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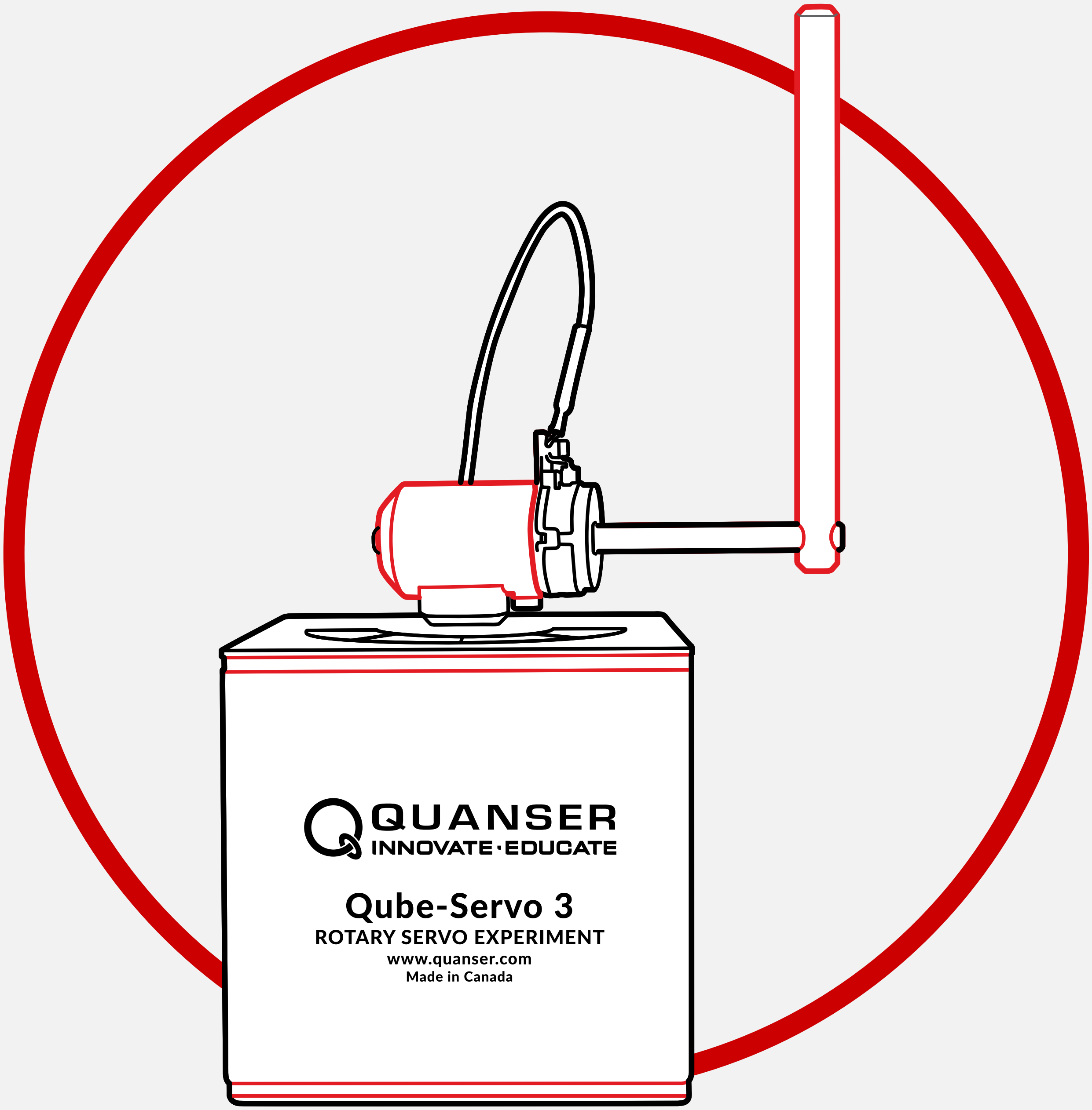


# Qube-Servo 3

## PD Position Control

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Caution

**This equipment is designed to be used for educational and research purposes and is not intended for use by the public.** The user is responsible for ensuring that the equipment will be used by technically qualified personnel only. Users are responsible for certifying any modifications or additions they make to the default configuration.

