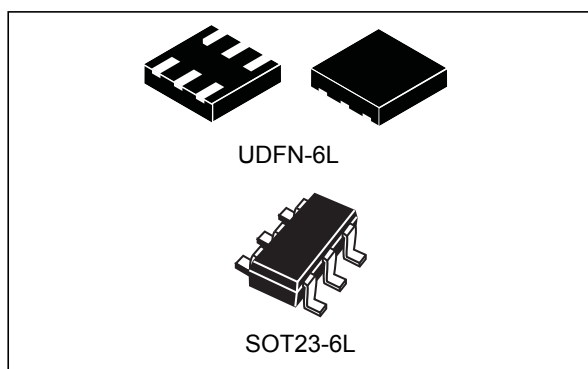


2.25 V low-voltage local digital temperature sensor

Datasheet - production data



- Accuracy
 - $\pm 0.5\text{ }^{\circ}\text{C}$ (typ) $0\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$
 - $\pm 0.5\text{ }^{\circ}\text{C}$ (typ) $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- One-shot mode for power saving
- Fast conversion time 21 ms (typ) 10-bit
- Pull-up resistor value allows single pin to select one of four slave addresses
- Supports 400 kHz serial clock
- SMBus 2.0 compatible
 - SMBus ALERT (ARA) support
 - SMBus timeout
- RoHS/green

Features

- Operating voltage 2.25 V to 3.6 V
- Operating temperature $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Programmable
 - 10 different conversion rates
0.0625 to 32 conversions/sec.
1 conversion/sec. - default
 - 4 different resolutions
9-bit ($0.5\text{ }^{\circ}\text{C}/\text{LSB}$) to 12-bit ($0.0625\text{ }^{\circ}\text{C}/\text{LSB}$)
10-bit ($0.25\text{ }^{\circ}\text{C}/\text{LSB}$) - default
- Low supply current
 - $50\text{ }\mu\text{A}$ (typ) for 8 conversions/sec.
 - $20\text{ }\mu\text{A}$ (typ) for 1 conversion/sec.
 - $3\text{ }\mu\text{A}$ (typ) standby

Applications

- Solid state drives
- Portable electronics
- Notebook computers
- Smart batteries
- Servers
- Telecom

Table 1. Device summary

| Order code | Pull-up resistor value | SMBus address | Comments |
|--------------------------------|------------------------|---------------|--|
| STTS751-0DP3F STTS751-0WB3F | 7.5 K $\pm 5\%$ | 1001 000 b | Address selection via resistor pull-up on Addr/Therm pin |
| | 12 K $\pm 5\%$ | 1001 001 b | |
| | 20 K $\pm 5\%$ | 0111 000 b | |
| | 33 K $\pm 5\%$ | 0111 001 b | |
| STTS751-1DP3F STTS751-1WB3F | 7.5 K $\pm 5\%$ | 1001 010 b | Address selection via resistor pull-up on Addr/Therm pin |
| | 12 K $\pm 5\%$ | 1001 011 b | |
| | 20 K $\pm 5\%$ | 0111 010 b | |
| | 33 K $\pm 5\%$ | 0111 011 b | |

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1 Description

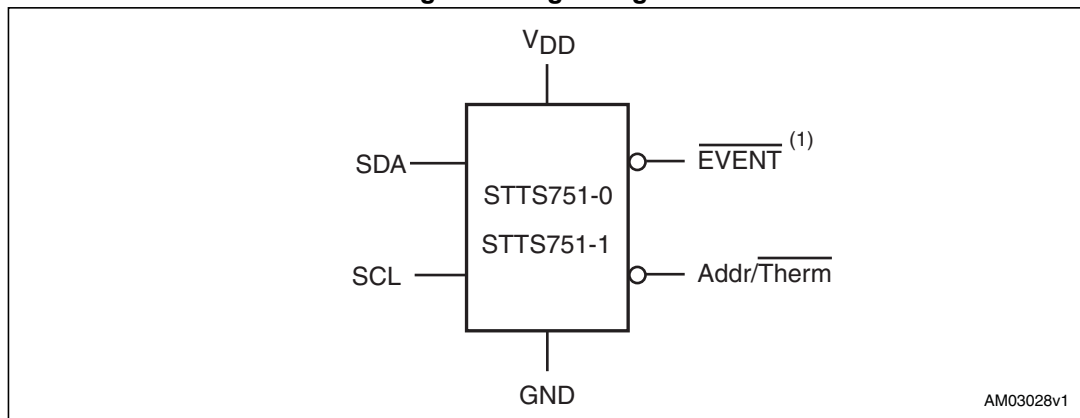
The STTS751 is a digital temperature sensor which communicates over a 2-wire SMBus 2.0 compatible bus. The temperature is measured with a user-configurable resolution between 9 and 12 bits. At 9 bits, the smallest step size is 0.5 °C, and at 12 bits, it is 0.0625 °C. At the default resolution (10 bits, 0.25 °C/LSB), the conversion time is nominally 21 milliseconds.

The open-drain $\overline{\text{EVENT}}$ output is used to indicate an alarm condition in which the measured temperature has exceeded the user-programmed high limit or fallen below the low limit. When the $\overline{\text{EVENT}}$ pin is asserted, the host can respond using the SMBus Alert Response Address (ARA) protocol to which the STTS751 will respond by sending its slave address.

The STTS751 is a 6-pin device that supports user-configurable slave addresses. Via the pull-up resistor on the Addr/Therm pin, one of four different slave addresses can be specified. Two order numbers (STTS751-0 and STTS751-1) provide two different sets of slave addresses bringing the total available to eight. Thus, up to eight devices can share the same 2-wire SMBus without ambiguity, thereby allowing monitoring of multiple temperature zones in an application.

The two-wire interface can support transfer rates up to 400 kHz. Two small footprint packages are available: a UDFN-6L and a standard SOT23-6L package.

Figure 1. Logic diagram



1. This pin may not float.

Table 2. Signal names

| Symbol | Type | Description |
|---------------------------|--------|--|
| Addr/Therm | Output | Address selection pin / thermal status pin |
| $\overline{\text{EVENT}}$ | Output | Event (alert) output |
| SDA | I/O | SMBus interface data I/O |
| SCL | Input | SMBus interface clock input |
| V _{DD} | Power | Device power supply |
| GND | Ground | Device ground |

Figure 2. Pinout - SOT23-6L and UDFN-6L

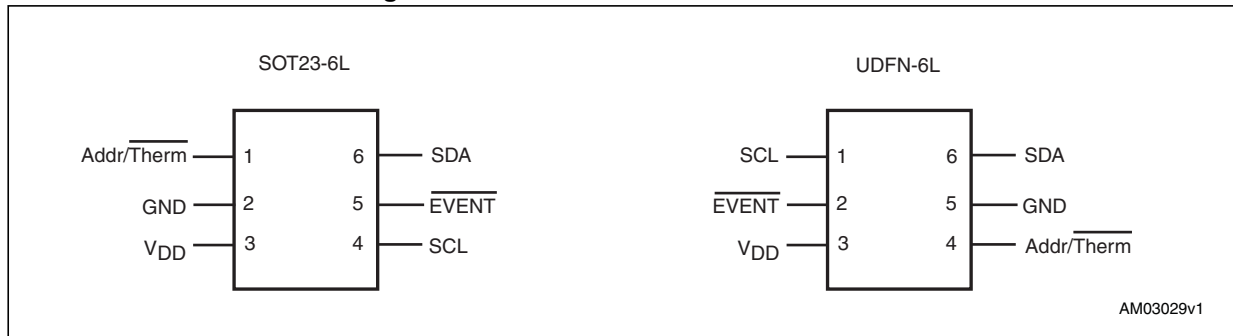


Table 3. Pin descriptions

| Pin | | Name | Description |
|----------|---------|-----------------|---|
| SOT23-6L | UDFN-6L | | |
| 1 | 4 | Addr/Therm | Open-drain output that can be used to turn on/off a fan or throttle a CPU clock in the event of an overtemperature condition. The pin at power-up determines the SMBus slave address according to the pull-up resistor value as shown in Table 1 . This pin must have a pull-up resistor connected to the same voltage as V _{DD} or tied to GND (pin cannot float). Total capacitance on this pin must be <100 pF. Note: By tying Addr/Therm to ground, the device functions as one address device only. The Therm functionality is then not available. The address for device STTS751-0 is 72h and the address for device STTS751-1 is 76h. |
| 2 | 5 | GND | GND |
| 3 | 3 | V _{DD} | Power supply V _{DD} |
| 4 | 1 | SCL | SMBus clock |
| 5 | 2 | EVENT | Open-drain interrupt output. Output supports the SMBus Alert (ARA). Note: This pin may not float. |
| 6 | 6 | SDA | SMBus data input/output |

