# MCP4725 SOT-23-6 Evaluation Board User's Guide

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# MCP4725 SOT-23-6 EVALUATION BOARD USER'S GUIDE

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# MCP4725 SOT-23-6 EVALUATION BOARD USER'S GUIDE

## 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 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 lay-out 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:

**DOCUMENTATION CONVENTIONS**

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


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## 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.

## THE MICROCHIP WEB SITE

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- **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

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- 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.


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# 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 $I^2C$ 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 volt-meter
- **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 $I^2C$ pull-up resistors. This 5 kΩ supports up to 400 kHz. The user can replace the $R_1$ and $R_3$ 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, $V_{DD}$, and $V_{SS}$ 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 $R_1$ and $R_3$ are the $I^2C$ 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 $R_1$ and $R_3$) and loading capacitors. The user can populate the board with their own components.

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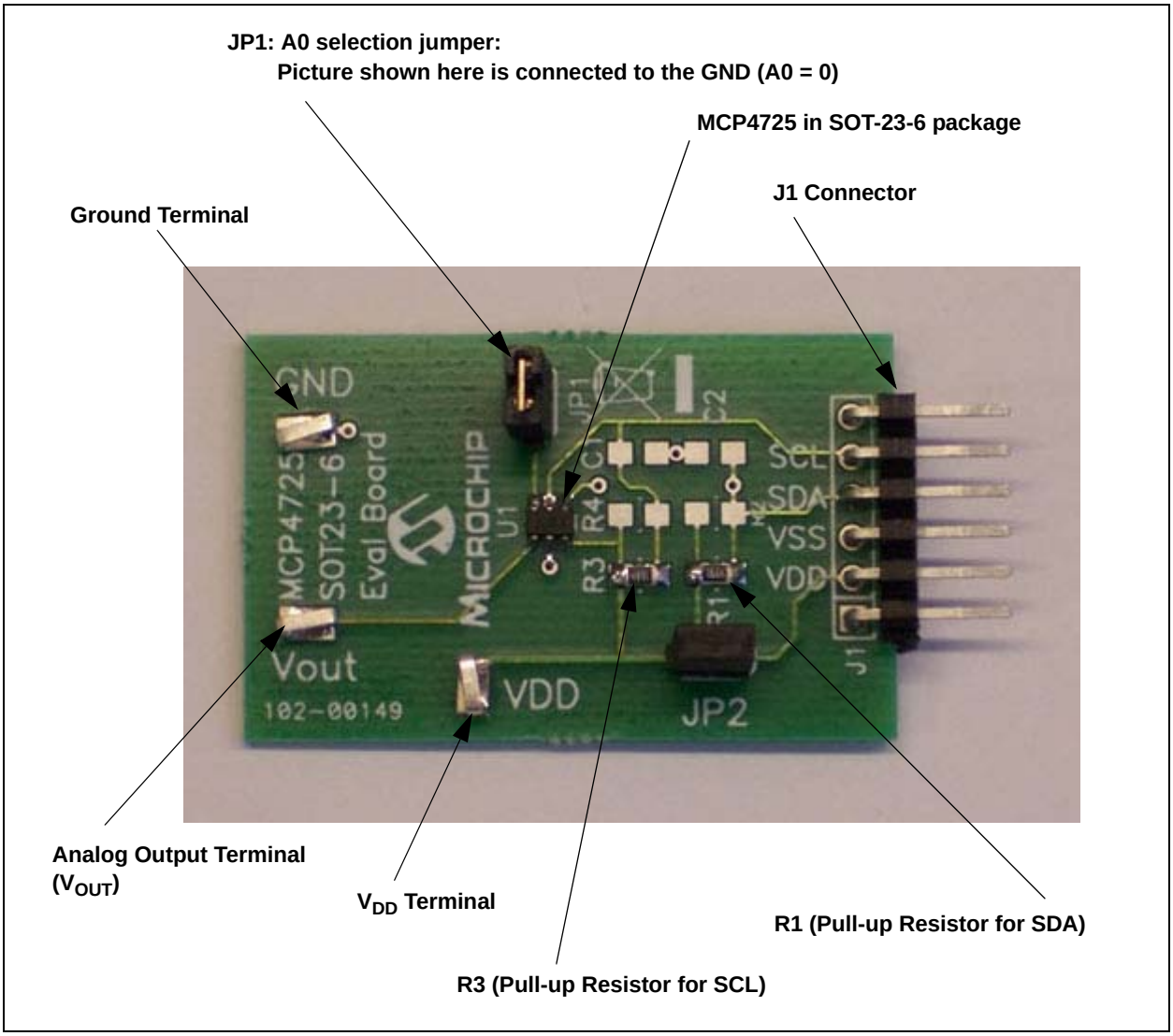


***FIGURE 1-1:*** *MCP4725 SOT-23-6 Evaluation Board.*


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### 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 $V_{OUT}$ and GND terminals on the MCP4725 SOT-23-6 Evaluation Board. Figure 1-2 shows the connection example.

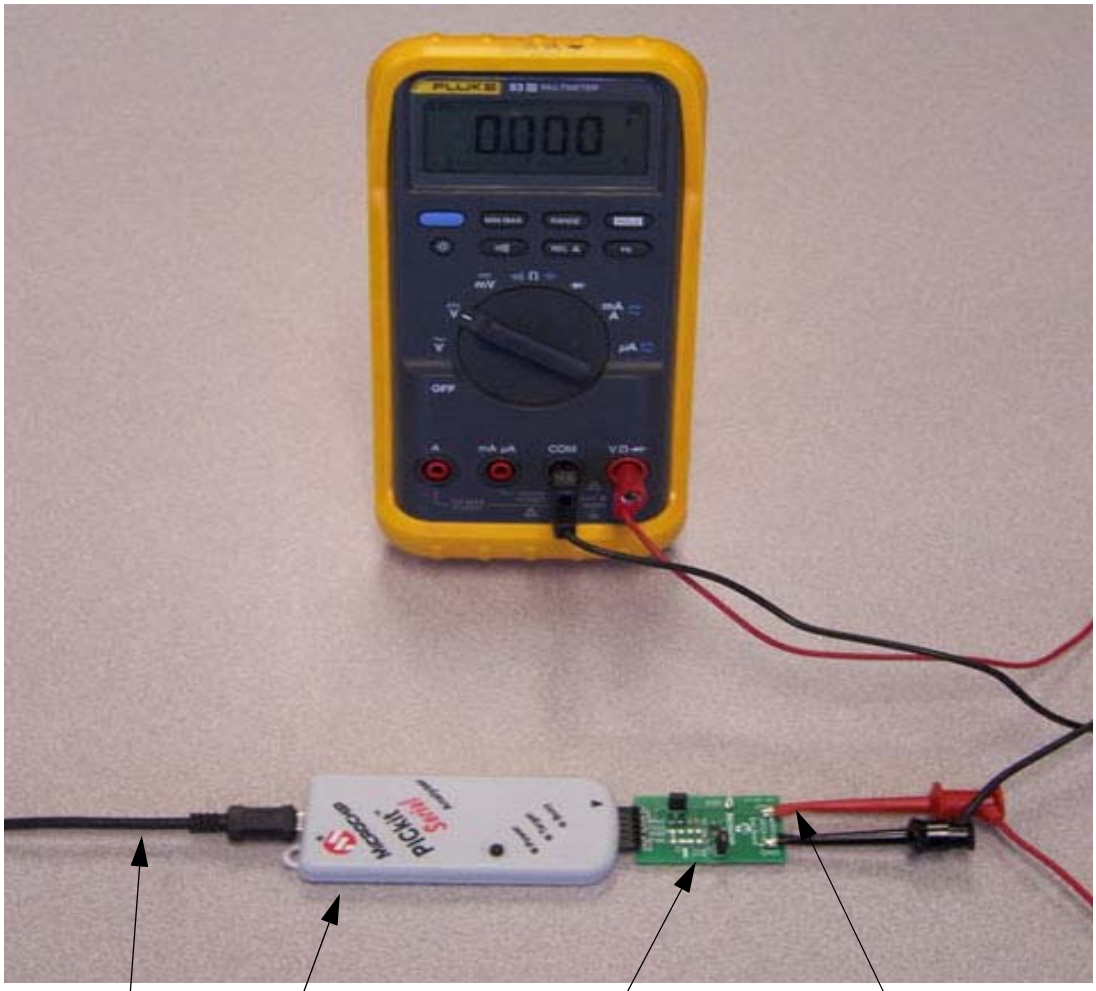
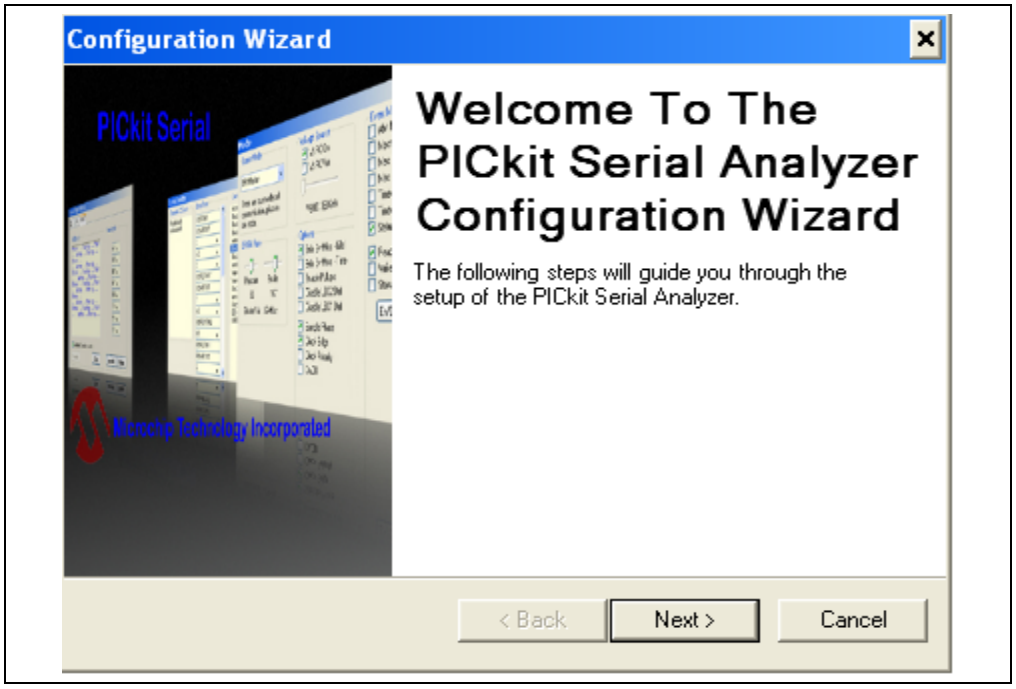


