Dual 350 MHz Low Power Amplifier

FEATURES
Low Power
- **1.7 mA/Amplifier Supply Current**
- **Fully Specified for ±5 V and +5 V Supplies**

High Output Current, 125 mA
High Speed
- **350 MHz, –3 dB Bandwidth (G = +1)**
- **150 MHz, –3 dB Bandwidth (G = +2)**
- **2,250 V/µs Slew Rate**
- **20 ns Settling Time to 0.1%**

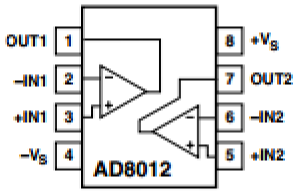
Low Distortion
- **–72 dBc Worst Harmonic @ 500 kHz, R_L = 100 Ω**
- **–66 dBc Worst Harmonic @ 5 MHz, R_L = 1 kΩ**

Good Video Specifications (R_L = 1 kΩ, G = +2)
- **0.02% Differential Gain Error**
- **0.06° Differential Phase Error**
- **Gain Flatness 0.1 dB to 40 MHz**
- **60 ns Overdrive Recovery**

Low Offset Voltage, 1.5 mV
Low Voltage Noise, 2.5 nV/√Hz
Available in 8-Lead SOIC and 8-Lead MSOP

APPLICATIONS
XDSL, HDSL Line Drivers
ADC Buffers
Professional Cameras
CCD Imaging Systems
Ultrasound Equipment
Digital Cameras

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD8012 is a dual, low power, current feedback amplifier capable of providing 350 MHz bandwidth while using only 1.7 mA per amplifier. It is intended for use in high frequency, wide dynamic range systems where low distortion and high speed are essential and low power is critical.

With only 1.7 mA of supply current, the AD8012 also offers exceptional ac specifications such as 20 ns settling time and 2,250 V/µs slew rate. The video specifications are 0.02% differential gain and 0.06 degree differential phase, excellent for such a low power amplifier. In addition, the AD8012 has a low offset of 1.5 mV.

The AD8012 is well suited for any application that requires high performance with minimal power.

The product is available in standard 8-lead SOIC or MSOP packages and operates over the industrial temperature range –40°C to +85°C.

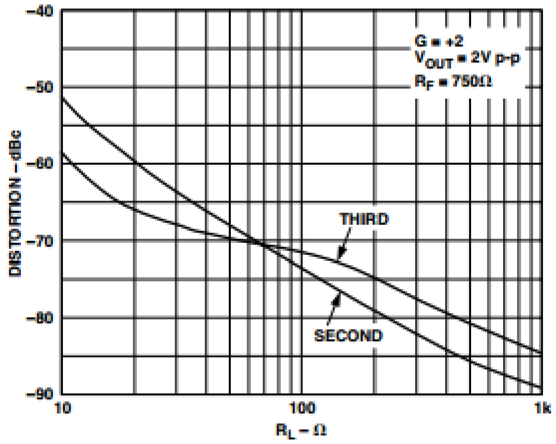


Figure 1. Distortion vs. Load Resistance, V_S = ±5 V, Frequency = 500 kHz

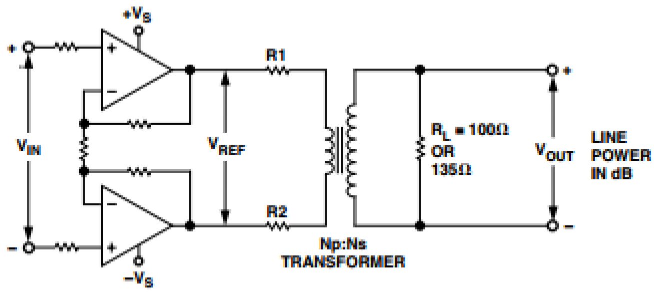


Figure 2. Differential Drive Circuit for XDSL Applications

AD8012–SPECIFICATIONS

DUAL SUPPLY (@ T_A = 25°C, V_S = ±5 V, G = +2, R_L = 100 Ω, R_F = R_G = 750 Ω, unless otherwise noted.)

