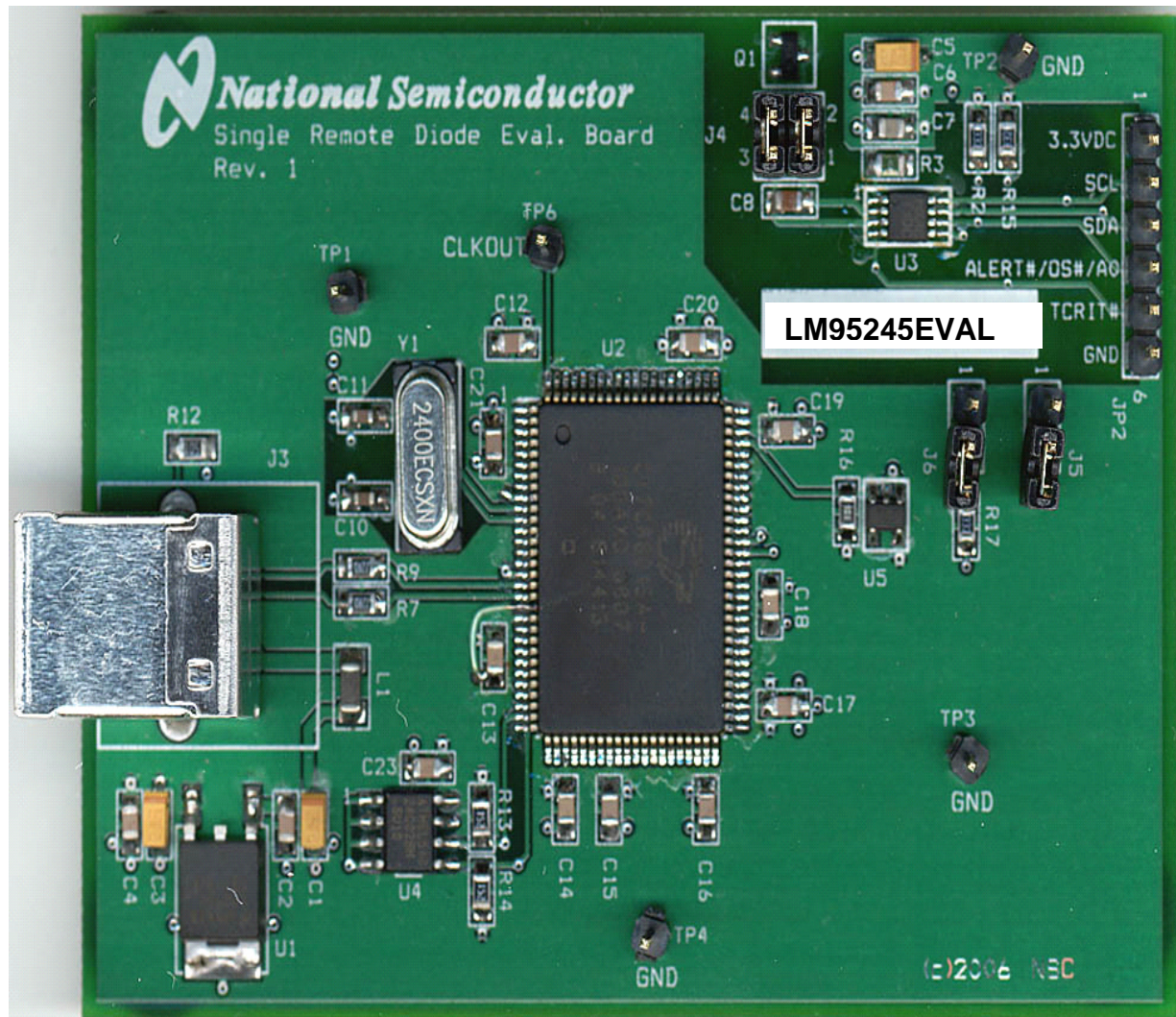


LM95245EVAL/NOPB Evaluation Board User's Guide



LM95245EVAL/NOPB Evaluation Board User's Guide

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LM95245 Evaluation Board User's Guide

References

1. "LM95245 Precision Dual Remote Diode Temperature Sensor with SMBus Interface and TruTherm™ Technology for 45 nm Process" datasheet.

The latest copy of the LM95245 datasheet can be obtained by going to the National Semiconductor website <http://www.national.com/ds/LM/LM95245.pdf>.

2. SensorEval Version 1.1.0d beta or later, Evaluation Board CD containing:
 - a. The SensorEval.exe executable program used to run the LM95245 Evaluation Board.
 - b. A softcopy of this User's Guide
 - c. A readme.txt file with useful information about the program.
 - d. A softcopy of the SensorEval Software manual.

1.0 Introduction

The LM95245EVAL/NOPB Evaluation Board is used together with the National Semiconductor SensorEval software (provided in the kit), and with a USB cable (not provided in the kit), and with an external personal computer (PC). Power to the LM95245EVAL/NOPB Evaluation Board is provided by the +5 VDC line of the USB connection. No external power supply or signal sources are required for operation of the LM95245 evaluation board.

Before connecting the PC to the LM95245EVAL/NOPB evaluation board through the USB cable, the PC is first turned on and allowed to go through its boot-up procedure. The user installs and initiates the SensorEval software. See Section 4.0 for details.

