Low Cost, High Speed, Rail-to-Rail Amplifiers

AD8051/AD8052/AD8054

FEATURES

High speed and fast settling on 5 V
- **110 MHz, −3 dB bandwidth (G = +1) (AD8051/AD8052)**
- **150 MHz, −3 dB bandwidth (G = +1) (AD8054)**
- **145 V/µs slew rate**
- **50 ns settling time to 0.1%**

Single-supply operation
- **Output swings to within 25 mV of either rail**
- **Input voltage range: −0.2 V to +4 V; V_S = 5 V**

Video specifications (G = +2)
- **0.1 dB gain flatness: 20 MHz; R_L = 150 Ω**
- **Differential gain/phase: 0.03%/0.03°**

Low distortion
- **−80 dBc total harmonic @ 1 MHz, R_L = 100 Ω**

Outstanding load drive capability
- **Drives 45 mA, 0.5 V from supply rails (AD8051/AD8052)**
- **Drives 50 pF capacitive load (G = +1) (AD8051/AD8052)**

Low power: 2.75 mA/amplifier (AD8054)

Low power: 4.4 mA/amplifier (AD8051/AD8052)

APPLICATIONS

Active filters
Analog-to-digital drivers
Clock buffer
Consumer video
Professional cameras
CCD imaging systems
CD/DVD ROMs

PIN CONNECTIONS (TOP VIEWS)

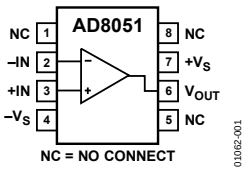

Figure 1. SOIC-8 (R)

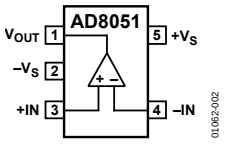

Figure 2. SOT-23-5 (RJ)

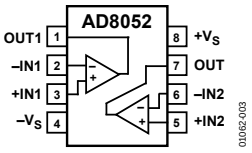

Figure 3. SOIC (R-8) and MSOP (RM-8)

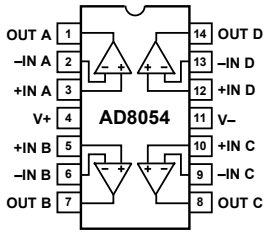

Figure 4. SOIC (R-14) and TSSOP (RU-14)

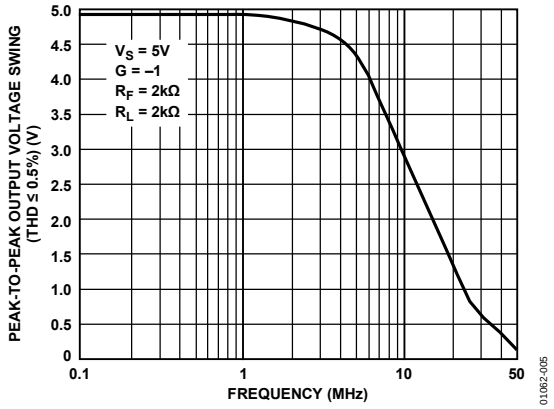

Figure 5. Low Distortion Rail-to-Rail Output Swing

GENERAL DESCRIPTION

The AD8051 (single), AD8052 (dual), and AD8054 (quad) are low cost, high speed, voltage feedback amplifiers. The amplifiers operate on +3 V, +5 V, or ±5 V supplies at low supply current. They have true single-supply capability with an input voltage range extending 200 mV below the negative rail and within 1 V of the positive rail.

Despite their low cost, the AD8051/AD8052/AD8054 provide excellent overall performance and versatility. The output voltage swings to within 25 mV of each rail, providing maximum output dynamic range with excellent overdrive recovery.

The AD8051/AD8052/AD8054 are well suited for video electronics, cameras, video switchers, or any high speed portable equipment. Low distortion and fast settling make them ideal for active filter applications.

