



LG1628AXA SONET/SDH 2.488 Gbits/s Transimpedance Amplifier

Features

- High data rate: 2.5 Gbits/s
- High gain: 5.8 k Ω transimpedance
- Complementary 50 Ω outputs
- Low noise
- Ultrawide dynamic range
- Single -5.2 V ECL power supply

Applications

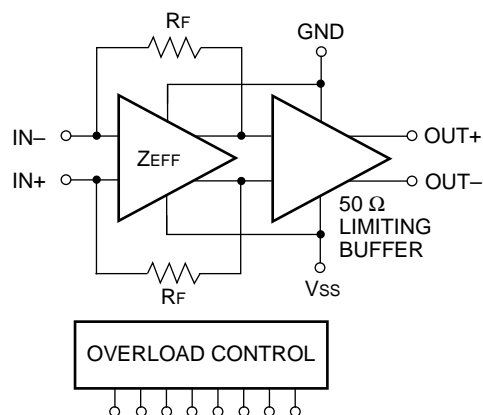
- SONET/SDH receivers
- SONET/SDH test equipment
- Digital video transmission

Functional Description

The Lucent Technologies Microelectronics Group LG1628AXA is a hybrid integrated circuit that combines the Lucent LG1628A gallium arsenide (GaAs) transimpedance amplifier chip with an external Si dual operational amplifier and necessary filtering to achieve an ultrawide dynamic range amplifier. The LG1628AXA is capable of handling input currents from 3 μA_{avg} to 4 mA_{avg} (patent pending). Amplifier operation is from a single -5.2 V power supply. The targeted transmission system is SONET OC-48 and SDH STM-16.

A complete receiver/regenerator can be constructed with an LG1628AXA followed by an LG1605 limiting amplifier and LG1600 clock and data regenerator.

Figure 1 shows the block diagram of the LG1628AXA transimpedance amplifier. The amplifier consists of a 4.2 k Ω differential transimpedance stage followed by a limiting buffer that provides complementary 50 Ω outputs.

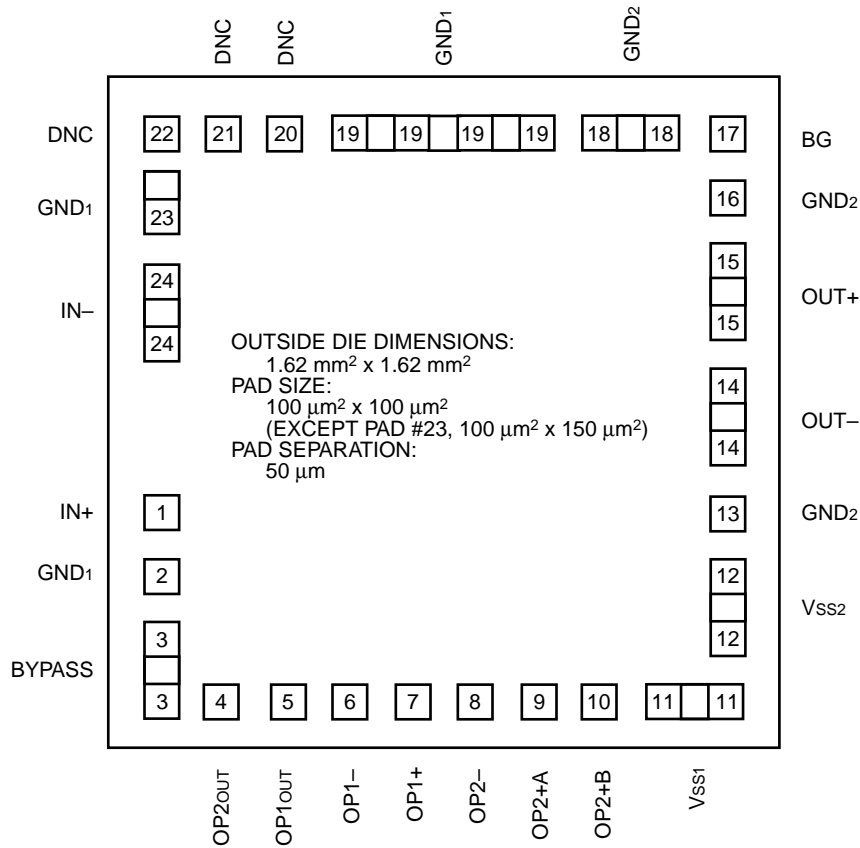


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Figure 1. LG1628AXA Functional Diagram

Die Pad Configuration

The die pad configuration is shown in Figure 2.



