

EMC1182 Temperature Sensor Evaluation Board User's Guide

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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).
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Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

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EMC1182 TEMPERATURE SENSOR EVALUATION 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 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 EMC1182 Temperature Sensor Evaluation 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 EMC1182 Temperature Sensor Evaluation 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 EMC1182 Temperature Sensor Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on installing and starting the SMSC™ Chip Manager application.
- **Chapter 3. "Hardware Description"** – Shows hardware details of the EMC1182 Temperature Sensor Evaluation Board.
- **Chapter 4. "Software Description"** – Describes the main operations in the SMSC Chip Manager software.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the EMC1182 Temperature Sensor Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the EMC1182 Temperature Sensor Evaluation 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) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the EMC1182 Temperature Sensor Evaluation Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **EMC1182 Data Sheet –** ***"Dual Channel 1.8V SMBus/I^{2}C Temperature Sensor with Resistance Error Correction, Beta Compensation"*** **(EMC1182 DS Rev. 1.0)**

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- Technical Support

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

DOCUMENT REVISION HISTORY

Revision A (August 2013)

- Initial Release of this Document.

NOTES:

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Chapter 1. Product Overview

1.1 INTRODUCTION

The EMC1182 Temperature Sensor Evaluation Board provides an easily accessible platform to test the various features of the EMC1182. The System Management Bus (SMBus) communication is accomplished using an Universal Serial Bus (USB) bridge, providing a standard interface for the application code interface. The board is populated with a 3x3 DFN version of the EMC1182 device.

1.2 EMC1182 DEVICE FEATURES

The EMC1182 device is a two-channel SMBus temperature sensor featuring both pin-selectable and fixed SMBus address capability. The communications bus is also compatible with I^2C communication protocol (see SMSC® application note AN 14.0 rev.1.1 - *"SMSC Dedicated Slave Devices in I^2C Systems"* for details on the differences between the SMSC SMBus implementation and standard I^2C/SMBus).

One externally connected temperature diode and one internal diode are available for temperature sensing. $\overline{\text{THERM}}$ and $\overline{\text{ALERT}}$ outputs have programmable temperature limits.

1.3 WHAT IS THE EMC1182 TEMPERATURE SENSOR EVALUATION BOARD?

All functions of the EMC1182 device can be tested and observed using the USB-based EMC1182 Temperature Sensor Evaluation Board. Figure 1-1 shows the block diagram of this board.

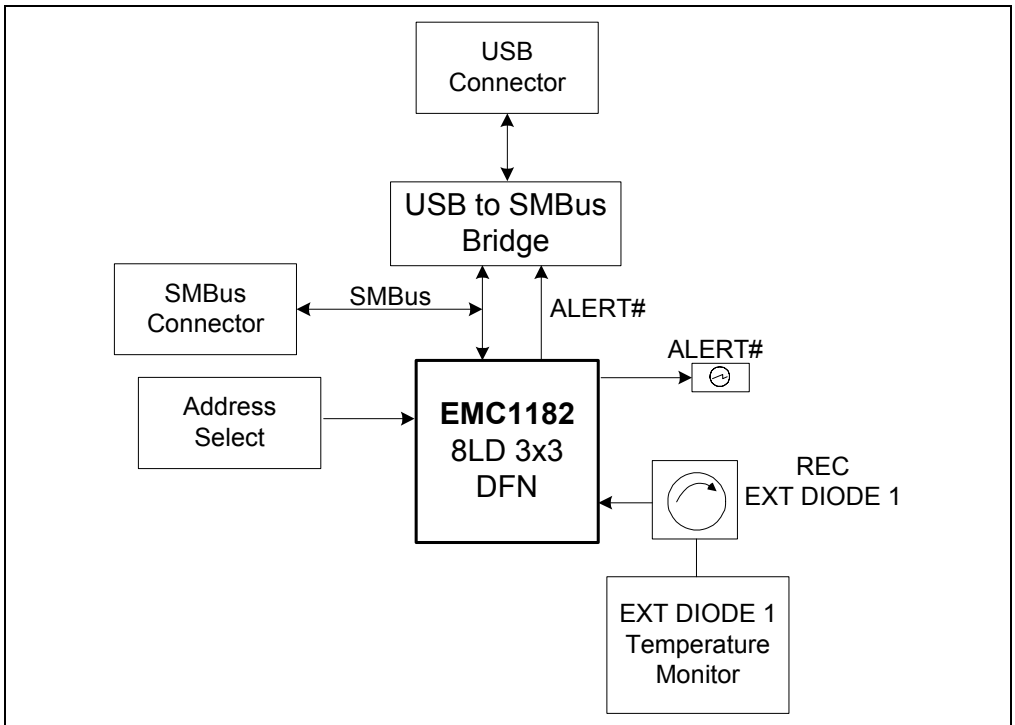


FIGURE 1-1: *EMC1182 Temperature Sensor Evaluation Board Block Diagram.*

The evaluation system is comprised of the EMC1182 Temperature Sensor Evaluation Board and the SMSC Chip Manager application. The EMC1182 Temperature Sensor Evaluation Board has the following features:

- Headers for connecting an external diode or CPU/GPU
- Resistance Error Correction verification
- USB-to-SMBus bridge for power and communications
- Capability to connect directly to an external SMBus master

The user can perform the following operations using the Chip Manager:

- Viewing and changing register values
- Saving settings of all registers, allowing for quick configuration at a later time
- Graphing of any register

The evaluation board was designed for ease of use and experimentation purposes. Figure 1-2 shows the top silk screen of the EMC1182 Temperature Sensor Evaluation Board.

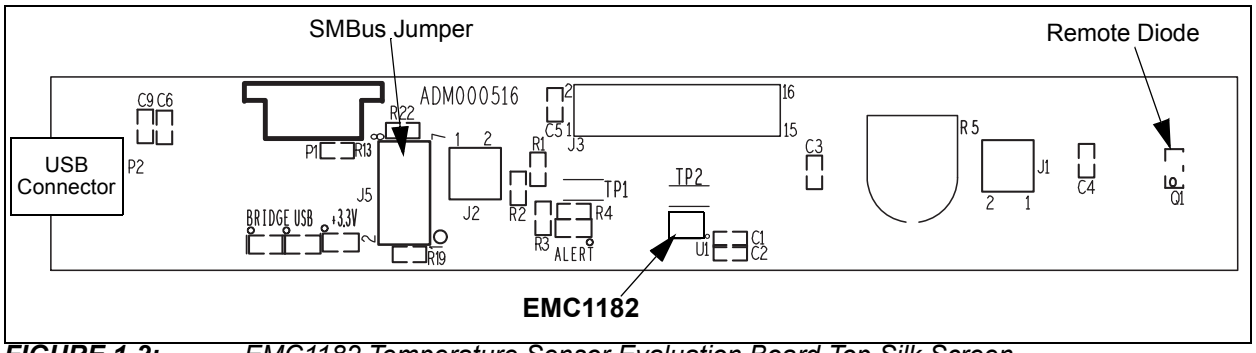


FIGURE 1-2: *EMC1182 Temperature Sensor Evaluation Board Top Silk Screen.*

1.4 WHAT THE EMC1182 TEMPERATURE SENSOR EVALUATION BOARD KIT CONTAINS

This EMC1182 Temperature Sensor Evaluation Board kit includes:

- EMC1182 Temperature Sensor Evaluation Board (ADM00516)
- Supplied USB cable
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 GETTING STARTED

2.1.1 System Requirements

To use the EMC1182 Temperature Sensor Evaluation Board, the following are required:

- A PC running the Microsoft® Windows® operating system
- A display resolution of 800x600 or larger, for viewing several windows simultaneously
- An available USB port

2.1.2 Installing the Evaluation Board

Follow the next steps to install the SMSC Chip Manager.

1. Download the `ChipMan.zip` file from the board web page. Unzip the archive. The application's revision history and install/uninstall notes may be found in the `readme.txt` file.
2. To install the Chip Manager application and the device driver on the PC, run the `Setup.exe`.
3. Connect the supplied USB cable to an available USB port on the PC. Plug the mini-B end of the USB cable into the board connector P3. The +3.3V and the Bridge ACT LEDs should illuminate.
4. If the USB Bridge driver has not previously been installed on the selected USB port, the Driver Software Installation window pops up, prompting for the driver install (see Figure 2-1).

