Ryerson University
Department of Electrical, Computer and Biomedical Engineering

BME639: CONTROL SYSTEMS BIOROBOTICS

Appendix A

Description of the Quanser Rotary Servo Module

This manual describes the system requirements and the typical connections used to connect the SRV02 rotary servo motor to a data acquisition device and a power amplifier.

A. Description

The following is a listing of the hardware components used in BME639 Lab:

A.1 Rotary Servo Plant: Quanser SRV02, which is consists of a DC motor that is encased in a solid aluminum frame and equipped with a planetary gearbox. The motor has its own internal gearbox that drives external gears. The SRV02 is equipped with three sensors: Analog position potentiometer, Optical encoder, and Speed tachometer. The potentiometer and encoder sensors measure the angular position of the load gear and the tachometer can be used to measured its velocity.

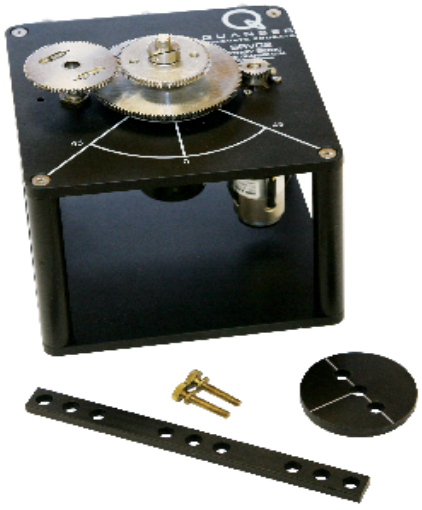

Figure 1: Quanser SRV02 rotary servo motor

A.2 Data Acquisition Board: Quanser Q2-USB, which connects to the computer through a USB port.

Figure 2: Quanser Q2-USB Data Acquisition Board

This unit has three main parts:

1. The encoder section :Used to connect up feedback signals from the servo to be accessed from Matlab.
2. The DAC (Digital to Analog Converter) :These connectors is the analog output from the Mathworks software.
3. The ADC (Analog to Digital Converter) :These connectors are used to connect to analog sources that we want to discretize and bring back into the Matlab environment.

A.3 Power Amplifier: Quanser VoltPAQ-X1, which is a linear voltage-controlled amplifier and it provides the necessary current to drive the servo as the data acquisition unit is incapable of driving the servo by itself.

Figure 3: Quanser VoltPAQ-X1 Power Amplifier

B. Wiring Procedure

This section describes the typical connections used to connect the SRV02 plant to a data acquisition device and a power amplifier. In this system three different feedback methods are available by using

the three sensors:

1. Tachometer analog feedback of the velocity gear shaft.
2. Potentiometer analog feedback of the position of the motor.
3. Digital encoder feedback of the position of the motor.

B.1 Tachometer Analog Feedback: In this case only the analog tachometer feedback and the analog output are used from the motor to determine the angular velocity of the gear shaft at any point. Figures (4) and (5) illustrate the schematic and modular wiring diagram. Follow these steps to connect the SRV02 system:

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

2. Connect the "**DAC Channel 0**" on the data acquisition unit to the "**Amplifier Command**" connector on the power amplifier. (Red on Figure(4) and (5))

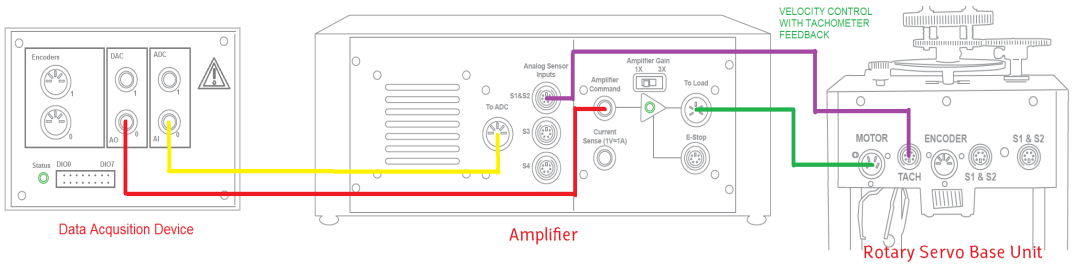

Figure 4: Schematic wiring diagram of SRV02 system - Tachometer analog feedback

Figure 5: Modular wiring diagram of SRV02 system - Tachometer analog feedback

3. Connect the "**ADC Channel 0**" on the data acquisition unit to the "**To ADC**" connector on the power amplifier. The cable that connects these two ports has several adapters as shown in Figure(6). (Yellow on Figure(4) and (5))

