



## 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.

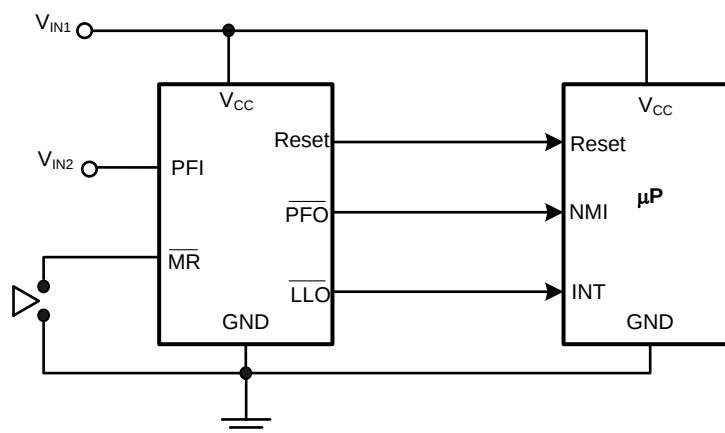
The LM3704 features include a manual reset, low-line output, and power-fail input detection. The power-fail input allows for a configurable second rail to be monitored helping detect upstream failures. The low-line output is used as a second interrupt line to indicate a fall in  $V_{\text{CC}}$  ( $1.02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

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

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)          |
|-------------|------------|--------------------------|
| LM3704      | VSSOP (10) | 3.00 mm $\times$ 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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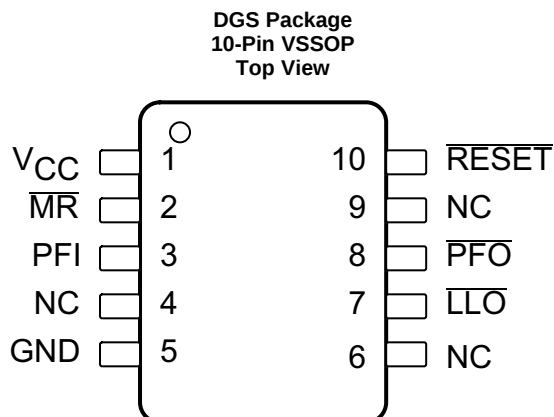
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## 4 Revision History

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     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <ul style="list-style-type: none"> <li>Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i>, <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section .....</li> </ul> | <b>1</b> |

