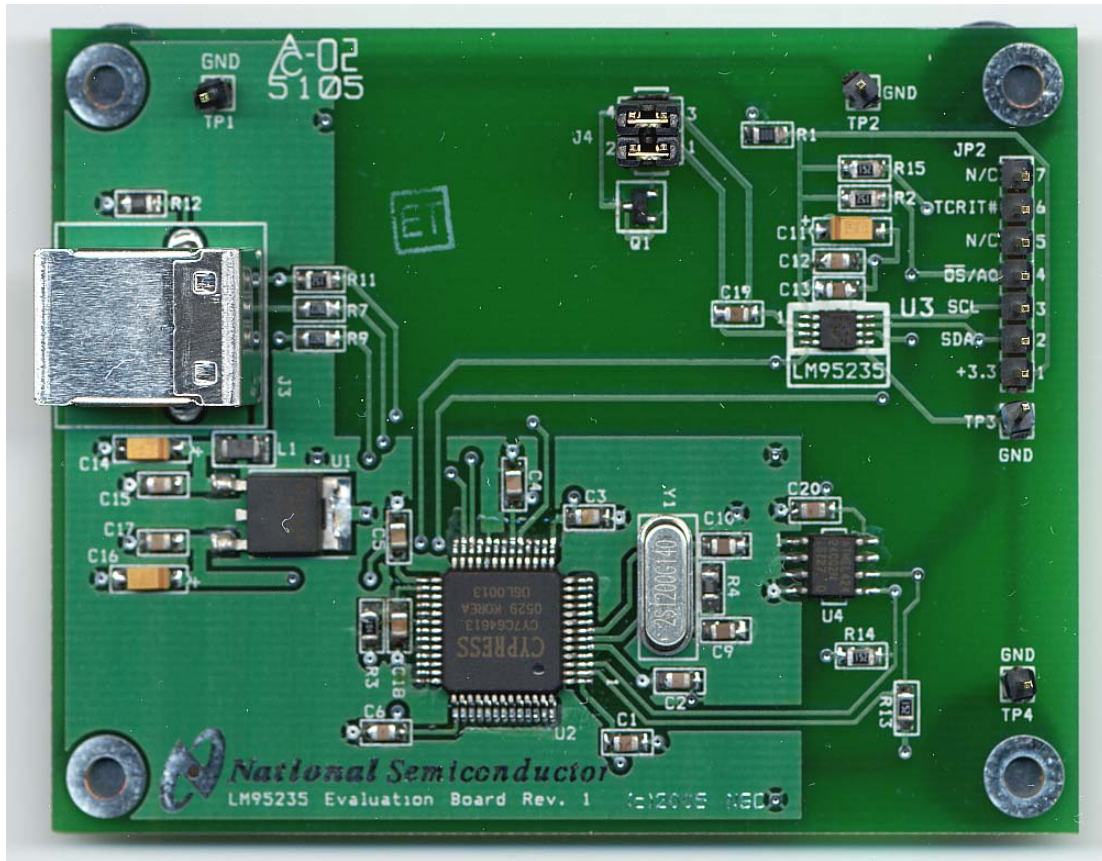


LM95235 Evaluation Board User's Guide



LM95235 Evaluation Board User's Guide

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LM95235 Evaluation Board User's Guide

References

1. "LM95235 Precision Remote Diode Temperature Sensor With SMBus Interface and TruTherm™ Technology" datasheet.

The latest copy of the LM95235 datasheet can be obtained by going to the National Semiconductor website www.national.com, by searching on "LM95235", and then downloading the LM95235.pdf file.

2. SensorEval Version 1.1.0a or later, Evaluation Board CD containing:
 - a. The SensorEval.exe executable program used to run the LM95235 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 LM95235 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 LM95235 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 LM95235 evaluation board.

Before connecting the PC to the LM95235 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 running, the user can connect the USB cable first to the computer and then to the LM95235 Evaluation Board.

