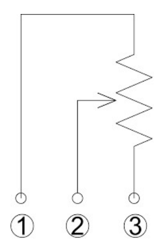
Don't Buy a Feedback Linear Actuator Until You Read These Important Tips

So, you are looking for an actuator with some level of positional control (feedback) and now you need to understand the difference between all the feedback actuators on the market. Well you have stumbled on the right place. There are really three main feedback technologies available. Firgelli sells all three types along with controllers. This article will help you understand the advantages and disadvantages of each type, so you can choose the one best suited for your application. This can get a little technical so feel free to skip ahead and just read the summaries for each feedback type.

TYPES OF ACTUATOR FEEDBACK

Potentiometer Feedback

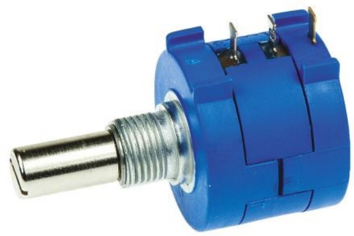
A potentiometer is simply a very thin layer of resistive material like Carbon or Cermet that has been printed onto a material. These materials offer electrical resistance that is very linear in its resistivity and can be easily changed by using a different formulation. Some potentiometers use a temperature stable resistance wire. Other potentiometers are fabricated with conductive plastic.



So, let's say you have a 6 inch stroke actuator and you want to run a carbon trace 6 inches long. What a potentiometer does is put 12VDC (or any other voltage you wish) through this carbon trace and then if you were to measure the voltage at the location very close to where the voltage is applied, you would read approximately 12VDC output.

If you then measure the voltage half way down the trace the voltage would be around half that. The further away you get from where the voltage is applied the lower the voltage output that you read, until eventually it is almost zero. So, in a nutshell, reading the voltage of a resistive strip in the form of a voltage reading is related to some sort of position.

Of course, you still need some sort of controller to be able to read this position and display it to you in a meaningful way. Or perhaps you only want to use this data to match a position to another actuator. For example: if you want to run two actuators together at the same speed. In this situation you need to read both positions at the same time, match them and then adjust the speed of the faster one to sync with the slower unit. Firgelli has developed a controller that does this for you.



Above: Linear and Rotary Potentiometers

Advantages:

Potentiometers have been around for decades. They are a relatively stable feedback devise that offers positional feedback without the need for a controller to perform any “homing” type cycle first. The feedback data is directly related to position and losing power or memory of the controller will not affect the control cycle.

Another advantage of potentiometers is that you can add them separately to your system as this technology does not need to be built inside the actuator. Check out Firgelli’s Linear Potentiometers here. Our Linear Potentiometers go up to 50” and you do not have to use the full length for them to work in your application. Internal pots are restricted in actuator stroke because they use rotary pots which can only rotate a certain number of turns before maxing out. This is why we offer linear pots separately with no stroke restriction.

Disadvantages:

Over time the resistive material can wear out and during the wear out phase the feedback signal can become erratic. In addition, the feedback signal is greatly affected by electrical noise that could cause a controller to get confused. Your controller software needs to be able to dampen out noise. Another downside is that typically potentiometer to potentiometer repeatability is not perfect. This means that two potentiometers will not give the exactly the same results.

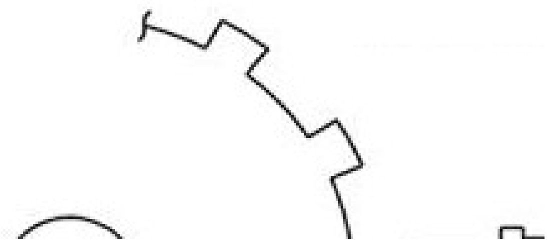
Another major disadvantage is that typically stroke lengths are limited because the longer a carbon trace on a potentiometer, due to stability of the resistive element, the worse the quality of the signal gets.   So typically, potentiometers are limited to smaller stroke actuators.

Summary:

Potentiometer feedback is good for applications where every time you turn power on to a device you don’t wish it to complete a homing cycle as you would with a Hall sensor or Optical sensor. The controller gets the absolute position instantly.

Hall Sensor Feedback:

A Hall effect sensor is nothing more than a magnetic sensor. A round magnetic disc is installed inside the linear actuator gear box and the Hall sensor simply offers a voltage pulse every time the magnet rotates 360 degrees. The rotating magnetic field is read as a voltage spike which is very repeatable. The output signal from the Hall sensor is simply a typical 5V pulse. The controller measures how many of these pulses are counted per an amount of time, usually in milliseconds.



Because the magnetic disc is installed in the gearbox somewhere, the magnet could rotate hundreds of times per second, and the more times it rotates the more resolution. This correlates to the accuracy of the measurement.

