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

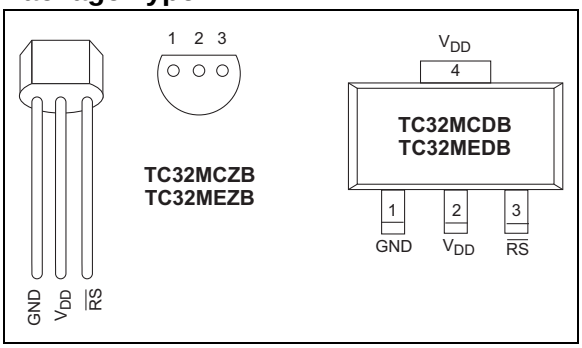
Applications:

- 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.

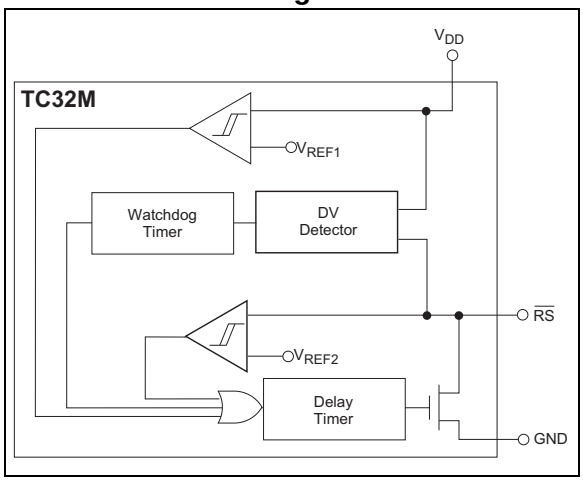
On power-up, the TC32M holds the processor in the Reset state for a minimum of 500 msec after V_{DD} is within tolerance to ensure a stable system start-up. Microprocessor sanity is monitored by the on-board Watchdog circuit. The microprocessor must provide a high-to-low level shift (through an external 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.

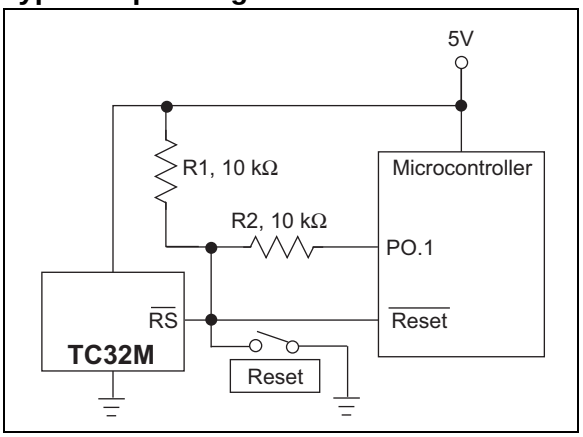
The TC32M is packaged in a space-saving TO-92 or SOT-223 package. It provides all of the functionality of the industry standard TC1232 in a smaller, lower cost configuration.

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Functional Block Diagram



Typical Operating Circuit



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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.

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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. (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).

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3.0 DETAILED DESCRIPTION

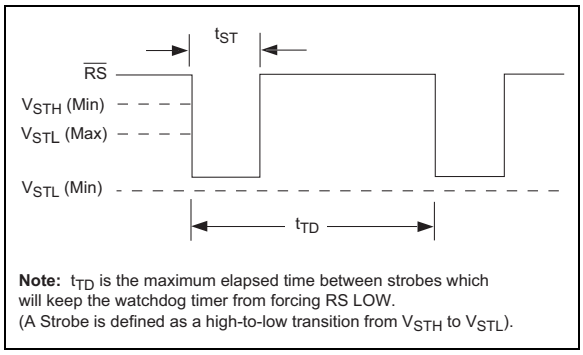
The TC32M provides three important functions to safeguard stable processor operation: precision processor monitor, Watchdog sanity timer and external override Reset control.

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.

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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 .

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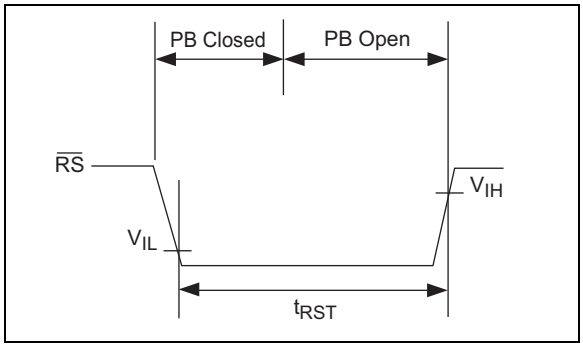


FIGURE 3-2: *$\overline{RS}$ Pulled Low By Push-Button Reset*

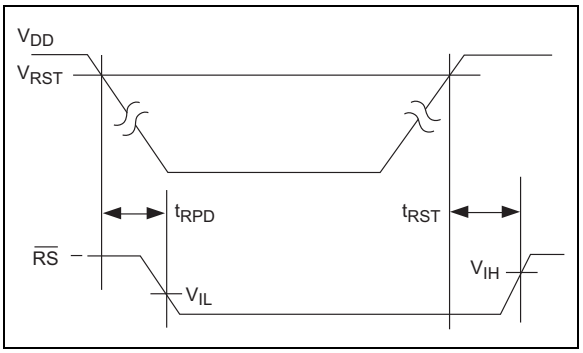


FIGURE 3-3: *Power-Up/Down Reset Timing*

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.

