2020

Differential Instrumentation Amplifier & 4 vs. 3 Wire Sensor Bridge Settings

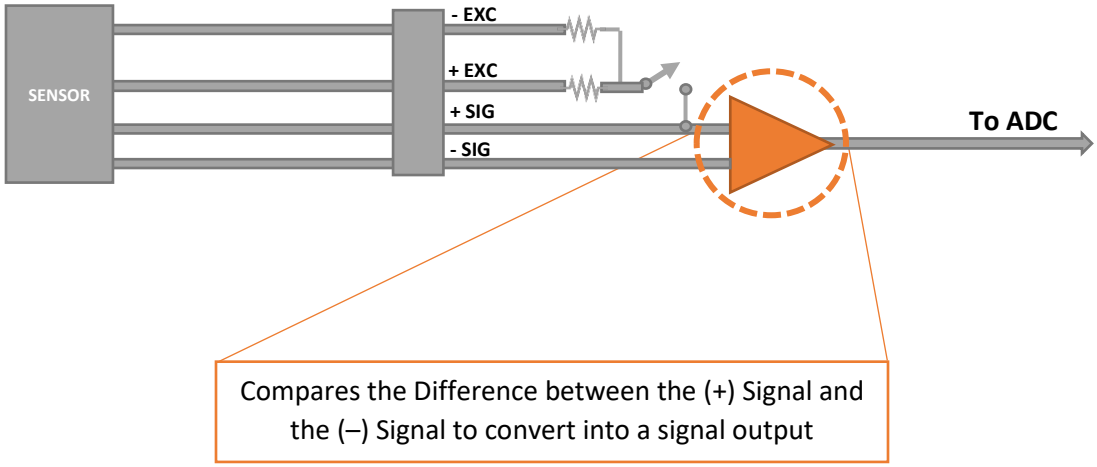
READING SENSOR SIGNAL BASICS, AMPLIFIER TASKS & SPECS

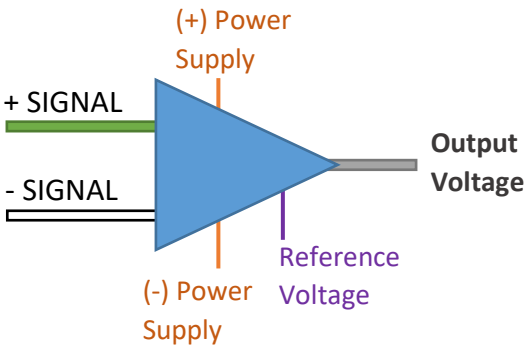
JOHN MOORS

Contents

Differential Instrumentation Amplifier (DIA): The Basics

The DIA plays a critical role in the signal chain. It receives a signal from the sensor and delivers it in an ideal state to be read by the Analog to Digital Converter (ADC).



