

Quick Start Guide: **Linear Servo Base with Pendulum**

STEP 1 Check Components and Details:

Make sure your Rotary Flexible Joint module includes the following components:

1. Linear Servo Base Unit
2. Set of two 5-pin DIN to 5-pin DIN encoder cables
3. Long (0.6m) pendulum
4. Medium (0.34m) pendulum
5. 7/64 Allen key
6. Linear Servo Base Resources*

*Content and courseware provided in digital form at www.quanser.com/resources.

STEP 2 Additional Components Required for Set Up

To complete the Rotary Flexible Joint module set up, you will also need the following.

1. QUARC Real-Time Rapid Control Prototyping Software
2. Power Amplifier (VoltPAQ-X1 pictured)
3. One of the following data acquisition devices:
 - a. Quanser Q2-USB, or
 - b. Quanser Q8-USB, or
 - c. Another QUARC supported DAQ device
4. RCA to RCA cable
5. 4-pin DIN to 6-pin DIN motor cable

Note:

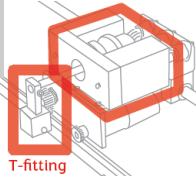
1. These components must be purchased separately.
2. Cables are shipped with Quanser VoltPAQ-X1 amplifier.

STEP 3**Install and Test QUARC**

1. Make sure you have all the required software as listed in the QUARC Compatibility Table included in the installation software and online at www.quanser.com
2. Follow the QUARC Installation Guide for further installation and testing instructions.
3. Make sure the QUARC Analog Loopback Demo is successfully ran before continuing.

STEP 4**Set Up the Hardware**

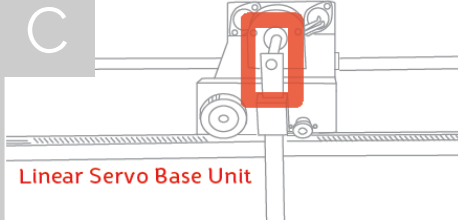
To set up your Linear Servo Base Unit and Pendulum, please read the following instructions carefully. For full details, see the Linear Servo Base Unit and Pendulum User Manual in the [Technical Resources](#).

A

Remove the T-fitting and additional weight from the top of the Linear Servo Base Unit cart, if installed.

B

Insert the long pendulum rod inside its T-fitting. Ensure that it sits properly. Tighten set screw as required.

**C**

Attach the pendulum to the shaft on the Linear Servo Base Unit cart. Tighten the T-fitting set screw.

D

Ensure that the track is located at the edge of a table, so that the pendulum is free to rotate 360-degrees in front of the cart. It is recommended to clamp down the ends of Linear Servo Base Unit track to the table (note: clamp not included).

STEP 5**Wiring**

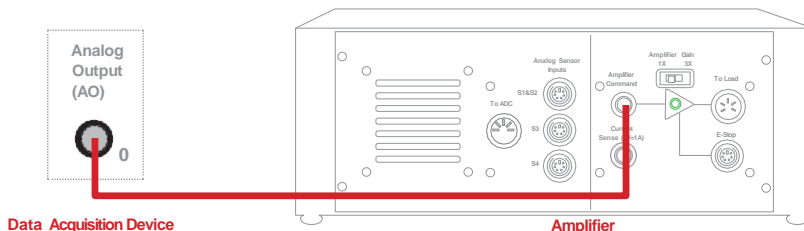
The connections shown below are illustrated using generic data acquisition (DAQ) device and a VoltPAQ-X1 amplifier (you may have a different DAQ or amplifier)

A

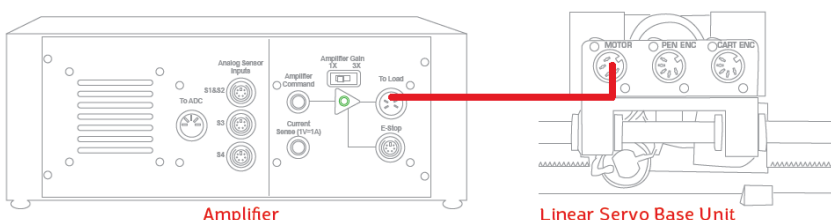
Before proceeding, set up and test your DAQ device (e.g., Q2-USB). For detailed instructions, see the DAQ device Quick Start Guide or User Manual.

