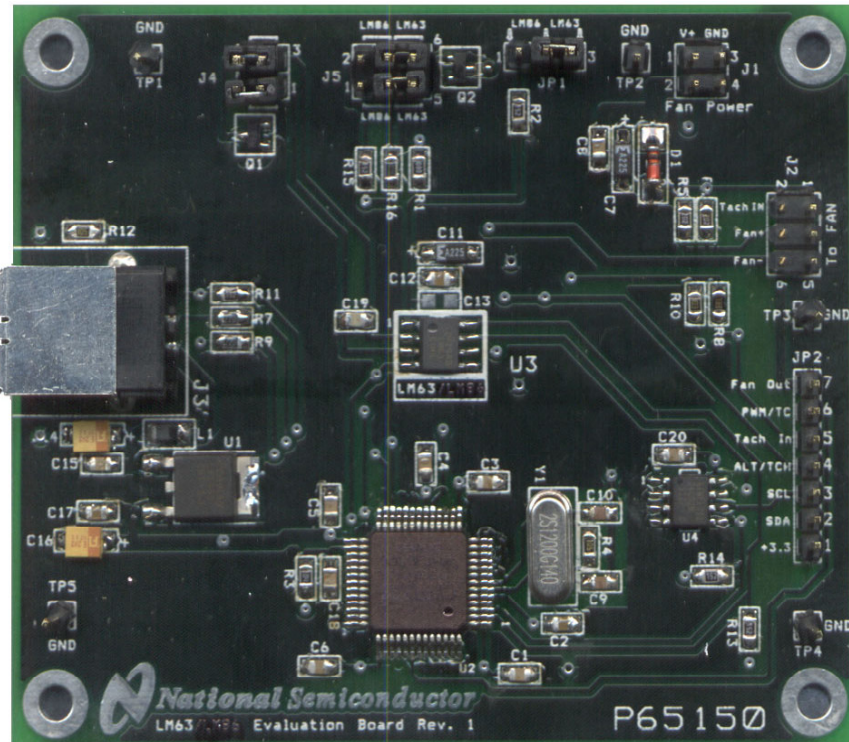




## LM63 Evaluation Board User's Guide



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## 1.0 Introduction

The LM63EVAL kit includes the following items:

1. The LM63 Evaluation Board
2. The SensorEval Software CD, including
  - a. the readme.txt file (read this first)
  - b. the installation setup file,
  - c. the SensorEval Software manual, and
  - d. this manual.

The LM63 Evaluation Board, as shown in Figure 1, is a complete PCBA (printed circuit board assembly). The board has a USB connector, a voltage regulator circuit, a microcontroller, an EEPROM, and a LM63 Remote Diode Temperature Sensor with Integrated Fan Control. A schematic and bill of materials is included in this User's Guide. Figure 1 shows the location of pin1 for proper orientation of the LM63 in the socket.

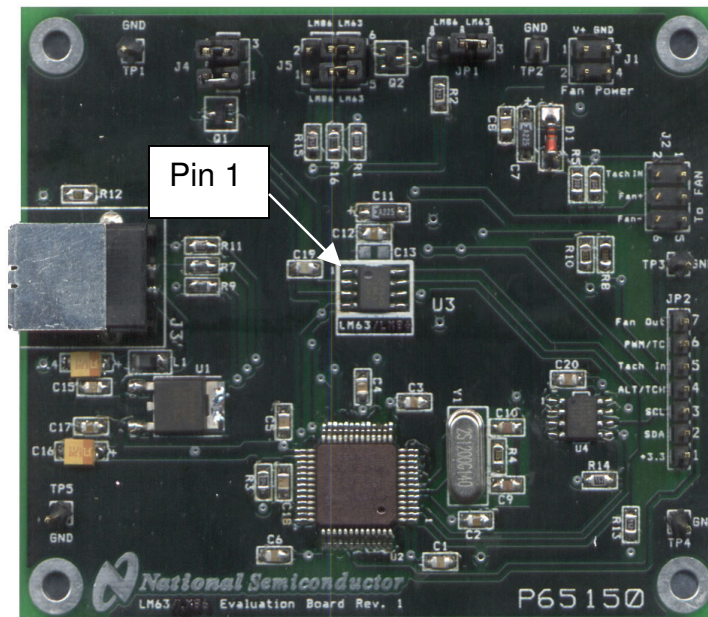


Figure 1. The LM63 Evaluation Board with Open Socket showing pin numbering convention.

