

## Application Note 1250

### Introduction

Avago Technologies' encoders are used in many applications. Encoders are closely related to motor related applications. They are used to detect position, direction and speed. This note briefly describes several uses of encoders, including sewing and vending machines, and tape drives.

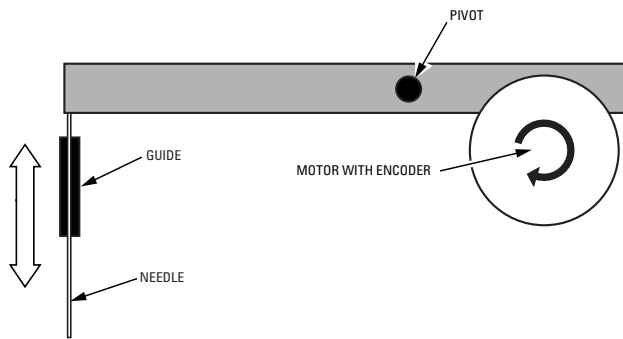


Figure 1. Sewing Machine Application

### Description

The diagram shown in Figure 1 is a schematic of a sewing machine and is one of the applications that uses an encoder. Encoders such as the Avago Technologies HEDS-5500/5600 series (Quick Assembly Encoder) and HEDS-9000/9100 series with line drivers are used in this application. These encoders use a transmissive technique.

Basically, a transmissive encoder consists of three portions: emitter side, detector side and a code wheel. (Refer to Figure 2, "Optical Arrangement"). The LED will be the light source and the light will be collimated into a parallel beam by a lens. The light passes through the moving code wheel, which will be placed between the emitter side and the detector side, causing the light beam to be interrupted by the windows and bar on the code wheel. (Resolution of the code wheel is determined by the numbers of windows and bars). Multiple photodiodes in the IC detector will translate the light patterns into electronic signals. The signal processing circuitry and the comparators will produce the final digital outputs through channel A and B.

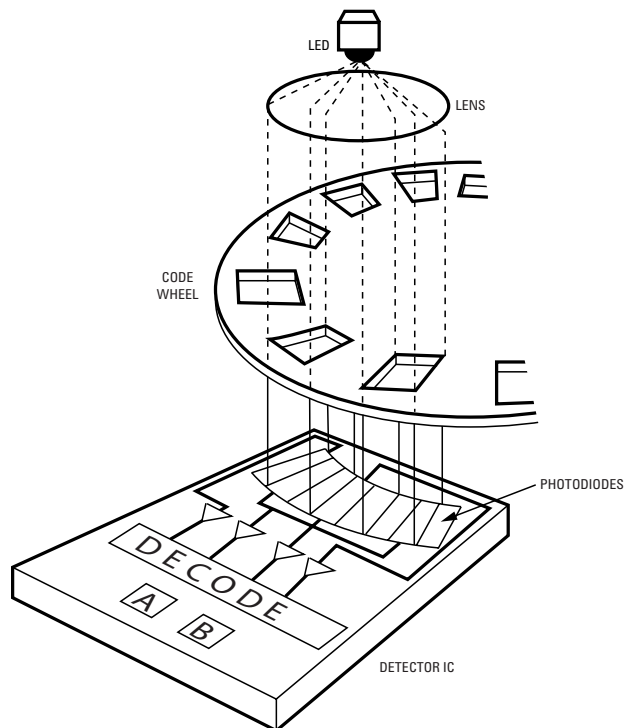
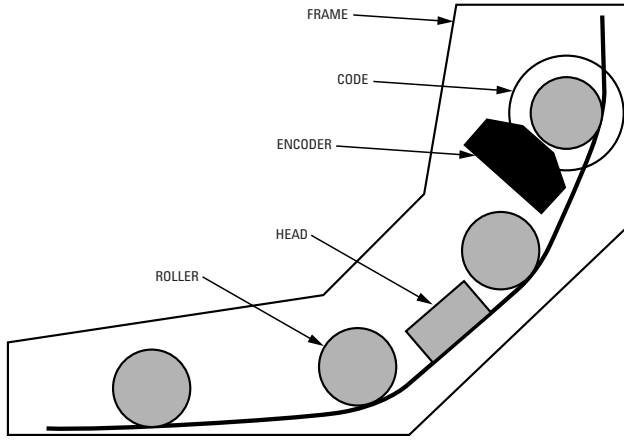