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth	G = +1, V_{OUT} < 0.4 V p-p, R_L = 1 kΩ	270	350		MHz
	G = +2, V_{OUT} < 0.4 V p-p, R_L = 1 kΩ	95	150		MHz
	G = +2, V_{OUT} < 0.4 V p-p, R_L = 100 Ω		90		MHz
0.1 dB Bandwidth	V_{OUT} < 0.4 V p-p, R_L = 1 kΩ/100 Ω		40/23		MHz
Large Signal Bandwidth	V_{OUT} = 4 V p-p		75		MHz
Slew Rate	V_{OUT} = 4 V p-p		2,250		V/µs
Rise and Fall Time	V_{OUT} = 2 V p-p		3		ns
Settling Time	0.1%, V_{OUT} = 2 V p-p		20		ns
	0.02%, V_{OUT} = 2 V p-p		35		ns
Overdrive Recovery	2× Overdrive		60		ns
NOISE/HARMONIC PERFORMANCE					
Distortion	V_{OUT} = 2 V p-p, G = +2				
Second Harmonic	500 kHz, R_L = 1 kΩ/100 Ω		–89/–73		dBc
	5 MHz, R_L = 1 kΩ/100 Ω		–78/–62		dBc
Third Harmonic	500 kHz, R_L = 1 kΩ/100 Ω		–84/–72		dBc
	5 MHz, R_L = 1 kΩ/100 Ω		–66/–52		dBc
Output IP3	500 kHz, Δf = 10 kHz, R_L = 1 kΩ/100 Ω		30/40		dBm
IMD	500 kHz, Δf = 10 kHz, R_L = 1 kΩ/100 Ω		–79/–77		dBc
Crosstalk	5 MHz, R_L = 100 Ω		–70		dB
Input Voltage Noise	f = 10 kHz		2.5		nV/√Hz
Input Current Noise	f = 10 kHz, +Input, –Input		15		pA/√Hz
Differential Gain	f = 3.58 MHz, R_L = 150 Ω/1 kΩ, G = +2		0.02/0.02		%
Differential Phase	f = 3.58 MHz, R_L = 150 Ω/1 kΩ, G = +2		0.3/0.06		Degrees
DC PERFORMANCE					
Input Offset Voltage			±1.5	±4	mV
	T_{MIN}–T_{MAX}			±5	mV
Open-Loop Transimpedance	V_{OUT} = ±2 V, R_L = 100 Ω	240	500		kΩ
	T_{MIN}–T_{MAX}	200			kΩ
INPUT CHARACTERISTICS					
Input Resistance	+Input		450		kΩ
Input Capacitance	+Input		2.3		pF
Input Bias Current	+Input, –Input		±3	±12	µA
	+Input, –Input, T_{MIN}–T_{MAX}			±15	µA
Common-Mode Rejection Ratio	V_{CM} = ±2.5 V	–56	–60		dB
Input Common-Mode Voltage Range		±3.8	±4.1		V
OUTPUT CHARACTERISTICS					
Output Resistance	G = +2		0.1		Ω
Output Voltage Swing		±3.85	±4		V
Output Current	T_{MIN}–T_{MAX}	70	125		mA
Short-Circuit Current			500		mA
POWER SUPPLY					
Supply Current/Amp			1.7	1.8	mA
	T_{MIN}–T_{MAX}			1.9	mA
Operating Range	Dual Supply	±1.5		±6.0	V
Power Supply Rejection Ratio		–58	–60		dB

Specifications subject to change without notice.

SINGLE SUPPLY (@ T_A = 25°C, V_S = +5 V, G = +2, R_L = 100 Ω, R_F = R_G = 750 Ω, unless otherwise noted.)

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth	G = +1, V_{OUT} < 0.4 V p-p, R_L = 1 kΩ	220	300		MHz
	G = +2, V_{OUT} < 0.4 V p-p, R_L = 1 kΩ	90	140		MHz
	G = +2, V_{OUT} < 0.4 V p-p, R_L = 100 Ω		85		MHz
0.1 dB Bandwidth	V_{OUT} < 0.4 V p-p, R_L = 1 kΩ/100 Ω		43/24		MHz
Large Signal Bandwidth	V_{OUT} = 2 V p-p		60		MHz
Slew Rate	V_{OUT} = 3 V p-p		1,200		V/μs
Rise and Fall Time	V_{OUT} = 2 V p-p		2		ns
Settling Time	0.1%, V_{OUT} = 2 V p-p		25		ns
	0.02%, V_{OUT} = 2 V p-p		40		ns
Overdrive Recovery	2× Overdrive		60		ns
NOISE/HARMONIC PERFORMANCE					
Distortion	V_{OUT} = 2 V p-p, G = +2				
Second Harmonic	500 kHz, R_L = 1 kΩ/100 Ω		–87/–71		dBc
	5 MHz, R_L = 1 kΩ/100 Ω		–77/–61		dBc
Third Harmonic	500 kHz, R_L = 1 kΩ/100 Ω		–89/–72		dBc
	5 MHz, R_L = 1 kΩ/100 Ω		–78/–52		dBc
Output IP3	500 kHz, R_L = 1 kΩ/100 Ω		30/40		dBm
IMD	500 kHz, R_L = 1 kΩ/100 Ω		–77/–80		dBc
Crosstalk	5 MHz, R_L = 100 Ω		–70		dB
Input Voltage Noise	f = 10 kHz		2.5		nV/√Hz
Input Current Noise	f = 10 kHz, +Input, –Input		15		pA/√Hz
	Black Level Clamped to +2 V, f = 3.58 MHz				
Differential Gain	R_L = 150 Ω/1 kΩ		0.03/0.03		%
Differential Phase	R_L = 150 Ω/1 kΩ		0.4/0.08		Degrees
DC PERFORMANCE					
Input Offset Voltage			±1	±3	mV
	T_{MIN}–T_{MAX}			±4	mV
Open-Loop Transimpedance	V_{OUT} = 2 V p-p, R_L = 100 Ω	200	400		kΩ
	T_{MIN}–T_{MAX}	150			kΩ
INPUT CHARACTERISTICS					
Input Resistance	+Input		450		kΩ
Input Capacitance	+Input		2.3		pF
Input Bias Current	+Input, –Input		±3	±12	μA
	+Input, –Input, T_{MIN}–T_{MAX}			±15	μA
Common-Mode Rejection Ratio	V_{CM} = 1.5 V to 3.5 V	–56	–60		dB
Input Common-Mode Voltage Range		1.5 to 3.5	1.2 to 3.8		V
OUTPUT CHARACTERISTICS					
Output Resistance	G = +2		0.1		Ω
Output Voltage Swing		1 to 4	0.9 to 4.2		V
Output Current	T_{MIN}–T_{MAX}	50	100		mA
Short-Circuit Current			500		mA
POWER SUPPLY					
Supply Current/Amp			1.55	1.75	mA
	T_{MIN}–T_{MAX}			1.85	mA
Operating Range	Single Supply	3		12	V
Power Supply Rejection Ratio		–58	–60		dB

Specifications subject to change without notice.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD8012 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 may 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.