Let's say you have a 24 Inch stroke actuator. And the controller counts 1,000 pulses over the entire stroke length. 1000/24" = 41.66 pulses per inch. Or 1 pulse per 0.024" (0.60mm). In this situation you have control and precision to within 0.024" (0.60mm) excluding any gear backlash.

There are two types of Hall sensors that you need to know about: directional and non-directional. This is very important because most linear actuator companies sell non-directional to save money. This means your controller does not know if your linear actuator is extending or retracting. Firgelli only sells directional Hall sensors so you know what direction you are heading in, and this is very important.

Advantages:

Hall effect sensors are extremely reliable and offer very good repeatability and positional control. The output signal is a stable digital pulse enabling the controller to ensure accurate position control.

Disadvantages:

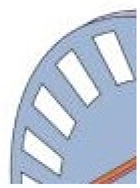
The feedback signal from a Hall sensor is just a digital pulse and is not related to position at all.   It needs to be told where its zero or home position is. This means the controller first needs to be directed through some sort of homing cycle. This is typically done by retracting the linear actuator to its starting point and then the controller begins counting the pulses from this point. But then the actuator needs to be fully extended to allow the controller to count the total number of pulses over its entire stroke length. At this point you then have some sort of results that can be used to move with precision.

Summary:

Hall sensors are very accurate and give very good resolution and precision. The devices are more than capable of controlling position to very fine increments and the durability is also excellent. If your application is able to accept a “homing cycle” every time it is powered up, then this is the way to go.

Optical Sensor Feedback:

Optical sensors work pretty much the same way Hall sensors do - in that they output a 5V pulse signal. However, instead of using a magnetic disc the system uses a small flat disc with holes or slits in it. The optical sensor simply reads the number of slots or holes as the disc rotates. This means a single disc can have many slots/holes to increase the accuracy significantly more than a Hall sensor.



Let’s say a disc has ten slots or holes in it and the disc is in the same location in the actuator as the magnetic disc in a Hall sensor setup. The resolution is now ten times more because there are now ten pulses per revolution instead of one. So, the 1000 pulses the Hall sensor would have read is now 10,000. The accuracy is calculated as 10,000 / 24” = 416.66 pulses per inch or 1 pulse per 0.0024” (0.06mm).

Advantages:

Optical sensors are extremely reliable and offer extremely good repeatability and positional control. The output signal is very easy to read, with a very stable feedback.

Disadvantages:

As with the Hall sensor, the feedback signal from an optical sensor is not related to position at all until it has been told where its zero or home position is. This means the controller first needs to be directed through some sort of homing cycle. This is typically done by retracting the linear actuator to its starting point and then the controller begins counting the pulses from this point. But then the actuator needs to be fully extended to allow the controller to count the total number of pulses over its entire stroke length. At this point you then have some sort of results that can be used to move with precision.

Another possible disadvantage is that because there are so many pulses per movement of stroke it’s important that your control device can read the pulses fast enough or you will have problems.

A third disadvantage is that optical sensors do not know direction. You must program polarity direction as part of your system. A DC linear actuator goes in each direction based on the polarity of the +ve and -ve wires from the power so it is not hard to determine direction based on this, but it is an extra step non the less.

Summary:

Optical sensors are extremely accurate and give extremely high resolution and accuracy. The devices are more than capable of controlling position to very fine increments and the durability is also excellent. If your application is able to accept a "Homing cycle" every time it is powered up then this is the way to go.

TIPS FOR BUYING A FEEDBACK ACTUATOR

Watch Out for Copy Cats - Directional or Not

We touched on this a little in the Hall sensor section, but it is probably our number one complaint. Someone buys a Hall sensor actuator from someone else but the actuator is useless because their controller needs some extra sensor to determine direction. Our Hall sensor actuators are bi-directional so they have an extra wire. As a rule of thumb if the Actuator does not have six wires (two for power and four for Hall sensor) then it is not directional sensing and beware.

Know What Type of Potentiometer is Used – Determines Lifespan

As mentioned above one of the disadvantages of potentiometers is that the carbon trace can wear over time. We only use Bourne's Pots. These are known in the electronics industry as the Rolls-Royce of potentiometers and will outlast the life time of anything else so worry not.

Determine Why You Need a Feedback Actuator

At this stage we have to assume you already know what a linear actuator is and how they work. If not, then we suggest you read our "What is a Linear Actuator and How Does it Work?" paper. Next you need to decide what type of feedback you need. To determine this, you must ask yourself what you need feedback for?

There are only two main reasons you need a feedback actuator:

You want to control two or more actuators to run at the same speed

You need to know the position of the actuator because you need to move it to a specific location/s

The level of precision and controller you are going to use really dictates which type to use. For controllers most, people use an Arduino Controller. Click here to see our selection of these controllers.

For automated controlling of two or more actuators at the same speed you can use our Feedback Actuator Controllers. No programming is required, simply wire the actuators into the controller and you are good to go. These plug-and-play controllers are simple and easy to set up.