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

Enhanced Product

AD8512-EP

FEATURES

- Fast settling time: 500 ns to 0.1%
- Low offset voltage: 1.0 mV maximum at V_S = ±15 V
- Low offset voltage drift: 1.7 µV/°C typical
- Low input bias current: 25 pA typical at V_S = ±15 V
- Dual-supply operation: ±5 V to ±15 V
- Low noise: 8.0 nV/√Hz typical at f = 1 kHz
- Low distortion: 0.0005%
- No phase reversal
- Unity gain stable

ENHANCED PRODUCT FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Military temperature range (−55°C to +125°C)
- Controlled manufacturing baseline
- 1 assembly/test site
- 1 fabrication site
- Product change notification
- Qualification data available on request

APPLICATIONS

- Instrumentation
- Multipole filters
- Precision current measurement
- Photodiode amplifiers
- Military communication
- Avionics

PIN CONFIGURATION

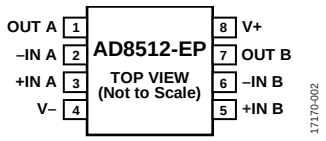

Figure 1.

GENERAL DESCRIPTION

The AD8512-EP is a dual-precision JFET amplifier that features low offset voltage, input bias current, input voltage noise, and input current noise.

The combination of low offsets, low noise, and very low input bias currents makes these amplifiers especially suitable for high impedance sensor amplification and precise current measurements using shunts. The combination of dc precision, low noise, and fast settling time results in superior accuracy in flight instruments, electronic measurement, and aviation equipment. Unlike many competitive amplifiers, the AD8512-EP maintains its fast settling performance even with substantial capacitive loads. Unlike many older JFET amplifiers, the AD8512-EP does not suffer from output phase reversal when input voltages exceed the maximum common-mode voltage range.

Fast slew rate and great stability with capacitive loads make the AD8512-EP suitable for high performance filters. Low input bias currents, low offset, and low noise result in a wide dynamic range of photodiode amplifier circuits. Low noise and distortion, high output current, and excellent speed make the AD8512-EP a great choice for military communication applications.

The AD8512-EP is available in an 8-lead narrow SOIC_N package. The AD8512-EP is specified over a military temperature range of −55°C to +125°C. Additional application and technical information can be found in the AD8512 data sheet.

Rev. 0 Document Feedback

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REVISION HISTORY

8/2018—Revision 0: Initial Version

SPECIFICATIONS

V_S = ±5 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			0.1	0.9	mV
		−55°C < T_A < +125°C			1.8	mV
Input Bias Current	I_B			21	75	pA
		−55°C < T_A < +85°C			0.7	nA
		−55°C < T_A < +125°C			7.5	nA
Input Offset Current	I_{OS}			5	50	pA
		−55°C < T_A < +85°C			0.3	nA
		−55°C < T_A < +125°C			0.5	nA
Input Capacitance						
Differential				12.5		pF
Common Mode				11.5		pF
Input Voltage Range			−2.0		+2.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −2.0 V to +2.5 V	86	100		dB
Large-Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, V_O = −3 V to +3 V	65	107		V/mV
Offset Voltage Drift (T_CV_{OS})	$\Delta V_{OS}/\Delta T$			1.7	12	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ	4.1	4.3		V
		R_L = 2 kΩ	3.9	4.2		V
		R_L = 600 Ω	3.7	4.1		V
Output Voltage Low	V_{OL}	R_L = 10 kΩ, −55°C < T_A < +125°C		−4.9	−4.7	V
		R_L = 2 kΩ, −55°C < T_A < +125°C		−4.9	−4.5	V
		R_L = 600 Ω, −55°C < T_A < +125°C		−4.8	−4.2	V
Output Current	I_{OUT}		±40	±54		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±4.5 V to ±18 V	86	130		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		2.0	2.3	mA
		−55°C < T_A < +125°C			2.5	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ		20		V/µs
Gain Bandwidth Product	GBP			8		MHz
Settling Time	t_S	To 0.1%, 0 V to 4 V step, G = +1		0.4		µs
Total Harmonic Distortion (THD) + Noise	THD + N	1 kHz, G = +1, R_L = 2 kΩ		0.0005		%
Phase Margin	φ_M			44.5		Degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 10 Hz		34		nV/√Hz
		f = 100 Hz		12		nV/√Hz
		f = 1 kHz		8.0	10	nV/√Hz
		f = 10 kHz		7.6		nV/√Hz
Peak-to-Peak Voltage Noise	e_n p-p	0.1 Hz to 10 Hz bandwidth		2.4	5.2	µV p-p