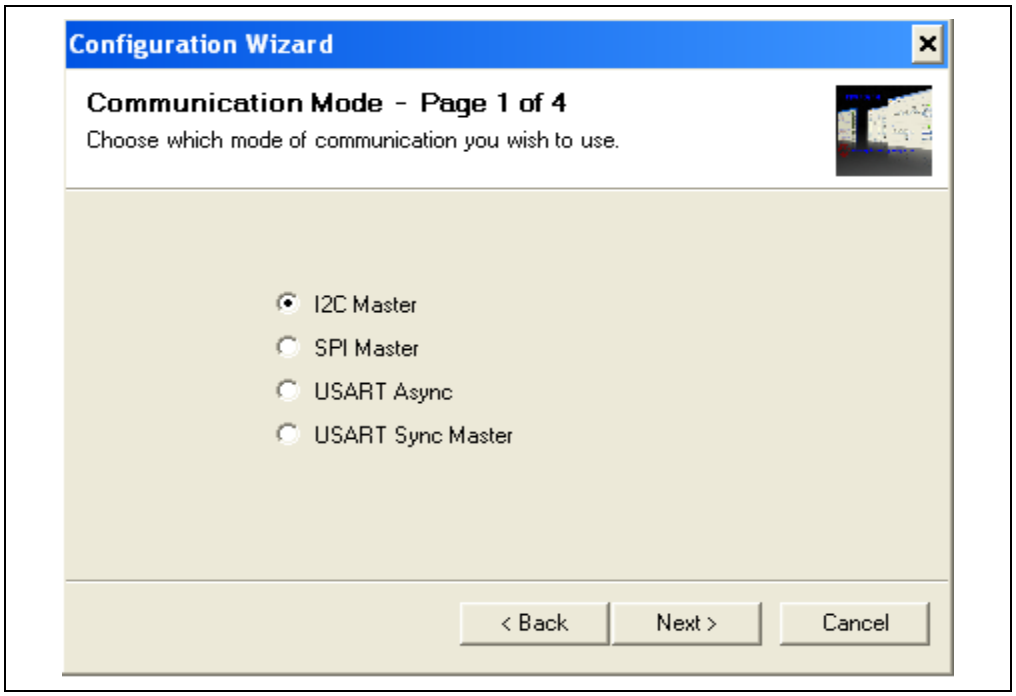

***FIGURE 1-2:*** *MCP4725 SOT-23-6 Evaluation Board Test Set Up.*

1.3.1.2 PICKIT SERIAL ANALYZER PC SOFTWARE SET-UP FOR DAC DEVICE PROGRAMMING AND ANALOG VOLTAGE OUTPUT MEASUREMENT

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.





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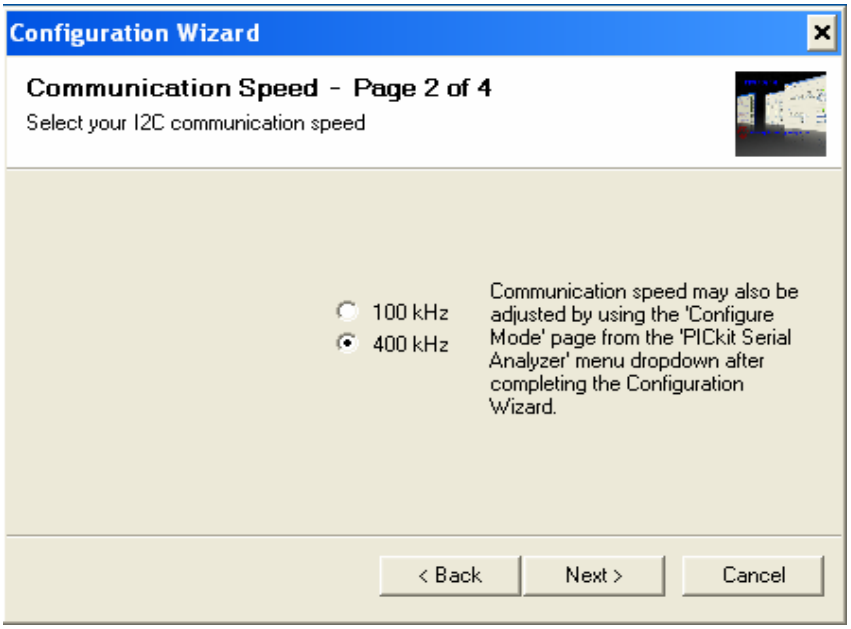
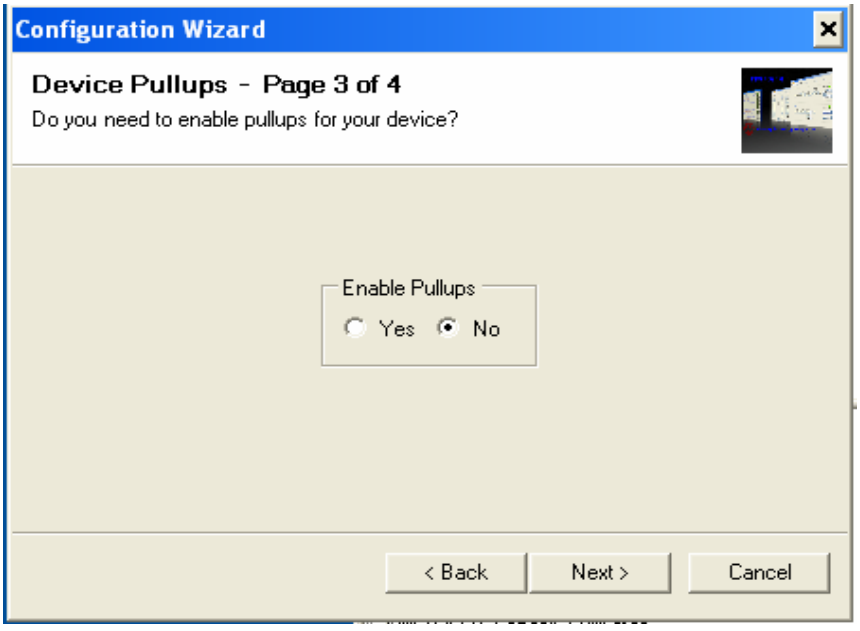
5. Select either **100 kHz** option or **400 kHz** option radio button and click the **Next >** button.




