

## EMC1002/EMC1033/EMC1402 EVB User Manual



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## 1 Overview

The EMC1002/1402 is an SMBus temperature sensing IC with 1 internal and 1 external sensor in an 8 pin MSOP package. The EMC1002/1402 has 2 Alert/Therm2 and Addr/Therm outputs that can be configured to signal when temperatures exceed programmed limits. Resistance Error Correction can eliminate the affect of series resistance to provide a more accurate temperature reading. This is especially important for microprocessors, FPGAs, and graphics chips. The EMC1033 is also supported by this evaluation board (EVB). The EMC1033 has an additional feature, "Anti-Parallel Diode" (APD) support which allows the connection of two diodes to the EMC1033's DP/DN inputs in opposite polarity.

The EVB-EMC1002, EVB-EMC1033 and EVB-EMC1402 are USB-based platforms for evaluating the EMC1002/1033/1402. A block diagram of the EVB is shown in [Figure 1.1](#) below.

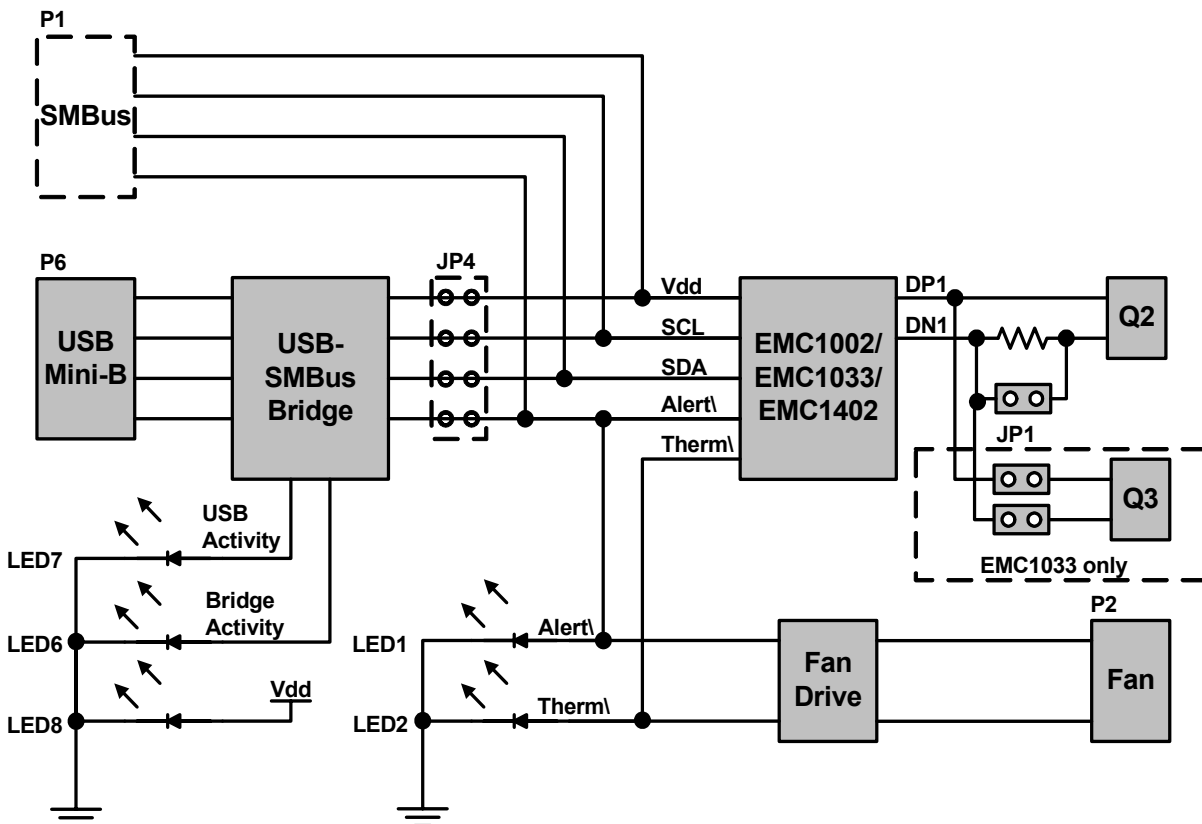


Figure 1.1 EMC1002 / EMC1033 / EMC1402 EVB Block Diagram

### 1.1 Related Documents

The CD included with the evaluation board contains the following documents:

