# LM4041 高精度マイクロパワー・シャント電圧リファレンス

## 1 特長

- 固定出力 (1.225V)、
  可変出力 (1.225V ~ 10V)
- 厳しい出力許容誤差と小さい温度係数
  - 0.1% 以下、100ppm/℃ – A グレード
  - 0.2% 以下、100ppm/℃ – B グレード
  - 0.5% 以下、100ppm/℃ – C グレード
  - 1.0% 以下、150ppm/℃ – D グレード
- 低い出力ノイズ。。20μ$V_{RMS}$ (標準値)
- 広い動作電流範囲。。
  45μA (標準値) ~ 12mA
- 容量性負荷の大小にかかわらず安定して動作するため、出力コンデンサは不要
- 利用可能なバージョン：
  - 産業用温度範囲：–40℃ ~ 85℃
  - 拡張動作温度範囲：–40℃ ~ 125℃

## 2 アプリケーション

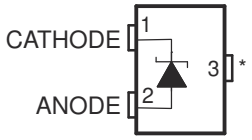
- データ収集システム
- 電源と電源モニタ
- 計装およびテスト機器
- プロセス制御
- 高精度オーディオ
- 車載用電子機器
- エネルギー管理 / 測定
- バッテリ駆動の機器

## 3 概要

LM4041 シリーズのシャント電圧リファレンスは、多様なアプリケーションに適した汎用性が高く使いやすい基準電圧です。外付けコンデンサを必要とせず、容量性負荷の大小にかかわらず安定して動作します。また、この基準電圧はダイナミック・インピーダンス、ノイズ、温度係数が小さく、広範囲の動作電流および温度にわたって安定した電圧を確実に出力します。LM4041 では、ウェハー・ソート時のヒューズとツェナー・ザップ逆方向ブレークダウンによる電圧調整を使用して、最大 0.1% (A グレード) から最大 1% (D グレード) までの 4 種類の出力電圧許容誤差の製品を提供しています。このため、アプリケーションに適した最良のコスト / 性能比を非常に柔軟に選択できます。LM4041 は、固定バージョン (公称 1.225V) または可変バージョン (出力を 1.225V ~ 10V の値に設定するための外付け抵抗分割器が必要です) で提供しています。

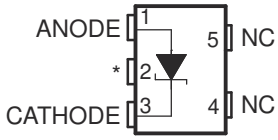
省スペースの SC-70 と SOT-23-3 にパッケージ化され、45μA (標準値) の電流で動作する LM4041 は、ポータブル・アプリケーションにも理想的です。スルーホール・パッケージの要求に対しては、TO-92 パッケージも提供しています。LM4041xI は –40℃ ~ 85℃の周囲温度範囲で動作します。LM4041xQ は –40℃ ~ 125℃の周囲温度範囲で動作します。

**1.2 V . . . DBZ (SOT-23) PACKAGE**
**(TOP VIEW)**




* Pin 3 must be connected to ANODE or left open.

**1.2 V . . . DCK (SC-70) PACKAGE**
**(TOP VIEW)**



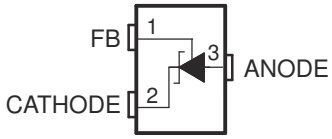

NC – No internal connection
* Pin 2 must be connected to ANODE or left open.

**1.2 V . . . LP (TO-92/TO-226) PACKAGE**
**(TOP VIEW)**

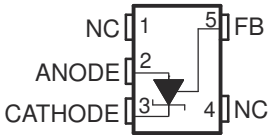



NC – No internal connection

**Adjustable . . . DBZ (SOT-23) PACKAGE**
**(TOP VIEW)**

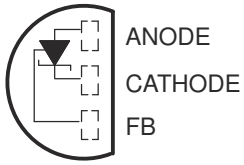



**Adjustable . . . DCK (SC-70) PACKAGE**
**(TOP VIEW)**




NC – No internal connection

**Adjustable . . . LP (TO-92/TO-226) PACKAGE**
**(TOP VIEW)**




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## 4 Functional Block Diagram

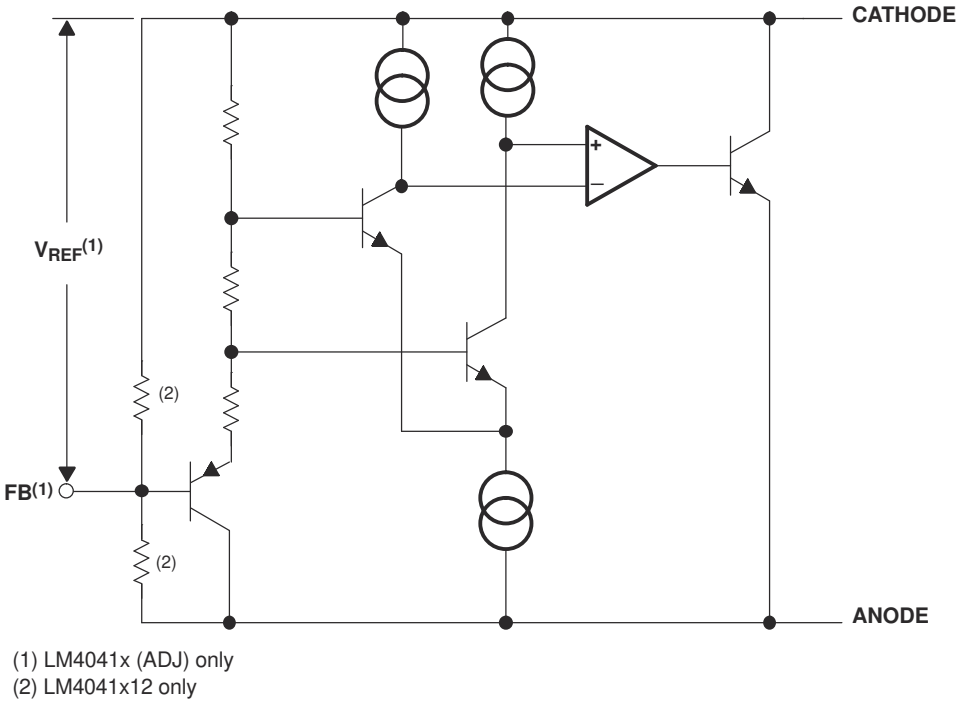



**図 4-1. Functional Block Diagram**

## 5 Absolute Maximum Ratings

over free-air temperature range (unless otherwise noted)

| | | | MIN | MAX (1) | UNIT |
|---|---|---|---|---|---|
| $V_Z$ | Continuous cathode voltage | | | 15 | V |
| $I_Z$ | Continuous cathode current | | –10 | 25 | mA |
| $\theta_{JA}$ | Package thermal impedance(2) (3) | DBZ package | | 206 | °C/W |
| | | DCK package | | 252 | |
| | | LP package | | 156 | |
| $T_J$ | Operating virtual junction temperature | | | 150 | °C |
| $T_{stg}$ | Storage temperature range | | –65 | 150 | °C |

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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

(3) The package thermal impedance is calculated in accordance with JESD 51-7.


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## 6 Recommended Operating Conditions

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $I_Z$ | Cathode current | | (1) | 12 | mA |
| $V_Z$ | Reverse breakdown voltage (adjustable version) | | | 10 | V |
| $T_A$ | Free-air temperature | LM4041 (I temperature) | –40 | 85 | °C |
| | | LM4041 (Q temperature) | –40 | 125 | |

(1) See parametric tables

## 7 LM4041x12I Electrical Characteristics

full-range $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_A$ | LM4041A12I | | | LM4041B12I | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_Z$ | Reverse breakdown voltage | $I_Z$ = 100 µA | 25°C | | 1.225 | | | 1.225 | | V |
| | Reverse breakdown voltage tolerance | $I_Z$ = 100 µA | 25°C | –1.2 | | 1.2 | –2.4 | | 2.4 | mV |
| | | | Full range | –9.2 | | 9.2 | –10.4 | | 10.4 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 45 | 75 | | 45 | 75 | µA |
| | | | Full range | | | 80 | | | 80 | |
| $\alpha_{VZ}$ | Average temperature coefficient of reverse breakdown voltage | $I_Z$ = 10 mA | 25°C | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA | 25°C | | ±15 | | | ±15 | | |
| | | | Full range | | | ±100 | | | ±100 | |
| | | $I_Z$ = 100 µA | 25°C | | ±15 | | | ±15 | | |
| $\Delta V_Z/\Delta I_Z$ | Reverse breakdown voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.7 | 1.5 | | 0.7 | 1.5 | mV |
| | | | Full range | | | 2 | | | 2 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 4 | 6 | | 4 | 6 | |
| | | | Full range | | | 8 | | | 8 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$ | 25°C | | 0.5 | 1.5 | | 0.5 | 1.5 | Ω |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | ppm |

