



MCP2221A USB-C Breakout Board User's Guide

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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 website (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 “DSXXXXXXA”, where “XXXXXXX” 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 MCP2221A USB-C Breakout Board. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Recommended Reading](#)
- [The Microchip Website](#)
- [Customer Support](#)
- [Document Revision History](#)

DOCUMENT LAYOUT

This document describes how to use the MCP2221A USB-C Breakout Board 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 MCP2221A USB-C Breakout Board
- **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 MCP2221A USB-C Breakout Board
- **Appendix B. “Bill of Materials”** – Lists the parts used to populate the MCP2221A USB-C Breakout Board

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CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> 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	<u><i>File>Save</i></u>
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	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [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 MCP2221A USB-C Breakout Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **MCP2221A Data Sheet – “USB 2.0 to I²C/UART Protocol Converter with GPIO” (20005565)**

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- **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
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- Field Application Engineer (FAE)
- Technical Support

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Technical support is available through the website at:
<https://www.microchip.com/support>.

DOCUMENT REVISION HISTORY

Revision A (May 2024)

- Initial release of this document.

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP2221A USB-C Breakout Board and covers the following topics:

- [MCP2221A USB-C Breakout Board General Description](#)
- [What the MCP2221A USB-C Breakout Board Kit Contains](#)

1.2 MCP2221A USB-C BREAKOUT BOARD GENERAL DESCRIPTION

The MCP2221A USB-C Breakout Board is a development and evaluation platform for the MCP2221A device. The board is comprised of a single DIP form factor board.

The MCP2221A USB-C Breakout Board has the following features:

- UART Tx and Rx signals
- I²C[™]/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 I²C/SMBus communication only

The accompanying PC software is used to evaluate/demonstrate the MCP2221A device as a USB-to-UART/I²C/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 MCP2221A.

1.3 WHAT THE MCP2221A USB-C BREAKOUT BOARD KIT CONTAINS

The MCP2221A USB-C Breakout Board kit includes:

- MCP2221A USB-C Breakout Board (BB62Z76A)
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP2221A USB-C Breakout Board is designed to demonstrate the device as a USB-to-UART/I²C/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)
- USB Type-C connector
- Access to the UART signals (Tx, Rx), I²C/SMBus (SCL, SDA) and all the GP signals (GP0 – GP3)
- PICKit Serial Analyzer compatible header
- 3.3 or 5V jumper-selectable VDD; the breakout board can be used to supply up to 500 mA to the rest of the system.
- I²C/SMBus on-board pull-up resistors. The user can remove the on-board pull-up resistors connected to the SCL and SDA lines.
- Staggered pin holes for press-fit insertion of the 7 pin headers.

2.2 BOARD SETUP

Follow these steps to install the software and set up the MCP2221A USB-C Breakout Board:

1. Download the support material (MCP2221 DLL, MCP2221 Utility, MCP2221 I²C/SMBus Terminal) that can be found on the board's web page, on the Microchip website.
2. Unzip and install the driver package for the MCP2221A 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-I²C/SMBus conversion.
4. Connect the MCP2221A USB-C Breakout Board 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 I²C/SMBus Terminal tool in order to exercise the I²C/SMBus.

