

## TL4051 Precision Micropower Shunt Voltage Reference

### 1 Features

- 1.225V fixed and adjustable (1.225V to 10V) outputs
- Tight output tolerances and low temperature coefficient
  - Max 0.1%, 50ppm/°C – A Grade
  - Max 0.2%, 50ppm/°C – B Grade
  - Max 0.5%, 50ppm/°C – C Grade
- Low output noise...20 $\mu$ V<sub>RMS</sub> (typical)
- Wide operating current range...60 $\mu$ A (typical) to 12mA
- Stable with all capacitive loads; No output capacitor required
- Available in
  - Industrial Temperature: –40°C to 85°C
  - Extended Temperature: –40°C to 125°C

### 2 Applications

- Data-acquisition systems
- Power supplies and power-supply monitors
- Instrumentation and Test Equipment
- Process control
- Precision audio
- Automotive electronics
- Energy management/metering
- Battery-powered equipment

### 3 Description

The TL4051 series of shunt voltage references are versatile easy-to-use references designed for a wide array of applications. The device is available in a fixed 1.225V output or an adjustable output whose voltage is determined by an external resistor divider. The device requires no external capacitors for operation and is stable with all capacitive loads. Additionally, the reference offers low dynamic impedance, low noise, and low temperature coefficient to maintain a stable output voltage over a wide range of operating currents and temperatures.

The TL4051 is offered in three initial tolerances, ranging from 0.1% (max) for the A grade to 0.5% (max) for the C grade. Thus, a great deal of flexibility is offered to designers in choosing the best cost-to-performance ratio for any application. Packaged in the space-saving SOT-23-3 and SC-70 packages and requiring a minimum current of 45 $\mu$ A (typical), the TL4051 also is an excellent choice for portable applications.

The TL4051xl is characterized for operation over an ambient temperature range of –40°C to 85°C. The TL4051xQ is characterized for operation over an ambient temperature range of –40°C to 125°C.

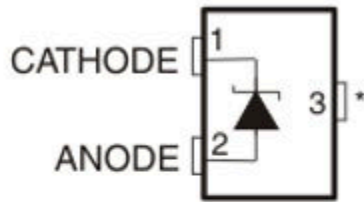


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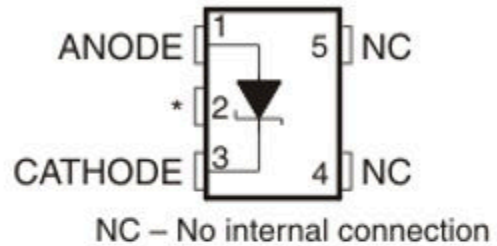
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## 4 Pin Configuration and Functions

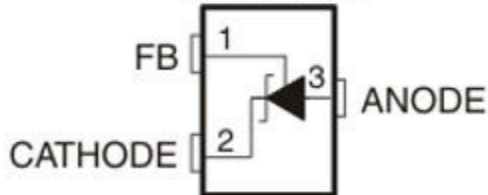
**1.2 V...DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)**



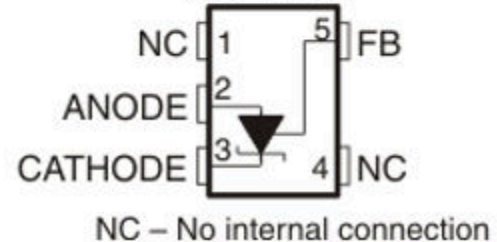
**1.2 V...DCK (SC-70) PACKAGE  
(TOP VIEW)**



**Adjustable...DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)**



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



\*This pin must be connected to ANODE or left open. In applications with high electromagnetic interference (for example, when placed near transformers or other electromagnetic sources) or significant high-frequency switching noise, it is recommended to connect this pin to the anode.

## 5 Specifications

### 5.1 Absolute Maximum Ratings <sup>(1)</sup>

over free-air temperature range (unless otherwise noted)

|                  |                                              | MIN         | MAX | UNIT |
|------------------|----------------------------------------------|-------------|-----|------|
| V <sub>Z</sub>   | Continuous cathode voltage                   |             | 15  | V    |
| I <sub>Z</sub>   | Continuous cathode current                   | –10         | 20  | mA   |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(2) (3)</sup> | DBZ package |     | 206  |
|                  |                                              | DCK package |     | 252  |
| T <sub>J</sub>   | Operating virtual junction temperature       |             | 150 | °C   |
| T <sub>stg</sub> | Storage temperature range                    | –65         | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *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<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 |
|                    |                         | 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. 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                                | <sup>(1)</sup> | 12  | mA   |
| V <sub>Z</sub> | Reverse breakdown voltage (adjustable version) |                | 10  | V    |
| T <sub>A</sub> | Free-air temperature                           | I temperature  |     | –40  |
|                |                                                | Q temperature  |     | 85   |

- (1) See parametric tables

## 5.4 TL4051x12I 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> | TL4051A12I |     |     | TL4051B12I |     |     | TL4051C12I |     |     | UNIT              |
|---------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------|----------------|------------|-----|-----|------------|-----|-----|------------|-----|-----|-------------------|
|                                 |                                                              |                                                                       |                | MIN        | TYP | MAX | MIN        | TYP | MAX | MIN        | TYP | MAX |                   |
| V <sub>Z</sub>                  | Reverse breakdown voltage                                    | I <sub>Z</sub> = 100μA                                                | 25°C           | 1.225      |     |     | 1.225      |     |     | 1.225      |     |     | V                 |
|                                 | Reverse breakdown voltage tolerance                          | I <sub>Z</sub> = 100μA                                                | 25°C           | −1.2       |     |     | −2.4       |     |     | −6         |     |     | mV                |
|                                 |                                                              |                                                                       | Full range     | −5.2       |     |     | −6.4       |     |     | −10.1      |     |     |                   |
| I <sub>Z,min</sub>              | Minimum cathode current                                      |                                                                       | 25°C           | 39         |     |     | 39         |     |     | 39         |     |     | μA                |
|                                 |                                                              |                                                                       | Full range     | 60         |     |     | 60         |     |     | 65         |     |     |                   |
| α <sub>VZ</sub>                 | Average temperature coefficient of reverse breakdown voltage | I <sub>Z</sub> = 10mA                                                 | 25°C           | ±20        |     |     | ±20        |     |     | ±20        |     |     | ppm/°C            |
|                                 |                                                              | I <sub>Z</sub> = 1mA                                                  | 25°C           | ±15        |     |     | ±15        |     |     | ±15        |     |     |                   |
|                                 |                                                              | I <sub>Z</sub> = 100μA                                                | 25°C           | ±15        |     |     | ±15        |     |     | ±15        |     |     |                   |
|                                 |                                                              |                                                                       | Full range     | ±50        |     |     | ±50        |     |     | ±50        |     |     |                   |
| $\frac{\Delta V_Z}{\Delta I_Z}$ | Reverse breakdown voltage change with cathode current change | I <sub>Z,min</sub> < I <sub>Z</sub> < 1mA                             | 25°C           | 0.3        |     |     | 0.3        |     |     | 0.3        |     |     | mV                |
|                                 |                                                              |                                                                       | Full range     | 1.1        |     |     | 1.5        |     |     | 1.5        |     |     |                   |
|                                 |                                                              | 1mA < I <sub>Z</sub> < 12mA                                           | 25°C           | 1.5        |     |     | 1.5        |     |     | 6          |     |     |                   |
|                                 |                                                              |                                                                       | Full range     | 6          |     |     | 6          |     |     | 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           | 0.3        |     |     | 0.3        |     |     | 0.3        |     |     | Ω                 |
| e <sub>N</sub>                  | Wide band noise                                              | I <sub>Z</sub> = 100μA, 10Hz ≤ f ≤ 10kHz                              | 25°C           | 20         |     |     | 20         |     |     | 20         |     |     | μV <sub>RMS</sub> |
|                                 | Long-term stability of reverse breakdown voltage             | t = 1000h, T <sub>A</sub> = 25°C ± 0.1°C, I <sub>Z</sub> = 100μA      | 25°C           | 120        |     |     | 120        |     |     | 120        |     |     | ppm               |
| V <sub>HYST</sub>               | Thermal hysteresis <sup>(1)</sup>                            | ΔT <sub>A</sub> = −40°C to 125°C                                      |                | 0.36       |     |     | 0.36       |     |     | 0.36       |     |     | mV/V              |

(1) Thermal hysteresis is defined as  $V_{Z,25^{\circ}\text{C}}$  (after cycling to  $-40^{\circ}\text{C}$ ) –  $V_{Z,25^{\circ}\text{C}}$  (after cycling to  $125^{\circ}\text{C}$ ).

