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AN205124

F²MC-8FX Family MB95200H/210H Series 8-Bit Microcontroller Battery Charger Reference Solution

Associated Part Family: MB95200H/210H Series

This application note describes the features of a Power Tool Battery Charger demo board. The battery charger solution is based on LPC MCU MB95F223K and MB39A132.

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1 Introduction

Power Tool Battery Charger Demo Board is used to charge the battery of handset. The battery charger solution is based on LPC MCU MB95F223K and MB39A132. MB95F223K is a SOP16 package MCU, which integrates composite timer, 8/10 A/D converter on chip. The MB39A132 is a DC/DC converter IC for charging Li-ion battery.

This demo set supports features below:

- Battery insertion detection
- 2, 3 and 4 cell battery pack
- Setting charger voltage
- Setting charger current
- LED display the charger status.

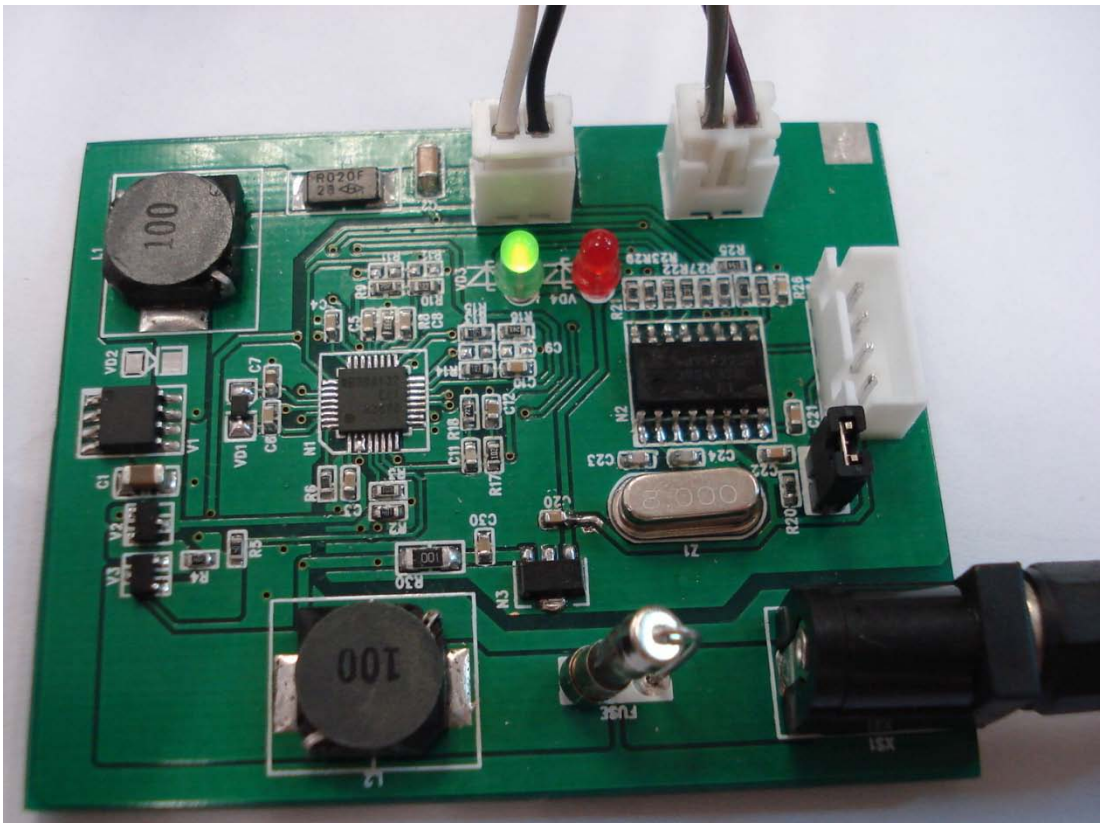
2 Demo Platform

Demo Platform of Battery Charger

2.1 Platform

Figure 1 shows the demo platform of battery charger. The red and green LEDs show the charger status.

Figure 1. Demo Platform



3 Features

Features of Battery Charger

3.1 Battery Insertion Detection

When battery insertion is detected, the charger checks the voltage and temperature of the inserted battery. The charger is stopped if it is abnormal.