## 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 <sub>CC</sub>       | −0.3               | 6                     | V    |
| All other inputs                      | −0.3               | V <sub>CC</sub> + 0.3 | V    |
| Power dissipation                     | See <sup>(2)</sup> |                       |      |
| Storage temperature, T <sub>stg</sub> | −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<sub>J</sub>(MAX), the junction-to-ambient thermal resistance, θ<sub>J-A</sub>, and the ambient temperature, T<sub>A</sub>. 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 θ<sub>J-A</sub> 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 <sub>(ESD)</sub> 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 <sub>A</sub> Free-air temperature | −40 | 85  | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | LM3704      | UNIT |
|-------------------------------|----------------------------------------------|-------------|------|
|                               |                                              | DGS (VSSOP) |      |
|                               |                                              | 10 PINS     |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 163.7       | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 58.3        | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 83.5        | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 6           | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 82.2        | °C/W |
| R <sub>θJC(bot)</sub>         | 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 |
|------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------|---------------------------|------------------|------|------|
| POWER SUPPLY                             |                                                                      |                                                                                           |                                |                           |                  |      |      |
| V <sub>CC</sub>                          | Operating voltage                                                    | LM3704, T <sub>J</sub> = −40°C to 85°C                                                    |                                | 1                         |                  | 5.5  | V    |
| I <sub>CC</sub>                          | V <sub>CC</sub> supply current                                       | All inputs = V <sub>CC</sub> ,<br>all outputs floating                                    | T <sub>J</sub> = 25°C          | 28                        |                  |      | μA   |
|                                          |                                                                      |                                                                                           | T <sub>J</sub> = −40°C to 85°C | 50                        |                  |      |      |
| RESET THRESHOLD                          |                                                                      |                                                                                           |                                |                           |                  |      |      |
| V <sub>RST</sub>                         | Reset threshold                                                      | V <sub>CC</sub> falling                                                                   | T <sub>J</sub> = 25°C          | −0.5%                     | V <sub>RST</sub> | 0.5% |      |
|                                          |                                                                      |                                                                                           | T <sub>J</sub> = −40°C to 85°C | −2%                       |                  | 2%   |      |
|                                          |                                                                      |                                                                                           | T <sub>J</sub> = 0°C to 70°C   | −1.5%                     |                  | 1.5% |      |
| V <sub>RSTH</sub>                        | Reset threshold hysteresis                                           |                                                                                           |                                | 0.0032 × V <sub>RST</sub> |                  |      | mV   |
| t <sub>RP</sub>                          | Reset time-out period                                                | Reset time-out period =<br>C                                                              | T <sub>J</sub> = 25°C          | 200                       |                  |      | ms   |
|                                          |                                                                      |                                                                                           | T <sub>J</sub> = −40°C to 85°C | 140                       |                  | 280  |      |
| t <sub>RD</sub>                          | V <sub>CC</sub> to reset delay                                       | V <sub>CC</sub> falling at 1 mV/μs                                                        |                                | 20                        |                  |      | μs   |
| RESET                                    |                                                                      |                                                                                           |                                |                           |                  |      |      |
| V <sub>OL</sub>                          | $\overline{\text{RESET}}$                                            | V <sub>CC</sub> > 1.0 V, I <sub>SINK</sub> = 50 μA,<br>T <sub>J</sub> = −40°C to 85°C     |                                |                           |                  | 0.3  | V    |
|                                          |                                                                      | V <sub>CC</sub> > 1.2 V, I <sub>SINK</sub> = 100 μA,<br>T <sub>J</sub> = −40°C to 85°C    |                                |                           |                  | 0.3  |      |
|                                          |                                                                      | V <sub>CC</sub> > 2.25 V, I <sub>SINK</sub> = 900 μA,<br>T <sub>J</sub> = −40°C to 85°C   |                                |                           |                  | 0.3  |      |
|                                          |                                                                      | V <sub>CC</sub> > 2.7 V, I <sub>SINK</sub> = 1.2 mA,<br>T <sub>J</sub> = −40°C to 85°C    |                                |                           |                  | 0.3  |      |
|                                          |                                                                      | V <sub>CC</sub> > 4.5 V, I <sub>SINK</sub> = 3.2 mA,<br>T <sub>J</sub> = −40°C to 85°C    |                                |                           |                  | 0.4  |      |
| V <sub>OH</sub>                          | $\overline{\text{RESET}}$                                            | V <sub>CC</sub> > 2.25 V, I <sub>SOURCE</sub> = 300 μA,<br>T <sub>J</sub> = −40°C to 85°C |                                | 0.8 × V <sub>CC</sub>     |                  |      | V    |
|                                          |                                                                      | V <sub>CC</sub> > 2.7 V, I <sub>SOURCE</sub> = 500 μA,<br>T <sub>J</sub> = −40°C to 85°C  |                                | 0.8 × V <sub>CC</sub>     |                  |      |      |
|                                          |                                                                      | V <sub>CC</sub> > 4.5 V, I <sub>SOURCE</sub> = 800 μA,<br>T <sub>J</sub> = −40°C to 85°C  |                                | V <sub>CC</sub> − 1.5     |                  |      |      |
| PFI/MR                                   |                                                                      |                                                                                           |                                |                           |                  |      |      |
| V <sub>PFT</sub>                         | PFI input threshold                                                  | T <sub>J</sub> = 25°C                                                                     |                                | 1.225                     |                  |      | V    |
|                                          |                                                                      | T <sub>J</sub> = −40°C to 85°C                                                            |                                | 1.2                       |                  | 1.25 |      |
| V <sub>MRT</sub>                         | $\overline{\text{MR}}$ Input threshold                               | T <sub>J</sub> = −40°C to 85°C                                                            | $\overline{\text{MR}}$ , low   |                           |                  | 0.8  | V    |
|                                          |                                                                      |                                                                                           | $\overline{\text{MR}}$ , high  | 2                         |                  |      |      |
| V <sub>PFTH</sub> /<br>V <sub>MRTH</sub> | PFI/ $\overline{\text{MR}}$ threshold hysteresis                     | PFI/ $\overline{\text{MR}}$ falling, V <sub>CC</sub> = V <sub>RST MAX</sub> to 5.5 V      |                                | 0.0032 × V <sub>RST</sub> |                  |      | mV   |
| I <sub>PFI</sub>                         | Input current (PFI only)                                             | T <sub>J</sub> = −40°C to 85°C                                                            |                                | −75                       |                  | 75   | nA   |
| R <sub>MR</sub>                          | $\overline{\text{MR}}$ pullup resistance                             | T <sub>J</sub> = 25°C                                                                     |                                | 56                        |                  |      | kΩ   |
|                                          |                                                                      | T <sub>J</sub> = −40°C to 85°C                                                            |                                | 35                        |                  | 75   |      |
| t <sub>MD</sub>                          | $\overline{\text{MR}}$ to reset delay                                |                                                                                           |                                | 12                        |                  |      | μS   |
| t <sub>MR</sub>                          | $\overline{\text{MR}}$ pulse width                                   | T <sub>J</sub> = −40°C to 85°C                                                            |                                | 25                        |                  |      | μS   |
| PFO, LLO                                 |                                                                      |                                                                                           |                                |                           |                  |      |      |
| V <sub>OL</sub>                          | $\overline{\text{PFO}}$ , $\overline{\text{LLO}}$ output low voltage | V <sub>CC</sub> > 2.25 V, I <sub>SINK</sub> = 900 μA,<br>T <sub>J</sub> = −40°C to 85°C   |                                |                           |                  | 0.3  | V    |
|                                          |                                                                      | V <sub>CC</sub> > 2.7 V, I <sub>SINK</sub> = 1.2 mA,<br>T <sub>J</sub> = −40°C to 85°C    |                                |                           |                  | 0.3  |      |
|                                          |                                                                      | V <sub>CC</sub> > 4.5 V, I <sub>SINK</sub> = 3.2 mA,<br>T <sub>J</sub> = −40°C to 85°C    |                                |                           |                  | 0.4  |      |

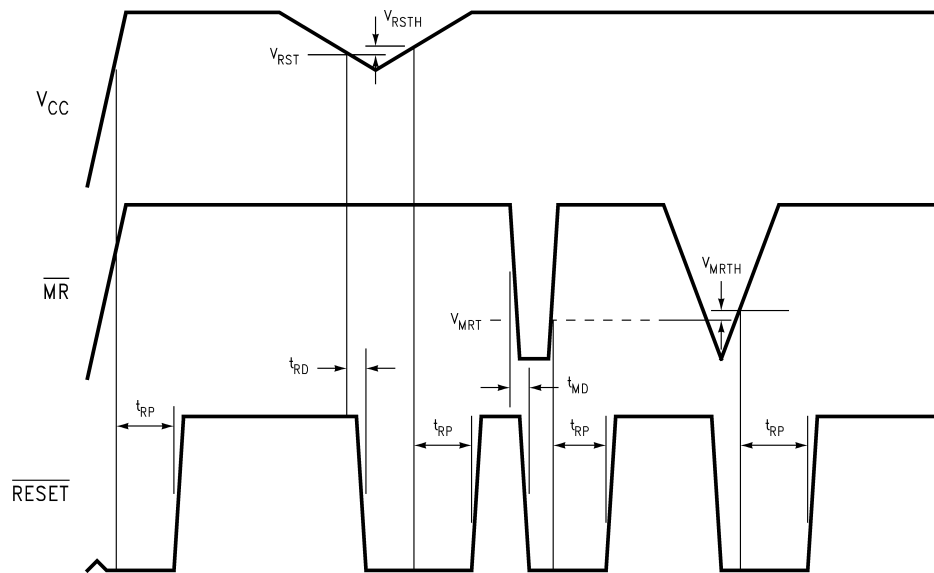
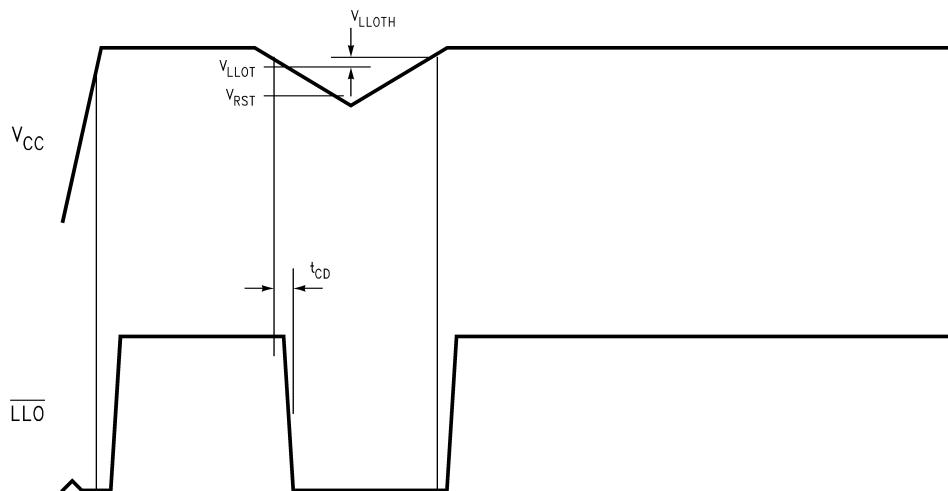
**LM3704**

