HEDR-542x Series
Optical Encoder Assemblies

Avago
T E C H N O L O G I E S

Application Note 1267
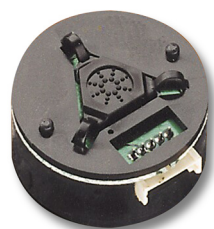
Introduction

The Avago Technologies HEDR-542x series Incremental optical shaft encoder assemblies are compact, economical and provide a two-channel quadrature output. Designed for a variety of commercial applications, the assemblies are available for mounting via set screws to the motor or with external mounting ears. They can be used with motor shafts from 2 mm to 5 mm in diameter with a press-fit/adhesive mounts or set screw hubs. The case is robust, fabricated from glass-filled PBT (polybutylene terephthalate), and the encoder assembly is specified for operation over the 0° C to +8° C temperature range. The HEDR-542x series operates from a single 5 V nominal supply.

Basic Operating Principles

The HEDR-542x assemblies use reflective technology to sense rotary position. The sensor consists of an LED light source and a photodetector IC in a single SO-8 surface mount package. The sensor is mounted on a PC board, which incorporates a series current-limiting resistor for the LED and pull-up resistors for the TTL-level digital outputs.

As seen in the block diagram in Figure 1, the sensor has three key parts:
(1) the LED light source,
(2) the photodetector IC, and
(3) a pair of lenses molded into the package.

The lens over the LED focuses light onto the codewheel and the image of the codewheel is reflected back through the second lens to the photodetector IC. As the codewheel rotates, an alternating pattern of light and dark corresponding to the pattern on the codewheel falls upon the photodiodes. This light pattern is used to produce internal signals A and its complement A', and B and B'. As part of the "push-pull" detector system, these signals are fed through comparators to produce the final digital outputs for Channels A and B.
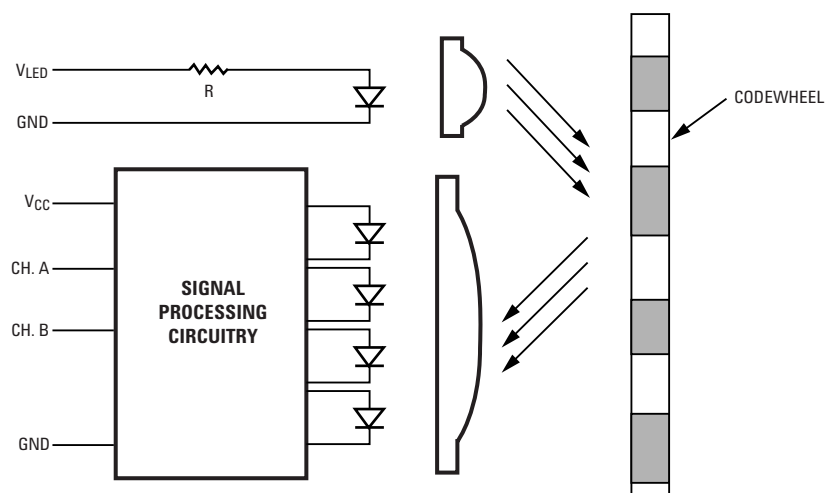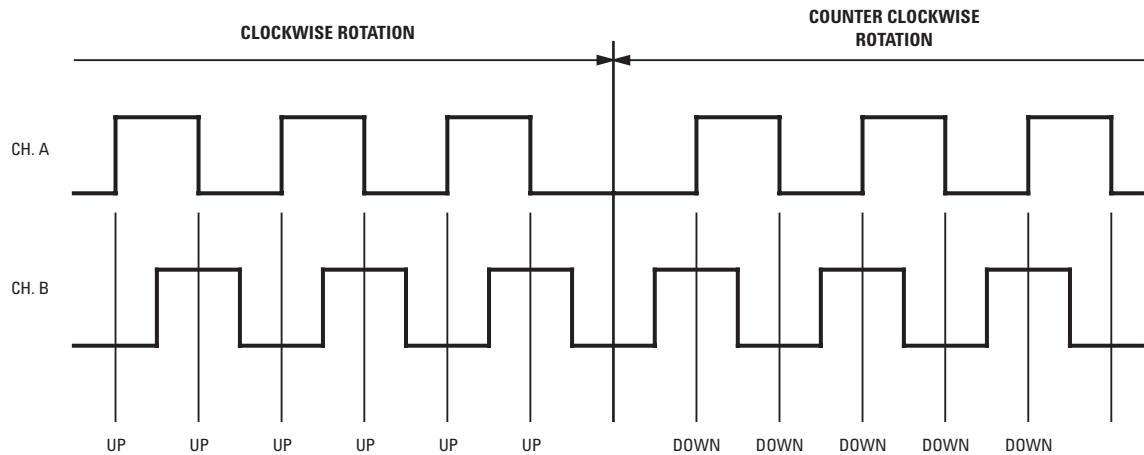

Figure 1.

Figure 2. 2X Decoding Waveform.

Using the Encoders

Channel A and Channel B have a quadrature relationship. As the codewheel rotates in one direction, Channel A leads Channel B by 90 electrical degrees, and as the codewheel rotates in the other direction Channel B leads Channel A by the same amount.

