

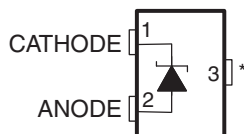
## FEATURES

- Fixed Output Voltages of 2.048 V, 2.5 V, 4.096 V, 5 V, 8.192 V, and 10 V
- 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...41  $\mu\text{V}_{\text{RMS}}$  Typ
- Wide Operating Current Range... 60  $\mu\text{A}$  Typ to 15 mA
- Stable With All Capacitive Loads; No Output Capacitor Required
- Available in Extended Temperature Range...–40°C to 125°C

## APPLICATIONS

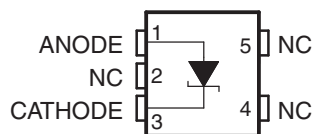
- Data-Acquisition Systems
- Power Supplies and Power-Supply Monitors
- Instrumentation and Test Equipment
- Process Controls
- Precision Audio
- Automotive Electronics
- Energy Management
- Battery-Powered Equipment

DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)



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

DCK (SC-70) PACKAGE  
(TOP VIEW)



NC – No internal connection

## DESCRIPTION/ORDERING INFORMATION

The TL4050 series of shunt voltage references are versatile easy-to-use references suitable for a wide array of applications. The two-terminal fixed-output 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 TL4050 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  $\mu\text{A}$  (typ), the TL4050 also is ideal for portable applications.

The TL4050xl is characterized for operation over an ambient temperature range of –40°C to 85°C. The TL4050xQ 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.

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS486–JUNE 2007

## ORDERING INFORMATION<sup>(1)</sup>

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
–40°C to 85°C	A grade: 0.1% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A20IDBZR	PREVIEW
				Reel of 250	TL4050A20IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A20IDCKR	PREVIEW
				Reel of 250	TL4050A20IDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A25IDBZR	PREVIEW
				Reel of 250	TL4050A25IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A25IDCKR	PREVIEW
				Reel of 250	TL4050A25IDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A41IDBZR	PREVIEW
				Reel of 250	TL4050A41IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A41IDCKR	PREVIEW
				Reel of 250	TL4050A41IDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A50IDBZR	PREVIEW
				Reel of 250	TL4050A50IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A50IDCKR	PREVIEW
				Reel of 250	TL4050A50IDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A82IDBZR	PREVIEW
				Reel of 250	TL4050A82IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A82IDCKR	PREVIEW
				Reel of 250	TL4050A82IDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A10IDBZR	PREVIEW
				Reel of 250	TL4050B10IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A10IDCKR	PREVIEW
				Reel of 250	TL4050B10IDCKT	

- (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.

**ORDERING INFORMATION (continued)**

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>	
–40°C to 85°C	B grade: 0.2% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B20IDBZR	PREVIEW
				Reel of 250	TL4050B20IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B20IDCKR	PREVIEW
				Reel of 250	TL4050B20IDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B25IDBZR	PREVIEW
				Reel of 250	TL4050B25IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B25IDCKR	PREVIEW
				Reel of 250	TL4050B25IDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B41IDBZR	PREVIEW
				Reel of 250	TL4050B41IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B41IDCKR	PREVIEW
				Reel of 250	TL4050B41IDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B50IDBZR	PREVIEW
				Reel of 250	TL4050B50IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B50IDCKR	PREVIEW
				Reel of 250	TL4050B50IDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B82IDBZR	PREVIEW
				Reel of 250	TL4050B82IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B82IDCKR	PREVIEW
				Reel of 250	TL4050B82IDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B10IDBZR	PREVIEW
				Reel of 250	TL4050B10IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B10IDCKR	PREVIEW
				Reel of 250	TL4050B10IDCKT	

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS486–JUNE 2007

## ORDERING INFORMATION (continued)

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
–40°C to 85°C	C grade: 0.5% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C20IDBZR	PREVIEW
				Reel of 250	TL4050C20IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C20IDCKR	PREVIEW
				Reel of 250	TL4050C20IDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C25IDBZR	PREVIEW
				Reel of 250	TL4050C25IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C25IDCKR	PREVIEW
				Reel of 250	TL4050C25IDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C41IDBZR	PREVIEW
				Reel of 250	TL4050C41IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C41IDCKR	PREVIEW
				Reel of 250	TL4050C41IDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C50IDBZR	PREVIEW
				Reel of 250	TL4050C50IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C50IDCKR	PREVIEW
				Reel of 250	TL4050C50IDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C82IDBZR	PREVIEW
				Reel of 250	TL4050C82IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C82IDCKR	PREVIEW
				Reel of 250	TL4050C82IDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C10IDBZR	PREVIEW
				Reel of 250	TL4050C10IDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C10IDCKR	PREVIEW
				Reel of 250	TL4050C10IDCKT	

**ORDERING INFORMATION<sup>(1)</sup>**

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
–40°C to 125°C	A grade: 0.1% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A20QDBZR	PREVIEW
				Reel of 250	TL4050A20QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A20QDCKR	PREVIEW
				Reel of 250	TL4050A20QDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A25QDBZR	PREVIEW
				Reel of 250	TL4050A25QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A25QDCKR	PREVIEW
				Reel of 250	TL4050A25QDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A41QDBZR	PREVIEW
				Reel of 250	TL4050A41QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A41QDCKR	PREVIEW
				Reel of 250	TL4050A41QDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A50QDBZR	PREVIEW
				Reel of 250	TL4050A50QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A50QDCKR	PREVIEW
				Reel of 250	TL4050A50QDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A82QDBZR	PREVIEW
				Reel of 250	TL4050A82QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A82QDCKR	PREVIEW
				Reel of 250	TL4050A82QDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A10QDBZR	PREVIEW
				Reel of 250	TL4050B10QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050A10QDCKR	PREVIEW
				Reel of 250	TL4050A10QDCKT	

- (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.

