# LM2901x-Q1 四线路汽车比较器

## 1 特性

- 符合汽车应用要求
- 具有符合 AEC-Q100 标准的下列特性：
  - 器件温度等级 1：-40°C 至 125°C 环境工作温度范围
  - 器件 HBM ESD 分类等级：
    - H1B（对于“AV”版本）
    - H1C（对于所有其他版本）
  - 器件 CDM ESD 分类等级 C6
- 单电源或双电源
- 独立于电源电压的低电源电流消耗：0.8mA（典型值）
- 低输入偏置电流：25nA（典型值）
- 低输入失调电流：2nA（典型值）
- 低输入失调电压：2mV（典型值）
- 共模输入电压范围包括接地
- 差动输入电压范围等于最大额定电源电压：±36V
- 低输出饱和电压
- 输出与 TTL、MOS 和 CMOS 兼容
- 对于采用 5 引脚 SOT-23 的单通道版本，请参阅 TL331-Q1 (SLVS969)

## 2 应用

- 汽车
  - HEV/EV 和动力总成
  - 信息娱乐系统与仪表组
  - 车身控制模块
- 工业
- 电器

## 3 说明

LM2901x-Q1 系列器件包含四个独立的电压比较器，这些比较器可在宽电压范围内由单电源供电。

如果两个电源之间的电压差在 2V 和 36V 之间且 $V_{CC}$ 比输入共模电压的至少高 +1.5V，也可使用双电源供电运行。漏极电流不受电源电压的影响。

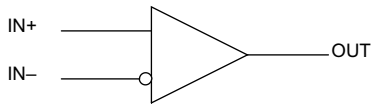
可将输出连接到其它集电极开路输出，以实现有线 AND 关联。

LM2901V-Q1 支持更高的 32V 电源电压，LM2901AV-Q1 支持更高的 32V 电源电压和更低的失调电压。

**器件信息**

| 器件型号 | 封装 (1) | 封装尺寸（标称值） |
|---|---|---|
| LM2901-Q1<br>LM2901A-Q1<br>LM2901AV-Q1 | TSSOP (14) | 4.40mm × 5.00mm |
| | SOIC (14) | 3.91mm × 8.65mm |

(1) 如需了解所有在售封装，请参阅数据表末尾的可订购产品附录。






**简化版原理图**

# Table of Contents



## 4 Revision History

| Changes from Revision E (January 2015) to Revision F (May 2021) | Page |
|---|---|
| • 更新了首页 HBM ESD 分级 | 1 |
| • 更新了整个文档中的表格、图和交叉参考的编号格式 | 1 |
| • Added seporate line for 1kV LM2901AV-Q1 HBM in ESD Ratings table | 4 |
| • Changed incorrect text in Apps Section Feature Description | 8 |
| • Changed incorrect Layout Example pinout | 11 |

| Changes from Revision D (April 2008) to Revision E (January 2015) | Page |
|---|---|
| • 向*特性* 部分添加了 AEC-Q100 结果 | 1 |
| • 添加了 *ESD 等级* 表、*特性说明* 部分、*器件功能模式*、*应用和实施* 部分、*电源相关建议* 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。 | 1 |
| • Added the common-mode voltage note to the $V_{ICR}$ parameter in the *Electrical Characteristics* table | 6 |

# 5 Pin Configuration and Functions

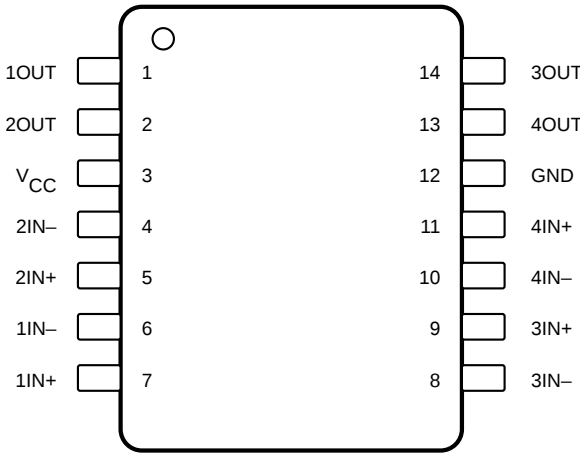



**图 5-1. D and PW Packages**
**14-Pin SOIC and TSSOP**
**Top View**

**表 5-1. Pin Functions**

| PIN | | I/O | DESCRIPTION |
|---|---|---|---|
| NO. | NAME | | |
| 1 | 1OUT | O | Output of comparator 1 |
| 2 | 2OUT | O | Output of comparator 2 |
| 3 | $V_{CC}$ | — | Supply Pin |
| 4 | 2IN – | I | Negative input of comparator 2 |
| 5 | 2IN+ | I | Positive input of comparator 2 |
| 6 | 1IN – | I | Negative input of comparator 1 |
| 7 | 1IN+ | I | Positive input of comparator 1 |
| 8 | 3IN – | I | Negative input of comparator 3 |
| 9 | 3IN+ | I | Positive input of comparator 3 |
| 10 | 4IN – | I | Negative input of comparator 4 |
| 11 | 4IN+ | I | Positive input of comparator 4 |
| 12 | GND | — | Ground |
| 13 | 4OUT | O | Output of comparator 4 |
| 14 | 3OUT | O | Output of comparator 3 |

# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

| | MIN | MAX | UNIT |
|---|---|---|---|
| Supply voltage, $V_{CC}$ (2) | | 36 | V |
| Differential input voltage, $V_{ID}$ (3) | | ±36 | |
| Input voltage range, $V_I$ (either input) | –0.3 | 36 | |
| Output voltage, $V_O$ | | 36 | |
| Output current, $I_O$ | | 20 | mA |
| Duration of output short circuit to ground(4) | Unlimited | | |
| Operating virtual junction temperature, $T_J$ | | 150 | °C |
| Storage temperature, $T_{stg}$ | –65 | 150 | °C |

(1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
(2) All voltage values, except differential voltages, are with respect to network ground.
(3) Differential voltages are at IN+ with respect to IN−.
(4) Short circuits from outputs to $V_{CC}$ can cause excessive heating and eventual destruction.

## 6.2 ESD Ratings

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per AEC Q100-002(1), (LM2901-Q1, LM2901V-Q1) | -2000 | 2000 | V |
| | | Human-body model (HBM), per AEC Q100-002(1), (LM2901AV-Q1 Only) | -1000 | 1000 | |
| | | Charged-device model (CDM), per AEC Q100-011 | -1000 | 1000 | |

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

## 6.3 Recommended Operating Conditions

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

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | LM2901-Q1 | 2 | 30 | V |
| | | LM2901V-Q1, LM2901AV-Q1 | 2 | 32 | |
| $T_A$ | Ambient temperature | | –40 | 125 | °C |
| $I_O$ | Output current (per comparator) | | 0 | 4 | mA |

## 6.4 Thermal Information

| THERMAL METRIC[1] | | LM2901x-Q1 | | UNIT |
|---|---|---|---|---|
| | | D (SOIC) | PW (TSSOP) | |
| | | 14 PINS | 14 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance[2] | 88.6 | 119.1 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 49.1 | 47.9 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 43.0 | 60.9 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 13.6 | 5.4 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 42.7 | 60.3 | °C/W |

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

(2) Maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A) / R_{\theta JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.

## 6.5 Electrical Characteristics LM2901x-Q1

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

| PARAMETER | | TEST CONDITIONS[1] | | $T_A$ [2] | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $V_{IC} = V_{ICR(min)}$, $V_O$ = 1.4 V, $V_{CC}$ = 5 V to MAX[3] | Non A devices | 25°C | | 2 | 7 | mV |
| | | | | Full range | | | 15 | |
| | | | A suffix devices | 25°C | | 1 | 2 | |
| | | | | Full range | | | 4 | |
| $I_{IO}$ | Input offset current | $V_O$ = 1.4 V | | 25°C | | 5 | 50 | nA |
| | | | | Full range | | | 200 | |
| $I_{IB}$ | Input bias current | $V_O$ = 1.4 V | | 25°C | | −25 | −250 | nA |
| | | | | Full range | | | −500 | |
| $V_{ICR}$ | Common-mode input-voltage range[4] | | | 25°C | 0 | | $V_{CC}$ − 1.5 | V |
| | | | | Full range | 0 | | $V_{CC}$ − 2 | |
| $A_{VD}$ | Large-signal differential-voltage amplification | $V_{CC}$ = 15 V, $V_O$ = 1.4 V to 11.4 V, $R_L \geq$ 15 kΩ to $V_{CC}$ | | 25°C | 25 | 100 | | V/mV |
| $I_{OH}$ | High-level output current | $V_{ID}$ = 1 V | $V_{OH}$ = 5 V | 25°C | | 0.1 | 50 | nA |
| | | | $V_{OH}$ = $V_{CC}$ MAX[3] | Full range | | | 1 | µA |
| $V_{OL}$ | Low-level output voltage | $V_{ID}$ = −1 V | $I_{OL}$ = 4 mA | 25°C | | 150 | 400 | mV |
| | | | | Full range | | | 700 | |
| $I_{OL}$ | Low-level output current | $V_{ID}$ = −1 V | $V_{OL}$ = 1.5 V | 25°C | 6 | 16 | | mA |
| $I_{CC}$ | Supply current (four comparators) | $V_O$ = 2.5 V, No load | $V_{CC}$ = 5 V | 25°C | | 0.8 | 2 | |
| | | | $V_{CC}$ = MAX[3] | | | 1 | 2.5 | |

(1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
(2) Full range (MIN to MAX) is −40°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
(3) $V_{CC}$ MAX = 30 V for non-V devices and 32 V for V-suffix devices.
(4) The voltage at either the input or common mode should not be allowed to negative by more that 0.3 V. The upper end of the common-mode voltage range is $V_{CC+}$ – 1.5 V; however, one input can exceed $V_{CC}$, and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 30 V without damage.

