National Semiconductor

ADVANCE INFORMATION
August 2006

LM95233
Dual Remote Diode and Local Temperature Sensor with SMBus Interface, $\overline{\text{TCRIT}}$s and TruTherm™ Technology

General Description

LM95233 is an 11-bit digital temperature sensor with a 2-wire System Management Bus (SMBus) interface that can monitor the temperature of two remote diodes as well as its own temperature. The LM95233 can be used to very accurately monitor the temperature of up to two external devices such as microprocessors, graphics processors or diode-connected 2N3904s. The LM95233's TruTherm technology allows sensing of 90nm or 65nm process thermal diodes accurately.

The LM95233 reports temperature in two different formats for +127.875˚C/–128˚C range and 0˚C/255˚C range. The LM95233 $\overline{\text{TCRIT1}}$, $\overline{\text{TCRIT2}}$ and $\overline{\text{TCRIT3}}$ outputs are triggered when any unmasked channel exceeds its corresponding programmable limit and can be used to shutdown the system, to turn on the system fans or as a microcontroller interrupt function. The current status of the $\overline{\text{TCRIT1}}$, $\overline{\text{TCRIT2}}$ and $\overline{\text{TCRIT3}}$ pins can be read back from the status registers. Mask registers are available for further control of the $\overline{\text{TCRIT}}$ outputs.

LM95233's remote temperature channels have programmable digital filters to minimize unwanted $\overline{\text{TCRIT}}$ events when temperature spikes are encountered.

For optimum flexibility and accuracy each LM95233 channel includes, registers for sub-micron process or 2N3904 diode model selection as well as offset correction. A three level address pin allows connection of up to 3 LM95233s to the same SMBus master. The LM95233 includes power saving functions such as: programmable conversion rate, shutdown mode, and turn off of unused channels.

Features

- Accurately senses die temperature of 2 remote ICs or diode junctions and local temperature
- TruTherm technology accurately senses sub-micron process thermal diodes
- 0.125˚C LSb temperature resolution
- 0.03125˚C LSb remote temperature resolution with digital filter enabled
- +127.875˚C/–128˚C and 0˚C/255˚C remote ranges
- Programmable digital filters and analog front end filter
- Remote diode fault detection, model selection and offset correction
- Mask and status register support
- 3 programmable $\overline{\text{TCRIT}}$ outputs with programmable shared hysteresis
- Programmable conversion rate and shutdown mode one-shot conversion control
- SMBus 2.0 compatible interface, supports TIMEOUT
- Three-level address pin
- 14-pin LLP package

Key Specifications

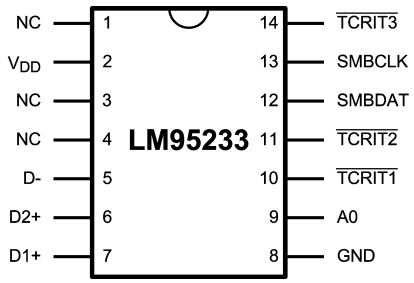
- Local Temperature Accuracy ±2.0 ˚C (max)
- Remote Diode Temperature Accuracy ±0.75 ˚C (max)
- Supply Voltage 3.0 V to 3.6 V
- Average Supply Current (1Hz conversion rate) 0.5 mA (typ)

