

MAXIM

300MHz, Low-Power, High-Output-Current, Differential Line Driver

General Description

The MAX4147 differential line driver offers high-speed performance while consuming only 100mW of power. Its amplifier has fully symmetrical inputs and outputs and uses laser-trimmed, matched, thin-film resistors to deliver 70dB CMR at 10MHz. Using current-feedback techniques, the MAX4147 achieves a 300MHz bandwidth and a 2000V/ μ s slew rate.

Optimized for differential, high-output-current applications such as transformer drivers, the MAX4147 drives $\pm 2.6V$ into a 26.5 Ω load (single-ended) or $\pm 5.6V$ into a 53 Ω load (differential). This device is preset for a closed-loop gain of 2V/V. Its ultra-low 0.008%/0.03 $^\circ$ differential gain/phase allow for a variety of video and RF signal-processing applications.

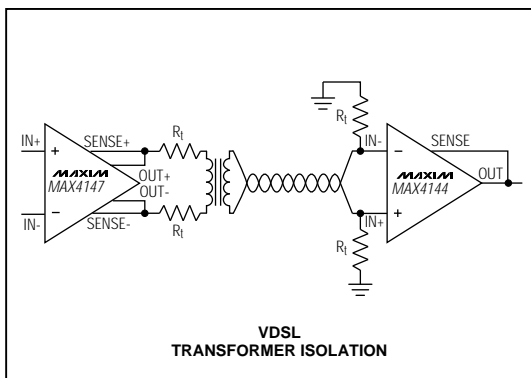
For power-sensitive applications, the MAX4147 has a shutdown function that reduces supply current to less than 1mA. In addition, superior SFDR (-82dBc at 10kHz, $R_L = 33\Omega$) makes it ideal as a transformer driver for HDSL applications.

For a complete differential transmission link, use the MAX4147 with the MAX4144 line receiver (see the MAX4144 data sheet for more information).

Applications

VDSL, ADSL, HDSL
Video Twisted-Pair Driver
Differential Pulse Amplifier
Differential ADC Driver

Typical Application Circuit



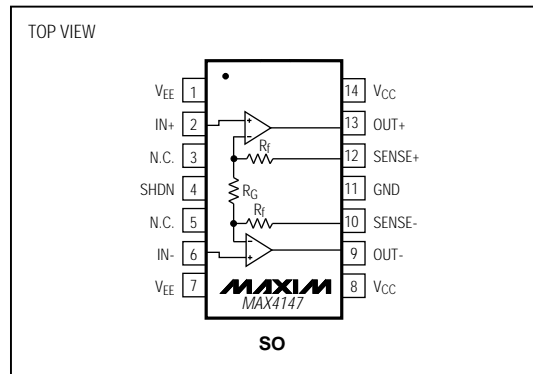
Features

- ◆ 2V/V Fixed Gain
- ◆ 300MHz -3dB Bandwidth
- ◆ 2000V/ μ s Slew Rate
- ◆ 82dBc SFDR at 10kHz
- ◆ 70dB CMR at 10MHz
- ◆ Low Differential Gain/Phase: 0.008%/0.03 $^\circ$
- ◆ High Output Drive: $\pm 5.6V$ into 53 Ω
- ◆ Low Power: 100mW

Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|------------|----------------------------------|-------------|
| MAX4147ESD | -40 $^\circ$ C to +85 $^\circ$ C | 14 SO |

Pin Configuration



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ABSOLUTE MAXIMUM RATINGS

| | | | |
|---|-------|-------------------------------------|-----------------|
| Supply Voltage (V_{CC} to V_{EE}) | 12V | Operating Temperature Range | |
| Voltage on Any Input to Ground ($V_{CC} + 0.3V$) to ($V_{EE} - 0.3V$) | | MAX4147ESD | -40°C to +85°C |
| Continuous Power Dissipation ($T_A = +70^\circ\text{C}$) | | Storage Temperature Range | -65°C to +160°C |
| SO (derate 8.33mW/°C above +70°C) | 667mW | Lead Temperature (soldering, 10sec) | +300°C |
| Short-Circuit Duration | 10sec | | |

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.