The LM63EVAL kit includes the SensorEval software, which is provided by National Semiconductor to communicate with the LM63 Evaluation Board by way of the USB cable (not provided) from the controlling computer. The SensorEval software is used to control the writing and reading of the digital registers in the LM63 for doing the initial register setup, reading the local and remote temperatures, establishing certain temperature limit setpoints, and setting up fan control and tachometer monitoring registers.

## 1.0 Introduction (Continued)

For the installation procedure for the SensorEval software see the readme.txt file on the SensorEval software CD. For detailed use of the LM63 software used with the LM63 Evaluation Board, please refer to the SensorEval software user's guide on the CD. The LM63 datasheet is available at [www.national.com](http://www.national.com).

## 2.0 Getting Started

### 2.1 Required Equipment

In order to use the LM63 Evaluation Board you will need to have the following required pieces of equipment:

1. A computer with at least a Pentium III processor, running Microsoft® Windows® 98/2000/XP<sup>1</sup> operating system, with 20 MB of free disk space, and at least one USB port
2. A standard USB cable (3 foot length should be sufficient) for connecting the computer to the LM63 Evaluation Board.
3. If you plan to test with a 3-terminal fan you must have:
  - a. A 3-terminal DC brushless fan rated at less than 0.40 Amp. Note that provisions are made on the board for either a standard processor fan connector or holes for soldering wires on the board.
  - b. A Power Supply capable of delivering the fan rated voltage (+12 VDC or +5 VDC) at **twice** the rated fan current. A pair of wires from the power supply to a female header connector to connect with J1, Fan Power input, is suggested.

If it is desired to run the software only, **without the LM63 Evaluation board**, omit items 2 and 3 and proceed to paragraph 2.3.

### 2.2 Optional Equipment

Optional pieces of equipment are as follows:

1. Remote Diode with wired connector to connect to a female 2-pin header, 0.1 in centers
2. Test equipment such as a digital voltmeter or oscilloscope.

### 2.3 Test Setup - Software

First, see the readme.txt file on the SensorEval CD for the latest installation instructions. Follow the installation procedures to load the software on the computer and, if desired, to verify the operation of the LM63 Evaluation Board.

The SensorEval icon will be on the desktop window after the software installation.

If it is desired to run the software without the LM63 Evaluation Board please proceed to the Software User's Guide on the SensorEval CD.

For use with the LM63 Evaluation Board disconnect the USB cable from the board and proceed to the next section for the hardware setup.

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<sup>1</sup> Microsoft®, Windows®, and XP® are registered trademarks of Microsoft Corporation.

## 2.0 Getting Started (continued)

### 2.4 Test Setup – Hardware

Figure 2 below shows an example of a typical LM63 Evaluation Board test setup for driving fans, attaching remote diodes, and monitoring the system.

