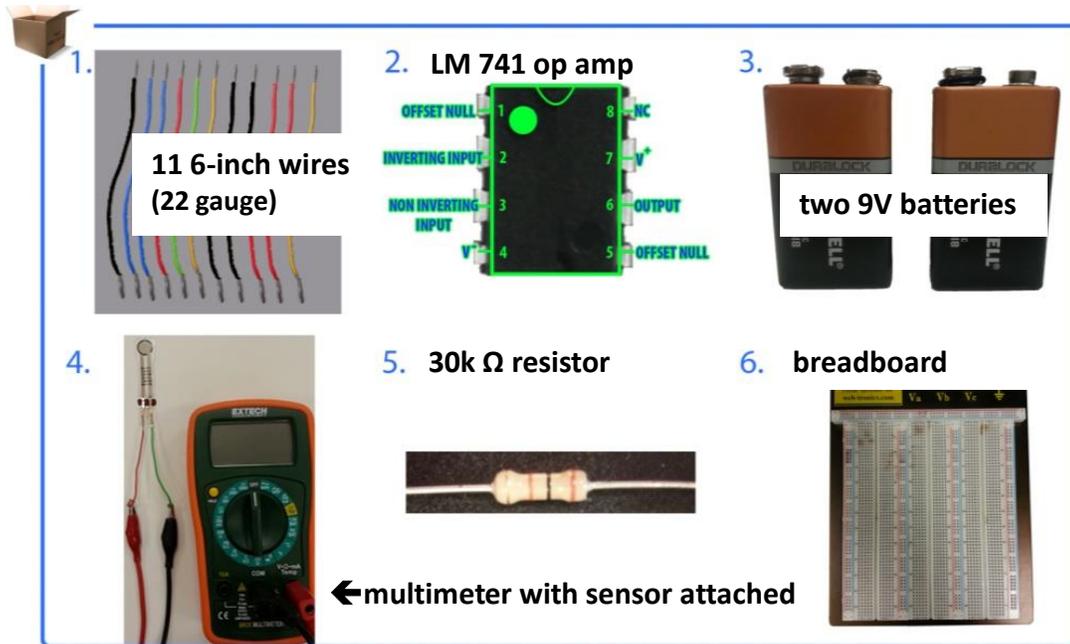


Building an Electric Circuit to Convert the Sensor Resistance into a Usable Voltage

INSTRUCTIONS

Use this instruction manual to help you build an electric circuit to convert the sensor resistance into a usable voltage. The goal is to determine the relationships between applied force and sensor voltage output. Make sure you have the following items:



1. Breadboard Basics

- A. Letters on the breadboard are used to identify vertical columns.
- B. Numbers on the breadboard are used to identify horizontal rows.
- C. The red lines in Figure 1 show how vertical columns and horizontal rows are internally connected.
- D. When you connect a power source to a set of vertical columns, you can access voltage (+) and ground (-) from that set of vertically holes.

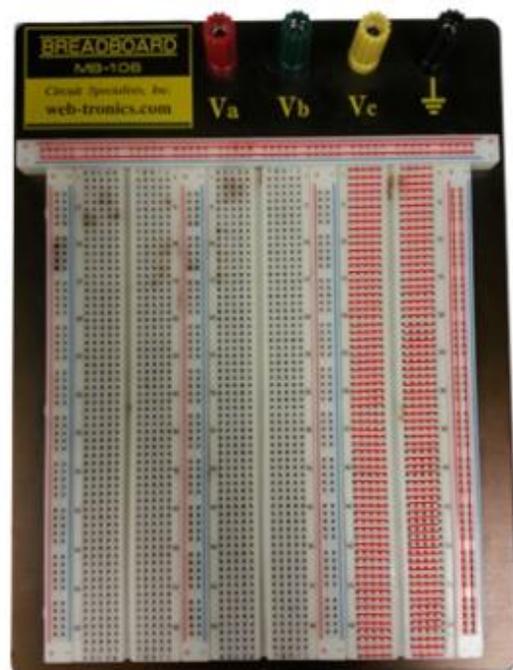


Figure 1

2. Operational Amplifier (Op Amp) Basics

- The main purpose of this integrated circuit is to amplify a weak signal.
- It usually has two inputs (inverting input [2], non-inverting input [3]), and one output (6).
- It has a wide range of functions: inverting amplifier, non-inverting amplifier, differential amplifier, voltage follower, summing amplifier, instrumentation amplifier.
- In our circuit, we will use it as a non-inverting amplifier. See the Figure 2 schematic.

