Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip’s Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip’s code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer’s risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELoo, KEELoo logo, microD, MPLAB, PIC, PICmicro, PICSTART, PRO MATE, rPIC and SmartShunt are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AmpLab, FilterLab, Linear Active Thermistor, Migratable Memory, MXDEV, MXMLAB, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, Mindi, MIWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, PICkit, PICDEM, PICDEM.net, PICLAB, PICtail, PowerCal, PowerInfo, PowerMate, PowerTool, REAL ICE, rLAB, Select Mode, Smart Serial, SmartTel, Total Endurance, UNI/O, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2007, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

Printed on recycled paper.
# Table of Contents

Preface .......................................................................................................................... 1  

Chapter 1. Product Overview  
1.1 Introduction ..................................................................................................... 5  
1.2 Features ......................................................................................................... 6  

Chapter 2. Installation and Operation  
2.1 Board Description ........................................................................................... 9  
2.2 Getting Started ............................................................................................. 11  

Appendix A. Schematic and Layouts  
A.1 Introduction .................................................................................................. 15  
A.2 Schematic .................................................................................................... 16  
A.3 Top Layer and Silk Screen ......................................................................... 17  
A.4 Bottom Layer ............................................................................................. 17  

Appendix B. Bill Of Materials (BOM)  

Worldwide Sales and Service .................................................................................. 22
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
MCP3421 Battery Fuel Gauge Demo Board. 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 MCP3421 Battery Fuel Gauge Demo Board
as a development tool. The manual layout is as follows:

• Chapter 1. “Product Overview” - Provides the important information about the
  MCP3421 Battery Fuel Gauge Demo Board.
• Chapter 2. “Installation and Operation” – Covers the installation and operation
  of the MCP3421 Battery Fuel Gauge Demo Board. It lists the required tools,
  shows how to set up the board, and demonstrates how to verify the amplifier
  operation.
• Appendix A. “Schematic and Layouts” – Shows the schematic and board
  layouts for the MCP3421 Battery Fuel Gauge Demo Board.
• Appendix B. “Bill Of Materials (BOM)” – Lists the parts used to build the
  MCP3421 Battery Fuel Gauge Demo 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></td>
<td></td>
</tr>
<tr>
<td>Italic characters</td>
<td>Referenced books</td>
<td><em>MPLAB® IDE User’s Guide</em></td>
</tr>
<tr>
<td>Emphasized text</td>
<td>...is the only compiler...</td>
<td></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</td>
<td>A menu path</td>
<td><em>File &gt; Save</em></td>
</tr>
<tr>
<td>angle bracket</td>
<td></td>
<td></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 <em>Power</em> tab</td>
</tr>
<tr>
<td>N’Rnnnn</td>
<td>A number in verilog format, where N</td>
<td>4'b0010, 2'hF1</td>
</tr>
<tr>
<td></td>
<td>is the total number of digits, R is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the radix and n is a digit.</td>
<td></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 New font:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plain Courier New</td>
<td>Sample source code</td>
<td><code>#define START</code></td>
</tr>
<tr>
<td>Filenames</td>
<td>autoexec.bat</td>
<td></td>
</tr>
<tr>
<td>File paths</td>
<td>c:\mcc18\h</td>
<td></td>
</tr>
<tr>
<td>Keywords</td>
<td>_asm, _endasm, static</td>
<td></td>
</tr>
<tr>
<td>Command-line options</td>
<td>-Opa+, -Opa-</td>
<td></td>
</tr>
<tr>
<td>Bit values</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>Constants</td>
<td>0xFF, ‘A’</td>
<td></td>
</tr>
<tr>
<td>Italic Courier New</td>
<td>A variable argument</td>
<td><em>file.o</em>, where <em>file</em> can be</td>
</tr>
<tr>
<td>Square brackets []</td>
<td>Optional arguments</td>
<td>any valid filename</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>Ellipses...</td>
<td>Replaces repeated text</td>
<td>var_name [, \n</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RECOMMENDED READING

This user's guide describes how to use MCP3421 Battery Fuel Gauge Demo Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

MPLAB® IDE, Simulator, Editor User's Guide (DS51025)

Consult this document for more information pertaining to the installation and features of the MPLAB Integrated Development (IDE) Software.

