

LM4041-N Precision Micropower Shunt Voltage Reference

Check for Samples: [LM4041-N](#)

FEATURES

- **Small Packages: SOT-23, TO-92, and SC70**
- **No Output Capacitor Required**
- **Tolerates Capacitive Loads**
- **Reverse Breakdown Voltage Options of 1.225V and Adjustable**

APPLICATIONS

- **Portable, Battery-Powered Equipment**
- **Data Acquisition Systems**
- **Instrumentation**
- **Process Control**
- **Energy Management**
- **Automotive**
- **Precision Audio Components**

DESCRIPTION

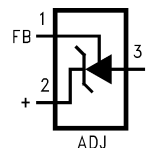
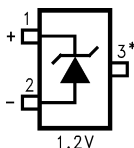
Ideal for space critical applications, the LM4041-N precision voltage reference is available in the sub-miniature SC70 and SOT-23 surface-mount packages. The LM4041-N's advanced design eliminates the need for an external stabilizing capacitor while ensuring stability with any capacitive load, thus making the LM4041-N easy to use. Further reducing design effort is the availability of a fixed (1.225V) and adjustable reverse breakdown voltage. The minimum operating current is 60 μ A for the LM4041-N 1.2 and the LM4041-N ADJ. Both versions have a maximum operating current of 12 mA.

The LM4041-N utilizes fuse and zener-zap reverse breakdown or reference voltage trim during wafer sort to ensure that the prime parts have an accuracy of better than $\pm 0.1\%$ (A grade) at 25°C. Bandgap reference temperature drift curvature correction and low dynamic impedance ensure stable reverse breakdown voltage accuracy over a wide range of operating temperatures and currents.

Key Specifications (LM4041-N 1.2)

Output voltage tolerance (A grade, 25°C)	$\pm 0.1\%$ (max)
Low output noise (10 Hz to 10kHz)	20 μ V _{rms}
Wide operating current range	60 μ A to 12mA
Industrial temperature range	-40°C to +85°C
Extended temperature range	-40°C to +125°C
Low temperature coefficient	100 ppm/°C (max)

Connection Diagrams



*This pin must be left floating or connected to pin 2.

Figure 1. SOT-23 - Top View
See Package Number DBZ0003A
(JEDEC Registration TO-236AB)



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*This pin must be left floating or connected to pin 1.

Figure 2. SC70 - Top View
See Package Number DCK0005A



**Figure 3. TO-92
Bottom View**
See Package Number LP0003A



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings⁽¹⁾⁽²⁾

Reverse Current		20 mA	
Forward Current		10 mA	
Maximum Output Voltage (LM4041-N ADJ)		15V	
Power Dissipation ($T_A = 25^\circ\text{C}$) ⁽³⁾	DBZ Package	306 mW	
	LP Package	550 mW	
	DCK Package	241mW	
Storage Temperature		-65°C to +150°C	
Lead Temperature	DBZ Packages	Vapor phase (60 seconds)	+215°C
		Infrared (15 seconds)	+220°C
	LP Package	Soldering (10 seconds)	+260°C
ESD Susceptibility	Human Body Model ⁽⁴⁾	2 kV	
	Machine Model ⁽⁴⁾	200V	
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices SNOA472 .			

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
- (3) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $PD_{max} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. For the LM4041-N, $T_{Jmax} = 125^\circ\text{C}$, and the typical thermal resistance (θ_{JA}), when board mounted, is $326^\circ\text{C}/\text{W}$ for the SOT-23 package, $415^\circ\text{C}/\text{W}$ for the SC70 package and $180^\circ\text{C}/\text{W}$ with 0.4" lead length and $170^\circ\text{C}/\text{W}$ with 0.125" lead length for the TO-92 package.
- (4) The human body model is a 100 pF capacitor discharged through a 1.5 k Ω resistor into each pin. The machine model is a 200 pF capacitor discharged directly into each pin. All pins are rated at 2kV for Human Body Model, but the feedback pin which is rated at 1kV.

Operating Ratings⁽¹⁾⁽²⁾

Temperature Range		$(T_{min} \leq T_A \leq T_{max})$
Industrial Temperature Range		$-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$
Extended Temperature Range		$-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$
Reverse Current	LM4041-N 1.2	60 μA to 12 mA
	LM4041-N ADJ	60 μA to 12 mA
Output Voltage Range	LM4041-N ADJ	1.24V to 10V

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $PD_{max} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. For the LM4041-N, $T_{Jmax} = 125^{\circ}\text{C}$, and the typical thermal resistance (θ_{JA}), when board mounted, is $326^{\circ}\text{C}/\text{W}$ for the SOT-23 package, $415^{\circ}\text{C}/\text{W}$ for the SC70 package and $180^{\circ}\text{C}/\text{W}$ with 0.4" lead length and $170^{\circ}\text{C}/\text{W}$ with 0.125" lead length for the TO-92 package.

LM4041-N 1.2 Electrical Characteristics (Industrial Temperature Range)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_A = T_J = 25^{\circ}\text{C}$. The grades A and B designate initial Reverse Breakdown Voltage tolerances of $\pm 0.1\%$ and $\pm 0.2\%$, respectively.

Symbol	Parameter	Conditions	Typical ⁽¹⁾	LM4041AIM3 LM4041AIZ Limits ⁽²⁾	LM4041BIM3 LM4041BIZ LM4041BIM7 Limits ⁽²⁾	Units (Limit)
V_R	Reverse Breakdown Voltage	$I_R = 100 \mu\text{A}$	1.225			V
	Reverse Breakdown Voltage Tolerance ⁽³⁾	$I_R = 100 \mu\text{A}$		± 1.2 ± 9.2	± 2.4 ± 10.4	mV (max) mV (max)
I_{RMIN}	Minimum Operating Current		45			μA
				60	60	μA (max)
				65	65	μA (max)
$\Delta V_R/\Delta T$	Average Reverse Breakdown Voltage Temperature Coefficient ⁽³⁾	$I_R = 10 \text{ mA}$	± 20			ppm/ $^{\circ}\text{C}$
		$I_R = 1 \text{ mA}$	± 15	± 100	± 100	ppm/ $^{\circ}\text{C}$ (max)
		$I_R = 100 \mu\text{A}$	± 15			ppm/ $^{\circ}\text{C}$

- (1) Typicals are at $T_J = 25^{\circ}\text{C}$ and represent most likely parametric norm.
- (2) Limits are 100% production tested at 25°C . Limits over temperature are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The boldface (over-temperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$. Where, $\Delta V_R/\Delta T$ is the V_R temperature coefficient, $\max \Delta T$ is the maximum difference in temperature from the reference point of 25°C to T_{MAX} or T_{MIN} , and V_R is the reverse breakdown voltage. The total over-temperature tolerance for the different grades in the industrial temperature range where $\max \Delta T = 65^{\circ}\text{C}$ is shown below:
A-grade: $\pm 0.75\% = \pm 0.1\% \pm 100 \text{ ppm}/^{\circ}\text{C} \times 65^{\circ}\text{C}$
B-grade: $\pm 0.85\% = \pm 0.2\% \pm 100 \text{ ppm}/^{\circ}\text{C} \times 65^{\circ}\text{C}$
C-grade: $\pm 1.15\% = \pm 0.5\% \pm 100 \text{ ppm}/^{\circ}\text{C} \times 65^{\circ}\text{C}$
D-grade: $\pm 1.98\% = \pm 1.0\% \pm 150 \text{ ppm}/^{\circ}\text{C} \times 65^{\circ}\text{C}$
E-grade: $\pm 2.98\% = \pm 2.0\% \pm 150 \text{ ppm}/^{\circ}\text{C} \times 65^{\circ}\text{C}$
The total over-temperature tolerance for the different grades in the extended temperature range where $\max \Delta T = 100^{\circ}\text{C}$ is shown below:
B-grade: $\pm 1.2\% = \pm 0.2\% \pm 100 \text{ ppm}/^{\circ}\text{C} \times 100^{\circ}\text{C}$
C-grade: $\pm 1.5\% = \pm 0.5\% \pm 100 \text{ ppm}/^{\circ}\text{C} \times 100^{\circ}\text{C}$
D-grade: $\pm 2.5\% = \pm 1.0\% \pm 150 \text{ ppm}/^{\circ}\text{C} \times 100^{\circ}\text{C}$
E-grade: $\pm 4.5\% = \pm 2.0\% \pm 150 \text{ ppm}/^{\circ}\text{C} \times 100^{\circ}\text{C}$
Therefore, as an example, the A-grade LM4041-N 1.2 has an over-temperature Reverse Breakdown Voltage tolerance of $\pm 1.2\text{V} \times 0.75\% = \pm 9.2 \text{ mV}$.