Figure 3. Block diagram

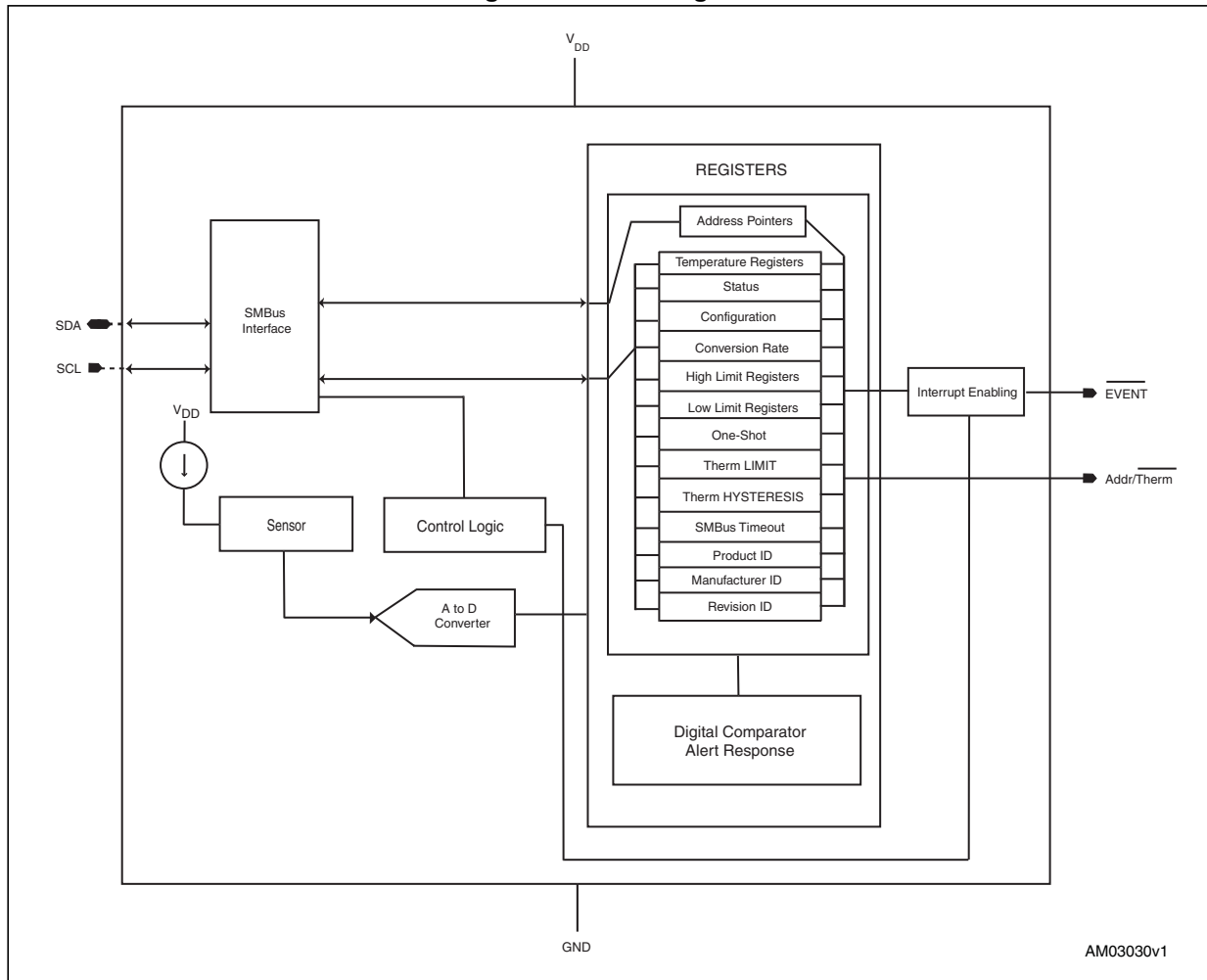
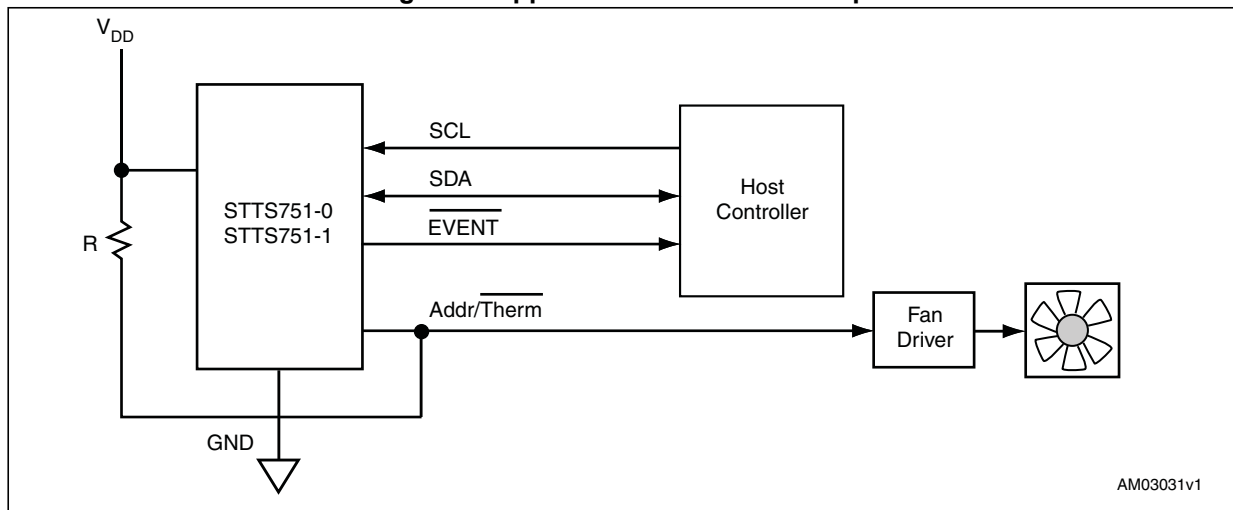


Figure 4. Application hardware hookup



2 Functional description

The STTS751 digital temperature sensor acquires the temperature and stores it in the temperature register. The resolution is programmable which allows the host controller to select the optimal configuration between sensitivity and conversion times. The STTS751 can be placed in standby mode to minimize power consumption.

The user can control the update rate of the temperature measurements via the configuration register ([Table 15 on page 17](#)). Sample rates can be adjusted from once every 16 seconds up to 32 samples per second, in powers-of-2 steps.

These devices also offer a one-shot feature. When the device is in the standby mode, writing to the one-shot register initiates a single temperature conversion. The result is compared with the limit registers, and the outputs updated accordingly. Then the device returns to the standby mode. Operating the device in this mode allows for very low average power consumption, thereby making this device ideal for low power applications.

The device supports the SMBus Alert Response address (ARA) protocol. The ARA is polled by the controller (host) device that supports this protocol whenever it detects that the $\overline{\text{EVENT}}$ pin has been asserted. The STTS751 will respond with its device address (refer to [Section 3.8 on page 12](#)).

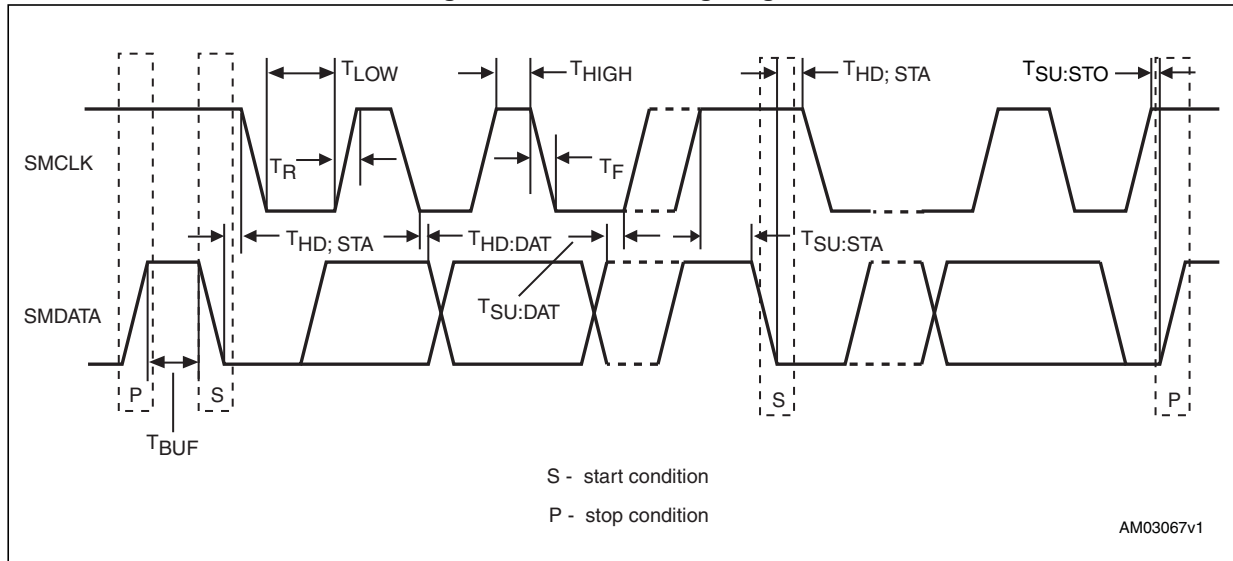
The STTS751 contains 16 registers. The register summary is shown in [Table 9 on page 13](#). Using register addresses not specified in the table may result in an incorrect response. These registers and their functions are described in more detail in the following sections.

