Electrical Evaluation for LTC6560 Single Channel Transimpedance Amplifier with Output Multiplexing

DESCRIPTION

Demonstration circuit 2807A features the LTC®6560 single channel transimpedance amplifier (TIA) with output multiplexing. The DC2807A accepts voltage pulses and converts them to current for the TIA. The board can also be used to measure bandwidth with a network analyzer. The LTC6560, which features 74kΩ transimpedance gain and 30µA linear input current range, is ideal for LIDAR receivers using avalanche photodiodes (APD). The LTC6560 operates from 5V single supply and consumes only 90mW. Utilizing the LTC6560's output MUX, multiple LTC6560 devices can combine into a single output. The LTC6560's fast overload recovery makes it well suited for LIDAR receivers. The LTC6560's single-ended output can swing $2V_{P-P}$ into a 100Ω load.

The LTC6560 is packaged in a compact 3mm × 3mm 16-pin leadless QFN package with an exposed pad for thermal management and low inductance.

Design files for this circuit board are available.

All registered trademarks and trademarks are the property of their respective owners.

CONNECTION DIAGRAM

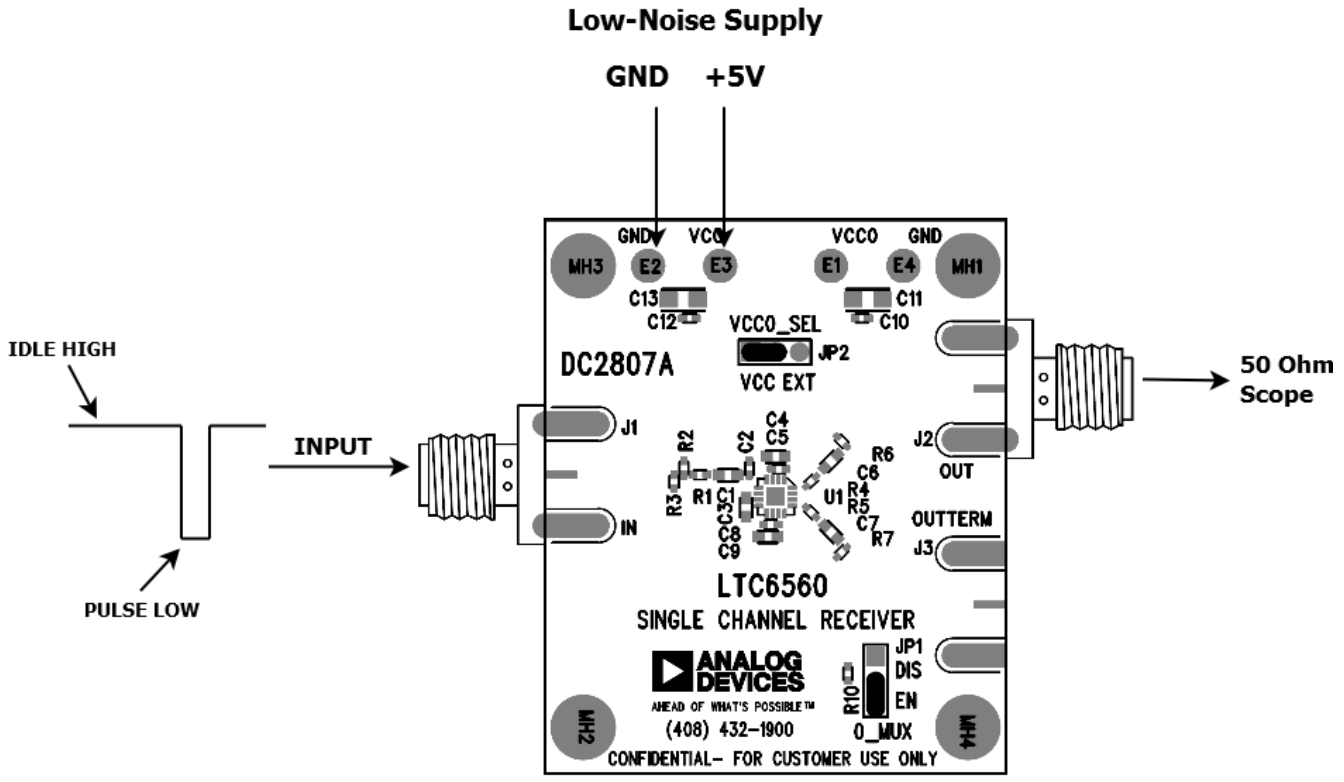


Figure 1. DC2807A Connection Diagram

QUICK START PROCEDURE

1. Connect a voltage pulse generator to the input to J1. J1 is 50Ω terminated to ground, and then AC-coupled. A 2k series resistor converts the voltage to a current. Refer to the input circuit description for details. The combination of 100pF AC-coupled input and 100pF AC-coupled output limits the DC2807A repetition rate to less than 100kHz. As an input example, a 25dB attenuator can be used to scale-down the pulse generators output that is set to $1V_{P-P}$. This will produce a peak current that is approximately 28µA.
