

General Description

The LM87 Design Kit allows quick connection and evaluation of the LM87 System Hardware Monitor integrated circuit. The Evaluation Board connects to and derives its power from the parallel printer port of a PC. The software was written using Visual Basic 5.0 and is compatible with PC type computers running Microsoft Windows 95 or Windows 98 operating system. Minimum 800 by 600 graphics resolution is recommended for best viewing.

With the LM87 evaluation board and software you can:

- Configure the LM87 registers
- View the LM87 register contents
- Quickly gain familiarity with the LM87 features and operation

1.0 Setup

1.1 Installation

The LM87 Design Kit consists of the LM87 Evaluation Board, software on three 3.5" diskettes, and this instruction manual.

- Insert Disk 1 into the 3.5" floppy drive of the PC. Install the software by clicking on the "Start" button, selecting "Run" and typing in the name of the drive followed by "\setup". For example type a:\setup. Then click on "OK" or press the Enter key. Alternatively, you can use the Windows Explorer to view the drive where the diskette is inserted, and double click on the "setup.exe" file.
- Follow the on screen instructions and select the drive and folder you would like the software installed on. The LM87 evaluation software uses approximately 3 Megabytes of disk space.
- Some features of the program require that Adobe Acrobat Reader be installed on the system. If this software is not present, primary software functions are available, but you will not be able to access the LM87 datasheet, evaluation board schematic, and user manual files. The Adobe Acrobat Reader software is available at: <http://www.adobe.com/acrobat/>

1.2 Board Preparation and Connection

- Make sure the jumpers are placed on the evaluation board at JP1, JP5, JP6-+5V, JP6-FAN/AIN1, JP6-FAN/AIN2, JP6-CI, JP7-INT# are installed.
- Run the software by clicking on the Windows "Start" button, then selecting "Programs->LM87 ->LM87Eval" to launch the program.
- Select the parallel printer port address and the device address of the evaluation board (default 00 with ADD_HI and ADD_LO not installed).
- Connect the board to the parallel printer port of the PC directly or through a cable less than 6 feet (2 meters) long.

2.0 Software

2.1 Launching the Program

To start the software, go to the Windows 'Start - Programs' menu and select 'LM87 – LM87Eval'.

2.2 Operation

- The software provides most of the commonly used information on the main panel. A series of menus are used to provide the following additional functions:
- File – Provides ability to load and save communication and watchdog limit settings. Also provides exit mechanism from the software.
- Communication Settings – Communications port and SMBus address settings.
- Registers – Provides access to all LM87 registers.
- Help – The LM87 datasheet, this manual and the evaluation board schematic can be accessed.

2.3 Initial Settings

When first launched, the software is configured for the following default communication settings:

- Parallel printer port address = 0x3F8h
- LM87 SMBus address bits = 00b

If different settings are required, adjust them through the Communication Settings menu. These alternate communication settings can be saved to disk by using the File-Save Communication Settings menu choice. Previously saved Communication Settings can be loaded via the File-Load Communication Settings menu item.

2.4 Power On

Click on the "DUT Power Off" button on the screen. The button text will change to "DUT Power On" and power will be applied to the LM87 through the parallel port. The board is now ready for communication. At this point, the state of all registers in the LM87 can be read. The Values, Limit Settings and Status Bits displayed in the main panel can be updated by clicking on the button labeled "Get All Values".

2.5 Configuration Registers

Additional Configuration and Control registers are accessed by selecting the menu "Registers". These additional choices provide the following functions:

- Channel Mode Register > This configures the device for the alternate input functions.
- Configuration Register 1 > This is used to configure basic features.
- Configuration Register 2 > This is used to configure more advanced features.
- DAC Setting Register > This allows easy adjustment of the fan drive DAC.
- VID Reading > This allows all 5 VID bits to be observed.
- User Choice > This panel provides Read/Write access to any register in the device.
- Test Register > Bit 0 allows the LM87 to be placed in the low power standby mode.