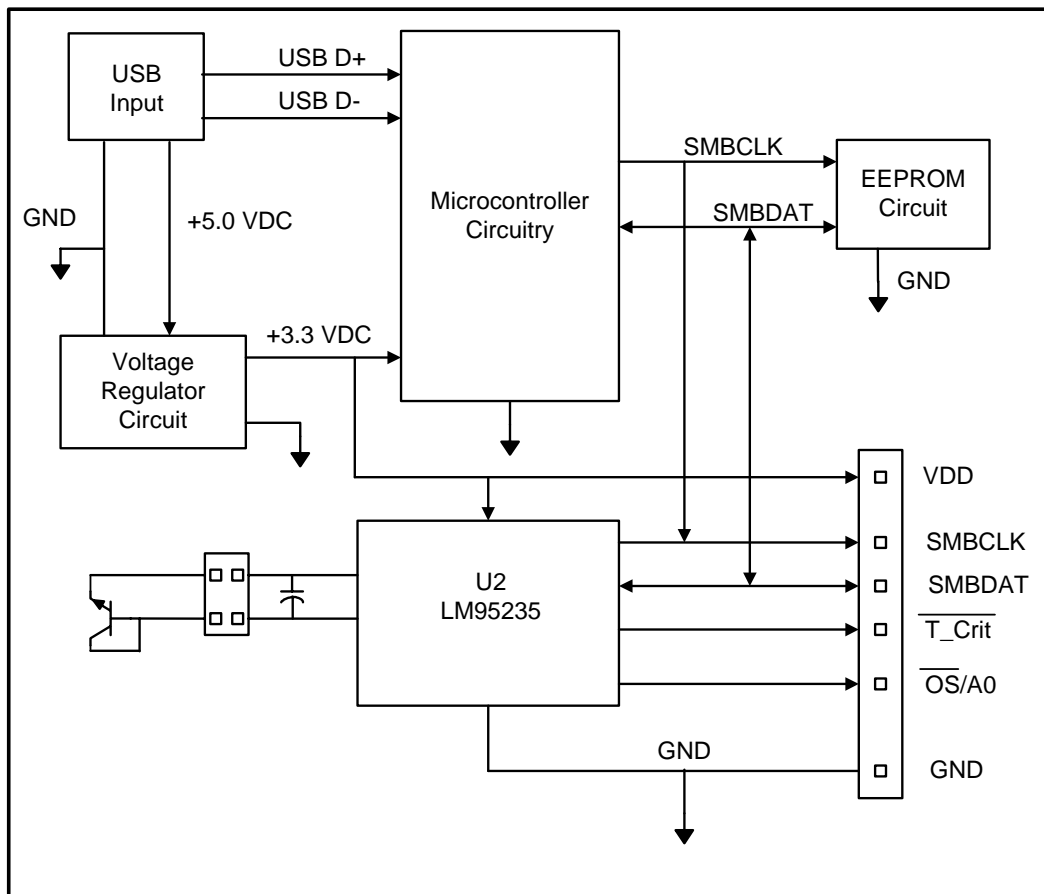
The PC should be able to recognize the board and the user simply selects the LM95235 Eval Board radio button.

The block diagram below describes the LM95235 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 LM95235 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 LM95235 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 the LM95235 device on the board.

1.1 Block Diagram

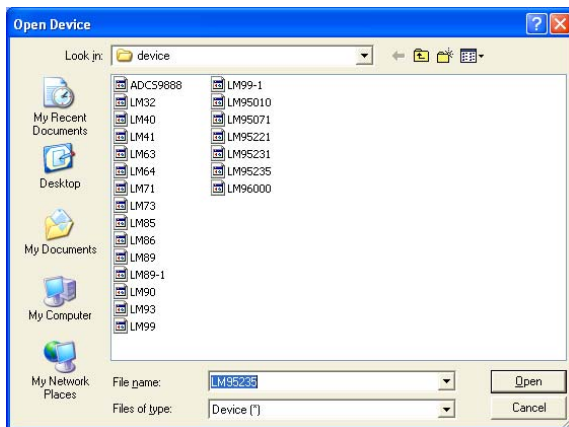


2.0 Quick Start

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 LM95235EVAL 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:



If not, select "Another Device". The next screen should look like this:



Select LM95235 and click on Open button.

