

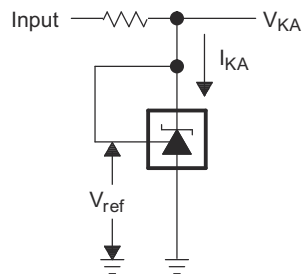
## TL431、TL432 精密可编程基准

## 1 特性

- 25°C 下的基准电压容差
  - 0.5% ( B 级 )
  - 1% ( A 级 )
  - 2% ( 标准级 )
- 可调节输出电压： $V_{ref}$  至 36V
- 工作温度范围：-40°C 至 125°C
- 典型温度漂移 (TL43xB)
  - 6mV ( C 级温度 )
  - 14mV ( I 级温度，Q 级温度 )
- 低输出噪声
- 输出阻抗典型值为 0.2  $\Omega$
- 灌电流能力：1mA 至 100mA

## 2 应用

- 机架服务器电源
- 工业交流/直流电源
- 交流逆变器和变频驱动器
- 伺服驱动器控制模块
- 笔记本电脑电源适配器设计



简化原理图

## 3 说明

TL431 和 TL432 器件是三端可调节并联稳压器，在适用的汽车级、商用级和军用级温度范围内均可满足规定的热稳定性。可以通过两个外部电阻器将输出电压设置为介于  $V_{ref}$  ( 约为

2.5V ) 和 36V 之间的任意值。这些器件的输出阻抗典型值为 0.2  $\Omega$ 。此类器件的有源输出电路具有非常明显的导通特性，因此非常适合用于替代许多应用中的齐纳二极管，例如板载稳压器、可调节电源和开关电源。

TL432 器件具有与 TL431 器件完全相同的功能和电气特性，但是具有不同的 DBV、DBZ 和 PK 封装引脚排列。

TL431 和 TL432 器件都具有 B、A 和标准三个等级，25°C 下的初始容差分别为 0.5%、1% 和 2%。此外，低输出温漂验证了在整个温度范围内具有出色的稳定性。

TL43xxC 器件运行温度范围为 0°C 至 70°C，TL43xxI 器件运行温度范围为 -40°C 至 85°C，TL43xxQ 器件运行温度范围为 -40°C 至 125°C。

器件信息

| 器件型号  | 封装 ( 引脚 ) <sup>(1)</sup> | 本体尺寸 ( 标称值 ) <sup>(2)</sup> |
|-------|--------------------------|-----------------------------|
| TL43x | SOT-23-3 (3)             | 2.90mm × 1.30mm             |
|       | SOT-23-5 (5)             | 2.90mm × 1.60mm             |
|       | SOIC (8)                 | 4.90mm × 3.90mm             |
|       | PDIP (8)                 | 9.50mm × 6.35mm             |
|       | SOP (8)                  | 6.20mm × 5.30mm             |

(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。

(2) 封装尺寸 ( 长 × 宽 ) 为标称值，并包括引脚 ( 如适用 )。



## 内容

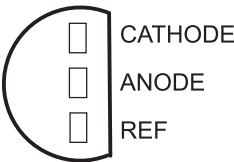
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## 4 器件比较表

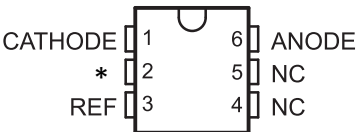
| 器件引脚分配         | 初始精度                              | 自然通风条件下的工作温度 (T <sub>A</sub> )                          |
|----------------|-----------------------------------|---------------------------------------------------------|
| TL431<br>TL432 | B : 0.5%<br>A : 1%<br>( 空白 ) : 2% | C : 0°C 至 70°C<br>I : -40°C 至 85°C<br>Q : -40°C 至 125°C |

5 引脚配置和功能

TL431, TL431A, TL431B ... LP (TO-92/TO-226) PACKAGE  
(TOP VIEW)



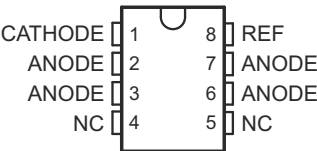
TL431A, TL431B ... DCK (SC-70) PACKAGE  
(TOP VIEW)



NC – No internal connection

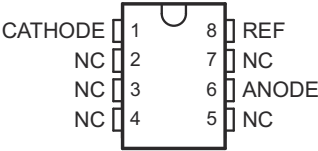
\* - Must be connected to ANODE or left open

TL431, TL431A, TL431B ... D (SOIC) PACKAGE  
(TOP VIEW)



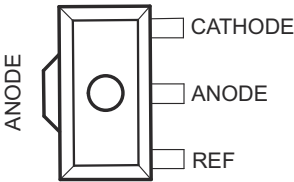
NC – No internal connection

TL431, TL431A, TL431B ... P (PDIP), PS (SOP),  
OR PW (TSSOP) PACKAGE  
(TOP VIEW)

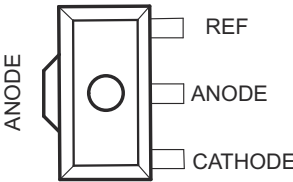


NC – No internal connection

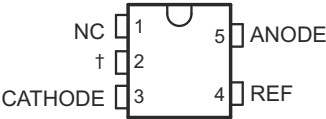
TL431, TL431A, TL431B ... PK (SOT-89) PACKAGE  
(TOP VIEW)



TL432, TL432A, TL432B ... PK (SOT-89) PACKAGE  
(TOP VIEW)



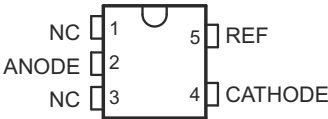
TL431, TL431A, TL431B ... DBV (SOT-23-5) PACKAGE  
(TOP VIEW)



NC – No internal connection

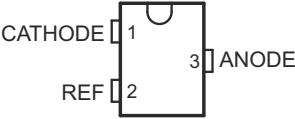
† Pin 2 is attached to Substrate and must be connected to ANODE or left open.

TL432, TL432A, TL432B ... DBV (SOT-23-5) PACKAGE  
(TOP VIEW)



NC – No internal connection

TL431, TL431A, TL431B ... DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)



TL432, TL432A, TL432B ... DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)

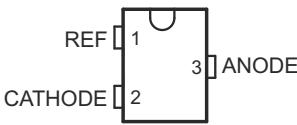


表 5-1. 引脚功能

| 引脚      |        |     |    |   |            |    |     |        |     |    | 类型  | 说明         |
|---------|--------|-----|----|---|------------|----|-----|--------|-----|----|-----|------------|
| 名称      | TL431x |     |    |   |            |    |     | TL432x |     |    |     |            |
|         | DBZ    | DBV | PK | D | P、PS<br>PW | LP | DCK | DBZ    | DBV | PK |     |            |
| CATHODE | 1      | 3   | 3  | 1 | 1          | 1  | 1   | 2      | 4   | 1  | I/O | 并联电流/电压输入  |
| REF     | 2      | 4   | 1  | 8 | 8          | 3  | 3   | 1      | 5   | 3  | I   | 相对于通用阳极的阈值 |

**表 5-1. 引脚功能 (续)**

| 引脚    |        |     |    |             |            |    |     |        |     |    | 类型 | 说明        |
|-------|--------|-----|----|-------------|------------|----|-----|--------|-----|----|----|-----------|
| 名称    | TL431x |     |    |             |            |    |     | TL432x |     |    |    |           |
|       | DBZ    | DBV | PK | D           | P、PS<br>PW | LP | DCK | DBZ    | DBV | PK |    |           |
| ANODE | 3      | 5   | 2  | 2、3、<br>6、7 | 6          | 2  | 6   | 3      | 2   | 2  | O  | 通用引脚，通常接地 |

## 6 规格

### 6.1 绝对最大额定值

在自然通风条件下的工作温度范围内测得 (除非另有说明) <sup>(1)</sup>

|              |                     | 最小值    | 最大值 | 单位 |
|--------------|---------------------|--------|-----|----|
| $V_{KA}$     | 阴极电压 <sup>(2)</sup> |        | 37  | V  |
| $I_{KA}$     | 连续阴极电流范围            | - 100  | 150 | mA |
| $I_{I(ref)}$ | 基准输入电流              | - 0.05 | 10  | mA |
| $T_J$        | 工作结温范围              |        | 150 | °C |
| $T_{stg}$    | 贮存温度范围              | - 65   | 150 | °C |

- (1) 应力超出绝对最大额定值下列出的值可能会对器件造成永久损坏。这些列出的值仅仅是应力等级，这并不表示器件在这些条件下以及在建议运行条件以外的任何其他条件下能够正常运行。长时间处于绝对最大额定条件下可能会影响器件的可靠性。
- (2) 除非另有说明，否则所有电压值均以 ANODE 为基准。

### 6.2 ESD 等级

|             |      | 值                                                         | 单位    |
|-------------|------|-----------------------------------------------------------|-------|
| $V_{(ESD)}$ | 静电放电 | 人体放电模型 (HBM), 符合 ANSI/ESDA/JEDEC JS-001 引脚 <sup>(1)</sup> | ±2000 |
|             |      | 充电器件模型 (CDM), 符合 JEDEC 规范 JESD22-C101 标准 <sup>(2)</sup>   | ±1000 |

- (1) JEDEC 文档 JEP155 指出：500V HBM 时能够在标准 ESD 控制流程下安全生产。若部署必要的预防措施，不足 500V HBM 时也能进行生产。
- (2) JEDEC 文档 JEP157 指出：250V CDM 时能够在标准 ESD 控制流程下安全生产。若部署必要的预防措施，不足 250V CDM 时也能进行生产。

### 6.3 热性能信息

| 热指标 <sup>(1)</sup>    |            | TL43xx |     |    |    |      |      |      |     |    | 单位   |
|-----------------------|------------|--------|-----|----|----|------|------|------|-----|----|------|
|                       |            | P      | PW  | D  | PS | DCK  | DBV  | DBZ  | LP  | PK |      |
|                       |            | 8 引脚   |     |    |    | 6 引脚 | 5 引脚 | 3 引脚 |     |    |      |
| R <sub>θJA</sub>      | 结至环境热阻     | 85     | 149 | 97 | 95 | 259  | 206  | 206  | 140 | 52 | °C/W |
| R <sub>θJC(top)</sub> | 结至外壳（顶部）热阻 | 57     | 65  | 39 | 46 | 87   | 131  | 76   | 55  | 9  | °C/W |

- (1) 有关新旧热指标的更多信息，请参阅 IC 封装热指标应用报告 (SPRA953)。

### 6.4 建议运行条件

请参阅<sup>(1)</sup>

|          |                | 最小值       | 最大值 | 单位  |
|----------|----------------|-----------|-----|-----|
| $V_{KA}$ | 阴极电压           | $V_{ref}$ | 36  | V   |
| $I_{KA}$ | 连续阴极电流范围       | 1         | 100 | mA  |
| $T_A$    | 自然通风条件下的工作温度范围 | TL43xxC   | 0   | 70  |
|          |                | TL43xxI   | -40 | 85  |
|          |                | TL43xxQ   | -40 | 125 |

- (1) 最大功耗是与  $T_{J(max)}$ 、 $\theta_{JA}$  和  $T_A$  相关的函数。在任何允许的环境温度下，允许的最大功耗为  $P_D = (T_{J(max)} - T_A) / \theta_{JA}$ 。在 150°C 的绝对最大  $T_J$  下运行可能会影响可靠性。

## 6.5 电气特性，TL431C、TL432C

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             | 最小值                                        | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | 2440                                       | 2495 | 2550 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | SOT23-3 和 TL432 器件                         |      | 6    | 16   |
|                                        |                      |          |                                                                                  | 所有其他器件                                     |      | 4    | 25   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            | 0.4  | 1.2  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            | 0.4  | 1    | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            | 0.1  | 1    | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅[动态阻抗](#)。

## 6.6 电气特性，TL431I、TL432I

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             | 最小值                                        | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | 2440                                       | 2495 | 2550 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | SOT23-3 和 TL432 器件                         |      | 14   | 34   |
|                                        |                      |          |                                                                                  | 所有其他器件                                     |      | 5    | 50   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 2.5  |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 1    |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 1    |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  |

(1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅温度系数。

(2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅动态阻抗。

## 6.7 电气特性，TL431Q、TL432Q

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             |                                            | 最小值  | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            | 2440 | 2495 | 2550 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            |      | 14   | 34   | mV   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 | mV/V |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   | mV/V |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 2.5  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 1    | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 1    | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅[动态阻抗](#)。

## 6.8 电气特性，TL431AC、TL432AC

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$ （除非另有说明）

| 参数                                             |                      | 测试电路     | 测试条件                                                                                                       | 最小值                                                  | 典型值  | 最大值       | 单位            |
|------------------------------------------------|----------------------|----------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------|-----------|---------------|
| $V_{\text{ref}}$                               | 基准电压                 | 请参阅图 7-1 | $V_{\text{KA}} = V_{\text{ref}}$ , $I_{\text{KA}} = 10\text{mA}$                                           | 2470                                                 | 2495 | 2520      | mV            |
| $V_{\text{I(dev)}}$                            | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | $V_{\text{KA}} = V_{\text{ref}}$ , $I_{\text{KA}} = 10\text{mA}$                                           | SOT23-3 和 TL432 器件                                   |      | 6 16      | mV            |
|                                                |                      |          |                                                                                                            | 所有其他器件                                               |      | 4 25      | mV            |
| $\Delta V_{\text{ref}} / \Delta V_{\text{KA}}$ | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | $I_{\text{KA}} = 10\text{mA}$                                                                              | $\Delta V_{\text{KA}} = 10\text{V} - V_{\text{ref}}$ |      | -1.4 -2.7 | mV/V          |
|                                                |                      |          |                                                                                                            | $\Delta V_{\text{KA}} = 36\text{V} - 10\text{V}$     |      | -1 -2     | mV/V          |
| $I_{\text{ref}}$                               | 基准输入电流               | 请参阅图 7-2 | $I_{\text{KA}} = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \infty$                                    | 2                                                    | 4    |           | $\mu\text{A}$ |
| $I_{\text{I(dev)}}$                            | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | $I_{\text{KA}} = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \infty$                                    | 0.8                                                  | 1.2  |           | $\mu\text{A}$ |
| $I_{\text{min}}$                               | 调节的最小阴极电流            | 请参阅图 7-1 | $V_{\text{KA}} = V_{\text{ref}}$                                                                           | 0.4                                                  | 0.6  |           | mA            |
| $I_{\text{off}}$                               | 关闭状态阴极电流             | 请参阅图 7-3 | $V_{\text{KA}} = 36\text{V}$ , $V_{\text{ref}} = 0$                                                        | 0.1                                                  | 0.5  |           | $\mu\text{A}$ |
| $ Z_{\text{KA}} $                              | 动态阻抗 (2)             | 请参阅图 7-1 | $V_{\text{KA}} = V_{\text{ref}}$ , $f \leq 1\text{kHz}$ ,<br>$I_{\text{KA}} = 1\text{mA}$ 至 $100\text{mA}$ | 0.2                                                  | 0.5  |           | $\Omega$      |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅温度系数。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅动态阻抗。

## 6.9 电气特性，TL431AI、TL432AI

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             | 最小值                                        | 典型值  | 最大值  | 单位   |      |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | 2470                                       | 2495 | 2520 | mV   |      |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      | SOT23-3 和 TL432 器件                         |      | 14   | 34   | mV   |
|                                        |                      |          |                                                                                  | 所有其他器件                                     |      | 5    | 50   | mV   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 | mV/V |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   | mV/V |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA , R1 = 10kΩ , R2 = ∞                                      |                                            |      | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA , R1 = 10kΩ , R2 = ∞                                      |                                            |      | 0.8  | 2.5  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 0.7  | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V , V <sub>ref</sub> = 0                                     |                                            |      | 0.1  | 0.5  | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅[动态阻抗](#)。

## 6.10 电气特性，TL431AQ、TL432AQ

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$ （除非另有说明）

| 参数                                     |                      | 测试电路     | 测试条件                                                                             |                                            | 最小值  | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            | 2470 | 2495 | 2520 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            |      | 14   | 34   | mV   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 | mV/V |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   | mV/V |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 2.5  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 0.7  | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 0.5  | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{I(\text{dev})}$  和  $I_{I(\text{dev})}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{I(\text{dev})}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{KA}| = \Delta V_{KA} / \Delta I_{KA}$ 。有关  $|Z_{KA}|$  的更多详细信息及其与  $V_{KA}$  的关系，请参阅[动态阻抗](#)。

## 6.11 电气特性，TL431BC、TL432BC

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             |                                            | 最小值  | 典型值  | 最大值  | 单位 |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|----|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            | 2483 | 2495 | 2507 | mV |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            |      | 6    | 16   | mV |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> | -1.4 | -2.7 | mV/V |    |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              | -1   | -2   | mV/V |    |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    | μA |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 1.2  | μA |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 0.6  | mA |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 0.5  | μA |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω  |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅[动态阻抗](#)。

## 6.12 电气特性，TL431BI、TL432BI

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$ （除非另有说明）

| 参数                                     |                      | 测试电路     | 测试条件                                                                             |                                            | 最小值  | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            | 2483 | 2495 | 2507 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            |      | 14   | 34   | mV   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 | mV/V |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   | mV/V |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 2.5  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 0.7  | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 0.5  | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅[温度系数](#)。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅[动态阻抗](#)。

## 6.13 电气特性，TL431BQ、TL432BQ

在推荐的工作条件下测得， $T_A = 25^\circ\text{C}$  (除非另有说明)

| 参数                                     |                      | 测试电路     | 测试条件                                                                             |                                            | 最小值  | 典型值  | 最大值  | 单位   |
|----------------------------------------|----------------------|----------|----------------------------------------------------------------------------------|--------------------------------------------|------|------|------|------|
| V <sub>ref</sub>                       | 基准电压                 | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            | 2483 | 2495 | 2507 | mV   |
| V <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电压偏差 (1) | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , I <sub>KA</sub> = 10mA                      |                                            |      | 14   | 34   | mV   |
| Δ V <sub>ref</sub> / Δ V <sub>KA</sub> | 基准电压变化与阴极电压变化之比      | 请参阅图 7-2 | I <sub>KA</sub> = 10mA                                                           | Δ V <sub>KA</sub> = 10V - V <sub>ref</sub> |      | -1.4 | -2.7 | mV/V |
|                                        |                      |          |                                                                                  | Δ V <sub>KA</sub> = 36V - 10V              |      | -1   | -2   | mV/V |
| I <sub>ref</sub>                       | 基准输入电流               | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 2    | 4    | μA   |
| I <sub>I(dev)</sub>                    | 整个温度范围内的基准输入电流偏差 (1) | 请参阅图 7-2 | I <sub>KA</sub> = 10mA, R1 = 10kΩ, R2 = ∞                                        |                                            |      | 0.8  | 2.5  | μA   |
| I <sub>min</sub>                       | 调节的最小阴极电流            | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub>                                               |                                            |      | 0.4  | 0.7  | mA   |
| I <sub>off</sub>                       | 关闭状态阴极电流             | 请参阅图 7-3 | V <sub>KA</sub> = 36V, V <sub>ref</sub> = 0                                      |                                            |      | 0.1  | 0.5  | μA   |
| Z <sub>KA</sub>                        | 动态阻抗 (2)             | 请参阅图 7-1 | V <sub>KA</sub> = V <sub>ref</sub> , f ≤ 1kHz ,<br>I <sub>KA</sub> = 1mA 至 100mA |                                            |      | 0.2  | 0.5  | Ω    |

- (1) 偏差参数  $V_{\text{I(dev)}}$  和  $I_{\text{I(dev)}}$  是指在额定温度范围内获得的最大和最小值之间的差异。有关  $V_{\text{I(dev)}}$  的更多详细信息及其与平均温度系数的关系，请参阅温度系数。
- (2) 动态阻抗被定义为： $|Z_{\text{KA}}| = \Delta V_{\text{KA}} / \Delta I_{\text{KA}}$ 。有关  $|Z_{\text{KA}}|$  的更多详细信息及其与  $V_{\text{KA}}$  的关系，请参阅动态阻抗。

