

# LM3710/LM3711 Microprocessor Supervisory Circuits with Power Fail Input, Low Line Output, Manual Reset and Watchdog Timer

Check for Samples: [LM3710](#), [LM3711](#)

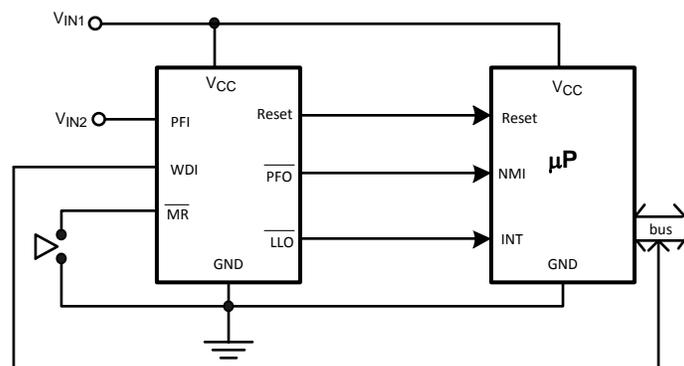
## FEATURES

- **Standard Reset Threshold Voltage: 3.08V**
- **Custom Reset Threshold Voltages: For other voltages between 2.2V and 5.0V in 10mV increments, contact TI**
- **No External Components Required**
- **Manual-Reset Input**
- **$\overline{\text{RESET}}$  (LM3710) or RESET (LM3711) Outputs**
- **Precision Supply Voltage Monitor**
- **Factory Programmable Reset and Watchdog Timeout Delays**
- **Separate Power Fail Comparator**
- **Available in DSBGA Package for Minimum Footprint**
- **$\pm 0.5\%$  Reset Threshold Accuracy at Room Temperature**
- **$\pm 2\%$  Reset Threshold Accuracy Over Temperature Extremes**
- **Reset Assertion Down to 1V  $V_{CC}$  ( $\overline{\text{RESET}}$  Option Only)**
- **28  $\mu\text{A}$   $V_{CC}$  Supply Current**

## APPLICATIONS

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

## Typical Application



## DESCRIPTION

The LM3710/LM3711 series of microprocessor supervisory circuits provide the maximum flexibility for monitoring power supplies and battery controlled functions in systems without backup batteries. The LM3710/LM3711 series are available in VSSOP-10 and 9-bump DSBGA packages.

Built-in features include the following:

**Reset:** Reset is asserted during power-up, power-down, and brownout conditions.  $\overline{\text{RESET}}$  is ensured down to  $V_{CC}$  of 1.0V.

**Manual Reset Input:** An input that asserts reset when pulled low.

**Power-Fail Input:** A 1.225V threshold detector for power fail warning, or to monitor a power supply other than  $V_{CC}$ .

**Low Line Output:** This early power failure warning indicator goes low when the supply voltage drops to a value which is 2% higher than the reset threshold voltage.

**Watchdog Timer:** The WDI (Watchdog Input) monitors one of the  $\mu\text{P}$ 's output lines for activity. If no output transition occurs during the watchdog timeout period, reset is activated.



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### Connection Diagram

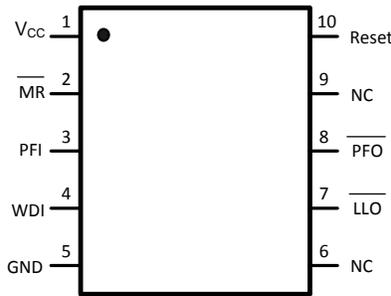


Figure 1. VSSOP-10

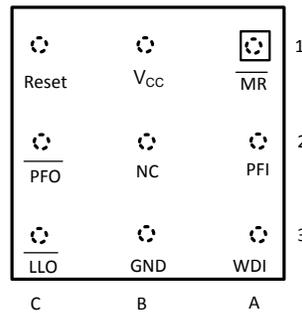


Figure 2. Top View (looking from the coating side) DSBGA 9 Bump Package

### PIN DESCRIPTIONS

| Pin No. |       | Name               | Function  |
|---------|-------|--------------------|---|
| DSBGA   | VSSOP |                    |   |
| A1      | 2     | $\overline{MR}$    | Manual-Reset input. When $\overline{MR}$ is less than $V_{MRT}$ (Manual Reset Threshold) $\overline{RESET}/RESET$ is engaged.   |
| B1      | 1     | $V_{CC}$           | Power Supply input.   |
| C1      | 10    | $\overline{RESET}$ | Reset Logic Output. Pulses low for $t_{RP}$ (Reset Timeout Period) when triggered, and stays low whenever $V_{CC}$ is below the reset threshold or when $\overline{MR}$ is below $V_{MRT}$ . It remains low for $t_{RP}$ after either $V_{CC}$ rises above the reset threshold, or after $\overline{MR}$ input rises above $V_{MRT}$ (LM3710 only). |
|         |       | RESET              | Reset Logic Output. RESET is the inverse of $\overline{RESET}$ (LM3711 only).   |
| C2      | 8     | $\overline{PFO}$   | Power-Fail Logic Output. When PFI is below $V_{PFT}$ , $\overline{PFO}$ goes low; otherwise, $\overline{PFO}$ remains high.   |
| C3      | 7     | $\overline{LLO}$   | Low-Line Logic Output. Early Power-Fail warning output. Low when $V_{CC}$ falls below $V_{LLOT}$ (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.  |
| B3      | 5     | GND                | Ground reference for all signals.   |
| A3      | 4     | WDI                | Watchdog Input Transition Monitor: If no transition activity occurs for a period exceeding $t_{WD}$ (Watchdog Timeout Period), reset is engaged.  |
| A2      | 3     | PFI                | Power-Fail Comparator Input. When PFI is less than $V_{PFT}$ (Power-Fail Reset Threshold), the $\overline{PFO}$ goes low; otherwise, $\overline{PFO}$ remains high.   |
| B2      | 6, 9  | NC                 | No Connect. Test input used at factory only. Leave floating.  |

