Electronics
Pulse Width Modulation Sensors

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- This document gives a few examples.

Shaft encoders

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- *Absolute* position sensing

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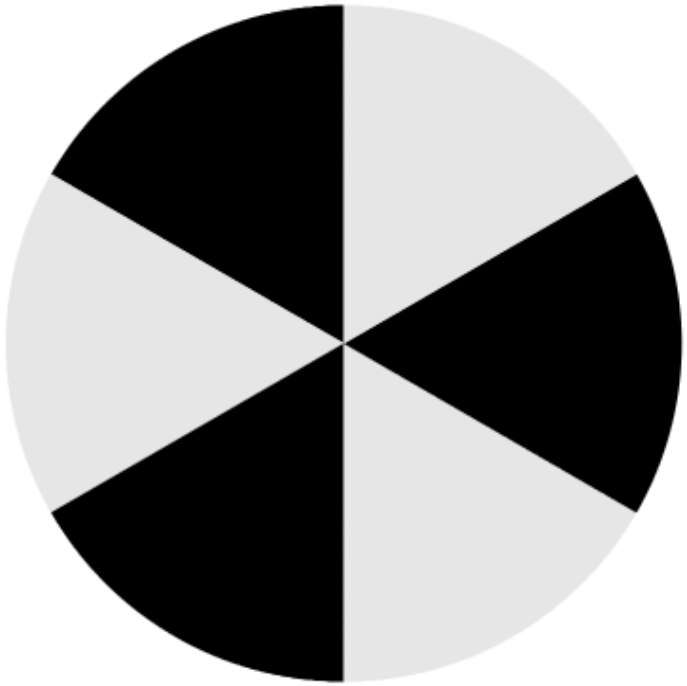
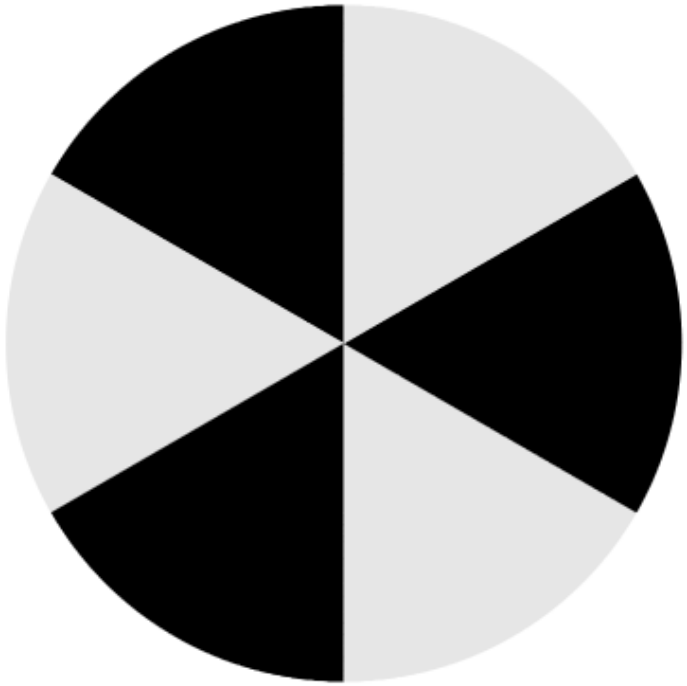
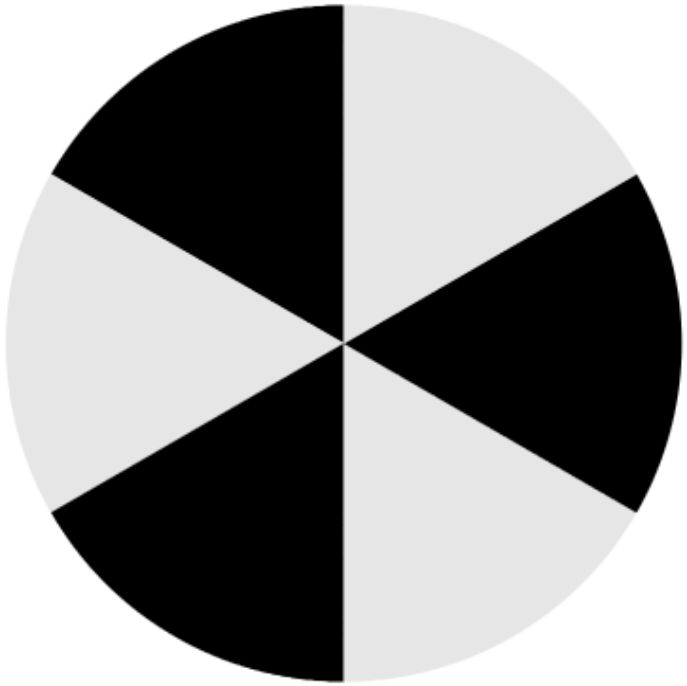
  uses PWM

