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DID YOU KNOW?
OPTICAL ROTARY ENCODER SOLUTIONS

Rotary Encoders Introduction

Rotary encoders are commonly employed to measure rotation speed and position in various applications that involve rotating components. There are primarily two types of encoders: absolute and incremental. Absolute encoders deliver precise positional information, continuously indicating the exact position of the rotating object. In contrast, incremental encoders monitor positional changes relative to a specific reference point but do not provide absolute positional data.

Fig. 01 - Industrial Robot With Multiple Rotational Axes

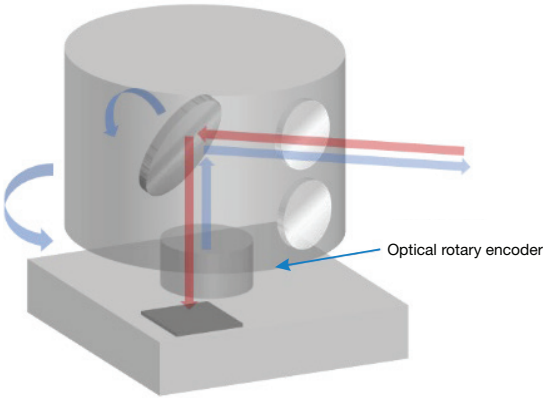

Fig. 02 - Rotational LiDAR Sensor

Encoders can be constructed using various technologies including optical, magnetic, mechanical, and capacitive. Among these, optical encoders are particularly valued for their high speed response time, minimal wear and tear due to their non-contact nature, and immunity to electromagnetic interference. These benefits make optical encoders a preferred choice in environments where precision and durability are critical.

Vishay offers a variety of sensors specialized for optical rotary encoders, and application support with application notes, code wheel design examples, and electrical specification for focus applications such as:

Industrial Robots: encoders are crucial in controlling and monitoring the precise movements of robot joints and limbs in manufacturing settings, enhancing accuracy and efficiency

LiDAR Sensors: in LiDAR systems used for mapping and autonomous vehicle navigation, encoders help in the precise angular measurement of the scanning equipment

Turn Knobs: encoders in turn knobs allow for precise control in user interfaces, such as adjusting volume or settings in electronic devices

Factory Automation: encoders enable the control of machinery and conveyor systems, ensuring high precision in the manufacturing processes and product handling

Camera Systems: PTZ cameras (pan - tilt - zoom) require multiple encoders to control the movement and angle of the camera

Fig. 03 - 360° Camera

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Transmissive Encoders

TCxT1350X01
High temp. release (125 °C)

(5.5 x 4.0 x 4.0) mm

1 and 2 Channels

TCxT1630X01
Triple channel

(5.5 x 5.85 x 7.0) mm

3 Channels

TCxT1800X01
Quad channel

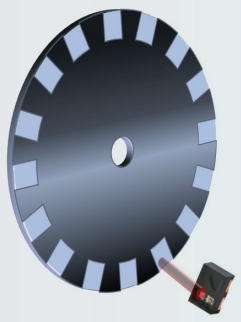
(5.5 x 5.85 x 7.0) mm

4 Channels

Transmissive Encoders

Transmissive encoders operate by sending and receiving light through an encoder disc that features slits allowing the light to pass through. They typically offer higher accuracy and faster response times compared to other types of encoders. The resolution of these devices can be adjusted by the design of the encoder disc and by increasing the number of openings.

Vishay offers specially designed transmissive sensors that integrate one emitter with multiple photodetectors. These components are matched in wavelength and performance, such as distance and rise and fall speeds, to ensure optimal results. 1-channel sensors like the TCPT1350 are used for measuring rotational speed, while 2-channel sensors such as the TCUT1350 are typically utilized for determining both rotation direction and speed. Additionally, a 4-channel sensor like the TCUT1800 allows for absolute encoding with 16 positions.



Reflective Encoders

VCNT2030
VCSEL emitter

(1.85 x 1.2 x 0.6) mm

VCNT2025X01
Automotive qualified

(2.5 x 2.0 x 0.8) mm

Reflective Encoders

The main advantage of reflective encoders lies in their simple design and minimal space and height requirements. Additionally, the encoder wheel often has a simpler mechanical design as it requires no special tooling, just color marking on the wheel.

Vishay offers integrated reflective sensors such as the VCNT2030, which includes an integrated VCSEL (vertical cavity surface emitting laser) emitter and a phototransistor. The VCSEL provides maximum precision due to its narrow emitting angle and fast rise and fall times, allowing for the emitter to be activated for shorter durations to save on energy or to transmit simple codes for information transfer. Moreover, this package is the smallest integrated solution available.

Another integrated sensor, the VCNT2025, features an infrared emitter and phototransistor housed in an automotive-qualified package that can operate up to 125 °C. The newly developed package minimizes crosstalk and offers a high signal to noise ratio, making it suitable for harsh environments.

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Discrete Encoders

Both transmissive and reflective encoder types can also be implemented using discrete components, which enhances design flexibility within a system. This approach is particularly beneficial for larger or unusual encoder wheels where a discrete solution might be the best fit. Vishay offers a wide range of packages featuring pairs of IR emitters and photodiodes. For instance, the VSMY5940 and VEMD4110 are both available in compact 0805 packages. Alternatively, the VSMY2943SLX01 and VEMT2023SLX01 form an emitter and detector pair housed in side-looker packages, which facilitate mounting the encoder wheel at a 90° angle to the PCB. Another option includes leaded parts like the TSAL4400 and TEFT4300, which offer flexibility for custom designs and angles.

Summary

- Signal Detection and Conversion: optical encoders capture and convert optical pulses from rotating disks into electrical signals
- Accuracy and Environmental Suitability: optical encoders provide enhanced accuracy and are suitable for use in environments with strong magnetic interference
- Design Advantages of Reflective Optical Encoders: reflective optical encoders are compact and simple to assemble due to their stacked manufacturing process
- Efficiency of Transmissive Encoders: transmissive encoders offer rapid and accurate signal processing by directly transmitting light through rotating disk slits
- Flexibility of Discrete Encoders: discrete encoders allow for tailored configurations and component adjustments, offering high design flexibility for varied applications

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