

4.1.5 TS3000 Standalone Thermal Sensor Component

Mobile Platform Memory Module Thermal Sensor Component Specification. Revision 1.03

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1 Device Standard

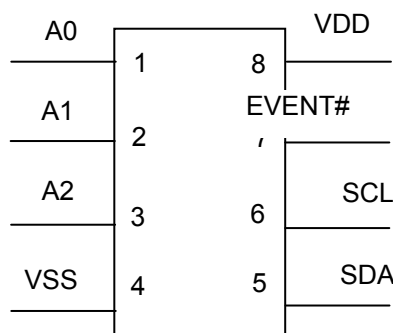
The TS3000av is a Temperature Sensor device designed to operate in one of three voltage ranges, 1.7-3.6 V, 2.3-3.6 V, or 3.0-3.6 V. All devices meet the thermal performance characteristics, and the 2.3-3.6 V or 3.0-3.3 V nominal devices shall operate the I²C bus at a 400 kHz maximum. Devices are intended to interface to I²C buses which have multiple devices on a shared bus, and must be uniquely addressed on this bus. A substantial reduction in supply current may be achieved using the software programmed shutdown mode. The device family contains two temperature grades designated with a second letter appended to the part number.

Common Features summary:

TS3000av Variations					
Base Part Number		a	Sensor Accuracy	v	Single Supply Voltage
TS3000	B		0.5 °C typ from 75-95 °C	1	1.7 to 3.6 V
			1.0 °C typ from 40-125 °C	2	2.3 to 3.6 V
			2.0 °C typ from -20-125 °C	3	3.0 to 3.6 V
	C		1.0 °C typ from 75-95 °C		
			2.0 °C typ from 40-125 °C		
			3.0 °C typ from -20-125 °C		

2 Memory Module Thermal Sensor

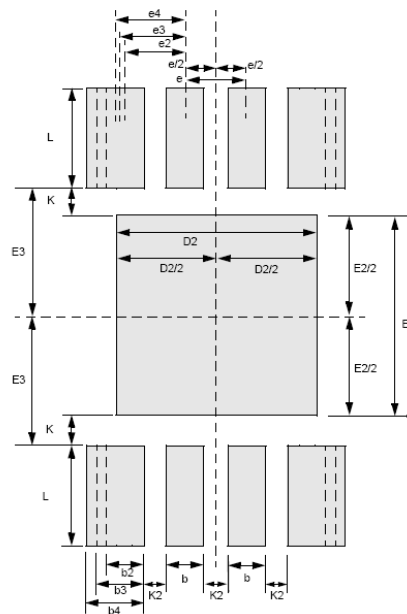
The Sensor component shares the SMBus/I²C with the Serial Presence Detect EEPROM (SPD) on the memory module. The recommended pin out (package) and footprint (PCB Layout) is as follows:



Remote TS
Matches SPD
Top View

LLP/MLP/PSON 8-pin (MO-229 V/WEED-7, V/WCED-3); TSSOP-8

Figure 1 - Pinout (and Package) Options for Thermal Sensor Components



The table lists three variations of landing pattern implementations, ranked as “Preferred”, “Intermediate”, and “Minimum Acceptable”.

TABLE 18. Parameters for SPD Common Landing Pattern

Parameter	Description	Dimension			Notes
		Min	Nom	Max	
D2	Heat paddle width	1.40	-	1.60	
E2	Heat paddle height	1.40	-	1.60	
E3	Heat paddle centerline to contact inner locus	1.00	-	1.05	
L	Contact length	0.70	-	0.80	
K	Heat paddle to contact keepout	0.20	-	-	
K2	Contact to contact keepout	0.20	-	-	
e	Contact centerline to contact centerline pitch for inner contacts	-	0.50	-	
b	Contact width for inner contacts	0.25	-	0.30	
e2	Landing pattern centerline to outer contact centerline, “minimum acceptable” option	-	0.50	-	1
b2	Corner contact width, “minimum acceptable” option	0.25	-	0.30	1
e3	Inner contact centerline to outer contact centerline, “intermediate” option	-	0.55	-	2
b3	Corner contact width, “intermediate” option	0.35	-	0.40	2
e4	Landing pattern centerline to outer contact centerline, “preferred” option	-	0.60	-	3
b4	Corner contact width, “preferred” option	0.45	-	0.50	3

Notes:
1. Minimum acceptable option to be used when routing prevents preferred or intermediate width contact.
2. Intermediate option to be used when routing prevents preferred width contact.
3. Preferred option to be used when possible.

Figure 2 - Recommended Landing Pattern Options (PCB Footprint)
See JESD21C-4.1.2 for details. All dimensions in mm

Table 1 – Pinout of Thermal Sensor

Pin	Description
Power Supply	
VDD	Positive Supply, Power
VSS	Negative Supply, Ground
SMBus/I²C Serial Interface	
SDA	SMBus/I ² C Data pin
SCL	SMBus/I ² C Clock pin
A0/A1/A2	Lower bits of the SMBus/I ² C Slave Address
Thermal Sensor	
EVENT#	Active Low. Open Drain EVENT# output pin. Driven low on comparator level, or Alert Interrupt

