LINEAR TECHNOLOGY

DESIGN NOTES

Power Monitor for Automotive and Telecom Applications Includes ADC and I²C Interface – Design Note 452

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Introduction

The LTC®4151 is a high side power monitor that includes a 12-bit ADC for measuring current and voltage, as well as the voltage on an auxiliary input. Data is read through the widely used I²C interface. An unusual feature in this device is its 7V to 80V operating range, allowing it to cover applications from 12V automotive to 48V telecom.

Automotive Power Monitoring

Automobile batteries serve more systems than ever before, many of which operate when the battery is not charging, such as information/entertainment systems or devices plugged into the accessory socket.

The high input voltage of the LTC4151 is a good fit for monitoring power in high transient environments such as automotive. Figure 1 shows the LTC4151 monitoring up to 16A through a 5mΩ sense resistor at an accessory socket, and feeding data via I²C to a microcontroller.

A portable GPS unit is used to illustrate the principle. In this case it is powered up and charging its own internal battery, drawing 396mA from the 12.1V supply. The 4.8W of power is relatively low and thus calls for no immediate need for alarm. However, a higher power device such as a built-in DVD player with dual LCD displays or an external 60W thermoelectric cooler plugged into the accessory socket would drain the battery considerably faster than the GPS. The digital information from the LTC4151 high resolution and accurate 12-bit ADC can be interpreted and displayed on an in-dash screen, or used by the host system to shut down the channel to avoid fully draining the battery.

Telecom Power Monitoring with PoE

One major advantage of the wide range input voltage of the LTC4151 is the ability to monitor higher voltage applications such as those used in telecommunications. The emerging IEEE802.3af Power over Ethernet (PoE) standard has gained much interest in the past few years.

In Figure 2 the LTC4151-1 monitors the isolated 48V power supply to the LTC4263 single port Power Sourcing Equipment (PSE) controller. Communication across isolation through optocouplers to a microcontroller is simplified with the LTC4151-1's split bidirectional SDA line to separate data in and data out. Pull-up resistors tie directly to the 48V supply for pins SCL and SDAI, which are internally clamped to 6V, and inverted SDAO is configured to be clamped by an optocoupler diode. With the low speed optocouplers shown, the LTC4263 generating its own

