Multimedia Expansion Board
User’s Guide
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INTRODUCTION

This chapter contains general information that will be useful to know before using the starter kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This user’s guide describes how to use the Multimedia Expansion Board and consists of the following chapters:

- **Chapter 1. “Introduction”** provides a brief overview of each starter kit, highlighting their features and uses.
- **Chapter 2. “Hardware”** provides the hardware descriptions of each starter kit.
- **Appendix A. “Board Layout and Schematics”** provides a block diagram, board layouts and detailed schematics of each starter kit.
CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

<table>
<thead>
<tr>
<th>Description</th>
<th>Represents</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arial font:</strong></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></td>
<td>Emphasized text</td>
<td>...is the only compiler...</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><em>File&gt;Save</em></td>
</tr>
<tr>
<td>Bold characters</td>
<td>A dialog button</td>
<td>Click <em>OK</em></td>
</tr>
<tr>
<td></td>
<td>A tab</td>
<td>Click the <em>Power</em> tab</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><strong>Courier New font:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plain Courier New</td>
<td>Sample source code</td>
<td>#define START</td>
</tr>
<tr>
<td></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></td>
<td>Constants (in source code)</td>
<td>0xFF, ‘A’</td>
</tr>
<tr>
<td>Italic Courier New</td>
<td>A variable argument</td>
<td><em>file.o</em>, where file can be any valid filename</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>Ellipses...</td>
<td>Replaces repeated text</td>
<td>var_name [, var_name...]</td>
</tr>
<tr>
<td></td>
<td>Represents code supplied by user</td>
<td>void main (void) { ... }</td>
</tr>
</tbody>
</table>
RECOMMENDED READING

The following Microchip documents are available and recommended as supplemental reference resources.

**Release Notes for the Multimedia Expansion Board**

For the latest information, Microchip has a dedicated web page for the Multimedia Expansion Board, which can be accessed at: http://www.microchip.com/PIC32

**PIC32MX3XX/4XX Family Data Sheet (DS61143) and PIC32MX5XX/6XX/7XX Family Data Sheet (DS61156)**

Refer these documents for detailed information on PIC32 32-bit devices. Reference information found in these data sheets includes:

- Device memory maps
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the devices

**MPLAB® C Compiler for PIC32 User’s Guide (DS51686)**

This document, formerly the MPLAB C32 C Compiler for PIC32 User’s Guide, details the use of Microchip’s MPLAB C Compiler for PIC32 to develop an application.

**MPLAB® IDE User’s Guide (DS51519)**

Refer this document for more information pertaining to the installation and implementation of the MPLAB IDE software, as well as the MPLAB Editor and MPLAB SIM Simulator software that are included with it.

THE MICROCHIP WEB SITE

Microchip provides online support through our web site at http://www.microchip.com. This web site makes files and information easily available to customers. Accessible by most Internet browsers, 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 listings
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listings of seminars and events; and listings of Microchip sales offices, distributors and factory representatives
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Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at http://www.microchip.com, click Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C18 and MPLAB C30 C compilers, and MPLAB C Compiler for PIC32; ASM32, MPASM™ and MPLAB ASM30 assemblers; MPLINK™, and MPLAB LINK30, MPLAB LINK32 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.

- **Emulators** – The latest information on Microchip in-circuit emulators. This includes the MPLAB REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.

- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes the MPLAB ICD 3 and PICkit™ 2.

- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.

- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 device programmer and the PICSTART® Plus, PICkit™ 1 and PICkit 2 development programmers.

CUSTOMER SUPPORT

Several channels are available to assist the users of Microchip products:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

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

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

Revision A (June 2010)

This is the initial release of the Multimedia Expansion Board User's Guide.
Chapter 1. Introduction

Thank you for purchasing Microchip Technology Multimedia Expansion Board. This compact, highly versatile board can be connected to any PIC32MX starter kit for the purpose of developing multimedia applications, such as audio, graphics and touch screen.