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS486–JUNE 2007

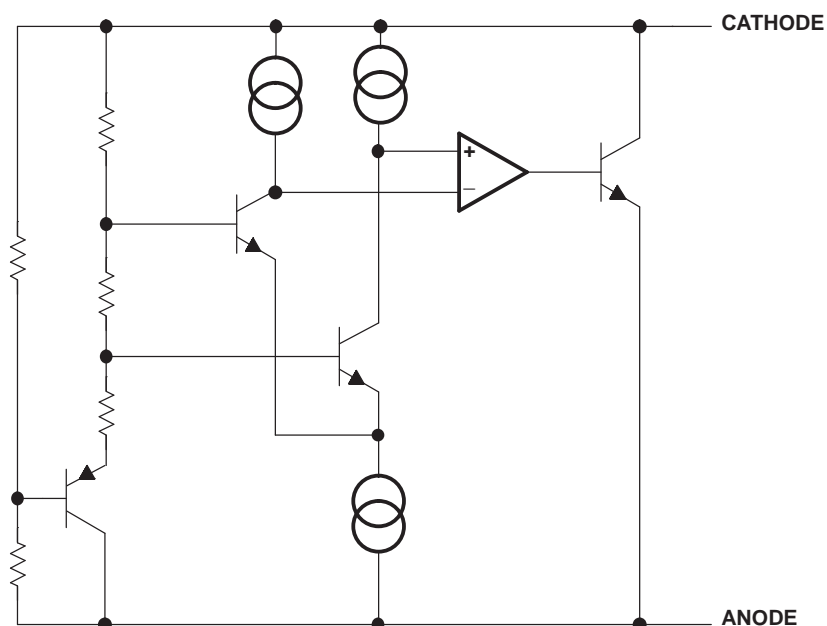
## ORDERING INFORMATION (continued)

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
–40°C to 125°C	B grade: 0.2% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B20QDBZR	PREVIEW
				Reel of 250	TL4050B20QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B20QDCKR	PREVIEW
				Reel of 250	TL4050B20QDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B25QDBZR	PREVIEW
				Reel of 250	TL4050B25QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B25QDCKR	PREVIEW
				Reel of 250	TL4050B25QDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B41QDBZR	PREVIEW
				Reel of 250	TL4050B41QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B41QDCKR	PREVIEW
				Reel of 250	TL4050B41QDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B50QDBZR	PREVIEW
				Reel of 250	TL4050B50QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B50QDCKR	PREVIEW
				Reel of 250	TL4050B50QDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B82QDBZR	PREVIEW
				Reel of 250	TL4050B82QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B82QDCKR	PREVIEW
				Reel of 250	TL4050B82QDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B10QDBZR	PREVIEW
				Reel of 250	TL4050B10QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050B10QDCKR	PREVIEW
				Reel of 250	TL4050B10QDCKT	

**ORDERING INFORMATION (continued)**

$T_A$	DEVICE GRADE	$V_{KA}$	PACKAGE <sup>(2)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>	
–40°C to 125°C	C grade: 0.5% initial accuracy and 50 ppm/°C temperature coefficient	2.048 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C20QDBZR	PREVIEW
				Reel of 250	TL4050C20QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C20QDCKR	PREVIEW
				Reel of 250	TL4050C20QDCKT	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C25QDBZR	PREVIEW
				Reel of 250	TL4050C25QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C25QDCKR	PREVIEW
				Reel of 250	TL4050C25QDCKT	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C41QDBZR	PREVIEW
				Reel of 250	TL4050C41QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C41QDCKR	PREVIEW
				Reel of 250	TL4050C41QDCKT	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C50QDBZR	PREVIEW
				Reel of 250	TL4050C50QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C50QDCKR	PREVIEW
				Reel of 250	TL4050C50QDCKT	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C82QDBZR	PREVIEW
				Reel of 250	TL4050C82QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C82QDCKR	PREVIEW
				Reel of 250	TL4050C82QDCKT	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C10QDBZR	PREVIEW
				Reel of 250	TL4050C10QDBZT	
			SC-70 – DCK	Reel of 3000	TL4050C10QDCKR	PREVIEW
				Reel of 250	TL4050C10QDCKT	

FUNCTIONAL BLOCK DIAGRAM



**Absolute Maximum Ratings<sup>(1)</sup>**

over free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$I_Z$	Continuous cathode current	-10	20	mA
$\theta_{JA}$	Package thermal impedance <sup>(2)(3)</sup>		206	°C/W
			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  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . 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)	15	mA	
$T_A$	Free-air temperature	I temperature	-40	85	°C
		Q temperature	-40	125	

- (1) See parametric tables



### TL4050x20I Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A20I			TL4050B20I			TL4050C20I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage $I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	2.048			2.048			2.048			V
$\Delta V_Z$	Reverse breakdown voltage tolerance $I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	-2.048		2.048	-4.096		4.096	-10.24		10.24	mV
		Full range	-9.0112		9.0112	-11.4688		11.4688	-14.7456		14.7456	
$I_{Z,\text{min}}$	Minimum cathode current	$25^\circ\text{C}$		41	60		41	60		41	60	$\mu\text{A}$
		Full range			65			65			65	
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage $I_Z = 10\ \text{mA}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			ppm/ $^\circ\text{C}$
		$25^\circ\text{C}$	$\pm 15$			$\pm 15$			$\pm 15$			
		$25^\circ\text{C}$	$\pm 15$			$\pm 15$			$\pm 15$			
		Full range	$\pm 50$			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change $I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^\circ\text{C}$		0.3	0.8		0.3	0.8		0.3	0.8	mV
		Full range			1.2			1.2			1.2	
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^\circ\text{C}$		2.3	6		2.3	6		2.3	6	
		Full range			8			8			8	
$Z_Z$	Reverse dynamic impedance $I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^\circ\text{C}$	0.3			0.3			0.3			$\Omega$
$e_N$	Wideband noise $I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^\circ\text{C}$	34			34			34			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage $t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup> $\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		0.7			0.7			0.7			mV

