# MCP3422 Evaluation Board for PICkit™ Serial User's Guide

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# MCP3422 EVALUATION BOARD FOR PICkit™ SERIAL USER'S GUIDE

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**NOTES:**


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# MCP3422 EVALUATION BOARD FOR PICkit™ SERIAL 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 MCP3422 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 MCP3422 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 MCP3422 Evaluation Board and instructions on how to use theMCP3422 Evaluation Board with PICkit™ Serial Analyzer.
- **Appendix A. "Schematic and Layouts"** – shows the schematic and layout diagrams for the MCP3422 Evaluation Board.
- **Appendix B. "Bill Of Materials (BOM)"** – lists the parts used to build the MCP3422 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 MCP3422 Evaluation Board. Other useful documents are listed below. 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.

**MCP3422 Data Sheet, *"18-Bit, Multi-Channel ΔΣ Analog-to-Digital Converter with $I^2C$™ Interface and On-Board Reference"*, DS22088**

This data sheet provides detailed information regarding the MCP3422 product family.

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- Local Sales Office
- 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 (November 2008)

- Initial Release of this Document.

**NOTES:**


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# Chapter 1. Quick Start Instructions

## 1.1 INTRODUCTION

The following sections provide an overview of the MCP3422 Evaluation Board and demonstrate how to use it with the PICkit™ Serial Analyzer (P/N: DV164122).

The following topics are covered:

- Description of the MCP3422 Evaluation Board
- How to use the MCP3422 Evaluation Board with the PICkit Serial Analyzer

## 1.2 DESCRIPTION OF THE MCP3422 EVALUATION BOARD

The MCP3422 Evaluation Board (P/N MCP3422EV) contains a MCP3422 18-Bit Delta-Sigma Analog-to-Digital Converter (ADC). The MCP3422 is a 2-channel ADC device with various options. The MCP3422 Evaluation Board has analog input connection pads and $V_{DD}$, SDA, and SCL test pads. The user can connect inputs and test the conversion results using the PICkit Serial Analyzer and its PC graphic user interface (GUI). The MCP3422 Evaluation Board has the following interface:

- PICkit Serial Analyzer for writing configuration register bits and reading the conversion data.

| **Note:** | The MCP3422 Evaluation Board can be used without the PICkit Serial Analyzer as long as the $V_{DD}$, SCL, and SDA are provided to the board. The MCP3422 Evaluation Board does not include MCU. |
|---|---|

The user can monitor the $I^2C$ communications by connecting an oscilloscope to the SDA and SCL test pads. Refer to **Appendix A. "Schematic and Layouts".**

### 1.2.1 $I^2C$ Address Bits for the MCP3422

The $I^2C$ device code and address bits of the MCP3422 device are programmed at factory:

- Device Code: '1101'
- A2, A1, A0 Address Bits: the MCP3422 device in the MCP3422 Evaluation Board uses default setting: (A2, A1, A0) = (0, 0, 0)
- Address Byte = 1101000R/$\overline{W}$

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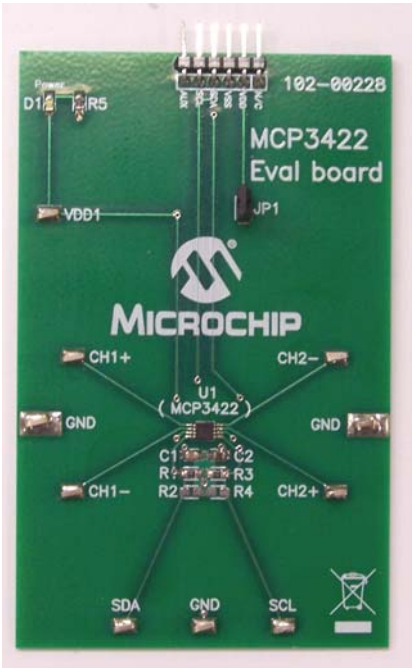


***FIGURE 1-1:*** *Front View of the MCP3422 Evaluation Board.*

## 1.3 GETTING STARTED WITH THE PICKIT SERIAL ANALYZER

Figure 1-1 shows the MCP3422 Evaluation Board and Figure 1-2 shows the MCP3422 Evaluation Board and PICkit Serial Analyzer.

The following instructions describe how to use them together:

1. Connect the MCP3422 Evaluation Board's 6-pin socket to the PICkit Serial Analyzer, as shown in Figure 1-2.
2. Connect the oscilloscope probes to the SCL and SDA test pins (optional).
3. **$V_{DD}$ Selection:** You can use the $V_{DD}$ from the PICkit Serial Analyzer or you can use your own external $V_{DD}$. The JP1 connector selects the $V_{DD}$ path.

   (a) Connect JP1, if using $V_{DD}$ from PICkit Serial Analyzer.

   (b) Disconnect JP1 and apply $V_{DD}$ at VDD1 pin, if you are using an external $V_{DD}$.
4. **Connecting $V_{DD}$:** LED D1 turns on when $V_{DD}$ is applied. The PICkit Serial Analyzer will provide $V_{DD}$ automatically, if it is connected to the PC. Make sure LED D1 turns on, when you execute the command using the PICkit Serial Analyzer.
5. **Connecting the analog inputs:** If you need to measure a single-ended input, connect the unused pin (example, CHX-) to $V_{SS}$.

- **Connecting the inputs**: The MCP3422 Evaluation Board has input pads for analog inputs for each input channel. You can connect all inputs at the same time and multiplex the input channel using configuration register settings. You can also leave the unused channel inputs floating.


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6. Use the PICkit Serial Analyzer PC GUI to send $I^2C$ write and read commands.

| CAUTION |
| --- |
| **Each analog input pin has an ESD diode. Certain input conditions can damage the device. Please follow the conditions below:**<br>**(a) Do not apply an input greater than the input range specified by the MCP3422 Data Sheet.**<br>**(b) Apply the input signal after $V_{DD}$ is powered-up.** |

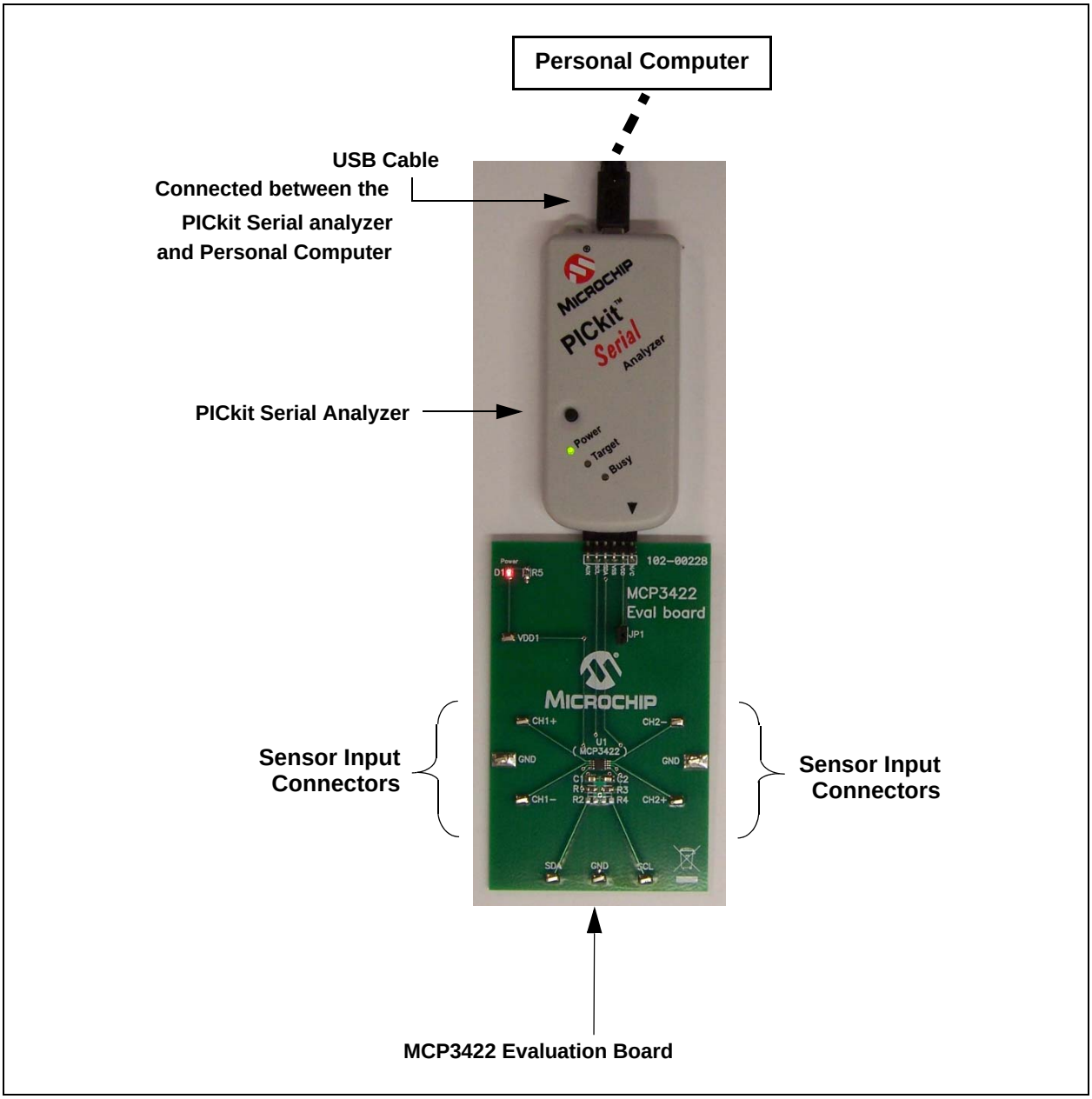


***FIGURE 1-2:*** *MCP3422 Evaluation Board with the PICkit Serial Analyzer.*

### 1.3.1 PICkit Serial Analyzer PC Software Setup for the MCP3422 Evaluation Board

The following steps describe how to set up and use the PICkit Serial Analyzer PC Graphic User Interface (GUI).

