MCP2221
Breakout Module
User's Guide

Note the following details of the code protection feature on Microchip devices:

• Microchip products meet the specification contained in their particular Microchip Data Sheet.

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• 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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Trademarks

QUALITY MANAGEMENT SYSTEM
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═ ISO/TS 16949 ═

Object of Declaration: MCP2221 Breakout Module

EU Declaration of Conformity
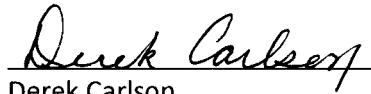
This declaration of conformity is issued by the manufacturer.
The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

MCP2221 BREAKOUT MODULE USER'S GUIDE

Table of Contents

NOTES:

MCP2221 BREAKOUT MODULE
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 "DSXXXXXXXXA", where "XXXXXXXX" 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 online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP2221 Breakout Module. 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 MCP2221 Breakout Module as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Contains important information about the MCP2221 Breakout Module
- **Chapter 2. "Installation and Operation"** – Covers the initial setup of this board, board operation and typical usage scenarios
- **Chapter 3. "Software Description"** – Covers the Graphical User Interface (GUI)
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and board layouts for the MCP2221 Breakout Module
- **Appendix B. "Bill of Materials"** – Lists the parts used to populate the MCP2221 Breakout Module

MCP2221 Breakout Module User's Guide

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 MCP2221 Breakout Module. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **MCP2221 Data Sheet –** *"USB 2.0 to I²C/UART Protocol Converter with GPIO"* **(DS20005292)**

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://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (July 2014)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP2221 Breakout Module and covers the following topics:

• MCP2221 Breakout Module General Description
• What the MCP2221 Breakout Module Kit Contains

1.2 MCP2221 BREAKOUT MODULE GENERAL DESCRIPTION

The MCP2221 Breakout Module is a development and evaluation platform for the MCP2221 device. The module is comprised of a single DIP form factor board.

The MCP2221 Breakout Module has the following features:

• UART Tx and Rx signals
• I^2C^{TM}/SMBus clock and data lines (SCL and SDA)
• Four GP lines, configurable for GPIO, dedicated or alternate function operation
• User-selectable (by using a jumper) power supply of 3.3V or 5V (up to 500 mA)
• DIP form factor (600 mil spacing between two 7-pin headers)
• PICkit™ Serial Analyzer header — used for UART and I^2C/SMBus communication only

The accompanying PC software is used to evaluate/demonstrate the MCP2221 device as a USB-to-UART/I^2C/SMBus protocol converter. It allows I/O control and custom device configuration.

A DLL package is included to allow development of custom PC applications using the MCP2221.

1.3 WHAT THE MCP2221 BREAKOUT MODULE KIT CONTAINS

The MCP2221 Breakout Module kit includes:

• MCP2221 Breakout Module (ADM00559)
• USB-to-mini-USB Cable
• Important Information Sheet

NOTES:

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP2221 Breakout Module is designed to demonstrate the device as a USB-to-UART/I^{2}C/SMBus protocol converter solution.

The package is comprised of a single board and has the following features:

- Small plug-in board with DIP form factor (two 7-pin headers spaced at 600 mil)
- Mini-USB connector
- Access to the UART signals (Tx, Rx), I^{2}C/SMBus (SCL, SDA) and all the GP signals (GP0 – GP3)
- PICkit Serial Analyzer compatible header
- 3.3 or 5V jumper-selectable V$_{DD}$; the breakout board can be used to supply up to 500 mA to the rest of the system.
- Jumper-selectable I^{2}C/SMBus on-board pull-up resistors. The user can select whether or not the on-board pull-up resistors will be connected to the SCL and SDA lines.

2.2 BOARD SETUP

Follow these steps to install the software and set up the MCP2221 Breakout Module:

1. Download the support material (MCP2221 DLL, MCP2221 Utility, MCP2221 I^{2}C/SMBus Terminal) that can be found on the board's web page, on the Microchip web site.
2. Unzip and install the driver package for the MCP2221 device.
3. Plug the board (using a DIP adapter or the PICkit Serial Analyzer header) into the target system needing UART-to-USB and/or USB-to-I^{2}C/SMBus conversion.
4. Connect the MCP2221 Breakout Module to a USB port on a Windows[®]-based PC.
5. Windows will automatically install the driver for this board. Wait for the installation to complete.

The board is now set up for operation. Optional steps for using the dedicated application include the following:

1. Unzip and install the PC software.
2. Start a Hyperterminal-like application (or any serial port application) in order to get access to the COM port.
3. Start the provided I^{2}C/SMBus Terminal tool in order to exercise the I^{2}C/SMBus.

MCP2221 Breakout Module User's Guide

FIGURE 2-1: **BREAKOUT MODULE LAYOUT**
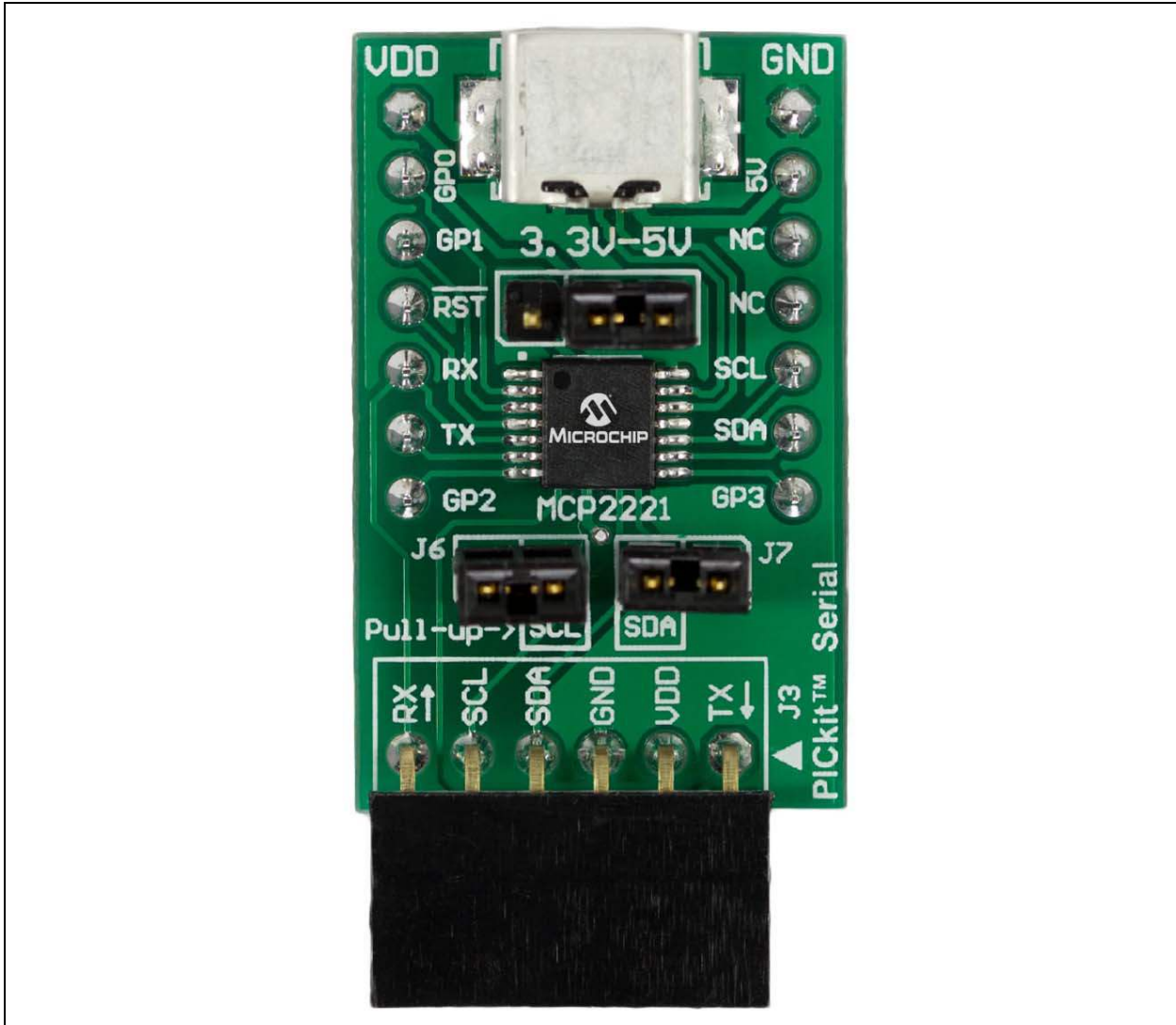
2.3 BOARD OPERATION

