EGR 120 Due date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Introduction to Engineering

File: N120Bot2

### Team Assignment #2

## Testing the Arduino-BOT Servos

**References**:

1) Arduino-BOT Lecture #2 - <http://faculty.tcc.edu/PGordy/Egr120/>

2) Robotics with the Board of Education Shield for Arduino web tutorials - <http://learn.parallax.com/tutorials/robot/shield-bot/robotics-board-education-shield-arduino>

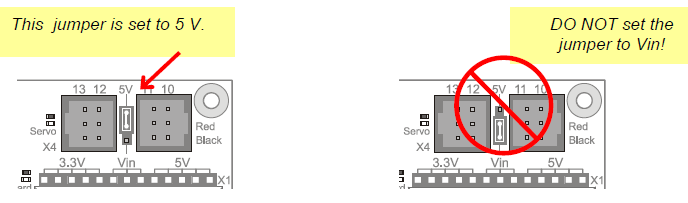
3) Board of Education Shield for Arduino documentation - <https://www.parallax.com/downloads/robotics-board-education-shield-arduino>

4) Arduino web site (software, microcontrollers, examples, and more) - <https://www.arduino.cc/>

**Team Assignment:**

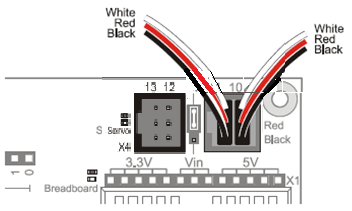
1) Check the Servo Port jumper

As indicated in Arduino-BOT Lecture #2, verify that the Servo Port jumper is in the 5V position (see diagram below).



2) Left and Right Servo Connections

As indicated in Arduino-BOT Lecture #2, verify that the left servo is connected to Servo Port 11 and the right servo is connected to Servo Port 10. The ball is a ***rear*** wheel for left/right reference. See the diagram below.



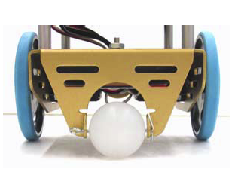
***Connect LEFT servo to Port 11***

***Connect RIGHT servo to Port 10***

**Left wheel**

**Rightwheel**

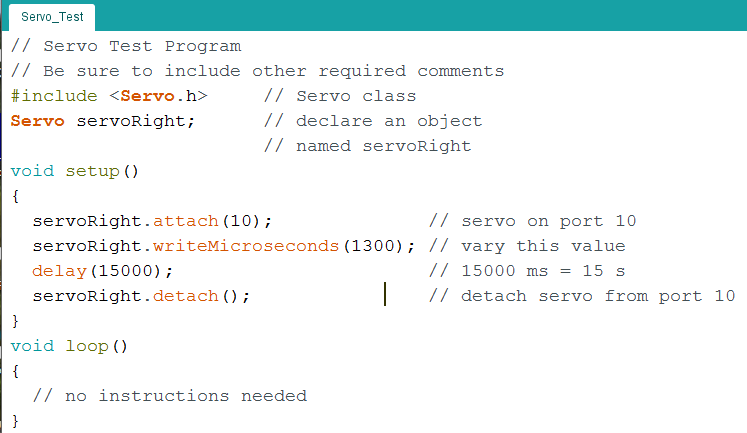
**Rear wheel**



3) Testing the right servo

Turn the Arduino-BOT on its side with the left wheel facing up. Put a piece of tape on the wheel to assist you in counting wheel revolutions.

* Enter the program below. Be sure to add a block of comments at the beginning of the program as done in previous programs.
* Use the program below to test the servo. Specifically:
* Begin by using a Pulse Width of 1300.
* Run the program and count the number of clockwise (CW) wheel revolutions (to the nearest ¼ revolution) that occur in 15 seconds (servo will stop after 15 seconds). Note: record CCW revolutions as negative.
* Record the value in the table provided (or in Excel).
* Repeat for Pulse Widths of 1320, 1340, … , 1700.
* If the Servo did not completely stop with a Pulse Width of 1500, find the exact Pulse Width needed to make it stop and record the value.
* Print one example of the program (any Pulse Width) to include in your team report.