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



Select the LM95235 Evaluation Board.
Click OK.

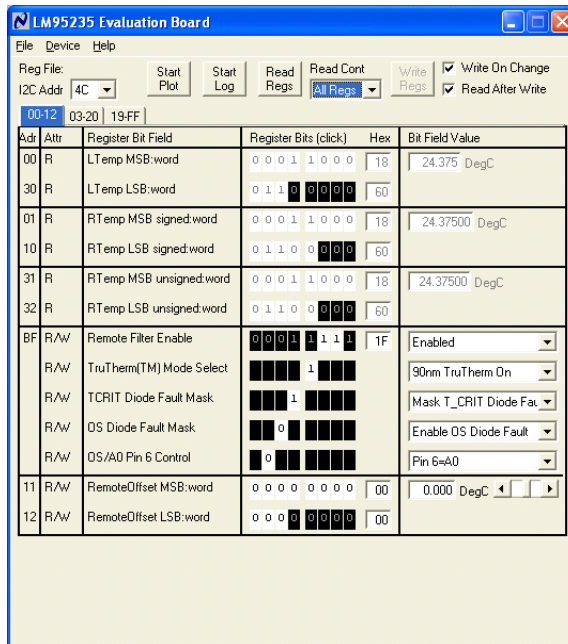
5. The next screen will look like this:

The screenshot shows the "LM95235 Evaluation Board" window. At the top, there are controls for "Reg File:", "I2C Addr:" (set to 4C), "Start Plot", "Start Log", "Read Regs:", "Read Cont:" (set to OFF), "Write Regs:", "Write On Change" (checked), and "Read After Write" (checked). Below these are fields for "00-12" and "03-20 | 19-FF". The main area is a table of registers:

Adr	Attr	Register Bit Field	Register Bits (click)	Hex	Bit Field Value
00	R	LTemp MSB:word	0 0 0 1 1 0 0 0	18	24.250 DegC
30	R	LTemp LSB:word	0 1 0 0 0 0 0 0	40	
01	R	RTemp MSB signed:word	0 0 0 1 1 0 0 0	18	24.37500 DegC
10	R	RTemp LSB signed:word	0 1 1 0 0 0 0 0	60	
31	R	RTemp MSB unsigned:word	0 0 0 1 1 0 0 0	18	24.37500 DegC
32	R	RTemp LSB unsigned:word	0 1 1 0 0 0 0 0	60	
BF	R/W	Remote Filter Enable	0 0 0 1 1 1 1 1	1F	Enabled
	R/W	TruTherm(TM) Mode Select	1 1 1 1 1 1 1 1		90nm TruTherm On
	R/W	TCRIT Diode Fault Mask	1 1 1 1 1 1 1 1		Mask_T_CRIT Diode Fa
	R/W	OS Diode Fault Mask	0 0 0 0 0 0 0 0		Enable OS Diode Fault
	R/W	OS/A0 Pin 6 Control	0 0 0 0 0 0 0 0		Pin 6=A0
11	R/W	RemoteOffset MSB:word	0 0 0 0 0 0 0 0	00	0.000 DegC
12	R/W	RemoteOffset LSB:word	0 0 0 0 0 0 0 0	00	

