19-1519 Rev 1; 10/99

EVALUATION KIT AVAILABLE

MAXIM

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable



## General Description

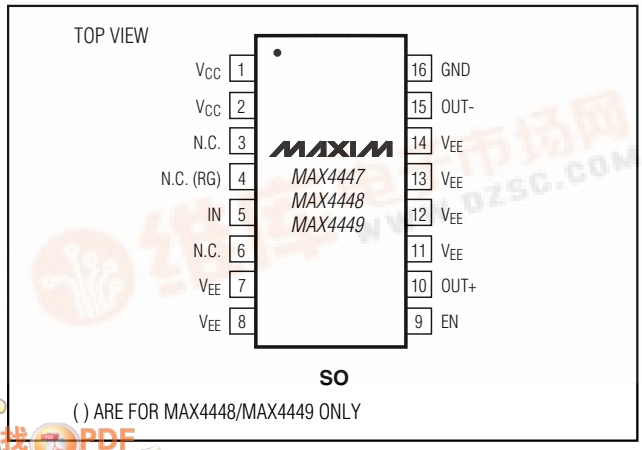
The MAX4447/MAX4448/MAX4449 single-ended-to-differential line drivers are designed for high-speed communications. Using current feedback for greater bandwidth, these devices deliver full-power bandwidths up to 405MHz and feature slew rates as high as 6500V/µs. The MAX4447 has a fixed gain of +2V/V and a small-signal bandwidth of 430MHz. The MAX4448/MAX4449 have small-signal bandwidths of 330MHz and 400MHz, respectively, and are internally compensated for minimum gain configurations of +2V/V and +5V/V, respectively. For greater design flexibility, the MAX4448/MAX4449 allow for variable gain selection using external gain-setting resistors. A low-power enable mode reduces current consumption below 5.5mA and places the outputs in a high-impedance state.

The MAX4447/MAX4448/MAX4449 can deliver differential output swings of ±6.2V from ±5V supplies with a 50Ω load. Excellent differential gain/phase and noise specifications make these amplifiers ideal for a wide variety of video and RF signal-processing and transmission applications.

## Applications

Differential Line Driver
Single-Ended-to-Differential Conversion
High-Speed Differential Transmitter
Coaxial to Twisted-Pair Converter
Differential Pulse Amplifier
Differential ADC Driver
xDSL Applications
Video and RF Signal Processing and Transmission

## Pin Configuration



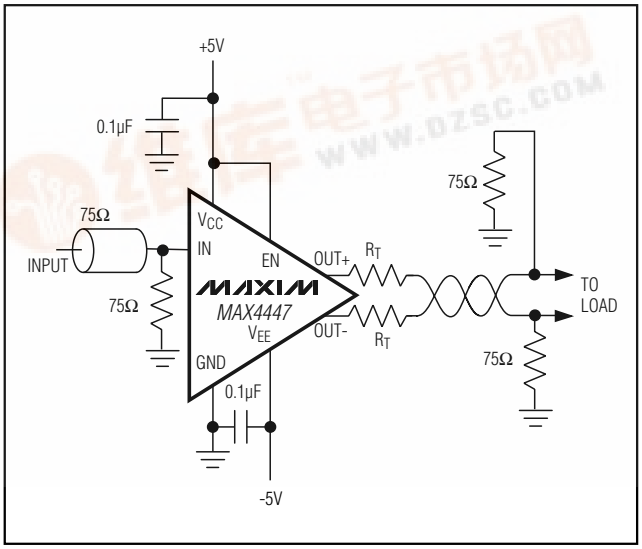

## Features

- 6500V/µs Slew Rate (MAX4449)
- Small-Signal Bandwidth
  - 430MHz (MAX4447)
  - 330MHz (MAX4448)
  - 400MHz (MAX4449)
- 200MHz 0.1dB Gain Flatness (MAX4447)
- 130mA Output Drive Current
- +2V/V Internally Fixed Gain (MAX4447)
- External Gain Selection
  - ≥+2V/V (MAX4448)
  - ≥+5V/V (MAX4449)
- -78dB SFDR at 100kHz
- Low Differential Gain/Phase: 0.01%/0.02°
- Ultra-Low Noise: 23nV/√Hz at $f_{IN}$ = 1MHz
- 8ns Settling Time to 0.1%

## Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX4447**ESE | -40°C to +85°C | 16 Narrow SO |
| **MAX4448**ESE | -40°C to +85°C | 16 Narrow SO |
| **MAX4449**ESE | -40°C to +85°C | 16 Narrow SO |

## Typical Operating Circuit



# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ to $V_{EE}$ .....+12V
Voltage on IN, EN, OUT+, OUT-, RG ....($V_{EE}$ - 0.3V) to ($V_{CC}$ + 0.3V)
Output Short-Circuit Duration to GND .....Indefinite
Continuous Power Dissipation ($T_A$ = +70°C)
16-Pin Narrow SO (derate 20mW/°C above +70°C) ..1600mW
Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## DC ELECTRICAL CHARACTERISTICS

