

3V Logic Output Temperature Sensor with Programmable Hysteresis

Features

- User Programmable Hysteresis and Temperature Set Point
- Easily Programs with Two External Resistors
- Wide Temperature Detection Range
 - TC07CXA: -0°C to +70°C
 - TC07EXA: -40°C to +85°C
 - TC07VXA: -40°C to +125°C
- 8-Pin MSOP and 8-Pin SOIC Packages
- Cost Effective

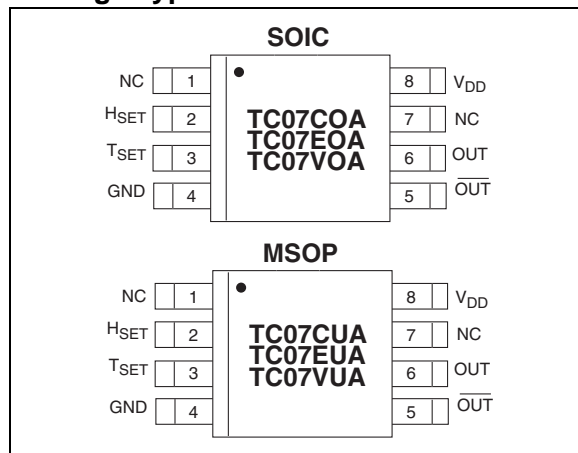
Applications

- Power Supply Over-Temperature Detection
- Consumer Equipment
- Temperature Regulators

Device Selection Table

Part Number	Package	Temperature Range
TC07COA	8-Pin SOIC	0°C to +70°C
TC07CUA	8-Pin MSOP	0°C to +70°C
TC07EOA	8-Pin SOIC	-40°C to +85°C
TC07EUA	8-Pin MSOP	-40°C to +85°C
TC07VOA	8-Pin SOIC	-40°C to +125°C
TC07VUA	8-Pin MSOP	-40°C to +125°C

Package Type



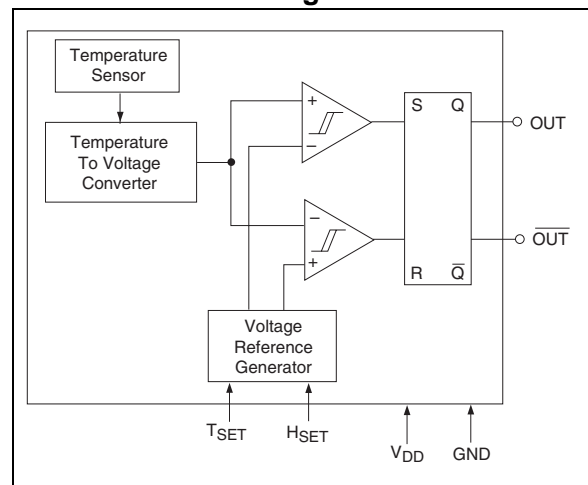
General Description

The TC07 is a programmable, logic output temperature detector that operates from power supply levels as low as 2.7V. Programming is accomplished with external resistors connected from the temperature set point input (T_{SET}) and the hysteresis control input (H_{SET}) to V_{DD}.

Complementary outputs (OUT and $\overline{\text{OUT}}$) are driven active when temperature exceeds the temperature threshold programmed by the resistor on T_{SET}. The states of these outputs are maintained (latched) until temperature falls below threshold programmed by the resistor on H_{SET}.

The TC07 has an operating temperature range of -40°C to +125°C (TC07VXA). It features low (<130μA) supply current and with 8-pin MSOP and 8-pin SOIC packages, making it suitable for a wide variety of applications.