LM4041-N 1.2 Electrical Characteristics (Industrial Temperature Range) (continued)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_A = T_J = 25^\circ\text{C}$. The grades A and B designate initial Reverse Breakdown Voltage tolerances of $\pm 0.1\%$ and $\pm 0.2\%$, respectively.

Symbol	Parameter	Conditions	Typical ⁽¹⁾	LM4041AIM3 LM4041AIZ Limits ⁽²⁾	LM4041BIM3 LM4041BIZ LM4041BIM7 Limits ⁽²⁾	Units (Limit)
$\Delta V_R/\Delta I_R$	Reverse Breakdown Voltage Change with Operating Current Change ⁽⁴⁾	$I_{RMIN} \leq I_R \leq 1 \text{ mA}$	0.7	1.5 2.0	1.5 2.0	mV mV (max) mV (max)
		$1 \text{ mA} \leq I_R \leq 12 \text{ mA}$	4.0	6.0 8.0	6.0 8.0	mV mV (max) mV (max)
Z_R	Reverse Dynamic Impedance	$I_R = 1 \text{ mA}$, $f = 120 \text{ Hz}$, $I_{AC} = 0.1 I_R$	0.5	1.5	1.5	Ω Ω (max)
e_N	Wideband Noise	$I_R = 100 \mu\text{A}$ $10 \text{ Hz} \leq f \leq 10 \text{ kHz}$	20			μV_{rms}
ΔV_R	Reverse Breakdown Voltage Long Term Stability	$t = 1000 \text{ hrs}$ $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ $I_R = 100 \mu\text{A}$	120			ppm
V_{HYST}	Thermal Hysteresis ⁽⁵⁾	$\Delta T = -40^\circ\text{C}$ to $+125^\circ\text{C}$	0.08			%

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at $+25^\circ\text{C}$ after cycling to temperature -40°C and the 25°C measurement after cycling to temperature $+125^\circ\text{C}$.

LM4041-N 1.2 Electrical Characteristics (Industrial Temperature Range)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_A = T_J = 25^\circ\text{C}$. The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of $\pm 0.5\%$, $\pm 1.0\%$ and $\pm 2.0\%$, respectively.

Symbol	Parameter	Conditions	Typical ⁽¹⁾	LM4041CIM3 LM4041CIZ LM4041CIM7 Limits ⁽²⁾	LM4041DIM3 LM4041DIZ LM4041DIM7 Limits ⁽²⁾	LM4041EIM3 LM4041EIZ LM4041EIM7 Limits ⁽²⁾	Units (Limit)
V_R	Reverse Breakdown Voltage	$I_R = 100 \mu\text{A}$	1.225				V
	Reverse Breakdown Voltage Tolerance ⁽³⁾	$I_R = 100 \mu\text{A}$		± 6 ± 14	± 12 ± 24	± 25 ± 36	mV (max) mV (max)

(1) Typicals are at $T_J = 25^\circ\text{C}$ and represent most likely parametric norm.

(2) Limits are 100% production tested at 25°C . Limits over temperature are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The boldface (over-temperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$. Where, $\Delta V_R/\Delta T$ is the V_R temperature coefficient, $\max \Delta T$ is the maximum difference in temperature from the reference point of 25°C to T_{MAX} or T_{MIN} , and V_R is the reverse breakdown voltage. The total over-temperature tolerance for the different grades in the industrial temperature range where $\max \Delta T = 65^\circ\text{C}$ is shown below:

A-grade: $\pm 0.75\% = \pm 0.1\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade: $\pm 0.85\% = \pm 0.2\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade: $\pm 1.15\% = \pm 0.5\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade: $\pm 1.98\% = \pm 1.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade: $\pm 2.98\% = \pm 2.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total over-temperature tolerance for the different grades in the extended temperature range where $\max \Delta T = 100^\circ\text{C}$ is shown below:

B-grade: $\pm 1.2\% = \pm 0.2\% \pm 100 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

C-grade: $\pm 1.5\% = \pm 0.5\% \pm 100 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade: $\pm 2.5\% = \pm 1.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade: $\pm 4.5\% = \pm 2.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade LM4041-N 1.2 has an over-temperature Reverse Breakdown Voltage tolerance of $\pm 1.2\text{V} \times 0.75\% = \pm 9.2 \text{ mV}$.

LM4041-N 1.2 Electrical Characteristics (Industrial Temperature Range) (continued)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_A = T_J = 25^\circ\text{C}$. The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of $\pm 0.5\%$, $\pm 1.0\%$ and $\pm 2.0\%$, respectively.

Symbol	Parameter	Conditions	Typical ⁽¹⁾	LM4041CIM3 LM4041CIZ LM4041CIM7 Limits ⁽²⁾	LM4041DIM3 LM4041DIZ LM4041DIM7 Limits ⁽²⁾	LM4041EIM3 LM4041EIZ LM4041EIM7 Limits ⁽²⁾	Units (Limit)
I_{RMIN}	Minimum Operating Current		45	60 65	65 70	65 70	μA $\mu\text{A (max)}$ $\mu\text{A (max)}$
$\Delta V_R/\Delta T$	V_R Temperature Coefficient ⁽³⁾	$I_R = 10\text{ mA}$ $I_R = 1\text{ mA}$ $I_R = 100\ \mu\text{A}$	± 20 ± 15 ± 15	± 100	± 150	± 150	ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C (max)}$ ppm/ $^\circ\text{C}$
$\Delta V_R/\Delta I_R$	Reverse Breakdown Voltage Change with Operating Current Change ⁽⁴⁾	$I_{RMIN} \leq I_R \leq 1\text{ mA}$	0.7	1.5 2.0	2.0 2.5	2.0 2.5	mV mV (max) mV (max)
		$1\text{ mA} \leq I_R \leq 12\text{ mA}$	2.5	6.0 8.0	8.0 10.0	8.0 10.0	mV mV (max) mV (max)
Z_R	Reverse Dynamic Impedance	$I_R = 1\text{ mA}$, $f = 120\text{ Hz}$ $I_{AC} = 0.1 I_R$	0.5	1.5	2.0	2.0	Ω $\Omega(\text{max})$
e_N	Wideband Noise	$I_R = 100\ \mu\text{A}$ $10\text{ Hz} \leq f \leq 10\text{ kHz}$	20				μV_{rms}
ΔV_R	Reverse Breakdown Voltage Long Term Stability	$t = 1000\text{ hrs}$ $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ $I_R = 100\ \mu\text{A}$	120				ppm
V_{HYST}	Thermal Hysteresis ⁽⁵⁾	$\Delta T = -40^\circ\text{C}$ to $+125^\circ\text{C}$	0.08				%

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at $+25^\circ\text{C}$ after cycling to temperature -40°C and the 25°C measurement after cycling to temperature $+125^\circ\text{C}$.

LM4041-N 1.2 Electrical Characteristics (Extended Temperature Range)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_A = T_J = 25^\circ\text{C}$. The grades C, D and E designate initial Reverse Breakdown Voltage tolerance of $\pm 0.5\%$, $\pm 1.0\%$ and $\pm 2.0\%$ respectively.