2.6 Starting Conversions

The LM87 default wakeup state is powered up, but NOT converting. To start Analog to Digital conversions, Configuration Register 1 must be adjusted. Open the Configuration Register 1 menu panel. The initial setting should be all 0's except Bit 3. To start conversions, change Bit 3 to 0 and set Bit 0 to 1. To change the state of any bit, simply click in the white bit position box and the value will change (The register is written and read back every time a bit is changed). Once the LM87 is converting, return to the main panel and click on "Get All Values" again. This will update all of the displayed readings with the newly converted values.

2.7 Basic Operation and Main Panel Functions

As previously stated, clicking on the “Get All Values” button updates all value and limit displays on the main panel. Additional features of the main panel include:

- Clicking in any white “Value” box causes the latest data to be displayed for that box.
- Clicking on any “Change” button allows the associated upper or lower limit to be changed.
- The “+2.5V”, “Vcc 3.3V”, and “FAN” buttons allow the alternate functions for those inputs to be selected directly from the front panel. The main panel display is reformatted and the appropriate mode bit in the Channel Mode Register is set or cleared. When “FAN” mode is selected, pull-down menus are available to set the internal clock divisor used for each FAN counter channel.
- The “Loop” buttons in the Temperature Measurement section cause the software to read and display updated temperature values approximately every second. This data can be logged to a text file is desired.
- Separate “Read” buttons are provided to read the latest interrupt status and mask register settings. Note that reading the status registers clears the status bits for certain channels.
- Individual interrupt mask bits can be set by clicking in the appropriate check box.
- A separate “Reset” button is provided to reset the external CI (Chassis Intrusion) circuit. An opaque cover must be placed over the light sensor before initiating the reset operation. After the Reset, two reads of the Interrupt Status register #2 can be performed to confirm that the Chassis Intrusion circuit has been reset.
- The Alarm Outputs section displays the status of the Int# output and provides a button to test the “Alert Response” feature of the LM87. The Int# jumper must be installed on the evaluation board to allowing monitoring of the Int# output. During the Alert Response test, the Enable Alert Response bit in Register 80h is set, and then an SMBus read at the Alert Response Address is performed. If the Int# output is active, the LM87 will reply to the Alert Response read. *Note: The Alert Response test will fail if the Int# is not active and/or enabled.

2.8 Additional Information

The Help menu provides access to the LM87 datasheet, this manual, and a schematic of the evaluation board. Please refer to the LM87 datasheet for detailed information on device operation.

2.9 Troubleshooting and Common Problems

There are several common problems that can occur when using the LM87 Evaluation board.

1. The most common error message seen is “SMB Acknowledge Error” which indicates that the LM87 is not responding with an acknowledge when expected. The most common causes of this error are:
 - No power applied to LM87 device. This can be caused by missing jumpers, poor connection between the evaluation board and parallel port, or the incorrect parallel port address setting. Check all of these possible causes and try again.
 - Wrong SMBus address setting. Check the address jumpers and the SMBus address setting.
2. Another common error is “Fatal Error: Bus Not Recovering – SDA low”. The most common cause is an incorrect parallel port address setting. If the wrong parallel port address is set, power and communications will not be directed to the port that the LM87 Evaluation board is on. Set the address to the proper value, and try again.

3.0 LM87 Evaluation Board Hardware Details

The schematic for the LM87 evaluation board is shown in FIGURE 2. The backup battery (BT1) for the Chassis Intrusion circuitry has not been installed on the evaluation board. The recommended battery is a Panasonic BR2330-1HE with 3V nominal cell voltage and 255 mAh capacity.

3.1 JP3

JP3, a four-pin header is provided for access to the SMBus and the power supply (V+ and GND) lines and is described in TABLE 2.

Table 1 JP3 Description

| Pin Number | Description |
|------------|-------------|
| 1 | V+ |
| 2 | SDA |
| 3 | SCL |
| 4 | GND |

This header may be used for daisy chaining multiple boards together by connecting the V+, SDA, SCL and GND pins of the different boards.

