



The Benefit of Using a Three Sense Pin Design on Battery / Meter Shunt Resistors

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The low values of battery shunts being produced today necessitate the use of precision analog to digital converters (ADCs) to interpret the voltage drop across the shunt's element. Many of these precision ADCs require the sense pins to be within a certain voltage range of the ADC's analog ground reference input. Ground reference is dependent on configuration (high side vs low side) and may not be the actual circuit or chassis "ground." An ideal sense circuit has high impedance inputs to limit current flow. Current flow within the sense circuit causes voltage drops that will affect the voltage reading of the ADC. The best way to achieve an ideal circuit configuration is through the use of an additional pin connected to the ground side of the battery shunt, outside of the main sensing circuit. This design allows for a very low voltage differential between the ADC analog ground reference and the sense pin ground, and limits the current flow through the actual sense circuit.

An example of a non-ideal design would be using a 2-pin shunt with one of the connections serving as a device ground as well as part of the sense circuit. This design does not meet the requirement of a low differential between the ADC analog ground and the sense pin ground; however, it fails to limit current flow through the sense circuit. If all of the components for the sensing device use 10 mA of current when powered, then that same 10 mA is passing through the ground pin. If there is a minimal 1 mΩ of resistance in between the PCB pin connection and the shunt itself, it creates a 10 μV drop. When sensing off a 100 μΩ shunt, a 10 μV drop equates to a 100 mA reading error. This error will vary part to part based on the PCB to shunt resistance and will vary within a single part over time based on the device power drawn under different operating modes. A designer should not attempt to correct for this error in software, as there are many factors that go into creating and changing it. The optimum way to eliminate all sources of error is through the use of a third ground pin on the shunt.