This chapter includes the following topics:

• Kit Contents
• Multimedia Features

1.1 KIT CONTENTS

The Multimedia Expansion Board kit contains the following items:

• Multimedia Expansion Board
• Multimedia Expansion Board Information Sheet

1.2 MULTIMEDIA FEATURES

The component layout of the Multimedia Expansion Board is shown in Figure 1-1 (front side) and Figure 1-2 (back side).

The front side of the board includes these key features, as shown in Figure 1-1:

1. 3.2 inch (8.1 cm) QVGA touch screen display with backlight.
2. Five user-controlled LEDs.
3. Four-way joystick (S2).
4. Fire button (S1).
5. Headphone jack.
7. Microphone input jack.
8. Power LED.
9. I/O expansion connector.
The back side of the board includes these key features, as indicated in Figure 1-2:

2. microSD card slot.
3. Regulated 3.3V and 1.8V power supply for powering the board via a starter kit or 9-14V power supply.
4. Accelerometer and temperature sensor (BMA150).
5. 24LC08 EEPROM.
6. 2 MB SPI Flash (SST25VF016).
7. 24-bit stereo audio codec (WM8731).
8. CPLD for SPI and Chip Select configuration.
9. PIC32 starter kit connector.
10. Integrated 802.11 wireless connectivity.
FIGURE 1-2: MULTIMEDIA EXPANSION BOARD COMPONENT LAYOUT (BACK SIDE)
Chapter 2. Hardware

This chapter describes the hardware used in the Multimedia Expansion Board. Topics covered include:

- Power Supply
- Starter Kit Connector
- Display
- microSD Card Slot
- Joystick and Fire Button
- User-Controlled LEDs
- Accelerometer and Temperature Sensor
- External Memory
- 24-bit Audio Codec
- 802.11 Wireless Connectivity
- I/O Expansion Connector
- CPLD

**Note:** Refer to Appendix B. “Bill of Materials (BOM)” for the manufacturer and part number information of the hardware components used in the Multimedia Expansion Board.

2.1 POWER SUPPLY

Power can be supplied to the Multimedia Expansion Board through the DC connector located on the Multimedia Expansion Board (Figure 2-1). By connecting a 9-14V power supply to the DC connector, the Multimedia Expansion Board and starter kit will receive the proper voltages. The user can also supply power via the starter kit. However, if the application uses multiple features of the Multimedia Expansion Board, it is recommended to use 9-14V power supply.

**FIGURE 2-1: DC POWER SUPPLY**

---

**CAUTION**

When connecting the Multimedia Expansion Board or starter kit, do not have power applied when connecting the DC power supply. Failure to heed this caution could result in hardware damage.
### 2.2 STARTER KIT CONNECTOR

Any PIC32 starter kit can be used in conjunction with the Multimedia Expansion Board through the PIC32 expansion connector, as shown in Figure 2-2. After connecting a PIC32 starter kit, applications can be developed and run using the rich features of the Multimedia Expansion Board. Table 2-1 provides information on starter kit pins and the corresponding Multimedia Expansion Board device.