Functional Block Diagram



TC07

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings*

Supply Voltage 7V
Input Voltage Any Input .(GND – 0.3V) to (V_{DD} + 0.3V)
Operating Temperature -40°C to +125°C
Storage Temperature, T_J..... -65°C to +150°C

*Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

TC07 ELECTRICAL SPECIFICATIONS

Electrical Characteristics: T _A = Over operational temperature range, unless otherwise specified.						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V _{DD}	Supply Voltage Range	2.7	–	5.5	V	
I _{DD}	Supply Current	–	130	300	μA	2.7V < V _{CC} < 5.5V
V _{OH}	Output Voltage (High)	0.8 x V _{DD}	–	–	V	I _{OUT} = 500μA
V _{OL}	Output Voltage (Low)	–	–	0.25 x V _{DD}	V	I _{OUT} = 1mA
H	Minimum Hysteresis	-5	–	–	°C	H _{SET} < T _{SET}
T _{SET}	Absolute Accuracy	T - 3	T ± 1	T + 3	°C	T = Programmed Temperature
H _{SET}	Absolute Accuracy	T - 5	T ± 1	T + 5	°C	T = Programmed Temperature

2.0 PIN DESCRIPTIONS

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

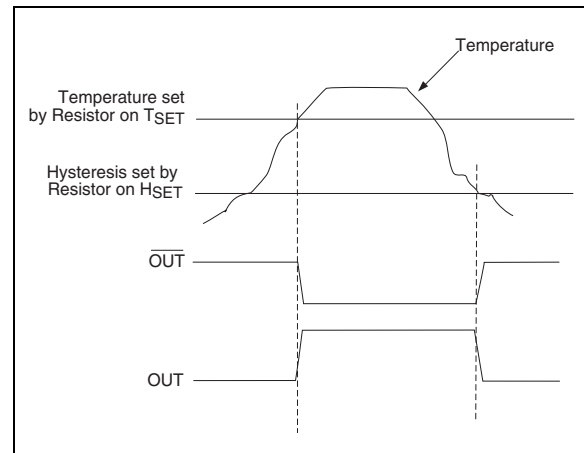
TABLE 2-1: PIN FUNCTION TABLE

Pin No. (8-Pin SOIC) (8-Pin MSOP)	Symbol	Description
1	NC	No Internal Connection
2	H _{SET}	Absolute Accuracy
3	T _{SET}	Absolute Accuracy
4	GND	Ground
5	$\overline{\text{OUT}}$	Minimum Hysteresis
6	OUT	Absolute Accuracy
7	NC	No Internal Connection
8	V _{DD}	Supply Voltage Range

3.0 DETAILED DESCRIPTION

The TC07 programs with resistors connected from the $\overline{\text{T}}_{\text{SET}}$ and H_{SET} inputs to V_{DD}. Output pins OUT and $\overline{\text{OUT}}$ are driven active when the temperature exceeds the setting determined by the programming resistor on T_{SET}. The outputs are maintained (latched) in their active states until temperature drops below the setting determined by the programming resistor on H_{SET} (Figure 3-1).

FIGURE 3-1: TC07 OUTPUT WAVEFORMS



4.0 TYPICAL APPLICATIONS

4.1 Trip Point Programming

The resistor values required to achieve the desired trip point temperatures on T_{SET} and H_{SET} are calculated using the formula below:

$$R_{TRIP} = 0.6 \times T^{2.13}$$

Where:

R_{TRIP} = Programming resistor value in Ohms
 T = Desired trip point temperature in degrees Kelvin.

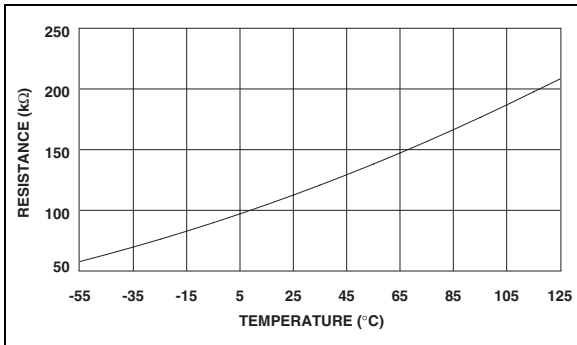
For example, to program the TC07 outputs to go active at 50°C and inactive at 30°C, the R_T and R_H programming resistors are calculated as follows:

$$R_T = 0.6 \times ((50 + 273.15)^{2.13}) = 132.8k\Omega$$

$$R_H = 0.6 \times ((30 + 273.15)^{2.13}) = 115.9k\Omega$$

Resistance values for T_{SET} and H_{SET} can be approximated using Figure 4-1. Care must be taken to ensure the H_{SET} programming resistor is a smaller value than the T_{SET} programming resistor. The temperature programmed on H_{SET} must be at least 5°C lower than the temperature value programmed by T_{SET} .

FIGURE 4-1: PROGRAMMING RESISTOR VALUES VS. TEMPERATURE



4.2 Cooling and Heating Applications

The TC07 can be used to control a DC fan as shown in Figure 4-2. The fan turns on when the sensed temperature rises above the temperature set at T_{SET} and remains on until the temperature falls below the temperature set at H_{SET} . The amount of “cooling” performed by the fan is dependent on the programmed hysteresis.

Figure 4-3 shows the TC07 acting as a heater thermostat. Circuit operation is identical to that of the cooling fan application in Figure 4-2.

FIGURE 4-2: TC07 AS A FAN CONTROLLER

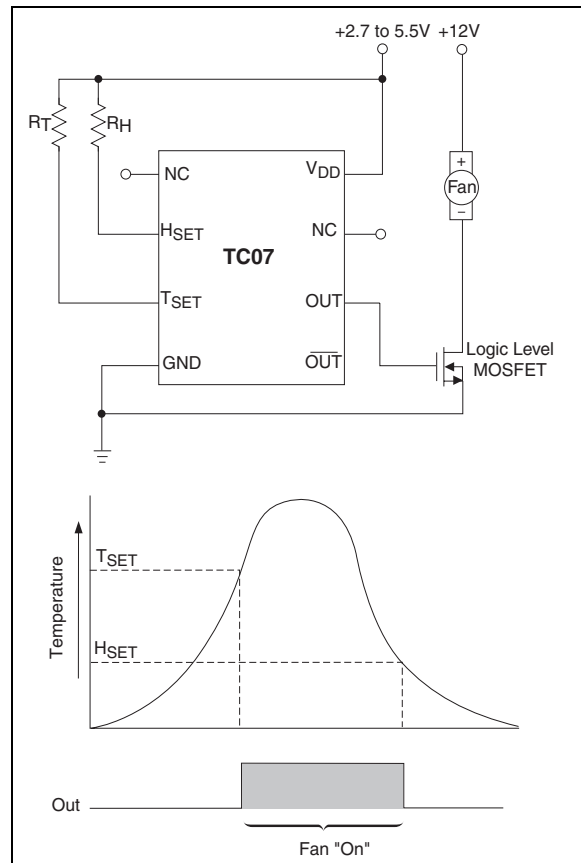
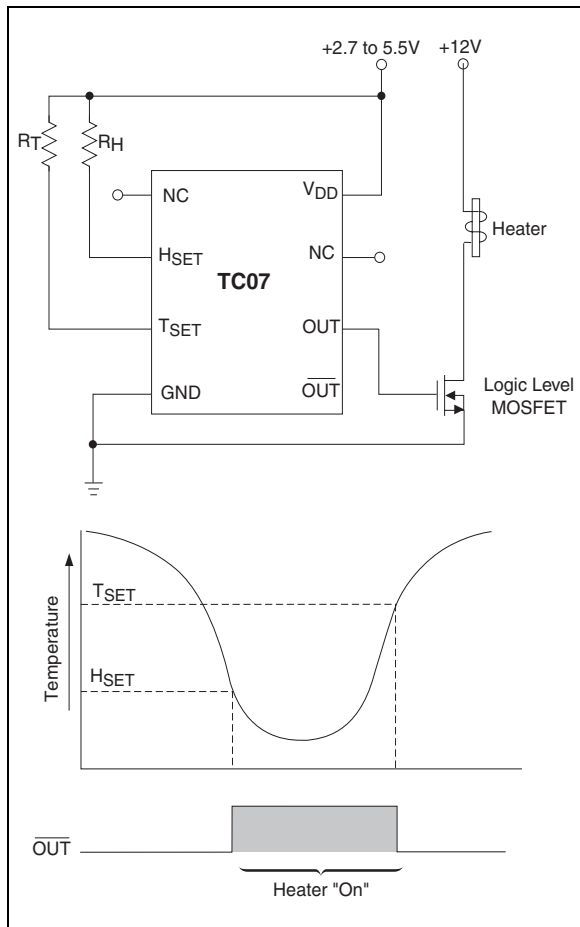