2. Connect J2 to an oscilloscope that is **50Ω terminated or other 50Ω systems**. J2 is AC-coupled with a 1000pF capacitor.
3. Connect a 5V low noise power supply shown in Figure 1. V_{CCO} is hardwired to V_{CO} by default.

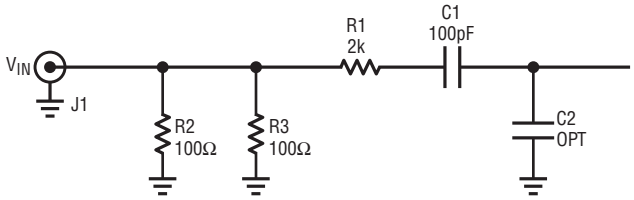


Figure 2. Input Circuit for DC2807A

INPUT CIRCUIT DESCRIPTION

The input stage, shown in Figure 2, is AC-coupled and 50Ω terminated to allow for interfacing to voltage pulse generators. A series resistor is used to convert the voltage pulse to a current pulse. This allows the use of a pulse generator to inject a current into the TIA. The following equation should be used calculate the injected current to the LTC6560:

$$I_{LTC6560} = V_{INP-P} / 2k\Omega \quad \text{EQ1}$$

The DC2807A allows insertion of excess capacitance C2 to simulate the effect of sensor (APD) capacitance on rise time and bandwidth.

OUTPUT CIRCUIT DESCRIPTION

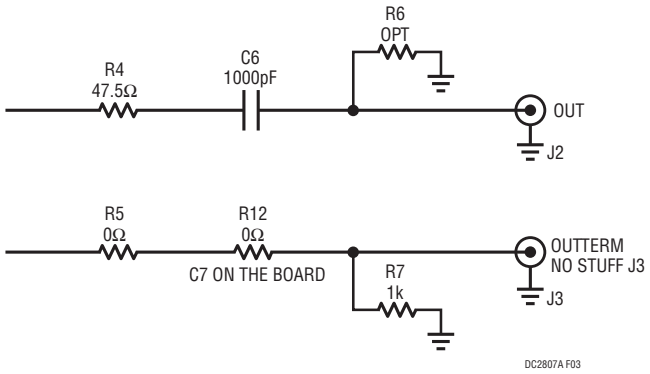


Figure 3. Output Circuit for DC2807A

For convenience, the LTC6560 offers two outputs: OUTTERM pin has an internal series 50Ω source resistor, and OUT pin has a direct connection. The schematic is shown in Figure 3. Only one output can be used to monitor at a time. The DC2807A output stage is AC-coupled 50Ω source to allow for interfacing to 50Ω systems. J2 is populated by default; this configuration connects to OUT pin on the LTC6560. J3 and its passives can be populated to use the OUTTERM pin. The LTC6560 implements a Class B output stage. A 1k pull-down resistor on OUTTERM provides a DC path to ground. This helps the LTC6560 output pull to ground when the LTC6560 output is AC-coupled.