#### TABLE 2-1: STARTER KIT PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Pin Type</th>
<th>Device Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>PMP Data &lt;7:0&gt;</td>
<td>I/O</td>
<td>Graphics Controller (SSD1926)</td>
<td>8-bit or 16-bit Data Bus</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PMP Data &lt;15:8&gt;</td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td>I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>RG13</td>
<td>O</td>
<td>Chip Select</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>RB10</td>
<td>O</td>
<td>Register Select</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>RC3</td>
<td>I</td>
<td>Wait Line</td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>RA10</td>
<td>O</td>
<td>Reset</td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>RB11</td>
<td>I/O</td>
<td>Touch Screen</td>
<td>X+</td>
</tr>
<tr>
<td>105</td>
<td>RB12</td>
<td>O</td>
<td></td>
<td>Y-</td>
</tr>
<tr>
<td>107</td>
<td>RB13</td>
<td>O</td>
<td></td>
<td>X-</td>
</tr>
<tr>
<td>127</td>
<td>RB14</td>
<td>I/O</td>
<td></td>
<td>Y+</td>
</tr>
<tr>
<td>72</td>
<td>RB0/CN2</td>
<td>I</td>
<td>Joystick</td>
<td>Left</td>
</tr>
<tr>
<td>70</td>
<td>RB1/CN3</td>
<td>I</td>
<td></td>
<td>Up</td>
</tr>
<tr>
<td>66</td>
<td>RB3/CN5</td>
<td>I</td>
<td></td>
<td>Down</td>
</tr>
<tr>
<td>64</td>
<td>RB4/CN6</td>
<td>I</td>
<td></td>
<td>Right</td>
</tr>
<tr>
<td>36</td>
<td>RB15/CN12</td>
<td>I</td>
<td></td>
<td>Fire</td>
</tr>
<tr>
<td>44</td>
<td>RD1</td>
<td>O</td>
<td>LEDs</td>
<td>LED1</td>
</tr>
<tr>
<td>42</td>
<td>RD2</td>
<td>O</td>
<td></td>
<td>LED2</td>
</tr>
<tr>
<td>40</td>
<td>RD3</td>
<td>O</td>
<td></td>
<td>LED3</td>
</tr>
<tr>
<td>35</td>
<td>RC1</td>
<td>O</td>
<td></td>
<td>LED4</td>
</tr>
<tr>
<td>37</td>
<td>RC2</td>
<td>O</td>
<td></td>
<td>LED5</td>
</tr>
</tbody>
</table>
### TABLE 2-1: STARTER KIT PIN DESCRIPTION (CONTINUED)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Pin Type</th>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>SDA2</td>
<td>I</td>
<td>I2C bus for BMA150, MCHP24LC08 and WM8731</td>
<td>I2C Bus</td>
</tr>
<tr>
<td>76</td>
<td>SCL2</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>SCK1</td>
<td>O</td>
<td>SPI Bus for WM8731</td>
<td>SPI Bus</td>
</tr>
<tr>
<td>93</td>
<td>SDI1</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>SDO1</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RA6</td>
<td>O</td>
<td>CPLD</td>
<td>Control Pins</td>
</tr>
<tr>
<td>6</td>
<td>RA7</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RG12</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RG14</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>SCK2</td>
<td>O</td>
<td>SPI Bus</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>SDI2</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>SDO2</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>RG9</td>
<td>O</td>
<td>Chip Select</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>SCK3A</td>
<td>O</td>
<td>SPI Bus</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>SDI3A</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>SDO3A</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>RF12</td>
<td>O</td>
<td>Chip Select</td>
<td></td>
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<td>SS1</td>
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<td>Codec DACLR</td>
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<td></td>
</tr>
<tr>
<td>81</td>
<td>INT3</td>
<td>I</td>
<td>MRF24WBOMA</td>
<td>External Interrupt</td>
</tr>
<tr>
<td>115</td>
<td>RA10</td>
<td>O</td>
<td></td>
<td>reset</td>
</tr>
<tr>
<td>71</td>
<td>RB8</td>
<td>O</td>
<td></td>
<td>Chip Enable</td>
</tr>
<tr>
<td>76</td>
<td>SCL2</td>
<td>I/O</td>
<td>PICtail J5</td>
<td>Pin 3</td>
</tr>
<tr>
<td>74</td>
<td>SDA2</td>
<td>I/O</td>
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<td>Pin 5</td>
</tr>
<tr>
<td>47</td>
<td>SDI2</td>
<td>I/O</td>
<td></td>
<td>Pin 7</td>
</tr>
<tr>
<td>49</td>
<td>SDO2</td>
<td>I/O</td>
<td></td>
<td>Pin 9</td>
</tr>
<tr>
<td>45</td>
<td>SCK2</td>
<td>I/O</td>
<td></td>
<td>Pin 11</td>
</tr>
<tr>
<td>51</td>
<td>RG9</td>
<td>I/O</td>
<td></td>
<td>Pin 13</td>
</tr>
<tr>
<td>88</td>
<td>U1RX</td>
<td>I/O</td>
<td></td>
<td>Pin 15</td>
</tr>
<tr>
<td>90</td>
<td>U1TX</td>
<td>I/O</td>
<td></td>
<td>Pin 17</td>
</tr>
<tr>
<td>92</td>
<td>U1RTS</td>
<td>I/O</td>
<td></td>
<td>Pin 19</td>
</tr>
<tr>
<td>94</td>
<td>U1CTS</td>
<td>I/O</td>
<td></td>
<td>Pin 21</td>
</tr>
<tr>
<td>73</td>
<td>RB9</td>
<td>I/O</td>
<td></td>
<td>Pin 23</td>
</tr>
<tr>
<td>115</td>
<td>RA10</td>
<td>O</td>
<td></td>
<td>Pin 25</td>
</tr>
<tr>
<td>85</td>
<td>INT1</td>
<td>I/O</td>
<td></td>
<td>Pin 27</td>
</tr>
<tr>
<td>84</td>
<td>SCL1</td>
<td>I/O</td>
<td></td>
<td>Pin 4</td>
</tr>
<tr>
<td>86</td>
<td>SDA1</td>
<td>I/O</td>
<td></td>
<td>Pin 6</td>
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<td>97</td>
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<td>I/O</td>
<td></td>
<td>Pin 8</td>
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<td>110</td>
<td>U2RX</td>
<td>I/O</td>
<td></td>
<td>Pin 16</td>
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<td>112</td>
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<td>106</td>
<td>U2RTS</td>
<td>I/O</td>
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<td>Pin 20</td>
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<td>108</td>
<td>U2CTS</td>
<td>I/O</td>
<td></td>
<td>Pin 22</td>
</tr>
</tbody>
</table>
FIGURE 2-2: EXPANSION CONNECTOR FOR EASY INTERFACE TO PIC32 STARTER KITS

