Zero-Drift, Single-Supply, Rail-to-Rail Input/Output Operational Amplifiers

AD8571/AD8572/AD8574

FEATURES

Low offset voltage: 1 µV
Input offset drift: 0.005 µV/°C
Rail-to-rail input and output swing
5 V/2.7 V single-supply operation
High gain: 145 dB typical
CMRR: 140 dB typical
PSRR: 130 dB typical
Ultralow input bias current: 10 pA typical
Low supply current: 750 µA per op amp
Overload recovery time: 50 µs
No external capacitors required

APPLICATIONS

Temperature sensors
Pressure sensors
Precision current sensing
Strain gage amplifiers
Medical instrumentation
Thermocouple amplifiers

GENERAL DESCRIPTION

This family of amplifiers has ultralow offset, drift, and bias current. The AD8571, AD8572, and AD8574 are single, dual, and quad amplifiers, respectively, featuring rail-to-rail input and output swings. All are guaranteed to operate from 2.7 V to 5 V single supply.

The AD857x family provides benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. Using Analog Devices, Inc., topology, these zero-drift amplifiers combine low cost with high accuracy. (No external capacitors are required.) Using a patented spread-spectrum, auto-zero technique, the AD857x family eliminates the intermodulation effects from interaction of the chopping function with the signal frequency in ac applications.

With an offset voltage of only 1 µV and drift of 0.005 µV/°C, the AD857x family is perfectly suited for applications where 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 range. Many more systems require the rail-to-rail input and output swings provided by the AD857x family.

PIN CONFIGURATIONS

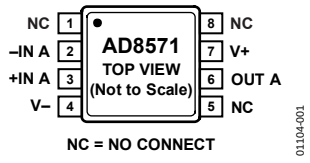

Figure 1. 8-Lead MSOP (RM Suffix)

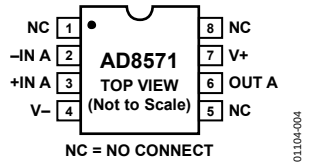

Figure 2. 8-Lead SOIC (R Suffix)

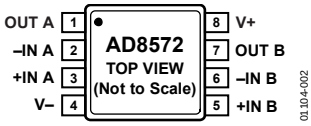

Figure 3. 8-Lead TSSOP (RU Suffix)

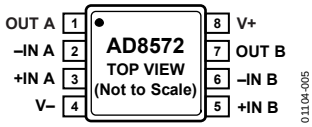

Figure 4. 8-Lead SOIC (R Suffix)

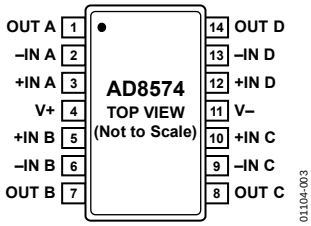

Figure 5. 14-Lead TSSOP (RU Suffix)

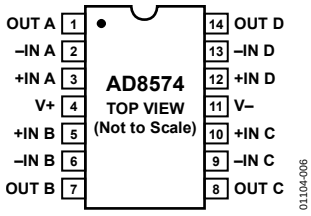

Figure 6. 14-Lead SOIC (R Suffix)

The AD857x family is specified for the extended industrial/automotive temperature range (–40°C to +125°C). The AD8571 single amplifier is available in 8-lead MSOP and narrow SOIC packages. The AD8572 dual amplifier is available in 8-lead narrow SOIC and surface-mount TSSOP packages. The AD8574 quad amplifier is available in 14-lead narrow SOIC and TSSOP packages.

SPECIFICATIONS

5 V ELECTRICAL CHARACTERISTICS

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

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	µV
		−40°C ≤ T_A ≤ +125°C			10	µV
Input Bias Current	I_B			10	50	pA
AD8571/AD8574		−40°C ≤ T_A ≤ +125°C		1.0	1.5	nA
AD8572		−40°C ≤ T_A ≤ +85°C		160	300	pA
		−40°C ≤ T_A ≤ +125°C		2.5	4	nA
Input Offset Current	I_{OS}			20	70	pA
AD8571/AD8574		−40°C ≤ T_A ≤ +125°C		150	200	pA
AD8572		−40°C ≤ T_A ≤ +85°C		30	150	pA
		−40°C ≤ T_A ≤ +125°C		150	400	pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 5 V	120	140		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Large Signal Voltage Gain[1]	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 4.7 V	125	145		dB
		−40°C ≤ T_A ≤ +125°C	120	135		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.005	0.04	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	4.99	4.998		V
		R_L = 100 kΩ to GND @ −40°C to +125°C	4.99	4.997		V
		R_L = 10 kΩ to GND	4.95	4.98		V
		R_L = 10 kΩ to GND @ −40°C to +125°C	4.95	4.975		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	10	mV
		R_L = 100 kΩ to V+ @ −40°C to +125°C		2	10	mV
		R_L = 10 kΩ to V+		10	30	mV
		R_L = 10 kΩ to V+ @ −40°C to +125°C		15	30	mV
Short-Circuit Limit	I_{SC}		±25	±50		mA
		−40°C to +125°C		±40		mA
Output Current	I_O			±30		mA
		−40°C to +125°C		±15		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	120	130		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current per Amplifier	I_{SY}	V_O = 0 V		850	975	µA
		−40°C ≤ T_A ≤ +125°C		1000	1075	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.4		V/µs
Overload Recovery Time				0.05	0.3	ms
Gain Bandwidth Product	GBP			1.5		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz		1.3		µV p-p
		0 Hz to 1 Hz		0.41		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		51		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		2		fA/√Hz

[1] Gain testing is dependent upon test bandwidth.

