## DESCRIPTION

Demonstration circuit DC1259A is a single-battery battery-backup controller featuring the LTC4110. The LTC4110 controller provides all the features and functions to offer a complete standalone battery-backup system. The LTC4110 is scalable with other LTC4110s to allow a larger battery array for increased capacity and/or redundancy.

A SMBus interface is offered to allow host communications in control and status and/or support Smart Batteries. However, no host is required to use the LTC4110. An on-board LTC1694 SMBus accelerator is used to provide 3.3V pull-up power and fast rise times of the bus for maximum speed and reliability.

From the factory, the DC1259A is configured for a 12.6V Li-ion Smart Battery in charge and discharge. The battery is connected to the BAT terminal. However, the Demoboard can be easily configured for a Standard Battery as well. Set JP1 to INT to allow batteries without a thermistor pin to be charged.

Note: If you use a standard battery, it is strongly recommended you have the final production version of the battery provide an extra pin to support the NTC/thermistor pin. This will allow the LTC4110 to:

1) Detect the physical presence of the battery and optionally report it to a host.

2) Start a complete charge cycle from the beginning including safe recovery of an over-discharged battery.

3) Allow the battery terminals to be 0V when no battery is present.

All the pin does inside the battery is connect a 300 ohm resistor (Li-ion) or a 10K NTC to Battery (B-) per the Smart Battery Standards. For more information, contact the factory.

Smart Batteries offer an integrated, high-accuracy gas gauge report allowing the host system to know exactly the state of charge of the battery at all times. Smart Batteries are the battery packs found on all mainstream notebooks made today. If you wish to try an industry standard Smart Battery that plugs-and-plays with the Demoboard, we recommend you contact Inspired Energy: http://www.inspired-energy.com/

If the battery you're using is not 12.6V Li-ion, the Demoboard provides jumper options to support other chemistries and cell stack voltages. Consult the Schematic and Datasheet for more information.

Power input is connected to the DCIN terminal. The recommended input power is 12V± 5% at 1.4A minimum up to 7A maximum as required to power the load. To successfully perform a calibration test, a 1.7A load on the VSYS or DCOUT terminals must be connected and turned on.

The battery backed load is to be connected to the DCOUT terminal. The VSYS terminal is optional and intended for loads that are NOT battery backed up. Why a VSYS connection? R1 exist as part of the Calibration protection system that looks for insufficient load current to support calibration safely. See datasheet for more information.

The Calibration feature of the LTC4110 allows one to test load the battery without generating any heat. The Flyback converter is used in reverse as a current source dumping current back into the DCIN supply. The DCIN supply simply sees a reduction in load current.

The 3 GPIO pins are initially defined to be STATUS pins on power up. JP4 can be used to change them to be Hi-Z state on power up until programmed by the host.

The optional DC1223A-B SMBUS to USB port adapter along with the associated "QuickEval" software is used to automatically download IDs over the internet to program the LTC4110. The software will allow one to control, monitor and data-log the system and battery status for demonstration purposes only. You DO NOT need this software to run the DC1259A. Contact your LT representative for ordering a DC1223A-B.

