TC32M

ECONOMONITOR™ – 3-Pin System Supervisor with Power Supply Monitor and Watchdog

Features:

- Incorporates the Functionality of the Industry Standard TC1232 (Processor Monitor, Watchdog and Manual Override Reset Controller) into a Small, Lower Cost Package
- Guards Against Unstable Processor Operation Resulting from Power “Brown-Out”
- Automatically Halts and Restarts an Out-of-Control Microprocessor
- Output can be Wire-ORed, or Hooked to Manual Reset Push-button Switch
- Space-Saving 3-Pin TO-92 or SOT-223 Package

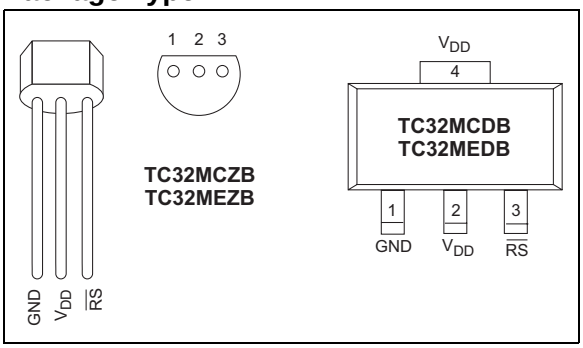
Applications:

- All Microprocessor-Based Systems
- Battery Powered Computers and Controllers
- Automotive Systems
- Intelligent Instruments
- Critical Processor Monitoring
- Embedded Controllers

Device Selection Table

Part Number	Package	Temp. Range
TC32MCDB	SOT-223	0°C to +70°C
TC32MCZB	TO-92	0°C to +70°C
TC32MEDB	SOT-223	-40°C to +85°C
TC32MEZB	TO-92	-40°C to +85°C

Package Type



General Description:

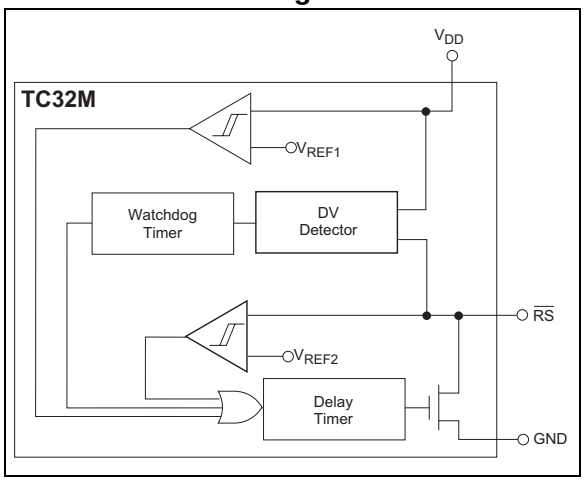
The TC32M is a fully-integrated processor supervisor in a 3-pin package. It provides three important functions to safeguard processor sanity: precision power on/off Reset control, Watchdog Timer and external Reset override.

On power-up, the TC32M holds the processor in the Reset state for a minimum of 500 msec after V_{DD} is within tolerance to ensure a stable system start-up. Microprocessor sanity is monitored by the on-board Watchdog circuit. The microprocessor must provide a high-to-low level shift (through an external resistor divider) on the RS pin of the TC32M. Should the processor fail to supply this signal within the specified time-out period (typically 700 msec), an out-of-control processor is indicated and the TC32M issues a processor Reset as a result.

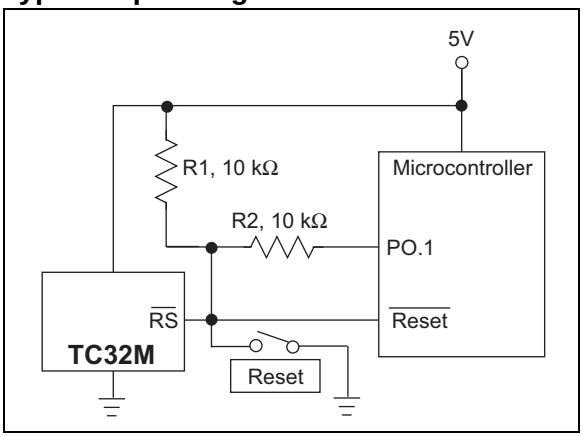
The output of the TC32M can be wire-ORed with a push-button switch (or electronic signal) to override the TC32M and unconditionally reset the processor. When connected to a push-button switch, the TC32M provides contact debounce.

The TC32M is packaged in a space-saving TO-92 or SOT-223 package. It provides all of the functionality of the industry standard TC1232 in a smaller, lower cost configuration.