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

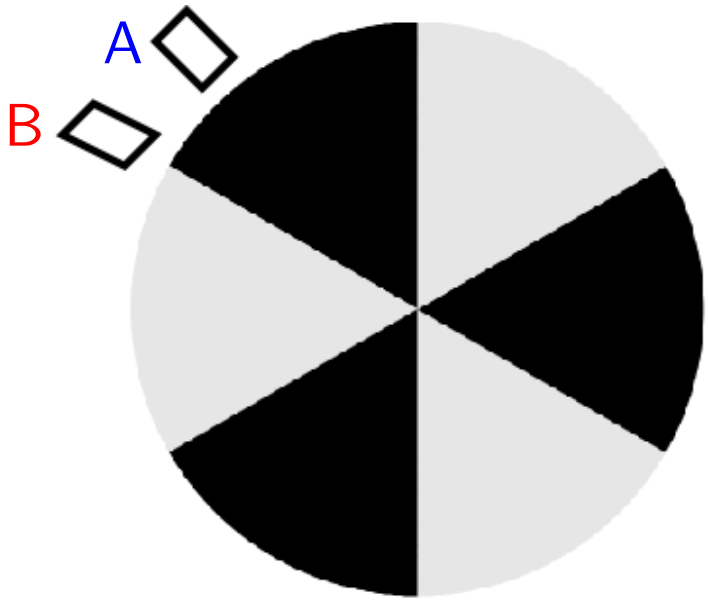




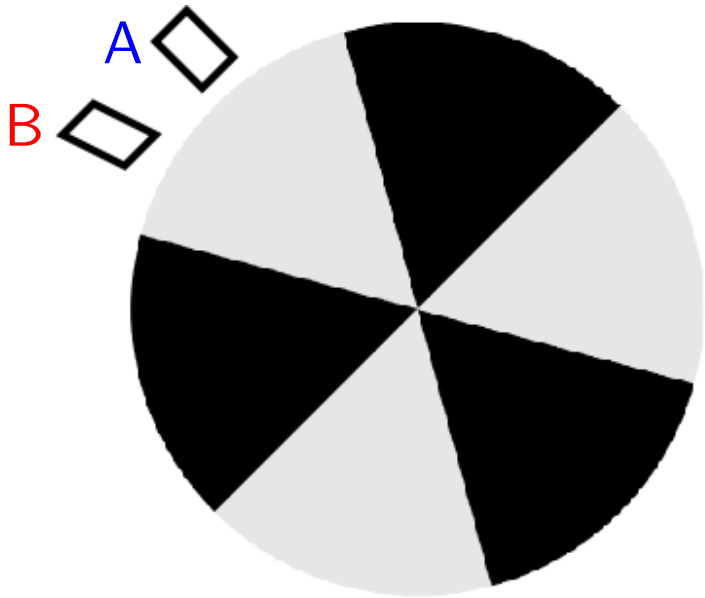
- Shaft encoder wheel



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



- Clockwise



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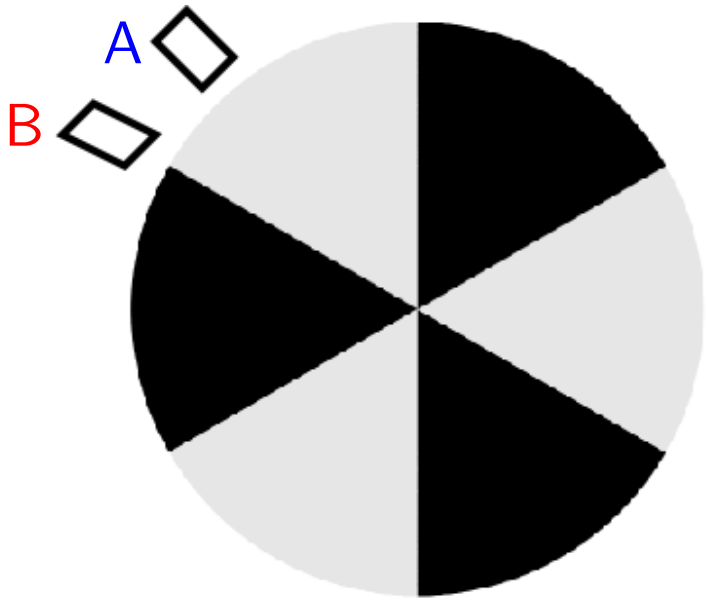

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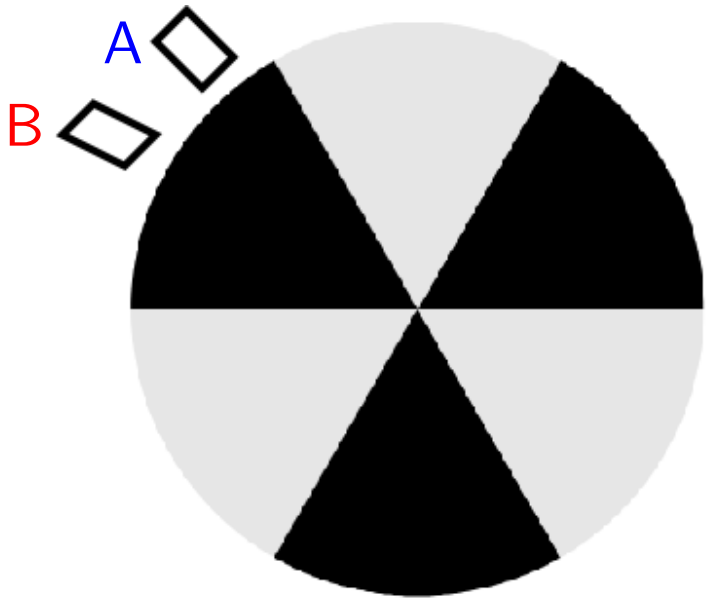

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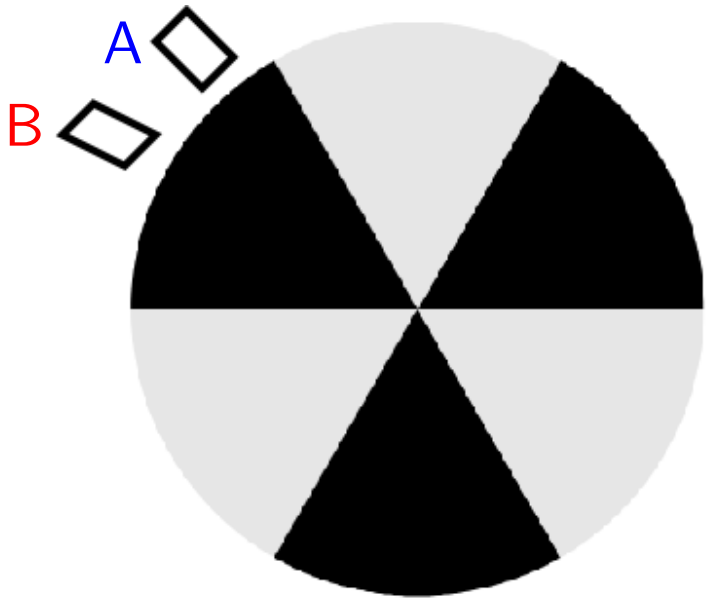

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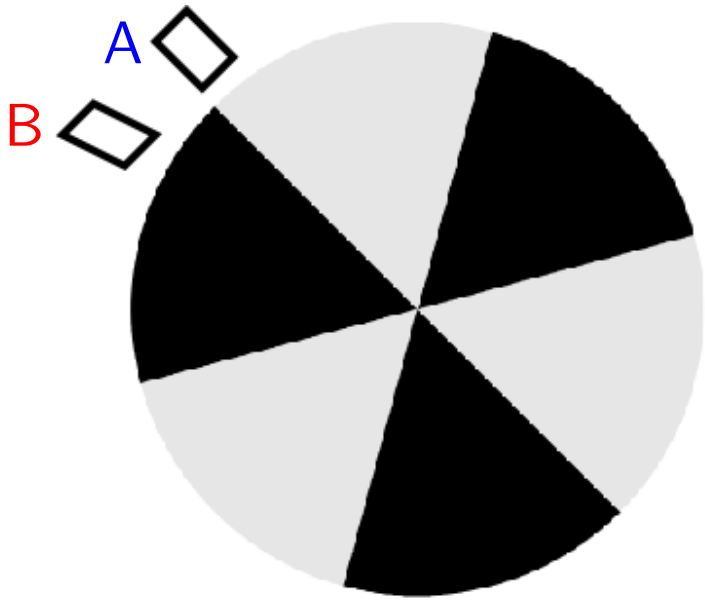