Charger stops the charge process and the red LED starts to flash when charger detects that battery type is unmatched. Charger continues the charge process when a new battery is inserted.

3.2 Support 2, 3 and 4 Cell Battery Pack

Adjusting R11 and R12 can change the number of charger cell.

When R11 is unconnected and R12 is 0 Ω, the charger supports 2 cells.

When R11 is unconnected and R12 is unconnected, the charger supports 3 cells.

When R11 is 0 Ω and R12 is unconnected, the charger supports 4 cells.

The demo current status supports 3 cells.

3.3 Support Setting Charger Voltage

Upon the setting of cell number, R9 and R10 can be adjusted to change the charge voltage.

$$N_{ADJ3} = \frac{R10}{R9 + R10}$$

When N_{ADJ3} >= 0.82, one cell charge voltage is 4.20 V.

When 0.48<= N_{ADJ3} <= 0.78, one cell charge voltage is 4.35 V.

When 0 <= N_{ADJ3} <= 0.18, one cell charge voltage is 4.00 V.

When 0.22 <= N_{ADJ3} <= 0.44, one cell charge voltage is $2 \times 5 \times N_{ADJ3}$ V.

Now the demo R9 is 2 K and R10 is 12 K, one cell charge voltage is 4.2 V and the charger voltage is 12.6 V.

3.4 Support Setting Charger Current

Upon above setting, R15 and R16 can be adjusted to change the upper limit of charge current.

$$N_{ADJ2} = \frac{R16}{R15 + R16}$$

When N_{ADJ2} >= 0.92, the upper limit of charge current is 2.85 A.

When 0 <= N_{ADJ2} <= 0.88, the upper limit of charge current is $2 \times (5 \times N_{ADJ2} - 0.075)$ A.

Now the demo R15 is 100 K and R16 is 24 K, the upper limit of charge current is 1.8 A.

3.5 LED Display the Charger Status

The demo has two LEDs: green LED and red LED.

The green LED keeps on showing that the charger enters standby mode when charging is started or the battery is fully charged.

The green light flashes to show that the charger is charging.

The red LED keeps on showing that the charger detects an over temperature in battery.

The red LED flashes to show that the battery is unmatched.

Charger stops the charge process when the red LED lights on or flash. Charger continues the charge process when a new battery is inserted or resumes to normal status.

4 Hardware

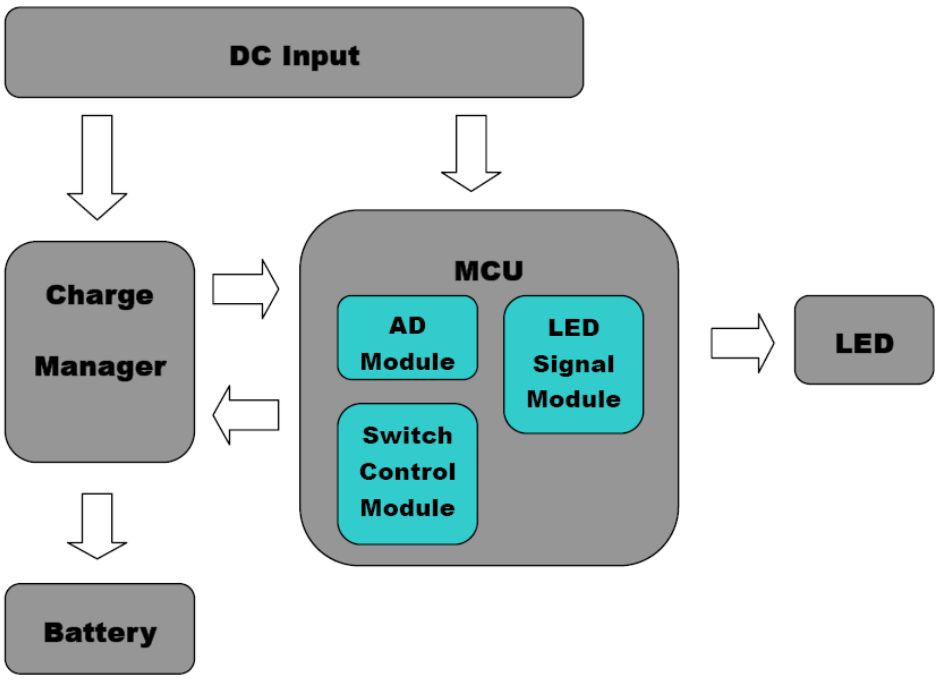
Hardware of Battery Charger

4.1 System Block Diagram

Figure 2 shows the demo system block diagram. The demo charger is developed based on MCU MB95F223K and MB39A132.