## 5.5 TL4051x12Q 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> | TL4051A12Q    |     |     | TL4051B12Q    |     |     | TL4051C12Q      |     |     | UNIT              |
|---------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------|----------------|---------------|-----|-----|---------------|-----|-----|-----------------|-----|-----|-------------------|
|                                 |                                                              |                                                                       |                | MIN           | TYP | MAX | MIN           | TYP | MAX | MIN             | TYP | MAX |                   |
| V <sub>Z</sub>                  | Reverse breakdown voltage                                    | I <sub>Z</sub> = 100μA                                                | 25°C           | 1.225         |     |     | 1.225         |     |     | 1.225           |     |     | V                 |
|                                 | Reverse breakdown voltage tolerance                          | I <sub>Z</sub> = 100μA                                                | 25°C           | −1.2      1.2 |     |     | −2.4      2.4 |     |     | −6      6       |     |     | mV                |
|                                 |                                                              |                                                                       | Full range     | −7.4      7.4 |     |     | −8.6      8.6 |     |     | −12.2      12.2 |     |     |                   |
| I <sub>Z,min</sub>              | Minimum cathode current                                      |                                                                       | 25°C           | 39      60    |     |     | 39      60    |     |     | 39      60      |     |     | μA                |
|                                 |                                                              |                                                                       | Full range     | 65            |     |     | 65            |     |     | 65              |     |     |                   |
| α <sub>VZ</sub>                 | Average temperature coefficient of reverse breakdown voltage | I <sub>Z</sub> = 10mA                                                 | 25°C           | ±20           |     |     | ±20           |     |     | ±20             |     |     | ppm/°C            |
|                                 |                                                              | I <sub>Z</sub> = 1mA                                                  | 25°C           | ±15           |     |     | ±15           |     |     | ±15             |     |     |                   |
|                                 |                                                              | I <sub>Z</sub> = 100μA                                                | 25°C           | ±15           |     |     | ±15           |     |     | ±15             |     |     |                   |
|                                 |                                                              |                                                                       | Full range     | ±50           |     |     | ±50           |     |     | ±50             |     |     |                   |
| $\frac{\Delta V_Z}{\Delta I_Z}$ | Reverse breakdown voltage change with cathode current change | I <sub>Z,min</sub> < I <sub>Z</sub> < 1mA                             | 25°C           | 0.3      1.1  |     |     | 0.3      1.1  |     |     | 0.3      1.1    |     |     | mV                |
|                                 |                                                              |                                                                       | Full range     | 1.5           |     |     | 1.5           |     |     | 1.5             |     |     |                   |
|                                 |                                                              | 1mA < I <sub>Z</sub> < 12mA                                           | 25°C           | 1.8      6    |     |     | 1.8      6    |     |     | 1.8      6      |     |     |                   |
|                                 |                                                              |                                                                       | Full range     | 8             |     |     | 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           |     |     | 0.5           |     |     | 0.5             |     |     | Ω                 |
| e <sub>N</sub>                  | Wide band noise                                              | I <sub>Z</sub> = 100μA, 10Hz ≤ f ≤ 10kHz                              | 25°C           | 20            |     |     | 20            |     |     | 20              |     |     | μV <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> = 100μA     | 25°C           | 120           |     |     | 120           |     |     | 120             |     |     | ppm               |
| V <sub>HYST</sub>               | Thermal hysteresis <sup>(1)</sup>                            | ΔT <sub>A</sub> = −40°C to 125°C                                      |                | 0.36          |     |     | 0.36          |     |     | 0.36            |     |     | mV/V              |

## 5.6 TL4051xl (Adjustable Version) Electrical Characteristics

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

| PARAMETER                                                                                  | TEST CONDITIONS                                                                                     | $T_A$              | TL4051AI |          |          | TL4051BI |          |          | TL4051CI |          |          | UNIT                  |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------------|
|                                                                                            |                                                                                                     |                    | MIN      | TYP      | MAX      | MIN      | TYP      | MAX      | MIN      | TYP      | MAX      |                       |
| $V_{REF}$ Reference voltage                                                                | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 5\text{V}$                                                       | $25^\circ\text{C}$ |          | 1.212    |          |          | 1.212    |          |          | 1.212    |          | V                     |
| Reference voltage tolerance <sup>(1)</sup>                                                 | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 5\text{V}$                                                       | $25^\circ\text{C}$ | -1.2     |          | 1.2      | -2.4     |          | 2.4      | -6       |          | 6        | mV                    |
|                                                                                            |                                                                                                     | Full range         | -5.2     |          | 5.2      | -6.4     |          | 6.4      | -10.1    |          | 10.1     |                       |
| $I_{Z,min}$ Minimum cathode current                                                        |                                                                                                     | $25^\circ\text{C}$ |          | 36       | 60       |          | 36       | 60       |          | 36       | 65       | $\mu\text{A}$         |
|                                                                                            |                                                                                                     | Full range         |          |          | 65       |          |          | 65       |          |          | 70       |                       |
| $\frac{\Delta V_{REF}}{\Delta I_Z}$ Reference voltage change with cathode current change   | $I_{Z,min} < I_Z < 1\text{mA}$                                                                      | $25^\circ\text{C}$ |          | 0.3      | 1.1      |          | 0.3      | 1.1      |          | 0.3      | 1.1      | mV                    |
|                                                                                            |                                                                                                     | Full range         |          |          | 1.5      |          |          | 1.5      |          |          | 1.5      |                       |
|                                                                                            | $1\text{mA} < I_Z < 12\text{mA}$                                                                    | $25^\circ\text{C}$ |          | 0.6      | 6        |          | 0.6      | 6        |          | 0.6      | 6        |                       |
|                                                                                            |                                                                                                     | Full range         |          |          | 8        |          |          | 8        |          |          | 8        |                       |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Reference voltage change with output voltage change | $I_Z = 1\text{mA}$                                                                                  | $25^\circ\text{C}$ | -1.69    |          | -2.8     | -1.69    |          | -2.8     | -1.69    |          | -2.8     | mV/V                  |
|                                                                                            |                                                                                                     | Full range         |          |          | -3.5     |          |          | -3.5     |          |          | -3.5     |                       |
| $I_{FB}$ Feedback current                                                                  |                                                                                                     | $25^\circ\text{C}$ |          | 70       | 130      |          | 70       | 130      |          | 70       | 130      | nA                    |
|                                                                                            |                                                                                                     | Full range         |          |          | 150      |          |          | 150      |          |          | 150      |                       |
| $\alpha V_{REF}$ Average temperature coefficient of reference voltage <sup>(1)</sup>       | $I_Z = 10\text{mA}$ ,<br>$V_Z = 2.5\text{V}$                                                        | $25^\circ\text{C}$ |          | $\pm 20$ |          |          | $\pm 20$ |          |          | $\pm 20$ |          | ppm/ $^\circ\text{C}$ |
|                                                                                            | $I_Z = 1\text{mA}$ ,<br>$V_Z = 2.5\text{V}$                                                         | $25^\circ\text{C}$ |          | $\pm 15$ |          |          | $\pm 15$ |          |          | $\pm 15$ |          |                       |
|                                                                                            | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 2.5\text{V}$                                                     | $25^\circ\text{C}$ |          | $\pm 15$ |          |          | $\pm 15$ |          |          | $\pm 15$ |          |                       |
|                                                                                            |                                                                                                     | Full range         |          |          | $\pm 50$ |          |          | $\pm 50$ |          |          | $\pm 50$ |                       |
| $Z_Z$ Reverse dynamic impedance                                                            | $I_Z = 1\text{mA}$ ,<br>$f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_Z$ ,<br>$V_Z = V_{REF}$             | $25^\circ\text{C}$ |          | 0.3      |          |          | 0.3      |          |          | 0.3      |          | $\Omega$              |
|                                                                                            | $I_Z = 1\text{mA}$ ,<br>$f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_Z$ ,<br>$V_Z = 10\text{V}$          | $25^\circ\text{C}$ |          | 2        |          |          | 2        |          |          | 2        |          |                       |
| $e_N$ Wide band noise                                                                      | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = V_{REF}$ ,<br>$10\text{Hz} \leq f \leq 10\text{kHz}$             | $25^\circ\text{C}$ |          | 20       |          |          | 20       |          |          | 20       |          | $\mu\text{V}_{RMS}$   |
| 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>$I_Z = 100\mu\text{A}$ | $25^\circ\text{C}$ |          | 120      |          |          | 120      |          |          | 120      |          | ppm                   |
| $V_{HYST}$ Thermal hysteresis <sup>(2)</sup>                                               | $\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$                                             |                    |          | 0.3      |          |          | 0.3      |          |          | 0.3      |          | mV/V                  |

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

(2) Thermal hysteresis is defined as  $V_{Z,25^\circ\text{C}}$  (after cycling to  $-40^\circ\text{C}$ ) –  $V_{Z,25^\circ\text{C}}$  (after cycling to  $125^\circ\text{C}$ ).