1. Install the PICkit Serial Analyzer software onto your personal computer (PC).
2. Connect the USB cable between the PICkit Serial Analyzer and the PC.
3. Run the PICkit Serial PC Software. The following graphic user interface (GUI) will appear.

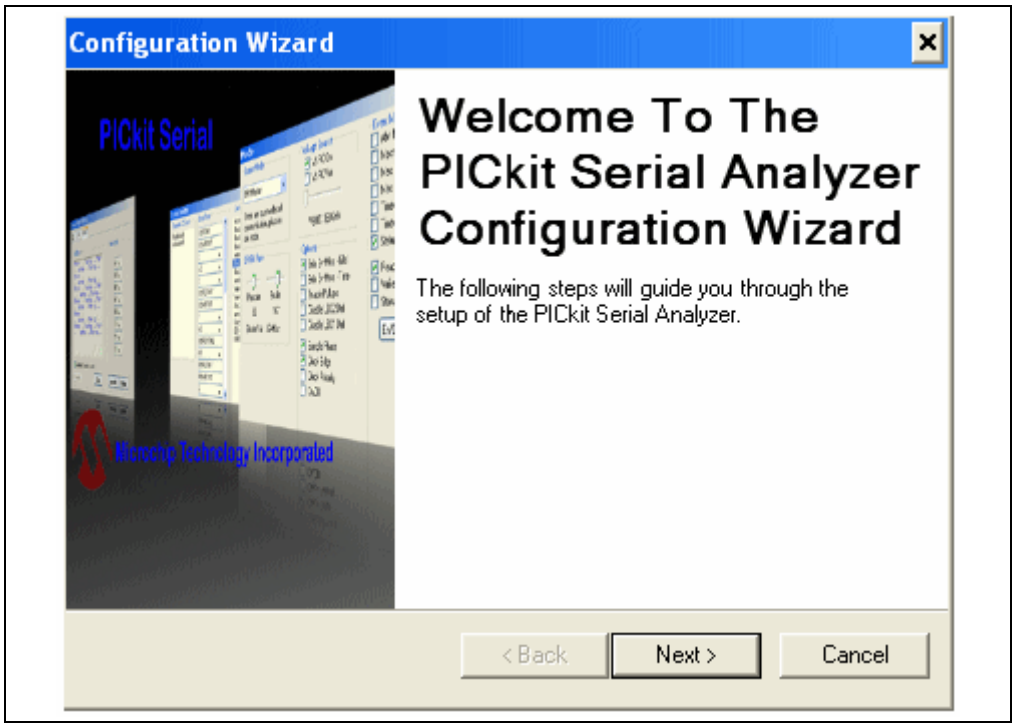


***FIGURE 1-3:*** *PICkit Serial Analyzer Configuration Wizard Welcome Window.*

Click the **Next** button and follow the instructions.


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4. Select the Communication Mode type: **I2C Master**, and click the **Next** button.

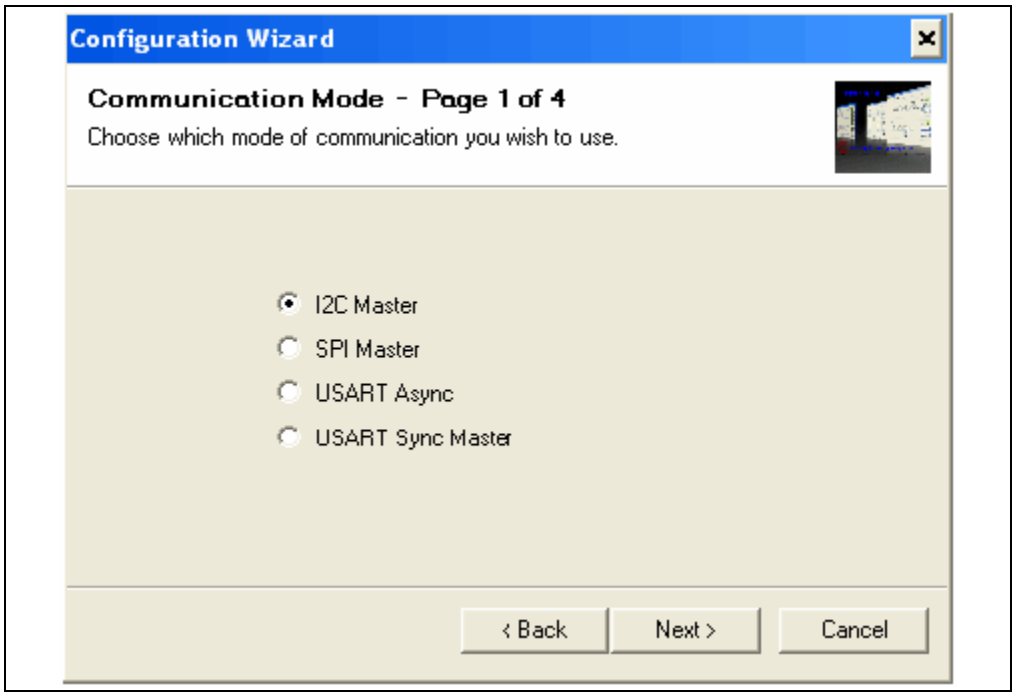


***FIGURE 1-4:*** *Step 1 - Communication Mode Selection.*

5. Select 100 kHz or 400 kHz. Either one will be fine. Click the **Next** button.

***FIGURE 1-5:*** *Step 2 - $I^2C$ Communication Speed Window.*

| **Note:** | The MCP3422 device supports the $I^2C$ bus data rate up to 3.4 MHz, but the current version of the PICkit Serial Analyzer supports the $I^2C$ bus data rate up to 400 kHz only. |
|---|---|

6. Select **No** on the Enable Pull-ups screen and click the **Next** button.

| **Note:** | The MCP3422 Evaluation Board has its own pull-up resistors. |
|---|---|

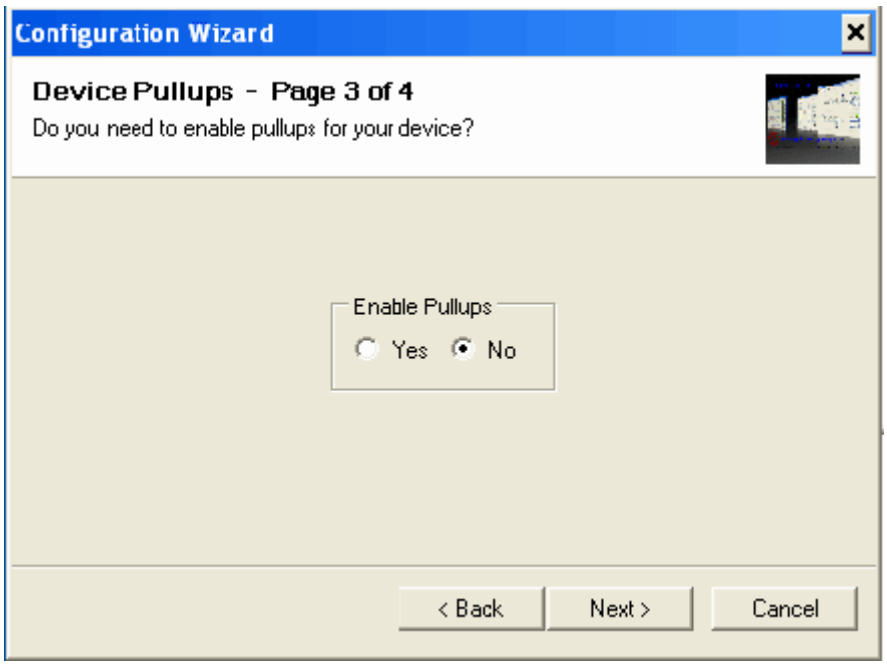


***FIGURE 1-6:*** *Step 3 - Device Pullups Window.*

7. Select the $V_{DD}$ voltage of the MCP3422 Evaluation Board and click the **Next** button.

### Case 1: When using $V_{DD}$ from the PICkit Serial Analyzer:

If you choose **PICkit Serial will power your device** and **5 Volt** as shown in Figure 1-7, the MCP3422 Evaluation Board will be powered by the 5V DC from the PICkit Serial Analyzer through the JP1 jumper. In this case, make sure that the JP1 jumper on the MCP3422 Evaluation Board is connected.

### Case 2: When using your own $V_{DD}$:

You can also provide your own $V_{DD}$ voltage by applying a $V_{DD}$ voltage at the VD1 test point. In this case, make sure that the JP1 jumper is disconnected.