3.2 JP5

The two pin header JP5 allows the disconnection of the on board voltage regulator, (an LP2950CZ-3.3) from the parallel printer port connection. The board is shipped with a jumper in place, allowing the board to derive all of its power from the parallel printer port.

Table 2 JP5 Power Supply Input Header Description

| Pin Number | Description |
|------------|---|
| 1 | Input of the LP2950CZ-3.3 |
| 2 | Parallel printer port rectifier circuitry |

3.3 JP1

The output of the LP2950CZ-3.3 is connected to the load circuitry through JP1. This allows the user to optionally power the LM87 and other circuitry with a voltage other than 3.3V. When daisy chaining boards it may be necessary to supply an external power source connected to pin 1 of JP1. When using an external supply, ensure that the voltage does not exceed the specifications of any of the Vcc powered circuitry.

Table 1 JP1 Power Supply Output Header Description

| Pin Number | Description |
|------------|----------------------------|
| 1 | Vcc powered circuitry |
| 2 | Output of the LP2950CZ-3.3 |

3.4 JP6

The 22-pin header JP6 allows access to the analog inputs, fan inputs, DAC output and Chassis Intrusion input of the LM87. The board comes shipped with shorting bars installed across the following pins:

- Pins 7 and 8
- Pins 15 and 16
- Pins 17 and 18
- Pins 19 and 20

Table 2 JP6 Description

| Pin Number | Description |
|------------|---|
| 1 | GND |
| 2 | Pin 19 of LM87, Vccp1 |
| 3 | GND |
| 4 | Pin 18 of LM87, +2.5Vin/D2+ |
| 5 | GND |
| 6 | Pin 17 of LM87, Vccp2/D2- |
| 7 | Regulated 3.3V from pin 2 of JP1 |
| 8 | Pin 16 of LM87, +5.0Vin |
| 9 | GND |
| 10 | Pin 15 of LM87, +12Vin |
| 11 | C4, base of Q2, collector of Q2B (alternate D1+ sensor) |
| 12 | Pin 14 of LM87, D1+ |
| 13 | C4, emitter of Q2, base of Q2B (alternate D1- sensor) |
| 14 | Pin 13 of LM87, D1- |
| 15 | Pin 4 of 74HCV14, used as a dummy fan oscillator |
| 16 | Pin 5 of LM87, FAN1/AIN1 input |
| 17 | Pin 2 of 74HCV14, used as a dummy fan oscillator |
| 18 | Pin 6 of LM87, FAN2/AIN2 input |
| 19 | R8 (chassis intrusion circuitry output) |
| 20 | Pin 7 of LM87, CI (Chassis Intrusion) input |
| 21 | GND |
| 22 | Pin 11 of LM87, DACOut/NTESTIN |

3.5 JP7

The 20 pin header JP7 allows access to VID0-VID4, RESET#, INT# and THERM# input and outputs pins of the LM87. The board comes shipped with shorting bars installed across the following pins:

Pins 9 and 10
as shown in FIGURE 1.