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $V_{EN} \geq$ 2V, $V_{OUT} = V_{OUT+} - V_{OUT-}$, $R_L = \infty$, $T_A = T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_A$ = +25°C.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Operating Supply Voltage Range | $V_{CC}$ | $V_{CC}$ guaranteed by PSRR test | | 4.5 | | 5.5 | V |
| | $V_{EE}$ | $V_{EE}$ guaranteed by PSRR test | | -5.5 | | -4.5 | |
| Input Voltage Range | $V_{IN}$ | Guaranteed by gain-error test | | -6/$A_V$ | | +6/$A_V$ | V |
| Input Offset Voltage | $V_{OS}$ | $V_{IN}$ = 0 | | | 1.3 | 50 | mV |
| Input Offset Voltage Temperature Coefficient | $TC_{VOS}$ | $V_{IN}$ = 0 | | | 25 | | µV/°C |
| Input Bias Current | $I_B$ | $V_{IN}$ = 0 | | | 7 | 45 | µA |
| Input Resistance | $R_{IN}$ | -3.0V ≤ $V_{IN}$ ≤ 3.0V | | | 50 | | kΩ |
| Gain | $A_V$ | -6V ≤ $V_{OUT}$ ≤ 6V | MAX4447 | | 2 | | V/V |
| | | | MAX4448/MAX4449 (Note 1) | | 2 × (1+300/$R_G$) | | |
| Gain Error | | -6V ≤ $V_{OUT}$ ≤ 6V | MAX4447 | | 0.1 | 2 | % |
| | | | MAX4448/MAX4449 | | -0.3 | 5 | |
| Gain Drift | | $V_{OUT}$ = 0 | MAX4447 | | -0.002 | | %/°C |
| | | | MAX4448/MAX4449 | | 0.01 | | |
| Output Voltage Swing | $V_{OUT}$ | $R_L$ = 100Ω between OUT+ and OUT- | | ±6.3 | ±7.4 | | V |
| | | $R_L$ = 50Ω between OUT+ and OUT- | | ±5.2 | ±6.2 | | |
| Output Current Drive | $I_{OUT}$ | $R_L$ = 20Ω between OUT+ and OUT- | | 90 | 130 | | mA |
| Output Short-Circuit Current | $I_{SC}$ | Short circuit to GND | | | 140 | | mA |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = ±4.5V to ±5.5V | | 53 | 75 | | dB |
| Output Leakage Current | $I_{OUT(OFF)}$ | $V_{EN}$ = 0, $V_{OUT+} = V_{OUT-}$ = 3.15V or -3.15V | | | 4 | 30 | µA |
| EN Logic Low Threshold | $V_{IL}$ | | | | | 0.8 | V |
| EN Logic High Threshold | $V_{IH}$ | | | 2 | | | V |
| EN Logic Input Low Current | $I_{IL}$ | $V_{EN}$ = 0 | | | -2.5 | 10 | µA |
| EN Logic Input High Current | $I_{IH}$ | $V_{EN}$ = 5V | | | 0.8 | 10 | µA |
| Quiescent Current | $I_Q$ | $V_{IN}$ = 0, $V_{EN} \geq V_{IH}$ | | | 46 | 55 | mA |
| | | $V_{IN}$ = 0, $V_{EN} \leq V_{IL}$ | | | 3.2 | 5.5 | |

## AC ELECTRICAL CHARACTERISTICS

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $R_L$ = 100Ω between OUT+ and OUT-, $A_{VCL}$ = +2V/V for MAX4447/MAX4448, $A_{VCL}$ = +5V/V for MAX4449, $V_{OUT}$ = $V_{OUT}$+ - $V_{OUT}$-, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Small-Signal -3dB Bandwidth | $BW_{SS}$ | $V_{OUT}$ = 100mVp-p | MAX4447 | | 430 | | MHz |
| | | | MAX4448 | | 330 | | |
| | | | MAX4449 | | 400 | | |
| Large-Signal -3dB Bandwidth | $BW_{LS}$ | $V_{OUT}$ = 8Vp-p | MAX4449 | | 250 | | MHz |
| | | $V_{OUT}$ = 4Vp-p | MAX4447 | | 250 | | |
| | | | MAX4448 | | 260 | | |
| | | | MAX4449 | | 320 | | |
| | | $V_{OUT}$ = 2Vp-p | MAX4447 | | 285 | | |
| | | | MAX4448 | | 310 | | |
| | | | MAX4449 | | 405 | | |
| 0.1dB Gain Flatness | | $V_{OUT}$ = 100mVp-p | MAX4447 | | 200 | | MHz |
| | | | MAX4448 | | 40 | | |
| | | | MAX4449 | | 140 | | |
| Slew Rate (Note 2) | SR | $V_{OUT}$ = 8V step | MAX4447 | | 5700 | | V/µs |
| | | | MAX4448 | | 4300 | | |
| | | | MAX4449 | | 6500 | | |
| | | $V_{OUT}$ = 4V step | MAX4447 | | 3000 | | |
| | | | MAX4448 | | 3000 | | |
| | | | MAX4449 | | 3700 | | |
| | | $V_{OUT}$ = 2V step | MAX4447 | | 1700 | | |
| | | | MAX4448 | | 1900 | | |
| | | | MAX4449 | | 1800 | | |
| Rise Time (Note 2) | $t_{RISE}$ | $V_{OUT}$ = 8V step | MAX4447 | | 670 | | ps |
| | | | MAX4448 | | 1030 | | |
| | | | MAX4449 | | 850 | | |
| | | $V_{OUT}$ = 4V step | MAX4447 | | 720 | | |
| | | | MAX4448 | | 820 | | |
| | | | MAX4449 | | 660 | | |
| | | $V_{OUT}$ = 2V step | MAX4447 | | 720 | | |
| | | | MAX4448 | | 520 | | |
| | | | MAX4449 | | 740 | | |

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

## AC ELECTRICAL CHARACTERISTICS (continued)

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $R_L$ = 100Ω between OUT+ and OUT-, $A_{VCL}$ = +2V/V for MAX4447/MAX4448, $A_{VCL}$ = +5V/V for MAX4449, $V_{OUT}$ = $V_{OUT}$+ - $V_{OUT}$-, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Fall Time (Note 2) | $t_{FALL}$ | $V_{OUT}$ = 8V step | MAX4447 | | 1100 | | ps |
| | | | MAX4448 | | 900 | | |
| | | | MAX4449 | | 900 | | |
| | | $V_{OUT}$ = 4V step | MAX4447 | | 900 | | |
| | | | MAX4448 | | 810 | | |
| | | | MAX4449 | | 780 | | |
| | | $V_{OUT}$ = 2V step | MAX4447 | | 800 | | |
| | | | MAX4448 | | 770 | | |
| | | | MAX4449 | | 660 | | |
| Settling Time | | Settle to 0.1%, $V_{OUT}$ = 2V step | | | 8 | | ns |
| Spurious-Free Dynamic Range | SFDR | $V_{OUT}$ = 2Vp-p | $f_C$ = 100kHz | | -78 | | dBc |
| | | | $f_C$ = 5MHz | | -78 | | |
| | | | $f_C$ = 20MHz | | -62 | | |
| | | | $f_C$ = 100MHz | | -46 | | |
| 2nd Harmonic Distortion | | $V_{OUT}$ = 2Vp-p | $f_C$ = 100kHz | | -78 | | dBc |
| | | | $f_C$ = 5MHz | | -78 | | |
| | | | $f_C$ = 20MHz | | -62 | | |
| | | | $f_C$ = 100MHz | | -46 | | |
| 3rd Harmonic Distortion | | $V_{OUT}$ = 2Vp-p | $f_C$ = 100kHz | | -86 | | dBc |
| | | | $f_C$ = 5MHz | | -86 | | |
| | | | $f_C$ = 20MHz | | -71 | | |
| | | | $f_C$ = 100MHz | | -54 | | |
| Differential Phase Error | DP | NTSC, $R_L$ = 150Ω | | | 0.02 | | degrees |
| Differential Gain Error | DG | NTSC, $R_L$ = 150Ω | | | 0.01 | | % |
| Input Noise Voltage Density | $e_N$ | f = 1MHz (Note 3) | | | 24 | | nV/√Hz |
| Input Noise Current Density | $i_N$ | f = 1MHz | | | 1.8 | | pA/√Hz |
| Output Impedance | $Z_{OUT±}$ | f = 10MHz, each output to ground | | | 1.0 | | Ω |
| Enable Time | | $V_{IN}$ = 1V, $V_{OUT}$ settle to within 1% | | | 55 | | ns |
| Disable Time | | $V_{IN}$ = 1V, $V_{OUT}$ settle to within 1% | | | 0.4 | | µs |
| Power-Up Time | $t_{ON}$ | $V_{IN}$ = 1V, $V_{OUT}$ settle to within 1% | | | 0.08 | | µs |
| Power-Down Time | $t_{OFF}$ | $V_{IN}$ = 1V, $V_{OUT}$ settle to within 1% | | | 0.5 | | µs |