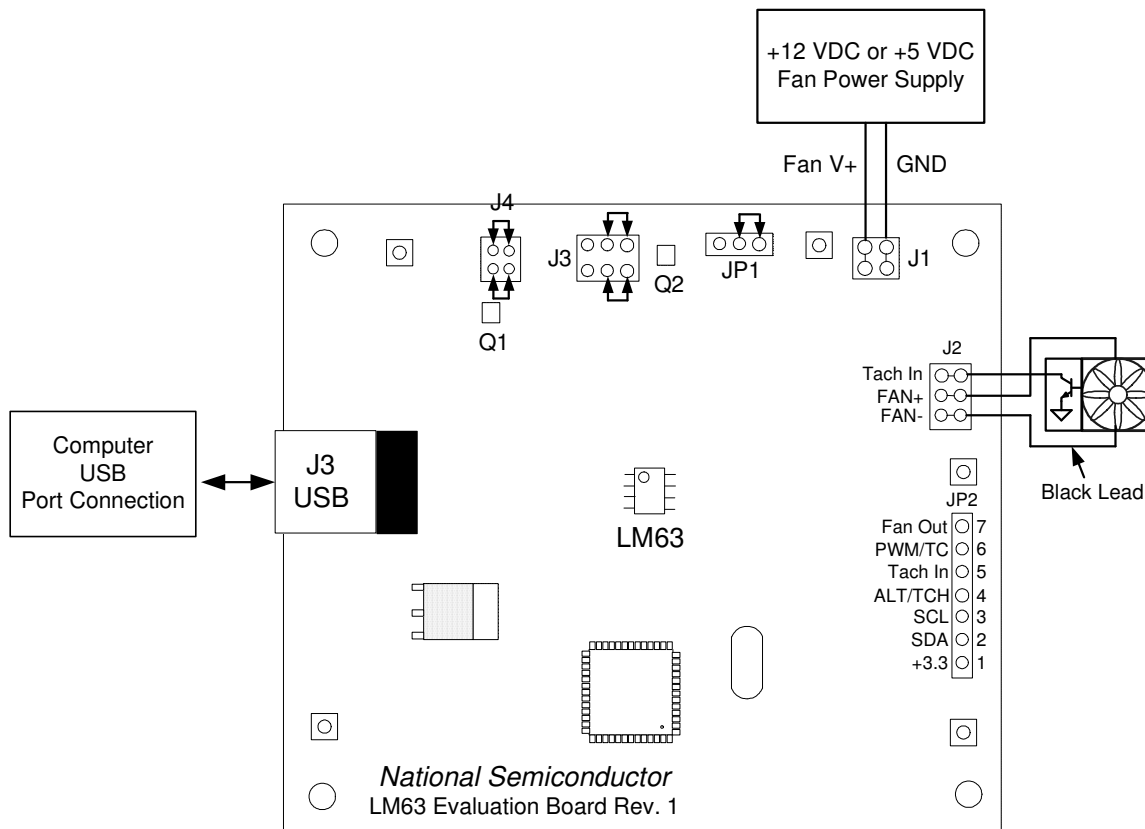


Figure 2. Test Setup using the LM63 Evaluation Board

No jumper is required on header JP2 for operation of the basic temperature measuring and fan control functions. Details about all of the header connectors, and connections to them, will be discussed later in this User Guide.

### Hardware Test Setup Procedure

1. Before connecting the power supply to the LM63 Evaluation Board, turn it on and set the output voltage to the voltage rating of the fan (+5 or +12 VDC). Turn the power supply off.
2. Connect the power supply to the LM63 Evaluation Board header J1 as shown in Figure 2. Make sure that the positive terminal is connected to V+ and the negative terminal is connected to the GND of J1.
3. Plug in the fan as shown in Figure 2. This pinout is standard for PC processor fans.
4. The LM63 Evaluation Board comes with jumpers installed on J4, which connects the on-board MMBT3904 diode-connected transistor to the input of the LM63 chip.
5. Connect the USB cable from the computer's USB port to the LM63 Evaluation Board
6. Turn on the fan power supply.
7. Start the SensorEval software.

## 2.0 Getting Started (continued)

### 2.5 Test Setup – System

For proper fan control follow the following procedure, using SensorEval as described in the SensorEval software manual.

***IMPORTANT!***

Registers 4A, 4B, 4D and then **either** 4C (PWM Value) **or** the Lookup Table in Registers 4F through 5F must be programmed in that order for the initial fan control setup. If the Lookup Table was selected then write Register 4A, bit 5.

[Note: In the example on the following pages we will be selecting bit(s) in Register 4C]

Change Register 4A as follows:

1. Set the PWM Clock Select to 1.4 kHz
2. Change the Tachometer Mode to the most accurate reading mode
3. You may change the polarity, if desired, but the traditional mode is with the fan off at 0V.

Change Register 4B, if desired, to change the Fan Spinup PWM Duty Cycle and Spinup Time.

Change Register 4C to 10 hex.

The fan should now start running.

