

DATA SHEET



NE1619 **HECETA4** Temperature and voltage monitor

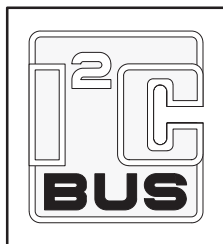
Product data sheet
Supersedes data of 2004 May 10

2004 Oct 05



HECETA4 Temperature and voltage monitor

NE1619



GENERAL DESCRIPTION

The NE1619 is designed for monitoring the temperatures and supply voltages of microprocessor-based systems by measuring those parameters and comparing the readings with programmable limits. The device provides five possible analog inputs, a remote temperature sensor input and on-board local temperature sensor. The device also monitors its own power supply and provides digital inputs for the Pentium/PRO power supply ID code.

The device communicates with the system controller via an SMBus (System Management bus) by which it can be programmed for operation and data collection. Readings come from conversions of the on-board A-to-D converter which cycles through all measurements in sequence in approximately one second when the conversion is started. The device includes a number of registers to store data of the device configuration, status, readings and limits. Except for the temperature-related data which are in 8-bit digital 2's complement format, all the data are in 8-bit digital straight format.

FEATURES

- Monitor local and remote temperatures
- Temperature accuracy of ± 2 °C for local, and ± 3 °C for remote channel
- Temperature resolution of 1 °C
- 2.8 V to 5.5 V supply range
- Monitor different power supplies: 12 V, 5 V, 3.3 V, 2.5 V, V_{CCP} , V_{DD}
- V_{IN} accuracy of $\pm 2\%$ of full scale
- Differential non-linearity of ± 1 LSB
- No calibration required
- Programmable temperature and voltage limits for alarms
- Programmable Reset low state pulse output
- SMBus 2-wire serial interface
- Small 16-lead SSOP (QSOP) package
- Compatible with Intel "Heceta 4" specification and reference designs utilizing it
- ESD protection exceeds 2000 V HBM per JESD22-A114, 250 V MM per JESD22-A115 and 1000 V CDM per JESD22-C101
- Latch-up testing is done to JESDEC Standard JESD78 which exceeds 100 mA

APPLICATIONS

- System thermal and hardware monitor
- Desktop computers
- Notebook computers
- Industrial controllers
- Telecom equipment

ORDERING INFORMATION

$T_{amb} = 0^{\circ}\text{C to } +125^{\circ}\text{C}$

| Type number | Topside mark | Package | | |
|-------------|--------------|---------------|--|----------|
| | | Name | Description | Version |
| NE1619DS | NE1619 | SSOP16 (QSOP) | plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm | SOT519-1 |

Standard packing quantities and other packaging data are available at www.standardproducts.philips.com/packaging.

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PINNING

Pin Configuration

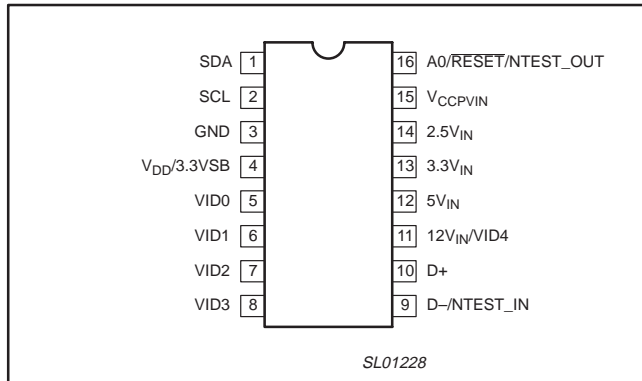


Figure 1. Pin configuration

Pin Description

| PIN # | SYMBOL | FUNCTION DESCRIPTION |
|-------|-------------------------|---|
| 1 | SDA | Digital I/O. SMBus serial bi-directional data. Open-drain output. |
| 2 | SCL | Digital Input. SMBus serial clock input. |
| 3 | GND | Ground. To be connected to system ground. |
| 4 | V _{DD} /3.3VSB | Power supply. Can be connected to +3.3 V standby power if monitoring in low power states is required. This pin also serves as the analog input to monitor the V _{DD} voltage level. |
| 5 | VID0 | Digital Input. For Voltage ID readouts from the processor. This value is read into the VID status register (LSB bit). |
| 6 | VID1 | Digital Input. For Voltage ID readouts from the processor. This value is read into the VID status register. |
| 7 | VID2 | Digital Input. For Voltage ID readouts from the processor. This value is read into the VID status register. |
| 8 | VID3 | Digital Input. For Voltage ID readouts from the processor. This value is read into the VID status register. |
| 9 | D-/NTEST_IN | Analog/Digital Input. This pin is connected to the negative terminal of the remote temperature sensor for analog input. If this pin is held high at power-up, for digital input, it enables the NAND-TREE test mode. |
| 10 | D+ | Analog Input. This pin is connected to the positive terminal of the remote temperature sensor. |
| 11 | 12V _{IN} /VID4 | Analog/Digital Input. Defaults at power-up to analog input for monitoring the +12 V supply. This pin is programmable to be a digital input for voltage ID readouts from the processor. Its state is read into the VID4 status register. |
| 12 | 5V _{IN} | Analog Input. For monitoring the +5 V supply. |
| 13 | 3.3V _{IN} | Analog Input. For monitoring the +3.3 V supply. |
| 14 | 2.5V _{IN} | Analog Input. For monitoring the +2.5 V supply. |
| 15 | V _{CCPVIN} | Analog Input. For monitoring the processor voltage supply (0 to 3.0 V) |
| 16 | A0/RESET/NTEST_OUT | Digital I/O. At power-up, the logic input of this pin defines the LSB bit of the device slave address. This pin can be configured to give a low pulse reset output of 20ms minimum. This pin also functions as the output in the NAND-TREE test mode. |