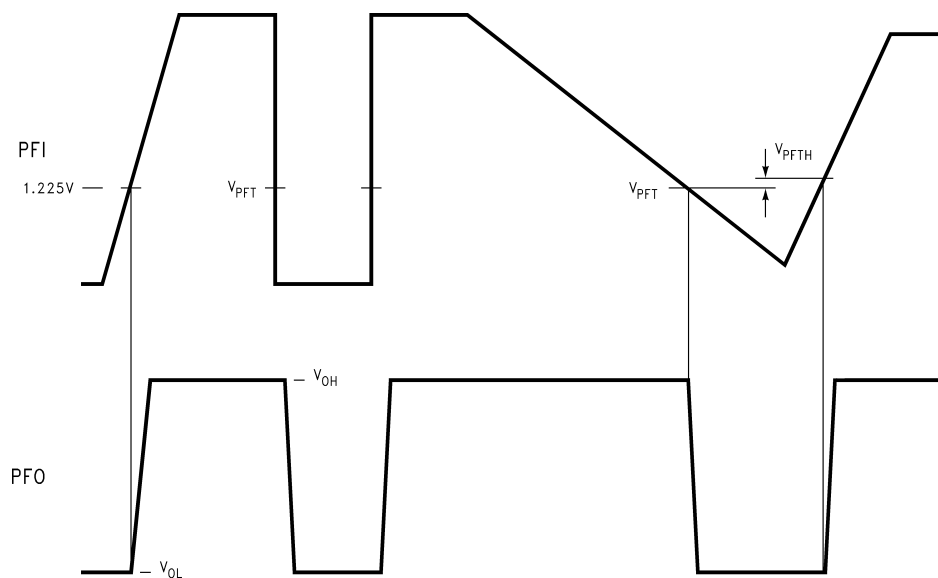
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**Electrical Characteristics (continued)**

 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 <sub>OH</sub>                                  | $\overline{\text{PFO}}$ , $\overline{\text{LLO}}$ output high voltage | V <sub>CC</sub> > 2.25 V, I <sub>SOURCE</sub> = 300 μA, T <sub>J</sub> = −40°C to 85°C |                                | 0.8 V <sub>CC</sub>       |                         | V   |      |
|                                                  |                                                                       | V <sub>CC</sub> > 2.7 V, I <sub>SOURCE</sub> = 500 μA, T <sub>J</sub> = −40°C to 85°C  |                                | 0.8 V <sub>CC</sub>       |                         |     |      |
|                                                  |                                                                       | V <sub>CC</sub> > 4.5 V, I <sub>SOURCE</sub> = 800 μA, T <sub>J</sub> = −40°C to 85°C  |                                | V <sub>CC</sub> − 1.5     |                         |     |      |
| <b><math>\overline{\text{LLO}}</math> OUTPUT</b> |                                                                       |                                                                                        |                                |                           |                         |     |      |
| V <sub>LLOT</sub>                                | $\overline{\text{LLO}}$ output threshold                              | V <sub>LLO</sub> − V <sub>RST</sub> , V <sub>CC</sub> falling                          | T <sub>J</sub> = 25°C          | 1.02 × V <sub>RST</sub>   |                         |     | V    |
|                                                  |                                                                       |                                                                                        | T <sub>J</sub> = −40°C to 85°C | 1.01 × V <sub>RST</sub>   | 1.03 × V <sub>RST</sub> |     |      |
| V <sub>LLOTH</sub>                               | Low-line comparator hysteresis                                        |                                                                                        |                                | 0.0032 × V <sub>RST</sub> |                         |     | mV   |
| t <sub>CD</sub>                                  | Low-line comparator delay                                             | V <sub>CC</sub> falling at 1 mV/μs                                                     |                                | 20                        |                         |     | μs   |