Block Diagram

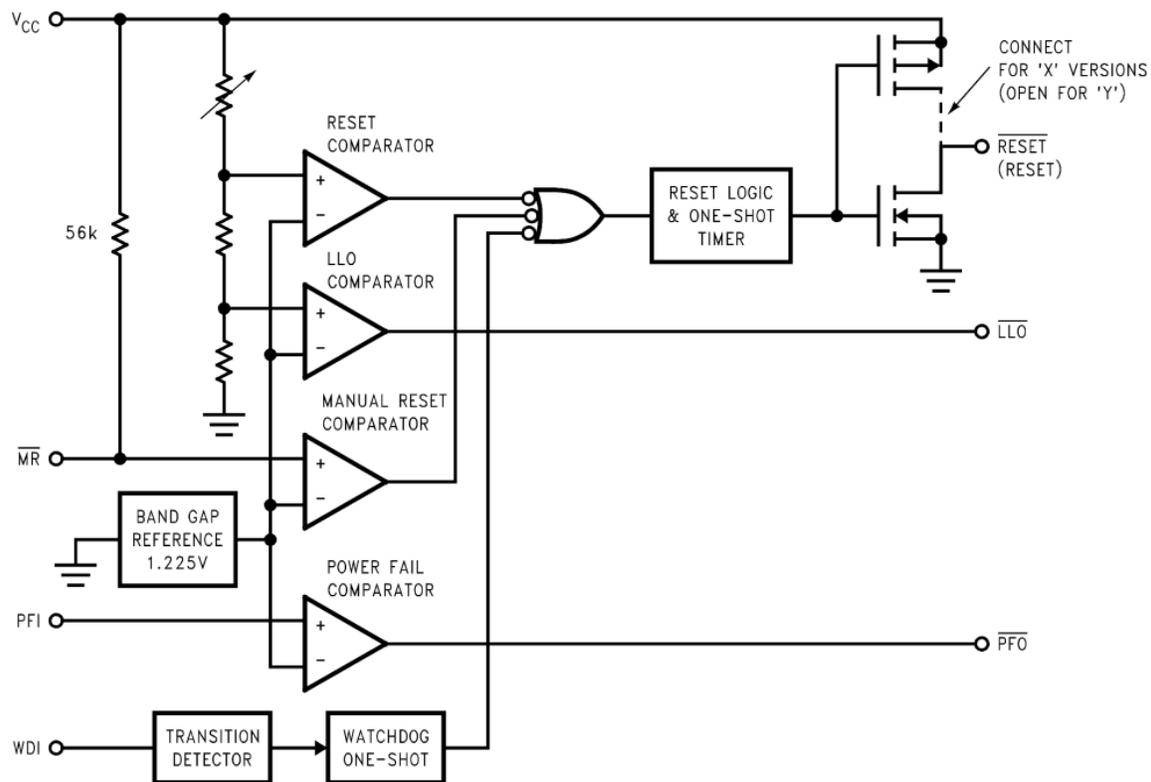


Table Of Functions

| Part Number | Active Low Reset | Active High Reset | Output (X = totem-pole) (Y = open-drain) | Reset Timeout Period | Watchdog Timeout Period | Manual Reset | Power Fail Comparator | Low Line Output |
|-------------|------------------|-------------------|--|----------------------|-------------------------|--------------|-----------------------|-----------------|
| LM3710      | x                |                   | X, Y <sup>(1)</sup>                      | Customized           | Customized              | x            | x                     | x               |
| LM3711      |                  | x                 | X  | Customized           | Customized              | x            | x                     | x               |

(1) Available upon request. Contact TI.



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.

**Absolute Maximum Ratings**<sup>(1)(2)</sup>

|                             |                          |
|-----------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ ) | -0.3V to 6.0V            |
| All Other Inputs            | -0.3V to $V_{CC} + 0.3V$ |
| ESD Ratings <sup>(3)</sup>  |                          |
| Human Body Model            | 1.5kV                    |
| Machine Model               | 150V                     |
| Power Dissipation           | (4)                      |

- (1) **Absolute Maximum Ratings** indicate limits beyond which damage to the device may occur. **Operating Ratings** indicate conditions for which the device is intended to be functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed conditions.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) The Human Body model is a 100 pF capacitor discharged through a 1.5 k $\Omega$  resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin.
- (4) 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 VSSOP-10 package is 195°C/W in a typical PC board mounting and the DSBGA package is 220°C/W.

**Operating Ratings**<sup>(1)</sup>

|                   |                            |
|-------------------|----------------------------|
| Temperature Range | -40°C $\leq T_J \leq$ 85°C |
|-------------------|----------------------------|

- (1) **Absolute Maximum Ratings** indicate limits beyond which damage to the device may occur. **Operating Ratings** indicate conditions for which the device is intended to be functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed conditions.

**LM3710/LM3711 Series Electrical Characteristics**

Limits in the standard typeface are for  $T_J = 25^\circ\text{C}$  and limits in **boldface type** apply over full operating range. Unless otherwise specified:  $V_{CC} = +2.2V$  to 5.5V.

| Symbol                 | Parameter                         | Conditions  | Min                               | Typ                    | Max               | Units         |
|------------------------|-----------------------------------|---|-----------------------------------|------------------------|-------------------|---------------|
| <b>POWER SUPPLY</b>    |                                   |   |                                   |                        |                   |               |
| $V_{CC}$               | Operating Voltage Range: $V_{CC}$ | LM3710  | <b>1.0</b>                        |                        | <b>5.5</b>        | V             |
|                        |                                   | LM3711  | <b>1.2</b>                        |                        | <b>5.5</b>        |               |
| $I_{CC}$               | $V_{CC}$ Supply Current           | All inputs = $V_{CC}$ ; all outputs floating                    |                                   | 28                     | <b>50</b>         | $\mu\text{A}$ |
| <b>RESET THRESHOLD</b> |                                   |   |                                   |                        |                   |               |
| $V_{RST}$              | Reset Threshold                   | $V_{CC}$ falling  | -0.5<br><b>-2</b>                 | $V_{RST}$              | +0.5<br><b>+2</b> | %             |
|                        |                                   | $V_{CC}$ falling: $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ | <b>-1.5</b>                       |                        | <b>+1.5</b>       |               |
| $V_{RSTH}$             | Reset Threshold Hysteresis        |   |                                   | $0.0032 \cdot V_{RST}$ |                   | mV            |
| $t_{RP}$               | Reset Timeout Period              | Reset Timeout Period = E, J, N, S                               | <b>1</b>                          | 1.4                    | <b>2</b>          | ms            |
|                        |                                   | Reset Timeout Period = F, K, P, T                               | <b>20</b>                         | 28                     | <b>40</b>         |               |
|                        |                                   | Reset Timeout Period = G, L, Q, U                               | <b>140</b>                        | 200                    | <b>280</b>        |               |
|                        |                                   | Reset Timeout Period = H, M, R, V                               | <b>1120</b>                       | 1600                   | <b>2240</b>       |               |
|                        |                                   |   |                                   |                        |                   |               |
| $t_{RD}$               | $V_{CC}$ to Reset Delay           | $V_{CC}$ falling at 1mV/ $\mu\text{s}$                          |                                   | 20                     |                   | $\mu\text{s}$ |
| <b>RESET (LM3711)</b>  |                                   |   |                                   |                        |                   |               |
| $V_{OL}$               | RESET                             | $V_{CC} > 2.25V$ , $I_{SINK} = 900\mu\text{A}$                  |                                   |                        | <b>0.3</b>        | V             |
|                        |                                   | $V_{CC} > 2.7V$ , $I_{SINK} = 1.2\text{mA}$                     |                                   |                        | <b>0.3</b>        |               |
|                        |                                   | $V_{CC} > 4.5V$ , $I_{SINK} = 3.2\text{mA}$                     |                                   |                        | <b>0.4</b>        |               |
| $V_{OH}$               | RESET                             | $V_{CC} > 1.2V$ , $I_{SOURCE} = 50\mu\text{A}$                  | <b>0.8 <math>V_{CC}</math></b>    |                        |                   | V             |
|                        |                                   | $V_{CC} > 1.8V$ , $I_{SOURCE} = 150\mu\text{A}$                 | <b>0.8 <math>V_{CC}</math></b>    |                        |                   |               |
|                        |                                   | $V_{CC} > 2.25V$ , $I_{SOURCE} = 300\mu\text{A}$                | <b>0.8 <math>V_{CC}</math></b>    |                        |                   |               |
|                        |                                   | $V_{CC} > 2.7V$ , $I_{SOURCE} = 500\mu\text{A}$                 | <b>0.8 <math>V_{CC}</math></b>    |                        |                   |               |
|                        |                                   | $V_{CC} > 4.5V$ , $I_{SOURCE} = 800\mu\text{A}$                 | <b><math>V_{CC} - 1.5V</math></b> |                        |                   |               |