3 SMBus interface

3.1 SMBus protocol

The STTS751 communicates over a 2-wire serial interface compatible with the SMBus standard. Temperature data, alarm limits and configuration information are communicated over the bus. A detailed timing diagram is shown below in [Figure 5](#).

Figure 5. SMBus timing diagram



The STTS751 supports standard SMBus protocols (see [Table 4](#), [5](#), [6](#), and [7](#)).

- WRITE byte
- READ byte
- SEND byte
- RECEIVE byte
- Alert response address

3.2 WRITE byte

The WRITE byte protocol is used to write one byte of data to the registers as shown in [Table 4](#). The gray data is sent by the STTS751 while the white data is sent by the host.

Table 4. SMBus WRITE byte protocol

| Start | Slave address | WR | ACK | Register address | ACK | Data | ACK | Stop |
|-------|---------------|-------|-------|------------------|-------|--------|-------|-------|
| 1 bit | 7 bits | 1 bit | 1 bit | 8 bits | 1 bit | 8 bits | 1 bit | 1 bit |

3.3 READ byte

The READ byte protocol is used to read one byte of data from the registers as shown in [Table 5](#).

Table 5. SMBus READ byte protocol

| Start | Slave address | WR | ACK | Register address | ACK | Start | Slave address | RD | ACK | Data | NACK | Stop |
|-------|---------------|-------|-------|------------------|-------|-------|---------------|-------|-------|--------|-------|-------|
| 1 bit | 7 bits | 1 bit | 1 bit | 8 bits | 1 bit | 1 bit | 7 bits | 1 bit | 1 bit | 8 bits | 1 bit | 1 bit |

3.4 SEND byte

The SEND byte protocol is used to set the internal address register to the correct address. It sends a register address with no data (see [Table 6](#)). The SEND byte can be followed by the RECEIVE byte protocol described below in order to read data from the register.

Table 6. SMBus SEND byte protocol

| Start | Slave address | WR | ACK | Register address | ACK | Stop |
|-------|---------------|-------|-------|------------------|-------|-------|
| 1 bit | 7 bits | 1 bit | 1 bit | 8 bits | 1 bit | 1 bit |

3.5 RECEIVE byte

The RECEIVE byte protocol is used to read data from the register when the internal register address pointer is known (see [Table 7](#)). This can be used for consecutive reads of the same register.

Table 7. SMBus RECEIVE byte protocol

| Start | Slave address | RD | ACK | Data | NACK | Stop |
|-------|---------------|-------|-------|--------|-------|-------|
| 1 bit | 7 bits | 1 bit | 1 bit | 8 bits | 1 bit | 1 bit |

3.6 SMBus addresses

The STTS751 is available in two versions. Each version has 4 slave addresses determined by the pull-up resistor value connected to the Addr/Therm pin. Refer to [Table 1](#) for valid address and recommended resistor values. The device will not respond to an invalid slave address.

3.7 SMBus timeout

The STTS751 supports SMBus timeout which is enabled by default at power-up. This can be disabled via bit 7 in the timeout register, refer to [Section 4.11: SMBus timeout register](#). When timeout is enabled, the STTS751 will time out after 25 to 35 ms of inactivity.

The STTS751 supports the SMBus timeout feature. If the host holds SCL low or the device drives SDA low for more than t_{TIMEOUT} (max), the STTS751 resets and releases the bus. This feature is turned on by default. The STTS751 also supports timeout while in standby mode and when the device is driving SDA low.

Note: The STTS751 never drives the clock line and it does not support clock stretching.

3.8 Alert response address

The STTS751 supports the SMBus alert response address (ARA) protocol. In the event of an out-of-limit temperature measurement, the $\overline{\text{EVENT}}$ output will be asserted. In response, the host (supporting the ARA protocol) will send the SMBus Alert Response Address to the general (slave) address of 0001_100b. All devices with active interrupts will respond with their client addresses as shown in [Table 1 on page 1](#) (with the LSB bit set to 0).

The STTS751 will acknowledge the ARA and respond with its slave device address. [Table 8](#) shows the ARA transfer. See [Section 5](#) for more information.

Table 8. SMBus protocol response to ARA

| Field | START | ALERT RESPONSE ADDRESS | RD | ACK | STTS751 SLAVE ADDRESS | NACK | STOP |
|-------|-------|------------------------|----|-----|-----------------------|------|------|
| Bits | 1 | 7 | 1 | 1 | 8 | 1 | 1 |

4 STTS751 register summary

The STTS751 uses 8-bit registers. Variables longer than 8 bits are managed in byte pairs. For example, when reading a 10-bit temperature value (10 bits is the default resolution.) the application must read two registers and then concatenate the upper byte with the 2 most significant bits of the lower byte.

Table 9 below summarizes the register map for the device. Accessing any invalid address results in indeterminate data.

Table 9. Registers/pointers

| Address pointers (h) | STTS751 register map | | | Power-up default values binary (dec) |
|----------------------|----------------------------------|------|------|--|
| | Device registers name | Size | Type | |
| 00 | Temperature value high byte | 8 | R | undefined |
| 01 | Status | 8 | R | undefined |
| 02 | Temperature value low byte | 8 | R | undefined |
| 03 | Configuration | 8 | R/W | 0000 0000 |
| 04 | Conversion rate | 8 | R/W | 0000 0100 |
| 05 | Temperature high limit high byte | 8 | R/W | 0101 0101 (85 °C) |
| 06 | Temperature high limit low byte | 8 | R/W | 0000 0000 |
| 07 | Temperature low limit high byte | 8 | R/W | 0000 0000 (0 °C) |
| 08 | Temperature low limit low byte | 8 | R/W | 0000 0000 |
| 0F | One-shot | 8 | W | N/A |
| 20 | THERM limit | 8 | R/W | 0101 0101 (85 °C) |
| 21 | THERM hysteresis | 8 | R/W | 0000 1010 (10 °C) |
| 22 | SMBus timeout enable | 8 | R/W | 1000 0000 (Enabled) |
| FD | Product ID register | 8 | R | STTS751-0 [0000 0000] STTS751-1 [0000 0001] |
| FE | Manufacturer ID | 8 | R | 0101 0011 (53h) |
| FF | Revision number | 8 | R | 0000 0001 |

In the following sections are the detailed descriptions of the registers along with their power-up default values. Examples are also included.

4.1 STTS751 register formats and details

The STTS751 register set is comprised of the 16 addresses shown in [Table 9](#). The individual registers are accessed by transferring their addresses via the SMBus interface as shown in [Section 3.2](#), [3.3](#), and [3.4](#). In the case of the RECEIVE byte sequence ([Section 3.5](#)) the address used is the address sent in the previous WRITE, READ or SEND byte sequence.

An example read sequence of the Therm hysteresis register, address 21h, with its default value, 0Ah, is shown below. The slave address used is 90h. The gray data is sent by the STTS751 while the white data is sent by the host.

Table 10. Pointer register format

| | | | | | | | | | | | | |
|-------|---------------|----|-----|------------------|-----|-------|---------------|----|-----|-----------|------|------|
| START | SLAVE ADDRESS | WR | ACK | REGISTER ADDRESS | ACK | START | SLAVE ADDRESS | RD | ACK | DATA | NACK | STOP |
| | 1001_000 | 0 | | 0010_0001 | | | 1001_000 | 1 | | 0000_1010 | | |

Note: All eight bits are used to select the register.

4.2 Temperature register format

The temperature data is a 12-bit number and is stored in two's complement format spanning the high byte and low byte registers as shown in [Table 11](#).

Table 11. Temperature register (two's complement)

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|-------------------------|------|-------|--------|---------|------|-----|------|------|------------------------|
| 00 | R | Temperature - high byte | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4°C | 2 °C | 1 °C | 00 |
| 02 | R | Temperature - low byte | ½ °C | ¼ °C | 1/8 °C | 1/16 °C | 0 | 0 | 0 | 0 | 00 |

The integer portion of the temperature is stored in the high byte, and the fractional portion in the low byte. The lower four bits of the low byte will always read 0. At power-up, the STTS751 defaults to 10-bit resolution. Thus, bits b5 and b4 of the lower byte will also read 0 until the device is configured to a higher resolution (via the Tres bits in the configuration register).

