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Table of Contents

Preface ........................................................................................................................................ 1
   Introduction .......................................................................................................................... 1
   Document Layout ............................................................................................................ 1
   Conventions Used in this Guide ....................................................................................... 2
   Recommended Reading .................................................................................................... 2
   The Microchip Web Site .................................................................................................... 3
   Customer Support ............................................................................................................ 3
   Document Revision History ............................................................................................ 3

Chapter 1. Product Overview
   1.1 Introduction .............................................................................................................. 5
   1.2 What is the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board? ........ 6
   1.3 What the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board Kit Includes: ........................................................................................................... 6

Chapter 2. Installation and Operation
   2.1 Introduction .............................................................................................................. 7
   2.2 Features ..................................................................................................................... 7
   2.3 Getting Started ......................................................................................................... 8

Appendix A. Schematic and Layouts
   A.1 Introduction ............................................................................................................. 11
   A.2 Board – Schematic .................................................................................................. 12
   A.3 Board – Assembly Drawing ................................................................................... 13
   A.4 Board – Top Layer .................................................................................................. 14
   A.5 Board – Top Metal Layer ....................................................................................... 15
   A.6 Board – Bottom Layer ........................................................................................... 16

Appendix B. Bill Of Materials (BOM)

Worldwide Sales and Service ............................................................................................... 18
INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board User’s Guide. 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 MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board. The manual layout is as follows:

• Chapter 1. “Product Overview” – Important information about the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board.
• 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 MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board.
• Appendix B. “Bill Of Materials (BOM)” – Lists the parts used to build the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board.
CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Represents</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arial font:</td>
<td>Referenced books</td>
<td><em>MPLAB® IDE User's Guide</em></td>
</tr>
<tr>
<td>Italic characters</td>
<td>Emphasized text</td>
<td><em>...is the only compiler...</em></td>
</tr>
<tr>
<td>Initial caps</td>
<td>A window</td>
<td>the Output window</td>
</tr>
<tr>
<td></td>
<td>A dialog</td>
<td>the Settings dialog</td>
</tr>
<tr>
<td></td>
<td>A menu selection</td>
<td>select Enable Programmer</td>
</tr>
<tr>
<td>Quotes</td>
<td>A field name in a window or dialog</td>
<td>&quot;Save project before build&quot;</td>
</tr>
<tr>
<td>Underlined, italic text with right angle bracket</td>
<td>A menu path</td>
<td>File&gt;Save</td>
</tr>
<tr>
<td>Bold characters</td>
<td>A dialog button</td>
<td>Click OK</td>
</tr>
<tr>
<td></td>
<td>A tab</td>
<td>Click the Power tab</td>
</tr>
<tr>
<td>'bnnnn'</td>
<td>A binary number where n is a digit</td>
<td>'b00100, 'b10</td>
</tr>
<tr>
<td>Text in angle brackets &lt; &gt;</td>
<td>A key on the keyboard</td>
<td>Press &lt;Enter&gt;, &lt;F1&gt;</td>
</tr>
<tr>
<td>Courier font:</td>
<td>Sample source code</td>
<td>#define START</td>
</tr>
<tr>
<td>Plain Courier</td>
<td>Filenames</td>
<td>autoexec.bat</td>
</tr>
<tr>
<td></td>
<td>File paths</td>
<td>c:\mcc18\h</td>
</tr>
<tr>
<td></td>
<td>Keywords</td>
<td>_asm, _endasm, static</td>
</tr>
<tr>
<td></td>
<td>Command-line options</td>
<td>-Opa+, -Opa-</td>
</tr>
<tr>
<td></td>
<td>Bit values</td>
<td>0, 1</td>
</tr>
<tr>
<td>Initial Courier</td>
<td>A variable argument</td>
<td>file.o, where file can be any valid filename</td>
</tr>
<tr>
<td>'0xnnnn'</td>
<td>A hexadecimal number where n is a hexadecimal digit</td>
<td>0xFFFF, 0x007A</td>
</tr>
<tr>
<td>Square brackets [ ]</td>
<td>Optional arguments</td>
<td>mcc18 [options] file [options]</td>
</tr>
<tr>
<td>Curly brackets and pipe character: {</td>
<td>Choice of mutually exclusive arguments; an OR selection</td>
<td>errorlevel {0</td>
</tr>
<tr>
<td>character: {</td>
<td>Ellipses...</td>
<td>Replaces repeated text var_name [, var_name...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Represents code supplied by user void main (void) { ... }</td>
</tr>
</tbody>
</table>