## 6.14 典型特性

高温和低温下的数据仅适用于各种器件在自然通风条件下的推荐工作温度范围内。

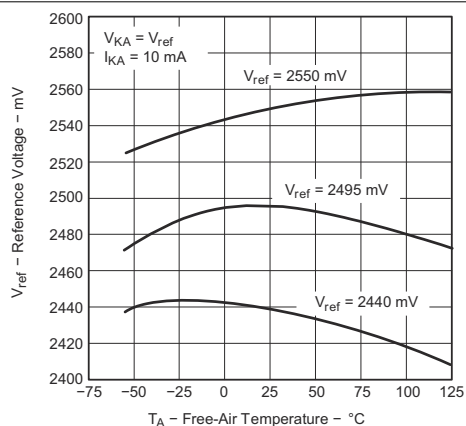


图 6-1. 基准电压与自然通风温度之间的关系

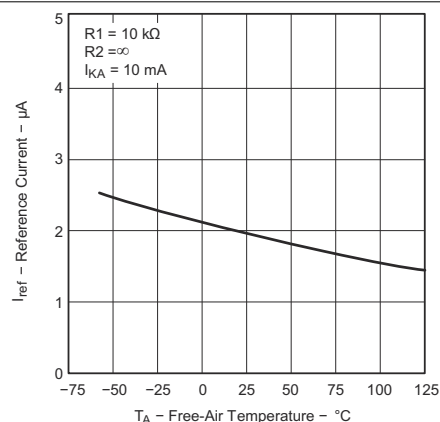


图 6-2. 基准电流与自然通风温度之间的关系

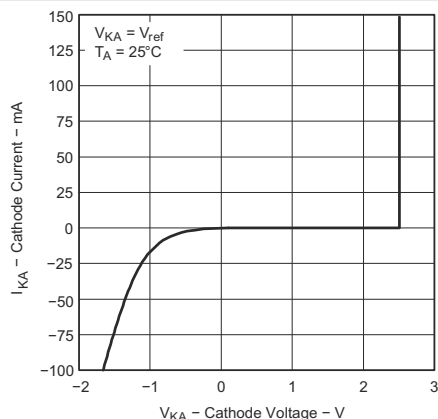


图 6-3. 阴极电流与阴极电压之间的关系

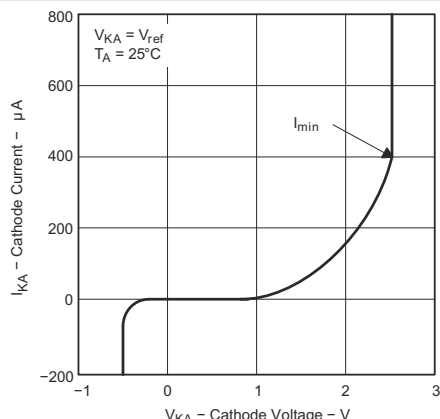


图 6-4. 阴极电流与阴极电压之间的关系

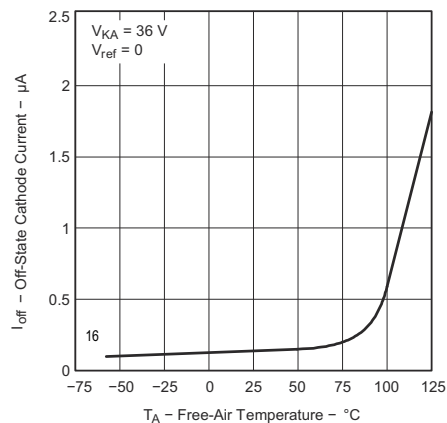


图 6-5. 关闭状态阴极电流与自然通风条件下的温度之间的关系

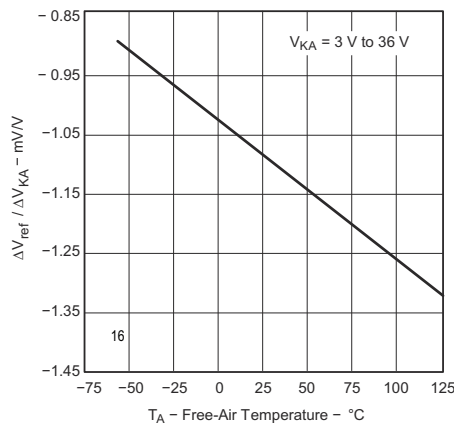


图 6-6.  $\Delta$  基准电压与  $\Delta$  阴极电压之比与自然通风条件下的温度之间的关系

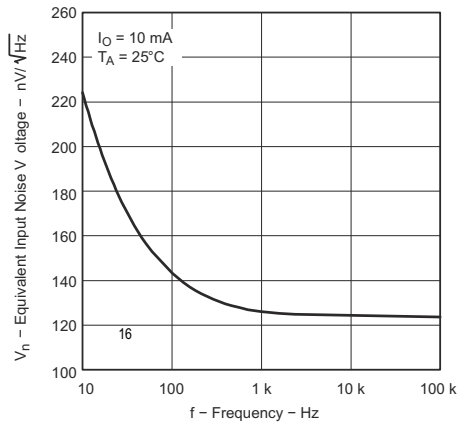


图 6-7. 等效输入噪声电压与频率间的关系

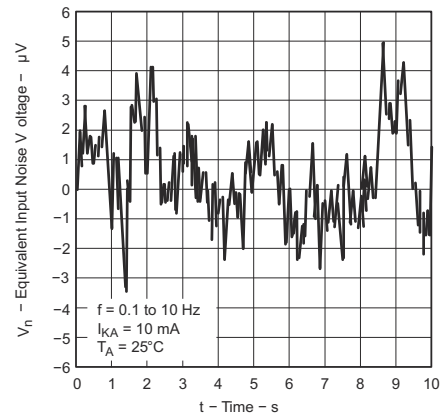


图 6-8. 10S 周期内的等效输入噪声电压

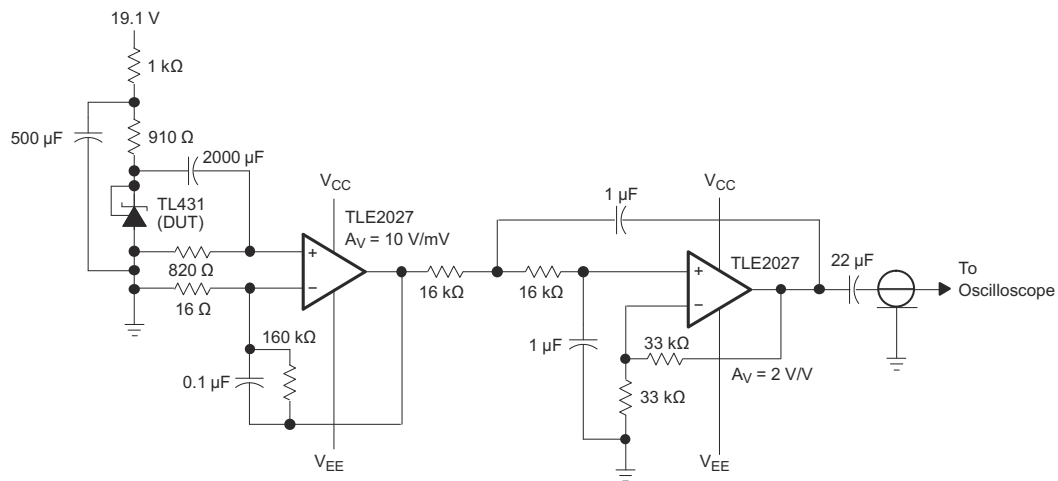


图 6-9. 10S 周期内等效输入噪声电压的测试电路

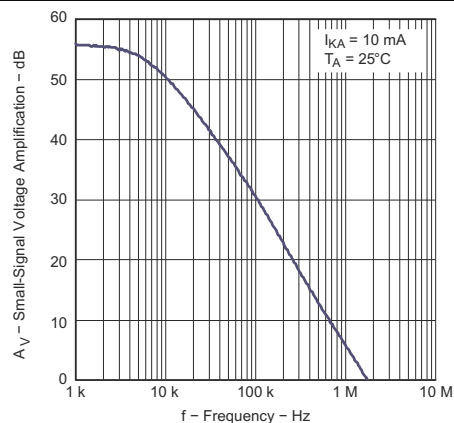


图 6-10. 小信号电压放大与频率之间的关系

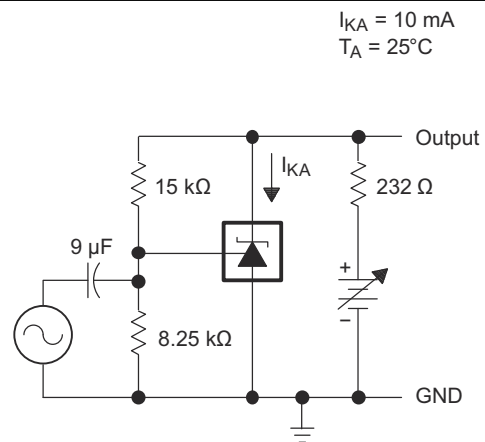


图 6-11. 电压放大测试电路

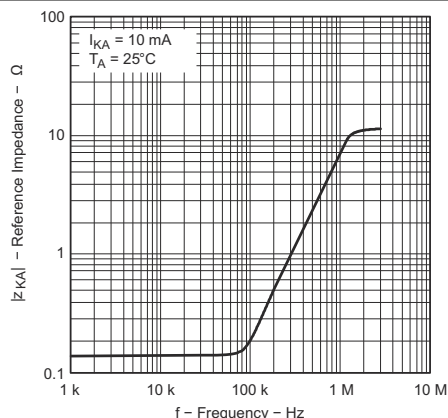


图 6-12. 基准阻抗与频率之间的关系

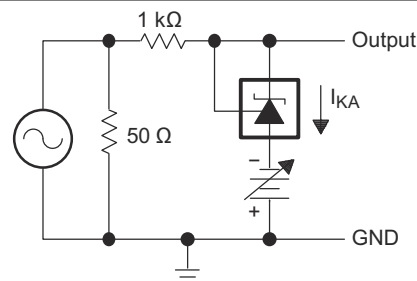


图 6-13. 基准阻抗测试电路

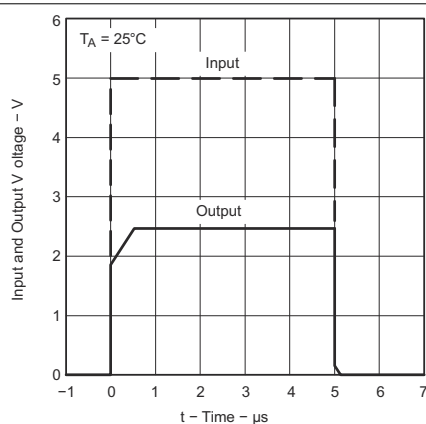


图 6-14. 脉冲响应

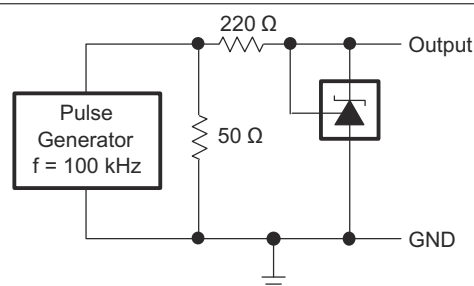
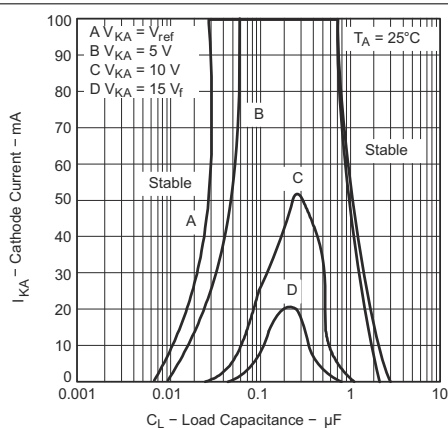
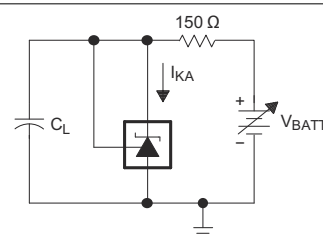


图 6-15. 脉冲响应测试电路

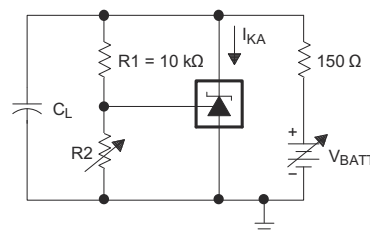


曲线下的区域表示可能导致器件振荡的条件。针对曲线 B、C 和 D，对 R2 和 V+ 进行了调整，以建立初始  $V_{KA}$  和  $I_{KA}$  条件，且  $C_L = 0$ 。然后，对  $V_{BATT}$  和  $C_L$  进行了调整，以确定稳定范围。

图 6-16. 所有 TL431 和 TL431A 器件的稳定性边界条件 (SOT23-3、SC-70 和 Q 级温度器件除外)

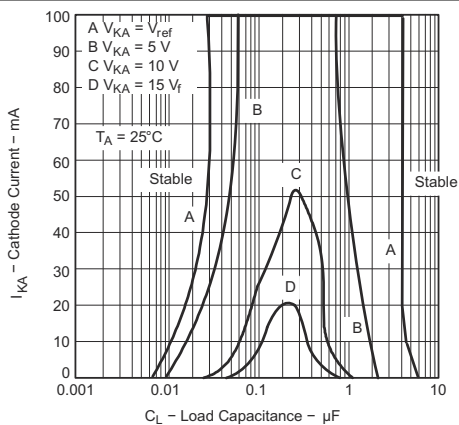


TEST CIRCUIT FOR CURVE A



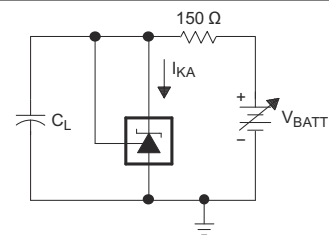
TEST CIRCUIT FOR CURVES B, C, AND D

图 6-17. 稳定性边界条件测试电路

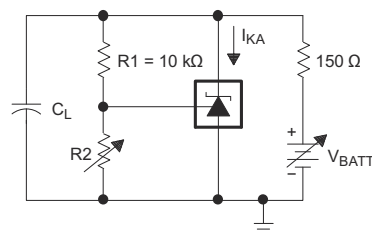


曲线下的区域表示可能导致器件振荡的条件。针对曲线 B、C 和 D，对 R2 和 V+ 进行了调整，以建立初始  $V_{KA}$  和  $I_{KA}$  条件，且  $C_L = 0$ 。然后，对  $V_{BATT}$  和  $C_L$  进行了调整，以确定稳定范围。

图 6-18. 所有 TL431B、TL432、SOT-23、SC-70 和 Q 级温度器件的稳定性边界条件



TEST CIRCUIT FOR CURVE A



TEST CIRCUIT FOR CURVES B, C, AND D

图 6-19. 稳定性边界条件测试电路

## 7 参数测量信息

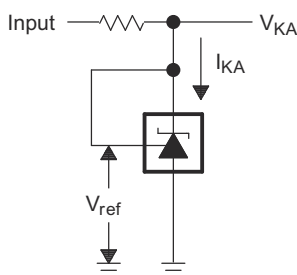


图 7-1. 针对  $V_{KA} = V_{ref}$  的测试电路

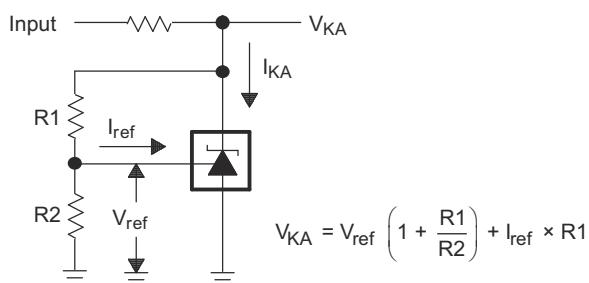


图 7-2. 针对  $V_{KA} > V_{ref}$  的测试电路

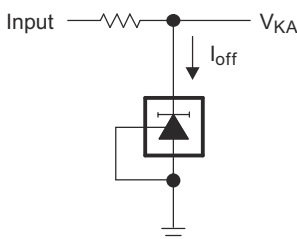


图 7-3. 针对  $I_{off}$  的测试电路

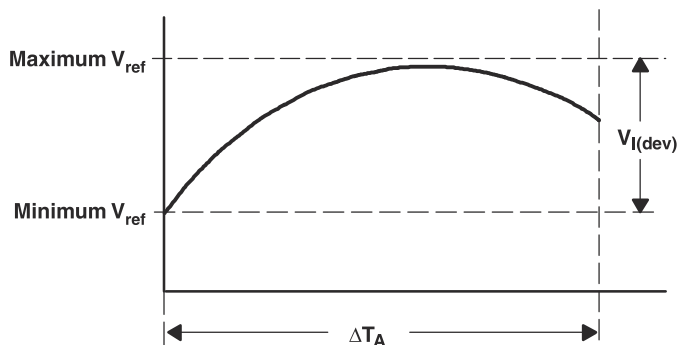
### 7.1 温度系数

基准电压  $V_{ref}$  在整个温度范围内的偏差叫做  $V_{I(dev)}$ 。参数  $V_{I(dev)}$  可用于找到器件的温度系数。基准输入电压的平均全范围温度系数  $\alpha_{Vref}$  定义为：

$$\left| \alpha_{Vref} \right| \left( \frac{ppm}{^{\circ}C} \right) = \frac{\left( \frac{V_{I(dev)}}{V_{ref} \text{ at } 25^{\circ}C} \right) \times 10^6}{\Delta T_A}$$

where:

$\Delta T_A$  is the rated operating temperature range of the device.