CAUTION

When connecting the Multimedia Expansion Board to a starter kit, do not have power applied to either the starter kit or the DC power supply. Failure to heed this caution could result in hardware damage.
2.3 DISPLAY

The Multimedia Expansion Board has a 3.2 inch (8.1 cm) QVGA TFT touchscreen, as shown in Figure 2-3. The display is controlled by a Solomon Systech SSD1926 LCD controller, which is shown in Figure 2-4. The display controller may be configured to use an 8-bit or 16-bit interface (see Section 2.12 “CPLD” for configuration data). The display also has a resistive touch screen and backlight controls, as shown in Figure 2-5.

FIGURE 2-3: 3.2 INCH (8.1 CM) QVGA TFT TOUCH SCREEN

FIGURE 2-4: SOLOMON SYSTECH SSD1926 LCD CONTROLLER
FIGURE 2-6: TOUCHSCREEN CONNECTOR

Use TFT2N0369-E for the same display with the touchscreen option added.

Truly LCD Module
TFT-G240320LTSW-118W-E
### TABLE 2-2: SOLOMON SYSTECH SSD1926 LCD CONTROLLER I/O CONNECTIONS

<table>
<thead>
<tr>
<th>SSD1926 Pin Description</th>
<th>Expansion Connector Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chip Select</td>
<td>RG13</td>
</tr>
<tr>
<td>Chip Reset(1)</td>
<td>RA10</td>
</tr>
<tr>
<td>Chip Register Select</td>
<td>RB10</td>
</tr>
<tr>
<td>Chip Wait</td>
<td>RC3</td>
</tr>
</tbody>
</table>

**Note 1:** This pin is shared with 802.11 and PICtail daughter boards.

### TABLE 2-3: DISPLAY TOUCH SCREEN I/O CONNECTIONS

<table>
<thead>
<tr>
<th>Touch Screen Pin</th>
<th>Expansion Connector Pin</th>
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</thead>
<tbody>
<tr>
<td>X+</td>
<td>AN11/RB11</td>
</tr>
<tr>
<td>X-</td>
<td>RB13</td>
</tr>
<tr>
<td>Y+</td>
<td>AN14/RB14</td>
</tr>
<tr>
<td>Y-</td>
<td>RB12</td>
</tr>
</tbody>
</table>
2.4 microSD CARD SLOT

The Solomon Systech SSD1926 Graphics Controller provides a four-wire SD card interface, as shown in Figure 2-7. The Multimedia Expansion Board takes advantage of this interface by providing a microSD card slot, as shown in Figure 2-8.