**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

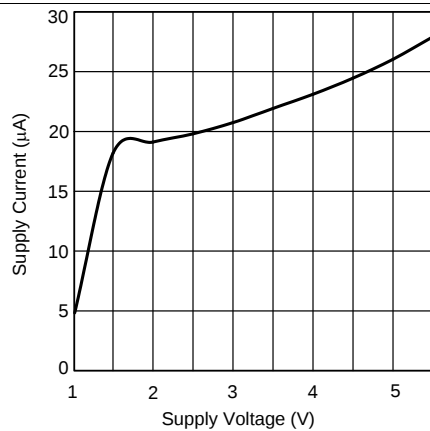


Figure 4. Supply Current vs Supply Voltage

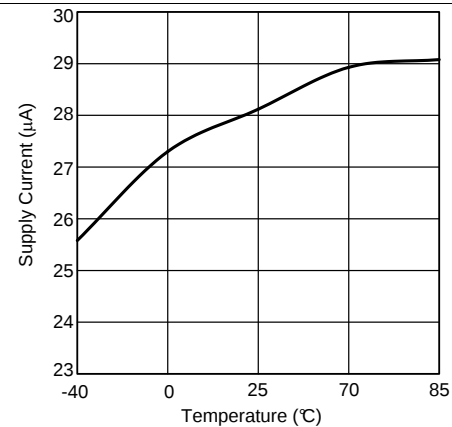


Figure 5. 3.3-V Supply Current vs Temperature

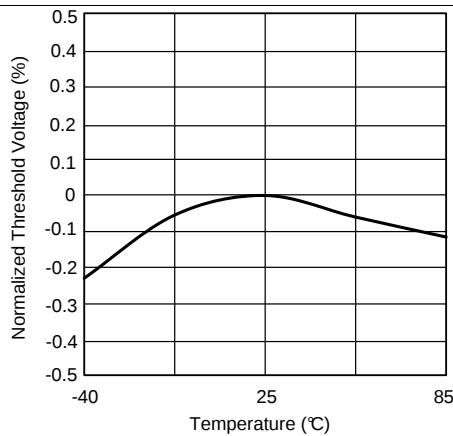


Figure 6. Normalized Reset Threshold Voltage vs Temperature

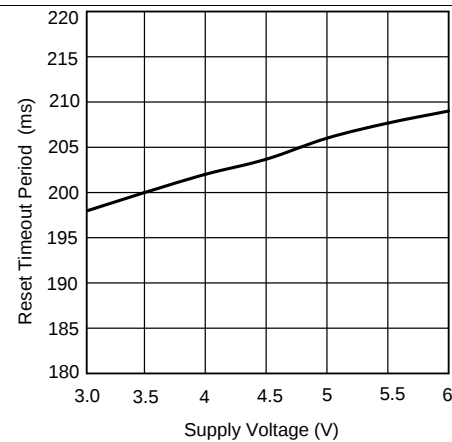


Figure 7. Reset Timeout Period vs  $V_{CC}$

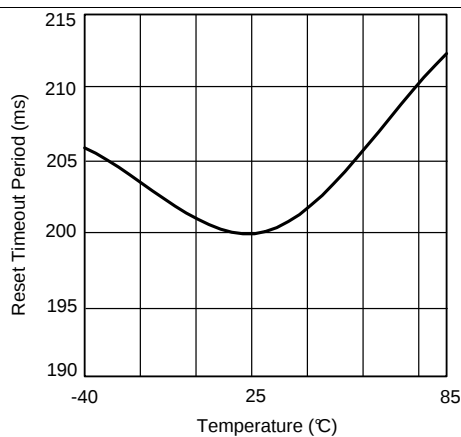
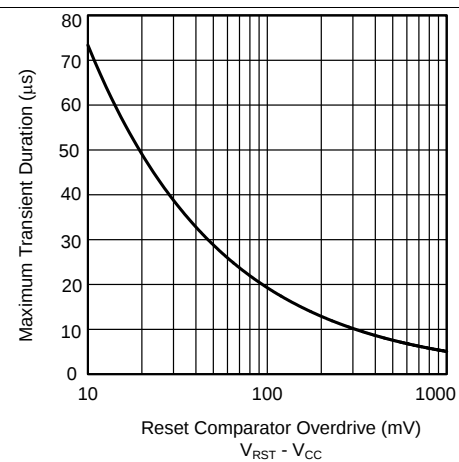


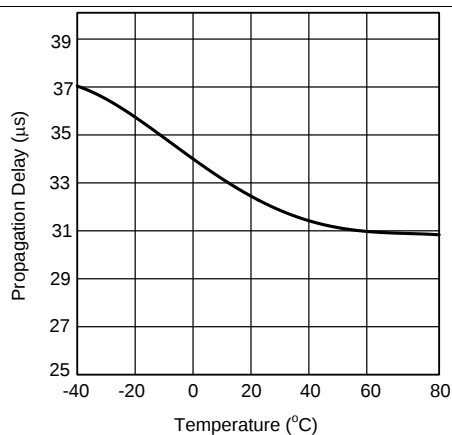
Figure 8. Reset Timeout Period vs Temperature



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

Figure 9. Maximum Transient Duration vs Reset Comparator Overdrive

## Typical Characteristics (continued)



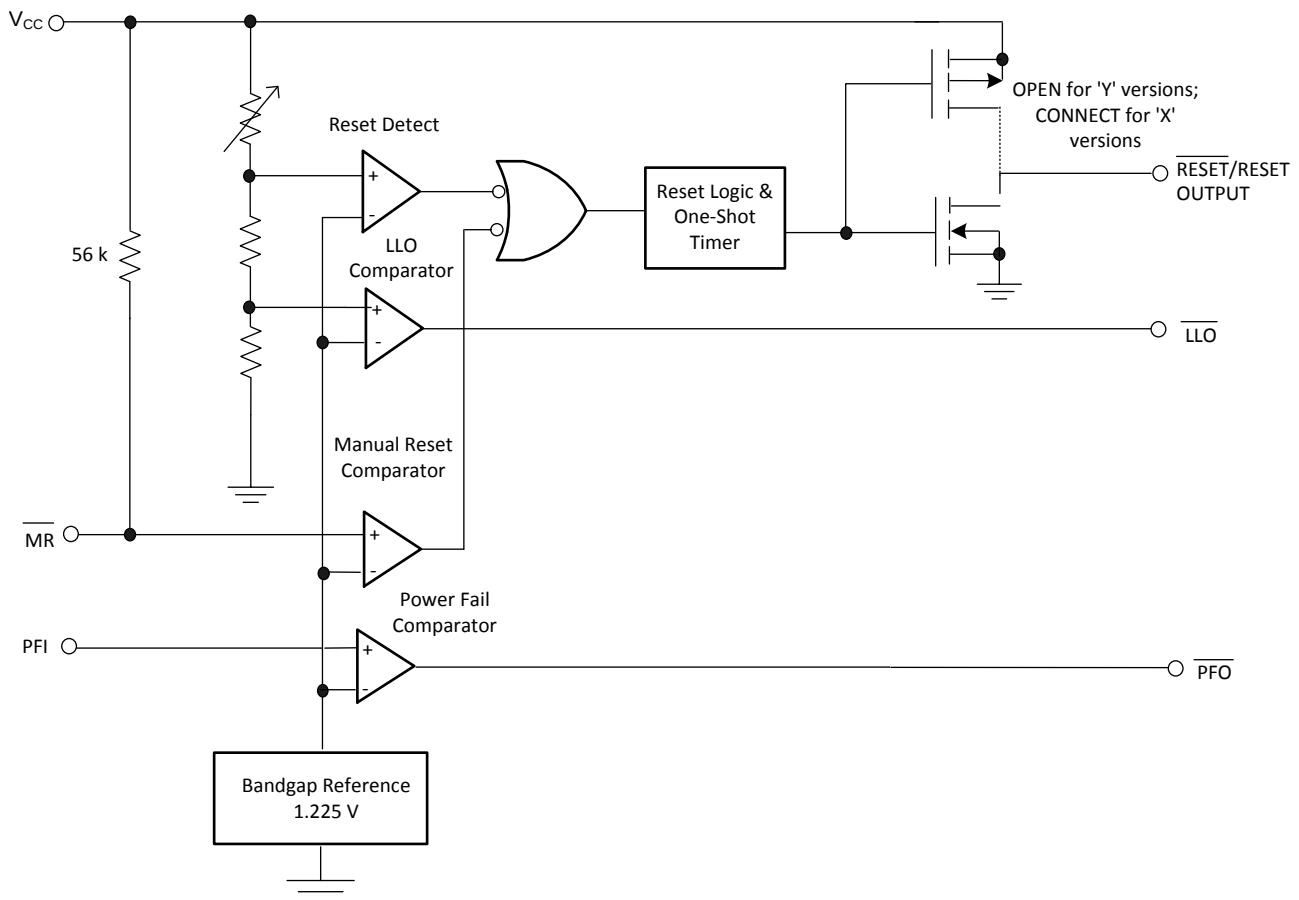
**Figure 10. Low-Line Comparator Propagation Delay vs Temperature**