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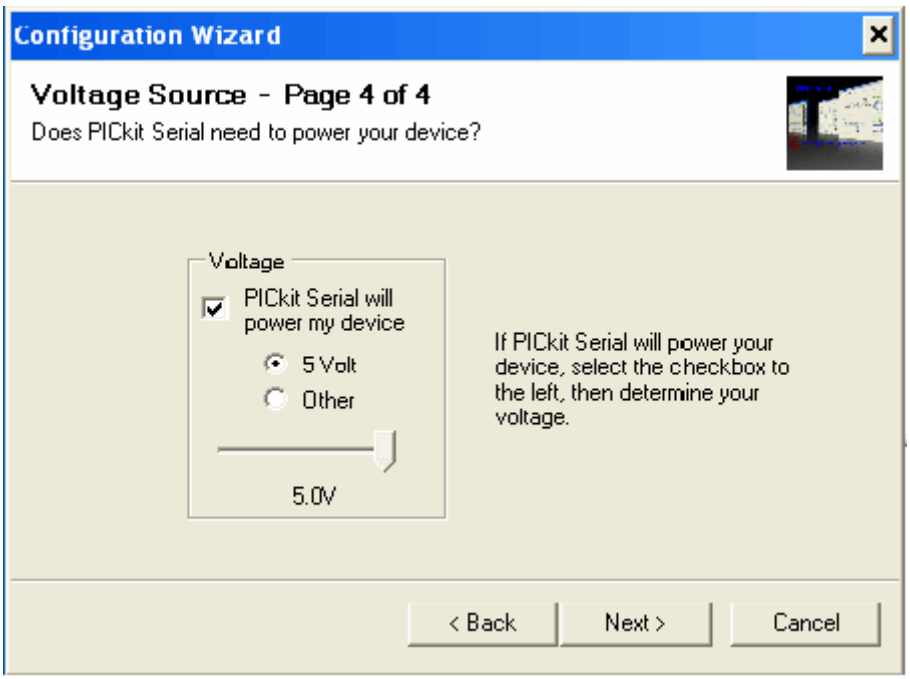


***FIGURE 1-7:*** *Step 4 - Voltage Source Selection Window.*

8. Click the **OK** button. You have made all the PICkit Serial Analyzer configuration setups. You are now ready to program the MCP3422 Evaluation Board using the PICkit Serial Analyzer.

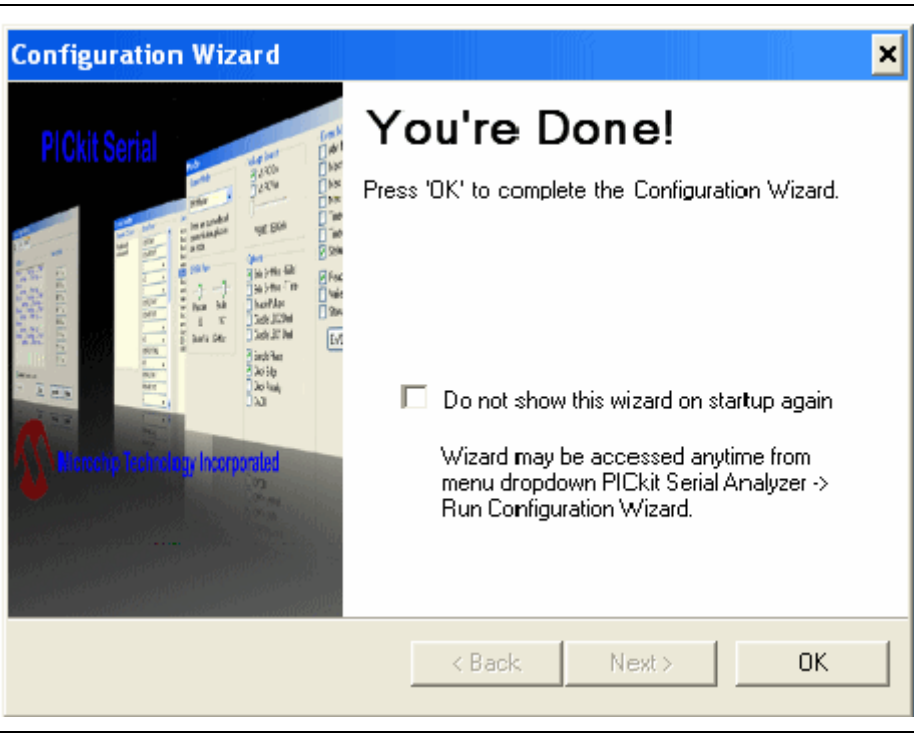


***FIGURE 1-8:*** *Configuration Wizard - Finishing Step.*

### 1.3.2 Creating Script Files

In order to make a communication connection between the PICkit Serial Analyzer and the MCP3422 Evaluation Board, a script file is needed. The following procedure shows how to create script files and how to use them.

- In the PICkit Serial Analyzer window, select from the menu *Communications> Script>Script Builder* (Figure 1-9).

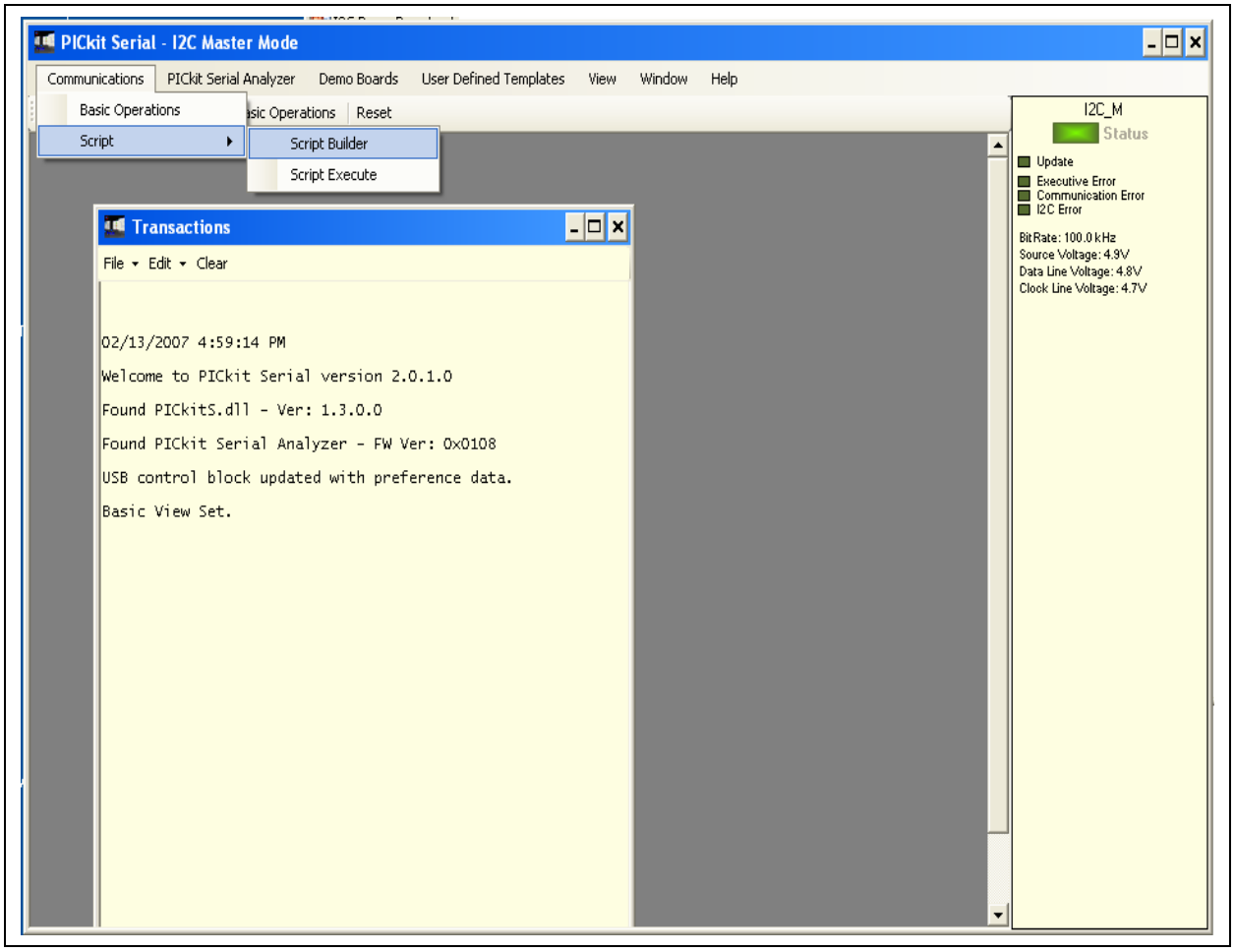


***FIGURE 1-9:*** *Creating a Script File with Script Builder.*

#### 1.3.2.1 CREATING A SCRIPT FILE FOR CONFIGURATION BYTE WRITING

1. Click on **WriteBlockAddrA8** in "Example $I^2C$ Scripts" column.

   This will result in filling in the spaces under the "Script Detail" column. You can now modify the "Script Detail" column parameters by right-clicking the mouse.

**How to modify the parameters box in Script Details:**

1. Under the "Script Detail" box, select the item in the parameter box.
2. Right-click the mouse button and an option box appears to the right of your selection, displaying the options available for the selected parameter.
3. Select the desired option and delete or insert the parameter box.
4. Keep the parameters in the order shown in Figure 1-10.


