

## LMV331 单路、LMV393 双路、LMV339 四路通用低电压比较器

### 1 特性

- 2.7V 和 5V 性能
- 低电源电流
  - LMV331 130  $\mu$ A (典型值)
  - LMV393 210  $\mu$ A (典型值)
  - LMV339 410  $\mu$ A (典型值)
- 输入共模电压范围包括接地
- 低输出饱和电压：200mV (典型值)
- 集电极开路输出可实现更大的灵活性

### 2 应用

- 迟滞比较器
- 振荡器
- 窗口比较器
- 工业设备
- 测试和测量

### 3 说明

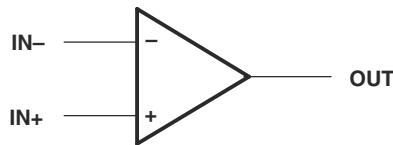
LMV393 和 LMV339 器件分别是双路和四路比较器的低电压 (2.7V 至 5.5V) 版本，它们的工作电压范围为 5V 至 30V。LMV331 是单路比较器。

LMV331、LMV339 和 LMV393 是颇具成本效益的解决方案，适用于在便携式消费类电子产品的电路设计中要求低电压运行、低功耗和节省空间的应用。无需消耗全部的电源电流，这类器件便可达到或超出常见 LM339 和 LM393 器件的规格。

器件信息

| 器件型号   | 封装 (引脚) <sup>(1)</sup> | 封装尺寸 (标称值)      |
|--------|------------------------|-----------------|
| LMV339 | SOIC (14)              | 8.65mm x 3.90mm |
| LMV393 | SOIC (8)               | 4.90mm x 3.90mm |
| LMV331 | SC70 (5)               | 2.00mm x 1.25mm |

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



简化原理图



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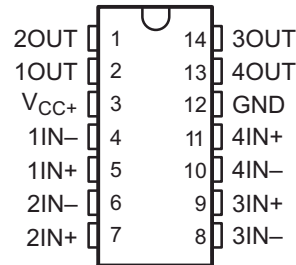
## 4 Revision History

注：以前版本的页码可能与当前版本的页码不同

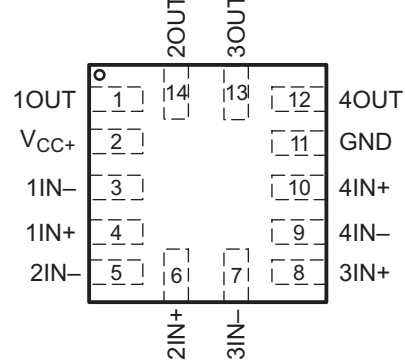
|                                                                                                         |             |
|---------------------------------------------------------------------------------------------------------|-------------|
| <b>Changes from Revision T (January 2015) to Revision U (October 2020)</b> .....                        | <b>Page</b> |
| • 更新了整个文档的表、图和交叉参考的编号格式。.....                                                                           | <b>1</b>    |
| <b>Changes from Revision S (October 2012) to Revision T (January 2015)</b> .....                        | <b>Page</b> |
| • 添加了应用、器件信息表、引脚功能表、ESD 等级表、热性能信息表、典型特性、特性说明部分、器件功能模式、应用和实施部分、电源建议部分、布局部分、器件和文档支持部分以及机械、封装和可订购信息部分..... | <b>1</b>    |
| • 删除了订购信息表.....                                                                                         | <b>1</b>    |
| <b>Changes from Revision R (May 2012) to Revision S (October 2012)</b> .....                            | <b>Page</b> |
| • Updated operating temperature range.....                                                              | <b>4</b>    |
| <b>Changes from Revision N (April 2011) to Revision O (February 2012)</b> .....                         | <b>Page</b> |
| • Changed $V_I$ in the <i>Absolute Maximum Ratings</i> from 5.5 V to $V_{CC+}$ .....                    | <b>4</b>    |
| <b>Changes from Revision M (November 2005) to Revision N (April 2011)</b> .....                         | <b>Page</b> |
| • 将文档格式从 Quicksilver 变更为 DocZone.....                                                                   | <b>1</b>    |
| • Added RUC package pin out drawing.....                                                                | <b>3</b>    |

## 5 Pin Configuration and Functions

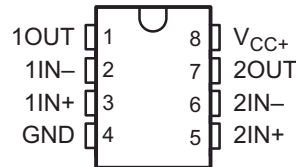
**LMV339 . . . D OR PW PACKAGE  
(TOP VIEW)**



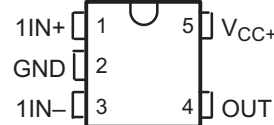
**LMV339 . . . RUC PACKAGE  
(TOP VIEW)**



**LMV393 . . . D, DDU, DGK OR PW PACKAGE  
(TOP VIEW)**



**LMV331 . . . DBV OR DCK PACKAGE  
(TOP VIEW)**



**表 5-1. Pin Functions**

| NAME                                   | PIN                     |                                |                   |               | TYPE | DESCRIPTION                         |
|----------------------------------------|-------------------------|--------------------------------|-------------------|---------------|------|-------------------------------------|
|                                        | LMV331<br>DBV or<br>DCK | LMV393<br>D, DDU,<br>DGK or PW | LMV339<br>D or PW | RUC           |      |                                     |
| 1IN - ,<br>2IN - ,<br>3IN - ,<br>4IN - | 3                       | 2, 6                           | 4, 6, 8, 10       | 3, 5, 7, 9    | I    | Comparator(s) negative input pin(s) |
| 1IN+ ,<br>2IN+ ,<br>3IN+ ,<br>4IN+     | 1                       | 3, 5                           | 5, 7, 9, 11       | 4, 6, 8, 10   | I    | Comparator(s) positive input pin(s) |
| GND                                    | 2                       | 4                              | 12                | 11            | I    | Ground                              |
| 1OUT,<br>2OUT,<br>3OUT,<br>4OUT        | 4                       | 1, 7                           | 2, 1, 14, 13      | 1, 14, 13, 12 | O    | Comparator(s) output pin(s)         |
| VCC+                                   | 5                       | 8                              | 3                 | 2             | I    | Supply Pin                          |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|                  |                                                                           | MIN                                                        | MAX              | UNIT      |
|------------------|---------------------------------------------------------------------------|------------------------------------------------------------|------------------|-----------|
| V <sub>CC</sub>  | Supply voltage <sup>(2)</sup>                                             |                                                            | 5.5              | V         |
| V <sub>ID</sub>  | Differential input voltage <sup>(3)</sup>                                 |                                                            | ±5.5             | V         |
| V <sub>I</sub>   | Input voltage range (either input)                                        | 0                                                          | V <sub>CC+</sub> | V         |
|                  | Duration of output short circuit (one amplifier) to ground <sup>(4)</sup> | At or below T <sub>A</sub> = 25°C, V <sub>CC</sub> ≤ 5.5 V |                  | Unlimited |
| T <sub>J</sub>   | Operating virtual junction temperature                                    |                                                            | 150              | °C        |
| T <sub>stg</sub> | Storage temperature range                                                 | - 65                                                       | 150              | °C        |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under [§ 6.3](#) is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values (except differential voltages and V<sub>CC</sub> specified for the measurement of I<sub>OS</sub>) are with respect to the network GND.
- (3) Differential voltages are at IN+ with respect to IN-.
- (4) Short circuits from outputs to V<sub>CC</sub> can cause excessive heating and eventual destruction.

### 6.2 ESD Ratings

|                    |                         |                                                                                          | VALUE | UNIT |
|--------------------|-------------------------|------------------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | ±2000 | V    |
|                    |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | ±1000 |      |

- (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

|                  |                                          | MIN                    | MAX | UNIT |
|------------------|------------------------------------------|------------------------|-----|------|
| V <sub>CC</sub>  | Supply voltage (single-supply operation) | 2.7                    | 5.5 | V    |
| V <sub>OUT</sub> | Output voltage                           | V <sub>CC+</sub> + 0.3 |     | V    |
| T <sub>A</sub>   | Operating free-air temperature           | - 40                   | 125 | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | LMV339  |     |      | LMV393 |     |     |     | LMV331 |     | UNIT |
|-------------------------------|----------------------------------------------|---------|-----|------|--------|-----|-----|-----|--------|-----|------|
|                               |                                              | D       | PW  | RUC  | D      | DDU | DGK | PW  | DBV    | DCK |      |
|                               |                                              | 14 PINS |     |      | 8 PINS |     |     |     | 5 PINS |     |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 86      | 113 | 216  | 97     | 210 | 172 | 149 | 206    | 252 | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | —       | —   | 51.3 | —      | —   | —   | —   | —      | —   |      |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | —       | —   | 59.0 | —      | —   | —   | —   | —      | —   |      |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | —       | —   | 1.2  | —      | —   | —   | —   | —      | —   |      |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | —       | —   | 59.0 | —      | —   | —   | —   | —      | —   |      |

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

## 6.5 Electrical Characteristics, $V_{CC+} = 2.7\text{ V}$

$V_{CC+} = 2.7\text{ V}$ ,  $GND = 0\text{ V}$ , at specified free-air temperature (unless otherwise noted)

| PARAMETER      | TEST CONDITIONS                                         | $T_A$                         | MIN  | TYP        | MAX | UNIT                         |
|----------------|---------------------------------------------------------|-------------------------------|------|------------|-----|------------------------------|
| $V_{IO}$       | Input offset voltage                                    | 25°C                          |      | 1.7        | 7   | mV                           |
| $\alpha_{VIO}$ | Average temperature coefficient of input offset voltage | – 40°C to 125°C               |      | 5          |     | $\mu\text{V}/^\circ\text{C}$ |
| $I_{IB}$       | Input bias current                                      | 25°C                          |      | 15         | 250 | nA                           |
|                |                                                         | – 40°C to 125°C               |      |            | 400 |                              |
| $I_{IO}$       | Input offset current                                    | 25°C                          |      | 5          | 50  | nA                           |
|                |                                                         | – 40°C to 125°C               |      |            | 150 |                              |
| $I_O$          | Output current (sinking)                                | $V_O \leq 1.5\text{ V}$       | 25°C | 5          | 23  | mA                           |
|                | Output Leakage Current                                  | 25°C                          |      | 0.003      |     | $\mu\text{A}$                |
|                |                                                         | – 40°C to 125°C               |      |            | 1   |                              |
| $V_{ICR}$      | Common-mode input voltage range                         | 25°C                          |      | – 0.1 to 2 |     | V                            |
| $V_{SAT}$      | Saturation voltage                                      | $I_O \leq 1.5\text{ mA}$      | 25°C | 200        |     | mV                           |
| $I_{CC}$       | Supply current                                          | LMV331                        | 25°C | 40         | 100 | $\mu\text{A}$                |
|                |                                                         | LMV393 (both comparators)     | 25°C | 70         | 140 |                              |
|                |                                                         | LMV339 (all four comparators) | 25°C | 140        | 200 |                              |

## 6.6 Electrical Characteristics, $V_{CC+} = 5\text{ V}$

$V_{CC+} = 5\text{ V}$ ,  $GND = 0\text{ V}$ , at specified free-air temperature (unless otherwise noted)

| PARAMETER                                                              | TEST CONDITIONS               | $T_A$           | MIN          | TYP   | MAX | UNIT                          |
|------------------------------------------------------------------------|-------------------------------|-----------------|--------------|-------|-----|-------------------------------|
| $V_{IO}$ Input offset voltage                                          |                               | 25°C            |              | 1.7   | 7   | mV                            |
|                                                                        |                               | – 40°C to 125°C |              |       | 9   |                               |
| $\alpha_{VIO}$ Average temperature coefficient of input offset voltage |                               | 25°C            |              | 5     |     | $\mu\text{ V}/^\circ\text{C}$ |
| $I_{IB}$ Input bias current                                            |                               | 25°C            |              | 25    | 250 | nA                            |
|                                                                        |                               | – 40°C to 125°C |              |       | 400 |                               |
| $I_{IO}$ Input offset current                                          |                               | 25°C            |              | 2     | 50  | nA                            |
|                                                                        |                               | – 40°C to 125°C |              |       | 150 |                               |
| $I_O$ Output current (sinking)                                         | $V_O \leq 1.5\text{ V}$       | 25°C            | 10           | 84    |     | mA                            |
| Output Leakage Current                                                 |                               | 25°C            |              | 0.003 |     | $\mu\text{A}$                 |
|                                                                        |                               | – 40°C to 125°C |              |       | 1   |                               |
| $V_{ICR}$ Common-mode input voltage range                              |                               | 25°C            | – 0.1 to 4.2 |       |     | V                             |
| $A_{VD}$ Large-signal differential voltage gain                        |                               | 25°C            | 20           | 50    |     | V/mV                          |
| $V_{SAT}$ Saturation voltage                                           | $I_O \leq 4\text{ mA}$        | 25°C            |              | 200   | 400 | mV                            |
|                                                                        |                               | – 40°C to 125°C |              |       | 700 |                               |
| $I_{CC}$ Supply current                                                | LMV331                        | 25°C            |              | 60    | 120 | $\mu\text{A}$                 |
|                                                                        |                               | – 40°C to 125°C |              |       | 150 |                               |
|                                                                        | LMV393 (both comparators)     | 25°C            |              | 100   | 200 |                               |
|                                                                        |                               | – 40°C to 125°C |              |       | 250 |                               |
|                                                                        | LMV339 (all four comparators) | 25°C            |              | 170   | 300 |                               |
|                                                                        |                               | – 40°C to 125°C |              |       | 350 |                               |