## 5.7 TL4051xQ (Adjustable Version) Electrical Characteristics

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

| PARAMETER                                                                                  | TEST CONDITIONS                                                                                        | $T_A$                | TL4051AQ |          |          | TL4051BQ |          |          | TL4051CQ |          |          | UNIT                    |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------------------|
|                                                                                            |                                                                                                        |                      | MIN      | TYP      | MAX      | MIN      | TYP      | MAX      | MIN      | TYP      | MAX      |                         |
| $V_{REF}$ Reference voltage                                                                | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 5\text{V}$                                                          | $25^{\circ}\text{C}$ |          | 1.212    |          |          | 1.212    |          |          | 1.212    |          | V                       |
| Reference voltage tolerance <sup>(1)</sup>                                                 | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 5\text{V}$                                                          | $25^{\circ}\text{C}$ | -1.2     |          | 1.2      | -2.4     |          | 2.4      | -6       |          | 6        | mV                      |
|                                                                                            |                                                                                                        | Full range           | -7.4     |          | 7.4      | -8.6     |          | 8.6      | -12.2    |          | 12.2     |                         |
| $I_{Z,min}$ Minimum cathode current                                                        |                                                                                                        | $25^{\circ}\text{C}$ |          | 36       | 60       |          | 36       | 60       |          | 36       | 65       | $\mu\text{A}$           |
|                                                                                            |                                                                                                        | Full range           |          |          | 70       |          |          | 70       |          |          | 75       |                         |
| $\frac{\Delta V_{REF}}{\Delta I_Z}$ Reference voltage change with cathode current change   | $I_{Z,min} < I_Z < 1\text{mA}$                                                                         | $25^{\circ}\text{C}$ |          | 0.3      | 1.1      |          | 0.3      | 1.1      |          | 0.3      | 1.1      | mV                      |
|                                                                                            |                                                                                                        | Full range           |          |          | 1.5      |          |          | 1.5      |          |          | 1.5      |                         |
|                                                                                            | $1\text{mA} < I_Z < 12\text{mA}$                                                                       | $25^{\circ}\text{C}$ |          | 0.6      | 6        |          | 0.6      | 6        |          | 0.6      | 6        |                         |
|                                                                                            |                                                                                                        | Full range           |          |          | 8        |          |          | 8        |          |          | 8        |                         |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Reference voltage change with output voltage change | $I_Z = 1\text{mA}$                                                                                     | $25^{\circ}\text{C}$ | -1.69    |          | -2.8     | -1.69    |          | -2.8     | -1.69    |          | -2.8     | mV/V                    |
|                                                                                            |                                                                                                        | Full range           |          |          | -3.5     |          |          | -3.5     |          |          | -3.5     |                         |
| $I_{FB}$ Feedback current                                                                  |                                                                                                        | $25^{\circ}\text{C}$ |          | 70       | 130      |          | 70       | 130      |          | 70       | 130      | nA                      |
|                                                                                            |                                                                                                        | Full range           |          |          | 150      |          |          | 150      |          |          | 150      |                         |
| $\alpha V_{REF}$ Average temperature coefficient of reference voltage <sup>(1)</sup>       | $I_Z = 10\text{mA}$ ,<br>$V_Z = 2.5\text{V}$                                                           | $25^{\circ}\text{C}$ |          | $\pm 20$ |          |          | $\pm 20$ |          |          | $\pm 20$ |          | ppm/ $^{\circ}\text{C}$ |
|                                                                                            | $I_Z = 1\text{mA}$ ,<br>$V_Z = 2.5\text{V}$                                                            | $25^{\circ}\text{C}$ |          | $\pm 15$ |          |          | $\pm 15$ |          |          | $\pm 15$ |          |                         |
|                                                                                            | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = 2.5\text{V}$                                                        | $25^{\circ}\text{C}$ |          | $\pm 15$ |          |          | $\pm 15$ |          |          | $\pm 15$ |          |                         |
|                                                                                            |                                                                                                        | Full range           |          |          | $\pm 50$ |          |          | $\pm 50$ |          |          | $\pm 50$ |                         |
| $Z_Z$ Reverse dynamic impedance                                                            | $I_Z = 1\text{mA}$ ,<br>$f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_Z$ ,<br>$V_Z = V_{REF}$                | $25^{\circ}\text{C}$ |          | 0.3      |          |          | 0.3      |          |          | 0.3      |          | $\Omega$                |
|                                                                                            | $I_Z = 1\text{mA}$ ,<br>$f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_Z$ ,<br>$V_Z = 10\text{V}$             | $25^{\circ}\text{C}$ |          | 2        |          |          | 2        |          |          | 2        |          |                         |
| $e_N$ Wide band noise                                                                      | $I_Z = 100\mu\text{A}$ ,<br>$V_Z = V_{REF}$ ,<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                | $25^{\circ}\text{C}$ |          | 20       |          |          | 20       |          |          | 20       |          | $\mu\text{V}_{RMS}$     |
| 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>$I_Z = 100\mu\text{A}$ | $25^{\circ}\text{C}$ |          | 120      |          |          | 120      |          |          | 120      |          | ppm                     |
| $V_{HYST}$ Thermal hysteresis <sup>(1)</sup>                                               | $\Delta T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$                                            |                      |          | 0.3      |          |          | 0.3      |          |          | 0.3      |          | mV/V                    |

(1) Thermal hysteresis is defined as  $V_{Z,25^{\circ}\text{C}}$  (after cycling to  $-40^{\circ}\text{C}$ ) –  $V_{Z,25^{\circ}\text{C}}$  (after cycling to  $125^{\circ}\text{C}$ ).

