High Performance Video Op Amp

Data Sheet

# AD811

## FEATURES

**High speed**
- **140 MHz bandwidth (3 dB, G = +1)**
- **120 MHz bandwidth (3 dB, G = +2)**
- **35 MHz bandwidth (0.1 dB, G = +2)**
- **2500 V/µs slew rate**
- **25 ns settling time to 0.1% (for a 2 V step)**
- **65 ns settling time to 0.01% (for a 10 V step)**

**Excellent video performance ($R_L$ =150 Ω)**
- **0.01% differential gain, 0.01° differential phase**
- **Voltage noise of 1.9 nV/√Hz**

**Low distortion: THD = −74 dB at 10 MHz**

**Excellent dc precision: 3 mV max input offset voltage**

**Flexible operation**
- **Specified for ±5 V and ±15 V operation**
- **±2.3 V output swing into a 75 Ω load ($V_S$ = ±5 V)**

## APPLICATIONS

**Video crosspoint switchers, multimedia broadcast systems**

**HDTV compatible systems**

**Video line drivers, distribution amplifiers**

**ADC/DAC buffers**

**DC restoration circuits**

**Medical**
- **Ultrasound**
- **PET**
- **Gamma**
- **Counter applications**

**MIL-STD-883B parts available**

## CONNECTION DIAGRAMS

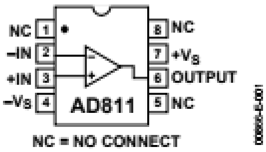
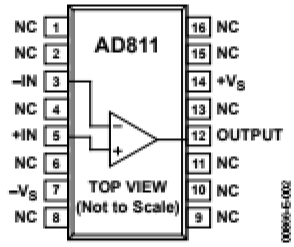
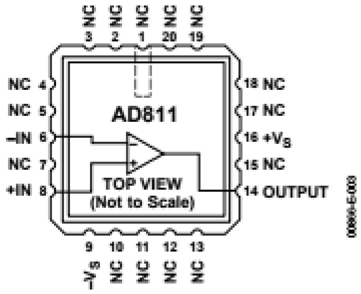



*Figure 1. 8-Lead Plastic (N-8), CERDIP (Q-8), SOIC_N (R-8)*




NOTES
1. NC = NO CONNECT. DO NOT CONNECT TO THIS PIN.

*Figure 2. 16-Lead SOIC_W (RW-16)*




NOTES
1. NC = NO CONNECT. DO NOT CONNECT TO THIS PIN.

*Figure 3. 20-Terminal LCC (E-20-1)*

## GENERAL DESCRIPTION

A wideband current feedback operational amplifier, the AD811 is optimized for broadcast-quality video systems. The −3 dB bandwidth of 120 MHz at a gain of +2 and the differential gain and phase of 0.01% and 0.01° ($R_L$ = 150 Ω) make the AD811 an excellent choice for all video systems. The AD811 is designed to meet a stringent 0.1 dB gain flatness specification to a bandwidth of 35 MHz (G = +2) in addition to low differential gain and phase errors. This performance is achieved whether driving one or two back-terminated 75 Ω cables, with a low power supply current of 16.5 mA. Furthermore, the AD811 is specified over a power supply range of ±4.5 V to ±18 V.

The AD811 is also excellent for pulsed applications where transient response is critical. It can achieve a maximum slew rate of greater than 2500 V/µs with a settling time of less than 25 ns to 0.1% on a 2 V step and 65 ns to 0.01% on a 10 V step.

The AD811 is ideal as an ADC or DAC buffer in data acquisition systems due to its low distortion up to 10 MHz and its wide unity gain bandwidth. Because the AD811 is a current feedback amplifier, this bandwidth can be maintained over a wide range of gains. The AD811 also offers low voltage and current noise of 1.9 nV/√Hz and 20 pA/√Hz, respectively, and excellent dc accuracy for wide dynamic range applications.

## SPECIFICATIONS

At $T_A$ = +25°C, $V_S$ = ±15 V dc, $R_{LOAD}$ = 150 Ω, unless otherwise noted.