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## 8 LM4041x12I Electrical Characteristics

full-range $T_A$ = –40°C to 85°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 µA | 25°C | | 1.225 | | | 1.225 | | V |
| | Reverse breakdown voltage tolerance | $I_Z$ = 100 µA | 25°C | –6 | | 6 | –12 | | 12 | mV |
| | | | Full range | –14 | | 14 | –24 | | 24 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 45 | 75 | | 45 | 75 | µA |
| | | | Full range | | | 80 | | | 80 | |
| $\alpha_{VZ}$ | Average temperature coefficient of reverse breakdown voltage | $I_Z$ = 10 mA | 25°C | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA | 25°C | | ±15 | | | ±15 | | |
| | | | Full range | | | ±100 | | | ±150 | |
| | | $I_Z$ = 100 µA | 25°C | | ±15 | | | ±15 | | |
| $\Delta V_Z/\Delta I_Z$ | Reverse breakdown voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.7 | 1.5 | | 0.7 | 2 | mV |
| | | | Full range | | | 2 | | | 2.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 2.5 | 6 | | 2.5 | 8 | |
| | | | Full range | | | 8 | | | 10 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$ | 25°C | | 0.5 | 1.5 | | 0.5 | 2 | Ω |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | ppm |


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## 9 LM4041x12Q Electrical Characteristics

full-range $T_A$ = –40°C to 125°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 µA | 25°C | | 1.225 | | | 1.225 | | V |
| | Reverse breakdown voltage tolerance | $I_Z$ = 100 µA | 25°C | –6 | | 6 | –12 | | 12 | mV |
| | | | Full range | –18.4 | | 18.4 | –31 | | 31 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 45 | 75 | | 45 | 75 | µA |
| | | | Full range | | | 80 | | | 80 | |
| $\alpha_{VZ}$ | Average temperature coefficient of reverse breakdown voltage | $I_Z$ = 10 mA | 25°C | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA | 25°C | | ±15 | | | ±15 | | |
| | | | Full range | | | ±100 | | | ±150 | |
| | | $I_Z$ = 100 µA | 25°C | | ±15 | | | ±15 | | |
| $\Delta V_Z/\Delta I_Z$ | Reverse breakdown voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.7 | 1.5 | | 0.7 | 2 | mV |
| | | | Full range | | | 2 | | | 2.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 2.5 | 6 | | 2.5 | 8 | |
| | | | Full range | | | 8 | | | 10 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$ | 25°C | | 0.5 | | | 0.5 | | Ω |
| | | | Full range | | | 1.5 | | | 2 | |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | ppm |

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## 10 LM4041xI (Adjustable Version) Electrical Characteristics

full-range $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_A$ | LM4041BI | | | LM4041CI | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_{REF}$ | Reference voltage | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | | 1.233 | | | 1.233 | | V |
| | Reference voltage tolerance(1) | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | –2.5 | | 2.5 | –6.2 | | 6.2 | mV |
| | | | Full range | –10.5 | | 10.5 | –14 | | 14 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 45 | 75 | | 45 | 75 | µA |
| | | | Full range | | | 80 | | | 80 | |
| $\Delta V_{REF}/\Delta I_Z$ | Reference voltage change with cathode current change | $I_{Z,min}$ < $I_Z$ < 1 mA | 25°C | | 0.7 | 1.5 | | 0.7 | 1.5 | mV |
| | | | Full range | | | 2 | | | 2 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 2 | 4 | | 2 | 4 | |
| | | | Full range | | | 6 | | | 6 | |
| $\Delta V_{REF}/\Delta V_{KA}$ | Reference voltage change with output voltage change | $I_Z$ = 1 mA | 25°C | | –1.55 | –2 | | –1.55 | –2 | mV/V |
| | | | Full range | | | –2.5 | | | –2.5 | |
| $I_{FB}$ | Feedback current | | 25°C | | 60 | 100 | | 60 | 100 | nA |
| | | | Full range | | | 120 | | | 120 | |
| $\alpha V_{REF}$ | Average temperature coefficient of reference voltage(1) | $I_Z$ = 10 mA, $V_Z$ = 5 V | 25°C | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA, $V_Z$ = 5 V | 25°C | | ±15 | | | ±15 | | |
| | | | Full range | | | ±100 | | | ±100 | |
| | | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | | ±15 | | | ±15 | | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = $V_{REF}$ | 25°C | | 0.3 | | | 0.3 | | Ω |
| | | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = 10 V | 25°C | | 2 | | | 2 | | |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, $V_Z$ = $V_{REF}$, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | ppm |

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


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## 11 LM4041xI (Adjustable Version) Electrical Characteristics

full-range $T_A$ = –40°C to 85°C (unless otherwise noted)

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

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

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## 12 LM4041xQ (Adjustable Version) Electrical Characteristics

full-range $T_A$ = –40°C to 125°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_A$ | LM4041CQ | | | LM4041DQ | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_{REF}$ | Reference voltage | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | | 1.233 | | | 1.233 | | V |
| | Reference voltage tolerance(1) | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | –6.2 | | 6.2 | –12 | | 12 | mV |
| | | | Full range | –18 | | 18 | –30 | | 30 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 45 | 75 | | 45 | 75 | µA |
| | | | Full range | | | 80 | | | 80 | |
| $\Delta V_{REF}/\Delta I_Z$ | Reference voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.7 | 1.5 | | 0.7 | 2 | mV |
| | | | Full range | | | 2 | | | 2.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 2 | 4 | | 2 | 6 | |
| | | | Full range | | | 8 | | | 10 | |
| $\Delta V_{REF}/\Delta V_{KA}$ | Reference voltage change with output voltage change | $I_Z$ = 1 mA | 25°C | | –1.55 | –2 | | –1.55 | –2.5 | mV/V |
| | | | Full range | | | –3 | | | –4 | |
| $I_{FB}$ | Feedback current | | 25°C | | 60 | 100 | | 60 | 150 | nA |
| | | | Full range | | | 120 | | | 200 | |
| $\alpha V_{REF}$ | Average temperature coefficient of reference voltage(1) | $I_Z$ = 10 mA, $V_Z$ = 5 V | 25°C | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA, $V_Z$ = 5 V | 25°C | | ±15 | | | ±15 | | |
| | | | Full range | | | ±100 | | | ±150 | |
| | | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°C | | ±15 | | | ±15 | | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = $V_{REF}$ | 25°C | | 0.3 | | | 0.3 | | Ω |
| | | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = 10 V | 25°C | | 2 | | | 2 | | |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, $V_Z$ = $V_{REF}$, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | ppm |

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


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## 13 Typical Characteristics

