

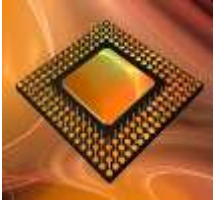


Modern Digital System Design

ECE 2372/Fall 2018

Hardware Project Kit

Adapted from
Dr. Tooraj Nikoubin
(Thank You!)

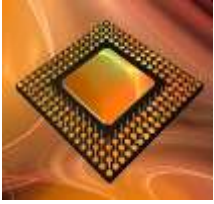


Introduction



- The Hardware project kit allows you to prototype simple logic circuits using real digital electronic components.
- You can purchase these kits from **IEEE Student Chapter office** in the basement of the ECE building
- The **cost is \$45** per kit and comes with the Digital kit, a breadboard and a 9V battery.

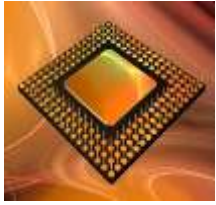




Introduction



- You will need a 9V battery for power up the kit (Included)
- Experience in soldering electronic components may become handy, even though it is not necessary to solder anything.
- Please refer to the data sheets of the integrated circuits for more details about their pin layout and other necessary details.
- These data sheets can be obtained from a simple web search.
- Example Data Sheet: <http://www.mouser.com/ProductDetail/Texas-Instruments/CD74HCT86E/?qs=MXJmdiNpZe%2FMzcfaKOr4w%3D%3D>

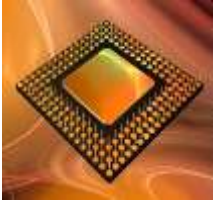


Contents



- The project kit contains the following items

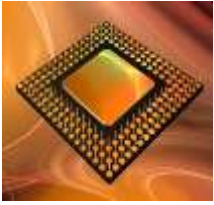
Description	Qty	Description	Qty
555 Timer	1	Breadboard	1
+5 VDC Voltage Regulator 7805	1	LED 10-Bar Display	1
74HCT00 NAND	1	Dual 7 Segment Display	1
74HCT02 NOR	1	22 Ga Solid Wire (5 assorted colors)	
74HCT04 NOT	1	9V Battery Snap Connector & Battery	1
74HCT08 AND	1	5 Pole Dip Switch	1
74HCT14 NOT (Schmidt Trigger)	1	1k SIP Resistors	1
74HCT32 OR	1	330 Ohm SIP Resistors	2
74HCT86 XOR	1	Push button switch	1
74HCT112 JK Flip Flop	1	Resistor (10 Meg)	2
74HCT157 Quad 2-input MUX	1	Resistor (100 k)	2
74HCT163 Counter	1	Resistor (1 k)	2
74HCT164 Shift Register	1	Resistor (300 Ohm)	4
74HCT251 8-to-1 MUX	1	Capacitor (0.01 MFD)	1
74HCT273 Octal D FF	1	Capacitor (0.033 MFD)	1
74HCT283 4-bit Adder	1	Capacitor (0.056 MFD)	1
74HCT390 Dual BCD Counter	1	Capacitor (0.068 MFD)	1
74HCT4543 BCD – 7 Segment	1	Capacitor (0.1 MFD)	1



Other Tools required

- In addition to the kit, you may choose to purchase the following tools
- Available at IEEE
 - Budget Wire-stripper/cutter \$10.00
 - Precision Wire cutter/stripper \$15.00
 - 4 ½" Diagonal-cutting mini pliers \$10.00
 - Tweezer \$3.50
 - Electrical Tape \$1.00

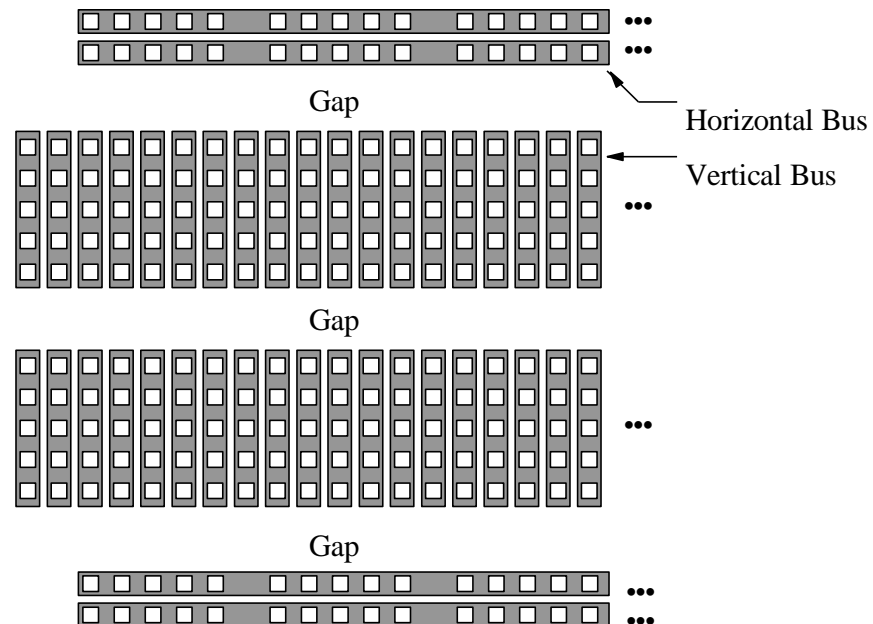
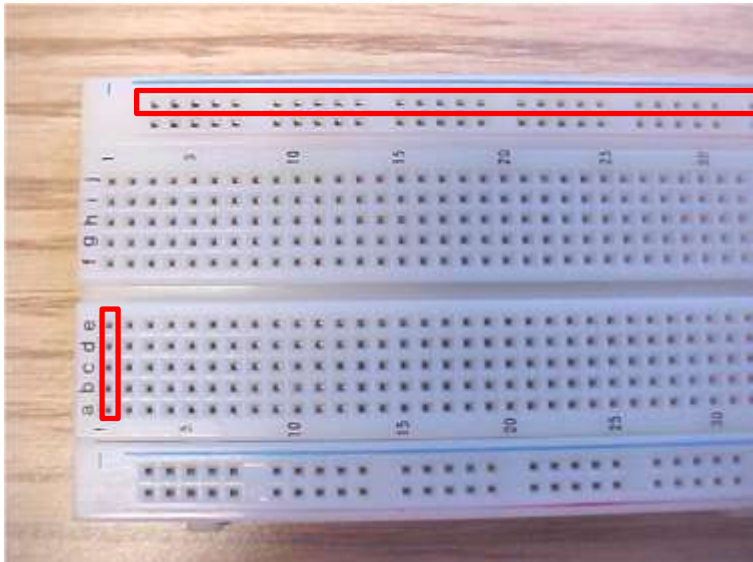


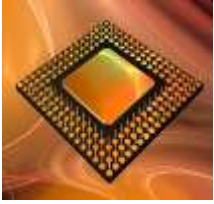


Bread Board



- Bread board is the substrate of your digital circuit on which you assemble the components and make necessary connections among them
- Holes in the bread board are connected internally as shown in the figure in the right



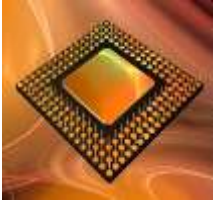


Jumper Wires



- You can use jumper wires to make necessary connections between components.
- Cut the hookup wires to the shortest length required and keep the wire as close to the surface of the breadboard as possible.
- “Looping” the wire high above the breadboard, while useful when quickly putting circuits together, is not good practice.

