National Semiconductor

ADVANCE INFORMATION
February 2005

LM95231
TruTherm™ Precision Dual Remote Diode Temperature Sensor with SMBus Interface

General Description

The LM95231 is a precision dual remote diode temperature sensor (RDTS) that uses National's TruTherm technology. The 2-wire serial interface of the LM95231 is compatible with SMBus 2.0. The LM95231 can sense three temperature zones, it can measure the temperature of its own die as well as two diode connected transistors. The LM95231 includes digital filtering and an advanced input stage that includes analog filtering and TruTherm technology that reduces non-ideality processor to processor spread. The diode connected transistors can be a "thermal diode" as found in Intel and AMD processors or can simply be a diode connected MMBT3904 transistor. TruTherm technology allows accurate measurement of "thermal diodes" found on small geometry processes, 90nm and below. The LM95231 supports user selectable thermal diode non-ideality of either a Pentium® 4 processor in the 90nm process or 2N3904.

The LM95231 resolution format for remote temperature readings can be programmed to be 11-bits signed or unsigned with the digital filtering disabled. When the filtering is enabled the resolution increases to 13-bits signed or unsigned. In the unsigned mode the LM95231 remote diode readings can resolve temperatures above 127˚C. Local temperature readings have a resolution of 9-bits plus sign.

Features

- Accurately senses die temperature of remote ICs or diode junctions
- Uses TruTherm technology for precision "thermal diode" temperature measurement
- Thermal diode input stage with analog filtering
- Thermal diode digital filtering
- Pentium 4 90nm or 2N3904 non-ideality selection
- Remote diode fault detection
- On-board local temperature sensing
- Remote temperature readings without digital filtering:
  - 0.125 ˚C LSb
  - 10-bits plus sign or 11-bits programmable resolution
  - 11-bits resolves temperatures above 127 ˚C
- Remote temperature readings with digital filtering:
  - 0.03125 ˚C LSb with filtering
  - 12-bits plus sign or 13-bits programmable resolution
  - 13-bits resolves temperatures above 127 ˚C
- Local temperature readings:
  - 0.25 ˚C
  - 9-bits plus sign
- Status register support
- Programmable conversion rate allows user optimization of power consumption
- Shutdown mode one-shot conversion control
- SMBus 2.0 compatible interface, supports TIMEOUT
- 8-pin MSOP package

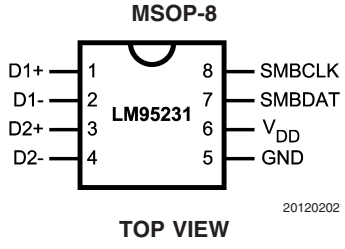
Key Specifications

- Remote Diode Temperature Accuracy
  - T_A=30˚C to 50˚C, T_D=45˚C to 85˚C ±0.75 ˚C (max)
  - T_A=0˚C to 85˚C, T_D=25˚C to 140˚C ±2.0 ˚C (max)
- Local Temperature Accuracy
  - T_A=0˚C to 85˚C ±3.0 ˚C (max)
- Supply Voltage 3.0 V to 3.6 V
- Supply Current 2 mA (typ)

Applications

- Processor/Computer System Thermal Management (e.g. Laptop, Desktop, Workstations, Server)
- Electronic Test Equipment
- Office Electronics

Connection Diagram



TOP VIEW

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I2C® is a registered trademark of Phillips Corporation.
Pentium™ is a trademark of Intel Corporation.

LM95231 TruTherm Precision Dual Remote Diode Temperature Sensor with SMBus Interface

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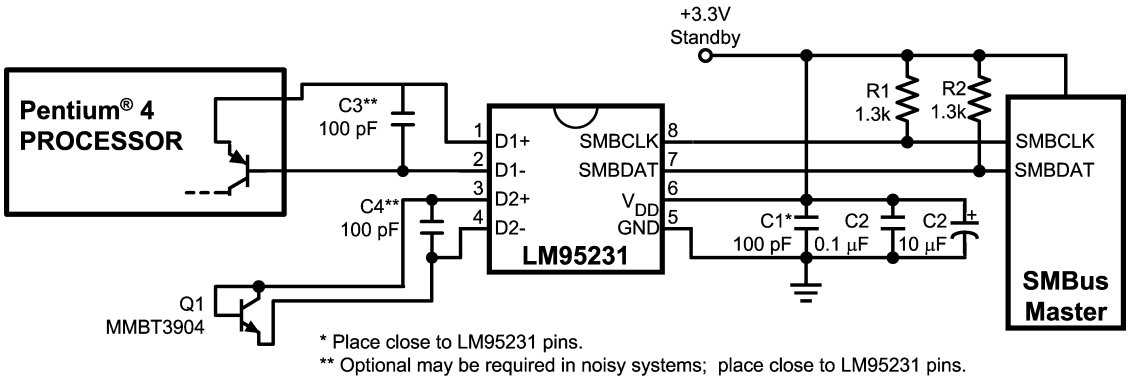
Ordering Information