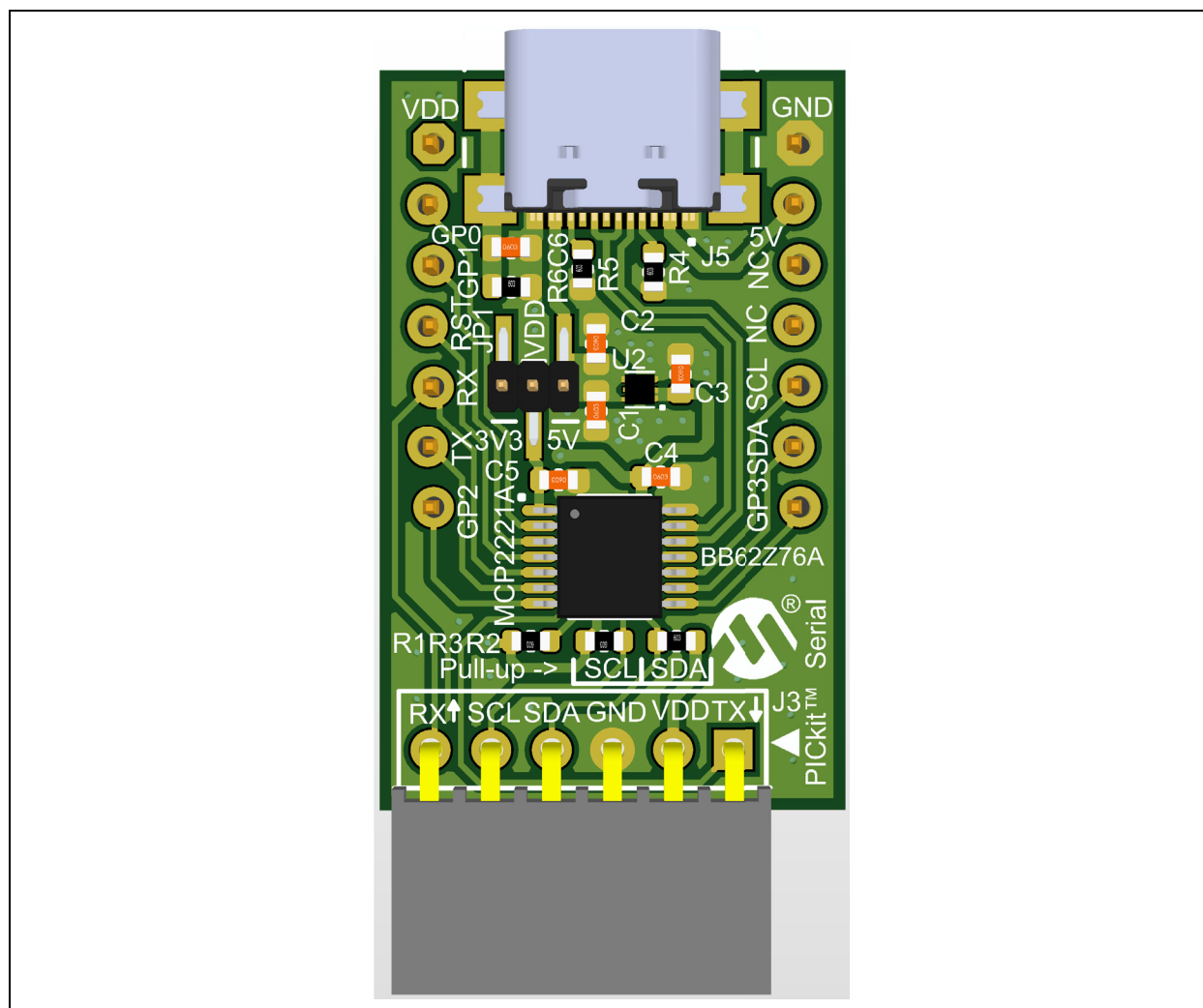


FIGURE 2-1: Breakout Board Layout.

2.3 BOARD OPERATION

The MCP2221A 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 MCP2221A device.

2.3.1 MCP2221A USB-C Breakout Board Operation

The MCP2221A USB-C Breakout Board can be used together with UART-based and/or I²C/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 MCP2221A 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 MCP2221A USB-C Breakout Board provides UART-to-USB and USB-to-I²C/SMBus access.
- DIP form factor (two 7-pin headers spaced at 600 mil)

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-I²C/SMBus protocol converter.

2.4 MCP2221A TYPICAL USAGE SCENARIOS

The MCP2221A can be used in systems where a UART bus is available. The MCP2221A enables the USB connection to a UART-based system.

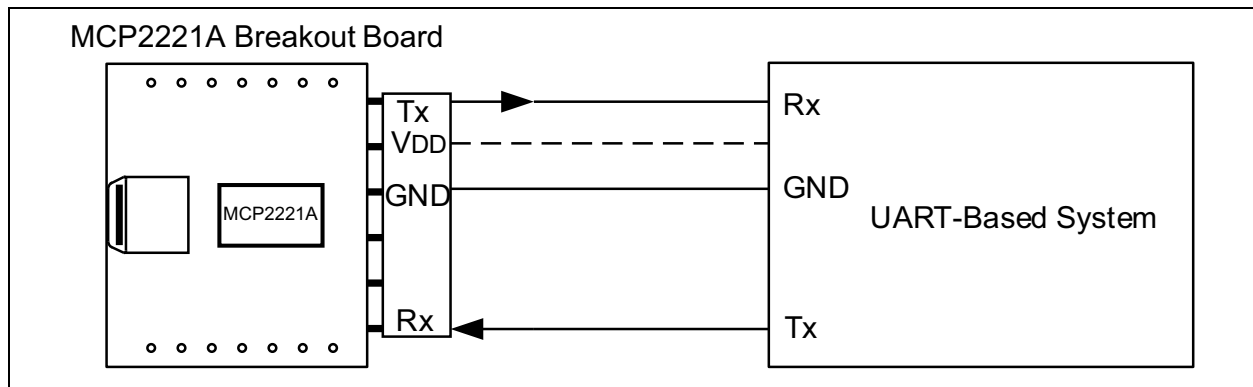


FIGURE 2-2: MCP2221A Typical Usage Diagram – UART-Based System.

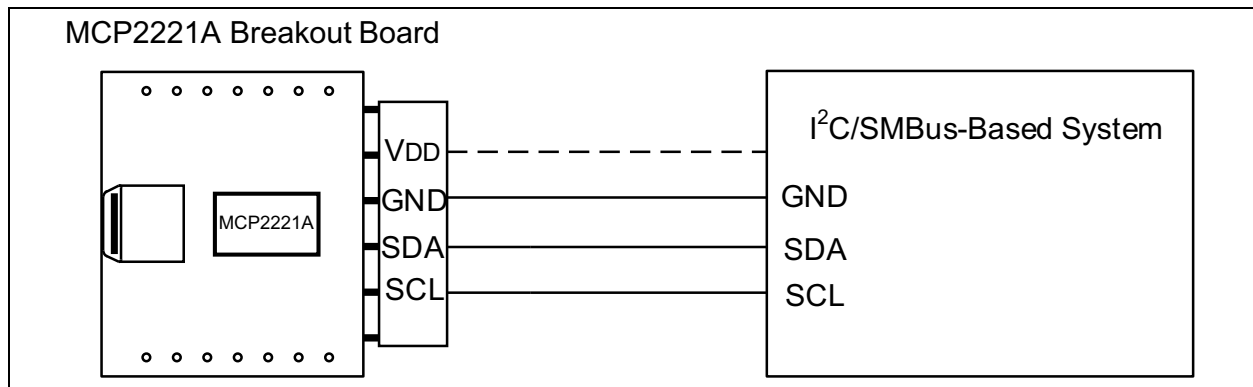


FIGURE 2-3: MCP2221A Typical Usage Diagram – I²C/SMBus-Based System.

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Chapter 3. Software Description

3.1 INTRODUCTION

The “MCP2221 I²C/SMBus Terminal” software requires a Microsoft® Windows® operating system and a USB port. To run the software, follow the steps described in this section.

1. Connect the MCP2221A USB-C Breakout Board to the PC using the provided USB cable.
2. To start the I²C®/SMBus Terminal application, select Start > All Programs > Microchip > MCP2221 I2C/SMBus Terminal. The interface detects the MCP2221A device automatically and is ready for use (see Figure 3-1).

3.2 I²C™/SMBUS TERMINAL AND THE MCP2221A

The I²C/SMBus Terminal application is provided as a support tool for the MCP2221A. It allows the user easy I²C/SMBus command manipulation using any MCP2221A-based system.