ELECTRICAL CHARACTERISTICS

($V_{CC} = +5V$, $V_{EE} = -5V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------------|-------------|--|------|------|-----|------------------------------|
| DC SPECIFICATIONS | | | | | | |
| Input Offset Voltage | V_{OS} | $V_{OUT} = 0V$, $R_L = \infty$ | | 0.5 | 6 | mV |
| Input Offset Voltage Drift | TCV_{OS} | $V_{OUT} = 0V$, $R_L = \infty$ | | 30 | | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current | I_B | $V_{OUT} = 0V$, $R_L = \infty$, $V_{IN} = -V_{OS}$ | | 9 | 20 | μA |
| Input Offset Current | I_{OS} | $V_{OUT} = 0V$, $R_L = \infty$, $V_{IN} = -V_{OS}$ | | 0.03 | 2 | μA |
| Input Voltage Noise | e_n | $f = 10\text{kHz}$ | | 8 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| | | $f = 1\text{MHz to } 100\text{MHz}$ | | 80 | | μVRMS |
| Input Current Noise | i_n | $f = 10\text{kHz}$ | | 1.7 | | $\text{pA}/\sqrt{\text{Hz}}$ |
| | | $f = 1\text{MHz to } 100\text{MHz}$ | | 17 | | nARMS |
| Input Capacitance | C_{IN} | | | 1 | | pF |
| Differential Input Resistance | | | | 1 | | $\text{M}\Omega$ |
| Differential Input Voltage Range | | $R_L = \infty$ | -3.6 | | 3.6 | V |
| Common-Mode Input Voltage Range | V_{CM} | $R_L = \infty$ | -2.8 | | 2.8 | V |
| Gain | A_V | $-1V \leq V_{OUT} \leq +1V$, $R_L = 53\Omega$ | | 2 | | V/V |
| Gain Error | | $-1V \leq V_{OUT} \leq +1V$, $R_L = 53\Omega$ | | 0.3 | 1 | % |
| Common-Mode Rejection | CMR | $V_{CM} = \pm 2.8V$ | 70 | 100 | | dB |
| Power-Supply Rejection | PSR | $V_S = \pm 4.5V$ to $\pm 5.5V$ | 70 | 100 | | dB |
| Quiescent Supply Current | I_{SY} | $V_{IN} = 0$, $R_L = \infty$ | | 10 | 13 | mA |
| Shutdown Supply Current | I_{SHDN} | $V_{IN} = 0$, $R_L = \infty$ | | 0.6 | 1 | mA |
| Output Voltage Swing | $ V_{OUT} $ | Single-ended, $R_L = \infty$ | 3.2 | 3.8 | | V |
| | | Differential, $R_L = \infty$ | 7.2 | 7.8 | | |
| | | Single-ended, $R_L = 26.5\Omega$ | 2.2 | 2.6 | | |
| | | Differential, $R_L = 53\Omega$ | 5.0 | 5.6 | | |
| Output Current Drive | I_{OUT} | $V_{OUT} = \pm 2.2V$ | 110 | 160 | | mA |
| SHDN High Threshold | V_{IH} | | | | 2.0 | V |
| SHDN Low Threshold | V_{IL} | | 0.8 | | | V |
| SHDN Input Current | I_{SHDN} | $V_{SHDN} = 0V$ | | 75 | 150 | μA |

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ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +5V, V_{EE} = -5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

