

FEATURES

Single AD8041 and Dual AD8042 Also Available
 Fully Specified at +3 V, +5 V, and ± 5 V Supplies
 Output Swings to Within 25 mV of Either Rail
 Input Voltage Range Extends 200 mV Below Ground
 No Phase Reversal with Inputs 1 V Beyond Supplies
 Low Power of 2.75 mA/Amplifier
 High Speed and Fast Settling on +5 V
 150 MHz -3 dB Bandwidth ($G = +1$)
 170 V/ μ s Slew Rate
 40 ns Settling Time to 0.1%
 Good Video Specifications ($R_L = 150 \Omega$, $G = +2$)
 Gain Flatness of 0.1 dB to 12 MHz
 0.06% Differential Gain Error
 0.15° Differential Phase Error
 Low Distortion
 -68 dBc Total Harmonic @ 5 MHz
 Outstanding Load Drive Capability
 Drives 30 mA 0.5 V from Supply Rails

APPLICATIONS

Active Filters
 Video Switchers
 Distribution Amplifiers
 A/D Driver
 Professional Cameras
 CCD Imaging Systems
 Ultrasound Equipment (Multichannel)

PRODUCT DESCRIPTION

The AD8044 is a quad, low power, voltage feedback, high speed amplifier designed to operate on +3 V, +5 V, or ± 5 V supplies. It has true single-supply capability with an input voltage range extending 200 mV below the negative rail and within 1 V of the positive rail.

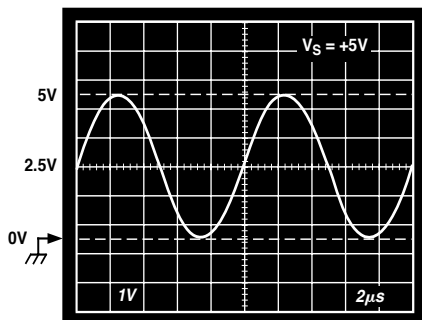


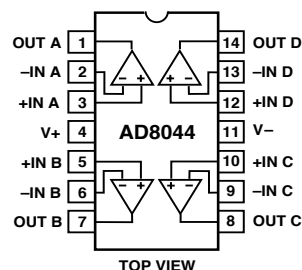
Figure 1. Output Swing: Gain = -1 , $R_L = 2 \text{ k}\Omega$

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CONNECTION DIAGRAM

14-Lead Plastic DIP and SOIC



The output voltage swing extends to within 25 mV of each rail, providing the maximum output dynamic range. Additionally, it features gain flatness of 0.1 dB to 12 MHz, while offering differential gain and phase error of 0.04% and 0.22° on a single +5 V supply. This makes the AD8044 useful for video electronics, such as cameras, video switchers, or any high speed portable equipment. The AD8044's low distortion and fast settling make it ideal for active filter applications.

The AD8044 offers low power supply current of 13.1 mA max and can run on a single +3.3 V power supply. These features are ideally suited for portable and battery-powered applications where size and power are critical.

The wide bandwidth of 150 MHz, along with 170 V/ μ s of slew rate on a single +5 V supply, make the AD8044 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. The AD8044 is available in 14-lead PDIP and SOIC.

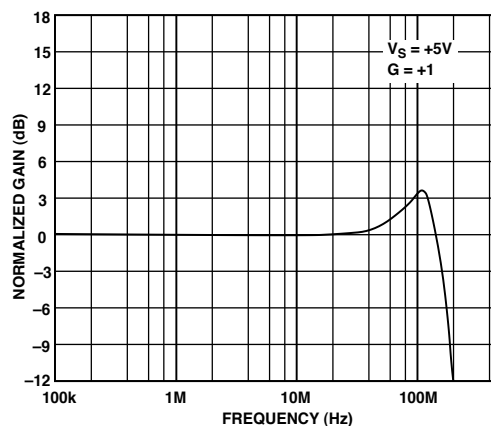


Figure 2. Frequency Response: Gain = $+1$, $V_S = +5 \text{ V}$

AD8044—SPECIFICATIONS (@ $T_A = +25^\circ\text{C}$, $V_S = +5\text{ V}$, $R_L = 2\text{ k}\Omega$ to 2.5 V , unless otherwise noted.)