**Table 1.**

| | | | AD811J/AD811A[1] | | | AD811S[2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Conditions** | **$V_S$** | **Min** | **Typ** | **Max** | **Min** | **Typ** | **Max** | **Unit** |
| DYNAMIC PERFORMANCE | | | | | | | | | |
| Small Signal Bandwidth (No Peaking) | | | | | | | | | |
| −3 dB | | | | | | | | | |
| G = +1 | $R_{FB}$ = 562 Ω | ±15 V | | 140 | | | 140 | | MHz |
| G = +2 | $R_{FB}$ = 649 Ω | ±15 V | | 120 | | | 120 | | MHz |
| G = +2 | $R_{FB}$ = 562 Ω | ±15 V | | 80 | | | 80 | | MHz |
| G = +10 | $R_{FB}$ = 511 Ω | ±15 V | | 100 | | | 100 | | MHz |
| 0.1 dB Flat | | | | | | | | | |
| G = +2 | $R_{FB}$ = 562 Ω | ±15 | | 25 | | | 25 | | MHz |
| | $R_{FB}$ = 649 Ω | ±15 | | 35 | | | 35 | | MHz |
| Full Power Bandwidth[3] | $V_{OUT}$ = 20 V p-p | ±15 | | 40 | | | 40 | | MHz |
| Slew Rate | $V_{OUT}$ = 4 V p-p | ±15 | | 400 | | | 400 | | V/µs |
| | $V_{OUT}$ = 20 V p-p | ±15 | | 2500 | | | 2500 | | V/µs |
| Settling Time to 0.1% | 10 V Step, $A_V$ = − 1 | ±15 | | 50 | | | 50 | | ns |
| Settling Time to 0.01% | 10 V Step, $A_V$ = − 1 | ±15 | | 65 | | | 65 | | ns |
| Settling Time to 0.1% | 2 V Step, $A_V$ = − 1 | ±15 | | 25 | | | 25 | | ns |
| Rise Time, Fall Time | $R_{FB}$ = 649, $A_V$ = +2 | ±15 | | 3.5 | | | 3.5 | | ns |
| Differential Gain | f = 3.58 MHz | ±15 | | 0.01 | | | 0.01 | | % |
| Differential Phase | f = 3.58 MHz | ±15 | | 0.01 | | | 0.01 | | Degree |
| THD at $f_C$ = 10 MHz | $V_{OUT}$ = 2 V p-p, $A_V$ = +2 | ±15 | | −74 | | | −74 | | dBc |
| Third-Order Intercept[4] | At $f_C$ = 10 MHz | ±15 | | 36 | | | 36 | | dBm |
| | | ±15 | | 43 | | | 43 | | dBm |
| INPUT OFFSET VOLTAGE | | ±5 V, ±15 V | | 0.5 | 3 | | 0.5 | 3 | mV |
| | $T_{MIN}$ to $T_{MAX}$ | | | | 5 | | | 5 | mV |
| Offset Voltage Drift | | | | 5 | | | 5 | | µV/°C |
| INPUT BIAS CURRENT | | | | | | | | | |
| −Input | | ±5 V, ±15 V | | 2 | 5 | | 2 | 5 | µA |
| | $T_{MIN}$ to $T_{MAX}$ | | | | 15 | | | 30 | µA |
| +Input | | ±5 V, ±1 5 V | | 2 | 10 | | 2 | 10 | µA |
| | $T_{MIN}$ to $T_{MAX}$ | | | | 20 | | | 25 | µA |
| TRANSRESISTANCE | $T_{MIN}$ to $T_{MAX}$ | | | | | | | | |
| | $V_{OUT}$ = ±10 V | | | | | | | | |
| | $R_L$ = ∞ | ±15 V | 0.75 | 1.5 | | 0.75 | 1.5 | | MΩ |
| | $R_L$ = 200 Ω | ±15 V | 0.5 | 0.75 | | 0.5 | 0.75 | | MΩ |
| | $V_{OUT}$ = ±2.5 V | | | | | | | | |
| | $R_L$ = 150 Ω | ±5 V | 0.25 | 0.4 | | 0.125 | 0.4 | | MΩ |
| COMMON-MODE REJECTION | | | | | | | | | |
| $V_{OS}$ (vs. Common Mode) | | | | | | | | | |
| $T_{MIN}$ to $T_{MAX}$ | $V_{CM}$ = ±2.5 V | ±5 V | 56 | 60 | | 50 | 60 | | dB |
| $T_{MIN}$ to $T_{MAX}$ | $V_{CM}$ = ±10 V | ±15 V | 60 | 66 | | 56 | 66 | | dB |
| Input Current (vs. Common Mode) | $T_{MIN}$ to $T_{MAX}$ | | | 1 | 3 | | 1 | 3 | µA/V |
| POWER SUPPLY REJECTION | $V_S$ = ±4.5 V to ±18 V | | | | | | | | |
| $V_{OS}$ | $T_{MIN}$ to $T_{MAX}$ | | 60 | 70 | | 60 | 70 | | dB |
| +Input Current | $T_{MIN}$ to $T_{MAX}$ | | | 0.3 | 2 | | 0.3 | 2 | µA/V |
| −Input Current | $T_{MIN}$ to $T_{MAX}$ | | | 0.4 | 2 | | 0.4 | 2 | µA/V |

| Parameter | Conditions | $V_S$ | AD811J/AD811A[1] Min | Typ | Max | AD811S[2] Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| INPUT VOLTAGE NOISE | f = 1 kHz | | | 1.9 | | | 1.9 | | nV/√Hz |
| INPUT CURRENT NOISE | f = 1 kHz | | | 20 | | | 20 | | pA/√Hz |
| OUTPUT CHARACTERISTICS | | | | | | | | | |
| Voltage Swing, Useful Operating Range[5] | | ±5 V | | ±2.9 | | | ±2.9 | | V |
| | | ±15 V | | ±12 | | | ±12 | | V |
| Output Current | $T_J$ = 25°C | | | 100 | | | 100 | | mA |
| Short-Circuit Current | | | | 150 | | | 150 | | mA |
| Output Resistance | (Open Loop at 5 MHz) | | | 9 | | | 9 | | Ω |
| INPUT CHARACTERISTIC | | | | | | | | | |
| +Input Resistance | | | | 1.5 | | | 1.5 | | MΩ |
| −Input Resistance | | | | 14 | | | 14 | | Ω |
| Input Capacitance | +Input | | | 7.5 | | | 7.5 | | pF |
| Common-Mode Voltage Range | | ±5 V | | ±3 | | | ±3 | | V |
| | | ±15 V | | ±13 | | | ±13 | | V |
| POWER SUPPLY | | | | | | | | | |
| Operating Range | | | ±4.5 | | ±18 | ±4.5 | | ±18 | V |
| Quiescent Current | | ±5 V | | 14.5 | 16.0 | | 14.5 | 16.0 | mA |
| | | ±15 V | | 16.5 | 18.0 | | 16.5 | 18.0 | mA |
| TRANSISTOR COUNT | Number of Transistors | | | 40 | | | 40 | | |

[1] The AD811JR is specified with ±5 V power supplies only, with operation up to ±12 V.
[2] See the Analog Devices military data sheet for 883B tested specifications.
[3] FPBW = slew rate/(2 π $V_{PEAK}$).
[4] Output power level, tested at a closed-loop gain of two.
[5] Useful operating range is defined as the output voltage at which linearity begins to degrade.

