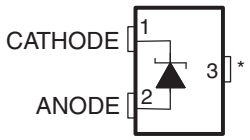
## FEATURES

- **1.225-V Fixed and Adjustable (1.225-V to 10-V) Outputs**
- **Tight Output Tolerances and Low Temperature Coefficient**
  - **Max 0.1%, 50 ppm/°C – A Grade**
  - **Max 0.2%, 50 ppm/°C – B Grade**
  - **Max 0.5%, 50 ppm/°C – C Grade**
- **Low Output Noise…20 $\mu V_{RMS}$ (Typ)**
- **Wide Operating Current Range… 60 μA (Typ) to 12 mA**
- **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**

## APPLICATIONS

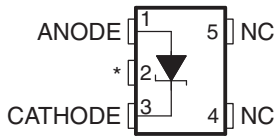
- **Data-Acquisition Systems**
- **Power Supplies and Power-Supply Monitors**
- **Instrumentation and Test Equipment**
- **Process Control**
- **Precision Audio**
- **Automotive Electronics**
- **Energy Management/Metering**
- **Battery-Powered Equipment**

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




* Pin 3 is attached to Substrate and must be connected to ANODE or left open.

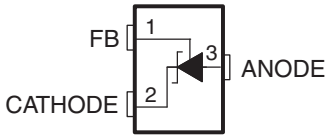
**1.2 V...DCK (SC-70) PACKAGE**
**(TOP VIEW)**



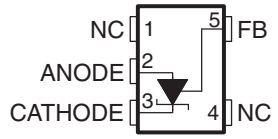

NC – No internal connection

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

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




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




NC – No internal connection

## DESCRIPTION/ORDERING INFORMATION

The TL4051 series of shunt voltage references are versatile easy-to-use references suitable for a wide array of applications. The device is available in a fixed 1.225-V 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 ensure 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 their applications. Packaged in the space-saving SOT-23-3 and SC-70 packages and requiring a minimum current of 45 μA (typ), the TL4051 also is ideal for portable applications.

The TL4051xI 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.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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## ORDERING INFORMATION(1)

| $T_A$ | DEVICE GRADE | $V_Z$ | PACKAGE(2) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING(3) |
|---|---|---|---|---|---|---|
| –40°C to 85°C | A grade: 0.1% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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: 0.2% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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: 0.5% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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 | |

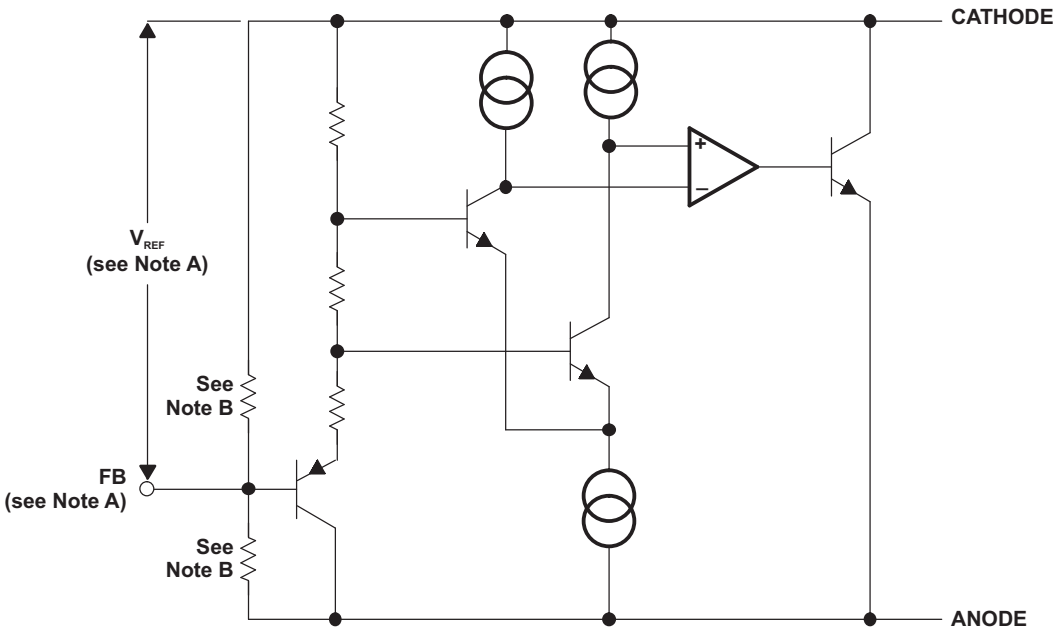
(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.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

## ORDERING INFORMATION(1)

| $T_A$ | DEVICE GRADE | $V_Z$ | PACKAGE(2) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING(3) |
|---|---|---|---|---|---|---|
| –40°C to 125°C | A grade: 0.1% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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: 0.2% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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: 0.5% initial accuracy and 50 ppm/°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 | |
| | | 1.2 V | 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.
(2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(3) The actual top-side marking has one additional character that designates the assembly/test site.

### FUNCTIONAL BLOCK DIAGRAM




A. TL4051x (Adjustable) only

B. TL4051x12 only

## Absolute Maximum Ratings(1)

over free-air temperature range (unless otherwise noted)

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_Z$ | Continuous cathode voltage | | | 15 | V |
| $I_Z$ | Continuous cathode current | | –10 | 20 | mA |
| $\theta_{JA}$ | Package thermal impedance(2)(3) | DBZ package | | 206 | °C/W |
| | | DCK package | | 252 | |
| $T_J$ | Operating virtual junction temperature | | | 150 | °C |
| $T_{stg}$ | Storage temperature range | | –65 | 150 | °C |

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

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

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

## Recommended Operating Conditions

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

(1) See parametric tables

## TL4051x12I Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | $T_A$ | TL4051A12I | | | TL4051B12I | | | TL4051C12I | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_Z$ | Reverse breakdown voltage | $I_Z$ = 100 µA | 25°C | | 1.225 | | | 1.225 | | | 1.225 | | V |
| | Reverse breakdown voltage tolerance | $I_Z$ = 100 µA | 25°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°C | | 39 | 60 | | 39 | 60 | | 39 | 60 | µA |
| | | | Full range | | | 65 | | | 65 | | | 65 | |
| $\alpha_{VZ}$ | Average temperature coefficient of reverse breakdown voltage | $I_Z$ = 10 mA | 25°C | | ±20 | | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | $I_Z$ = 100 µA | 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 | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.3 | 1.1 | | 0.3 | 1.1 | | 0.3 | 1.1 | mV |
| | | | Full range | | | 1.5 | | | 1.5 | | | 1.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 1.8 | 6 | | 1.8 | 6 | | 1.8 | 6 | |
| | | | Full range | | | 8 | | | 8 | | | 8 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$ | 25°C | | 0.5 | | | 0.5 | | | 0.5 | | Ω |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | | 120 | | ppm |
| $V_{HYST}$ | Thermal hysteresis(1) | $\Delta T_A$ = –40°C to 125°C | | | 0.36 | | | 0.36 | | | 0.36 | | mV/V |

(1) Thermal hysteresis is defined as $V_{Z,25°C}$ (after cycling to –40°C) – $V_{Z,25°C}$ (after cycling to 125°C).

