Dual, 16 MHz, Rail-to-Rail FET Input Amplifier

AD823

FEATURES

- **Single-supply operation**
  - **Output swings rail-to-rail**
  - **Input voltage range extends below ground**
  - **Single-supply capability from 3 V to 36 V**
- **High load drive**
  - **Capacitive load drive of 500 pF, G = +1**
  - **Output current of 15 mA, 0.5 V from supplies**
- **Excellent ac performance on 2.6 mA/amplifier**
  - **−3 dB bandwidth of 16 MHz, G = +1**
  - **350 ns settling time to 0.01% (2 V step)**
  - **Slew rate of 22 V/µs**
- **Good dc performance**
  - **800 µV maximum input offset voltage**
  - **2 µV/°C offset voltage drift**
  - **25 pA maximum input bias current**
- **Low distortion: −108 dBc worst harmonic @ 20 kHz**
- **Low noise: 16 nV/√Hz @ 10 kHz**
- **No phase inversion with inputs to the supply rails**

APPLICATIONS

- **Battery-powered precision instrumentation**
- **Photodiode preamps**
- **Active filters**
- **12-bit to 16-bit data acquisition systems**
- **Medical instrumentation**

GENERAL DESCRIPTION

The AD823 is a dual precision, 16 MHz, JFET input op amp that can operate from a single supply of 3.0 V to 36 V or from dual supplies of ±1.5 V to ±18 V. It has true single-supply capability with an input voltage range extending below ground in single-supply mode. Output voltage swing extends to within 50 mV of each rail for $I_{OUT} \leq 100$ µA, providing outstanding output dynamic range.

An offset voltage of 800 µV maximum, an offset voltage drift of 2 µV/°C, input bias currents below 25 pA, and low input voltage noise provide dc precision with source impedances up to a Gigaohm. It provides 16 MHz, −3 dB bandwidth, −108 dB THD @ 20 kHz, and a 22 V/µs slew rate with a low supply current of 2.6 mA per amplifier. The AD823 drives up to 500 pF of direct capacitive load as a follower and provides an output current of 15 mA, 0.5 V from the supply rails. This allows the amplifier to handle a wide range of load conditions.

CONNECTION DIAGRAM

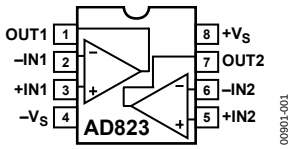


Figure 1. 8-Lead PDIP and SOIC

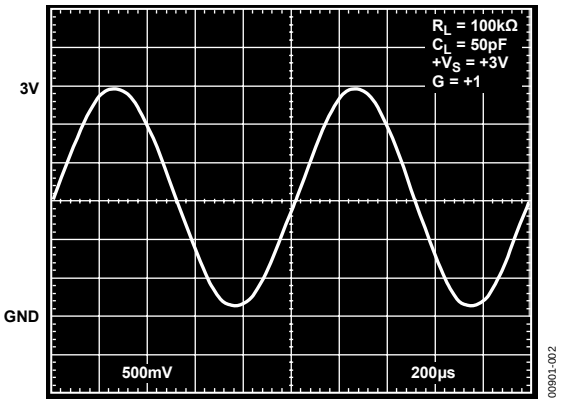


Figure 2. Output Swing, $+V_S$ = +3 V, G = +1

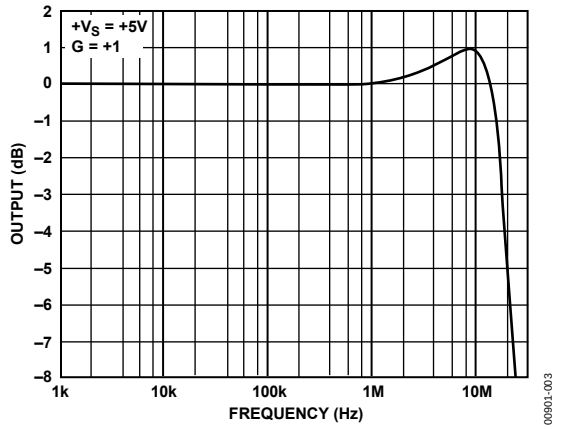


Figure 3. Small Signal Bandwidth, G = +1

This combination of ac and dc performance, plus the outstanding load drive capability, results in an exceptionally versatile amplifier for applications such as A/D drivers, high speed active filters, and other low voltage, high dynamic range systems.