4.3 Temperature limit register format

The high and low limit registers have the same format as the temperature register with the integer portion of the two's complement value stored in the high byte and the fractional portion in the low byte. These registers are read-write.

Note that the high limit defaults to 85 °C.

Table 12. Temperature limit register (two's complement format)

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|------------------------|------|-------|--------|---------|------|-----|------|------|------------------------|
| 05 | R/W | High limit - high byte | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4°C | 2 °C | 1 °C | 55 (85 °C, dec) |
| 06 | R/W | High limit - low byte | ½ °C | ¼ °C | 1/8 °C | 1/16 °C | 0 | 0 | 0 | 0 | 00 |
| 07 | R/W | Low limit - high byte | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4°C | 2 °C | 1 °C | 00 |
| 08 | R/W | Low limit - low byte | ½ °C | ¼ °C | 1/8 °C | 1/16 °C | 0 | 0 | 0 | 0 | 00 |

4.4 Temperature examples

The table below shows several examples of how the data is arranged in the high and low byte pairs used for the temperature and limit registers.

Table 13. Temperature examples (two's complement format)

| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---------------------------|-----------|------|-------|--------|---------|------|-----|------|------|
| Weighting of the bits | High byte | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4°C | 2 °C | 1 °C |
| | Low byte | ½ °C | ¼ °C | 1/8 °C | 1/16 °C | 0 | 0 | 0 | 0 |
| -64 °C | High byte | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Low byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -63 °C | High byte | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Low byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -1 °C | High byte | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Low byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| +1 °C | High byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Low byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| +5.3125 °C ⁽¹⁾ | High byte | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | Low byte | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| +125 °C | High byte | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Low byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

1. With 12-bit resolution selected.

Note: The maximum and minimum values for the temperature registers are 127.9375 (7F:F0h, high byte : low byte) and -64 (C0:00h), respectively. This also applies to the high and low limit registers.



4.5 Status register

Table 14. Status register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|----------|------|-------------------|------------------|-----|-----|-----|-----|------|------------------------|
| 01 | R | Status | Busy | T _{HIGH} | T _{LOW} | RFU | RFU | RFU | RFU | THRM | undefined |

The STTS751 status register is read-only and located at address 01h. The various status bits function as described below.

Busy: [7] Bit =1 when a temperature conversion is in progress.

T_{HIGH}: [6] Bit = 1 indicates temperature high limit has been exceeded ($T_A > \text{high limit}$). T_{HIGH} is cleared when the status register is read, provided the condition no longer exists.

T_{LOW}: [5] Bit = 1 indicates the is at or below the low limit ($T_A \leq \text{low limit}$). T_{LOW} is cleared when the status register is read, provided the condition no longer exists.

RFU: [4:1] Not used - reserved.

THRM: [0] Bit = 1 indicates the measured temperature has crossed the Therm limit. The THRM bit will go low when the temperature falls below the Therm limit minus the Therm Hysteresis. When the THRM bit is high, the $\text{Addr}/\overline{\text{Therm}}$ output will be asserted low.

4.6 Configuration register

The STTS751 configuration register is read/write and controls the functionality of temperature measurements. It is located at address 03h. The configuration register bits function as described below.

Table 15. Configuration register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|---------------|-------|------------------------------|----|-----|-------|-------|-----|-----|------------------------|
| 03 | R/W | Configuration | MASK1 | $\overline{\text{RUN/STOP}}$ | 0 | RFU | Tres1 | Tres0 | RFU | RFU | 00 |

Description

MASK1: [bit 7]

- 0: $\overline{\text{EVENT}}$ is enabled. Any out-of-limit condition asserts the EVENT pin (active low).
- 1: $\overline{\text{EVENT}}$ is disabled.

$\overline{\text{RUN/STOP}}$: [bit 6]

- 0: Device is running in continuous conversion mode.
- 1: Device is in standby mode drawing minimum power.

The $\overline{\text{RUN/STOP}}$ bit controls temperature conversions by the ADC. When this bit is 0, the ADC converts temperatures in continuous mode, at a rate as selected by the Conversion Rate register ([Section 4.7](#)). When the $\overline{\text{RUN/STOP}}$ bit is 1, the ADC will be in standby mode, thus reducing current supply significantly.

Note: The device can still be accessed via the SMBus while in standby mode.

When $\overline{\text{RUN/STOP}}$ is 1 and the one-shot register is written to, the ADC will execute a temperature measurement and then return to standby mode.

[bit 5]: This bit must always be 0.

RFU: [bit 4] Not used - reserved.

Tres1:Tres0 [bits 3 and 2]

These bits select one of the four programmable resolutions for temperature data on the STTS751 providing resolutions down to 0.0625 °C/LSB. The default resolution is 10 bits, 0.25 °C/LSB.

Table 16. Conversion resolution

| Tres1:Tres0 | Temperature resolution | LSB step size (°C) |
|-------------|------------------------|--------------------|
| 00 | 10 bits (default) | 0.25 |
| 01 | 11 bits | 0.125 |
| 11 | 12 bits | 0.0625 |
| 10 | 9 bits | 0.5 |

RFU [bits 1 and 0] Not used - reserved.

4.7 Conversion rate register

The STTS751 conversion rate register is read/write and controls the number of times the temperature value will be updated each second.

Table 17. Conversion rate register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|-----------------|----|----|----|----|-----------|----|----|------------|------------------------|
| 04 | R/W | Conversion rate | 0 | 0 | 0 | 0 | CONV[3:0] | | | 04 (1/sec) | |

The upper four bits of the register are reserved and default to 0 on power-up. The lower four bits control the conversion rate as shown in the table below. The power-up default is 1 conversion per second. The current draw is proportional to the conversion rate, and goes up at higher rates.

Table 18. Conversion rates

| CONV[3:0] (hex) | Conversions per second | Typical current (µA) | Comment |
|--------------------|------------------------|----------------------|-----------------------------------|
| 0 | 0.0625 | 15 | |
| 1 | 0.125 | | |
| 2 | 0.25 | | |
| 3 | 0.5 | | |
| 4 | 1 | 20 | |
| 5 | 2 | | |
| 6 | 4 | | |
| 7 | 8 | 50 | |
| 8 | 16 | | 9, 10, or 11-bit resolutions only |
| 9 | 32 | 125 | 9 or 10-bit resolutions only |
| A-F | reserved | | |

Note: The user must program the conversion rate and resolution bits (Tres1:Tres0 in the configuration register, address 03h) to be consistent with this table. For a sampling rate of 32 conversions per second, the maximum resolution is 10 bits. For 16 conversions per second, the maximum is 11 bits.

4.8 One-shot register

The STTS751 can be configured to perform a single temperature conversion on demand. When the device is placed in standby mode (by setting $\overline{RUN/STOP}$ to 1 in the configuration register) a write to the one-shot register will invoke a temperature conversion. The device will set the busy bit while the conversion is in progress. The conversion is complete when the busy bit is cleared. The STTS751 returns to standby mode upon completion of the conversion.

The one-shot register is write-only and is located at address 0Fh. The value written to invoke the one-shot conversion is a don't care. The device responds only to the write at address 0Fh and ignores the value written.

Note: Writes to the one-shot register will be ignored when the STTS751 is in continuous conversion mode (ie. when $\overline{RUN/STOP}=0$).

Table 19. One-shot register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|---------------|-----|----------|----|----|----|----|----|----|----|----|---------------------------|
| 0F | W | One shot | X | X | X | X | X | X | X | X | n/a |

4.9 Therm limit

The Therm limit is a read/write register located at address 20h. The power-on default value is 85 °C (55h). The format is 8-bit, two's complement integer. This is the same format as the upper byte of the temperature register (*Section 4.2: Temperature register format*).

Whenever the temperature exceeds the value of the therm limit, the Addr/Therm output will be asserted (low). See *Section 6* for more information.

Table 20. Therm limit

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|----------|------|-------|-------|-------|------|------|------|------|------------------------|
| 20 | R/W | Therm | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4 °C | 2 °C | 1 °C | 55 (85 °C, dec) |

4.10 Therm hysteresis

The Therm hysteresis values controls the hysteresis for Addr/Therm output. Once Therm output has asserted, it will not de-assert until the temperature has fallen below the respective therm limit minus the therm hysteresis value. See *Section 5* for more information.

The therm hysteresis register is read/write and is located at address 21h. The power-up default value is 10 °C (0Ah). The format is 8-bit, two's complement integer.

Table 21. Therm hysteresis

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|------------------|------|-------|-------|-------|------|------|------|------|------------------------|
| 21 | R/W | Therm hysteresis | sign | 64 °C | 32 °C | 16 °C | 8 °C | 4 °C | 2 °C | 1 °C | 0A (10 °C, dec) |

4.11 SMBus timeout register

At power-up, the STTS751 is configured with an SMBus timeout of 25 to 35 milliseconds (t_{TIMEOUT}). See *Section 3.7* for more information.