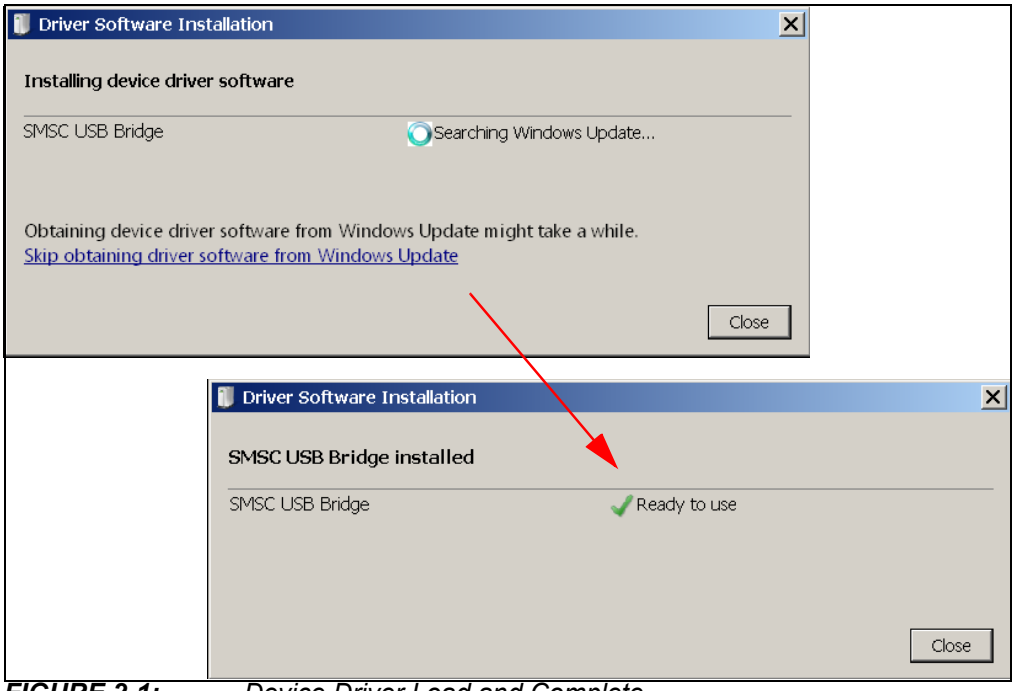


FIGURE 2-1: *Device Driver Load and Complete.*

5. After the driver installation is complete, the initial setup screen for the Chip Manager application appears (see Figure 2-2). Click **Next** to start the installation.

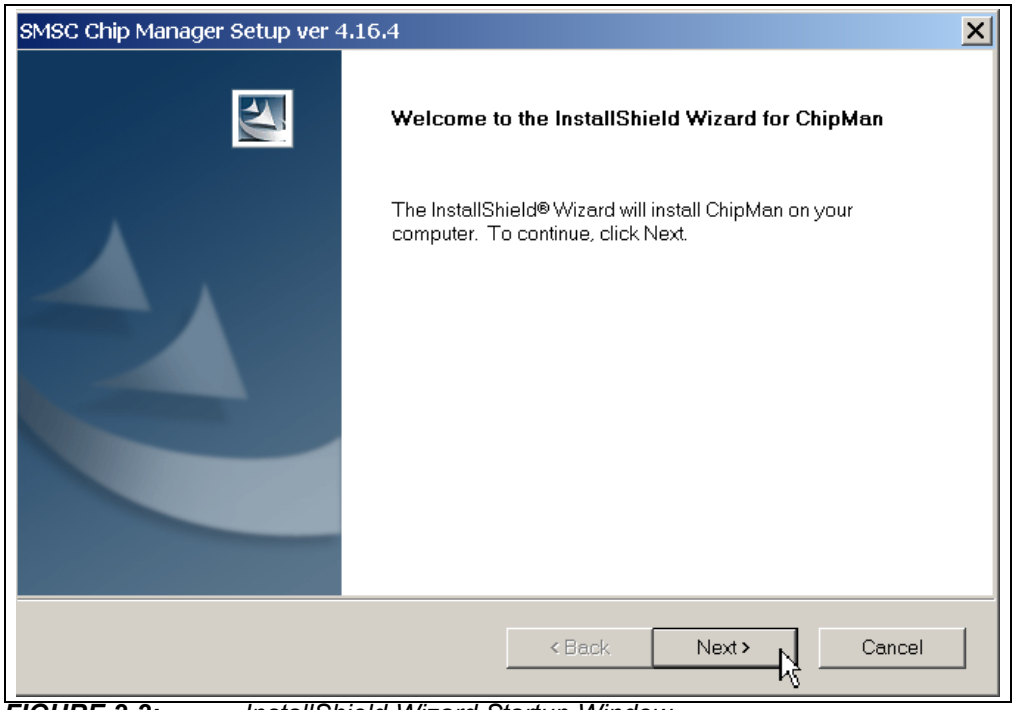


FIGURE 2-2: *InstallShield Wizard Startup Window.*

6. Read and accept the licensing agreement, in order to complete the installation. To continue, click **Yes**.

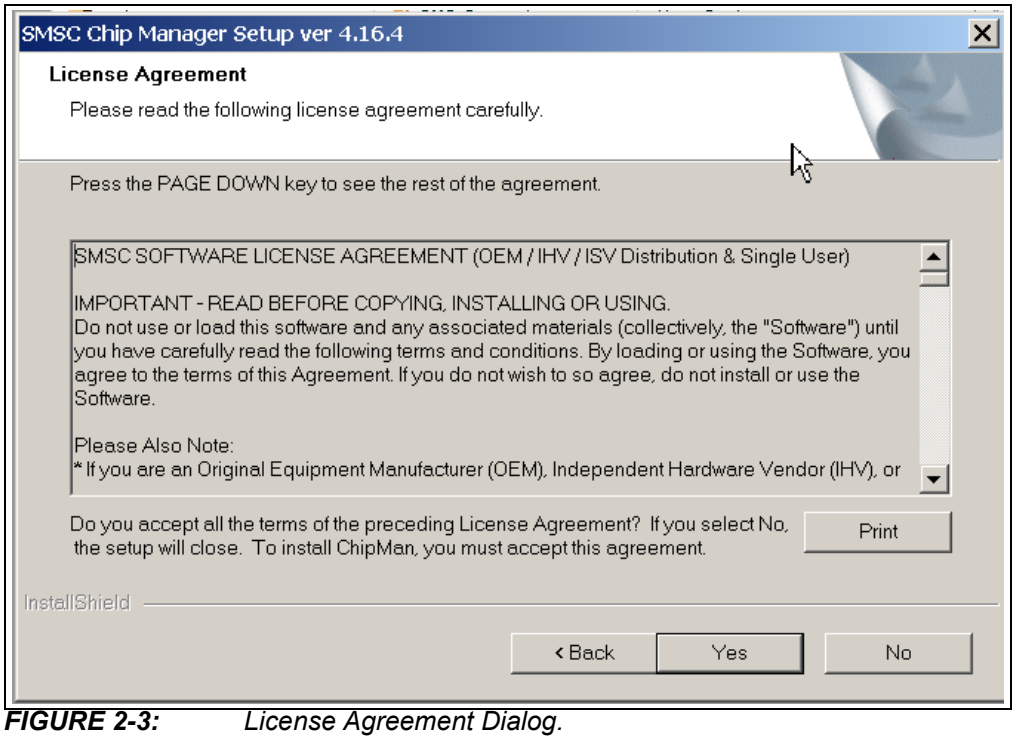


FIGURE 2-3: *License Agreement Dialog.*

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7. On the Choose Destination Location dialog, browse for the desired location, or click **Next** to install in the default location (see Figure 2-4). The application setup window appears, showing the installation progress (see Figure 2-5).

