EMC1833 Evaluation Board User's Guide

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ISBN: 978-1-5224-2696-7

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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 "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 EMC1833 Evaluation Board User's Guide. 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 EMC1833 Evaluation Board User's Guide 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 EMC1833 Evaluation Board User's Guide.
- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the evaluation board and instructions on how to use the board.
- **Chapter 3. "Software GUI Description"** – Includes instructions to evaluate the EMC1833 for temperature sensing applications.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the EMC1833 Evaluation Board User's Guide.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the EMC1833 Evaluation Board User's Guide.

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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	*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) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the EMC1833 Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

EMC1812/13/14/15/33 Data Sheet – ***"EMC1812/13/14/15/33 DS Multi-Channel Low-Voltage Remote Diode Sensor Family Data Sheet"*** (**DS20005751**).

PIC18(L)F2X/45K50 Data Sheet – "***28/40/44-Pin, Low-Power, High-Performance Microcontrollers with XLP Technology"*** **(DS30000684).**

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- **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

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- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or 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 website at:
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DOCUMENT REVISION HISTORY

Revision A (February 2018)

- Initial release of this document.

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NOTES:

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the EMC1833 Evaluation Board:

- What is the EMC1833 Device?
- What is the EMC1833 Evaluation Board?
- What the EMC1833 Evaluation Board Kit Contains

1.2 EMC1833 DEVICE OVERVIEW

The EMC1833 Evaluation Board is used to evaluate the EMC18XX family of remote diode temperature monitors. Users can now easily evaluate many of the integrated features of the EMC18XX device family. The device also has a on-board connector configured for an anti-parallel diode to allow for off-board temperature measurements. In addition, the evaluation board connects to PC through a USB interface. Temperature can be data-logged using the Microchip Thermal Management Software Graphical User Interface (GUI).

1.3 EMC1833 EVALUATION BOARD OVERVIEW

The board enables users to easily evaluate many custom programmable features such as Rate of Change, Temperature Alert Limit settings, Temperature Conversion Rate, Resistance Error Correction (REC) and Power Modes.

Figure 1-1 shows the top view of the EMC1833 Evaluation Board.

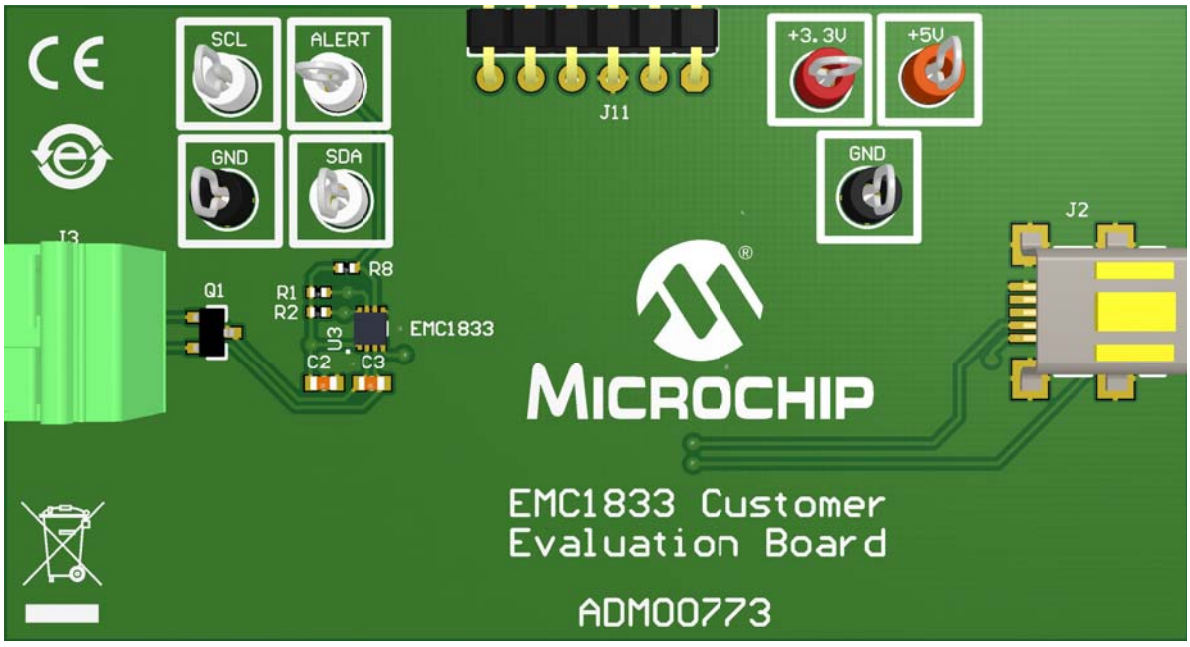

FIGURE 1-1: *EMC1833 Evaluation Board (ADM00773) - Top View.*

Figure 1-2 shows the bottom view of the EMC1833 Evaluation Board.

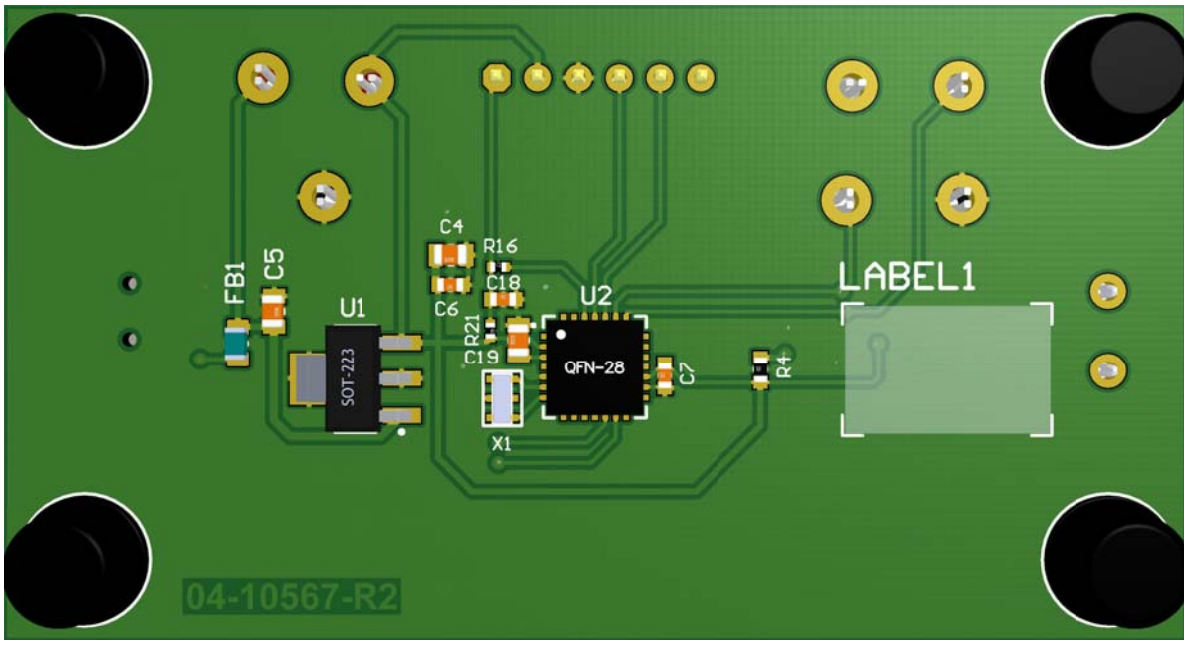

FIGURE 1-2: *EMC1833 Evaluation Board (ADM00773) - Bottom View.*

1.4 EVALUATION BOARD KIT CONTENTS

The EMC1833 Evaluation Board Kit includes:

- EMC1833 Evaluation Board (ADM00773)
- USB cable
- 2N3904FS-ND transistor (TO-92 package)
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 GETTING STARTED

This section describes how to power-up and interface with the EMC1833 Evaluation Board. Items discussed in this chapter include:

- System and configuration requirements
- The hardware setup required prior to using the evaluation board
- Performing software setup
- Operating the device's software interface, the Thermal Management Utility - [EMC1833] GUI.

2.2 SYSTEM AND CONFIGURATION REQUIREMENTS

The EMC1833 Evaluation Board is designed to be used in a Microsoft® Windows® XP® (SP3 or later) environment, based on the Microsoft.NETTM Framework 2. Users can utilize the Microsoft .NET Framework 2 web installer package to download and install the .NET Framework components. For USB connectivity, the minimal physical requirement for the PC is a standard USB 2.0 port. In case the board connects to the PC through a USB hub, use a self-powered hub.

2.3 BOARD SETUP

Before the EMC1833 Evaluation Board can be used, a few steps must be performed to install the PC software and configure the board's hardware.

1. Download the support material (PC application) that can be found on the ADM00773 board page, at www.microchip.com. Unzip the archive and install the `.exe` file.
2. Connect the collector and base of the transistor to the DP input and the emitter to the DN input. The orientation of the transistor is shown below. Note the transistor is flat side down, as you can observe in Figure 2-1.

FIGURE 2-1: *Board Connections.*

2.3.1 Hardware Setup and Description

Follow these steps to set up the hardware:

1. The board has a mini-USB connector for a PC interface. Connect the USB cable from the evaluation board to a PC.
2. Start the Thermal Management Software GUI for temperature data logging or to evaluate the sensor board features.

This evaluation board is fully powered from PC USB source, 5V. Once power is applied via USB, and the USB is successfully enumerated then the PIC® microcontroller is ready to receive commands from the host PC to program the EMC1833 settings or transfer temperature data.

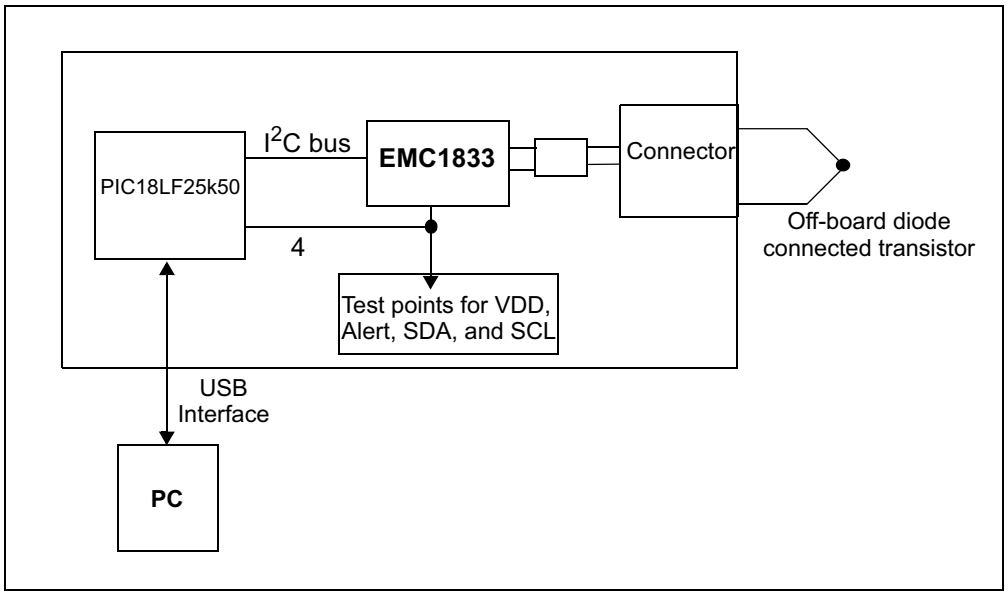

FIGURE 2-2: *EMC1833 Evaluation Board Circuit Block Diagram.*

The block diagram in Figure 2-2 shows that the EMC1833 device is able to monitor and report the ambient temperature of two external diode-connected transistors. One diode is installed on the PCB. A two-pin connector allows the user to connect an additional transistor for evaluation of off-board temperature applications. The Alert outputs, SDA, SCK, and VDD are connected to test points for external connections; in addition, these outputs are also connected to the microcontroller I/O pins so that the Alert Output statuses can be detected in software.