- n Evaluation Board Checklist
- n Bill Of Materials
- n Schematic
- n Jumper Settings and Connector List
- n EMC1002, EMC1033, or EMC1402 Datasheet
- n Register Manager Application
- n Register Manager Readme.txt
- n EMC1002.ini, EMC1033.ini and EMC1402.ini Register Definition Files

## 2 Getting Started

### 2.1 System Requirements

To use the EVB you will need:

- n A PC running Windows 2000 or XP
- n Display resolution 800x600 (or larger to view several windows simultaneously)
- n An available USB port

#### 2.1.1 Feature Summary

- n Windows Register Manager application allows viewing and changing register values as well as graphing temperature history
- n USB communication to evaluation board
- n Resistive Error Correction can be demonstrated
- n LEDs for  $\overline{\text{Alert/Therm2}}$  and  $\overline{\text{Addr/Therm}}$  indication as well as USB bridge activity
- n Low cost fan control driven by  $\overline{\text{Alert/Therm2}}$  and  $\overline{\text{Addr/Therm}}$  outputs
- n An external SMBus master may also be used (circuit modifications required)

#### 2.1.2 Board Layout

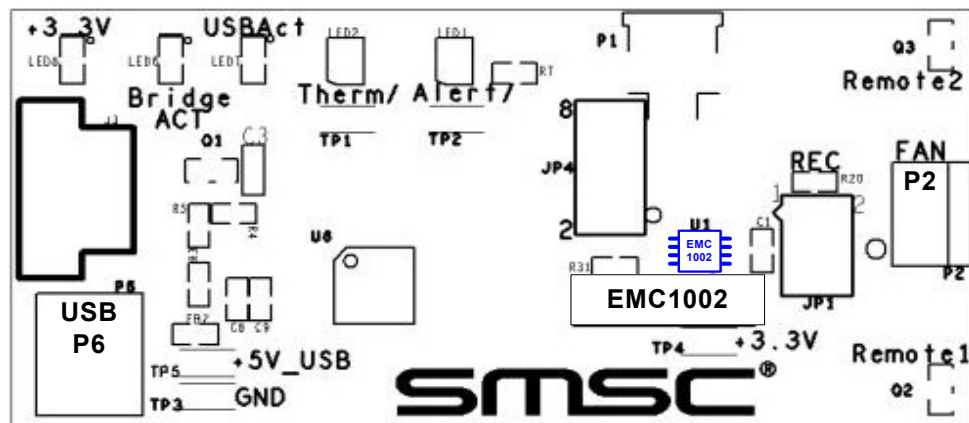
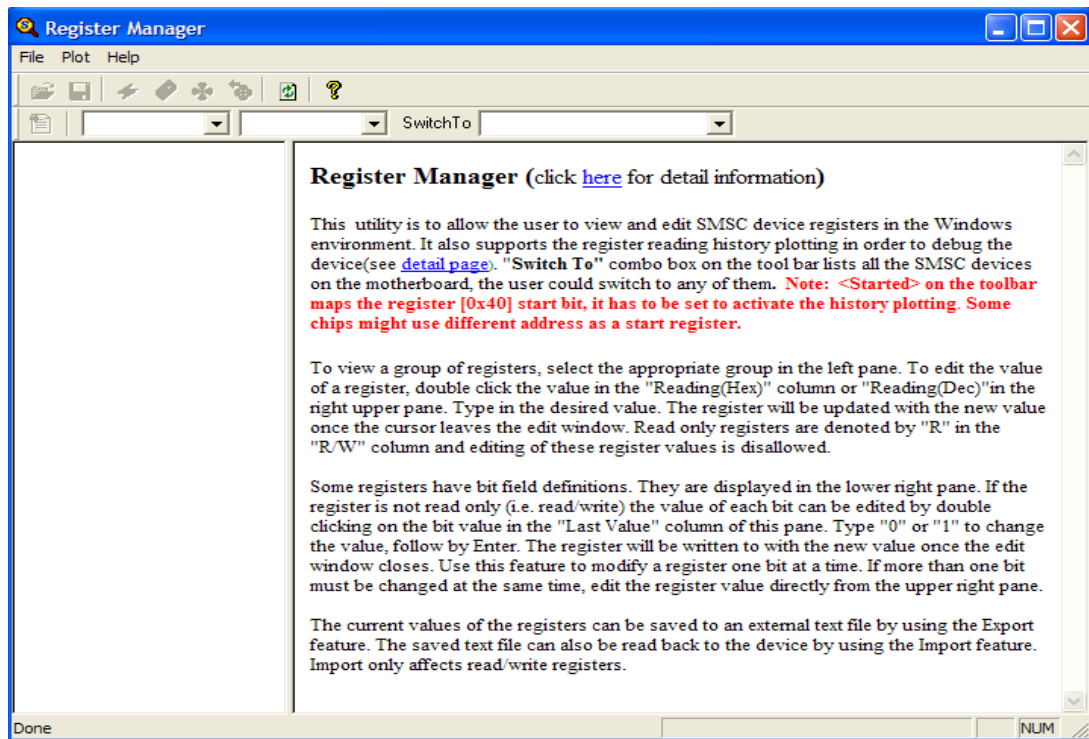


