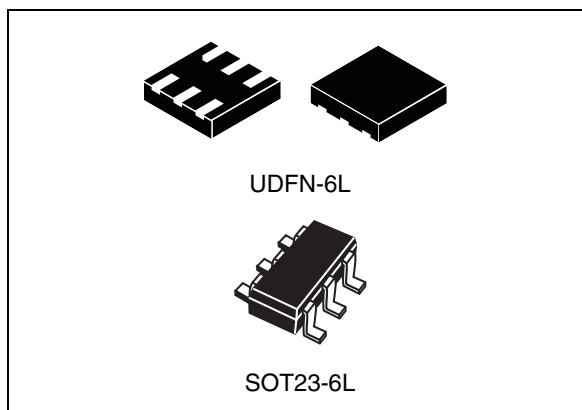


## 2.25 V low-voltage local digital temperature sensor

### 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  $^{\circ}\text{C}/\text{LSB}$ ) to 12-bit (0.0625  $^{\circ}\text{C}/\text{LSB}$ )  
10-bit (0.25  $^{\circ}\text{C}/\text{LSB}$ ) - default
- Low supply current
  - 50  $\mu\text{A}$  (typ) for 8 conversions/sec.
  - 20  $\mu\text{A}$  (typ) for 1 conversion/sec.
  - 3  $\mu\text{A}$  (typ) standby
- Accuracy
  - $\pm 1.0\text{ }^{\circ}\text{C}$  (typ)  $0\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$
  - $\pm 2.0\text{ }^{\circ}\text{C}$  (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

### 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	

# Contents

- 1 Description . . . . . 6**
- 2 Functional description . . . . . 9**
- 3 SMBus interface . . . . . 10**
  - 3.1 SMBus protocol . . . . . 10
  - 3.2 WRITE byte . . . . . 11
  - 3.3 READ byte . . . . . 11
  - 3.4 SEND byte . . . . . 11
  - 3.5 RECEIVE byte . . . . . 11
  - 3.6 SMBus addresses . . . . . 12
  - 3.7 SMBus timeout . . . . . 12
  - 3.8 Alert response address . . . . . 12
- 4 STTS751 register summary . . . . . 13**
  - 4.1 STTS751 register formats and details . . . . . 14
  - 4.2 Temperature register format . . . . . 14
  - 4.3 Temperature limit register format . . . . . 15
  - 4.4 Temperature examples . . . . . 15
  - 4.5 Status register . . . . . 16
  - 4.6 Configuration register . . . . . 17
  - 4.7 Conversion rate register . . . . . 18
  - 4.8 One-shot register . . . . . 19
  - 4.9 Therm limit . . . . . 20
  - 4.10 Therm hysteresis . . . . . 20
  - 4.11 SMBus timeout register . . . . . 20
  - 4.12 STTS751 product ID . . . . . 21
  - 4.13 STTS751 manufacturer’s ID . . . . . 21
  - 4.14 STTS751 revision ID . . . . . 21
- 5 EVENT output . . . . . 22**

---

6	<b>Addr/Therm output</b> .....	<b>23</b>
7	<b>Maximum ratings</b> .....	<b>24</b>
8	<b>DC and AC parameters</b> .....	<b>25</b>
9	<b>Package mechanical data</b> .....	<b>28</b>
10	<b>Part numbering</b> .....	<b>34</b>
11	<b>Revision history</b> .....	<b>35</b>

## List of tables

Table 1.	Device summary . . . . .	1
Table 2.	Signal names . . . . .	6
Table 3.	Pin descriptions . . . . .	7
Table 4.	SMBus WRITE byte protocol . . . . .	11
Table 5.	SMBus READ byte protocol . . . . .	11
Table 6.	SMBus SEND byte protocol . . . . .	11
Table 7.	SMBus RECEIVE byte protocol . . . . .	11
Table 8.	SMBus protocol response to ARA . . . . .	12
Table 9.	Registers/pointers . . . . .	13
Table 10.	Pointer register format . . . . .	14
Table 11.	Temperature register (two's complement) . . . . .	14
Table 12.	Temperature limit register (two's complement format) . . . . .	15
Table 13.	Temperature examples (two's complement format) . . . . .	15
Table 14.	Status register. . . . .	16
Table 15.	Configuration register . . . . .	17
Table 16.	Conversion resolution . . . . .	18
Table 17.	Conversion rate register . . . . .	18
Table 18.	Conversion rates . . . . .	19
Table 19.	One-shot register . . . . .	19
Table 20.	Therm limit . . . . .	20
Table 21.	Therm hysteresis . . . . .	20
Table 22.	SMBus timeout register . . . . .	20
Table 23.	Product ID register . . . . .	21
Table 24.	Manufacturer's ID register . . . . .	21
Table 25.	Revision ID register . . . . .	21
Table 26.	Absolute maximum ratings . . . . .	24
Table 27.	Operating and AC measurement conditions . . . . .	25
Table 28.	DC and AC characteristics . . . . .	26
Table 29.	AC characteristics . . . . .	27
Table 30.	UDFN-6L (2 mm x 2 mm x 0.5 mm) package mechanical data . . . . .	29
Table 31.	SOT23-6L (2.90 mm x 2.80 mm) package mechanical data . . . . .	30
Table 32.	Carrier tape dimensions for UDFN-6L and SOT23-6L packages . . . . .	32
Table 33.	Reel dimensions for 8 mm carrier tape - UDFN-6L and SOT23-6L packages . . . . .	33
Table 34.	Ordering information scheme . . . . .	34
Table 35.	Document revision history . . . . .	35