Functional Block Diagram



Typical Operating Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings*

Supply Voltage (V_{DD} to GND) ..... +6.0V
Input Voltage Any Pin..... (GND – 0.3V) to (V_{DD} +0.3V)
Operating Temperature Range
TC32MC Package..... 0°C to +70°C
TC32ME Package..... -40°C to +85°C
Storage Temperature Range ..... -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.

TC32M ELECTRICAL SPECIFICATIONS

Recommended DC Operating Conditions: T_A = -40°C to +85°C unless otherwise noted.						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Units**	**Test Conditions**
V_{DD}	Supply Voltage	4.5	—	5.5	V	
V_{IH}	$\overline{RS}$ Input HIGH Level for PB	2.0	—	—	V	
V_{IL}	$\overline{RS}$ Input LOW Level for PB	—	—	0.3	V	
DC Electrical Characteristics: V_{DD} = 4.5V to 5.5V, T_A = -40°C to +85°C unless otherwise noted.						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Units**	**Test Conditions**
I_{IL}	$\overline{RS}$ Input Leakage	-1	—	+1	mA	
I_{OL}	$\overline{RS}$ Output Current	2.0	10	—	mA	V_{OL} = 0.4V
I_{CC}	Operating Current	—	50	200	µA	**Note 1**
V_{STH}	$\overline{RS}$ Strobe HIGH Level	(V_{DD} – 0.5V)	—	—	V	Figure 3-1
V_{STL}	$\overline{RS}$ Strobe LOW Level	2.00	—	(V_{DD} – 1.5V)	V	Figure 3-1
V_{RST}	Reset Threshold	4.25	—	4.50	V	V_{DD} Falling (**Note 2**, Figure 3-3)
Capacitance Electrical Characteristics: T_A = 25°C unless otherwise noted.						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Units**	**Test Conditions**
C_{IN}	Input Capacitance	—	—	5	pF	
C_{OUT}	Output Capacitance	—	—	7	pF	
AC Electrical Characteristics: T_A = -40°C to +85°C, V_{DD} = 5V ±10%, unless otherwise noted.						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Units**	**Test Conditions**
t_{RST}	Reset Active Time	500	700	900	msec	Figure
t_{ST}	$\overline{RS}$ Strobe Pulse Width	500	—	—	nsec	Figure 3-1
t_{TD}	Watchdog Time-out Period	500	700	900	msec	Figure 3-1
t_{RPD}	V_{DD} Detect to $\overline{RS}$ LOW	—	—		nsec	Figure 3-1

Note 1: No output load.
2: All voltages referenced to ground.

2.0 PIN DESCRIPTIONS

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

TABLE 2-1: PIN FUNCTION TABLE

Pin No. (SOT-223, TO-92)	Symbol	Description
1	GND	Ground.
2	V_{DD}	The +5V power supply input.
3	RS	$\overline{\text{Reset/Strobe}}$ (Bidirectional). The open drain goes active if: V_{DD} falls below 4.5V nominal. If pulled low by an external electronic signal or switch closure. If the Watchdog is not strobed within the minimum Watchdog Time-out period. During power-up and power-down. In the Input mode, $\overline{\text{RS}}$ connects to a voltage level shift network (typically a resistor divider to V_{DD}.) The Watchdog Timer is reset when processor causes a voltage level $\leq V_{STL}$ to be applied to $\overline{\text{RS}}$.
4	V_{DD}	The +5V power supply input (SOT-223 only).

3.0 DETAILED DESCRIPTION

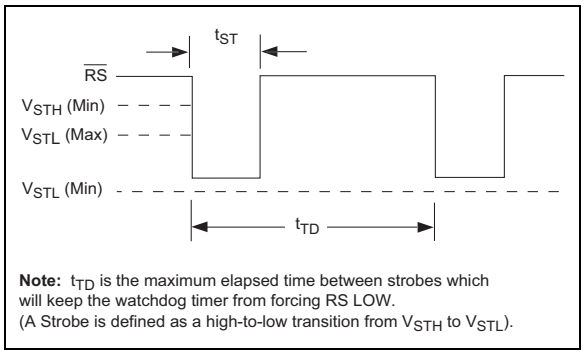
The TC32M provides three important functions to safeguard stable processor operation: precision processor monitor, Watchdog sanity timer and external override Reset control.

3.1 Processor Monitor

The $\overline{RS}$ pin is immediately driven low any time V_{DD} is below the nominal threshold voltage. As a result, this pin is LOW when power is initially applied, holding the processor in its Reset state. $\overline{RS}$ remains low for a minimum of 500 msec after V_{DD} is within tolerance to allow the power supply and processor to stabilize.

