PICkit™ Serial SPI Demo Board User's Guide

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PICkit™ SERIAL SPI DEMO 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 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 PICkit™ Serial SPI Demo 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 PICkit™ Serial SPI Demo Board as a development tool. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the PICkit™ Serial SPI Demo Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to use the PICkit™ Serial SPI Demo Board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the PICkit™ Serial SPI Demo Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the PICkit™ Serial SPI Demo 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 PICkit™ Serial SPI Demo Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

25AA020A/25LC020A Data Sheet, *"2K SPI Bus Serial EEPROM"* (DS21833)

This data sheet provides detailed information regarding the 25LC020A family.

TC77 Data Sheet, *"Thermal Sensor with SPI Interface"* (DS20092)

This data sheet provides detailed information regarding the TC77 product.

MCP3201 Data Sheet, *"2.7V 12-Bit A/D Converter with SPI Serial Interface"* (DS21290)

This data sheet provides detailed information regarding the MCP3201 product.

MCP4821/MCP4822 Data Sheet, *"12-Bit DAC with Internal Vref and SPI Interface"* (DS21953)

This data sheet provides detailed information regarding the MCP4822 product.

MCP41XXX/42XXX Data Sheet, *"Single/Dual Digital Potentiometer with SPI Interface"* (DS11195)

This data sheet provides detailed information regarding the MCP41010 product.

MCP6S91/2/3 Data Sheet, *"Single Ended, Rail-to-Rail I/O, Low Gain PGA"* (DS21908)

This data sheet provides detailed information regarding the MCP6S92 product.

MCP23008/MCP23S08 Data Sheet, *"8-Bit I/O Expander with Serial Interface"* (DS21919)

This data sheet provides detailed information regarding the MCP23008/MCP23S08 product.

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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

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

Customers should contact their distributor, representative or field application engineer for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (April 2007)

- Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

The PICkit™ Serial SPI Demo Board demonstrates SPI serial communications and operation of the following devices:

- 25LC020A - 2K SPI Bus Serial EEPROM
- TC77-5.0 - Thermal Sensor with SPI Interface
- MCP3201 - 2.7V 12-Bit A/D Converter with SPI Serial Interface
- MCP4822 - 12-Bit DAC with Internal V_{REF} and SPI Interface
- MCP41010 - Single/Dual Digital Potentiometer with SPI Interface
- MCP6S92 - Single-Ended, Rail-to-Rail I/O, Low-Gain PGA
- MCP23S08 - 8-Bit I/O Expander with Serial Interface

The PICkit™ Serial SPI Demo Board was designed to easily connect to the PICkit Serial Analyzer (DV164122). The PICkit Serial Analyzer provides the SPI master mode serial communications and power. The PICkit™ Serial SPI Demo Board devices all operate in the SPI slave mode and can easily be connected to virtually any demo or development board by connecting the communications lines to connector P1.

1.2 HIGHLIGHTS

This chapter discusses:

- SPI Serial Communications
- SPI Demo Board Operation
- SPI Demo Board Devices

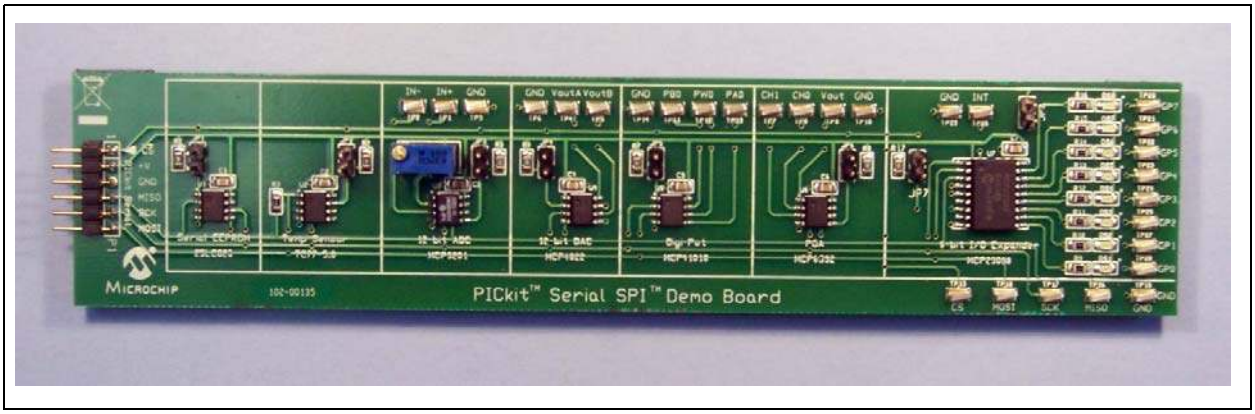


FIGURE 1-1: *PICkit™ Serial SPI Demo Board.*

1.3 SPI SERIAL COMMUNICATIONS

It is assumed that the user is familiar with the SPI protocol. For more information see:

- An SPI tutorial is available on the Microchip Technology website. Click on the links: Support --> Getting Started --> PIC MCU Tutorials --> SPI - PICmicro® Serial Peripheral Interface
- Several application notes are available on the Microchip Technology website. Click on links: Design --> App Notes --> Function: Communications --> SPI

1.4 WHAT THE PICkit™ SERIAL SPI DEMO BOARD KIT INCLUDES

This PICkit™ Serial SPI Demo Board Kit includes:

- PICkit™ Serial SPI Demo Board (102-00135)
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - PICkit™ Serial SPI Demo Board User's Guide (DS51658)

Chapter 2. Installation and Operation

2.1 SPI DEMO BOARD OPERATION

The PICkit™ Serial SPI Demo Board was designed to easily connect to the PICkit Serial Analzyer (DV164122). Refer to the PICkit Serial Analyzer User's Guide (DS51647) chapter on SPI Master Communications mode for configuration and operation information of the PICkit Serial Analyzer.

The PICkit Serial Analyzer provides the SPI master mode serial communications and power. The PICkit™ Serial SPI Demo Board devices all operate in the SPI slave mode. Figure 2-1 shows the PICkit™ Serial SPI Demo Board block diagram.

The PICkit Serial Analyzer has only one active low chip select ($\overline{CS}$) line. Individual devices are enabled by inserting the 2-pin shunt onto jumper JP1 through JP7 to connect the CS line to the device. Only one jumper should be inserted at a time.

Note: Only one jumper should be inserted into JP1 though JP7 at a time. Incorrect device operation will occur.

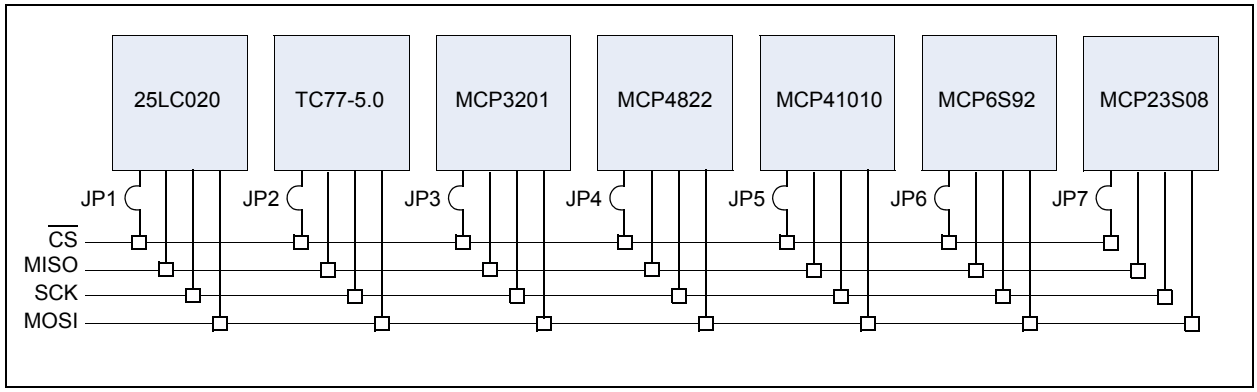


FIGURE 2-1: *PICkit™ Serial SPI Demo Board Block Diagram.*

Connector P1 connects to the PICkit Serial Analyzer or virtually any demo or development board. Connector P1 pin assignments are listed in Table 2-1.

TABLE 2-1: SPI DEMO BOARD CONNECTOR P1 PIN ASSIGNMENTS

Pin	Label	Type	Description
1	$\overline{CS}$	Input	Chip Select (Active Low)
2	+V	Power	Power
3	GND	Ground	Ground
4	MISO	Output	Master In, Slave Out
5	SCK	Input	Serial Clock
6	MOSI	Input	Master Out, Slave In

2.2 DEVICES

2.2.1 25LC020A 2K SPI Bus Serial EEPROM

The 25LC020A is a 2Kbit Serial EEPROM. Refer to the 25AA020A/25LC020A Data Sheet (DS21833) for complete information.

