A LEVEL DESIGN ENGINEERING

6.6 ELECTRONIC OUTPUT COMPONENTS

Learning objectives

- ❑ What are the common electronic output components?
- ❑ Which circuit symbols are used to represent the components?
- ❑ What are the common applications of these components?
- ❑ Why are they used?

Key words:

Components, active, passive, device, input, output, application, sensor

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Starter

What can you remember about input components?

Which types of input components would be used in these products/applications?

PIR (Passive Infrared)

LDR
(Light Dependent Resistor)

Thermistor

Accelerometer

Variable resistor

Ultrasonic

Ultrasonic / thermistor / accelerometer / PIR (Passive Infrared) / variable resistor / LDR (Light Dependent Resistor)

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What can you remember about systems?

What are the inputs and outputs to a computer system?

Keyboard

Mouse

Microphone

Monitor

Printer

Speaker

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Motor

LED Display

Buzzer

Lamp

How many output components can you name?

Speaker

Heater

LED

Stepper motor

Servo motor

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

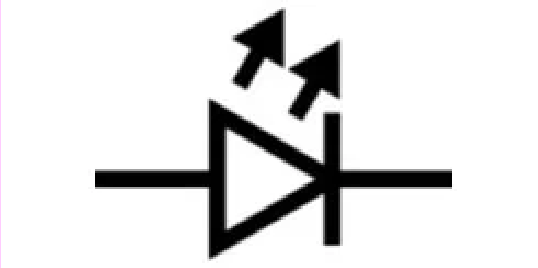
What are the <u>light output</u> components?

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

LED - Light Emitting Diodes

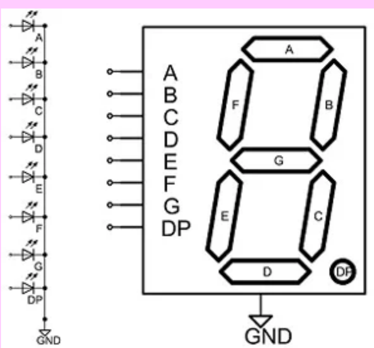


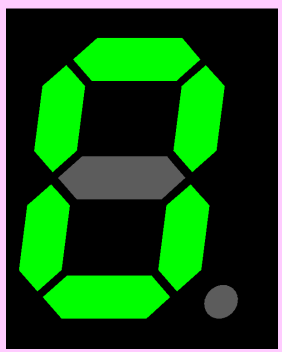
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

LED display – 7 segment



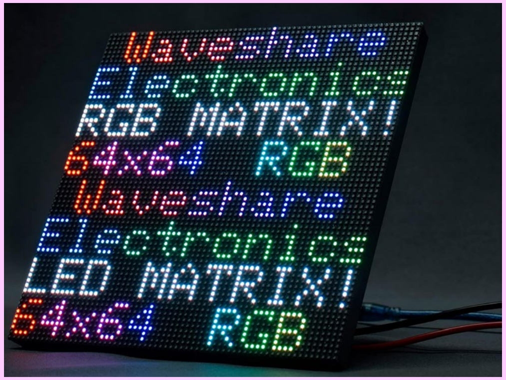


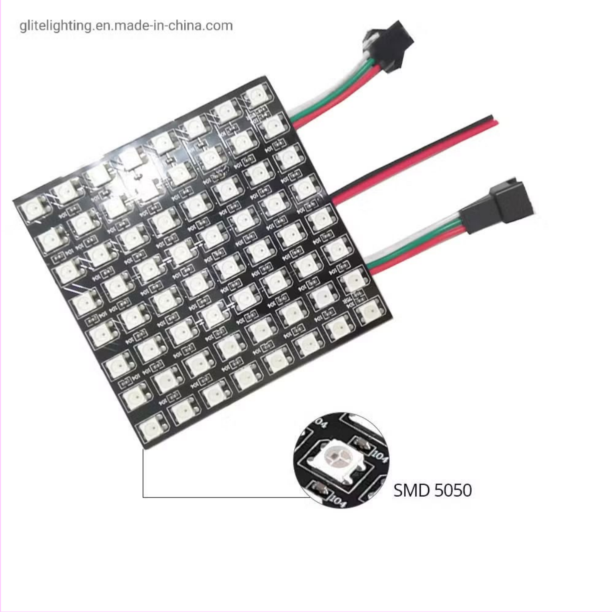
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

LED display – LED Matrix





Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

LCD (Liquid Crystal Display)

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

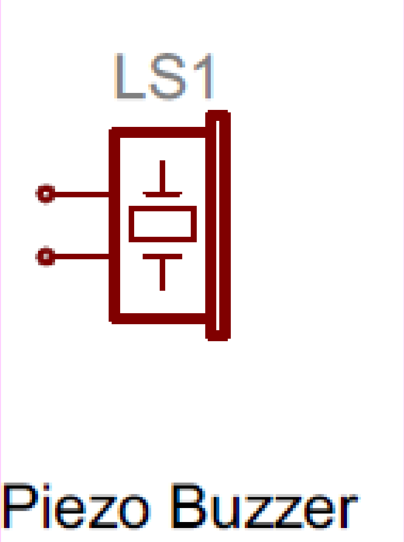
What are the <u>sound output</u> components?

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Piezo transducer

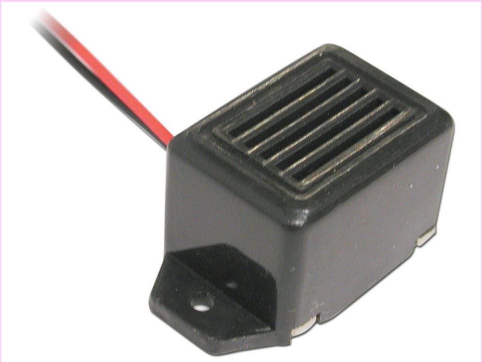


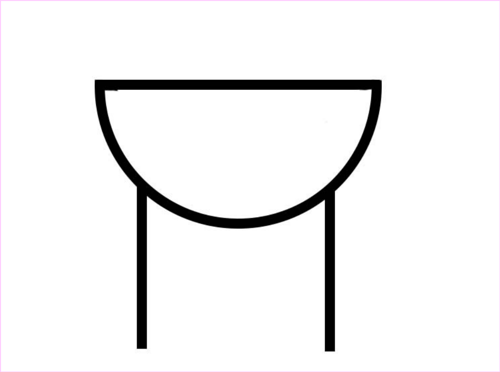
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Buzzer



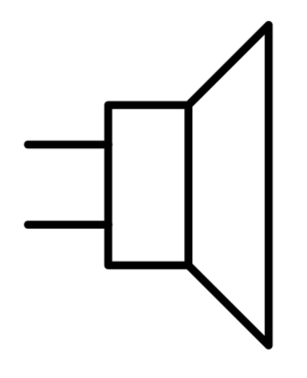


Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Speakers



Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

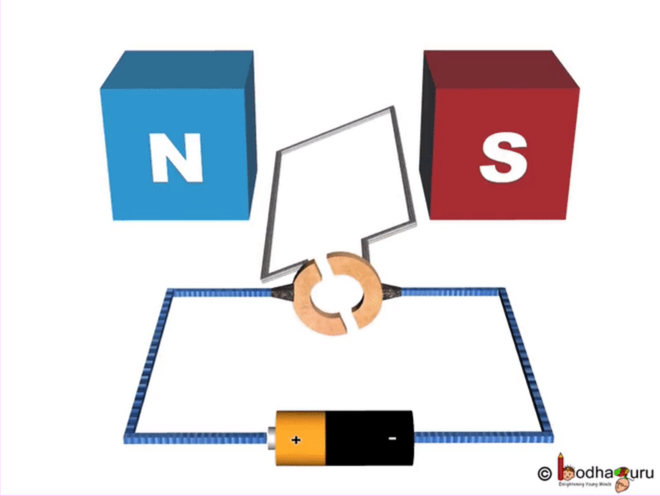
What are the <u>motion output</u> components?