## 6.6 Switching Characteristics LM2901x-Q1

$V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Response time[2] | $R_L$ connected to 5 V through 5.1 kΩ, $C_L$ = 15 pF[1] | 100-mV input step with 5-mV overdrive | | 1.3 | | µs |
| | | TTL-level input step | | 0.3 | | |

(1) $C_L$ includes probe and jig capacitance.
(2) The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## 6.7 Typical Characteristics LM2901x-Q1

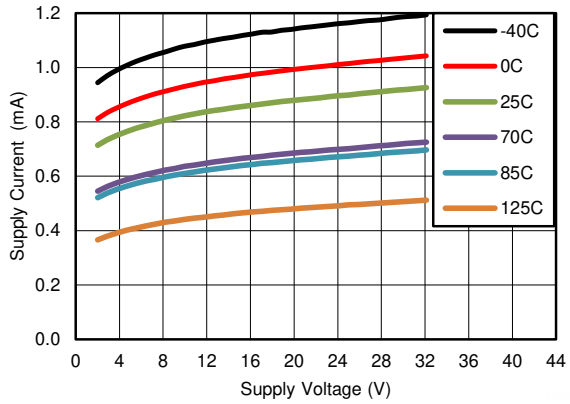



图 6-1. Supply Current vs Supply Voltage

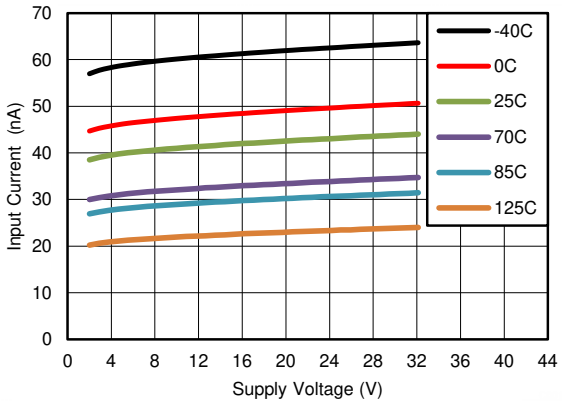



图 6-2. Input Bias Current vs Supply Voltage

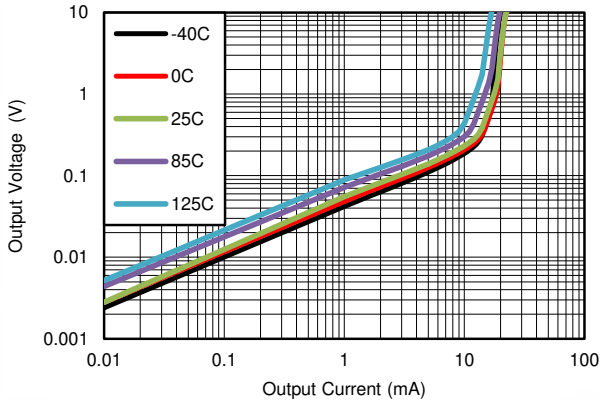



图 6-3. Output Saturation Voltage

# 7 Detailed Description

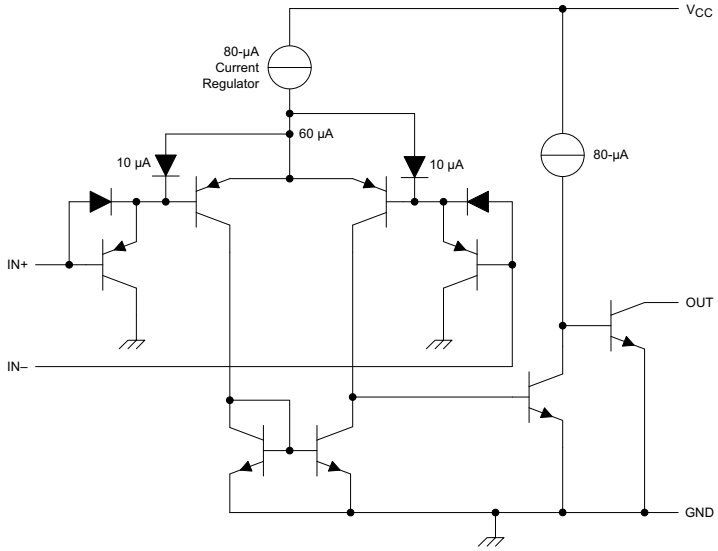
## 7.1 Overview

The LM2901x-Q1 family of devices is a quad comparator with the ability to operate up to an absolute maximum of 36 V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications because of the very wide supply voltage range (2 V to 30 V or 32 V), low $I_Q$, and fast response of the device.

This device is AEC-Q100 qualified and can operate over a wide temperature range ( – 40°C to 125°C).

The open-collector output allows the user to configure the logic-high voltage of the output ($V_{OH}$) independent of $V_{CC}$ and can be used with multiple comparators in wired AND functionality.

## 7.2 Functional Block Diagram




## 7.3 Feature Description

The LM2901x-Q1 family of devices consists of a PNP Darlington pair input, allowing the device to operate with very high gain and fast response with minimal input bias current. The input Darlington pair creates a limit on the input common-mode voltage ability, allowing the LM2901x-Q1 family of devices to accurately function from ground to $V_{CC}$ – 2 V for the lower voltage input. The higher voltage input may go up to the maximum $V_{CC}$. This ability enables a wide input range even when using modern-day supplies of 3.3 V and 5 V.

