

# Quick Start Guide for Demo Board DC364A-A and DC364A-B

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Demonstration boards DC364A-A and DC364A-B are complete constant-current/constant-voltage battery chargers designed to charge one Lithium-Ion cell. Both feature the LTC1732 Linear Battery Charger driving a P-channel MOSFET in a series pass linear regulator configuration for charging at a maximum current of 700mA (limited by the power dissipation capabilities of the pass transistor).

Demo board DC364A-A features the LTC1732-4, which has a recharge threshold voltage of 3.8V, making it suitable for charging 4.1V or 4.2V cells (selectable by jumper on the demo board).

Demo board DC364A-B features the LTC1732-4.2, which is recommended only for charging a 4.2V cell, due to its recharge threshold voltage of 4.05V.

Other Features include:

- Preset float voltages of 4.1 and 4.2V  $\pm$  1% (DC364A-A)
- 700mA Constant Current (can be programmed for other charge currents)
- 3-hour charge termination timer. This timer can be set for other time periods through a capacitor change. For instance, you may want to use a much shorter period (on the order of 30 seconds) when evaluating the board with a battery simulator instead of a Li-Ion battery.
- Manual Shutdown
- C/10 Trickle charge for deeply discharged batteries
- Auto recharge when battery voltage drops below preset threshold (3.8V for DC364A-A and 4.05V for DC364A-B).
- Low battery drain current when the input supply is removed
- Input Power OK LED indicator (ACPR)
- C/10 Charge LED indicator (CHRG)

Small surface mount components are used to minimize board space and height with the circuitry occupying approximately 0.15 square inches of board space with a height of 0.054 inches (1.4mm).

## Typical Demo Board Specifications

Item	Specification
Input Voltage Range	4.7V to 5.3V (upper range limited by MOSFET dissipation)
Output Voltage $V_{BAT}$ (constant voltage mode)	4.1 or 4.2V $\pm 1\%$ DC364A-A 4.2V $\pm 1\%$ DC364A-B (use for 4.2V cells only)
Output Current $I_{BAT}$ (constant current mode)	700mA $\pm 8\%$
Output Current $I_{BAT}$ (trickle current mode)	100mA $\pm 40\%$
C/10 CHRG LED Threshold Level	80mA $\pm 50\%$
Trickle Charge Threshold Voltage	2.457V
Battery Drain Current with $V_{IN}$ Removed	3 $\mu$ A Note: If $V_{IN}$ is pulled down to 0V, the current drain from the battery will be higher due to the leakage current of the input Schottky diode. A silicon diode could be used for the input diode if the slightly greater forward voltage drop is not a problem.

## Test Equipment Required for Demo Board Evaluation

Item	Specification
Digital voltmeter for measuring input voltage	3.5 digits
Digital voltmeter for measuring battery voltage	4.5 digits, resolution to 1mV
Digital voltmeter for measuring voltage across current sense resistor	3.5 digits, resolution to 1mV
Li-Ion cell <i>or</i> Battery Simulator	
Li-Ion Cell	4.1 or 4.2V Rechargeable Li-Ion Cell
Battery Simulator	
Power supply with coarse and fine output voltage adjust controls	0 to 5V, 2A
Power resistor (preload for power supply)	2 $\Omega$ , 10W
Current sense resistor for measuring charge current	0.1 $\Omega$ , 1%, 1W
Current sense resistor for measuring battery drain current	1k, 1%, 0.5W

