LMS33460 3-V Undervoltage Detector

1 Features
- Ultra-Low Power
- 3-V Detection
- Input Voltage From 0.8 V to 7 V
- Open-Drain Output
- Ultra-Small 5-Pin SC70 Package
- Extended Temperature Range (–40°C to 85°C)
- Ultra-Low Quiescent Current (1 µA Typical)

2 Applications
- Low Battery Voltage Detectors
- Power Fail Indicators
- Processor Reset Generators
- Battery Backup Controls
- Battery-Operated Equipment
- Hand-Held Instruments
- Undervoltage Detectors

3 Description
The LMS33460 device is an undervoltage detector with a 3-V threshold and extremely low power consumption. The LMS33460 is specifically designed to accurately monitor power supplies. It is especially suited to battery-powered systems where low quiescent current and small size are required. This IC generates an active output whenever the input voltage drops below 3 V.

This part uses a precision on-chip voltage reference and a comparator to measure the input voltage. Built-in hysteresis helps to prevent erratic operation in the presence of noise. The UVD is available in the ultra-miniature 5-pin SC70 package.

Device Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BODY SIZE (NOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS33460</td>
<td>SC70 (5)</td>
<td>2.00 mm × 1.25 mm</td>
</tr>
</tbody>
</table>

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

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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 D (April 2013) to Revision E 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

• Deleted Ordering Information table; see POA at the end of the data sheet. ........................................................................... 1

• Added Thermal Information table ........................................................................................................................................... 4

• Changed $R_{\text{JA}}$ value From: 478 To: 275.5 .............................................................................................................................. 4

Changes from Revision C (April 2013) to Revision D Page

• Changed layout of National Semiconductor Data Sheet to TI format .......................................................... 1
5 Pin Configuration and Functions

![DCK Package 5-Pin SC70 Top View](image)

**Pin Functions**

<table>
<thead>
<tr>
<th>PIN</th>
<th>I/O</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>2</td>
<td>— Internally connected to ground. Can be left floating or connected to GND (pin 3).</td>
</tr>
<tr>
<td>GND</td>
<td>3</td>
<td>— Ground</td>
</tr>
<tr>
<td>NC</td>
<td>1</td>
<td>— No connection</td>
</tr>
<tr>
<td>VIN</td>
<td>5</td>
<td>I Input supply</td>
</tr>
<tr>
<td>VOUT</td>
<td>4</td>
<td>O Voltage output</td>
</tr>
</tbody>
</table>

6 Specifications

6.1 Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>V</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>mA</td>
</tr>
<tr>
<td>240</td>
<td>240</td>
<td>°C</td>
</tr>
<tr>
<td>150</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

(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.

6.2 ESD Ratings

<table>
<thead>
<tr>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>±2500</td>
<td>V</td>
</tr>
<tr>
<td>±200</td>
<td>V</td>
</tr>
</tbody>
</table>

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

6.3 Recommended Operating Conditions

<table>
<thead>
<tr>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>−40</td>
<td>85</td>
<td>°C</td>
</tr>
</tbody>
</table>

---

Submit Documentation Feedback

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Product Folder Links: LMS33460
6.4 Thermal Information

<table>
<thead>
<tr>
<th>THERMAL METRIC&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>LMS33460 DCK (SC70)</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{\theta JV}$</td>
<td>Junction-to-ambient thermal resistance</td>
<td>275.5</td>
</tr>
<tr>
<td>$R_{\theta JC}$</td>
<td>Junction-to-case (top) thermal resistance</td>
<td>102.5</td>
</tr>
<tr>
<td>$R_{\theta JB}$</td>
<td>Junction-to-board thermal resistance</td>
<td>54</td>
</tr>
<tr>
<td>$\psi_{JT}$</td>
<td>Junction-to-top characterization parameter</td>
<td>2.7</td>
</tr>
<tr>
<td>$\psi_{JB}$</td>
<td>Junction-to-board characterization parameter</td>
<td>53.3</td>
</tr>
</tbody>
</table>

