



# **MCP23X17**

## **Evaluation Board**

### **User's Guide**

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## Preface

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### 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](http://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 “DSXXXXA”, where “XXXX” is the document number and “A” is the revision level of the document.

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP23X17 Evaluation 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 MCP23X17 Evaluation Board 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 MCP23X17 Evaluation Board.
- **Chapter 2. “Installation and Operation”** – Includes instructions on how to get started with the MCP23X17 Evaluation Board.
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams for the MCP23X17 Evaluation Board.
- **Appendix B. “Bill Of Materials (BOM)”** – Lists the parts used to build the MCP23X17 Evaluation Board.

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## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

| Description                                      | Represents                                                                                           | Examples                                                    |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| <b>Arial font:</b>                               |                                                                                                      |                                                             |
| Italic characters                                | Referenced books                                                                                     | <i>MPLAB® IDE User's Guide</i>                              |
|                                                  | Emphasized text                                                                                      | ...is the <i>only</i> 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                                                                                          | <u><i>File&gt;Save</i></u>                                  |
| Bold characters                                  | A dialog button                                                                                      | Click <b>OK</b>                                             |
|                                                  | A tab                                                                                                | Click the <b>Power</b> 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>                                         |
| <b>Courier New font:</b>                         |                                                                                                      |                                                             |
| 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                                                                                  | <i>file.o</i> , where <i>file</i> can be any valid filename |
| Square brackets [ ]                              | Optional arguments                                                                                   | mcc18 [options] <i>file</i> [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)<br>{ ...<br>}                              |

## RECOMMENDED READING

For more information regarding the Stand-Alone CAN controller, CAN I/O expander, and CAN transceiver devices, refer to the appropriate data sheet. Table 1-1 shows the device and associated data sheet literature number. These documents can be downloaded from the Microchip web site at: [www.microchip.com](http://www.microchip.com).

**TABLE 1-1: DEVICES AND DATA SHEET LITERATURE NUMBERS**

| Device          | Literature # | Device           | Literature # |
|-----------------|--------------|------------------|--------------|
| <b>MCP23X17</b> | DS21952      | <b>PIC16F818</b> | DS39598      |

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

## DOCUMENT REVISION HISTORY

### Revision B (August 2006)

- Add disclaimer to Bill of Materials regarding RoHS-Compliant part numbers.

### Revision A (January 2006)

- Initial Release of this Document.

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## **Chapter 1. Product Overview**

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### **1.1 INTRODUCTION**

This chapter provides an overview of the MCP23X17 Evaluation Board and covers the following topics:

- What is the MCP23X17 Evaluation Board?
- What the MCP23X17 Evaluation Board kit includes

### **1.2 WHAT IS THE MCP23X17 EVALUATION BOARD?**

The MCP23X17 Evaluation Board allows the system designer to evaluate the operation of the MCP23X17 General Purpose I/O (GPIO) expander. The board demonstrates the MCP23X17 performance in a simple circuit (4 inputs and 12 outputs).

### **1.3 WHAT THE MCP23X17 EVALUATION BOARD KIT INCLUDES**

This MCP23X17 Evaluation Board Kit includes:

- One MCP23X17 Evaluation Board
  - MCP23017 GPIO Expander with I<sup>2</sup>C™ interface (installed)
  - MCP23S17 GPIO Expander with SPI interface (installed)
- One AIPD Evaluation Board
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - MCP23X17 Evaluation Board User's Guide (DS51592)

# MCP23X17 Evaluation Board User's Guide

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## **Chapter 2. Installation and Operation**

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### **2.1 INTRODUCTION**

This chapter discusses the setup and operation of the MCP23X17 Evaluation Board.

The MCP23X17 Evaluation Board is designed to demonstrate simple, low-cost input/output expansion using the MCP23X17 devices and a low-cost PICmicro<sup>®</sup> microcontroller.