Data can be read or written to the 25LC020A.

2.2.2 TC77-5.0 Thermal Sensor with SPI Interface

The TC77 is a serially accessible digital temperature sensor. Refer to the TC77 Data Sheet (DS20092) for complete information.

The temperature can be read from the TC77.

2.2.3 MCP3201 2.7V 12-Bit A/D Converter with SPI Serial Interface

The MCP3201 is a successive approximation 12-bit Analog-to-Digital Converter with on-board sample and hold circuitry. Refer to the MCP3201 Data Sheet (DS21290) for complete information.

The device provides a single pseudo-differential input. Potentiometer R6 is configured as a voltage divider (see schematic in **Appendix A. "Schematic and Layouts"**). The wiper is connected to IN+. The voltage can be read by the MCP3201 by grounding IN- with a test lead and can be verified using a volt meter on test points IN+ and GND.

2.2.4 MCP4822 12-Bit DAC with Internal Vref and SPI Interface

The MCP4822 is a 12-Bit Digital-to-Analog Converter (DAC). Refer to the MCP4821/MCP4822 Data Sheet (DS21953) for complete information.

The output of the MCP4822 can be measured using a volt meter at test points V_{OUTA}, V_{OUTB}, and GND.

2.2.5 MCP41010 Single/Dual Digital Potentiometer with SPI Interface

The MCP41010 is a single 10 kΩ digital potentiometer. Refer to the MCP41XXX/42XXX Data Sheet (DS11195) for complete information.

The resistance of the digital potentiometer can be measured using an ohm meter at test points P_{A0}, P_{W0}, P_{B0}, and GND.

2.2.6 MCP6S92 Single-Ended, Rail-to-Rail I/O, Low-Gain PGA

The MCP6S92 is a single-ended programmable gain amplifier (PGA). Refer to the MCP6S91/2/3 Data Sheet (DS21908) for complete information.

The gain of the PGA can be measured by applying a signal to inputs CH0 or CH1 and GND, and measuring the output on test points Vout and GND.

2.2.7 MCP23S08 8-Bit I/O Expander with Serial Interface

The MCP23008 is an 8-bit I/O Expander. Refer to the MCP23008/MCP23S08 Data Sheet (DS21919) for complete information.

The output of the MCP23S08 drives LEDs DS1 through DS8. The LEDs provide an easy to see indication of the MCP23S08 operation. Jumper JP8 must be closed using a 2-pin shunt for the LEDs to operate. The LEDs can be disabled by removing JP8.

The output of the MCP23S08 is connected to test points GP0 through GP7 and GND. These test points can be monitored by a volt meter or connected to an external device. LEDs DS1 through DS8 can be used to monitor the output by closing JP8 with a 2-pin shunt or disable by removing JP8.

