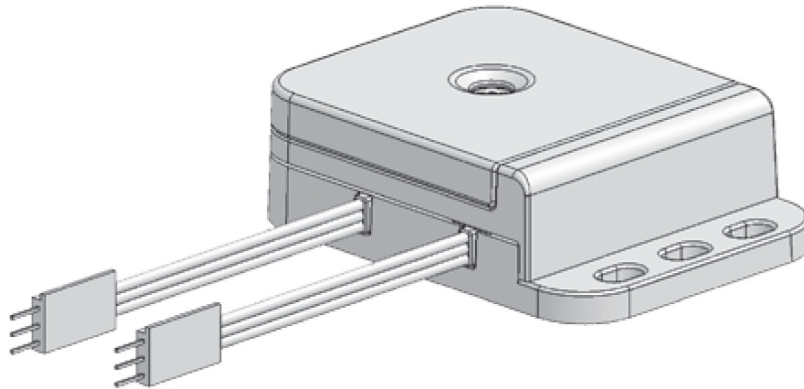


Optical Shaft Encoder (2-pack)

Basic Optical Shaft Encoders are commonly used for position and motion sensing. Basically, a disc with a pattern of cutouts around the circumference is positioned between an LED and a light detector; as the disc rotates, the light from the LED is blocked in a regular pattern. This pattern is processed to determine how far the disc has rotated. If the disc is then attached to a wheel on a robot, it is possible to determine the distance that wheel traveled, based on the circumference of the wheel and the number of revolutions it made.

With the Quadrature Encoder, there are 2 output channels. Only one output can be used as a basic Optical Shaft Encoder. The term quadrature refers to the situation where there are two output channels; that is, two square waves 90 degrees out of phase with each other, being outputted by the unit. The two output channels of the Quadrature Encoder can be used to indicate both position and direction of rotation.

Optical Shaft Encoder x 2



Limited 90-day Warranty

This product is warranted by VEX Robotics, Inc. against manufacturing defects in material and workmanship under normal use for ninety (90) days from the date of purchase from authorized VEX Robotics dealers. For complete warranty details and exclusions, check with your dealer.

VEX Robotics, Inc.
1519 IH 30 W
Greenville, TX 75402

0312

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: Changes or modifications not expressly approved by the manufacturer responsible for compliance could void the user's authority to operate the equipment.

- THIS CLASS B DIGITAL APPARATUS COMPLIES WITH CANADIAN ICES-003.
- CET APPAREIL NUMERIQUE DE LA CLASSE B EST CONFORME A LA NORME NMB-003 DU CANADA.

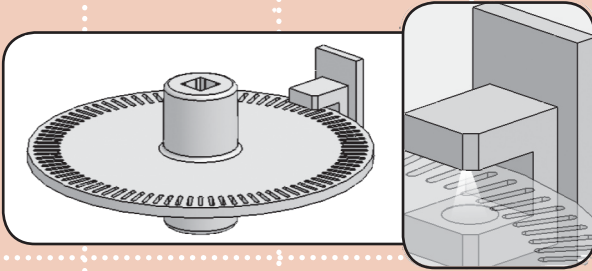
Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

For More Information, and additional Parts & Pieces refer to:
www.VEXrobotics.com

Optical Shaft Encoder (2-pack), continued

1 Technical Overview

The Optical Shaft Encoder uses an infrared light sensor to detect illumination from an infrared LED passing through slots cut in the circumference of a rotating wheel.



From basic geometry, we know that the circumference of a circle is equal to (π) times the diameter of the circle.

A diagram illustrating the formula for the circumference of a circle. It shows a circle with a curved arrow around its perimeter labeled 'circumference'. This is followed by an equals sign, then a circle with a horizontal double-headed arrow through its center labeled 'diameter of wheel'. This is followed by a multiplication sign and the Greek letter pi (π), with the text '(pi = approx. 3.14)' in parentheses.
$$\text{circumference} = \text{diameter of wheel} \times \pi \quad (\pi = \text{approx. } 3.14)$$

The distance travelled by a wheel, then, is simply the circumference of the wheel times the number of revolutions the wheel has made.

