

## LM4041 精密微功耗并联电压基准

### 1 特性

- 具有 1.225V 固定输出电压和可调输出电压 ( 1.225V 至 10V )
- 严格输出容差和低温度系数
  - 0.1% ( 最大值 ), 100ppm/°C - A 级
  - 0.2% ( 最大值 ), 100ppm/°C - B 级
  - 0.5% ( 最大值 ), 100ppm/°C - C 级
  - 1.0% ( 最大值 ), 150ppm/°C - D 级
- 低输出噪声 ...20  $\mu$ V<sub>RMS</sub> ( 典型值 )
- 宽工作电流范围 ...  
45  $\mu$ A ( 典型值 ) 至 12mA
- 与所有容性负载一起工作时保持稳定；无需输出电容器
- 可采用
  - 工业温度：-40°C 至 85°C
  - 工作温度范围：-40°C 至 125°C

### 2 应用

- 数据采集系统
- 电源和电源监控器
- 仪表和测试设备
- 过程控制
- 精密音频
- 汽车电子产品
- 能源管理/计量
- 电池供电设备

### 3 说明

LM4041 系列并联电压基准功能多样、易于使用，适合各种应用。这些器件无需外部电容器即可运行，与所有容性负载一起工作时均保持稳定。此外，该基准具备低动态阻抗、低噪声和低温度系数，可确保在宽工作电流和温度范围内实现稳定的输出电压。LM4041 在晶圆筛选期间使用保险丝和齐纳击穿反向击穿电压修整，以提供四种输出电压容差 - 从最高 0.1% ( A 级 ) 到最高 1% ( D 级 )。这样设计人员可以非常灵活地为应用选择具有高性价比的产品。LM4041 可提供固定电压 ( 1.225V 标称值 ) 或可调电压版本 ( 需要外部电阻分压器将输出设为 1.225V 至 10V 间的任意值 )。

LM4041 采用节省空间的 SC-70 和 SOT-23-3 封装，最低电流为 45  $\mu$ A ( 典型值 )，也适用于便携式应用。如需穿孔封装，我们还提供 TO-92 封装。LM4041xI 的额定工作环境温度范围是 - 40°C 至 85°C。LM4041xQ 的额定工作环境温度范围是 - 40°C 至 125°C。



## Table of Contents

|                                                                      |           |                                                                      |           |
|----------------------------------------------------------------------|-----------|----------------------------------------------------------------------|-----------|
| <b>1 特性</b> .....                                                    | <b>1</b>  | 5.10 Typical Characteristics.....                                    | <b>12</b> |
| <b>2 应用</b> .....                                                    | <b>1</b>  | <b>6 Functional Block Diagram</b> .....                              | <b>15</b> |
| <b>3 说明</b> .....                                                    | <b>1</b>  | <b>7 Application Information</b> .....                               | <b>16</b> |
| <b>4 Pin Configuration and Functions</b> .....                       | <b>3</b>  | 7.1 Output Capacitor.....                                            | <b>16</b> |
| Pin Functions.....                                                   | <b>3</b>  | 7.2 SOT-23 and SC-70 Pin Connections.....                            | <b>16</b> |
| 引脚功能：ADJ 引脚排列.....                                                   | <b>4</b>  | 7.3 Adjustable Version.....                                          | <b>17</b> |
| <b>5 Specifications</b> .....                                        | <b>5</b>  | 7.4 Cathode and Load Currents.....                                   | <b>17</b> |
| 5.1 Absolute Maximum Ratings.....                                    | <b>5</b>  | <b>8 器件和文档支持</b> .....                                               | <b>18</b> |
| 5.2 ESD Ratings.....                                                 | <b>5</b>  | 8.1 接收文档更新通知.....                                                    | <b>18</b> |
| 5.3 Recommended Operating Conditions.....                            | <b>6</b>  | 8.2 商标.....                                                          | <b>18</b> |
| 5.4 LM4041x12I Electrical Characteristics.....                       | <b>6</b>  | 8.3 静电放电警告.....                                                      | <b>18</b> |
| 5.5 LM4041x12I Electrical Characteristics.....                       | <b>7</b>  | 8.4 支持资源.....                                                        | <b>18</b> |
| 5.6 LM4041x12Q Electrical Characteristics.....                       | <b>8</b>  | 8.5 术语表.....                                                         | <b>18</b> |
| 5.7 LM4041xI (Adjustable Version) Electrical<br>Characteristics..... | <b>9</b>  | <b>9 Revision History</b> .....                                      | <b>18</b> |
| 5.8 LM4041xI (Adjustable Version) Electrical<br>Characteristics..... | <b>10</b> | <b>10 Mechanical, Packaging, and Orderable<br/>Information</b> ..... | <b>20</b> |
| 5.9 LM4041xQ (Adjustable Version) Electrical<br>Characteristics..... | <b>11</b> |                                                                      |           |

## 4 Pin Configuration and Functions

### Pin Functions

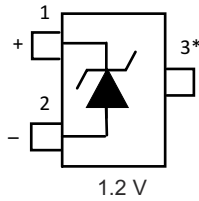


图 4-1. DBZ Package  
3-Pin SOT-23  
Top View

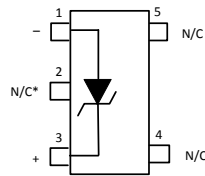


图 4-2. DCK Package  
5-Pin SC70  
Top View

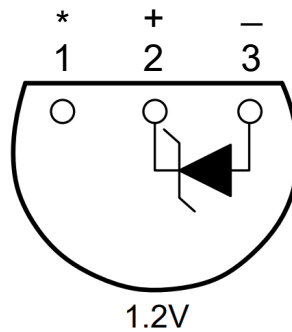


图 4-3. LP Package  
3-Pin TO-92  
Bottom View

### Pin Functions

| NAME    | PIN    |      |       | I/O | DESCRIPTION                                     |
|---------|--------|------|-------|-----|-------------------------------------------------|
|         | SOT-23 | SC70 | TO-92 |     |                                                 |
| Anode   | 2      | 1    | 3     | O   | Anode pin, normally grounded                    |
| Cathode | 1      | 3    | 2     | I/O | Shunt current and output voltage                |
| FB      | —      | —    | —     | I   | Feedback pin for adjustable output voltage      |
| NC*     | 3      | 2    | 1     | —   | **Must float or connect to anode <sup>(1)</sup> |
| NC      | —      | 4, 5 | —     | —   | No connect                                      |

- (1) In applications with high electromagnetic interference (for example, when placed near transformers or other electromagnetic sources) or significant high-frequency switching noise, TI recommends to connect this pin to the anode.

引脚功能：ADJ 引脚排列

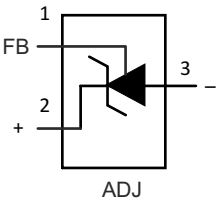


图 4-4. DBZ 封装  
3 引脚 SOT-23  
顶视图

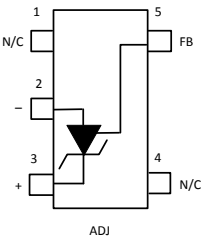


图 4-5. DCK 封装  
5 引脚 SC70  
顶视图

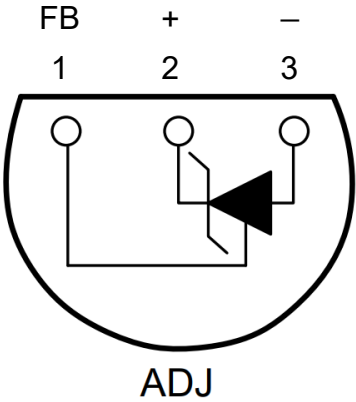


图 4-6. LP 封装  
3 引脚 TO-92  
底视图

| 引脚   |        |      |       | I/O | 说明           |
|------|--------|------|-------|-----|--------------|
| 名称   | SOT-23 | SC70 | TO-92 |     |              |
| 正极   | 3      | 2    | 3     | O   | 正极引脚、正常接地    |
| 负极   | 2      | 3    | 2     | I/O | 分流电流和输出电压    |
| FB   | 1      | 5    | 1     | I   | 可调输出电压的反馈引脚  |
| NC** | —      | —    | —     | —   | **必须悬空或连接到正极 |
| NC   | —      | 1、4  | —     | —   | 无连接          |

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over free-air temperature range (unless otherwise noted)

|                  |                                              | MIN         | MAX <sup>(1)</sup> | UNIT |
|------------------|----------------------------------------------|-------------|--------------------|------|
| V <sub>Z</sub>   | Continuous cathode voltage                   |             | 15                 | V    |
| I <sub>Z</sub>   | Continuous cathode current                   | – 10        | 25                 | mA   |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(2) (3)</sup> | DBZ package | 206                | °C/W |
|                  |                                              | DCK package | 252                |      |
|                  |                                              | LP package  | 156                |      |
| T <sub>J</sub>   | Operating virtual junction temperature       |             | 150                | °C   |
| T <sub>stg</sub> | Storage temperature range                    | – 65        | 150                | °C   |

- (1) Stresses beyond those listed under "absolute maximum ratings" can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
- (2) Maximum power dissipation is a function of T<sub>J</sub>(max), θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J</sub>(max) – T<sub>A</sub>) / θ<sub>JA</sub>. Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

### 5.2 ESD Ratings

|                    |                         |                                                                                | VALUE | UNIT |
|--------------------|-------------------------|--------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic Discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1) (2)</sup>          | ±2000 | V    |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(3)</sup> | ±500  |      |

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) The human-body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin. All pins are rated at 2kV for human-body model, but the feedback pin which is rated at 1kV.
- (3) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250V CDM is possible with the necessary precautions.