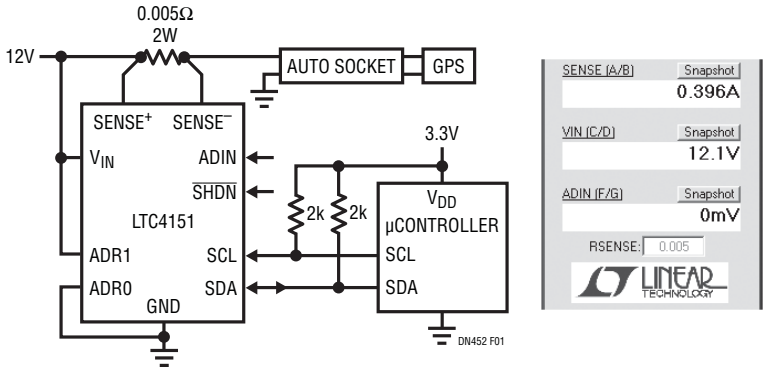
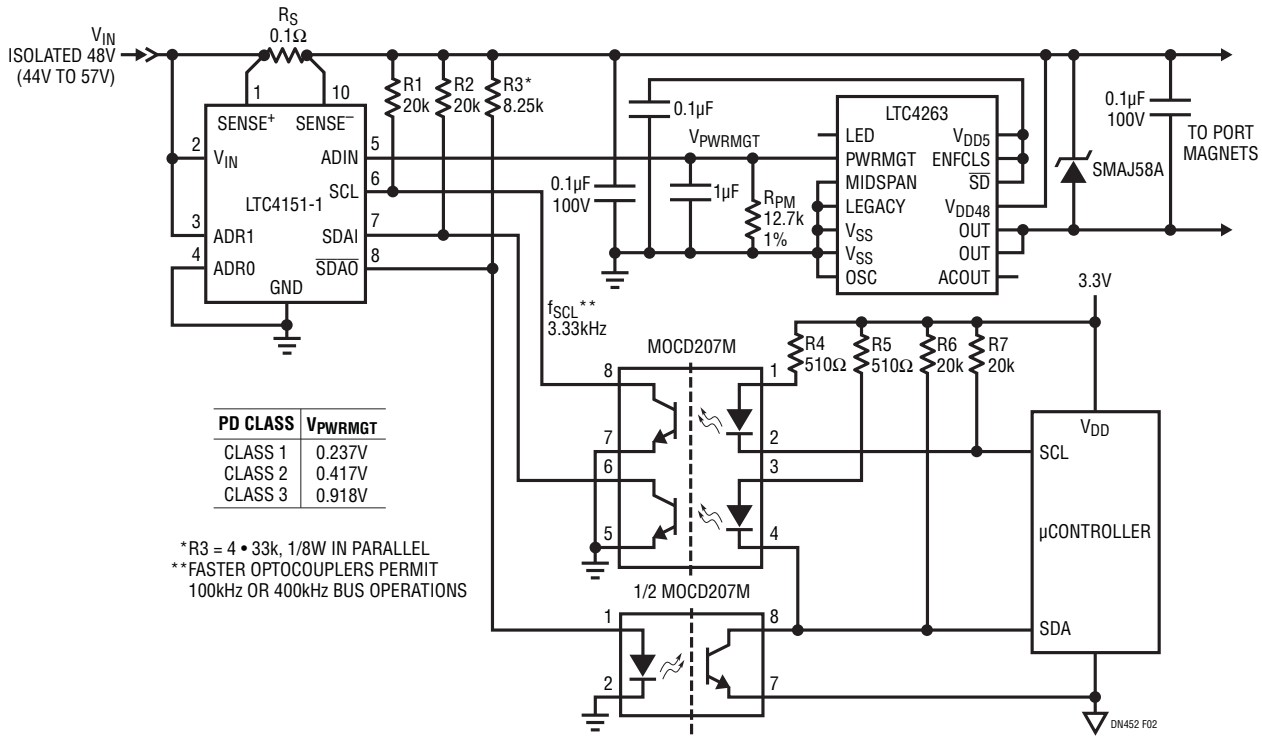


Figure 1. The LTC4151 Monitoring Voltage and Current of an Auto Socket with a GPS Unit



PD CLASS	V_{PWRMGT}
CLASS 1	0.237V
CLASS 2	0.417V
CLASS 3	0.918V

*R3 = 4 • 33k, 1/8W IN PARALLEL
**FASTER OPTOCOUPLERS PERMIT 100kHz OR 400kHz BUS OPERATIONS

Figure 2. The LTC4151-1 in a PoE Single Port PSE with the LTC4263. I²C Communication to an Isolated Microcontroller

5V supply, and the LTC4151 high voltage protected I²C pins, a separate digital supply is not needed on the PoE side, just the single isolated 48V supply.

Optional power classes (4W, 7W and 15.4W) categorize the power requirements of a Powered Device (PD) on the cable end. The LTC4263 outputs a current to a power management resistor that is proportional to the power class of the plugged-in PD. The LTC4151-1 measures the resulting voltage through its auxiliary ADC input and reports this to the microcontroller, which in turn interprets what power class is present. The microcontroller can then read the current being drawn at the port to determine if the PD is abiding by its power class, and confirm that the supply voltage to the PSE controller meets PoE standards.

The LTC4151 has a configurable address so multiple LTC4151s can operate on the same bus, allowing for a multiport solution with monitoring at each port. This assists with the controller power management functions, which utilizes the available power from an optimized supply to the individual ports.

Additional benefits of the LTC4151 is the integrated current sense amplifier, input voltage resistor divider, precise ADC reference voltage and channel select MUX. These improve accuracy versus variances of external components and also save on costs of discrete parts.

Conclusion

The LTC4151 is an easy to use but feature-rich power monitoring device suitable for a wide variety of automotive, telecom and industrial applications. It provides accurate voltage and current monitoring of a positive supply rail from 7V to 80V via a simple I²C interface.

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