Symbol	Parameter	Conditions	Typical ⁽¹⁾	LM4041CEM3 Limits ⁽²⁾	LM4041DEM3 Limits ⁽²⁾	LM4041EEM3 Limits ⁽²⁾	Units (Limit)	
V_R	Reverse Breakdown Voltage	$I_R = 100 \mu\text{A}$	1.225				V	
	Reverse Breakdown Voltage Error ⁽³⁾	$I_R = 100 \mu\text{A}$		± 6 ± 18.4	± 12 ± 31	± 25 ± 43	mV (max) mV (max)	
I_{RMIN}	Minimum Operating Current		45	60 68	65 73	65 73	μA μA (max) μA (max)	
$\Delta V_R/\Delta T$	VR Temperature Coefficient ⁽³⁾	$I_R = 10 \text{ mA}$	± 20				ppm/ $^\circ\text{C}$	
		$I_R = 1 \text{ mA}$	± 15	± 100	± 150	± 150	ppm/ $^\circ\text{C}$ (max)	
		$I_R = 100 \mu\text{A}$	± 15				ppm/ $^\circ\text{C}$	
$\Delta V_R/\Delta I_R$	Reverse Breakdown Change with Current ⁽⁴⁾	$I_{RMIN} \leq I_R \leq 1.0 \text{ mA}$	0.7	1.5 2.0	2.0 2.5	2.0 2.5	mV mV (max) mV (max)	
			2.5	6.0 8.0	8.0 10.0	8.0 10.0	mV mV (max) mV (max)	
		$1 \text{ mA} \leq I_R \leq 12 \text{ mA}$						
Z_R	Reverse Dynamic Impedance	$I_R = 1 \text{ mA}$, $f = 120 \text{ Hz}$, $I_{AC} = 0.1 I_R$	0.5	1.5	2.0	2.0	Ω Ω (max)	
e_N	Noise Voltage	$I_R = 100 \mu\text{A}$ $10 \text{ Hz} \leq f \leq 10 \text{ kHz}$	20				μV_{rms}	
ΔV_R	Long Term Stability (Non-Cumulative)	$t = 1000 \text{ hrs}$ $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ $I_R = 100 \mu\text{A}$	120				ppm	
V_{HYST}	Thermal Hysteresis ⁽⁵⁾	$\Delta T = -40^\circ\text{C}$ to $+125^\circ\text{C}$	0.08				%	

(1) Typicals are at $T_J = 25^\circ\text{C}$ and represent most likely parametric norm.

(2) Limits are 100% production tested at 25°C . Limits over temperature are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The boldface (over-temperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$. Where, $\Delta V_R/\Delta T$ is the V_R temperature coefficient, $\max \Delta T$ is the maximum difference in temperature from the reference point of 25°C to T_{MAX} or T_{MIN} , and V_R is the reverse breakdown voltage. The total over-temperature tolerance for the different grades in the industrial temperature range where $\max \Delta T = 65^\circ\text{C}$ is shown below:

A-grade: $\pm 0.75\% = \pm 0.1\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade: $\pm 0.85\% = \pm 0.2\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade: $\pm 1.15\% = \pm 0.5\% \pm 100 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade: $\pm 1.98\% = \pm 1.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade: $\pm 2.98\% = \pm 2.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total over-temperature tolerance for the different grades in the extended temperature range where $\max \Delta T = 100^\circ\text{C}$ is shown below:

B-grade: $\pm 1.2\% = \pm 0.2\% \pm 100 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

C-grade: $\pm 1.5\% = \pm 0.5\% \pm 100 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade: $\pm 2.5\% = \pm 1.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade: $\pm 4.5\% = \pm 2.0\% \pm 150 \text{ ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade LM4041-N 1.2 has an over-temperature Reverse Breakdown Voltage tolerance of $\pm 1.2\text{V} \times 0.75\% = \pm 9.2 \text{ mV}$.

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at $+25^\circ\text{C}$ after cycling to temperature -40°C and the 25°C measurement after cycling to temperature $+125^\circ\text{C}$.

LM4041-N ADJ (Adjustable) Electrical Characteristics (Industrial Temperature Range)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_J = 25^\circ\text{C}$ unless otherwise specified (SOT-23, see⁽¹⁾), $I_{RMIN} \leq I_R \leq 12\text{ mA}$, $V_{REF} \leq V_{OUT} \leq 10\text{V}$. The grades C and D designate initial Reference Voltage Tolerances of $\pm 0.5\%$ and $\pm 1\%$, respectively for $V_{OUT} = 5\text{V}$.

Symbol	Parameter	Conditions	Typical ⁽²⁾	LM4041CIM3 LM4041CIZ LM4041CIM7 ⁽³⁾	LM4041DIM3 LM4041DIZ LM4041DIM7 ⁽³⁾	Units (Limit)	
V_{REF}	Reference Voltage	$I_R = 100\ \mu\text{A}$, $V_{OUT} = 5\text{V}$	1.233			V	
	Reference Voltage Tolerance ⁽⁴⁾	$I_R = 100\ \mu\text{A}$, $V_{OUT} = 5\text{V}$		± 6.2 ± 14	± 12 ± 24	mV (max) mV (max)	
I_{RMIN}	Minimum Operating Current		45	60 65	65 70	μA μA (max) μA (max)	
		Reference Voltage Change with Operating Current Change ⁽⁵⁾	$I_{RMIN} \leq I_R \leq 1\text{ mA}$ SOT-23: $V_{OUT} \geq 1.6\text{V}$ ⁽⁶⁾	0.7	1.5 2.0	2.0 2.5	mV mV (max) mV (max)
			$1\text{ mA} \leq I_R \leq 12\text{ mA}$ SOT-23: $V_{OUT} \geq 1.6\text{V}$ ⁽⁶⁾	2	4 6	6 8	mV mV (max) mV (max)
$\Delta V_{REF}/\Delta V_O$	Reference Voltage Change with Output Voltage Change	$I_R = 1\text{ mA}$	-1.55	-2.0 -2.5	-2.5 -3.0	mV/V mV/V (max) mV/V (max)	
I_{FB}	Feedback Current		60	100 120	150 200	nA nA (max) nA (max)	
$\Delta V_{REF}/\Delta T$	Average Reference Voltage Temperature Coefficient ⁽⁴⁾	$V_{OUT} = 5\text{V}$, $I_R = 10\text{ mA}$	20			ppm/ $^\circ\text{C}$	
		$I_R = 1\text{ mA}$	15	± 100	± 150	ppm/ $^\circ\text{C}$ (max)	
		$I_R = 100\ \mu\text{A}$	15			ppm/ $^\circ\text{C}$	
Z_{OUT}	Dynamic Output Impedance	$I_R = 1\text{ mA}$, $f = 120\text{ Hz}$, $I_{AC} = 0.1 I_R$					
		$V_{OUT} = V_{REF}$	0.3			Ω	
		$V_{OUT} = 10\text{V}$	2			Ω	
e_N	Wideband Noise	$I_R = 100\ \mu\text{A}$, $V_{OUT} = V_{REF}$ $10\text{ Hz} \leq f \leq 10\text{ kHz}$	20			μV_{rms}	
ΔV_{REF}	Reference Voltage Long Term Stability	$t = 1000\text{ hrs}$, $I_R = 100\ \mu\text{A}$, $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$	120			ppm	
V_{HYST}	Thermal Hysteresis ⁽⁷⁾	$\Delta T = -40^\circ\text{C}$ to $+125^\circ\text{C}$	0.08			%	

- When $V_{OUT} \leq 1.6\text{V}$, the LM4041-N ADJ in the SOT-23 package must operate at reduced I_R . This is caused by the series resistance of the die attach between the die (-) output and the package (-) output pin. See the [Output Saturation \(SOT-23 only\)](#) curve in the [Typical Performance Characteristics](#) section.
- Typicals are at $T_J = 25^\circ\text{C}$ and represent most likely parametric norm.
- Limits are 100% production tested at 25°C . Limits over temperature are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- Reference voltage and temperature coefficient will change with output voltage. See [Typical Performance Characteristics](#) curves.
- Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- When $V_{OUT} \leq 1.6\text{V}$, the LM4041-N ADJ in the SOT-23 package must operate at reduced I_R . This is caused by the series resistance of the die attach between the die (-) output and the package (-) output pin. See the [Output Saturation \(SOT-23 only\)](#) curve in the [Typical Performance Characteristics](#) section.
- Thermal hysteresis is defined as the difference in voltage measured at $+25^\circ\text{C}$ after cycling to temperature -40°C and the 25°C measurement after cycling to temperature $+125^\circ\text{C}$.

LM4041-N ADJ (Adjustable) Electrical Characteristics (Extended Temperature Range)

Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX} ; all other limits $T_J = 25^\circ\text{C}$ unless otherwise specified (SOT-23, see ⁽¹⁾), $I_{RMIN} \leq I_R \leq 12\text{ mA}$, $V_{REF} \leq V_{OUT} \leq 10\text{ V}$. The grades C and D designate initial Reference Voltage Tolerances of $\pm 0.5\%$ and $\pm 1\%$, respectively for $V_{OUT} = 5\text{ V}$.

