

Tiny Serial Digital Thermal Sensor

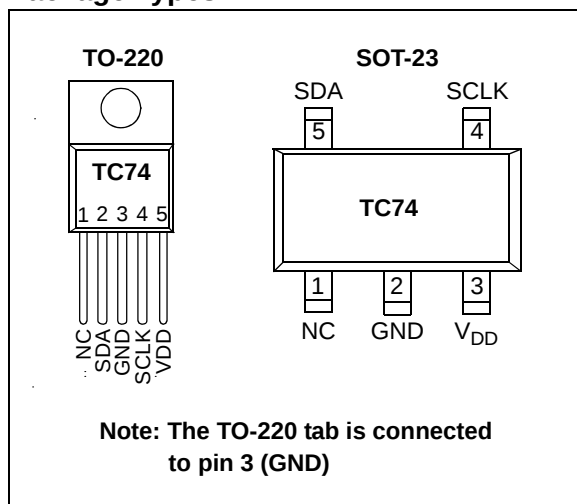
Features

- Digital Temperature Sensing in SOT-23-5 or TO-220 Packages
- Outputs Temperature as an 8-Bit Digital Word
- Simple SMBus/I²C™ Serial Port Interface
- Solid-State Temperature Sensing:
 - $\pm 2^{\circ}\text{C}$ (max.) Accuracy from $+25^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
 - $\pm 3^{\circ}\text{C}$ (max.) Accuracy from 0°C to $+125^{\circ}\text{C}$
- 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



General Description

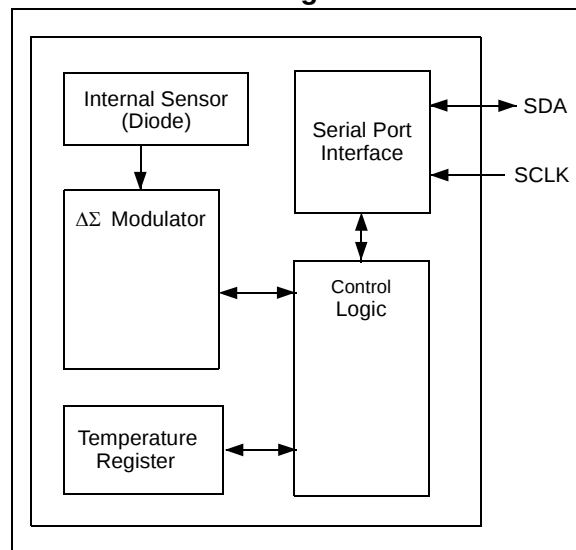
The TC74 is a serially accessible, digital temperature sensor particularly suited for low cost and small form-factor applications. Temperature data is converted from the onboard thermal sensing element and made available as an 8-bit digital word.

Communication with the TC74 is accomplished via a 2-wire SMBus/I²C 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



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 × V_{DD}	—	—	V	
Logic Input Low	V_{IL}	—	—	0.2 × 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 ² C 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%
SMBus/I ² C Rise Time	t_R	—	—	1000	nsec	10% to 90%
SMBus/I ² C Fall Time	t_F	—	—	300	nsec	90% to 10%