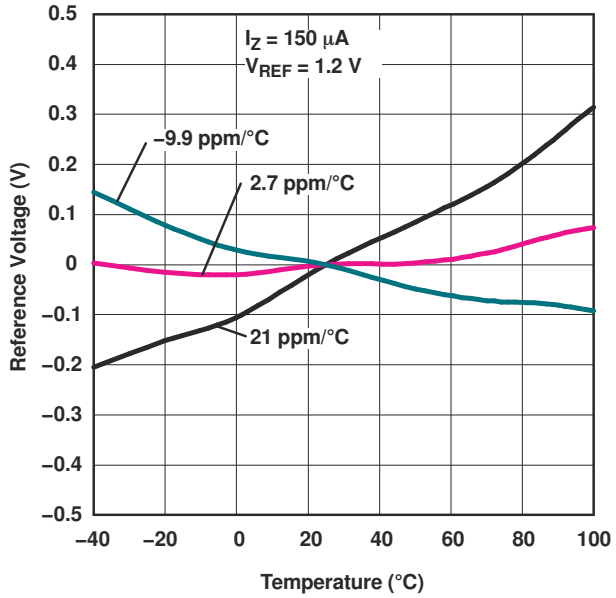



**図 13-1. Temperature Drift for Different Average Temperature Coefficients**

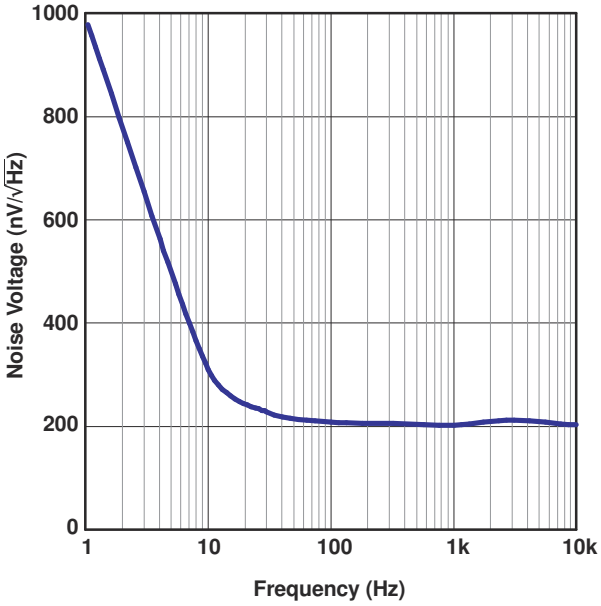



**図 13-2. Noise Voltage vs Frequency**

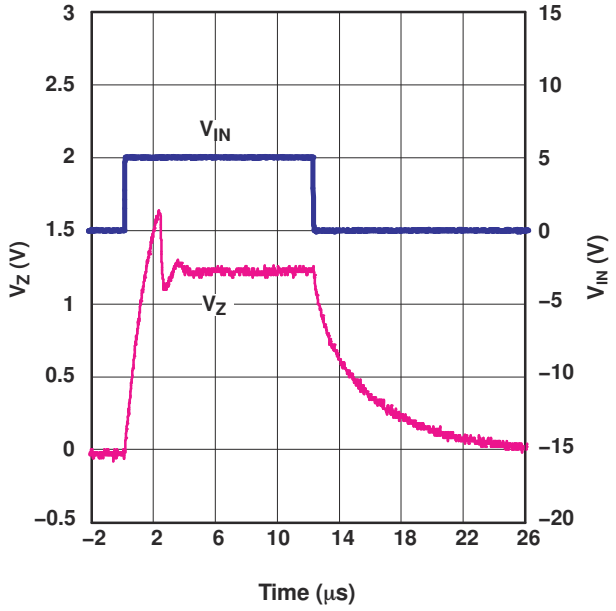



**図 13-3. Start-Up Characteristics**

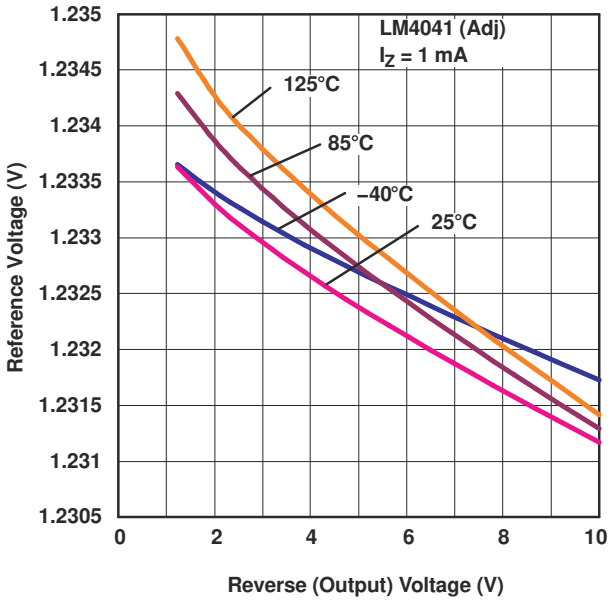



**図 13-4. Reference Voltage vs Reverse (Output) Voltage (for Different Temperatures)**

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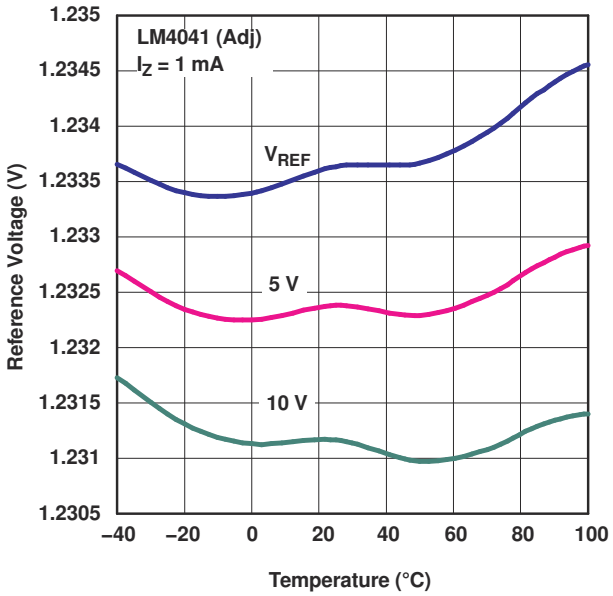



