DESCRIPTION

Demonstration circuit DC766 is a single cell Li-ion charger in a QFN3x3. Charge rates as high as 950mA can be achieved due to the excellent thermal performance of the LTC4068's package, and internal die temperature control loop that prevents excessive PCB heating under worst-case conditions. The user is provided with a control jumper to enable the charger. An enable terminal is also provided to simplify wiring the demo board into a system. The user is also provided with 4 status outputs. The PROG terminal outputs a current proportional to the charge current. The ACPR terminal is pulled low whenever sufficient input voltage is present to allow battery charging. The CHRG terminal is pulled low every time charge current is supplied to the output. The status of the ACPR and CHRG outputs of the LTC4068 are also indicated visually by two LED's.

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

Table 1. Performance Summary

PARAMETER	CONDITION	VALUE
Input Voltage		4.5-6.3V
Iout	Vin=5V, Vbat=3.6V	800mA +- 7%
Float voltage	Vin =5V	4.20v+-1%
Trickle Charge threshold	V_{IN} = 5V	2.9V +-0.1V
C/20 detection	V_{IN} =5V Vbat=4.2	30mA-50mA
Recharge threshold	Vin 5V	Vfloat – 60mV – Vfloat-150mV

OPERATING PRINCIPLES

Demo DC766 is a simple single cell Li-ion charger. The demo features the LTC4068-4.2 charger IC. This charger implements a constant die temperature, constant current, and constant voltage charge scheme. Charge termination occurs when the charge rate falls to beneath 5% of the programmed charge current. A new feature of the LTC4068-4.2 is that the charge termination point is adjustable between C/2 and C/20 by means of a resistor on the Iterm pin. A topping charge will be applied if the cell voltage falls to 4.1V to insure long-term charge maintenance. Deeply discharged cells are conditioned with a low C/10 trickle current until the cell voltage reaches 2.9V whereupon full charge current is applied. In the event that full charge current would result in excessive IC temperature a die temperature control loop backs off the charge current to maintain a reasonable PC board temperature. Two LED's are provided for status indication. A charge LED is provided that illuminates every time the charger is charging the battery, and an AC power LED is provided to indicate that the part is out of under-voltage lockout The peak charge current is 800mA. Peak charge current is set by means of the value of the resistor on the PROG pin of the LTC4068. The Prog pin outputs a current proportional to 1/1000th of the charge current. This current in combination with the program resistor generates a voltage. The LTC4068 constant current loop regulates this charge current proportional voltage to be 1.00 volts. The voltage at the PROG pin can also serve as a crude ammeter. If the voltage is 1.00 volts then 100% of charge current is being applied to the battery. If this voltage falls to 0.5 volts then the charge current has also dropped to 50% of full charge current. The Iterm pin functions in a similar way to the Prog pin. A current proportional to the charge current is output through the pin. This current in combination with a resistor on the Iterm pin generates a voltage. The charging terminates whenever the voltage on the Iterm pin falls to 100mV.

QUICK START PROCEDURE

Demonstration circuit DC766 is easy to set up to evaluate the performance of the LTC4068-4.2. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Connect input power supply, meters and output load as shown in Figure 1.
2. Set the battery simulator voltage to zero, slowly raise the input voltage. When the supply voltage exceeds 3.9V the charger should activate and the charge LED will illuminate.

   NOTE: Make sure that the input voltage does not exceed 6.3V.
3. Note that so long as the battery voltage is under the Trickle Charge threshold of 2.9V the charge current is 10% of the selected charge current or approximately 80mA.
4. Increase the battery voltage to about 3V and note that the charge current has increased beyond the trickle charge current. Verify that the LTC4068-4.2 thermal loop is working by touching a soldering iron to the PCB to heat up the 4068 and note that the charge current decreases. Remove the iron and the charge current will increase. This demonstrates the "constant die temperature" operating mode.
5. Continue to increase the battery voltage. Note that as the voltage drop across the 4068 decreases the constant die temperature loop is no longer active and the charge current is the programmed charge current of 800mA
6. Continue to increase the battery voltage, as the battery voltage approaches the float voltage of 4.2V the charge current will begin to drop. Note that as the charge current drops to 5% of the programmed current the charger terminates. Charge current falls to 0 and the charge LED extinguishes.
7. Now slowly decrease the battery voltage to simulate a long term self-discharge of the battery. Note that as the battery voltage drops to 4.10V that another charge cycle is initiated.
8. Place the enable jumper in the OFF position. Note that the battery current draw is extremely low (approx 1uA) also note that the supply current draw is low (approx 20uA).