## TL4051x12Q Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | $T_A$ | TL4051A12Q | | | TL4051B12Q | | | TL4051C12Q | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_Z$ | Reverse breakdown voltage | $I_Z$ = 100 µA | 25°C | | 1.225 | | | 1.225 | | | 1.225 | | V |
| | Reverse breakdown voltage tolerance | $I_Z$ = 100 µA | 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 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 39 | 60 | | 39 | 60 | | 39 | 60 | µA |
| | | | Full range | | | 65 | | | 65 | | | 65 | |
| $\alpha_{VZ}$ | Average temperature coefficient of reverse breakdown voltage | $I_Z$ = 10 mA | 25°C | | ±20 | | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | $I_Z$ = 100 µA | 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 | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.3 | 1.1 | | 0.3 | 1.1 | | 0.3 | 1.1 | mV |
| | | | Full range | | | 1.5 | | | 1.5 | | | 1.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°C | | 1.8 | 6 | | 1.8 | 6 | | 1.8 | 6 | |
| | | | Full range | | | 8 | | | 8 | | | 8 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$ | 25°C | | 0.5 | | | 0.5 | | | 0.5 | | Ω |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | | 120 | | ppm |
| $V_{HYST}$ | Thermal hysteresis(1) | $\Delta T_A$ = –40°C to 125°C | | | 0.36 | | | 0.36 | | | 0.36 | | mV/V |

(1) Thermal hysteresis is defined as $V_{Z,25°C}$ (after cycling to –40°C) – $V_{Z,25°C}$ (after cycling to 125°C).

## TL4051xI (Adjustable Version) Electrical Characteristics

full range $T_A$ = –40°C to 85°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 µA, $V_Z$ = 5 V | 25°C | | 1.212 | | | 1.212 | | | 1.212 | | V |
| | Reference voltage tolerance(1) | $I_Z$ = 100 µA, $V_Z$ = 5 V | 25°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°C | | 36 | 60 | | 36 | 60 | | 36 | 65 | µA |
| | | | Full range | | | 65 | | | 65 | | | 70 | |
| $\frac{\Delta V_{REF}}{\Delta I_Z}$ | Reference voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.3 | 1.1 | | 0.3 | 1.1 | | 0.3 | 1.1 | mV |
| | | | Full range | | | 1.5 | | | 1.5 | | | 1.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°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 mA | 25°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°C | | 70 | 130 | | 70 | 130 | | 70 | 130 | nA |
| | | | Full range | | | 150 | | | 150 | | | 150 | |
| $\alpha V_{REF}$ | Average temperature coefficient of reference voltage(1) | $I_Z$ = 10 mA, $V_Z$ = 2.5 V | 25°C | | ±20 | | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA, $V_Z$ = 2.5 V | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | $I_Z$ = 100 µA, $V_Z$ = 2.5 V | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | | Full range | | | ±50 | | | ±50 | | | ±50 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = $V_{REF}$ | 25°C | | 0.3 | | | 0.3 | | | 0.3 | | Ω |
| | | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = 10 V | 25°C | | 2 | | | 2 | | | 2 | | |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, $V_Z$ = $V_{REF}$, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | | 120 | | ppm |
| $V_{HYST}$ | Thermal hysteresis(2) | $\Delta T_A$ = –40°C to 125°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 $V_{Z,25°C}$ (after cycling to –40°C) – $V_{Z,25°C}$ (after cycling to 125°C).

## TL4051xQ (Adjustable Version) Electrical Characteristics

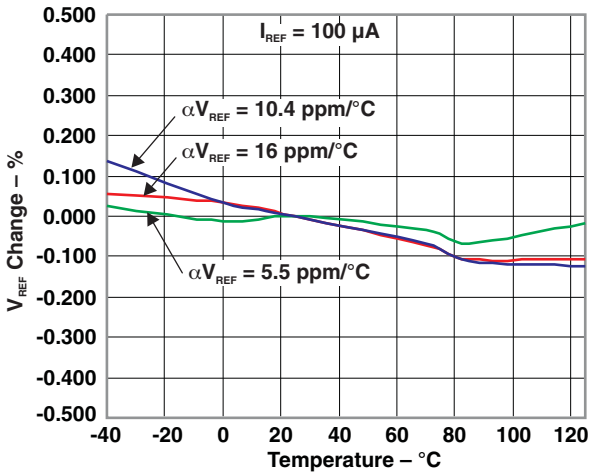
full range $T_A$ = –40°C to 125°C (unless otherwise noted)