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2.4 SOFTWARE SETUP

Follow the installation procedure illustrated below:

1. Open the `Thermal Management Utility v1.5.5.exe` then click **Next** in the Application Install window.

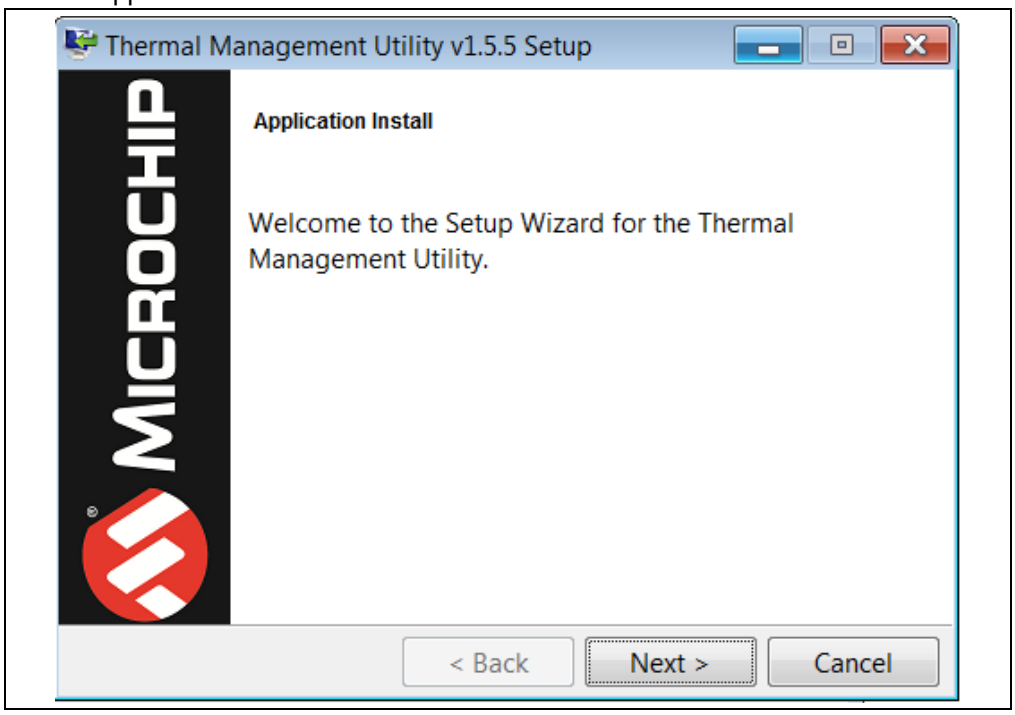

FIGURE 2-3: *Application Install Dialog Box.*

2. **Read** and **Accept** the License Agreement and click **Next**.

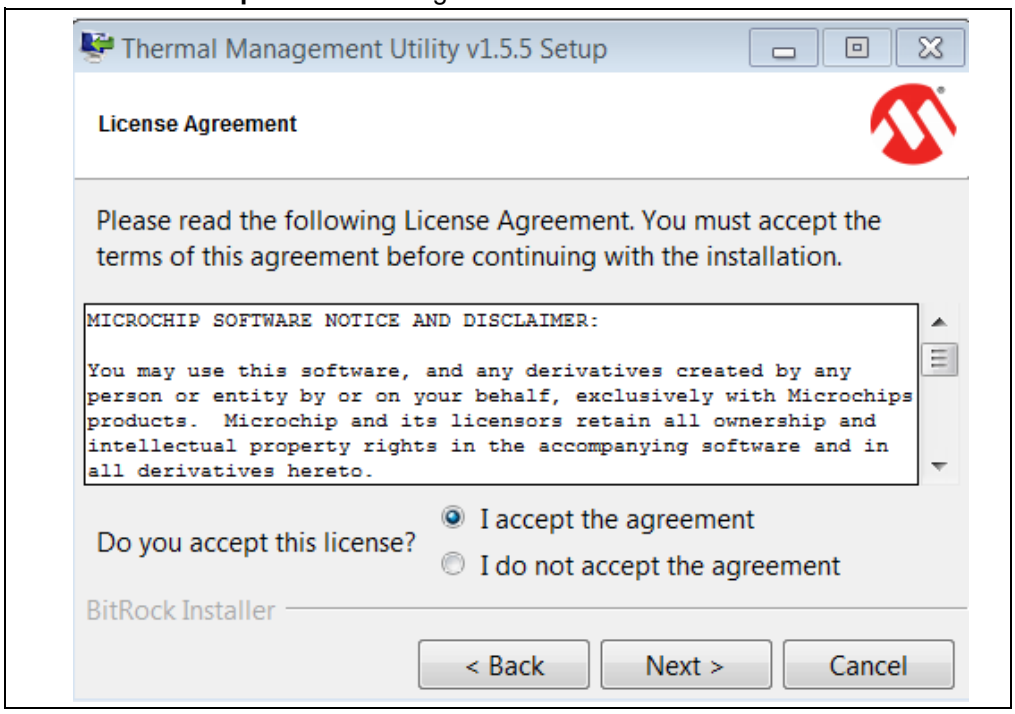

FIGURE 2-4: *License Agreement Dialog Box.*

3. Select an installation directory and click **Next**.

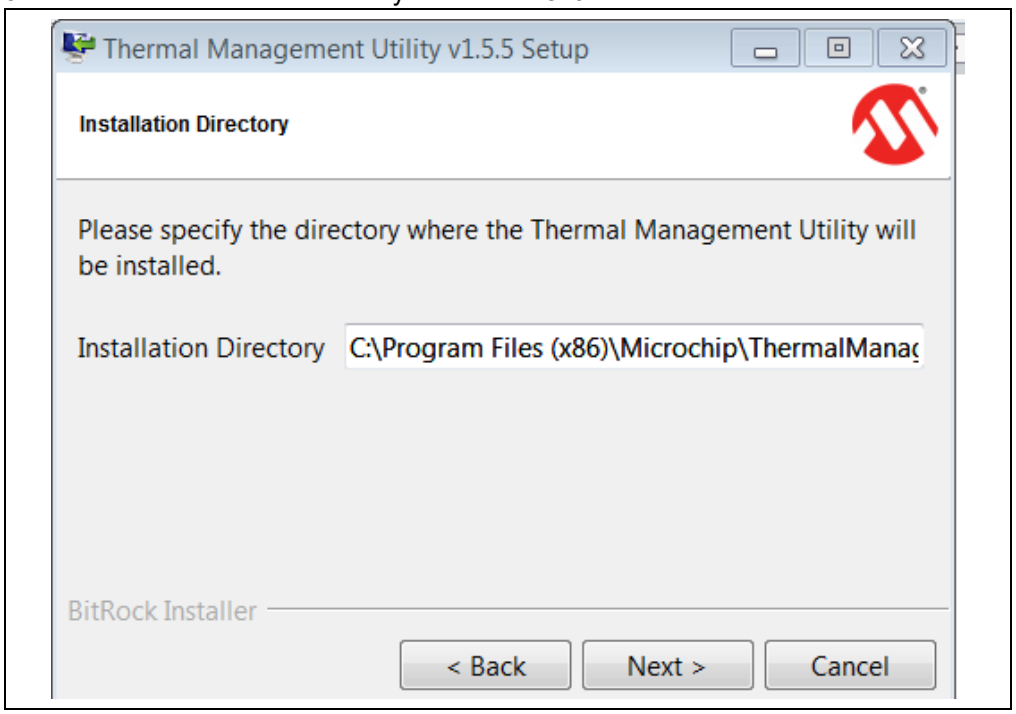

FIGURE 2-5: *Installation Directory Dialog Box.*

4. Select **Next** to continue with the installation process.

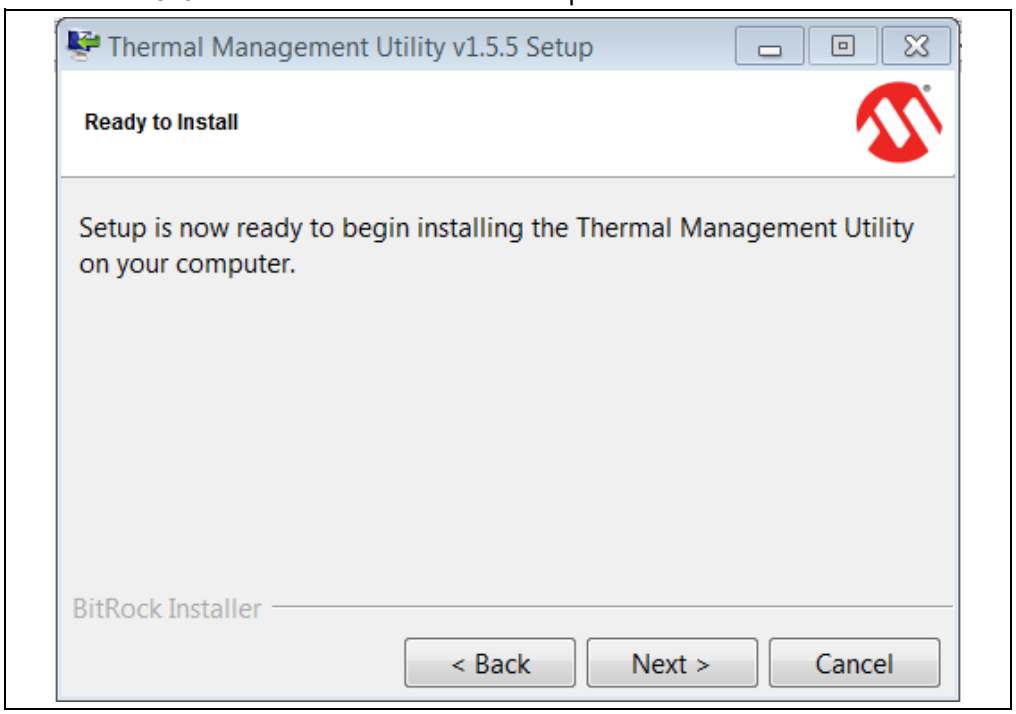

FIGURE 2-6: *Ready to Install Dialog Box.*

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5. In the **Install Complete** dialog box click **Finish** to finalize installation.

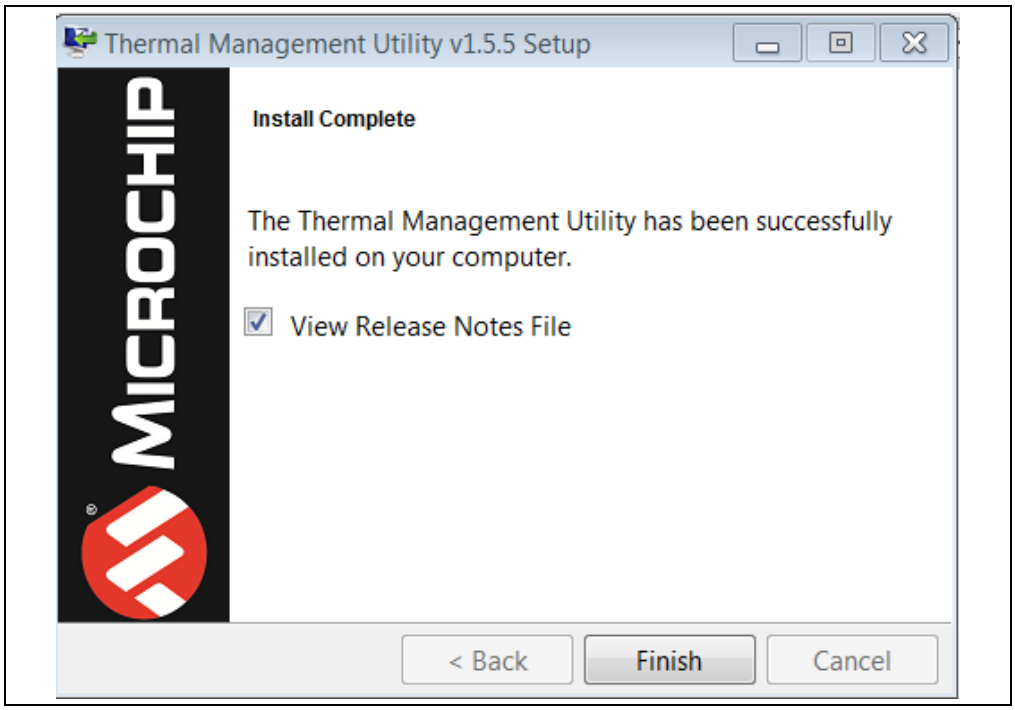

FIGURE 2-7: *Install Complete Dialog Box.*

NOTES:

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Chapter 3. Software GUI Description

3.1 THERMAL MANAGEMENT UTILITY SOFTWARE GUI OVERVIEW

The Microchip Thermal Management Software GUI allows users to evaluate the EMC1833 for temperature sensing applications. Once the hardware is connected, the software recognizes the device ID and displays the corresponding GUI for the evaluation board. Disconnecting the USB will close the GUI. This tool enables users to evaluate the sensor features and perform temperature data-log. Figure 3-1 depicts the Thermal Management Utility GUI.