## 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 **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 **MR** is below  $V_{MRT}$ . Once the  $V_{CC}$  rises above the reset threshold, or after **MR** input rises above  $V_{MRT}$ , the **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  $\mu P$  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.

**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 **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 ( $\text{PFI}/\overline{\text{PFO}}$ )

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

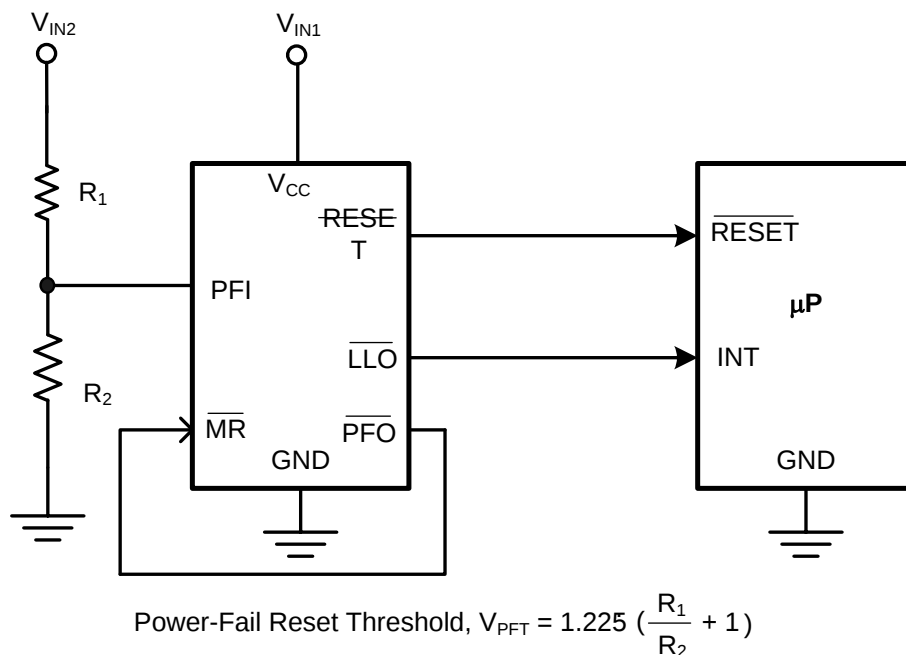
### NOTE

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

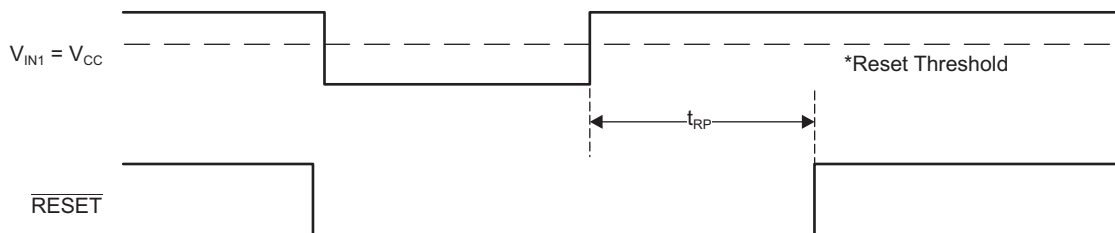
The component count is minimal; employing two resistors as part of a voltage-divider circuit is all that is needed for the typical application of monitoring two critical supplies shown in [Figure 11](#).

#### 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](#).

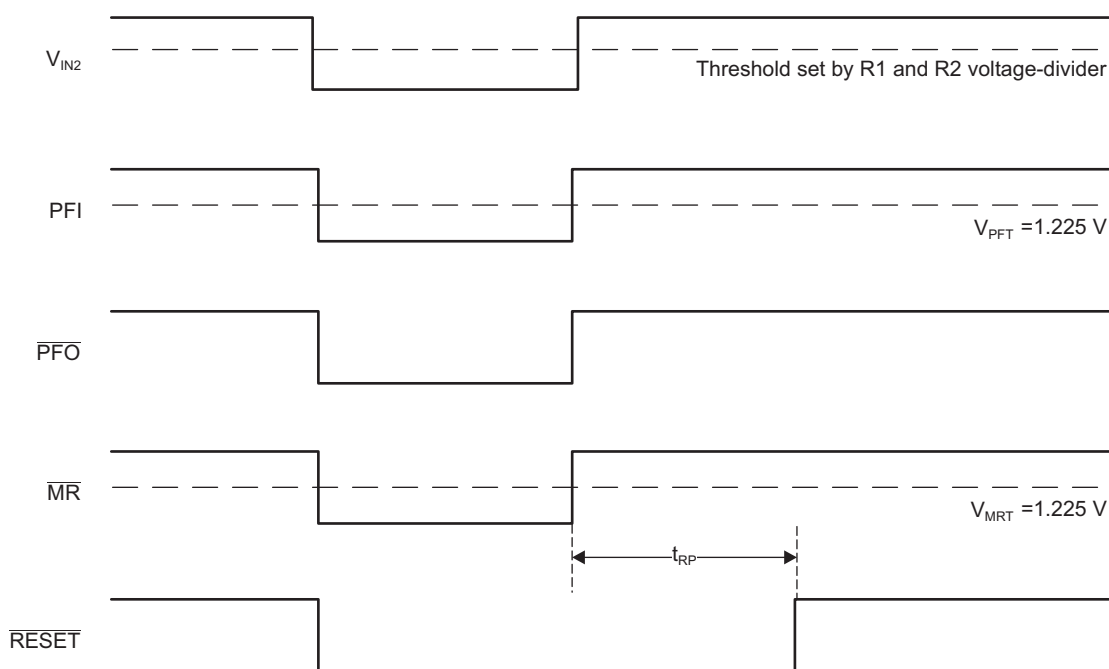
## Typical Application (continued)