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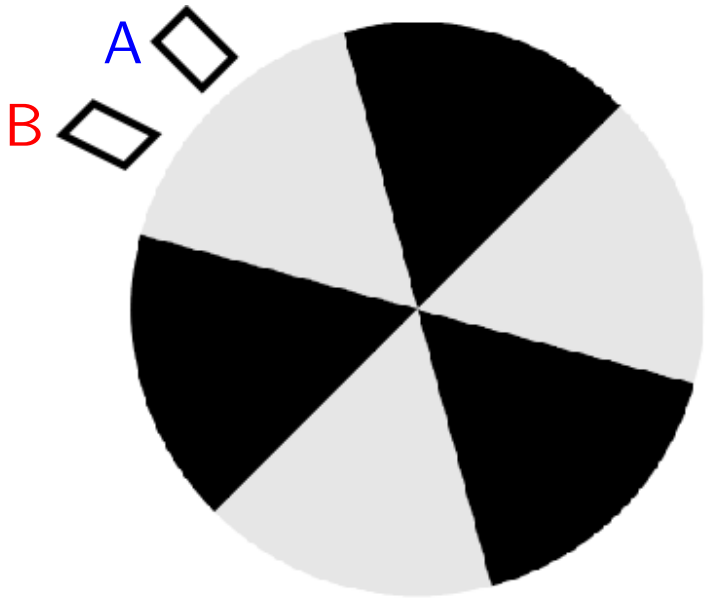

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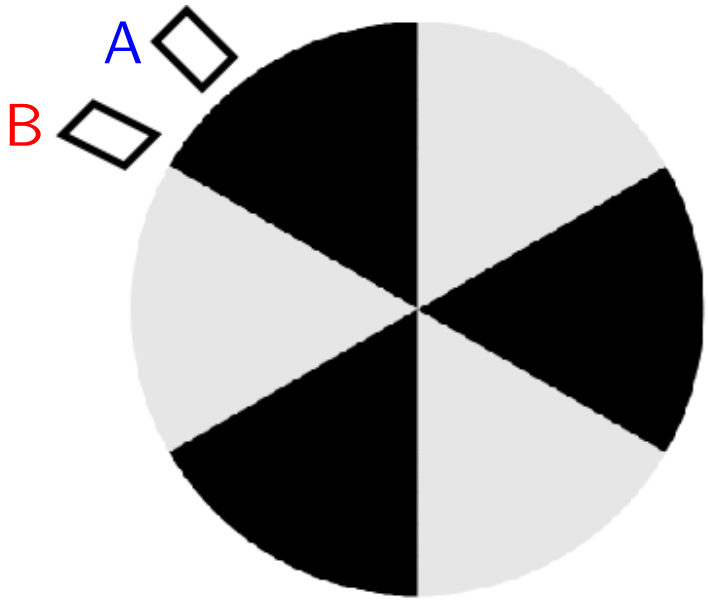

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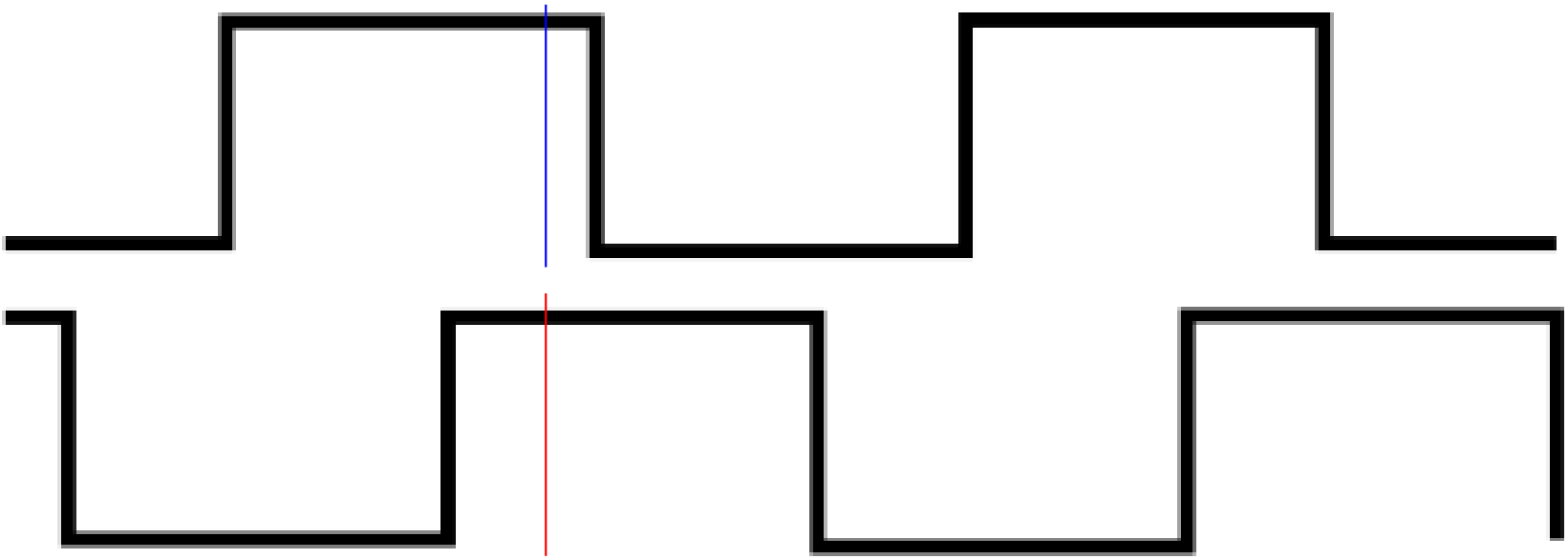
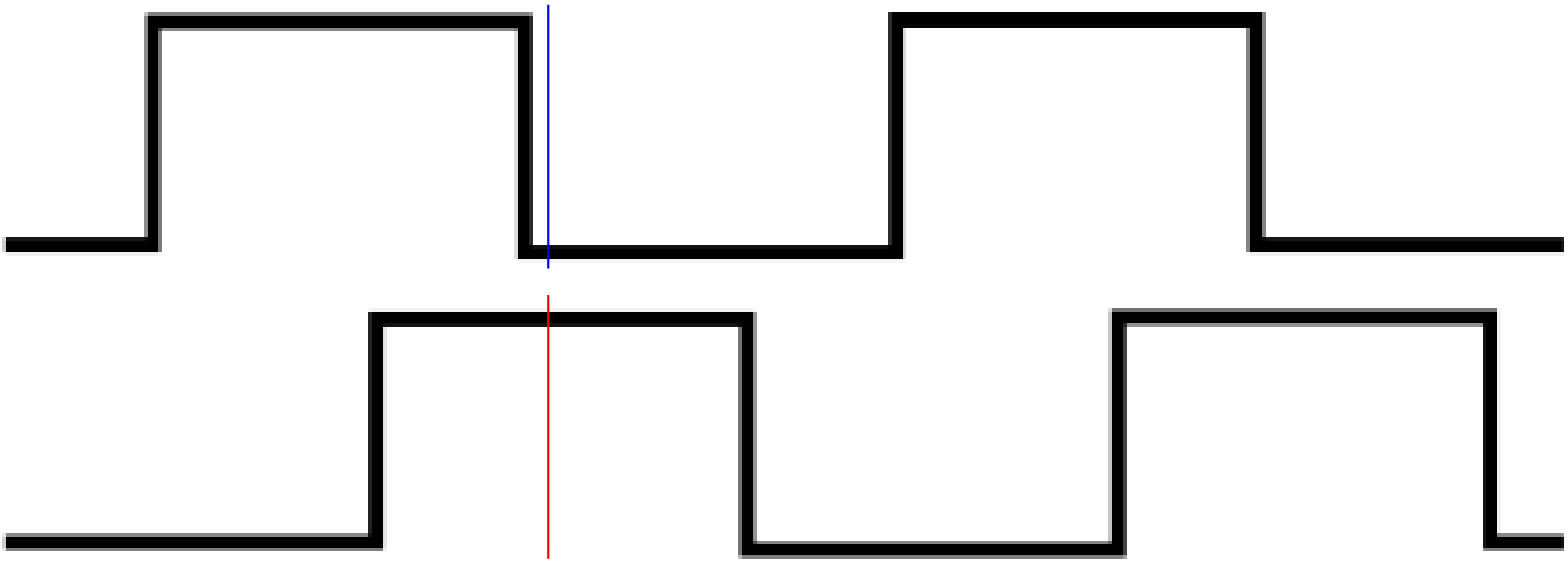


