

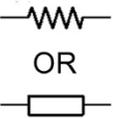
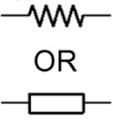
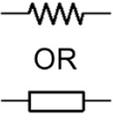
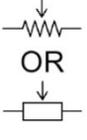
- This list shows all items included in your “theDemonstrator”
- Many parts look similar. Be sure to keep all parts in their respective bags and only open one bag at a time.
- If any parts are missing, please contact Sales@FVResearch.com right away.

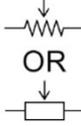
LEDs

Symbol	Kit QTY	Image	Description and Schematic Name
	22		5MM Clear Red LED LED1, LED12-LED21, LED33-LED43
	21		5MM Clear Green LED LED22-LED32

Resistors

All fixed resistor tolerances are $\pm 5\%$ (gold stripe)

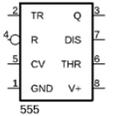
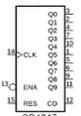
	20		620 Ω ¼W 5% Carbon Film Resistor (Blue, Red, Brown, Gold) R1-R10, R12-R21
	20		1.3K Ω ¼W 5% Carbon Film Resistor (Brown, Orange, Red, Gold) R11, R23-R44
	1		1.5K Ω ¼W 5% Carbon Film Resistor (Brown, Green, Red, Gold) R22
	1		10K Ω Potentiometer The value is printed on the bottom as B103 (10,000 Ω = code 103) VR1

 OR 	1		100KΩ Potentiometer (100,000Ω = code 104) The value is printed on the bottom as B104 VR2
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Capacitors			
The color of the capacitors may vary from the picture.			

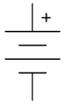
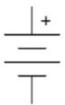
	1		.1µF Ceramic Capacitor (100,000pF = code 104) C1
 OR 	1		220µF Electrolytic Capacitor 16V C2
 OR 	1		10µF Electrolytic Capacitor 16V C3
	1		.001µF Ceramic Capacitor (1,000pF = code 102) C4

Integrated Circuits			
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	1		555 Timer 8 Pin IC IC1
	1		CD4017 Decade Counter 16 Pin IC IC2

Switches and Pushbuttons			
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	1		SPDT Slide Switch 300Ma 30V S1
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	1		SPST-NO Pushbutton Switch 0.1A 32V S2
Connectors and Sockets			
No Symbol	1		8 Position IC DIP Socket IC1
No Symbol	1		16 Position IC DIP Socket IC2
	1		Barrel Connector (2.00mm ID (0.079"), 5.50mm OD (0.217")) Same power connector as the Arduino Uno. J1
No Symbol	2		15 Position Single Row Female Header J2, J3
Batteries and Battery Connectors			
	1		9 Volt Battery (Brand may vary) BAT1
	1		9V Battery Holder BAT1
Tools and Hardware			
No Symbol	3		#2-56 Pan Head Slotted Nylon Bolt BAT1
No Symbol	3		#2 Nylon Washer BAT1

No Symbol	3		#2-56 Nylon Hex Nut BAT1
Tools and Hardware Continued			
No Symbol	1		3D Printed Lead Forming Tool Printed from this design: thingiverse.com/thing:26025
No Symbol	1		Static Dissipative Bag (Helps with anti-static precautions)
Printed Circuit Board (PCB)			
No Symbol	1		106-200 FutureVision Research theDemonstrator PCB
Microcontrollers			
	1		<p>Arduino Nano (Sold separately)</p> <p>Note: When purchased from FVResearch.com, your Arduino Nano comes preprogrammed with theDemonstrator sketch. If you need the sketch, please visit FVResearch.com/theDemonstrator</p>

Following these instructions step by step will help ensure that your kit works the first time.

As you build your kit, please keep these points in mind:

1. The parts for your kit are organized by value. For instance, all 620Ω resistors are in the same bag. The part description printed on the bag can be confusing. Look for the spot on the bag label marked “Customer Ref:”, this will give you the schematic locations for that part value (e.g. R1-R10, R12-21)
2. Leave all parts in their respective bags until ready to use them. This is especially true for the CD4017 Decade Counter IC, which is highly sensitive to static discharge.
3. Always double-check that each part is inserted the correct direction before you trim its leads.
4. All leads must be trimmed before you insert the 9-volt battery and before you connect the Arduino Nano to USB.

You can trim leads after soldering each part, in batches (e.g. after you finish a row of LEDs), or you can trim them all at once when you finish. The battery clips, buttons, switches and Arduino Nano headers, and IC sockets do not need to be trimmed.

