2.7 V, 800 μA, 80 MHz Rail-to-Rail I/O Amplifiers

AD8031/AD8032

FEATURES

Low power
- **Supply current 800 μA/amplifier**
- **Fully specified at +2.7 V, +5 V, and ±5 V supplies**

High speed and fast settling on 5 V
- **80 MHz, −3 dB bandwidth (G = +1)**
- **30 V/μs slew rate**
- **125 ns settling time to 0.1%**

Rail-to-rail input and output
- **No phase reversal with input 0.5 V beyond supplies**
- **Input CMVR extends beyond rails by 200 mV**
- **Output swing to within 20 mV of either rail**

Low distortion
- **−62 dB @ 1 MHz, V_O = 2 V p-p**
- **−86 dB @ 100 kHz, V_O = 4.6 V p-p**

Output current: 15 mA

High grade option: V_{OS} (maximum) = 1.5 mV

APPLICATIONS

High speed, battery-operated systems
High component density systems
Portable test instruments
A/D buffers
Active filters
High speed, set-and-demand amplifiers

GENERAL DESCRIPTION

The AD8031 (single) and AD8032 (dual) single-supply, voltage feedback amplifiers feature high speed performance with 80 MHz of small signal bandwidth, 30 V/μs slew rate, and 125 ns settling time. This performance is possible while consuming less than 4.0 mW of power from a single 5 V supply. These features increase the operation time of high speed, battery-powered systems without compromising dynamic performance.

The products have true single-supply capability with rail-to-rail input and output characteristics and are specified for +2.7 V, +5 V, and ±5 V supplies. The input voltage range can extend to 500 mV beyond each rail. The output voltage swings to within 20 mV of each rail providing the maximum output dynamic range.

The AD8031/AD8032 also offer excellent signal quality for only 800 μA of supply current per amplifier; THD is −62 dBc with a 2 V p-p, 1 MHz output signal, and −86 dBc for a 100 kHz, 4.6 V p-p signal on +5 V supply. The low distortion and fast settling time make them ideal as buffers to single-supply ADCs.

CONNECTION DIAGRAMS

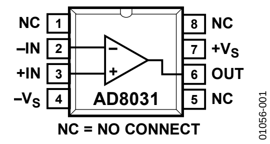


Figure 1. 8-Lead PDIP (N) and SOIC_N (R)

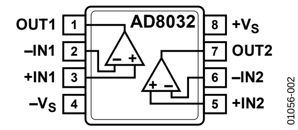


Figure 2. 8-Lead PDIP (N), SOIC_N (R), and MSOP (RM)

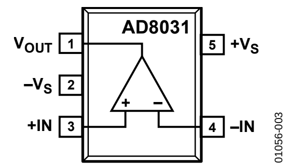


Figure 3. 5-Lead SOT-23 (RJ-5)

Operating on supplies from +2.7 V to +12 V and dual supplies up to ±6 V, the AD8031/AD8032 are ideal for a wide range of applications, from battery-operated systems with large bandwidth requirements to high speed systems where component density requires lower power dissipation. The AD8031/AD8032 are available in 8-lead PDIP and 8-lead SOIC_N packages and operate over the industrial temperature range of −40°C to +85°C. The AD8031A is also available in the space-saving 5-lead SOT-23 package, and the AD8032A is available in an 8-lead MSOP package.

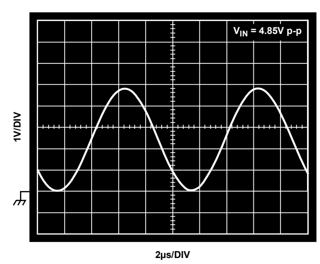


Figure 4. Input V_{IN}

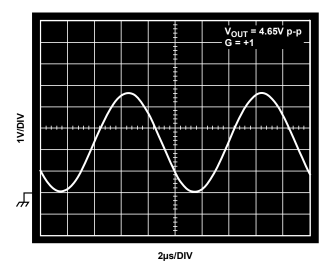


Figure 5. Output V_{OUT}

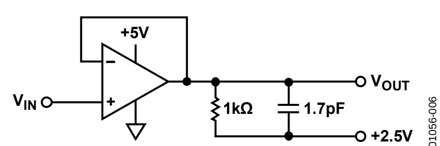


Figure 6. Rail-to-Rail Performance at 100 kHz

SPECIFICATIONS

+2.7 V SUPPLY

@ T_A = 25°C, V_S = 2.7 V, R_L = 1 kΩ to 1.35 V, R_F = 2.5 kΩ, unless otherwise noted.