FIGURE 4-3: TC07 AS A HEATER THERMOSTAT



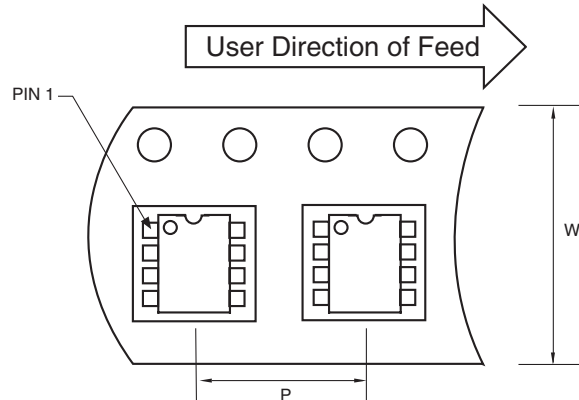
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

Package marking data not available at this time.

5.2 Taping Form

Component Taping Orientation for 8-Pin MSOP Devices

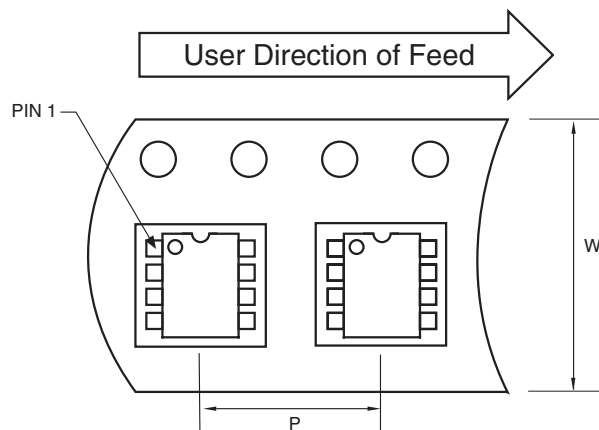


Standard Reel Component Orientation
for TR Suffix Device

Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
8-Pin MSOP	12 mm	8 mm	2500	13 in

