Collin Wells *Sep 18, 2015*

My previous posts discussed the basics of 4-wire sensor transmitters, along with a detailed design of an output-isolated sensor transmitter. Today, I'm discussing power-isolated 4-wire sensor transmitters.

First, let's review the high-level diagram of the output-isolated transmitter (Figure 1) that I discussed in my last post. In this topology, the transmitter is isolated from the power supply and sensor, which share a common ground. While Figure 1 shows a local power supply, the 4-wire analog input module could have powered the output-isolated transmitter.

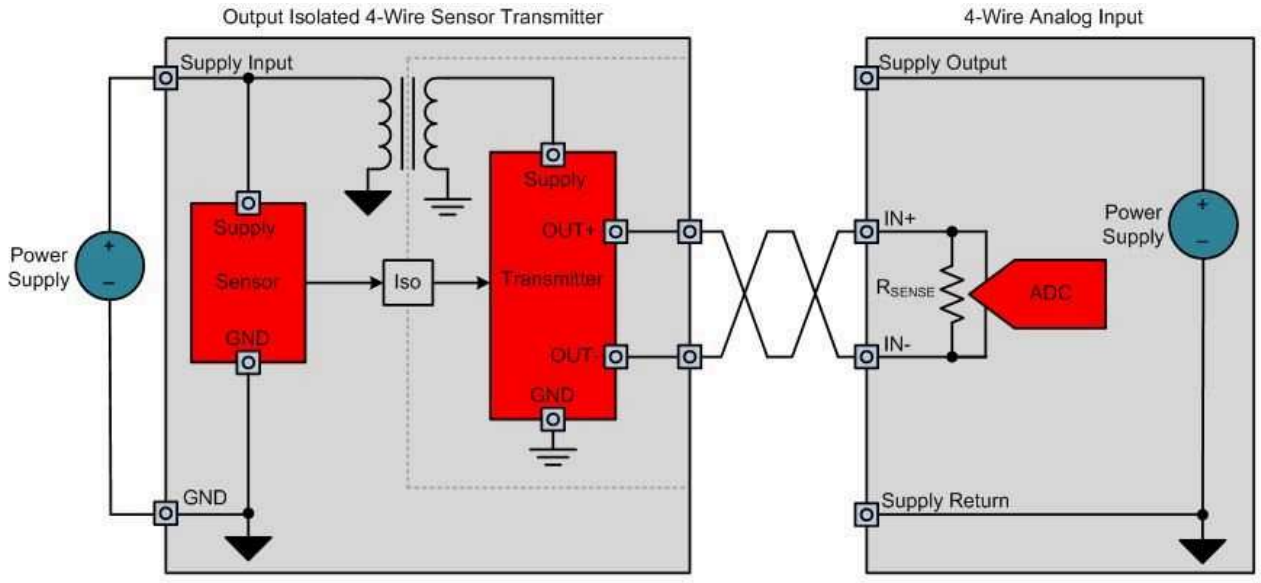

Figure 1: Output-isolated 4-wire sensor transmitter with local power supply

Figure 2 is a high-level diagram for a power-isolated transmitter. In a power-isolated transmitter, the sensor and transmitter share a common GND while the power supply is isolated from them. Therefore, the sensor doesn't require isolation from the transmitter and current loop and should be able to safely tolerate the effects of wiring issues or shorts to other potentials on the current-loop wires.

The circuit in Figure 2 is powered with a supply local to the sensor transmitter, similar to the output-isolated circuit in Figure 1. Transmitters accepting AC power-supply voltages that must be isolated and converted to a regulated DC voltage to power the sensor and transmitter will commonly use this configuration.

