MCP9800 Temperature Sensor Demonstration Board User's Guide

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MCP9800 TEMPERATURE SENSOR 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 website (http:www.microchip.com) to obtain the latest available documentation.

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 is useful to know before using the MCP9800 Temperature Sensor Demo Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Website
- Product Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP9800 Temperature Sensor Demo Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP9800 Temperature Sensor Demo Board.
- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the MCP9800 Temperature Sensor Demo Board and instructions for how to start using it.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP9800 Temperature Sensor Demo Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP9800 Temperature Sensor 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 the MCP9800 Temperature Sensor Demo Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

MCP9800/1/2/3 Data Sheet, *"2-Wire High-Accuracy Temperature Sensor"* (DS20001909)

This data sheet provides detailed information regarding the MCP9800 Temperature Sensor.

THE MICROCHIP WEBSITE

Microchip provides online support via our website at http:www.microchip.com where files and information are easily available to customers. The website contains the following:

- **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
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Users of Microchip products can receive assistance through several channels:

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

Customers can 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 at microchip.com/support.

DOCUMENT REVISION HISTORY

Revision B (June 2023)

The following is a list of modifications:

- Added Recommended Reading.
- Updated Recommended Reading.
- Added Product Change Notification Service.
- Updated **Chapter 1. "Product Overview"**.
- Updated **Chapter 2. "Installation and Operation"**.
- Updated Figure 2-1, Figure 2-2 and Figure 2-3.
- Updated **Appendix A. "Schematic and Layouts"**.
- Updated **Appendix B. "Bill Of Materials (BOM)"**.

Revision A (August 2008)

- Initial Release of this document.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP9800 Temperature Sensor Demo Board and covers the following topics:

- MCP9800 Temperature Sensor Demo Board Overview
- MCP9800 Temperature Sensor Demo Board Features
- What does the MCP9800 Temperature Sensor Demo Board Kit include?

1.2 MCP9800 TEMPERATURE SENSOR DEMO BOARD OVERVIEW

The MCP9800 Temperature Sensor Demo Board demonstrates the features of the MCP9800 Temperature Sensor. Users can connect the MCP9800 Temperature Sensor Demo Board to a PC using a Micro-USB interface and evaluate its performance.

1.3 MCP9800 TEMPERATURE SENSOR DEMO BOARD FEATURES

The MCP9800 Temperature Sensor Demo Board has the following features:

- Standard 6-pin header for programming
- Microchip Thermal Management Graphical User Interface (GUI) that is used to:
  - Display the temperature in degrees Celsius (°C)
  - Configure the temperature measurement resolution (9, 10, 11 or 12-bit)
  - Read an over-temperature condition
  - Set the temperature alert
  - Log the temperature data
  - Program sensor registers

1.4 WHAT DOES THE MCP9800 TEMPERATURE SENSOR DEMO BOARD KIT INCLUDE?

The MCP9800 Temperature Sensor Demo Board Kit includes the following:

- MCP9800 Temperature Sensor Demo Board (EV15S71A)
- Microchip Thermal Management GUI
- MCP9800 Temperature Sensor Demo Board User's Guide (this document)
- MCP9800/1/2/3 Data Sheet – *"2-Wire High-Accuracy Temperature Sensor"* (DS20001909)

NOTES:

Chapter 2. Installation and Operation

2.1 GETTING STARTED

This section describes how to quickly configure the MCP9800 Temperature Sensor Demo Board and PICkit™ 4. Figure 2-1 displays the configuration block diagram.