(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  $125^\circ\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

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## TL4050x20Q Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A20Q			TL4050B20Q			TL4050C20Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage $I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	2.048			2.048			2.048			V
$\Delta V_Z$	Reverse breakdown voltage tolerance $I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	-2.048		2.048	-4.096		4.096	-10.24		10.24	mV
		Full range	-12.288		12.288	-14.7456		14.7456	-17.2032		17.2032	
$I_{Z,\text{min}}$	Minimum cathode current	$25^\circ\text{C}$	41		60	41		60	41		60	$\mu\text{A}$
		Full range			65			65			65	
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage $I_Z = 10\ \text{mA}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			ppm/ $^\circ\text{C}$
		$25^\circ\text{C}$	$\pm 15$			$\pm 15$			$\pm 15$			
		$25^\circ\text{C}$	$\pm 15$			$\pm 15$			$\pm 15$			
		Full range	$\pm 50$			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change $I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^\circ\text{C}$	0.3		0.8	0.3		0.8	0.3		0.8	mV
		Full range			1.2			1.2			1.2	
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^\circ\text{C}$	2.3		6	2.3		6	2.3		6	
		Full range			8			8			8	
$Z_Z$	Reverse dynamic impedance $I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^\circ\text{C}$	0.3			0.3			0.3			$\Omega$
$e_N$	Wideband noise $I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^\circ\text{C}$	34			34			34			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage $t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup> $\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		0.7			0.7			0.7			mV

(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  $125^\circ\text{C}$ ).

### TL4050x25I Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A25I			TL4050B25I			TL4050C25I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$ Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C	2.5			2.5			2.5			V
$\Delta V_Z$ Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C	-2.5	2.5		-5	5		-13	13		mV
		Full range	-11		11	-14		14	-21		21	
$I_{Z,\text{min}}$ Minimum cathode current		25°C	41		60	41		60	41		60	$\mu\text{A}$
		Full range	65			65			65			
$\alpha_{VZ}$ Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C	$\pm 20$			$\pm 20$			$\pm 20$			ppm/°C
	$I_Z = 1\ \text{mA}$	25°C	$\pm 15$			$\pm 15$			$\pm 15$			
	$I_Z = 100\ \mu\text{A}$	25°C	$\pm 15$			$\pm 15$			$\pm 15$			
		Full range	$\pm 50$			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$ Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C	0.3	0.8		0.3	0.8		0.3	0.8		mV
		Full range	1.2			1.2			1.2			
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C	2.3		6	2.3		6	2.3		6	
		Full range	8			8			8			
$Z_Z$ Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C	0.3			0.3			0.3			$\Omega$
$e_N$ Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C	41			41			41			$\mu\text{V}_{\text{RMS}}$
Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$ Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		0.7			0.7			0.7			mV

(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  $125^\circ\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

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## TL4050x25Q Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A25Q			TL4050B25Q			TL4050C25Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C			2.5			2.5			V
$\Delta V_Z$	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C			-2.5			2.5			mV
			Full range			-15			15			
$I_{Z,\text{min}}$	Minimum cathode current		25°C			41			60			$\mu\text{A}$
			Full range			65			65			
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C			$\pm 20$			$\pm 20$			ppm/°C
		$I_Z = 1\ \text{mA}$	25°C			$\pm 15$			$\pm 15$			
		$I_Z = 100\ \mu\text{A}$	25°C			$\pm 15$			$\pm 15$			
			Full range			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C			0.3			0.8			mV
			Full range			1.2			1.2			
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C			2.3			6			
			Full range			8			8			
$Z_Z$	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C			0.3			0.3			$\Omega$
$e_N$	Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C			41			41			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$				120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$				0.7			0.7			mV

(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  $125^\circ\text{C}$ ).

### TL4050x411 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A411			TL4050B411			TL4050C411			UNIT		
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX			
$V_Z$ Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	$25^{\circ}\text{C}$	4.096			4.096			4.096			V		
$\Delta V_Z$ Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	$25^{\circ}\text{C}$	-4.1	4.1		-8.2	8.2		-21	21		mV		
		Full range	-18		18		-22		22		-34		34	
$I_{Z,\text{min}}$ Minimum cathode current		$25^{\circ}\text{C}$	52		68		52		68		52		68	
		Full range	73			73			73			73		
$\alpha_{VZ}$ Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	$25^{\circ}\text{C}$	$\pm 30$			$\pm 30$			$\pm 30$			ppm/ $^{\circ}\text{C}$		
	$I_Z = 1\ \text{mA}$	$25^{\circ}\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$					
	$I_Z = 100\ \mu\text{A}$	$25^{\circ}\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$					
		Full range	$\pm 50$			$\pm 50$			$\pm 50$					
$\frac{\Delta V_Z}{\Delta I_Z}$ Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^{\circ}\text{C}$	0.2		0.9		0.2		0.9		0.2		0.9	
		Full range	1.2			1.2			1.2					
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^{\circ}\text{C}$	2		7		2		7		2		7	
		Full range	10			10			10					
$Z_Z$ Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^{\circ}\text{C}$	0.5			0.5			0.5			$\Omega$		
$e_N$ Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^{\circ}\text{C}$	93			93			93			$\mu\text{V}_{\text{RMS}}$		
Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm		
$V_{\text{HYST}}$ Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$		1.148			1.148			1.148			mV		

(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  $125^{\circ}\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

