16 V, 1.2 MHz, CMOS Rail-to-Rail Input/Output Operational Amplifier

Known Good Die

ADA4665-2-KGD

FEATURES

Low supply current per amplifier: 290 µA typical, I_{OUT} = 0 mA
Low input bias current: 1 pA maximum
Wide gain bandwidth product: 1.2 MHz typical
Slew rate: 1 V/µs typical
Offset voltage drift: 3 µV/°C typical
Single-supply operation: 5 V to 16 V
Dual-supply operation: ±2.5 V to ±8 V
Unity-gain stable

APPLICATIONS

Portable systems
High density power budget systems
Medical equipment
Physiological measurement
Precision references
Multipole filters
Sensors
Transimpedance amplifiers
Buffer and level shifting

GENERAL DESCRIPTION

The ADA4665-2-KGD is a rail-to-rail, input and output, dual amplifier optimized for lower power budget designs. The ADA4665-2-KGD offers a low supply current of 400 µA maximum per amplifier at 25°C and 600 µA maximum per amplifier over the extended industrial temperature range. This feature makes the ADA4665-2-KGD well suited for low power applications.

In addition, the ADA4665-2-KGD has a low bias current of 1 pA maximum, low offset voltage drift of 3 µV/°C, and bandwidth of 1.2 MHz. The combination of these features, together with a wide supply voltage range from 5 V to 16 V, allows the device to be used in a wide variety of other applications, including process control, instrumentation equipment, buffering, and sensor front ends.

Furthermore, its rail-to-rail input and output swing adds to its versatility. The ADA4665-2-KGD is specified from −40°C to +125°C.

Additional application and technical information can be found in the ADA4665-2 data sheet.

Known Good Die (KGD): this die is fully guaranteed to data sheet specifications.

Rev. 0 Document Feedback

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REVISION HISTORY

10/2019—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—16 V OPERATION

Supply voltage (V_{SY}) = 16 V, common-mode voltage (V_{CM}) = V_{SY}/2, and T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 16 V		1	4	mV
		V_{CM} = 0 V to 16 V		1	6	mV
		−40°C ≤ T_A ≤ +125°C			9	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		3		µV/°C
Input Bias Current	I_B			0.1	1	pA
		−40°C ≤ T_A ≤ +125°C			200	pA
Input Offset Current	I_{OS}			0.1	1	pA
		−40°C ≤ T_A ≤ +125°C			40	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		16	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 16 V	55	75		dB
		−40°C ≤ T_A ≤ +125°C	50			dB
Large Signal Voltage Gain	A_{VO}	Load resistance (R_L) = 10 kΩ, output voltage (V_{OUT}) = 0.5 V to 15 V	85	100		dB
		−40°C ≤ T_A ≤ +125°C	75			dB
Input Resistance	R_{IN}			4		GΩ
Input Capacitance						
Differential Mode	C_{INDM}			2		pF
Common Mode	C_{INCM}			7		pF
OUTPUT CHARACTERISTICS						
Output Voltage						
High	V_{OH}	R_L = 100 kΩ to V_{CM}	15.95	15.99		V
		−40°C ≤ T_A ≤ +125°C	15.9			V
		R_L = 10 kΩ to V_{CM}	15.9	15.95		V
		−40°C ≤ T_A ≤ +125°C	15.8			V
Low	V_{OL}	R_L = 100 kΩ to V_{CM}		4	7.5	mV
		−40°C ≤ T_A ≤ +125°C			15	mV
		R_L = 10 kΩ to V_{CM}		40	75	mV
		−40°C ≤ T_A ≤ +125°C			150	mV
Short-Circuit Current	I_{SC}			±30		mA
Closed-Loop Output Impedance	Z_{OUT}	Frequency = 100 kHz, A_V = 1		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 5 V to 16 V	70	95		dB
		−40°C ≤ T_A ≤ +125°C	65			dB
Supply Current per Amplifier	I_{SY}	Output current (I_{OUT}) = 0 mA		290	400	µA
		−40°C ≤ T_A ≤ +125°C			600	µA
Operating Range	V_{SY}	Dual supply	±2.5		±8	V
		Single supply	5		16	V
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ, load capacitance (C_L) = 50 pF, A_V = 1		1		V/µs
Settling Time to 0.1%	t_S	Input voltage (V_{IN}) = 1 V step, R_L = 2 kΩ, C_L = 50 pF		6.5		µs
Gain Bandwidth Product	GBP	R_L = 10 kΩ, C_L = 50 pF, A_V = 1		1.2		MHz
Phase Margin	Φ_M	R_L = 10 kΩ, C_L = 50 pF, A_V = 1		50		Degrees