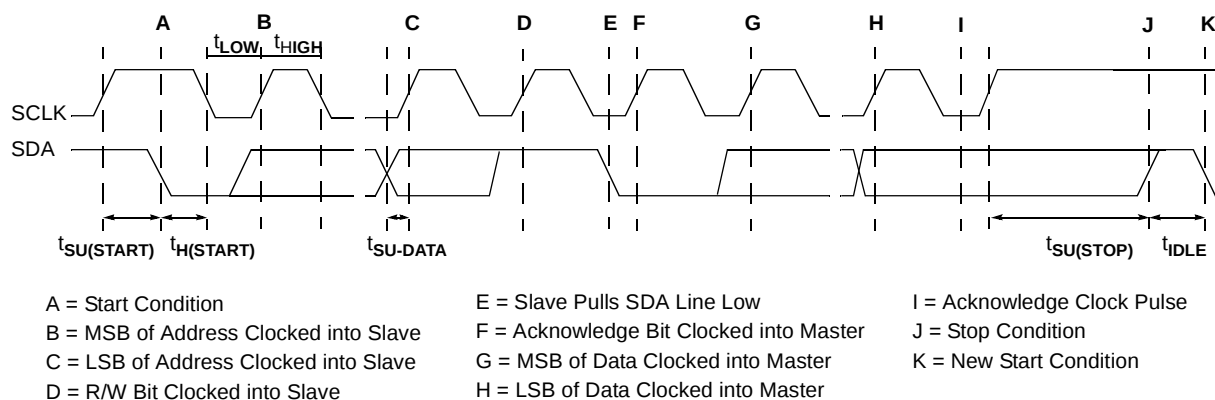
- Note 1:** Operating current is an average value integrated over multiple conversion cycles. Transient current may exceed this specification.
- 2:** Maximum ensured conversion time after Power-on Reset (POR to DATA_RDY) is 250 msec.
- 3:** Output current should be minimized for best temperature accuracy. 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.

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, $-40^{\circ}C \leq T_A \leq 125^{\circ}C$. Note 5						
Parameters	Sym	Min	Typ	Max	Units	Conditions
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.
- 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 $1^{\circ}C/V$ of V_{DD} change.

SMBUS Read Timing Diagram



SMBUS Write Timing Diagram

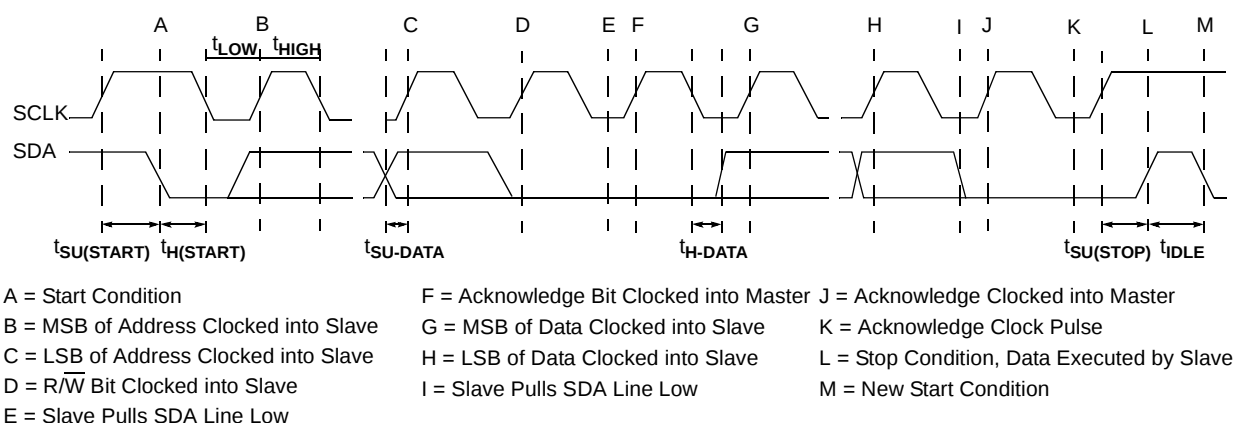


FIGURE 1-1: Timing Diagrams.

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 ² C Serial Clock
5	2	SDA	Bidirectional	SMBus/I ² C 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/I²C Serial Clock (SCLK)

Input. SMBus/I²C 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/I²C in both directions using this pin. See System Management Bus Specification, Rev. 1.0 for timing diagrams.

3.0 DETAILED DESCRIPTION

3.1 Functional Description

The TC74 acquires and converts temperature information from its onboard solid-state sensor with a resolution of $\pm 1^{\circ}\text{C}$. It stores the data in an internal register which is then read through the serial port. The system interface is a slave SMBus/I²C port, through which temperature data can be read at any time. Eight SMBus/I²C addresses are programmable for the TC74, which allows for a multi-sensor configuration. Also, there is low power Standby mode when temperature acquisition is suspended.