Four MCP23X17 pins are configured as inputs and connected to four momentary push buttons. The remaining twelve GPIO pins are configured as outputs and connected to LEDs. Each button causes the LEDs to sequence in a predetermined pattern.

The MCP23X17 is provided in small, space-saving 18-lead SSOP packages.

### **2.2 FEATURES**

The MCP23X17 Evaluation Board has the following features:

- Two 16-bit GPIO Expanders
  - MCP23017 with I<sup>2</sup>C interface
  - MCP23S17 with SPI interface
- Slide switch for selecting between the two GPIO expanders.
- Four momentary buttons and twelve LEDs, each connected to an individual GPIO pin to demonstrate the input/output functionality of the MCP23X17.
- Headers for the MCP23X17 pins to allow evaluation in a user defined application.
- Jumpers (not populated, but shorted by a trace on the bottom of the PCB) to isolate the MCP23X17 from the LEDs and buttons, so they can be evaluated in a custom circuit.
- Header for programming the PIC16F818.

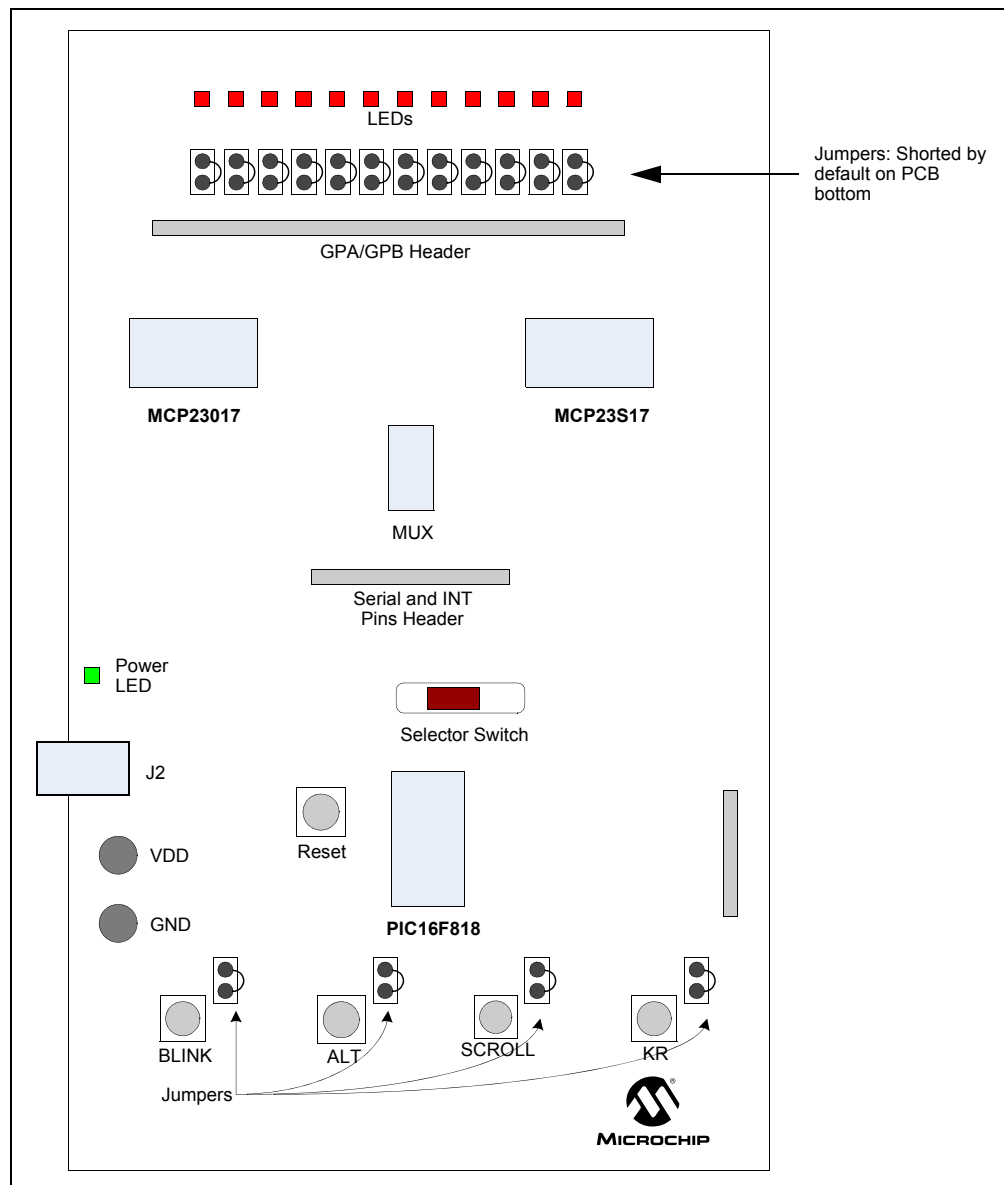
# MCP23X17 Evaluation Board User's Guide