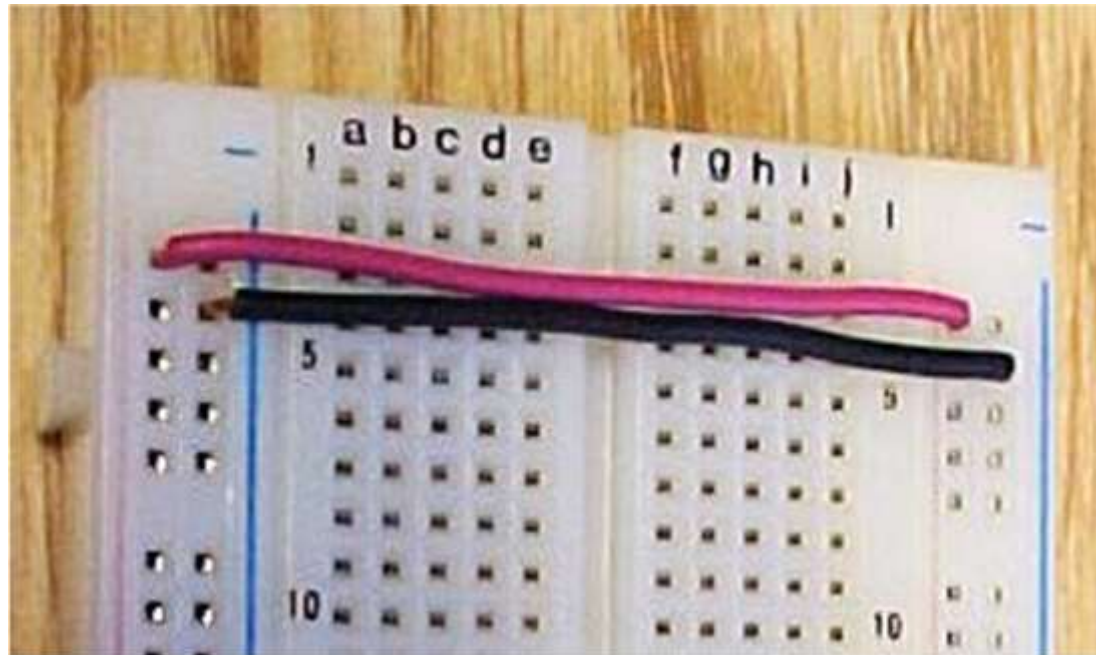


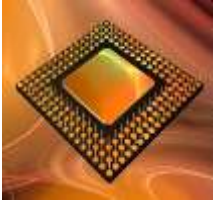


Jumper Wires



- You can also connect components to the same bus line in order to make connections.
- It's a good idea to connect top and bottom horizontal buses using jumper wires, so that you get +5V and Ground buses on both ends.

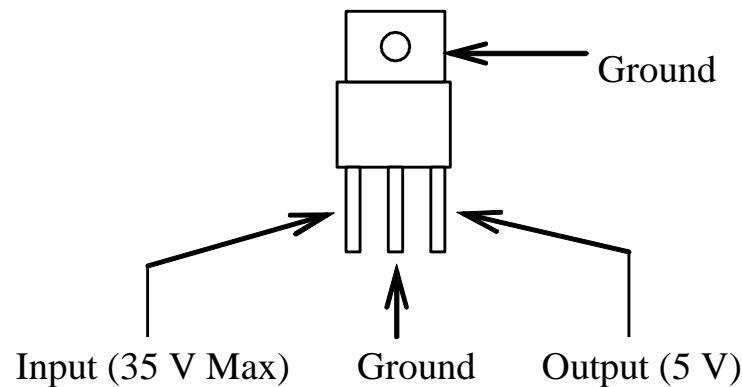


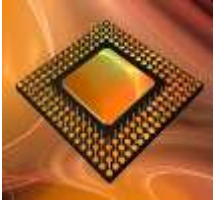


Power Supply

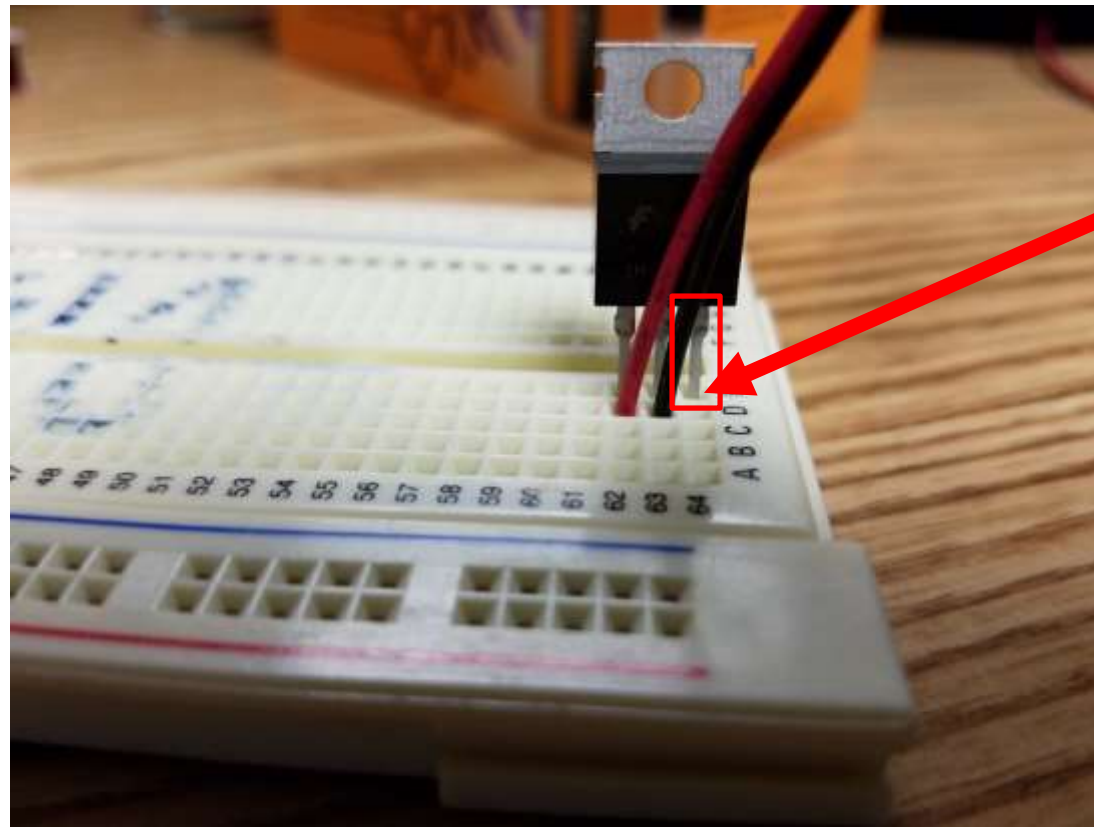


- You need to provide 5V DC power supply for the logic ICs in the kit.
- Since you have a 9V battery as your power source, you need to step down the voltage to 5V using 7805 voltage regulator.