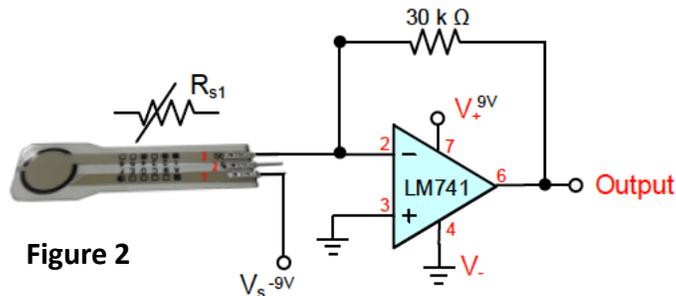


Figure 2

3. Resistor Basics

- As the name implies, a resistor is used in a circuit to create resistance to an electrical current. It limits the current passing through it.
- Resistors have variable (Figure 3A) or fixed resistance (Figure 3B). A diagonal line through its symbol denotes that its resistance will vary.
- The unit of a resistor is ohms (Ω).



Figure 3A

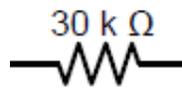


Figure 3B

4. Op Amp 741 Placement

- Locate pin 1, which is identified by a circle.
- Place your op amp chip center in-between vertical column “e” and “f.”
- Note: Do NOT place your chip in-between “a-e” or “f-j.”

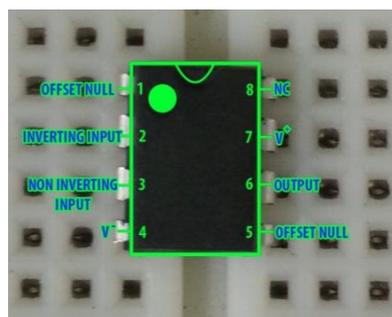


Figure 4A

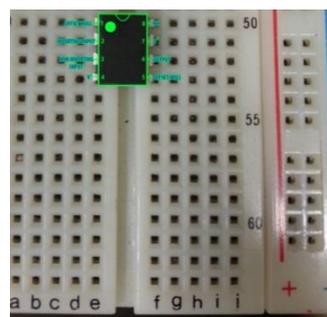


Figure 4B

5. Op Amp 741 – Voltage Connection (V+)

Connect a wire from pin 7 to your voltage supply (vertical “+” column). See Figures 5A and 5B.

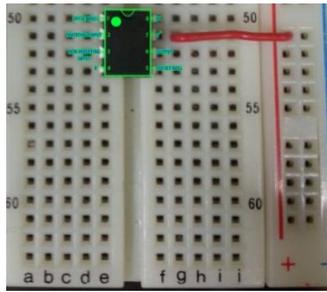


Figure 5A

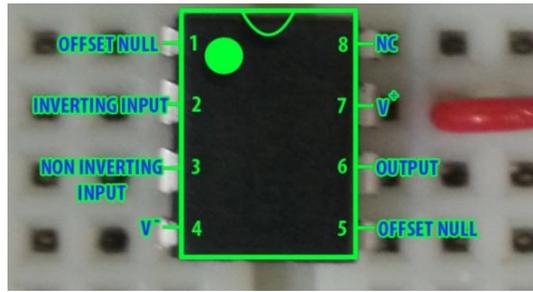


Figure 5B

6. Op Amp 741 – Ground Connection (V-)

Connect a wire from pin 4 to your ground supply (vertical “-” column). See Figures 6A and 6B.