- Shaft encoder timing
- 1
- 1



- Shaft encoder timing
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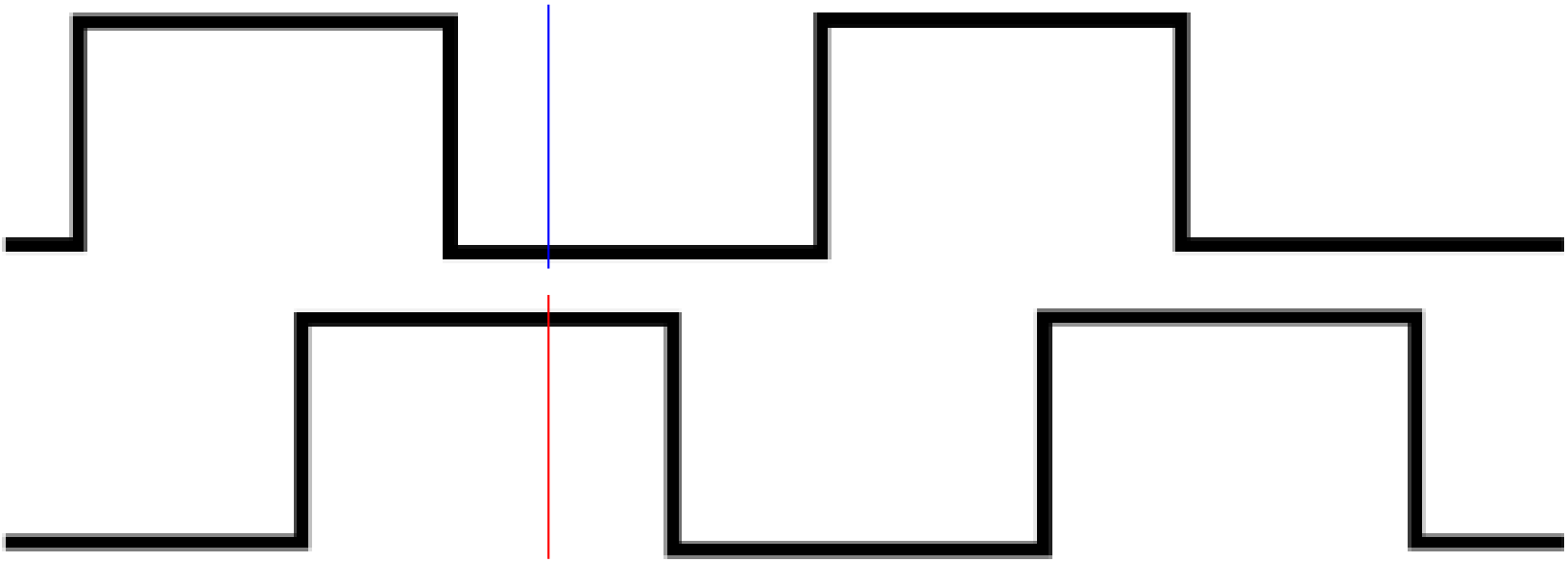
- 1



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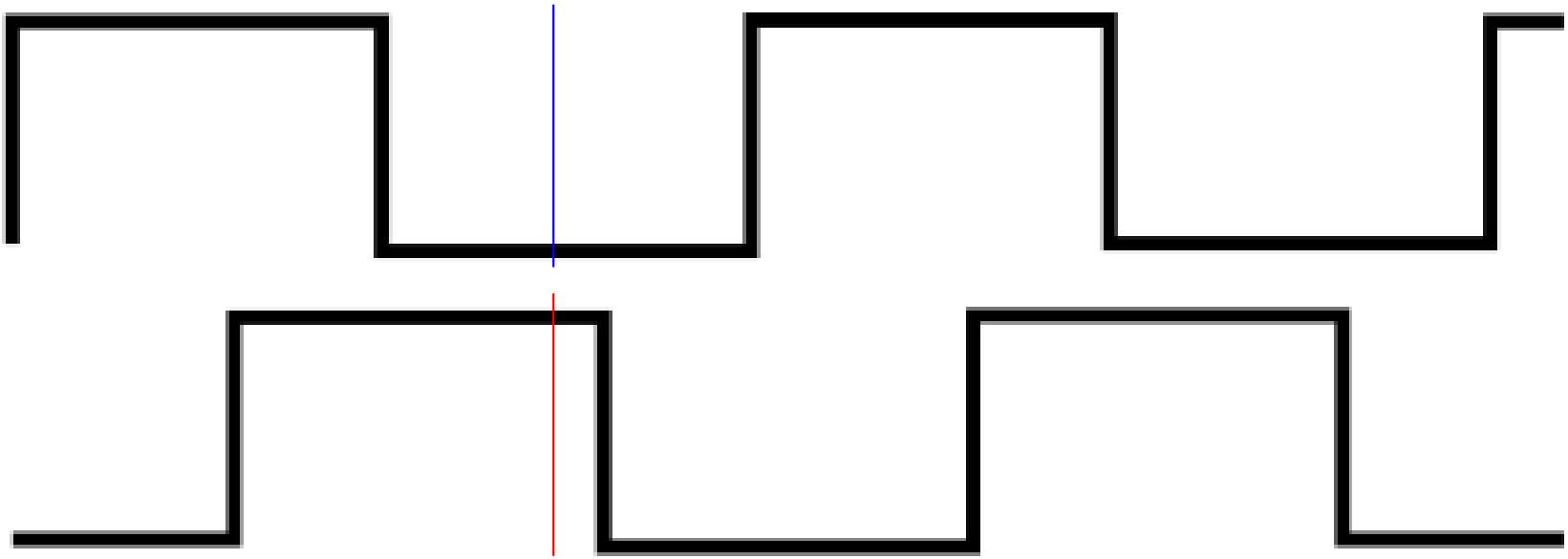