## 5.8 Typical Characteristics

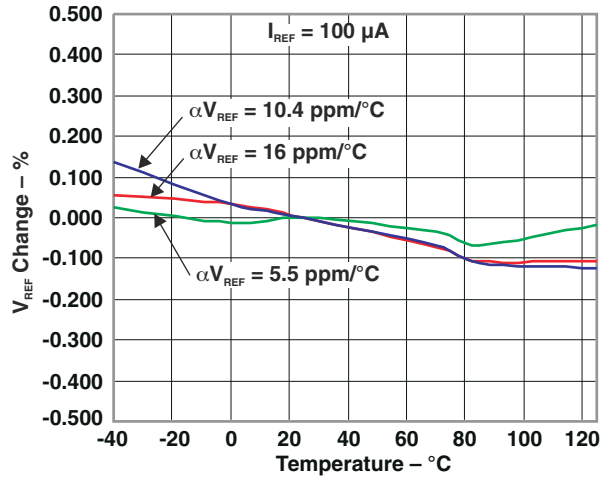


Figure 5-1. Temperature Drift For Different Average Temperature Coefficients

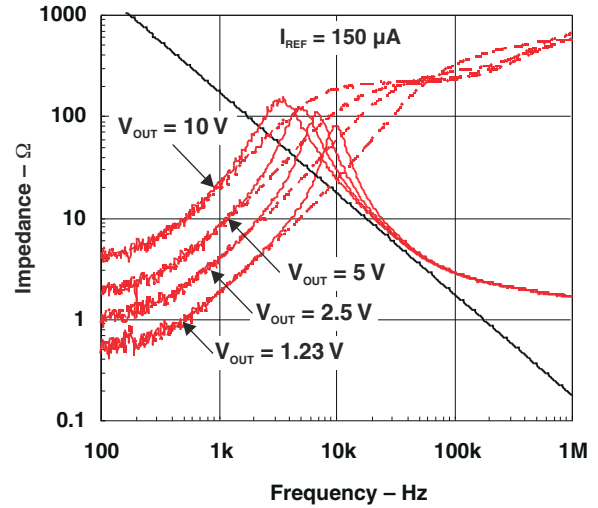


Figure 5-2. Output Impedance vs Frequency

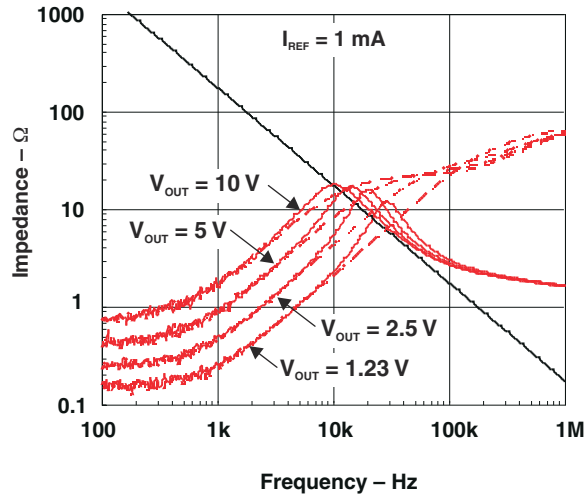


Figure 5-3. Output Impedance vs Frequency

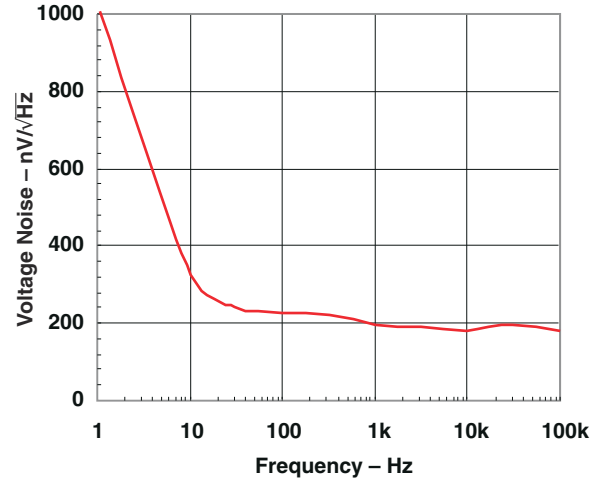


Figure 5-4. Noise Voltage vs Frequency

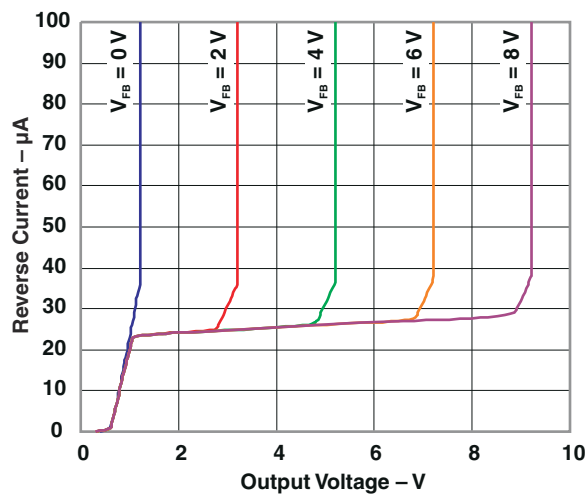


Figure 5-5. Reverse Characteristics

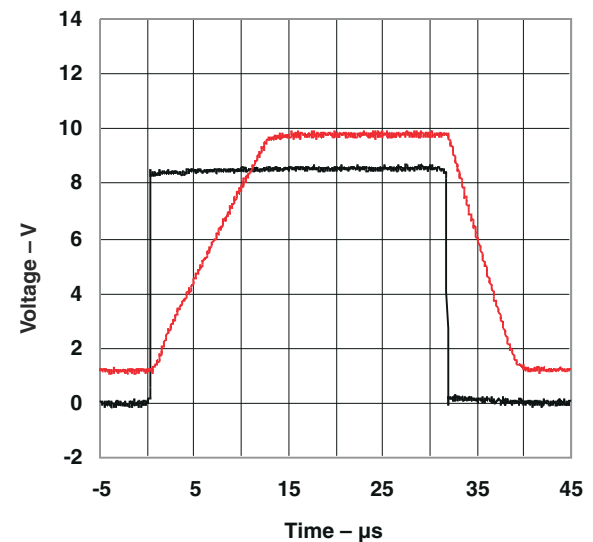


Figure 5-6. Large Signal Pulse Response

## 5.8 Typical Characteristics (continued)

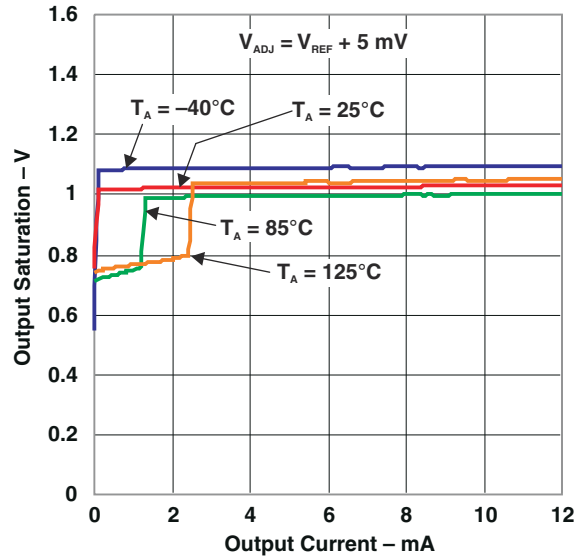


Figure 5-7. Output Saturation vs Output Current

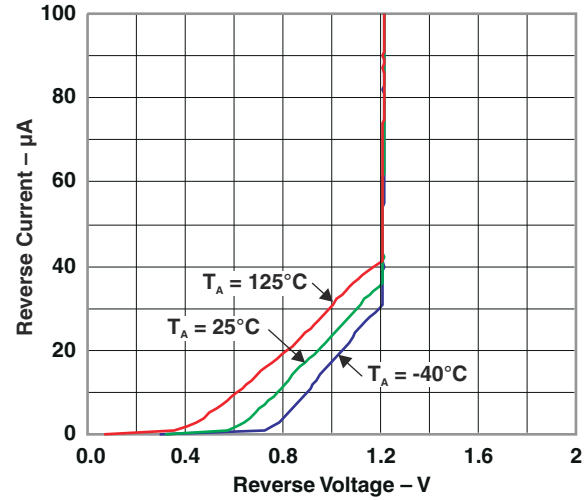


Figure 5-8. Reverse Current vs Reverse Voltage

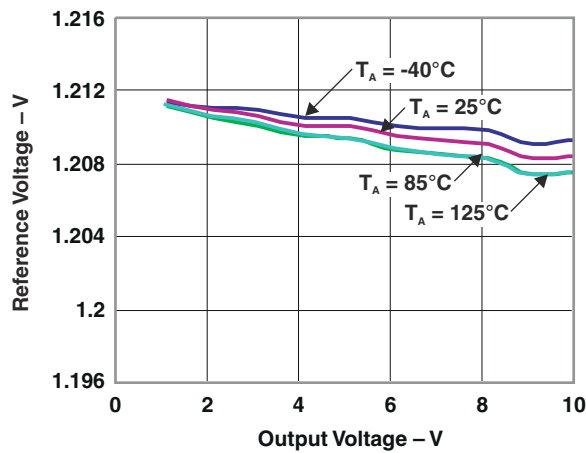


Figure 5-9. Reference Voltage vs Output Voltage

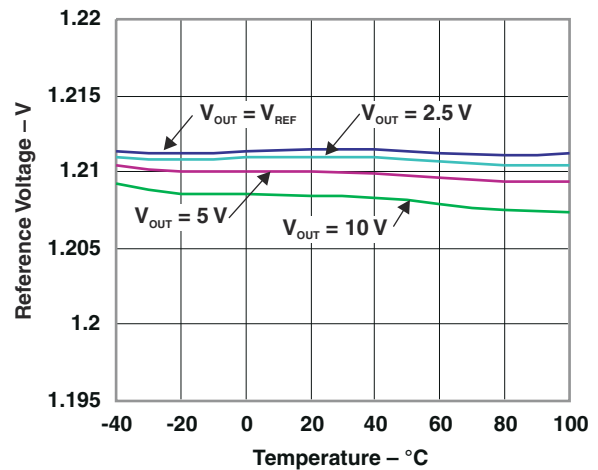


Figure 5-10. Reference Voltage vs Temperature

## 5.8 Typical Characteristics (continued)

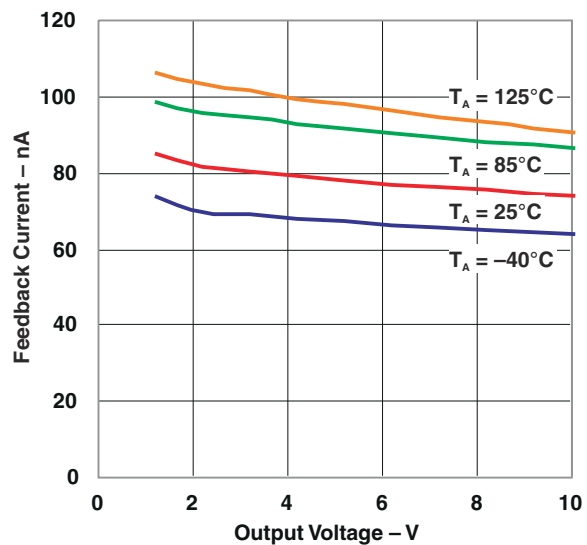
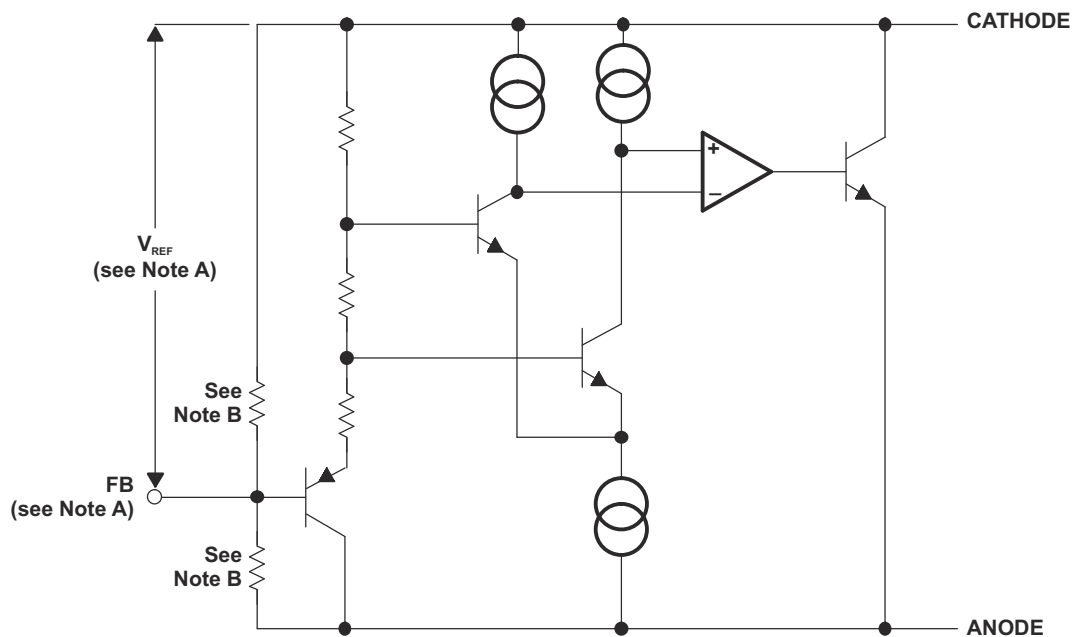


Figure 5-11. Feedback Current vs Output Voltage

## 6 Detailed Description

### 6.1 Functional Block Diagram



- A. TL4051x (Adjustable) only
- B. TL4051x12 only

## 7 Application Information

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

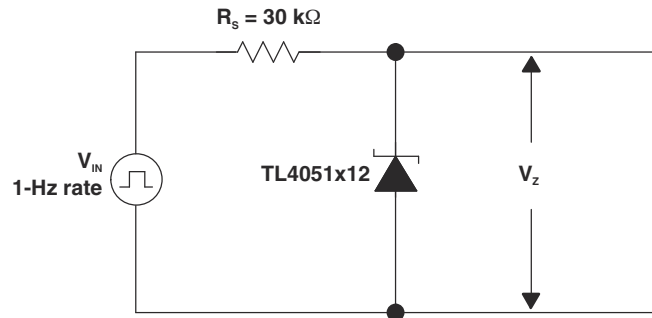


**Figure 7-1. Start-Up Characteristics Test Circuit**

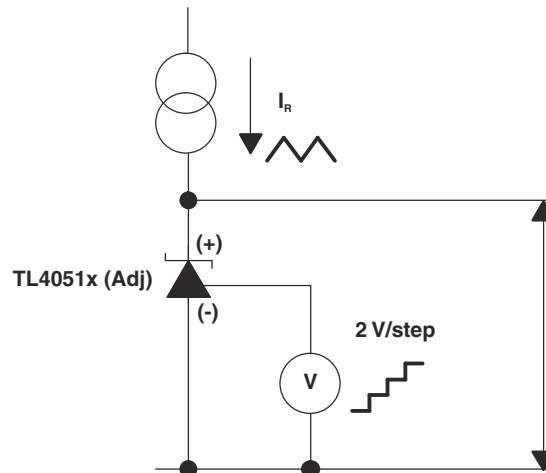


**Figure 7-2. Reverse Characteristics Test Circuit**

### 7.1 Output Capacitor

The TL4051 does not require an output capacitor across CATHODE and ANODE for stability. However, if an output bypass capacitor is desired, the TL4051 is designed to be stable with all capacitive loads.

### 7.2 SOT-23 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.

### 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 Figure 7-3.

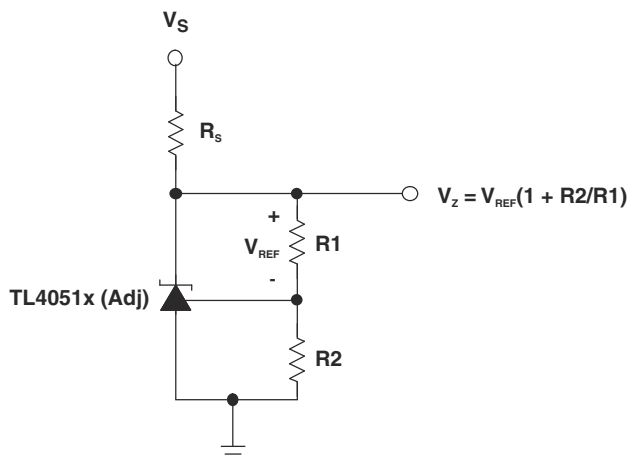


**Figure 7-3. Adjustable Shunt Regulator**

When the output voltage,  $V_Z$ , is set below 2.5V on adjustable versions of TL4051, 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 Figure 7-4), an external resistor,  $R_S$ , is connected between the supply and the cathode of the TL4051.  $R_S$  must be set properly, as it sets the total current available to supply the load ( $I_L$ ) and bias the TL4051 ( $I_Z$ ). 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 Equation 1.

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

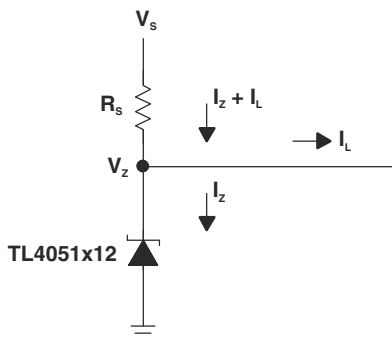