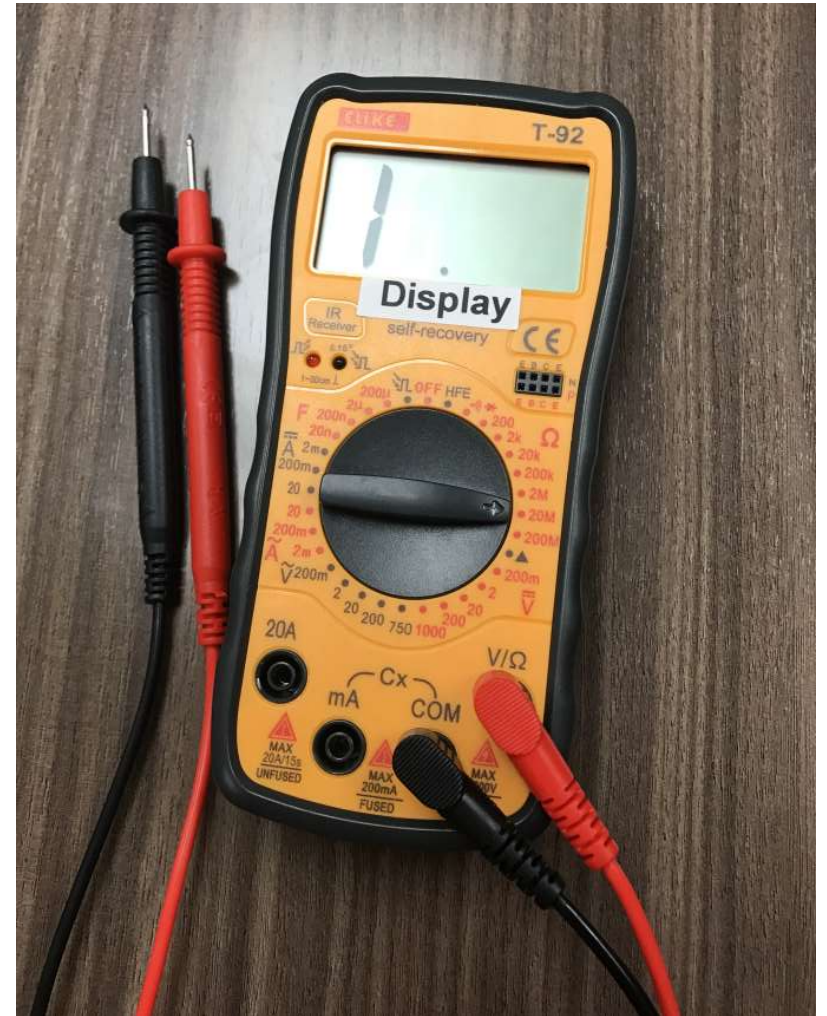
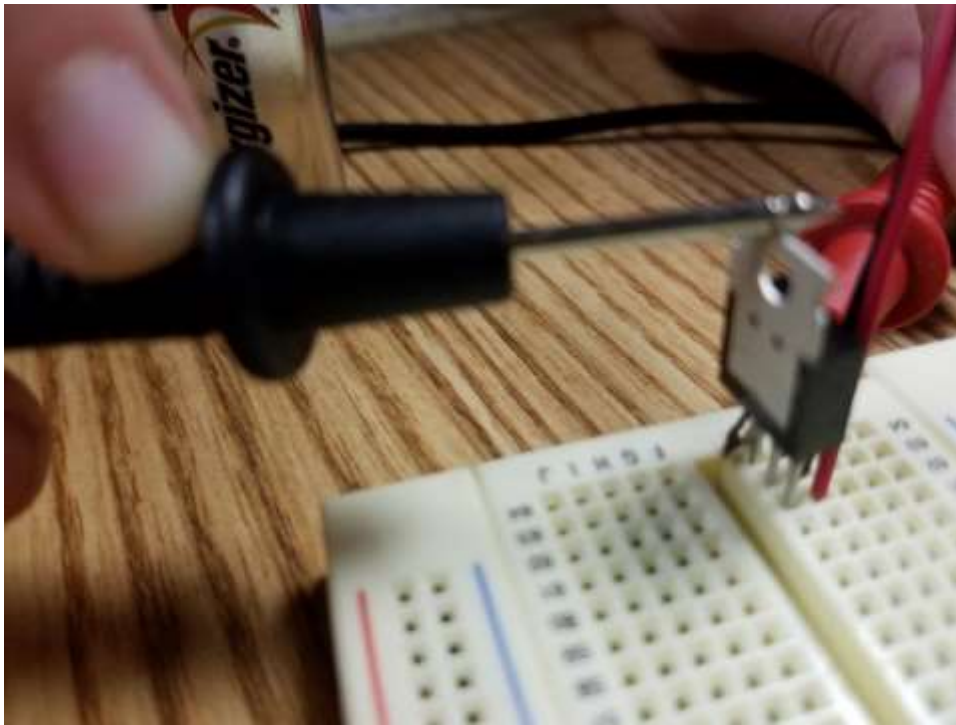