### 5.3 Recommended Operating Conditions

|                |                                                |                        | MIN  | MAX | UNIT |
|----------------|------------------------------------------------|------------------------|------|-----|------|
| I <sub>Z</sub> | Cathode current                                |                        | (1)  | 12  | mA   |
| V <sub>Z</sub> | Reverse breakdown voltage (adjustable version) |                        |      | 10  | V    |
| T <sub>A</sub> | Free-air temperature                           | LM4041 (I temperature) | – 40 | 85  | °C   |
|                |                                                | LM4041 (Q temperature) | – 40 | 125 |      |

(1) See parametric tables

### 5.4 LM4041x12I Electrical Characteristics

full-range  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (unless otherwise noted)

| PARAMETER                              |                                                              | TEST CONDITIONS                                                       | T <sub>A</sub> | LM4041A12I |     |      | LM4041B12I |     |      | UNIT               |
|----------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------|----------------|------------|-----|------|------------|-----|------|--------------------|
|                                        |                                                              |                                                                       |                | MIN        | TYP | MAX  | MIN        | TYP | MAX  |                    |
| V <sub>Z</sub>                         | Reverse breakdown voltage                                    | I <sub>Z</sub> = 100 μ A                                              | 25°C           | 1.225      |     |      | 1.225      |     |      | V                  |
|                                        | Reverse breakdown voltage tolerance                          | I <sub>Z</sub> = 100 μ A                                              | 25°C           | - 1.2      |     | 1.2  | - 2.4      |     | 2.4  | mV                 |
|                                        |                                                              |                                                                       | Full range     | - 9.2      |     | 9.2  | - 10.4     |     | 10.4 |                    |
| I <sub>Z,min</sub>                     | Minimum cathode current                                      |                                                                       | 25°C           | 45         |     | 75   | 45         |     | 75   | μ A                |
|                                        |                                                              |                                                                       | Full range     |            |     | 80   |            |     | 80   |                    |
| α <sub>VZ</sub>                        | Average temperature coefficient of reverse breakdown voltage | I <sub>Z</sub> = 10mA                                                 | 25°C           | ±20        |     |      | ±20        |     |      | ppm/°C             |
|                                        |                                                              | I <sub>Z</sub> = 1mA                                                  | 25°C           | ±15        |     |      | ±15        |     |      |                    |
|                                        |                                                              |                                                                       | Full range     |            |     | ±100 |            |     | ±100 |                    |
|                                        |                                                              | I <sub>Z</sub> = 100 μ A                                              | 25°C           | ±15        |     |      | ±15        |     |      |                    |
| Δ V <sub>Z</sub> /<br>Δ I <sub>Z</sub> | Reverse breakdown voltage change with cathode current change | I <sub>Z,min</sub> < I <sub>Z</sub> < 1mA                             | 25°C           | 0.7        |     | 1.5  | 0.7        |     | 1.5  | mV                 |
|                                        |                                                              |                                                                       | Full range     |            |     | 2    |            |     | 2    |                    |
|                                        |                                                              | 1mA < I <sub>Z</sub> < 12mA                                           | 25°C           | 4          |     | 6    | 4          |     | 6    |                    |
|                                        |                                                              |                                                                       | Full range     |            |     | 8    |            |     | 8    |                    |
| Z <sub>Z</sub>                         | Reverse dynamic impedance                                    | I <sub>Z</sub> = 1mA, f = 120Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub> | 25°C           | 0.5        |     | 1.5  | 0.5        |     | 1.5  | Ω                  |
| e <sub>N</sub>                         | Wideband noise                                               | I <sub>Z</sub> = 100 μ A, 10Hz ≤ f ≤ 10kHz                            | 25°C           | 20         |     |      | 20         |     |      | μ V <sub>RMS</sub> |
|                                        | Long-term stability of reverse breakdown voltage             | t = 1000 h, T <sub>A</sub> = 25°C ± 0.1°C, I <sub>Z</sub> = 100 μ A   | 25°C           | 120        |     |      | 120        |     |      | ppm                |

## 5.5 LM4041x12I Electrical Characteristics

full-range  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (unless otherwise noted)

| PARAMETER                       | TEST CONDITIONS                                              | $T_A$                                                                                                     | LM4041C12I |          |           | LM4041D12I |          |           | UNIT                       |
|---------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------|----------|-----------|------------|----------|-----------|----------------------------|
|                                 |                                                              |                                                                                                           | MIN        | TYP      | MAX       | MIN        | TYP      | MAX       |                            |
| $V_Z$                           | Reverse breakdown voltage                                    | $I_Z = 100\ \mu\text{A}$                                                                                  |            | 1.225    |           |            | 1.225    |           | V                          |
|                                 | Reverse breakdown voltage tolerance                          | $I_Z = 100\ \mu\text{A}$                                                                                  |            | – 6      | 6         |            | – 12     | 12        | mV                         |
|                                 |                                                              | Full range                                                                                                |            | – 14     | 14        |            | – 24     | 24        |                            |
| $I_{Z,\min}$                    | Minimum cathode current                                      | $25^{\circ}\text{C}$                                                                                      |            | 45       | 75        |            | 45       | 75        | $\mu\text{A}$              |
|                                 |                                                              | Full range                                                                                                |            |          | 80        |            |          | 80        |                            |
| $\alpha_{VZ}$                   | Average temperature coefficient of reverse breakdown voltage | $I_Z = 10\text{mA}$                                                                                       |            | $\pm 20$ |           |            | $\pm 20$ |           | ppm/ $^{\circ}\text{C}$    |
|                                 |                                                              | $I_Z = 1\text{mA}$                                                                                        |            | $\pm 15$ |           |            | $\pm 15$ |           |                            |
|                                 |                                                              | Full range                                                                                                |            |          | $\pm 100$ |            |          | $\pm 150$ |                            |
|                                 |                                                              | $I_Z = 100\ \mu\text{A}$                                                                                  |            | $\pm 15$ |           |            | $\pm 15$ |           |                            |
| $\frac{\Delta V_Z}{\Delta I_Z}$ | Reverse breakdown voltage change with cathode current change | $I_{Z,\min} < I_Z < 1\text{mA}$                                                                           |            | 0.7      | 1.5       |            | 0.7      | 2         | mV                         |
|                                 |                                                              | Full range                                                                                                |            |          | 2         |            |          | 2.5       |                            |
|                                 |                                                              | $1\text{mA} < I_Z < 12\text{mA}$                                                                          |            | 2.5      | 6         |            | 2.5      | 8         |                            |
|                                 |                                                              | Full range                                                                                                |            |          | 8         |            |          | 10        |                            |
| $Z_Z$                           | Reverse dynamic impedance                                    | $I_Z = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_Z$                                           |            | 0.5      | 1.5       |            | 0.5      | 2         | $\Omega$                   |
| $e_N$                           | Wideband noise                                               | $I_Z = 100\ \mu\text{A}$ ,<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                      |            | 20       |           |            | 20       |           | $\mu\text{V}_{\text{RMS}}$ |
|                                 | Long-term stability of reverse breakdown voltage             | $t = 1000\text{ h}$ ,<br>$T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ ,<br>$I_Z = 100\ \mu\text{A}$ |            | 120      |           |            | 120      |           | ppm                        |

## 5.6 LM4041x12Q Electrical Characteristics

full-range  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                       | TEST CONDITIONS                                              | $T_A$                                                                                           | LM4041C12Q |          |           | LM4041D12Q |          |           | UNIT             |
|---------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------|----------|-----------|------------|----------|-----------|------------------|
|                                 |                                                              |                                                                                                 | MIN        | TYP      | MAX       | MIN        | TYP      | MAX       |                  |
| $V_Z$                           | Reverse breakdown voltage                                    | $I_Z = 100\ \mu\text{A}$                                                                        |            | 1.225    |           |            | 1.225    |           | V                |
|                                 | Reverse breakdown voltage tolerance                          | $I_Z = 100\ \mu\text{A}$                                                                        |            |          |           |            |          |           | mV               |
|                                 |                                                              | 25°C                                                                                            | - 6        |          | 6         | - 12       |          | 12        |                  |
|                                 |                                                              | Full range                                                                                      | - 18.4     |          | 18.4      | - 31       |          | 31        | $\mu\text{A}$    |
|                                 |                                                              | 25°C                                                                                            |            | 45       | 75        |            | 45       | 75        |                  |
| $I_{Z,\min}$                    | Minimum cathode current                                      | Full range                                                                                      |            |          | 80        |            |          | 80        | ppm/°C           |
|                                 |                                                              | 25°C                                                                                            |            | $\pm 20$ |           |            | $\pm 20$ |           |                  |
| $\alpha_{VZ}$                   | Average temperature coefficient of reverse breakdown voltage | $I_Z = 10\text{mA}$                                                                             |            | $\pm 15$ |           |            | $\pm 15$ |           | mV               |
|                                 |                                                              | $I_Z = 1\text{mA}$                                                                              |            |          |           |            |          |           |                  |
|                                 |                                                              | Full range                                                                                      |            |          | $\pm 100$ |            |          | $\pm 150$ |                  |
|                                 |                                                              | $I_Z = 100\ \mu\text{A}$                                                                        |            | $\pm 15$ |           |            | $\pm 15$ |           |                  |
| $\frac{\Delta V_Z}{\Delta I_Z}$ | Reverse breakdown voltage change with cathode current change | $I_{Z,\min} < I_Z < 1\text{mA}$                                                                 |            | 0.7      | 1.5       |            | 0.7      | 2         | $\Omega$         |
|                                 |                                                              | Full range                                                                                      |            |          | 2         |            |          | 2.5       |                  |
|                                 |                                                              | $1\text{mA} < I_Z < 12\text{mA}$                                                                |            | 2.5      | 6         |            | 2.5      | 8         |                  |
|                                 |                                                              | Full range                                                                                      |            |          | 8         |            |          | 10        |                  |
| $Z_Z$                           | Reverse dynamic impedance                                    | $I_Z = 1\text{mA}$ , $f = 120\text{Hz}$ , $I_{AC} = 0.1 I_Z$                                    |            | 0.5      |           |            | 0.5      |           | $\mu\text{VRMS}$ |
|                                 |                                                              | Full range                                                                                      |            |          | 1.5       |            |          | 2         |                  |
| $e_N$                           | Wideband noise                                               | $I_Z = 100\ \mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$                               |            | 20       |           |            | 20       |           | ppm              |
|                                 | Long-term stability of reverse breakdown voltage             | $t = 1000\text{ h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$ |            | 120      |           |            | 120      |           |                  |

## 5.7 LM4041xl (Adjustable Version) Electrical Characteristics

full-range  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (unless otherwise noted)