# ABSOLUTE MAXIMUM RATINGS

**Table 2.**

| Parameter | Rating |
|---|---|
| Supply Voltage | ±18 V |
| AD811JR Grade Only | ±12 V |
| Internal Power Dissipation | Observe Derating Curves |
| 8-Lead PDIP Package | $\theta_{JA}$ = 90°C/ W |
| 8-Lead CERDIP Package | $\theta_{JA}$ = 110°C/W |
| 8-Lead SOIC_N Package | $\theta_{JA}$ = 155°C/W |
| 16-Lead SOIC_W Package | $\theta_{JA}$ = 85°C/W |
| 20-Lead LCC Package | $\theta_{JA}$ = 70°C/W |
| Output Short-Circuit Duration | Observe Derating Curves |
| Common-Mode Input Voltage | $\pm V_S$ |
| Differential Input Voltage | ±6 V |
| Storage Temperature Range (Q, E) | −65°C to +150°C |
| Storage Temperature Range (N, R) | −65°C to +125°C |
| Operating Temperature Range | |
| AD811J | 0°C to +70°C |
| AD811A | −40°C to +85°C |
| AD811S | −55°C to +125°C |
| Lead Temperature Range (Soldering 60 sec) | 300°C |

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

## MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD811 is limited by the associated rise in junction temperature. For the plastic packages, the maximum safe junction temperature is 145°C. For the CERDIP and LCC packages, the maximum junction temperature is 175°C. If these maximums are exceeded momentarily, proper circuit operation is restored as soon as the die temperature is reduced. Leaving the device in the overheated condition for an extended period can result in device burnout. To ensure proper operation, it is important to observe the derating curves in Figure 21 and Figure 24.

While the AD811 is internally short-circuit protected, this may not be sufficient to guarantee that the maximum junction temperature is not exceeded under all conditions. An important example is when the amplifier is driving a reverse-terminated 75 Ω cable and the cable's far end is shorted to a power supply. With power supplies of ±12 V (or less) at an ambient temperature of +25°C or less, and the cable shorted to a supply rail, the amplifier is not destroyed, even if this condition persists for an extended period.

## METALIZATION PHOTOGRAPH

Contact the factory for the latest dimensions.

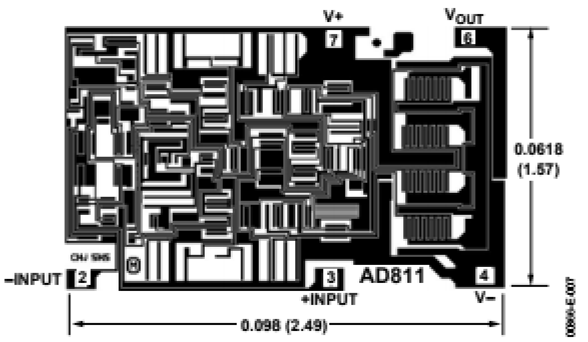



*Figure 4. Metalization Photograph*
*Dimensions Shown in Inches and (Millimeters)*