The output stage of the AD8012 is designed for maximum load current capability. As a result, shorting the output to common can cause the AD8012 to source or sink 500 mA. To ensure proper operation, it is necessary to observe the maximum power derating curves. Direct connection of the output to either power supply rail can destroy the device.

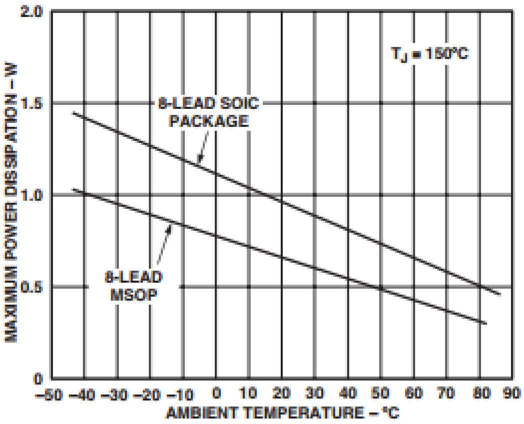
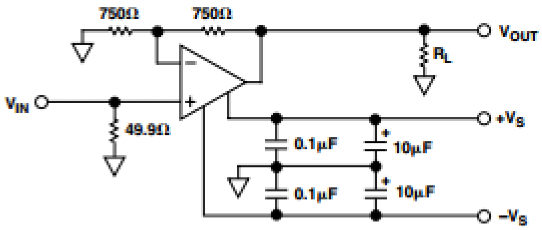
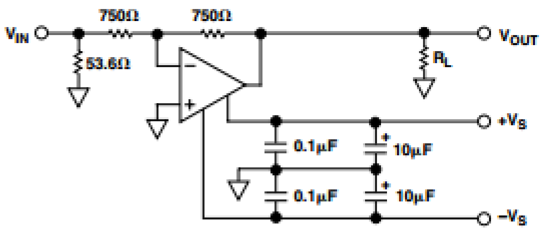


Figure 3. Plot of Maximum Power Dissipation vs. Temperature for AD8012

Test Circuits



Test Circuit 1. Gain = +2



Test Circuit 2. Gain = –1

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . 12.6 V
Internal Power Dissipation[2]
  SOIC Package (R) . . . . 0.8 W
  MSOP Package (RM) . . . . 0.6 W
Input Voltage (Common Mode) . . . . $\pm V_S$
Differential Input Voltage . . . . ±2.5 V
Output Short-Circuit Duration
  . . . . Observe Power Derating Curves
Storage Temperature Range RM, R . . . . . . –65°C to +125°C
Operating Temperature Range (A Grade) . . . –40°C to +85°C
Lead Temperature Range (Soldering 10 sec) . . . . 300°C

NOTES

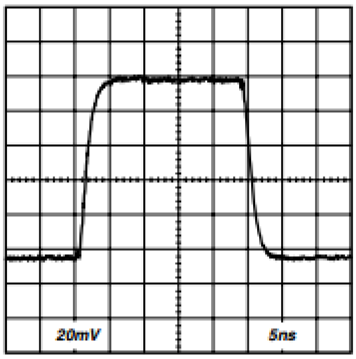
[1]Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

[2]Specification is for device in free air at +25°C.
8-Lead SOIC Package: θ_{JA} = 155°C/W
8-Lead MSOP Package: θ_{JA} = 200°C/W

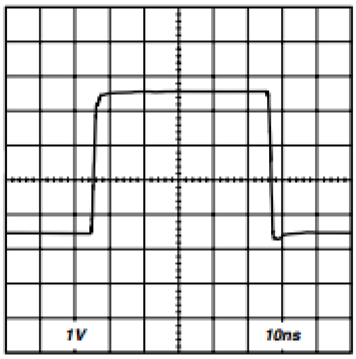
ORDERING GUIDE

Model	Temperature Range	Package Description	Package Options	Branding
AD8012AR	–40°C to +85°C	8-Lead SOIC	R-8	
AD8012AR-REEL	–40°C to +85°C	13″ Tape and Reel	R-8	
AD8012AR-REEL7	–40°C to +85°C	7″ Tape and Reel	R-8	
AD8012ARM	–40°C to +85°C	8-Lead MSOP	RM-08	H6A
AD8012ARM-REEL	–40°C to +85°C	13″ Tape and Reel	RM-08	H6A
AD8012ARM-REEL7	–40°C to +85°C	7″ Tape and Reel	RM-08	H6A
AD8012ARMZ*	–40°C to +85°C	8-Lead MSOP	RM-08	H6A
AD8012ARMZ-REEL*	–40°C to +85°C	13″ Tape and Reel	RM-08	H6A
AD8012ARMZ-REEL7*	–40°C to +85°C	7″ Tape and Reel	RM-08	H6A

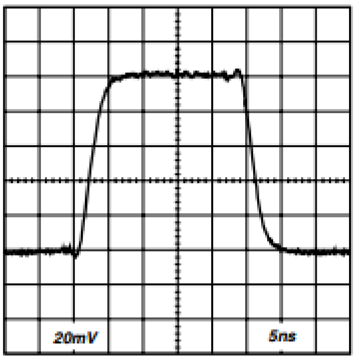
*Z = Pb-free product.