3 Key Features

- Temperature accuracy
 - TS3000Cv = Typical accuracy of ± 1.0 °C for the active range from 70 ~ 95 °C.
 - TS300Cv = Typical accuracy of ± 2.0 °C for other monitor ranges from 40 ~ 125 °C.
 - TS3000Bv = Support for higher accuracy of ± 0.5 °C (typical) over the active range.
- Ambient temperature (T_A) sense through an operating range of -20 to +125 °C.
- Temperature sample rate minimum of 8 samples/s.
- Operating voltage range
 - TS3000a1 = 1.7 V to 3.6 V.
 - TS3000a2 = 2.3 V to 3.6 V.
 - TS3000a3 = 3.0 V to 3.6 V.
- Low operating current (~500 uA typical).
- Selectable 0, 1.5 °C, 3 °C, 6 °C Hysteresis.
- Package
 - LLP/MLP/PSON or TSSOP 8 pin (E = 3 mm D = 3 mm or E = 3 mm D = 2 mm) package for all memory modules including SO-DIMMs .
 - JEDEC Registration MO-229 V/WEED-7 (3 mm by 3 mm) or V/WCED-3 (2 mm by 3 mm) footprint.
 - Exposed DAP to be connected to V_{SS} to enhance thermal conductivity.
- Security bits for robust operation.
- SMBus/I²C compatible serial interface supporting up to 400 kHz bus speeds.
- Dual purpose event pin: Comparator or Interrupt (compatible with SMBus Alert) mode.
- Since this device could be used in memory modules at other operating voltages, the thermal sensor is not required to operate at any other voltage range than specified here. However, it is required that

the thermal sensor does not inhibit any operation of the module (i.e., bus activity) while the module operates at other voltages.

- Since this device will reside on the same address bus as other devices, it is required to allow up to 10 V on the A0 pin.

4 Electrical Characteristics

Operating Conditions for TS3000av Family

Symbol	Parameter	TS3000a1		TS3000a2		TS3000a3		Units
		Min	Max	Min	Max	Min	Max	
VDD	Supply Voltage	1.7	3.6	2.3	3.6	3.0	3.6	V

Table 2. Specifications at $T_A = -20\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$, unless otherwise noted

Parameter	Min	Typ	Max	Unit	Test Conditions
POWER SUPPLY					$V_{DDMIN} \leq V_{DD} \leq V_{DDMAX}$
Allowable voltage on pin A0 (pin 1)			10	V	Pin A0 must be capable of supporting up to 10 V consistent with EE1002 and TSE2002av device family specifications
Leakage on pin A0 in overvoltage state		500		uA	
Average Operating Supply Current, I_{DD}			500	μA	
TEMPERATURE-TO-DIGITAL CONVERTER					
Local Sensor Accuracy (C grade) ¹		± 1.0	± 2.0	$^{\circ}\text{C}$	$75\text{ }^{\circ}\text{C} \leq T_A \leq 95\text{ }^{\circ}\text{C}$, Active Range
		± 2.0	± 3.0	$^{\circ}\text{C}$	$40\text{ }^{\circ}\text{C} \leq T_A \leq 125\text{ }^{\circ}\text{C}$, Monitor Range
		± 3.0	± 4.0	$^{\circ}\text{C}$	$-20\text{ }^{\circ}\text{C} \leq T_A \leq 125\text{ }^{\circ}\text{C}$
Local Sensor Accuracy (B grade) ¹		± 0.5	± 1.0	$^{\circ}\text{C}$	$75\text{ }^{\circ}\text{C} \leq T_A \leq 95\text{ }^{\circ}\text{C}$, Active Range
		± 1.0	± 2.0	$^{\circ}\text{C}$	$40\text{ }^{\circ}\text{C} \leq T_A \leq 125\text{ }^{\circ}\text{C}$, Monitor Range
		± 2.0	± 3.0	$^{\circ}\text{C}$	$-20\text{ }^{\circ}\text{C} \leq T_A \leq 125\text{ }^{\circ}\text{C}$
Resolution		0.25		$^{\circ}\text{C}$	
Conversion Time			125	ms	Worst case conversion time

¹ Refer to individual vendor datasheets for explanation of accuracy testing methodology.

Table 2. Specifications at $T_A = -20\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$, unless otherwise noted

SMBus/I ² C INTERFACE					
Logic Input High Voltage, V_{IH} (SCL, SDA)	-0.5		$0.3 * V_{DD}$	V	
Logic Input Low Voltage, V_{IL} (SCL, SDA)	$0.7 * V_{DD}$		$V_{DD} + 1$	V	
Logic Output Low Voltage, V_{OL} (SCL, SDA)			0.4	V	I_{PULL_UP} of 350 μ A
SMBus/I ² C Output Low Sink Current	6			mA	SDA Forced to 0.6 V
Logic Input Current, I_{IH} , I_{IL}	-5		+5	μ A	
Input Hysteresis ²	$0.10 * V_{DD}$			V	$V_{DD} < 2.2\text{ V}$
	$0.05 * V_{DD}$			V	$V_{DD} \geq 2.2\text{ V}$
SMBus/I ² C Input Capacitance (SCL, SDA)		5		pF	
SMBus/I ² C Clock Frequency	10		100	kHz	$V_{DD} < 2.2\text{ V}$
	10		400	kHz	$V_{DD} \geq 2.2\text{ V}$
Pulse width of spikes which must be suppressed by the input filter	n/a		n/a	ns	$f \leq 100\text{ KHz}$
	0		50	ns	$f > 100\text{ KHz}$

4.1 SMBus/I²C

4.1.1 SMBus/I²C Communications

The data registers in this device are selected by the Pointer Register. At power-up the Pointer Register is set to "00", the location for the Capability Register. The Pointer Register latches the last location it was set to. Each data register falls into one of three types of user accessibility:

1. Read only
2. Write only
3. Write/Read same address

A Write to this device will always include the address byte and the pointer byte. A write to any register, other than the pointer register, requires two data bytes.

Reading this device can take place either of two ways:

1. If the location latched in the Pointer Register is correct (most of the time it is expected that the Pointer Register will point to one of the Read Temperature Registers because that will be the data most frequently read), then the read can simply consist of an address byte, followed by retrieving the two data bytes.

² Optional.