



1GHz Transimpedance Preamplifier with 25dB Dynamic Range

MAX3260

General Description

The MAX3260 high-speed transimpedance amplifier is ideally suited for Fibre Channel and SDH/SONET applications. An extended dynamic range makes the MAX3260 useful in optical receiver systems with as much as 25dB of input signal range. A DC-restore feedback network prevents amplifier saturation in all Fibre Channel applications by allowing input currents as high as 900 μ A to be amplified linearly. To reduce noise, the restore function is disabled at low input levels, allowing detection of signals as small as 2.4 μ A with a signal-to-noise ratio of 10.

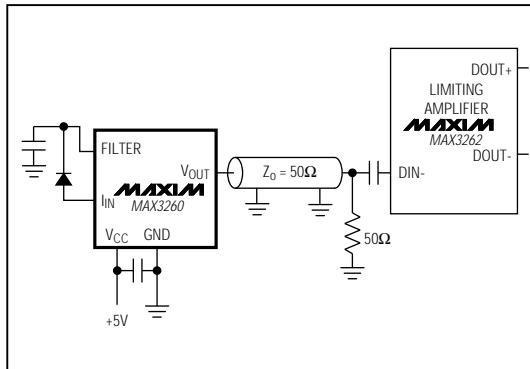
The filter output (FILTER) of the MAX3260 provides a convenient voltage source for a photodiode, especially when the circuit will be placed into a TO-style header with the photodiode. The filter output is connected to VCC through a 1k Ω on-chip resistor. In combination with a bypass capacitor, the filter function significantly reduces the amount of noise present at the cathode of the photodiode.

The MAX3260 operates from a single +5V supply consuming only 115mW of power when the output is AC coupled. With 50 Ω output termination, it consumes less than 300mW of power.

Applications

- High-Speed Fiber Optics
- 531Mbps and 1062Mbps Fibre Channel
- 622Mbps SDH/SONET
- Current-to-Voltage Converters
- PIN-Preamplifiers

Typical Operating Circuit



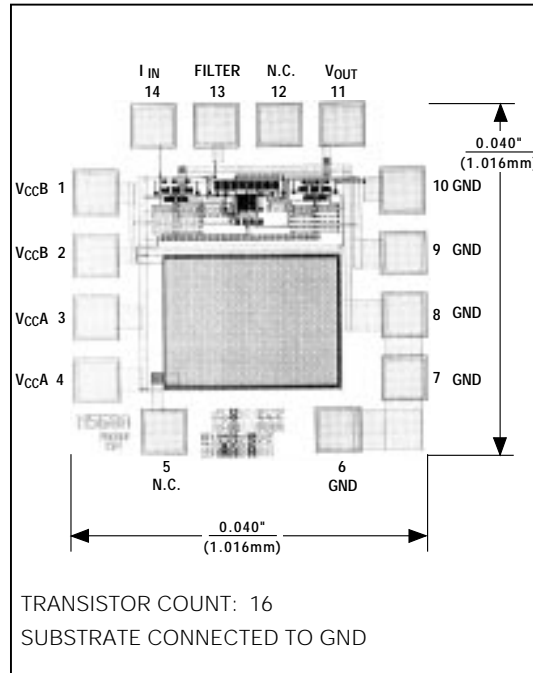
Features

- ◆ 1GHz Bandwidth
- ◆ Single 5V Supply
- ◆ 25dB Dynamic Range
- ◆ Optimized for TO-Style Header

Ordering Information

| PART | T _J RANGE | PIN-PACKAGE |
|------------|----------------------|-------------|
| MAX3260C/D | 0°C to +100°C | Dice |

Chip Topography



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ABSOLUTE MAXIMUM RATINGS

| | | | |
|--|--------|--|-----------------|
| Supply Voltage, V_{CCA} , V_{CCB} to GND | 0V, 6V | Output Voltage, V_{OUT} | 0V, 6V |
| Input Current, I_{IN} , FILTER | 1.5mA | Operating Junction Temperature Range | -55°C to +150°C |
| Input Bias Voltage, V_{IN} | 0V, 6V | Processing Temperature | +400°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.