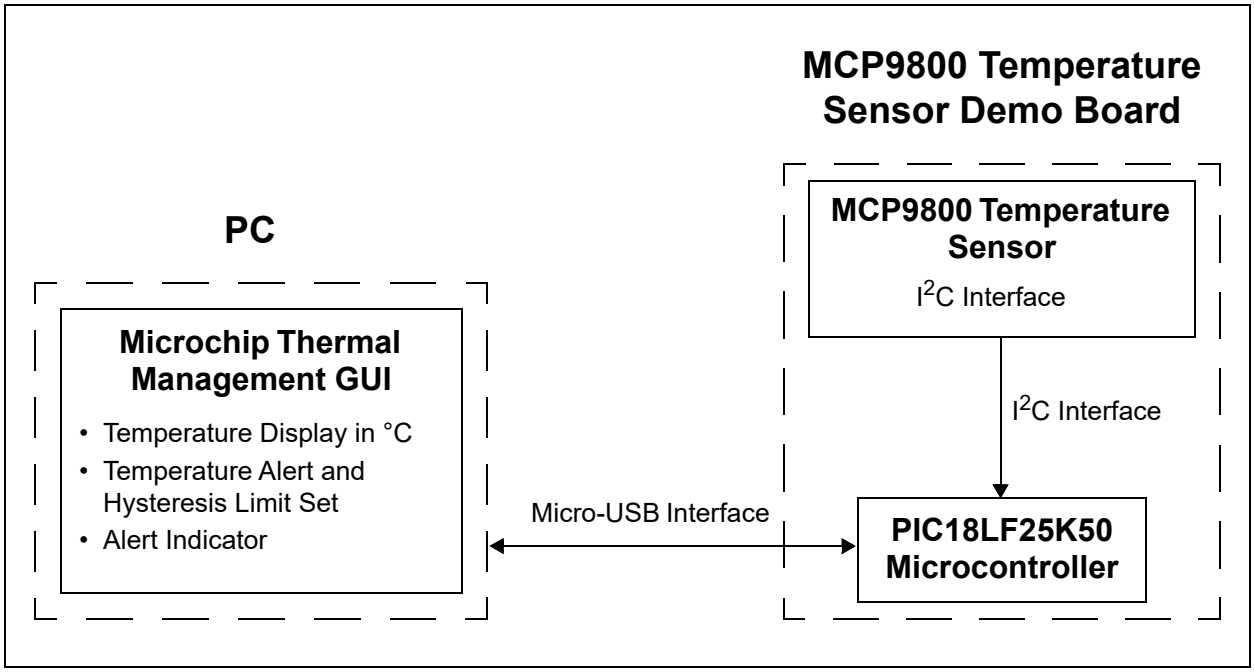


FIGURE 2-1: *MCP9800 Temperature Sensor Demo Board Block Diagram.*

2.1.1 Hardware Setup

1. The MCP9800 Temperature Sensor Demo Board has a Micro-USB connector for interfacing with a computer. Connect the USB cable from the MCP9800 Temperature Sensor Demo Board to a PC.
2. Start the Microchip Thermal Management GUI to display the temperature, to log temperature data or to evaluate the features of the MCP9800 Temperature Sensor.

2.2 FUNCTIONAL DESCRIPTION

2.2.1 The MCP9800 Temperature Sensor Demo Board

The MCP9800 Temperature Sensor Demo Board has two components:

- MCP9800 Temperature Sensor
- PIC18LF25K50 Microcontroller that controls the MCP9800 Temperature Sensor and the PC interface via Micro-USB

The PIC18LF25K50 Microcontroller communicates with the MCP9800 Temperature Sensor and displays the temperature in the GUI. The PIC18LF25K50 supports a full speed USB protocol to interface with a PC and provide additional user interface to access all MCP9800 Temperature Sensor features. For more details, see **Section 1.3 "MCP9800 Temperature Sensor Demo Board Features"**.

2.2.2 The MCP9800 Temperature Sensor Device

The MCP9800 Temperature Sensor comes with user-programmable registers that provide flexibility for temperature sensing applications. The register settings allow users to:

- Set the temperature measurement resolution
- Specify the temperature alert output and hysteresis limits
- Configure the power-saving Shutdown and One-Shot (single conversion on command while in Shutdown) modes

When the temperature changes beyond the specified limits, the MCP9800 Temperature Sensor outputs an alert signal. The user has the option of setting the alert output signal polarity as an active-low or active-high comparator output for thermostat operation or as temperature event interrupt output for microprocessor-based systems.

This device has I^2C/SMBus compatible serial interface (for further details, refer to the **MCP9800/1/2/3 Data Sheet, *"2-Wire High-Accuracy Temperature Sensor"*— DS20001909**).

2.2.3 User-Selectable Features

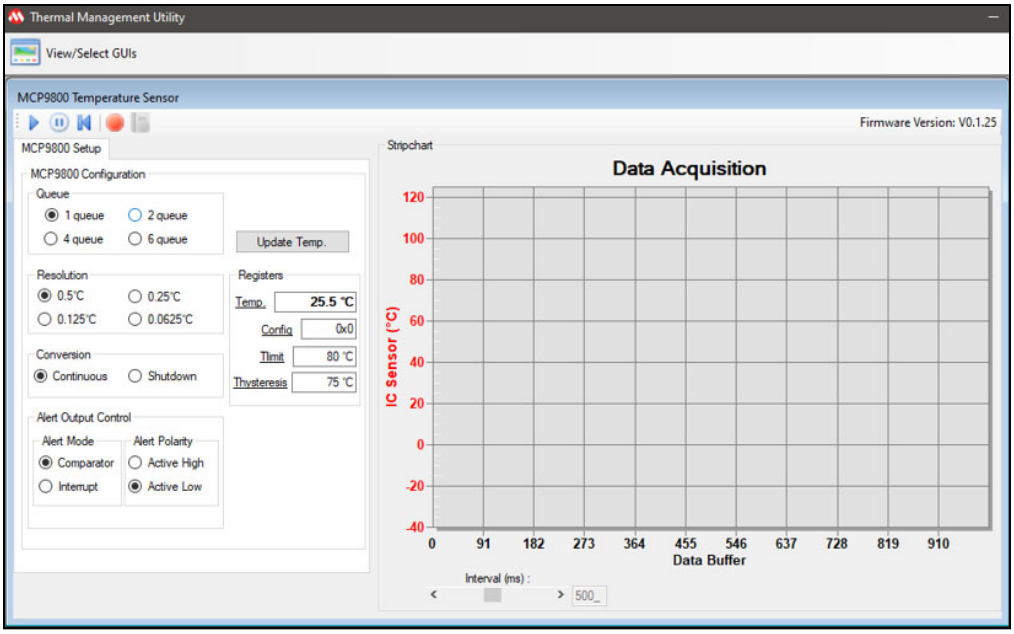
The demo firmware allows users to configure the temperature limit and hysteresis limit registers (T_{SET} and T_{HYST}). When the ambient temperature exceeds the programmed T_{SET} limit, the MCP9800 Temperature Sensor outputs an Alert signal in the GUI.