Symbol	Parameter	Conditions	Typical ⁽²⁾	LM4041CEM3 ⁽³⁾	LM4041DEM3 ⁽³⁾	Units (Limit)	
V_{REF}	Reference Voltage	$I_R = 100\ \mu\text{A}$, $V_{OUT} = 5\text{ V}$	1.233			V	
	Reference Voltage Tolerance ⁽⁴⁾	$I_R = 100\ \mu\text{A}$, $V_{OUT} = 5\text{ V}$		± 6.2 ± 18	± 12 ± 30	mV (max) mV (max)	
I_{RMIN}	Minimum Operating Current		45	60 68	65 73	μA μA (max) μA (max)	
		Reference Voltage Change with Operating Current Change ⁽⁵⁾	$I_{RMIN} \leq I_R \leq 1\text{ mA}$ SOT-23: $V_{OUT} \geq 1.6\text{ V}$ ⁽¹⁾	0.7	1.5 2.0	2.0 2.5	mV mV (max) mV (max)
			$1\text{ mA} \leq I_R \leq 12\text{ mA}$ SOT-23: $V_{OUT} \geq 1.6\text{ V}$ ⁽¹⁾	2	8 6	10 8	mV mV (max) mV (max)
$\Delta V_{REF}/\Delta V_O$	Reference Voltage Change with Output Voltage Change	$I_R = 1\text{ mA}$	-1.55	-2.0 -3.0	-2.5 -4.0	mV/V mV/V (max) mV/V (max)	
I_{FB}	Feedback Current		60	100 120	150 200	nA nA (max) nA (max)	
		Average Reference Voltage Temperature Coefficient ⁽⁴⁾	$V_{OUT} = 5\text{ V}$, $I_R = 10\text{ mA}$	20	± 100	± 150	ppm/ $^\circ\text{C}$
			$I_R = 1\text{ mA}$	15			ppm/ $^\circ\text{C}$ (max)
$I_R = 100\ \mu\text{A}$	15	ppm/ $^\circ\text{C}$					
Z_{OUT}	Dynamic Output Impedance	$I_R = 1\text{ mA}$, $f = 120\text{ Hz}$, $I_{AC} = 0.1 I_R$					
			$V_{OUT} = V_{REF}$	0.3		Ω	
e_N	Wideband Noise	$I_R = 100\ \mu\text{A}$, $V_{OUT} = V_{REF}$ $10\text{ Hz} \leq f \leq 10\text{ kHz}$					
			$V_{OUT} = 10\text{ V}$	2		Ω	
ΔV_{REF}	Reference Voltage Long Term Stability	$t = 1000\text{ hrs}$, $I_R = 100\ \mu\text{A}$, $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$	120			ppm	
V_{HYST}	Thermal Hysteresis ⁽⁶⁾	$\Delta T = -40^\circ\text{C}$ to $+125^\circ\text{C}$	0.08			%	

- (1) When $V_{OUT} \leq 1.6\text{ V}$, the LM4041-N ADJ in the SOT-23 package must operate at reduced I_R . This is caused by the series resistance of the die attach between the die (-) output and the package (-) output pin. See the [Output Saturation \(SOT-23 only\)](#) curve in the [Typical Performance Characteristics](#) section.
- (2) Typical values are at $T_J = 25^\circ\text{C}$ and represent most likely parametric norm.
- (3) Limits are 100% production tested at 25°C . Limits over temperature are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (4) Reference voltage and temperature coefficient will change with output voltage. See [Typical Performance Characteristics](#) curves.
- (5) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (6) Thermal hysteresis is defined as the difference in voltage measured at $+25^\circ\text{C}$ after cycling to temperature -40°C and the 25°C measurement after cycling to temperature $+125^\circ\text{C}$.

Typical Performance Characteristics

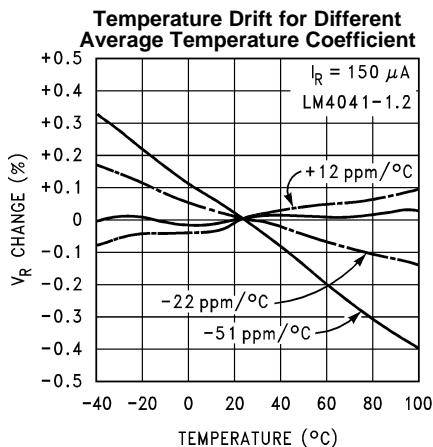


Figure 4.

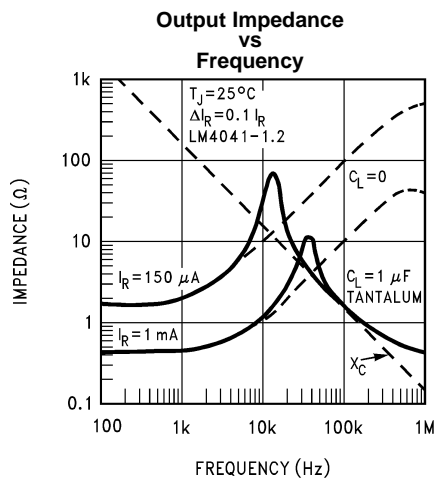


Figure 5.

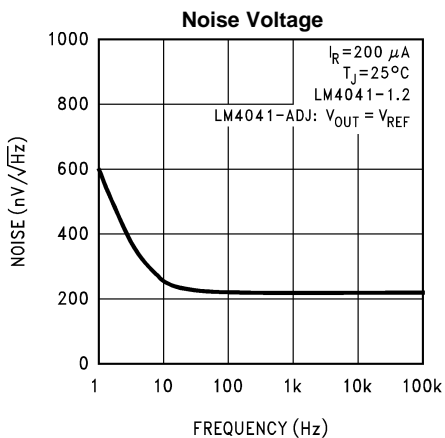


Figure 6.

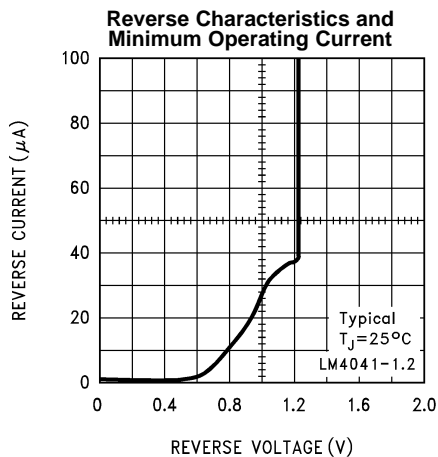


Figure 7.

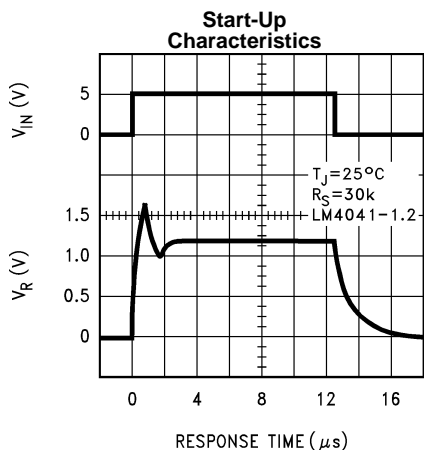


Figure 8.