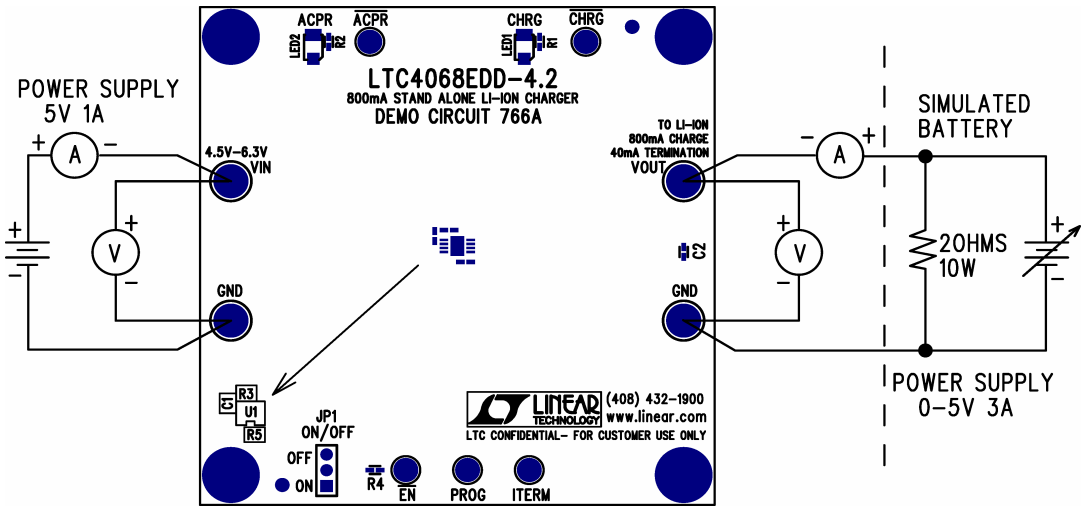
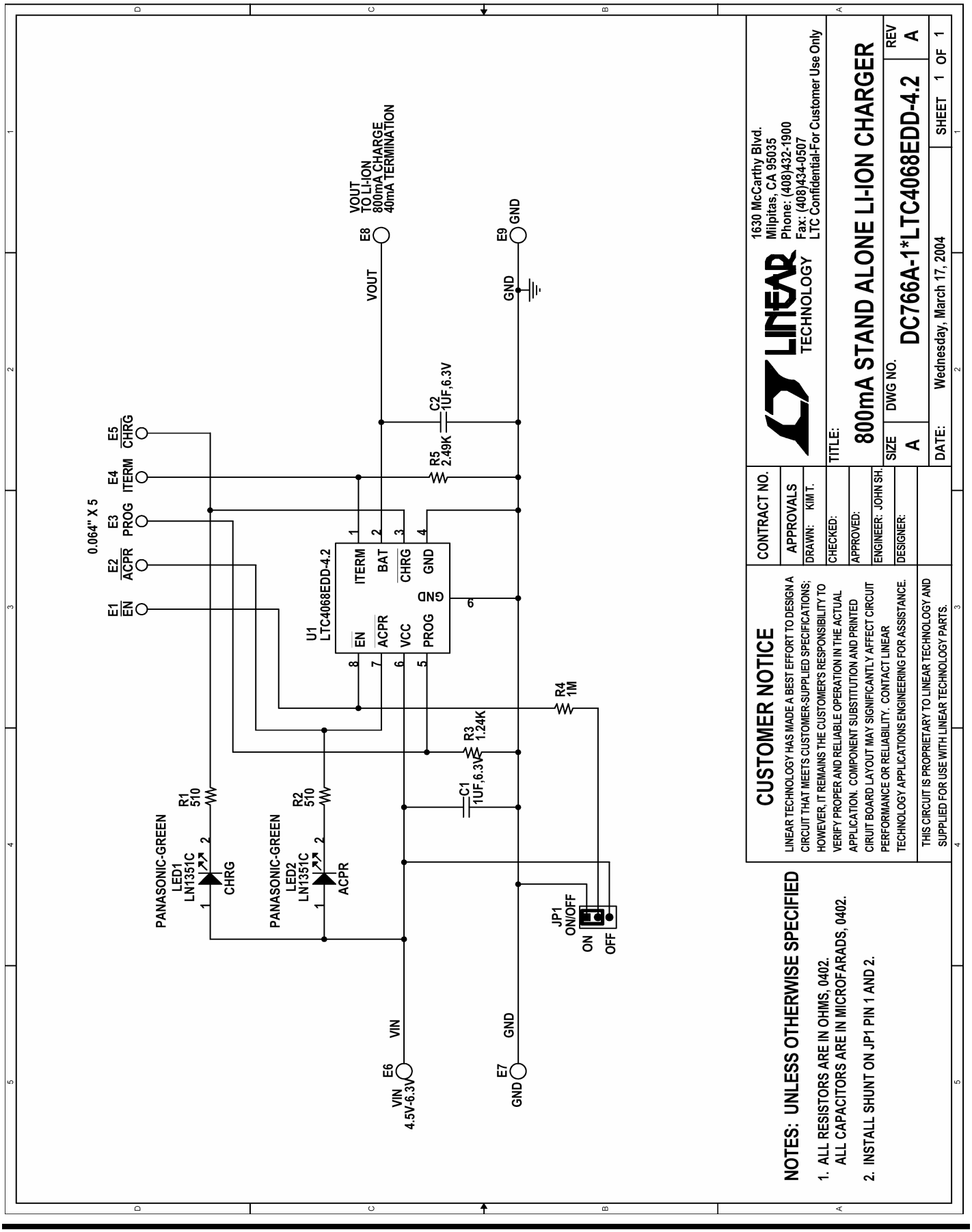