**図 13-5. Reference Voltage vs Temperature (for Different Reverse Voltages)**

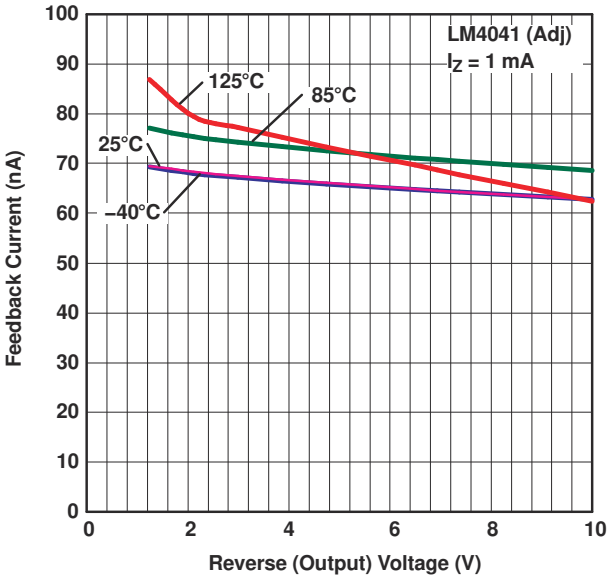



**図 13-6. Feedback Current vs Reverse (Output) Voltage (for Different Temperatures)**

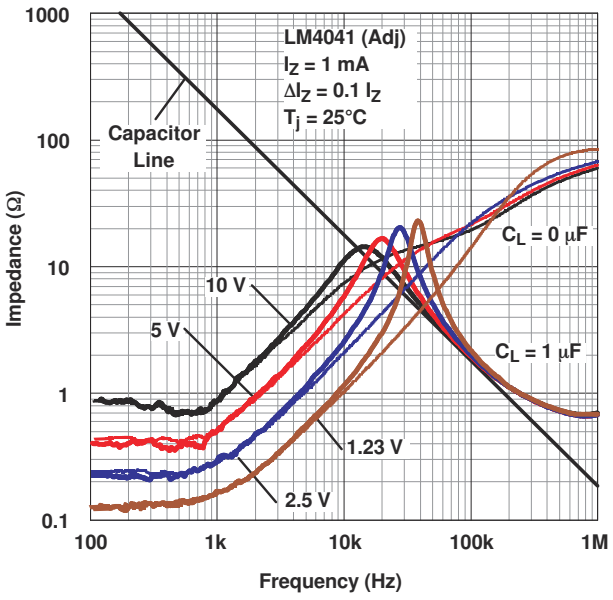



**図 13-7. Output Impedance vs Frequency**

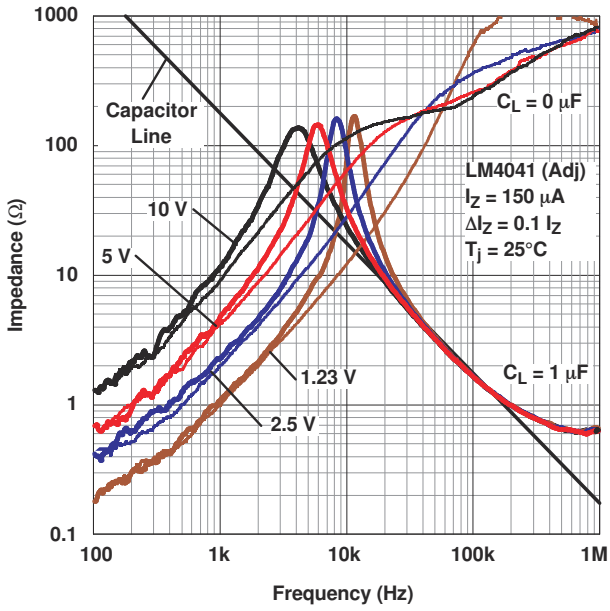



**図 13-8. Output Impedance vs Frequency**


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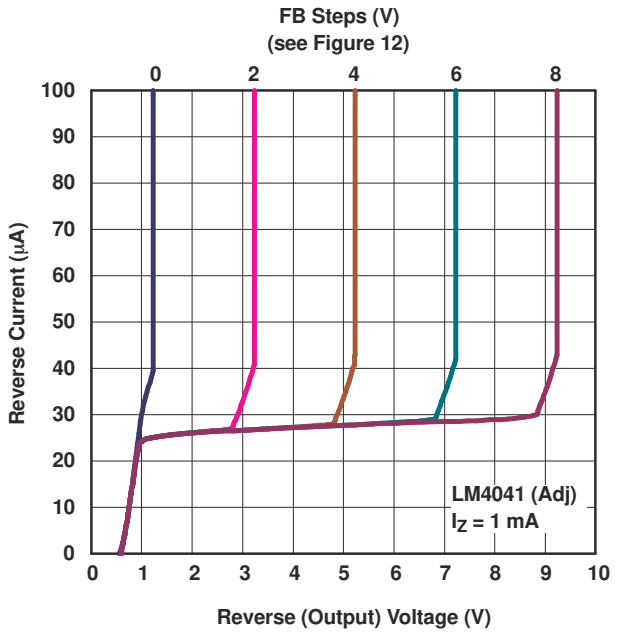



図 13-9. Reverse Characteristics

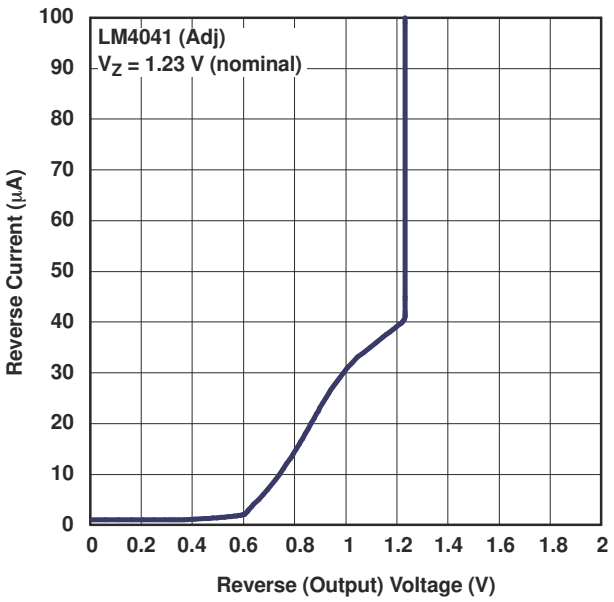



図 13-10. Reverse Characteristics and Minumum Operating Current

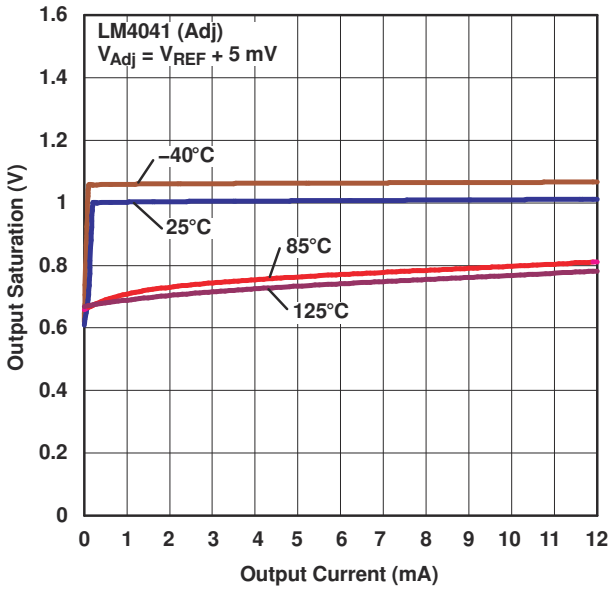



図 13-11. Output Saturation vs Output Current

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# 14 Application Information

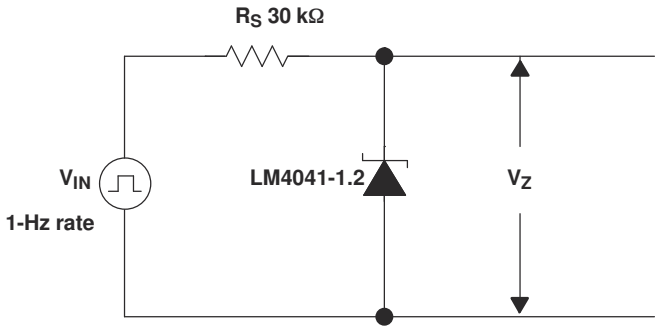



**図 14-1. Startup Characteristics Test Circuit**

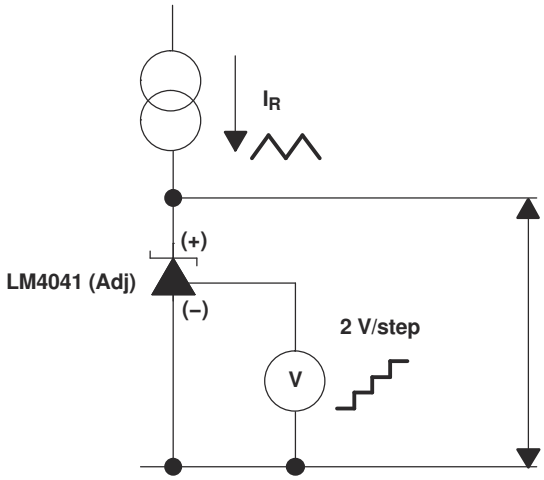



**図 14-2. Reverse Characteristics Test Circuit**

## 14.1 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.

## 14.2 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.


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## 14.3 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 図 14-3.

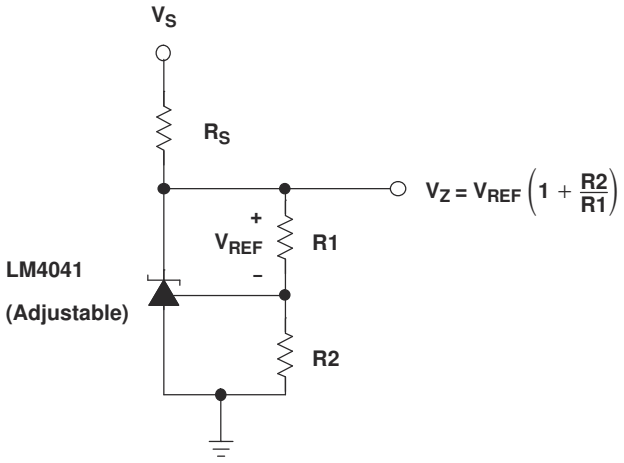



**図 14-3. Adjustable Shunt Regulator**

## 14.4 Cathode and Load Currents

In a typical shunt regulator configuration (see 図 14-4), an external resistor, $R_S$, is connected between the supply and the cathode of the LM4041. $R_S$ must be set properly, as it 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 its maximum recommended rating of 12 mA.

$R_S$ is calculated as shown in 式 1.

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

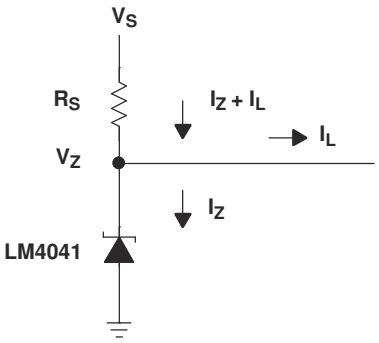



**図 14-4. Shunt Regulator**

## 15 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

| Changes from Revision E (February 2006) to Revision F (September 2020) | Page |
|---|---|
| • 文書全体にわたって表、図、相互参照の採番方法を更新 | 1 |
| • Deleted *Ordering Information* table. See Mechanical, Packaging, and Orderable Information at the end of the data sheet. | 2 |


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## 16 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.