B

Make sure everything is powered OFF before making any of these connections. This includes turning OFF your PC and the amplifier

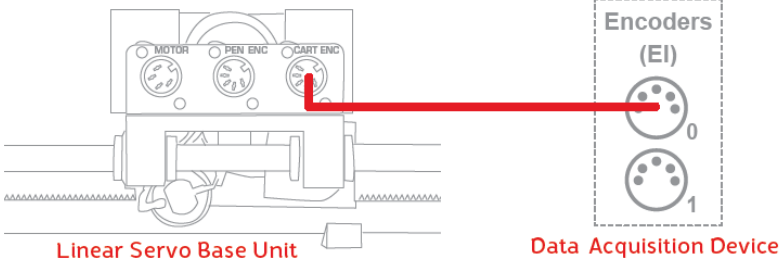
C

Using the RCA to RCA cable, connect **Analog Output Channel #0** (AO #0) on the data acquisition (DAQ) device to the **Amplifier Command** socket on the amplifier.

D

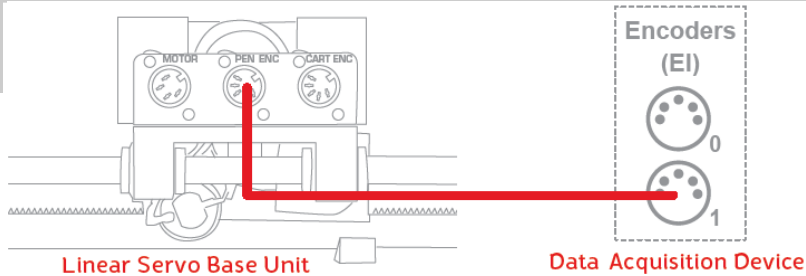
Using the 4-pin DIN to 6-pin DIN motor cable, connect the **To Load** socket on the amplifier to the **Motor** socket on the Linear Servo Base Unit.

E



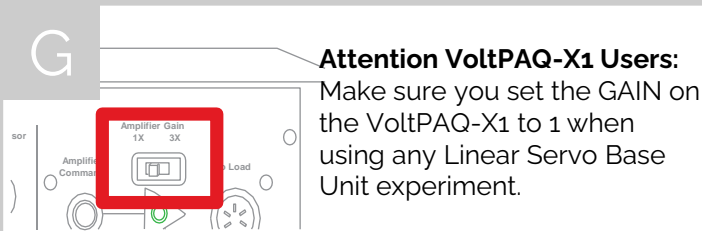
Using the 5-pin DIN to 5-pin DIN encoder cable, connect the **Encoder Channel #0** (EI #0) on the data acquisition (DAQ) device to the **Cart Encoder** connector (CART ENC) on the Linear Servo Base Unit Cart.

F

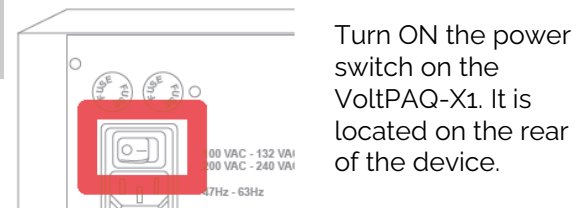


Using the 5-pin DIN to 5-pin DIN encoder cable, connect the **Pendulum Encoder** socket on the **Linear Servo Base Unit** panel to the **Encoder Channel #1** (EI #1) socket on the data acquisition (DAQ) device.

G



H



STEP 6

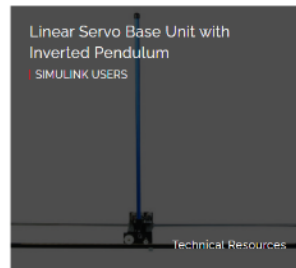
Testing the Linear Servo Base Unit and Pendulum

Follow the procedure below to test your Linear Servo Base Unit and Pendulum module.

A

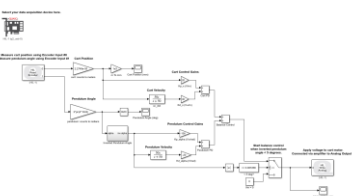
Make sure amplifier and DAQ are powered ON.

B



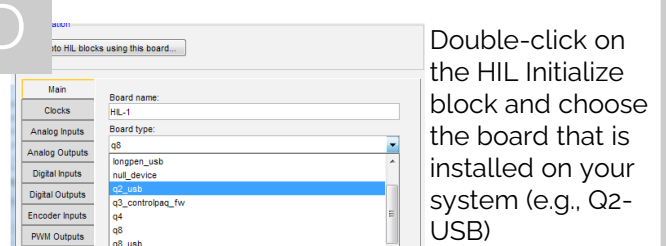
1. Download the Linear Servo Base Unit with Inverted Pendulum **Simulink Technical Resources** and **Simulink Courseware Resources** from www.quanser.com/resources.
2. Unzip the **Technical Resources** file to a folder on your local hard drive

C



Open the Simulink model file found under the Quick Start folder on your hard drive.

