NOVOSENSE
纳芯微电子

# NST1075

# High Accuracy Temperature Sensor With SMBus and I²C Interface

Datasheet (EN) 1.2

## Product Overview

The NST1075 is a low-power, high precision digital temperature sensor compatible with SMBus and I²C interfaces, and it supports up to 27 device addresses and provides SMBus Reset and Alert functions. The typical accuracy of NST1075 is ±0.5°C without requiring calibration or external component signal conditioning. It has a 12-bit analog-to-digital converter (ADC) inside, and the resolution is 0.0625°C. it is highly linear and does not require complex calculations or lookup tables to derive temperature.

it's an ideal substitute that substitute for negative temperature coefficient (NTC) and positive temperature coefficient (PTC) thermistor. NST1075 device works over a temperature range of –55°C to 125°C, which makes it suitable for onboard and off board applications in automotive, industrial, and consumer markets. Because of low power consumption, it can also be applied to IoT. The NST1075 is available in WSON (8) package.

## Key Features

- High Accuracy over –55°C to 125°C Wide Temperature Range
  - -20 °C ~ 85 °C: ±0.5 °C (Typical)
  - -20 °C ~ 85 °C: ±1 °C (Maximum)
  - -55 °C ~ 125 °C: ±1.5 °C (Maximum)
- Proportional to Temperature with 0.0625°C Resolution
- Power up Defaults Permit Stand-Alone Operation as Thermostat
- Supports up to 27 Device Addresses
- Supply Operation range from 1.62V to 5.5V
- Operating Current: 30μA (Typical)
- Shutdown Current: 0.2μA (Typical)
- Digital Interface: SMBus, I²C
- Package: WSON (8)

## Applications

- General System Thermal Management
- Computer Thermal Protection
- Portable Computers
- Industrial Internet of Things (IoT)
- Communications Infrastructure
- Power-system Monitors
- Thermal Protection
- Environmental Detection and HVAC

## Device Information

| *Part Number* | *Package* | *Body Size* |
|---|---|---|
| NST1075 | WSON8 | 2.0mm × 2.0mm |

## Functional Block Diagrams

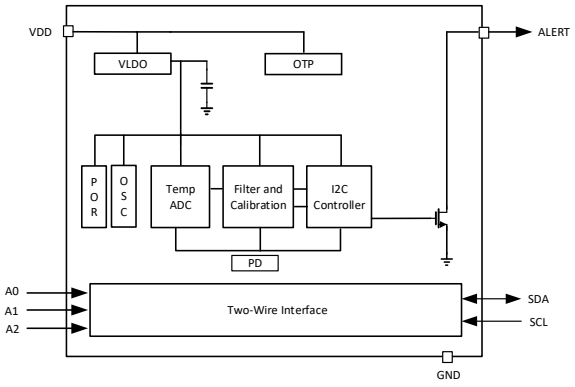



Figure 1 NST1075 Functional Block Diagram

# INDEX

# 1. Pin Configuration and Functions

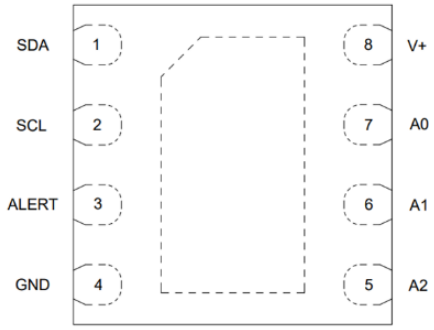



Figure 1.1 NST1075 Pin Configuration(Top View)

Table 1.1 NST1075 Pin Function Description

| Pinout | | Type | Description |
|---|---|---|---|
| No. | Name | | |
| 1 | SDA | I/O | Serial data. Open-drain, requires a pullup resistor |
| 2 | SCL | I | Serial clock. Open-drain, requires a pullup resistor. |
| 3 | ALERT | O | Over temperature alert. Open-drain, requires a pullup resistor. |
| 4 | GND | GND | Ground |
| 5 | A2 | I | Address selected. Connect to GND, VDD or leave these pins floating. |
| 6 | A1 | | |
| 7 | A0 | | |
| 8 | V+ | Power | Supply voltage, 1.62 V to 5.5 V |

# 2. Absolute maximum ratings

| Parameters | Symbol | Min | Typ | Max | Unit | Comments |
|---|---|---|---|---|---|---|
| Supply Voltage Pin (VDD) | VDD | -0.3 | | 6.5 | V | |
| Voltage at A0, A1 and A2 Pins | A0, A1, A2 | -0.3 | | 6.5 | V | |
| Voltage at OS, SCL and SDA Pins | ALERT, SCL, SDA | -0.3 | | 6.5 | V | |
| Storage Temperature | | -60 | | 155 | ℃ | |
| Operation Temperature | $TB_{operation}$ | -55 | | 125 | ℃ | |
| Maximum Junction Temperature | | | | 155 | ℃ | |
| ESD Susceptibility | HBM | ±5 | | | kV | |
| | CDM | ±2 | | | kV | |

# 3. Specifications

## 3.1. Electrical characteristics

At $T_A$ = +25°C and VDD = +1.62V to +5.5V, $R_{pu}$ = 4.7kohm, unless otherwise noted.

| *Parameters* | *Symbol* | *Min* | *Typ* | *Max* | *Unit* | *Comments* |
|---|---|---|---|---|---|---|
| ***Supply*** | | | | | | |
| Supply Voltage Range | VDD | 1.62 | | 5.5 | V | |
| Supply Sensitivity | | | 7 | | m°C /V | |
| Operation Current | $I_{CONV}$ | | 30 | 40 | μA | Conversion |
| Shutdown Current | $I_{SD}$ | | 0.2 | | μA | Serial Bus Inactive |
| | $I_{SD}$ | | 10 | | μA | SCL Frequency = 400kHz |
| **Temperature Range and Resolution** | | | | | | |
| Temperature Range | | -55 | | 125 | °C | |
| Resolution | | | 0.0625 | | °C | |
| Accuracy | | | ±0.5 | ±1 | °C | from -20°C to 85°C |
| | | | | ±1.5 | °C | from -55°C to 125°C |
| Conversion Time | $T_{CONV}$ | | 20 | 50 | ms | for VDD< 2V, the max Conversion Time 50ms |
| ALERT Output Saturation Voltage | | | | 0.5 | V | $I_{OUT}$ = 4mA |
| $I^2C$ Time out time | $T_{TIMEOUT}$ | | 54 | | ms | |
| **Digital DC Characteristics** | | | | | | |
| High-level Input Voltage | $V_H$ | VDD*0.7 | | VDD+0.3 | V | |
| Low-level Input Voltage | $V_L$ | -0.3 | | VDD*0.3 | V | |
| High-level Input Current | | | | 1 | μA | |
| Low-level Input Current | | | | -1 | μA | |
| Digital Inputs Capacitance | $C_{IN}$ | | 5 | | pF | |
| Output Leakage Current | $I_{OH}$ | | | 1 | μA | $V_{OH}$ = 5V |
| Low-Level Output Voltage | $V_{OL}$ | | | 0.4 | V | $I_{OL}$ = 3mA |
| **Thermal response** | | | | | | |
| Thermal Response | | | 0.70 | | s | Stirred Oil Thermal Setting to 63% of Final Value |
| **Drift** | | | | | | |
| Drift (1) | | | 0.1 | | °C | |

Notes: (1). Drift data is based on a 1000-hour stress test at +125°C with VDD = 5.5V.