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

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

**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.

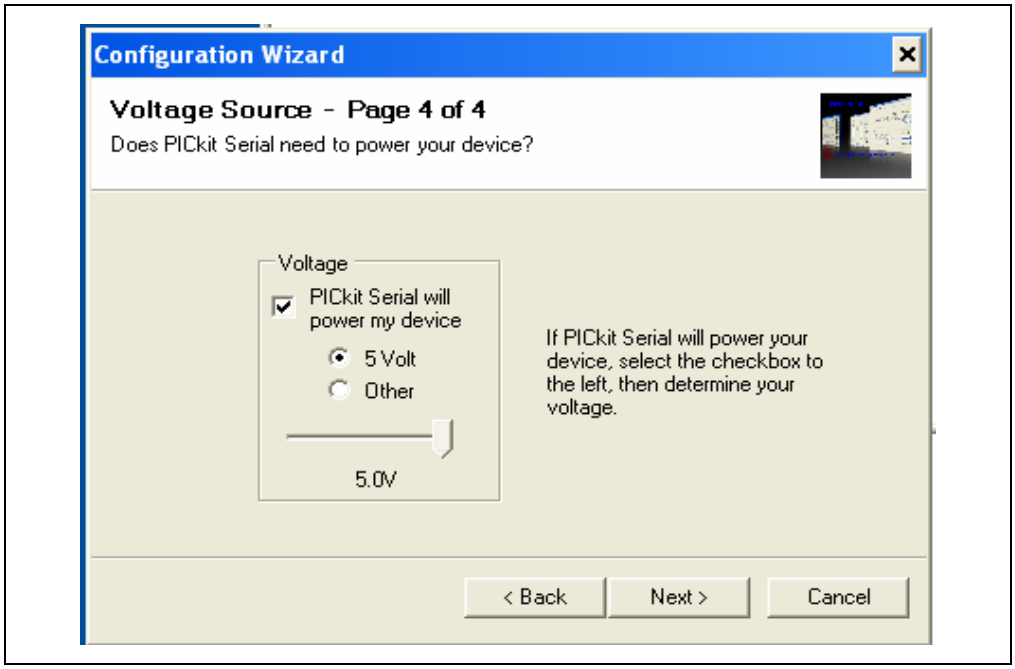
   **Case 1: When you use $V_{DD}$ from the PICkit Serial Analyzer:**

   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 $V_{DD}$:**

   If you want to provide your own $V_{DD}$ voltage through the $V_{DD}$ 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 $V_{DD}$ at the $V_{DD}$ terminal.





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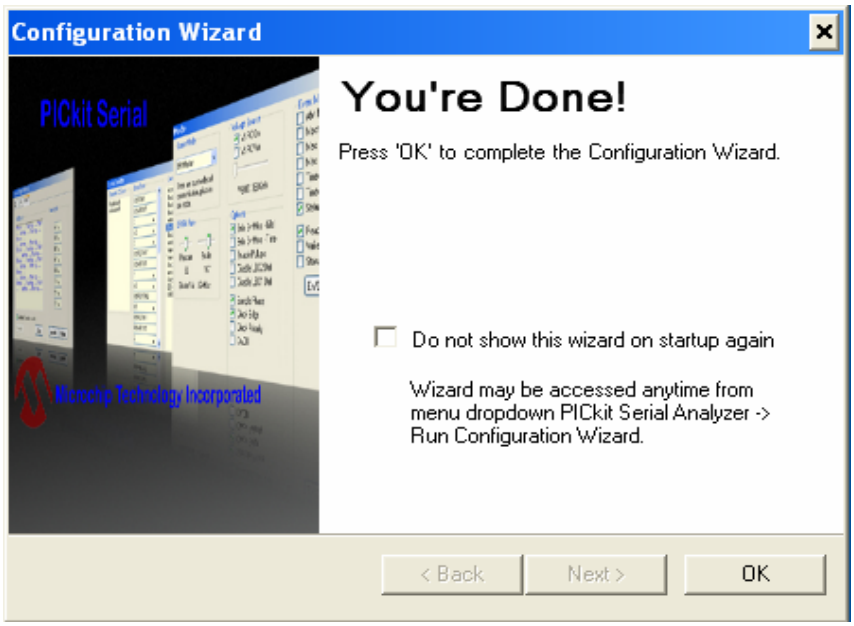
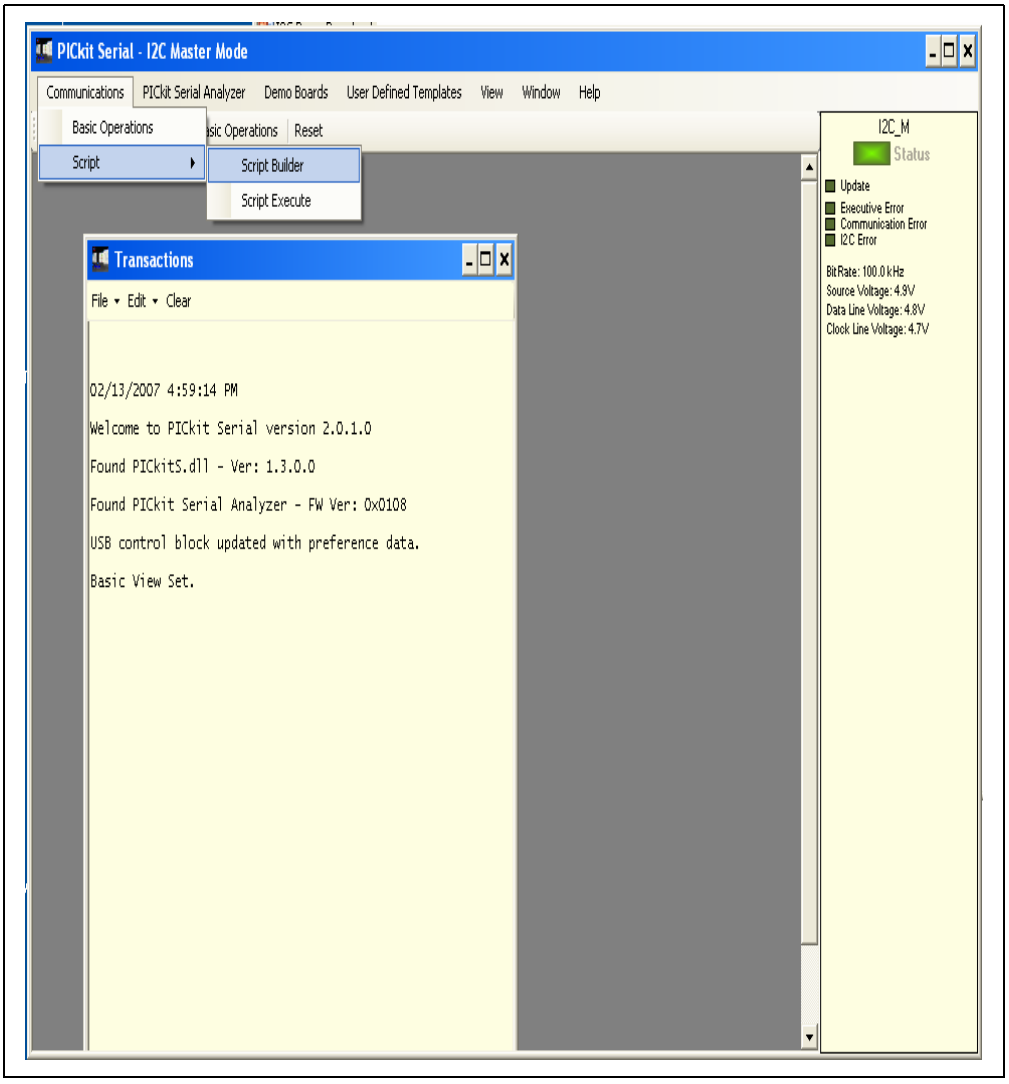
8. Click the **OK** button. You have done all PICkit Serial Analyzer Configuration Set-up. You are now ready to program the MCP4725 device using the PICkit Serial Analyzer.



