1 nV/√Hz, Low Power, Rail-to-Rail Output Amplifiers

Preliminary Technical Data

ADA4897-2

FEATURES

- **Low wideband noise**
  - **1 nV/√Hz**
  - **2.8 pA/√Hz**
- **Low 1/f noise**
  - **2.4 nV/√Hz @ 10 Hz**
- **Low distortion: −115 dBc @ 100 kHz, V_{OUT} = 2 V p-p**
- **Low power: 3 mA/amp**
- **Low input offset voltage: 0.5 mV maximum**
- **High speed**
  - **230 MHz, −3 dB bandwidth (G = +1)**
  - **120 V/µs slew rate**
  - **45 ns settling time to 0.1%**
- **Rail-to-rail output**
- **Wide supply range: 3 V to 10 V**
- **Output disable feature**

APPLICATIONS

- **Low noise preamplifier**
- **Ultrasound amplifiers**
- **PLL Loop filters**
- **High performance ADC drivers**
- **DAC buffers**

GENERAL DESCRIPTION

The ADA4897-2 is a unity gain stable, low noise, rail-to-rail output, high speed voltage feedback amplifier that has a quiescent current of 3 mA. With the 1/f noise of 2.4 nV/√Hz at 10 Hz and a spurious-free dynamic range of −80 dBc at 2 MHz, the ADA4897-2 is an ideal solution in a variety of applications, including ultrasound, low noise preamplifiers, and drivers of high performance ADCs. Analog Devices, Inc., proprietary next generation SiGe bipolar process and innovative architecture enables such a high performance amplifier.

TheADA4897-2 has 230 MHz bandwidth, 120 V/µs slew rate, and settle to 0.1% in 45 ns. With a wide supply voltage range (3 V to 10 V), the ADA4897-2/ADA4897-1 is an ideal candidates for systems that require high dynamic range, precision, and high speed.

The ADA4897-2 is available in an 10-lead MSOP package and operates over the extended industrial temperature range of −40°C to +125°C.

FUNCTIONAL BLOCK DIAGRAM

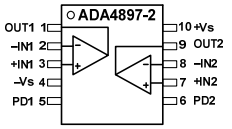

Figure 1. 10-Lead ADA4897-2 MSOP

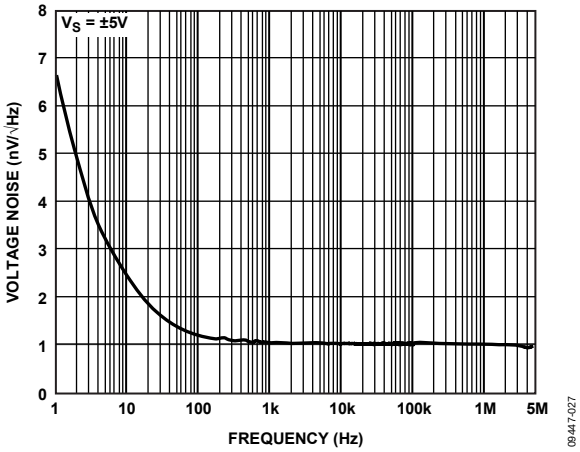

Figure 2.Voltage Noise vs. Frequency

Table 1. Other Low Noise Amplifiers

Part Number	V_N (nV/√Hz) @ 1 kHz	V_N (nV/√Hz) @ 100 kHz	BW (MHz)	Supply Voltage (V)
AD797	0.9	0.9	8	10 to 30
AD8021	5	2.1	490	5 to 24
AD8099	7	0.95	510	5 to 12
AD8045	6	3	1000	3.3 to 12
ADA4899-1	1.4	1	600	5 to 12
ADA4896-2/ ADA4897-1/	1	1	230	3 to 10
ADA4898-1/ ADA4898-2	0.9	0.9	65	10 to 32

Table 2. Complementary ADCs

Part Number	Bits	Speed (MSPS)	Power (mW)
AD7944	14	2.5	15.5
AD7985	16	2.5	15.5
AD7986	18	2	15

Rev. PrA

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 **www.analog.com**
Fax: 781.461.3113

TABLE OF CONTENTS

Features 1
Applications 1
General Description 1
Functional Block Diagram 1
Revision History 2
Specifications 3
±5 V Supply 3
+5 V Supply 5
+3 V Supply 7
Outline Dimensions 9
Ordering Guide 9

SPECIFICATIONS

±5 V SUPPLY

T_A = 25°C, G = +1, R_L = 1 kΩ to ground, unless otherwise noted.

