Precision, Very Low Noise, Low Input Bias Current, Wide Bandwidth JFET Operational Amplifiers

AD8610/AD8620

FEATURES

Low noise: 6 nV/√Hz
Low offset voltage: 100 µV maximum
Low input bias current: 10 pA maximum
Fast settling: 600 ns to 0.01%
Low distortion
Unity gain stable
No phase reversal
Dual-supply operation: ±5 V to ±13 V

APPLICATIONS

Photodiode amplifiers
ATE
Instrumentation
Sensors and controls
High performance filters
Fast precision integrators
High performance audio

PIN CONFIGURATIONS

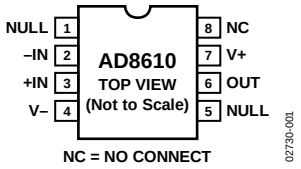

Figure 1. 8-Lead MSOP and 8-Lead SOIC_N

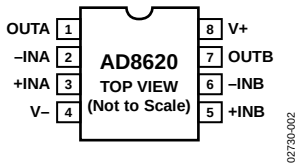

Figure 2. 8-Lead SOIC_N

GENERAL DESCRIPTION

The AD8610/AD8620 are very high precision JFET input amplifiers featuring ultralow offset voltage and drift, very low input voltage and current noise, very low input bias current, and wide bandwidth. Unlike many JFET amplifiers, the AD8610/AD8620 input bias current is low over the entire operating temperature range. The AD8610/AD8620 are stable with capacitive loads of over 1000 pF in noninverting unity gain; much larger capacitive loads can be driven easily at higher noise gains. The AD8610/AD8620 swing to within 1.2 V of the supplies even with a 1 kΩ load, maximizing dynamic range even with limited supply voltages. Outputs slew at 50 V/µs in either inverting or noninverting gain configurations, and settle to 0.01% accuracy in less than 600 ns. Combined with high input impedance, great precision, and very high output drive, the AD8610/AD8620 are ideal amplifiers for driving high performance ADC inputs and buffering DAC converter outputs.

Applications for the AD8610/AD8620 include electronic instruments; ATE amplification, buffering, and integrator circuits; CAT/MRI/ultrasound medical instrumentation; instrumentation quality photodiode amplification; fast precision filters (including PLL filters); and high quality audio.

The AD8610/AD8620 are fully specified over the extended industrial temperature range (−40°C to +125°C). The AD8610 is available in the narrow 8-lead SOIC and the tiny 8-lead MSOP surface-mount packages. The AD8620 is available in the narrow 8-lead SOIC package. The 8-lead MSOP packaged devices are avail-able only in tape and reel.

SPECIFICATIONS

@ V_S = ±5.0 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage (AD8610B)	V_{OS}			45	100	µV
		−40°C < T_A < +125°C		80	200	µV
Offset Voltage (AD8620B)	V_{OS}			45	150	µV
		−40°C < T_A < +125°C		80	300	µV
Offset Voltage (AD8610A/AD8620A)	V_{OS}			85	250	µV
		25°C < T_A < 125°C		90	350	µV
		−40°C < T_A < +125°C		150	850	µV
Input Bias Current	I_B		−10	+2	+10	pA
		−40°C < T_A < +85°C	−250	+130	+250	pA
		−40°C < T_A < +125°C	−2.5	+1.5	+2.5	nA
Input Offset Current	I_{OS}		−10	+1	+10	pA
		−40°C < T_A < +85°C	−75	+20	+75	pA
		−40°C < T_A < +125°C	−150	+40	+150	pA
Input Voltage Range			−2		+3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −1.5 V to +2.5 V	90	95		dB
Large Signal Voltage Gain	A_{VO}	R_L = 1 kΩ, V_O = −3 V to +3 V	100	180		V/mV
Offset Voltage Drift (AD8610B)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.5	1	µV/°C
Offset Voltage Drift (AD8620B)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.5	1.5	µV/°C
Offset Voltage Drift (AD8610A/AD8620A)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.8	3.5	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 1 kΩ, −40°C < T_A < +125°C	3.8	4		V
Output Voltage Low	V_{OL}	R_L = 1 kΩ, −40°C < T_A < +125°C		−4	−3.8	V
Output Current	I_{OUT}	V_{OUT} > ±2 V		±30		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±5 V to ±13 V	100	110		dB
Supply Current per Amplifier	I_{SY}	V_O = 0 V		2.5	3.0	mA
		−40°C < T_A < +125°C		3.0	3.5	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ	40	50		V/µs
Gain Bandwidth Product	GBP			25		MHz
Settling Time	t_S	A_V = +1, 4 V step, to 0.01%		350		ns
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		1.8		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		6		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		5		fA/√Hz
Input Capacitance	C_{IN}					
Differential Mode				8		pF
Common Mode				15		pF
Channel Separation	C_S					
f = 10 kHz				137		dB
f = 300 kHz				120		dB