MCP3421 Data Sheet, “18-Bit ADC with I2C Interface and On-Board Reference” (DS22003)

Data sheet for the 18 bit ADC MCP3421. This data sheet is needed to understand how the MCP3421 is used to measure the current and battery voltage.

MCP73831/2 Data Sheet, “Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers” (DS21984)

Data sheet for the Single-Cell Li-Ion, Li-Polymer Charger. This data sheet is helpful to understand how the battery fuel is charged.

PIC18F2455/2550/4455/4550 Data Sheet, (DS39632)

This data sheet is needed if the user wants to modify the firmware used in the demo board.

Note: In the MCP3421 Battery Fuel Gauge Demo Board Kit, the battery charging function is disabled. Contact Microchip Technology, Inc., if you need this function enabled.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

• Product Support – Data sheets and errata, application notes and sample programs, design resources, user’s guides and hardware support documents, latest software releases and archived software

• General Technical Support – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing

• Business of Microchip – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

• Distributor or Representative
• Local Sales Office
• Field Application Engineer (FAE)
• Technical Support

Customers should contact their distributor, representative or field application engineer for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

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

Revision A (October 2007)

- Initial Release of this Document.
Chapter 1.  Product Overview

1.1  INTRODUCTION

The MCP3421 Battery Fuel Gauge Demo Board is used to demonstrate the MCP3421 device for battery fuel gauging applications.

The MCP3421 Battery Fuel Gauge Demo Board includes two MCP3421 devices, MCP73831 (single cell Li-Ion/Li-Polymer Charger), and PIC18F4550 MCU.

The MCP3421 device is a low-power, single channel 18-bit delta-sigma Analog-to-Digital Converter (ADC) in a SOT-23 package. It has an internal voltage reference ($V_{REF} = 2.048V$) and programmable gain amplifier ($x1,x2, x4, x8$). It communicates with a master device with I$^2$C interface.

The MCP3421 Battery Fuel Gauge Demo Board measures: (a) the battery voltage and (b) the current coming out from the battery in the discharging mode and into the battery in the charging mode using the ADC device (if charging mode is enabled (optional)). It calculates the total fuel used and also remaining fuels. The measurement takes places approximately every one second and updates the measurement data and calculated results on the LCD for about every second.

The MCP3421 Battery Fuel Gauge Demo Board includes 2x16 LCD. The LCD displays: (a) measured battery voltage and current, (b) calculated results of battery fuel used.

The MCP3421 Battery Fuel Gauge Demo Board also includes a buzzer. This buzzer makes a buzzing sound when the battery voltage drops 50% or the battery is not connected.

The PIC18F4550 communicates with the MCP3421 and calculates the fuels. The board also includes a USB connector for a PC graphic user interface (GUI) utility. This GUI is available only for the training class and not included with this demo kit.

Figure 1-1 shows the picture of the MCP3421 Battery Fuel Gauge Demo Board. The board includes device foot prints for the two channel 18-bit ADC (MCP3422). The MCP3421 and MCP3422 are the same device family with the same electrical performance, but the MCP3422 has two channels. Therefore, the two MCP3421 devices on the board can be replaced with one MCP3422 device.

**Note:** MCP3421 Battery Fuel Gauge Demo Board has a feature to charge the battery in use. This feature is currently disabled in firmware. Please contact Microchip Technology Inc. if you need the battery charging feature.
1.2 FEATURES

The MCP3421 Battery Fuel Gauge Demo Board has the following features:

- Measure the battery voltage and display the result on LCD.
- Measure the current coming out from the battery (discharging current) or coming into the battery (charging current) and displays the value on LCD.

