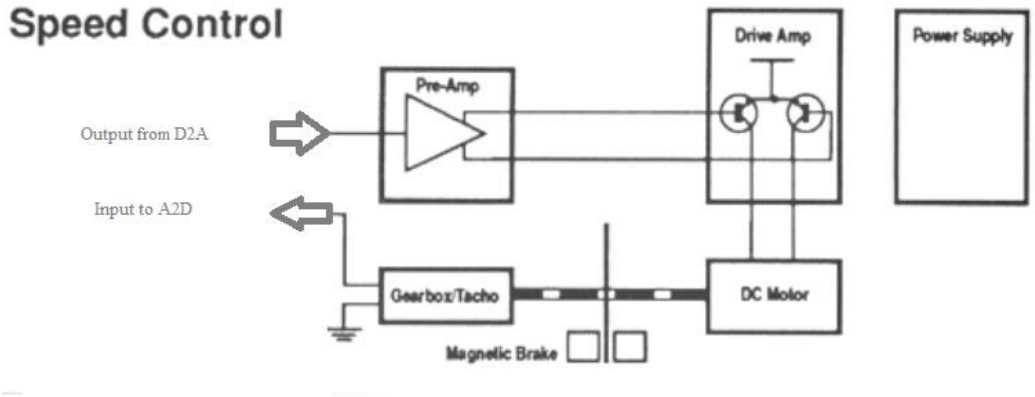
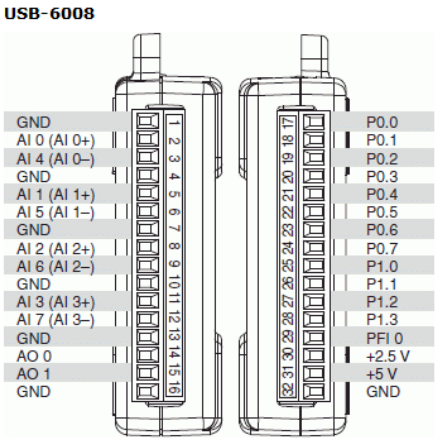
TECH 3821
End of Semester Project
Part 1

Ver USB-6008-1.21

Note: Due to limited lab equipment, you will probably have to work on this lab outside of normal lab times.

Objective	To calibrate the Feedback Educational Servo (ES151) Trainer to read Revolutions Per Minute (RPM).
Background	For this experiment we will be using the Feedback Educational Servo (ES151) Trainer. The block diagram of the system is as follows:  By the end of this 3 part lab, we will control the speed of the DC motor via a PID control using the Tachometer to provide feedback and sending control signals to the Pre-Amp to adjust the speed of the motor. We can use the Magnetic Break as a process upset to test the control response. We will create a LabVIEW VI to act as our controller and used the National Instruments (NI) USB-6008 Data Acquisition Device for the IO necessary to interface between the Controller and the ES151.

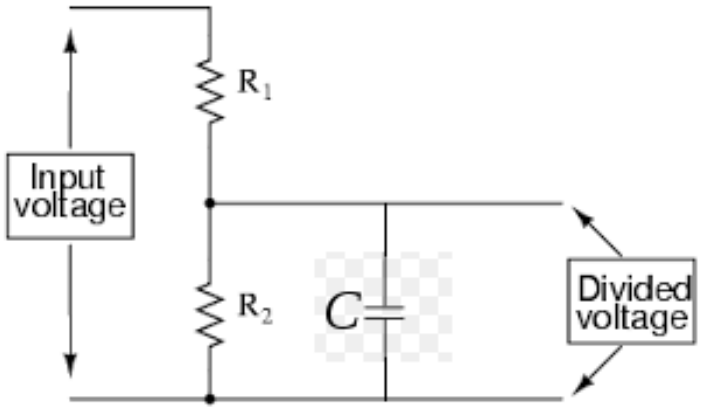
The Pinout of the NI USB-6008 is shown below:



We will program a LabVIEW VI to act as our controller.

Since the ES151 uses voltage range of -15 to +15V for the tachometer output and the USB-6008 has an analog input range of -10 to +10V we need to use a simple circuit to bridge the two devices.

