

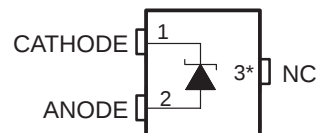
LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

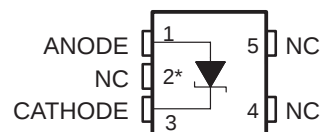
- Fixed Output Voltages of 2.048 V, 2.5 V, 3 V, 4.096 V, 5 V, 8.192 V, and 10 V
- Tight Output Tolerances and Low Temperature Coefficient
 - Max 0.1%, 100 ppm/°C – A Grade
 - Max 0.2%, 100 ppm/°C – B Grade
 - Max 0.5%, 100 ppm/°C – C Grade
 - Max 1.0%, 150 ppm/°C – D Grade
- Low Output Noise . . . 35 μVRMS (Typ)
- Wide Operating Current Range . . . 60 μA to 20 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) PACKAGE
(TOP VIEW)



* This pin must be left open or connected to Pin 2, due to an internal connection to ANODE (die substrate).

DCK (SC-70) PACKAGE
(TOP VIEW)



* This pin must be left open or connected to Pin 1, due to an internal connection to ANODE (die substrate).

LP (TO-92/TO-226) PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

The LM4040 series of shunt voltage references are versatile, easy-to-use references that cater to a vast array of applications. The 2-pin fixed-output device requires no external resistors or 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 LM4040 uses fuse and Zener-zap reverse breakdown voltage trim during wafer sort to offer four output voltage tolerances, ranging from 0.1% (max) for the A grade to 1% (max) for the D grade. Thus, a great deal of flexibility is offered to designers in choosing the best cost-to-performance ratio for their applications.

Packaged in space-saving SC-70 and SOT-23-3 packages and operating from a minimum current of 60 μA to 100 μA , the LM4040 is also ideal for portable applications. The LM4040xI is characterized for operation over an ambient temperature range of –40°C to 85°C. The LM4040xQ is characterized for operation over an ambient temperature range of –40°C to 125°C.



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

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

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2005, Texas Instruments Incorporated

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

ORDERING INFORMATION

T _A	DEVICE GRADE	V _{KA}	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
–40°C to 85°C	A grade: 0.1% initial accuracy and 100 ppm/°C temperature coefficient	2.048 V	SC-70 (DCK)	Reel of 3000	LM4040A20IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A20IDBZR	PREVIEW
				Reel of 250	LM4040A20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A20ILP	
				Reel of 2000	LM4040A20ILPR	
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040A25IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A25IDBZR	
				Reel of 250	LM4040A25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A25ILP	
				Reel of 2000	LM4040A25ILPR	
		3 V	SC-70 (DCK)	Reel of 3000	LM4040A30IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A30IDBZR	
				Reel of 250	LM4040A30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A30ILP	
				Reel of 2000	LM4040A30ILPR	
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040A41IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A41IDBZR	
				Reel of 250	LM4040A41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A41ILP	
				Reel of 2000	LM4040A41ILPR	
		5 V	SC-70 (DCK)	Reel of 3000	LM4040A50IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A50IDBZR	
				Reel of 250	LM4040A50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A50ILP	
				Reel of 2000	LM4040A50ILPR	
		8.192 V	SC-70 (DCK)	Reel of 3000	LM4040A82IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A82IDBZR	
				Reel of 250	LM4040A82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A82ILP	
				Reel of 2000	LM4040A82ILPR	
		10 V	SC-70 (DCK)	Reel of 3000	LM4040A10IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A10IDBZR	
				Reel of 250	LM4040A10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A10ILP	
				Reel of 2000	LM4040A10ILPR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

ORDERING INFORMATION (continued)

T _A	DEVICE GRADE	V _{KA}	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
–40°C to 85°C	B grade: 0.2% initial accuracy and 100 ppm/°C temperature coefficient	2.048 V	SC-70 (DCK)	Reel of 3000	LM4040B20IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B20IDBZR	
				Reel of 250	LM4040B20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B20ILP	
				Reel of 2000	LM4040B20ILPR	
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040B25IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B25IDBZR	
				Reel of 250	LM4040B25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B25ILP	
				Reel of 2000	LM4040B25ILPR	
		3 V	SC-70 (DCK)	Reel of 3000	LM4040B30IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B30IDBZR	
				Reel of 250	LM4040B30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B30ILP	
				Reel of 2000	LM4040B30ILPR	
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040B41IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B41IDBZR	
				Reel of 250	LM4040B41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B41ILP	
				Reel of 2000	LM4040B41ILPR	
		5 V	SC-70 (DCK)	Reel of 3000	LM4040B50IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B50IDBZR	
				Reel of 250	LM4040B50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B50ILP	
				Reel of 2000	LM4040B50ILPR	
		8.192 V	SC-70 (DCK)	Reel of 3000	LM4040B82IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B82IDBZR	
				Reel of 250	LM4040B82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B82ILP	
				Reel of 2000	LM4040B82ILPR	
		10 V	SC-70 (DCK)	Reel of 3000	LM4040B10IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B10IDBZR	
				Reel of 250	LM4040B10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B10ILP	
				Reel of 2000	LM4040B10ILPR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.



LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

ORDERING INFORMATION (continued)

T _A	DEVICE GRADE	V _{KA}	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	C grade: 0.5% initial accuracy and 100 ppm/°C temperature coefficient	2.048 V	SC-70 (DCK)	Reel of 3000	LM4040C20IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C20IDBZR	
				Reel of 250	LM4040C20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C20ILP	
		2.5 V		Reel of 2000	LM4040C20ILPR	4MU_
			SC-70 (DCK)	Reel of 3000	LM4040C25IDCKR	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C25IDBZR	
				Reel of 250	LM4040C25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C25ILP	PREVIEW
				Reel of 2000	LM4040C25ILPR	
		3 V	SC-70 (DCK)	Reel of 3000	LM4040C30IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C30IDBZR	
				Reel of 250	LM4040C30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C30ILP	
		4.096 V		Reel of 2000	LM4040C30ILPR	PREVIEW
			SC-70 (DCK)	Reel of 3000	LM4040C41IDCKR	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C41IDBZR	
				Reel of 250	LM4040C41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C41ILP	PREVIEW
				Reel of 2000	LM4040C41ILPR	
		5 V	SC-70 (DCK)	Reel of 3000	LM4040C50IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C50IDBZR	
				Reel of 250	LM4040C50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C50ILP	
		8.192 V		Reel of 2000	LM4040C50ILPR	PREVIEW
			SC-70 (DCK)	Reel of 3000	LM4040C82IDCKR	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C82IDBZR	
				Reel of 250	LM4040C82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C82ILP	PREVIEW
				Reel of 2000	LM4040C82ILPR	
		10 V	SC-70 (DCK)	Reel of 3000	LM4040C10IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C10IDBZR	
				Reel of 250	LM4040C10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C10ILP	
				Reel of 2000	LM4040C10ILPR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

ORDERING INFORMATION (continued)

T _A	DEVICE GRADE	V _{KA}	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	D grade: 1.0% initial accuracy and 150 ppm/°C temperature coefficient	2.048 V	SC-70 (DCK)	Reel of 3000	LM4040D20IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D20IDBZR	
				Reel of 250	LM4040D20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D20ILP	
				Reel of 2000	LM4040D20ILPR	
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040D25IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D25IDBZR	4ME_
				Reel of 250	LM4040D25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D25ILP	
				Reel of 2000	LM4040D25ILPR	
		3 V	SC-70 (DCK)	Reel of 3000	LM4040D30IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D30IDBZR	
				Reel of 250	LM4040D30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D30ILP	
				Reel of 2000	LM4040D30ILPR	
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040D41IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D41IDBZR	
				Reel of 250	LM4040D41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D41ILP	
				Reel of 2000	LM4040D41ILPR	
		5 V	SC-70 (DCK)	Reel of 3000	LM4040D50IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D50IDBZR	
				Reel of 250	LM4040D50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D50ILP	
				Reel of 2000	LM4040D50ILPR	
		8.192 V	SC-70 (DCK)	Reel of 3000	LM4040D82IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D82IDBZR	
				Reel of 250	LM4040D82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D82ILP	
				Reel of 2000	LM4040D82ILPR	
		10 V	SC-70 (DCK)	Reel of 3000	LM4040D10IDCKR	PREVIEW
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D10IDBZR	
				Reel of 250	LM4040D10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D10ILP	
				Reel of 2000	LM4040D10ILPR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.



LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

ORDERING INFORMATION (continued)

T _A	DEVICE GRADE	V _{KA}	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 125°C	C grade: 0.5% initial accuracy and 100 ppm/°C temperature coefficient	2.048 V	SOT-23-3 (DBZ)	Reel of 3000	LM4040C20QDBZR	PREVIEW
				Reel of 250	LM4040C20QDBZT	
		2.5 V		Reel of 3000	LM4040C25QDBZR	4MA_
				Reel of 250	LM4040C25QDBZT	
		3 V		Reel of 3000	LM4040C30QDBZR	PREVIEW
				Reel of 250	LM4040C30QDBZT	
		5 V		Reel of 3000	LM4040C50QDBZR	
				Reel of 250	LM4040C50QDBZT	
	D grade: 1.0% initial accuracy and 150 ppm/°C temperature coefficient	2.048 V	SOT-23-3 (DBZ)	Reel of 3000	LM4040D20QDBZR	
				Reel of 250	LM4040D20QDBZT	
		2.5 V		Reel of 3000	LM4040D25QDBZR	4MB_
				Reel of 250	LM4040D25QDBZT	
		3 V		Reel of 3000	LM4040D30QDBZR	PREVIEW
				Reel of 250	LM4040D30QDBZT	
		5 V		Reel of 3000	LM4040D50QDBZR	
				Reel of 250	LM4040D50QDBZT	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

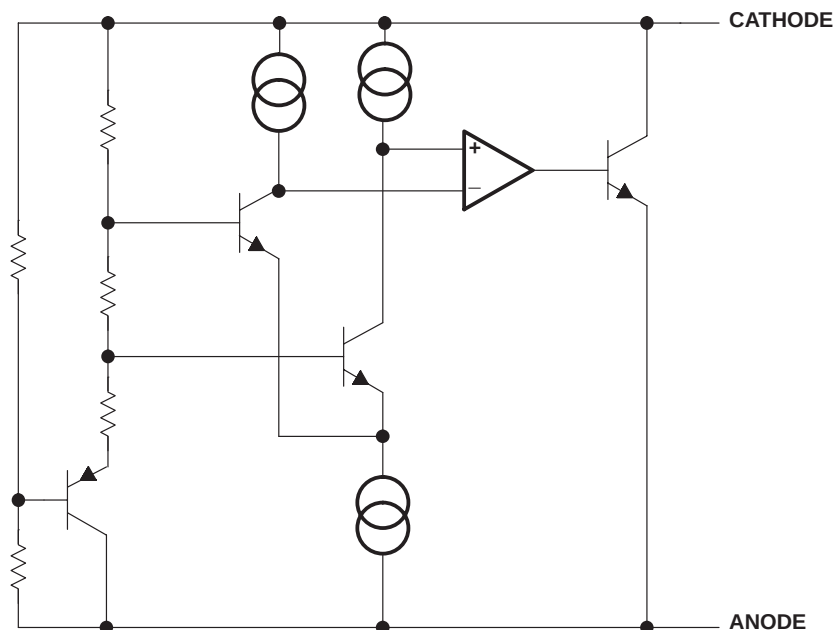
‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

functional block diagram



absolute maximum ratings over free-air temperature range (unless otherwise noted)[†]

Continuous cathode current, I_Z	–10 mA to 25 mA
Package thermal impedance, θ_{JA} (see Notes 1 and 2): DBZ package	206°C/W
DCK package	252°C/W
LP package	156°C/W
Operating virtual junction temperature, T_J	150°C
Storage temperature range, T_{stg}	–65°C to 110°C

[†] 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.

- NOTES: 1. 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.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

		MIN	MAX	UNIT
I_Z	Cathode current	‡	20	mA
T_A	Free-air temperature range	LM4040xxxI	–40	85
		LM4040xxxQ	–40	125

‡ See parametric tables



LM4040

PRECISION MICROPPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x20I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040A20I			LM4040B20I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 100 μA	25°C	2.048			2.048			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 100 μA	25°C	−2		2	−4.1		4.1	mV
			Full range	−15		15	−17		17	
I _{Z,min}	Minimum cathode current		25°C	45		60	45		60	μA
			Full range			65	65			
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±20			±20			ppm/°C
		I _Z = 1 mA	25°C	±15			±15			
			Full range		±100			±100		
		I _L = 100 μA	25°C	±15			±15			
ΔV _Z /ΔI _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	mV
			Full range			1	1			
		1 mA < I _Z < 15 mA	25°C	2.5		6	2.5		6	
			Full range			8	8			
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.3		0.8	0.3		0.8	Ω
e _N	Wideband noise	I _Z = 100 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	35			35			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			ppm
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = −40°C to 125°C		0.08			0.08			%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x20I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040C20I			LM4040D20I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 100 μA	25°C	2.048			2.048			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 100 μA	25°C	-10	10		-20	20		mV
			Full range	-23 23		-40 40				
I _{Z,min}	Minimum cathode current		25°C	45 60		45 65		μA		
			Full range	65		70				
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±20		±20		ppm/°C		
		I _Z = 1 mA	25°C	±15		±15				
			Full range	±100		±150				
		I _L = 100 μA	25°C	±15		±15				
ΔV _Z /ΔI _Z	Reverse breakdown voltage change with cathode current change	I _{Z,min} < I _Z < 1 mA	25°C	0.3	0.8	0.3	1	mV		
			Full range	1		1.2				
		1 mA < I _Z < 15 mA	25°C	2.5	6	2.5	8			
			Full range	8		10				
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.3	0.9	0.3	1.1	Ω		
e _N	Wideband noise	I _Z = 100 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	35			35		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		ppm	
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = -40°C to 125°C		0.08			0.08		%	

