DEMO CIRCUIT 1473A
QUICK START GUIDE

LT3650EDD-8.4/8.2
2A Monolithic Li-Ion Battery Charger

DESCRIPTION

Demonstration Circuit 1473A is a 2A Monolithic Li-Ion Battery Charger featuring the LT3650EDD-8.4/8.2. The LT3650 is a complete mid-power Li-Ion battery charger that can operate over a wide input voltage range. The charger is a CC/CV charger with a maximum charge current externally programmable up to 2A. A precondition feature trickle charges a low-voltage battery and bad battery detection provides a signal if the battery doesn't respond to preconditioning. The LT3650EDD-8.4/8.2 is available in a 12-lead (3mm × 3mm) DFN surface mount package with an exposed pad.

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

Table 1: Typical Specifications (25°C)

HV Input Voltage Range	9V to 32V
VOUT	7.4V to 8.48V
Output Float Voltage (constant voltage mode)	8.4V/8.2V
Output Current Limit ILIM	2A (R_{RNG} equals 20kΩ)

OPERATING PRINCIPLE

LT3650 is a complete monolithic mid-power Li-Ion battery charger, addressing high input voltage applications with solutions that require a minimum of external components. The IC uses a 1MHz constant frequency, average-current mode step-down architecture.

The LT3650 incorporates a 2A switch that is driven by a bootstrapped supply to maximize efficiency during charging cycles. A wide input range allows operation to fully charge from 10V +/- 5% (single cell) to 32V. A precision-threshold shutdown pin allows the incorporation of UVLO functionality using a simple resistor-divider. The IC can also be put into a low-current shutdown mode, in which the input supply bias is reduced to only 15uA.

The LT3650 incorporates several degrees of charge current control freedom. The overall maximum charge current is set using an external inductor current sense resistor. A maximum charge current programming pin allows dynamic manipulation of the battery charge current. The LT3650 also incorporates a system input-supply current limit control feature that servos the battery charge current to accommodate overall system load requirements. The LT3650 automatically enters a battery precondition mode if the sensed battery voltage is very low. In this mode, the charging current is reduced to 15% of the programmed maximum, as set by the inductor sense resistor, R_{SENSE}. Once the battery voltage climbs above an internally set threshold of 5.7V / cell, the IC automatically

increases maximum charging current to the full programmed value.

The LT3650 can use a charge-current based 'C/10' termination scheme, which ends a charge cycle when the battery charge current falls to 1/10th the programmed maximum charge current. The LT3650 also contains an internal charge cycle control timer, for timer-based termination. When using the internal timer, the IC combines C/10 detection with a programmable time constraint, during which the charging cycle can continue beyond the C/10 level to "top-off" a battery. The charge cycle terminates when a specific time elapses, typically 3 hours. When the timer-based scheme is used, the IC also supports 'bad-battery' detection, which triggers a system fault if a battery stays in precondition mode for more than 1/8th of the total charge cycle time.

Once charging is terminated and the LT3650 is not actively charging, the IC automatically enters a low-current standby mode where supply bias currents are reduced to < 100uA. If the battery voltage drops 2.5% from the full-charge float voltage, the LT3650 engages an automatic charge cycle restart. The IC also automatically restarts a new charge cycle after a bad battery fault once the failed battery is removed and replaced with another battery.

The LT3650 includes provisions for a battery temperature monitoring circuit. This feature monitors battery temperature during the charging cycle using a thermistor, and suspends charging and signals a fault condition if the battery temperature moves outside a safe charging range of 0^{0}C to 50^{0}C.

The LT3650 contains two digital open-collector outputs, which provide charger status and signal fault conditions. These binary-coded pins signal battery charging, standby or shutdown modes, battery temperature faults, and bad battery faults.

QUICK START PROCEDURE

Demonstration circuit 1473A is easy to set up to evaluate the performance of the LT3650EDD-8.4/8.2.

Using short twisted pair leads for any power connections, with all loads and power supplies off, refer to Figure 1 for the proper measurement and equipment setup.