### RECOMMENDED READING

This user's guide describes how to use MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board. The following Microchip document is recommended as supplemental reference resources.

**MCP73213 Data Sheet, “Dual-Cell Li-Ion / Li-Polymer Battery Charge Management Controller with Input Overvoltage Protection”, DS22190**

This data sheet provides detailed information regarding the MCP73213 product family.
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Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (July 2009)

- Initial Release of this Document.
1.1 INTRODUCTION

The MCP73213 product family is highly integrated linear charge management controllers for dual-cell Li-Ion and Li-Polymer batteries. The MCP73213 product family operates with minimum external components, which is ideal for use in space-limited and cost-effective applications. The maximum 18V rated input over voltage protection and battery short circuit protection offer designers a secondary protection in addition to the Li-Ion battery protection circuit.

This chapter provides an overview of the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board and covers the following topics:

• “What is the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board?”
• “What the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board Kit Includes”

FIGURE 1-1: MCP73213 Typical Application.
1.2 WHAT IS THE MCP73213 OVP DUAL-CELL LI-ION BATTERY CHARGER EVALUATION BOARD?

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board demonstrates the features of Microchip’s MCP73213 “Dual-Cell Li-Ion / Li-Polymer Battery Charge Management Controller with Input Overvoltage Protection”.

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board is designed with two charging currents. The default value is 500 mA and when PROG via is tied to ground, the two parallel resistors output 1000 mA charging current to a Li-Ion battery. One blue LED status output allows the user to learn if the MCP73213 is in charging state or not.

**Note:** Refer to Table 2-2 for Charge Status Outputs and Table 2-1 for Fast Charge Current vs. Resistor Lookup Table.

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board comes with an installed MCP73213 device in the 3 mm x 3 mm DFN package. The factory preset battery regulation voltage is 8.40V with 10% precondition current, 10% termination current set point, automatic recharge and 6.5V OVP threshold voltage.

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board 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 MCP73213 OVP DUAL-CELL LI-ION BATTERY CHARGER EVALUATION BOARD KIT INCLUDES:

This MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board kit includes:

- MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board, 102-00261
- Important Information Sheet
Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP73213 is a highly integrated Li-Ion battery charge management controller for use in space-limited and cost-sensitive applications. The MCP73213 provides specific charge algorithms for Li-Ion / Li-Polymer batteries to achieve optimal capacity and safety in the shortest charging time possible. Along with its small physical size, the low number of external components makes the MCP73213 ideally suitable for portable applications.

The absolute maximum voltage, up to 18V, allows the use of MCP73213 in harsh environments, such as low cost ac-dc adapter.

The MCP73213 employs a constant current / constant voltage charge algorithm. The various charging voltage regulations provide design engineers flexibility to use in different applications. The fast charge, constant current value is set with one external resistor from 130 mA to 1100 mA. The MCP73213 limits the charge current based on die temperature during high power or high ambient conditions. This thermal regulation optimizes the charge cycle time while maintaining device reliability.

The PROG pin of the MCP73213 also serves as enable pin. When high impedance is applied, the MCP73213 will be in standby mode.

Typical applications for the reference design are Digital Camcorders, Portable Media Players, Handheld Medical devices, Portable Communicators, Ultra Mobile Computers and Netbook computers.