## List of figures

Figure 1.	Logic diagram . . . . .	6
Figure 2.	Pinout - SOT23-6L and UDFN-6L. . . . .	7
Figure 3.	Block diagram . . . . .	8
Figure 4.	Application hardware hookup . . . . .	8
Figure 5.	SMBus timing diagram . . . . .	10
Figure 6.	<u>EVENT</u> output. . . . .	22
Figure 7.	Therm output . . . . .	23
Figure 8.	AC measurement I/O waveform . . . . .	25
Figure 9.	UDFN-6L (2 mm x 2 mm x 0.5 mm) package mechanical drawing . . . . .	29
Figure 10.	SOT23-6L (2.90 mm x 2.80 mm) package mechanical drawing. . . . .	30
Figure 11.	UDFN-6L package footprint . . . . .	31
Figure 12.	SOT23-6L package footprint. . . . .	31
Figure 13.	Carrier tape for UDFN-6L and SOT23-6L packages. . . . .	32
Figure 14.	Reel schematic . . . . .	33

# 1 Description

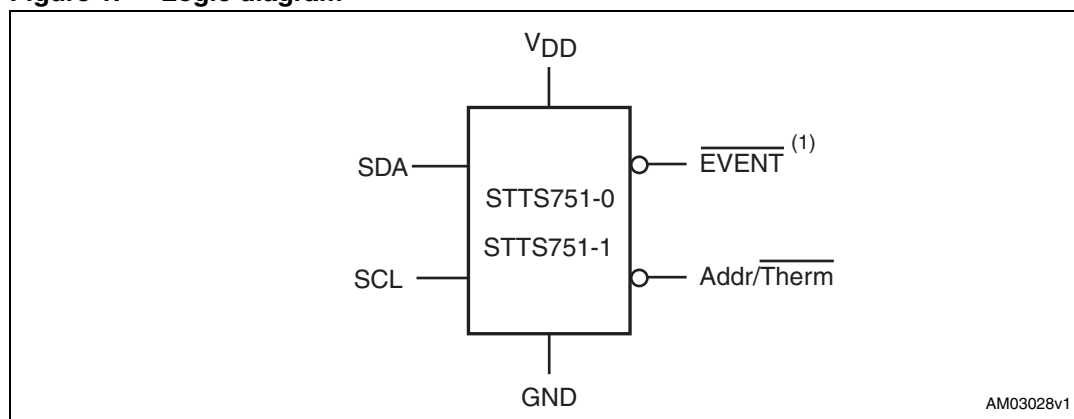
The STTS751 is a digital temperature sensor which communicates over a 2-wire SMBus 2.0 compatible bus. The temperature is measured with a user-configurable resolution between 9 and 12 bits. At 9 bits, the smallest step size is 0.5 °C, and at 12 bits, it is 0.0625 °C. At the default resolution (10 bits, 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  $\text{Addr}/\overline{\text{Therm}}$  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
$\text{Addr}/\overline{\text{Therm}}$	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
$V_{\text{DD}}$	Power	Device power supply
GND	Ground	Device ground

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

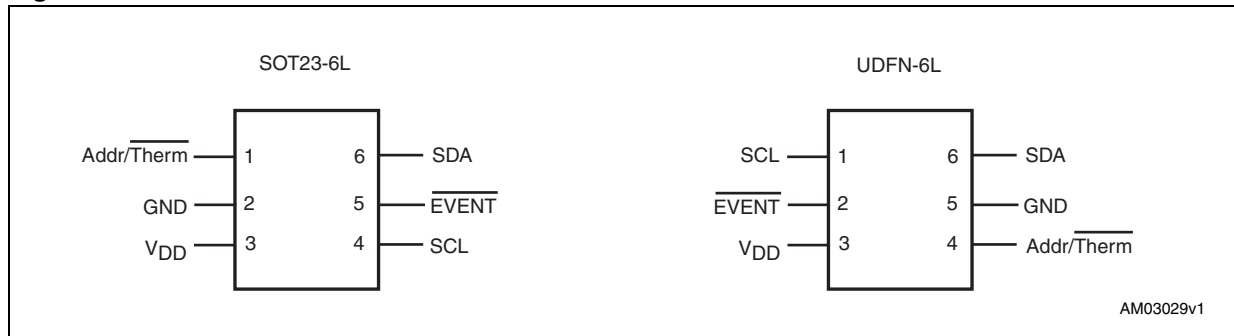


Table 3. Pin descriptions

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 <a href="#">Table 1</a> . This pin must have a pull-up resistor connected to the same voltage as V <sub>DD</sub> 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 <sub>DD</sub>	Power supply V <sub>DD</sub>
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