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Figure 2. Die Pad Configuration

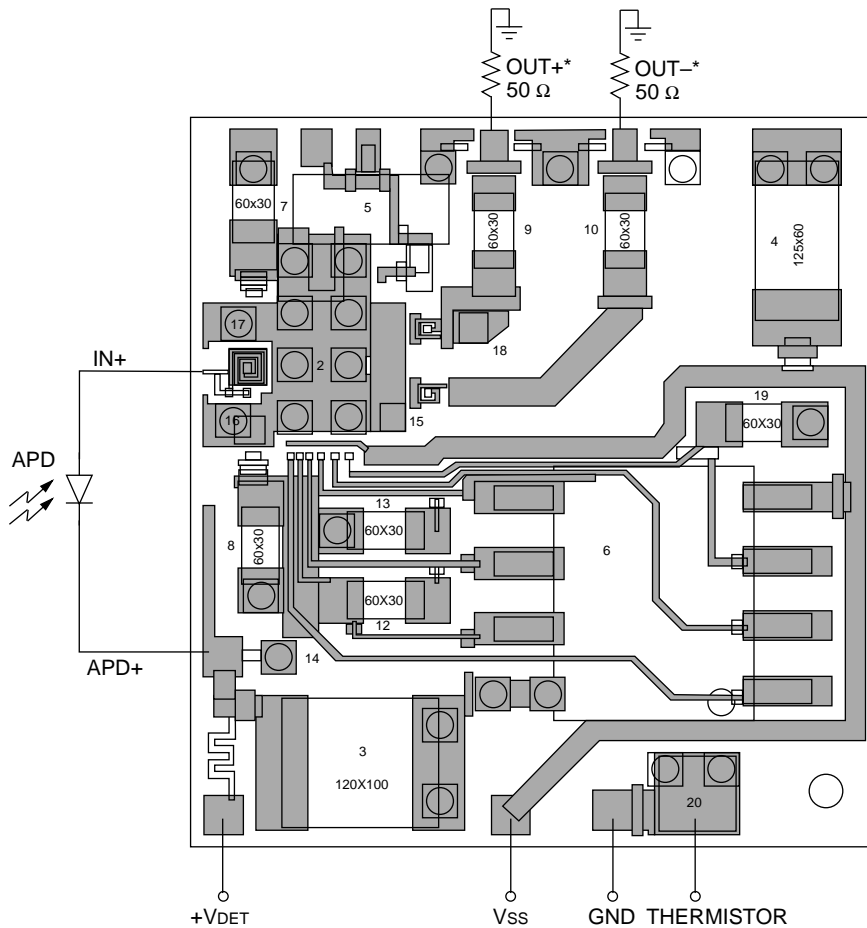
Die Pad Configuration (continued)

The pad descriptions for the LG1628AXA are given in Table 1.

Table 1. Pad Descriptions

| Pad | Symbol | Description |
|------------|------------------|---|
| 1 | IN+ | Amplifier input; connect to detector anode, current should enter this node. |
| 2, 19, 23 | GND1 | Ground. |
| 3 | BYPASS | Connections between these nodes and an external dual op amp form the overload control circuitry. See the test circuit in Figure 4 for wiring details. To operate the amplifier without overload control connect OP2OUT to V _{SS} , OP1OUT to GND, and leave BYPASS and the remaining op amp connections open (Figure 5). |
| 4 | OP2OUT | |
| 5 | OP1OUT | |
| 6 | OP1- | |
| 7 | OP1+ | |
| 8 | OP2- | |
| 9 | OP2+A | |
| 10 | OP2+B | |
| 11 | V _{SS1} | Supply voltage; -5.2 Vdc nominal. |
| 12 | V _{SS2} | Supply voltage; -5.2 Vdc nominal. |
| 13, 16, 18 | GND2 | Ground. |
| 14 | OUT- | Inverted data output (produces low-level output for current entering IN+). |
| 15 | OUT+ | Noninverted data output (produces high-level output for current entering IN+). |
| 17 | BG | Connection for external -2.5 Vdc voltage reference (typically use an Si band-gap). |
| 20, 21, 22 | DNC | Do not connect; internal test point or reserved for future use. |
| 24 | IN- | Inverting input; must provide ac bypass to ground when using overload control. |

Typical Connections and Padout of the Hybrid Integrated Circuit



5-5336(F).r3

* OUT- is delayed approximately 25 ps with respect to OUT+ due to the longer microstrip line associated with OUT-. An extra delay should be added to OUT+ before connecting to the next circuit.