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FUNCTIONAL BLOCK DIAGRAM

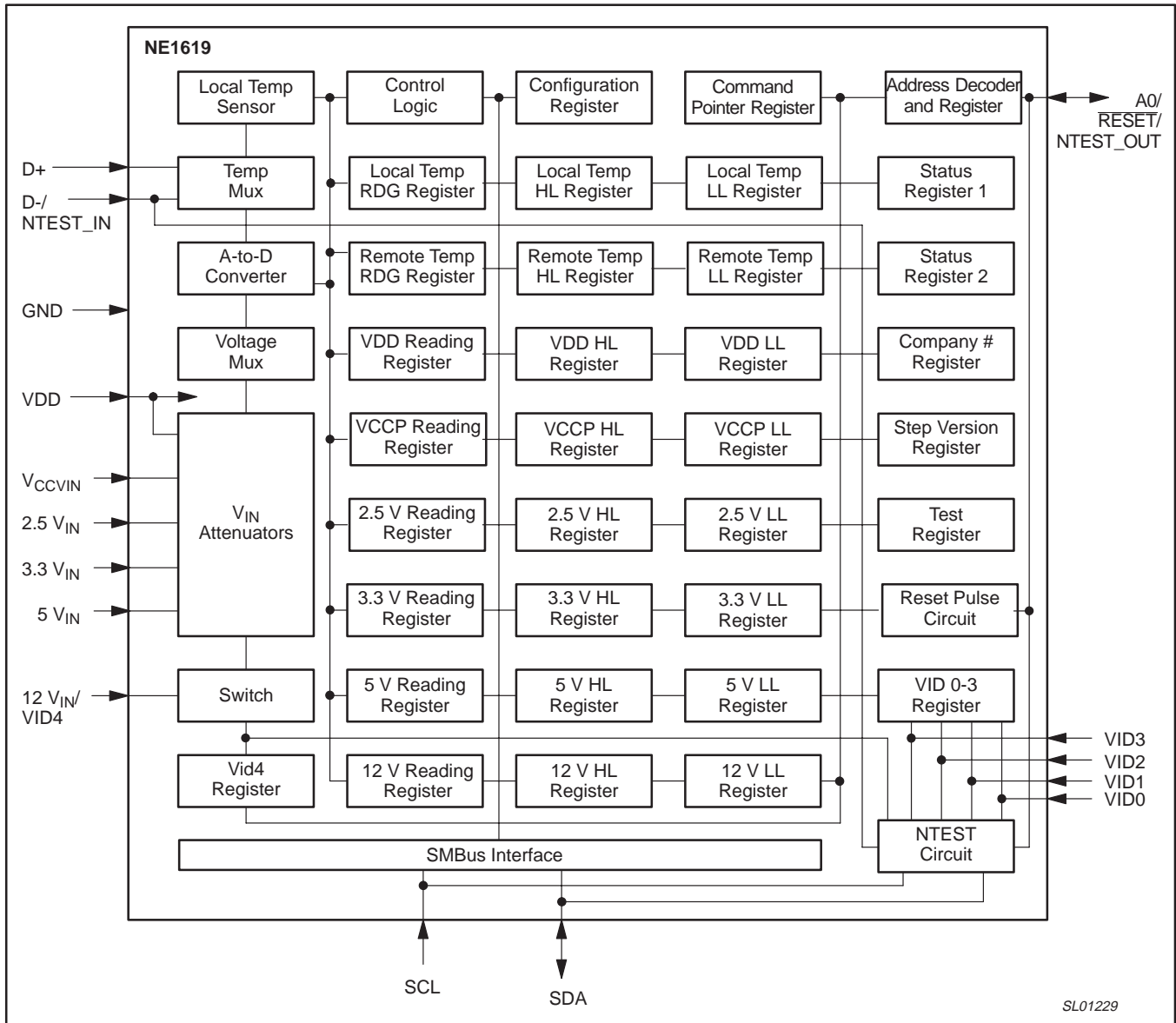


Figure 2. Functional block diagram

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TYPICAL APPLICATION CIRCUIT

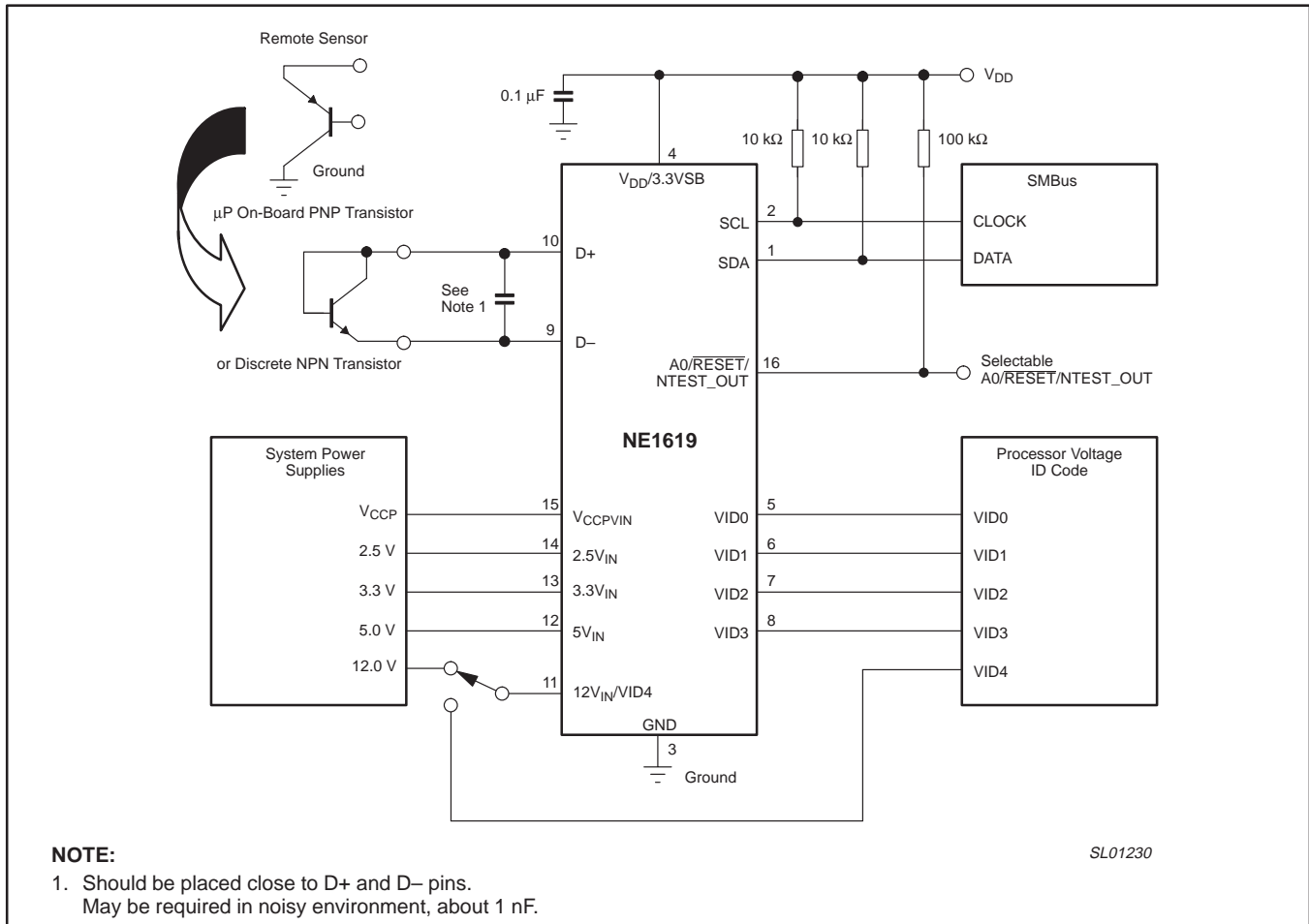


Figure 3. Typical application circuit

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | MIN. | MAX. | UNIT |
|--|------|----------------------|------|
| V _{DD} to GND | -0.3 | 6 | V |
| 12V _{IN} to GND | -0.3 | 18 | V |
| 5V _{IN} , 3.3V _{IN} , 2.5V _{IN} , V _{CCP} to GND | -0.3 | 6 | V |
| Other pins to GND | -0.3 | V _{DD} +0.3 | V |
| Input current at any pin | -5 | 5 | mA |
| Package input current | -20 | 20 | mA |
| Operating temperature range | 0 | +125 | °C |
| Maximum junction temperature | - | +150 | °C |
| Storage temperature range | -65 | +150 | °C |