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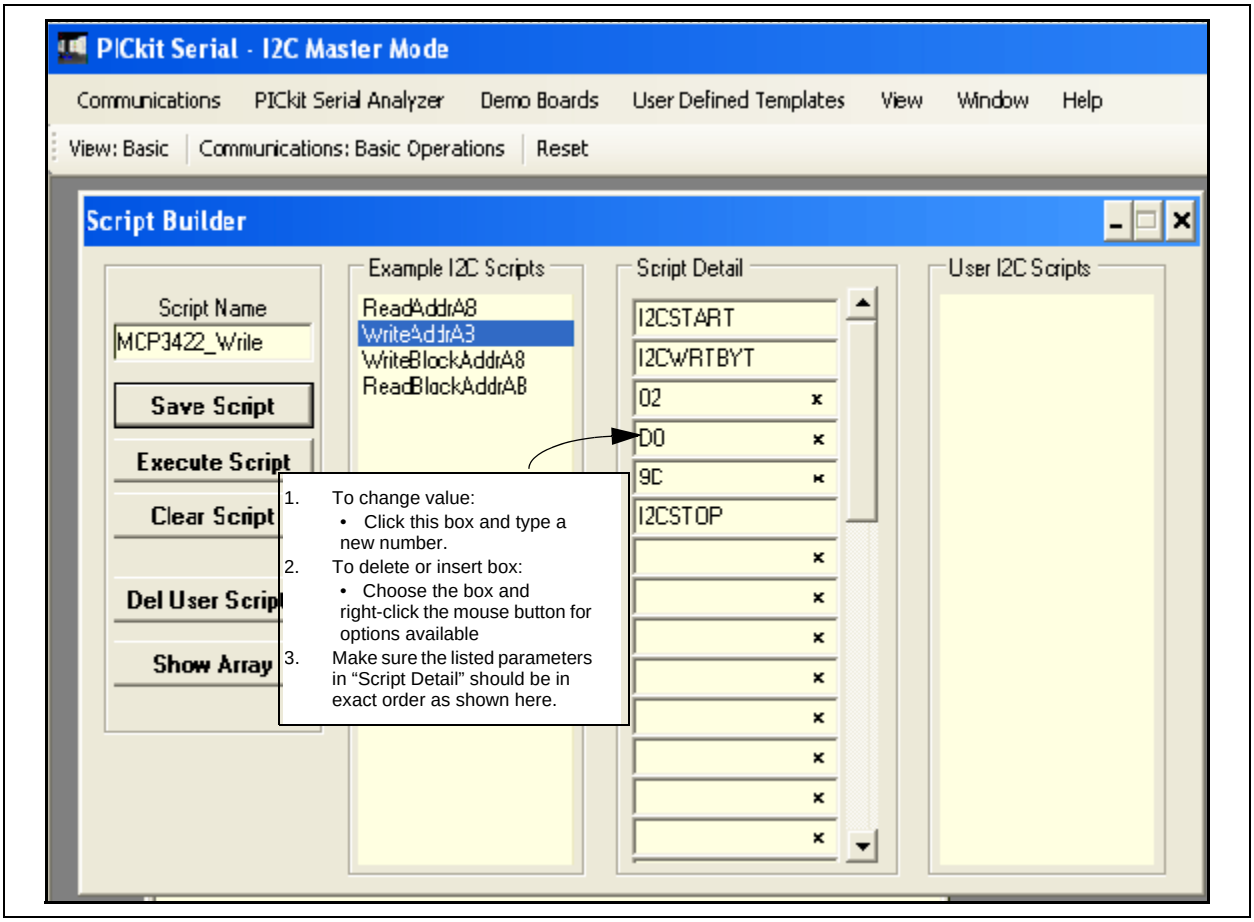
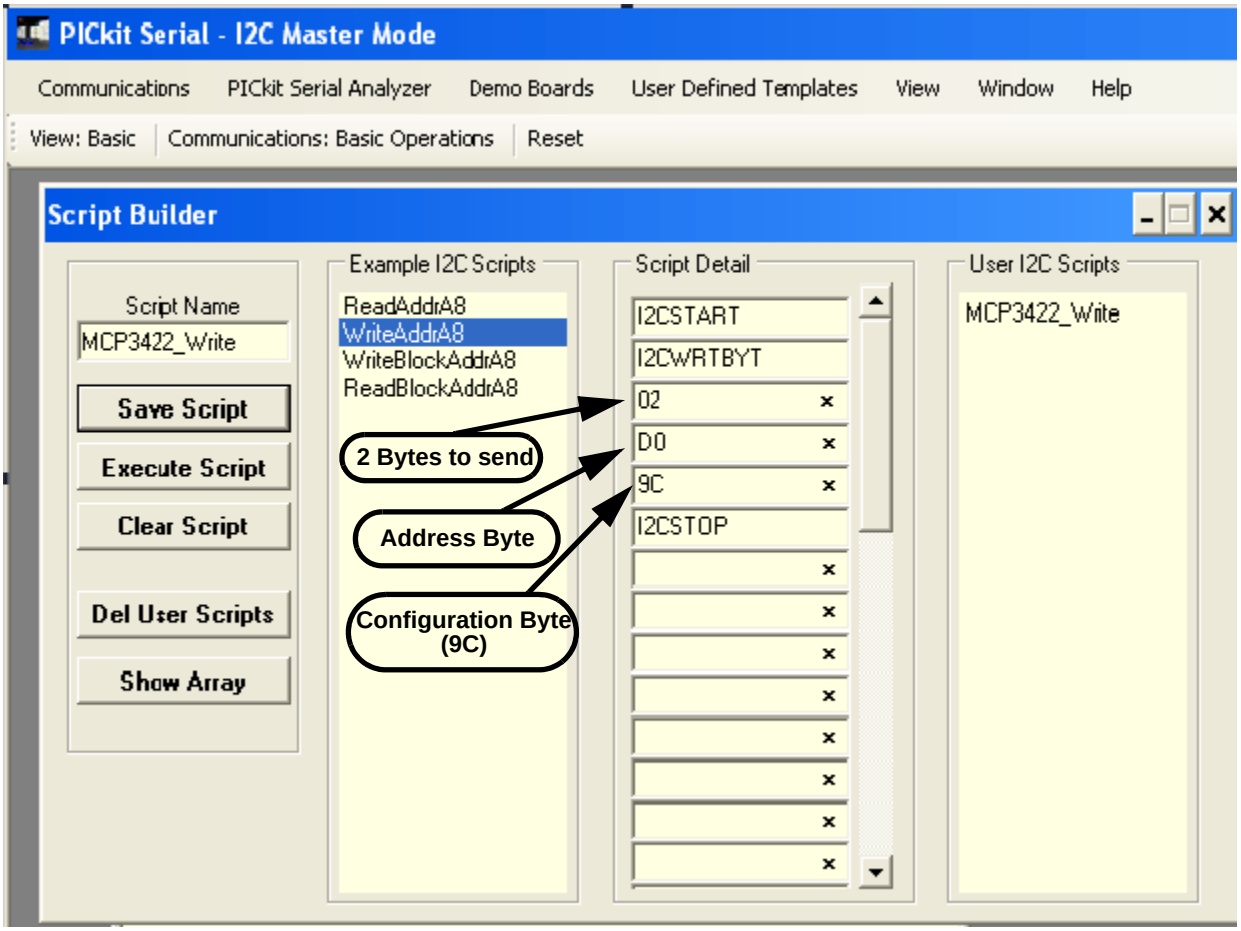



***FIGURE 1-10:*** *Modifying Parameters in Script Builder Window.*

4. Change the parameter value.

| Script Detail | |
|---|---|
| I2CSTART | * |
| I2CWRTBYT | * |
| 02 | ------> This means there are two bytes to send |
| D0 | ------> 1st Write Byte: Address byte with W/R bit = 1101-0000 |
| 9C | ------> 2nd Write Byte (Configuration Byte): 1001-1100 |
| I2CSTOP | * |

**Note:** All 6 parameters above must be listed in the same order as shown here. The parameters above with * are not modifiable.




**Note:** The "9C" in the configuration byte selects the following options:
- Conversion Mode: Continuous Conversion
- Channel Selection: Channel 1
- Bit Resolution: 18 bits
- Gain Selection: 1x

***FIGURE 1-11:*** *Script File Example for the $I^2C$ Write Command.*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1.3.2.2 SAVING THE SCRIPT FILE AND PROGRAMMING THE MCP3422 CONFIGURATION REGISTER

1. Change the 2nd and 3rd data bytes you want in the Script Detail.
2. Type in any script name (i.e., MCP3422_Write) in the space below the **Script Name** menu.
3. Click the **Save Script** button.
4. Click the **Execute Script** button.

**Note:** At this point, the PICkit Serial transmits the $I^2C$ Write Command to the MCP3422 device. The saved file name will appear in “Users I2C Scripts” column, and can be re-used any time by selecting the file name.

5. You can also see the SCL and SDA waveforms using the oscilloscope.

**Note:** When you click on the “Execute Script” menu, the “Busy” LED on the PICkit Serial Analyzer will momentarily turn on and then turn off. If the LED remains ON, a communications problem has occurred. Remove the PICkit Serial Analyzer from your computer and re-check the parameter values including the order of parameters under the “Script Detail” column, and try again until the “Busy” LED turns OFF immediately after sending the I2C command.