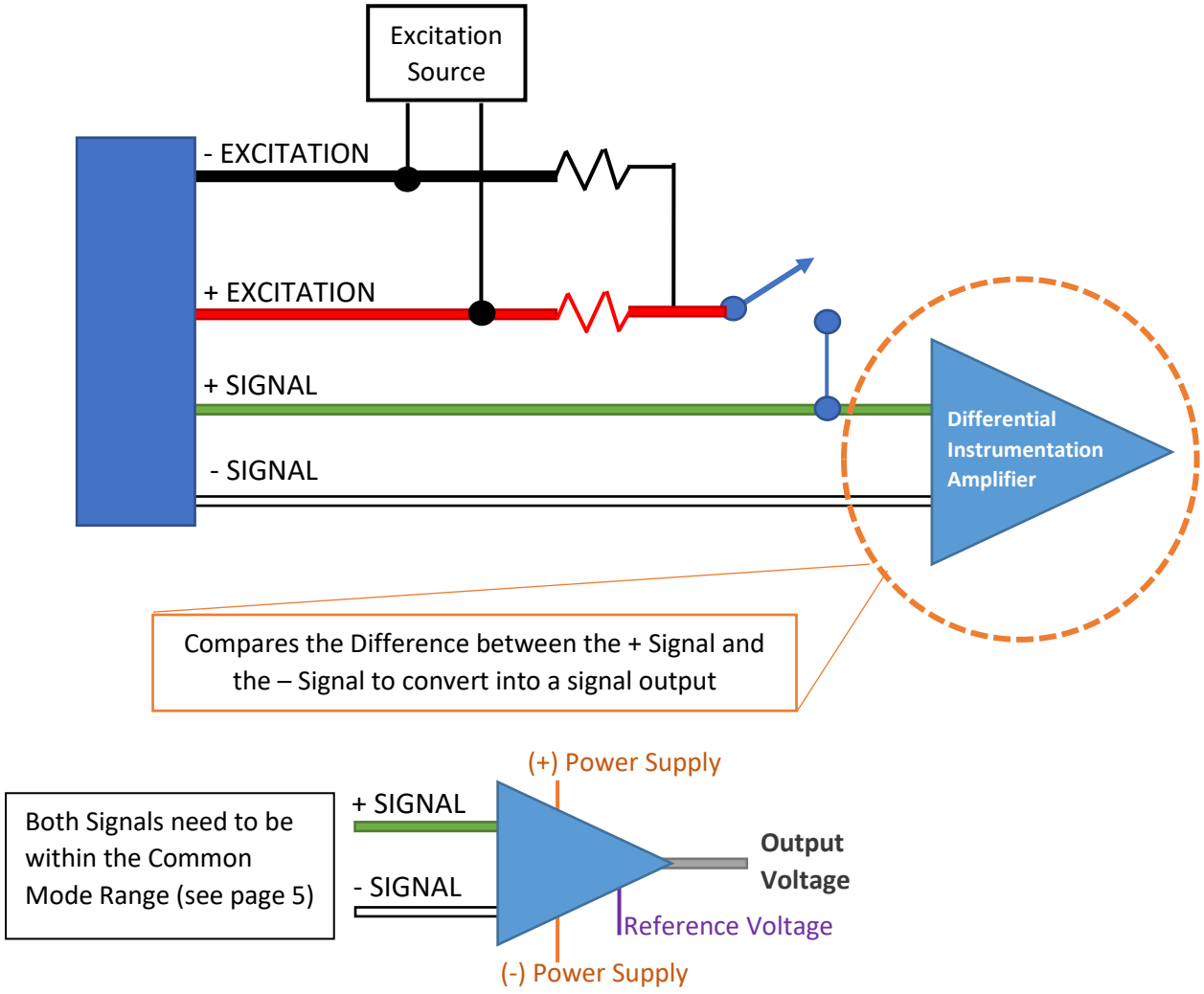


Reading Sensor Output

To register what your sensor is reading, we're essentially comparing a changing signal against a known reference. The difference between the + Signal and the – Signal is the actual quantity that we will read into our system. This, combined with our Sensitivity, tells us the Engineering Units (EU) we are reading from the sensor. See *Figure 1* below for details.

We therefore need this comparison to know how to translate the sensor readings. If a sensor only gives us one signal rather than two, we need to remedy that on the DAS end to make sure we have what we need. How we therefore treat a 4-Wire sensor is different than how we treat a 3-Wire sensor.