- MCU: AD module, switch control module and LED signal module
- DC input
- Charge manager
- LED
- Battery

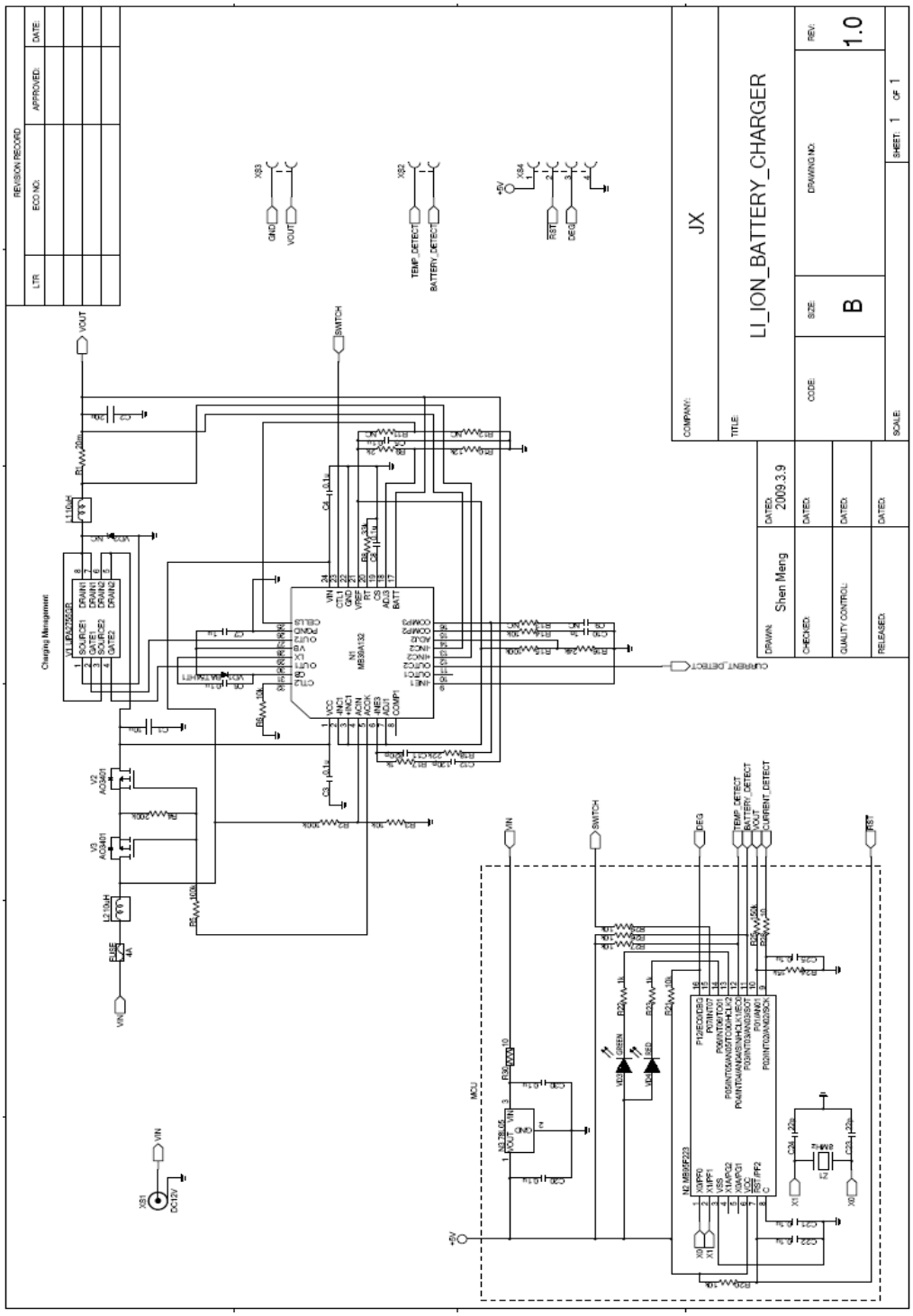
Figure 2. System Block Diagram



4.2 Schematic

Figure 3 shows the schematic.