3.2 Watchdog Timer

The processor drives the $\overline{RS}$ pin with an input/output (I/O) line in series with an resistor voltage divider to V_{DD}. Pulling the bottom resistor of this divider low results in an internal voltage change (*strobe*) sufficient to reset the Watchdog Timer, but above the V_{IL} input threshold of the processor Reset pin. The processor must continuously apply strobes in this manner within a set period to verify proper software execution. A momentary Reset (500 msec minimum) is generated by the TC32M if a hardware or software failure keeps $\overline{RS}$ from being strobed within the Watchdog Time-out period. This action typically initiates the processor's power-up routine. If the interruption persists, new Reset pulses are generated each time-out period until $\overline{RS}$ is strobed. This time-out period is typically 700 msec.



Note: t_{TD} is the maximum elapsed time between strobes which will keep the watchdog timer from forcing RS LOW. (A Strobe is defined as a high-to-low transition from V_{STH} to V_{STL}).

FIGURE 3-1: *Watchdog Strobe*

The software routine that drives the $\overline{RS}$ strobe must be in a section of the program that executes frequently enough so the time between toggles is less than one Watchdog Time-out period. The strobe signal can be derived from microprocessor address, data and/or control signals. Typical circuit examples are shown in Figure .

3.3 Resistor Value Selection

The values of R1 and R2 must be chosen to ensure a valid low strobe level (V_{STL}) on $\overline{RS}$ when the processor I/O line is low. The use of 10 kΩ, ±5% tolerance resistors are recommended. These values result in a nominal strobe level of 2.5 on $\overline{RS}$ (min/max of 2.13V/3.08V, assuming V_{DD} = 5.0V ±10%). Other resistor values can be used, so long as the additive tolerances of the power supply and resistor values result in a strobe that falls within V_{STH} and V_{STL} under all additive tolerance conditions.

3.4 External Override Reset Control

A built-in debounce circuit allows a push-button switch (PB) or other electronic signal to be wire-ORed to this pin as an external $\overline{\text{Reset}}$ override control. The external $\overline{\text{Reset}}$ is required to be an active low signal. Internally, this input is timed to provide a minimum $\overline{\text{Reset}}$ pulse width of 500 msec. Reference Figure .

t

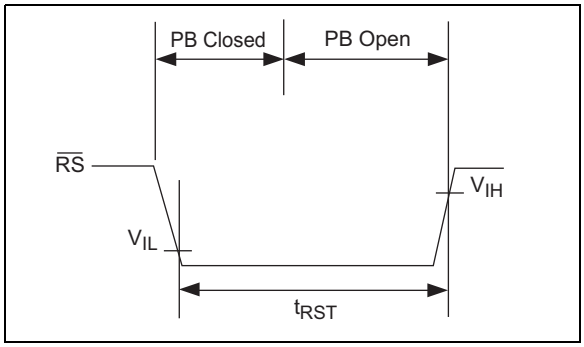


FIGURE 3-2: *$\overline{\text{RS}}$ Pulled Low By Push-Button Reset*

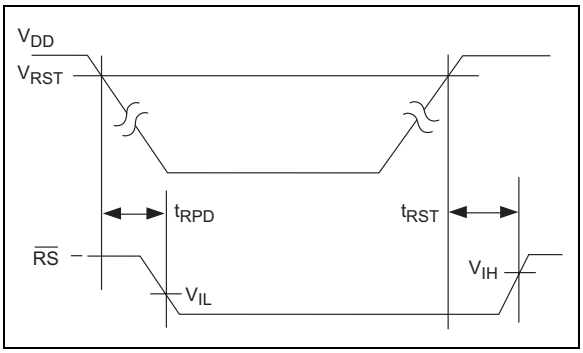


FIGURE 3-3: *Power-Up/Down Reset Timing*

3.5 Supply Monitor Noise Sensitivity

The TC32M is optimized for fast response to negative-going changes in V_{DD}. Systems with an inordinate amount of electrical noise on V_{DD} (such as systems using relays), may require a 0.01 µF bypass capacitor to reduce detection sensitivity. This capacitor should be installed as close to the TC32M as possible to keep the capacitor lead length short.