The output consists of an open collector bipolar transistor. The transistor sinks current when the negative input voltage is higher than the positive input voltage and the offset voltage. The $V_{OL}$ is resistive and scales with the output current. See 图 6-3 in *节 6.7* for the $V_{OL}$ values with respect to the output current.

The special pinout of this device separates input pins from the output pins to reduce parasitic coupling between input and output.

## 7.4 Device Functional Modes

### 7.4.1 Voltage Comparison

The LM2901x-Q1 family of devices 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 pullup) based on the input differential polarity.

# 8 Application and Implementation

**备注**

以下应用部分的信息不属于 TI 组件规范，TI 不担保其准确性和完整性。客户应负责确定 TI 组件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

## 8.1 Application Information

The LM2901x-Q1 family of devices is typically 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 the LM2901x-Q1 family of devices optimal for level shifting to a higher or lower voltage.

## 8.2 Typical Application

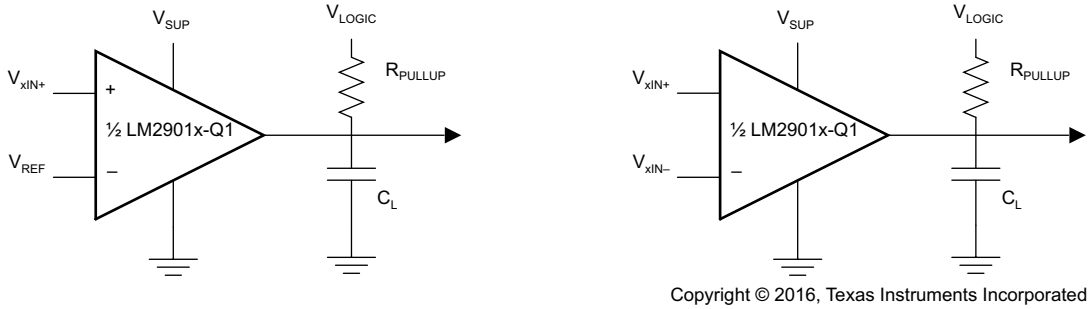





**图 8-1. Single-Ended and Differential Comparator Configurations**

### 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**

| PARAMETER | EXAMPLE VALUE |
|---|---|
| Input voltage range | 0 V to $V_{SUP}$ – 1.5 V |
| Supply voltage | 2 V to 36 V |
| Logic supply voltage | 2 V to 36 V |
| Output current ($R_{PULLUP}$) | 1 µA to 20 mA |
| Input overdrive voltage | 100 mV |
| Reference voltage | 2.5 V |
| Load capacitance ($C_L$) | 15 pF |

### 8.2.2 Detailed Design Procedure

#### *8.2.2.1 Input Voltage Range*

When selecting the input voltage range, the input common-mode voltage range ($V_{ICR}$) must be considered. If temperature operation is above or below 25°C the $V_{ICR}$ can range from 0 V to $V_{CC}$ – 2 V. The $V_{ICR}$ range limits the input voltage range to as high as $V_{CC}$ – 2 V and as low as 0 V. Operation outside of this range can yield incorrect comparisons.

The following lists some input voltage scenarios and the resulting outcomes:

- When both IN – and IN+ are both within the common-mode range:
  - If IN – is higher than IN+ and the offset voltage, then the output is low and the output transistor is sinking current.

- If IN – is lower than IN+ and the offset voltage, then the output is in high impedance and the output transistor is not conducting.

- When IN – is higher than common-mode and IN+ is within common-mode, the output is low and the output transistor is sinking current.
- When IN+ is higher than common-mode and IN – is within common-mode, then the output is in high impedance and the output transistor is not conducting.
- When IN – and IN+ are both higher than common-mode, then the output is low and the output transistor is sinking current.

#### *8.2.2.2 Minimum Overdrive Voltage*

The overdrive voltage is the differential voltage produced between the positive and negative inputs of the comparator over the offset voltage ($V_{IO}$). To make an accurate comparison the overdrive voltage ($V_{OD}$) must be higher than the input offset voltage ($V_{IO}$). The overdrive voltage can also determine the response time of the comparator, with the response time decreasing as the overdrive increases. 图 8-2 and 图 8-3 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 load or pullup resistance and logic or pullup voltage. The output current produces an 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. See 节 *8.2.2.4* for more information.

#### *8.2.2.4 Response Time*

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

Use 方程式 1 and 方程式 2 to calculate the approximate values of the rise time ($t_r$) and fall time ($t_f$).

$$t_P \approx R_{PULLUP} \times C_L \quad (1)$$

$$t_N \approx R_{CE} \times C_L \quad (2)$$

To find the value of $R_{CE}$, use the slope of 图 6-3 in the linear region at the desired temperature, or divide $V_{OL}$ by $I_O$.

### 8.2.3 Application Curves

The following curves were generated with 5 V on $V_{CC}$ and $V_{LOGIC}$, $R_{PULLUP}$ = 5.1 kΩ, and 50-pF scope probe.

