Zero-Drift, Single-Supply, Rail-to-Rail Input/Output Operational Amplifier

Data Sheet

AD8629-EP

FEATURES

Lowest auto-zero amplifier noise
Low offset voltage: 1 μV typical
Input offset drift: 0.002 μV/°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 μs
No external components required

ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)
Extended temperature range: −55°C to +125°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

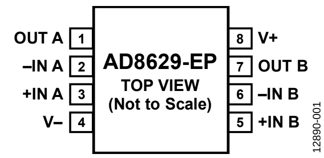

Figure 1. 8-Lead SOIC_N (R-8)

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 (±1.35 V to ±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 μV, drift of less than 0.05 μV/°C, and noise of only 0.5 μV 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°C to +125°C). The AD8629-EP is available in a standard 8-lead narrow SOIC plastic package.

Rev. A **Document Feedback**

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—V_S = 5.0 V

V_S = 5.0 V, V_{CM} = 2.5 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	µV
		−55°C ≤ T_A ≤ +125°C			15	µV
Input Bias Current	I_B			30	100	pA
		−55°C ≤ T_A ≤ +125°C			1.5	nA
Input Offset Current	I_{OS}			50	200	pA
		−55°C ≤ T_A ≤ +125°C			250	pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 5 V	120	140		dB
		−55°C ≤ T_A ≤ +125°C	115	130		dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 4.7 V	125	145		dB
		−55°C ≤ T_A ≤ +125°C	120	135		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−55°C ≤ T_A ≤ +125°C		0.008	0.05	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to ground	4.99	4.996		V
		−55°C ≤ T_A ≤ +125°C	4.99	4.995		V
		R_L = 10 kΩ to ground	4.95	4.98		V
		−55°C ≤ T_A ≤ +125°C	4.95	4.97		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	5	mV
		−55°C ≤ T_A ≤ +125°C		2	5	mV
		R_L = 10 kΩ to V+		10	20	mV
		−55°C ≤ T_A ≤ +125°C		15	20	mV
Short-Circuit Limit	I_{SC}		±25	±50		mA
		−55°C ≤ T_A ≤ +125°C		±40		mA
Output Current	I_O			±30		mA
		−55°C ≤ T_A ≤ +125°C		±15		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V, −55°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current per Amplifier	I_{SY}	V_O = V_S/2		0.85	1.1	mA
		−55°C ≤ T_A ≤ +125°C		1.0	1.2	mA
INPUT CAPACITANCE	C_{IN}					
Differential				1.5		pF
Common Mode				8.0		pF
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		1.0		V/µs
Overload Recovery Time				0.05		ms
Gain Bandwidth Product	GBP			2.5		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.5		µV p-p
		0.1 Hz to 1.0 Hz		0.16		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		22		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		5		fA/√Hz

ELECTRICAL CHARACTERISTICS—V_S = 2.7 V

V_S = 2.7 V, V_{CM} = 1.35 V, V_O = 1.4 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	μV
		−55°C ≤ T_A ≤ +125°C			15	μV
Input Bias Current	I_B			30	100	pA
		−55°C ≤ T_A ≤ +125°C		1.0	1.5	nA
Input Offset Current	I_{OS}			50	200	pA
		−55°C ≤ T_A ≤ +125°C			250	pA
Input Voltage Range			0		2.7	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 2.7 V	115	130		dB
		−55°C ≤ T_A ≤ +125°C	110	120		dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 2.4 V	110	140		dB
		−55°C ≤ T_A ≤ +125°C	105	130		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−55°C ≤ T_A ≤ +125°C		0.002	0.05	μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to ground	2.68	2.695		V
		−55°C ≤ T_A ≤ +125°C	2.68	2.695		V
		R_L = 10 kΩ to ground	2.67	2.68		V
		−55°C ≤ T_A ≤ +125°C	2.67	2.675		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	5	mV
		−55°C ≤ T_A ≤ +125°C		2	5	mV
		R_L = 10 kΩ to V+		10	20	mV
		−55°C ≤ T_A ≤ +125°C		15	20	mV
Short-Circuit Limit	I_{SC}		±10	±15		mA
		−55°C ≤ T_A ≤ +125°C		±10		mA
Output Current	I_O			±10		mA
		−55°C ≤ T_A ≤ +125°C		±5		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V, −55°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current per Amplifier	I_{SY}	V_O = V_S/2		0.75	1.0	mA
		−55°C ≤ T_A ≤ +125°C		0.9	1.2	mA
INPUT CAPACITANCE	C_{IN}					
Differential				1.5		pF
Common Mode				8.0		pF
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		1		V/μs
Overload Recovery Time				0.05		ms
Gain Bandwidth Product	GBP			2		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.5		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		22		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		5		fA/√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[1]	±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

[1] 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

θ_{JA} is specified for worst-case conditions, that is, θ_{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	θ_{JA}	θ_{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