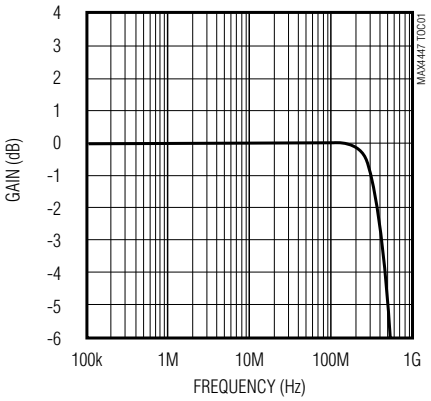
**Note 1:** $R_G$ is the gain resistor. See Figure 1.
**Note 2:** Input step voltage has <100ps rise (fall) time. Measured at the output from 10% to 90% (90% to 10%) levels.
**Note 3:** Includes the current noise contribution through the on-die feedback resistor.

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

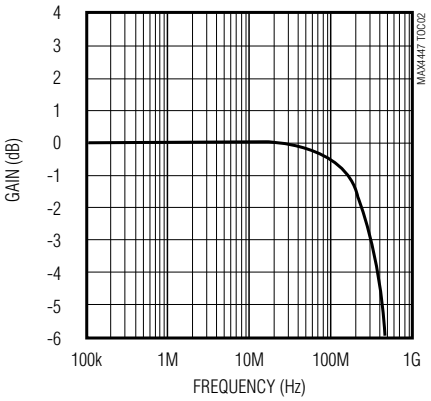
## Typical Operating Characteristics

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $V_{EN}$ = +5V, $V_{OUT}$ = $V_{OUT+}$ - $V_{OUT-}$, $R_L$ = 100Ω between OUT+ and OUT-, $A_V$ = +2V/V for MAX4447/MAX4448, $A_V$ = +5V/V for MAX4449, $T_A$ = +25°C, unless otherwise noted.)

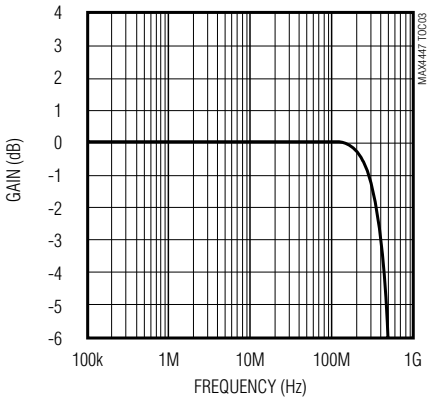
**MAX4447**
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**



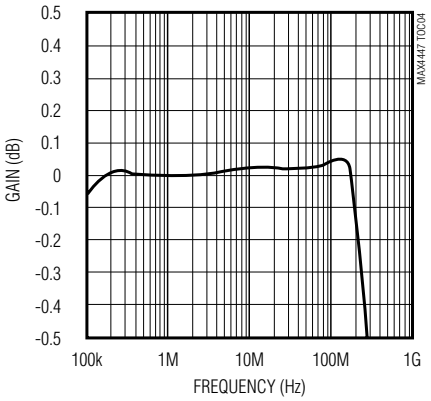

**MAX4448**
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**




**MAX4449**
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**




**MAX4447**
**GAIN FLATNESS vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**

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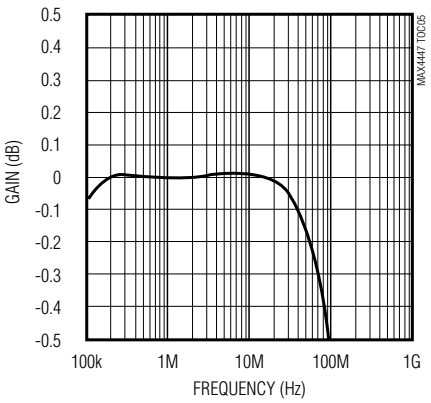
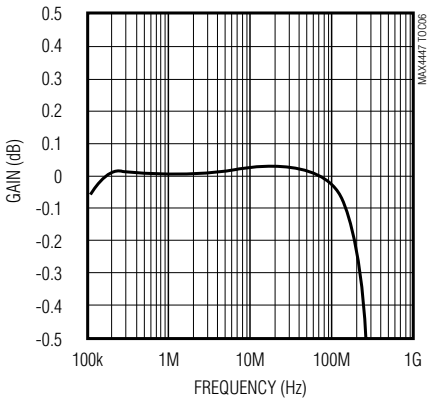
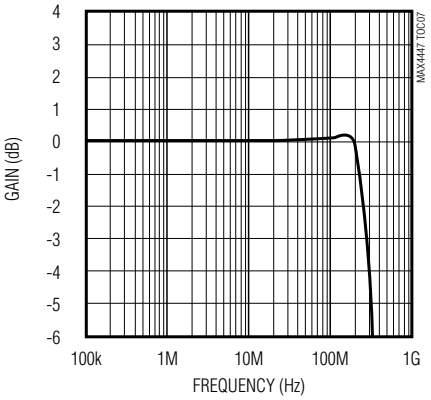
**GAIN FLATNESS vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**