After the SensorEval software is installed, the user can connect the USB cable first to the computer and then to the LM95245EVAL/NOPB Evaluation Board.

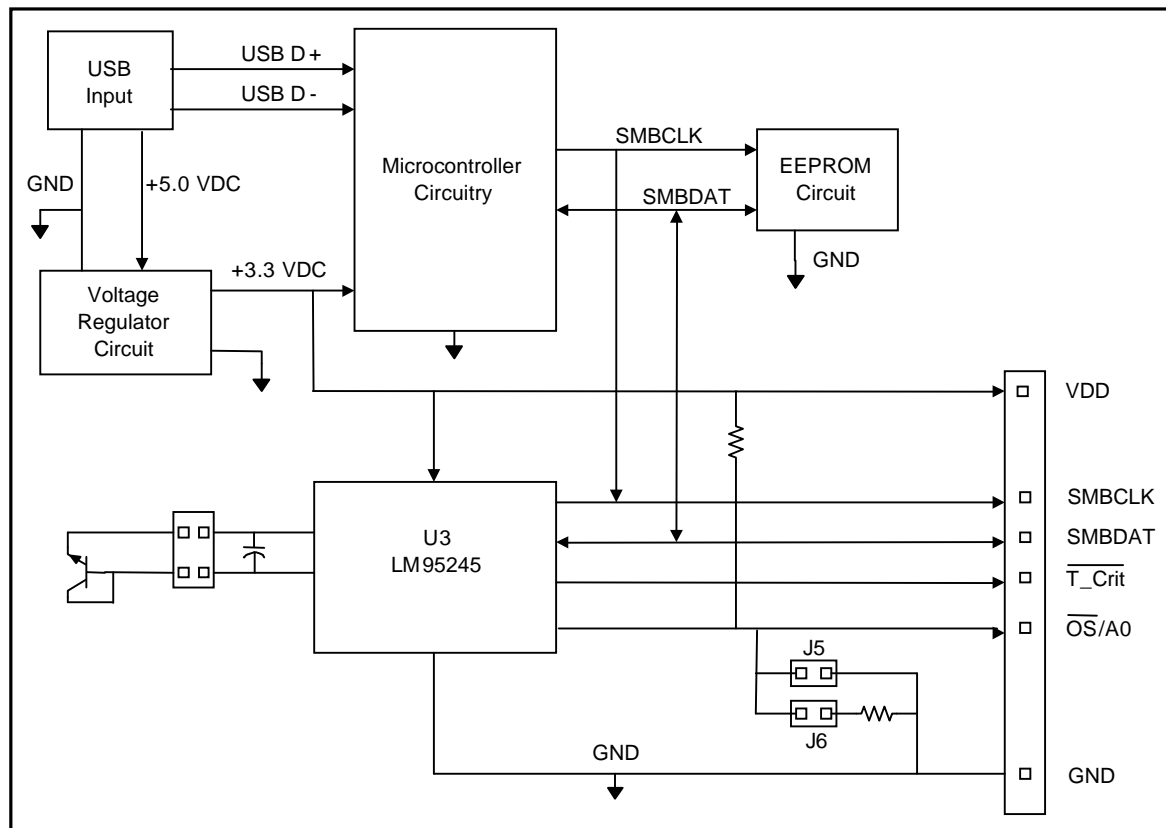
The PC should be able to recognize the board and the user simply selects the LM95245EVAL/NOPB Eval Board radio button.

The block diagram below describes the LM95245EVAL/NOPB Evaluation Board itself. The USB input provides the +5.0 VDC power to the board, which is regulated down to 3.3 VDC to power the IC's. The EEPROM is programmed at the factory with a unique ID code for this particular board. When the USB cable is plugged in, the PC interrogates the USB devices and can identify this device as the LM95245 Evaluation Board.

The microcontroller on the board provides the serial SMBus clock (SMBCLK), provides the SMBus data (SMBDAT) signal, and relays the information from the LM95245 to the PC via the USB lines.

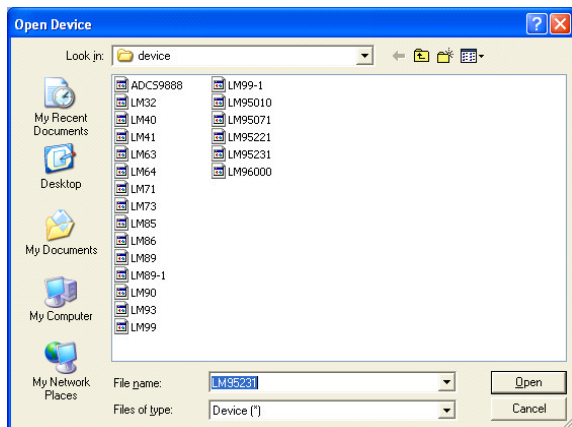
The block in the lower right of the Block Diagram shows the signals that are available to probe by the user for either of the LM95245 devices on the board.