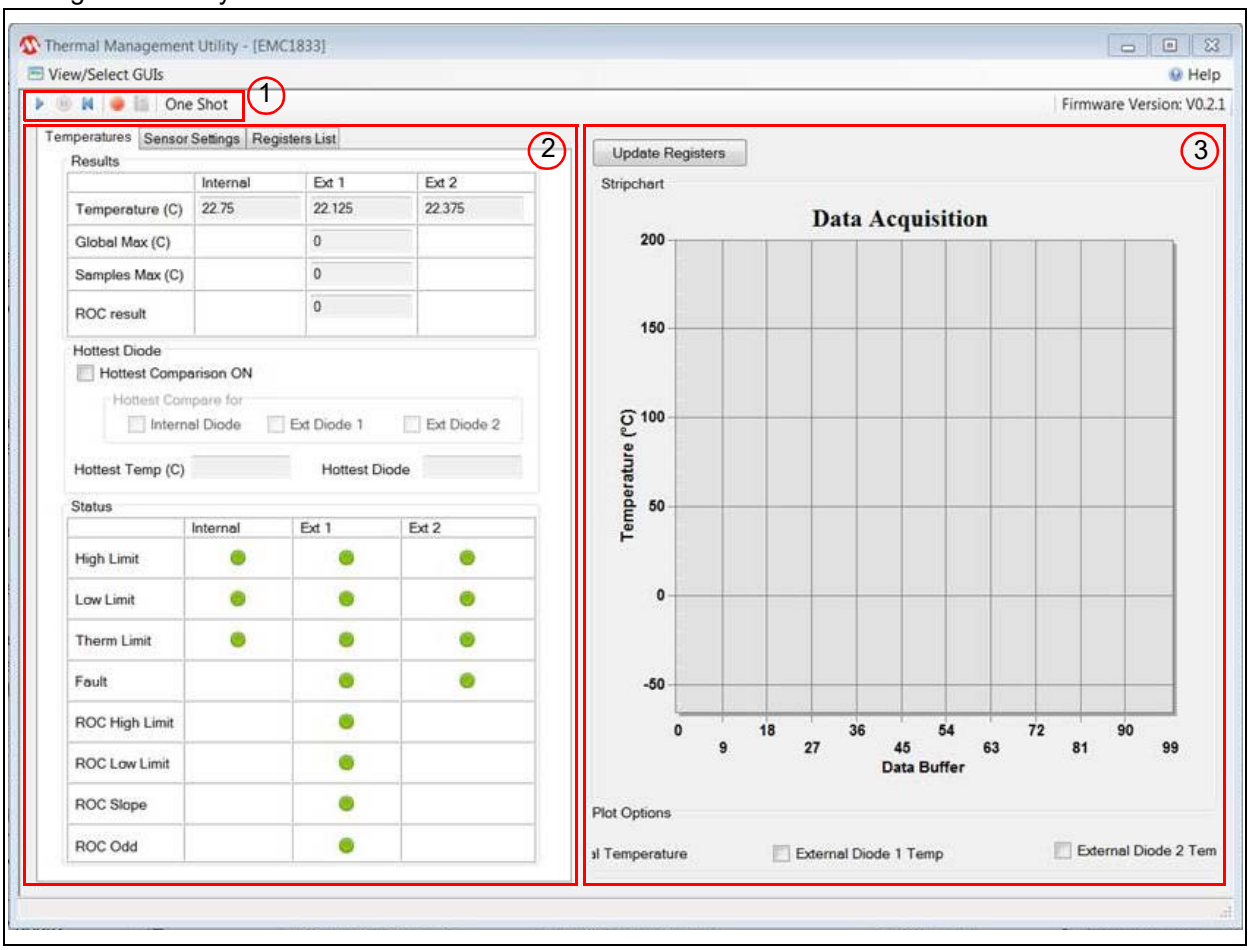

FIGURE 3-1: *Thermal Management Utility GUI.*

As displayed in Figure 3-1, the GUI can be divided into three sections:

1. One Shot action buttons
2. Temperatures, Sensor Settings and Registers List tabs
3. Data Acquisition Charting area

3.2 REAL-TIME ACQUISITION ACTION BUTTONS

The **Play**, **Stop**, and **Reset** icons (Figure 3-2) can be used to perform continuous data acquisitions.

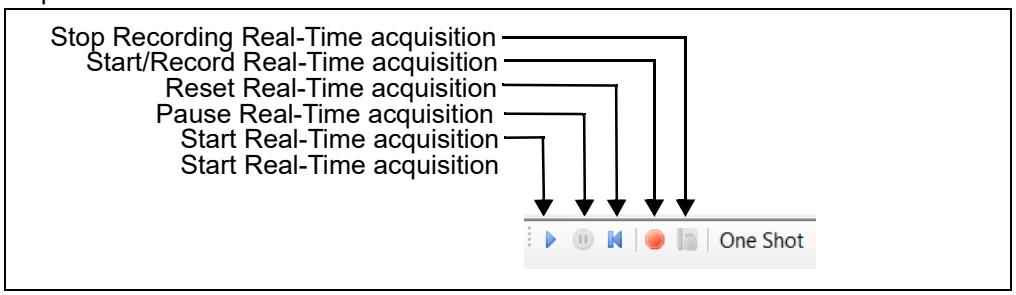

FIGURE 3-2: *Real-Time Acquisition Icons.*

To initiate data logging, click the **Record Acquisitions** button. The system displays the Save As window (see Figure 3-3), where users need to select a file name and a location, then click the **Save** button.

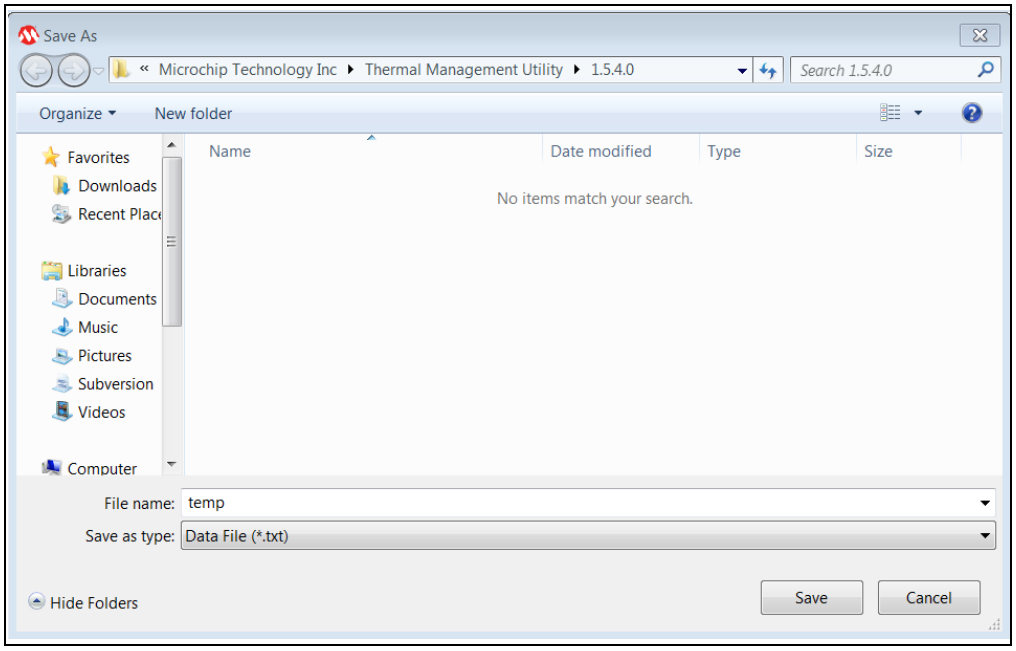

FIGURE 3-3: *Save As Window for Recording Acquisitions.*

To stop the data logging click the **Stop Recording** button. Users can now go to the file location to view the file.

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3.3 TEMPERATURES, SENSOR SETTINGS AND REGISTERS LIST TABS

3.3.1 Temperatures Tab

The **Temperatures** tab displayed in Figure 3-4 shows the results of the Internal Diode 1 and Diode 2 sensors. This tab also displays the result of the various user programmable features of the EMC1833, such as the temperature ALERT and THERM status, Diode Fault status, the Rate of Change (ROC), and hottest diode comparison.

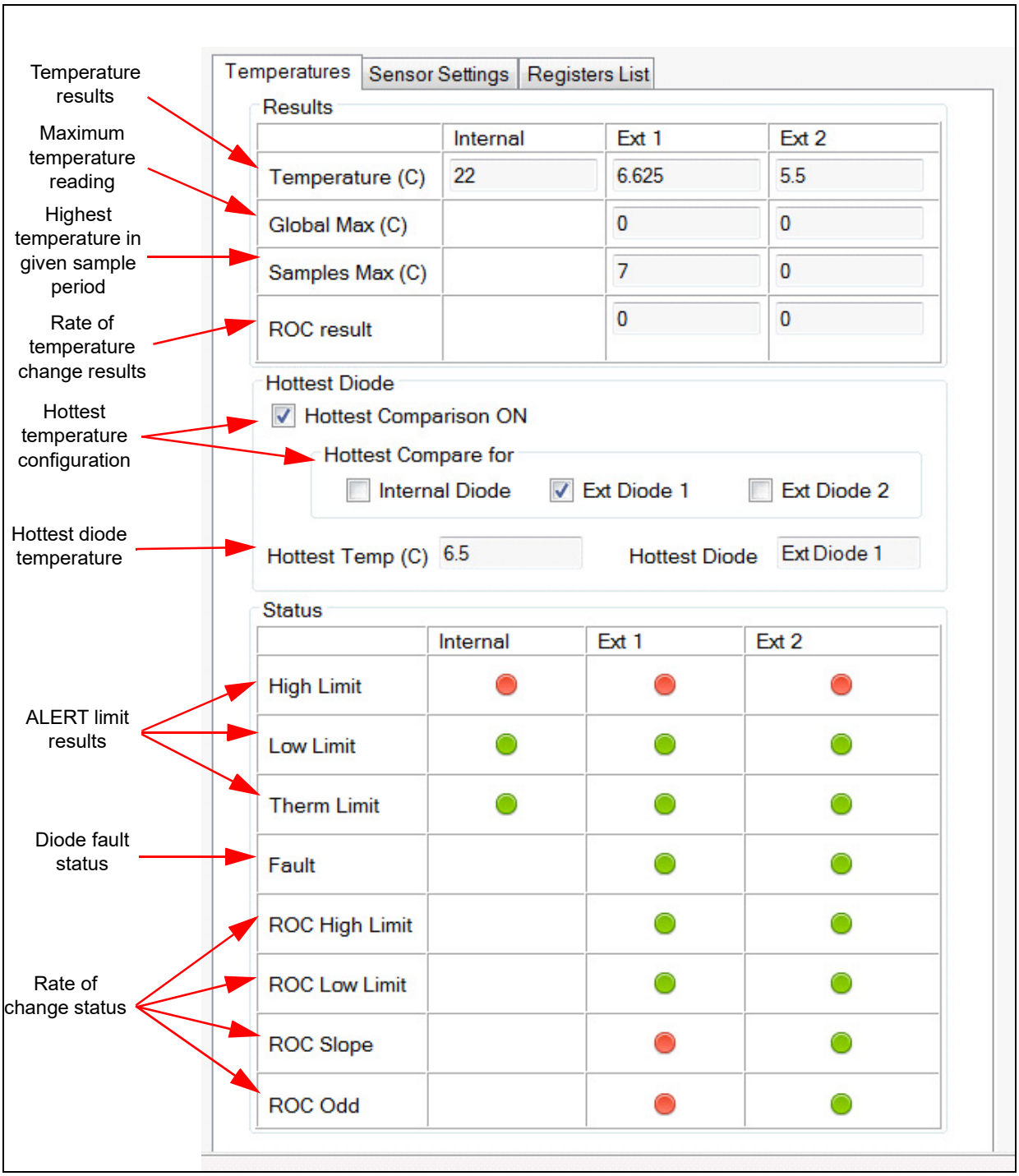

FIGURE 3-4: *Temperatures Tab.*

3.3.2 Sensor Settings Tab

The Sensor Settings tab is divided into two sections:

- General Settings
- Rate of Change

Figure 3-5 displays the **General Settings** section under the **Sensor Settings** tab. This is where the user configures and enables/disables various features of the device.

Refer to the MCP1812/13/14/15/33 data sheet for detailed information on the operation of these features and settings.