**Note:** The charging current is only available when the battery charging mode is enabled.

- Calculate the battery fuel that has been used and display the result on LCD.
- Turn on beep sounds if the battery is used more than 50% of its initial value, or the battery is not connected.

**Note:** The MCP3421 Battery Fuel Gauge Demo Board can be also configured very easily for other sensor output measurements. Just connect the sensor output at the ADC input terminal. The LCD will display the voltage.

The MCP3421 Battery Fuel Gauge Demo Board includes a 9V and 1.5V AAA batteries. Please make sure the positive lead of the 1.5V battery holder is connected to TP9 and the negative lead (black) is connected to the GND terminal.

**WARNING**

The U1 and U5 devices may get damaged if the polarity of the battery connection is reversed. If the connection is accidently reversed, replace the U1 and U5 devices in order to obtain accurate measurements.
FIGURE 1-1: MCP3421 Battery Fuel Gauge Demo Board (Top Side).

NOTICE

Note 1: Use 9V Power Supply or 9V Battery. Do not use both at same time.

2: 1.5V battery connection: connect the positive lead (red) to TP9 and the negative lead (black) to the GND terminal. A reversed connection will damage the U1 and U5 devices.
FIGURE 1-2: MCP3421 Battery Fuel Gauge Demo Board (Bottom Side).
Chapter 2. Installation and Operation

2.1 BOARD DESCRIPTION

The major components of the MCP3421 Battery Fuel Gauge Demo Board are:

1. MCP3421 devices (U1 and U5).
   - U1: Measuring current using the R12 current sensor.
   - U5: Measuring battery voltage.
2. PIC MCU - PIC18F4550 (U2).
3. MPLAB ICD2 Header (P2).
4. USB connector (Not used for this version).
7. 9V Power Supply (BAT 1 and 9V power supply, use only one).
8. 1.5V AAA Battery with battery holder.
9. 2 x 16 LCD (LCD1).
10. MCP73831 device (U3).
11. Switches (SW1, SW2, SW3, SW4, Reset Switch).
12. Potentiometer (R1).

For more detailed circuit information, refer to Appendix A: “Schematics and Layouts” and Appendix B: Bill of Materials”.

2.1.1 Power Supply

The MCP3421 Battery Fuel Gauge Demo Board needs a 9V power supply to provide a 5V DC power to all active components including MCU, ADC, battery charger devices, etc. The user can use a 9V power supply or 9V battery. The MCP3421 Battery Fuel Gauge Demo Board has two connectors for both the 9V power supply and 9V battery. Do not use both power sources at same time.

Note: All active electrical components on the board are powered by the 9V power source. The 1.5V AAA battery that is connected to TP9 (positive) and GND (negative) terminals DOES NOT power the board components. During the discharging, the current path of the test battery is from the 1.5V battery to the ground via a 10 mili-ohm current sensor and an 100Ω resistor. During the recharging mode (if recharging mode is enabled), the current path is from the VBAT pin of U3 (MCP73831) to the battery via the current sensor.

2.1.2 Microcontroller (MCU)

The PIC18F4550 (44-pin, TQFT) is used to control ADC devices, charger, buzzer, and LCD. All fuel gauge computations are takes place in the MCU.

2.1.3 LCD Display

The LCD display used is a 2 x 16 character dot matrix type display. The PIC18F4550 device writes characters to the LCD.
2.1.4 Buzzer

This demo board has a buzzer. The buzzer beeps when the board is first powered up and also when the battery fuel is consumed 50% or less, or the battery is disconnected.

2.1.5 USB Connector

This board has a USB connector for the PIC18F4550. The current firmware version for the PIC18F4550 is not including the USB interface feature.

2.1.6 Interface to MPLAB® ICD2 Programmer

The MCP3421 Battery Fuel Gauge Demo Board includes the PIC18F4550. This MCU is used to control the data acquisition devices (ADC) and compute the fuel gauging parameters. The MCU also sends characters to the LCD.

