MCP7383X
Li-Ion System
Power Path Management
Reference Design

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
═ ISO/TS 16949:2002 ═

LI-ION SYSTEM PPM REFERENCE DESIGN

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Li-Ion System PPM Reference Design

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the Li-Ion System PPM Reference Design. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the Li-Ion System PPM Reference Design as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the Li-Ion System PPM Reference Design.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this user's guide and a description of the user's guide.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the Li-Ion System PPM Reference Design.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the Li-Ion System PPM Reference Design.

Li-Ion System PPM Reference Design

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`

	Represents code supplied by user	`void main (void)`
		`{ ...`
		`}`

RECOMMENDED READING

This user's guide describes how to use Li-Ion System PPM Reference Design. The following Microchip document is recommended as supplemental reference resources.

MCP73832 Data Sheet, "Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers", DS21984

This data sheet provides detailed information regarding the MCP73832 product family.

MCP73833 Data Sheet, "Stand-Alone Linear Li-Ion / Li-Polymer Charge Management Controller", DS22005

This data sheet provides detailed information regarding the MCP73833 product family

AN1149, "Design A Load Sharing System Power Path Management with Microchip's Stand-Alone Li-Ion Battery Charger", DS01149

This application note provides general information regarding designing with Microchip's stand-alone Li-Ion / Li-Polymer charge management controller product family.

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• Field Application Engineer (FAE)
• Technical Support

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Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (July 2008)

• Initial Release of this Document.

Li-Ion System PPM Reference Design

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

Portable electronics has played an important role in modern era. Due to the natural characteristics of Li-Ion / Li-Polymer batteries, they are the most popular power sources for mobile devices. However, extra care in design is always important to implement Li-Ion / Li-Polymer batteries. System Power Path Management allows end-users to charge their batteries without interruption. This reference design is developed to assist product designers in reducing product design cycle and time by utilizing Microchip's favorite stand-alone Li-Ion battery charge management controllers with system power path management.

This chapter provides an overview of the Li-Ion Battery Charger System Power Path Management Reference Designand covers the following topics:

• "What is the Li-Ion Battery Charger System Power Path Management Reference Design?"
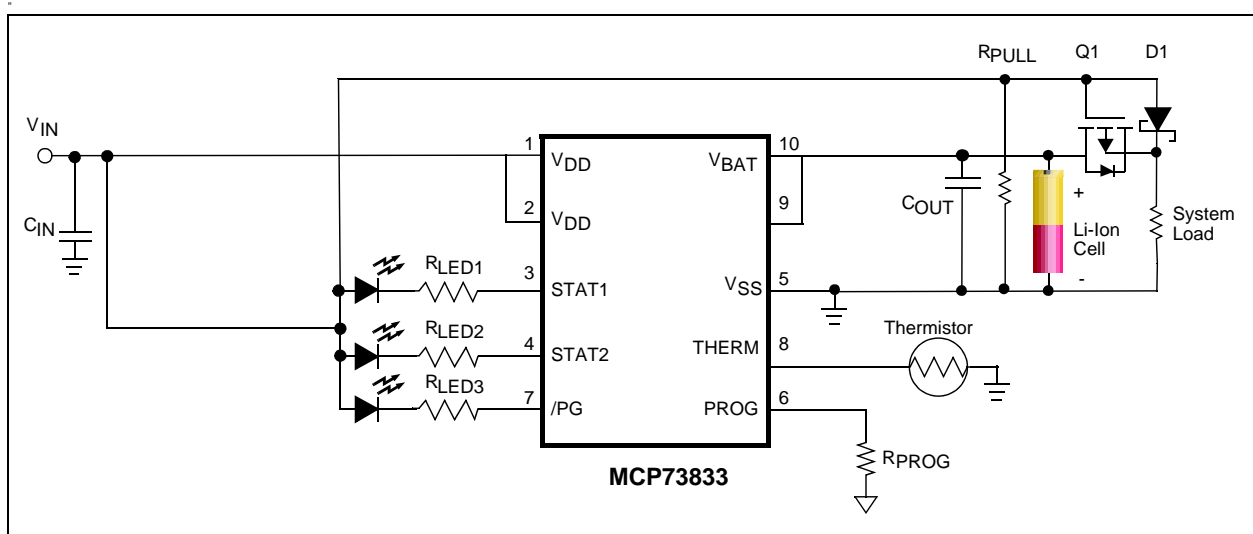• "What the Li-Ion Battery Charger System Power Path Management Reference Design Kit includes.