The MCP2221 will be detected by a Windows-based PC host as a composite device. The accompanying software can be used to exercise the board's features and also provides a reference point for users who want to design their own applications based on the MCP2221 device.

2.3.1 MCP2221 Breakout Module Operation

The MCP2221 Breakout Module can be used together with UART-based and/or I^2C/SMBus systems. The breakout board eases the USB support addition.

The board has the following features:

- UART signals (Tx, Rx)
- Four GP signals that can be configured for:
  - GPIO functionality (digital input or output pins; please see the MCP2221 Data Sheet for the exact GP pin options)
  - Dedicated function pins (signal important system states, such as USB Configured, USB Suspend)
  - Alternate function pins (clock output, analog inputs or outputs)

- Jumper-selectable power supply: 3.3 or 5V (up to 500 mA)
- PICkit Serial Analyzer header – the board can be directly plugged into systems that have this type of header. The MCP2221 Breakout Module provides UART-to-USB and USB-to-I^{2}C/SMBus access.
- DIP form factor (two 7-pin headers spaced at 600 millimeters)

By using the provided software and libraries, the user can create personalized PC applications, using the breakout board as a USB-to-UART and/or USB-to-I^{2}C/SMBus protocol converter.

2.4   MCP2221 TYPICAL USAGE SCENARIOS

The MCP2221 can be used in systems where a UART bus is available. The MCP2221 enables the USB connection to a UART-based system.

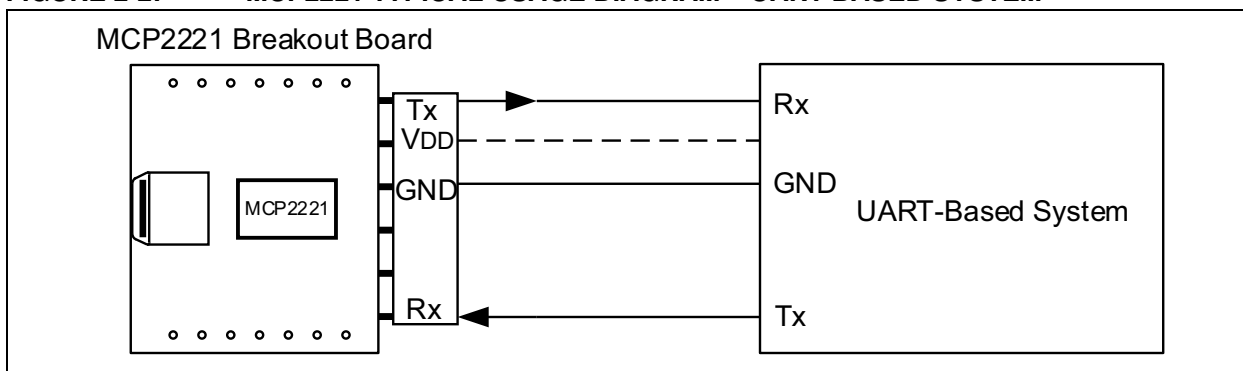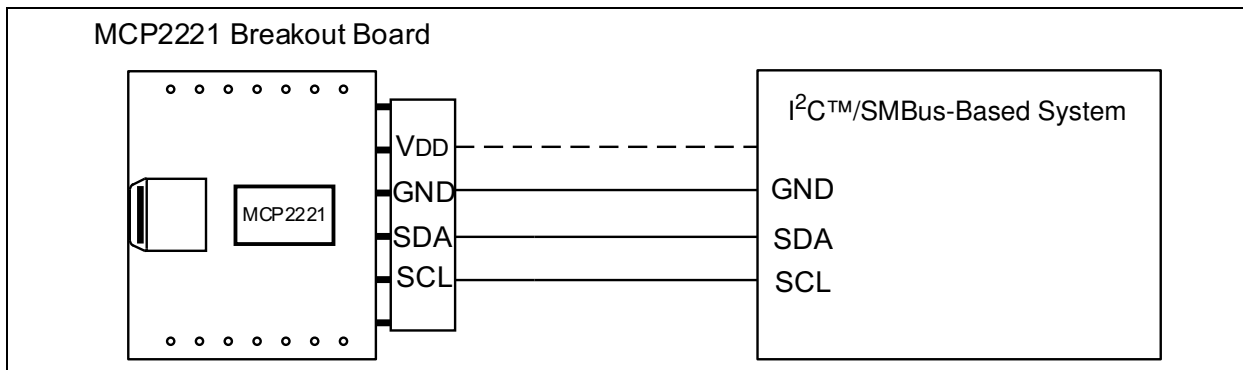**FIGURE 2-2:   MCP2221 TYPICAL USAGE DIAGRAM – UART-BASED SYSTEM**

FIGURE 2-3:   MCP2221 TYPICAL USAGE DIAGRAM – I^{2}C/SMBUS-BASED SYSTEM

NOTES:

Chapter 3. Software Description

3.1   INTRODUCTION

The I^{2}C/SMBus functionality of the MCP2221 Breakout Module requires a Microsoft$^®$ Windows$^®$ XP/7/8 operating system and a USB port. To run the software, follow the steps described in this section.

1.   Connect the MCP2221 Breakout Module to the PC using the provided USB cable.
2.   To start the I^{2}C$^®$/SMBus Terminal application, select _Start > All Programs > Microchip > MCP2221 I2C/SMBus Terminal_. The interface detects the MCP2221 device automatically and is ready for use (see Figure 3-1).

3.2   I^{2}C™/SMBUS TERMINAL AND THE MCP2221

The I^{2}C/SMBus Terminal application is provided as a support tool for the MCP2221. It allows the user easy I^{2}C/SMBus command manipulation using any MCP2221-based system.

