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Interfacing the ADL5315 High-Side Current Mirror to a Translinear Logarithmic Amplifier in a Photodiode Power Detector Application

CIRCUIT FUNCTION AND BENEFITS

The ADL5315 addresses the need for precision high-side monitoring of the PIN photodiode current in fiber optic systems and is useful in many nonoptical applications as well. It is optimized for use with the Analog Devices, Inc., AD8305, a translinear logarithmic amplifier that takes advantage of the wide input current range of the ADL5315. The circuit presented in this application note and shown in Figure 2 provides high accuracy power monitoring using the ADL5315 precision wide range, high-side current mirror and the AD8305 translinear logarithmic amplifier (log amp). This configuration is ideal for high accuracy power monitoring because the full current mirror range (3 nA to 3 mA) of the ADL5315 can be used.

The measured rms noise voltage at the output of the AD8305 vs. the input current, I_{INPT}, is shown in Figure 1, both for the AD8305 by itself and in cascade with the ADL5315. The relatively low noise produced by the ADL5315, combined with the additional noise filtering inherent in the frequency response characteristics of the AD8305, results in minimal degradation to the noise performance of the AD8305.

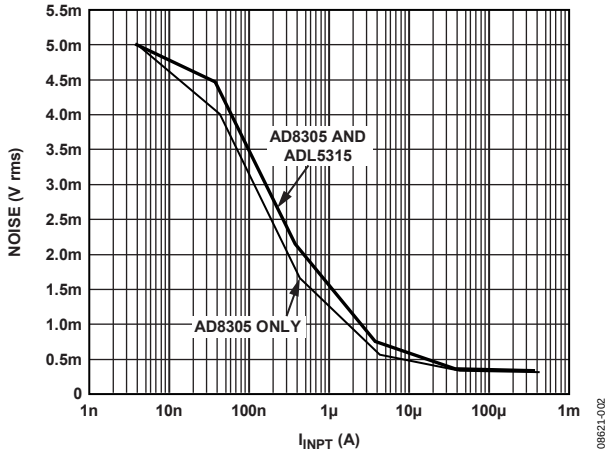

Figure 1. RMS Noise of the AD8305 vs. the AD8305 Cascaded with the ADL5315

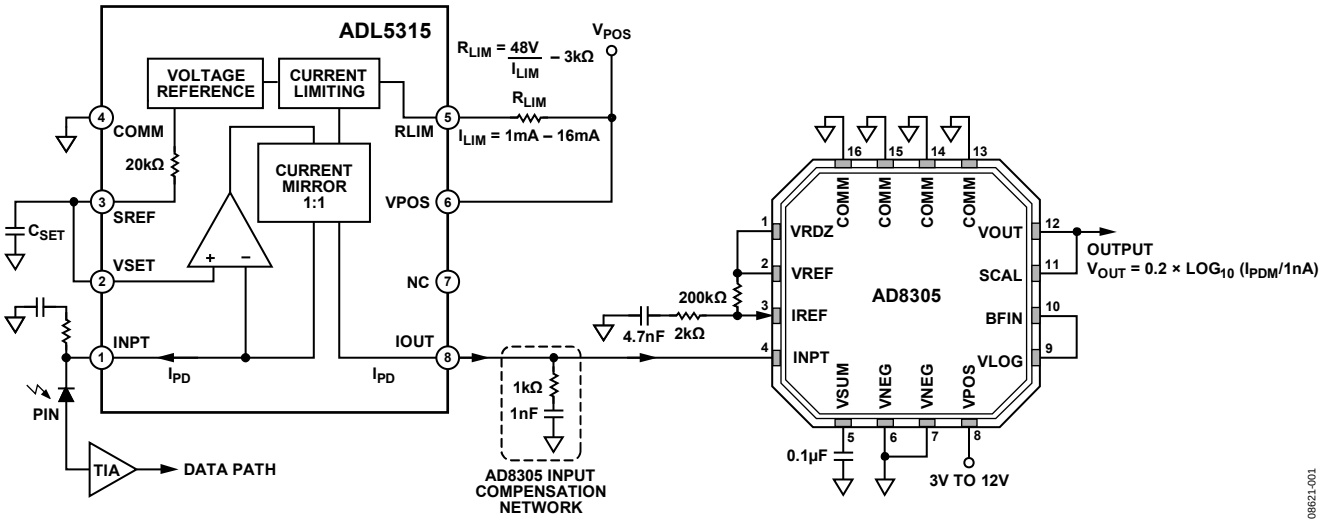

Figure 2. Connecting the ADL5315 to the AD8305 (Simplified Schematic: Decoupling and All Connections Not Shown)

