36V, Micropower, Overvoltage Protection, Rail-to-Rail I/O Amplifiers

Preliminary Technical Data

ADA4096-2

FEATURES

32V Input Overvoltage Protection above/below the supply rails

Rail-to-Rail Input and Output Swing

Low Power: 60 μA/Amplifier typ

Unity Gain Bandwidth:

800 kHz typ @ Vsy = ±15 V

550 kHz typ @ Vsy = ±5 V

475 kHz typ @ Vsy = ±1.5 V

Single-Supply Operation: 3 V to 30 V

Low Offset Voltage: 250 μV max

High Open-Loop Gain: 120 dB typ

Unity-Gain Stable

No Phase Reversal

APPLICATIONS

Battery Monitoring

Sensor Conditioners

Portable Power Supply Control

Portable Instrumentation

GENERAL DESCRIPTION

The ADA4096 family of operational amplifier features micro-power operation and rail-to-rail input and output ranges. The extremely low power requirements and guaranteed operation from 3 V to 30 V (±1.5 V to ±15 V) make these amplifiers perfectly suited to monitor battery usage and to control battery charging. Their dynamic performance, including 27 nV/√*Hz* voltage noise density, recommends them for battery-powered audio applications. The amplifier can drive capacitive loads up to 200 pF without oscillation.

The ADA4096 has overvoltage protection inputs that allow the voltage input to exceed 32V above and below the supply rails without damage, glitching, or phase reversal, making the device ideal for robust industrial applications.

The ADA4096 are specified over the extended industrial (–40°C to +125°C) temperature range. The dual ADA4096-2 is available in 8-lead LFCSP (2x2) and 8-lead MSOP packages.

PIN CONFIGURATIONS

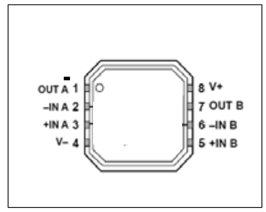

Figure 1. 8-LeadLFCSP (2x2)

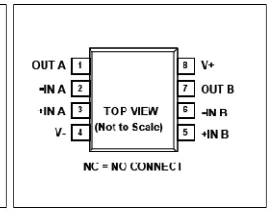

Figure 2. 8-Lead MSOP (RM)

Rev. PrB

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS – V_S = ±15V

V_S = ±15 V, V_{CM} = Vs/2, T_A = 25°C, unless otherwise specified.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			35	250	µV
		−40°C < T_A < +125°C			400	µV
Input Bias Current	I_B			±3	±10	nA
		−40°C < T_A < +125°C			±15	nA
Input Offset Current	I_{OS}			±0.1	±1.5	nA
		−40°C < T_A < +125°C			±3	nA
Input Voltage Range		−40°C < T_A < +125°C	-15		+15	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = -15 V to +15 V		95		dB
		−40°C < T_A < +125°C	75			dB
		V_{CM} = -13 V to +13 V	95	107		dB
		−40°C < T_A < +125°C	89			dB
Large Signal Voltage Gain	A_{VO}	-14.7 < V_{OUT}< +14.7,R_L = 10kΩ	110	120		dB
		−40°C < T_A < +125°C	105			dB
		-11 < V_{OUT} < +11, R_L = 2kΩ	100	112		dB
		−40°C < T_A < +125°C	90			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		1		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to GND	14.93	14.94		V
		−40°C < T_A < +125°C	14.9			V
		R_L = 2 kΩ to GND	14.10	14.30		V
		−40°C < T_A < +125°C	12.00			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to GND		-14.96	-14.80	V
		−40°C < T_A < +125°C			-14.75	V
		R_L = 2 kΩ to GND		-14.75	-14.65	V
		−40°C < T_A < +125°C			-14.0	V
Short Circuit Limit	I_{SC}			±10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 3 V to 36 V	100			dB
		−40°C to +125°C	90			dB
Supply Current/Amplifier	I_{SY}	V_O = V_S /2		60	75	µA
		−40°C < T_A < +125°C			100	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR			0.4		V/µs
Unity Gain Crossover	UGC	V_{p-}= 5mV ; R_L= 10k ; A_v=1		800		kHz
Gain Bandwidth Product	GBP	V_{p-}= 5mV ; R_L= 10k ; A_v=40dB		800		kHz
-3dB Small Signal Bandwidth						kHz
Phase Margin	ΦM			64		Degrees
NOISE PERFORMANCE						
Peak-to-Peak Noise	$e_{n\ p-p}$	f = 0.1 to 10 Hz		0.4		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		27		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		TBD		fA/√Hz