4. Connect the "**TACH**" on the SRV02 to the "**Analog Sensors S1 & S2**" connector on the power amplifier. (Magenta on Figure(4) and (5))

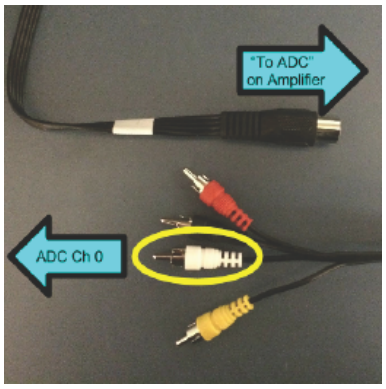

Figure 6: ADC connector cable - Tachometer analog feedback

5. Connect the "**Motor**" connector on the SRV02 to the "**To Load**" connector on the power amplifier. (Green on Figure(4) and (5))

6. **Attention VoltPAQ-X1 Users:** Make sure you set the GAIN on the VoltPAQ-X1 to 1 when using any Rotary Servo Base Unit experiment. (Figure(7))

Figure 7: GAIN set up on the VoltPAQ-X1

7. Turn ON the power switch on the VoltPAQ-X1 power amplifier. It is located on the rear of the device.

Figure(8) shows the the final layout of the connections for tachometer analog feedback of SRV02 system.

B.2 Potentiometer Analog Feedback: In this case only the analog potentiometer feedback and the analog output are used motor to determine the angular position of the motor at any point. Figures (9) and (10) illustrate the schematic and modular wiring diagram. Follow these steps to connect the SRV02 system:

Figure 8: Tachometer analog feedback final layout

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

2. Connect the "**DAC Channel 0**" on the data acquisition unit to the "**Amplifier Command**" connector on the power amplifier. (Red on Figure(9) and (10))

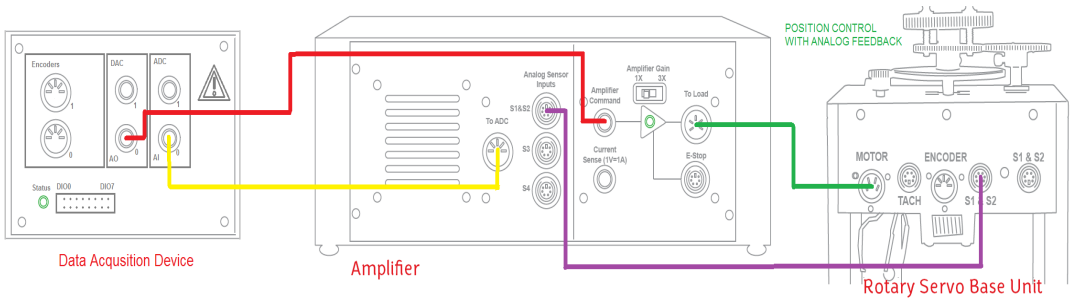

Figure 9: Schematic wiring diagram of SRV02 system - Potentiometer analog feedback

Figure 10: Modular wiring diagram of SRV02 system - Potentiometer analog feedback

3. Connect the "**ADC Channel 0**" on the data acquisition unit to the "**To ADC**" connector on the power amplifier. The cable that connects these two ports has several adapters as shown in Figure(11). (Yellow on Figure(9) and (10))

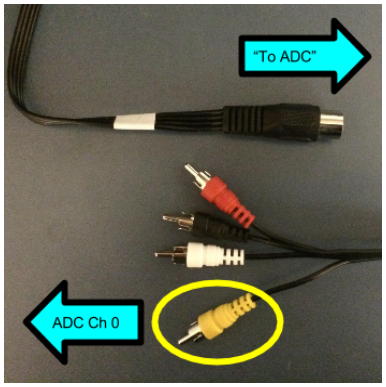

Figure 11: ADC connector cable - Potentiometer analog feedback

4. Connect the "**S1 & S2**" connector on the SRV02 to the "**Analog Sensors S1 & S2**" connector on the power amplifier. (Magenta on Figure(9) and (10))

5. Connect the "**Motor**" connector on the SRV02 to the "**To Load**" connector on the power amplifier. (Green on Figure(9) and (10))