**Vary the pulse width from 1300 to 1700 and count the wheel revolutions**

Note: If you are testing the right servo and the left servo is also turning, you can stop it by attaching it to a pin and then detachinging. For example:

**Servo servoLeft;**

**servoLeft.attach(11);**

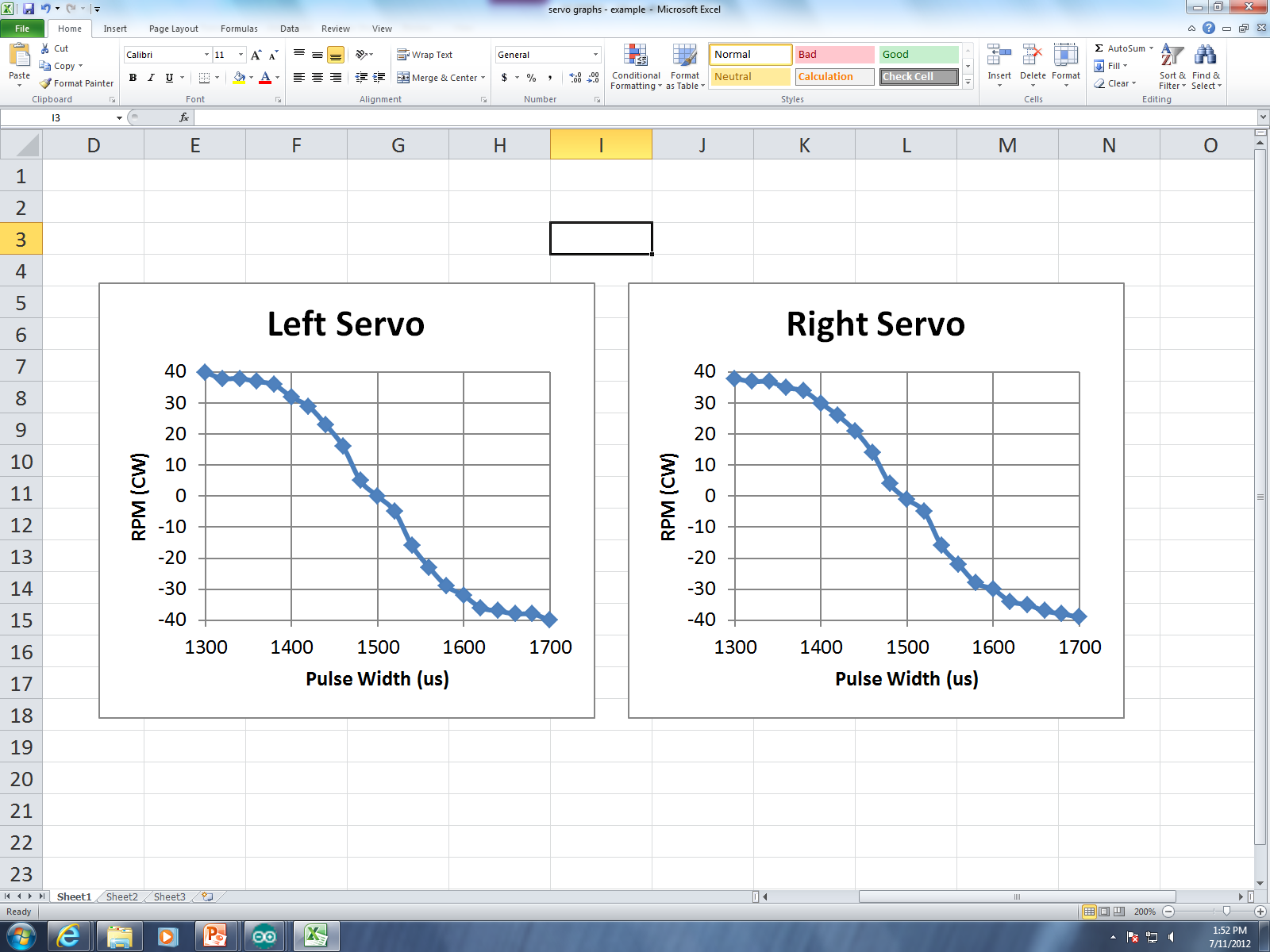
**servoLeft.detach( );**

4) Testing the left servo

Repeat step 3 for the left servo. Change the servo port in the Arduino code and use appropriate variable names for the left servo. Print a sample program for your team report.