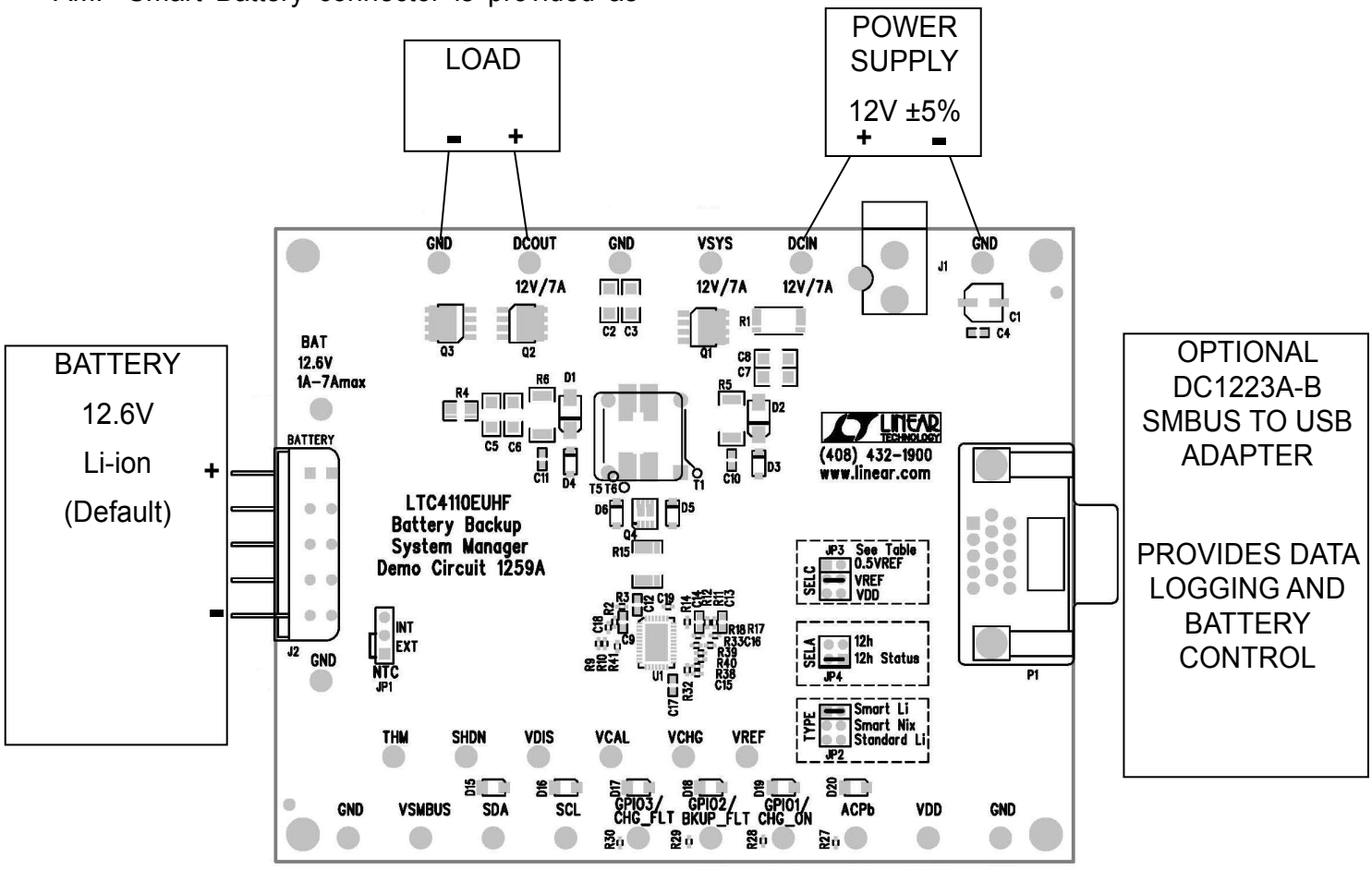
**Design files for this circuit board are available. Call the LTC factory.**