FIGURE 2-7: microSD CARD SLOT

FIGURE 2-8: SOLOMON SYSTECH SSD1926 LCD CONTROLLER AND microSD CARD CONNECTION SCHEMATIC
2.5 JOYSTICK AND FIRE BUTTON

The Multimedia Expansion Board provides a four direction joystick with a fire button (Figure 2-9). The directional joystick and fire button can be used to interact with and provide feedback to an application. The joystick (S2) is also connected to the fire button (S1), as shown in Figure 2-10, which allows the user to press either the fire button or the joystick to register a fire command.

FIGURE 2-9: JOYSTICK (S2 SWITCH)

FIGURE 2-10: FIRE BUTTON (S1 SWITCH)

FIGURE 2-11: JOYSTICK AND FIRE BUTTON CONNECTION SCHEMATIC

TABLE 2-4: JOYSTICK AND FIRE BUTTON CONNECTIONS

<table>
<thead>
<tr>
<th>Joystick and Fire Button Pin Description</th>
<th>Expansion Connector Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>RB1/CN3</td>
</tr>
<tr>
<td>Down</td>
<td>RB3/CN5</td>
</tr>
<tr>
<td>Left</td>
<td>RB0/CN2</td>
</tr>
<tr>
<td>Right</td>
<td>RB4/CN6</td>
</tr>
<tr>
<td>Fire</td>
<td>RB15/CN12</td>
</tr>
</tbody>
</table>
2.6 USER-CONTROLLED LEDS

The Multimedia Expansion Board provides five user-controlled LEDs, as shown in Figure 2-12.

FIGURE 2-12: LEDS

![LEDs](image)

FIGURE 2-13: LED CONNECTION SCHEMATIC

![LED Connection Schematic](image)

TABLE 2-5: LED CONNECTIONS

<table>
<thead>
<tr>
<th>LED Description</th>
<th>Expansion Connector Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED 1</td>
<td>RD1</td>
</tr>
<tr>
<td>LED 2</td>
<td>RD2</td>
</tr>
<tr>
<td>LED 3</td>
<td>RD3</td>
</tr>
<tr>
<td>LED 4</td>
<td>RC1</td>
</tr>
<tr>
<td>LED 5</td>
<td>RC2</td>
</tr>
</tbody>
</table>
2.7 ACCELEROMETER AND TEMPERATURE SENSOR

To measure acceleration and temperature, the Multimedia Expansion Board provides an interface to the BMA150, which is a 3-axis (x, y and z plane) accelerometer and temperature sensor, as shown in Figure 2-14. The PIC microcontroller uses an I2C bus interface to communicate with the BMA150.

FIGURE 2-14: BMA150 ACCELEROMETER AND TEMPERATURE SENSOR

FIGURE 2-15: BMA150 CONNECTION SCHEMATIC
2.8 EXTERNAL MEMORY

The Multimedia Expansion Board provides two different on-board storage mediums, an EEPROM (24LC08) and serial NOR Flash (SST25VF016).

2.8.1 EEPROM

The 24LC08 is a 128-byte EEPROM, as shown in Figure 2-16. The PIC32 microcontroller uses an I²C bus interface to communicate to the 24LC08.

FIGURE 2-16: 24LC08 EEPROM

FIGURE 2-17: 24LC08 CONNECTION SCHEMATIC
2.8.2 NOR Flash

The SST25VF016 is a 2 MB NOR Flash, as shown in Figure 2-18. The PIC32 microcontroller uses a SPI bus interface to communicate to the SST25VF016. The CPLD needs to be properly configured for the PIC32 microcontroller to be able to access the SST25VF016. For configuration information, see Section 2.12 “CPLD”.