3.1.1 STANDBY MODE

The host is allowed, by the TC74, to put it into a low power ($I_{DD} = 5 \mu\text{A}$, typical) Standby mode. In this mode, the A/D converter is halted and the temperature data registers are frozen. The SMBus/I²C port, though, operates normally. Standby mode is enabled by setting the SHDN bit in the CONFIG register. Table 3-1 summarizes this operation.

TABLE 3-1: STANDBY MODE OPERATION

SHDN Bit	Operating Mode
0	Normal
1	Standby

3.1.2 SMBUS/I²C SLAVE ADDRESS

The TC74 is internally programmed to have a default SMBus/I²C address value of 1001 101b. Seven other addresses are available by custom order (contact Microchip Technology Inc).

3.2 Serial Port Operation

The Serial Clock input (SCLK) and bidirectional data port (SDA) form a 2-wire bidirectional serial port for programming and interrogating the TC74. The conventions used in this bus architecture are listed in Table 3-2.

TABLE 3-2: SERIAL BUS CONVENTIONS

Term	Explanation
Transmitter	The device sending data to the bus.
Receiver	The device receiving data from the bus.
Master	The device which controls the bus initiating transfers (START), generating the clock and terminating transfers (STOP).
Slave	The device addressed by the master.
START	A unique condition signaling the beginning of a transfer indicated by SDA falling (high-low) while SCLK is high.
STOP	A unique condition signaling the end of a transfer indicated by SDA rising (low-high) while SCLK is high.
ACK	A Receiver acknowledges the receipt of each byte with this unique condition. The Receiver drives SDA low during SCLK high of the ACK clock-pulse. The Master provides the clock pulse for the ACK cycle.
Busy	Communication is not possible because the bus is in use.
NOT Busy	When the bus is idle, both SDA and SCLK will remain high.
Data Valid	The state of SDA must remain stable during the high period of SCLK in order for a data bit to be considered valid. SDA only changes state while SCLK is low during normal data transfers (see START and STOP conditions).

All transfers take place under the control of a host, usually a CPU or microcontroller, acting as the Master. This host provides the clock signal for all transfers. The TC74 always operates as a Slave. The serial protocol is illustrated in Figure 3-1. All data transfers have two phases and all bytes are transferred MSB first. Accesses are initiated by a START condition, followed by a device address byte and one or more data bytes. The device address byte includes a Read/Write selection bit. Each access must be terminated by a STOP condition. A convention called "Acknowledge" (ACK) confirms receipt of each byte. Note that SDA can change only during periods when SCLK is low (SDA changes while SCLK is high are reserved for START and STOP conditions).