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## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM4041A12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU \| SN | Level-1-260C-UNLIM | -40 to 85 | (4MK3, 4MKU) | Samples |
| LM4041A12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MK3, 4MKU) | Samples |
| LM4041A12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MKU | Samples |
| LM4041B12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4ML3, 4MLU) | Samples |
| LM4041B12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4ML3, 4MLU) | Samples |
| LM4041B12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MLU | Samples |
| LM4041BIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MG3, 4MGU) | Samples |
| LM4041BIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MG3, 4MGU) | Samples |
| LM4041BIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MGU | Samples |
| LM4041BIDCKT | ACTIVE | SC70 | DCK | 5 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MGU | Samples |
| LM4041C12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MM3, 4MMU) | Samples |
| LM4041C12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MM3, 4MMU) | Samples |
| LM4041C12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MMU | Samples |
| LM4041C12IDCKRE4 | ACTIVE | SC70 | DCK | 5 | 3000 | TBD | Call TI | Call TI | -40 to 85 | | Samples |
| LM4041C12IDCKRG4 | ACTIVE | SC70 | DCK | 5 | 3000 | TBD | Call TI | Call TI | -40 to 85 | | Samples |
| LM4041C12ILP | ACTIVE | TO-92 | LP | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPC12I | Samples |
| LM4041C12ILPR | ACTIVE | TO-92 | LP | 3 | 2000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPC12I | Samples |
| LM4041C12QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MS3, 4MSU) | Samples |
| LM4041C12QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MS3, 4MSU) | Samples |
| LM4041CIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MH3, 4MHU) | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM4041CIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MH3, 4MHU) | Samples |
| LM4041CIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MHU | Samples |
| LM4041CIDCKT | ACTIVE | SC70 | DCK | 5 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MHU | Samples |
| LM4041CILP | LIFEBUY | TO-92 | LP | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPCI | |
| LM4041CILPE3 | NRND | TO-92 | LP | 3 | 1000 | TBD | Call TI | Call TI | -40 to 85 | | |
| LM4041CILPR | LIFEBUY | TO-92 | LP | 3 | 2000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPCI | |
| LM4041CQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MP3, 4MPU) | Samples |
| LM4041CQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MP3, 4MPU) | Samples |
| LM4041D12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MN3, 4MNU) | Samples |
| LM4041D12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MN3, 4MNU) | Samples |
| LM4041D12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MNU | Samples |
| LM4041D12ILP | ACTIVE | TO-92 | LP | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPD12I | Samples |
| LM4041D12ILPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | TBD | Call TI | Call TI | -40 to 85 | | Samples |
| LM4041D12ILPR | ACTIVE | TO-92 | LP | 3 | 2000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPD12I | Samples |
| LM4041D12QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MT3, 4MTU) | Samples |
| LM4041DIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MJ3, 4MJU) | Samples |
| LM4041DIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (4MJ3, 4MJU) | Samples |
| LM4041DIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | MJU | Samples |
| LM4041DILP | LIFEBUY | TO-92 | LP | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPDI | |
| LM4041DILPR | LIFEBUY | TO-92 | LP | 3 | 2000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 85 | NPDI | |
| LM4041DQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MR3, 4MRU) | Samples |
| LM4041DQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (4MR3, 4MRU) | Samples |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

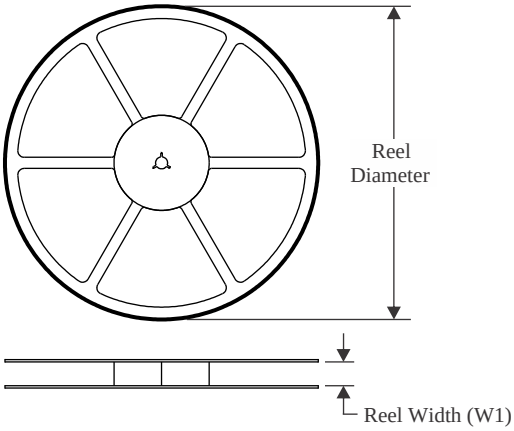
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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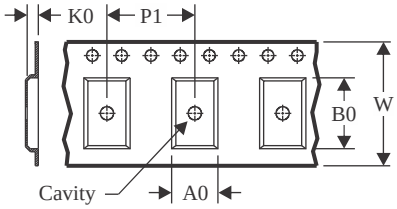
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## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

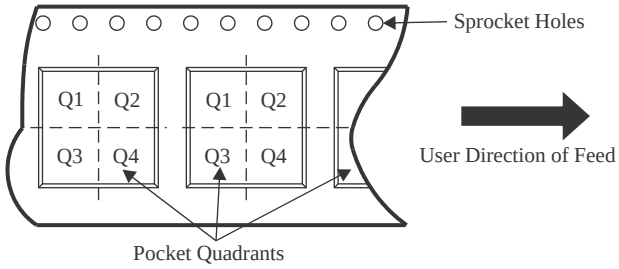



**TAPE DIMENSIONS**




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

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

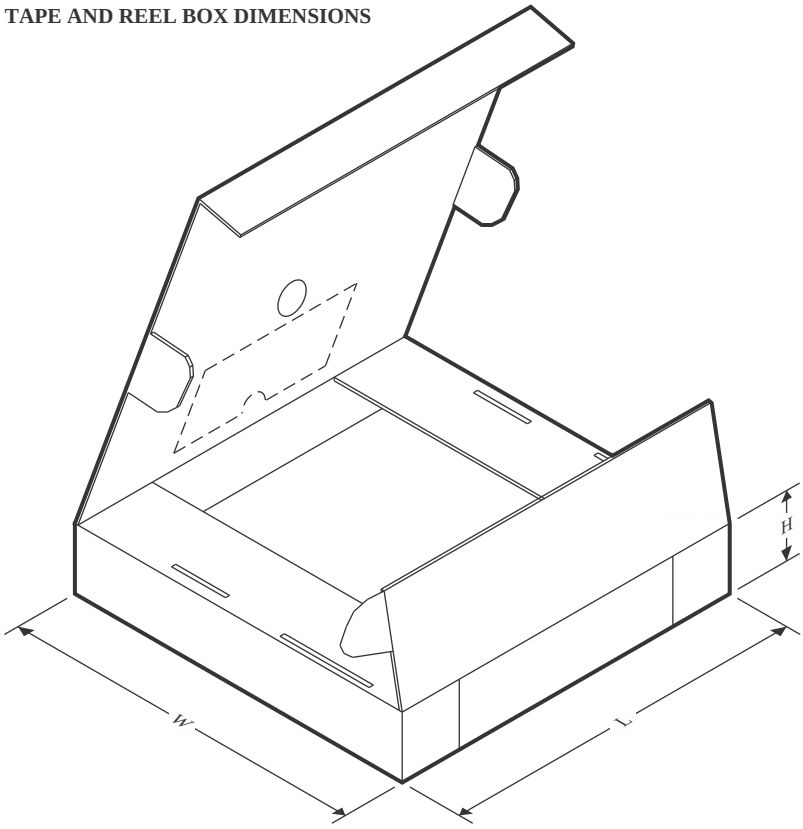



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 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 |
| LM4041BIDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| 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 |
| 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 |
| LM4041C12QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 2.9 | 3.35 | 1.35 | 4.0 | 8.0 | Q3 |

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 178.0 | 9.2 | 3.15 | 2.77 | 1.22 | 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 |
| 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 | 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 |
| 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 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 |
| LM4041DIDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 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 |
| 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 | 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 |
| LM4041BIDBZR | SOT-23 | DBZ | 3 | 3000 | 200.0 | 183.0 | 25.0 |
| LM4041BIDBZR | 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 |
| LM4041C12IDCKR | SC70 | DCK | 5 | 3000 | 200.0 | 183.0 | 25.0 |
| 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 | 180.0 | 180.0 | 18.0 |