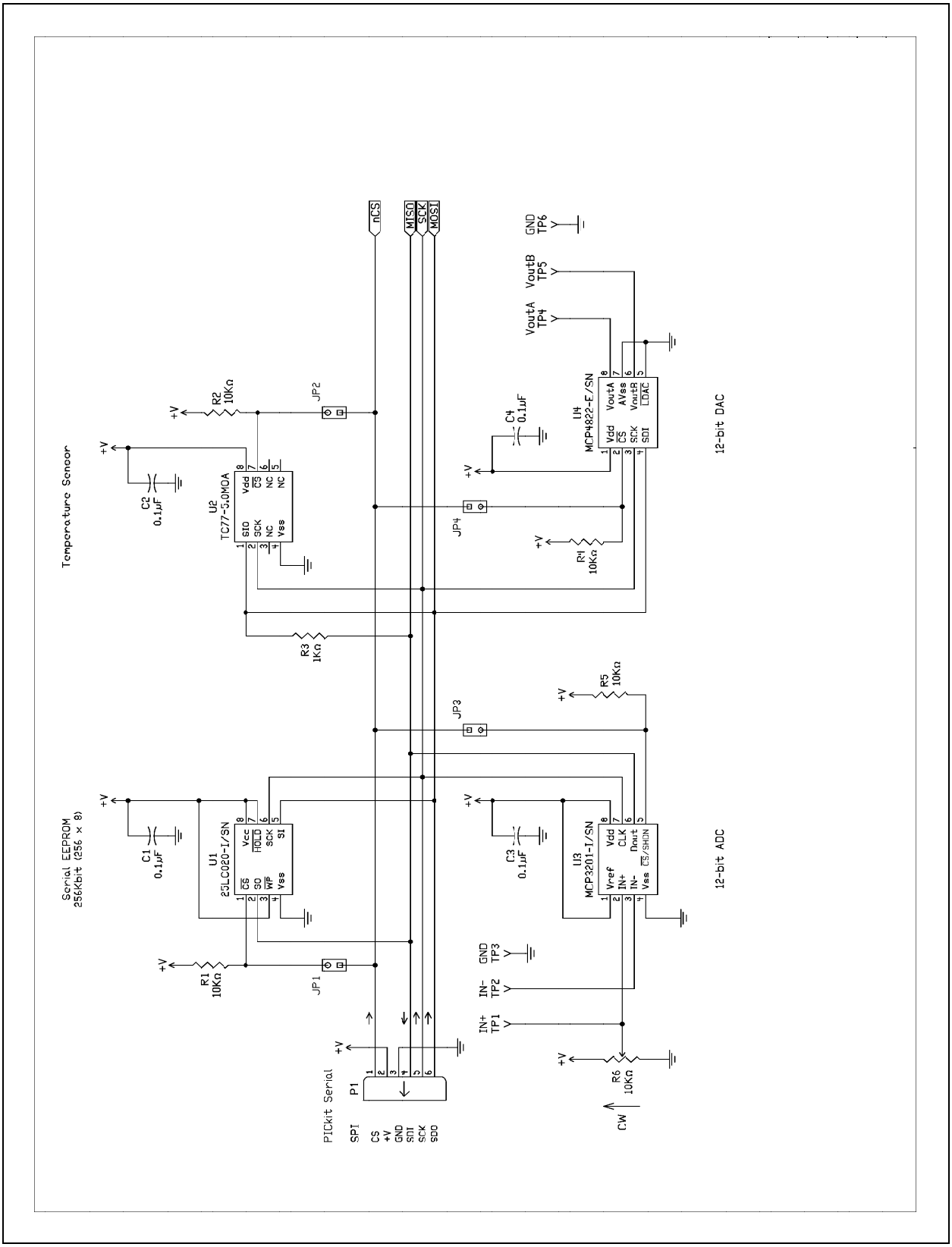
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