FIGURE 3-1:   THE I^{2}C/SMBUS TERMINAL USER INTERFACE
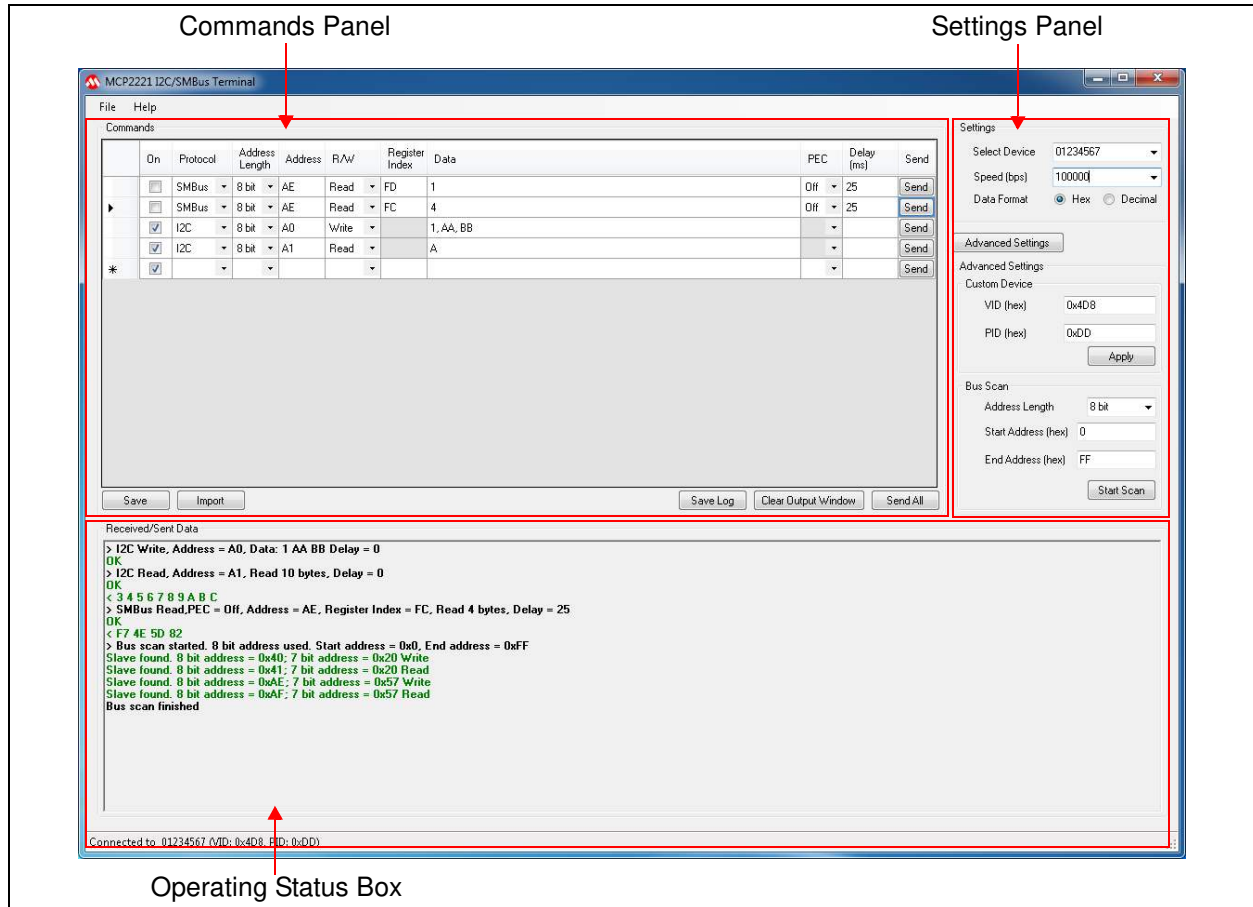
3.3 CONFIGURING PARAMETERS

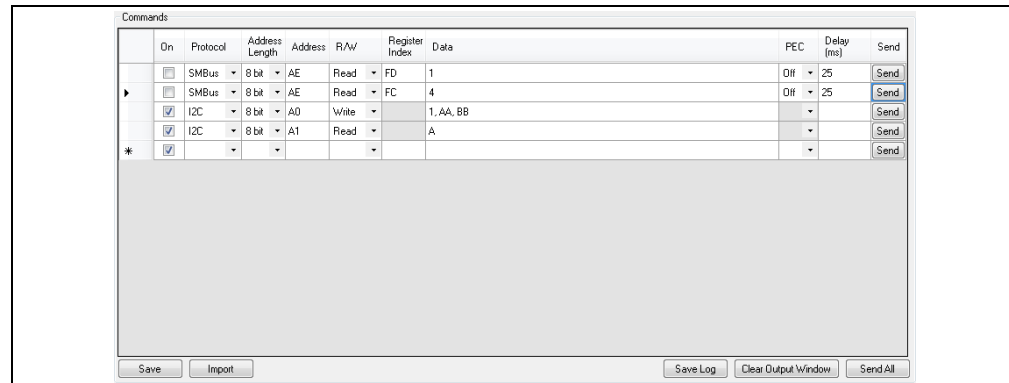As depicted in Figure 3-1, the MCP2221 Breakout Module user interface is divided into three parts:

- Commands Panel
- Settings Panel
- Operating Status Box

3.3.1 Commands Panel

Figure 3-2 shows a detailed view of the **Commands** panel.

FIGURE 3-2: COMMANDS PANEL

3.3.1.1 "ON" CHECK BOX

This check box is used when pressing the **Send All** button. Data lines that have the check box enabled will be sent to the slave.

3.3.1.2 "PROTOCOL" FIELD

This field allows selecting between I^{2}C and SMBus.

3.3.1.3 "ADDRESS LENGTH" FIELD

This field allows setting the address length for the slave address to 7 bit or 8 bit.

3.3.1.4 "R/W" FIELD

This field specifies whether the command sent to the slave is a read or a write operation.

3.3.1.5 "REGISTER INDEX" FIELD

This field is used only for SMBus communication and specifies the register address on which the operation will take place.

3.3.1.6 "DATA" FIELD

The content of this field varies depending on the Read/Write selection.

For a "Read" operation, the data field will contain a single value, specifying the number of bytes that will be read from the slave.

For a "Write" operation, the data field will contain the data bytes that will be sent to the slave. Values should be separated by commas. The following formats are accepted for hexadecimal representation: 0xFF and FF.

The data field can be left empty for write commands. This can be used to scan the bus and verify that the slave responds correctly.

3.3.1.7 "PEC" (PACKET ERROR CHECK) FIELD

This field is used for SMBus only and will enable/disable the error checking for SMBus packets.

3.3.1.8 "DELAY" FIELD

This field is used to insert the delay period after the message has been sent. To enable the delay, press the **Send All** button.

3.3.1.9 "SEND" FIELD

When pressing the **Send** button on the selected field, the command will be transmitted from the corresponding line to the slave.

3.3.1.10 BUTTONS

The buttons in the Commands panel and their descriptions are listed in Table 3-1.

TABLE 3-1: COMMANDS PANEL BUTTONS

| Button	Description
Save	This button allows saving all the commands present in the **Commands** list. The default file format is .csv but .txt files are also supported.
Import	This button allows importing a previously saved command list. The imported commands will be added after any existing commands.
Save Log	This button allows saving the contents of the Received/Sent Data field to a .txt file.
Clear Output Window	This button allows erasing the contents of the Received/Sent Data field. This window can also be cleared by right clicking in the "Received/Sent Data" area and selecting **Clear Output Window**.
Send All	This button allows sending all the enabled ("on" checkbox enabled) commands to the slave. If configured, delays will be inserted between consecutive commands.