## 2.3 GETTING STARTED

The MCP23X17 Evaluation Board is a fully functional, assembled and tested board for evaluation of the MCP23017 (I<sup>2</sup>C interface) and MCP23S17 (SPI interface) general purpose I/O expanders. The following describes the basic setup and operation (see Figure 2-1):

1. Either connect a 9V power supply into the power jack (J2) or connect a 5V power supply to the V<sub>DD</sub> and GND test points.
2. The green power LED will illuminate.
3. The device selector slide switch selects between the two devices. Slide the switch towards the device of choice.
4. On power-up, the LEDs will sequence in a slow scroll pattern.
5. Press a button and the LED sequencing will match the function defined by the button. For example, pressing the "Blink" button will cause the LEDs to continuously blink.

**FIGURE 2-1: BOARD LAYOUT**



## 2.4 MCP23X17 EVALUATION BOARD DESCRIPTION

### 2.4.1 Major Board Components

1. MCP23017 and MCP23S17 - The two devices under evaluation/demonstration. Both devices are connected to the same inputs and outputs and selector switch is used to select which device the PICmicro controls. A mux is used to route the serial (I<sup>2</sup>C or SPI) from the PICmicro to the MCP23X17.
2. LEDs - These are connected to the MCP23X17 GPIO configured as outputs.
3. Momentary Buttons - These are connected to the MCP23X17 configured as inputs.
4. PIC16F818 - Reads the selector switch and controls the MCP23X17 devices.
5. Headers - There are two headers which are connected to the MCP23X17 pins to allow off-board connections.
6. Jumpers - The jumpers are used to isolate the MCP23X17 pins so they can be connected to an off-board circuit. The jumpers are not populated, however, they are shorted by a trace on the bottom of the PCB.
7. Power - The boards can be powered by 9V via the power jack (J2) or by applying 5V directly to the power points (TP1 and TP2).

