**SubTeam:** Electrical **Level:** Basic **Time Required:** 90 minutes

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| **Title:** Motors – Controlling direction and speed of a 2-wire DC Motor |
| **Learning Objectives:** Understand that ……….   * The most basic function of the motor is to covert the electrical input to mechanical output. * A 2-wire motor requires that a voltage be applied across its two wires. * A 2-wire DC motor can reverse direction by reversing the voltage polarity on the wires. * Changing the voltage input to a 2-wire DC motor changes it’s speed. * A DPDT switch can be used to control the direction of a 2-wire DC motor. * An electronic DPDT switch (aka H-Bridge motor controller) can be used by a computer to control the speed and direction of a 2-wire DC motor. * A motor controller is needed to the match the current needs of the motor with the current supplied by the control circuit.   ***It is assumed that the student has the following background understanding.***   * How to find and use datasheets for electrical and mechanical components. * How to read a schematic to wire up your circuit. * How to use a breadboard to wire a circuit. * How to strip wires. * How to use a DC power supply. * How to use a multimeter to look for short circuits and faulty connections. |
| **Materials:** Multimeter, Variable Power Supply, Breadboard, #22 Gauge Wire, Vex 2-wire 393 (or 269) DC Motor, SN754410 Motor Controller |
| **Reference Material:**  [**VEX Datasheet 2\_wire\_269\_motor\_ig.pdf**](file:///C:\Users\Jean\Desktop\Robotics Training\VEX Datasheet 2_wire_269_motor_ig.pdf)  [**VEX Datasheet 2\_wire\_393\_motor\_ig.pdf**](file:///C:\Users\Jean\Desktop\Robotics Training\VEX Datasheet 2_wire_393_motor_ig.pdf)  [**sn754410 Datasheet.pdf**](file:///C:/Users/David/Desktop/sn754410 Datasheet.pdf)  [**Schematic - Using a DPDT Switch to control DC Motor Direction.docx**](file:///C:\Users\Jean\Desktop\Robotics Training\Schematic - Using a DPDT Switch to control DC Motor Direction.docx) |

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| **Procedure:**   1. Wire up the circuit shown below. Refer to the datasheet for the motor to determine what voltage you should be using. What happens if you use a lower voltage?      1. Rewire up the circuit as shown below. What changes? Electrically what has changed?      1. Now rewire the circuit so that you can control motor *direction* with a switch. Use the schematic below as a guide and add a DPDT to the circuit. What is a DPDT and how do you connect it? Do some research if necessary. Does it make sense to color code the wires with the standard black (Ground/GND/0V) and Red (Power/PWR/x.xV) as in the schematics above? Why or why not?      1. In practice, the above circuit is not very practical. In most cases, it is necessary to add a *motor controller* to the circuit. A motor controller acts as intermediary between the control circuit, the power source and the motor. A motor controller is necessary because a CMOS or TTL control circuit can provide roughly 0.1 Amps of current whereas most DC motors require several amps. Datasheets can provide the exact output current supplied and/or input current required for all of your parts. Use the schematic below to assist you in adding a SN754410 motor controller to your circuit. Note the use of two separate power supplies that share a common ground.      1. Use your multimeter to measure the voltage across your motor when it is running and when it is stopped. Do so by putting your multimeter on the DC voltage scale and putting the meter wires in **parallel** with the motor. 2. Use your multimeter to measure the current (amperes) through your motor when it is running. Do so by putting your multimeter on the DC-current scale, moving the red probe to the 10A input connector, and then placing your multimeter in **series** with the motor. NOTE: if you do not configure your multimeter as described above, you will blow the fuse in your multimeter. 3. Enter your final design into *National Instruments Multi Sim* circuit simulator software. Add voltmeters and ammeters to analyze the voltage and current outputs going to the motor. Can you replicate these measurements on your actual circuit? What test equipment would you need to do this? |