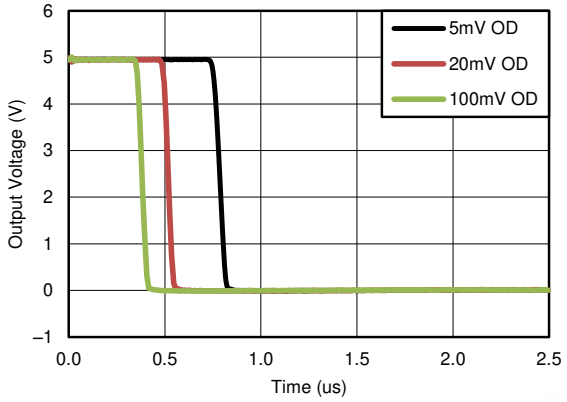



**图 8-2. Response Time for Various Overdrives Negative Transition**

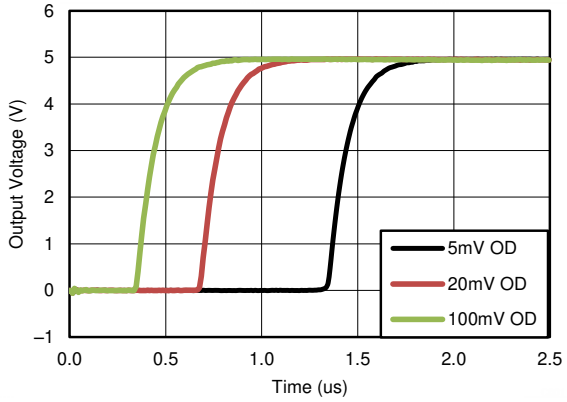



**图 8-3. Response Time for Various Overdrives Positive Transition**

# 9 Power Supply Recommendations

For fast response and comparison applications with noisy or AC inputs, TI recommends using a bypass capacitor on the supply pin to reject any variation on the supply voltage. This variation can take away from some of the input common mode range of the comparator and create an inaccurate comparison.

# 10 Layout

## 10.1 Layout Guidelines

For accurate comparator applications without hysteresis, maintaining a stable power supply with minimized noise and glitches, which can affect the high-level input common-mode voltage range, is important. To achieve a stable power supply, place a bypass capacitor between the positive and negative (if available) supply voltage and ground. If a negative supply is not being used, do not put a capacitor between the GND pin of the IC and system ground.

## 10.2 Layout Example

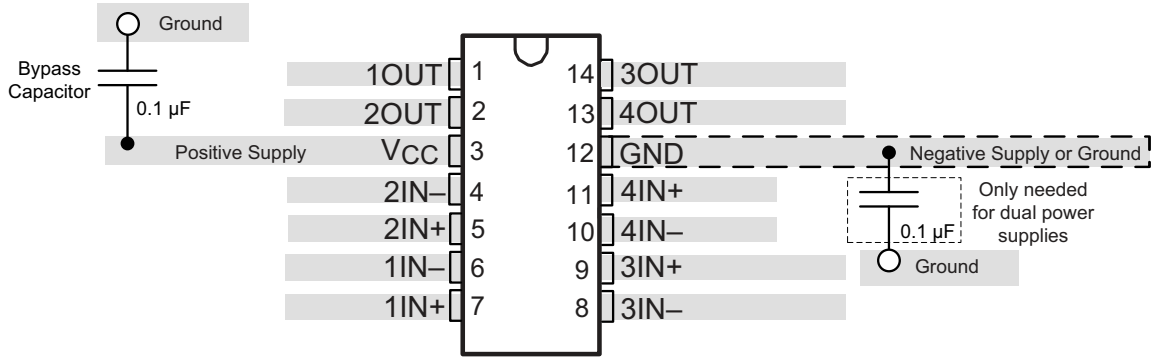



**图 10-1. LM2901x-Q1 Layout Example**

# 11 Device and Documentation Support

## 11.1 Documentation Support

### 11.1.1 Related Documentation

For related documentation, see the following:

TL331-Q1 *Single Differential Comparator*, SLVS969

## 11.2 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 |
|---|---|---|---|---|---|
| LM2901-Q1 | Click here | Click here | Click here | Click here | Click here |
| LM2901V-Q1 | Click here | Click here | Click here | Click here | Click here |
| LM2901AV-Q1 | Click here | Click here | Click here | Click here | Click here |
| LM2901B-Q1 | Click here | Click here | Click here | Click here | Click here |

## 11.3 Trademarks

所有商标均为其各自所有者的财产。

## 11.4 静电放电警告

静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

## 11.5 术语表

TI 术语表　　本术语表列出并解释了术语、首字母缩略词和定义。

# 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 (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM2901AVQDRG4Q1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901AVQ | Samples |
| LM2901AVQDRQ1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901AVQ | Samples |
| LM2901AVQPWRG4Q1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901AVQ | Samples |
| LM2901AVQPWRQ1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901AVQ | Samples |
| LM2901QDRG4Q1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901Q1 | Samples |
| LM2901QDRQ1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901Q1 | Samples |
| LM2901QPWRG4Q1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901Q1 | Samples |
| LM2901QPWRQ1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901Q1 | Samples |
| LM2901VQDRG4Q1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901VQ1 | Samples |
| LM2901VQDRQ1 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901VQ1 | Samples |
| LM2901VQPWRG4Q1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901VQ | Samples |
| LM2901VQPWRQ1 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 2901VQ | Samples |

(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) **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.