Table 22. SMBus timeout register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | Power-up default (hex) |
|------------|-----|---------------|---------|----|----|----|----|----|----|----|------------------------|
| 22 | R/W | SMBus timeout | TIMEOUT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 |

TIMEOUT: [bit 7]

1: SMBus timeout is enabled. Default condition.

0: SMBus timeout is disabled.

[bits 6:0] Not used - reserved.

4.12 STTS751 product ID

The two versions of the STTS751 as shown in [Table 1](#) can be identified via the read-only Product ID register at address FDh. The STTS751-0 has a Product ID of 00h. The STTS751-1 has a Product ID of 01h.

Table 23. Product ID register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | hex |
|------------|-----|------------|----|----|----|----|----|----|----|----|---------------|
| FD | R | Product ID | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00: STTS751-0 |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01: STTS751-1 |

4.13 STTS751 manufacturer's ID

The read-only manufacturer's ID is located at address FEh. For the STTS751, the value is 53h.

Table 24. Manufacturer's ID register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | hex |
|------------|-----|----------|----|----|----|----|----|----|----|----|-----|
| FE | R | Mfg ID | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 53 |

4.14 STTS751 revision ID

The STTS751 revision ID register pointer is read-only and can be accessed at address FFh. The value is formatted as an unsigned, 8-bit integer.

Table 25. Revision ID register

| ADDR (hex) | R/W | Register | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|------------|-----|-------------|----|----|----|----|----|----|----|----|
| FF | R | Revision ID | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

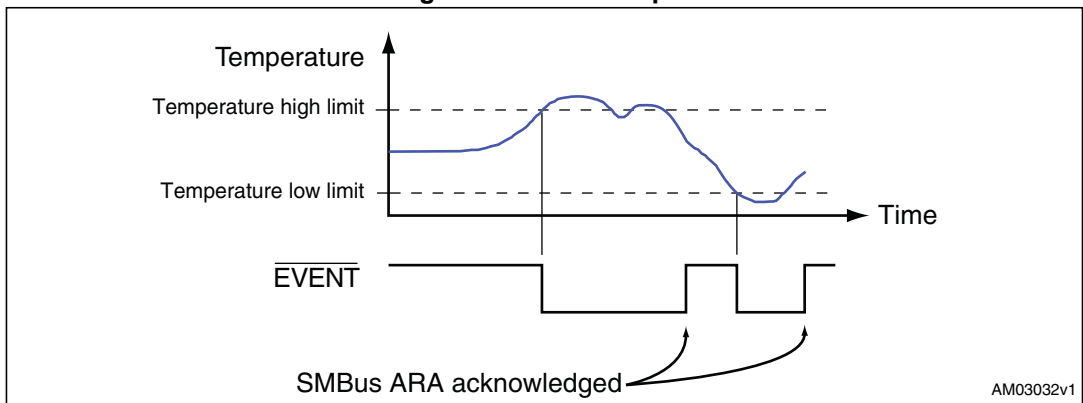
5 $\overline{\text{EVENT}}$ output

The STTS751 $\overline{\text{EVENT}}$ output is open drain and requires a pull-up resistor.

The $\overline{\text{EVENT}}$ pin is asserted (low) whenever the temperature exceeds the high limit or is equal to or below the low limit. Once asserted, the output will remain asserted until the STTS751 receives an SMBus Alert Response Address (ARA) from the host and acknowledges with its slave address. The output will be deasserted when the ARA is acknowledged. If the triggering condition is still true, the output will be reasserted at the next temperature conversion.

Figure 6 below shows how the $\overline{\text{EVENT}}$ output functions.

Figure 6. $\overline{\text{EVENT}}$ output



6 Addr/Therm output

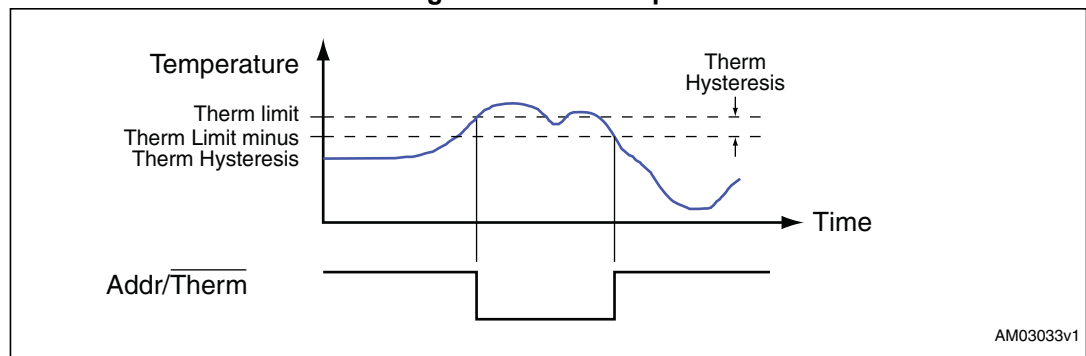
The Addr/Therm pin functions normally as an output to alert the system of an over temperature condition. It is open drain and requires a pull-up resistor. During power-up, the pull-up value is sensed by the STTS751 to determine what its slave address will be as depicted in [Table 1](#).

The $\overline{\text{Therm}}$ output is asserted low whenever the temperature exceeds the Therm limit (address 20h). Only the upper 8 bits of the temperature register are used in the comparison with the Therm limit. Once asserted, $\overline{\text{Therm}}$ will remain asserted until temperature falls below the Therm limit minus the therm hysteresis value. For example, if the Therm limit is 25 °C, and the therm hysteresis value is 10 °C, the $\overline{\text{Therm}}$ output will assert when the temperature exceeds 25 °C. It will remain asserted until the temperature falls down to or below 15 °C (25 – 10).

This pin can be used to control a fan or other failsafe device as shown in [Figure 4 on page 8](#).

[Figure 7](#) below shows how the $\overline{\text{Therm}}$ output functions.

Figure 7. $\overline{\text{Therm}}$ output



AM03033v1

7 Maximum ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 26. Absolute maximum ratings

| Symbol | Parameter | Value | Unit | |
|-----------------|--|------------------------|------|------|
| T_{STG} | Storage temperature (V_{DD} off) | -55 to 150 | °C | |
| $T_{SLD}^{(1)}$ | Lead solder temperature | 260 | °C | |
| V_{IO} | Input or output voltage | -0.3 to $V_{DD} + 0.3$ | V | |
| V_{DD} | Supply voltage | 5.0 | V | |
| I_O | Output current | 20 | mA | |
| θ_{JA} | Thermal resistance (junction to ambient) | UDFN-6L | 78 | °C/W |
| | | SOT23-6L | 191 | |

1. Reflow at peak temperature of 260 °C. The time above 255 °C must not exceed 30 seconds.

8 DC and AC parameters

This section summarizes the operating measurement conditions, and the DC and AC characteristics of the device. The parameters in the DC and AC characteristics tables that follow, are derived from tests performed under the measurement conditions summarized in [Table 27: Operating and AC measurement conditions](#). Designers should check that the operating conditions in their circuit match the operating conditions when relying on the quoted parameters.

Table 27. Operating and AC measurement conditions

| Parameter | Conditions | Unit |
|---|--|------|
| V _{DD} supply voltage - temperature sensor | 2.25 to 3.6 | V |
| Ambient operating temperature (T _A) | -40 to +125 | °C |
| Input rise and fall times | 5 | ns |
| Input pulse voltages | 0.2 V _{DD} to 0.8 V _{DD} | V |
| Input and output timing reference voltages | 0.3 V _{DD} to 0.7 V _{DD} | V |