**FCC Notice** This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

**Industry Canada Notice** This Class A digital apparatus complies with CAN ICES-3 (A). Cet appareil numérique de la classe A est conforme à la norme NMB-3 (A) du Canada.
**Japan VCCI Notice** This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことが あります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI–A

**Waste Electrical and Electronic Equipment (WEEE)**
This symbol indicates that waste products must be disposed of separately from municipal household waste, according to Directive 2012/19/EU of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces the environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources.

**电子信息产品污染控制管理办法 (中国 RoHS)**

中国客户Quanser Consulting Inc. 关于关于限制在电子电气设备中使用某些有害成分的指令 (RoHS)。

**CE Compliance** CE

This product meets the essential requirements of applicable European Directives as follows:
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

**Warning**: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Qube-Servo 3 – Application Guide

# PD Position Control

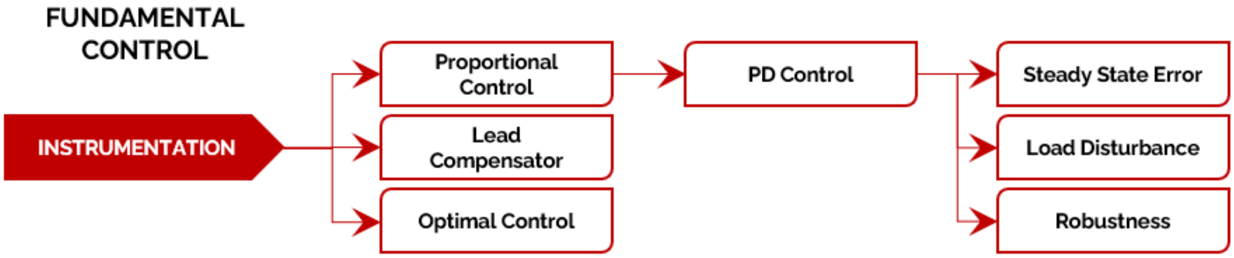
## Why explore PD Control?

A PD (Proportional-Derivative) controller combines two control actions to improve system performance in DC motors. The proportional term generates a control signal based on the error between desired and actual position, while the derivative term responds to how quickly this error is changing. This derivative action acts as a form of predictive control, anticipating future errors by looking at how quickly the error is changing. In motor applications, this combination works like having a spring (P term) and a damper (D term) working together, helping achieve faster response times while reducing oscillations. While PD control provides good dynamic response and is relatively simple to implement, it may not completely eliminate steady-state error in the system.

## Background

This lab is part of the Fundamental Control skills progression of the Qube-Servo 3. This will give you hands-on experience in applying fundamental control techniques to a DC motor system. It will help you understand how different control strategies can be used to regulate the motor's speed and position, while also understanding the impact of load disturbances and the importance of system robustness.

The lab progression is as follows:




Prior to starting this lab, please review the following concept reviews (should be located in Documents/Quanser/4_concept_reviews/),

- Concept Review – Controls → PID Control (PID Control, Proportional Control and For Qube-Servo/PD Position Control sections).

## Getting started

In this lab, you will implement PD control onto the Qube-Servo 3. Using PD control, you will adjust the control gains to gain intuition on the effects of changing the proportional and derivative control gains. Then, you will compare the closed loop transfer function of the system with the standard second order characteristic transfer function. You will calculate the control gains required to achieve certain peak times and percent overshoots. Finally, you will validate these calculations by implementing those calculated control gains on the Qube.

Ensure you have completed the following labs

- **Hardware Interfacing Lab**
- **Filtering Lab**
- **Proportional Control Lab**

Before you begin this lab, ensure that the following criteria are met.

- If using a physical Qube-Servo 3, make sure it has been setup and tested. See the Qube-Servo 3 Quick Start Guide for details on this step. Make sure the inertia disc load is attached to the Qube-Servo 3.
- If using the virtual Qube-Servo 3, make sure you have Quanser Interactive Labs open in the Qube 3 - DC Motor → Servo Workspace.
- You are familiar with the basics of Simulink. See the [Simulink Onramp] for more help with getting started with Simulink.