Ultralow Distortion, Wide Bandwidth Voltage Feedback Op Amps

AD9631/AD9632

FEATURES

Wide Bandwidth
- **AD9631, G = +1**
- **AD9632, G = +2**
- **Small Signal**
  - **320 MHz**
  - **250 MHz**
- **Large Signal (4 V p-p)**
  - **175 MHz**
  - **180 MHz**

Ultralow Distortion (SFDR), Low Noise
- **–113 dBc Typ @ 1 MHz**
- **–95 dBc Typ @ 5 MHz**
- **–72 dBc Typ @ 20 MHz**
- **46 dBm Third Order Intercept @ 25 MHz**
- **7.0 nV/$\sqrt{Hz}$ Spectral Noise Density**

High Speed
- **Slew Rate 1300 V/μs**
- **Settling 16 ns to 0.01%, 2 V Step**
- **±3 V to ±5 V Supply Operation**
- **17 mA Supply Current**

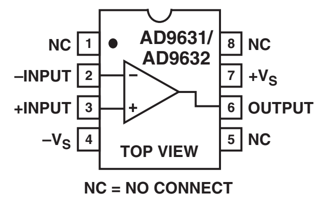
APPLICATIONS

ADC Input Driver
Differential Amplifiers
IF/RF Amplifiers
Pulse Amplifiers
Professional Video
DAC Current to Voltage
Baseband and Video Communications
Pin Diode Receivers
Active Filters/Integrators/Log Amps

GENERAL DESCRIPTION

The AD9631 and AD9632 are very high speed and wide bandwidth amplifiers. They are an improved performance alternative to the AD9621 and AD9622. The AD9631 is unity gain stable. The AD9632 is stable at gains of 2 or greater. Using a voltage feedback architecture, the AD9631/AD9632's exceptional settling time, bandwidth, and low distortion meet the requirements of many applications that previously depended on current feedback amplifiers. Its classical op amp structure works much more predictably in many designs.

PIN CONFIGURATION
8-Lead PDIP (N)
and SOIC (R) Packages



A proprietary design architecture has produced an amplifier that combines many of the best characteristics of both current feedback and voltage feedback amplifiers. The AD9631 and AD9632 exhibit exceptionally fast and accurate pulse response (16 ns to 0.01%) as well as extremely wide small signal and large signal bandwidth and ultralow distortion. The AD9631 achieves –72 dBc at 20 MHz, and 320 MHz small signal and 175 MHz large signal bandwidths.

These characteristics position the AD9631/AD9632 ideally for driving flash as well as high resolution ADCs. Additionally, the balanced high impedance inputs of the voltage feedback architecture allow maximum flexibility when designing active filters.

The AD9631/AD9632 are offered in the industrial (–40°C to +85°C) temperature range. They are available in PDIP and SOIC.

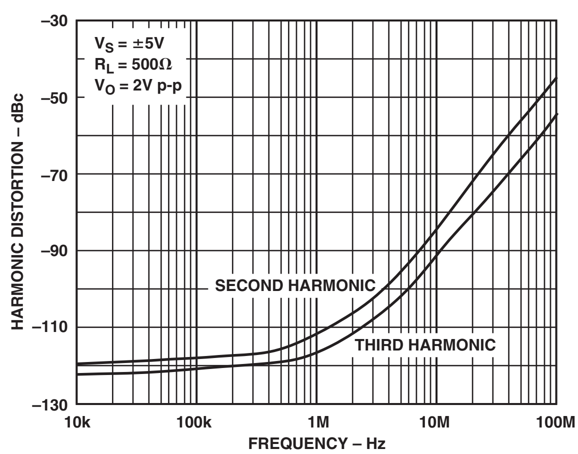


Figure 1. AD9631 Harmonic Distortion vs. Frequency, G = +1

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AD9631/AD9632–SPECIFICATIONS

ELECTRICAL CHARACTERISTICS ($\pm V_S = \pm 5$ V; $R_{LOAD} = 100\ \Omega$; $A_V = 1$ (AD9631); $A_V = 2$ (AD9632), unless otherwise noted.)