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x20Q electrical characteristics at extended temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 125°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040C20Q			LM4040D20Q			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 100 μA	25°C	2.048			2.048			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 100 μA	25°C	−10		10	−20		20	mV
			Full range	−30		30	−50		50	
I _{Z,min}	Minimum cathode current		25°C	45		60	45		65	μA
			Full range			68			73	
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±20			±20			ppm/°C
		I _Z = 1 mA	25°C	±15			±15			
				Full range			±100			
			I _L = 100 μA	25°C	±15			±15		
ΔV _Z /ΔI _Z	Reverse breakdown voltage change with cathode current change	I _{Z,min} < I _Z < 1 mA	25°C	0.3		0.8	0.3		1	mV
			Full range			1			1.2	
		1 mA < I _Z < 15 mA	25°C	2.5		6	2.5		8	
			Full range			8			10	
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.3		0.9	0.3		1.1	Ω
e _N	Wideband noise	I _Z = 100 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	35			35			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			ppm
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = −40°C to 125°C		0.08			0.08			%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) $- V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x25I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040A25I			LM4040B25I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		2.5			2.5		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		25 $^{\circ}\text{C}$					mV
				Full range					
$I_{Z,\text{min}}$	Minimum cathode current			25 $^{\circ}\text{C}$					μA
				Full range					
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		25 $^{\circ}\text{C}$					ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		25 $^{\circ}\text{C}$					
				Full range					
		$I_L = 100\ \mu\text{A}$		25 $^{\circ}\text{C}$					
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		25 $^{\circ}\text{C}$					mV
				Full range					
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		25 $^{\circ}\text{C}$					
				Full range					
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1 I_Z$		25 $^{\circ}\text{C}$					Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		25 $^{\circ}\text{C}$					μVRMS
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$, $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$, $I_Z = 100\ \mu\text{A}$							ppm
V_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C							%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x25I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C25I			LM4040D25I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		2.5			2.5		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$							mV
$I_{Z,\text{min}}$	Minimum cathode current	25°C		45	75		45	75	μA
		Full range			80			80	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 20			± 20		ppm/ $^{\circ}\text{C}$
		25°C		± 15			± 15		
		Full range			± 100			± 150	
		$I_L = 100\ \mu\text{A}$		± 15			± 15		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.3	0.8		0.3	1	mV
					1			1.2	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		2.5	6		2.5	8	
		Full range			8			10	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.3	0.9		0.3	1.1	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		35			35		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x25Q electrical characteristics at extended temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 125°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040C25Q			LM4040D25Q			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 100 μA	25°C	2.5			2.5			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 100 μA	25°C	−12 12			−25 25			mV
			Full range	−38 38			−63 63			
I _{Z,min}	Minimum cathode current		25°C	45 75			45 75			μA
			Full range	80			80			
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±20			±20			ppm/°C
		I _Z = 1 mA	25°C	±15			±15			
			Full range	±100			±150			
		I _L = 100 μA	25°C	±15			±15			
ΔV _Z /ΔI _Z	Reverse breakdown voltage change with cathode current change	I _{Z,min} < I _Z < 1 mA	25°C	0.3 0.8			0.3 1			mV
			Full range	1			1.2			
		1 mA < I _Z < 15 mA	25°C	2.5 6			2.5 8			
			Full range	8			10			
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.3 0.9			0.3 1.1			Ω
e _N	Wideband noise	I _Z = 100 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	35			35			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			ppm
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = −40°C to 125°C		0.08			0.08			%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x30I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040A30I			LM4040B30I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$			3			6	mV
		Full range		-22	22		-26	26	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		47	62		47	62	μA
		Full range			67			67	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 20			± 20		ppm/ $^{\circ}\text{C}$
		25°C		± 15			± 15		
		Full range			± 100			± 100	
		$I_L = 100\ \mu\text{A}$		± 15			± 15		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.6	0.8		0.6	0.8	mV
		Full range			1.1			1.1	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		2.7	6		2.7	6	
		Full range			9			9	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.4	0.9		0.4	0.9	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		35			35		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x30I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C30I			LM4040D30I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		–15	15		–30	30	mV
		Full range		–34	34		–59	59	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		45	60		45	65	μA
		Full range			65			70	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 20			± 20		ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		± 15			± 15		
		Full range			± 100			± 150	
		$I_L = 100\ \mu\text{A}$		± 15			± 15		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$	25°C	0.4	0.8		0.4	1.1	mV
			Full range		1.1			1.3	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$	25°C	2.7	6		2.7	8	
			Full range		9			11	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.4	0.9		0.4	1.2	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		35			35		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x30Q electrical characteristics at extended temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 125°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C30Q			LM4040D30Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$			15			30	mV
		Full range			45			75	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		47	62		47	67	μA
		Full range			70			75	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 20			± 20		ppm/ $^{\circ}\text{C}$
		25°C		± 15			± 15		
		Full range			± 100			± 150	
		$I_L = 100\ \mu\text{A}$		± 15			± 15		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.4	0.8		0.4	1.1	mV
		Full range			1.1			1.3	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		2.7	6		2.7	8	
		Full range			9			11	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.4	0.9		0.4	1.2	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		35			35		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x41I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040A41I			LM4040B41I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		4.096			4.096		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		25°C			25°C		mV
				Full range			Full range		
$I_{Z,\text{min}}$	Minimum cathode current			25°C			25°C		μA
				Full range			Full range		
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		25°C			25°C		ppm/°C
		$I_Z = 1\ \text{mA}$		25°C			25°C		
				Full range			Full range		
		$I_L = 100\ \mu\text{A}$		25°C			25°C		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		25°C			25°C		mV
				Full range			Full range		
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		25°C			25°C		
				Full range			Full range		
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		25°C			25°C		Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		25°C			25°C		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C			0.08			0.08	%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).



LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x41I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040C41I			LM4040D41I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 100 μA	25°C	4.096			4.096			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 100 μA	25°C	−20		20	−41		41	mV
			Full range	−47		47	−81		81	
I _{Z,min}	Minimum cathode current		25°C	50		68	50		73	μA
			Full range			73	78			
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±30			±30			ppm/°C
		I _Z = 1 mA	25°C	±20			±20			
			Full range		±100			±150		
		I _L = 100 μA	25°C	±20			±20			
ΔV _Z /ΔI _Z	Reverse breakdown voltage change with cathode current change	I _{Z,min} < I _Z < 1 mA	25°C	0.5		0.9	0.5		1.2	mV
			Full range			1.2	1.5			
		1 mA < I _Z < 15 mA	25°C	3		7	3		9	
			Full range			10	13			
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.5		1	0.5		1.3	Ω
e _N	Wideband noise	I _Z = 100 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	80			80			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			ppm
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = −40°C to 125°C		0.08			0.08			%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x50I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040A50I			LM4040B50I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		–5	5		–10	10	mV
				–38	38		–43	43	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		54	74		54	74	μA
		Full range			80			80	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 30			± 30		ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		± 20			± 20		
		Full range			± 100			± 100	
		$I_L = 100\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.5	1		0.5	1	mV
					1.4			1.4	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		3.5	8		3.5	8	
		Full range			12			12	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.5	1.1		0.5	1.1	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		80			80		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).



LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x50I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C50I			LM4040D50I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		25			50		mV
		Full range		58			99		
$I_{Z,\text{min}}$	Minimum cathode current	25°C		54	74		54	79	μA
		Full range			80			85	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 30			± 30		ppm/ $^{\circ}\text{C}$
		25°C		± 20			± 20		
		Full range		± 100			± 150		
		$I_L = 100\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.5	1		0.5	1.3	mV
		Full range			1.4			1.8	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		3.5	8		3.5	10	
		Full range			12			15	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.5	1.1		0.5	1.5	Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		80			80		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x50Q electrical characteristics at extended temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 125°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C50Q			LM4040D50Q			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 100\ \mu\text{A}$		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 100\ \mu\text{A}$		25			50		mV
		Full range		75			125		
$I_{Z,\text{min}}$	Minimum cathode current	25°C		54			54		μA
		Full range		83			88		
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 30			± 30		ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		± 20			± 20		
		Full range		± 100			± 150		
		$I_L = 100\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.5			0.5		mV
		Full range		1.4			1.8		
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		3.5			3.5		
		Full range		12			15		
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.5			0.5		Ω
e_N	Wideband noise	$I_Z = 100\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		80			80		μVRMS
	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_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x82I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER		TEST CONDITIONS	T _A	LM4040A82I			LM4040B82I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reverse breakdown voltage	I _Z = 150 μA	25°C	8.192			8.192			V
ΔV _Z	Reverse breakdown voltage tolerance	I _Z = 150 μA	25°C	−8.2		8.2	−16		16	mV
			Full range	−61		61	−70		70	
I _{Z,min}	Minimum cathode current		25°C	67		91	67		91	μA
			Full range			95	95			
α _{VZ}	Average temperature coefficient of reverse breakdown voltage	I _Z = 10 mA	25°C	±40			±40			ppm/°C
		I _Z = 1 mA	25°C	±20			±20			
			Full range			±100	±100			
		I _L = 150 μA	25°C	±20			±20			
ΔV _Z /ΔI _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	mV
			Full range			2.5	2.5			
		1 mA < I _Z < 15 mA	25°C	7		10	7		10	
			Full range			18	18			
Z _Z	Reverse dynamic impedance	I _Z = 1 mA, f = 120 Hz, I _{AC} = 0.1 I _Z	25°C	0.6		1.5	0.6		1.5	Ω
e _N	Wideband noise	I _Z = 150 μA, 10 Hz ≤ f ≤ 10 kHz	25°C	130			130			μV _{RMS}
	Long-term stability of reverse breakdown voltage	t = 1000 h, T _A = 25°C ± 0.1°C, I _Z = 150 μA		120			120			ppm
V _{HYST}	Thermal hysteresis (see Note 3)	ΔT _A = −40°C to 125°C		0.08			0.08			%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x82I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C82I			LM4040D82I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 150\ \mu\text{A}$		8.192			8.192		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 150\ \mu\text{A}$			41			82	mV
					94			162	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		67	91		67	96	μA
		Full range			95			100	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 40			± 40		ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		± 20			± 20		
		Full range			± 100			± 150	
		$I_L = 150\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.6	1.3		0.6	1.7	mV
					2.5			3	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		7	10		7	15	
		Full range			18			24	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.6	1.5		0.6	1.9	Ω
e_N	Wideband noise	$I_Z = 150\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		130			130		μV_{RMS}
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$, $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$, $I_Z = 150\ \mu\text{A}$		120			120		ppm
V_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).



LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x10I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040A10I			LM4040B10I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 150\ \mu\text{A}$		10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 150\ \mu\text{A}$			10			20	mV
		Full range			75			85	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		75	100		75	100	μA
		Full range			103			103	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 40			± 40		ppm/ $^{\circ}\text{C}$
		25°C		± 20			± 20		
		Full range			± 100			± 100	
		$I_L = 150\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.8	1.5		0.8	1.5	mV
		Full range			3.5			3.5	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		8	12		8	12	
		Full range			23			23	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.7	1.7		0.7	1.7	Ω
e_N	Wideband noise	$I_Z = 150\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		180			180		μVRMS
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$, $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$, $I_Z = 150\ \mu\text{A}$		120			120		ppm
V_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

LM4040

PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

**LM4040x10I electrical characteristics at industrial temperature range (unless otherwise noted)
(full-range $T_A = -40^{\circ}\text{C}$ to 85°C)**

PARAMETER	TEST CONDITIONS	T_A	LM4040C10I			LM4040D10I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse breakdown voltage	$I_Z = 150\ \mu\text{A}$		10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	$I_Z = 150\ \mu\text{A}$			50			100	mV
					115			198	
$I_{Z,\text{min}}$	Minimum cathode current	25°C		75	100		75	110	μA
		Full range			103			113	
α_{VZ}	Average temperature coefficient of reverse breakdown voltage	$I_Z = 10\ \text{mA}$		± 40			± 40		ppm/ $^{\circ}\text{C}$
		$I_Z = 1\ \text{mA}$		± 20			± 20		
		Full range			± 100			± 150	
		$I_L = 150\ \mu\text{A}$		± 20			± 20		
$\Delta V_Z / \Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,\text{min}} < I_Z < 1\ \text{mA}$		0.8	1.5		0.8	2	mV
		Full range			3.5			4	
		$1\ \text{mA} < I_Z < 15\ \text{mA}$		8	12		8	18	
		Full range			23			29	
Z_Z	Reverse dynamic impedance	$I_Z = 1\ \text{mA}$, $f = 120\ \text{Hz}$, $I_{AC} = 0.1\ I_Z$		0.7	1.7		0.7	2.3	Ω
e_N	Wideband noise	$I_Z = 150\ \mu\text{A}$, $10\ \text{Hz} \leq f \leq 10\ \text{kHz}$		180			180		μVRMS
	Long-term stability of reverse breakdown voltage	$t = 1000\ \text{h}$, $T_A = 25^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$, $I_Z = 150\ \mu\text{A}$		120			120		ppm
V_{HYST}	Thermal hysteresis (see Note 3)	$\Delta T_A = -40^{\circ}\text{C}$ to 125°C		0.08			0.08		%

NOTE 3: Thermal hysteresis is defined as $V_{Z,25^{\circ}\text{C}}$ (after cycling to -40°C) – $V_{Z,25^{\circ}\text{C}}$ (after cycling to 125°C).

start-up characteristics

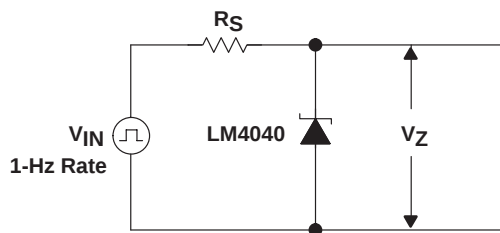


Figure 1. Test Circuit

LM4040

PRECISION MICROPPOWER SHUNT VOLTAGE REFERENCE

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

output capacitor

The LM4040 does not require an output capacitor across cathode and anode for stability. However, if an output bypass capacitor is desired, the LM4040 is designed to be stable with all capacitive loads.

SOT-23 and SC-70 pin connections

There is a parasitic Schottky diode connected between pins 2 and 3 of the SOT-23 packaged device. Thus, pin 3 of the SOT-23 package must be left floating or connected to pin 2. Similarly, pin 2 of the SC-70 package also must be left floating or connected to pin 1.