Power Supply Alt. Method

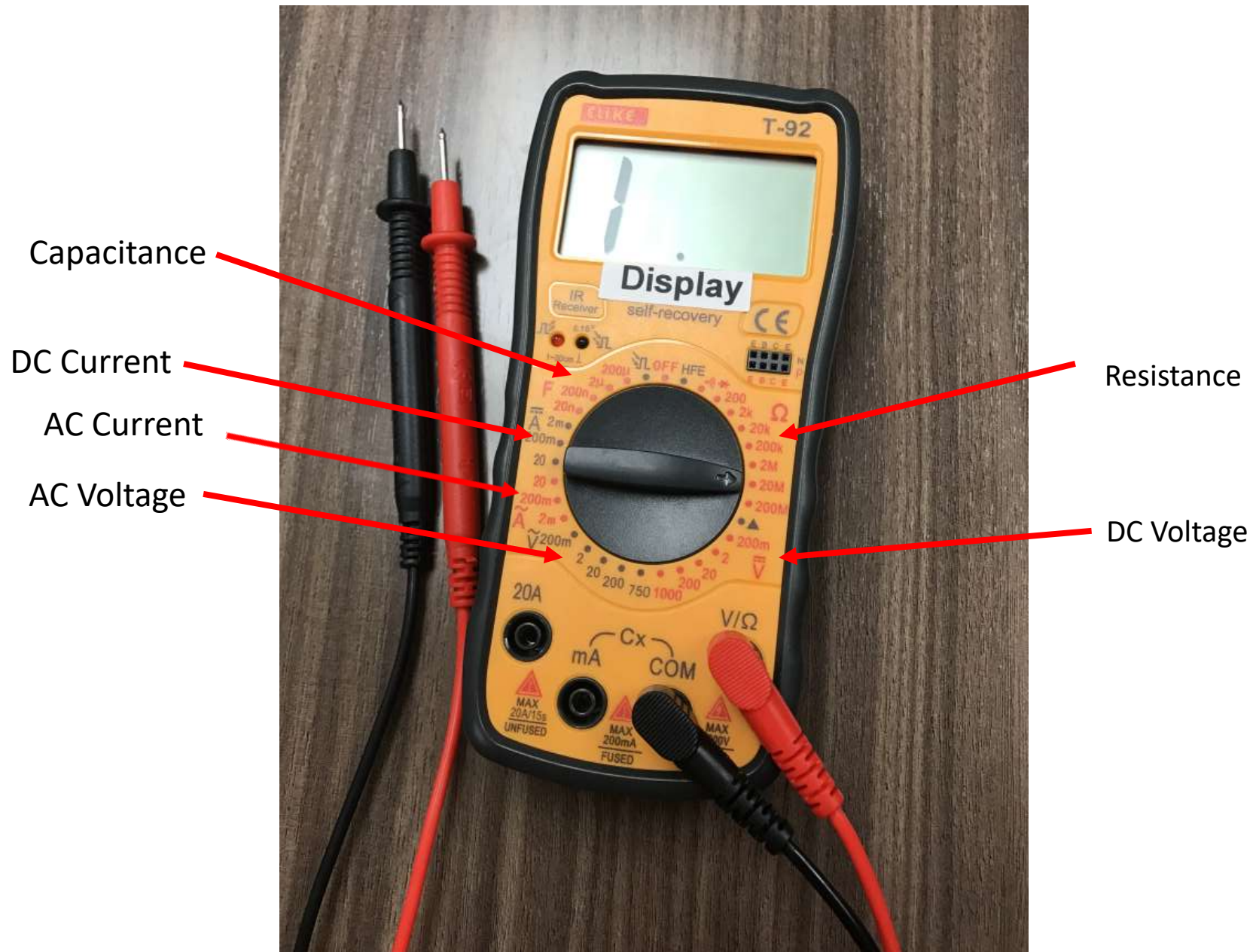


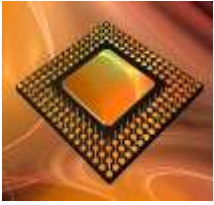
5V Output

Using The Multimeter



Digital Multimeter

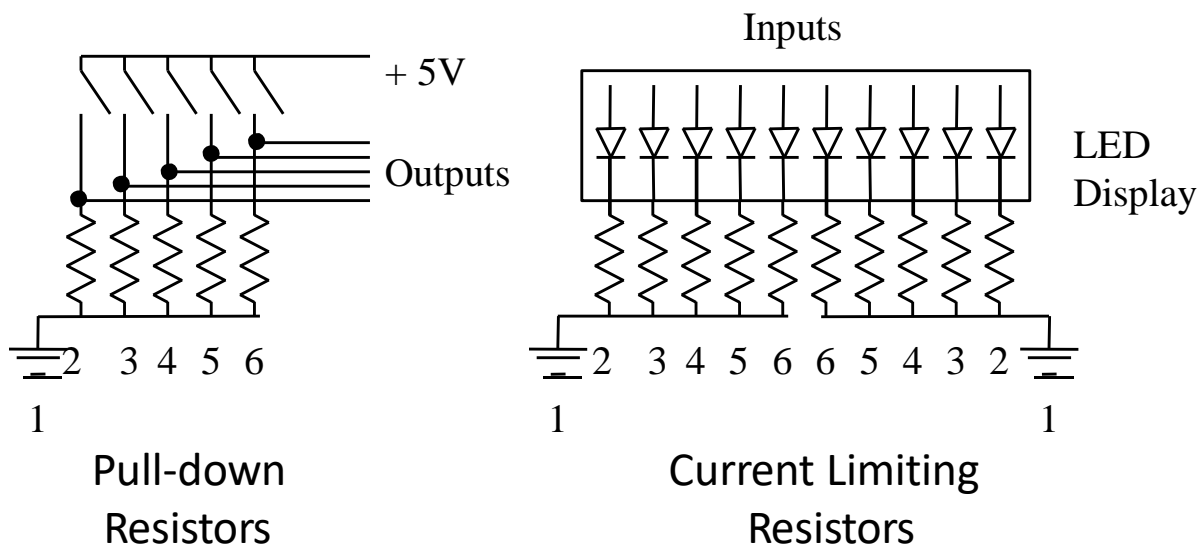


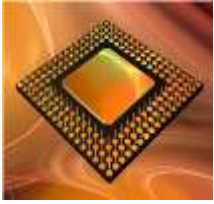


Pull Down and Current Limiting Resistors



- The provided 5-pole DIP switch can be used as a logic input to the logic circuits you make.
- Pull down resistors are used in logic inputs in order to avoid the floating inputs.
- Current limiting resistors are used to avoid drawing too much current from the logic ICs.

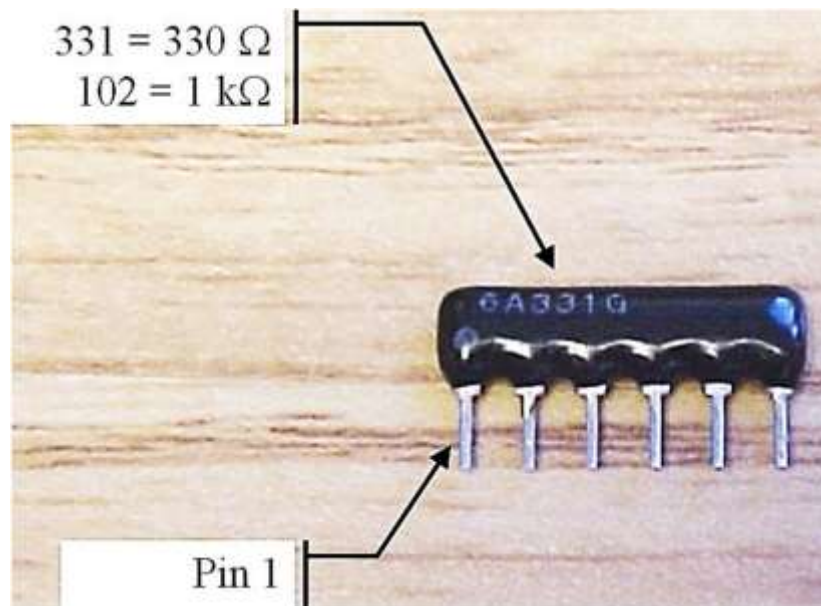




Bussed Resistors

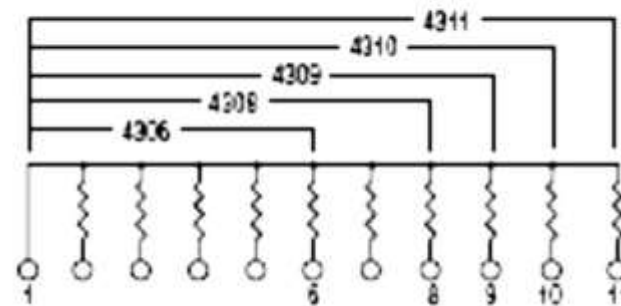


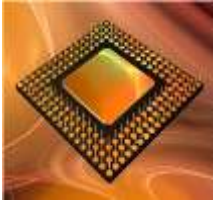
- Resistors come in SIP packages can be used to provide current limiting or pull down resistors without much wire clutter
- Pin 1 of the package is the common pin.



Bussed Resistors (101 Circuit)

Model 4306R-101-RC (6 Pin)
Model 4308R-101-RC (8 Pin)
Model 4309R-101-RC (9 Pin)
Model 4310R-101-RC (10 Pin)
Model 4311R-101-RC (11 Pin)

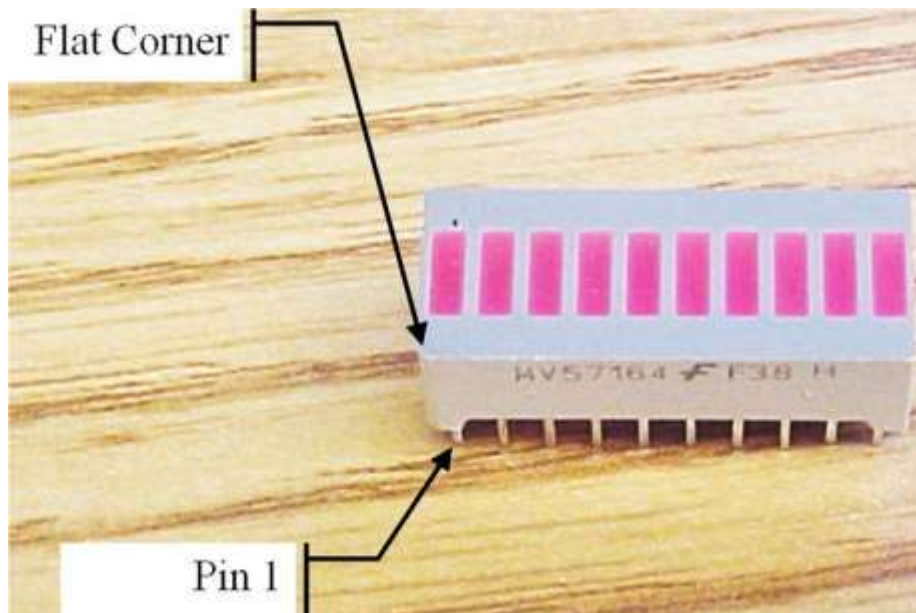




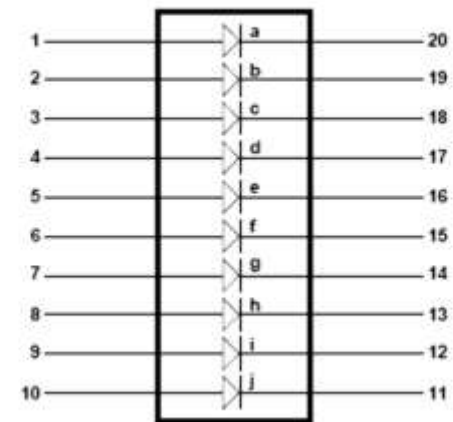
LED Bar Display

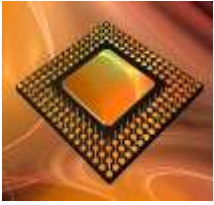


- The LED bar display can be used to display your logic outputs.