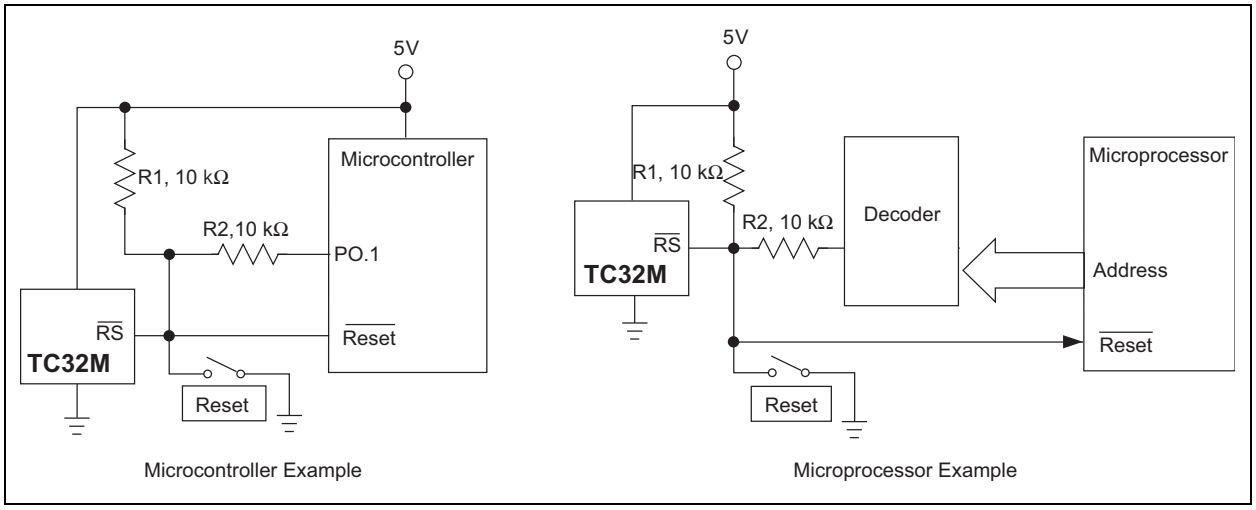


FIGURE 3-4: *TC32M Hardware Connections (R1, R2 Chosen To Meet V_{STH}, V_{STL})*

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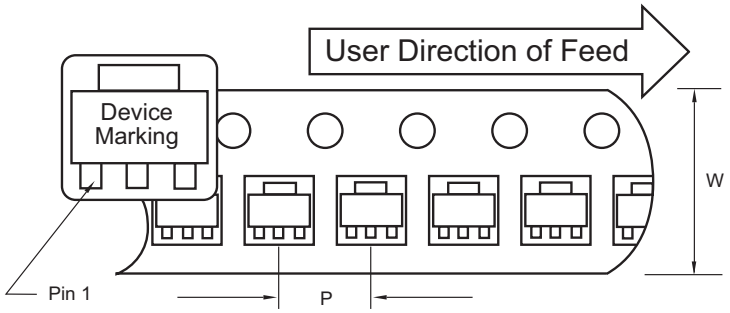
4.0 PACKAGING INFORMATION