Figure 8. AC measurement I/O waveform

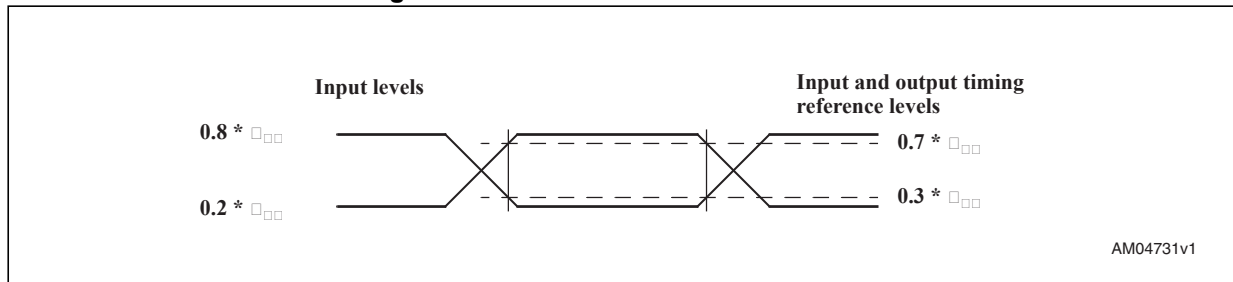


Table 28. DC and AC characteristics

| Symbol | Description | Test condition ⁽¹⁾ | Min | Typ ⁽²⁾ | Max | Unit |
|--|--|--|-----------------------|--------------------|-----------------------|--------|
| V _{DD} | Supply voltage | | 2.25 | | 3.6 | V |
| I _{DD} | Operating current dependent upon conversion rate | 0.0625 conversions/second ⁽³⁾ | | 15 | 35 | μA |
| | | 1 conversion/second ⁽³⁾ | | 20 | 40 | μA |
| | | 8 conversions/second | | 50 | 85 | μA |
| | | 32 conversions/second | | 125 | 250 | μA |
| I _{SB} | Standby current | | | 3 | 8 | μA |
| Temperature measurement | | | | | | |
| Accuracy ⁽⁴⁾ | 2.25 V to 3.6 V | 0 °C to 85 °C | | ±0.5 | ±1.5 | °C |
| | | -40 °C to +125 °C | | ±0.5 | ±2.5 | °C |
| Resolution | STTS751 is programmable from 9 bits to 12 bits (0.5 °C/LSB to 0.0625 °C) | 9-bit temperature data | | 0.5 | | °C/LSB |
| | | | | 9 | | bits |
| | | 10-bit temperature data (default) | | 0.25 | | °C/LSB |
| | | | | 10 | | bits |
| 11-bit temperature data | | 0.125 | | °C/LSB | | |
| | | 11 | | bits | | |
| 12-bit temperature data | | 0.0625 | | °C/LSB | | |
| | | 12 | | bits | | |
| t _{CONV} | Conversion time | 9-bit | | 10.5 | 14 | ms |
| | | 10-bit (default) | | 21 | 28 | ms |
| | | 11-bit | | 42 | 56 | ms |
| | | 12-bit | | 84 | 112 | ms |
| V _{OL} | Low level output voltage Addr/Therm, EVENT | I _{OL} = 4 mA | | | 0.4 | V |
| I _{OH} | High level output leakage current EVENT, SDA, Addr/Therm | V _{OH} = V _{DD} | | | 1 | μA |
| SMBus interface inputs (SDA, SCL) | | | | | | |
| V _{IH} | Input logic high (SCL, SDA) | 2.3 V ≤ V _{DD} ≤ 3.6 V | 0.7 x V _{DD} | | | V |
| V _{IL} | Input logic low (SCL, SDA) | 2.3 V ≤ V _{DD} ≤ 3.6 V | | | 0.3 x V _{DD} | V |
| I _{HI} | Logical "1" input current | 0 V ≤ V _{IN} ≤ V _{DD} | -1 | | 1 | μA |
| I _{LI} | Logical "0" input current | 0 V ≤ V _{IN} ≤ V _{DD} | -1 | | 1 | μA |
| C _{IN} | Input capacitance (SDA) | | | 5 | | pF |
| I _{SINK} | SMBus output low sink current | SDA forced to 0.6 V | 6 | | | mA |

Table 28. DC and AC characteristics (continued)

| Symbol | Description | Test condition ⁽¹⁾ | Min | Typ ⁽²⁾ | Max | Unit |
|----------------------|--|--------------------------------------|------|--------------------|-----|------|
| V _{PV} | Pull-up supply voltage (open drain) | (Addr/Therm) | -0.3 | | 3.6 | V |
| | | $\overline{\text{EVENT}}$, SDA, SCL | -0.3 | | 5.5 | V |
| V _{POR} | Power On Reset threshold (POR) - TS | V _{DD} falling edge | | 1.75 | | V |
| t _{TIMEOUT} | SMBus timeout ⁽⁵⁾ | | 25 | | 35 | ms |
| t _{SP} | Spike suppression Pulse width of spikes that must be suppressed by the input filter | Input filter on SCL and SDA | | | 50 | ns |

- Valid for ambient operating temperature: T_A = -40 to +125 °C; V_{DD} = 2.25 V to 3.6 V (except where noted).
- Typical numbers are for T_A = +25 °C; V_{DD} = 3.0 V
- Not tested, guaranteed by design.
- Accuracy measurements made at resolutions > 10 bits.
- SMBus timeout min and max are valid for T_A = -30 to +125 °C.

Table 29. AC characteristics

| Symbol | Description | Min | Typ | Max | Unit |
|---------------------|--|-----|-----|-----|------|
| f _{SCL} | SMBus/I ² C clock frequency | 10 | | 400 | kHz |
| t _{HIGH} | Clock high period | 600 | | | ns |
| t _{LOW} | Clock low period | 1.3 | | | μs |
| t _R | Clock/data rise time | | | 300 | ns |
| t _F | Clock/data fall time | | | 300 | ns |
| t _{SU:DAT} | Data setup time | 100 | | | ns |
| t _{HD:DI} | Data in hold time | 0 | | | ns |
| t _{HD:DAT} | Data out hold time | 300 | | | ns |
| t _{SU:STA} | Start condition setup time | 600 | | | ns |
| t _{HD:STA} | Hold time after (repeated) start condition. After this period, the first clock cycle is generated. | 600 | | | ns |
| t _{SU:STO} | Stop condition setup time | 600 | | | ns |
| t _{BUF} | Bus free time between stop (P) and start (S) conditions | 1.3 | | | μs |

9 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.

9.1 UDFN-6L package information

Figure 9. UDFN-6L (2 mm x 2 mm x 0.5 mm) package outline

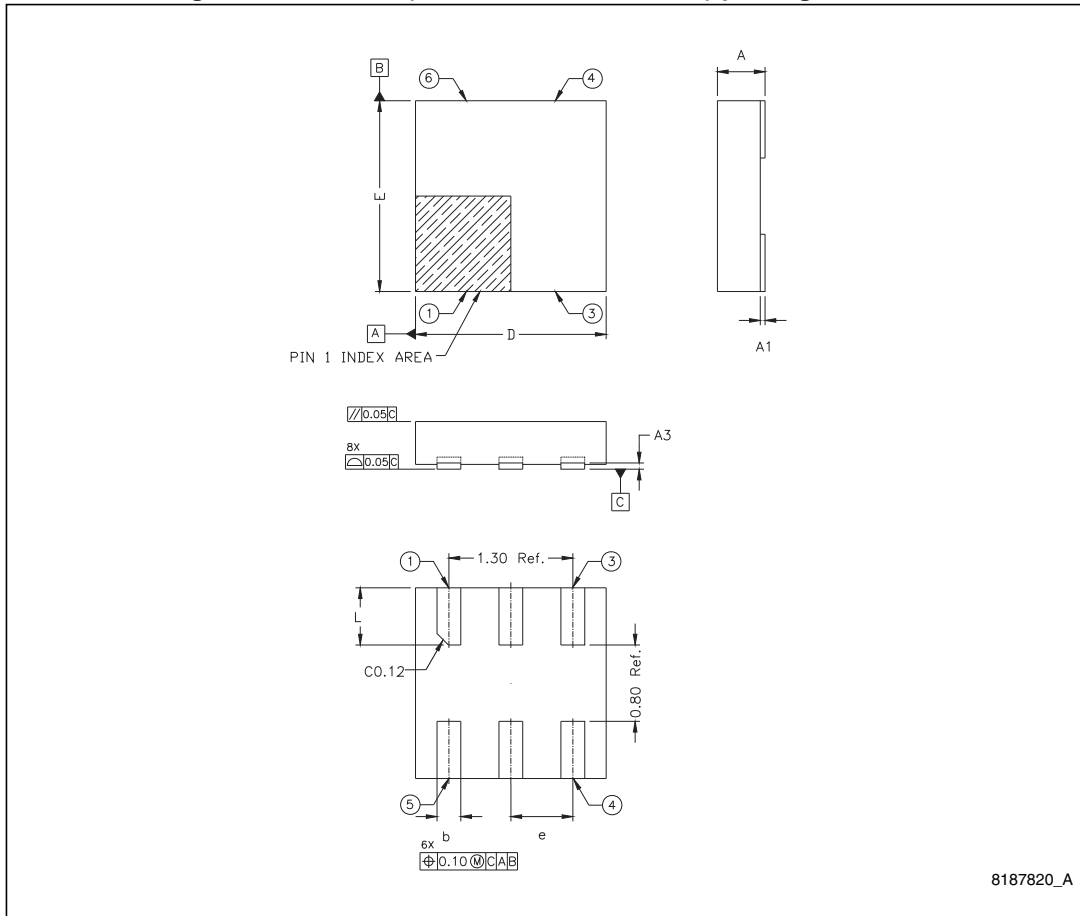
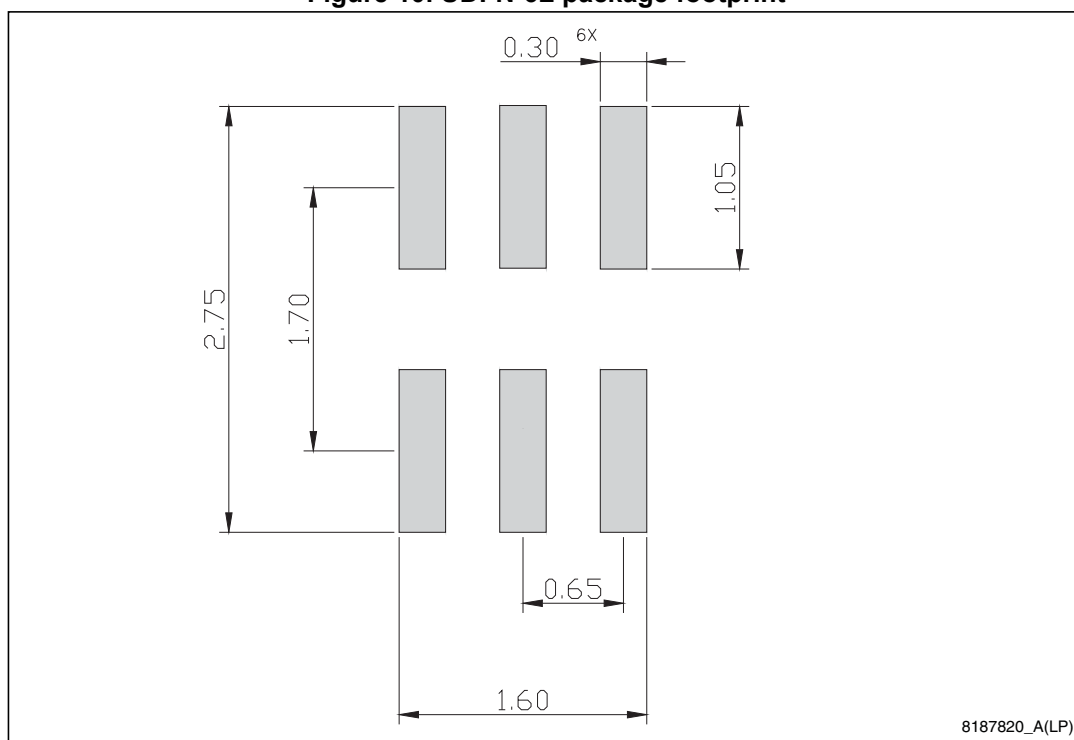