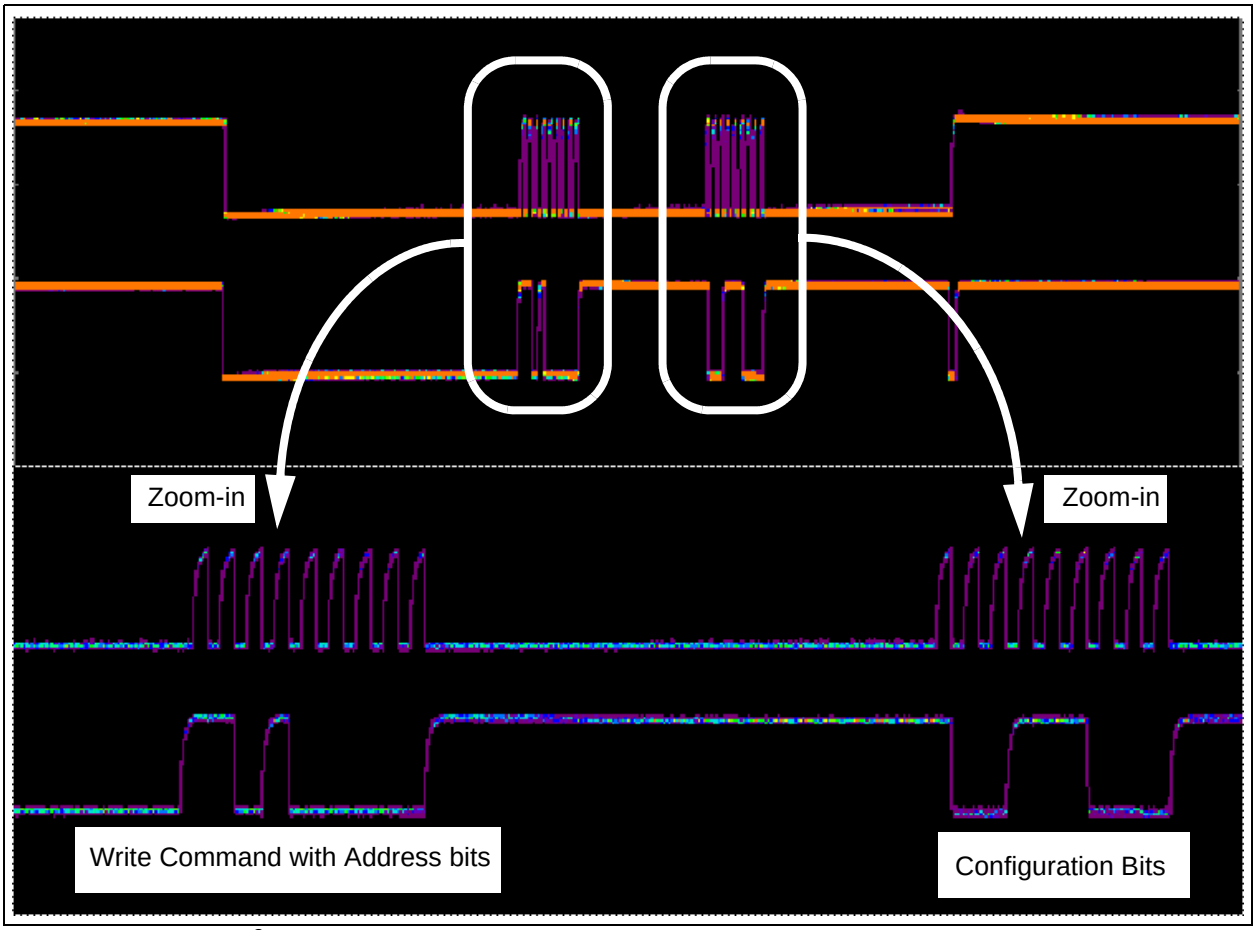


***FIGURE 1-12:*** *$I^2C$ Write Command Waveforms for the MCP3422.*

### 1.3.3 Reading the Conversion Data using the PICkit Serial Analyzer

You can read back the conversion data by following the next steps.

#### 1.3.3.1 CREATING A SCRIPT FILE TO READ THE CONVERSION DATA

1. Click on **ReadAddrA8** in "Example I2C Scripts" column.

   This will result in filling in the spaces under the "Script Detail"column. Now you can modify the parameter boxes (delete or insert) in the "Script Detail" column with options. The list of options will appear if you click with the right mouse button on the parameter box. You can delete the parameter box or add a new one.

2. Make sure the Script Detail parameters are listed in order as follows:

| Script Detail | |
|---|---|
| I2CSTART | * |
| I2CWRTBYT | * |
| 01 | ------> This means there is one byte for address |
| D1 | ------> Address byte with W/R bit = 1101-0001 |
| I2CRDBYTNLB | * |
| 5 | ------> 5 bytes to read |
| I2CSTOP | * |

**Note:** All 7 parameters above must be listed in order. The parameters above with * are not modifiable.

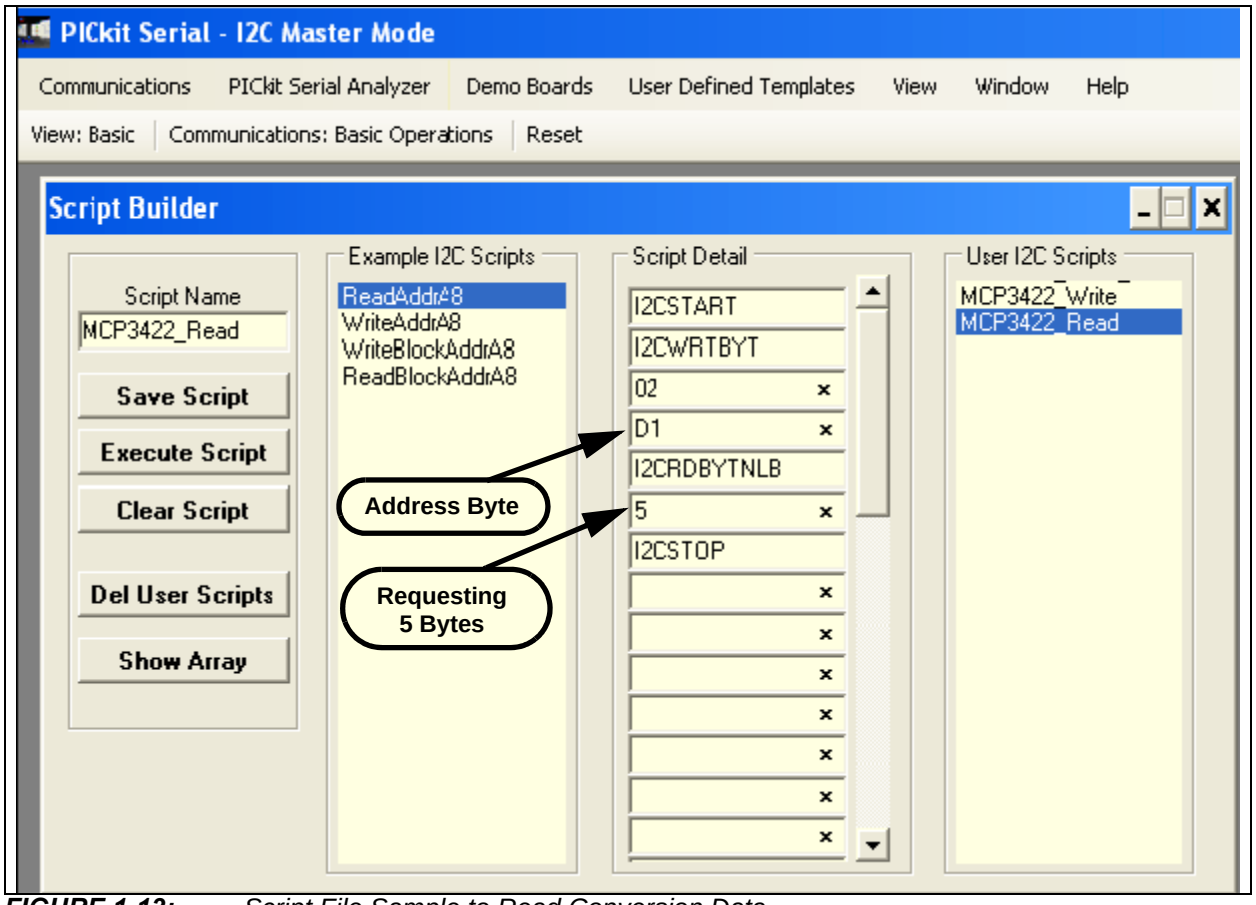


***FIGURE 1-13:*** *Script File Sample to Read Conversion Data.*


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3. Type in any script name (i.e., MCP3422_Read) in the space below the Script Name menu.
4. Click the **Save Script** button.
5. Click the **Execute Script** button.

**Note:** At this point, the PICkit Serial transmits the $I^2C$ Read Command to the MCP3422 device. The saved file name will appear in the “Users I2C Scripts” column, and can be re-used any time by selecting the file name.

6. You can also see the SCL and SDA waveforms using the oscilloscope.

**Note:** When you click on the Execute Script menu, the “Busy” LED on the PICkit Serial Analyzer will momentarily turn on and then turn off. If the LED remains ON, a communications problem has occurred. Remove the PICkit Serial Analyzer from your computer and re-check the parameter values, including the order of parameters under the “Script Detail” column, and try again until the “Busy” LED turns OFF immediately after sending the I2C command.