$\alpha_{Vref}$  可能是正数，也可能是负数，具体取决于较低温度条件下出现的是最小  $V_{ref}$  还是最大  $V_{ref}$ 。全范围温度系数是一个平均值，因此在额定工作温度范围的任何分段内都可能得到大于或小于该平均值的值。有关温度系数的更多详细信息，请参阅《电压基准选择基础知识》白皮书。

## 7.2 动态阻抗

动态阻抗定义为  $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$ 。当器件在配备两个外部电阻器的情况下运行时（参见图 6-13），电路的总动态阻抗为  $|z'| = \frac{\Delta V}{\Delta I}$ ，约等于  $|Z_{KA}| \left(1 + \frac{R1}{R2}\right)$ 。

该器件的  $V_{KA}$  可能会受该动态阻抗的影响。电气特性中指定了针对  $V_{KA}$  的器件测试电流  $I_{test}$ 。任何对  $I_{test}$  的偏离都可能会造成输出  $V_{KA}$  上的偏差。图 7-4 显示了动态阻抗对  $V_{KA}$  的影响。

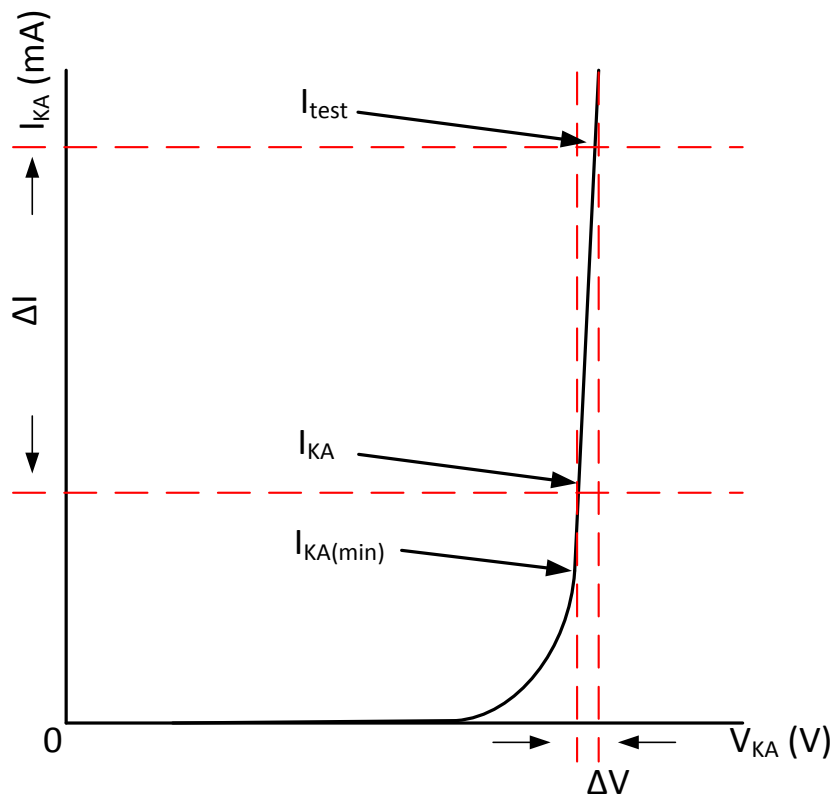


图 7-4. 动态阻抗

## 8 详细说明

### 8.1 概述

此标准器件已经证明可广泛应用于从电源到信号路径的各种应用。这是由于它的关键部件包含精确的电压基准和运算放大器，这是非常基本的模拟构建块。TL43xx 与其关键元器件搭配使用，可用作单个电压基准、误差放大器、电压钳位或具有集成基准的比较器。

TL43xx 能够运行并调整到 2.5V 至 36V 的阴极电压，这使得该器件成为了工业、汽车、电信和计算领域中各种终端设备的最佳选择。若要将该器件用作并联稳压器或误差放大器，必须为阴极引脚提供  $>1\text{mA}$  ( $I_{\min(\text{max})}$ ) 的电流。在这种情况下，可以从阴极引脚和基准引脚施加反馈，以创建内部基准电压的副本。

您可以购买初始容差为 0.5%、1% 和 2% (在 25°C 条件下) 的各种基准电压选件。这些基准选件以在 TL431 或 TL432 之后跟 B (0.5%)、A (1.0%) 和空白 (2.0%) 的形式表示。TL431 和 TL432 的功能相同，但具有不同的引脚排列选项。

TL43xxC 器件运行温度范围为 0°C 至 70°C，TL43xxI 器件运行温度范围为 -40°C 至 85°C，TL43xxQ 器件运行温度范围为 -40°C 至 125°C。

### 8.2 功能方框图

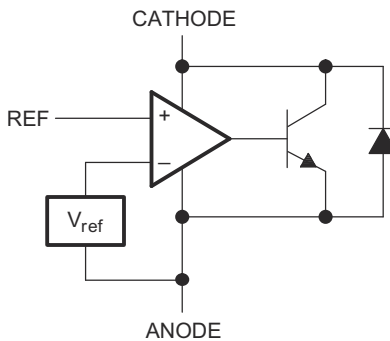


图 8-1. 等效原理图

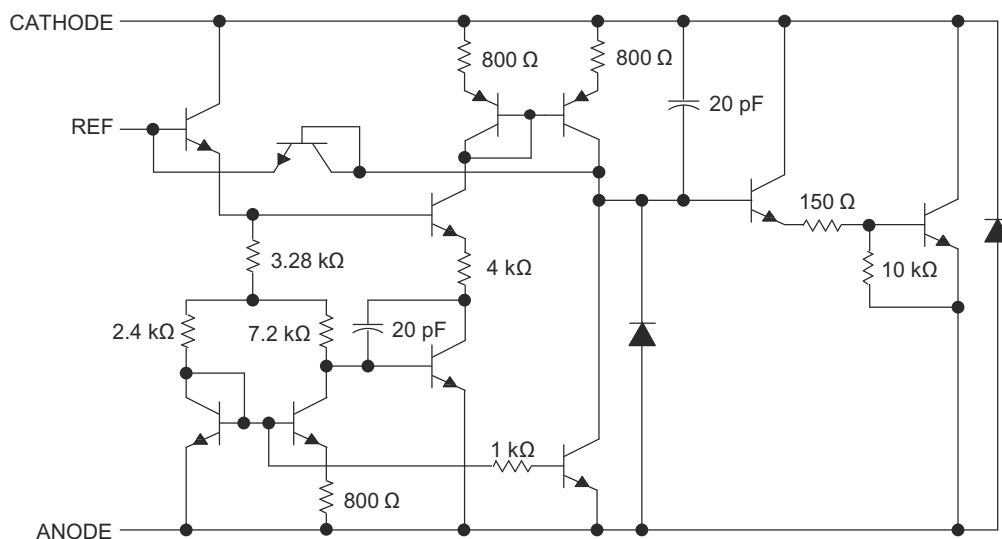


图 8-2. 详细的原理图

## 8.3 特性说明

TL43xx 由内部基准和根据基准引脚和虚拟内部引脚之间的差异输出灌电流的放大器组成。该灌电流由内部达林顿对产生，如上文中的原理图（图 8-2）所示。使用达林顿对是为了使该器件能够吸收最高 100mA 的电流。

在具有足够电压余量 ( $\geq 2.5V$ ) 和阴极电流 ( $I_{KA}$ ) 的情况下运行时，TL431 会将基准引脚电压强制为 2.5V。不过，基准引脚不能悬空，因为基准引脚需要  $I_{REF} \geq 4\mu A$ （请参阅 [电气特性, TL431C、TL432C](#)）。这是因为基准引脚会被驱动到 npn 中，后者要有基极电流才能正常工作。

当从阴极引脚和基准引脚施加反馈时，TL43xx 将作为齐纳二极管，根据向阴极提供的电流将输出电压调节至恒定电压。这是由于内部放大器和基准进入了适当的运行区域。在开环、伺服或误差放大实现中，为了使该器件保持在合适的线性区域，必须向其施加与在反馈情况下所需电流的大小相同的电流，从而使 TL43xx 具有足够的增益。

与许多线性稳压器不同的是，TL43xx 通过内部补偿来达到稳定，无需在阴极和阳极之间使用输出电容器。但是，如果需要为该器件使用输出电容器，图 6-18 可作为一个指导，来帮助您选择用于保持稳定性的合适电容器。

## 8.4 器件功能模式

### 8.4.1 开环 (比较器)

当 TL43xx 的阴极/输出电压或电流未以任何形式馈送回基准/输入引脚时，该器件便是处于开环状态。在向该器件施加合适的阴极电流 ( $I_{KA}$ ) 后，TL43xx 将会具有图 9-2 中所示的特性。这种配置具有如此高的增益，因此 TL43xx 通常用作比较器。TL43xx 具有集成的内部基准，因此，当用户想要监控单个信号的某个电平时，该器件便成为了他们的理想选择。

### 8.4.2 闭环

当 TL43xx 的阴极/输出电压或电流以任何形式馈送回基准/输入引脚时，该器件便是处于闭环状态。涉及 TL43xx 的多数应用都是采用这种模式，从而实现调节至固定电压或电流的目的。反馈使得该器件能够作为误差放大器，计算输出电压的一部分，并对其进行调整以保持期望的调节。实现该目标的途径是：将输出电压以某种方式关联至基准引脚，从而使其等于内部基准电压（这可以通过电阻反馈或直接反馈来实现）。

## 9 应用和实现

### 备注

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

### 9.1 应用信息

该器件具有很多应用和设置，因此许多情况都无法在本数据表中进行详述。链接的应用手册可帮助设计人员在使用此器件时制定理想的选择。

应用手册 [了解 TL431/TL432 数据表中的稳定性边界条件图 \(SLVA482\)](#) 可帮助用户更深入地了解此类器件的稳定性特征和选择合适的负载电容器。应用手册 [在可调并联稳压器上设置并联电压 \(SLVA445\)](#) 可协助设计人员设置并联电压，以达到该设备的理想精度。

### 9.2 典型应用

#### 9.2.1 具有集成基准的比较器

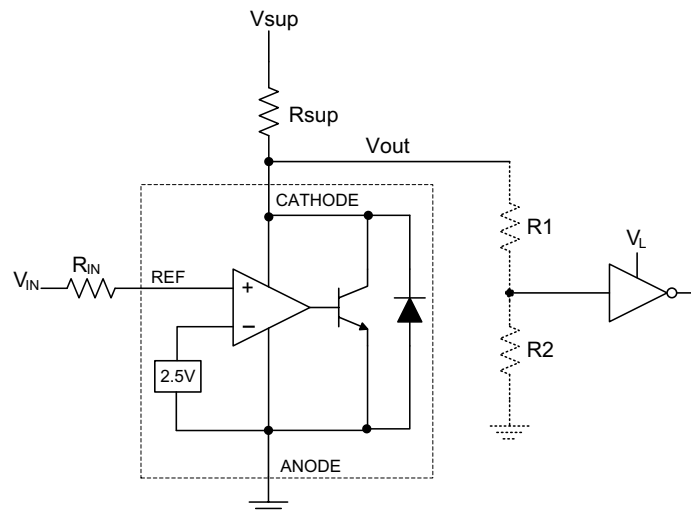


图 9-1. 比较器应用原理图

### 9.2.1.1 设计要求

本设计示例使用 [表 9-1](#) 中所列的参数作为输入参数。

**表 9-1. 设计参数**

| 设计参数                   | 示例值                 |
|------------------------|---------------------|
| 输入电压范围                 | 0V 至 5V             |
| 输入电阻                   | 10k $\Omega$        |
| 电源电压                   | 24V                 |
| 阴极电流 ( $I_K$ )         | 5mA                 |
| 输出电压电平                 | $\sim 2V - V_{SUP}$ |
| 逻辑输入阈值 $V_{IH}/V_{IL}$ | $V_L$               |

### 9.2.1.2 详细设计过程

在将 TL431 用作具有基准电压的比较器时，需要确定以下参数：

- 输入电压范围
- 基准电压精度
- 输出/逻辑输入高低电平阈值
- 电流源电阻

#### 9.2.1.2.1 基本操作

在 [图 9-1](#) 所示的配置中，TL431 将作为比较器，将  $V_{REF}$  引脚电压与内部虚拟基准电压进行比较。在获得合适的阴极电流 ( $I_K$ ) 时，TL43xx 将具有足够的开环增益来提供快速响应。[图 9-2](#) 展示了这种情况，其中  $R_{SUP}=10k\Omega$  ( $I_{KA}=500\mu A$ ) 的情况要比  $R_{SUP}=1k\Omega$  ( $I_{KA}=5mA$ ) 时的响应速度慢得多。在  $I_{min}$  附近及以下运行可能会导致增益较低，从而导致响应速度缓慢。

##### 9.2.1.2.1.1 过驱

未为基准引脚提供足够的过驱动电压也可能会导致响应较慢或不准确。该电压高于内部虚拟基准电压。内部虚拟基准电压将在  $2.5V \pm 0.5\%$ 、1.0% 或 1.5% (具体取决于所使用的版本) 范围内。所提供的过驱动电压越高，TL431 的响应速度就会越快。

对于 TL431 用作比较器的应用，最好是将跳闸点设置为高于正预期误差 (对于 A 版本来说是 +1.0%) 为了实现快速响应，将跳闸点设置为高于内部  $V_{REF}$  的 10% 就足够了。

为了实现从  $V_{in}$  到基准引脚的最低压降或电压差，建议使用阻值低于  $10k\Omega$  的输入电阻器来提供  $I_{ref}$ 。

### 9.2.1.2.2 输出电压和逻辑输入电平

为了使 TL431 能够正常地用作比较器，逻辑输出必须可供接收逻辑器件读取。这是通过了解输入高低电平阈值电压电平（通常表示为  $V_{IH}$  和  $V_{IL}$ ）来实现的。

如图 9-2 中所示，TL431 在开环/比较器模式下的输出低电平电压大约为 2V，这通常已经足够支持 5V 的供应逻辑。但却无法支持 3.3V 和 1.8V 的供应逻辑。为了适应这种情况，可以在输出端连接一个电阻分压器，以将输出电压衰减到方便低电压逻辑接收器件读取的电压。

TL431 的输出高电压等于  $V_{SUP}$ ，因为 TL431 处于集电极开路状态。如果  $V_{SUP}$  远高于接收逻辑的最大输入电压容差，则必须对输出进行衰减，以确保输出逻辑的稳定性。

当在输出端上使用电阻分压器时，务必要使电阻分压器（图 9-1 中的 R1 和 R2）之和远高于  $R_{SUP}$ ，以免影响 TL431 在关闭时将电压拉近至  $V_{SUP}$  的能力。

#### 9.2.1.2.2.1 输入电阻

在此应用中，TL431 需要具有输入电阻，以确保此器件所提供的所需基准拉电流 ( $I_{REF}$ ) 在开启期间保持在合适的运行区域内。基准引脚上的实际电压为  $V_{REF}=V_{IN}-I_{REF}*R_{IN}$ 。 $I_{REF}$  可能会高达 4 $\mu$ A，因此建议使用足够小的电阻，这将能够减小  $I_{REF}$  通过  $V_{IN}$  造成的误差。

### 9.2.1.3 应用曲线

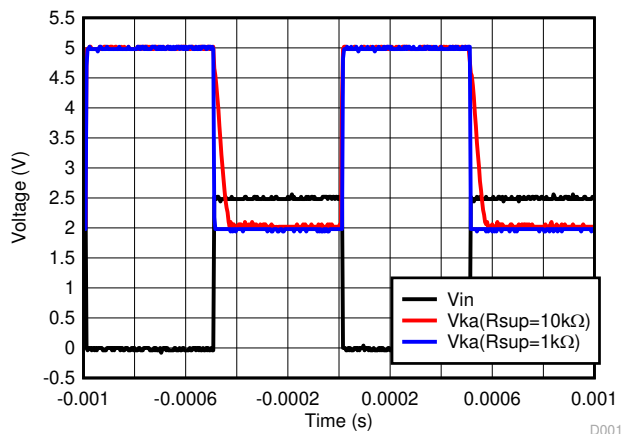


图 9-2. 各种阴极电流情况下的输出响应

## 9.2.2 并联稳压器/基准

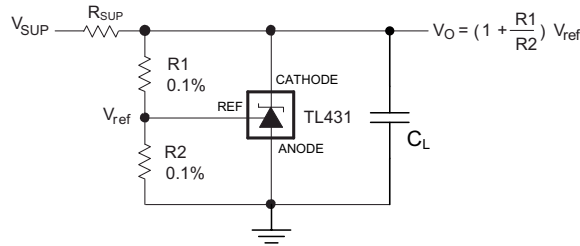


图 9-3. 并联稳压器原理图

### 9.2.2.1 设计要求

本设计示例使用表 9-1 中所列的参数作为输入参数。

表 9-2. 设计参数

| 设计参数                   | 示例值        |
|------------------------|------------|
| 基准初始精度                 | 1.0%       |
| 电源电压                   | 24V        |
| 阴极电流 (I <sub>k</sub> ) | 5mA        |
| 输出电压电平                 | 2.5V - 36V |
| 负载电容                   | 10 μF      |
| 反馈电阻器值和精度 (R1 和 R2)    | 10k Ω      |

### 9.2.2.2 详细设计过程

在将 TL431 用作并联稳压器时，需要确定以下参数：

- 输入电压范围
- 温度范围
- 总精度
- 阴极电流
- 基准初始精度
- 输出电容

#### 9.2.2.2.1 可编程输出/阴极电压

为了将阴极电压编程至调节电压，必须对阴极和阳极引脚之间的电阻桥进行分流，即将中点处连接至基准引脚。您可以在图 9-3 中看到该电路，其中电阻桥由 R1 和 R2 组成。您可以使用图 9-3 中所示的公式计算出并联稳压器配置中的阴极/输出电压近似值。您还可以通过考虑阴极电流，更精确地确定阴极电压：

$$V_O = (1 + R_1/R_2) * V_{REF} - I_{REF} * R_1$$

为了使该公式有效，TL43xx 必须完全偏置，以便它具有足够的开环增益来减小任何增益误差。这可以通过满足节 6.5 中指示的 I<sub>min</sub> 规格来实现。

### 9.2.2.2.2 总精度

当对高于单位增益 ( $V_{KA}=V_{REF}$ ) 的输出进行编程时，除  $V_{REF}$  之外，TL43xx 还容易受其他误差的影响，这些误差可能会影响整体精度。这些误差包括：

- R1 和 R2 的精度
- $V_{I(dev)}$  - 基准电压随温度的变化
- $\Delta V_{REF} / \Delta V_{KA}$  - 基准电压变化与阴极电压变化之比
- $|z_{KA}|$  - 动态阻抗，通过阴极电流导致阴极电压的变化

将所有这些变量考虑在内，便可确定最坏情况下的阴极电压。应用手册 [在可调并联稳压器上设置并联电压 \(SLVA445\)](#) 可协助设计人员设置并联电压，以达到该设备的理想精度。

### 9.2.2.2.3 稳定性

虽然 TL43xx 在没有容性负载的情况下是稳定的，但是接收并联稳压器输出电压的器件可能会产生 TL43xx 稳定区域 (如 [图 6-16](#) 和 [图 6-18](#) 中所示) 内的容性负载。此外，设计人员可以使用容性负载来改进瞬态响应或进行电源去耦。在阴极和阳极之间使用额外电容时，请参阅 [图 6-16](#) 和 [图 6-18](#)。此外，应用手册 [了解 TL431/TL432 数据表中的稳定性边界条件图 \(SLVA482\)](#) 可帮助用户更深入地了解此类器件的稳定性特征和选择合适的负载电容器。

### 9.2.2.2.4 启动时间

如 [图 9-4](#) 中所示，TL43xx 具有高达约 2V 的快速响应，然后会缓慢充电至其编程值。这得益于 TL43xx 为了达到稳定性标准而配备的补偿电容 (如 [图 6-18](#) 所示)。尽管存在二次延迟，TL43xx 的快速响应仍然能够满足许多钳位应用的需要。

### 9.2.2.3 应用曲线

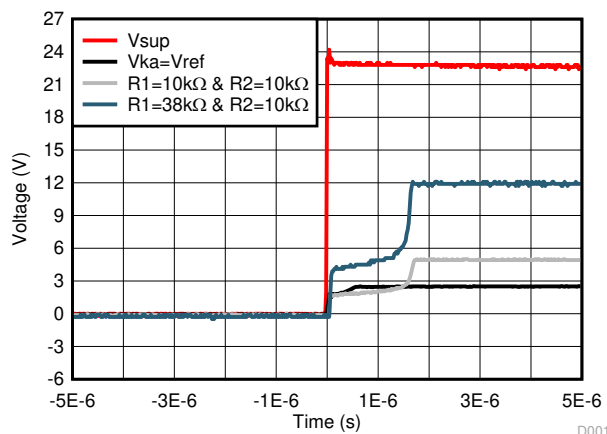
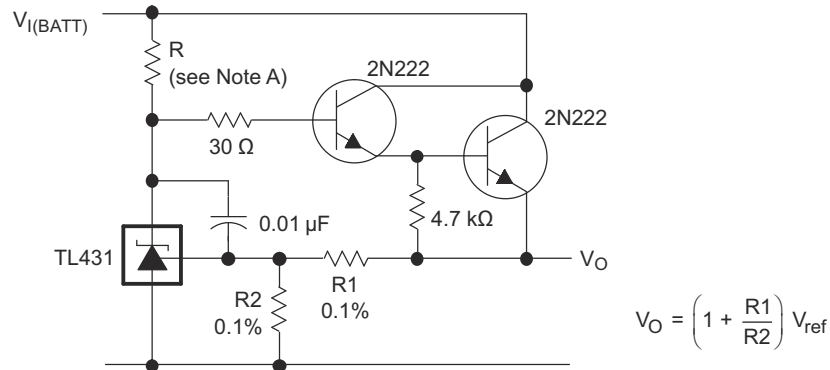


图 9-4. TL43xx 启动响应

### 9.3 系统示例



A. R 应在最低  $V_{(BATT)}$  情况下向 TL431 提供  $\geq 1\text{mA}$  的阴极电流。

图 9-5. 精密大电流串联稳压器

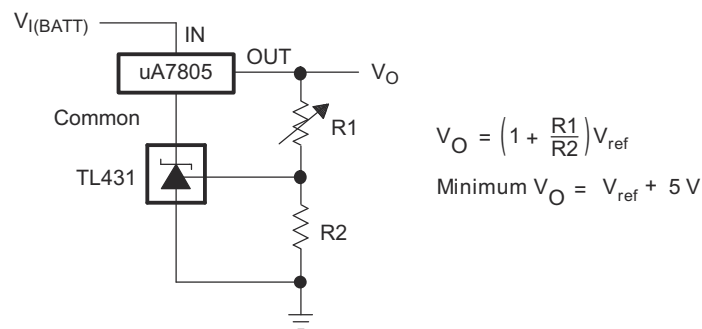


图 9-6. 三端固定稳压器的输出控制

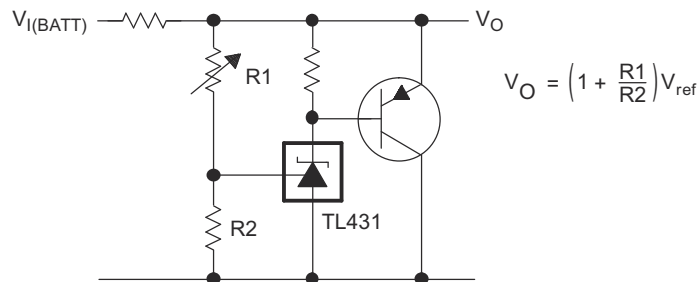
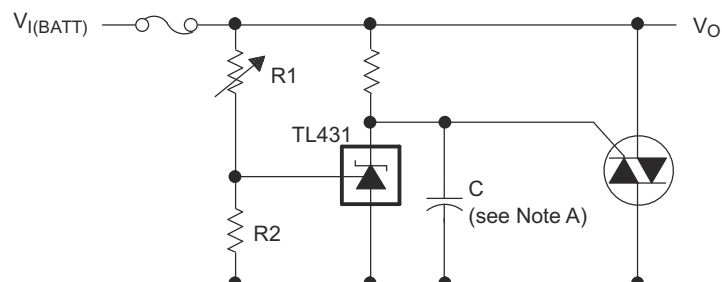