### 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**

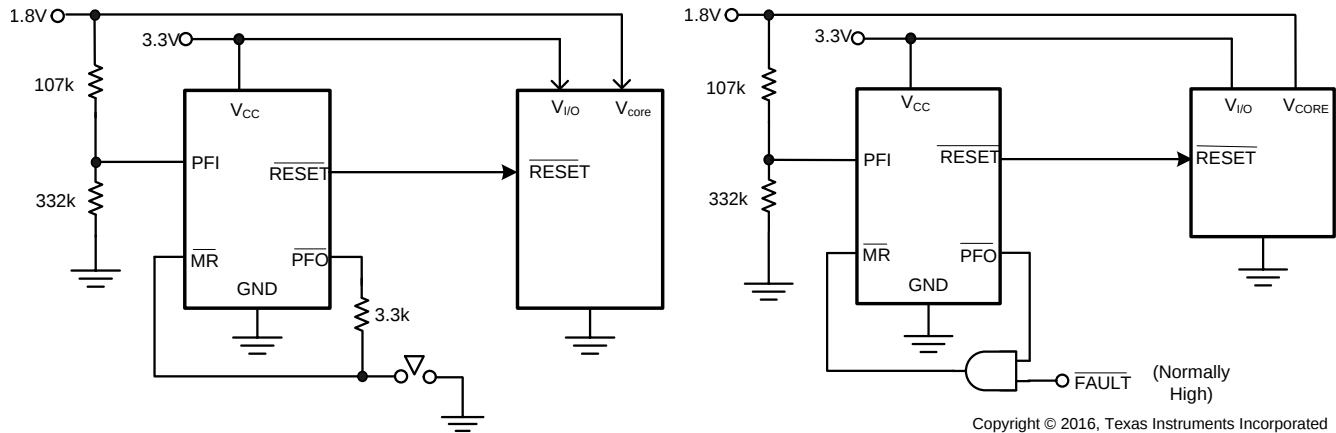


See [Electrical Characteristics](#) for high and low levels of this specific application.

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

### 8.3 System Examples

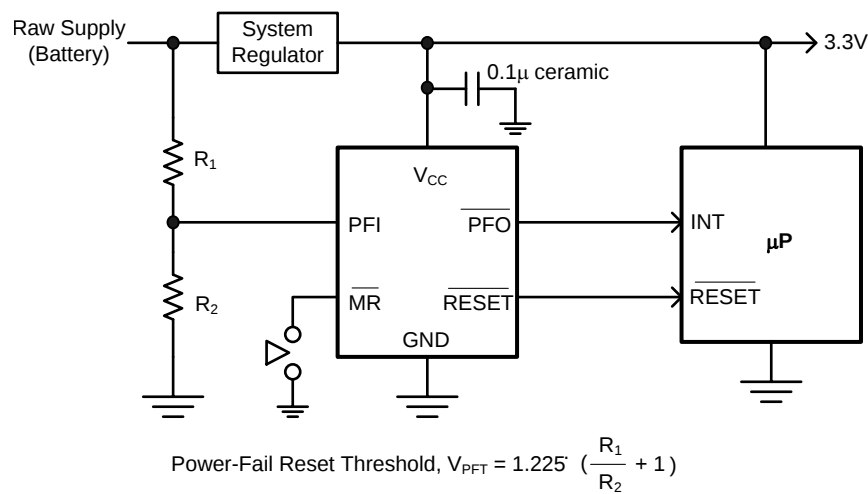
The LM3704 voltage supervisor has various features such as power-fail input detection, low-line output, and manual reset while requiring few to no additional components making it versatile and easy-to-use. See [Figure 14](#) through [Figure 18](#) for a variety of circuit applications.