## 6.7 Switching Characteristics, $V_{CC+} = 2.7\text{ V}$

$T_A = 25^\circ\text{C}$ ,  $V_{CC+} = 2.7\text{ V}$ ,  $R_L = 5.1\text{ k}\Omega$ ,  $GND = 0\text{ V}$  (unless otherwise noted)

| PARAMETER                                                      | TEST CONDITIONS          | TYP  | UNIT |
|----------------------------------------------------------------|--------------------------|------|------|
| $t_{PHL}$ Propagation delay high to low level output switching | Input overdrive = 10 mV  | 1000 | ns   |
|                                                                | Input overdrive = 100 mV | 350  |      |
| $t_{PLH}$ Propagation delay low to high level output switching | Input overdrive = 10 mV  | 500  | ns   |
|                                                                | Input overdrive = 100 mV | 400  |      |

## 6.8 Switching Characteristics, $V_{CC+} = 5\text{ V}$

$T_A = 25^\circ\text{C}$ ,  $V_{CC+} = 5\text{ V}$ ,  $R_L = 5.1\text{ k}\Omega$ ,  $\text{GND} = 0\text{ V}$  (unless otherwise noted)

| PARAMETER                                                      | TEST CONDITIONS          | TYP | UNIT |
|----------------------------------------------------------------|--------------------------|-----|------|
| $t_{PHL}$ Propagation delay high to low level output switching | Input overdrive = 10 mV  | 600 | ns   |
|                                                                | Input overdrive = 100 mV | 200 |      |
| $t_{PLH}$ Propagation delay low to high level output switching | Input overdrive = 10 mV  | 450 | ns   |
|                                                                | Input overdrive = 100 mV | 300 |      |

## 6.9 Typical Characteristics

Unless otherwise specified,  $V_S = +5\text{V}$ , single supply,  $T_A = 25^\circ\text{C}$

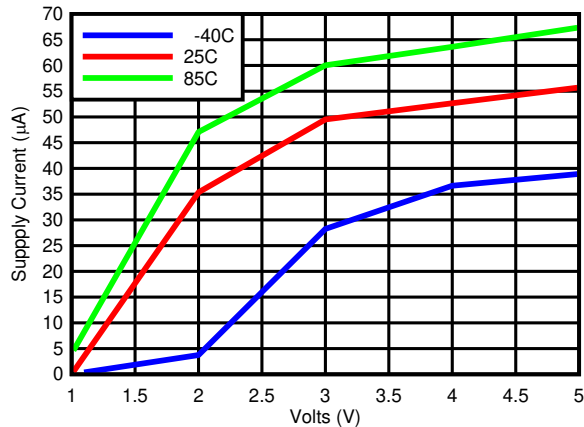


图 6-1. Supply Current vs Supply Voltage Output High (LMV33x)

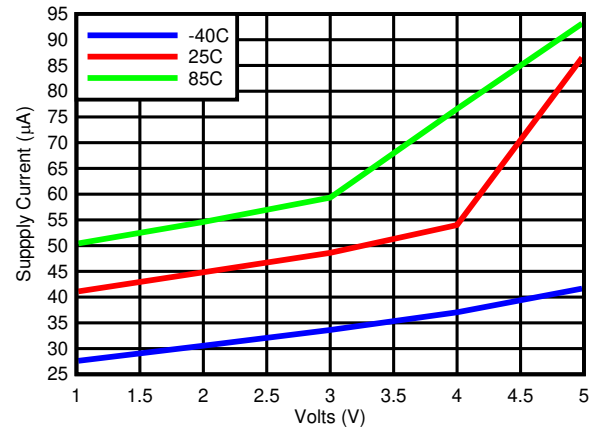


图 6-2. Supply Current vs Supply Voltage Output Low (LMV33x)

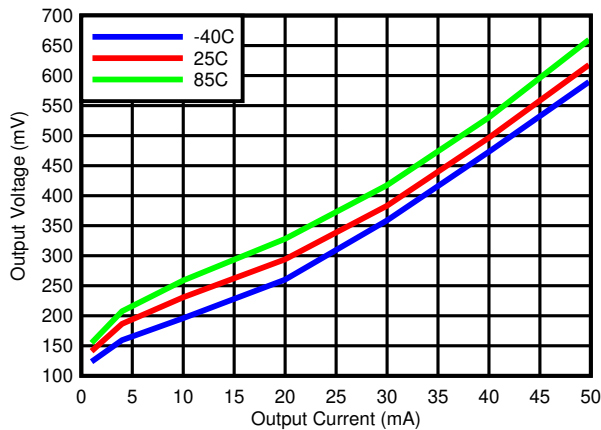


图 6-3. Output Voltage vs Output Current

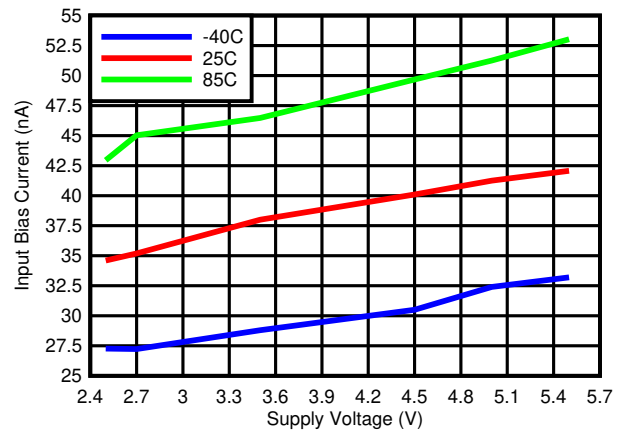


图 6-4. Input Bias Current vs Supply Voltage

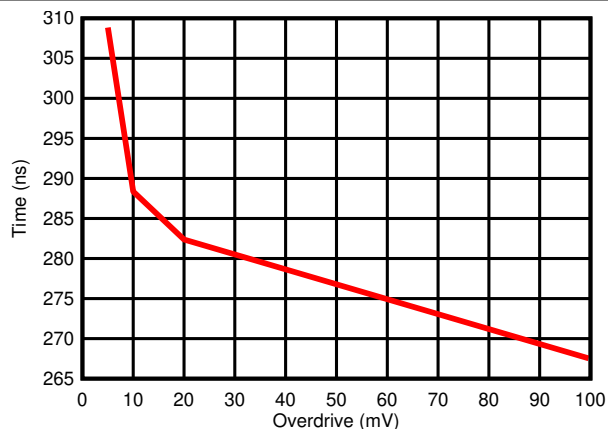


图 6-5. Response Time vs Input Overdrives  
Negative Transition ( $V_{CC}=5\text{ V}$ )

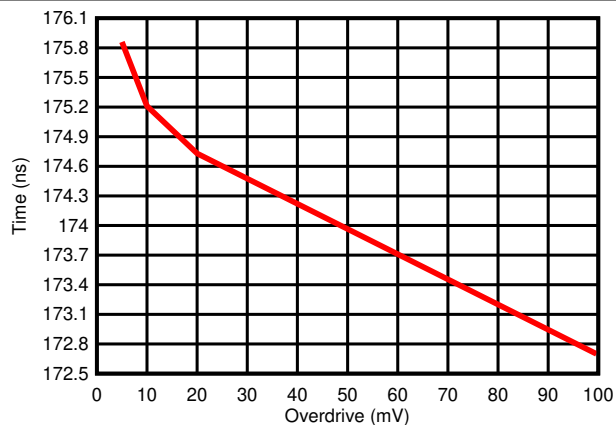


图 6-6. Response Time vs Input Overdrives  
Positive Transition ( $V_{CC} = 5\text{ V}$ )

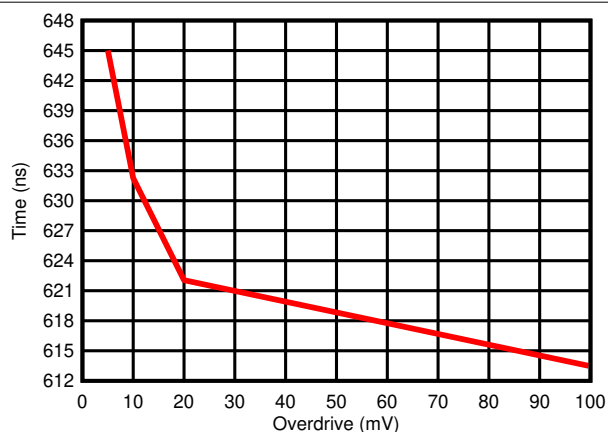


图 6-7. Response Time vs Input Overdrives  
Negative Transition ( $V_{CC} = 2.7\text{ V}$ )

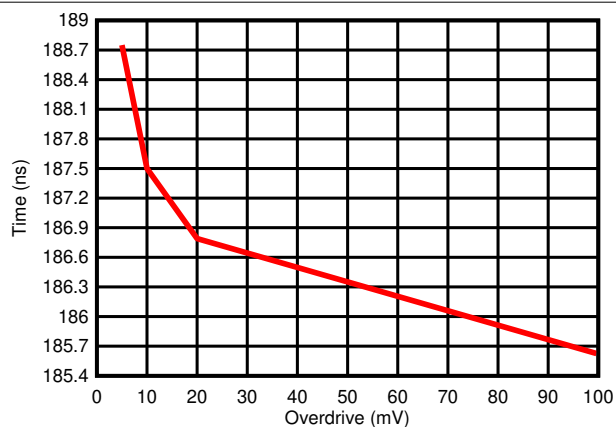


图 6-8. Response Time vs Input Overdrives  
Positive Transition ( $V_{CC} = 2.7\text{ V}$ )

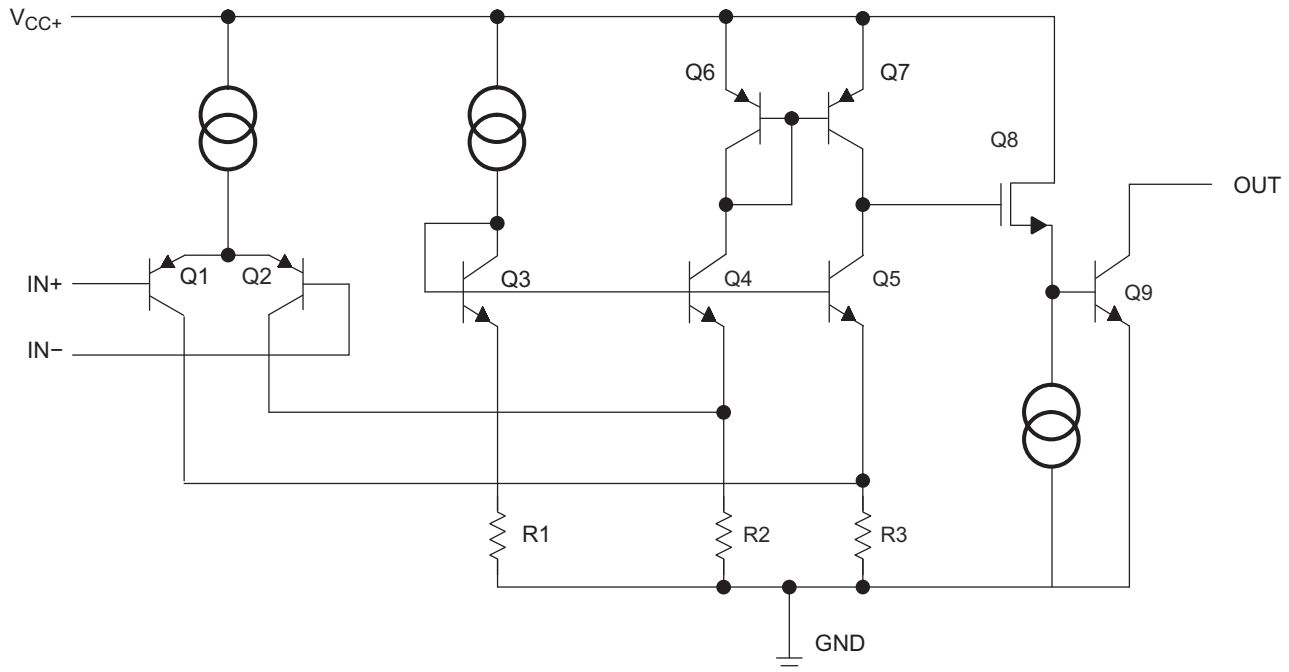
## 7 Detailed Description

### 7.1 Overview

The LMV331, LMV393 and LMV339 family of comparators have the ability to operate up to 5 V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to its low  $I_q$  and fast response.