FIGURE 1-1: *MCP73833 With System Power Path Management Application.*

Li-Ion System PPM Reference Design

1.2 WHAT IS THE LI-ION BATTERY CHARGER SYSTEM POWER PATH MANAGEMENT REFERENCE DESIGN?

The Li-Ion Battery Charger System Power Path Management Reference Design demonstrates the features of Microchip's MCP73832 *"Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers"* and MCP73833 *"Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers"* with the load sharing system power path management capability.

There are two independent circuits on the reference design. First circuit is designed with MCP73832, which allows maximum programmable fast charge current up to 500 mA. The second circuit is designed with MCP73833, which allows maximum programmable fast charge current up to 1A and has a power good indicator and an additional status output. Two preset values of fast charge current are available for each circuit by a SPDT dip on the board for users to experience different speed.

> **Note:** Please refer to Table 2-1 for Charge Status Outputs and Table 2-2 for charge current setups.

Both circuits come with load sharing system power path management feature. This feature allows a DC Power Source to support system load while charging a Li-Ion battery. When the DC Power Source is absent, the Li-Ion battery will support system load and stop charging.

The Li-Ion Battery Charger System Power Path Management Reference Design is designed to observe the performance and features on the circuits via multiple test points. Circuits can also be implemented into suitable applications without additional work.

1.3 WHAT THE LI-ION BATTERY CHARGER SYSTEM POWER PATH MANAGEMENT REFERENCE DESIGN KIT INCLUDES

This Li-Ion Battery Charger System Power Path Management Reference Design kit includes:

- Li-Ion Battery Charger System Power Path Management Reference Design, 102-00120
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - Li-Ion System PPM Reference Design, DS51746
  - MCP73833 Data Sheet, *"Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers"*, DS21984
  - MCP73832 Data Sheet, *"Stand-Alone Linear Li-Ion / Li-Polymer Charge Management Controller"*, DS22005

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The Li-Ion Battery Charger System Power Path Management Reference Design demonstrates Microchip's stand-alone Linear Li-Ion Battery Chargers - MCP73832 and MCP73833 while allowing input power source to operate the system load. The system load can also be supported by the Li-Ion battery when input power is disconnected. A number of device options allow the MCP73832 and the MCP73833 to be utilized in a variety of applications. Please refer to the MCP73832 data sheet (DS21984) and MCP73833 data sheet (DS22005) for device options.

Typical applications for the reference design are Smart Phones, PDA, Portable Media Players, MP3 Players, Digital Cameras, Handheld Medical devices, Bluetooth head-sets, Ultra-Mobile PC and Portable Communicators.

2.2 FEATURES

The Li-Ion Battery Charger System Power Path Management Reference Design has the following features:

- Load sharing system power path management that support charging single cell Li-Ion battery and system load at the same time without affecting charging algorithm of Microchip's stand-alone charge management controllers.
- The system load is supported by Li-Ion battery when input power source is removed
- Blue LED indicates charge status
- Additional Red LED to indicate Power-Good ($\overline{PG}$) and Green LED to indicate charge complete (Available from MCP73833)
- Dip Switch to select programmable fast charge current between1000 mA (H) and 50 mA (L) for MCP73833 and 400 mA (H) and 25 mA (L) for MCP73832
- Available THERM pin on the MCP73833 for temperature monitoring with a thermister. It is disabled by default and can be enabled to use with NTC thermister.
- Preconditioning of deeply depleted cells.
- Internal Safety Timer (available from MCP73833)
- Automatic Charge Termination
- Automatic Recharge
- Thermal Regulation
- Small DFN packages with Exposed Pad as additional heat sink.

2.3   GETTING STARTED

The Li-Ion Battery Charger System Power Path Management Reference Design is fully assembled and tested for charging a single-cell Li-Ion or Li-Polymer battery with or without system load.

2.3.1   Power Input and Output Connection

2.3.1.1   POWERING THE LI-ION BATTERY CHARGER SYSTEM POWER PATH MANAGEMENT REFERENCE DESIGN

1. Connect the positive battery terminal to V_{BAT+} and negative battery terminal to V_{BAT-}.
2. Connect the 5V DC power supply Negative Terminal to V_{SS}.
3. Connect the 5V DC power supply Positive Terminal to V_{DD}.
4. It should initiate the battery charging cycle when the power source is present.
5. Position the DIP Switch to "H" for 400 mA fast charge current rate of MCP73832 and 1000 mA fast charge current rate of MCP73833.
6. Position the DIP Switch to "L" for 25 mA fast charge current rate of MCP73832 and 50 mA fast charge current rate of MCP73833.