Figure 3. Typical Connections to the HIC (See Figure 4 for a Schematic of the Circuitry on the HIC.)

Table 2. HIC Pad Functional Description

| Symbol | Description |
|------------|--|
| IN+ | Amplifier input; connect to detector anode, current should enter this node. |
| APD+ | RF bypassed connection for the cathode of the APD. |
| +VDET | APD power supply connection. |
| VSS | Supply voltage; -5.2 Vdc nominal. |
| GND | Ground (back of HIC is also ground). |
| Thermistor | Negative temperature coefficient thermistor for APD gain control. |
| OUT+ | Noninverted data output (produces high-level output for current entering IN+). |
| OUT- | Inverted data output (produces low-level output for current entering IN+). |

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent or latent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Table 3. Absolute Maximum Ratings

| Parameter | Min | Max | Unit |
|---|-----|-----------------|------|
| Supply Voltage Range (V _{SS}) | -7 | 0.5 | V |
| Power Dissipation | — | 1 | W |
| Voltage (all pins) | 0.5 | V _{SS} | V |
| Storage Temperature Range | -40 | 125 | °C |
| Operating Temperature Range | 0 | 100 | °C |

Recommended Operating Conditions

Table 4. Recommended Operating Conditions

| Parameter | Symbol | Min | Max | Unit |
|---------------------|-----------------|------|------|------|
| Ambient Temperature | T _A | 0 | 85 | °C |
| Power Supply | V _{SS} | -4.7 | -5.7 | V |

Handling Precautions

Although protection circuitry has been designed into this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. Lucent Technologies Microelectronics Group employs a human-body model (HBM) and a charged-device model (CDM) for ESD-susceptibility testing and protection design evaluation. No industry-wide standard has been adopted for the CDM. However, a standard HBM (resistance = 1500 Ω, capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes. The HBM ESD threshold presented here was obtained by using these circuit parameters.

Table 5. ESD Threshold

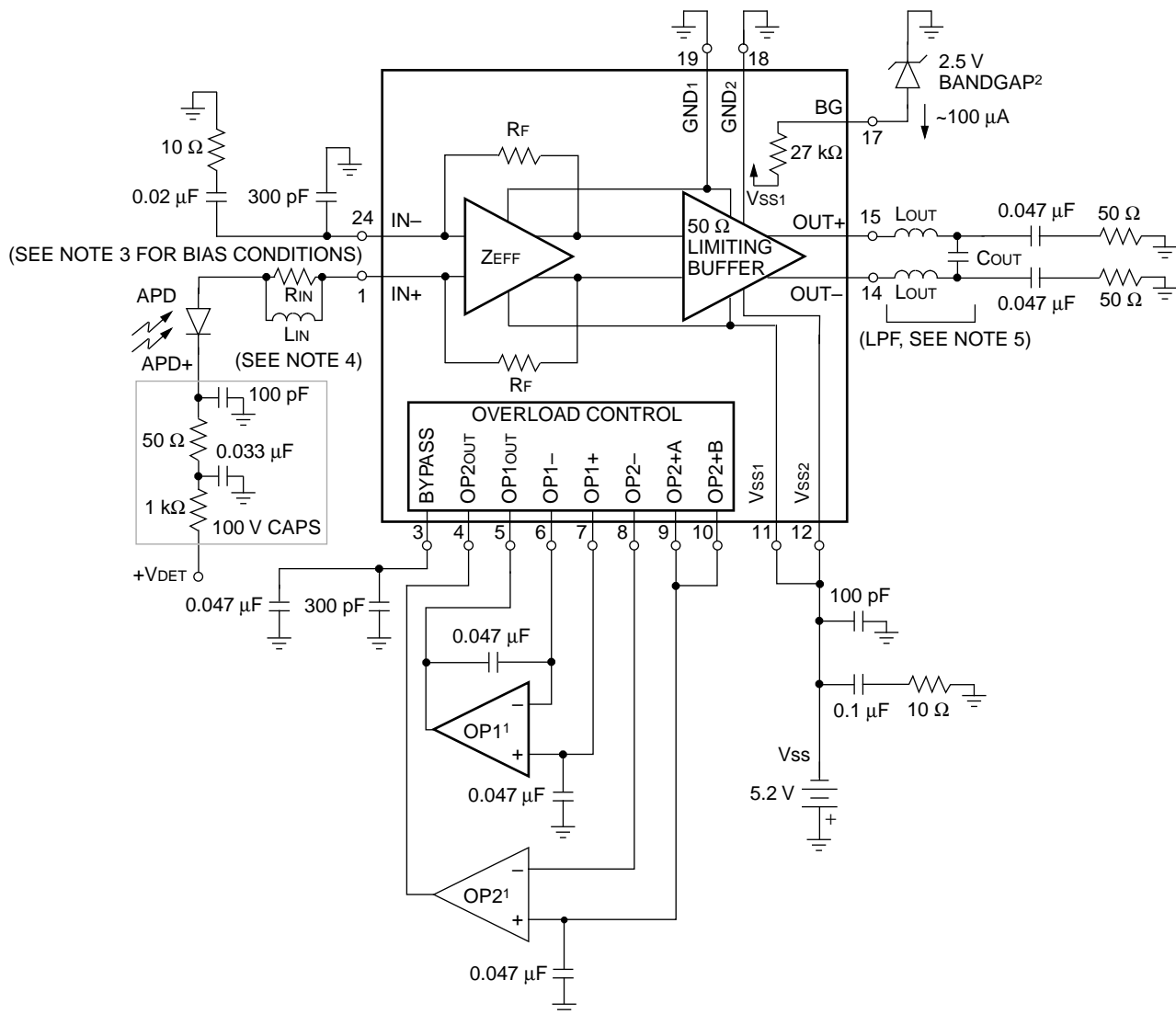
| HBM ESD Threshold | |
|-------------------|---------|
| Device | Voltage |
| LG1628AXA | >500 V |