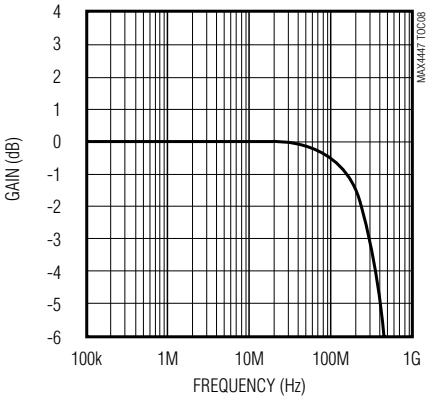

**MAX4449**
**GAIN FLATNESS vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**



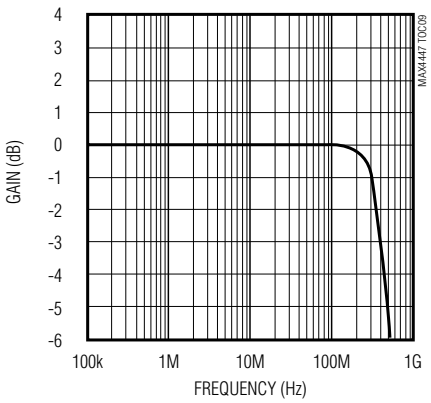

**MAX4447**
**LARGE-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 2Vp-p)**




**MAX4448**
**LARGE-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 2Vp-p)**




**MAX4449**
**LARGE-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 2Vp-p)**

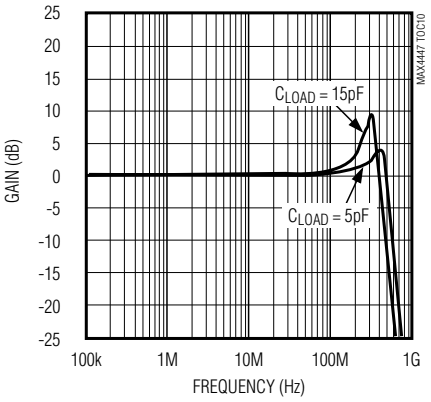


# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

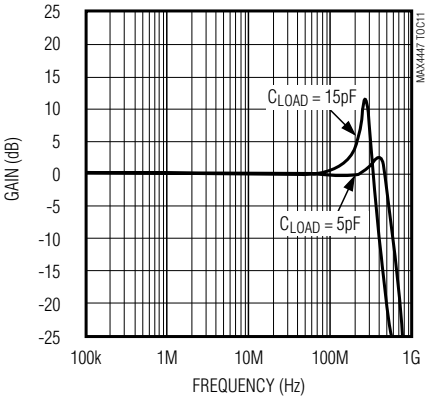
## Typical Operating Characteristics (continued)

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $V_{EN}$ = +5V, $V_{OUT}$ = $V_{OUT+}$ - $V_{OUT-}$, $R_L$ = 100Ω between OUT+ and OUT-, $A_V$ = +2V/V for MAX4447/MAX4448, $A_V$ = +5V/V for MAX4449, $T_A$ = +25°C, unless otherwise noted.)

**MAX4447**
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**




**MAX4448**
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**

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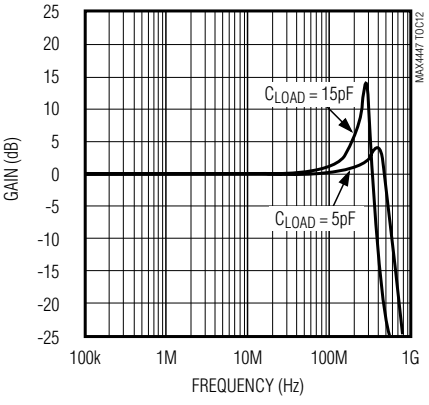
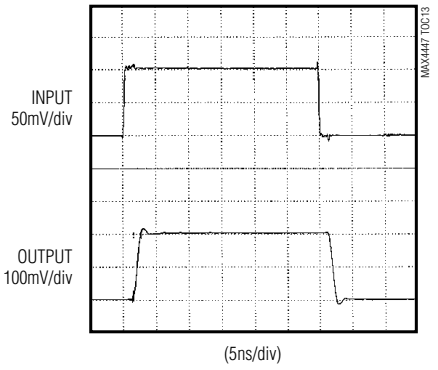
**SMALL-SIGNAL GAIN vs. FREQUENCY**
**($V_{OUT}$ = 100mVp-p)**




**MAX4447**
**SMALL-SIGNAL PULSE RESPONSE**

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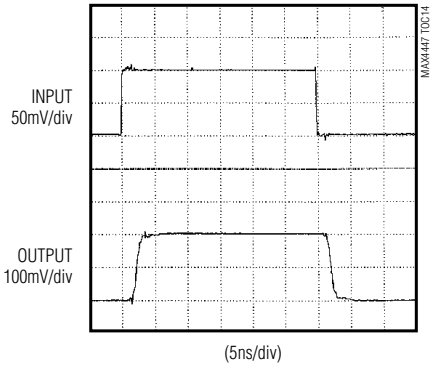
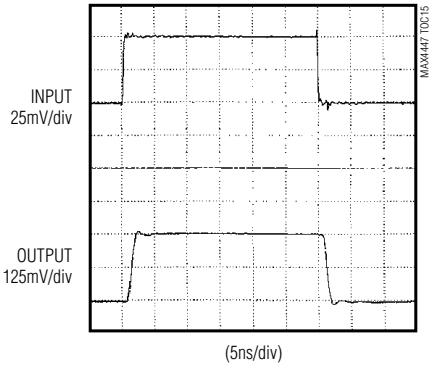
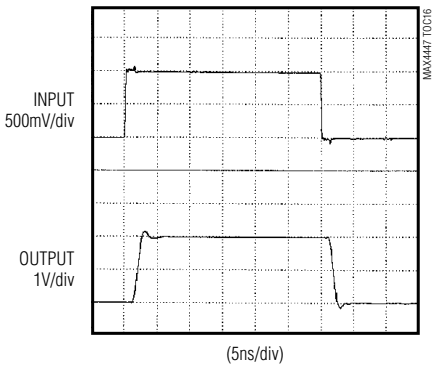