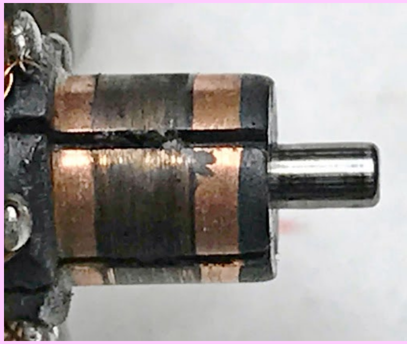
Learning objectives:

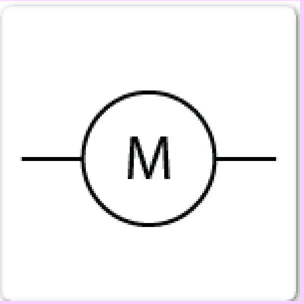
- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Motors – Standard/brush







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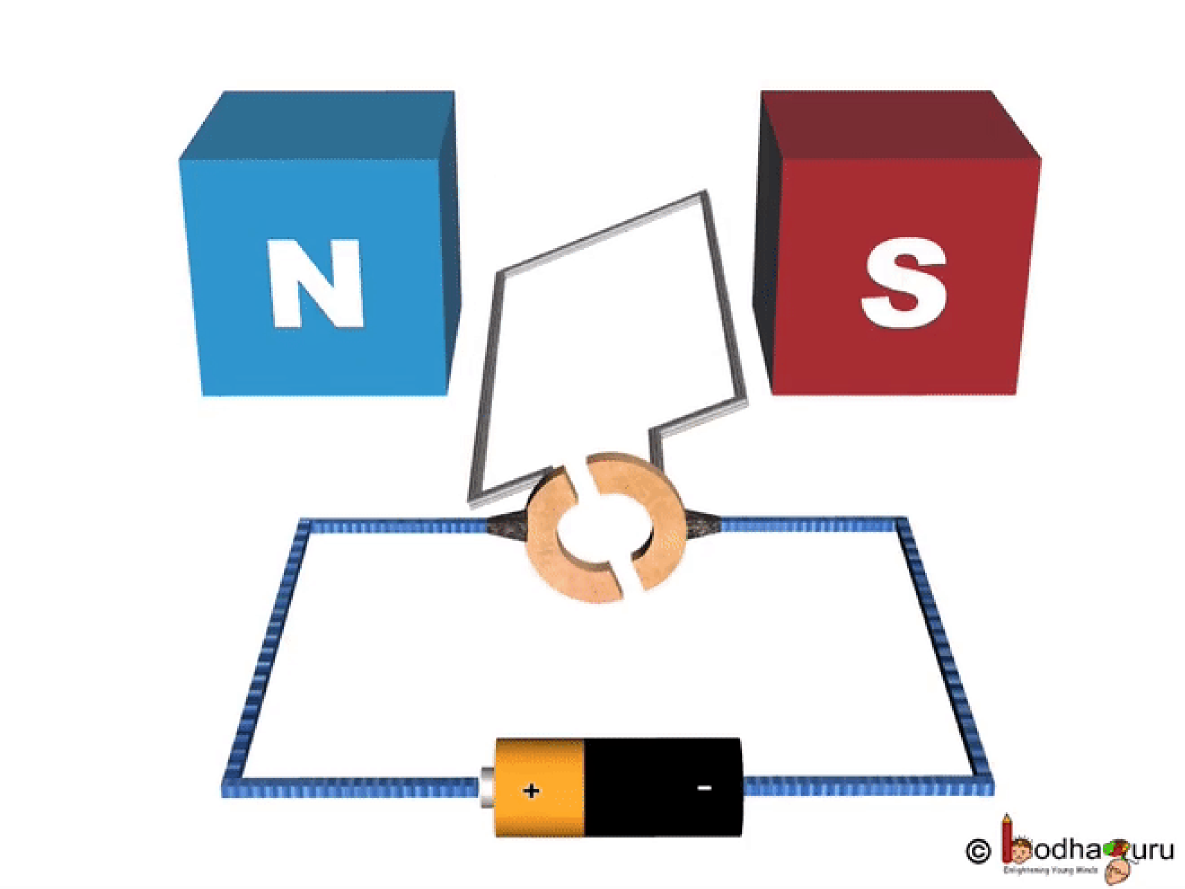
Explanation



Learning objectives:

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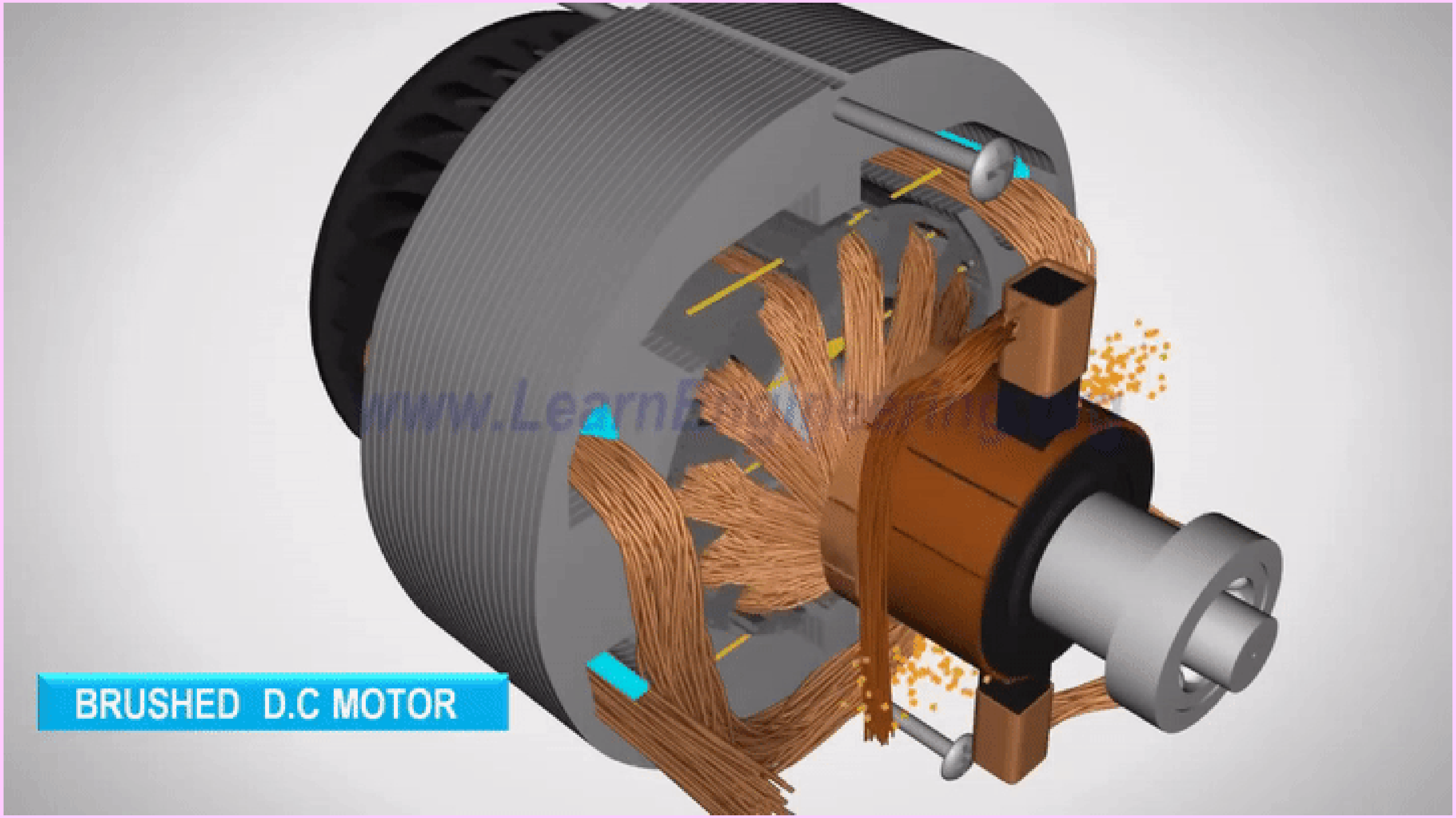
Explanation



Learning objectives:

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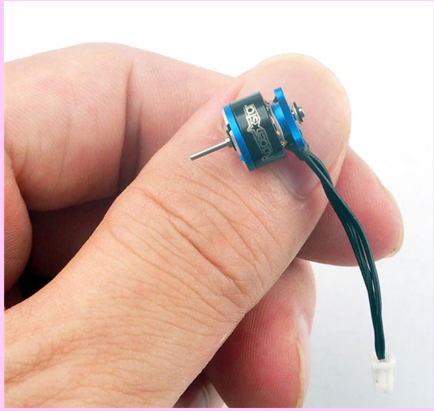
- ❑ What are their common applications?