图 9-7. 大电流并联稳压器



A. 请参阅图 6-16 和图 6-18 中的稳定性边界条件，以确定 C 的允许值。

图 9-8. Crowbar 电路

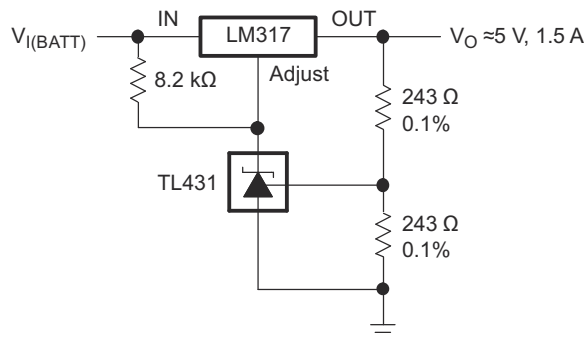
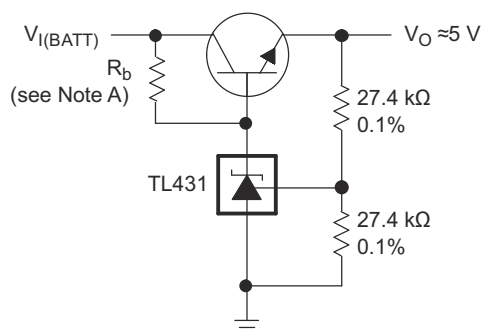


图 9-9. 精密 5V、1.5A 稳压器



A.  $R_b$  应向 TL431 提供  $\geq 1\text{mA}$  的阴极电流。

图 9-10. 高效 5V 精密稳压器

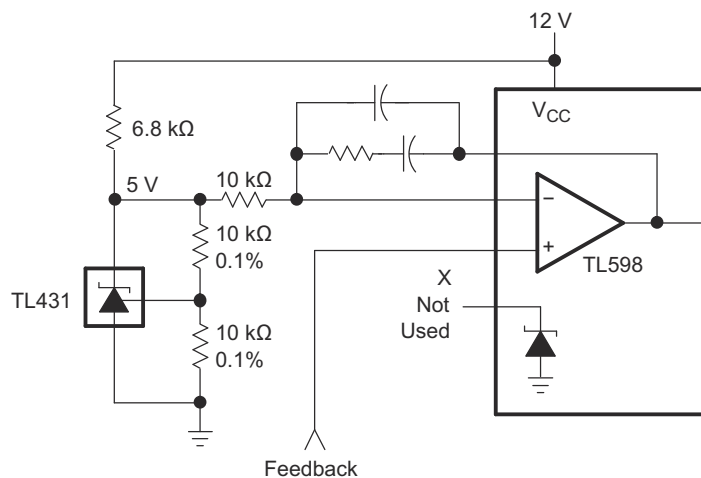
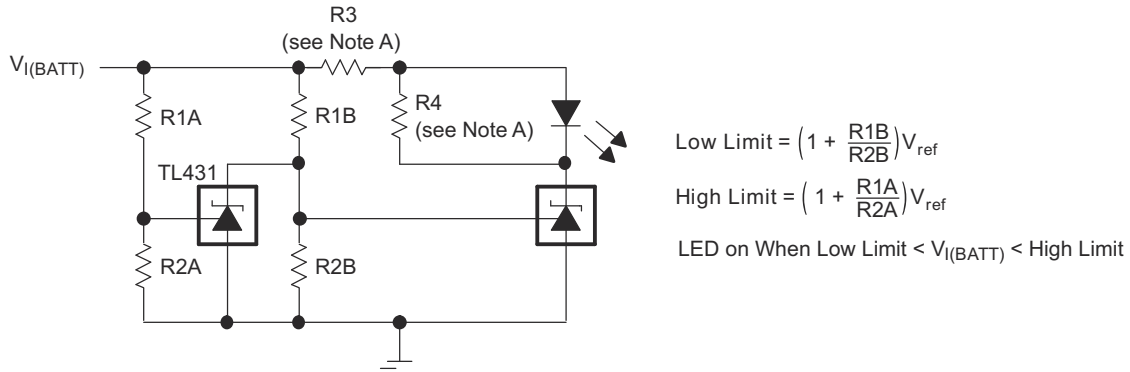


图 9-11. 具有基准电压的 PWM 转换器



A. 选择 R3 和 R4，以在可用的  $V_{I(BATT)}$  条件下提供所需的 LED 强度并为 TL431 提供  $\geq 1\text{mA}$  的阴极电流。

图 9-12. 电压监控器

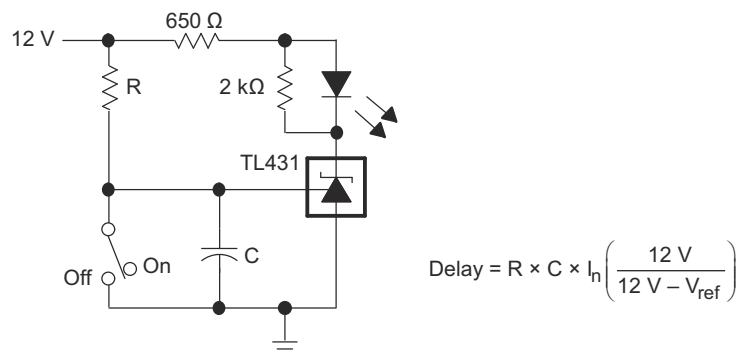


图 9-13. 延迟计时器

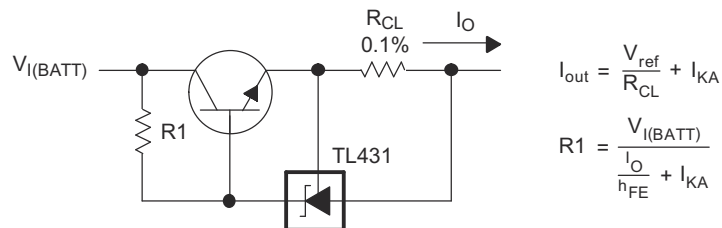


图 9-14. 精密限流器

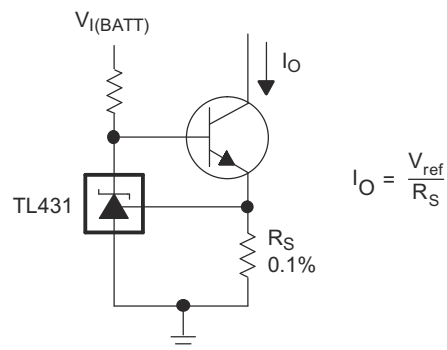


图 9-15. 精密恒定电流吸收器

## 9.4 电源相关建议

当使用 TL43xx 作为线性稳压器来为负载供电时，设计人员通常会在输出/阴极引脚上使用旁路电容。这样做时，请确保电容符合图 6-16 和图 6-18 中所示的稳定性标准。

为了避免超出最大阴极电流，请确保电源电压符合电流要求的限制。另外，请务必限制流入基准引脚的电流，以免其超过绝对最大额定值。

对于分流高电流的应用，请注意阴极和阳极迹线的长度，从而调整迹线宽度以获得适当的电流密度。

## 9.5 布局

### 9.5.1 布局指南

旁路电容器应尽可能靠近该部件。载流迹线需要具有适合其所承载的电流量的宽度；对于 TL43xx，这些电流很低。

### 9.5.2 布局示例

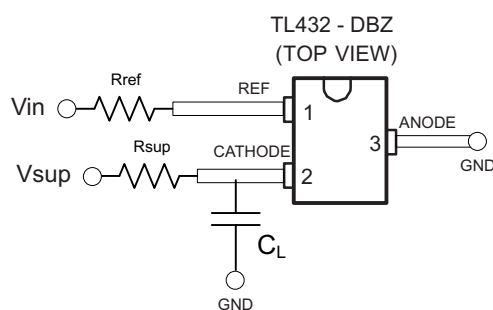
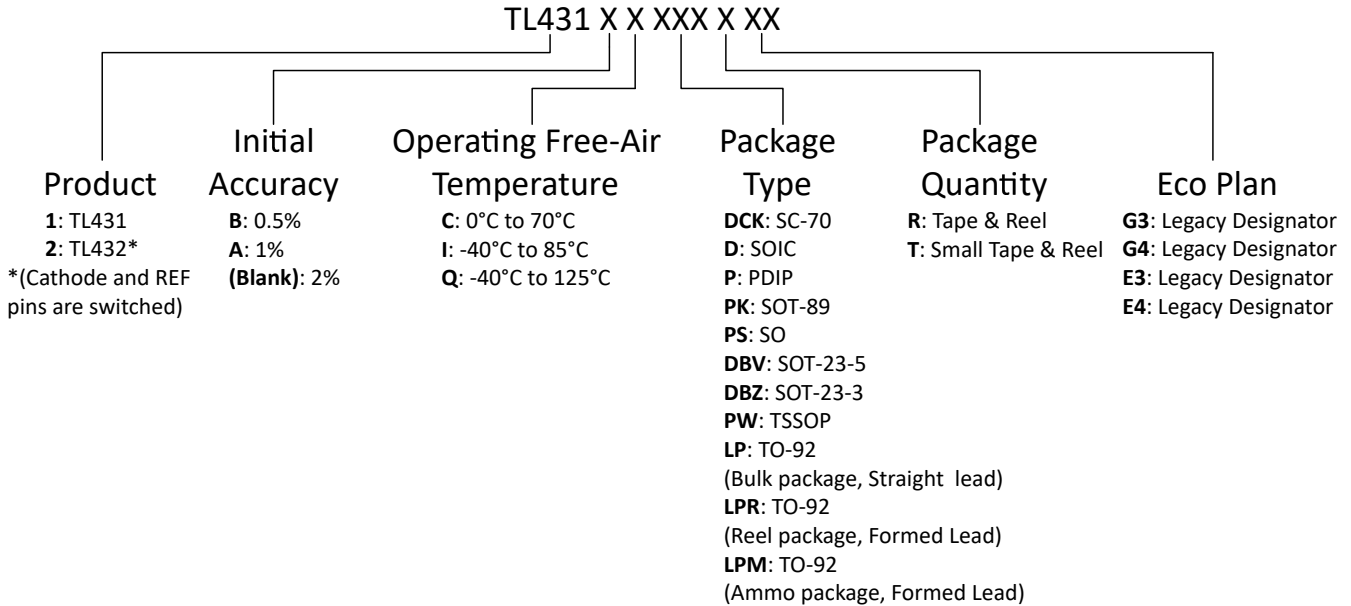


图 9-16. DBZ 布局示例

## 10 器件和文档支持

### 10.1 器件命名规则

TI 通过分配前缀和后缀来区分 TL43x 系列的所有组合。环保计划标识符是曾用于区分无铅和绿色环保器件的旧标识符。更多详细信息和可以订购的组合请参阅**机械、封装和可订购信息**中的“封装选项附录”。



### 10.2 相关链接

下表列出了快速访问链接。类别包括技术文档、支持和社区资源、工具和软件，以及申请样片或购买产品的快速链接。

**表 10-1. 相关链接**

| 器件    | 产品文件夹                | 样片与购买                | 技术文档                 | 工具和软件                | 支持和社区                |
|-------|----------------------|----------------------|----------------------|----------------------|----------------------|
| TL431 | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> |
| TL432 | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> | <a href="#">点击此处</a> |

### 10.3 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](https://ti.com) 上的器件产品文件夹。点击 [通知](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 10.4 支持资源

**TI E2E™ 中文支持论坛**是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的**使用条款**。

### 10.5 商标

TI E2E™ is a trademark of Texas Instruments.  
所有商标均为其各自所有者的财产。

## 10.6 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。

## 10.7 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。

## 11 修订历史记录

| Changes from Revision R (August 2023) to Revision S (May 2024) | Page |
|----------------------------------------------------------------|------|
| • 更新了引脚图.....                                                  | 4    |

| Changes from Revision Q (July 2022) to Revision R (August 2023) | Page |
|-----------------------------------------------------------------|------|
| • 更新了 <i>应用</i> 部分的链接.....                                      | 1    |
| • 更新了 <i>说明</i> 部分.....                                         | 1    |
| • 删除了 <b>KTP</b> 封装.....                                        | 4    |
| • 添加了详细的 <i>温度系数</i> 和 <i>动态阻抗</i> 部分.....                      | 20   |
| • 更新了 <i>应用</i> 部分.....                                         | 27   |
| • 更新了 <i>器件命名规则</i> 图中的 <b>LP</b> 封装.....                       | 33   |

| Changes from Revision P (November 2018) to Revision Q (July 2022) | Page |
|-------------------------------------------------------------------|------|
| • 更新了整个文档中的表格、图和交叉参考的编号格式.....                                    | 1    |
| • 更正了 <i>引脚功能表</i> 中的器件名称.....                                    | 4    |

| Changes from Revision O (January 2015) to Revision P (November 2018) | Page |
|----------------------------------------------------------------------|------|
| • 向 <i>说明</i> 部分添加了文本.....                                           | 1    |
| • 添加了 <b>TL43x</b> <i>器件比较表</i> .....                                | 3    |
| • 添加了 <b>TL43x</b> <i>器件命名规则</i> 部分.....                             | 33   |

| Changes from Revision N (January 2014) to Revision O (January 2015)                                                                                                                                                                    | Page |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| • 添加了 <i>应用</i> 、 <i>器件信息表</i> 、 <i>引脚功能表</i> 、 <b>ESD</b> <i>等级表</i> 、 <i>热性能信息表</i> 、 <i>特性说明</i> 部分、 <i>器件功能模式</i> 、 <i>应用和实施</i> 部分、 <i>电源相关建议</i> 部分、 <i>布局</i> 部分、 <i>器件和文档支持</i> 部分以及 <i>机械</i> 、 <i>封装</i> 和 <i>可订购信息</i> 部分。. | 1    |
| • 添加了“应用” .....                                                                                                                                                                                                                        | 1    |

