TC74

Tiny Serial Digital Thermal Sensor

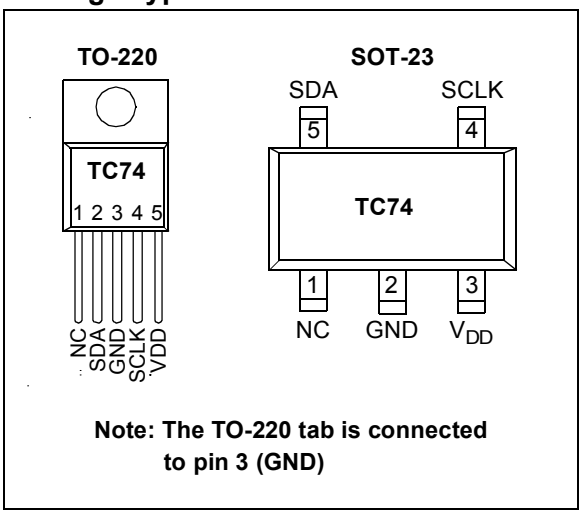
Features

- Digital Temperature Sensing in SOT-23-5 or TO-220 Packages
- Outputs Temperature as an 8-Bit Digital Word
- Simple SMBus/I^{2}C™ Serial Port Interface
- Solid-State Temperature Sensing:
  - ±2°C (max.) Accuracy from +25°C to +85°C
  - ±3°C (max.) Accuracy from 0°C to +125°C
- Supply Voltage of 2.7V to 5.5V
- Low Power:
  - 200 µA (typ.) Operating Current
  - 5 µA (typ.) Standby Mode Current

Applications

- Thermal Protection for Hard Disk Drives and other PC Peripherals
- PC Card Devices for Notebook Computers
- Low Cost Thermostat Controls
- Power Supplies
- Thermistor Replacement

Package Types



Note: The TO-220 tab is connected to pin 3 (GND)

General Description

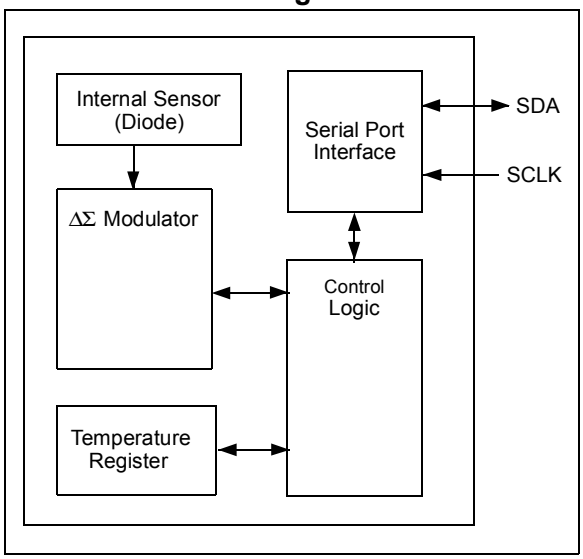
The TC74 is a serially accessible, digital temperature sensor particularly suited for low cost and small form-factor applications. Temperature data is converted from the onboard thermal sensing element and made available as an 8-bit digital word.

Communication with the TC74 is accomplished via a 2-wire SMBus/I^{2}C compatible serial port. This bus also can be used to implement multi-drop/multi-zone monitoring. The SHDN bit in the CONFIG register can be used to activate the low power Standby mode.

Temperature resolution is 1°C. Conversion rate is a nominal 8 samples/sec. During normal operation, the quiescent current is 200 µA (typ). During standby operation, the quiescent current is 5 µA (typ).

Small size, low installed cost and ease of use make the TC74 an ideal choice for implementing thermal management in a variety of systems.