> **Note:**   Fast Charge Current can be programmed with various resistors that based on the Figure 2-1 and Figure 2-2.
>
> **Note:**   The Li-Ion battery pack can be replaced with test circuit or electronic load that can sink current with DC power supply. Please refer to Figure 2-3.

7. Connected positive of load to System Load on the board and negative of load to either V_{SS} or V_{BAT-}. The load can be a power resistor or E-Load.
8. Remove DC power supply, the load should be supported by the Li-Ion battery now.

> **Note:**   MCP73832 circuit is labeled "A" on the reference design while MCP73833 circuit is labeled "B" on the reference design.
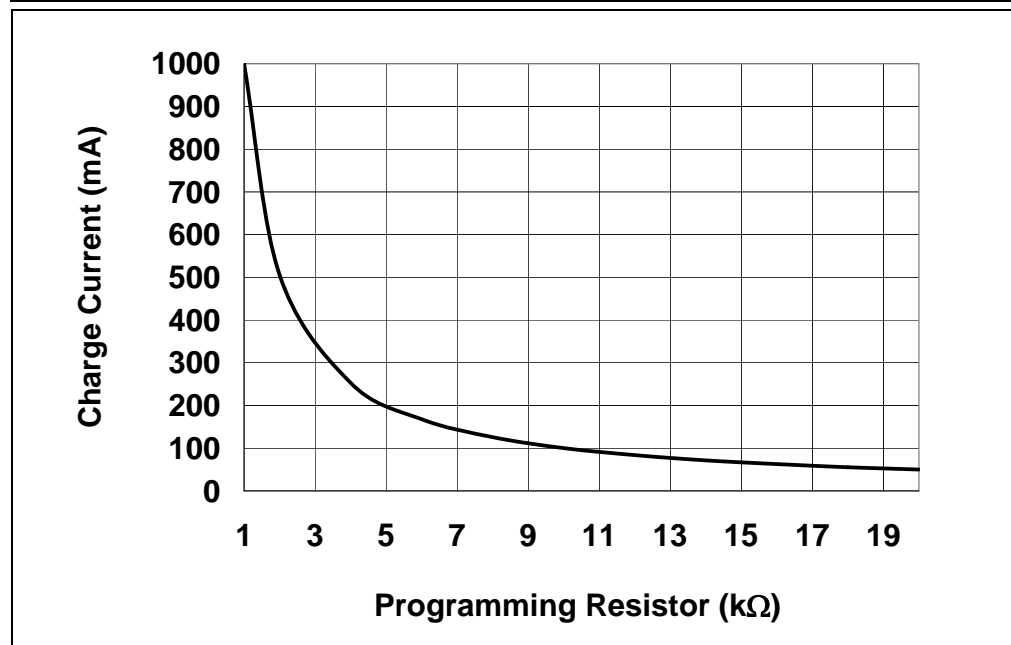
FIGURE 2-1:   *MCP73833 Charge Current (I_{OUT}) vs. Programming Resistor (R_{PROG}).*
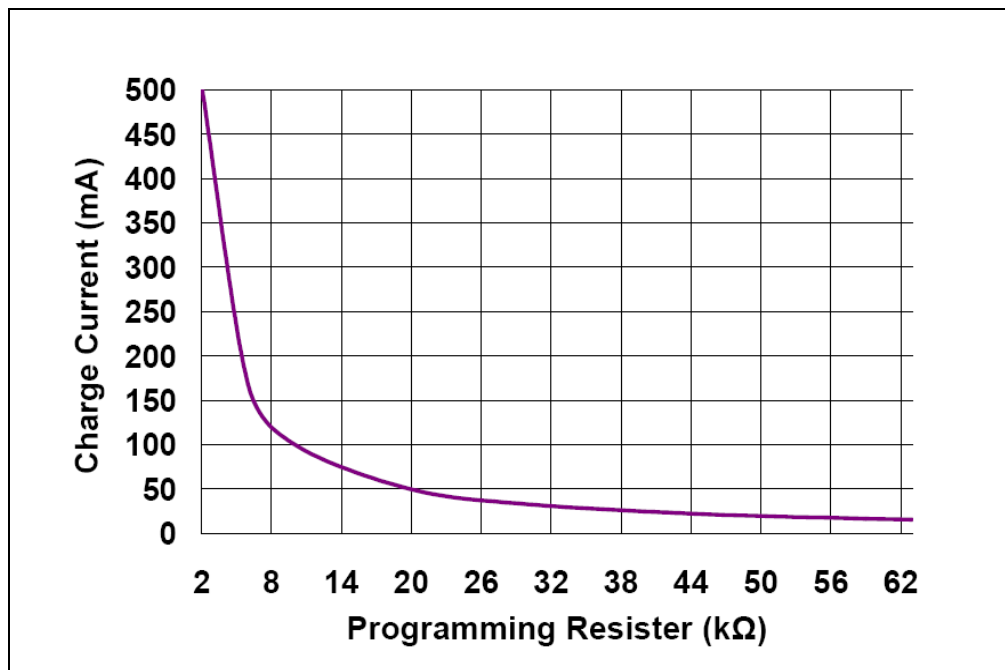
FIGURE 2-2: *MCP73832 Charge Current (IOUT) vs. Programming Resistor (R$_{PROG}$).*
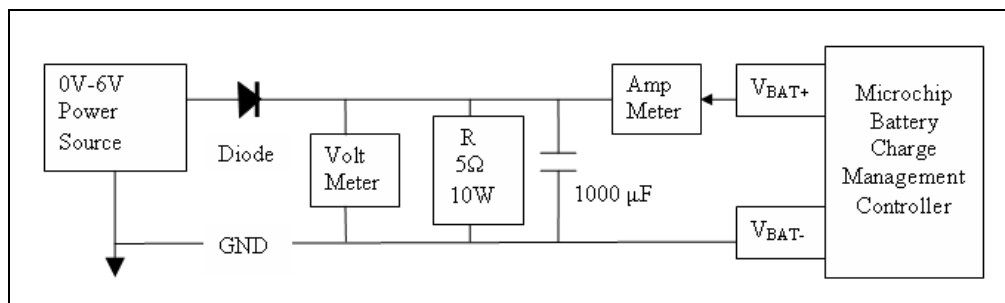
FIGURE 2-3: *Simulated Battery Load.*