2.2 FEATURES

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board has the following features:

- 13V Input Overvoltage Protection
- 10% Preconditioning of deeply depleted cells.
- 32-Minute Preconditioning Timer
- 6-Hour Safety Timer
- 10% Automatic Charge Termination
- 500 mA and 1000 mA Preset Fast Charge Current
- Automatic Recharge
- Thermal Regulation
- One Blue LED indicates charge status
- Small DFN packages with Exposed Pad as additional heat sink
2.3 GETTING STARTED

The MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board is fully assembled and tested for charging a single-cell Li-Ion or Li-Polymer battery.

2.3.1 Power Input and Output Connection

2.3.1.1 POWERING THE MCP73213 OVP DUAL-CELL LI-ION BATTERY CHARGER EVALUATION BOARD

1. Connect the positive battery terminal to \( V_{\text{BAT}^+} \) and negative battery terminal to \( V_{\text{BAT}^-} \).
2. Connect the 9V DC power supply Negative Terminal to \( V_{\text{SS}} \).
3. Connect the 9V DC power supply Positive Terminal to \( V_{\text{DD}} \).
4. It should initiate the battery charging cycle when the power source is present and \( V_{\text{BAT}} \) is below recharge threshold. For example, when \( V_{\text{REG}} \) is 8.4V, \( V_{\text{BAT}} \) needs to be lower than 7.98V to initiate the charge cycle.

5. The charging status table is available on Table 2-2.
6. The fast charge current is preset at 500 mA and can be increased to 1A by connecting PROG via to ground.

---

**Note:** The Li-Ion battery pack can be replaced with test circuit or electronic load that can sink current with DC power supply. Refer to Figure 2-3.

**Note:** Fast Charge Current can be programmed with various resistors based on Figure 2-2 and Table 2-1.

![Board Top Assembly Diagram]

**FIGURE 2-1:** Board Top Assembly.
FIGURE 2-2: MCP73213 Charge Current (I\text{OUT}) vs. Programming Resistor (R\text{PROG}).

TABLE 2-1: MCP73213 RESISTOR LOOKUP TABLE

<table>
<thead>
<tr>
<th>Charge Current (mA)</th>
<th>Recommended E96 Resistor (Ω)</th>
<th>Recommended E24 Resistor (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>10k</td>
<td>10k</td>
</tr>
<tr>
<td>150</td>
<td>8.45k</td>
<td>8.20k</td>
</tr>
<tr>
<td>200</td>
<td>6.20k</td>
<td>6.20k</td>
</tr>
<tr>
<td>250</td>
<td>4.99k</td>
<td>5.10k</td>
</tr>
<tr>
<td>300</td>
<td>4.02k</td>
<td>3.90k</td>
</tr>
<tr>
<td>350</td>
<td>3.40k</td>
<td>3.30k</td>
</tr>
<tr>
<td>400</td>
<td>3.00k</td>
<td>3.00k</td>
</tr>
<tr>
<td>450</td>
<td>2.61k</td>
<td>2.70k</td>
</tr>
<tr>
<td>500</td>
<td>2.32k</td>
<td>2.37k</td>
</tr>
<tr>
<td>550</td>
<td>2.10k</td>
<td>2.20k</td>
</tr>
<tr>
<td>600</td>
<td>1.91k</td>
<td>2.00k</td>
</tr>
<tr>
<td>650</td>
<td>1.78k</td>
<td>1.80k</td>
</tr>
<tr>
<td>700</td>
<td>1.62k</td>
<td>1.60k</td>
</tr>
<tr>
<td>750</td>
<td>1.50k</td>
<td>1.50k</td>
</tr>
<tr>
<td>800</td>
<td>1.40k</td>
<td>1.50k</td>
</tr>
<tr>
<td>850</td>
<td>1.33k</td>
<td>1.30k</td>
</tr>
<tr>
<td>900</td>
<td>1.24k</td>
<td>1.20k</td>
</tr>
<tr>
<td>950</td>
<td>1.18k</td>
<td>1.20k</td>
</tr>
<tr>
<td>1000</td>
<td>1.10k</td>
<td>1.10k</td>
</tr>
<tr>
<td>1100</td>
<td>1.00k</td>
<td>1.00k</td>
</tr>
</tbody>
</table>
**TABLE 2-2: MCP73213 CHARGE STATUS OUTPUTS**