Functional Block Diagram



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1.0 ELECTRICAL CHARACTERISTICS

1.1 Absolute Maximum Ratings†

Supply Voltage (V_{DD}) ..... +6V

Voltage On Any Pin ..... (GND – 0.3V) to (V_{DD} + 0.3V)

Current On Any Pin ..... ±50 mA

Operating Temperature (T_A) ..... -40°C ≤ T_A ≤ +125°C

Storage Temperature (T_{STG}) ..... -65°C to +150°C

Junction Temperature (T_J) ..... +150°C

† Notice: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, V_{DD} = 3.3V for TC74AX-3.3VXX and V_{DD} = 5.0V for TC74AX-5.0VXX, -40°C ≤ T_A ≤ 125°C. **Note 5**

Parameters	Sym	Min	Typ	Max	Units	Conditions
Power Supply						
Power-on Reset Threshold	V_{POR}	1.2	—	2.2	V	V_{DD} Falling Edge or Rising Edge
Supply Voltage	V_{DD}	2.7	—	5.5	V	**Note 5**
Operating Current	I_{DD}	—	200	350	µA	V_{DD} = 5.5V, **Note 1**
Standby Supply Current	$I_{DD-STANDBY}$	—	5.0	10	µA	V_{DD} = 3.3V Serial Port Inactive, **Note 4**
Temperature-to-Bits Converter						
Temperature Accuracy	T_{ERR}	-2.0 -3.0 —	— — ±2.0	+2.0 +3.0 —	°C	+25°C <T_A < +85°C 0°C < T_A < +125°C -40°C < T_A < 0°C
Conversion Rate	CR	4	8	—	SPS	**Note 2**
Serial Port Interface						
Logic Input High	V_{IH}	0.8 x V_{DD}	—	—	V	
Logic Input Low	V_{IL}	—	—	0.2 x V_{DD}	V	
SDA Output Low	V_{OL}	— —	— —	0.4 0.6	V V	I_{OL} = 3 mA I_{OL} = 6 mA, **Note 3**
Input Capacitance SDA, SCLK	C_{IN}	—	5.0	—	pF	
I/O Leakage	I_{LEAK}	-1.0	0.1	1.0	µA	
Serial Port AC Timing (C_{LOAD} = 80 pF)						
SMBus/I^2C Clock Frequency	f_{SMB}	10	—	100	kHz	
Low Clock Period	t_{LOW}	4.7	—	—	µsec	10% to 10%
High Clock Period	t_{HIGH}	4.0	—	—	µsec	90% to 90%

Note 1: Operating current is an average value integrated over multiple conversion cycles. Transient current may exceed this specification.

2: Maximum ensured conversion time after Power-on Reset (POR to DATA_RDY) is 250 msec.

3: Output current should be minimized for best temperature accuracy. Power dissipation within the TC74 will cause self-heating and temperature drift error.

4: SDA and SCLK must be connected to V_{DD} or GND.

5: V_{DD} = 3.3V for TC74AX -3.3 VXX. V_{DD} = 5.0V for TC74AX -5.0 VXX. All part types of the TC74 will operate properly over the wider power supply range of 2.7V to 5.5V. Each part type is tested and specified for rated accuracy at its nominal supply voltage. As V_{DD} varies from the nominal value, accuracy will degrade 1°C/V of V_{DD} change.

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DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, V_{DD} = 3.3V for TC74AX-3.3VXX and V_{DD} = 5.0V for TC74AX-5.0VXX, -40°C ≤ T_A ≤ 125°C. **Note 5**

Parameters	Sym	Min	Typ	Max	Units	Conditions
SMBus/I^2C Rise Time SMBus/I^2C Fall Time	t_R t_F	— —	— —	1000 300	nsec nsec	10% to 90% 90% to10%
START Condition Setup Time (for repeated START Condition)	$t_{SU(START)}$	4.0	—	—	µsec	90% SCLK to 10% SDA
START Condition Hold Time	$t_{H(START)}$	4.0	—	—	µsec	
Data In Setup Time	$t_{SU-DATA}$	1000	—	—	nsec	
Data In Hold Time	t_{H-DAT}	1250	—	—	nsec	
STOP Condition Setup Time	$t_{SU(STOP)}$	4.0	—	—	µsec	
Bus Free Time Prior to New Transition	t_{IDLE}	4.7	—	—	µsec	
Power-on Reset Delay	t_{POR}	—	500	—	µsec	$V_{DD} \geq V_{POR}$ (Rising Edge)

Note 1: Operating current is an average value integrated over multiple conversion cycles. Transient current may exceed this specification.

