Low Noise, Low Gain Drift, G = 2000, Instrumentation Amplifier

Data Sheet

AD8428-KGD

FEATURES

- Fixed gain of 2000
- Access to internal nodes provides flexibility
- Low noise: 1.5 nV/√Hz voltage noise
- High accuracy dc performance
  - Gain drift: 10 ppm/°C maximum
  - Input offset voltage, average temperature coefficient: 1 µV/°C maximum
  - Total gain error: 0.2% maximum
  - CMRR, dc to 60 Hz: 130 dB minimum
- Excellent ac specifications
  - −3 dB small signal bandwidth: 3.5 MHz
  - Slew rate: 40 V/µs minimum
- Power supply operating range: ±4 V to ±18 V
- ESD protection: 5000 V (HBM)
- Temperature range for specified performance: −40°C to +85°C
- Operational up to 125°C
- Known Good Die (KGD): these die are fully guaranteed to data sheet specifications.

APPLICATIONS

- Sensor interface
- Medical instrumentation
- Patient monitoring

FUNCTIONAL BLOCK DIAGRAM

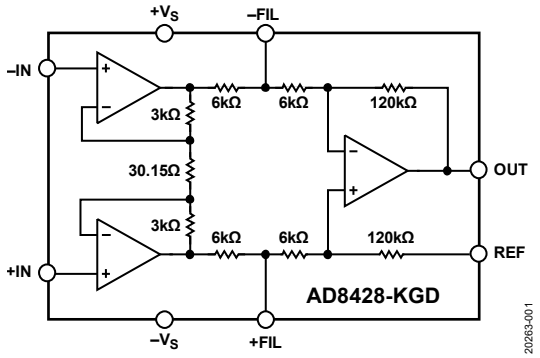

Figure 1.

GENERAL DESCRIPTION

The AD8428-KGD is an ultralow noise instrumentation amplifier (in-amp) designed to accurately measure small, high speed signals.

All gain setting resistors for the AD8428-KGD are internal to the device and are precisely matched. Care is taken in both the chip pinout and layout that results in excellent gain drift and quick settling to the final gain value after the device powers on.

The high common-mode rejection ratio (CMRR) of the AD8428-KGD prevents unwanted signals from corrupting the signal of interest. The pin configuration of the AD8428-KGD is designed to avoid parasitic capacitance mismatches that can degrade CMRR at high frequencies.

The AD8428-KGD is one of the fastest in-amps available. The circuit architecture is designed for high bandwidth at high gain.

The AD8428-KGD uses a current feedback topology for the initial preamplifier gain stage of 200, followed by a difference amplifier stage of 10. This architecture results in a 3.5 MHz bandwidth at a gain of 2000.

The AD8428-KGD pin configuration allows access to internal nodes between the first and second stages. This feature can be useful for modifying the frequency response between the two amplification stages, thereby preventing unwanted signals from contaminating the output results.

The performance of the AD8428-KGD is specified from −40°C to +85°C and operational to 125°C.

Additional application and technical information can be found in the AD8428 data sheet.

Rev. 0 Document Feedback

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700
Technical Support www.analog.com