The AD823 is available over the industrial temperature range of −40°C to +85°C and is offered in both 8-lead PDIP and 8-lead SOIC packages.

SPECIFICATIONS

At T_A = 25°C, $+V_S$ = +5 V, R_L = 2 kΩ to 2.5 V, unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth, $V_O \leq$ 0.2 V p-p	G = +1	12	16		MHz
Full Power Response	V_O = 2 V p-p		3.5		MHz
Slew Rate	G = −1, V_O = 4 V Step	14	22		V/µs
Settling Time					
to 0.1%	G = −1, V_O = 2 V Step		320		ns
to 0.01%	G = −1, V_O = 2 V Step		350		ns
NOISE/DISTORTION PERFORMANCE					
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 1 kHz		1		fA/√Hz
Harmonic Distortion	R_L = 600 Ω to 2.5 V, V_O = 2 V p-p, f = 20 kHz		−108		dBc
Crosstalk					
f = 1 kHz	R_L = 5 kΩ		−105		dB
f = 1 MHz	R_L = 5 kΩ		−63		dB
DC PERFORMANCE					
Initial Offset			0.2	0.8	mV
Maximum Offset Over temperature			0.3	2.0	mV
Offset Drift			2		µV/°C
Input Bias Current	V_{CM} = 0 V to 4 V		3	25	pA
at T_{MAX}	V_{CM} = 0 V to 4 V		0.5	5	nA
Input Offset Current			2	20	pA
at T_{MAX}			0.5		nA
Open-Loop Gain	V_O = 0.2 V to 4 V, R_L = 2 kΩ	20	45		V/mV
T_{MIN} to T_{MAX}		20			V/mV
INPUT CHARACTERISTICS					
Input Common-Mode Voltage Range		−0.2 to +3	−0.2 to +3.8		V
Input Resistance			10^{13}		Ω
Input Capacitance			1.8		pF
Common-Mode Rejection Ratio	V_{CM} = 0 V to 3 V	60	76		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing					
I_L = ±100 µA			0.025 to 4.975		V
I_L = ±2 mA			0.08 to 4.92		V
I_L = ±10 mA			0.25 to 4.75		V
Output Current	V_{OUT} = 0.5 V to 4.5 V		16		mA
Short-Circuit Current	Sourcing to 2.5 V		40		mA
	Sinking to 2.5 V		30		mA
Capacitive Load Drive	G = +1		500		pF
POWER SUPPLY					
Operating Range		3		36	V
Quiescent Current	T_{MIN} to T_{MAX}, total		5.2	5.6	mA
Power Supply Rejection Ratio	V_S = 5 V to 15 V, T_{MIN} to T_{MAX}	70	80		dB

At T_A = 25°C, $+V_S$ = +3.3 V, R_L = 2 kΩ to 1.65 V, unless otherwise noted.