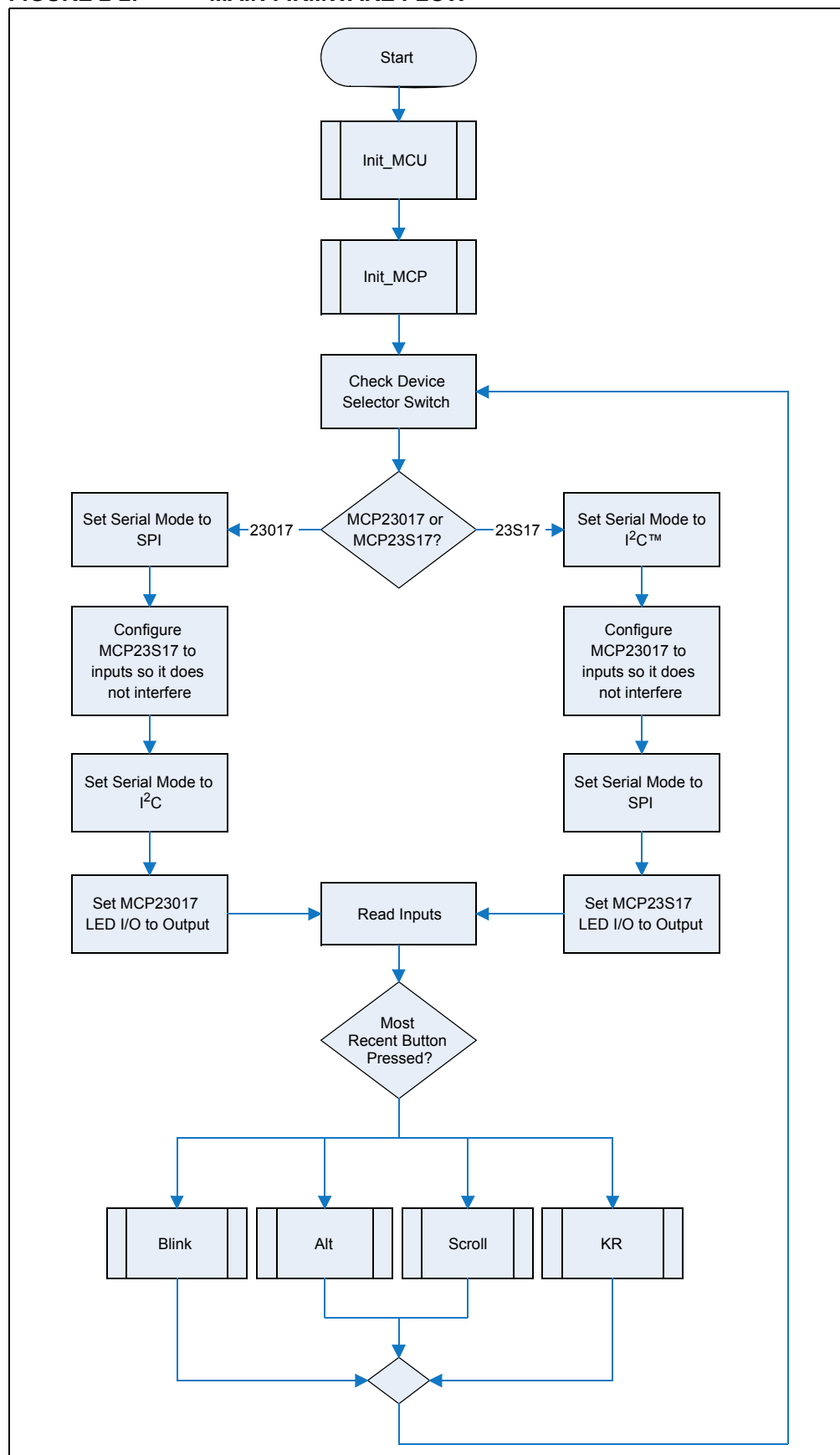
## 2.5 FIRMWARE DESCRIPTION

See Figure 2-2 for the main firmware flow diagram

1. The firmware first configures the PIC16F818 microcontroller.
2. The firmware configures the MCP23X17 devices (4-inputs, 12-outputs, enable interrupts, etc.).
3. The firmware checks the selector switch to determine which MCP23X17 to communicate with during the main loop.
4. The “other” MCP23X17 is configured to all inputs so that it does not cause contention on LED connections.
5. The MCP23X17 inputs are sampled.
6. The LEDs light up in a pattern as defined by the button which was pressed. If no button is pressed, the LEDs maintain the current sequence.