Parameter	Conditions	AD9631A Min	AD9631A Typ	AD9631A Max	AD9632A Min	AD9632A Typ	AD9632A Max	Unit
DYNAMIC PERFORMANCE								
Bandwidth (–3 dB)								
Small Signal	$V_{OUT} \leq 0.4$ V p-p	220	320		180	250		MHz
Large Signal[1]	$V_{OUT} = 4$ V p-p	150	175		155	180		MHz
Bandwidth for 0.1 dB Flatness	$V_{OUT} = 300$ mV p-p							
	AD9631, $R_F = 140\ \Omega$; AD9632, $R_F = 425\ \Omega$		130			130		MHz
Slew Rate, Average ±	$V_{OUT} = 4$ V Step	1000	1300		1200	1500		V/μs
Rise/Fall Time	$V_{OUT} = 0.5$ V Step		1.2			1.4		ns
	$V_{OUT} = 4$ V Step		2.5			2.1		ns
Settling Time								
To 0.1%	$V_{OUT} = 2$ V Step		11			11		ns
To 0.01%	$V_{OUT} = 2$ V Step		16			16		ns
HARMONIC/NOISE PERFORMANCE								
Second Harmonic Distortion	2 V p-p; 20 MHz, $R_L = 100\ \Omega$		–64	–57		–54	–47	dBc
	$R_L = 500\ \Omega$		–72	–65		–72	–65	dBc
Third Harmonic Distortion	2 V p-p; 20 MHz, $R_L = 100\ \Omega$		–76	–69		–74	–67	dBc
	$R_L = 500\ \Omega$		–81	–74		–81	–74	dBc
Third Order Intercept	25 MHz		46			41		dBm
Noise Figure	$R_S = 50\ \Omega$		18			14		dB
Input Voltage Noise	1 MHz to 200 MHz		7.0			4.3		$nV/\sqrt{Hz}$
Input Current Noise	1 MHz to 200 MHz		2.5			2.0		$pA/\sqrt{Hz}$
Average Equivalent Integrated Input Noise Voltage	0.1 MHz to 200 MHz		100			60		μV rms
Differential Gain Error (3.58 MHz)	$R_L = 150\ \Omega$		0.03	0.06		0.02	0.04	%
Differential Phase Error (3.58 MHz)	$R_L = 150\ \Omega$		0.02	0.04		0.02	0.04	Degree
Phase Nonlinearity	DC to 100 MHz		1.1			1.1		Degree
DC PERFORMANCE[2], $R_L = 150\ \Omega$								
Input Offset Voltage[3]			3	10		2	5	mV
	T_{MIN}–T_{MAX}			13			8	mV
Offset Voltage Drift			±10			±10		μV/°C
Input Bias Current			2	7		2	7	μA
	T_{MIN}–T_{MAX}			10			10	μA
Input Offset Current			0.1	3		0.1	3	μA
	T_{MIN}–T_{MAX}			5			5	μA
Common-Mode Rejection Ratio	$V_{CM} = \pm 2.5$ V	70	90		70	90		dB
Open-Loop Gain	$V_{OUT} = \pm 2.5$ V	46	52		46	52		dB
	T_{MIN}–T_{MAX}	40			40			dB
INPUT CHARACTERISTICS								
Input Resistance			500			500		kΩ
Input Capacitance			1.2			1.2		pF
Input Common-Mode Voltage Range			±3.4			±3.4		V
OUTPUT CHARACTERISTICS								
Output Voltage Range, $R_L = 150\ \Omega$		±3.2	±3.9		±3.2	±3.9		V
Output Current			70			70		mA
Output Resistance			0.3			0.3		Ω
Short Circuit Current			240			240		mA
POWER SUPPLY								
Operating Range		±3.0	±5.0	±6.0	±3.0	±5.0	±6.0	V
Quiescent Current			17	18		16	17	mA
	T_{MIN}–T_{MAX}			21			20	mA
Power Supply Rejection Ratio	T_{MIN}–T_{MAX}	50	60		56	66		dB

NOTES

[1] See Absolute Maximum Ratings and Theory of Operation sections of this data sheet.

[2] Measured at $A_V = 50$.

[3] Measured with respect to the inverting input.

Specifications subject to change without notice.