The AD8051/AD8052 in the 8-lead SOIC, the AD8052 in the MSOP, the AD8054 in the 14-lead SOIC, and the 14-lead TSSOP packages are available in the extended temperature range of −40°C to +125°C.

SPECIFICATIONS

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

Table 1.

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_{OUT} = 0.2 V p-p	70	110		80	150		MHz
	G = −1, +2, V_{OUT} = 0.2 V p-p		50			60		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 0.2 V p-p, R_L = 150 Ω to 2.5 V							
	R_F = 806 Ω (AD8051A/AD8052A)		20					MHz
	R_F = 200 Ω (AD8054A)					12		MHz
Slew Rate	G = −1, V_{OUT} = 2 V step	100	145		140	170		V/µs
Full Power Response	G = +1, V_{OUT} = 2 V p-p		35			45		MHz
Settling Time to 0.1%	G = −1, V_{OUT} = 2 V step		50			40		ns
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion[1]	f_C = 5 MHz, V_{OUT} = 2 V p-p, G = +2		−67			−68		dB
Input Voltage Noise	f = 10 kHz		16			16		nV/√Hz
Input Current Noise	f = 10 kHz		850			850		fA/√Hz
Differential Gain Error (NTSC)	G = +2, R_L = 150 Ω to 2.5 V		0.09			0.07		%
	R_L = 1 kΩ to 2.5 V		0.03			0.02		%
Differential Phase Error (NTSC)	G = +2, R_L = 150 Ω to 2.5 V		0.19			0.26		Degrees
	R_L = 1 kΩ to 2.5 V		0.03			0.05		Degrees
Crosstalk	f = 5 MHz, G = +2		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage			1.7	10		1.7	12	mV
	T_{MIN} − T_{MAX}			25			30	mV
Offset Drift			10			15		µV/°C
Input Bias Current			1.4	2.5		2	4.5	µA
	T_{MIN} − T_{MAX}			3.25			4.5	µA
Input Offset Current			0.1	0.75		0.2	1.2	µA
Open-Loop Gain	R_L = 2 kΩ to 2.5 V	86	98		82	98		dB
	T_{MIN} − T_{MAX}		96			96		dB
	R_L = 150 Ω to 2.5 V	76	82		74	82		dB
	T_{MIN} − T_{MAX}		78			78		dB
INPUT CHARACTERISTICS								
Input Resistance			290			300		kΩ
Input Capacitance			1.4			1.5		pF
Input Common-Mode Voltage Range			−0.2 to +4			−0.2 to +4		V
Common-Mode Rejection Ratio	V_{CM} = 0 V to 3.5 V	72	88		70	86		dB

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
OUTPUT CHARACTERISTICS								
Output Voltage Swing	R_L = 10 kΩ to 2.5 V		0.015 to 4.985			0.03 to 4.975		V
	R_L = 2 kΩ to 2.5 V	0.1 to 4.9	0.025 to 4.975		0.125 to 4.875	0.05 to 4.95		V
	R_L = 150 Ω to 2.5 V	0.3 to 4.625	0.2 to 4.8		0.55 to 4.4	0.25 to 4.65		V
Output Current	V_{OUT} = 0.5 V to 4.5 V		45			30		mA
	$T_{MIN} - T_{MAX}$		45			30		mA
Short-Circuit Current	Sourcing		80			45		mA
	Sinking		130			85		mA
Capacitive Load Drive	G = +1 (AD8051/AD8052)		50					pF
	G = +2 (AD8054)					40		pF
POWER SUPPLY								
Operating Range		3		12	3		12	V
Quiescent Current/Amplifier			4.4	5		2.75	3.275	mA
Power Supply Rejection Ratio	ΔV_S = ±1 V	70	80		68	80		dB
OPERATING TEMPERATURE RANGE	RJ-5	−40		+85				°C
	RM-8, R-8, RU-14, R-14	−40		+125	−40		+125	°C

[1] Refer to Figure 19.

@ T_A = 25°C, V_S = 3 V, R_L = 2 kΩ to 1.5 V, unless otherwise noted.