Li-Ion System PPM Reference Design
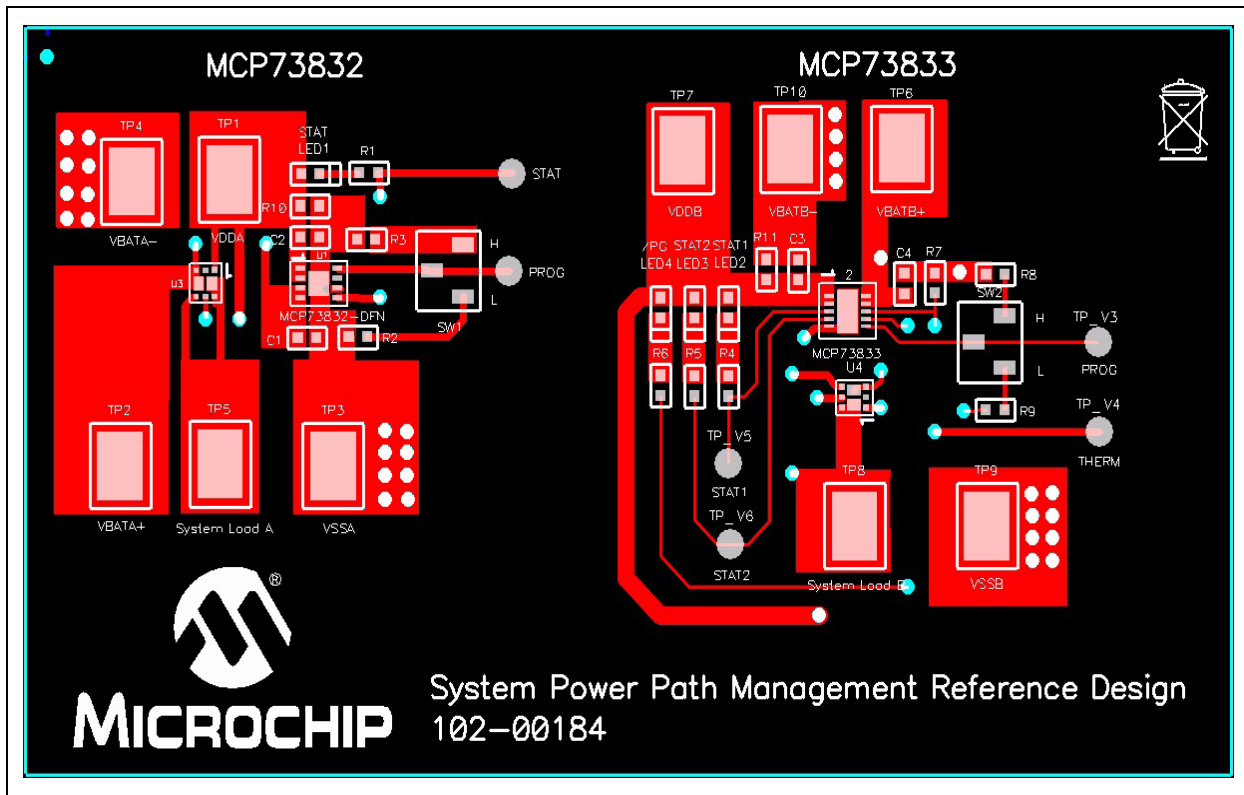
FIGURE 2-4:   *Board Top Assembly.*