Table 2.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth, $V_O \leq 0.2$ V p-p	G = +1	12	15		MHz
Full Power Response	V_O = 2 V p-p		3.2		MHz
Slew Rate	G = −1, V_O = 2 V Step	13	20		V/µs
Settling Time					
to 0.1%	G = −1, V_O = 2 V Step		250		ns
to 0.01%	G = −1, V_O = 2 V Step		300		ns
NOISE/DISTORTION PERFORMANCE					
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 1 kHz		1		fA/√Hz
Harmonic Distortion	R_L = 100 Ω, V_O = 2 V p-p, f = 20 kHz		−93		dBc
Crosstalk					
f = 1 kHz	R_L = 5 kΩ		−105		dB
f = 1 MHz	R_L = 5 kΩ		−63		dB
DC PERFORMANCE					
Initial Offset			0.2	1.5	mV
Maximum Offset Over temperature			0.5	2.5	mV
Offset Drift			2		µV/°C
Input Bias Current	V_{CM} = 0 V to 2 V		3	25	pA
at T_{MAX}	V_{CM} = 0 V to 2 V		0.5	5	nA
Input Offset Current			2	20	pA
at T_{MAX}			0.5		nA
Open-Loop Gain	V_O = 0.2 V to 2 V, R_L = 2 kΩ	15	30		V/mV
T_{MIN} to T_{MAX}		12			V/mV
INPUT CHARACTERISTICS					
Input Common-Mode Voltage Range		−0.2 to +1	−0.2 to +1.8		V
Input Resistance			10^{13}		Ω
Input Capacitance			1.8		pF
Common-Mode Rejection Ratio	V_{CM} = 0 V to 1 V	54	70		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing					
I_L = ±100 µA			0.025 to 3.275		V
I_L = ±2 mA			0.08 to 3.22		V
I_L = ±10 mA			0.25 to 3.05		V
Output Current	V_{OUT} = 0.5 V to 2.5 V		15		mA
Short-Circuit Current	Sourcing to 1.5 V		40		mA
	Sinking to 1.5 V		30		mA
Capacitive Load Drive	G = +1		500		pF
POWER SUPPLY					
Operating Range		3		36	V
Quiescent Current	T_{MIN} to T_{MAX}, total		5.0	5.7	mA
Power Supply Rejection Ratio	V_S = 3.3 V to 15 V, T_{MIN} to T_{MAX}	70	80		dB

At T_A = 25°C, V_S = ±15 V, R_L = 2 kΩ to 0 V, unless otherwise noted.

Table 3.

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth, V_O ≤ 0.2 V p-p	G = +1	12	16		MHz
Full Power Response	V_O = 2 V p-p		4		MHz
Slew Rate	G = −1, V_O = 10 V Step	17	25		V/µs
Settling Time					
to 0.1%	G = −1, V_O = 10 V Step		550		ns
to 0.01%	G = −1, V_O = 10 V Step		650		ns
NOISE/DISTORTION PERFORMANCE					
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 1 kHz		1		fA/√Hz
Harmonic Distortion	R_L = 600 Ω, V_O = 10 V p-p, f = 20 kHz		−90		dBc
Crosstalk					
f = 1 kHz	R_L= 5 kΩ		−105		dB
f = 1 MHz	R_L= 5 kΩ		−63		dB
DC PERFORMANCE					
Initial Offset			0.7	3.5	mV
Maximum Offset Over temperature			1.0	7	mV
Offset Drift			2		µV/°C
Input Bias Current	V_{CM} = 0 V		5	30	pA
	V_{CM} = −10 V		60		pA
at T_{MAX}	V_{CM} = 0 V		0.5	5	nA
Input Offset Current			2	20	pA
at T_{MAX}			0.5		nA
Open-Loop Gain	V_O = +10 V to −10 V, R_L = 2 kΩ	30	60		V/mV
T_{MIN} to T_{MAX}		30			V/mV
INPUT CHARACTERISTICS					
Input Common-Mode Voltage Range		−15.2 to +13	−15.2 to +13.8		V
Input Resistance			10^{13}		Ω
Input Capacitance			1.8		pF
Common-Mode Rejection Ratio	V_{CM} = −15 V to +13 V	66	82		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing					
I_L = ±100 µA			−14.95 to +14.95		V
I_L = ±2 mA			−14.92 to +14.92		V
I_L = ±10 mA			−14.75 to +14.75		V
Output Current	V_{OUT} = −14.5 V to +14.5 V		17		mA
Short-Circuit Current	Sourcing to 0 V		80		mA
	Sinking to 0 V		60		mA
Capacitive Load Drive	G = +1		500		pF
POWER SUPPLY					
Operating Range		3		36	V
Quiescent Current	T_{MIN} to T_{MAX}, total		7.0	8.4	mA
Power Supply Rejection Ratio	V_S = 5 V to 15 V, T_{MIN} to T_{MAX}	70	80		dB

ABSOLUTE MAXIMUM RATINGS

Table 4

Parameter	Rating
Supply Voltage	36 V
Internal Power Dissipation	
PDIP (N)	1.3 W
SOIC (R)	0.9 W
Input Voltage (Common Mode)	$\pm V_S$
Differential Input Voltage	±1.2 V
Output Short-Circuit Duration	See Figure 4
Storage Temperature Range N, R	−65°C to +125°C
Operating Temperature Range	−40°C to +85°C
Lead Temperature Range (Soldering, 10 sec)	300°C

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.