The open-drain output allows the user to configure the output's logic low voltage ( $V_{OL}$ ) and can be utilized to enable the comparator to be used in AND functionality.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

The LMV331, LMV393 and LMV339 consists of a PNP input, whose  $V_{be}$  creates a limit on the input common mode voltage capability, allowing LMV33x to accurately function from ground to  $V_{CC} - V_{be}$  (~700mV) differential input. This enables much head room for modern day supplies of 3.3 V and 5.0 V.

The output consists of an open drain NPN (pull-down or low side) transistor. The output NPN will sink current when the positive input voltage is higher than the negative input voltage and the offset voltage. The  $V_{OL}$  is resistive and will scale with the output current. Please see [Figure 6-3](#) for  $V_{OL}$  values with respect to the output current.

### 7.4 Device Functional Modes

#### 7.4.1 Voltage Comparison

The LMV33x operates solely as a voltage comparator, comparing the differential voltage between the positive and negative pins and outputs a logic low or high impedance (logic high with pull-up) based on the input differential polarity.

## 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

LMV331, LMV393, and LMV339 will typically be used to compare a single signal to a reference or two signals against each other. Many users take advantage of the open drain output to drive the comparison logic output to a logic voltage level to an MCU or logic device. The wide supply range and high voltage capability makes LMV331, LMV393, and LMV339 optimal for level shifting to a higher or lower voltage.

### 8.2 Typical Application

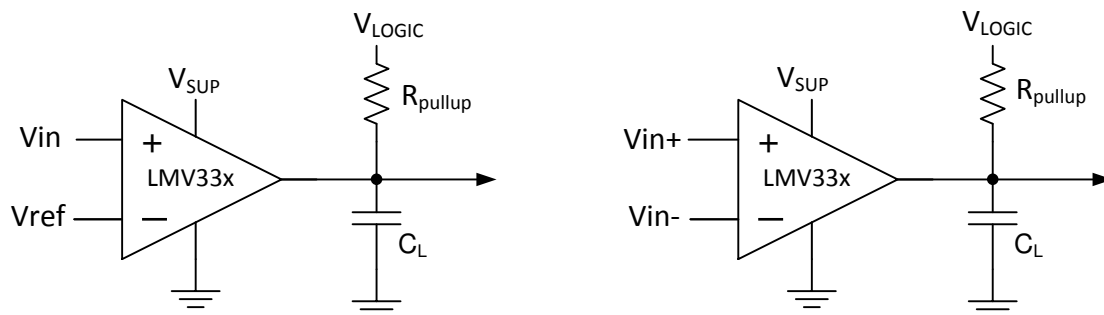


图 8-1. Typical Application Schematic

#### 8.2.1 Design Requirements

For this design example, use the parameters listed in 表 8-1 as the input parameters.

表 8-1. Design Parameters

| DESIGN PARAMETER                                          | EXAMPLE VALUE      |
|-----------------------------------------------------------|--------------------|
| Input Voltage Range                                       | 0 V to 4.2 V       |
| Supply Voltage                                            | 2.7 V to 5V        |
| Logic Supply Voltage (R <sub>PULLUP</sub> Voltage)        | 1 V to 5 V         |
| Output Current (V <sub>LOGIC</sub> /R <sub>PULLUP</sub> ) | 1 $\mu$ A to 20 mA |
| Input Overdrive Voltage                                   | 100 mV             |
| Reference Voltage                                         | 2.5 V              |
| Load Capacitance (C <sub>L</sub> )                        | 15 pF              |

#### 8.2.2 Detailed Design Procedure

When using LMV331, LMV393, and LMV339 in a general comparator application, determine the following:

- Input Voltage Range
- Minimum Overdrive Voltage
- Output and Drive Current
- Response Time

### 8.2.2.1 Input Voltage Range

When choosing the input voltage range, the input common mode voltage range ( $V_{ICR}$ ) must be taken in to account. If operating temperature is above or below 25°C the  $V_{ICR}$  can range from 0 V to  $V_{CC} - 0.7$  V. This limits the input voltage range to as high as  $V_{CC} - 0.7$  V and as low as 0 V. Operation outside of this range can yield incorrect comparisons.

Below is a possible list of input voltage situation and their outcomes:

1. When both IN- and IN+ are both within the common mode range:
  - a. If IN- is higher than IN+ and the offset voltage, the output is low and the output transistor is sinking current
  - b. If IN- is lower than IN+ and the offset voltage, the output is high impedance and the output transistor is not conducting
2. When IN- is higher than common mode and IN+ is within common mode, the output is low and the output transistor is sinking current
3. When IN+ is higher than common mode and IN- is within common mode, the output is high impedance and the output transistor is not conducting
4. When IN- and IN+ are both higher than common mode, the output is low and the output transistor is sinking current

### 8.2.2.2 Minimum Overdrive Voltage

Overdrive Voltage is the differential voltage produced between the positive and negative inputs of the comparator over the offset voltage ( $V_{IO}$ ). In order to make an accurate comparison; the Overdrive Voltage ( $V_{OD}$ ) should be higher than the input offset voltage ( $V_{IO}$ ). Overdrive voltage can also determine the response time of the comparator, with the response time decreasing with increasing overdrive. 图 8-2 show positive and negative response times with respect to overdrive voltage.

### 8.2.2.3 Output and Drive Current

Output current is determined by the pull-up resistance ( $R_{pullup}$ ) and Vlogic voltage, refer to 图 8-1. The output current will produce a output low voltage ( $V_{OL}$ ) from the comparator. In which  $V_{OL}$  is proportional to the output current. Use 图 6-3 to determine  $V_{OL}$  based on the output current.

The output current can also effect the transient response. More will be explained in the next section.

### 8.2.2.4 Response Time

The transient response can be determined by the load capacitance ( $C_L$ ), load/pull-up resistance ( $R_{PULLUP}$ ) and equivalent collector-emitter resistance ( $R_{CE}$ ).

- The positive response time ( $\tau_P$ ) is approximately  $\tau_P \sim R_{PULLUP} \times C_L$
- The negative response time ( $\tau_N$ ) is approximately  $\tau_N \sim R_{CE} \times C_L$ 
  - $R_{CE}$  can be determine by taking the slope of 图 6-3 in it's linear region at the desired temperature, or by dividing the  $V_{OL}$  by  $I_{out}$

## 8.2.3 Application Curves

The following curves were generated with 5 V on  $V_{CC}$  and  $V_{Logic}$ ,  $R_{PULLUP} = 5.1 \text{ k}\Omega$ , and 50 pF scope probe.

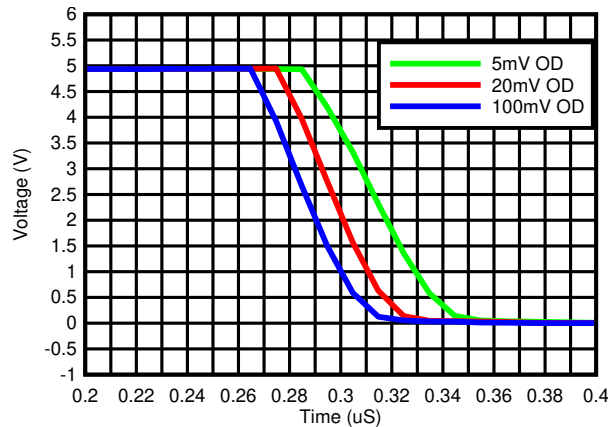


图 8-2. Response Time for Various Overdrives (Negative Transition)

## 9 Power Supply Recommendations

For fast response and comparison applications with noisy or AC inputs, it is recommended to use a bypass capacitor on the supply pin to reject any variation on the supply voltage. This variation cause temporary fluctuations in the comparator's input common mode range and create an inaccurate comparison.

## 10 Layout

### 10.1 Layout Guidelines

For accurate comparator applications without hysteresis it is important maintain a stable power supply with minimized noise and glitches, which can affect the high level input common mode voltage range. In order to achieve this, it is best to add a bypass capacitor between the supply voltage and ground. This should be implemented on the positive power supply and negative supply (if available). If a negative supply is not being used, do not put a capacitor between the IC's GND pin and system ground.

### 10.2 Layout Example

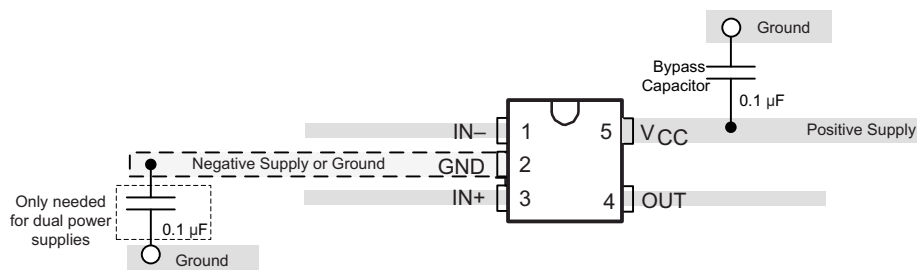


图 10-1. LMV331 Layout Example

## 11 Device and Documentation Support

### 11.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**表 11-1. Related Links**

| PARTS  | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|--------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| LMV331 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LMV393 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LMV339 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 11.2 Trademarks

所有商标均为其各自所有者的财产。

### 11.3 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.

### 11.4 Glossary

#### **TI Glossary**

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

## 12 Mechanical, Packaging, and Orderable Information

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

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LMV331IDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R1IF, R1IK)            | <a href="#">Samples</a> |
| LMV331IDBVRE4    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R1IF, R1IK)            | <a href="#">Samples</a> |
| LMV331IDBVRG4    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R1IF, R1IK)            | <a href="#">Samples</a> |
| LMV331IDBVT      | LIFEBUY       | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R1IF, R1IK)            |                         |
| LMV331IDBVTG4    | LIFEBUY       | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R1IF, R1IK)            |                         |
| LMV331IDCKR      | ACTIVE        | SC70         | DCK                | 5    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              | <a href="#">Samples</a> |
| LMV331IDCKRE4    | ACTIVE        | SC70         | DCK                | 5    | 3000           | RoHS & Green    | NIPDAUAG                             | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              | <a href="#">Samples</a> |
| LMV331IDCKRG4    | ACTIVE        | SC70         | DCK                | 5    | 3000           | RoHS & Green    | NIPDAUAG                             | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              | <a href="#">Samples</a> |
| LMV331IDCKT      | LIFEBUY       | SC70         | DCK                | 5    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              |                         |
| LMV331IDCKTE4    | LIFEBUY       | SC70         | DCK                | 5    | 250            | RoHS & Green    | NIPDAUAG                             | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              |                         |
| LMV331IDCKTG4    | LIFEBUY       | SC70         | DCK                | 5    | 250            | RoHS & Green    | NIPDAUAG                             | Level-1-260C-UNLIM   | -40 to 125   | (R2F, R2R)              |                         |
| LMV339ID         | LIFEBUY       | SOIC         | D                  | 14   | 50             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LMV339I                 |                         |
| LMV339IDR        | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LMV339I                 | <a href="#">Samples</a> |
| LMV339IPW        | LIFEBUY       | TSSOP        | PW                 | 14   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV339I                  |                         |
| LMV339IPWR       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV339I                  | <a href="#">Samples</a> |
| LMV339IPWRG4     | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV339I                  | <a href="#">Samples</a> |
| LMV339IRUCR      | LIFEBUY       | QFN          | RUC                | 14   | 3000           | RoHS & Green    | NIPDAUAG                             | Level-1-260C-UNLIM   | -40 to 125   | (RT, RTR)               |                         |
| LMV393ID         | LIFEBUY       | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  |                         |
| LMV393IDDUR      | LIFEBUY       | VSSOP        | DDU                | 8    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | RABR                    |                         |
| LMV393IDGKR      | ACTIVE        | VSSOP        | DGK                | 8    | 2500           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (R9B, R9Q, R9R)         | <a href="#">Samples</a> |
| LMV393IDGKRG4    | LIFEBUY       | VSSOP        | DGK                | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | (R9B, R9Q, R9R)         |                         |
| LMV393IDR        | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  | <a href="#">Samples</a> |
| LMV393IDRG4      | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  | <a href="#">Samples</a> |
| LMV393IPW        | LIFEBUY       | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  |                         |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>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 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| LMV393IPWG4      | LIFEBUY       | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  |         |
| LMV393IPWR       | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  | Samples |
| LMV393IPWRG4     | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | MV393I                  | Samples |

<sup>(1)</sup> 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.

<sup>(2)</sup> **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.

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

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

<sup>(5)</sup> 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.