## 3.2. I²C Timing Diagram

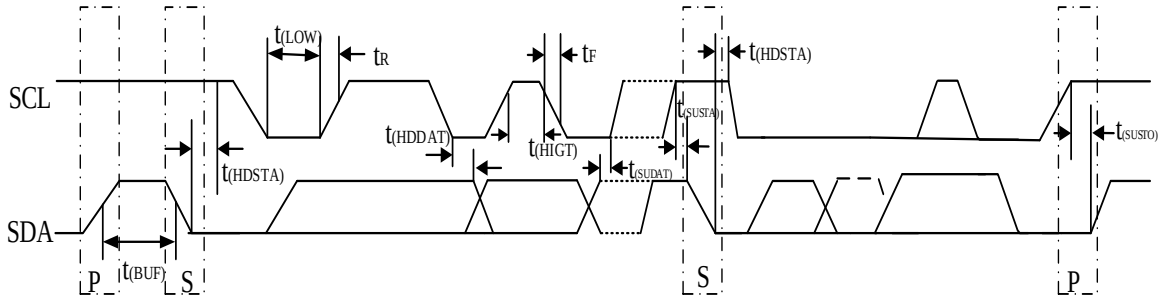



Figure 3.1 I²C Timing Diagram

## 3.3. I²C Timing characteristics

At $T_A$ = +25°C and VDD = +1.62V to +5.5V, $R_{pu}$ = 5.1kohm, unless otherwise noted.

| Parameters | Symbol | STARDARD MODE | | FAST MODE | | HIGH-SPEED MODE | | Unit | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | |
| SCL operating frequency | $F_{SCL}$ | 0.001 | 0.1 | 0.001 | 0.4 | 0.001 | 2 | MHz | |
| Bus-free time between STOP and START conditions | $t_{(BUF)}$ | 4.7 | - | 1300 | - | 160 | - | ns | |
| Hold time after repeated START condition; after this period, the first clock is generated | $t_{(HDSTA)}$ | 4000 | - | 600 | - | 160 | - | ns | |
| Repeated START condition setup time | $t_{(SUSTA)}$ | 4700 | - | 600 | - | 160 | - | ns | |
| STOP condition setup time | $t_{(SUSTO)}$ | 4000 | - | 600 | - | 160 | - | ns | |
| Data hold time | $t_{(HDDAT)}$ | 0 | 3450 | 4 | 900 | 4 | 120 | ns | |
| Data setup time | $t_{(SUDAT)}$ | 250 | - | 100 | - | 10 | - | ns | |
| SCL clock low period | $t_{(LOW)}$ | 4700 | - | 1300 | - | 280 | - | ns | |
| SCL clock high period | $t_{(HIGH)}$ | 4000 | - | 600 | - | 60 | - | ns | |
| Data fall time | $t_{FD}$ | - | 300 | - | 300 | - | 150 | ns | |
| Clock rise time (SCL≤100kHz) | $t_{RC}$ | - | 1000 | - | 300 | - | 40 | ns | |
| | | - | 1000 | - | 1000 | - | - | ns | |
| Clock fall time | $t_{FC}$ | - | 300 | - | 300 | - | 40 | ns | |

Notes:

1. A device must internally provide a hold time of at least 300 ns for the SDA signal (referred to the $V_{IHmin}$ of the SCL signal) to bridge the undefined region of the falling edge of SCL.

2. The maximum t(HDDAT) has only to be met if the device does not stretch the LOW period (t(LOW)) of the SCL signal.

3. A Fast-mode I²C-bus device can be used in a Standard-mode I²C -bus system, but the requirement t(SUDAT) >250ns must then be met. This will automatically be the case if the device does not stretch the LOW period of the SCL signal.

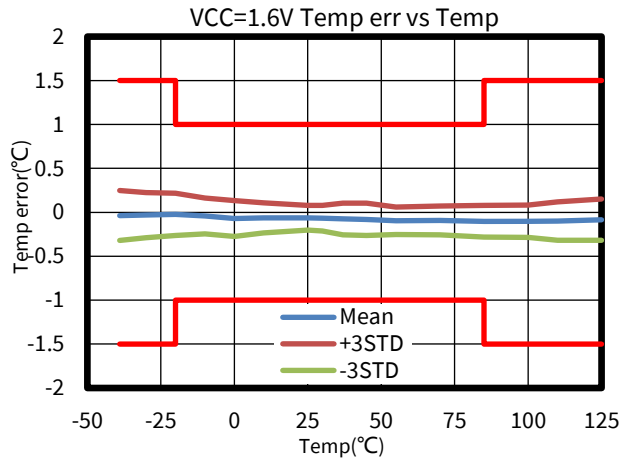
If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line tr max + $t_{(SUDAT)}$ = 1000 + 250 = 1250ns (according to the Standard-mode I²C -bus specification) before the SCL line is released.

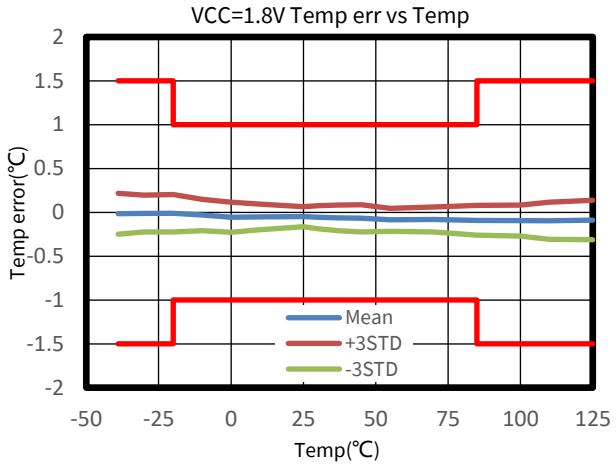
## 3.4. Thermal Information

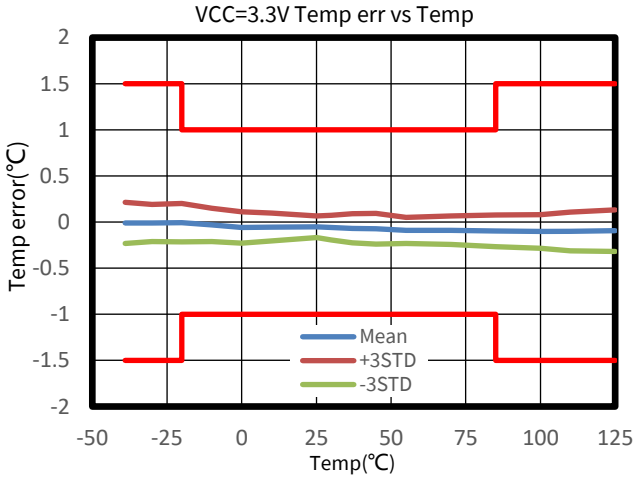
| Thermal Metric | | Value | Unit |
|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 95 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 48.3 | °C/W |
| $R_{\theta JC(TOP)}$ | Junction-to-case (top) thermal resistance | 60 | °C/W |
| $\varphi_{JT}$ | Junction-to-top characterization parameter | 6 | °C/W |
| $\varphi_{JB}$ | Junction-to-board characterization parameter | 48 | °C/W |

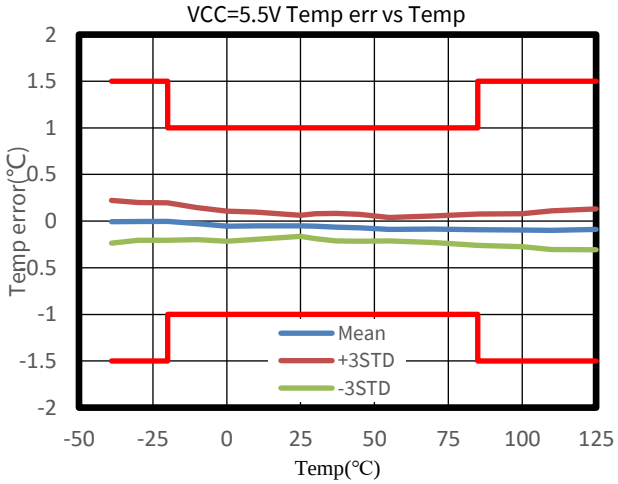
## 3.5. Typical Characteristics

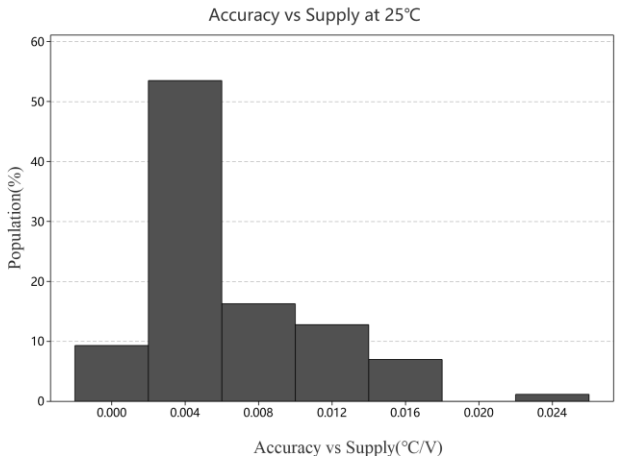
At $T_A$ = +25°C and VDD = 3.3 V, $R_{pu}$ = 4.7kohm, High resolution Mode, unless otherwise noted.