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FIGURE 2-2: MAIN FIRMWARE FLOW





# MCP23X17 EVALUATION BOARD USER'S GUIDE

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## Appendix A. Schematic and Layouts

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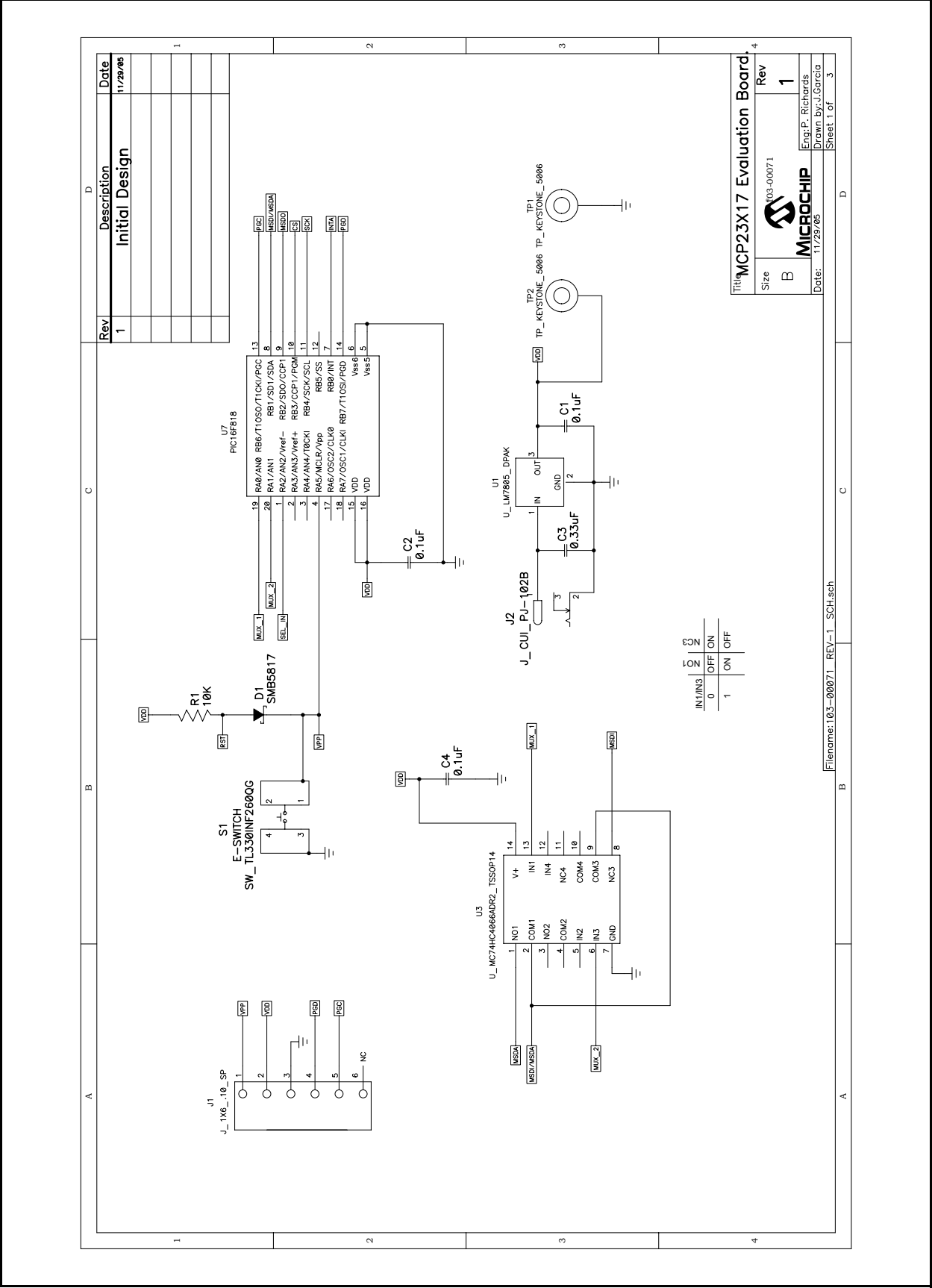
### A.1 INTRODUCTION

This appendix contains the schematic and PCB layout for the MCP23X17 Evaluation Board. Diagrams included:

- Board Schematics (pages 1 thru 3)
- Board - Top Layer (with silk screen)
- Board - Bottom Layer