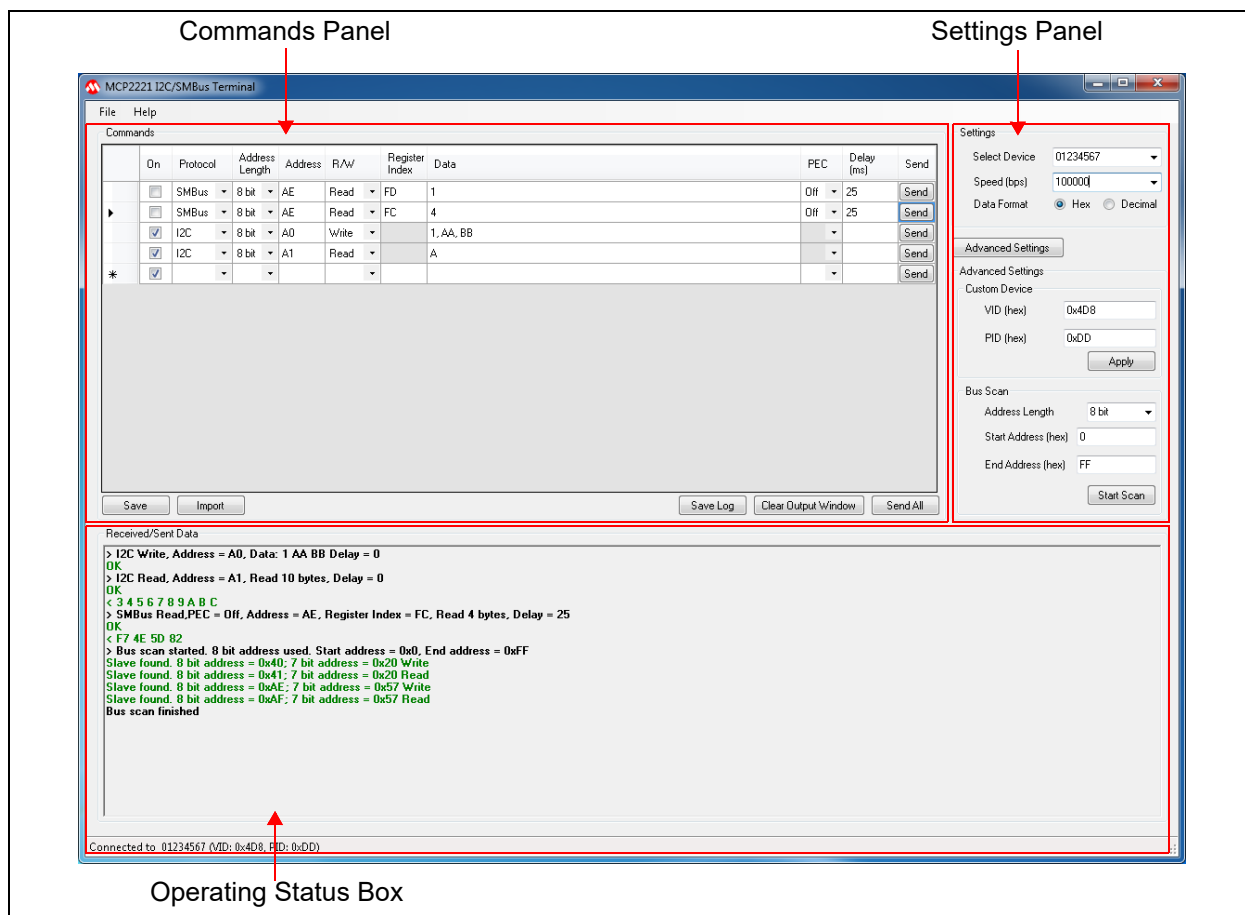


FIGURE 3-1: The I²C/SMBus Terminal User Interface.

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3.3 CONFIGURING PARAMETERS

As depicted in [Figure 3-1](#), the MCP2221A USB-C Breakout Board 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.

On	Protocol	Address Length	Address	R/W	Register Index	Data	PEC	Delay (ms)	Send
☐	SMBus	8 bit	AE	Read	FD	1	Off	25	Send
☐	SMBus	8 bit	AE	Read	FC	4	Off	25	Send
☒	I2C	8 bit	A0	Write		1, AA, BB			Send
☒	I2C	8 bit	A1	Read		A			Send
☒									Send

Save Import Save Log Clear Output Window Send All

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 I²C 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.

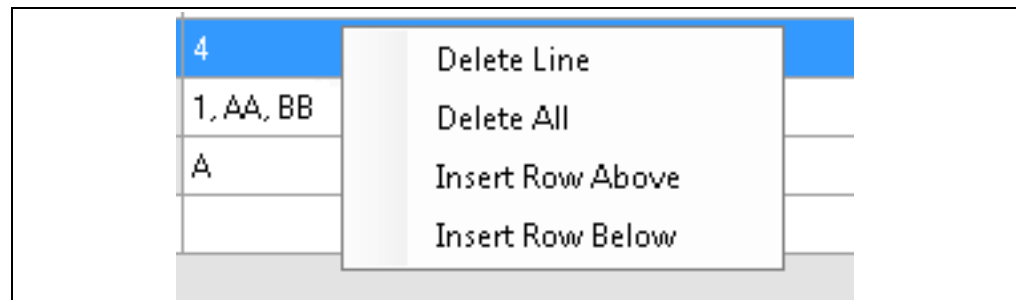


FIGURE 3-3: Adding and Deleting Command Rows.

Deleting can also be done by selecting the line and pressing the <Delete> key on the keyboard.

