3mm × 3mm, 16-Bit ADC Brings Accurate, Precise High Side Current Sensing to Tight Spaces

by Leo Chen

Introduction

Power monitoring circuits are increasingly used throughout automotive, industrial, communications and computing applications as electronics designers strive to continually improve thermal performance, increase efficiency and generally make their products more "green."

The problem is that power monitoring always looks like the perfect feature until space and cost constraints come into play. Power monitoring is usually considered an ancillary function, so its footprint should be as small as possible to maximize space available to the main application. The LTC2460 16-bit Delta-Sigma ADC solves the space and design cost problem when paired with one of Linear Technology's current sense amplifiers, such as the LTC6102.

The LTC2460 proves that big-feature ADCs can come in tiny packages. It is available in a 3mm × 3mm DFN (or a 12-pin MSOP), and integrates a 10ppm/°C precision reference. The integrated reference paired together with an extremely easy to drive input stage (50nA average input current) makes it possible to use the LTC2460 with little to no support circuitry.

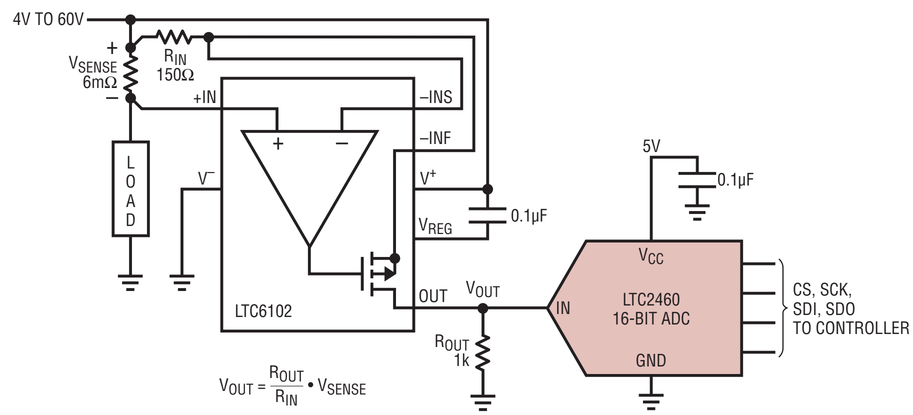

Figure 1. A simple and compact high side current sensing solution that combines a high resolution ΔΣ ADC (LTC2460) with a high precision current sensing amplifier (LTC6102).

Measuring Power Means Measuring Current

Measuring power supply input and output voltages is fairly straightforward, as any voltage can be scaled with a simple divider or amplifier and compared to a voltage reference. Current measurement is generally more complicated, especially at commonly used high voltages such as –12V, 24V and 48V.

To measure current, a small sense resistor is placed directly in series with the supply. A current sense amplifier takes the small voltage drop across this sense resistor and sources a proportional signal current. If the current is monitored on a high voltage power supply, an accurate and precise current sense amplifier, such as the LTC6102, is required to accurately resolve the small voltage drop riding on the high common mode voltage.

Typically the signal current produced by the current sense amp is converted via a grounded resistor to a properly scaled voltage, which, in this case, can be measured directly using the LTC2460's easy to drive input. The 16-bit output data can then be used to compute power consumption and efficiency.

Accurate, Precise and Very Compact High Side Current Sense Design

Figure 1 shows a 48V, 8A current measurement application. The LTC6102 is a precision current sense amplifier that offers 10µV maximum input offset voltage, 50nV/°C input offset drift (maximum), and low 3nA (maximum) input bias current.

This current sense amplifier has zero-drift and sources a 1mA maximum current out of its OUT pin. This current is converted into a voltage across the 1kΩ resistor to ground, which allows the connected LTC2460 to measure a 0V to 1V input. This input range spans 80% of the ADC's input resolution. Of course, the output of the current sense amplifier can be scaled to use as much of the LTC2460's input range as needed, while providing for overrange conditions.

Another advantage to the LTC2460 is the narrow input bandwidth of approximately 30Hz. This provides excellent rejection of power supply ripple noise, and allows accurate measurement of the DC component of the current.

Conclusion

The LTC2460 and the LTC6102 facilitate a compact, high resolution, high accuracy current sense solution. The LTC2460 is a 16-bit ADC in a tiny package that includes an integrated precision reference, while the LTC6102 provides high precision, current measurements that in turn can be easily digitized by the ADC.