Applications

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

Connection Diagram

LLP-14



TOP VIEW

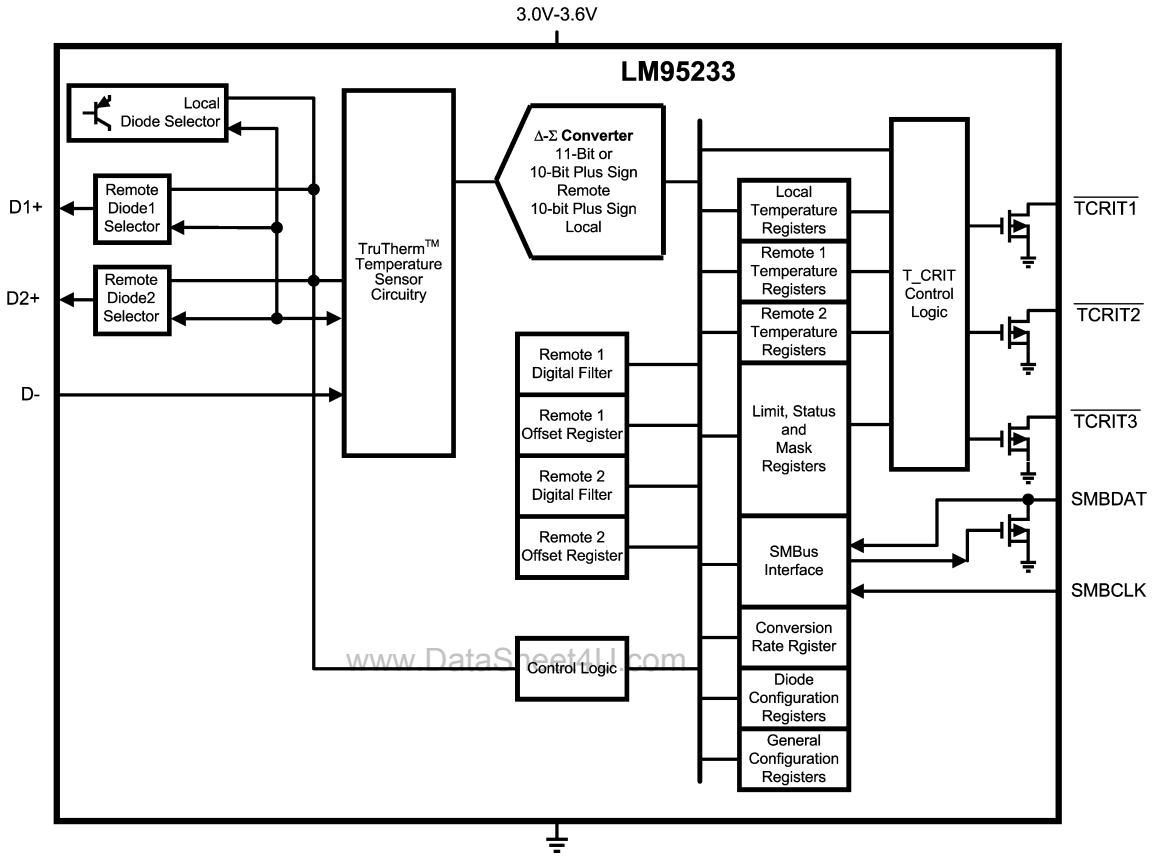
TruTherm™ is a trademark of National Semiconductor Corporation.

LM95233 Dual Remote Diode and LocalTemperature Sensor with SMBus Interface, TCRITs and TruTherm Technology

Ordering Information

Part Number	Package Marking	NS Package Number	Transport Media
LM95233CISD	95233CI	SDA14B (LLP-14)	1000 Units on Tape and Reel
LM95233CISDX	95233CI	SDA14B (LLP-14)	4500 Units on Tape and Reel

Simplified Block Diagram



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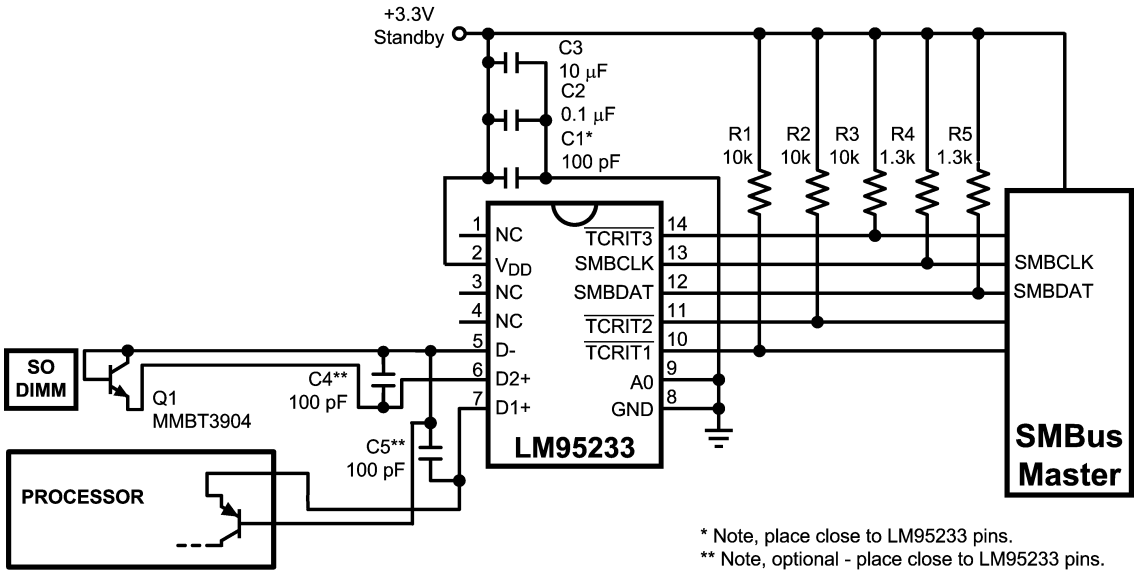
Pin Descriptions

Label	Pin #	Function	Typical Connection
NC	1	No Connect	Not connected. May be left floating, connected to GND or V_{DD}.
V_{DD}	2	Positive Supply Voltage Input	DC Voltage from 3.0 V to 3.6 V. V_{DD} should be bypassed with a 0.1µF capacitor in parallel with 100pF. The 100pF 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.
NC	3	No Connect	Not connected. May be left floating, connected to GND or V_{DD}.
NC	4	No Connect	Not connected. May be left floating, connected to GND or V_{DD}.
D–	5	Diode Return Current Sink	To all Diode Cathodes. Common D- pin for all two remote diodes.