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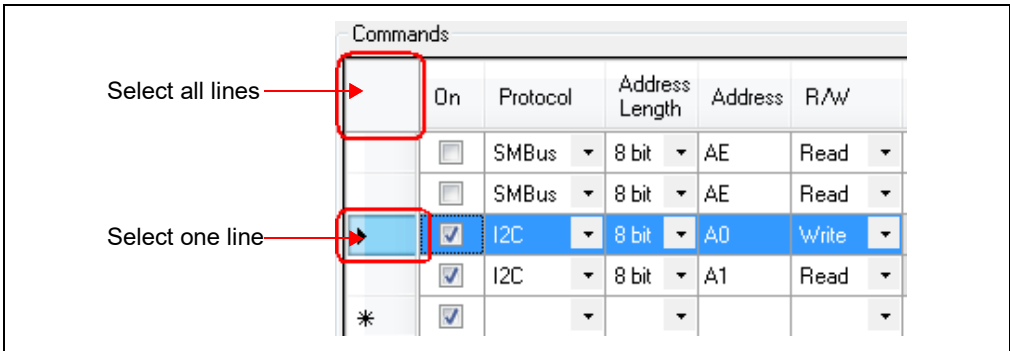


FIGURE 3-4: Command Selection.

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.

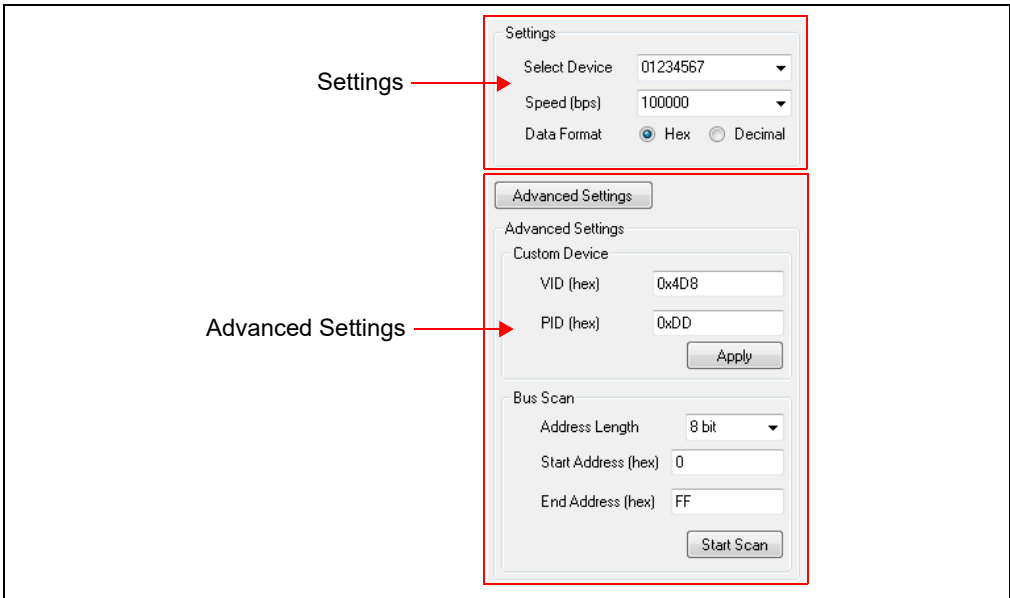


FIGURE 3-5: Setting Panel.

3.3.2.1 SELECT DEVICE

This drop-down menu contains a list of the connected MCP2221A 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 radices, 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 MCP2221A 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 MCP2221A 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](#).

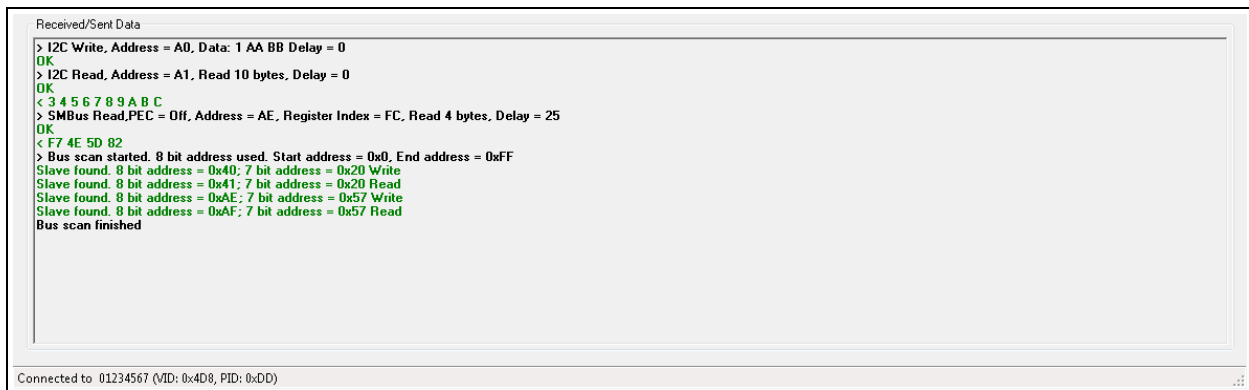


FIGURE 3-6: *Operating Status Box.*

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.

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

1. If multiple MCP2221A 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](#).

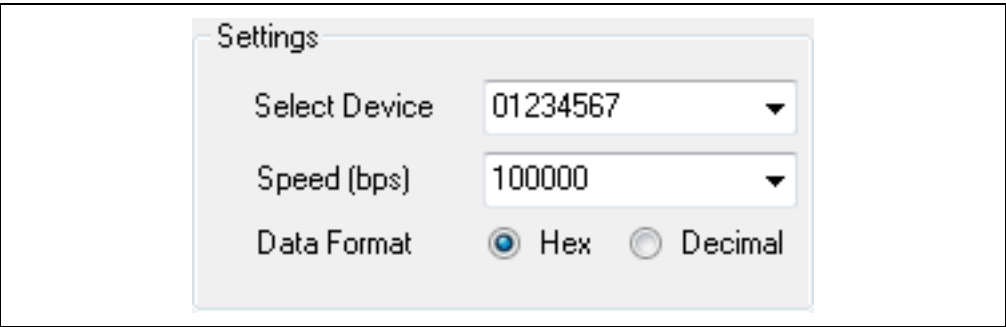


FIGURE 3-7: Device Settings.

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.

