MCP3421 SOT23-6 Evaluation Board User's Guide

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- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
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MCP3421 SOT23-6 EVALUATION BOARD USER'S GUIDE

Table of Contents

NOTES:

MCP3421 SOT23-6 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 MCP3421 SOT23-6 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 MCP3421 SOT23-6 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 MCP3421 SOT23-6 Evaluation Board and instructions on how to obtain the ADC conversion results using the PICKit Serial Analyzer.
- **Appendix A. "Schematic and Layouts"** – shows the schematic and layout diagrams for the MCP3421 SOT23-6 Evaluation Board.
- **Appendix B. "Bill Of Materials (BOM)"** – lists the parts used to build the MCP3421 SOT23-6 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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP3421 SOT23-6 Evaluation Board with the PICkit Serial Analyzer. 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.

MCP3421 Data Sheet, *"18-Bit Analog-to-Digital Converter with I^2C Interface and On-Board Reference"*, DS22003

This data sheet provides detailed information regarding the MCP3421 product.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, 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 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

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) 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 (January 2009)

- Initial Release of this Document.

Chapter 1. Quick Start Instructions

1.1 INTRODUCTION

The following sections provide an overview of the MCP3421 SOT23-6 Evaluation Board and demonstrate how to use it with the PICkit™ Serial Analyzer (P/N: DV164122).

The following topics are covered:

- Description of the MCP3421 SOT23-6 Evaluation Board
- Using MCP3421 SOT23-6 Evaluation Board with the PICkit Serial Analyzer to evaluate the MCP3421 device

1.2 DESCRIPTION OF THE MCP3421 SOT23-6 EVALUATION BOARD

The MCP3421 SOT23-6 Evaluation Board (P/N MCP3421EV) contains a MCP3421 18-bit Delta-Sigma Analog-to-Digital Converter (ADC). The MCP3421 is an 18-bit single channel ADC device with various options. The MCP3421 SOT23-6 Evaluation Board has analog input connection pads and V_{DD}, SDA, and SCL test pads. The user can connect any sensor input signal to this evaluation board and test the ADC conversion results. The PICkit Serial Analyzer's PC graphic user interface (GUI) provides the user's interface for writing configuration register bits of the MCP3421 and displays the ADC conversion values. The PICkit Serial Analyzer links between the GUI and the MCP3421 SOT23-6 Evaluation Board, and provides the I^2C communication PC to the MCP3421 SOT23-6 Evaluation Board. The user also can use this MCP3421 SOT23-6 Evaluation Board without the PICkit Serial Analyzer by providing the I^2C communication signal to the SDA and SCL test pads on the board.

This evaluation board has the following interface:

- PICkit Serial Analyzer (P/N: DV164122) for writing configuration register bits and reading the conversion data.

Note: The user can use this board without the PICkit Serial Analyzer as long as the V_{DD}, SCL, and SDA are provided to the board. This 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

The I^2C device code and address bits of the MCP3421 device on this board are "1101000". These bits are programmed at the factory during production.

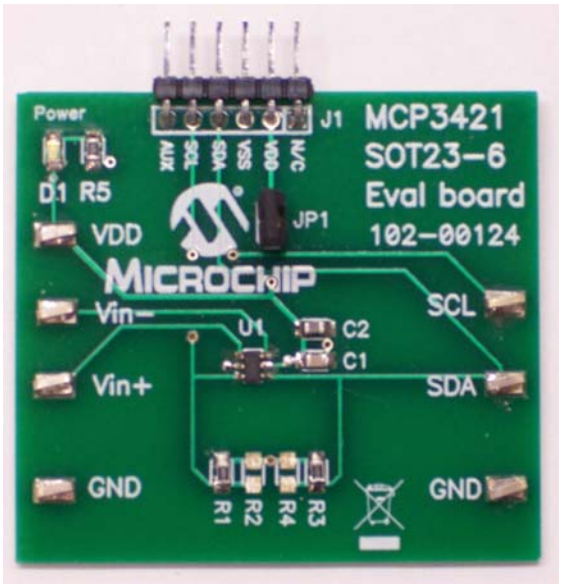


FIGURE 1-1: *Front and Back Views of the MCP3421 SOT23-6 Evaluation Board.*

1.3 GETTING STARTED WITH PICKIT SERIAL ANALYZER

Figure 1-1 shows the MCP3421 SOT23-6 Evaluation Board and Figure 1-2 shows the Evaluation Board and PICkit Serial Analyzer connection.

The following steps describe how to use them together:

1. Connect the MCP3421 SOT23-6 Evaluation Board's J1 pin socket to the PICkit Serial Analyzer as shown in Figure 1-2.
2. Connect the oscilloscope probes to SCL and SDA test pins (optional).
3. V_{DD} selection: You can use the V_{DD} from the PICkit Serial Analyzer or use your own external V_{DD}. You can select the V_{DD} path using the JP1 connector:
   (a) Connect JP1, if using V_{DD} from PICkit Serial Analyzer,
   (b) Disconnect JP1 and apply V_{DD} at V_{DD} pin, if you are using external V_{DD}.

> **Note:** If you are using external V_{DD}, connect the external V_{DD} at V_{DD} pad).

4. Connect V_{DD}, if external V_{DD} is used.

> **Note:** Do not connect V_{DD} if you are using V_{DD} from the PICkit Serial Analyzer. The PICkit Serial Analyzer provides the V_{DD} automatically if it is connected to PC.

5. LED D1 turns on when V_{DD} is applied.

> **Note:** If the V_{DD} is provided from the PICkit Serial Analyzer, then the LED may not be turned on until you execute a command. See **Section 1.3.2.1 "Creating a Script File for Configuration Byte Writing"** for executing the I^2C command.

6. **Connecting analog inputs**: If you need to measure single-ended input, connect the unused pin (example, V_{IN}-) to V_{SS}.
7. Use the PICkit Serial Analyzer PC GUI to send I^2C write and read commands. See **Section 1.3.2.1 "Creating a Script File for Configuration Byte Writing"**.
8. Execute the PICkit Serial Analyzer Script file and obtain the ADC conversion results. The conversion results appear on the PICkit Serial Analyzer PC GUI. You can also observe the conversion results using the oscilloscope.

CAUTION

The analog input pin has ESD diodes. Certain input conditions can damage the device. Please pay attention to the following conditions:

(a) Do not apply input greater than the input range specified by the MCP3421 data sheet.

(b) Apply input signal after V_{DD} is powered-up.