# TYPICAL PERFORMANCE CHARACTERISTICS

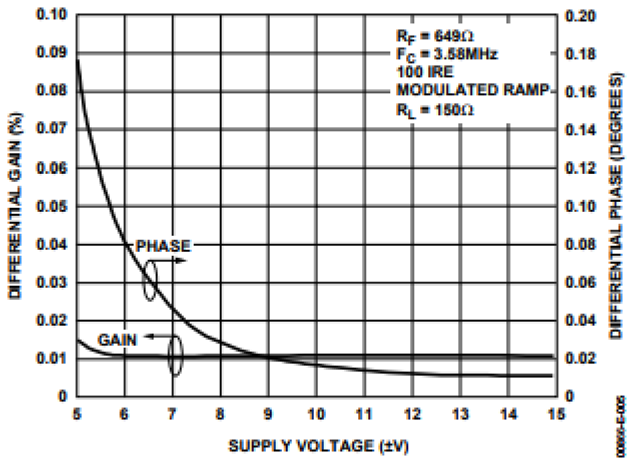



*Figure 5. Differential Gain and Phase*

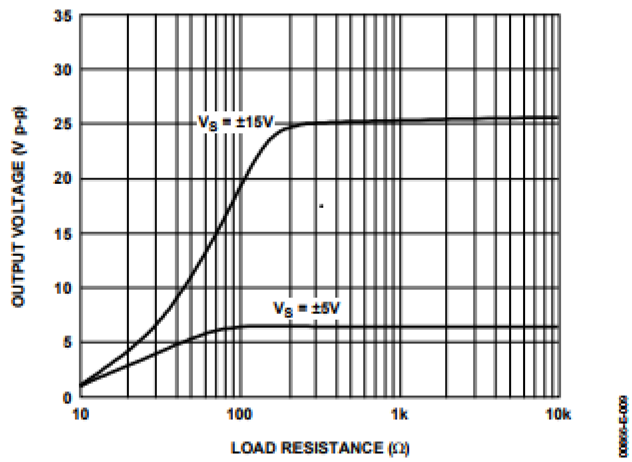



*Figure 8. Output Voltage Swing vs. Resistive Load*

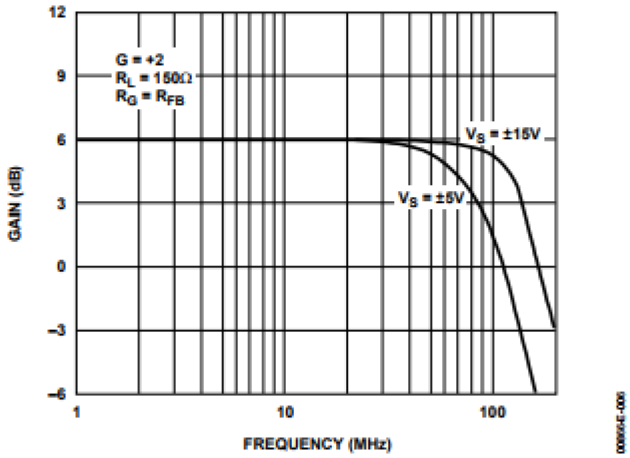



*Figure 6. Frequency Response*

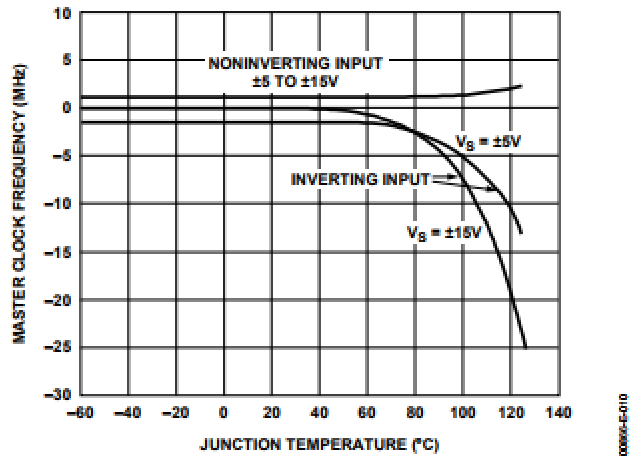



*Figure 9. Input Bias Current vs. Junction Temperature*

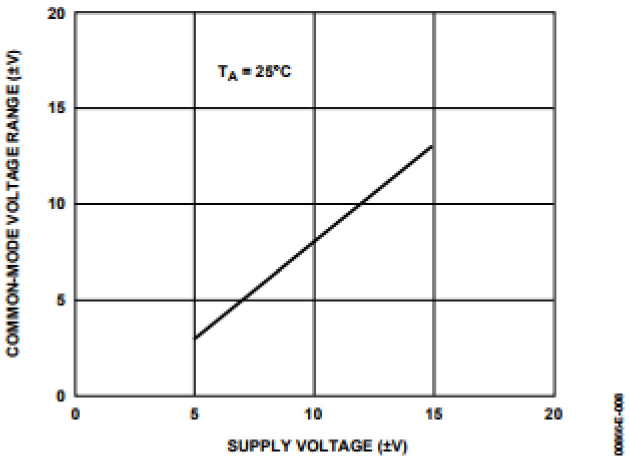



*Figure 7. Input Common-Mode Voltage Range vs. Supply Voltage*

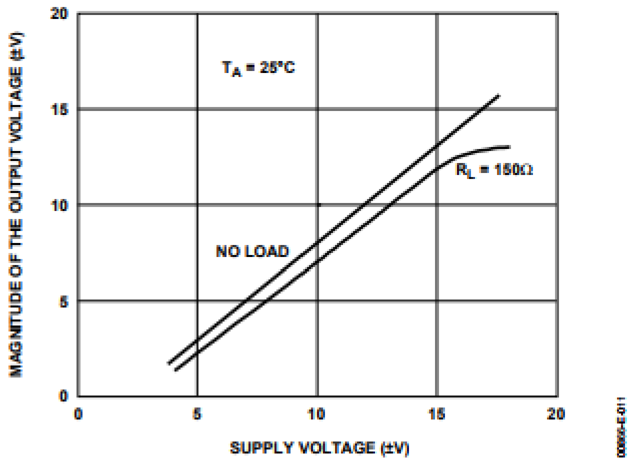



*Figure 10. Output Voltage Swing vs. Supply Voltage*

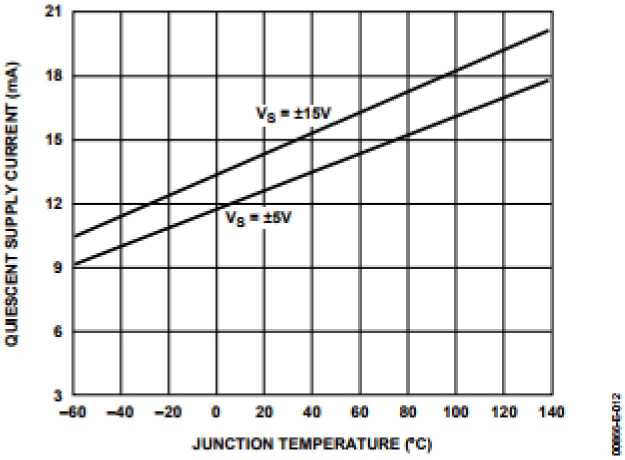