Figure 2.1 EMC1002 Board Outline and Silkscreen

#### 2.1.3 Installing the EVB

1. Install the RegMan application and device driver on a PC by running Setup.exe from the RegMan distribution CD. A revision history and install/uninstall notes may be found in the readme.txt file on the disk.
2. Connect the supplied USB cable to an available USB port on the PC. Plug the “mini-B” end of the USB cable into EVB connector P6. The +3.3V, Bridge ACT,  $\overline{\text{Alert/Therm2}}$  and  $\overline{\text{Addr/Therm}}$  LEDs should illuminate. After the EVB is connected to the PC the “Find New Hardware” wizard will pop up for USB driver installation. Follow the instructions in the readme.txt file to complete the installation process.
3. Start the EVB Software by selecting the Register Manager application from the SMSC folder from the Programs Windows Start menu. The EVB will initialize and the Register Manager Help screen will appear as in [Figure 2.2](#). The USBAct LED should be blinking when the Register Manager is running.

**Note:** The Windows Register Manager application allows viewing and changing register values for a variety of EVBs including the EMC1001, EMC1002, EMC1023 and 1033. The Register Manager software only needs to be installed once to support all of these EVBs. The list of supported EVBs may be found in the readme.txt file included on the distribution CD.



**Figure 2.2 Register Manager Help Screen**

## 3 Circuit Description

### 3.1 Introduction

The EMC1002 EVB provides the means to demonstrate EMC1002/1033/1402 features and to view and modify registers. LED Indicators and test points are included to show status information and a fan driver circuit linearly drives a 5V fan to 3 different speeds based on programmable temperature limits.

### 3.2 EMC1002/1033/1402

The EMC1002/1402 are SMBus temperature sensors with 1 internal and 1 external sensor in an 8 pin MSOP package. The EMC1033 has the same features plus support for a second external sensor in parallel with Remote 1 using the “Anti-Parallel Diode” (APD) function. Communications with the EMC1002/1033/1402 is via the SMBus. Alert/Therm2 and Addr/Therm outputs may be configured to assert when temperatures exceed programmed limits.

### 3.3 USB to SMBus Bridge

The USB to SMBus bridge is based on an 8051 microcontroller with integrated USB and SMBus interfaces as well as internal flash and RAM. During EVB manufacture, firmware is loaded into the bridge that provides the interface between the SMBus and the USB driver. Power is sourced to the MCU from the USB interface.

### 3.4 Remote Diode with Resistance Error Correction (R.E.C.)

Two diode-connected 2N3904 transistors may be mounted on the EVB, Remote1 and Remote2. Remote2 is only populated for the EMC1033 EVB and may be disabled by removing jumpers on JP1. The Remote1 diode DN signal path has a series resistor to demonstrate the EMC1002/1033/1402 's R.E.C. feature. The resistor may be effectively removed from the circuit by installing a jumper on JP1. See the Jumper Settings and Connection List for details on jumper settings.

### 3.5 Power Source

This demo board derives +5V power from the USB port. The bridge microcontroller has an internal voltage regulator that supplies +3.3V to the EMC1002/1033/1402 and other EVB circuits.

### 3.6 Fan Drive Circuit

The fan drive circuit linearly drives a 5V, 2-wire fan. Three different drive voltages are possible with the resistor values used on this EVB, 0, 2.4 and 4.1V. If R6 is populated with an 820 ohm resistor, the fan drive voltages will be approximately 2.4, 3.2. and 4.1V. Other fan drive voltage combinations can be achieved by varying R3, R4 and R6. R3 and R4 are located on the top side of the PCB next to transistor Q1. R6 is on the bottom side of the PCB directly opposite Q1.

