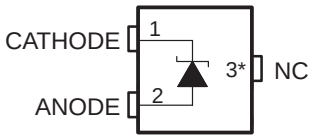
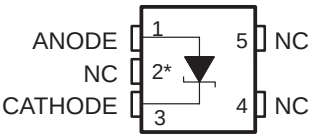
- **Fixed Output Voltages of 2.048 V, 2.5 V, 3 V, 4.096 V, 5 V, 8.192 V, and 10 V**
- **Tight Output Tolerances and Low Temperature Coefficient**
  - **Max 0.1%, 100 ppm/°C − A Grade**
  - **Max 0.2%, 100 ppm/°C − B Grade**
  - **Max 0.5%, 100 ppm/°C − C Grade**
  - **Max 1.0%, 150 ppm/°C − D Grade**
- **Low Output Noise . . . 35 μV_{RMS} (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)



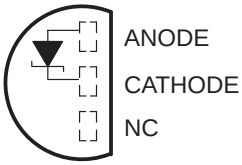
* This pin must be left open or connected to Pin 2, due to an internal connection to ANODE (die substrate).

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.

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
				Reel of 250	LM4040A20IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A20IDBZR	PREVIEW
				Reel of 250	LM4040A20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A20ILP	PREVIEW
				Ammo pack of 2000	LM4040A20ILPM	PREVIEW
				Reel of 2000	LM4040A20ILPR	PREVIEW
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040A25IDCKR	PREVIEW
				Reel of 250	LM4040A25IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A25IDBZR	PREVIEW
				Reel of 250	LM4040A25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A25ILP	PREVIEW
				Ammo pack of 2000	LM4040A25ILPM	PREVIEW
				Reel of 2000	LM4040A25ILPR	PREVIEW
		3 V	SC-70 (DCK)	Reel of 3000	LM4040A30IDCKR	PREVIEW
				Reel of 250	LM4040A30IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A30IDBZR	PREVIEW
				Reel of 250	LM4040A30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A30ILP	PREVIEW
				Ammo pack of 2000	LM4040A30ILPM	PREVIEW
				Reel of 2000	LM4040A30ILPR	PREVIEW
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040A41IDCKR	PREVIEW
				Reel of 250	LM4040A41IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A41IDBZR	PREVIEW
				Reel of 250	LM4040A41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A41ILP	PREVIEW
				Ammo pack of 2000	LM4040A41ILPM	PREVIEW
				Reel of 2000	LM4040A41ILPR	PREVIEW
		5 V	SC-70 (DCK)	Reel of 3000	LM4040A50IDCKR	PREVIEW
				Reel of 250	LM4040A50IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A50IDBZR	PREVIEW
				Reel of 250	LM4040A50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A50ILP	PREVIEW
				Ammo pack of 2000	LM4040A50ILPM	PREVIEW
				Reel of 2000	LM4040A50ILPR	PREVIEW

† 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.

ORDERING INFORMATION (continued)

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	8.192 V	SC-70 (DCK)	Reel of 3000	LM4040A82IDCKR	PREVIEW
				Reel of 250	LM4040A82IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A82IDBZR	PREVIEW
				Reel of 250	LM4040A82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A82ILP	PREVIEW
				Ammo pack of 2000	LM4040A82ILPM	PREVIEW
				Reel of 2000	LM4040A82ILPR	PREVIEW
		10 V	SC-70 (DCK)	Reel of 3000	LM4040A10IDCKR	PREVIEW
				Reel of 250	LM4040A10IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040A10IDBZR	PREVIEW
				Reel of 250	LM4040A10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040A10ILP	PREVIEW
				Ammo pack of 2000	LM4040A10ILPM	PREVIEW
				Reel of 2000	LM4040A10ILPR	PREVIEW

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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
				Reel of 250	LM4040B20IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B20IDBZR	PREVIEW
				Reel of 250	LM4040B20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B20ILP	PREVIEW
				Ammo pack of 2000	LM4040B20ILPM	PREVIEW
				Reel of 2000	LM4040B20ILPR	PREVIEW
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040B25IDCKR	PREVIEW
				Reel of 250	LM4040B25IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B25IDBZR	PREVIEW
				Reel of 250	LM4040B25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B25ILP	PREVIEW
				Ammo pack of 2000	LM4040B25ILPM	PREVIEW
				Reel of 2000	LM4040B25ILPR	PREVIEW
		3 V	SC-70 (DCK)	Reel of 3000	LM4040B30IDCKR	PREVIEW
				Reel of 250	LM4040B30IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B30IDBZR	PREVIEW
				Reel of 250	LM4040B30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B30ILP	PREVIEW
				Ammo pack of 2000	LM4040B30ILPM	PREVIEW
				Reel of 2000	LM4040B30ILPR	PREVIEW
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040B41IDCKR	PREVIEW
				Reel of 250	LM4040B41IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B41IDBZR	PREVIEW
				Reel of 250	LM4040B41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B41ILP	PREVIEW
				Ammo pack of 2000	LM4040B41ILPM	PREVIEW
				Reel of 2000	LM4040B41ILPR	PREVIEW
		5 V	SC-70 (DCK)	Reel of 3000	LM4040B50IDCKR	PREVIEW
				Reel of 250	LM4040B50IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B50IDBZR	PREVIEW
				Reel of 250	LM4040B50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B50ILP	PREVIEW
				Ammo pack of 2000	LM4040B50ILPM	PREVIEW
				Reel of 2000	LM4040B50ILPR	PREVIEW

† 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.