3.3.1.11 ADDING AND DELETING COMMAND ROWS

New lines are added automatically at the end of the list when the last line is being edited.

To manually insert an empty row in a specific location, right click on a command row and select "Insert Row Above" or "Insert Row Below" from the context menu.

The right click context menu also allows deleting a specific line or the entire commands table.
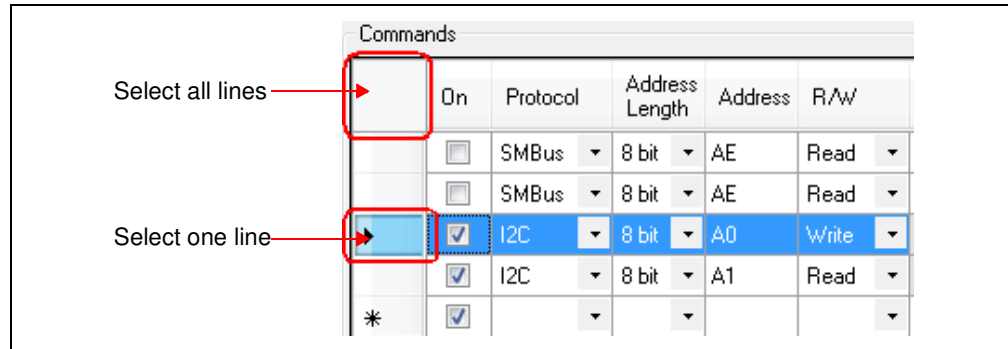
FIGURE 3-3: ADDING AND DELETING COMMAND ROWS
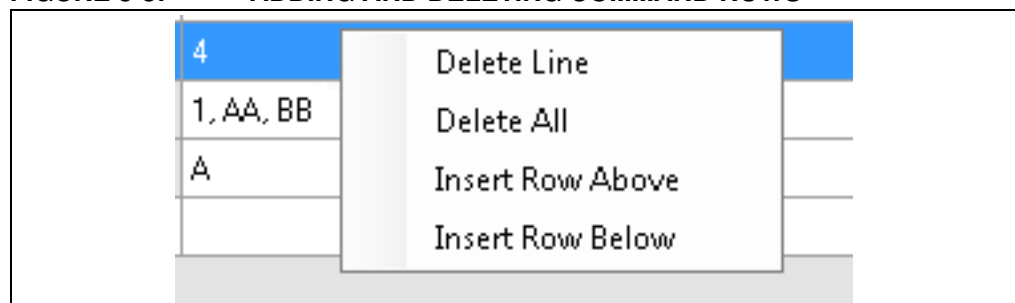
Deleting can also be done by selecting the line and pressing the <Delete> key on the keyboard.
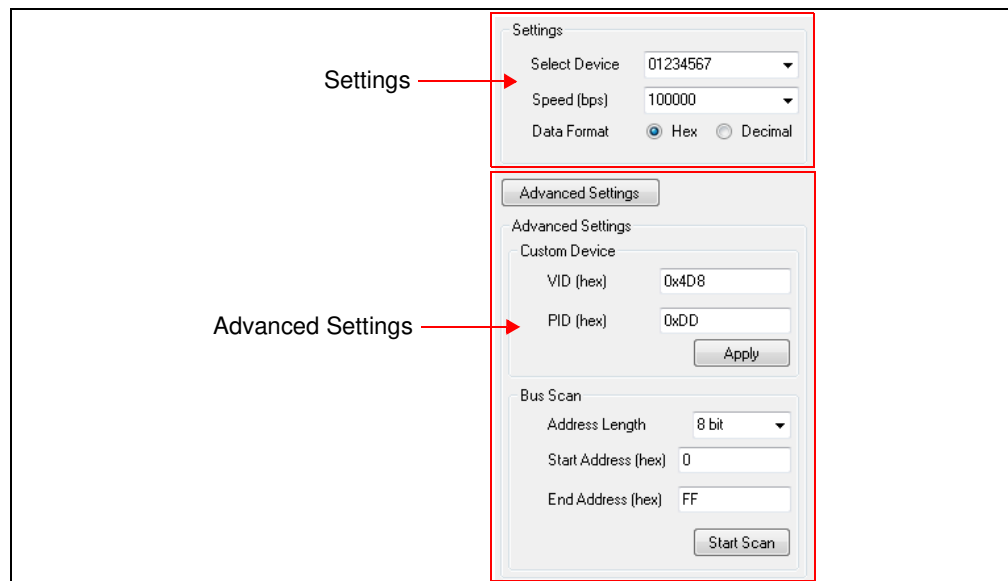
FIGURE 3-4: COMMAND SELECTION

Command lines can be rearranged by left clicking on a line, then dragging and dropping it into the desired location.

3.3.2 Settings Panel

Figure 3-5 shows a detailed view of the **Settings** panel.

FIGURE 3-5: SETTINGS PANEL

3.3.2.1 SELECT DEVICE

This drop-down menu contains a list of the connected MCP2221 devices. The selected device will be used when the **Send**/**Send All** buttons are pressed, as well as for the Bus Scan option. The device list is automatically refreshed.

3.3.2.2 SPEED OPTION

This option is used to set the communication speed to values ranging from 100 kbps to 400 kbps. Custom speeds can be used by typing in the desired value.

3.3.2.3 DATA FORMAT OPTIONS

These options allow selecting between using hexadecimal or decimal formatting for the input fields. This selection applies to the "Address", "Register Index" and "Data" fields in the **Commands** panel and to the "Start Address" and "End Address" fields under the **Bus Scan** option. When switching between the two radixes, the values from the affected fields will be automatically converted.

To display the Advanced Settings panel, press the **Advanced Settings** button. The options in the Advanced Settings panel are described below.

3.3.2.4   CUSTOM DEVICE OPTIONS

The terminal can be used with MCP2221 devices which have been configured with different VID and PID values. To connect to a custom device, provide the VID and PID values and press the **Apply** button so the new settings take effect. The status message in the bottom left corner of the screen should update with a message on the number of devices which were found.
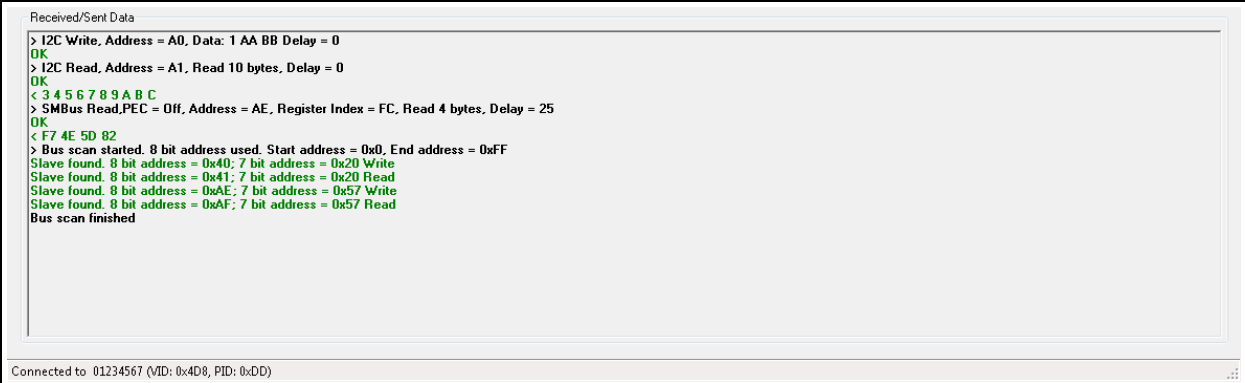
3.3.2.5   BUS SCAN OPTION

The scan options can be used to detect what slaves are connected to the system. After pressing the **Start Scan** button, the MCP2221 will go through the address range provided in the "Start Address" and "End Address" fields and report the addresses which have sent back acknowledgments. The format of the address used for the scan is selectable between 7 and 8 bits in length.

