PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

Check for Samples: TL4050-Q1

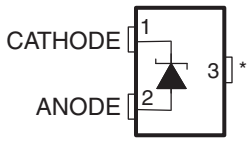
FEATURES

- **Qualified for Automotive Applications**
- **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 μV_{RMS} Typ**
- **Wide Operating Current Range: 60 μA Typ to 15 mA**
- **Stable With All Capacitive Loads; No Output Capacitor Required**
- **Available in Extended Temperature Range: –40°C to 125°C**

APPLICATIONS

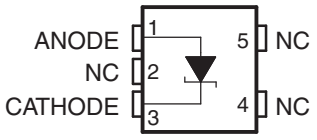
- **Data-Acquisition Systems**
- **Power Supplies and Power-Supply Monitors**
- **Instrumentation and Test Equipment**
- **Process Controls**
- **Precision Audio**
- **Automotive Electronics**
- **Energy Management**
- **Battery-Powered Equipment**

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 μA (typ), the TL4050 also is ideal for portable applications.

The TL4050xI 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.

ORDERING INFORMATION(1)

T_A	DEVICE GRADE	V_{KA}	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050A20IDBZRQ1	Product Preview
				Reel of 250	TL4050A20IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A20IDCKRQ1	Product Preview
				Reel of 250	TL4050A20IDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A25IDBZRQ1	Product Preview
				Reel of 250	TL4050A25IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A25IDCKRQ1	Product Preview
				Reel of 250	TL4050A25IDCKTQ1	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A41IDBZRQ1	Product Preview
				Reel of 250	TL4050A41IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A41IDCKRQ1	Product Preview
				Reel of 250	TL4050A41IDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A50IDBZRQ1	Product Preview
				Reel of 250	TL4050A50IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A50IDCKRQ1	Product Preview
				Reel of 250	TL4050A50IDCKTQ1	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A82IDBZRQ1	Product Preview
				Reel of 250	TL4050A82IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A82IDCKRQ1	Product Preview
				Reel of 250	TL4050A82IDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A10IDBZRQ1	Product Preview
				Reel of 250	TL4050B10IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A10IDCKRQ1	Product Preview
				Reel of 250	TL4050B10IDCKTQ1	

(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, thermal data, and symbolization are available at www.ti.com/packaging.

ORDERING INFORMATION [1] (continued)

T_A	DEVICE GRADE	V_{KA}	PACKAGE [2]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050B20IDBZRQ1	Product Preview
				Reel of 250	TL4050B20IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B20IDCKRQ1	Product Preview
				Reel of 250	TL4050B20IDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B25IDBZRQ1	Product Preview
				Reel of 250	TL4050B25IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B25IDCKRQ1	Product Preview
				Reel of 250	TL4050B25IDCKTQ1	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B41IDBZRQ1	Product Preview
				Reel of 250	TL4050B41IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B41IDCKRQ1	Product Preview
				Reel of 250	TL4050B41IDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B50IDBZRQ1	Product Preview
				Reel of 250	TL4050B50IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B50IDCKRQ1	Product Preview
				Reel of 250	TL4050B50IDCKTQ1	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B82IDBZRQ1	Product Preview
				Reel of 250	TL4050B82IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B82IDCKRQ1	Product Preview
				Reel of 250	TL4050B82IDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B10IDBZRQ1	Product Preview
				Reel of 250	TL4050B10IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B10IDCKRQ1	Product Preview
				Reel of 250	TL4050B10IDCKTQ1	

ORDERING INFORMATION (1) (continued)

T_A	DEVICE GRADE	V_{KA}	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050C20IDBZRQ1	TMWU
				Reel of 250	TL4050C20IDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050C20IDCKRQ1	Product Preview
				Reel of 250	TL4050C20IDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C25IDBZRQ1	Product Preview
				Reel of 250	TL4050C25IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C25IDCKRQ1	Product Preview
				Reel of 250	TL4050C25IDCKTQ1	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C41IDBZRQ1	Product Preview
				Reel of 250	TL4050C41IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C41IDCKRQ1	Product Preview
				Reel of 250	TL4050C41IDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C50IDBZRQ1	Product Preview
				Reel of 250	TL4050C50IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C50IDCKRQ1	Product Preview
				Reel of 250	TL4050C50IDCKTQ1	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C82IDBZRQ1	Product Preview
				Reel of 250	TL4050C82IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C82IDCKRQ1	Product Preview
				Reel of 250	TL4050C82IDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C10IDBZRQ1	Product Preview
				Reel of 250	TL4050C10IDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C10IDCKRQ1	Product Preview
				Reel of 250	TL4050C10IDCKTQ1	

ORDERING INFORMATION(1)

T_A	DEVICE GRADE	V_{KA}	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050A20QDBZRQ1	Product Preview
				Reel of 250	TL4050A20QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A20QDCKRQ1	Product Preview
				Reel of 250	TL4050A20QDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A25QDBZRQ1	Product Preview
				Reel of 250	TL4050A25QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A25QDCKRQ1	Product Preview
				Reel of 250	TL4050A25QDCKTQ1	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A41QDBZRQ1	Product Preview
				Reel of 250	TL4050A41QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A41QDCKRQ1	Product Preview
				Reel of 250	TL4050A41QDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A50QDBZRQ1	TLGU
				Reel of 250	TL4050A50QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050A50QDCKRQ1	7GU
				Reel of 250	TL4050A50QDCKTQ1	Product Preview
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A82QDBZRQ1	Product Preview
				Reel of 250	TL4050A82QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A82QDCKRQ1	Product Preview
				Reel of 250	TL4050A82QDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050A10QDBZRQ1	Product Preview
				Reel of 250	TL4050B10QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050A10QDCKRQ1	Product Preview
				Reel of 250	TL4050A10QDCKTQ1	

(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, thermal data, and symbolization are available at www.ti.com/packaging.