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	8.192 V	SC-70 (DCK)	Reel of 3000	LM4040B82IDCKR	PREVIEW
				Reel of 250	LM4040B82IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B82IDBZR	PREVIEW
				Reel of 250	LM4040B82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B82ILP	PREVIEW
				Ammo pack of 2000	LM4040B82ILPM	PREVIEW
				Reel of 2000	LM4040B82ILPR	PREVIEW
		10 V	SC-70 (DCK)	Reel of 3000	LM4040B10IDCKR	PREVIEW
				Reel of 250	LM4040B10IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040B10IDBZR	PREVIEW
				Reel of 250	LM4040B10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040B10ILP	PREVIEW
				Ammo pack of 2000	LM4040B10ILPM	PREVIEW
				Reel of 2000	LM4040B10ILPR	PREVIEW

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

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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
				Reel of 250	LM4040C20IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C20IDBZR	PREVIEW
				Reel of 250	LM4040C20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C20ILP	PREVIEW
				Ammo pack of 2000	LM4040C20ILPM	PREVIEW
				Reel of 2000	LM4040C20ILPR	PREVIEW
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040C25IDCKR	PREVIEW
				Reel of 250	LM4040C25IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C25IDBZR	4MU_
				Reel of 250	LM4040C25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C25ILP	PREVIEW
				Ammo pack of 2000	LM4040C25ILPM	PREVIEW
				Reel of 2000	LM4040C25ILPR	PREVIEW
		3 V	SC-70 (DCK)	Reel of 3000	LM4040C30IDCKR	PREVIEW
				Reel of 250	LM4040C30IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C30IDBZR	PREVIEW
				Reel of 250	LM4040C30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C30ILP	PREVIEW
				Ammo pack of 2000	LM4040C30ILPM	PREVIEW
				Reel of 2000	LM4040C30ILPR	PREVIEW
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040C41IDCKR	PREVIEW
				Reel of 250	LM4040C41IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C41IDBZR	PREVIEW
				Reel of 250	LM4040C41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C41ILP	PREVIEW
				Ammo pack of 2000	LM4040C41ILPM	PREVIEW
				Reel of 2000	LM4040C41ILPR	PREVIEW
		5 V	SC-70 (DCK)	Reel of 3000	LM4040C50IDCKR	PREVIEW
				Reel of 250	LM4040C50IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C50IDBZR	PREVIEW
				Reel of 250	LM4040C50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C50ILP	PREVIEW
				Ammo pack of 2000	LM4040C50ILPM	PREVIEW
				Reel of 2000	LM4040C50ILPR	PREVIEW

† 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.

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	8.192 V	SC-70 (DCK)	Reel of 3000	LM4040C82IDCKR	PREVIEW
				Reel of 250	LM4040C82IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C82IDBZR	PREVIEW
				Reel of 250	LM4040C82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C82ILP	PREVIEW
				Ammo pack of 2000	LM4040C82ILPM	PREVIEW
				Reel of 2000	LM4040C82ILPR	PREVIEW
		10 V	SC-70 (DCK)	Reel of 3000	LM4040C10IDCKR	PREVIEW
				Reel of 250	LM4040C10IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040C10IDBZR	PREVIEW
				Reel of 250	LM4040C10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040C10ILP	PREVIEW
				Ammo pack of 2000	LM4040C10ILPM	PREVIEW
				Reel of 2000	LM4040C10ILPR	PREVIEW

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

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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
				Reel of 250	LM4040D20IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D20IDBZR	PREVIEW
				Reel of 250	LM4040D20IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D20ILP	PREVIEW
				Ammo pack of 2000	LM4040D20ILPM	PREVIEW
				Reel of 2000	LM4040D20ILPR	PREVIEW
		2.5 V	SC-70 (DCK)	Reel of 3000	LM4040D25IDCKR	PREVIEW
				Reel of 250	LM4040D25IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D25IDBZR	4ME_
				Reel of 250	LM4040D25IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D25ILP	PREVIEW
				Ammo pack of 2000	LM4040D25ILPM	PREVIEW
				Reel of 2000	LM4040D25ILPR	PREVIEW
		3 V	SC-70 (DCK)	Reel of 3000	LM4040D30IDCKR	PREVIEW
				Reel of 250	LM4040D30IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D30IDBZR	PREVIEW
				Reel of 250	LM4040D30IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D30ILP	PREVIEW
				Ammo pack of 2000	LM4040D30ILPM	PREVIEW
				Reel of 2000	LM4040D30ILPR	PREVIEW
		4.096 V	SC-70 (DCK)	Reel of 3000	LM4040D41IDCKR	PREVIEW
				Reel of 250	LM4040D41IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D41IDBZR	PREVIEW
				Reel of 250	LM4040D41IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D41ILP	PREVIEW
				Ammo pack of 2000	LM4040D41ILPM	PREVIEW
				Reel of 2000	LM4040D41ILPR	PREVIEW
		5 V	SC-70 (DCK)	Reel of 3000	LM4040D50IDCKR	PREVIEW
				Reel of 250	LM4040D50IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D50IDBZR	PREVIEW
				Reel of 250	LM4040D50IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D50ILP	PREVIEW
				Ammo pack of 2000	LM4040D50ILPM	PREVIEW
				Reel of 2000	LM4040D50ILPR	PREVIEW

† 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.