**OTHER QUALIFIED VERSIONS OF LM2901-Q1, LM2901AV-Q1, LM2901V-Q1 :**

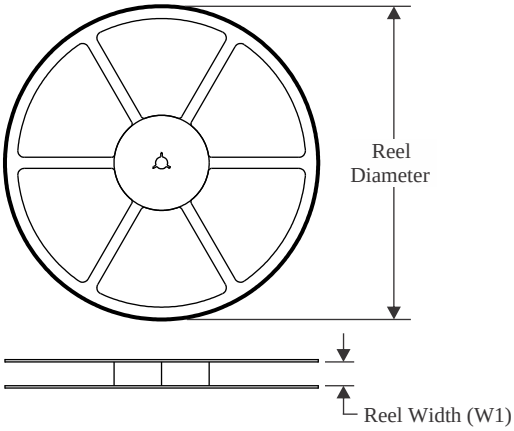
- Catalog : LM2901, LM2901AV, LM2901V

NOTE: Qualified Version Definitions:

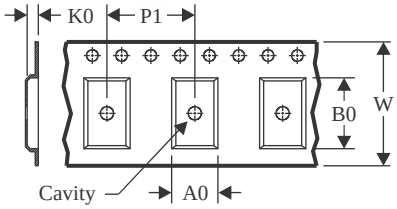
- Catalog - TI's standard catalog product

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

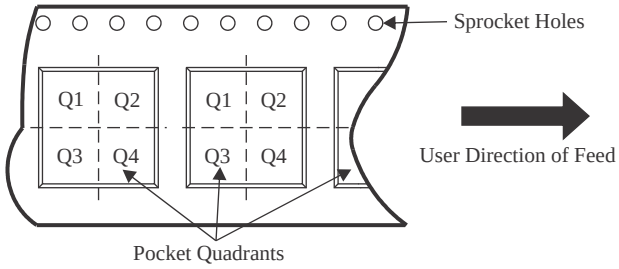



**TAPE DIMENSIONS**




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

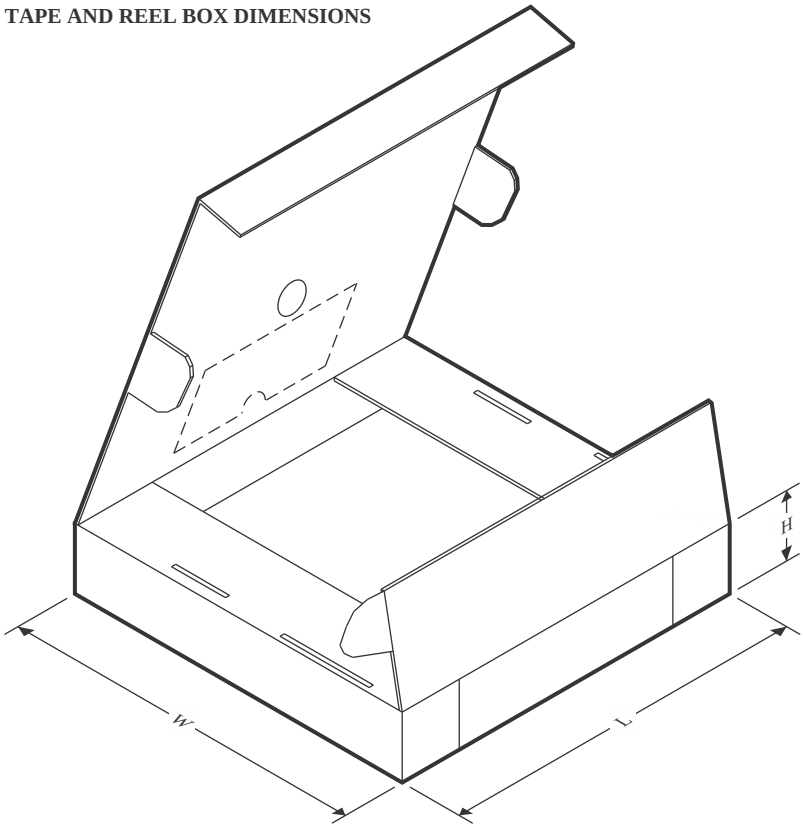
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LM2901AVQPWRG4Q1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2901AVQPWRQ1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2901QPWRG4Q1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2901QPWRQ1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2901VQPWRG4Q1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2901VQPWRQ1 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