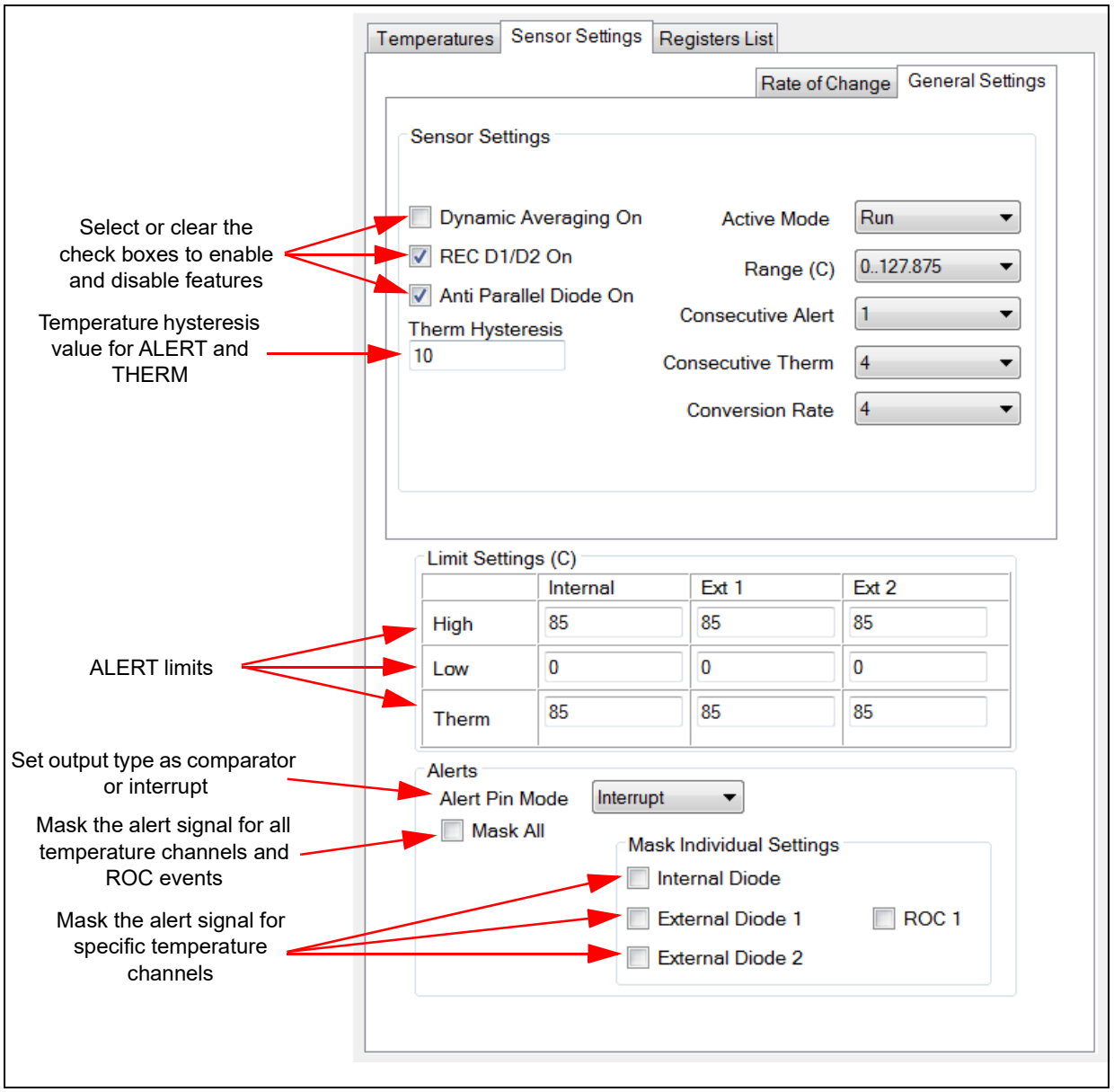

FIGURE 3-5: *Sensor Settings Tab - General Settings.*

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Figure 3-6 displays the **Rate of Change** (ROC) section under the **Sensor Settings** tab. This is where the user configures the ROC feature. Refer to the MCP1812/13/14/15/33 data sheet for detailed information regarding the ROC setup and operation.

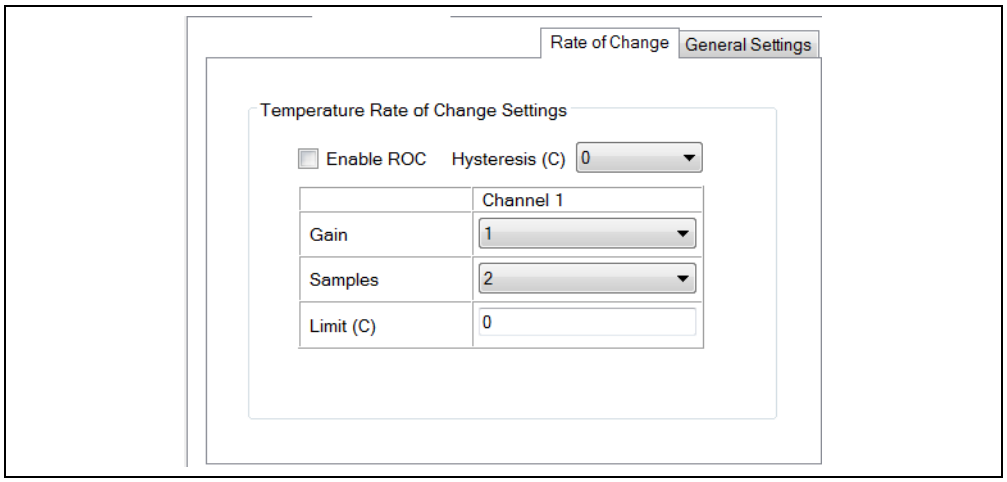


FIGURE 3-6: *Rate of Change Tab.*

Since the software is constantly polling the status register the status bits are cleared as soon as an out of bounds condition is satisfied when in the Interrupt mode.

A quick way to validate the ROC is utilizing the Standby mode along with the one-shot temperature measurement.

ROC validation example:

1. Select Standby mode.
2. Set the **Gain** and **Samples** drop downs.
3. Select the **Enable ROC** check box.
4. Click one-shot.
5. Update registers and log temperature for Remote Diode 1.
6. Repeat steps 4 and 5 for the samples selected (when all samples have completed the ROC result value will update).
7. Calculate the ROC result using Equation 3-1 and compare to the calculated value in the ROC result within the GUI.

EQUATION 3-1:

$$\frac{\Delta T}{\Delta t} = \frac{[T(t_{max}) - T(t_0)] ¥ gain}{(sample - 1)}$$

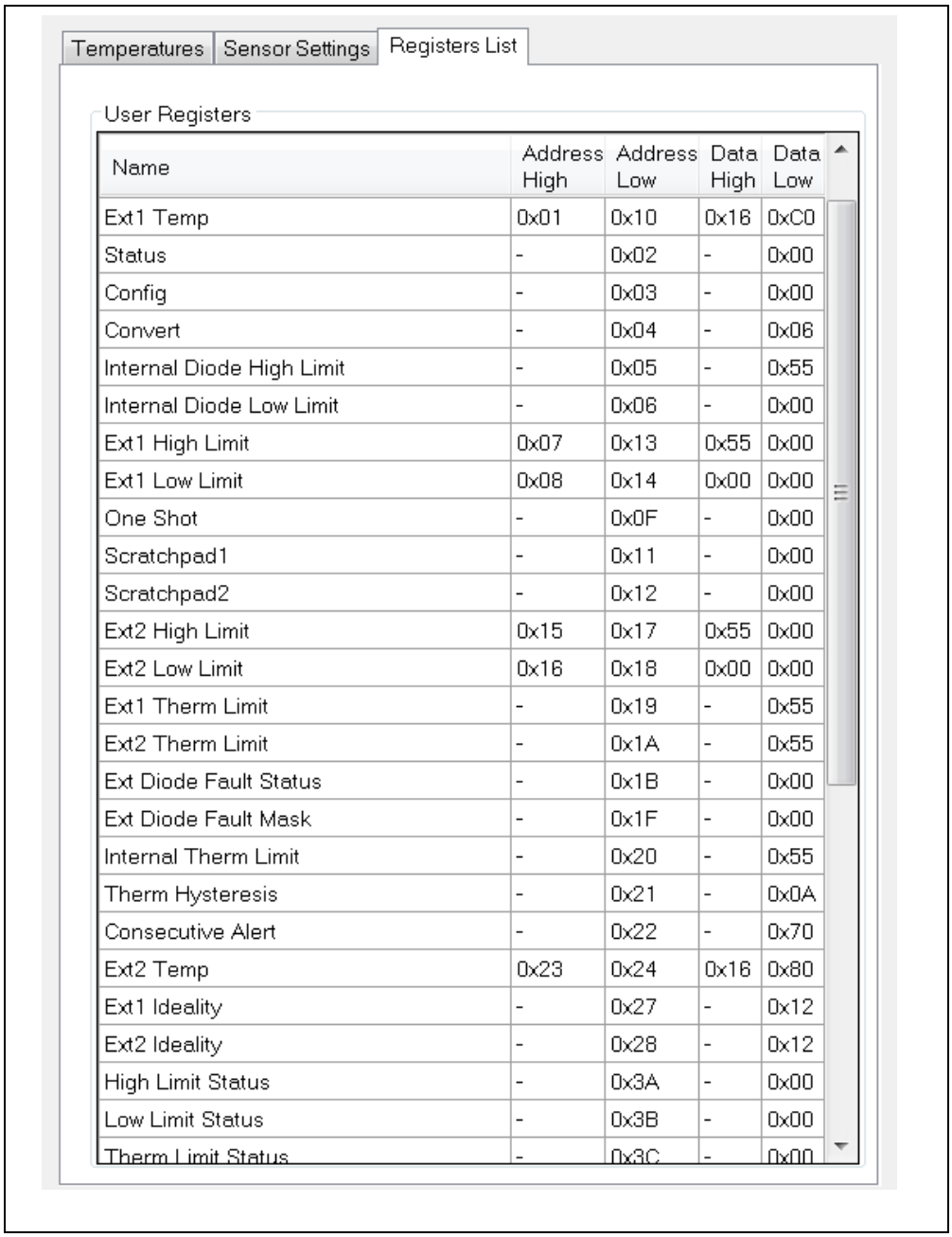
Where:

$T(T_{Tmax})$ = Temperature at the end of the interval.

$T(t_0)$ = Temperature at the beginning of the interval.

3.3.3 Registers List Tab

The **Registers List** tab (Figure 3-7) contains a read-only table that contains all the user registers.



Name	Address High	Address Low	Data High	Data Low
Ext1 Temp	0x01	0x10	0x16	0xC0
Status	-	0x02	-	0x00
Config	-	0x03	-	0x00
Convert	-	0x04	-	0x06
Internal Diode High Limit	-	0x05	-	0x55
Internal Diode Low Limit	-	0x06	-	0x00
Ext1 High Limit	0x07	0x13	0x55	0x00
Ext1 Low Limit	0x08	0x14	0x00	0x00
One Shot	-	0x0F	-	0x00
Scratchpad1	-	0x11	-	0x00
Scratchpad2	-	0x12	-	0x00
Ext2 High Limit	0x15	0x17	0x55	0x00
Ext2 Low Limit	0x16	0x18	0x00	0x00
Ext1 Therm Limit	-	0x19	-	0x55
Ext2 Therm Limit	-	0x1A	-	0x55
Ext Diode Fault Status	-	0x1B	-	0x00
Ext Diode Fault Mask	-	0x1F	-	0x00
Internal Therm Limit	-	0x20	-	0x55
Therm Hysteresis	-	0x21	-	0x0A
Consecutive Alert	-	0x22	-	0x70
Ext2 Temp	0x23	0x24	0x16	0x80
Ext1 Ideality	-	0x27	-	0x12
Ext2 Ideality	-	0x28	-	0x12
High Limit Status	-	0x3A	-	0x00
Low Limit Status	-	0x3B	-	0x00
Therm Limit Status	-	0x3C	-	0x00

FIGURE 3-7: *Registers List Tab.*

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3.4 DATA ACQUISITION CHARTING AREA

Figure 3-8 shows the data acquisition interface with a plot of the EMC1833 Internal Diode, Diode 1 and Diode 2.