ELECTRICAL CHARACTERISTICS

($V_{CC} = +5V$, output terminated with 50Ω to ground, 100% tested, $T_J = +27^\circ\text{C}$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|---------------|---------------------------|-------|-------|-------|---------------|
| DC SPECIFICATIONS | | | | | | |
| Input Bias Voltage | V_{IN} | | | 1.6 | | V |
| DC-Restore Time Constant | t_{DC} | | | 1 | | μs |
| Filter Resistor Value | R_{FILTER} | | 750 | | 1250 | Ω |
| Supply Current | I_{VCC} | 50Ω load to ground | | 56 | 70 | mA |
| DC Transimpedance | | $I_{IN} > 400\mu\text{A}$ | -400 | | | V/A |
| | | $I_{IN} < 100\mu\text{A}$ | -2400 | -2000 | -1600 | |
| DC-Restore Activation Current | $I_{RESTORE}$ | | | 350 | | μA |
| AC SPECIFICATIONS (Not production tested) | | | | | | |
| Small-Signal Transimpedance | GT | | -2400 | -2000 | -1600 | V/A |
| -3dB Bandwidth | BWU | | 0.8 | 1.0 | | GHz |
| Peak Input Current | I_{IN} | | | | 900 | μA |
| Pulse-Width Distortion | PWD | (Notes 1, 2, 3) | | | 100 | ps |
| Input Referred Current Noise | I_{NRMS} | (Notes 2, 4) | | | 240 | nA |
| Power-Supply Rejection Ratio | PSRR | | | 21 | | dB |
| Output Resistance | R_{OUT} | | | 3 | | Ω |

Note 1: Input is a square wave with 0.5GHz frequency and <200ps rise time.

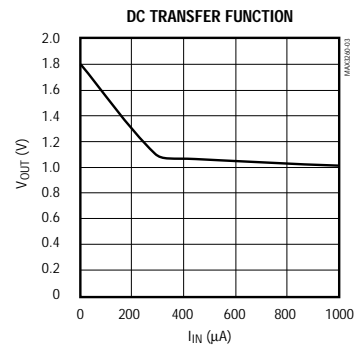
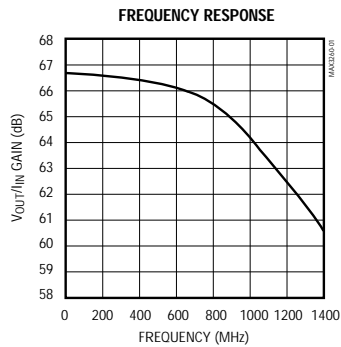
Note 2: External capacitance on the input $\leq 0.4\text{pF}$.

Note 3: Pulse-width distortion measured at the 50% level of the output pulses: Input is $900\mu\text{A}$, zero-peak.

Note 4: Output noise is measured through a four-pole Bessel filter with -3dB bandwidth of 800MHz. Noise is then referred to the input by dividing the DC transimpedance.

Typical Operating Characteristics

($T_J = +27^\circ\text{C}$, unless otherwise noted.)

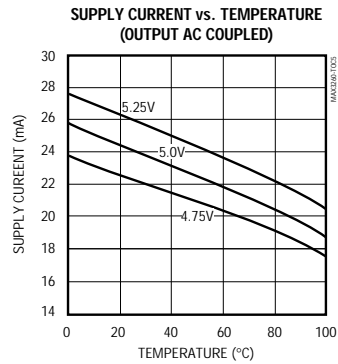
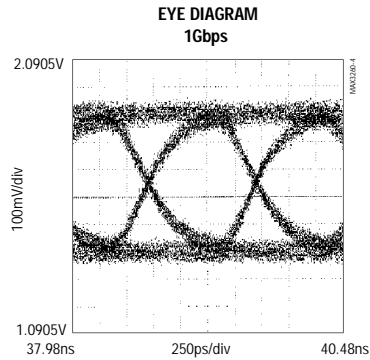


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Typical Operating Characteristics (continued)

(T_J = +27°C, unless otherwise noted.)

MAX3260



Detailed Description

The MAX3260 is a high-speed transimpedance amplifier, designed to accommodate input currents with a large dynamic range. This circuit is optimized to operate in a 1062Mbps Fibre Channel receiver, and is also suitable for use in 622Mbps SONET applications.

The MAX3260 employs shunt-shunt feedback around a bipolar amplifier. The resulting circuit provides an inverted current-to-voltage conversion. The conversion gain is nominally -2000V/A.

Modern fiber-optic communications systems place many requirements on transimpedance preamplifiers. Power budgets are important when considering a pre-amp, since the circuit will generally be placed into a small module or header, which limits the amount of heat dissipation. In addition, the signal presented to the pre-amp may carry an 18dB to 20dB dynamic range, which must be amplified linearly to prevent the addition of jitter. Finally, preamp noise generally determines the receiver sensitivity, and must be held to a minimum.