Although the HEDR-542x does have two channels in quadrature, it is intended to be applied with Channel A providing counts, and Channel B indicating direction.

Counting can be accomplished by:
• Counting every rising edge on Channel A (called "1X decoding"), which means that the number of rising edges per revolution on Channel A equals the count per revolution [CPR] of the codewheel.

• Counting every rising and falling edge on Channel A (called "2X decoding"), which means that the number of rising and falling edges per revolution on Channel A is twice the CPR of the codewheel.

The state of Channel B (logic high or low) when a rising or falling edge occurs on Channel A can be used to determine the direction of rotation (Refer to Figure 2).

It is not recommended that full 4X quadrature decoding be used (every edge of both Channel A and Channel B or every logic state width). The relationship between Channels A and B is guaranteed to be in quadrature, but this relationship is not tightly controlled enough to enable accurate 4X decoding.

Why use Avago Technologies' HEDR-542x Series Encoders?

1. Miniature size
With its diameter of 23 mm (0.9 inches) and height of 17.9 mm (0.7 inches) the encoder is suitable for incorporation with small motors and in applications constrained by space, weight and cost.

2. Quick and easy assembly
The design of the encoder permits it to be quickly and easily installed on a motor. The installation of the encoder to the motor shaft requires three simple steps. The cover is easily snapped on to the encoder body. An installation guide is provided in the product data sheet.

3. Robust housing
The housing is made of glass-filled PBT (polybutylene terephthalate). It can withstand a wide range of temperatures and the material is tough with good strain and tensile stress characteristics, providing excellent protection to the encoder.

4. Mounting versatility
The HEDR-542x series encoders are available with a selection of mounting options to suit different applications and various-sized motors.

Product ESD Handling Precaution
Electrostatic discharge (ESD) is a sudden discharge of stored-up static charge. ESD is usually generated by touching or rubbing an insulator. Table 1 shows the International Electrotechnical Commission (IEC), International Standard for ESD test level classifications.

Table 1. IEC International Standard for ESD Tests Level Classification.

Contact Discharge		Air Discharge	
Level	Test Voltage (kV)	Level	Test Voltage (kV)
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
X[1]	Special	X[1]	Special

Note:
[1] "X" is an open level. The level has to be specified in the dedicated equipment specification. If higher voltages than those shown are specified, special test equipment may be needed.
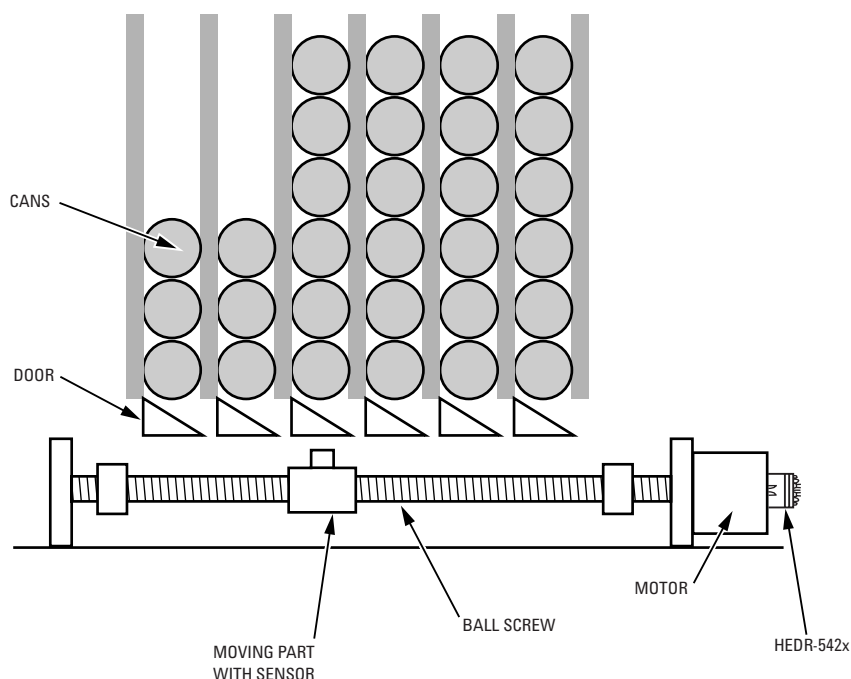
The ESD classification of Avago Technologies' HEDR-542x series assemblies is Level 1 for both contact and air discharge. HEDR-542x series encoders are packed in anti-static trays for shipment. ESD handling precautions need to be taken when using the product.

Typical Applications
• Vending machines.
• Security and access control, e.g. security camera pan-tilt mounts and card readers.
• Volumetric fluid dispensing machines.
• Air handling/ventilation systems.

Illustrations of the applications are shown in Figures 3 through 6.

Note: These optical encoders are not suitable for life support systems and critical care medical equipment (e.g. heart-lung machines, respiratory/anesthesia equipment, peristaltic pumps used in operating theaters and critical care units).

Figure 3. Optical Encoder used in a Vending Machine.

Figure 4. Shaft Encoder in a Card Reader.

Figure 5. Shaft Encoder in a Volumetric Fluid Dispensing Machine.

Figure 6. Shaft Encoder in Air Ventilation System.

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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