## Quick Start Procedure

Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Install jumper JP1 to select the cell voltage.  
For a 4.2V cell, JP1 should be between the center pin and the top pin; for a 4.1V cell it should be connected to the center and the bottom pin.
2. Install jumper JP2 to enable the charger.
3. Set the input power supply to 0V, and then connect it to the  $V_{IN}$  and GND pins of the demo board.
4. Set the battery simulator to 0V, and then connect it to the BAT and GND pins.
5. Connect the digital voltmeters as shown in the setup diagram to measure  $V_{IN}$ , charger voltage (VBAT) and the charge current (IBAT).
6. Start the demo board evaluation by increasing the input power supply to approximately 3.8V (battery simulator power supply set for 0V). The charger output voltage and charge current should be 0. The CHRG and ACPR LEDs should be off. **The charger is off due to the undervoltage lockout feature.**
7. Increase the input voltage to 5V and keep the battery simulator power supply at 0V. Both LEDs (CHRG and ACPR) should now be on, the charger output voltage (VBAT) should be approximately 200mV, and the charge current should be approximately 100mA (10mV on the charge current DVM). **This is the trickle charge mode for a deeply discharged battery.** Typically, a battery that has not been charged for a long time.
8. Starting from 0V, slowly increase the battery simulator power supply (VBAT), observing the charger's output voltage on the DVM. When the charger's output voltage exceeds approximately 2.5V, the charger will suddenly enter the Constant current portion of the charge cycle resulting in an abrupt increase in charge current (IBAT) to the programmed value of approximately 700mA (70mV on the charge current DVM). **This is the constant current mode.**
9. Continue slowly increasing the battery simulator power supply, thus simulating a battery accepting charge. The charge current should remain at the programmed value of 700mA until the charger output voltage is within approximately 10mV of the preset charge voltage, at which time the charge current will begin to decrease. **This is the beginning of the constant voltage portion of the charge cycle.**
10. Continue slowly increasing the battery simulator power supply until the charge current drops to approximately 200mA (20mV on the charge current DVM), then read the charger output voltage. **This reading is the charger float voltage (VBAT) which will be either 4.1V or 4.2V  $\pm$  40mV depending on the location of the SELECT jumper.**
11. Remove the SHDN jumper (JP2). The charger will shut down, dropping the charge current to 0mA. The ACPR LED remains on and the charge LED goes out.
12. Replace the SHDN jumper (JP2).
13. Continue slowly increasing the battery simulator power supply while observing the CHRG LED. The LED will go out when the charge current drops to approximately 10% of the programmed charge current of 700mA. **This verifies that the C/10 output is operating correctly.**

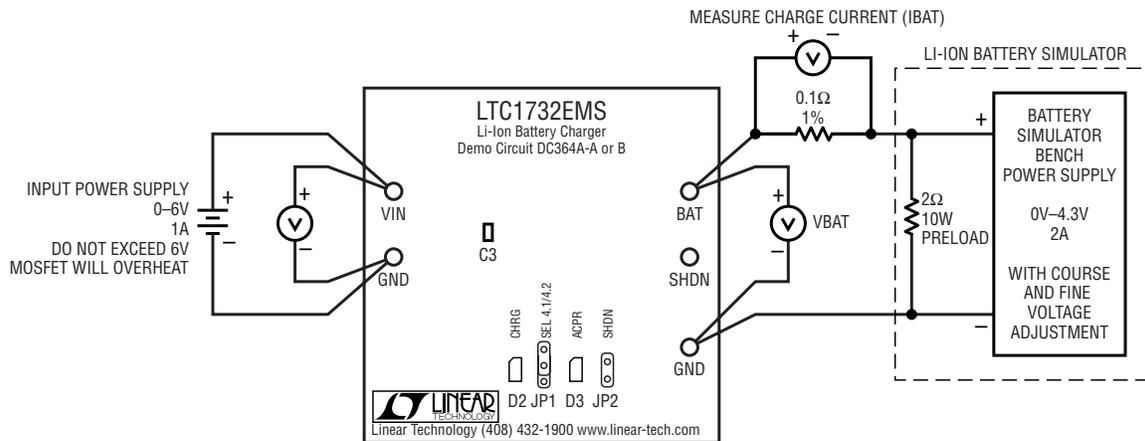
The current through the LED drops from approximately 10mA when the LED is on, to approximately 50 $\mu$ A when the charge current drops to 10%, and drops to 0 $\mu$ A after the timer has timed out (3 hours when a 0.1 $\mu$ F timing capacitor is used).

At C/10, when the CHRG LED goes out, the battery is approximately 94% charged. The charger will continue charging for a total of 3 hours (0.1 $\mu$ F timing capacitor) and then stop, at which point the battery is approximately 99% charged.

**Note** For evaluation purposes, the time can be decreased from the programmed 3 hours to approximately 30 seconds by reducing the timer capacitor (C3) from 0.1 $\mu$ F to 270pF.