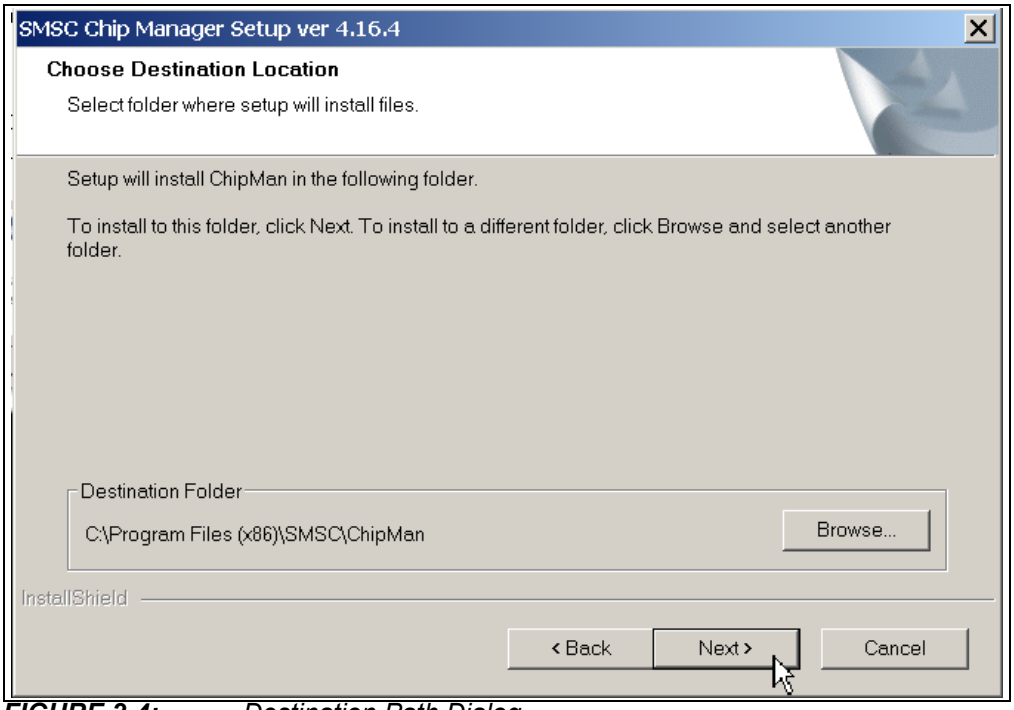


FIGURE 2-4: *Destination Path Dialog.*

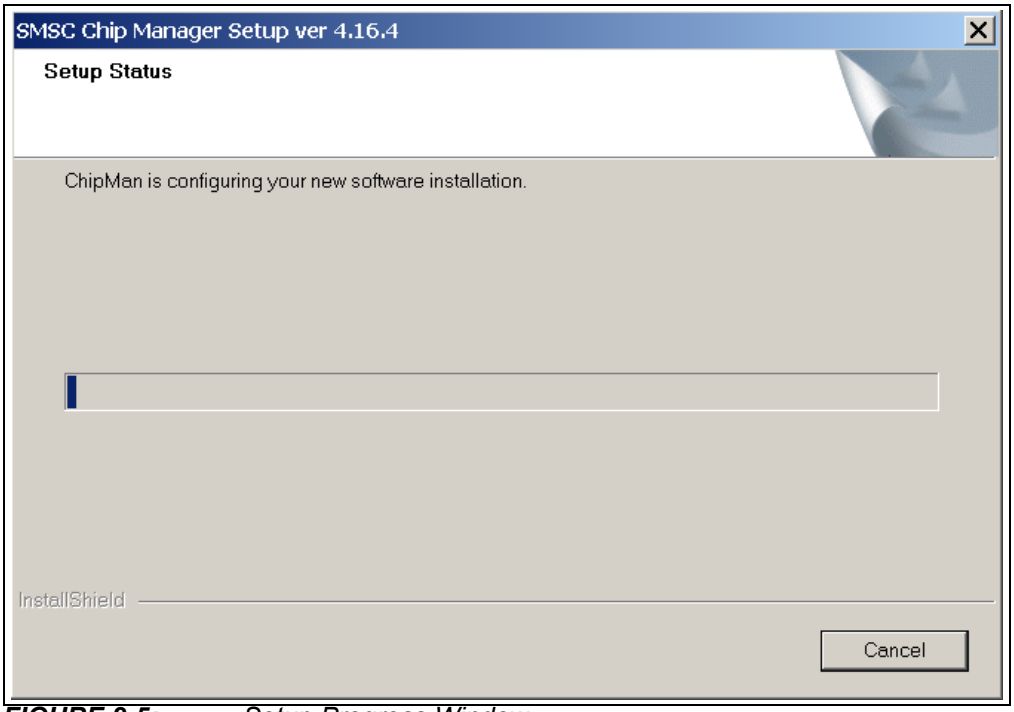


FIGURE 2-5: *Setup Progress Window.*

8. After the setup is complete, the MSXML Parser used by the Chip Manager software is installed, as shown in Figure 2-6. Once the setup completes successfully, press **Finish** to exit the install.

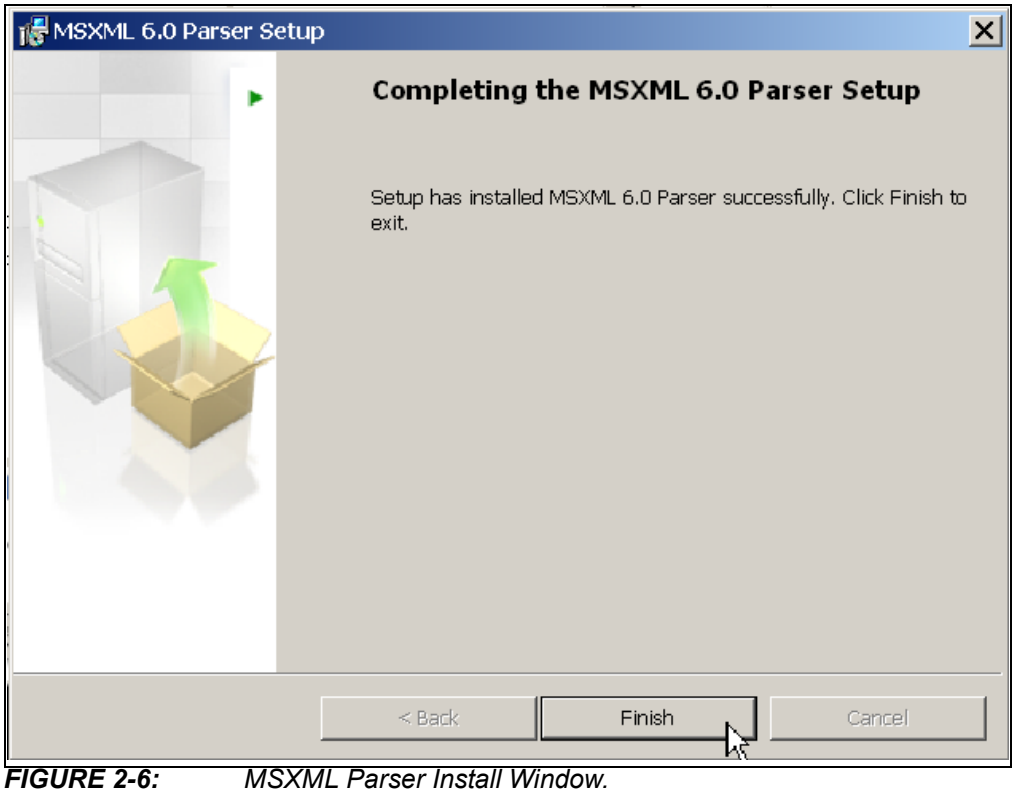


FIGURE 2-6: *MSXML Parser Install Window.*

9. Start the software by either going to Windows *Start button > All Programs > SMSC > SMSC Chip Manager* or by double-clicking the software icon ( ) on the desktop. The evaluation board software will initialize and the SMSC Chip Manager with the Quick Help screen appears (see Figure 2-7).

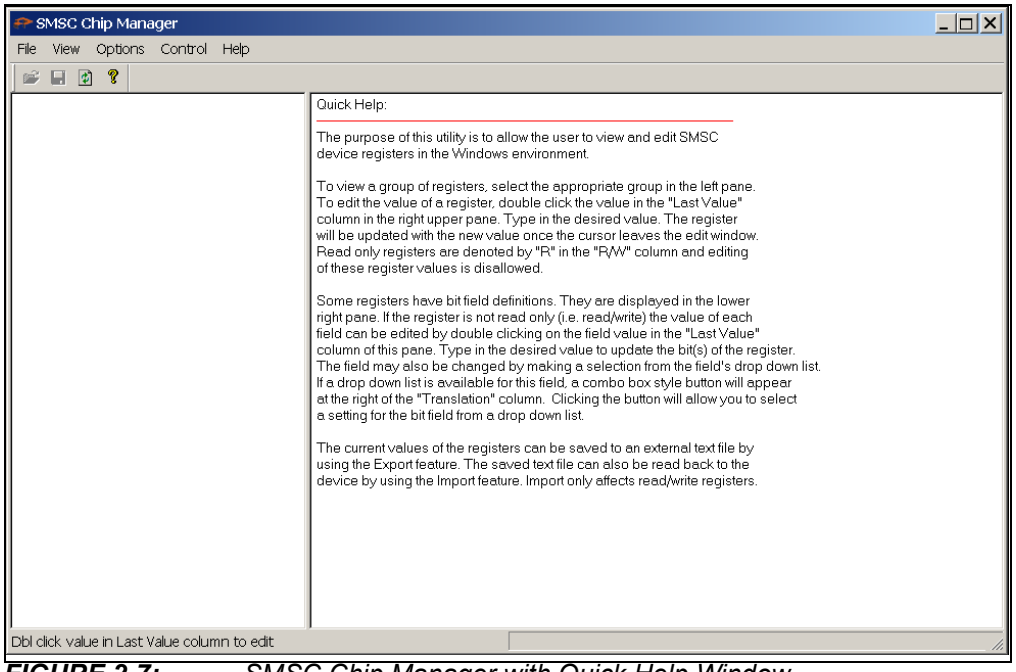


FIGURE 2-7: *SMSC Chip Manager with Quick Help Window.*

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10. If a message stating that no device has been selected appears, click **Yes** to select a device. Alternatively, go to the Chip Manager's main menu, select *Options > Select Device*. In either case, the Select SMSC Device window displays, as shown in Figure 2-8.

    In the "SMSC Device" list, choose EMC1182. From the "Master Controller" drop-down list choose "SMBus USB-SMB-SPI Bridge". Click **OK** to complete the device selection.