*Figure 11. Quiescent Supply Current vs. Junction Temperature*

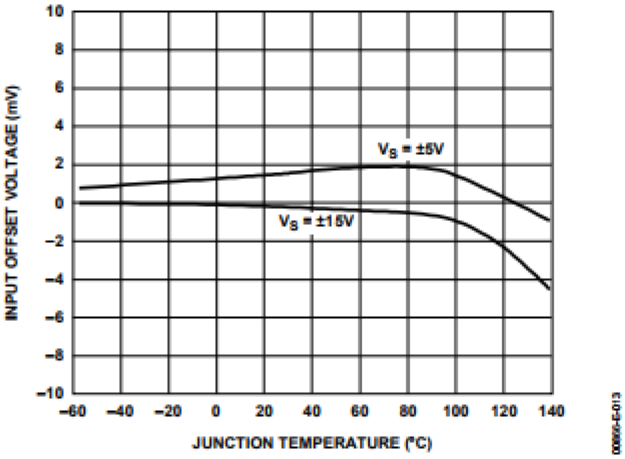



*Figure 12. Input Offset Voltage vs. Junction Temperature*

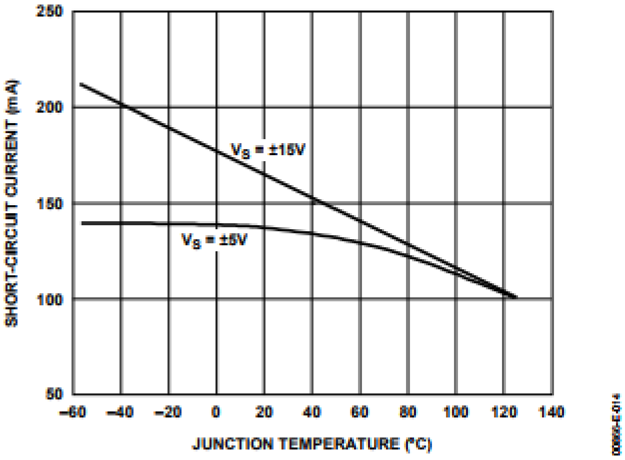



*Figure 13. Short-Circuit Current vs. Junction Temperature*

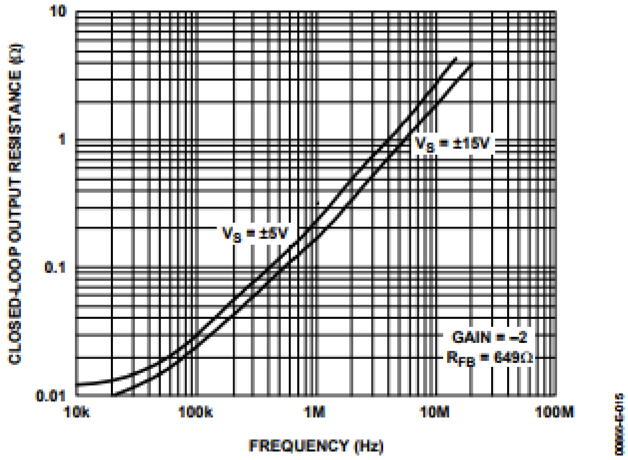



*Figure 14. Closed-Loop Output Resistance vs. Frequency*

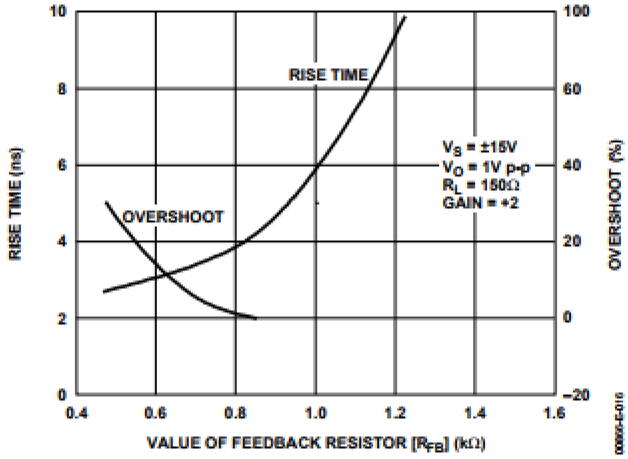



*Figure 15. Rise Time and Overshoot vs. Value of Feedback Resistor, $R_{FB}$*

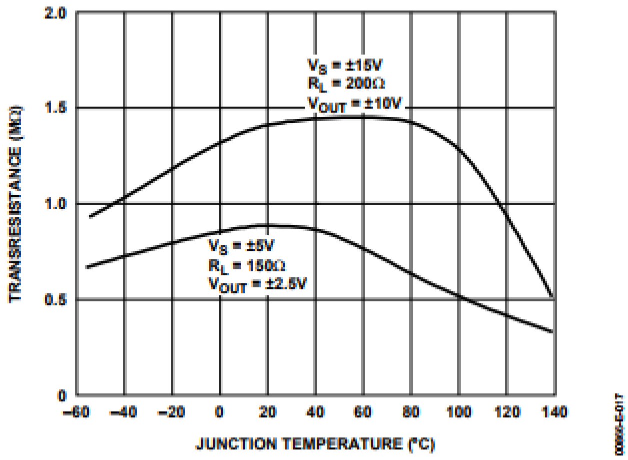



*Figure 16. Transresistance vs. Junction Temperature*

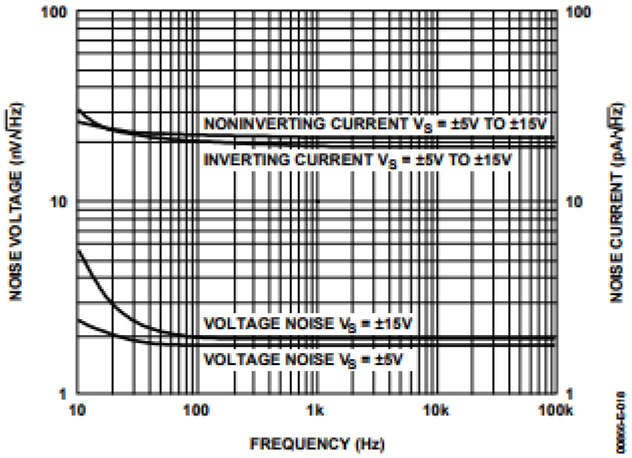



