Avalanche photodiodes (APDs) are the photo detector of choice for long-haul fiber optic communication systems because of their high sensitivity and high internal gain. An important characteristic of APDs is that their internal gain is optimal when there is a high voltage reverse bias (30V to 90V) across the APD. Nevertheless, the high gain is all for naught if the sensitivity of the APD is compromised by a noisy bias supply.

Traditionally, such low noise bias supplies required custom circuits that brought with them another problem: large space requirements. Linear Technology’s LT1930A 2.2MHz step-up DC/DC converter in a 5-lead SOT-23 package solves these APD bias voltage problems and does so in a compact package suitable for most fiber optic applications.

The LT1930A, a capacitor-diode tripler and an external DAC provide a bias voltage of up to 90V, allowing easy temperature compensation (via the DAC) to optimize internal gain. By running the IC at a switching frequency of 2.2MHz, one can use tiny, low cost capacitors and inductors to keep the circuit footprint under 0.5in². The LT1930A’s constant frequency PWM operation keeps output noise low and easy to filter.

Figure 1 shows a high voltage, low noise APD bias supply that works from an input range of 2.6V to 6.3V. The DAC, driven from a processor, adjusts the output from 30V to 90V to compensate for temperature dependent APD gain fluctuations. The LT1930A includes a 35V switch making it capable of producing 105V output through a capacitor-diode tripler.

To eliminate noise from the internal reference and error amplifier, two 0.15µF tantalum feedback capacitors are used in series. A series connection ensures a sufficient voltage rating of the feedback capacitance. Ceramic feedback capacitors have a piezoelectric response to temperature and low frequency vibrations under 1kHz, which is amplified by the LT1930A internal error amplifier. These should not be used unless noise in that bandwidth is acceptable. To protect the switch pin from negative voltage swings, a clamping diode is tied to ground. An identical diode is placed at the feedback (FB) pin, along with a 1k resistor to protect the part from a sudden short in the load, which would force the feedback

Figure 2. 50V Avalanche photodiode bias shows 200mVp-p ripple and noise, improving fiber optic receiver sensitivity.
capacitor’s negative side to the negative value of the output voltage. All other capacitors can be ceramic, which are small and capable of handling the high voltages of the regulator.

Figure 2 shows the AC coupled noise of a 50V output with a 5V input. The switching noise is less than 200μVp-p, allowing greater sensitivity and dynamic range than most APD bias solutions. Oscilloscope measurement bandwidth is 100Hz to 10MHz, all probe cables are coaxial and special attention is given to grounding.1

Conclusion

The LT1930A exceeds all of the stringent demands of an APD reverse-bias voltage, eliminating the need for custom APD bias supplies. The LT1930A solution not only provides the cleanest output in the industry for APDs, but also achieves this in a fraction of the space required by other solutions.

1. Discussion of low noise measurement issues is available in “A Monolithic Switching Regulator with 100μV Output Noise,” Linear Technology Corporation, Application Note 70 by Jim Williams.

Applications

Figure 5 shows an application for the LTC1911-1.8V. Here the SS/SHDN pin has been connected to the input supply, thus disabling the soft-start function. In this application the output will come up immediately when the supply is applied. This application is good for users who are not worried about slight transients on the input supply caused by the IC turning on, and don’t need the shutdown feature. Here, shutdown is effectively achieved by removing the input supply.

Figure 6 shows an application for the LTC1911-1.5V. Here the SS/SHDN pin is connected to a soft-start capacitor and an open drain device. This application allows the user full access to the shutdown function as well as soft-start to limit the inrush current at power on or coming out of shutdown. The open drain device can be omitted for users who only wish to limit the inrush current, but do not need the shutdown feature of the part.

Conclusion

The LTC1911-1.8 and LTC1911-1.5 are well suited for medium to low power step-down applications with tight board space requirements. These low noise step-down DC/DC converters can deliver 250mA of output current and provide efficient operation over the input voltage range of 2.7V to 5.5V. Both parts come in the thermally enhanced MSOP-8 packages. The LTC1911 keeps external components to a minimum, requiring only four or five inexpensive external capacitors, helping designers meet the tightest space requirements. LTC1911 is a good match for single cell Li-Ion as well as 3-cell NiMH/NiCd battery powered applications.

LTC1851, continued from page 8

shutdown modes and retain the stored program. The user can run a programmed sequence, interrupt and take direct control of the MUX or shut the converter down and then return to the programmed sequence. Any edge of M1 or M0 will reset the counter and/or pointer so that Scan Mode always starts at MUX address 000 and the sequencer always starts at location 0000.

Conclusion

The LTC1851 has everything you’ve ever wanted from a Multiplexed ADC. It has a programmable input MUX and sample-and-hold that can handle single-ended, differential, unipolar or bipolar inputs. It has a flexible reference that offers three internal ranges and two options for using an external reference. The ADC is a low power, high performance 12-bit, 1.25Msps converter. The three operational modes make it easy to use in the simplest applications but powerful enough to solve your toughest problems. Stop adapting your inputs to the ADC and start using an ADC designed to adapt itself to your inputs and your application.

Authors can be contacted at (408) 432-1900