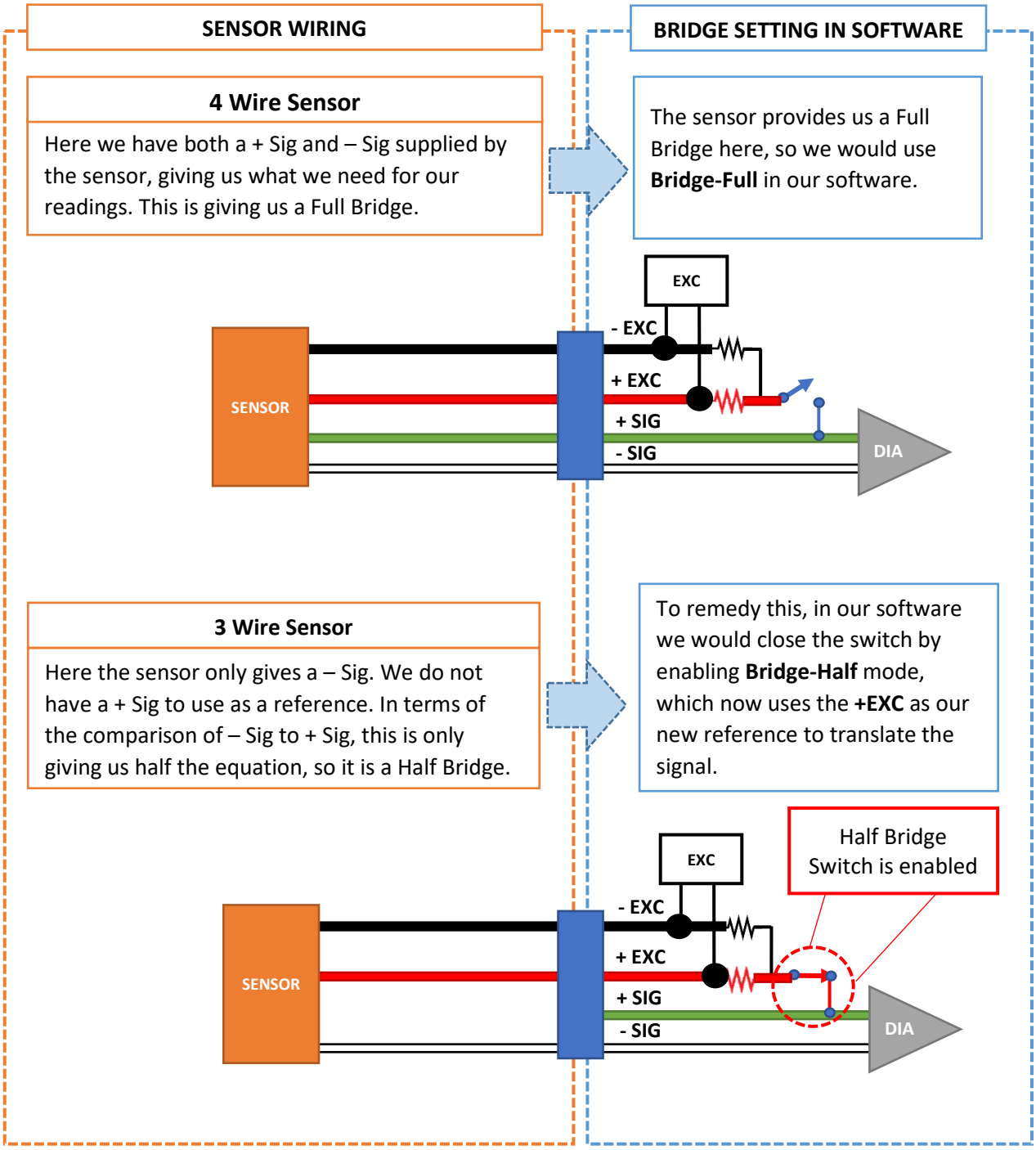
Figure 1: Basic Signal to Output
NOTE: Wire colors are for typical wiring, the colors for your sensor and/or system may vary



Sensor Wiring and Corresponding Bridge Settings

When setting up our software to properly read the signal, we need to make sure we account for how that differential must be calculated. If the sensor has 3 wires instead of 4, we can still get usable readings simply by telling our software what mode to use.

Figure 2: 4-Wire Sensors vs. 3-Wire Sensors and Corresponding Bridge Software Settings