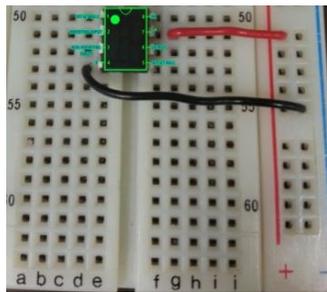


Figure 6A

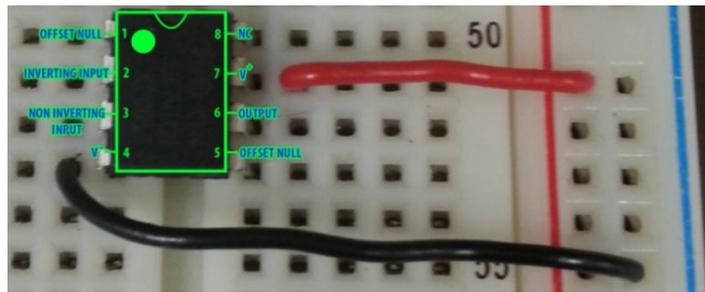


Figure 6B

7. Op Amp 741 – Non-Inverting Input Connection

Use 2 wires to connect from pin 3 to your ground supply (vertical “-” column). See Figures 7A and 7B.

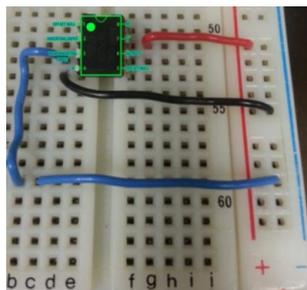


Figure 7A

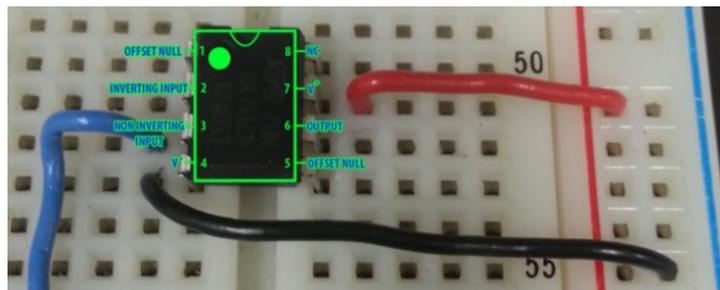


Figure 7B

8. Op Amp 741 – Inverting Input Connection

Connect a wire from pin 2 to any horizontal row above the op amp chip. See Figures 8A and 8B.

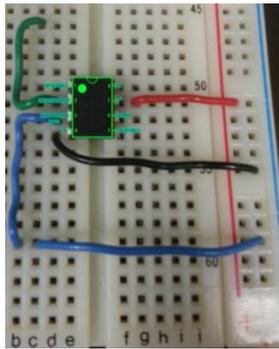


Figure 8A

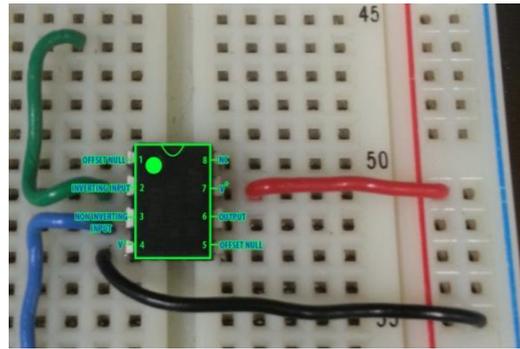


Figure 8B

9. Op Amp 741 – Output Connection

- A. Connect a wire from pin 6 to any horizontal row above the op amp chip.
- B. You can choose to horizontally align it to an inverting input row from the previous step.
- C. See Figures 9A and 9B.

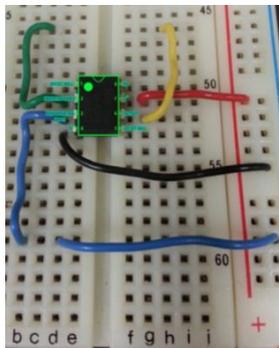


Figure 9A

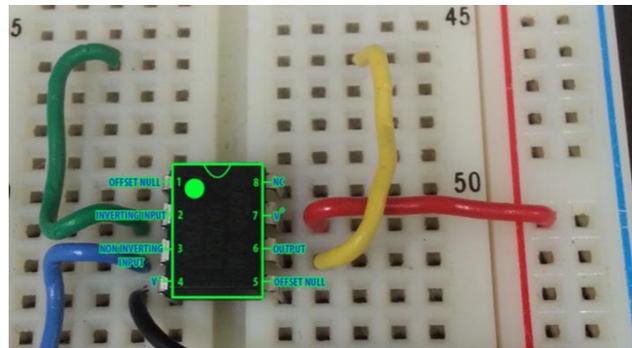


Figure 9B

10. Resistor Connection – 30k Ohms

Place the 30k ohms resistor in-between your inverting input and output connections. See Figures 10A and 10B.