TABLE OF CONTENTS

REVISION HISTORY

10/2019—Revision 0: Initial Version

SPECIFICATIONS

Supply voltage (V_S) = ±15 V, REF voltage (V_{REF}) = 0 V, T_A = 25°C, G = 2000, and load resistance (R_L) = 10 kΩ, unless otherwise noted.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
CMRR	Referred to input (RTI), common-mode voltage (V_{CM}) = ±10 V				
DC to 60 Hz		130			dB
At 50 kHz		110			dB
NOISE, RTI	+IN voltage (V_{+IN}), –IN voltage (V_{-IN}) = 0 V				
Voltage Noise	Frequency = 1 kHz		1.3	1.5	nV/√Hz
	Frequency = 0.1 Hz to 10 Hz		40	50	nV p-p
Current Noise	Frequency = 1 kHz		1.5		pA/√Hz
	Frequency = 0.1 Hz to 10 Hz		150		pA p-p
VOLTAGE OFFSET					
Input Offset (V_{OSI})				100	µV
Average Temperature Coefficient	T_A = −40°C to +85°C			1	µV/°C
Offset RTI vs. Supply (Power Supply Rejection Ratio)		120			dB
INPUT CURRENT					
Input Bias Current				200	nA
Over Temperature	T_A = −40°C to +85°C		250		pA/°C
Input Offset Current				50	nA
Over Temperature	T_A = −40°C to +85°C		20		pA/°C
DYNAMIC RESPONSE					
−3 dB Small Signal Bandwidth			3.5		MHz
Settling Time					
To 0.01%	10 V step		0.75		µs
To 0.001%	10 V step		1.4		µs
Slew Rate		40	50		V/µs
GAIN					
First Stage Gain			200		V/V
Subtractor Stage Gain			10		V/V
Total Gain Error	Output voltage (V_{OUT}) = −10 V to +10 V			0.2	%
Total Gain Nonlinearity	V_{OUT} = −10 V to +10 V			5	ppm
Gain Drift				10	ppm/°C
INPUT					
Impedance (Pin to Ground)[1]			1‖2		GΩ‖pF
Input Operating Voltage Range	V_S = ±4 V to ±18 V	$-V_S$ + 2.5		$+V_S$ − 2.5	V
Over Temperature	T_A = −40°C to +85°C	$-V_S$ + 2.5		$+V_S$ − 2.5	V
OUTPUT					
Output Voltage Swing	R_L = 2 kΩ	$-V_S$ + 1.7		$+V_S$ − 1.2	V
Over Temperature	T_A = −40°C	$-V_S$ + 2.0		$+V_S$ − 1.3	V
	T_A = +85°C	$-V_S$ + 1.6		$+V_S$ − 1.1	V
Output Voltage Swing	R_L = 10 kΩ	$-V_S$ + 1.7		$+V_S$ − 1.0	V
Over Temperature	T_A = −40°C	$-V_S$ + 1.8		$+V_S$ − 1.2	V
	T_A = +85°C	$-V_S$ + 1.4		$+V_S$ − 0.9	V
Short-Circuit Current			30		mA

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
REFERENCE INPUT					
Input Impedance (R_{IN})			132		kΩ
Input Current (I_{IN})	$V_{IN}+$, $V_{IN}-$ = 0 V		6.5		μA
Voltage Range		$-V_S$		$+V_S$	V
Reference Gain to Output			1		V/V
Reference Gain Error			0.01		%
FILTER TERMINALS					
R_{IN}[2]			6		kΩ
Voltage Range		$-V_S$		$+V_S$	V
POWER SUPPLY					
Operating Range		±4		±18	V
Quiescent Current			6.5	6.8	mA
Over Temperature	T_A = −40°C to +85°C			8	mA
TEMPERATURE RANGE					
For Specified Performance		−40		+85	°C
Operational[3]		−40		+125	°C

[1] The differential and common-mode input impedances are calculated from the pin impedance: differential impedance (Z_{DIFF}) = 2(pin impedance (Z_{PIN})); common-mode impedance (Z_{CM}) = Z_{PIN}/2.
[2] To calculate the actual impedance, see Figure 1.
[3] See the AD8428 data sheet for expected operation between 85°C and 125°C.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	±18 V
Output Short-Circuit Current Duration	Indefinite
Maximum Voltage at −IN, +IN[1]	$\pm V_S$
Maximum Voltage at −FIL, +FIL	$\pm V_S$
Differential Input Voltage[1]	±1 V
Maximum Voltage at REF	$\pm V_S$
Temperature Range	
Storage	−65°C to +150°C
Specified	−40°C to +85°C
Maximum Junction Temperature	140°C
Electrostatic Discharge (ESD)	
Human Body Model (HBM)	5000 V
Charged Device Model	1250 V
Machine Model	400 V

[1] For voltages beyond these limits, use input protection resistors. See the AD8428 data sheet for more information.

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.

