ANALOG DEVICES

Dual High Speed, Low Noise Op Amp

AD8022

FEATURES

- **Low power amplifiers provide low noise and low distortion, ideal for xDSL modem receiver**
- **Wide supply range: +5 V, ±2.5 V to ±12 V voltage supply**
- **Low power consumption: 4.0 mA/Amp**
- **Voltage feedback**
  - **Ease of Use**
  - **Lower total noise (insignificant input current noise contribution compared to current feedback amps)**
- **Low noise and distortion**
  - **2.5 nV/√Hz voltage noise @ 100 kHz**
  - **1.2 pA/√Hz current noise**
  - **MTPR < −66 dBc (G = +7)**
  - **SFDR 110 dB @ 200 kHz**
- **High speed**
  - **130 MHz bandwidth (−3 dB), G = +1**
  - **Settling time to 0.1%, 68 ns**
  - **50 V/µs slew rate**
- **High output swing: ±10.1 V on ±12 V supply**
- **Low offset voltage, 1.5 mV typical**

APPLICATIONS

- **Receiver for ADSL, VDSL, HDSL, and proprietary xDSL systems**
- **Low noise instrumentation front end**
- **Ultrasound preamps**
- **Active filters**
- **16-bit ADC buffers**

GENERAL DESCRIPTIONS

The AD8022 consists of two low noise, high speed, voltage feedback amplifiers. Each amplifier consumes only 4.0 mA of quiescent current, yet has only 2.5 nV/√Hz of voltage noise. These dual amplifiers provide wideband, low distortion performance, with high output current optimized for stability when driving capacitive loads. Manufactured on ADI's high voltage generation of XFCB bipolar process, the AD8022 operates on a wide range of supply voltages. The AD8022 is available in both an 8-lead MSOP and an 8-lead SOIC. Fast over voltage recovery and wide bandwidth make the AD8022 ideal as the receive channel front end to an ADSL, VDSL, or proprietary xDSL transceiver design.

In an xDSL line interface circuit, the AD8022's op amps can be configured as the differential receiver from the line transformer or as independent active filters.

FUNCTIONAL BLOCK DIAGRAM

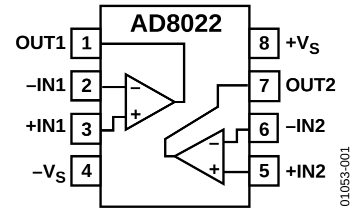

Figure 1.