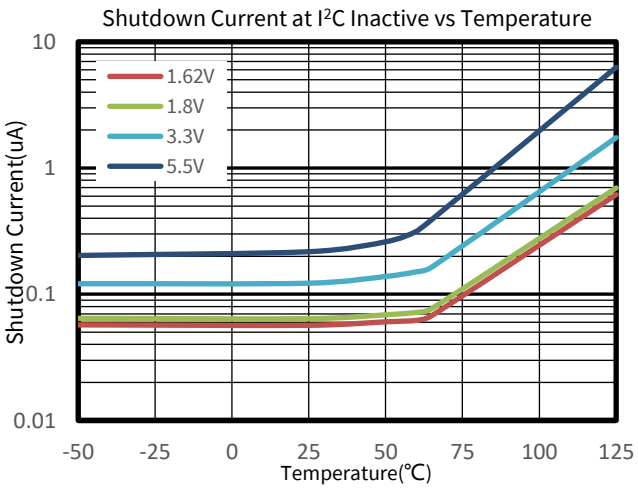


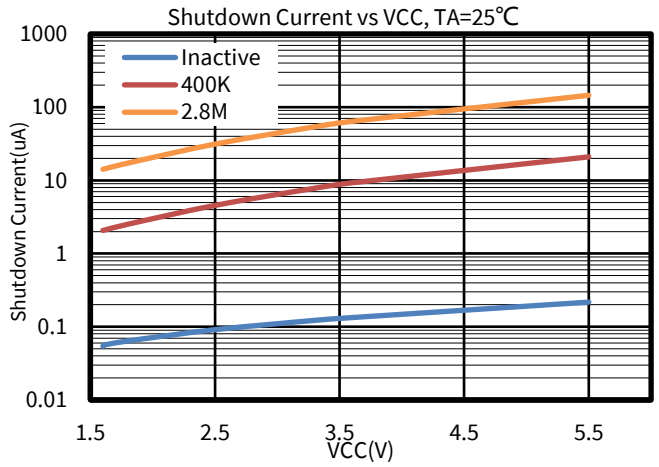



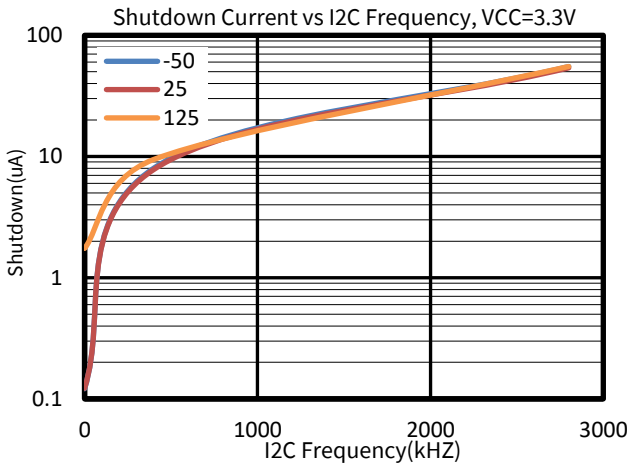



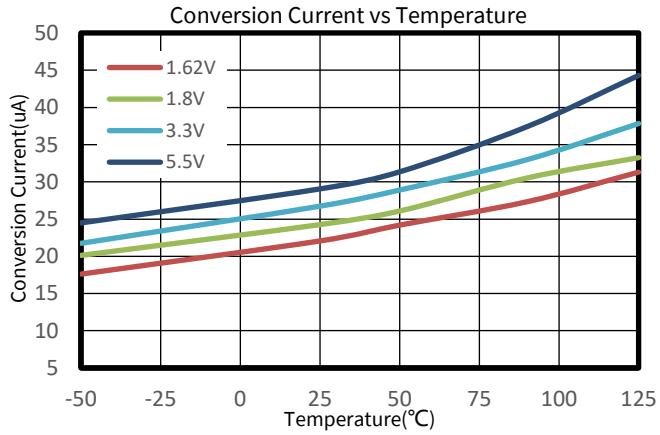



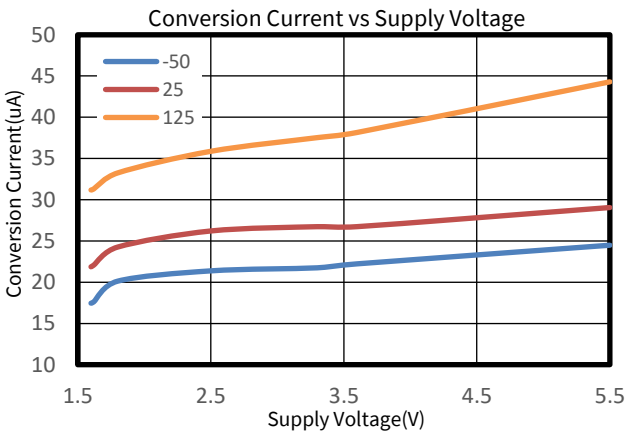



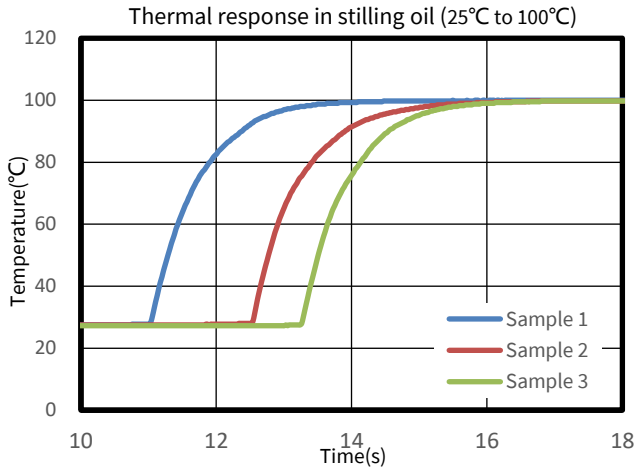





# 4. Function Description

## 4.1. Overview

The Digital temperature sensor NST1075 has a wide supply voltage range of 1.62V to 5.5V. NST1075 measures temperature using a band-gap structure and 12-bit, delta-sigma (ΔΣ) analog-to-digital converter (ADC). In the range of –20°C to 85°C, the typical accuracy is ± 0.5°C, and in the range of –55°C to 125°C the maximum accuracy is ±1.5°C.

The NST1075 communicates with the master device through a 2-wire interface (SMBus and $I^2C$), which operates up to 400kHz in $I^2C$ fast mode and 2MHz in $I^2C$ High speed mode. On the same 2-wire bus, the NST1075 allows up to 27 devices, by three address pins. The NST1075 has a bus fault timeout feature, if the SDA line remains low for more than $T_{TIMEOUT}$ (see specification), it will reset to the IDLE state (SDA set to high impedance) and wait for a new start condition, and it should be noted that when in Shutdown Mode, the TIMEOUT feature is not functional. An integrated low-pass filter on both the SDA and the SCL line of the NST1075, its communications are reliable in noisy environments by these filters.

## 4.2. Functional Block Diagram

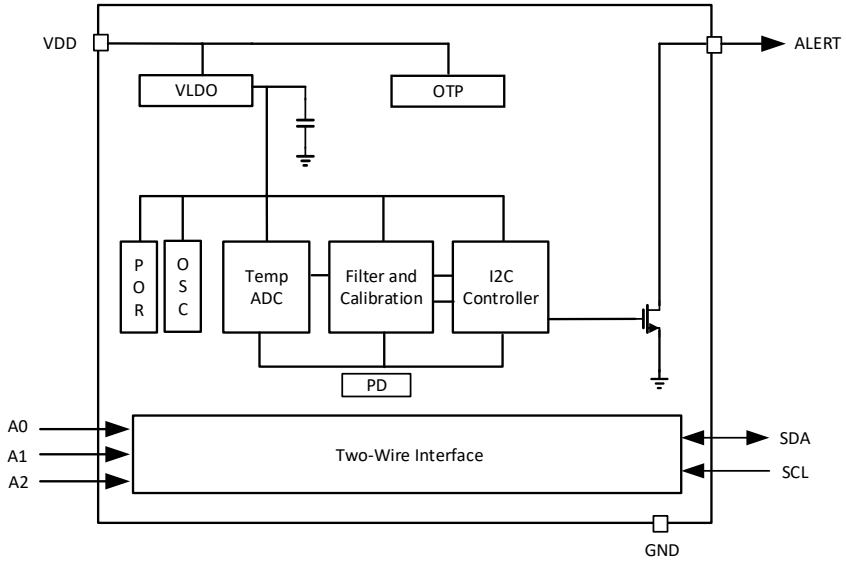



Figure 4.1 NST1075 Functional Block Diagram

## 4.3. Device Functions

### 4.3.1. Shutdown Mode (SD)

For power-sensitive applications, The NST1075 device offers a low-power shutdown mode, which reducing current consumption to typically less than 0.1 μA. Shutdown mode is enabled when write 1 to SD bit of the configuration register. In shutdown mode a One-shot command can be sent to perform a temperature transition, and the device shuts down automatically when the temperature transition is complete. When SD write to 0, the device maintains a continuous conversion state. For the NST1075, Time-out feature is turned off in Shutdown Mode.