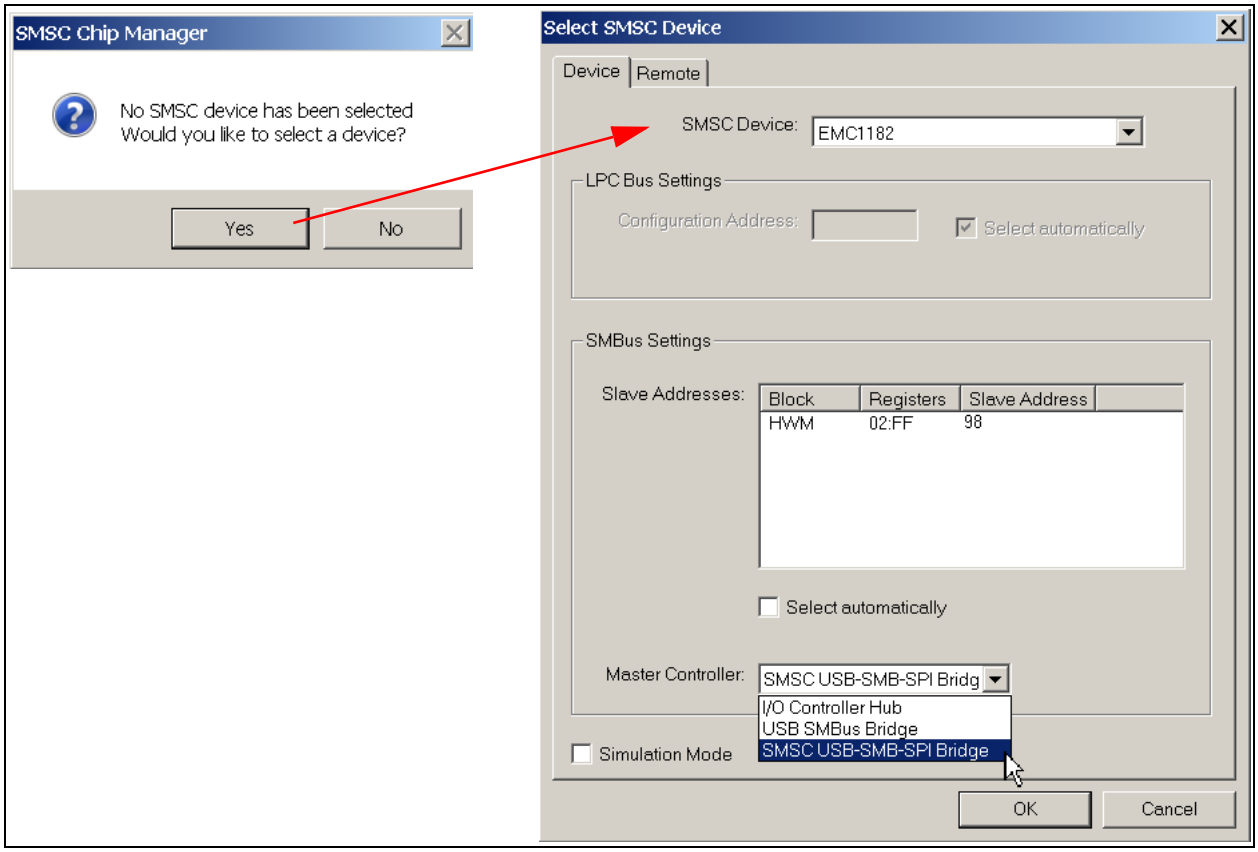


FIGURE 2-8: *Select SMSC Device Window.*

11. From the Chip Manager main menu, ensure that *Options > Auto refresh Registers* is checked. In the left panel, click the hardware monitor (HWM) to expand the content, then select any of the register groups, as shown in Figure 2-9. The USB Activity LED on the board starts blinking when any of the register groups are selected. The register values are automatically updated every second when the Auto Refresh option is on.

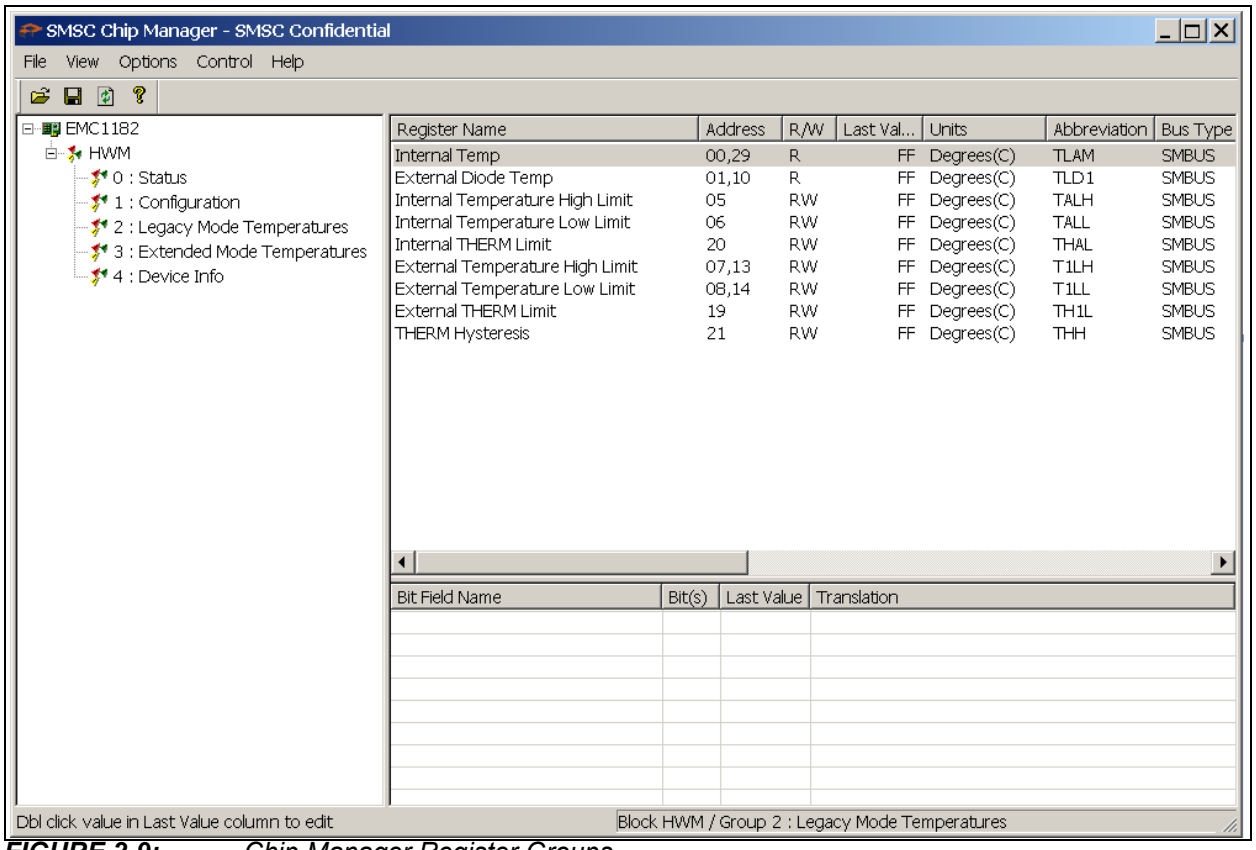


FIGURE 2-9: *Chip Manager Register Groups.*

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Chapter 3. Hardware Description

3.1 INTRODUCTION

The EMC1182 Temperature Sensor Evaluation Board provides the means to demonstrate all of the EMC1182 features, and allows the registers to be viewed and modified. LEDs indicating status information and test points are included to enable system voltage monitoring, using a voltmeter or an oscilloscope.

3.1.1 Power Source

The board requires only one universal serial bus (USB) connection to power the board. The USB-to-SMBus bridge regulates the +5V USB power to +3.3V used by the EMC1182 and other evaluation board circuitry.

3.2 USB-TO-SMBUS BRIDGE

The USB-to-SMBus bridge is based on an 8-bit microcontroller with integrated USB and SMBus interfaces, as well as internal flash and RAM. During the evaluation board manufacturing process, the firmware is loaded into the bridge that provides the interface between the USB and the SMBus. Power is sourced to the microcontroller from the USB interface for device power and communication.

3.2.1 Direct SMBus Connect Option

It is also possible to connect an external SMBus master to the EMC1182 Temperature Sensor Evaluation Board. A few jumper settings are required to drive the EMC1182 on the evaluation board, as explained in the following steps:

- Remove the jumpers on header JP10 and connect the SMBus master to the SDA, SCL and $\overline{\text{ALERT}}$ pins (3, 5 and 7, respectively), as well as an external supply for +3.3V (pin 1).
- Remove resistors R19, R20, R22 and R25, shown in Figure 3-1.
- The +3.3V can be supplied by the SMBus bridge by leaving the +3.3V jumper in place and retaining the USB connection.

3.2.2 Supplemental 1.8V SMBus Pull-up

A 1.8V (nominal) linear regulator is placed on the board along with the jumpers to connect SDA and SCL to a 1.8V pull-up supply. Once the jumper resistors are disconnected, jumpers connecting J2-1 to J2-2 and J2-3 to J2-4 may be installed to activate the 1.8V pull-ups. This jumper is identified in Figure 3-1 by the blue circle.