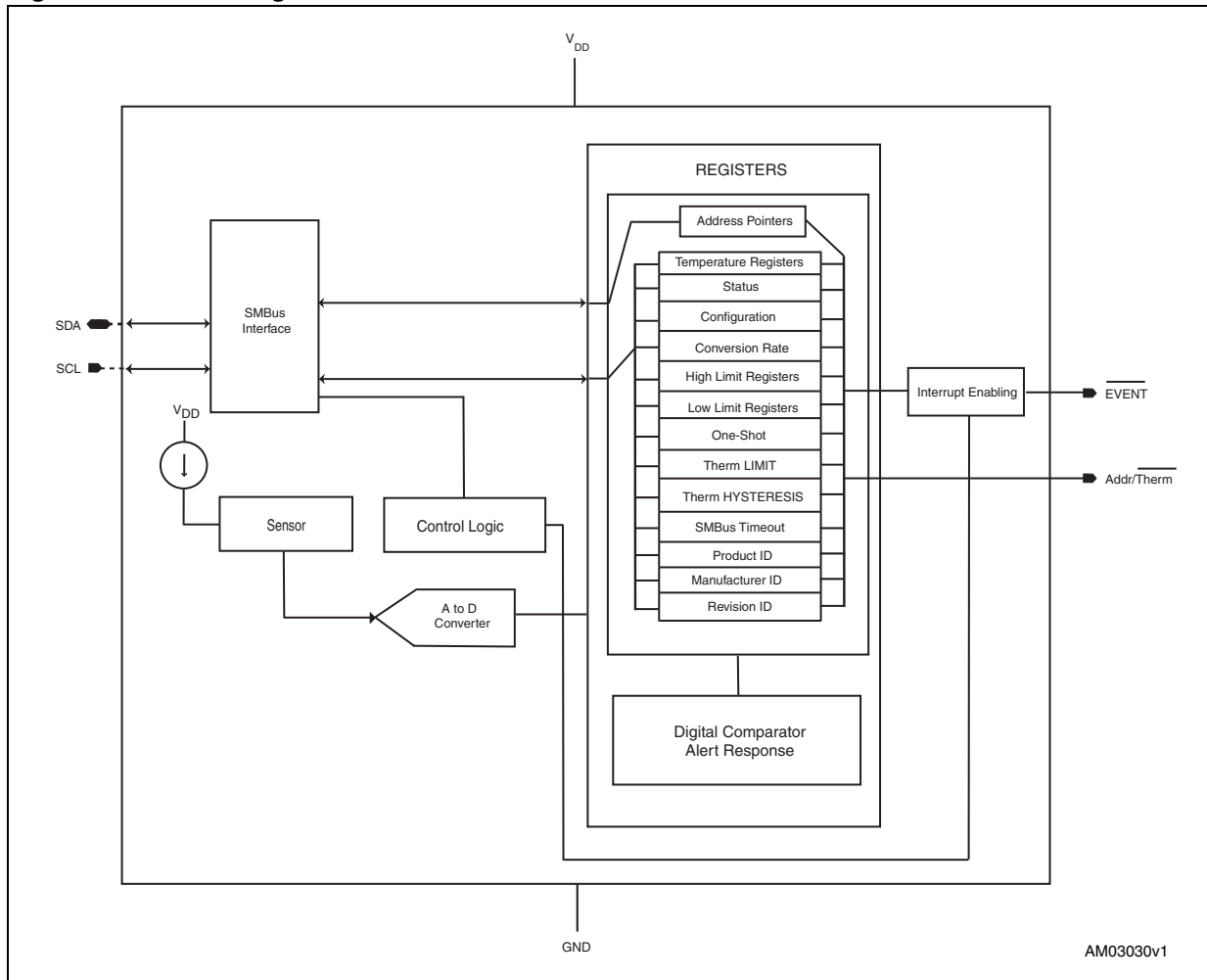
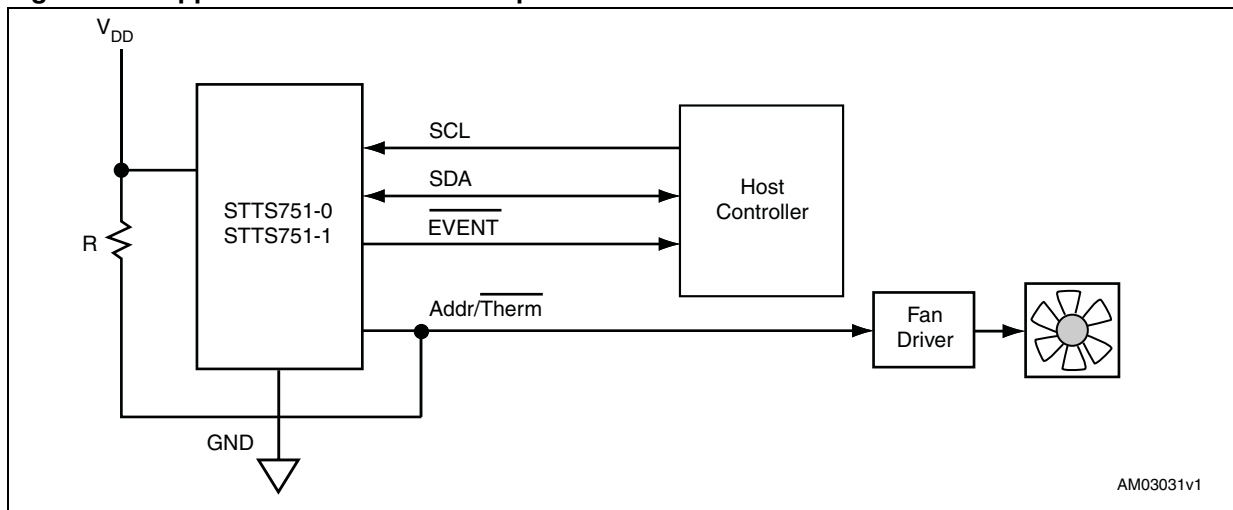


Figure 4. Application hardware hookup





## 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](#)).

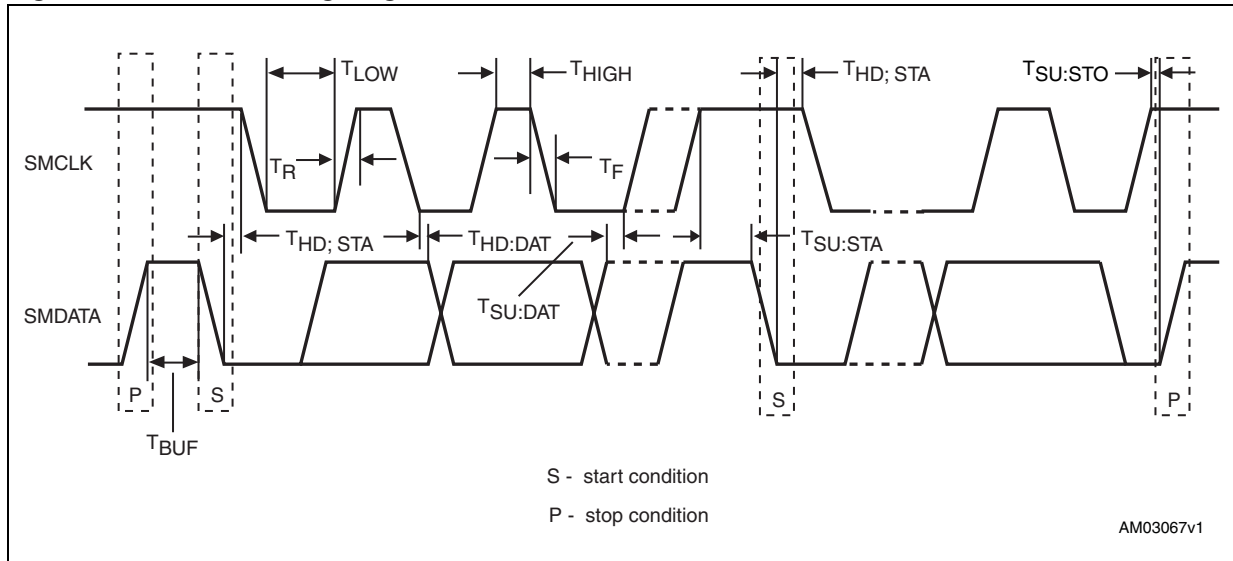
The STTS751 contains 16 registers. The register summary is shown in [Table 9 on page 13](#). Using register addresses not specified in the table may result in an incorrect response. These registers and their functions are described in more detail in the following sections.