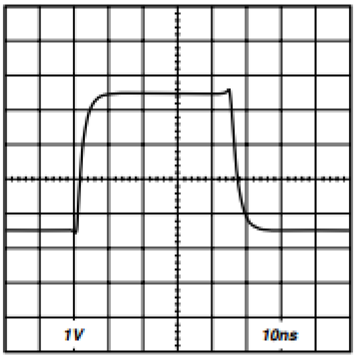
*TPC 1. 100 mV Step Response; G = +2, V_S = ±2.5 V or ±5 V, R_L = 1 kΩ**



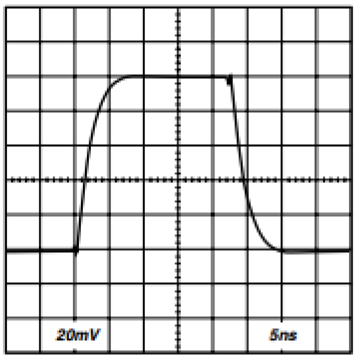
TPC 2. 4 V Step Response; G = +2, V_S = ±5 V, R_L = 1 kΩ



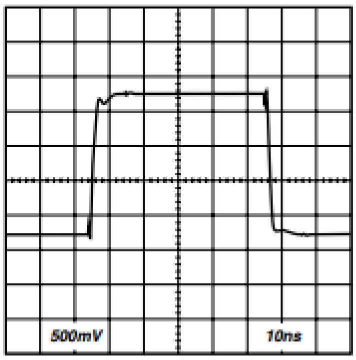
*TPC 3. 100 mV Step Response; G = –1, V_S = ±2.5 V or ±5 V, R_L = 1 kΩ**



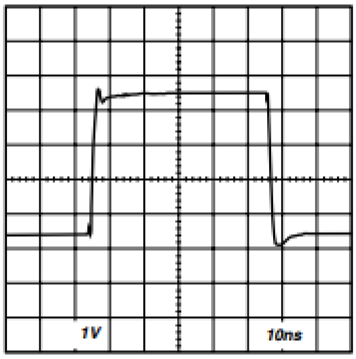
TPC 4. 4 V Step Response; G = –1, V_S = ±5 V, R_L = 1 kΩ



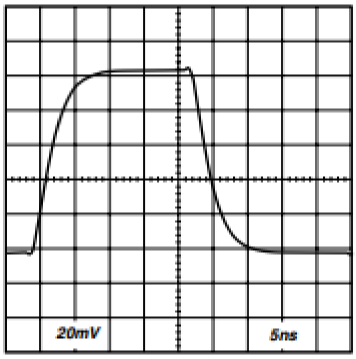
*TPC 5. 100 mV Step Response; G = +2, V_S = ±2.5 V or ±5 V, R_L = 100 Ω**



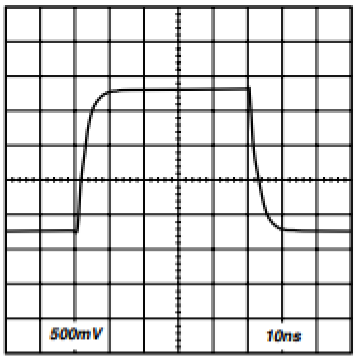
TPC 6. 2 V Step Response; G = +2, V_S = ±2.5 V, R_L = 100 Ω



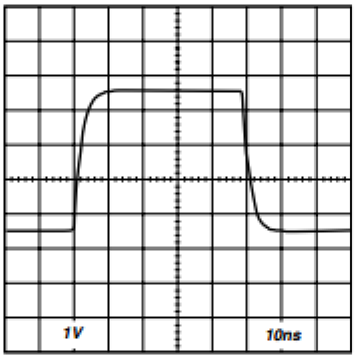
TPC 7. 4 V Step Response; G = +2, V_S = ±5 V, R_L = 100 Ω



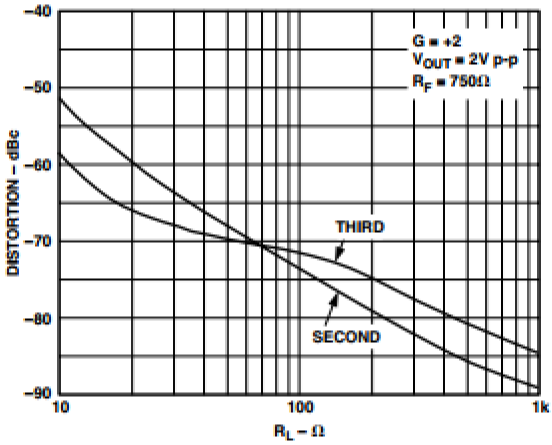
TPC 8. 100 mV Step Response; G = –1, V_S = ±2.5 V or ±5 V, R_L = 100 Ω*



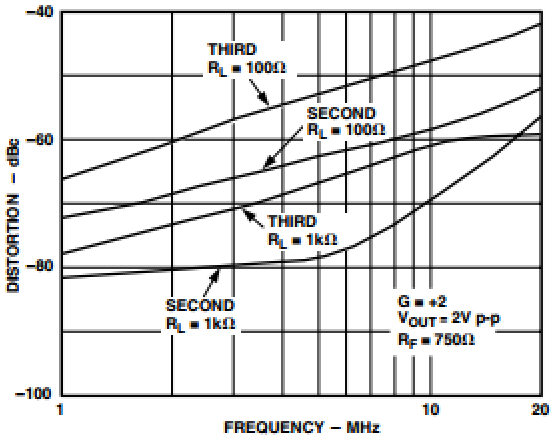
TPC 9. 2 V Step Response; G = –1, V_S = ±2.5 V, R_L = 100 Ω