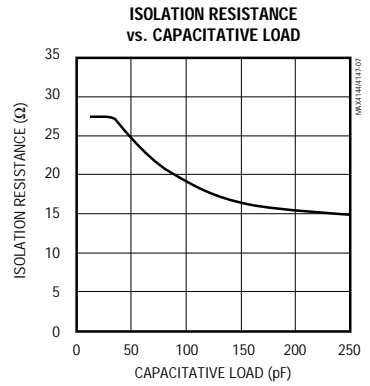
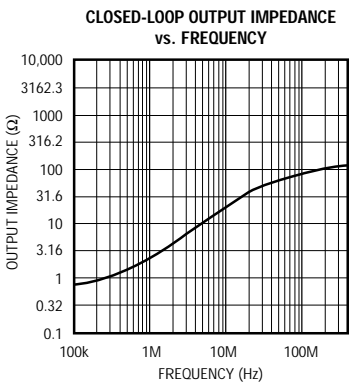
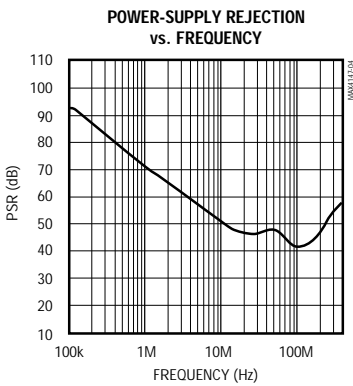
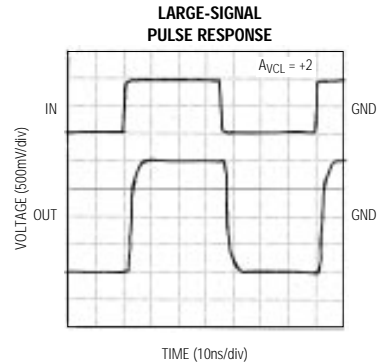
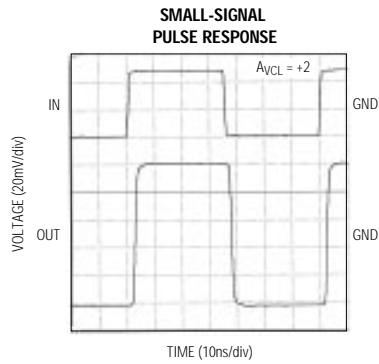
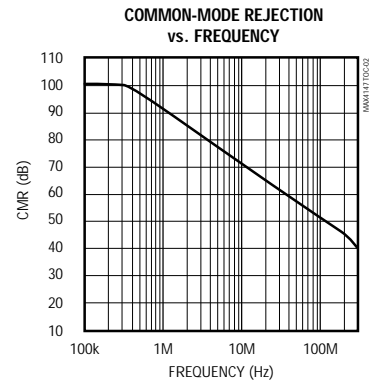
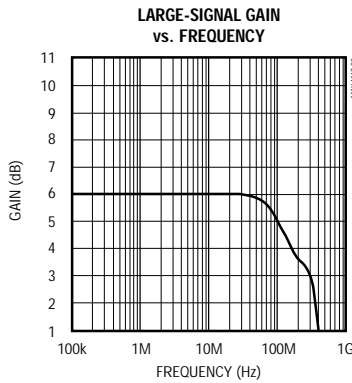
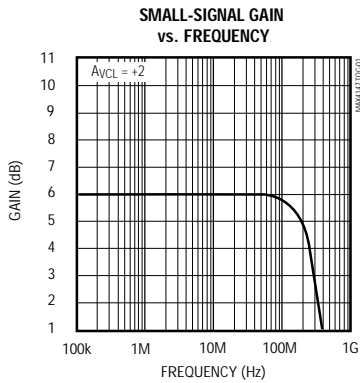
| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|-----------------------------|----------------|--|-----|-------|-----|---------|
| AC SPECIFICATIONS | | | | | | |
| -3dB Bandwidth | BW(-3dB) | V _{OUT} ≤ 0.1V _{RMS} | | 300 | | MHz |
| Full-Power Bandwidth | FPBW | V _{OUT} = 2V _{p-p} | | 250 | | MHz |
| 0.1dB Bandwidth | BW(0.1dB) | V _{OUT} ≤ 0.1V _{RMS} | | 70 | | MHz |
| Common-Mode Rejection | CMR | f = 10MHz | | 70 | | dB |
| Slew Rate | SR | Differential, -2V ≤ V _{OUT} ≤ +2V | | 2000 | | V/μs |
| Settling Time | t _s | 1V ≤ V _{OUT} ≤ +1V, R _L = 150Ω, Av _{CL} = +2 | | 10 | | ns |
| | | | | 30 | | |
| Differential Gain | DG | f = 3.58MHz, R _L = 150Ω | | 0.008 | | % |
| Differential Phase | DP | f = 3.58MHz, R _L = 150Ω | | 0.03 | | degrees |
| Spurious-Free Dynamic Range | SFDR | f _C = 10kHz, V _{OUT} = 4.0V _{p-p} , R _L = 33Ω single-ended, R _S = 50Ω, Figure 1 | | -82 | | dBc |
| | | f _C = 5MHz, V _{OUT} = 2V _{p-p} , R _L = 150Ω differential, Figure 2 | | -75 | | |

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Typical Operating Characteristics

