23, R24 | RES, CHIP, 300, 1/16W, 5% 0603 | VISHAY, CRCW0603300RJNEA |
| 13 | 1 | P1 | CONNECTOR, DSUB, 15 PIN | AMP INC 1-1470250-3 |
| 14 | 4 | STAND-OFF | STAND-OFF, NYLON 0.25" | KEYSTONE, 8831(SNAP ON) |
| 15 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT #1104B |
| 16 | 2 | | STENCIL | STENCIL 1104B |

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SCHEMATIC DIAGRAM



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ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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