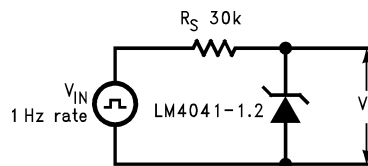
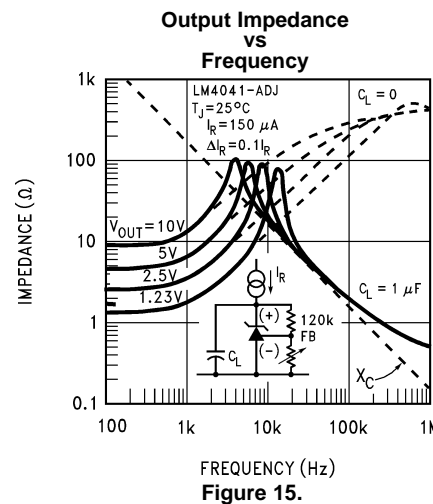
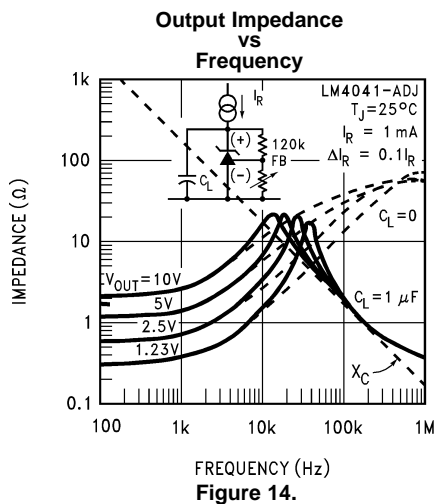
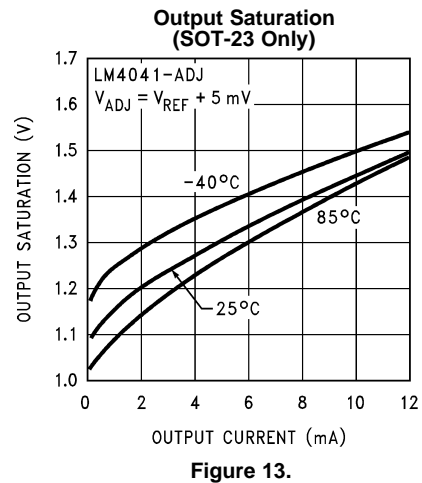
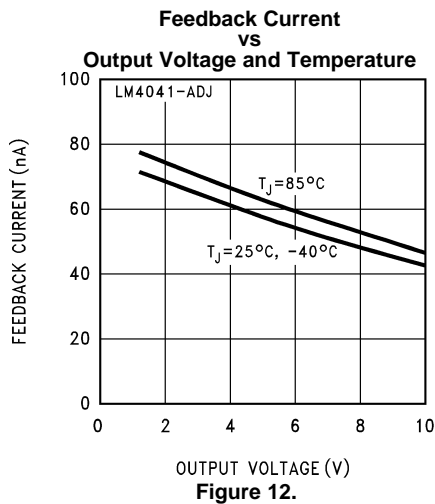
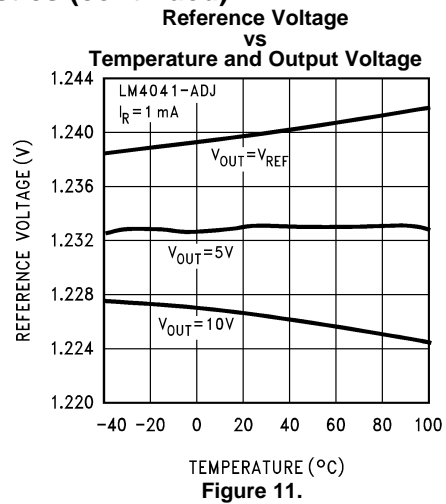
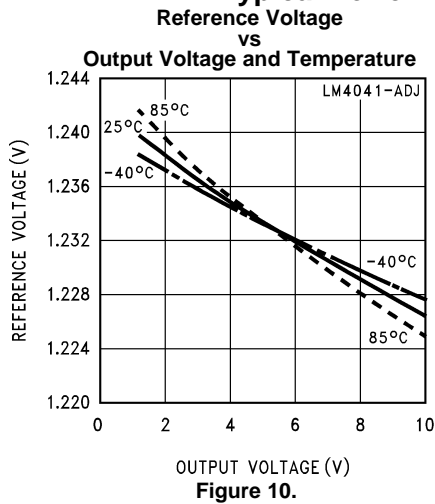


Figure 9.

Typical Performance Characteristics (continued)



Typical Performance Characteristics (continued)

Reverse Characteristics
FB STEPS (V)

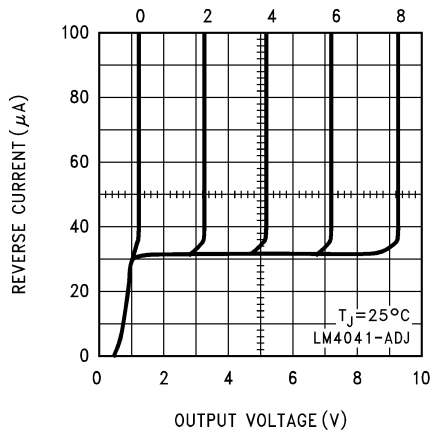


Figure 16.

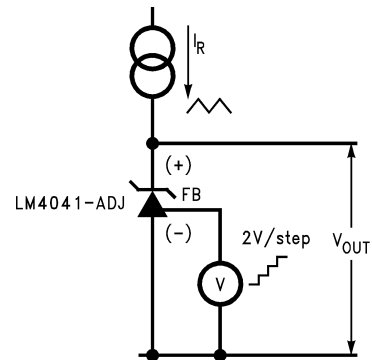


Figure 17.

Large Signal Response

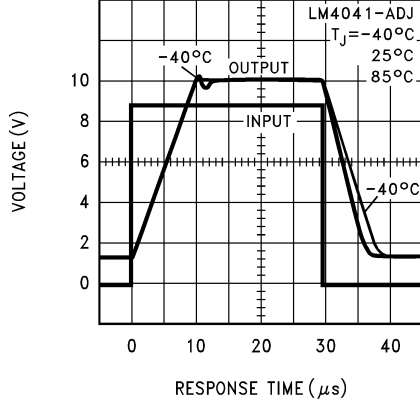


Figure 18.

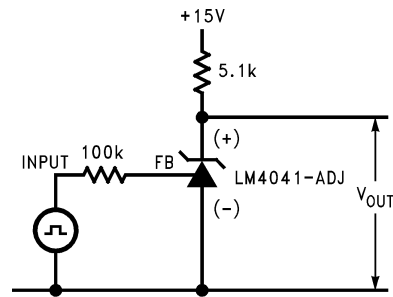
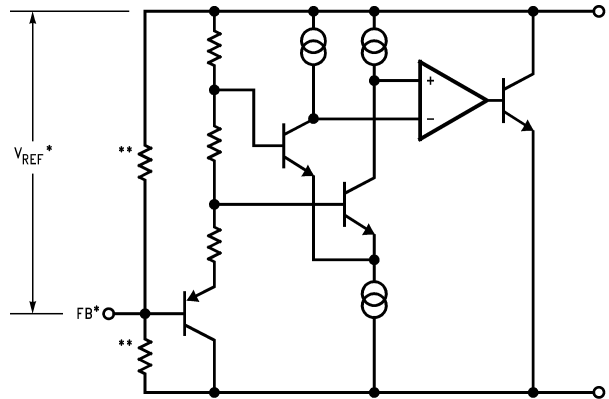


Figure 19.

Functional Block Diagram



*LM4041-N ADJ only

**LM4041-N 1.2 only

APPLICATIONS INFORMATION

The LM4041-N is a precision micro-power curvature-corrected bandgap shunt voltage reference. For space critical applications, the LM4041-N is available in the sub-miniature SOT-23 and SC70 surface-mount package. The LM4041-N has been designed for stable operation without the need of an external capacitor connected between the “+” pin and the “-” pin. If, however, a bypass capacitor is used, the LM4041-N remains stable. Design effort is further reduced with the choice of either a fixed 1.2V or an adjustable reverse breakdown voltage. The minimum operating current is 60 μ A for the LM4041-N 1.2 and the LM4041-N ADJ. Both versions have a maximum operating current of 12 mA.

LM4041-Ns using the SOT-23 package have pin 3 connected as the (-) output through the package's die attach interface. Therefore, the LM4041-N 1.2's pin 3 must be left floating or connected to pin 2 and the LM4041-N ADJ's pin 3 is the (-) output.

LM4041-Ns using the SC70 package have pin 2 connected as the (-) output through the packages' die attach interface. Therefore, the LM4041-N 1.2's pin 2 must be left floating or connected to pin 1, and the LM4041-N ADJ's pin 2 is the (-) output.

The typical thermal hysteresis specification is defined as the change in +25°C voltage measured after thermal cycling. The device is thermal cycled to temperature -40°C and then measured at 25°C. Next the device is thermal cycled to temperature +125°C and again measured at 25°C. The resulting V_{OUT} delta shift between the 25°C measurements is thermal hysteresis. Thermal hysteresis is common in precision references and is induced by thermal-mechanical package stress. Changes in environmental storage temperature, operating temperature and board mounting temperature are all factors that can contribute to thermal hysteresis.