Component Taping Orientation for 8-Pin SOIC (Narrow) Devices

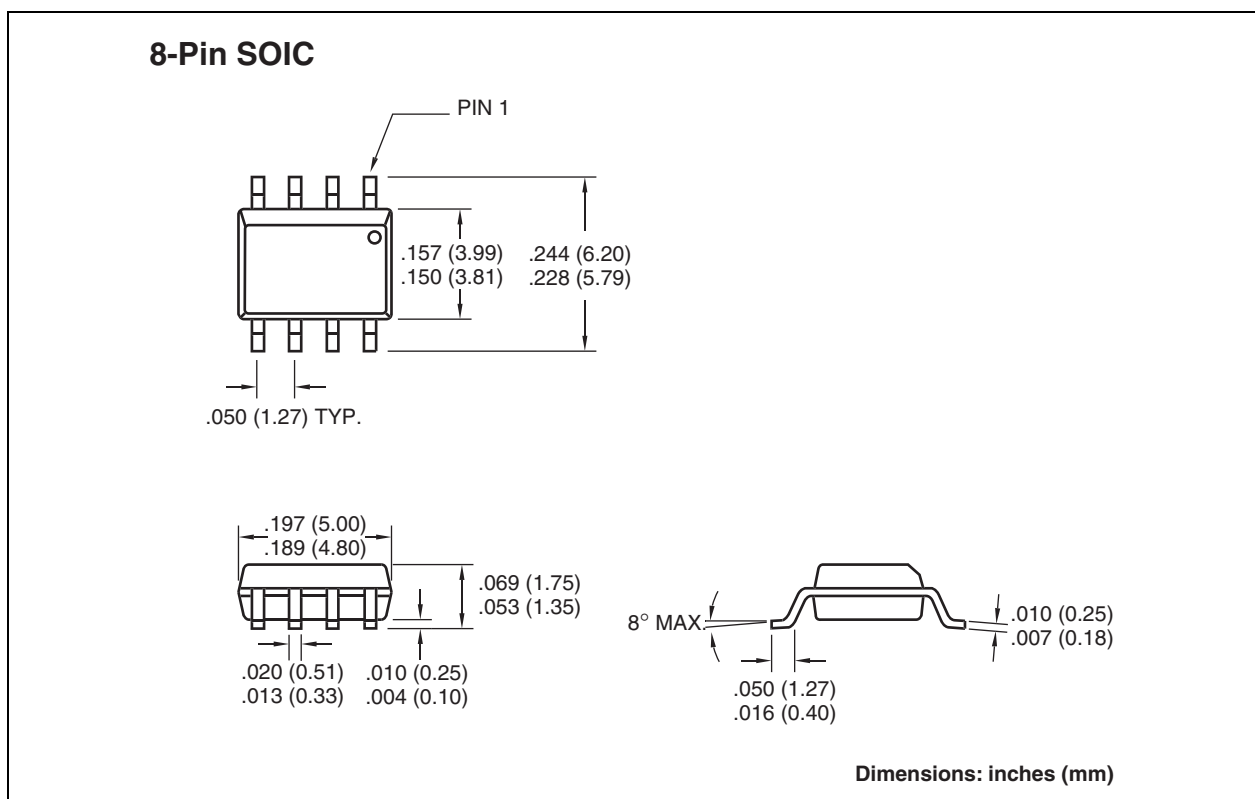
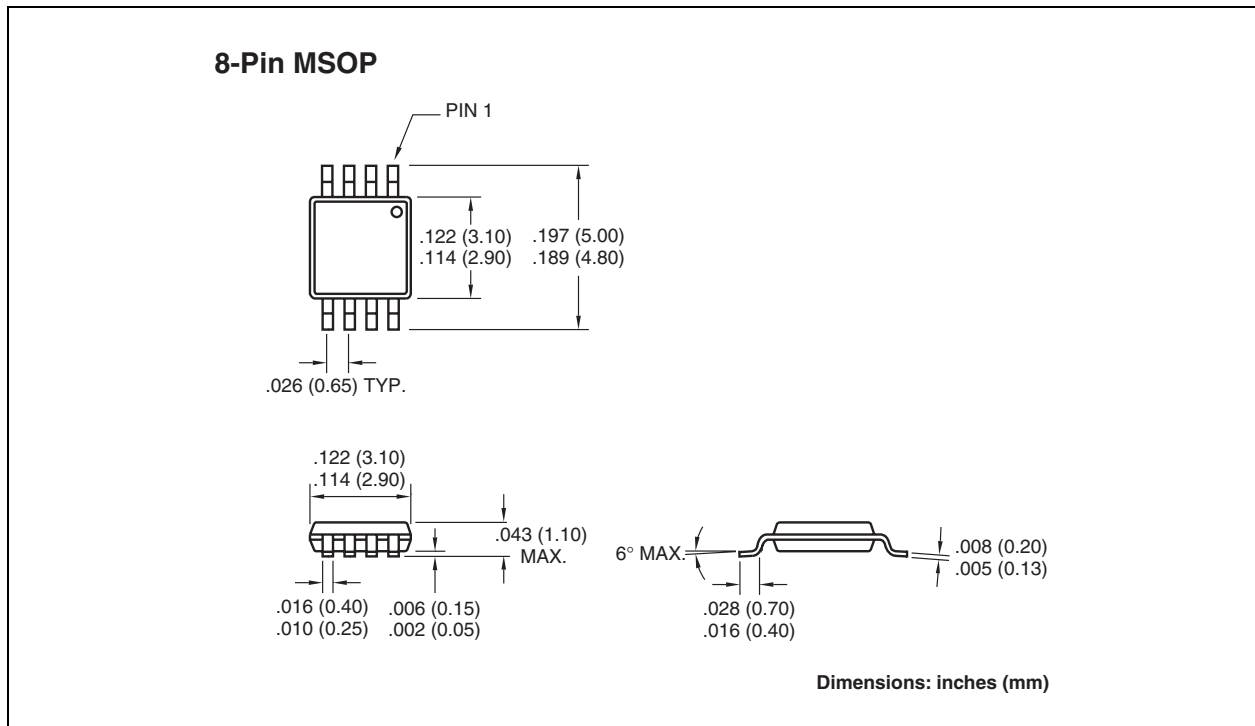