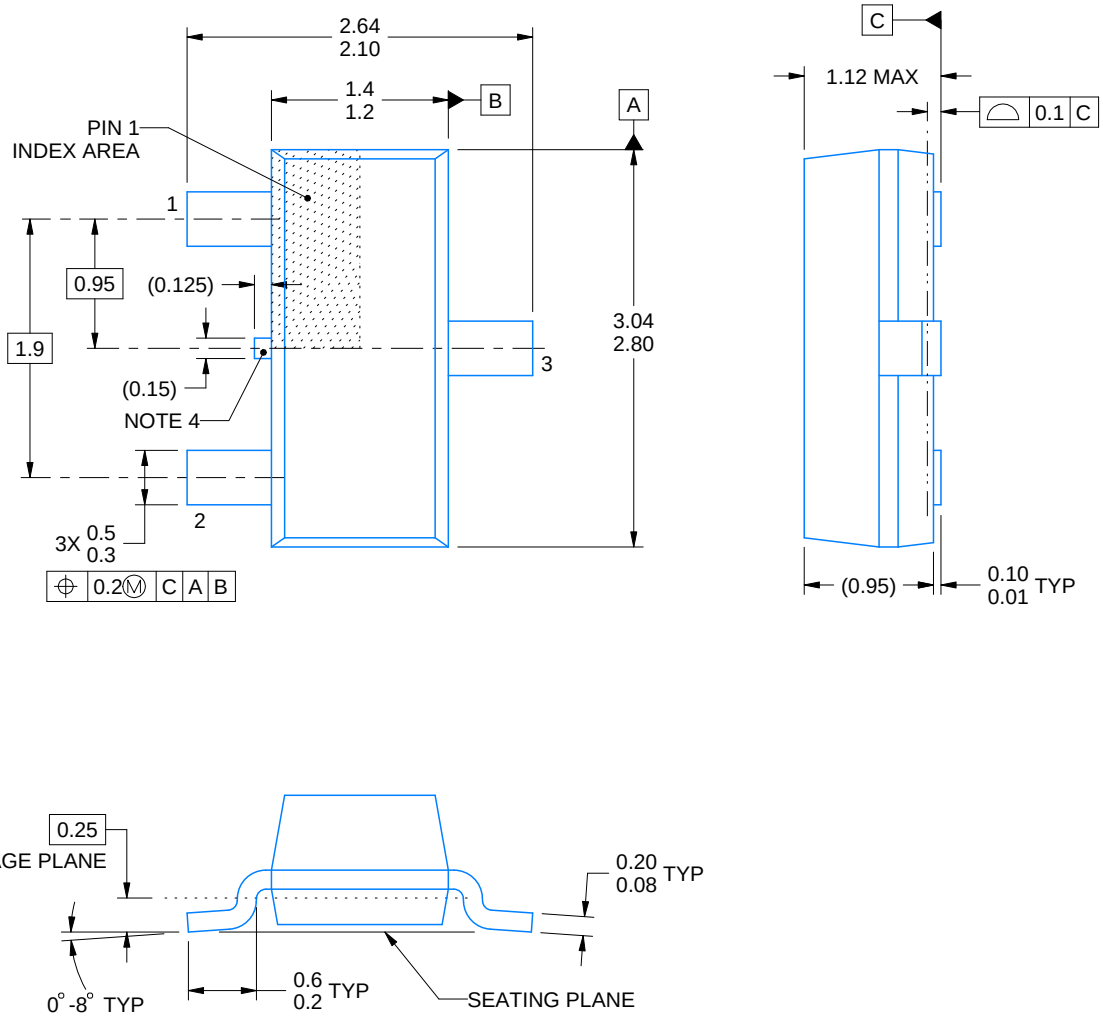
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LM4041CIDBZR | SOT-23 | DBZ | 3 | 3000 | 200.0 | 183.0 | 25.0 |
| LM4041CIDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| LM4041CIDBZT | SOT-23 | DBZ | 3 | 250 | 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 | 200.0 | 183.0 | 25.0 |
| LM4041CQDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 180.0 | 18.0 |
| LM4041D12IDBZT | SOT-23 | DBZ | 3 | 250 | 210.0 | 185.0 | 35.0 |
| LM4041D12IDCKR | SC70 | DCK | 5 | 3000 | 200.0 | 183.0 | 25.0 |
| LM4041DIDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 180.0 | 18.0 |
| LM4041DIDBZR | SOT-23 | DBZ | 3 | 3000 | 200.0 | 183.0 | 25.0 |
| LM4041DIDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 180.0 | 18.0 |
| LM4041DIDCKR | 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 |

# PACKAGE OUTLINE

## DBZ0003A

## SOT-23 - 1.12 mm max height

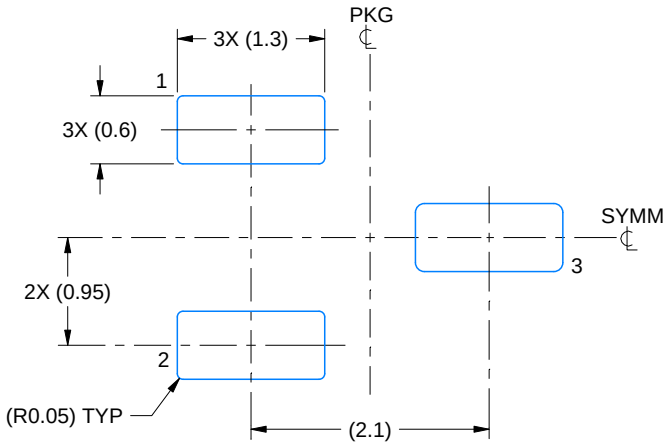
SMALL OUTLINE TRANSISTOR



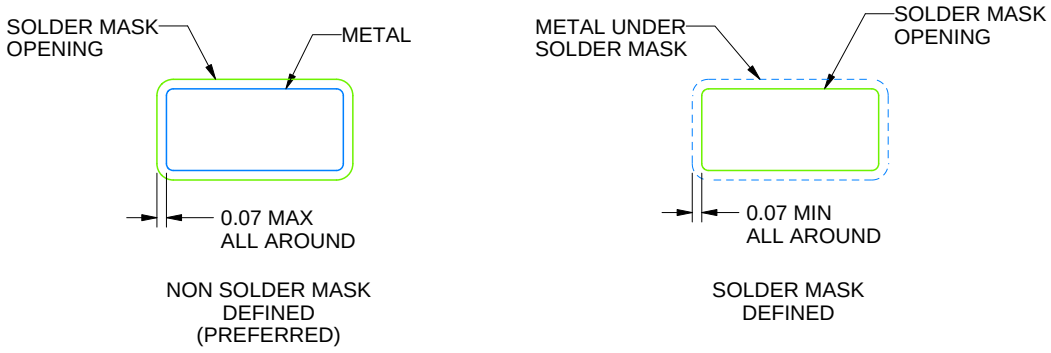

4214838/D 03/2023

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.




LAND PATTERN EXAMPLE
SCALE:15X

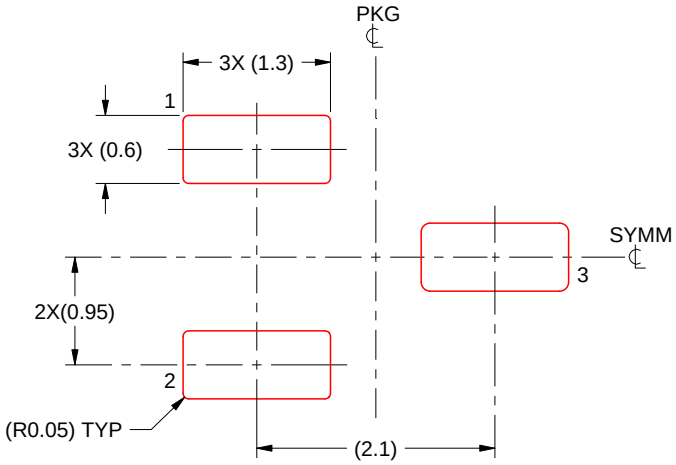



SOLDER MASK DETAILS

4214838/D 03/2023

NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.
5. 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:15X

4214838/D 03/2023

NOTES: (continued)