<sup>(6)</sup> 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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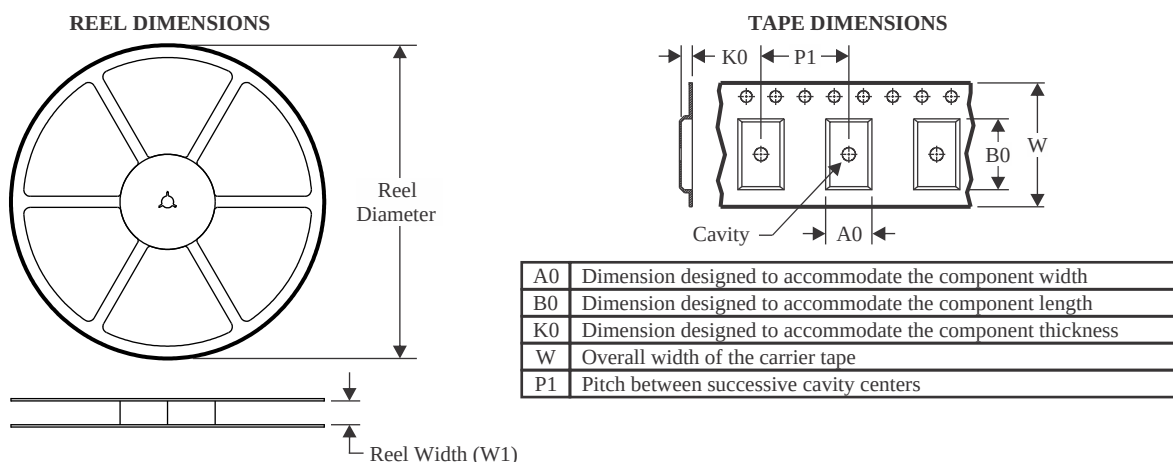
**OTHER QUALIFIED VERSIONS OF LMV331, LMV393 :**

- Automotive : [LMV331-Q1](#), [LMV393-Q1](#)

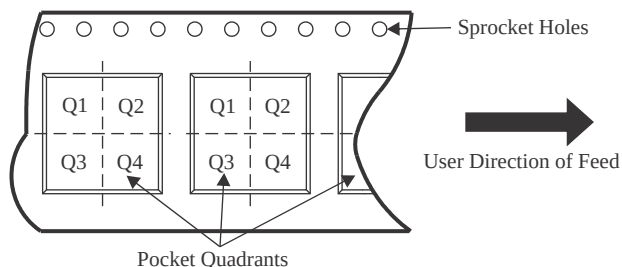
## NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

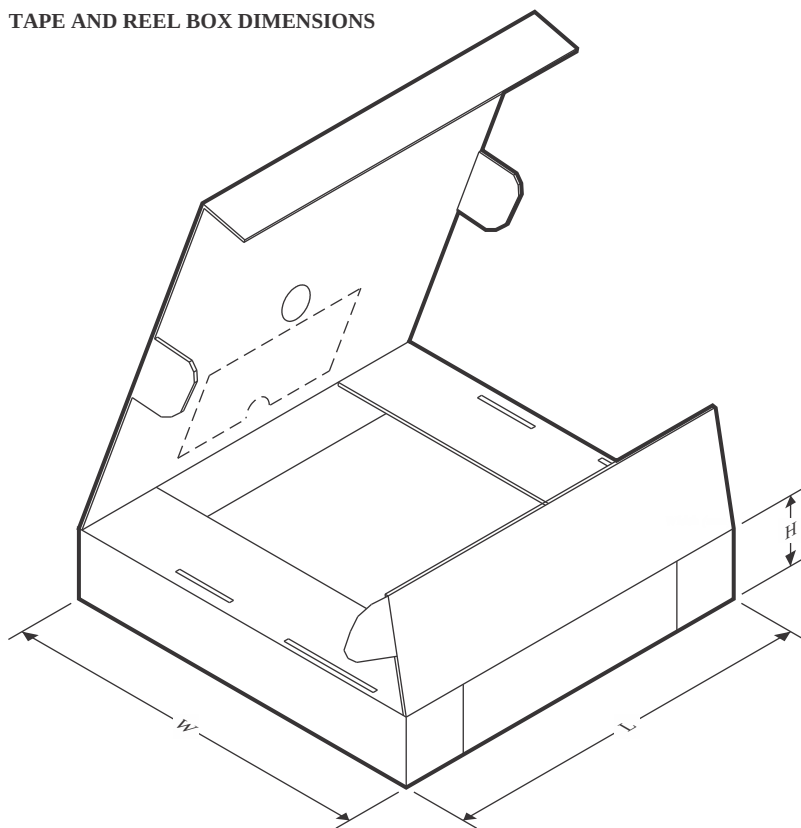


\*All dimensions are nominal

| 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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMV331IDBVR | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| LMV331IDBVR | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.17    | 3.23    | 1.37    | 4.0     | 8.0    | Q3            |
| LMV331IDBVT | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| LMV331IDBVT | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.17    | 3.23    | 1.37    | 4.0     | 8.0    | Q3            |
| LMV331IDCKR | SC70         | DCK             | 5    | 3000 | 178.0              | 9.0                | 2.4     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LMV331IDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.47    | 2.3     | 1.25    | 4.0     | 8.0    | Q3            |
| LMV331IDCKT | SC70         | DCK             | 5    | 250  | 180.0              | 8.4                | 2.47    | 2.3     | 1.25    | 4.0     | 8.0    | Q3            |
| LMV331IDCKT | SC70         | DCK             | 5    | 250  | 178.0              | 9.0                | 2.4     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LMV339IDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LMV339IDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LMV339IPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LMV339IRUCR | QFN          | RUC             | 14   | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 0.55    | 4.0     | 8.0    | Q2            |
| LMV393IDDUR | VSSOP        | DDU             | 8    | 3000 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| LMV393IDGKR | VSSOP        | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LMV393IDGKR | VSSOP        | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LMV393IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |

| 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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMV393IDRG4 | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| LMV393IPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LMV393IPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

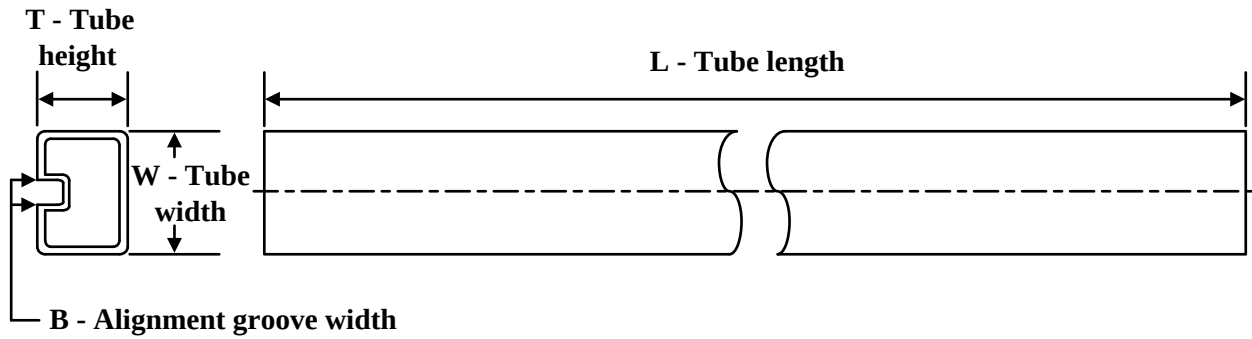


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMV331IDBVR | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| LMV331IDBVR | SOT-23       | DBV             | 5    | 3000 | 205.0       | 200.0      | 33.0        |
| LMV331IDBVT | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| LMV331IDBVT | SOT-23       | DBV             | 5    | 250  | 205.0       | 200.0      | 33.0        |
| LMV331IDCKR | SC70         | DCK             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| LMV331IDCKR | SC70         | DCK             | 5    | 3000 | 202.0       | 201.0      | 28.0        |
| LMV331IDCKT | SC70         | DCK             | 5    | 250  | 202.0       | 201.0      | 28.0        |
| LMV331IDCKT | SC70         | DCK             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| LMV339IDR   | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| LMV339IDR   | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LMV339IPWR  | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LMV339IRUCR | QFN          | RUC             | 14   | 3000 | 202.0       | 201.0      | 28.0        |
| LMV393IDDUR | VSSOP        | DDU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| LMV393IDGKR | VSSOP        | DGK             | 8    | 2500 | 358.0       | 335.0      | 35.0        |
| LMV393IDGKR | VSSOP        | DGK             | 8    | 2500 | 370.0       | 355.0      | 55.0        |
| LMV393IDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| LMV393IDRG4 | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| LMV393IPWR  | TSSOP        | PW              | 8    | 2000 | 356.0       | 356.0      | 35.0        |

---

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMV393IPWR | TSSOP        | PW              | 8    | 2000 | 356.0       | 356.0      | 35.0        |

**TUBE**


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| LMV339ID    | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| LMV339IPW   | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| LMV393ID    | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| LMV393IPW   | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |
| LMV393IPWG4 | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |



### SOT - 1.1 max height

4214834/E 06/2024

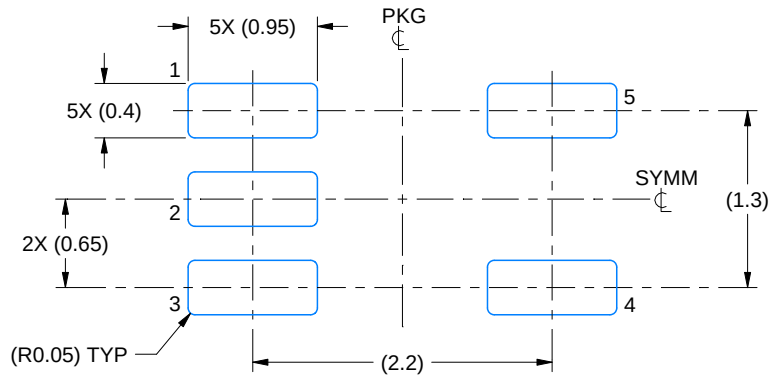
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

# EXAMPLE BOARD LAYOUT

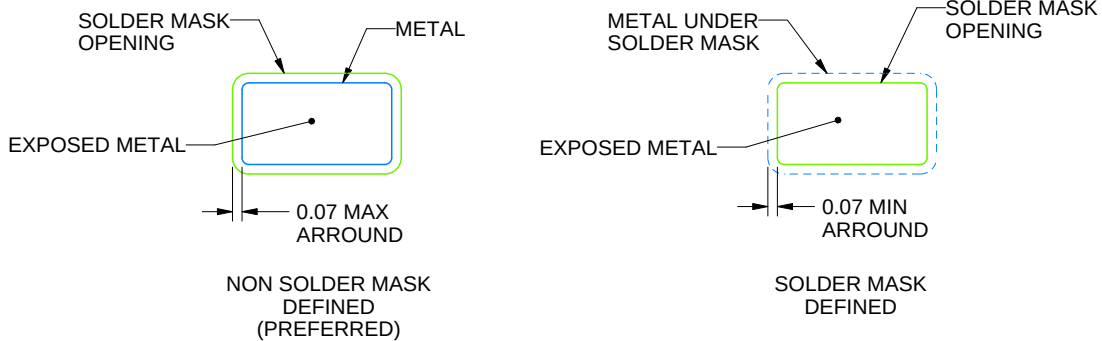
DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X

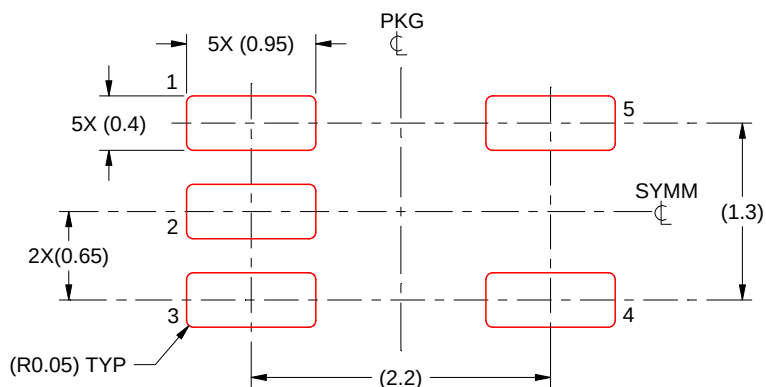


SOLDER MASK DETAILS

4214834/E 06/2024

NOTES: (continued)