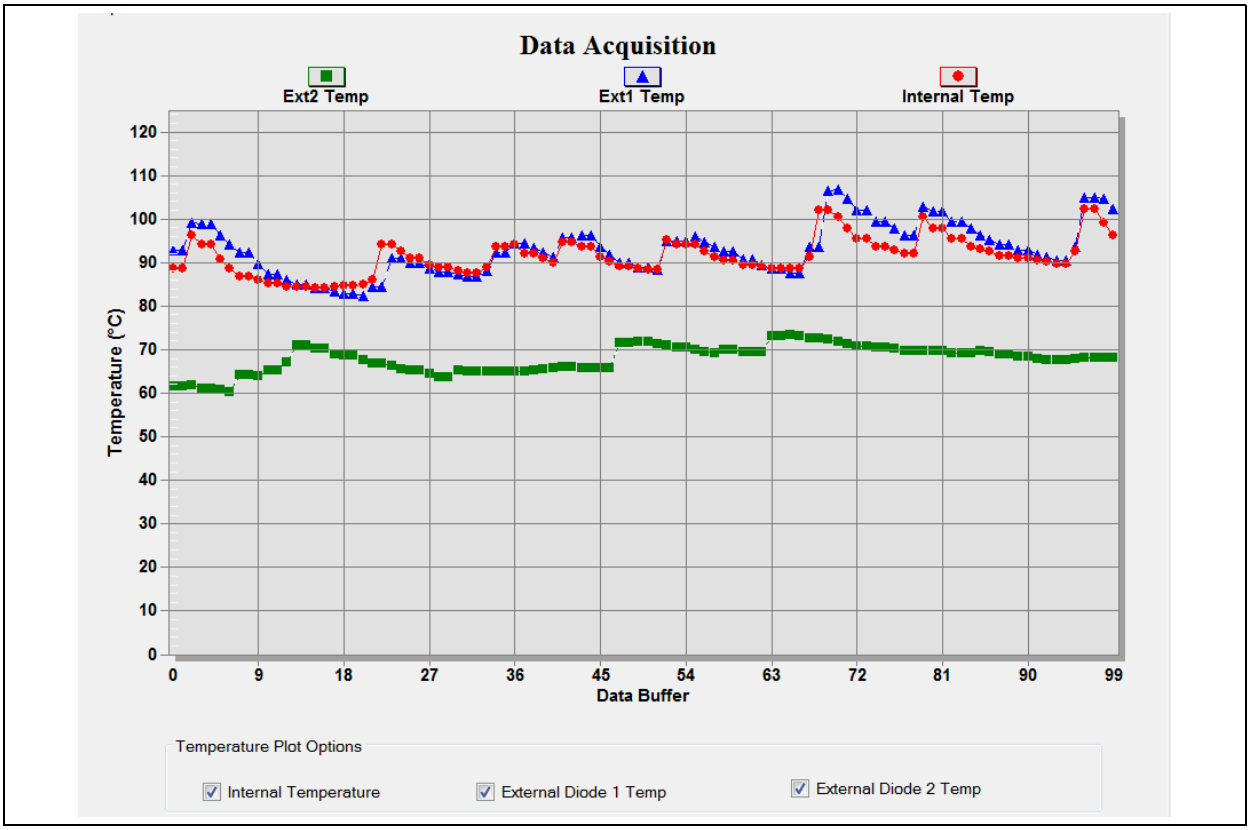

FIGURE 3-8: *Microchip Thermal Management Sensor GUI Data Plot.*

The logging interval can be adjusted using the interval scroll bar from 100ms to 30s, as shown in Figure 3-8.

The data acquisition charting area (Figure 3-8) can be customized by double clicking the chart. Performing this action opens the Data Acquisition Customization window, available in Figure 3-9.

Users can also zoom into a specific plot range by clicking and dragging the section. The data in the chart can also be exported using the **Export** button.

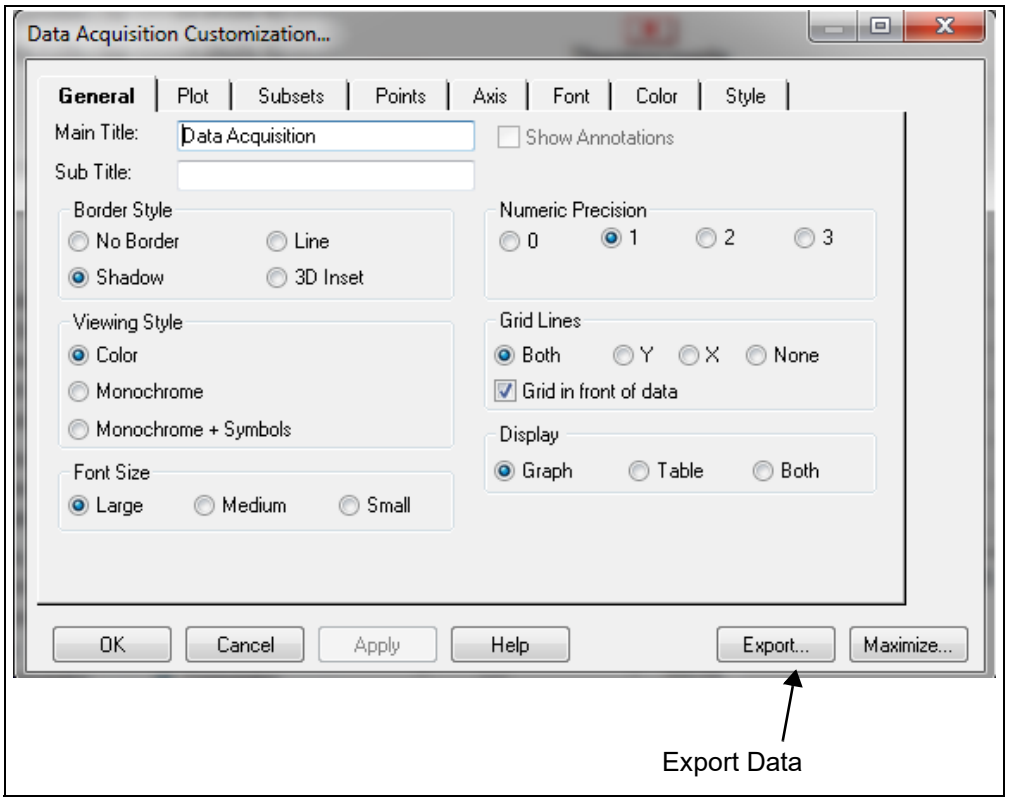

FIGURE 3-9: *Data Acquisition Customization Window.*

3.4.0.1 DATA ACQUISITION CUSTOMIZATION WINDOW DESCRIPTION

The Data Acquisition Customization window contains eight tabs which contain different options allowing users to customize the data acquisition charting area.

The **General** tab (Figure 3-9) determines how the data acquisition charting area is displayed. General options include the border style, viewing style, font size, numeric precision and grid lines.

The **Display** option determines how the data acquisition charting area is generated: a graph, a table, or both.

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The **Plot** tab, displayed in Figure 3-10, allows users to customize the appearance of the data sensor plots.

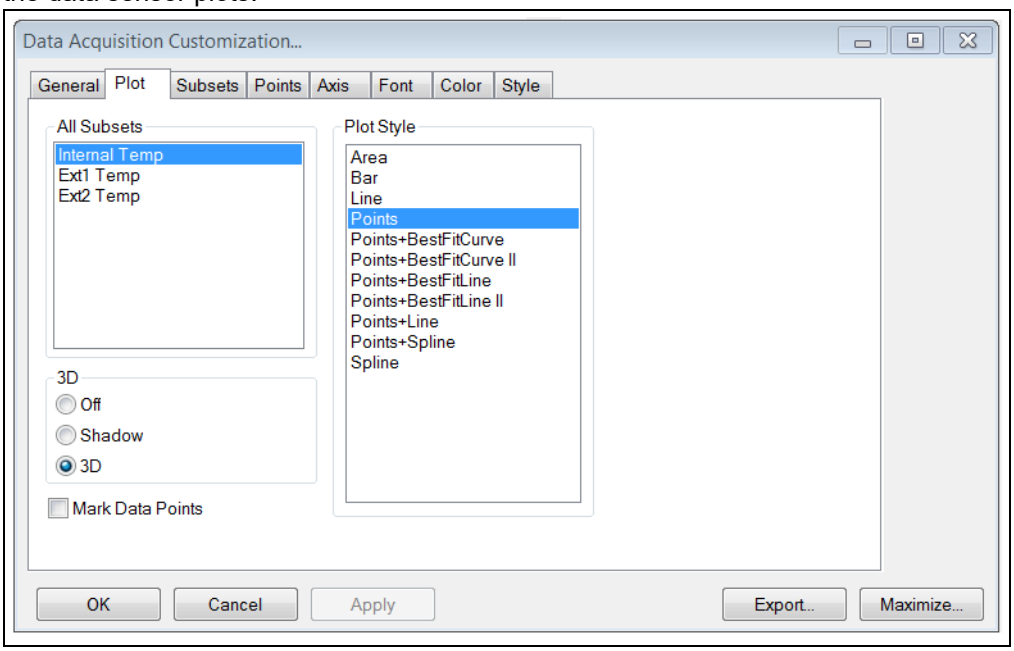

FIGURE 3-10: *Data Acquisition Customization - Plot Tab.*

Users can also control the appearance of the subsets plots using the **Subsets** tab, displayed in Figure 3-11.

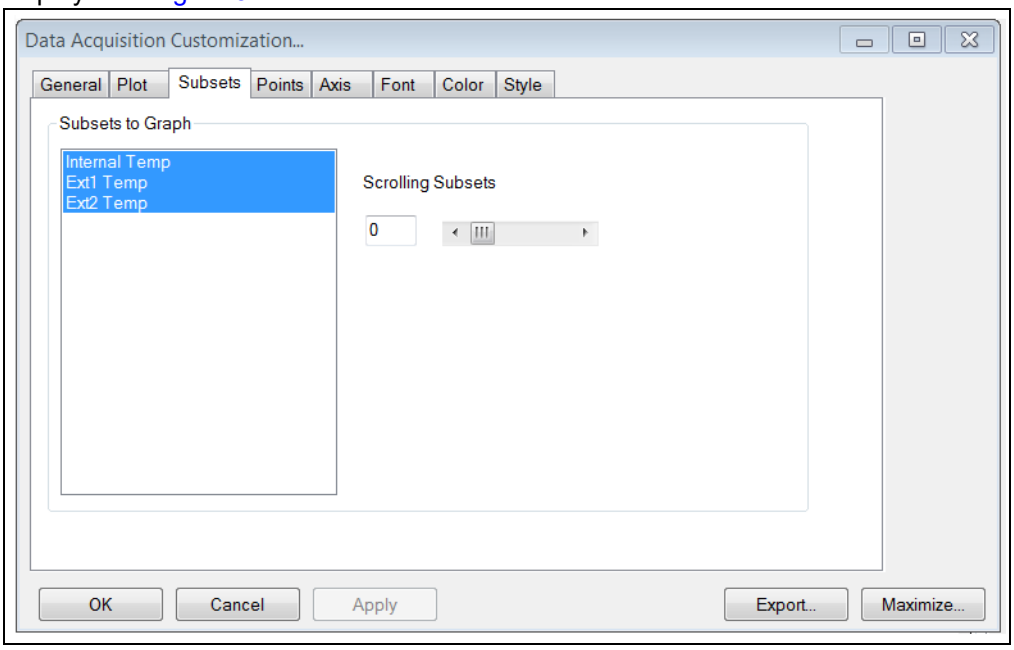

FIGURE 3-11: *Data Acquisition Window - Subsets Tab.*

The **Points** tab, displayed in Figure 3-12, controls the number of data points displayed in the graph and the orientation of the labels on the X-Axis.

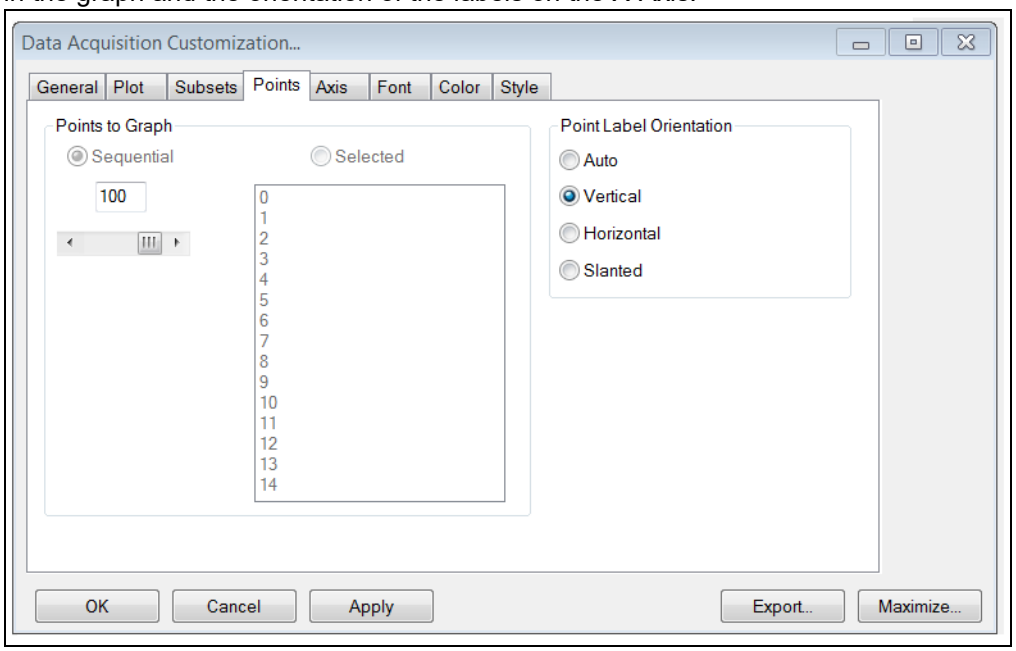

FIGURE 3-12: *Data Acquisition Window - Points Tab.*

The **Axis** tab, displayed in Figure 3-13, determines the scale and range of the Y-Axis.