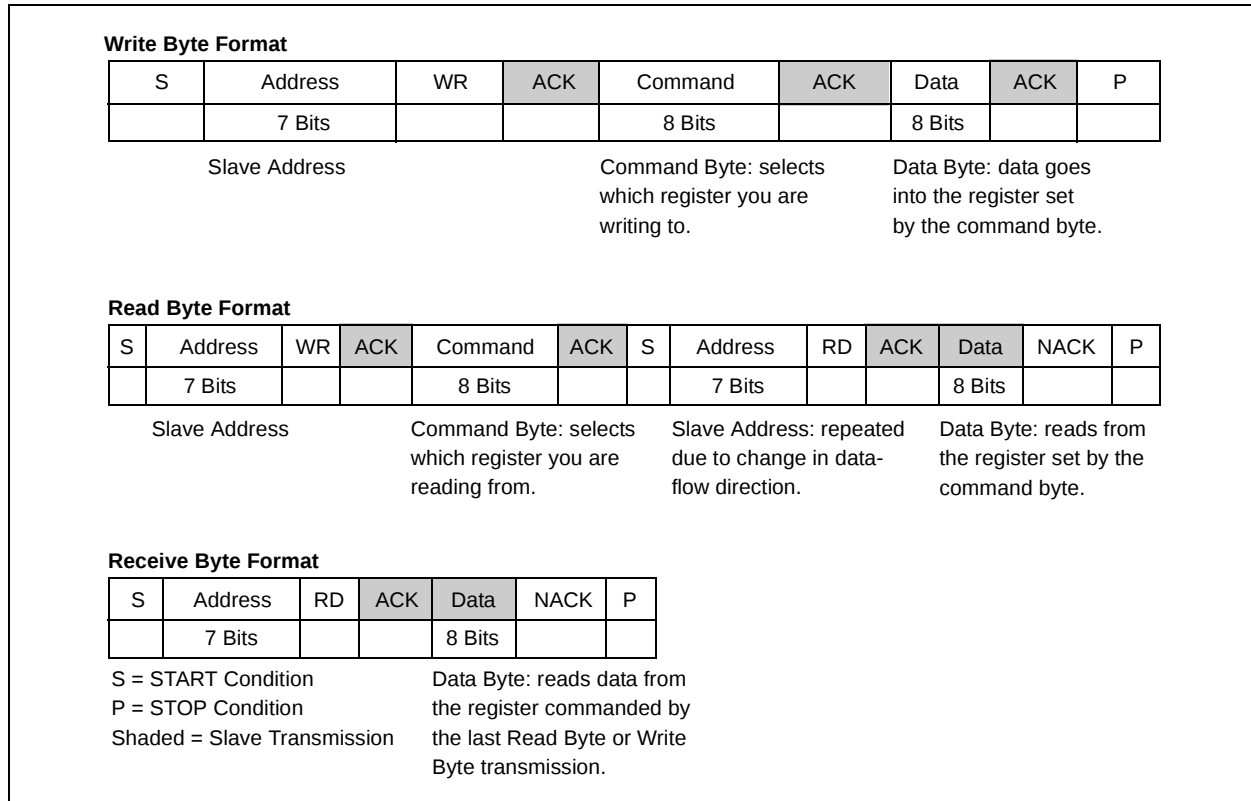


FIGURE 3-1: SMBus/I²C Protocols.

3.3 START Condition (S)

The TC74 continuously monitors the SDA and SCLK lines for a START condition (a high-to-low transition of SDA while SCLK is high) and will not respond until this condition is met.

3.4 Address Byte

Immediately following the START condition, the host must transmit the address byte to the TC74. The states of A2, A1 and A0 determine the SMBus/I²C address for the TC74. The 7-bit address transmitted in the serial bit stream must match for the TC74 to respond with an Acknowledge (indicating the TC74 is on the bus and ready to accept data). The 8-bit in the address byte is a Read/Write bit. This bit is a '1' for a read operation or '0' for a write operation. During the first phase of any transfer, this bit will be set = 0, indicating that the command byte is being written.

3.5 Acknowledge (ACK)

Acknowledge (ACK) provides a positive handshake between the host and the TC74. The host releases SDA after transmitting 8 bits. The host then generates a ninth clock cycle to allow the TC74 to pull the SDA line low. This action acknowledges that the TC74 successfully received the previous 8 bits of data or address.

3.6 Data Byte

After a successful ACK of the address byte, the host must transmit the data byte to be written, or clock-in the data to be read (see the appropriate timing diagrams). ACK will be generated upon a successful write of a data byte into the TC74.

3.7 STOP Condition (P)

Communications must be terminated by a STOP condition (a low-to-high transition of SDA while SCLK is high). The STOP condition must be communicated by the transmitter to the TC74. Refer to Figure 1-1, "Timing Diagrams", for serial bus timing.

4.0 REGISTER SET AND PROGRAMMER'S MODEL

TABLE 4-1: COMMAND BYTE DESCRIPTION (SMBUS/I²C READ_BYTE AND WRITE_BYTE)

Command	Code	Function
RTR	00h	Read Temperature (TEMP)
RWCR	01h	Read/Write Configuration (CONFIG)

TABLE 4-2: CONFIGURATION REGISTER (CONFIG); 8 BITS, READ/ WRITE)

Bit	POR	Function	Type	Operation
D[7]	0	STANDBY Switch	Read/Write	1 = standby, 0 = normal
D[6]	0	Data Ready *	Read Only	1 = ready, 0 = not ready
D[5]-D[0]	0	Reserved - Always returns zero when read	N/A	N/A

Note 1: *DATA_RDY bit RESET at power-up and SHDN enable.