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

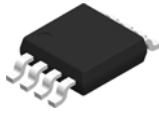


SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:18X

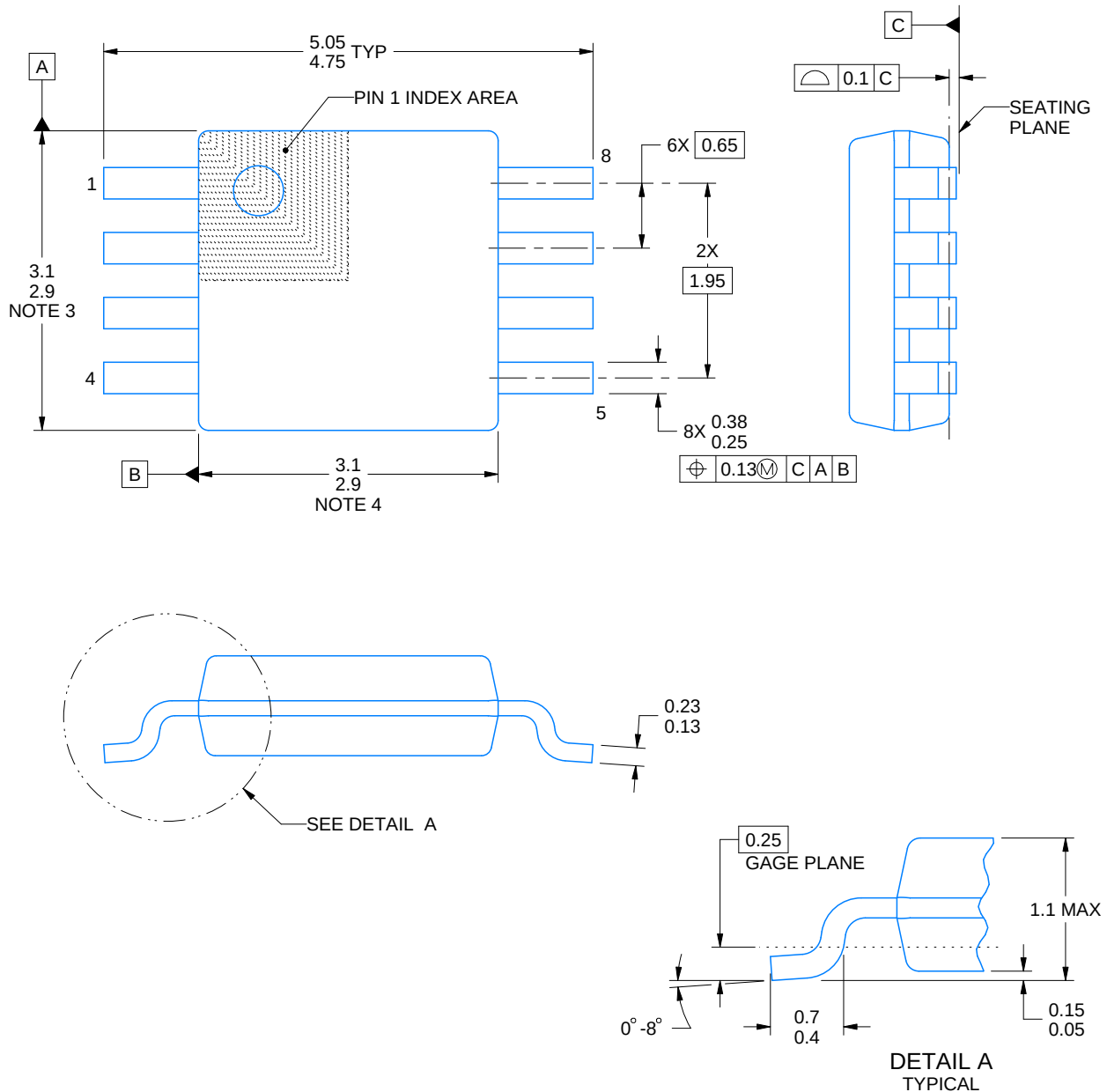
4214834/E 06/2024

NOTES: (continued)

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

**DGK0008A****PACKAGE OUTLINE****VSSOP - 1.1 mm max height**

SMALL OUTLINE PACKAGE



4214862/A 04/2023

**NOTES:**

PowerPAD is a trademark of Texas Instruments.

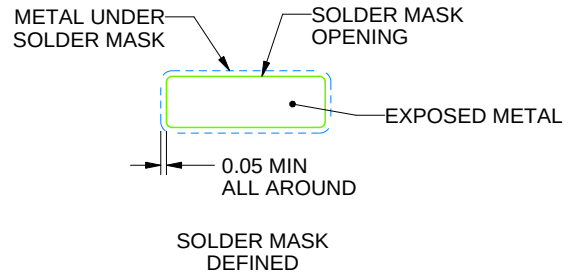
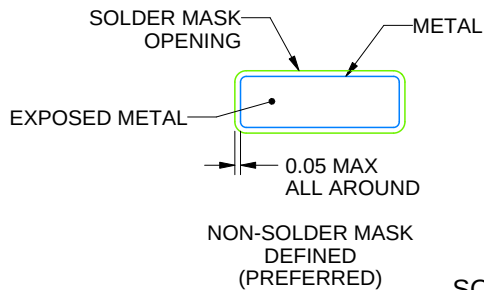
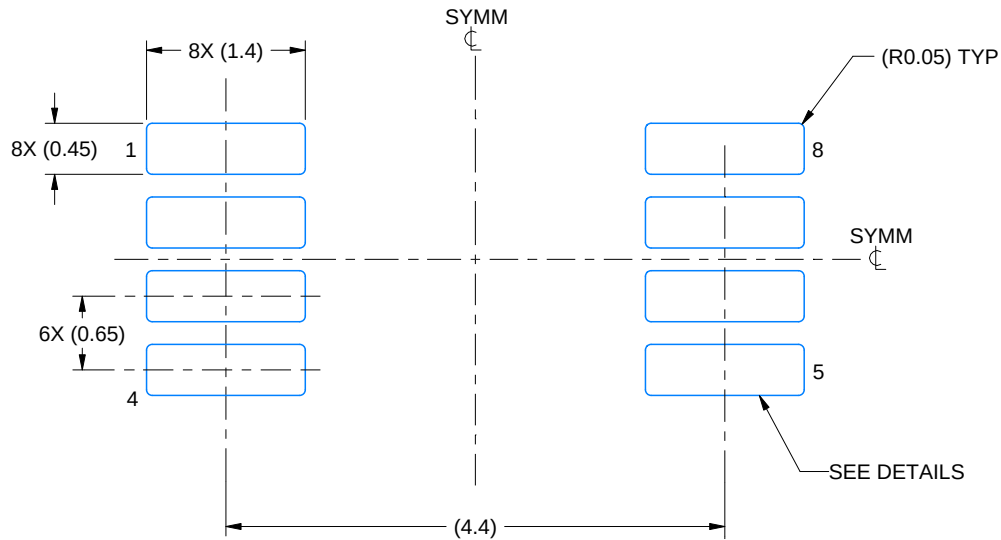
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

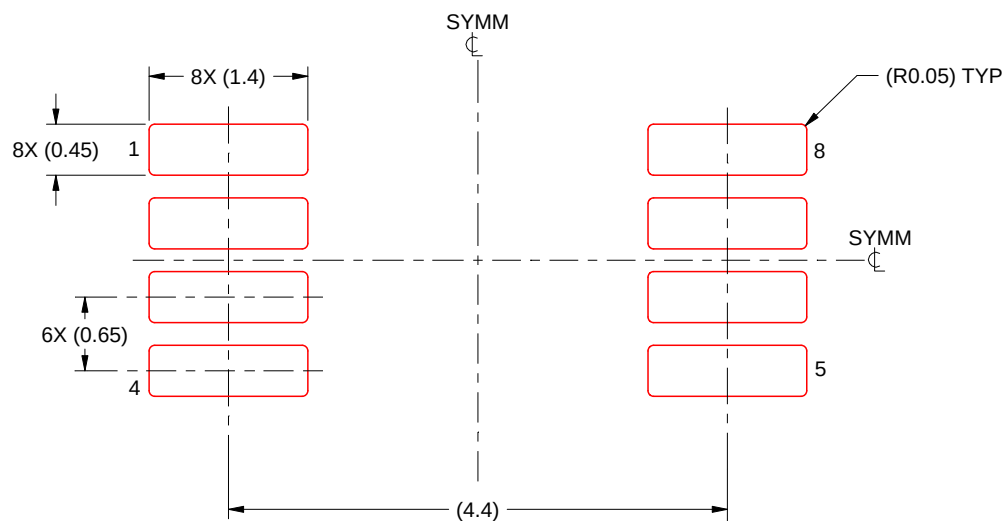
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

## EXAMPLE STENCIL DESIGN

DGK0008A

<sup>TM</sup> VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
SCALE: 15X

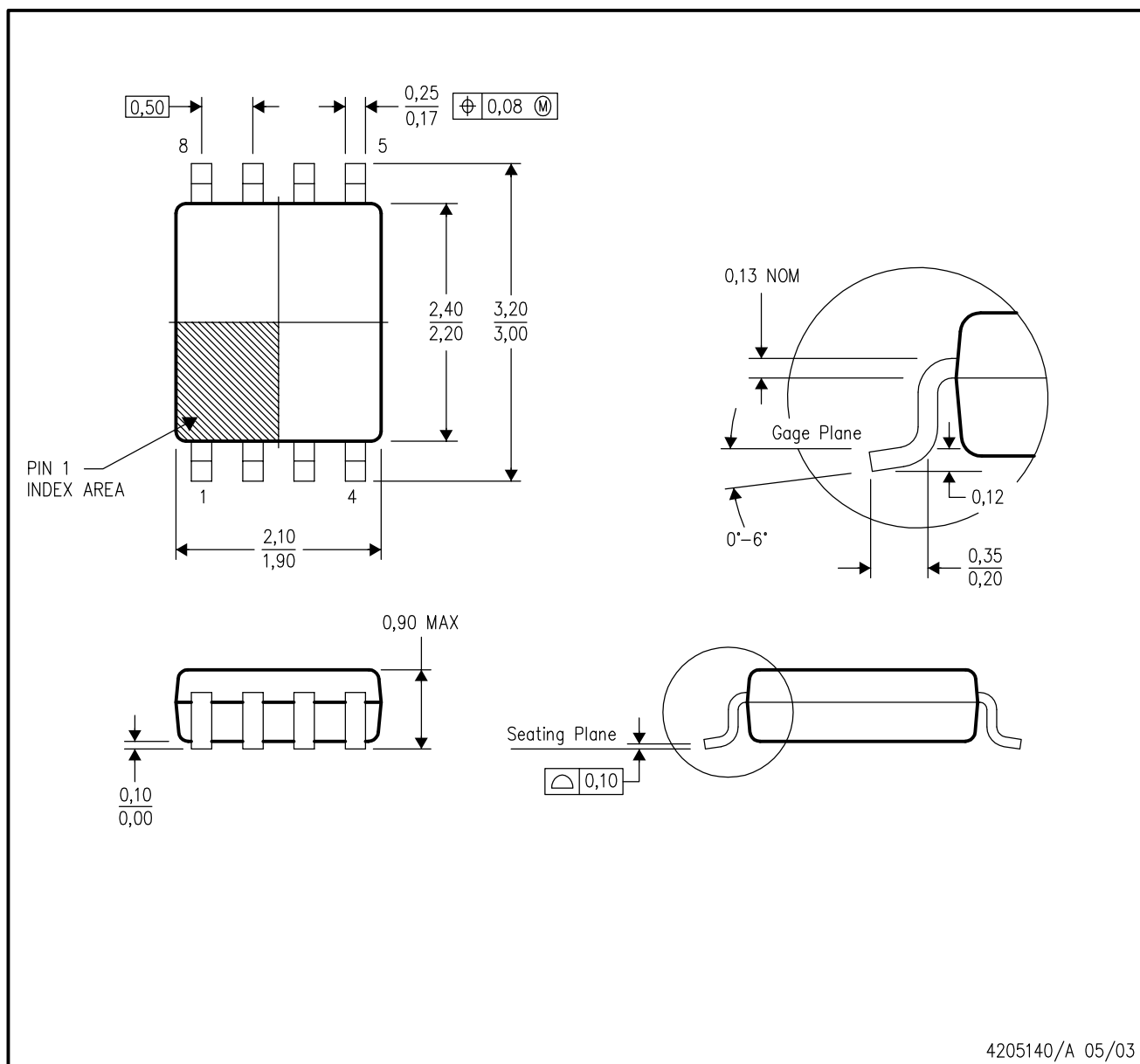
4214862/A 04/2023

NOTES: (continued)