Parameter	Conditions	AD8044A			Units
		Min	Typ	Max	
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth, V _O < 0.5 V p-p	G = +1	80	150		MHz
Bandwidth for 0.1 dB Flatness	G = +2, R _L = 150 Ω		12		MHz
Slew Rate	G = –1, V _O = 4 V Step	140	170		V/μs
Full Power Response	V _O = 2 V p-p		26		MHz
Settling Time to 1%	G = –1, V _O = 2 V Step		30		ns
Settling Time to 0.1%			40		ns
NOISE/DISTORTION PERFORMANCE					
Total Harmonic Distortion	f _C = 5 MHz, V _O = 2 V p-p, G = +2, R _L = 1 kΩ		–68		dB
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 10 kHz		850		fA/√Hz
Differential Gain Error (NTSC)	G = +2, R _L = 150 Ω to 2.5 V		0.04		%
Differential Phase Error (NTSC)	G = +2, R _L = 150 Ω to 2.5 V		0.22		Degrees
Crosstalk	f = 5 MHz, R _L = 1 kΩ, G = +2		–60		dB
DC PERFORMANCE					
Input Offset Voltage	T _{MIN} –T _{MAX}		1.0	6	mV
Offset Drift			8	8	mV
Input Bias Current	T _{MIN} –T _{MAX}		2	4.5	μV/°C
				4.5	μA
Input Offset Current	R _L = 1 kΩ T _{MIN} –T _{MAX}		0.2	1.2	μA
Open-Loop Gain		82	94		dB
			88		dB
INPUT CHARACTERISTICS					
Input Resistance	V _{CM} = 0 V to 3.5 V		225		kΩ
Input Capacitance			1.6		pF
Input Common-Mode Voltage Range			–0.2 to 4		V
Common-Mode Rejection Ratio		80	90		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing	R _L = 10 kΩ to 2.5 V		0.03 to 4.975		V
	R _L = 1 kΩ to 2.5 V	0.25 to 4.75	0.075 to 4.91		V
	R _L = 150 Ω to 2.5 V	0.55 to 4.4	0.25 to 4.65		V
Output Current	T _{MIN} –T _{MAX} , V _{OUT} = 0.5 V to 4.5 V		30		mA
Short Circuit Current	Sourcing		45		mA
	Sinking		85		mA
Capacitive Load Drive	G = +2		40		pF
POWER SUPPLY					
Operating Range	V _S = 0, +5 V, ±1 V	3		12	V
Quiescent Current			11	13.1	mA
Power Supply Rejection Ratio		70	80		dB
OPERATING TEMPERATURE RANGE					
		–40		+85	°C

Specifications subject to change without notice.

SPECIFICATIONS (@ $T_A = +25^\circ\text{C}$, $V_S = +3\text{ V}$, $R_L = 2\text{ k}\Omega$ to 1.5 V , unless otherwise noted.)

AD8044

Parameter	Conditions	AD8044A			Units
		Min	Typ	Max	
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth, V _O < 0.5 V p-p	G = +1	80	135		MHz
Bandwidth for 0.1 dB Flatness	G = +2, R _L = 150 Ω		10		MHz
Slew Rate	G = –1, V _O = 2 V Step	110	150		V/μs
Full Power Response	V _O = 2 V p-p		22		MHz
Settling Time to 1%	G = –1, V _O = 2 V Step		35		ns
Settling Time to 0.1%			55		ns
NOISE/DISTORTION PERFORMANCE					
Total Harmonic Distortion	f _C = 5 MHz, V _O = 2 V p-p, G = –1, R _L = 100 Ω		–48		dB
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 10 kHz		600		fA/√Hz
Differential Gain Error (NTSC)	G = +2, R _L = 150 Ω to 1.5 V, Input V _{CM} = 0.5 V		0.13		%
Differential Phase Error (NTSC)	G = +2, R _L = 150 Ω to 1.5 V, Input V _{CM} = 0.5 V		0.3		Degrees
Crosstalk	f = 5 MHz, R _L = 1 kΩ, G = +2		–60		dB
DC PERFORMANCE					
Input Offset Voltage	T _{MIN} –T _{MAX}		1.5	5.5	mV
Offset Drift			8	7.5	mV
Input Bias Current	T _{MIN} –T _{MAX}		2	4.5	μA
Input Offset Current				4.5	μA
Open-Loop Gain	R _L = 1 kΩ	80	92		dB
	T _{MIN} –T _{MAX}		88		dB
INPUT CHARACTERISTICS					
Input Resistance			225		kΩ
Input Capacitance			1.6		pF
Input Common-Mode Voltage Range			–0.2 to 2		V
Common-Mode Rejection Ratio	V _{CM} = 0 V to 1.5 V	76	90		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing	R _L = 10 kΩ to 1.5 V		0.025 to 2.98		V
	R _L = 1 kΩ to 1.5 V	0.17 to 2.82	0.06 to 2.93		V
	R _L = 150 Ω to 1.5 V	0.35 to 2.55	0.15 to 2.75		V
Output Current	T _{MIN} –T _{MAX} , V _{OUT} = 0.5 V to 2.5 V		25		mA
Short Circuit Current	Sourcing		30		mA
	Sinking		50		mA
Capacitive Load Drive	G = +2		35		pF
POWER SUPPLY					
Operating Range		3		12	V
Quiescent Current			10.5	12.5	mA
Power Supply Rejection Ratio	V _S = 0, +3 V, +0.5 V	70	80		dB
OPERATING TEMPERATURE RANGE					
		0		+70	°C

Specifications subject to change without notice.