6. **Attention VoltPAQ-X1 Users:** Make sure you set the GAIN on the VoltPAQ-X1 to 1 when using any Rotary Servo Base Unit experiment. (Figure(7))

7. Turn ON the power switch on the VoltPAQ-X1 power amplifier. It is located on the rear of the device.

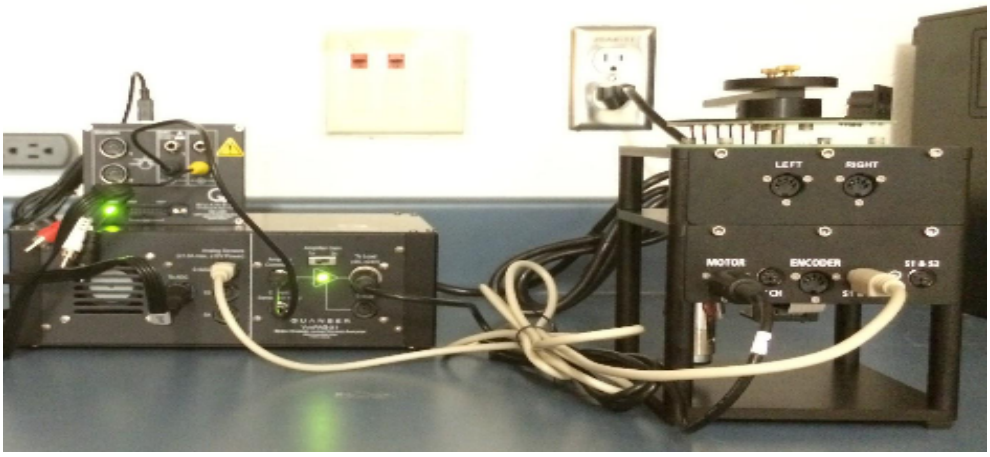

Figure 12: Potentiometer analog feedback final layout

Figure(12) shows the the final layout of the connections for potentiometer analog feedback of SRV02 system.

B.3 Digital Encoder Feedback: In this case only the digital optical encoder feedback and the analog output are used motor to determine the angular position of the motor at any point. Figures (13) and (14) illustrate the schematic and modular wiring diagram. Follow these steps to connect the SRV02 system:

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

2. Connect the "**DAC Channel 0**" on the data acquisition unit to the "**Amplifier Command**" connector on the power amplifier. (Red on Figure(13) and (14))

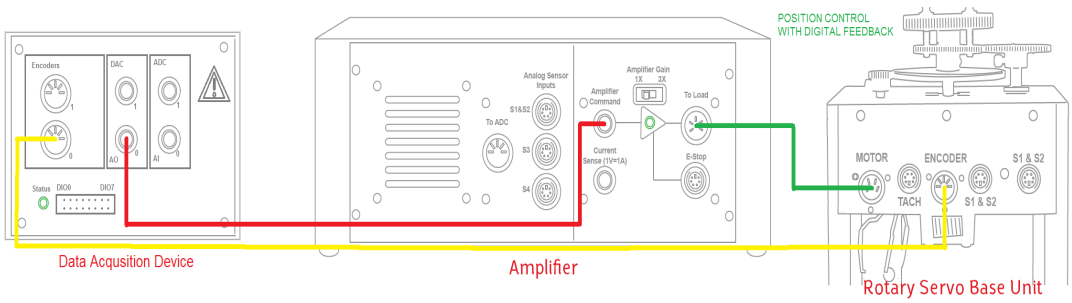

Figure 13: Schematic wiring diagram of SRV02 system - Digital encoder feedback

Figure 14: Modular wiring diagram of SRV02 system - Digital encoder feedback

3. Connect the "**Encoder Channel 0**" on the data acquisition unit to the "**Encoders**" connector on the SRV02. (Yellow on Figure(13) and (14))

4. Connect the "**Motor**" connector on the SRV02 to the "**To Load**" connector on the power amplifier. (Green on Figure(13) and (14))

5. **Attention VoltPAQ-X1 Users:** Make sure you set the GAIN on the VoltPAQ-X1 to 1 when using any Rotary Servo Base Unit experiment. (Figure(7))

6. Turn ON the power switch on the VoltPAQ-X1 power amplifier. It is located on the rear of the device.

Figure 15: Digital encoder feedback final layout

Figure(15) shows the the final layout of the connections for digital encoder feedback of SRV02 system.