**Figure 7-4. Shunt Regulator**

## 8 Device and Documentation Support

### 8.1 Ordering Information <sup>(1)</sup>

**Table 8-1. Ordering Information <sup>(1)</sup>**

| T <sub>A</sub> | DEVICE GRADE                                                              | V <sub>Z</sub> | PACKAGE <sup>(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>(3)</sup> |
|----------------|---------------------------------------------------------------------------|----------------|------------------------|--------------|-----------------------|---------------------------------|
| –40°C to 85°C  | A grade:<br>0.1% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051AIDBZR          | TN2_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051AIDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051AIDCKR          | 97_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051AIDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051A12IDBZR        | TN8_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051A12IDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051A12IDCKR        | 9D_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051A12IDCKT        |                                 |
|                | B grade:<br>0.2% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051BIDBZR          | TN3_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051BIDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051BIDCKR          | 98_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051BIDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051B12IDBZR        | TN9_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051B12IDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051B12IDCKR        | 9E_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051B12IDCKT        |                                 |
|                | C grade:<br>0.5% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051CIDBZR          | TN4_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051CIDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051CIDCKR          | 99_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051CIDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051C12IDBZR        | TNU_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051C12IDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051C12IDCKR        | 9F_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051C12IDCKT        |                                 |

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).
- (3) The actual top-side marking has one additional character that designates the assembly/test site.