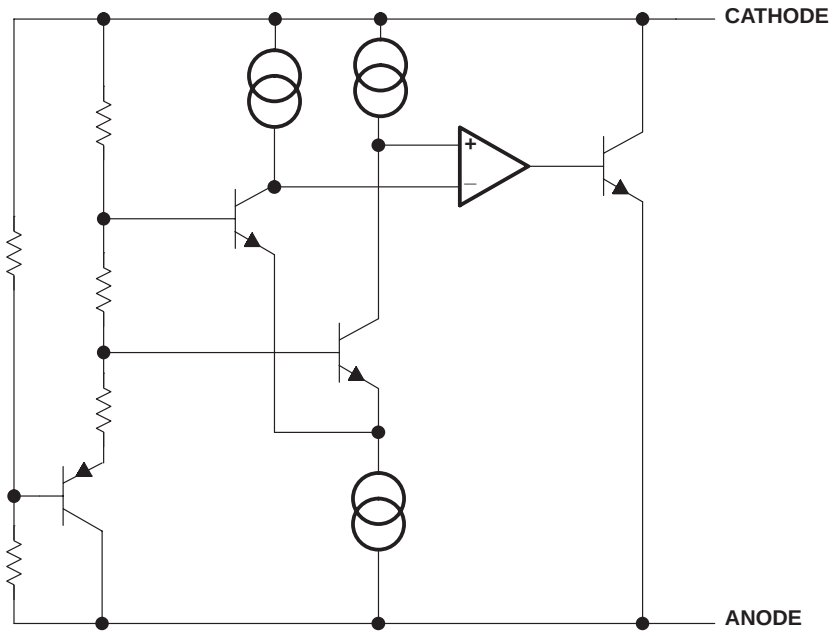
ORDERING INFORMATION (continued)

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	8.192 V	SC-70 (DCK)	Reel of 3000	LM4040D82IDCKR	PREVIEW
				Reel of 250	LM4040D82IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D82IDBZR	PREVIEW
				Reel of 250	LM4040D82IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D82ILP	PREVIEW
				Ammo pack of 2000	LM4040D82ILPM	PREVIEW
				Reel of 2000	LM4040D82ILPR	PREVIEW
		10 V	SC-70 (DCK)	Reel of 3000	LM4040D10IDCKR	PREVIEW
				Reel of 250	LM4040D10IDCKT	
			SOT-23-3 (DBZ)	Reel of 3000	LM4040D10IDBZR	PREVIEW
				Reel of 250	LM4040D10IDBZT	
			TO-92/TO-226 (LP)	Bulk of 1000	LM4040D10ILP	PREVIEW
				Ammo pack of 2000	LM4040D10ILPM	PREVIEW
				Reel of 2000	LM4040D10ILPR	PREVIEW
−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	PREVIEW
				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	PREVIEW
				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	PREVIEW
				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.

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	°C
		LM4040xxxQ	−40	125	

‡ See parametric tables

LM4040x20I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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		
$\Delta V_Z/\Delta I_Z$	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	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x20I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.3	0.8		0.3	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x20Q electrical characteristics at extended temperature range (unless otherwise noted) (full-range T_A = −40°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			±150	
		I_L = 100 µA	25°C		±15			±15		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.3	0.8		0.3	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x25I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		2.5			2.5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−2.5		2.5	−5		5	mV
			Full range	−19		19	−21		21	
$I_{Z,min}$	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			±100	
		I_L = 100 µA	25°C		±15			±15		
$\Delta V_Z/\Delta I_Z$	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	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x25I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 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	−29		29	−49		49	
$I_{Z,min}$	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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.3	0.8		0.3	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x25Q electrical characteristics at extended temperature range (unless otherwise noted) (full-range T_A = −40°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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.3	0.8		0.3	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x30I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−3		3	−6		6	mV
			Full range	−22		22	−26		26	
$I_{Z,min}$	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 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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.6	0.8		0.6	0.8	mV
			Full range			1.1			1.1	
		1 mA < I_Z < 15 mA	25°C		2.7	6		2.7	6	
			Full range			9			9	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.4	0.9		0.4	0.9	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x30I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−15		15	−30		30	mV
			Full range	−34		34	−59		59	
$I_{Z,min}$	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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.4	0.8		0.4	1.1	mV
			Full range			1.1			1.3	
		1 mA < I_Z < 15 mA	25°C		2.7	6		2.7	8	
			Full range			9			11	
z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.4	0.9		0.4	1.2	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x30Q electrical characteristics at extended temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		3			3		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−15		15	−30		30	mV
			Full range	−15		45	−75		75	
$I_{Z,min}$	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 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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.4	0.8		0.4	1.1	mV
			Full range			1.1			1.3	
		1 mA < I_Z < 15 mA	25°C		2.7	6		2.7	8	
			Full range			9			11	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.4	0.9		0.4	1.2	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x41I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		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	mV
			Full range	−31		31	−35		35	
$I_{Z,min}$	Minimum cathode current		25°C		50	68		50	68	µA
			Full range			73			73	
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			±100	
		I_L = 100 µA	25°C		±20			±20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.5	0.9		0.5	0.9	mV
			Full range			1.2			1.2	
		1 mA < I_Z < 15 mA	25°C		3	7		3	7	
			Full range			10			10	
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	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x41I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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		
$\Delta V_Z/\Delta I_Z$	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x50I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−5		5	−10		10	mV
			Full range	−38		38	−43		43	
$I_{Z,min}$	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 mA	25°C		±30			±30		ppm/°C
		I_Z = 1 mA	25°C		±20			±20		
			Full range			±100			±100	
		I_L = 100 µA	25°C		±20			±20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.5	1		0.5	1	mV
			Full range			1.4			1.4	
		1 mA < I_Z < 15 mA	25°C		3.5	8		3.5	8	
			Full range			12			12	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.5	1.1		0.5	1.1	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x50I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−25		25	−50		50	mV
			Full range	−58		58	−99		99	
$I_{Z,min}$	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 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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.5	1		0.5	1.3	mV
			Full range			1.4			1.8	
		1 mA < I_Z < 15 mA	25°C		3.5	8		3.5	10	
			Full range			12			15	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.5	1.1		0.5	1.5	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x50Q electrical characteristics at extended temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		5			5		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 100 µA	25°C	−25		25	−50		50	mV
			Full range	−75		75	−125		125	
$I_{Z,min}$	Minimum cathode current		25°C		54	74		54	79	µA
			Full range			83			88	
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		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.5	1		0.5	1	mV
			Full range			1.4			1.8	
		1 mA < I_Z < 15 mA	25°C		3.5	8		3.5	8	
			Full range			12			15	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.5	1.1		0.5	1.1	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x82I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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		
$\Delta V_Z/\Delta I_Z$	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	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x82I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		8.192			8.192		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 150 µA	25°C	−41		41	−82		82	mV
			Full range	−94		94	−162		162	
$I_{Z,min}$	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 mA	25°C		±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20		
			Full range			±100			±150	
		I_L = 150 µA	25°C		±20			±20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.6	1.3		0.6	1.7	mV
			Full range			2.5			3	
		1 mA < I_Z < 15 mA	25°C		7	10		7	15	
			Full range			18			24	
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	1.9	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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x10I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 150 µA	25°C	−10		10	−20		20	mV
			Full range	−75		75	−85		85	
$I_{Z,min}$	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 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		
$\Delta V_Z/\Delta I_Z$	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	mV
			Full range			3.5			3.5	
		1 mA < I_Z < 15 mA	25°C		8	12		8	12	
			Full range			23			23	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.7	1.7		0.7	1.7	Ω
e_N	Wideband noise	I_Z = 150 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		180			180		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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

