Quad, Low Power, Precision Rail-to-Rail Output Op Amp

Preliminary Technical Data

AD8624

FEATURES

Very low offset voltage: 125 µV maximum
Supply current: 250 µA maximum
Input bias current: 200 pA maximum
Low input offset voltage drift: 0.5 µV/°C
Very low voltage noise: 11 nV/√Hz
Operating temperature: −40°C to +125°C
Rail-to-rail output swing
±2.5 V to ±18 V operation

APPLICATIONS

Portable precision instrumentation
Laser diode control loops
Strain gage amplifiers
Medical instrumentation
Thermocouple amplifiers

PIN CONFIGURATIONS

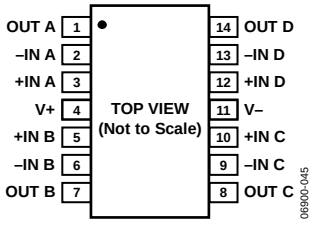

Figure 1. 14-Lead TSSOP (RU-14)

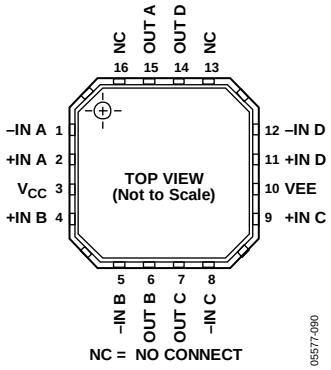

Figure 2. 16-Lead LFCSP (CP-16-4 Suffix)

GENERAL DESCRIPTION

The AD8624 is a quad, precision rail-to-rail output operational amplifier with a low supply current of only 350 µA maximum over temperature and supply voltages. It offers low offset, drift, and voltage noise combined with very low input bias currents over the full operating temperature range.

With typical offset voltage of only 10 µV, offset drift of 0.5 µV/°C, and noise of only 11nV/√Hz, it is perfectly suited for applications where large error sources cannot be tolerated. Many systems can take advantage of the low noise, dc precision, and rail-to-rail output swing provided by the ADA8624 to maximize the signal-to-noise ratio and dynamic range for low power operation.

The AD8624 is specified over the extended industrial temperature range of −40°C to +125°C. The AD8624 is available in an 14-lead TSSOP and 16-lead LFCSP (4x4x0.85mm) surface-mount package. The AD8624 is part of a growing family of 36 V, low power op amps from Analog Devices.

Table 1. Low Power Op Amps

Supply	40 V	36 V	12 V to 16 V	5 V
Single	OP97	OP777 OP1177	OP196 AD8663	AD8603
Dual	OP297	OP727 OP2177 AD706 AD8622	OP296 AD8667	AD8607
Quad	OP497	OP747 OP4177 AD704	OP496 AD8669	AD8609

Rev. PrA

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—±2.5 V OPERATION

V_S = ±2.5 V, V_{CM} = 0 V, V_O = 0 V, T_A = +25°C, unless otherwise specified.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			10	125	µV
		−40°C ≤ T_A ≤ +125°C			230	µV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.5	1.2	µV/°C
Input Bias Current	I_B			30	200	pA
		−40°C ≤ T_A ≤ +125°C			400	pA
Input Offset Current	I_{OS}			25	200	pA
		−40°C ≤ T_A ≤ +125°C			300	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	−1.3		+1.3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −1.3 V to +1.3 V	110	120		dB
		−40°C ≤ T_A ≤ +125°C	107			dB
Open-Loop Gain	A_{VO}	R_L = 10 kΩ, V_O = −2.0 V to +2.0 V	118	135		dB
		−40°C ≤ T_A ≤ +125°C	109			dB
Input Resistance, Differential Mode	R_{INDM}			1		GΩ
Input Resistance, Common Mode	R_{INCM}			1		TΩ
Input Capacitance, Differential Mode	C_{INDM}			5.5		pF
Input Capacitance, Common Mode	C_{INCM}			3		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to ground	2.45	2.49		V
		−40°C ≤ T_A ≤ +125°C	2.41			V
		R_L = 10 kΩ to ground	2.40	2.45		V
		−40°C ≤ T_A ≤ +125°C	2.36			V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to ground		−2.49	−2.45	V
		−40°C ≤ T_A ≤ +125°C			−2.41	V
		R_L = 10 kΩ to ground		−2.45	−2.40	V
		−40°C ≤ T_A ≤ +125°C			−2.36	V
Short-Circuit Current	I_{SC}			±30		mA
Closed-Loop Output Impedance	Z_{OUT}	F = 1 kHz, A_V = 1		2		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±2.0 V to ±18.0 V	125	145		dB
		−40°C ≤ T_A ≤ +125°C	120			dB
Supply Current/Amplifier	I_{SY}	I_O = 0 mA		175	225	µA
		−40°C ≤ T_A ≤ +125°C			310	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ, C_L = 20 pF, A_V = 1		0.4		V/µs
Gain Bandwidth Product	GBP	C_L = 20 pF, A_V = 1		580		kHz
Phase Margin	Φ_M	C_L = 20 pF, A_V = 1		72		Degrees
NOISE PERFORMANCE						
Voltage Noise	$e_{n\ p\text{-}p}$	f = 0.1 Hz to 10 Hz		0.2		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		12		nV/√Hz
Uncorrelated Current Noise Density	i_n	f = 1 kHz		0.15		pA/√Hz
Correlated Current Noise Density	i_n	f = 1 kHz		0.07		pA/√Hz