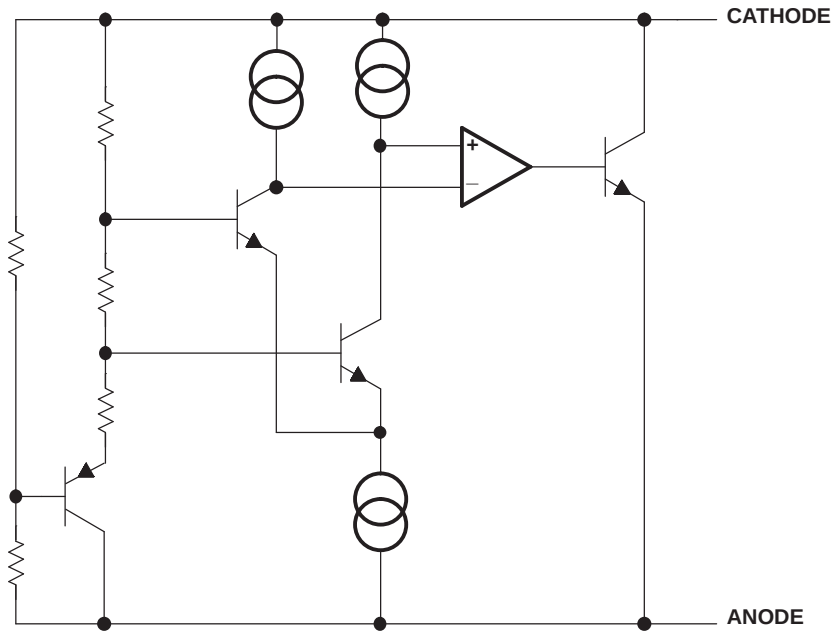
ORDERING INFORMATION (1) (continued)

T_A	DEVICE GRADE	V_{KA}	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050B20QDBZRQ1	Product Preview
				Reel of 250	TL4050B20QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B20QDCKRQ1	Product Preview
				Reel of 250	TL4050B20QDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B25QDBZRQ1	TLHU
				Reel of 250	TL4050B25QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050B25QDCKRQ1	7HU
				Reel of 250	TL4050B25QDCKTQ1	Product Preview
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B41QDBZRQ1	TMXU
				Reel of 250	TL4050B41QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050B41QDCKRQ1	Product Preview
				Reel of 250	TL4050B41QDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B50QDBZRQ1	TLJU
				Reel of 250	TL4050B50QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050B50QDCKRQ1	7JU
				Reel of 250	TL4050B50QDCKTQ1	Product Preview
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B82QDBZRQ1	Product Preview
				Reel of 250	TL4050B82QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B82QDCKRQ1	Product Preview
				Reel of 250	TL4050B82QDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050B10QDBZRQ1	Product Preview
				Reel of 250	TL4050B10QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050B10QDCKRQ1	Product Preview
				Reel of 250	TL4050B10QDCKTQ1	

ORDERING INFORMATION (1) (continued)

T_A	DEVICE GRADE	V_{KA}	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–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	TL4050C20QDBZRQ1	TMYU
				Reel of 250	TL4050C20QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050C20QDCKRQ1	Product Preview
				Reel of 250	TL4050C20QDCKTQ1	
		2.5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C25QDBZRQ1	Product Preview
				Reel of 250	TL4050C25QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C25QDCKRQ1	Product Preview
				Reel of 250	TL4050C25QDCKTQ1	
		4.096 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C41QDBZRQ1	Product Preview
				Reel of 250	TL4050C41QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C41QDCKRQ1	Product Preview
				Reel of 250	TL4050C41QDCKTQ1	
		5 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C50QDBZRQ1	TKZU
				Reel of 250	TL4050C50QDBZTQ1	Product Preview
			SC-70 – DCK	Reel of 3000	TL4050C50QDCKRQ1	Product Preview
				Reel of 250	TL4050C50QDCKTQ1	
		8.192 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C82QDBZRQ1	Product Preview
				Reel of 250	TL4050C82QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C82QDCKRQ1	Product Preview
				Reel of 250	TL4050C82QDCKTQ1	
		10 V	SOT-23-3 – DBZ	Reel of 3000	TL4050C10QDBZRQ1	Product Preview
				Reel of 250	TL4050C10QDBZTQ1	
			SC-70 – DCK	Reel of 3000	TL4050C10QDCKRQ1	Product Preview
				Reel of 250	TL4050C10QDCKTQ1	

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS(1)

over free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
I_Z	Continuous cathode current		–10	20	mA
θ_{JA}	Package thermal impedance(2) (3)	DBV 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 $T_J(max)$, θ_{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)	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°C to 85°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 µA	25°C		2.048			2.048			2.048		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°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	
$I_{Z,min}$	Minimum cathode current		25°C		41	60		41	60		41	60	µA
			Full range			65			65			65	
α_{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	0.8		0.3	0.8		0.3	0.8	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 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 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.3			0.3			0.3		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		34			34			34		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			0.7			0.7			0.7		mV

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

TL4050x20Q ELECTRICAL CHARACTERISTICS

at extended temperature range, full range T_A = –40°C to 125°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 µA	25°C		2.048			2.048			2.048		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°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	
$I_{Z,min}$	Minimum cathode current		25°C		41	60		41	60		41	60	µA
			Full range			65			65			65	
α_{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	0.8		0.3	0.8		0.3	0.8	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 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 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.3			0.3			0.3		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		34			34			34		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			0.7			0.7			0.7		mV

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

TL4050x25I ELECTRICAL CHARACTERISTICS

at industrial temperature range, full range T_A = –40°C to 85°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 µA	25°C		2.5			2.5			2.5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–2.5		2.5	–5		5	–13		13	mV
			Full range	–11		11	–14		14	–21		21	
$I_{Z,min}$	Minimum cathode current		25°C		41	60		41	60		41	60	µA
			Full range			65			65			65	
α_{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	0.8		0.3	0.8		0.3	0.8	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 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 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.3			0.3			0.3		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		41			41			41		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			0.7			0.7			0.7		mV

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

TL4050x25Q ELECTRICAL CHARACTERISTICS

at extended temperature range, full range T_A = –40°C to 125°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 µA	25°C		2.5			2.5			2.5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–2.5		2.5	–5		5	–13		13	mV
			Full range	–15		15	–18		18	–25		25	
$I_{Z,min}$	Minimum cathode current		25°C		41	60		41	60		41	60	µA
			Full range			65			65			65	
α_{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	0.8		0.3	0.8		0.3	0.8	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 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 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.3			0.3			0.3		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		41			41			41		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			0.7			0.7			0.7		mV