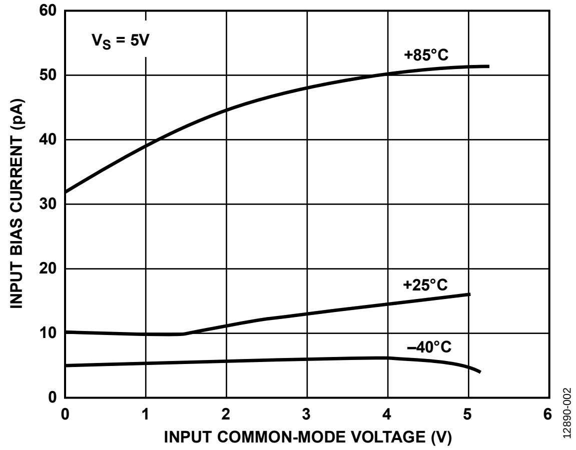

Figure 2. Input Bias Current vs. Input Common-Mode Voltage

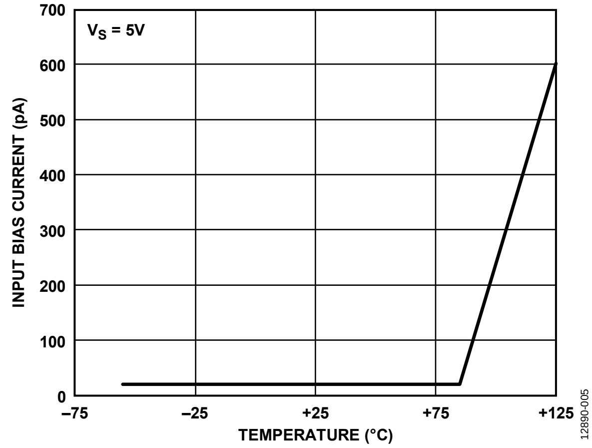

Figure 5. Input Bias Current vs. Temperature

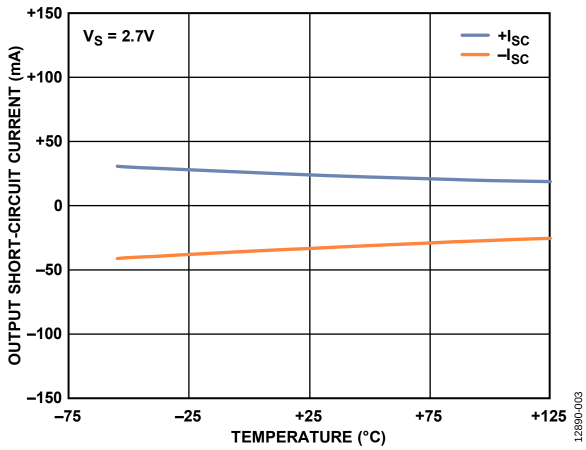

Figure 3. Output Short-Circuit Current vs. Temperature (2.7 V)

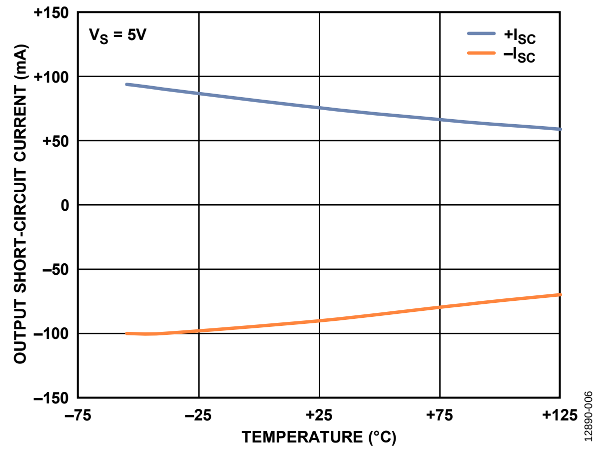

Figure 6. Output Short-Circuit Current vs. Temperature (5 V)

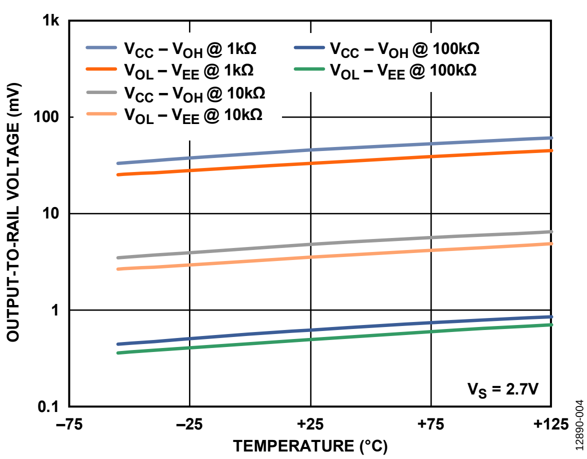

Figure 4. Output-to-Rail Voltage vs. Temperature (2.7 V)