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

## DDU (R-PDSO-G8)

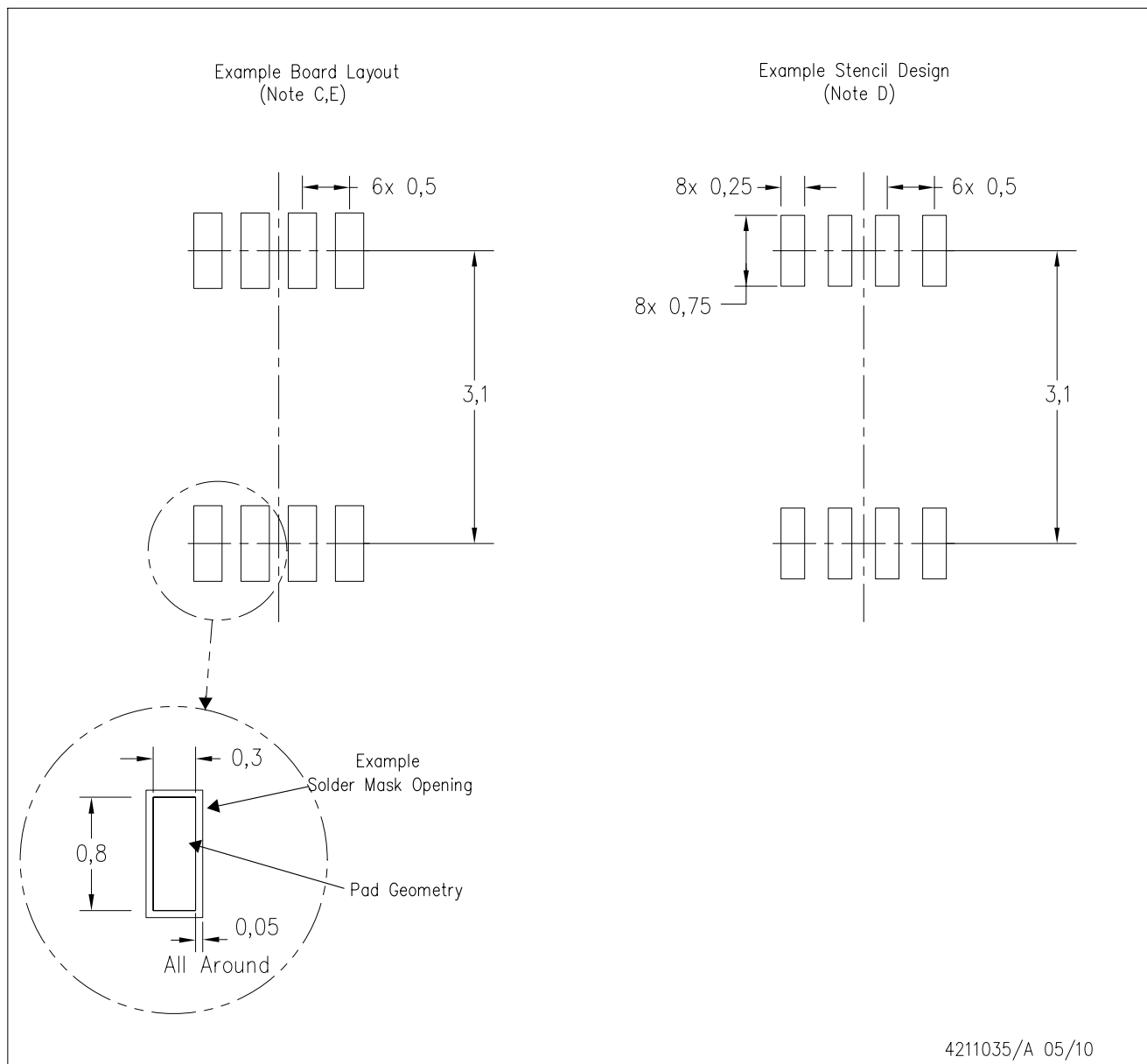
## PLASTIC SMALL-OUTLINE PACKAGE



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

DDU (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE (DIE UP)



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. 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. Refer to IPC-7525.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



## PACKAGE OUTLINE

## SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



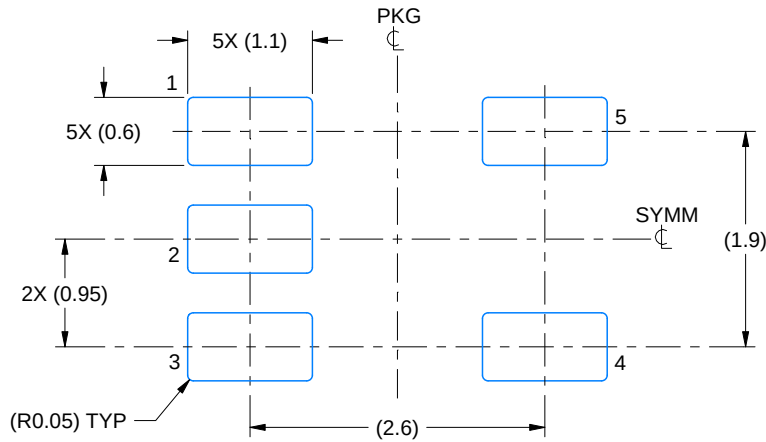
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

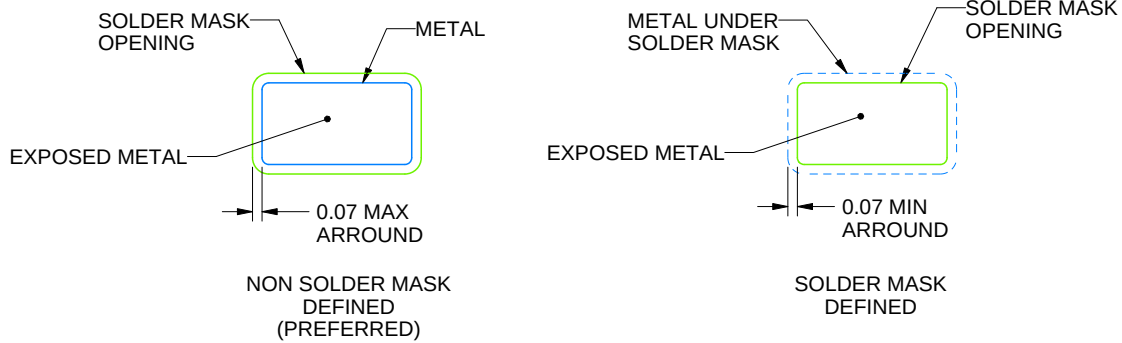
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/J 02/2024

NOTES: (continued)

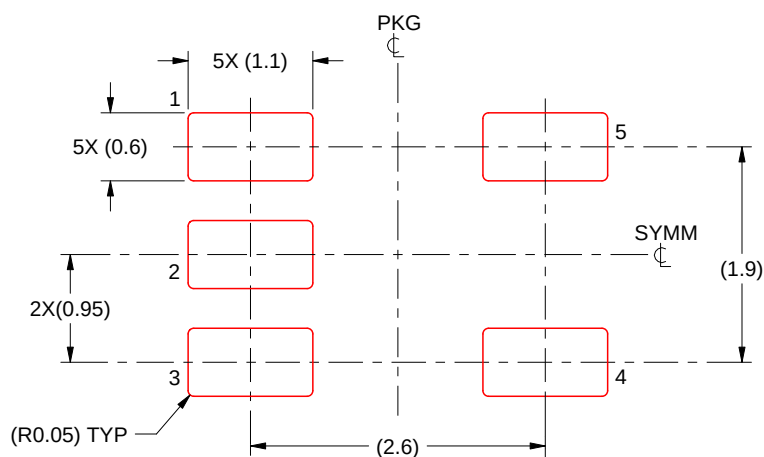
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

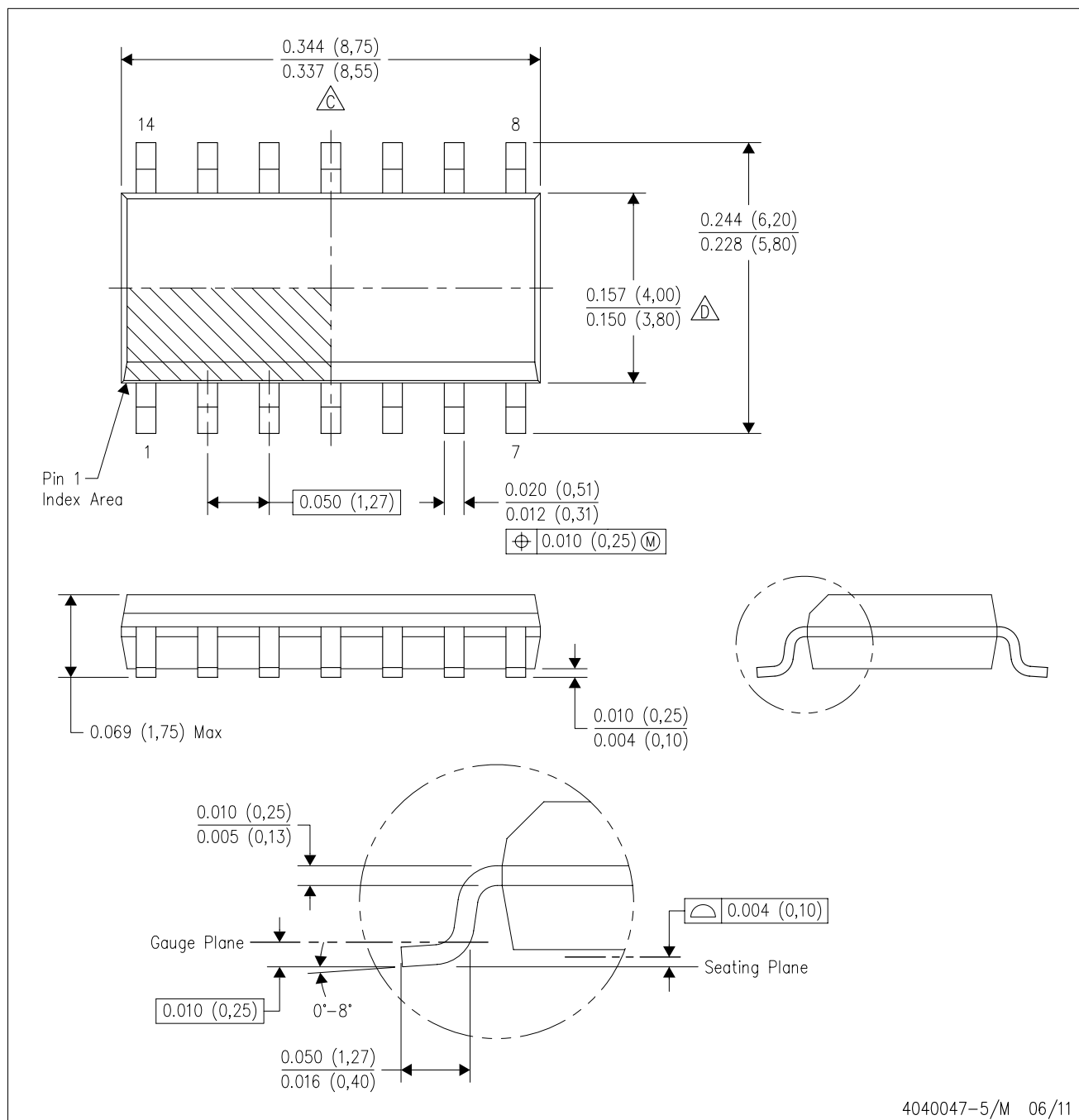
4214839/J 02/2024

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.

## D (R-PDSO-G14)

## PLASTIC SMALL OUTLINE

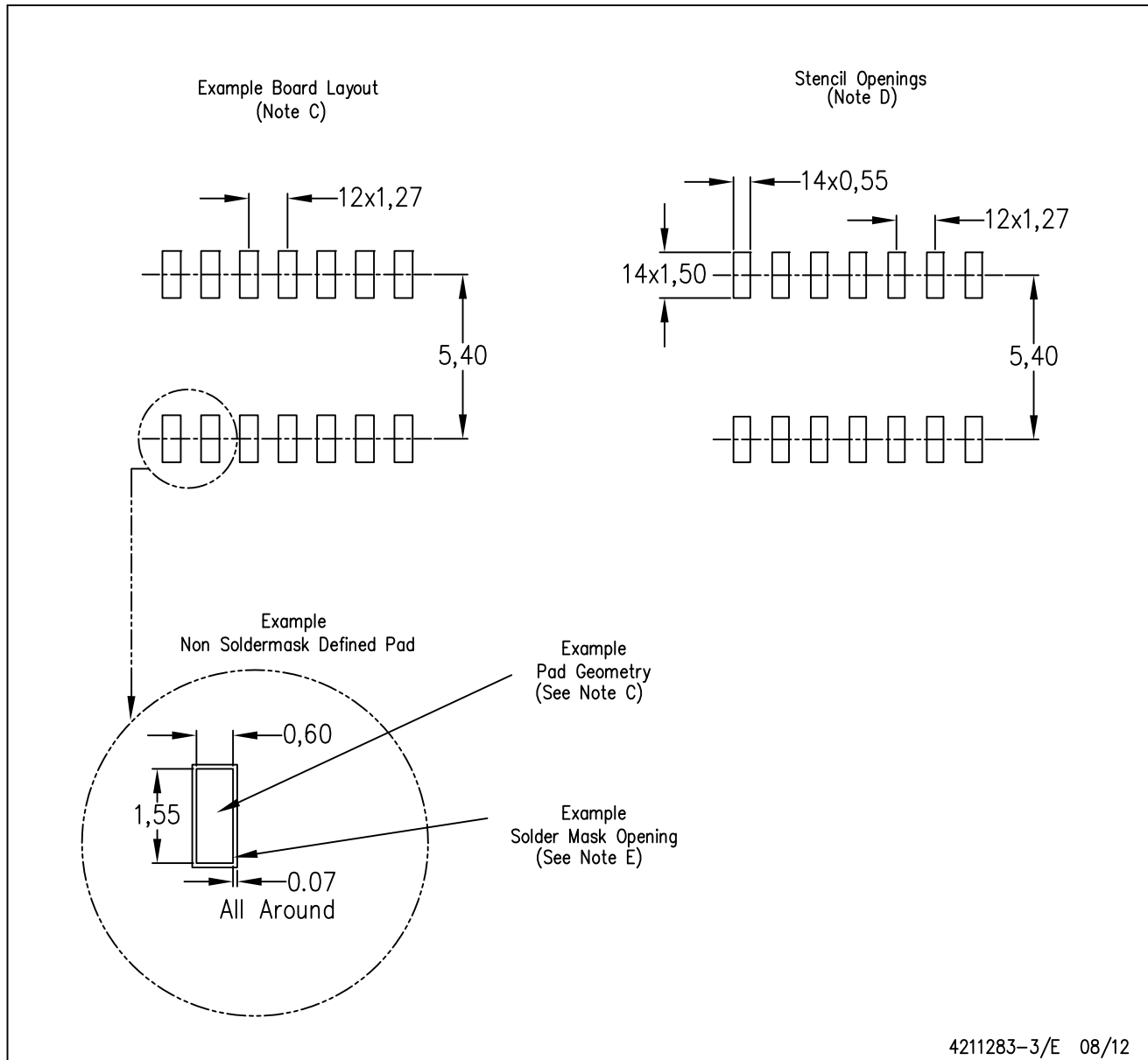


NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
**C** Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.  
**D** Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.  
E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

