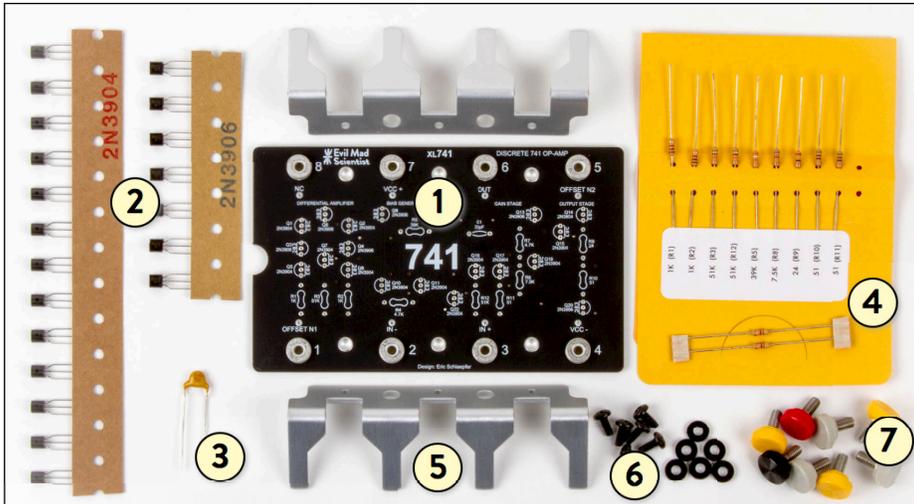




## XL741 Discrete Operational Amplifier

Re-create one of the most classic, popular, and all-around useful chips of all time.

v1.0



### Kit Contents:

1. Circuit board with threaded inserts
2. Transistors:
  - 2N3904 (13 pcs.)
  - 2N3906 (7 pcs.)
3. Capacitor: 33 pF Ceramic
4. Resistors:
  - 4.7 k (2 pcs.)
  - 9 others in resistor wallet
5. Aluminum "IC Legs" stand (two halves)
6. Mounting screws & spacers for "IC Legs" stand (6 pcs. each)
7. Thumbscrews with color-coded caps:
  - Gray, Yellow (3 each)
  - Red, Black (1 each)

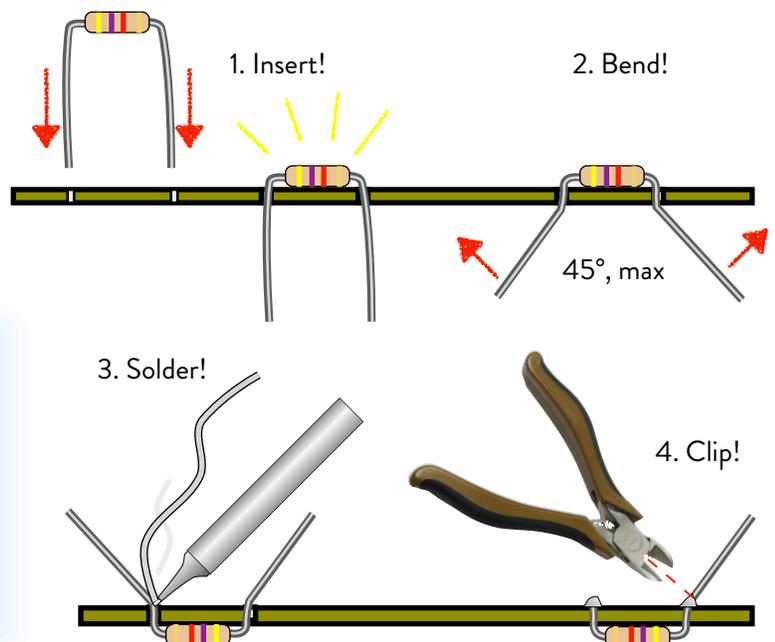


### Required Tools and Materials (not included with kit):

- A. Soldering iron  
*Recommended:* 25-50 W pencil type, e.g., Weller WLC100
- B. Solder  
*Recommended:* Rosin-core solder, 0.020 - 0.035" diameter
- C. Small "flush" wire clippers  
*Recommended:* Sears Craftsman #45660 diagonal cutting pliers
- D. Phillips head screwdriver, "#2" size

### Basics: How to Solder Components to a Circuit Board

0. For resistors only, pre-bend the leads as shown
1. Insert a component at its given location.  
Push it down gently, as far as it will go.
  - Resistors should go down flush to the board.
  - Other components may not quite sit flush.
2. Gently bend its leads out, up to 45°, to hold it in place while you solder.
3. One at a time, from the back side, solder the leads of the component to the circuit board.
  - i. The tip of your iron needs to be shiny (tinned) for soldering to work well. If it isn't, melt some fresh solder against it and quickly swipe it clean against a wet sponge.
  - ii. Place the solder against the joint that you wish to connect.
  - iii. Touch the iron to the solder and joint for about one second. Count it out: "one thousand one."
  - iv. The solder should melt to the joint and leave a shiny wet-looking joint. If not, let it cool and try again.
4. From the bottom side, clip the excess leads, close to the board. (But, not so close that you're clipping the board itself.)



