

# Electronics Pulse Width Modulation Sensors

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- This document gives a few examples.

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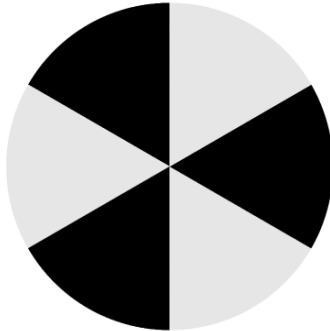
# Shaft encoders

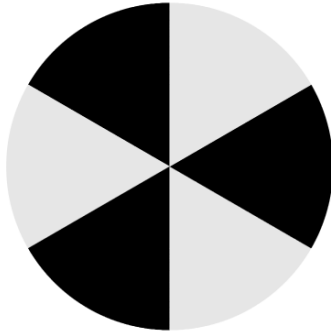
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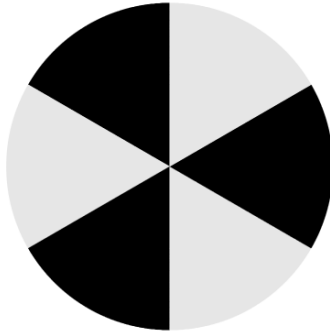
- *Absolute* position sensing  
doesn't use PWM
- *Incremental rotary* encoding  
uses PWM

As long as you know the initial position, you can update if you can sense changes.

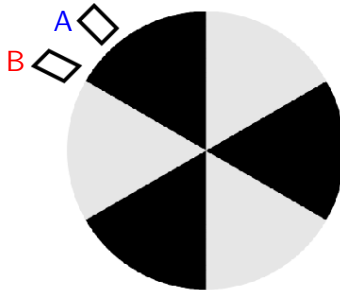




- Shaft encoder wheel

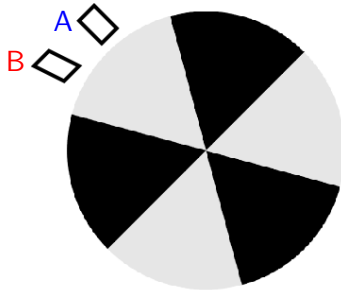


- Shaft encoder wheel
- Two sensors will allow determination of rotation *speed* and *angle*