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

TL4050x41I ELECTRICAL CHARACTERISTICS

at industrial temperature range, full range T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	TL4050A41I			TL4050B41I			TL4050C41I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	I_Z = 100 µA	25°C		4.096			4.096			4.096		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–4.1		4.1	–8.2		8.2	–21		21	mV
			Full range	–18		18	–22		22	–34		34	
$I_{Z,min}$	Minimum cathode current		25°C		52	68		52	68		52	68	µA
			Full range			73			73			73	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±30			±30			±30		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.2	0.9		0.2	0.9		0.2	0.9	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 mA	25°C		2	7		2	7		2	7	
			Full range			10			10			10	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.5			0.5			0.5		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		93			93			93		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			1.148			1.148			1.148		mV

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

TL4050x41Q ELECTRICAL CHARACTERISTICS

at extended temperature range, full range T_A = –40°C to 125°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 µA	25°C		4.096			4.096			4.096		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–4.1		4.1	–8.2		8.2	–21		21	mV
			Full range	–25		25	–29		29	–41		41	
$I_{Z,min}$	Minimum cathode current		25°C		52	68		52	68		52	68	µA
			Full range			78			78			78	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±30			±30			±30		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.2	0.9		0.2	0.9		0.2	0.9	mV
			Full range			1.2			1.2			1.2	
		1 mA < I_Z < 15 mA	25°C		2	7		2	7		2	7	
			Full range			10			10			10	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.5			0.5			0.5		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		93			93			93		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			1.148			1.148			1.148		mV

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

TL4050x50I ELECTRICAL CHARACTERISTICS

at industrial temperature range, full range T_A = –40°C to 85°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 µA	25°C		5			5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–5		5	–10		10	–25		25	mV
			Full range	–22		22	–27		27	–42		42	
$I_{Z,min}$	Minimum cathode current		25°C		56	74		56	74		56	74	µA
			Full range			80			80			80	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±30			±30			±30		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.2	1		0.2	1		0.2	1	mV
			Full range			1.4			1.4			1.4	
		1 mA < I_Z < 15 mA	25°C		2	8		2	8		2	8	
			Full range			12			12			12	
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		93			93			93		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			1.4			1.4			1.4		mV

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

TL4050x50Q ELECTRICAL CHARACTERISTICS

at extended temperature range, full range T_A = –40°C to 125°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 µA	25°C		5			5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–5		5	–10		10	–25		25	mV
			Full range	–30		30	–35		35	–50		50	
$I_{Z,min}$	Minimum cathode current		25°C		56	74		56	74		56	74	µA
			Full range			90			90			90	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±30			±30			±30		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.2	1		0.2	1		0.2	1	mV
			Full range			1.4			1.4			1.4	
		1 mA < I_Z < 15 mA	25°C		2	8		2	8		2	8	
			Full range			12			12			12	
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		93			93			93		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			1.4			1.4			1.4		mV

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

TL4050x82I ELECTRICAL CHARACTERISTICS

at industrial temperature range, full range T_A = –40°C to 85°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 µA	25°C		8.192			8.192			8.192		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–8.2		8.2	–16		16	–41		41	mV
			Full range	–35		35	–43		43	–68		68	
$I_{Z,min}$	Minimum cathode current		25°C		74	91		74	91		74	91	µA
			Full range			95			95			95	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±40			±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.6	1.3		0.6	1.3		0.6	1.3	mV
			Full range			2.5			2.5			2.5	
		1 mA < I_Z < 15 mA	25°C		7	10		7	10		7	10	
			Full range			18			18			18	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.6			0.6			0.6		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		150			150			150		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			2.3			2.3			2.3		mV

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

TL4050x82Q ELECTRICAL CHARACTERISTICS

at extended temperature range, full range T_A = –40°C to 125°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 µA	25°C		8.192			8.192			8.192		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–8.2		8.2	–16		16	–41		41	mV
			Full range	–49		49	–57		57	–82		82	
$I_{Z,min}$	Minimum cathode current		25°C		74	91		74	91		74	91	µA
			Full range			100			100			100	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±40			±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.6	1.3		0.6	1.3		0.6	1.3	mV
			Full range			2.5			2.5			2.5	
		1 mA < I_Z < 15 mA	25°C		7	10		7	10		7	10	
			Full range			18			18			18	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.6			0.6			0.6		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		150			150			150		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			2.3			2.3			2.3		mV

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

TL4050x10I ELECTRICAL CHARACTERISTICS

at industrial temperature range, full range T_A = –40°C to 85°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 µA	25°C		10			10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–10		10	–20		20	–50		50	mV
			Full range	–43		43	–53		53	–83		83	
$I_{Z,min}$	Minimum cathode current		25°C		80	100		80	100		80	100	µA
			Full range			103			103			103	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±40			±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.8	1.5		0.8	1.5		0.8	1.5	mV
			Full range			3.5			3.5			3.5	
		1 mA < I_Z < 15 mA	25°C		8	12		8	12		8	12	
			Full range			23			23			23	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.7			0.7			0.7		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		150			150			150		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			2.8			2.8			2.8		mV

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

TL4050x10Q ELECTRICAL CHARACTERISTICS

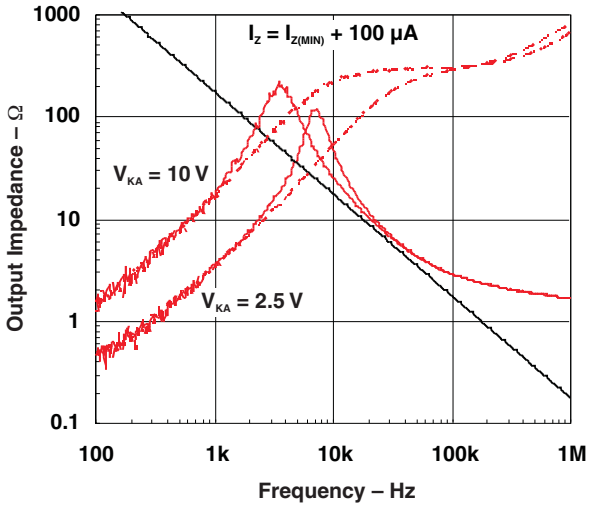
at extended temperature range, full range T_A = –40°C to 125°C (unless otherwise noted)