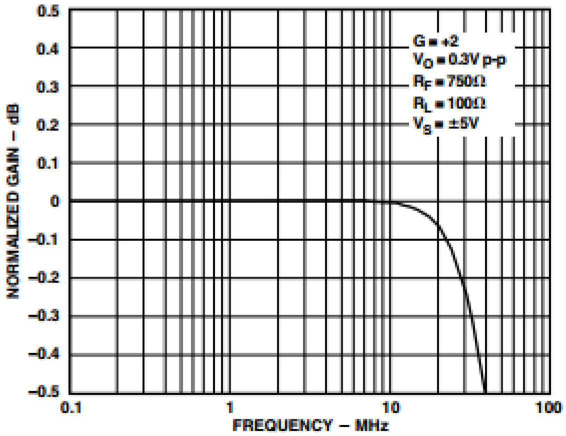
TPC 10. 4 V Step Response; G = –1, V_S = ±5 V, R_L = 100 Ω



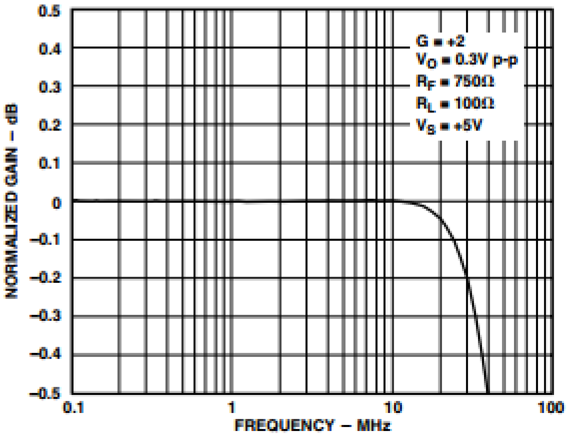
TPC 11. Distortion vs. Load Resistance; V_S = ±5 V, Frequency = 500 kHz



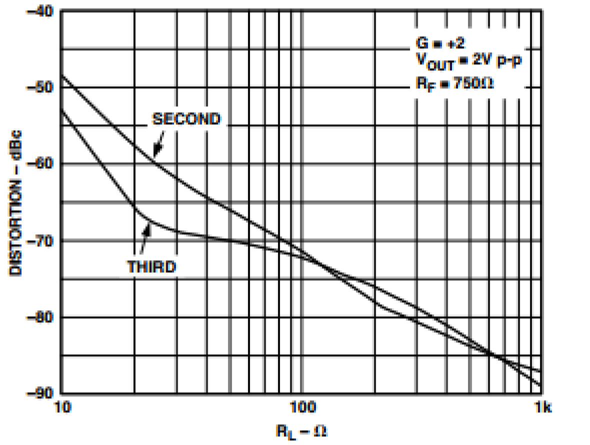
TPC 12. Distortion vs. Frequency; V_S = ±5 V



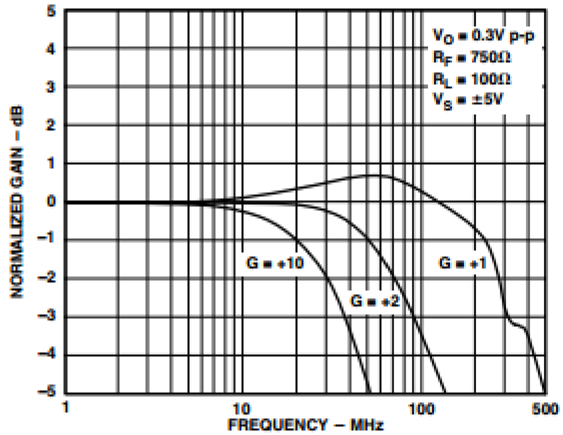
TPC 13. Gain Flatness; V_S = ±5 V



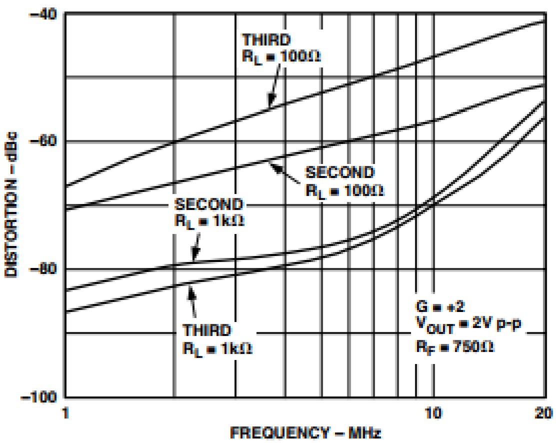
TPC 16. Gain Flatness; V_S = +5 V



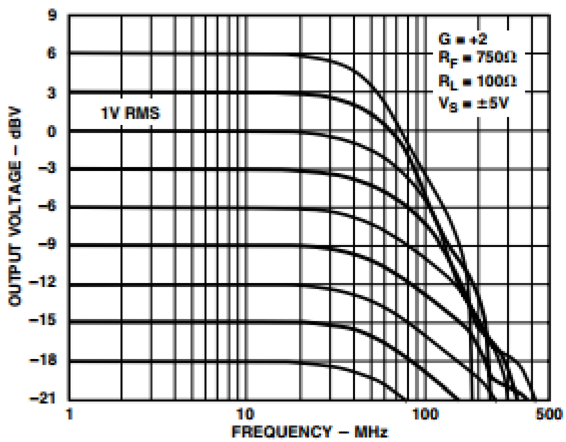
TPC 14. Distortion vs. Load Resistance; V_S = +5 V, Frequency = 500 kHz