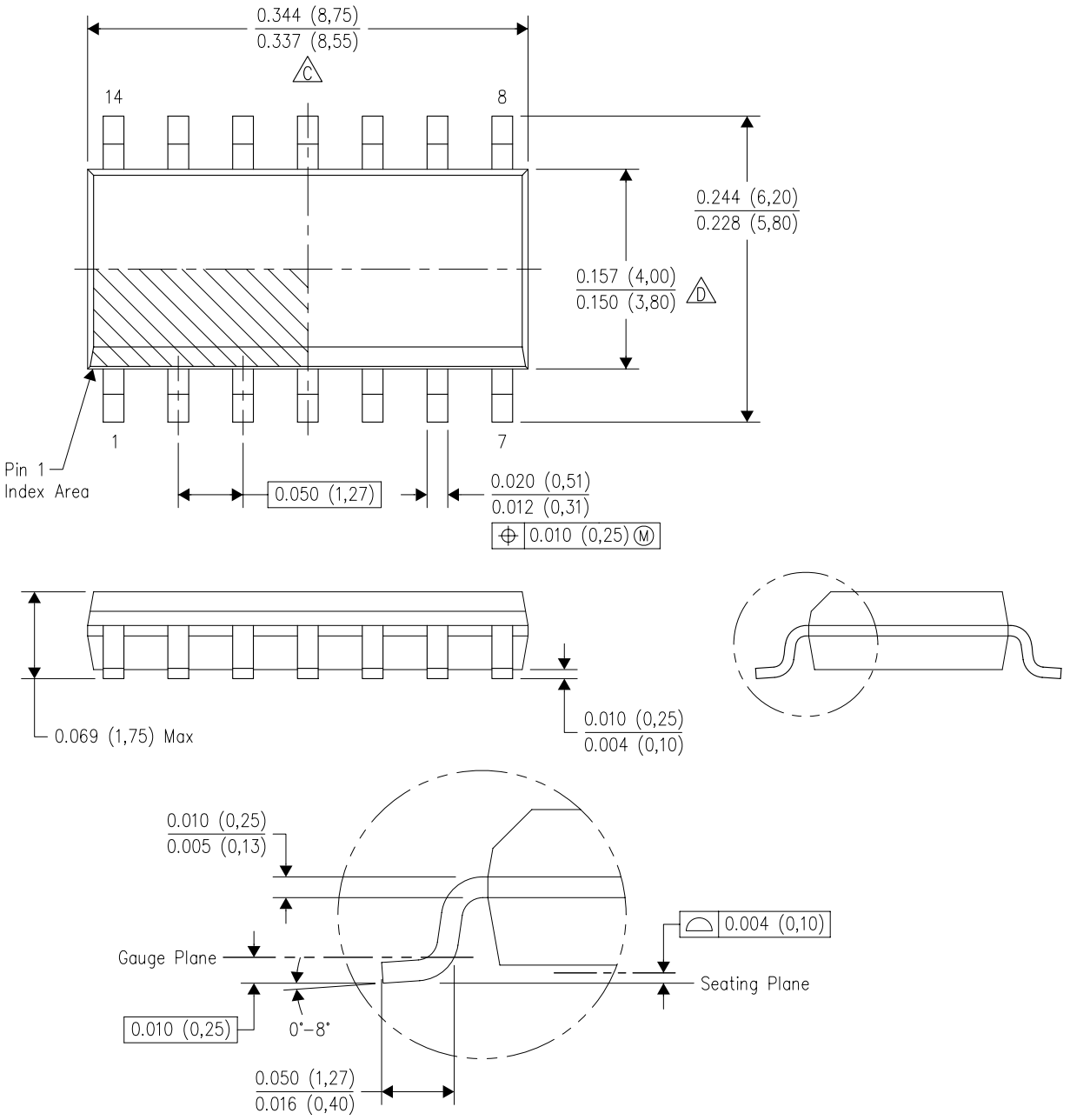
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LM2901AVQPWRG4Q1 | TSSOP | PW | 14 | 2000 | 367.0 | 367.0 | 35.0 |
| LM2901AVQPWRQ1 | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| LM2901QPWRG4Q1 | TSSOP | PW | 14 | 2000 | 367.0 | 367.0 | 35.0 |
| LM2901QPWRQ1 | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| LM2901VQPWRG4Q1 | TSSOP | PW | 14 | 2000 | 367.0 | 367.0 | 35.0 |
| LM2901VQPWRQ1 | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |

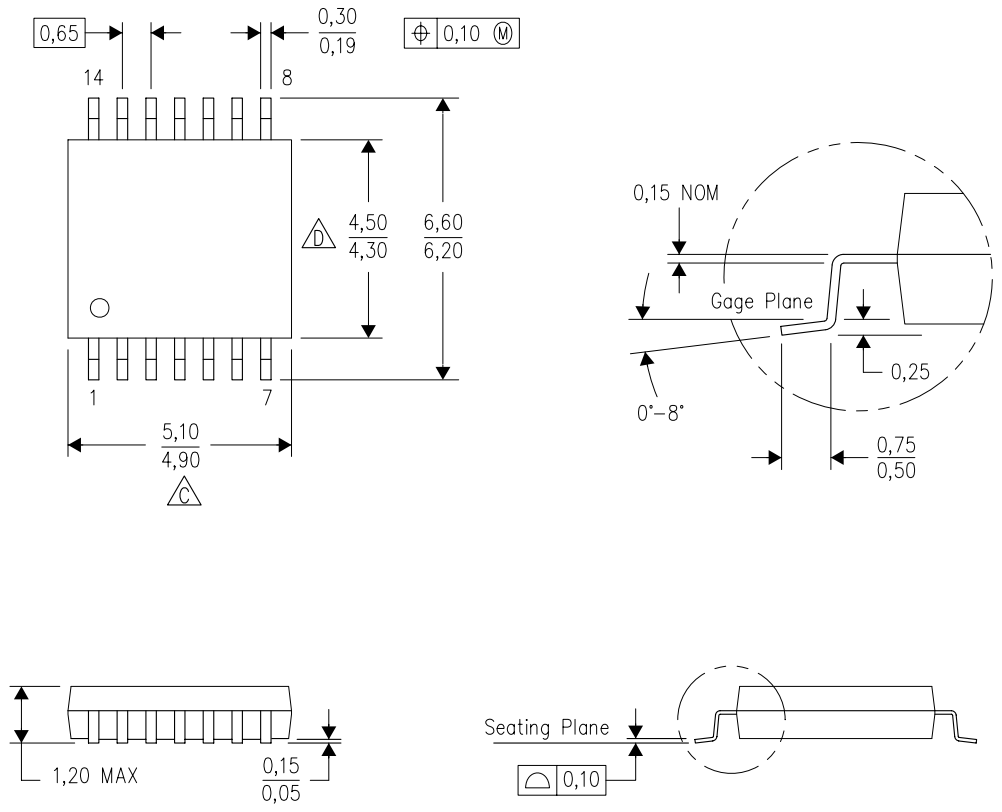
D (R–PDSO–G14) PLASTIC SMALL OUTLINE




4040047–5/M 06/11

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.

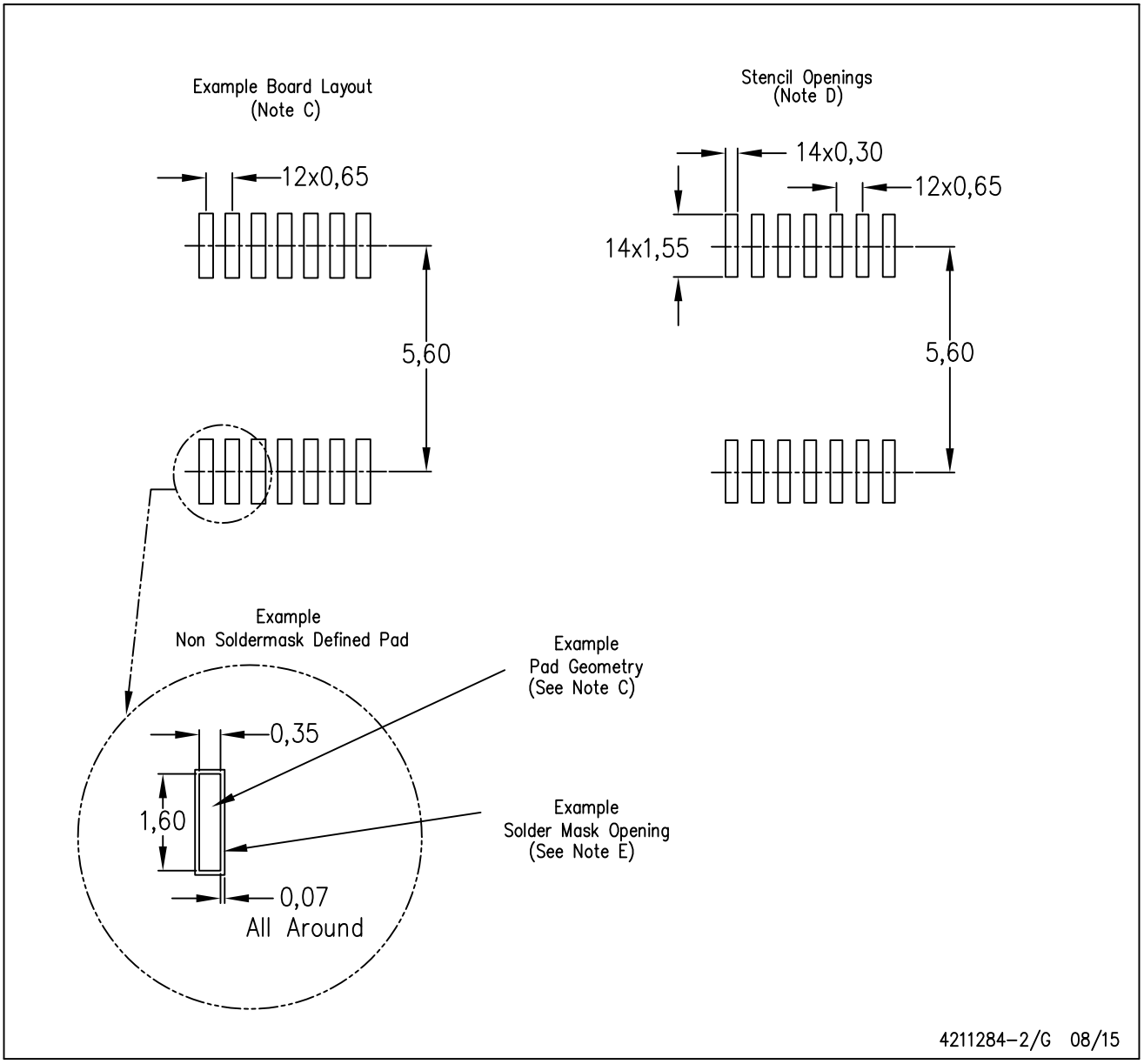
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE




4040064–3/G 02/11

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
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 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

PW (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.

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