A diagram illustrating the formula for distance traveled. It shows three circles, each with a curved arrow around its perimeter, representing revolutions. A horizontal double-headed arrow spans the width of the three circles, representing the total distance traveled.
$$\text{distance} = (\text{circumference}) \times (\text{number of revolutions})$$

Assuming we use a wheel with a diameter of 2.75", the distance the wheel travelled would be:

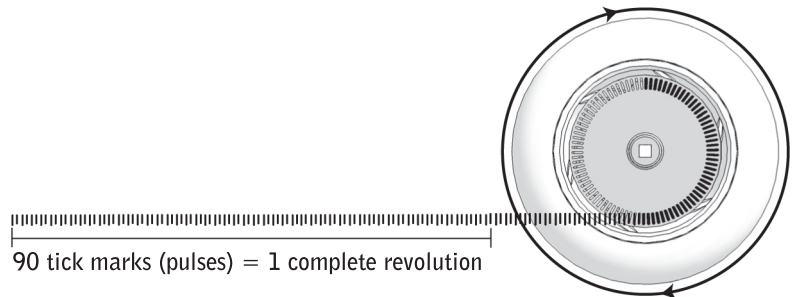
$$\text{distance} = 8.64'' \times (\text{number of revolutions})$$

Optical Shaft Encoder (2-pack), continued

1 Technical overview continued

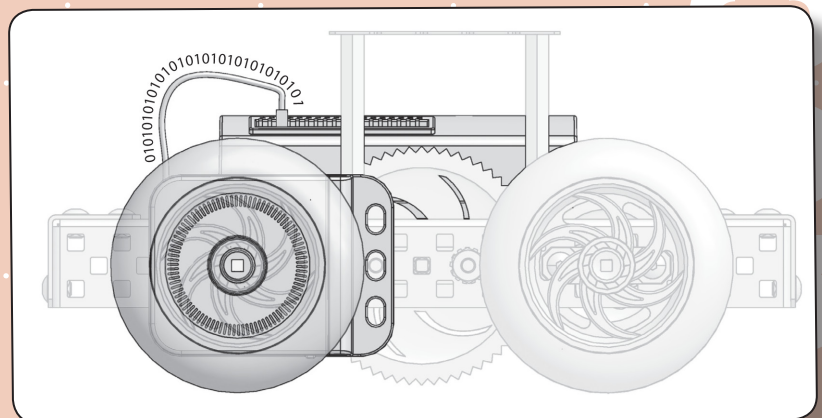
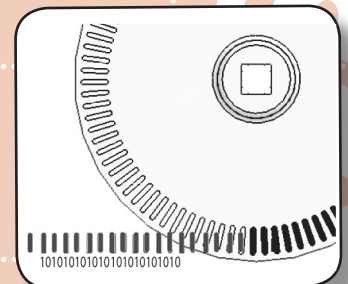
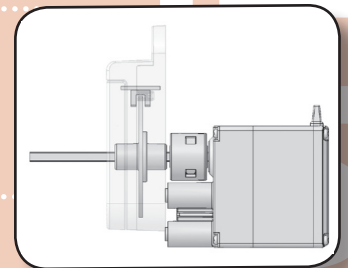
By knowing how many slots are cut into the encoder wheel, we can determine how many revolutions the robot wheel has made based on the number of times the light sensor has picked up illumination from the LED. The encoder wheel included in this kit has 90 slots.

By mounting a shaft encoder on the axle of one of your robot's wheels, you'll be able to determine how many times that wheel has rotated. That, in turn, can be used to calculate the distance the robot has travelled, based on the diameter of the wheel.