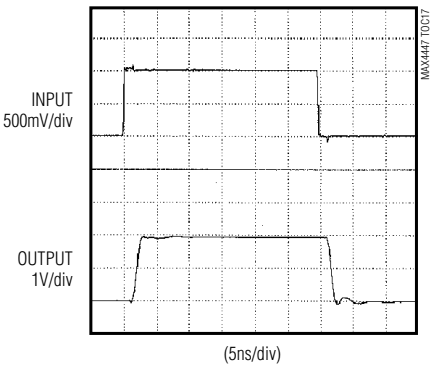

**MAX4449**
**SMALL-SIGNAL PULSE RESPONSE**




**MAX4447**
**LARGE-SIGNAL PULSE RESPONSE**




**MAX4448**
**LARGE-SIGNAL PULSE RESPONSE**




**MAX4449**
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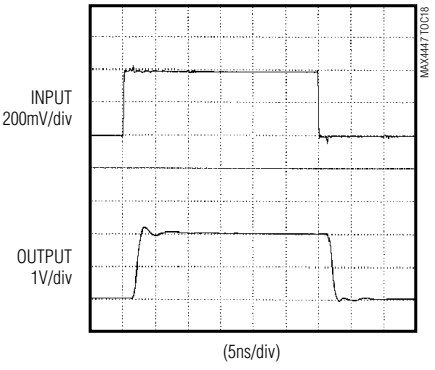

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

## Typical Operating Characteristics (continued)

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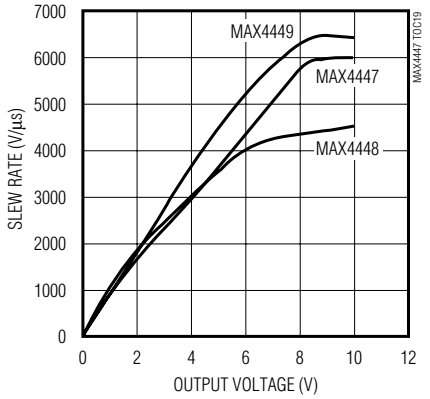
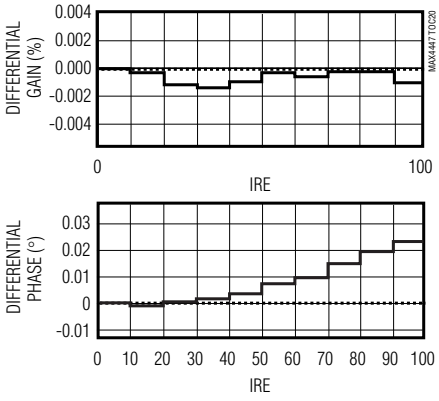
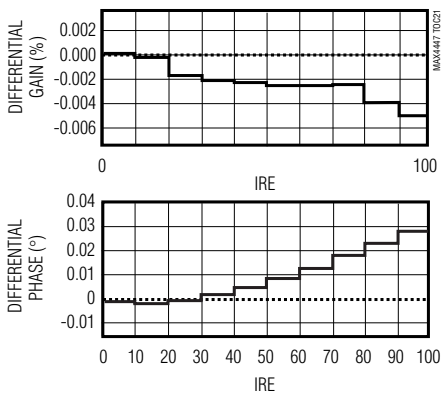
**SLEW RATE vs. OUTPUT VOLTAGE**



