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Precision Low noise CMOS Rail-to-Rail Input/Output Operational Amplifiers

Preliminary Technical Data AD8605/AD8606/AD8608

FEATURES
Low Offset Voltage: 300 µV max
Low Input Bias Currents
Low Noise: 6.5 nV/√Hz
Low Supply Current: 1 mA/Amp
Wide Bandwidth: 10 MHz
Slew Rate: 5 V/µs
Low Distortion
No Phase Reversal
High gain
Unity Gain Stable
Single-Supply Operation: 2.7 to 6 Volts

APPLICATIONS
Barcode Scanners
Battery Powered Instrumentation
Multi-pole Filters
Sensors
ASIC Input or Output Amplifier
Audio
Photodiode amplification

GENERAL DESCRIPTION

The AD8605, AD8606 and AD8608 are single, dual and quad rail-to-rail input and output single supply amplifiers featuring very low offset voltage, low input voltage and current noise and wide signal bandwidth. These amplifiers use a patented trimming technique that achieves superior precision without laser trimming. All are fully specified to operate from +3V to +5V single supply.

The combination of low offsets, low noise, very low input bias currents, and high speed make these amplifiers useful in a wide variety of applications. Filters, integrators, photo-diode amplifiers and high impedance sensors all benefit from the combination of performance features. Audio and other AC applications benefit from the wide bandwidth and low distortion.
Applications for these amplifiers include portable and loop-powered instrumentation, audio amplification for portable devices, portable phone headsets, bar code scanners, and multi-pole filters.

The ability to swing rail-to-rail at both the input and output enables designers to buffer CMOS ADCs, DACs, ASICs and other wide output swing devices in single supply systems.

The AD8605, AD8606 and AD8608 are specified over the extended industrial (-40° to +125°C) temperature range. The AD8605, single, is available in the tiny 5-lead SOT-23 package. The AD8606, dual, is available in the 8-lead micro-SOIC and narrow SOIC surface mount packages. The AD8608, quad, is available in 14-lead TSSOP and narrow 14-pin SOIC packages.

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

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ELECTRICAL CHARACTERISTICS (V_S=+2.7V, V_{CM} = V_S/2, T_A=+25°C unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0V to 3V		80	300	µV
		-40°< T_A < +125°C			750	µV
Input Bias Current	I_B			0.2	60	pA
		-40°< T_A < +85°C			100	pA
		-40°< T_A < +125°C			100	pA
Input Offset Current	I_{OS}			0.1	30	pA
		-40°< T_A < +85°C			50	pA
		-40°< T_A < +125°C			500	pA
Input Voltage Range			0		3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 2.7V	80	95		dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ V_O= 0.5V to 2.5V	200	350		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1mA	2.65	2.67		V
		-40°C < T_A < +125°C	2.6			V
Output Voltage Low	V_{OL}	I_L = 1mA		20	30	mV
		-40°C < T_A < +125°C			50	mV
Output Current	I_{OUT}			±30		mA
Closed Loop Output Impedance	Z_{OUT}	f=1 MHz, A_V = 1		12		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	80	95		dB
Supply Current/Amplifier	I_{SY}	V_O = 0V		1150	1300	µA
		-40°< T_A < +125°C			1500	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L =2 kΩ		5		V/µs
Settling Time	t_s	To 0.01%		<0.5		µs
Gain Bandwidth Product	GBP			9		MHz
Phase Margin	Øo			50		degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f=1kHz		8		nV/√Hz
Voltage Noise Density	e_n	f=10kHz		6.5		nV/√Hz
Current Noise Density	i_n	f=1kHz		0.05		pA/√Hz

ELECTRICAL CHARACTERISTICS (@ V_S=+5.0V, V_{CM} = V_S/2, T_A=+25°C unless otherwise noted)

Parameter	Symbol	Conditions	A Grade			Units
			Min	Typ	Max	
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0V to 5V		80	300	µV
		-40°< T_A < +125°C			750	µV
Input Bias Current	I_B			0.2	60	pA
		-40°< T_A < +85°C			100	pA
		-40°< T_A < +125°C			1000	pA
Input Offset Current	I_{OS}			0.1	30	pA
		-40°< T_A < +85°C			50	pA
		-40°< T_A < +125°C			500	pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 5V	85	100		dB
Large Signal Voltage Gain	A_{VO}	V_O= 0.5V to 4.5V, R_L = 2 kΩ , V_{CM}= 0V	1000	2000		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1mA	4.97	4.98		V
		I_L = 10mA	4.7	4.79		V
		-40°C to +125°C	4.6			V
Output Voltage Low	V_{OL}	I_L = 1mA		15	30	mV
Output Voltage High	V_{OL}	I_L = 10mA		125	175	mV
		-40°C to +125°C			250	mV
Output Current	I_{OUT}			±80		mA
Closed Loop Output Impedance	Z_{OUT}	f=1 MHz, A_V = 1		10		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	80	95		dB
Supply Current/Amplifier	I_{SY}	V_O = 0V		1200	1400	µA
		-40°< T_A < +125°C			1600	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L =2 kΩ		5		V/µs
Settling Time	t_s	To 0.01%		<1		µs
Full Power Bandwidth	BWp	<1% Distortion		360		kHz
Gain Bandwidth Product	GBP			10		MHz
Phase Margin	Øo			55		degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f=1kHz		8		nV/√Hz
Voltage Noise Density	e_n	f=10kHz		6.5		nV/√Hz
Current Noise Density	i_n	f=1kHz		0.05		pA/√Hz

ABSOLUTE MAXIMUM RATINGS [1]

Supply voltage .....+6V
Input Voltage.....Gnd to Vs
Differential Input Voltage .....±6V
Output Short-Circuit Duration to Gnd[2] ... Observe Derating Curves
Storage Temperature Range
R, RT, RM, RU Package.....-65°C to +150°C
Operating Temperature Range
AD8605/AD8606/AD8608.....-40°C to +125°C
Junction Temperature Range
R, RT, RM, RU Package.....-65°C to +150°C
Lead Temperature Range (Soldering, 60 Sec).....+300°C

Package Type	θ_{JA}	θ_{JC}	Units
5-Pin SOT-23 (RT)	230	--	°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

[1] Absolute maximum ratings apply at 25°C, unless otherwise noted.

[2] θ_{JA} is specified for the worst-case conditions, i.e., θ_{JA} is specified for device soldered in circuit board for surface mount packages.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8605ART	-40°C to +125°C	5-Pin SOT-23	RT-5
AD8606ARM	-40°C to +125°C	8-Pin micro-SOIC	RM-8
AD8606AR	-40°C to +125°C	8-Pin SOIC	R-8
AD8608AR	-40°C to +125°C	14-Pin SOIC	R-14
AD8608ARU	-40°C to +125°C	14-Pin TSSOP	RU-14