ELECTRICAL CHARACTERISTICS—±15 V OPERATION

V_S = ±15 V, V_{CM} = 0 V, V_O = 0 V, T_A = +25°C, unless otherwise specified.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			10	125	µV
		−40°C ≤ T_A ≤ +125°C			230	µV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.5	1.2	µV/°C
Input Bias Current	I_B			45	200	pA
		−40°C ≤ T_A ≤ +125°C			500	pA
Input Offset Current	I_{OS}			35	200	pA
		−40°C ≤ T_A ≤ +125°C			500	pA
Input Voltage Range			−13.8		+13.8	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −13.8 V to +13.8 V	125	135		dB
		−40°C ≤ T_A ≤ +125°C	112			dB
Open-Loop Gain	A_{VO}	R_L = 10 kΩ, V_O = −13.5 V to +13.5 V	125	137		dB
		−40°C ≤ T_A ≤ +125°C	120			dB
Input Resistance, Differential Mode	R_{INDM}			1		GΩ
Input Resistance, Common Mode	R_{INCM}			1		TΩ
Input Capacitance, Differential Mode	C_{INDM}			5.5		pF
Input Capacitance, Common Mode	C_{INCM}			3		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to ground	14.94	14.97		V
		−40°C ≤ T_A ≤ +125°C	14.84			V
		R_L = 100 kΩ to ground	14.86	14.89		V
		−40°C ≤ T_A ≤ +125°C	14.75			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to ground		−14.97	−14.94	V
		−40°C ≤ T_A ≤ +125°C			−14.92	V
		R_L = 100 kΩ to ground		−14.89	−14.90	V
		−40°C ≤ T_A ≤ +125°C			−14.80	V
Short-Circuit Current	I_{SC}			±40		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1kHz, Av = 1		1.5		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±2.0 V to ±18.0 V	125	145		dB
		−40°C ≤ T_A ≤ +125°C	120			dB
Supply Current/Amplifier	I_{SY}	I_O = 0 mA		215	250	µA
		I_O = 0 mA, −40°C ≤ T_A ≤ +125°C			350	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ, C_L = 20 pF, A_V = 1		0.48		V/µs
Gain Bandwidth Product	GBP	C_L = 20 pF, A_V = 1		600		kHz
Phase Margin	Φ_M	C_L = 20 pF, A_V = 1		72		Degrees
NOISE PERFORMANCE						
Voltage Noise	$e_{n\,p-p}$	f = 0.1 Hz to 10 Hz		0.2		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		11		nV/√Hz
Uncorrelated Current Noise Density	i_n	f = 1 kHz		0.15		pA/√Hz
Correlated Current Noise Density	i_n	f = 1 kHz		0.06		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	± 18 V
Input Voltage	±V supply
Input Current[1]	±10 mA
Differential Input Voltage	±10 V
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, 60 sec)	300°C

[1] The input pins have clamp diodes to power the supply pins. The input current should be limited to 10 mA or less whenever input signals exceed the power supply rail by 0.5 V.

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.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages. This was measured using a standard 2-layer board.

Table 5. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
14-Lead TSSOP (RU-14)	TBD	TBD	°C/W
16-Lead LFCSP (CP-16)	TBD	TBD	°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.

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