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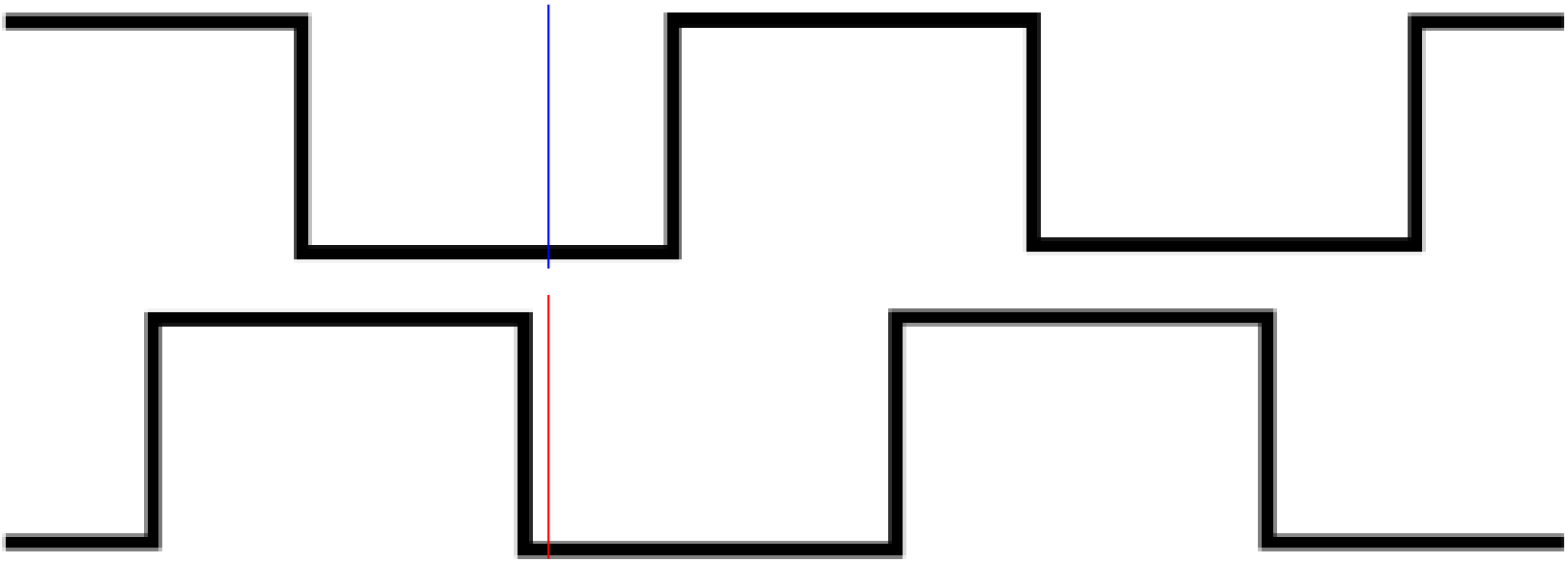

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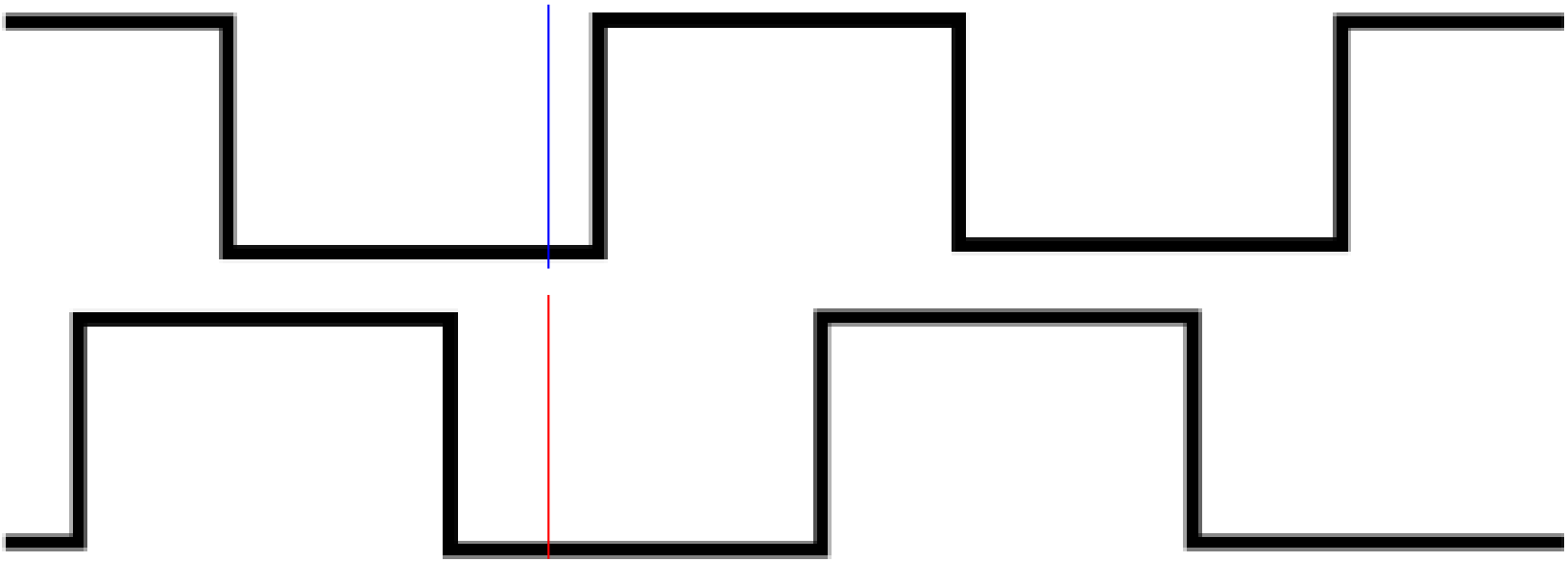