Explanation

Motors – Brushless

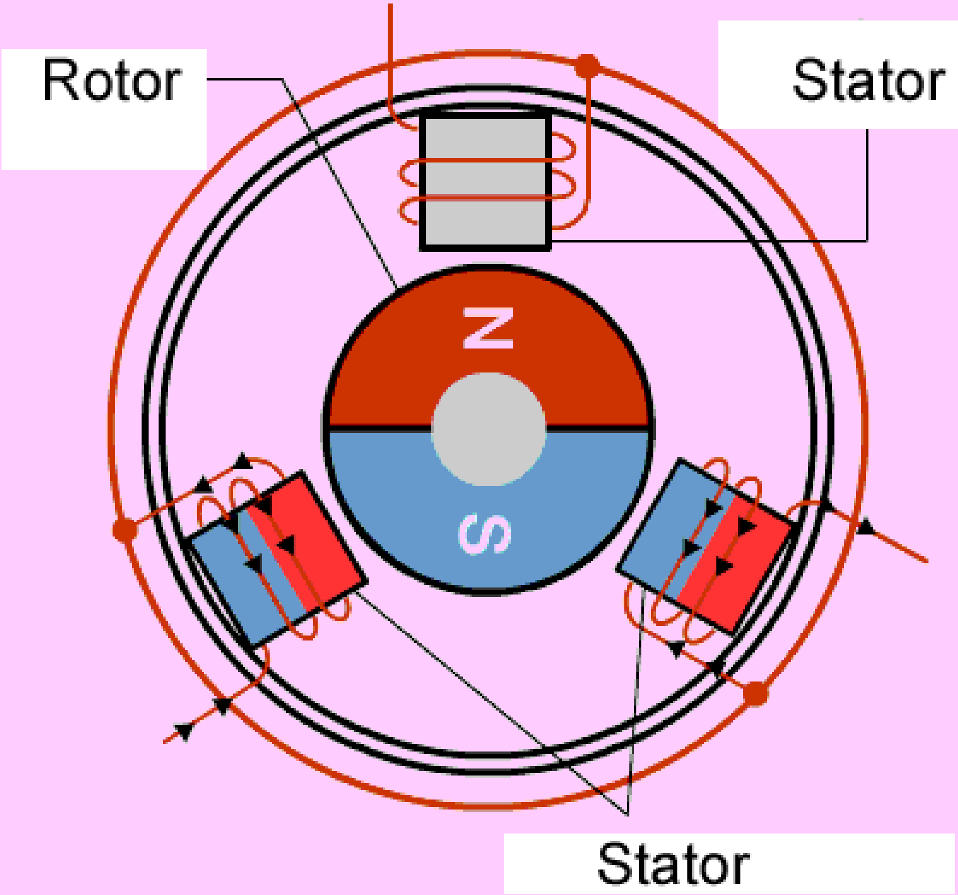


Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

How do brushless motors work?



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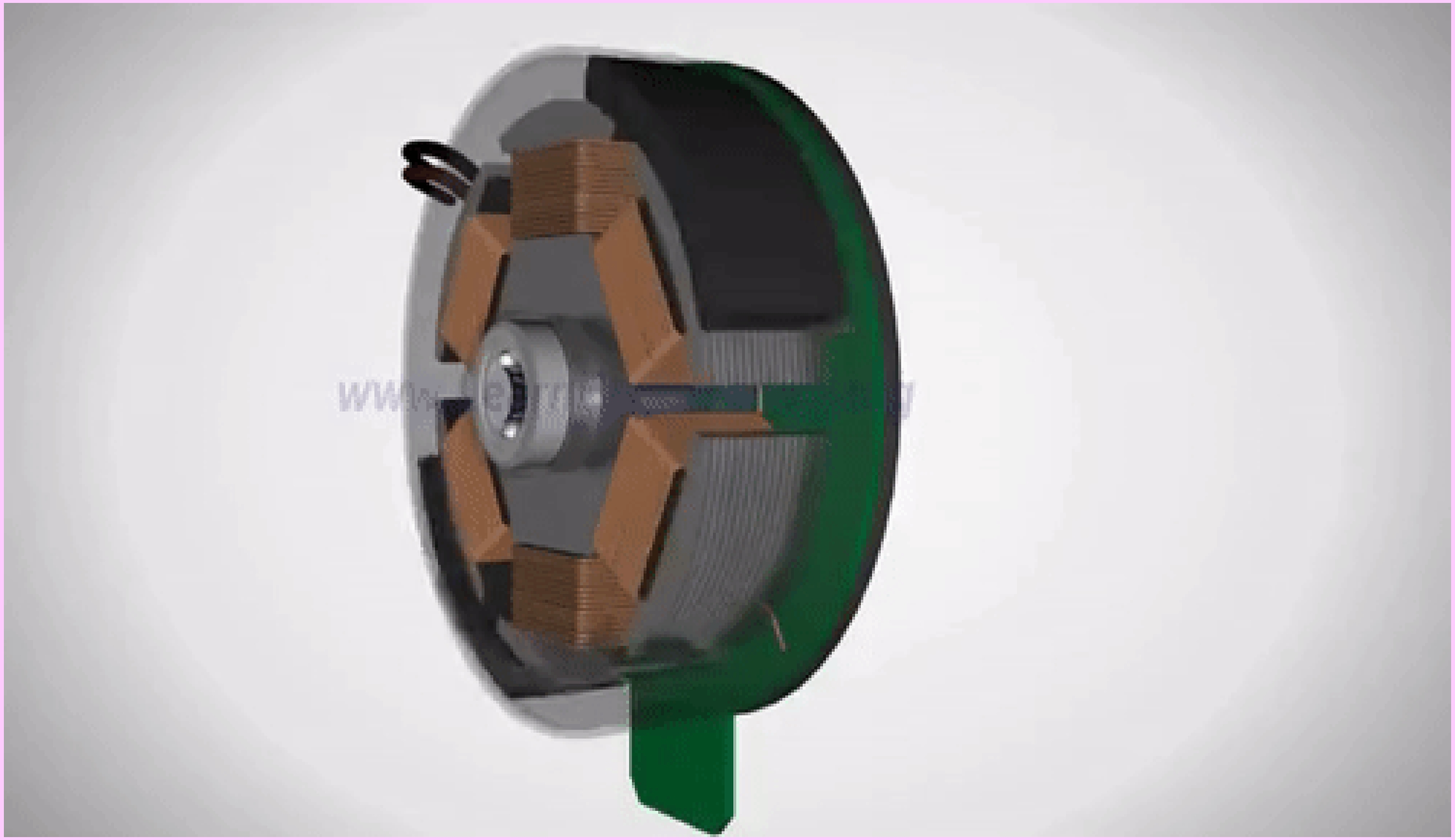
Explanation

How do brushless motors work?

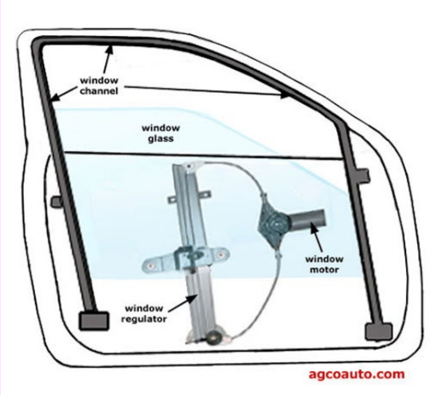


Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Motors – Geared motor

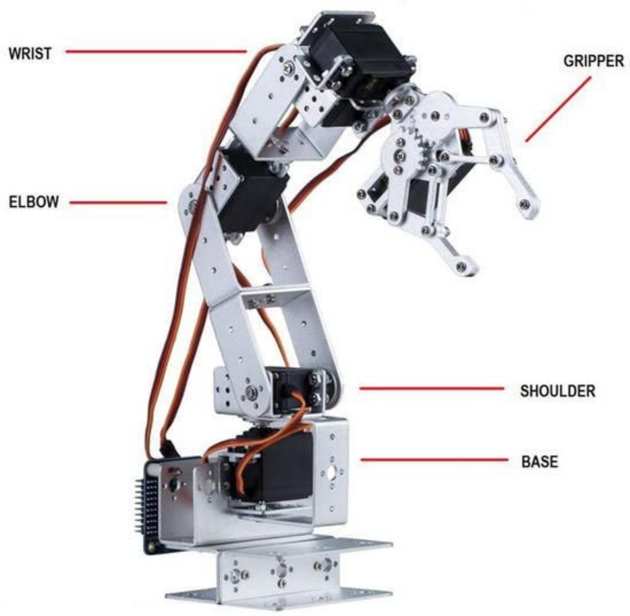


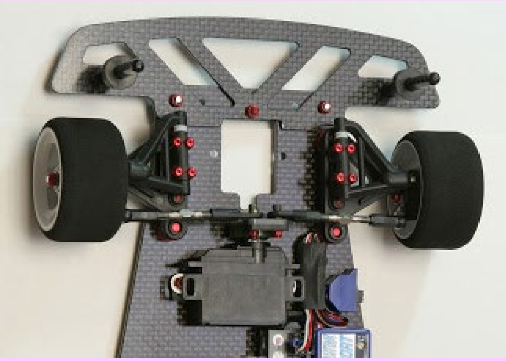
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Motors – Servo motor