Part Number	Package Marking	NS Package Number	Transport Media	SMBus Device Address
LM95231CIMM	LM95231CIMM	MUA08A (MSOP-8)	1000 Units on Tape and Reel	010 1011
LM95231CIMMX	LM95231CIMM	MUA08A (MSOP-8)	3500 Units on Tape and Reel	010 1011

Pin Descriptions

Label	Pin #	Function	Typical Connection
D1+	1	Diode Current Source	To Diode Anode. Connected to remote discrete diode-connected transistor junction or to the diode-connected transistor junction on a remote IC whose die temperature is being sensed. A capacitor is not required between D1+ and D1-. A 100 pF capacitor between D1+ and D1– can be added and may improve performance in noisy systems.
D1–	2	Diode Return Current Sink	To Diode Cathode. A capacitor is not required between D1+ and D1-. A 100 pF capacitor between D1+ and D1– can be added and may improve performance in noisy systems.
D2+	3	Diode Current Source	To Diode Anode. Connected to remote discrete diode-connected transistor junction or to the diode-connected transistor junction on a remote IC whose die temperature is being sensed. A capacitor is not required between D2+ and D2-. A 100 pF capacitor between D2+ and D2– can be added and may improve performance in noisy systems.
D2–	4	Diode Return Current Sink	To Diode Cathode. A capacitor is not required between D2+ and D2-. A 100 pF capacitor between D2+ and D2– can be added and may improve performance in noisy systems.
GND	5	Power Supply Ground	System low noise ground
V_{DD}	6	Positive Supply Voltage Input	DC Voltage from 3.0 V to 3.6 V. V_{DD} should be bypassed with a 0.1 µF capacitor in parallel with 100 pF. The 100 pF capacitor should be placed as close as possible to the power supply pin. Noise should be kept below 200 mVp-p, a 10 µF capacitor may be required to achieve this.
SMBDAT	7	SMBus Bi-Directional Data Line, Open-Drain Output	From and to Controller; may require an external pull-up resistor
SMBCLK	8	SMBus Clock Input	From Controller; may require an external pull-up resistor

Typical Application



* Place close to LM95231 pins.
** Optional may be required in noisy systems; place close to LM95231 pins.

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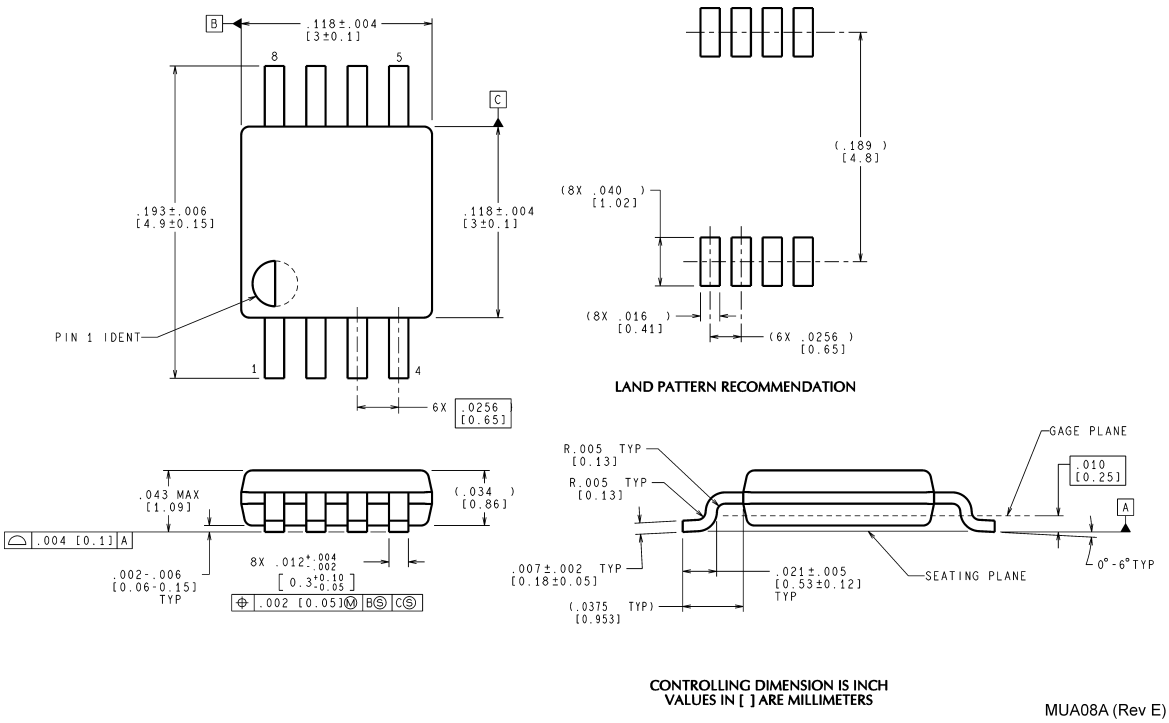
Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MUA08A (Rev E)

8-Lead Molded Mini-Small-Outline Package (MSOP),
JEDEC Registration Number MO-187
Order Number LM95231CIMM or LM95231CIMMX
NS Package Number MUA08A

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