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

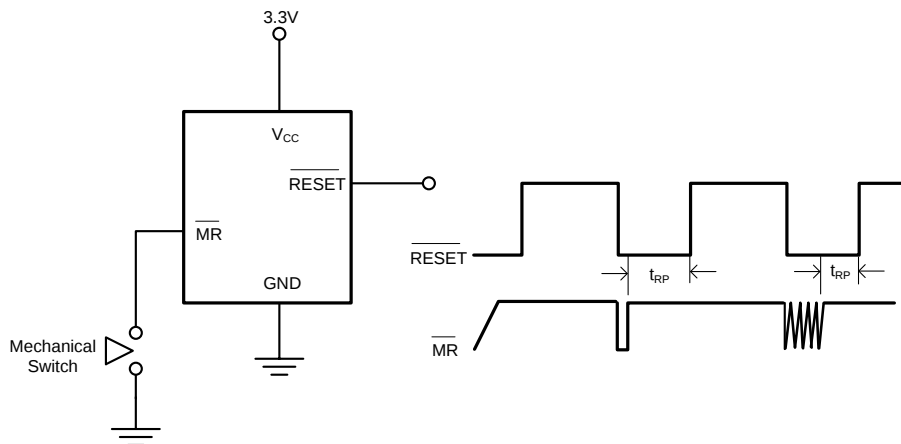
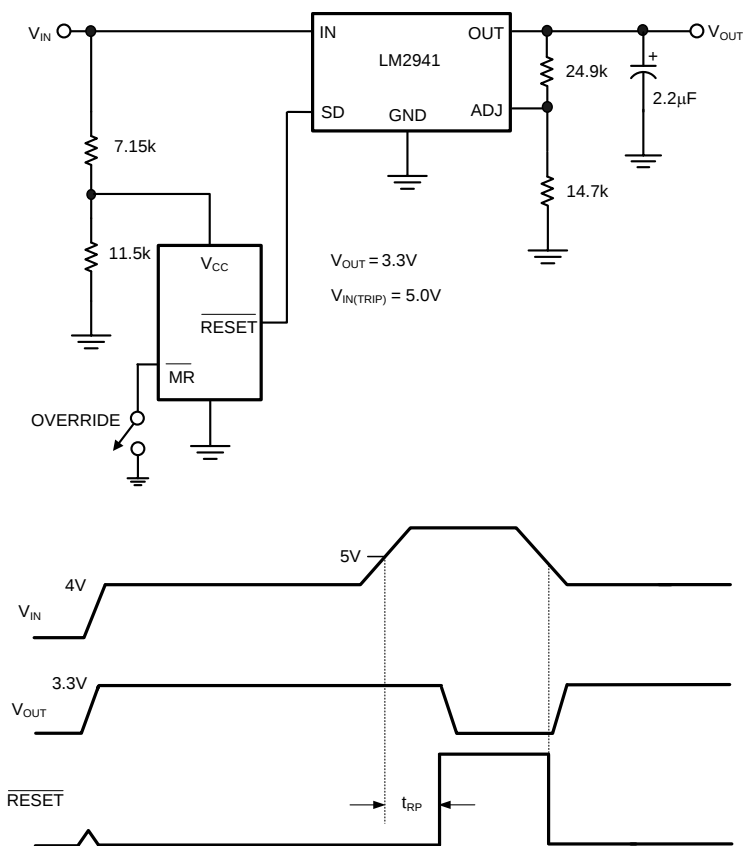
**Figure 15. Monitoring Dual Supplies Plus External Fault Input**



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The 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**



## 9 Power Supply Recommendations

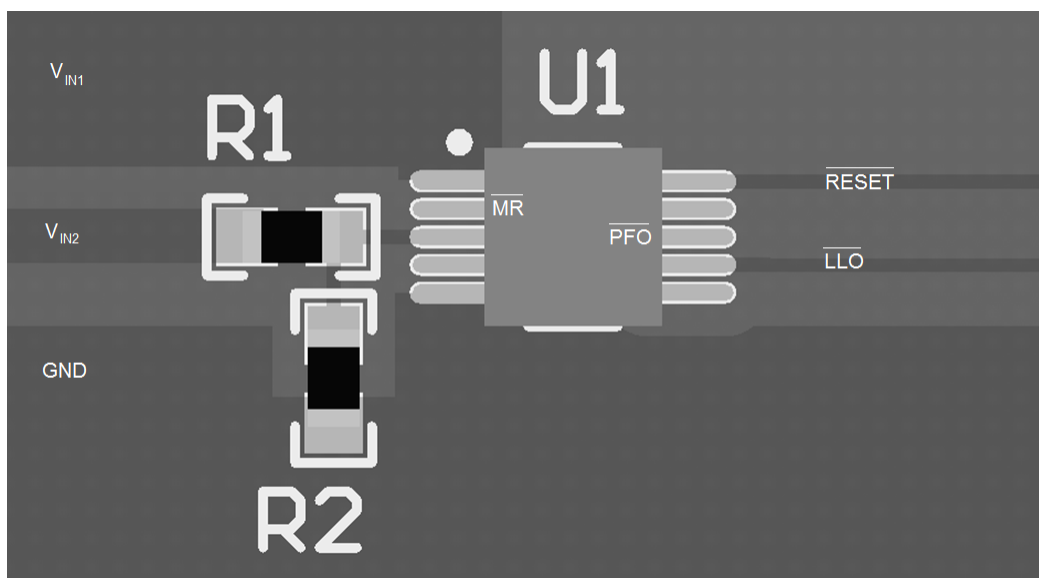
The input power supply to the  $V_{CC}$  pin of the LM3704 must be kept at a voltage lower than the recommended voltage of 5.5 V. All other input pins must be kept at a voltage lower than  $V_{CC} + 0.3$  V. Do not exceed absolute maximum ratings found in [Absolute Maximum Ratings](#) in any circumstance.

## 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 part number               | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM3704XCMM-308/NO.A                 | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R35B                |
| <a href="#">LM3704XCMM-308/NOPB</a> | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R35B                |
| LM3704YCMM-232/NO.A                 | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R76B                |
| <a href="#">LM3704YCMM-232/NOPB</a> | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R76B                |
| LM3704YCMM-308/NO.A                 | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R48B                |
| <a href="#">LM3704YCMM-308/NOPB</a> | Active        | Production           | VSSOP (DGS)   10 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R48B                |
| LM3704YCMX-308/NO.A                 | Active        | Production           | VSSOP (DGS)   10 | 3500   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R48B                |
| <a href="#">LM3704YCMX-308/NOPB</a> | Active        | Production           | VSSOP (DGS)   10 | 3500   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R48B                |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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## TAPE AND REEL INFORMATION