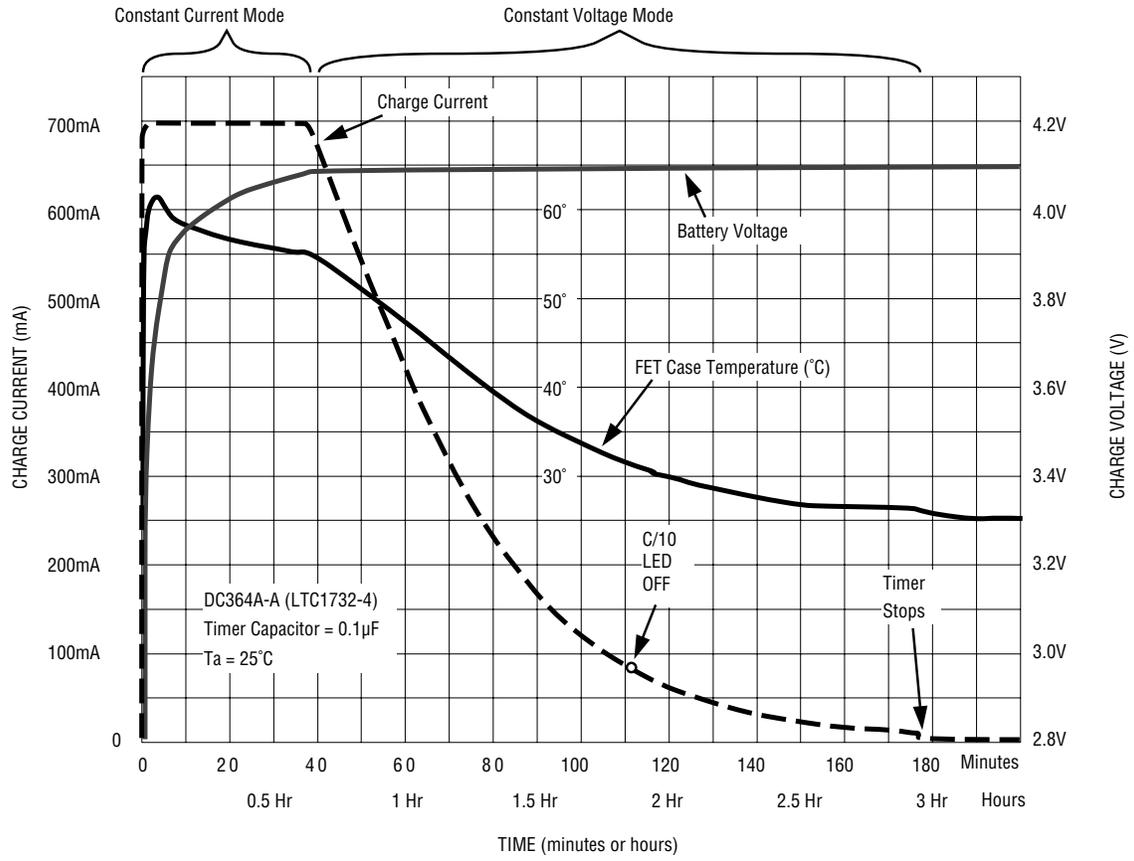
14. After the timer has timed out, slowly decrease the battery simulator power supply. At approximately 3.8V for demo board DC364A-A, a new 700mA charge cycle begins. With demo board DC364A-B, this should occur at approximately 4.05V. **This is the Recharge Threshold Voltage.**
15. To verify battery drain current, remove the input supply voltage, replace the 0.1 $\Omega$  current sense resistor with a 1k $\Omega$ , and set the battery simulator power supply to approximately 4V. **The charge current DVM will now read battery drain current with 1mV/ $\mu$ A.**

If  $V_{IN}$  is pulled down to 0V, the current drain from the battery will be higher due to the leakage current of the input Schottky diode. A silicon diode could be used for the input diode if the slightly greater forward voltage drop is not a problem.



**Figure 1. Proper Measurement Equipment Setup**

**Note** Although it would take more time, this charger can also be evaluated using a rechargeable Li-Ion battery in place of the battery simulator pictured here. If you use a real battery, keep the DC resistance between the charger and the battery to a minimum, as this will affect the charge current in the constant voltage mode.



**Figure 2. Typical Charge Cycle Using DC364A-A**

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