Table 3.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
–3 dB Bandwidth	G = +1, V_{OUT} = 0.02 V p-p		230		MHz
	G = +1, V_{OUT} = 2 V p-p		30		MHz
	G = +2, V_{OUT} = 0.02 V p-p		90		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 2 V p-p, R_L = 100 Ω		7		MHz
Slew Rate	G = +2, V_{OUT} = 6 V step		120		V/µs
Settling Time to 0.1%	G = +2, V_{OUT} = 2 V step		45		ns
Settling Time to 0.01%	G = +2, V_{OUT} = 2 V step		90		ns
NOISE/HARMONIC PERFORMANCE					
Harmonic Distortion (dBc) SFDR	f_C= 100 kHz, V_{OUT} = 2 V p-p		–115		dBc
	f_C= 1 MHz, V_{OUT} = 2 V p-p		–93		dBc
	f_C = 2 MHz, V_{OUT} = 2 V p-p		–80		dBc
	f_C = 5 MHz, V_{OUT} = 2 V p-p		–61		dBc
Input Voltage Noise	f = 10 Hz		2.4		nV/√Hz
	f = 100 kHz		1		nV/√Hz
Input Current Noise	f = 10 Hz		31		pA/√Hz
	f = 100 kHz		2.8		pA/√Hz
0.1 Hz to 10 Hz Noise	G = +101, R_F = 1 kΩ, R_G = 10 Ω		99		nV p-p
DC PERFORMANCE					
Input Offset Voltage		–500	–28	+500	µV
Input Offset Voltage Drift			0.2		µV/°C
Input Bias Current		–17	–11	–4	µA
Input Bias Current Drift			3		nA/°C
Input Bias Offset Current		–0.6	–0.02	+0.6	µA
Open-Loop Gain	V_{OUT} = –4 V to +4 V	100	110		dB
INPUT CHARACTERISTICS					
Input Resistance	Common mode/differential		10M/10k		Ω
Input Capacitance	Common mode/differential		3/11		pF
Input Common-Mode Voltage Range			–4.9 to +4.1		V
Common-Mode Rejection	V_{CM} = –2 V to +2 V	–92	–120		dB
OUTPUT CHARACTERISTICS					
Output Overdrive Recovery Time	V_{IN} = ±5 V, G = +2		81		ns
+Output Voltage Swing	R_L = 1 kΩ	4.85	4.96		V
–Output Voltage Swing	R_L = 1 kΩ	–4.85	–4.97		V
+Output Voltage Swing	R_L = 100 Ω	4.5	4.73		V
–Output Voltage Swing	R_L = 100 Ω	–4.5	–4.84		V
Output Current	45 dBc SFDR		80		mA
Short-Circuit Current	Sinking/sourcing		135		mA
Capacitive Load Drive	30% overshoot, G = +2		39		pF
POWER SUPPLY					
Operating Range			3 to 10		V
Quiescent Current per Amplifier		2.8	3.0	3.2	mA
	$\overline{\text{DISABLE}}$ = –5 V		0.25		mA
Positive Power Supply Rejection	$+V_S$ = 4 V to 6 V, $–V_S$ = –5 V	–96	–125		dB
Negative Power Supply Rejection	$+V_S$ = 5 V, $–V_S$ = –4 V to –6 V	–96	–121		dB

Parameter	Conditions	Min	Typ	Max	Unit
$\overline{\text{DISABLE}}$ PIN					
$\overline{\text{DISABLE}}$ Voltage	Enabled		>+V_S – 0.5		V
	Disabled		<+V_S – 2		V
Input Current					
Enabled	$\overline{\text{DISABLE}}$ = +5 V		−2.5		µA
Disabled	$\overline{\text{DISABLE}}$ = −5 V		−80		µA
Switching Speed					
Enabled			0.25		µs
Disabled			12		µs

+5 V SUPPLY

T_A = 25°C, G = +1, R_L = 1 kΩ to midsupply, unless otherwise noted.