### 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  $\overline{EVENT}$  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 <sup>(1)</sup>	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 <sub>HIGH</sub>	T <sub>LOW</sub>	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<sub>HIGH</sub>: [6] Bit = 1 indicates temperature high limit has been exceeded ( $T_A > \text{high limit}$ ). T<sub>HIGH</sub> is cleared when the status register is read, provided the condition no longer exists.

T<sub>LOW</sub>: [5] Bit = 1 indicates the is at or below the low limit ( $T_A \leq \text{low limit}$ ). T<sub>LOW</sub> 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 ( $\mu$ A)	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/ $\overline{\text{Therm}}$  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/ $\overline{\text{Therm}}$  output. Once  $\overline{\text{Therm}}$  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 ( $t_{\text{TIMEOUT}}$ ). 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

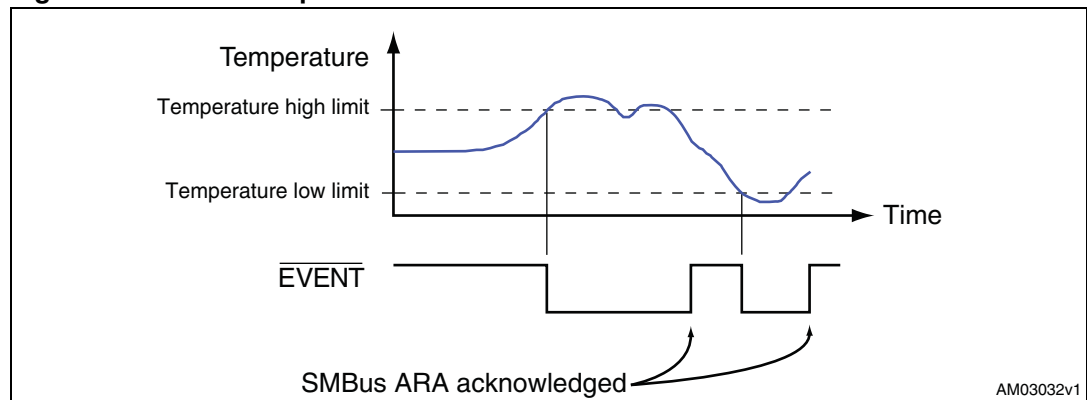
## 5 $\overline{\text{EVENT}}$ output

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/ $\overline{\text{Therm}}$ output

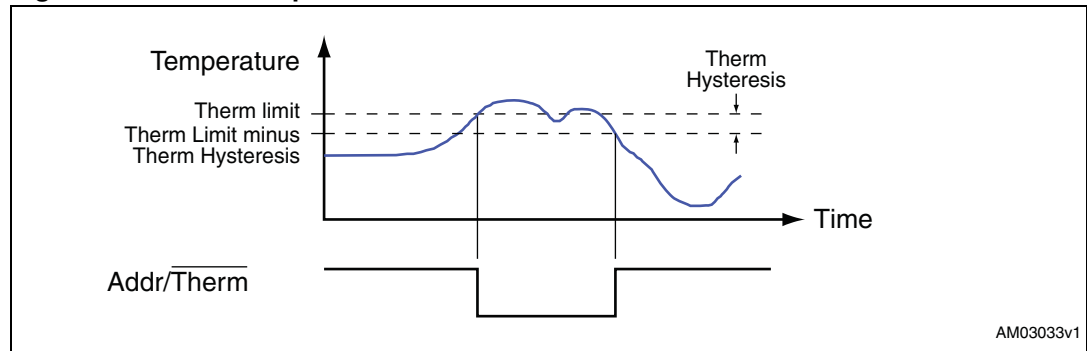
The Addr/ $\overline{\text{Therm}}$  pin functions normally as an output to alert the system of an over temperature condition. It is open drain and requires a pull-up resistor. During power-up, the pull-up value is sensed by the STTS751 to determine what its slave address will be as depicted in [Table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



## 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	
$\theta_{JA}$	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 <sub>DD</sub> supply voltage - temperature sensor	2.25 to 3.6	V
Ambient operating temperature (T <sub>A</sub> )	-40 to +125	°C
Input rise and fall times	5	ns
Input pulse voltages	0.2 V <sub>DD</sub> to 0.8 V <sub>DD</sub>	V
Input and output timing reference voltages	0.3 V <sub>DD</sub> to 0.7 V <sub>DD</sub>	V