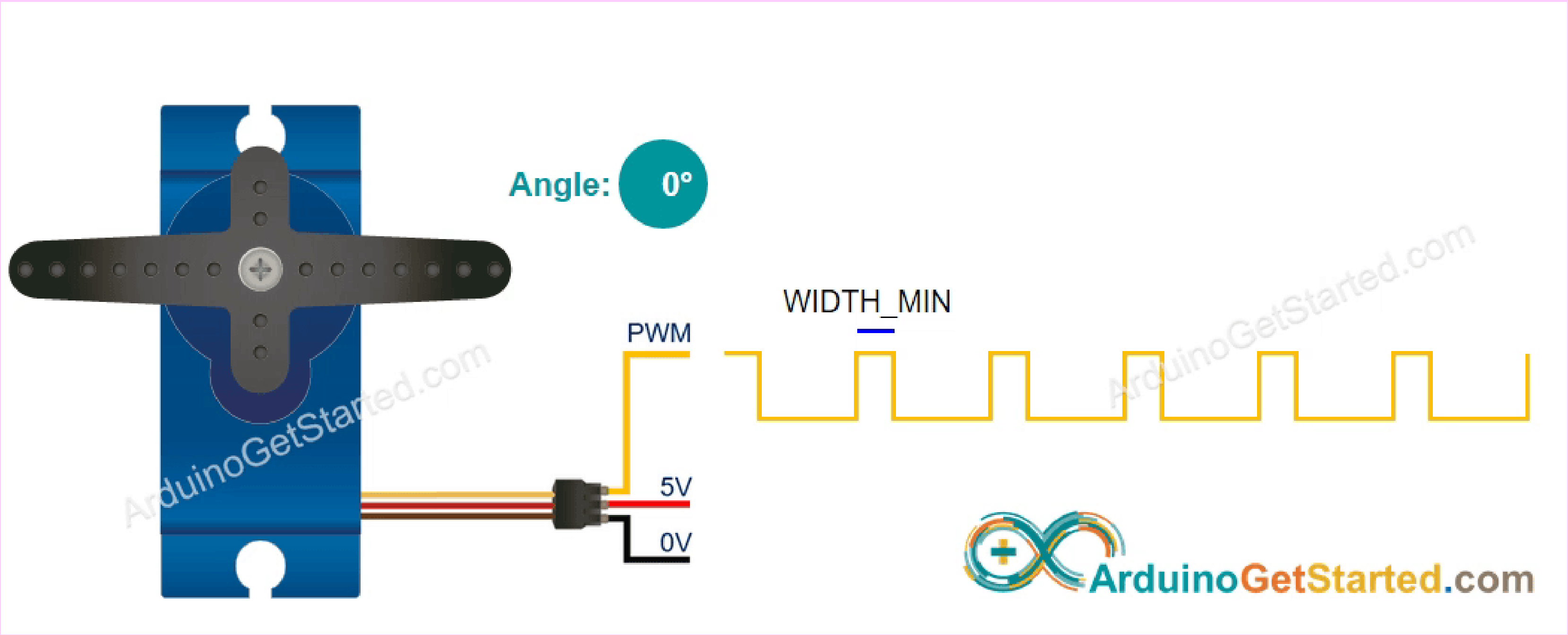


Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

How do servo motors work?



https://www.youtube.com/watch?v=GXHQemuRtWU

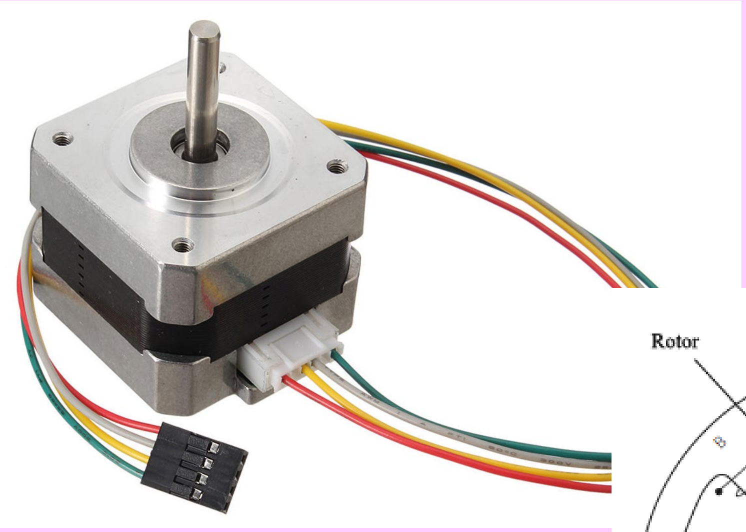
https://www.youtube.com/watch?v=hdSBnw9IwXw

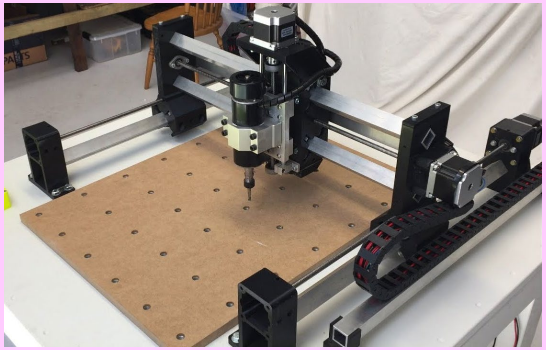
Learning objectives:

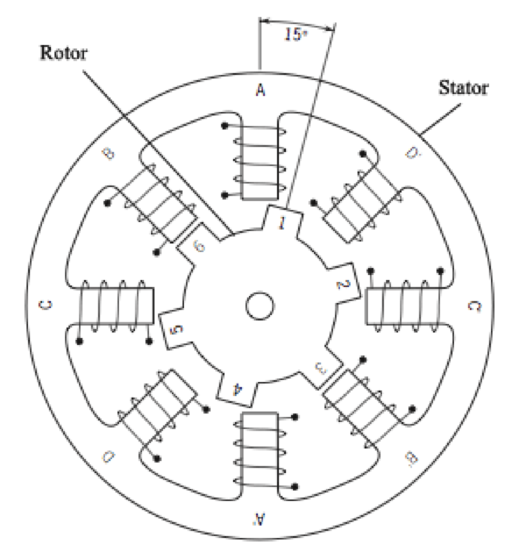
- ❑ What are the common electronic output components?
- ❑ What are their common applications?

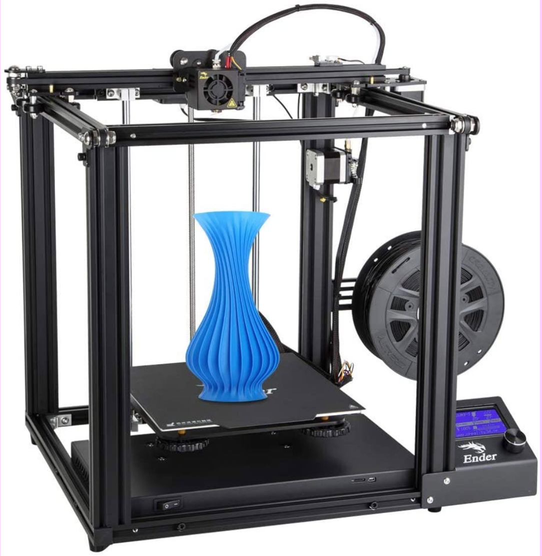
Explanation

Motors – Stepper motors









https://www.youtube.com/watch?v=09Mpkjcr0bo

Learning objectives:

- ❑ What are the common electronic output components?
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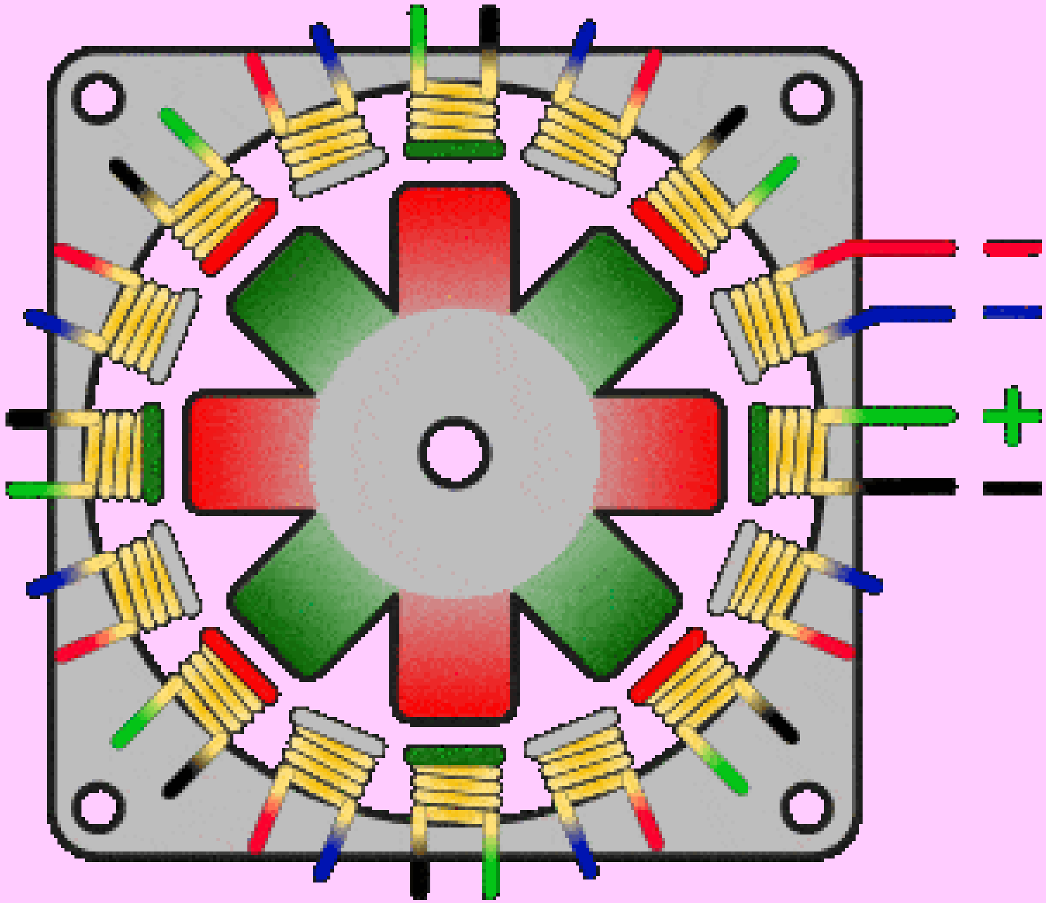
Explanation

How do stepper motors work?