FIGURE 2-18: SST25VF016 NOR FLASH

FIGURE 2-19: SST25VF016 CONNECTION SCHEMATIC

[Diagram of SST25VF016 connection schematic]
2.9 24-BIT AUDIO CODEC

Using the WM8731 24-bit Audio Codec, the Multimedia Expansion Board can run applications that require audio playback and/or recording, as shown in Figure 2-20. For playing back audio, the Multimedia Expansion Board provides two output jacks, a headphone and line out jack, which are shown in Figure 2-21. A microphone input jack is also provided for audio recording. The WM8731 interfaces to the PIC32 microcontroller via the SPI and I^2C buses.

FIGURE 2-20: WM8731 24-BIT AUDIO CODEC

FIGURE 2-21: HEADPHONE, LINE OUT AND MICROPHONE JACKS
FIGURE 2-22: WM8731 CONNECTION SCHEMATIC
FIGURE 2-23: LINE OUT, HEADPHONE, AND MICROPHONE SCHEMATICS
2.10 802.11 WIRELESS CONNECTIVITY

The Multimedia Expansion Board has 802.11 wireless connectivity, which is provided by the Microchip MRF24WBOMA module, as shown in Figure 2-24. The PIC32 microcontroller uses a SPI bus interface to communicate to the MRF24WBOMA. The CPLD needs to be properly configured for the PIC32 microcontroller to access the MRF24WBOMA. For configuration information, see Section 2.12 “CPLD”.

FIGURE 2-24: MRF24WBOMA 802.11 WIRELESS CONNECTIVITY

FIGURE 2-25: MRF24WBOMA CONNECTION SCHEMATIC
2.11 I/O EXPANSION CONNECTOR

The Multimedia Expansion Board provides an expansion slot, which enables the use of several of Microchip’s PICtail™ daughter boards, as shown in Figure 2-26. For more information on how to properly interface to the board as not all daughter boards are compatible, refer to the specific PICtail daughter board schematic.

**FIGURE 2-26: I/O EXPANSION CONNECTOR**

**FIGURE 2-27: I/O EXPANSION CONNECTOR SCHEMATIC**

[Diagram of I/O Expansion Connector and Schematic]
2.12 CPLD

A CPLD is provided to configure the graphics controller bus interface, SPI channel and Chip Selects used for SPI Flash, the MRF24WBOMA, and the expansion slot, as shown in Figure 2-28. The general I/O inputs are used to change the configuration, which can be done at run time. Table 2-6 provides information on the Graphics Bus Width CPLD configuration. Table 2-7 and Table 2-8 provide information on the SPI channels that are configured by the CPLD. Table 2-9 provides information on the default CPLD configuration combinations for PIC32MX Starter Kits.

FIGURE 2-28: CPLD

FIGURE 2-29: CPLD SLOT CONNECTION SCHEMATIC
### TABLE 2-6: GRAPHICS BUS WIDTH

<table>
<thead>
<tr>
<th>RG14 Pin Setting</th>
<th>Width</th>
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<tr>
<td>0</td>
<td>8</td>
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<tr>
<td>1</td>
<td>16</td>
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</table>

### TABLE 2-7: CPLD SPI SOURCE SELECT

<table>
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<tr>
<th>RG12 Pin Setting</th>
<th>SPI</th>
<th>Chip Select</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>SPI3A</td>
<td>RF12</td>
</tr>
<tr>
<td>1</td>
<td>SPI2/SPI2A</td>
<td>RG9</td>
</tr>
</tbody>
</table>

### TABLE 2-8: CPLD SPI PERIPHERAL DESTINATION SELECT

<table>
<thead>
<tr>
<th>RA7 Pin Setting</th>
<th>RA6 Pin Setting</th>
<th>Peripheral</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>SPI Flash</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>MRF24WBOMA</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Expansion Slot</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

### TABLE 2-9: PIC32MX STARTER KIT CPLD

<table>
<thead>
<tr>
<th>Expansion Connector Pin</th>
<th>PIC32MX General Purpose Starter Kit (DM320001)</th>
<th>PIC32MX USB II Starter Kit (DM320003-2)</th>
<th>PIC32MX Ethernet Starter Kit (DM320004)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG14</td>
<td>RG12</td>
<td>RA7</td>
<td>RA6</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>x</td>
<td>1</td>
<td>x</td>
<td>x</td>
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<tr>
<td>x</td>
<td>x</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Legend:** An ‘x’ indicates this pin is a ‘don’t care’, — = unimplemented.
Appendix A. Board Layout and Schematics

