

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

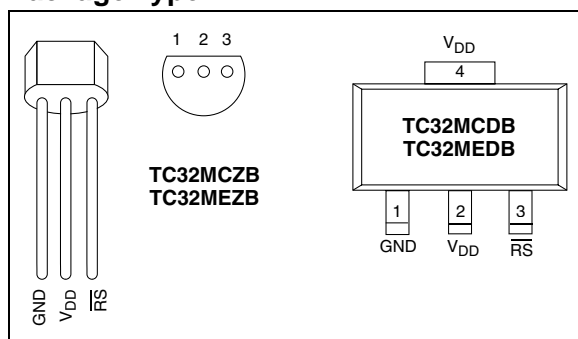
Applications

- 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.

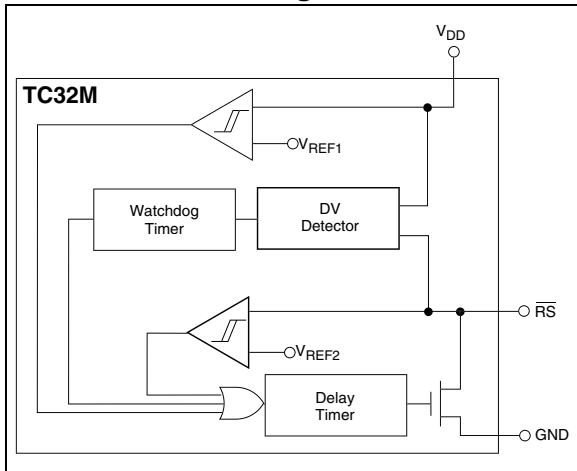
On power-up, the TC32M holds the processor in the reset state for a minimum of 500msec after V_{DD} is within tolerance to ensure a stable system start-up. Microprocessor sanity is monitored by the on-board watchdog circuit. The microprocessor must provide a high-to-low level shift (through an external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

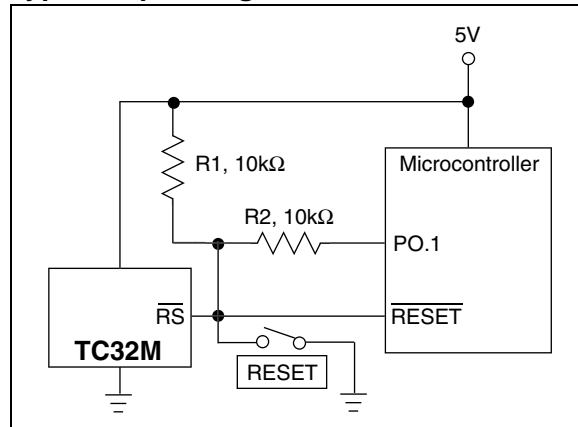
The TC32M is packaged in a space-saving TO-92 or SOT-223 package. It provides all of the functionality of the industry standard TC1232 in a smaller, lower cost configuration.

TC32M

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: $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ 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: $V_{DD} = 4.5\text{V}$ to 5.5V , $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ unless otherwise noted.						
Symbol	Parameter	Min	Typ	Max	Units	Test Conditions
I_{IL}	\overline{RS} Input Leakage	-1	—	+1	μA	
I_{OL}	\overline{RS} Output Current	2.0	10	—	mA	$V_{OL} = 0.4\text{V}$
I_{CC}	Operating Current	—	50	200	μA	Note 1
V_{STH}	\overline{RS} Strobe HIGH Level	$(V_{DD} - 0.5\text{V})$	—	—	V	Figure 3-1
V_{STL}	\overline{RS} Strobe LOW Level	2.00	—	$(V_{DD} - 1.5\text{V})$	V	Figure 3-1
V_{RST}	RESET Threshold	4.25	—	4.50	V	V_{DD} Falling (Note 2, Figure 3-3)
Capacitance Electrical Characteristics: $T_A = 25^\circ\text{C}$ 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: $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{DD} = 5\text{V} \pm 10\%$, unless otherwise noted.						
Symbol	Parameter	Min	Typ	Max	Units	Test Conditions
t_{RST}	RESET Active Time	500	700	900	msec	Figure 3-2
t_{ST}	\overline{RS} Strobe Pulse Width	500	—	—	nsec	Figure 3-1
t_{TD}	Watchdog Timeout Period	500	700	900	msec	Figure 3-1
t_{RPD}	V_{DD} Detect to \overline{RS} LOW	—	—	—	nsec	Figure 3-3

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

TC32M

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	\overline{RS}	$\overline{RESET}/\overline{STROBE}$ (Bidirectional). The open drain goes active if: 1. V_{DD} falls below 4.5V nominal. 2. If pulled low by an external electronic signal or switch closure. 3. If the watchdog is not strobed within the minimum watchdog timeout period. 4. During power-up and power-down. In the input mode, \overline{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{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.