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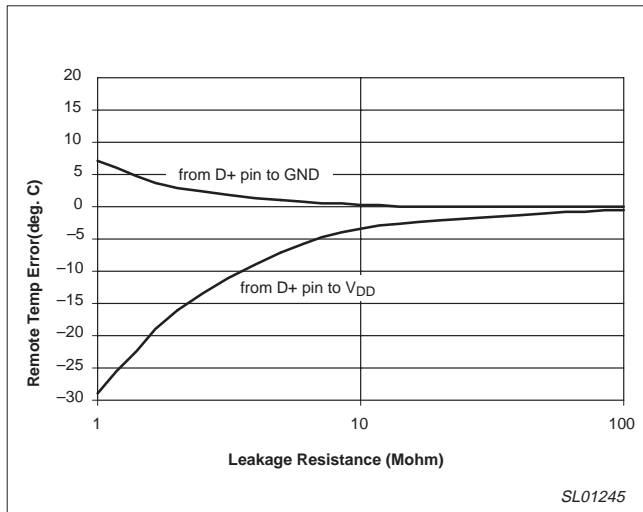


Figure 4. Temp Error versus PC Board Leakage Resistance

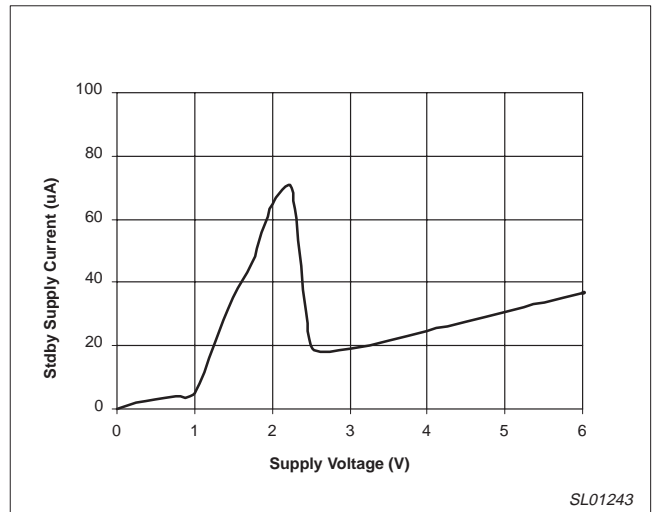


Figure 6. Standby Current versus Supply Voltage

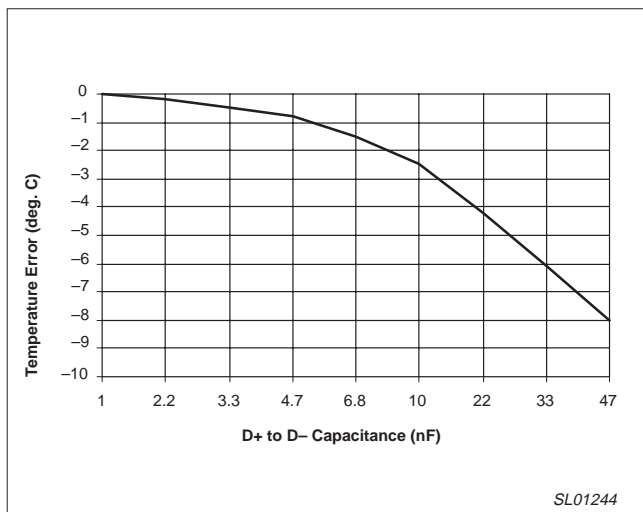


Figure 5. Temp Error versus D+D- Capacitance

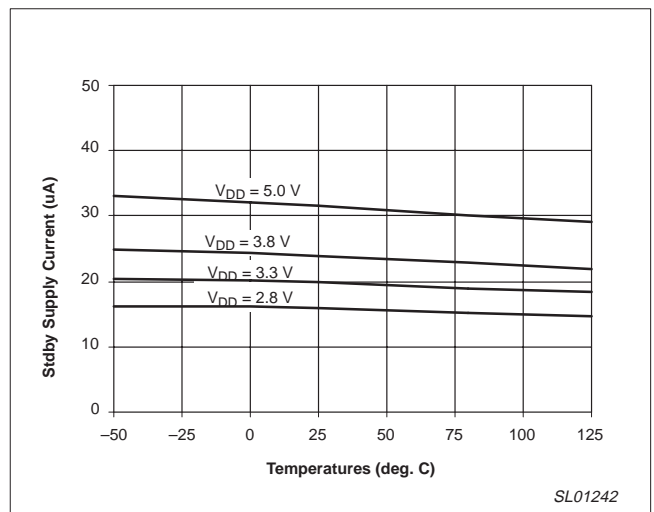


Figure 7. Standby Current versus Temperature

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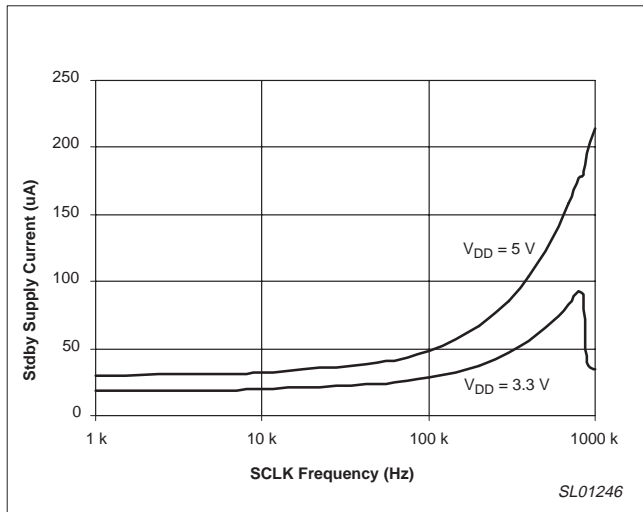


