

HOW TO READ CIRCUIT DIAGRAMS

by [aplauche](#) on June 18, 2009

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Intro: HOW TO READ CIRCUIT DIAGRAMS

this instructable will show you exactly how to read all those confusing circuit diagrams and then how to assemble the circuits on a breadboard!

for all the electronics hobbyist wannabes this is a MUST-READ instructable.



















knowing how to read circuits is a very useful skill that will help you out all the time. especially if you start messing around with building little electronics projects.

In addition to reading this instructable it may be a good idea for you to read my other instructable "electronics components and what they do" to get a good understanding of what you are doing when building a project. (woops not done with this yet, i got caught up with other stuff, check back in a week or so)








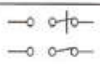
















Step 1: So What Are All Those Symbols???

here is a little guide that shows you the basic symbols for all sorts of components. its handy to keep a little guide like this around in case you forgot some. Plus, while you're beginning you might have to refer to it pretty frequently. I have boxed the most common symbols in red, these are the ones you should get to know by heart. the others you can always refer back to the guide for.

dont be overwhelmed its simpler than you think, just stay with me

Antenna		Gate, NAND	
Battery		Gate, OR	
Capacitor (C)		Gate, NOR	
Capacitor (C), Variable		Ground	
Coil		Incandescent lamp	
Coil, Variable		Inductor (L)	
Crystal and resonator (X)		Inverter	
Diode (D)			
Diode (LED), LED			
Diode (D), Photo			
Gate, AND			

**MORE SYMBOLS
ON NEXT IMAGE**

IR detector		Speaker	
Meter		Switch (S), SPST	
Microphone (MIC)		Switch (S), SPDT	
Motor (M)		Switch (S), DPDT	
Operational amplifier (U or IC)		Switch (S), normally open	
Photocell/Photoresistor*		Switch (S), normally closed	
Piezoelectric buzzer		Transistor (Q), NPN Bipolar	
Power (+V)		Transistor (Q), Phototransistor	
Relay (RLY)		Transistor (Q), PNP Bipolar	
Resistor (R)		Transistor (Q), N Channel Mosfet	
Resistor (R), Variable**		Transistor (Q), P Channel Mosfet	
Solar cell		Voltage regulator (VR)	

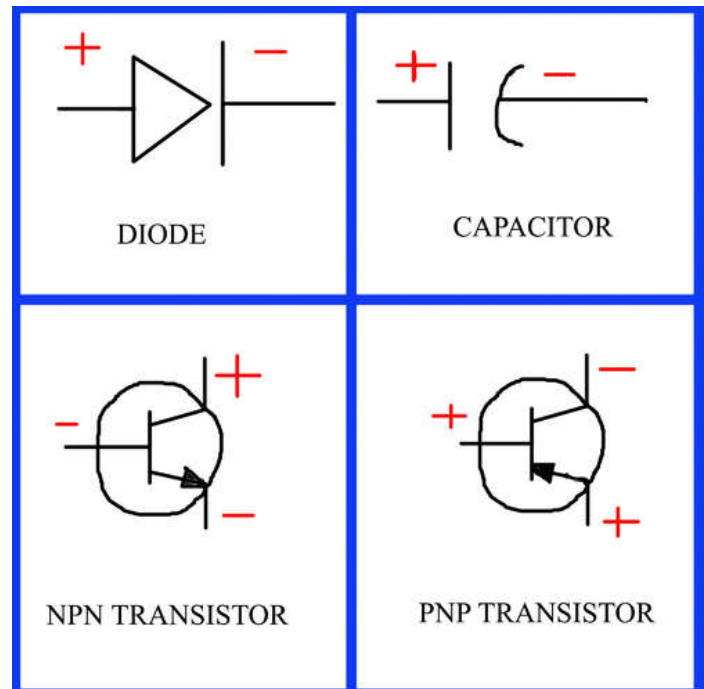
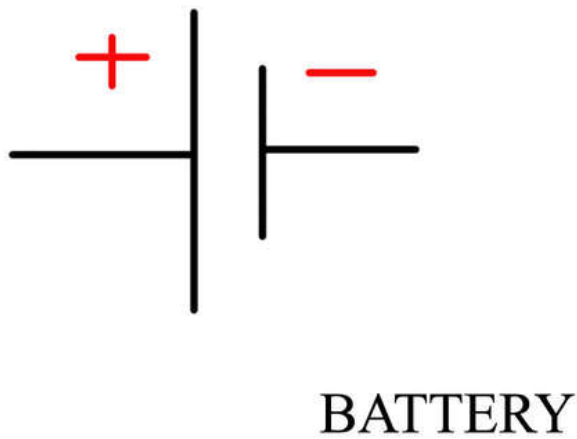
Step 2: Okay, but how is each part connected?

physically parts are connected by wires, in the diagrams you will see black lines going from one part to the next. this means that you connect them with a wire when the black lines cross in a diagram there are ways of telling whether or not the wires should be connected to each other as shown below.