| PARAMETER                              |                                                                     | TEST CONDITIONS                                                                                           | T <sub>A</sub> | LM4041BI |     |       | LM4041CI |     |       | UNIT               |
|----------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------|----------|-----|-------|----------|-----|-------|--------------------|
|                                        |                                                                     |                                                                                                           |                | MIN      | TYP | MAX   | MIN      | TYP | MAX   |                    |
| V <sub>REF</sub>                       | Reference voltage                                                   | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | 1.233    |     |       | 1.233    |     |       | V                  |
|                                        | Reference voltage tolerance <sup>(1)</sup>                          | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | – 2.5    |     | 2.5   | – 6.2    |     | 6.2   | mV                 |
|                                        |                                                                     |                                                                                                           | Full range     | – 10.5   |     | 10.5  | – 14     |     | 14    |                    |
| I <sub>Z,min</sub>                     | Minimum cathode current                                             |                                                                                                           | 25°C           | 45       |     | 75    | 45       |     | 75    | μ A                |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 80    |          |     | 80    |                    |
| Δ V <sub>REF</sub> / Δ I <sub>Z</sub>  | Reference voltage change with cathode current change                | I <sub>Z,min</sub> < I <sub>Z</sub> < 1mA                                                                 | 25°C           | 0.7      |     | 1.5   | 0.7      |     | 1.5   | mV                 |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 2     |          |     | 2     |                    |
|                                        |                                                                     | 1mA < I <sub>Z</sub> < 12mA                                                                               | 25°C           | 2        |     | 4     | 2        |     | 4     |                    |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 6     |          |     | 6     |                    |
| Δ V <sub>REF</sub> / Δ V <sub>KA</sub> | Reference voltage change with output voltage change                 | I <sub>Z</sub> = 1mA                                                                                      | 25°C           | – 1.55   |     | – 2   | – 1.55   |     | – 2   | mV/V               |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | – 2.5 |          |     | – 2.5 |                    |
| I <sub>FB</sub>                        | Feedback current                                                    |                                                                                                           | 25°C           | 60       |     | 100   | 60       |     | 100   | nA                 |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 120   |          |     | 120   |                    |
| α V <sub>REF</sub>                     | Average temperature coefficient of reference voltage <sup>(1)</sup> | I <sub>Z</sub> = 10mA, V <sub>Z</sub> = 5V                                                                | 25°C           | ±20      |     |       | ±20      |     |       | ppm/°C             |
|                                        |                                                                     | I <sub>Z</sub> = 1mA, V <sub>Z</sub> = 5V                                                                 | 25°C           | ±15      |     |       | ±15      |     |       |                    |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | ±100  |          |     | ±100  |                    |
|                                        |                                                                     | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | ±15      |     |       | ±15      |     |       |                    |
| Z <sub>Z</sub>                         | Reverse dynamic impedance                                           | I <sub>Z</sub> = 1mA, f = 120Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub> , V <sub>Z</sub> = V <sub>REF</sub> | 25°C           | 0.3      |     |       | 0.3      |     |       | Ω                  |
|                                        |                                                                     | I <sub>Z</sub> = 1mA, f = 120Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub> , V <sub>Z</sub> = 10V              | 25°C           | 2        |     |       | 2        |     |       |                    |
| e <sub>N</sub>                         | Wideband noise                                                      | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = V <sub>REF</sub> , 10Hz ≤ f ≤ 10kHz                            | 25°C           | 20       |     |       | 20       |     |       | μ V <sub>RMS</sub> |
|                                        | Long-term stability of reverse breakdown voltage                    | t = 1000 h, T <sub>A</sub> = 25°C ± 0.1°C, I <sub>Z</sub> = 100 μ A                                       | 25°C           | 120      |     |       | 120      |     |       | ppm                |

(1) Reference voltage tolerance and average temperature coefficient change with output voltage ( $V_Z$ ). See *Typical Characteristics*.

## 5.8 LM4041xl (Adjustable Version) Electrical Characteristics

full-range  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (unless otherwise noted)

| PARAMETER                      |                                                                     | TEST CONDITIONS                                                                                     | $T_A$                | LM4041DI |          |           | UNIT                    |
|--------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------|----------|----------|-----------|-------------------------|
|                                |                                                                     |                                                                                                     |                      | MIN      | TYP      | MAX       |                         |
| $V_{REF}$                      | Reference voltage                                                   | $I_Z = 100\ \mu\text{A}$ , $V_Z = 5\text{V}$                                                        | $25^{\circ}\text{C}$ |          | 1.233    |           | V                       |
|                                | Reference voltage tolerance <sup>(1)</sup>                          | $I_Z = 100\ \mu\text{A}$ , $V_Z = 5\text{V}$                                                        | $25^{\circ}\text{C}$ | - 12     |          | 12        | mV                      |
|                                |                                                                     |                                                                                                     | Full range           | - 24     |          | 24        |                         |
| $I_{Z,min}$                    | Minimum cathode current                                             |                                                                                                     | $25^{\circ}\text{C}$ |          | 45       | 75        | $\mu\text{A}$           |
|                                |                                                                     |                                                                                                     | Full range           |          |          | 80        |                         |
| $\Delta V_{REF}/\Delta I_Z$    | Reference voltage change with cathode current change                | $I_{Z,min} < I_Z < 1\text{mA}$                                                                      | $25^{\circ}\text{C}$ |          | 0.7      | 2         | mV                      |
|                                |                                                                     |                                                                                                     | Full range           |          |          | 2.5       |                         |
|                                |                                                                     | $1\text{mA} < I_Z < 12\text{mA}$                                                                    | $25^{\circ}\text{C}$ |          | 2        | 6         |                         |
|                                |                                                                     |                                                                                                     | Full range           |          |          | 8         |                         |
| $\Delta V_{REF}/\Delta V_{KA}$ | Reference voltage change with output voltage change                 | $I_Z = 1\text{mA}$                                                                                  | $25^{\circ}\text{C}$ | - 1.55   |          | - 2       | mV/V                    |
|                                |                                                                     |                                                                                                     | Full range           |          |          | - 3       |                         |
| $I_{FB}$                       | Feedback current                                                    |                                                                                                     | $25^{\circ}\text{C}$ |          | 60       | 150       | nA                      |
|                                |                                                                     |                                                                                                     | Full range           |          |          | 200       |                         |
| $\alpha V_{REF}$               | Average temperature coefficient of reference voltage <sup>(1)</sup> | $I_Z = 10\text{mA}$ , $V_Z = 5\text{V}$                                                             | $25^{\circ}\text{C}$ |          | $\pm 20$ |           | ppm/ $^{\circ}\text{C}$ |
|                                |                                                                     | $I_Z = 1\text{mA}$ , $V_Z = 5\text{V}$                                                              | $25^{\circ}\text{C}$ |          | $\pm 15$ |           |                         |
|                                |                                                                     |                                                                                                     | Full range           |          |          | $\pm 150$ |                         |
|                                |                                                                     | $I_Z = 100\ \mu\text{A}$ , $V_Z = 5\text{V}$                                                        | $25^{\circ}\text{C}$ |          | $\pm 15$ |           |                         |
| $Z_Z$                          | Reverse dynamic impedance                                           | $I_Z = 1\text{mA}$ , $f = 120\text{Hz}$ , $I_{AC} = 0.1\ I_Z$ , $V_Z = V_{REF}$                     | $25^{\circ}\text{C}$ |          | 0.3      |           | $\Omega$                |
|                                |                                                                     | $I_Z = 1\text{mA}$ , $f = 120\text{Hz}$ , $I_{AC} = 0.1\ I_Z$ , $V_Z = 10\text{V}$                  | $25^{\circ}\text{C}$ |          | 2        |           |                         |
| $e_N$                          | Wideband noise                                                      | $I_Z = 100\ \mu\text{A}$ , $V_Z = V_{REF}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$                 | $25^{\circ}\text{C}$ |          | 20       |           | $\mu\text{V}_{RMS}$     |
|                                | Long-term stability of reverse breakdown voltage                    | $t = 1000\text{ h}$ , $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ , $I_Z = 100\ \mu\text{A}$ | $25^{\circ}\text{C}$ |          | 120      |           | ppm                     |

(1) Reference voltage tolerance and average temperature coefficient change with output voltage ( $V_Z$ ). See *Typical Characteristics*.

## 5.9 LM4041xQ (Adjustable Version) Electrical Characteristics

full-range  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                              |                                                                     | TEST CONDITIONS                                                                                           | T <sub>A</sub> | LM4041CQ |     |     | LM4041DQ |     |       | UNIT               |      |  |
|----------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------|----------|-----|-----|----------|-----|-------|--------------------|------|--|
|                                        |                                                                     |                                                                                                           |                | MIN      | TYP | MAX | MIN      | TYP | MAX   |                    |      |  |
| V <sub>REF</sub>                       | Reference voltage                                                   | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | 1.233    |     |     | 1.233    |     |       | V                  |      |  |
|                                        | Reference voltage tolerance <sup>(1)</sup>                          | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | – 6.2    |     | 6.2 | – 12     |     | 12    | mV                 |      |  |
|                                        |                                                                     |                                                                                                           | Full range     | – 18     |     | 18  | – 30     |     | 30    |                    |      |  |
| I <sub>Z,min</sub>                     | Minimum cathode current                                             |                                                                                                           | 25°C           | 45       |     | 75  | 45       |     | 75    | μ A                |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 80  |          |     | 80    |                    |      |  |
| Δ V <sub>REF</sub> / Δ I <sub>Z</sub>  | Reference voltage change with cathode current change                | I <sub>Z,min</sub> < I <sub>Z</sub> < 1mA                                                                 | 25°C           | 0.7      |     | 1.5 | 0.7      |     | 2     | mV                 |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 2   |          |     | 2.5   |                    |      |  |
|                                        |                                                                     | 1mA < I <sub>Z</sub> < 12mA                                                                               | 25°C           | 2        |     | 4   | 2        |     | 6     |                    |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 8   |          |     | 10    |                    |      |  |
| Δ V <sub>REF</sub> / Δ V <sub>KA</sub> | Reference voltage change with output voltage change                 | I <sub>Z</sub> = 1mA                                                                                      | 25°C           | – 1.55   |     | – 2 | – 1.55   |     | – 2.5 | mV/V               |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | – 3 |          |     | – 4   |                    |      |  |
| I <sub>FB</sub>                        | Feedback current                                                    |                                                                                                           | 25°C           | 60       |     | 100 | 60       |     | 150   | nA                 |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     | 120 |          |     | 200   |                    |      |  |
| α V <sub>REF</sub>                     | Average temperature coefficient of reference voltage <sup>(1)</sup> | I <sub>Z</sub> = 10mA, V <sub>Z</sub> = 5V                                                                | 25°C           | ±20      |     |     | ±20      |     |       | ppm/°C             |      |  |
|                                        |                                                                     | I <sub>Z</sub> = 1mA, V <sub>Z</sub> = 5V                                                                 | 25°C           | ±15      |     |     | ±15      |     |       |                    |      |  |
|                                        |                                                                     |                                                                                                           | Full range     |          |     |     | ±100     |     |       |                    | ±150 |  |
|                                        |                                                                     | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = 5V                                                             | 25°C           | ±15      |     |     | ±15      |     |       |                    |      |  |
| Z <sub>Z</sub>                         | Reverse dynamic impedance                                           | I <sub>Z</sub> = 1mA, f = 120Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub> , V <sub>Z</sub> = V <sub>REF</sub> | 25°C           | 0.3      |     |     | 0.3      |     |       | Ω                  |      |  |
|                                        |                                                                     | I <sub>Z</sub> = 1mA, f = 120Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub> , V <sub>Z</sub> = 10V              | 25°C           | 2        |     |     | 2        |     |       |                    |      |  |
| e <sub>N</sub>                         | Wideband noise                                                      | I <sub>Z</sub> = 100 μ A, V <sub>Z</sub> = V <sub>REF</sub> , 10Hz ≤ f ≤ 10kHz                            | 25°C           | 20       |     |     | 20       |     |       | μ V <sub>RMS</sub> |      |  |
|                                        | Long-term stability of reverse breakdown voltage                    | t = 1000 h, T <sub>A</sub> = 25°C ± 0.1°C, I <sub>Z</sub> = 100 μ A                                       | 25°C           | 120      |     |     | 120      |     |       | ppm                |      |  |

(1) Reference voltage tolerance and average temperature coefficient change with output voltage ( $V_Z$ ). See *Typical Characteristics*.