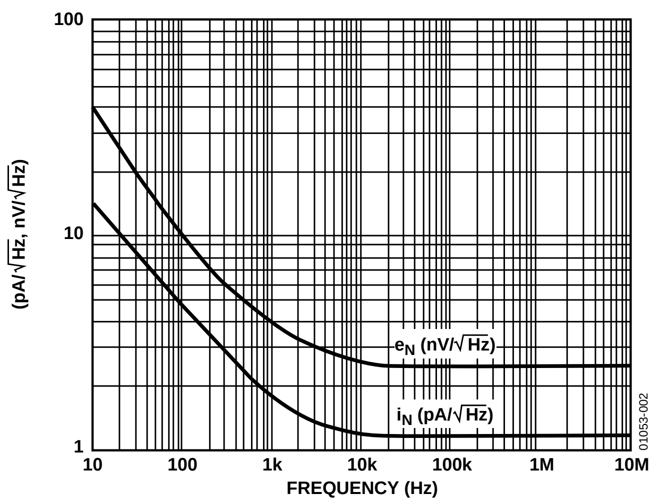

Figure 2. Current and Voltage Noise vs. Frequency

SPECIFICATIONS

At 25°C, V_S = ±12 V, R_L = 500 Ω, G = +1, T_{MIN} = −40°C, T_{MAX} = +85°C, unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Small Signal Bandwidth	V_{OUT} = 50 mV p-p	110	130		MHz
Bandwidth for 0.1 dB Flatness	V_{OUT} = 50 mV p-p		25		MHz
Large Signal Bandwidth[1]	V_{OUT} = 4 V p-p		4		MHz
Slew Rate	V_{OUT} = 2 V p-p, G = +2	40	50		V/μs
Rise and Fall Time	V_{OUT} = 2 V p-p, G = +2		30		ns
Settling Time 0.1%	V_{OUT} = 2 V p-p		62		ns
Overdrive Recovery Time	V_{OUT} = 150% of max output voltage, G = +2		200		ns
NOISE/DISTORTION PERFORMANCE					
Distortion	V_{OUT} = 2 V p-p				
Second Harmonic	f_C = 1 MHz		−95		dBc
Third Harmonic	f_C = 1 MHz		−100		dBc
Multitone Input Power Ratio[2]	G = +7 differential				
	26 kHz to 132 kHz		−67.2		dBc
	144 kHz to 1.1 MHz		−66		dBc
Voltage Noise (RTI)	f = 100 kHz		2.5		nV/√Hz
Input Current Noise	f = 100 kHz		1.2		pA/√Hz
DC PERFORMANCE					
Input Offset Voltage			−1.5	±6	mV
	T_{MIN} to T_{MAX}			±7.25	mV
Input Offset Current			±120		nA
Input Bias Current			2.5	5.0	μA
	T_{MIN} to T_{MAX}			±7.5	μA
Open-Loop Gain			72		dB
INPUT CHARACTERISTICS					
Input Resistance (Differential)			20		kΩ
Input Capacitance			0.7		pF
Input Common-Mode Voltage Range			−11.25 to +11.75		V
Common-Mode Rejection Ratio	V_{CM} = ±3 V		98		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing	R_L = 500 Ω		±10.1		V
	R_L = 2 kΩ		±10.6		V
Linear Output Current	G = +1, R_L = 150 Ω, dc error = 1%		±55		mA
Short-Circuit Output Current			100		mA
Capacitive Load Drive	R_S = 0 Ω, <3 dB of peaking		75		pF
POWER SUPPLY					
Operating Range		+4.5		±13.0	V
Quiescent Current			4.0	5.5	mA/Amp
	T_{MIN} to T_{MAX}			6.1	mA/Amp
Power Supply Rejection Ratio	V_S = ±5V to ±12 V		80		dB
OPERATING TEMPERATURE RANGE		−40		+85	°C

[1] FPBW = Slew Rate/(2π V_{PEAK}).
[2] Multitone testing performed with 800 mV rms across a 500 Ω load at Point A and Point B on the circuit of Figure 23.

At 25°C, V_S = ±2.5 V, R_L = 500 Ω, G = +1, T_{MIN} = −40°C, T_{MAX} = +85°C, unless otherwise noted.

Table 2.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Small Signal Bandwidth	V_{OUT} = 50 mV p-p	100	120		MHz
Bandwidth for 0.1 dB Flatness	V_{OUT} = 50 mV p-p		22		MHz
Large Signal Bandwidth[1]	V_{OUT} = 3 V p-p		4		MHz
Slew Rate	V_{OUT} = 2 V p-p, G = +2	30	42		V/µs
Rise and Fall Time	V_{OUT} = 2 V p-p, G = +2		40		ns
Settling Time 0.1%	V_{OUT} = 2 V p-p		75		ns
Overdrive Recovery Time	V_{OUT} = 150% of max output voltage, G = +2		225		ns
NOISE/DISTORTION PERFORMANCE					
Distortion	V_{OUT} = 2 V p-p				
Second Harmonic	f_C = 1 MHz		−77.5		dBc
Third Harmonic	f_C = 1 MHz		−94		dBc
Multitone Input Power Ratio[2]	G = +7 differential, V_S = ±6 V				
	26 kHz to 132 kHz		−69		dBc
	144 kHz to 1.1 MHz		−66.7		dBc
Voltage Noise (RTI)	f = 100 kHz		2.3		nV/√Hz
Input Current Noise	f = 100 kHz		1		pA/√Hz
DC PERFORMANCE					
Input Offset Voltage			−0.8	±5.0	mV
	T_{MIN} to T_{MAX}			±6.25	mV
Input Offset Current			±65		nA
Input Bias Current			2.0	5.0	µA
	T_{MIN} to T_{MAX}			7.5	µA
Open-Loop Gain			64		dB
INPUT CHARACTERISTICS					
Input Resistance (Differential)			20		kΩ
Input Capacitance			0.7		pF
Input Common-Mode Voltage Range			−1.83 to +2.0		V
Common-Mode Rejection Ratio	V_{CM} = ±2.5 V, V_S = ±5.0 V		98		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing	R_L = 500 Ω		−1.38 to +1.48		V
Linear Output Current	G = +1, R_L = 100 Ω, dc error = 1%		±32		mA
Short-Circuit Output Current			80		mA
Capacitive Load Drive	R_S = 0 Ω, <3 dB of peaking		75		pF
POWER SUPPLY					
Operating Range		+4.5		±13.0	V
Quiescent Current			3.5	4.25	mA/Amp
	T_{MIN} to T_{MAX}			4.4	mA/Amp
Power Supply Rejection Ratio	ΔV_S = ±1 V		86		dB
OPERATING TEMPERATURE RANGE		−40		+85	°C

[1] FPBW = Slew Rate/(2 π V_{PEAK}).
[2] Multitone testing performed with 800 mV rms across a 500 Ω load at Point A and Point B on the circuit of Figure 23.