Common Mode Range, Differential Input Range, and Output Range

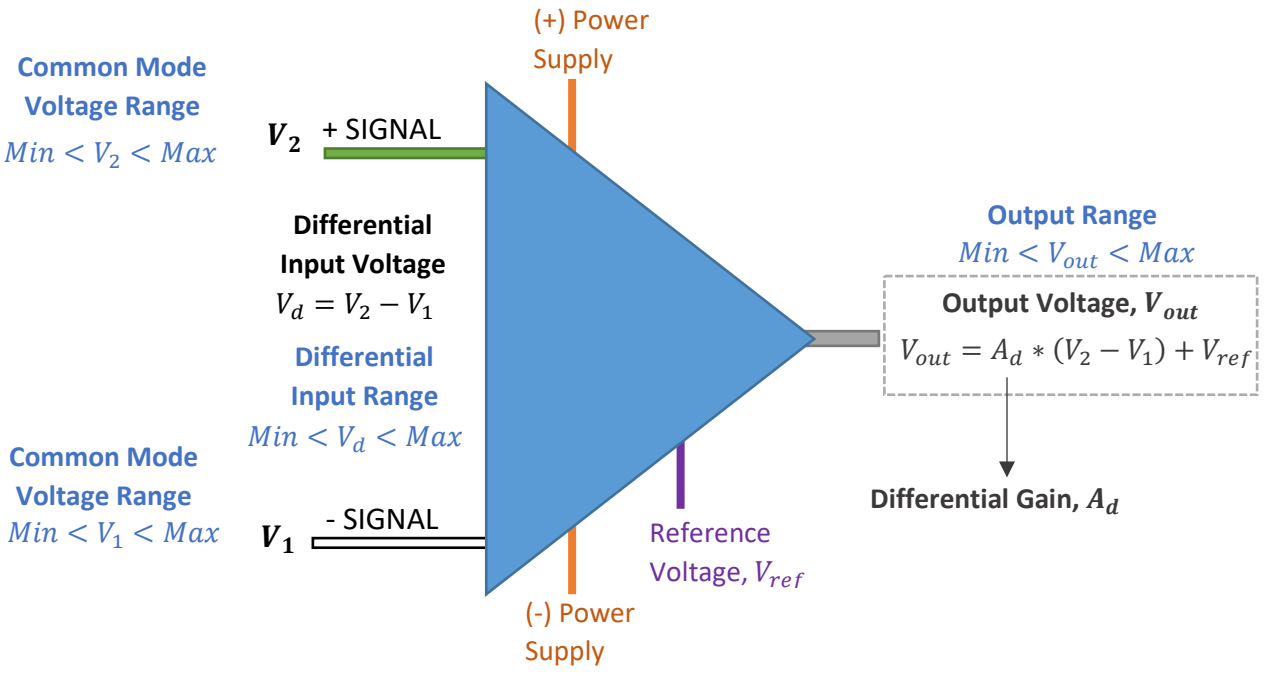
The Differential Instrumentation Amplifier is responsible for acquiring a meaningful signal from the sensor and delivering it in a way that maximizes the range of our Analog to Digital Converter (ADC). It accomplishes this task with three main steps:

1. **Compares two input signals and removes the common elements between them to reject noise and acquire the difference.**
    a. **These signals may both be received directly from the sensor, or one from the sensor and a comparative signal we can set.**
2. **Applies a gain to that difference.**
3. **Adds a reference voltage to center the signals within the linear voltage range of the signal chain.**
    a. **This includes other amplifiers, filters, and the ADC itself.**

Ranges

For every Amplifier, there are limits to its operating elements.
The voltage limits are broken down into three groups:

- **Common Mode Range**
- **Differential Input Range**
- **Output Range**



For how the above applies to Bipolar/Unipolar sensors, click here for the article: **Further Reading**

Need More Help?

The online Help Center has additional resources to help get you up and running!

We have support engineers in multiple time zones with various backgrounds who can assist. Registering creates a profile for your setup and keeps your records/requests organized going forward. You don't need to be registered to submit a Help Ticket, but it keeps all your info in one place.

Here's how to get started. **The buttons below will take you directly to the specific web pages**.

1. Head to our Help Center main page for support resources.
2. Register as a new user.
3. Submit a Help Ticket. You can CC members of your organization, attach files, and add any helpful links.
4. Feel free at any time to check out our Knowledge Base. It has articles, videos, and breakdowns of our hardware and software, as well as general information and best practices. We're frequently updating this library to keep users informed.
5. Our Video Library has Webinar Recordings, Product Overviews, and Training. If you'd like to join a future webinar, let us know.

We are looking forward to supporting your needs!