# MCP23X17 Evaluation Board User's Guide

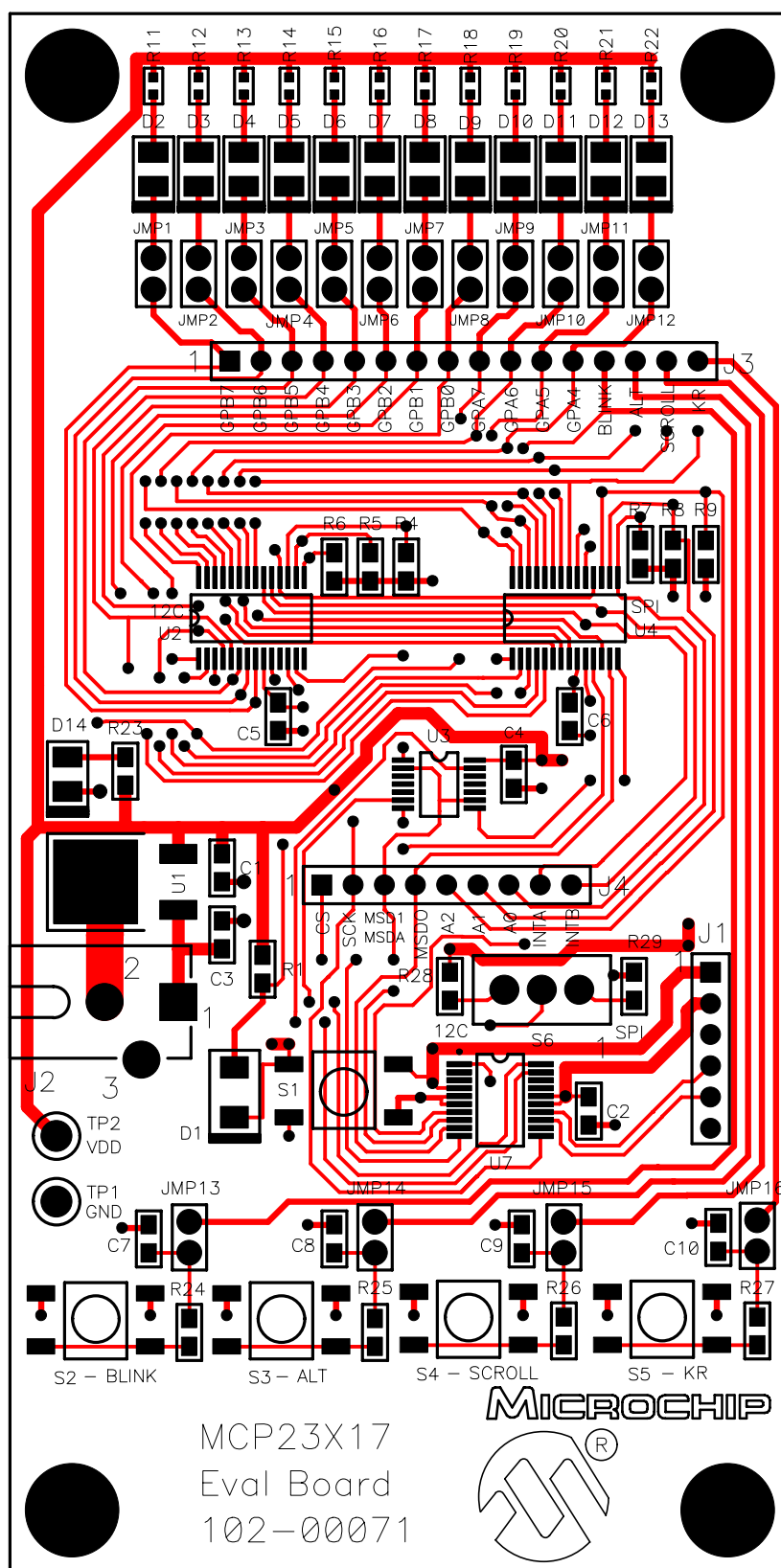
## A.2 BOARD SCHEMATIC (PAGE 1)





