

## LM3704 Voltage Supervisor With Power-Fail Input, Low-Line Output and Manual Reset

### 1 Features

- Available Threshold Voltage of 3.08 V and 2.32 V
- No External Components Required
- Manual-Reset Input
- Available in Both Open-Drain and Push-Pull Configuration
- Reset Time-Out Delay of 200 ms
- Separate Power-Fail Comparator
- $\pm 0.5\%$  Reset Threshold Accuracy at Room Temperature
- $\pm 2\%$  Reset Threshold Accuracy Over Temperature
- 28- $\mu\text{A}$   $V_{\text{CC}}$  Supply Current

### 2 Applications

- Embedded Controllers and Processors
- Intelligent Instruments
- Automotive Systems
- Critical  $\mu\text{P}$  Power Monitoring

### 3 Description

The LM3704 is a feature-rich, easy-to-use voltage supervisor. It is offered in both push-pull and open-drain configuration with a tight 2% accuracy over temperature.

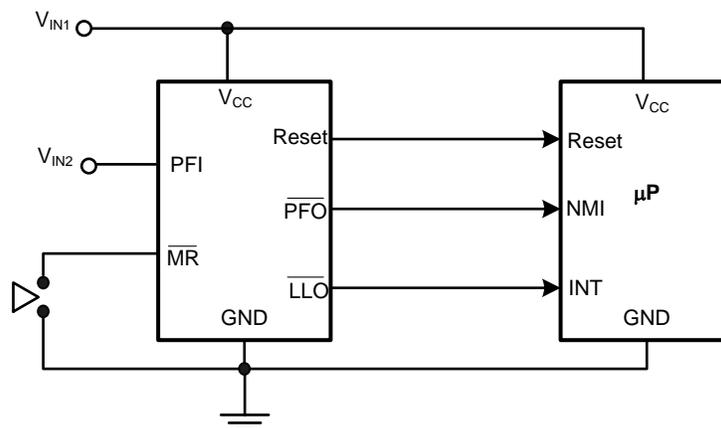
The LM3704 features include a manual reset, low-line output, and power-fail input detection. The power-fail input allows for a configurable second rail to be monitored helping detect upstream failures. The low-line output is used as a second interrupt line to indicate a fall in  $V_{\text{CC}}$  ( $1.02 \times \text{VRST}$ ).

#### Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)   |
|-------------|------------|-------------------|
| LM3704      | VSSOP (10) | 3.00 mm x 3.00 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

#### Typical Application



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## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

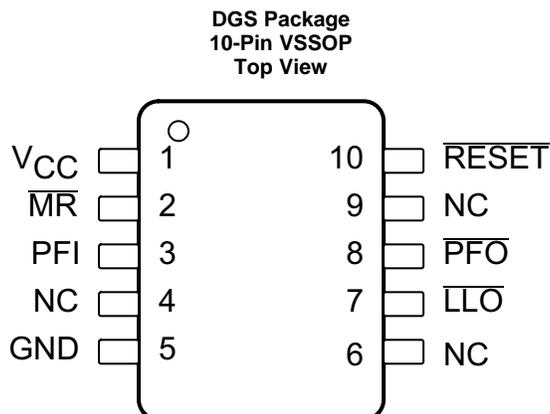
### Changes from Revision E (November 2012) to Revision F

Page

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section .....

1

## 5 Pin Configuration and Functions



**Pin Functions**

| PIN |                           | I/O | DESCRIPTION   |
|-----|---------------------------|-----|---|
| NO. | NAME                      |     |   |
| 1   | V <sub>CC</sub>           | I   | Power supply input.   |
| 2   | $\overline{\text{MR}}$    | I   | Manual-reset input. When $\overline{\text{MR}}$ is less than V <sub>MRT</sub> (manual reset threshold) $\overline{\text{RESET}}$ /RESET is engaged.   |
| 3   | PFI                       | I   | Power-fail comparator input. When PFI is less than V <sub>PFT</sub> (power-fail reset threshold), the $\overline{\text{PFO}}$ goes low. Otherwise, $\overline{\text{PFO}}$ remains high.  |
| 4   | NC                        | —   | No connection.  |
| 5   | GND                       | —   | Ground reference for all signals.   |
| 6   | NC                        | —   | No connection.  |
| 7   | $\overline{\text{LLO}}$   | O   | Low-line logic output. Early power-fail warning output. Low when V <sub>CC</sub> falls below V <sub>LLOT</sub> (low-line output threshold). This output can be used to generate an NMI (non-maskable interrupt) to provide an early warning of imminent power failure.  |
| 8   | $\overline{\text{PFO}}$   | O   | Power-fail logic output. When PFI is below V <sub>PFT</sub> , $\overline{\text{PFO}}$ goes low; otherwise, $\overline{\text{PFO}}$ remains high.  |
| 9   | NC                        | —   | No connection. Test input used at factory only. Leave floating.   |
| 10  | $\overline{\text{RESET}}$ | O   | Reset logic output. Pulses low for t <sub>RP</sub> (reset time-out period) when triggered, and stays low whenever V <sub>CC</sub> is below the reset threshold or when $\overline{\text{MR}}$ is below V <sub>MRT</sub> . It remains low for t <sub>RP</sub> after either V <sub>CC</sub> rises above the reset threshold, or after $\overline{\text{MR}}$ input rises above V <sub>MRT</sub> . |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                | MIN                | MAX            | UNIT |
|--------------------------------|--------------------|----------------|------|
| Supply voltage, $V_{CC}$       | -0.3               | 6              | V    |
| All other inputs               | -0.3               | $V_{CC} + 0.3$ | V    |
| Power dissipation              | See <sup>(2)</sup> |                |      |
| Storage temperature, $T_{stg}$ | -65                | 150            | °C   |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_J(\text{MAX})$ , the junction-to-ambient thermal resistance,  $\theta_{J-A}$ , and the ambient temperature,  $T_A$ . The maximum allowable power dissipation at any ambient temperature is calculated using:

$$P(\text{MAX}) = \frac{T_J(\text{MAX}) - T_A}{\theta_{J-A}}$$

Where the value of  $\theta_{J-A}$  for the 10-pin VSSOP package is 195°C/W in a typical printed-circuit board (PCB) mounting and the DSBGA package is 220°C/W.

### 6.2 ESD Ratings

|  |  | VALUE | UNIT |
|--|--|-------|------|
| $V_{\text{ESD}}$ Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±1500 | V    |
|  | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±150  |      |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|                            | MIN | MAX | UNIT |
|----------------------------|-----|-----|------|
| $T_A$ Free-air temperature | -40 | 85  | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | LM3704      | UNIT |
|-------------------------------|--|-------------|------|
|                               |  | DGS (VSSOP) |      |
|                               |  | 10 PINS     |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 163.7       | °C/W |
| $R_{\theta JC(\text{top})}$   | Junction-to-case (top) thermal resistance    | 58.3        | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 83.5        | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 6           | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 82.2        | °C/W |
| $R_{\theta JC(\text{bot})}$   | Junction-to-case (bottom) thermal resistance | —           | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