The MAX3260 employs several techniques to address the needs of fiber-optic preamplifiers. The output of the MAX3260 operates in the 1V to 2V range (depending

on the average input) to keep output standing current at a minimum. The reduced output voltage helps keep power consumption low, but also reduces the dynamic range of the output stage. Fiber communications transimpedance amplifiers commonly use dynamic control of the shunt-shunt feedback loop to vary the gain. The unwanted side-effect of this technique is a circuit bandwidth that varies with input current. To prevent output-stage saturation, the MAX3260 employs a DC-restore circuit. As input signal power increases, DC current is drawn away from the input node of the amplifier. This reduces the DC gain of the amplifier without affecting the small-signal performance. To prevent noise feedback at low signals, an integrated comparator senses the power level and disables the DC-restore function.

The MAX3260's filter output provides a convenient voltage source for a photodiode, especially when the circuit will be placed into a TO-style header with the photodiode. The filter output is connected to V_{CC} through an on-chip 1kΩ resistor. In combination with a bypass capacitor, the filter function reduces the bandwidth at the anode of the photodiode, therefore significantly reducing the amount of noise at the cathode. The filter connection can be left unconnected if not used.

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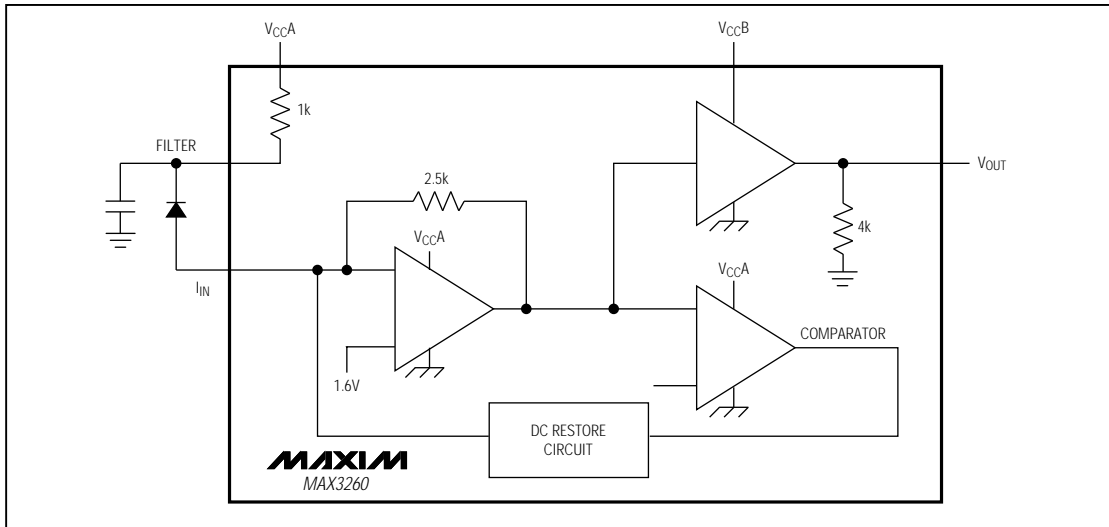


Figure 1. Functional Diagram

Wire Bonding

For high current density and reliable operation, the MAX3260 uses gold metallization. Connections to the die should be made with gold wire only, using ball bonding techniques. Wedge bonding is not recommended. Die pad size is 4 mils.

Design Procedure

The MAX3260 is a high-speed, high-gain component. Its performance is strongly affected by module design and layout. Improper design techniques can cause oscillations or ringing.

In fiber-optic receiver applications, it is highly recommended that the transimpedance preamplifier be placed close to the photodetector, in the same package or header if possible. This reduces parasitic inductance and improves static-discharge protection during manufacturing. An alternative layout is to assemble the preamplifier on a hybrid circuit board. In either case, the designer should ensure that power-supply runs to the VccA and VccB inputs are properly filtered. Keep ground connections to the MAX3260 short and minimize inductance. Multiple vias may be required when connecting to the ground plane on a circuit board, to reduce the ground inductance.

The MAX3260 will typically be connected to a limiting or post amplifier by means of a controlled-impedance transmission line. If a transmission line is used, it is important to end-terminate the line with the characteristic impedance to prevent reflections into the output of the MAX3260.

Applications Information

The MAX3260 consumes approximately 23mA of current with no output load. Typically, the majority of power used by the preamplifier is consumed in the output termination. The termination is needed at the end of the transmission line connecting MAX3260 to a limiting amplifier. The average output level is typically 1.6V, and is maintained at that level by the DC-restore function. A 50Ω termination to ground will consume 32mA of standing current. Power consumption can be reduced by terminating to higher resistance. A 75Ω transmission line and termination would consume only 22mA. Power consumption can be reduced dramatically by excluding the transmission line and termination, which requires very short distances between the MAX3260 and the following circuit.

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