The board has an 8-pin connector for the ICD In-Circuit Serial Programming™ (ICSP™). The MCU source code is written in assembly language. The user can modify the code for their own experiment using the MPLAB ICD2 Programmer. The user needs an ICD-2 ICSP adapter socket (P/N: AC164110) between the MPLAB ICD2 Programmer and the MCP3421 Battery Fuel Gauge Demo Board.

2.1.7 Jumper

The MCP3421 Battery Fuel Gauge Demo Board uses two jumpers, JP1 and JP2. JP1 is used to provide a battery discharge path. Connect JP1 (while JP2 is disconnected) when testing battery discharging. Contact Microchip Technology Inc., if you need the battery charging mode.

**Note:** Do not connect both JP1 and JP2 at the same time.

2.1.8 Push Button Switches

The MCP3421 Battery Fuel Gauge Demo Board has 5 push button switches.

- **SW1** is used to enter the battery fuel gauging mode.
- **SW2, SW3, SW4:** are not Used.
- **Reset SW** is the MCLR reset pin switch and is used to reset the MCU.

2.1.9 Potentiometer (R1)

This potentiometer is used to calibrate the input voltage to the ADC and is calibrated before shipping to the customer. If the customer wants to calibrate, then refer to Step 5 of the calibration procedure in **Section 2.2.1 “Battery Fuel Measurement”**.

2.1.10 Signal Outputs

The MCP3421 Battery Fuel Gauge Demo Board has various test points to capture the communication between the MCU and ADC devices. The user can see the I2C communication data streams at SCL and SDA test pins using an oscilloscope. The SYNC terminal is used as a “trigger” source when the SCL and SDA signals are captured. The board also has the test terminals for the battery charger (U3): Prog 1, Prog 2 and C-STAT terminals.
2.2 GETTING STARTED

You can simulate battery voltage discharging and charging using the MCP3421 Battery Fuel Gauge Demo Board.

**Battery Fuel Measurement Mode:** The MCP3421 Battery Fuel Gauge Demo Board measures the currents coming from the battery every second and computes how many fuels are being used. The fuel is calculated from the time when the MCP3421 Battery Fuel Gauge Demo Board is powered and the fuel measurement is initiated. When JP1 jumper is connected, a battery discharging path from the battery to the current sensor to the 100Ω resistor (R11) to ground is created. This simulates how battery fuel is consumed in real applications. The differential input pins of U1 (ADC) are connected across the current sensor and measure the current passing through the current sensor. The ADC can determine whether the measured current is discharging current or charging current by testing the sign of the current value. In the battery discharging path, the direction of current flow is from the battery to the ground through R12 and R11. Therefore, the LCD will display a positive sign (‘+’) on the display.

### 2.2.1 Battery Fuel Measurement

The battery fuel being used is measured by setting up a discharge path. This discharge path is created when connecting Jumper 1 (JP1) while disconnecting Jumper 2 (JP2).


**Note:** Make sure JP2 is not connected.

2. Connect a 9V power supply to J1, or connect a 9V battery to TP11.

There are two 9V connections. You can use either 9V battery or 9V power supply. Only one power source is used.

3. The LED D3 will turn on, and the LCD will display the following message:

   ![Microchip Fuel Gauge Demo](image)

4. A few seconds later, the LCD will display the following message:

   ![Disconnect JP2, ConntJP1, Push S1](image)

5. Press S1. The LCD will display the following message:

   ![Connect 1.5V Bat at TP9, Press S1](image)

If the 1.5V battery is disconnected, connect the positive lead (red) of the 1.5V battery holder to the TP9 terminal and the negative lead (black) to the GND terminal. Make sure the 1.5V AAA battery is correctly inserted into the battery holder. Press the S1 push button.
6. The LCD will display the following message continuously:

![Display with values]

V = +1.5203062 V
I = +0.0141780 A

Fuel Used:
0.02452 mAh

**WARNING**

If the 1.5V AAA battery is reverse connected to the TP9 and GND, it will cause permanent damage to the U1 and U5 devices. The reading on the LCD is not reliable anymore.