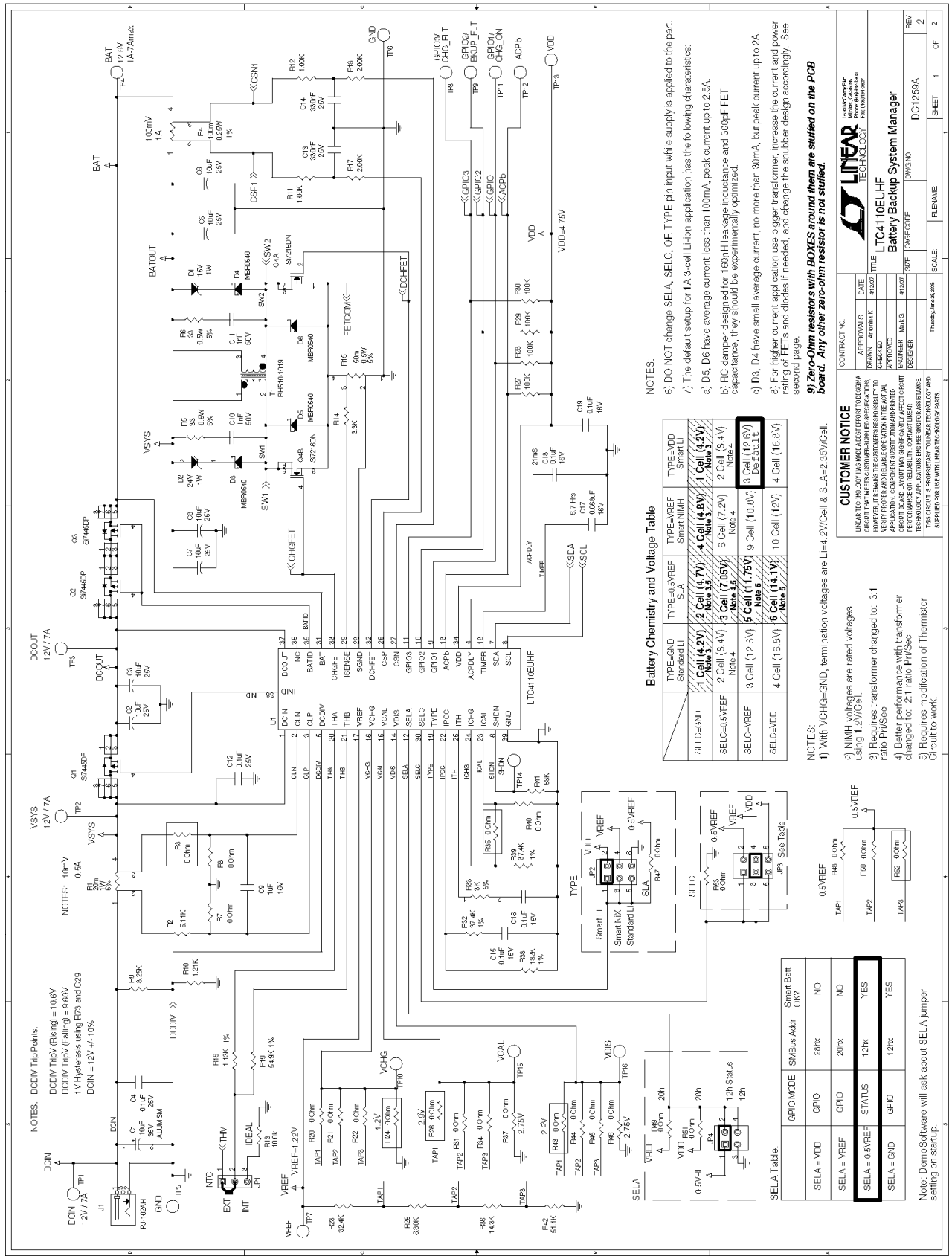
**Table 1. Performance Summary**

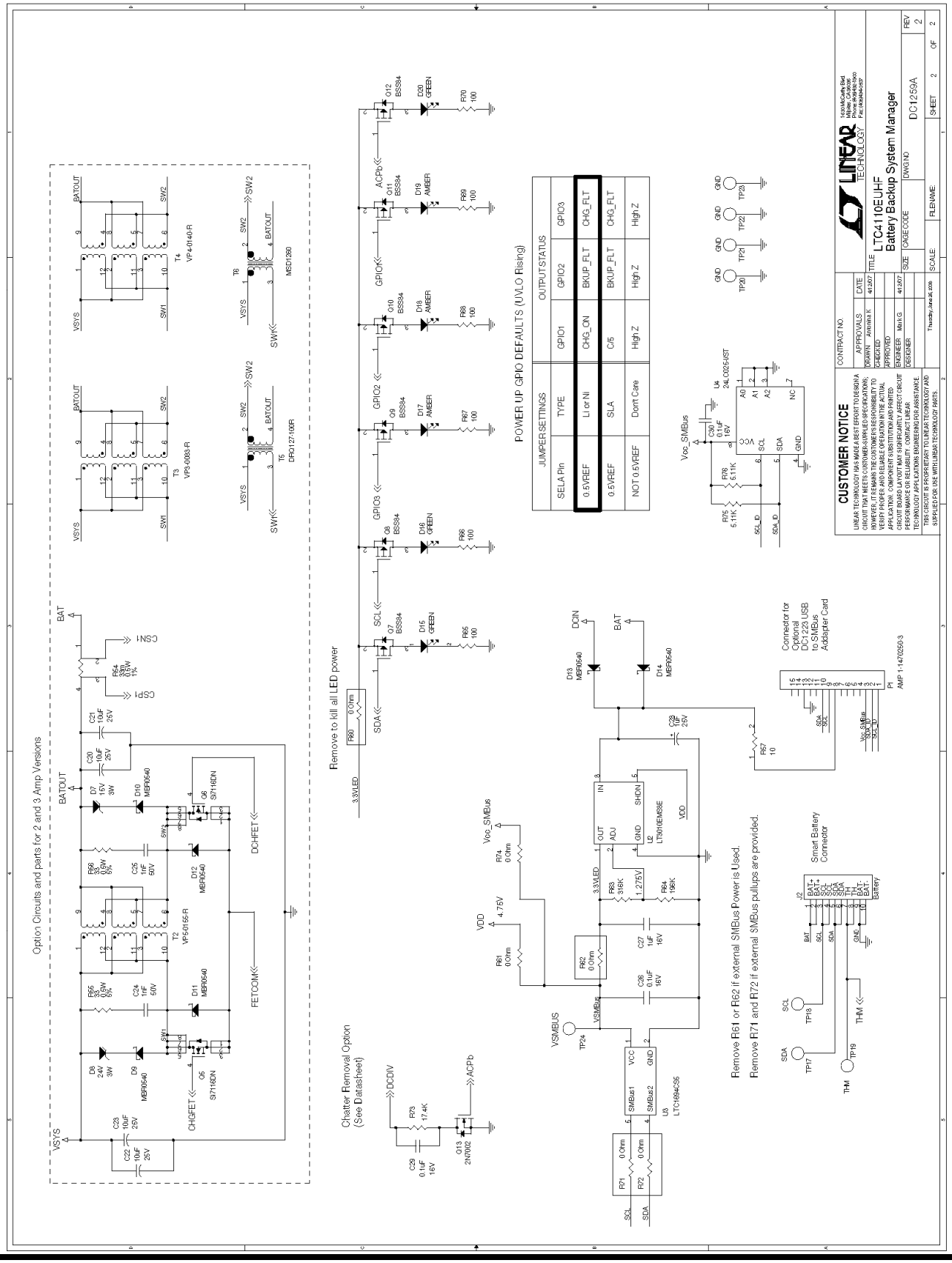
| Parameter | Conditions/Notes | Value |
|---|---|---|
| DCIN Input Voltage Range | 19V Abs Max. | 12V± 5% |
| DCIN Trip voltage (Falling) | | 10.2V± 2.5% |
| DCIN Trip voltage (Rising) | | 11.2V± 2.5% |
| DCIN Hysteresis (Rising) | Set by R73. C29 used as a low pass filter for noise rejection. | +1V |
| DCIN minimum Current for Chg Only | | 1.4A |
| DCIN Minimum Current | Current needed for charge and calibration test. | 3.1 A |
| Maximum Load Current | VSYS + DCOUT | 7A |
| Minimum Load Current for Calibration | VSYS + DCOUT Load current > 0.65A (DCIN min) + 1A Cal Current. | 1.7A |
| Battery Chemistry Select/Type | Preset for Smart Li-ion per JP2 | Smart Li-ion |
| Battery Charge Voltage | Preset for 3 cells per JP3: Vchg = GND | 12.6V±0.5% |
| Battery Charge Current | Full-scale Current as set by Ichg and R4 | 1A± 3.3% |
| Battery Discharge Cutoff Voltage | Set by Vdis pin. 2.9V/Cell. | 8.7V± 2% |
| Calibration Discharge Cutoff Voltage | Set by Vcal pin. 2.9V/Cell. | 8.7V± 2% |
| Calibration Discharge Current | Full-Scale Current as set by Ical and R4 | 1A ± 3.3% |
| Calibration DCIN Min load current Shdn | Cal Fault Min DCIN Current Shutdown. (Detected by R1) | 0.5A ± 30% |
| Calibration DCIN OVP Shutdown Rising | Cal Fault OVP Shutdown voltage. (Detected by DCDIV) | 13.2V |
| SMBus Address | Smart Battery Default. Adjustable. | 12h |
| Power Up GPIO Mode | Preset per JP4 | Status |
| SMBus voltage (internal) | Removing R62 allows external power of VSMBUS terminal. | 3.3V |
| ACPb Delay on power up. | Delay in ACPb being asserted after DCDIV detection. Set by C18. | 21ms |
| Max Bulk Charge Time allowed. | Set by Vref load current and C17. See datasheet. | 6.7Hours |
| NTC/Battery Detection | Set per JP1 to detect the presence of a Smart Battery when plugged in. | EXT |

## QUICK START PROCEDURE

1. Connect a properly rated power source to DCIN terminals J1 or terminals labeled DCIN and GND.
2. Optionally connect a load to DCOUT 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 DC1223A-B demonstration software to control and configure the DC1259A.