**LM3710/LM3711 Series Electrical Characteristics (continued)**

 Limits in the standard typeface are for  $T_J = 25^\circ\text{C}$  and limits in **boldface type** apply over full operating range. Unless otherwise specified:  $V_{CC} = +2.2\text{V}$  to  $5.5\text{V}$ .

| Symbol                | Parameter  | Conditions   | Min  | Typ                         | Max   | Units         |
|-----------------------|--|--|--|-----------------------------|---|---------------|
| $I_{LKG}$             | Output Leakage Current   | $V_{RESET} = 5.5\text{V}$  |  |                             | <b>1.0</b>  | $\mu\text{A}$ |
| <b>RESET (LM3710)</b> |  |  |  |                             |   |               |
| $V_{OL}$              | RESET  | $V_{CC} > 1.0\text{V}$ , $I_{SINK} = 50\mu\text{A}$  |  |                             | <b>0.3</b>  | V             |
|                       |  | $V_{CC} > 1.2\text{V}$ , $I_{SINK} = 100\mu\text{A}$   |  |                             | <b>0.3</b>  |               |
|                       |  | $V_{CC} > 2.25\text{V}$ , $I_{SINK} = 900\mu\text{A}$  |  |                             | <b>0.3</b>  |               |
|                       |  | $V_{CC} > 2.7\text{V}$ , $I_{SINK} = 1.2\text{mA}$   |  |                             | <b>0.3</b>  |               |
|                       |  | $V_{CC} > 4.5\text{V}$ , $I_{SINK} = 3.2\text{mA}$   |  |                             | <b>0.4</b>  |               |
| $V_{OH}$              | RESET  | $V_{CC} > 2.25\text{V}$ , $I_{SOURCE} = 300\mu\text{A}$  | <b><math>0.8 V_{CC}</math></b>                         |                             |   |               |
|                       |  | $V_{CC} > 2.7\text{V}$ , $I_{SOURCE} = 500\mu\text{A}$   | <b><math>0.8 V_{CC}</math></b>                         |                             |   |               |
|                       |  | $V_{CC} > 4.5\text{V}$ , $I_{SOURCE} = 800\mu\text{A}$   | <b><math>V_{CC} - 1.5\text{V}</math></b>               |                             |   |               |
| <b>WDI</b>            |  |  |  |                             |   |               |
| WDI                   | Watchdog Input Current   |  | <b>-1</b>  |                             | <b>+1</b>   | $\mu\text{A}$ |
| $WDI_T$               | Watchdog Input Threshold                                       |  | <b><math>0.2 \cdot V_{CC}</math></b>                   | 1.225                       | <b><math>0.8 \cdot V_{CC}</math></b>                    | V             |
| $t_{WD}$              | Watchdog Timeout Period  | Watchdog Timeout Period = E, F, G, H<br>Watchdog Timeout Period = J, K, L, M<br>Watchdog Timeout Period = N, P, Q, R<br>Watchdog Timeout Period = S, T, U, V | <b>4.3</b><br><b>71</b><br><b>1120</b><br><b>17900</b> | 6.2<br>102<br>1600<br>25600 | <b>9.3</b><br><b>153</b><br><b>2400</b><br><b>38400</b> | ms            |
| <b>PFI/MR</b>         |  |  |  |                             |   |               |
| $V_{PFT}$             | PFI Input Threshold  |  | <b>1.200</b>   | 1.225                       | <b>1.250</b>  | V             |
| $V_{MRT}$             | MR Input Threshold   | MR, Low  |  |                             | <b>0.8</b>  | V             |
|                       |  | MR, High   | <b>2.0</b>   |                             |   |               |
| $V_{PFTH}/V_{MRTH}$   | PFI/MR Threshold Hysteresis                                    | PFI/MR falling: $V_{CC} = V_{RST\ MAX}$ to $5.5\text{V}$   |  | $0.0032 \cdot V_{RST}$      |   | mV            |
| $I_{PFI}$             | Input Current (PFI only)                                       |  | <b>-75</b>   |                             | <b>75</b>   | nA            |
| $R_{MR}$              | MR Pull-up Resistance  |  | <b>35</b>  | 56                          | <b>75</b>   | k $\Omega$    |
| $t_{MD}$              | MR to Reset Delay  |  |  | 12                          |   | $\mu\text{s}$ |
| $t_{MR}$              | MR Pulse Width   |  | <b>25</b>  |                             |   | $\mu\text{s}$ |
| <b>PFO, LLO</b>       |  |  |  |                             |   |               |
| $V_{OL}$              | PFO, LLO Output Voltage  | $V_{CC} > 2.25\text{V}$ , $I_{SINK} = 900\mu\text{A}$  |  |                             | <b>0.3</b>  | V             |
|                       |  | $V_{CC} > 2.7\text{V}$ , $I_{SINK} = 1.2\text{mA}$   |  |                             | <b>0.3</b>  |               |
|                       |  | $V_{CC} > 4.5\text{V}$ , $I_{SINK} = 3.2\text{mA}$   |  |                             | <b>0.4</b>  |               |
| $V_{OH}$              |  | $V_{CC} > 2.25\text{V}$ , $I_{SOURCE} = 300\mu\text{A}$  | <b><math>0.8 V_{CC}</math></b>                         |                             |   |               |
|                       |  | $V_{CC} > 2.7\text{V}$ , $I_{SOURCE} = 500\mu\text{A}$   | <b><math>0.8 V_{CC}</math></b>                         |                             |   |               |
|                       |  | $V_{CC} > 4.5\text{V}$ , $I_{SOURCE} = 800\mu\text{A}$   | <b><math>V_{CC} - 1.5\text{V}</math></b>               |                             |   |               |
| <b>LLO OUTPUT</b>     |  |  |  |                             |   |               |
| $V_{LLOT}$            | LLO Output Threshold ( $V_{LLO} - V_{RST}$ , $V_{CC}$ falling) |  | <b><math>1.01 \cdot V_{RST}</math></b>                 | $1.02 \cdot V_{RST}$        | <b><math>1.03 \cdot V_{RST}</math></b>                  | V             |
| $V_{LLOTH}$           | Low-Line Comparator Hysteresis                                 |  |  | $0.0032 \cdot V_{RST}$      |   | mV            |
| $t_{CD}$              | Low-Line Comparator Delay                                      | $V_{CC}$ falling at $1\text{mV}/\mu\text{s}$   |  | 20                          |   | $\mu\text{s}$ |