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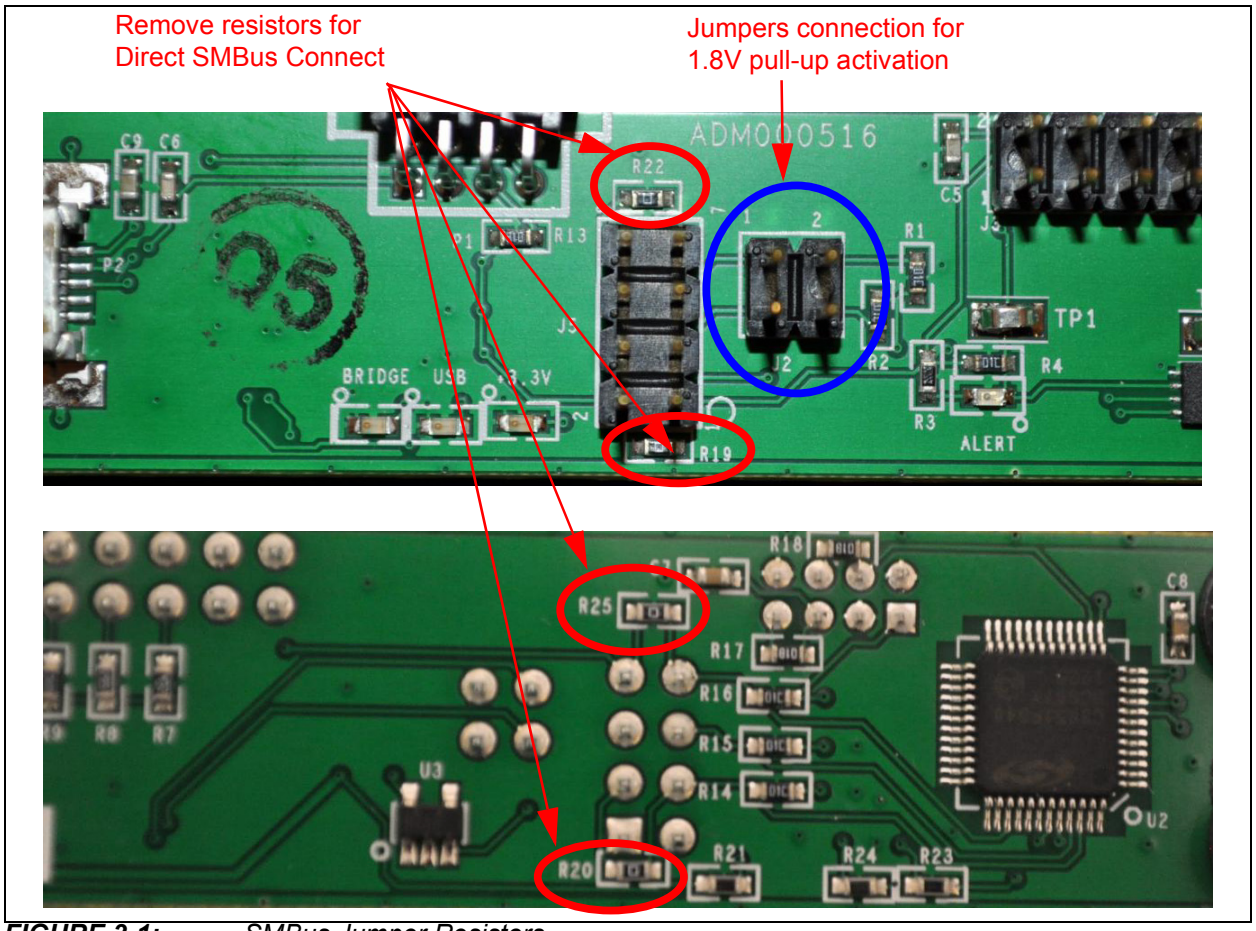


FIGURE 3-1: *SMBus Jumper Resistors.*

3.3 RESISTANCE ERROR CORRECTION (REC)

The external diode 1 (Q1) on the board has a series resistance adjustment on the DN line. Checking the Resistance Error Correction (REC) feature is accomplished by turning the resistor wheel R5. With the REC on, the temperature will not change as the wheel is turned. With REC off, a significant temperature error will occur.

3.4 TEST POINTS

The EMC1182 Temperature Sensor Evaluation Board includes test points for the following:

- $\overline{\text{ALERT}}$ output (TP1)
- $\overline{\text{THERM}}$ output (TP2)

3.5 LED INDICATORS

Table 3-1 details the LEDs status of the following signals:

TABLE 3-1: LED STATUS INDICATORS

LED No.	Signal	When LED is OFF	When LED is ON	Color
LED1	$\overline{\text{ALERT}}$	+3.3V power OFF	$\overline{\text{ALERT}}$	red
LED3	+3.3V	+3.3V power OFF	+3.3V power ON	green
LED4	Bridge Activity	NO Activity on USB/SMBus Bridge	Activity on USB/SMBus Bridge	green
LED5	USB Activity	NO Activity on USB port	Activity on USB port	green

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3.6 REMOTE DIODES

The evaluation board is populated with jumpers to connect to the on-board diode or an off-board diode (see Table 3-2).

To connect to an off-board CPU or GPU, remove both jumpers from header J1. Then connect Pin 1 to the 'remote+' terminal of the off-board diode and Pin 2 to the 'remote–' terminal of the off-board diode. Make sure a common ground exists between the off-board diode (GPU, etc.) and the evaluation board. Ensure that the off-board diode is properly biased. Consult the CPU manufacturer's data sheet for guidance on interfacing to the thermal diode. Refer to the EMC1182 Temperature Sensor Evaluation Board schematic in **Appendix A. "Schematic and Layouts"** for details on the evaluation board header connections.

TABLE 3-2: REMOTE DIODE CONFIGURATIONS

Jumper	Configuration	Pin 1	Pin 2	Pin 3	Pin 4
J1	On-board diode (Q1)	short/DP		short/DN	
	General purpose remote diode	open	remote+/DP	open	remote–/DN
	CPU/GPU diode	good common ground			

3.7 OTHER SENSOR FEATURES

Other features, such as Conversion Rate, Dynamic Averaging and Digital Filtering, can be controlled with the EMC1182 registers. Refer to the device data sheet for details on the register description.

NOTES:

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Chapter 4. Software Description

4.1 CHIP MANAGER APPLICATION OVERVIEW

The Chip Manager application enables the user to display temperature readings, set temperature limits and read/write configuration register values. The Chip Manager initially displays a Quick Help screen (see Figure 2-7). For detailed information on application features and usage, select *Help > Contents* to display the HTML-based Help document, as shown in Figure 4-1.

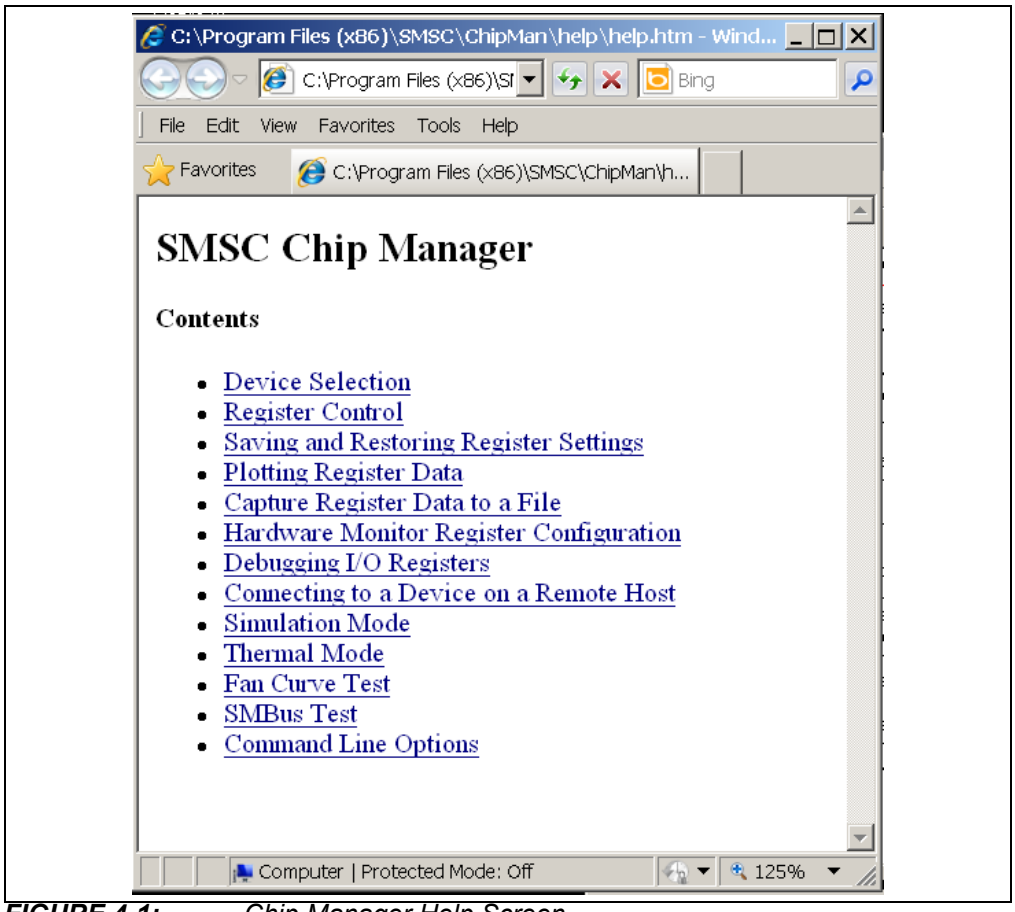


FIGURE 4-1: *Chip Manager Help Screen.*

4.1.1 Real-Time Register Graphs

The Chip Manager software has the ability to plot register values in real-time, up to a 10 Hz continuous rate.

4.1.2 Selecting Registers to Plot

1. To plot a register, right-click the desired register name or value. Select the "Add Register(s) to Plot" from the context menu (see Figure 4-2), to add the register or value to the plot list.