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

6.5 Electrical Characteristics

$T_J = 25°C$ (unless otherwise noted)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DET}$</td>
<td>Detector threshold</td>
<td>$V_{IN}$ falling</td>
<td>2.85</td>
<td>3</td>
<td>3.15</td>
</tr>
<tr>
<td>$V_{HYS}$</td>
<td>Detector voltage hysteresis</td>
<td>$V_{IN}$ rising</td>
<td>0.095</td>
<td>0.155</td>
<td>0.215</td>
</tr>
<tr>
<td>$I_{IN}$</td>
<td>Input supply current</td>
<td>$V_{IN} = 2.87$ V</td>
<td>1</td>
<td>2.2</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{IN} = 4.7$ V</td>
<td>1.2</td>
<td>3.6</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{IN} = 7$ V&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>25</td>
<td>200</td>
<td>µA</td>
</tr>
<tr>
<td>$V_{IN(MAX)}$</td>
<td>Maximum operating voltage</td>
<td></td>
<td>7</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{IN(MIN)}$</td>
<td>Minimum operating voltage</td>
<td>$T_J = -40°C$ to $85°C$</td>
<td>0.7</td>
<td>1.1</td>
<td>V</td>
</tr>
<tr>
<td>$I_{OUT(LOW)}$</td>
<td>Output current low</td>
<td>$V_{OUT} = 0.05$ V, $V_{IN} = 1.1$ V</td>
<td>0.01</td>
<td>0.6</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{OUT} = 0.5$ V, $V_{IN} = 1.5$ V</td>
<td>2</td>
<td>11</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{PDHL}$</td>
<td>Output delay time (output transition high to low)</td>
<td>$C_L = 10$ pF, $R_L = 470$ kΩ</td>
<td>130</td>
<td>200</td>
<td>µs</td>
</tr>
<tr>
<td>$\Delta V_{DET}/\Delta T$</td>
<td>Detect voltage temperature coefficient</td>
<td>$T_J = -40°C$ to $85°C$</td>
<td>±120</td>
<td>PPM/°C</td>
<td></td>
</tr>
</tbody>
</table>

(1) Quiescent current increases substantially above 5.5 V, but is very low in the normal range below 5.5 V.
6.6 Typical Characteristics

\( T_A = 25^\circ C, R_L = 470 \, k\Omega, \) and \( C_L = 10 \, pF \) (unless otherwise noted)

---

**Figure 1. Detector Threshold vs Temperature**

**Figure 2. Supply Current vs Input Voltage**

**Figure 3. Propagation Delay Time (\( t_{PDHL} \)) vs Temperature**

**Figure 4. Propagation Delay Time (\( t_{PDLH} \)) vs Temperature**

**Figure 5. \( V_{OUT(LOW)} \) vs \( V_{IN} \)**
7 Detailed Description

7.1 Overview

The LMS33460 is a micropower undervoltage-sensing circuit with an open-drain output configuration, which requires a pull resistor.

The LMS33460 features a voltage reference, a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation.

![Propagation Delay Timing Diagram](image)

**Figure 6. Propagation Delay Timing Diagram**

![Propagation Delay Test Circuit](image)

**Figure 7. Propagation Delay Test Circuit**
### 7.2 Functional Block Diagram

![Functional Block Diagram](image)

### 7.3 Feature Description

The input supply ($V_{IN}$) is the voltage that is being monitored and as it decreases past 3 V, the active-low output ($V_{OUT}$) transitions to a logic low state. When $V_{IN}$ rises above 3 V plus the built-in hysteresis, $V_{OUT}$ returns to its original state of logic high. The LMS33460 has built-in hysteresis when the input supply is coming back up to help prevent erratic output operation when the input voltage crosses the threshold.

The LMS33460 is useful in a variety of applications that require low voltage detection and is suited for battery-powered systems where low quiescent current and small package size is required. It can also be used as a precision reset circuit for microcontroller applications.

### 7.4 Device Functional Modes

#### 7.4.1 Start Up

As the input voltage ($V_{IN}$) ramps up, the output ($V_{OUT}$) remains logic low until $V_{IN}$ reaches 3.15 V due to the built-in hysteresis (nominally 150 mV). After $V_{IN}$ crosses that threshold, $V_{OUT}$ remains logic high until $V_{IN}$ drops below the 3-V threshold. The hysteresis only applies to the $V_{IN}$ rising threshold.
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
This device is ideal to use in battery-powered or microprocessor based systems and can be used as a low voltage indicator or reset circuit.

