MCP4725
SOT-23-6
Evaluation Board
User’s Guide
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Preface

NOTICE TO CUSTOMERS

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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 MCP4725 SOT-23-6 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 MCP4725 SOT-23-6 Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. “Quick Start Instructions”** – this chapter provides an overview of the MCP4725 SOT-23-6 Evaluation Board and instructions on how to program the DAC register and EEPROM of the MCP4725 device.
- **Appendix A. “Schematics and Board Layouts”** – shows the schematic and layout diagrams for the MCP4725 SOT-23-6 Evaluation Board.
- **Appendix B. “Bill Of Materials (BOM)”** – lists the parts used to build the MCP4725 SOT-23-6 Evaluation Board.
CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

<table>
<thead>
<tr>
<th>DOCUMENTATION CONVENTIONS</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>Emphasized text</td>
<td>the Output window</td>
<td><em>...is the only compiler...</em></td>
</tr>
<tr>
<td>Initial caps</td>
<td>A window</td>
<td>the Settings dialog</td>
</tr>
<tr>
<td></td>
<td>A dialog</td>
<td>select Enable Programmer</td>
</tr>
<tr>
<td></td>
<td>A menu selection</td>
<td></td>
</tr>
<tr>
<td>Quotes</td>
<td>A field name in a window or dialog</td>
<td><em>“Save project before build”</em></td>
</tr>
<tr>
<td>Underlined, italic text</td>
<td>A menu path</td>
<td><em>File&gt;Save</em></td>
</tr>
<tr>
<td>with right 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 Power tab</td>
</tr>
<tr>
<td>N'Rnnnn</td>
<td>A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.</td>
<td><em>4'b0010, 2'hF1</em></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><code>#define START</code></td>
</tr>
<tr>
<td>Filenames</td>
<td><code>autoexec.bat</code></td>
<td></td>
</tr>
<tr>
<td>File paths</td>
<td><code>c:\mcc18\h</code></td>
<td></td>
</tr>
<tr>
<td>Keywords</td>
<td><code>_asm, _endasm, static</code></td>
<td></td>
</tr>
<tr>
<td>Command-line options</td>
<td><code>-Opa+, -Opa-</code></td>
<td></td>
</tr>
<tr>
<td>Bit values</td>
<td><code>0, 1</code></td>
<td></td>
</tr>
<tr>
<td>Constants</td>
<td><code>0xFF, ‘A’</code></td>
<td></td>
</tr>
<tr>
<td>Italic Courier New</td>
<td>A variable argument</td>
<td><code>file.o, where file can be any valid filename</code></td>
</tr>
<tr>
<td>Square brackets [ ]</td>
<td>Optional arguments</td>
<td><code>mcc18 [options] file [options]</code></td>
</tr>
<tr>
<td>Curly brackets and pipe</td>
<td>Choice of mutually exclusive arguments; an OR selection</td>
<td>`errorlevel {0</td>
</tr>
<tr>
<td>character: {}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ellipses...</td>
<td>Replaces repeated text</td>
<td><code>var_name [, var_name...]</code></td>
</tr>
<tr>
<td>Represents code supplied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>by user</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RECOMMENDED READING

This user's guide describes how to use MCP4725 SOT-23-6 Evaluation Board. The following Microchip documents are available and recommended as supplemental reference resources.

PICkit™ Serial Analyzer User’s Guide (DS51647)
Consult this document for instructions on how to use the PICkit Serial Analyzer hardware and software.

MCP4725 Data Sheet, “12-Bit DAC with EEPROM Memory in SOT-23-6” (DS22039)
This data sheet provides detailed information regarding the MCP4725 product family.

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• Field Application Engineer (FAE)
• Technical Support

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

Revision A (October 2007)

• Initial Release of this Document.
Chapter 1. Quick Start Instructions

1.1 INTRODUCTION

The following sections provide an overview of the MCP4725 SOT-23-6 Evaluation Board and Instruction how to program the DAC register and EEPROM of the MCP4725 device using the PICkit Serial Analyzer. The following sections cover the following topics:

- What is the MCP4725 SOT-23-6 Evaluation Board?
- How to use the MCP4725 SOT-23-6 Evaluation Board with the PICkit Serial Analyzer

1.2 WHAT IS THE MCP4725 SOT-23-6 EVALUATION KIT

The MCP4725 SOT-23-6 Evaluation Board contains the MCP4725 single channel 12-Bit Digital-to-Analog Converter (DAC) and I2C loading resistors. The purpose of this board is:

- **Quick evaluation of the MCP4725 features using the PICkit Serial Analyzer:** The user can program the DAC Register or EEPROM using the PICkit Serial Analyzer and measure the MCP4725 device analog output voltage using a voltmeter.