## 8.2 Ordering Information <sup>(1)</sup>

**Table 8-2. Ordering Information <sup>(1)</sup>**

| T <sub>A</sub> | DEVICE GRADE                                                              | V <sub>Z</sub> | PACKAGE <sup>(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>(3)</sup> |
|----------------|---------------------------------------------------------------------------|----------------|------------------------|--------------|-----------------------|---------------------------------|
| –40°C to 125°C | A grade:<br>0.1% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051AQDBZR          | TN5_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051AQDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051AQDCKR          | 9A_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051AQDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051A12QDBZR        | TNV_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051A12QDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051A12QDCKR        | 9G_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051A12QDCKT        |                                 |
|                | B grade:<br>0.2% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051BQDBZR          | TN6_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051BQDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051BQDCKR          | 9B_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051BQDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051B12QDBZR        | TNW_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051B12QDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051B12QDCKR        | 9H_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051B12QDCKT        |                                 |
|                | C grade:<br>0.5% initial accuracy and<br>50ppm/°C temperature coefficient | ADJ            | SOT-23-3 – DBZ         | Reel of 3000 | TL4051CQDBZR          | TN7_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051CQDBZT          |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051CQDCKR          | 9C_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051CQDCKT          |                                 |
|                |                                                                           | 1.2V           | SOT-23-3 – DBZ         | Reel of 3000 | TL4051C12QDBZR        | TNY_                            |
|                |                                                                           |                |                        | Reel of 250  | TL4051C12QDBZT        |                                 |
|                |                                                                           |                | SC-70 – DCK            | Reel of 3000 | TL4051C12QDCKR        | 9J_                             |
|                |                                                                           |                |                        | Reel of 250  | TL4051C12QDCKT        |                                 |

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).
- (3) The actual top-side marking has one additional character that designates the assembly/test site.

## 8.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

## 8.4 Support Resources

**TI E2E™ support forums** are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

## 8.5 Trademarks

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## 8.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## 8.7 Glossary

[TI Glossary](#)      This glossary lists and explains terms, acronyms, and definitions.

## 9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from Revision * (June 2007) to Revision A (March 2025)</b>                                 | <b>Page</b> |
|-------------------------------------------------------------------------------------------------------|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1           |
| • Added information about device behavior in high EMI environments.....                               | 1           |
| • Added ESD ratings.....                                                                              | 4           |
| • Added information about device behavior with cathode voltage <2.5V.....                             | 14          |

## 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 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="#">TL4051A12IDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN8U                |
| TL4051A12IDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN8U                |
| <a href="#">TL4051A12IDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN8U                |
| TL4051A12IDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN8U                |
| <a href="#">TL4051A12QDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TNVU                |
| TL4051A12QDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TNVU                |
| <a href="#">TL4051A12QDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TNVU                |
| TL4051A12QDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TNVU                |
| <a href="#">TL4051A12QDCKR</a>   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9GU                 |
| TL4051A12QDCKR.A                 | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9GU                 |
| <a href="#">TL4051A12QDCKRG4</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 9GU                 |
| TL4051A12QDCKRG4.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 9GU                 |
| <a href="#">TL4051AIDBZR</a>     | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN2U                |
| TL4051AIDBZR.A                   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN2U                |
| <a href="#">TL4051AIDBZT</a>     | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN2U                |
| TL4051AIDBZT.A                   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN2U                |
| <a href="#">TL4051AIDCKR</a>     | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 85    | 97U                 |
| TL4051AIDCKR.A                   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 85    | 97U                 |
| <a href="#">TL4051AQDBZR</a>     | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TN5U                |
| TL4051AQDBZR.A                   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TN5U                |
| <a href="#">TL4051AQDCKR</a>     | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9AU                 |
| TL4051AQDCKR.A                   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9AU                 |
| <a href="#">TL4051B12IDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (TN93, TN9U)        |
| TL4051B12IDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (TN93, TN9U)        |
| <a href="#">TL4051B12IDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (TN93, TN9U)        |
| TL4051B12IDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (TN93, TN9U)        |
| <a href="#">TL4051B12QDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (TNW3, TNWU)        |

| 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) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TL4051B12QDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (TNW3, TNWU)        |
| <a href="#">TL4051B12QDCKR</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9HU                 |
| TL4051B12QDCKR.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9HU                 |
| <a href="#">TL4051BIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN3U                |
| TL4051BIDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN3U                |
| <a href="#">TL4051BIDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN3U                |
| TL4051BIDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN3U                |
| <a href="#">TL4051BIDCKR</a>   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 85    | 98U                 |
| TL4051BIDCKR.A                 | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 85    | 98U                 |
| <a href="#">TL4051BQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TN6U                |
| TL4051BQDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TN6U                |
| <a href="#">TL4051BQDCKR</a>   | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9BU                 |
| TL4051BQDCKR.A                 | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9BU                 |
| <a href="#">TL4051BQDCKRG4</a> | NRND          | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 9BU                 |
| TL4051BQDCKRG4.A               | NRND          | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 9BU                 |
| <a href="#">TL4051C12IDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TNUU                |
| TL4051C12IDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TNUU                |
| <a href="#">TL4051C12IDBZT</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TNUU                |
| TL4051C12IDBZT.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TNUU                |
| <a href="#">TL4051C12IDCKR</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 85    | 9FU                 |
| TL4051C12IDCKR.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 85    | 9FU                 |
| <a href="#">TL4051C12QDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TNYU                |
| TL4051C12QDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TNYU                |
| <a href="#">TL4051C12QDBZT</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | TNYU                |
| TL4051C12QDBZT.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | TNYU                |
| <a href="#">TL4051C12QDCKR</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9JU                 |
| TL4051C12QDCKR.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9JU                 |

| 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="#">TL4051CIDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN4U                |
| TL4051CIDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN4U                |
| <a href="#">TL4051CIDBZT</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | TN4U                |
| TL4051CIDBZT.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | TN4U                |
| <a href="#">TL4051CIDCKR</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 85    | 99U                 |
| TL4051CIDCKR.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 85    | 99U                 |
| <a href="#">TL4051CQDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | Call TI   Nipdau                     | Level-1-260C-UNLIM                | -40 to 125   | TN7U                |
| TL4051CQDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | Call TI                              | Level-1-260C-UNLIM                | -40 to 125   | TN7U                |
| <a href="#">TL4051CQDCKR</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | NIPDAU   POST-<br>PLAT AG SPOT       | Level-1-260C-UNLIM                | -40 to 125   | 9CU                 |
| TL4051CQDCKR.A               | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | POST-PLAT AG SPOT                    | Level-1-260C-UNLIM                | -40 to 125   | 9CU                 |

<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.