TYPICAL CHARACTERISTICS

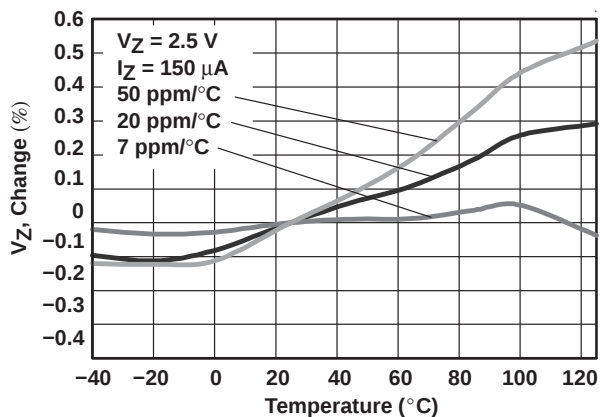


Figure 2. Temperature Drift for Different Average Temperature Coefficients

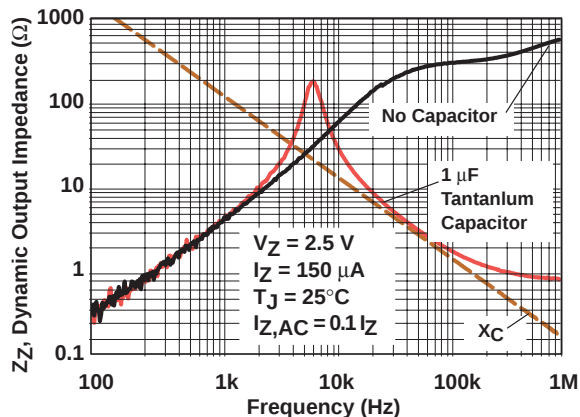


Figure 3. Output Impedance vs Frequency

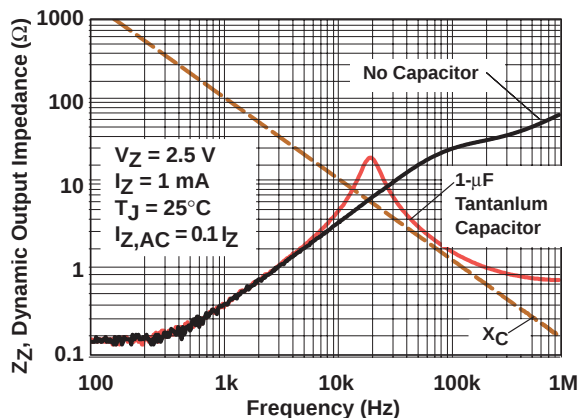


Figure 4. Output Impedance vs Frequency

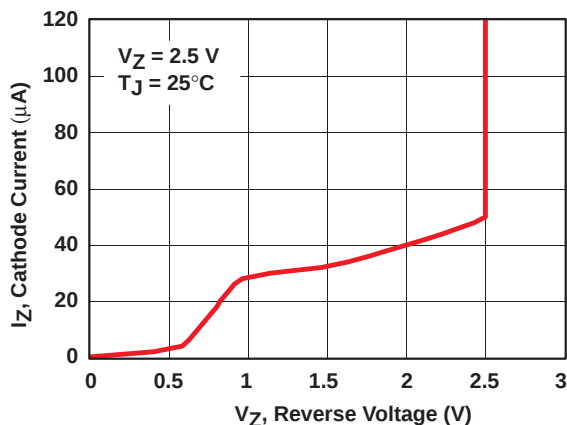


Figure 5. Temperature Drift for Different Average Temperature Coefficient

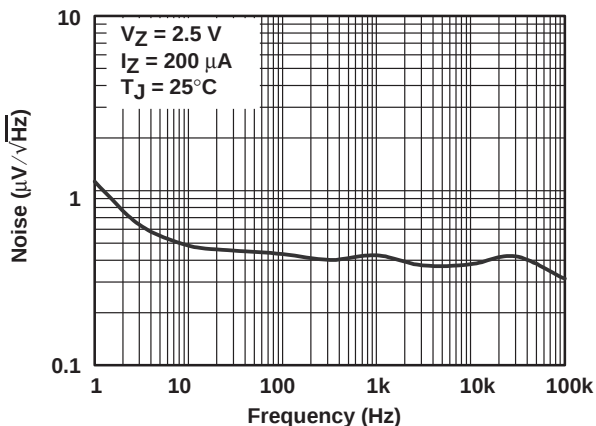


Figure 6. Noise Voltage vs Frequency

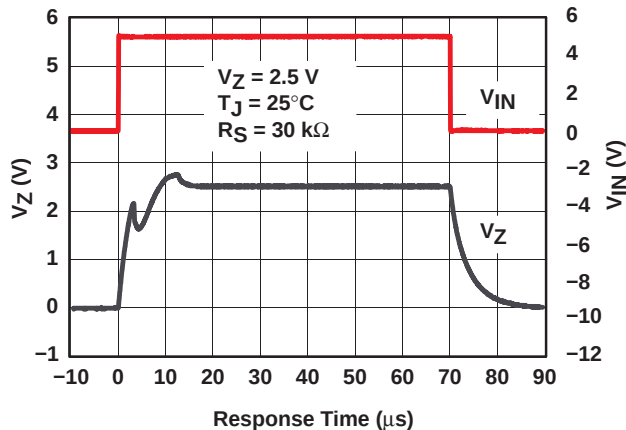


Figure 7. Start-Up Characteristics

LM4040

SLOS456A – JANUARY 2005 – REVISED FEBRUARY 2005

APPLICATION INFORMATION

use with ADCs or DACs

The LM4040x-41 and LM4040x-82 are designed to be 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 LM4040x-41 (4.096 V) permits operation with a LSB of 1 mV. For 12-bit ADCs or DACs operating from supplies of 10 V (or higher), the LM4040x-82 (8.192 V) allows a LSB of 2 mV.

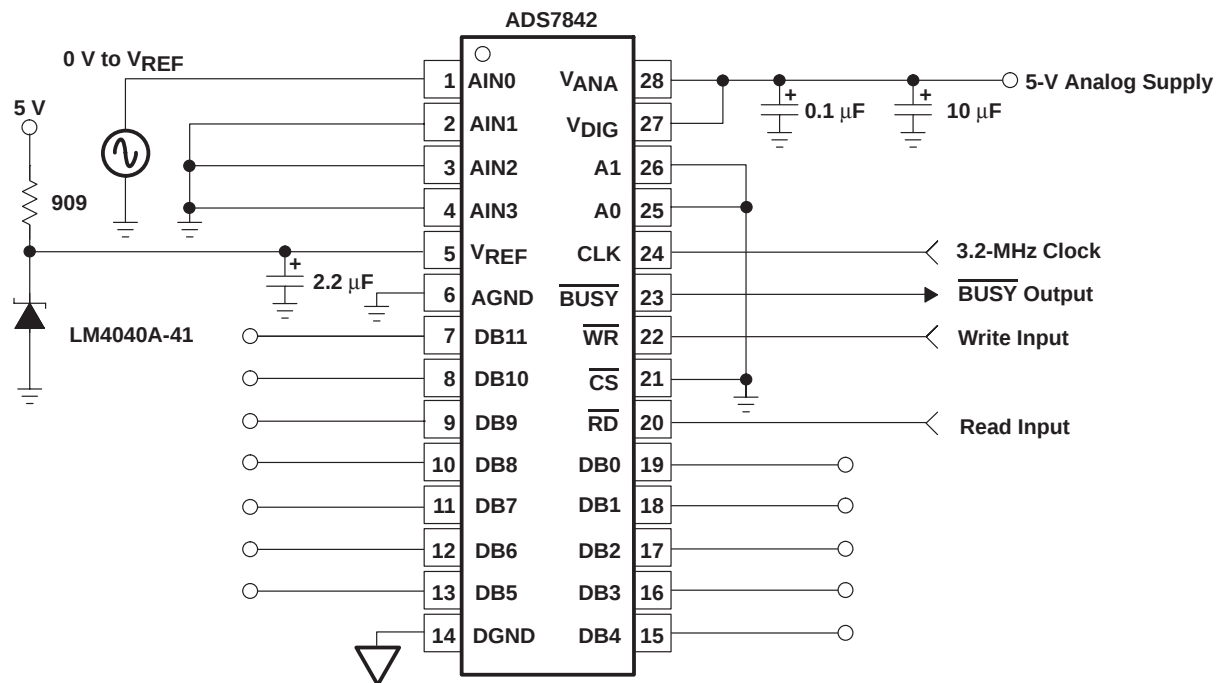


Figure 8. Data-Acquisition Circuit With LM4040x-41

APPLICATION INFORMATION

cathode and load currents

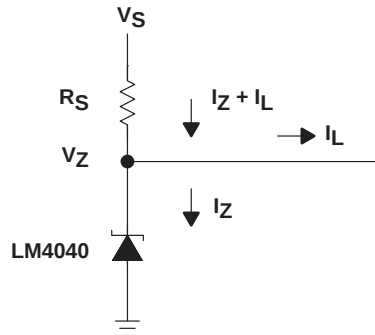


Figure 9. Shunt Regulator

In a typical shunt-regulator configuration (see Figure 3), an external resistor, R_S , is connected between the supply and the cathode of the LM4040. R_S needs to be set properly, as it sets the total current available to supply the load (I_L) and bias the LM4040 (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 needs to 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 needs to be large enough to limit I_Z to less than its maximum rated value of 20 mA.