3.3.3   Operating Status Box

This box provides the user with the results of the communication and the operating status. Examples of status messages are shown in Figure 3-6.

FIGURE 3-6:   OPERATING STATUS BOX

The "Received/Sent Data" field in the operating status box contains the communication results. The application status message is shown in the bottom left corner of the operating status box.

3.4 EXAMPLE FOR INTERFACING WITH THE MCP23008 (8-BIT I/O EXPANDER)

1. If multiple MCP2221 devices are connected, choose the one to be used from the Select Device drop-down menu. Also, select the desired communication speed from the Speed list, as shown in Figure 3-7.

FIGURE 3-7: DEVICE SETTINGS

2. With A0, A1, A2 pins on the board tied to a 0 logic level, select the protocol, address length, slave address and whether the operation is a read or a write (Figure 3-8). Set the slave address to 40. These settings need to be made for every new command.

FIGURE 3-8: COMMAND SETTINGS

3. For the Write sequence, first configure the pins as outputs. The IODIR register has a 0h address, so writing 0h to this register will set all the port pins as outputs.

To set all the pins high, write FF(hex) to the OLAT register (address 0A(hex)), as shown in Figure 3-9. The first data byte represents the register address, while the second data byte represents the value that will be written.

The commands can be sent individually, by pressing the **Send** button, or consecutively, by pressing the **Send All** button.

Verify whether the settings have been applied by reading back the port value from the GPIO register (address 09(hex)). Send a write command to specify the register address. Then, send a read command specifying the number of bytes that will be read.

FIGURE 3-9: WRITE SEQUENCE

4. The command sequence in Figure 3-10 sets the address for the GPIO register and reads one byte of data from the slave, obtaining the value from the register.

FIGURE 3-10: **READ SEQUENCE**

| ☑ | I2C | ▾ | 8 bit | ▾ | 40 | Write | ▾ | | 9 | | ▾ | 250 | Send |
| ☑ | I2C | ▾ | 8 bit | ▾ | 41 | Read | ▾ | | 1 | | ▾ | 250 | Send |

5. The results of the four commands sent in steps 3 and 4 are shown in Figure 3-11.

FIGURE 3-11: **WRITE AND READ COMMAND OUTPUT**

```
Received/Sent Data
> I2C Write, Address = 40, Data: 0 0 Delay = 250
OK
> I2C Write, Address = 40, Data: A FF Delay = 250
OK
> I2C Write, Address = 40, Data: 9 Delay = 250
OK
> I2C Read, Address = 41, Read 1 bytes, Delay = 250
OK
< FF
```

MCP2221 Breakout Module User's Guide

NOTES:

MCP2221 BREAKOUT MODULE
USER'S GUIDE

Appendix A. Schematic and Layouts

A.1   INTRODUCTION

This appendix contains the following schematics and layouts for the MCP2221 Breakout Module:

- Board – Schematic
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Silk
- Board – Bottom Copper and Silk
- Board – Bottom Copper