Follow the procedure below:

1. Jumper and Power Supply Setting:

   JP1 = 1 **PS1 = OFF**

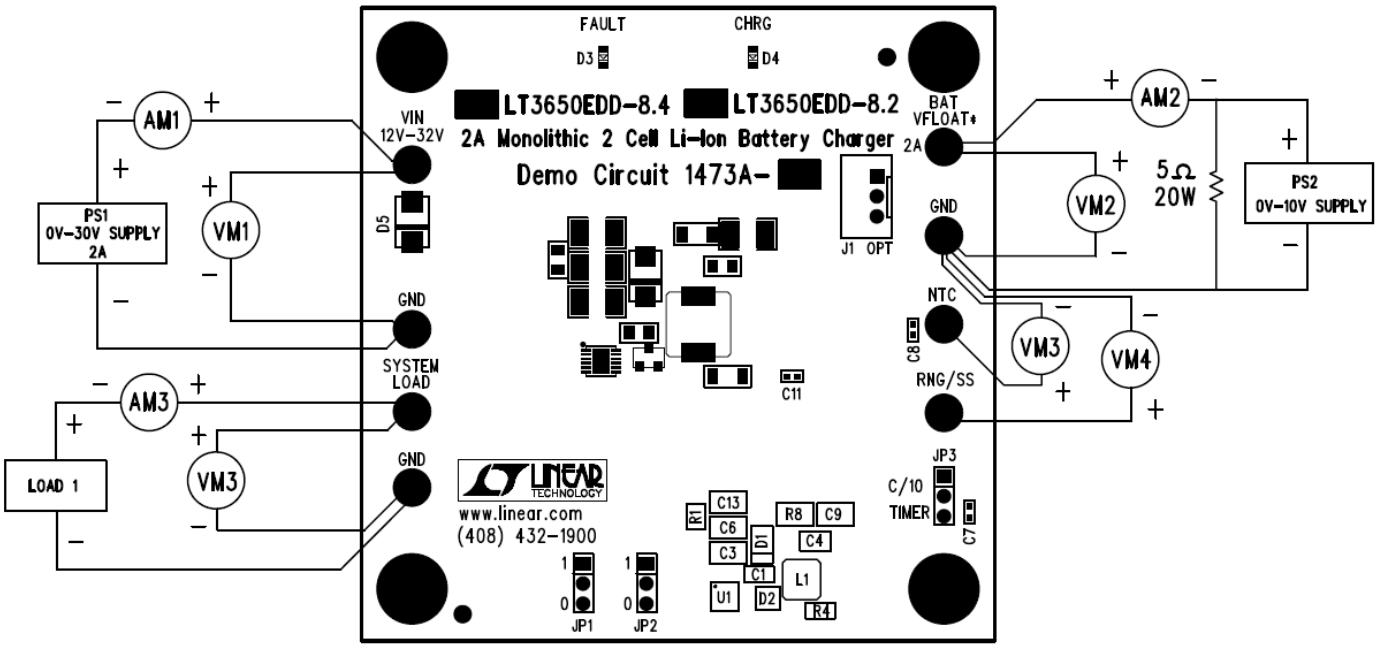
   JP2 = 1 **PS2 = OFF**

   JP3=C/10

2. Turn on PS2 and slowly increase the voltage to 5.4V while monitoring the current into the BAT pin. If the current is less than 5mA, turn on PS1. Increase the voltage on PS1 to 5V while monitoring the input current. If the current is less than 5mA, increase PS1 to 12V.
3. Verify that the battery charging current, IBAT, is between 250mA and 350mA. The CHRG LED should be on and the FAULT LED should be off.
4. Increase PS2 until VBAT is 7.2V. Verify the input current, IIN, is between 1.3A and 1.7A, the battery current, IBAT, is between 1.775A and 2.225A and that the CHRG LED is on.
5. Increase PS2 until VBAT is 8.5V. Verify the battery charging current, IBAT, is less than 5mA and that the CHRG LED is off.
6. Decrease PS2 until VBAT is 7.8V. Verify the battery current, IBAT, is between 1.775A and 2.225A that the CHRG LED is on.
7. Decrease PS2 until VBAT is 7.2V. Connect a 10K resistor from the RNG/SS pin to ground. Verify the charging current, IBAT, is between 850mA and 1.1A. Verify the voltage, VNTC, on the NTC turret is between 450mV and 550mV and the voltage,

VRNG, on the RNG/SS turret is between 1.8V and 1.9V. Remove the 10K resistor from the RNG/SS pin to ground.

8. Set JP1 to 0. Verify the charging current, IBAT, is less than 5mA and that the FAULT LED and the CHRG LED are off.
9. Set JP1 to 1. Connect a jumper from the NTC pin to ground. Verify the charging current, IBAT, is less than 5mA and that the FAULT LED and the CHRG LED are on.
10. Remove the jumper from NTC to ground. Verify the charging current, IBAT, is between 1.775A and 2.225A and that the FAULT LED is off and the CHRG LED is on.
11. Turn on LOAD1 and set to 1A. Verify the voltage, Vsystem, on the System Load turret is approximately equal to Vin.
12. Turn off PS1, PS2 and LOAD1.