For the Tachometer, we will use a simple voltage divider circuit to bring the voltage down to an acceptable range for the Analog Input Channel:

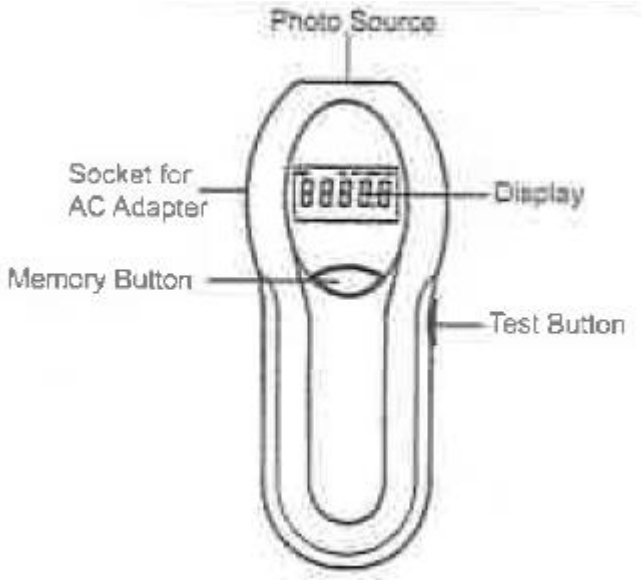


Where:

Input voltage is from the Velocity Output of the ES151
R1 = 2.2k
R2 = 1K
C = 499pF (used to filter noise)

Input Voltage – Connect to ES151 Velocity Output (Tachometer)
Divider Voltage – Connected to AI 0

	The output of the voltage divider will be an acceptable range for the USB-6008 analog input channel. The capacitor filters out some of the electronic noise from the tachometer. The ES151 Servo Amplifier can take inputs of -15V to 15V on Input "T" (Pre-Amp Input). Negative would drive the motor in the opposite direction of the positive voltage. Although the ES151 Servo Amplifier input "T" can take values of -15V to 15V, the analog Output from the USB-6008 can only produce 0v to +5V. Since this will generate a sufficient speed for the experiment will use the NI USB-6008 Analog output AO 0 to provide the ES151 Servo Amplifiers input directly. Don't forget a COMMON GROUND will be needed between the ES151 and the NI USB-6008.
Procedure LabVIEW Code	Create a VI that will allow you to get the data necessary to calibrate the tachometer voltage to RPM's. The VI should allow you to enter an output voltage to change the speed of the motor and graph and display to tachometer voltage for this purpose. Please keep the voltage output between 0 and 3V (to keep the speeds reasonable). You will need to: Read the ES151 Tachometer (Velocity Output). You will need an Analog Input with the following settings: • Acquire Signal | Analog In | Voltage | AI 0 • Name it "TachIn" (w/o "" and keeping case) • Max 10, Min -10 • For "Terminal Configuration" set it to "RSE" • For "Acquisition Mode" set it to "1 sample on demand" Supply the ES151 Servo Amplifier Input "T" you will need to configure an Analog Output select the following settings: • Generate Signal | Analog Out | Voltage AO 0 • Name it "MotorOut" (w/o "" and keeping case) • Max 5, Min 0 • For "Terminal Configuration" set it to "RSE" • For "Acquisition Mode" set it to "1 sample on demand" Use a CONTROL for the Analog Write Data input and an Indicator for the data coming out of the Analog Read. You also want to take the same values to a Graph | Waveform Chart. Except for the IO names, the entire thing should be in a WHILE LOOP.

	Lastly, since we only have two working ES151 units, you will need transfer your VI to another pc. If you name the io correctly it will work without issue, if an error occurs when moving to the different PC see Lab #2 for instructions on Reopening a VI on another computer.
Procedure Calibrate Tach to RPM	Run your VI above. Set the Analog Output to 0V Turn on the ES151 unit. Adjust the "SET Zero" knob until the motor stops turning. Now collect the data necessary to calibrate the motor speed to RPMs. Use the provided Photo Sensor Tachometer.  To measure the RPM, hold the tachometer 2" to 8" away from the spinning disk as shown below:

Hold the Test Button in to obtain reading on LCD display.

It is suggested you record the following in an Excel Spreadsheet:

- Analog Output Value (going from 0V to 3V in reasonable increments)
- Analog Input from Tach
- RPM

Graph RPM vs Analog Input from Tach and obtain the linear trend line equation and R^2 values.

Use the above to display RPM on the LabVIEW VI (similar to previous labs) and verify that the speed displayed is accurate.

Turn in a zip file containing your VI, VI Documentation and the Calibration Excel Spreadsheet via online submission.