1.1 Block Diagram



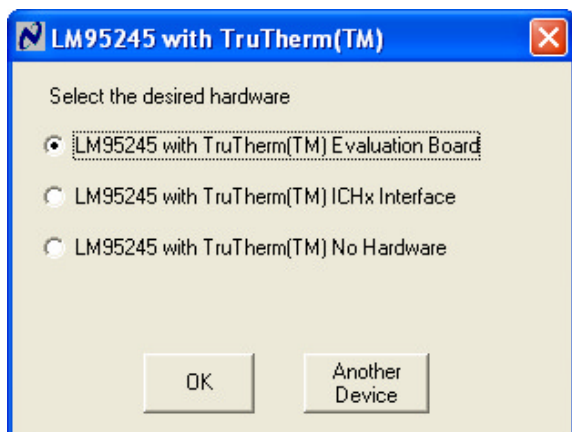
2.0 Quick Start

1. Install the CD into the CD drive of the computer and install the SensorEval software (see Section 4.0).
2. Hookup the USB cable between the PC or notebook computer and the LM95245EVAL/NOPB board as shown in Quick Start Diagram (See Section 2.1).
3. Run the SensorEval software clicking the icon on the desktop. The first screen after the installation will look like this:



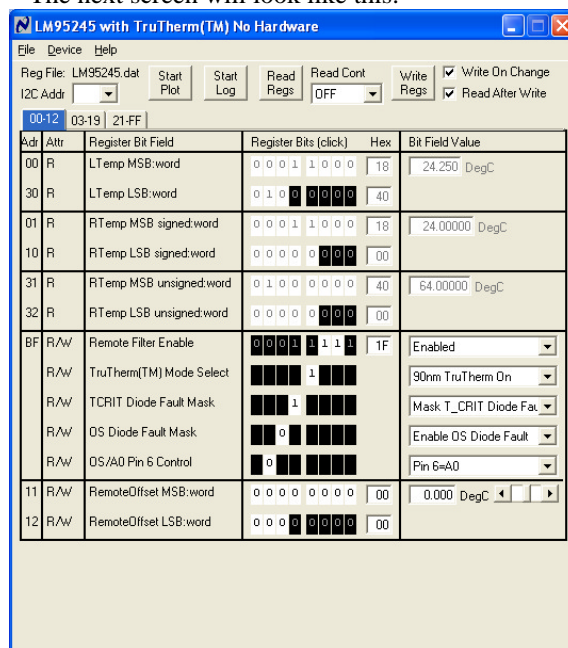
Select LM95245 and click on Open button.

4. The next screen (first screen after the first run of the program) will look like this:



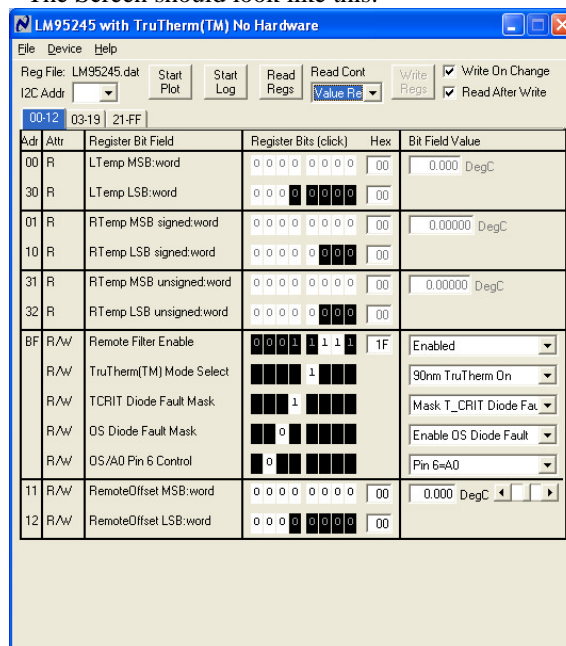
Select the LM95245 Evaluation Board.
Click OK.

5. The next screen will look like this:



Under “Read Cont” select Value Regs to read the temperature values continuously.

6. The Screen should look like this:



Local (on-chip) and remote temperatures should read continuously.

7. If the user clicks the 03-19 tab the next screen will look like this:

LM95245 with TruTherm(TM) No Hardware

File Device Help

Reg File: LM95245.dat Start Plot Start Log Read Regs Read Cont Value Re Write Regs Write On Change Read Alter Write