R_S is calculated according to the equation:

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

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LM4040A10IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040A10IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A10IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040A10ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A10ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040A25IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040A25IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A25IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040A25ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A25ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040A30IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040A30IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A30IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040A30ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A30ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040A41IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040A41IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A41IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040A41ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A41ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040A50IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A50IDCKR	PREVIEW	SC70	DCK	6	3000	None	Call TI	Call TI
LM4040A50ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A82IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040A82IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040A82IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040A82ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040A82ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B10IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B10IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B10IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B10ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040B10ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B25IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B25IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B25IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B25ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040B25ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B30IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B30IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B30IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B30ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LM4040B30ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B41IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B41IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B41IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B41ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040B41ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B50IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B50IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B50IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B50ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040B50ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040B82IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040B82IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040B82IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040B82ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040B82ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C10IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C10IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C10IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040C10ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C10ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C20QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C20QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C25IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C25IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C25IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040C25ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C25ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C25QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C25QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C30IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C30IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C30ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C30ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C30QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C30QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C41IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C41IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C41IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040C41ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C41ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C50IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C50IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LM4040C50IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040C50ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C50ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040C50QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C50QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C82IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040C82IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040C82IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040C82ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040C82ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D10IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D10IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D10IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D10ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D10ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D20QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D20QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D25IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D25IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D25IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D25ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D25ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D25QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D25QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D30IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D30IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D30IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D30ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D30ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D30QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D30QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D41IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D41IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D41IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D41ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D41ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D50IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D50IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D50IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D50ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D50ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI
LM4040D50QDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D50QDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LM4040D82IDBZR	PREVIEW	SOT-23	DBZ	3	3000	None	Call TI	Call TI
LM4040D82IDBZT	PREVIEW	SOT-23	DBZ	3	250	None	Call TI	Call TI
LM4040D82IDCKR	PREVIEW	SC70	DCK	5	3000	None	Call TI	Call TI
LM4040D82ILP	PREVIEW	TO-92	LP	3	1000	None	Call TI	Call TI
LM4040D82ILPR	PREVIEW	TO-92	LP	3	2000	None	Call TI	Call TI

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

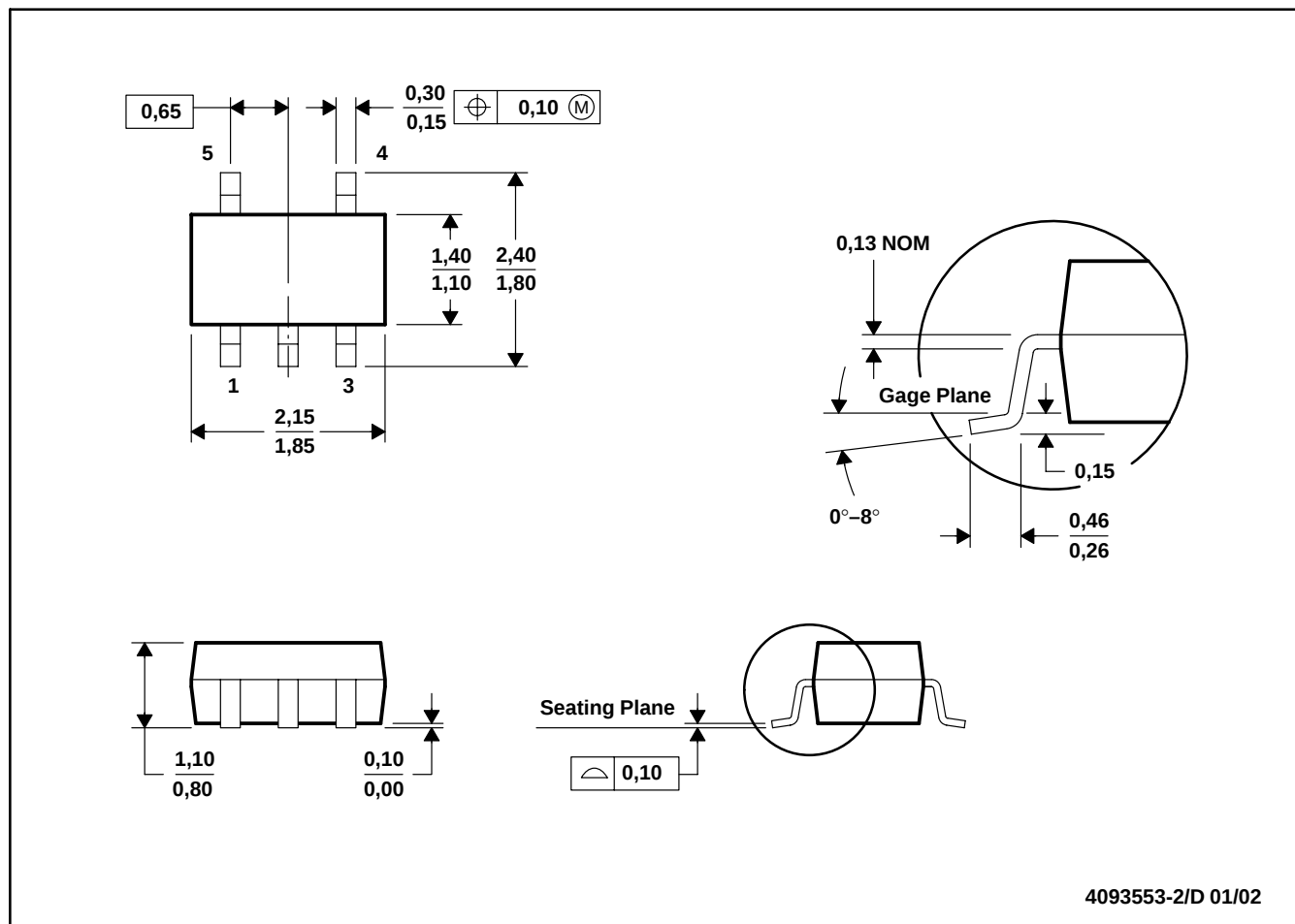
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

DCK (R-PDSO-G5)