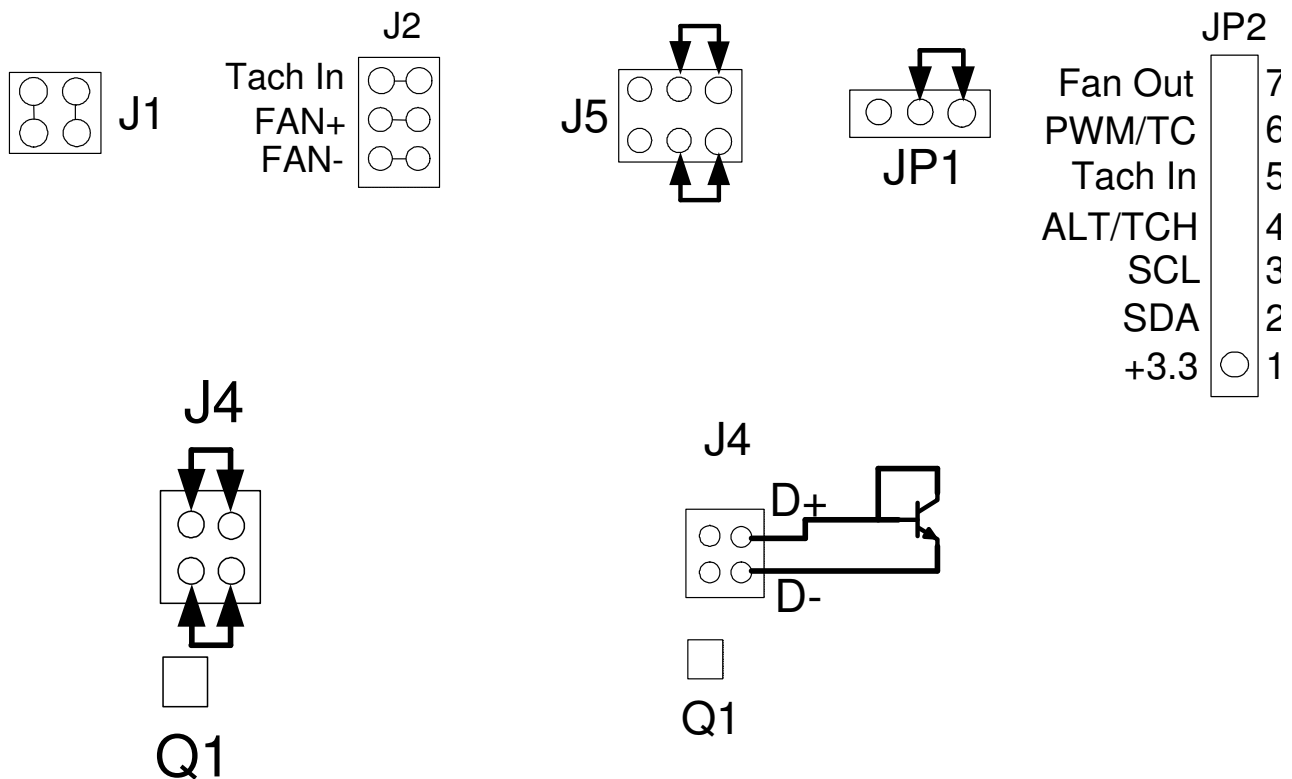
For continuous temperature and tach readings select the read continuous check box. You may also log the data to a file.

### 3.0 Connection Details

Table 1 below describes all the connections and test points of the LM63.

**Table 1. LM63 Evaluation Board Connections and Test Points**

Symbol	Description of the Connections
J1	Fan Power – connect the power supply for the fan to the V+ pin (+12 or +5) and the negative to GND.
J2	Connect the 3-terminal fan to the header, paying attention to the black lead going to the V- pin.
J4	This allows the user to either: (1) connect jumpers horizontally to the top and bottom pin pairs to connect to the on-board MMBT3904 <b>or</b> (2) to remove the jumpers and connect a remote diode directly to the input of the LM63.
J5	The pins marked “LM63” must be jumpered.
JP1	The pins marked “LM63” must be jumpered.
JP2	Fan Out is the open-collector connection to the Fan V- pin. PWM/TC is the PWM output of the LM63 (the “TC” is obsolete). Tach In is the same as the Tach IN from the fan. ALERT/Tach is the LM63 pin connection for the ALERT function (no tach) or Tach function if selected. The SCL and SDA are the SMBus SMBclock and SMBdata signal lines respectively. The +3.3 pin is the 3.3 VDC on-board voltage for the LM63 supply.