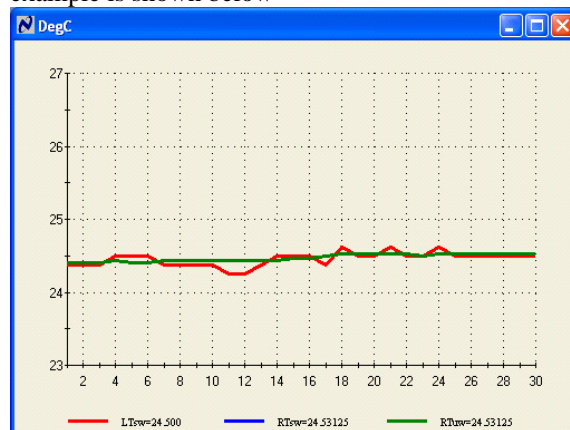
00-12 03-19 21-FF

| Addr | Attr | Register Bit Field | Register Bits (click) | Hex | Bit Field Value |
|------|------|-----------------------------|-----------------------|-----|-------------------|
| 03 | R/W | STOP/RUN# | 0 0 0 0 0 0 0 0 | 00 | Active/Converting |
| | R/W | Remote T_CRIT Mask | 0 0 0 0 0 0 0 0 | | Disabled |
| | R/W | Remote OS Mask | 0 0 0 0 0 0 0 0 | | Disabled |
| | R/W | Local T_CRIT Mask | 0 0 0 0 0 0 0 0 | | Disabled |
| | R/W | Local OS Mask | 0 0 0 0 0 0 0 0 | | Disabled |
| 04 | R/W | Conversion Rate | 0 0 0 0 0 0 1 0 | 02 | 1.0 sec |
| 0F | W | One Shot Conversion | 0 0 0 0 0 0 0 0 | 00 | |
| 02 | R | Busy | 0 0 0 0 0 0 0 0 | 00 | Not Converting |
| | R | Remote OS | 0 0 0 0 0 0 0 0 | | |
| | R | Diode Fault | 0 0 0 0 0 0 0 0 | | |
| | R | Remote TCRIT | 0 0 0 0 0 0 0 0 | | |
| | R | Shared Local OS and TCRIT | 0 0 0 0 0 0 0 0 | | |
| 33 | R | Not Ready | 0 0 0 0 0 0 0 0 | 00 | Ready |
| 07 | R/W | Remote OS Limit | 0 1 0 1 0 1 0 1 | 55 | 85 DegC |
| 20 | R/W | Local Shared OS TCRIT Limit | 0 1 0 1 0 1 0 1 | 55 | 85 DegC |
| 19 | R/W | Remote TCRIT Limit | 0 1 1 0 1 1 1 0 | 6E | 110 DegC |

By turning on or off the filters, and/or changing the models, and/or changing the TruTherm controls the user can experiment with their effects on the temperature readings.

8. If the user clicks on the Start Plot button a graph box will appear and will graph the temperature. An

example is shown below



The sampled data can also be save in a Log file by selecting "Start Log". Setup for the Log file can be found under the "File" menu.

Open Log File

Look in: LM95235

Test05

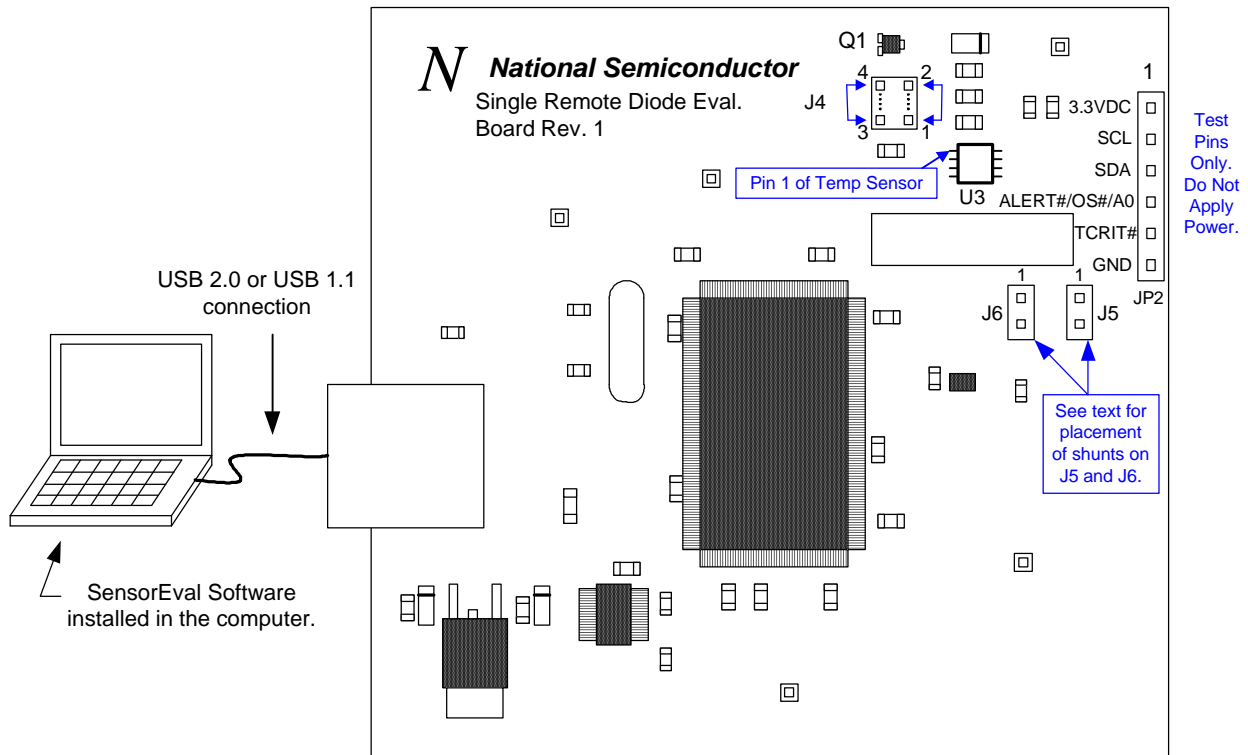
File name: LM95235

Files of type: Log files (*.txt,*.log)

Open Cancel

2.1 Quick Start Diagram

Important! NO EXTERNAL POWER SUPPLY OR SIGNAL INPUTS ARE REQUIRED!