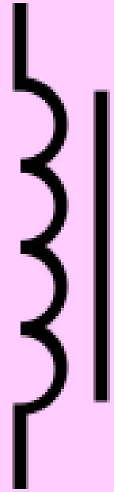


Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Solenoid



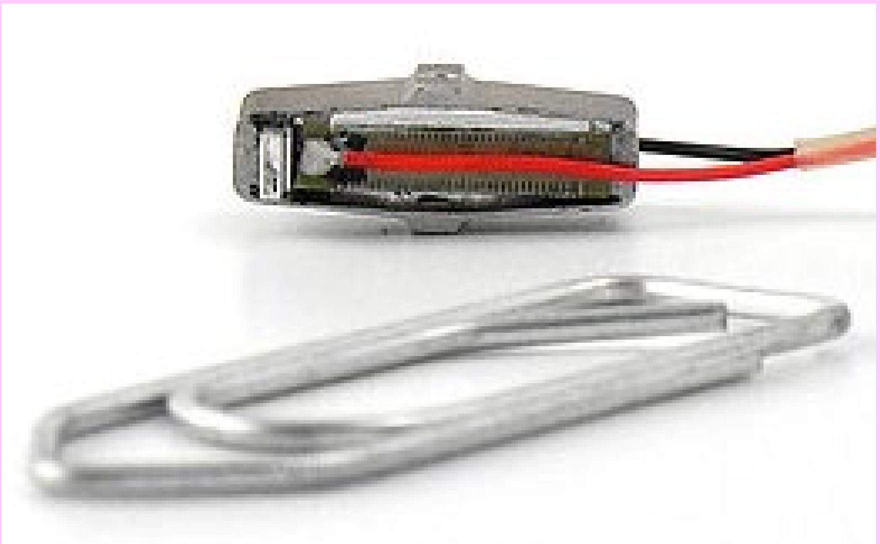
[Bing Videos](#)

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

Piezo actuator



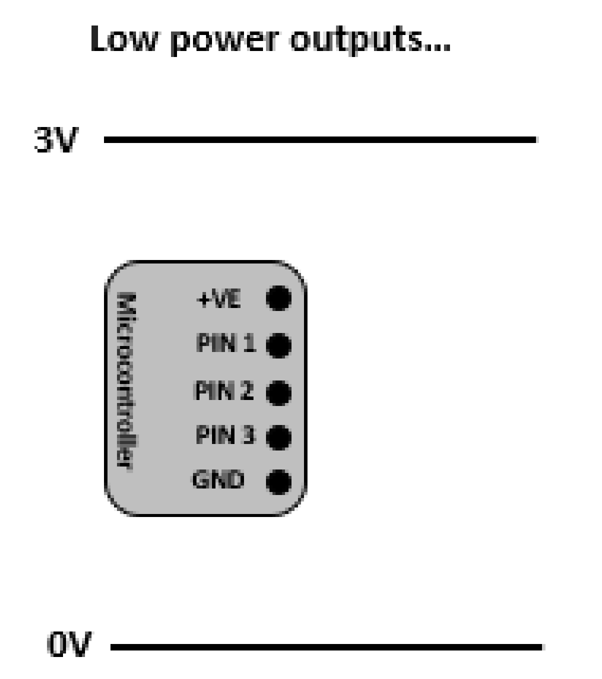
https://www.youtube.com/watch?v=-5jf_wwB_MI

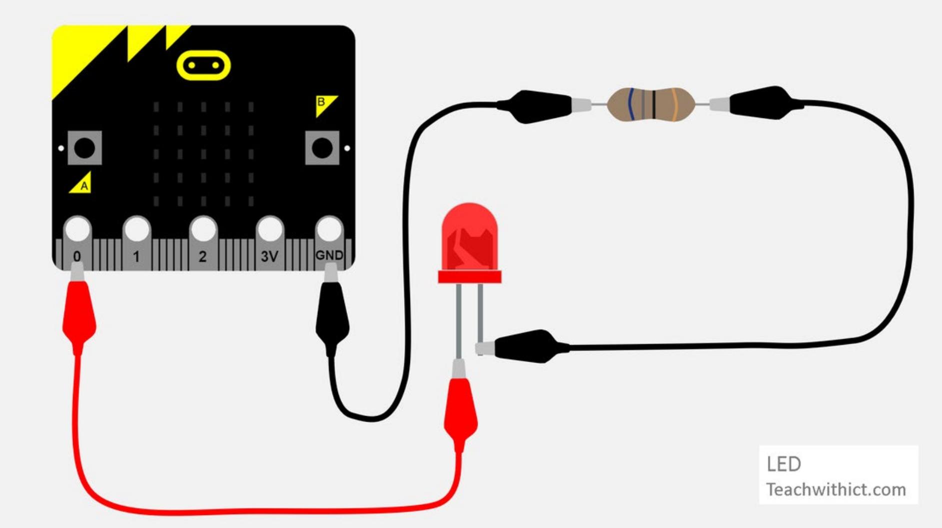
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

How can we connect <u>low power output devices</u> to a microcontroller?





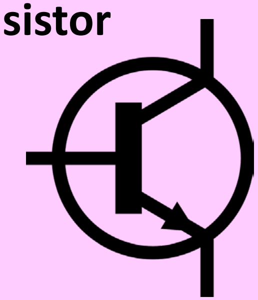
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

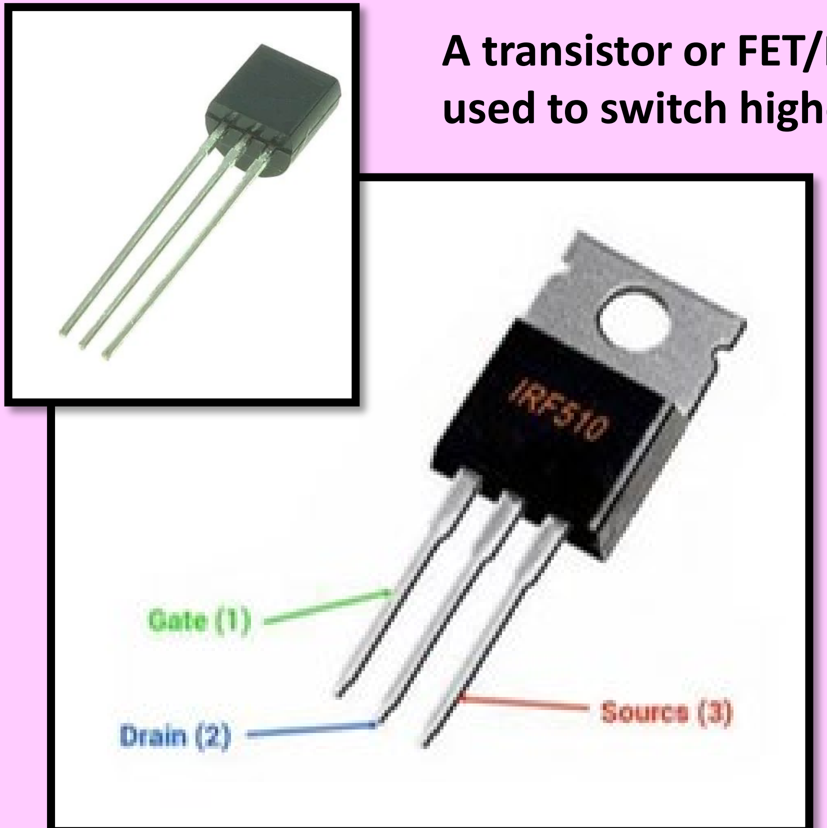
Explanation

How can we connect <u>high power output devices</u> to a microcontroller?

Transistor

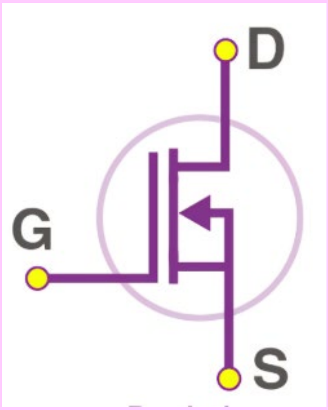


A transistor or FET/MOSFET must be used to switch higher currents.