Electrical Characteristics

TA = 25 °C, VSS = -5.2 V, CDETECTOR = 0.5 pF, RLOAD = 50 Ω, unless otherwise indicated.

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|--------|------|------|------|-------|
| Power Supply Voltage | VSS | -5.7 | -5.2 | -4.7 | V |
| Power Supply Current | ISS | — | 140 | — | mA |
| Effective Small-signal Transimpedance (Single-ended input to either OUT+ or OUT- each driving a 50 Ω load, differ- ential gain is twice this value.) | TZ | — | 5.8 | — | kΩ |
| Small-signal Bandwidth | BW | 1.5 | 1.6 | — | GHz |
| Transimpedance Peaking | TPK | — | 0 | 1 | dB |
| Output Return Loss | S22 | 10 | 15 | — | dB |
| Input Noise Current (100 kHz—2.5 GHz) | INOISE | — | 300 | 350 | nArms |
| Operating Temperature Range | TOP | 0 | — | 85 | °C |

Test Circuit with Overload Control

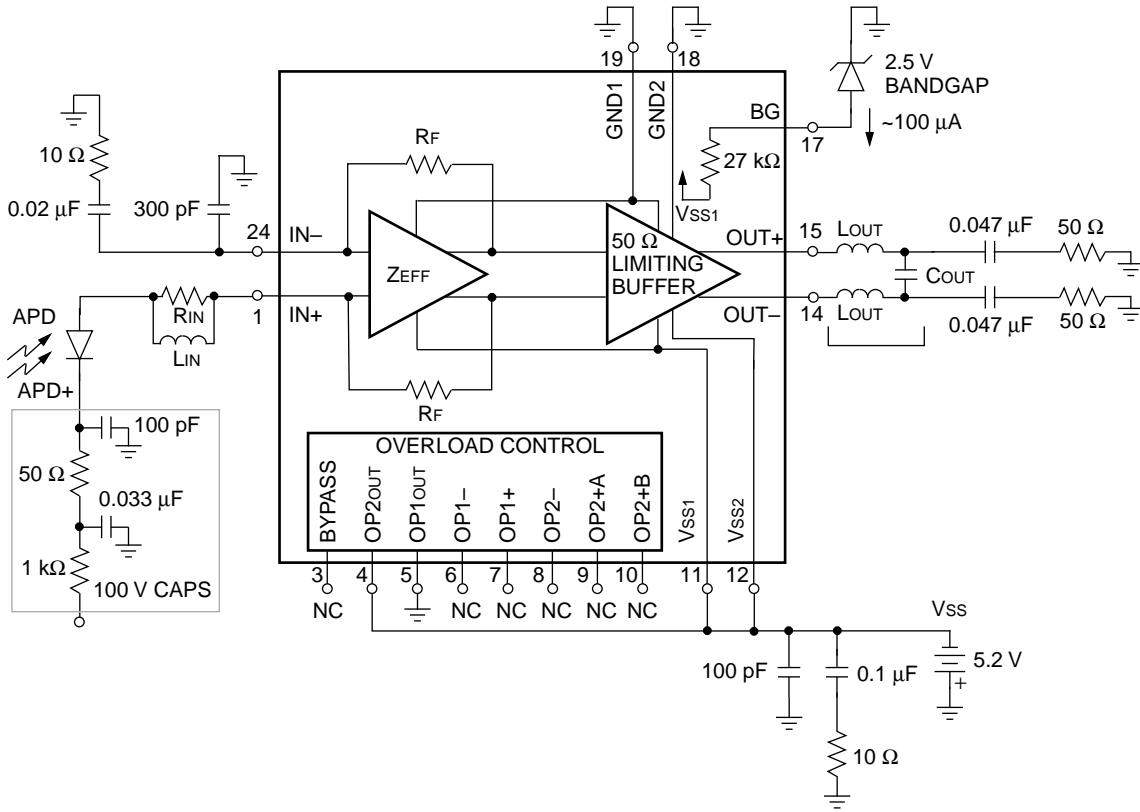


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- Operational amplifiers OP1 and OP2 should have the following characteristics (suggested op amps are the LMC6082IM or OP291GS, both are available as dual op amps in an 8-pin SOIC package):
 - Single 5 V supply operation.
 - Maximum input offset voltage of 1 mV.
 - Low-level output includes negative rail.
 - High-level output to within 2 V of the positive rail.
 - Gain bandwidth product ≥ 1.8 MHz.
 - Large signal voltage gain ≥ 100 V/mV.