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	Frequency = 0.1 Hz to 10 Hz		3		μV p-p
Voltage Noise Density	e_n	Frequency = 1 kHz		32		nV/√Hz
		Frequency = 10 kHz		27		nV/√Hz
Current Noise Density	i_n	Frequency = 1 kHz		50		fA/√Hz

ELECTRICAL CHARACTERISTICS—5 V OPERATION

V_{SY} = 5 V, V_{CM} = V_{SY}/2, and T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 5 V		1	4	mV
		V_{CM} = 0 V to 5 V		1	6	mV
		−40°C ≤ T_A ≤ +125°C			9	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		3		µV/°C
Input Bias Current	I_B			0.1	1	pA
		−40°C ≤ T_A ≤ +125°C			100	pA
Input Offset Current	I_{OS}			0.1	1	pA
		−40°C ≤ T_A ≤ +125°C			10	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 5 V	55	75		dB
		−40°C ≤ T_A ≤ +125°C	50			dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ, V_{OUT} = 0.5 V to 4.5 V	85	100		dB
		−40°C ≤ T_A ≤ +125°C	75			dB
Input Resistance	R_{IN}			1		GΩ
Input Capacitance						
Differential Mode	C_{INDM}			2		pF
Common Mode	C_{INCM}			7		pF
OUTPUT CHARACTERISTICS						
Output Voltage						
High	V_{OH}	R_L = 100 kΩ to V_{CM}	4.95	4.99		V
		−40°C ≤ T_A ≤ +125°C	4.9			V
		R_L = 10 kΩ to V_{CM}	4.9	4.96		V
		−40°C ≤ T_A ≤ +125°C	4.8			V
Low	V_{OL}	R_L = 100 kΩ to V_{CM}		3	5	mV
		−40°C ≤ T_A ≤ +125°C			10	mV
		R_L = 10 kΩ to V_{CM}		30	50	mV
		−40°C ≤ T_A ≤ +125°C			100	mV
Short-Circuit Current	I_{SC}			±8		mA
Closed-Loop Output Impedance	Z_{OUT}	Frequency = 100 kHz, A_V = 1		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 5 V to 16 V	70	95		dB
		−40°C ≤ T_A ≤ +125°C	65			dB
Supply Current per Amplifier	I_{SY}	I_{OUT} = 0 mA		270	350	µA
		−40°C ≤ T_A ≤ +125°C			600	µA
Operating Range	V_{SY}	Dual supply	±2.5		±8	V
		Single supply	5		16	V
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ, C_L = 50 pF, A_V = 1		1		V/µs
Settling Time to 0.1%	t_S	V_{IN} = 1 V step, R_L = 2 kΩ, C_L = 50 pF		6.5		µs
Gain Bandwidth Product	GBP	R_L = 10 kΩ, C_L = 50 pF, A_V = 1		1.2		MHz
Phase Margin	Φ_M	R_L = 10 kΩ, C_L = 50 pF, A_V = 1		50		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	Frequency = 0.1 Hz to 10 Hz		3		µV p-p
Voltage Noise Density	e_n	Frequency = 1 kHz		32		nV/√Hz
		Frequency = 10 kHz		27		nV/√Hz
Current Noise Density	i_n	Frequency = 1 kHz		50		fA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
V_{SY}	16.5 V
V_{IN}[1]	Ground – 0.3 V to V_{SY} + 0.3 V
Input Current	±10 mA
Differential V_{IN}	±V_{SY}
Output Short-Circuit Duration to Ground	Indefinite
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−40°C to +125°C
Junction Range	−65°C to +150°C
Lead (Soldering, 60 sec)	300°C

[1] The input pins have clamp diodes connected to the power supply pins.