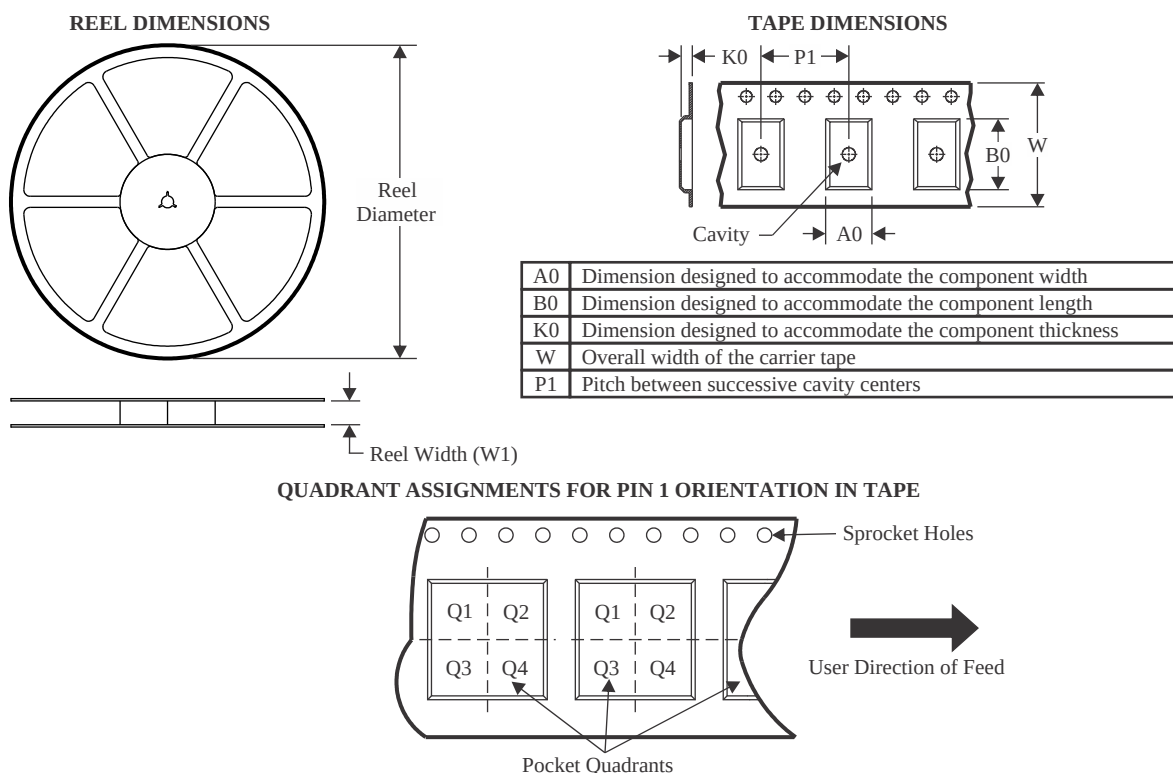
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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.

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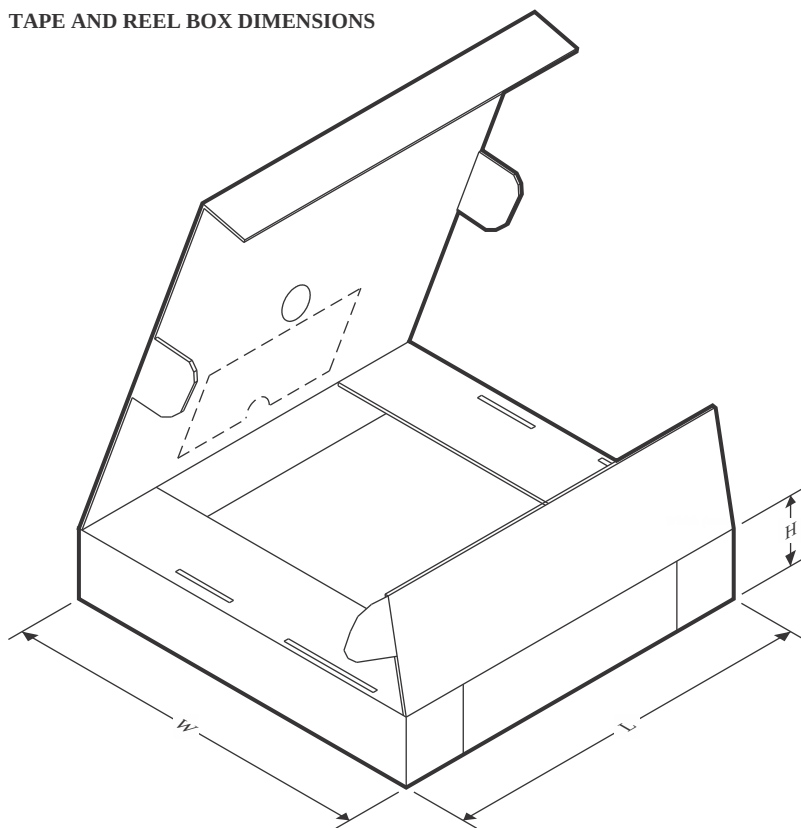
**TAPE AND REEL INFORMATION**


\*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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL4051A12IDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051A12IDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051A12QDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051A12QDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051A12QDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051A12QDCKR   | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051A12QDCKRG4 | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051AIDBZR     | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051AIDBZR     | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051AIDBZT     | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051AIDCKR     | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051AIDCKR     | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051AQDBZR     | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051AQDBZR     | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051AQDCKR     | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051AQDCKR     | SC70         | DCK             | 5    | 3000 | 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL4051B12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.2                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051B12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051B12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051B12IDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051B12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051B12QDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051B12QDCKR | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051BIDCKR   | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051BIDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051BQDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051BQDCKR   | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051BQDCKRG4 | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051C12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051C12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051C12IDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051C12IDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051C12IDCKR | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051C12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051C12QDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051C12QDCKR | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051C12QDCKR | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051CIDCKR   | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051CIDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| TL4051CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 179.0              | 8.4                | 3.15    | 2.95    | 1.22    | 4.0     | 8.0    | Q3            |
| TL4051CQDCKR   | SC70         | DCK             | 5    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TL4051CQDCKR   | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.55    | 1.2     | 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) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL4051A12IDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051A12IDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051A12QDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051A12QDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051A12QDCKR   | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051A12QDCKR   | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051A12QDCKRG4 | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051AIDBZR     | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051AIDBZR     | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051AIDBZT     | SOT-23       | DBZ             | 3    | 250  | 203.0       | 203.0      | 35.0        |
| TL4051AIDCKR     | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051AIDCKR     | SC70         | DCK             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TL4051AQDBZR     | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051AQDBZR     | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051AQDCKR     | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051AQDCKR     | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051B12IDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TL4051B12IDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL4051B12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051B12IDBZT | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051B12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051B12QDCKR | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051B12QDCKR | SC70         | DCK             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TL4051BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 203.0       | 203.0      | 35.0        |
| TL4051BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051BIDCKR   | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051BIDCKR   | SC70         | DCK             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TL4051BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 203.0       | 203.0      | 35.0        |
| TL4051BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051BQDCKR   | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051BQDCKR   | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051BQDCKRG4 | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051C12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051C12IDBZR | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051C12IDBZT | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051C12IDCKR | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051C12IDCKR | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051C12QDBZR | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051C12QDBZT | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051C12QDCKR | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051C12QDCKR | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051CIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TL4051CIDBZT   | SOT-23       | DBZ             | 3    | 250  | 200.0       | 183.0      | 25.0        |
| TL4051CIDCKR   | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051CIDCKR   | SC70         | DCK             | 5    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TL4051CQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 200.0       | 183.0      | 25.0        |
| TL4051CQDCKR   | SC70         | DCK             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TL4051CQDCKR   | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |

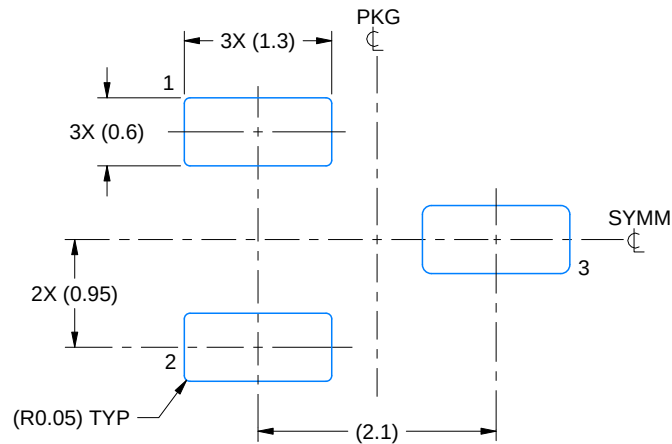


# EXAMPLE BOARD LAYOUT

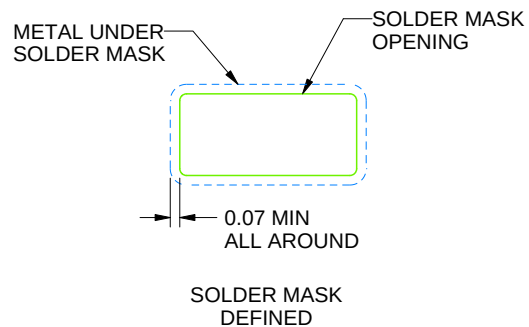
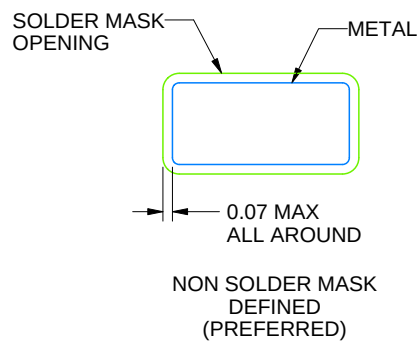
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