A.1 MULTIMEDIA EXPANSION BOARD BLOCK DIAGRAM

FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE MULTIMEDIA EXPANSION BOARD
A.2 MULTIMEDIA EXPANSION BOARD LAYOUT

FIGURE A-2: MULTIMEDIA EXPANSION BOARD LAYOUT - FRONT SIDE (TOP ASSEMBLY)
A.3 MULTIMEDIA EXPANSION BOARD SCHEMATICS

FIGURE A-4: SOLOMON SYSTECH SSD1926 LCD CONTROLLER
FIGURE A-5: CPLD
FIGURE A-8: JOYSTICK AND FIRE BUTTON

UP AN1/CN3/RB1
AN15/CN12/RB15
LEFT AN0/CN2/RB0
FIRE AN15/CN12/RB15

S1

S2

AN4/CN5/RB4 RIGHT
AN3/CN4/RB3 DOWN
FIGURE A-9: TOUCHSCREEN SOCKETS

Use TFT2N0369-E for the same display with the touch screen option added.

Truly LCD Module
TFT-G240320LT SW-118W-E
FIGURE A-10: MEMORY

EEPROM Memory
(I2C Slave Addr = 1010 000X)

24LC08_SOT23_5

+3.3V

FL_CS
FL_SDI

+3.3V

SCL2
SDA2

R8
1K
1K
R7

16M Serial Flash

+3.3V

U6

SST25VF016B-50-4C-S2AF

+3.3V

C42
.1uF

C41
.1uF

+3.3V
FIGURE A-11: AUDIO

[Diagram of audio circuit with components labeled and connections shown]
FIGURE A-13: WIRELESS

FIGURE A-14: I/O EXPANSION CONNECTOR
FIGURE A-16: ANALOG PLANES

FIGURE A-17: DIGITAL PLANES
FIGURE A-18: ACCELEROMETER

3 Axis Accelerometer
(I2C Slave Addr = 0111 000X)

![Accelerometer Circuit Diagram]

FIGURE A-19: USER AND POWER LEDs

![User and Power LEDs Circuit Diagram]

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# Appendix B. Bill of Materials (BOM)

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

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
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<tr>
<td>34</td>
<td>C1, C2, C3, C4, C7, C9, C20, C21, C22, C23, C26, C29, C30, C32, C34, C35, C39, C41, C44, C37, C40, C42, C46, C47, C49, C51, C54, C55, C56, C62, C67, C53, C65, C66</td>
<td>CAP CER .10UF 16V Y5V 0603</td>
<td>CAP0603</td>
<td>TDK Corporation</td>
<td>C1608Y5V1C104Z</td>
<td>DKC</td>
<td>445-1326-1-ND</td>
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<td>1</td>
<td>C11</td>
<td>CAP CER 4.7UF 50V Y5V 1206</td>
<td>CAP1206</td>
<td>TDK Corporation</td>
<td>C3216Y5V1H475Z</td>
<td>DKC</td>
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<tr>
<td>3</td>
<td>C13, C14, C17</td>
<td>CAP TANTALUM 1.0UF 35V 20% SMD</td>
<td>CAP1206_POL</td>
<td>Kemet</td>
<td>B45196H6105M109</td>
<td>DKC</td>
<td>495-2279-1-ND</td>
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<td>2</td>
<td>C15, C16</td>
<td>CAP CER 18PF 50V C0G 5% 0603</td>
<td>CAP0603</td>
<td>TDK Corporation</td>
<td>C1608C0G1H180J</td>
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<td>CAP CER 820PF 50V 10% X7R 0603</td>
<td>CAP0603</td>
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<td>TDK Corporation</td>
<td>C1608C0G1H080D</td>
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<td>CAP CERAMIC 10PF 50V NP0 0603</td>
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<td>Kemet</td>
<td>C0603C100J5GACTU</td>
<td>DKC</td>
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<tr>
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<td>C31</td>
<td>CAP CERAMIC 220PF 50V NP0 0603</td>
<td>CAP0603</td>
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<td>CAP CER 240PF 50V 5% C0G 0603</td>
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<td>GRM1885C1H241JA01D</td>
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<td>CAP0603</td>
<td>Murata</td>
<td>GRM188R71H562KA01D</td>
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<td>C45</td>
<td>CAP CER 4.7UF 10V Y5V 0603</td>
<td>CAP0603</td>
<td>Murata</td>
<td>GRM188F51A475ZE20D</td>
<td>DKC</td>
<td>490-3302-1-ND</td>
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<tr>
<td>9</td>
<td>C5, C8, C10, C15, C19, C33, C43, C48, C50</td>
<td>CAP CER 10UF 16V Y5V 0805</td>
<td>CAP0805</td>
<td>Murata</td>
<td>GRM21BF51C106ZE15L</td>
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<td>C57</td>
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<td>CAP1206</td>
<td>TDK Corporation</td>
<td>C3216Y5V1C226Z</td>
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## TABLE B-1: MULTIMEDIA EXPANSION BOARD BILL OF MATERIALS (BOM)