Table 2.

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_{OUT} = 0.2 V p-p	70	110		80	135		MHz
	G = −1, +2, V_{OUT} = 0.2 V p-p		50			65		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 0.2 V p-p, R_L = 150 Ω to 2.5 V							
	R_F = 402 Ω (AD8051A/AD8052A)		17					MHz
	R_F = 200 Ω (AD8054A)					10		MHz
Slew Rate	G = −1, V_{OUT} = 2 V step	90	135		110	150		V/µs
Full Power Response	G = +1, V_{OUT} = 1 V p-p		65			85		MHz
Settling Time to 0.1%	G = −1, V_{OUT} = 2 V step		55			55		ns
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion[1]	f_C = 5 MHz, V_{OUT} = 2 V p-p, G = −1, R_L = 100 Ω to 1.5 V		−47			−48		dB
Input Voltage Noise	f = 10 kHz		16			16		nV/√Hz
Input Current Noise	f = 10 kHz		600			600		fA/√Hz
Differential Gain Error (NTSC)	G = +2, V_{CM} = 1 V							
	R_L = 150 Ω to 1.5 V		0.11			0.13		%
	R_L = 1 kΩ to 1.5 V		0.09			0.09		%
Differential Phase Error (NTSC)	G = +2, V_{CM} = 1 V							
	R_L = 150 Ω to 1.5 V		0.24			0.3		Degrees
	R_L = 1 kΩ to 1.5 V		0.10			0.1		Degrees
Crosstalk	f = 5 MHz, G = +2		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage			1.6	10		1.6	12	mV
	T_{MIN} – T_{MAX}			25			30	mV
Offset Drift			10			15		µV/°C
Input Bias Current			1.3	2.6		2	4.5	µA
	T_{MIN} – T_{MAX}			3.25			4.5	µA
Input Offset Current			0.15	0.8		0.2	1.2	µA
Open-Loop Gain	R_L = 2 kΩ	80	96		80	96		dB
	T_{MIN} – T_{MAX}		94			94		dB
	R_L = 150 Ω	74	82		72	80		dB
	T_{MIN} – T_{MAX}		76			76		dB
INPUT CHARACTERISTICS								
Input Resistance			290			300		kΩ
Input Capacitance			1.4			1.5		pF
Input Common-Mode Voltage Range			−0.2 to +2			−0.2 to +2		V
Common-Mode Rejection Ratio	V_{CM} = 0 V to 1.5 V	72	88		70	86		dB

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
OUTPUT CHARACTERISTICS								
Output Voltage Swing	R_L = 10 kΩ to 1.5 V		0.01 to 2.99			0.025 to 2.98		V
	R_L = 2 kΩ to 1.5 V	0.0.75 to 2.9	0.02 to 2.98		0.1 to 2.9	0.35 to 2.965		V
	R_L = 150 Ω to 1.5 V	0.2 to 2.75	0.125 to 2.875		0.35 to 2.55	0.15 to 2.75		V
Output Current	V_{OUT} = 0.5 V to 2.5 V		45			25		mA
	$T_{MIN} - T_{MAX}$		45			25		mA
Short-Circuit Current	Sourcing		60			30		mA
	Sinking		90			50		mA
Capacitive Load Drive	G = +1 (AD8051/AD8052)		45					pF
	G = +2 (AD8054)					35		pF
POWER SUPPLY								
Operating Range		3		12	3		12	V
Quiescent Current/Amplifier			4.2	4.8		2.625	3.125	mA
Power Supply Rejection Ratio	ΔV_S = 0.5 V	68	80		68	80		dB
OPERATING TEMPERATURE RANGE	RJ-5	−40		+85				°C
	RM-8, R-8, RU-14, R-14	−40		+125	−40		+125	°C

[1] Refer to Figure 19.

@ T_A = 25°C, V_S = ±5 V, R_L = 2 kΩ to ground, unless otherwise noted.

Table 3.