## 5.10 Typical Characteristics

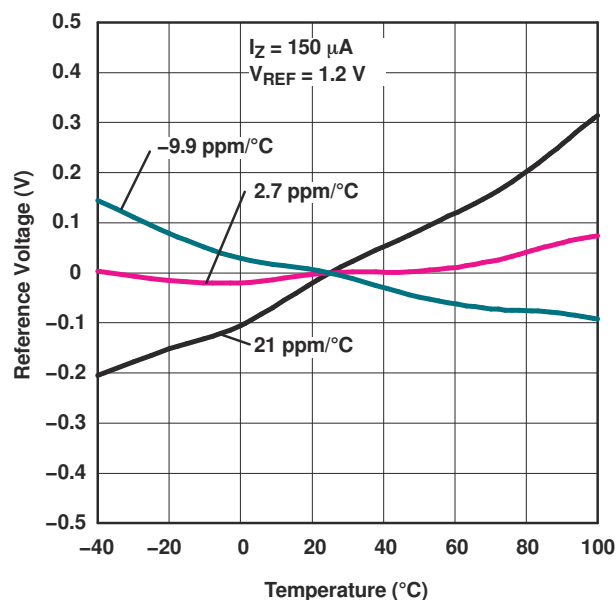


图 5-1. Temperature Drift for Different Average Temperature Coefficients

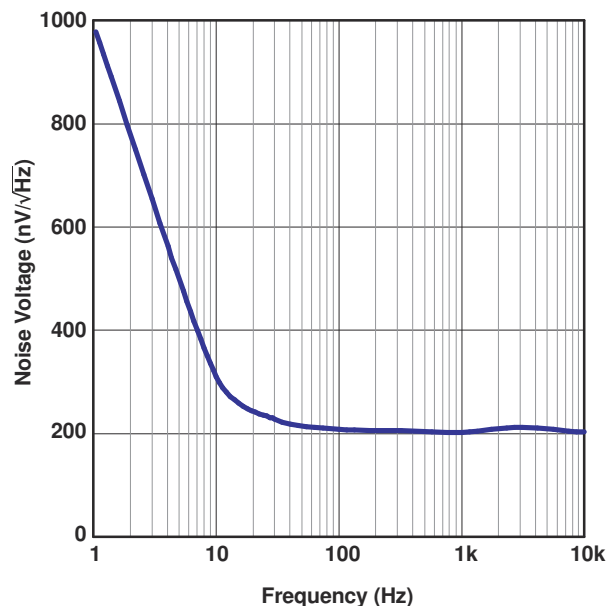


图 5-2. Noise Voltage vs Frequency

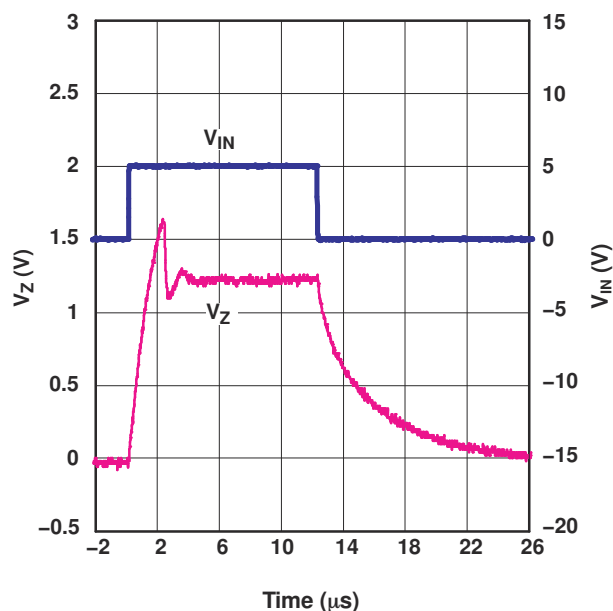


图 5-3. Start-Up Characteristics

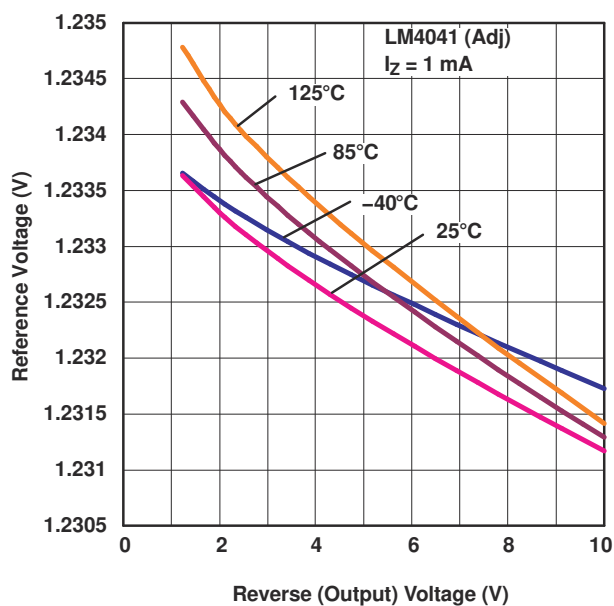


图 5-4. Reference Voltage vs Reverse (Output) Voltage (for Different Temperatures)

## 5.10 Typical Characteristics (continued)

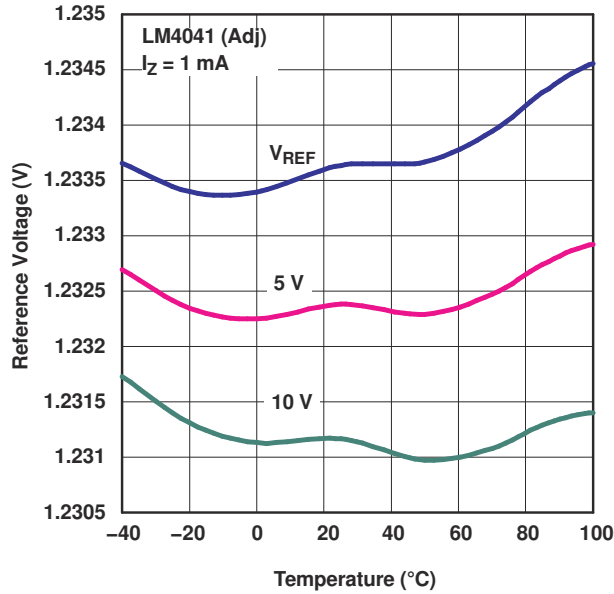


图 5-5. Reference Voltage vs Temperature (for Different Reverse Voltages)

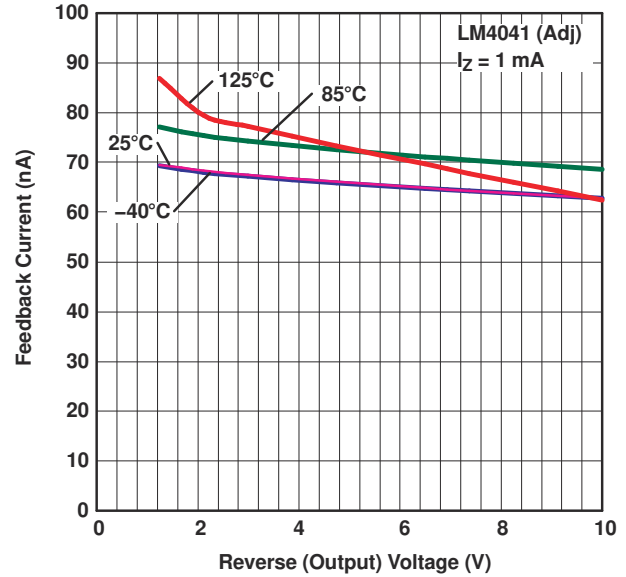


图 5-6. Feedback Current vs Reverse (Output) Voltage (for Different Temperatures)