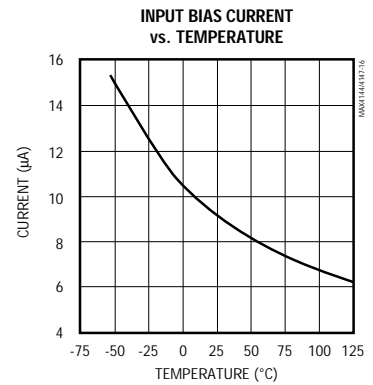
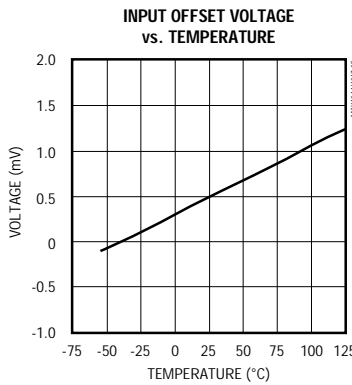
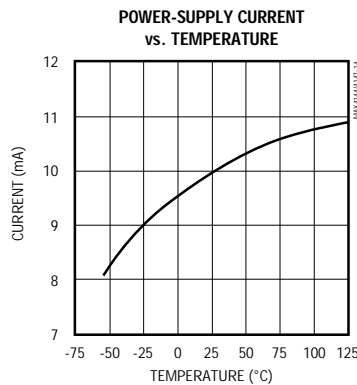
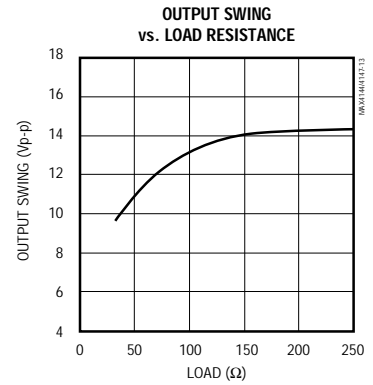
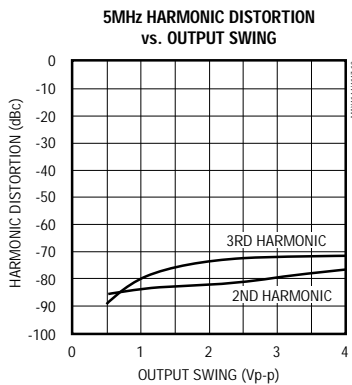
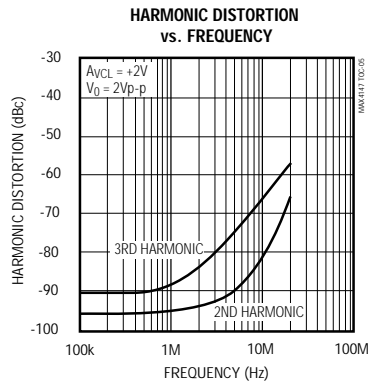
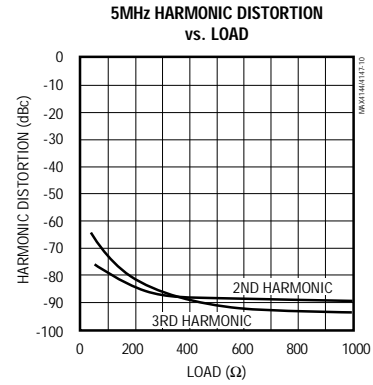
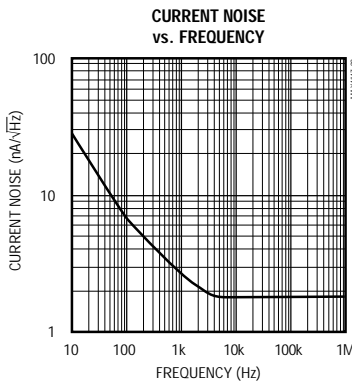
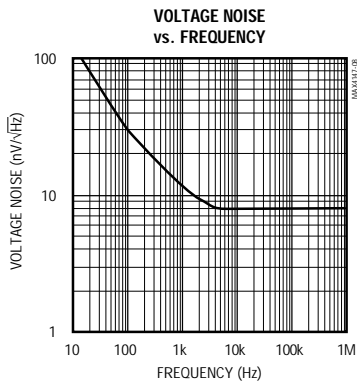
($V_{CC} = +5V$, $V_{EE} = -5V$, $R_L = 150\Omega$, $T_A = +25^\circ C$, unless otherwise noted.)



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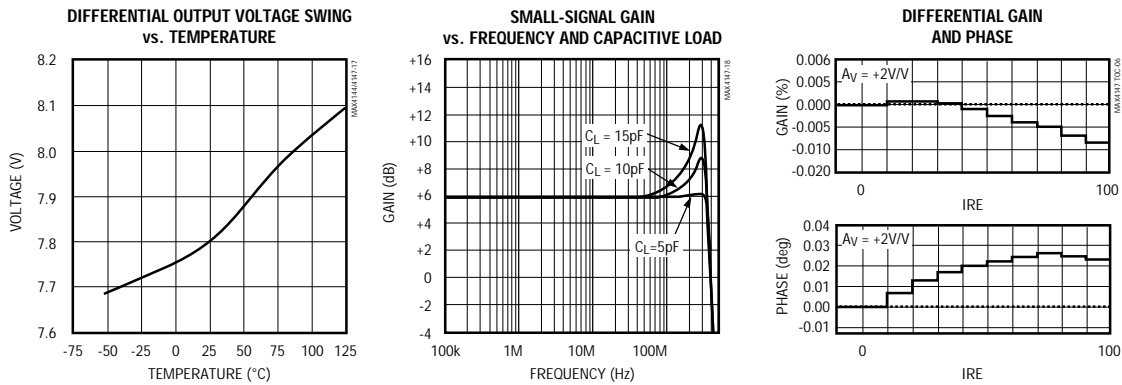
Typical Operating Characteristics (continued)
 (V_{CC} = +5V, V_{EE} = -5V, R_L = 150Ω, T_A = +25°C, unless otherwise noted.)