Table 4.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth	G = +1, V_{OUT} = 0.02 V p-p		230		MHz
	G = +1, V_{OUT} = 2 V p-p		30		MHz
	G = +2, V_{OUT} = 0.02 V p-p		90		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 2 V p-p, R_L = 100 Ω		7		MHz
Slew Rate	G = +2, V_{OUT} = 3 V step		100		V/µs
Settling Time to 0.1%	G = +2, V_{OUT} = 2 V step		45		ns
Settling Time to 0.01%	G = +2, V_{OUT} = 2 V step		95		ns
NOISE/Harmonic PERFORMANCE					
Harmonic Distortion (dBc) SFDR	f_C = 100 kHz, V_{OUT} = 2 V p-p		−115		dBc
	f_C = 1 MHz, V_{OUT} = 2 V p-p		−93		dBc
	f_C = 2 MHz, V_{OUT} = 2 V p-p		−80		dBc
	f_C = 5 MHz, V_{OUT} = 2 V p-p		−61		dBc
Input Voltage Noise	f = 10 Hz		2.4		nV/√Hz
	f = 100 kHz		1		nV/√Hz
Input Current Noise	f = 10 Hz		31		pA/√Hz
	f = 100 kHz		2.8		pA/√Hz
0.1 Hz to 10 Hz Noise	G = +101, R_F = 1 kΩ, R_G = 10 Ω		99		nV p-p
DC PERFORMANCE					
Input Offset Voltage		−500	−30	+500	µV
Input Offset Voltage Drift			0.2		µV/°C
Input Bias Current		−17	−11	−4	µA
Input Bias Current Drift			3		nA/°C
Input Bias Offset Current		−0.6	−0.02	+0.6	µA
Open-Loop Gain	V_{OUT} = 0.5 V to 4.5 V	97	110		dB
INPUT CHARACTERISTICS					
Input Resistance	Common mode/differential		10M/10k		Ω
Input Capacitance	Common mode/differential		3/11		pF
Input Common-Mode Voltage Range			0.1 to 4.1		V
Common-Mode Rejection	V_{CM} = +1 V to +4 V	−91	−118		dB
OUTPUT CHARACTERISTICS					
Overdrive Recovery Time	V_{IN} = 0 V to 5 V, G = +2		96		ns
+Output Voltage Swing	R_L = 1 kΩ	4.85	4.98		V
−Output Voltage Swing	R_L = 1 kΩ	0.15	0.014		V
+Output Voltage Swing	R_L = 100 Ω	4.8	4.88		V
−Output Voltage Swing	R_L = 100 Ω	0.2	0.08		
Output Current	45 dBc SFDR		70		mA
Short-Circuit Current	Sinking/sourcing		125		mA
Capacitive Load Drive	30% overshoot, G = +2		39		pF
POWER SUPPLY					
Operating Range			3 to 10		V
Quiescent Current per Amplifier		2.6	2.8	2.9	mA
	$\overline{\text{DISABLE}}$ = 0 V		0.18		
Positive Power Supply Rejection	$+V_S$ = 4.5 V to 5.5 V, $-V_S$ = 0 V	−96	−123		dB
Negative Power Supply Rejection	$+V_S$ = 5 V, $-V_S$ = −0.5 V to +0.5 V	−96	−121		dB

Parameter	Conditions	Min	Typ	Max	Unit
$\overline{\text{DISABLE}}$ PIN					
$\overline{\text{DISABLE}}$ Voltage	Enabled		>+V_S − 0.5		V
	Disabled		<+V_S − 2		V
Input Current					
Enabled	$\overline{\text{DISABLE}}$ = +5 V		−2.5		µA
Disabled	$\overline{\text{DISABLE}}$ = 0 V		−50		µA
Switching Speed					
Enabled			0.25		µs
Disabled			12		µs

+3 V SUPPLY

T_A = 25°C, G = +1, R_L = 1 kΩ to midsupply, unless otherwise noted.

