

## FEATURES

Lowest auto-zero amplifier noise  
 Low offset voltage: 1  $\mu\text{V}$  typical  
 Input offset drift: 0.002  $\mu\text{V}/^\circ\text{C}$  typical  
 Rail-to-rail input and output swing  
 5 V single-supply operation  
 High gain, CMRR, and PSRR: 130 dB  
 Very low input bias current: 100 pA maximum  
 Low supply current: 1.0 mA  
 Overload recovery time: 50  $\mu\text{s}$   
 No external components required

## ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)  
 Extended temperature range:  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$   
 Controlled manufacturing baseline  
 One assembly/test site  
 One fabrication site  
 Enhanced product change notification  
 Qualification data available on request

## APPLICATIONS

Pressure and position sensors  
 Strain gage amplifiers  
 Medical instrumentation  
 Thermocouple amplifiers  
 Precision current sensing  
 Photodiode amplifiers

## PIN CONFIGURATION

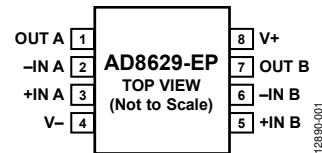


Figure 1. 8-Lead SOIC\_N (R-8)

## GENERAL DESCRIPTION

The **AD8629-EP** amplifier has ultralow offset, drift, and bias current. The device is a wide bandwidth auto-zero amplifier featuring rail-to-rail input and output swing and low noise. Operation is fully specified from 2.7 V to 5 V single supply ( $\pm 1.35$  V to  $\pm 2.5$  V dual supply).

The **AD8629-EP** provides benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. Using Analog Devices, Inc., topology, this zero-drift amplifier combines low cost with high accuracy and low noise. No external capacitor is required. In addition, the **AD8629-EP** greatly reduces the digital switching noise found in most chopper-stabilized amplifiers.

With an offset voltage of only 1  $\mu\text{V}$ , drift of less than 0.05  $\mu\text{V}/^\circ\text{C}$ , and noise of only 0.5  $\mu\text{V}$  p-p (0 Hz to 10 Hz), the **AD8629-EP** is suited for applications where error sources cannot be tolerated. Position and pressure sensors, medical equipment, and strain gage amplifiers benefit greatly from nearly zero drift over the operating temperature range. Many systems can take advantage of the rail-to-rail input and output swings provided by the **AD8629-EP** to reduce input biasing complexity and maximize SNR.

The **AD8629-EP** is specified for the extended industrial temperature range ( $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ ). The **AD8629-EP** is available in a standard 8-lead narrow SOIC plastic package.

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## REVISION HISTORY

8/15—Rev. 0 to Rev. A	
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6/15—Revision 0: Initial Version

## SPECIFICATIONS

ELECTRICAL CHARACTERISTICS— $V_S = 5.0\text{ V}$ 

$V_S = 5.0\text{ V}$ ,  $V_{CM} = 2.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		30	15	$\mu\text{V}$
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		50	100	$\text{pA}$
Input Voltage Range		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			1.5	$\text{nA}$
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{ V to } 5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	0	120	200	$\text{pA}$
Large Signal Voltage Gain	$A_{VO}$	$R_L = 10\text{ k}\Omega$ , $V_O = 0.3\text{ V to } 4.7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	115	140	250	$\text{pA}$
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120	135	5	$\text{V}$
OUTPUT CHARACTERISTICS						
Output Voltage High	$V_{OH}$	$R_L = 100\text{ k}\Omega$ to ground $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.99	4.996		$\text{V}$
		$R_L = 10\text{ k}\Omega$ to ground $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.99	4.995		$\text{V}$
Output Voltage Low	$V_{OL}$	$R_L = 100\text{ k}\Omega$ to $V_+$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.95	4.98		$\text{V}$
		$R_L = 10\text{ k}\Omega$ to $V_+$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.95	4.97		$\text{V}$
Short-Circuit Limit	$I_{SC}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	$\text{mV}$
Output Current	$I_O$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		2	5	$\text{mV}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		10	20	$\text{mV}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		15	20	$\text{mV}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	$\pm 25$	$\pm 50$		$\text{mA}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 40$		$\text{mA}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 30$		$\text{mA}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 15$		$\text{mA}$
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to } 5.5\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	115	130		$\text{dB}$
Supply Current per Amplifier	$I_{SY}$	$V_O = V_S/2$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.85	1.1	$\text{mA}$
				1.0	1.2	$\text{mA}$
INPUT CAPACITANCE						
Differential	$C_{IN}$			1.5		$\text{pF}$
Common Mode				8.0		$\text{pF}$
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 10\text{ k}\Omega$		1.0		$\text{V}/\mu\text{s}$
Overload Recovery Time				0.05		$\text{ms}$
Gain Bandwidth Product	GBP			2.5		$\text{MHz}$
NOISE PERFORMANCE						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.5		$\mu\text{V p-p}$
		0.1 Hz to 1.0 Hz		0.16		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		22		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 10\text{ Hz}$		5		$\text{fA}/\sqrt{\text{Hz}}$