### 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**.





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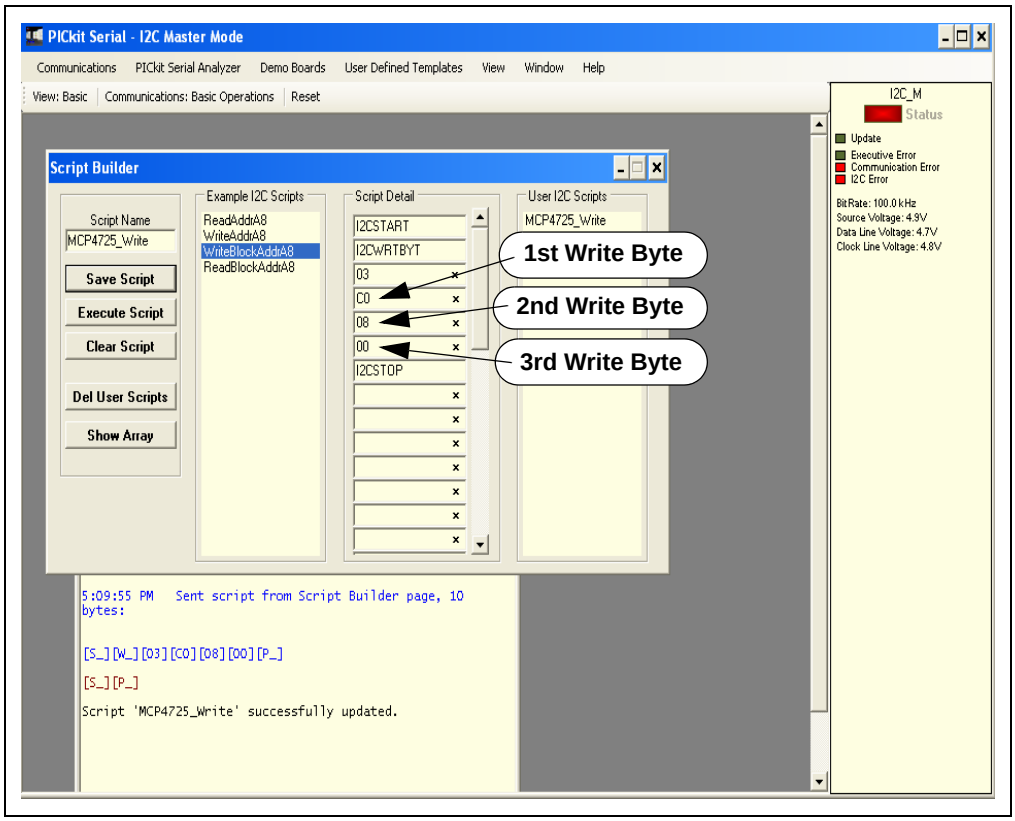
2. You need to create a script file using the following instructions.

   a) Type in any script name (i.e., MCP4725_Write) in the space below the **Script Name** menu item.

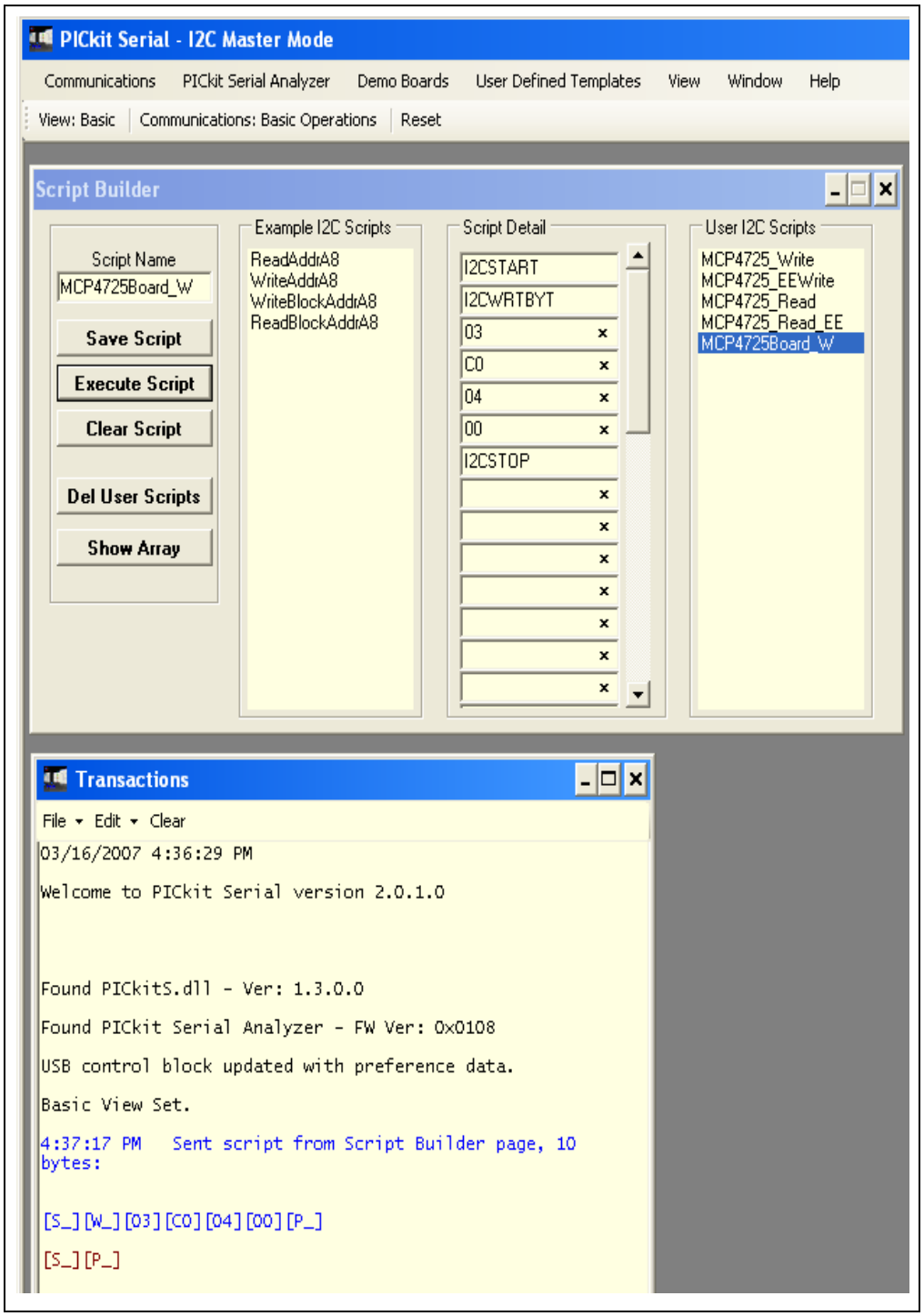
   b) Type in the following parameters in order in the text box area provided in the **Script Detail** box.

| Script Detail | |
|---|---|
| I2CSTART | |
| I2CWRTBYT | |
| 03 | ----------> This means there are three bytes to send |
| C0 | ----------> 1st Write Byte: Address byte = 1100-0000 |
| 08 | ----------> 2nd Write Byte: 0000-1000 |
| 00 | ----------> 3rd Write Byte: 0000-0000 |
| I2CSTOP | |

**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: $V_{OUT} = V_{DD} * 0.5V$.



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.





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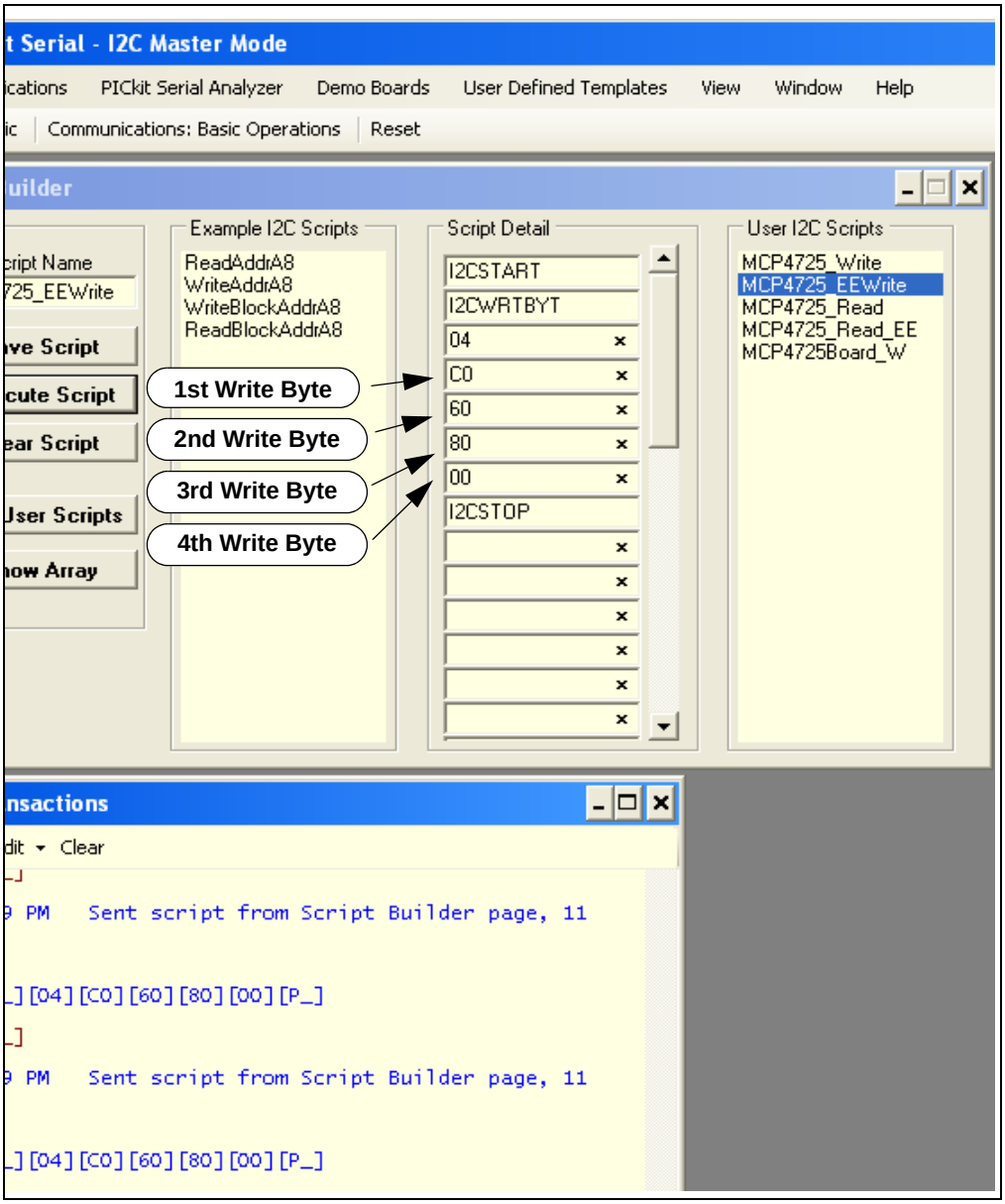
4. Programming DAC Register and EEPROM