**Note:** Full fan ON cannot be achieved with this circuit due to transistor voltage drop.

The fan drive voltage is set by controlling Q1's base and emitter voltages. When neither the Alert/Therm2 or Addr/Therm outputs are asserted low, no current flows through Q1's base terminal so the base and emitter voltages are high and the fan will be OFF. When the Alert/Therm2 output is asserted low, the base voltage is set by the resistor divider R3/R4. When the Addr/Therm output is asserted low, the transistor is turned ON fully, resulting in the maximum fan drive voltage for this circuit, which is approximately 4.1V.

### 3.7 System Interrupts / LEDs

The Alert/Therm2 and Therm outputs each have a dual-color LED to indicate the Normal (green) and Alert (red) status The Alert/Therm2 line is also routed to the USB bridge to provide Alert status to the RegMan application.

### 3.8 Direct SMBus Connect Option

It is also possible to connect an external SMBus master to the EMC1002 EVB. A few modifications to the circuit are required:

- n Cut 3 traces connecting JP4 pins 3-4, 5-6 and 7-8 on the bottom side of the PCB. This will disconnect the USB bridge from the SMBus. The pullup resistors for the SMBus SDA, SCL and Alert/Therm2 signals are also disconnected so external pullups will need to be supplied by the SMBus Master.
- n Install P1 or JP4 to provide an SMBus connector. See the Jumper Settings and Connection List for details.
- n Optionally remove zero ohm resistor R31. When removed, the USB to SMBus bridge will not supply +3.3V to the circuitry so power will need to be provided from an external source. If R31 is left installed, power will be supplied from the USB connector when connected to a computer or USB hub.

### 3.9 Test Points

Test points are provided for:

- n Alert/Therm2 output, EMC1002/1033/1402 pin 6
- n Addr/Therm output, EMC1002/1033/1402 pin 4
- n Ground
- n +3.3V power
- n +5V\_USB power

### 3.10 LED Indicators

LEDs indicate the status of the following signals:

- n Alert/Therm2, EMC1002/1033/1402 pin 6
- n Addr/Therm, EMC1002/1033/1402 pin 4
- n +3.3V
- n USB Activity - blinking indicates USB traffic
- n Bridge Activity, when ON indicates the Bridge is functioning

## 4 Demo Description

### 4.1 Register Manager Overview

The Register Manager application (RegMan) initially displays the main Help screen, where detailed description of the application's features may be found. The Help screens can be displayed at any time by selecting Help from the menubar or pressing the ? button on the toolbar. RegMan enables the user to display temperature readings, set temperature limits and read/write configuration register values.

### 4.2 Temperature History Graph

To open a Temperature History Graph window, select Plot -> Temperature History Plot from the menubar. The history plot continuously updates the temperature reported by the temp sensor. There are several display options, including which temperatures to display (internal, external, external2 for EMC1033 only), whether limits should be displayed, and if so, for which temp sensor. See a typical Temperature History Graph in [Figure 4.1](#) below:

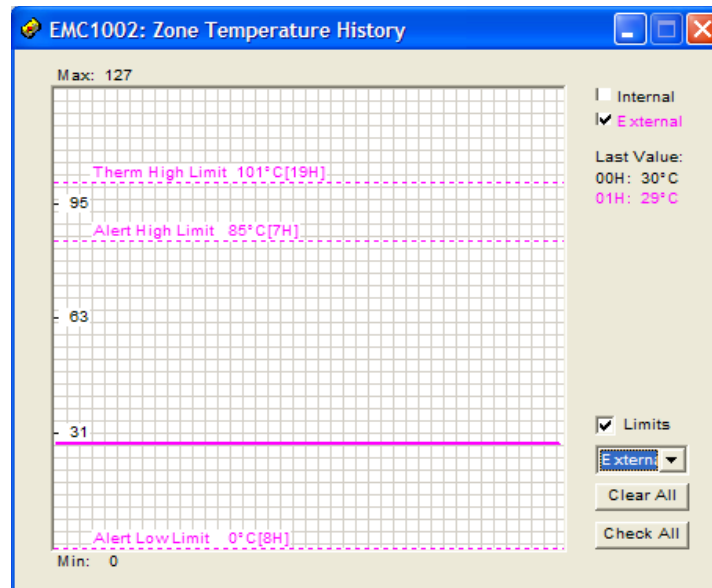


Figure 4.1 Temperature History Plot

### 4.3 Temperature Limits and $\overline{\text{Alert/Therm2}}$ , $\overline{\text{Addr/Therm}}$ Outputs

The high and low limits are displayed as dashed lines, initially with values set in the EMC1002.ini file. (or EMC1033.ini) These limits may be changed either in the register manager or by dragging the line on the history plot. If any of the Temp High or Temp Low Limits are exceeded, the  $\overline{\text{Alert/Therm2}}$  output will assert. If the Ext THERM Limit or the Local THERM Limit are exceeded, the  $\overline{\text{Addr/Therm}}$  output will be asserted.