Connection to On-Board MMBT3904

Connection to Off-Board Remote Diode

Figure 3. Header Connectors on the LM63 Evaluation Board

### 4.0 Schematic of the LM63 Evaluation Board

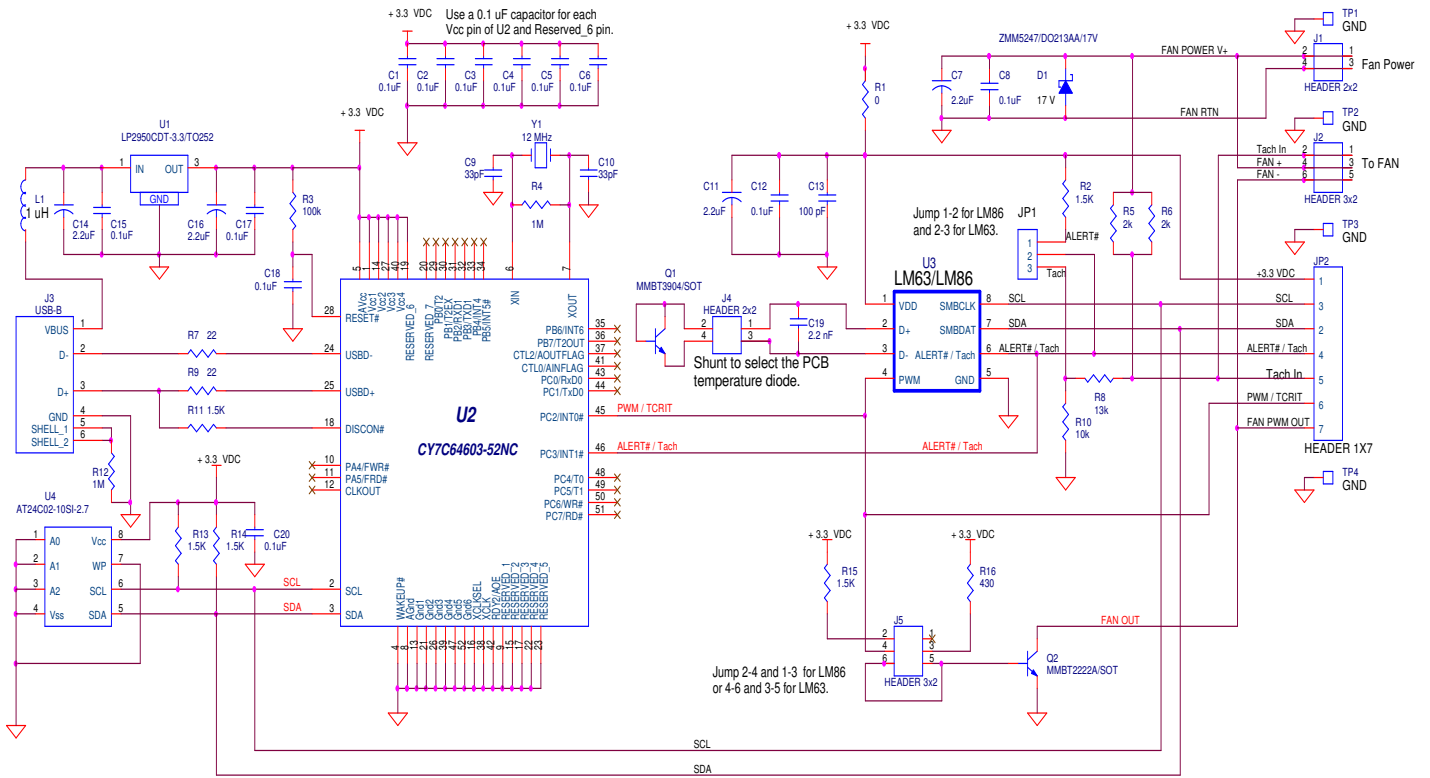


Figure 5. LM63 Evaluation Board Schematic



## 5.0 LM63 Evaluation Board - Bill of Materials

Item	Quantity	Reference	Part
1	10	C1,C2,C3,C4,C5,C6,C8, C12,C15,C17,C18,C20	Capacitor, ceramic,0.1uF
2	2	C9,C10	Capacitor, ceramic,33pF
3	4	C7,C11,C14,C16	Capacitor, ceramic,2.2uF
4	1	C13	Capacitor, ceramic,100 pF
5	1	C19	Capacitor, ceramic,2.2 nF
6	1	D1	Zener Diode ZMM5247/17V
7	1	JP1	HEADER, 1X3
8	2	JP1,JP2	HEADER, 2X5
9	1	JP2	HEADER, 1X7
10	1	J3	Connector, USB-B
11	2	J1,J4	HEADER 2x2
12	1	J2,J5	HEADER 3x2
13	1	L1	Filter, 1uH, Stewart MI1206K900R-00
14	1	Q1	Transistor, NPN, MMBT3904/SOT
15	1	Q2	Transistor, NPN, MMBT2222A/SOT
16	1	R1	Resistor, SMT, 0 Ohm
17	2	R2,R6	Resistor, SMT,1M
18	2	R7,R9	Resistor, SMT,22 Ohm
19	5	R2,R11,R13,R14,R15	Resistor, SMT,1.5 k
20	1	R10	Resistor, SMT,10 k
21	1	R18	Resistor, SMT,0 Ohm
22	2	R5,R6	Resistor, SMT,2k
24	1	R16	Resistor, SMT,430 Ohm
25	1	R8	Resistor, SMT,13k
26	4	TP1,TP2,TP3,TP4,TP5,TP6	T POINTS (1X1 Headers)
27	1	U1	IC, 3.3 VDC Voltage Regulator, National LP2950CDT-3.3
28	1	U2	IC, microcontroller, Cypress CY7C64603-52NC
29	1	U3	IC, EEPROM, Atmel AT24C02-10SI-2.7
30	1	U4	LM63C1MM Device Under Test
31	1	Y1	Crystal, 12 MHz, Pletronics 2S1200G140
32	1		Circuit Board, Fabricated, LM63 Evaluation Board, Rev 1