Table 1.

Parameter	Conditions	AD8031A/AD8032A Min	Typ	Max	AD8031B/AD8032B Min	Typ	Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_O < 0.4 V p-p	54	80		54	80		MHz
Slew Rate	G = −1, V_O = 2 V step	25	30		25	30		V/μs
Settling Time to 0.1%	G = −1, V_O = 2 V step, C_L = 10 pF		125			125		ns
DISTORTION/NOISE PERFORMANCE								
Total Harmonic Distortion	f_C = 1 MHz, V_O = 2 V p-p, G = +2		−62			−62		dBc
	f_C = 100 kHz, V_O = 2 V p-p, G = +2		−86			−86		dBc
Input Voltage Noise	f = 1 kHz		15			15		nV/√Hz
Input Current Noise	f = 100 kHz		2.4			2.4		pA/√Hz
	f = 1 kHz		5			5		pA/√Hz
Crosstalk (AD8032 Only)	f = 5 MHz		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage	V_{CM} = V_{CC}/2; V_{OUT} = 135 V		±1	±6		±0.5	±1.5	mV
	T_{MIN} to T_{MAX}		±6	±10		±1.6	±2.5	mV
Offset Drift	V_{CM} = V_{CC}/2; V_{OUT} = 135 V		10			10		μV/°C
Input Bias Current	V_{CM} = V_{CC}/2; V_{OUT} = 135 V		0.45	2		0.45	2	μA
	T_{MIN} to T_{MAX}			2.2			2.2	μA
Input Offset Current			50	500		50	500	nA
Open-Loop Gain	V_{CM} = V_{CC}/2; V_{OUT} = 0.35 V to 2.35 V	76	80		76	80		dB
	T_{MIN} to T_{MAX}	74			74			dB
INPUT CHARACTERISTICS								
Common-Mode Input Resistance			40			40		MΩ
Differential Input Resistance			280			280		kΩ
Input Capacitance			1.6			1.6		pF
Input Voltage Range			−0.5 to +3.2			−0.5 to +3.2		V
Input Common-Mode Voltage Range			−0.2 to +2.9			−0.2 to +2.9		V
Common-Mode Rejection Ratio	V_{CM} = 0 V to 2.7 V	46	64		46	64		dB
	V_{CM} = 0 V to 1.55 V	58	74		58	74		dB
Differential Input Voltage				3.4			3.4	V
OUTPUT CHARACTERISTICS								
Output Voltage Swing Low	R_L = 10 kΩ	0.05	0.02		0.05	0.02		V
Output Voltage Swing High		2.6	2.68		2.6	2.68		V
Output Voltage Swing Low	R_L = 1 kΩ	0.15	0.08		0.15	0.08		V
Output Voltage Swing High		2.55	2.6		2.55	2.6		V
Output Current			15			15		mA
Short Circuit Current	Sourcing		21			21		mA
	Sinking		−34			−34		mA
Capacitive Load Drive	G = +2 (See Figure 46)		15			15		pF
POWER SUPPLY								
Operating Range		2.7		12	2.7		12	V
Quiescent Current per Amplifier			750	1250		750	1250	μA
Power Supply Rejection Ratio	V_S− = 0 V to −1 V or V_S+ = +2.7 V to +3.7 V	75	86		75	86		dB

+5 V SUPPLY

@ T_A = 25°C, V_S = 5 V, R_L = 1 kΩ to 2.5 V, R_F = 2.5 kΩ, unless otherwise noted.

Table 2.