<table>
<thead>
<tr>
<th>CHARGE CYCLE STATE</th>
<th>STAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutdown</td>
<td>Hi-Z</td>
</tr>
<tr>
<td>Standby</td>
<td>Hi-Z</td>
</tr>
<tr>
<td>Preconditioning</td>
<td>L</td>
</tr>
<tr>
<td>Constant Current Fast Charge</td>
<td>L</td>
</tr>
<tr>
<td>Constant Voltage</td>
<td>L</td>
</tr>
<tr>
<td>Charge Complete - Standby</td>
<td>Hi-Z</td>
</tr>
<tr>
<td>Temperature Fault</td>
<td>1.6 second 50% D.C. Flashing (Type 1)</td>
</tr>
<tr>
<td></td>
<td>Hi-Z (Type 2)</td>
</tr>
<tr>
<td>Timer Fault</td>
<td>1.6 second 50% D.C. Flashing (Type 1)</td>
</tr>
<tr>
<td></td>
<td>Hi-Z (Type 2)</td>
</tr>
<tr>
<td>Preconditioning Timer Fault</td>
<td>1.6 second 50% D.C. Flashing (Type 1)</td>
</tr>
<tr>
<td></td>
<td>Hi-Z (Type 2)</td>
</tr>
</tbody>
</table>

**FIGURE 2-3:** Simulated Battery Load.
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP73213 OVP Dual-Cell Li-Ion Battery Charger Evaluation Board:

• Board – Schematic
• Board – Top Layer
• Board – Top Metal Layer
• Board – Bottom Layer
A.3 BOARD – TOP LAYER

TP3
VSS

TP1
VDD

C2

R3
PROG

R1
D1

R2
STAT

U1

C1

TP4
VBAT–

VBAT+

TP2

102-00261
MCP73213EV–2SOVP

OVP Dual Cell Li–Ion Battery Charger
A.4 BOARD – TOP METAL LAYER
# Appendix B. Bill Of Materials (BOM)

## TABLE B-1: BILL OF MATERIALS

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Bump</td>
<td>BUMPON HEMISPHERE .44X.20 WHITE</td>
<td>3M</td>
<td>SJ5003-9-ND</td>
</tr>
<tr>
<td>2</td>
<td>C1, C2</td>
<td>CAP CERAMIC 4.7 µF 25V X5R 1206</td>
<td>TDK</td>
<td>C2012X5R1E475M</td>
</tr>
<tr>
<td>1</td>
<td>D1</td>
<td>Blue Water Clear 0603 SMD LED</td>
<td>Para Light USA</td>
<td>L-C191LBCT-U1</td>
</tr>
<tr>
<td>1</td>
<td>PCB</td>
<td>RoHS Compliant Bare PCB, MCP73213 Evaluation Board</td>
<td>Microchip Technology Inc.</td>
<td>104-00261</td>
</tr>
<tr>
<td>2</td>
<td>R1, R3</td>
<td>RES 2.37K OHM 1/10W 1% 0603 SMD</td>
<td>Panasonic® - ECG</td>
<td>ERJ-3EKF2371V</td>
</tr>
<tr>
<td>1</td>
<td>R2</td>
<td>RES 1K OHM 1/10W 1% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3EKF1001V</td>
</tr>
<tr>
<td>4</td>
<td>TP1, TP2, TP3, TP4</td>
<td>PC Test Point Compact SMT</td>
<td>Keystone Electronics®</td>
<td>5016</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>Dual-Cell Li-Ion/Li-Poly Battery Charger with OVP</td>
<td>Microchip Technology Inc.</td>
<td>MCP73213-A6S/MF</td>
</tr>
</tbody>
</table>

**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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