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
DYNAMIC PERFORMANCE								
−3 dB Small Signal Bandwidth	G = +1, V_{OUT} = 0.2 V p-p	70	110		85	160		MHz
	G = −1, +2, V_{OUT} = 0.2 V p-p		50			65		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_{OUT} = 0.2 V p-p, R_L = 150 Ω,							
	R_F = 1.1 kΩ (AD8051A/AD8052A)		20					MHz
	R_F = 200 Ω (AD8054A)					15		MHz
Slew Rate	G = −1, V_{OUT} = 2 V step	105	170		150	190		V/µs
Full Power Response	G = +1, V_{OUT} = 2 V p-p		40			50		MHz
Settling Time to 0.1%	G = −1, V_{OUT} = 2 V step		50			40		MHz
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion	f_C = 5 MHz, V_{OUT} = 2 V p-p, G = +2		−71			−72		dB
Input Voltage Noise	f = 10 kHz		16			16		nV/√Hz
Input Current Noise	f = 10 kHz		900			900		fA/√Hz
Differential Gain Error (NTSC)	G = +2, R_L = 150 Ω		0.02			0.06		%
	R_L = 1 kΩ		0.02			0.02		%
Differential Phase Error (NTSC)	G = +2, R_L = 150 Ω		0.11			0.15		Degrees
	R_L = 1 kΩ		0.02			0.03		Degrees
Crosstalk	f = 5 MHz, G = +2		−60			−60		dB
DC PERFORMANCE								
Input Offset Voltage			1.8	11		1.8	13	mV
	T_{MIN} − T_{MAX}			27			32	mV
Offset Drift			10			15		µV/°C
Input Bias Current			1.4	2.6		2	4.5	µA
	T_{MIN} − T_{MAX}			3.5			4.5	µA
Input Offset Current			0.1	0.75		0.2	1.2	µA
Open-Loop Gain	R_L = 2 kΩ	88	96		84	96		dB
	T_{MIN} − T_{MAX}		96			96		dB
	R_L = 150 Ω	78	82		76	82		dB
	T_{MIN} − T_{MAX}		80			80		dB
INPUT CHARACTERISTICS								
Input Resistance			290			300		kΩ
Input Capacitance			1.4			1.5		pF
Input Common-Mode Voltage Range			−5.2 to +4			−5.2 to +4		V
Common-Mode Rejection Ratio	V_{CM} = −5 V to +3.5 V	72	88		70	86		dB
OUTPUT CHARACTERISTICS								
Output Voltage Swing	R_L = 10 kΩ		−4.98 to +4.98			−4.97 to +4.97		V
	R_L = 2 kΩ	−4.85 to +4.85	−4.97 to +4.97		−4.8 to +4.8	−4.9 to +4.9		V
	R_L = 150 Ω	−4.45 to +4.3	−4.6 to +4.6		−4.0 to +3.8	−4.5 to +4.5		V
Output Current	V_{OUT} = −4.5 V to +4.5 V		45			30		mA
	T_{MIN} − T_{MAX}		45			30		mA
Short-Circuit Current	Sourcing		100			60		mA
	Sinking		160			100		mA
Capacitive Load Drive	G = +1 (AD8051/AD8052)		50					pF
	G = +2 (AD8054)					40		pF

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Unit
POWER SUPPLY								
Operating Range		3		12	3		12	V
Quiescent Current/Amplifier			4.8	5.5		2.875	3.4	mA
Power Supply Rejection Ratio	$\Delta V_S = \pm 1$	68	80		68	80		dB
OPERATING TEMPERATURE RANGE	RJ-5	−40		+85				°C
	RM-8, R-8, RU-14, R-14	−40		+125	−40		+125	°C

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Ratings
Supply Voltage	12.6 V
Internal Power Dissipation[1]	
SOIC Packages	Observe power derating curves
SOT-23 Package	Observe power derating curves
MSOP Package	Observe power derating curves
TSSOP Package	Observe power derating curves
Input Voltage (Common Mode)	$\pm V_S$
Differential Input Voltage	±2.5 V
Output Short-Circuit Duration	Observe power derating curves
Storage Temperature Range (R)	−65°C to +150°C
Operating Temperature Range (A Grade)	−40°C to +125°C
Lead Temperature (Soldering 10 sec)	300°C

[1] See Table 5.