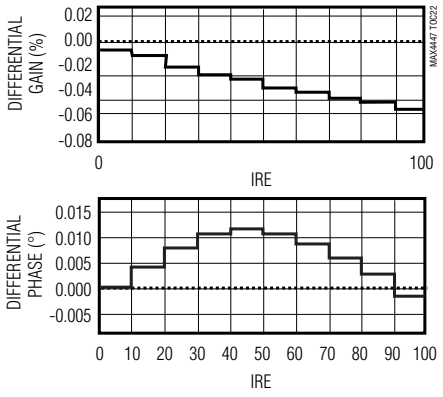

**MAX4447 DIFFERENTIAL GAIN AND PHASE**



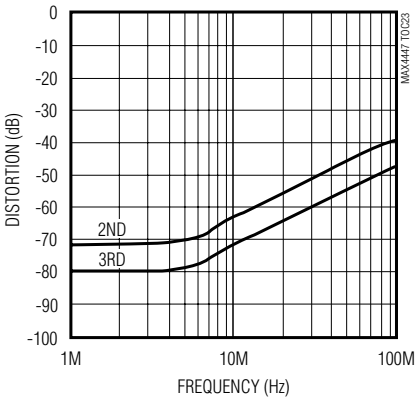

**MAX4448 DIFFERENTIAL GAIN AND PHASE**



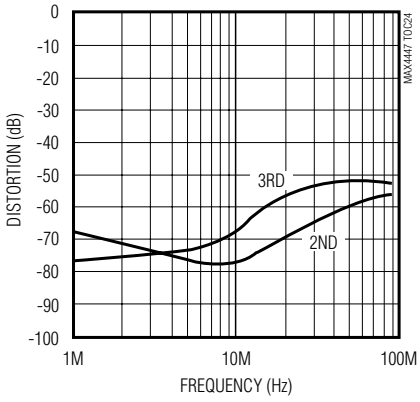

**MAX4449 DIFFERENTIAL GAIN AND PHASE**



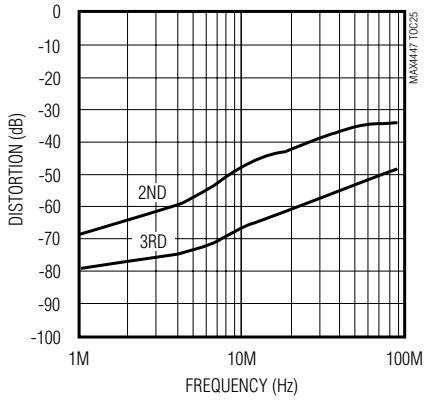

**MAX4447 HARMONIC DISTORTION vs. FREQUENCY ($V_{OUT}$ = 2Vp-p)**



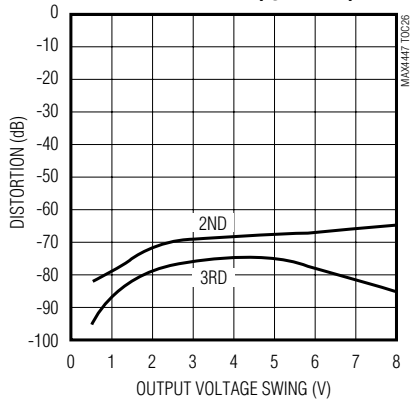

**MAX4448 HARMONIC DISTORTION vs. FREQUENCY ($V_{OUT}$ = 2Vp-p)**



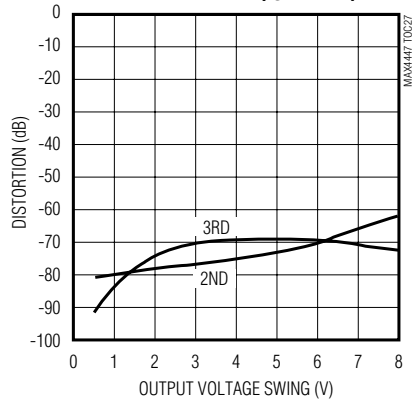

**MAX4449 HARMONIC DISTORTION vs. FREQUENCY ($V_{OUT}$ = 2Vp-p)**




**MAX4447 HARMONIC DISTORTION vs. OUTPUT VOLTAGE SWING ($f_C$ = 5MHz)**




**MAX4448 HARMONIC DISTORTION vs. OUTPUT VOLTAGE SWING ($f_C$ = 5MHz)**

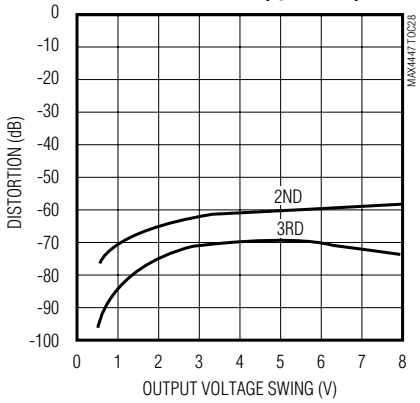


# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

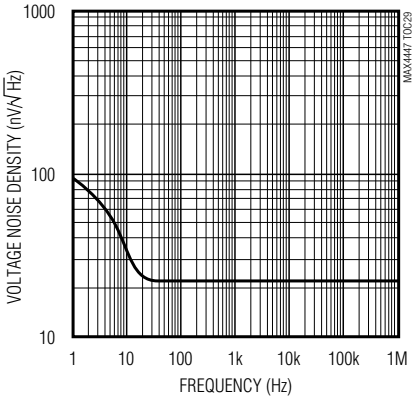
## Typical Operating Characteristics (continued)

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $V_{EN}$ = +5V, $V_{OUT}$ = $V_{OUT+}$ - $V_{OUT-}$, $R_L$ = 100Ω between OUT+ and OUT-, $A_V$ = +2V/V for MAX4447/MAX4448, $A_V$ = +5V/V for MAX4449, $T_A$ = +25°C, unless otherwise noted.)

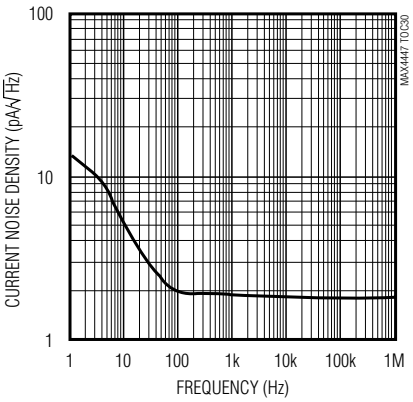
**MAX4449**
**HARMONIC DISTORTION vs. OUTPUT VOLTAGE SWING ($f_C$ = 5MHz)**