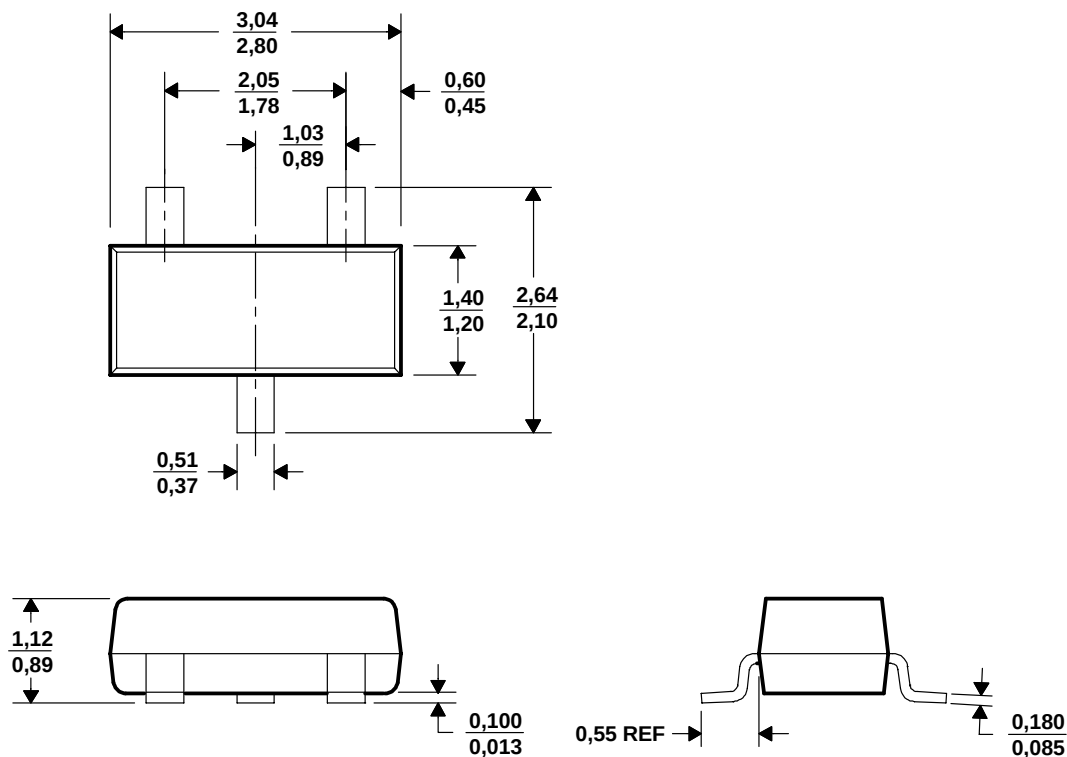
PLASTIC SMALL-OUTLINE PACKAGE



- 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.
 D. Falls within JEDEC MO-203

DBZ (R-PDSO-G3)

PLASTIC SMALL-OUTLINE

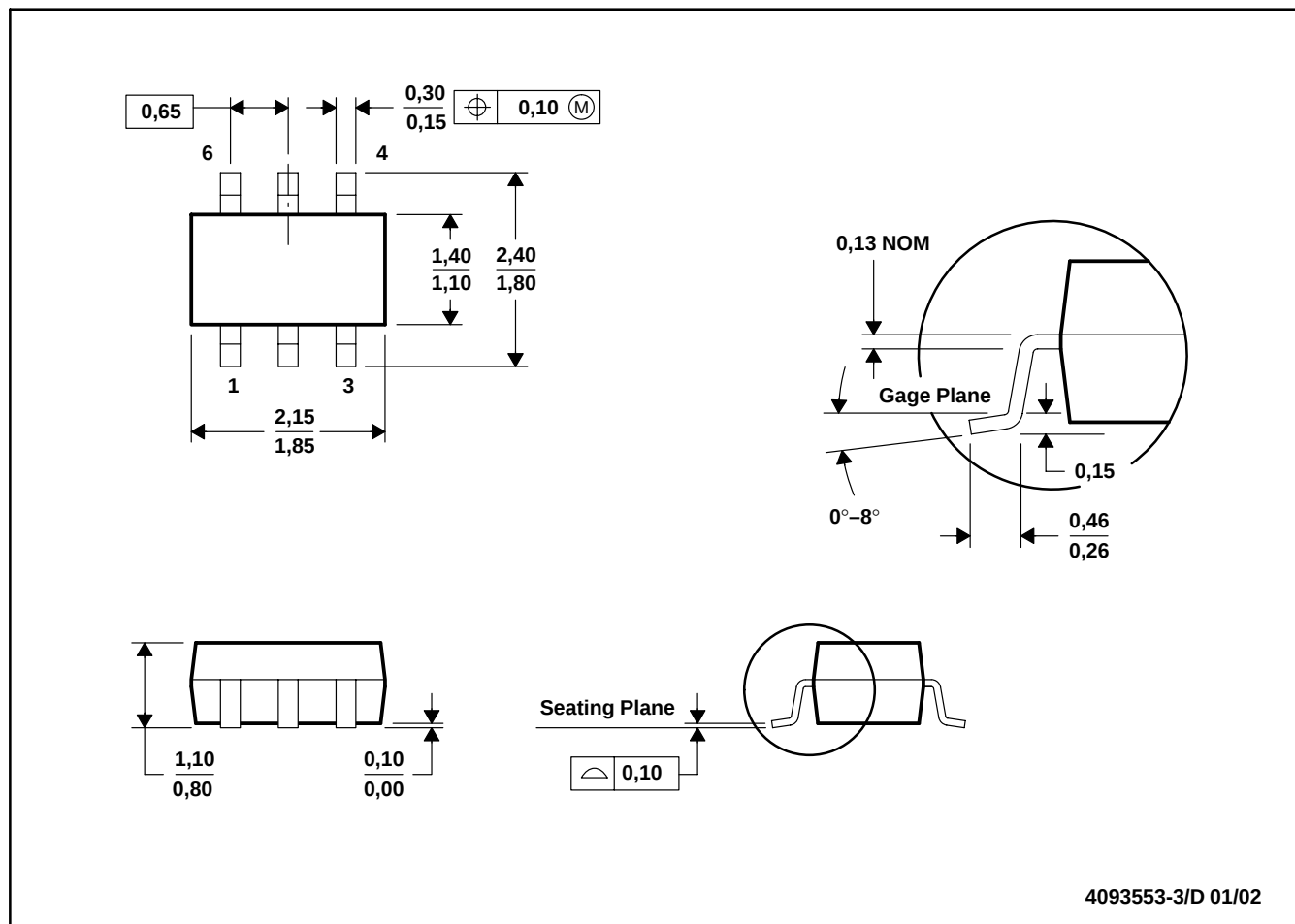


4203227/A 08/01

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Dimensions are inclusive of plating.
 - D. Dimensions are exclusive of mold flash and metal burr.