3.0 Functional Description

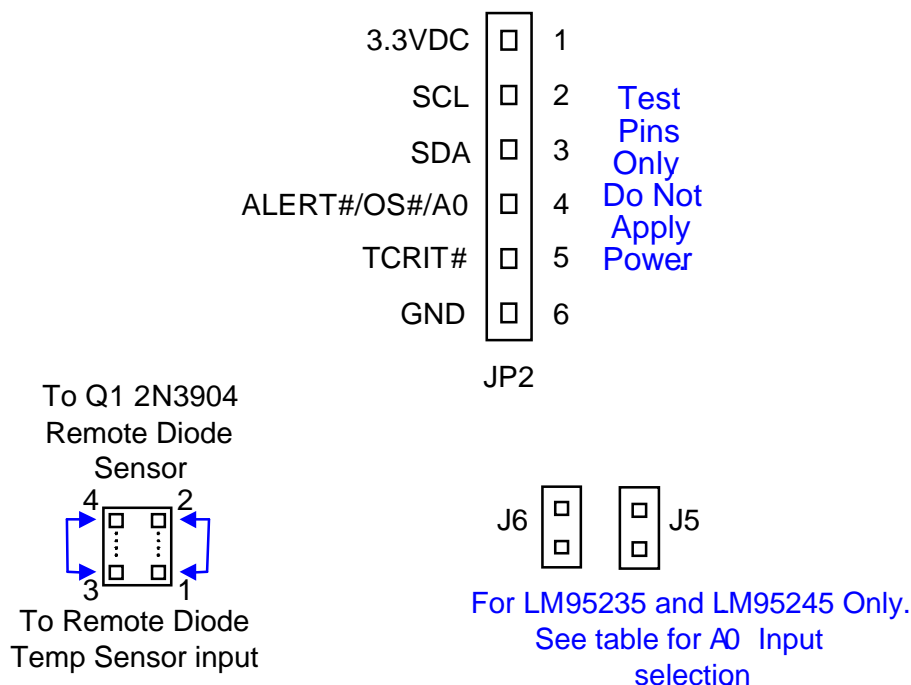
The LM95245EVAL/NOPB Evaluation Board, along with the SensorEval Software, provides the system designer with a convenient way to learn about the operation of the LM95245 Temperature Sensor chip. The user simply has to install the SensorEval software on his PC, run it, connect the USB cable from the PC to the Evaluation Board, and the user can read the temperatures. It's that simple! The user doesn't have to provide any power or external signals to the evaluation board.

Power to the LM95245EVAL/NOPB Evaluation Board is taken from the USB 5-Volt line. This +5

VDC is the input to the on-board LM2950 low dropout voltage regulator, which regulates the output voltage to +3.3 VDC. This output voltage powers the LM95245, the on-board microcontroller, and the EEPROM chip where the board ID information is stored.

The microcontroller provides the SMBus Clock (SMBCLK) signal and the SMBus Data (SMBDAT) signal to the LM95245 chip. This communication between the LM95245 and the PC USB data lines is controlled by the microcontroller. For all of the details of this communication protocol see the latest LM95245 datasheet, available at www.national.com.

3.1 LM95245 Evaluation Board Connections and Table



| Connector Label | Pin Number | Description | | |
|--|------------|---|------------|------------------------|
| J3 | N/A | USB Cable Input. Connect the USB cable to this jack <i>after</i> the SensorEval software has been loaded on the PC. | | |
| JP2 Output header provides user with signals for test purposes only. <i>Do not apply any external power or signals to any of the pins on these headers!</i> | 1 | V _{DD} . The +3.3 VDC voltage supplied by the on-board voltage regulator to the LM95245 V _{DD} input pin. Do not connect an external power supply to this pin! | | |
| | 2 | SMBCLK. Clock signal for SMBus. | | |
| | 3 | SMBDAT. Data signal for the SMBus. | | |
| | 4 | ALERT#/OS#/A0 For the LM95245 this pin can be set to either the ALERT# function or the AO Address Select function. | | |
| | 5 | TCrit#. This is the Active Low Open Drain pin which indicates that the Temperature limit has been exceeded. | | |
| | 6 | GND. System ground. | | |
| J4 Connection to temperature diodes <i>Do not apply any external power or signals to any of the pins on these headers!</i> | 1,2 | Connect for D+ connection | | |
| | 3,4 | Connect for D- connection | | |
| J5, J6 These are jumpered as indicated if the LM95245 is in the A0 Address Select function mode. | | J5 Jumper | J6 Jumper | A0 Address Select, Hex |
| | | NO | NO | Hi = 4C |
| | | NO | YES | Mid = 29 |
| | | YES | Don't Care | Low = 18 |

4.0 Software Installation and Operation

4.1 Installation

The CD provided in the LM95245EVAL/NOPB Evaluation Board Kit contains the SensorEval software used to make the LM95245EVAL/NOPB Evaluation Board operate with the user's PC. It is assumed that the user will be using a PC with a Pentium® III or higher processor and Microsoft Windows® XP/2000/98/ME operating system.