Parameter	Conditions	AD8031A/AD8032A Min	Typ	Max	AD8031B/AD8032B Min	Typ	Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_O < 0.4 V p-p	54	80		54	80		MHz
Slew Rate	G = −1, V_O = 2 V step	27	32		27	32		V/µs
Settling Time to 0.1%	G = −1, V_O = 2 V step, C_L = 10 pF		125			125		ns
DISTORTION/NOISE PERFORMANCE								
Total Harmonic Distortion	f_C = 1 MHz, V_O = 2 V p-p, G = +2		−62			−62		dBc
	f_C = 100 kHz, V_O = 2 V p-p, G = +2		−86			−86		dBc
Input Voltage Noise	f = 1 kHz		15			15		nV/√Hz
Input Current Noise	f = 100 kHz		2.4			2.4		pA/√Hz
	f = 1 kHz		5			5		pA/√Hz
Differential Gain	R_L = 1 kΩ		0.17			0.17		%
Differential Phase	R_L = 1 kΩ		0.11			0.11		Degrees
Crosstalk (AD8032 Only)	f = 5 MHz		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage	V_{CM} = V_{CC}/2; V_{OUT} = 2.5 V		±1	±6		±0.5	±1.5	mV
	T_{MIN} to T_{MAX}		±6	±10		±1.6	±2.5	mV
Offset Drift	V_{CM} = V_{CC}/2; V_{OUT} = 2.5 V		5			5		µV/°C
Input Bias Current	V_{CM} = V_{CC}/2; V_{OUT} = 2.5 V		0.45	1.2		0.45	1.2	µA
	T_{MIN} to T_{MAX}			2.0			2.0	µA
Input Offset Current			50	350		50	250	nA
Open-Loop Gain	V_{CM} = V_{CC}/2; V_{OUT} = 1.5 V to 3.5 V	76	82		76	82		dB
	T_{MIN} to T_{MAX}	74			74			dB
INPUT CHARACTERISTICS								
Common-Mode Input Resistance			40			40		MΩ
Differential Input Resistance			280			280		kΩ
Input Capacitance			1.6			1.6		pF
Input Voltage Range			−0.5 to +5.5			−0.5 to +5.5		V
Input Common-Mode Voltage Range			−0.2 to +5.2			−0.2 to +5.2		V
Common-Mode Rejection Ratio	V_{CM} = 0 V to 5 V	56	70		56	70		dB
	V_{CM} = 0 V to 3.8 V	66	80		66	80		dB
Differential Input Voltage				3.4			3.4	V
OUTPUT CHARACTERISTICS								
Output Voltage Swing Low	R_L = 10 kΩ	0.05	0.02		0.05	0.02		V
Output Voltage Swing High		4.95	4.98		4.95	4.98		V
Output Voltage Swing Low	R_L = 1 kΩ	0.2	0.1		0.2	0.1		V
Output Voltage Swing High		4.8	4.9		4.8	4.9		V
Output Current			15			15		mA
Short Circuit Current	Sourcing		28			28		mA
	Sinking		−46			−46		mA
Capacitive Load Drive	G = +2 (See Figure 46)		15			15		pF
POWER SUPPLY								
Operating Range		2.7		12	2.7		12	V
Quiescent Current per Amplifier			800	1400		800	1400	µA
Power Supply Rejection Ratio	V_S− = 0 V to −1 V or V_S+ = +5 V to +6 V	75	86		75	86		dB

±5 V SUPPLY

@ T_A = 25°C, V_S = ±5 V, R_L = 1 kΩ to 0 V, R_F = 2.5 kΩ, unless otherwise noted.

Table 3.