Users can configure the MCP9800 Temperature Sensor measurement resolution to 9, 10, 11 or 12-bit. The default temperature measurement resolution is 12-bit.

2.2.4 Microchip Thermal Management GUI

The Microchip Thermal Management GUI is a software tool that allows users to evaluate the MCP9800 Temperature Sensor features. Once the hardware is connected, the software recognizes the device ID and displays the corresponding GUI for the MCP9800 Temperature Sensor Demo Board, as shown in Figure 2-2.

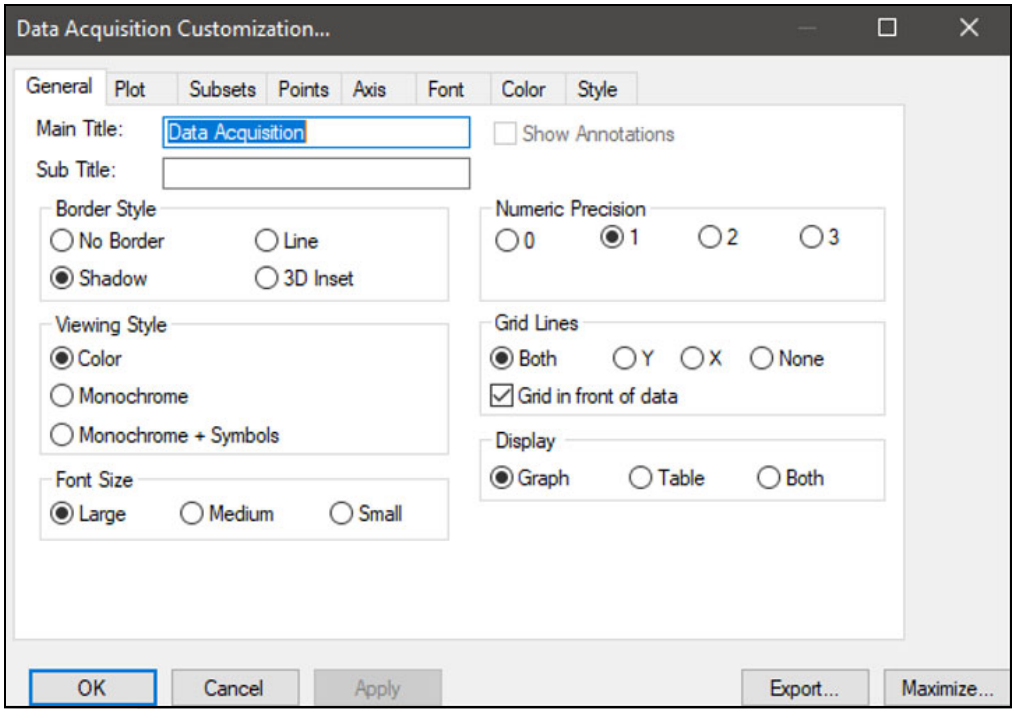
FIGURE 2-2: MICROCHIP THERMAL MANAGEMENT GUI



The tool enables users to log temperature data. The **Play**, **Stop** and **Reset** buttons are used to continuously log data, while the **Record** button enables users to log data to an external file. The logging interval can be adjusted between 100 ms to 1000 ms using the Interval scroll bar.

The real-time Data Acquisition charting tool can be customized by double-clicking the chart, as shown in Figure 2-3. More options are available by right-clicking the chart. Users can also zoom into a specific plot range by clicking and dragging the section.