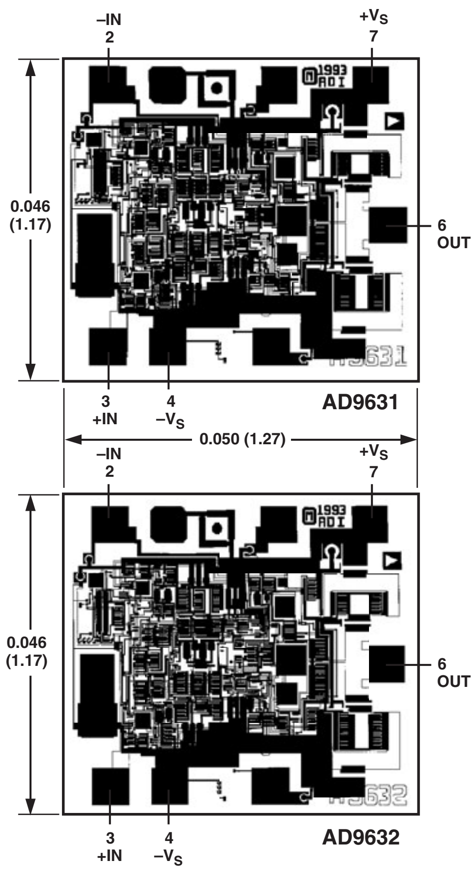
ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage ($+V_S$ to $–V_S$) . . . . 12.6 V
Voltage Swing × Bandwidth Product . . . . 550 V-MHz
Internal Power Dissipation[2]
  Plastic Package (N) . . . . 1.3 W
  Small Outline Package (R) . . . . 0.9 W
Input Voltage (Common Mode) . . . . $\pm V_S$
Differential Input Voltage . . . . ±1.2 V
Output Short Circuit Duration
  . . . . Observe Power Derating Curves
Storage Temperature Range N, R . . . . –65°C to +125°C
Operating Temperature Range (A Grade) . . . . –40°C to +85°C
Lead Temperature Range (Soldering 10 sec) . . . . 300°C

NOTES
[1] 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.
[2] Specification is for device in free air:
8-Lead PDIP Package: θ_{JA} = 90°C/W
8-Lead SOIC Package: θ_{JA} = 140°C/W

METALLIZATION PHOTO

Dimensions shown in inches and (millimeters)
Connect Substrate to $–V_S$



MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by these devices is limited by the associated rise in junction temperature. The maximum safe junction temperature for plastic encapsulated devices is determined by the glass transition temperature of the plastic, approximately 150°C. Exceeding this limit temporarily may cause a shift in parametric performance due to a change in the stresses exerted on the die by the package. Exceeding a junction temperature of 175°C for an extended period can result in device failure.

While the AD9631 and AD9632 are internally short circuit protected, this may not be sufficient to guarantee that the maximum junction temperature (150°C) is not exceeded under all conditions. To ensure proper operation, it is necessary to observe the maximum power derating curves.

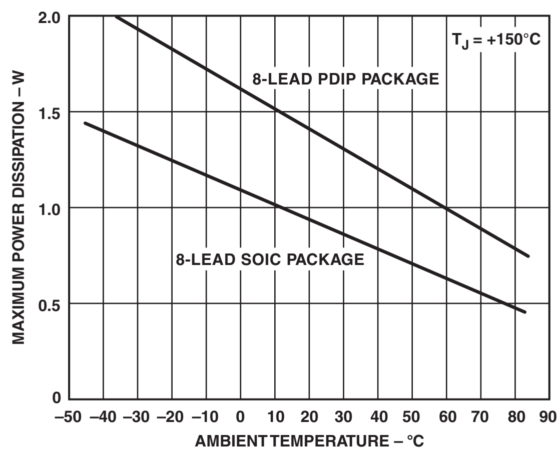


Figure 2. Maximum Power Dissipation vs. Temperature

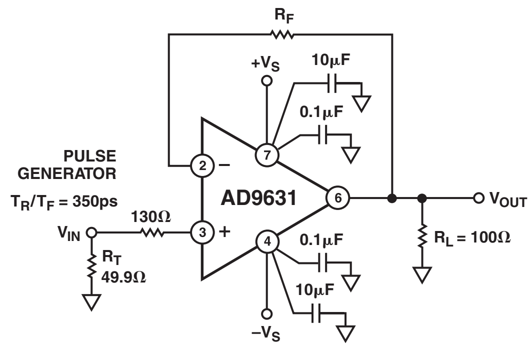
ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD9631AN	–40°C to +85°C	PDIP	N-8
AD9631AR	–40°C to +85°C	SOIC	R-8
AD9631AR-REEL	–40°C to +85°C	SOIC	R-8
AD9631AR-REEL7	–40°C to +85°C	SOIC	R-8
AD9631CHIPS		Die	
AD9632AN	–40°C to +85°C	PDIP	N-8
AD9632AR	–40°C to +85°C	SOIC	R-8
AD9632AR-REEL	–40°C to +85°C	SOIC	R-8
AD9632AR-REEL7	–40°C to +85°C	SOIC	R-8