Figure 8. Standby Current versus SCLK Frequency

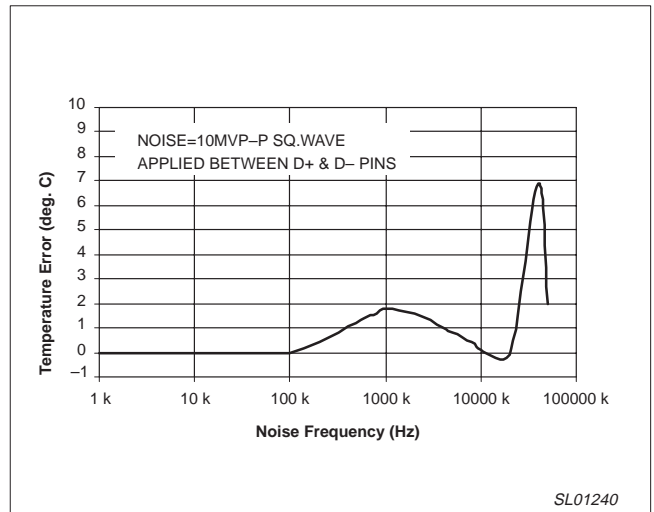


Figure 10. Temp error versus Different Mode Noise Frequency

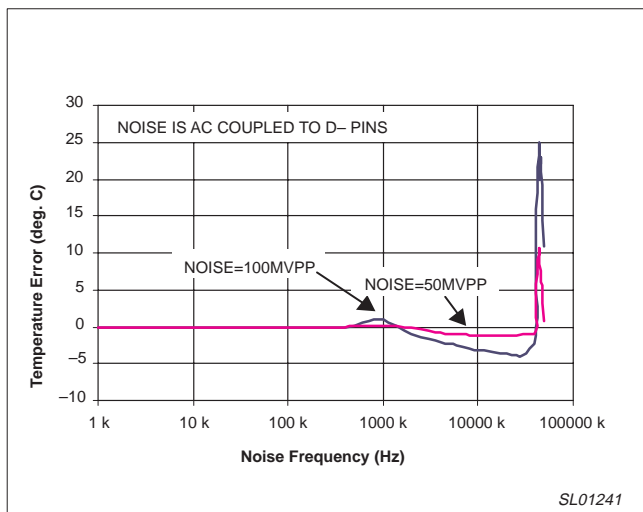


Figure 9. Temp Error versus Common Mode Noise

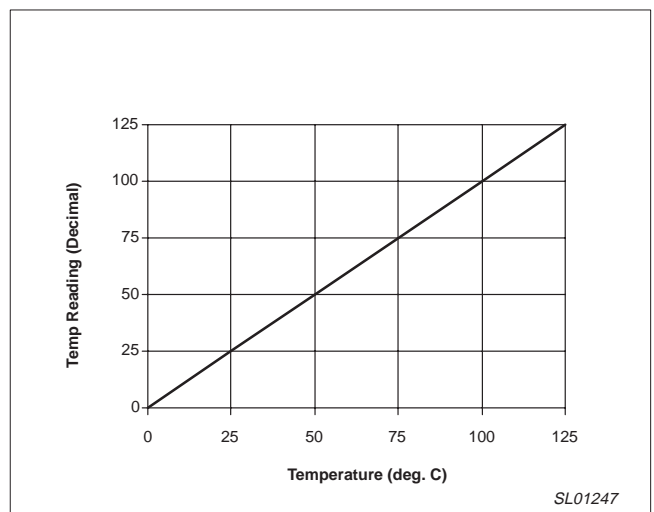


Figure 11. Relationship between Temperature and Temp reading

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DC ELECTRICAL CHARACTERISTICS $V_{DD} = 3.3\text{ V}$ (see Note 4); $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ unless otherwise specified.

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|--|--|---|------|-----------|-------------|--------------------|
| V_{DD} | Supply voltage | | 2.8 | 3.3 | 5.5 | V |
| I_{DD} | Supply current | Standby mode | – | 100 | – | μA |
| I_{DD} | Supply current | Operating mode | – | 250 | 500 | μA |
| t_C | Total monitoring cycle time ¹ | All conversions | – | 0.25 | 0.50 | sec |
| T_R | Temperature resolution | Local and Remote | – | ± 1.0 | – | $^{\circ}\text{C}$ |
| T_{AI} | Internal temperature accuracy | $T_{amb} = 25\text{ }^{\circ}\text{C}$ | – | – | ± 2.0 | $^{\circ}\text{C}$ |
| | | $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $+120\text{ }^{\circ}\text{C}$ | – | – | ± 3.0 | $^{\circ}\text{C}$ |
| T_{AE} | External temperature accuracy | $T_{amb} = 25\text{ }^{\circ}\text{C}$ | – | – | ± 3.0 | $^{\circ}\text{C}$ |
| | | $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $+120\text{ }^{\circ}\text{C}$ | – | – | ± 5.0 | $^{\circ}\text{C}$ |
| I_S | Remote source current | High level | – | 100 | – | μA |
| | | Low level | – | 10 | – | μA |
| Voltage-to-Digital converter ($12V_{IN}$, $5V_{IN}$, $3.3V_{IN}$, $2.5V_{IN}$, V_{CCP}, V_{DD}) | | | | | | |
| VUE | Unadjusted error | | – | – | ± 2.0 | %FS |
| VDNL | Differential non-linearity error | | – | ± 1.0 | – | LSB |
| VRIN | V_{IN} input resistance | | 100 | 200 | – | $\text{k}\Omega$ |
| VPSS | V_{IN} power supply sensitivity | | – | ± 1.0 | – | %/V |
| Digital output (SDA, A0²) | | | | | | |
| V_{OH} | Output High voltage | $I_{OUT} = -3.0\text{ mA}$, $V_{DD} = 2.8\text{ V}$ | – | – | 2.4 | V |
| V_{OL} | Output Low voltage | $I_{OUT} = 3.0\text{ mA}$, $V_{DD} = 3.8\text{ V}$ | 0.4 | – | – | V |
| I_{OH} | Output High leakage current | $V_{OUT} = V_{DD}$ | – | 0.1 | 10.0 | μA |
| SMB digital input voltages (SDA, SCL) | | | | | | |
| V_{IH} | Input High voltage | | – | – | $0.6V_{DD}$ | V |
| V_{IL} | Input Low voltage | | – | – | $0.3V_{DD}$ | V |
| Digital input voltages (A0, VID0–4, NT_IN³) | | | | | | |
| V_{IH} | Input High voltage | | – | – | 2.0 | V |
| V_{IL} | Input Low voltage | | 0.4 | – | – | V |
| Digital input current (all digital inputs) | | | | | | |
| I_{IH} | Input High current | $V_{IN} = V_{DD}$ | –1.0 | – | – | μA |
| I_{IL} | Input Low current | $V_{IN} = \text{GND}$ | – | – | 1.0 | μA |
| C_{IN} | Input capacitance | | – | 20.0 | – | pF |

NOTES:

- Total monitoring cycle time includes all temperature conversions and all voltage conversions.
- When A0 is selected as output in NAND-TREE test mode.
- When D– is selected as input in NAND-TREE test mode.
- Operating the device at 2.8 V to 5.5 V is allowed, but parameter values in characteristics table are not guaranteed.

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SMBus INTERFACE AC CHARACTERISTICS