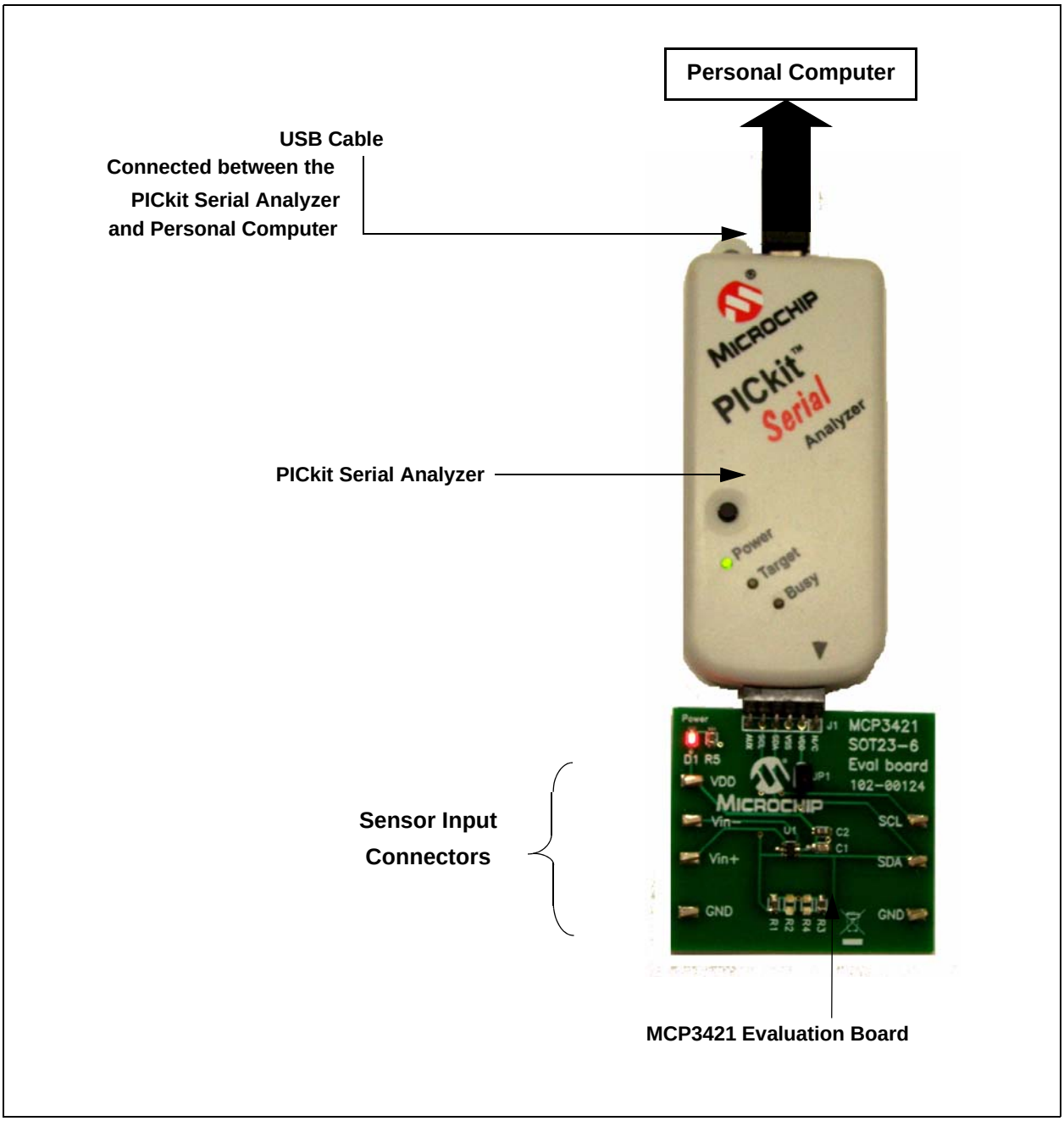


FIGURE 1-2: *MCP3421 SOT23-6 Evaluation Board with the PICkit Serial Analyzer.*

1.3.1 PICkit Serial Analyzer PC Software Set-Up for the MCP3421 SOT23-6 Evaluation Board

The following steps describe how to set up and use the PICkit Serial Analyzer PC Graphic User Interface (GUI) to write the configuration bits of the MCP3421 on the Evaluation Board and read the ADC conversion results.

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

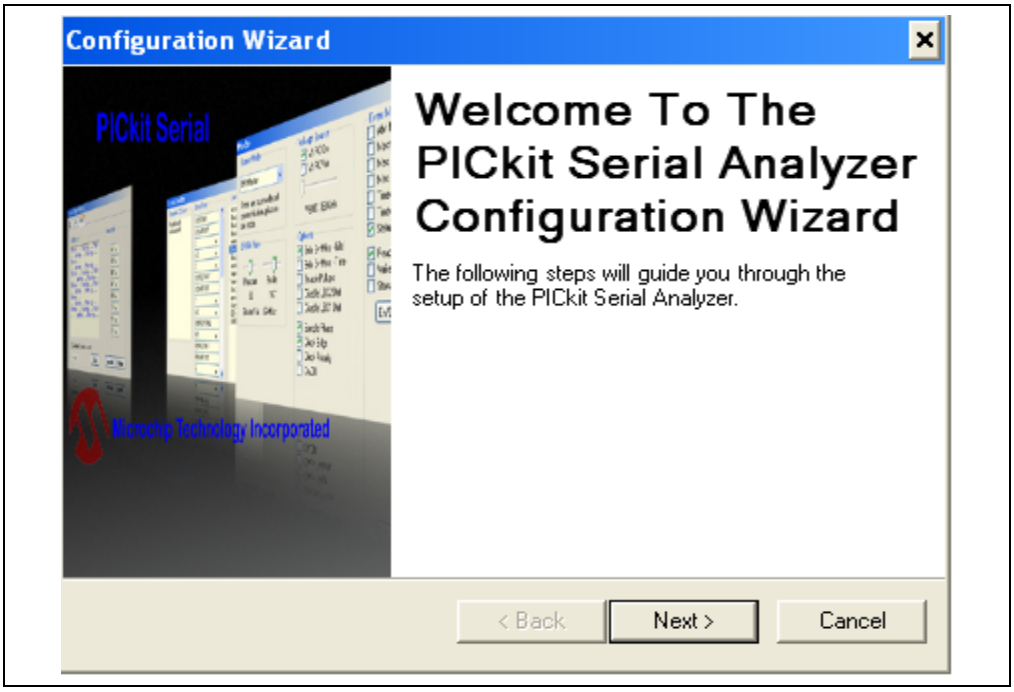


FIGURE 1-3: *PICkit Serial Analyzer Configuration Wizard Welcome Window.*

4. Select the I^2C Master option as communication mode, and click the **Next** button.

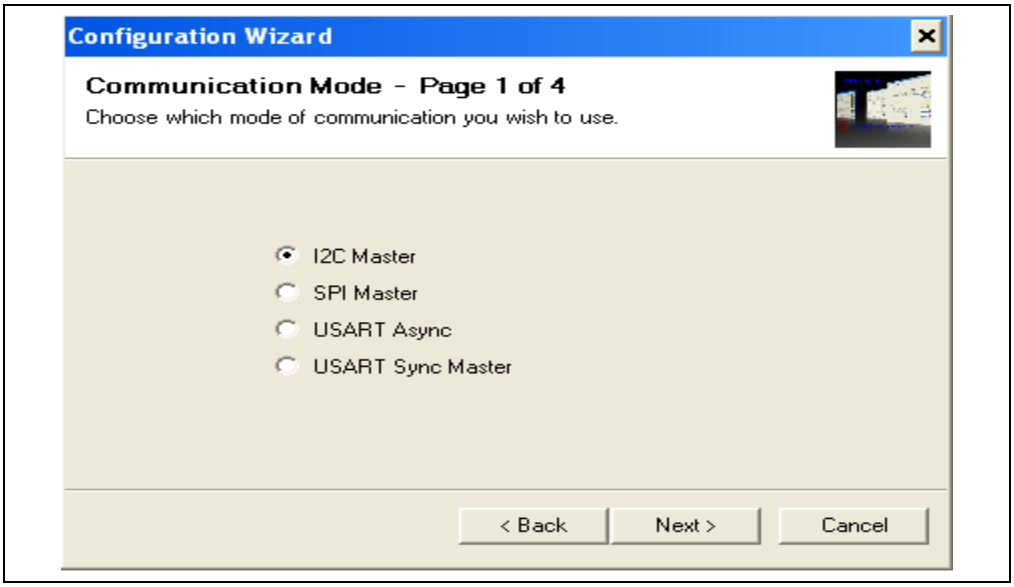


FIGURE 1-4: *Step 1 - Communication Mode Selection.*

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

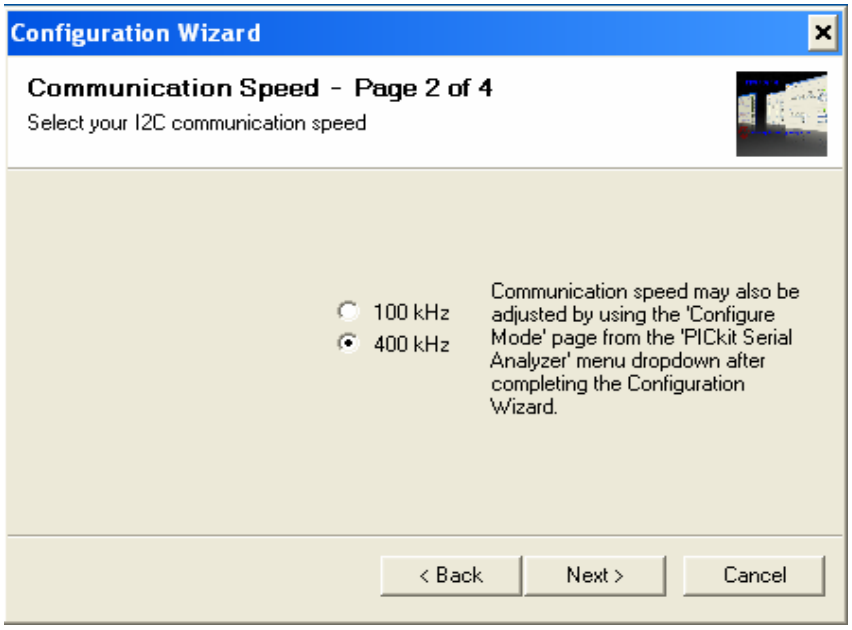


FIGURE 1-5: *Step 2 - I2C Communication Speed Window.*

Note: The MCP3421 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 Enable Pull-ups, and click the **Next** button.

Note: The MCP3421 SOT23-6 Evaluation Board has its own pull-up resistors, therefore, you don't need additional pull-up resistors from the PICkit Serial Analyzer.