AD8044—SPECIFICATIONS (@ $T_A = +25^\circ\text{C}$, $V_S = \pm 5\text{ V}$, $R_L = 2\text{ k}\Omega$ to 0 V , unless otherwise noted.)

Parameter	Conditions	Min	AD8044A Typ	Max	Units
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth, V _O < 0.5 V p-p	G = +1	85	160		MHz
Bandwidth for 0.1 dB Flatness	G = +2, R _L = 150 Ω		15		MHz
Slew Rate	G = –1, V _O = 8 V Step	150	190		V/μs
Full Power Response	V _O = 2 V p-p		29		MHz
Settling Time to 0.1%	G = –1, V _O = 2 V Step		30		ns
Settling Time to 0.01%			40		ns
NOISE/DISTORTION PERFORMANCE					
Total Harmonic Distortion	f _C = 5 MHz, V _O = 2 V p-p, G = +2		–72		dB
Input Voltage Noise	f = 10 kHz		16		nV/√Hz
Input Current Noise	f = 10 kHz		900		fA/√Hz
Differential Gain Error (NTSC)	G = +2, R _L = 150 Ω		0.06		%
Differential Phase Error (NTSC)	G = +2, R _L = 150 Ω		0.15		Degrees
Crosstalk	f = 5 MHz, R _L = 1 kΩ, G = +2		–60		dB
DC PERFORMANCE					
Input Offset Voltage	T _{MIN} –T _{MAX}		1.4	6.5	mV
Offset Drift			10	9	mV
Input Bias Current	T _{MIN} –T _{MAX}		2	4.5	μA
Input Offset Current				4.5	μA
Open-Loop Gain	R _L = 1 kΩ	82	0.2	1.2	μA
	T _{MIN} –T _{MAX}		96		dB
			92		dB
INPUT CHARACTERISTICS					
Input Resistance			225		kΩ
Input Capacitance			1.6		pF
Input Common-Mode Voltage Range			–5.2 to 4		V
Common-Mode Rejection Ratio	V _{CM} = –5 V to 3.5 V	76	90		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing	R _L = 10 kΩ		–4.97 to +4.97		V
	R _L = 1 kΩ	–4.6 to +4.6	–4.85 to +4.85		V
	R _L = 150 Ω	–4.0 to +3.8	–4.5 to +4.5		V
Output Current	T _{MIN} –T _{MAX} , V _{OUT} = –4.5 V to +4.5 V		30		mA
Short Circuit Current	Sourcing		60		mA
	Sinking		100		mA
Capacitive Load Drive	G = +2		40		pF
POWER SUPPLY					
Operating Range		3		12	V
Quiescent Current			11.5	13.6	mA
Power Supply Rejection Ratio	V _S = –5, +5 V, ±1 V	70	80		dB
OPERATING TEMPERATURE RANGE					
		–40		+85	°C

Specifications subject to change without notice.

AD8044

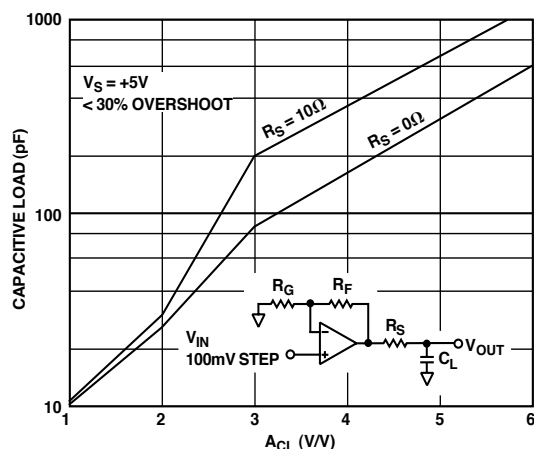


Figure 35. Capacitive Load Drive vs. Closed-Loop Gain

APPLICATIONS

RGB Buffer

The AD8044 can provide buffering of RGB signals that include ground while operating from a single +3 V or +5 V supply.