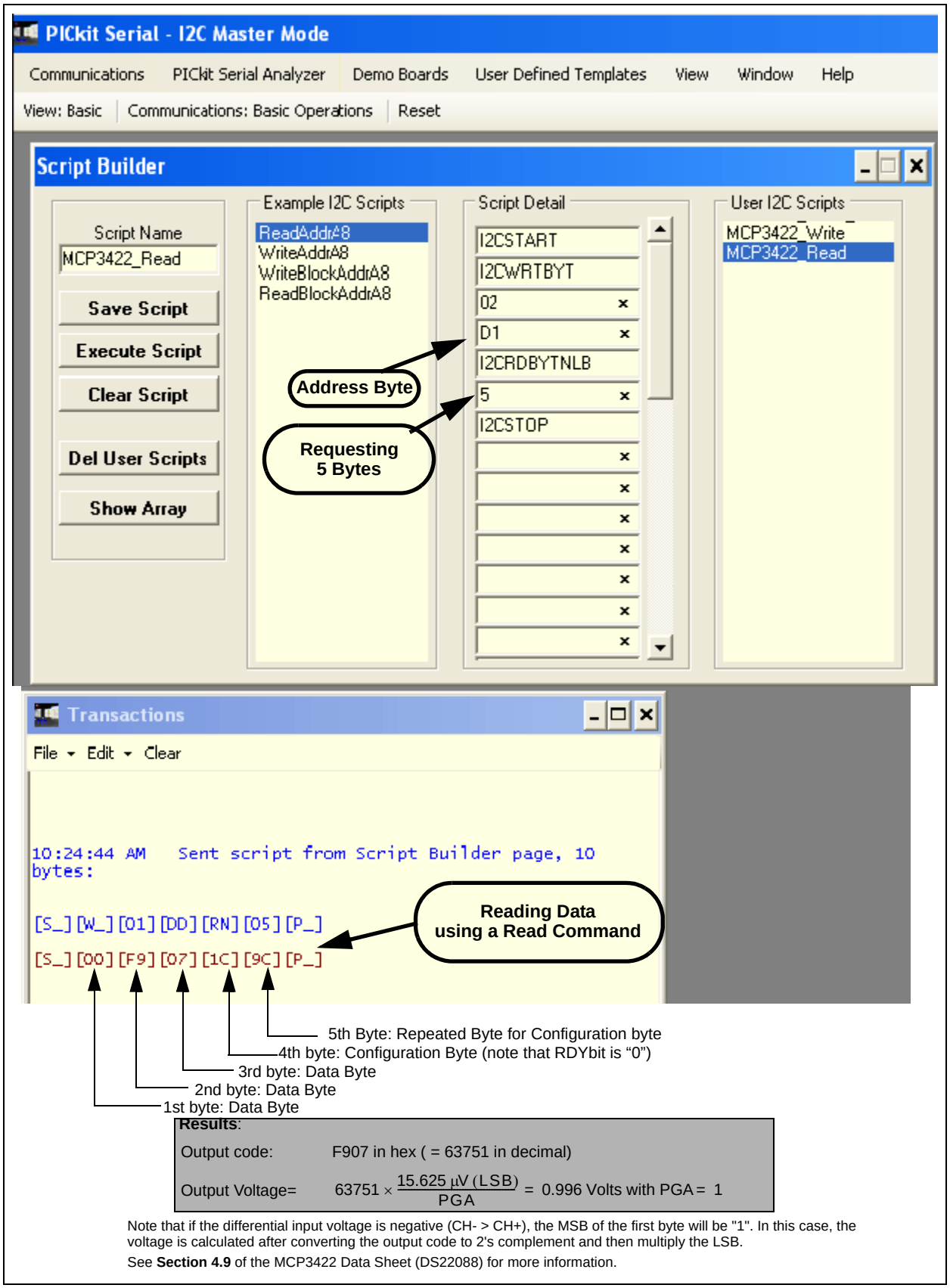


***FIGURE 1-14:*** *Reading Conversion Results. Note that the Input = 0.996V is applied at Ch.1. The reading indicates the measured value is 0.996 Volts.*


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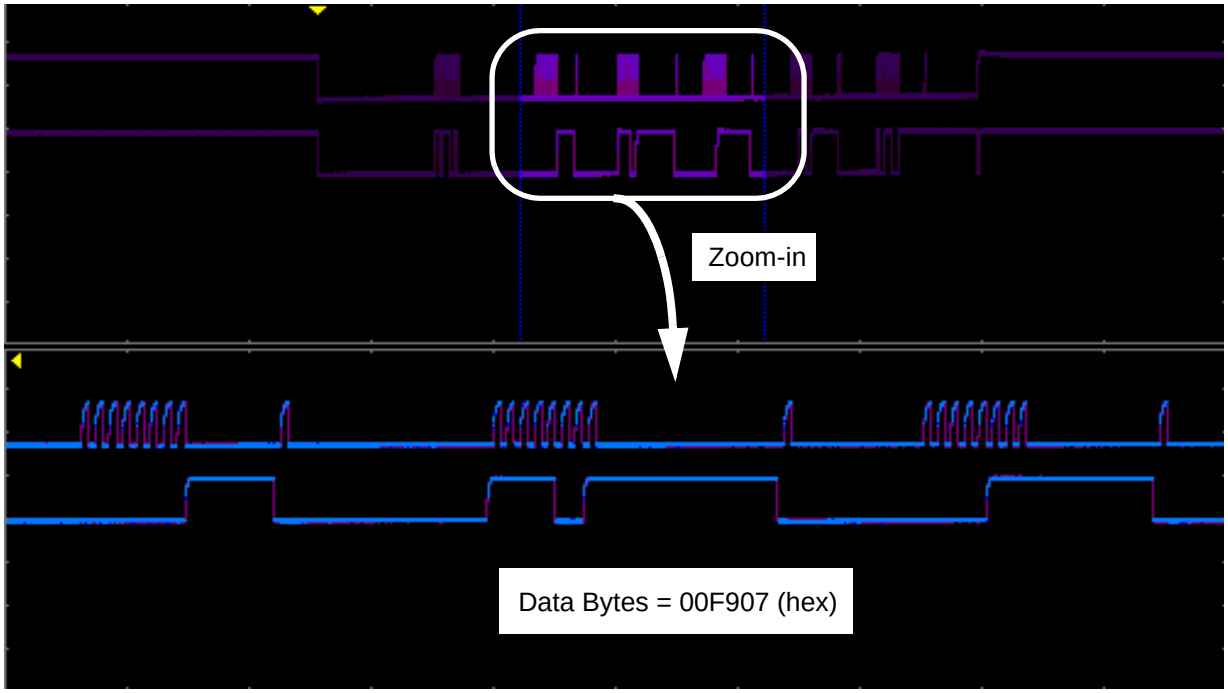
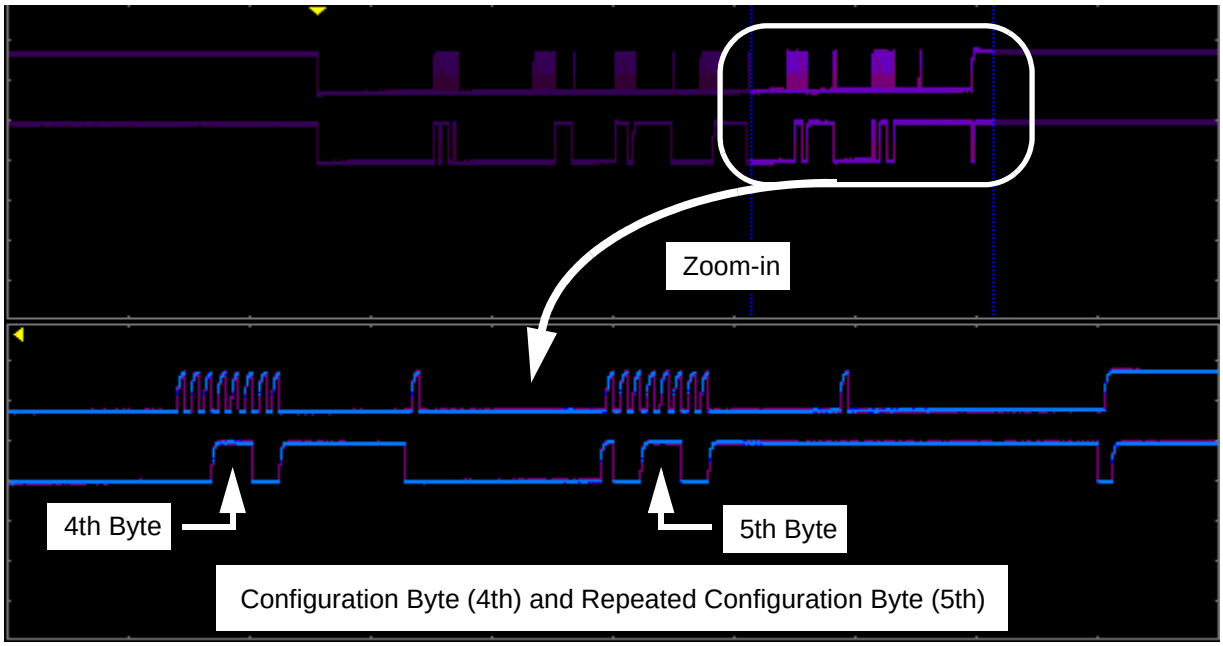



(a) Read command and outputs. The 3 data bytes are zoomed in for better clarity.




