QUBE™-SERVO 2

Low cost, self-contained servomotor solution for undergraduate mechatronics and control labs.

See system specifications on reverse.

QUANSER QUALITY AND PRECISION AT AN AFFORDABLE PRICE

The Quanser QUBE™-Servo 2 is a fully integrated lab experiment, designed for teaching mechatronics and control concepts at the undergraduate level.

Integrating Quanser-developed QFLEX 2 computing interface technology, QUBE-Servo 2 offers educators more flexibility in lab configurations, using a PC, or microcontrollers, such as NI myRIO, Arduino and Raspberry Pi[1]. With the comprehensive course materials included, you can build a state-of-the-art undergraduate teaching lab for your mechatronics or control courses, and engage students in various design and capstone projects.

HOW IT WORKS

The QUBE-Servo 2 experiment consists of a DC motor with an optical encoder providing position and velocity feedback, a built-in amplifier with integrated current sensor, a data acquisition device and a QFLEX 2 computing interface.

The experiment includes two add-on modules - an inertia disk and a pendulum. With a quick-connect interface, you can easily attach the module, or remove it while the controller is running to observe the effect of different inertias on a controller response. Moreover, you can design and 3D print your own add-on modules to expand the scope of the experiment, or to create an engaging student project[2].

The QUBE-Servo 2 also has a user-controllable tri-color LED strip. It can be programmed to indicate state, power, or other control performance parameters of the experiment.

QUBE-SERVO INTERFACE OPTIONS

The QUBE-Servo 2 is available with two different, easily interchangeable interface panels[1]:

- QUBE-Servo 2 USB experiment (with QFLEX 2 USB panel) interfaces to Quanser's control software running on your lab's PC via a standard USB 2.0 connection. The QUBE-Servo 2 USB can be used with MATLAB®/Simulink® and Quanser QUARC software, or with LabVIEW™, using the Quanser RCP software. With the USB version of the experiment, you can take full advantage of the comprehensive course materials and lab experiments for your controls-based courses and projects.
- QUBE-Servo 2 Embedded experiment (with QFLEX 2 Embedded panel) interfaces to your microcontroller (not included with the QUBE-Servo 2 Embedded) via SPI connection. The QUBE-Servo 2 Embedded does not require any additional software. This option is ideal to expose students to various microcontroller techniques, as well as for final (capstone) projects in mechatronics, control, or other and similar programs.

Note: The QUBE-Servo 2 experiment includes one interface panel of your choice. Additional interface panel(s) can be purchased separately.

QUBE-SERVO 2 SOLUTION COMPONENTS

- QUBE-Servo 2 with QFLEX 2 interface panel of your choice *(USB or Embedded)*, inertia disk and pendulum modules
  Optional: Additional QFLEX 2 interface panel
- Quanser control software (required for QUBE-Servo 2 USB experiment): QUARC for MATLAB/Simulink or QRCP for LabVIEW*
- Complete dynamic model and pre-build controllers
- ABET[3]-aligned, flexible digital media courseware (for QUBE-Servo 2 USB experiment)
- Arduino examples and interfacing datasheet (for QUBE-Servo 2 Embedded experiment)

**MATLAB/Simulink and LabVIEW licenses not included*

MODULAR, DIGITAL MEDIA COURSEWARE

The QUBE-Servo 2 solution comes with a mix-and-match, rich digital media courseware for easy adaptation of materials to specific course. A comprehensive mapping tool allows you to align courseware sections with specific chapters of the most popular control engineering textbooks, such as Control Systems Engineering by Norman S. Nise. The courseware is also aligned with the requirements of ABET[3] accreditation. All this allows professors to get their labs running faster, saving months of time typically required to develop lab materials and exercises.

The QUBE-Servo 2 Embedded experiment is provided with Arduino examples, as well as an interfacing datasheet detailing the connections and protocols used. The courseware resources developed for QUBE-Servo 2 USB experiment are included for reference.

[1] Similar experiment - QUBE-Servo for NI myRIO allows for control using NI myRIO embedded controller via MXP interface. The QUBE-Servo for NI myRIO is available exclusively from National Instruments. For details, visit www.ni.com.
[2] The performance and safety of the experiment is guaranteed only with the original parts supplied by Quanser. Quanser does not carry any responsibility for damages caused when using any third-party add-on modules.
[3] ABET, Inc. is the recognized accreditor for college and university programs in applied science, computing, engineering, and technology.

SYSTEM SPECIFICATIONS

QUBE-Servo 2

FEATURES

- Compact and integrated rotary servo system
- Tool-less quick connect module interface
- Direct-drive brushed DC motor
- High resolution optical encoder
- Built-in voltage amplifier with integrated current and tachometer sensors
- Integrated data acquisition(DAQ) device
- User-controllable tri-color LED
- Flexible QFLEX 2 computing interface for USB and SPI connections
- Easy-connect cables and connectors
- Open architecture design, allowing users to design their own controller
- Fully compatible with MATLAB®/Simulink® and LabVIEW™
- Fully documented system models and parameters provided for MATLAB®/Simulink®, LabVIEW™
- Microcontroller examples and interfacing datasheet provided for the QUBE-Servo 2 Embedded
- Additional community-created resources available on www.QuanserShare.com

COURSEWARE TOPICS COVERED

Inertia Disk Module:

- Hardware integration
- Step response modeling
- Noise measurement and filtering
- Electromechanical modeling
- Second-order systems
- PD control
- Stability analysis

Inverted Pendulum Module:

- Pendulum modeling
- Moment of inertia
- Balance control
- State-feedback LQR-based control
- State space modeling
- Swing-up control

COURSEWARE TEXTBOOK MAPPING

- Control Systems Engineering by Norman S. Nise
- Feedback Systems by K.J. Åström, R.M. Murray
- Mechatronics by W. Bolton
- Modern Control Systems by R.C. Dorf, R.H. Bishop
- Modern Control Engineering by K. Ogata
- Automatic Control Systems by F. Golnaraghi, B.C. Kuo
- Control Systems Engineering by I.J. Nagrath, M. Gopal
- Feedback Control of Dynamic Systems by G.F. Franklin, J.D. Powell, A. Emai-Naeini

DEVICE SPECIFICATION

Dimensions (W x H x D)	102 mm x 102 mm x 117 mm
Weight	1.2 kg
Pendulum length (pivot to tip)	9.5 cm
Servomotor encoder resolution	512 counts/revolution*
Inverted pendulum encoder resolution	512 counts/revolution*
DC motor nominal voltage	18 V
DC motor nominal current	0.54 A
DC motor nominal speed (no load)	4050 RPM
Interfaces available: QFLEX 2 USB	USB 2.0
QFLEX 2 Embedded	SPI

* Non-quadrature decoding

About Quanser:

Quanser is the world leader in education and research for real-time control design and implementation. We specialize in outfitting engineering control laboratories to help universities captivate the brightest minds, motivate them to success and produce graduates with industry-relevant skills. Universities worldwide implement Quanser's open architecture control solutions, industry-relevant curriculum and cutting-edge work stations to teach Introductory, Intermediate or Advanced controls to students in Electrical, Mechanical, Mechatronics, Robotics, Aerospace, Civil, and various other engineering disciplines.

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