### 4.3.2. One-shot (OS)

The NST1075 supports a one-shot temperature measurement mode when continuous temperature monitoring is not required. First set the chip into shutdown mode, write 1 to the OS bit to wake up the chip once and perform a temperature conversion. During the conversion, the OS bit reads 0. After the single conversion is complete, the device returns to the Shutdown state. At the end of the conversion, the OS bit reads 1.

### 4.3.3. Converter Resolution

The converter resolution bits control the resolution of the internal ADC. This control allows the user to maximize efficiency by programming for higher resolution or faster conversion time. The resolution bits and the relationship between resolution and conversion time, please refer to Congfiguration Register.

#### 4.3.4. Temperature Alert

NST1075 also incorporates a digital comparator that compares a series of readings (the number of which can be selected by the user) with user-programmable setpoint. The comparator triggers the ALERT pin state, which is programmable for mode and polarity. allowing the user to define the number of consecutive error conditions that must occur before ALERT is activated.

##### 4.3.4.1. Thermostat Mode (TM)

The thermostat mode bit of the NST1075 indicates whether the device is operating in Comparator mode (TM = 0) or interrupt mode (TM = 1).

**Comparator Mode (TM = 0)**: In comparator mode (TM = 0), when the temperature is equal to or exceeds the value of the $\mathbf{T_{HIGH}}$ register, the alert pin is activated until the temperature is lower than the value of the $\mathbf{T_{LOW}}$ register.

**Interrupt Mode (TM = 1)**: In interrupt mode (TM = 1), the ALERT pin is activated when the temperature exceeds $\mathbf{T_{HIGH}}$ or goes below $\mathbf{T_{LOW}}$ registers. When the main controller reads the temperature register, the alert pin is cleared. For more information about comparison mode and interrupt mode, see the *High and Low Limit Registers* section.

##### 4.3.4.2. Polarity

The polarity bit allows the user to control the output polarity of the NST1075 AL bit. When POL bit is 0, AL bit is active low, when POL bit is 1, AL bit is active high, while the state of AL bit is inverted. And the operation of AL bit in different modes is shown in Figure 4.2.

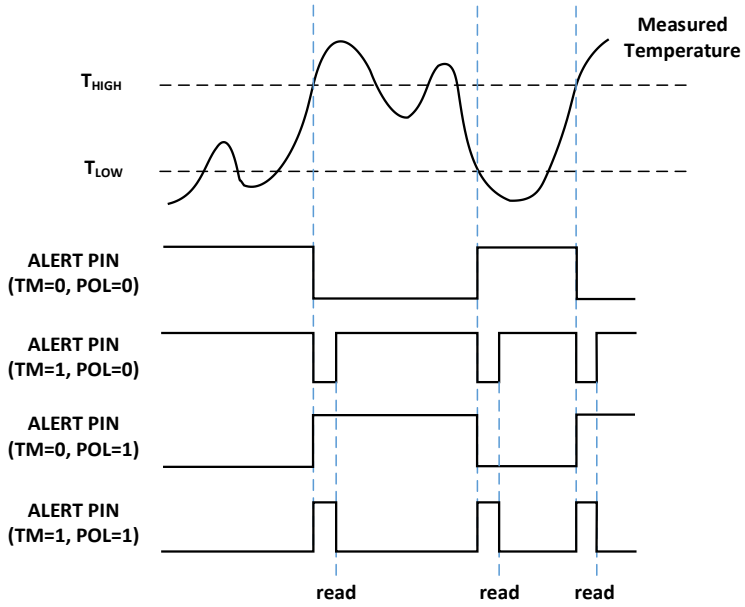



Figure 4.2 Output Transfer Function Diagram

##### 4.3.4.3 Fault Queue

A fault condition is generated when the temperature measurement value exceeds the $T_{HIGH}$ and $T_{LOW}$ register values, and the number of fault conditions activated by the trigger alert can be programmed by the fault queue. False triggering of alerts due to temperature noise can be avoided by using a fault queue. The number of measured faults that can be programmed to trigger a device alert condition, please refer to Congfiguration Register. See the *High and Low Limit Registers* section for the format and byte order of the $T_{HIGH}$ and $T_{LOW}$ registers.

### 4.4. Serial Bus

The NST1075 is compatible with SMBus and $I^2C$ interfaces. data on the $I^2C$-bus can be transferred at rates of up to 100kbit/s in the Standard-mode, up to 400k bit/s in the Fast-mode, or up to 2M bit/s in the High-speed mode. All data bytes are transmitted MSB-firstly.

#### 4.4.1. Bus Overview

The device on the bus that initiates the transmission is referred to as the master device, and the devices controlled by the master are slaves. The bus must be controlled by a master device that generates the serial clock (SCL), controls bus access and generates START and STOP conditions.

#### 4.4.2. Bus Address

For communication between the master and the slave, a byte address needs to be sent first, including 7bit slave address bits and 1bit read and write direction bits. NST1075 has three address pins, allowing up to 27 devices to be addressed on one bus interface. Table 4.1 describes the pin logic levels used to properly connect up to 27 devices. “1” indicates the pin is connected to the supply (VDD); “0” indicates the pin is connected to GND; “float” indicates the pin is left unconnected. The state of pins A0, A1, and A2 is sampled on every bus communication and must be set prior to any activity on the interface.

Table 4.1 Address Pins and Slave Addresses for the NST1075

| *A0* | *A1* | *A2* | *SLAVE ADDRESS* | |
|---|---|---|---|---|
| | | | *BINARY* | *HEX* |
| 0 | 0 | 0 | 1001000 | 48 |
| 1 | 0 | 0 | 1001001 | 49 |
| 0 | 1 | 0 | 1001010 | 4A |
| 1 | 1 | 0 | 1001011 | 4B |
| 0 | 0 | 1 | 1001100 | 4C |
| 1 | 0 | 1 | 1001101 | 4D |
| 0 | 1 | 1 | 1001110 | 4E |
| 1 | 1 | 1 | 1001111 | 4F |
| 0 | 0 | Float | 1110000 | 70 |
| Float | 0 | Float | 1110001 | 71 |
| 1 | 0 | Float | 1110010 | 72 |
| 0 | 1 | Float | 1110011 | 73 |
| Float | 1 | Float | 1110100 | 74 |
| 1 | 1 | Float | 1110101 | 75 |
| 0 | Float | Float | 1110110 | 76 |
| 1 | Float | Float | 1110111 | 77 |
| 0 | Float | 0 | 0101000 | 28 |
| 1 | Float | 0 | 0101001 | 29 |
| 0 | Float | 1 | 0101010 | 2A |
| 1 | Float | 1 | 0101011 | 2B |
| Float | 0 | 0 | 0101100 | 2C |
| Float | 1 | 0 | 0101101 | 2D |
| Float | 0 | 1 | 0101110 | 2E |
| Float | 1 | 1 | 0101111 | 2F |
| Float | Float | 0 | 0110101 | 35 |
| Float | Float | 1 | 0110110 | 36 |
| Float | Float | Float | 0110111 | 37 |

#### 4.4.3. Bus Function

##### 4.4.3.1. Writing and Reading to the NST1075

Writing operation is triggered by sending the slave address in write mode (R/W=0), then the master sends pointer register, and send the data byte afterwards. The transaction is ended by a STOP condition.

During writing operation, NST1075 is used as the slave receiver. The master transfers the slave address byte firstly, including 7 address bits and 1bit write direction bits, NST1075 acknowledges after receiving the valid address. the second byte

transmitted by master is the pointer register address, then NST1075 acknowledges and the next byte of data is written to the pointer register. The master can terminate communication by generating a STOP condition. The details of this sequence are shown in Figure 4.4.

To be able to read registers, firstly the register address must be sent in write mode (R/W=0), then either a stop or a repeated start condition must be generated. When the slave is addressed as read mode (R/W=1), then the slave sends out 1 byte data. After reading the data the master needs to generate the NACK and stop condition to end the transaction. The details of this sequence are shown in Figure 4.5.

If repeated reads from the same register are required, it is not necessary to send the pointer register byte repeatedly because the NST1075 remembers the pointer register value until it is changed by the next write operation.

#### 4.4.3.2. SMBus Alert Function

When the NST1075 is operating in interrupt mode (TM=1), the NST1075 supports the SMBus Alert function, the ALERT pin of the NST1075 can be connected as a SMBus Alert signal. When the master monitors that the alert is active, the master can send the SMBus alert command (00011001) on the bus, if the ALERT pin of the NST1075 is active, the device responds to the SMBus Alert command by returning its slave address on the SDA line. The eighth bit (LSB) of the slave address byte indicates whether a temperature above $T_{HIGH}$ or below $T_{LOW}$ has caused an ALERT condition: this bit is high if the temperature is greater than or equal to $T_{HIGH}$. the bit is low if the temperature is less than $T_{LOW}$. The details of this sequence are shown in Figure 4.6.