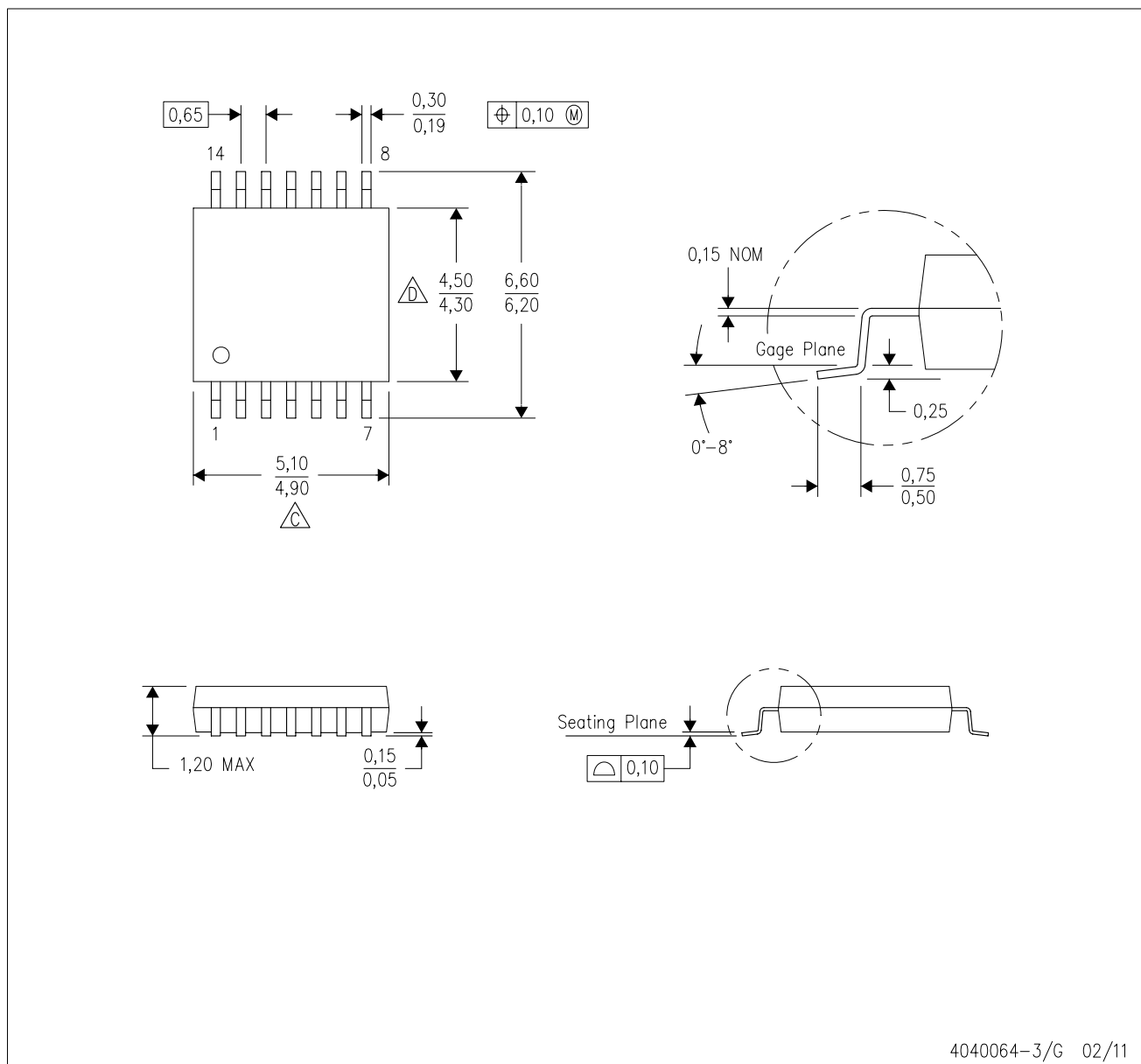
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. 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. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

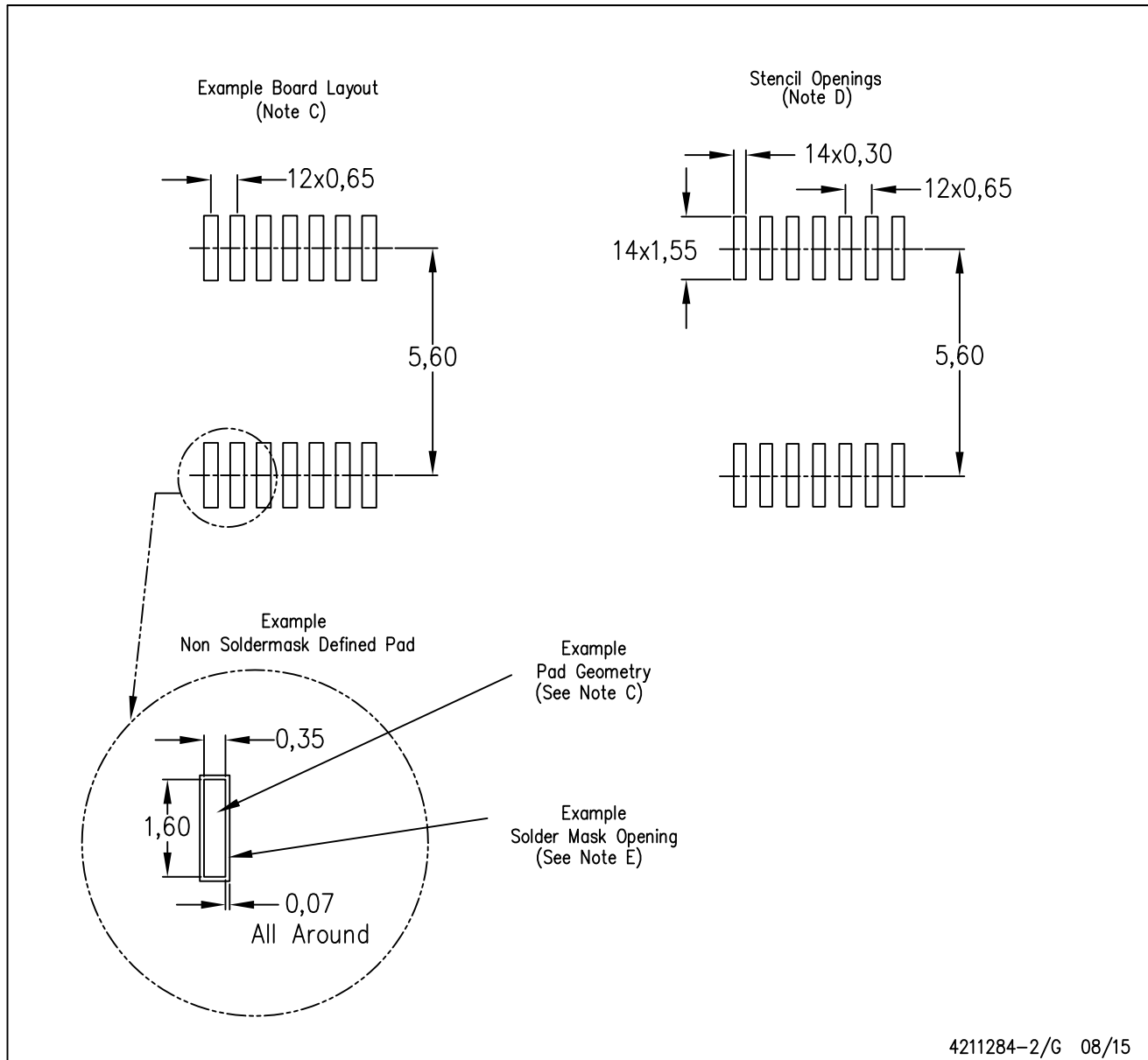
PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



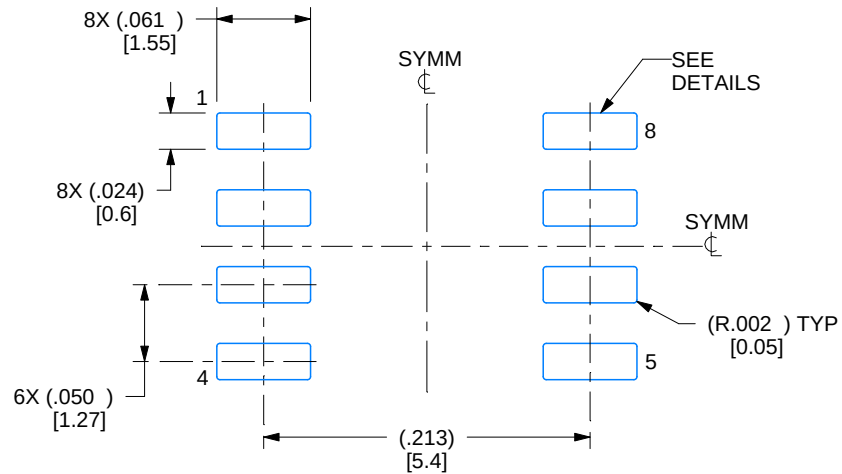
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

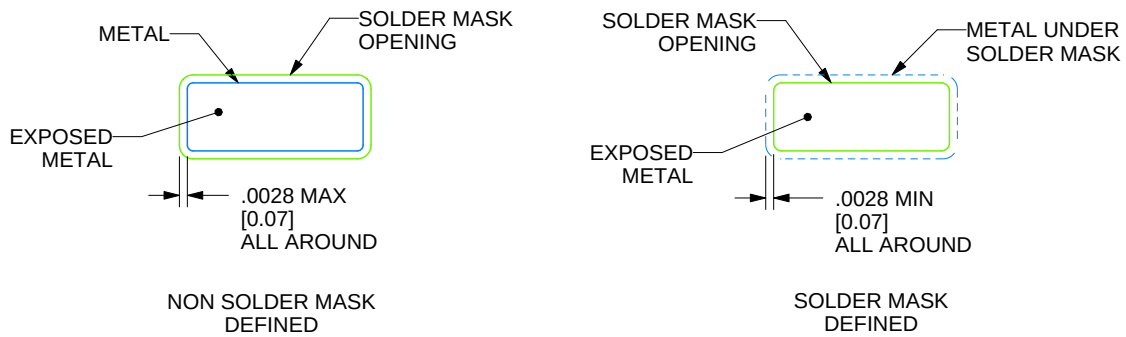
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

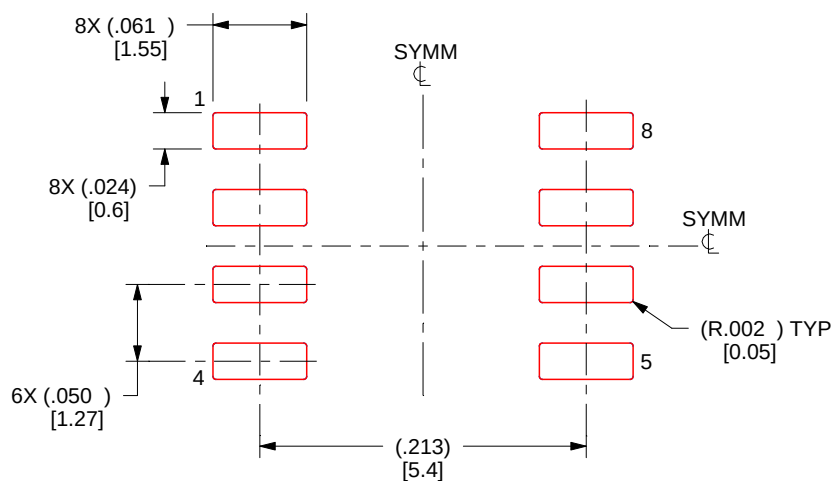
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

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.