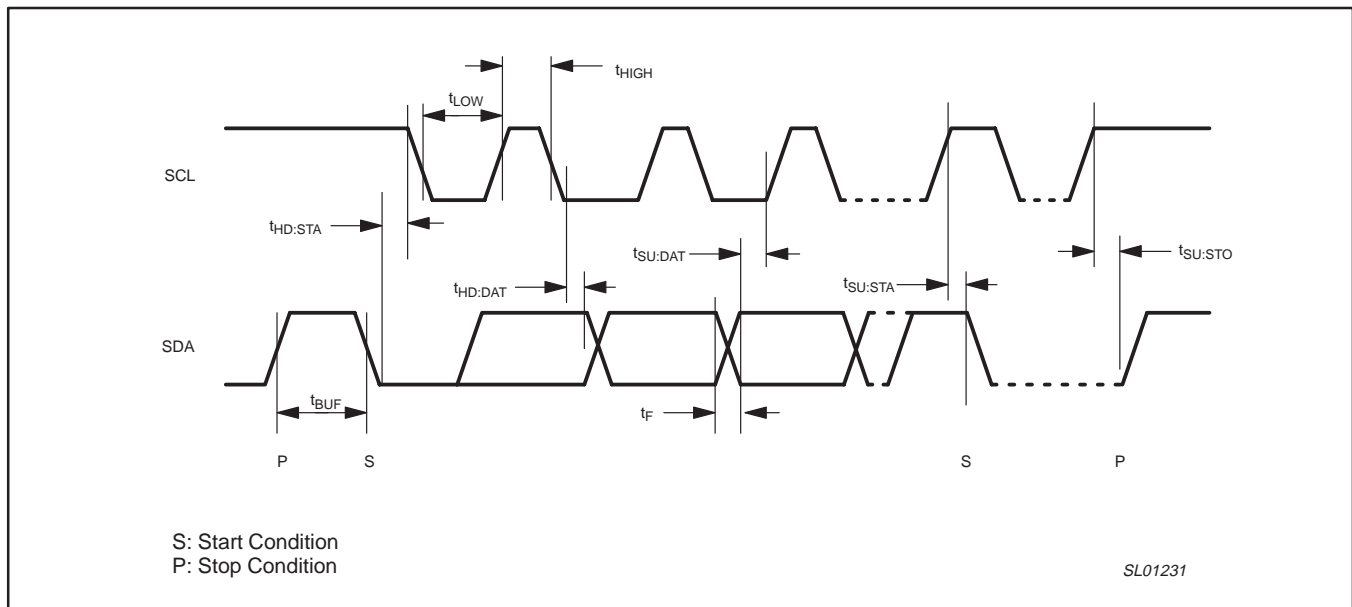
$V_{DD} = 3.3\text{ V}$, $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ unless otherwise specified.

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------|---------------------|-----------|------|------|------|---------------|
| t_{SCL} | SCL clock frequency | | – | – | 400 | kHz |
| t_{BUF} | SMBus free time | | 4.7 | – | – | μs |
| t_{LOW} | SCL Low time | | 4.7 | – | – | μs |
| t_{HIGH} | SCL High time | | 4.0 | – | – | μs |
| $t_{SU:STA}$ | Start set-up time | | 100 | – | – | ns |
| $t_{HD:STA}$ | Start hold time | | 100 | – | – | ns |
| $t_{SU:STO}$ | Stop set-up time | | 4.0 | – | – | μs |
| $t_{SU:DAT}$ | Data set-up time | | 250 | – | – | ns |
| $t_{HD:DAT}$ | Data hold time | | 0 | – | – | ns |
| t_F | Fall time | | – | – | 1.0 | μs |

NOTE:

1. These specifications are guaranteed by design and not tested in production.

TIMING DIAGRAM



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Table 1. List of registers

| NAME | COMMAND OR ADDRESS | R/W | POR STATE | DESCRIPTION |
|--------|--------------------|-----------|-----------|--|
| CR | 40h | R/W | 0000 1000 | Configuration register |
| SR1 | 41h | Read only | 0000 0000 | Status register #1 |
| SR2 | 42h | Read only | 0000 0000 | Status register #2 |
| VID | 47h | Read only | 0000 xxxx | VID register, xxxx = VID3–VID0 |
| VID4 | 49h | Read only | 1000 000x | VID4 register, x = VID4 |
| CID | 3Eh | Read only | 1010 0001 | Company number |
| SID | 3Fh | Read only | 0010 0001 | Stepping version number |
| TEST | 15h | R/W | N/A | Manufacturer test register |
| 2.5VR | 20h | Read only | N/A | 2.5V _{IN} reading register |
| VCCPR | 21h | Read only | N/A | V _{CCPVIN} reading register |
| 3.3VR | 22h | Read only | N/A | 3.3V _{IN} reading register |
| 5VR | 23h | Read only | N/A | 5V _{IN} reading register |
| 12VR | 24h | Read only | N/A | 12V _{IN} reading register |
| VDDR | 25h | Read only | N/A | V _{DD} reading register |
| ETR | 26h | Read only | N/A | External or remote temperature reading register |
| ITR | 27h | Read only | N/A | Internal or local temperature reading register |
| 2.5VHL | 2Bh | R/W | 0000 0000 | 2.5V _{IN} high limit register |
| 2.5VLL | 2Ch | R/W | 0000 0000 | 2.5V _{IN} low limit register |
| VCCPHL | 2Dh | R/W | 0000 0000 | V _{CCPVIN} high limit register |
| VCCPLL | 2Eh | R/W | 0000 0000 | V _{CCPVIN} low limit register |
| 3.3VHL | 2Fh | R/W | 0000 0000 | 3.3V _{IN} high limit register |
| 3.3VLL | 30h | R/W | 0000 0000 | 3.3V _{IN} low limit register |
| 5VHL | 31h | R/W | 0000 0000 | 5V _{IN} high limit register |
| 5VLL | 32h | R/W | 0000 0000 | 5V _{IN} low limit register |
| 12VHL | 33h | R/W | 0000 0000 | 12V _{IN} high limit register |
| 12VLL | 34h | R/W | 0000 0000 | 12V _{IN} low limit register |
| VDDHL | 35h | R/W | 0000 0000 | V _{DDVIN} high limit register |
| VDDL | 36h | R/W | 0000 0000 | V _{DDVIN} low limit register |
| ETHL | 37h | R/W | 0000 0000 | External or remote temperature high limit register |
| ETLL | 38h | R/W | 0000 0000 | External or remote temperature low limit register |
| ITHL | 39h | R/W | 0000 0000 | Internal or local temperature high limit register |
| ITLL | 3Ah | R/W | 0000 0000 | Internal or local temperature low limit register |

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Table 2. Configuration Register (CR, 40h, default = 0000 1000)

| BIT | NAME | R/W | DESCRIPTION |
|-----|--------------------------------|------|---|
| 0 | START | R/W | Logic 1 enables startup of monitor device, logic 0 places the device in standby mode. Power-up default = 0. At startup, limit checking functions and scanning begins. Note, all High and Low limits should be set into the ASIC prior turning on this bit. |
| 1 | Reserved | Read | Power-up default = 0. |
| 2 | Reserved | Read | Power-up default = 0. |
| 3 | Reserved | Read | Power-up default = 1. |
| 4 | RESET | R/W | Setting this bit generates a minimum 20ms low pulse on the Reset pin, if the reset function is enabled. Power-up default = 0. |
| 5 | 12V _{IN} /VID4 SELECT | R/W | Selects whether pin 11 acts as a 12 volt analog input monitoring pin, or as a VID[4] input. This pin defaults to the 12 volt analog input. Power-up default = 0. |
| 6 | Reserved | Read | Power-up default = 0. |
| 7 | Initialization | R/W | Logic 1 restores power-up default values to the configuration register and the status registers. This bit automatically clears itself. Power-up default = 0. |

Table 3. Status Register 1 (SR1, 41h, default = 0000 0000)

| BIT | NAME | R/W | DESCRIPTION |
|-----|---------------------|------|--|
| 0 | +2.5V_ERROR | Read | A one indicates 2.5V _{IN} High or Low limit has been exceeded. |
| 1 | VCCP_ERROR | Read | A one indicates V _{CCPVIN} High or Low limit has been exceeded. |
| 2 | +3.3V_ERROR | Read | A one indicates 3.3V _{IN} High or Low limit has been exceeded. |
| 3 | +5V_ERROR | Read | A one indicates 5V _{IN} High or Low limit has been exceeded. |
| 4 | Internal Temp Error | Read | A one indicates internal or local temp High or Low limit has been exceeded. |
| 5 | External Temp Error | Read | A one indicates external or remote temp High or Low limit has been exceeded. |
| 6 | Reserved | Read | |
| 7 | Reserved | Read | |