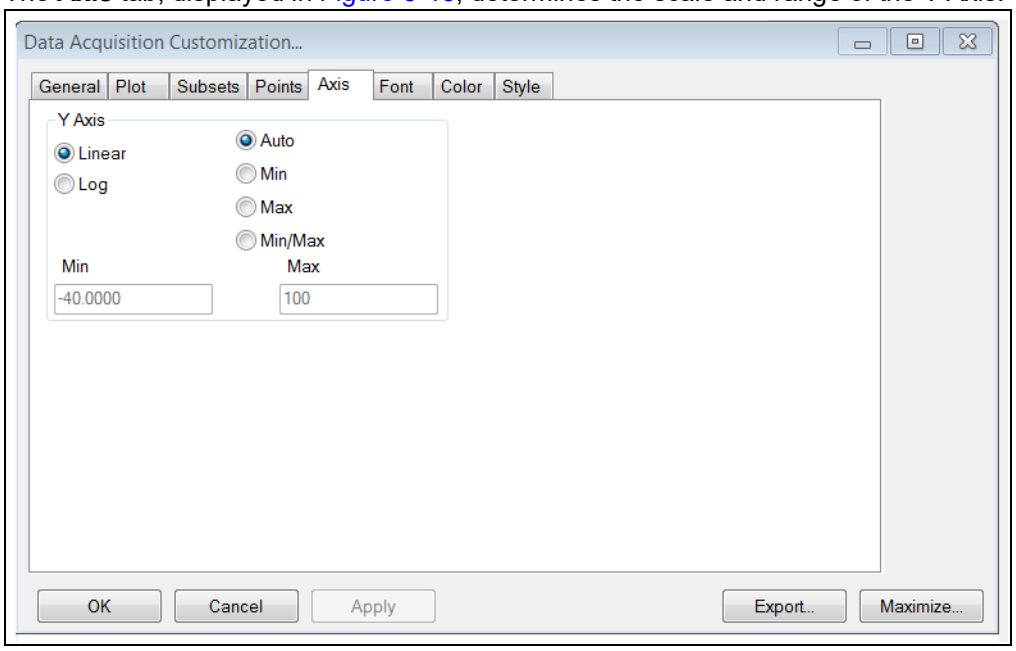

FIGURE 3-13: *Data Acquisition Window - Axis Tab.*

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Users can modify the options in the **Font** tab, displayed in Figure 3-14, to change the size, font and style of the text that appears in the data acquisition charting area. A sample text is also provided for preview before applying the changes to the charting area.

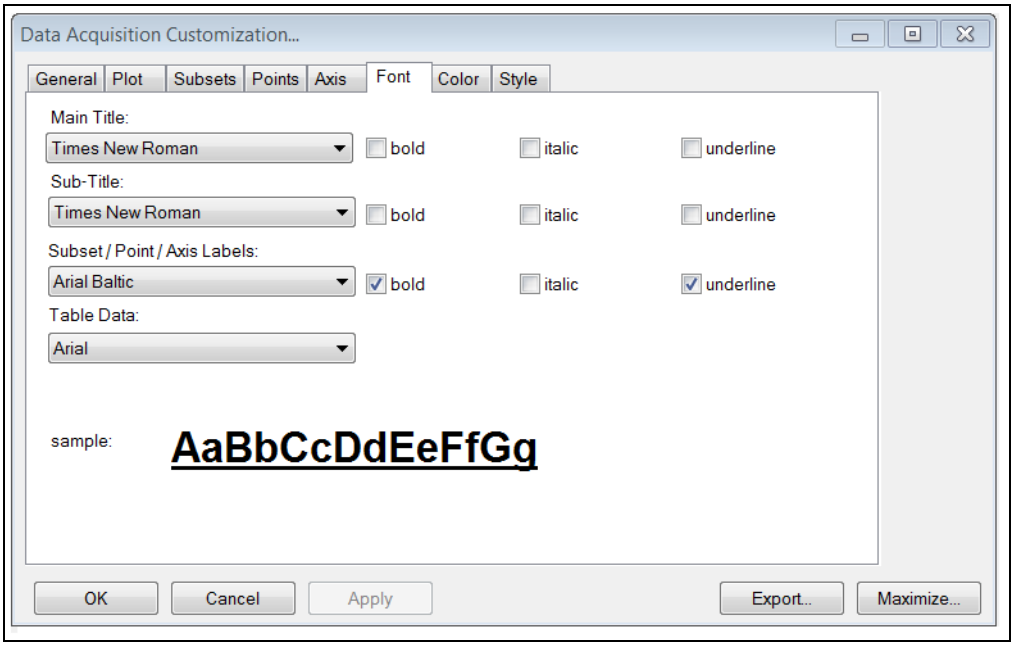

FIGURE 3-14: *Data Acquisition Window - Font Tab.*

The **Color** tab, displayed in Figure 3-15, determines which colors are used by the system. Optionally, users can select a preconfigured style in the Quick Styles section.

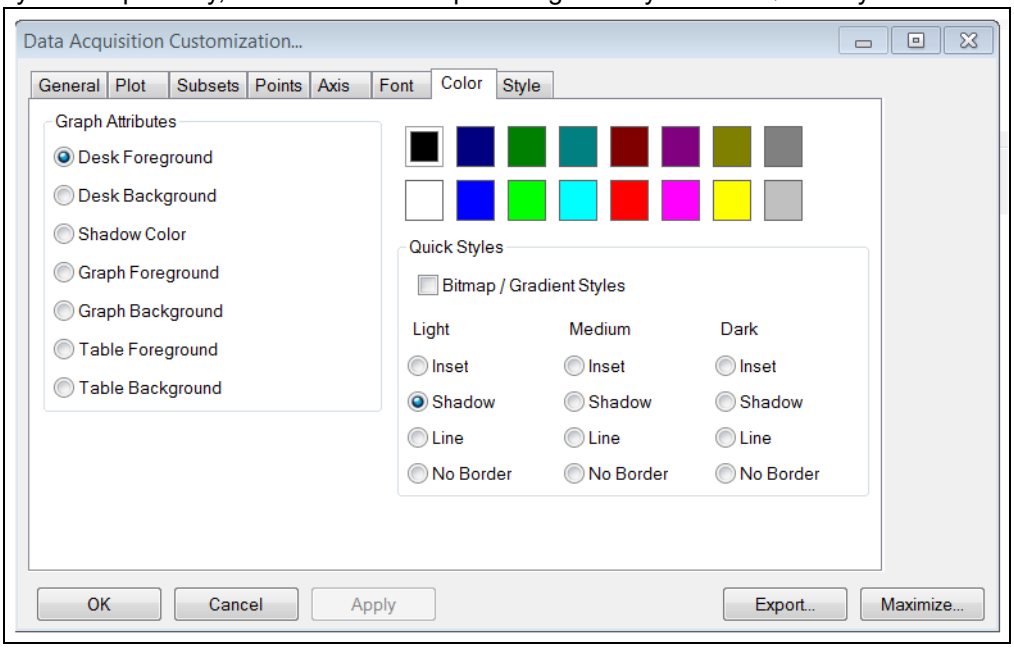

FIGURE 3-15: *Data Acquisition Window - Color Tab.*

Through the **Style** tab, displayed in Figure 3-16, users can customize the line style, color, and data point type for each temperature plot.

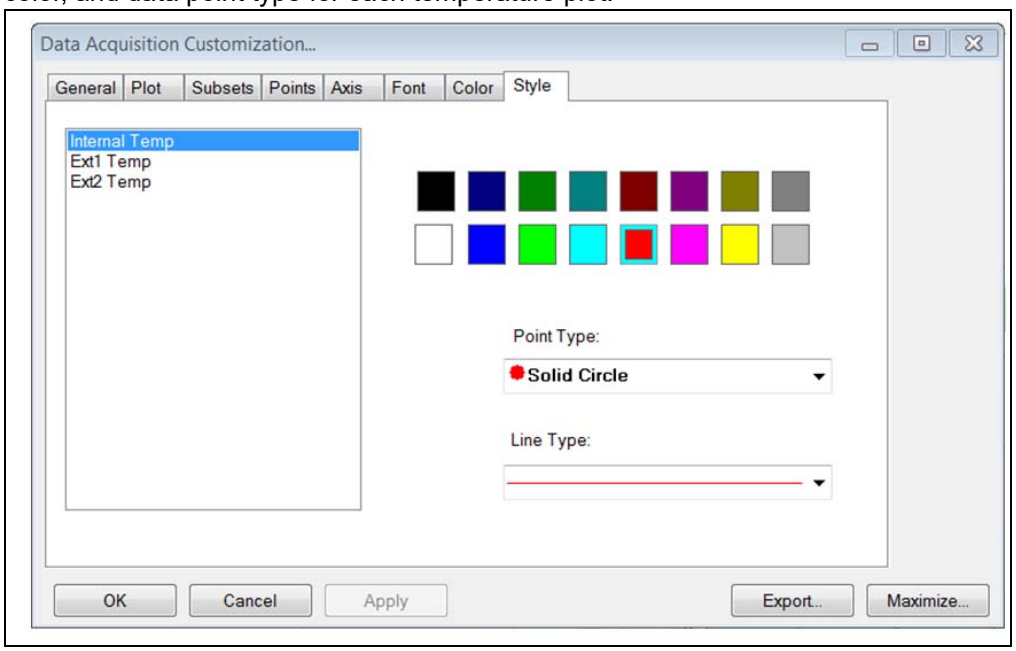

FIGURE 3-16: *Data Acquisition Window - Style Tab.*

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NOTES:

Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the EMC1833 Evaluation Board:

- ADM00773 Board – Schematic
- ADM00773 Board – Schematic 2
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom silk

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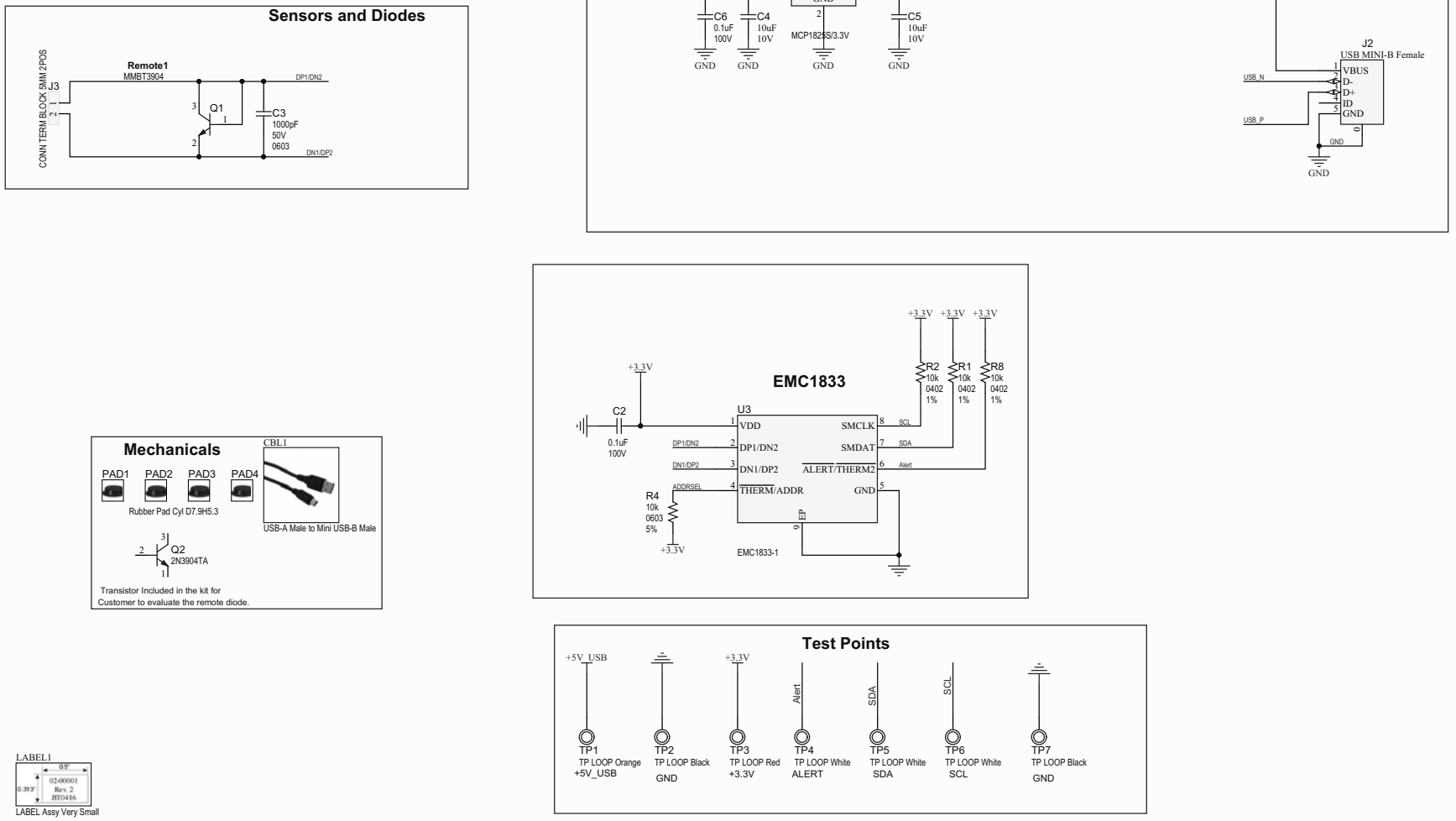
A.2 ADM00773 BOARD – SCHEMATIC



