

# Challenge description

## Student Group

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## Challenge description

Pulse-width modulation (PWM) is widely used in modern electronics to control the power delivered to electrical loads. Typical applications include LED brightness control and motor speed control.

In PWM, the voltage applied to a load is rapidly switched on and off. When PWM is used to control an LED, a sufficiently high switching frequency prevents the human eye from perceiving the individual switching events. Instead, only the average brightness is perceived.

The brightness of the LED is determined by the duty cycle of the rectangular signal, which is defined as the ratio of the on-time to the signal period.

A constant supply voltage is available for the experiment. This raises the following questions:

- How can a constant voltage be converted into a PWM signal?
- How can the duty cycle of this signal be adjusted to control the brightness of the LED?

To answer these questions, two operational-amplifier circuits are investigated: the Schmitt trigger and the integrator. First, both circuits are analyzed separately. Afterwards, they are combined to form an oscillator that generates the required PWM signal. Finally, the circuit is modified to enable brightness control of the LED.

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