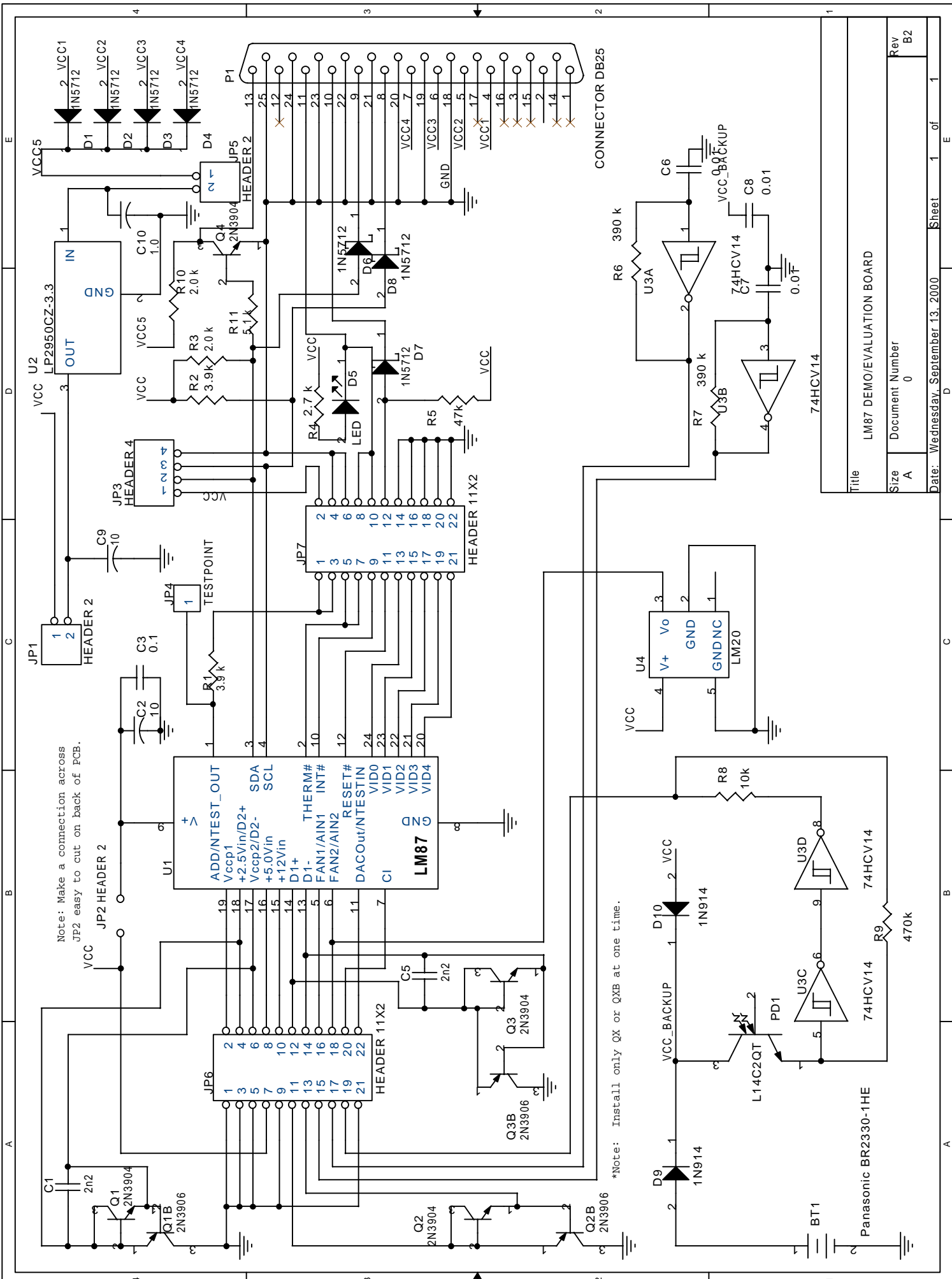
Table 3 JP7 Description

| Pin Number | Description |
|------------|---|
| 1 | Pin 1 of LM87, ADD_HI (Connects ADD to Vcc through a 3.9k resistor)** |
| 2 | Vcc |
| 3 | Pin 1 of LM87, ADD_LO (Connects ADD to GND through a 3.9k resistor)** |
| 4 | GND |
| 5 | Pin 2 of LM87, THERM#In (Allows THERM# to be jumpered to GND for input use) |
| 6 | GND |
| 7 | Pin 2 of LM87, THERM#Out (Allows THERM# to be monitored by software) |
| 8 | LED D5 cathode and Pin 11 of Connector P1 DB25 (parallel printer port) |
| 9 | Pin 10 of LM87, INT# (Allows INT# to be monitored by software) |
| 10 | LED D5 cathode and Pin 11 of Connector P1 DB25 (parallel printer port) |
| 11 | Pin 12 of LM87, RESET# |
| 12 | R5 and D7 (Allows PC to apply a Reset Input to the LM87 RESET#) |
| 13 | Pin 24 of LM87, VID0 |
| 14 | GND |
| 15 | Pin 23 of LM87, VID1 |
| 16 | GND |
| 17 | Pin 22 of LM87, VID2 |
| 18 | GND |
| 19 | Pin 21 of LM87, VID3 |
| 20 | GND |
| 21 | Pin 20 of LM87, VID4 |
| 22 | GND |