LM4040x10I electrical characteristics at industrial temperature range (unless otherwise noted) (full-range T_A = −40°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 µA	25°C		10			10		V
ΔV_Z	Reverse breakdown voltage tolerance	I_Z = 150 µA	25°C	−50		50	−100		100	mV
			Full range	−115		115	−198		198	
$I_{Z,min}$	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 mA	25°C		±40			±40		ppm/°C
		I_Z = 1 mA	25°C		±20			±20		
			Full range			±100			±150	
		I_L = 150 µA	25°C		±20			±20		
$\Delta V_Z/\Delta I_Z$	Reverse breakdown voltage change with cathode current change	$I_{Z,min} < I_Z < 1$ mA	25°C		0.8	1.5		0.8	2	mV
			Full range			3.5			4	
		1 mA < I_Z < 15 mA	25°C		8	12		8	18	
			Full range			23			29	
Z_Z	Reverse dynamic impedance	I_Z = 1 mA, f = 120 Hz, I_{AC} = 0.1 I_Z	25°C		0.7	1.7		0.7	2.3	Ω
e_N	Wideband noise	I_Z = 150 µA, 10 Hz ≤ f ≤ 10 kHz	25°C		180			180		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 $V_{Z,25°C}$ (after cycling to −40°C) − $V_{Z,25°C}$ (after cycling to 125°C).

start-up characteristics

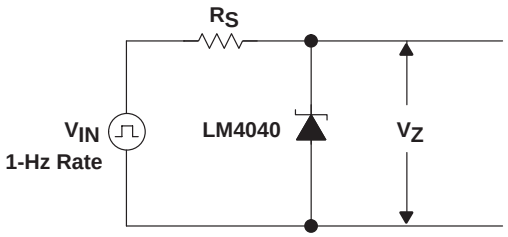


Figure 1. Test Circuit

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 must also be left floating or connected to pin 1.

APPLICATION INFORMATION

use with ADCs or DACs

The LM4040x-41 and LM4040x-82 are designed to be cost-effective voltage reference 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.