- An on-chip 75 k Ω resistor to the negative supply is provided for biasing the voltage reference. Approximately 100 μ A of current will be drawn. (Suggested bandgap reference is the LM4040BIM-2.5, available in an SOT-23 package.)
- Node IN+ is nominally at -3.3 Vdc. APD supply voltage +V_{DET} should be adjusted appropriately.
- R_{IN}L_{IN} may be necessary to achieve stability depending on the physical arrangement of the APD and its associated parasitics (series inductance and other resonances). The amplifier will be stable with a 0.5 pF detector capacitance in series with a 0.5 nH inductor, but packaged detectors usually do not behave so ideally at frequencies above a few gigahertz. A parallel RL network consisting of a 200 Ω resistor and a 6 nH inductor is provided on HIC and may be optionally used with a slight noise penalty. Good isolation from output to input is also essential for amplifier stability.
- A low-pass filter is provided on the LG1628AXA HIC to reduce higher-frequency noise contributions (Butterworth N = 2, Z_o = 50 and f_c = 4.25 GHz, L_{OUT} = 2.65 nH, C_{OUT} = 0.5 pF).

Figure 4. Optical Receiver with Overload Control

Test Circuit with Overload Control Disabled

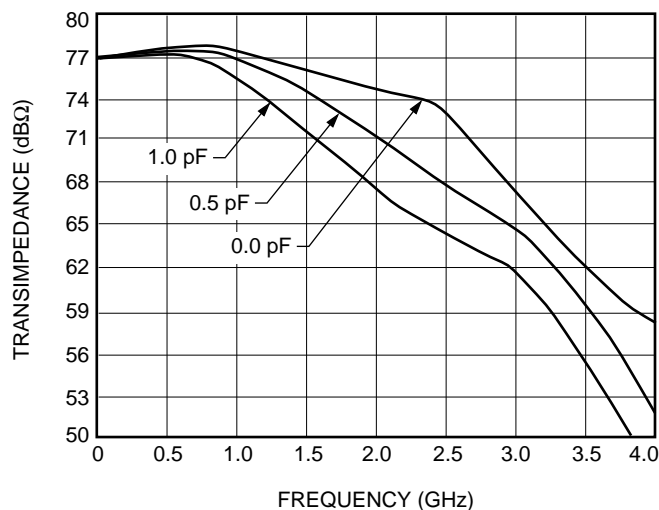


Note: Notes 2, 3, 4, and 5 from the previous page (Figure 4) apply to this drawing.