| 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 µA, $V_Z$ = 5 V | 25°C | | 1.212 | | | 1.212 | | | 1.212 | | V |
| | Reference voltage tolerance(1) | $I_Z$ = 100 µA, $V_Z$ = 5 V | 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 | |
| $I_{Z,min}$ | Minimum cathode current | | 25°C | | 36 | 60 | | 36 | 60 | | 36 | 65 | µA |
| | | | Full range | | | 70 | | | 70 | | | 75 | |
| $\frac{\Delta V_{REF}}{\Delta I_Z}$ | Reference voltage change with cathode current change | $I_{Z,min} < I_Z < 1$ mA | 25°C | | 0.3 | 1.1 | | 0.3 | 1.1 | | 0.3 | 1.1 | mV |
| | | | Full range | | | 1.5 | | | 1.5 | | | 1.5 | |
| | | 1 mA < $I_Z$ < 12 mA | 25°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 mA | 25°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°C | | 70 | 130 | | 70 | 130 | | 70 | 130 | nA |
| | | | Full range | | | 150 | | | 150 | | | 150 | |
| $\alpha V_{REF}$ | Average temperature coefficient of reference voltage(1) | $I_Z$ = 10 mA, $V_Z$ = 2.5 V | 25°C | | ±20 | | | ±20 | | | ±20 | | ppm/°C |
| | | $I_Z$ = 1 mA, $V_Z$ = 2.5 V | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | $I_Z$ = 100 µA, $V_Z$ = 2.5 V | 25°C | | ±15 | | | ±15 | | | ±15 | | |
| | | | Full range | | | ±50 | | | ±50 | | | ±50 | |
| $Z_Z$ | Reverse dynamic impedance | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = $V_{REF}$ | 25°C | | 0.3 | | | 0.3 | | | 0.3 | | Ω |
| | | $I_Z$ = 1 mA, f = 120 Hz, $I_{AC}$ = 0.1 $I_Z$, $V_Z$ = 10 V | 25°C | | 2 | | | 2 | | | 2 | | |
| $e_N$ | Wideband noise | $I_Z$ = 100 µA, $V_Z$ = $V_{REF}$, 10 Hz ≤ f ≤ 10 kHz | 25°C | | 20 | | | 20 | | | 20 | | $\mu V_{RMS}$ |
| | Long-term stability of reverse breakdown voltage | t = 1000 h, $T_A$ = 25°C ± 0.1°C, $I_Z$ = 100 µA | 25°C | | 120 | | | 120 | | | 120 | | ppm |
| $V_{HYST}$ | Thermal hysteresis(2) | $\Delta T_A$ = –40°C to 125°C | | | 0.3 | | | 0.3 | | | 0.3 | | mV/V |

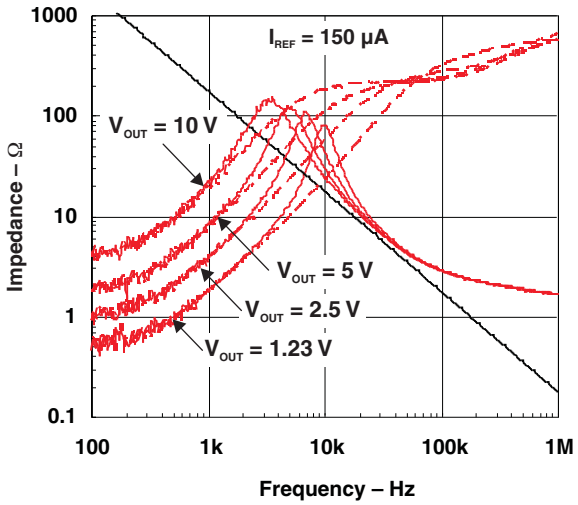
(1) Reference voltage tolerance and average temperature coefficient change with output voltage ($V_Z$). See *Typical Characteristics*.
(2) Thermal hysteresis is defined as $V_{Z,25°C}$ (after cycling to –40°C) – $V_{Z,25°C}$ (after cycling to 125°C).

