10 µA, Rail-to-Rail I/O, Zero Input Crossover Distortion Amplifier

Preliminary Technical Data

ADA4505-4

FEATURES

PSRR: 100 dB minimum
CMRR: 105 dB typical
Very low supply current: 10 µA per amplifier maximum
1.8 V to 5 V single-supply or ±0.9 to ±2.5V dual-supply operation
Rail-to-rail input and output
2.5 mV offset voltage maximum
Very low input bias current: 0.5 pA typical

APPLICATIONS

Pressure and position sensors
Remote security
Medical monitors
Battery-powered consumer equipment
Hazard detectors

PIN CONFIGURATION

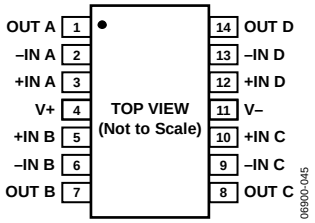

Figure 1. 14-Lead TSSOP (RU-14)

GENERAL DESCRIPTION

The ADA4505-4 is a quad micropower amplifier featuring rail-to-rail input and output swings while operating from a 1.8 V to 5 V single or from ±0.9 V to ±2.5 V dual power supply.

Employing a new circuit technology, this low cost amplifier offers zero input crossover distortion (excellent PSRR and CMRR performance) and very low bias current, while operating with a supply current of less than 10 µA per amplifier.

This combination of features makes the ADA4505-4 amplifier an ideal choice for battery-powered applications because it minimizes errors due to power supply voltage variations over the lifetime of the battery, and maintains high CMRR even for a rail-to-rail op amp.

Remote battery-powered sensors, handheld instrumentation and consumer equipment, hazard detectors (for example, smoke, fire, and gas), and patient monitors can benefit from the features of the ADA4505-4 amplifier.

The ADA4505-4 is specified for both the industrial temperature range (−40°C to +85°C) and the extended industrial temperature range (−40°C to +125°C). The ADA4505-4 quad amplifiers are available in the standard 14-lead TSSOP package.

The ADA4505-4 is a member of a growing series of zero crossover op amps offered by Analog Devices, Inc., including the AD8506, which also operates from a 1.8 V to 5 V single or from ±0.9 V to ±2.5 V dual power supply.

Rev. PrA

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—5 V OPERATION

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

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	0 V ≤ V_{CM} ≤ 5 V		0.5	2.5	mV
		−40°C ≤ T_A ≤ +125°C			3	mV
Input Bias Current	I_B			0.5	2	pA
		−40°C ≤ T_A ≤ +85°C			50	pA
		−40°C ≤ T_A ≤ +125°C			300	pA
Input Offset Current	I_{OS}			0.05	1	pA
		−40°C ≤ T_A ≤ +85°C			25	pA
		−40°C ≤ T_A ≤ +125°C			65	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		5	V
Common-Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 5 V	90	105		dB
		−40°C ≤ T_A ≤ +85°C	90			dB
		−40°C ≤ T_A ≤ +125°C	85			dB
Large Signal Voltage Gain	A_{VO}	0.05 V ≤ V_{OUT} ≤ 4.95 V	105	120		dB
		−40°C ≤ T_A ≤ +125°C	100			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		2		µV/°C
Input Resistance	R_{IN}			220		GΩ
Input Capacitance Differential Mode	$C_{IN(DM)}$			2.5		pF
Input Capacitance Common Mode	$C_{IN(CM)}$			4.7		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	4.98	4.99		V
		−40°C ≤ T_A ≤ +125°C	4.98			V
		R_L = 10 kΩ to GND	4.9	4.95		V
		−40°C ≤ T_A ≤ +125°C	4.9			V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V_{SY}		2	5	mV
		−40°C ≤ T_A ≤ +125°C			5	mV
		R_L = 10 kΩ to V_{SY}		10	25	mV
		−40°C ≤ T_A ≤ +125°C			25	mV
Short-Circuit Limit	I_{SC}	V_{OUT} = V_{SY} or GND		±40		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 1.8 V to 5 V	100	110		dB
		−40°C ≤ T_A ≤ +85°C	100			dB
		−40°C ≤ T_A ≤ +125°C	95			dB
Supply Current per Amplifier	I_{SY}	V_{OUT} = V_{SY}/2		7	10	µA
		−40°C ≤ T_A ≤ +125°C			15	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 100 kΩ, C_L = 20 pF, G = 1		6		mV/µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L = 20 pF, G = 1		50		kHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L = 20 pF, G = 1		52		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		2.95		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		55		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		20		fA/√Hz

ELECTRICAL CHARACTERISTICS—1.8 V OPERATION

V_{SY} = 1.8 V, V_{CM} = V_{SY}/2, T_A = 25°C, unless otherwise specified.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	0 V ≤ V_{CM} ≤ 1.8 V		0.5	2.5	mV
		−40°C ≤ T_A ≤ +125°C			3	mV
Input Bias Current	I_B			0.5	2	pA
		−40°C ≤ T_A ≤ +85°C			50	pA
		−40°C ≤ T_A ≤ +125°C			300	pA
Input Offset Current	I_{OS}			0.05	1	pA
		−40°C ≤ T_A ≤ +85°C			25	pA
		−40°C ≤ T_A ≤ +125°C			50	pA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		1.8	V
Common-Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 1.8 V	85	100		dB
		−40°C ≤ T_A ≤ +85°C	85			dB
		−40°C ≤ T_A ≤ +125°C	80			dB
Large Signal Voltage Gain	A_{VO}	0.05 V ≤ V_{OUT} ≤ 1.75 V	95	115		dB
		−40°C ≤ T_A ≤ +125°C	95			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		2.5		µV/°C
Input Resistance	R_{IN}			220		GΩ
Input Capacitance Differential Mode	C_{INDM}			2.5		pF
Input Capacitance Common Mode	C_{INCM}			4.7		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	1.78	1.79		V
		−40°C ≤ T_A ≤ +125°C	1.78			V
		R_L = 10 kΩ to GND	1.65	1.75		V
		−40°C ≤ T_A ≤ +125°C	1.65			V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V_{SY}		2	5	mV
		−40°C ≤ T_A ≤ +125°C			5	mV
		R_L = 10 kΩ to V_{SY}		12	25	mV
		−40°C ≤ T_A ≤ +125°C			25	mV
Short-Circuit Limit	I_{SC}	V_{OUT} = V_{SY} or GND		±3.8		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 1.8 V to 5 V	100	110		dB
		−40°C ≤ T_A ≤ +85°C	100			dB
		−40°C ≤ T_A ≤ +125°C	95			dB
Supply Current per Amplifier	I_{SY}	V_{OUT} = V_{SY}/2		7	10	µA
		−40°C ≤ T_A ≤ +125°C			15	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 100 kΩ, C_L = 20 pF, G = 1		6.5		mV/µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L = 20 pF, G = 1		50		kHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L = 20 pF, G = 1		52		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		2.95		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		55		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		20		fA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	5.5 V
Input Voltage	$\pm V_{SY}$ ± 0.1 V
Input Current[1]	±10 mA
Differential Input Voltage[2]	$\pm V_{SY}$
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] Input pins have clamp diodes to the supply pins. Input current should be limited to 10 mA or less whenever the input signal exceeds the power supply rail by 0.5 V.
[2] Differential input voltage is limited to 5 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 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 two-layer board.

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit

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.