## 12 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件可用的最新数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)  | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|--------------------------|-------------------------|
| TL431ACD         | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 431AC                    | <a href="#">Samples</a> |
| TL431ACDBVR      | ACTIVE        | SOT-23       | DBV             | 5    | 3000        | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TACG, TACJ, TACS)       | <a href="#">Samples</a> |
| TL431ACDBVT      | ACTIVE        | SOT-23       | DBV             | 5    | 250         | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TACG, TACJ, TACU)       | <a href="#">Samples</a> |
| TL431ACDBZR      | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TAC3, TACG, TACS, TACU) | <a href="#">Samples</a> |
| TL431ACDBZRG4    | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TAC3                     | <a href="#">Samples</a> |
| TL431ACDBZT      | ACTIVE        | SOT-23       | DBZ             | 3    | 250         | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TAC3, TACG, TACS, TACU) | <a href="#">Samples</a> |
| TL431ACDBZTG4    | ACTIVE        | SOT-23       | DBZ             | 3    | 250         | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TAC3                     | <a href="#">Samples</a> |
| TL431ACDCKR      | ACTIVE        | SC70         | DCK             | 6    | 3000        | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T4S, T4U)               | <a href="#">Samples</a> |
| TL431ACDR        | ACTIVE        | SOIC         | D               | 8    | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 431AC                    | <a href="#">Samples</a> |
| TL431ACDRG4      | OBSOLETE      | SOIC         | D               | 8    |             | TBD             | Call TI                              | Call TI              | 0 to 70      | 431AC                    |                         |
| TL431ACLP        | ACTIVE        | TO-92        | LP              | 3    | 1000        | RoHS & Green    | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431AC                  | <a href="#">Samples</a> |
| TL431ACLPM       | ACTIVE        | TO-92        | LP              | 3    | 2000        | RoHS & Green    | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431AC                  | <a href="#">Samples</a> |
| TL431ACLPR       | ACTIVE        | TO-92        | LP              | 3    | 2000        | RoHS & Green    | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431AC                  | <a href="#">Samples</a> |
| TL431ACP         | ACTIVE        | PDIP         | P               | 8    | 50          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | TL431ACP                 | <a href="#">Samples</a> |
| TL431ACPK        | ACTIVE        | SOT-89       | PK              | 3    | 1000        | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | 0 to 70      | 4A                       | <a href="#">Samples</a> |
| TL431ACPSR       | ACTIVE        | SO           | PS              | 8    | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T431A                    | <a href="#">Samples</a> |
| TL431ACPWR       | ACTIVE        | TSSOP        | PW              | 8    | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T431A                    | <a href="#">Samples</a> |
| TL431AID         | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 431AI                    | <a href="#">Samples</a> |
| TL431AIDBVR      | ACTIVE        | SOT-23       | DBV             | 5    | 3000        | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (TAIG, TAIJ, TAIS)       | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|--------------------------|-------------------------|
| TL431AIDBVRG4    | OBSOLETE      | SOT-23       | DBV                | 5    |                | TBD             | Call TI                              | Call TI              | -40 to 85    | TAIG                     |                         |
| TL431AIDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (TAIG, TAIJ, TAIU)       | <a href="#">Samples</a> |
| TL431AIDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3AG, TAI3, TAIS, TAIU) | <a href="#">Samples</a> |
| TL431AIDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | TAI3                     | <a href="#">Samples</a> |
| TL431AIDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3AG, TAI3, TAIS, TAIU) | <a href="#">Samples</a> |
| TL431AIDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | TAI3                     | <a href="#">Samples</a> |
| TL431AIDCKR      | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | T5U                      | <a href="#">Samples</a> |
| TL431AIDCKRE4    | ACTIVE        | SC70         | DCK                | 6    | 3000           | TBD             | Call TI                              | Call TI              | -40 to 85    |                          | <a href="#">Samples</a> |
| TL431AIDCKRG4    | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T5U                      | <a href="#">Samples</a> |
| TL431AIDCKT      | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | T5U                      | <a href="#">Samples</a> |
| TL431AIDR        | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 431AI                    | <a href="#">Samples</a> |
| TL431AIDRG4      | OBSOLETE      | SOIC         | D                  | 8    |                | TBD             | Call TI                              | Call TI              | -40 to 85    | 431AI                    |                         |
| TL431AILP        | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 85    | TL431AI                  | <a href="#">Samples</a> |
| TL431AILPM       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 85    | TL431AI                  | <a href="#">Samples</a> |
| TL431AILPR       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 85    | TL431AI                  | <a href="#">Samples</a> |
| TL431AIPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 4B                       | <a href="#">Samples</a> |
| TL431AQDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (TAQG, TAQJ, TAQU)       | <a href="#">Samples</a> |
| TL431AQDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (TAQG, TAQJ, TAQU)       | <a href="#">Samples</a> |
| TL431AQDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (TAQ3, TAQG, TAQS, TAQU) | <a href="#">Samples</a> |
| TL431AQDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | TAQS                     | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-----------------------------|-------------------------|
| TL431AQDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (TAQG, TAQS, TAQU)          | <a href="#">Samples</a> |
| TL431AQDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | TAQS                        | <a href="#">Samples</a> |
| TL431AQDCKR      | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T7U                         | <a href="#">Samples</a> |
| TL431AQDCKT      | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T7U                         | <a href="#">Samples</a> |
| TL431AQP         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 4D                          | <a href="#">Samples</a> |
| TL431BCD         | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T431B                       | <a href="#">Samples</a> |
| TL431BCDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3GG, T3GJ, T3GU)          | <a href="#">Samples</a> |
| TL431BCDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3GG, T3GJ, T3GU)          | <a href="#">Samples</a> |
| TL431BCDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3G3, T3GG, T3GS,<br>T3GU) | <a href="#">Samples</a> |
| TL431BCDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T3G3                        | <a href="#">Samples</a> |
| TL431BCDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3G3, T3GG, T3GS,<br>T3GU) | <a href="#">Samples</a> |
| TL431BCDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T3G3                        | <a href="#">Samples</a> |
| TL431BCDCKR      | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | T2U                         | <a href="#">Samples</a> |
| TL431BCDCKT      | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | T2U                         | <a href="#">Samples</a> |
| TL431BCDE4       | ACTIVE        | SOIC         | D                  | 8    | 75             | TBD             | Call TI                              | Call TI              | 0 to 70      |                             | <a href="#">Samples</a> |
| TL431BCDR        | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T431B                       | <a href="#">Samples</a> |
| TL431BCLP        | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | 0 to 70      | T431B                       | <a href="#">Samples</a> |
| TL431BCLPR       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | 0 to 70      | T431B                       | <a href="#">Samples</a> |
| TL431BCPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | 0 to 70      | 4C                          | <a href="#">Samples</a> |
| TL431BID         | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | Z431B                       | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|--------------------------|-------------------------|
| TL431BIDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3FG, T3FJ, T3FU)       | <a href="#">Samples</a> |
| TL431BIDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3FG, T3FJ, T3FU)       | <a href="#">Samples</a> |
| TL431BIDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3F3, T3FG, T3FS, T3FU) | <a href="#">Samples</a> |
| TL431BIDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T3F3                     | <a href="#">Samples</a> |
| TL431BIDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3F3, T3FG, T3FS, T3FU) | <a href="#">Samples</a> |
| TL431BIDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T3F3                     | <a href="#">Samples</a> |
| TL431BIDCKR      | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | T3U                      | <a href="#">Samples</a> |
| TL431BIDCKT      | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | T3U                      | <a href="#">Samples</a> |
| TL431BIDE4       | ACTIVE        | SOIC         | D                  | 8    | 75             | TBD             | Call TI                              | Call TI              | -40 to 85    |                          | <a href="#">Samples</a> |
| TL431BIDG4       | ACTIVE        | SOIC         | D                  | 8    | 75             | TBD             | Call TI                              | Call TI              | -40 to 85    |                          | <a href="#">Samples</a> |
| TL431BIDR        | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | Z431B                    | <a href="#">Samples</a> |
| TL431BIDRG4      | OBSOLETE      | SOIC         | D                  | 8    |                | TBD             | Call TI                              | Call TI              | -40 to 85    | Z431B                    |                         |
| TL431BILP        | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 85    | Z431B                    | <a href="#">Samples</a> |
| TL431BILPR       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 85    | Z431B                    | <a href="#">Samples</a> |
| TL431BIP         | OBSOLETE      | PDIP         | P                  | 8    |                | TBD             | Call TI                              | Call TI              | -40 to 85    | TL431BIP                 |                         |
| TL431BIPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 4I                       | <a href="#">Samples</a> |
| TL431BQD         | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | T431BQ                   | <a href="#">Samples</a> |
| TL431BQDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T3HJ, T3HU)             | <a href="#">Samples</a> |
| TL431BQDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T3HJ, T3HU)             | <a href="#">Samples</a> |
| TL431BQDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T3H3, T3HG, T3HS, T3HU) | <a href="#">Samples</a> |
| TL431BQDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T3HS                     | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-----------------------------|-------------------------|
| TL431BQDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T3HG, T3HS, T3HU)          | <a href="#">Samples</a> |
| TL431BQDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T3HS                        | <a href="#">Samples</a> |
| TL431BQDCKR      | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T8U                         | <a href="#">Samples</a> |
| TL431BQDCKT      | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T8U                         | <a href="#">Samples</a> |
| TL431BQDE4       | ACTIVE        | SOIC         | D                  | 8    | 75             | TBD             | Call TI                              | Call TI              | -40 to 125   |                             | <a href="#">Samples</a> |
| TL431BQDR        | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | T431BQ                      | <a href="#">Samples</a> |
| TL431BQDRG4      | ACTIVE        | SOIC         | D                  | 8    | 2500           | TBD             | Call TI                              | Call TI              | -40 to 125   |                             | <a href="#">Samples</a> |
| TL431BQLP        | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 125   | T431BQ                      | <a href="#">Samples</a> |
| TL431BQLPM       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 125   | T431BQ                      | <a href="#">Samples</a> |
| TL431BQLPR       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green    | SN                                   | N / A for Pkg Type   | -40 to 125   | T431BQ                      | <a href="#">Samples</a> |
| TL431BQPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 3H                          | <a href="#">Samples</a> |
| TL431CD          | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |
| TL431CDBVR       | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3CG, T3CJ, T3CS,<br>T3HJ) | <a href="#">Samples</a> |
| TL431CDBVT       | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3CG, T3CJ, T3CS)          | <a href="#">Samples</a> |
| TL431CDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3C3, T3CG, T3CS,<br>T3CU) | <a href="#">Samples</a> |
| TL431CDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | T3C3                        | <a href="#">Samples</a> |
| TL431CDBZT       | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T3CG, T3CS, T3CU)          | <a href="#">Samples</a> |
| TL431CDBZTG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | T3CS                        | <a href="#">Samples</a> |
| TL431CDG4        | ACTIVE        | SOIC         | D                  | 8    | 75             | TBD             | Call TI                              | Call TI              | 0 to 70      |                             | <a href="#">Samples</a> |
| TL431CDR         | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|---------------------|--------------------------------------|----------------------|--------------|-----------------------------|-------------------------|
| TL431CDR-J       | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |
| TL431CDRG4       | OBSOLETE      | SOIC         | D                  | 8    |                | TBD                 | Call TI                              | Call TI              | 0 to 70      | TL431C                      |                         |
| TL431CLP         | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green        | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |
| TL431CLP-Z       | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green        | SN                                   | N / A for Pkg Type   |              | TL431C                      | <a href="#">Samples</a> |
| TL431CLPM        | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green        | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |
| TL431CLPR        | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green        | SN                                   | N / A for Pkg Type   | 0 to 70      | TL431C                      | <a href="#">Samples</a> |
| TL431CPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green        | SN                                   | Level-2-260C-1 YEAR  | 0 to 70      | 43                          | <a href="#">Samples</a> |
| TL431CPKE6       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS &<br>Non-Green | SNBI                                 | Level-1-260C-UNLIM   | 0 to 70      | 43                          | <a href="#">Samples</a> |
| TL431CPSR        | OBSOLETE      | SO           | PS                 | 8    |                | TBD                 | Call TI                              | Call TI              | 0 to 70      | T431                        |                         |
| TL431ID          | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | TL431I                      | <a href="#">Samples</a> |
| TL431IDBVR       | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3IG, T3IJ, T3IS)          | <a href="#">Samples</a> |
| TL431IDBVT       | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T3IG, T3IJ, T3IU)          | <a href="#">Samples</a> |
| TL431IDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 85    | (T3I3, T3IG, T3IS,<br>T3IU) | <a href="#">Samples</a> |
| TL431IDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 85    | T3IS                        | <a href="#">Samples</a> |
| TL431IDBZT       | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 85    | (T3IG, T3IS, T3IU)          | <a href="#">Samples</a> |
| TL431IDBZTG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 85    | T3IS                        | <a href="#">Samples</a> |
| TL431IDR         | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | TL431I                      | <a href="#">Samples</a> |
| TL431IDRG4       | OBSOLETE      | SOIC         | D                  | 8    |                | TBD                 | Call TI                              | Call TI              | -40 to 85    | TL431I                      |                         |
| TL431ILP         | ACTIVE        | TO-92        | LP                 | 3    | 1000           | RoHS & Green        | SN                                   | N / A for Pkg Type   | -40 to 85    | TL431I                      | <a href="#">Samples</a> |
| TL431ILPR        | ACTIVE        | TO-92        | LP                 | 3    | 2000           | RoHS & Green        | SN                                   | N / A for Pkg Type   | -40 to 85    | TL431I                      | <a href="#">Samples</a> |
| TL431IP          | OBSOLETE      | PDIP         | P                  | 8    |                | TBD                 | Call TI                              | Call TI              | -40 to 85    | TL431IP                     |                         |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|---------------------|--------------------------------------|----------------------|--------------|-----------------------------|-------------------------|
| TL431IPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green        | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 3I                          | <a href="#">Samples</a> |
| TL431IPK3        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS &<br>Non-Green | SNBI                                 | Level-1-260C-UNLIM   | -40 to 85    | 3I                          | <a href="#">Samples</a> |
| TL431QD          | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | T431Q                       | <a href="#">Samples</a> |
| TL431QDBVR       | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T3QG, T3QJ, T3QU)          | <a href="#">Samples</a> |
| TL431QDBVT       | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T3QG, T3QJ, T3QU)          | <a href="#">Samples</a> |
| TL431QDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T3Q3, T3QG, T3QS,<br>T3QU) | <a href="#">Samples</a> |
| TL431QDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T3QS                        | <a href="#">Samples</a> |
| TL431QDBZT       | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T3QG, T3QS, T3QU)          | <a href="#">Samples</a> |
| TL431QDBZTG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T3QS                        | <a href="#">Samples</a> |
| TL431QDCKR       | ACTIVE        | SC70         | DCK                | 6    | 3000           | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T6U                         | <a href="#">Samples</a> |
| TL431QDCKT       | ACTIVE        | SC70         | DCK                | 6    | 250            | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | T6U                         | <a href="#">Samples</a> |
| TL431QDR         | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | T431Q                       | <a href="#">Samples</a> |
| TL431QPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green        | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 3Q                          | <a href="#">Samples</a> |
| TL432ACDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T4BG, T4BJ, T4BU)          | <a href="#">Samples</a> |
| TL432ACDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | 0 to 70      | (T4B3, T4BG, T4BS,<br>T4BU) | <a href="#">Samples</a> |
| TL432ACDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | T4BS                        | <a href="#">Samples</a> |
| TL432ACDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | 0 to 70      | (T4BG, T4BS, T4BU)          | <a href="#">Samples</a> |
| TL432ACDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green        | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | T4BS                        | <a href="#">Samples</a> |
| TL432AIDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green        | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4AG, T4AJ, T4AU)          | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|--------------------------|-------------------------|
| TL432AIDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4A3, T4AG, T4AS, T4AU) | <a href="#">Samples</a> |
| TL432AIDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T4A3                     | <a href="#">Samples</a> |
| TL432AIDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4A3, T4AG, T4AS, T4AU) | <a href="#">Samples</a> |
| TL432AIDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T4A3                     | <a href="#">Samples</a> |
| TL432AIPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 2E                       | <a href="#">Samples</a> |
| TL432AQDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T4DJ, T4DU)             | <a href="#">Samples</a> |
| TL432AQDBVT      | ACTIVE        | SOT-23       | DBV                | 5    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | (T4DJ, T4DU)             | <a href="#">Samples</a> |
| TL432AQDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T4D3, T4DG, T4DS, T4DU) | <a href="#">Samples</a> |
| TL432AQDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T4DS                     | <a href="#">Samples</a> |
| TL432AQDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T4DG, T4DS, T4DU)       | <a href="#">Samples</a> |
| TL432AQDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T4DS                     | <a href="#">Samples</a> |
| TL432AQPCK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 2F                       | <a href="#">Samples</a> |
| TL432BCDBVR      | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TBCJ, TBCU)             | <a href="#">Samples</a> |
| TL432BCDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | 0 to 70      | (TBCG, TBCS, TBCU)       | <a href="#">Samples</a> |
| TL432BCDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | TBCS                     | <a href="#">Samples</a> |
| TL432BCDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (TBCG, TBCS, TBCU)       | <a href="#">Samples</a> |
| TL432BCDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | TBCS                     | <a href="#">Samples</a> |
| TL432BCPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | 0 to 70      | 2G                       | <a href="#">Samples</a> |
| TL432BIDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4F3, T4FG, T4FS, T4FU) | <a href="#">Samples</a> |
| TL432BIDBZRG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T4F3                     | <a href="#">Samples</a> |

| 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                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|--------------------------|-------------------------|
| TL432BIDBZT      | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4F3, T4FG, T4FS, T4FU) | <a href="#">Samples</a> |
| TL432BIDBZTG4    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | T4F3                     | <a href="#">Samples</a> |
| TL432BIPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 2H                       | <a href="#">Samples</a> |
| TL432BQDBZR      | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | (T4H3, T4HS, T4HU)       | <a href="#">Samples</a> |
| TL432BQPK        | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 2J                       | <a href="#">Samples</a> |
| TL432CDBVR       | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | (T4CG, T4CJ, T4CU)       | <a href="#">Samples</a> |
| TL432CDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | 0 to 70      | (T4CG, T4CS, T4CU)       | <a href="#">Samples</a> |
| TL432CDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | 0 to 70      | T4CS                     | <a href="#">Samples</a> |
| TL432CPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | 0 to 70      | 2A                       | <a href="#">Samples</a> |
| TL432IDBVR       | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 85    | (T4IG, T4IJ, T4IU)       | <a href="#">Samples</a> |
| TL432IDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 85    | (T4IG, T4IS, T4IU)       | <a href="#">Samples</a> |
| TL432IDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 85    | T4IS                     | <a href="#">Samples</a> |
| TL432IDBZT       | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 85    | (T4IG, T4IS, T4IU)       | <a href="#">Samples</a> |
| TL432IDBZTG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 85    | T4IS                     | <a href="#">Samples</a> |
| TL432IPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 85    | 2B                       | <a href="#">Samples</a> |
| TL432QDBZR       | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM   | -40 to 125   | (T4QG, T4QS, T4QU)       | <a href="#">Samples</a> |
| TL432QDBZRG4     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM   | -40 to 125   | T4QS                     | <a href="#">Samples</a> |
| TL432QPK         | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | RoHS & Green    | SN                                   | Level-2-260C-1 YEAR  | -40 to 125   | 2C                       | <a href="#">Samples</a> |

<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.

**OBSOLETE:** 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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm 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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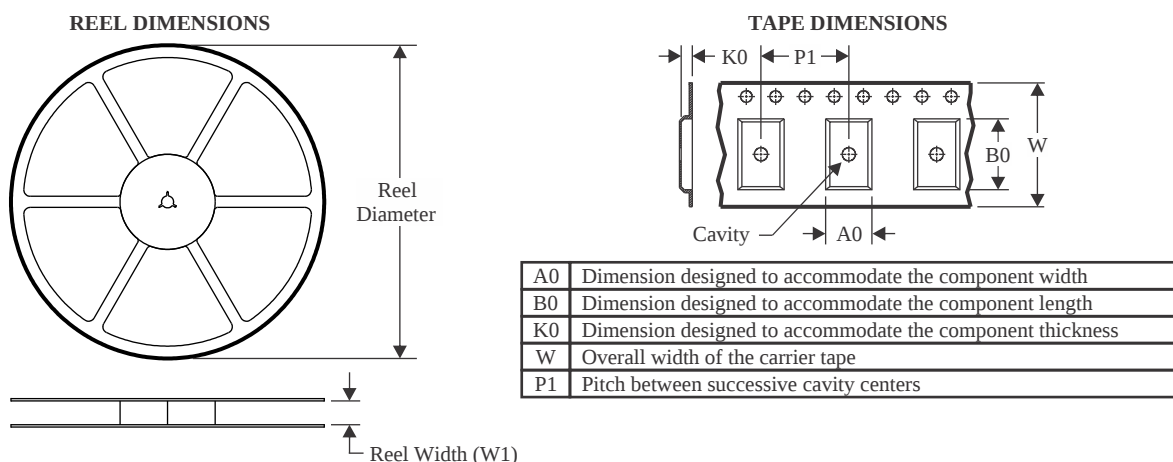
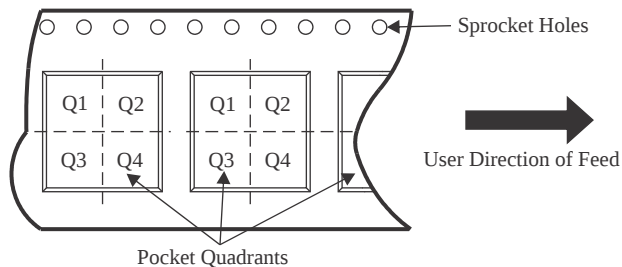
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#### **OTHER QUALIFIED VERSIONS OF TL431, TL432 :**

- Automotive : [TL431-Q1](#), [TL432-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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL431ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431ACDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431ACDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.41    | 2.41    | 1.2     | 4.0     | 8.0    | Q3            |
| TL431ACDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431ACPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431ACPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431ACPSR    | SO           | PS              | 8    | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| TL431ACPWR    | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TL431AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |

| 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL431AIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AIDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AIDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AIDCKRG4 | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AIDCKT   | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AIDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AIDR     | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431AIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431AIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431AQDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AQDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AQDCKT   | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AQDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431AQPCK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431AQPCK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431BCDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BCDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BCDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BCDCKT   | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BCDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BCDR     | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431BCPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431BCPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431BIDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |

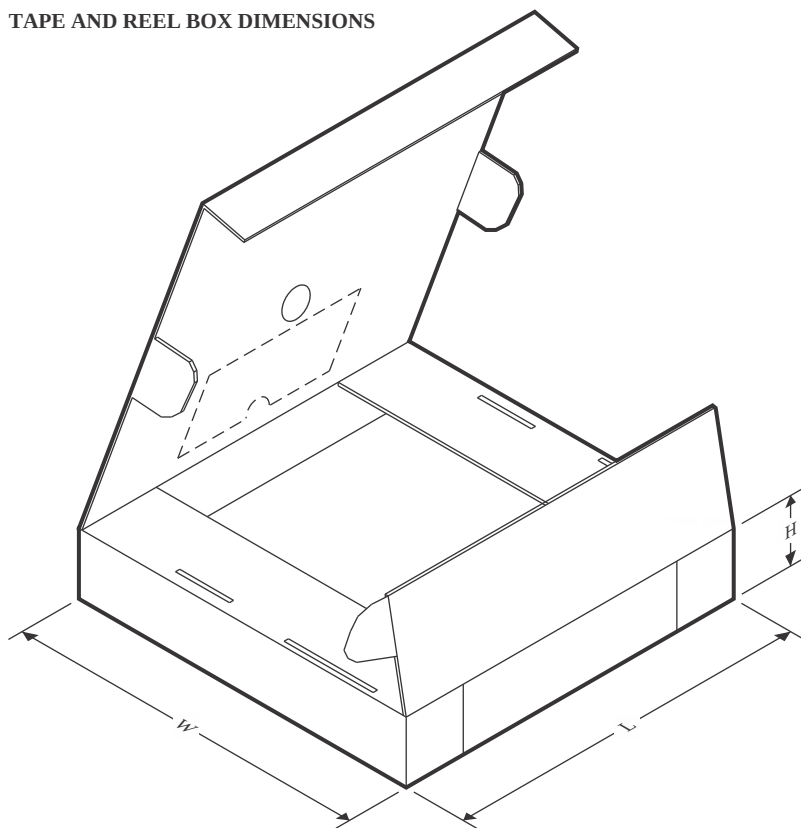
| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL431BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BIDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BIDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BIDCKT   | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BIDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BIDR     | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431BIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431BIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431BQDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431BQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431BQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431BQDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BQDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BQDCKT   | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BQDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431BQDR     | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431BQDR     | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431BQPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431CDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431CDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431CDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431CDR      | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431CDR-J    | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431CPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431CPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431CPKE6    | SOT-89       | PK              | 3    | 1000 | 180.0              | 13.0               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431IDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431IDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |

| 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL431IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431IDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431IDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431IDR      | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431IPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431IPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL431QDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431QDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431QDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL431QDCKR    | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431QDCKR    | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431QDCKT    | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431QDCKT    | SC70         | DCK             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL431QDR      | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL431QPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432ACDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432AIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432AQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |

| 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432AQP      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432AQP      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BCDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BCPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BCPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432BIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432BQPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432BQPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432CDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432CDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432CPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432CPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432IDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TL432IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432IDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432IDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432IDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432IDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432IPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432IPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |

| 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL432QDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TL432QPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TL432QPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL431ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431ACDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431ACDCKR   | SC70         | DCK             | 6    | 3000 | 183.0       | 183.0      | 20.0        |
| TL431ACDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431ACPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431ACPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431ACPSR    | SO           | PS              | 8    | 2000 | 356.0       | 356.0      | 35.0        |
| TL431ACPWR    | TSSOP        | PW              | 8    | 2000 | 356.0       | 356.0      | 35.0        |
| TL431AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |

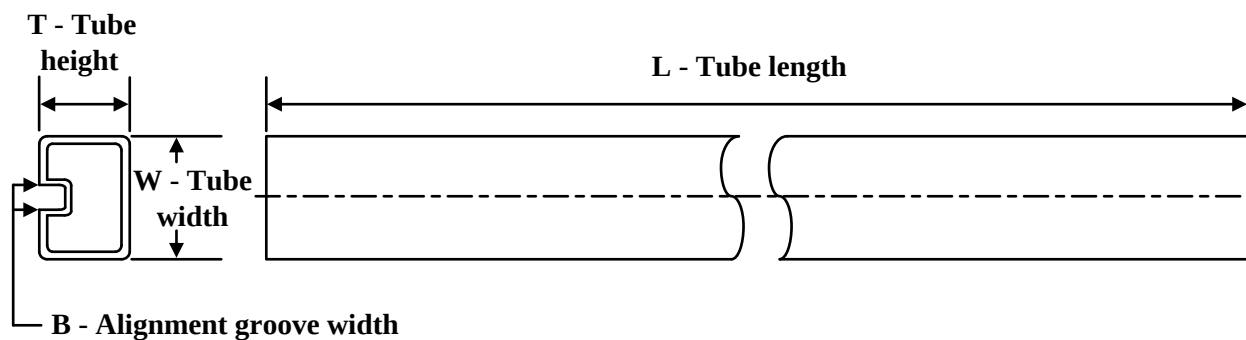
| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AIDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431AIDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AIDCKRG4 | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431AIDCKT   | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AIDCKT   | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TL431AIDR     | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TL431AIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431AIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AQDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431AQDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431AQDCKT   | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431AQDCKT   | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TL431AQP      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431AQP      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431BCDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BCDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BCDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431BCDCKT   | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BCDCKT   | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TL431BCDR     | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TL431BCPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431BCPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431BIDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL431BIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BIDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431BIDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BIDCKT   | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BIDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TL431BIDR     | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TL431BIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431BIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431BQDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BQDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BQDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TL431BQDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431BQDCKT   | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431BQDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TL431BQDR     | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TL431BQDR     | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| TL431BQPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431CDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431CDBVT    | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431CDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431CDR      | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL431CDR-J    | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL431CPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431CPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431CPKE6    | SOT-89       | PK              | 3    | 1000 | 182.0       | 182.0      | 20.0        |
| TL431IDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431IDBVT    | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431IDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431IDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431IDR      | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL431IPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL431IPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL431QDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431QDBVT    | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431QDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL431QDCKR    | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TL431QDCKR    | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TL431QDCKT    | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TL431QDCKT    | SC70         | DCK             | 6    | 250  | 210.0       | 185.0      | 35.0        |
| TL431QDR      | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TL431QPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432ACDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432AIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AQDBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432AQP      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432AQP      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432BCDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BCPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432BCPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432BIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432BIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432BQPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432BQPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432CDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432CDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432CPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432CPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432IDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432IDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432IDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432IDBZT    | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432IDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL432IPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TL432IPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432QDBZRG4  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL432QPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TL432QPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |

## TUBE

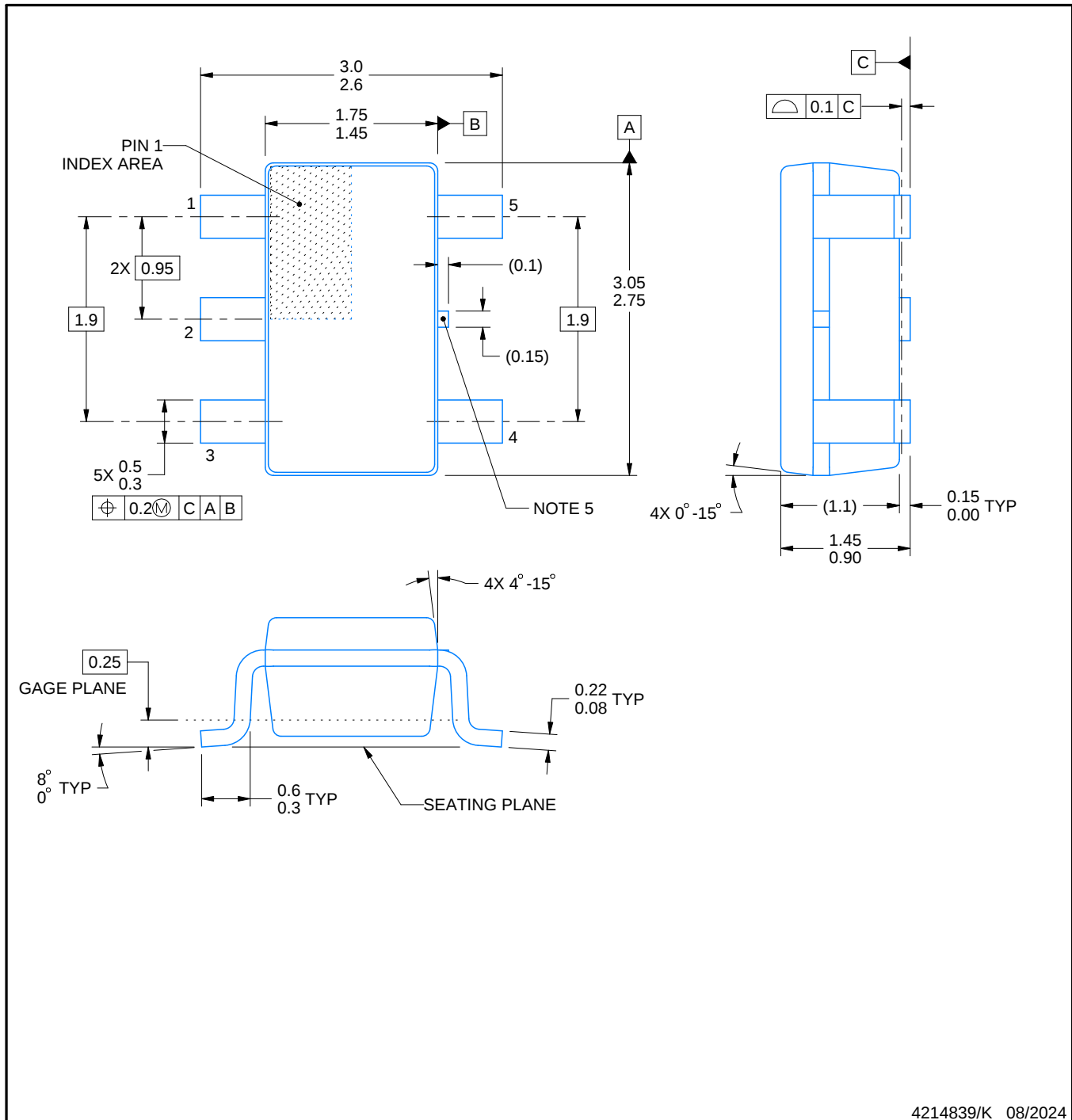


\*All dimensions are nominal

| Device   | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|----------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TL431ACD | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431ACP | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TL431AID | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431BCD | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431BID | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431BQD | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431CD  | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431ID  | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TL431QD  | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |

**DBV0005A****PACKAGE OUTLINE****SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR

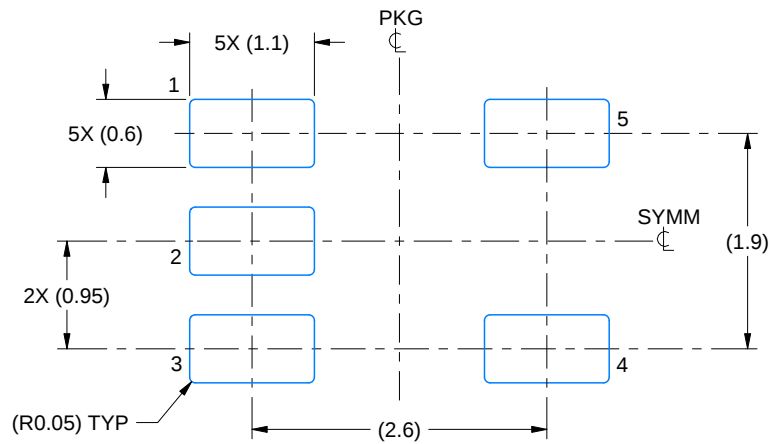
**NOTES:**

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. 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.

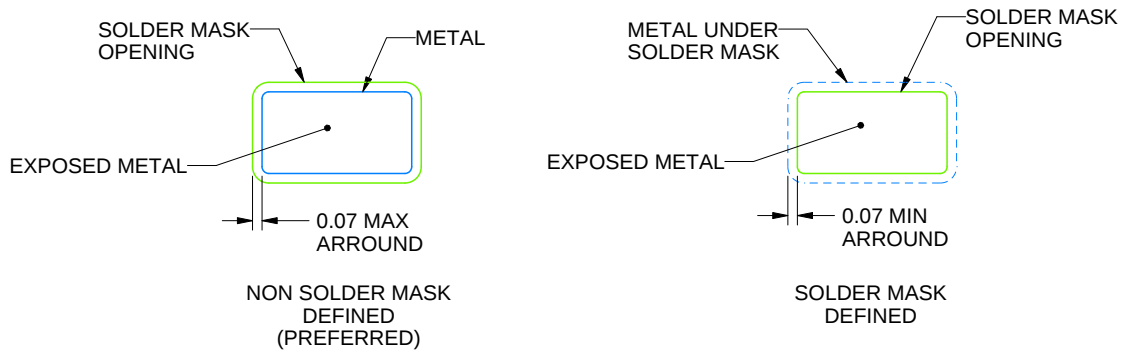
**DBV0005A**

**SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



## SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

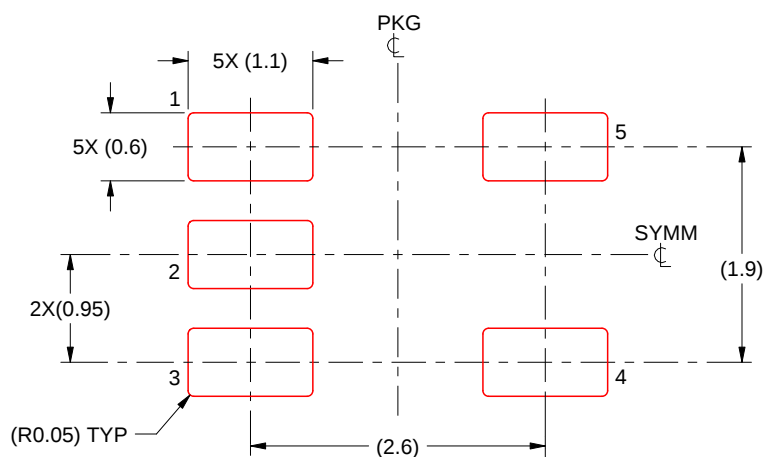
6. Publication IPC-7351 may have alternate designs.  
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR

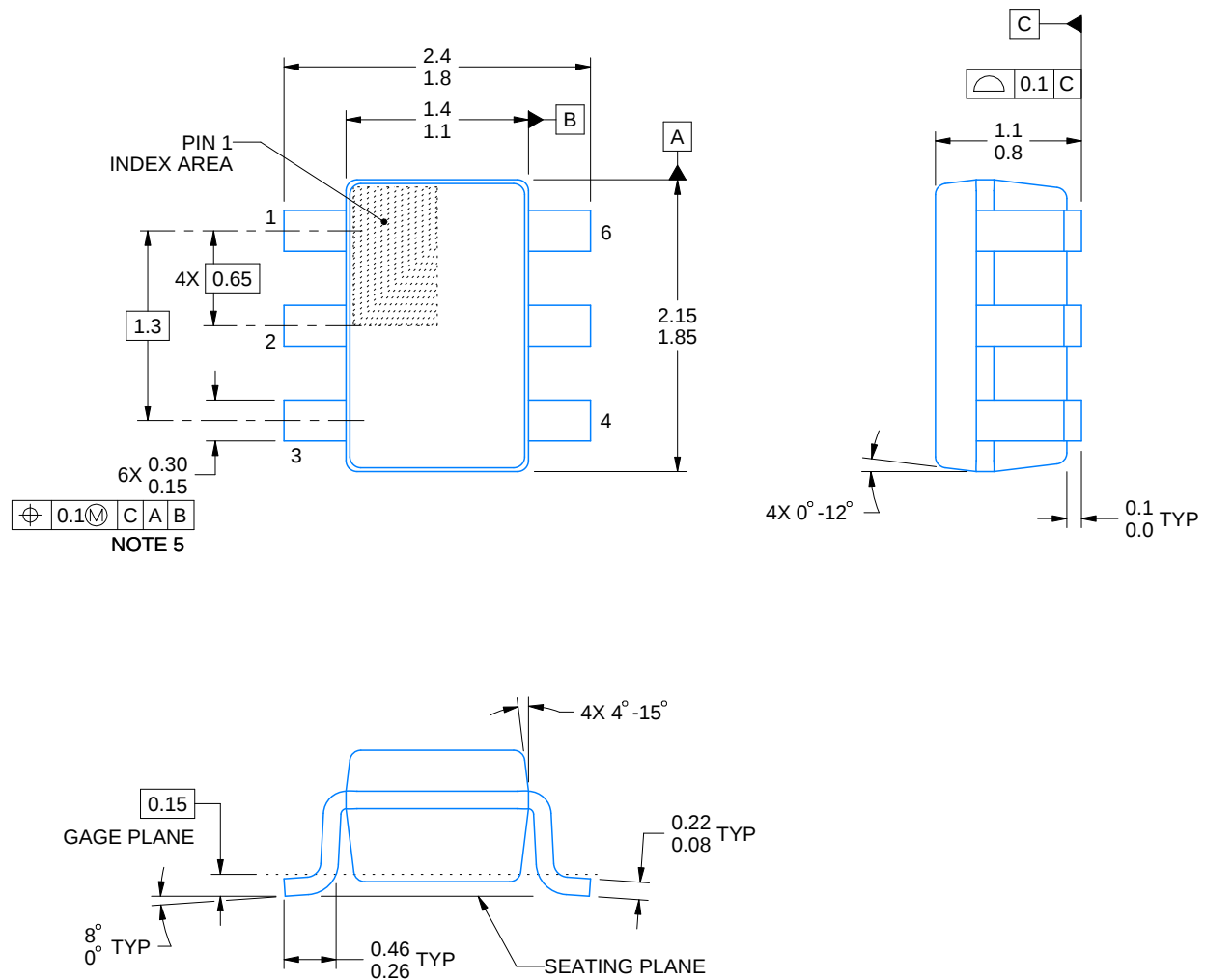


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

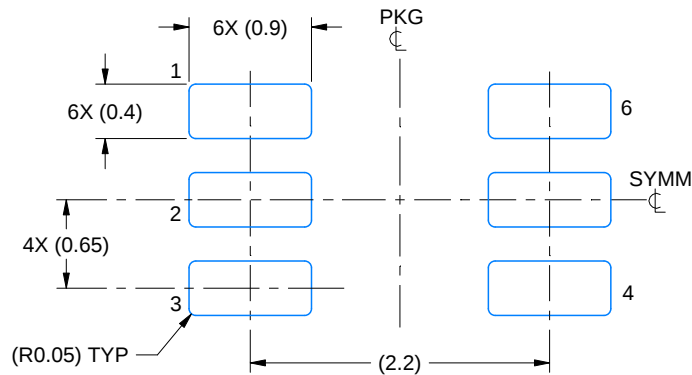
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



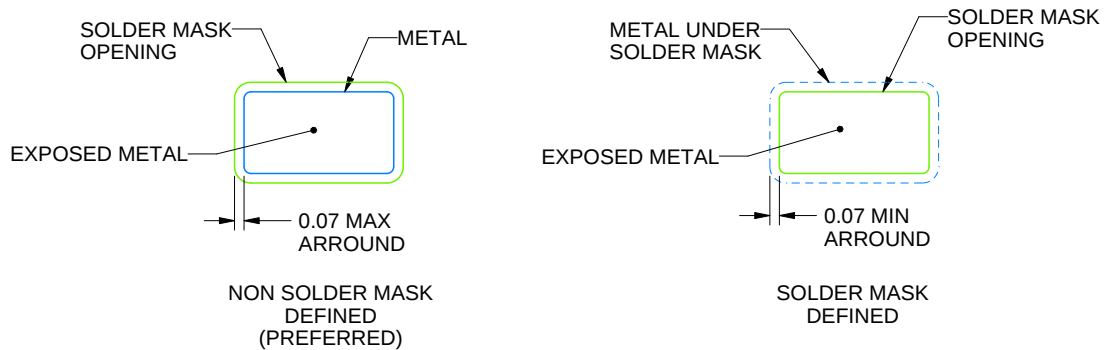
4214835/D 11/2024

## NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
4. Falls within JEDEC MO-203 variation AB.



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X

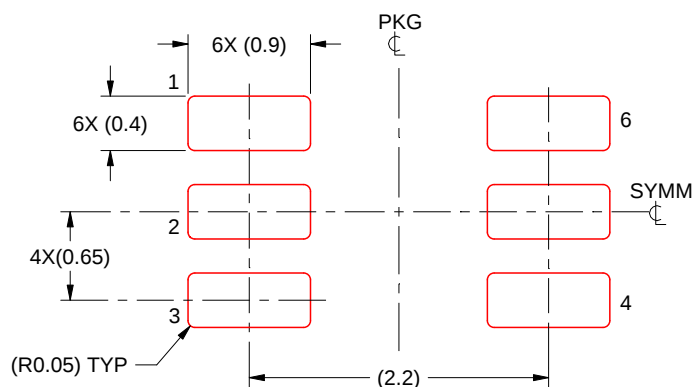


## SOLDER MASK DETAILS

4214835/D 11/2024

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. 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

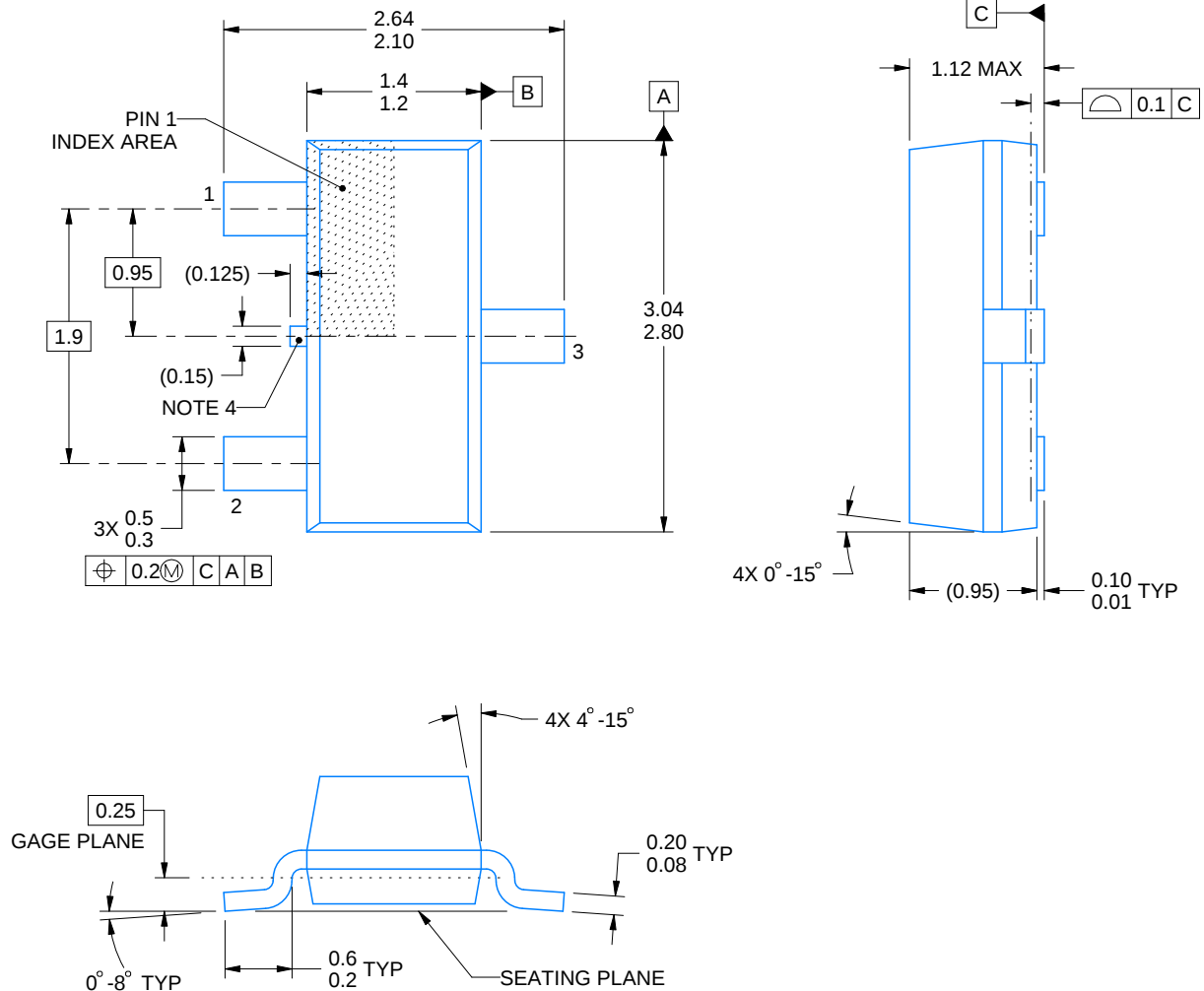
4214835/D 11/2024

NOTES: (continued)