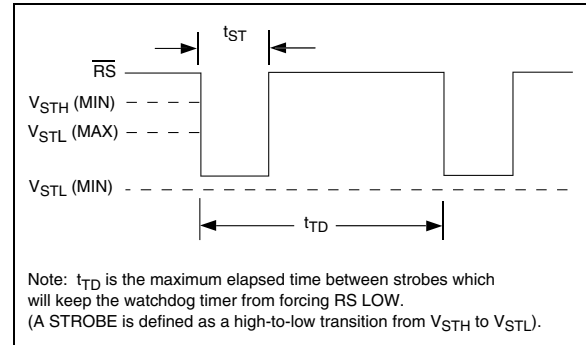
3.1 Processor Monitor

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 500msec 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 a 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 (500msec minimum) is generated by the TC32M if a hardware or software failure keeps \overline{RS} from being strobed within the watchdog timeout period. This action typically initiates the processor's power-up routine. If the interruption persists, new reset pulses are generated each timeout period until \overline{RS} is strobed. This timeout period is typically 700msec.

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 timeout period. The strobe signal can be derived from microprocessor address, data and/or control signals. Typical circuit examples are shown in Figure 3-4.

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 10k Ω , $\pm 5\%$ 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 $V_{DD} = 5.0V \pm 10\%$). 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.

TC32M

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 500msec. Reference Figure 3-2.

FIGURE 3-2: $\overline{\text{RS}}$ PULLED LOW BY PUSH-BUTTON RESET

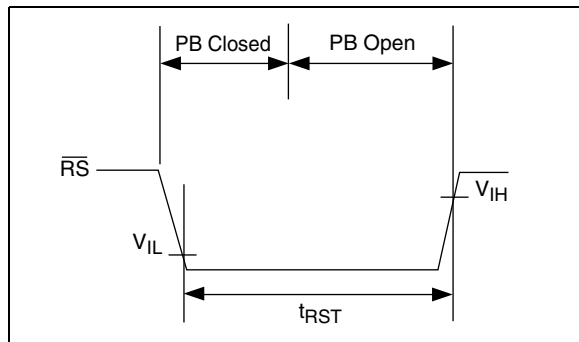
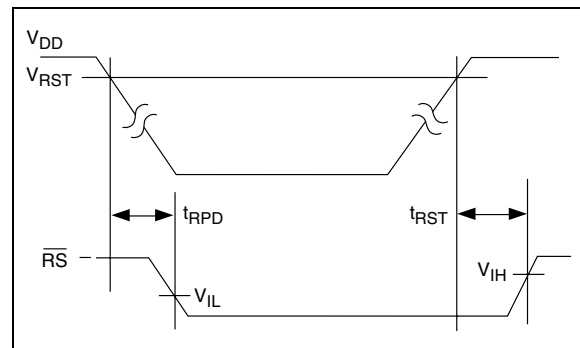


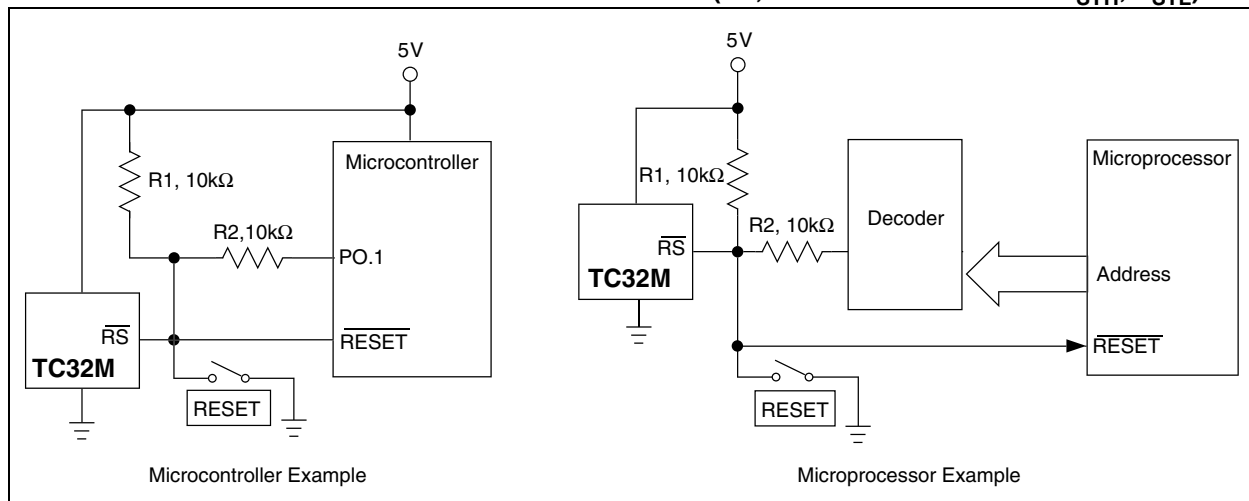
FIGURE 3-3: POWER UP/DOWN RESET TIMING



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 $0.01\mu\text{F}$ 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})