**Figure 8. AC measurement I/O waveform**

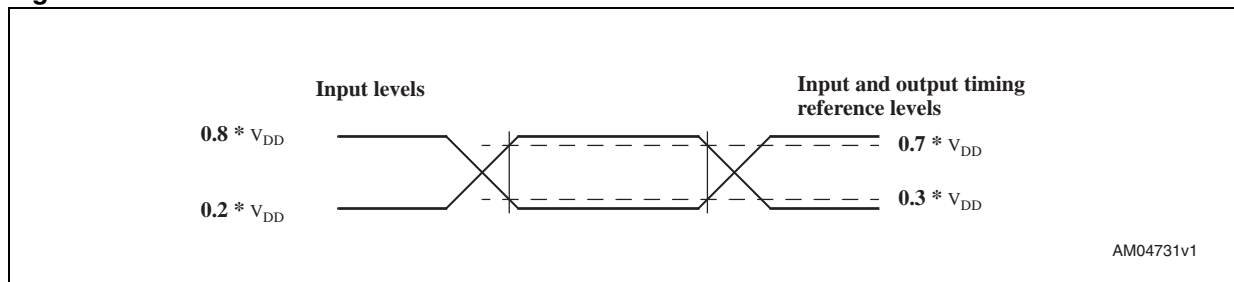


Table 28. DC and AC characteristics

Symbol	Description	Test condition <sup>(1)</sup>	Min	Typ <sup>(2)</sup>	Max	Unit
V <sub>DD</sub>	Supply voltage		2.25		3.6	V
I <sub>DD</sub>	Operating current dependent upon conversion rate	0.0625 conversions/second <sup>(3)</sup>		15	35	μA
		1 conversion/second <sup>(3)</sup>		20	40	μA
		8 conversions/second		50	85	μA
		32 conversions/second		125	250	μA
I <sub>SB</sub>	Standby current			3	8	μA
<b>Temperature measurement</b>						
Accuracy <sup>(4)</sup>	2.25 V to 3.6 V	0 °C to 85 °C		±1.0	±1.5	°C
		-40 °C to +125 °C		±2.0	±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 <sub>CONV</sub>	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 <sub>OL</sub>	Low level output voltage Addr/Therm, EVENT	I <sub>OL</sub> = 4 mA			0.4	V
I <sub>OH</sub>	High level output leakage current EVENT, SDA, Addr/Therm	V <sub>OH</sub> = V <sub>DD</sub>			1	μA
<b>SMBus interface inputs (SDA, SCL)</b>						
V <sub>IH</sub>	Input logic high (SCL, SDA)	2.3 V ≤ V <sub>DD</sub> ≤ 3.6 V	0.7 x V <sub>DD</sub>			V
V <sub>IL</sub>	Input logic low (SCL, SDA)	2.3 V ≤ V <sub>DD</sub> ≤ 3.6 V			0.3 x V <sub>DD</sub>	V
I <sub>HI</sub>	Logical "1" input current	0 V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	-1		1	μA
I <sub>LI</sub>	Logical "0" input current	0 V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	-1		1	μA
C <sub>IN</sub>	Input capacitance (SDA)			5		pF
I <sub>SINK</sub>	SMBus output low sink current	SDA forced to 0.6 V	6			mA

Table 28. DC and AC characteristics (continued)

Symbol	Description	Test condition <sup>(1)</sup>	Min	Typ <sup>(2)</sup>	Max	Unit
V <sub>PV</sub>	Pull-up supply voltage (open drain)	(Addr/Therm)	-0.3		3.6	V
		$\overline{\text{EVENT}}$ , SDA, SCL	-0.3		5.5	V
V <sub>POR</sub>	Power On Reset threshold (POR) - TS	V <sub>DD</sub> falling edge		1.75		V
t <sub>TIMEOUT</sub>	SMBus timeout <sup>(5)</sup>		25		35	ms
t <sub>SP</sub>	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<sub>A</sub> = -40 to +125 °C; V<sub>DD</sub> = 2.25 V to 3.6 V (except where noted).
- Typical numbers are for T<sub>A</sub> = +25 °C; V<sub>DD</sub> = 3.0 V
- Not tested, guaranteed by design.
- Accuracy measurements made at resolutions > 10 bits.
- SMBus timeout min and max are valid for T<sub>A</sub> = -30 to +125 °C.