### Typical Performance Characteristics

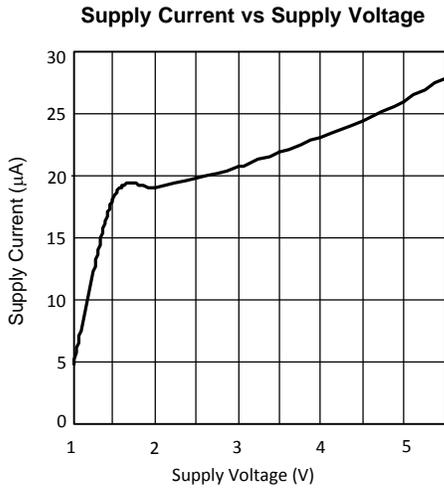


Figure 3.

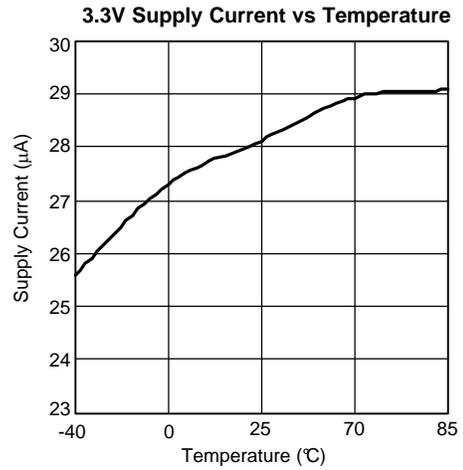


Figure 4.

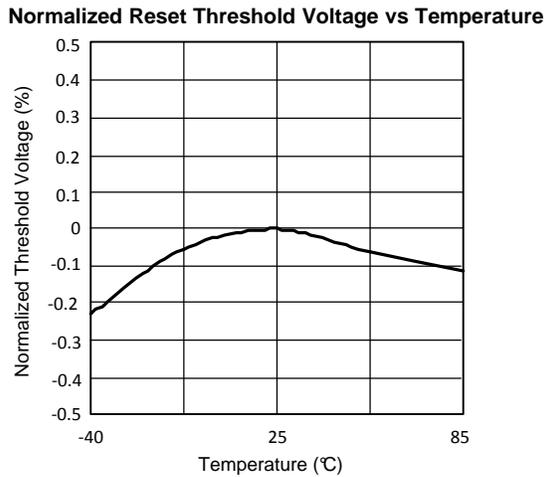


Figure 5.

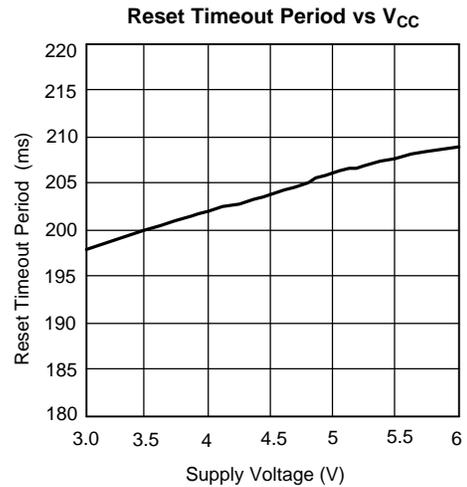


Figure 6.

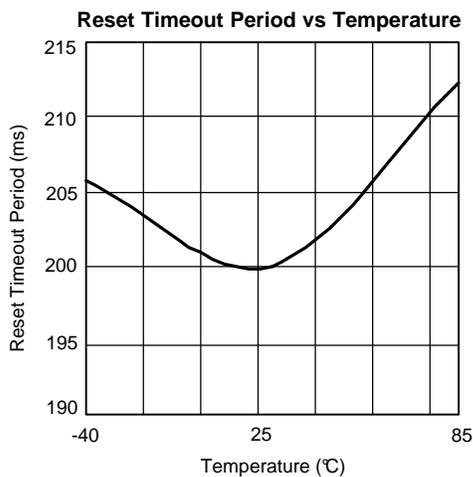


Figure 7.

Max. Transient Duration vs Reset Comparator Overdrive ( $V_{CC} = 3.3V$ )

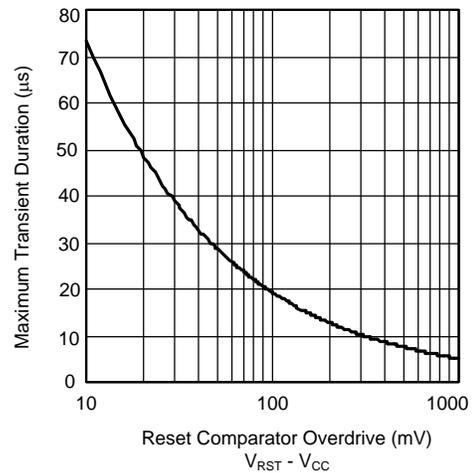
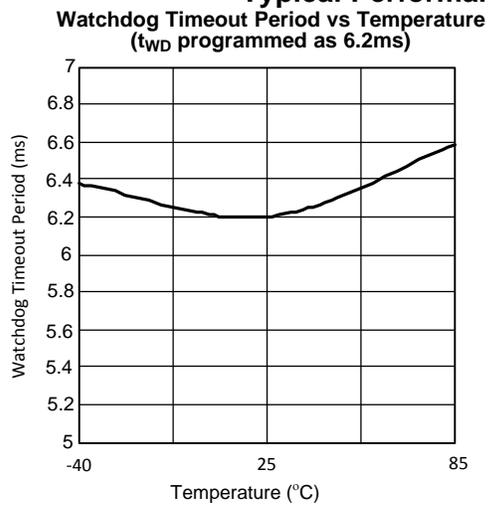
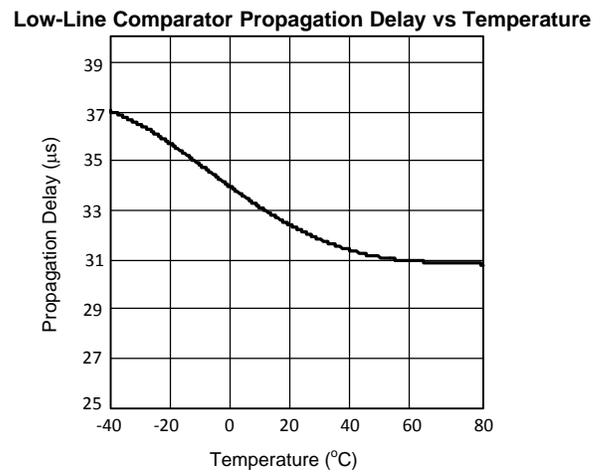


