

# 16V Low Cost, High Performance CMOS Rail-to-Rail Operational Amplifiers

Preliminary Technical Data

AD8661/AD8662/AD8664

## FEATURES

Low Offset Voltage: 75  $\mu$ V max  
 Low Input Bias Currents 1pA Max  
 Single-Supply Operation: 5 to 16 Volts  
 Dual-Supply Operation: +/- 2.5 to +/-8 Volts  
 Low Noise: 10 nV/ $\sqrt$ Hz  
 Wide Bandwidth: 4 MHz  
 Unity Gain Stable

## APPLICATIONS

Multi-pole Filters  
 Sensors  
 Medical Equipment  
 Consumer Audio  
 Photodiode amplification  
 ADC driver

## GENERAL DESCRIPTION

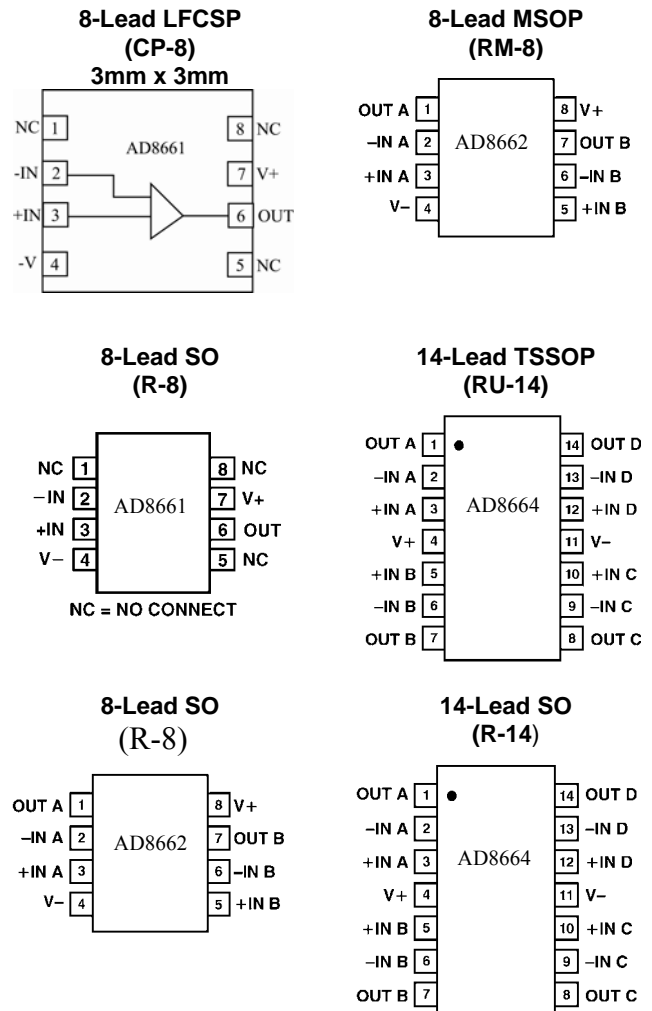
The AD8661, AD8662 and AD8664 are single, dual and quad rail-to-rail output single supply amplifiers that use Analog Devices' patented DigiTrim<sup>®</sup> trimming technique to achieve low offset voltage. The AD8661 family features an extended operating range with supply voltages up to 16 V. They also feature low input bias currents, wide signal bandwidth, and low input voltage and current noise.

The combination of low offsets, very low input bias currents, and wide supply range make these amplifiers useful in a wide variety of applications normally associated with much higher priced JFET amplifiers. Systems utilizing high impedance sensors, such as photo-diodes benefit from the combination of low input bias current, low noise, low offset and bandwidth. The wide operating voltage range matches today's high performance ADCs and DACs. Audio applications and medical monitoring equipment can take advantage of the high input impedance, low voltage and current noise, wide bandwidth and the lack of "popcorn" noise (found in many other low input bias current amplifiers).

The AD8661, AD8662 and AD8664 are specified over the extended industrial (-40° to +125°C) temperature range. The AD8661, single, is available in the tiny 8-lead LFCSP (MO-220) 3mm x 3mm and 8-lead SOIC package. The AD8662, dual, is available in the 8-lead micro-SOIC and narrow SOIC surface mount packages. The AD8664, quad, is available in 14-lead TSSOP and narrow 14-pin SOIC packages.

LFCSP, MSOP and TSSOP versions are available in tape and reel only.

