16V Dual Auto-Zero, Rail-to-Rail Output, Precision Amplifier

Preliminary Technical Data

AD8639

FEATURES

Low Offset Voltage: 9 µV maximum
Input Offset Drift: 0.04 µV/°C
Rail-to-Rail output swing
16V Single or ±8V Dual Supply Operation
High PSRR: 143 dB typical
High Gain and CMRR: 133 dB typical
Very Low Input Bias Current: 40 pA
Low Supply Current: 1.3 mA/amp

APPLICATIONS

Pressure and Position Sensors
Strain Gage Amplifiers
Medical Instrumentation
Thermocouple Amplifiers
Automotive Sensors
Precision References
Precision Current Sources

FUNCTIONAL BLOCK DIAGRAM

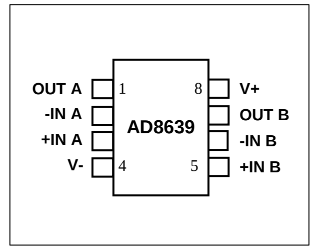

Figure 1.8-lead SOIC Package

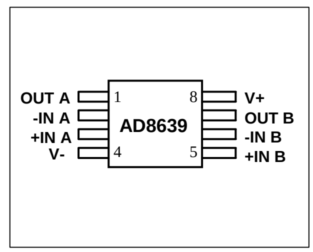

Figure 2. 8-lead MSOP Package

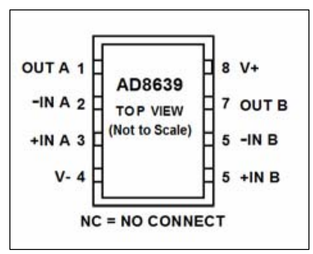

Figure 3. 8-lead LFCSP(3x3mm) Package

GENERAL DESCRIPTION

The AD8639 is a dual, wide bandwidth, auto-zero amplifier featuring rail-to-rail output swing and low noise. This amplifier has very low offset, drift, and bias current. Operation is fully specified from 5 V to 16 V single supply (±2.5 V to ±8 V dual supply).

The AD8639 provides benefits previously found only in expensive zero-drift or chopper-stabilized amplifiers. Using the Analog Devices, Inc., topology, these auto-zero amplifiers combine low cost with high accuracy and low noise. No external capacitors are required. In addition, the AD8639 greatly reduces the digital switching noise found in most chopper-stabilized amplifiers.

With a typical offset voltage of only 3 µV, drift of less than 0.04 µV/°C, and noise of only 1.2 µV p-p (0.1 Hz to 10 Hz), the AD8639 is suited for applications in which error sources cannot be tolerated. Position and pressure sensors, medical equipment, and strain gage amplifiers benefit greatly from nearly zero drift over their operating temperature ranges. Many systems can take advantage of the rail-to-rail output swing provided by the AD8639 to maximize SNR.

The AD8639 is specified for the extended industrial temperature range (−40°C to +125°C). The AD8639 is available in tiny 8-lead LFCSP (3x3mm), MSOP, and SOIC packages.

The AD8639 is a member of a growing series of auto-zero op amps offered by Analog Devices (see Table 1).

Table 1. Auto-Zero Op Amps

Supply	5V	5V Low Power	16V
Single	AD8628	AD8538	AD8638
Dual	AD8629	AD8539	AD8639
Quad	AD8630		