Parameter	Conditions	AD8031A/AD8032A Min	Typ	Max	AD8031B/AD8032B Min	Typ	Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_O < 0.4 V p-p	54	80		54	80		MHz
Slew Rate	G = −1, V_O = 2 V step	30	35		30	35		V/µs
Settling Time to 0.1%	G = −1, V_O = 2 V step, C_L = 10 pF		125			125		ns
DISTORTION/NOISE PERFORMANCE								
Total Harmonic Distortion	f_C = 1 MHz, V_O = 2 V p-p, G = +2		−62			−62		dBc
	f_C = 100 kHz, V_O = 2 V p-p, G = +2		−86			−86		dBc
Input Voltage Noise	f = 1 kHz		15			15		nV/√Hz
Input Current Noise	f = 100 kHz		2.4			2.4		pA/√Hz
	f = 1 kHz		5			5		pA/√Hz
Differential Gain	R_L = 1 kΩ		0.15			0.15		%
Differential Phase	R_L = 1 kΩ		0.15			0.15		Degrees
Crosstalk (AD8032 Only)	f = 5 MHz		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage	V_{CM} = 0 V; V_{OUT} = 0 V		±1	±6		±0.5	±1.5	mV
	T_{MIN} to T_{MAX}		±6	±10		±1.6	±2.5	mV
Offset Drift	V_{CM} = 0 V; V_{OUT} = 0 V		5			5		µV/°C
Input Bias Current	V_{CM} = 0 V; V_{OUT} = 0 V		0.45	1.2		0.45	1.2	µA
	T_{MIN} to T_{MAX}			2.0			2.0	µA
Input Offset Current			50	350		50	250	nA
Open-Loop Gain	V_{CM} = 0 V; V_{OUT} = ±2 V	76	80		76	80		dB
	T_{MIN} to T_{MAX}	74			74			dB
INPUT CHARACTERISTICS								
Common-Mode Input Resistance			40			40		MΩ
Differential Input Resistance			280			280		kΩ
Input Capacitance			1.6			1.6		pF
Input Voltage Range			−5.5 to +5.5			−5.5 to +5.5		V
Input Common-Mode Voltage Range			−5.2 to +5.2			−5.2 to +5.2		V
Common-Mode Rejection Ratio	V_{CM} = −5 V to +5 V	60	80		60	80		dB
	V_{CM} = −5 V to +3.5 V	66	90		66	90		dB
Differential/Input Voltage				3.4			3.4	V
OUTPUT CHARACTERISTICS								
Output Voltage Swing Low	R_L = 10 kΩ	−4.94	−4.98		−4.94	−4.98		V
Output Voltage Swing High		+4.94	+4.98		+4.94	+4.98		V
Output Voltage Swing Low	R_L = 1 kΩ	−4.7	−4.85		−4.7	−4.85		V
Output Voltage Swing High		+4.7	+4.75		+4.7	+4.75		V
Output Current			15			15		mA
Short Circuit Current	Sourcing		35			35		mA
	Sinking		−50			−50		mA
Capacitive Load Drive	G = +2 (See Figure 46)		15			15		pF
POWER SUPPLY								
Operating Range		±1.35		±6	±1.35		±6	V
Quiescent Current per Amplifier			900	1600		900	1600	µA
Power Supply Rejection Ratio	V_S− = −5 V to −6 V or V_S+ = +5 V to +6 V	76	86		76	86		dB

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	12.6 V
Internal Power Dissipation[1]	
8-Lead PDIP (N)	1.3 W
8-Lead SOIC_N (R)	0.8 W
8-Lead MSOP (RM)	0.6 W
5-Lead SOT-23 (RJ)	0.5 W
Input Voltage (Common Mode)	$\pm V_S \pm 0.5$ V
Differential Input Voltage	±3.4 V
Output Short-Circuit Duration	Observe Power Derating Curves
Storage Temperature Range (N, R, RM, RJ)	−65°C to +125°C
Lead Temperature (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.

[1] Specification is for the device in free air:
8-Lead PDIP: θ_{JA} = 90°C/W.
8-Lead SOIC_N: θ_{JA} = 155°C/W.
8-Lead MSOP: θ_{JA} = 200°C/W.
5-Lead SOT-23: θ_{JA} = 240°C/W.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD8031/AD8032 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 can 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 AD8031/AD8032 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 shown in Figure 7.

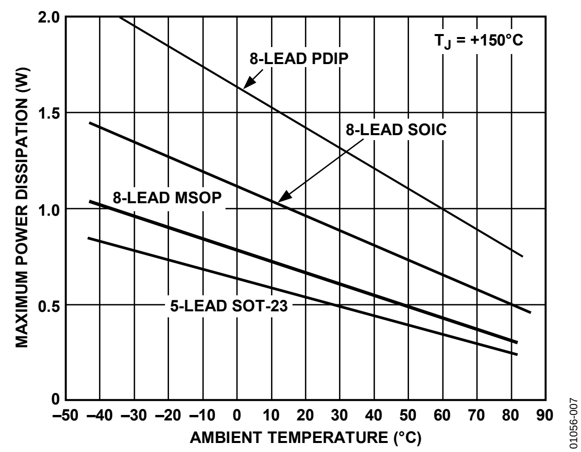
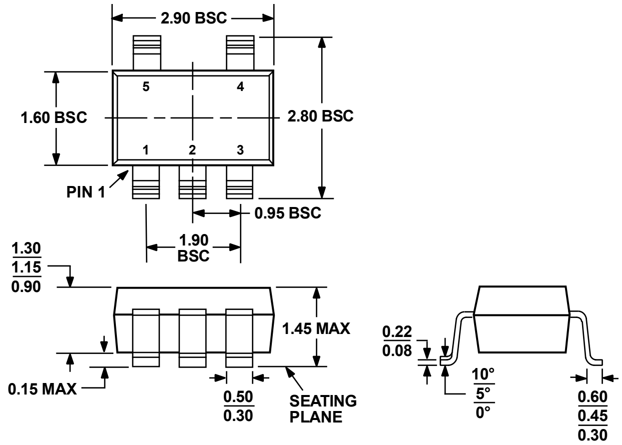