Installation Steps

Resistors

- **Although resistors are not a polarized part, they should be inserted so the color code can be read the same direction as the silkscreen writing that shows their resistance.**
1. Install the 620Ω resistors, which are labeled R1-R10, and R12-21
Note: Use the provided lead forming tool to bend the leads of each resistor.
 2. Install the 1.3KΩ resistors, which are labeled R11, and R23-R44
 3. Install 1.5KΩ resistor, which is labeled R22

Sockets

4. Install the IC (Integrated Circuit) sockets for IC1 and IC2.
Notes: The dimple at one end of the socket should match the direction of the dimple shown on the silkscreened outline.
Do not insert the IC chips into the sockets at this time.
5. Install the two 15 position pin headers for the Arduino Nano.
Note: Make sure each header is sitting flat on the circuit board before you apply solder. Consider using small pieces of masking tape to hold the header in place...but be sure to remove the tape afterwards.

LEDs

- **Both the red and green LEDs have clear bezels. Don't take the green LEDs out of their bag until all the red LEDs have been installed.**
 - **The short lead on each LED is negative (cathode)**
 - **The negative leads for all LEDs face the flat side of the silkscreened outline.**
6. Install all red LEDs, which are labeled LED1, LED12-LED21, and LED33-LED43
 7. Install all green LEDs, which are labeled LED2-LED11, and LED22-LED32

Capacitors

- **Capacitors C2 and C3 are electrolytic and therefore polarized. The short lead (negative) must be inserted in the hole marked with a small dot on the silkscreened outline.**
 - **Although not polarized, the value printed on C1 and C4 should face the corresponding value silkscreened on the circuit board.**
8. Install the .1 μ F ceramic capacitor marked C1
 9. Install the 220 μ F electrolytic capacitor marked C2.
 10. Install the 10 μ F electrolytic capacitor marked C3.
 11. Install the .001 μ F ceramic capacitor marked C4.

Variable Resistors

- **The two variable resistors, VR1 and VR2 look identical, but have different resistance values. Double-check the code printed on the bottom of each variable resistor before inserting it into place.**
12. Install the 10K Ω (code 103) variable resistor labeled VR1
 13. Install the 100K Ω (code 104) variable resistor labeled VR2

Switches and Pushbuttons

14. Install the slide switch marked S1. The knob on the slide switch must face the edge of the circuit board.
15. Install the pushbutton marked S2. The flat edge of the pushbutton must face the flat edge of the silkscreened outline

Power Supply Connections

16. Install the power connector J1.
17. Mount the battery socket, BAT1 to the circuit board using the provided nylon hardware.
 - a. Insert a washer on each bolt
 - b. Insert a bolt into each of the three mounting holes
 - c. Fasten each bolt using a nut. Do not over tighten!
18. Once the battery socket is mounted in place, solder the two battery connections.

DO NOT INSTALL THE BATTERY OR CONNECT A POWER ADAPTER AT THIS TIME.

Integrated Circuits

- Before installing IC1 and IC2, inspect your board using the information on the next page, titled "Inspection and Placement of the Integrated Circuit Chips".
 - You must observe anti-static precautions when installing both chips. The anti-static precautions are provided on the next page.
 - Pin 1 on each IC is marked with a dot, dash or small indent. Ensure pin 1 on the IC faces the dimple on the socket and silkscreened outline.
19. Install the 555 timer IC marked IC1.
 20. Install the CD4017 decade counter IC marked IC2.



106-200 theDemonstrator Solder Kit Assembly Instructions

Microcontroller

21. Insert an Arduino Nano programmed with theDemonstrator Sketch. Ensure that the USB connector on the Nano faces the edge of the circuit board.
(If you still need to upload the sketch, please visit FVResearch.com/theDemonstrator.)

Now that all parts have been installed, you're ready to apply power. Don't forget to fully inspect your board as explained under "Inspection and Placement of the Integrated Circuit Chips.

Ensure that your board is sitting on a non-conductive surface, installed the 9 Volt battery and power up your board!

If your board does not function as expected, turn the power off, remove the battery, and review the assembly instructions to look for mistakes.

Inspection and Placement of the Integrated Circuit chips

It is important to inspect your board before inserting the two Integrated Circuit chips.

Please follow these steps:

1. Double check the value and direction of each part against the information printed on the circuit board.
2. Inspect your solder connections and check for poor connections, cold solder joints, solder bridges, etc.
3. Correct any faulty connections
4. Ensure all component leads are trimmed
5. Clean the flux from your circuit board using an appropriate cleaner and a soft brush.
 - a. If using rosin based flux, use rubbing alcohol, isopropyl alcohol or flux remover (use appropriate precautions (i.e. eye protection and rubber gloves)
 - b. If using water soluble flux, wash with warm water and a soft brush.
6. Ensure your circuit board is fully dry before installing the ICs and before applying power.

Anti-static precautions for the integrated circuit chips

The CD4017 decade counter IC is a CMOS (Complementary Metal-Oxide Semiconductor) component. CMOS chips are highly vulnerable to static discharge. (Static discharge occurs when electrons jump from one surface to another.) Therefore, we must observe anti-static precautions when installing this chip onto the circuit board.