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## TL4050x41Q Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A41Q			TL4050B41Q			TL4050C41Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$ Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	4.096			4.096			4.096			V
$\Delta V_Z$ Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	-4.1	4.1		-8.2	8.2		-21	21		mV
		Full range	-25		25	-29		29	-41		41	
$I_{Z,\text{min}}$ Minimum cathode current		$25^\circ\text{C}$	52		68	52		68	52		68	$\mu\text{A}$
		Full range	78			78			78			
$\alpha_{VZ}$ Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	$25^\circ\text{C}$	$\pm 30$			$\pm 30$			$\pm 30$			ppm/ $^\circ\text{C}$
	$I_Z = 1\ \text{mA}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
		Full range	$\pm 50$			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$ Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^\circ\text{C}$	0.2	0.9		0.2	0.9		0.2	0.9		mV
		Full range	1.2			1.2			1.2			
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^\circ\text{C}$	2		7	2		7	2		7	
		Full range	10			10			10			
$Z_Z$ Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^\circ\text{C}$	0.5			0.5			0.5			$\Omega$
$e_N$ Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^\circ\text{C}$	93			93			93			$\mu\text{V}_{\text{RMS}}$
Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$ Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		1.148			1.148			1.148			mV

(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  $125^\circ\text{C}$ ).

**TL4050x50I Electrical Characteristics**

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A50I			TL4050B50I			TL4050C50I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C			5			5			V
$\Delta V_Z$	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C			-5			5			mV
			Full range			-22			22			
$I_{Z,\text{min}}$	Minimum cathode current		25°C			56			74			$\mu\text{A}$
			Full range			80			80			
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C			$\pm 30$			$\pm 30$			ppm/°C
		$I_Z = 1\ \text{mA}$	25°C			$\pm 20$			$\pm 20$			
		$I_Z = 100\ \mu\text{A}$	25°C			$\pm 20$			$\pm 20$			
			Full range			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C			0.2			1			mV
			Full range			1.4			1.4			
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C			2			8			
			Full range			12			12			
$Z_Z$	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C			0.5			0.5			$\Omega$
$e_N$	Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C			93			93			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$				120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$				1.4			1.4			mV

(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  $125^\circ\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

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## TL4050x50Q Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A50Q			TL4050B50Q			TL4050C50Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C			5			5			V
$\Delta V_Z$	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C			-5			5			mV
			Full range			-30			30			
$I_{Z,\text{min}}$	Minimum cathode current		25°C			56			74			$\mu\text{A}$
			Full range			90			90			
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C			$\pm 30$			$\pm 30$			ppm/°C
		$I_Z = 1\ \text{mA}$	25°C			$\pm 20$			$\pm 20$			
		$I_Z = 100\ \mu\text{A}$	25°C			$\pm 20$			$\pm 20$			
			Full range			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C			0.2			1			mV
			Full range			1.4			1.4			
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C			2			8			
			Full range			12			12			
$Z_Z$	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C			0.5			0.5			$\Omega$
$e_N$	Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C			93			93			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$				120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$				1.4			1.4			mV

(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  $125^\circ\text{C}$ ).



### TL4050x82I Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A82I			TL4050B82I			TL4050C82I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$ Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	8.192			8.192			8.192			V
$\Delta V_Z$ Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	-8.2	8.2		-16	16		-41	41		mV
		Full range	-35		35		-43		43		-68	
$I_{Z,\text{min}}$ Minimum cathode current		$25^\circ\text{C}$	74		91		74		91		$\mu\text{A}$	
		Full range			95				95			
$\alpha_{VZ}$ Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	$25^\circ\text{C}$	$\pm 40$			$\pm 40$			$\pm 40$			ppm/ $^\circ\text{C}$
	$I_Z = 1\ \text{mA}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
		Full range				$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$ Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^\circ\text{C}$	0.6		1.3		0.6		1.3		mV	
		Full range			2.5				2.5			
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^\circ\text{C}$	7		10		7		10			
		Full range			18				18			
$Z_Z$ Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^\circ\text{C}$	0.6			0.6			0.6			$\Omega$
$e_N$ Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^\circ\text{C}$	150			150			150			$\mu\text{V}_{\text{RMS}}$
Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$ Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		2.3			2.3			2.3			mV

(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  $125^\circ\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

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## TL4050x82Q Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A82Q			TL4050B82Q			TL4050C82Q			UNIT												
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX													
$V_Z$	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C			8.192			8.192			8.192			V									
$\Delta V_Z$	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C			-8.2			8.2			-16			16			-41			41			mV
			Full range			-49			49			-57			57			-82			82			
$I_{Z,\text{min}}$	Minimum cathode current		25°C			74			91			74			91			$\mu\text{A}$						
			Full range			100			100			100			100									
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C			$\pm 40$			$\pm 40$			$\pm 40$			ppm/°C									
		$I_Z = 1\ \text{mA}$	25°C			$\pm 20$			$\pm 20$			$\pm 20$												
		$I_Z = 100\ \mu\text{A}$	25°C			$\pm 20$			$\pm 20$			$\pm 20$												
			Full range			$\pm 50$			$\pm 50$			$\pm 50$												
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C			0.6			1.3			0.6			1.3			mV						
			Full range			2.5			2.5			2.5												
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C			7			10			7			10									
			Full range			18			18			18												
$Z_Z$	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C			0.6			0.6			0.6			$\Omega$									
$e_N$	Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C			150			150			150			$\mu\text{V}_{\text{RMS}}$									
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$				120			120			120			ppm									
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$				2.3			2.3			2.3			mV									

(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  $125^\circ\text{C}$ ).