FET (Field Effect Transistor)

MOSFET (Metal Oxide Semiconductor Field Effect Transistor)



Learning objectives:

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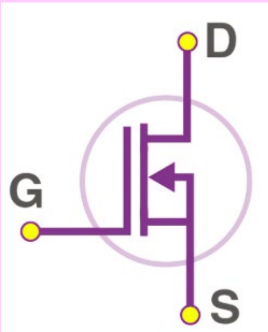
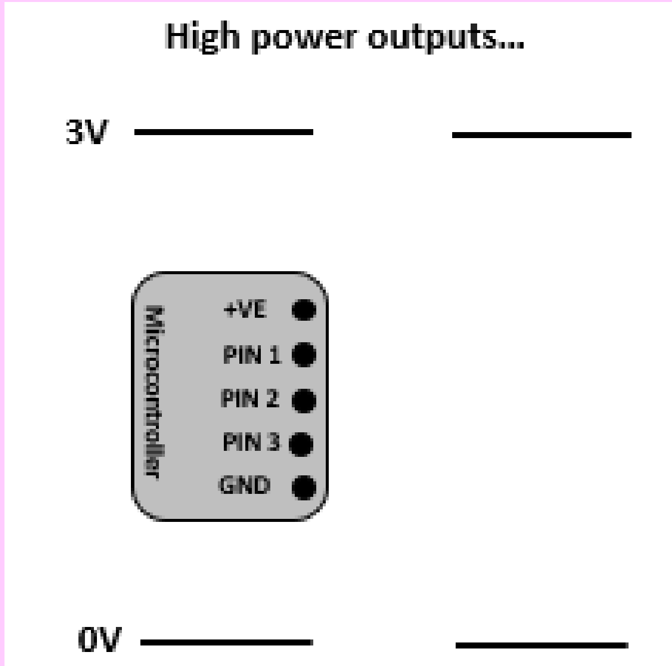
Explanation

How can we connect <u>High power output devices</u> to a microcontroller?





Learning objectives:

- ❑ What are the common electronic output components?
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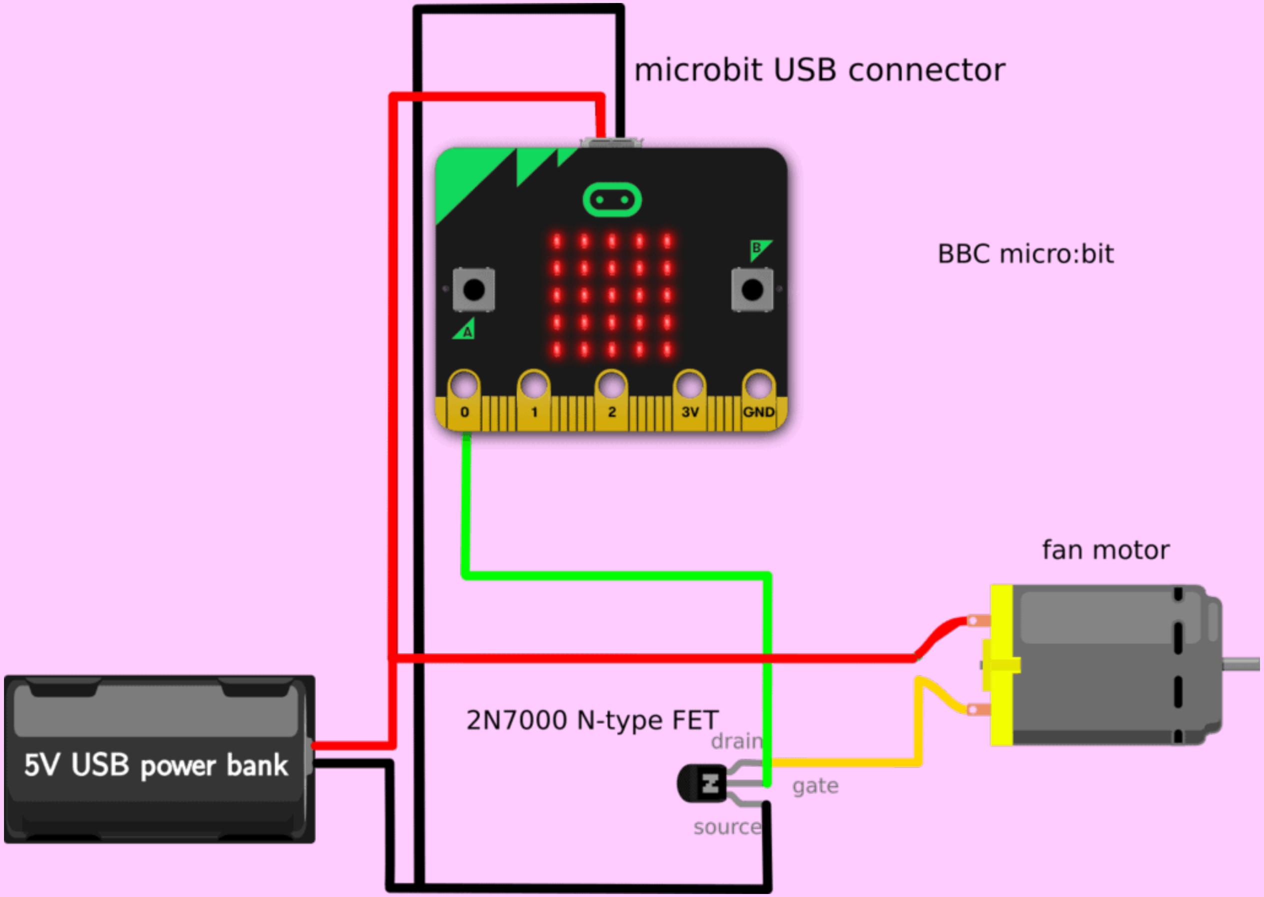
How can we connect <u>High power output devices</u> to a microcontroller?

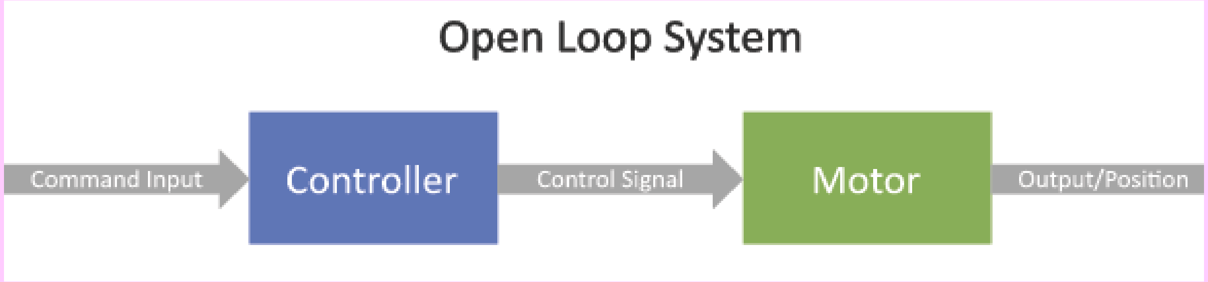


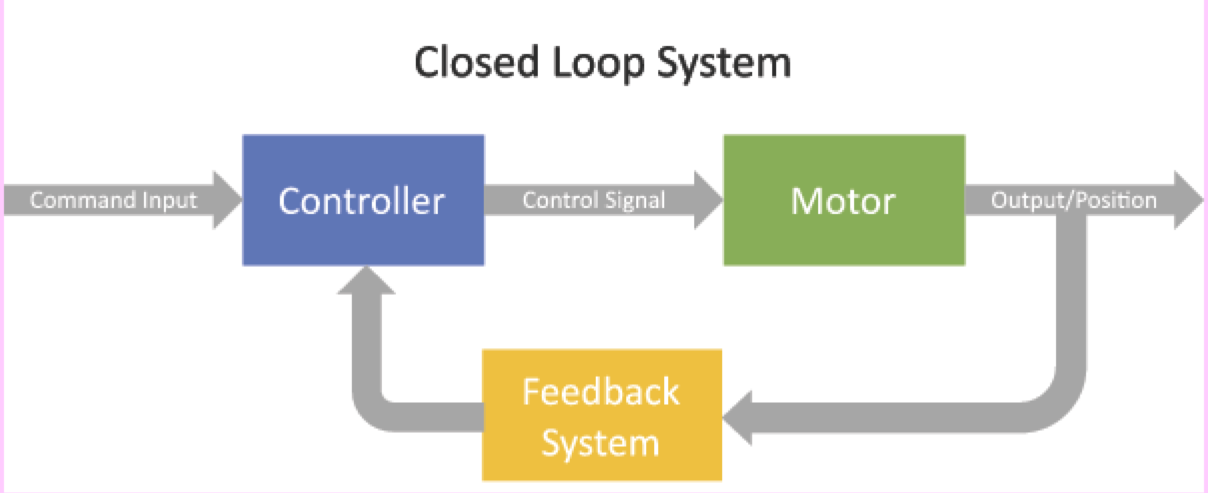
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is the difference between an open and closed loop system?