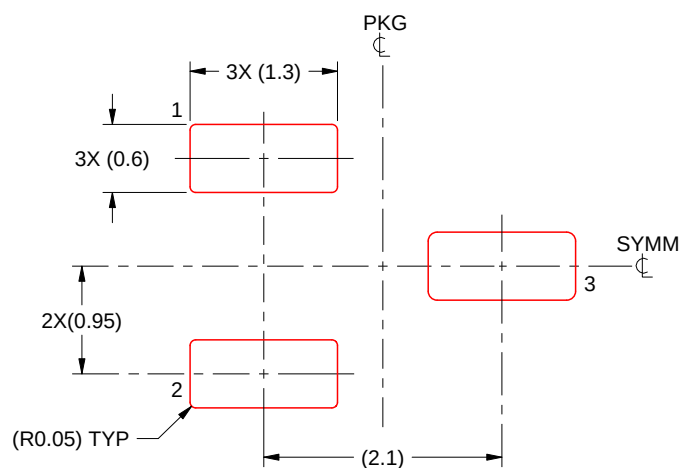
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR

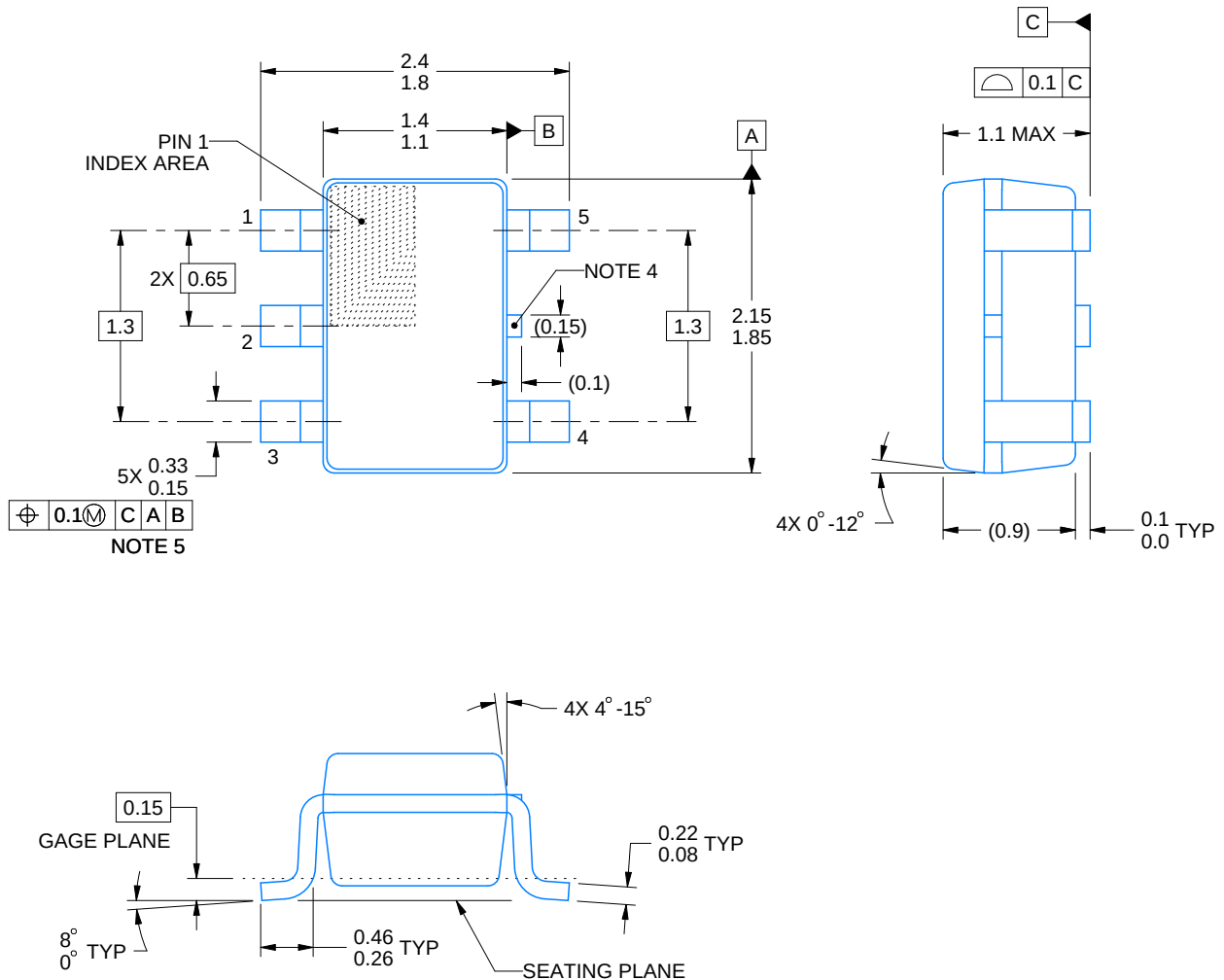


SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:15X

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NOTES: (continued)

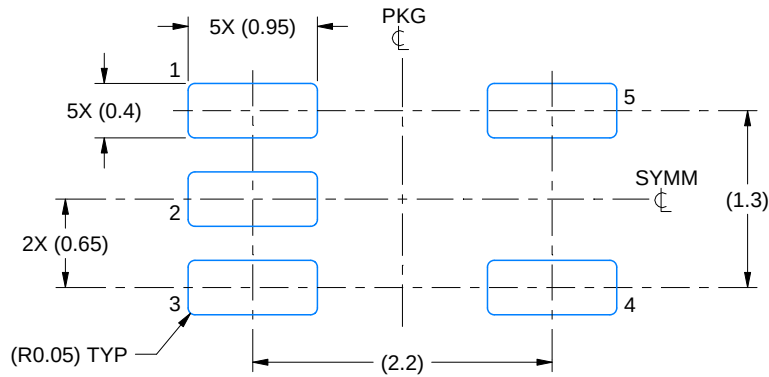
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



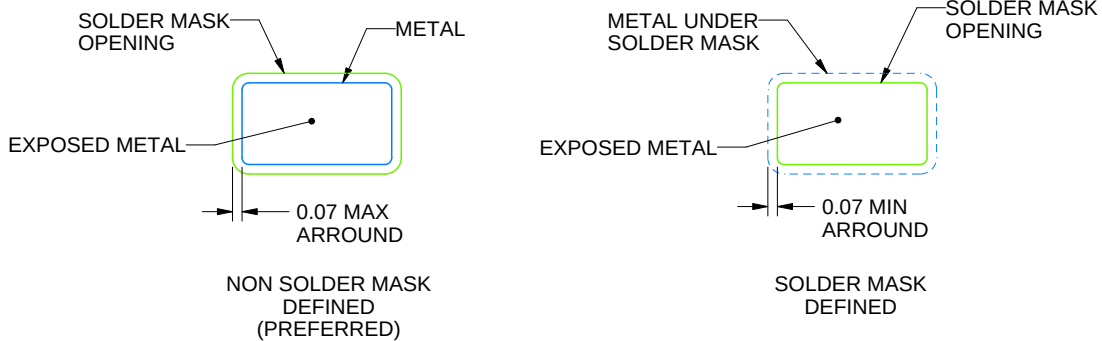
4214834/G 11/2024

## 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

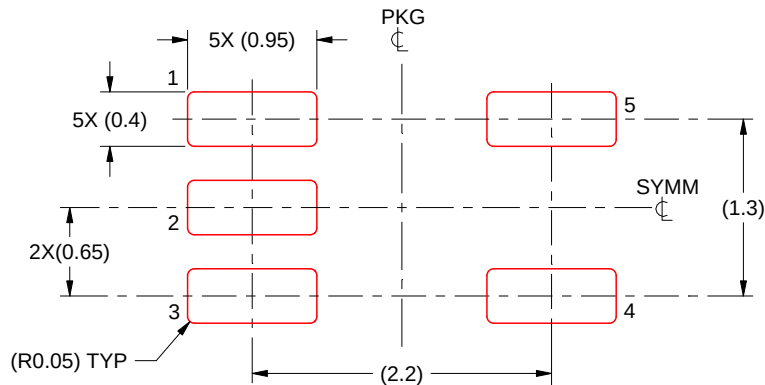


SOLDER MASK DETAILS

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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

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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.

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