CONNECTING MULTIPLE LTC6560s FOR OUTPUT MUXING

The outputs of the LTC6560 can be wire OR'd together to combine multiple inputs. When the OMUX pin is high, the LTC6560s output goes to a high impedance state. When the OMUX pin is low, the LTC6560 is enabled. Only one LTC6560 can be enabled at a time. Source resistors are necessary to avoid reflections from the paths that are inactive. Be sure to keep the output lengths as short as possible to mitigate the effects of transmission line stubs. Figure 4 shows how multiple LTC6560 are connected. Both J2 (OUT Pin) or J3 (OUTTERM Pin) can be used to implement output MUXing. By replacing C6 or C7, respectively with a 0Ω 0402 resistor, the output can be DC-coupled to connect multiple DC2807A boards. A DC block can then be used to interface with 50Ω systems.

QUICK START PROCEDURE

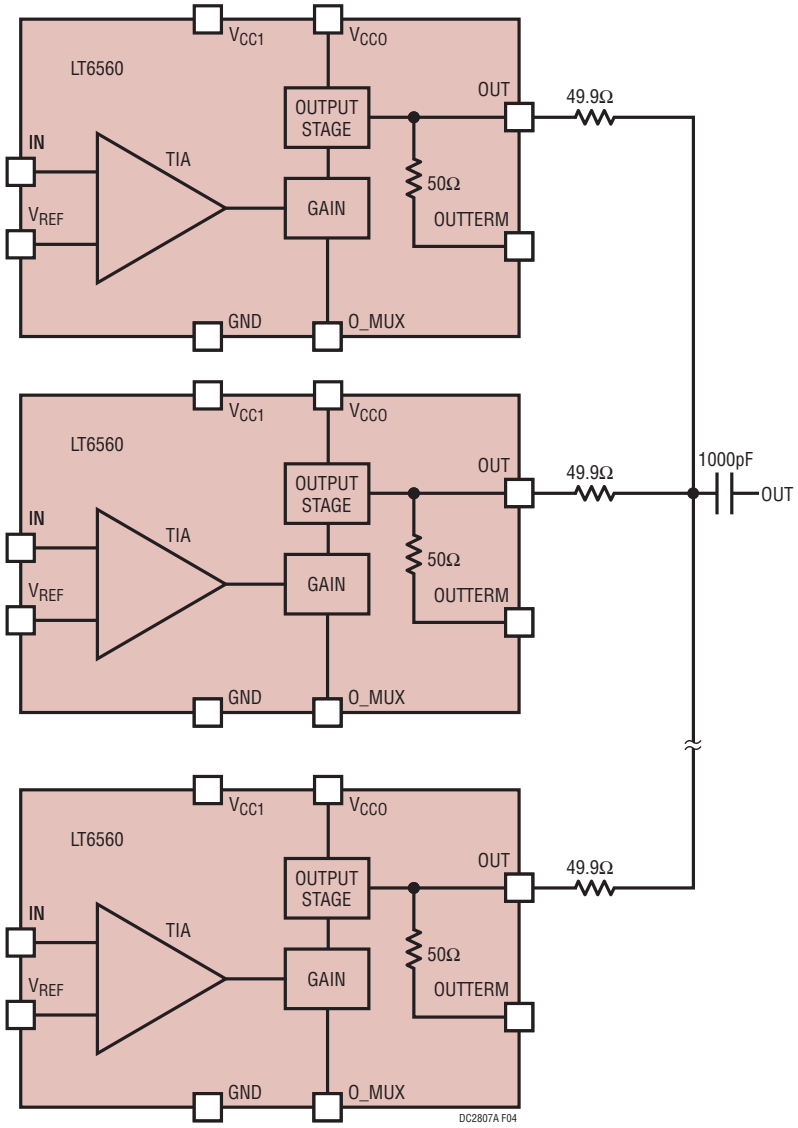


Figure 4. Diagram of Wire OR'd Outputs of Multiple LTC6560s

QUICK START PROCEDURE

LAYOUT CONSIDERATIONS

The DC2807A layout is optimized to maximize the LTC6560's performance. The V_{REF} capacitor should be orthogonal to the input trace. This orientation helps to reduce coupling from the input to V_{REF}. Local bypass for V_{CCO} and V_{CC} should be as close as possible to the LTC6560. The ground pad in the center of the LTC6560 is important for dissipating the heat from the die and to minimized the ground inductance. Maximizing the number of vias and employing multiple ground plane layers will most effectively heat sink the LTC6560. Figure 5 shows the DC2807A layout.