**ELECTRICAL CHARACTERISTICS— $V_S = 2.7\text{ V}$** 

$V_S = 2.7\text{ V}$ ,  $V_{CM} = 1.35\text{ V}$ ,  $V_O = 1.4\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 2.**

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		30	100	$\mu\text{V}$ $\text{pA}$
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1.0	1.5	$\text{nA}$ $\text{pA}$
Input Voltage Range			0		2.7	$\text{V}$
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{ V to } 2.7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	115	130		$\text{dB}$
Large Signal Voltage Gain	$A_{VO}$	$R_L = 10\text{ k}\Omega$ , $V_O = 0.3\text{ V to } 2.4\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	120		$\text{dB}$
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		105	130	$\text{dB}$ $\mu\text{V}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 100\text{ k}\Omega$ to ground $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	2.68	2.695		$\text{V}$
		$R_L = 10\text{ k}\Omega$ to ground $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	2.67	2.68		$\text{V}$
Output Voltage Low	$V_{OL}$	$R_L = 100\text{ k}\Omega$ to $V_+$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	2.67	2.675		$\text{V}$
		$R_L = 10\text{ k}\Omega$ to $V_+$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	$\text{mV}$
Short-Circuit Limit	$I_{SC}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	$\pm 10$	$\pm 15$		$\text{mV}$ $\text{mA}$
Output Current	$I_O$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 10$		$\text{mA}$ $\text{mA}$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to } 5.5\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	115	130		$\text{dB}$
Supply Current per Amplifier	$I_{SY}$	$V_O = V_S/2$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.75	1.0	$\text{mA}$ $\text{mA}$
<b>INPUT CAPACITANCE</b>						
Differential	$C_{IN}$			1.5		$\text{pF}$
Common Mode				8.0		$\text{pF}$
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 10\text{ k}\Omega$		1		$\text{V}/\mu\text{s}$
Overload Recovery Time				0.05		$\text{ms}$
Gain Bandwidth Product	GBP			2		$\text{MHz}$
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.5		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		22		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 10\text{ Hz}$		5		$\text{fA}/\sqrt{\text{Hz}}$

## ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	GND – 0.3 V to $V_S + 0.3$ V
Differential Input Voltage <sup>1</sup>	±5.0 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–55°C to +125°C
Junction Temperature Range	–65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C
ESD	
HBM 8-Lead SOIC_N	±4000 V
FICDM 8-Lead SOIC_N	±1250 V

<sup>1</sup> The differential input voltage is limited to ±5 V or the supply voltage, whichever is less.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## THERMAL CHARACTERISTICS

$\theta_{JA}$  is specified for worst-case conditions, that is,  $\theta_{JA}$  is specified for the device soldered in a circuit board for surface-mount packages. This was measured using a standard two-layer board.

Table 4.

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead SOIC_N (R-8)	158	43	°C/W

## ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

TYPICAL PERFORMANCE CHARACTERISTICS

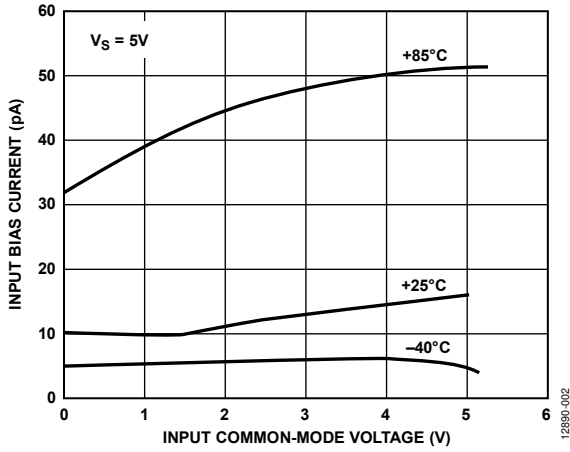


Figure 2. Input Bias Current vs. Input Common-Mode Voltage

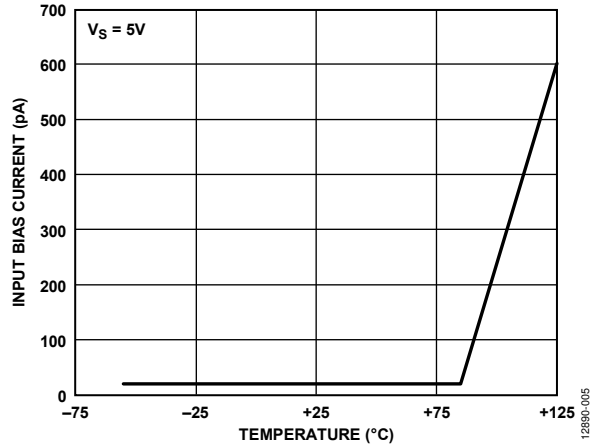


Figure 5. Input Bias Current vs. Temperature

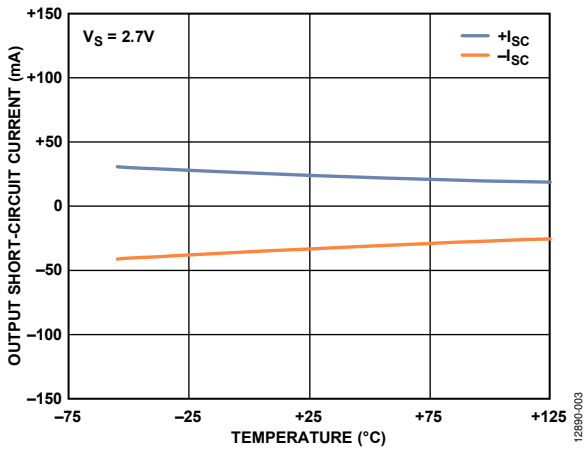


Figure 3. Output Short-Circuit Current vs. Temperature (2.7 V)

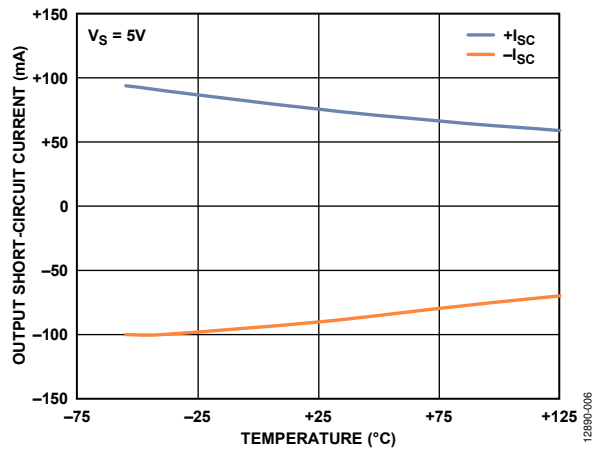


Figure 6. Output Short-Circuit Current vs. Temperature (5 V)

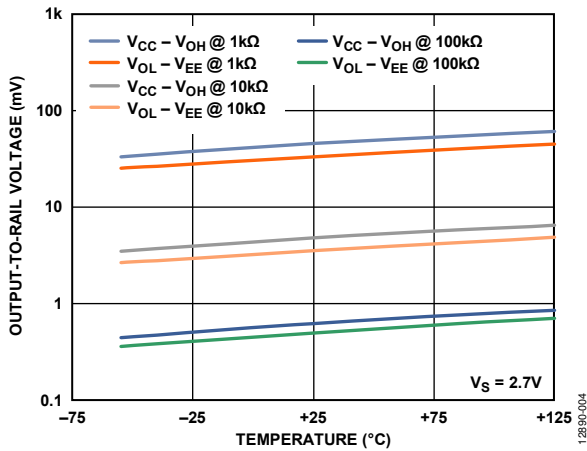


Figure 4. Output-to-Rail Voltage vs. Temperature (2.7 V)

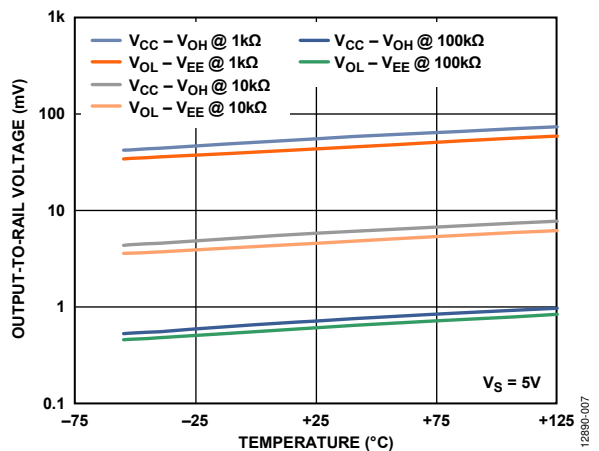


Figure 7. Output-to-Rail Voltage vs. Temperature (5 V)