Figure 8.

**Typical Performance Characteristics (continued)**



**Figure 9.**



**Figure 10.**

## CIRCUIT INFORMATION

### RESET OUTPUT

The Reset input of a  $\mu\text{P}$  initializes the device into a known state. The LM3710/LM3711 microprocessor supervisory circuits assert a forced reset output to prevent code execution errors during power-up, power-down, and brownout conditions.

$\overline{\text{RESET}}$  is ensured valid for  $V_{\text{CC}} > 1\text{V}$ . Once  $V_{\text{CC}}$  exceeds the reset threshold, an internal timer maintains the output for the reset timeout period. After this interval, reset goes high. The LM3710 offers an active-low  $\overline{\text{RESET}}$ ; The LM3711 offers an active-high RESET.

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

The Manual Reset input ( $\overline{\text{MR}}$ ) will initiate a forced reset also. See the [MANUAL RESET INPUT \( \$\overline{\text{MR}}\$ \)](#) section.

### RESET THRESHOLD

The LM3710/LM3711 family is available with a reset voltage of 3.08V. Other reset thresholds in the 2.20V to 5.0V range, in steps of 10 mV, are available; contact Texas Instruments for details.

### 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 $\Omega$  pull-up. When the  $\overline{\text{MR}}$  input is pulled below  $V_{\text{MRT}}$  (1.225V) 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 timeout 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.

### POWER-FAIL COMPARATOR (PFI/ $\overline{\text{PFO}}$ )

The PFI is compared to a 1.225V 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 as follows:

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

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

### 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  $1.02 \cdot V_{\text{RST}}$ ) with hysteresis of  $0.0032 \cdot V_{\text{RST}}$ .

### WATCHDOG TIMER INPUT (WDI)

The watchdog timer input monitors one of the microprocessor's output lines for activity. Each time a transition occurs on this monitored line, the watchdog counter is reset. However, if no transition occurs and the timeout period is reached, the LM3710/LM3711 assumes that the microprocessor has locked up and the reset output is activated.

WDI is a high impedance input.

## SPECIAL PRECAUTIONS FOR THE DSBGA PACKAGE

As with most integrated circuits, the LM3710 and LM3711 are sensitive to exposure from visible and infrared (IR) light radiation. Unlike a plastic encapsulated IC, the DSBGA package has very limited shielding from light, and some sensitivity to light reflected from the surface of the PC board or long wavelength IR entering the die from the side may be experienced. This light could have an unpredictable affect on the electrical performance of the IC. Care should be taken to shield the device from direct exposure to bright visible or IR light during operation.

## DSBGA MOUNTING

The DSBGA package requires specific mounting techniques which are detailed in TI Application Note AN-1112 (SNVA009). Referring to the section **Surface Mount Assembly Considerations**, it should be noted that the pad style which must be used with the 9-pin package is the NSMD (non-solder mask defined) type.

For best results during assembly, alignment ordinals on the PC board may be used to facilitate placement of the DSBGA device.