Step 3: HOLD UP: What about Polarity?

some components to a circuit board are polarized, meaning one side is positive and the other is negative. this means you have to attach it in a certain way. for most symbols polarity is included in the symbol. in the the photos below you will find a guide to distinguishing polarity for various symbols. to find out the polarity of the physical part a general rule of thumb is to look for which metal lead wire on the part is longer. this is the + side.





longer lead is positive.

Step 4: YOUR FIRST SCHEMATIC!!!

Okay, so now that we've gone through the basics, lets try to read a real world schematic of a circuit. so lets dissect this circuit!

*I have numbered each symbol so that we stay on the same page while im describing each part

the first symbol you see is the one with two horizontal lines, one smaller than the other. do you remember what this is? you can always look back at the guide. its a battery. in this case a nine volt battery. if you look back at the polarity chapter you will see that the longer line represents the positive terminal of the battery. next you can see that there is a line connecting the positive side of the battery to the second part which if you look back at the guide you will find is a switch with two positions: closed (on), and open (off). seems backwards? its not because if you think of that little door like thing on the symbol closing than it would complete the circuit, thus being "on".

so when we flick the switch closed where does the electricity go next? that squiggly line is a resistor. this is a symbol you REALLY want to memorize. they are in almost every circuit. basically in just makes sure that the not too much power from the battery is sucked up by the next part by resisting the flow of electricity.

so the final part is the triangle thing. that is a diode (as you can see on that handy chart in this ible). in this case a light emitting diode, or LED. remember LEDs are polarized so when you actually go to make this circuit make sure you put it in right.

finally you can see that the negative side of the LED connects back to the negative battery terminal and the circuit is complete!

THERE IT IS! a flash light! you can now continue on to building the actual thing!

building this circuit will bring its own challenges. so, if you want to be walked through check out my instructable: "making circuits: the beauty of breadboards". it will go through the exact steps of building this flashlight, including where to buy parts for cheapest. but also teach you more important knowledge for building all sorts of circuits. (i did actually make this one)

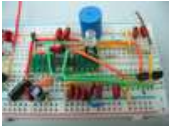
important note, the schematic will not tell you all you need to know. in most there will be text seperate telling you exactly what parts to buy, you cant just throw in any resistor or any capacitor and whatnot. i have the details for the parts in this project in the next instructable mentioned above.

PLEASE RATE AND COMMENT

this is my first ible, i need feedback



Related Instructables



Building Circuits: The Beauty of Breadboards by aplauche



Quiz-O-Tron 3000: Arduino quiz contestant lockout system by RoysterBot



Optical Doorbell Alarm by mischka



Building A Stereo Tube Amp by thobson



How to Prototype Without Using Printed Circuit Boards by firesign



Make your own Lathe from other peoples rubbish by bongodrummer

Comments

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4269srd says:

i like it! but you should go into a little bigger schematics. im going to see what other things u have. thanks!

Feb 23, 2011. 6:01 PM [REPLY](#)



RANDOMFISHYFACE says:

the symbol for **Diode(D)**, **Photo** and **Gate,AND** look exactly the same. what is up with that?

Jan 31, 2010. 4:40 PM [REPLY](#)



kanishuw says:

Yes. that's a mistake. The symbol of AND gate looks the same as NAND gate when you remove the dot near the output.

Jan 20, 2011. 7:56 PM [REPLY](#)

Symbol for NOR gate should have a dot similar to the NAND gate near the output.



airgun_expert says:
They aren't. You just can't see it because of image quality and size.

May 30, 2010. 8:18 PM [REPLY](#)



RANDOMFISHYFACE says:
no sir they are the same if you click on the enlarged version (www.instructables.com/files/orig/FIW/DFTY/FW39JKC5/FIWDFTYFW39JKC5.jpg) then zoom in on that area you will see that they are exactly the same

May 30, 2010. 9:20 PM [REPLY](#)



PJcollazo says:
Very helpful! I didn't remember this from a couple years back.