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

| Script Detail | |
|---|---|
| I2CSTART | |
| I2CWRTBYT | |
| 04 | ----------> This means Master will send four bytes |
| C0 | ----------> 1st Write Byte: Address byte = 1100-0000 |
| 60 | ----------> 2nd Write Byte: 0110-0000 |
| 80 | ----------> 3rd Write Byte: 1000-0000 |
| 00 | ----------> 4th Write Byte: 0000-0000 |
| I2CSTOP | |



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 $V_{DD}$ from the MCP4725 SOT-23-6 Evaluation Board once, and bring back up the $V_{DD}$ again. You will see the same analog voltage output at the $V_{OUT}$ terminal.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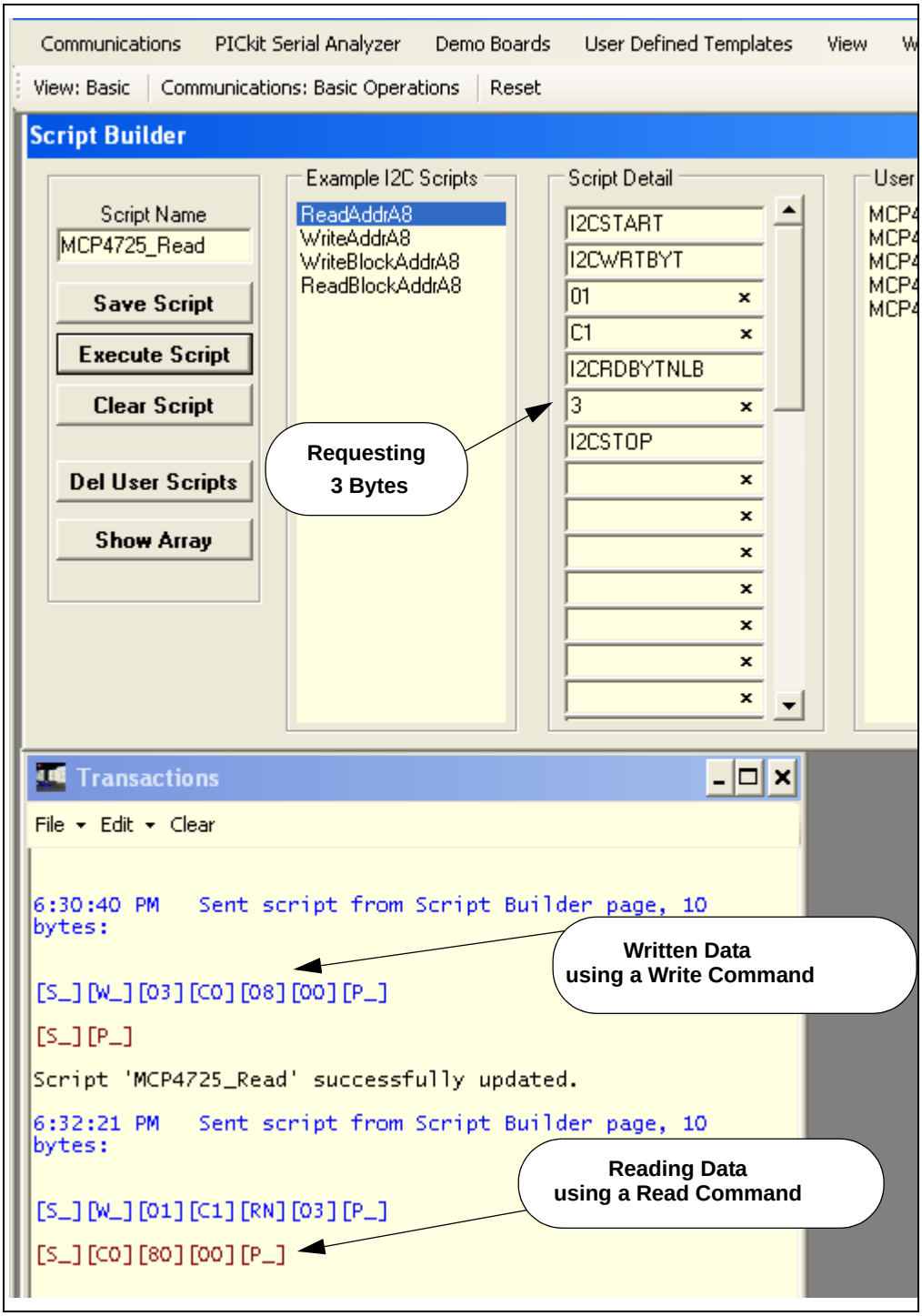
6. Reading the DAC Register Data using the PICkit Serial Analyzer

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.

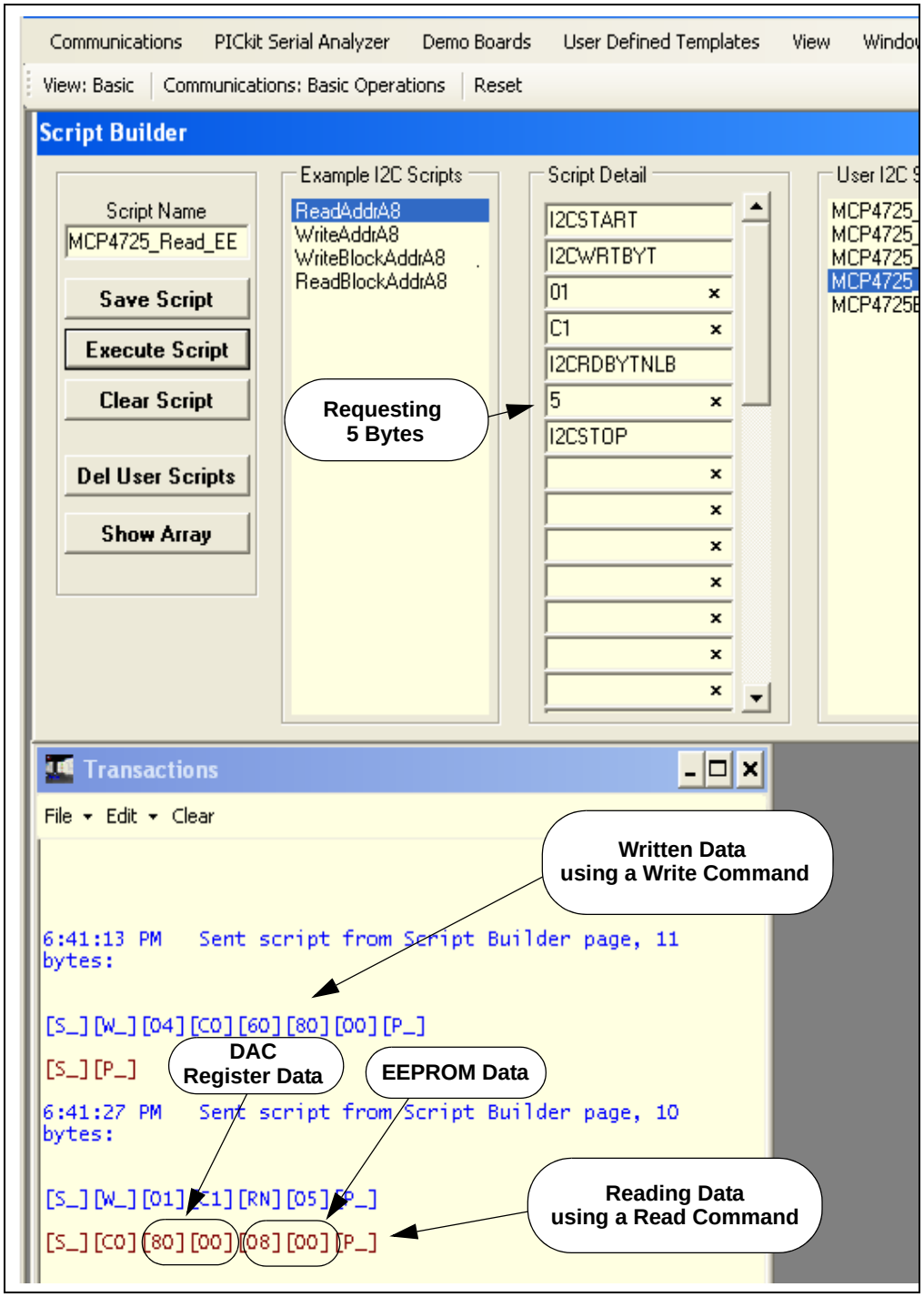


7. Reading both the DAC Register and EEPROM data.

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.