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 µA	25°C		10			10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	–10		10	–20		20	–50		50	mV
			Full range	–60		60	–70		70	–100		100	
$I_{Z,min}$	Minimum cathode current		25°C		80	100		80	100		80	100	µA
			Full range			110			110			110	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	I_Z = 10 mA	25°C		±40			±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20			±20		
		I_Z = 100 µA	25°C		±20			±20			±20		
			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		0.8	1.5		0.8	1.5		0.8	1.5	mV
			Full range			3.5			3.5			3.5	
		1 mA < I_Z < 15 mA	25°C		8	12		8	12		8	12	
			Full range			23			23			23	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.7			0.7			0.7		Ω
e_N	Wideband noise	I_Z = 100 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		150			150			150		μV_{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T_A = 25°C ± 0.1°C, I_Z = 100 µA			120			120			120		ppm
V_{HYST}	Thermal hysteresis (1)	ΔT_A = –40°C to 125°C			2.8			2.8			2.8		mV

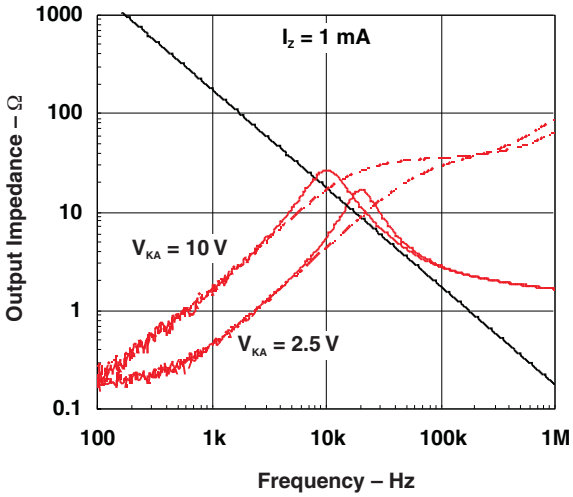
(1) Thermal hysteresis is defined as $V_{Z,25°C}$ (after cycling to –40°C) – $V_{Z,25°C}$ (after cycling to 125°C).

TYPICAL CHARACTERISTICS

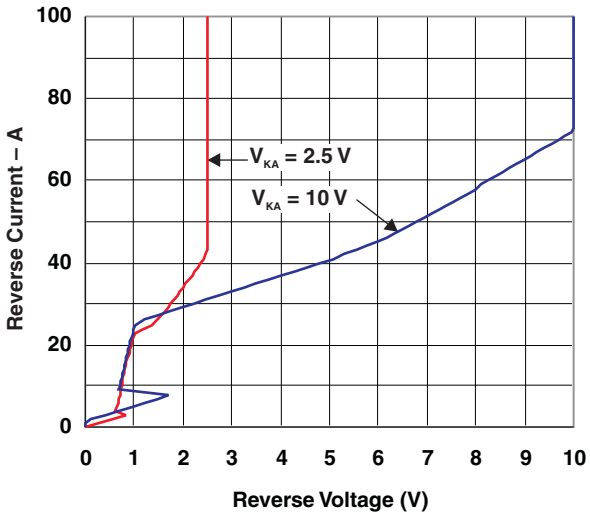
OUTPUT IMPEDANCE vs FREQUENCY



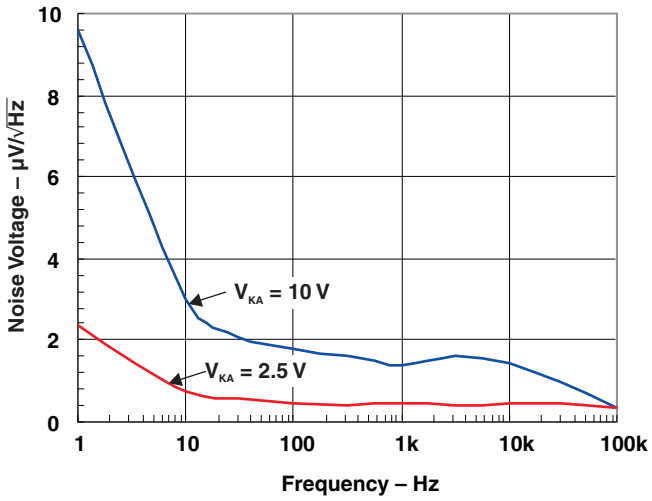
OUTPUT IMPEDANCE vs FREQUENCY



REVERSE CHARACTERISTICS AND MINIMUM OPERATING CURRENT

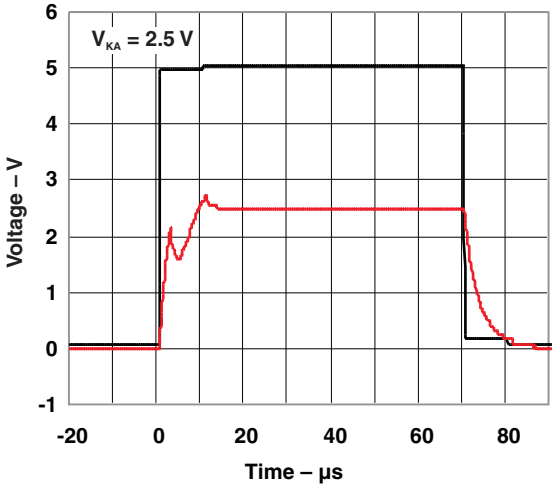


NOISE VOLTAGE vs FREQUENCY

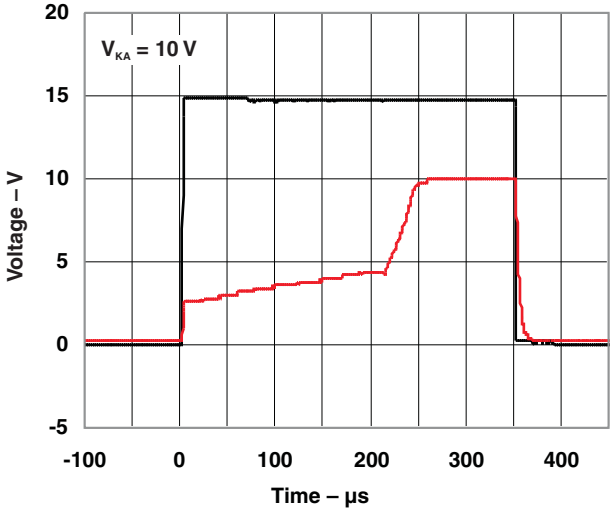


TYPICAL CHARACTERISTICS (continued)

