Collin Wells *Oct 21, 2015*

My previous posts discussed the basics of 4-wire transmitters and showed circuit-level design options for output and power-isolated 4-wire sensor transmitters. In this post, I'll cover the final isolation configuration for 4-wire sensor transmitters – fully isolated – in which the sensor, power supply and output transmitter are all completely isolated from each other.

Figure 1 is a high-level block diagram of a fully isolated 4-wire transmitter. As shown with the dotted grey lines in the figure below, the sensor, transmitter and power-supply input are all completed electrically isolated from each other. While the circuit in Figure 1 shows a system powered from the analog input module, a local power supply can power the transmitter as well without affecting the design topology.

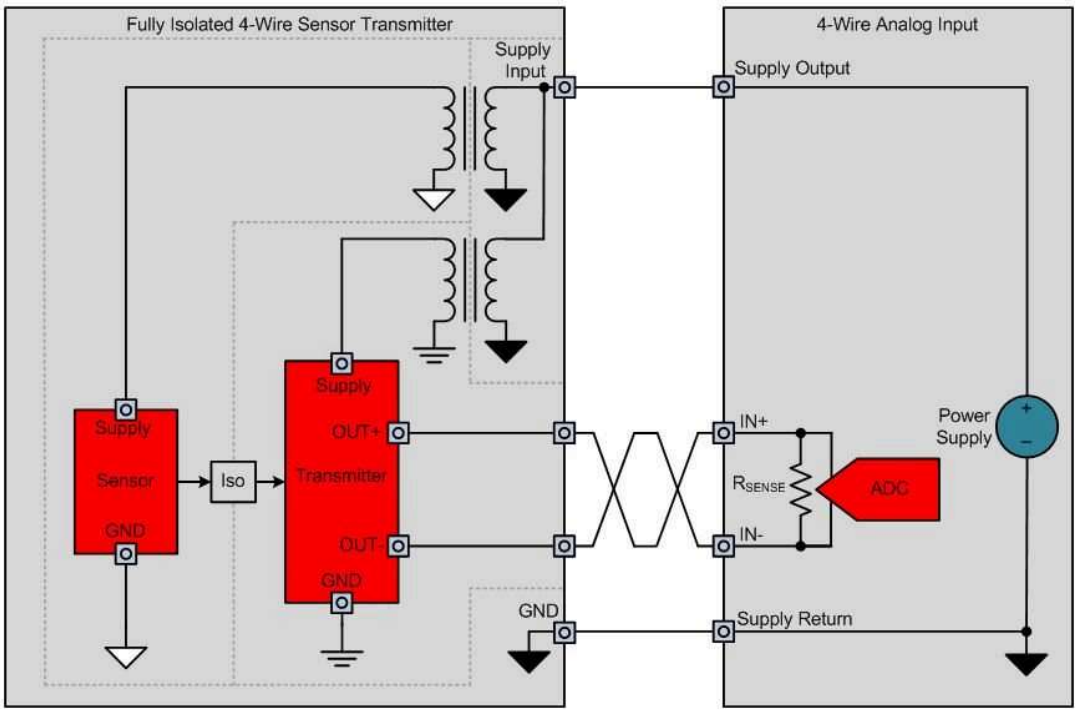

Figure 1: Block Diagram of a Fully Isolated 4-Wire Sensor Transmitter

To achieve isolation between the three sections of the design, a fully isolated 4-wire sensor transmitter requires data isolation between the sensor and transmitter, along with the generation of two independent isolated power supplies for the sensor and output stage. While this may seem like a daunting design task, you can use the same circuits shown in my previous blogs about power-isolated and output-isolated transmitters to construct a fully isolated transmitter. The requirements for the output stage haven't changed between the transmitter topologies, so the low-side current-sink circuit featuring the DAC8560 and OPA317, shown in Figure 2, can be used for the output stage. Other DC accurate digital-to-analog converters (DAC) and operational amplifiers (op amp) can be used in place of these devices, or a circuit that sources current could be designed as well.