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### 1.3.3 Examples of the MCP4725 Programming

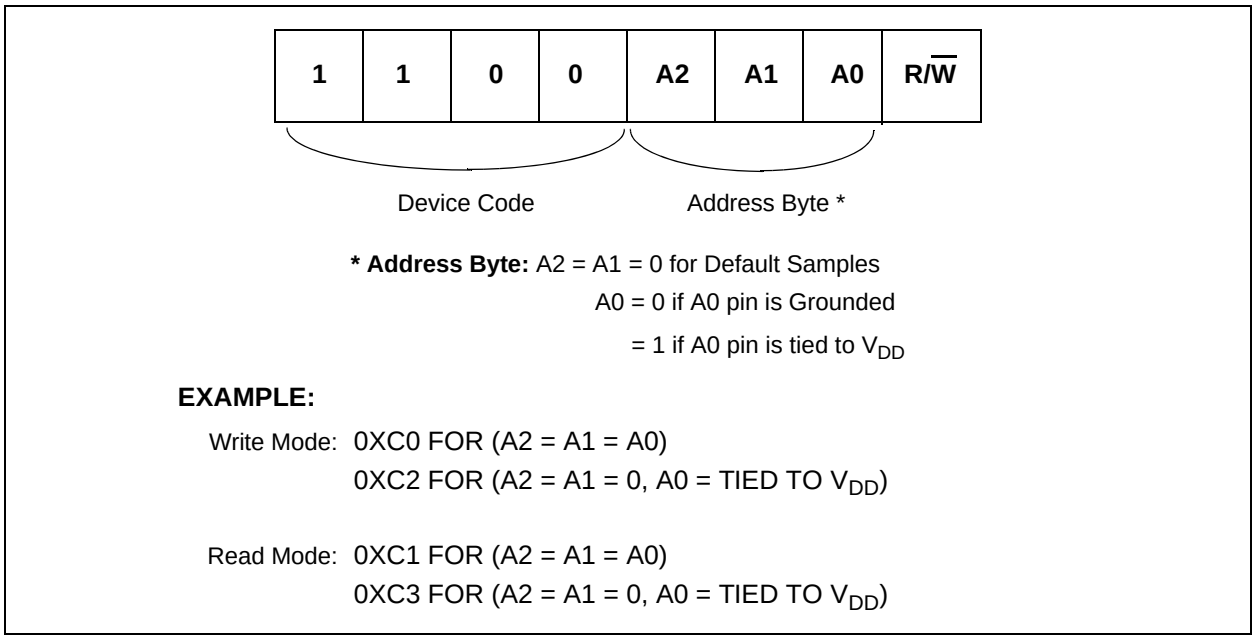


***FIGURE 1-3:*** *MCP4725 Device Address Byte.*

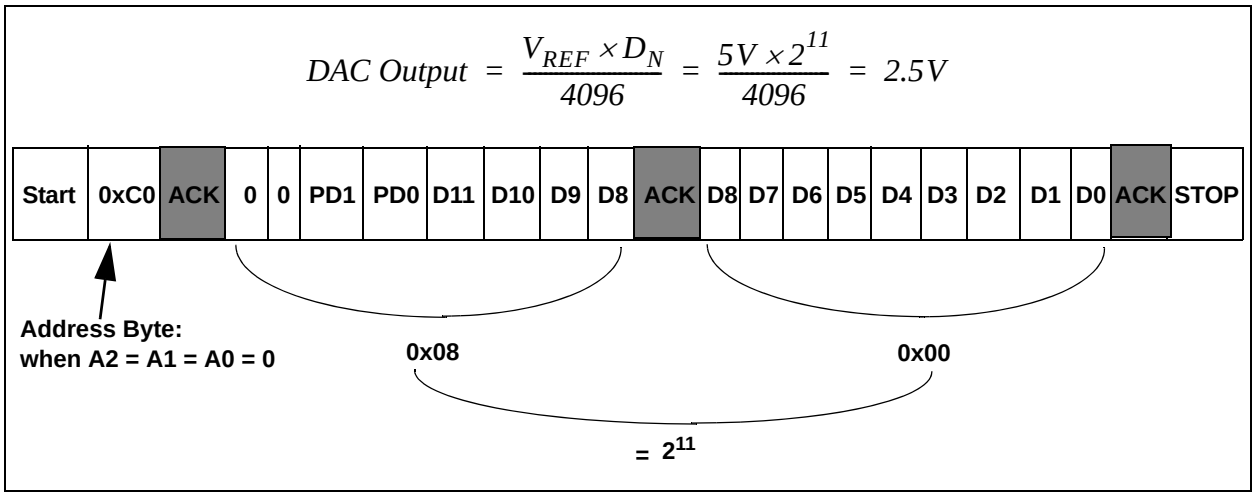


***FIGURE 1-4:*** *Fast Mode (Write Command) for $V_{OUT}$ = 2.5V when $V_{REF}$ = 5V.*

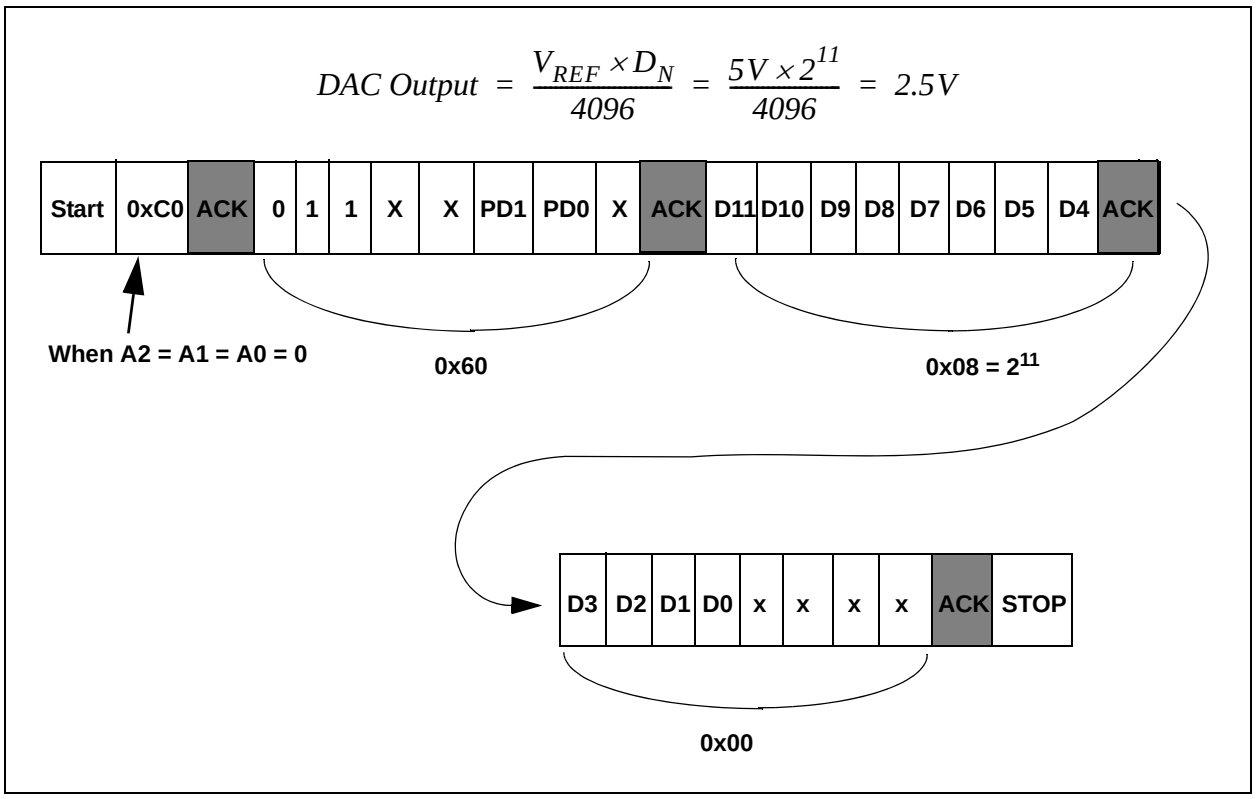


***FIGURE 1-5:*** *Write Command Example for EEPROM and DAC Register for $V_{OUT}$ = 2.5V when $V_{REF}$ = 5V.*


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# 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