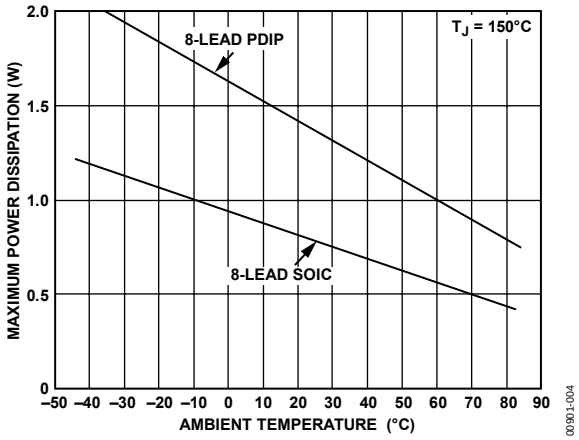


Figure 4. Maximum Power Dissipation vs. Temperature

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Specification is for device in free air.

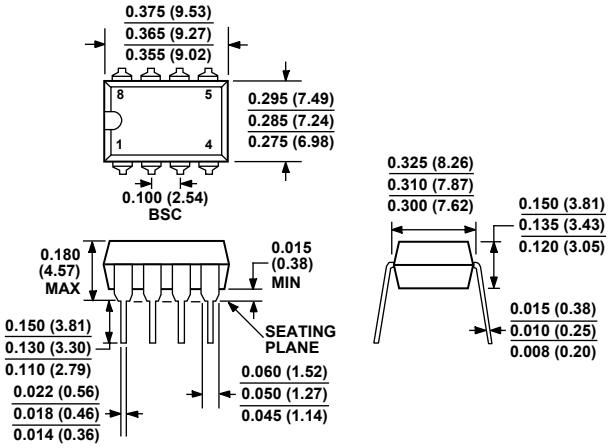
Table 5. Thermal Resistance

Package Type	θ_{JA}	Unit
8-Lead PDIP	90	°C/W
8-Lead SOIC	160	°C/W

ESD CAUTION

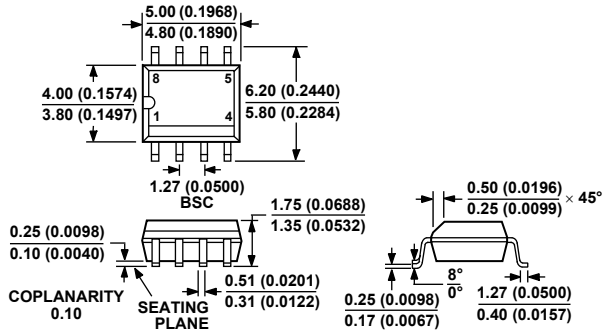
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-095AA
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 47. 8-Lead Plastic Dual In-Line Package [PDIP]
Narrow Body
(N-8)
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MS-012AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 48. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Models	Temperature Range	Package Description	Package Option
AD823AN	−40°C to +85°C	8-Lead PDIP	N-8
AD823ANZ[1]	−40°C to +85°C	8-Lead PDIP	N-8
AD823AR	−40°C to +85°C	8-Lead SOIC_N	R-8
AD823AR-REEL	−40°C to +85°C	8-Lead SOIC_N, 13″ Reel	R-8
AD823AR-REEL7	−40°C to +85°C	8-Lead SOIC_N, 7″ Reel	R-8
AD823ARZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD823ARZ-RL[1]	−40°C to +85°C	8-Lead SOIC_N, 13″ Reel	R-8
AD823ARZ-R7[1]	−40°C to +85°C	8-Lead SOIC_N, 7″ Reel	R-8

[1] Z = RoHS Compliant Part.