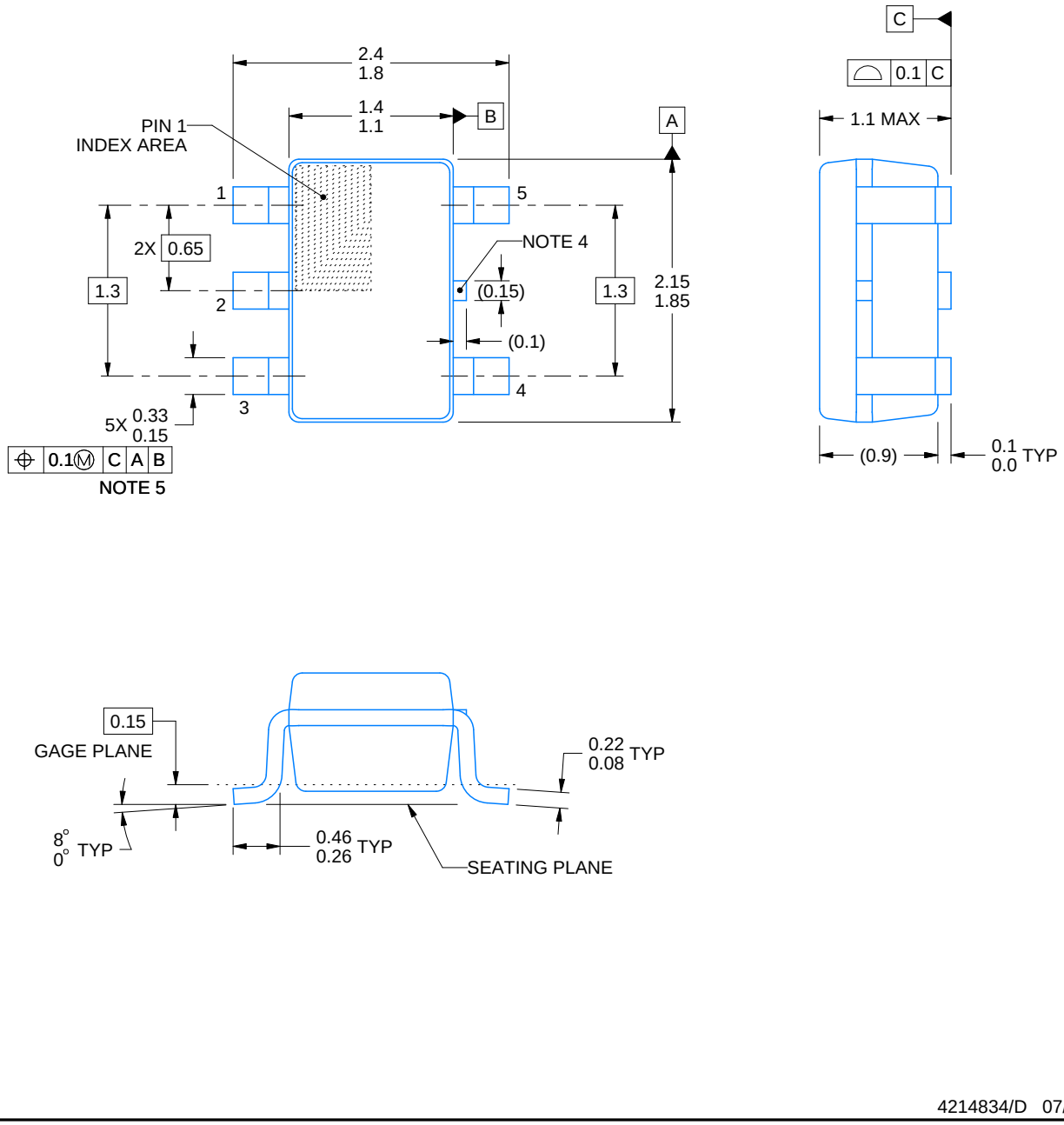
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

# PACKAGE OUTLINE

## DCK0005A

## SOT - 1.1 max height

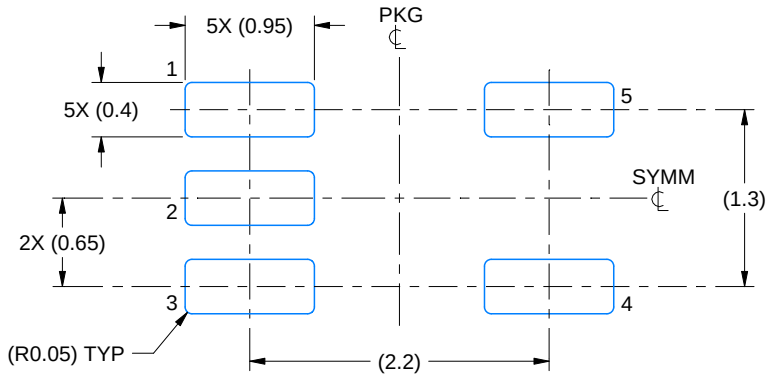
SMALL OUTLINE TRANSISTOR



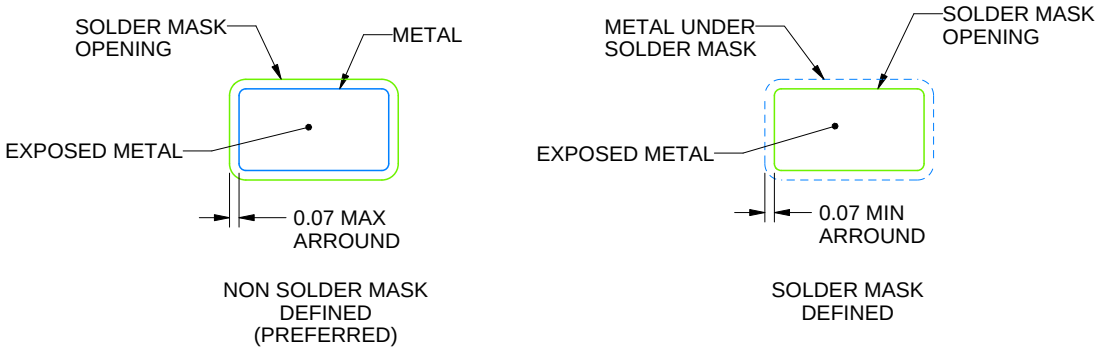

4214834/D 07/2023

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. Refernce JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X

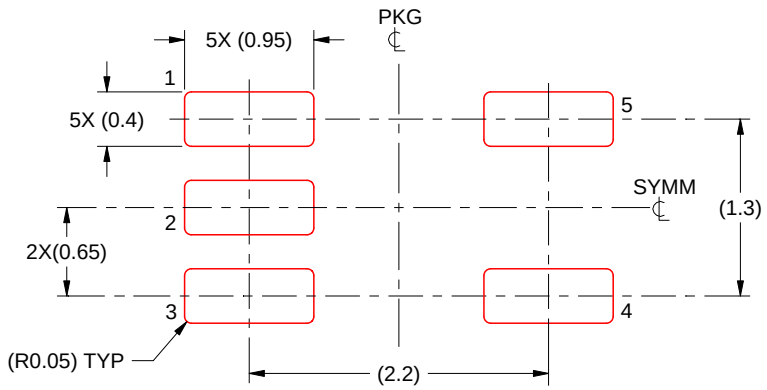



SOLDER MASK DETAILS

4214834/D 07/2023

NOTES: (continued)

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




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

4214834/D 07/2023

NOTES: (continued)