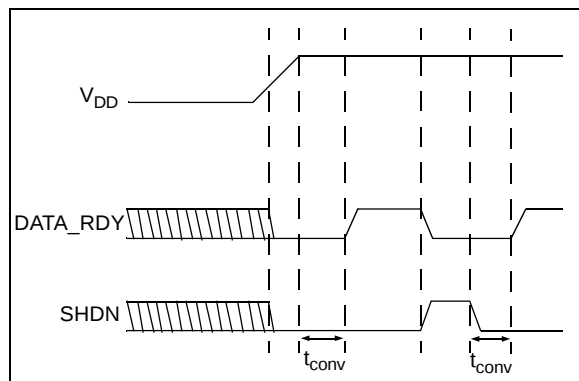


FIGURE 4-1: DATA_RDY, SHDN Operation Logic Diagram.

4.1 Temperature Register (TEMP), 8 Bits, READ ONLY

The binary value (2's complement format) in this register represents temperature of the onboard sensor following a conversion cycle. The registers are automatically updated in an alternating manner.

TABLE 4-3: TEMPERATURE REGISTER (TEMP)

D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
MSB	X	X	X	X	X	X	LSB

In temperature data registers, each unit value represents one degree (Celsius). The value is in 2's complement binary format such that a reading of 0000 0000b corresponds to 0°C. Examples of this temperature to binary value relationship are shown in Table 4-4.

TABLE 4-4: TEMPERATURE-TO-DIGITAL VALUE CONVERSION (TEMP)

Actual Temperature	Registered Temperature	Binary Hex
+130.00°C	+127°C	0111 1111
+127.00°C	+127°C	0111 1111
+126.50°C	+126°C	0111 1110
+25.25°C	+25°C	0001 1001
+0.50°C	0°C	0000 0000
+0.25°C	0°C	0000 0000
0.00°C	0°C	0000 0000
-0.25°C	-1°C	1111 1111
-0.50°C	-1°C	1111 1111
-0.75°C	-1°C	1111 1111
-1.00°C	-1°C	1111 1111
-25.00°C	-25°C	1110 0111
-25.25°C	-26°C	1110 0110
-54.75°C	-55°C	1100 1001
-55.00°C	-55°C	1100 1001
-65.00°C	-65°C	1011 1111

4.2 Register Set Summary

The TC74 register set is summarized in Table 4-5. All registers are 8 bits wide.

TABLE 4-5: TC74 REGISTER SET SUMMARY

Name	Description	POR State	Read	Write
TEMP	Internal Sensor Temperature (2's Complement)	0000 0000b ⁽¹⁾	√	N/A
CONFIG	CONFIG Register	0000 0000b	√	√

Note 1: The TEMP register will be immediately updated by the A/D converter after the DATA_RDY Bit goes high.

5.0 PACKAGING INFORMATION

5.1 SOT23A Package Marking Information

5-Pin SOT-23A

1 & 2 = part number code + temp. range and voltage
3 = year and quarter code
4 = lot ID number

SOT-23 Package Marking Codes

SOT-23 (V)	Address	Code	SOT-23 (V)	Address	Code
TC74A0-3.3VCT	1001 000	V0	TC74A0-5.0VCT	1001 000	U0
TC74A1-3.3VCT	1001 001	V1	TC74A1-5.0VCT	1001 001	U1
TC74A2-3.3VCT	1001 010	V2	TC74A2-5.0VCT	1001 010	U2
TC74A3-3.3VCT	1001 011	V3	TC74A3-5.0VCT	1001 011	U3
TC74A4-3.3VCT	1001 100	V4	TC74A4-5.0VCT	1001 100	U4
TC74A5-3.3VCT	1001 101*	V5	TC74A5-5.0VCT	1001 101*	U5
TC74A6-3.3VCT	1001 110	V6	TC74A6-5.0VCT	1001 110	U6
TC74A7-3.3VCT	1001 111	V7	TC74A7-5.0VCT	1001 111	U7