Figure 2. Optical Arrangement



**Figure 3. SDLT Tape Drive**

**Function of an encoder in the sewing machine**

Encoders are closely related to motor related applications. They are used to detect position, direction and speed. When used in the sewing machine, the encoder is part of a motor closed loop application. This is an error-checking loop to ensure that the system is running/working per input from users. The encoder is used to provide digital signals to the control system (controller) for the spindle speed control.

**NOTE:**

For more information on the recommended parts please visit Avago Technologies' website: <http://www.avagotech.com>

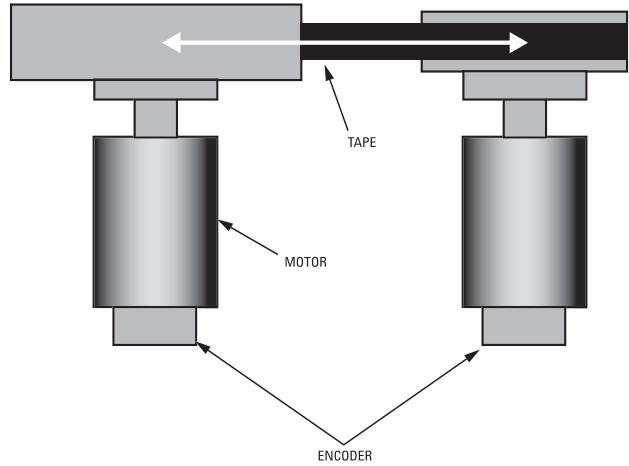
Then select "Housed Encoders" in the product category. You will see three categories: P, S and K family. Select K-family to get more information on the product mentioned above.

**Tape Drive Applications**

There are various kinds of tape drives on the market. They all have different reading technologies (DLT, Super DLT, LTO, etc), different speeds and capacities. But there is one thing that is common between most of them: most tape drives need some kind of closed loop control to move the tape at the proper velocity and in the correct direction. A basic closed loop control system normally consists of:

- A motor
- A sensor for feedback
- A controller to process the signals

In the case of the tape drive (as shown in Figure 3), an optical encoder (HEDS-9000/9100 series) is used to provide sensory feedback on velocity, acceleration and direction of the tape. The codewheel is spun via friction by the moving tape. This movement is turned into electrical signals by the optical encoder and is later interpreted by the controller.



**Figure 4. Tape Drive**

In the tape drive application shown in Figure 4 above, two encoders are used. Both Avago Technologies HEDS-5500/5600 series are connected to the motor shaft. The parts are used in tandem to:

- Control the amount of tape moved from one reel to another
- Control direction
- Control speed
- Control tension of the tape over the magnetic head.