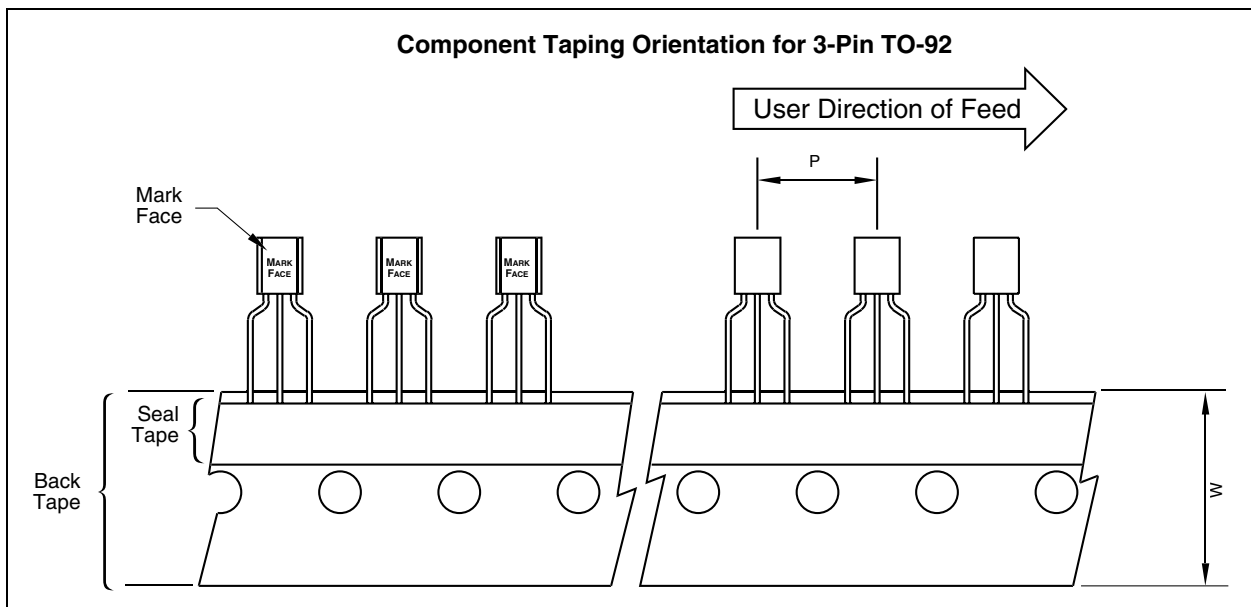
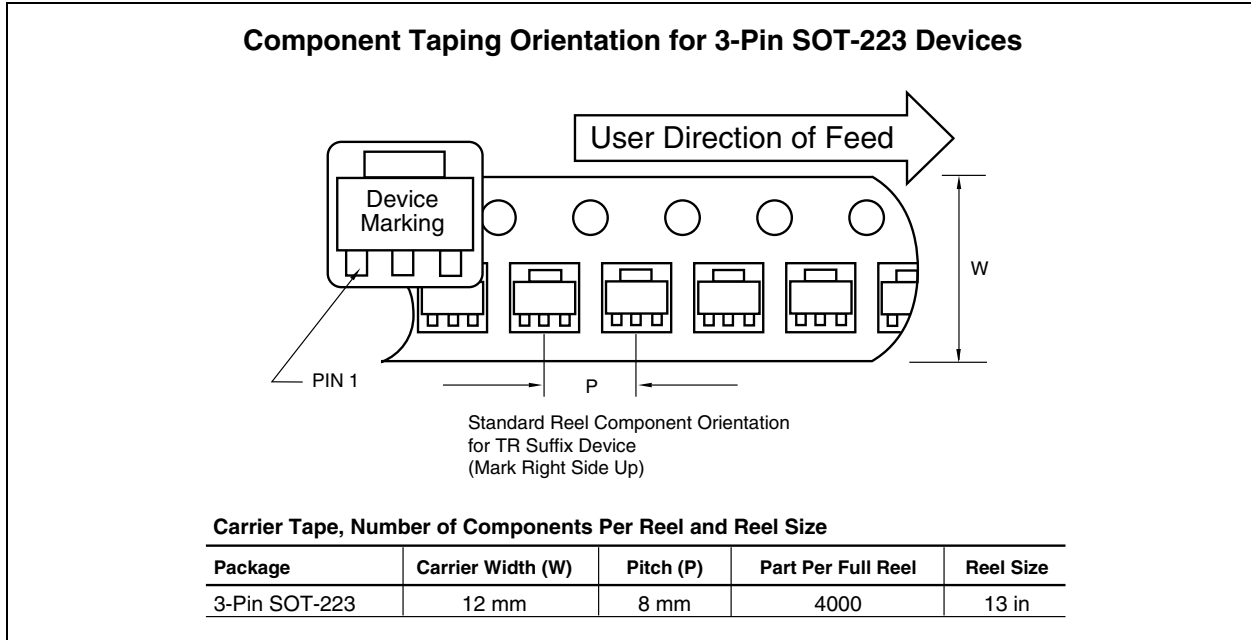