Figure 7. Maximum Power Dissipation vs. Temperature

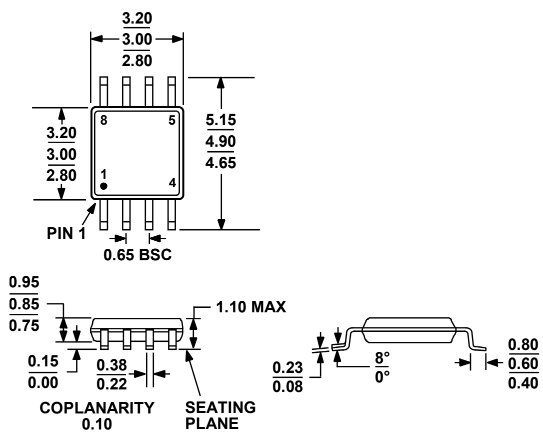
ESD CAUTION

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.



COMPLIANT TO JEDEC STANDARDS MO-178-AA

Figure 56. 5-Lead Small Outline Transistor Package [SOT-23]
(RJ-5)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-187-AA

Figure 57. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
AD8031AN	–40°C to +85°C	8-Lead PDIP	N-8	
AD8031ANZ[1]	–40°C to +85°C	8-Lead PDIP	N-8	
AD8031AR	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8031AR-REEL	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8031AR-REEL7	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8031ARZ[1]	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8031ARZ-REEL[1]	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8031ARZ-REEL7[1]	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8031ART-R2	–40°C to +85°C	5-Lead SOT-23	RJ-5	H0A
AD8031ART-REEL	–40°C to +85°C	5-Lead SOT-23, 13" Tape and Reel	RJ-5	H0A
AD8031ART-REEL7	–40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H0A
AD8031ARTZ-R2[1]	–40°C to +85°C	5-Lead SOT-23	RJ-5	H04
AD8031ARTZ-REEL[1]	–40°C to +85°C	5-Lead SOT-23, 13" Tape and Reel	RJ-5	H04
AD8031ARTZ-REEL7[1]	–40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H04
AD8031BN	–40°C to +85°C	8-Lead PDIP	N-8	
AD8031BNZ[1]	–40°C to +85°C	8-Lead PDIP	N-8	
AD8031BR	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8031BR-REEL	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8031BR-REEL7	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8031BRZ[1]	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8031BRZ-REEL[1]	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8031BRZ-REEL7[1]	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8032AN	–40°C to +85°C	8-Lead PDIP	N-8	
AD8032ANZ[1]	–40°C to +85°C	8-Lead PDIP	N-8	
AD8032AR	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8032AR-REEL	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8032AR-REEL7	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8032ARZ[1]	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8032ARZ-REEL[1]	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8032ARZ-REEL7[1]	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8032ARM	–40°C to +85°C	8-Lead MSOP	RM-8	H9A
AD8032ARM-REEL	–40°C to +85°C	8-Lead MSOP, 13" Tape and Reel	RM-8	H9A
AD8032ARM-REEL7	–40°C to +85°C	8-Lead MSOP, 7" Tape and Reel	RM-8	H9A
AD8032ARMZ[1]	–40°C to +85°C	8-Lead MSOP	RM-8	H9A#
AD8032ARMZ-REEL[1]	–40°C to +85°C	8-Lead MSOP, 13" Tape and Reel	RM-8	H9A#
AD8032ARMZ-REEL7[1]	–40°C to +85°C	8-Lead MSOP, 7" Tape and Reel	RM-8	H9A#
AD8032BN	–40°C to +85°C	8-Lead PDIP	N-8	
AD8032BNZ[1]	–40°C to +85°C	8-Lead PDIP	N-8	
AD8032BR	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8032BR-REEL	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8032BR-REEL7	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8032BRZ[1]	–40°C to +85°C	8-Lead SOIC_N	R-8	
AD8032BRZ-REEL[1]	–40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8032BRZ-REEL7[1]	–40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	

[1] Z = RoHS Compliant Part, # denotes lead-free product may be top or bottom marked.