If this happens, one of the symptoms is that the LCD will display a higher reading or a lesser reading (negative) sign in the current “I” reading. Please replace the U1 and U5 devices, if this incident occurred or contact Microchip Technology Inc.
ADC Input Voltage Calibration:

The potentiometer (R1) is used to calibrate the ADC input voltage. If the displayed battery voltage on the LCD is suspicious, the customer can calibrate the ADC input voltage using the following method:

1. Connect a digital voltmeter between the TP9 (Battery) and Ground (TP4).
2. Read the volts value on the LCD while adjusting the potentiometer. Adjust the potentiometer until the reading on the LCD is the same as the reading on the Digital Volt Meter (DVM). This completes the ADC input calibration.

**Note:** The MCP3421 (U5) is used to measure the battery voltage. The internal reference voltage of the MCP3421 is 2.048V. The MCP3421 (U5) will give a saturated output if the input is greater than its reference voltage (2.048V). To avoid the saturation, the MCP3421 Battery Fuel Gauge Demo Board uses a voltage divider formed by R3, R4 and R1. The potentiometer (R1) is used to calibrate the voltage divider, and provide 50% of the voltage applied at TP9 to the input pin of the MCP3421 (U5). The microcontroller (U2) firmware takes into account this voltage divider value automatically. The firmware multiplies a factor of 2 on the U5 result and displays the result on the LCD.

**FIGURE 2-1:** MCP3421 Battery Fuel Gauge Computation Algorithm.
FIGURE 2-2: MCP3421 Battery Fuel Gauge Computation Algorithm with Battery Recharge Feature Enabled. (Contact Microchip Technology Inc., if you need this feature enabled).
Appendix A. Schematic and Layouts

NOTICE TO CUSTOMERS

All documentation becomes dated, and this user’s guide is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some schematics and board layouts may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

A.1 INTRODUCTION

This appendix contains the schematics and PCB layouts for the MCP3421 Battery Fuel Gauge Demo Board. This Appendix includes:

- Schematic
- Top Layer (with silk screen)
- Bottom Layer
NOTES:
## NOTICE TO CUSTOMERS

All documentation becomes dated, and this user’s guide is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so the Bill Of Materials may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