ELECTRICAL CHARACTERISTICS

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

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			0.1	1.0	mV
		−55°C < T_A < +125°C			1.8	mV
Input Bias Current	I_B			25	80	pA
		−55°C < T_A < +85°C			0.7	nA
		−55°C < T_A < +125°C			10	nA
Input Offset Current	I_{OS}			6	75	pA
		−55°C < T_A < +85°C			0.3	nA
		−55°C < T_A < +125°C			0.5	nA
Input Capacitance						
Differential				12.5		pF
Common Mode				11.5		pF
Input Voltage Range			−13.5		+13.0	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −12.5 V to +12.5 V	86	108		dB
Large-Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, V_{CM} = 0 V, V_O = −13.5 V to +13.5 V	115	196		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1.7	12	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ	14.0	14.2		V
		R_L = 2 kΩ	13.8	14.1		V
		R_L = 600 Ω	13.5	13.9		V
		R_L = 600 Ω, −55°C < T_A < +125°C	11.4			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ, −55°C < T_A < +125°C		−14.9	−14.6	V
		R_L = 2 kΩ, −55°C < T_A < +125°C		−14.8	−14.5	V
		R_L = 600 Ω		−14.3	−13.8	V
		R_L = 600 Ω, −55°C < T_A < +125°C			−12.1	V
Output Current	I_{OUT}			±70		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±4.5 V to ±18 V	86			dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		2.2	2.5	mA
		−55°C < T_A < +125°C			2.6	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ		20		V/µs
Gain Bandwidth Product	GBP			8		MHz
Settling Time	t_S	To 0.1%, 0 V to 10 V step, G = +1		0.5		µs
		To 0.01%, 0 V to 10 V step, G = +1		0.9		µs
Total Harmonic Distortion (THD) + Noise	THD + N	1 kHz, G = +1, R_L = 2 kΩ		0.0005		%
Phase Margin	φ_M			52		Degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 10 Hz		34		nV/√Hz
		f = 100 Hz		12		nV/√Hz
		f = 1 kHz		8.0	10	nV/√Hz
		f = 10 kHz		7.6		nV/√Hz
Peak-to-Peak Voltage Noise	e_n p-p	0.1 Hz to 10 Hz bandwidth		2.4	5.2	µV p-p

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	±18 V
Input Voltage	$\pm V_S$
Power Dissipation	See Figure 2
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−55°C to +125°C
Junction Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec)	300°C
Electrostatic Discharge (Human Body Model)	2000 V

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

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

θ_{JA} is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure. θ_{JC} is the junction to case thermal resistance.

Table 4. Thermal Resistance

Package Type[1]	θ_{JA}	θ_{JC}	Unit
R-8	158	43	°C/W

[1] Thermal impedance simulated values are based on a JEDEC 2S2P thermal test board. See JEDEC JESD-51.

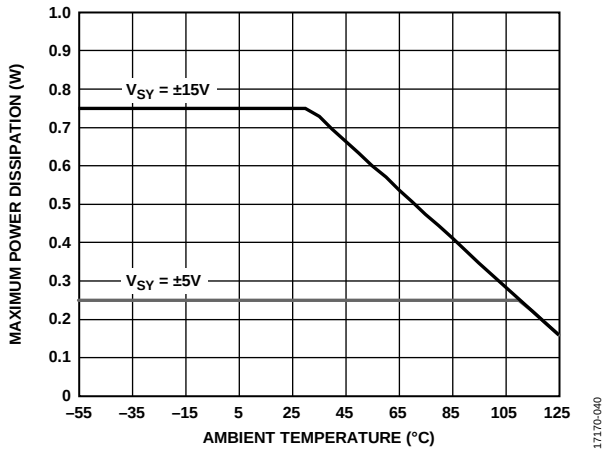

Figure 2. Maximum Power Dissipation vs. Ambient Temperature

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.