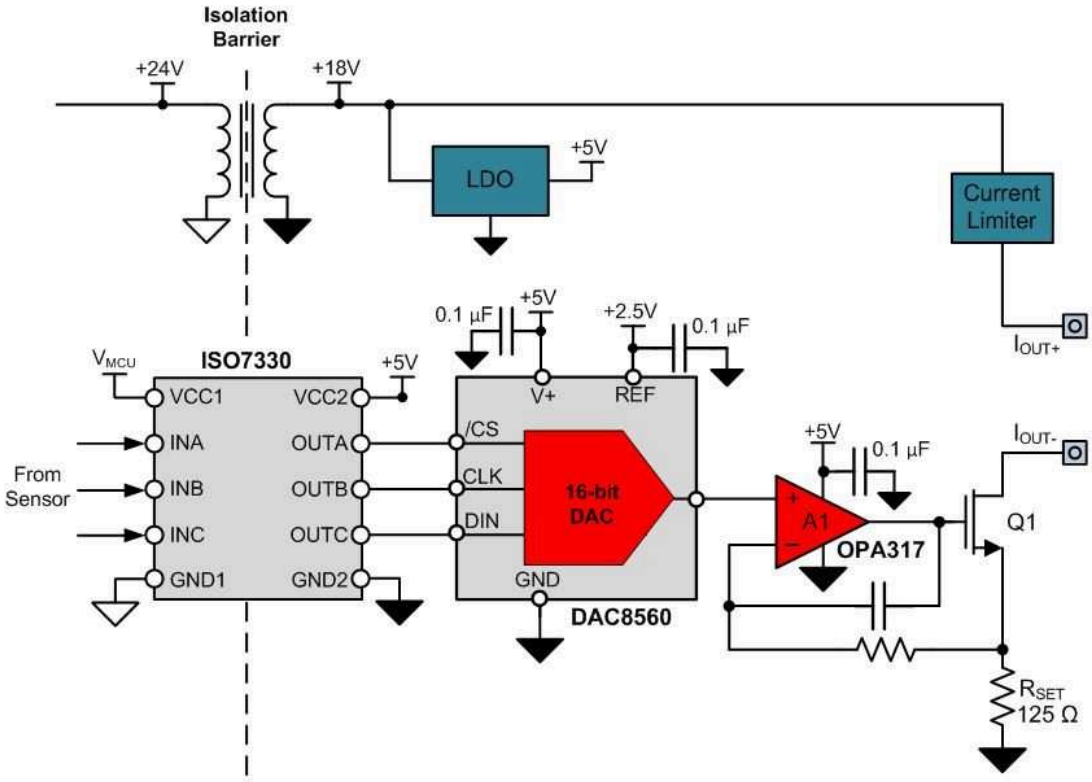

Figure 2: Isolated transmitter output stage for fully isolated 4-wire transmitters

While other power options may need to be explored depending on the input and output voltage and current requirements, the configurability of the LM5017 based fly-buck topology, shown in Figure 3, is a good candidate for both isolated supply solutions.

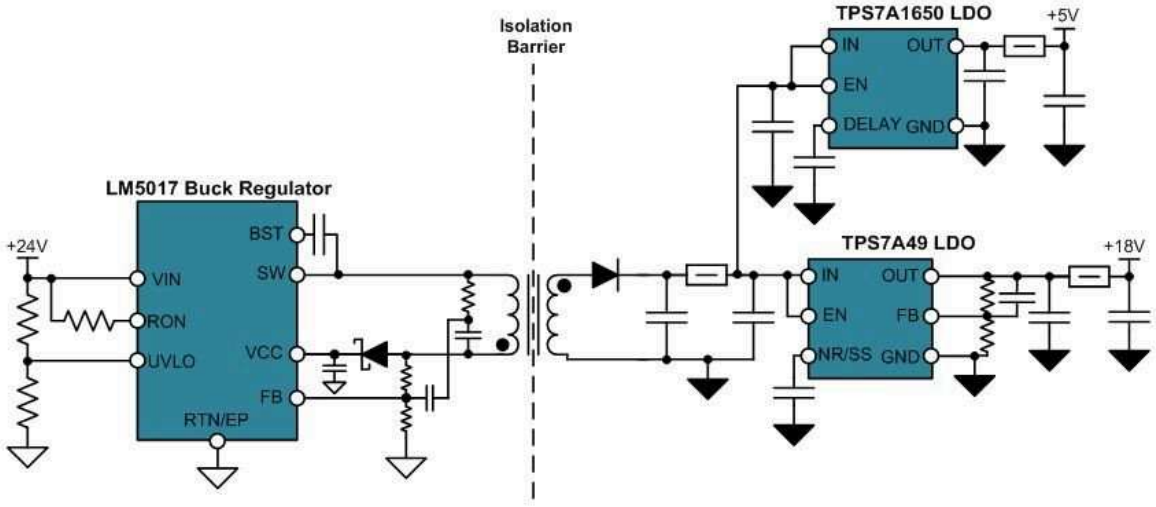

Figure 3: Isolated power supply for fully isolated 4-wire transmitters

This post discusses fully isolated 4-wire sensor transmitters and presents design options for the power supply and output stage sections of the design, concluding my series on 4-wire sensor transmitters.

- Send me a message or post a reply to this post if you'd like to see another sensor transmitter topic explained or if you have any questions about the material in these posts.

Additional resources

- Check out these TI Designs reference designs for 2-wire transmitters:
  - Bridge Sensor Signal Conditioner with Current Loop Output, EMC Protection TI Designs reference design.
  - Low Cost Loop-Powered 4-20mA Transmitter EMC/EMI Tested TI Designs Reference Design.
  - Isolated Loop Powered Thermocouple Transmitter TI Designs Reference Design.
- 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.