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage ($+V_S$ to $-V_S$)	26.4 V
Internal Power Dissipation[1]	
8-Lead SOIC (R)	1.6 W
8-Lead MSOP (RM)	1.2 W
Input Voltage (Common Mode)	$\pm V_S$
Differential Input Voltage	±0.8 V
Output Short-Circuit Duration	Observe Power Derating Curves
Storage Temperature Range	−65°C to +125°C
Operating Temperature Range (A Grade)	−40°C to +85°C
Lead Temperature Range (Soldering 10 sec)	300°C

[1] Specification is for the device in free air:
8-Lead SOIC: θ_{JA} = 160°C/W.
8-Lead MSOP: θ_{JA} = 200°C/W.

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.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD8022 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. Temporarily exceeding this limit 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 AD8022 is 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.

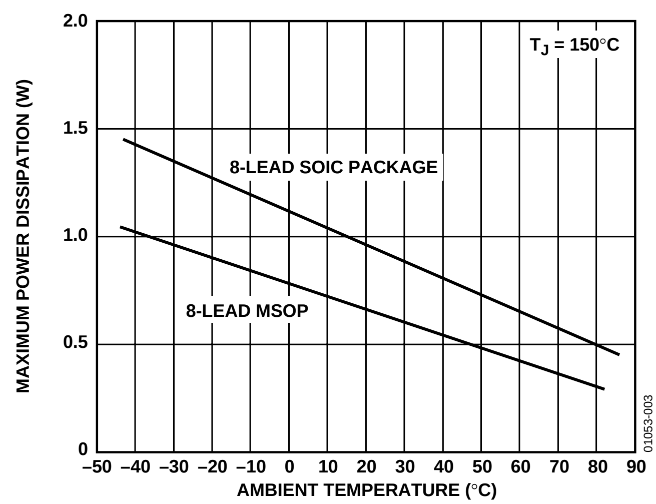

Figure 3. Maximum Power Dissipation vs. Temperature

ESD 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 this product 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.

OUTLINE DIMENSIONS

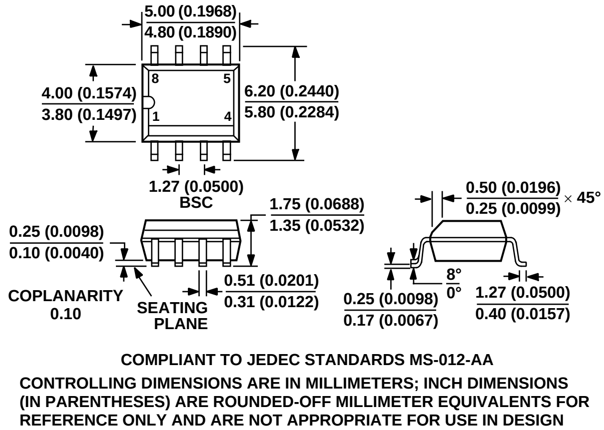

Figure 43. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-8)—Dimensions shown in millimeters and (inches)

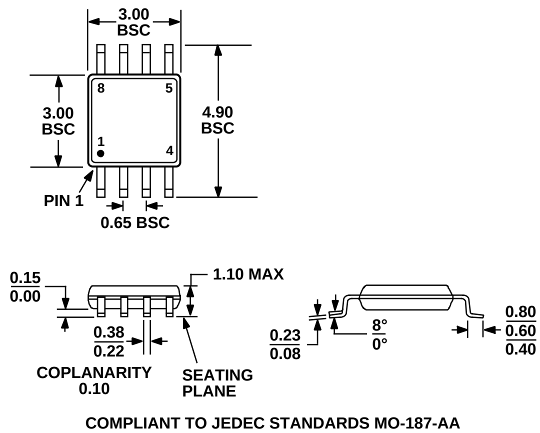

Figure 44. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)—Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8022AR	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022AR-REEL	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022AR-REEL7	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022ARZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022ARZ-REEL[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022ARZ-REEL7[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD8022ARM	−40°C to +85°C	8-Lead MSOP	RM-8
AD8022ARM-REEL	−40°C to +85°C	8-Lead MSOP	RM-8
AD8022ARM-REEL7	−40°C to +85°C	8-Lead MSOP	RM-8
AD8022ARMZ[1]	−40°C to +85°C	8-Lead MSOP	RM-8
AD8022ARMZ-REEL[1]	−40°C to +85°C	8-Lead MSOP	RM-8
AD8022ARMZ-REEL7[1]	−40°C to +85°C	8-Lead MSOP	RM-8

[1] Z = Pb-free part.

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