If multiple slaves respond to the SMBus alert command issued by the master, the SMBus alert arbiter will arbitrate to determine which slave to clear the alert status. The one with the lowest slave address wins the arbitration. If the NST1075 wins the arbitration, the ALERT pin of the NST1075 is cleared when the SMBus ALERT command is completed. If NST1075 loses arbitration, the ALERT pin of NST1075 will not be cleared.

#### 4.4.3.3. General Call

The NST1075 provides the general call function. when the general call address (0 000 000) sent by host is received and the R/W bit is 0, the device replies to the command. If the second byte is 00000110, the NST1075 latches the state of its address pins and resets its internal registers to the value at power-up.

#### 4.4.3.4. High-Speed Mode

The NST1075 supports bus operation above 400 kHz, requiring that the master device must switch the bus to high-speed mode operation by issuing a high-speed mode master code (00001XXX) in the first byte after the START condition. The NST1075 does not acknowledge this byte, the NST1075 switches the input filter of SCL, SDA and output filter of SDA to high-speed mode, allowing data transfer up to 2MHz(For VDD<1.8V, the Hs-mode up to 1.6MHz). After issuing the master code for high-speed mode, the master will transmit a two-wire slave address to initiate the data transfer operation. The bus will continue to operate in high-speed mode until a stop signal appears on the bus. Once the stop signal is received, the SCL, SDA input filter and SDA output filter of the NST1075 switch to the fast mode.

#### 4.4.3.5. Time-out Function

The NST1075 resets the $I^2C$ interface when the SCL or SDA is continuously pulled low for 54ms (typical) between the START and STOP signals, the NST1075 release the SDA and SCL line and waits for the master to initiate a START condition. To avoid activating the timeout function, the SCL operating frequency must be maintained at a rate of at least 1kHz.

#### 4.4.3.6. $I^2C$ Timing

The NST1075 devices supports SMBus and $I^2C$ interfaces. Figure 4.3 to Figure 4.6 describe the various Bus operations on the NST1075. The following list provides bus definitions. Parameters for Figure 4.3 are defined in the $I^2C$ Timing Requirements.

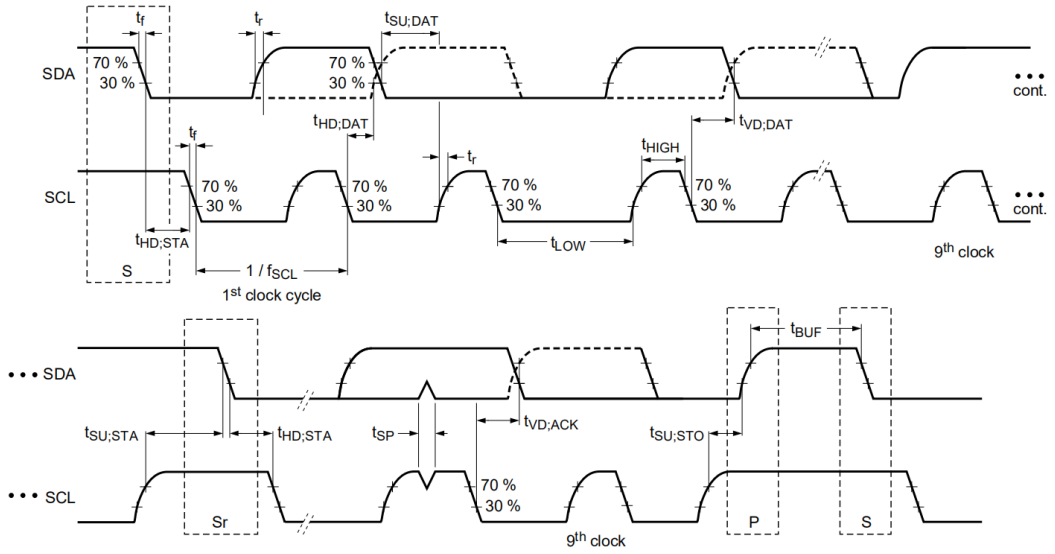



Figure 4.3 I²C Timing Diagram

**Bus Idle**: Both SDA and SCL lines remain high.

**Start Data Transfer**: A high-to-low transition of SDA with SCL high is a START condition which must precede any other command.

**Stop Data Transfer**: A low-to-high transition of SDA with SCL high is a STOP condition. The termination of each data transfer can be done with a RESTART or STOP.

**Data Transfer**: The amount of data bytes transferred between START and STOP is controlled by the master and is unlimited. The receiver acknowledges the transfer of data.

**Acknowledge**: All addresses and data words are serially transmitted to and from the device in 8-bit words. The device sends a zero to acknowledge that it has received each word when the address is matched. This happens during the ninth clock cycle. The data transfer can be terminated by the host generating a not-acknowledge during the host receiving data.