### TL4050x10I Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	$T_A$	TL4050A10I			TL4050B10I			TL4050C10I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$ Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	10			10			10			V
$\Delta V_Z$ Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	-10		10	-20		20	-50		50	mV
		Full range	-43		43	-53		53	-83		83	
$I_{Z,\text{min}}$ Minimum cathode current		$25^\circ\text{C}$	80		100	80		100	80		100	$\mu\text{A}$
		Full range			103			103			103	
$\alpha_{VZ}$ Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	$25^\circ\text{C}$	$\pm 40$			$\pm 40$			$\pm 40$			ppm/ $^\circ\text{C}$
	$I_Z = 1\ \text{mA}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
	$I_Z = 100\ \mu\text{A}$	$25^\circ\text{C}$	$\pm 20$			$\pm 20$			$\pm 20$			
		Full range			$\pm 50$			$\pm 50$			$\pm 50$	
$\frac{\Delta V_Z}{\Delta I_Z}$ Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	$25^\circ\text{C}$	0.8		1.5	0.8		1.5	0.8		1.5	mV
		Full range			3.5			3.5			3.5	
	$1\ \text{mA} < I_Z < 15\ \text{mA}$	$25^\circ\text{C}$	8		12	8		12	8		12	
		Full range			23			23			23	
$Z_Z$ Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	$25^\circ\text{C}$	0.7			0.7			0.7			$\Omega$
$e_N$ Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	$25^\circ\text{C}$	150			150			150			$\mu\text{V}_{\text{RMS}}$
Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$		120			120			120			ppm
$V_{\text{HYST}}$ Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$		2.8			2.8			2.8			mV

(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  $125^\circ\text{C}$ ).

# TL4050 PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS486–JUNE 2007

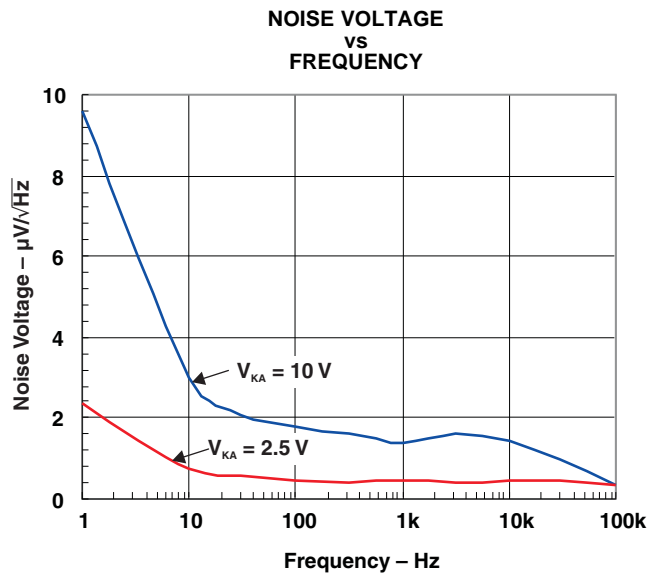
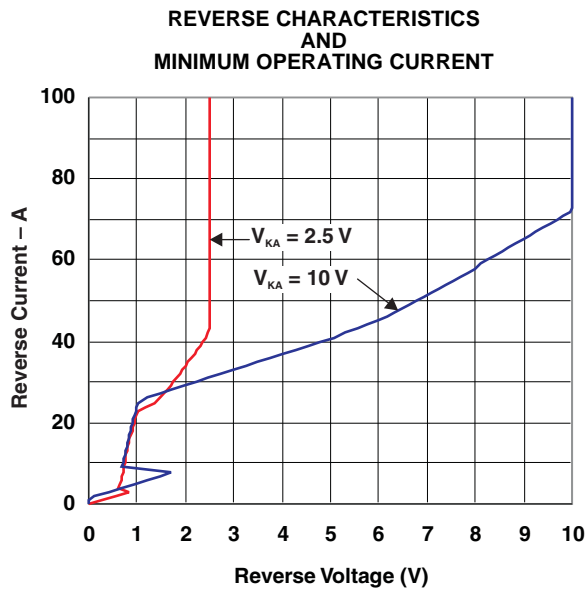
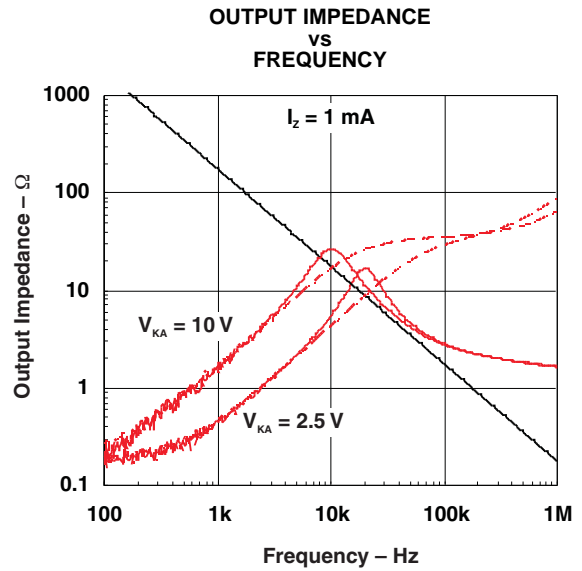
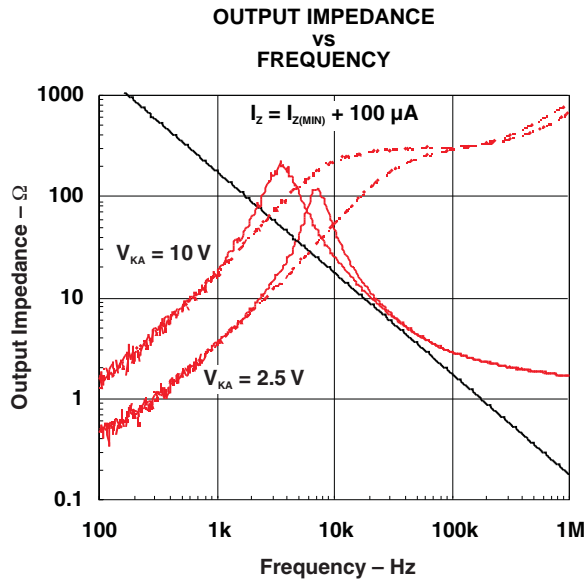
## TL4050x10Q Electrical Characteristics