When driving two monitors from the same RGB video source it is necessary to provide an additional driver for one of the monitors to prevent the double termination situation that the second monitor presents. This has usually required a dual-supply op amp because the level of the input signal from the video driver goes all the way to ground during horizontal blanking. In single-supply systems it can be a major inconvenience and expense to add an additional negative supply.

A single AD8044 can provide the necessary drive capability and yet does not require a negative supply in this application. Figure 36 is a schematic that uses three amplifiers out of a single AD8044 to provide buffering for a second monitor.

The source of the RGB signals is shown to be from a set of three current output DACs that are within a single-supply graphics IC. This is typically the situation in most PCs and workstations that may use either a standalone triple DAC or DACs that are integrated into a larger graphics chip.

During horizontal blanking, the current output from the DACs is turned off and the RGB outputs are pulled to ground by the termination resistors. If voltage sources were used for the RGB signals, then the termination resistors near the graphics IC would be in series and the rest of the circuit would remain the same. This is because a voltage source is an ac short circuit, so a series resistor is required to make the drive end of the line see 75 Ω to ac ground. On the other hand, a current source has a very high output impedance, so a shunt resistor is required to make the drive end of the line see 75 Ω to ground. In either case, the monitor terminates its end of the line with 75 Ω.

The circuit in Figure 36 shows minimum signal degradation when using a single-supply for the AD8044. The circuit performs equally well on either a +3 V or +5 V supply.

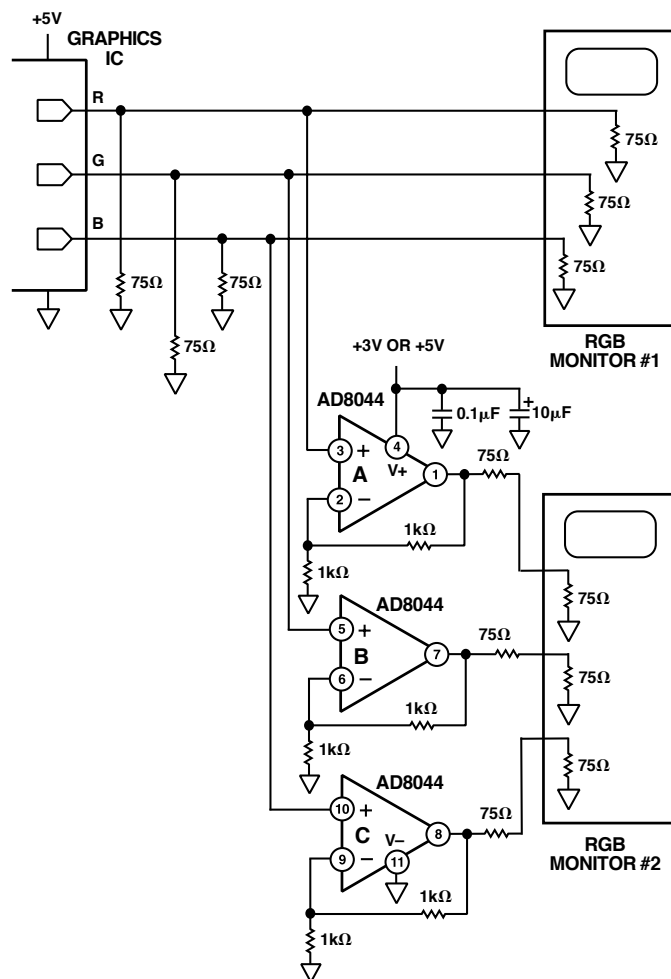


Figure 36. Single Supply RGB Video Driver

Figure 37 is an oscilloscope photo of the circuit in Figure 36 operating from a +3 V supply and driven by the Blue signal of a color bar pattern. Note that the input and output are at ground during the horizontal blanking interval. The RGB signals are specified to output a maximum of 700 mV peak. The output of the AD8044 is 1.4 V with the termination resistors providing a divide-by-two.

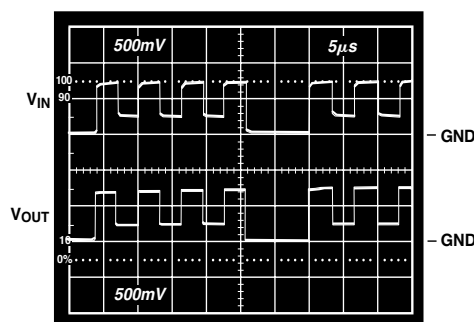


Figure 37. +3 V, RGB Buffer