LARGE SIGNAL PULSE RESPONSE



LARGE SIGNAL PULSE RESPONSE



APPLICATION INFORMATION

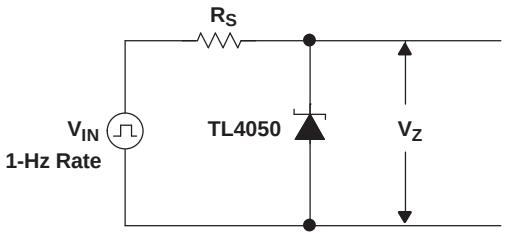


Figure 1. Start-Up Test Circuit

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.

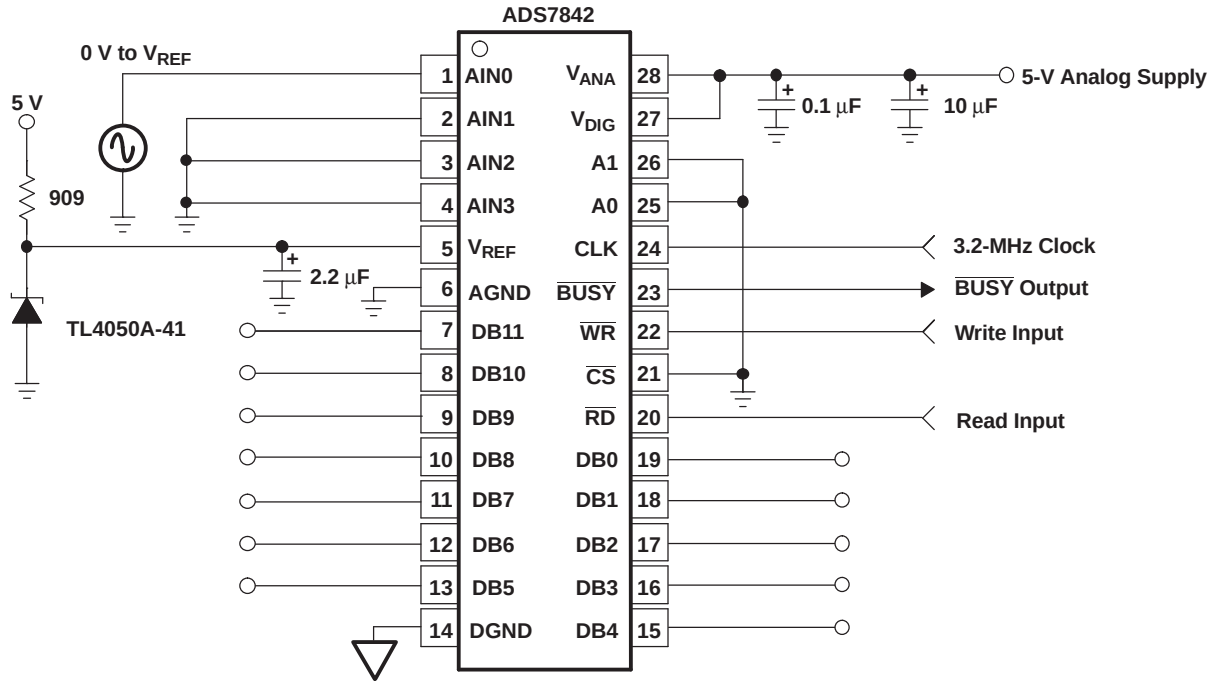


Figure 2. Data-Acquisition Circuit With TL4050x-41

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:

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

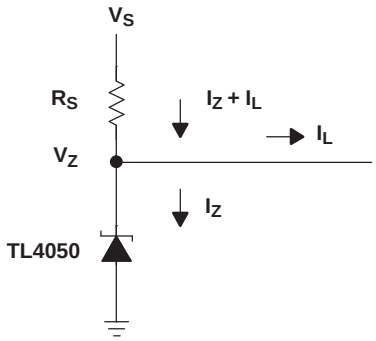


Figure 3. Shunt Regulator

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
TL4050A50QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TLGU	Samples
TL4050A50QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	7GU	Samples
TL4050B25QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TLHU	Samples
TL4050B25QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	7HU	Samples
TL4050B41QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TMXU	Samples
TL4050B50QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TLJU	Samples
TL4050B50QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	7JU	Samples
TL4050C20QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TMYU	Samples
TL4050C50QDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TKZU	Samples

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

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

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

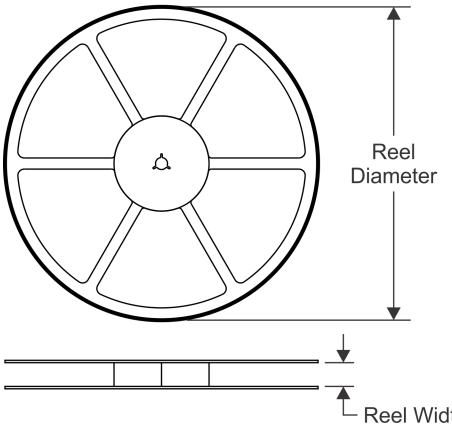
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

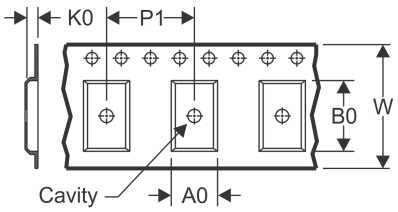
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