Table 4. Status Register 2 (SR2, 42h, default = 0000 0000)

| BIT | NAME | R/W | DESCRIPTION |
|-----|--------------------|------|--|
| 0 | +12V_ERROR | Read | A one indicates 12V _{IN} High or Low limit has been exceeded. |
| 1 | VDD_ERROR | Read | A one indicates V _{DD} High or Low limit has been exceeded. |
| 2 | Reserved | Read | Undefined. |
| 3 | Reserved | Read | Undefined. |
| 4 | Reserved | Read | Undefined. |
| 5 | Reserved | Read | Undefined. |
| 6 | Remote Diode Fault | Read | A one indicates either a short or open circuited fault on the remote thermal diode inputs. |
| 7 | Reserved | Read | Undefined. |

Table 5. VID (VID, 47h, default = 0000 VID[3:0])

| BIT | NAME | R/W | DESCRIPTION |
|-----|--------------|------|--|
| 0–3 | VID[0:3] | Read | The VID[0:3] inputs from Pentium/PRO power supplies ID to indicate the operating voltage (e.g. 1.5V to 2.9V). Power-up default = VID[0:3]. |
| 4–6 | Reserved | Read | Undefined. |
| 7 | RESET ENABLE | Read | When set to 1, enables the RESET pin output function. This bit defaults to 0 at Power-up and enables addressing function. |

Table 6. VID4 (VID4, 49h, default = 1000 000VID[4])

| BIT | NAME | R/W | DESCRIPTION |
|-----|----------|------|--|
| 0 | VID4 | Read | VID4 input, if selected, from Pentium/PRO power supplied ID. Power-up default = 0 and pin 11 is not selected for VID4. |
| 1–7 | Reserved | Read | Power-up default = 1000 000 |

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FUNCTIONAL DESCRIPTION

SMBus serial interface

The NE1619 can be connected to a compatible 2-wire serial interface SMBus as a slave device under the control of a master device or controller, using two device terminals SCL and SDA. The controller will provide a clock signal to the device SCL pin and write/read data to/from the device through the SDA pin.

Data of 8-bit digital byte or word are used for communication between the controller and the device.

Notice that external pull-up resistors, about 10 kΩ, are needed for the two terminals SCL and SDA.

Slave address

The NE1619 slave address on the SMBus is defined by the hardware connection applied to the device pin 16. At power-up this pin is automatically reset to its address sensing function A0. This logic input will set up the value of the LSB bit of the 7-bit address. Because A0 is a two-level digital input and the other 6 bits of the address are predefined to 010110, only two slave addresses can be used as listed below for the device:

Table 7.

| A0 connection (Pin 16) | Slave address |
|------------------------|---------------|
| GND | 0101100 |
| V _{DD} | 0101101 |

Because the logic is sampled and latched into the device storage only at power-up, the device pin 16 can be programmed for different functions while power is on without effecting the address definition.

Registers

The NE1619 contains a number of registers, as listed in Table 1, in order to store data of the device setup and operation results. The table indicates the command value and read/write capability of each register for SMBus communication and also the power-up default values for some registers. It includes:

- Configuration register to provide control and configuration as well as initialization the NE1619,
- Status registers to provide the flags resulting from limit comparisons,
- Reading registers to store results of measurements,
- Limit registers to store programmable limit data,
- ID and test registers.

Data are stored in registers by 8-bit digital byte, either in 2's complement format for temperature-related data or in straight format for others. Writing and reading registers will be done on the SMBus by a controller using the SMBus protocols that will be described more in the last section of this functional description. Notice that attempting to write to a "Read only" register will produce an invalid result.

Power-on reset

When the power is applied to the NE1619, also called hardware reset, the registers are reset to their default value, if defined, as shown in Table 1. The content of registers which have indeterminate default value such as reading registers will be unknown. The on-board A-to-D converter is disabled and the monitoring function is not started. The device enters standby mode and draws a supply current less than 100 μA.

Because all limit registers are reset to zero, writing limits into the limits registers should usually be the first action to be performed after power-on reset.

Initialization

Initialization or software reset of the NE1619 can be initiated by setting bit 7 of the configuration register. This bit automatically clears itself after being set. The initialization performs a similar reset function to power-on reset, except that the reading and limit registers are not reset.

Starting conversion

The NE1619 monitoring function is started by setting (to 1) the START bit (bit 0) of the configuration register. The device then performs a loop of monitoring about every second. In monitoring function, the device cycles sequentially through all measurements of temperatures and voltages and also performs the comparisons between readings and limits accordingly. The inputs are sampled in this order: Remote diode temperature, Local temperature, V_{DD}V_{IN}, 12V_{IN}, 5V_{IN}, 3.3V_{IN}, 2.5V_{IN} and V_{CCP}V_{IN}.

Measured values are stored in reading registers and results of limit comparison are reflected by the state of the flag bits in the status registers. Reading and status data can be read at any time. Limit values should be written into limit registers before starting conversion to avoid false conditions of the status.

Resetting (to 0) the START bit (bit 0) of the configuration register will stop the monitoring function and put the device into its standby mode thereby reducing power consumption.

Temperature measurement

The NE1619 contains an on-chip temperature sensor to measure the local or internal temperature and provides input pins (D– and D+) to measure the remote or external temperature with the use of a remote diode-type sensor. The remote sensor should be connected to the D– and D+ pins properly.

The method of temperature measurement is based on the change of the diode V_{BE} at two different operating current levels given by:

$$\Delta V_{BE} = (KT/q) \cdot \ln(N)$$

where:

- K: Boltzmann's constant
- T: absolute temperature in °K
- q: charge on the electron
- N: ratio of the two currents
- LN: natural logarithm

The NE1619 provides two current sources of about 10 μA and 100 μA during the measurement of the remote diode V_{BE} and the sensed voltage between two pins D– and D+ is limited within 0.25 V and 0.95 V.

The external diode should be selected to meet this current and voltage requirements. The diode-connected PNP transistor provided on the Pentium series microprocessor is typically used, or the discrete diode-connected transistor 2N3904 is recommended.

For temperature measurement, local or remote, the ΔV_{BE} is converted into digital data by the on-chip sigma-delta A-to-D converter. The result is stored in the temperature reading register and is also compared with the limits stored in the temperature limit registers in order to set the temperature flag bits in the status register as described in Table 3.

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NAND-tree test

A NAND tree is provided in the NE1619 for Automated Test Equipment (ATE) board level connectivity testing. The device is placed into NAND tree test mode by powering up with Pin 9 (D-/NTEST_IN) held high. In this test mode Pin 16 (A0/RESET/NTEST_OUT) becomes the NAND-tree output and all input pins become NAND-tree inputs as illustrated in Figure 12.

To perform a NAND tree test all pins should be initially driven low. Then one-by-one toggle them high (and keep them high), starting with the input closest to the output, cycling toward the farthest, the NAND tree output will toggle with each input change.