FIGURE 2-3: DATA ACQUISITION CHART SETUP OPTIONS



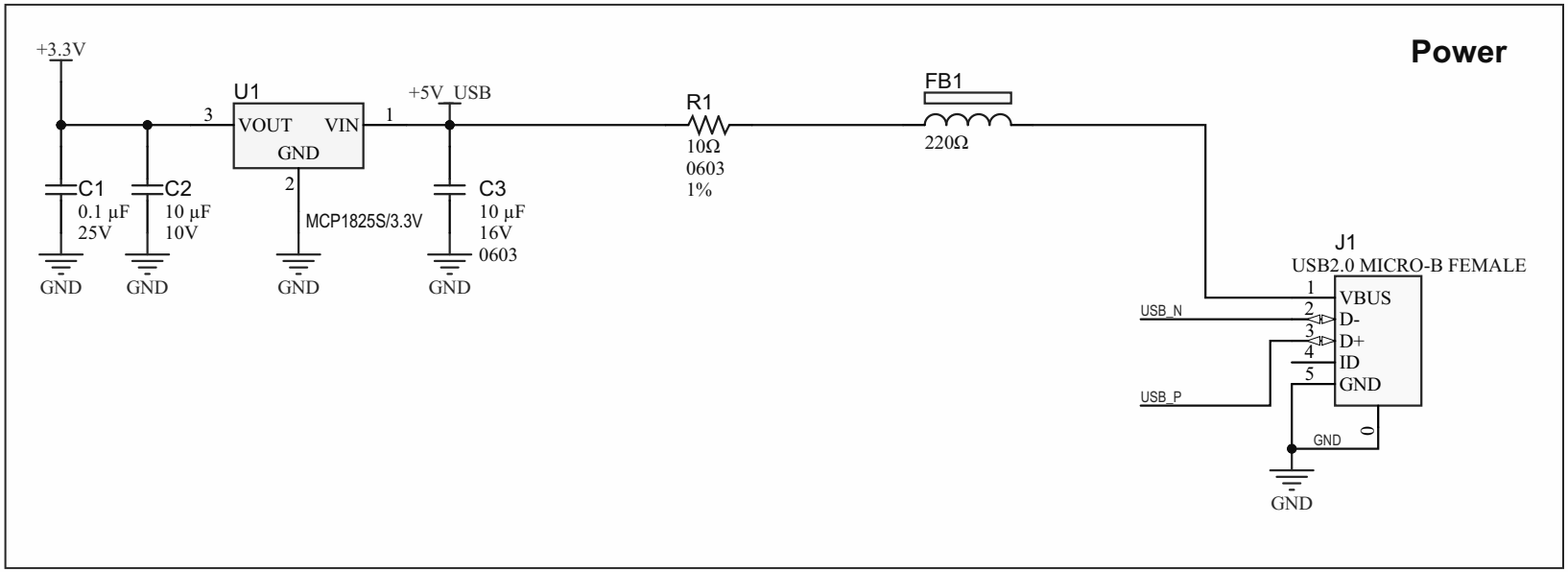
Appendix A. Schematic and Layouts

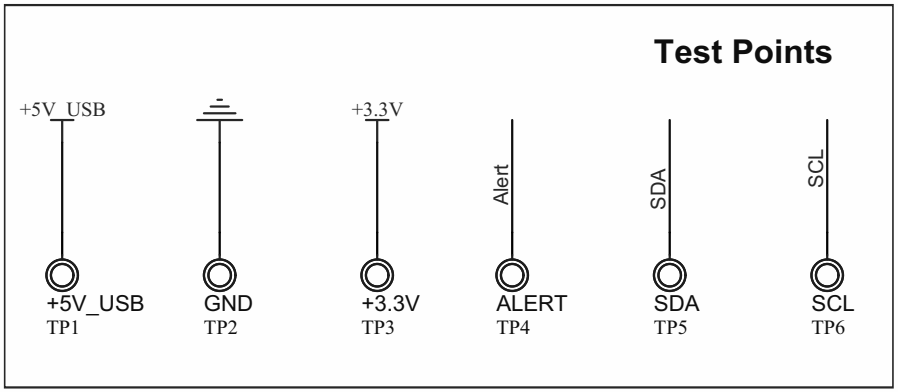
A.1 INTRODUCTION

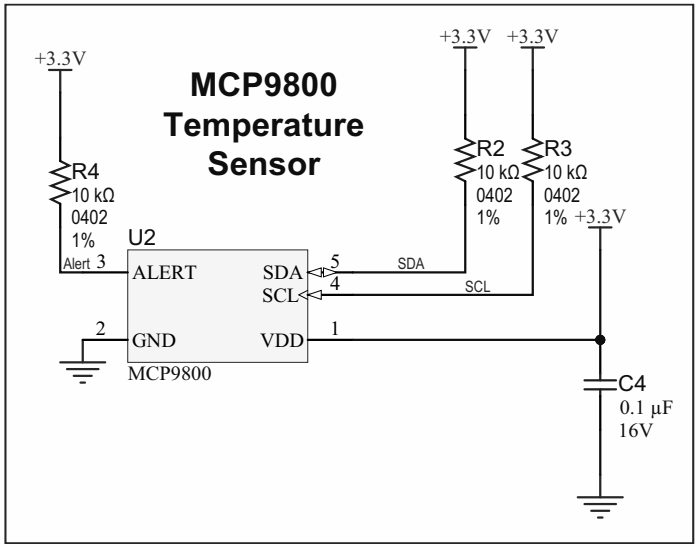
This appendix contains the following schematics and layouts for the MCP9800 Temperature Sensor Demo Board:

- Board Schematic — Power, Test Points, MCP9800 Temperature Sensor
- Board Schematic — Connectivity
- Board — Top Silk Layer
- Board — Top Copper and Silk Layer
- Board — Top Copper Layer
- Board — Bottom Copper Layer
- Board — Bottom Copper and Silk Layer
- Board — Bottom Silk Layer