ELECTRICAL CHARACTERISTICS – V_S = ±5V

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

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			35	250	µV
		−40°C < T_A < +125°C			400	µV
Input Bias Current	I_B			±10	±12	nA
		−40°C < T_A < +125°C			±19	nA
Input Offset Current	I_{OS}			±1.5	±2	nA
		−40°C < T_A < +125°C			±3	nA
Input Voltage Range		−40°C < T_A < +125°C	-5		+5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = -5V to +5 V	74	86		dB
		−40°C < T_A < +125°C	68			dB
		V_{CM} = -3V to +3 V	91	103		dB
		−40°C < T_A < +125°C	85			dB
Large Signal Voltage Gain	A_{VO}	-4.8 < V_{OUT} < +4.8, R_L = 10kΩ	103	111		dB
		−40°C < T_A < +125°C	99			dB
		-4.7< V_{OUT} < +4.7, R_L = 2kΩ	95	103		dB
		−40°C < T_A < +125°C	88			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		1		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to GND	4.96	4.97		V
		−40°C < T_A < +125°C	4.95			V
		R_L = 2 kΩ to GND	4.80	4.90		V
		−40°C < T_A < +125°C	4.70			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to GND		-4.98	-4.97	V
		−40°C < T_A < +125°C			-4.95	V
		R_L = 2 kΩ to GND		-4.90	-4.80	V
		−40°C < T_A < +125°C			-4.75	V
Short Circuit Limit	I_{SC}			±10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 3 V to 36 V	100			dB
		−40°C to +125°C	90			dB
Supply Current/Amplifier	I_{SY}	V_O = V_S /2		47	55	µA
		−40°C < T_A < +125°C			75	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR			0.3		V/µs
Unity Gain Crossover	UGC	V_{p-}= 5mV ; R_L= 10k ; A_v=1		550		kHz
Gain Bandwidth Product	GBP	V_{p-}= 5mV ; R_L= 10k ; A_v=40dB		550		kHz
-3dB Small Signal Bandwidth						
Phase Margin	Φ_M			60		Degrees
NOISE PERFORMANCE						
Peak-to-Peak Noise	$e_{n\ p\text{-}p}$	f = 0.1 to 10 Hz		TBD		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		TBD		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		TBD		fA/√Hz

ELECTRICAL CHARACTERISTICS – VS = ±1.5V

V_S = ±1.5 V, V_{CM} = Vs/2, T_A = 25°C, unless otherwise specified.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			35	250	µV
		°0C < T_A < +125°C			350	µV
		−40°C < T_A < +125°C			900	µ V
Input Bias Current	I_B			±10	±13	nA
		−40°C < T_A < +125°C			±16	nA
Input Offset Current	I_{OS}			±0.1	±1.5	nA
		−40°C < T_A < +125°C			±3	nA
Input Voltage Range		−40°C < T_A < +125°C	-1.5		+1.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to ±1.5 V	63	77		dB
		−40°C < T_A < +125°C	58			dB
Large Signal Voltage Gain	A_{VO}	-1.4 < V_{OUT} < +1.4,R_L = 10kΩ	92	94		dB
		−40°C < T_A < +125°C	84			dB
		-1.3 < V_{OUT} < +1.3, R_L = 2kΩ	88	92		dB
		−40°C < T_A < +125°C	77			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		1		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10 kΩ to GND	1.48	1.49		V
		−40°C < T_A < +125°C	1.45			V
		R_L = 2 kΩ to GND	1.45	1.46		V
		−40°C < T_A < +125°C	1.40			V
Output Voltage Low	V_{OL}	R_L = 10 kΩ to GND		-1.49	-1.48	V
		−40°C < T_A < +125°C			-1.45	V
		R_L = 2 kΩ to GND		-1.48	-1.47	V
		−40°C < T_A < +125°C			-1.40	V
Short Circuit Limit	I_{SC}			±10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 3 V to 36 V	100			dB
		−40°C to +125°C	90			dB
Supply Current/Amplifier	I_{SY}	V_O = V_S /2		40		µA
		−40°C < T_A < +125°C			80	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR			0.25		V/µs
Unity Gain Crossover	UGC	$V_{p\text{-}}$= 5mV ; R_L= 10k ; A_v=1		475		kHz
Gain Bandwidth Product	GBP	$V_{p\text{-}}$= 5mV ; R_L= 10k ; A_v=40dB		475		kHz
-3dB Small Signal Bandwidth						kHz
Phase Margin	Φ_M			60		Degrees
NOISE PERFORMANCE						
Peak-to-Peak Noise	$e_{n\ p\text{-}p}$	f = 0.1 to 10 Hz		TBD		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		TBD		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		TBD		fA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	36 V
Input Voltage	
Operating Conditions	$V^- \leq$ Vin $\leq V^+$
Overvoltage Condition[1]	$V^- - 32V \leq$ Vin $\leq V^+ + 32V$
Differential Input Voltage	$\pm V_{sy}$
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] Performance specifications are not guaranteed during overvoltage conditions.

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.

Table 5. 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.

PR09241-0-5/11(PrB)