## PIN CONFIGURATIONS



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## ELECTRICAL CHARACTERISTICS

( $V_S=+5.0V$ ,  $V_{CM} = V_S/2$ ,  $T_A=+25^\circ C$  unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$V_{SY} = 8V$ , $V_{CM} = 3V$ $V_{CM} = 0.1V$ to $3.0V$ $-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$			75	$\mu V$
				30	300	$\mu V$
					650	$\mu V$
					750	$\mu V$
Input Bias Current	$I_B$	$-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$		0.3	1	pA
					50	pA
					300	pA
Input Offset Current	$I_{OS}$	$-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$		0.2	TBD	pA
					20	pA
					75	pA
					3.0	V
Input Voltage Range			tbd			
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0.1V$ to $3.0V$	80	95		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 10 k\Omega$ $V_O = 0.5V$ to $4.5V$	70	100		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			3	10	$\mu V/^\circ C$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$I_L = 1mA$ $I_L = 10mA$ $-40^\circ C < T_A < +125^\circ C$	4.80	4.85		V
			4.80	4.85		V
			4.75			V
Output Voltage Low	$V_{OL}$ $V_{OL}$	$I_L = 1mA$ $I_L = 1mA$ $-40^\circ C < T_A < +125^\circ C$		60	120	mV
				60	120	mV
					150	mV
Output Current	$I_{OUT}$			$\pm 19$		mA
Closed Loop Output Impedance	$Z_{OUT}$	$f=1 MHz$ , $A_V = 1$		65		$\Omega$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 5 V$ to $16 V$	80	95		dB
Supply Current/Amplifier	$I_{SY}$	$V_O = 0V$ $-40^\circ < T_A < +125^\circ C$		1.2	1.8	mA
					2.0	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 10 k\Omega$		3		V/ $\mu s$
Settling Time	$t_s$	To 0.1%, 0 V to 1V step		<1		$\mu s$
Gain Bandwidth Product	GBP			4		MHz
Phase Margin	$\phi_o$ degrees	$C_L = 15 pF$			60	
<b>NOISE PERFORMANCE</b>						
Peak-to-Peak Noise	$e_n$ p-p	$f=0.1Hz$ to $10 Hz$		2.5		$\mu V$ p-p
Voltage Noise Density	$e_n$	$f=1kHz$		12		nV/ $\sqrt{Hz}$
Voltage Noise Density	$e_n$	$f=10kHz$		10		nV/ $\sqrt{Hz}$
Current Noise Density	$i_n$	$f=1kHz$		0.1		pA/ $\sqrt{Hz}$

## ELECTRICAL CHARACTERISTICS ( $V_S = \pm 8.0V$ , $V_{CM} = 0$ , $T_A = +25^\circ C$ unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$V_{SY} = 8V$ , $V_{CM} = 3V$ $V_{CM} = -8.1V$ to $+6.0V$ $-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$			75	$\mu V$
				30	300	$\mu V$
					650	$\mu V$
					750	$\mu V$
Input Bias Current	$I_B$	$-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$		0.3	1	pA
					50	pA
					300	pA
Input Offset Current	$I_{OS}$	$-40^\circ < T_A < +85^\circ C$ $-40^\circ < T_A < +125^\circ C$		0.2	TBD	pA
					20	pA
					75	pA
Input Voltage Range			tbd		6	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -8.1V$ to $+6.0V$	80	95		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 10 k\Omega$ $V_O = -7.5V$ to $+7.5V$	70	85		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			3	10	$\mu V/^\circ C$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$I_L = 1mA$ $I_L = 10mA$ $-40^\circ C < T_A < +125^\circ C$	7.90	7.95		V
			7.6	7.7		V
			7.4			V
Output Voltage Low	$V_{OL}$	$I_L = 1mA$ $I_L = 10mA$ $-40^\circ C < T_A < +125^\circ C$		-7.97	-7.93	mV
				-7.8	-7.7	mV
					-7.5	mV
Output Current	$I_{OUT}$			$\pm 140$		mA
Closed Loop Output Impedance	$Z_{OUT}$	$f = 1 MHz$ , $A_V = 1$		45		$\Omega$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 5V$ to $16V$	80	95		dB
Supply Current/Amplifier	$I_{SY}$	$V_O = 0V$ $-40^\circ < T_A < +125^\circ C$		1.5	1.8	mA
					2.0	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 10 k\Omega$		3		V/ $\mu s$
Settling Time	$t_s$	To 0.1%, 0 V to 1V step		<1		$\mu s$
Gain Bandwidth Product	GBP			4		MHz
Phase Margin	$\phi_o$	$C_L = 15 pF$		60		degrees
<b>NOISE PERFORMANCE</b>						
Peak-to-Peak Noise	$e_n$ p-p	$f = 0.1Hz$ to $10 Hz$		2.5		$\mu V$ p-p
Voltage Noise Density	$e_n$	$f = 1kHz$		12		nV/ $\sqrt{Hz}$
Voltage Noise Density	$e_n$	$f = 10kHz$		10		nV/ $\sqrt{Hz}$
Current Noise Density	$i_n$	$f = 1kHz$		0.1		pA/ $\sqrt{Hz}$

### ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

Supply voltage.....	+18V
Input Voltage.....	Gnd to V <sub>s</sub>
Differential Input Voltage .....	±18V
Output Short-Circuit Duration to Gnd <sup>2</sup> .....	Observe Derating Curves
Storage Temperature Range	
R, CP, RM, RU Package.....	-65°C to +150°C
Operating Temperature Range	
AD8661/AD8662/AD8664 .....	-40°C to +125°C
Junction Temperature Range	
R, CP, RM, RU Package.....	-65°C to +150°C
Lead Temperature Range (Soldering, 60 Sec).....	+300°C

Package Type	$\theta_{JA}$	$\theta_{JC}$	Units
8-Pin LFCSP (CP)		--	°C/W
8-Pin microSOIC (RM)	210	45	°C/W
8-Pin SOIC (R)	158	43	°C/W
14-Pin SOIC (R)	120	36	°C/W
14-Pin TSSOP (RU)	180	35	°C/W

### NOTES

<sup>1</sup> Absolute maximum ratings apply at 25°C, unless otherwise noted.

