Z8 Encore! XP®

Intelligent Li-Ion Battery Charger Using the F082A

Application Brief

Z8 Encore! XP®
Flash Microcontrollers

Introduction

Lithium-ion (Li-Ion) batteries are one of the most popular types of power sources for consumer electronics such as laptops, cell phones, and digital cameras. They have several advantages over other types of rechargeable batteries:

- They are smaller and lighter.
- The can store more energy.
- They do not suffer from memory effects.
- They hold a charge much longer.

Due to the nature of its chemistry, an Li-Ion battery should be charged early and often. The challenge with charging Li-Ion batteries is they require chargers that can carefully monitor the charging process. Otherwise the battery can be irreversibly damaged.

The solution: Create an intelligent charger to deliver constant current over constant voltage. Li-Ion batteries have a nominal open-circuit voltage of 3.6 V, and a typical charging voltage of 4.2 V. Our charger must therefore use current-limiting circuitry.

The goal: Charge with constant current until the cell reaches 4.2 V, and continue applying a constant voltage until the current drops to nearly zero.

This application brief presents a concept for an intelligent Li-Ion battery charger using the Zilog Z8 Encore! XP® F082A with 8 kB of Flash memory. The target battery for our application is a typical Li-Ion battery pack rated at 7.2 V and 2400 mA h capacity.

Features and Functions

We designed our intelligent Li-Ion battery charger to provide the following features and functions:

- Constant current/constant voltage charging using discrete components while enabling control over various battery parameters.

- LEDs to indicate:
  - Charging in progress.
  - Bad battery.
  - Charging complete.

- Data on whether the system is operating on AC or battery sent via the F082A UART.

- Charging rate of 100 mA (fixed).

- Maximum charging voltage 8.4 V.

- Low battery voltage detection at 6.4 V

- Bad battery voltage detection when the cell measures 5 V or below.

- Single-ended voltage measurement and differential current measurement using an analog channel on the F082A.

- Temperature measurement using the temperature sensor on the F082A.

- The ability to change the charge source from AC to battery and vice versa to insure uninterrupted power to the load.

- Battery power made available to an external load via MOSFET.

- Charge termination when current drops down to between 3% and 7% of the total charging capacity (72 mA to 168 mA).

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Hardware Circuit Details

The hardware circuit (see Figure 1) is designed using the 28-pin Z8 Encore! XP F082A with 8 kB of Flash memory. The following F082A microcontroller (MCU) features are used in the design:

- Internal precision oscillator (5.5296 MHz) used to set the system clock.

- The voltage and current information output via the UART.

- LED indication of charge status and battery state.

The application requires a 12 V dc, 500 mA adapter to charge the battery provide power to the load. When the adapter is disconnected or absent, the design will supply power to the load using the battery.

Block Diagram
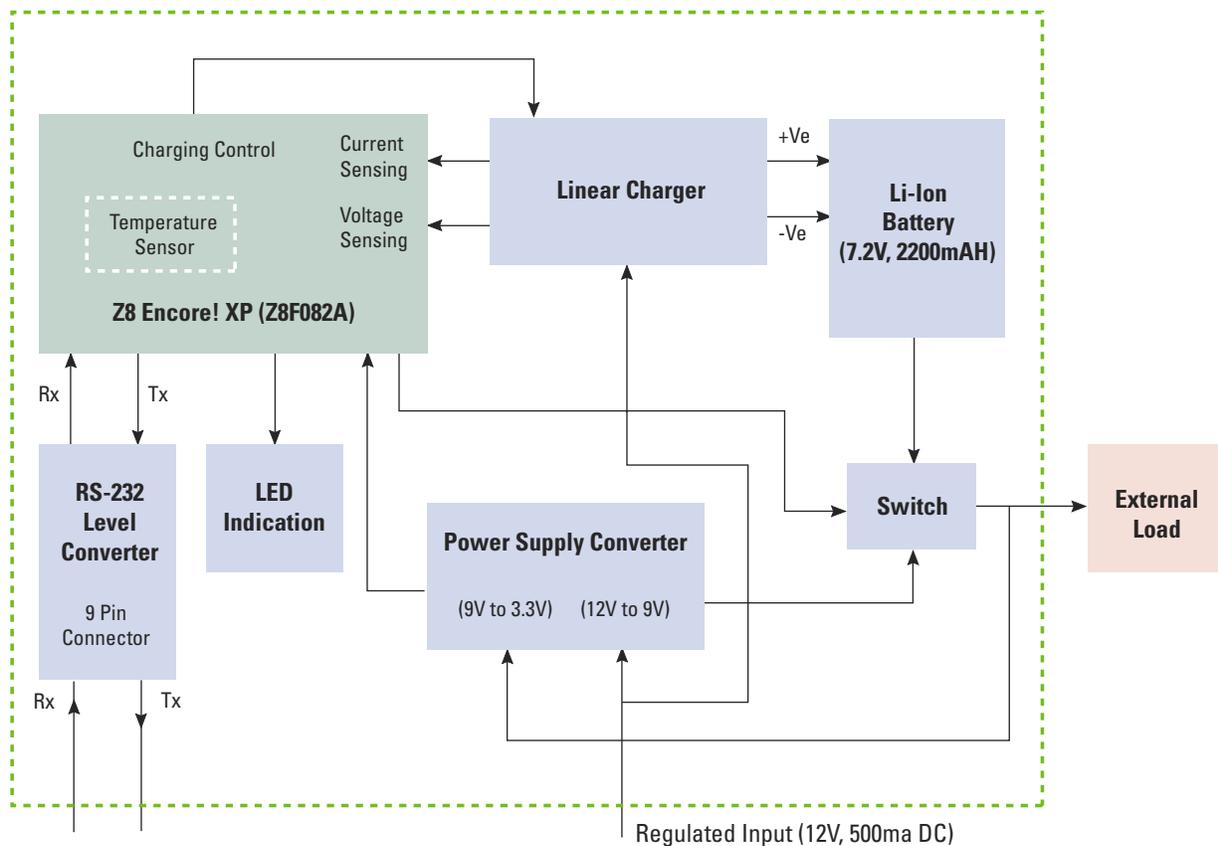
Input: 12V, 500mA DC
Output: Parameters of battery for PC, Supply voltage for Load
        Temperature is sensed by On-Chip temperature sensor.
LED indications are for Charging Mode, Charging ON/OFF, Battery Good/Bad
MOSFET is used as a switch.

Figure 1. Low-Cost Li-Ion Battery Charger Block Diagram

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Applications and Support Tools

The Z8 Encore! XP Flash microcontrollers are supported by the USB Smart Cable or the Opto-Isolated USB Smart Cable.

The microcontroller is also supported by the ZDS II Z8 Encore! XP integrated development environment (IDE) with ANSI C-Compiler, available on www.zilog.com.

Related Documentation

More information about the Z8 Encore! XP F082A described in this application brief is available in the following documents:

- *Z8 Encore! XP® Series Product Brief*, PB0159

- *Z8 Encore! XP® 8K and 4K Series Product Specification*, PS0228

- *eZ8 CPU User Manual,* UM0128

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