## Timing Diagrams

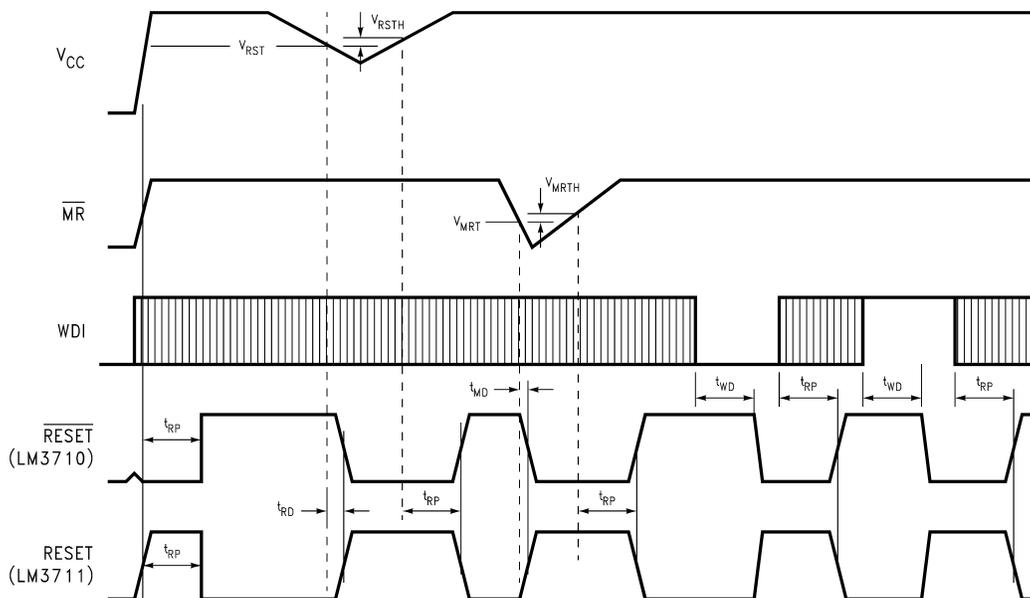


Figure 11. LM3710/LM3711 Reset Time with  $\overline{MR}$  and WDI

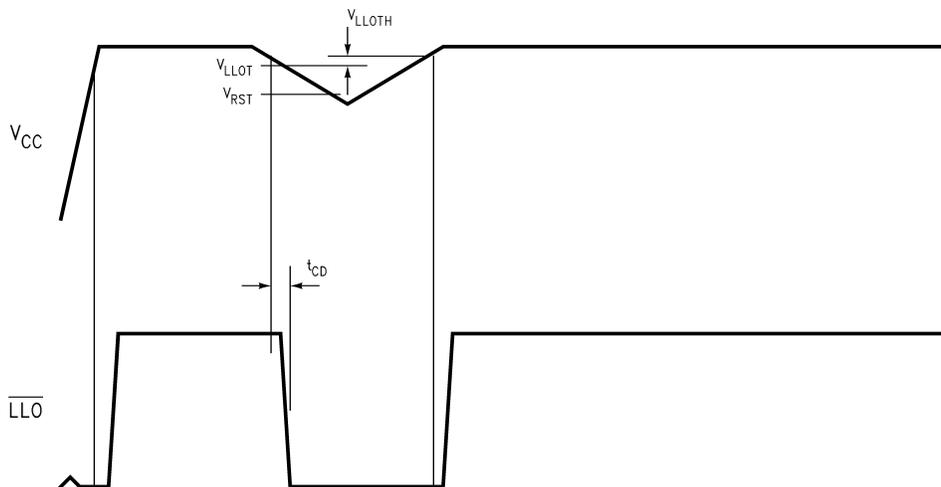


Figure 12.  $\overline{LLO}$  Output

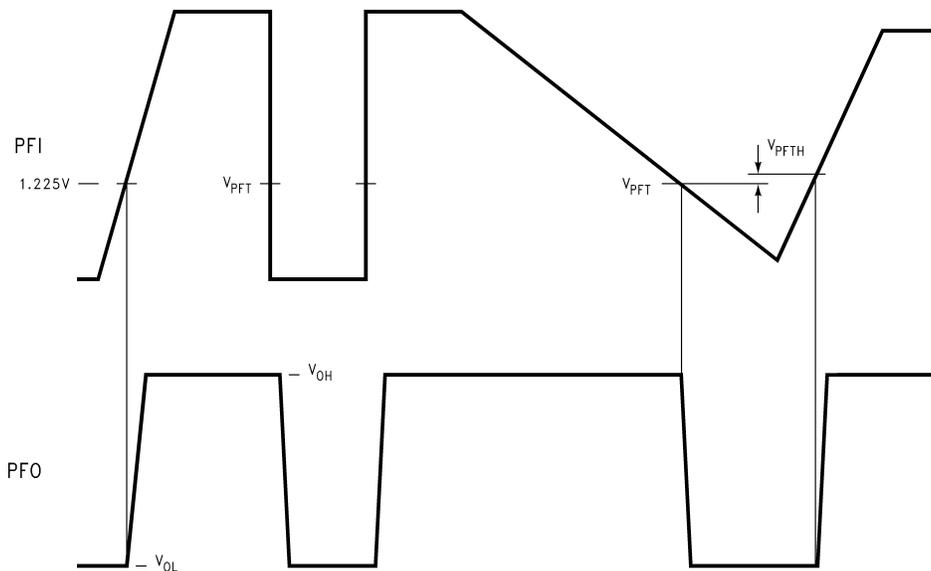


Figure 13. PFI Comparator Timing Diagram

Typical Application Circuits

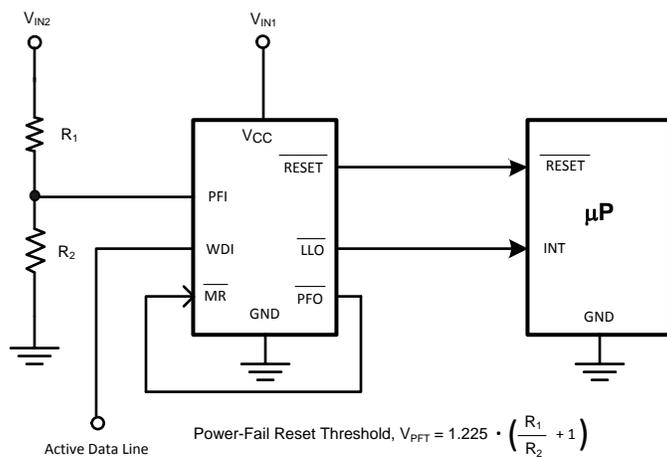


Figure 14. Monitoring Two Critical Supplies And Dataline

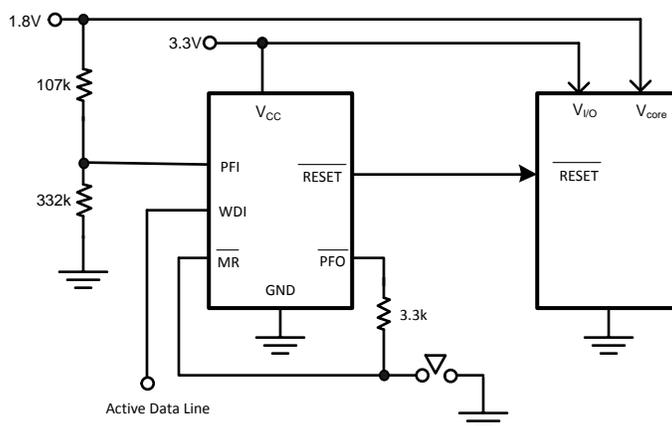


Figure 15. Monitoring Two Supplies plus Manual Reset And Dataline

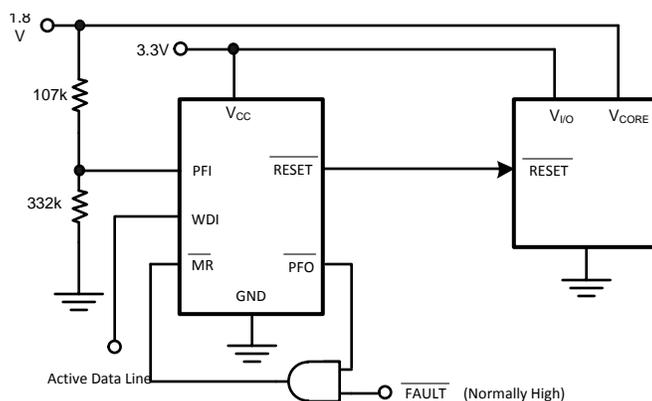
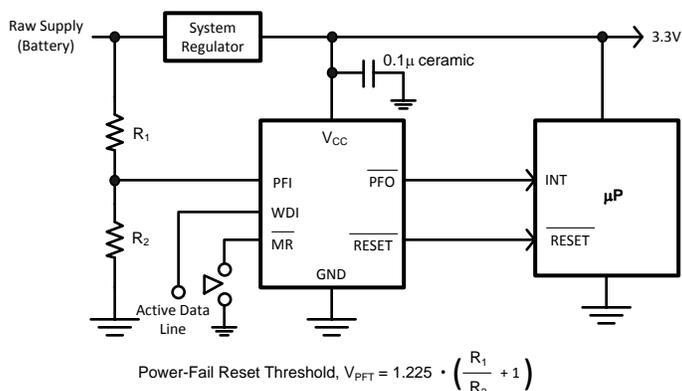