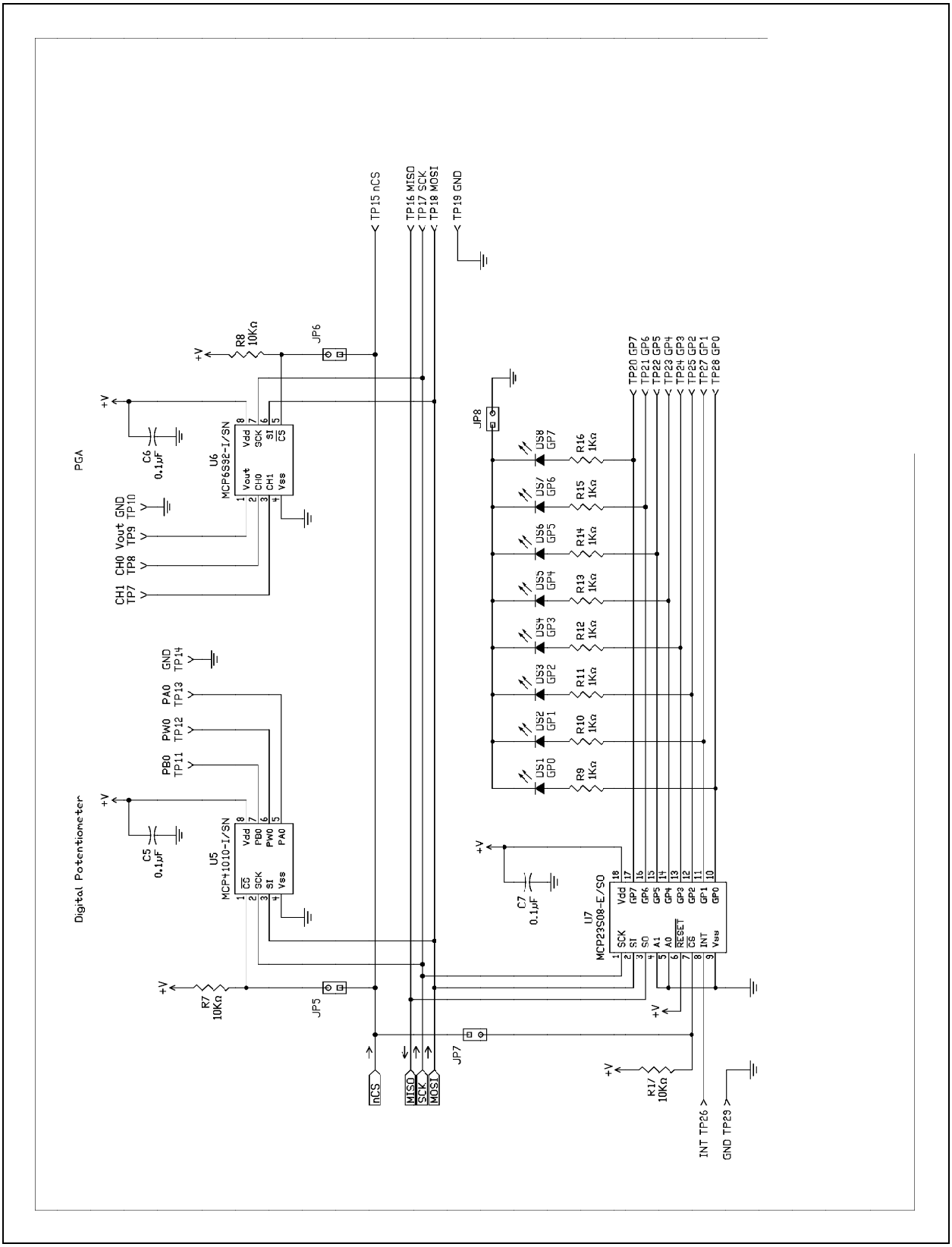
This appendix contains the following schematics and layouts for the PICkit™ Serial SPI Demo Board User's Guide:

- Board – Schematic - Page 1
- Board – Schematic - Page 2
- Board – Top Silk Layer
- Board – Top Metal Layer
- Board – Bottom Metal Layer