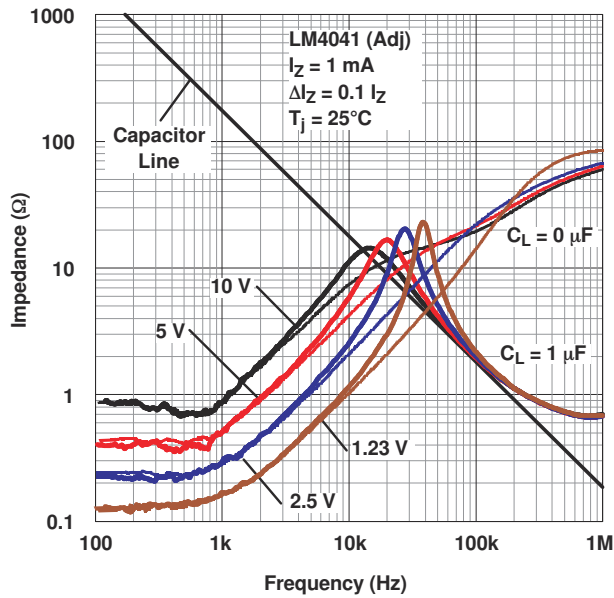


图 5-7. Output Impedance vs Frequency

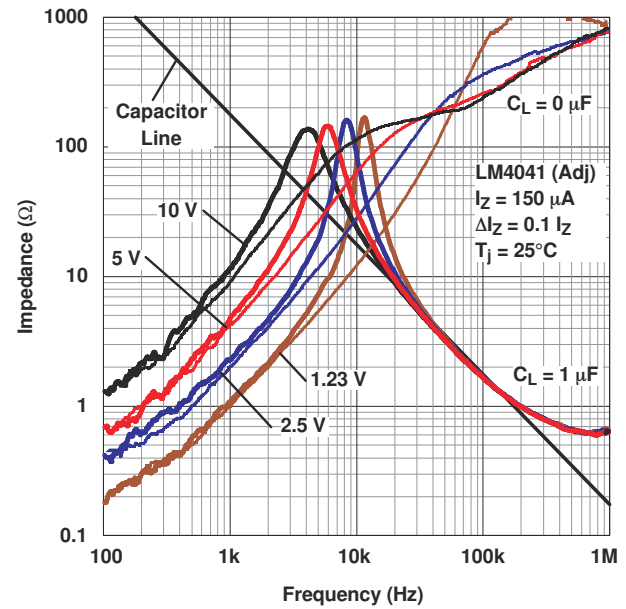


图 5-8. Output Impedance vs Frequency

## 5.10 Typical Characteristics (continued)

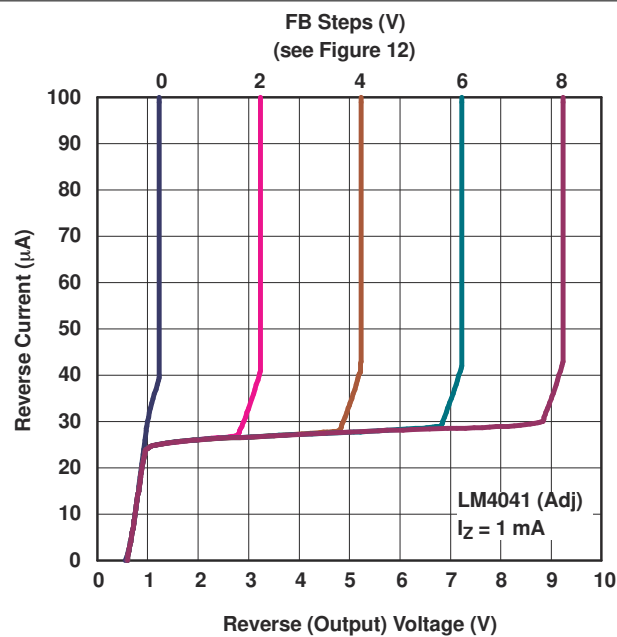


图 5-9. Reverse Characteristics

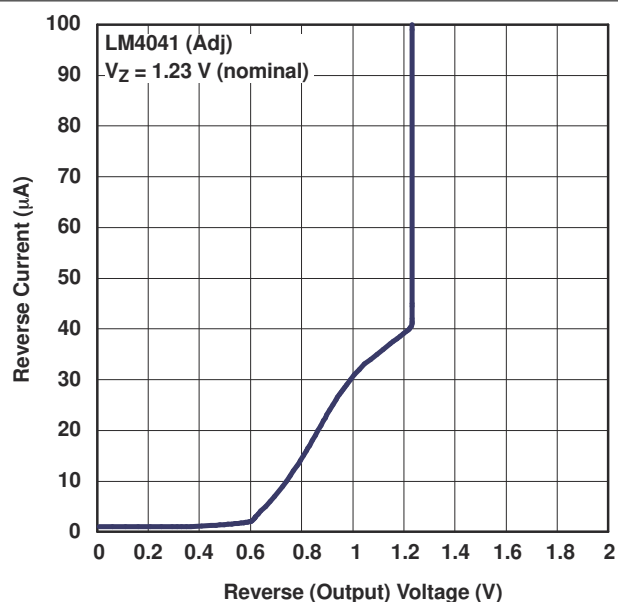


图 5-10. Reverse Characteristics and Minimum Operating Current

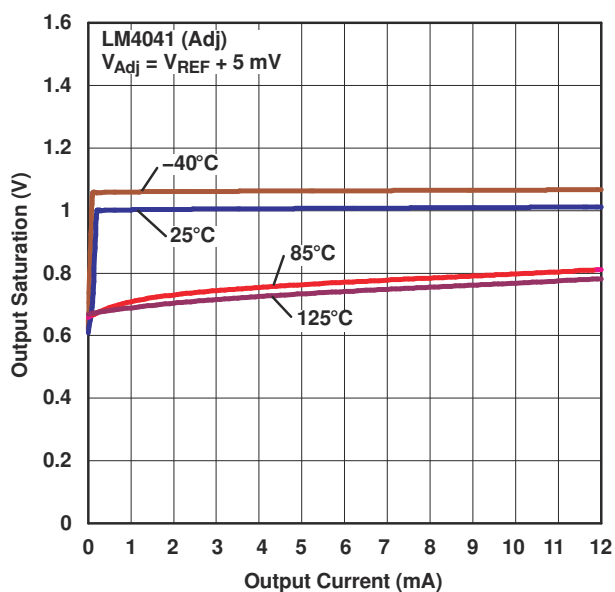
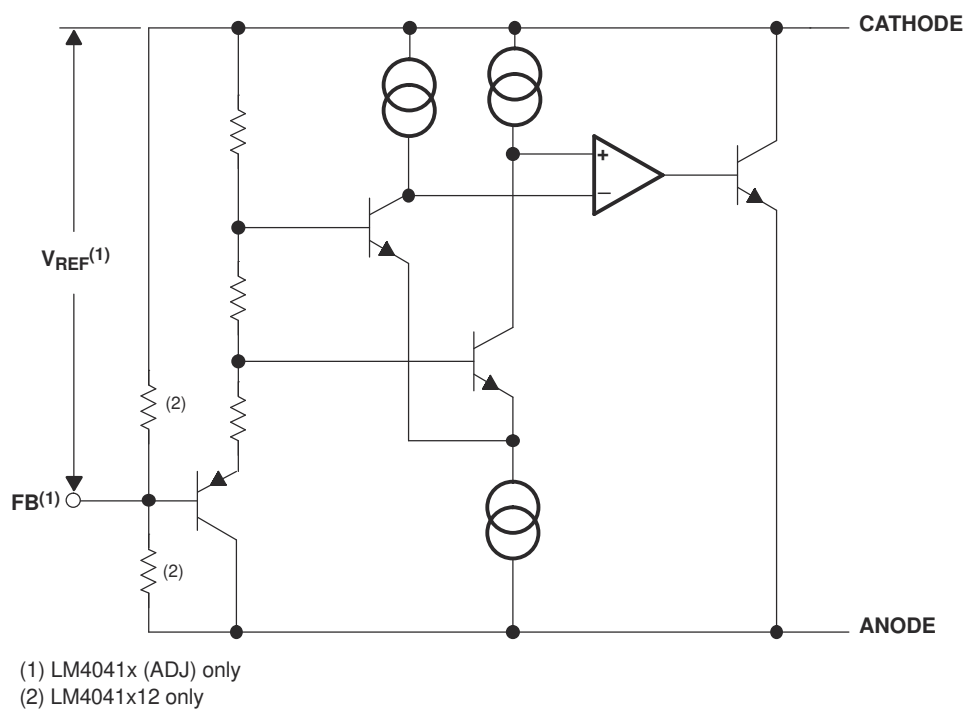


图 5-11. Output Saturation vs Output Current

## 6 Functional Block Diagram



**图 6-1. Functional Block Diagram**

## 7 Application Information

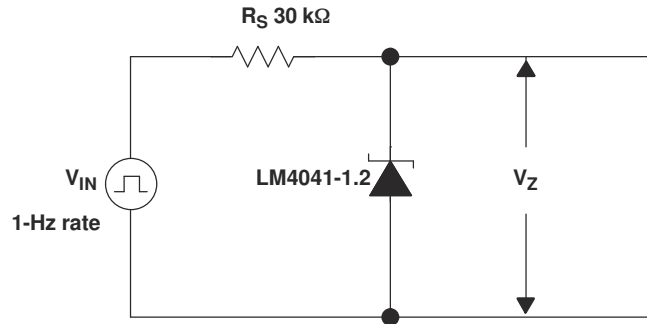


图 7-1. Startup Characteristics Test Circuit

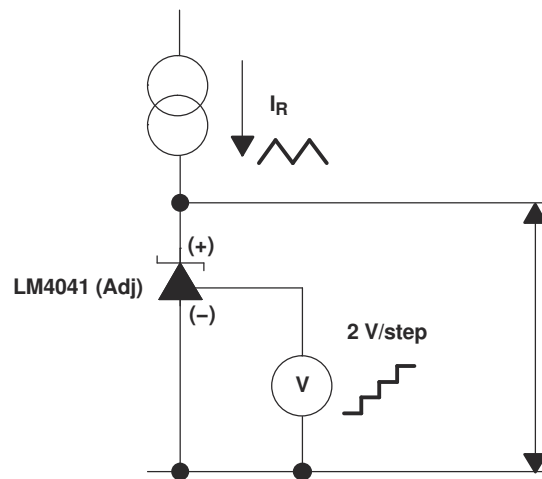


图 7-2. Reverse Characteristics Test Circuit

### 7.1 Output Capacitor

The LM4041 does not require an output capacitor across CATHODE and ANODE for stability. However, if an output bypass capacitor is desired, the LM4041 is designed to be stable with all capacitive loads.

### 7.2 SOT-23 and SC-70 Pin Connections

There is a parasitic Schottky diode connected between pins 2 and 3 of the SOT-23 packaged device. Thus, pin 3 of the SOT-23 package must be left floating or connected to pin 2. Similarly, pin 2 of the SC-70 package also must be left floating or connected to pin 1.

### 7.3 Adjustable Version

The adjustable version allows  $V_Z$  to be set by a user-defined resistor divider. The output voltage,  $V_Z$ , is set according to the equation shown in 图 7-3.

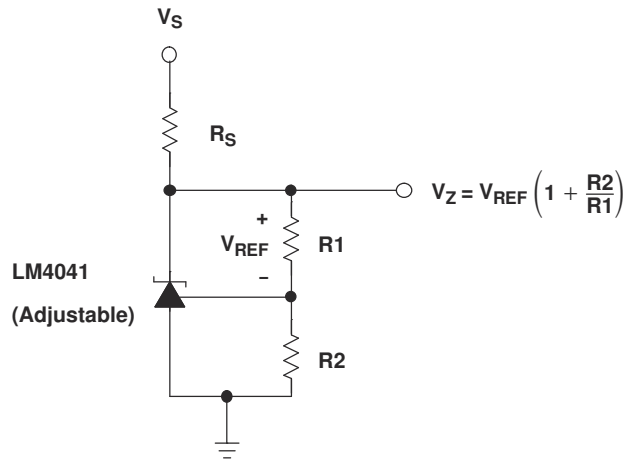


图 7-3. Adjustable Shunt Regulator

When the output voltage,  $V_Z$ , is set below 2.5V on adjustable versions of LM4041, the device can experience increased reference voltage change with output voltage change ( $\Delta V_{REF}/\Delta V_{KA}$ ) when compared to output voltages set equal to or above 2.5V.

### 7.4 Cathode and Load Currents

In a typical shunt regulator configuration (see 图 7-4), an external resistor,  $R_S$ , is connected between the supply and the cathode of the LM4041.  $R_S$  must be set properly, this sets the total current available to supply the load ( $I_L$ ) and bias the LM4041 ( $I_Z$ ). In all cases,  $I_Z$  must stay within a specified range for proper operation of the reference. Taking into consideration one extreme in the variation of the load and supply voltage (maximum  $I_L$  and minimum  $V_S$ ),  $R_S$  must be small enough to supply the minimum  $I_Z$  required for operation of the regulator, as given by data sheet parameters. At the other extreme, maximum  $V_S$  and minimum  $I_L$ ,  $R_S$  must be large enough to limit  $I_Z$  to less than the maximum recommended rating of 12mA.