In a conventional shunt regulator application ([Figure 20](#)), an external series resistor (R_S) is connected between the supply voltage and the LM4041-N. R_S determines the current that flows through the load (I_L) and the LM4041-N (I_Q). Since load current and supply voltage may vary, R_S should be small enough to supply at least the minimum acceptable I_Q to the LM4041-N even when the supply voltage is at its minimum and the load current is at its maximum value. When the supply voltage is at its maximum and I_L is at its minimum, R_S should be large enough so that the current flowing through the LM4041-N is less than 12 mA.

R_S should be selected based on the supply voltage, (V_S), the desired load and operating current, (I_L and I_Q), and the LM4041-N's reverse breakdown voltage, V_R .

$$R_S = \frac{V_S - V_R}{I_L + I_Q}$$

The LM4041-N ADJ's output voltage can be adjusted to any value in the range of 1.24V through 10V. It is a function of the internal reference voltage (V_{REF}) and the ratio of the external feedback resistors as shown in [Figure 21](#). The output voltage is found using the equation

$$V_O = V_{REF}[(R_2/R_1) + 1]$$

where

- V_O is the output voltage. The actual value of the internal V_{REF} is a function of V_O . The “corrected” V_{REF} is determined by

$$V_{REF} = \Delta V_O (\Delta V_{REF}/\Delta V_O) + V_Y$$

where

- $V_Y = 1.240$ V

and

- $\Delta V_O = (V_O - V_Y)$

$\Delta V_{REF}/\Delta V_O$ is found in the Electrical Characteristics and is typically -1.55 mV/V. You can get a more accurate indication of the output voltage by replacing the value of V_{REF} in [Equation 1](#) with the value found using [Equation 2](#).

Note that the actual output voltage can deviate from that predicted using the typical value of $\Delta V_{REF}/\Delta V_O$ in [Equation 2](#): for C-grade parts, the worst-case $\Delta V_{REF}/\Delta V_O$ is -2.5 mV/V. For D-grade parts, the worst-case $\Delta V_{REF}/\Delta V_O$ is -3.0 mV/V.

Typical Applications

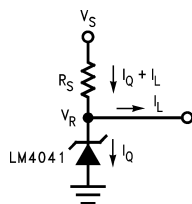
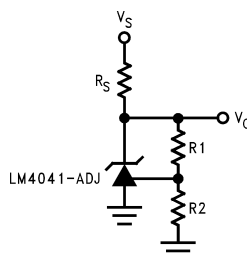


Figure 20. Shunt Regulator



$$V_O = V_{REF}[(R2/R1) + 1]$$

Figure 21. Adjustable Shunt Regulator

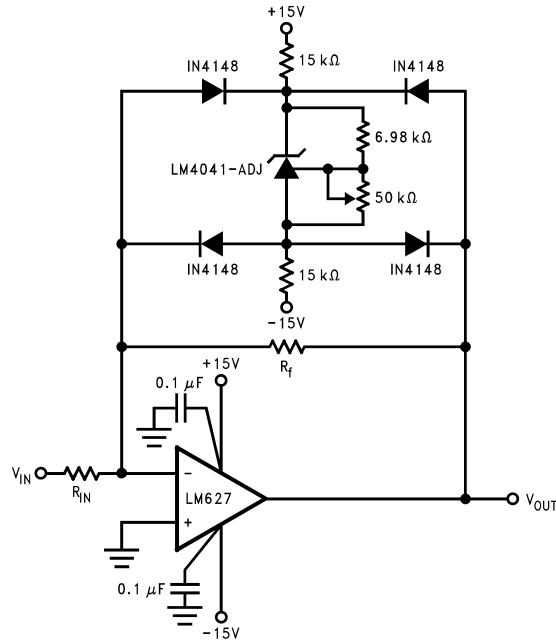


Figure 22. Bounded amplifier reduces saturation-induced delays and can prevent succeeding stage damage. Nominal clamping voltage is $\pm V_O$ (LM4041-N's reverse breakdown voltage) $+2$ diode V_F .

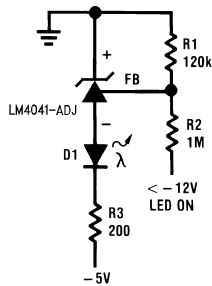


Figure 23. Voltage Level Detector

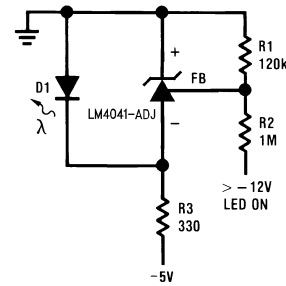


Figure 24. Voltage Level Detector

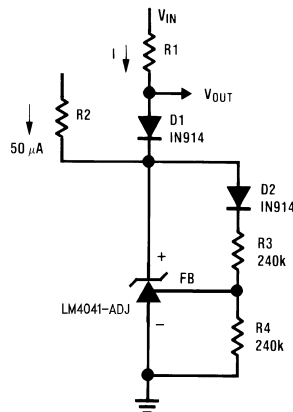


Figure 25. Fast Positive Clamp
 $2.4V + V_{D1}$

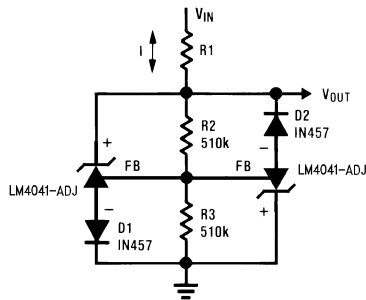


Figure 26. Bidirectional Clamp $\pm 2.4V$

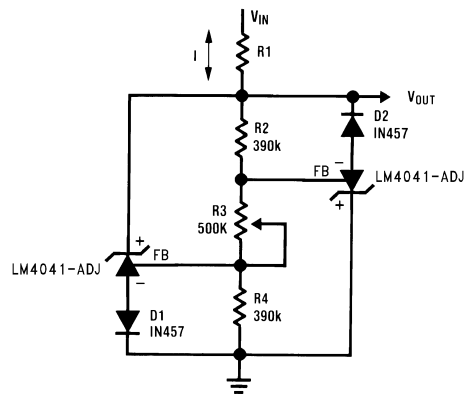


Figure 27. Bidirectional Adjustable Clamp $\pm 18V$ to $\pm 2.4V$

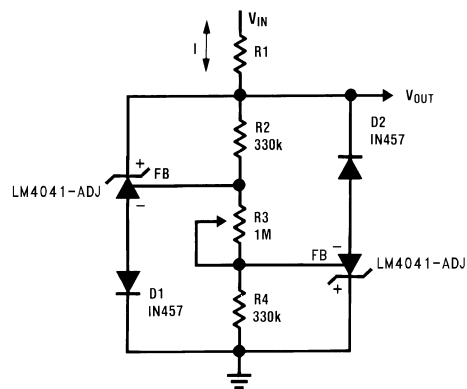


Figure 28. Bidirectional Adjustable Clamp $\pm 2.4V$ to $\pm 6V$

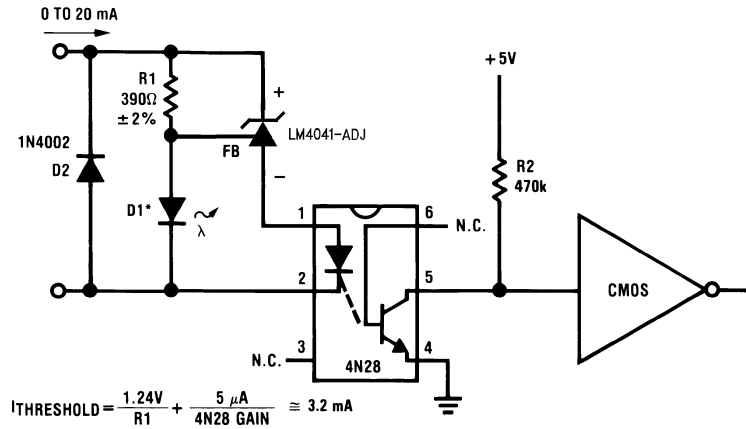
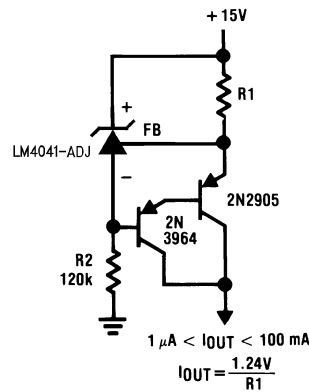


Figure 29. Simple Floating Current Detector



*D1 can be any LED, $V_F = 1.5V$ to $2.2V$ at 3 mA . D1 may act as an indicator. D1 will be on if $I_{THRESHOLD}$ falls below the threshold current, except with $I = 0$.