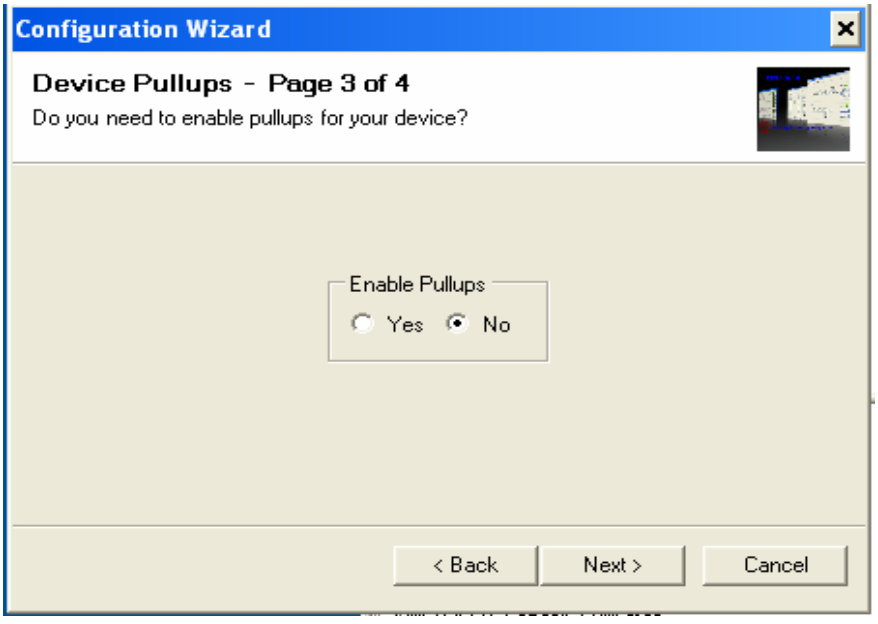


FIGURE 1-6: *Step 3 - Device Pullups Window.*

7. Select the V_{DD} voltage of the MCP3421 SOT23-6 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** and **5 Volt** as shown below, the MCP3421 SOT23-6 Evaluation Board is 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 MCP3421 SOT23-6 Evaluation Board is connected.

Case 2: When you use your own V_{DD}:

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

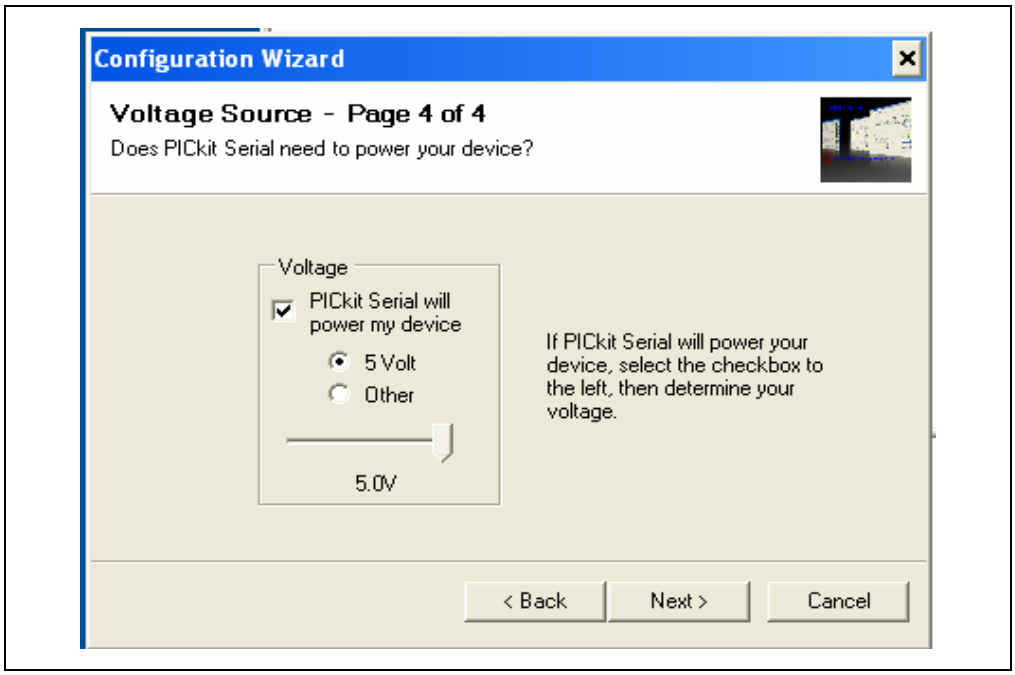


FIGURE 1-7: *Step 4 - Voltage Source Selection Window.*

8. Click the **OK** button. You have made all of the PICkit Serial Analyzer configuration set-ups. You are now ready to program the MCP3421 SOT23-6 Evaluation Board using the PICkit Serial Analyzer.

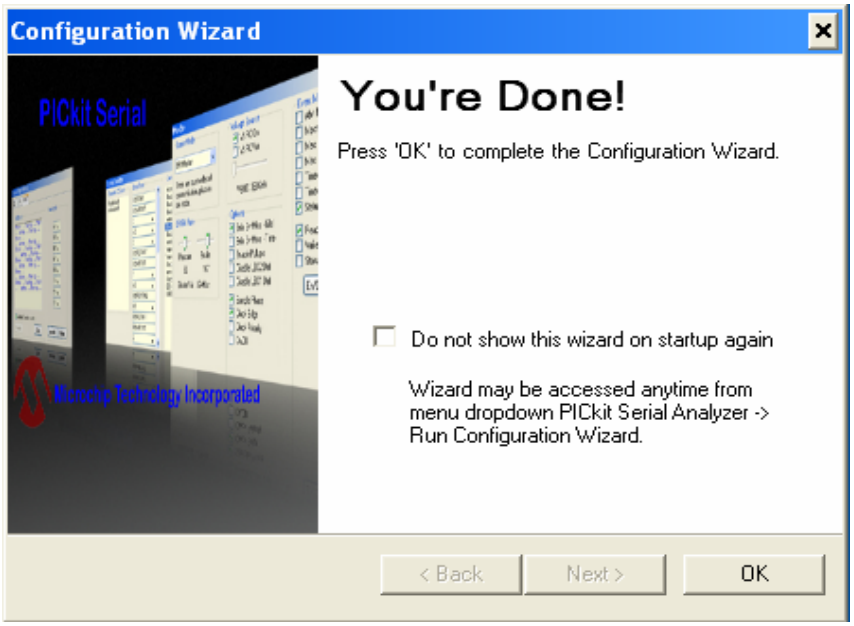


FIGURE 1-8: *Configuration Wizard - Finishing Step.*

1.3.2 Creating Script Files

In order to make a communication between the PICkit Serial Analyzer and the MCP3421 SOT23-6 Evaluation Board, a script file is needed. The following procedure shows how to create script files and how to use them.

- Select **Communication -----> Script ---> Script Builder**

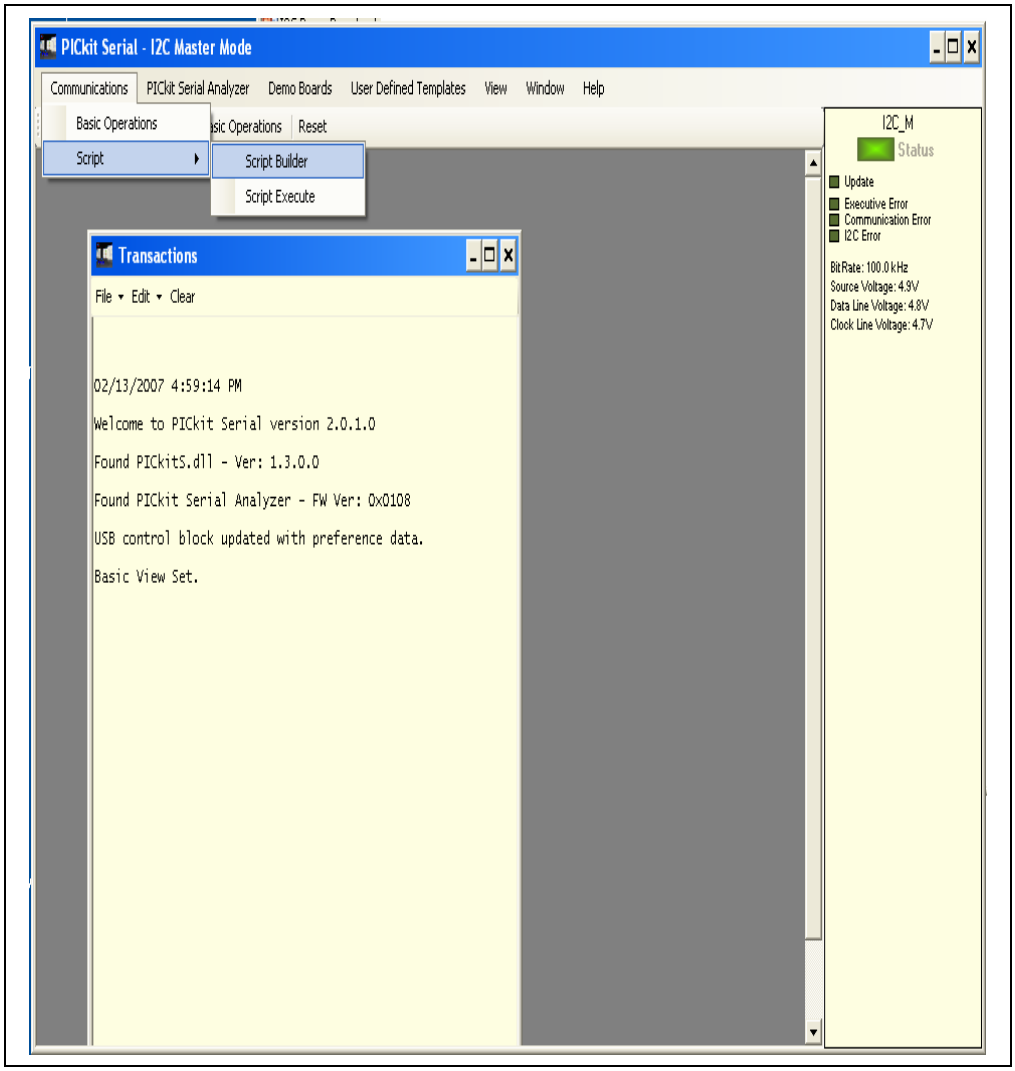


FIGURE 1-9: *Creating a Script File with Script Builder.*

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. Now you can modify the **Script Detail** column parameters by clicking with the right mouse button.