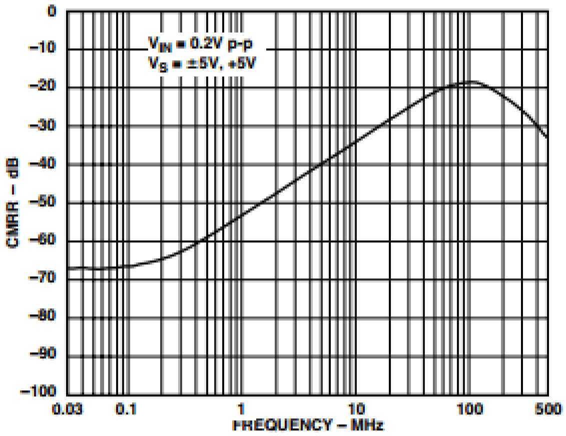
TPC 17. Frequency Response; V_S = ±5 V



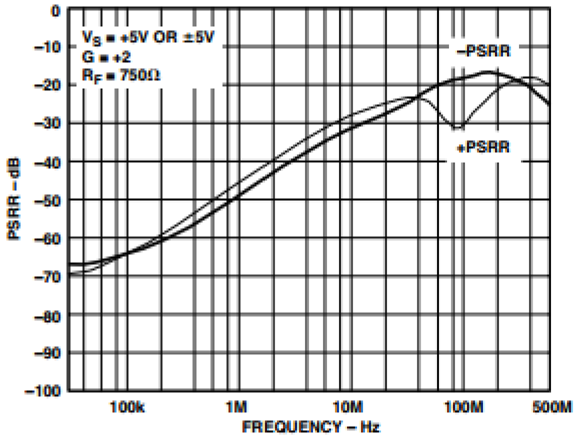
TPC 15. Distortion vs. Frequency; V_S = +5 V



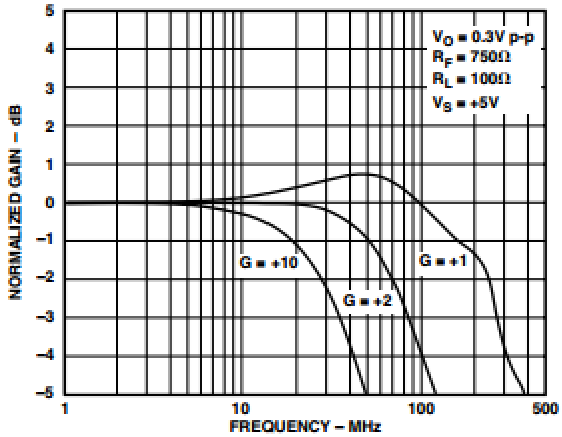
TPC 18. Output Voltage vs. Frequency; V_S = ±5 V, G = +2, R_L = 100 Ω



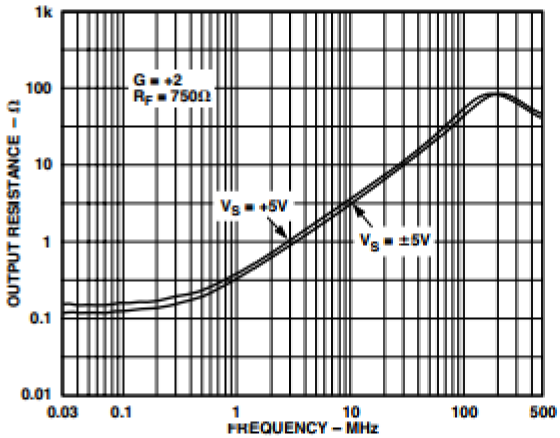
TPC 19. CMRR vs. Frequency; $V_S = \pm 5$ V, +5 V



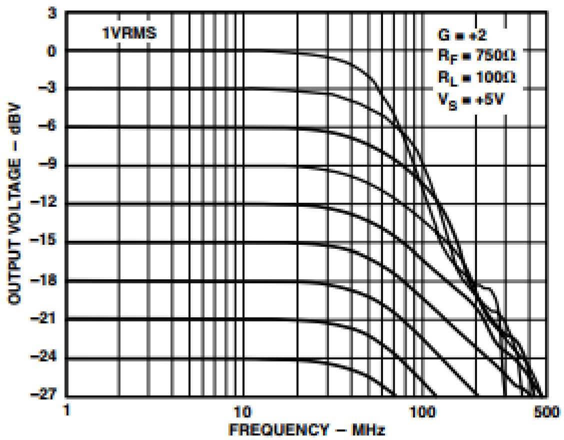
TPC 22. PSRR vs. Frequency; $V_S = \pm 5$ V, +5 V



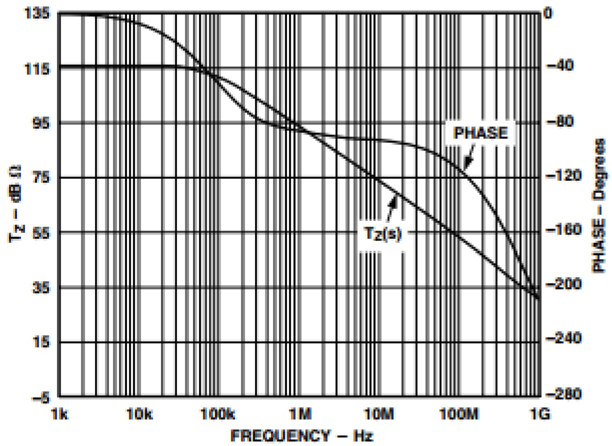
TPC 20. Frequency Response; $V_S = +5$ V