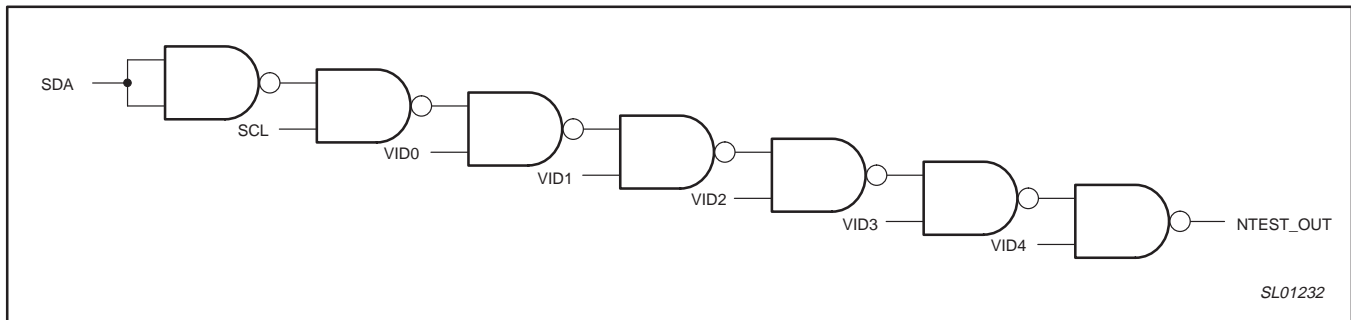


Figure 12. NAND-tree circuitry

Table 9. NAND-tree test vectors

| VECTOR # | SDA | SCL | VID0 | VID1 | VID2 | VID3 | VID4 | NTEST_OUT |
|----------|-----|-----|------|------|------|------|------|-----------|
| 1 | L | L | L | L | L | L | L | H |
| 2 | L | L | L | L | L | L | H | L |
| 3 | L | L | L | L | L | H | H | H |
| 4 | L | L | L | L | H | H | H | L |
| 5 | L | L | L | H | H | H | H | H |
| 6 | L | L | H | H | H | H | H | L |
| 7 | L | H | H | H | H | H | H | H |
| 8 | H | H | H | H | H | H | H | L |

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SMBus interface protocol

The NE1619 can communicate over a compatible 2-wire serial interface SMBus using the two device pins SCL and SDA. The device employs three standard SMBus protocols: Write Byte, Read Byte and Receive byte.

Data formats of those protocols are shown below with following notices:

- The SMBus controller initiates data transfer by establishing a start condition (S) and terminates data transfer by generating a stop condition (P).
- Data is sent over the serial bus in sequence of 9 clock pulses for each 8-bit data byte followed by 1-bit status of the device acknowledgement (A).

- The 7-bit slave address is replaced by the selected address of the device.
- The command byte is replaced by the selected command of the device register.
- The receive byte format is used for quickly transfer data from a reading register which was previously selected by a read.
- During the transition between start and stop conditions, data must be stable and valid when the SCL is high.

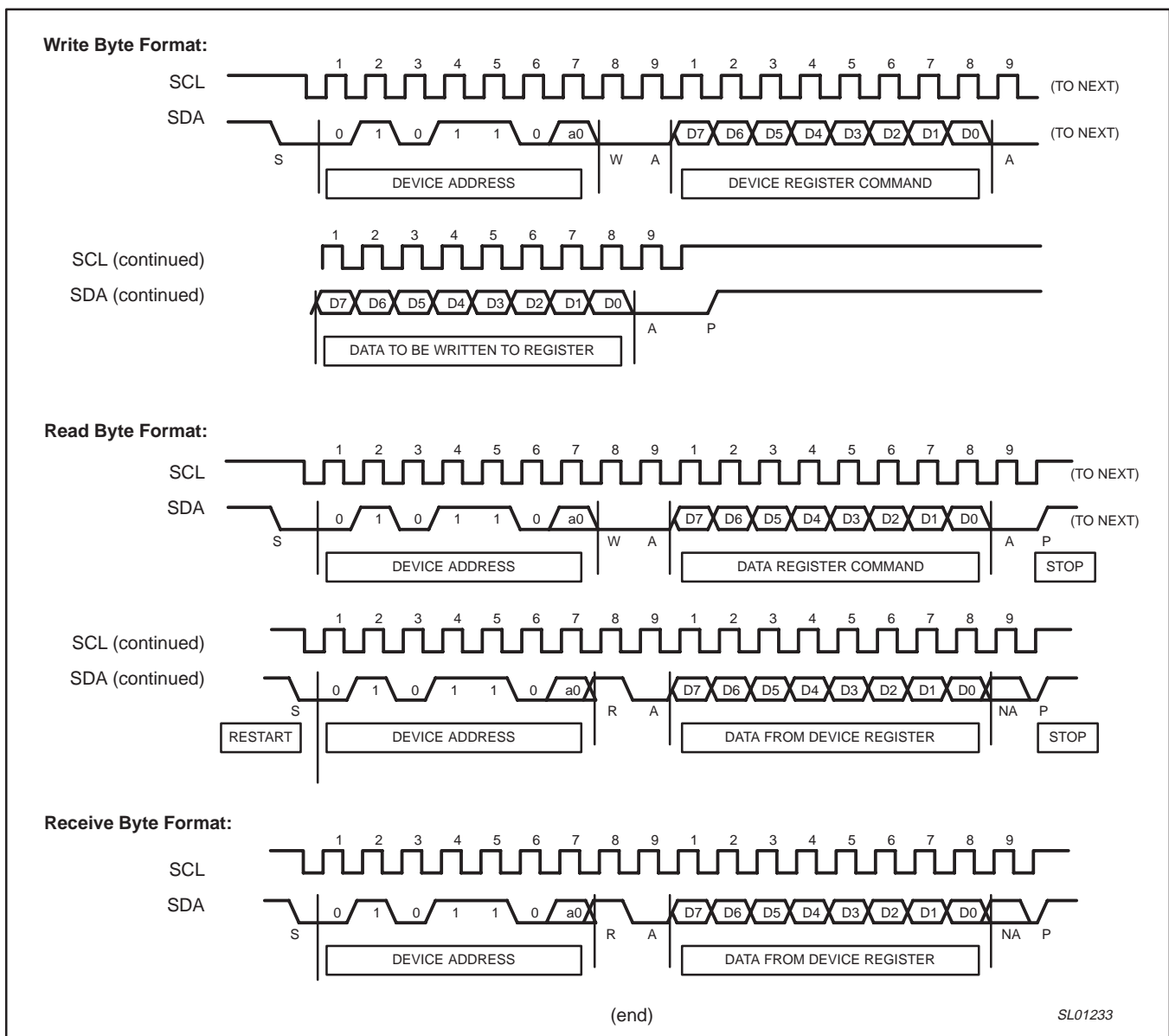


Figure 13. NE1619 SMBus interface protocols

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Printed Circuit Board layout considerations

Care must be taken in PCB layout to minimize noise induced at the remote temperature sensor inputs, especially in extremely noisy environments, such as a computer motherboard. Noise induced in the traces running between the device sensor inputs and the remote diode can cause temperature conversion errors. Typical sensor signal levels to the NE1619 is a few microvolts. The following guidelines are recommended:

1. Place the NE1619 as close as possible to the remote sensor. It can be from 4 to 8 inches, as long as the worst noise sources such as clock generator, data and address buses, CRTs are avoided.
2. Route the D+ and D- lines parallel and close together with ground guards enclosing them (see Figure 14).
3. Leakage currents due to PC board contamination must be considered. Error can be introduced by these leakage currents.
4. Use wide traces to reduce inductance and noise pickup. Narrow traces more readily pickup noise. The minimum width of 10 mil and space of 10 mil are recommended.
5. Place a bypass capacitor of 100 nF close to the V_{DD} pin and an input filter capacitor of 2200 pF close to the D+ and D- pins.
6. If the remote sensor is operating in a noisy environment and located several feet away from the NE1619, a shielded twisted pair cable is recommended. Make sure the shield of the cable is connected to the NE1619 ground pin, and leave the shield at the remote end unconnected. Shield connecting to ground of both ends could create a ground loop (refer to Figure 15) and defeat the purpose of the shielded cable. Also, cold soldered joints and damaged cable could introduce series resistance and result in measurement error. For instance, a 1 Ω resistance can introduce a change of temperature of about 0.5 °C.



Figure 14. PCB layout for D+ and D-

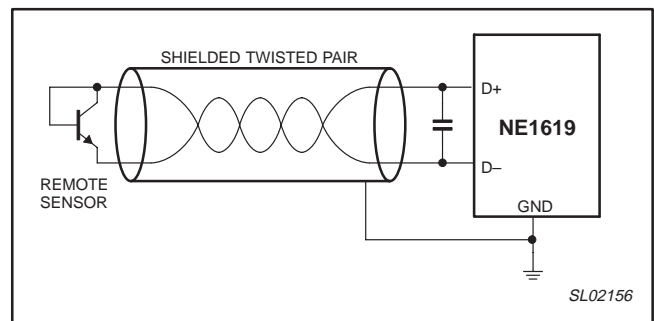


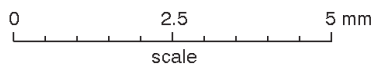
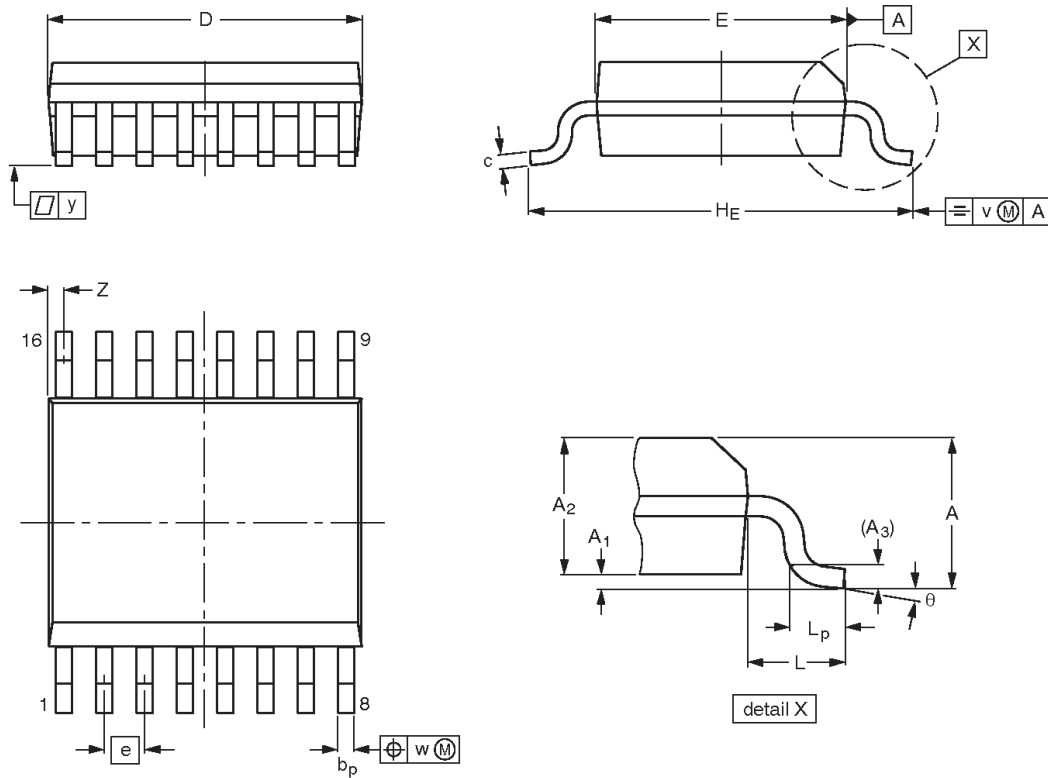
Figure 15. Using shielded twisted pair

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SSOP16: plastic shrink small outline package; 16 leads;
body width 3.9 mm; lead pitch 0.635 mm

SOT519-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|-------|----------------|---|----------------|-----|------|------|------------------|----------|
| mm | 1.73 | 0.25 0.10 | 1.55 1.40 | 0.25 | 0.31 0.20 | 0.25 0.18 | 5.0 4.8 | 4.0 3.8 | 0.635 | 6.2 5.8 | 1 | 0.89 0.41 | 0.2 | 0.18 | 0.09 | 0.18 0.05 | 8° 0° |

Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|-------|--|---------------------|-----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT519-1 | | | | | | -99-05-04 03-02-18 |

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REVISION HISTORY

| Rev | Date | Description |
|-----|----------|---|
| _4 | 20041005 | <p>Product data sheet (9397 750 14175). Supersedes data of 2004 May 10 (9397 750 13254).</p> <p>Modifications:</p> <ul style="list-style-type: none"> ● “Features” section on page 2: add ESD and Latch-up bullets to bottom of list. ● “Ordering information” table: change temperature range from “$T_{amb} = 0\text{ °C}$ to $+120\text{ °C}$” to “$T_{amb} = 0\text{ °C}$ to $+125\text{ °C}$” ● Add figure titles to Pin configuration, Functional block diagram, Typical application circuit. ● Section “Typical operating circuit” re-named to “Typical application circuit”; figure modified. ● “Absolute maximum ratings” table: change Operating temperature range maximum from $+120\text{ °C}$ to $+125\text{ °C}$ ● Figure 4 re-titled ● “DC electrical characteristics” table: add Note 4 and its reference at table description line. ● “SMBus interface AC characteristics” table: change temperature range from “$T_{amb} = 0\text{ °C}$ to $+120\text{ °C}$” to “$T_{amb} = 0\text{ °C}$ to $+125\text{ °C}$” ● Section “Printed Circuit Board layout considerations”: <ul style="list-style-type: none"> – paragraph 5: change from “Place a bypass capacitor of 10 nF close to ...” to “Place a bypass capacitor of 100 nF close to ...” – paragraph 6 re-written – add Figure 15 |
| _3 | 20040510 | Product data (9397 750 13254). Supersedes data of 2001 Aug 29. |
| _2 | 20010829 | Product data (9397 750 08874). Supersedes data of 2000 Jul 13. |
| _1 | 20000713 | Product specification (9397 750 07323). |

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|-------|----------------------------------|-----------------------------------|--|
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