Modifying the Script Details parameters:

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 that are available for the parameter selected.
3. Select the desired options (delete or insert the parameter box).
4. Keep the parameters in the same order as shown below.

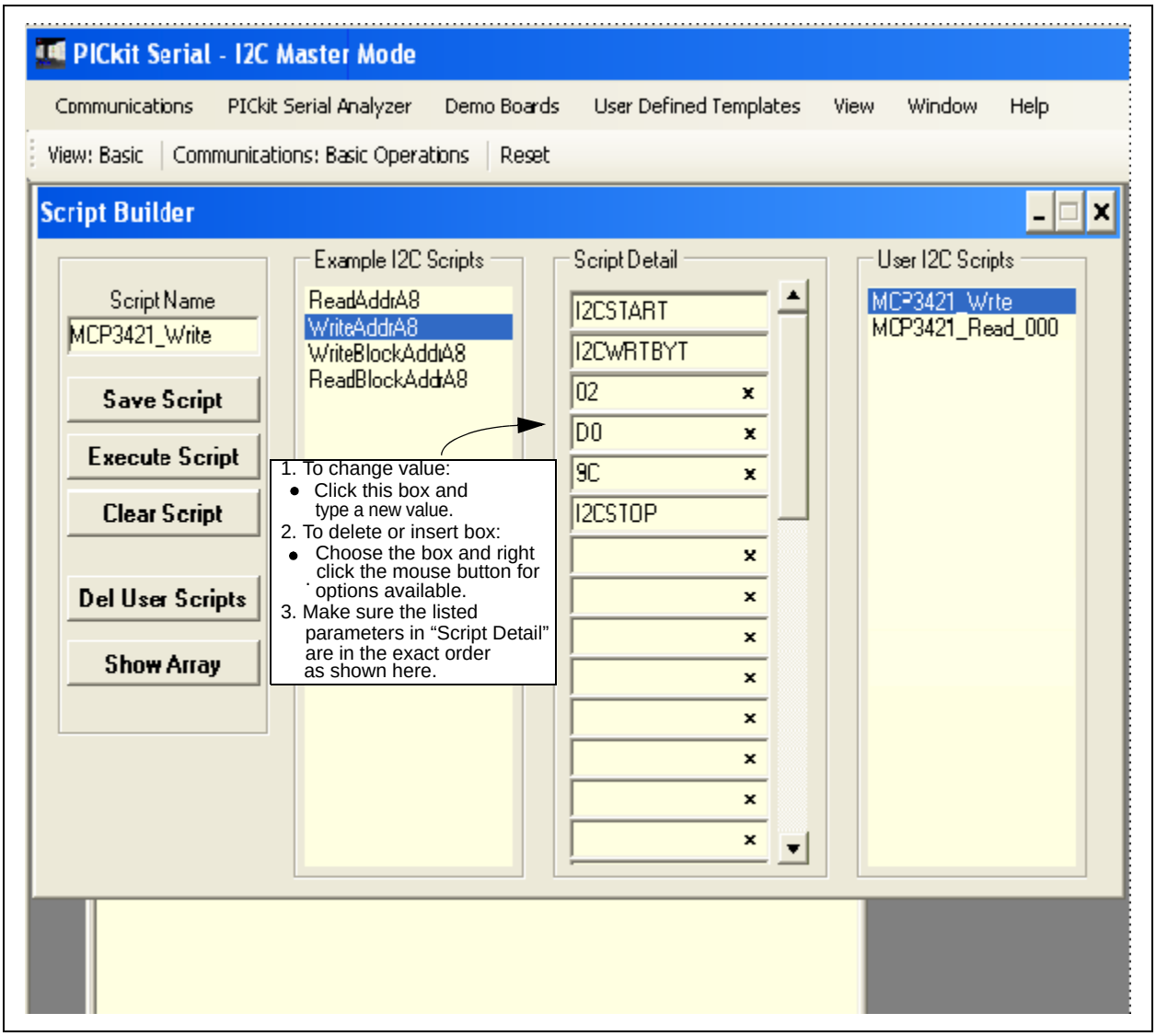
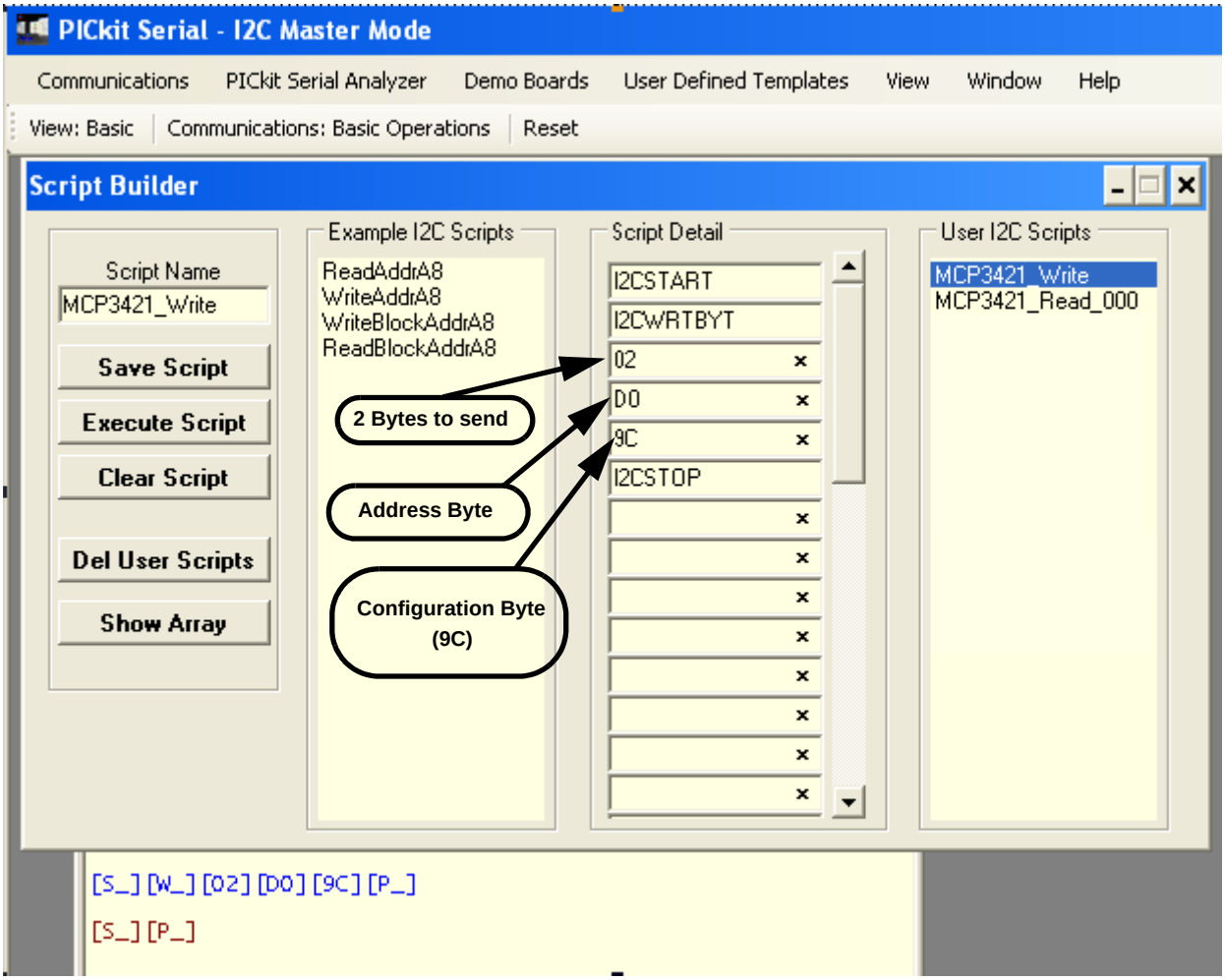


FIGURE 1-10: *Modifying Parameters in the Script Builder Window.*

5. 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: 1001-1100
I2CSTOP	*	

Note: All 6 parameters above must be listed in the same order as shown here. The parameter above with * are not modifiable. Address bits (A2, A1, A0) = (0,0,0) for this evaluation board. See the MCP3421 Data Sheet for more information on address bit selection.