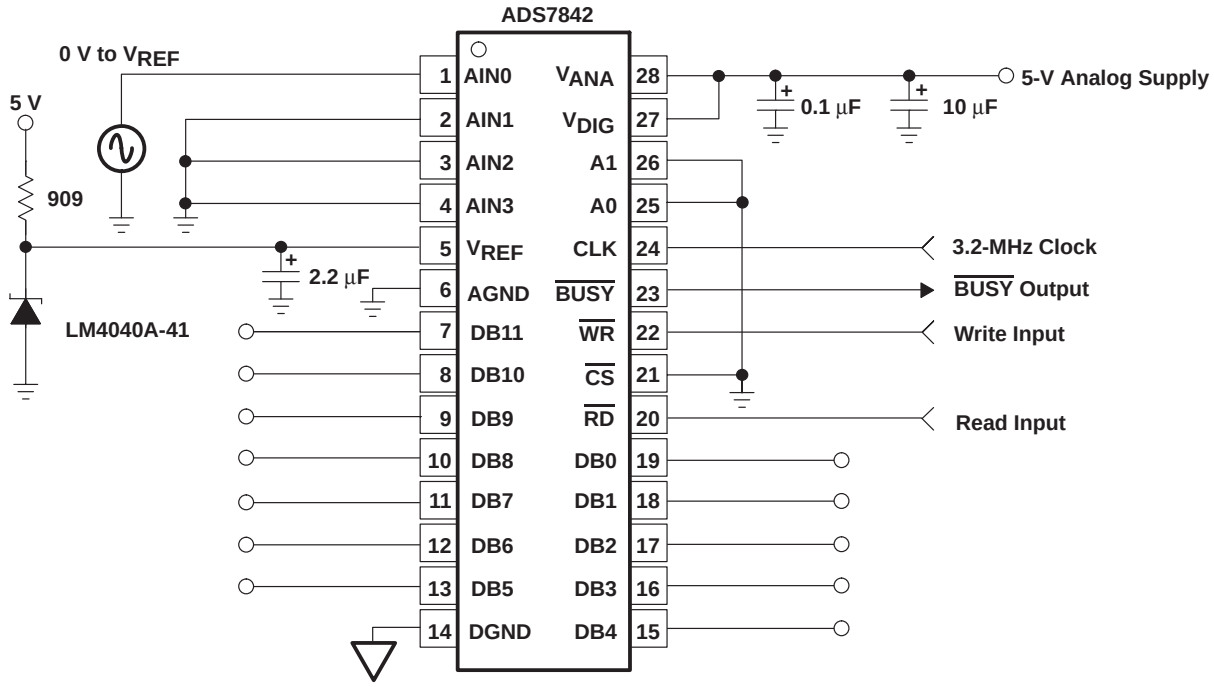


Figure 2. Data Acquisition Circuit With LM4040x-41

APPLICATION INFORMATION

cathode and load currents

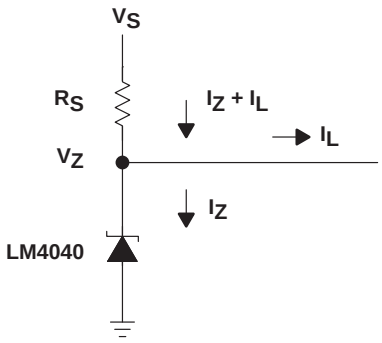


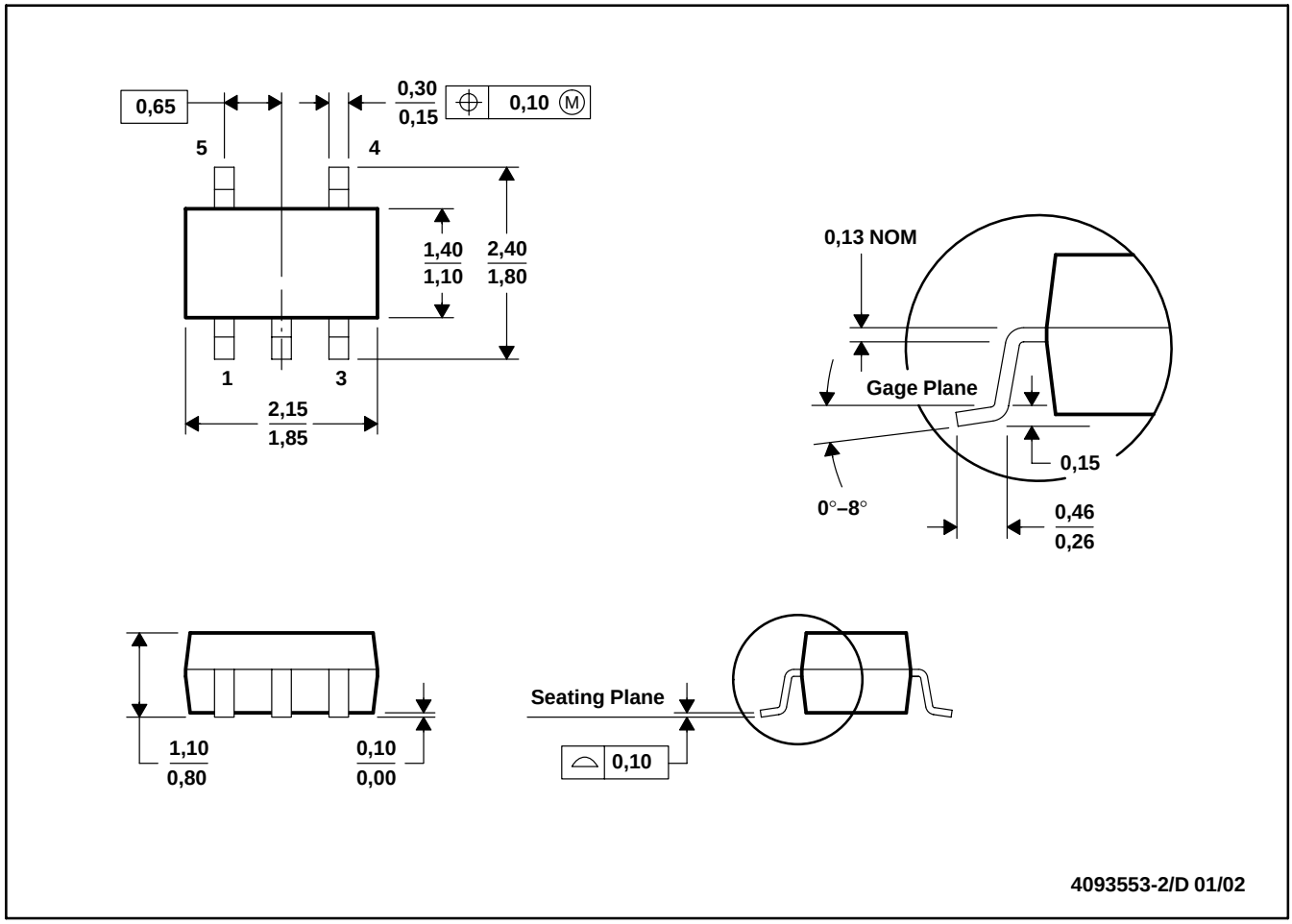
Figure 3. Shunt Regulator

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 needs to 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:

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

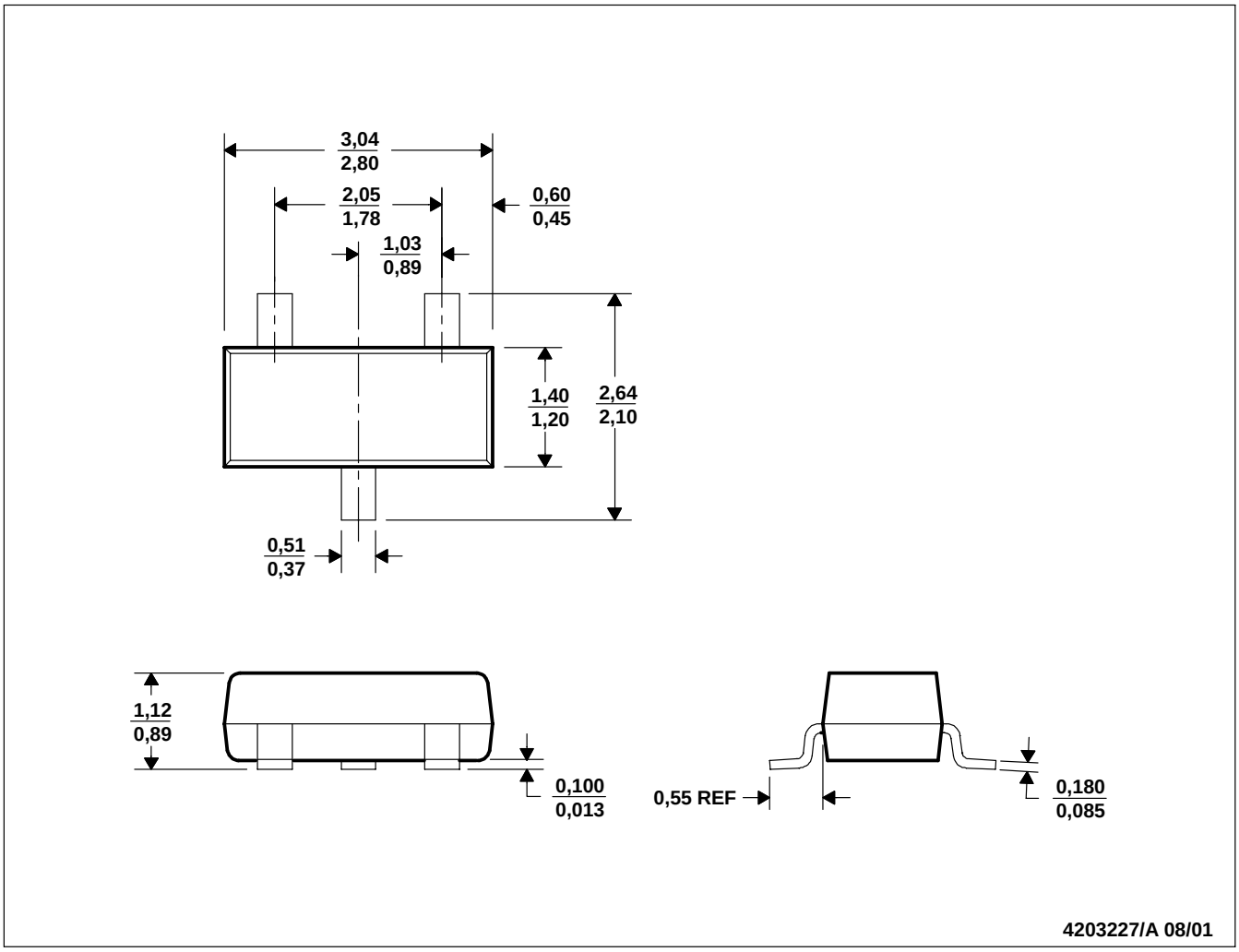
DCK (R-PDSO-G5) **PLASTIC SMALL-OUTLINE PACKAGE**