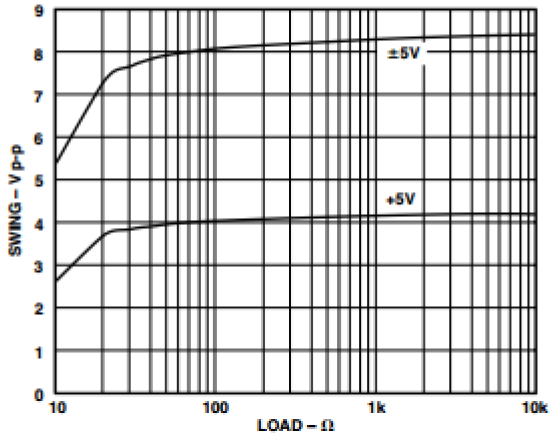
TPC 23. Output Resistance vs. Frequency



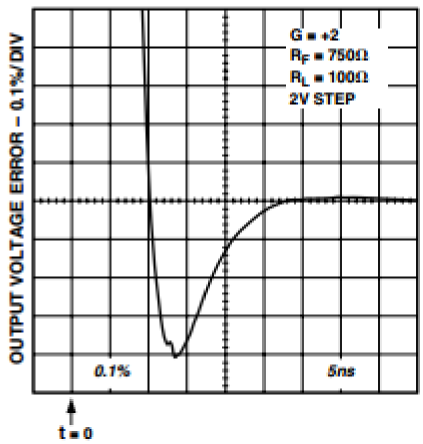
TPC 21. Output Voltage vs. Frequency; $V_S = +5$ V, $G = +2$, $R_L = 100\ \Omega$



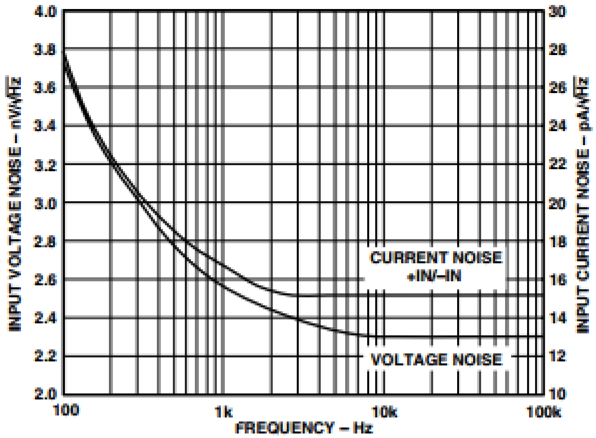
TPC 24. Open-Loop Transimpedance and Phase vs. Frequency



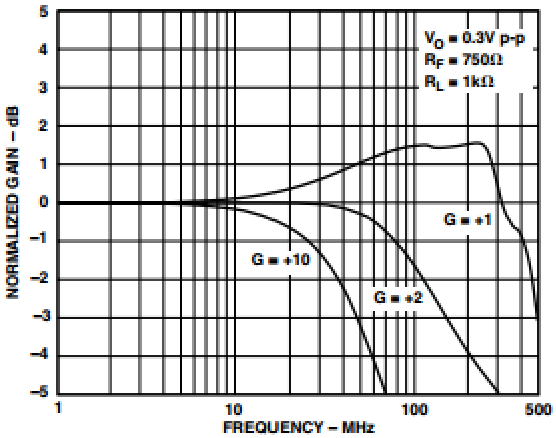
TPC 25. Output Swing vs. Load



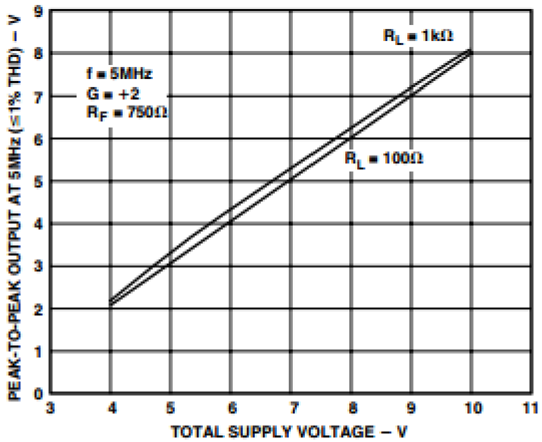
TPC 28. Settling Time, $V_S = \pm 5$ V



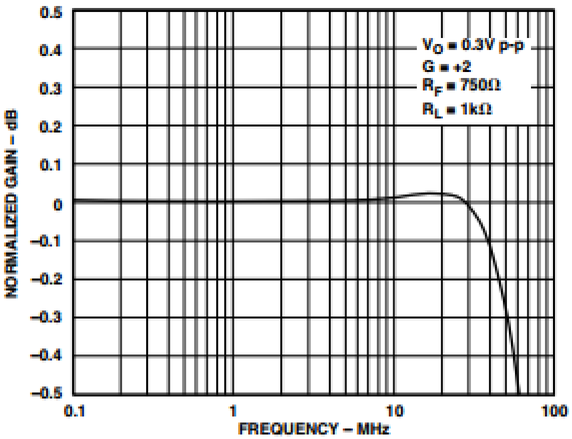
TPC 26. Noise vs. Frequency



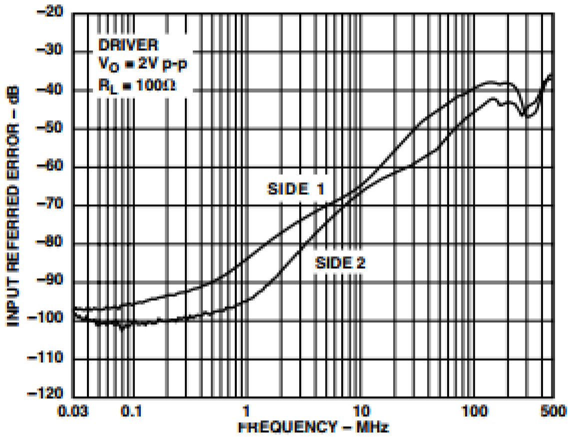
TPC 29. Frequency Response; $V_S = \pm 5$ V