*Figure 17. Input Noise vs. Frequency*

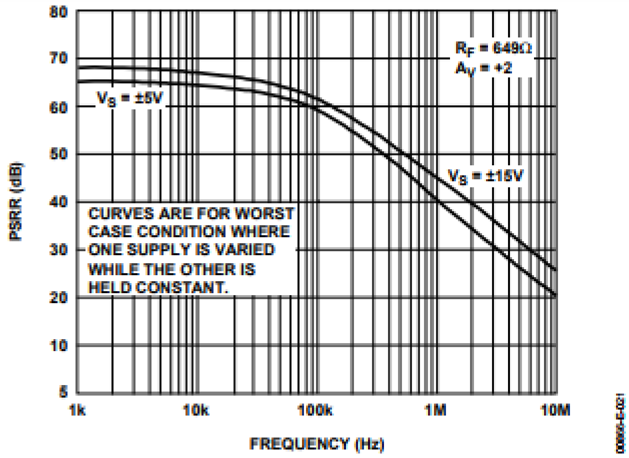



*Figure 20. Power Supply Rejection Ration vs. Frequency*

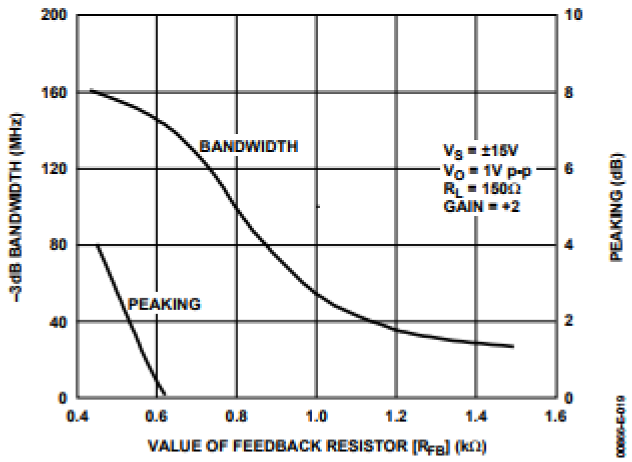



*Figure 18. –3 dB Bandwidth and Peaking vs. Value of $R_{FB}$*

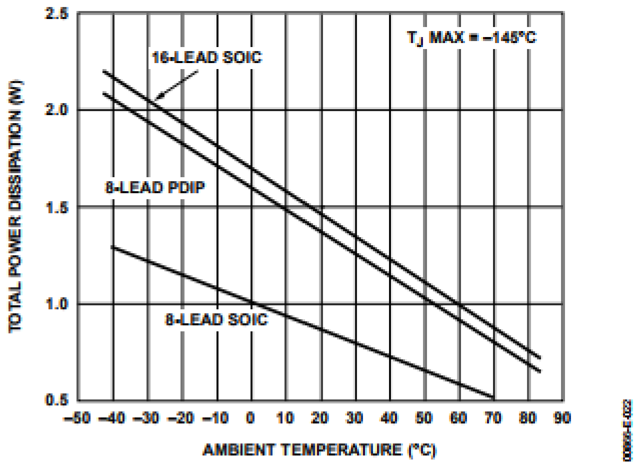



*Figure 21. Maximum Power Dissipation vs. Temperature for Plastic Packages*

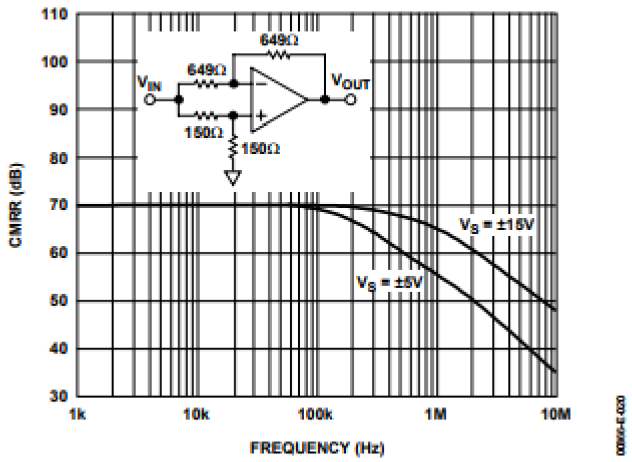



*Figure 19. Common-Mode Rejection Ratio vs. Frequency*

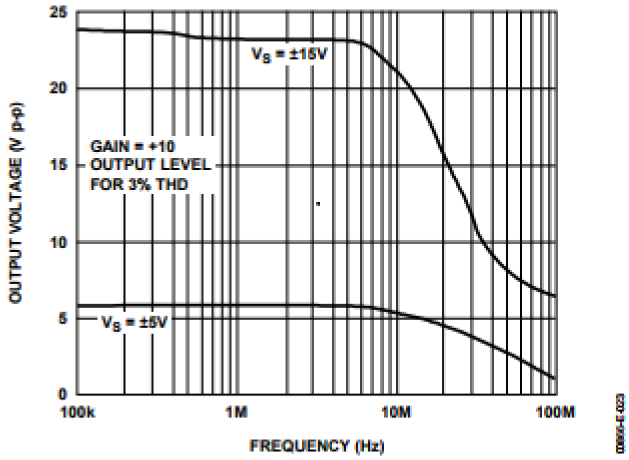



*Figure 22. Large Signal Frequency Response*

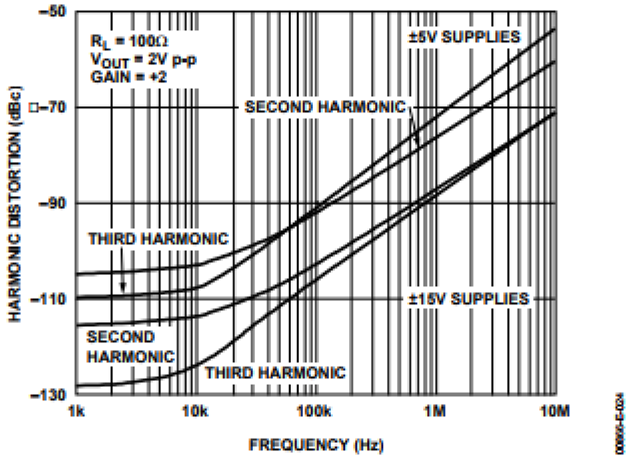



Figure 23. Harmonic Distortion vs. Frequency