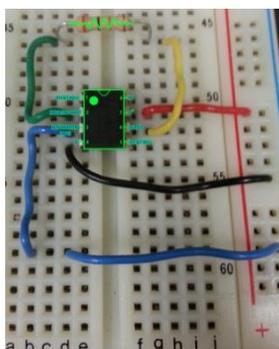


Figure 10A

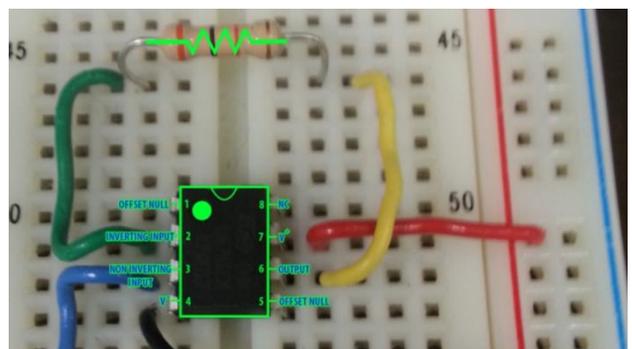


Figure 10B

11. Power Supply – Obtaining +9V and -9V

- A. Place the 9V batteries side by side, as shown in Figure 11A.
- B. Connect the two 9V batteries in series. To do this, connect the positive terminal of the left battery to the negative terminal of the right battery.
- C. Connect the multimeter to verify the output voltage on each side.
- D. Figure 11B shows a reading of a negative voltage.
- E. NOTE: REMEMBER WHICH SIDE OUTPUTS NEGATIVE and POSITIVE.
- F. NOTE: Connecting batteries incorrectly may cause the batteries to overheat!



Figure 11A

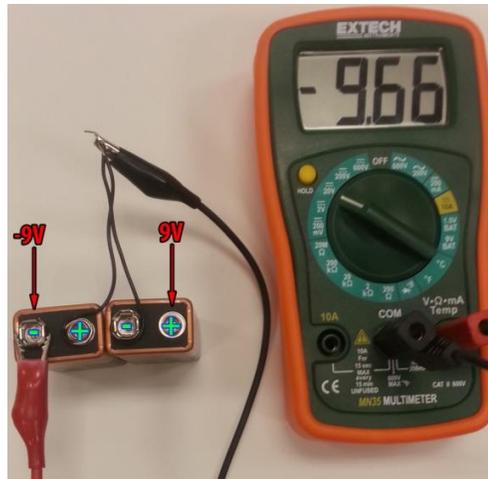


Figure 11B

12. Power Supply – Power Op Amp with +9V

- A. Disconnect wires in the previous step.
- B. Connect the positive terminal to the positive vertical column on the breadboard.
- C. Connect the negative terminal to the negative vertical column on the breadboard.
- D. NOTE: Connecting batteries incorrectly may cause the batteries to overheat!

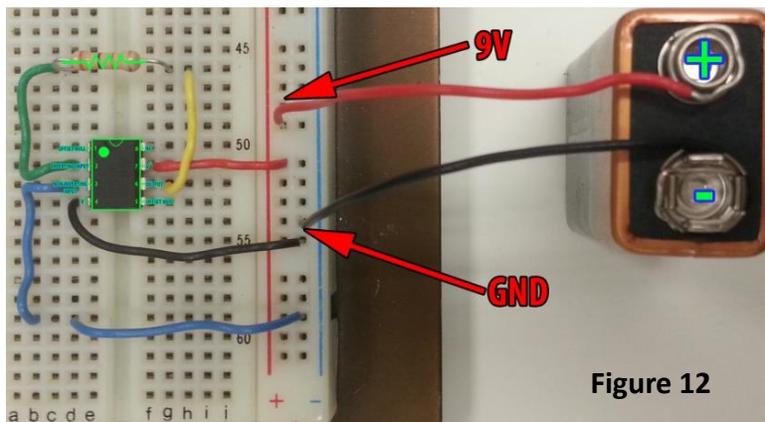


Figure 12

13. Power Supply – Power Sensor with -9V

- A. Connect the negative terminal to pin 1 of the FlexiForce sensor.
- B. Connect a wire to pin 3 of the FlexiForce sensor
- C. NOTE: PIN 2 DOES NOT GET USED!!
- D. NOTE: Connecting batteries incorrectly may cause the batteries to overheat!