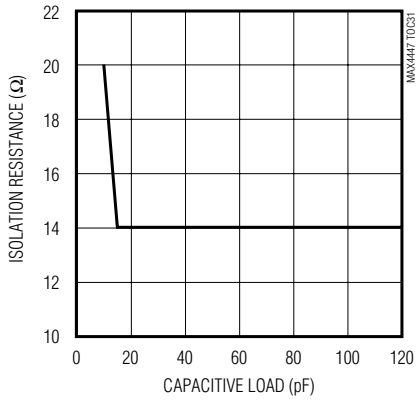

**VOLTAGE NOISE DENSITY vs. FREQUENCY**



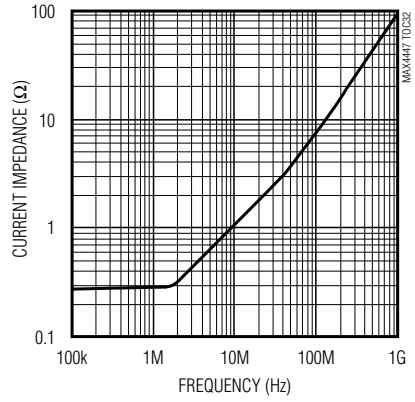

**CURRENT NOISE DENSITY vs. FREQUENCY**



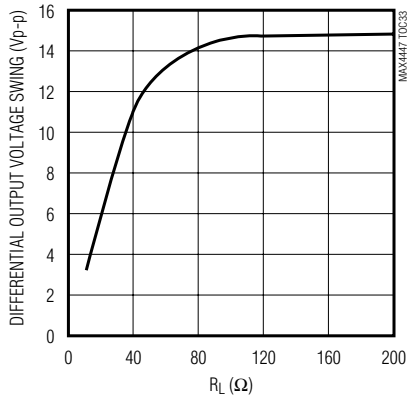

**ISOLATION RESISTANCE vs. CAPACITIVE LOAD**



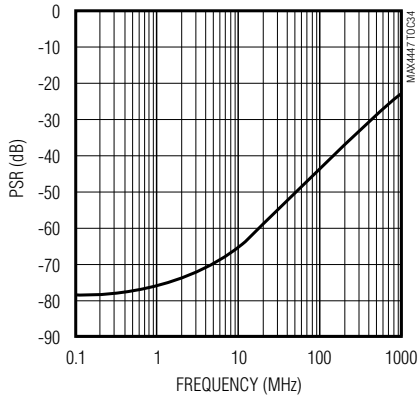

**OUTPUT IMPEDANCE vs. FREQUENCY**



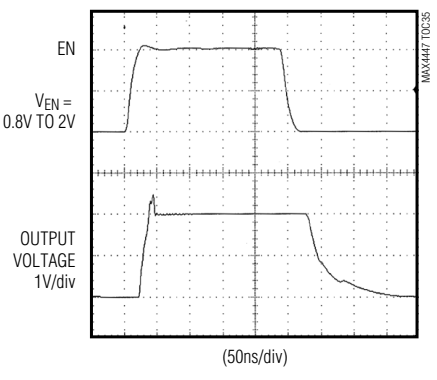

**DIFFERENTIAL OUTPUT VOLTAGE SWING vs. RESISTIVE LOAD**



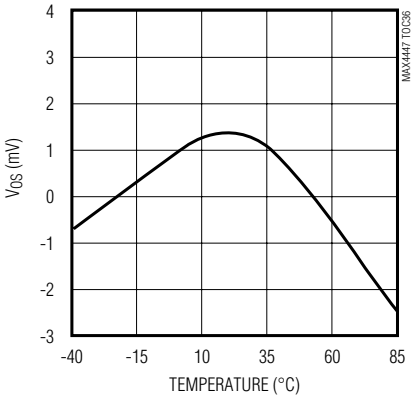

**POWER-SUPPLY REJECTION vs. FREQUENCY**




**SHUTDOWN RESPONSE TIME**




**OFFSET VOLTAGE vs. TEMPERATURE**

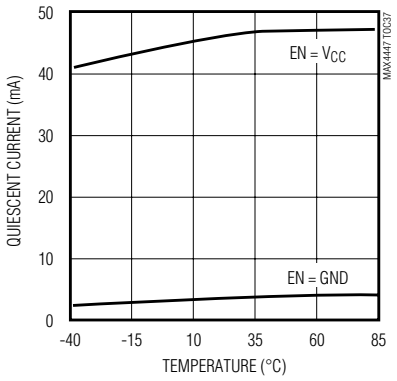


# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

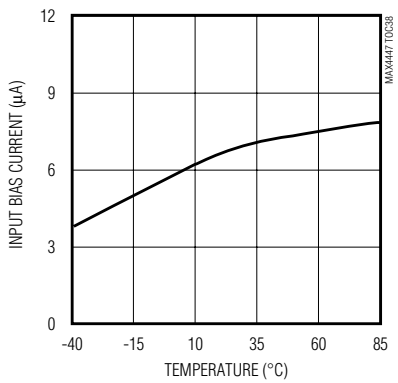
## Typical Operating Characteristics (continued)

($V_{CC}$ = +5V, $V_{EE}$ = -5V, $V_{EN}$ = +5V, $V_{OUT}$ = $V_{OUT+}$ - $V_{OUT-}$, $R_L$ = 100Ω between OUT+ and OUT-, $A_V$ = +2V/V for MAX4447/MAX4448, $A_V$ = +5V/V for MAX4449, $T_A$ = +25°C, unless otherwise noted.)

**QUIESCENT CURRENT vs. TEMPERATURE**




**INPUT BIAS CURRENT vs. TEMPERATURE**




## Pin Description

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| MAX4447 | MAX4448 MAX4449 | | |
| 1, 2 | 1, 2 | $V_{CC}$ | Positive Power Supply. Bypass with a 0.1µF capacitor to GND. |
| 3, 4, 6 | 3, 6 | N.C. | No Connection. Not internally connected. Connect to GND for best AC performance. |
| — | 4 | RG | Gain-Set Resistor. Connect gain-setting resistor from RG to GND. |
| 5 | 5 | IN | Amplifier Noninverting Input |
| 7, 8, 11, 12, 13, 14 | 7, 8, 11, 12, 13, 14 | $V_{EE}$ | Negative Power-Supply Input. Bypass with a 0.1µF capacitor to GND. |
| 9 | 9 | EN | Active-High, TTL-Compatible, Enable Input. Connect to $V_{CC}$ for normal operation. Connect to GND for low-power operation. |
| 10 | 10 | OUT+ | Positive Polarity Output |
| 15 | 15 | OUT- | Negative Polarity Output |
| 16 | 16 | GND | Ground |

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

## Detailed Description

The MAX4447/MAX4448/MAX4449 single-ended-to-differential converters are capable of transmitting high-speed signals such as T1 or xDSL over twisted-pair cable. Excellent gain and phase characteristics, along with low distortion, make these devices suitable for video and RF signal processing and transmission. These converters can be interfaced directly to some of Maxim's wireless products, such as the MAX2450/MAX2451.

The MAX4447/MAX4448/MAX4449 offer wide small-signal bandwidths of 430MHz, 330MHz, and 400MHz, respectively. Internally trimmed resistors minimize gain errors to under 2% over the full output range. Other features include a high slew rate up to 6500V/µs and high output current (130mA), which allow these amplifiers to be used in numerous high-speed communications applications.

## Applications Information

### Grounding and Bypassing

Use high-frequency design techniques when designing the PC board for the MAX4447/MAX4448/MAX4449:

- Use a multilayer board with one layer dedicated as the ground plane.
- Do not wire-wrap or use breadboards, due to high inductance.
- Avoid IC sockets, due to high parasitic capacitance and inductance.
- Bypass supplies with 0.1µF. Use surface-mount capacitors to minimize lead inductance.
- Keep signal lines as short and straight as possible. Do not make 90° turns; round all corners. Do not cross signals if possible.
- Ensure that the ground plane is free from voids.

### Output Short-Circuit Protection

Output short-circuit protection typically limits the current to 140mA when shorted to GND, thereby keeping the power dissipation under the absolute maximum power dissipating rating. However, when shorted to either supply, the short-circuit current can be significantly higher and cause damage to the device.

### Low-Power Enable Mode

The MAX4447/MAX4448/MAX4449 are disabled when EN goes low. This reduces supply current to only 3.2mA and places the outputs into a higher impedance.

