Low Cost, High Speed Rail-to-Rail Amplifiers

AD8051/AD8052/AD8054

FEATURES

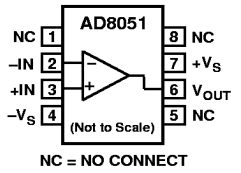
- Low Cost Single (AD8051), Dual (AD8052) and Quad (AD8054)
- Voltage Feedback Architecture
- Fully Specified at +3 V, +5 V and ±5 V Supplies
- Single Supply Operation
  - Output Swings to Within 25 mV of Either Rail
  - Input Voltage Range: –0.2 V to +4 V; V_S = +5 V
- High Speed and Fast Settling on +5 V:
  - 110 MHz –3 dB Bandwidth (G = +1) (AD8051/AD8052)
  - 140 MHz –3 dB Bandwidth (G = +1) (AD8054)
  - 145 V/μs Slew Rate
  - 50 ns Settling Time to 0.1%
- Small Packaging
  - AD8051 Available in SOT-23-5
  - AD8052 Available in microSOIC-8
  - AD8054 Available in TSSOP-14
- Good Video Specifications (G = +2)
  - Gain Flatness of 0.1 dB to 20 MHz; R_L = 150 Ω
  - 0.03% Differential Gain Error; R_L = 1K
  - 0.03° Differential Phase Error; R_L = 1K
- 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 of 2.75 mA/Amplifier (AD8054)

APPLICATIONS

- Coax Cable Driver
- Active Filters
- Video Switchers
- A/D Driver
- Professional Cameras
- CCD Imaging Systems
- CD/DVD ROM

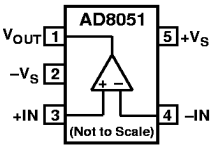
CONNECTION DIAGRAMS

R-8, SOIC

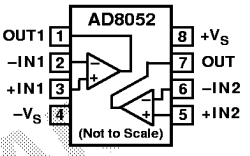


NC = NO CONNECT

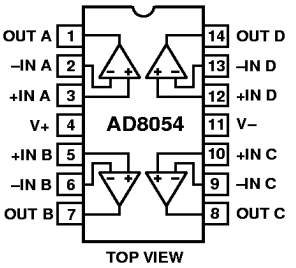
SOT-23-5 (RT)



R-8, microSOIC (RM)



R-14 and TSSOP-14 (RU-14)



The AD8051/AD8052/AD8054 offer low power supply current and can operate on a single +3 V power supply. These features are ideally suited for portable and battery powered applications where size and power are critical.

The wide bandwidth and fast slew rate on a single +5 V supply make these amplifiers useful in many general purpose, high speed applications where dual power supplies of up to ±6 V and single supplies from +3 V to +12 V are needed.

All of this low cost performance is offered in an 8-lead SOIC, along with a tiny SOT-23-5 package (AD8051), a microSOIC package (AD8052) and a TSSOP-14 (AD8054).

PRODUCT DESCRIPTION

The AD8051 (single), AD8052 (dual) and AD8054 (quad) are low cost, voltage feedback, high speed amplifiers designed to operate on +3 V, +5 V or ±5 V supplies. 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 swing extends to within 25 mV of each rail, providing the maximum output dynamic range with excellent overdrive recovery. This makes the AD8051/AD8052/AD8054 useful for video electronics such as cameras, video switchers or any high speed portable equipment. Low distortion and fast settling make it ideal for active filter applications.