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

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BAT1</td>
<td>BATTERY ALKALINE 9V</td>
<td>Gold Peak</td>
<td>29A</td>
</tr>
<tr>
<td>1</td>
<td>BAT1 + lug</td>
<td>CONN BATT 9V MALE OFF-BRD SNAP</td>
<td>Keystone Electronics®</td>
<td>635</td>
</tr>
<tr>
<td>1</td>
<td>BAT1 - lug</td>
<td>CONN BATT 9V FEMALE OFF-BRD SNAP</td>
<td>Keystone Electronics</td>
<td>636</td>
</tr>
<tr>
<td>0</td>
<td>BAT2</td>
<td>DO NOT POPULATE Polymer Li-Ion Battery; One Mini size (25x20x5 mm) 3.7V, 170mAh for Micro RC Car or Device</td>
<td>—</td>
<td>PL-052025</td>
</tr>
<tr>
<td>1</td>
<td>BAT3</td>
<td>IC Test Clips Red</td>
<td>Kobiconn</td>
<td>13IC307</td>
</tr>
<tr>
<td>1</td>
<td>BAT3</td>
<td>IC Test Clips Black</td>
<td>Kobiconn</td>
<td>13IC308</td>
</tr>
<tr>
<td>1</td>
<td>BAT3</td>
<td>HOLDER BATTERY 1CELL AAA 6&quot;LEAD</td>
<td>Keystone Electronics</td>
<td>2467</td>
</tr>
<tr>
<td>1</td>
<td>BT3</td>
<td>Alkaline Batteries AAA SIZE ALKALINE-CELL</td>
<td>Gold Peak</td>
<td>GP24AU-OS2</td>
</tr>
<tr>
<td>1</td>
<td>BUZZER PIEZO</td>
<td>BUZZER PIEZO 4KHZ 17.5MM SMT</td>
<td>Mallory Sonalert Products Inc</td>
<td>AST100Q</td>
</tr>
<tr>
<td>9</td>
<td>C1, C4, C7, C9, C10, C11, C12, C13, C19</td>
<td>CAP .1UF 16V CERAMIC X7R 0603</td>
<td>Panasonic® - ECG</td>
<td>ECJ-1VB1C104K</td>
</tr>
<tr>
<td>2</td>
<td>C2, C3</td>
<td>CAP CERAMIC 4.7UF 6.3V X5R 0603</td>
<td>Panasonic - ECG</td>
<td>ECJ-1VB0J475K</td>
</tr>
<tr>
<td>3</td>
<td>C5, C17, C18</td>
<td>CAP 1.0UF 16V CERAMIC X5R 0603</td>
<td>Panasonic - ECG</td>
<td>ECJ-1VB1C105K</td>
</tr>
<tr>
<td>1</td>
<td>C6</td>
<td>CAP CER .33UF 16V X7R 0603</td>
<td>Murata Electronics North America</td>
<td>GRM188R71C334KA01D</td>
</tr>
<tr>
<td>2</td>
<td>C8,C14</td>
<td>CAP CER 10UF 6.3V X5R 0603</td>
<td>Murata Electronics North America</td>
<td>GRM188R60J106ME47D</td>
</tr>
<tr>
<td>2</td>
<td>C15, C16,</td>
<td>CAP CERAMIC 18PF 50V 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ECJ-1VC1H180J</td>
</tr>
<tr>
<td>1</td>
<td>D1</td>
<td>LED THIN 565NM GRN DIFF 0805 SMD</td>
<td>Lumex® Inc.</td>
<td>SML-LXT0805GW-TR</td>
</tr>
</tbody>
</table>