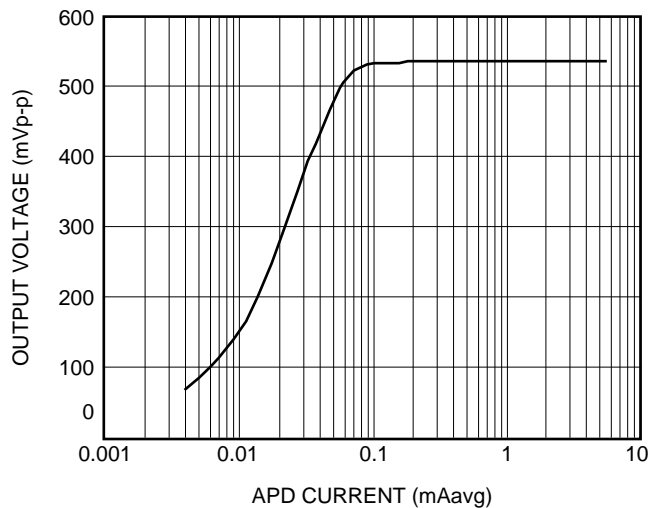
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Figure 5. Optical Receiver with Overload Control Disabled

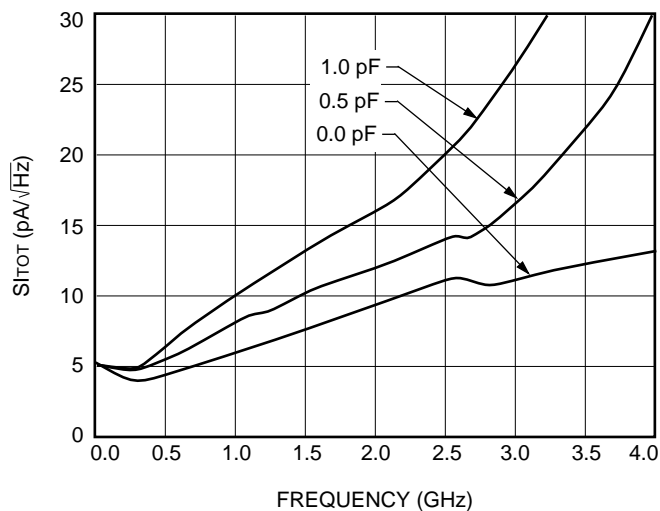
Characteristic Curves (at $T_A = 25\text{ }^\circ\text{C}$, $V_{SS} = -5.2\text{ V}$, $C_{DETECTOR} = 0.0\text{ pF}, 0.5\text{ pF}, 1.0\text{ pF}$, $R_{LOAD} = 50\text{ }\Omega$)