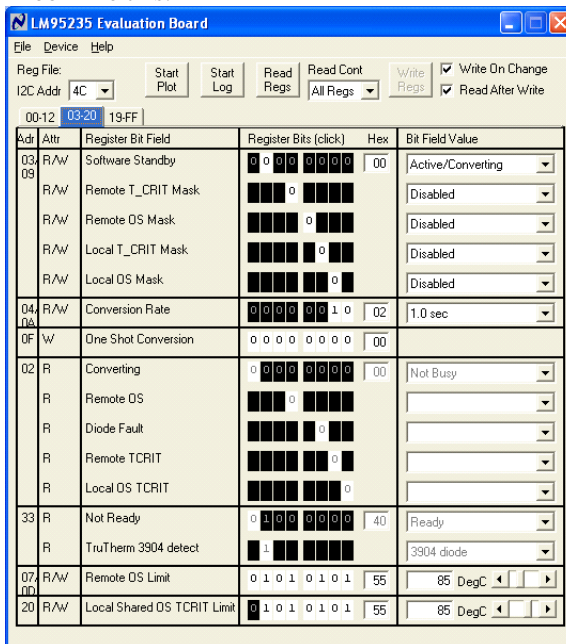
Make sure that "4C" is selected in the upper left box labeled "I2C Addr". Select "All Regs" in the "Read Cont" box to read all of the registers, including the temperature registers continuously.

6. The Screen should look like this:

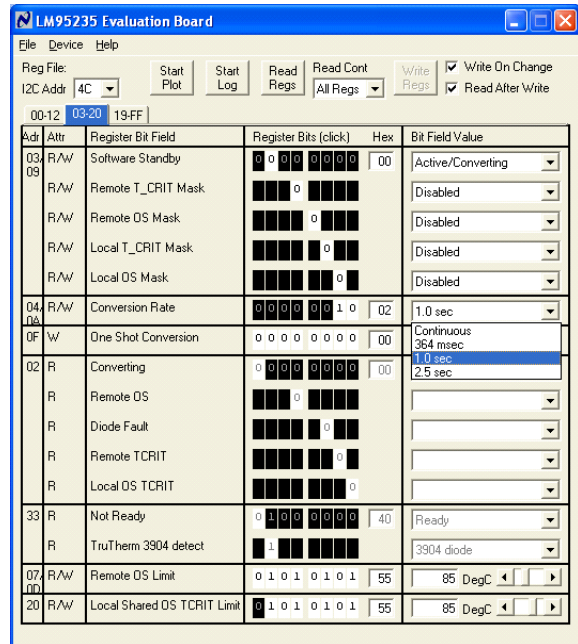


Local (on-chip) and remote temperatures should read continuously. The user can experiment with the different settings of Address BF.

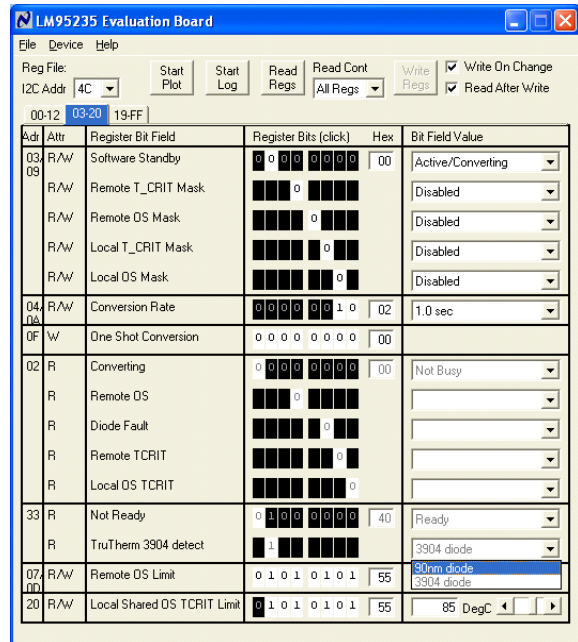
7. If the user clicks the 06-FF tab the next screen will look like this:



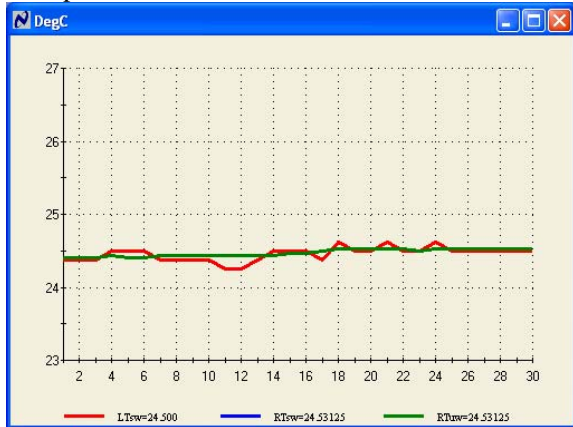
The user can experiment with the Mask settings. Also the user can change the conversion rate. The next screen shows the possibilities for the Conversion Rate.