Figure 1. Proper Measurement Equipment Setup


0.064" X 5
E1 EN
E2 ACPR
E3 PROG
E4 ITERM
E5 CHRG
U1 LTC4068EDD-4.2
EN
ACPR
VCC
PROG
GND
ITERM
BAT
CHRG
GND
R1 510
R2 510
R3 1.24K
R4 1M
R5 2.49K
C1 1UF,6.3V
C2 1UF,6.3V
PANASONIC-GREEN LED1 LN1351C CHRG
PANASONIC-GREEN LED2 LN1351C ACPR
JP1 ON/OFF
ON
OFF
E6 VIN
VIN 4.5V-6.3V
E7 GND
GND
E8 VOUT
VOUT TO LI-ION 800mA CHARGE 40mA TERMINATION
E9 GND
GND
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 IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
CONTRACT NO.
APPROVALS
DRAWN: KIM T.
CHECKED:
APPROVED:
ENGINEER: JOHN SH.
DESIGNER:
LINEAR TECHNOLOGY
1630 McCarthy Blvd.
Milpitas, CA 95035
Phone: (408)432-1900
Fax: (408)434-0507
LTC Confidential-For Customer Use Only
TITLE:
800mA STAND ALONE LI-ION CHARGER
SIZE A
DWG NO. DC766A-1*LTC4068EDD-4.2
REV A
DATE: Wednesday, March 17, 2004
SHEET 1 OF 1
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, 0402.
ALL CAPACITORS ARE IN MICROFARADS, 0402.
2. INSTALL SHUNT ON JP1 PIN 1 AND 2.