MCP2221 Breakout Module User's Guide

A.2   BOARD – SCHEMATIC
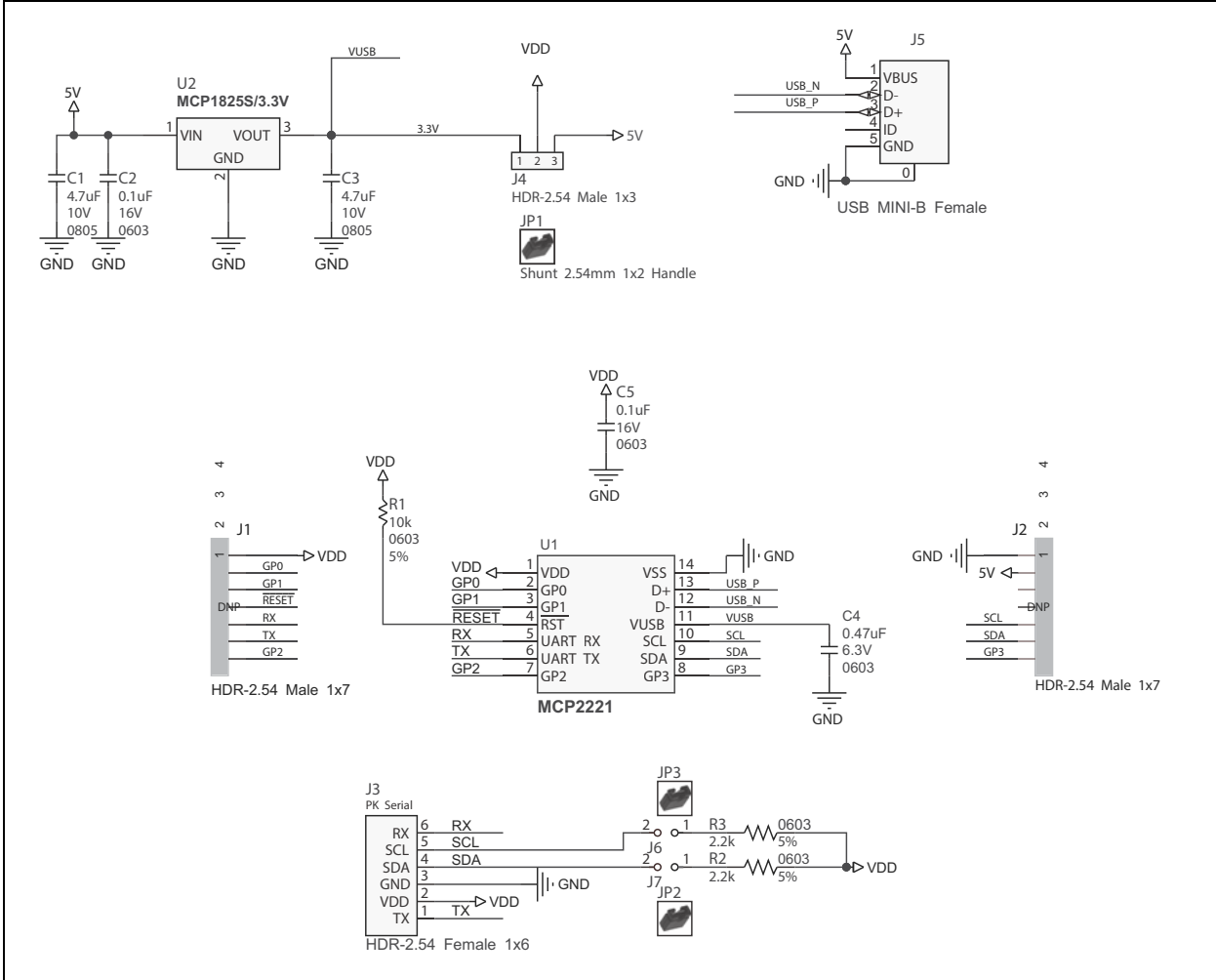
A.3   BOARD – TOP SILK
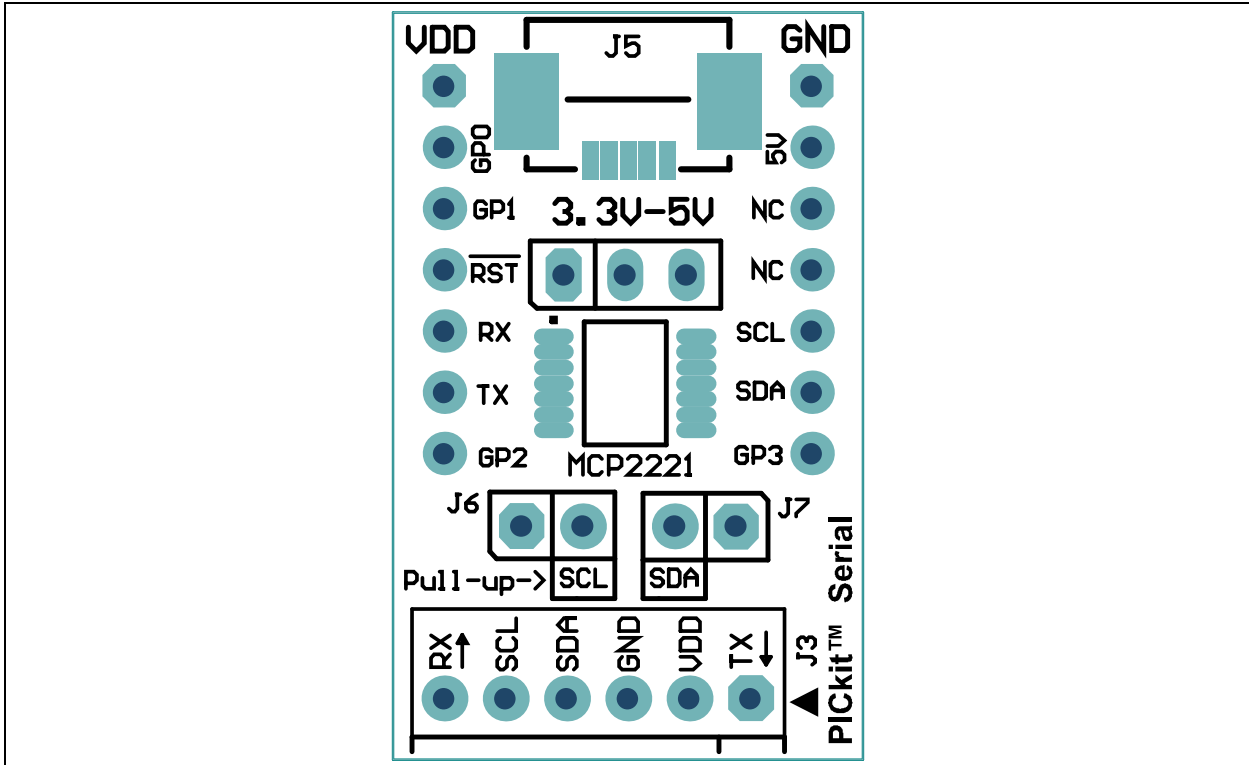
A.4   BOARD – TOP COPPER AND SILK