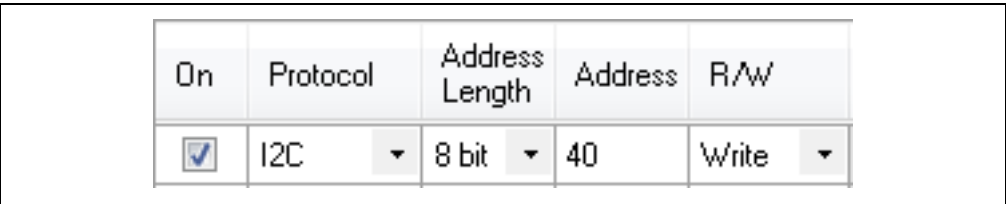


FIGURE 3-8: Command Settings.

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.

On	Protocol	Address Length	Address	R/W	Register Index	Data	PEC	Delay (ms)	Send
☒	I2C	8 bit	40	Write		0,0		250	<button>Send</button>
☒	I2C	8 bit	40	Write		A,FF		250	<button>Send</button>

FIGURE 3-9: Write Sequence.

- 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.

☒	I2C	▼	8 bit	▼	40	Write	▼		9		▼	250	Send
☒	I2C	▼	8 bit	▼	41	Read	▼		1		▼	250	Send

FIGURE 3-10: Read Sequence.

- The results of the four commands sent in steps 3 and 4 are shown in [Figure 3-11](#).

```
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
```

FIGURE 3-11: Write and Read Command Output.

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NOTES:

Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP2221A USB-C Breakout Board:

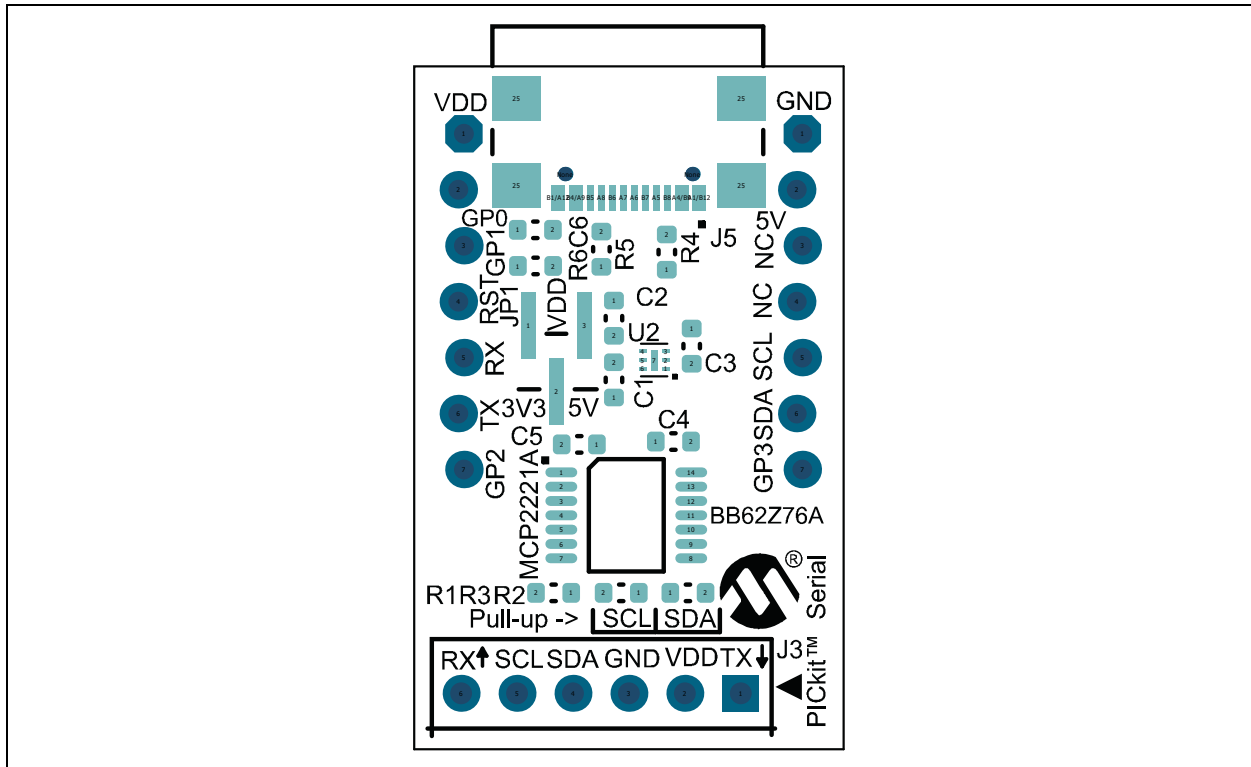
- [Board – Schematic](#)
- [Board – Top Silk](#)
- [Board – Top Copper and Silk](#)
- [Board – Top Copper](#)
- [Board – Bottom Copper](#)
- [Board – Bottom Copper and Silk](#)
- [Board – Bottom Silk](#)