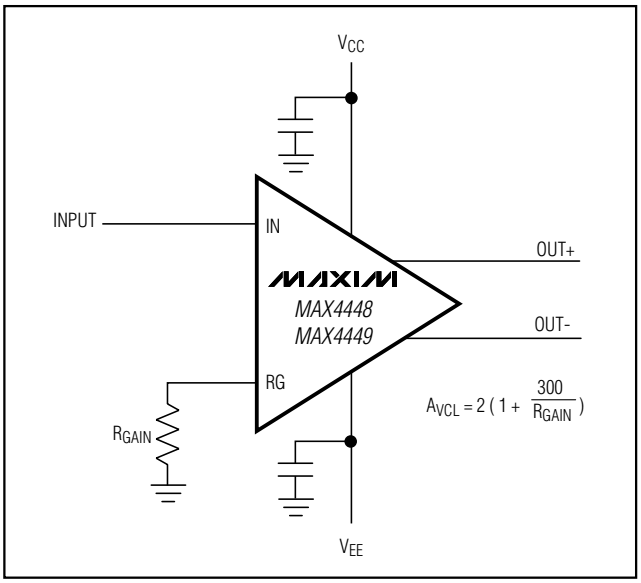



*Figure 1. Setting the Amplifier Gain*

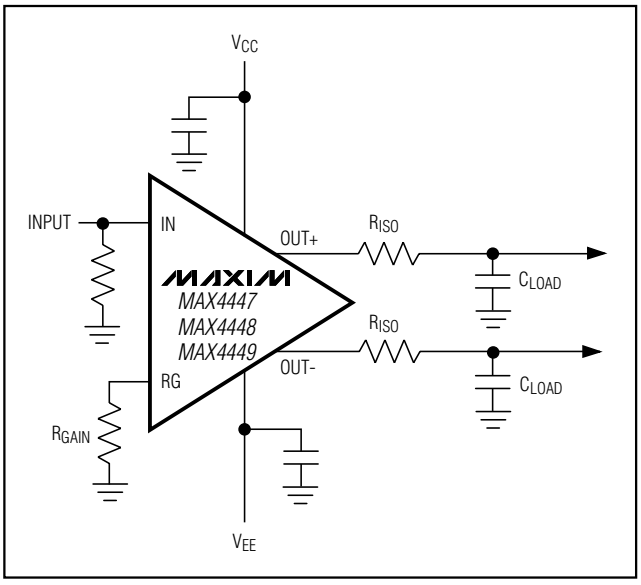



*Figure 2. Using an Isolation Resistor for High Capacitive Loads*

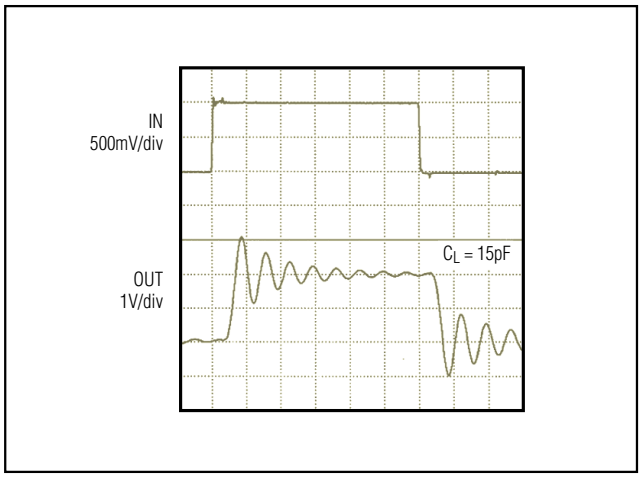



*Figure 3. Capacitive-Loaded Output Step Response Without Isolation Resistor*

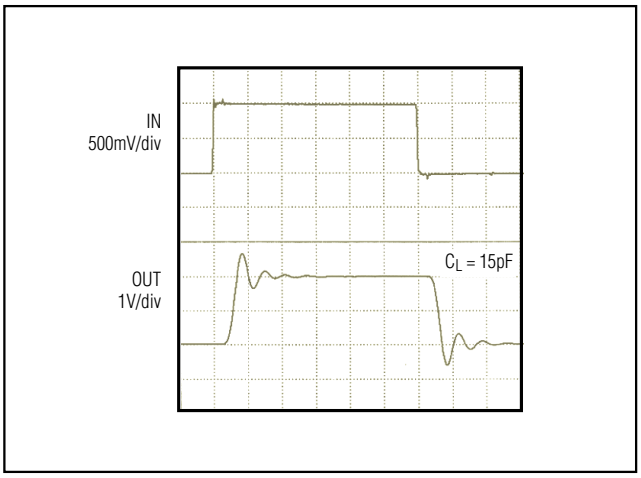



*Figure 4. Capacitive-Loaded Output Step Response with 14Ω Isolation Resistor*

### Setting Gain

The MAX4448/MAX4449 are stable with minimum gain of +2V/V and +5V/V, respectively. An external resistor, $R_{GAIN}$, connected between RG and GND sets the gain of these devices. Calculate the gain as follows:

$$Gain = 2 (1 + 300 / R_{GAIN})$$

$R_{GAIN}$ for the MAX4449 must be ≤200Ω.

### Driving Capacitive Loads

The MAX4447/MAX4448/MAX4449 are designed to drive capacitive loads. However, excessive capacitive loads may cause ringing or instability at the output as phase margin is reduced. Adding a small series isolation resistor at the output helps reduce the ringing but slightly increases gain error.

### Twisted-Pair Line Driver

The MAX4447/MAX4448/MAX4449 are well-suited to drive twisted-pair cables. The 24AWG telephone wire widely used produces losses at the higher frequencies. Compensate for these losses by increasing the gain slightly.

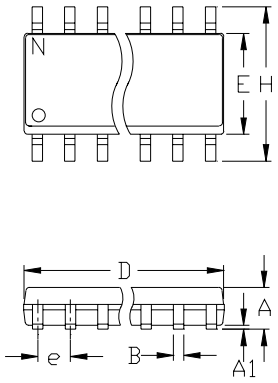
## Chip Information

TRANSISTOR COUNT: 291

# 6500V/µs, Wideband, High-Output-Current, Single-Ended-to-Differential Line Drivers with Enable

## Package Information

SOICNEPS




| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| e | 0.050 | | 1.27 | |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| h | 0.010 | 0.020 | 0.25 | 0.50 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |

| | INCHES | | MILLIMETERS | | | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | N | MS012 |
| D | 0.189 | 0.197 | 4.80 | 5.00 | 8 | A |
| D | 0.337 | 0.344 | 8.55 | 8.75 | 14 | B |
| D | 0.386 | 0.394 | 9.80 | 10.00 | 16 | C |

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION

PACKAGE FAMILY OUTLINE: SOIC .150" TITLE

1/1

21-0041 A DOCUMENT CONTROL NUMBER REV