## 6.5 Electrical Characteristics

at  $T_J = 25^\circ\text{C}$  and  $V_{CC} = 2.2\text{ V}$  to  $5.5\text{ V}$  (unless otherwise noted)

| PARAMETER                                    |  | TEST CONDITIONS   |   | MIN                 | TYP       | MAX  | UNIT          |
|--|--|---|---|---------------------|-----------|------|---------------|
| <b>POWER SUPPLY</b>                          |  |   |   |                     |           |      |               |
| $V_{CC}$                                     | Operating voltage                                | LM3704, $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   | 1                   |           | 5.5  | V             |
| $I_{CC}$                                     | $V_{CC}$ supply current                          | All inputs = $V_{CC}$ ,<br>all outputs floating   | $T_J = 25^\circ\text{C}$                        |                     | 28        |      | $\mu\text{A}$ |
|  |  |   | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ |                     |           | 50   |               |
| <b>RESET THRESHOLD</b>                       |  |   |   |                     |           |      |               |
| $V_{RST}$                                    | Reset threshold                                  | $V_{CC}$ falling  | $T_J = 25^\circ\text{C}$                        | -0.5%               | $V_{RST}$ | 0.5% |               |
|  |  |   | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ | -2%                 |           | 2%   |               |
|  |  |   | $T_J = 0^\circ\text{C}$ to $70^\circ\text{C}$   | -1.5%               |           | 1.5% |               |
| $V_{RSTH}$                                   | Reset threshold hysteresis                       |   |   | 0.0032 × $V_{RST}$  |           |      | mV            |
| $t_{RP}$                                     | Reset time-out period                            | Reset time-out period =<br>C  | $T_J = 25^\circ\text{C}$                        |                     | 200       |      | ms            |
|  |  |   | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ | 140                 |           | 280  |               |
| $t_{RD}$                                     | $V_{CC}$ to reset delay                          | $V_{CC}$ falling at 1 mV/ $\mu\text{s}$   |   |                     | 20        |      | $\mu\text{s}$ |
| <b>RESET</b>                                 |  |   |   |                     |           |      |               |
| $V_{OL}$                                     | $\overline{\text{RESET}}$                        | $V_{CC} > 1.0\text{ V}$ , $I_{SINK} = 50\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$     |   |                     |           | 0.3  | V             |
|  |  | $V_{CC} > 1.2\text{ V}$ , $I_{SINK} = 100\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$    |   |                     |           | 0.3  |               |
|  |  | $V_{CC} > 2.25\text{ V}$ , $I_{SINK} = 900\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   |                     |           | 0.3  |               |
|  |  | $V_{CC} > 2.7\text{ V}$ , $I_{SINK} = 1.2\text{ mA}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$       |   |                     |           | 0.3  |               |
|  |  | $V_{CC} > 4.5\text{ V}$ , $I_{SINK} = 3.2\text{ mA}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$       |   |                     |           | 0.4  |               |
| $V_{OH}$                                     | $\overline{\text{RESET}}$                        | $V_{CC} > 2.25\text{ V}$ , $I_{SOURCE} = 300\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ |   | $0.8 \times V_{CC}$ |           |      | V             |
|  |  | $V_{CC} > 2.7\text{ V}$ , $I_{SOURCE} = 500\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$  |   | $0.8 \times V_{CC}$ |           |      |               |
|  |  | $V_{CC} > 4.5\text{ V}$ , $I_{SOURCE} = 800\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$  |   | $V_{CC} - 1.5$      |           |      |               |
| <b>PFI/<math>\overline{\text{MR}}</math></b> |  |   |   |                     |           |      |               |
| $V_{PFT}$                                    | PFI input threshold                              | $T_J = 25^\circ\text{C}$  |   |                     | 1.225     |      | V             |
|  |  | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   | 1.2                 |           | 1.25 |               |
| $V_{MRT}$                                    | $\overline{\text{MR}}$ Input threshold           | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   | $\overline{\text{MR}}$ , low                    |                     |           | 0.8  | V             |
|  |  |   | $\overline{\text{MR}}$ , high                   | 2                   |           |      |               |
| $V_{PFTH}/$<br>$V_{MRTH}$                    | PFI/ $\overline{\text{MR}}$ threshold hysteresis | PFI/ $\overline{\text{MR}}$ falling, $V_{CC} = V_{RST\text{ MAX}}$ to $5.5\text{ V}$                            |   | 0.0032 × $V_{RST}$  |           |      | mV            |
| $I_{PFI}$                                    | Input current (PFI only)                         | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   | -75                 |           | 75   | nA            |
| $R_{MR}$                                     | $\overline{\text{MR}}$ pullup resistance         | $T_J = 25^\circ\text{C}$  |   |                     | 56        |      | k $\Omega$    |
|  |  | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   | 35                  |           | 75   |               |
| $t_{MD}$                                     | $\overline{\text{MR}}$ to reset delay            |   |   |                     | 12        |      | $\mu\text{s}$ |
| $t_{MR}$                                     | $\overline{\text{MR}}$ pulse width               | $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   | 25                  |           |      | $\mu\text{s}$ |
| <b>PFO, LLO</b>                              |  |   |   |                     |           |      |               |
| $V_{OL}$                                     | PFO, LLO output low voltage                      | $V_{CC} > 2.25\text{ V}$ , $I_{SINK} = 900\ \mu\text{A}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$   |   |                     |           | 0.3  | V             |
|  |  | $V_{CC} > 2.7\text{ V}$ , $I_{SINK} = 1.2\text{ mA}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$       |   |                     |           | 0.3  |               |
|  |  | $V_{CC} > 4.5\text{ V}$ , $I_{SINK} = 3.2\text{ mA}$ ,<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$       |   |                     |           | 0.4  |               |

**Electrical Characteristics (continued)**

at  $T_J = 25^\circ\text{C}$  and  $V_{CC} = 2.2\text{ V to }5.5\text{ V}$  (unless otherwise noted)

| PARAMETER  | TEST CONDITIONS  | MIN   | TYP                     | MAX                   | UNIT          |
|--|--|---|-------------------------|-----------------------|---------------|
| $V_{OH}$ $\overline{\text{PFO}}$ , $\overline{\text{LLO}}$ output high voltage | $V_{CC} > 2.25\text{ V}$ , $I_{SOURCE} = 300\ \mu\text{A}$ , $T_J = -40^\circ\text{C to }85^\circ\text{C}$ | $0.8 V_{CC}$                                  |                         |                       | V             |
|  | $V_{CC} > 2.7\text{ V}$ , $I_{SOURCE} = 500\ \mu\text{A}$ , $T_J = -40^\circ\text{C to }85^\circ\text{C}$  | $0.8 V_{CC}$                                  |                         |                       |               |
|  | $V_{CC} > 4.5\text{ V}$ , $I_{SOURCE} = 800\ \mu\text{A}$ , $T_J = -40^\circ\text{C to }85^\circ\text{C}$  | $V_{CC} - 1.5$                                |                         |                       |               |
| <b><math>\overline{\text{LLO}}</math> OUTPUT</b>                               |  |   |                         |                       |               |
| $V_{LLOT}$ $\overline{\text{LLO}}$ output threshold                            | $V_{LLO} - V_{RST}$ , $V_{CC}$ falling   | $T_J = 25^\circ\text{C}$                      | $1.02 \times V_{RST}$   |                       | V             |
|  |  | $T_J = -40^\circ\text{C to }85^\circ\text{C}$ | $1.01 \times V_{RST}$   | $1.03 \times V_{RST}$ |               |
| $V_{LLOTH}$ Low-line comparator hysteresis                                     |  |   | $0.0032 \times V_{RST}$ |                       | mV            |
| $t_{CD}$ Low-line comparator delay   | $V_{CC}$ falling at $1\text{ mV}/\mu\text{s}$  |   | 20                      |                       | $\mu\text{s}$ |