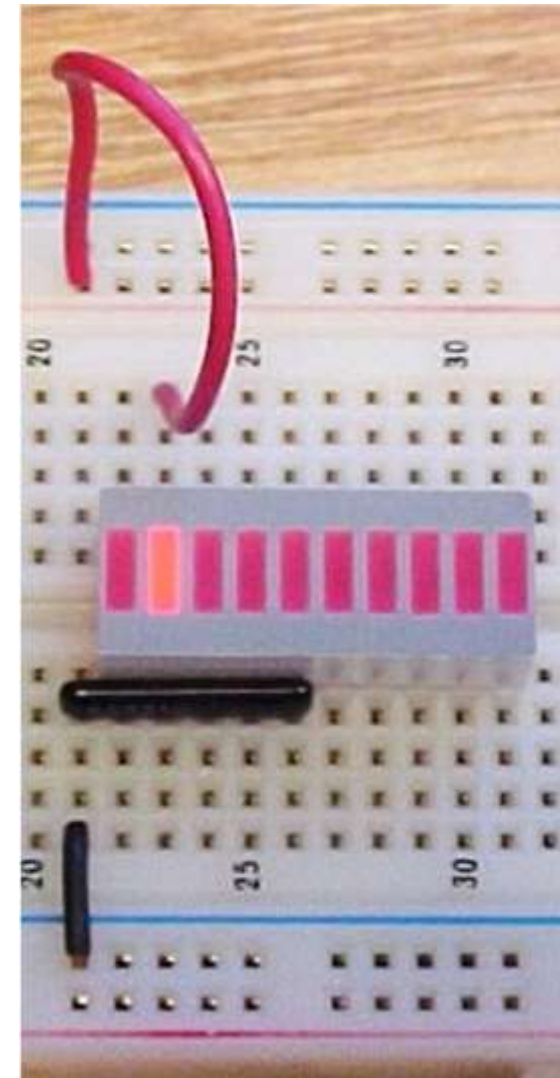
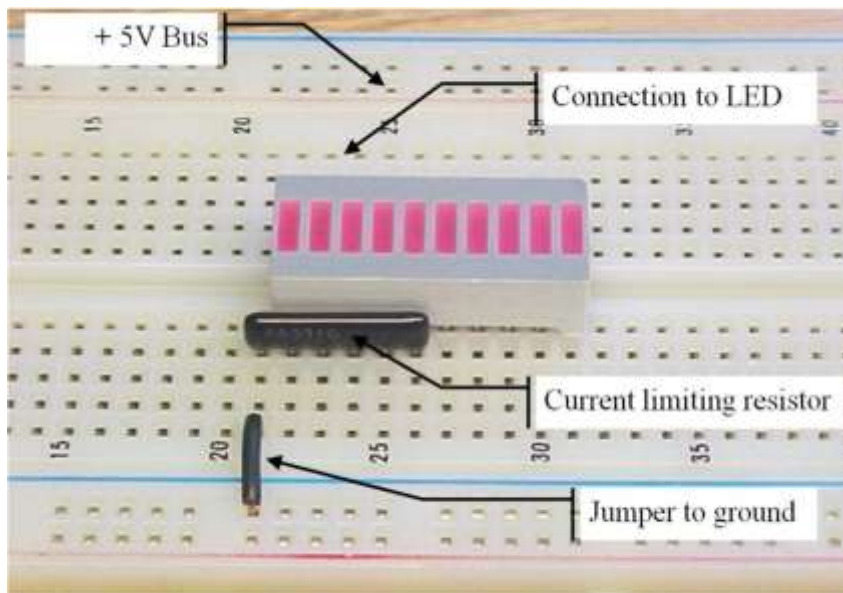
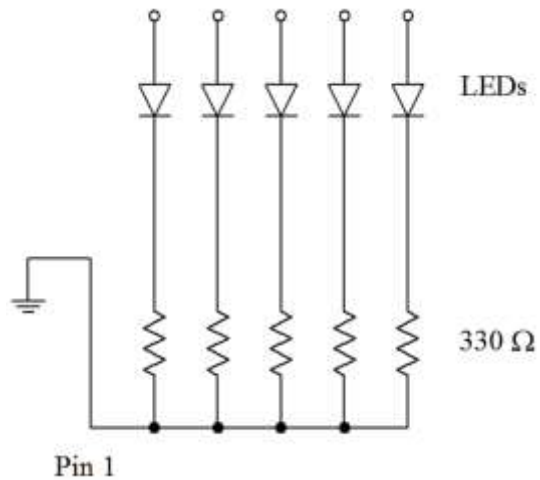


Internal Circuit Diagram

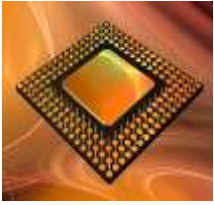




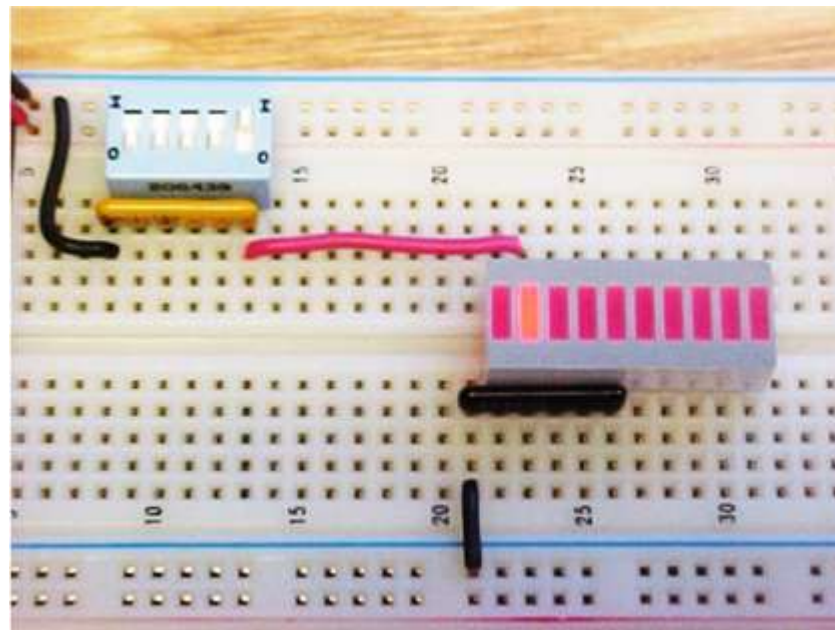
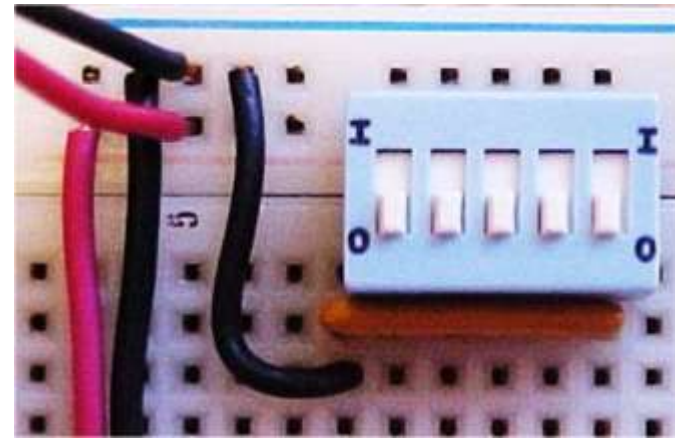
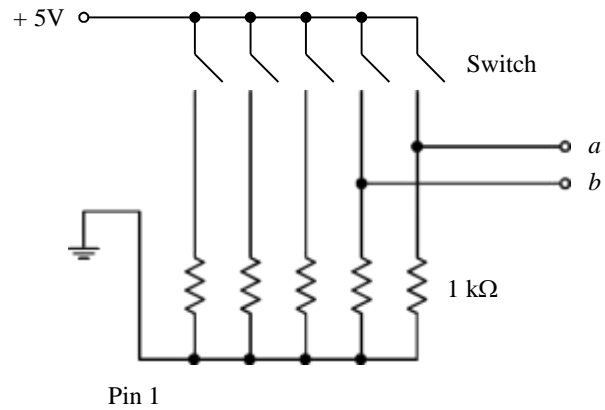
LED Bar Display