- **Easy handling of the MCP4725 device in a tiny SOT23-6 package:** The MCP4725 device is available in a small SOT-23-6 package. This board makes it easy to handle the small package device for user’s application evaluations. The user can simply connect the J1 pins on the evaluation board to the user’s test board for a quick evaluation of the MCP4725 device. The MCP4725 supports standard mode (100 kHz), fast mode (400 kHz), and high speed mode (3.4 MHz). This evaluation board is using 5 kΩ for the I2C pull-up resistors. This 5 kΩ supports up to 400 kHz. The user can replace the R1 and R3 with lower values (less than 1 kΩ) for the high-speed mode (3.4 MHz).

1.3 GETTING STARTED WITH PICKIT SERIAL ANALYZER

The user can use the MCP4725 SOT-23-6 Evaluation Board in two different ways: (a) together with the PICkit Serial Analyzer or (b) by connecting this board to the user’s target board directly.

Figure 1-1 shows the MCP4725 SOT-23-6 Evaluation Board. The SCL, SDA, VDD, and VSS pins in the J1 connector are connected to the MCP4725 device.

The MCP4725 SOT-23-6 Evaluation Kit contains two MCP4725 SOT-23-6 Evaluation Boards. This board can easily be programmed using the PICkit Serial Analyzer (DV164122). It is highly recommended that the user order the MCP4725 SOT-23-6 Evaluation Board and the PICkit Serial Analyzer at the same time.

On the MCP4725 SOT-23-6 Evaluation Board, the R1 and R3 are the I2C pull-up load resistors for the SDA and SCL, respectively. The user can replace them with their own component values of interest. It is also recommended that these pull-up resistors be removed if the user’s test board has the pull-up resistors already. The MCP4725 SOT-23-6 Evaluation Board also has footprints for additional pull-up resistors (in parallel with the R1 and R3) and loading capacitors. The user can populate the board with their own components.
FIGURE 1-1: MCP4725 SOT-23-6 Evaluation Board.

- JP1: A0 selection jumper:
  - Picture shown here is connected to the GND (A0 = 0)
- Ground Terminal
- MCP4725 in SOT-23-6 package
- J1 Connector
- Analog Output Terminal (VOUT)
- VDD Terminal
- R1 (Pull-up Resistor for SDA)
- R3 (Pull-up Resistor for SCL)
1.3.1 Getting Started with PICkit Serial Analyzer

This section describes how to evaluate the MCP4725 device using the PICkit Serial Analyzer.

1.3.1.1 HARDWARE SET-UP

1. Connect the MCP4725 SOT-23-6 Evaluation Board and the PICkit Serial Analyzer together using the J1 connector.
2. Connect a USB cable between the PICkit Serial Analyzer and a Personal Computer.
3. Connect a Digital Voltmeter to \( V_{\text{OUT}} \) and GND terminals on the MCP4725 SOT-23-6 Evaluation Board. Figure 1-2 shows the connection example.

![MCP4725 SOT-23-6 Evaluation Board Test Set Up.](image)
1. Install the PICkit Serial Analyzer software in your computer.
2. Connect the USB cable between the PICkit Serial Analyzer and your PC.
3. Run the PICkit Serial PC Software: It will open up the following graphic user interface (GUI). Click Next > and follow the instructions:

4. Select the **I2C Master** option radio button for the Communication Mode type and click the Next > button.
5. Select either **100 kHz** option or **400 kHz** option radio button and click the **Next >** button.

![Configuration Wizard](image)

**Note:** The MCP4725 SOT-23-6 Evaluation Board supports the I\(^2\)C bus data rate up to 3.4 MHz, but the current version of the PICkit Serial Analyzer only supports the I\(^2\)C bus data rate up to 400 kHz.