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

# GENERIC PACKAGE VIEW

## LP 3 TO-92 - 5.34 mm max height

TRANSISTOR OUTLINE



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

# LP0003A

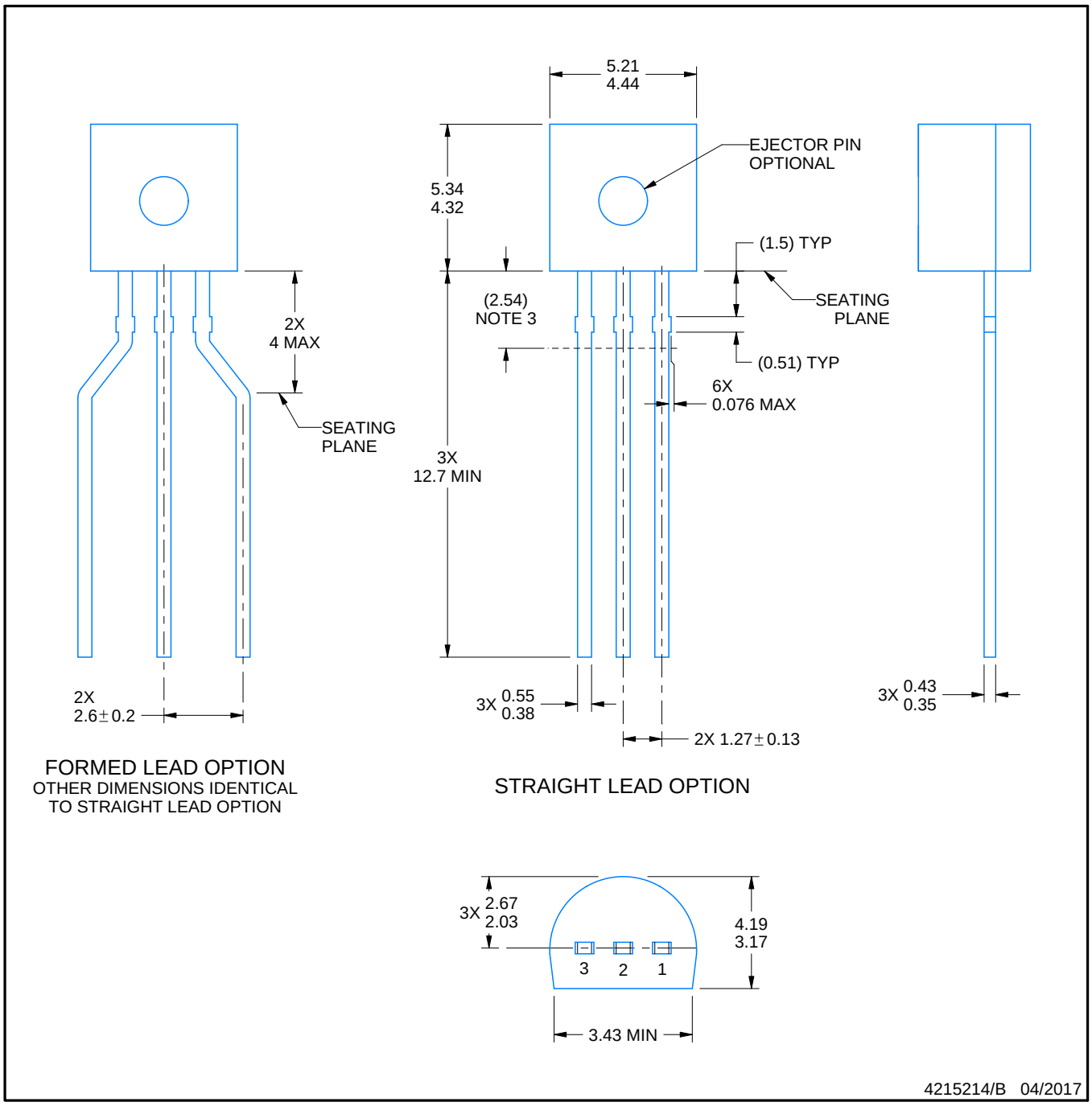




## PACKAGE OUTLINE

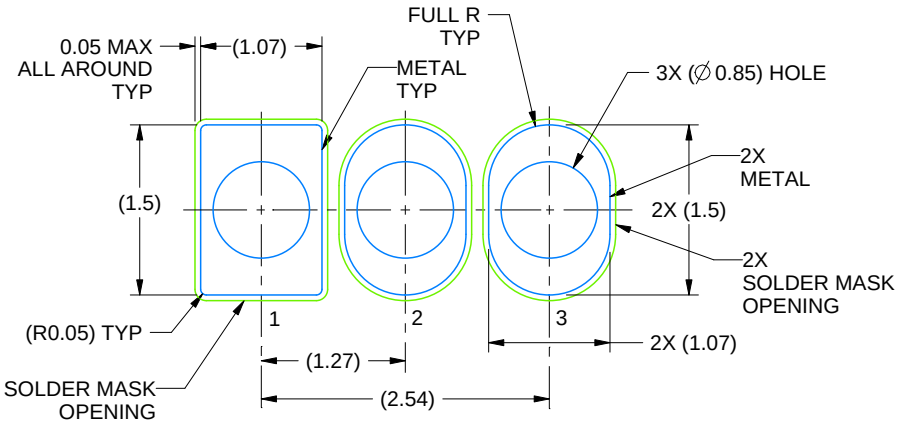
### TO-92 - 5.34 mm max height

TO-92

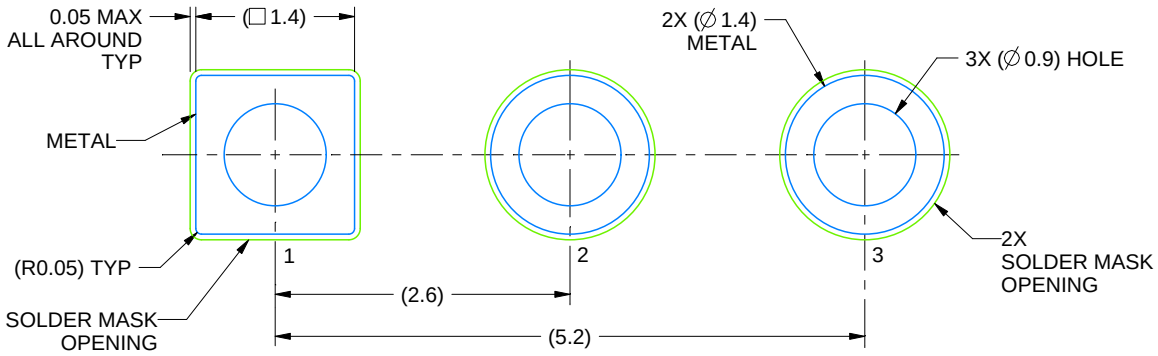



NOTES:

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.




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



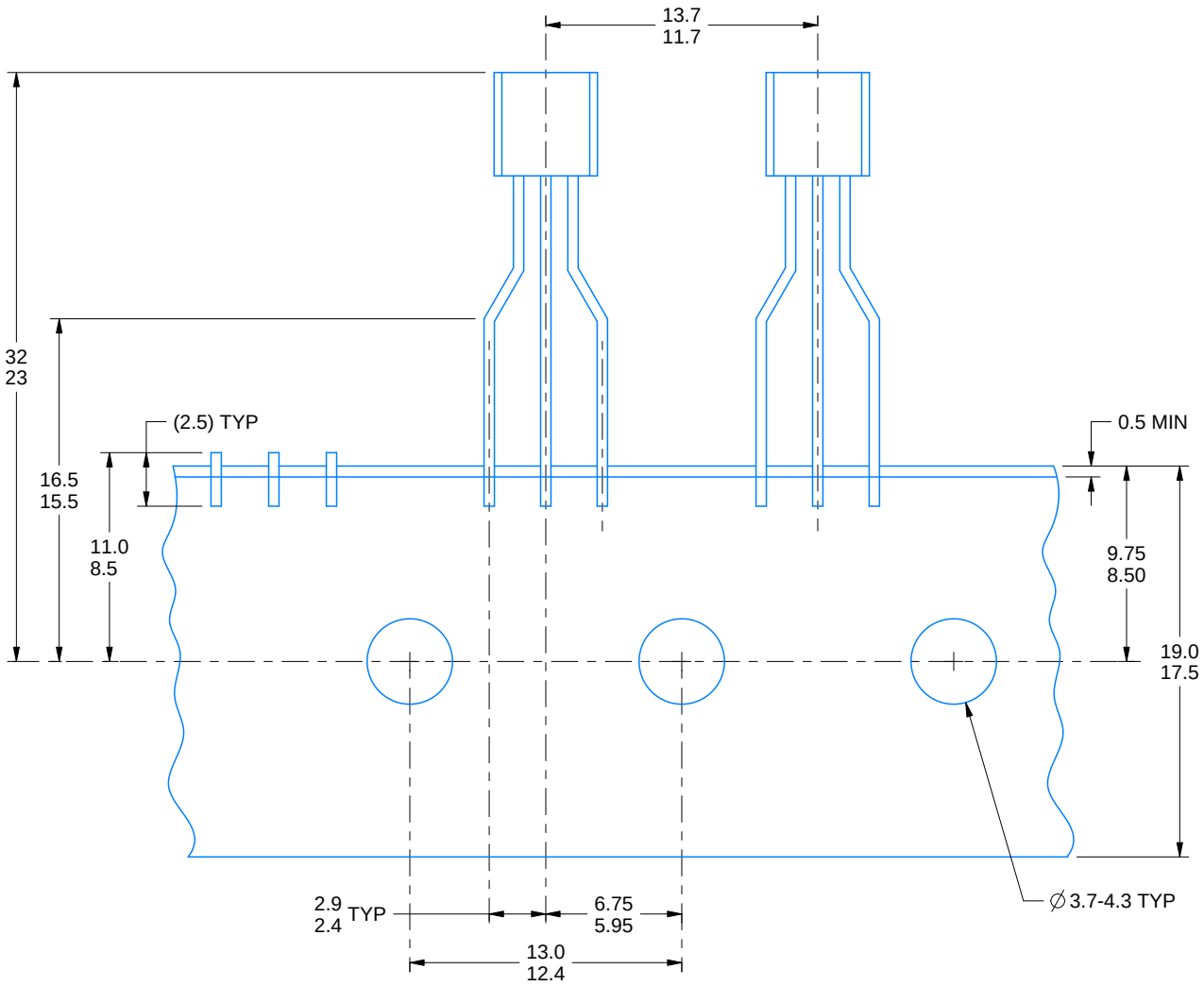

LAND PATTERN EXAMPLE
FORMED LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X

4215214/B 04/2017

# LP0003A

## TO-92 - 5.34 mm max height

TO-92




FOR FORMED LEAD OPTION PACKAGE

4215214/B 04/2017

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