## TYPICAL CHARACTERISTICS

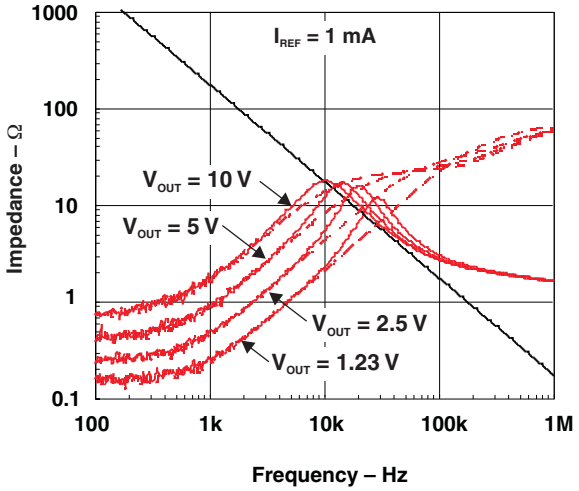
**TEMPERATURE DRIFT FOR DIFFERENT AVERAGE TEMPERATURE COEFFICIENTS**



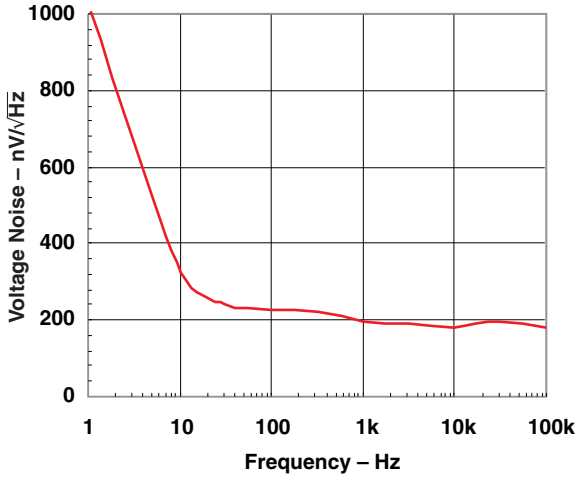

**OUTPUT IMPEDANCE vs FREQUENCY**




**OUTPUT IMPEDANCE vs FREQUENCY**

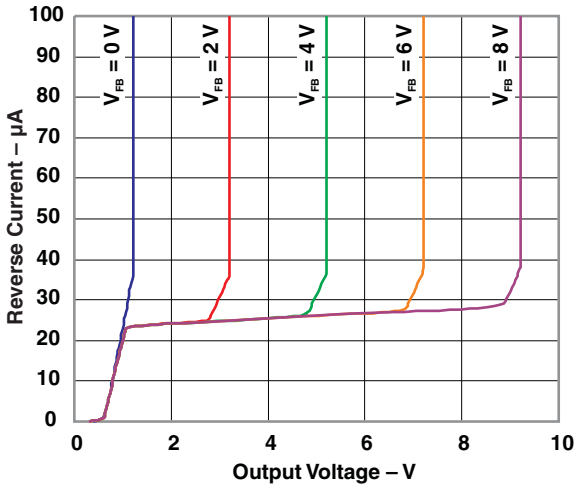



**NOISE VOLTAGE vs FREQUENCY**

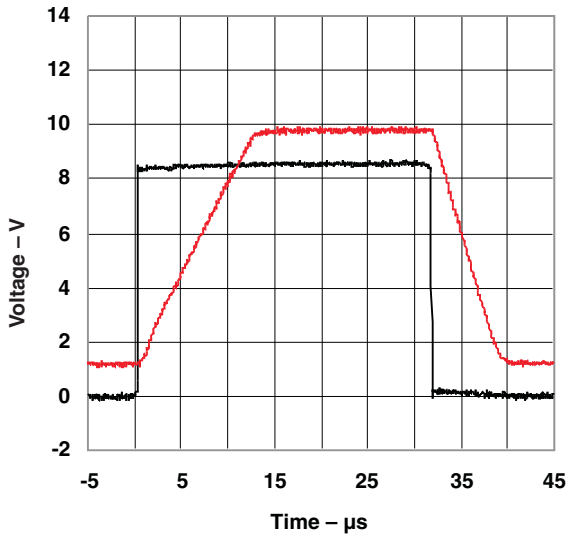


## TYPICAL CHARACTERISTICS (continued)

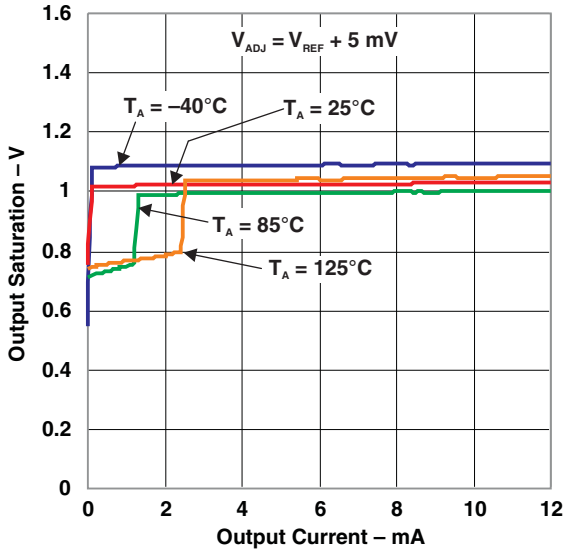
### REVERSE CHARACTERISTICS



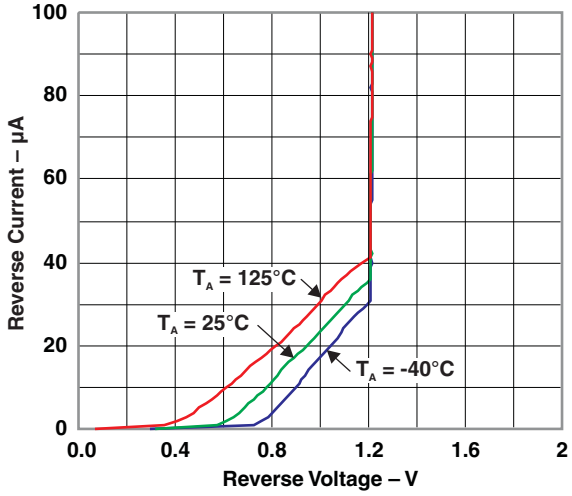

### LARGE SIGNAL PULSE RESPONSE




### OUTPUT SATURATION vs OUTPUT CURRENT

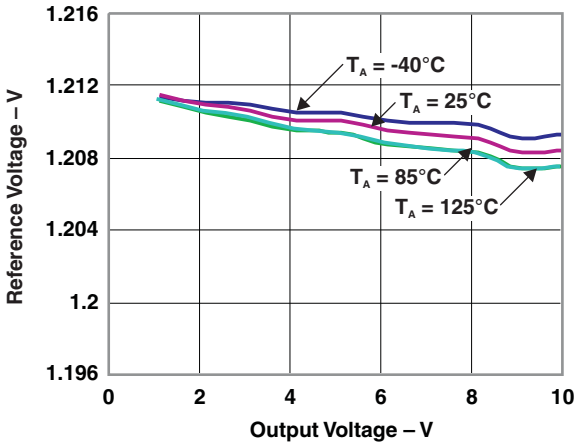



### REVERSE CURRENT vs REVERSE VOLTAGE

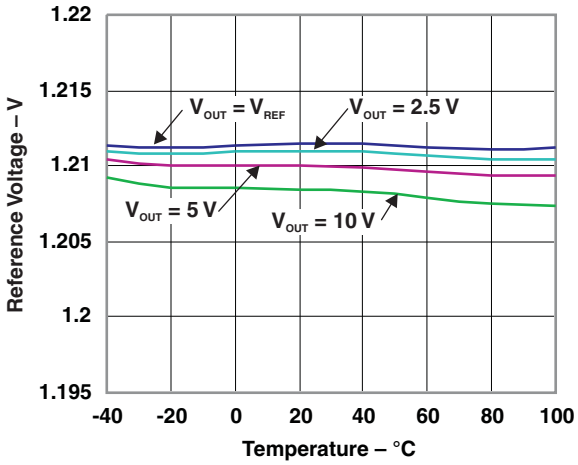


## TYPICAL CHARACTERISTICS (continued)

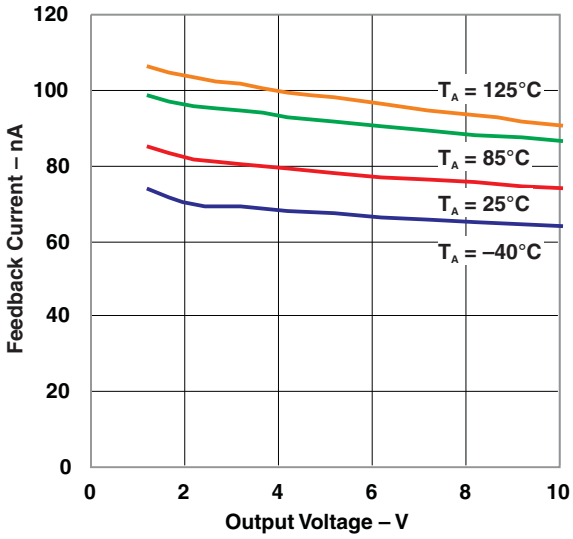
REFERENCE VOLTAGE
vs
OUTPUT VOLTAGE




REFERENCE VOLTAGE
vs
TEMPERATURE




FEEDBACK CURRENT
vs
OUTPUT VOLTAGE



## APPLICATION INFORMATION

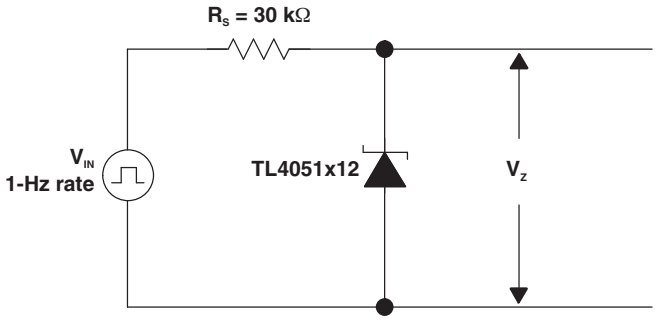



**Figure 1. Start-Up Characteristics Test Circuit**

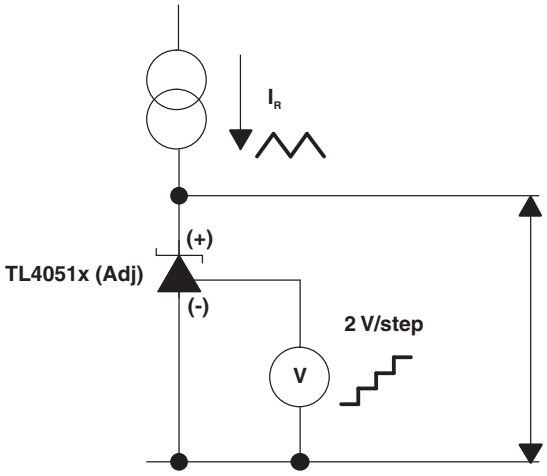



**Figure 2. Reverse Characteristics Test Circuit**

### 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.

### 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.

## APPLICATION INFORMATION (continued)

### 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 3.

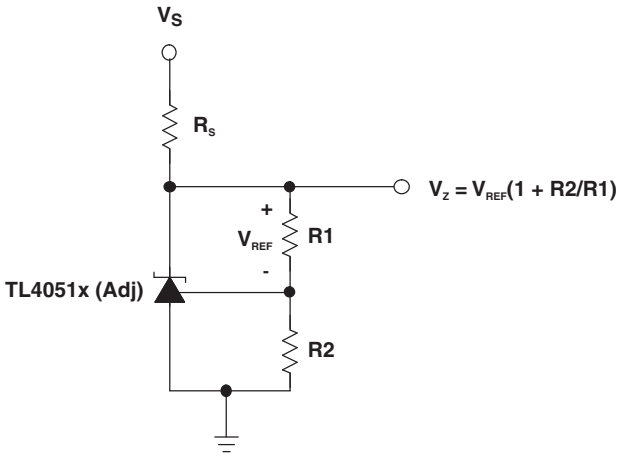



**Figure 3. Adjustable Shunt Regulator**

### Cathode and Load Currents

In a typical shunt regulator configuration (see Figure 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.

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

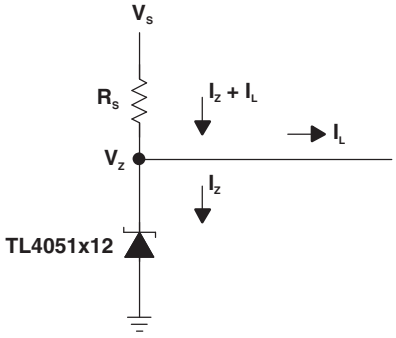



**Figure 4. Shunt Regulator**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TL4051A12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN8U | Samples |
| TL4051A12IDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN8U | Samples |
| TL4051A12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN8U | Samples |
| TL4051A12IDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN8U | Samples |
| TL4051A12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9DU | Samples |
| TL4051A12IDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9DU | Samples |
| TL4051A12QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNVU | Samples |
| TL4051A12QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNVU | Samples |
| TL4051A12QDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNVU | Samples |
| TL4051A12QDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9GU | Samples |
| TL4051A12QDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9GU | Samples |
| TL4051AIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN2U | Samples |
| TL4051AIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN2U | Samples |
| TL4051AIDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN2U | Samples |
| TL4051AIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 97U | Samples |
| TL4051AIDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 97U | Samples |
| TL4051AQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN5U | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TL4051AQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN5U | Samples |