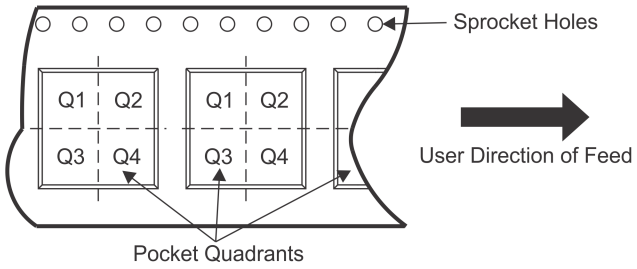


TAPE DIMENSIONS



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

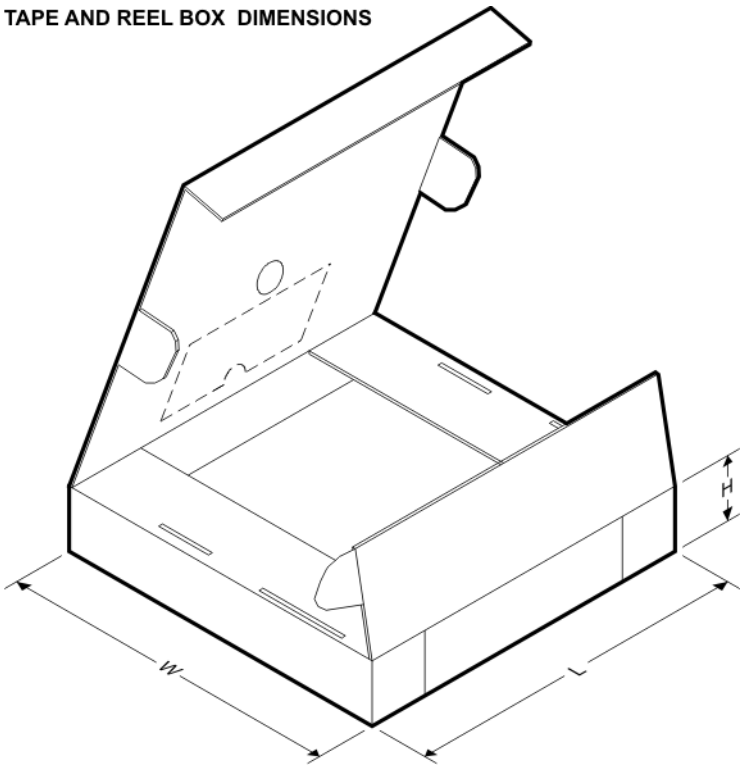
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TL4050A50QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050A50QDCKRQ1	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B25QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B25QDCKRQ1	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050B41QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B50QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050B50QDCKRQ1	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TL4050C20QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
TL4050C50QDBZRQ1	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3

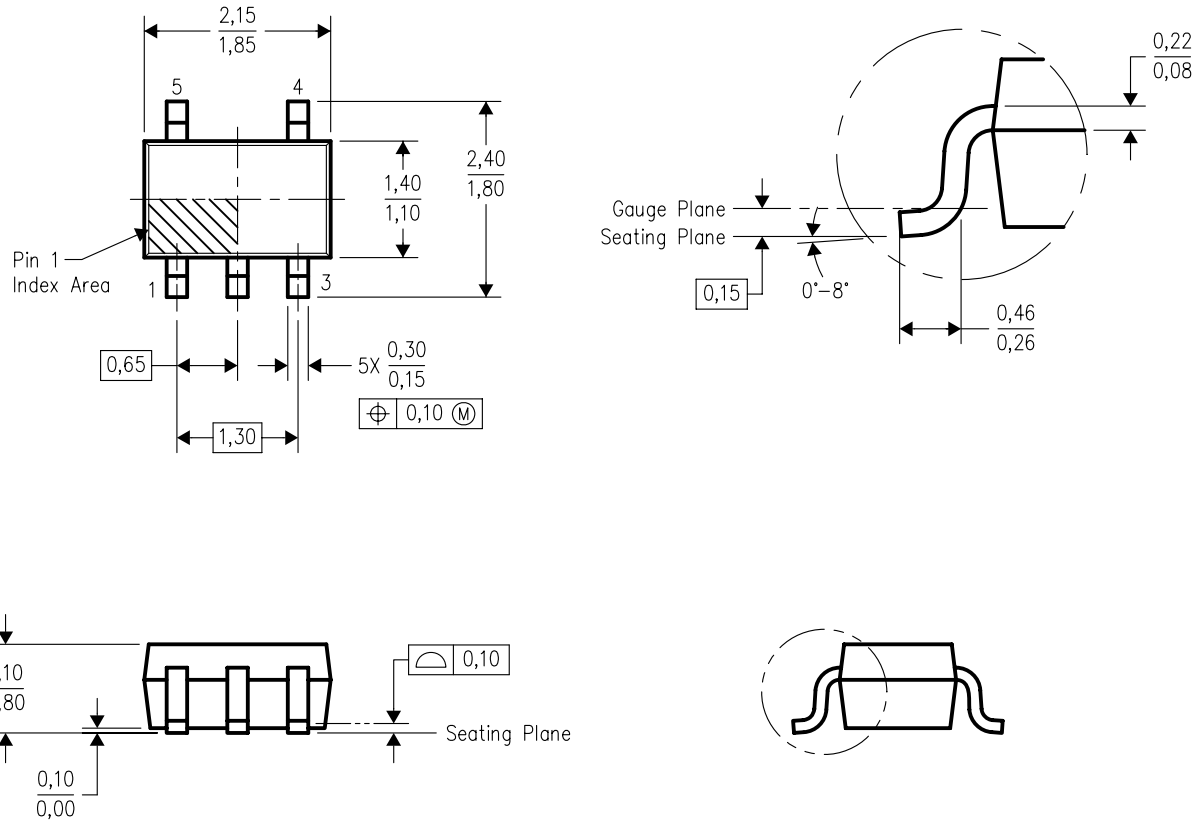
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL4050A50QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0
TL4050A50QDCKRQ1	SC70	DCK	5	3000	203.0	203.0	35.0
TL4050B25QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0
TL4050B25QDCKRQ1	SC70	DCK	5	3000	203.0	203.0	35.0
TL4050B41QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0
TL4050B50QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0
TL4050B50QDCKRQ1	SC70	DCK	5	3000	203.0	203.0	35.0
TL4050C20QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0
TL4050C50QDBZRQ1	SOT-23	DBZ	3	3000	203.0	203.0	35.0