The software is installed as follows:

1. Insert the SensorEval CD into the CD drive of the PC. See details in the readme.txt file.
2. The software manual, provided on the CD, may be useful to the user during this process.
3. Follow all of the Installation instructions in the windows as the SensorEval software is installing.
4. The installation process will put an icon on the PC desktop so that the SensorEval program will run when the icon is double-clicked.

4.2 Operation

Follow the following procedure for operation the LM95245 Evaluation Board using the SensorEval software:

3. Run the SensorEval program by either double-clicking on the icon on the desktop or by selecting Start, Program Files, National Semiconductor, National SensorEval.
4. Plug in the USB cable on both the PC and the LM95245 Evaluation Board.

Follow the following procedure for operation the LM95245EVAL/NOPB Evaluation Board using the SensorEval software:

1. Run the SensorEval program by either double-clicking on the icon on the desktop or by selecting Start, Program Files, National Semiconductor, National SensorEval.
2. Plug in the USB cable on both the PC and the LM95245EVAL/NOPB Evaluation Board.

Follow the register setup steps given in section 2.0 Quick Start of this User's Guide. Make sure that you are following the given procedure for the specific evaluation board you are working with.

Refer to the electrical schematic, layout and connector diagrams for proper connections to external remote thermal diodes.

Follow the register setup steps given in section 2.0 Quick Start of this User's Guide. Make sure that you are following the given procedure for the specific evaluation board you are working with.

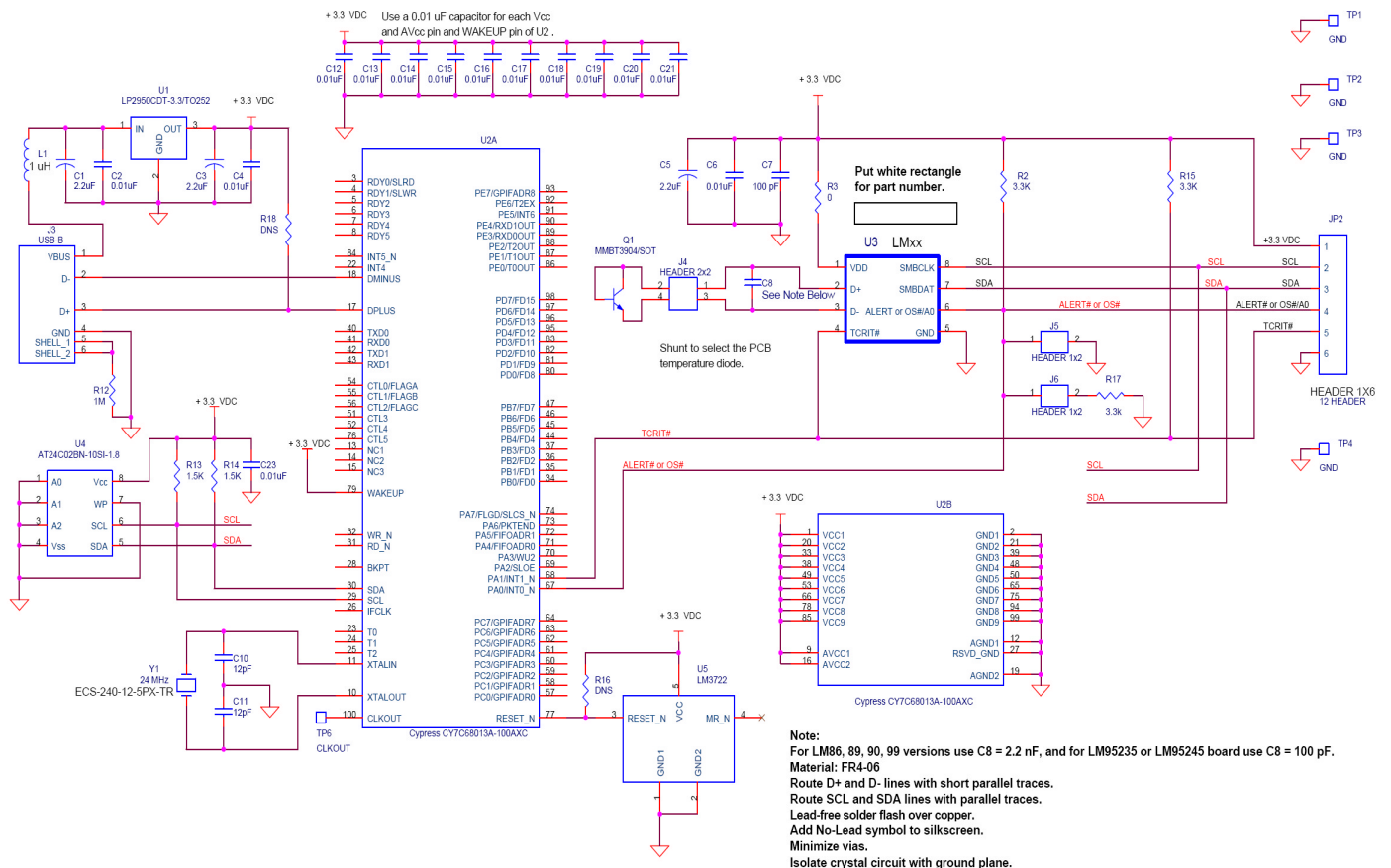
Refer to the electrical schematic, layout and connector diagrams for proper connections to external remote thermal diodes.