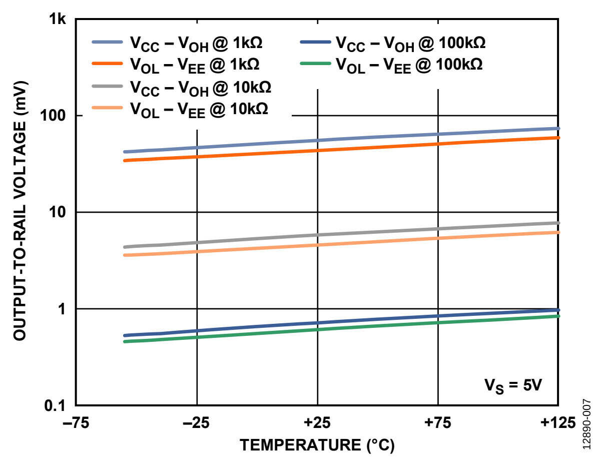

Figure 7. Output-to-Rail Voltage vs. Temperature (5 V)

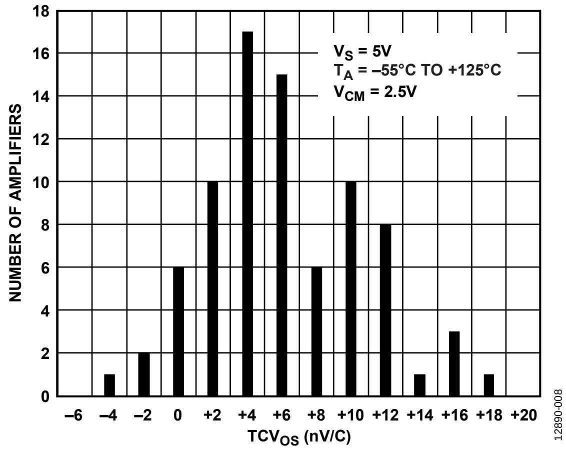

Figure 8. Input Offset Voltage Drift Distribution

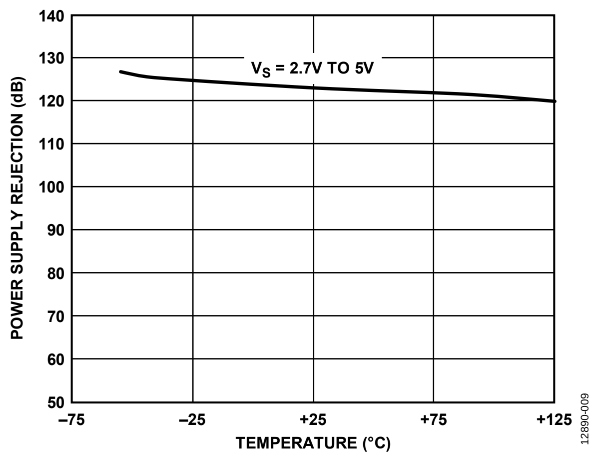

Figure 9. Power Supply Rejection vs. Temperature

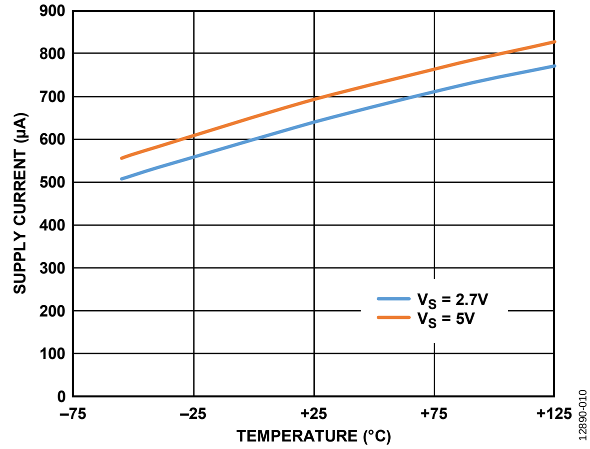

Figure 10. Supply Current vs. Temperature

OUTLINE DIMENSIONS

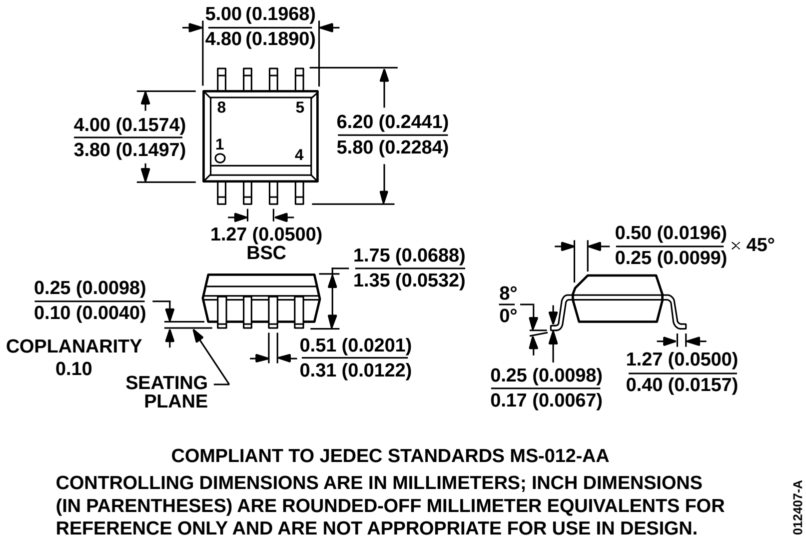

Figure 11. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1]	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

[1] Z = RoHS Compliant Part.

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