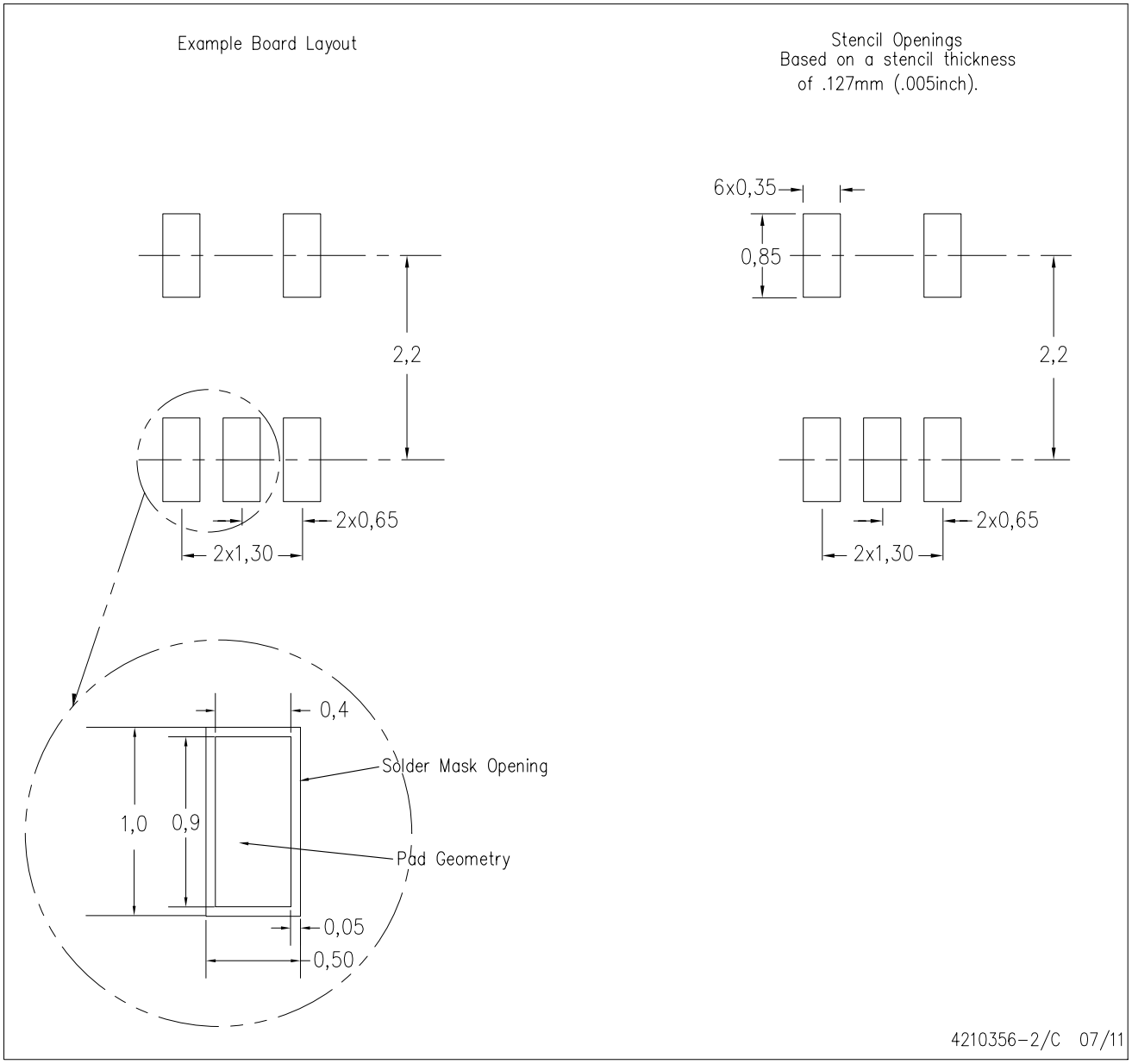
DCK (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



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

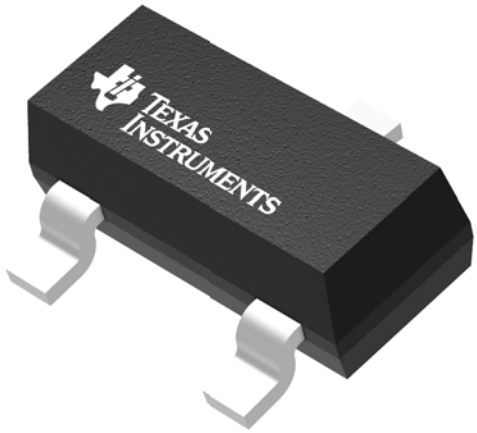


NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting 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.