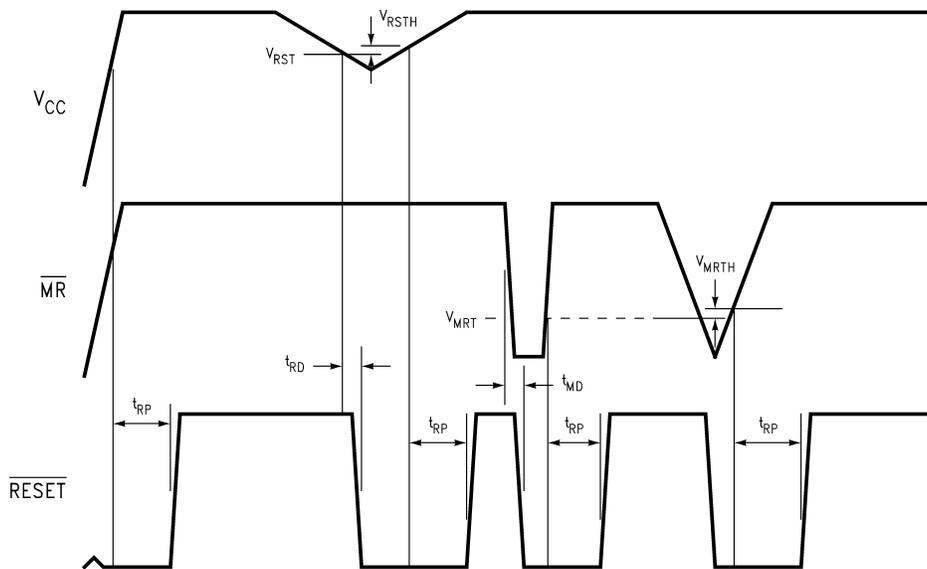


Figure 1. LM3704 Reset Time With  $\overline{\text{MR}}$

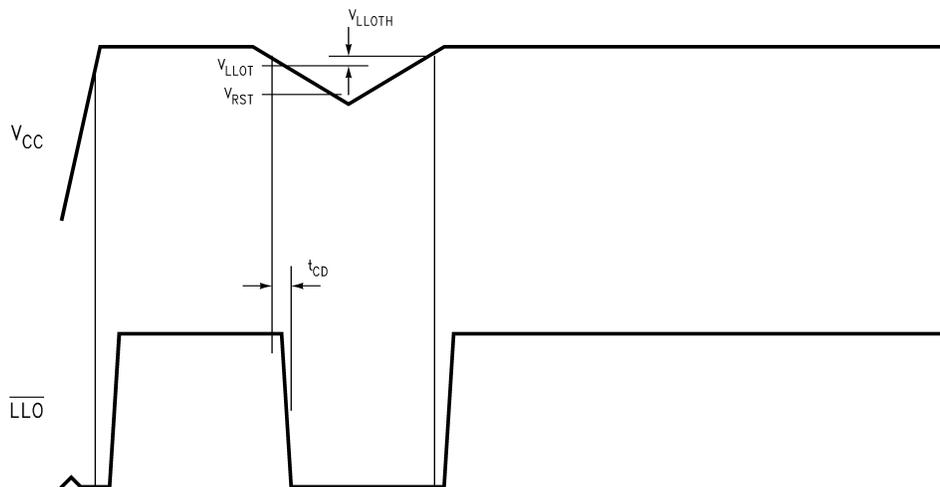


Figure 2.  $\overline{\text{LLO}}$  Output

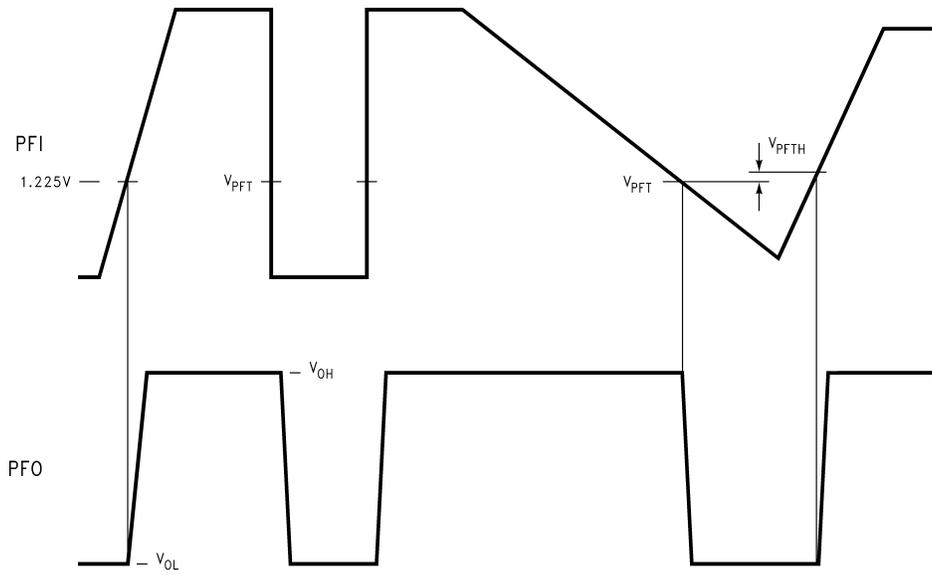


Figure 3. PFI Comparator Timing Diagram

## 6.6 Typical Characteristics

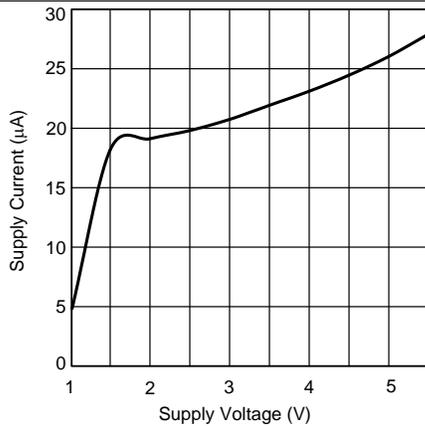


Figure 4. Supply Current vs Supply Voltage

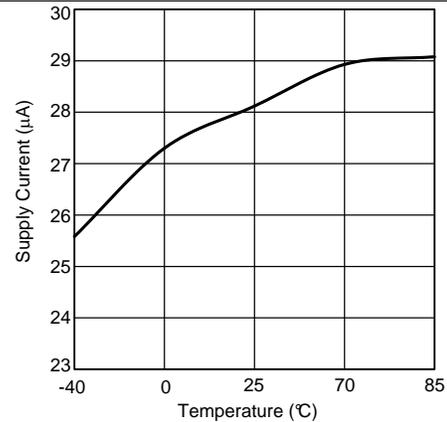


Figure 5. 3.3-V Supply Current vs Temperature

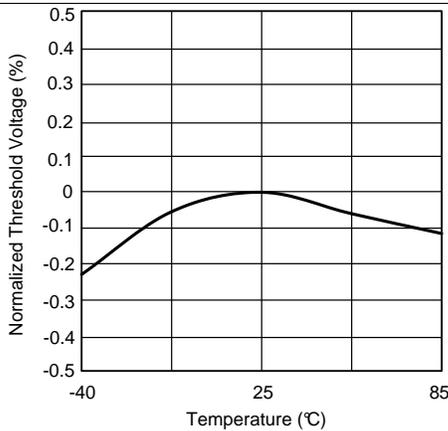


Figure 6. Normalized Reset Threshold Voltage vs Temperature

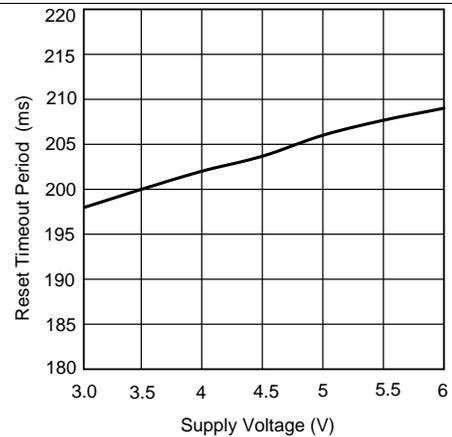


Figure 7. Reset Timeout Period vs  $V_{CC}$

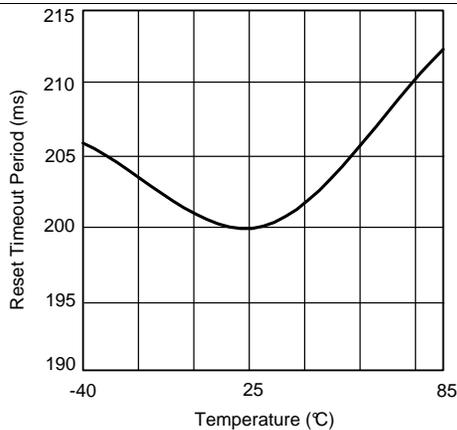
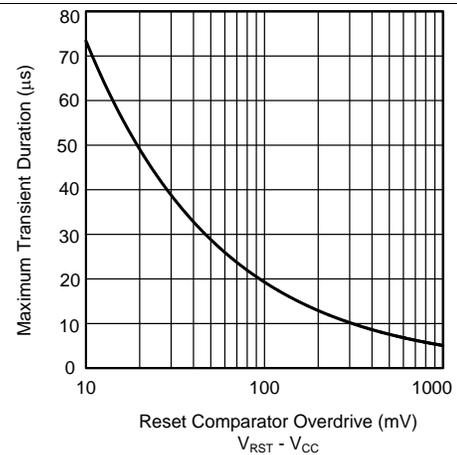


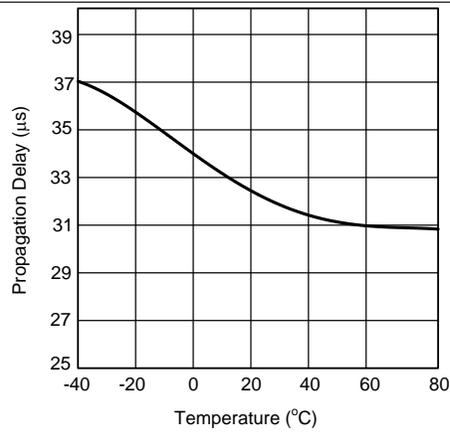
Figure 8. Reset Timeout Period vs Temperature



$V_{CC} = 3.3\text{ V}$

Figure 9. Maximum Transient Duration vs Reset Comparator Overdrive

**Typical Characteristics (continued)**



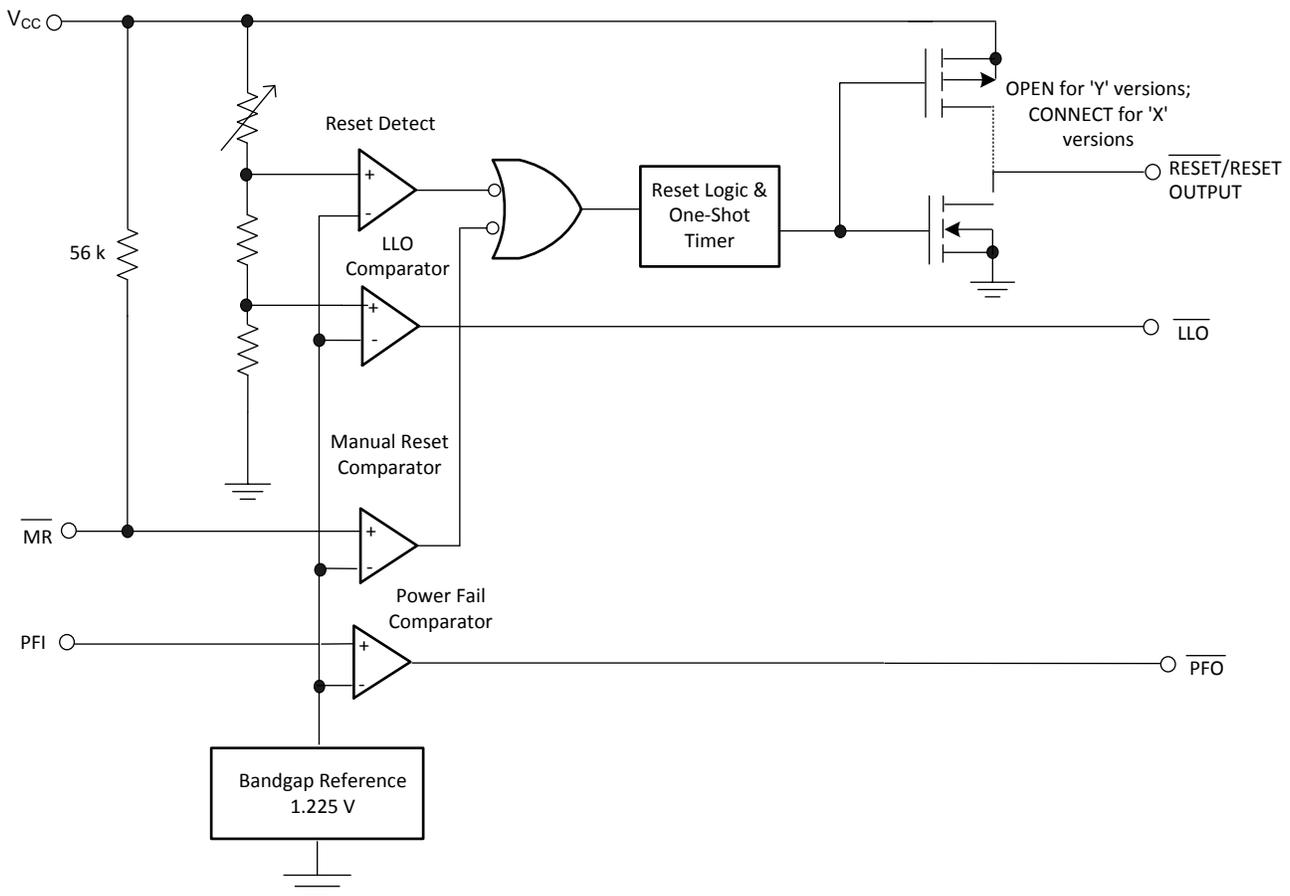
**Figure 10. Low-Line Comparator Propagation Delay vs Temperature**

## 7 Detailed Description

### 7.1 Overview

The LM3704 microprocessor supervisory circuit monitors power supplies and battery-controlled functions in systems and does not require external components. There is a standard reset threshold voltage of 3.08 V while other custom reset threshold voltages are available to provide maximum monitoring flexibility. The  $\overline{\text{RESET}}$  pin pulses low for the reset time-out period when triggered and stays low whenever  $V_{CC}$  is below the reset threshold or when  $\overline{\text{MR}}$  is below  $V_{\text{MRT}}$ . Once the  $V_{CC}$  rises above the reset threshold, or after  $\overline{\text{MR}}$  input rises above  $V_{\text{MRT}}$ , the  $\overline{\text{RESET}}$  pin remains low for the reset timeout period before coming up.

### 7.2 Functional Block Diagram



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### 7.3 Feature Description

#### 7.3.1 Reset Output

The reset input of a  $\mu\text{P}$  initializes the device into a known state. The LM3704 microprocessor supervisory circuit asserts a forced reset output to prevent code execution errors during power-up, power-down, and brownout conditions.

$\overline{\text{RESET}}$  is ensured valid for  $V_{CC} > 1$  V. Once  $V_{CC}$  exceeds the reset threshold, an internal timer maintains the output for the reset time-out period. After this interval, reset goes high. The LM3704 offers an active-low  $\overline{\text{RESET}}$ .