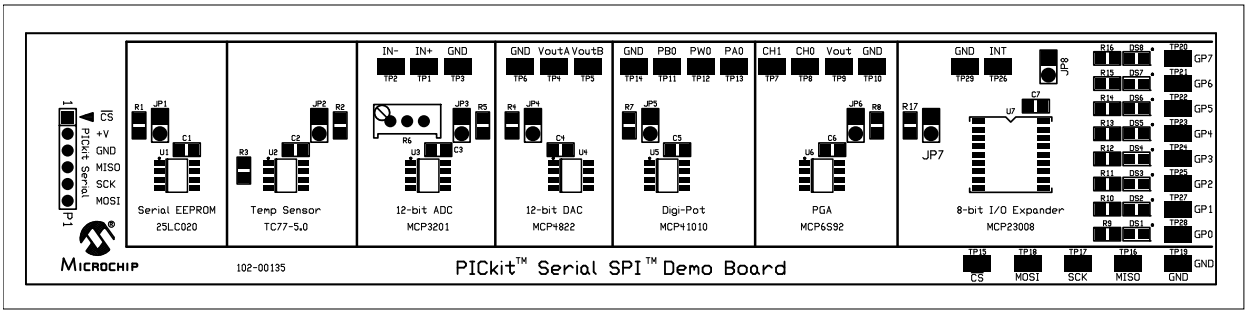
A.2 BOARD - SCHEMATIC - PAGE 1



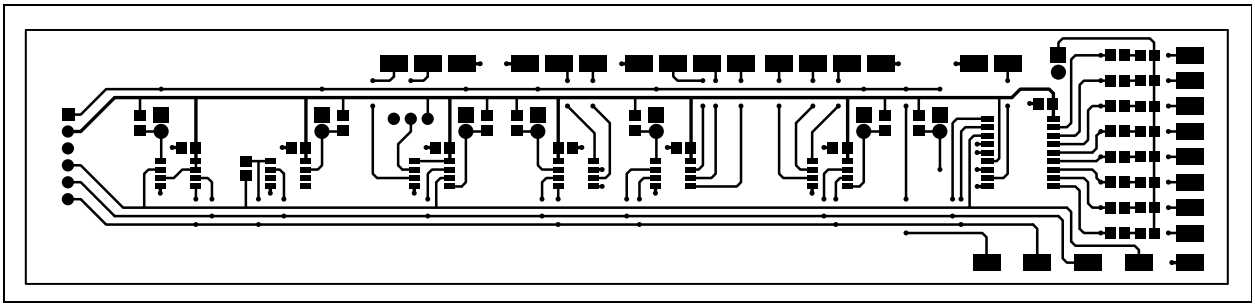
A.3 BOARD - SCHEMATIC - PAGE 2



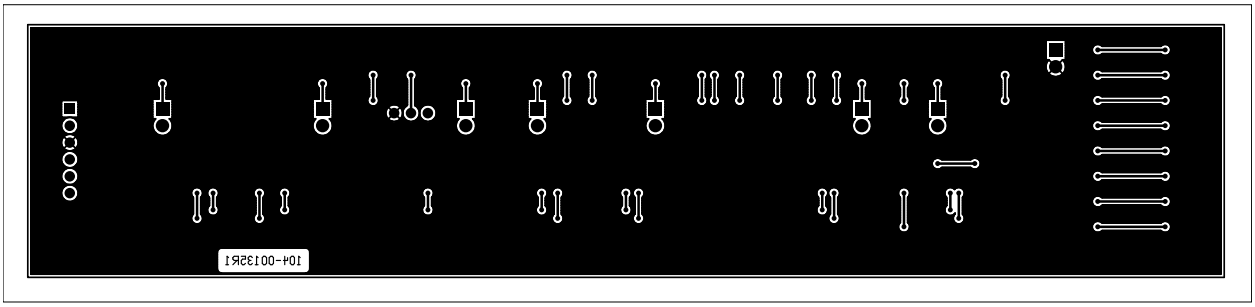
A.4 BOARD - TOP SILK LAYER



A.5 BOARD - TOP LAYER



A.6 BOARD - BOTTOM LAYER



Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
7	C1, C2, C3, C4, C5, C6, C7	Capacitor, Ceramic, SMT 0805	Panasonic® - ECG	ECJ-2VB1E104K
8	DS1, DS2, DS3, DS4, DS5, DS6, DS7, DS8	LED RED ORANGE CLEAR 0805 SMD	LITE-ON INC	LTST-C170EKT
4	EA Corner	BUMPON SQUARE .40X.10 BLACK	3M	SJ-5007 (BLACK)
1	JP1	CONN JUMPER SHORTING GOLD FLASH	Sullins Electronics Corp.	SPC02SYAN
8	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8	CONN HEADER 2POS .100 VERT TIN	Molex/Waldom Electronics Corp	22-28-4020
1	P1	CONN HEADER 6POS .100 R/A GOLD	Molex/Waldom Electronics Corp	22-28-8062
7	R1, R2, R4, R5, R7, R8, R17	RES 10K OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ103V
9	R3, R9, R10, R11, R12, R13, R14, R15, R16	RES 1.0K OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ102V
1	R6	POT 10K OHM 3/8" SQ CERM SL MT	Bourns Inc.	3296W-1-103LF
29	TP1 - TP29	TEST POINT PC COMPACT SMT	Keystone Electronics®	5016
1	U1	2K SPI Bus Serial EEPROM	Microchip Technology	25LC020-I/SN
1	U2	Thermal Sensor with SPI Interface	Microchip Technology	TC77-5.0MOA
1	U3	2.7V 12-Bit A/D Converter with SPI Serial Interface	Microchip Technology	MCP3201-I/SN
1	U4	12 Bit DAC with Internal Vref and SPI Interface	Microchip Technology	MCP4822-E/SN
1	U5	Single/Dual Digital Potentiometer with SPI Interface	Microchip Technology	MCP14010-I/SN
1	U6	Single-Ended, Rail-to-Rail I/O, Low-Gain PGA	Microchip Technology	MCP6S92-I/SN
1	U7	8-Bit I/O Expander with Serial Interface	Microchip Technology	MCP23S08-E/SO

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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