Figure 16. Monitoring Dual Supplies plus External Fault Input And Dataline



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

Figure 17. Microprocessor Supervisor with Early Warning Detector

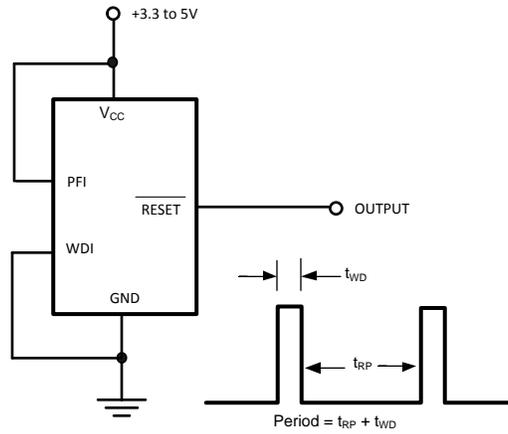


Figure 18. LM3710 Long Period oscillator

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**REVISION HISTORY**

| <b>Changes from Revision D (March 2013) to Revision E</b>  | <b>Page</b>              |
|--|--------------------------|
| <hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul> | <hr/> <a href="#">12</a> |

**PACKAGING INFORMATION**

| Orderable Device    | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|---------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM3710XKMM-463/NOPB | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   |              | R74B                    | <a href="#">Samples</a> |
| LM3710XQMM-308/NOPB | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 85    | R37B                    | <a href="#">Samples</a> |
| LM3710YQMM-232/NOPB | ACTIVE        | VSSOP        | DGS             | 10   | 1000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   |              | R77B                    | <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.

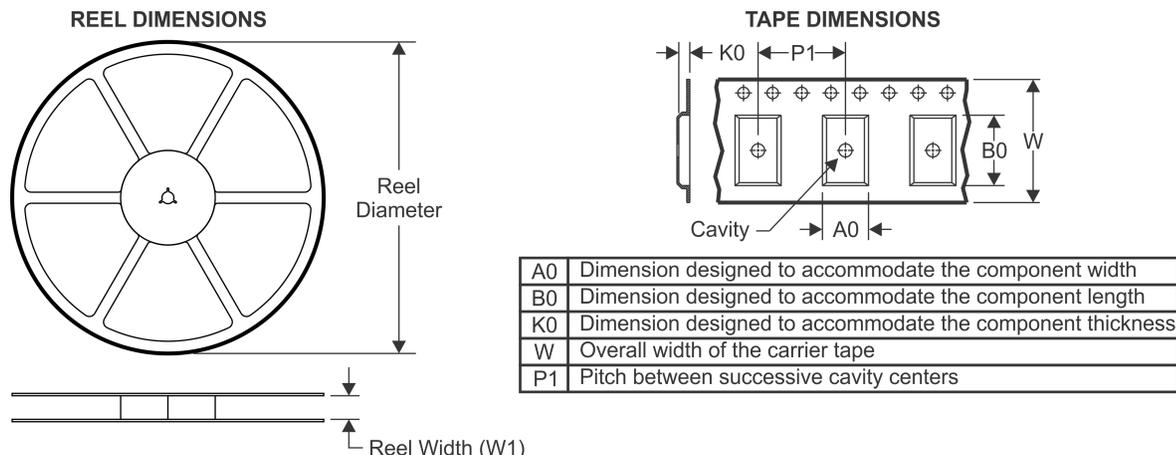
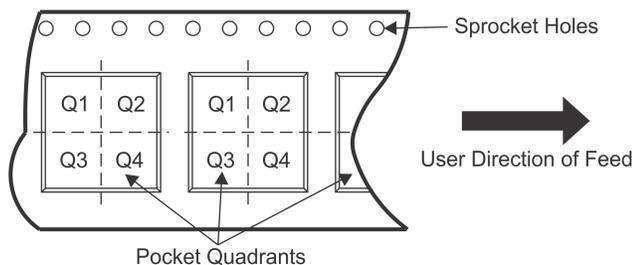
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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 finish/Ball material - Orderable Devices 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.

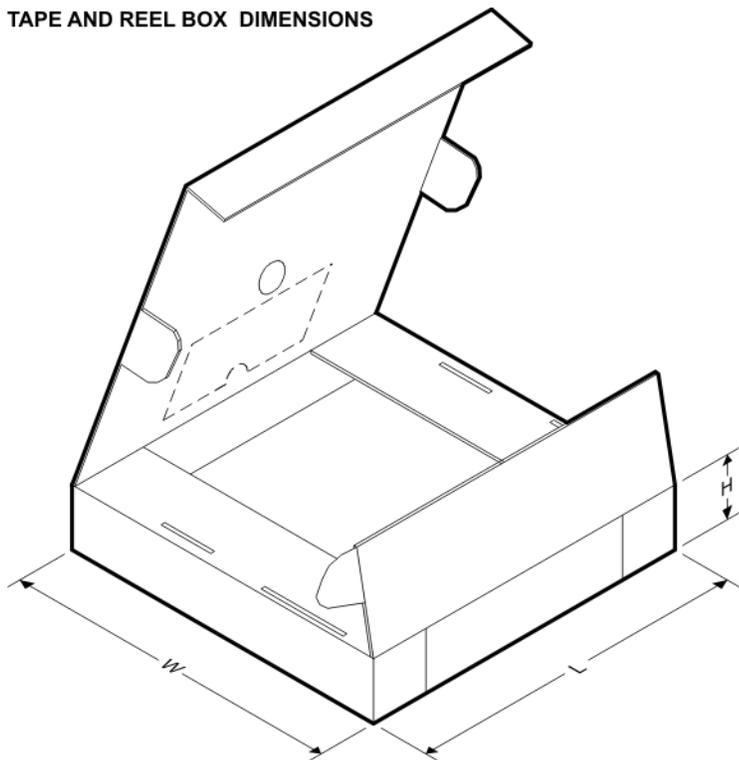
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**TAPE AND REEL INFORMATION**

**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 |
|---------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3710XKMM-463/NOPB | VSSOP        | DGS             | 10   | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3710XQMM-308/NOPB | VSSOP        | DGS             | 10   | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM3710YQMM-232/NOPB | VSSOP        | DGS             | 10   | 1000 | 178.0              | 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) |
|---------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM3710XKMM-463/NOPB | VSSOP        | DGS             | 10   | 1000 | 208.0       | 191.0      | 35.0        |
| LM3710XQMM-308/NOPB | VSSOP        | DGS             | 10   | 1000 | 208.0       | 191.0      | 35.0        |
| LM3710YQMM-232/NOPB | VSSOP        | DGS             | 10   | 1000 | 208.0       | 191.0      | 35.0        |