Any time  $V_{CC}$  drops below the reset threshold (such as during a brownout), the reset activates. When  $V_{CC}$  again rises above the reset threshold, the internal timer starts. Reset holds until  $V_{CC}$  exceeds the reset threshold for longer than the reset time-out period. After this time, reset releases.

## Feature Description (continued)

The Manual Reset input ( $\overline{\text{MR}}$ ) initiates a forced reset also. See [Manual Reset Input \( \$\overline{\text{MR}}\$ \)](#).

### 7.3.2 Reset Threshold

The LM3704 is available with a reset voltage of 3.08 V. Other reset thresholds in the 2.20-V to 5-V range, in steps of 10 mV, are available; contact Texas Instruments for details.

### 7.3.3 Manual Reset Input ( $\overline{\text{MR}}$ )

Many  $\mu\text{P}$ -based products require a manual reset capability, allowing the operator to initiate a reset. The  $\overline{\text{MR}}$  input is fully debounced and provides an internal 56-k $\Omega$  pullup. When the  $\overline{\text{MR}}$  input is pulled below  $V_{\text{MRT}}$  (1.225 V) for more than 25  $\mu\text{s}$ , reset is asserted after a typical delay of 12  $\mu\text{s}$ . Reset remains active as long as  $\overline{\text{MR}}$  is held low, and releases after the reset time-out period expires after  $\overline{\text{MR}}$  rises above  $V_{\text{MRT}}$ . Use  $\overline{\text{MR}}$  with digital logic to assert or to daisy chain supervisory circuits. It may be used as another low-line comparator by adding a buffer.

### 7.3.4 Power-Fail Comparator (PFI/ $\overline{\text{PFO}}$ )

The PFI is compared to a 1.225-V internal reference,  $V_{\text{PFT}}$ . If PFI is less than  $V_{\text{PFT}}$ , the Power-Fail Output ( $\overline{\text{PFO}}$ ) drops low. The power-fail comparator signals a falling power supply, and is driven typically by an external voltage divider that senses either the unregulated supply or another system supply voltage. The voltage divider generally is chosen so the voltage at PFI drops below  $V_{\text{PFT}}$  several milliseconds before the main supply voltage drops below the reset threshold, providing advanced warning of a brownout.

The voltage threshold is set by  $R_1$  and  $R_2$  and is calculated with [Equation 1](#).

$$V_{\text{PFT}} = \left( \frac{R_1 + R_2}{R_2} \right) \times 1.225\text{V} \quad (1)$$

#### NOTE

This comparator is completely separate from the rest of the circuitry, and may be employed for other functions as needed.

### 7.3.5 Low-Line Output ( $\overline{\text{LLO}}$ )

The low-line output comparator is typically used to provide a non-maskable interrupt to a  $\mu\text{P}$  when  $V_{\text{CC}}$  begins falling.  $\overline{\text{LLO}}$  monitors  $V_{\text{CC}}$  and goes low when  $V_{\text{CC}}$  falls below  $V_{\text{LLOT}}$  (typically  $1.02 \times V_{\text{RST}}$ ) with hysteresis of  $0.0032 \times V_{\text{RST}}$ .

## 7.4 Device Functional Modes

### 7.4.1 $\overline{\text{RESET}}$ Output Low

Anytime  $V_{\text{CC}}$  drops below the reset threshold, the  $\overline{\text{RESET}}$  output drops low and remains low until  $V_{\text{CC}}$  rises above the threshold and the reset time-out period has expired. The manual reset input ( $\overline{\text{MR}}$ ) also causes the reset to be active. If  $\overline{\text{MR}}$  input is pulled below  $V_{\text{MRT}}$  for more than 25  $\mu\text{s}$ , the  $\overline{\text{RESET}}$  output drops low and remains low until  $\overline{\text{MR}}$  rises above the manual reset threshold ( $V_{\text{MRT}}$ ) and the reset time-out period has expired.

### 7.4.2 $\overline{\text{RESET}}$ Output High

The  $\overline{\text{RESET}}$  output remains high as long as  $V_{\text{CC}}$  is above the reset threshold and  $\overline{\text{MR}}$  is above the manual reset threshold ( $V_{\text{MRT}}$ ).

## 8 Application and Implementation

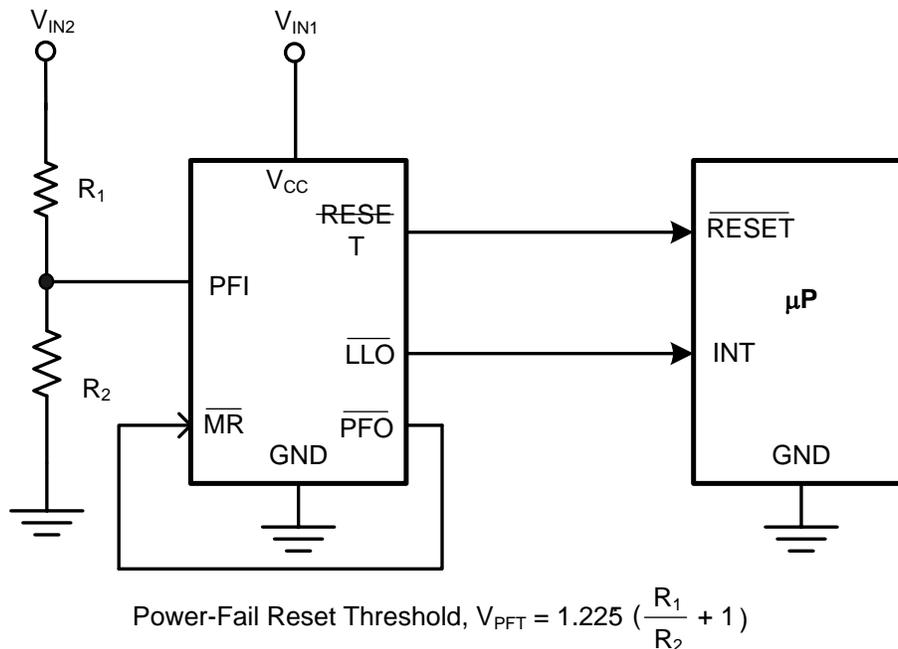
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 8.1 Application Information

The LM3704 is a microprocessor supervisory circuit that provides the maximum flexibility for monitoring power supplies and battery-controlled functions. The reset threshold is typically 3.08 V but can be customized for voltages between 2.2 V and 5 V in 10-mV increments by contacting Texas Instruments. The power-fail input, which is a 1.225-V threshold detector for power-fail warning, can be adjusted using a resistor divider as shown in [Figure 11](#). This section shows various application circuits to provide different monitoring solutions.

### 8.2 Typical Application



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**Figure 11. Monitoring Two Critical Supplies**

#### 8.2.1 Design Requirements

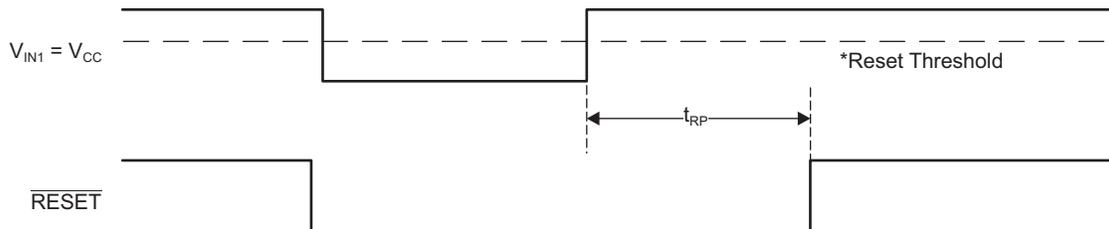
The component count is minimal; employing two resistors as part of a voltage-divider circuit is all that is needed for the typical application of monitoring two critical supplies shown in [Figure 11](#).