**Note:** 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.
### TABLE B-1: BILL OF MATERIALS (BOM) (CONTINUED)

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>D2, D6, D7, D8, D9, D10, D11, D12, D13, D14</td>
<td>LED THIN 635NM RED DIFF 0805 SMD</td>
<td>Lumex Inc.</td>
<td>SML-LXT0805IW-TR</td>
</tr>
<tr>
<td>1</td>
<td>D3</td>
<td>Lumex Opto/Components Inc</td>
<td>Lumex Inc.</td>
<td>SML-LX15IC-TR</td>
</tr>
<tr>
<td>1</td>
<td>D4</td>
<td>DIODE SWITCH 100V 150MA SOD123</td>
<td>Micro Commercial Co.</td>
<td>1N4148W-TP</td>
</tr>
<tr>
<td>1</td>
<td>D5</td>
<td>DIODE SWITCHING 100V DO35</td>
<td>Micro Commercial Co.</td>
<td>1N914B-TP</td>
</tr>
<tr>
<td>4</td>
<td>Ea. Comer</td>
<td>SCREW MACH PHIL 4-40X1/4 NYLON</td>
<td>Building Fasteners</td>
<td>NY PMS 440 0025 PH</td>
</tr>
<tr>
<td>4</td>
<td>Ea. Comer</td>
<td>STANDOFF HEX .375/4-40THR NYLON</td>
<td>Keystone Electronics</td>
<td>1902B</td>
</tr>
<tr>
<td>1</td>
<td>J1</td>
<td>CONN POWER JACK 2.5MM PCB CIRC</td>
<td>CUI Inc</td>
<td>PJ-102B</td>
</tr>
<tr>
<td>2</td>
<td>JP1, JP2</td>
<td>CONN HEADER VERT 2POS .100 TIN</td>
<td>Tyco® Electronics/Amp</td>
<td>3-644695-2</td>
</tr>
<tr>
<td>0</td>
<td>JP3</td>
<td>Do Not Populate</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>SHNTS JP1 &amp; JP2</td>
<td>SHUNT LP W/HANDLE 2 POS 30AU</td>
<td>Tyco Electronics/Amp</td>
<td>881545-2</td>
</tr>
<tr>
<td>1</td>
<td>L1</td>
<td>INDUCTOR FIXED SMD 10UH 10%</td>
<td>Panasonic - ECG</td>
<td>ELJ-FC100KF</td>
</tr>
<tr>
<td>1</td>
<td>LCD1</td>
<td>16 X 2 LCD Character Display</td>
<td>Fema</td>
<td>CG1626-SGR1</td>
</tr>
<tr>
<td>0</td>
<td>P2</td>
<td>Do Not Populate</td>
<td>Tyco Electronics/Amp</td>
<td>3-644456-6</td>
</tr>
<tr>
<td>1</td>
<td>PCB</td>
<td>RoHS Compliant Bare PCB, MCP3421 Battery Fuel Gauge Demo Board</td>
<td>—</td>
<td>104-00121</td>
</tr>
<tr>
<td>1</td>
<td>R1</td>
<td>POT 200K OHM THUMBWHEEL CERM ST</td>
<td>Bourns Inc.</td>
<td>3352T-1-204LF</td>
</tr>
<tr>
<td>7</td>
<td>R2, R7, R10, R17, R18, R28, R29</td>
<td>RES 10.0K OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW060310K0FKEA</td>
</tr>
<tr>
<td>1</td>
<td>R3</td>
<td>RES 510K OHM 1/10W 5% 0603 SMD</td>
<td>Rohm</td>
<td>MCR03EZPJ514</td>
</tr>
<tr>
<td>1</td>
<td>R4</td>
<td>RES 390K OHM 1/10W 5% 0603 SMD</td>
<td>Rohm</td>
<td>MCR03EZPJ394</td>
</tr>
<tr>
<td>1</td>
<td>R5</td>
<td>RES 100K OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW0603100KFKEA</td>
</tr>
<tr>
<td>1</td>
<td>R6</td>
<td>RES 2.49K OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW0603249KFEA</td>
</tr>
<tr>
<td>2</td>
<td>R8, R9</td>
<td>RES 221 OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW0603221RFKEA</td>
</tr>
<tr>
<td>1</td>
<td>R11</td>
<td>RES 100 OHM 1/8W 1% 0805 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-6ENF1000V</td>
</tr>
<tr>
<td>1</td>
<td>R12</td>
<td>RES CURRENT SENSE .010 OHM 3W</td>
<td>Ohmite</td>
<td>13FR010E</td>
</tr>
<tr>
<td>9</td>
<td>R13, R14, R15, R19, R26, R27, R32, R33, R34</td>
<td>RES 1.5K OHM 1/16W .5% 0603 SMD</td>
<td>Susumu Co Ltd</td>
<td>RR0816P-152-D</td>
</tr>
<tr>
<td>2</td>
<td>R16, R30, R31</td>
<td>RES 1.0K OHM 1/10W .5% 0603 SMD</td>
<td>Yageo® Corporation</td>
<td>RT0603DRD071KL</td>
</tr>
</tbody>
</table>