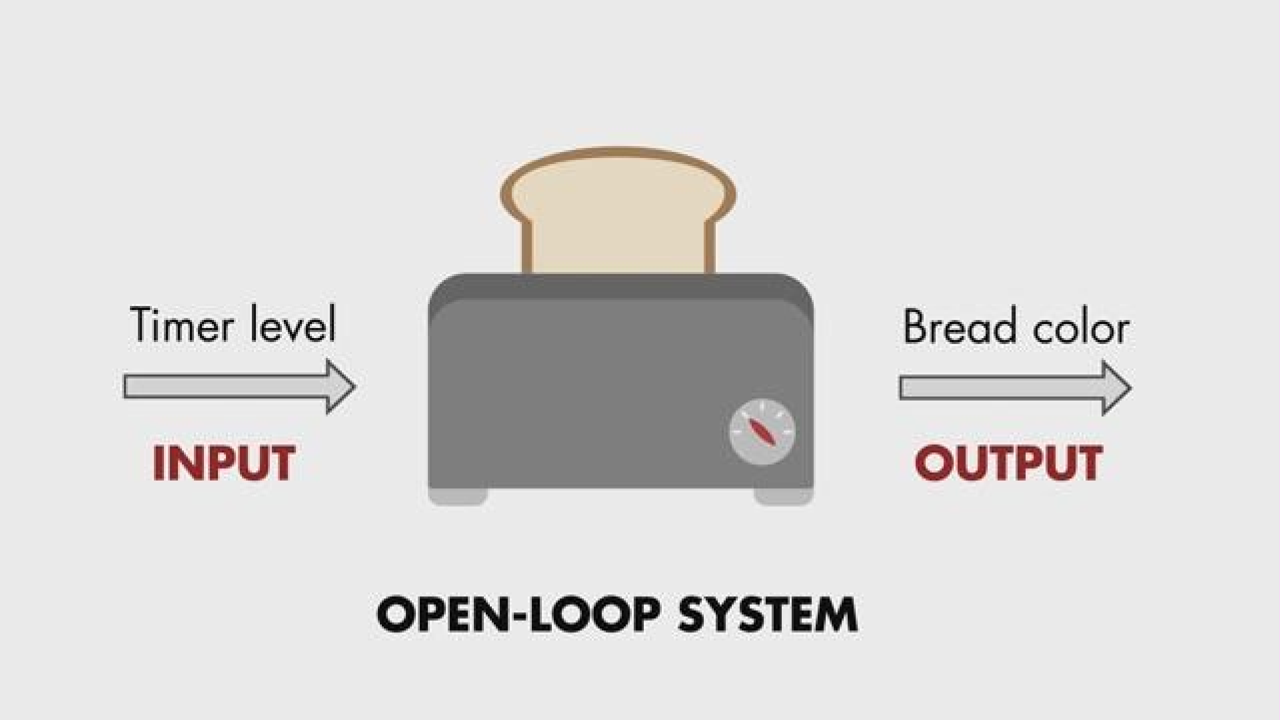
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is an example of an <u>open loop</u> system?

A standard electric toaster



Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What are the pros and cons of an <u>open loop</u> system?

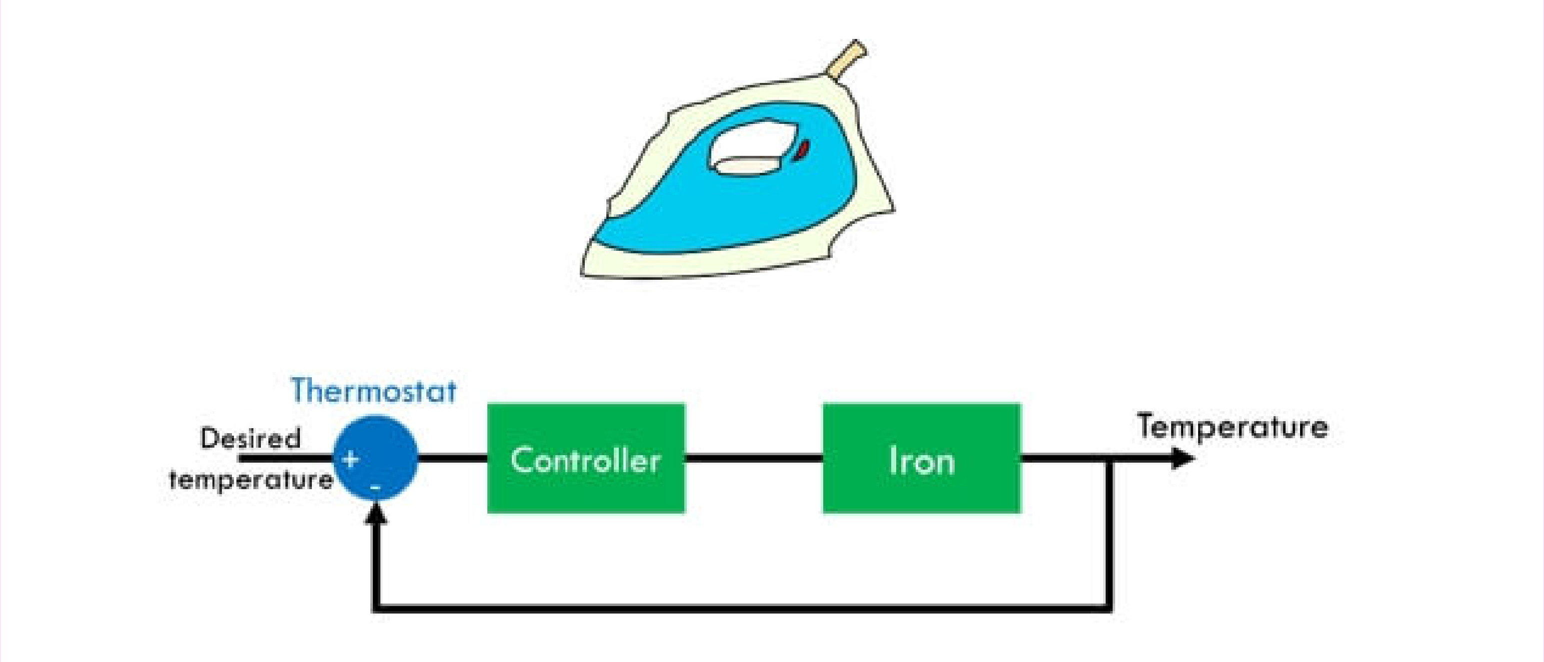
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is an example of an <u>closed loop</u> system?

A modern steam iron



Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is an example of an <u>closed loop</u> system?

An electric oven

Central heating system

Thermostatic control electric fan heater

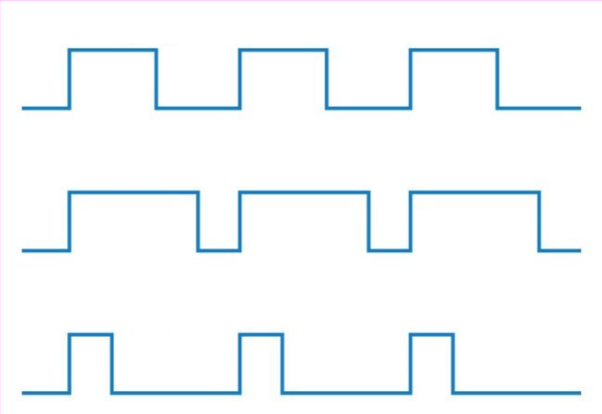
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is Pulse Width Modulation (PWM)?

-Pulse width modulation (PWM) is a technique that can produce an analogue output.



-The output is not a true analogue signal but rather a rapidly pulsed on-off signal

-The ratio of on-time to off-time determines the average analogue effect produced

VIDEO LINK

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What are the benefits of using <u>Pulse Width Modulation</u> (PWM)?

-PWM results in greater efficiency of DC motors.

-This method improves speed control and reduces power loss.

-The pulse reaches full supply voltage which in turn produces more torque.

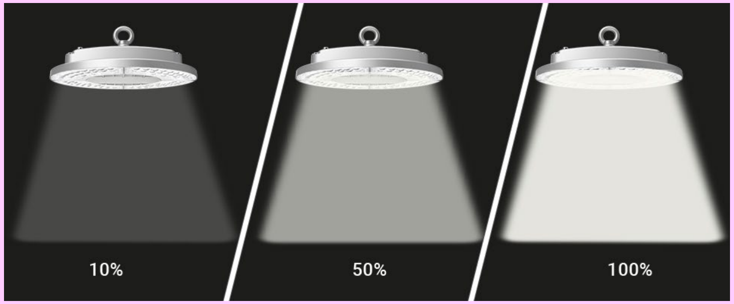
Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

How is Pulse Width Modulation (PWM) used?