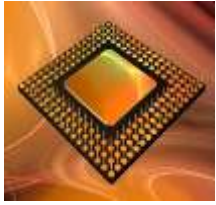


Testing The LEDs

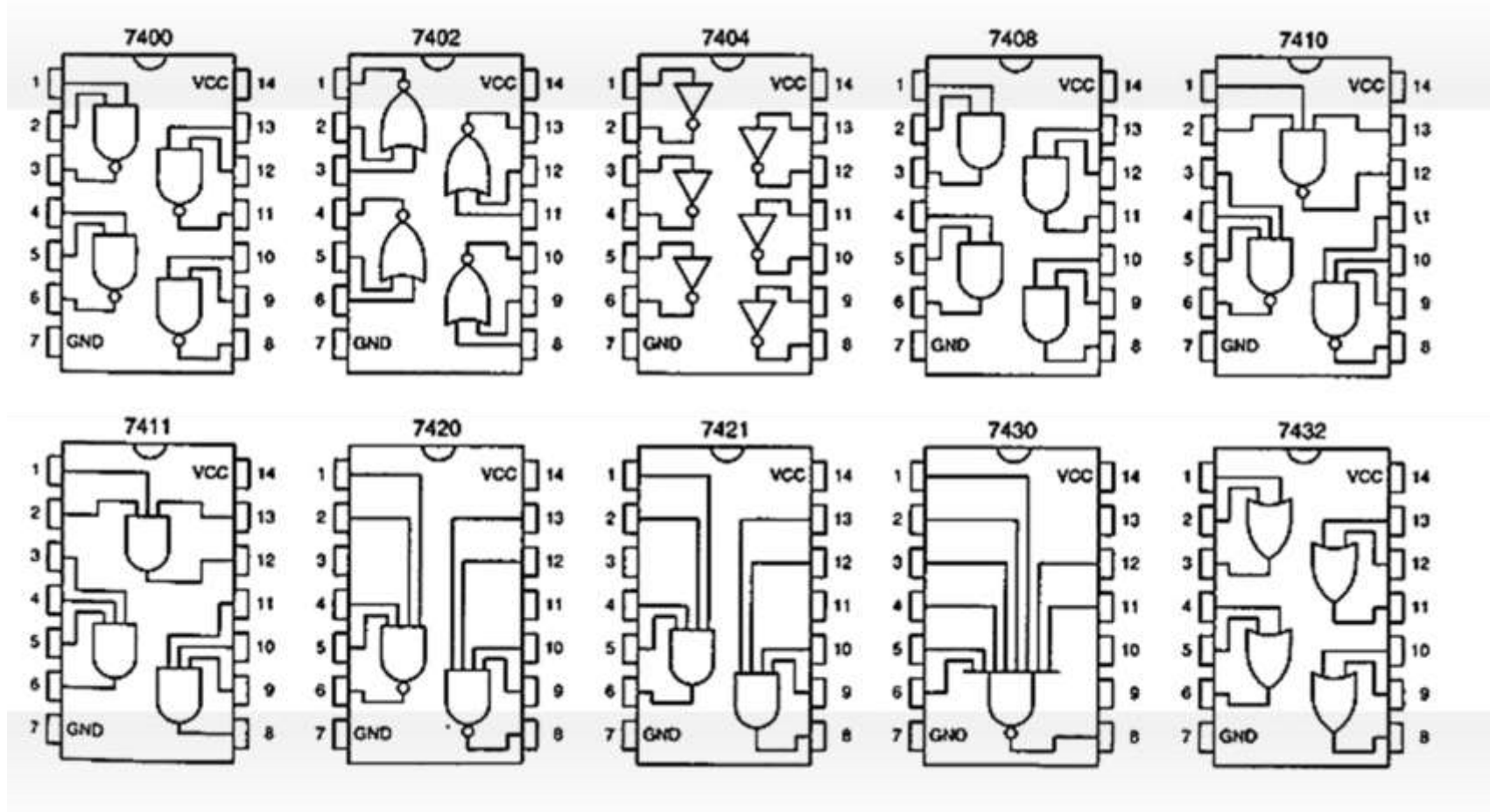


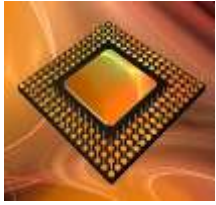
DIP Switches



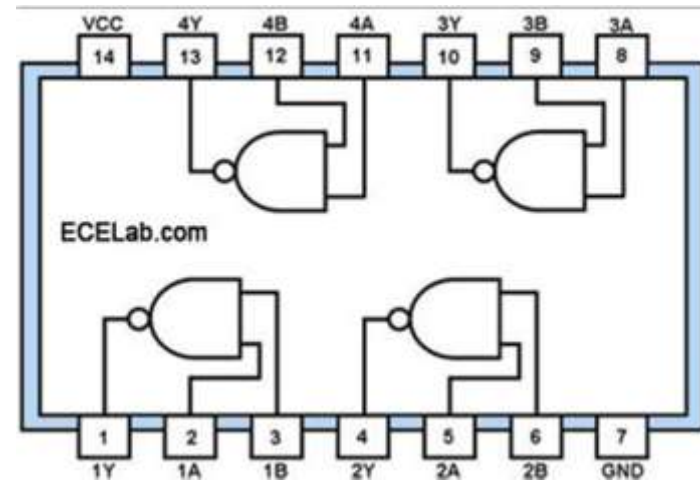


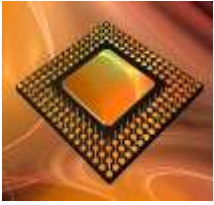
IC Chips





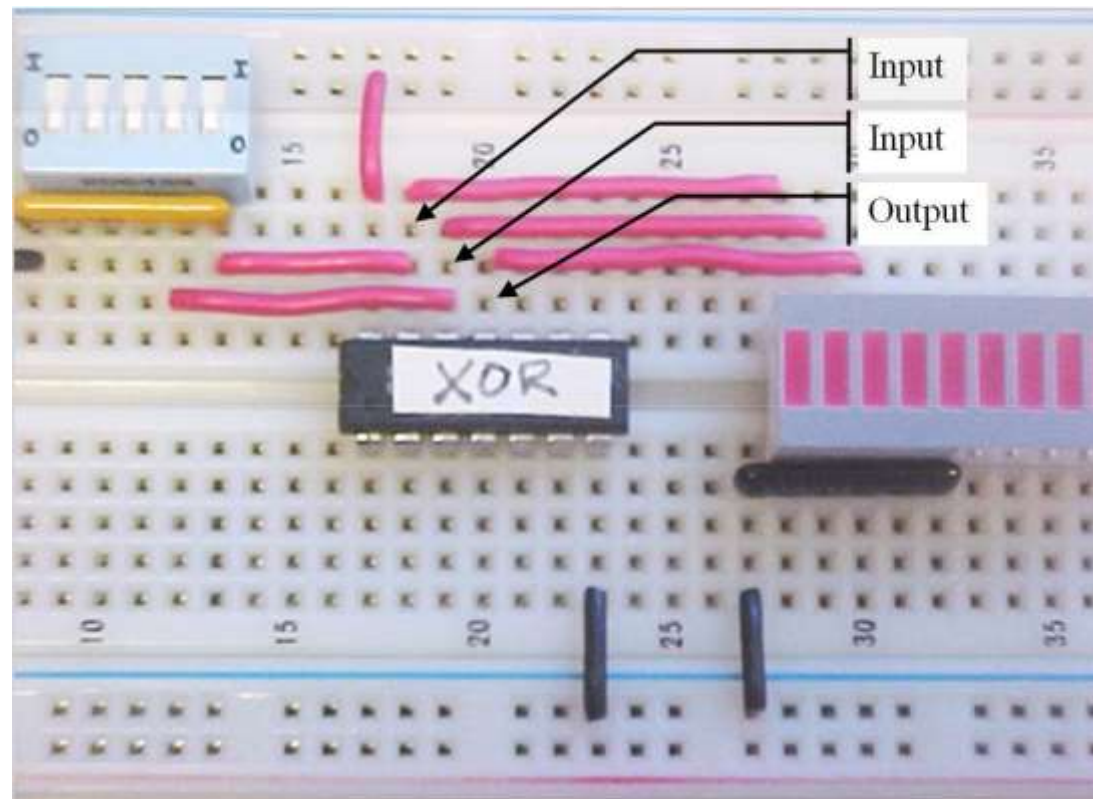
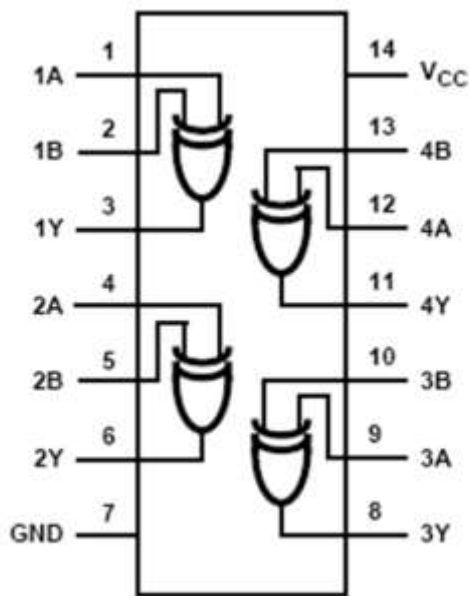
IC Chip