5.0 Electrical and Mechanical Specifications

5.1 Electrical Specifications

| Power Requirements | |
|--|------------------------------|
| The Board uses the +5.0 VDC and GND lines from the USB connection. This +5.0 VDC voltage is regulated down to +3.3 VDC for board power. * NO EXTERNAL POWER SUPPLY INPUTS ARE REQUIRED * | +5.0 ± 0.1 V, 100 mA max. |

5.2 Electrical Schematic



Schematic of the LM95245EVAL/NOPB Evaluation Board

5.3 Evaluation Board Layout

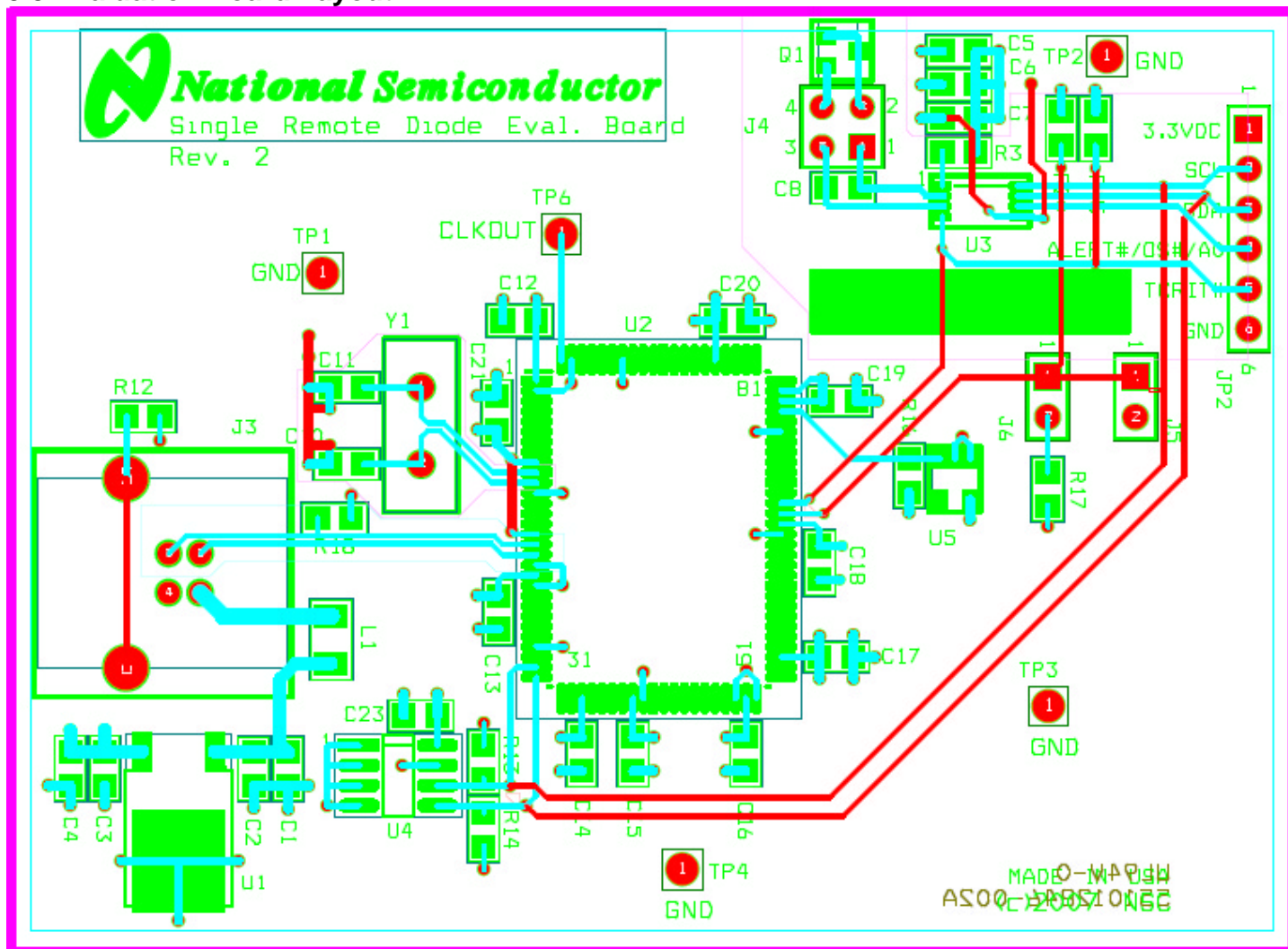


Figure 5.3 Layout diagram of the LM95245EVAL/NOPB Evaluation Board

5.4 Bill of Materials for LM95245 Evaluation Board

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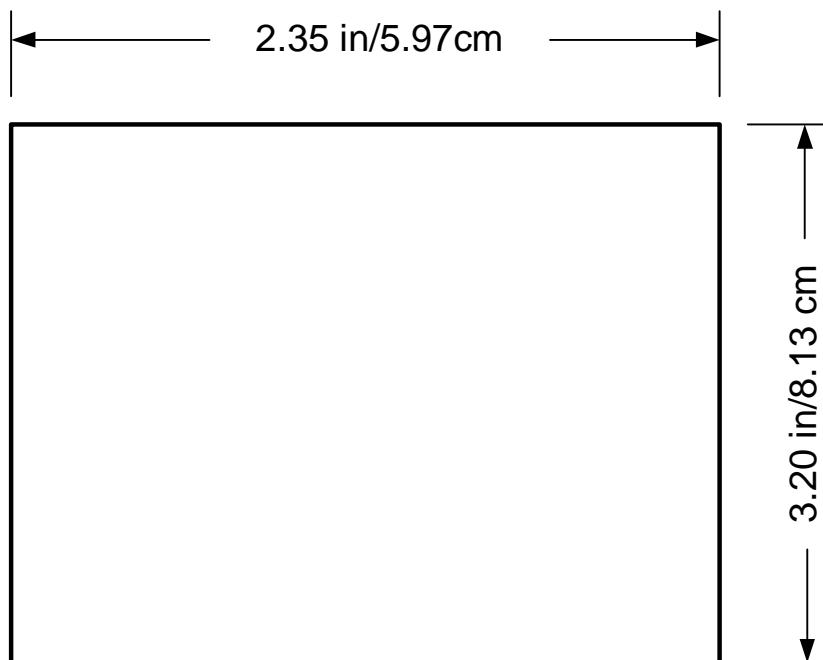
| | | | Total QTY for Board Build | Single Remote Diode Temperature Sensor Eval Board | | Created: March 23, 20007 Last Updated: March 23, 20007 | Board Layout Revision: 1.0 Schematic Revision: 1.0 |
|---|-----|-----|---------------------------|--|--------------------------------------|---|---|
| Item | NSC | Qty | | Part Reference | Value | Footprint | Manufacturer |
| SMT Capacitors | | | | | | | |
| 1 | | 3 | | C1,C3, C5 | 2.2 uF | c3216 | Kemet |
| 2 | | 14 | | C2,C4,C6,C12,C13,C14,C15,C16,C17,C18,C19,C20,C21,C23 | 10 nF | c0805 | Panasonic |
| 3 | | 1 | | C7 | 100 pF | c0805 | |
| 4a | | 1 | | C8 (for LM95235 only) | 100 pF | c0805 | |
| 4b | | 1 | | C8 (For all others) | 2.2 nF | c0805 | |
| 5 | | 2 | | C10,C11 | 12 pF | c1206 | Kemet |
| Connectors | | | | | | | |
| 6 | | 1 | | J3 | Connector, USB-B | usb-jack-b | Mill-Max |
| 7 | | 1 | | J4 | CONN, 2X2 Headers, 0.1 in centers | th_4_hdr1x4_m_str_100 | Sullins |
| 8 | | 2 | | J5, J6 | CONN, 1X2 Headers, 0.1 in centers | TP40 | Sullins |
