UNIVERSITY OF SANTO TOMAS
Faculty of Engineering
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FINAL PROJECT

MODELLING THE ANGLE-RESISTANCE RELATIONSHIP OF A B10K POTENTIOMETER

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Introduction

Potentiometers can be used in robotics and in everyday devices. They are commonly found in audio equipment for controlling volume, bass, or tone, and while also found in lighting for controlling brightness. A potentiometer, also known as a "pot," is a resistor that varies in resistance in response to movement of its sensing element. The voltage output is changed as a result, producing a proportionate analog signal that can be used to indicate motion, pressure, or location (Ceo, 2025).

In a potentiometer, two terminals are attached to the ends of a resistive element (usually a carbon mixture), while the third terminal is connected to a movable wiper. The wiper's location determines the division of resistance between the terminals (Keim, n.d.). There according to are three types of potentiometers: rotary, linear, and digital, with rotary being the most common (see Figure 1). They can also be classified by taper, which describes how resistance changes with movement. Most tapers are either linear taper with indicator "B" or log taper with indicator "A".

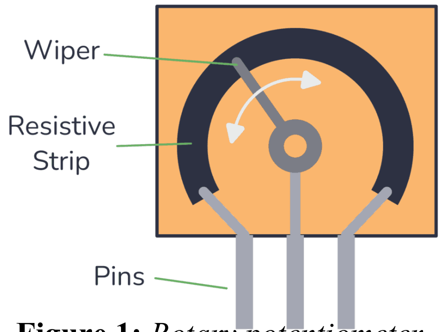

Figure 1: *Rotary potentiometer*

The component used for this study is a B10K rotary potentiometer and has a linear (B) taper with a rated resistance of 10 kΩ and is a single-turn device (Makerlab Electronics, n.d.-b). Since it is single turn, its rotation is typically about 270° maximum, or around 3/4 of a full turn (Keim, n.d.).

In this study, we looked at how a B-type (linear taper) rotary potentiometer changes its resistance as you turn it. The independent variable is the measure of rotation, θ (in degrees), taken from a starting point. The dependent variable is the resistance, $R(\theta)$ (in ohms), measured between the middle terminal and the same outer terminal used as the starting point. Two constants are included in the model: R_{max}, the maximum resistance of the potentiometer, and θ_{max}, the maximum allowable rotation.

These variables show a relationship between the rotation angle and the resistance that can be used to estimate resistance for any angle with a restriction of $0 \leq \theta \leq \theta_{max}$. With this, the model can be obtained using a linear equation, where the resistance varies directly with the angle of rotation. Therefore, the resistance as a function of angle is modeled by

$$R(\theta) = R_{max}\left(\frac{\theta}{\theta_{max}}\right), \quad \text{for } 0 \leq \theta \leq \theta_{max} \tag{1}$$

where:

- $R(\theta)$ = resistance at angle θ (Ω)
- R_{max} = maximum resistance (Ω)
- θ = angle of rotation (degrees)
- θ_{max} = maximum rotation angle (degrees)

For a B10K potentiometer,

$$R(\theta) = 10{,}000\left(\frac{\theta}{270°}\right), \quad \text{for } 0 \leq \theta \leq \theta_{max} \tag{2}$$