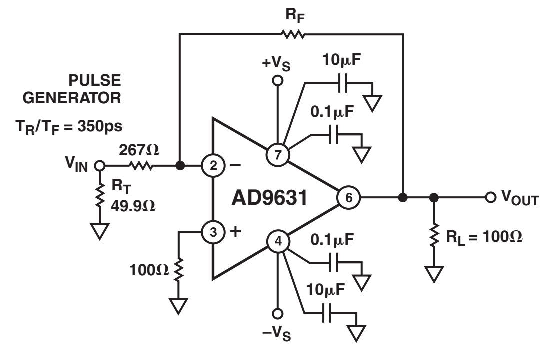
CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD9631/AD9632 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

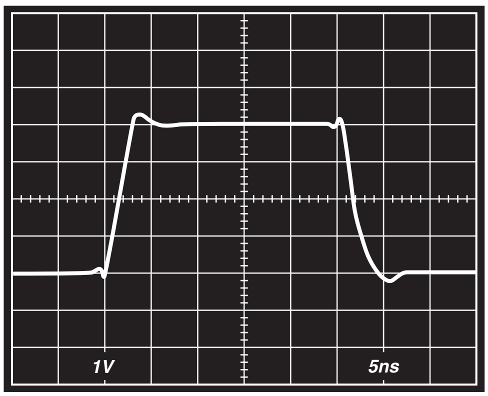
AD9631/AD9632–Typical Performance Characteristics



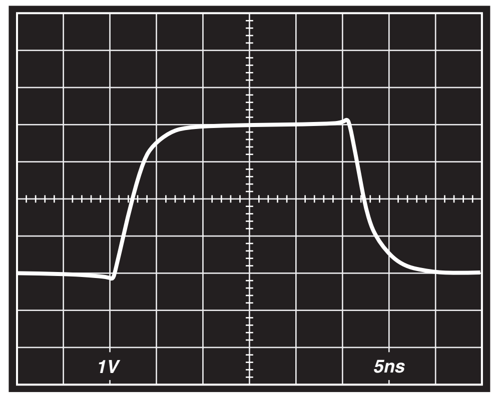
TPC 1. AD9631 Noninverting Configuration, G = +1



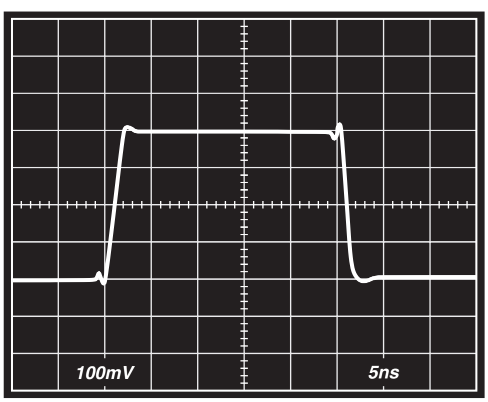
TPC 4. AD9631 Inverting Configuration, G = –1



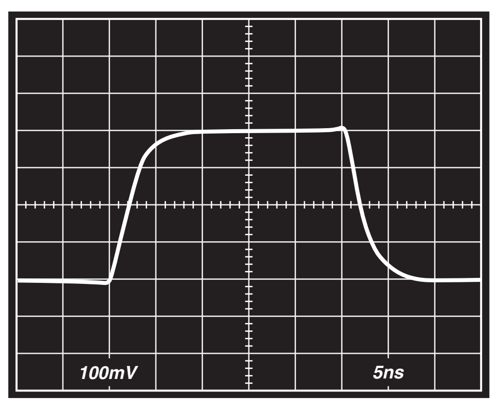
TPC 2. AD9631 Large Signal Transient Response; V_O = 4 V p-p, G = +1, R_F = 250 Ω



TPC 5. AD9631 Large Signal Transient Response; V_O = 4 V p-p, G = –1, $R_F = R_{IN}$ = 267 Ω



TPC 3. AD9631 Small Signal Transient Response; V_O = 400 mV p-p, G = +1, R_F = 140 Ω



TPC 6. AD9631 Small Signal Transient Response; V_O = 400 mV p-p, G = –1, $R_F = R_{IN}$ = 267 Ω