NOTES: DCDIV Trip Points:
DCDIV TripV (Rising) = 10.6V
DCDIV TripV (Falling) = 9.60V
1V Hysteresis using R73 and C29
DCIN = 12V +/- 10%
NOTES: 10mV
0.5A
100mV
1A
DCIN
12V / 7A
VSYS
12V / 7A
BAT
12.6V
1A-7Amax
DCOUT
12V / 7A
LTC4110EUHF
Battery Backup System Manager
DC1259A
Battery Chemistry and Voltage Table
TYPE=GND Standard LI
TYPE=0.5VREF SLA
TYPE=VREF Smart NiMH
TYPE=VDD Smart LI
SELC=GND
1 Cell (4.2V) Note 3
2 Cell (4.7V) Note 3,5
4 Cell (4.8V) Note 3
1 Cell (4.2V) Note 3
SELC=0.5VREF
2 Cell (8.4V) Note 4
3 Cell (7.05V) Note 4,5
6 Cell (7.2V) Note 4
2 Cell (8.4V) Note 4
SELC=VREF
3 Cell (12.6V)
5 Cell (11.75V) Note 5
9 Cell (10.8V)
3 Cell (12.6V) Default
SELC=VDD
4 Cell (16.8V)
6 Cell (14.1V) Note 5
10 Cell (12V)
4 Cell (16.8V)
NOTES:
1) With VCHG=GND, termination voltages are Li=4.2V/Cell & SLA=2.35V/Cell.
2) NiMH voltages are rated voltages using 1.2V/Cell.
3) Requires transformer changed to: 3:1 ratio Pri/Sec
4) Better performance with transformer changed to: 2:1 ratio Pri/Sec
5) Requires modification of Thermistor Circuit to work.
6) DO NOT change SELA, SELC, OR TYPE pin input while supply is applied to the part.
7) The default setup for 1A 3-cell Li-ion application has the following charateristics:
a) D5, D6 have average current less than 100mA, peak current up to 2.5A.
b) RC damper designed for 160nH leakage inductance and 300pF FET capacitance, they should be experimentally optimized.
c) D3, D4 have small average current, no more than 30mA, but peak current up to 2A.
8) For higher current application use bigger transformer, increase the current and power rating of FETs and diodes if needed, and change the snubber design accordingly. See second page.
9) Zero-Ohm resistors with BOXES around them are stuffed on the PCB board. Any other zero-ohm resistor is not stuffed.
CUSTOMER NOTICE
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION OF THE CIRCUIT IN ITS INTENDED APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
LINEAR TECHNOLOGY
1630 McCarthy Blvd.
Milpitas, California
Phone: (408)432-1900
Fax: (408)434-0507
CONTRACT NO.
APPROVALS
DRAWN Ahmina K
CHECKED
APPROVED
ENGINEER Mark G
DESIGNER
DATE
4/13/07
4/13/07
4/13/07
TITLE
LTC4110EUHF
Battery Backup System Manager
SIZE
CAGE CODE
DWG NO
DC1259A
REV
2
Thursday, June 28, 2007
SCALE:
FILENAME:
SHEET 1 OF 2
SELA Table.
GPIO MODE
SMBus Addr
Smart Batt OK?
SELA = VDD
GPIO
28hx
NO
SELA = VREF
GPIO
20hx
NO
SELA = 0.5VREF
STATUS
12hx
YES
SELA = GND
GPIO
12hx
YES
Note: DemoSoftware will ask about SELA jumper setting on startup.