Figure 30. Current Source

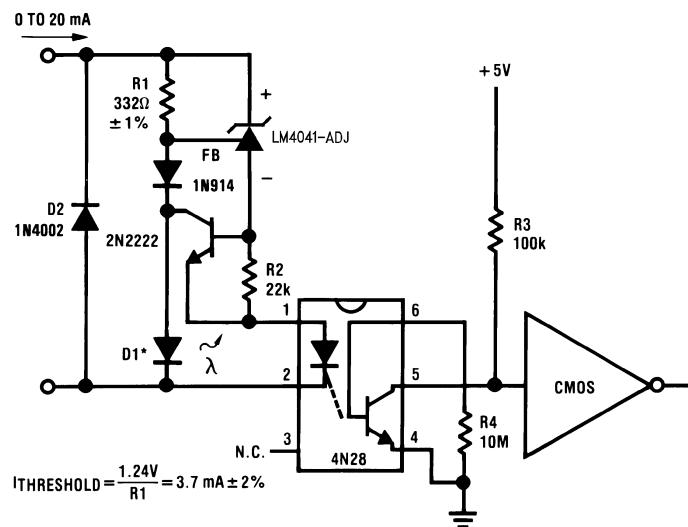
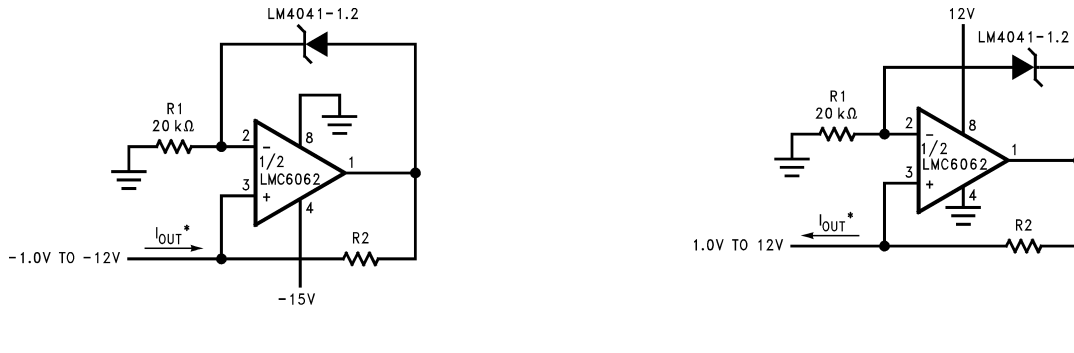


Figure 31. Precision Floating Current Detector



$$I_{OUT}^* = \frac{1.2V}{R2}$$

Figure 32. Precision 1 μ A to 1 mA Current Sources

REVISION HISTORY

Changes from Revision D (April 2013) to Revision E	Page
• Changed layout of National Data Sheet to TI format	16

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM4041AIM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	R1A	Samples
LM4041AIM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1A	Samples
LM4041AIM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1A	Samples
LM4041AIZ-1.2/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041A IZ1.2	Samples
LM4041BIM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	R1B	Samples
LM4041BIM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1B	Samples
LM4041BIM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	R1B	Samples
LM4041BIM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1B	Samples
LM4041BIM7-1.2	ACTIVE	SC70	DCK	5	1000	TBD	Call TI	Call TI	-40 to 85	R1B	Samples
LM4041BIM7-1.2/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1B	Samples
LM4041BIM7X-1.2	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	R1B	Samples
LM4041BIM7X-1.2/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1B	Samples
LM4041BIZ-1.2/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041B IZ1.2	Samples
LM4041CEM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 125	R1C	Samples
LM4041CEM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1C	Samples
LM4041CEM3-ADJ	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 125	RAC	Samples
LM4041CEM3-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	RAC	Samples
LM4041CEM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 125	R1C	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM4041CEM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1C	Samples
LM4041CEM3X-ADJ	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 125	RAC	Samples
LM4041CEM3X-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	RAC	Samples
LM4041CIM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	R1C	Samples
LM4041CIM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1C	Samples
LM4041CIM3-ADJ	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	RAC	Samples
LM4041CIM3-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAC	Samples
LM4041CIM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	R1C	Samples
LM4041CIM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1C	Samples
LM4041CIM3X-ADJ	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	RAC	Samples
LM4041CIM3X-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAC	Samples
LM4041CIM7-1.2	ACTIVE	SC70	DCK	5	1000	TBD	Call TI	Call TI	-40 to 85	R1C	Samples
LM4041CIM7-1.2/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1C	Samples
LM4041CIM7-ADJ	ACTIVE	SC70	DCK	5	1000	TBD	Call TI	Call TI	-40 to 85	RAC	Samples
LM4041CIM7-ADJ/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAC	Samples
LM4041CIM7X-1.2	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	R1C	Samples
LM4041CIM7X-1.2/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1C	Samples
LM4041CIM7X-ADJ	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	RAC	Samples
LM4041CIM7X-ADJ/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAC	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM4041CIZ-1.2/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041C IZ1.2	Samples
LM4041CIZ-ADJ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041C IZADJ	Samples
LM4041DEM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 125	R1D	Samples
LM4041DEM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1D	Samples
LM4041DEM3-ADJ	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 125	RAD	Samples
LM4041DEM3-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	RAD	Samples
LM4041DEM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 125	R1D	Samples
LM4041DEM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1D	Samples
LM4041DEM3X-ADJ	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 125	RAD	Samples
LM4041DEM3X-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	RAD	Samples
LM4041DIM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	R1D	Samples
LM4041DIM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1D	Samples
LM4041DIM3-ADJ	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	RAD	Samples
LM4041DIM3-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAD	Samples
LM4041DIM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	R1D	Samples
LM4041DIM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1D	Samples
LM4041DIM3X-ADJ	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	RAD	Samples
LM4041DIM3X-ADJ/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAD	Samples
LM4041DIM7-1.2	ACTIVE	SC70	DCK	5	1000	TBD	Call TI	Call TI	-40 to 85	R1D	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM4041DIM7-1.2/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1D	Samples
LM4041DIM7-ADJ/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAD	Samples
LM4041DIM7X-1.2	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	R1D	Samples
LM4041DIM7X-1.2/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1D	Samples
LM4041DIM7X-ADJ	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	RAD	Samples
LM4041DIM7X-ADJ/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	RAD	Samples
LM4041DIZ-1.2/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041D IZ1.2	Samples
LM4041DIZ-ADJ/LFT1	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		4041D IZADJ	Samples
LM4041DIZ-ADJ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	4041D IZADJ	Samples
LM4041EEM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 125	R1E	Samples
LM4041EEM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1E	Samples
LM4041EEM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 125	R1E	Samples
LM4041EEM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R1E	Samples
LM4041EIM3-1.2	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	-40 to 85	R1E	Samples
LM4041EIM3-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1E	Samples
LM4041EIM3X-1.2	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	-40 to 85	R1E	Samples
LM4041EIM3X-1.2/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1E	Samples
LM4041EIM7-1.2	ACTIVE	SC70	DCK	5	1000	TBD	Call TI	Call TI	-40 to 85	R1E	Samples
LM4041EIM7-1.2/NOPB	ACTIVE	SC70	DCK	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1E	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM4041EIM7X-1.2	ACTIVE	SC70	DCK	5	3000	TBD	Call TI	Call TI	-40 to 85	R1E	Samples
LM4041EIM7X-1.2/NOPB	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	R1E	Samples

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

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DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



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

DBZ (R-PDSO-G3)

