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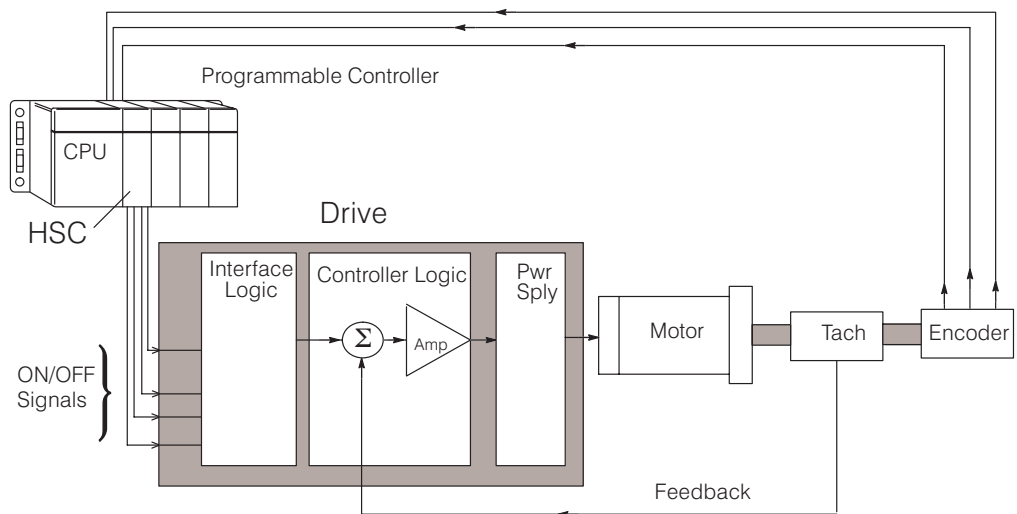# Introduction to Motor Drives and Encoders

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In This Chapter. . . .

— What is a Drive and How Does it Connect to the HSC

— What is an Encoder and How Does it Connect to the HSC

What is a Drive and How Does It Connect the HSC?

The word drive can have many meanings. Here we need to limit our definition to any intelligent electronic equipment that provides adjustable speed control for a motor. The motor can be AC or DC. From the standpoint of the HSC, it doesn't matter.

Drives provide many functions for the motor. Most often the drives have some form of rectification that takes place in addition to providing intelligent control for the motor. When working with the HSC you do not have to be concerned about the drive's internal power conversion because the power requirements of the drive and the PLC are handled separately. The HSC only connects to the drive's logic function.

The following simplified diagram shows the basic sections of a common type of electronic motor drive.

If you're new to motion applications, you may think that when an output signal is received by the drive from the HSC, the signal has some inherent property that affects the speed or direction of the motor shaft. In reality, all four outputs of the HSC (CW, CCW, OUT1, and OUT2) look the same electrically. The signals are simply discrete ON/OFF signals. What makes them different is where they are connected to the drive. It is the intelligence of the drive (and not the HSC) that determines how the signals affect the motor operation. The PLC merely takes advantage of the I/O functionality that has been pre-programmed inside the drive itself.

Some drives (or intelligent motor controllers) will have connecting terminals marked CW, CCW , or maybe even deceleration or brake. In these cases the terminals have been internally set up by the drive manufacturer to properly use the signals received. In most cases however there are no such markings. You will program the I/O points on the drive to perform whatever function you wish from those available on your drive. It could be to change motor direction, change speed, or any number of functions. You then, have the responsibility of matching up the drive I/O with the proper output signals from the HSC.
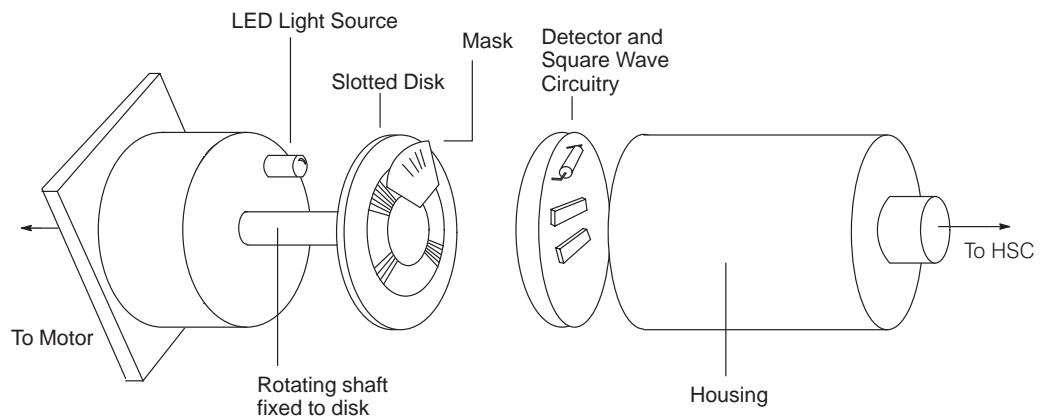
What is an Encoder and How Does It Connect to the HSC?

The word encoder can be a confusing term to those who have never used them. There are many types of encoders and the word itself can have as broad or narrow of a definition as a particular application might dictate. We will limit our discussion here to **incremental encoders**. Even narrowing the scope down to this family of encoders can present quite a large array of products offered by various manufacturers. We will not attempt to describe every type, and will only cover the subject in the most common and general sense.

From the standpoint of the HSC, it is only looking for a square pulse train (or trains in the case of a quadrature encoder). It doesn't really care how they were produced or the physical appearance of what has sent the signal(s). As long as the incoming signals have the proper width requirements and are not being received faster than 100 kHz, the HSC can count them.

How the Incremental Encoder Works

The most common encoder is the rotary incremental optical encoder. Inside its housing, are usually five basic components: light source (usually an LED), a slotted disk, a mask, a photo detector, and square wave circuitry. A quadrature encoder has a second light source and sensor (Phase B) located over the disk track. A single signal (non-quadrature) encoder is shown in the diagram below.

LED Light Source

Mask

Detector and Square Wave Circuitry

Slotted Disk

To HSC

To Motor

Rotating shaft fixed to disk

Housing

The quantity of slots on the disk is equivalent to the number of pulses per turn. Most quadrature encoders also provide a single isolated slot on the disk called the Z marker. It is aligned with its own separate LED. The pulse from this channel provides a reference once per revolution. The automatic home search function, built into the HSC, makes use of the Z-marker when you connect a quadrature encoder to the HSC with the Z-marker attached to **INZ**.

What is the Z-Marker?

The Z-marker helps to more closely define a home base to which the working apparatus can be accurately returned. It's kind of like "top dead center" on a crankshaft for purposes of timing your spark with the correct piston position.

The D4-HSC does not use the Z-signal for error detection or correction of any lost pulses or extra pulses that are associated with a particular revolution of the encoder. The HSC merely uses the Z-signal to make sure the slotted disk of the encoder is always in the same position at the start of each work cycle.