

# LP3947 Evaluation Board

National Semiconductor  
Application Note 1341  
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## LP3947 Overview

The LP3947 is a complete charge management system that safely charges and maintains a one cell Li-Ion battery. The LP3947 offers the flexibility of programming charge current, battery regulation voltage and End Of Charge (EOC) termination selection through the use of I<sup>2</sup>C interface, or the part operates on default values. The LP3947 supports charging from USB port. For more information on these products, please refer to the datasheet.

## Evaluation Kit Overview

LP3947 evaluation kit supports complete functional evaluation of the power management IC. All user accessible functions of the circuit can be controlled and some parameters can be programmed via the use of the I<sup>2</sup>C interface port. The PC software provided emulates the I<sup>2</sup>C bus communication protocol. Hand shaking logic to interface to PC's parallel port and all necessary level shifting is provided.

## Getting Started

The following instructions show how to use the LP3947 evaluation kit in default conditions. **The battery charger on LP3947 operates in default mode independent of an external controller.** Please use the ESD protection (ground cable) to prevent any unwanted damaging ESD events.

1. Connect a power supply (4.5V to 6.0V) to "Adaptor" and "GND" pins located at the upper section of the PCB. Power supply's negative terminal should be connected to "GND" and positive to "Adaptor".
2. Connect a Li-Ion battery pack to "BATT" and "GND" pin located at the lower section of the PCB. The battery

pack's negative terminal should be connected to "GND" and positive to "BATT."

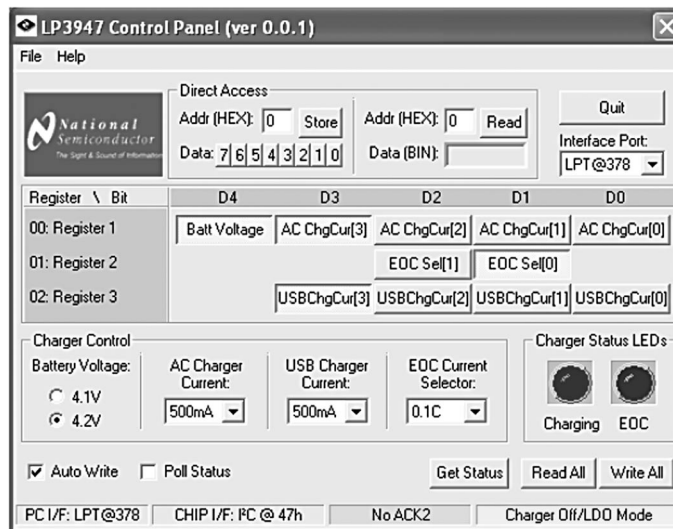
3. The evaluation board is now ready for operation. Turning ON the power supply will start the charge cycle if battery is not fully charged.
4. Install the evaluation software on a PC by following the instruction on the "Evaluation Board Software Installation" section.
5. To control and program other functions and parameters available on LP3947, connect the LPT cable to the evaluation board and the LPT port of your PC.
6. Start the software by double-clicking on its icon.
7. The evaluation kit is now ready to use and the LP3947 can be programmed and controlled through the PC software.

## Evaluation Board Software Installation

Install the evaluation software on a PC by copying the "LP3947cp.exe" from the CD to the LP3947 folder in your computer. Double click on the software icon to start the software.

## The Control Panel

The LP3947's parameters can be controlled from this control panel. The software permits the flexibility of programming in hex codes as well as the convenience of a menu driven operation.



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**Note 1:** When the LP3947 is powered up initially, it operates on default values as shown.

## Selecting Between AC Adaptor and USB Power Port

The LP3947 is designed to accept charging from either AC adaptor or USB port. A simple external circuit is used to allow simultaneous connection from the two sources, with AC adaptor taking priority over USB power port.

When charging from an AC adaptor, the "MODE" pin should be set high. In AC adaptor mode, the LP3947 can charge using default values of 500 mA charge current, 4.2V termination voltage and 0.1C EOC, or it can be programmed via I<sup>2</sup>C to change these parameters. For more detail, please refer to the LP3947 datasheet.

When charging from a USB power source, the "MODE" pin should be set low. In USB mode, only 100 mA and 500 mA charge current is allowed. In USB mode, charge always starts with 100 mA (the "ISEL" pin is pulled high). To change charge current to 500 mA, set the "ISEL" pin to low. Once "ISEL" pin is set to low, it is possible to program charge current to other values using I<sup>2</sup>C.

## Using Thermistor Interface

The LP3947 continuously monitors the battery temperature by measuring the voltage between the Ts pin and ground.