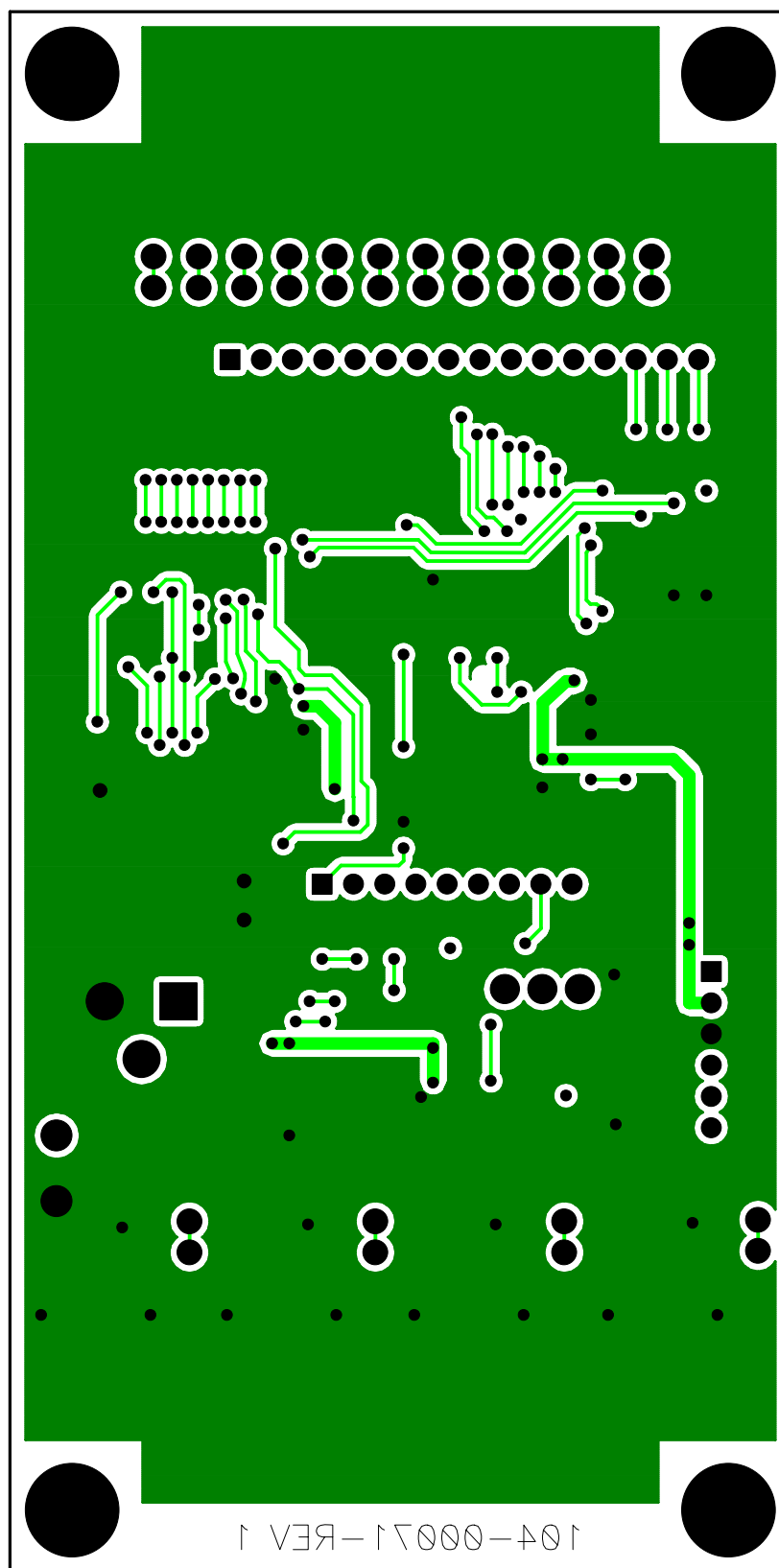


## A.5 BOARD - TOP LAYER (WITH SILK SCREEN)



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## A.6 BOARD - BOTTOM LAYER



## Appendix B. Bill Of Materials (BOM)

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

| Qty | Reference                          | Description                                                             | Manufacturer                        | Part Number        |
|-----|------------------------------------|-------------------------------------------------------------------------|-------------------------------------|--------------------|
| 9   | C1,C2,C4,C5,<br>C6,C7C8,C9,<br>C10 | CAP .1UF 16V CERAMIC X7R 0805                                           | Panasonic - ECG                     | ECJ-2VB1C104K      |
| 1   | C3                                 | CAP CER .33UF 16V Y5V 0805                                              | Murata Electronics<br>North America | GRM219F51C334ZA01D |
| 1   | D1                                 | RECT SCHOTTKY 1A 20V DO-214AA                                           | Micro Commercial Co.                | SMB5817-TP         |
| 12  | D2 -D13                            | LED RED 635NM PLCC 120DEG                                               | LITE-ON INC.                        | LTST-T670EKT       |
| 1   | D14                                | LED GREEN 565NM PLCC 120DEG                                             | LITE-ON INC.                        | LTST-T670GKT       |
| 16  | JMP1- JMP16                        | Do Not populate                                                         | —                                   | —                  |
| 1   | J1                                 | Do Not populate                                                         | —                                   | —                  |
| 1   | J4                                 | Do Not populate                                                         | —                                   | —                  |
| 1   | J3                                 | Do Not populate                                                         | —                                   | —                  |
| 1   | J2                                 | CONN POWER JACK 2.5MM PCB CIRC                                          | CUI Inc.                            | PJ-102B            |
| 1   | U7                                 | 18/20-Pin Enhanced Flash Microcontrol-<br>lers with nanoWatt Technology | Microchip Technology<br>Inc.        | PIC16F818          |