Rev. PrA

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—5 V OPERATION

V_{SY} = 5 V, V_{CM} = 2.5 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	−0.1 V ≤ V_{CM} ≤ +3.0 V		3	9	μV
		−40°C ≤ T_A ≤ +125°C			23	μV
Input Bias Current	I_B			1.5	40	pA
		−40°C ≤ T_A ≤ +85°C		7	40	pA
		−40°C ≤ T_A ≤ +125°C		45	105	pA
Input Offset Current	I_{OS}			7	40	pA
		−40°C ≤ T_A ≤ +85°C		7	40	pA
		−40°C ≤ T_A ≤ +125°C		16.5	60	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	−0.1		+3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 3 V	118	133		dB
		−40°C ≤ T_A ≤ +125°C	118			dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ, V_O = 0.5 V to 4.5 V	120	136		dB
		−40°C ≤ T_A ≤ +125°C	119			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.04	0.15	μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to V_{CM}	4.97	4.985		V
		−40°C ≤ T_A ≤ +125°C	4.97			V
		R_L = 2 kΩ to V_{CM}	4.90	4.93		V
		−40°C ≤ T_A ≤ +125°C	4.86			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to V_{CM}		7.5	10	mV
		−40°C ≤ T_A ≤ +125°C			15	mV
		R_L = 2 kΩ to V_{CM}		32	40	mV
		−40°C ≤ T_A ≤ +125°C			55	mV
Short-Circuit Current	I_{SC}	T_A = 25°C		±19		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 100 kHz, A_V = 1		4.2		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 4.5 V to 16 V	127	143		dB
		−40°C ≤ T_A ≤ +125°C	125			dB
Supply Current/Amplifier	I_{SY}	I_O = 0 mA		1.0	1.3	mA
		−40°C ≤ T_A ≤ +125°C			1.5	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		2.5		V/μs
Settling Time to 0.1%	t_s	2 V step, C_L = 20 pF, R_L = 1 kΩ		3		μs
Overload Recovery Time				50		μs
Gain Bandwidth Product	GBP	R_L = 2 kΩ, C_L = 20 pF		1.35		MHz
Phase Margin	Φ_M	R_L = 2 kΩ, C_L = 20 pF		70		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		1.2		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		60		nV/√Hz

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—5 V OPERATION

V_{SY} = 16 V, V_{CM} = 8 V, T_A = 25°C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	−0.1 V ≤ V_{CM} ≤ +14.0 V		3	9	µV
		−40°C ≤ T_A ≤ +125°C			23	µV
Input Bias Current	I_B			1	75	pA
		−40°C ≤ T_A ≤ +85°C		4	75	pA
		−40°C ≤ T_A ≤ +125°C		85	250	pA
Input Offset Current	I_{OS}			20	70	pA
		−40°C ≤ T_A ≤ +85°C		20	75	pA
		−40°C ≤ T_A ≤ +125°C		50	150	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	−0.1		+14	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 14 V	127	142		dB
		−40°C ≤ T_A ≤ +125°C	127			dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ, V_O = 0.5 V to 15.5 V	130	147		dB
		−40°C ≤ T_A ≤ +125°C	130			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.04	0.15	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to V_{CM}	15.94	15.96		V
		−40°C ≤ T_A ≤ +125°C	15.93			V
		R_L = 2 kΩ to V_{CM}	15.77	15.82		V
		−40°C ≤ T_A ≤ +125°C	15.7			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to V_{CM}		30	40	mV
		−40°C ≤ T_A ≤ +125°C			60	mV
		R_L = 2 kΩ to V_{CM}		110	130	mV
		−40°C ≤ T_A ≤ +125°C			190	mV
Short-Circuit Current	I_{SC}	T_A = 25°C		±37		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 100 kHz, A_V = 1		3		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 4.5 V to 16 V	127	143		dB
		−40°C ≤ T_A ≤ +125°C	125			dB
Supply Current/Amplifier	I_{SY}	I_O = 0 mA		1.25	1.5	mA
		−40°C ≤ T_A ≤ +125°C			1.7	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		2		V/µs
Settling Time to 0.1%	t_s	4 V step, C_L = 20 pF, R_L = 1 kΩ		4		µs
Overload Recovery Time				50		µs
Gain Bandwidth Product	GBP	R_L = 2 kΩ, C_L = 20 pF		1.5		MHz
Phase Margin	Φ_M	R_L = 2 kΩ, C_L = 20 pF		74		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		1.2		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		60		nV/√Hz

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