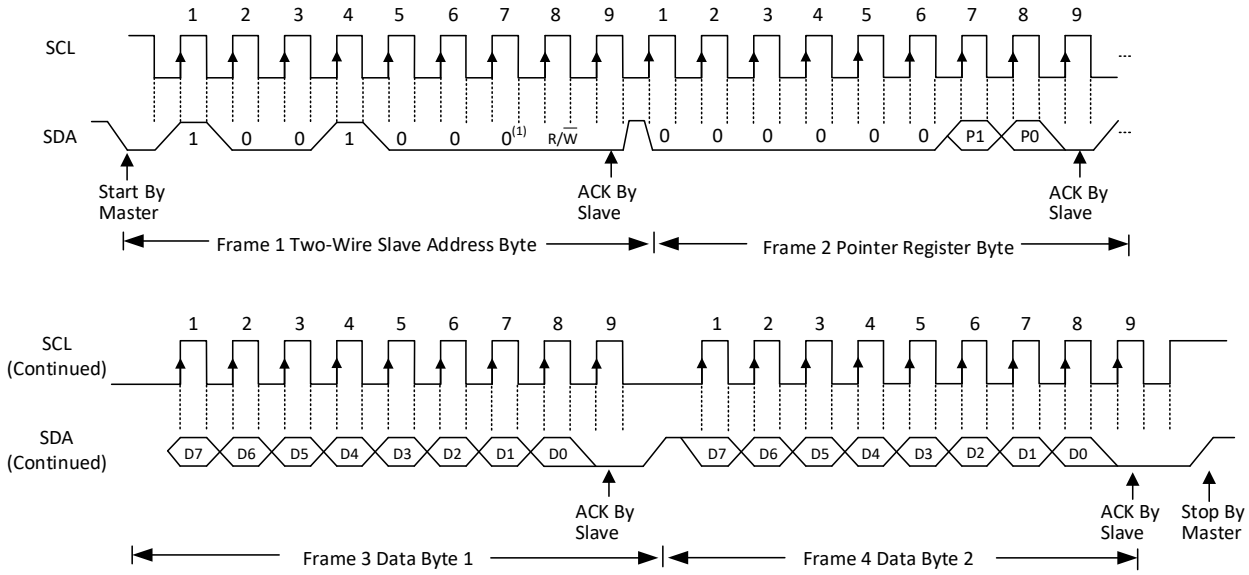



Figure 4.4 I²C Timing Diagram for the NST1075 Write Word Format

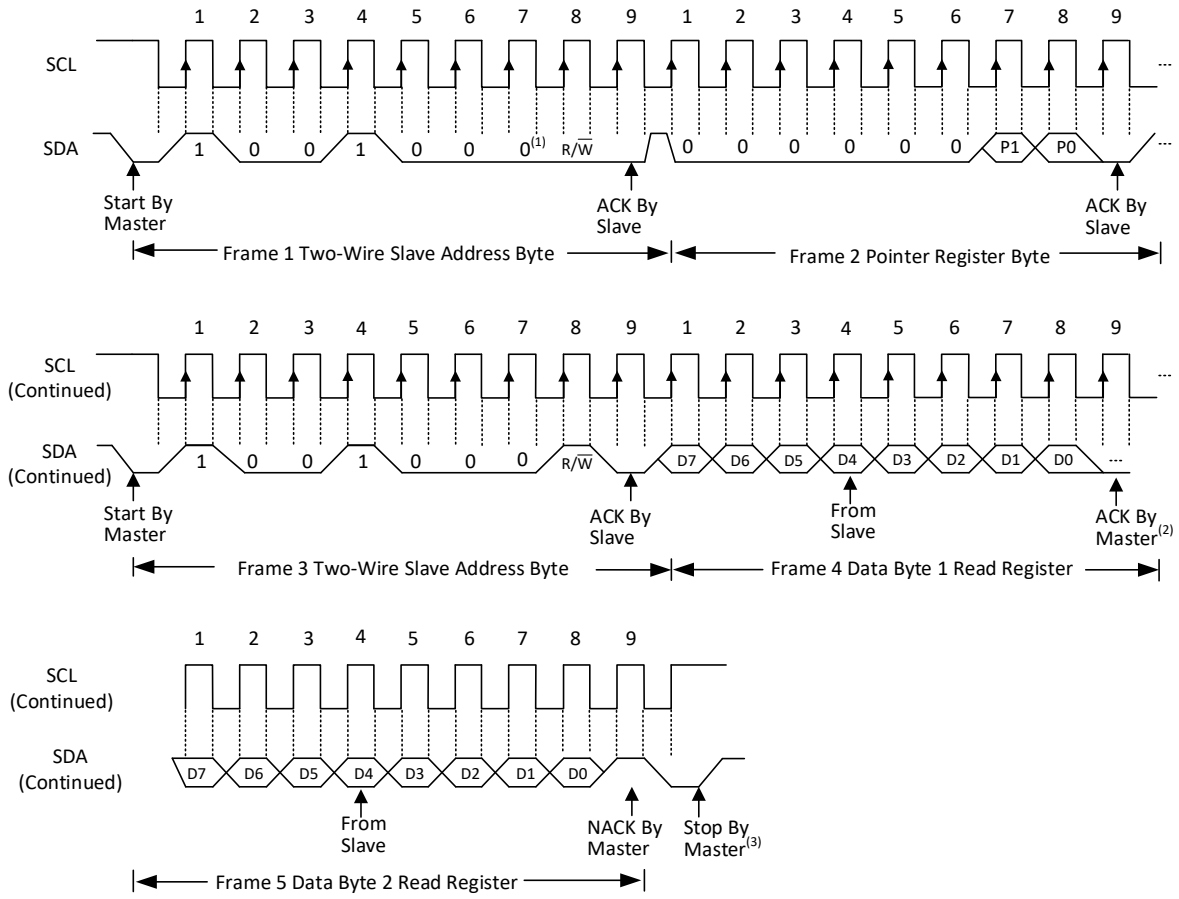



Figure 4.5 I²C Timing Diagram for Read Word Format

*(1) Slave address 1001000 is shown.*
*(2) Master should leave SDA high to terminate a single-byte read operation.*
*(3) Master should leave SDA high to terminate a two-byte read operation.*

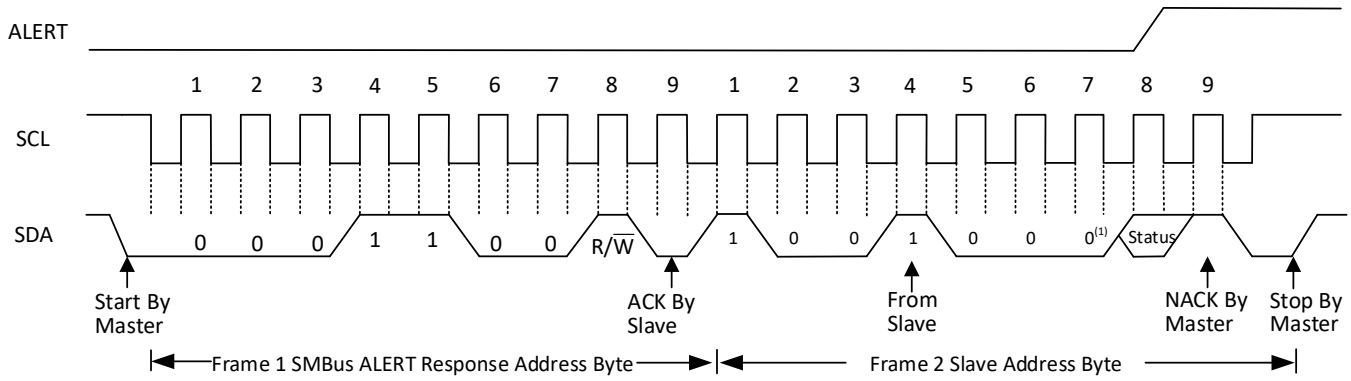



Figure 4.6 Timing Diagram for SMBus ALERT

# 5. On-Chip Register

## 5.1. Pointer Register

Figure 5.1 shows the internal register structure of the NST1075. The 8-bit Pointer register of the devices is used to address a given data registers. The Pointer register uses the two LSBs to identify which of the data registers must respond to a read or write command. Table 5.1 identifies the bits of the Pointer Register Byte. Table 5.2 describes the Pointer Address of the Registers available in the NST1075. Power-up reset value of P2/P1/P0 is 000.

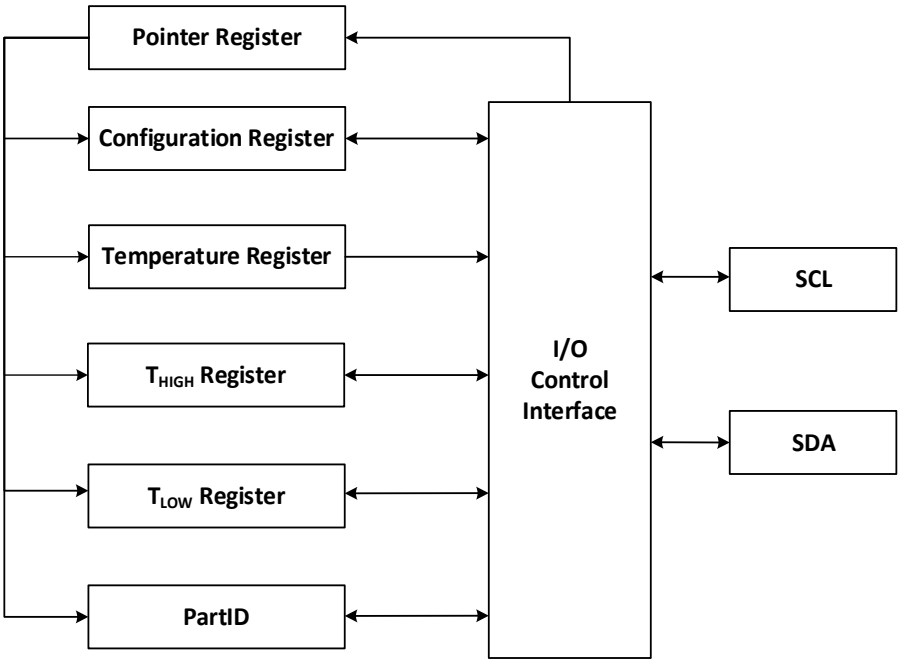



Figure 5.1 Internal Register Structure of the NST1075

Table 5.1 Pointer Register Byte

| *P7* | *P6* | *P5* | *P4* | *P3* | *P2* | *P1* | *P0* |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | Register bit | | |

Table 5.2 Pointer Register Description

| *BIT NO.* | *Name* | *Description* |
|---|---|---|
| **Bits 7:3** | **NA** | P3 to P7 must always be 0 during the write command. |
| **Bits 2:0** | **Pointer[2:0]** | **000:** Temperature register (default)<br>**001:** Configuration register<br>**010:** $T_{LOW}$ register<br>**011:** $T_{HIGH}$ register<br>**111:** PartID register |

## 5.2. Temperature Register

The temperature register is a read-only register used to store the results of each completed temperature conversion, which consists of 2 Bytes in the format shown in Table 5.3 , with MSB output first and followed by the LSB, and 12-bit MSBs used to indicate the temperature value. The data format for temperature is listed in Table 5.4, the resolution is 0.0625°C. Negative numbers are represented in binary complement format. After power-up or reset and before the first temperature conversion is completed, the value of the temperature register is 0.

By addressing the Configuration register and setting the resolution bits accordingly. The user can obtain 9, 10, 11, or 12 bits of resolution. For 9, 10, 11, or 12-bit resolution, the unused least significant bits (LSBs) set to 0.