Controlling motor speed



Dimming lights

Audio amplification

Learning objectives:

- ❑ What are the common electronic output components?
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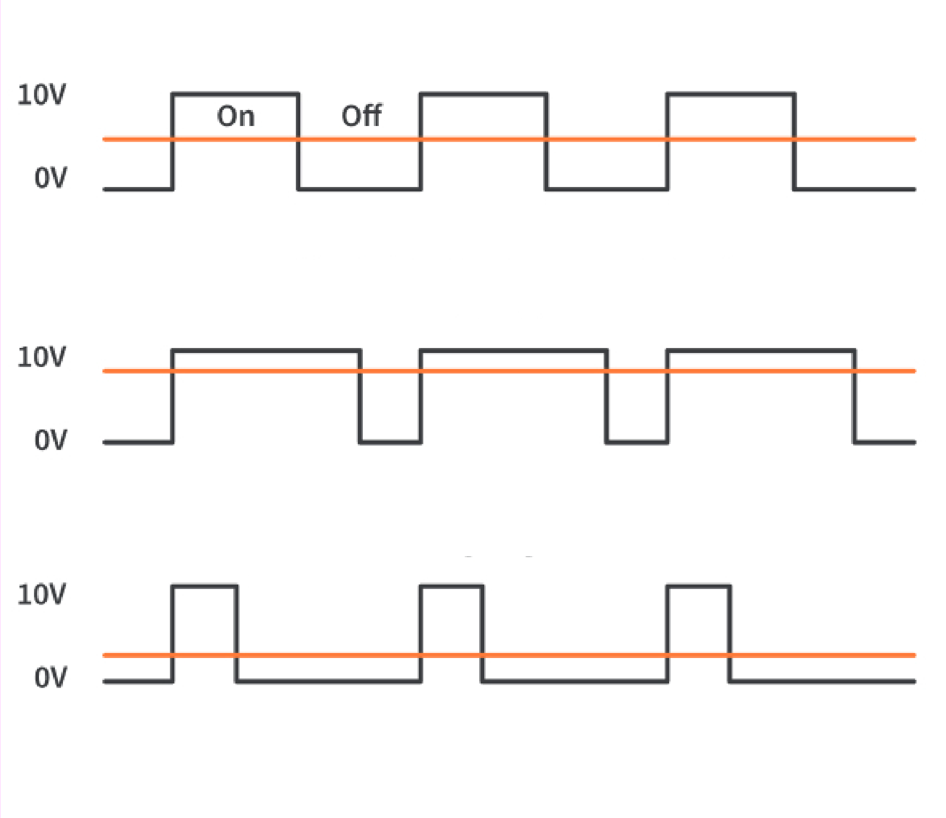
Explanation

How can Pulse Width Modulation be used to vary voltage?



Learning objectives:

- ❑ What are the common electronic output components?
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Explanation

How can Pulse Width Modulation be used to vary current?

Actual current = 5A

Actual current = 7.5A

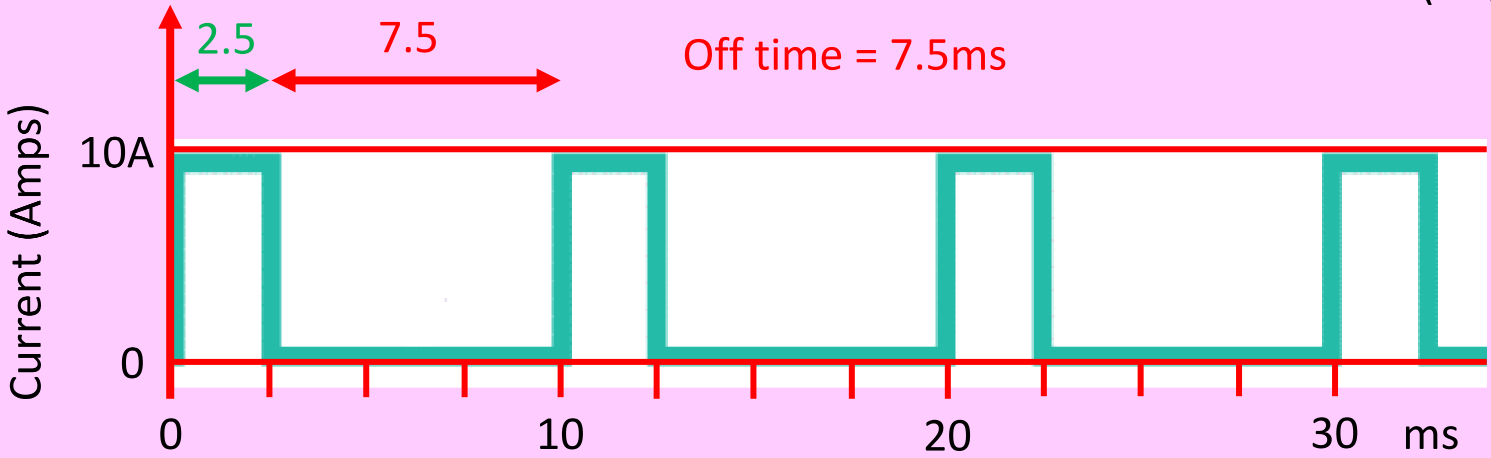
Actual current = 2.5A

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What do we mean by the term <u>duty cycle</u>?



$$duty\ cycle = \frac{2.5}{10}$$

$$duty\ cycle = 0.25$$

$$duty\ cycle = 25\%$$

$$Average\ current = 10 \times 0.25$$

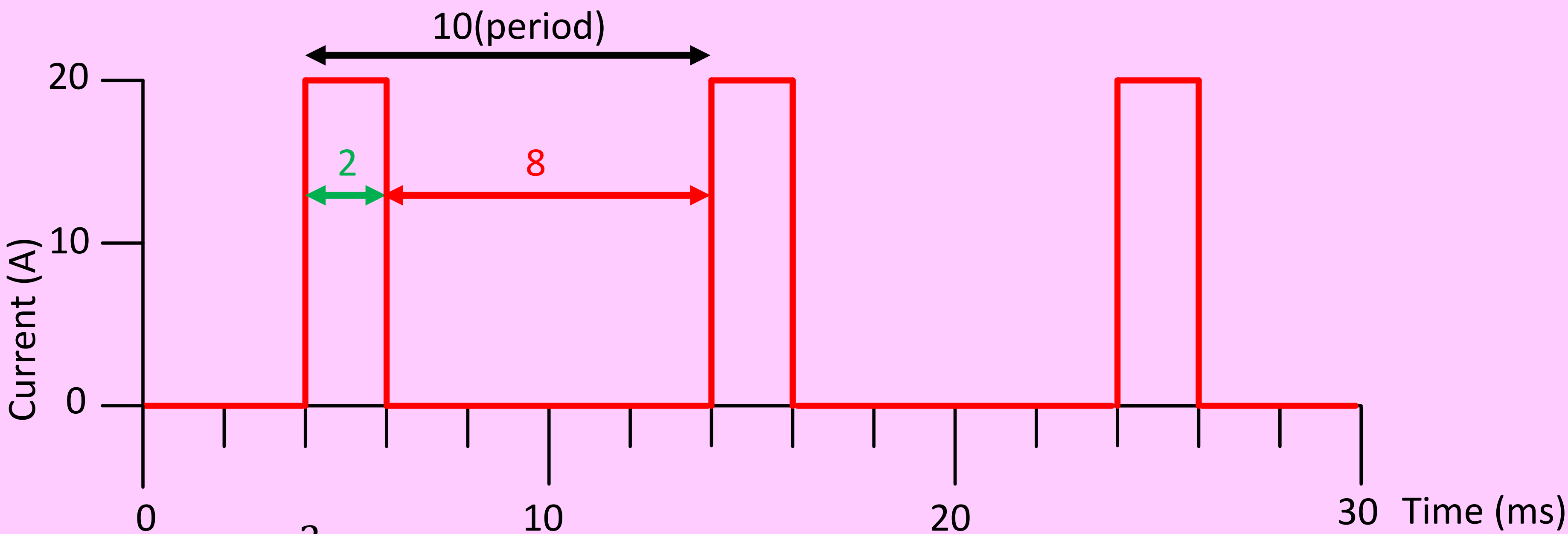
$$Average\ current = 2.5A$$

Learning objectives:

- ❑ What are the common electronic output components?
- ❑ What are their common applications?

Explanation

What is the <u>duty cycle</u> in this example?
What would the <u>average current</u> be?



$$duty\ cycle = \frac{2}{10}$$

$$duty\ cycle = \frac{1}{5}$$

$$duty\ cycle = 20\%$$

$$Average\ current = 20 \times 0.2$$

$$Average\ current = 4\ A$$

Learning objectives:

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- ❑ What are their common applications?