Table 29. AC characteristics

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

## 9 Package mechanical data

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

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

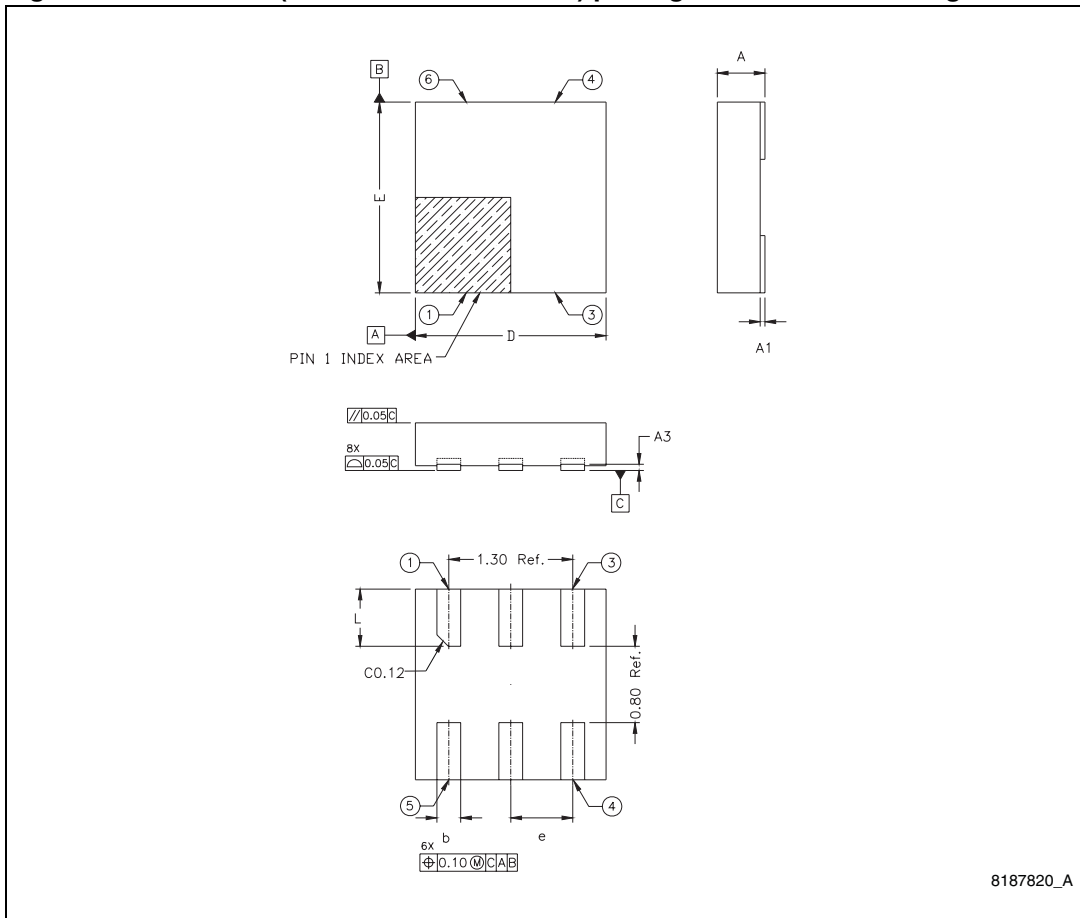


Table 30. UDFN-6L (2 mm x 2 mm x 0.5 mm) package mechanical data

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. SOT23-6L (2.90 mm x 2.80 mm) package mechanical drawing

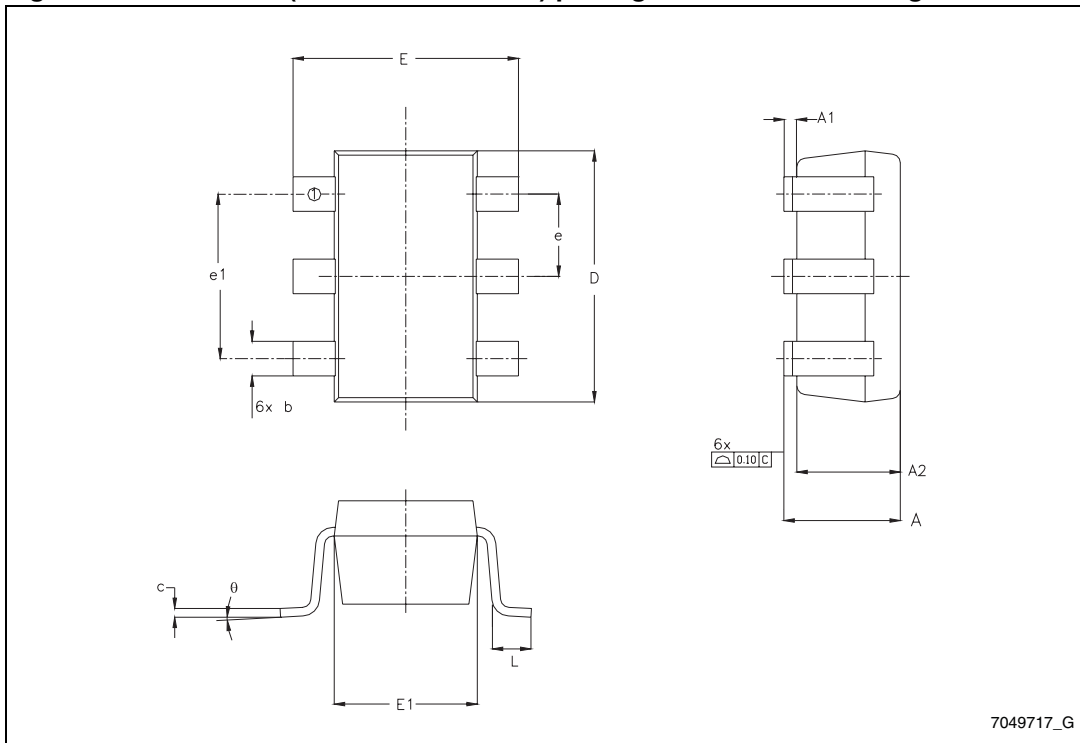


Table 31. SOT23-6L (2.90 mm x 2.80 mm) package mechanical data

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
$\theta$	0°	4°	8°	0°	4°	8°
N	6			6		