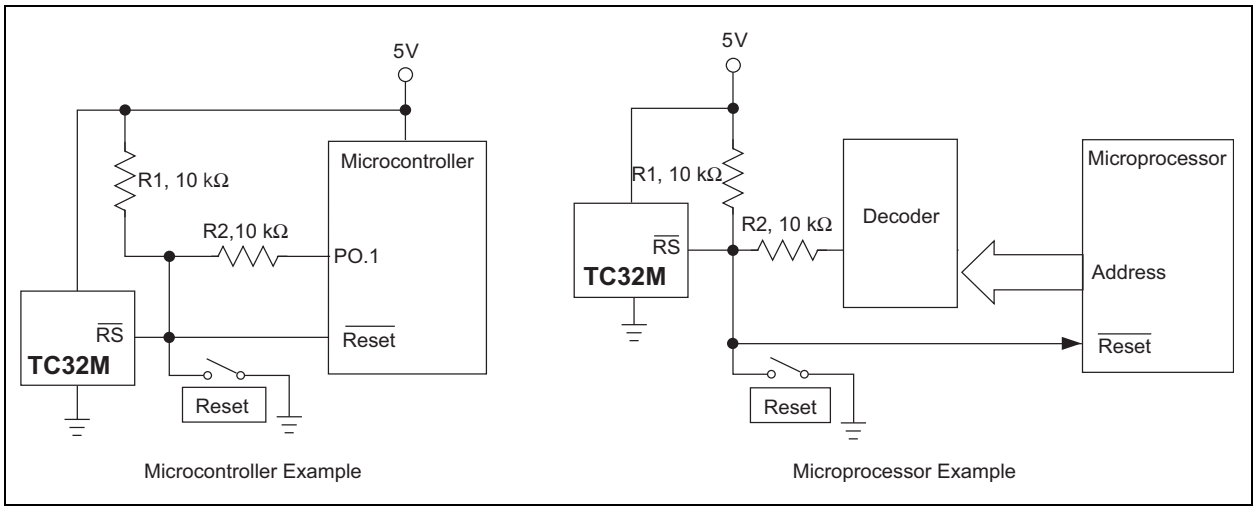


FIGURE 3-4: *TC32M Hardware Connections (R1, R2 Chosen To Meet V_{STH}, V_{STL})*

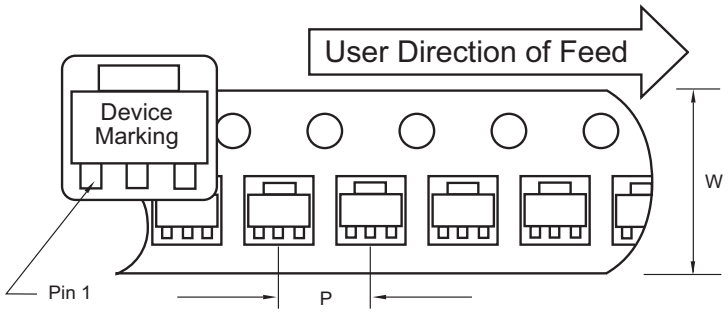
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

Package marking data not available at this time.

4.2 Taping Form

Component Taping Orientation for 3-Pin SOT-223 Devices

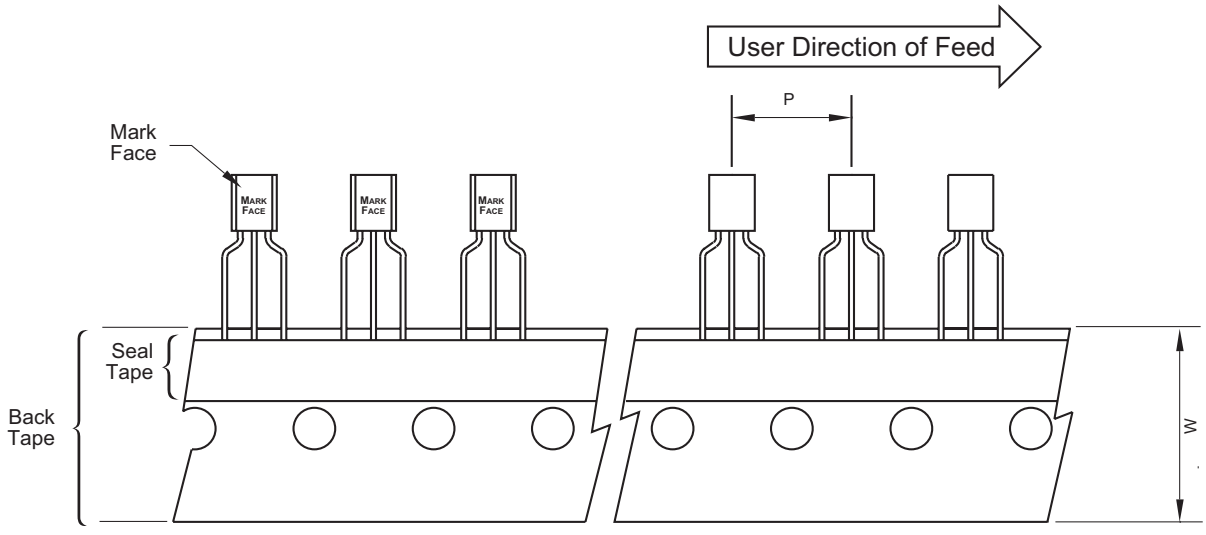


Standard Reel Component Orientation
for 713 Suffix Device
(Mark Right Side Up)