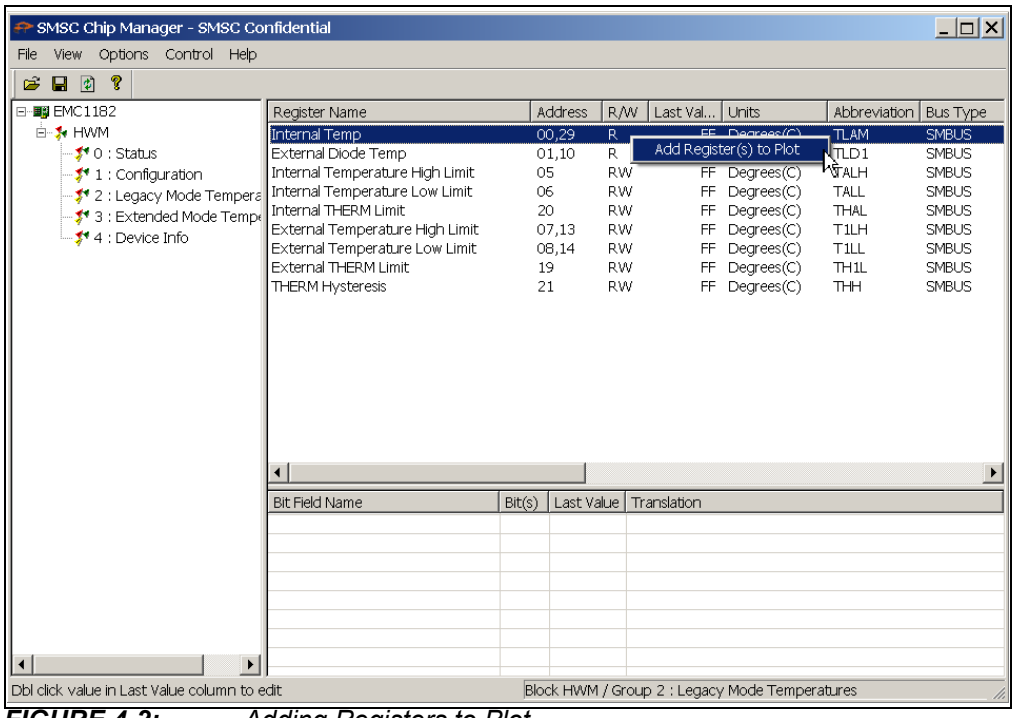


FIGURE 4-2: *Adding Registers to Plot.*

2. Once the desired register is added to be plotted, a graphic plot window will appear with a legend on top, as shown in Figure 4-3. The two windows can be rearranged independently.

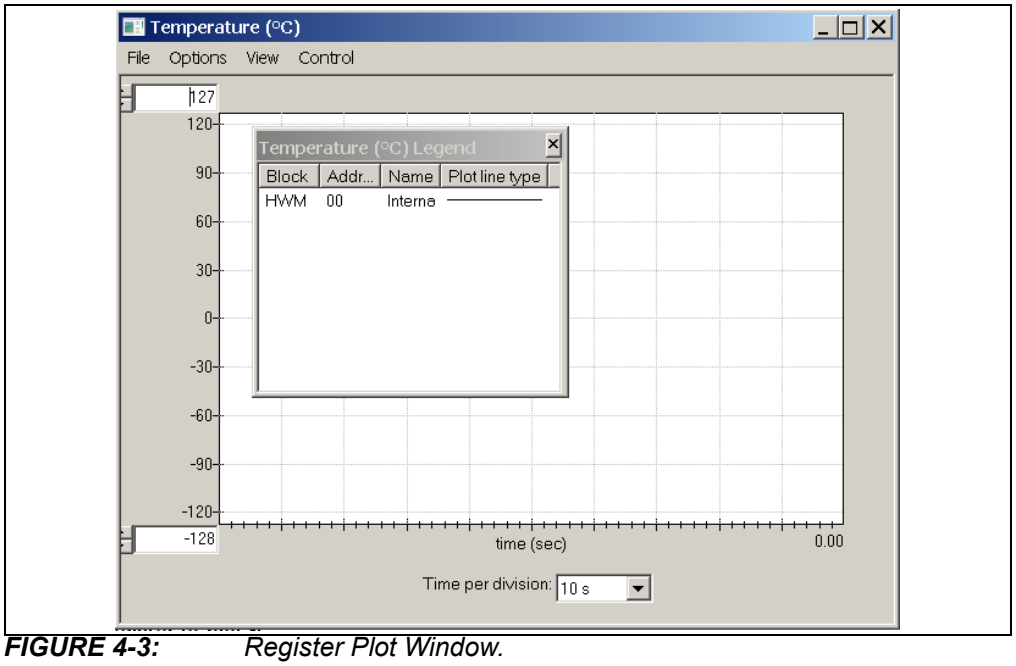


FIGURE 4-3: *Register Plot Window.*

3. To plot additional registers, go back to the Chip Manager main window and repeat Step 1.

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4.1.3 Starting the Plots

All plots can be started simultaneously by selecting *Control > Plots > Start All Plots* from the menu, in the main application window. Multiple plots will be in sync if they are started simultaneously.

Individual plots may be paused at any time by clicking *Control > Pause* in the plot window. This will not cause loss of captured data on the other plot windows.

For a better view on the plot, select a different “Time per division” value in the drop-down menu at the bottom of the plotting window. This scale change affects both the real-time mode and the playback mode, while the rate at which data is recorded is unaffected.

4.1.4 Sampling a Plot

Figure 4-4 is an example of temperature history. Internal Temperature, External Diode 1 Temperature and External Diode 1 High Limit are selected for plotting. The results after the plot starting are that the External Diode Temperature High Limit is reduced, the External diode 1 starts at room temperature and is then heated by simply placing a finger on the external diode Q1.

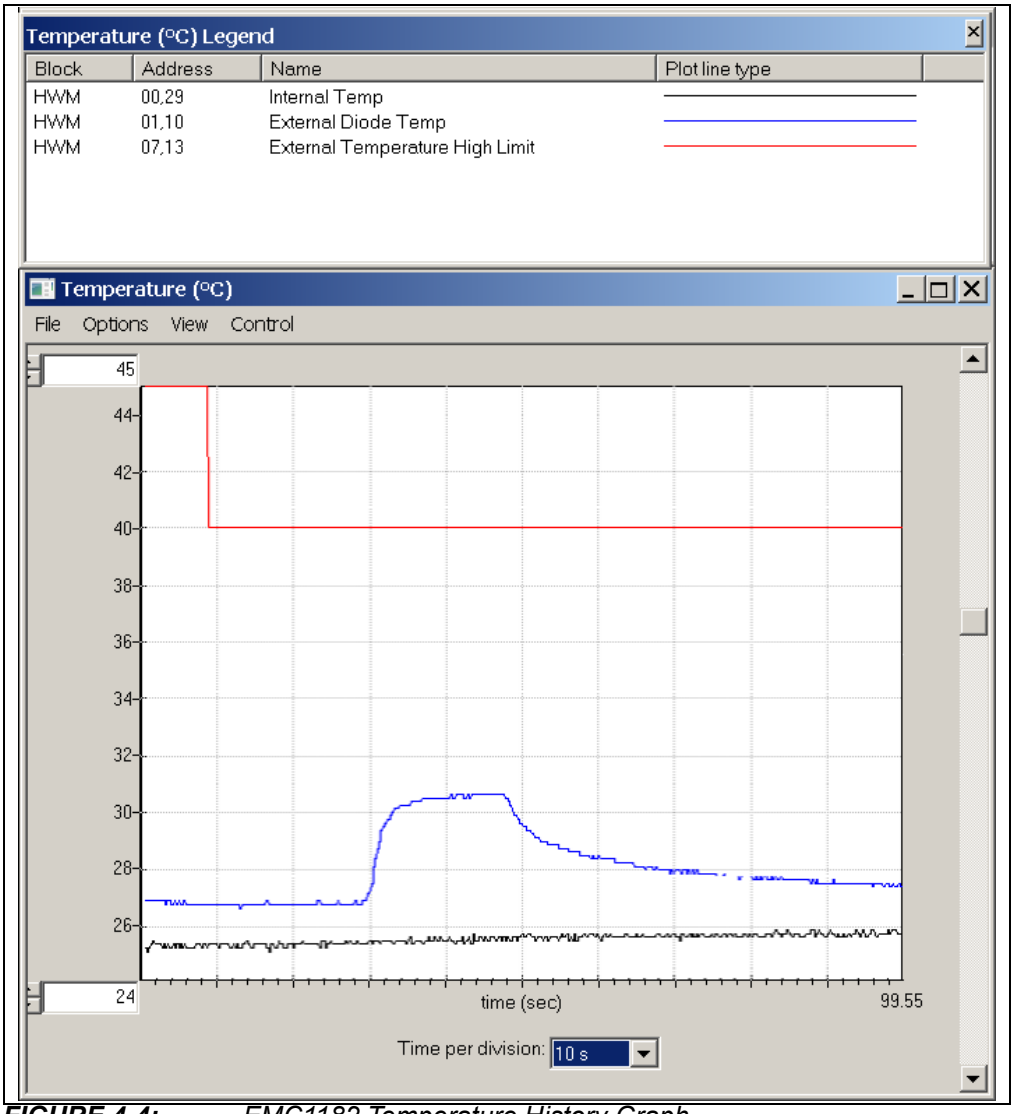


FIGURE 4-4: *EMC1182 Temperature History Graph.*

4.1.5 Exporting and Importing the Plot Data

The data on each plot window may be stored in a semicolon-separated text file. To save the data, follow the steps:

1. Stop the plotting by selecting *Control > Stop* from the plot window, or *Control > Plots > Stop All Plots* from the Chip Manager main window.
2. Select *File > Export* from the plot window to save the data.