Figure 11. UDFN-6L package footprint

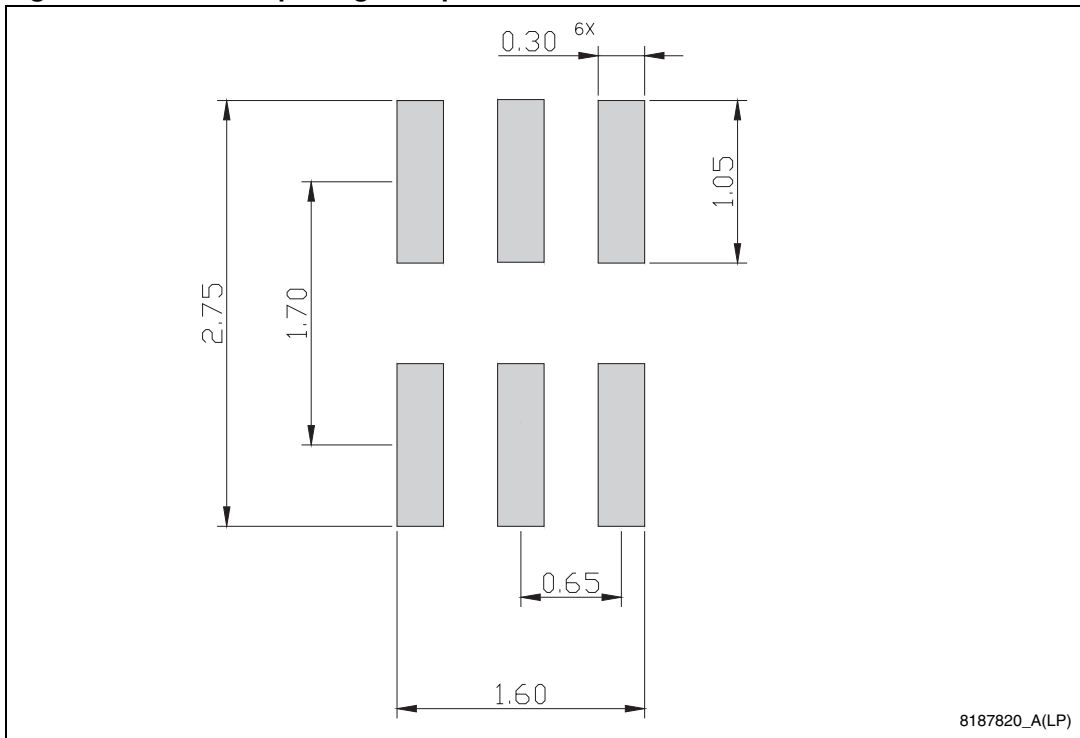


Figure 12. SOT23-6L package footprint

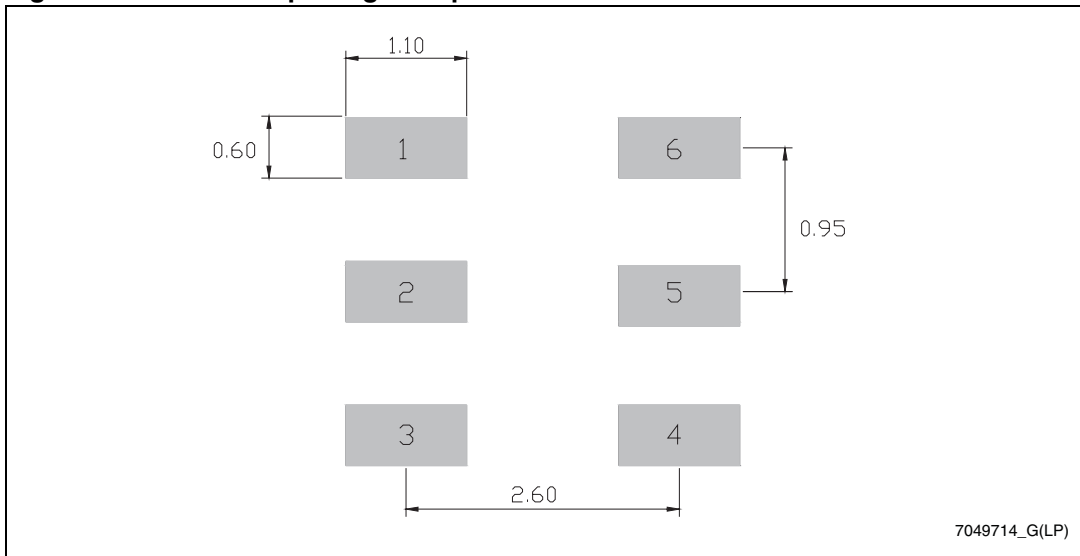
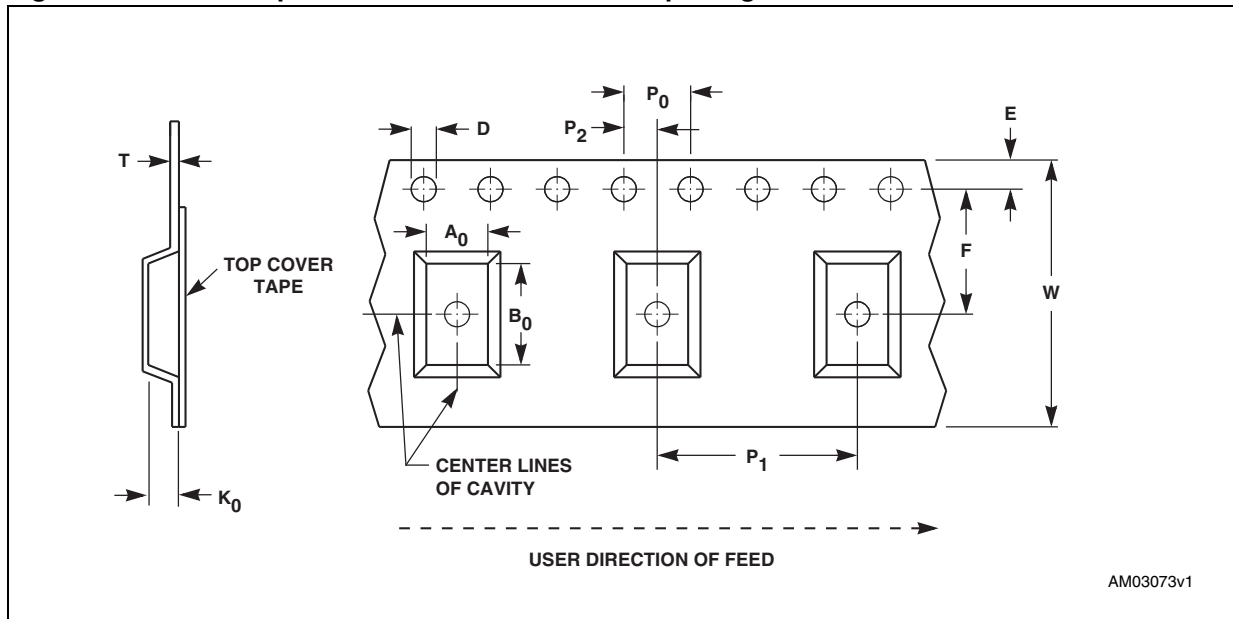


Figure 13. Carrier tape for UDFN-6L and SOT23-6L packages



AM03073v1

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

Package	W	D	E	P <sub>0</sub>	P <sub>2</sub>	F	A <sub>0</sub>	B <sub>0</sub>	K <sub>0</sub>	P <sub>1</sub>	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