$R_S$  is calculated as shown in 方程式 1.

$$R_S = \frac{(V_S - V_Z)}{(I_L + I_Z)} \quad (1)$$

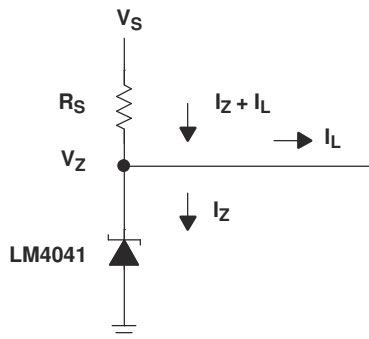


图 7-4. Shunt Regulator

## 8 器件和文档支持

### 8.1 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](https://www.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。

### 8.2 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。

### 8.3 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。

### 8.4 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](#)。

### 8.5 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

## 9 Revision History

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision G (July 2024) to Revision H (March 2025)                 | Page |
|--------------------------------------------------------------------------------|------|
| • Updated LP pin numbering.....                                                | 3    |
| • Added electromagnetic interference note and updated LP pinout numbering..... | 3    |
| • Added ESD ratings.....                                                       | 5    |
| • Added reference voltage change with output voltage change details.....       | 17   |

| Changes from Revision F (September 2020) to Revision G (July 2024) | Page |
|--------------------------------------------------------------------|------|
| • 更新了 <a href="#">应用</a> 链接.....                                   | 1    |
| • Updated pinout diagrams .....                                    | 3    |

**Changes from Revision E (February 2006) to Revision F (September 2020)****Page**

- 更新了整个文档中的表、图和交叉参考的编号格式..... 1
- Deleted *Ordering Information* table. See Mechanical, Packaging, and Orderable Information at the end of the data sheet..... 15

## 10 Mechanical, Packaging, and Orderable Information

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

**PACKAGING INFORMATION**

| Orderable<br>part number        | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4041A12IDBZR</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (4MK3, 4MKU)        |
| <a href="#">LM4041A12IDBZT</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (4MK3, 4MKU)        |
| <a href="#">LM4041A12IDCKR</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | MKU                 |
| <a href="#">LM4041B12IDBZR</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (4ML3, 4MLU)        |
| <a href="#">LM4041B12IDBZT</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (4ML3, 4MLU)        |
| <a href="#">LM4041B12IDCKR</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | MLU                 |
| <a href="#">LM4041BIDBZR</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MG3, 4MGU)        |
| <a href="#">LM4041BIDBZR1G4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MG3, 4MGU)        |
| <a href="#">LM4041BIDBZT</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MG3, 4MGU)        |
| <a href="#">LM4041BIDCKR</a>    | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MGU                 |
| <a href="#">LM4041BIDCKT</a>    | Active        | Production           | SC70 (DCK)   5   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MGU                 |
| <a href="#">LM4041C12IDBZR</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MM3, 4MMU)        |
| <a href="#">LM4041C12IDBZT</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (4MM3, 4MMU)        |
| <a href="#">LM4041C12IDCKR</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | MMU                 |
| <a href="#">LM4041C12ILP</a>    | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPC12I              |
| <a href="#">LM4041C12ILPR</a>   | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPC12I              |
| <a href="#">LM4041C12QDBZR</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (4MS3, 4MSU)        |
| <a href="#">LM4041C12QDBZT</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (4MS3, 4MSU)        |
| <a href="#">LM4041CIDBZR</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MH3, 4MHU)        |
| <a href="#">LM4041CIDBZT</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MH3, 4MHU)        |
| <a href="#">LM4041CIDCKR</a>    | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MHU                 |
| <a href="#">LM4041CIDCKT</a>    | Active        | Production           | SC70 (DCK)   5   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MHU                 |
| <a href="#">LM4041CILP</a>      | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | NPCI                |
| <a href="#">LM4041CILPR</a>     | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPCI                |
| <a href="#">LM4041CQDBZR</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | (4MP3, 4MPU)        |
| <a href="#">LM4041CQDBZT</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | (4MP3, 4MPU)        |
| <a href="#">LM4041D12IDBZR</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MN3, 4MNU)        |
| <a href="#">LM4041D12IDBZT</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (4MN3, 4MNU)        |
| <a href="#">LM4041D12IDCKR</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | MNU                 |

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4041D12ILP</a>   | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPD12I              |
| <a href="#">LM4041D12ILPR</a>  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPD12I              |
| <a href="#">LM4041D12QDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (4MT3, 4MTU)        |
| <a href="#">LM4041DIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MJ3, 4MJU)        |
| <a href="#">LM4041DIDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 85    | (4MJ3, 4MJU)        |
| <a href="#">LM4041DIDCKR</a>   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MJU                 |
| <a href="#">LM4041DIDCKRG4</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MJU                 |
| <a href="#">LM4041DILP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | NPDI                |
| <a href="#">LM4041DILPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | NPDI                |
| <a href="#">LM4041DQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | (4MR3, 4MRU)        |
| <a href="#">LM4041DQDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | (4MR3, 4MRU)        |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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

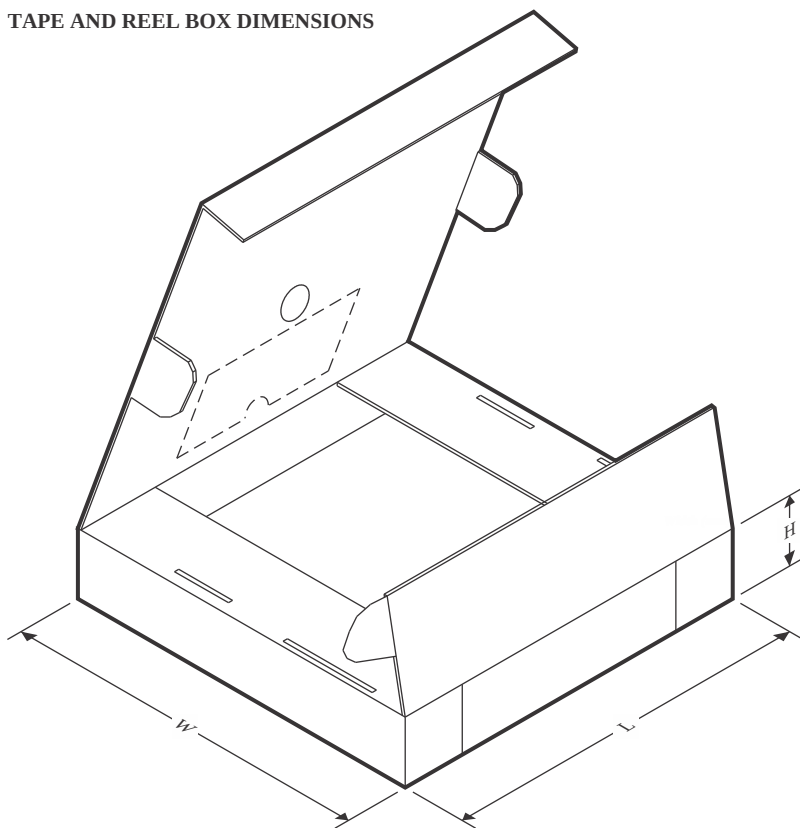
**TAPE AND REEL INFORMATION**


\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4041A12IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041A12IDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041A12IDCKR  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041A12IDCKR  | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041B12IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041B12IDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041B12IDCKR  | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041B12IDCKR  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041BIDBZR    | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDBZR    | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDBZR1G4 | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDBZR1G4 | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDBZT    | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041BIDCKR    | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041BIDCKT    | SC70         | DCK             | 5    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4041C12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041C12IDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041C12IDCKR | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041C12IDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041C12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041C12QDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CIDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041CIDCKT   | SC70         | DCK             | 5    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041CQDBZT   | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041D12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041D12IDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041D12IDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041D12IDCKR | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041D12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4041DIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DIDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DIDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041DIDCKRG4 | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4041DQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DQDBZT   | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| LM4041DQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |

## TAPE AND REEL BOX DIMENSIONS



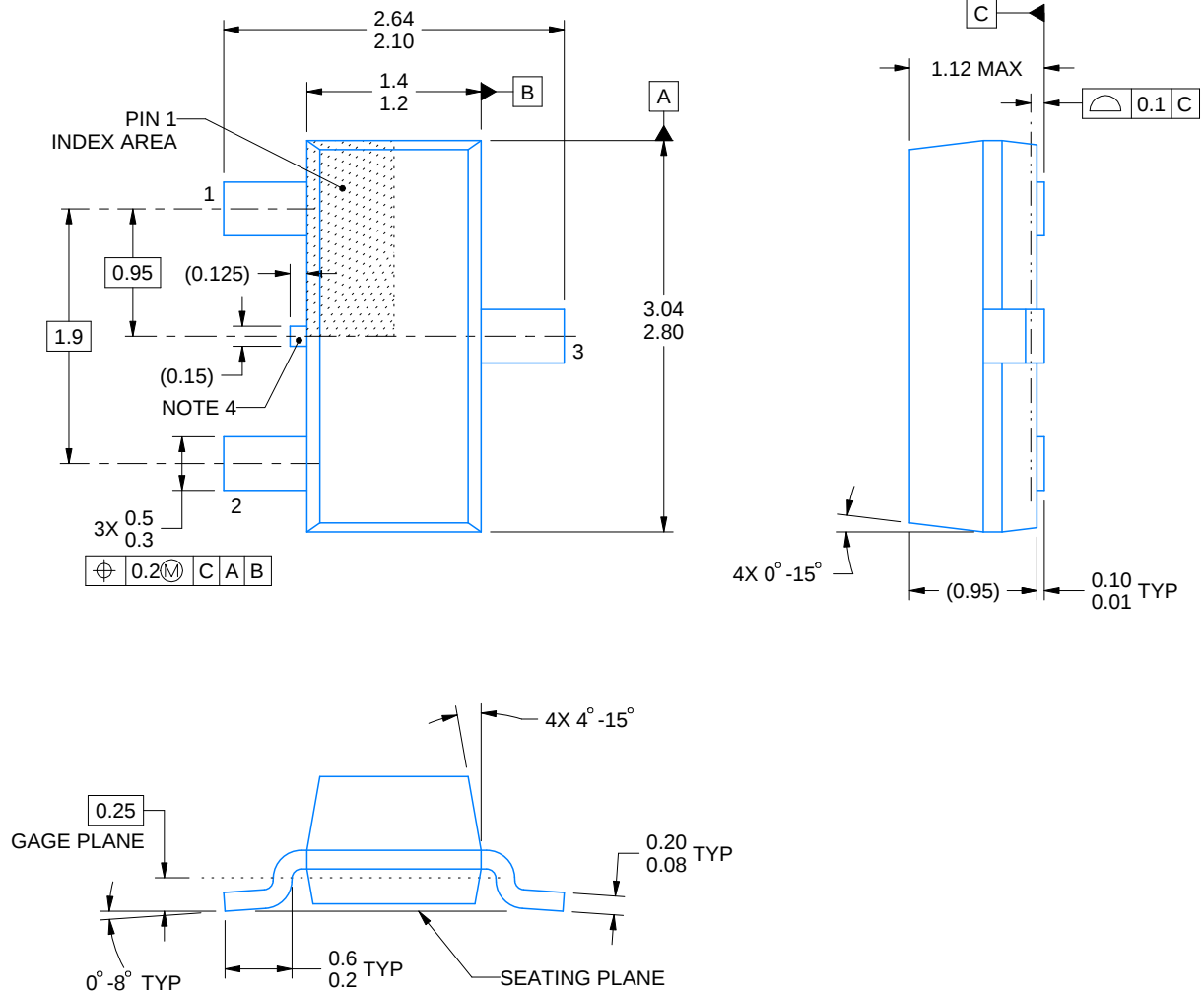
\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4041A12IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041A12IDBZT  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| LM4041A12IDCKR  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041A12IDCKR  | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041B12IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041B12IDBZT  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| LM4041B12IDCKR  | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041B12IDCKR  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041BIDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041BIDBZR    | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041BIDBZR1G4 | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041BIDBZR1G4 | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041BIDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| LM4041BIDBZT    | SOT-23       | DBZ             | 3    | 250  | 200.0       | 183.0      | 25.0        |
| LM4041BIDCKR    | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041BIDCKT    | SC70         | DCK             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| LM4041C12IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041C12IDBZT  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4041C12IDCKR | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041C12IDCKR | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041C12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041C12QDBZT | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| LM4041CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 203.0       | 203.0      | 35.0        |
| LM4041CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| LM4041CIDCKR   | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041CIDCKT   | SC70         | DCK             | 5    | 250  | 200.0       | 183.0      | 25.0        |
| LM4041CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041CQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| LM4041CQDBZT   | SOT-23       | DBZ             | 3    | 250  | 200.0       | 183.0      | 25.0        |
| LM4041D12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041D12IDBZT | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| LM4041D12IDCKR | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041D12IDCKR | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041D12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4041DIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041DIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041DIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| LM4041DIDCKR   | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041DIDCKRG4 | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041DQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| LM4041DQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| LM4041DQDBZT   | SOT-23       | DBZ             | 3    | 250  | 203.0       | 203.0      | 35.0        |
| LM4041DQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |

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

SMALL OUTLINE TRANSISTOR



4214838/F 08/2024

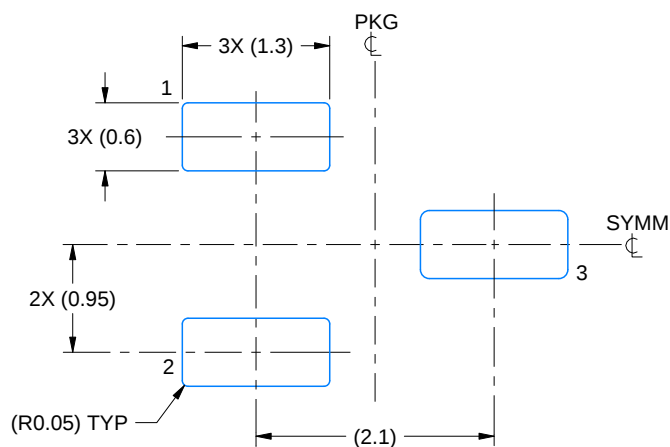
**NOTES:**

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

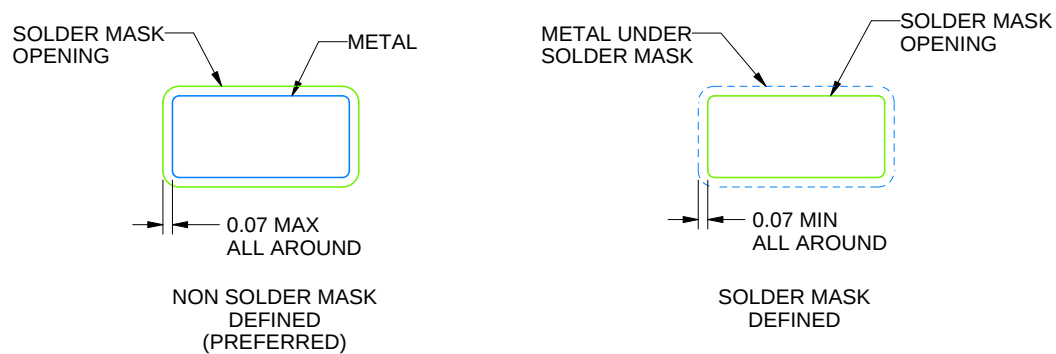
**DBZ0003A**

## SOT-23 - 1.12 mm max height

## SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



## SOLDER MASK DETAILS

4214838/F 08/2024

NOTES: (continued)

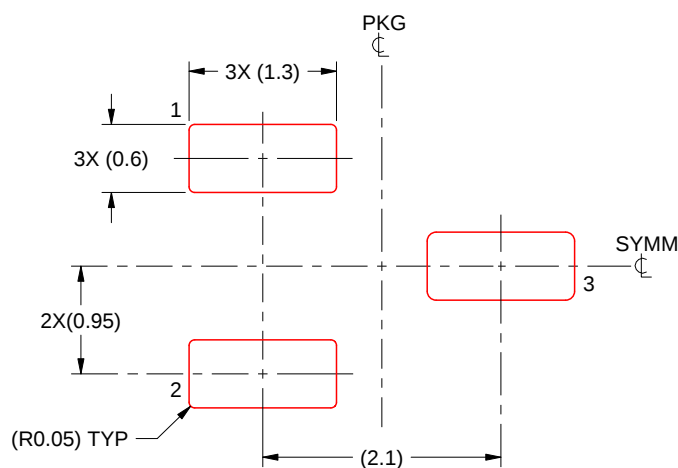
5. Publication IPC-7351 may have alternate designs.  
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR

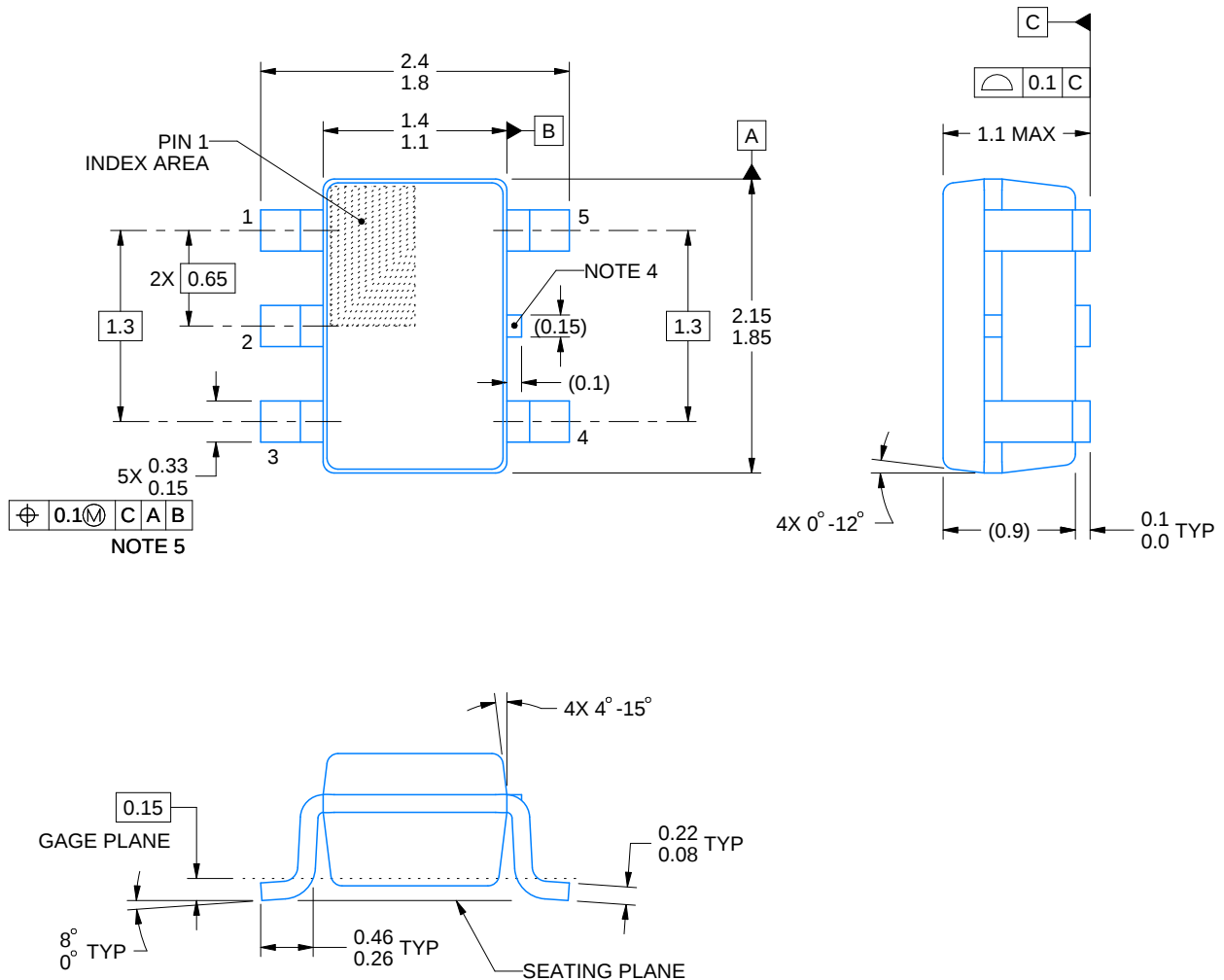


SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:15X

4214838/F 08/2024

NOTES: (continued)

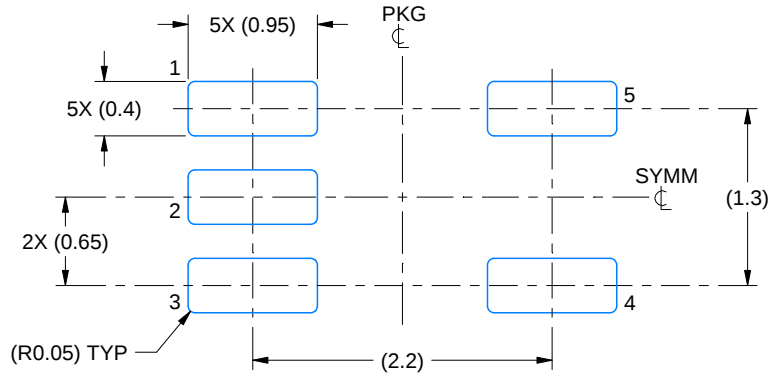
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



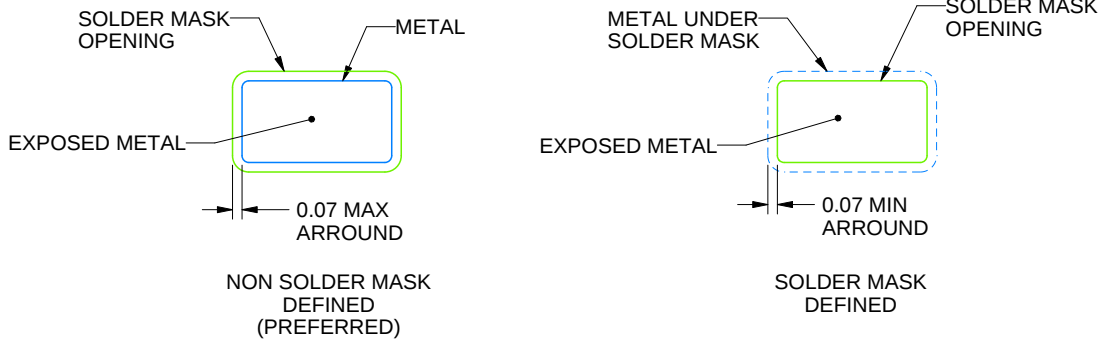
4214834/G 11/2024

## 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. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X

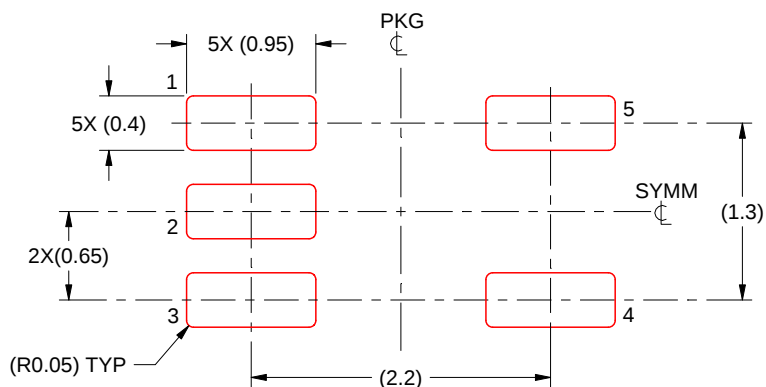


SOLDER MASK DETAILS

4214834/G 11/2024

NOTES: (continued)