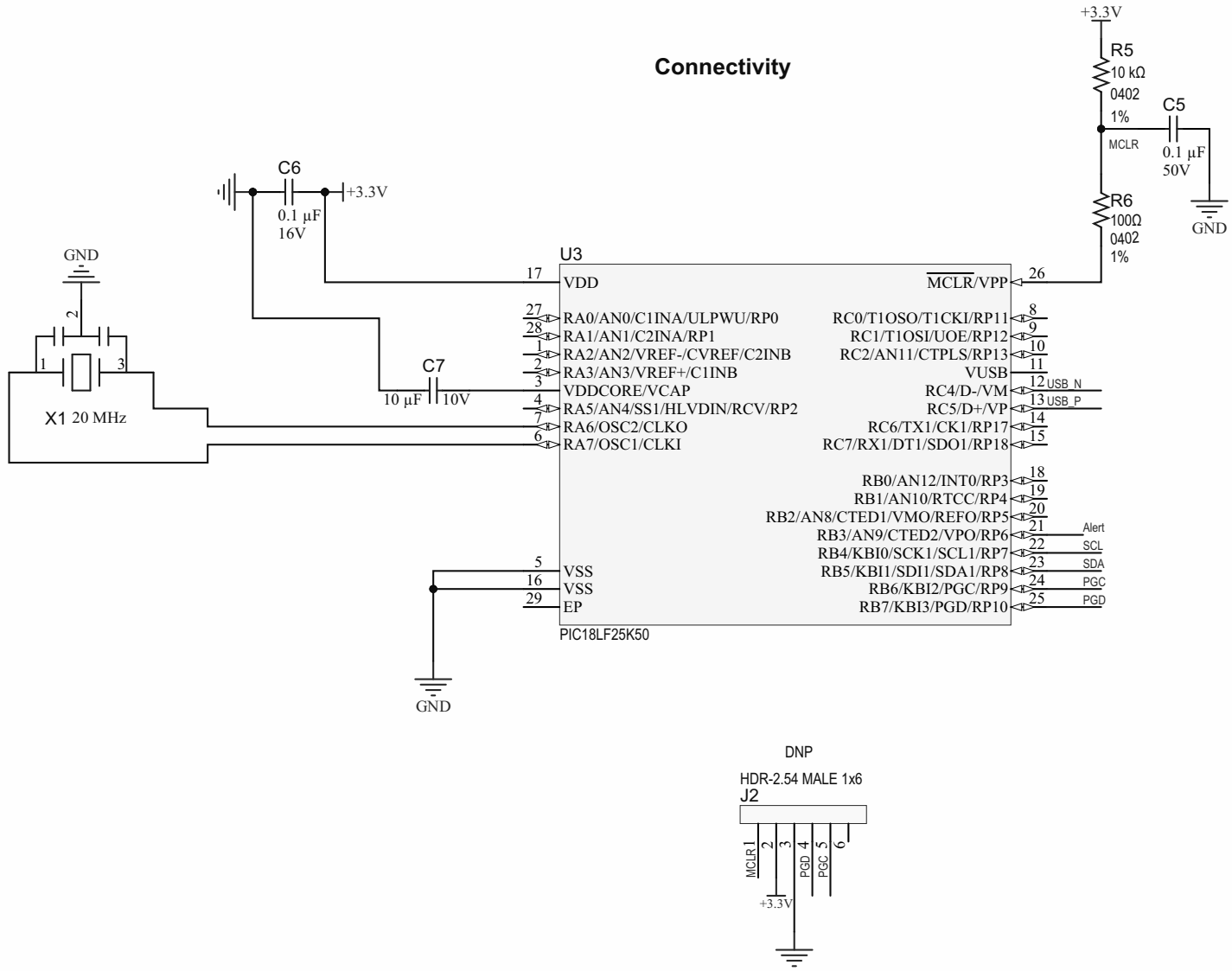
A.2 BOARD SCHEMATIC — POWER, TEST POINTS, MCP9800 TEMPERATURE SENSOR



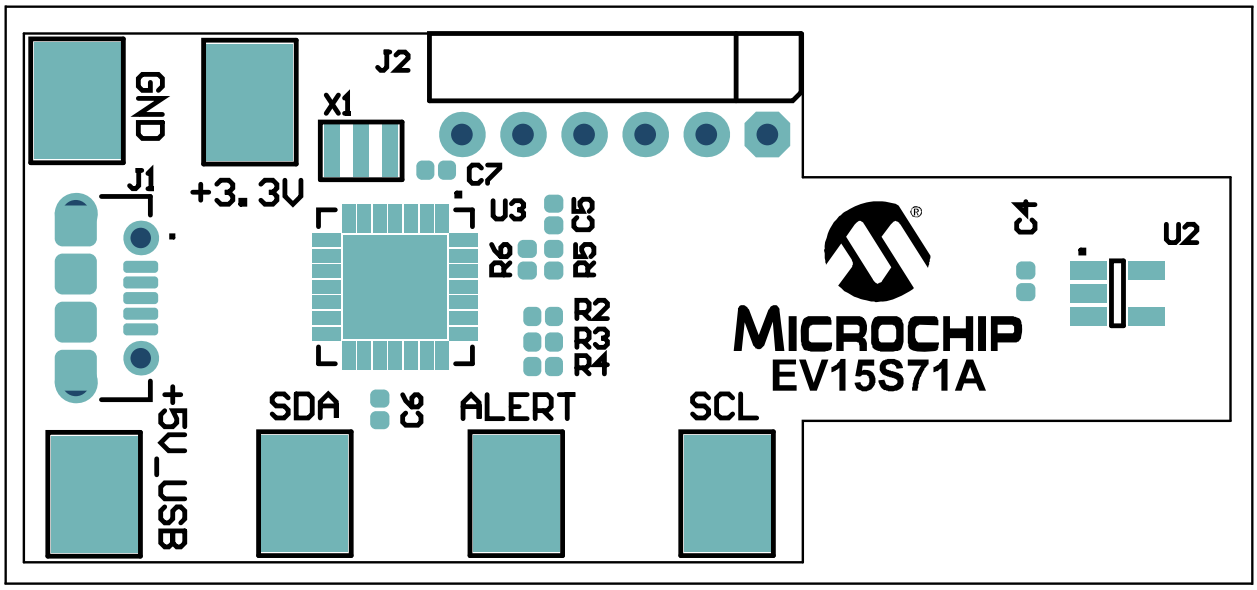




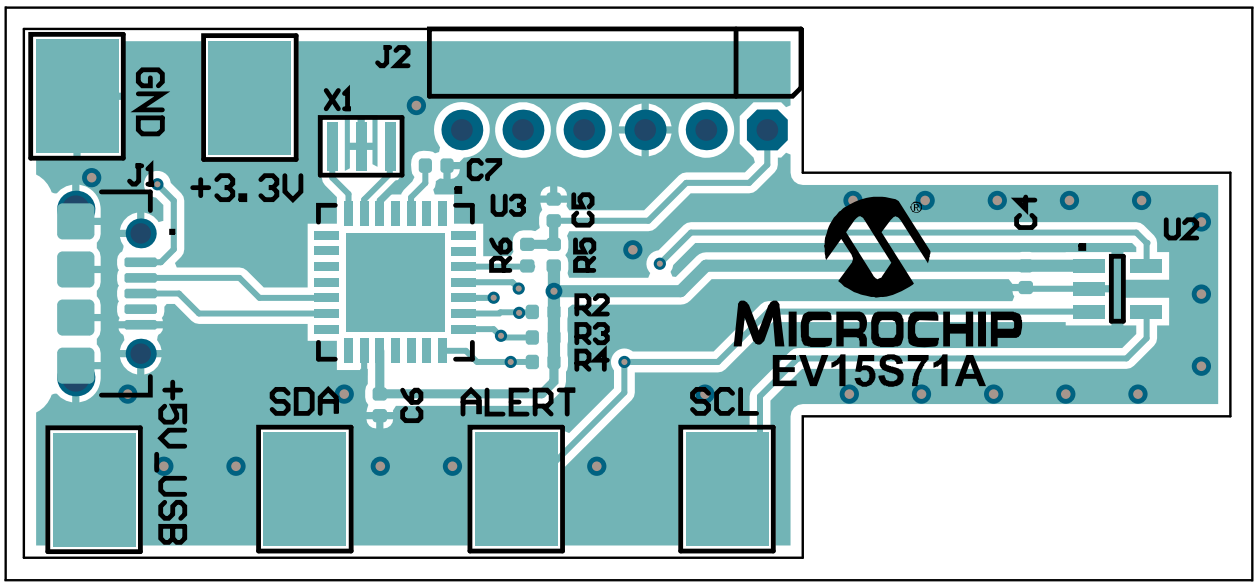
A.3 BOARD SCHEMATIC — CONNECTIVITY



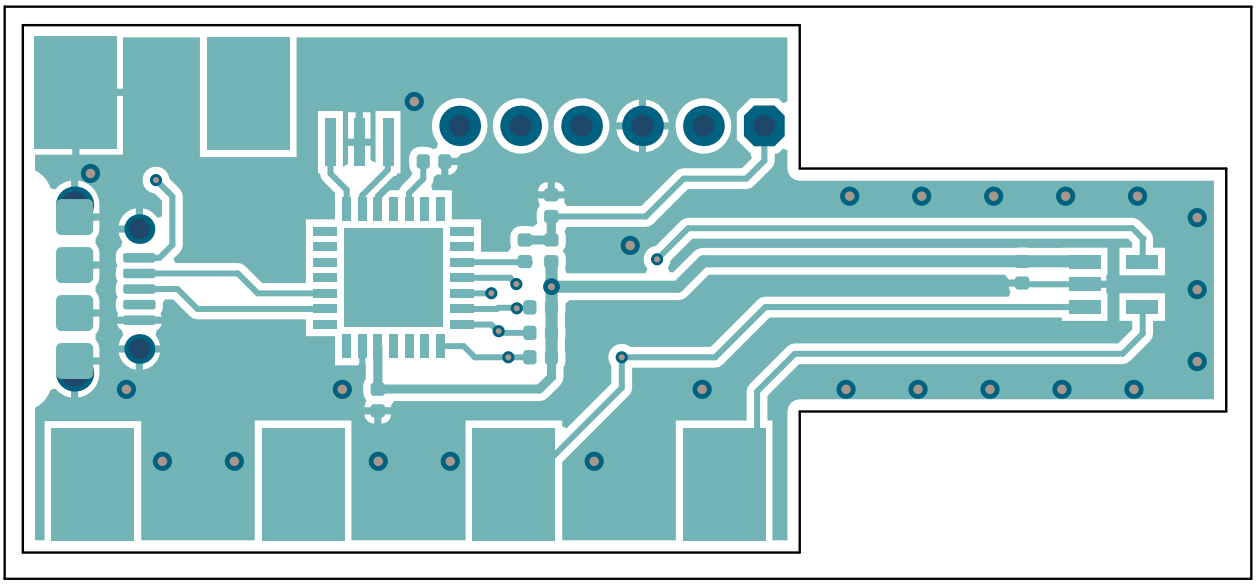
A.4 BOARD — TOP SILK LAYER



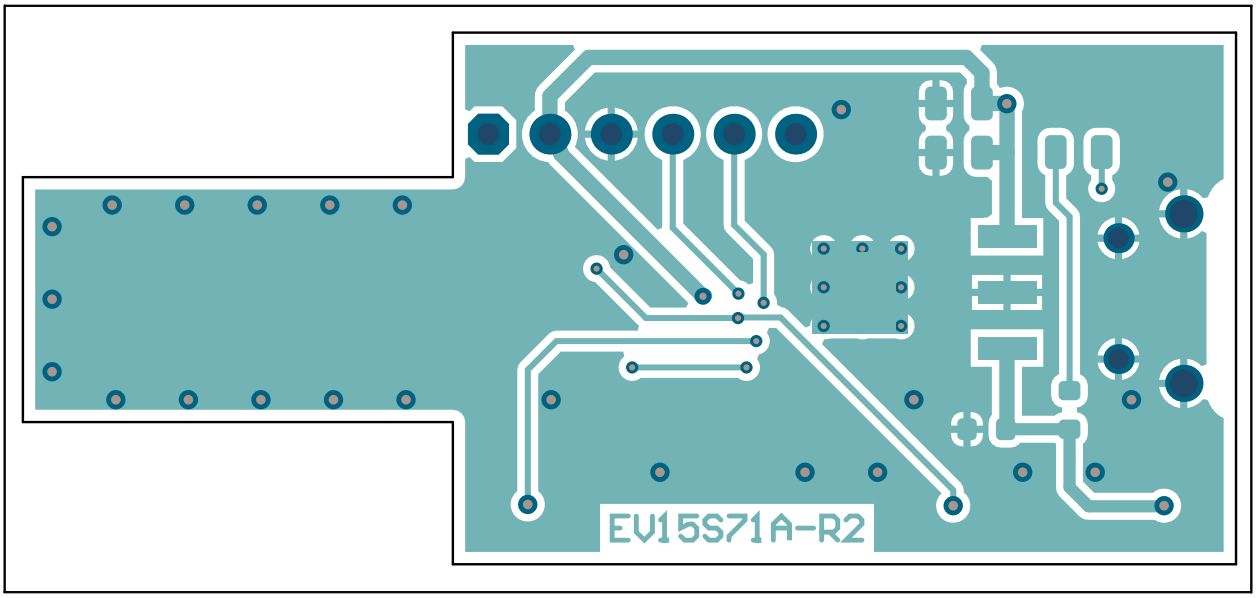
A.5 BOARD — TOP COPPER AND SILK LAYER



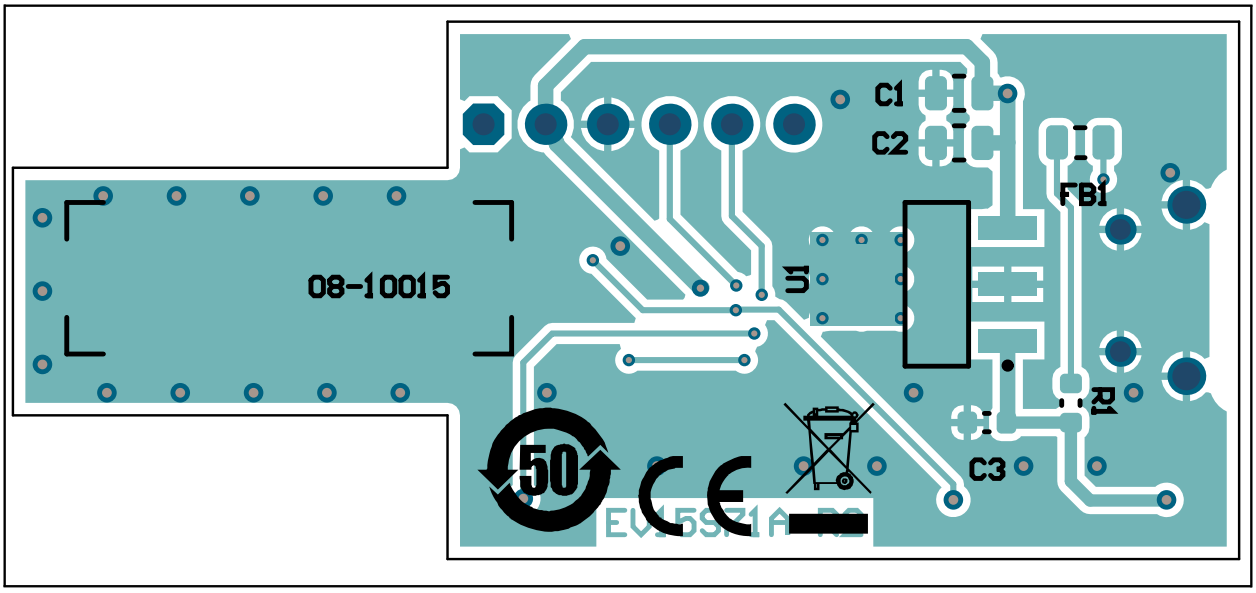
A.6 BOARD — TOP COPPER LAYER



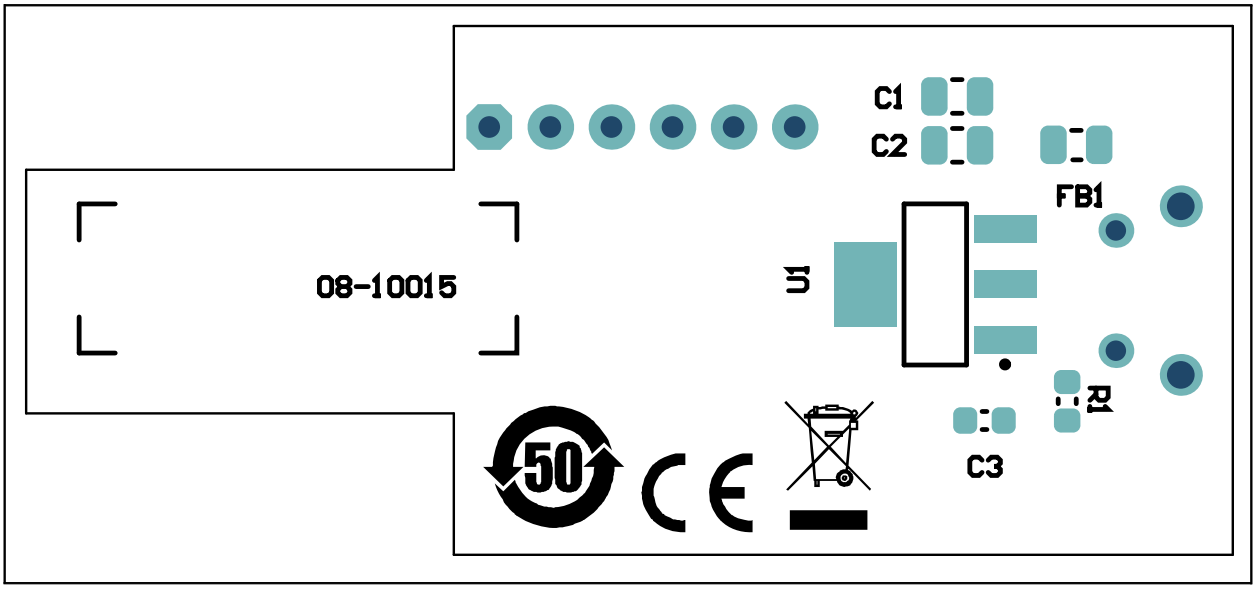
A.7 BOARD — BOTTOM COPPER LAYER



A.8 BOARD — BOTTOM COPPER AND SILK LAYER



A.9 BOARD — BOTTOM SILK LAYER



Appendix B. Bill Of Materials (BOM)