Table 5.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth	G = +1, V_{OUT} = 0.02 V p-p		230		MHz
	G = −1, V_{OUT} = 1 V p-p		45		MHz
	G = +2, V_{OUT} = 0.02 V p-p		90		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 2 V p-p, R_L = 100 Ω		7		MHz
Slew Rate	G = +2, V_{OUT} = 1 V step		85		V/µs
Settling Time to 0.1%	G = +2, V_{OUT} = 2 V step		45		ns
Settling Time to 0.01%	G = +2, V_{OUT} = 2 V step		96		ns
NOISE/Harmonic PERFORMANCE					
Harmonic Distortion (dBc) SFDR	f_C = 100 kHz, V_{OUT} = 2 V p-p, G = +2		−105		dBc
	f_C = 1 MHz, V_{OUT} = 1 V p-p, G = −1		−84		dBc
	f_C = 2 MHz, V_{OUT} = 1 V p-p, G = −1		−77		dBc
	f_C = 5 MHz, V_{OUT} = 1 V p-p, G = −1		−60		dBc
Input Voltage Noise	f = 10 Hz		2.3		nV/√Hz
	f = 100 kHz		1		nV/√Hz
Input Current Noise	f = 10 Hz		31		pA/√Hz
	f = 100 kHz		2.8		pA/√Hz
0.1 Hz to 10 Hz Noise	G = +101, R_F = 1 kΩ, R_G = 10 Ω		99		nV p-p
DC PERFORMANCE					
Input Offset Voltage		−500	−30	+500	uV
Input Offset Voltage Drift			0.2		µV/°C
Input Bias Current		−17	−11	−4	µA
Input Bias Current Drift			3		nA/°C
Input Bias Offset Current		−0.6	−0.02	+0.6	µA
Open-Loop Gain	V_{OUT}= 0.5 V to 2.5 V	95	108		dB
INPUT CHARACTERISTICS					
Input Resistance	Common mode/differential		10M/10k		Ω
Input Capacitance	Common mode/differential		3/11		pF
Input Common-Mode Voltage Range			0.1 to 2.1		V
Common-Mode Rejection	V_{CM} = +1.1 V to +1.9 V	−90	−124		dB
OUTPUT CHARACTERISTICS					
Overdrive Recovery Time	V_{IN} = 0 V to +3 V, G = +2		83		ns
+Output Voltage Swing	R_L = 1 kΩ	2.85	2.97		V
−Output Voltage Swing	R_L = 1 kΩ	0.15	0.01		V
+Output Voltage Swing	R_L = 100 Ω	2.8	2.92		V
−Output Voltage Swing	R_L = 100 Ω	0.2	0.05		V
Output Current	45 dBc SFDR		60		mA
Short-Circuit Current	Sinking/sourcing		120		mA
Capacitive Load Drive	30% overshoot, G = +2		39		pF
POWER SUPPLY					
Operating Range			3 to 10		V
Quiescent Current per Amplifier		2.5	2.7	2.9	mA
	$\overline{\text{DISABLE}}$ = 0 V		0.15		
Positive Power Supply Rejection	$+V_S$ = 2.7 V to 3.7 V, $-V_S$ = 0 V	−96	−121		dB
Negative Power Supply Rejection	$+V_S$ = 3 V, $-V_S$ = −0.3 V to 0.7 V	−96	−120		dB

Parameter	Conditions	Min	Typ	Max	Unit
$\overline{\text{DISABLE}}$ PIN					
$\overline{\text{DISABLE}}$ Voltage	Enabled		>+V_S −0.5		V
	Disabled		<−V_S + 2		V
Input Current					
Enabled	$\overline{\text{DISABLE}}$ = +3 V		−2.5		µA
Disabled	$\overline{\text{DISABLE}}$ = 0 V		−40		µA
Switching Speed					
Enabled			0.25		µs
Disabled			12		µs

OUTLINE DIMENSIONS

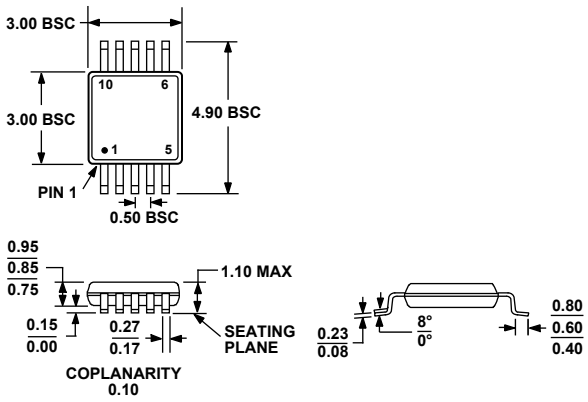

Figure 3. 10-Lead Mini Small Outline Package [MSOP]
(RM-10)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option	Ordering Quantity	Branding
ADA4897-2ARMZ	−40°C to +125°C	10-Lead MSOP	RM-10	1	
ADA4897-2ARMZ-R7	−40°C to +125°C	10-Lead MSOP	RM-10	1,000	
ADA4897-2ARMZ-RL	−40°C to +125°C	10-Lead MSOP	RM-10	3,000	

[1] Z = RoHS Compliant Part.

NOTES

PR09447-0-9/11(PrA)