#### 8.2.2 Detailed Design Procedure

The voltage-divider circuit that connects to the power-fail reset pin is chosen such that the reset threshold at the device is 1.225 V as shown in [Figure 11](#).

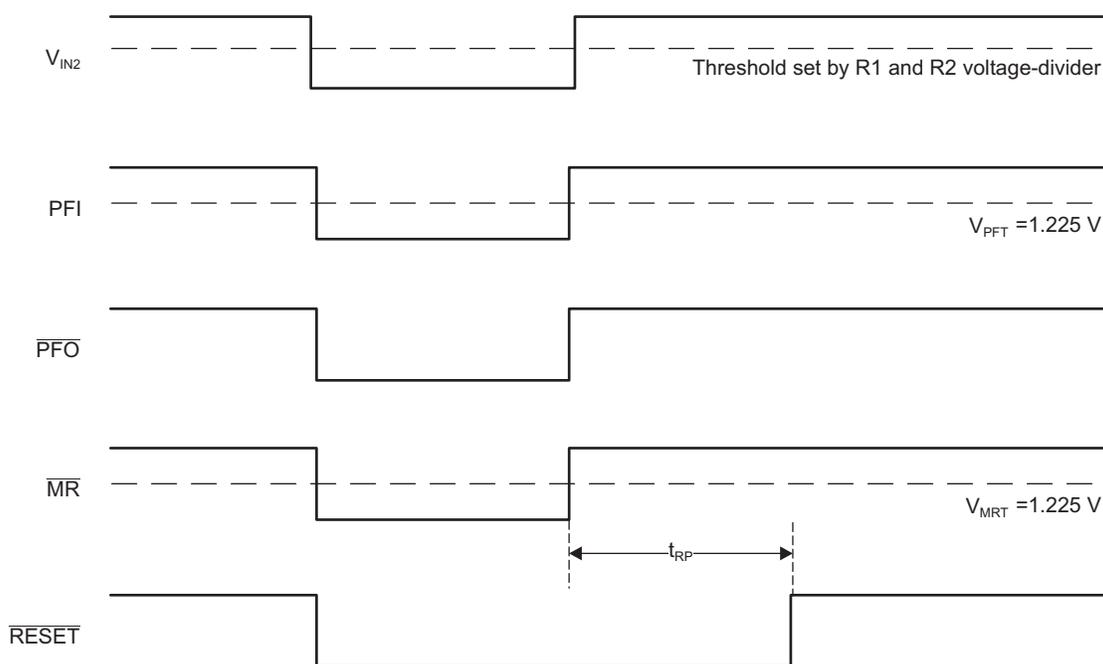
**Typical Application (continued)**

**8.2.3 Application Curves**



Standard reset threshold is 3.08 V. Custom reset voltages are available between 2.2 V and 5 V in 10-mV increments by contacting Texas Instruments.

**Figure 12. Monitoring  $V_{IN1}$  for Reset Condition**

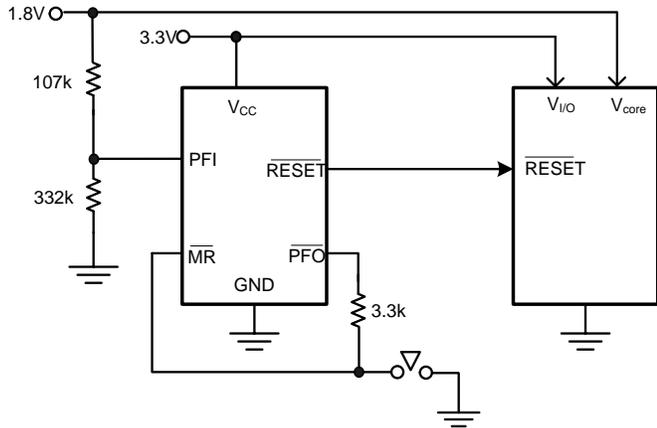


See [Electrical Characteristics](#) for high and low levels of this specific application.

**Figure 13. Monitoring  $V_{IN2}$  for Reset Condition**

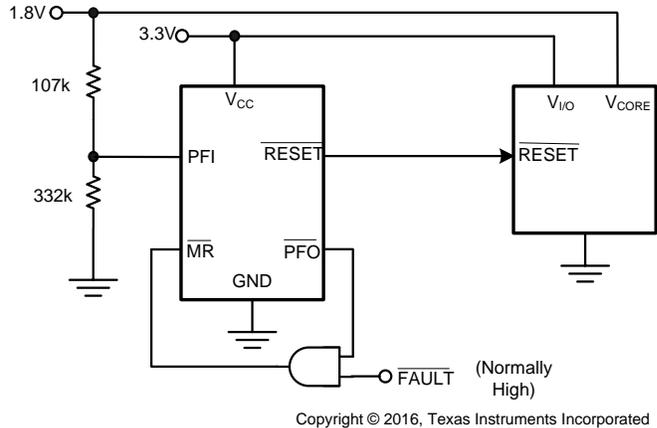
### 8.3 System Examples

The LM3704 voltage supervisor has various features such as power-fail input detection, low-line output, and manual reset while requiring few to no additional components making it versatile and easy-to-use. See Figure 14 through Figure 18 for a variety of circuit applications.



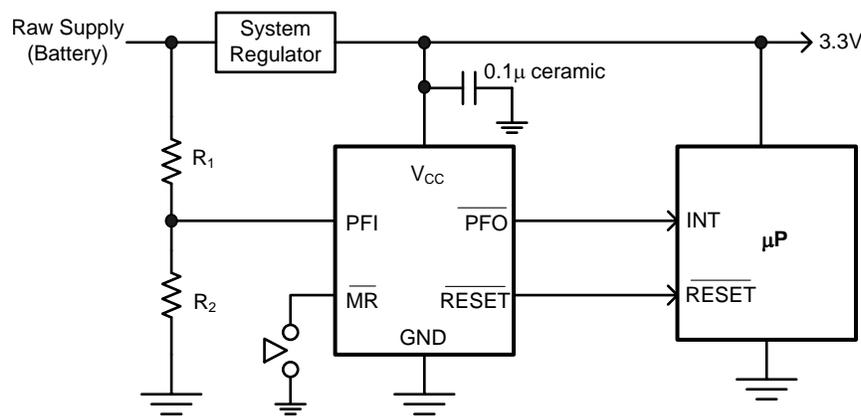
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**Figure 14. Monitoring Two Supplies Plus Manual Reset**



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**Figure 15. Monitoring Dual Supplies Plus External Fault Input**