Note: * Default Address

TO-220 Package Marking Information

TO-220

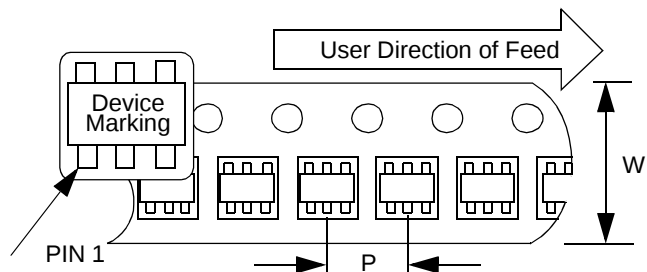
Legend: XX...X Customer specific information*
YY Year code (last 2 digits of calendar year)
WW Week code (week of January 1 is week '01')
NNN Alphanumeric traceability code

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line thus limiting the number of available characters for customer specific information.

* Standard marking consists of Microchip part number, year code, week code, and traceability code.

5.2 Taping Forms

Component Taping Orientation for 5-Pin SOT-23A (EIAJ SC-74A) Devices



Standard Reel Component Orientation
for TR Suffix Device
(Mark Right Side Up)

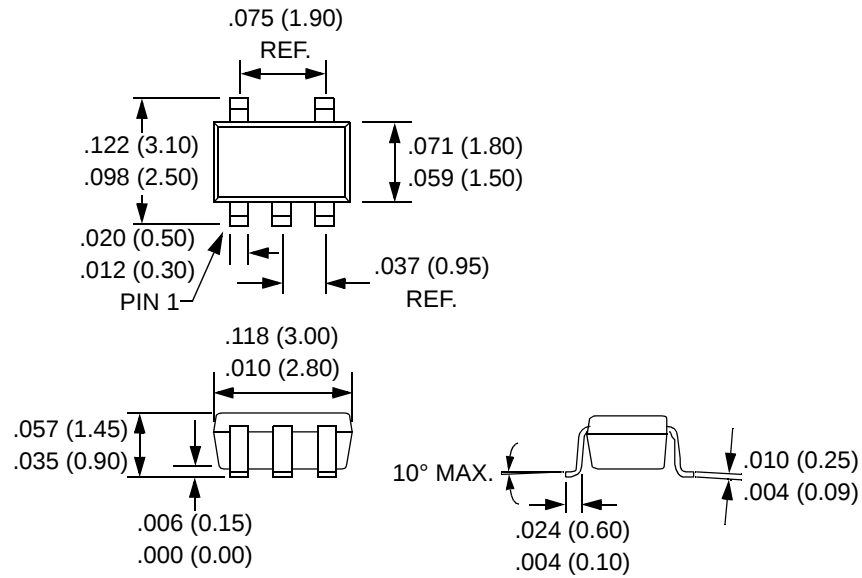
Carrier Tape, Number of Components Per Reel and Reel Size:

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
5-Pin SOT-23A	8 mm	4 mm	3000	7 in.

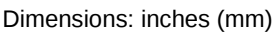
5.3 Package Dimensions

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

SOT-23A-5



Dimensions: inches (mm)



6.0 REVISION HISTORY

Revision D (December 2012)

Added a note to each package outline drawing.