Table 30. UDFN-6L (2 mm x 2 mm x 0.5 mm) package mechanical data

| Sym | mm | | | inches | | |
|-----|------|-------|------|--------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.45 | 0.50 | 0.55 | 0.018 | 0.020 | 0.022 |
| A1 | 0.00 | | 0.05 | 0.000 | | 0.002 |
| A3 | | 0.065 | | | 0.003 | |
| b | 0.20 | 0.25 | 0.30 | 0.008 | 0.010 | 0.012 |
| D | 1.95 | 2.00 | 2.05 | 0.077 | 0.079 | 0.081 |
| E | 1.95 | 2.00 | 2.05 | 0.077 | 0.079 | 0.081 |
| e | | 0.65 | | | 0.026 | |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |

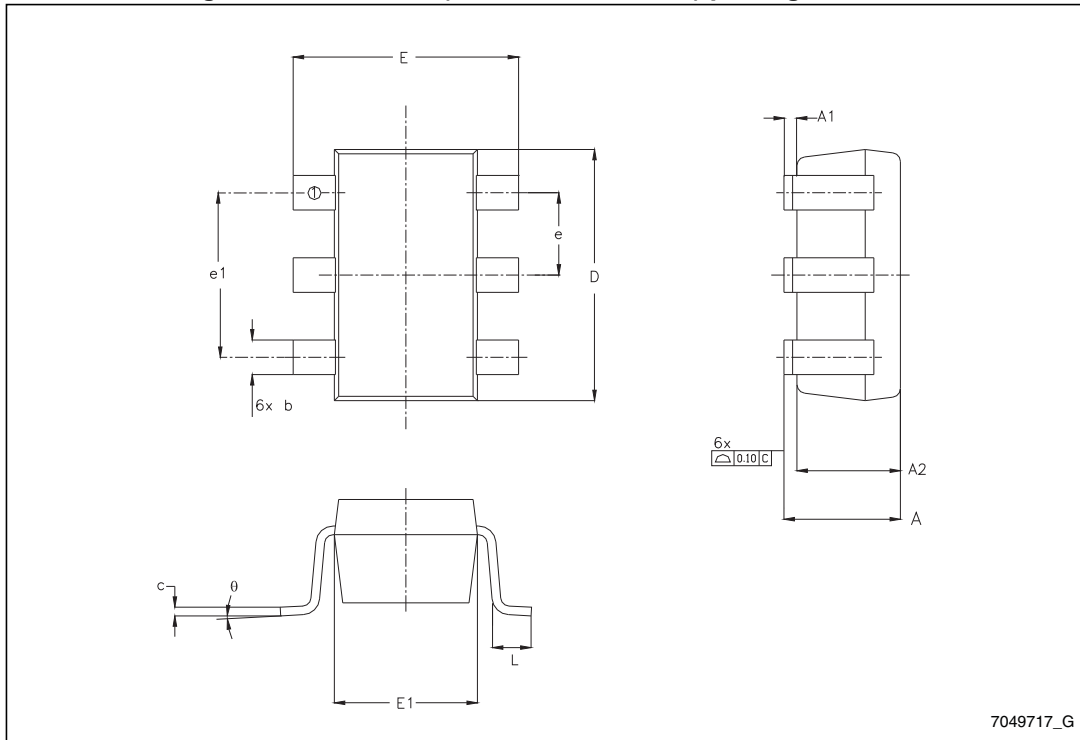
Figure 10. UDFN-6L package footprint



8187820_A(LP)

9.2 SOT23-6L package information

Figure 11. SOT23-6L (2.90 mm x 2.80 mm) package outline

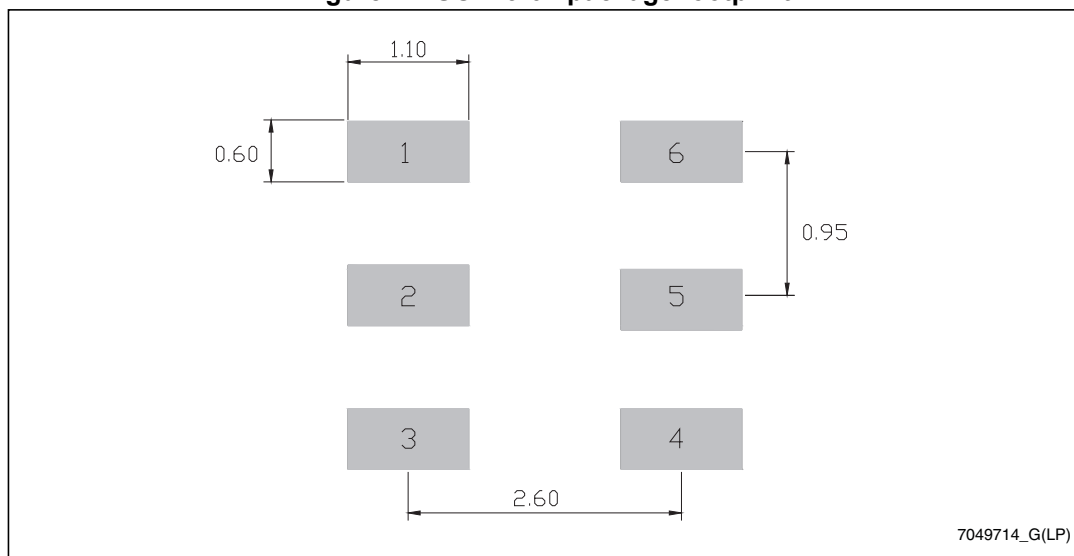


7049717_G

Table 31. SOT23-6L (2.90 mm x 2.80 mm) package mechanical data

| Sym | mm | | | inches | | |
|-----|------|------|------|--------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | | | 1.45 | | | 0.057 |
| A1 | 0.00 | | 0.15 | 0.000 | | 0.006 |
| A2 | 0.90 | 1.15 | 1.30 | 0.035 | 0.045 | 0.051 |
| b | 0.30 | | 0.50 | 0.012 | | 0.020 |
| c | 0.08 | | 0.22 | 0.003 | | 0.009 |
| D | | 2.90 | | | 0.114 | |
| E | | 2.80 | | | 0.110 | |
| E1 | | 1.60 | | | 0.063 | |
| e | | 0.95 | | | 0.037 | |
| e1 | | 1.90 | | | 0.075 | |
| L | 0.30 | 0.45 | 0.60 | 0.012 | 0.018 | 0.024 |
| θ | 0° | 4° | 8° | 0° | 4° | 8° |
| N | 6 | | | 6 | | |