\*All dimensions are nominal

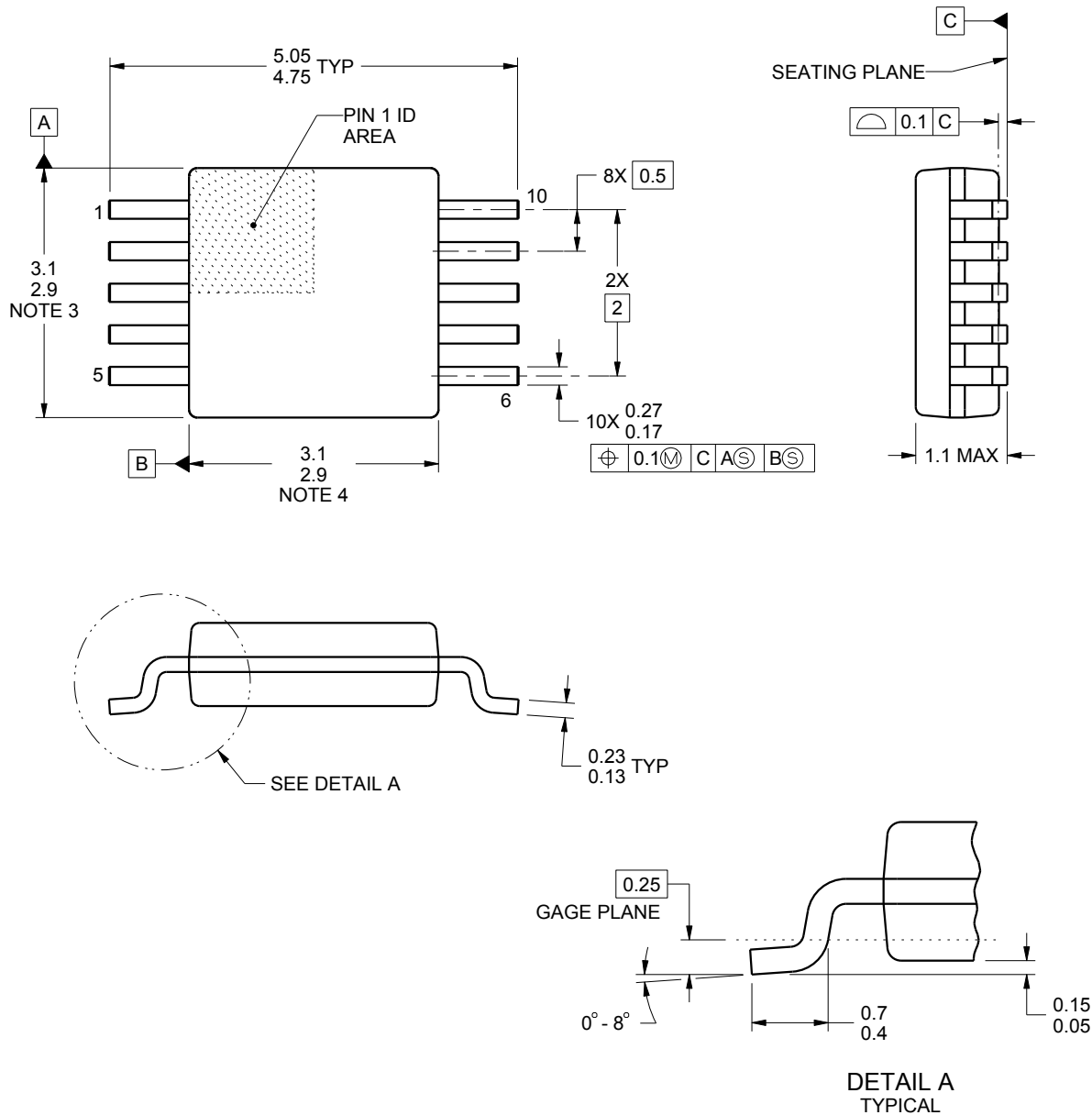
| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3704XCMM-308/NOPB  | VSSOP        | DGS             | 10   | 1000 | 177.8              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3704YCMM-232/NOPB  | VSSOP        | DGS             | 10   | 1000 | 177.8              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3704YCMM-308/NOPB  | VSSOP        | DGS             | 10   | 1000 | 177.8              | 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 | 208.0       | 191.0      | 35.0        |
| LM3704YCMM-232/NOPB      | VSSOP        | DGS             | 10   | 1000 | 208.0       | 191.0      | 35.0        |
| LM3704YCMM-308/NOPB      | VSSOP        | DGS             | 10   | 1000 | 208.0       | 191.0      | 35.0        |
| LM3704YCMMX-308/<br>NOPB | VSSOP        | DGS             | 10   | 3500 | 367.0       | 367.0      | 35.0        |



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**NOTES:**

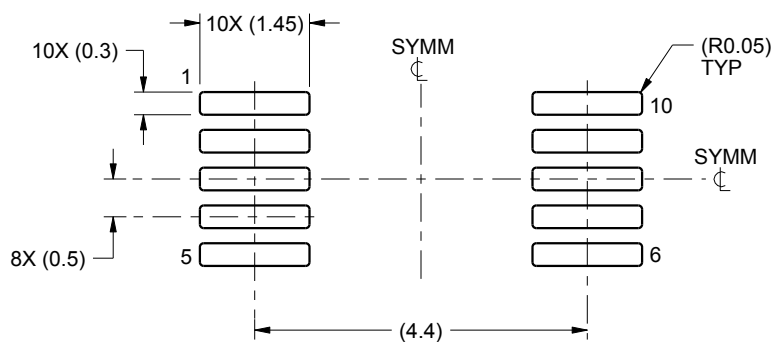
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187, variation BA.

# EXAMPLE BOARD LAYOUT

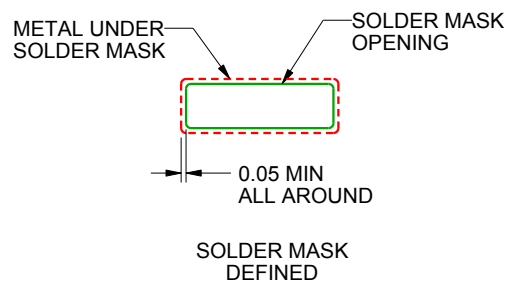
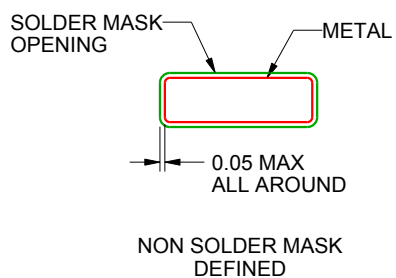
DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

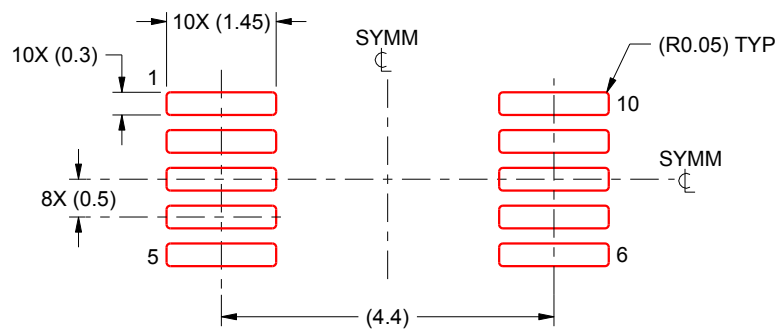
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DGS0010A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:10X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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