| TL4051AQDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9AU | Samples |
| TL4051AQDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9AU | Samples |
| TL4051B12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN9U | Samples |
| TL4051B12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN9U | Samples |
| TL4051B12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9EU | Samples |
| TL4051B12IDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9EU | Samples |
| TL4051B12QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNWU | Samples |
| TL4051B12QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNWU | Samples |
| TL4051B12QDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9HU | Samples |
| TL4051B12QDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9HU | Samples |
| TL4051BIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN3U | Samples |
| TL4051BIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN3U | Samples |
| TL4051BIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 98U | Samples |
| TL4051BIDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 98U | Samples |
| TL4051BQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN6U | Samples |
| TL4051BQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN6U | Samples |
| TL4051BQDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9BU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TL4051BQDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9BU | Samples |
| TL4051C12IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TNUU | Samples |
| TL4051C12IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TNUU | Samples |
| TL4051C12IDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9FU | Samples |
| TL4051C12IDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9FU | Samples |
| TL4051C12QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNYU | Samples |
| TL4051C12QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TNYU | Samples |
| TL4051C12QDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9JU | Samples |
| TL4051C12QDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9JU | Samples |
| TL4051CIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN4U | Samples |
| TL4051CIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TN4U | Samples |
| TL4051CIDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 99U | Samples |
| TL4051CIDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 99U | Samples |
| TL4051CQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN7U | Samples |
| TL4051CQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | TN7U | Samples |
| TL4051CQDCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9CU | Samples |
| TL4051CQDCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 9CU | Samples |

**(1)** The marketing status values are defined as follows:

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

**(2)** Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

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

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

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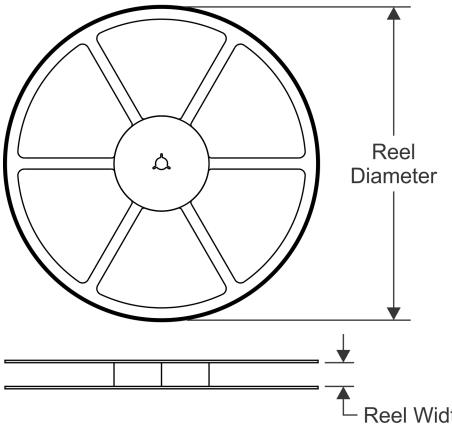
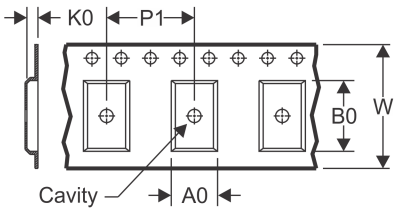
## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