6. Select **No** on Device Pullups and click the **Next >** button.

![Configuration Wizard](image)

**Note:** The MCP4725 SOT-23-6 Evaluation Board has its own pull-up resistors.
7. Select the Voltage Source option for the MCP4725 SOT-23-6 Evaluation Board and click the Next > button.

Case 1: When you use VDD from the PICkit Serial Analyzer:
If you choose PICkit Serial will power my device option, and the 5 Volt option as shown below, the MCP4725 SOT-23-6 Evaluation Board is powered by the 5 VDC from the PICkit Serial Analyzer through the J1 connector. In this case, make sure that the JP2 jumper on the MCP4725 SOT-23-6 Evaluation Board is connected.

You can also click on the Other option and move the slide bar for other than 5 volts.

Case 2: When you use your own VDD:
If you want to provide your own VDD voltage through the VDD terminal on the MCP4725 SOT-23-6 Evaluation Board, then do not select the PICkit Serial will power my device option. In this case, you have to remove the JP2 jumper on the board and provide the VDD at the VDD terminal.
8. Click the **OK** button. You have done all PICkit Serial Analyzer Configuration Set-up. You are now ready to program the MCP4725 device using the PICkit Serial Analyzer.

![Configuration Wizard](image)

You're Done!

Press 'OK' to complete the Configuration Wizard.

- Do not show this wizard on startup again

Wizard may be accessed anytime from:
- menu dropdown PICkit Serial Analyzer ➔
- Run Configuration Wizard.
1.3.2 Creating Script File to program the DAC Register and EEPROM Data

1. From the Communications tab, select the Script option and go to the Script Builder.
2. You need to create a script file using the following instructions.
   a) Type in any script name (i.e., MCP4725_Write) in the space below the **Script Name** menu item.
   b) Type in the following parameters in order in the text box area provided in the **Script Detail** box.

<table>
<thead>
<tr>
<th><strong>Script Detail</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>I2CSTART</td>
</tr>
<tr>
<td>I2CWRTBYT</td>
</tr>
<tr>
<td>03</td>
</tr>
<tr>
<td>C0</td>
</tr>
<tr>
<td>08</td>
</tr>
<tr>
<td>00</td>
</tr>
<tr>
<td>I2CSTOP</td>
</tr>
</tbody>
</table>

   -----------> This means there are three bytes to send
   -----------> 1st Write Byte: Address byte = 1100-0000
   -----------> 2nd Write Byte: 0000-1000
   -----------> 3rd Write Byte: 0000-0000

**Note:** You can choose any data you want for the 2nd and 3rd write bytes. If you use the above write data, the MPC4725 device will output:

\[ V_{OUT} = V_{DD} \times 0.5 \]
3. Programming DAC Register (Fast Mode)
   a) Change 2nd and 3rd data bytes you want in the Script Detail.
   b) Click **Execute Script** Menu item.
   c) The device gives an analog output voltage ($V_{OUT}$) at the VOUT terminal on the board.
4. Programming DAC Register and EEPROM

   a) Type in the following parameters in order in the spaces below the **Script Detail** menu and click on the **Execute Script** button.

   ```
   I2CSTART
   I2CWRTBYT
   04
   C0
   60
   80
   00
   I2CSTOP
   ```

   This means Master will send four bytes:
   
   - 1st Write Byte: Address byte = 1100-0000
   - 2nd Write Byte: 0110-0000
   - 3rd Write Byte: 1000-0000
   - 4th Write Byte: 0000-0000
5. Verifying the EEPROM Data.

After sending the EEPROM write command in Step 4, the device holds the data in the EEPROM. The data in the EEPROM is non-volatile. To check this non-volatile data, you can remove the VDD from the MCP4725 SOT-23-6 Evaluation Board once, and bring back up the VDD again. You will see the same analog voltage output at the VOUT terminal.
6. Reading the DAC Register Data using the PICkit Serial Analyzer

This experiment can be done in two steps:

(a) Write the DAC Register with Fast Mode Command.
(b) Send Read Command and see the results on the PICkit Serial Transactions page.
7. Reading both the DAC Register and EEPROM data.