A.5   BOARD – TOP COPPER

A.6   BOARD – BOTTOM SILK

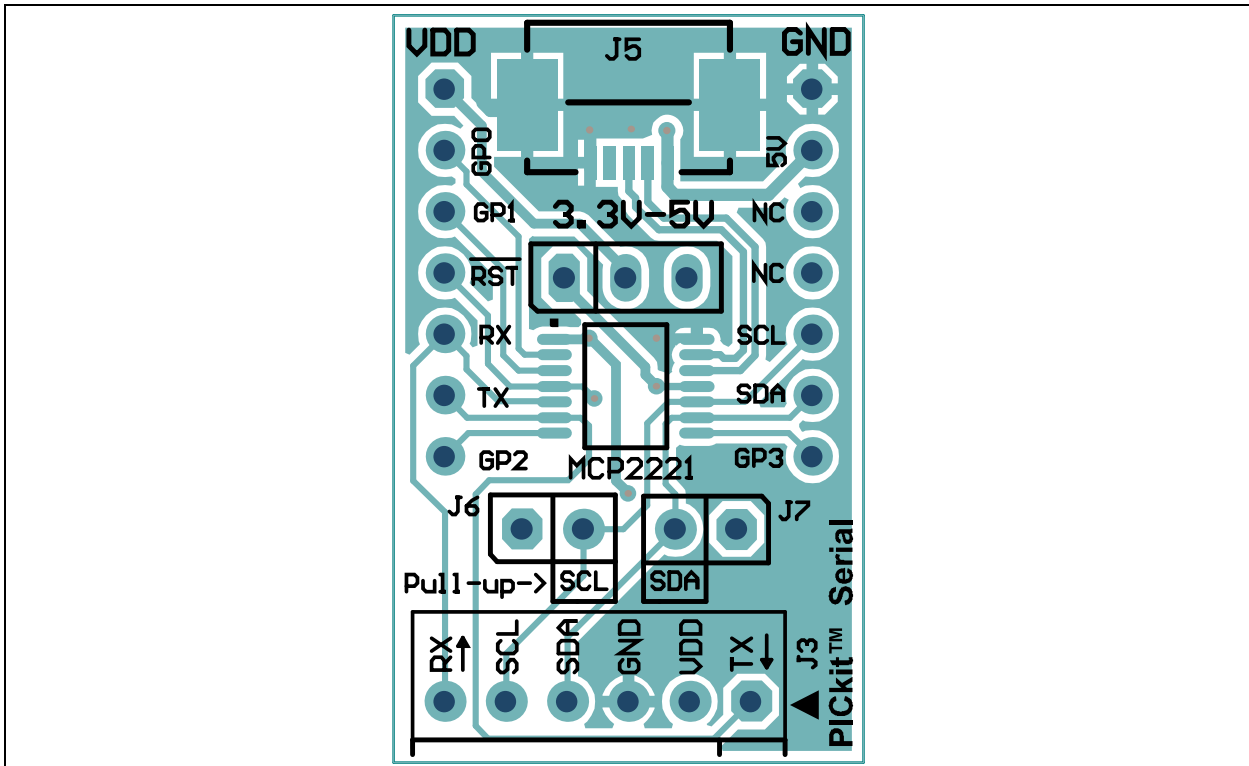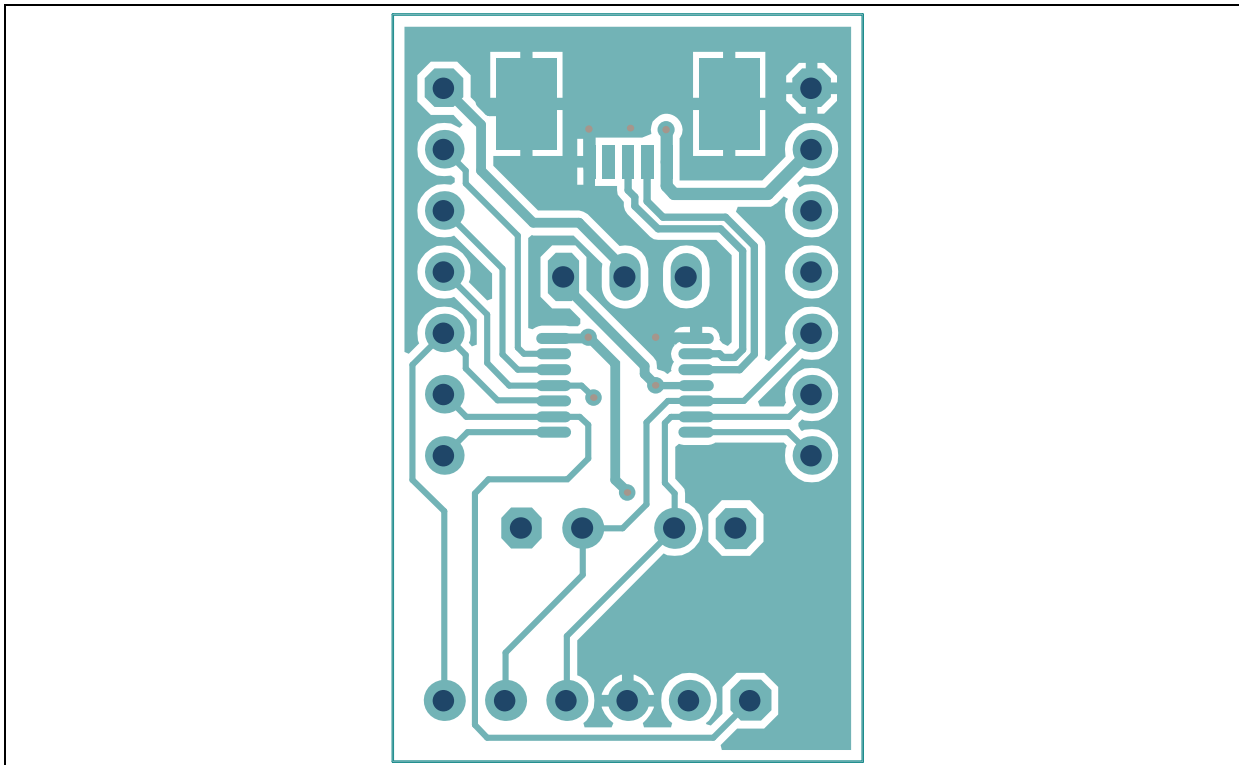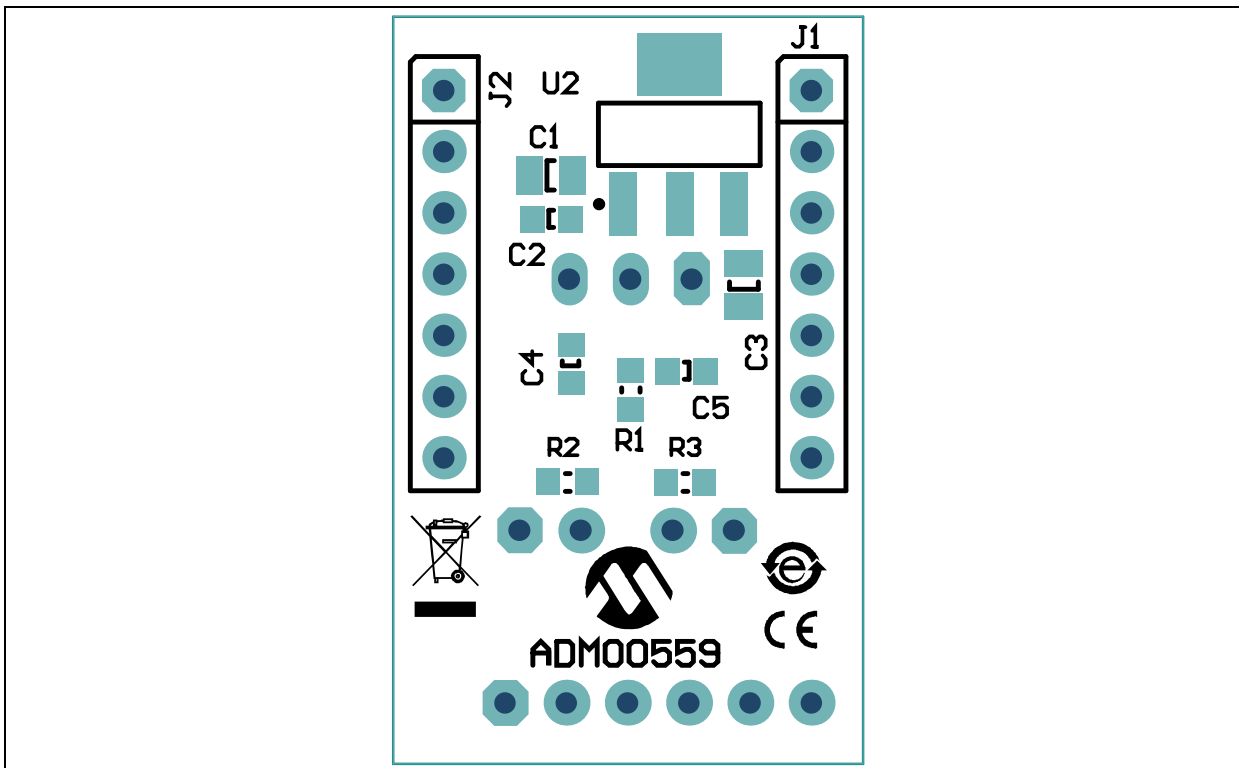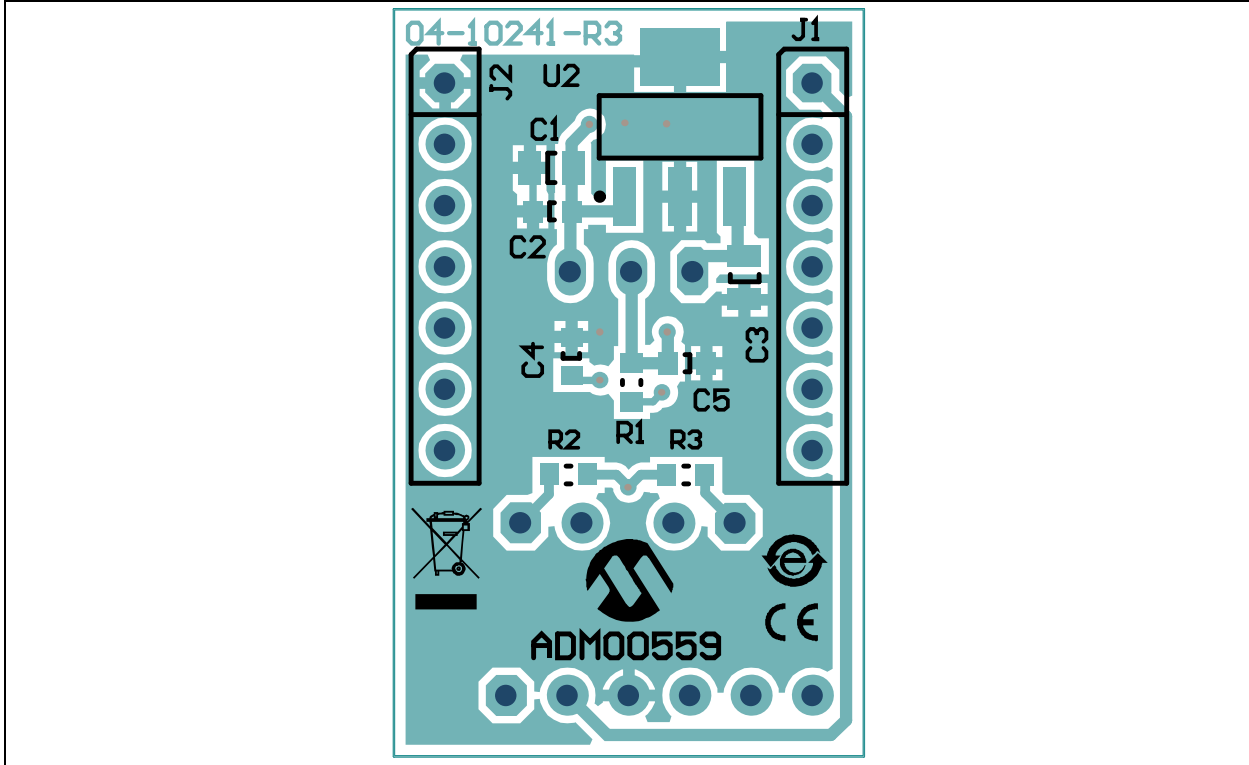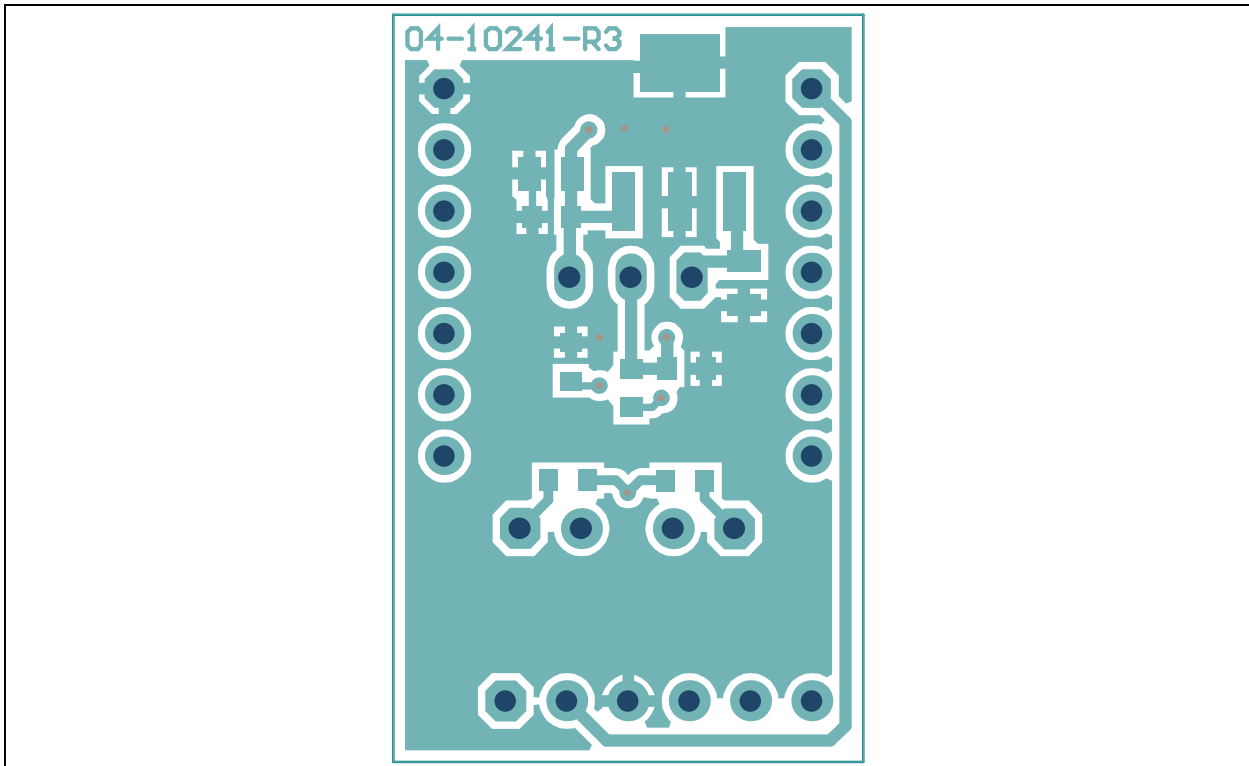## A.7   BOARD – BOTTOM COPPER AND SILK