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Typical Operating Characteristics (continued)

($V_{CC} = +5V$, $V_{EE} = -5V$, $R_L = 150\Omega$, $T_A = +25^\circ C$, unless otherwise noted.)



Pin Description

| PIN | NAME | FUNCTION |
|-------|----------|---|
| 1, 7 | V_{EE} | Negative Power Supply. Connect to -5V. |
| 2 | IN+ | Noninverting Input |
| 3, 5 | N.C. | No Connect. Not internally connected. |
| 4 | SHDN | Logic Input for Shutdown Circuitry. A logic low enables the amplifier. A logic high disables the amplifier. |
| 6 | IN- | Inverting Input |
| 8, 14 | V_{CC} | Positive Power Supply |
| 9 | OUT- | Inverting Output |
| 10 | SENSE- | Sense Line for the Inverting Output. Connect to OUT-, close to the pin. |
| 11 | GND | Ground |
| 12 | SENSE+ | Sense Line for the Noninverting Output. Connect to OUT+, close to the pin. |
| 13 | OUT+ | Noninverting Output |

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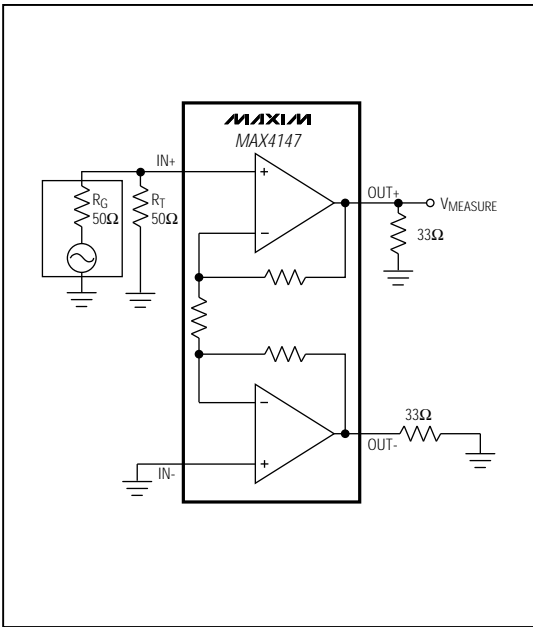


Figure 1. Single-Ended Distortion Setup

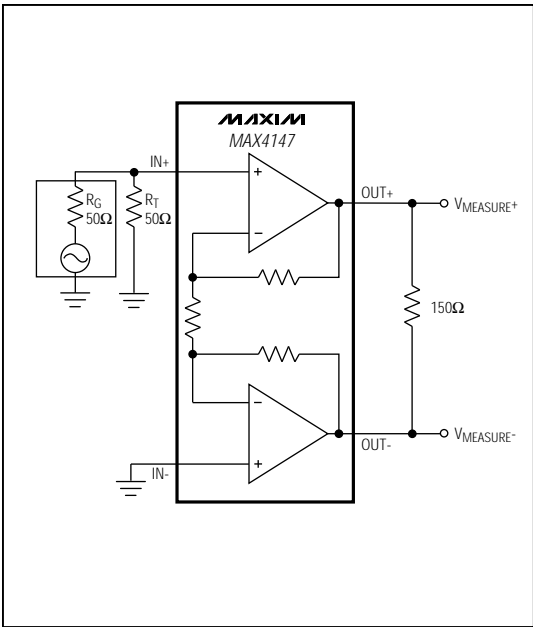


Figure 2. Differential Distortion Setup

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Package Information

**Narrow SO
SMALL-OUTLINE
PACKAGE
(0.150 in.)**

| DIM | 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 | 0.150 | 0.157 | 3.80 | 4.00 |
| e | 0.050 | | 1.27 | |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |

| DIM | PINS | INCHES | | MILLIMETERS | |
|-----|------|--------|-------|-------------|-------|
| | | MIN | MAX | MIN | MAX |
| D | 8 | 0.189 | 0.197 | 4.80 | 5.00 |
| D | 14 | 0.337 | 0.344 | 8.55 | 8.75 |
| D | 16 | 0.386 | 0.394 | 9.80 | 10.00 |

21-0041A

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