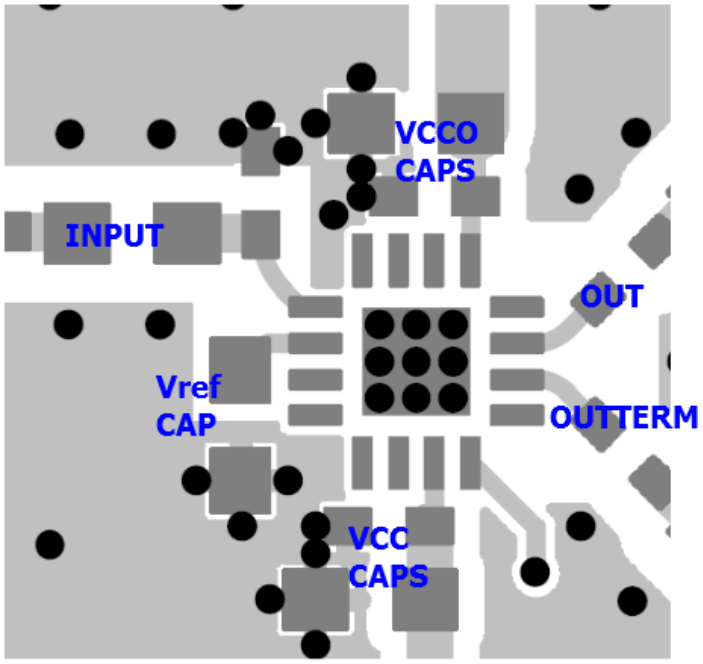


Figure 5. DC2807A Recommended Layout

INPUT AND OUTPUT

The input of the DC2807A is shown in Figure 6 and is attenuated by 25dB. A 25dB reduction of 300mV is 16.9mV. Using Equation 1, the peak current that the TIA sees is 8.4µA. Thus, the output of the DC2807A should be 310mV since the scope is 50Ω terminated.

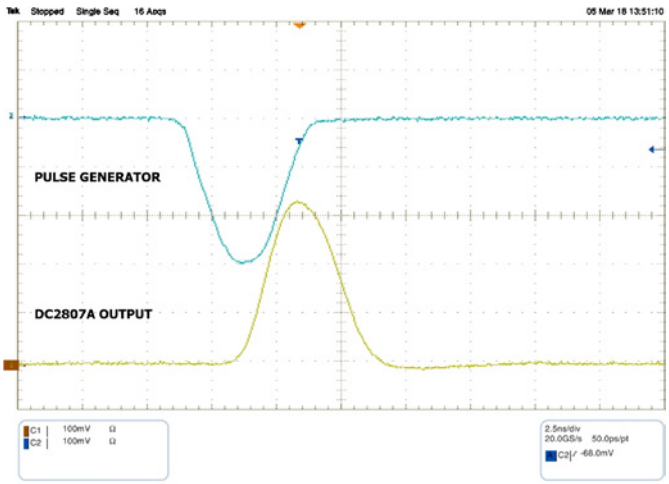


Figure 6. Scope Shoot of DC2807A

QUICK START PROCEDURE

EXTERNAL CONNECTIONS

Connections

J1: IN – The input stage is AC-coupled and then 50Ω terminated to allow for interfacing to voltage pulse generators.

J2: OUT – The analog output of the LTC6560.

J3: OUTTERM – The analog output of the LTC6560 with the internal 50Ω series resistor.

Turrets

E1: V_{CCO} – LTC6560 V_{CCO} analog input when JP2 is in the external (EXT) position.

E2, E4: GND – The DC2807A ground.

E3: V_{CC} – LTC6560 V_{CC} analog input. The V_{CCO} analog input is connected to this node when JP2 is in the V_{CC} position.

Jumpers

JP1: O_MUX – Enables (EN) or disables (DIS) the LTC6560 output. The output goes high impedance when the LTC6560 is disabled. O_MUX does not reduce power to the LTC6560 when the LTC6560 is disabled.

JP2: VCCO_SEL – selects the input for the LTC6560 V_{CCO} to V_{CC} turret (V_{CC}) or external (EXT) through the V_{CCO} turret. V_{CCO} is hardwired to V_{CC} by default.

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices.

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

© ANALOG DEVICES, INC. 2019