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.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

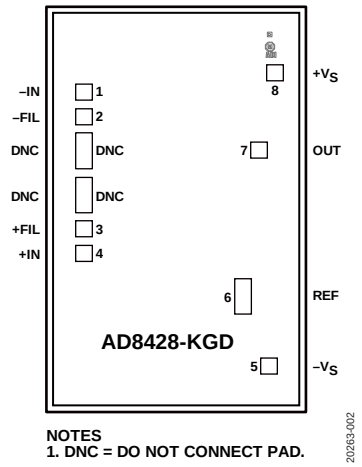

Figure 2. Pad Configuration

Table 3. Pad Function Descriptions

Pad No.	Mnemonic	X Coordinate (µm)	Y Coordinate (µm)	Description
1	−IN	−661	+665	Negative Input Pad
2	−FIL	−661	+525	Negative Filter Pad
Not applicable	DNC	−661	+331.024	Do Not Connect Pad
Not applicable	DNC	−661	+83.008	Do Not Connect Pad
3	+FIL	−661	−111	Positive Filter Pad
4	+IN	−661	−251	Positive Input Pad
5	$-V_S$	+682	−1231	Negative Power Supply Pad
6	REF	+538	−839	Reference Voltage Pad
7	OUT	+626	+337	Output Pad
8	$+V_S$	+717	+979	Positive Power Supply Pad

OUTLINE DIMENSIONS

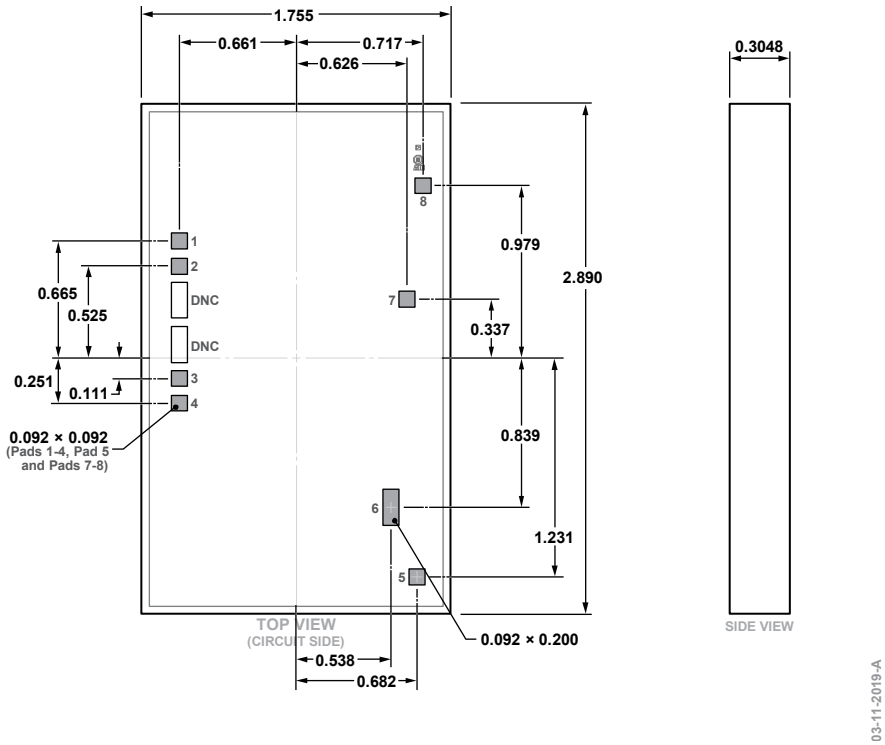

Figure 3. 8-Pad Bare Die [CHIP]
(C-8-16)
Dimensions shown in millimeters

DIE SPECIFICATIONS AND ASSEMBLY RECOMMENDATIONS

Table 4. Die Specifications

Parameter	Value	Unit
Scribe Line Width	90	µm
Die Size	1755 × 2890	µm
Thickness	304.8	µm
Backside	None[1]	Not applicable
Passivation	1 silicon oxide nitride/18 polyimide	µm
Bond Pads Opening (Minimum)	92 × 92	µm
Bond Pad Composition	1.0 aluminum (Al), silicon(Si)/0.5 copper (Cu)	%

[1] If connecting the backside to a voltage potential, tie the backside to $-V_S$. Otherwise, leave the backside floating.

Table 5. Assembly Recommendations

Assembly Component	Recommendation
Die Attach	Hitachi EN4900GC conductive
Bonding Method	0.8 mils, gold
Bonding Sequence	Unspecified

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
AD8428-KGD-WP	−40°C to +85°C	8-Pad Bare Die [CHIP], Waffle Pack	C-8-16

[1] The AD8428-KGD-WP is a RoHS compliant part.