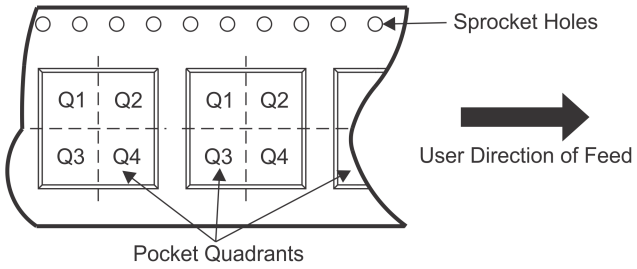



**TAPE DIMENSIONS**




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

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

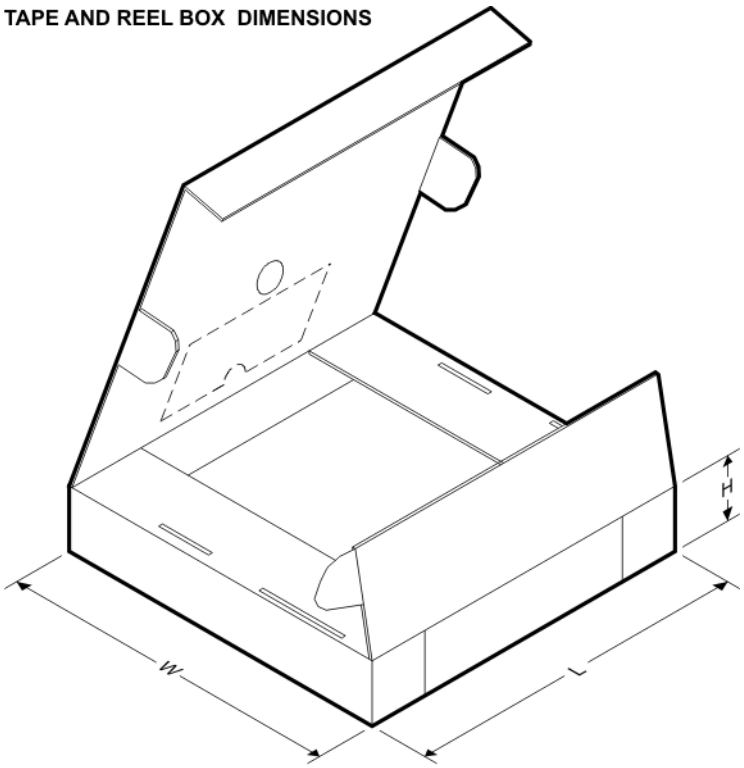



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TL4051A12IDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TL4051A12IDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TL4051A12IDCKR | SC70 | DCK | 5 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051A12IDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051A12QDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TL4051A12QDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051A12QDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051AIDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 |
| TL4051AQDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051AQDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TL4051B12IDCKR | SC70 | DCK | 5 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051B12IDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051B12QDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TL4051B12QDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051B12QDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 |
| TL4051BIDCKR | SC70 | DCK | 5 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051BIDCKT | SC70 | DCK | 5 | 250 | 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 |
| TL4051BQDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051BQDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051C12IDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TL4051C12QDBZR | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TL4051C12QDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051C12QDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 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 |
| TL4051CIDCKT | SC70 | DCK | 5 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 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 |
| TL4051CQDBZT | SOT-23 | DBZ | 3 | 250 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |

**TAPE AND REEL BOX DIMENSIONS**

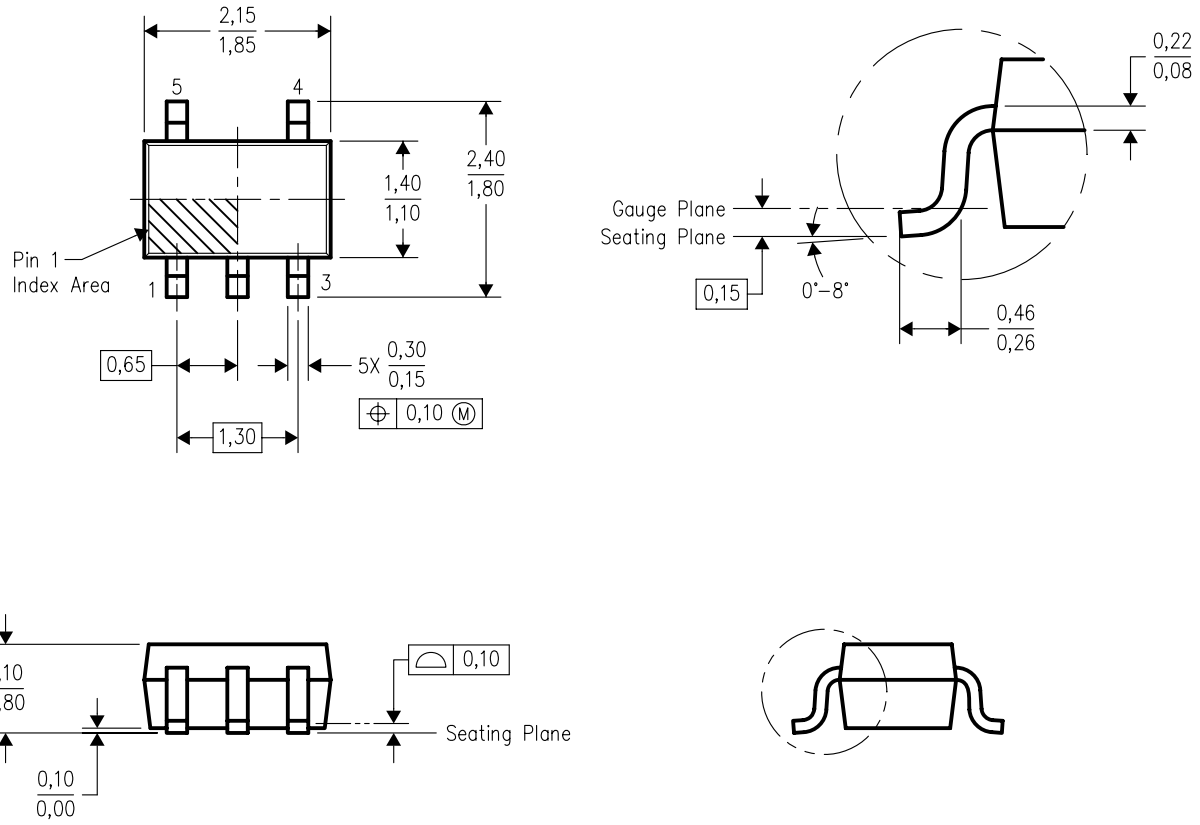



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TL4051A12IDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051A12IDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051A12IDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051A12IDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051A12QDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051A12QDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051A12QDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051A12QDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051AIDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051AIDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051AIDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051AIDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051AQDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051AQDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051AQDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051AQDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051B12IDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051B12IDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051B12IDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051B12IDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TL4051B12QDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051B12QDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051B12QDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051B12QDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051BIDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051BIDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051BIDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051BIDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051BQDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051BQDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051BQDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051BQDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051C12IDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051C12IDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051C12IDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051C12IDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051C12QDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051C12QDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051C12QDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051C12QDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051CIDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051CIDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051CIDCKR | SC70 | DCK | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051CIDCKT | SC70 | DCK | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TL4051CQDBZR | SOT-23 | DBZ | 3 | 3000 | 203.0 | 203.0 | 35.0 |
| TL4051CQDBZT | SOT-23 | DBZ | 3 | 250 | 203.0 | 203.0 | 35.0 |