D

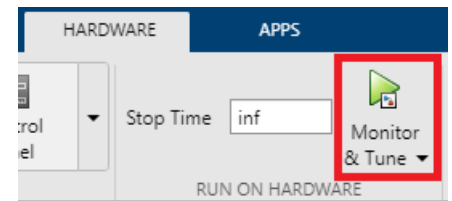


E

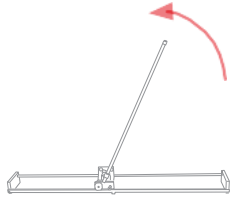
Make sure the pendulum is not moving and hanging down vertically with the tip towards the ground.

F

Click the **Monitor & Tune** button in the *HARDWARE* or *QUARC* tab in Simulink to generate and run the real-time QUARC model.



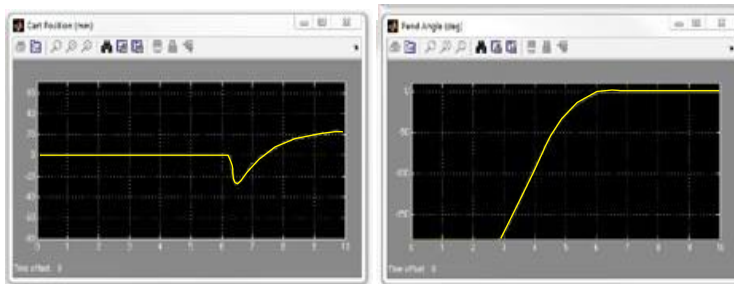
G



1. Slowly raise the pendulum to the upright position.
2. When the pendulum is close to vertical, the controller will activate and attempt to balance the pendulum. *Immediately release the pendulum when you feel the balance controller engage.*
3. If there is a problem, stop the controller by clicking on the **Stop** button (see Step I).

Do not attempt to lower the pendulum manually once the controller has engaged!

H



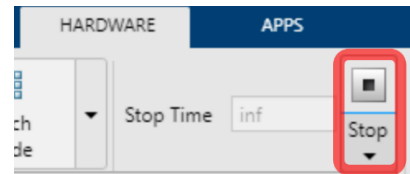
Sample response of pendulum balance control engaging.

The scopes show a sample response when the pendulum balance control engages. Once the pendulum is balanced, try to disturb it as little as possible. If the pendulum is unable to balance, consult the Troubleshooting section at the end of this guide.

I

Click on the **Stop** button under the *HARDWARE* or *QUARC* tab to stop running the model.

Stay clear of the pendulum when it stops balancing and swings down!



TROUBLESHOOTING

Review the following recommendations before contacting Quanser's technical support engineers.

Verify that the setup and connections outlined in Step 4 and 5. Ensure that the Rotary Servo Base Unit has been set up and tested successfully. Review the Rotary Servo Base Unit Quick Start Guide and User Manual setup and troubleshooting section for more information.

Getting an error when trying to build or run the Quick Start Simulink model (.mdl)

- A. Verify that the MATLAB/Simulink and compiler version are compared with your version of QUARC. See the QUARC Software Compatibility table supplied in the QUARC Quick Installation Guide or online at <http://www.quanser.com/products/quarc-real-time-control-software/>.
- B. Type **ver** in the MATLAB Command Window and verify that *Quanser Real-Time Control (QUARC)* is on the list. If not, then go through the QUARC Quick Installation Guide to install QUARC. If it is listed, run **mex-setup** as described in the QUARC installation guide.

You see 'An operating system specific kernel-level driver for the specified card could not be found' message.

- A. Make sure the DAQ is connected to the PC and powered ON.
- B. If using the Quanser Q2-USB, ensure that the USB Status LED is lit **green**
- C. Go to Windows Device Manager and verify that your data acquisition (DAQ) device is displayed. If you are using Quanser Q2-USB or Q8-USB DAQ, then look under the Universal Serial Bus controllers heading for Q2-USB A and B items (or Q8-USB A and B)
- D. Refer to the DAQ device User Manual for more troubleshooting guidelines.

The Motor is not responding.

- A. Review the connections in steps 5C and 5D.
- B. Ensure the power amplifier is powered ON and operational, i.e., when using the VoltPAQ-X1 verify that the green LED is lit.
- C. Verify that the data acquisition device is functional. Go through the DAQ User Manual for troubleshooting guidelines.

An encoder is not reading.

- A. Review the connections in steps 5E and 5F.
- B. Verify that the data acquisition (DAQ) device is functional. Refer to the DAQ User Manual for troubleshooting guidelines.

LEARN MORE

To browse and download the latest Quanser resources visit www.quanser.com/courseware

STILL NEED HELP

For further assistance from a Quanser engineer, contact us at tech@quanser.com

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Expand the Linear Servo Base Unit to the follower popular experiments using Quanser Linear Control add-on modules

Linear Pendulum



Linear Flexible Joint



Flexible Inverted Pendulum



Seesaw Pendulum