A.8   BOARD – BOTTOM COPPER

NOTES:

Appendix B. Bill of Materials

TABLE B-1:   BILL OF MATERIALS

Qty	Reference	Description	Manufacturer	Part Number
2	C1, C3	Cap. cer. 4.7 µF 10V 10% X5R SMD 0805	Taiyo Yuden Co., Ltd.	LMK212BJ475KD-T
2	C2, C5	Cap. cer. 0.1 µF 16V 10% X7R SMD 0603	NIC Components Corp.	NMC0603X7R104K16TRPF
1	C4	Cap. cer. 0.47 µF 6.3V 10% X5R SMD 0603	Murata Electronics®	GRM188R60J474KA01D
1	J3	Conn. hdr - 2.54 female 1x6 Gold TH R/A	Sullins Connector Solutions	PPPC061LGBN-RC
1	J4	Conn. hdr - 2.54 male 1x3 Gold 5.84MH TH vert.	FCI	68000-103HLF
1	J5	Conn. USB Mini-B female SMD R/A	Hirose Electric Co., Ltd.	UX60SC-MB-5ST(80)
2	J6, J7	Conn. hdr - 2.54 male 1x2 gold 5.84MH TH vert.	FCI	68001-202HLF
3	JP1 – JP3	Mech. HW Jumper 2.54 mm 1x2 handle gold	TE Connectivity, Ltd.	881545-2
	PCB	Printed Circuit Board – MCP2221 Breakout Module	—	104-00559
1	R1	Resistor TKF 10 kΩ 5% 1/10W SMD 0603	Panasonic® - ECG	ERJ-3GEYJ103V
2	R2, R3	Resistor TKF 2.2 kΩ 5% 1/10W SMD 0603	NIC Components Corp.	NRO6J222TRF
1	U1	USB-to-I^{2}C and UART Bridge TSSOP-14	Microchip Technology Inc,	**MCP2221-I/ST**
1	U2	Analog LDO 3.3V **MCP1825ST-3302E/DB** SOT-223-3	MicrochipTechnology Inc.	**MCP1825S-3302E/DB**

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.

Worldwide Sales and Service

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