8.2 Typical Application

![Typical Application Schematic](image)

Figure 8. Typical Application Schematic

8.2.1 Design Requirements
For this design example, use the parameters listed in Table 1 as the input parameters.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>EXAMPLE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input supply voltage maximum</td>
<td>7 V</td>
</tr>
<tr>
<td>V\text{OUT} maximum</td>
<td>7 V</td>
</tr>
<tr>
<td>V\text{OUT} minimum</td>
<td>0 V</td>
</tr>
<tr>
<td>Pullup resistor</td>
<td>470 kΩ</td>
</tr>
</tbody>
</table>

8.2.2 Detailed Design Procedure
The LMS33460 is a very easy to use low voltage detector. All that required is the input supply voltage and a pullup resistor at the output. TI recommends 470 kΩ for the pullup resistor.
8.2.3 Application Curve

\[ R_L = 475 \, \text{k}\Omega \]

Figure 9. LMS33460 Turnon

9 Power Supply Recommendations

The input of the LMS33460 is designed to handle up to the recommended supply voltage of 7 V and remain in the recommended input voltage range during operation. No input capacitor is required.

10 Layout

10.1 Layout Guidelines

Place the output pullup resistor, and delay capacitor if used, as close as possible to the IC. Keep traces short between the IC and the components used at the output to ensure the timing delay is as accurate as possible.

10.2 Layout Example

Figure 10. Layout Example Diagram
11 Device and Documentation Support

11.1 Receiving Notification of Documentation Updates
To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on Alert me to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

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, 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
This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

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

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>PIns</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS33460MG</td>
<td>NRND</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-40 to 85</td>
<td>C33</td>
<td></td>
</tr>
<tr>
<td>LMS33460MG/NOPB</td>
<td>ACTIVE</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 85</td>
<td>C33</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(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.

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

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check [http://www.ti.com/productcontent](http://www.ti.com/productcontent) for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.
### TAPE AND REEL INFORMATION

#### Reel Dimensions

- **Reel Diameter**
- **Reel Width (W1)**

#### Tape Dimensions

- **K0**: Dimension designed to accommodate the component width
- **B0**: Dimension designed to accommodate the component length
- **A0**: Dimension designed to accommodate the component thickness
- **W**: Overall width of the carrier tape
- **P1**: Pitch between successive cavity centers

#### Quadrant Assignments for Pin 1 Orientation in Tape

- **Q1**: Quadrant 1
- **Q2**: Quadrant 2
- **Q3**: Quadrant 3
- **Q4**: Quadrant 4

*All dimensions are nominal*

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
<th>K0 (mm)</th>
<th>P1 (mm)</th>
<th>W (mm)</th>
<th>Pin1 Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS33460MG</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>178.0</td>
<td>8.4</td>
<td>2.25</td>
<td>2.45</td>
<td>1.2</td>
<td>4.0</td>
<td>8.0</td>
<td>Q3</td>
</tr>
<tr>
<td>LMS33460MG/NOPB</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>178.0</td>
<td>8.4</td>
<td>2.25</td>
<td>2.45</td>
<td>1.2</td>
<td>4.0</td>
<td>8.0</td>
<td>Q3</td>
</tr>
</tbody>
</table>
### TAPE AND REEL BOX DIMENSIONS

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMS33460MG</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>210.0</td>
<td>185.0</td>
<td>35.0</td>
</tr>
<tr>
<td>LMS33460MG/NOPB</td>
<td>SC70</td>
<td>DCK</td>
<td>5</td>
<td>1000</td>
<td>210.0</td>
<td>185.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>

*All dimensions are nominal*
MECHANICAL DATA

DCK (R–PDSO–G5)  PLASTIC SMALL–OUTLINE PACKAGE

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. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO-203 variation AA.
LAND PATTERN DATA

DCK (R–PDSO–G5) PLASTIC SMALL OUTLINE

Example Board Layout

Stencil Openings
Based on a stencil thickness of .127mm (.005inch).

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC-7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7526 for other stencil recommendations.
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