To review saved data:

1. Select *File > Import* from an open plot window and then select the file name to open.

Note: Importing a saved data file into a plot window with a different data type is not allowed by the Chip Manager application. In this case, a warning message will display. It is recommended to choose a file name that reflects the data type when exporting the plot data.

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Appendix A. Schematic and Layouts

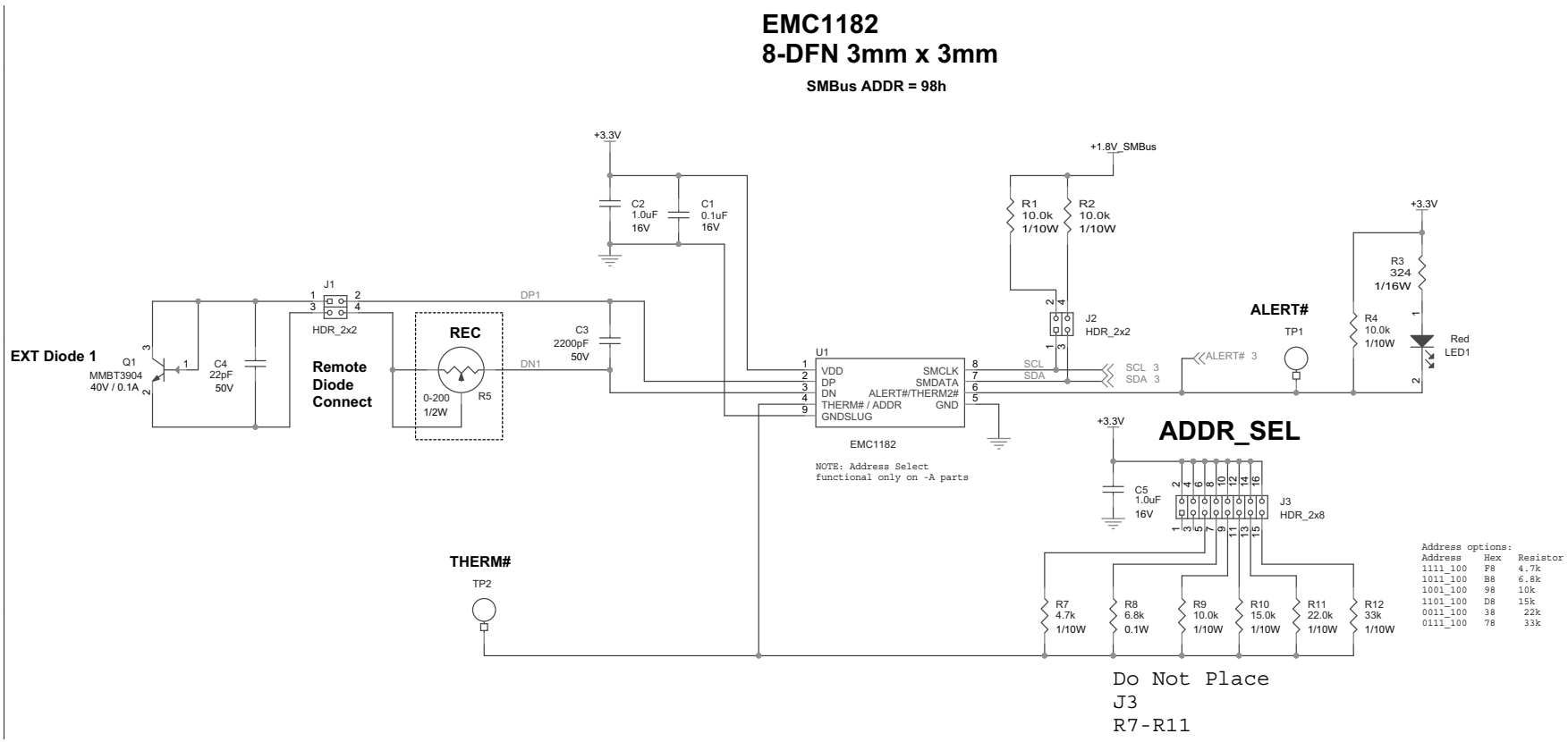
A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the EMC1182 Temperature Sensor Evaluation Board:

- Board – EMC1182 and Interface Schematic
- Board – USB-to-SMBus Bridge Schematic
- Board – Top Silk
- Board – Top Pads
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Pads
- Board – Bottom Silk

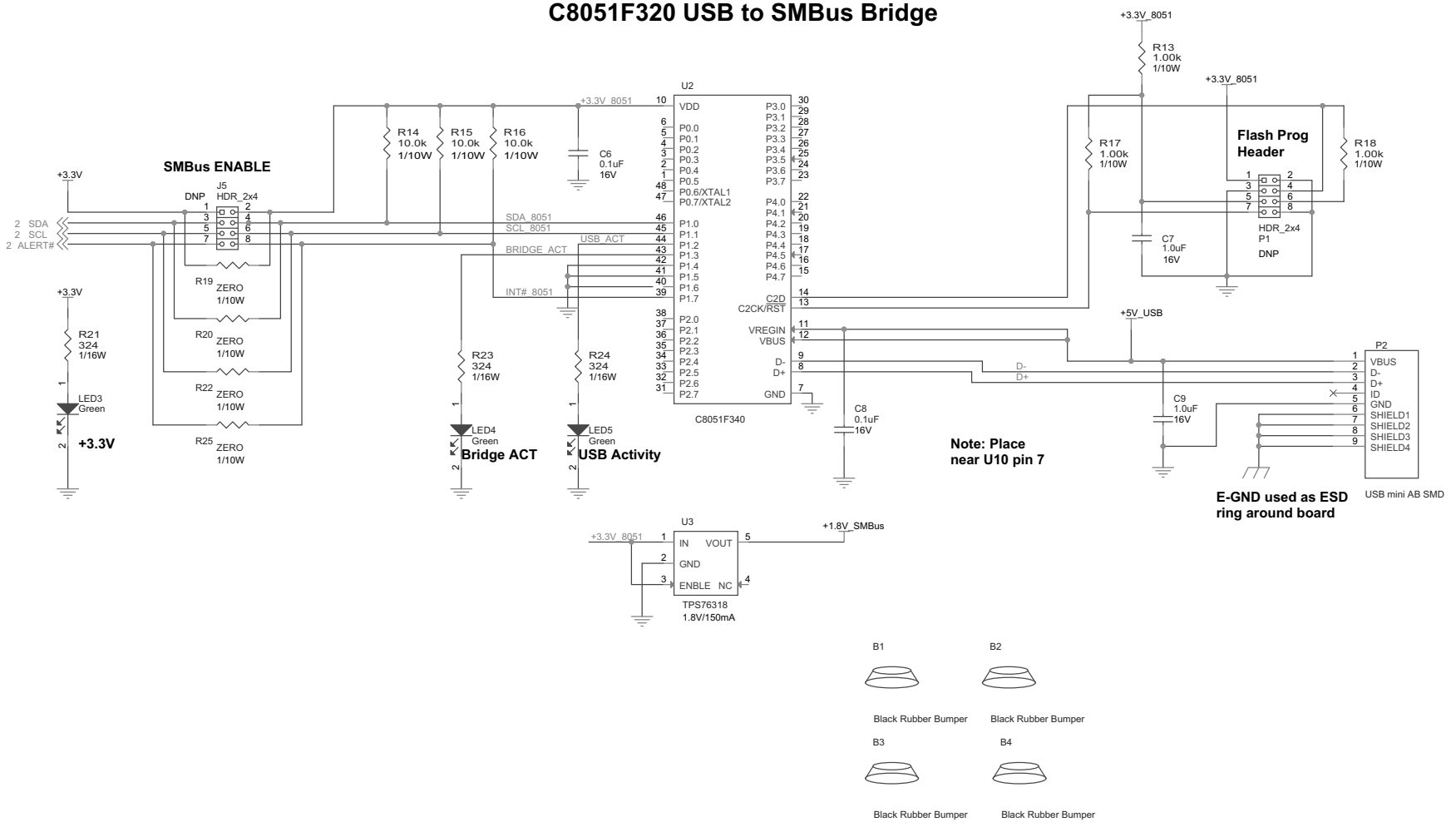
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A.2 BOARD – EMC1182 AND INTERFACE SCHEMATIC



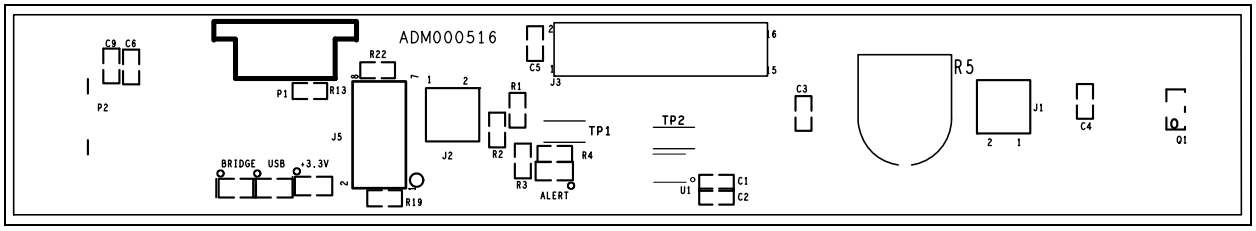
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A.3 BOARD – USB-TO-SMBUS BRIDGE SCHEMATIC