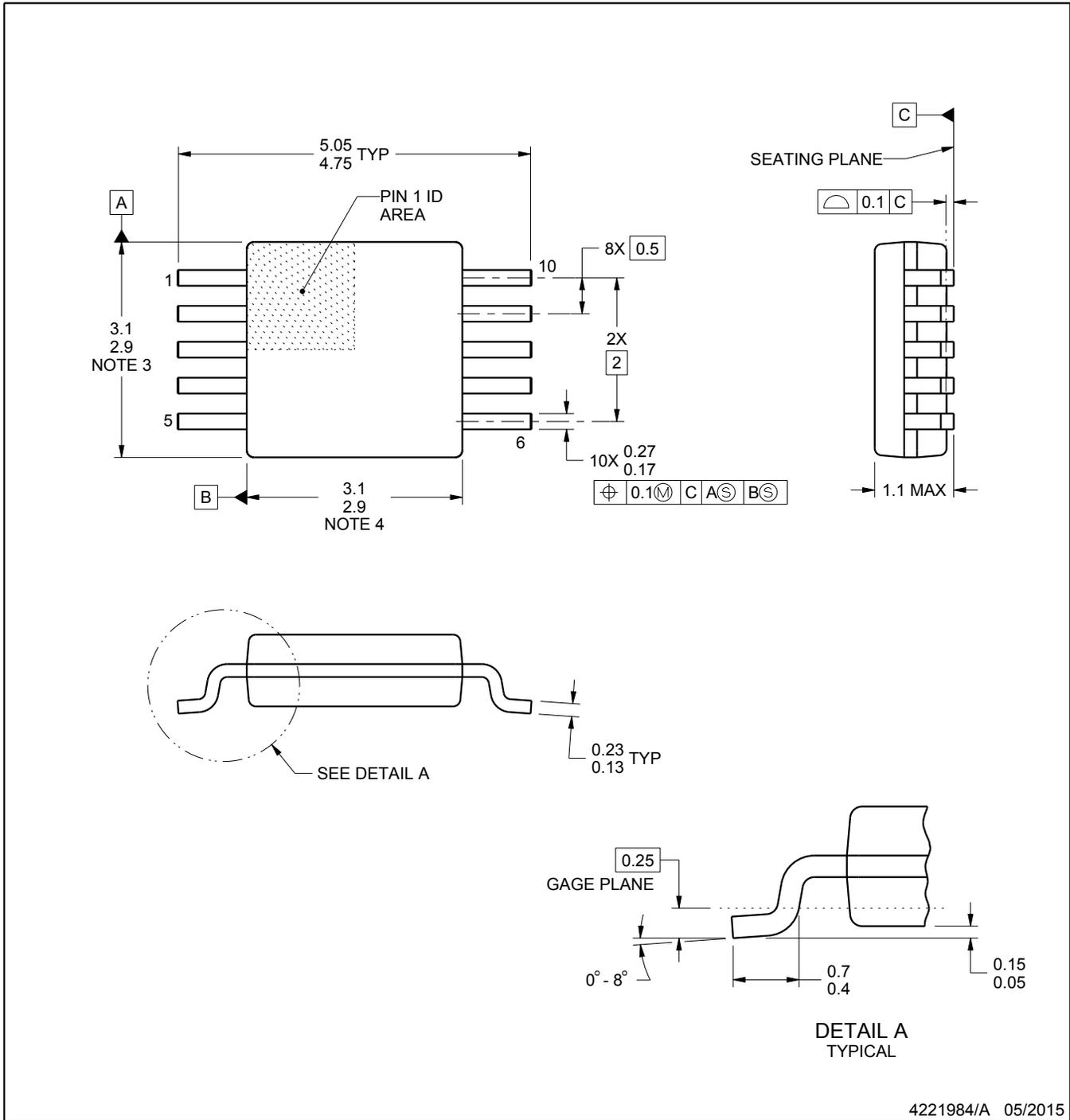
# DGS0010A



# PACKAGE OUTLINE

## VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



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### NOTES:

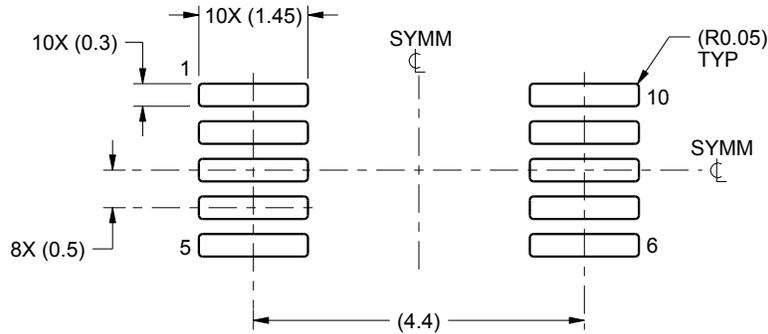
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

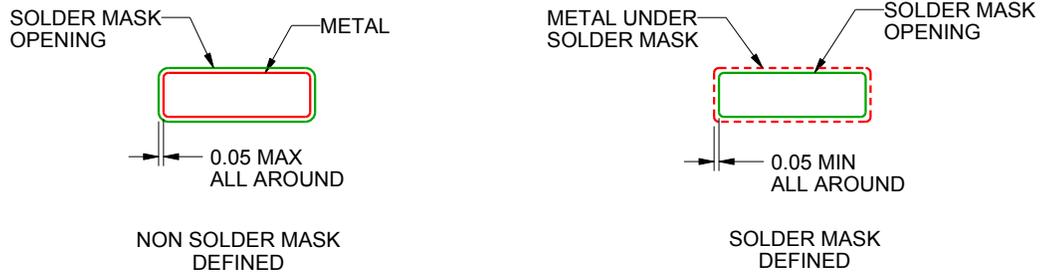
DGS0010A

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)

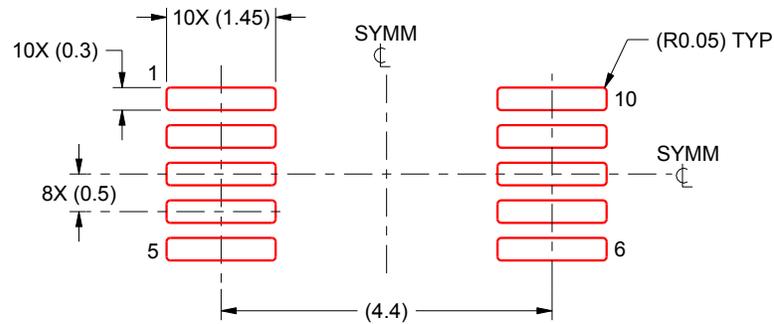
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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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