Option Circuits and parts for 2 and 3 Amp Versions
Remove to kill all LED power
Chatter Removal Option
(See Datasheet)
Remove R61 or R62 if external SMBus Power is Used.
Remove R71 and R72 if external SMBus pullups are provided.
POWER UP GPIO DEFAULTS (UVLO Rising)
JUMPER SETTINGS
OUTPUT STATUS
SELA Pin
TYPE
GPIO1
GPIO2
GPIO3
0.6VREF
Li or Ni
CHG_ON
BKUP_FLT
CHG_FLT
0.6VREF
SLA
C/5
BKUP_FLT
CHG_FLT
NOT 0.6VREF
Don't Care
High Z
High Z
High Z
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THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
CONTRACT NO.
APPROVALS
DRAWN Antonina K
CHECKED
APPROVED
ENGINEER Mark G
DESIGNER
Thursday, June 28, 2007
DATE
4/13/07
4/13/07
4/13/07
LINEAR TECHNOLOGY
TITLE
LTC4110EUHF
Battery Backup System Manager
SIZE
CAGE CODE
DWG NO
DC1259A
REV
2
SCALE:
FILENAME:
SHEET 2 OF 2

| Item | Qty | Reference | Part Description | Manufacturer / Part # |
|---|---|---|---|---|
| **REQUIRED CIRCUIT COMPONENTS** | | | | |
| | 6 | C2,C3,C5-C8 | CAP.,SM, X5R,10uF, 25V, 10%,1206 | Murata, GRM31CR6C106KA88L |
| | 1 | C12 | CAP., X7R, 0.1uF,10%,25V, 0603 | AVX, 06033C104KAT2A |
| | 1 | C9 | CAP., X7R, 1uF,10%, 16V, 0603 | Murata, GRM188R71C105KA12D |
| | 2 | C10,C11 | CAP., X7R, 1nF, 10%,50V, 0603 | AVX, 06035C102KAT2A |
| | 2 | C13,C14 | CAP., X5R, 0.33uF, 10%, 25V, 0603 | Taiyo Yuden, TMK107BJ334KA-T |
| | 4 | C15,C16,C18,C19 | CAP., X5R, 0.1uF,10%,16V, 0402 | AVX, 0402YD104KAT2A |
| | 1 | C17 | CAP., X7R, 68nF, 10%,16V, 0603 | AVX, 0603YC683KAT2A |
| | 1 | C29 | CAP., X7R, 0.1uF,10%,10V, 0402 | MURATA, GRM155R61A104KA01 |
| | 1 | D1 | DIODE, zener, 15V, SMA | Diodes Inc., SMAZ15-13-F |
| | 1 | D2 | DIODE, zener, 24V, SMA | Diodes Inc., SMAZ24-13-F |
| | 4 | D3-6 | DIODE, schottky, MBR05401G, SOD123 | ON Semi., MBR0540T1G |
| | 3 | Q1,Q2,Q3 | Mosfet,P-Chan, SI7445DP, PPAK_SO-8 | Vishay, SI7445DP-T1-E3 |
| | 1 | Q4 | Mosfet,N-Chan,Si7216DN,PPAK-1212-DUAL | Vishay, SI7216DN-T1-E3 |
| | 1 | Q13 | Transistor, N-Chan, 2N7002, SOT-23 | Fairchild, Semi., 2N7002 |
| | 1 | T1 | Trans, L10-1019 | BH Electronics, L10-1019 |
| | 1 | U1 | I.C., LTC4110EUHF, QFN38 | Linear Tech.,LTC4110EUHF |
| | 1 | R1 | Res.,sense, 20m, 5%, 2512_KELVIN | Panasonic, ERJ-M1WSJ20MU |
| | 1 | R2 | Res.,chip, 5.11K, 1%, 1/10W, 0402 | VISHAY, CRCW04025K11FKED |
| | 1 | R4 | Res, sense 100m, 1%, 0.25W1206_KELVIN | Panasonnic, ERJ-8RSFR10V |
| | 2 | R5,R6 | Res., chip, 33, 0.5W, 5%, 2010 | Panasonic, ERJ-12ZYJ330U |
| | 1 | R9 | Res.,chip, 8.87K, 1%, 1/16W, 0402 | VISHAY, CRCW04028K87FKED |
| | 1 | R10 | Res.,chip, 1.21K, 1%, 1/16W, 0402 | VISHAY, CRCW04021K21FKED |
| | 2 | R11,R12 | Res.,chip, 1.00K, 1%, 1/16W, 0402 | VISHAY, CRCW04021K00FKED |
| | 1 | R14 | Res., chip, 3.32K,1%, 1/16W, 0402 | VISHAY, CRCW04023K32FKED |
| | 1 | R15 | Res., sense,50m, 1%, 0.5W, 1812_KELVIN | Panasonic, ERJ-L12KF50MU |
| | 1 | R16 | Res., chip, 1.13K, 1%, 1/16W, 0402 | VISHAY, CRCW04021K13FKED |
| | 2 | R18,R17 | Res., chip, 2.00K, 1%, 1/16W, 0402 | VISHAY, CRCW04022K00FKED |
| | 1 | R19 | Res., chip, 54.9K, 1%, 1/16W, 0402 | VISHAY, CRCW040254K9FKED |
| | 1 | R23 | Res., chip, 32.4K, 1%, 1/16W, 0402 | VISHAY, CRCW040232K4FKED |
| | 1 | R25 | Res., chip, 6.80K, 1%, 1/16W, 0402 | VISHAY, CRCW04026K80FKED |
| | 4 | R27,R28,R29,R30 | Res., chip, 100K, 1%, 1/16W, 0402 | VISHAY, CRCW0402100KFKED |
| | 2 | R32,R39 | Res., chip, 37.4K, 1%, 1/16W, 0402 | VISHAY, CRCW040237K4FKED |
| | 1 | R33 | Res., chip, 3K, 1%, 0402 | VISHAY, CRCW04023K00FKED |
| | 1 | R36 | Res., chip, 14.3K, 1%, 1/16W, 0402 | VISHAY, CRCW040214K3FKED |
| | 1 | R38 | Res., chip, 182K, 1%, 1/16W, 0402 | VISHAY, CRCW0402182KFKED |
| | 1 | R41 | Res., chip, 68K, 1%, 0402 | VISHAY, CRCW040268K0FKED |
| | 1 | R42 | Res., chip, 51.1K, 1%, 1/16W, 0402 | VISHAY, CRCW040251K1FKED |
| | 1 | R73 | Res., chip, 19.6K, 1%, 0402 | VISHAY, CRCW040219K6FKED |
| | | | | |

| ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS | | | | |
|---|---|---|---|---|
| | 1 | C1 | CAP.,ALUM, 10uF, 35V, 20%, AECAP-C35V | SANYO., 35CE10AX |
| | 1 | C4 | CAP., X7R, 0.1uF,10%,25V, 0603 | AVX, 06033C104KAT2A |
| | 1 | C27 | CAP., X7R, 1uF,10%, 16V, 0603 | Murata, GRM188R71C105KA12D |
| | 0 | C24,C25 | CAP., X7R, 1nF, 10%,50V, 0603 | AVX, 06035C102KAT2A |
| | 2 | C26,C30 | CAP., X5R, 0.1uF,10%,16V, 0402 | AVX, 0402YD104KAT2A |
| | 1 | C28 | CAP., TANT,1uF, 10%, 25V, size A | AVX, TAJA105K025R |
| | 0 | C20-C23 | CAP.,SM, X5R,10uF, 25V, 10%,1206 | Murata, GRM31CR6C106KA88L |
| | 0 | D7 | DIODE, zener, 15V, SMA | Diodes Inc., SMAZ15-13-F |
| | 0 | D8 | DIODE, zener, 24V, SMA | Diodes Inc., SMAZ24-13-F |
| | 0 | D9-D12 | DIODE, schottky, MBR05401G, SOD123 | ON Semi., MBR0540T1G |
| | 2 | D13-D14 | DIODE, schottky, MBR05401G, SOD123 | ON Semi., MBR0540T1G |
| | 3 | D15,D16,D20 | LED,GREEN, LN1351C,4V ,15mA | Panasonic, LN1351CTR |
| | 3 | D17,D18,D19 | LED, AMBER, LN1451C, 4V,15mA | Panasonic, LN1451CTR |
| | 1 | JP1 | 0.079, single row header, 3PIN | SAMTEC, TMM103-02-L-S |
| | 2 | JP2,JP3 | 0.079, dual row header, 3x2 | SAMTEC, TMM103-02-L-D |
| | 1 | JP4 | 0.079, dual row header, 2x2 | SAMTEC, TMM102-02-L-D |
| | 4 | JPX1-JPX4 | Shunt, 0.079 | SAMTEC, 2SN-BK-G |
| | 1 | J1 | CONN.,DC POWER JACK, T/H, PJ-102AH | CUI INC., CUI-PJ-102AH (PBF) |
| | 1 | J2 | Right-Angle Header, Keyless, 787441-1 | TycoEllectronics. 5787441-1 (PBF) |
| | 1 | P1 | 15 position, right angle t/h con., | TycoElectronics. 1-1734530-3 |
| | 0 | Q6,Q5 | Mosfet, N-Chan, SI7116DN, PPAK-1212-8 | Vishay, SI7116DN-T1-E3 |
| | 6 | Q7,Q8,Q9,Q10,Q11,Q12 | Transistor, P-Chan, BSS84, SOT-23 | Diodes Inc., BSS84-7-F |
| | 0 | T2 | Trans, VP5-0155-R | Cooper Bussmann, VP5-0155-R |
| | 0 | T3 | Trans., VP3-0083-R | Cooper Bussmann, VP5-0083-R |
| | 0 | T4 | Trans., VP4-0140-R | Cooper Bussmann, VP4-0140-R |
| | 0 | T5 | Trans., DRQ127-100-R | Coiltronics, DRQ127-100-R |
| | 0 | T6 | Trans., MSD1260-183ML | CoilCraft, MSD1260-183ML |
| | 1 | U2 | I.C., LT3010EMS8E, MS8E | Linear Tech., LTC3010MS8E |
| | 1 | U3 | I.C., LTC1694CS5#TRPBF, TSOT23-5 | Linear Tech., LTC1694CS5#TRPBF |
| | 1 | U4 | I.C., 24LC025-I/ST, TSSOP-8 | Microchip, 24LC025-I/ST |
| | | | | |
| | 2 | R3,R35 | Res.,chip, 0 Ohm, 0402 | VISHAY, CRCW04020000Z0ED |
| | 0 | R7,R8 ,R40 | DO NOT INSTALL 0402 | |
| | 1 | R13 | Res., chip, 10.0k, 1%, 1/16W, 0603 | VISHAY, CRCW060310K0FKED |
| | 0 | R20,R21,R22,R31,R34,R37 | DO NOT INSTALL 0603 | |
| | | R44-R50 | | |
| | 8 | R24,R26,R43,R52 | Res.,chip, 0 Ohm, 0603 | VISHAY, CRCW06030000Z0EA |
| | | R60,R62,R71,R72, | | |
| | | R51,R53,R61,R74 | | |