Note: All connections from equipment should be Kelvin connected directly to the Board PINS which they are connected to on this diagram and any input, or output, leads should be twisted pair

Figure 1. Proper Measurement Equipment Setup

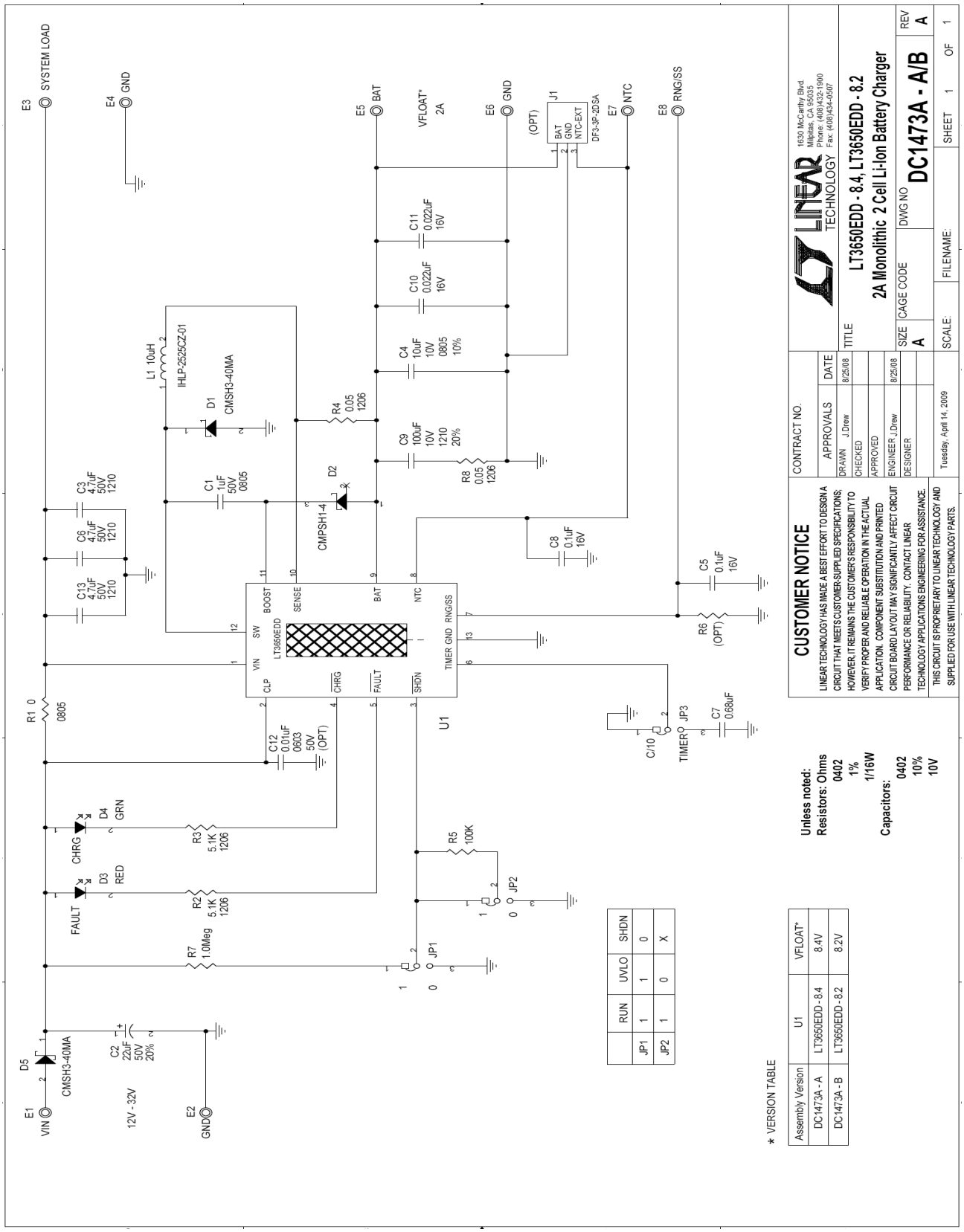


Figure 2: Schematic diagram