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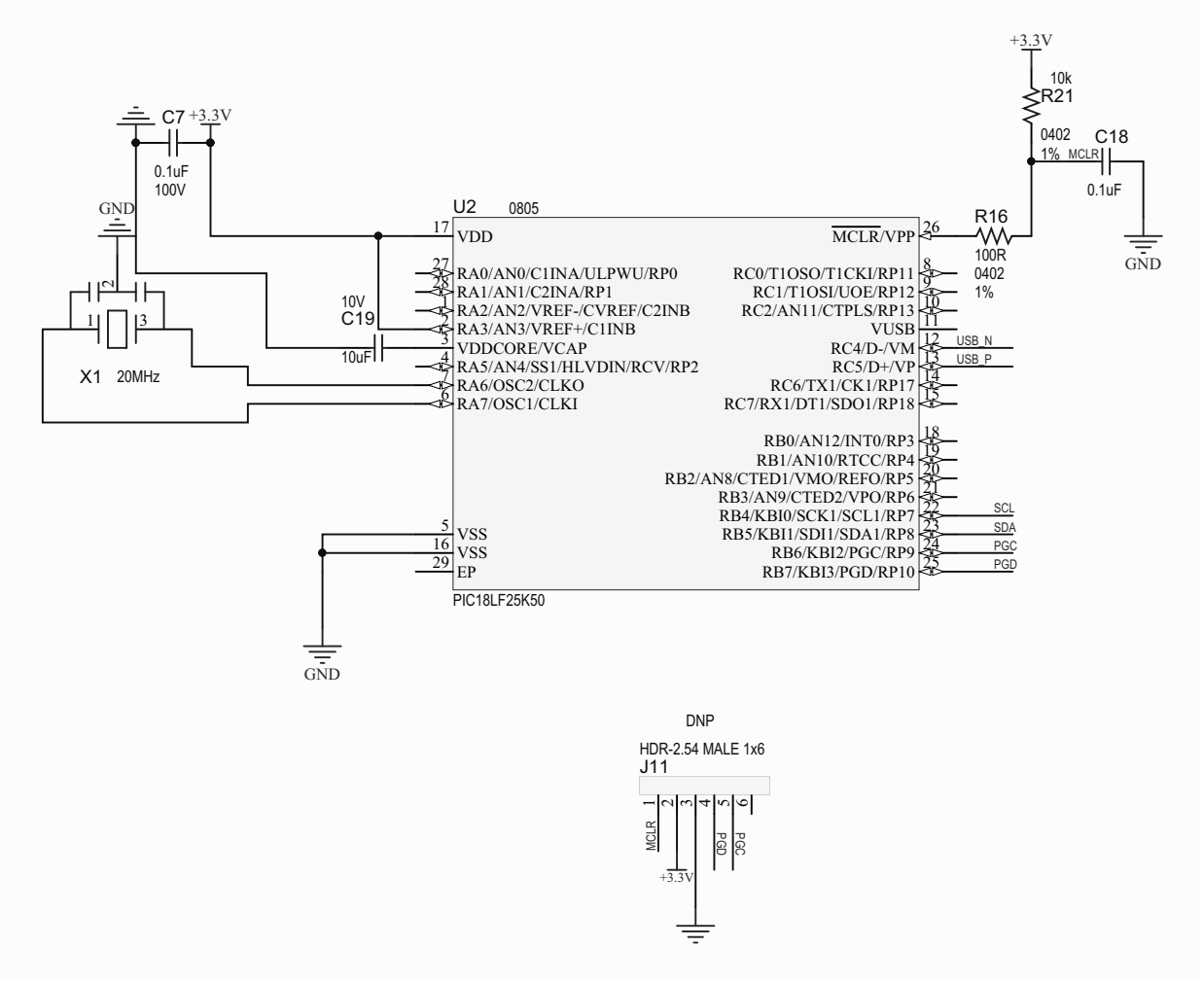
A.3 ADM00773 BOARD – SCHEMATIC 2



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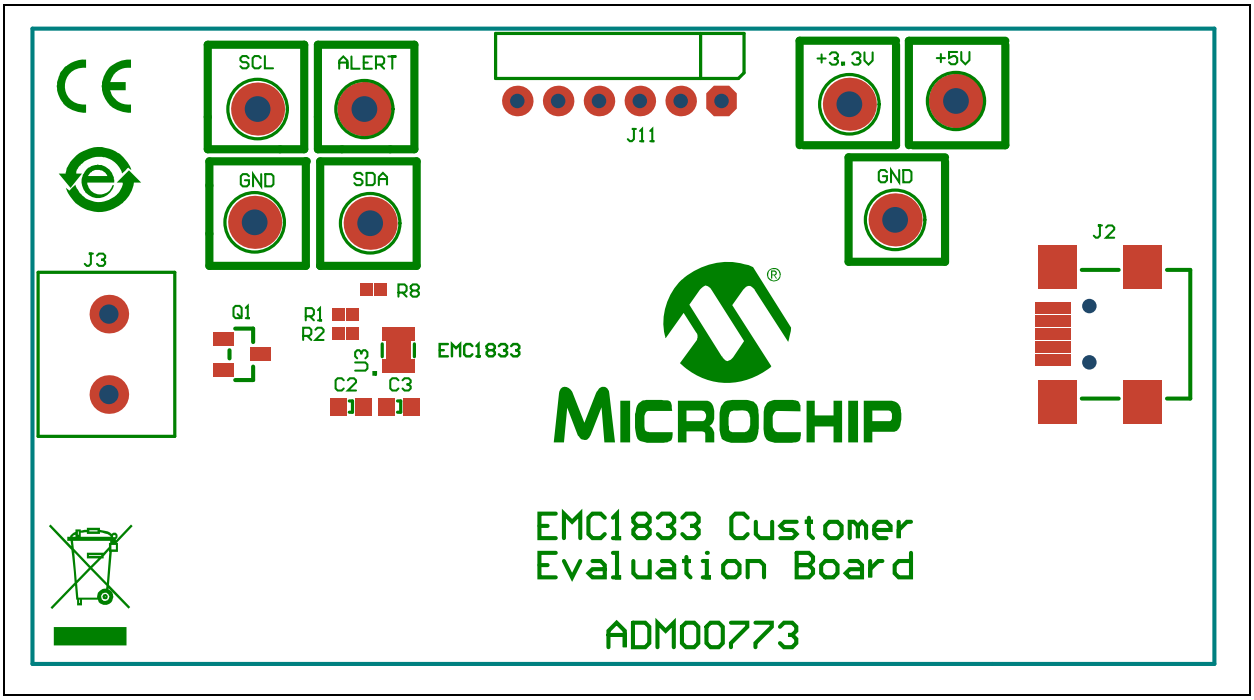
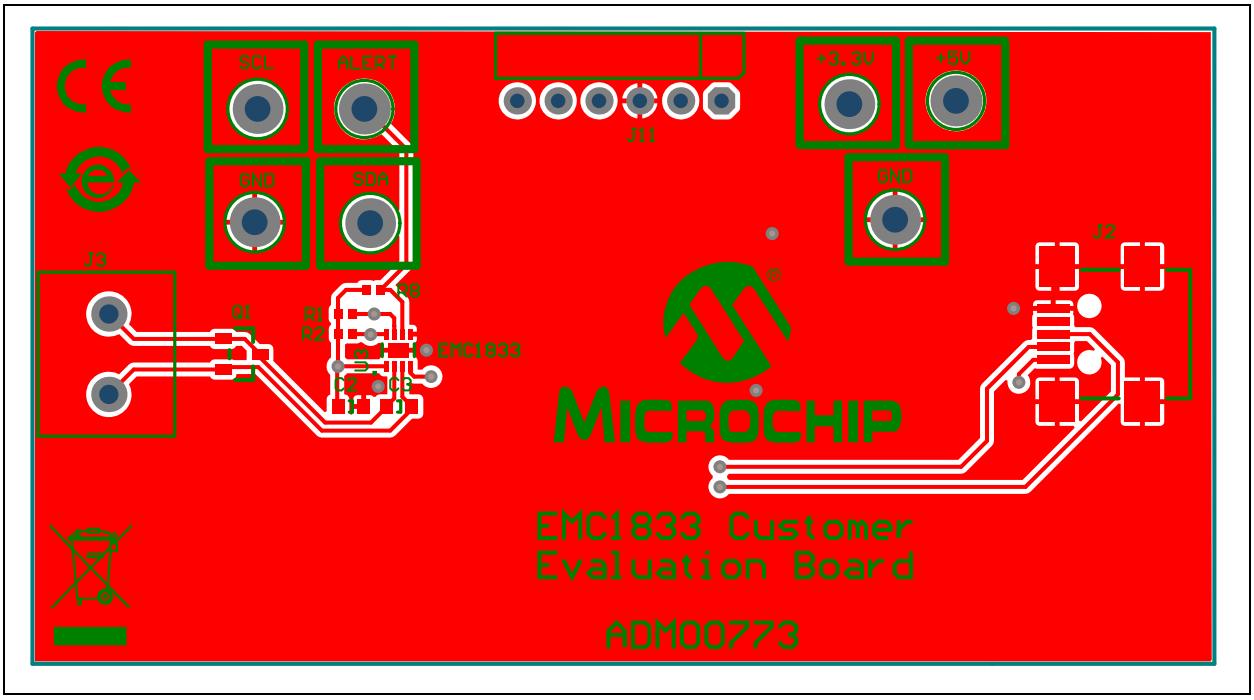
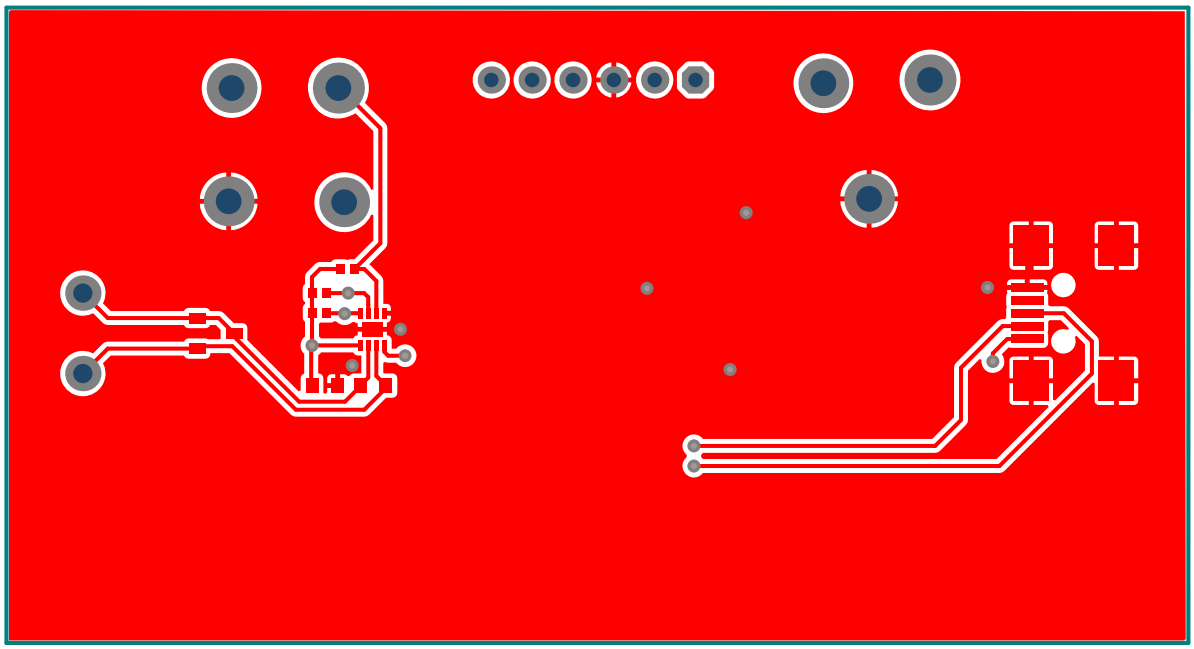
A.4 BOARD – TOP SILK