Aug 7, 2010. 5:21 PM [REPLY](#)



PKTraceur says:
I still don't understand how microchips, like 555 timers and those other black rectangles with like, 20 leads work. Nor do I get caps. For that matter, how the heck does electricity flow? Oh well, camera tasers are still awesome. -PKT

Aug 10, 2009. 6:36 PM [REPLY](#)



aplauche says:
micro chips are very complicated small circuits. they are built out of the same things as most circuits: resistors, capacitors, transistors, etc.... just shrunk way down. hence micro. so really a micro chip is just a very tiny circuit board pre-made for your use

Aug 30, 2009. 11:27 AM [REPLY](#)



PKTraceur says:
You're the first one in 3 years to make microchips actually make sense. Thank you. -PKT

Aug 30, 2009. 1:10 PM [REPLY](#)



Alfa_Romeo says:
Great post this one, hope in your next post you will go "deep" in this matter

Aug 30, 2009. 10:35 AM [REPLY](#)



tundrawolf says:
Boy, that circuit looks almost edible. *Drools* resistorssssss

Aug 13, 2009. 5:57 PM [REPLY](#)



sageserver says:
to help people understand how these parts work go to <http://www.falstad.com/circuit>
It taught me about ac circuits.

Jun 19, 2009. 7:36 PM [REPLY](#)



sageserver says:
There are some variations for parts. Like LEDs can be a diode with 2 arrows going out. regarding the schematic for the flashlight, usually there's not a resistor because resistors just throw away current, and flashlights (bulb type) are not LEDs.

Jun 19, 2009. 7:41 PM [REPLY](#)



aplauche says:
I know, but I wanted something that could be constructed with very little cost on a simple breadboard so people could get the experience. this instructable really isn't about the flashlight, it's about understanding schematics like the title says. I just chose a simple LED you could turn on and off so that people could really see that their circuit worked

Jun 19, 2009. 7:46 PM [REPLY](#)



sageserver says:
The first circuit I did that used an IC is a simple 555 timer circuit. very easy to understand.

Jul 14, 2009. 3:23 PM [REPLY](#)



Iridium7 says:
Sorry to bother you so much but I have a lot of questions, can you take a piece of breadboard and break it to the size you want and have it still work?

Jul 4, 2009. 8:27 AM [REPLY](#)



aplauche says:
No problem. It should still work, I have done that before with no problems so I'm fairly sure it's okay to do

Jul 5, 2009. 12:52 PM [REPLY](#)



Iridium7 says:
Where is a good place to get circuit/breadboards?

Jul 3, 2009. 2:44 PM [REPLY](#)



aplauche says:

Jul 3, 2009. 3:15 PM

i got mine from radioshack, although i've heard you can get them for cheaper at online dealers.
http://www.mouser.com/Search/Refine.aspx?Keyword=breadboard
<b are a bunch of different sizes on that site. it all depends on what size project you are doing for what size you want. this little light thing wouldnt take much s all for instance



Iridium7 says:

Jul 3, 2009. 2:56 PM **REPLY**

and what did you use for the resistor and the wires on the gram cracker thing?



Phenomenal says:

Jun 29, 2009. 1:14 AM **REPLY**

Is your graham cracker circuit in step 2 a blinking light?



aplauche says:

Jun 29, 2009. 5:25 AM **REPLY**

yes actually, it is.



elleadnih says:

Jun 21, 2009. 9:43 PM **REPLY**

and in here <http://www.instructables.com/id/SZU4RKFFVMQZSE1/>

whats the scare thingy there, and the arrows in the diodes?



aplauche says:

Jun 22, 2009. 11:11 AM **REPLY**

hmmm... you mean the thing with a bunch of gray dots in it? the LPT?
its actually a port on your computer. each gray thing represents a different pin on the port.

i think its something kind of like this.

<http://www.4rows.com/images/miata/SerialLink/P1002271.jpg>



elleadnih says:

Jun 22, 2009. 10:32 PM **REPLY**

yea thnx I was saying the other cuare but I now know what it is thnx and great instructible really helped me



elleadnih says:

Jun 21, 2009. 9:40 PM **REPLY**

hey a big question, at the exercice you put in this instructible the las part is a diode, now here's my question "Is a Diode a LED? or is it first the diode soldered to the LED?" I know a LED is a Light Emitting Diode, its just for confirmation...



aplauche says:

Jun 22, 2009. 10:36 AM **REPLY**

an LED is a type of diode. there are other types of diodes as well. in this case the diode symbol IS an LED, its just there is no specific LED symbol so the general diode symbol is used



elleadnih says:

Jun 21, 2009. 9:44 PM **REPLY**

square*



gmoon says:

Jun 19, 2009. 7:49 PM **REPLY**

Kind of strange to use a tube circuit schematic for the opening illustration, as there are no tube symbols on the keys sheets in step 1... Maybe replacing it with a transistorized circuit would be helpful.



aplauche says:

Jun 19, 2009. 7:52 PM **REPLY**

haha yeah i just put a random circuit image for my main image. i should probably change it to something less complicated



aplauche says:

Jun 19, 2009. 4:23 PM **REPLY**

to the admins, i accidentally entered this into the art of sound contest. please ignore this entry.