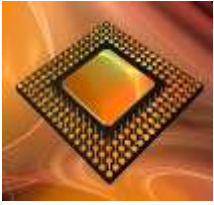




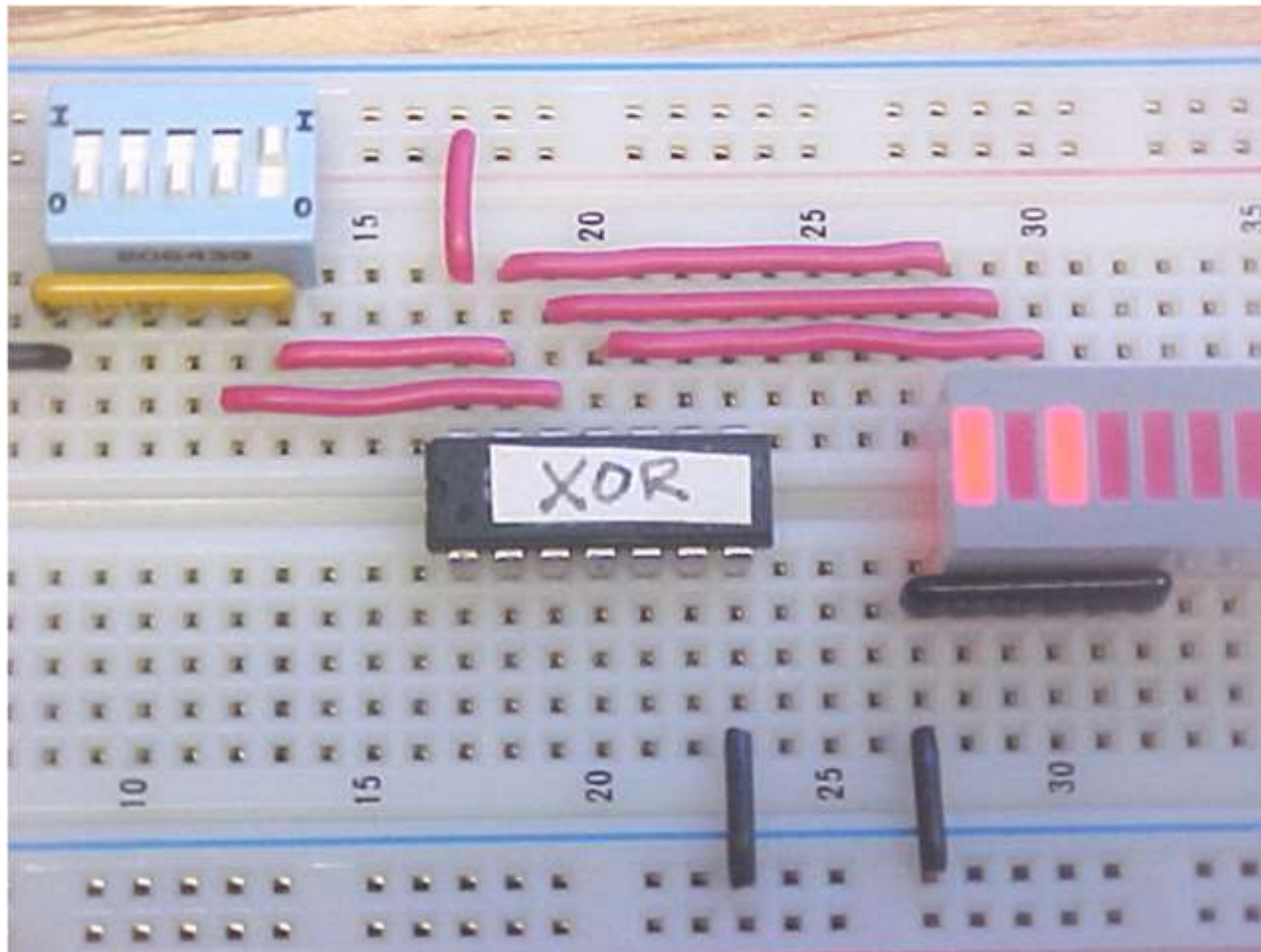
XOR Test Circuit

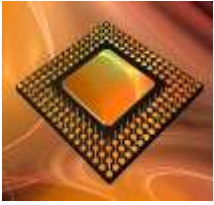
- Use 74HCT86 Quad 2-input XOR IC to demonstrate the XOR truth table.
- We only use one of the four XOR gates available in the IC.