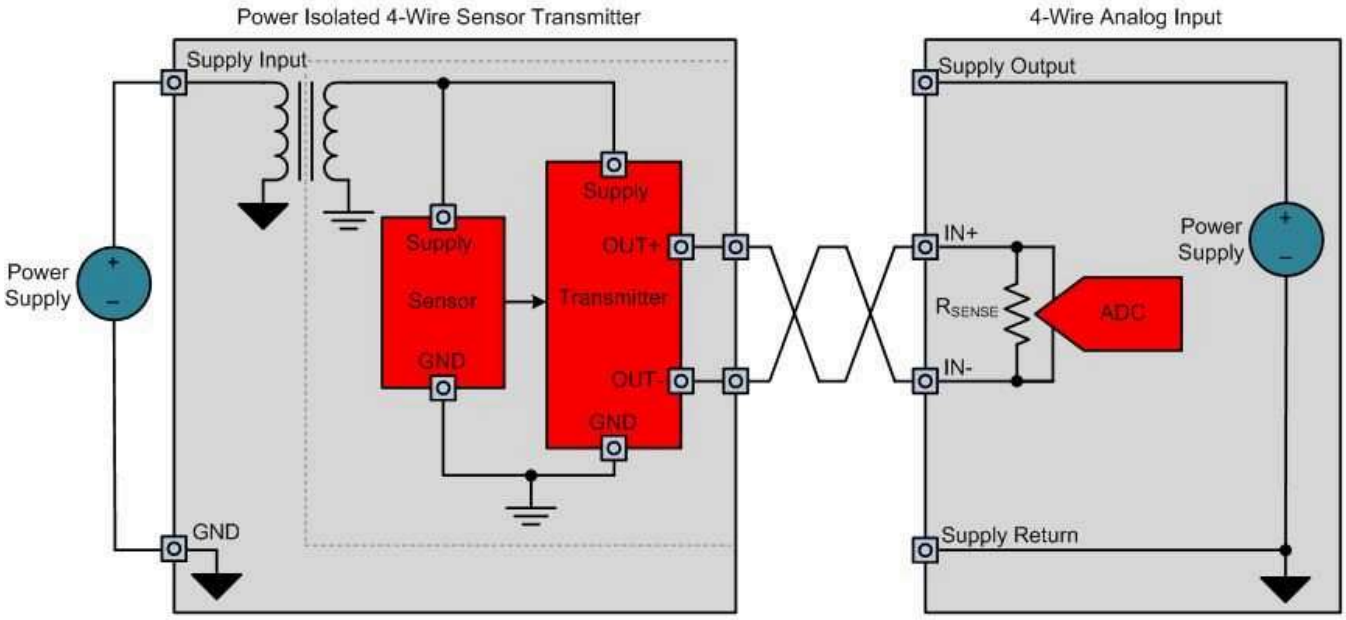

Figure 2: Power-isolated 4-wire sensor transmitter with local power supply

Figure 3 displays the connections for a power-isolated 4-wire transmitter powered from the analog input module supply instead of the local power supply.

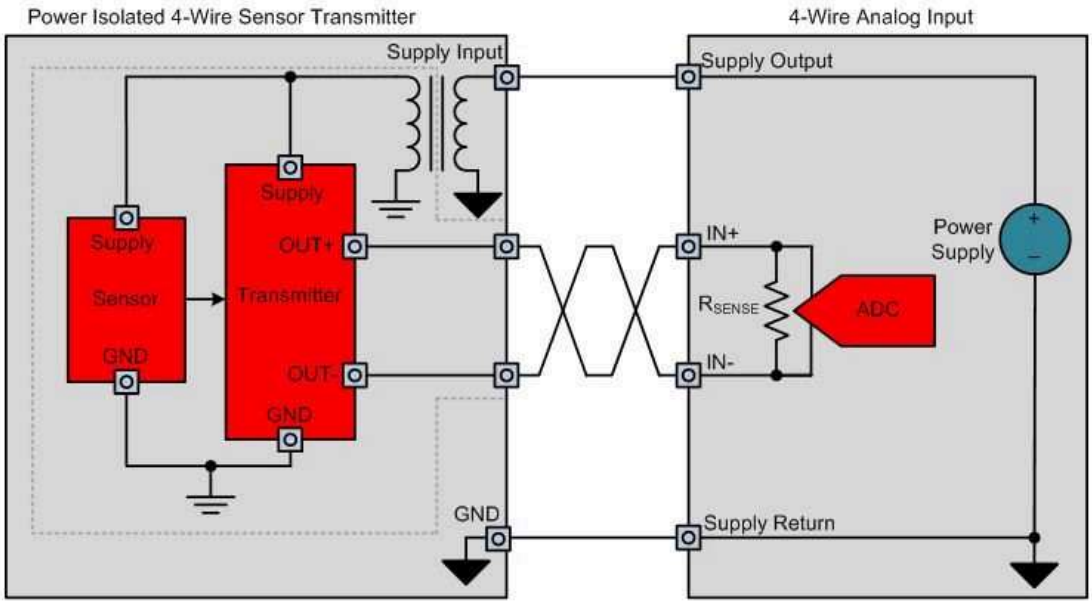

Figure 3: Power-isolated 4-wire sensor transmitter

You can use the same building blocks I introduced in my previous post to design a power-isolated 4-wire sensor transmitter. Figure 4 displays a simplified circuit example for a power-isolated 4-wire sensor transmitter. The transmitter accepts DC power-supply voltages that could be local to the sensor

- transmitter or provided from the 4-wire analog input module. The power-isolated 4-wire transmitter no longer requires a way to transmit the sensor data over an isolation barrier to the transmitter, eliminating the need for a digital or analog data-isolation solution.