Figure 3. Battery Charger



4.3 MCU Pin Assignment

Table 1 shows the MB95F223K pin assignment in this system.

Table 1. Pin Assignment

Pin Number	Pin	Function
10	P01/INT01	AD input, VOUT
9	P02/INT02	AD input, CURRENT_DETECT
11	P03/INT03	AD input, BATTERY_DETECT
12	P04/INT04	AD input, TEMP_DETECT
13	P05/INT05	LED output, Green LED
14	P06/INT06	LED output, Red LED
15	P07/INT07	Switch output

5 Firmware

Firmware of Battery Charger

5.1 Flowchart

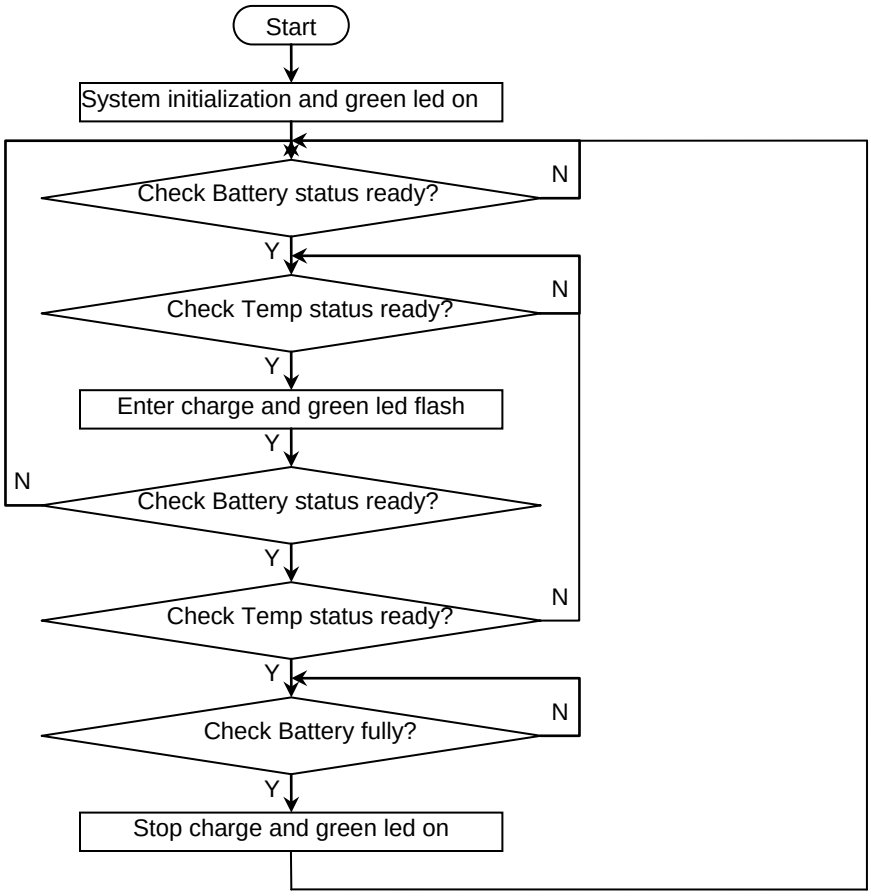
MCU initializes the on-chip peripherals and initializes the system parameters when the battery is detected and battery temperature is normal.

When above status is normal, the system will entry charging process and continue to check the battery status and temperature.

When the battery is fully charged, the charge process stops.

The description of main loop function is shown in Figure 4.

Figure 4. Main Loop Flowchart



5.2 Firmware Project

This demo uses MB95F223K to implement all the functions. MB2146-08-E and SOFTUNE V3 are used to debug the demo.