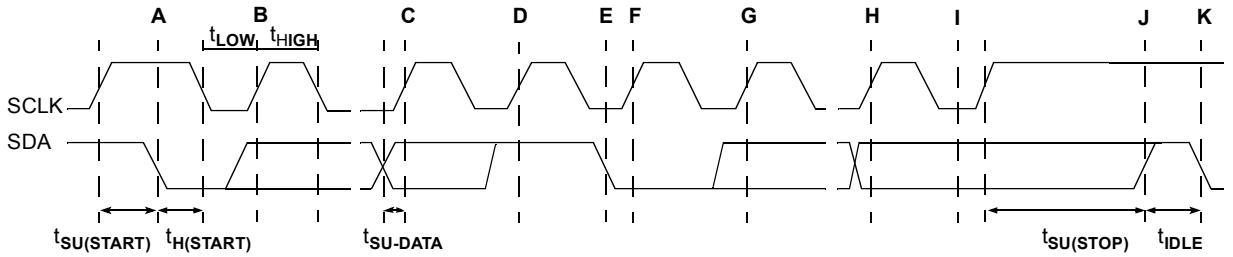
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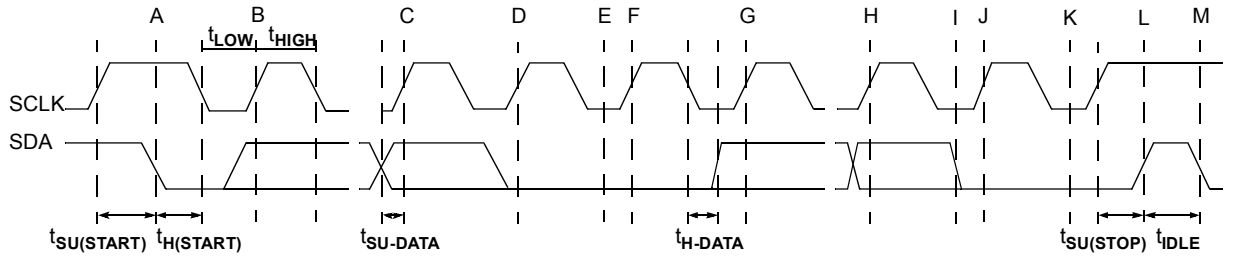
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SMBUS Read Timing Diagram



A = Start Condition
B = MSB of Address Clocked into Slave
C = LSB of Address Clocked into Slave
D = R/W Bit Clocked into Slave
E = Slave Pulls SDA Line Low
F = Acknowledge Bit Clocked into Master
G = MSB of Data Clocked into Master
H = LSB of Data Clocked into Master
I = Acknowledge Clock Pulse
J = Stop Condition
K = New Start Condition

SMBUS Write Timing Diagram



A = Start Condition
B = MSB of Address Clocked into Slave
C = LSB of Address Clocked into Slave
D = R/$\overline{W}$ Bit Clocked into Slave
E = Slave Pulls SDA Line Low
F = Acknowledge Bit Clocked into Master
G = MSB of Data Clocked into Slave
H = LSB of Data Clocked into Slave
I = Slave Pulls SDA Line Low
J = Acknowledge Clocked into Master
K = Acknowledge Clock Pulse
L = Stop Condition, Data Executed by Slave
M = New Start Condition

FIGURE 1-1: *Timing Diagrams.*

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2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

Pin No. (5-Pin SOT-23)	Pin No. (5-Pin TO-220)	Symbol	Type	Description
1	1	NC	None	No Internal Connection
2	3	GND	Power	System Ground
3	5	V_{DD}	Power	Power Supply Input
4	4	SCLK	Input	SMBus/I^2C Serial Clock
5	2	SDA	Bidirectional	SMBus/I^2C Serial Data

2.1 Ground (GND)

Input. Ground return for all TC74 functions.

2.2 Power Supply Input (V_{DD})

Power supply input. See Electrical Specifications.

2.3 SMBus/I^2C Serial Clock (SCLK)

Input. SMBus/I^2C serial clock. Clocks data into and out of the TC74. See System Management Bus Specification, Rev. 1.0, for timing diagrams.

2.4 Serial Data (SDA)

Bidirectional. Serial data is transferred on the SMBus/I^2C in both directions using this pin. See System Management Bus Specification, Rev. 1.0 for timing diagrams.