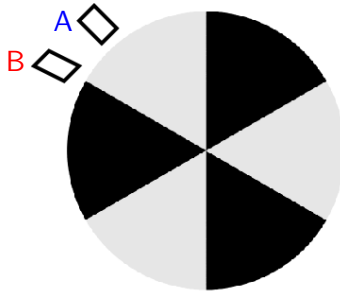


- Clockwise

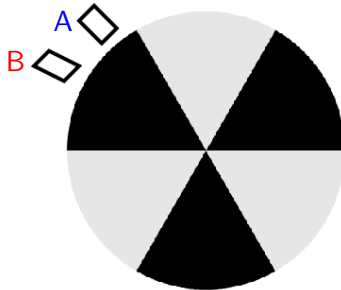




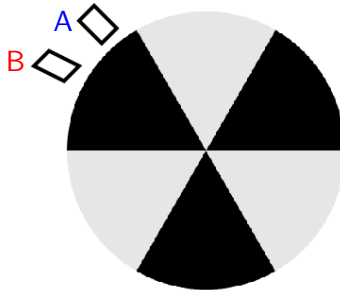
- Clockwise



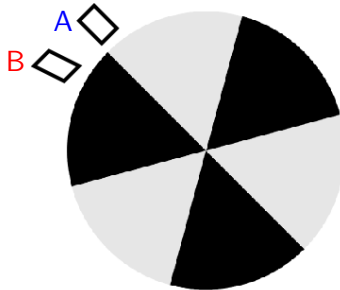
- Clockwise



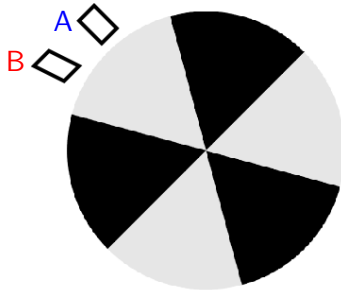
- Clockwise



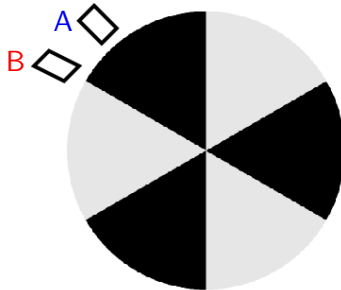
- Counter-clockwise



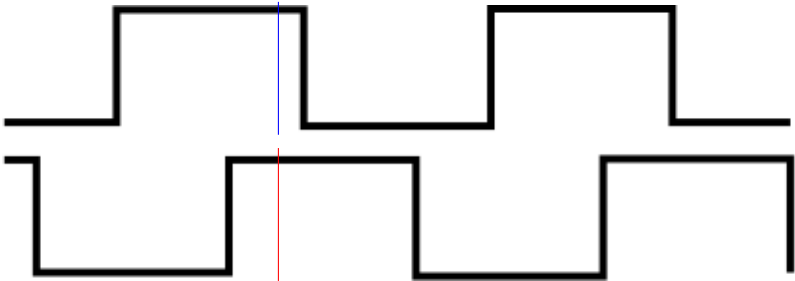
- Counter-clockwise



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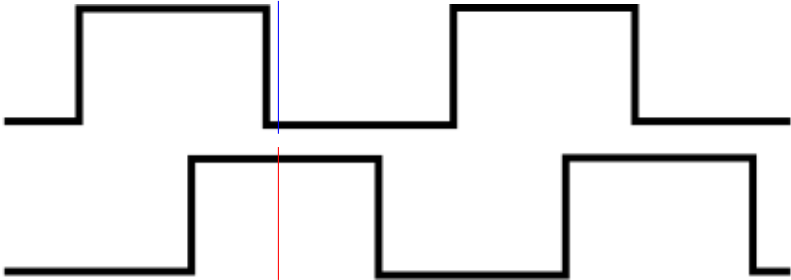


- Counter-clockwise

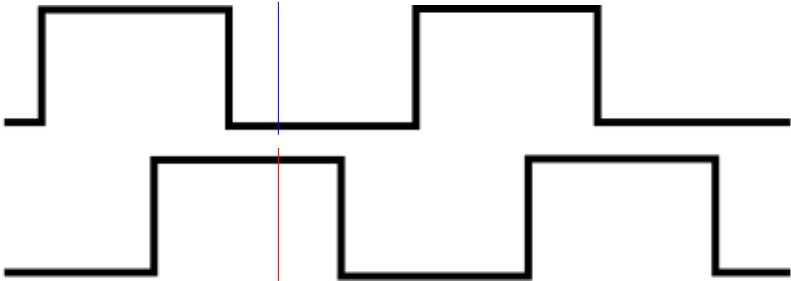


- Shaft encoder timing
- 1
- 1

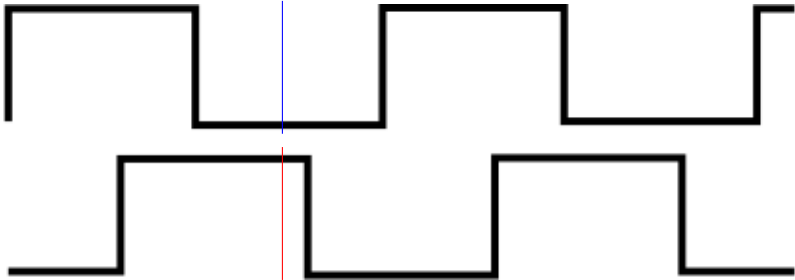




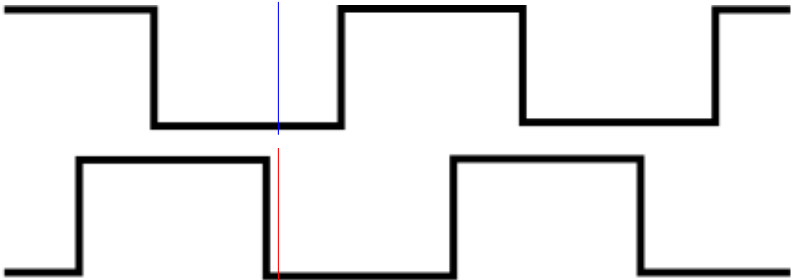
- Shaft encoder timing
- 0
- 1



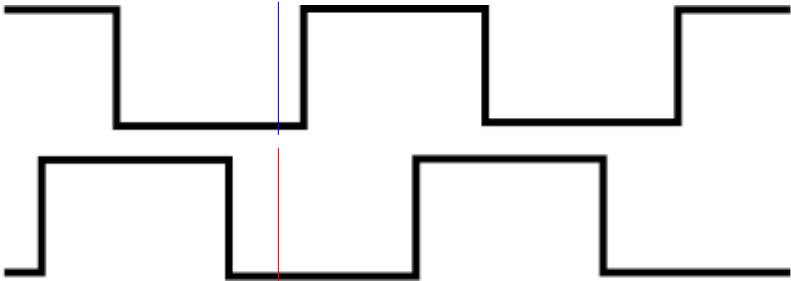
- Shaft encoder timing
- 0
- 1



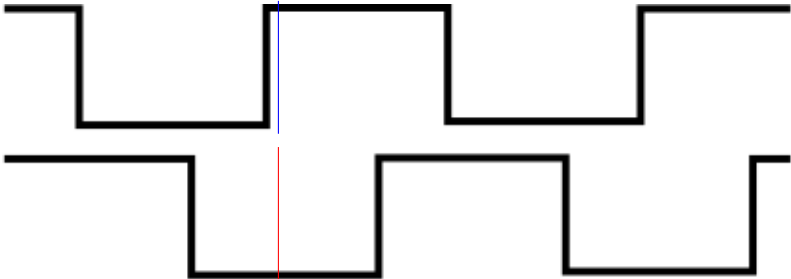
- Shaft encoder timing
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- 1