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

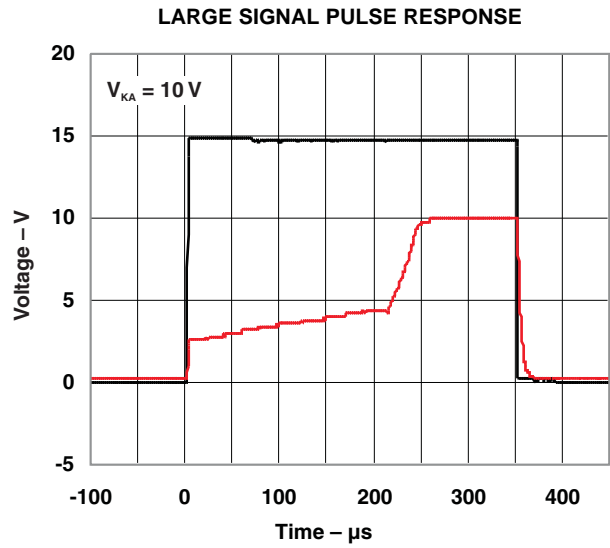
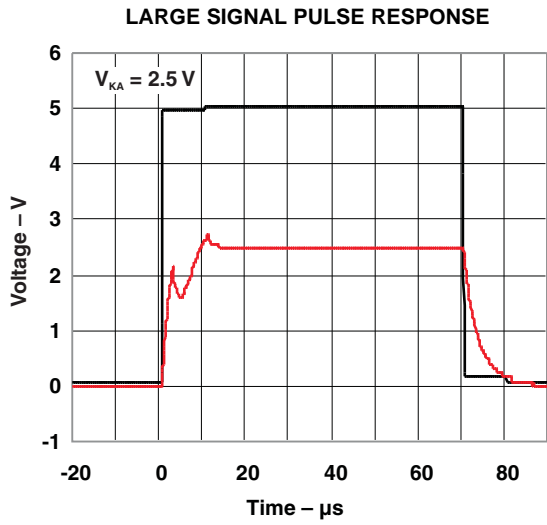
PARAMETER	TEST CONDITIONS	$T_A$	TL4050A10Q			TL4050B10Q			TL4050C10Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$	25°C			10			10			V
$\Delta V_Z$	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$	25°C			-10			10			mV
			Full range			-60			60			
$I_{Z,\text{min}}$	Minimum cathode current		25°C			80			100			$\mu\text{A}$
			Full range			110			110			
$\alpha_{VZ}$	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$	25°C			$\pm 40$			$\pm 40$			ppm/°C
		$I_Z = 1\ \text{mA}$	25°C			$\pm 20$			$\pm 20$			
		$I_Z = 100\ \mu\text{A}$	25°C			$\pm 20$			$\pm 20$			
			Full range			$\pm 50$			$\pm 50$			
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C			0.8			1.5			mV
			Full range			3.5			3.5			
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C			8			12			
			Full range			23			23			
$Z_Z$	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$ , $f = 120\ \text{Hz}$ , $I_{AC} = 0.1 I_Z$	25°C			0.7			0.7			$\Omega$
$e_N$	Wideband noise	$I_Z = 100\ \mu\text{A}$ , $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$	25°C			150			150			$\mu\text{V}_{\text{RMS}}$
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$ , $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_Z = 100\ \mu\text{A}$				120			120			ppm
$V_{\text{HYST}}$	Thermal hysteresis <sup>(1)</sup>	$\Delta T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$				2.8			2.8			mV

(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  $125^\circ\text{C}$ ).

**TYPICAL CHARACTERISTICS**



TYPICAL CHARACTERISTICS (continued)



## APPLICATION INFORMATION

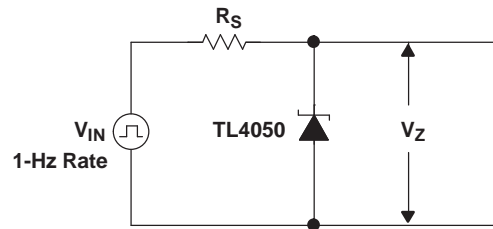


Figure 1. Start-Up Test Circuit

### Output Capacitor

The TL4050 does not require an output capacitor across cathode and anode for stability. However, if an output bypass capacitor is desired, the TL4050 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.

### Use With ADCs or DACs

The TL4050x-41 is designed to be a cost-effective voltage reference as required in 12-bit data-acquisition systems. For 12-bit systems operating from 5-V supplies, such as the ADS7842 (see Figure 2), the TL4050x-41 (4.096 V) permits operation with an LSB of 1 mV.