The  $\overline{\text{Alert/Therm2}}$  and  $\overline{\text{Addr/Therm}}$  outputs are asserted active Low when a temperature exceeds the programmed limits. The state of these outputs can be monitored by the associated bi-color LEDs or test points on the PCB.

The  $\overline{\text{Alert/Therm2}}$  output pin can be configured to function as either an SMBus  $\overline{\text{Alert}}$  output or as a  $\overline{\text{Therm2}}$  output. When configured as an SMBus  $\overline{\text{Alert}}$  pin it will follow the SMBus Alert Response protocol to clear the assert state. When configured as a  $\overline{\text{Therm2}}$  output it will not require the SMBus Alert Response Protocol to clear the pin's status. This pin is initialized as a  $\overline{\text{Therm2}}$  output by the EMC1002/1033/1402 .ini file. Change register 0x09 bit #5 to "0" to configure the pin function to  $\overline{\text{Alert}}$  mode.

**Note:** Asserting the  $\overline{\text{Addr/Therm}}$  output low will also turn on the ARA LED on this EVB. This is because the fan driver circuit will pull down the  $\overline{\text{Alert/Therm2}}$  output when  $\overline{\text{Addr/Therm}}$  is low. The SMBus ARA Protocol will not function in this case.

#### 4.4 Fan Driver

The fan driver utilizes the  $\overline{\text{Alert/Therm2}}$  and  $\overline{\text{Addr/Therm}}$  outputs to drive a +5V fan to 3 different fan speeds. See the Circuit Description above for information about the fan driver. Normally, the fan driver is OFF. To turn the fan ON at low speed, the  $\overline{\text{Alert/Therm2}}$  output must be asserted low. This can be caused by dragging the High Temp Limit line below the current temperature on the Zone Temperature History graph, using the Register Manager to set the High Temp Limit value lower than the current temperature or heating the temp sensor to exceed the limit.

To turn the fan ON to high speed, the  $\overline{\text{Addr/Therm}}$  output must be asserted low. This will occur when the current temperature exceeds the associated THERM limit.

**Note:** When  $\overline{\text{Alert/Therm2}}$  is configured as a  $\overline{\text{Therm2}}$  output, temperatures exceeding the High Temp Limit will cause it to assert, however the Low Temp Limit is ignored.

#### 4.5 SMBus Alert Protocol (ARA) Support

When the  $\overline{\text{Alert/Therm2}}$  output is asserted an SMBus Alert interrupt is generated and an indicator light will turn RED on the Register Manager panel. Press the Response button to cause RegMan to send the SMBus Alert Address to the EMC1002/1033/1402. The EMC1002/1033/1402 will respond with its SMBus address which is displayed in a text box next to the Response button on the RegMan interface. If the temperature is still above the limit, the indicator will remain lit and the  $\overline{\text{Alert/Therm2}}$  output will stay asserted. If the temperature is below the limit the indicator will turn OFF and the  $\overline{\text{Alert/Therm2}}$  output will de-assert.

#### 4.6 Resistance Error Correction (R.E.C.)

R.E.C. is normally enabled in the EMC1002/1033/1402, however, for demonstration purposes this evaluation board uses a special test mode to disable R.E.C. To show the R.E.C. feature, remove the jumper on JP1 pins 1-2. This will insert a 100 ohm series resistor into the circuit and cause a temperature reading error of approximately 60°C. Replace the jumper and the temperature will return to its correct reading. Now enable R.E.C. by entering the value 0x0c into R.E.C. configuration register 0x53. With R.E.C. enabled, the temperature will not change when the jumper is removed.

#### 4.7 Ideality Factor Correction

The Ideality Factor can be adjusted in Ideality Factor Registers 0x27 and 0x28 (EMC1033 only). These registers will normally hold the default value which is correct for the diodes installed on the EVB. Increasing or decreasing the value will cause a corresponding change in the temperature reading.

#### 4.8 Anti-Parallel Diode (EMC1033 only)

The EMC1033 supports an Anti-Parallel Diode (APD) configuration, where 2 diodes share the same DP and DN lines but are in opposite polarity to each other. The Remote2 diode can be disconnected from the circuit by removing one or both jumpers on JP1 pins 3-4 and 5-6. The APD function is normally enabled on device power-up; the function can be disabled by writing a "1" to Configuration Register 0x09, bit 0.