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



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

4214834/G 11/2024

NOTES: (continued)

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

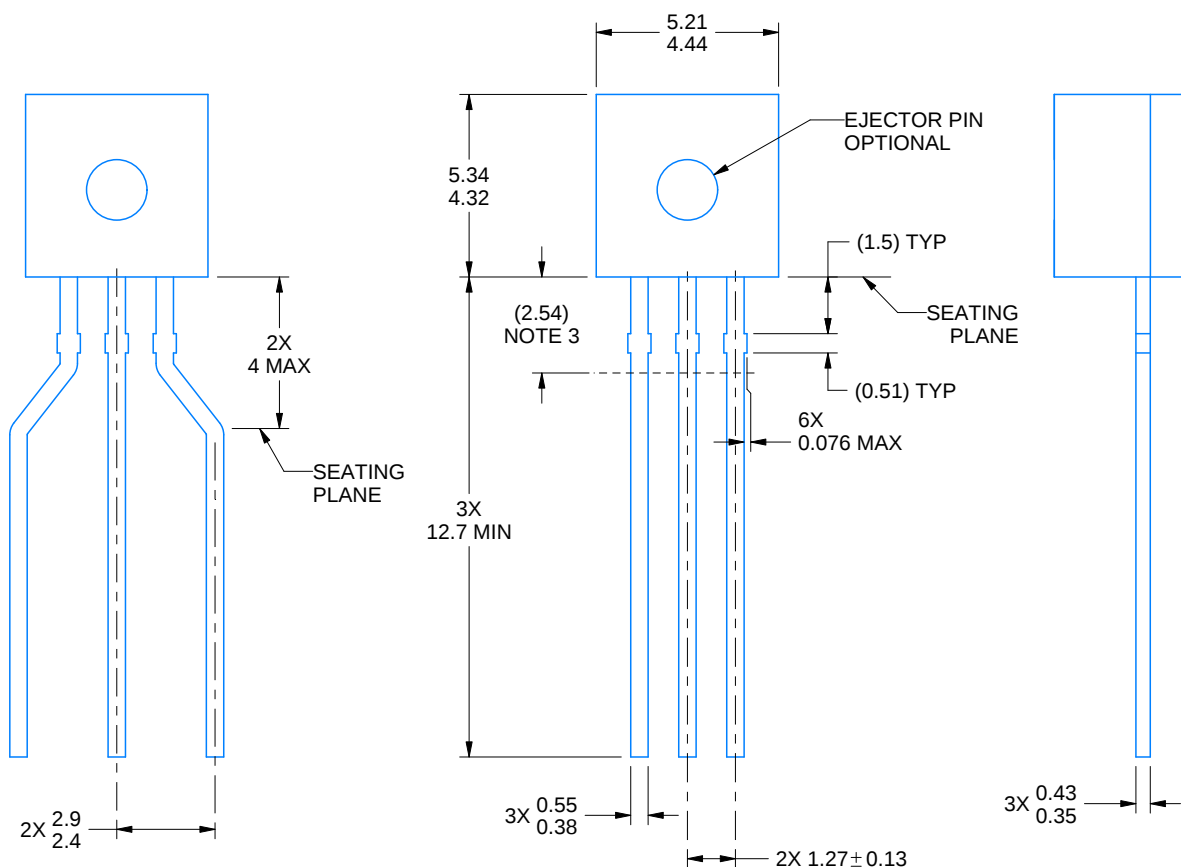
LP0003A



# PACKAGE OUTLINE

TO-92 - 5.34 mm max height

TO-92



4215214/C 04/2025

## NOTES:

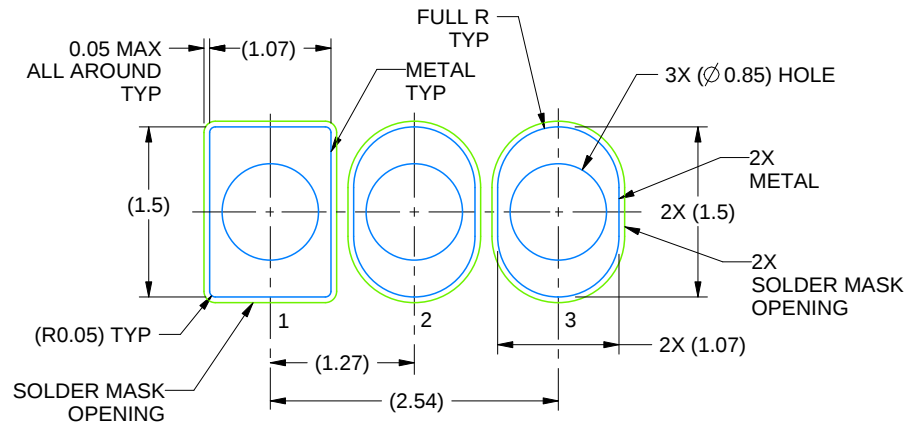
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping 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

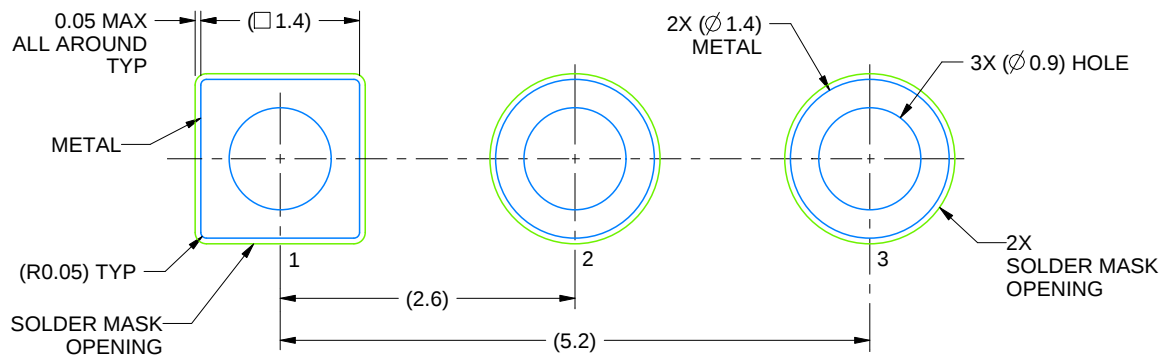
LP0003A

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

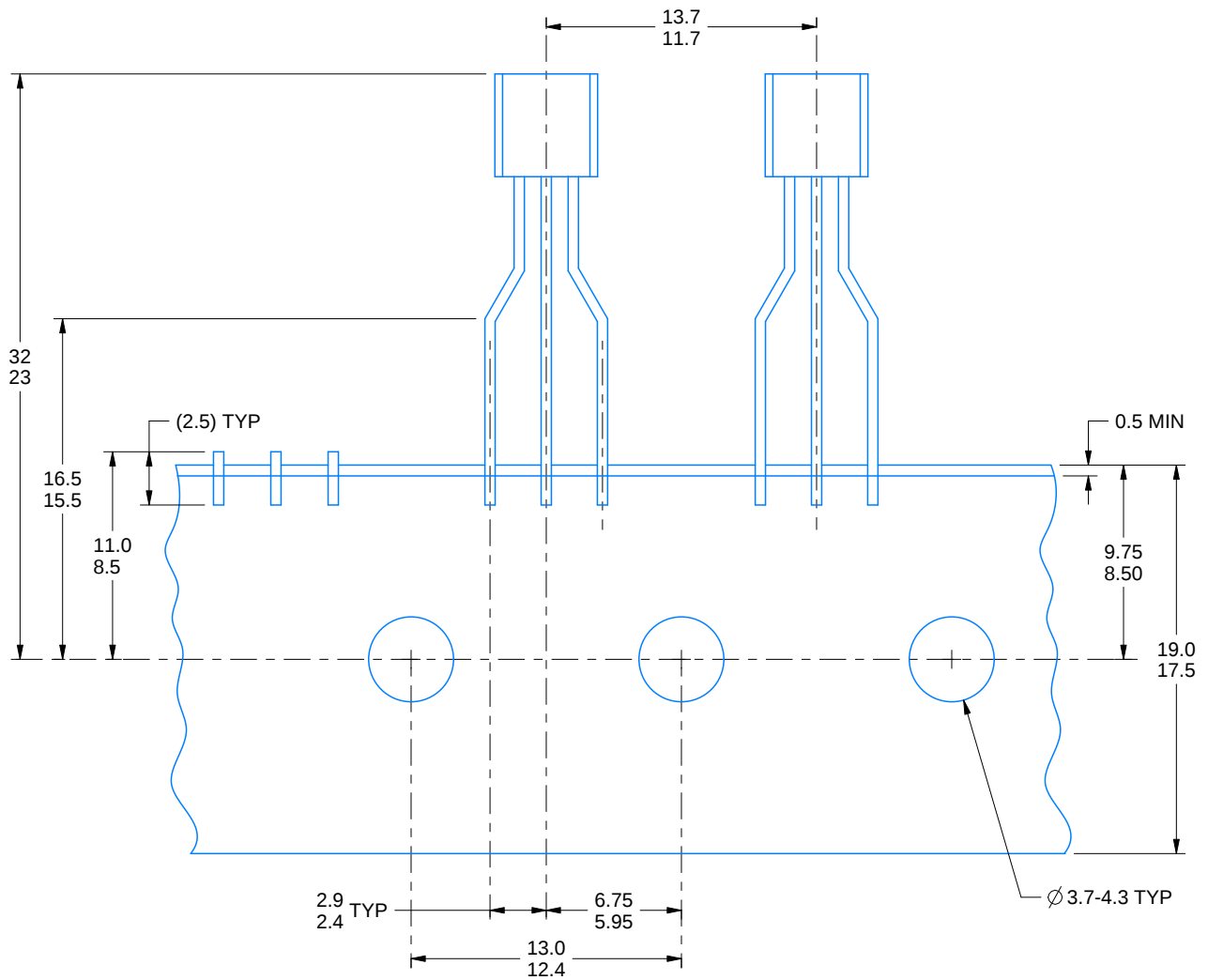
4215214/C 04/2025

# TAPE SPECIFICATIONS

LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

4215214/C 04/2025

## 重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、某特定用途方面的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他功能安全、信息安全、监管或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。您应全额赔偿因在这些资源的使用中对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，TI 对此概不负责。

TI 提供的产品受 [TI 的销售条款](#) 或 [ti.com](#) 上其他适用条款/TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

邮寄地址：Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
版权所有 © 2025，德州仪器 (TI) 公司