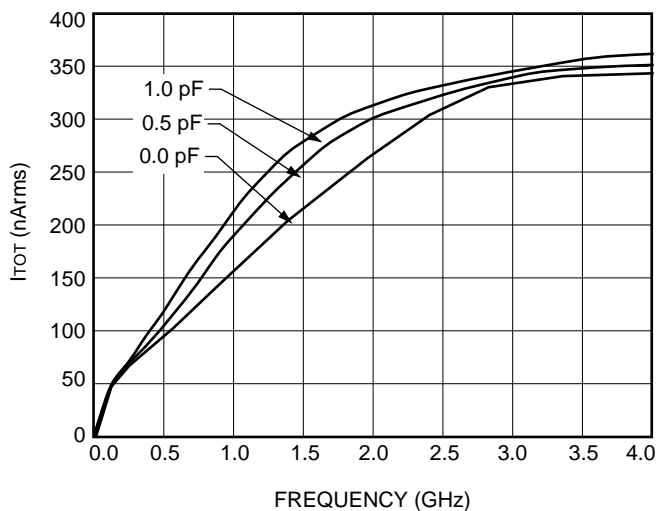
A. Small-Signal Transimpedance



B. Overload Characteristics¹



C. Input Spectral Noise Density



D. Total Input Noise Current

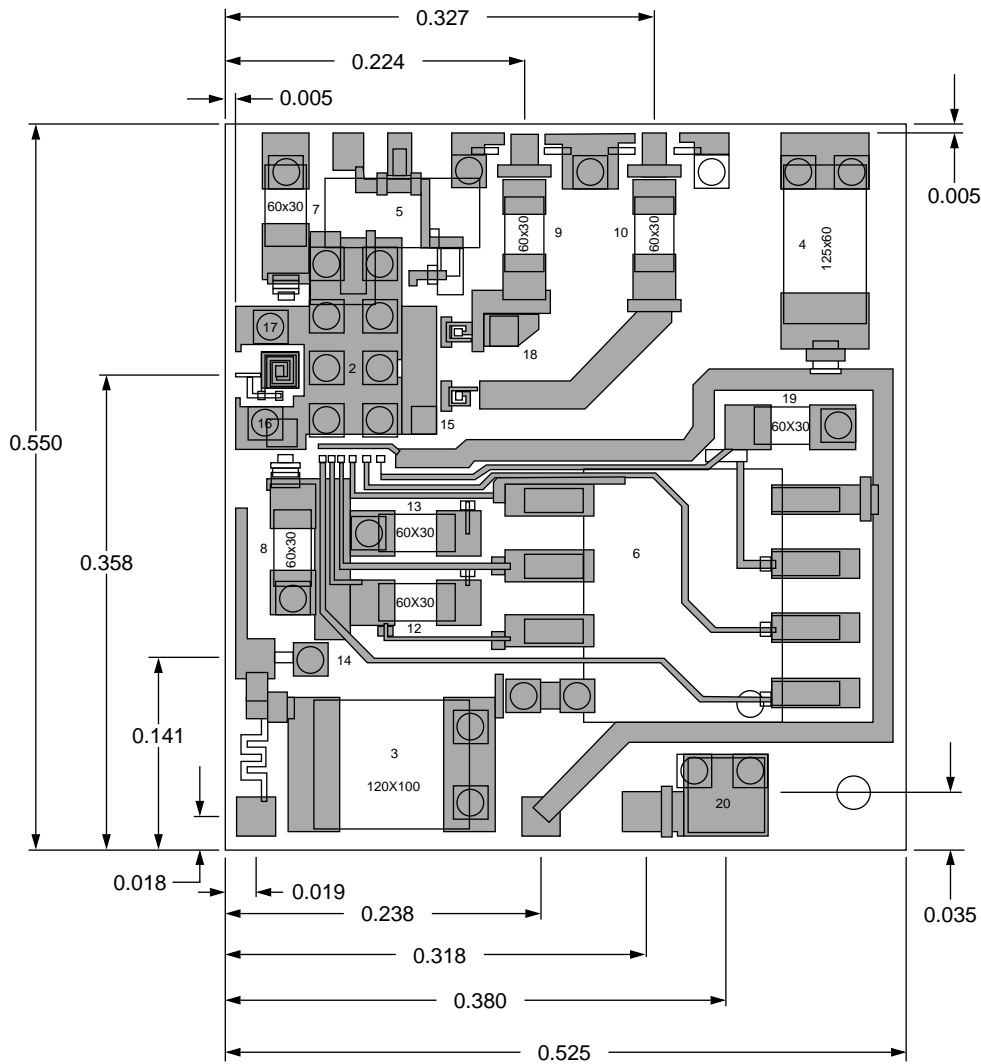
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1. >25 dB dynamic range requires an external Si dual operational amplifier. The detector polarity is such that current enters the LG1628A (i.e., the detector anode is connected to the LG1628A).

Figure 6. Characteristic Curves as Measured on the LG1628AXA Hybrid Integrated Circuit

Dimensional Drawing of the Hybrid Integrated Circuit (HIC)

Dimensions are in inches. Ceramic thickness is 0.025 inches.



5-5336(F).ar3

Figure 7. HIC Dimensions and Location of Bonding Pads

Ordering Information

| Device Code | Package | Temperature | Comcode (Ordering Number) |
|-------------|--|---------------|---------------------------|
| LG1628AXA | Hybrid Integrated Circuit Differential Output | 0 °C to 85 °C | 107791469 |
| LG1628BXA* | Hybrid Integrated Circuit Single-ended Output | 0 °C to 85 °C | 108052085 |

* Second output on BXA is terminated through to ground 50 Ω on hybrid.

Notes

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