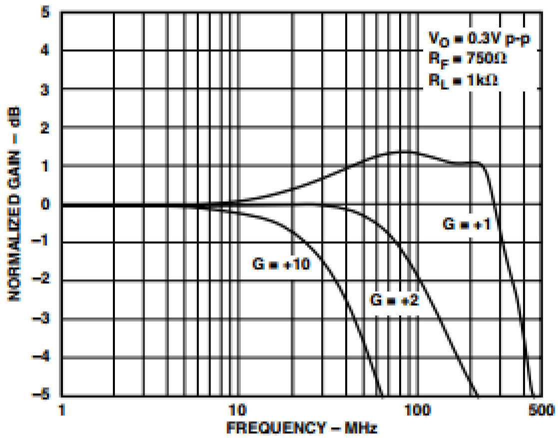
TPC 27. Output Swing vs. Supply



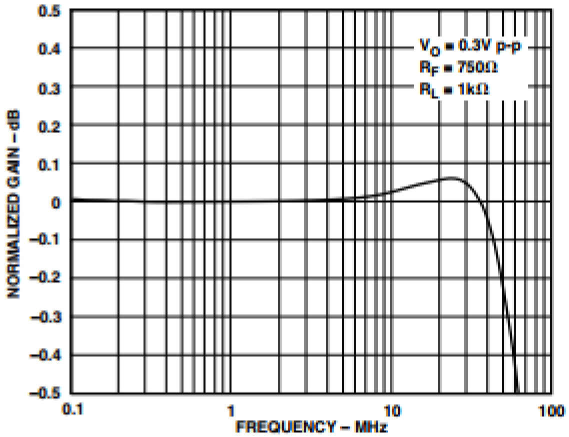
TPC 30. Gain Flatness; $V_S = \pm 5$ V



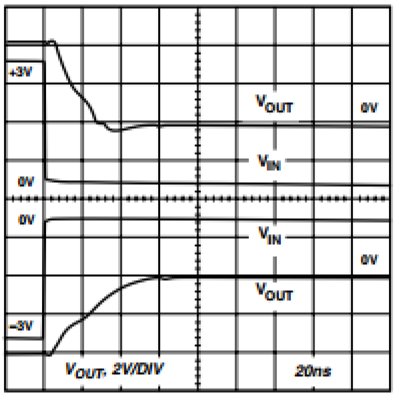
TPC 31. Crosstalk vs. Frequency



TPC 32. Frequency Response; V_S = +5 V



TPC 33. Gain Flatness; V_S = +5 V



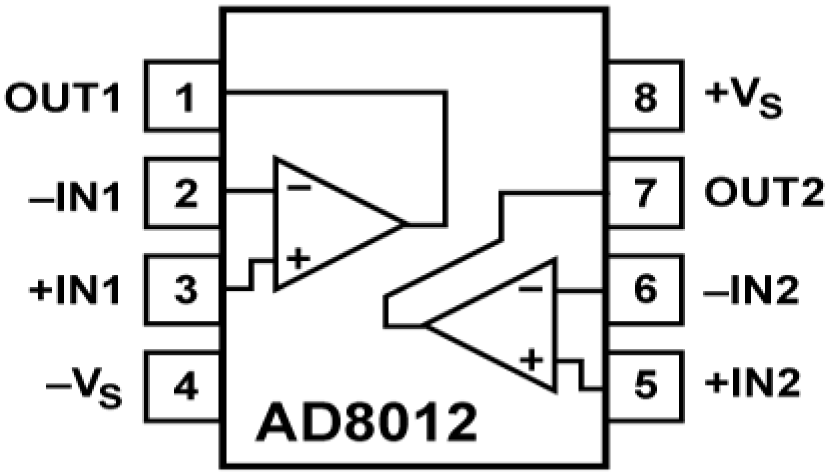
TPC 34. Overdrive Recovery; V_S = ±5 V, G = +2, R_F = 750 Ω, R_L = 100 Ω, V_{IN} = 3 V p-p (T = 1 µs)

AD8012 – это малопотребляющий двухканальный усилитель с обратной связью по току, обеспечивающий ширину полосы 350 МГц при потребляемом токе всего 1.7 мА на канал. Он предназначен для применения в высокочастотных системах с широким динамическим диапазоном, в которых требуются низкий уровень искажений и высокое быстродействие и критически важно низкое энергопотребление.

ОСОБЕННОСТИ И ПРЕИМУЩЕСТВА

- Малое энергопотребление
  Потребляемый ток 1.7 мА/канал
  Полная спецификация характеристик для напряжений питания ±5 В и +5 В
- Высокий выходной ток: 125 мА
- Высокое быстродействие
  Ширина полосы по уровню -3 дБ: 350 МГц (G = +1)
  Ширина полосы по уровню -3 дБ: 150 МГц (G = +2)
  Скорость нарастания 2250 В/мкс
  Время установления до 0.1%: 20 нс
- Низкое напряжение смещения: 1.5 мВ
- Низкий шум напряжения: 2.5 нВ/√Гц
- Низкие искажения
  Наихудшая гармоника -72 дБн при 500 кГц, R_L = 100 Ом
  Наихудшая гармоника -66 дБн при 5 МГц, R_L = 1 кОм
- Хорошие характеристики передачи видеосигнала (R_L = 1 кОм, G = +2)
- Погрешность дифференциального коэффициента усиления 0.02%
  Погрешность дифференциальной фазы 0.06°
  Полоса с неравномерностью усиления в пределах 0.1 дБ: 40 МГц
  Время восстановления после перегрузки: 60 нс

КОНФИГУРАЦИЯ ВЫВОДОВ AD8012



Конфигурация выводов AD8012