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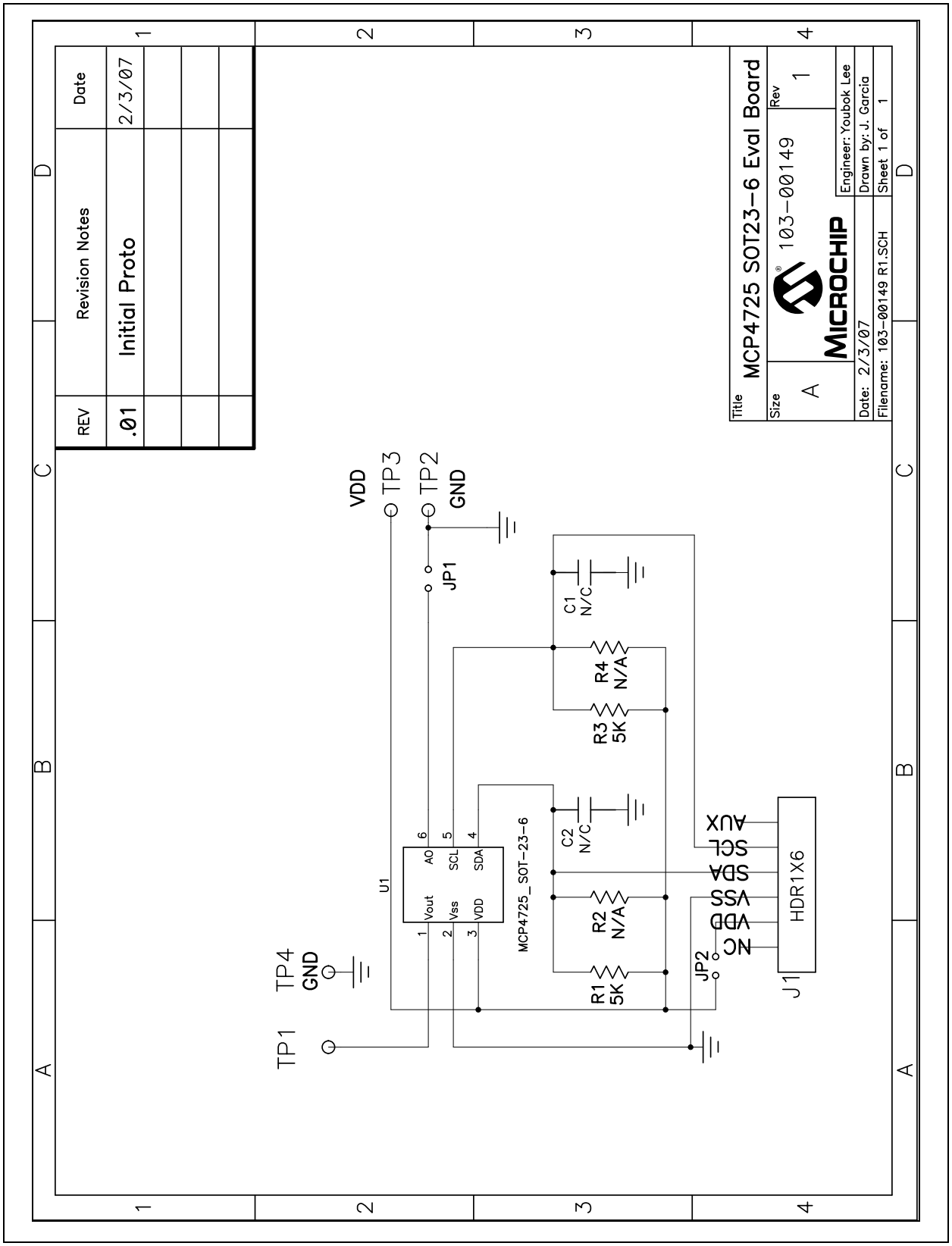
## A.2 BOARD - SCHEMATIC





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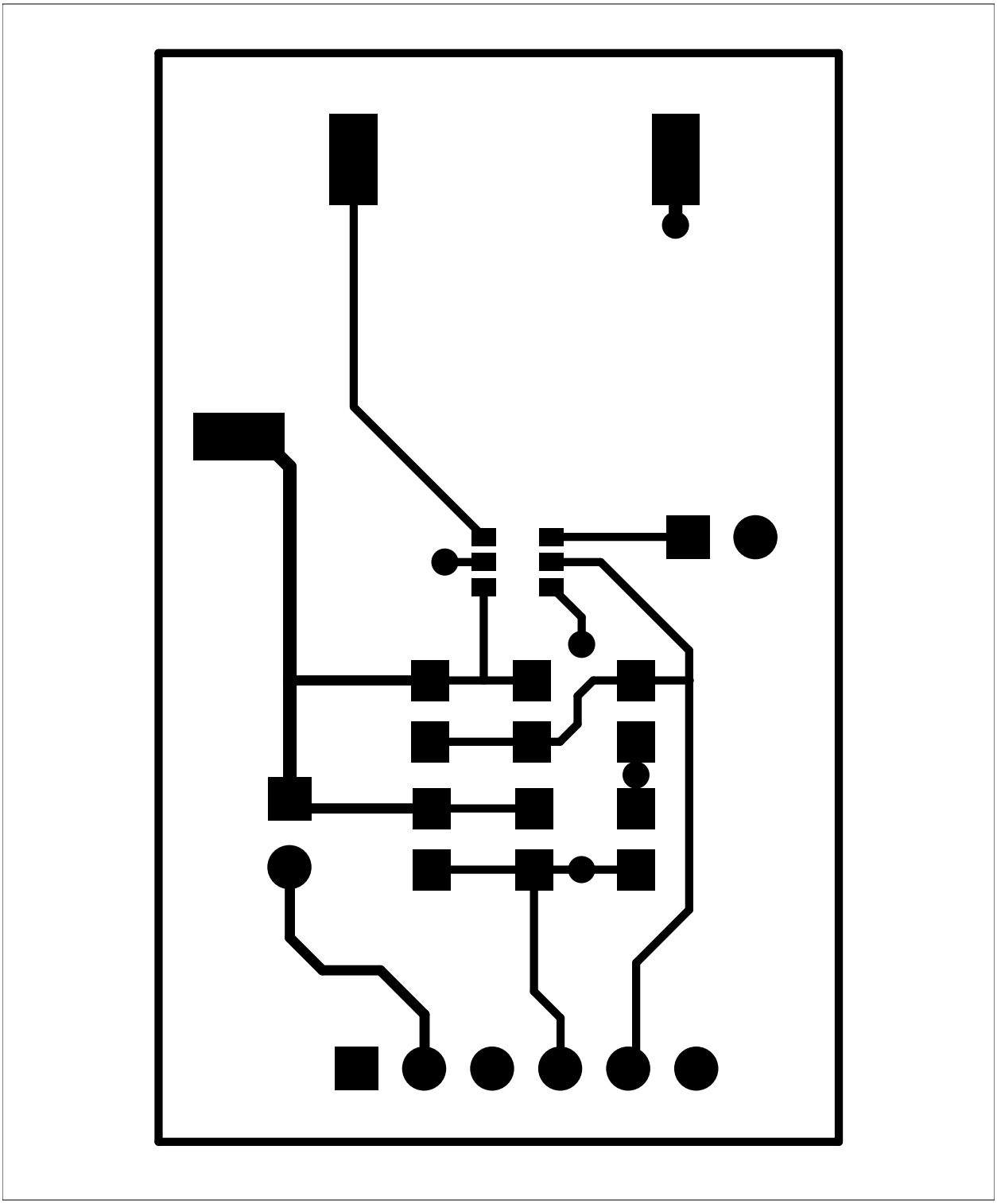
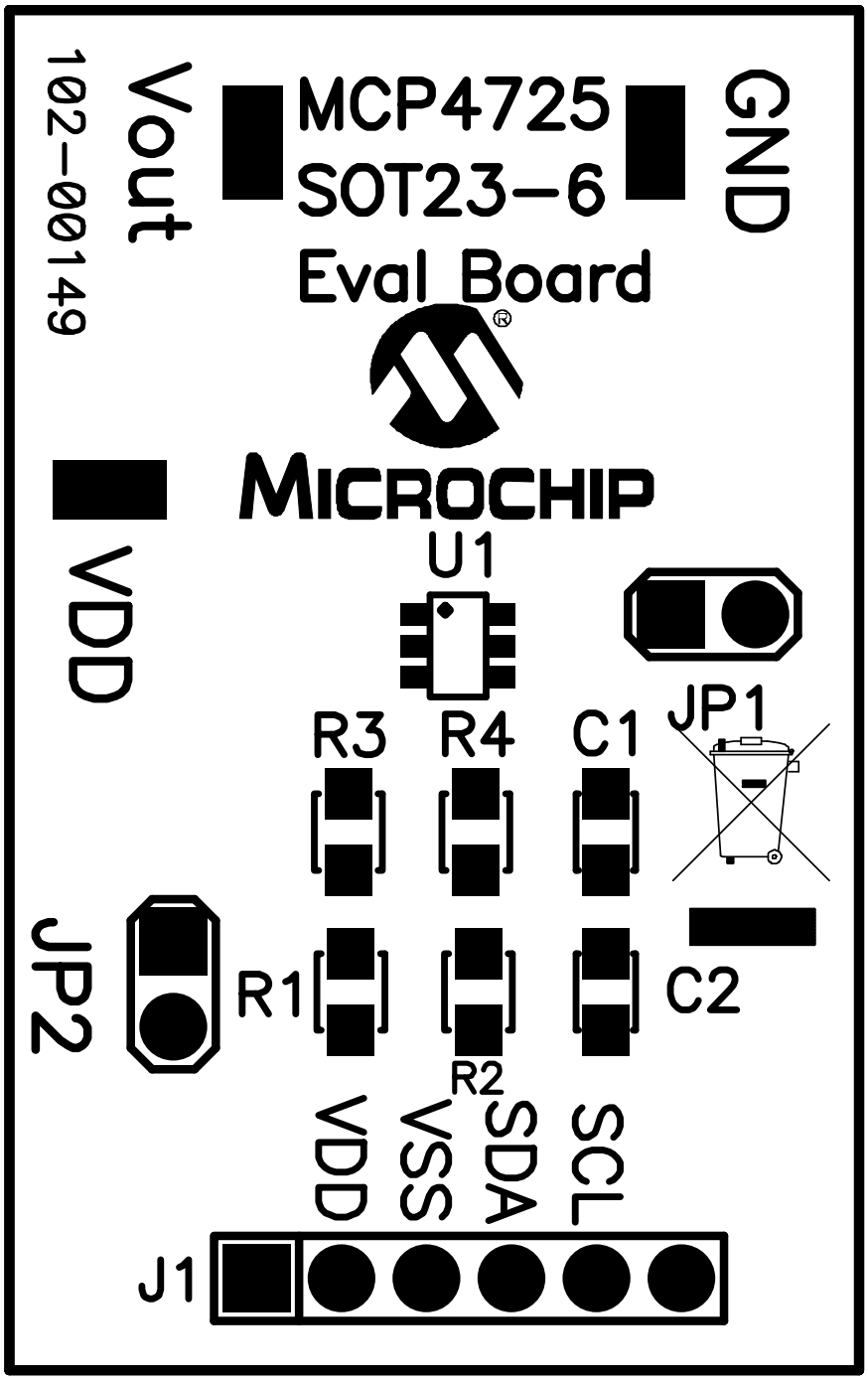
## A.3 BOARD - TOP LAYER