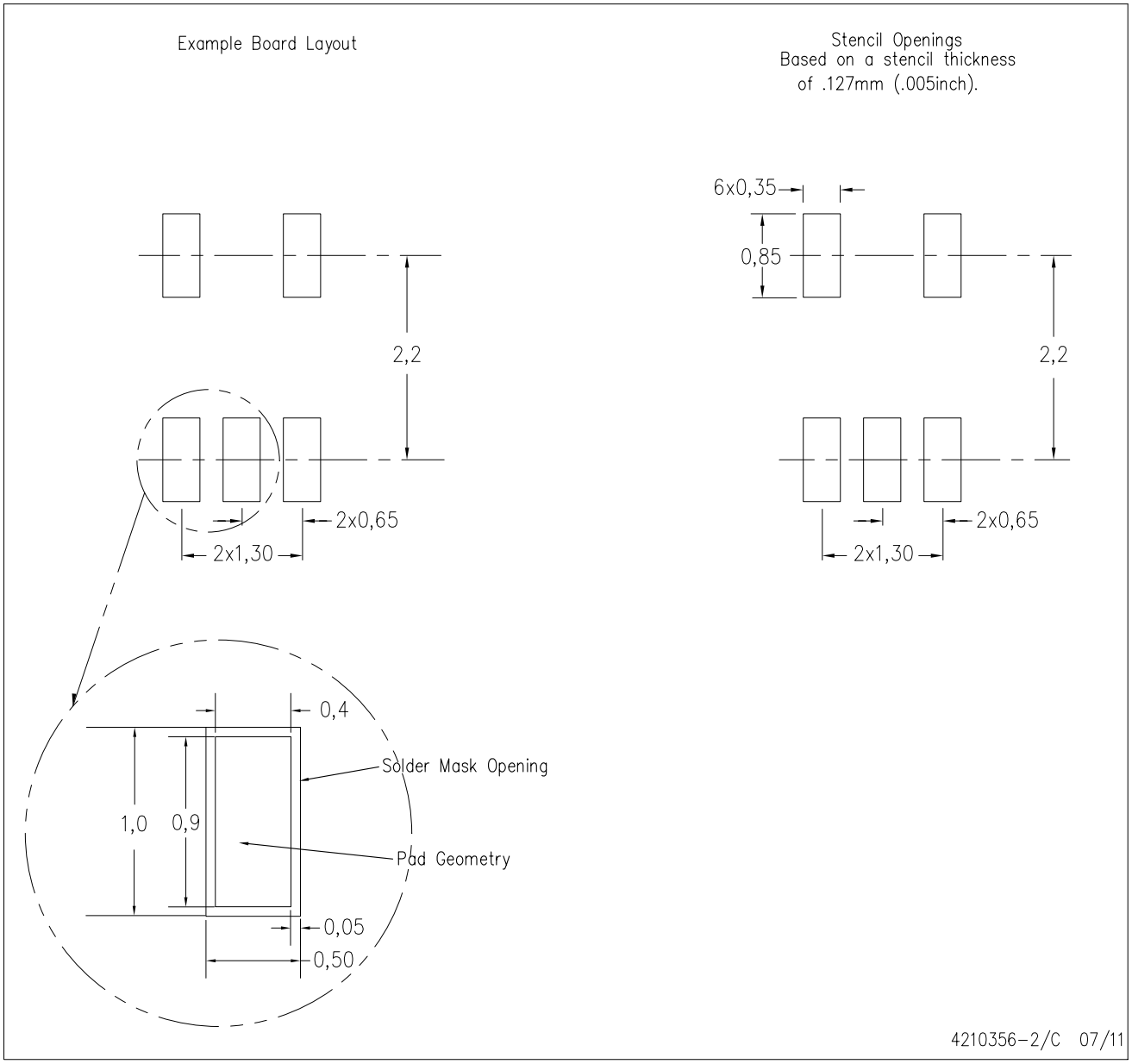
## DCK (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE




4093553–3/G 01/2007

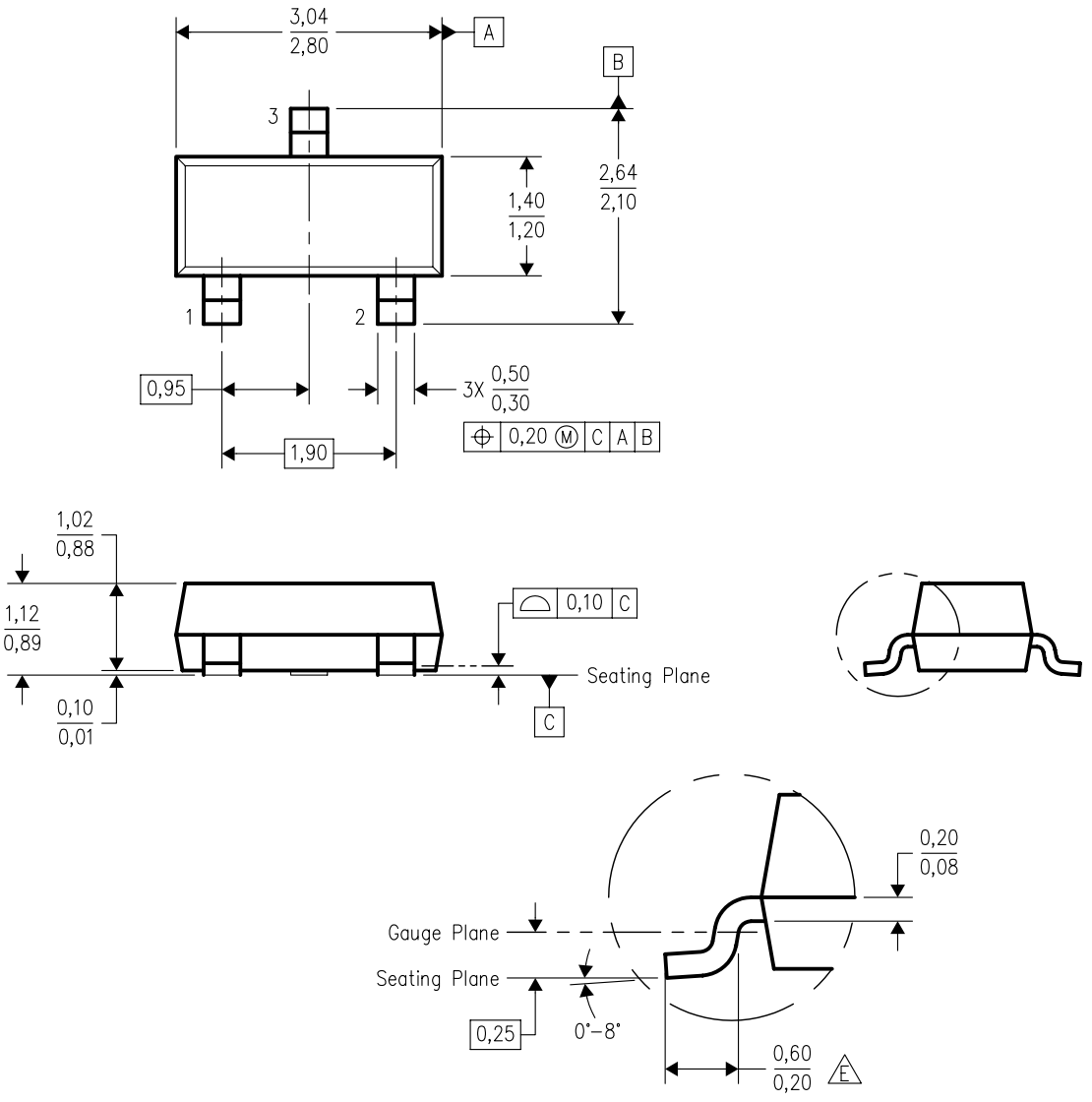
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–203 variation AA.

DCK (R–PDSO–G5) PLASTIC SMALL OUTLINE



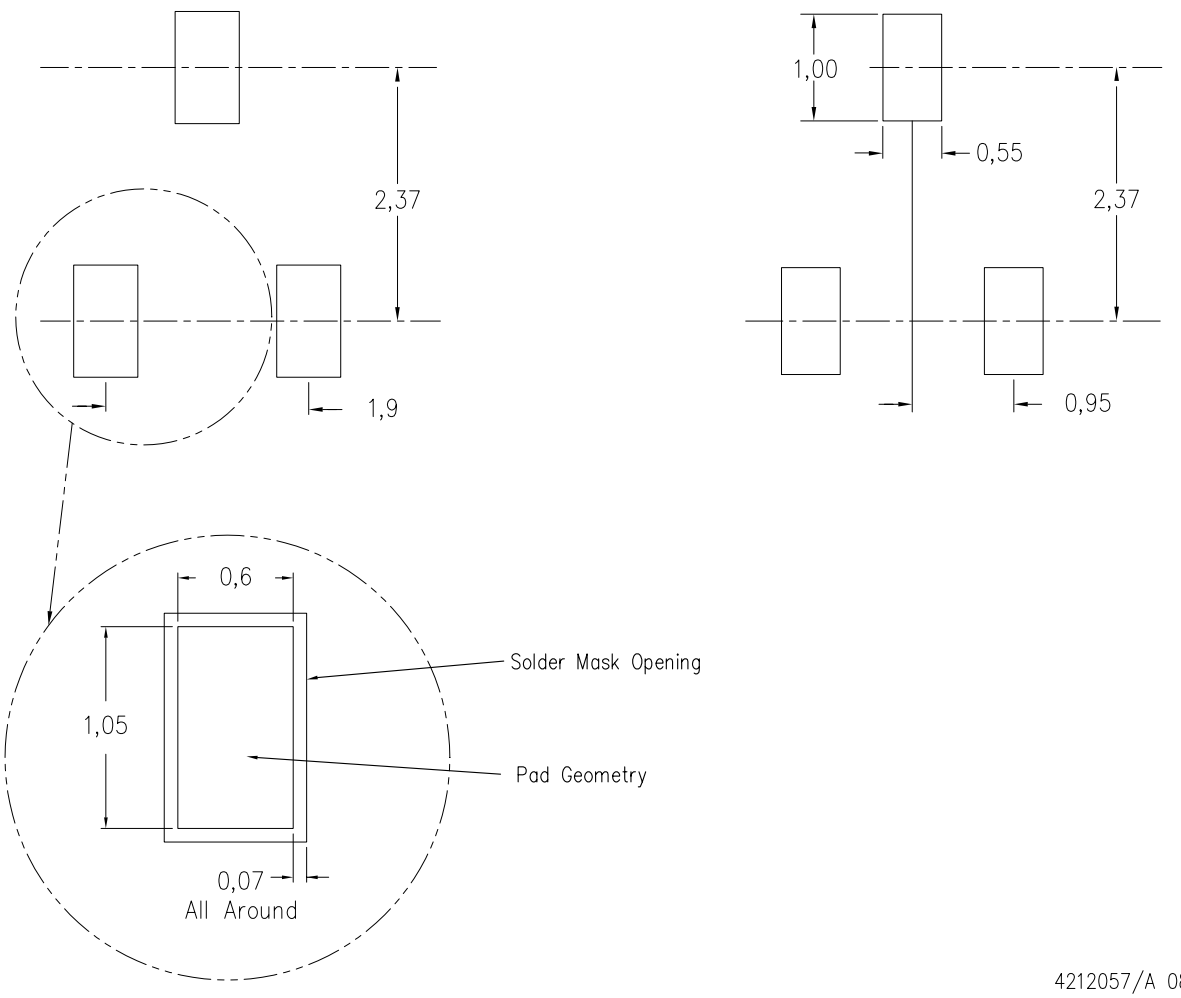

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

## DBZ (R–PDSO–G3) PLASTIC SMALL–OUTLINE




NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Lead dimensions are inclusive of plating.
D. Body dimensions are exclusive of mold flash and protrusion. Mold flash and protrusion not to exceed 0.25 per side.
E. Falls within JEDEC TO–236 variation AB, except minimum foot length.

DBZ (R–PDSO–G3) PLASTIC SMALL OUTLINE




NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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