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

**DBZ0003A****PACKAGE OUTLINE****SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



4214838/F 08/2024

**NOTES:**

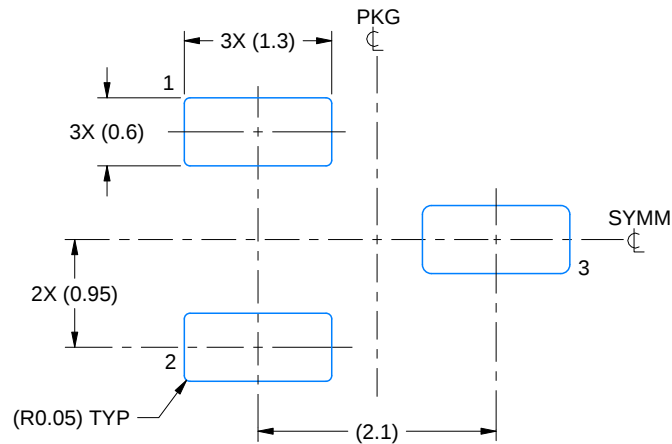
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. 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

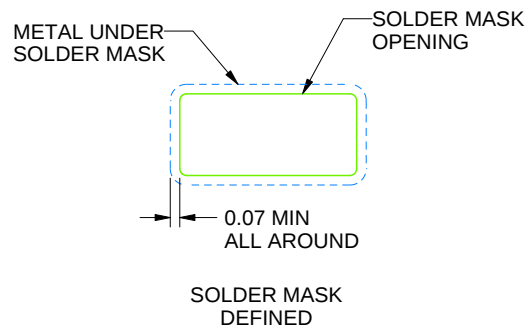
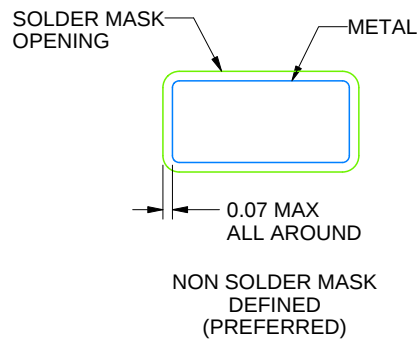
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

4214838/F 08/2024

NOTES: (continued)

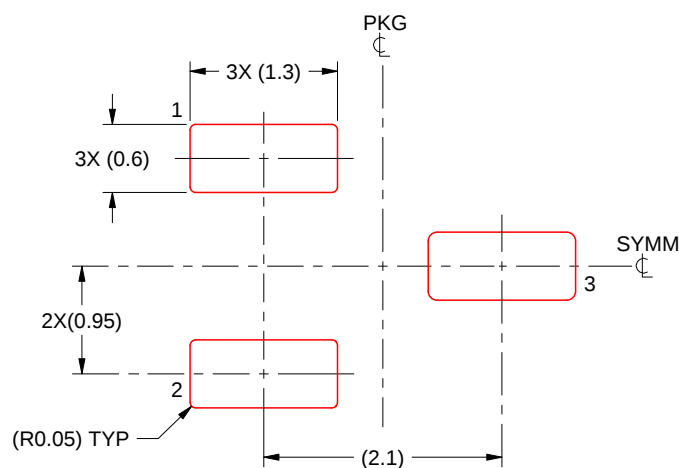
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



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

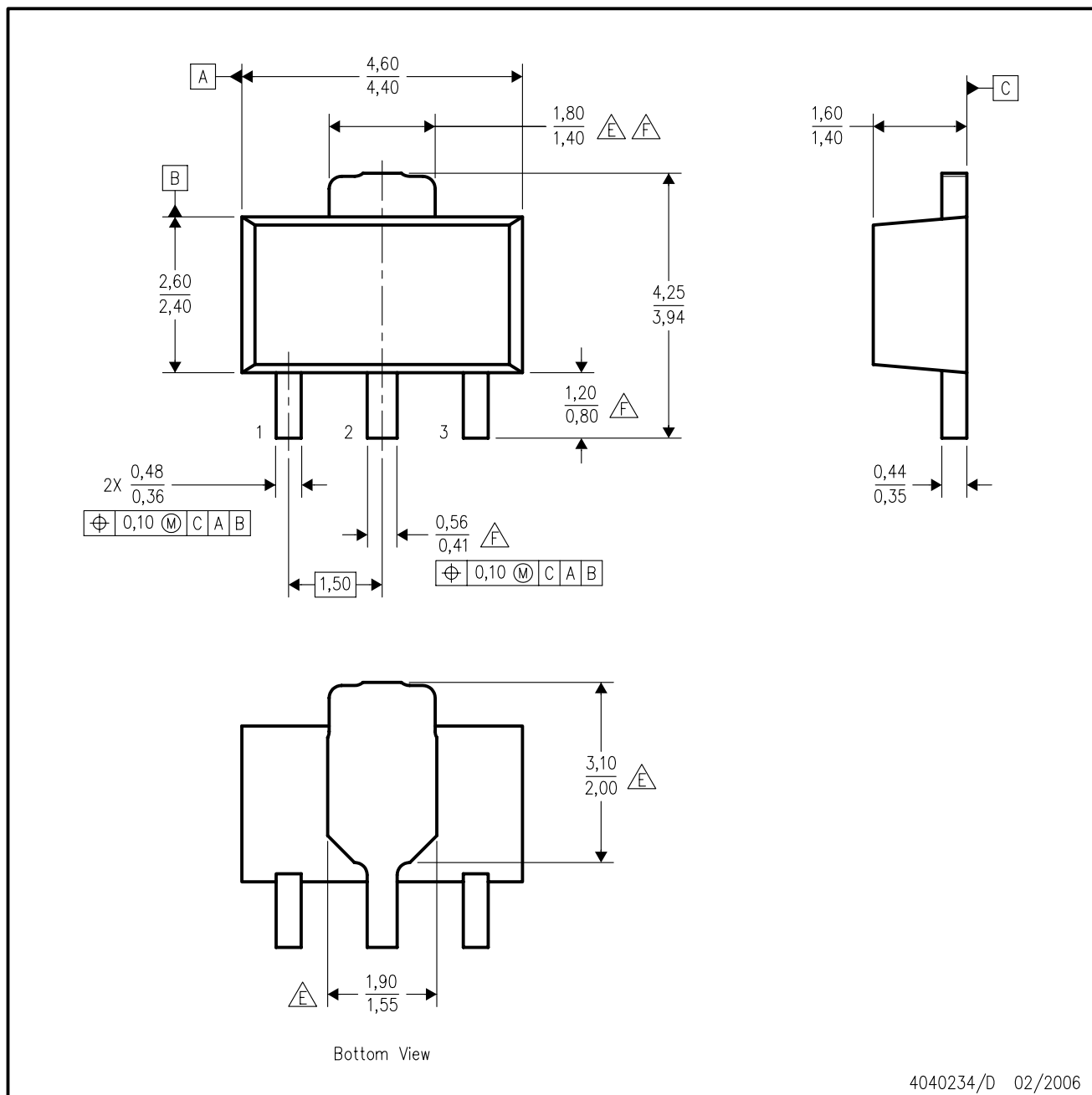
4214838/F 08/2024

NOTES: (continued)

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

PK (R-PSSO-F3)

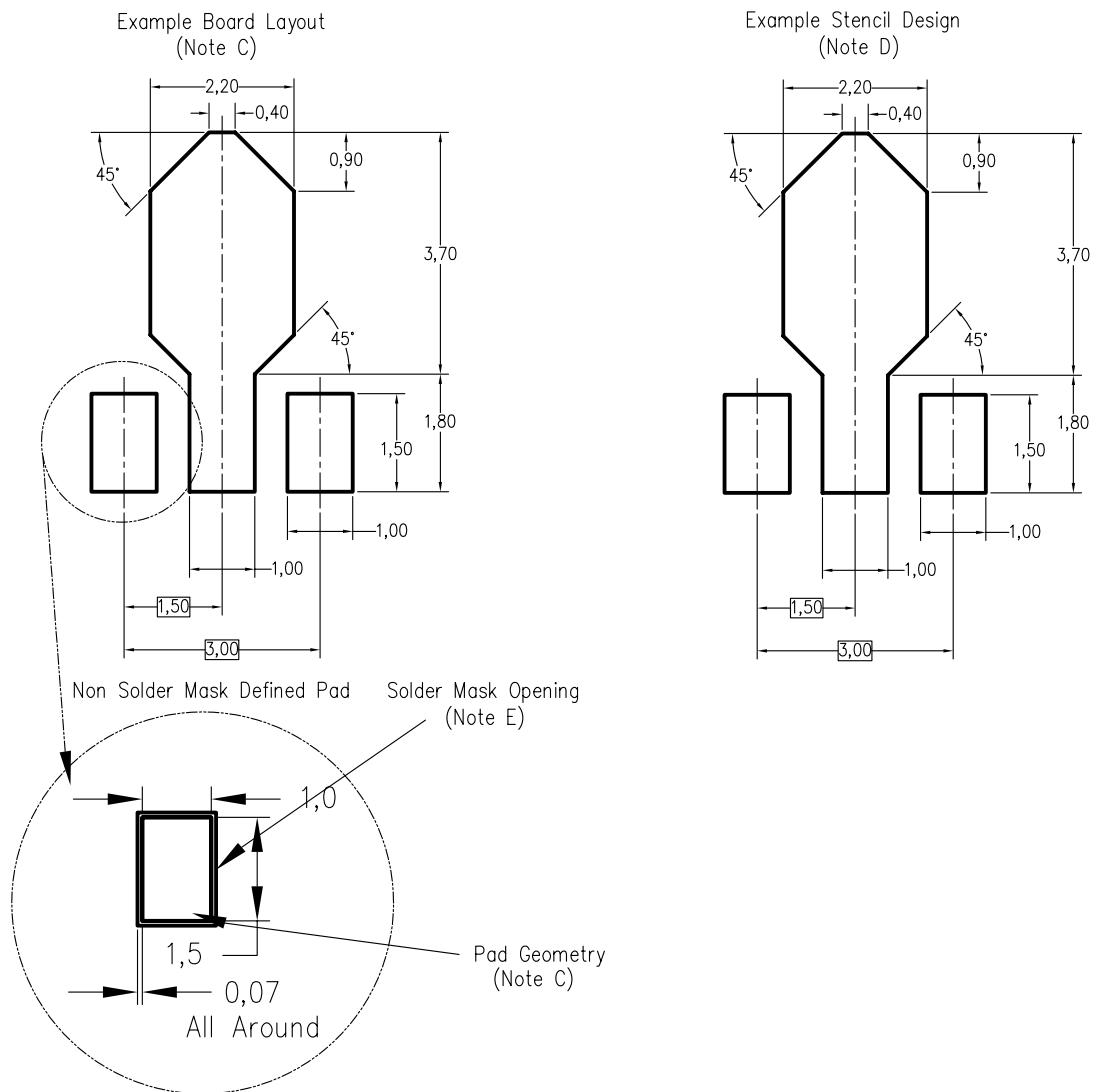
PLASTIC SINGLE-IN-LINE PACKAGE



4040234/D 02/2006

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - The center lead is in electrical contact with the tab.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion not to exceed 0.15 per side.
- △E Thermal pad contour optional within these dimensions.
- △F Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, minimum tab width.

# PK (R-PDSO-G3)

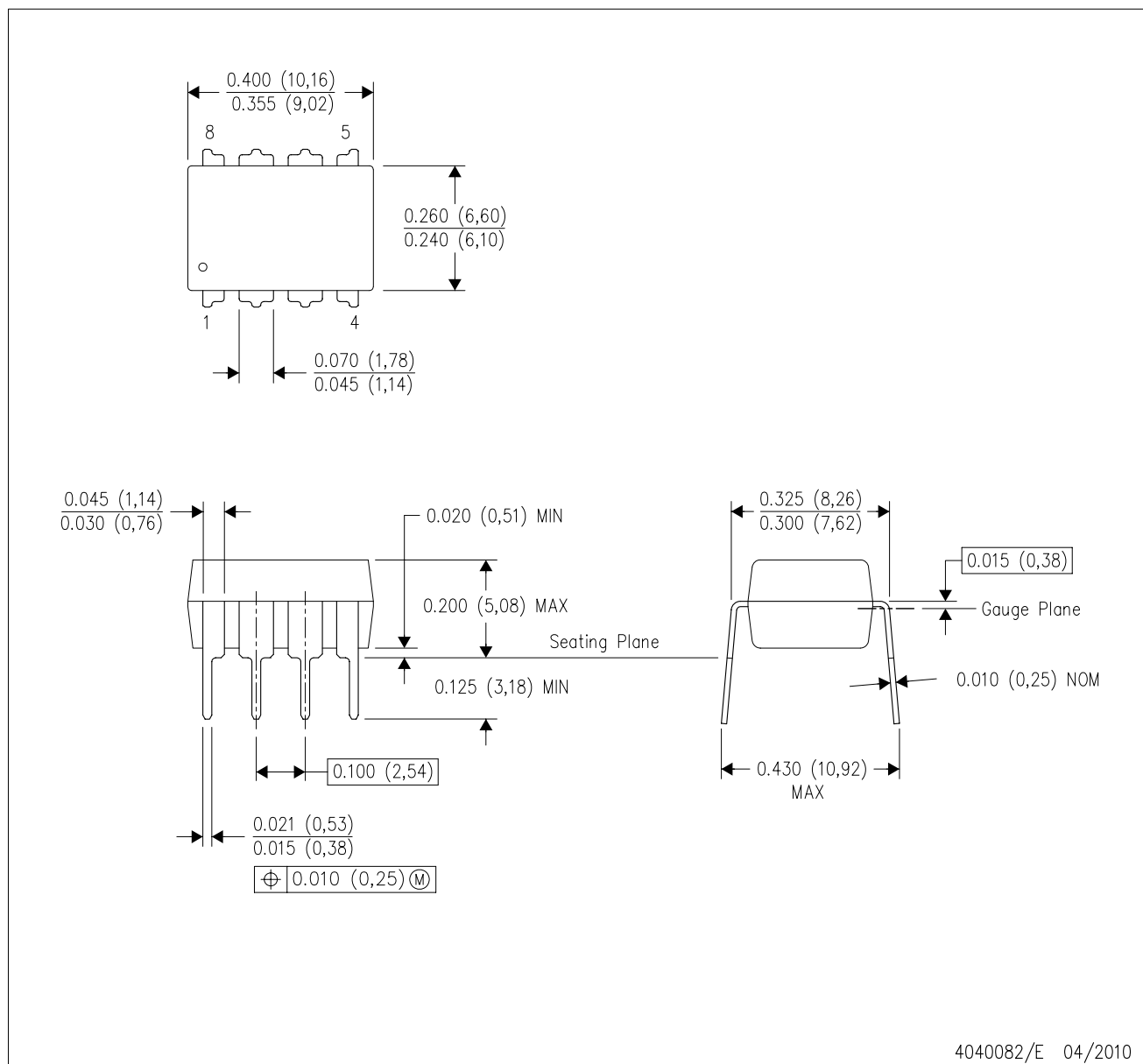


4208221/A 09/06

- 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.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



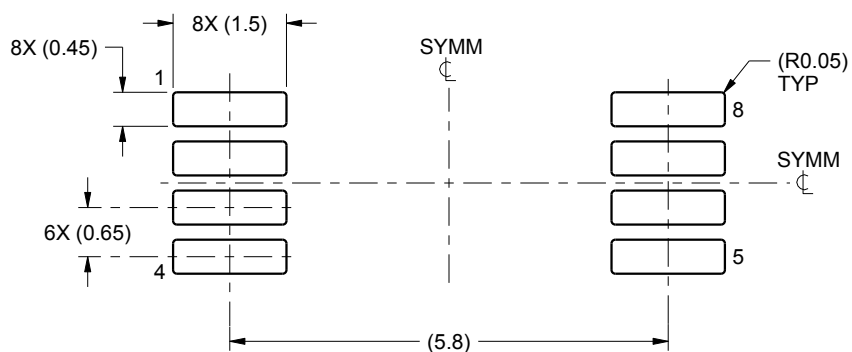
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.



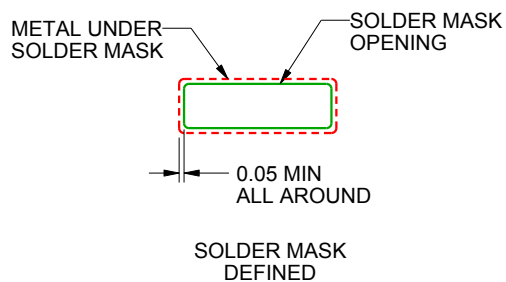
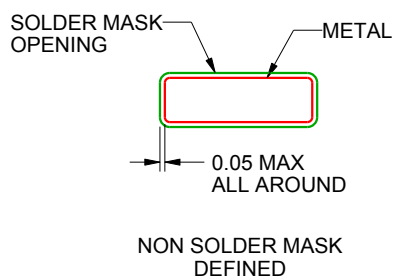
**PW0008A**

## 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.

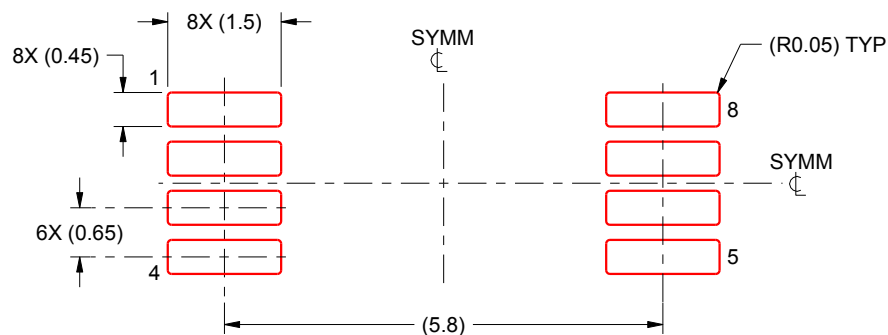
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## 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

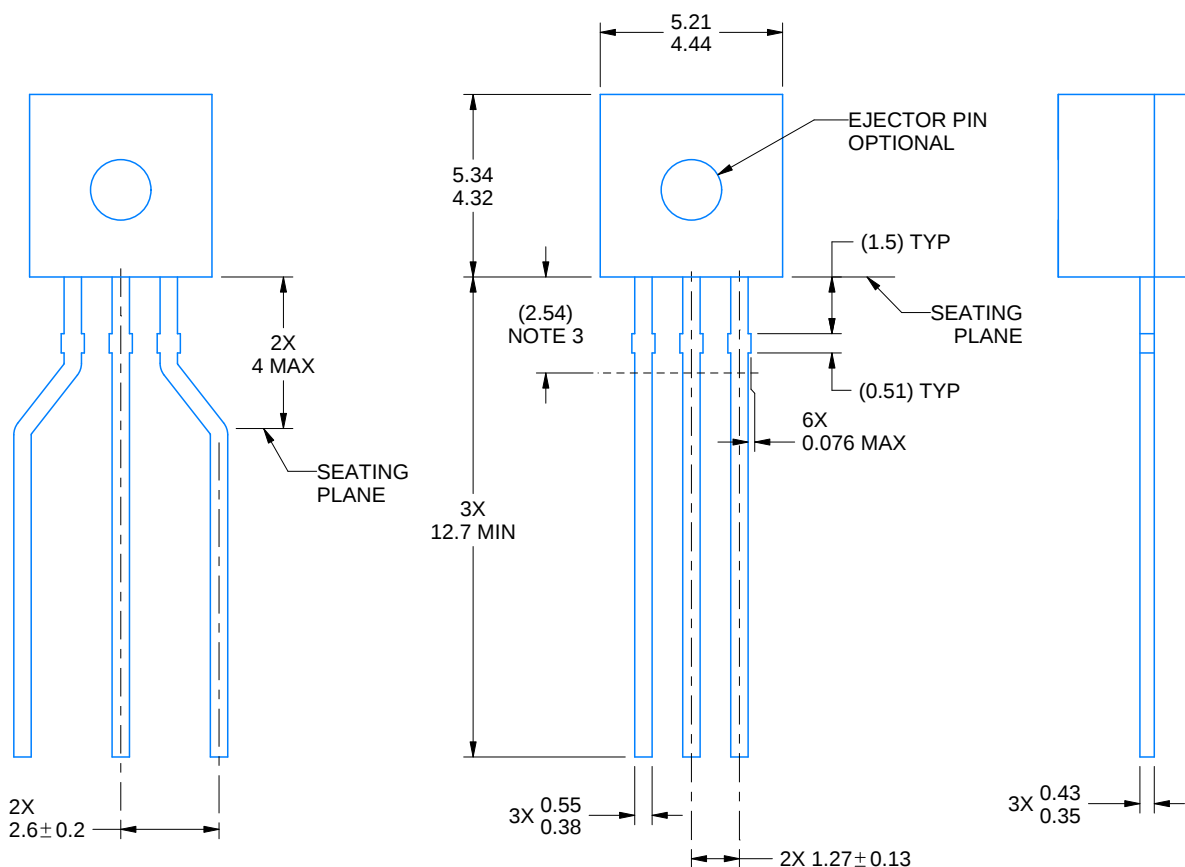
4221848/A 02/2015

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.