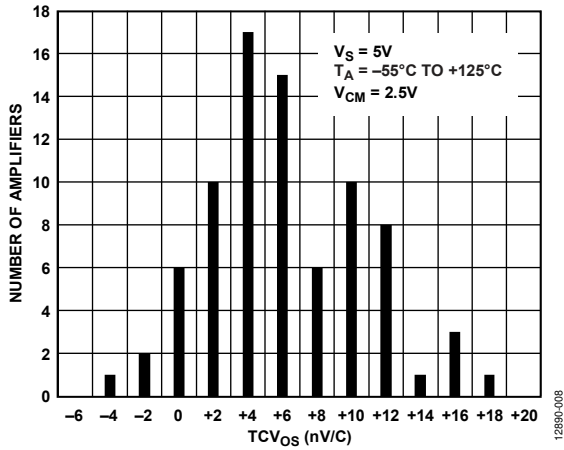


Figure 8. Input Offset Voltage Drift Distribution

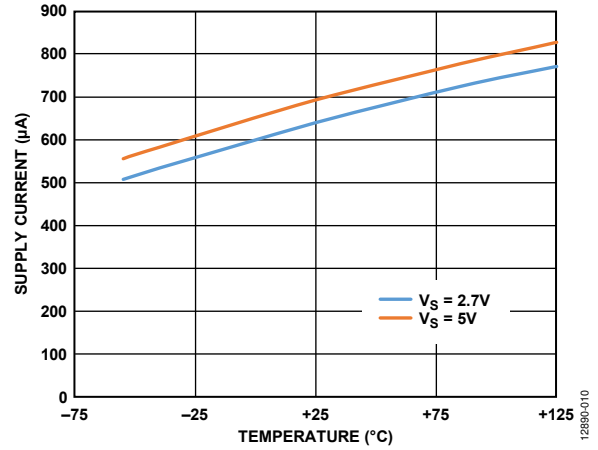


Figure 10. Supply Current vs. Temperature

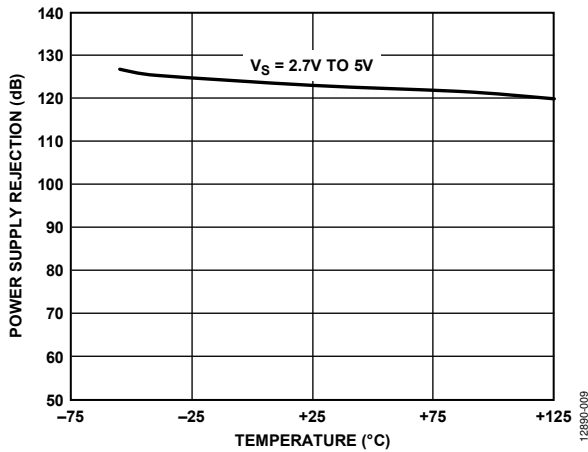
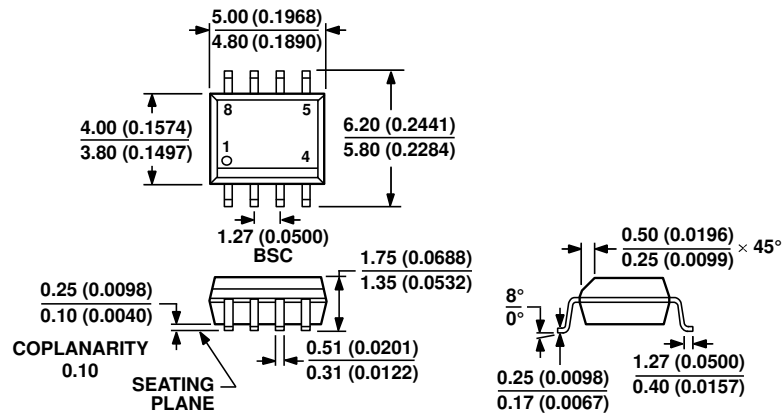


Figure 9. Power Supply Rejection vs. Temperature

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 11. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-8)  
 Dimensions shown in millimeters and (inches)

012407-A

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option
AD8629TRZ-EP	-55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8
AD8629TRZ-EP-R7	-55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8

<sup>1</sup> Z = RoHS Compliant Part.