LABEL

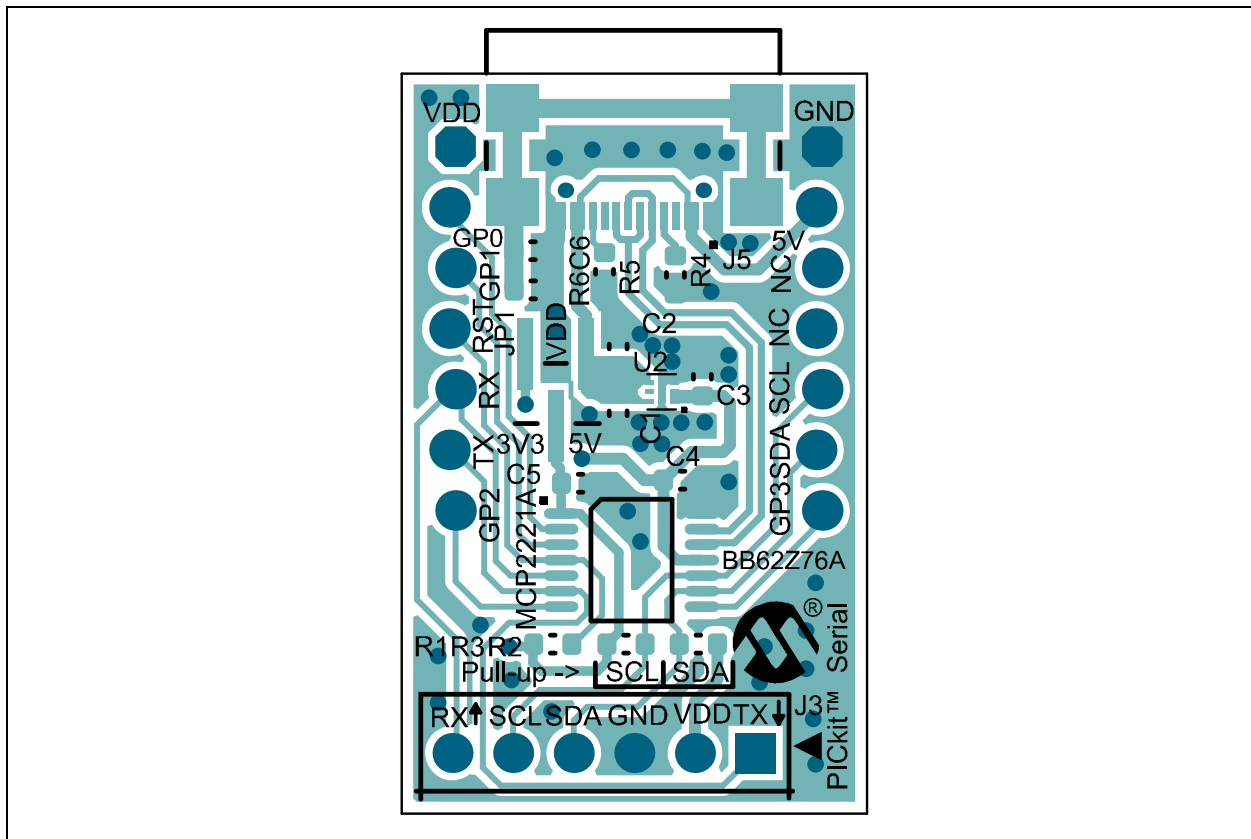
	[ASSY# / REV] SN: [SERIAL] [DATE yyyy.mm.dd]
---	--