Carrier Tape, Number of Components Per Reel and Reel Size

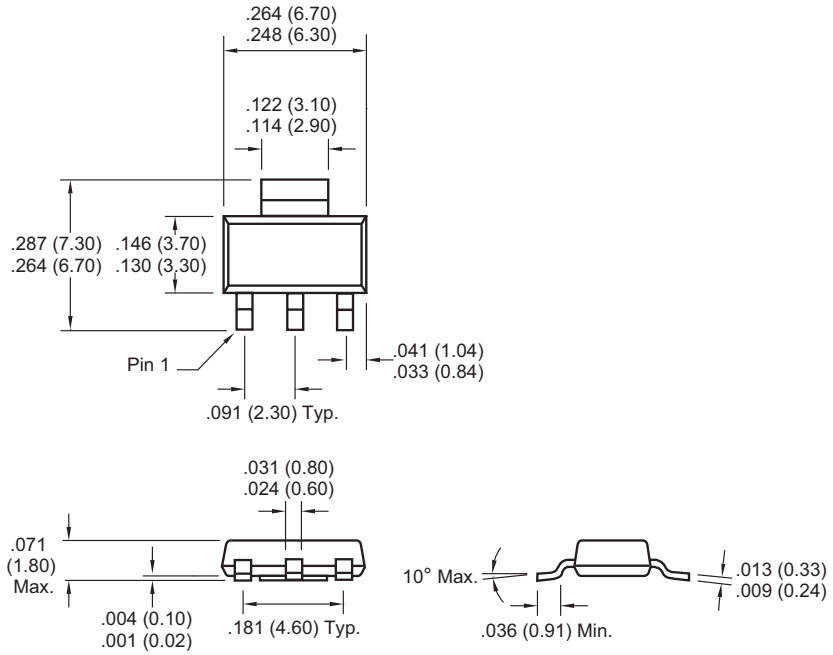
Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
3-Pin SOT-223	12 mm	8 mm	4000	13 in

Component Taping Orientation for 3-Pin TO-92



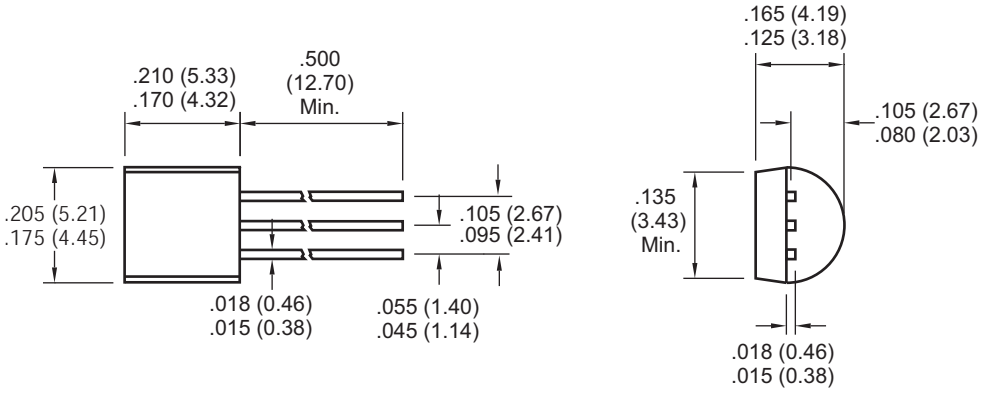
4.3 Package Dimensions

3-Pin SOT-223



Dimensions: inches (mm)

TO-92-3



Dimensions: inches (mm)

PRODUCT IDENTIFICATION SYSTEM

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

PART CODE	TC32M	X	XX

Temperature:
- C: Commercial (0°C to +70°C)
- E: Extended (-40°C to +85°C)

Package Type:
- ZB: 3-Pin TO-92
- DB: 3-Pin SOT223
- DB713: 3-Pin Tape & Reel SOT223

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.

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.

Trademarks

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: 60-4-646-8870
Fax: 60-4-646-5086

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: 886-3-572-9526
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

10/31/05