| | | | | |
|---|---|---|---|---|
| **ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS** | | | | |
| | 0 | R54 | Res., sense, 33m, 1%, 0.5W, 1206_KELVIN | Panasonnic, ERJ-8RQFR33V |
| | 0 | R55,R56 | Res., chip, 33, 0.5W, 5%, 2010 | Panasonic, ERJ-12ZYJ330U |
| | 1 | R57 | Res., chip, 10, 1%, 0402 | VISHAY, CRCW040210R0FKED |
| | 1 | R63 | Res., chip, 316K, 1%, 0603 | VISHAY, CRCW0603316KFKEA |
| | 1 | R64 | Res., chip, 196K, 1%, 0603 | VISHAY, CRCW0603196KFKEA |
| | 6 | R65,R66,R67,R68,R69,R70 | Res., chip, 100, 1%, 0603 | VISHAY, CRCW0603100RFKEA |
| | 2 | R75,R76 | Res.,chip, 5.11K, 1%, 1/10W, 0402 | VISHAY, CRCW04025K11FKED |
| | | | | |
| **HARDWARE FOR DEMO BOARD ONLY** | | | | |
| | | | | |
| | 24 | TP1-TP24 | Testpoint, turret, 0.063" | MILL MAX, 2308-2-00-80-00-00-07-0 |
| | 4 | MTGS AT 4 CORNERS | STANDOFF, NYLON .5 1/2" | KEYSTONE, 8833 (SNAP-ON) |