PCBA LABEL 18X6mm

A.3 BOARD – TOP SILK

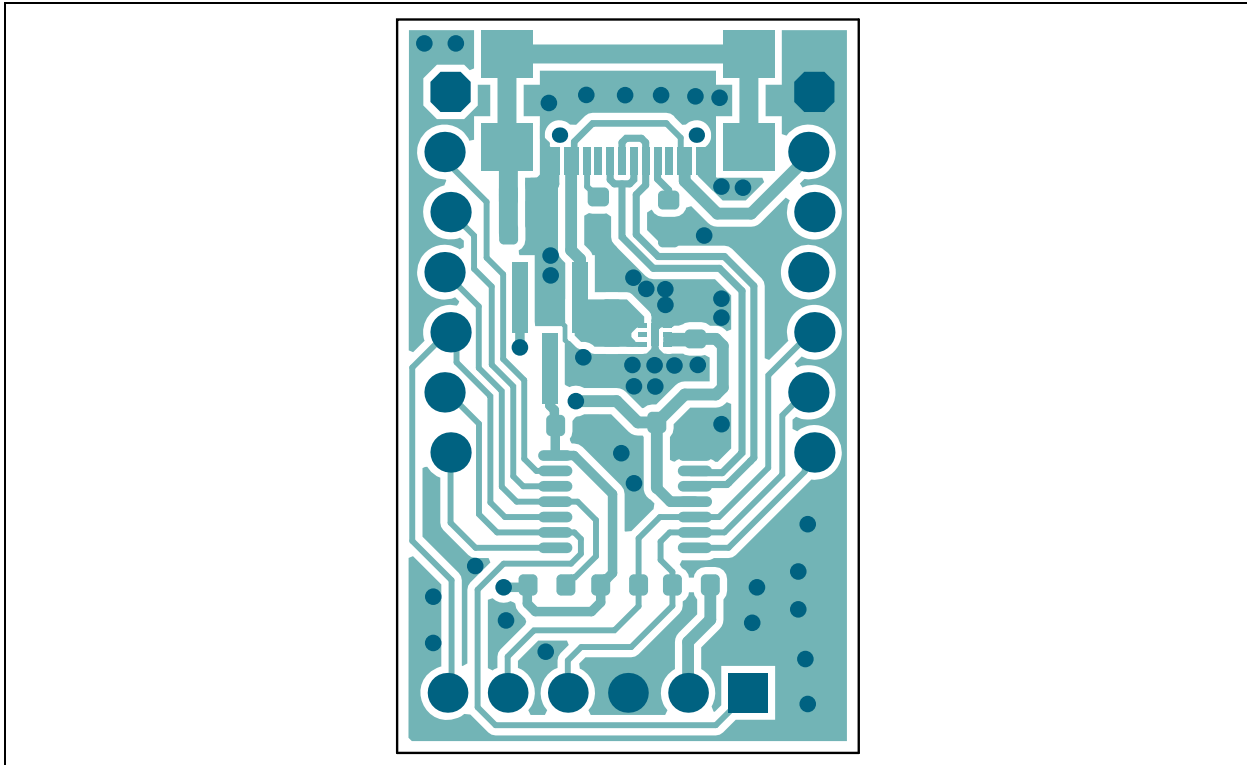


A.4 BOARD – TOP COPPER AND SILK

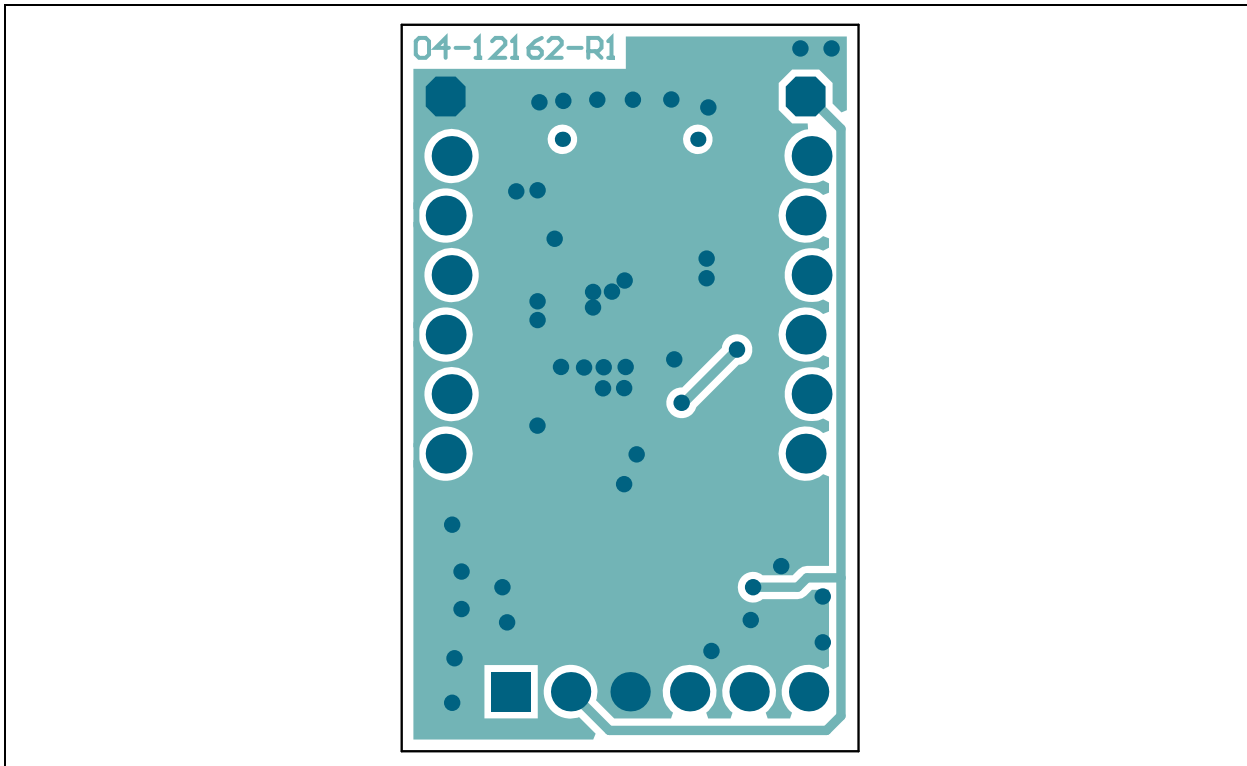


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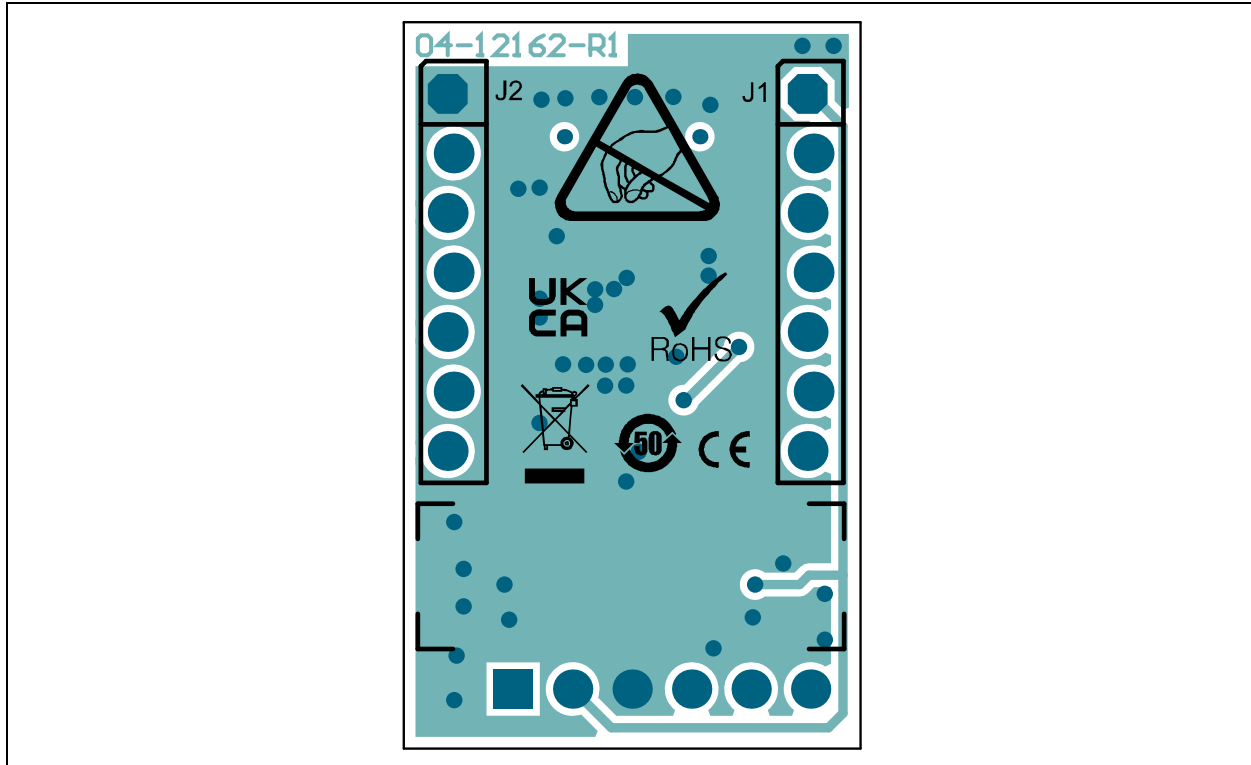
A.5 BOARD – TOP COPPER