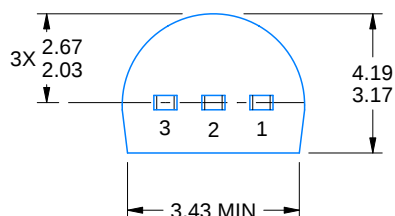


Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



FORMED LEAD OPTION  
OTHER DIMENSIONS IDENTICAL  
TO STRAIGHT LEAD OPTION

STRAIGHT LEAD OPTION



4215214/B 04/2017

NOTES:

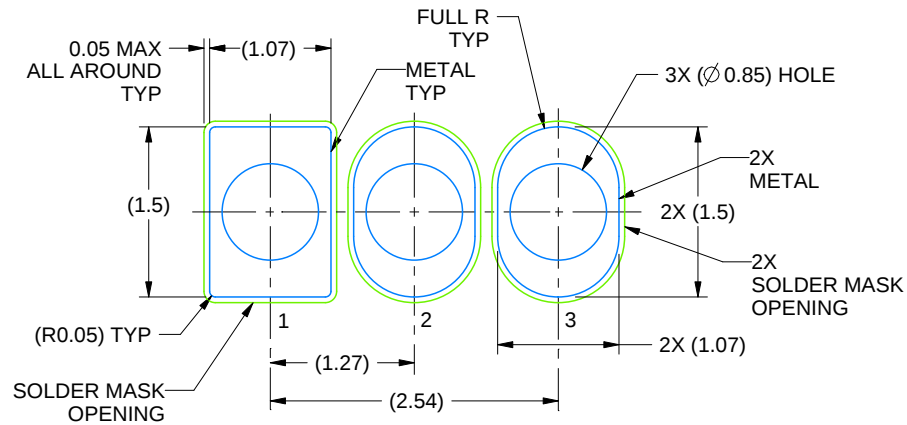
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
  - a. Straight lead option available in bulk pack only.
  - b. Formed lead option available in tape and reel or ammo pack.
  - c. Specific products can be offered in limited combinations of shipping medium and lead options.
  - d. Consult product folder for more information on available options.

# EXAMPLE BOARD LAYOUT

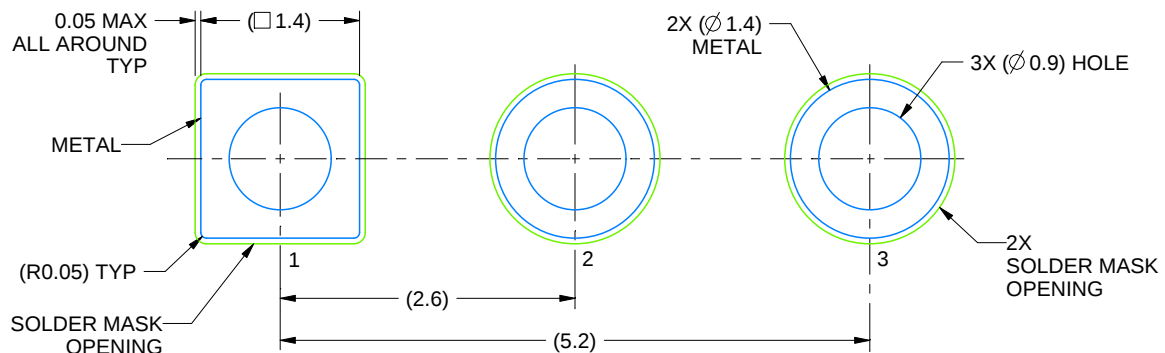
LP0003A

TO-92 - 5.34 mm max height

TO-92



LAND PATTERN EXAMPLE  
STRAIGHT LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X



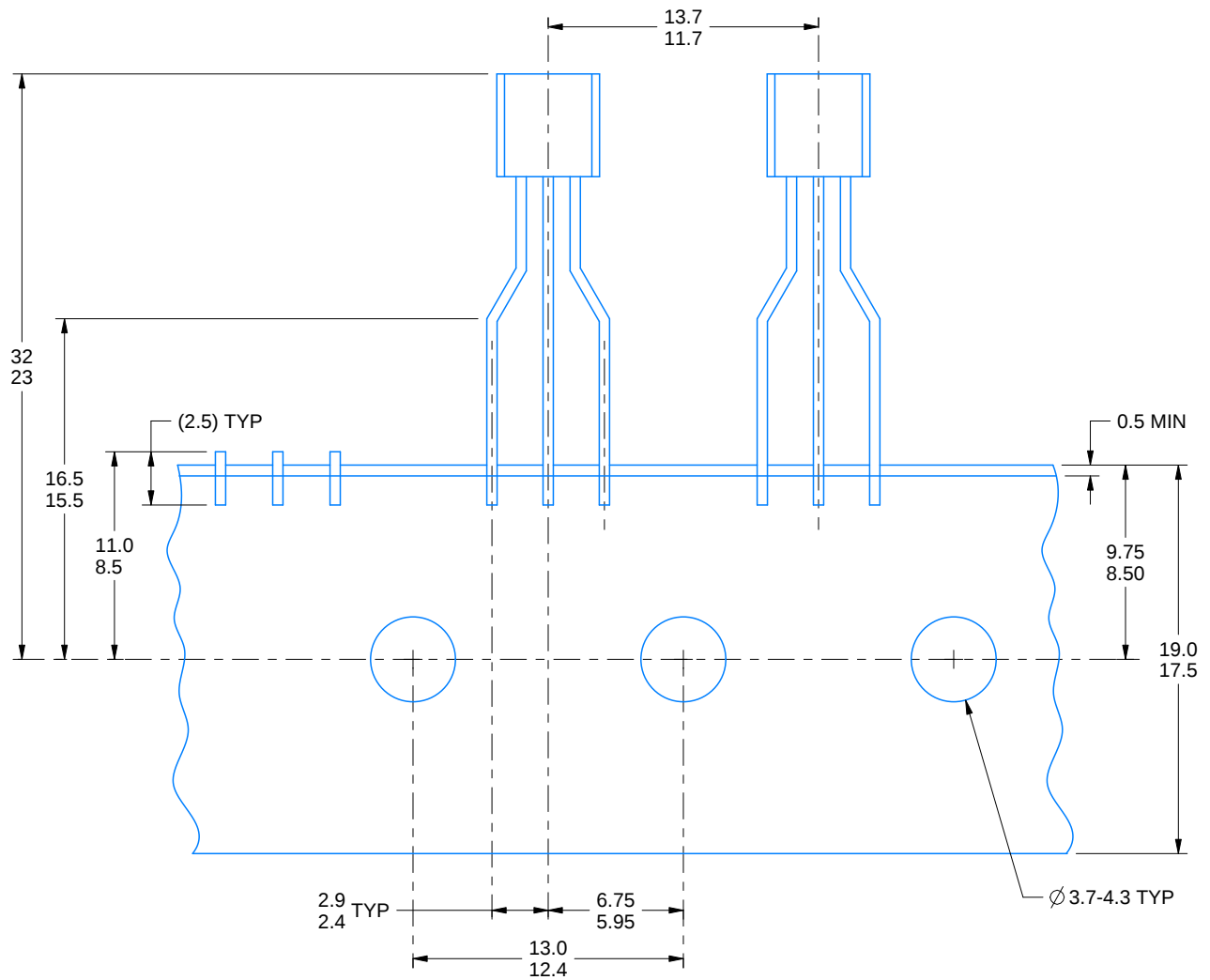
LAND PATTERN EXAMPLE  
FORMED LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X

4215214/B 04/2017

**LP0003A**

**TO-92 - 5.34 mm max height**

TO-92



FOR FORMED LEAD OPTION PACKAGE

4215214/B 04/2017



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



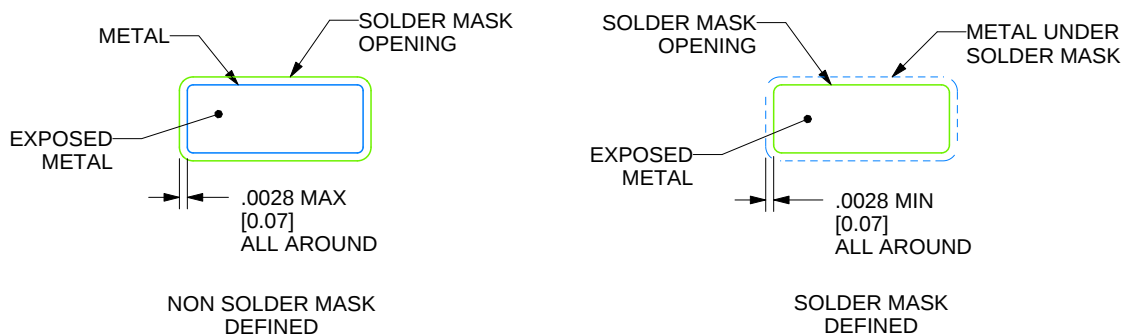
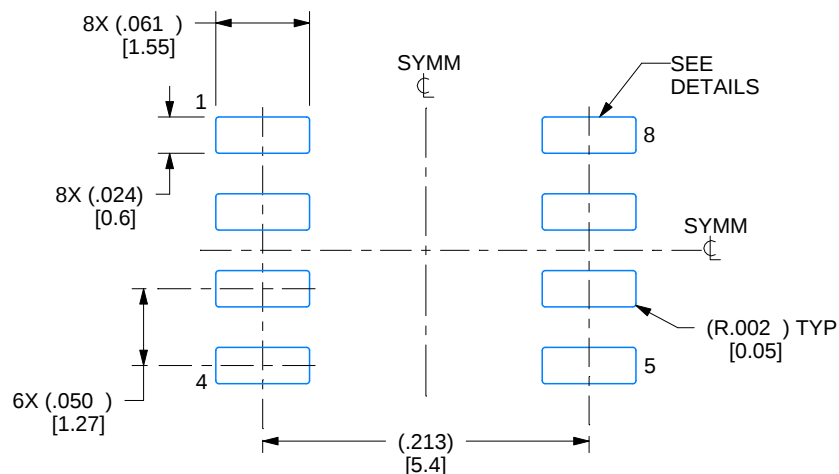
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate 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



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

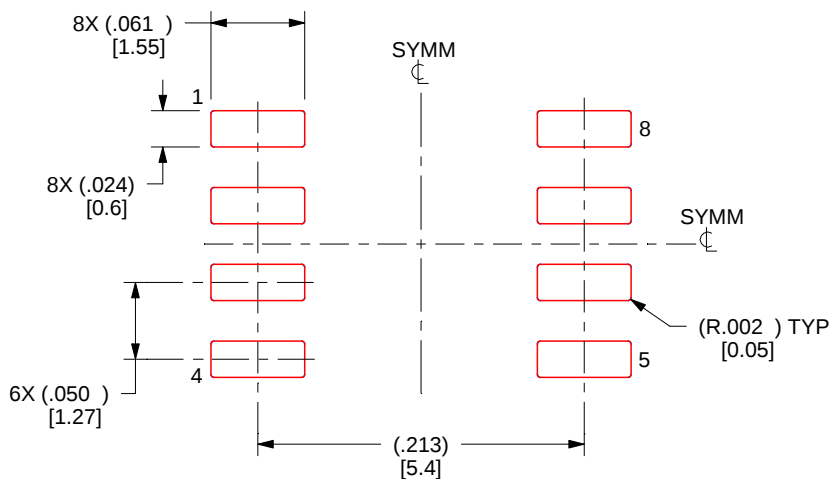
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## 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

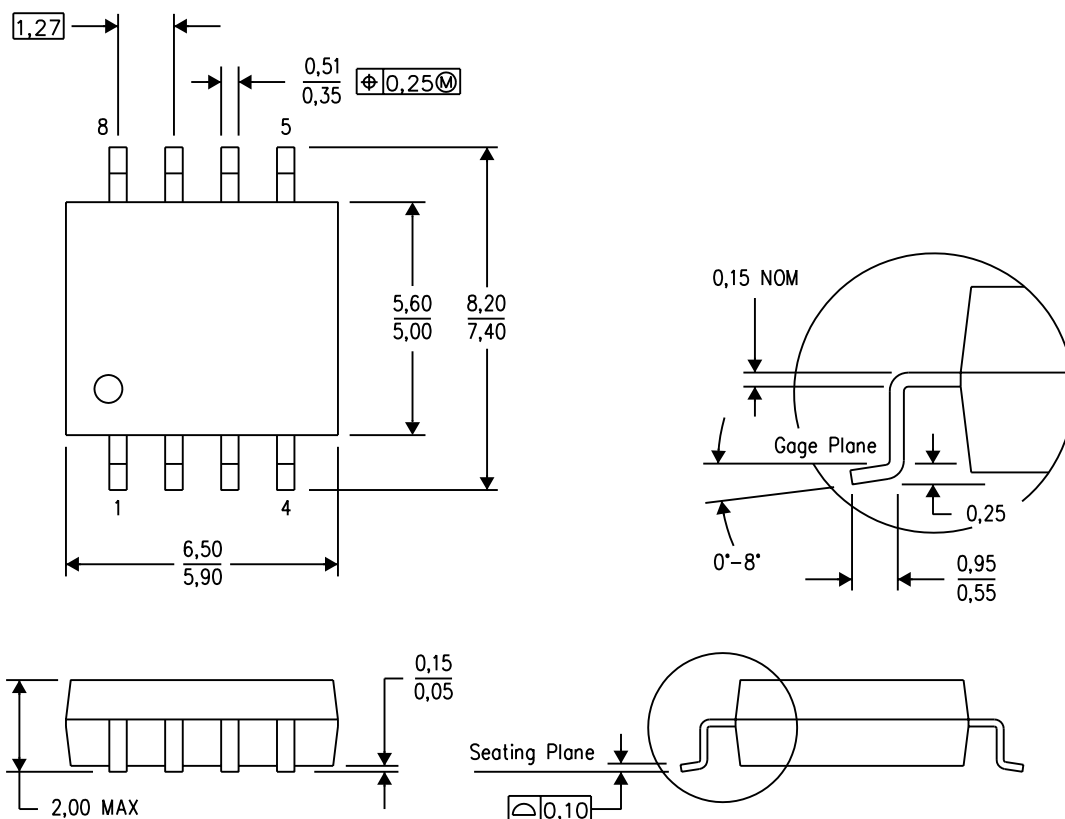
NOTES: (continued)

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.

# MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

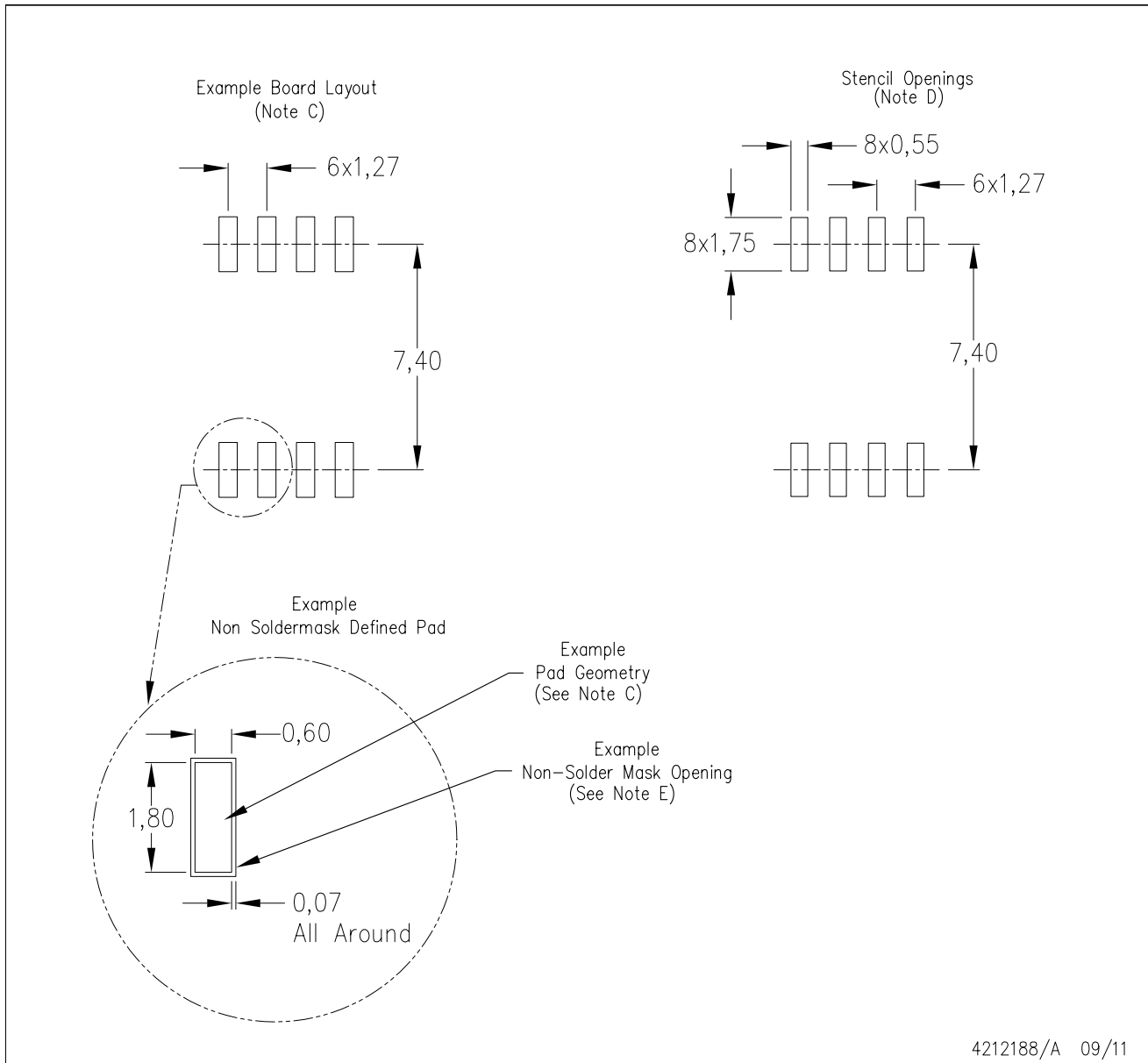


4040063/C 03/03

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## PS (R-PDSO-G8)

## 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.

## 重要通知和免责声明

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