5) Analysis

* + Type the two tables into Excel. Include information such as course number, team assignment number, Arduino-BOT number, team number, each team member’s name (only if present), a descriptive title, and the filename (pick an appropriate filename).
  + Graph CW RPM versus PULSOUT for each servo (use a separate graph for each servo). An example is shown below:



* + Add additional columns to your tables in Excel for velocity in in/s, ft/s, and mph. Include sample Excel formulas under the table. Note that the Arduino-BOT has wheels with a diameter of 2.5 inches. (Hint: The robot travels a distance equal to one wheel circumference for each revolution.)
  + Note that the Arduino-BOT will travel forward if the right servo turns clockwise and the left servo turns counter-clockwise. What is the Arduino-BOT’s maximum forward speed in rpm, in/s, ft/s, and mph?
  + Using the maximum forward speed shown above, how long will it take the robot to travel 10 feet? (Show your calculation.) Note that Time = Distance/Velocity.

**Table for recording servo speeds in lab (or enter the values directly into Excel)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Pulse Width (us) | # CW Revolutions in 15 s | RPM  (CW) |  | Pulse Width (us) | # CW Revolutions in 15 s | RPM  (CW) |
| 1300 |  |  |  | 1300 |  |  |
| 1320 |  |  |  | 1320 |  |  |
| 1340 |  |  |  | 1340 |  |  |
| 1360 |  |  |  | 1360 |  |  |
| 1380 |  |  |  | 1380 |  |  |
| 1400 |  |  |  | 1400 |  |  |
| 1420 |  |  |  | 1420 |  |  |
| 1440 |  |  |  | 1440 |  |  |
| 1460 |  |  |  | 1460 |  |  |
| 1480 |  |  |  | 1480 |  |  |
| 1500 |  |  |  | 1500 |  |  |
| 1520 |  |  |  | 1520 |  |  |
| 1540 |  |  |  | 1540 |  |  |
| 1560 |  |  |  | 1560 |  |  |
| 1580 |  |  |  | 1580 |  |  |
| 1600 |  |  |  | 1600 |  |  |
| 1620 |  |  |  | 1620 |  |  |
| 1640 |  |  |  | 1640 |  |  |
| 1660 |  |  |  | 1660 |  |  |
| 1680 |  |  |  | 1680 |  |  |
| 1700 |  |  |  | 1700 |  |  |
|  | 0 | 0 |  |  | 0 | 0 |

4) **Report**

Organize your results into a report and submit a single typed report for the group to the instructor by the assigned due date. The report should consist of:

1. **Title Page** – Include a title page as shown below.
2. **Program Printouts** – Include printouts for both programs (for any Pulse Width value). Always include comments ***in all programs*** specifying the course number, team assignment number, BOE-BOT number, your team number, each team member’s name (only if present), the program number (Program 2A), the filename (pick an appropriate filename), and a description. Also include comments explaining the code.
3. **Analysis** - Neatly present all required tables, graphs, and calculations. All tables and graphs should be nicely formatted. Include descriptive titles or headings for calculations.
4. **Discussion -** Write 1-2 paragraphs discussing the following:

* Did you run into any problems testing the servos?
* Is one of your servos faster than the other? List the max speed in rpm for each servo.
* Does the speed vary linearly as the Pulse Width varies from 1300 to 1700 us?
* Did your servos stop at exactly 1500 us? If not, show the Pulse Width value where they stopped.
* What direction and speed (full-speed CW, for example) might you use on each servo to make your robot go forward, go backward, turn left, and turn right?

EGR 120

Introduction to Engineering

# Team Assignment #2 – Testing the Arduino-BOT Servos

Date

Group #N (your group number)

Arduino-BOT number

Attendance & Participation Record:

(list all team members and all dates when teams worked

together in class on this assignment and check boxes to mark attendance)

|  |  |  |
| --- | --- | --- |
| Team Member | Date 1 | Date 2 |
| John Doe | ✓ | ✓ |
| etc |  |  |
|  |  |  |
|  |  |  |

Demonstration of Programs

|  |  |
| --- | --- |
| Program | Successfully  Demonstrated |
| 1 | ✓ |
| 2 | ✓ |