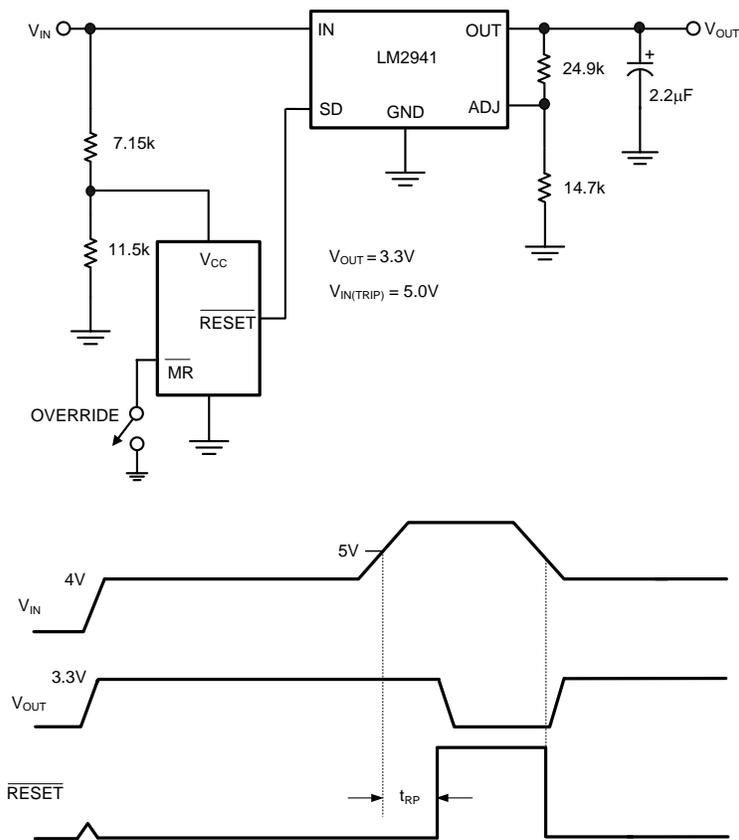
$$\text{Power-Fail Reset Threshold, } V_{PFT} = 1.225 \left( \frac{R_1}{R_2} + 1 \right)$$

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$\overline{\text{MR}}$  input with its 1.225-V nominal threshold, may monitor an additional supply voltage. An internal 56-kΩ pullup resistor is included on this input.

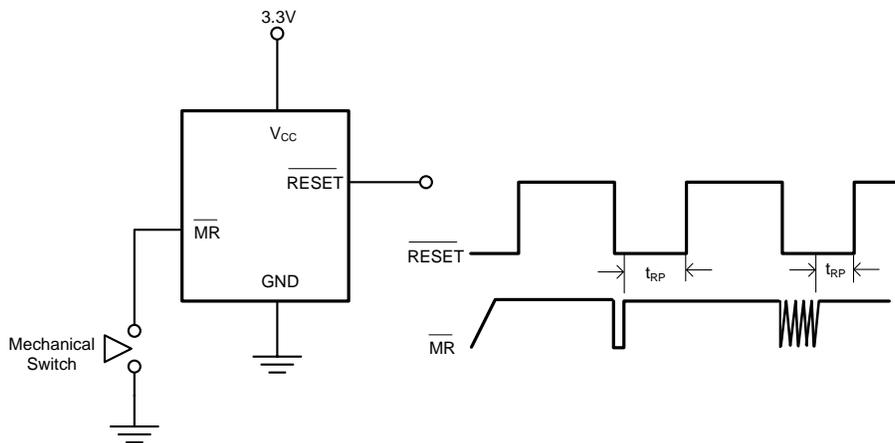
**Figure 16. Microprocessor Supervisor With Early Warning Detector**

System Examples (continued)



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Figure 17. Regulator/Switch With Long-Term Overvoltage Lockout Prevents Overdissipation in Linear Regulator



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Figure 18. Switch Debouncer

## 9 Power Supply Recommendations

The input power supply to the  $V_{CC}$  pin of the LM3704 must be kept at a voltage lower than the recommended voltage of 5.5 V. All other input pins must be kept at a voltage lower than  $V_{CC} + 0.3$  V. Do not exceed absolute maximum ratings found in [Absolute Maximum Ratings](#) in any circumstance.

## 10 Layout

### 10.1 Layout Guidelines

Keep traces short between IC and external components.

### 10.2 Layout Example

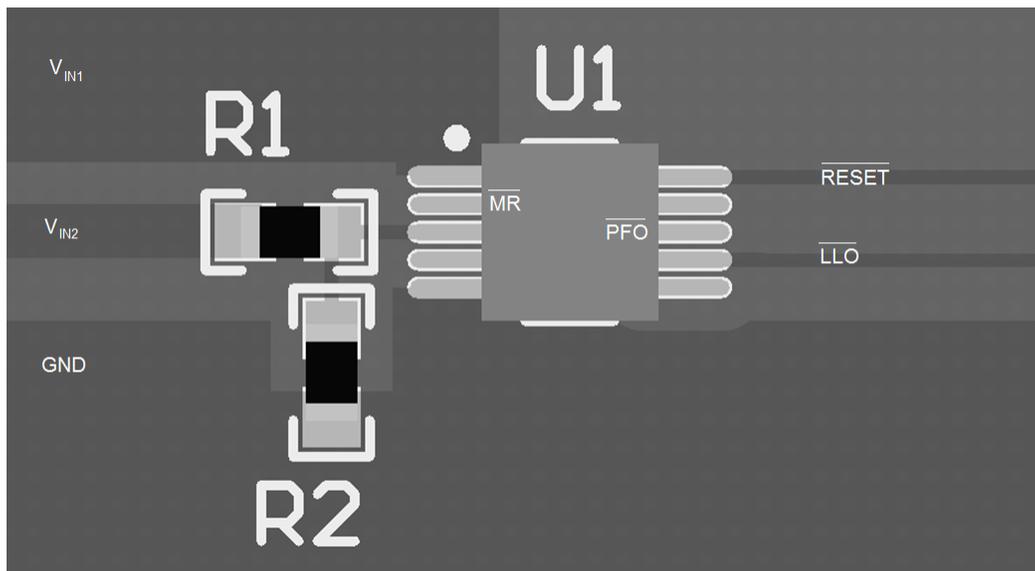


Figure 19. Layout Example for Application Circuit

## 11 Device and Documentation Support

### 11.1 Device Support

#### 11.1.1 Device Nomenclature

**Table 1. Table of Functions**

| PART NUMBER | OUTPUT<br>(X = TOTEM-POLE)<br>(Y = OPEN-DRAIN) | RESET TIMEOUT PERIOD |
|-------------|--|----------------------|
| LM3704      | X, Y   | 200 ms               |

### 11.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 11.3 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 11.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 11.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

| Orderable Device     | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|----------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM3704XCMM-308/NOPB  | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 85    | R35B                    | <a href="#">Samples</a> |
| LM3704YCMM-232/NOPB  | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | R76B                    | <a href="#">Samples</a> |
| LM3704YCMM-308/NOPB  | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 85    | R48B                    | <a href="#">Samples</a> |
| LM3704YCMMX-308/NOPB | ACTIVE        | VSSOP        | DGS             | 10   | 3500        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 85    | R48B                    | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