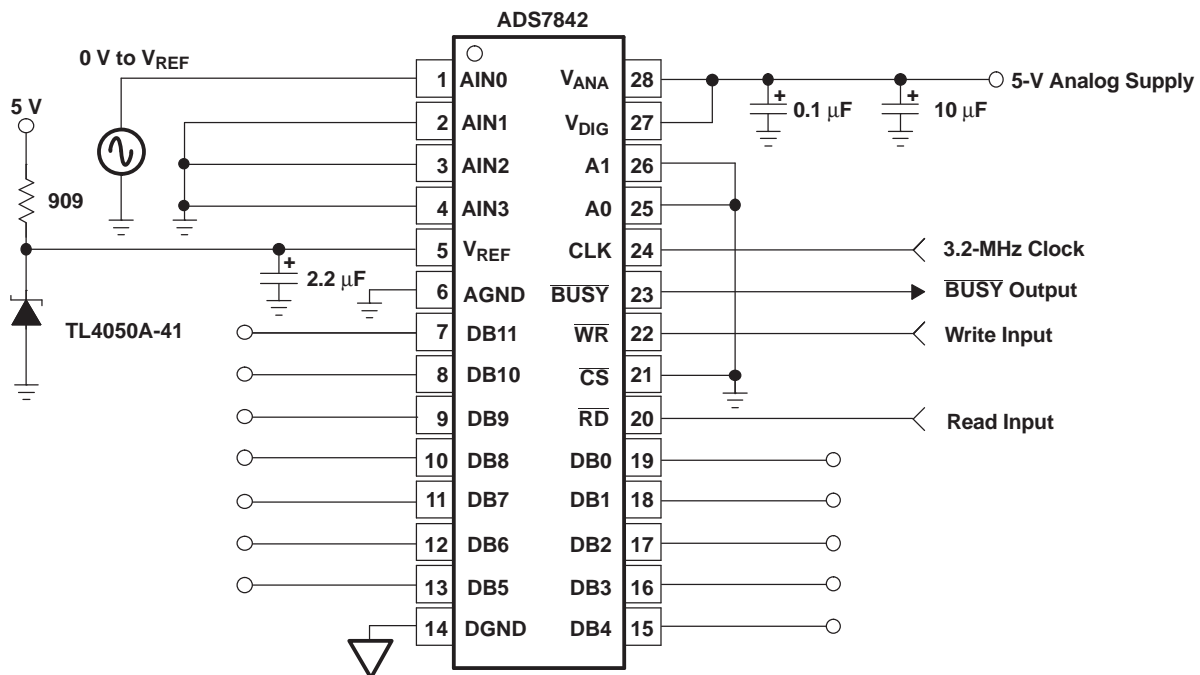


Figure 2. Data-Acquisition Circuit With TL4050x-41

APPLICATION INFORMATION (continued)

Cathode and Load Currents

In a typical shunt-regulator configuration (see Figure 3), an external resistor,  $R_S$ , is connected between the supply and the cathode of the TL4050.  $R_S$  must be set properly, as it sets the total current available to supply the load ( $I_L$ ) and bias the TL4050 ( $I_Z$ ). 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-rated value of 15 mA.

$R_S$  is calculated according to Equation 1:

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

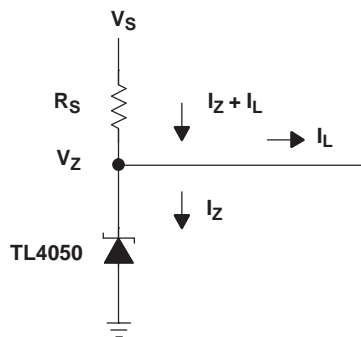


Figure 3. Shunt Regulator



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050A10IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A10QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050A25QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A25QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A41QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050A50IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050A50QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050B10QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B10QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B25QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050B41IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B41QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050B50QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050C10IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C10QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050C25QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C25QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C41QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL4050C50IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL4050C50QDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> 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)

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

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**OTHER QUALIFIED VERSIONS OF TL4050B41 :**

- Automotive: [TL4050B41-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

**TAPE AND REEL INFORMATION**



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



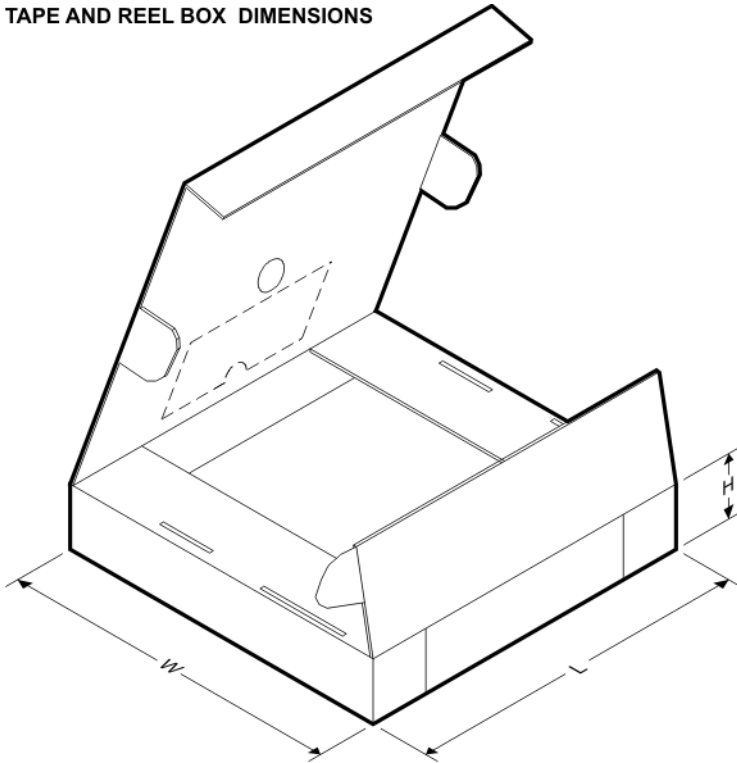
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TL4050A10IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A10IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A10IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A10IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A10QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A10QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A10QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A10QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A25IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A25IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A25IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A25IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A25QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A25QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A25QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A25QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A41IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A41IDBZT	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
TL4050A41IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A41IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A41QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A41QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A41QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A41QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A50IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A50IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A50IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A50IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A50QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A50QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A50QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050A50QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B10IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B10IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B10IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B10IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B10QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B10QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B10QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B10QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B25IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B25IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B25IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B25IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B25QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B25QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B25QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B25QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B41IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B41IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B41IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B41IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B41QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B41QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B41QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B41QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B50IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B50IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B50IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B50IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B50QDBZR	SOT-23	DBZ	3	3000	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
TL4050B50QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B50QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B50QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C10IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C10IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C10IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C10IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C10QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C10QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C10QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C10QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C25IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C25IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C25IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C25IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C25QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C25QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C25QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C25QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C41IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C41IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C41IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C41IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C41QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C41QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C41QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C41QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C50IDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C50IDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C50IDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C50IDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C50QDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C50QDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C50QDCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C50QDCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