<sup>2</sup>  $\theta_{JA}$  is specified for the worst-case conditions, i.e.,  $\theta_{JA}$  is specified for device soldered in circuit board for surface mount packages.

### ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding Information
AD8661ACP	-40°C to +125°C	8-Pin LFCSP	CP-8	
AD8661ARZ	-40°C to +125°C	8-Pin SOIC	R-8	
AD8662ARMZ	-40°C to +125°C	8-Pin micro-SOIC	RM-8	
AD8662ARZ	-40°C to +125°C	8-Pin SOIC	R-8	
AD8664ARZ	-40°C to +125°C	14-Pin SOIC	R-14	
AD8664ARUZ	-40°C to +125°C	14-Pin TSSOP	RU-14	

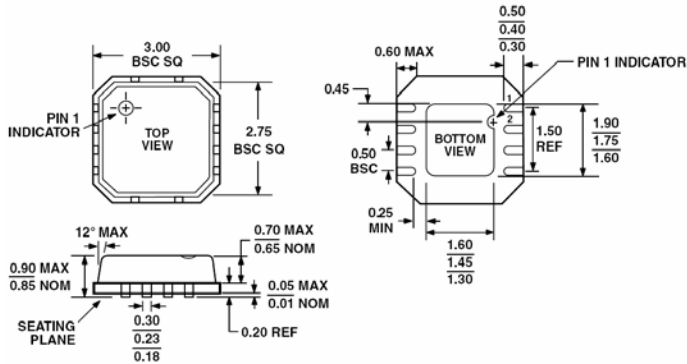
### CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 1500 V readily accumulate on the human body and test equipment and can discharge without detection. Although this device features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

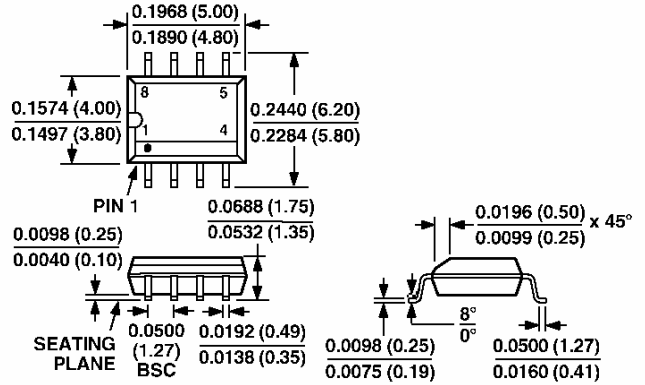


OUTLINE DIMENSIONS

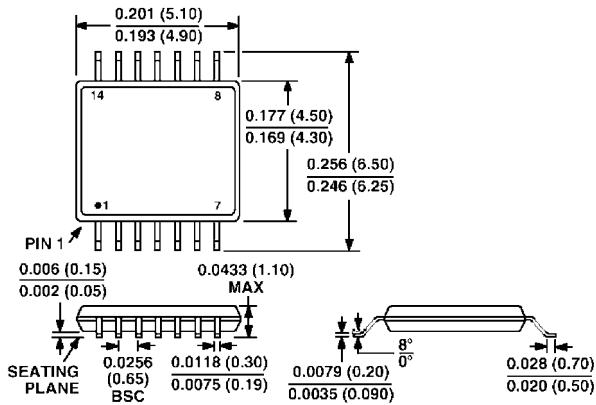
8-Lead LFCSP  
(CP-8 Suffix)



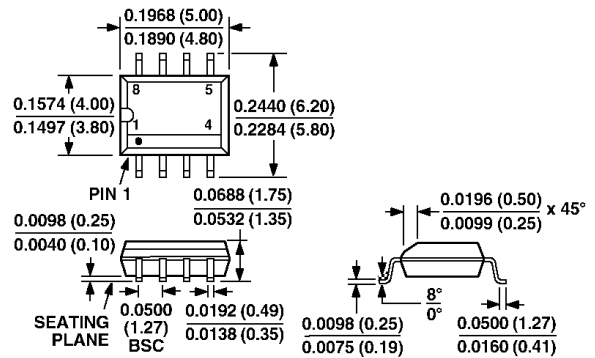
8-Lead SOIC  
(RM-8)



14-Lead TSSOP  
(RU-14)



8-Lead SO  
(R-8)



14-Lead SO  
(R-14)