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

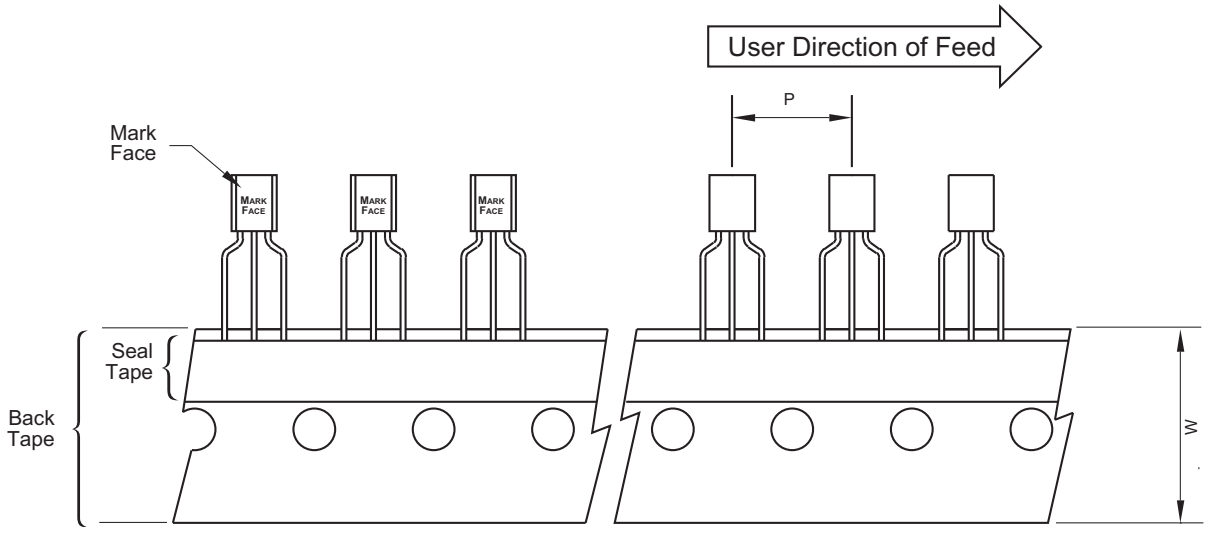


Standard Reel Component Orientation
for 713 Suffix Device
(Mark Right Side Up)

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

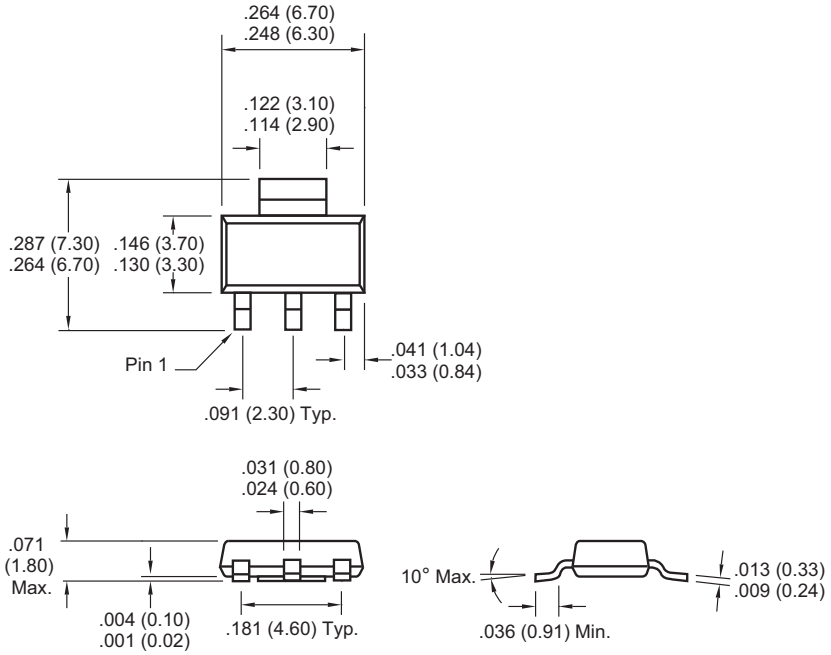
Component Taping Orientation for 3-Pin TO-92



4.3 Package Dimensions

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

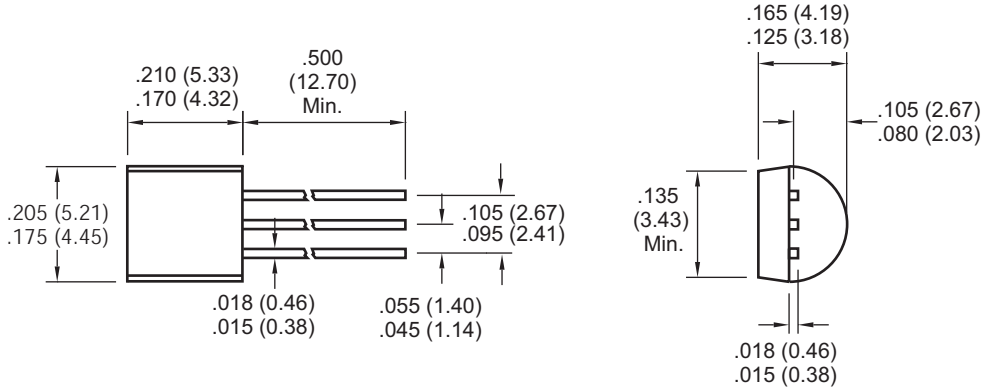
3-Pin SOT-223



Dimensions: inches (mm)

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

TO-92-3



Dimensions: inches (mm)

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5.0 REVISION HISTORY

Revision D (December 2012)

Added a note to each package outline drawing.

NOTES:

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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

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