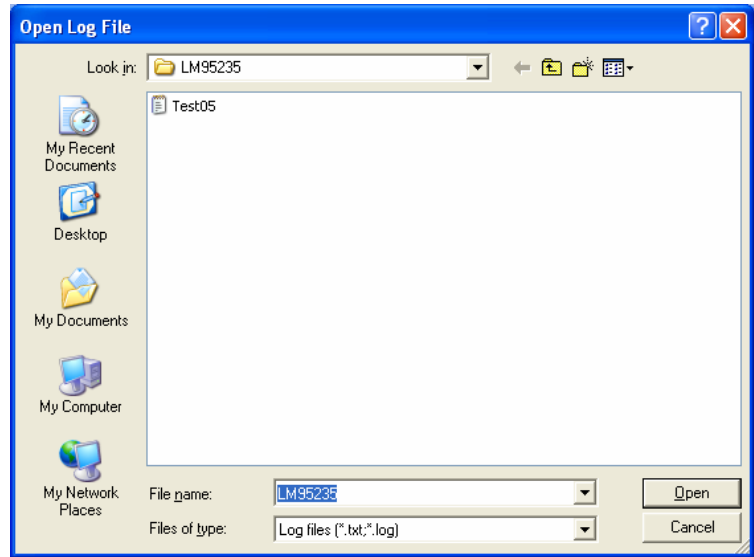
The user can also select the 3904 diode or the processor thermal diode called "90 nm".



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

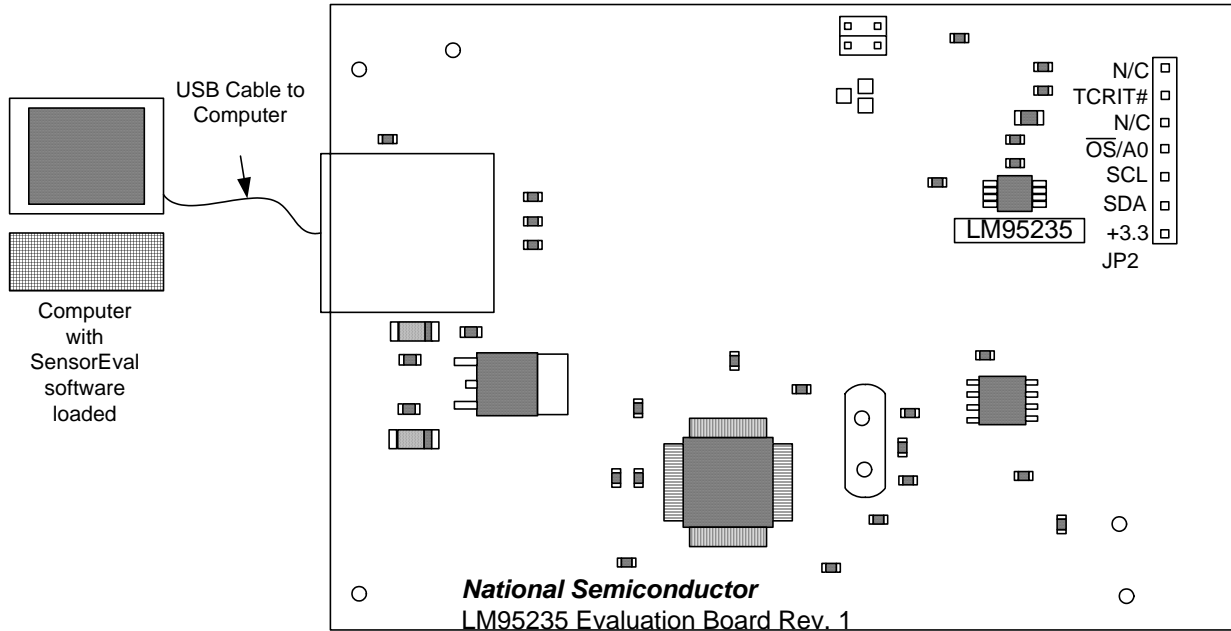


9. If the user selects the Start Log button the following screen will appear. The user then enters the filename that he chooses to log the data into.