TYPICAL PERFORMANCE CHARACTERISTICS

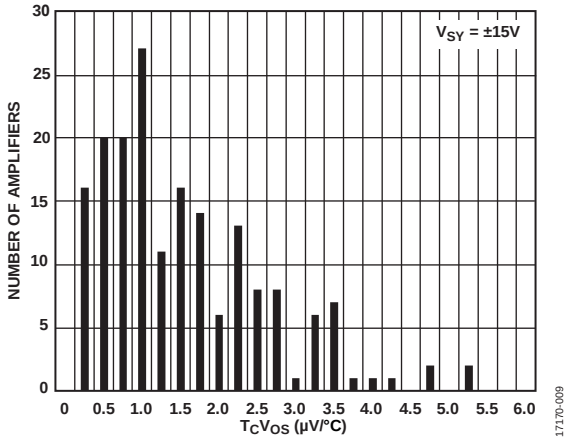

Figure 3. T_CV_{OS} Distribution

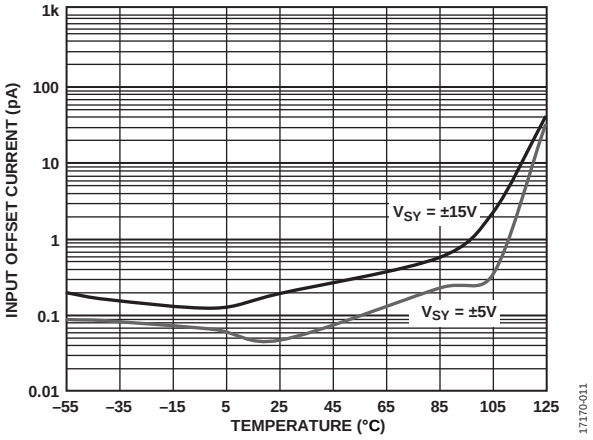

Figure 5. Input Offset Current vs. Temperature

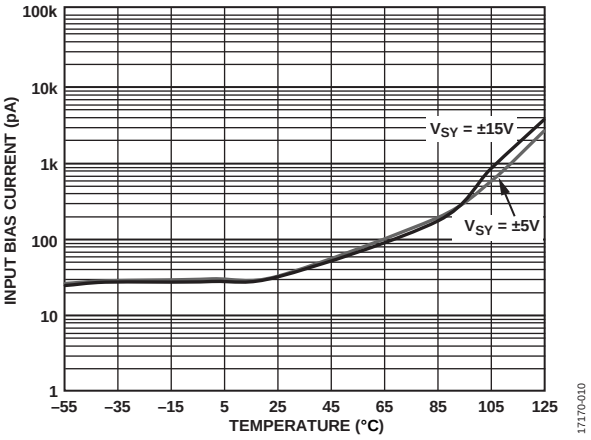

Figure 4. Input Bias Current vs. Temperature

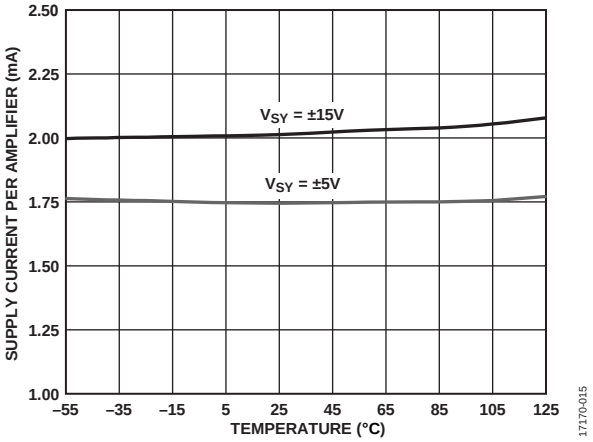

Figure 6. Supply Current per Amplifier vs. Temperature

OUTLINE DIMENSIONS

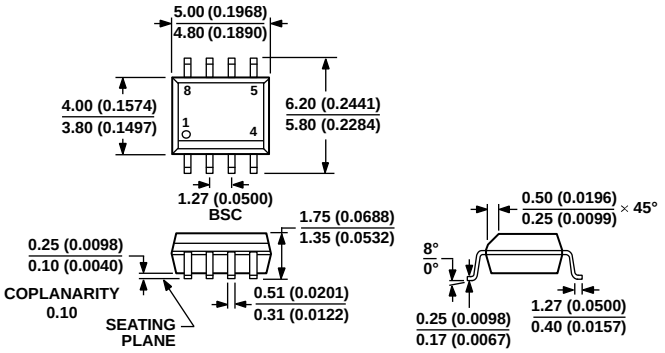

Figure 7. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option	Marking Code
AD8512TRZ-EP	−55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8	DNL
AD8512TRZ-EP-R7	−55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8	DNL

[1] Z = RoHS Compliant Part

D17170-0-8/18(0)

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