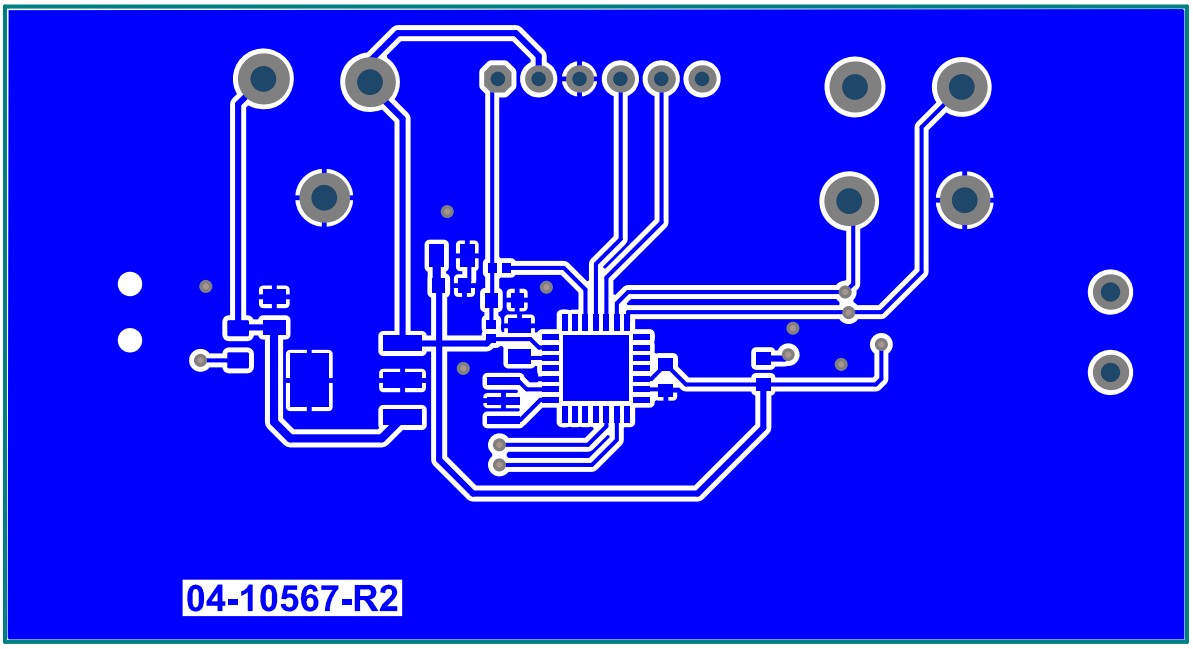
A.5 BOARD – TOP COPPER AND SILK



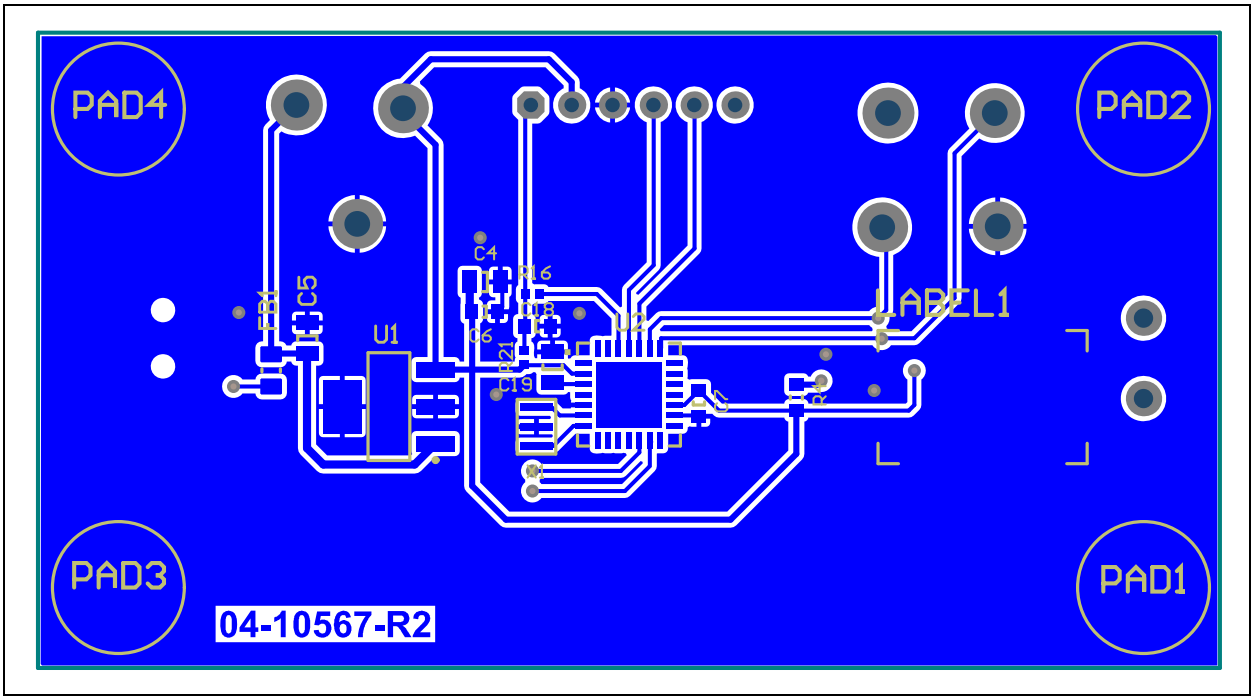
A.6 BOARD – TOP COPPER



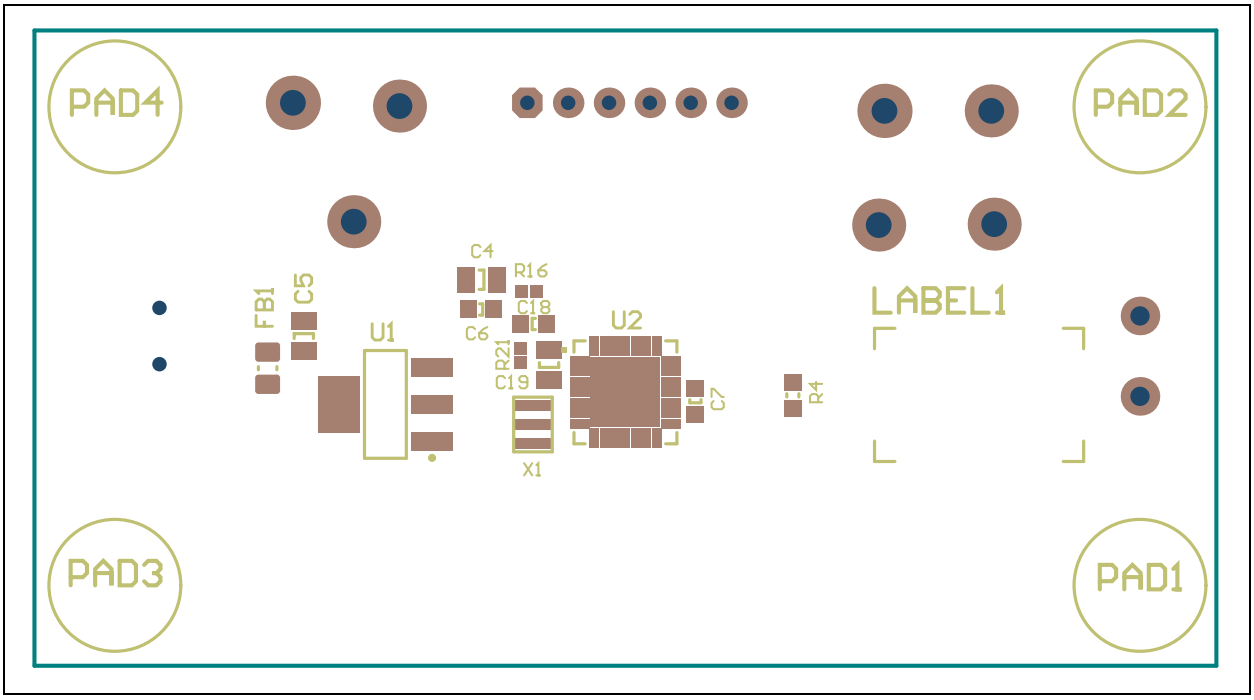
A.7 BOARD – BOTTOM COPPER



A.8 BOARD – BOTTOM COPPER AND SILK



A.9 BOARD – BOTTOM SILK



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM) FOR EMC1833 EVALUATION BOARD (ADM00773) (1)

Qty.	Reference	Description	Manufacturer	Part Number
4	C2, C6, C7, C18	Capacitor Ceramic, 0.1 µF, 100V, 10%, X7R, SMD, 0603	Murata Electronics North America, Inc.	GRM188R72A104KA35D
1	C3	Capacitor Ceramic, 1000 pF, 50V, 20%, X7R, SMD, 0603	KEMET	C0603C102M5RACTU
2	C4, C5	Capacitor Ceramic,10 µF, 10V, 10%, X5R, SMD, 0805	Taiyo Yuden Co., Ltd.	LMK212BJ106KD-T
1	C19	Capacitor Ceramic, 10 µF, 10V, 10%, X5R, SMD, 0805	Taiyo Yuden Co., Ltd.	LMK212BJ106KG-T
1	FB1	Ferrite, 2A, 220R, SMD, 0805	Murata Electronics North America, Inc.	BLM21PG221SN1D
1	J2	Connector USB mini-B, Female, SMD, R/A	Hirose Electric Co., Ltd.	UX60-MB-5ST
1	J3	Connector Term, Block, 5 MM 2-Position, GRN	PHOENIX CONTACT	1792863
4	PAD1, PAD2, PAD3, PAD4	Mechanical HW Rubber PAD, Cylindrical, D7.9, H5.3, Black	3M	SJ61A11
1	PCB1	Printed Circuit Board - EMC1833 Evaluation Board	Microchip Technology Inc.	**04-10567-R2**
1	Q1	Transistor BJT, NPN, 40V, 200 mA, 310 mW, SOT-23-3	Fairchild Semiconductor®	MMBT3904
4	R1, R2, R8, R21	Resistor TKF, 10k, 1%, 1/10W, SMD, 0402	Panasonic® - BSG	ERJ-2RKF1002X
1	R4	Resistor TKF, 10k, 5%, 1/10W, SMD, 0603	Panasonic® - BSG	ERJ-3GEYJ103V
1	R16	Resistor TKF, 100R, 1%, 1/10W, SMD, 0402	Panasonic® - BSG	ERJ-2RKF1000X
1	TP1	Connector Test Point, Loop, Orange, TH	Keystone Electronics Corp.	5013
2	TP2, TP7	Connector Test Point, Loop, Black, TH	Keystone Electronics Corp.	5011
1	TP3	Connector Test Point, Loop, Red, TH	Keystone Electronics Corp.	5010
3	TP4, TP5, TP6	Connector Test Point, Loop, White, TH	Keystone Electronics Corp.	5012
1	U1	Microchip Analog LDO, 3.3V, SOT-223-3	Microchip Technology Inc.	**MCP1825ST-3302E/DB**
1	U2	Microchip MCU, 8-bit, 48 MHz, 32 kB, 2 kB, QFN-28	Microchip Technology Inc.	**PIC18LF25K50-I/ML**
1	U3	Three Channel 1.8V, I^2C, Temperature Sensor	Microchip Technology Inc.	**EMC1833T-AE/RW**
1	X1	DO NOT POPULATE	Murata Electronics North America, Inc.	CSTCE20M0V13L99-R0

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) FOR EMC1833 EVALUATION BOARD (ADM00773) - MECHANICAL PARTS(1)

Qty.	Reference	Description	Manufacturer	Part Number
1	CBL1	Mechanical HW, cable USB-A Male to Mini USB-B Male, 3 ft, Black	Qualtek Electronics Corp.	3021003-03
1	Q2	Transistor, NPN, 40V, 0.2A, TO-92	Fairchild Semiconductor®	2N3904TA

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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