Note that the "9C" in the configuration byte selects the following options:

- Conversion Mode: Continuous Conversion
- Bit Resolution: 18 bits
- Gain Selection: 1x

FIGURE 1-11: *Script File Example for the I^2C Write Command.*

1.3.2.2 SAVING THE SCRIPT FILE AND PROGRAMMING THE CONFIGURATION REGISTER

1. Change the 2nd and 3rd data bytes you want in the Script Detail.
2. Type in any script name (i.e., MCP3421_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 MCP3421 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. Try again until the “Busy” LED goes OFF immediately after executing the write command.

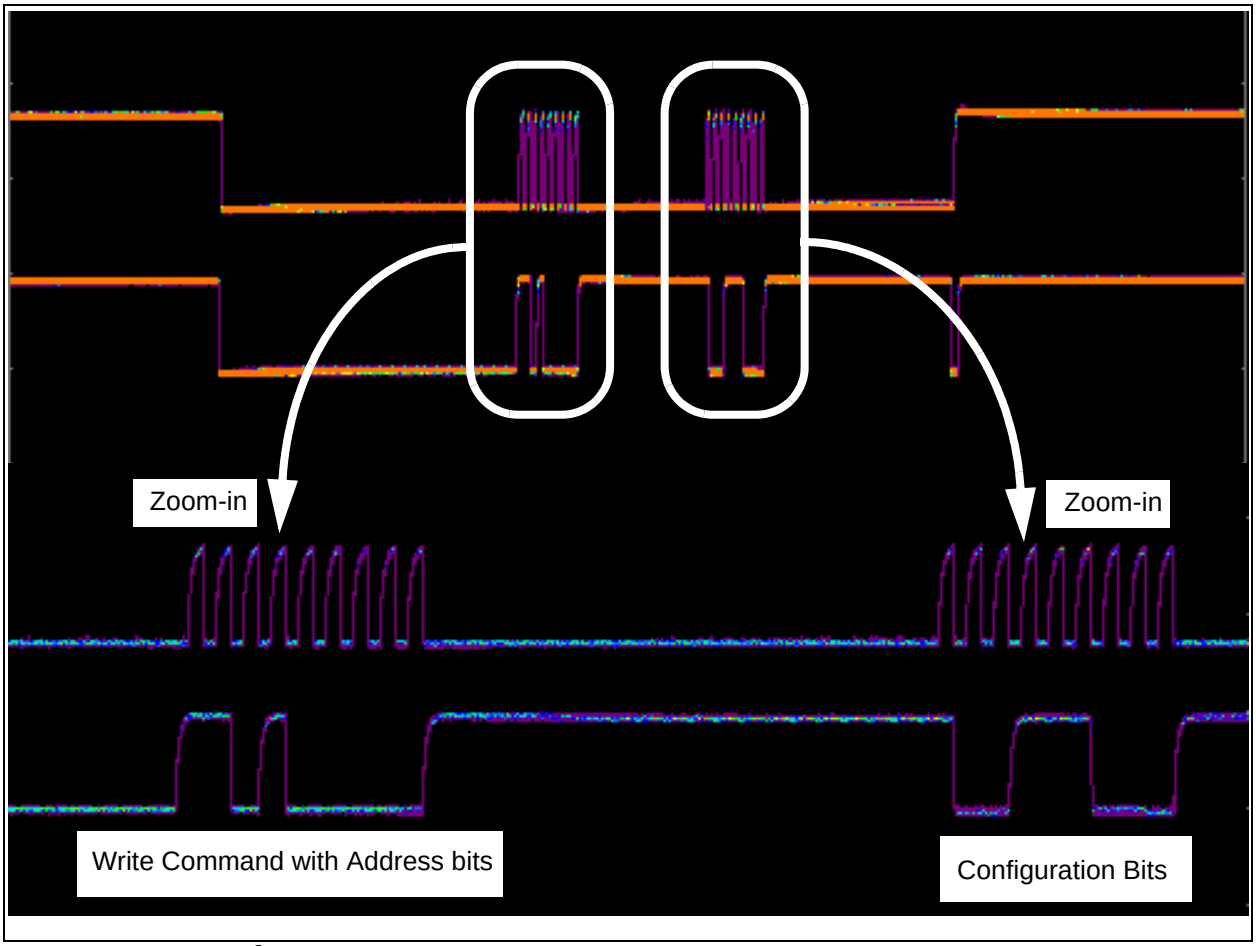


FIGURE 1-12: *I^2C Write Command Waveforms for the MCP3421.*

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 the right mouse button at the parameter box. You can delete the parameter box or add a new one.
- Make sure you have 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 the same order as shown here. The parameters above with * are not modifiable. Address bits (A2, A1, A0) = (0,0,0) for the MCP3421 in this evaluation board. See the MCP3421 Data Sheet for more information on address bit selection.