| 12  | R11 - R22                          | RES 475 OHM 1/10W 1% 0603 SMD                                           | Panasonic - ECG                     | ERJ-3EKF4750V      |
| 6   | R4 -R9                             | RES 0.0 OHM 1/8W 5% 0805 SMD                                            | Panasonic - ECG                     | ERJ-6GEY0R00V      |
| 3   | R1,R28,<br>R29                     | RES 10.0K OHM 1/8W 1% 0805 SMD                                          | Panasonic - ECG                     | ERJ-6ENF1002V      |
| 4   | R24 -R27                           | RES 100 OHM 1/8W 1% 0805 SMD                                            | Panasonic - ECG                     | ERJ-6ENF1000V      |
| 1   | R23                                | RES 475 OHM 1/8W 1% 0805 SMD                                            | Panasonic - ECG                     | ERJ-6ENF4750V      |
| 1   | S6                                 | SWITCH,SLD,MIN,SPDT,ON-ON,                                              | JAMECO VALUEPRO                     | G4050X             |
| 5   | S1-S5                              | SWITCH TACT 6MM SMD MOM 160GF                                           | Omron Electronics Inc.              | B3S-1000           |
| 1   | TP1                                | TEST POINT PC MULTI PURPOSE BLK                                         | Keystone Electronics                | 5011               |
| 1   | TP2                                | TEST POINT PC MULTI PURPOSE RED                                         | Keystone Electronics                | 5010               |
| 1   | U1                                 | IC POSITIVE REGULATOR 5V D2PAK                                          | STMicroelectronics                  | L7805CD2T-TR       |
| 1   | U3                                 | IC QUAD BILATERAL SWITCH<br>14TSSOP                                     | Texas Instruments                   | CD74HC4066PWR      |
| 1   | U4                                 | 16 Bit I/O Expander with Serial Interface                               | Microchip Technology<br>Inc.        | MCP23S17-E/SS      |
| 1   | U2                                 | 16 Bit I/O Expander with Serial Interface                               | Microchip Technology<br>Inc.        | MCP23017-E/SS      |

**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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