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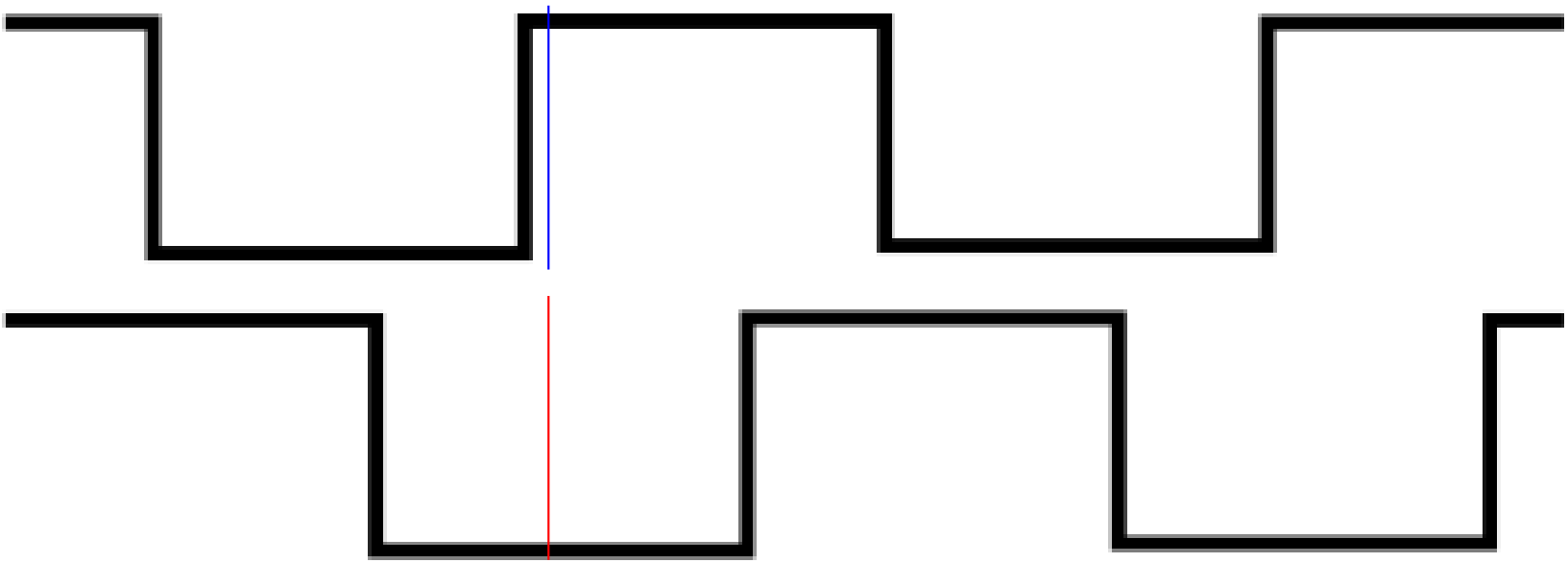

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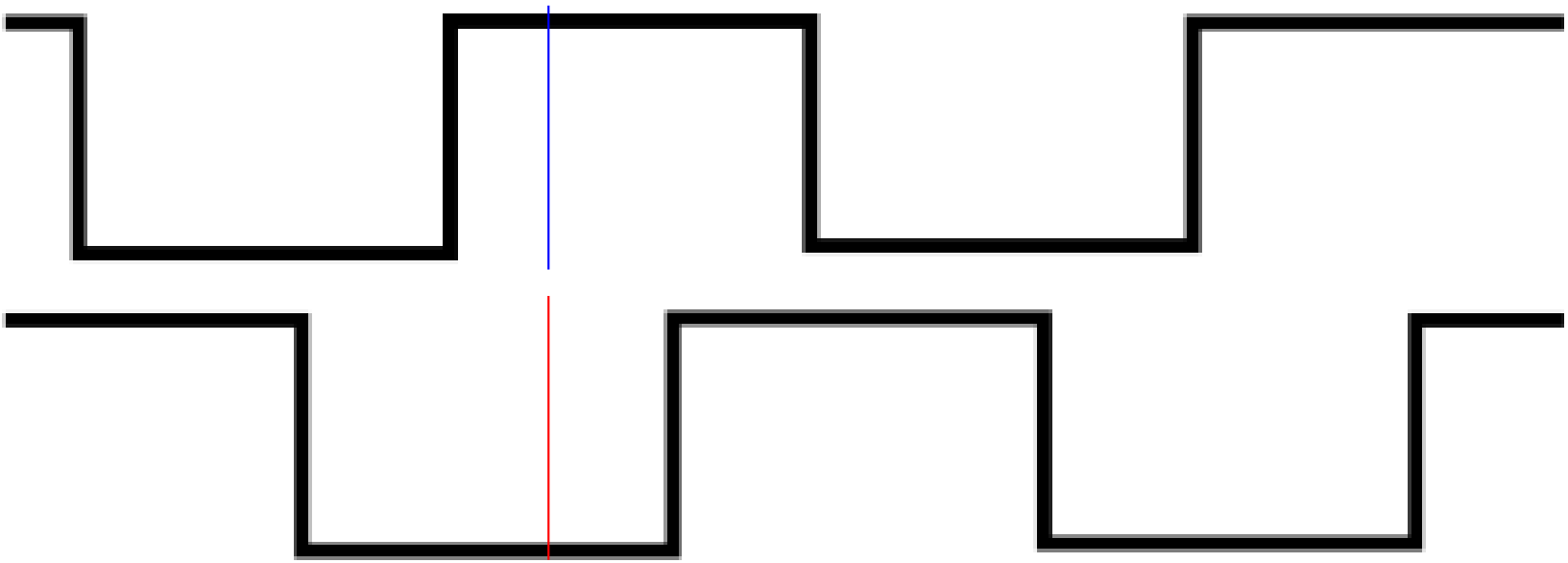