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.

THERMAL RESISTANCE

Specification is for device in free air.

Table 5. Thermal Resistance

Package Type	θ_{JA}	Unit
8-Lead SOIC	125	°C/W
5-Lead SOT-23	180	°C/W
8-Lead MSOP	150	°C/W
14-Lead SOIC	90	°C/W
14-Lead TSSOP	120	°C/W

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD8051/AD8052/AD8054 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 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 AD8051/AD8052/AD8054 are internally short-circuit protected, this cannot 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.

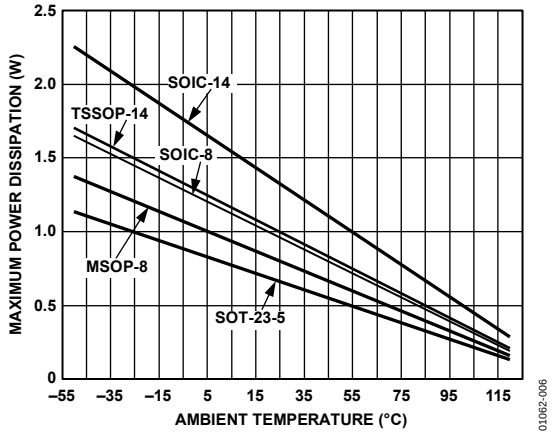

Figure 6. Maximum Power Dissipation vs. Temperature for AD8051/AD8052/AD8054

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.

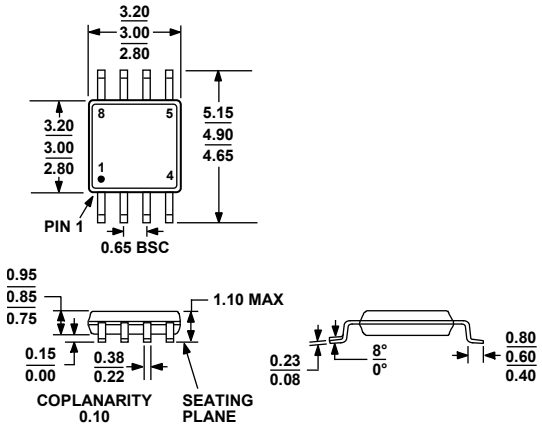

Figure 55. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters

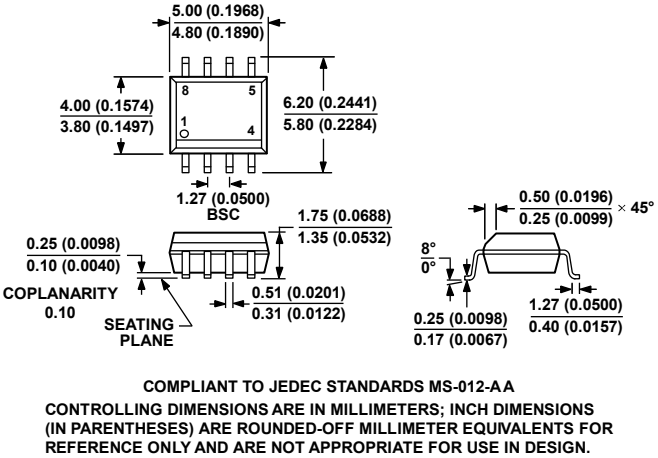

Figure 56. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-8)
Dimensions shown in millimeters and (inches)