TC74

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>XX</u>	<u>-XX</u>	<u>X</u>	<u>XX</u>
Device	Address Options	Supply Voltage	Operating Temperature	Package
Device: TC74: Serial Digital Thermal Sensor Address Options: A0 = 1001 000 A1 = 1001 001 A2 = 1001 010 A3 = 1001 011 A4 = 1001 100 A5 = 1001 101 * A6 = 1001 110 A7 = 1001 111 * Default Address Supply Voltage: 3.3 = Accuracy optimized for 3.3V 5.0 = Accuracy optimized for 5.0V Operating Temperature: V = -40°C ≤ T_A ≤ +125°C Package: CTTR = SOT-23-5 (Tape and Reel only)				
Examples: a) TC74A0-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor b) TC74A1-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor c) TC74A2-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor d) TC74A3-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor e) TC74A4-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor f) TC74A5-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor * g) TC74A6-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor h) TC74A7-3.3VCTTR: SOT-23 Serial Digital Thermal Sensor a) TC74A0-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor b) TC74A1-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor c) TC74A2-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor d) TC74A3-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor e) TC74A4-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor f) TC74A5-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor * g) TC74A6-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor h) TC74A7-5.0VCTTR: SOT-23 Serial Digital Thermal Sensor * Default Address				

<u>PART NO.</u>	<u>XX</u>	<u>-XX</u>	<u>X</u>	<u>XX</u>
Device	Address Options	Supply Voltage	Operating Temperature	Package
Device: TC74: Serial Digital Thermal Sensor Address Options: A0 = 1001 000 A1 = 1001 001 A2 = 1001 010 A3 = 1001 011 A4 = 1001 100 A5 = 1001 101 * A6 = 1001 110 A7 = 1001 111 * Default Address Output Voltage: 3.3 = Accuracy optimized for 3.3V 5.0 = Accuracy optimized for 5.0V Operating Temperature: V = -40°C ≤ T_A ≤ +125°C Package: AT = TO-220-5				
Examples: a) TC74A0-3.3VAT: TO-220 Serial Digital Thermal Sensor b) TC74A1-3.3VAT: TO-220 Serial Digital Thermal Sensor c) TC74A2-3.3VAT: TO-220 Serial Digital Thermal Sensor d) TC74A3-3.3VAT: TO-220 Serial Digital Thermal Sensor e) TC74A4-3.3VAT: TO-220 Serial Digital Thermal Sensor f) TC74A5-3.3VAT: TO-220 Serial Digital Thermal Sensor * g) TC74A6-3.3VAT: TO-220 Serial Digital Thermal Sensor h) TC74A7-3.3VAT: TO-220 Serial Digital Thermal Sensor a) TC74A0-5.0VAT: TO-220 Serial Digital Thermal Sensor b) TC74A1-5.0VAT: TO-220 Serial Digital Thermal Sensor c) TC74A2-5.0VAT: TO-220 Serial Digital Thermal Sensor d) TC74A3-5.0VAT: TO-220 Serial Digital Thermal Sensor e) TC74A4-5.0VAT: TO-220 Serial Digital Thermal Sensor f) TC74A5-5.0VAT: TO-220 Serial Digital Thermal Sensor * g) TC74A6-5.0VAT: TO-220 Serial Digital Thermal Sensor h) TC74A7-5.0VAT: TO-220 Serial Digital Thermal Sensor * Default Address				

Sales and Support

Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

New Customer Notification System

Register on our web site (www.microchip.com/cn) to receive the most current information on our products.

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, KEELoQ, KEELoQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC³² logo, rPIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MTP, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

Analog-for-the-Digital Age, Application Maestro, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscient Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICTail, REAL ICE, rLAB, Select Mode, SQI, Serial Quad I/O, Total Endurance, TSHARC, UniWinDriver, WiperLock, ZENA and Z-Scale are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

GestIC and ULPP are registered trademarks of Microchip Technology Germany II GmbH & Co. & KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2001-2012, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.



Printed on recycled paper.

ISBN: 9781620768396

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO/TS 16949 =

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELoQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hangzhou
Tel: 86-571-2819-3187
Fax: 86-571-2819-3189

China - Hong Kong SAR
Tel: 852-2943-5100
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8864-2200
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Osaka
Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

Japan - Tokyo
Tel: 81-3-6880-3770
Fax: 81-3-6880-3771

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-213-7828
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

Данный компонент на территории Российской Федерации

Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9