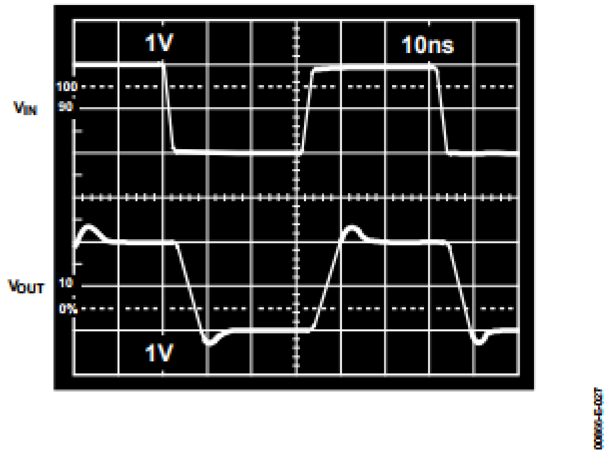



Figure 26. Small Signal Pulse Response, Gain = +1

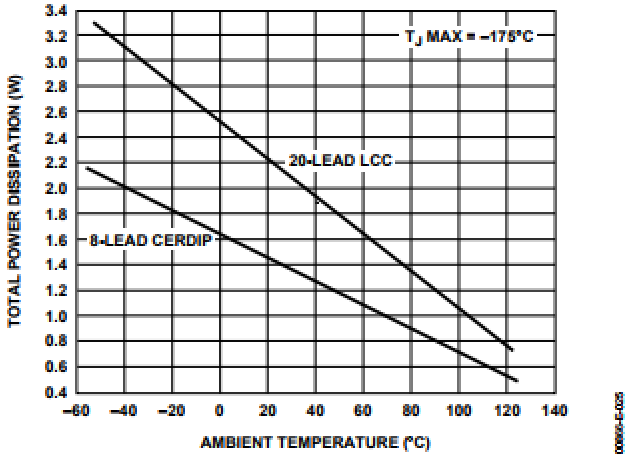



Figure 24. Maximum Power Dissipation vs. Temperature for Hermetic Packages

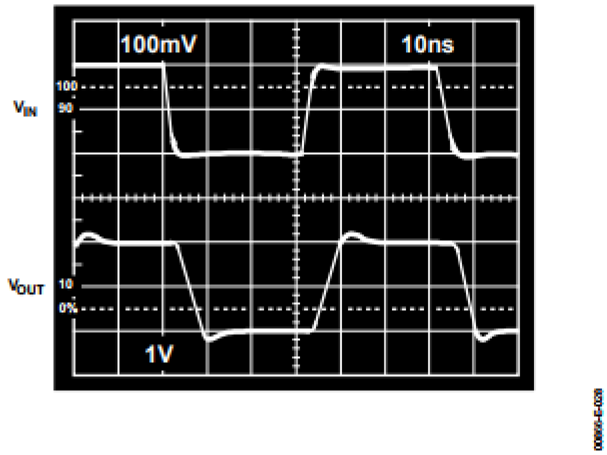



Figure 27. Small Signal Pulse Response, Gain = +10

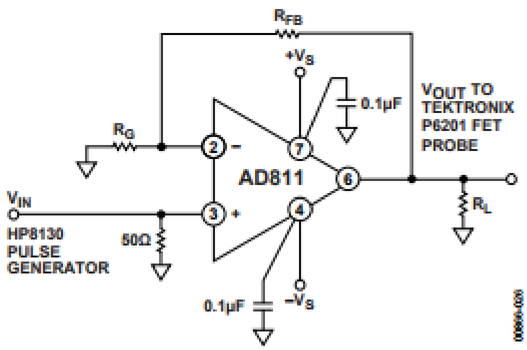



Figure 25. Noninverting Amplifier Connection

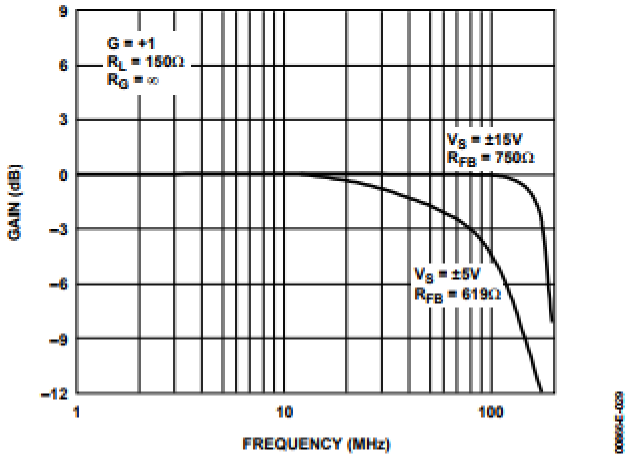



Figure 28. Closed-Loop Gain vs. Frequency, Gain = +1

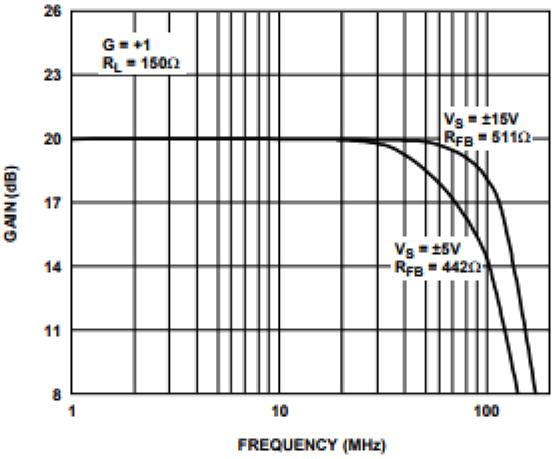



*Figure 29. Closed-Loop Gain vs. Frequency, Gain = +10*

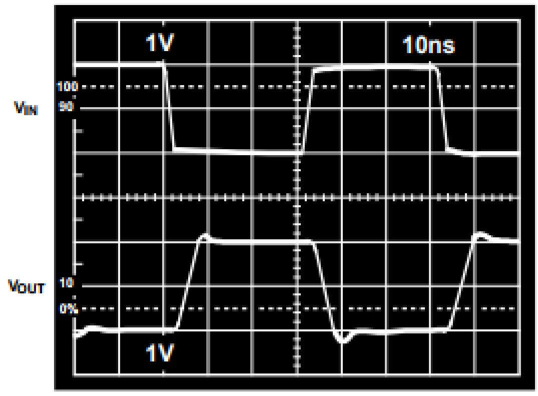