**Caution: Do NOT install jumpers for both ADD_HI and ADD_LO at the same time. This will short Vcc to GND and can cause damage to the on board voltage regulator.

3.6 JP2 and JP4

In addition to these headers, JP2 has been provided to permit measurement of the LM87 supply current. This connector is not installed in the circuit board. To measure the LM87 supply current, cut the printed circuit board trace between pin 1 and pin 2 of JP2. Then install a two-pin header and measure the current that flows between the two pins. A shorting jack can be used to operate the LM87 normally when you are finished measuring. JP4 has been providing for monitoring the NTEST_OUT signal when evaluating the NAND tree test mode of the LM87.



| | | |
|-------|-------------------------------|----------------------------|
| Title | | LM87 DEMO/EVALUATION BOARD |
| Size | Document Number | 0 |
| Rev | | B2 |
| Date: | Wednesday, September 13, 2000 | Sheet 1 of 1 |

4.0 LM87 Evaluation Board Bill of Materials

| Item | Quantity | Reference | Part |
|------|----------|----------------|---|
| 1 | 1 | BT1 | Panasonic BR2330-1HE 3V Lithium (Not included) |
| 2 | 3 | C1,C4,C5 | 2n2 |
| 3 | 2 | C2,C9 | 10u, 16V, 6032, 20% |
| 4 | 1 | C3 | 0.1u, 25v, 0805, +80%, -20% |
| 5 | 3 | C6,C7,C8 | 0.01u, 25V, 0805, 5% |
| 6 | 1 | C10 | 1.0u, 25V, 6032, 20% |
| 7 | 7 | D1-D4,D6,D7,D8 | 1N5817 |
| 8 | 1 | D5 | RED LED, HLMP-K150 |
| 9 | 2 | D9,D10 | 1N914 |
| 10 | 3 | JP1, JP5 | HEADER 2X1 |
| 11 | 1 | JP3 | HEADER 4X1 |
| 12 | 1 | JP4 | TESTPOINT |
| 13 | 2 | JP7,JP6 | HEADER 11X2 |
| 14 | 1 | PD1 | L14C2QT |
| 15 | 1 | P1 | CONNECTOR DB25, MALE RIGHT ANGLE |
| 16 | 0 | Q1B,Q2B,Q3B | 2N3906 (Not included) |
| 17 | 1 | Q1,Q2,Q3,Q4 | 2N3904 (Only Q3,Q4 installed) |
| 18 | 2 | R1,R1 | 3.9k, 1/8 W, TH, 5% |
| 19 | 1 | R4 | 2.7k, 1/8 W, TH, 5% |
| 20 | 1 | R5 | 47k, 1/8 W, TH, 5% |
| 21 | 2 | R6,R7 | 390k, 1/8 W, TH, 5% |
| 22 | 1 | R8 | 10k, 1/8 W, TH, 5% |
| 23 | 1 | R9 | 470k, 1/8 W, TH, 5% |
| 24 | 1 | R3,R10 | 2K, 1/8 W, TH, 5% |
| 25 | 1 | R11 | 5.1k, 1/8 W, TH, 5% |
| 26 | 1 | U1 | LM87CIMT |
| 27 | 0 | U1-Socket | OTS-24-0.55-01 (24 TSSOP ZIF) |
| 28 | 1 | U2 | LP2950CZ-3.3 |
| 29 | 1 | U3 | 74HCV14M |
| 30 | 1 | U4 | LM20CIM7 (Not included) |
| 31 | 7 | N/A | SHORTING JACKS |