Note that official “work place” anti-static precautions are more thorough than the process we’ll use on this project. However, we find that our precautions are sufficient for our needs.



ESD susceptibility symbol

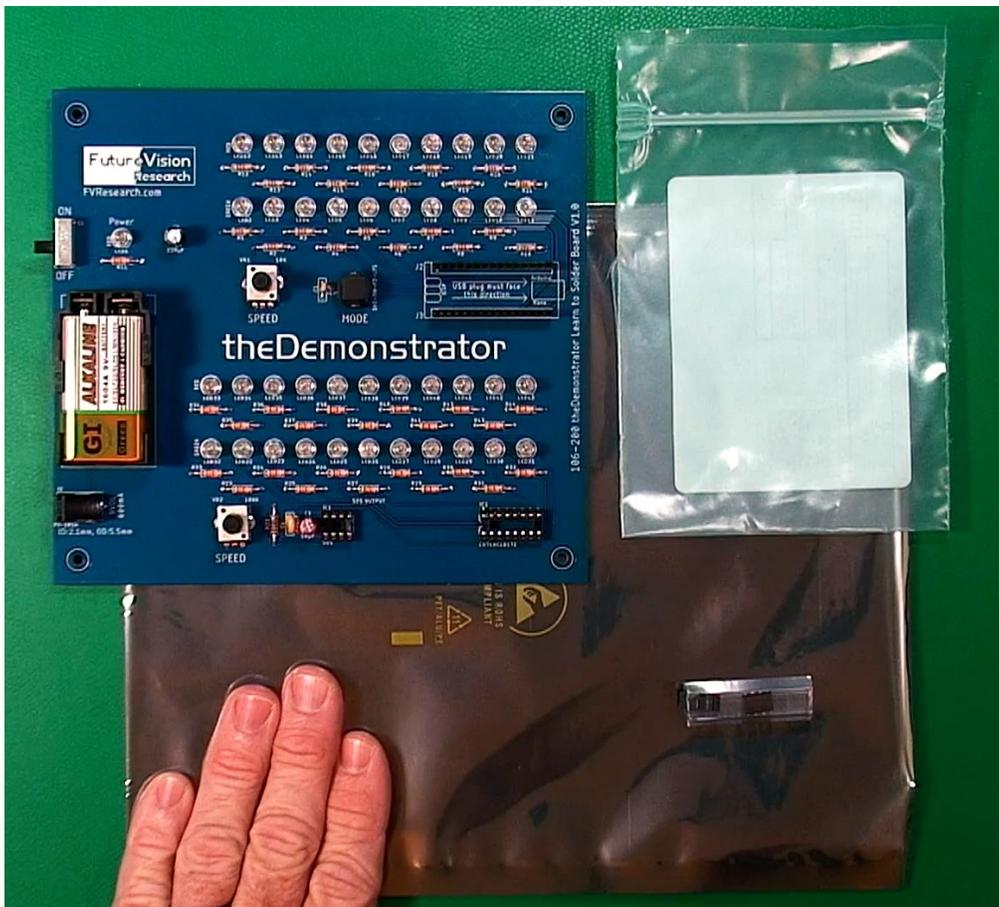
To give you some practice, we’ll install the 555 timer IC first and use the same anti-static precautions as the ones we’ll observe when installing the CD4017.

Preparing your anti-static work area

- Lay out your supplies on a table and sit down on a chair.
 - A stationary chair (no wheels) is best. Definitely do not use a roller chair that is sitting on a plastic mat.
- Once you sit down, do not stand up until you finish installing the two chips. (You’ll begin to build a static charge as soon as you stand up.)
- If anyone else is with you, ask them to not touch you or your work area. Doing so could cause a static discharge.
- Ensure there are no pets around. A pet touching you or your work area could cause a static discharge.

Anti-static process for installing an Integrated Circuit chip

1. Lay out the anti-static bag provided in your kit. This bag is made of materials designed to dissipate (remove) static charges. This anti-static bag will be your anti-static work surface.
2. Place your circuit board onto the anti-static work surface.
3. Place the anti-static bag containing the IC onto your anti-static work surface. This allows electrons to “balance out” between the circuit board and the bag.
4. Ensure that you touch the anti-static work surface so electrons “balance out” between you and the work surface.
5. Open the anti-static bag for your chip and remove the tube or anti-static pad holding IC and place it on your anti-static surface.
6. Remove the chip from its holder and place it in the proper socket.
 - a. Ensure that pin 1 is facing the direction of the dimple on the socket and silkscreened symbol.
 - b. Ensure that all pins are lined up with the socket and gentle press down until the chip is fully seated.



Use the static dissipative bag provided in your kit to protect your chips from static discharge.