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REVISION HISTORY

12/2017—Rev. A to Rev. B

Document Title Changed from CN0056 to AN-1512 ..... Universal
Changes to Circuit Description Section and Figure 3 3

4/2010—Rev. 0 to Rev. A

Changes to Circuit Note Title and to Circuit Function and Benefits Section 1
Changes to Circuit Description Section 2
Changes to Learn More Section 3

1/2009—Revision 0: Initial Version

CIRCUIT DESCRIPTION

In this circuit, the ADL5315 sets the bias voltage on the input PIN photodiode. This voltage is delivered at the INPT pin of the AD8305 and is controlled by the voltage at the VSET pin. VSET is driven by the on-board reference, V_{SREF}, which is equal to VPOS – 1 V.

The input current, I_{INPT}, is precisely mirrored at a ratio of 1:1 to the IOUT pin. This interface is optimized for use with any of Analog Devices translinear logarithmic amplifiers (for example, the AD8304 or AD8305) to offer a precise, wide dynamic range measurement of the optical power incident upon the PIN diode.

The ADL5315 is primarily designed for wide dynamic range applications, simplifying power monitoring designs where access is only permitted to the cathode of a PIN photodiode or receiver module.

Figure 3 shows a more generic application where the ADL5315 provides an accurate bias to a PIN diode while simultaneously mirroring the diode current to be measured by a translinear logarithmic amplifier.

If a linear voltage output is preferred at IOUT, a single external resistor to ground is all that is necessary to perform the conversion.

Careful consideration must be given to the layout of the printed circuit board (PCB) in this configuration. Leakage current paths in the board itself may lead to measurement errors at the output of the translinear log amp, particularly when measuring the low end of the dynamic range for the ADL5315. It is recommended, when designing such an interface, to use a guard potential to minimize this leakage. This technique can be done by connecting the VSUM pin of the translinear log amp to the NC pin of the ADL5315, as shown in Figure 3, with the VSUM guard trace running on both sides of the IOUT trace. Additional details on using VSUM can be found in the AD8304 and AD8305 data sheets. The VSET pin of the ADL5315 can be used in a similar fashion to guard the INPT trace.

The circuit must be constructed on a multilayer PCB with a large area ground plane. Proper layout, grounding, and decoupling techniques must be used to achieve optimum performance (see MT-031, MT-077, MT-078, MT-101, ADL5315-EVALZ, and AD8305-EVALZ).

COMMON VARIATIONS

The AD8304, ADL5306, and ADL5310 amplifiers can be connected to the ADL5315 in a similar fashion.

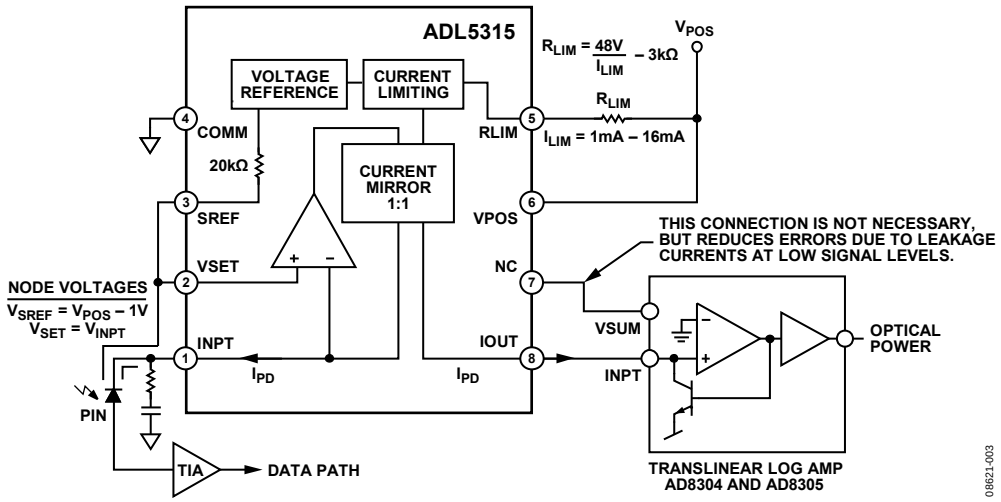

Figure 3. Typical Connection of the ADL5315 to the Translinear Logarithmic Amplifiers (Simplified Schematic: Decoupling and All Connections Not Shown)

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