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 DESCRIPTION

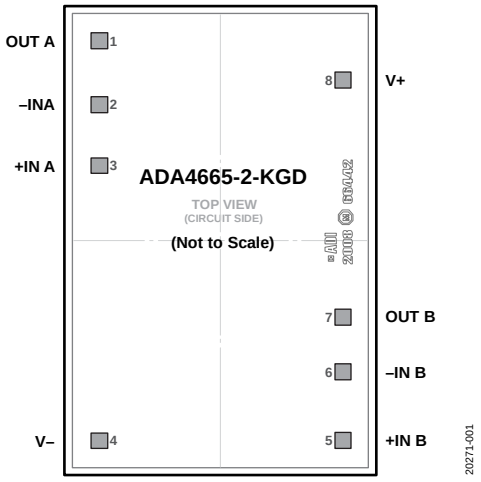

Figure 1. Pad Configuration

Table 4. Pad Configuration Descriptions[1]

Pad No.	Mnemonic	X Coordinate	Y Coordinate	Description
1	OUT A	−541	+888	Output, Channel A
2	−IN A	−541	+604	Inverting Input, Channel A
3	+IN A	−541	+331	Noninverting Input, Channel A
4	V−	−541	−888	Negative Supply Voltage
5	+IN B	+541	−888	Noninverting Input, Channel B
6	−IN B	+541	−583	Inverting Input, Channel B
7	OUT B	+541	−337	Output, Channel B
8	V+	+541	+713	Positive Supply Voltage

[1] All dimensions are referenced from the center of the die to the center of each bond pad.

OUTLINE DIMENSIONS

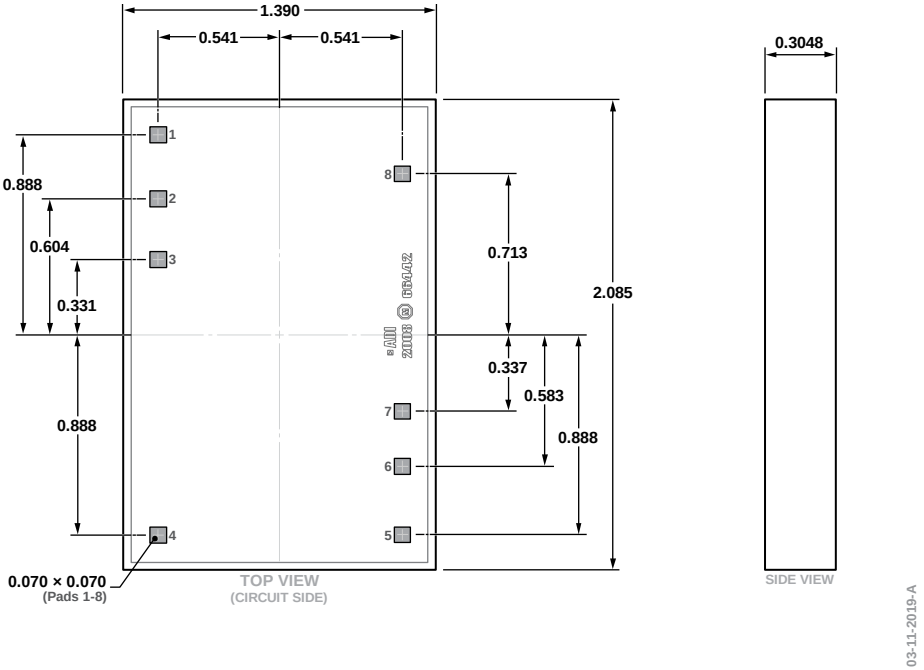

Figure 2. 8-Pad Bare Die [CHIP]
(C-8-18)
Dimensions shown in millimeters

DIE SPECIFICATIONS AND ASSEMBLY RECOMMENDATIONS

Table 5. Die Specifications

Parameter	Value	Unit
Chip Size	1310 × 2015	µm
Scribe Line Width	80	µm
Die Size	1390 × 2085	µm
Thickness	305	µm
Backside	Negative supply	Not applicable
Passivation	1 (oxynitride)	µm
Bond Pads (Minimum)	70 × 70	µm
Bond Pad Composition	99.5 aluminum (Al)/0.5 copper (Cu)	%

Table 6. Assembly Recommendations

Assembly Component	Recommendation
Die Attach	Hitachi CEL 9240HF10AK
Bonding Method	Gold ball or aluminum wedge
Bonding Sequence	Unspecified

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
ADA4665-2-KGD-WP	−40°C to +125°C	8-Pad Bare Die [CHIP], Waffle Pack	C-8-18

[1] Z = RoHS Compliant Part.