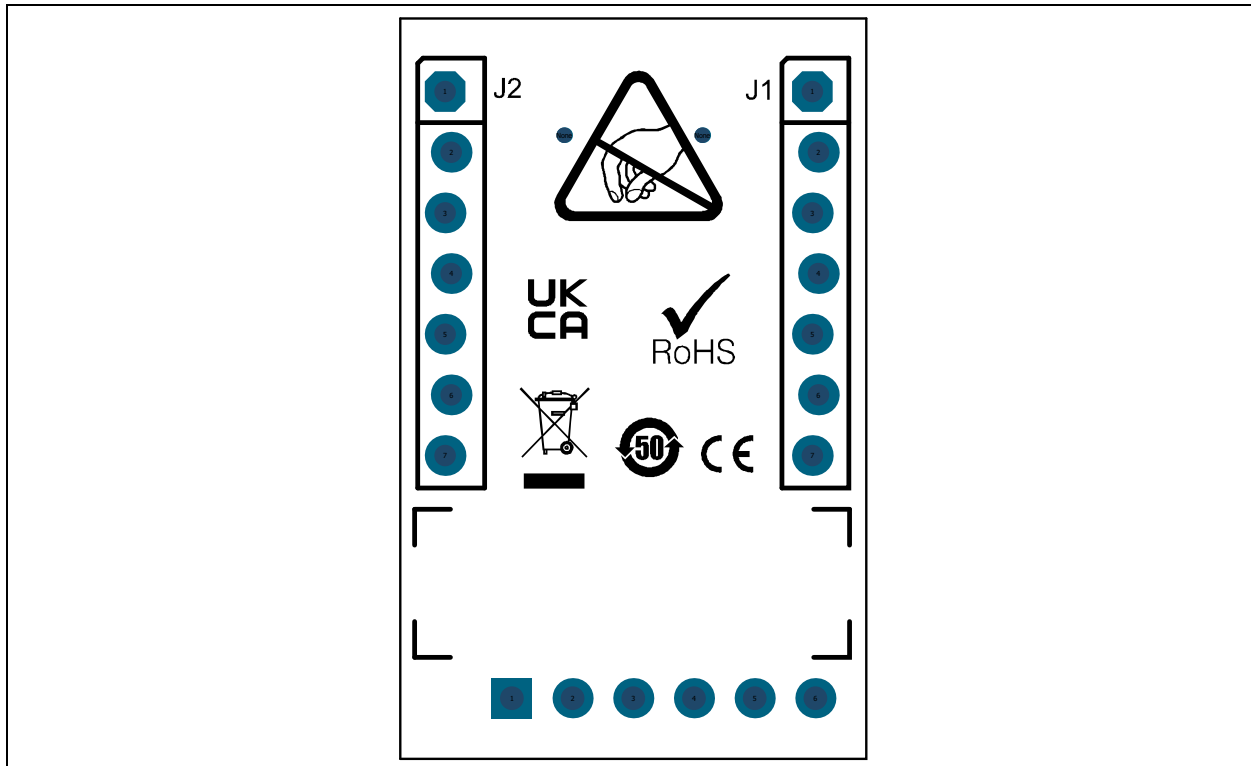
A.6 BOARD – BOTTOM COPPER



A.7 BOARD – BOTTOM COPPER AND SILK



A.8 BOARD – BOTTOM SILK



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NOTES:

Appendix B. Bill of Materials

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Ref.	Description	Manufacturer	Part Number
2	C1, C3	Capacitor, ceramic, 2.2 μ F, 10V, 10%, X7RSMD, 0603	Würth Elektronik	885012206027
2	C2, C5	Capacitor, ceramic, 0.1 μ F, 16V, 10%, X7RSMD, 0603	Würth Elektronik	885012206046
1	C4	Capacitor, ceramic, 0.47 μ F, 16V, 10%, X7R, SMD, 0603	Murata Electronics®	GRM188R71C474KA88D
1	C6	Capacitor, ceramic, 100 pF, 50V, 10%, X7R, SMD, 0603	Würth Elektronik	885012206077
1	J3	Connector, header, 2.54, female, 1x6, gold, Through Hole, R/A	Sullins Connector Solutions	PPPC061LGBN-RC
1	J5	Connector, USB, 2.0, Type-C, female, Surface Mount/Through Hole, R/A	GCT Semiconductor Inc.	USB4110-GF-A
3	JP1	Connector, header, male, 1x3, 1.27 mm, AU, Surface Mount	TE Connectivity, Ltd.	881545-2
1	PCB	Printed Circuit Board – MCP2221A USB-C Breakout Board	—	04-10241-R4
1	R1	Resistor, TKF, 10 k, 5%, 1/10W, SMD 0603	Panasonic® - ECG	ERJ-3GEYJ103V
2	R2, R3	Resistor, TKF, 2.2 k, 5%, 1/10W, SMD 0603	Panasonic - ECG	ERJ-3GEYJ222V
2	R4, R5	Resistor, TKF, 5.1k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF5101V
1	R6	Resistor, TKF, 1M, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-071ML

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.

TABLE B-2: BILL OF MATERIALS (BOM) – MICROCHIP PARTS

Qty	Reference	Description	Manufacturer	Part Number
1	U1	Interface, USB, I ² C, UART, TSSOP-14	Microchip Technology Inc.	MCP2221A-I/ST
1	U2	Analog, LDO, 3.3V, 6-TDFN	Microchip Technology Inc.	MIC5528-3.3YMT-TR

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.

TABLE B-3: BILL OF MATERIALS (BOM) – MECHANICAL PARTS

Qty	Reference	Description	Manufacturer	Part Number
1	JP1_M	HW, jumper, 1.27 mm, black, W/handle	Harwin Plc.	M50-2000005
1	LABEL	Label, PCBA, 18x6 mm, Datamatrix, Assy#/Rev/Serial/Date	ACT Logimark AS	505462

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.

TABLE B-4: BILL OF MATERIALS (BOM) – DO NOT POPULATE PARTS

Qty	Reference	Description	Manufacturer	Part Number
0	J1, J2	Connector, header, 2.54 male, 1x7, gold, 5.84MH, Through Hole, vertical	Samtec, Inc.	TSW-107-07-G-S

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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