Table 5.3 Temperature Register(12-bit)

| ***Bit*** | ***D15*** | ***D14*** | ***D13*** | ***D12*** | ***D11*** | ***D10*** | ***D9*** | ***D8*** |
|---|---|---|---|---|---|---|---|---|
| - | T11 | T10 | T9 | T8 | T7 | T6 | T5 | T4 |
| - | R | R | R | R | R | R | R | R |
| ***Bit*** | ***D7*** | ***D6*** | ***D5*** | ***D4*** | ***D3*** | ***D2*** | ***D1*** | ***D0*** |
| - | T3 | T2 | T1 | T0 | - | - | - | - |
| - | R | R | R | R | R | R | R | R |

Table 5.4 Temperature Data Format(12-bit)

| ***TEMPERATURE(°C)*** | ***DIGITAL OUTPUT*** | |
|---|---|---|
| | ***BINARY*** | ***HEX*** |
| 127.9375 | 0111 1111 1111 (0000) | 7FF(0) |
| 100 | 0110 0100 0000 (0000) | 640(0) |
| 80 | 0101 0000 0000 (0000) | 500(0) |
| 50 | 0011 0010 0000 (0000) | 320(0) |
| 25 | 0001 1001 0000 (0000) | 190(0) |
| 0.25 | 0000 0000 0100 (0000) | 004(0) |
| 0 | 0000 0000 0000 (0000) | 000(0) |
| -0.25 | 1111 1111 1100 (0000) | FFC(0) |
| -25 | 1110 0111 0000 (0000) | E70(0) |
| -55 | 1100 1001 0000 (0000) | C90(0) |

## 5.3. Configuration Register

The Configuration register is an 8-bit read/write register used to store bits that control the operational modes of the temperature sensor. Read and write operations are performed MSB first. The format of the Configuration register for the NST1075 is shown in Table 5.5, followed by a breakdown of the register bits, as shown in Table 5.6. The power-up or reset value of the Configuration register are all bits equal to 0.

Table 5.5 Configuration Register Format

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|
| Name | OS | R1 | R0 | F1 | F0 | POL | TM | SD |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |

Table 5.6 Configuration Register Description

| BIT NO. | Name | Description |
|---|---|---|
| **Bit 7** | **OS** | **0:** Continuous-Conversion Mode (default)<br>**1:** One-shot Mode |
| **Bits 6:5** | **Converter Resolution [1:0]** | **00:** 9bit (0.5°C default)<br>**01:** 10bit (0.25°C)<br>**10:** 11bit (0.125°C)<br>**11:** 12bit (0.0625°C) |
| **Bits 4:3** | **Fault Queue [1:0]** | **00:** Consecutive faults are 1 (default)<br>**01:** Consecutive faults are 2<br>**10:** Consecutive faults are 4<br>**11:** Consecutive faults are 6 |
| **Bit 2** | **Polarity** | **0:** AL bit is active low (default)<br>**1:** AL bit is active High |
| **Bit 1** | **Thermostat** | **0:** Comparator mode (default)<br>**1:** Interrupt mode |
| **Bit 0** | **Shutdown** | **0:** Continuous-Conversion Mode(default)<br>**1:** Shutdown Mode |

## 5.4. High and Low Limit Registers

In comparator mode (TM = 0), the ALERT pin of the NST1075 becomes active when the temperature equals or exceeds the value in THIGH and generates a consecutive number of faults according to fault bits F1 and F0. The ALERT pin remains active until the temperature falls below the indicated $T_{LOW}$ value for the same number of faults.

In interrupt mode (TM = 1), the ALERT pin becomes active when the temperature equals or exceeds $T_{HIGH}$ for a consecutive number of fault conditions. The ALERT pin remains active until a read operation of any register occurs, or the device successfully responds to the SMBus Alert response address. The ALERT pin is also cleared if the device is placed in shutdown mode. When the ALERT pin is cleared, it only become active again by the temperature falling below $T_{LOW}$. When the temperature falls below $T_{LOW}$, the ALERT pin becomes active and remains active until cleared by a read operation of any register or a successful response to the SMBus Alert response address. When the ALERT pin is cleared, the above cycle repeats, with the ALERT pin becoming active when the temperature equals or exceeds $T_{HIGH}$. The ALERT pin can also be cleared by resetting the device with the general call reset command. This action also clears the state of the internal registers in the device by returning the device to comparator mode (TM = 0).

Table 5.7 and Table 5.8 describe the format for the $T_{HIGH}$ and $T_{LOW}$ registers. The most significant byte is sent first, followed by the least significant byte. Power-up reset values for $T_{HIGH}$ and $T_{LOW}$ are: THIGH = 80°C and TLOW = 75°C.

The format of the data for THIGH and TLOW is the same as for the Temperature register.

Table 5.7 $T_{LOW}$ Register (02H) (12-bit)

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 |
|---|---|---|---|---|---|---|---|---|
| Name | H11 | H10 | H9 | H8 | H7 | H6 | H5 | H4 |
| Default | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| - | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| **Bit** | **D7** | **D6** | **D5** | **D4** | **D3** | **D2** | **D1** | **D0** |
| Name | H3 | H2 | H1 | H0 | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |

Table 5.8 $T_{HIGH}$ Register (03H) (12-bit)

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 |
|---|---|---|---|---|---|---|---|---|
| Name | H11 | H10 | H9 | H8 | H7 | H6 | H5 | H4 |
| Default | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| - | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| **Bit** | **D7** | **D6** | **D5** | **D4** | **D3** | **D2** | **D1** | **D0** |
| Name | H3 | H2 | H1 | H0 | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |

All 12 bits for the Temperature, THIGH, and TLOW registers are used in the comparisons for the ALERT function for all converter resolutions. The three LSBs in THIGH and TLOW can affect the ALERT output even if the converter is configured for 9-bit resolution.

## 5.5. PRODID: Product ID Register

Table 5.9 Product ID Register

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|
| Default | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| - | R | R | R | R | R | R | R | R |

D4--D7: Product Identification Nibble. Always returns **Ah** to uniquely identify this part as the NST1075.

D0--D3: Die Revision Nibble. Returns **1h** to uniquely identify the revision level as one.

# 6. Typical Application

## 6.1. Application information

No external components are required to operate the NST1075 other than pull-up resistors on SCL, SDA and ALERT, a bypass capacitor of 0.01μF is recommended. the sensing device for the NST1075 device is the device itself. The thermal path is through the package leads as well as the plastic package. The low thermal resistance of the metal results in the leads providing the primary thermal path. The typical application of NST1075 is shown in Figure 5.1.

## 6.2. Typical application

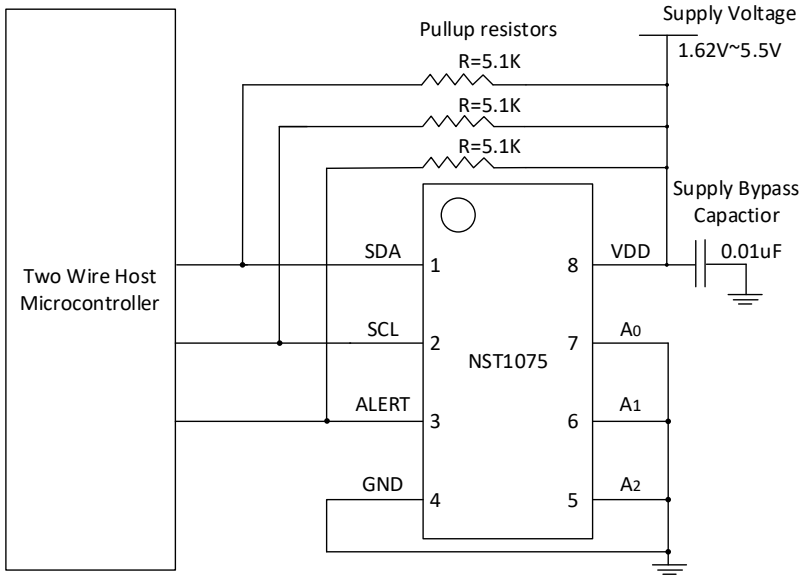
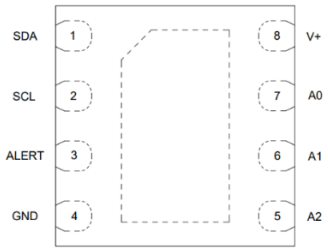