Pin Descriptions (Continued)

Label	Pin #	Function	Typical Connection
D2+	6	Diode Current Source	To second 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 D-. A 100 pF capacitor between D2+ and D- can be added and may improve perfomance in noisy systems. Float this pin if this thermal diode is not used.
D1+	7	Diode Current Source	To first 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 D-. A 100 pF capacitor between D1+ and D- can be added and may improve perfomance in noisy systems. Float this pin if this thermal diode is not used.
GND	8	Power Supply Ground	System low noise ground.
A0	9	Dgital Input	SMBus slave address select pin. Selects one of three addresses. Can be tied to V_{DD}, GND, or to the middle of a resistor divider connected between V_{DD} and GND.
$\overline{\text{TCRIT1}}$	10	Digital Output, Open-Drain	Critical temperature output 1. Requires pull-up resistor. Active "LOW".
$\overline{\text{TCRIT2}}$	11	Digital Output, Open-Drain	Critical temperature output 2. Requires pull-up resistor. Active "LOW".
SMBDAT	12	SMBus Bi-Directional Data Line, Open-Drain Output	From and to Controller; may require an external pull-up resistor
SMBCLK	13	SMBus Clock Input	From Controller; may require an external pull-up resistor
$\overline{\text{TCRIT3}}$	14	Digital Output, Open-Drain	Critical temperature output 3. Requires pull-up resistor. Active "LOW".

Typical Application



* Note, place close to LM95233 pins.
** Note, optional - place close to LM95233 pins.

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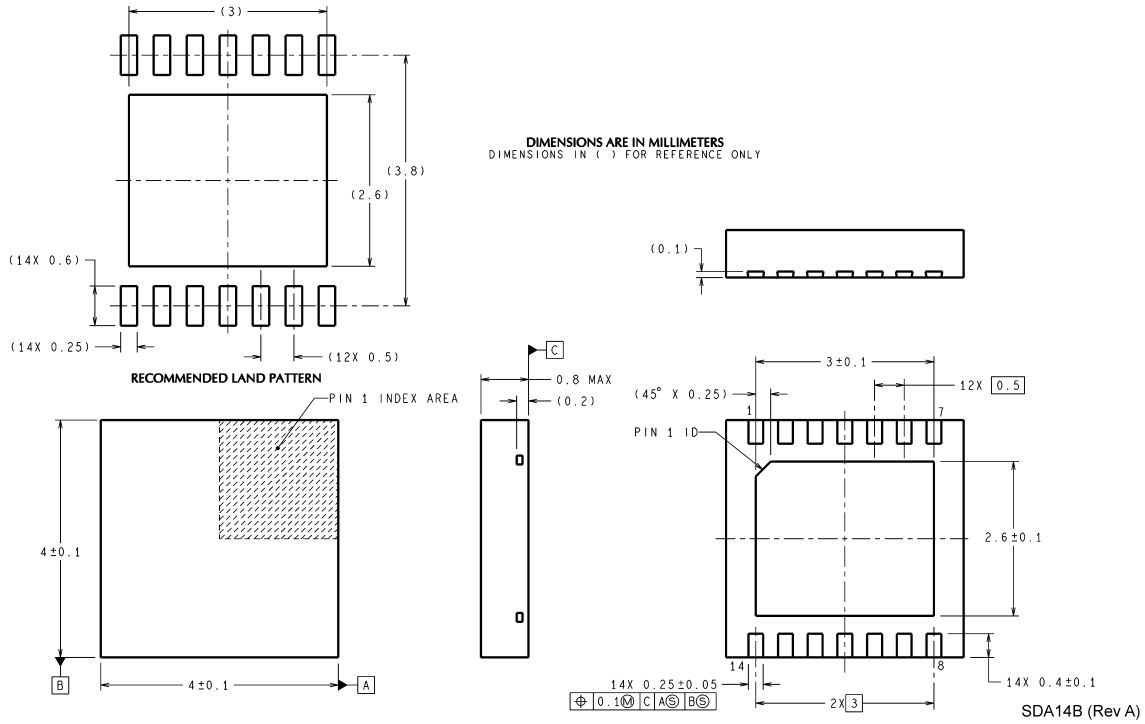
Physical Dimensions inches (millimeters)

unless otherwise noted



14-Lead Molded Leadless Leadframe Package (LLP),
Order Number LM95233CISD or LM95233CISDX
NS Package Number SDA14B

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