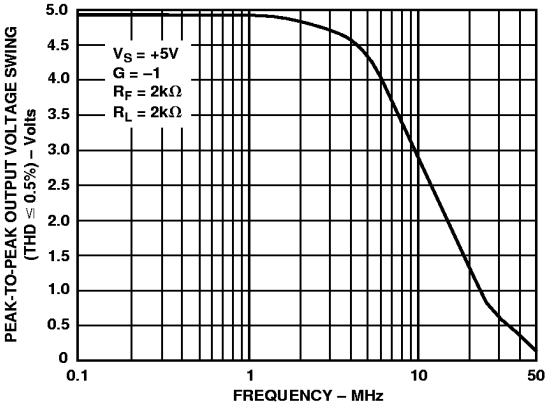


Figure 1. Low Distortion Rail-to-Rail Output Swing

REV. 0

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AD8051/AD8052/AD8054–SPECIFICATIONS (@T_A = +25°C, V_S = +5 V, R_L = 2 kΩ to +2.5 V, unless otherwise noted)

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Units
DYNAMIC PERFORMANCE								
–3 dB Small Signal Bandwidth	G = +1, V_O = 0.2 V p-p	70	110		80	150		MHz
	G = –1, +2, V_O = 0.2 V p-p		50			60		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_O = 0.2 V p-p, R_L = 150 Ω to +2.5 V,							
	R_F = 806 Ω for AD8051A/AD8052A		20					MHz
	R_F = 200 Ω for AD8054A					12		MHz
Slew Rate	G = –1, V_O = 2 V Step	100	145		140	170		V/µs
Full Power Response	G = +1, V_O = 2 V p-p		35			45		MHz
Settling Time to 0.1%	G = –1, V_O = 2 V Step		50			40		ns
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion[1]	f_C = 5 MHz, V_O = 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
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	Δ V_S = ±1 V	70	80		68	80		dB
OPERATING TEMPERATURE RANGE		–40		+85	–40		+85	°C

NOTE
[1]Refer to Figure 15.

Specifications subject to change without notice.

SPECIFICATIONS (@T_A = +25°C, V_S = +3 V, R_L = 2 kΩ to +1.5 V, unless otherwise noted)

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Units
DYNAMIC PERFORMANCE								
–3 dB Small Signal Bandwidth	G = +1, V_O = 0.2 V p-p	70	110		80	135		MHz
	G = –1, +2, V_O = 0.2 V p-p		50			65		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_O = 0.2 V p-p,							
	R_L = 150 Ω to 2.5 V,							
	R_F = 402 Ω for AD8051A/AD8052A		17					MHz
	R_F = 200 Ω for AD8054A					10		MHz
Slew Rate	G = –1, V_O = 2 V Step	90	135		110	150		V/µs
Full Power Response	G = +1, V_O = 1 V p-p		65			85		MHz
Settling Time to 0.1%	G = –1, V_O = 2 V Step		55			55		ns
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion[1]	f_C = 5 MHz, V_O = 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 k Ω 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
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	0.075 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		–40		+85	–40		+85	°C

NOTE
[1]Refer to Figure 15.

Specifications subject to change without notice.

AD8051/AD8052/AD8054–SPECIFICATIONS (@T_A = +25°C, V_S = ±5 V, R_L = 2 kΩ to Ground, unless otherwise noted)

Parameter	Conditions	AD8051A/AD8052A Min	AD8051A/AD8052A Typ	AD8051A/AD8052A Max	AD8054A Min	AD8054A Typ	AD8054A Max	Units
DYNAMIC PERFORMANCE								
–3 dB Small Signal Bandwidth	G = +1, V_O = 0.2 V p-p	70	110		85	160		MHz
	G = –1, +2, V_O = 0.2 V p-p		50			65		MHz
Bandwidth for 0.1 dB Flatness	G = +2, V_O = 0.2 V p-p, R_L = 150 Ω,							
	R_F = 1.1 kΩ for AD8051A/AD8052A		20					MHz
	R_F = 200 Ω for AD8054A					15		MHz
Slew Rate	G = –1, V_O = 2 V Step	105	170		150	190		V/µs
Full Power Response	G = +1, V_O = 2 V p-p		40			50		MHz
Settling Time to 0.1%	G = –1, V_O = 2 V Step		50			40		ns
NOISE/DISTORTION PERFORMANCE								
Total Harmonic Distortion	f_C = 5 MHz, V_O = 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
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	ΔV_S = ±1 V	68	80		68	80		dB
OPERATING TEMPERATURE RANGE		–40		+85	–40		+85	°C

Specifications subject to change without notice.