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

MPDS108 – AUGUST 2001

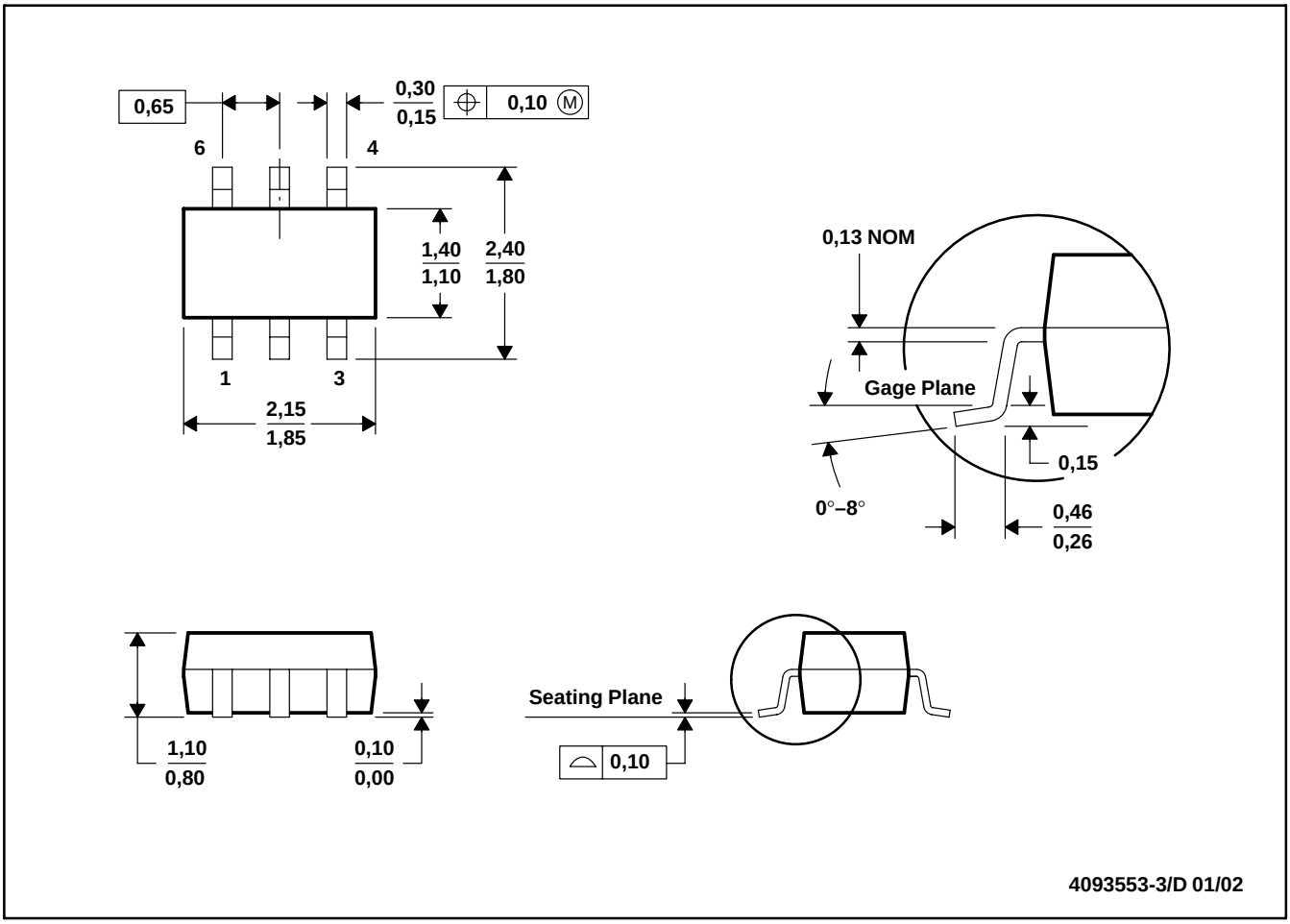
DBZ (R-PDSO-G3) **PLASTIC SMALL-OUTLINE**