2.1 Quick Start Diagram

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



3.0 Functional Description

The LM95235 Evaluation Board, along with the SensorEval Software, provides the system designer with a convenient way to learn about the operation of the LM95235 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 LM95235 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 LM95235, 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 LM95235 chip. This communication between the LM95235 and the PC USB data lines is controlled by the microcontroller. For all of the details of this communication protocol see the latest LM95235 datasheet, available at www.national.com.

3.1 LM95235 Evaluation Board Connection Table

Connector Label	Pin Number	Description
J1	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. Do not apply any external power or signals to any of the pins on these headers!	1	V _{DD} . The +3.3 VDC voltage supplied by the on-board voltage regulator to the LM95235 V _{DD} input pin. Do not connect an external power supply to this pin!
	2	SMBDAT. Data signal for the SMBus.
	3	SMBCLK. Clock signal for SMBus.
	4	OS#/A0. When this pin is pulled low it enables the Overtemperature Shutdown (OS) feature. When this pin is pulled high it is the Address pin function.
	5	No Connection.
	6	T_Crit#. This is the signal that goes low when the Set Temperature is exceeded.
	7	No Connection.
J4 Connection to temperature diodes Do not apply any external power or signals to any of the pins on these headers!	3, 4	Connect for D+ connection
	1, 2	Connect for D- connection

4.0 Software Installation and Operation

4.1 Installation

The CD provided in the LM95235 Evaluation Board Kit contains the SensorEval software used to make the LM95235 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 LM95235 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, SensorEval.
2. Plug in the USB cable on both the PC and the LM95235 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.

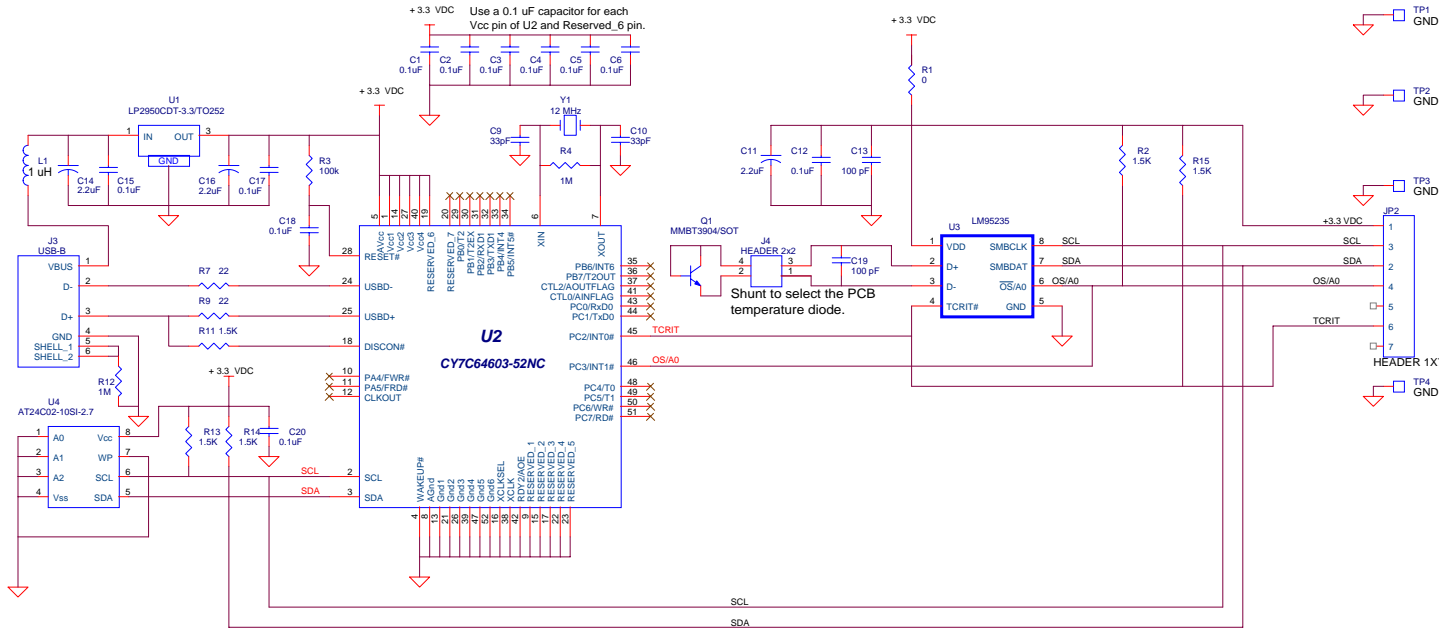
Refer to the electrical schematic, layout and connector diagrams for proper connections to external remote thermal diodes.