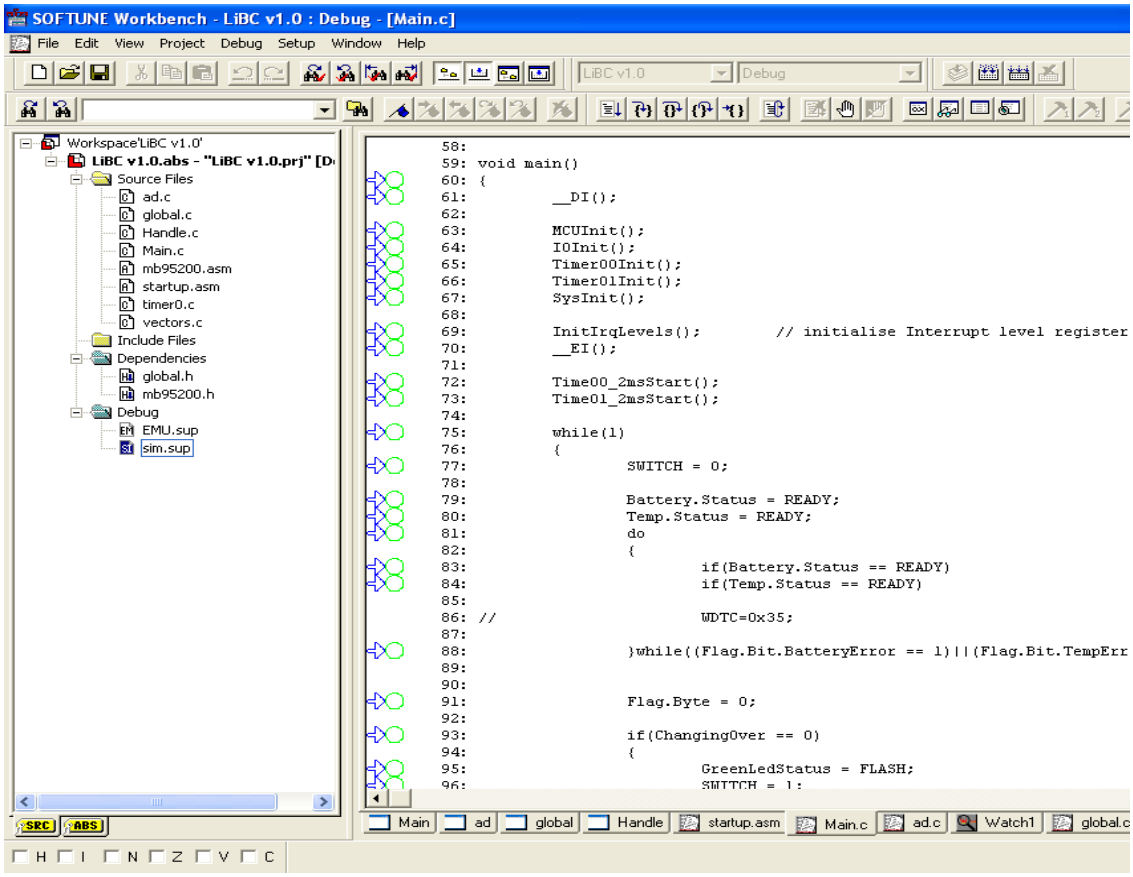
The table below explains the functions of the main files.

Table 2. Battery Charger Function

Files	Function
ad.c	Detect battery type, temperature, current and voltage
Global.c	Define global variable
Handle.c	Function module
Main.c	Main function
Ma95200.asm	Cypress MCU head file
Startup.asm	MCU configure file
Timer0.c	System clock function
Vecter.c	Interrupt setting file

The project is shown in Figure 5.

Figure 5. Demo Project



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Document History

Document Title: AN205124 – F²MC-8FX Family MB95200H/210H Series 8-Bit Microcontroller Battery Charger Reference Solution

Document Number: 002-05124

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	HUAL	09/27/2010	Initial release
*A	5276162	HUAL	05/18/2016	Migrated Spansion Application Note MCU-AN-500100-E-10 to Cypress format.

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