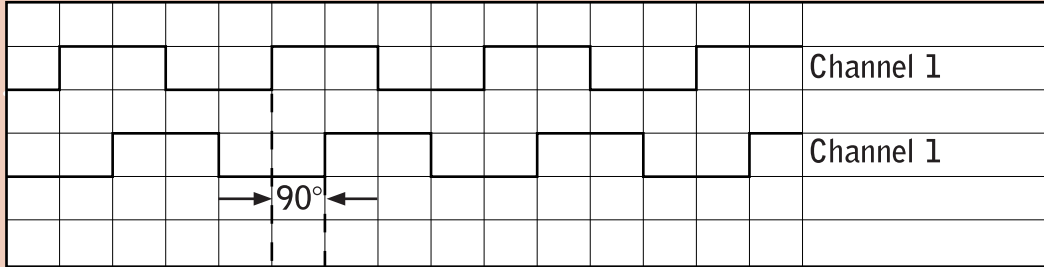
The Optical Shaft Encoder can detect up to 1700 pulses per second, which corresponds to 18.9 revolutions per second and 1133 rpm (revolutions per minute). Faster revolutions will not be interpreted correctly, resulting in erroneous positional data being passed to the Microcontroller.

This is a digital sensor, which means that the signal it will pass to the VEX Microcontroller will either be high (1) or low (0). The sensor output is low (0) when the light from the IR LED passes through a cutout segment of the encoder wheel and falls on the detector, and high (1) when the light is blocked by an opaque segment of the encoder wheel. This means that the VEX Microcontroller will be receiving a string of 1's and 0's as your robot moves. The string of 1's and 0's will then be interpreted by your program and used to determine the robot's actions.



Optical Shaft Encoder (2-pack), continued

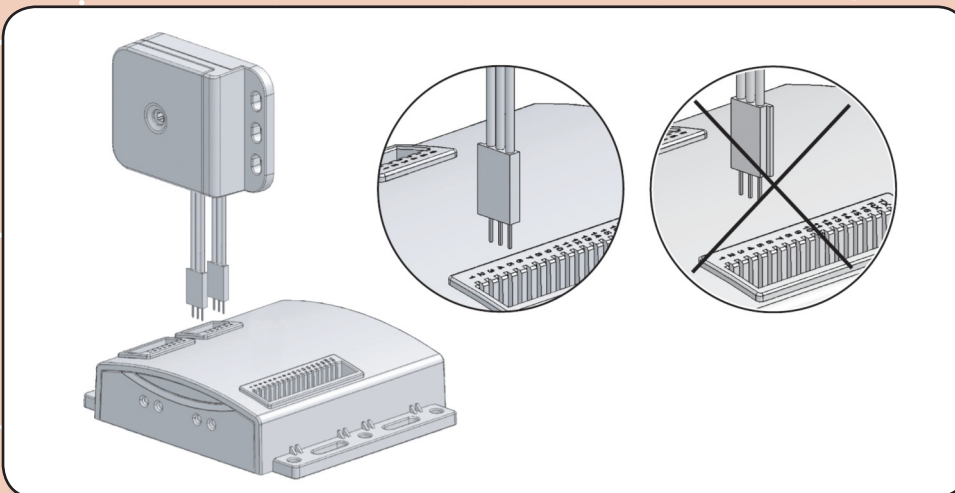
With the Quadrature Encoder, you will use both outputs (Channel 1 and Channel 2) to determine the direction of rotation. The channels are separated in phase by 90 degrees as shown below.



For example, if channel 1 leads channel 2, the wheel is rotating clockwise. Likewise, if channel 2 leads channel 1, the wheel is rotating counter-clockwise. By monitoring the relative phase and number of pulses of channel 1 and 2, you can determine how fast, how far, and what direction your robot is traveling.

2 Reprogramming your Microcontroller to read the sensor

You'll need to plug your shaft encoder into any port in the Interrupt bank on a VEX Microcontroller. Depending on your specific application, you may be able to use any port in the Analog/Digital bank. Note that the connector is keyed to fit into the Microcontroller port in a specific orientation; plugging it in backwards could damage or even destroy your sensor.



In order for your robot to be able to read the sensor, you will have to reprogram the Microcontroller.