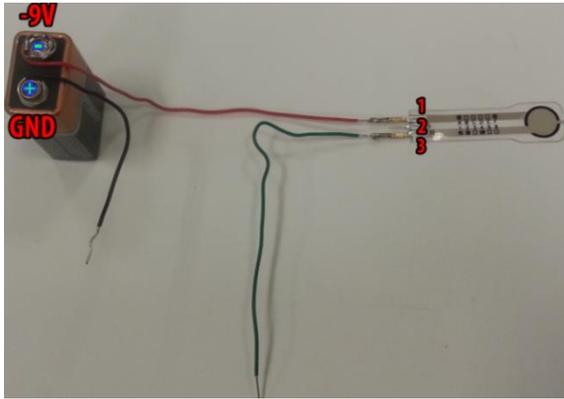


Figure 13A

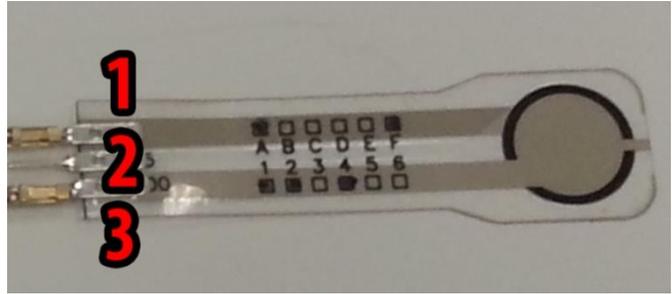


Figure 13B

14. Connect Sensor to Breadboard

- A. Connect the positive terminal of the lower battery to the negative vertical column of the breadboard.
- B. Connect pin 3 of the FlexiForce sensor to pin 2 of the op amp.
- C. NOTE: Connecting batteries incorrectly may cause the batteries to overheat!

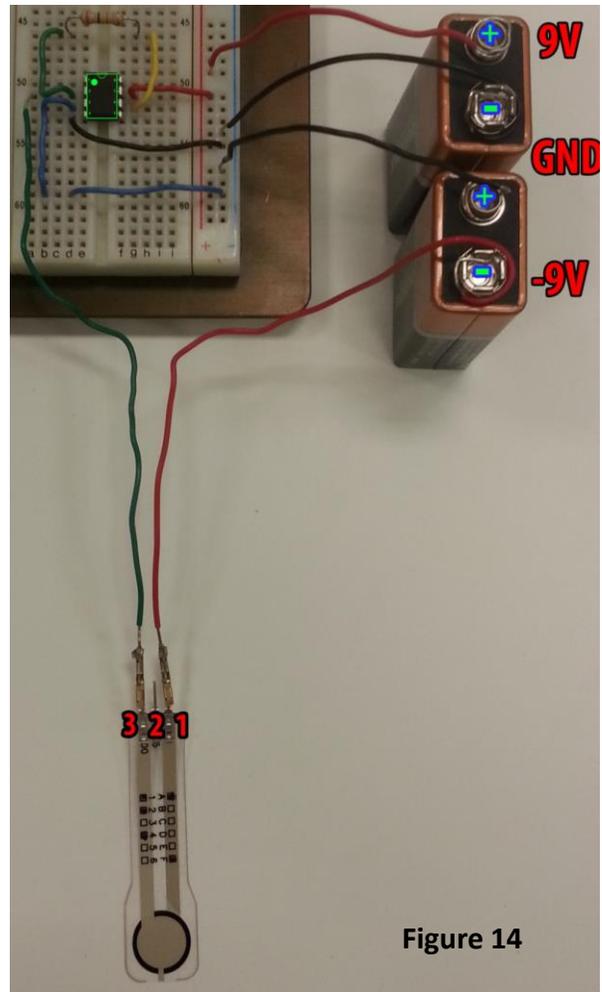


Figure 14