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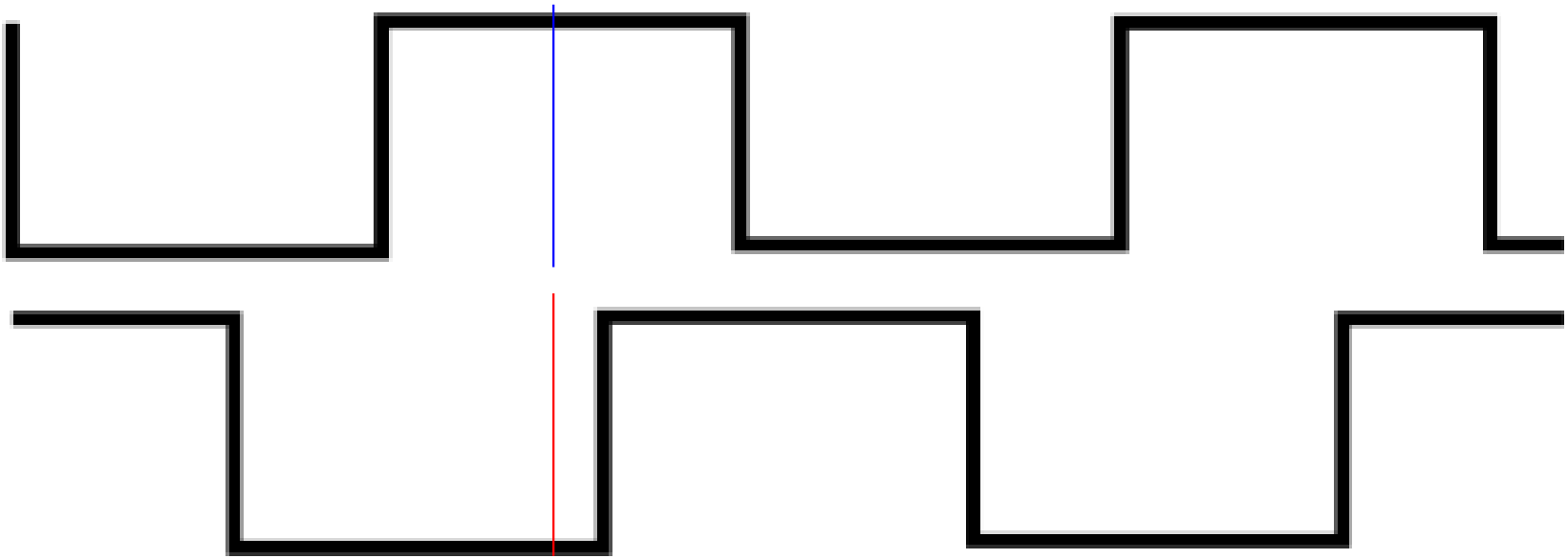

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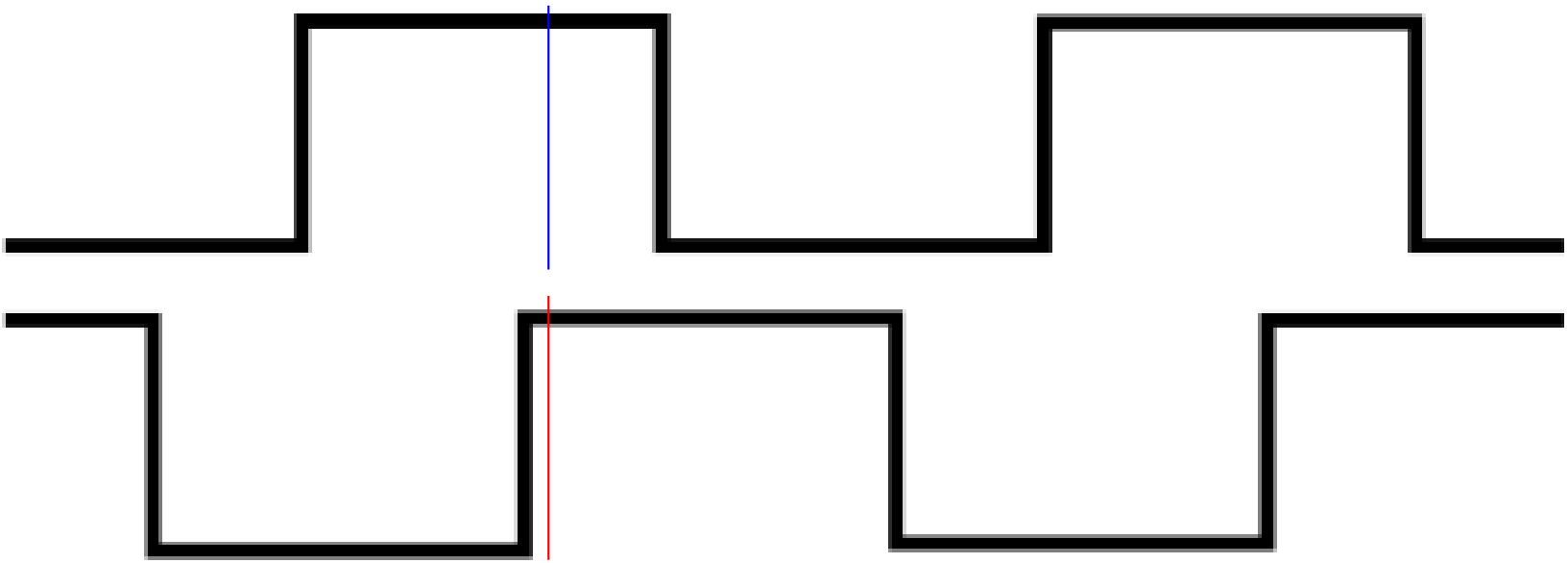

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- *Speed* of rotation from frequency of either channel

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- *Angle* of rotation from combination

Ultrasonic sensors

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Ultrasonic sensors

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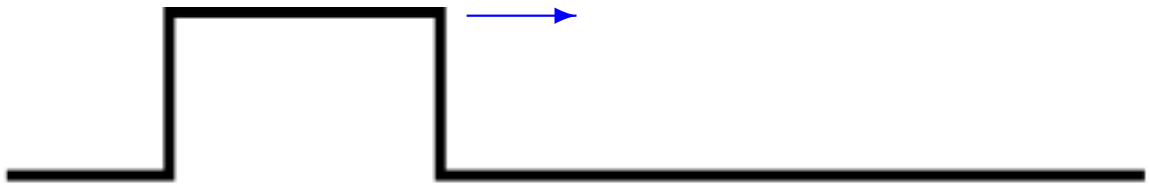
- *Receiver* registers echo

- **transmit**



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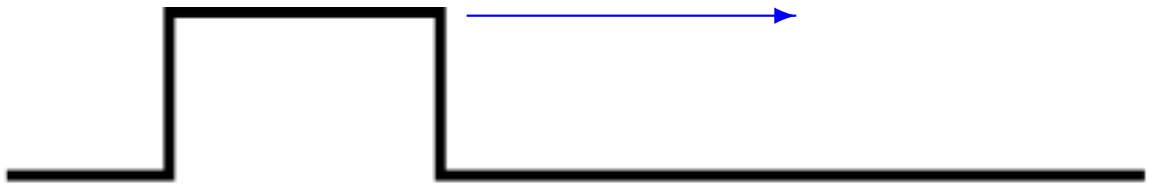