TABLE 2-1:   MCP73833 CHARGE STATUS OUTPUTS

CHARGE CYCLE STATE	STAT1 (BLUE)	STAT2 (GREEN)	$\overline{PG}$ (RED)
Shutdown	OFF	OFF	OFF
Standby	OFF	OFF	ON
Charge in Progress	ON	OFF	ON
Charge Complete (EOC)	OFF	ON	ON
Temperature Fault	OFF	OFF	ON
Timer Fault	OFF	OFF	ON
System Test Mode	ON	ON	ON

TABLE 2-2:   MCP73832 CHARGE STATUS OUTPUTS

CHARGE CYCLE STATE	STAT (BLUE)
Shutdown	OFF
No Battery Present	OFF
Preconditioning	ON
Constant-Current Fast Charge	ON
Constant Voltage	ON
Charge Complete - Standby	OFF

Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the Li-Ion Battery Charger System Power Path Management Reference Design:

- Board – Schematic
- Board – Top Layer
- Board – Top Metal Layer
- Board – Bottom Layer

A.2   BOARD – SCHEMATIC

Schematic and Layouts

A.3   BOARD – TOP LAYER
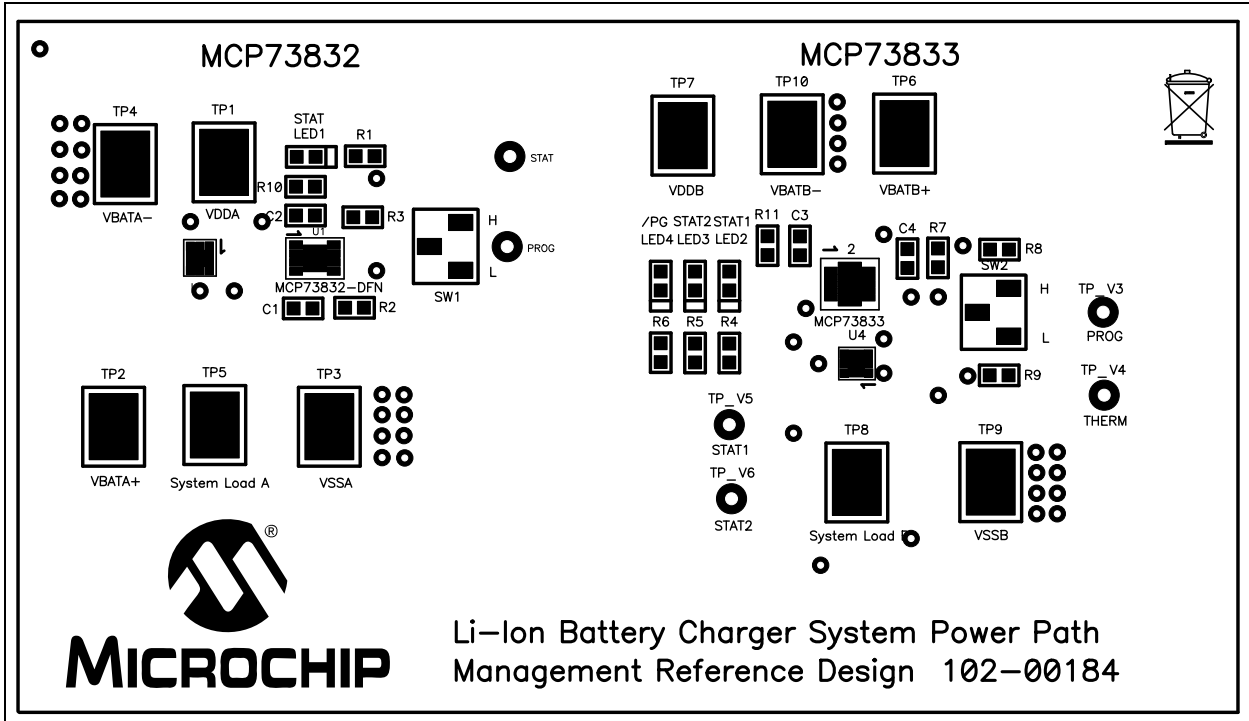
A.4   BOARD – TOP METAL LAYER