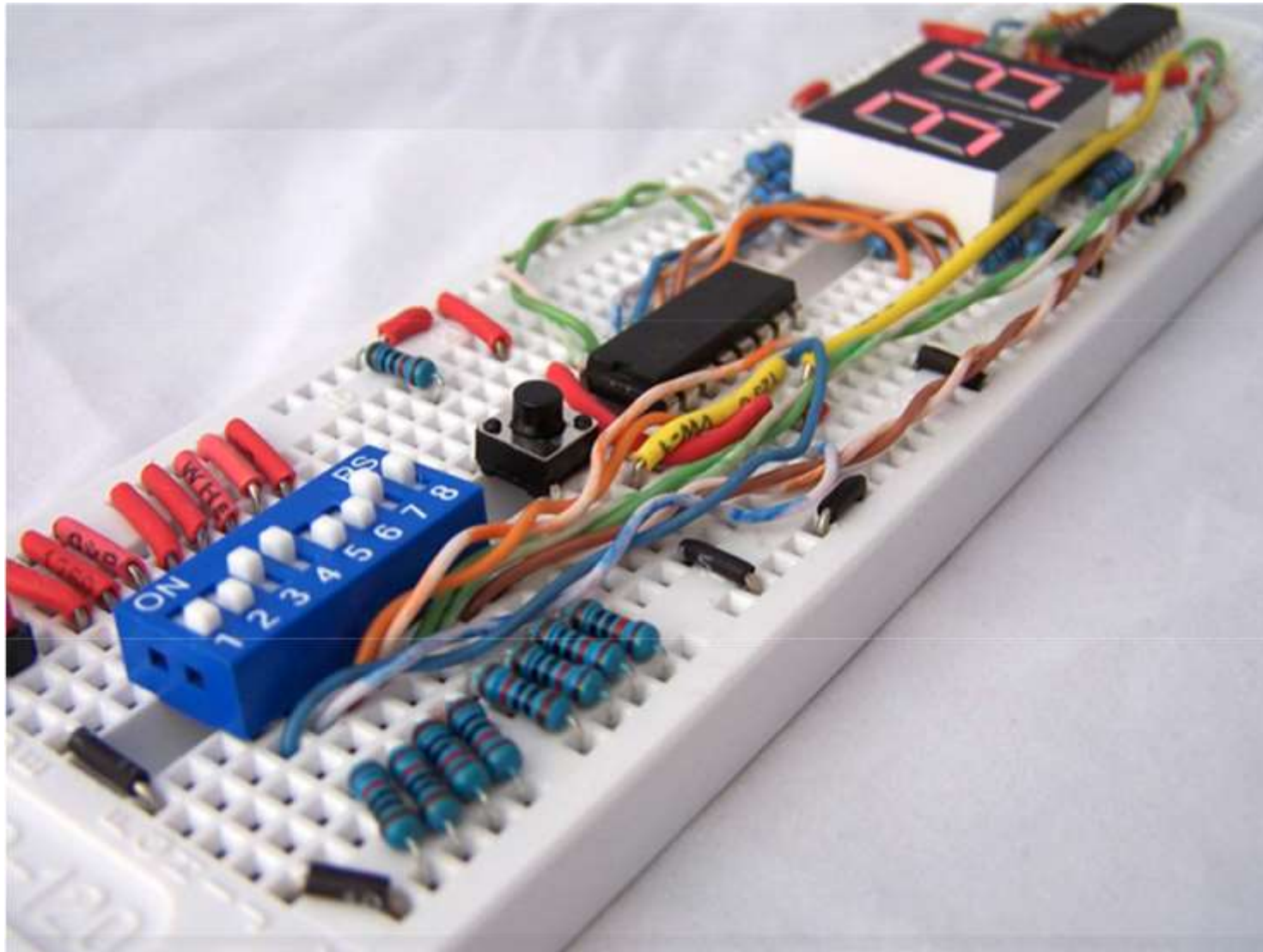


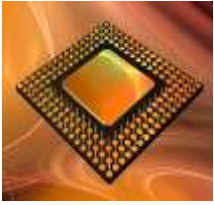
XOR Test Circuit (Finished)





Sample of Digital Circuit implementation on the breadboard

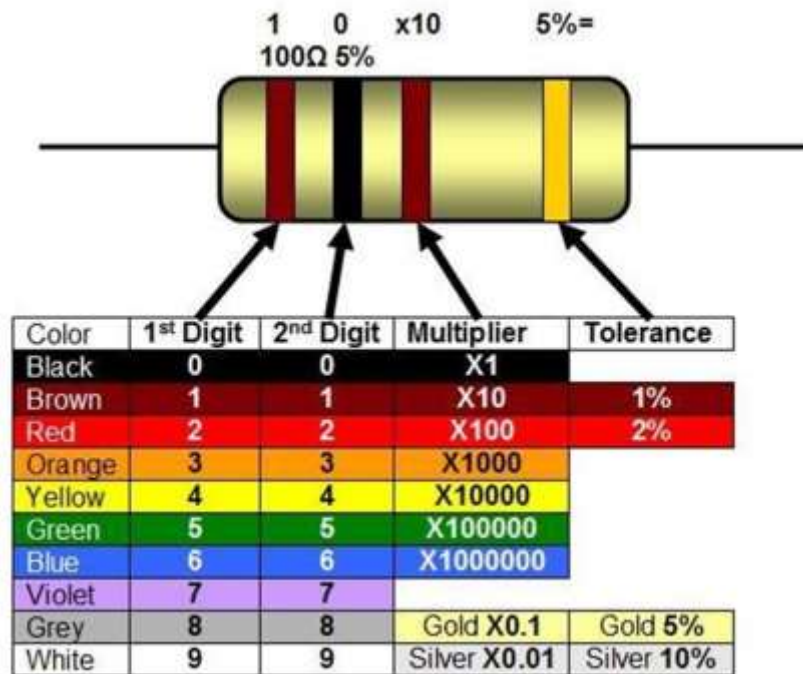




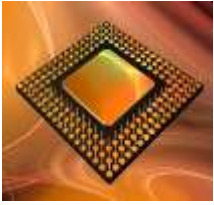
Resistor Color Code



- Resistor values are identified using the color bands printed on their body.
- Depending on the resistor, you will find a 4-band code or 5-band code.



4-band Color Code Chart

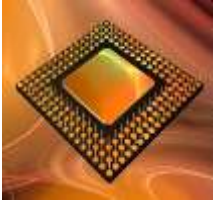


Resistor Color Code

1 0 x10 1% =
1KΩ 1%

Color	1 st Digit	2 nd Digit	3 rd Digit	Multiplier	Tolerance
Black	0	0	0	X1	
Brown	1	1	1	X10	1%
Red	2	2	2	X100	2%
Orange	3	3	3	X1000	
Yellow	4	4	4	X10000	
Green	5	5	5	X100000	
Blue	6	6	6	X1000000	
Violet	7	7	7		
Grey	8	8	8	Gold X0.1	Gold 5%
White	9	9	9	Silver X0.01	Silver 10%

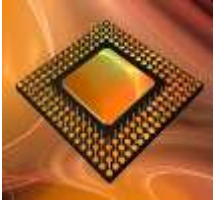
5-band Color Code Chart



Helpful Tips



- Always wear personal protective equipment such as suitable eye ware to protect yourself when working with electronic equipment.
- Be careful not to bend the pins of the Integrated Circuits as they become unusable if the pins were bent too badly.
- Integrated circuits are static sensitive. Take extra precautions when handling them.
An Anti static wrist band would be a good solution to the static electricity problem.
- Labeling each IC with labels such as 'AND', " OR" will make the easily recognizable and relieve you from reading the tiny part numbers printed on them each and every time.



How to provide elements?

1. If you provided the elements for ECE 1304 course before, you can ask for some chips and basic elements from stack room.

2. You can order the elements from following link:

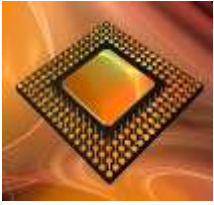
https://smile.amazon.com/ELEGOO-Project-Starter-Tutorial-Arduino/dp/B01D8KOZF4/ref=sr_1_1?ie=UTF8&qid=1541790682&sr=8-1&keywords=elegoo+uno+project+super+starter+kit+with+tutorial+for+arduino

[Amazon.com: ELEGOO UNO Project Super Starter Kit with Tutorial for Arduino: Electronics](https://smile.amazon.com/ELEGOO-Project-Starter-Tutorial-Arduino/dp/B01D8KOZF4/ref=sr_1_1?ie=UTF8&qid=1541790682&sr=8-1&keywords=elegoo+uno+project+super+starter+kit+with+tutorial+for+arduino)

smile.amazon.com

Amazon.com: ELEGOO UNO Project Super Starter Kit with Tutorial for Arduino: Electronics

3. You can buy them from IEEE



List of components for project 4 & 5



Project-4 (2-bit adder)

Quantity

1.Breadboard	1
2.Wire Stripper cutter (sample shown in the link below)	1

<https://www.ebay.com/i/332305215741?chn=ps>

3.Jumper Wire	8 meters
4.9v Battery	1
5.LED 10-Bar Display	1
6.10 pole-Dip Switch	1
7.Bussed Resistor (10 pin resistor network)	2
8.Voltage Regulator (LM 7805)	1
9.AND gate (IC 7408)	1
10.OR gate (IC 7432)	1
11.XOR gate (IC 7486)	1
12.Resistor (100 ohm/330 ohm)	10

(for project 5 only)

Additional Component for Project-2(4-bit binary multiplier)

1.4-Bit Binary Full adder (IC 7483)	2
2.AND gate (IC 7408)	3
3.Jumper wire	5 meters



Thank You