(b) Read command and outputs. The last two data bytes are zoomed in for better clarity.

***FIGURE 1-15:*** *Read Command and Data on $I^2C$ bus. Note the $\overline{RDY}$ bit in 4th byte is "0". This means the conversion data just read is the latest conversion data. The $\overline{RDY}$ bit becomes "1" in the 5th byte (repeated byte). This means the device is now in the process of new conversion and the new result is not ready yet.*

### 1.3.4 Experiment with inputs at CH2

Repeat instructions from **Section 1.3.2 "Creating Script Files"** to **Section 1.3.3 "Reading the Conversion Data using the PICkit Serial Analyzer"** for the Channel 2 input.

| **Note:** | To write the configuration register for channel 2 input, you can just use the "MCP3422_Write" file and modify the configuration byte data only. |
|---|---|

To read the conversion data, use the same script file for all channels.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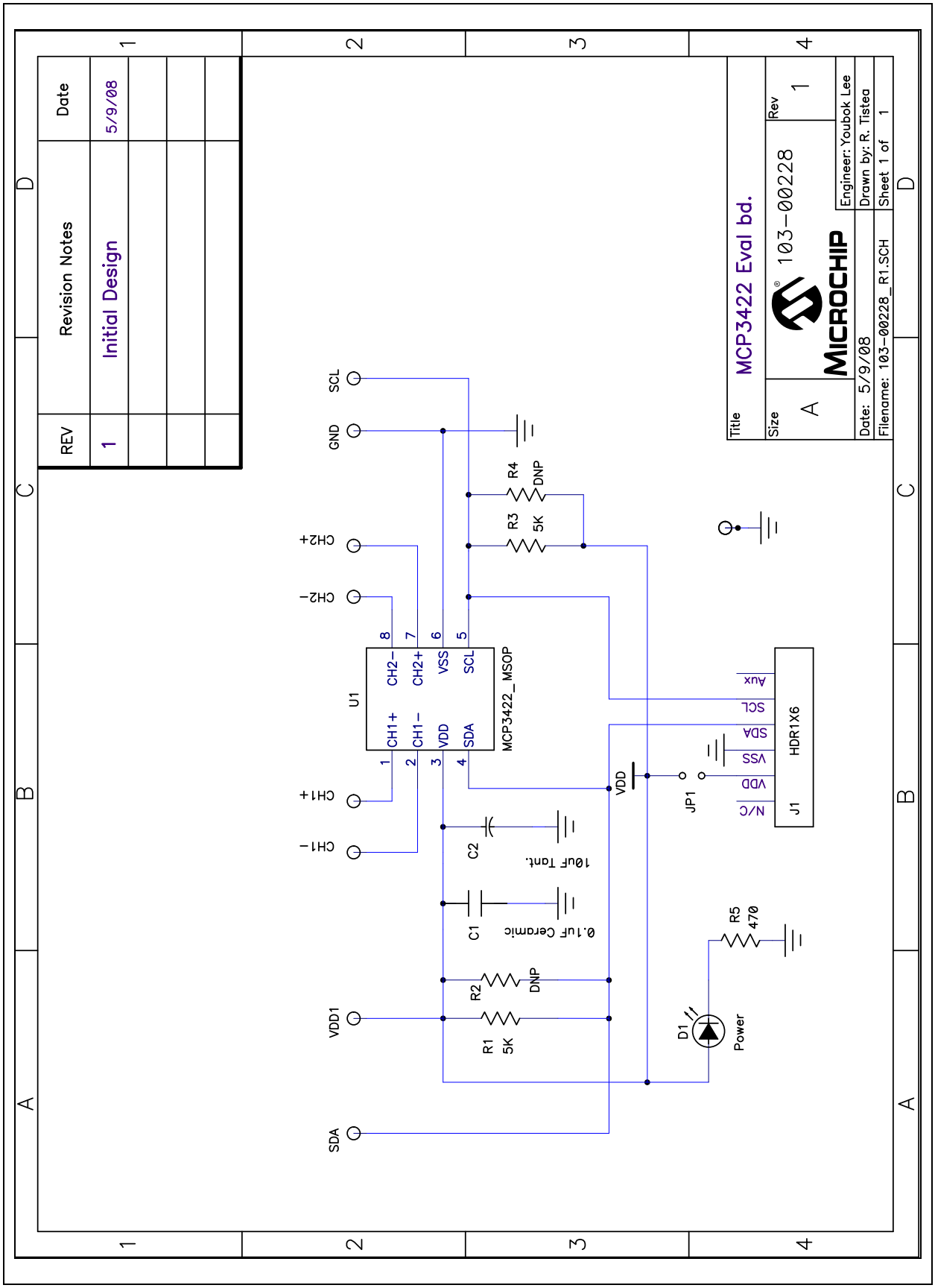
# Appendix A. Schematic and Layouts

## A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP3422 Evaluation Board:

- Board – Schematic
- Board – Top Layer
- Board – Top Metal Layer
- Board – Bottom Layer

## A.2 BOARD SCHEMATIC





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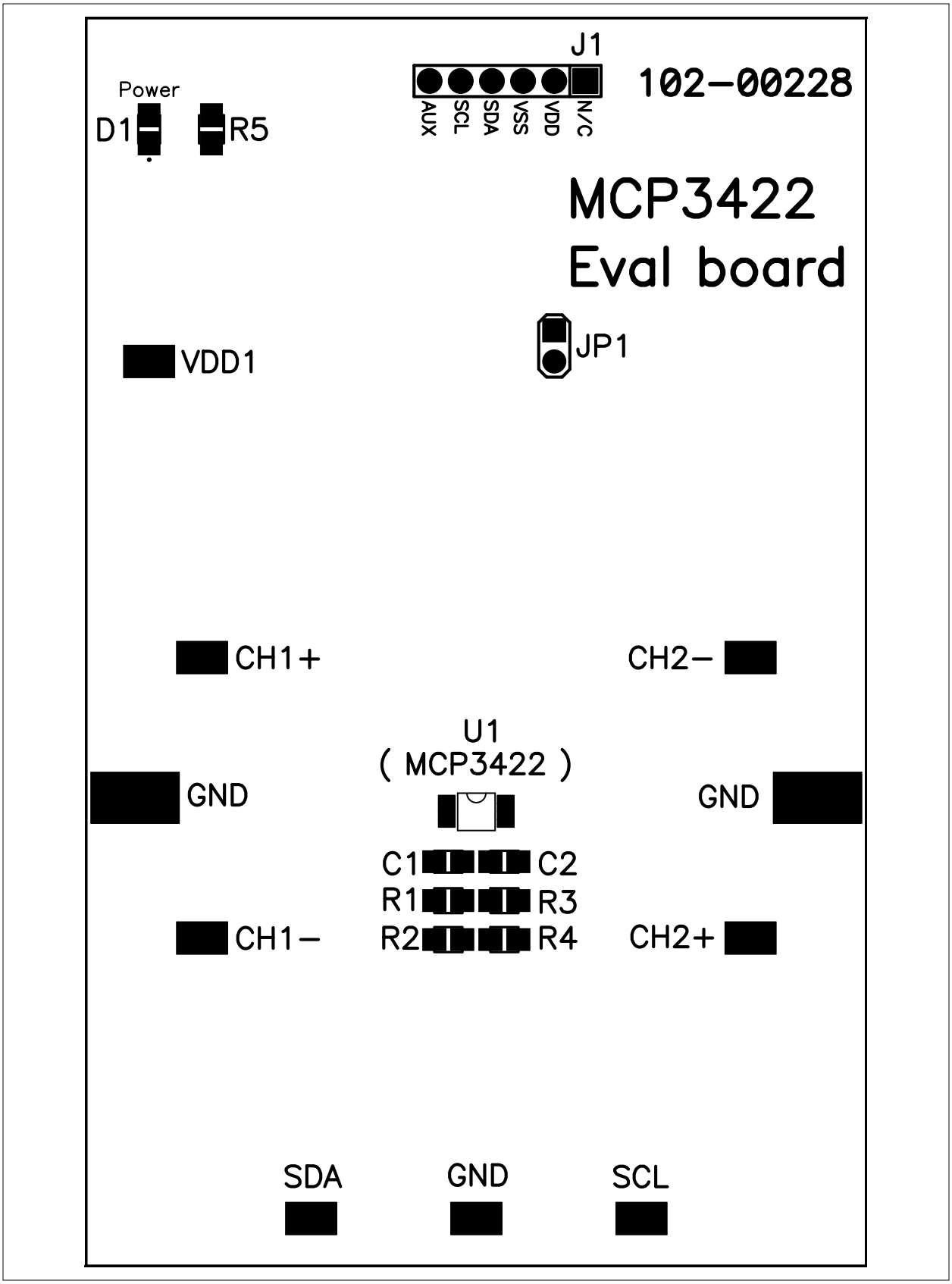
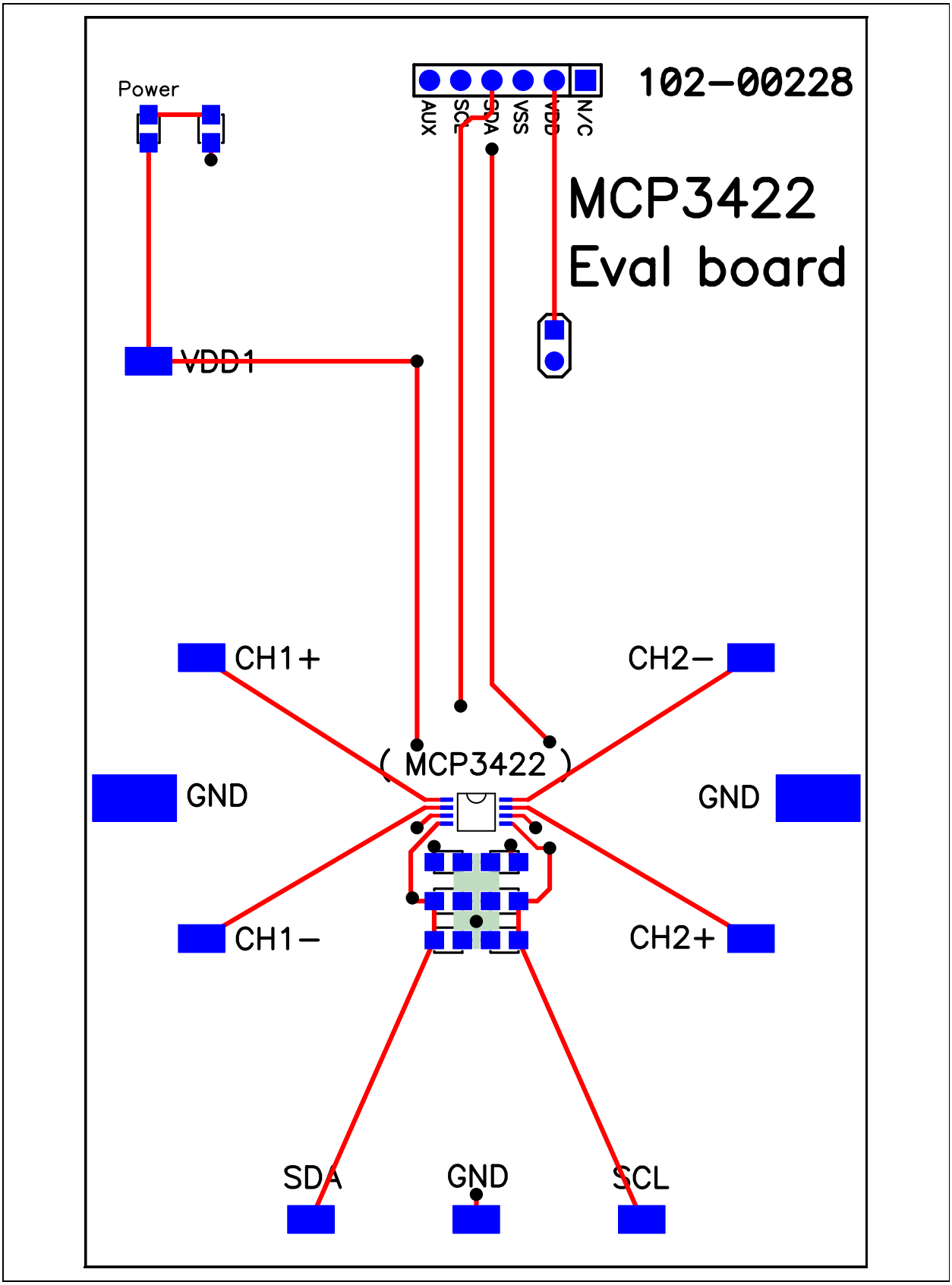
## A.3 BOARD – TOP LAYER