GENERIC PACKAGE VIEW

DBZ 3 SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



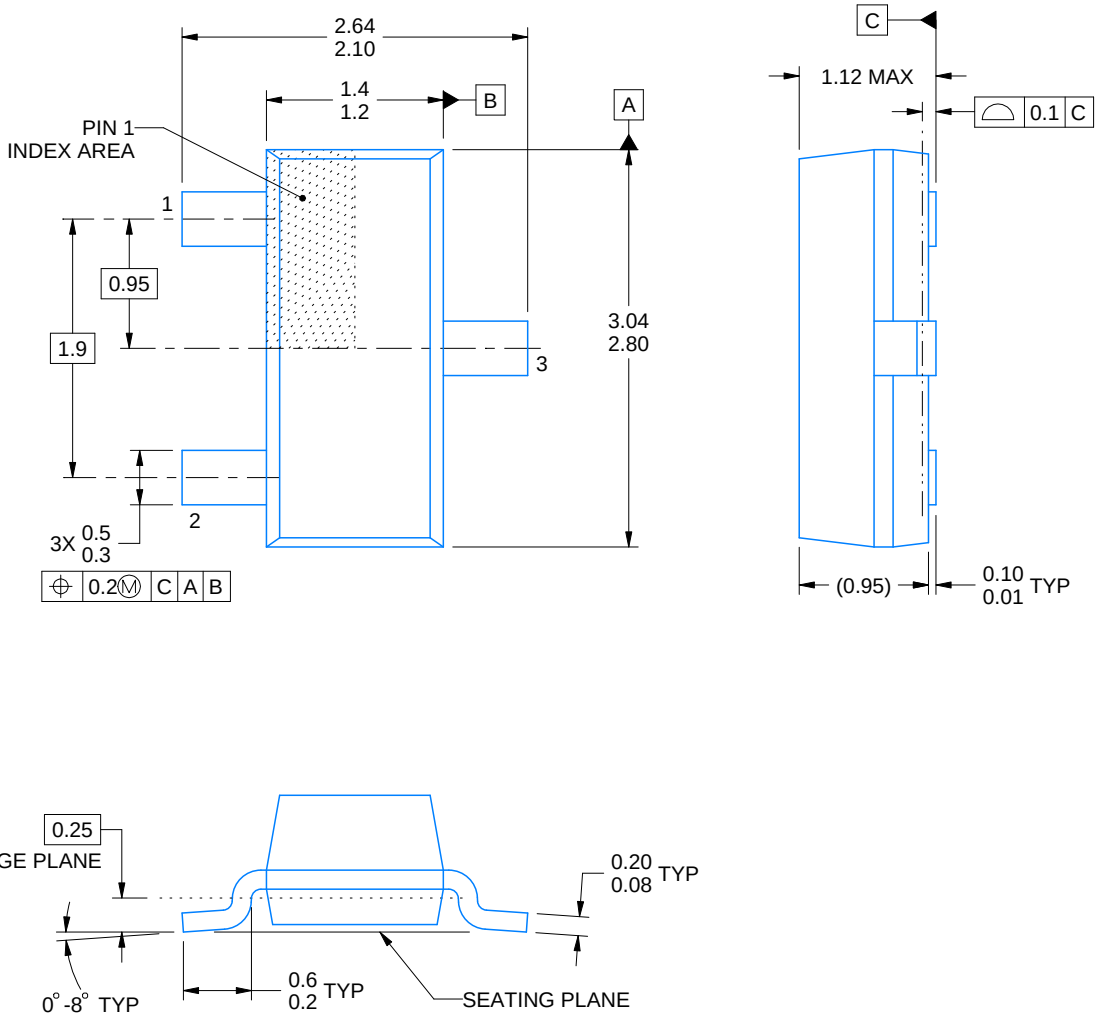
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



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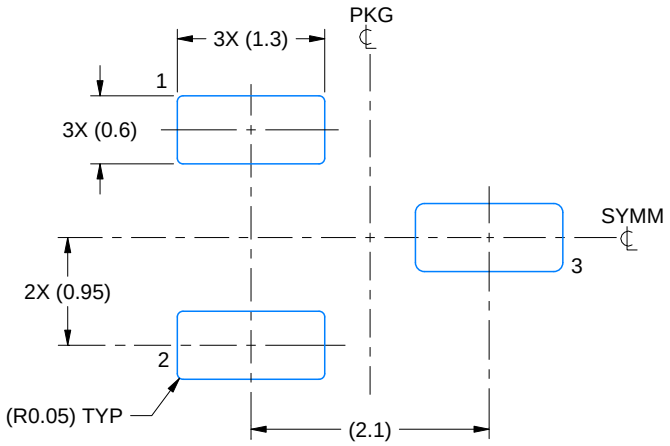
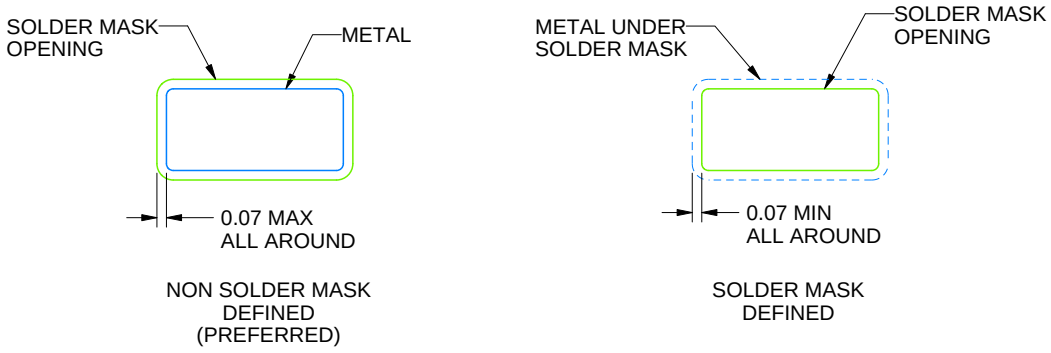
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS

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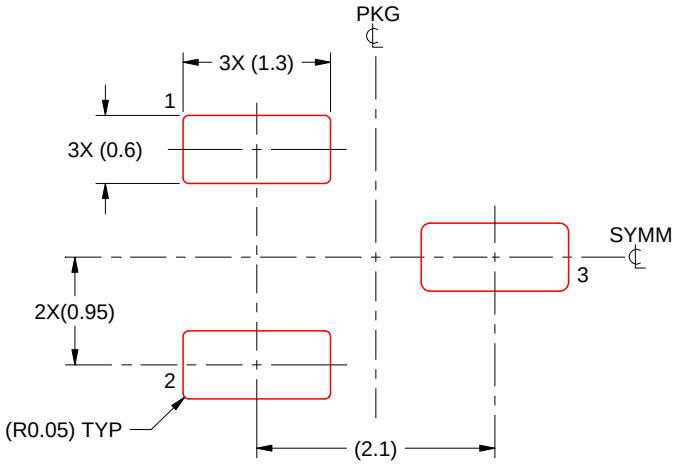
NOTES: (continued)

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



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

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NOTES: (continued)

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

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