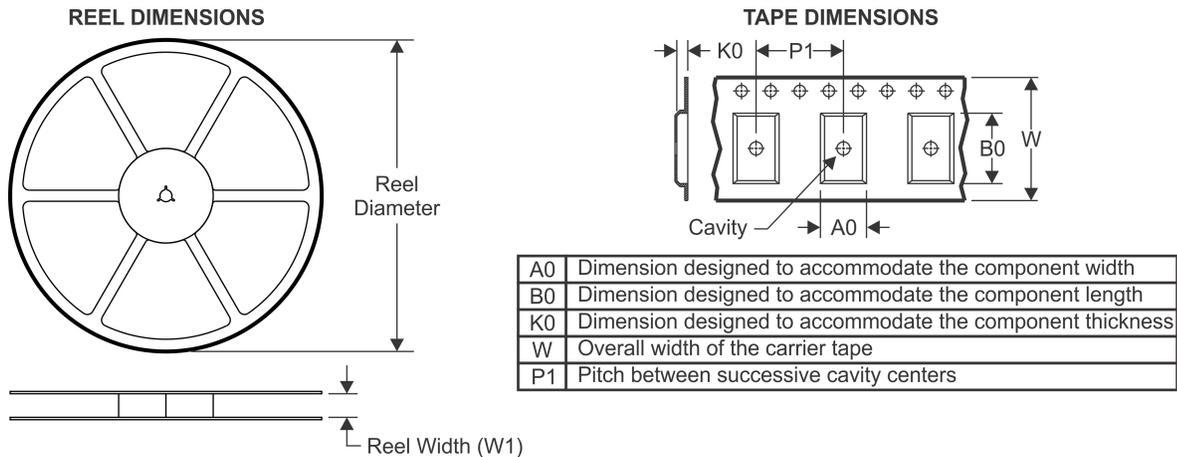
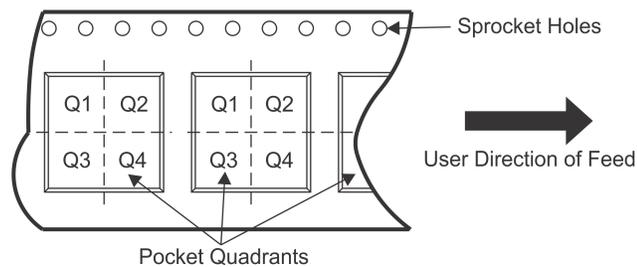
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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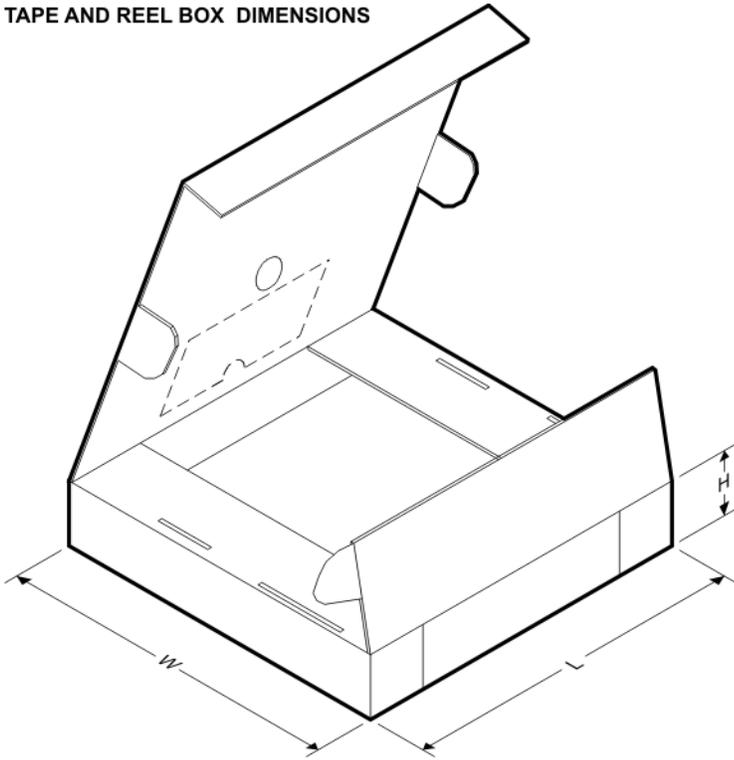
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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3704XCMM-308/NOPB  | VSSOP        | DGS             | 10   | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3704YCMM-232/NOPB  | VSSOP        | DGS             | 10   | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3704YCMM-308/NOPB  | VSSOP        | DGS             | 10   | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3704YCMMX-308/NOPB | VSSOP        | DGS             | 10   | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |

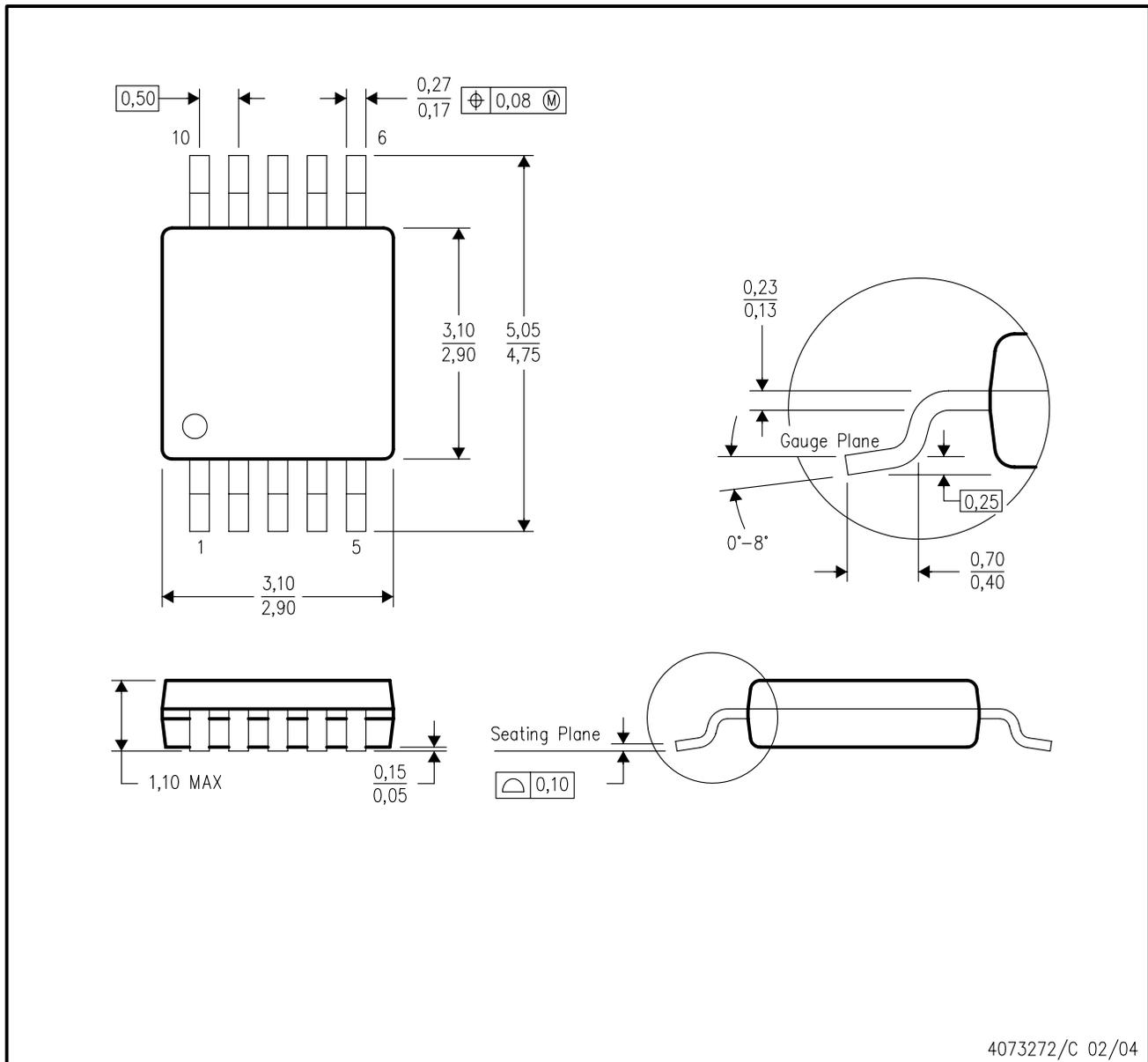
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device                   | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM3704XCMM-308/NOPB      | VSSOP        | DGS             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM3704YCMM-232/NOPB      | VSSOP        | DGS             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM3704YCMM-308/NOPB      | VSSOP        | DGS             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM3704YCMMX-308/NOP<br>B | VSSOP        | DGS             | 10   | 3500 | 367.0       | 367.0      | 35.0        |

DGS (S-PDSO-G10)

PLASTIC SMALL-OUTLINE PACKAGE



4073272/C 02/04

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion.
  - D. Falls within JEDEC MO-187 variation BA.

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