**Note:** 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.
### TABLE B-1: BILL OF MATERIALS (BOM) (CONTINUED)

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R20</td>
<td>RES 332 OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW0603332RFKEA</td>
</tr>
<tr>
<td>2</td>
<td>R21, R22</td>
<td>RES 24.9 OHM 1/10W 1% 0603 SMD</td>
<td>Vishay/Dale</td>
<td>CRCW060324R9FKEA</td>
</tr>
<tr>
<td>0</td>
<td>R23</td>
<td>Do Not Populate — —</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>R24</td>
<td>RES 523 OHM 1/10W 1% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3EKF5230V</td>
</tr>
<tr>
<td>1</td>
<td>R25</td>
<td>RES 4.7K OHM 1/10W 5% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3GEYJ472V</td>
</tr>
<tr>
<td>2</td>
<td>R35, R36</td>
<td>RES 0.0 OHM 1/10W 5% 0603 SMD</td>
<td>Yageo Corporation</td>
<td>RC0603JR-070RL</td>
</tr>
<tr>
<td>5</td>
<td>S1, S2, S3, S4, S5</td>
<td>SWITCH LT TOUCH 6X3.5 100GF SMD</td>
<td>Panasonic - ECG</td>
<td>EVQ-PJS04K</td>
</tr>
<tr>
<td>12</td>
<td>TP1&lt;&gt;TP18</td>
<td>PC TEST POINT COMPACT SM</td>
<td>Keystone Electronics</td>
<td>5016</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>18-Bit Analog-to-Digital Converter with I2C Interface and On-Board Reference</td>
<td>Microchip Technology Inc.</td>
<td>MCP3421A0T-E/OT</td>
</tr>
<tr>
<td>1</td>
<td>U2</td>
<td>High-Performance, Enhanced Flash, USB Microcontroller, 44-Pin, QFP</td>
<td>Microchip Technology Inc.</td>
<td>PIC18F4550-I/PT</td>
</tr>
<tr>
<td>1</td>
<td>U3</td>
<td>Minature Single Cell, Fully integrated Li-Ion, Li-Polymer Charge Management Controller</td>
<td>Microchip Technology Inc.</td>
<td>MCP73831-2ACI/OT Alternate Part# MCP73831-2ACI/OT</td>
</tr>
<tr>
<td>1</td>
<td>U4</td>
<td>MCP1702 mA Low Quiescent Current LDO Regulator</td>
<td>Microchip Technology Inc.</td>
<td>MCP1702T-5002I/CB</td>
</tr>
<tr>
<td>1</td>
<td>U5</td>
<td>18-Bit Analog-to-Digital Converter with I2C Interface and On-Board Reference</td>
<td>Microchip Technology Inc.</td>
<td>MCP3421A3T-E/OT</td>
</tr>
<tr>
<td>0</td>
<td>U6</td>
<td>Do Not Populate — —</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>USB1</td>
<td>CONN RECEIPT MINI USB2.0 5POS</td>
<td>Hirose Electronic Co. Ltd</td>
<td>UX60-MB-5ST</td>
</tr>
<tr>
<td>1</td>
<td>X1</td>
<td>CRYSTAL 20.000MHZ 18PF FUND SMD</td>
<td>Connor-Winfield</td>
<td>XM-1-20.0000</td>
</tr>
</tbody>
</table>

**Note:** 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.
## WORLDWIDE SALES AND SERVICE

### AMERICAS

#### Corporate Office
2355 West Chandler Blvd.
Chandler, AZ  85224-6199
Tel:  480-792-7200
Fax:  480-792-7277
Technical Support:  http://support.microchip.com
Web Address:  www.microchip.com

#### Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

#### Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

#### Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

#### Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

#### Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

#### Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

#### Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

#### Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

#### Toronto
Mississauga, Ontario, Canada
Tel: 905-673-0699
Fax: 905-673-6509

### ASIA/PACIFIC

#### Asia Pacific Office
Suites 3707-14, 37th Floor Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

#### Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

#### China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

#### China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

#### China - Fuzhou
Tel: 86-591-8750-3506
Fax: 86-591-8750-3521

#### China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

#### China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

#### China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

#### China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

#### China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

#### China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

#### China - Shunde
Tel: 86-757-2839-5507
Fax: 86-757-2839-5571

#### China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

#### China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

#### India - Bangalore
Tel: 91-80-4182-8400
Fax: 91-80-4182-8422

#### India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

#### India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

#### Japan - Yokohama
Tel: 81-45-471-6166
Fax: 81-45-471-6122

#### Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

#### Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or 82-2-558-5934

#### Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

#### Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

#### Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

#### Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

#### Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

#### Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

#### Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

#### Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

### EUROPE

#### Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

#### Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

#### France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

#### Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

#### Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

#### Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

#### Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

#### UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

10/05/07