TABLE B-1: MCP9800 TEMPERATURE SENSOR DEMO BOARD — BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
6	+3.3V, +5V_USB, ALERT, GND, SCL, SDA	Connector, Test Point, Top and Bottom Silver, 3.81x2.84 mm, Surface Mount	Keystone® Electronics Corp.	5016
1	C1	Ceramic Capacitor, 0.1 µF, 25V, ±10%, X5R, Surface Mount, 0603	Kyocera AVX	06033D104KAT2A
2	C2, C3	Ceramic Capacitor, 10 µF, 16V, ±20%, X5R, Surface Mount, 0603	Taiyo Yuden Co., Ltd.	EMK107BBJ106MA-T
3	C4, C5, C6	Ceramic Capacitor, 0.1 µF, 16V, -20% +80%, Y5V, Surface Mount, 0402	Yageo Corporation	CC0402ZRY5V7BB104
1	C7	Ceramic Capacitor, 10 µF, 10V, ±20%, X5R, Surface Mount, 0402	Kyocera AVX	0402ZD106MAT2A
1	CBL1	Mechanical USB Cable, USB 2.0, A Male to Micro-B Male, 0.91m	Qualtek Electronics Corp.	3025030-03
1	FB1	Ferrite Bead, 2A, 220Ω, Surface Mount, 0805	Murata Manufacturing Co., Ltd.	BLM21PG221SN1D
1	J1	Connector, USB 2.0, Micro-B, Female, Through Hole/Surface Mount, Right Angle	Amphenol ICC (FCI)	10118194-0001LF
1	J2	**DO NOT POPULATE**	3M™	961106-5604-AR
1	LABEL1	Label, PCBA, 18x6 mm, Datamatrix Assy#/Rev/Serial/Date	ACT Logimark AS	505462
1	PCB1	MCP9800 Temperature Sensor Demo Board – Printed Circuit Board	Microchip Technology Inc.	**11633-R2**
1	R1	Resistor, Thick Film, 10Ω, ±1%, 1/10W, Surface Mount, 0603, AEC-Q200	Vishay/Dale	CRCW060310R0FKEA
4	R2, R3, R4, R5	Resistor, Thick Film, 10 kΩ, ±1%, 1/10W, Surface Mount, 0402	Panasonic® - ECG	ERJ-2RKF1002X
1	R6	Resistor, Thick Film, 100Ω, ±1%, 1/10W, Surface Mount, 0402	Panasonic - ECG	ERJ-2RKF1000X
1	U1	Microchip Analog LDO Regulator, 3.3V, SOT-223-3	Microchip Technology Inc.	**MCP1825S-3302E/DB**
1	U2	Microchip Analog Temperature Sensor, -55 °C to +125 °C, SOT-23-5	Microchip Technology Inc.	**MCP9800A2T-M/OT**
1	U3	Microchip Microcontroller, 8-bit, 48 MHz, 32 kB Program Memory, 2 kB RAM, QFN-28	Microchip Technology Inc.	**PIC18LF25K50-I/ML**
1	X1	Ceramic Resonator, 20 MHZ, 15 µF, ±0,1%, Surface Mount, CSTCE-V13L	Murata Electronics®	CSTNE20M0VH3L000R0

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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