Li-Ion System PPM Reference Design

A.5   BOARD – BOTTOM LAYER

104-00184 REV-1

Appendix B. Bill Of Materials (BOM)

TABLE B-1: **BILL OF MATERIALS (BOM)**

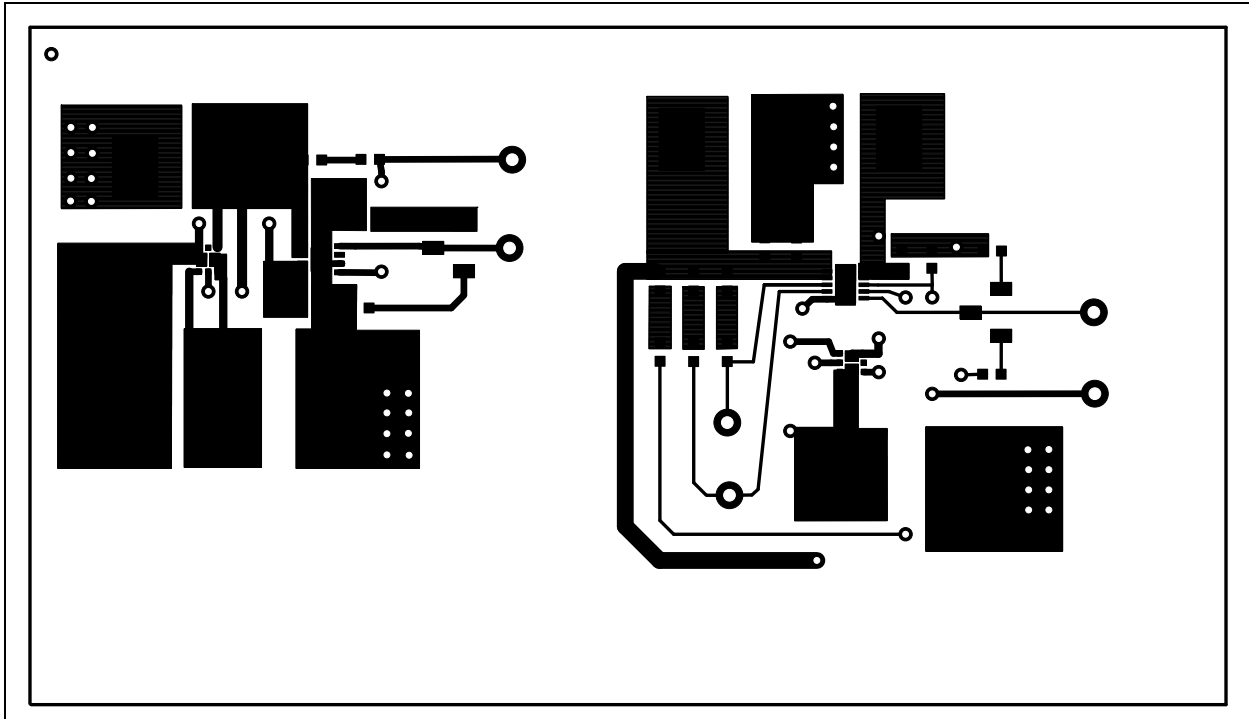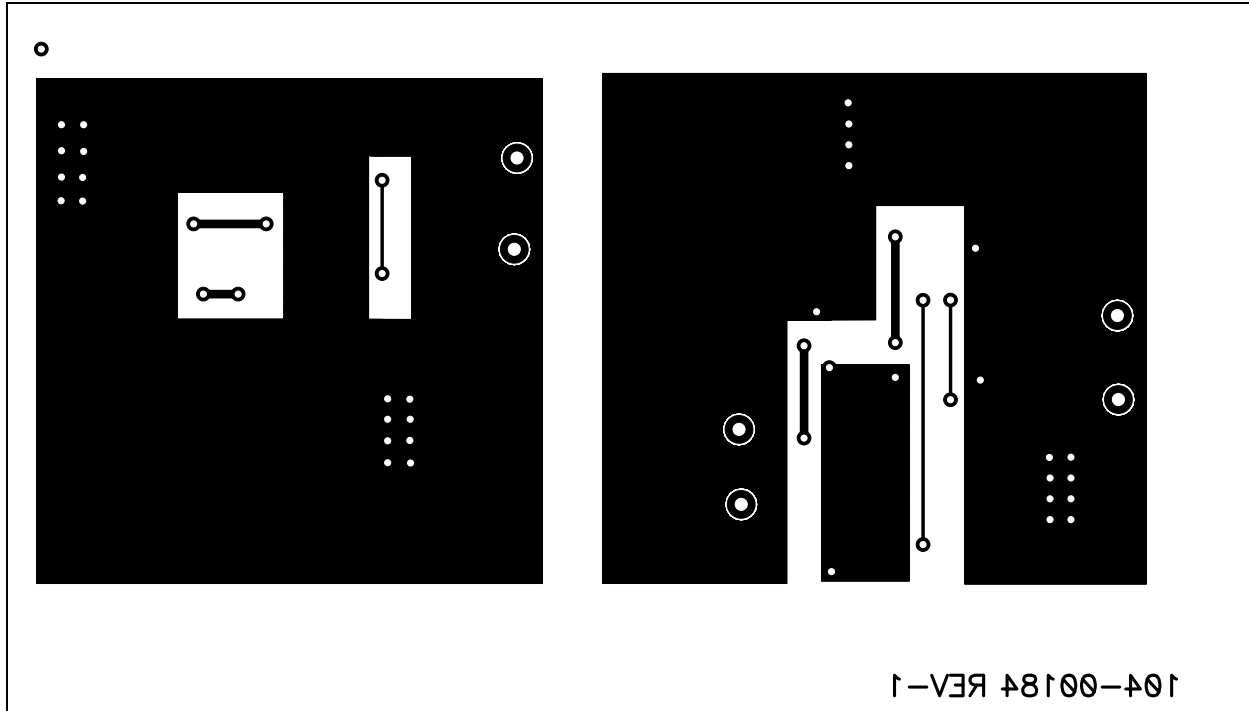| Qty	Reference	Description	Manufacture	Part Number
4	Bump	BUMPON HEMISPHERE .44X.20 WHITE	3M	SJ5003-9-ND
4	C1, C2, C3, C4	CAP CERAMIC 4.7 uF 10 X5R 0603	Taiyo Yuden	LMK107BJ475KA-T
2	LED1, LED2	Blue Water Clear 0603 SMD LED	Para Light USA	L-C191LBCT-U1
1	LED3	True Green Water Clear 0603 SMD LED	Para Light USA	L-C191LGCT-U1
1	LED4	Super Red Water Clear 0603 SMD LED	Para Light USA	L-C191KRCT-U1
1	PCB	Printed Circuit Board	—	104-00184-R1
4	R1, R4, R5, R6	RES 221 OHM 1/10W 1% 0603 SMD	Panasonic® - ECG	ERJ-3EKF2210V
1	R2	RES 41.2K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4122V
1	R3	RES 2.49K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF2491V
3	R7, R10, R11	RES 10K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1002V
1	R8	RES 1K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1001V
1	R9	RES 20K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF2002V
2	SW1, SW2	SWITCH SLIDE SPDT SMD J-LEAD	Copal Electronics Inc	CJS-1200TA
10	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10	PC Test Point Compact SMT	Keystone Electronics®	5016
1	U1	Miniature Single Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management	Microchip Technology Inc	MCP73832-2ATI/MC
1	U2	Stand-Alone Linear Li-Ion / Li-Polymer Charge Management Controller	Microchip Technology Inc	MCP73833-AMI/MF
2	U3, U4	MOSFET/SCHOTTKY P-CH MICROFET2X2	Fairchild Semiconductor®	FDFMA2P857

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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