Standard Reel Component Orientation
for TR Suffix Device

Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
8-Pin SOIC (N)	12 mm	8 mm	2500	13 in

5.3 Package Dimensions



TC07

NOTES:

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 Corporate Literature Center U.S. FAX: (480) 792-7277
3. 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.

TC07

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's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELoQ, microID, MPLAB, PIC, PICmicro, PICSTART, PRO MATE, PowerSmart, rPIC, and SmartShunt are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AmpLab, FilterLab, Migratable Memory, MXDEV, MXLAB, PICMASTER, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, dsPICDEM, dsPICDEM.net, dsPICworks, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, Linear Active Thermistor, MPASM, MPLIB, MPLINK, MPSIM, PCKIT, PICDEM, PICDEM.net, PICLAB, PICtail, PowerCal, PowerInfo, PowerMate, PowerTool, rLAB, rPICDEM, Select Mode, Smart Serial, SmartTel, Total Endurance and WiperLock 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.

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

© 2005, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949:2002 ==**

Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, 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://support.microchip.com>
Web Address:
www.microchip.com

Atlanta
Alpharetta, GA
Tel: 770-640-0034
Fax: 770-640-0307

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

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

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

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

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

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

San Jose
Mountain View, CA
Tel: 650-215-1444
Fax: 650-961-0286

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

ASIA/PACIFIC

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

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8676-6200
Fax: 86-28-8676-6599

China - Fuzhou
Tel: 86-591-8750-3506
Fax: 86-591-8750-3521

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

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: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Shunde
Tel: 86-757-2839-5507
Fax: 86-757-2839-5571

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

China - Xian
Tel: 86-29-8833-7250
Fax: 86-29-8833-7256

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-2229-0061
Fax: 91-80-2229-0062

India - New Delhi
Tel: 91-11-5160-8631
Fax: 91-11-5160-8632

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

Japan - Yokohama
Tel: 81-45-471-6166
Fax: 81-45-471-6122

Korea - Gumi
Tel: 82-54-473-4301
Fax: 82-54-473-4302

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

Malaysia - Penang
Tel: 604-646-8870
Fax: 604-646-5086

Philippines - Manila
Tel: 632-634-9065
Fax: 632-634-9069

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

Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

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

EUROPE

Austria - Wels
Tel: 43-7242-2244-399
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