This experiment can be done by two steps:

(a) Write the DAC Register and EEPROM data using a write command.
(b) Send Read Command (Request 5 bytes) and see the results on the PICkit Serial Transactions page.
1.3.3 Examples of the MCP4725 Programming

**FIGURE 1-3:** MCP4725 Device Address Byte.

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>A2</th>
<th>A1</th>
<th>A0</th>
<th>R/W</th>
</tr>
</thead>
</table>

Device Code

Address Byte *

* **Address Byte:** A2 = A1 = 0 for Default Samples
  A0 = 0 if A0 pin is Grounded
  = 1 if A0 pin is tied to VDD

**EXAMPLE:**

Write Mode: 0XC0 FOR (A2 = A1 = A0)
0XC2 FOR (A2 = A1 = 0, A0 = TIED TO VDD)

Read Mode: 0XC1 FOR (A2 = A1 = A0)
0XC3 FOR (A2 = A1 = 0, A0 = TIED TO VDD)

**FIGURE 1-4:** Fast Mode (Write Command) for VOUT = 2.5V when VREF = 5V.

\[
DAC \text{ Output} = \frac{V_{REF} \times D_N}{4096} = \frac{5V \times 2^{11}}{4096} = 2.5V
\]

Start 0xC0 ACK 0 0 PD1 PD0 D11 D10 D9 D8 ACK D8 D7 D6 D5 D4 D3 D2 D1 D0 ACK STOP

Address Byte: when A2 = A1 = A0 = 0
0x08
0x00

\[= 2^{11}\]
FIGURE 1-5: Write Command Example for EEPROM and DAC Register for $V_{OUT} = 2.5V$ when $V_{REF} = 5V$.

$$DAC\ Output = \frac{V_{REF} \times D_N}{4096} = \frac{5V \times 2^{11}}{4096} = 2.5V$$

When $A2 = A1 = A0 = 0$

$0x60$ $0x08 = 2^{11}$

$0x00$
Appendix A. Schematics and Board Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP4725 SOT-23-6 Evaluation Board:

- Board – Schematic
- Board – Top Layer
- Board – Top Silk Layer
- Board – Bottom Metal Layer
A.2 BOARD - SCHEMATIC
A.3 BOARD - TOP LAYER
A.4 BOARD - TOP SILK LAYER

102-00149

VDD

MCP4725

SOT23-6

Eval Board

Microchip

VDD

R3

R4

C1

JP1

R1

R2

C2

JP2

J1

VSS

SDA

SCL

VDD
A.5 BOARD - BOTTOM LAYER
### Appendix B. 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>2</td>
<td>C1, C2</td>
<td>Not Populated</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>GND, VDD, VOUT</td>
<td>TEST POINT PC COMPACT SMT</td>
<td>Keystone Electronics</td>
<td>5016</td>
</tr>
<tr>
<td>1</td>
<td>J1</td>
<td>CONN HEADER 6POS .100 R/A GOLD</td>
<td>Molex/Waldom Electronics Corp</td>
<td>22-28-8062</td>
</tr>
<tr>
<td>2</td>
<td>JP1, JP2</td>
<td>CONN HEADER 2POS .100 VERT TIN</td>
<td>Molex/Waldom Electronics Corp</td>
<td>22-28-4020</td>
</tr>
<tr>
<td>2</td>
<td>JP1, JP2</td>
<td>CONN JUMPER SHORTING GOLD FLASH</td>
<td>Sullins Electronics Corp.</td>
<td>SPC02SYAN</td>
</tr>
<tr>
<td>1</td>
<td>PCB</td>
<td>RoHS Compliant Bare PCB, MCP4725 SOT23-6 Eval Board</td>
<td>—</td>
<td>104-000149</td>
</tr>
<tr>
<td>2</td>
<td>R1, R3</td>
<td>RES 4.99K OHM 1/8W 1% 0805 SMD</td>
<td>Panasonic® - ECG</td>
<td>ERJ-6ENF4991V</td>
</tr>
<tr>
<td>2</td>
<td>R2, R4</td>
<td>Not Populated</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>MCP4725_SOT-23-6</td>
<td>Microchip Technology Inc.</td>
<td>MCP4725_SOT-23-6</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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10/05/07