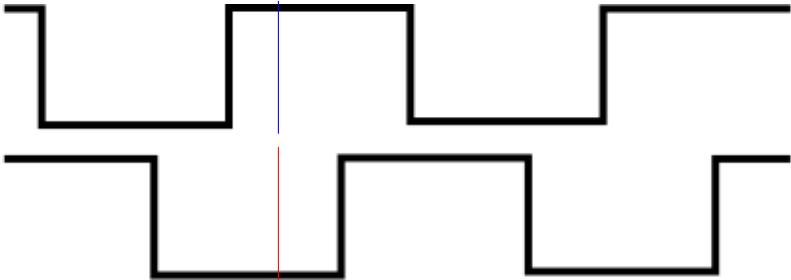
- Shaft encoder timing
- 0
- 0



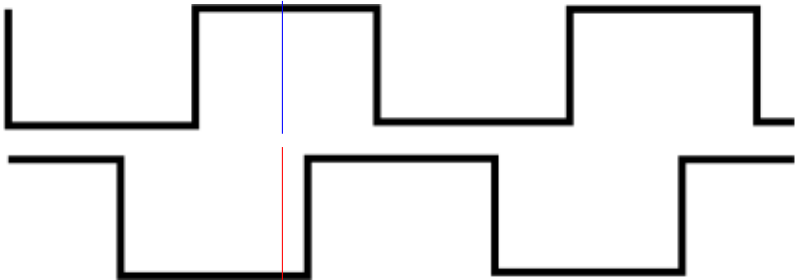
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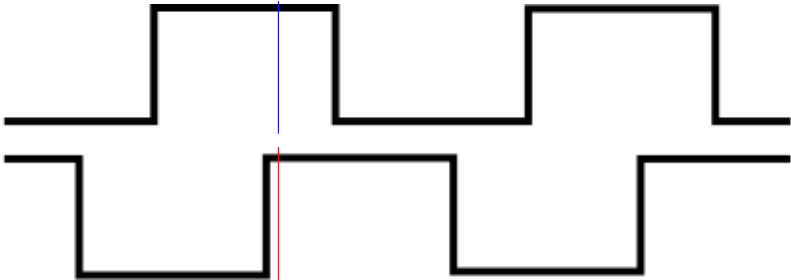


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- *Speed* of rotation from frequency of either channel

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- *Angle* of rotation from combination

# Ultrasonic sensors

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- *Transmitter* sends out pulse

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- *Transmitter* sends out pulse
- *Receiver* registers echo

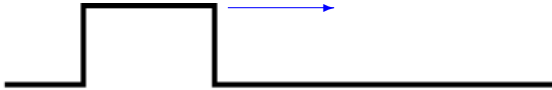


- transmit

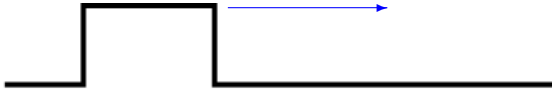


- transmit

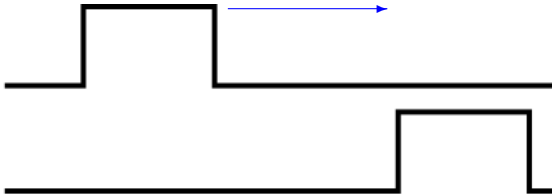




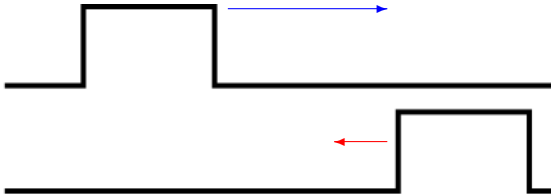
- transmit



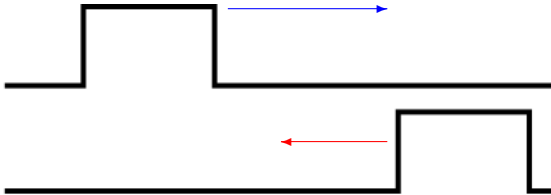
- transmit



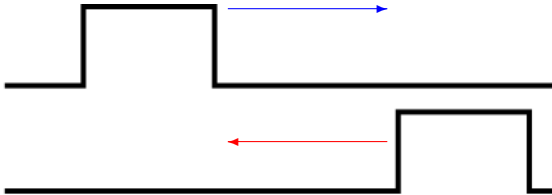
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where  $v$  is the speed of sound



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- since  $2d = vt$   
where  $v$  is the speed of sound

Why is it  $2d$ ?

# V to F and F to V converters

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- *V to F converters* take in an analog *voltage* and produce a string of digital pulses where the *frequency* is proportional to the input analog voltage

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- *F to V converters* take in a string of digital pulses and produce an analog *voltage* where the analog voltage is proportional to the input *frequency*