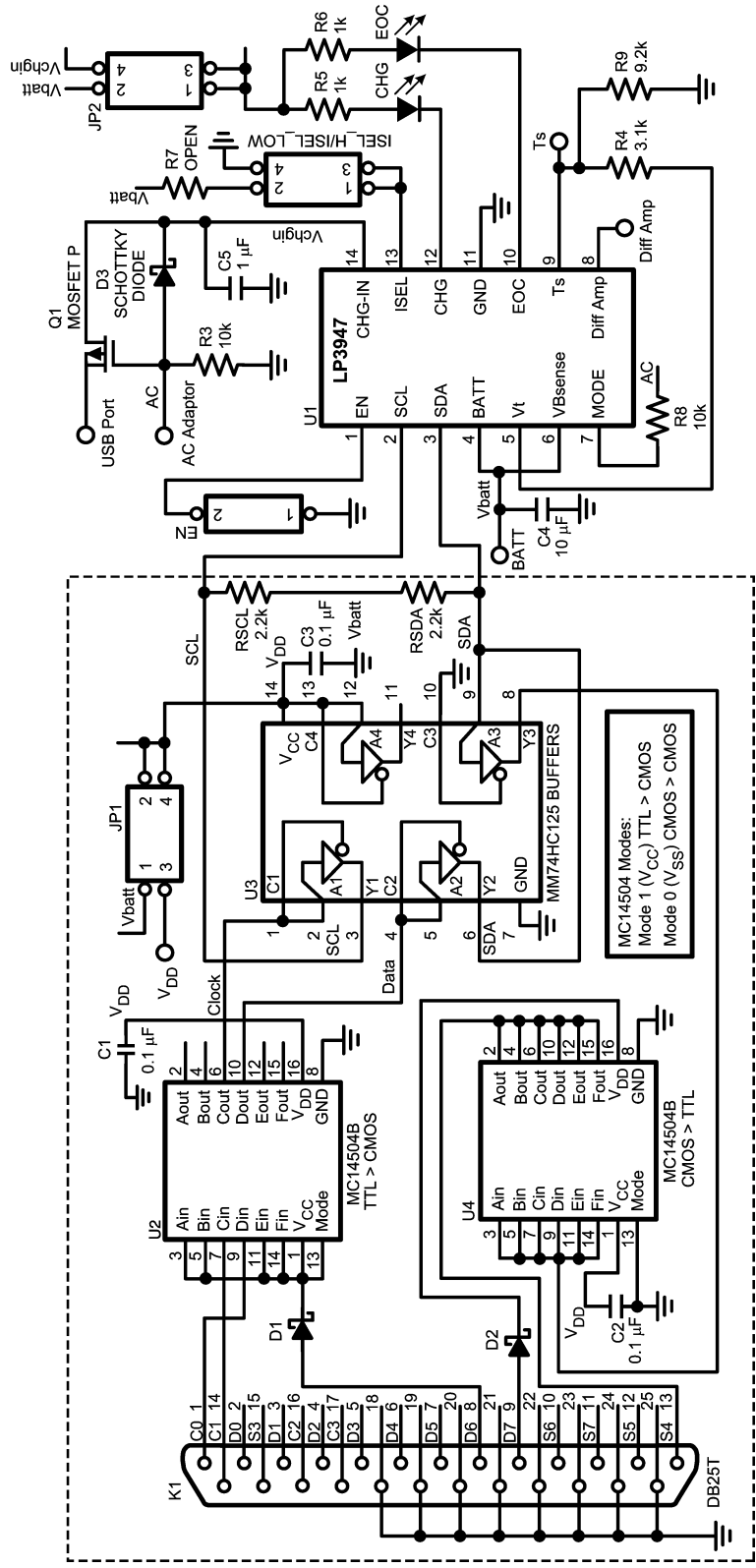
Thermistor pin from the battery pack is connected to the Ts pin. An external resistor, Rs, is connected to V<sub>T</sub> pin. These two resistors create a voltage divider that feeds into two comparators inside the LP3947. Depending on the battery temperature, the voltage divider creates a voltage that may be inside or outside the comparators' window (2.427V to 1.390V). If the voltage is inside the comparators' window, battery temperature is within the temperature range that allows charging. If it is outside, charging suspends and both LEDs turn on.

In the case where there is no battery, Ts pin is floating. This forces the LP3947 into LDO mode. In the LDO mode, BATT pin acts like a battery providing 4.2V (or 4.1V) and up to 1.2 AMP of current.

## LP3947 Evaluation Board Schematic

The evaluation board with I<sup>2</sup>C interface has circuit inside the dashed box assembled. The evaluation board without I<sup>2</sup>C interface does not have circuit inside the dashed box assembled and resistors RSCL and RSDA are connected to ground.

# LP3947 Evaluation Board Schematic (Continued)



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## Bill of Material for LP3947

Designator	Description	Footprint	Comment
C1, C2, C3	0.1 $\mu$ F, Ceramic	0805	TDK C2012X7R1H104K
C4	10 $\mu$ F, Ceramic	0805	TDK C2012X5R0J106M
C5	1 $\mu$ F, Ceramic	0805	TDK C2012X5R0J105M
RSCL, RSDA	2.2k	0805	
R4	3.1k	0805	
R3, R8	10k	0805	
R7	open		
R5, R6	1k	0805	
R9 (between Ts and ground pins)	9.2K		Through Hole
D1, D2, D3	SCHOTTKY Rectifier	0805 2x	On Semi MBRM120
CHG	Red LED	0805 2x	Vishay TLMT3100
EOC	Green LED	0805 2x	Vishay TLMC3100
EN, ISEL_L	HEADER 2X1		SPC Tech
JP1, JP2	Jumper from pin 1 to 2		
Q1	MOSFET Switch	SOT23-5	Temic Si3441DV
K1	DB25T		SPC Tech
U1	Battery Charger	LDA14A	NSC LP3947ISD
U2	Level Shifter	0.15" SOIC16	On Semi MC14504B
U3	3 State Quad Buffers	0.15" SOIC14	Fairchild MM74HC125M
U4	Level Shifter	0.15" SOIC16	On Semi MC14504B

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