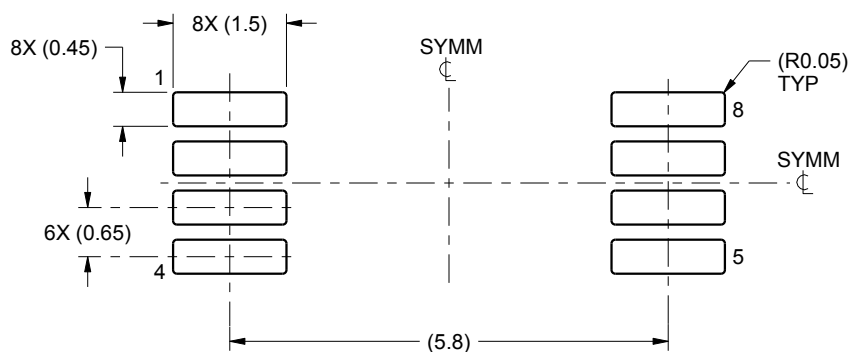


# EXAMPLE BOARD LAYOUT

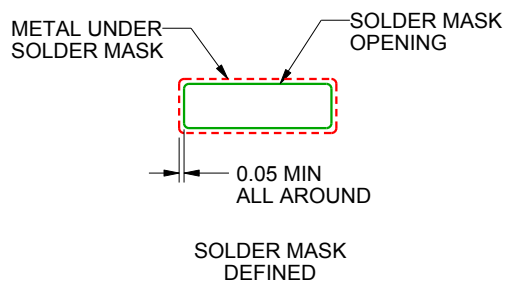
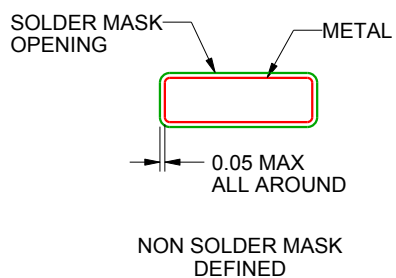
PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

4221848/A 02/2015

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

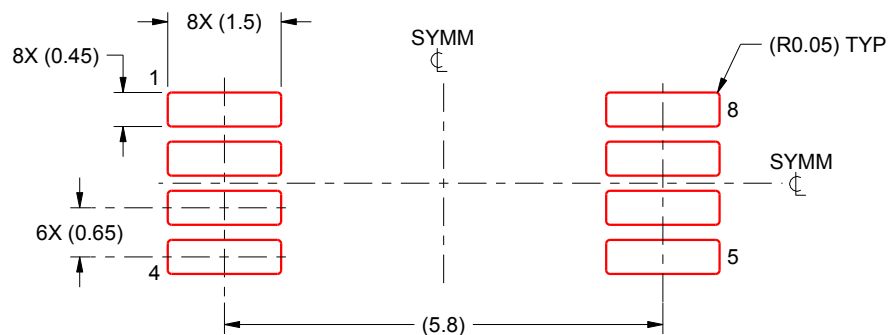
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4221848/A 02/2015

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.

## GENERIC PACKAGE VIEW

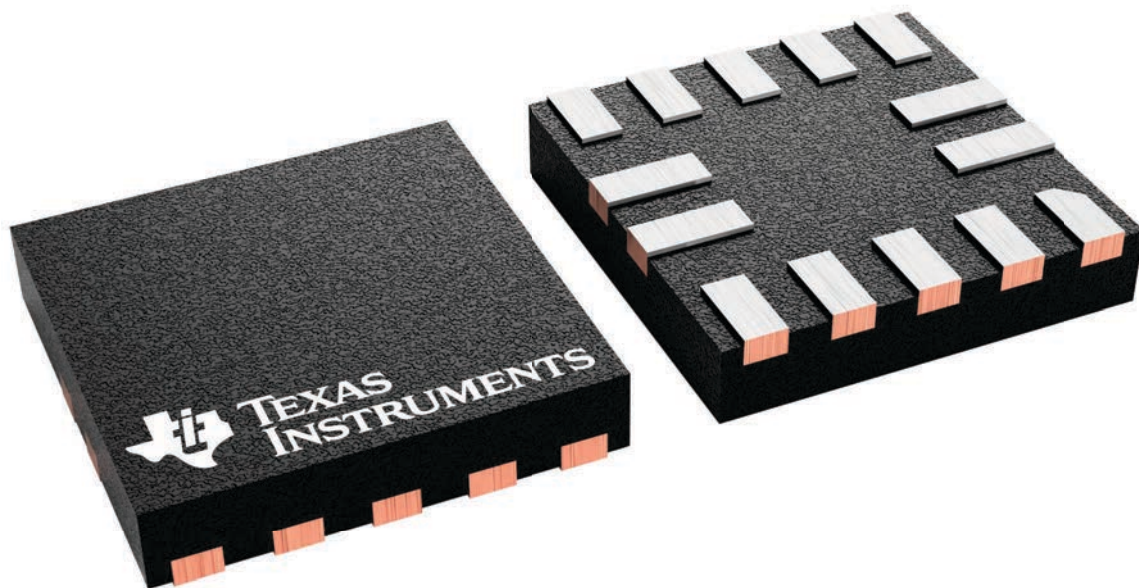
**RUC 14**

**X2QFN - 0.4 mm max height**

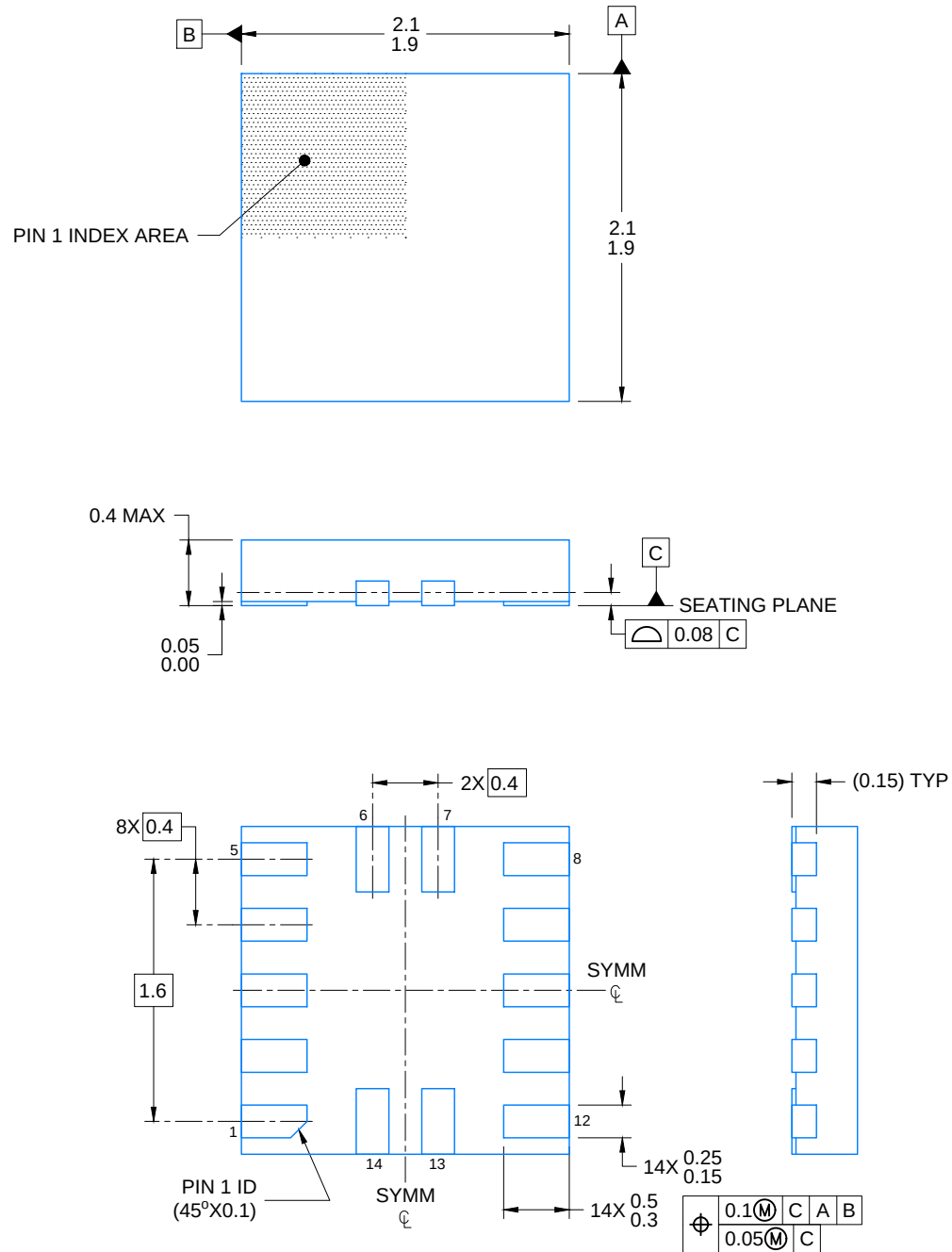
2 x 2, 0.4 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



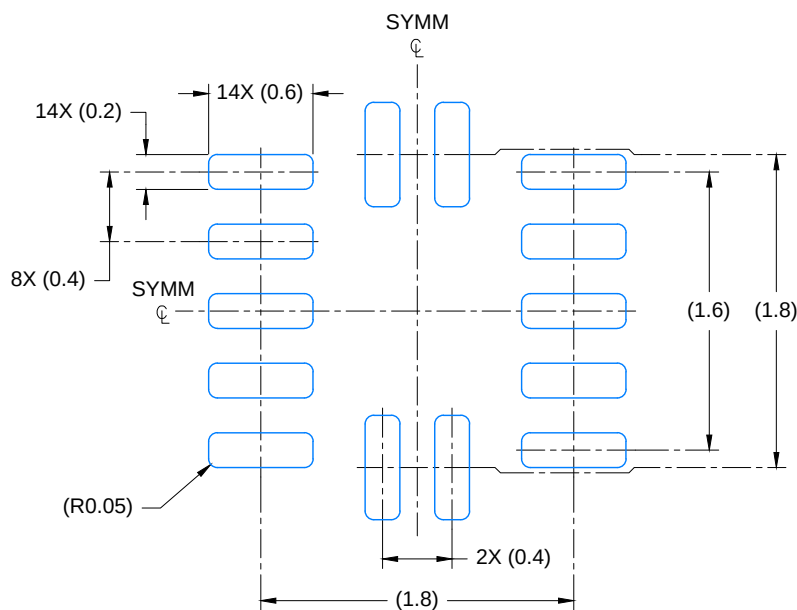
4229871/A



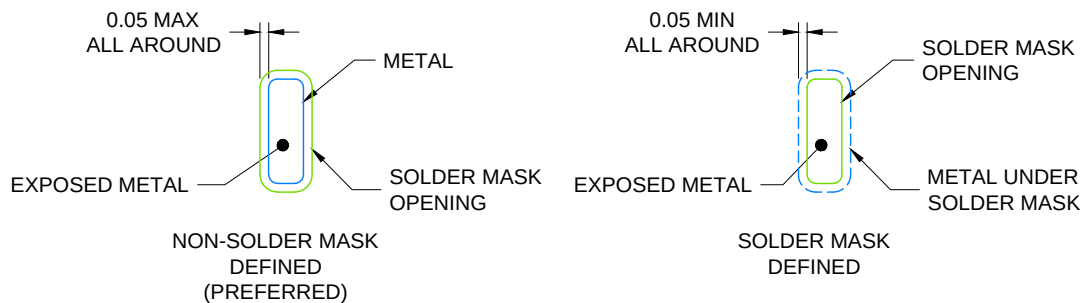
4220584/A 05/2019

## 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.



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 23X



SOLDER MASK DETAILS

4220584/A 05/2019

NOTES: (continued)

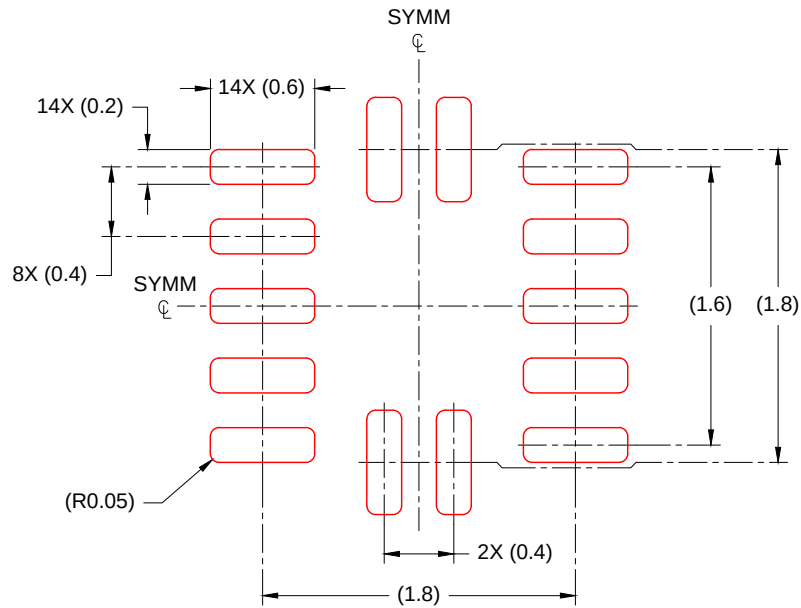
- For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).

## EXAMPLE STENCIL DESIGN

RUC0014A

X2QFN - 0.4 mm max height

PLASTIC QUAD FLAT PACK- NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.100mm THICK STENCIL  
SCALE: 23X

4220584/A 05/2019

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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