| 9 | | 1 | | JP2 | CONN, 1X6 Headers, 0.1 in centers | TP40 | Sullins |
| 10 | | 4 | | TP1, TP2, TP3, TP4, TP6 | CONN, 1X1 Headers, 0.1 in centers | TP40 | Sullins |
| Ferrites | | | | | | | |
| 11 | | 1 | 10 | L1 | CM CHOKE | | Steward |
| Resistors | | | | | | | |
| 12 | | 3 | | R2,R15,R17 | 3.3K | r0805 | Panasonic |
| 13 | | 1 | | R3 | 0 | r0805 | Susumu Co Ltd |
| 14 | | 1 | | R12 | 1 Meg | r0805 | Panasonic |
| 15 | | 2 | | R13,R14 | 1.5K | r0805 | Panasonic |
| IC's | | | | | | | |
| 18 | NSC | 1 | | U1 | LP2950CDT-3.3/TO252 | TO263_7P | National Semiconductor |
| 19 | NSC | 1 | | U2 | Cypress CY7C68013A-100AXC | 100tqfp | Cypress |
| 20 | NSC | 1 | | U3 | Device Under Test (DUT) | msop8 | National Semiconductor |
| 21 | NSC | 1 | | U4 | 24C02 | soic8 | Atmel |
| 22 | NSC | 1 | | U5 | LM3722 | SOT23-stx | National Semiconductor |
| Transistors | | | | | | | |
| 22 | | 1 | | Q1 | MMBT3904/SOT | SOT23-stx | On Electronics |
| Misc | | | | | | | |
| 23 | NSC | 1 | | BOARD | Single Remote Diode Temp Sensor Eval | 6.4240 X 4.7400 | Advanced Circuits |
| 24 | NSC | 1 | | Y2 | 24 MHz | hc49us | ECS Inc. |
| DO NOT SOLDER THE FOLLOWING TO BOARD | | | | | | | |
| 25 | | 1 | | R18 (for USB 1.1 only) | 1.5K | r0805 | Panasonic |
| 25 | | 1 | | R16 | 10K | r0805 | Panasonic |

5.4 Mechanical Specifications

5.4.1 Operating Mechanical and Environmental Specifications

| | Minimum | Typical | Maximum |
|-------------|---------|---------|---------|
| Temperature | 0°C | 25°C | 70°C |

5.4.2 Evaluation Board Basic Dimensions



5.4.3 Electrostatic Discharge (ESD) Precautions

The user shall use ESD precautions as specified in National Semiconductor ESD control document (SC)CSI-3-038 available through www.national.com.

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