PLASTIC SMALL-OUTLINE

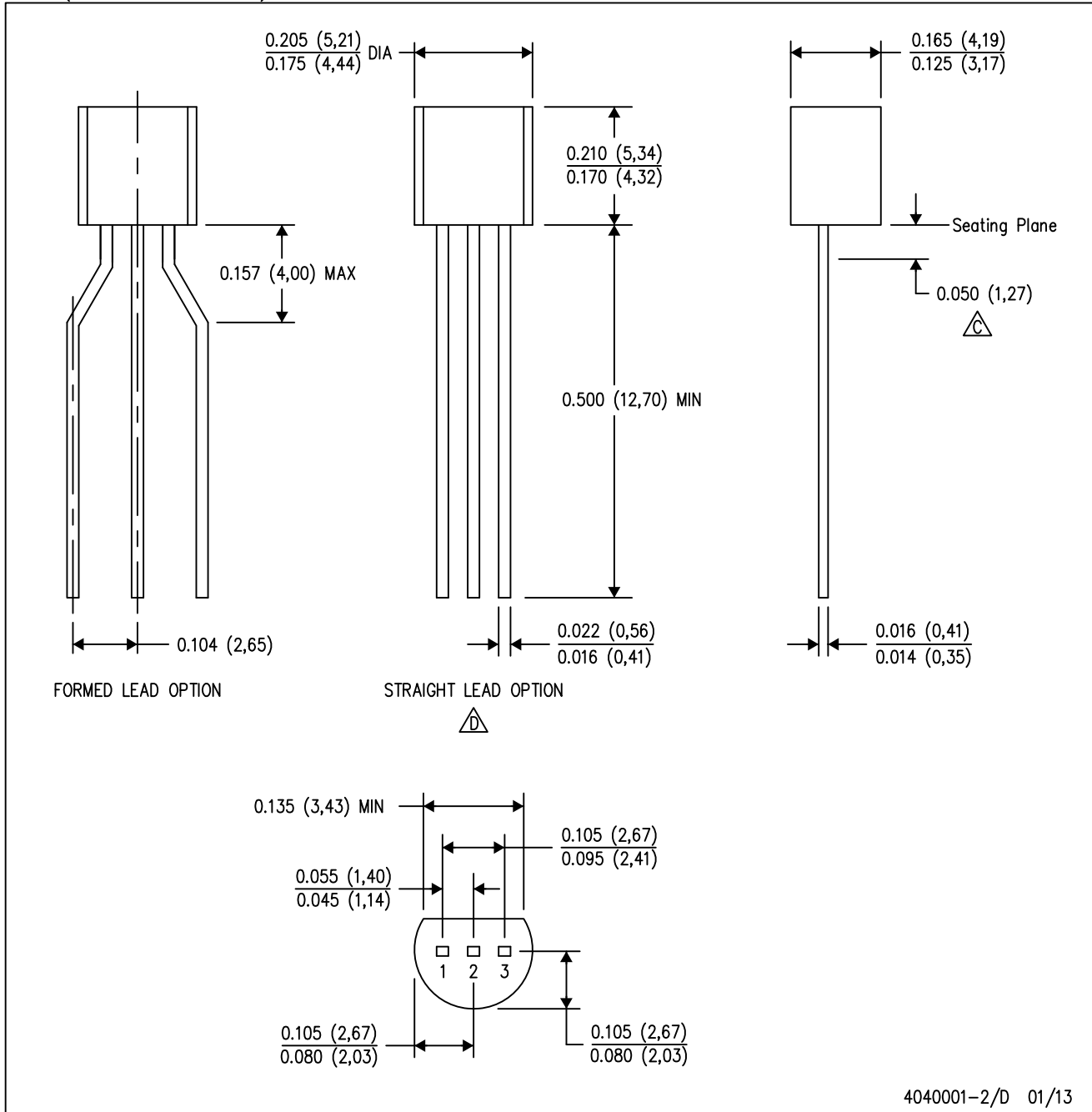


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Lead dimensions are inclusive of plating.
 - D. Body dimensions are exclusive of mold flash and protrusion. Mold flash and protrusion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

MECHANICAL DATA

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE

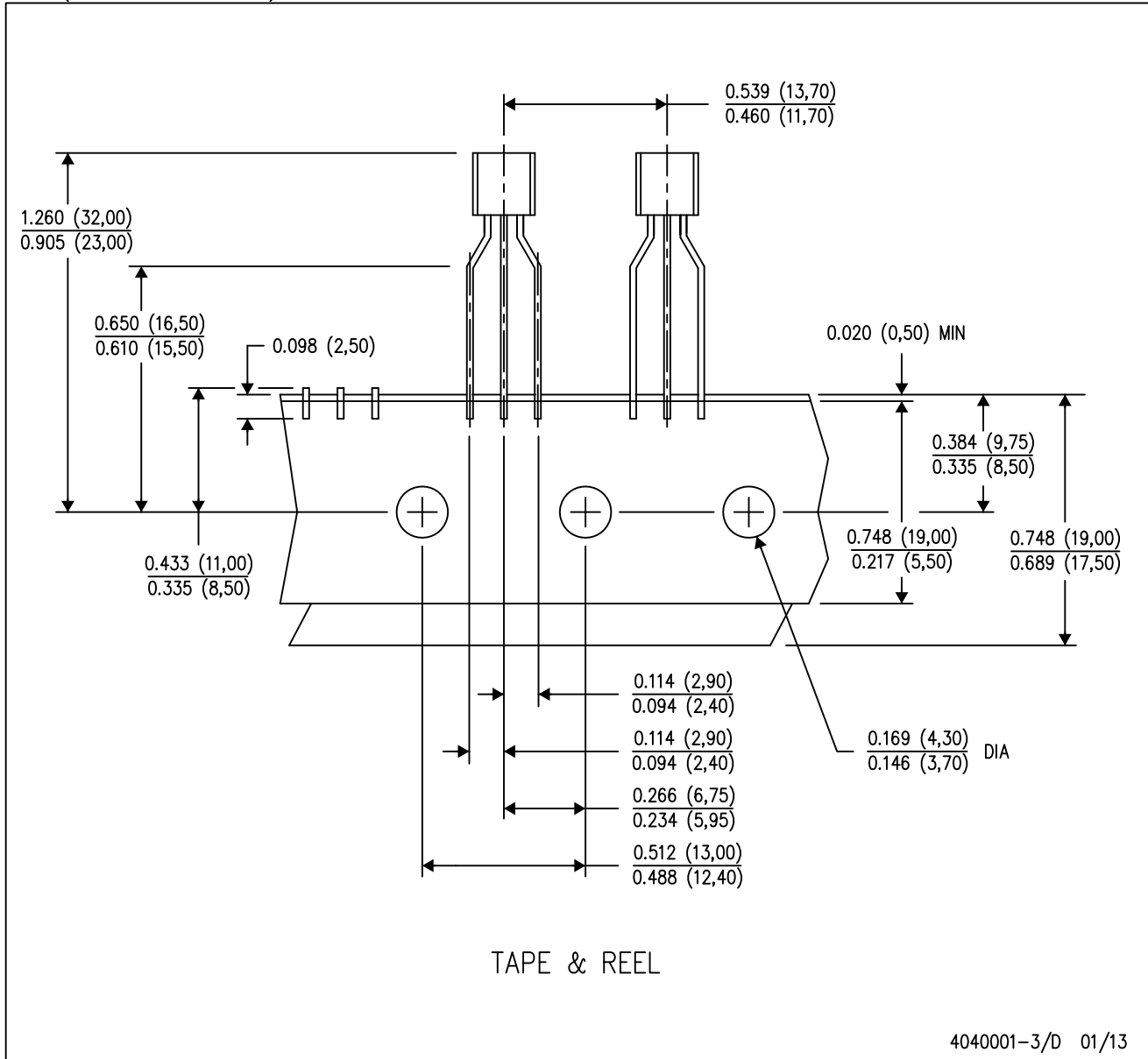


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Lead dimensions are not controlled within this area.
 - Falls within JEDEC TO-226 Variation AA (TO-226 replaces TO-92).
 - Shipping Method:
 - Straight lead option available in either bulk pack or tape & reel.
 - Formed lead option available in tape & reel or ammo pack.
 - Specific products can be offered in limited combinations of shipping mediums and lead options.
 - Consult product folder for more information on available options.

MECHANICAL DATA

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 Formed Lead Option package.

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