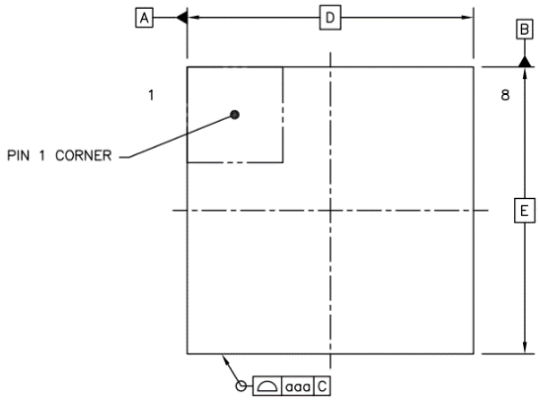

Figure 6.1. Typical Connections of the NST1075

# 7. Package information

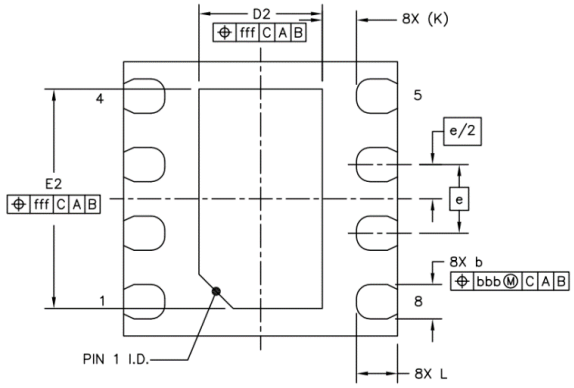
## 7.1. WSON (8) package



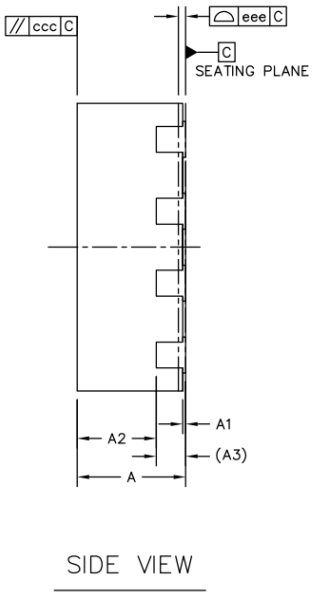

DSG Package 8-Pin WSON Top View




TOP VIEW



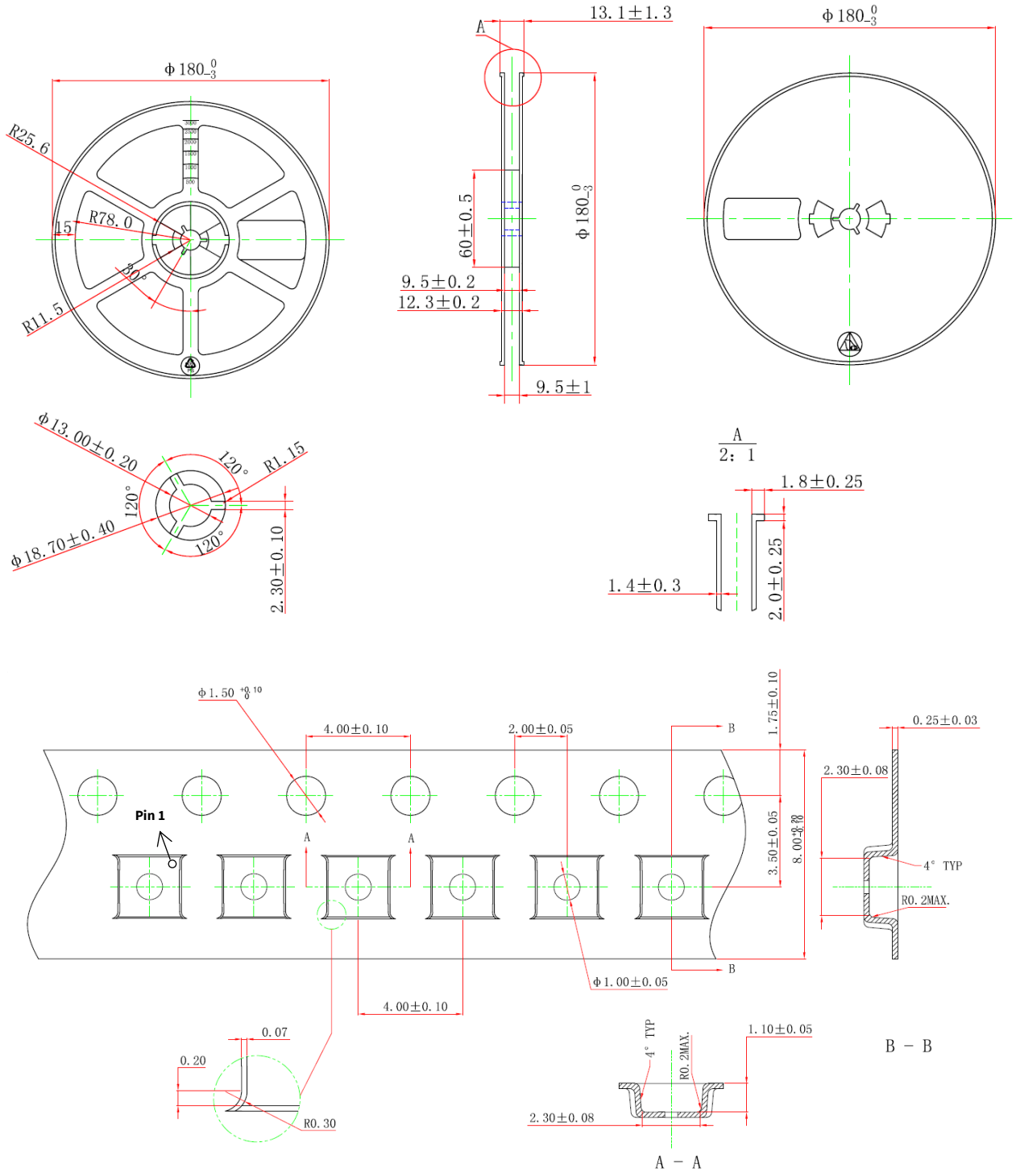

BOTTOM VIEW




SIDE VIEW

| | | SYMBOL | MIN | NOM | MAX |
|---|---|---|---|---|---|
| TOTAL THICKNESS | | A | 0.7 | 0.75 | 0.8 |
| STAND OFF | | A1 | 0 | 0.02 | 0.05 |
| MOLD THICKNESS | | A2 | --- | 0.55 | --- |
| L/F THICKNESS | | A3 | | 0.203 REF | |
| LEAD WIDTH | | b | 0.2 | 0.25 | 0.3 |
| BODY SIZE | X | D | | 2 BSC | |
| | Y | E | | 2 BSC | |
| LEAD PITCH | | e | | 0.5 BSC | |
| LEAD LENGTH | | L | 0.25 | 0.3 | 0.35 |
| EP SIZE | X | D2 | 0.8 | 0.9 | 1 |
| | Y | E2 | 1.5 | 1.6 | 1.7 |
| LEAD TO EP | | K | 0.15 | 0.25 | 0.35 |
| PACKAGE EDGE TOLERANCE | | aaa | | 0.1 | |
| MOLD FLATNESS | | ccc | | 0.1 | |
| COPLANARITY | | eee | | 0.05 | |
| LEAD OFFSET | | bbb | | 0.1 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## 7.2. Tape and Reel



# 8. Order information

| *Type* | *Unit* | *MSL* | *Marking*[1,2] | *Description* |
|---|---|---|---|---|
| NST1075-DDADR | 4000ea/Reel | 1 | 1075XYYM | WSON(8) package, Reel |
| NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260°C according to the JEDEC industry standard classifications and peak solder temperatures (Reflow profile: J-STD-020E). | | | | |

(1) The marking relates to the logo, the lot trace code information.

(2) If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

## 9. Marking

| *Type* | *Line* | *Name* | *Remark* |
|---|---|---|---|
|  | Line1 | 1075 | The model of the product |
| | Line2 | XYYW | X: Year<br>YY: week<br>W: Serial number |

# 10. Revision history

| *Revision* | *Description* | *Date* |
|---|---|---|
| 0.1 | Initial Version | 2022/6/9 |
| 0.2 | Add Order information | 2022/9/5 |
| 0.3 | Add Tape and Reel information | 2022/9/14 |
| 1.0 | Modify some descriptions. Add Electrical characteristics information. Add Thermal Information | 2022/11/16 |
| 1.1 | Modify Order information | 2022/12/23 |
| 1.2 | Modify Order information. Add Marking information | 2023/03/10 |

# IMPORTANT NOTICE

The information given in this document shall in no event be regarded as any warranty or authorization of, express or implied, including but not limited to accuracy, completeness, merchantability, fitness for a particular purpose or infringement of any third party's intellectual property rights.

You are solely responsible for your use of Novosense' products and applications, and for the safety thereof. You shall comply with all laws, regulations and requirements related to Novosense's products and applications, although information or support related to any application may still be provided by Novosense.

The resources are intended only for skilled developers designing with Novosense' products. Novosense reserves the rights to make corrections, modifications, enhancements, improvements or other changes to the products and services provided. Novosense authorizes you to use these resources exclusively for the development of relevant applications designed to integrate Novosense's products. Using these resources for any other purpose, or any unauthorized reproduction or display of these resources is strictly prohibited. Novosense shall not be liable for any claims, damages, costs, losses or liabilities arising out of the use of these resources.

For further information on applications, products and technologies, please contact Novosense(www.novosns.com ).

**Suzhou Novosense Microelectronics Co., Ltd**