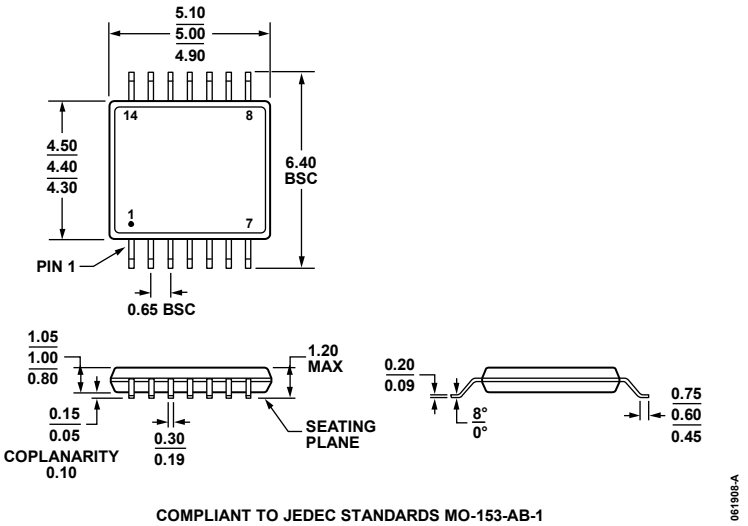

Figure 57. 14-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-14)
Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
AD8051AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8051AR-REEL	−40°C to +125°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8051AR-REEL7	−40°C to +125°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8051ARZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8	
AD8051ARZ-REEL[1]	−40°C to +85°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8051ARZ-REEL7[1]	−40°C to +85°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8051ART-R2	−40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H2A
AD8051ART-REEL	−40°C to +85°C	5-Lead SOT-23, 13" Tape and Reel	RJ-5	H2A
AD8051ART-REEL7	−40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H2A
AD8051ARTZ-R2[1]	−40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H06
AD8051ARTZ-REEL[1]	−40°C to +85°C	5-Lead SOT-23, 13" Tape and Reel	RJ-5	H06
AD8051ARTZ-REEL7[1]	−40°C to +85°C	5-Lead SOT-23, 7" Tape and Reel	RJ-5	H06
AD8052AR	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8052AR-REEL	−40°C to +125°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8052AR-REEL7	−40°C to +125°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8052ARZ[1]	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8052ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N, 13" Tape and Reel	R-8	
AD8052ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N, 7" Tape and Reel	R-8	
AD8052ARM	−40°C to +125°C	8-Lead MSOP	RM-8	H4A
AD8052ARM-REEL	−40°C to +125°C	8-Lead MSOP, 13" Tape and Reel	RM-8	H4A
AD8052ARM-REEL7	−40°C to +125°C	8-Lead MSOP, 7" Tape and Reel	RM-8	H4A
AD8052ARMZ[1]	−40°C to +125°C	8-Lead MSOP	RM-8	H4A#
AD8052ARMZ-REEL7[1]	−40°C to +125°C	8-Lead MSOP, 7" Tape and Reel	RM-8	H4A#
AD8054AR	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8054AR-REEL	−40°C to +125°C	14-Lead SOIC_N, 13" Tape and Reel	R-14	
AD8054AR-REEL7	−40°C to +125°C	14-Lead SOIC_N, 7" Tape and Reel	R-14	
AD8054ARZ[1]	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8054ARZ-REEL[1]	−40°C to +125°C	14-Lead SOIC_N, 13" Tape and Reel	R-14	
AD8054ARZ-REEL7[1]	−40°C to +125°C	14-Lead SOIC_N, 7" Tape and Reel	R-14	
AD8054ARU	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8054ARU-REEL	−40°C to +125°C	14-Lead TSSOP, 13" Tape and Reel	RU-14	
AD8054ARU-REEL7	−40°C to +125°C	14-Lead TSSOP, 7" Tape and Reel	RU-14	
AD8054ARUZ[1]	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8054ARUZ-REEL[1]	−40°C to +125°C	14-Lead TSSOP, 13" Tape and Reel	RU-14	
AD8054ARUZ-REEL7[1]	−40°C to +125°C	14-Lead TSSOP, 7" Tape and Reel	RU-14	

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