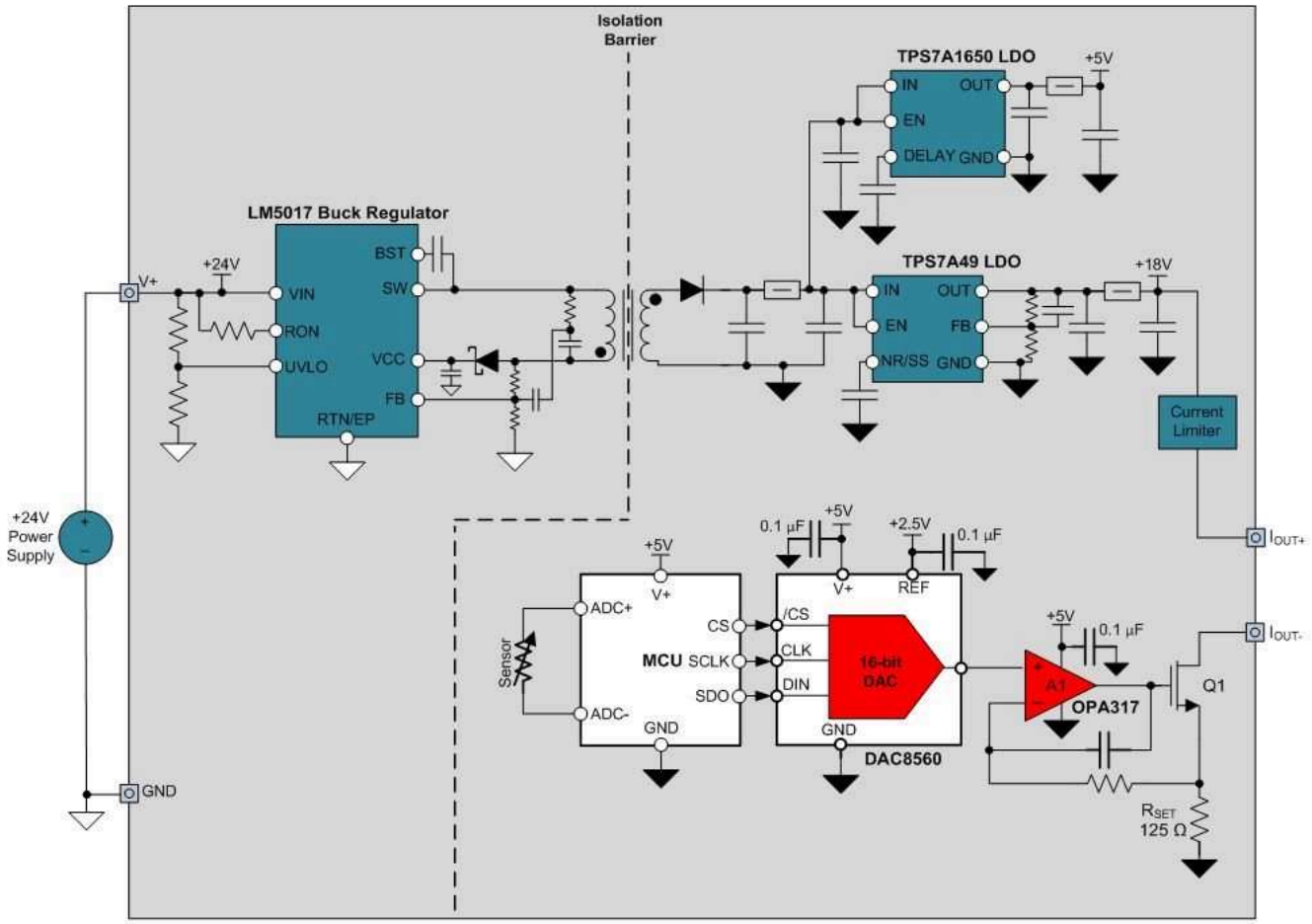

Figure 3: Power-isolated 4-wire sensor transmitter

In my next post, I'll finish this series on 4-wire transmitters by covering fully isolated 4-wire transmitters.

Additional resources

- Check out these TI Designs reference designs for 2-wire transmitters:
  - Bridge Sensor Signal Conditioner with Current Loop Output, EMC Protection (TIPD126).
  - Isolated Loop Powered Thermocouple Transmitter Reference Design (TIDA-00189)
  - Low Cost Loop-Powered 4-20mA Transmitter EMC/EMI Tested Reference Design (TIPD158).
- Read these 3-wire blog posts from my colleague Kevin Duke
  - An overview of analog outputs and architectures.
  - The evolution of 3-wire analog outputs.

- Find commonly used analog design formulas in the new Analog Engineer's Pocket Reference e-book by my colleagues Art Kay and Tim Green.