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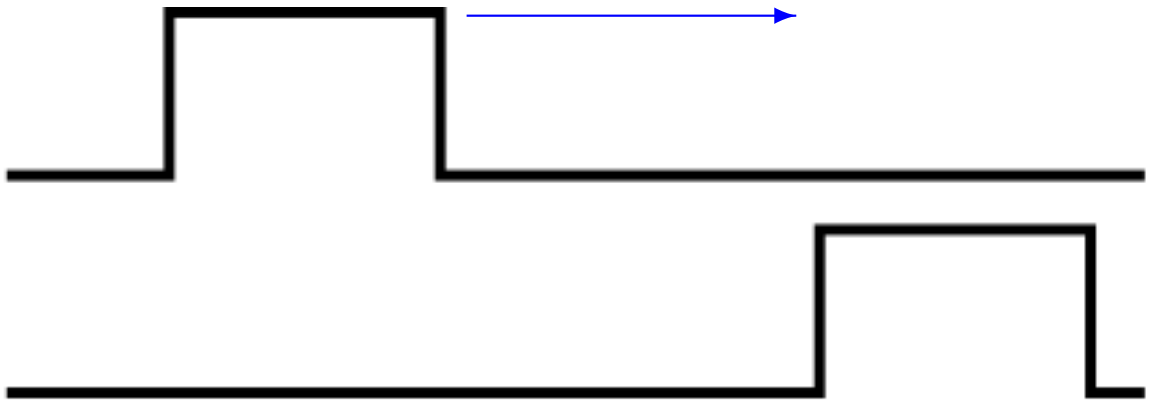
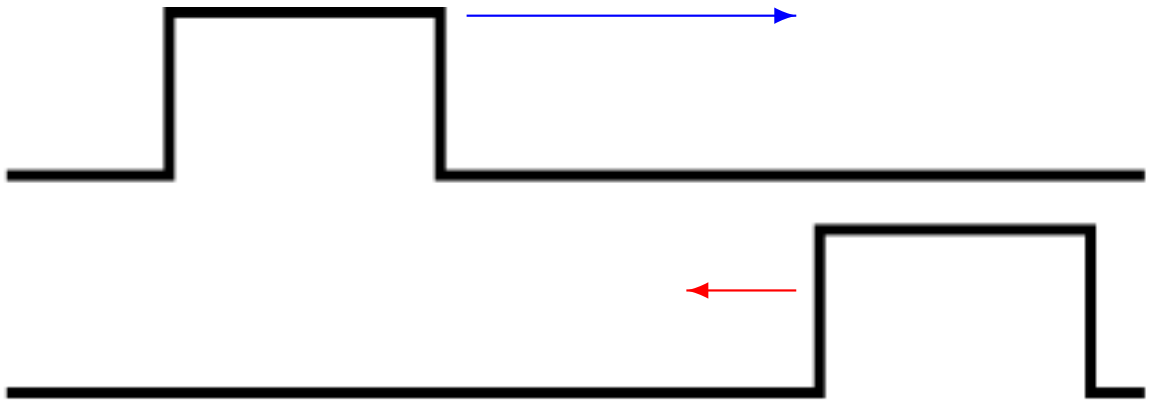


- transmit
- **receive**



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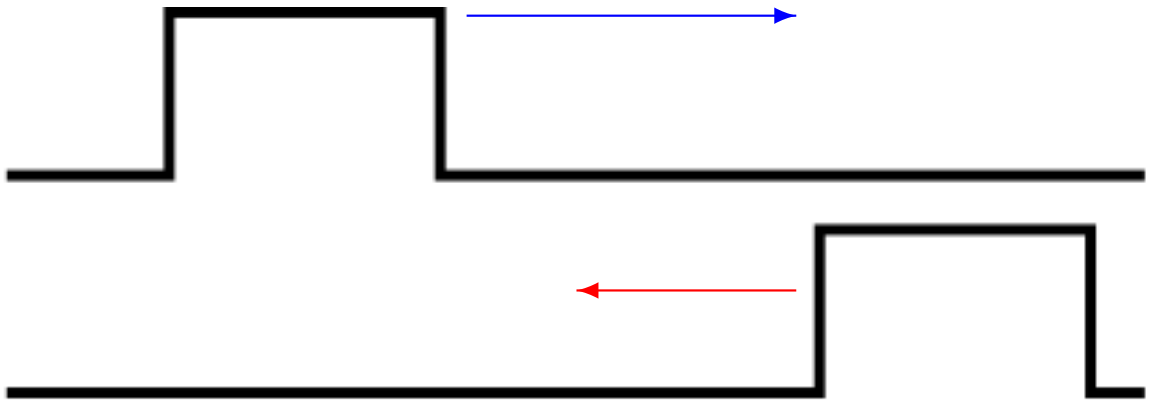

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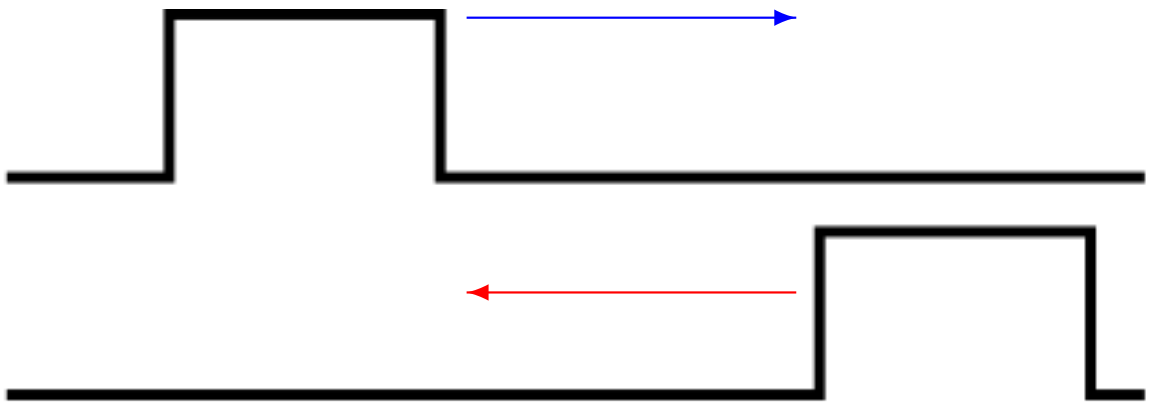

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Why is it $2d$?

V to F and F to V converters

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- **p.ChangeDutyCycle(*dc*)**

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  change frequency
- **p.ChangeDutyCycle(*dc*)**

  change duty cycle *(percent)*
- **p.stop()**

  stop PWM

Python PWM sample code

Python PWM sample code

```
import time
import RPi.GPIO as GPIO
GPIO.setmode(GPIO.BOARD)
GPIO.setup(12, GPIO.OUT)
p = GPIO.PWM(12, 50)  # chan=12 freq=50Hz
p.start(0)
try:
    while 1:
        for dc in range(0, 101, 5):
            p.ChangeDutyCycle(dc)
            time.sleep(0.1)
except KeyboardInterrupt:
    pass
p.stop()
GPIO.cleanup()
```

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Note: These pins are shared with the audio subsystem.