ELECTRICAL SPECIFICATIONS

@ V_S = ±13 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage (AD8610B)	V_{OS}			45	100	μV
		−40°C < T_A < +125°C		80	200	μV
Offset Voltage (AD8620B)	V_{OS}			45	150	μV
		−40°C < T_A < +125°C		80	300	μV
Offset Voltage (AD8610A/AD8620A)	V_{OS}			85	250	μV
		25°C < T_A < 125°C		90	350	μV
		−40°C < T_A < +125°C		150	850	μV
Input Bias Current	I_B		−10	+3	+10	pA
		−40°C < T_A < +85°C	−250	+130	+250	pA
		−40°C < T_A < +125°C	−3.5		+3.5	nA
Input Offset Current	I_{OS}		−10	+1.5	+10	pA
		−40°C < T_A < +85°C	−75	+20	+75	pA
		−40°C < T_A < +125°C	−150	+40	+150	pA
Input Voltage Range			−10.5		+10.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −10 V to +10 V	90	110		dB
Large Signal Voltage Gain	A_{VO}	R_L = 1 kΩ, V_O = −10 V to +10 V	100	200		V/mV
Offset Voltage Drift (AD8610B)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.5	1	μV/°C
Offset Voltage Drift (AD8620B)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.5	1.5	μV/°C
Offset Voltage Drift (AD8610A/AD8620A)	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.8	3.5	μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 1 kΩ, −40°C < T_A < +125°C	+11.75	+11.84		V
Output Voltage Low	V_{OL}	R_L = 1 kΩ, −40°C < T_A < +125°C		−11.84	−11.75	V
Output Current	I_{OUT}	V_{OUT} > 10 V		±45		mA
Short-Circuit Current	I_{SC}			±65		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±5 V to ±13 V	100	110		dB
Supply Current per Amplifier	I_{SY}	V_O = 0 V		3.0	3.5	mA
		−40°C < T_A < +125°C		3.5	4.0	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ	40	60		V/μs
Gain Bandwidth Product	GBP			25		MHz
Settling Time	t_S	A_V = +1, 10 V step, to 0.01%		600		ns
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		1.8		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		6		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		5		fA/√Hz
Input Capacitance	C_{IN}					
Differential Mode				8		pF
Common Mode				15		pF
Channel Separation	C_S					
f = 10 kHz				137		dB
f = 300 kHz				120		dB

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	27.3 V
Input Voltage	V_{S-} to V_{S+}
Differential Input Voltage	±Supply voltage
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +125°C
Junction Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec)	300°C

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

Table 4. Thermal Resistance

Package Type	θ_{JA}[1]	θ_{JC}	Unit
8-Lead MSOP (RM)	190	44	°C/W
8-Lead SOIC (R)	158	43	°C/W

[1] θ_{JA} is specified for worst-case conditions, that is, θ_{JA} is specified for a device soldered in circuit board for surface-mount packages.

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.

OUTLINE DIMENSIONS

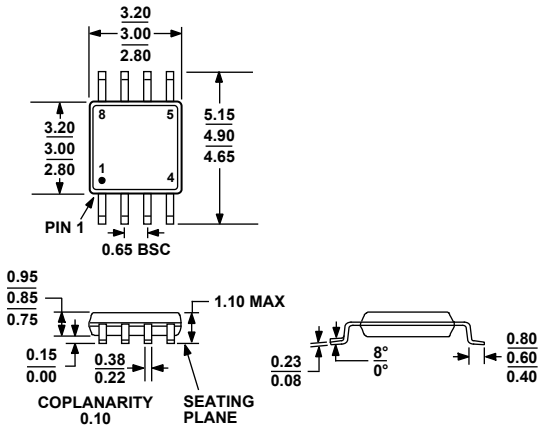

Figure 71. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters

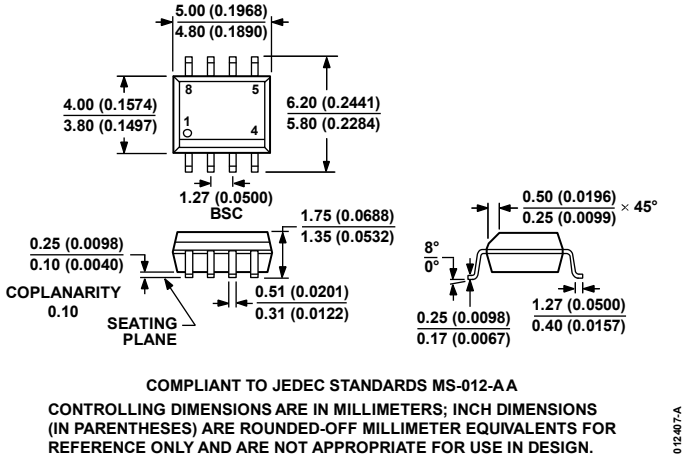

Figure 72. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
AD8610AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610AR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610AR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610ARZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610ARM-REEL	−40°C to +125°C	8-Lead MSOP	RM-8	B0A
AD8610ARM-R2	−40°C to +125°C	8-Lead MSOP	RM-8	B0A
AD8610ARMZ-REEL[1]	−40°C to +125°C	8-Lead MSOP	RM-8	B0A#
AD8610ARMZ-R2[1]	−40°C to +125°C	8-Lead MSOP	RM-8	B0A#
AD8610BR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610BR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610BR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610BRZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610BRZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8610BRZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620AR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620AR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620ARZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BRZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BRZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8620BRZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	

[1] Z = RoHS Compliant Part, # denotes RoHs-compliant product can be top or bottom marked.