4.0 PACKAGING INFORMATION

4.1 Package Marking Information

Package marking data not available at this time.

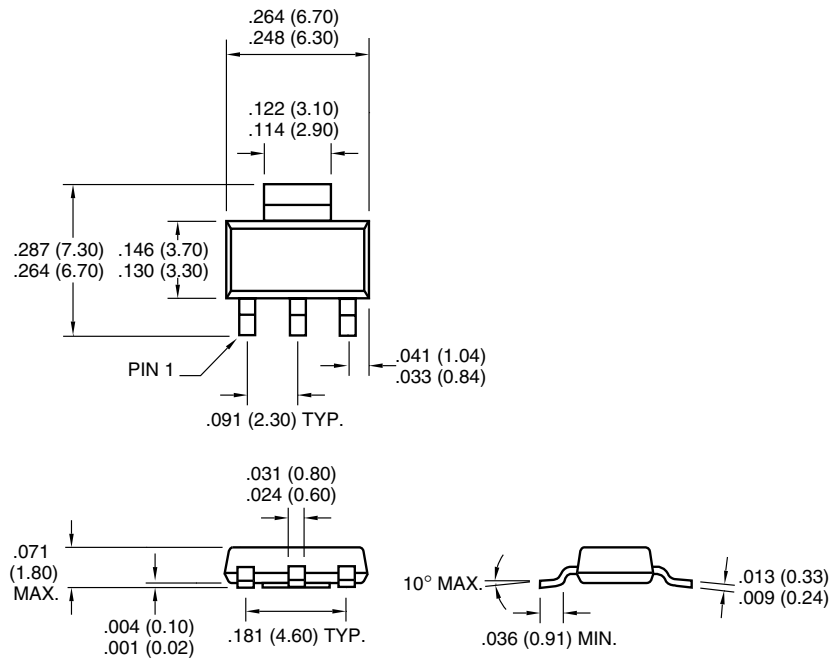
4.2 Taping Form



TC32M

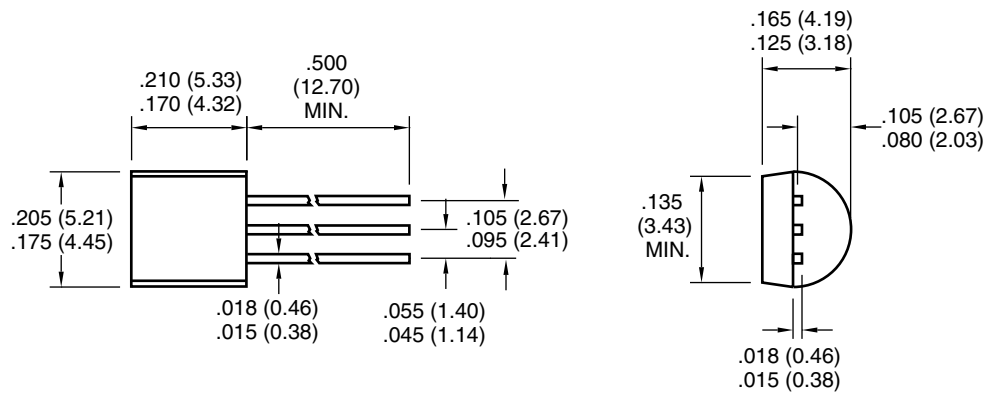
4.3 Package Dimensions

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.

TC32M

NOTES:

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. 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 intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, FilterLab, KEELOQ, microID, MPLAB, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

dsPIC, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, MXDEV, MXLAB, PICC, PICDEM, PICDEM.net, rPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A.

Serialized Quick Turn Programming (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.

© 2002, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



MICROCHIP

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: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo

2767 S. Albright Road
Kokomo, Indiana 46902
Tel: 765-864-8360 Fax: 765-864-8387

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Consulting (Shanghai)
Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu

Microchip Technology Consulting (Shanghai)
Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-86766200 Fax: 86-28-86766599

China - Fuzhou

Microchip Technology Consulting (Shanghai)
Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Shanghai

Microchip Technology Consulting (Shanghai)
Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai)
Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

China - Hong Kong SAR

Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Nordic ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy

Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Microchip Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

05/01/02