*Figure 32. Small Signal Pulse Response, Gain = −1*

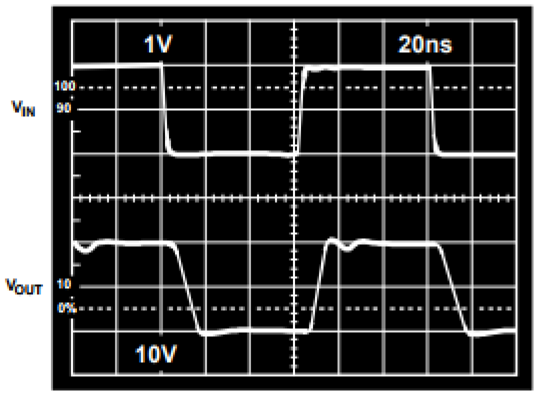



*Figure 30. Large Signal Pulse Response, Gain = +10*

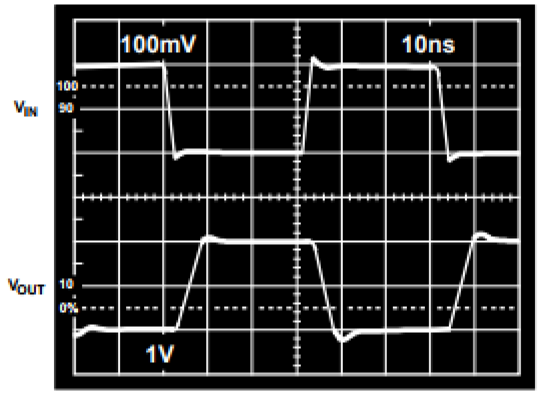



*Figure 33. Small Signal Pulse Response, Gain = −10*

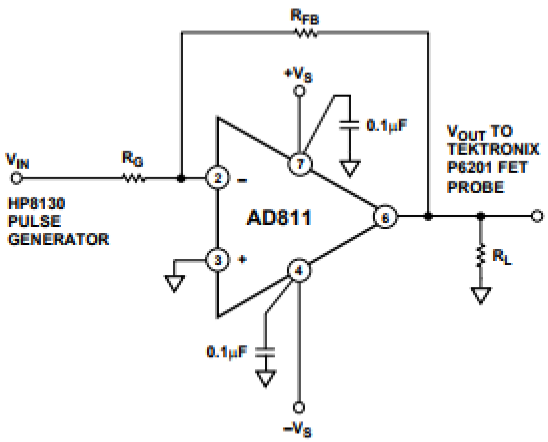



*Figure 31. Inverting Amplifier Connection*

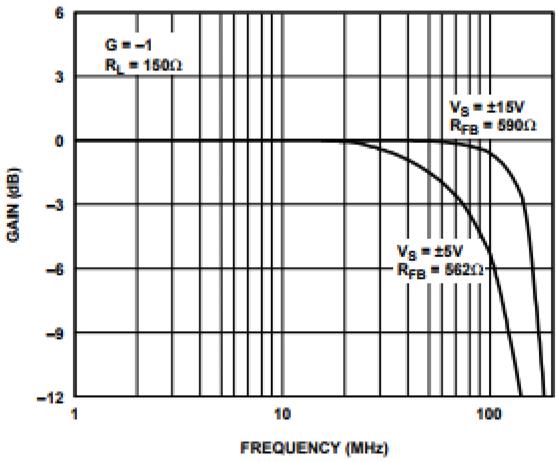



*Figure 34. Closed-Loop Gain vs. Frequency, Gain = −1*

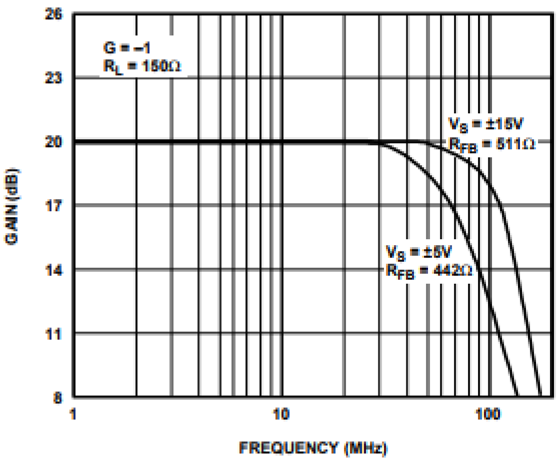



*Figure 35. Closed-Loop Gain vs. Frequency, Gain = −10*

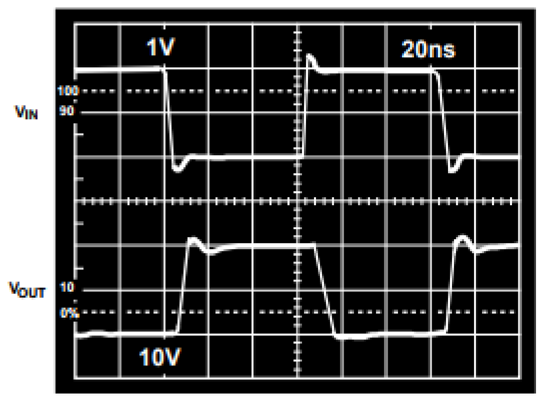



*Figure 36. Large Signal Pulse Response, Gain = −10*