## A.4 BOARD - TOP SILK LAYER





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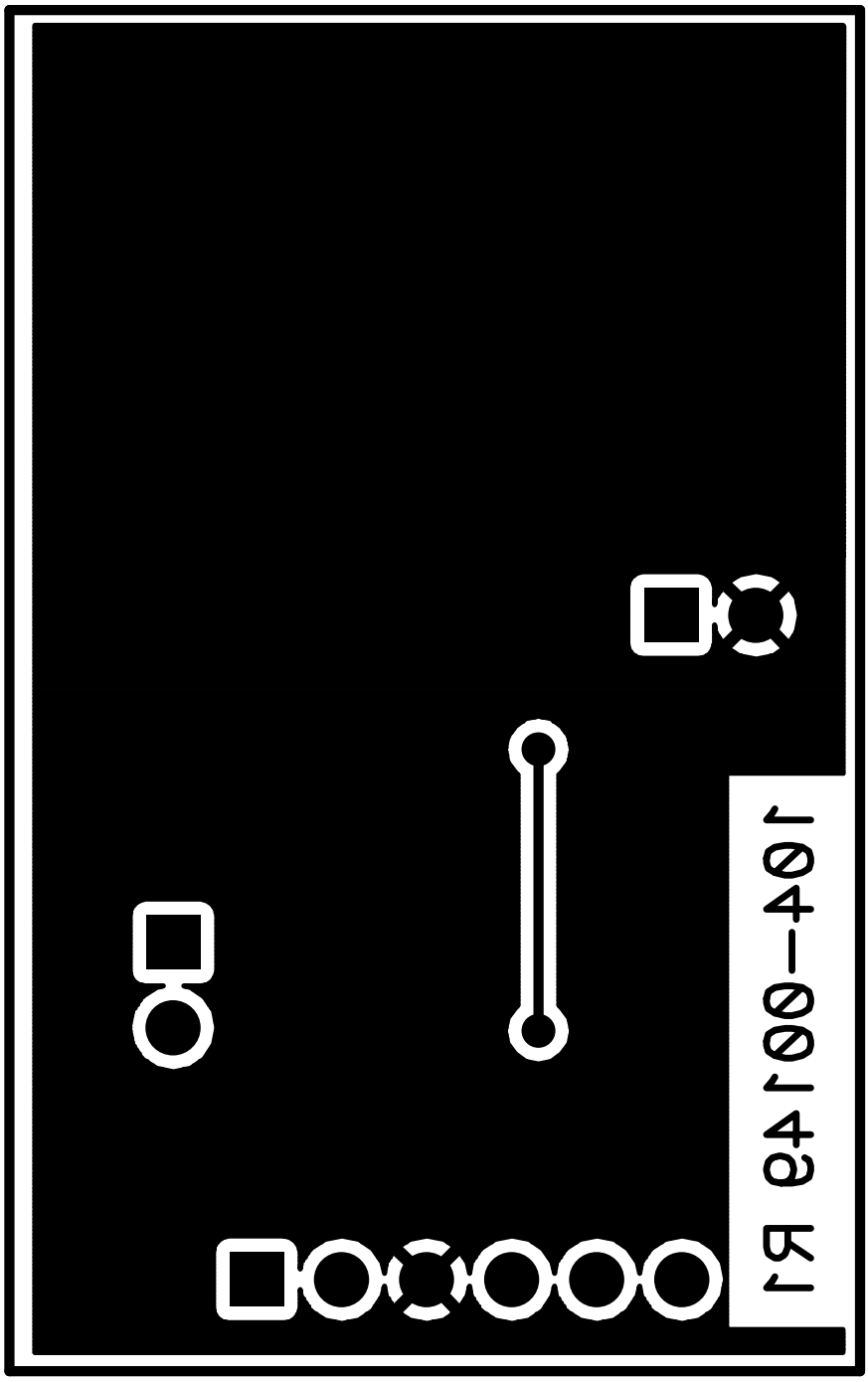
## A.5 BOARD - BOTTOM LAYER



**NOTES:**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# Appendix B. Bill Of Materials (BOM)

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

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 2 | C1, C2 | Not Populated | — | — |
| 3 | GND, VDD VOUT | TEST POINT PC COMPACT SMT | Keystone Electronics | 5016 |
| 1 | J1 | CONN HEADER 6POS .100 R/A GOLD | Molex/Waldom Electronics Corp | 22-28-8062 |
| 2 | JP1,JP2 | CONN HEADER 2POS .100 VERT TIN | Molex/Waldom Electronics Corp | 22-28-4020 |
| 2 | JP1,JP2 | CONN JUMPER SHORTING GOLD FLASH | Sullins Electronics Corp. | SPC02SYAN |
| 1 | PCB | RoHS Compliant Bare PCB, MCP4725 SOT23-6 Eval Board | — | 104-000149 |
| 2 | R1,R3 | RES 4.99K OHM 1/8W 1% 0805 SMD | Panasonic® - ECG | ERJ-6ENF4991V |
| 2 | R2,R4 | Not Populated | — | — |
| 1 | U1 | MCP4725_SOT-23-6 | Microchip Technology Inc. | MCP4725_SOT-23-6 |

**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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