## A.4 BOARD – TOP METAL LAYER





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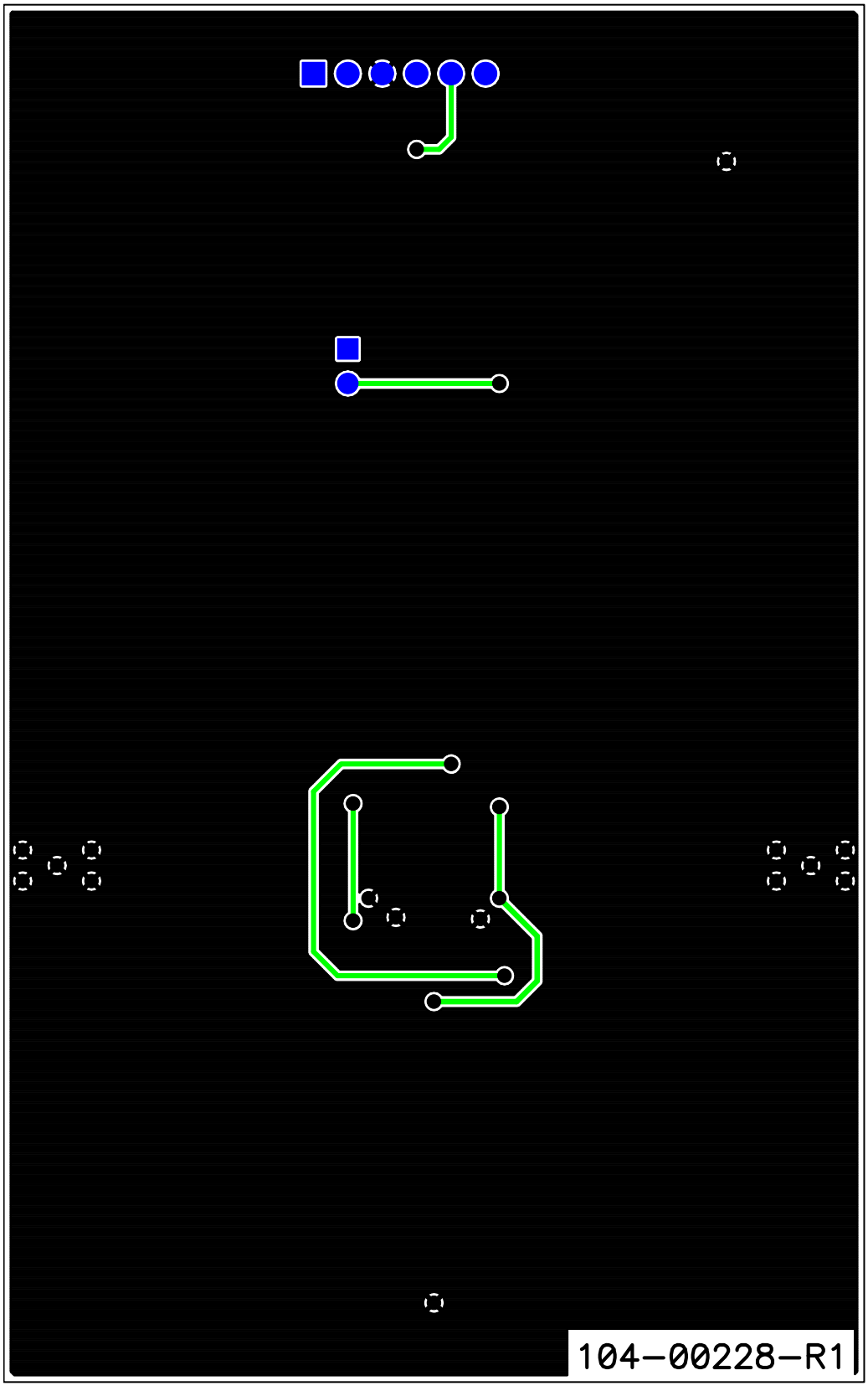
## A.5 BOARD – BOTTOM LAYER



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

**TABLE B-1: BILL OF MATERIALS**

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | C1 | CAP .1UF 25V CERAMIC X7R 0805 | Panasonic® - ECG | ECJ-2VB1E104K |
| 1 | C2 | CAP CERAMIC 10UF 6.3V X5R 0805 | Panasonic - ECG | ECJ-2FB0J106K |
| 1 | D1 | LED RED ORANGE CLEAR 0805 SMD | LITE-ON INC | LTST-C170EKT |
| 1 | J1 | CONN HEADER 6POS .100 R/A TIN | Molex®/Waldom® Electronics Corp | 22-05-2061 |
| 1 | JP1 | CONN HEADER 2POS .100 VERT TIN | Molex/Waldom Electronics Corp | 22-03-2021 |
| 1 | JP1 Shunt | .100" Shorting Block with Handle | JAMECO VALUEPRO | 2012JH-R |
| 1 | PCB | RoHS Compliant Bare PCB, MCP3422 Eval Board for PICKit Serial | — | 104-00228 |
| 2 | R1, R3 | RES 4.99K OHM 1/8W 1% 0805 SMD | Microchip Technology Inc. | ERJ-6ENF4991V |
| 2 | R2, R4 | DO NOT POPULATE | — | — |
| 1 | R5 | RES 470 OHM 1/8W 5% 0805 SMD | Panasonic - ECG | ERJ-6GEYJ471V |
| 1 | U1 | 2 Channel 18 Bit Data Sigma ADC | Microchip Technology Inc | MCP3422-E/MS |
| 10 | VDD1, CH1+, CH1-, CH2+, CH2-, SDA, SCL, GND | TEST POINT PC COMPACT SMT | Keystone Electronics® | 5016 |

**Note:** The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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