DCK (R-PDSO-G6)

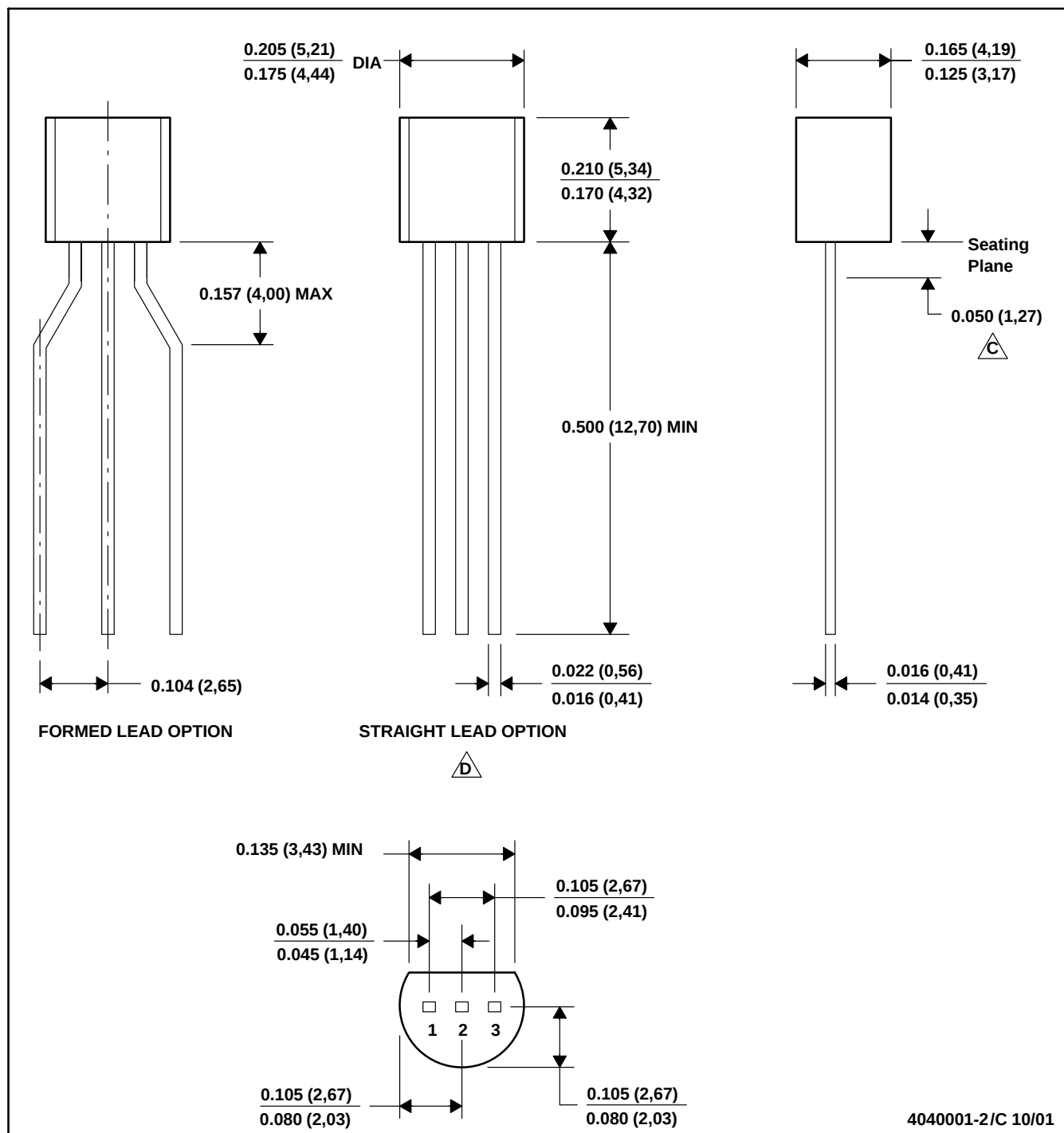
PLASTIC SMALL-OUTLINE PACKAGE



- 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.
 D. Falls within JEDEC MO-203

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



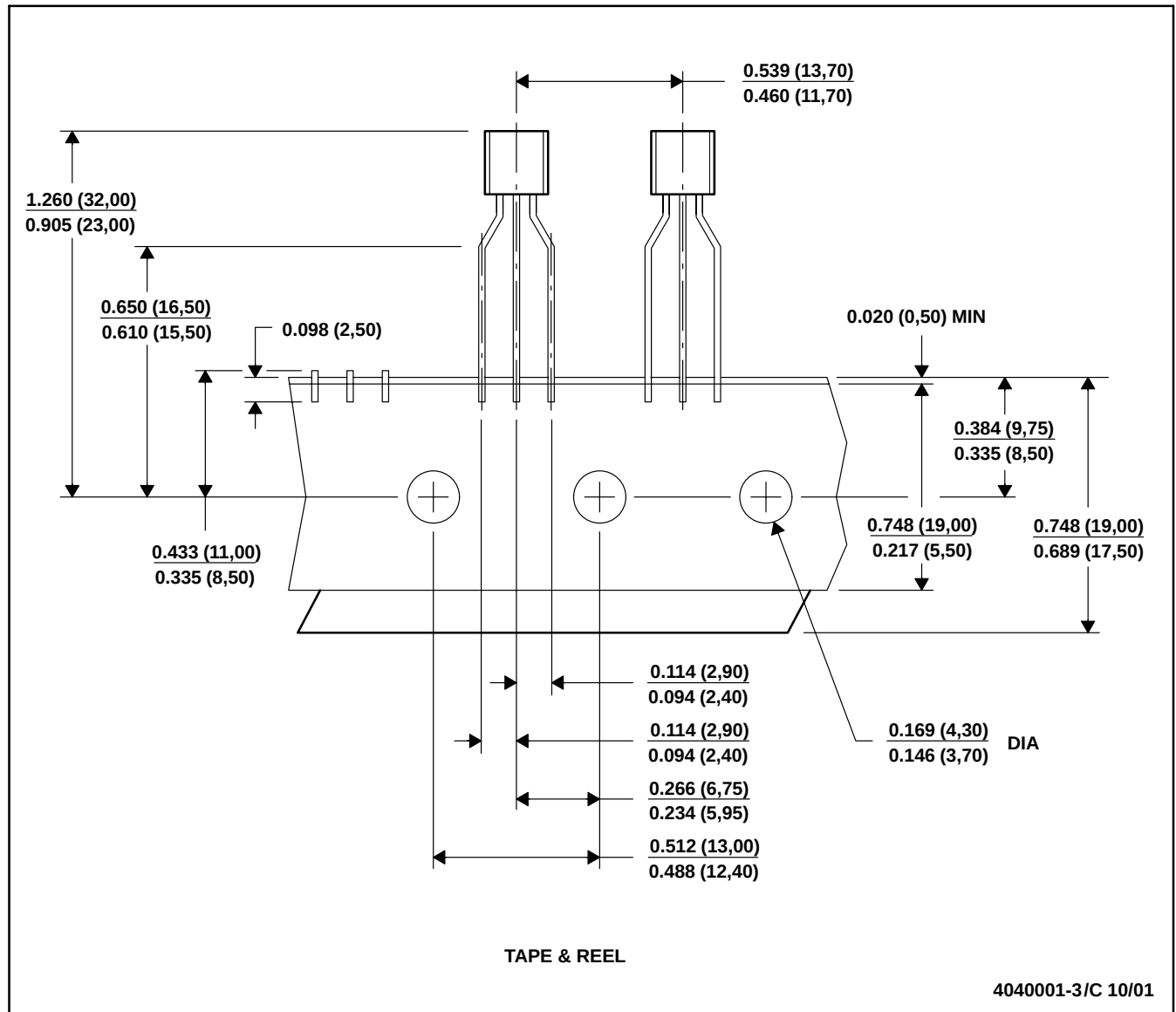
- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 $\triangle C$ Lead dimensions are not controlled within this area
 $\triangle D$ Falls within JEDEC TO -226 Variation AA (TO-226 replaces TO-92)
 E. Shipping Method:
 Straight lead option available in bulk pack only.
 Formed lead option available in tape & reel or ammo pack.

MECHANICAL DATA

MSOT002A – OCTOBER 1994 – REVISED NOVEMBER 2001

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Tape and Reel information for the Format Lead Option package.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

Copyright © 2005, Texas Instruments Incorporated