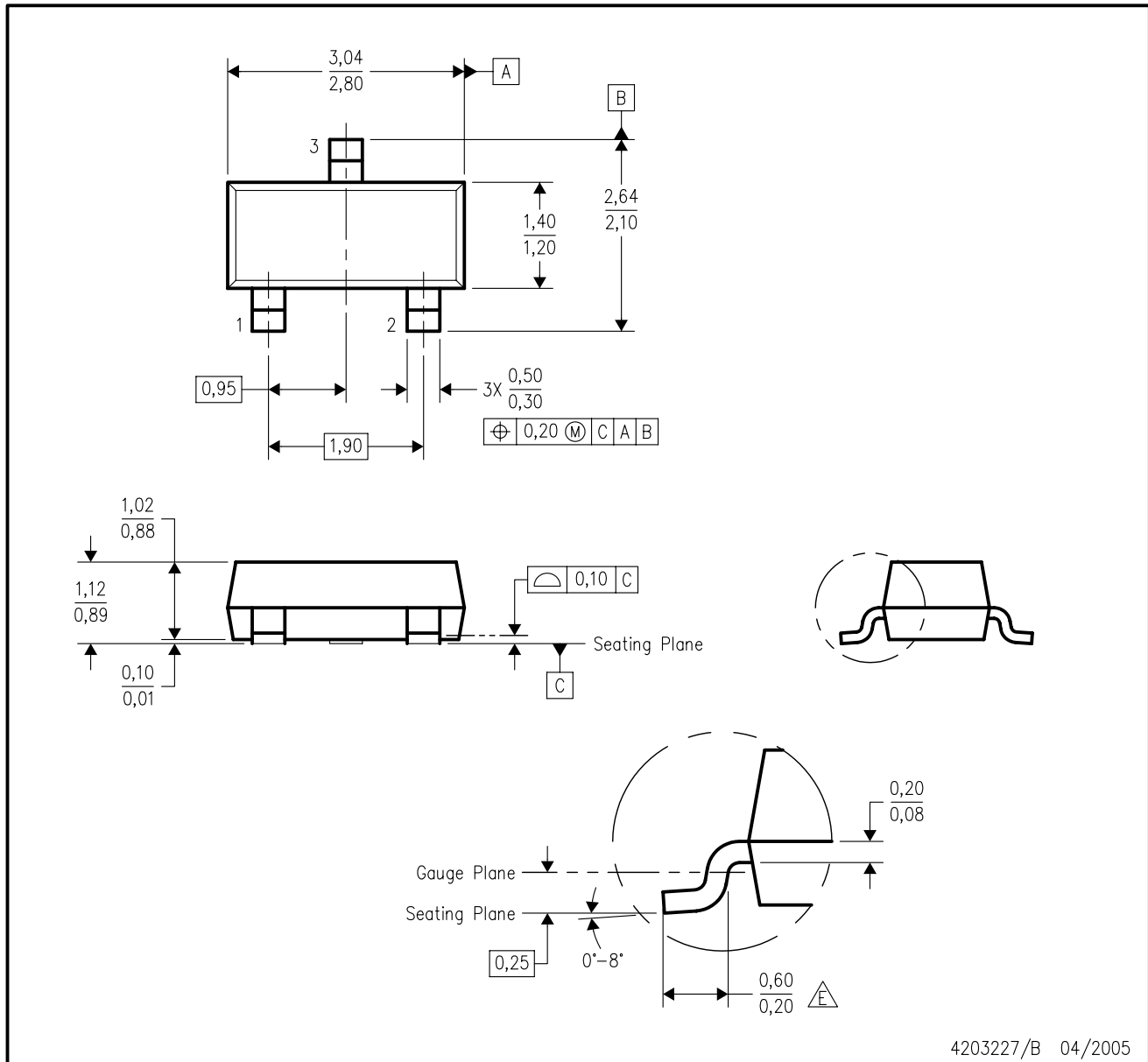
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL4050A10IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A10IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A10IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A10IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A10QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A10QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A10QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A10QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A25IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A25IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A25IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A25IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A25QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A25QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A25QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A25QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A41IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A41IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A41IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A41IDCKT	SC70	DCK	5	250	195.0	200.0	45.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL4050A41QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A41QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A41QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A41QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A50IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A50IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A50IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A50IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050A50QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050A50QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050A50QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050A50QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B10IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B10IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B10IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B10IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B10QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B10QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B10QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B10QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B25IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B25IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B25IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B25IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B25QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B25QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B25QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B25QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B41IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B41IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B41IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B41IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B41QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B41QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B41QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B41QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B50IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B50IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B50IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B50IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050B50QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050B50QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050B50QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050B50QDCKT	SC70	DCK	5	250	195.0	200.0	45.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL4050C10IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C10IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C10IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C10IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C10QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C10QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C10QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C10QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C25IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C25IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C25IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C25IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C25QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C25QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C25QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C25QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C41IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C41IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C41IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C41IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C41QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C41QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C41QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C41QDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C50IDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C50IDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C50IDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C50IDCKT	SC70	DCK	5	250	195.0	200.0	45.0
TL4050C50QDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
TL4050C50QDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
TL4050C50QDCKR	SC70	DCK	5	3000	195.0	200.0	45.0
TL4050C50QDCKT	SC70	DCK	5	250	195.0	200.0	45.0

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.
  - $\triangle E$  Falls within JEDEC TO-236 variation AB, except minimum foot length.



DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.

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