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<td>CAP CER 1.0UF 16V Y5V 0603</td>
<td>CAP0603</td>
<td>Murata</td>
<td>GRM188F51C105ZA01D</td>
<td>DKC</td>
<td>490-1582-1-ND</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C58, C59, C60, C61</td>
<td>CAP CER 1.0UF 16V Y5V 0805</td>
<td>CAP0805</td>
<td>Murata</td>
<td>GRM216F51C104ZA01D</td>
<td>DKC</td>
<td>490-1734-1-ND</td>
<td></td>
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<tr>
<td>2</td>
<td>C6, C12</td>
<td>CAP 220UF 6.3V ELECT HA SMD</td>
<td>CAP_SMT_C</td>
<td>Panasonic</td>
<td>EEE-HA0J221WP</td>
<td>DKC</td>
<td>PCE4161CT-ND</td>
<td></td>
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<tr>
<td>2</td>
<td>C63, C64</td>
<td>CAP 10UF 10V ELECT VS BI-POLAR</td>
<td>CAP_VS_B</td>
<td>Panasonic</td>
<td>EEE-1AA100NR</td>
<td>DKC</td>
<td>PCE4288CT-ND</td>
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<td>1</td>
<td>D1</td>
<td>Schottky (Diodes &amp; Rectifiers) 30V</td>
<td>DIODE_SOD-323</td>
<td>Central Semi</td>
<td>CMDSH-3TR</td>
<td>Mouser</td>
<td>610-CMDSH-3</td>
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<td>Cui Inc.</td>
<td>PJ-002B-SMT</td>
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<td>Hirose</td>
<td>FH12A-40S-0.5SSH(55)</td>
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<td>FCI</td>
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<td>RMCF 1/16 47K 1% R</td>
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<td>EVQ-Q7GA50</td>
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<td>IC PWM STP-DWN REG 1A TSOT23-6</td>
<td>LM2734_TSOT_6</td>
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<td>LM2734YMK/NOPB</td>
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<td>Audio CODECs Stereo Codec with H/P</td>
<td>WM8731L_SSOP28</td>
<td>Wolfson</td>
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<td>CRYSTAL 12.0000 MHZ 18PF SMD</td>
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### TABLE B-1: MULTIMEDIA EXPANSION BOARD BILL OF MATERIALS (BOM)

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<tr>
<th>Item</th>
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<td>CRYSTAL 4.00 MHZ 8.0 PF SMD</td>
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<td>NX8045GB 4MHZ AT-W</td>
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<td>IC CONTROLLER BOOST 2.55V 8MSOP</td>
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<td>MCP1652S-E/MS</td>
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<td>Bivar Inc</td>
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Fax: 86-25-8473-2470

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**Korea - Seoul**  
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**France - Paris**  
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Fax: 33-1-69-30-90-79

**Germany - Munich**  
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