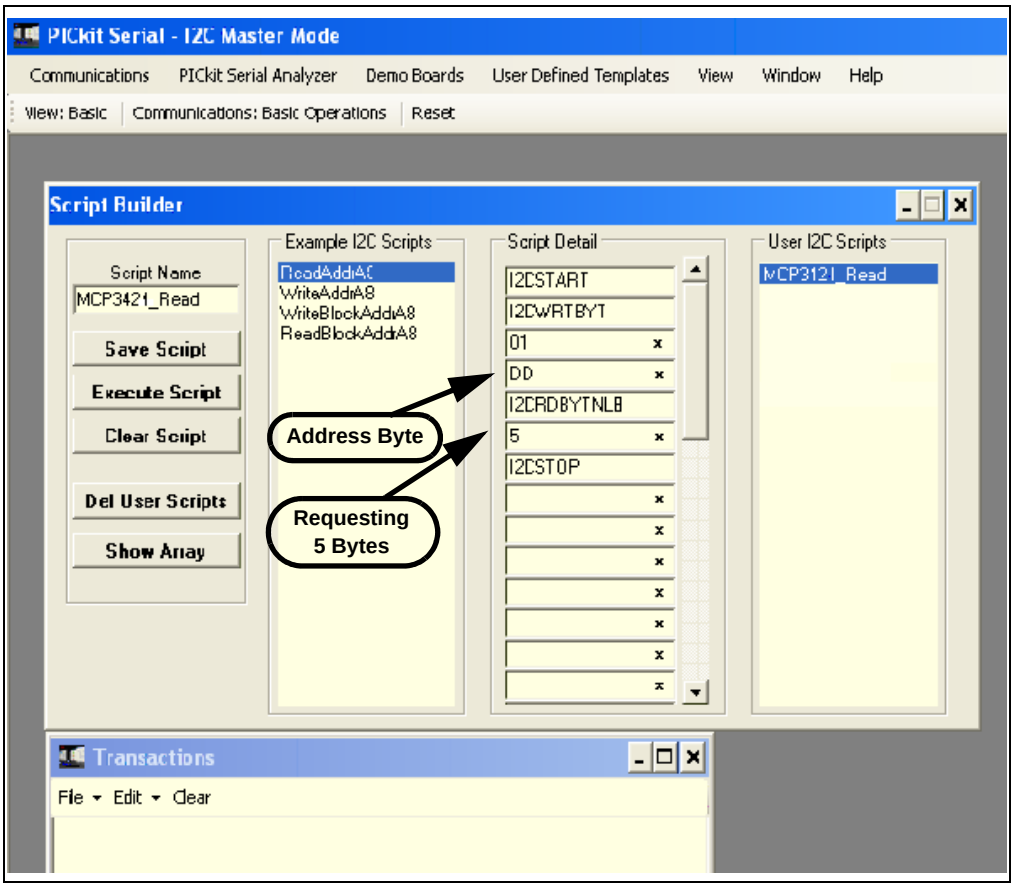


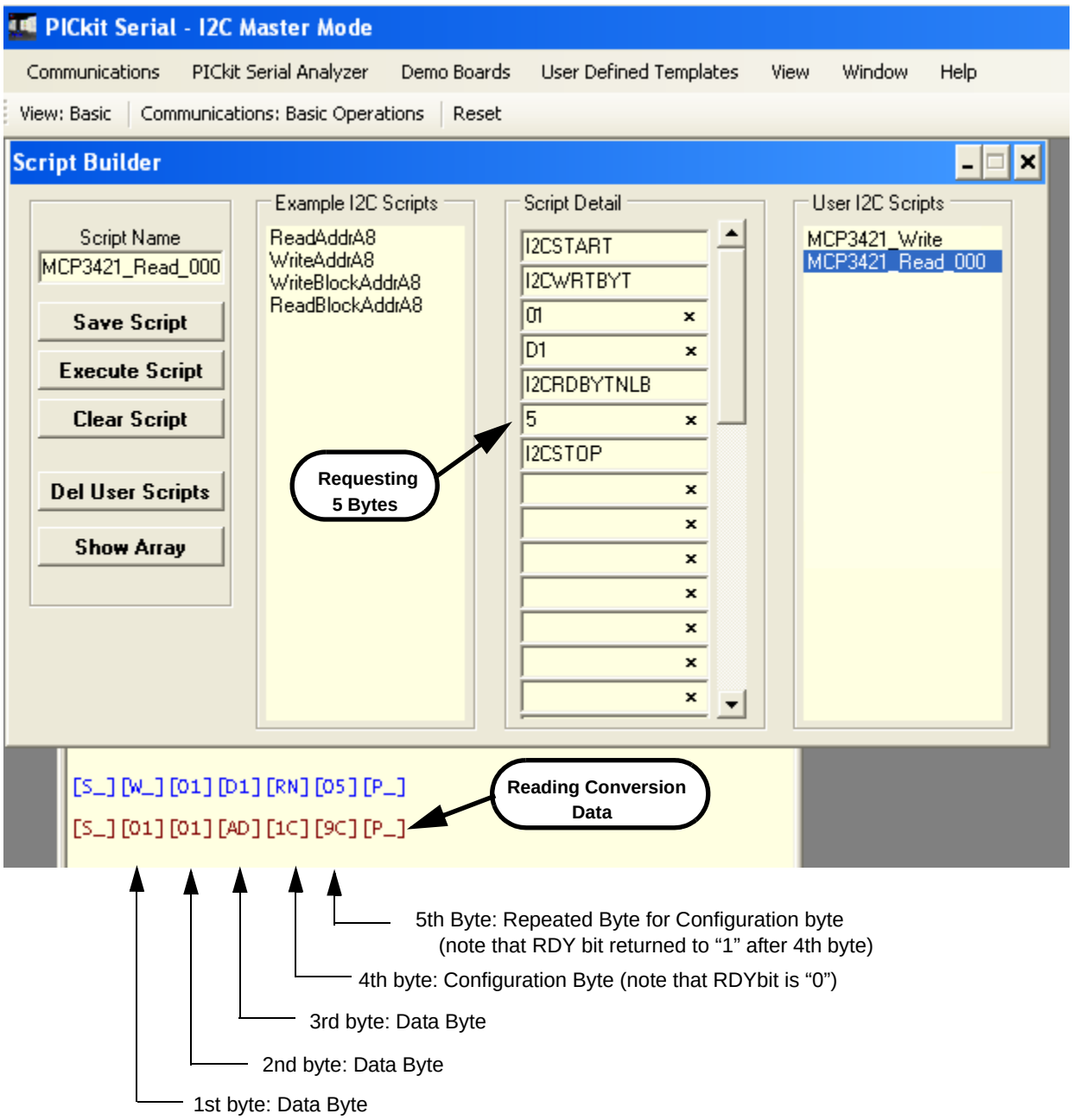
FIGURE 1-13: *Script File Sample to Read Conversion Data.*

2. Type in any script name (i.e., MCP3421_Read) in the space below the **Script Name** menu.
3. Click **Save Script** button.
4. Click **Execute Script** button.

Note: At this point, the PICkit™ Serial transmits the I^2C Read Command to the MCP3421 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. Try again until the “Busy” LED goes OFF immediately after executing the read command.



Results:

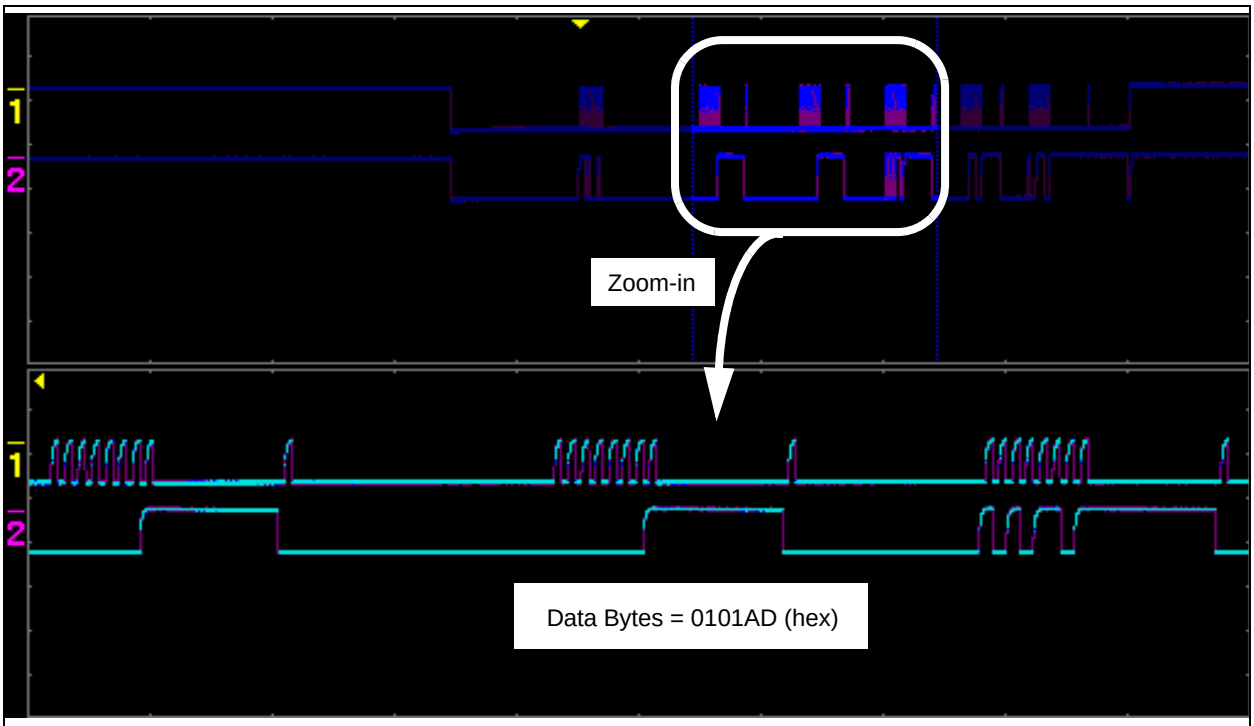
Output code: 101AD in hex (= 65965 in decimal)

Output Voltage: 65865 x $\frac{15.625\ mV\ (LSB)}{PGA}$ = 1.0307 V with PGA = 1

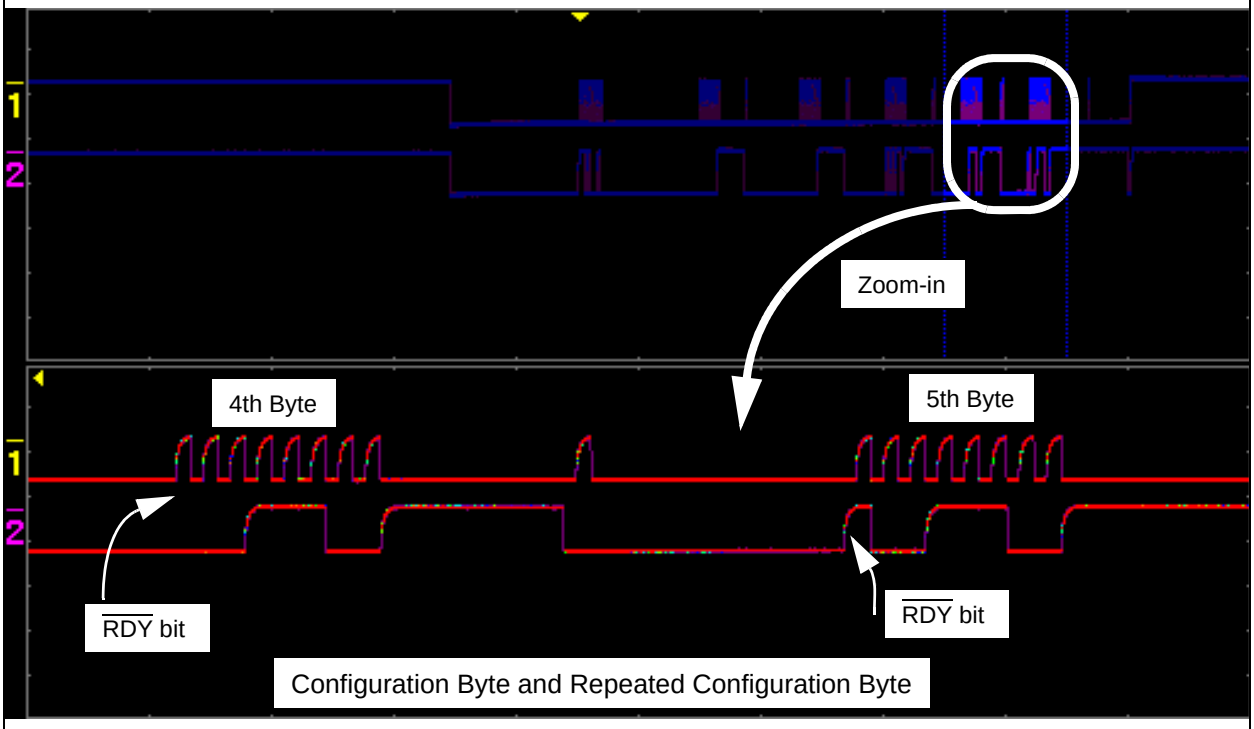
Note:

* 1 LSB with 18 bit resolution option: 15.625 µV

FIGURE 1-14: *Reading Conversion Results: Note that the single ended Input = 1.0307V is applied at Ch.1. The reading indicates the measured value is 1.0307V. See* Figure 1-15 *for waveforms.*



(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. After the $\overline{RDY}$ bit is read out at the 4th byte, the $\overline{RDY}$ bit becomes "1" in the 5th byte (repeated byte). This means the device is now in the process of a new conversion and the latest conversion result is not ready yet.*

NOTES:

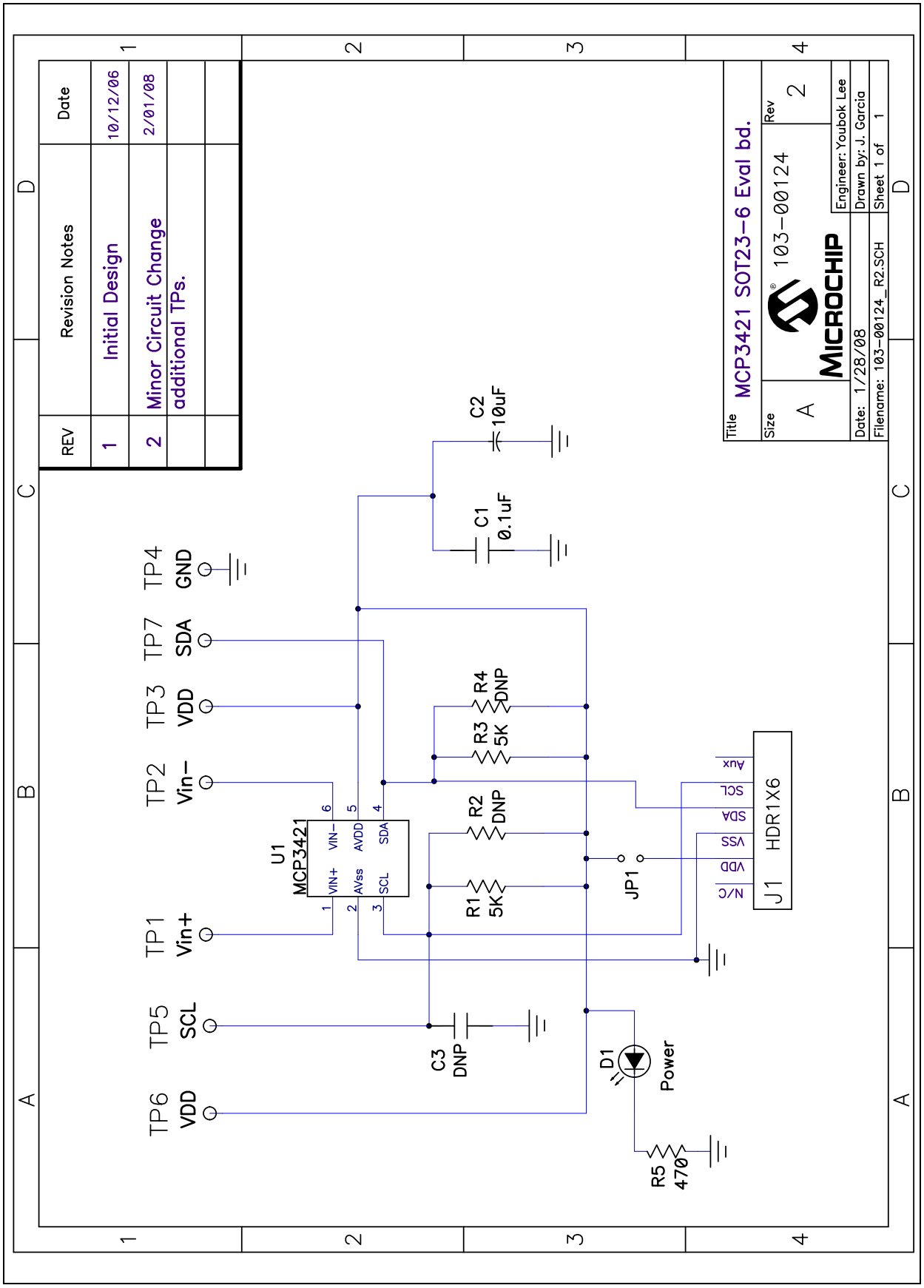
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

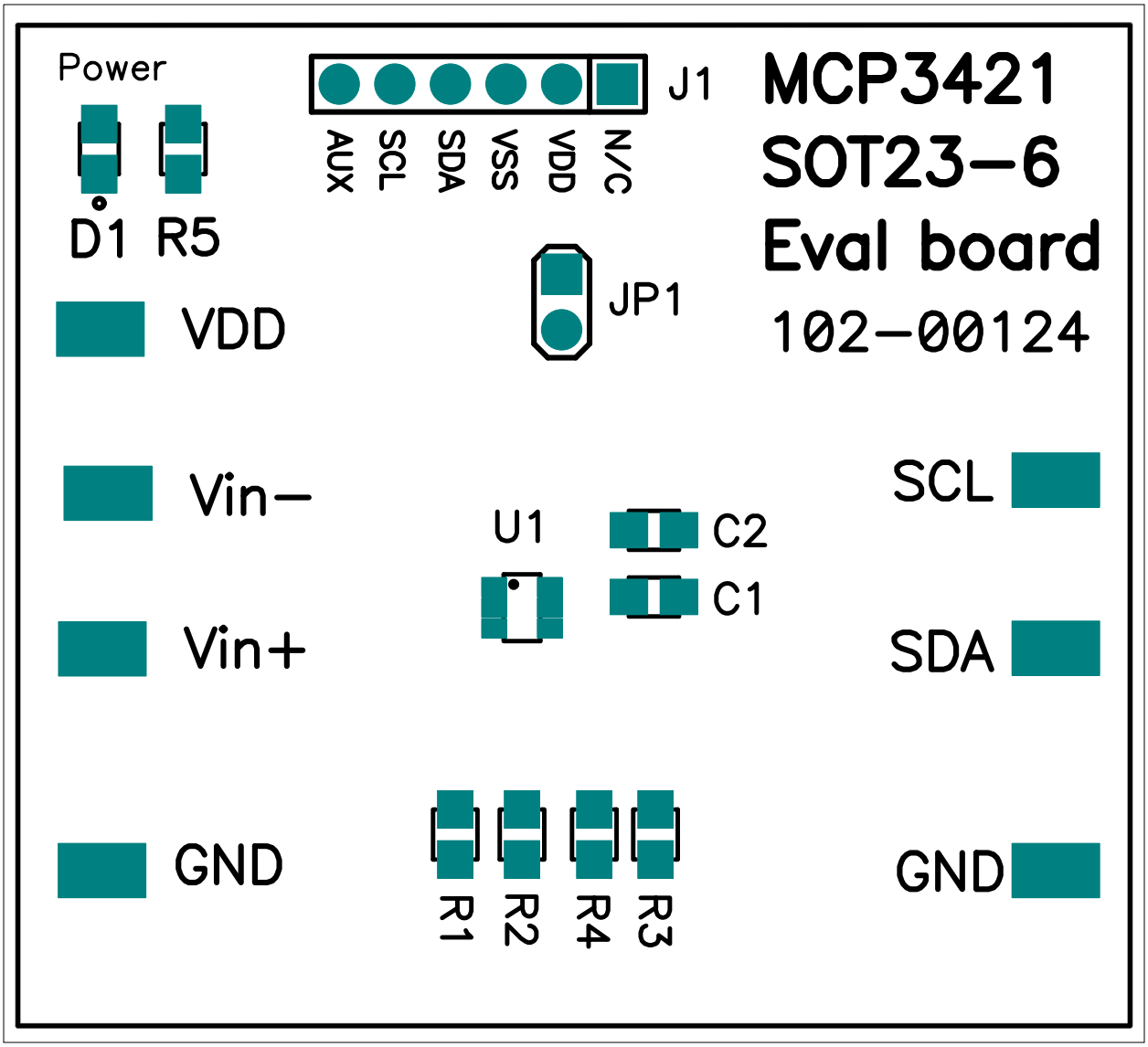
This appendix contains the following schematics and layouts for the MCP3421 SOT23-6 Evaluation Board:

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

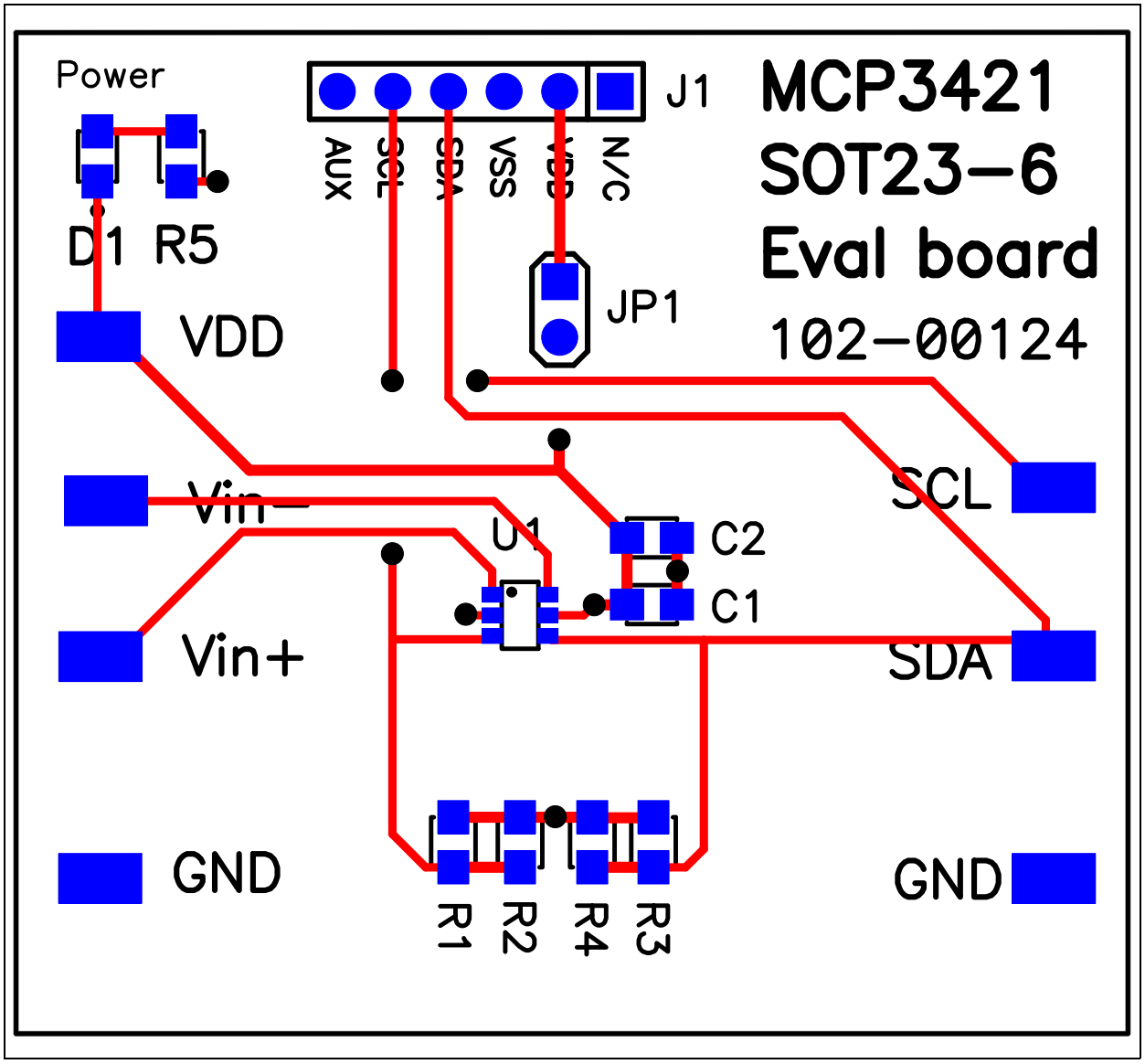
A.2 BOARD – SCHEMATIC



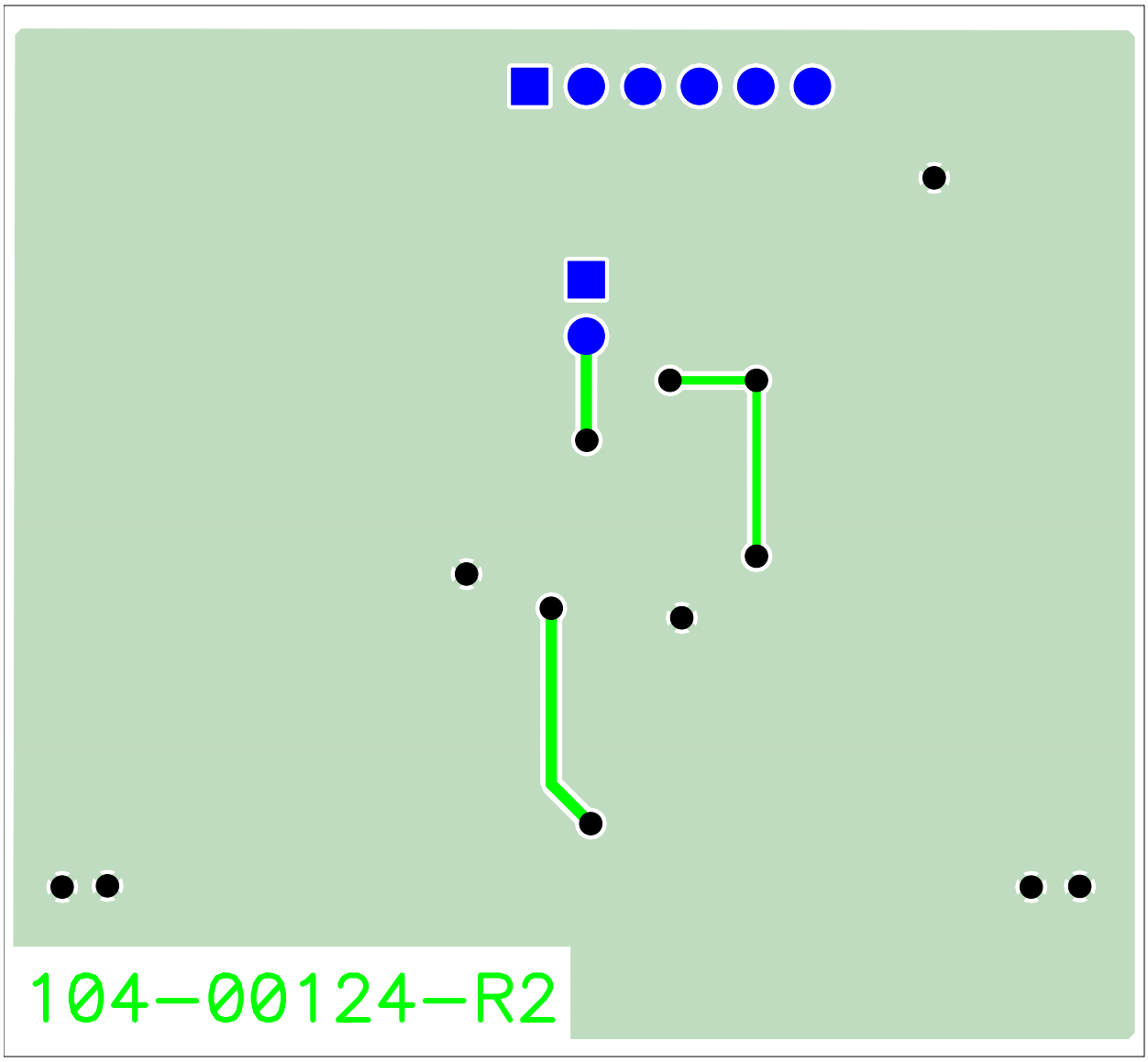
A.3 BOARD – TOP LAYER



A.4 BOARD – TOP METAL LAYER



A.5 BOARD – BOTTOM METAL LAYER



NOTES:

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	PCB	RoHS Compliant Bare PCB, MCP3421EV	—	104-00124
2	R1,R3	RES 4.99K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4991V
2	R2,R4	DO NOT POPULATE	—	—
1	R5	RES 470 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ471V
1	U1	18-Bit Analog-to-Digital Converter with I2C Interface and On-Board Reference	Microchip Technology Inc.	MCP3421A0T-E/OT
7	VDD Vin+ Vin- GND SCL SDA VDD	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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