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 LM95235 Evaluation Board

5.3 Evaluation Board Layout

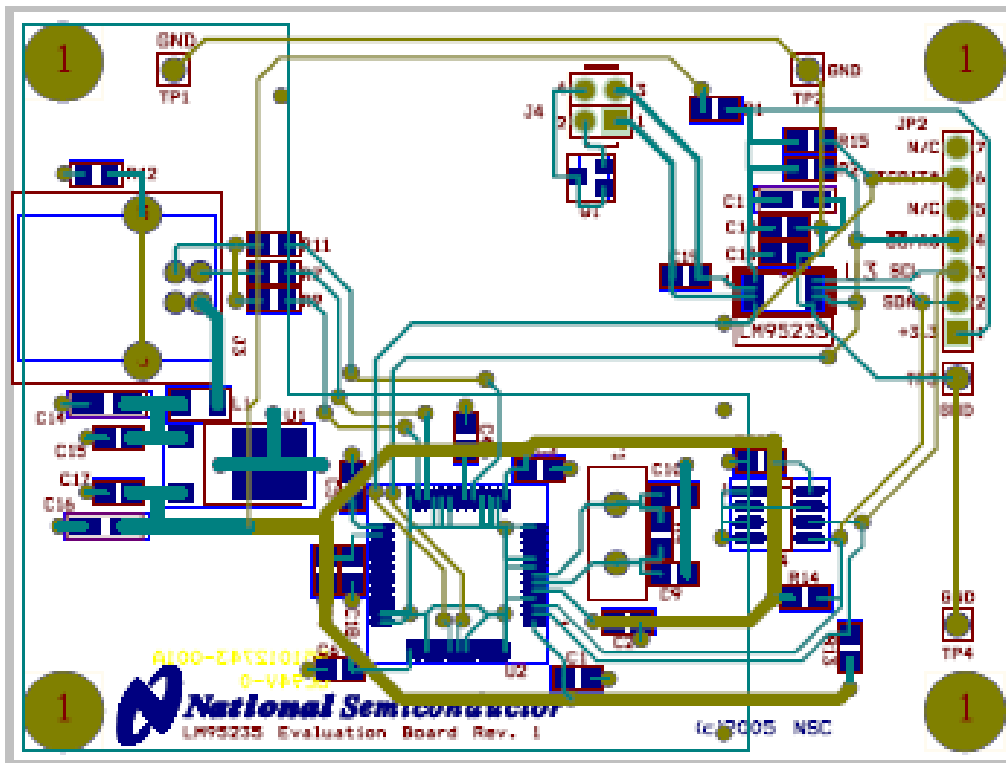


Figure 5.3 Layout diagram of the LM95235 Evaluation Board
(Note: socket and socket area not stuffed.)