2.7 V ELECTRICAL CHARACTERISTICS

V_S = 2.7 V, V_{CM} = 1.35 V, V_O = 1.35 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	µV
		−40°C ≤ T_A ≤ +125°C			10	µV
Input Bias Current	I_B			10	50	pA
AD8571/AD8574		−40°C ≤ T_A ≤ +125°C		1.0	1.5	nA
AD8572		−40°C ≤ T_A ≤ +85°C		160	300	pA
		−40°C ≤ T_A ≤ +125°C		2.5	4	nA
Input Offset Current	I_{OS}			10	50	pA
AD8571/AD8574		−40°C ≤ T_A ≤ +125°C		150	200	pA
AD8572		−40°C ≤ T_A ≤ +85°C		30	150	pA
		−40°C ≤ T_A ≤ +125°C		150	400	pA
Input Voltage Range			0		2.7	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 2.7 V	115	130		dB
		−40°C ≤ T_A ≤ +125°C	110	130		dB
Large Signal Voltage Gain[1]	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 2.4 V	110	140		dB
		−40°C ≤ T_A ≤ +125°C	105	130		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.005	0.04	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	2.685	2.697		V
		R_L = 100 kΩ to GND @ −40°C to +125°C	2.685	2.696		V
		R_L = 10 kΩ to GND	2.67	2.68		V
		R_L = 10 kΩ to GND @ −40°C to +125°C	2.67	2.675		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	10	mV
		R_L = 100 kΩ to V+ @ −40°C to +125°C		2	10	mV
		R_L = 10 kΩ to V+		10	20	mV
		R_L = 10 kΩ to V+ @ −40°C to +125°C		15	20	mV
Short-Circuit Limit	I_{SC}		±10	±15		mA
		−40°C to +125°C		±10		mA
Output Current	I_O			±10		mA
		−40°C to +125°C		±5		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	120	130		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current per Amplifier	I_{SY}	V_O = 0 V		750	900	µA
		−40°C ≤ T_A ≤ +125°C		950	1000	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.5		V/µs
Overload Recovery Time				0.05		ms
Gain Bandwidth Product	GBP			1		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz		2.0		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		94		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		2		fA/√Hz

[1] Gain testing is dependent upon test bandwidth.

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	GND to V_S + 0.3 V
Differential Input Voltage[1]	±5.0 V
ESD (Human Body Model)	2000 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] Differential input voltage is limited to ±5.0 V or the supply voltage, whichever is less.

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 CHARACTERISTICS

θ_{JA} is specified for the worst-case conditions, that is, θ_{JA} is specified for a device soldered in a circuit board for SOIC and TSSOP packages.

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead SOIC (R)	158	43	°C/W
8-Lead MSOP (RM)	190	44	°C/W
8-Lead TSSOP (RU)	240	43	°C/W
14-Lead SOIC (R)	120	36	°C/W
14-Lead TSSOP (RU)	180	36	°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.

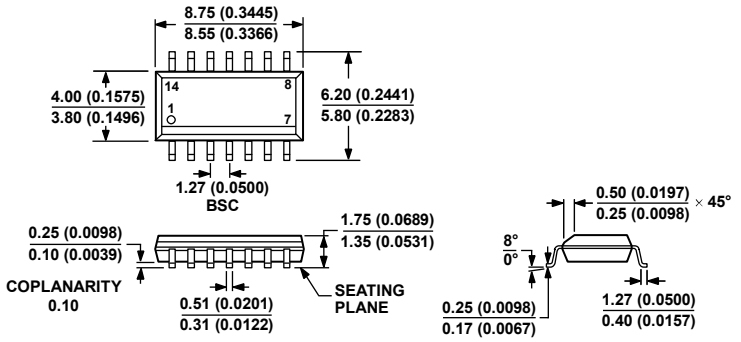

Figure 73. 14-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-14)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
AD8571AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571AR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571AR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571ARZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8571ARM-R2	−40°C to +125°C	8-Lead MSOP	RM-8	AJA
AD8571ARM-REEL	−40°C to +125°C	8-Lead MSOP	RM-8	AJA
AD8571ARMZ-R2[1]	−40°C to +125°C	8-Lead MSOP	RM-8	AJA#
AD8571ARMZ-REEL[1]	−40°C to +125°C	8-Lead MSOP	RM-8	AJA#
AD8572AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572AR-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572AR-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572ARZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8572ARU	−40°C to +125°C	8-Lead TSSOP	RU-8	
AD8572ARU-REEL	−40°C to +125°C	8-Lead TSSOP	RU-8	
AD8572ARUZ[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
AD8572ARUZ-REEL[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
AD8574AR	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574AR-REEL	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574AR-REEL7	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574ARZ[1]	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574ARZ-REEL[1]	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574ARZ-REEL7[1]	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8574ARU	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8574ARU-REEL	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8574ARUZ[1]	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8574ARUZ-REEL[1]	−40°C to +125°C	14-Lead TSSOP	RU-14	

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