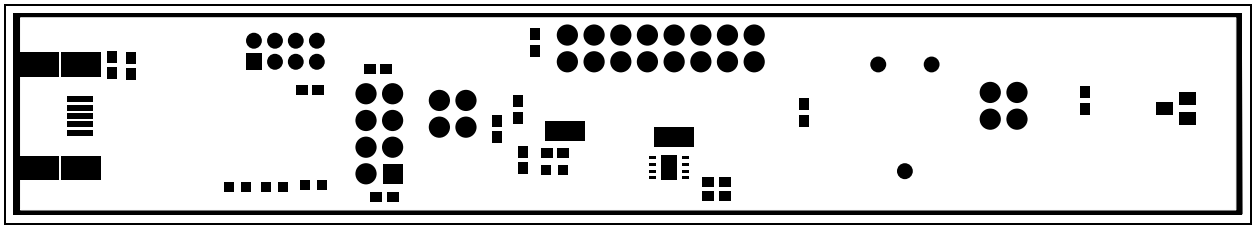


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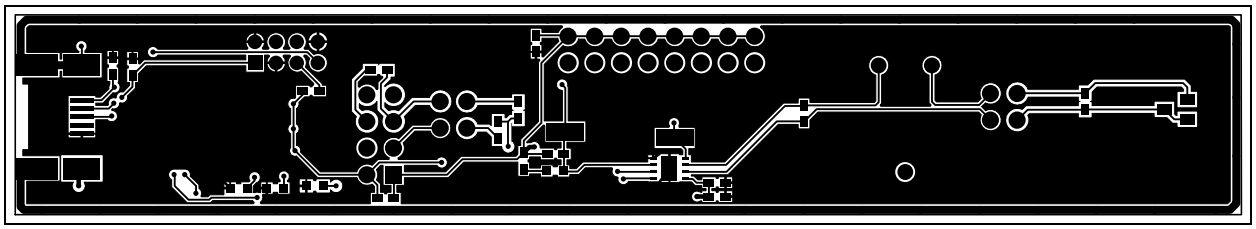
A.4 BOARD – TOP SILK



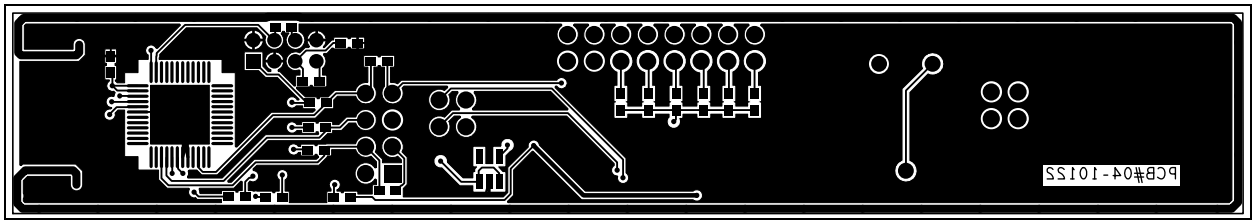
A.5 BOARD – TOP PADS



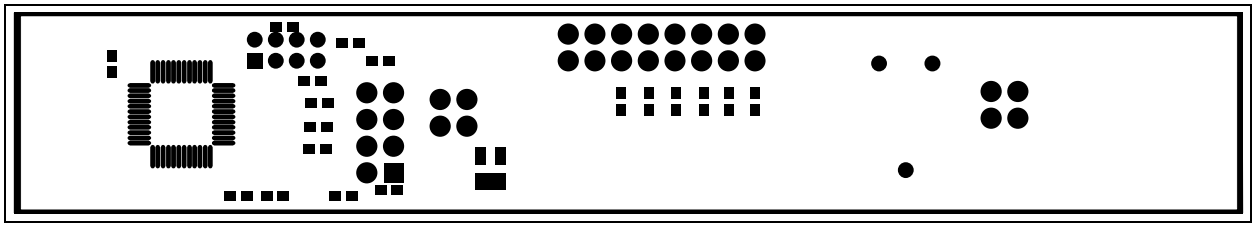
A.6 BOARD – TOP COPPER



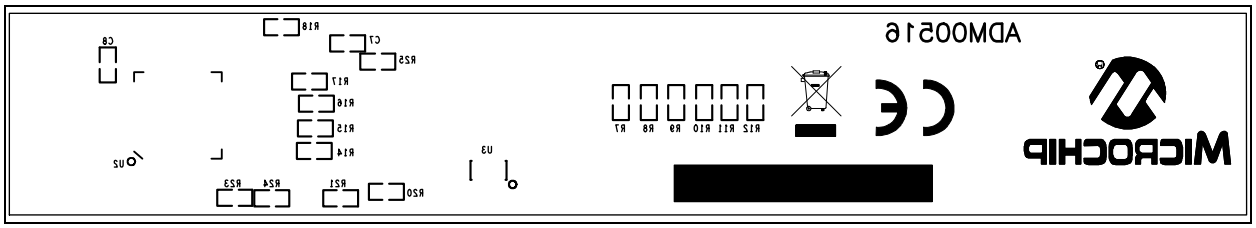
A.7 BOARD – BOTTOM COPPER



A.8 BOARD – BOTTOM PADS



A.9 BOARD – BOTTOM SILK



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Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIAL (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
4	B1, B2, B3, B4	Bumper blk .3705.19" cylinder	Richco®, Inc.	RBS-35BK
3	C1, C6, C8	Capacitor ceramic 0.1 µF 16V 10% X7R 0603	Panasonic® - ECG	ECJ-1VB1C104K
4	C2, C5, C7, C9	Capacitor ceramic 1.0 µF 16 VDC 10% X5R 06	Panasonic - ECG	ECJ-1VB1C105K
1	C3	Capacitor ceramic 2200 pF 50V 20% X7R 060	Murata Electronics®	GRM188R71H222MA01D
1	C4	Capacitor ceramic 22 pF 50V NP0 0603	KEMET®	C0603C220J5GACTU
2	J1, J2	Header, 2 X 2, 0.1 inch, vertical	Samtec, Inc.	TSW-102-07-L-D
0	J3	Header, 2 X 8, 0.1 inch, vertical	Samtec, Inc.	TSW-108-07-L-D
1	J3	Header, 1 X 2, 0.1 Inch, vertical, **DO NOT POPULATE**	Molex® Connector Corporation	22-28-4020
1	J5	Header, 2 X 4, 0.1 INCH, vertical	Samtec, Inc.	TSW-104-07-L-D
1	LED1	LED red clear 0603 SMT	Lite-On® Technology Corporation	LTST-C190CKT
3	LED3, LED4, LED5	LED green SMT	Stanley Electric Co., Ltd.	BG1111C-TR
1	P1	Connector Header 8 POS 2MM right angle gold	Molex Connector Corporation	87833-0820
1	P2	Connector recept. USB mini AB 5 POS right angle	Molex Connector Corporation	56579-0576
1	PCB	EMC1182 Temperature Sensor Evaluation Board – Printed Circuit Board	—	104-00516
1	Q1	Transistor NPN SOT-23 MMBT3904	Fairchild Semiconductor®	MMBT3904
6	R1, R2, R4, R14, R15, R16	Resistor 10.0K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0710KL
0	R10	Resistor 15.0K Ohm1/10W 1% 0603 SMD, **DO NOT POPULATE**	Yageo Corporation	RC0603FR-0715KL
0	R11	Resistor 22.0K Ohm 1/16W 1% 0603 SMD, **DO NOT POPULATE**	Yageo Corporation	RC0603FR-0722KL
1	R12	Resistor 33K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0733KL
3	R13, R17, R18	Resistor 1.00K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-071KL
4	R19, R20, R22, R25	Resistor zero Ohm 1/10W 5% 0603	Yageo Corporation	RC0603JR-070RL
4	R3, R21, R23, R24	Resistor 324 Ohm 1/16W 1% 0603	Panasonic - ECG	ERJ-3EKF3240V
1	R5	Trimpot 200 Ohm thumb wheel	Bourns®, Inc.	3352E-1-201LF

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-1: BILL OF MATERIAL (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
0	R7	Resistor 4.7K Ohm 1/10W 1% 0603 SMD, **DO NOT POPULATE**	Yageo Corporation	9C06031A4701FKHFT
0	R8	Resistor 6.8K OHM 0.1W 5% 0603, **DO NOT POPULATE**	Yageo Corporation	RC0603JR-076K8L
0	R9	Resistor 10.0K OHM 1/10W 1% 0603, **DO NOT POPULATE**	Yageo Corporation	RC0603FR-0710KL
2	TP1, TP2	TEST POINT	Keystone Electronics Corp.	5015
1	U1	Dual Channel 1.8V SMBus/I^2C Temperature Sensor with Resistance Error Correction, Beta Compensation	Microchip Technology Inc.	**EMC1182-1-AIA-TR**
1	U2	IC 8051 MCU Flash 64K 48 TQFP	Silicon Laboratories® Inc.	C8051F340-GQ
1	U3	IC LDO Reg. 150 MA 1.8V SOT23-5	Texas Instruments	TPS76318QDBVRQ1

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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