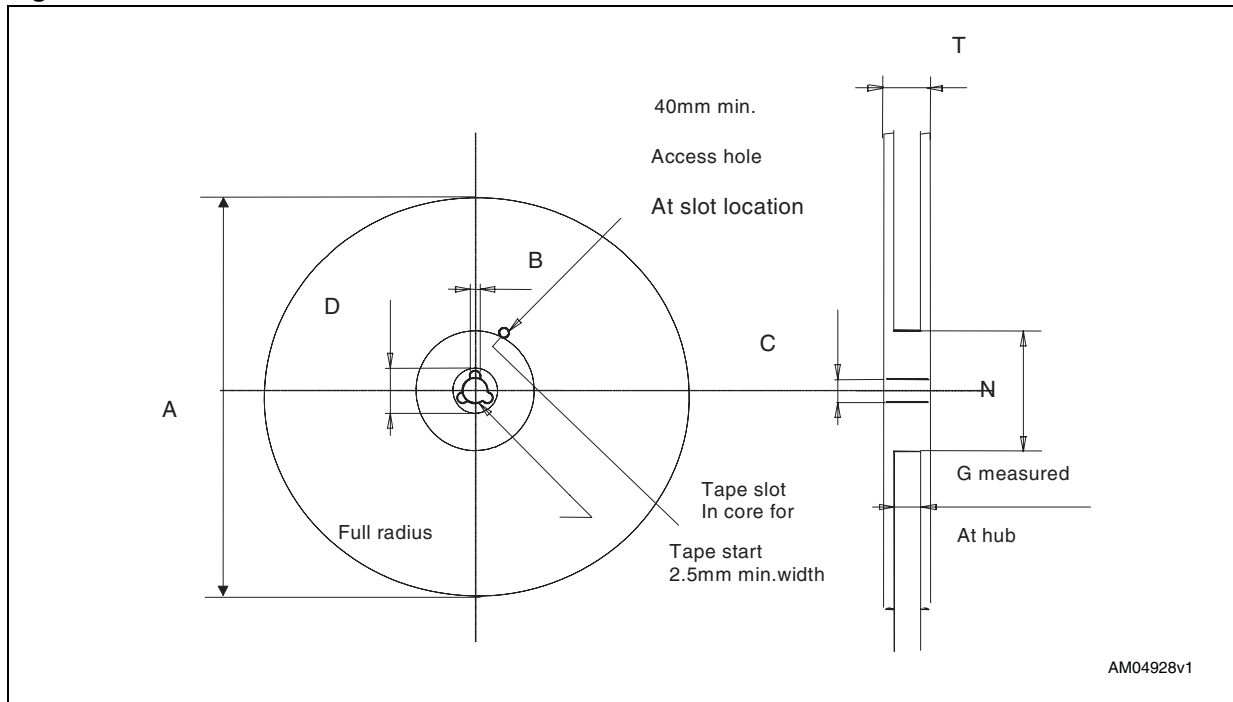


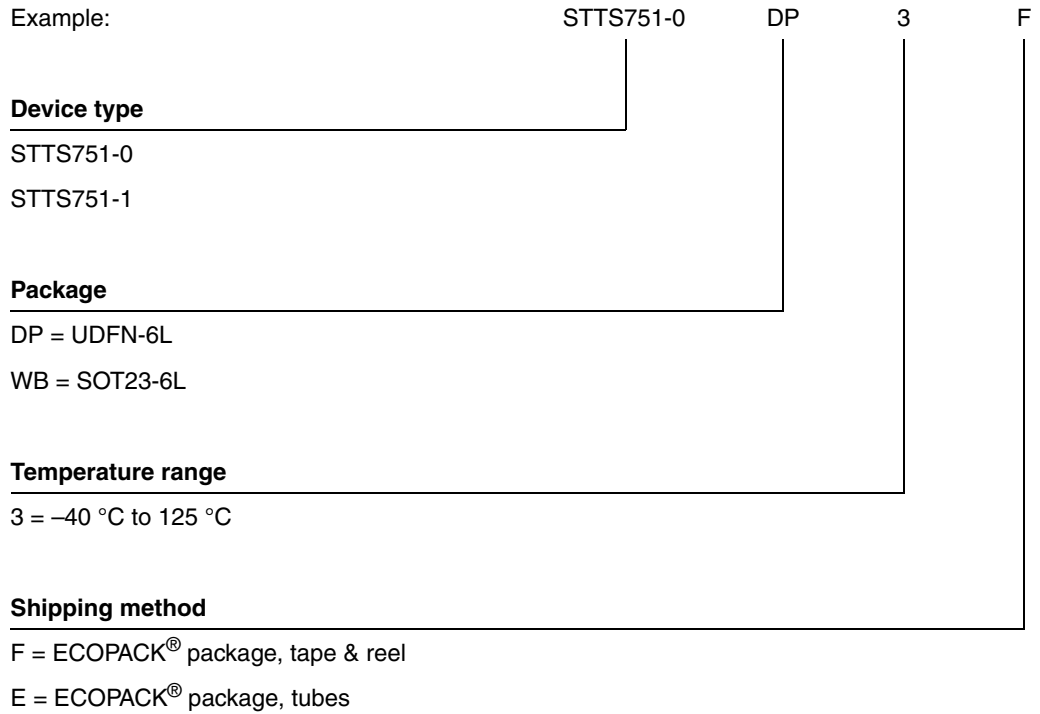
Table 33. Reel dimensions for 8 mm carrier tape - UDFN-6L and SOT23-6L packages

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**



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 <i>Features</i> ; removed $\overline{\text{Therm2}}$ throughout document (from <i>Section 1, 2, 3.8, 4.6, 4.10, 5, Figure 1, 2, 3, 4, 6, Table 2, 3, 15, 28</i> ); updated <i>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</i> ; added package footprints ( <i>Figure 11 and 12</i> ); minor textual changes.
12-May-2010	3	Updated <i>Section 3.7, Section 4.11, Section 5, Figure 6, 7, 11, 12, Table 3, 9, 25, 28, Table 31</i> ; added tape and reel information ( <i>Figure 13, 14 and Table 32, 33</i> ); minor textual changes in title and document.
01-Jul-2010	4	Document status upgraded to full datasheet; updated cover page; added footnote to <i>Table 28</i> ; minor textual changes.
20-Jul-2010	5	Removed footnote from <i>Table 28</i> .

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2010 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)