5.4 Bill of Materials for LM95235 Evaluation Board

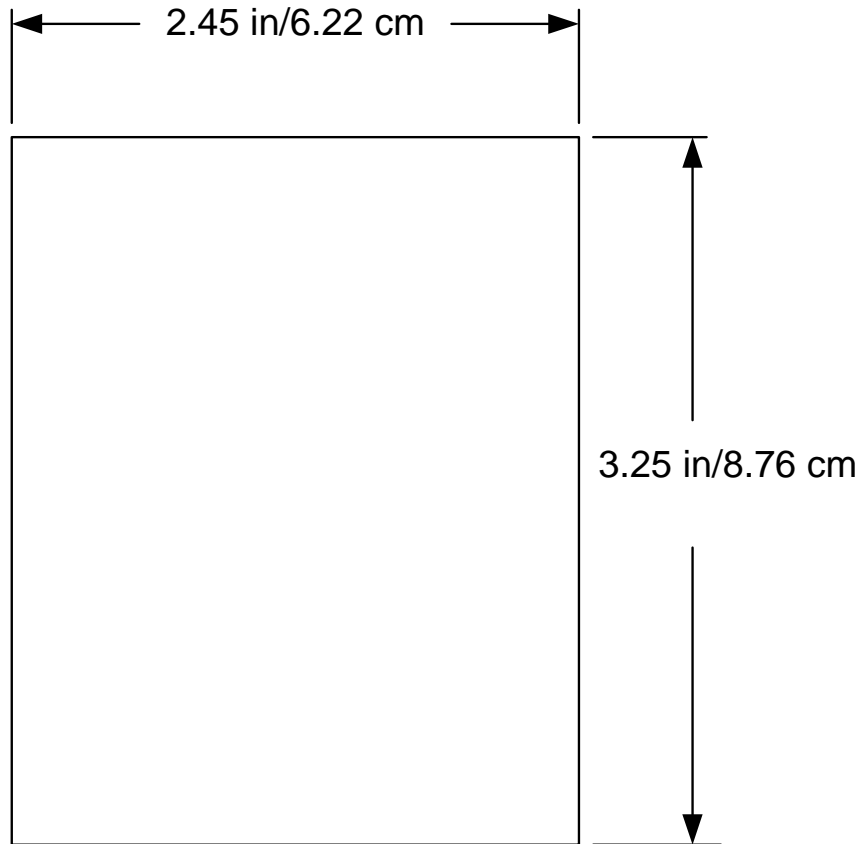
Item	Qty	Reference	Part	PCB Footprint
1	11	C1,C2,C3,C4,C5,C6, C12,C15,C17,C20	Capacitor, SMD, ceramic, 0.1uF	sm/c_0805
2	2	C9, C10	Capacitor, SMD, ceramic, 33 pF	sm/c_0805
3	3	C11,C14,C16	Capacitor, SMD, ceramic, 2.2 uF	sm/ct_3216_12
4	2	C13,C19	Capacitor, SMD, ceramic, 100 pF	sm/c_0805
5	1	J3	Connector, USB-B	tm/usb_typeb
6	1	J4	HEADER 2x2	blkcon.100/vh/tm1sqsw.100/4
7	1	L1	Filter, 1uH, Stewart MI1206K900R-00	sm/l_1206
8	1	Q1	Transistor, SMD, MMBT3904/SOT	sm/mmbt3904a
9	1	R1	Resistor, SMD, 0 Ohms	sm/r_0805
10	2	R4,R12	Resistor, SMD, 1M	sm/r_0805
11	2	R7,R9	Resistor, SMD, 22 Ohms	sm/r_0805
12	5	R2,R11,R13,R14,R15	Resistor, SMD, 1.5K	sm/r_0805
13	1	R3	Resistor, SMD, 100k Ohms	sm/r_0805
14	1	U1	IC, National LP2950CDT-3.3/TO252	to252ab/dpak
15	1	U2	IC, Cypress CY7C64613-52NC	sm/PQFP-52
16	1	U4	IC, EPROM, Atmel AT24C02-10SI-2.7	sog.050/8/wg.244/l.200
17	1	U3	LM95235C1MM	sm/msop-8
18	1	Y1	Crystal, 12 MHz, Pletronics 2S1200G140	tm/hc-49

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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