Figure 12. SOT23-6L package footprint



9.3 Packing information

Figure 13. Carrier tape for UDFN-6L and SOT23-6L packages

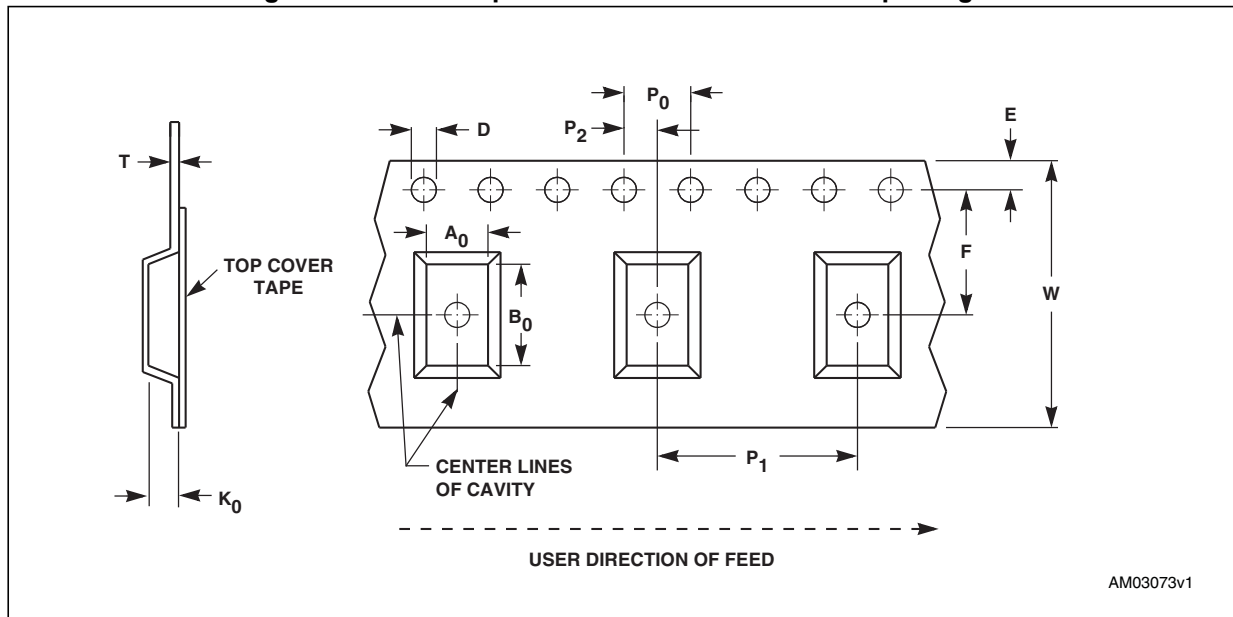


Table 32. Carrier tape dimensions for UDFN-6L and SOT23-6L packages

| Package | W | D | E | P ₀ | P ₂ | F | A ₀ | B ₀ | K ₀ | P ₁ | T | Unit |
|----------|-------------------------|-------------------------|---------------|----------------|----------------|---------------|----------------|----------------|----------------|----------------|-----------------|------|
| UDFN-6L | 8.00 ±0.30 | 1.50 +0.10/ -0.00 | 1.75 ±0.10 | 4.00 ±0.10 | 2.00 ±0.05 | 3.50 ±0.05 | 2.20 ±0.10 | 2.20 ±0.10 | 0.75 ±0.10 | 4.00 ±0.10 | 0.25 ±0.05 | mm |
| SOT23-6L | 8.00 +0.30/ -0.10 | 1.50 +0.10/ -0.00 | 1.75 ±0.10 | 4.00 ±0.10 | 2.00 ±0.10 | 3.50 ±0.05 | 3.23 ±0.10 | 3.17 ±0.10 | 1.37 ±0.10 | 4.00 ±0.10 | 0.254 ±0.013 | mm |

Figure 14. Reel schematic

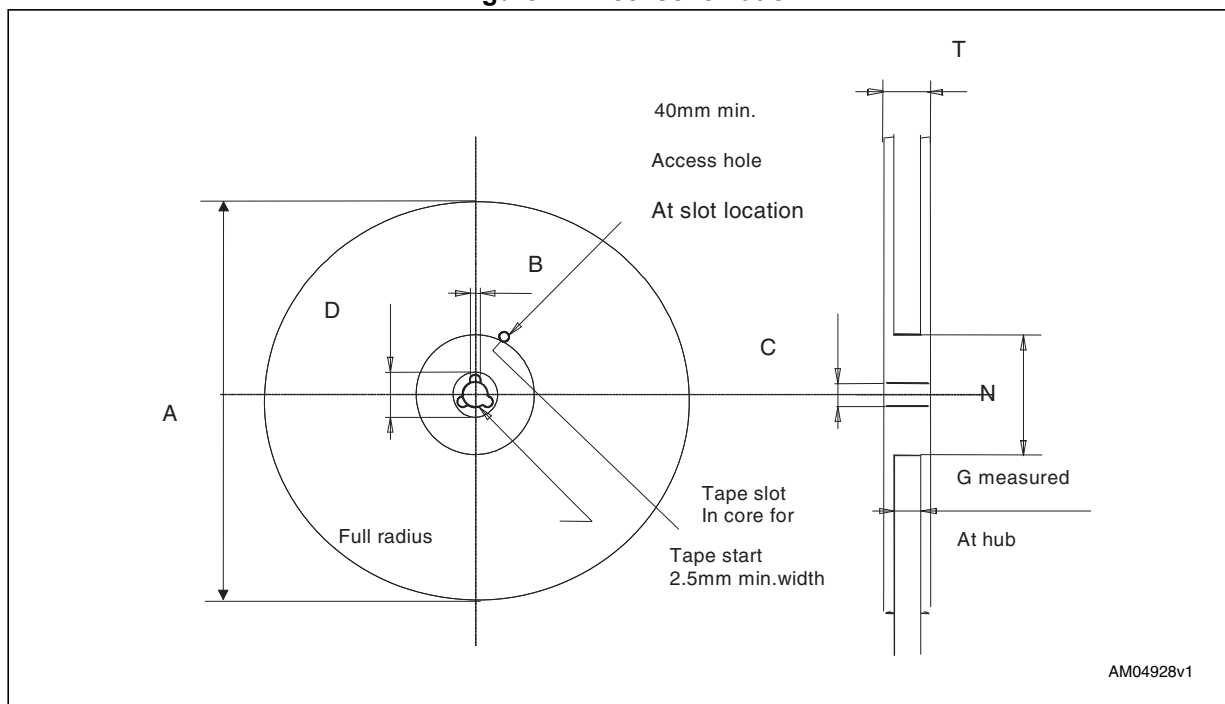


Table 33. Reel dimensions for 8 mm carrier tape - UDFN-6L and SOT23-6L packages

| A (max) | B (min) | C | D (min) | N (min) | G | T (max) |
|--------------------|------------|-------------------|------------|------------|---------------------|------------|
| 180 mm (7 inch) | 1.5 mm | 13 mm ± 0.2 mm | 20.2 mm | 60 mm | 8.4 mm + 2/-0 mm | 14.4 mm |

Note: The dimensions given in Table 33 incorporate tolerances that cover all variations on critical parameters.

10 Part numbering

Table 34. Ordering information scheme

| | | | | |
|--------------------------|--|----|---|---|
| Example: | STTS751-0 | DP | 3 | F |
| Device type | STTS751-0 STTS751-1 | | | |
| Package | DP = UDFN-6L WB = SOT23-6L | | | |
| Temperature range | 3 = -40 °C to 125 °C | | | |
| Shipping method | F = ECOPACK® package, tape & reel E = ECOPACK® package, tubes | | | |

For other options, or for more information on any aspect of this device, please contact the ST sales office nearest you.

11 Revision history

Table 35. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 06-Nov-2009 | 1 | Initial release. |
| 21-Jan-2010 | 2 | Updated Features; removed <u>Therm2</u> throughout document (from Section 1, 2, 3.8, 4.6, 4.10, 5, Figure 1, 2, 3, 4, 6, Table 2, 3, 15, 28); updated Figure 3, Section 3.4, Section 4.6, Section 4.8, Section 4.10, Table 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25; added package footprints (Figure 11 and 12); minor textual changes. |
| 12-May-2010 | 3 | Updated Section 3.7, Section 4.11, Section 5; Figure 6, 7, 11, 12; Table 3, 9, 25, 28, 31; added tape and reel information (Figure 13, 14 and Table 32, 33); minor textual changes in title and document. |
| 01-Jul-2010 | 4 | Document status promoted to full datasheet; updated cover page; added footnote to Table 28; minor textual changes. |
| 20-Jul-2010 | 5 | Removed footnote from Table 28. |
| 10-Sep-2018 | 6 | Updated Accuracy in <i>Features</i> and <i>Table 28: DC and AC characteristics</i> |

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