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

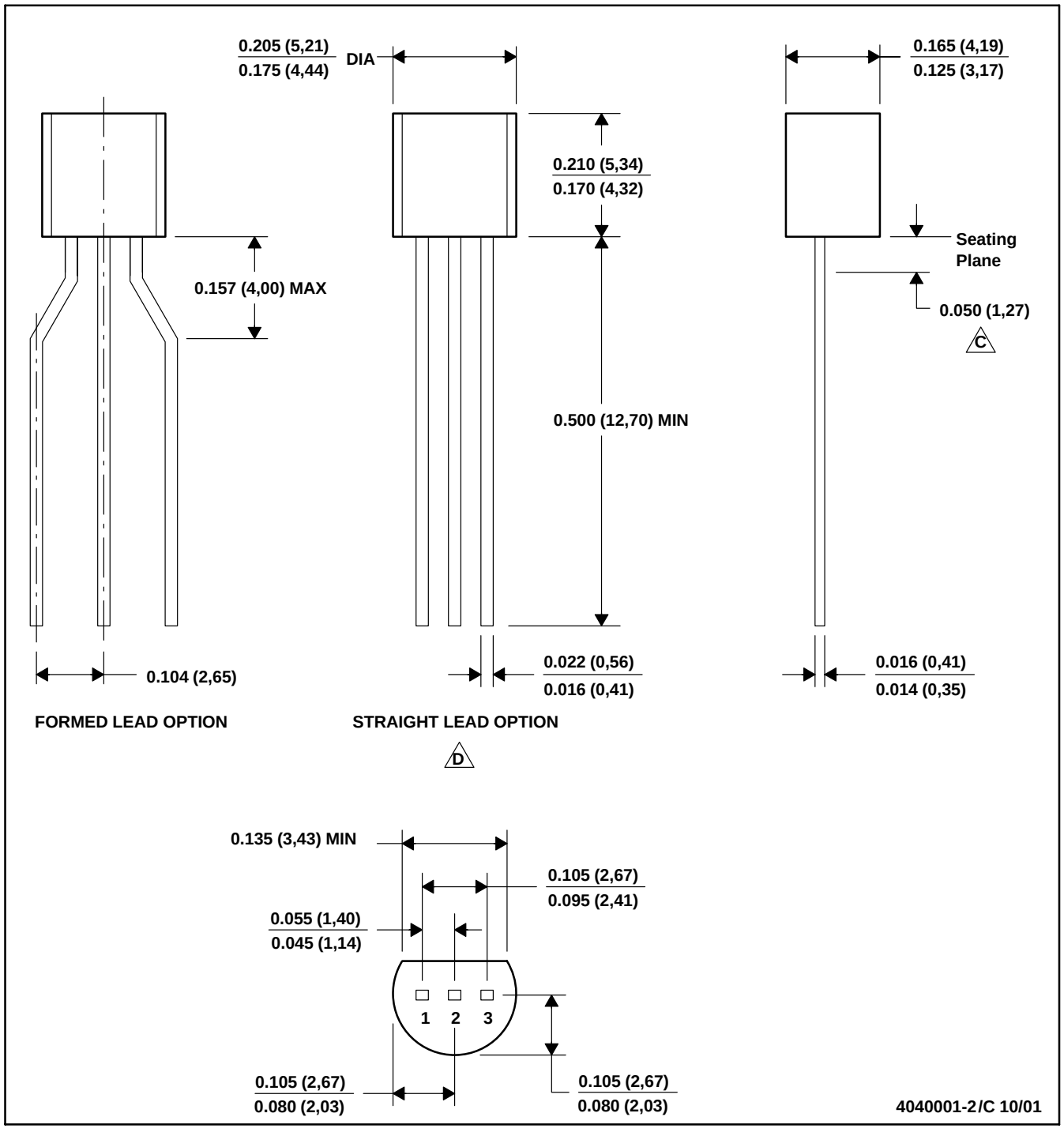
MPDS114 – FEBRUARY 2002

DCK (R-PDSO-G6) **PLASTIC SMALL-OUTLINE PACKAGE**



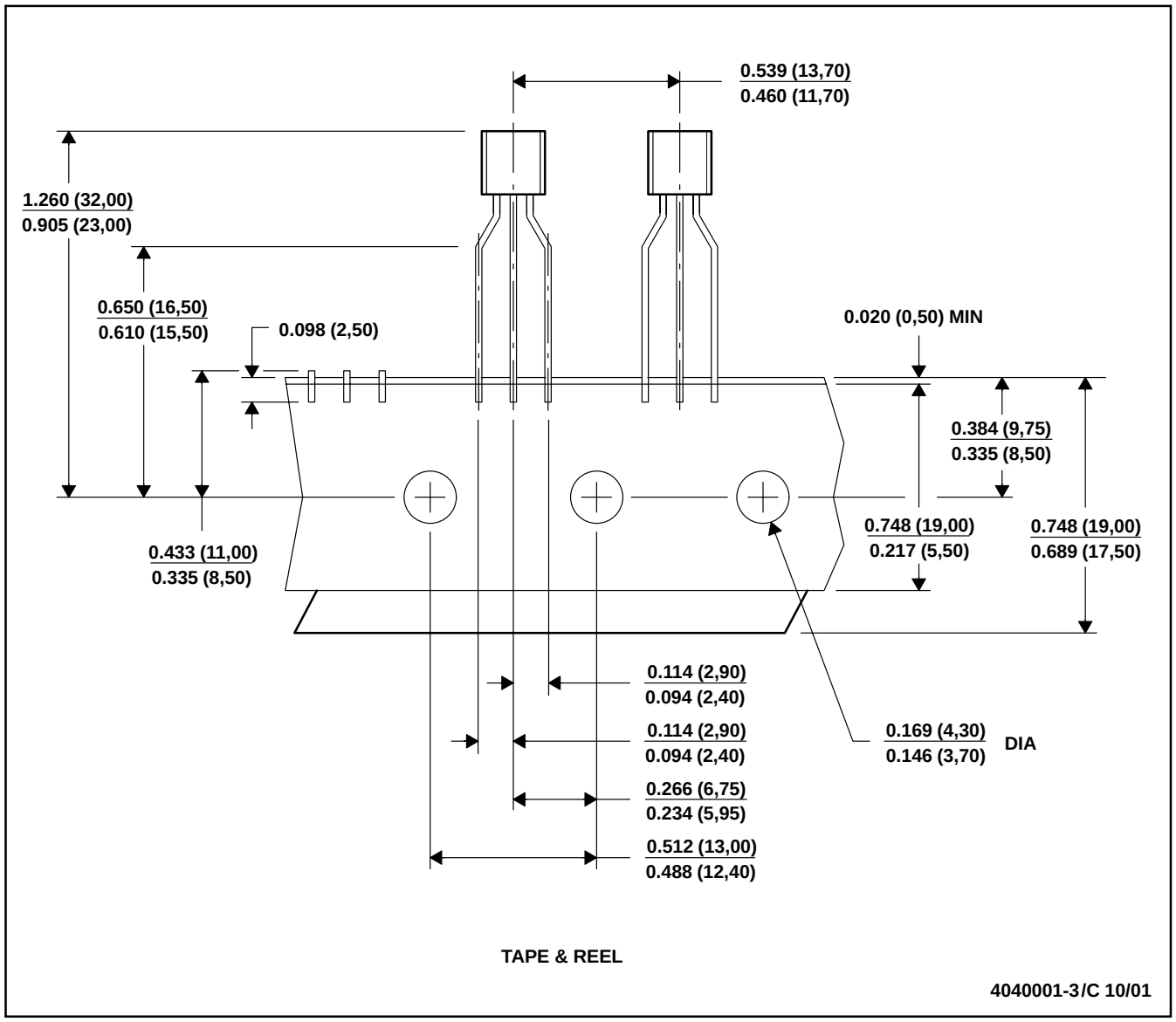
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-203

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.
C. Lead dimensions are not controlled within this area
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.

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.

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