**NOTE:**

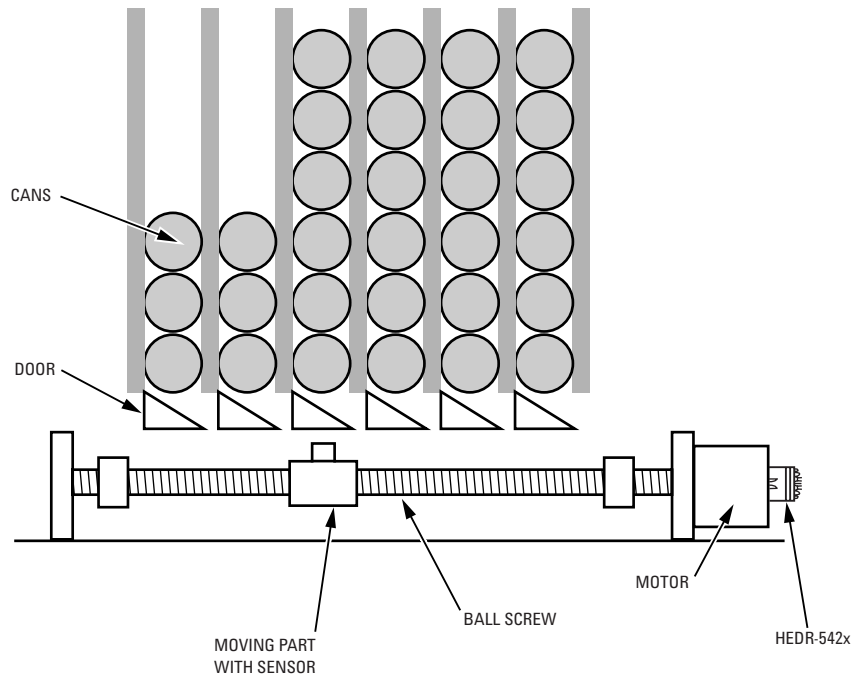
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1. Then select "Housed Encoders" in the product category. You will see three categories: P, S & K family. Select K-family to get more information on the HEDS-5500/5600 series product mentioned above.

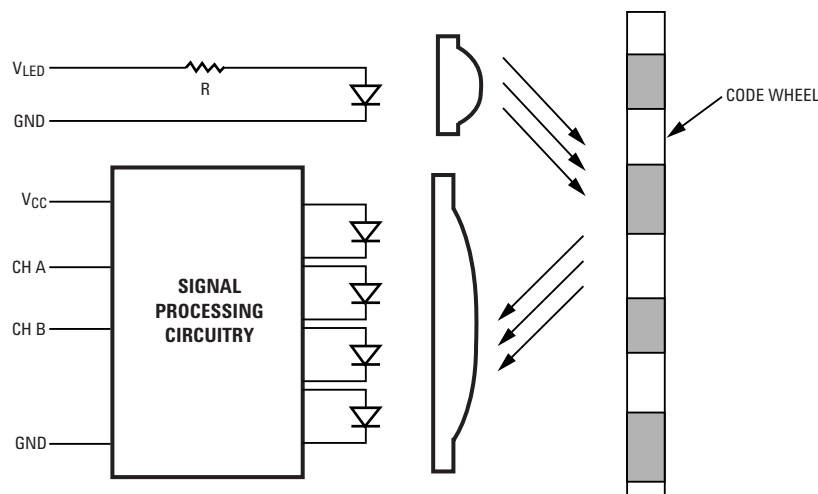
2. Select "Transmissive Encoder Modules" in the product category. You will see three more categories. Information on the Avago Technologies HEDS-9000/9100 series is available in either 11 mm or 23.36 mm optical radius.

## Vending Machine Applications

The diagram shown in Figure 5 is a schematic of a vending machine. Housed Encoders such as the Agvago Technologies' HEDS-5500/5600 series or the HEDR-542x series are used in this application. The HEDS-5500/5600 series is using transmissive techniques while the HEDR-542x series encoder is using reflective techniques.



**Figure 5. Typical Vending Machine Application**



**Figure 6. Function of an encoder in a vending machine**

A reflective type encoder consists of three portions: emitter side, detector side and codewheel. As can be seen in Figure 6, the emitter and detector are on the same side of the encoder unlike the transmissive encoder, in which case they are opposite to each other.

The light from the LED will be focused through the lens on the codewheel. The light is either reflected or not reflected back to the lens over the photodiode IC. As the codewheel rotates, an alternating light and dark pattern corresponding to the pattern of the codewheel falls upon the photodiodes. This light will be converted to digital signals by the signal processing circuitry. These signals are fed through comparators that are part of the signal processing circuitry to produce the final outputs for channels A and B.

The encoder is used in this closed loop motor control. It is used to help the motor system in controlling positioning and speed of the moving door.

Note:  
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<http://www.avagotech.com>

Then select "Housed Encoders" under "Product Category". You will see three categories: P, S & K family. Select K-family to get more information on the Avago Technologies' HEDS-5500/5600 series or the HEDR-542X series.

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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