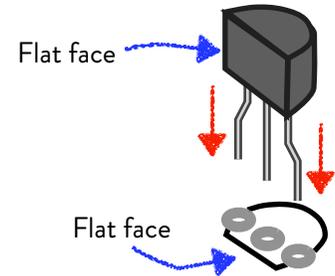
## Assembly Step 1: Add the Resistors and the Capacitor

1. Identify the two “loose” 4.7 k resistors (color code: yellow, violet, red, gold)
2. Install first 4.7 k resistor goes at location **R4**. Pre-bend its leads, insert it (either orientation), solder, and clip as described earlier (in “How to Solder Components to the Circuit Board”).
3. Install the other 4.7 k resistor, in the same way, at location **R7**.
4. Install the other 9 resistors, in the locations given by the table:
5. Install the capacitor at **C1**. Insert it only as far as it will go. Solder and clip the two leads.

Value	Color Code	Location(s)
1 k $\Omega$	brown, black, red, gold	R1,R2
51 k $\Omega$	green, brown, orange, gold	R3,R12
39 k $\Omega$	orange, white, orange, gold	R5
7.5 k $\Omega$	violet, green, red, gold	R8
24 $\Omega$	red, yellow, black, gold	R9
51 $\Omega$	green, brown, black, gold	R10,R11

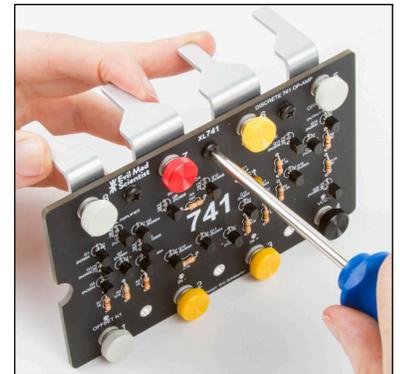
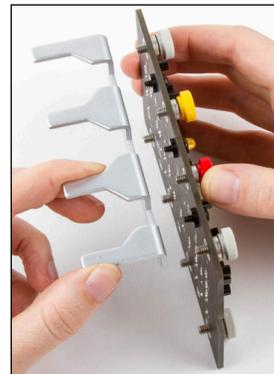
## Assembly Step 2: Add the Transistors

1. Identify the strip of thirteen 2N3904 transistors, and gently remove them from the tape.
2. Install the first 2N3904 transistor at location **Q1**. Transistor orientation is **very important**. Match the *flat face* of the transistor to the *flat face* of the drawing on the circuit board.  
 → (Double check, please! Installing a transistor backwards is the most common assembly error.)  
 Push the transistor in gently, as far as it will go, and then solder and clip its leads.
3. Install the remaining 2N3904 transistors at **Q2, Q5-7, Q10-11, Q14-18, and Q22**.
4. Install the 2N3906 transistors (with equal care) at locations **Q3-4, Q8-9, Q12-13, and Q20**.



## Assembly Step 3: Terminal Posts and Stand

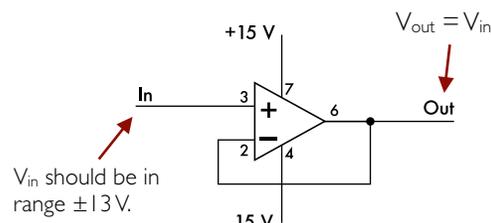
1. Thread in the eight thumbscrews (terminal posts) by hand:  
 Gray at pins 1, 5, and 8. Yellow at 2, 3, and 6. Black at 4, and Red at 7.
2. Install the first half of the “IC Legs” stand:
  - i. Hold the circuit board up on its side as shown. From the top side of the board, slip a black screw through each of the three screw holes between the thumbscrews. Then from the bottom side, slip one black plastic spacer over each of those screws.
  - ii. Move the first half of the anodized aluminum “IC Legs” stand into position and guide its three pilot holes onto the three black screws. Begin engaging the screws to trap the spacers in place.
  - iii. Alternating amongst the three, tighten the three screws until just firm; do not over-tighten.
3. Repeat the same set of steps to install the second half of the stand. Once you have finished both sides, you may wish to momentarily loosen the screws slightly and straighten the stand with respect to the circuit board.



## Testing and using your new 741 Op-Amp

- The xL741 Op-Amp can be used as a direct substitute for a  $\mu$ 741 op-amp IC in most circuits. See the xL741 datasheet for detailed electrical specifications and much more information. Note in particular that the differential input voltage (difference between pins 2 and 3) is restricted to  $\pm 11$  V.

- Suggested simple test circuit:  
 Voltage follower, or “analog buffer”



You can connect to the 741 through bare wire, alligator clips, or spade or ring lugs, using the terminal posts. You can also directly solder wires to the small pins next to each terminal post, if you’re careful to clip the wires such that they don’t touch the aluminum legs.

- You can find additional resources about this kit and about the 741 op-amp on our documentation wiki. Please visit: [wiki.evilmadscientist.com/741](http://wiki.evilmadscientist.com/741)