Breadboard Basics for Absolute Beginners

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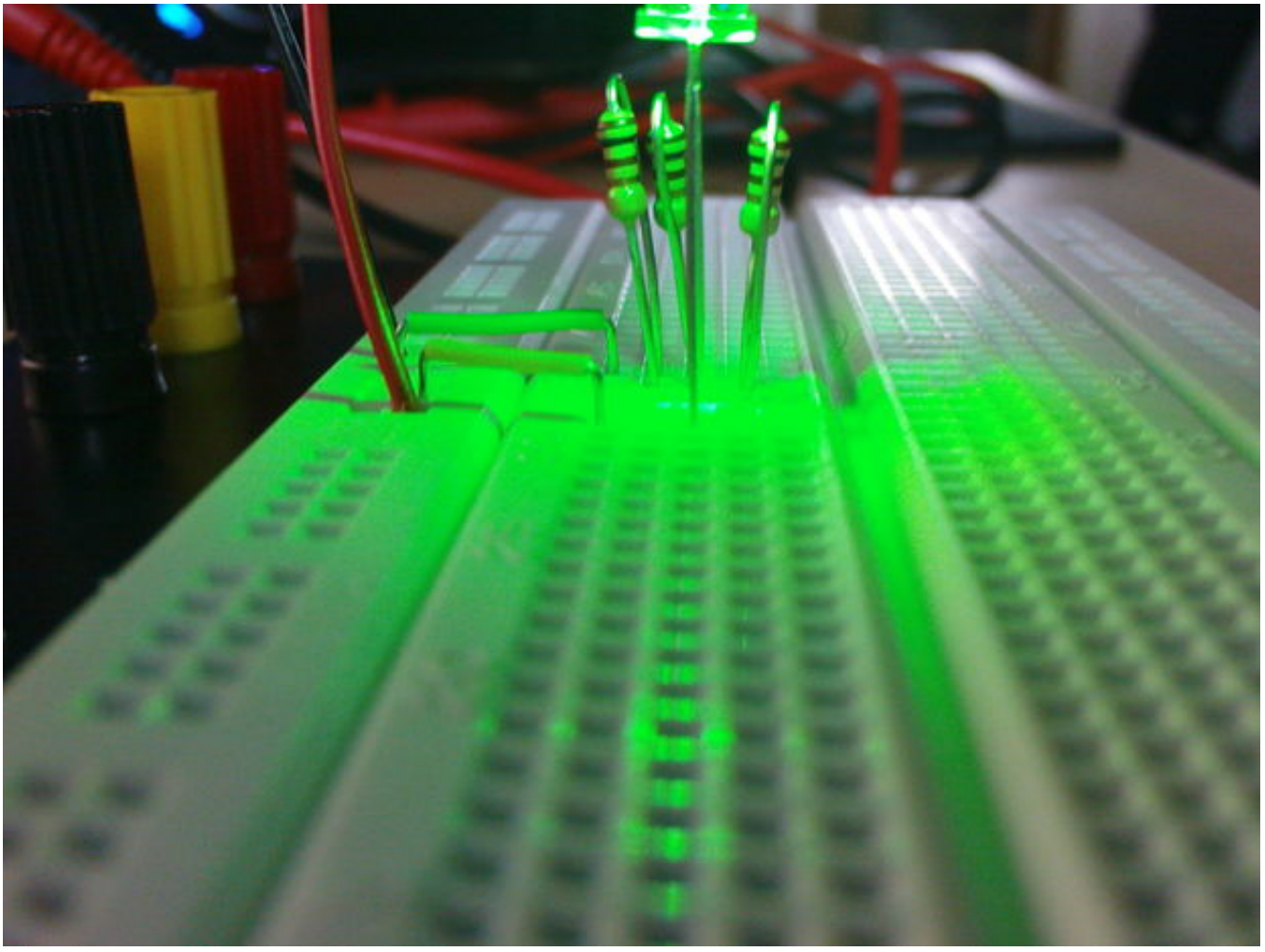
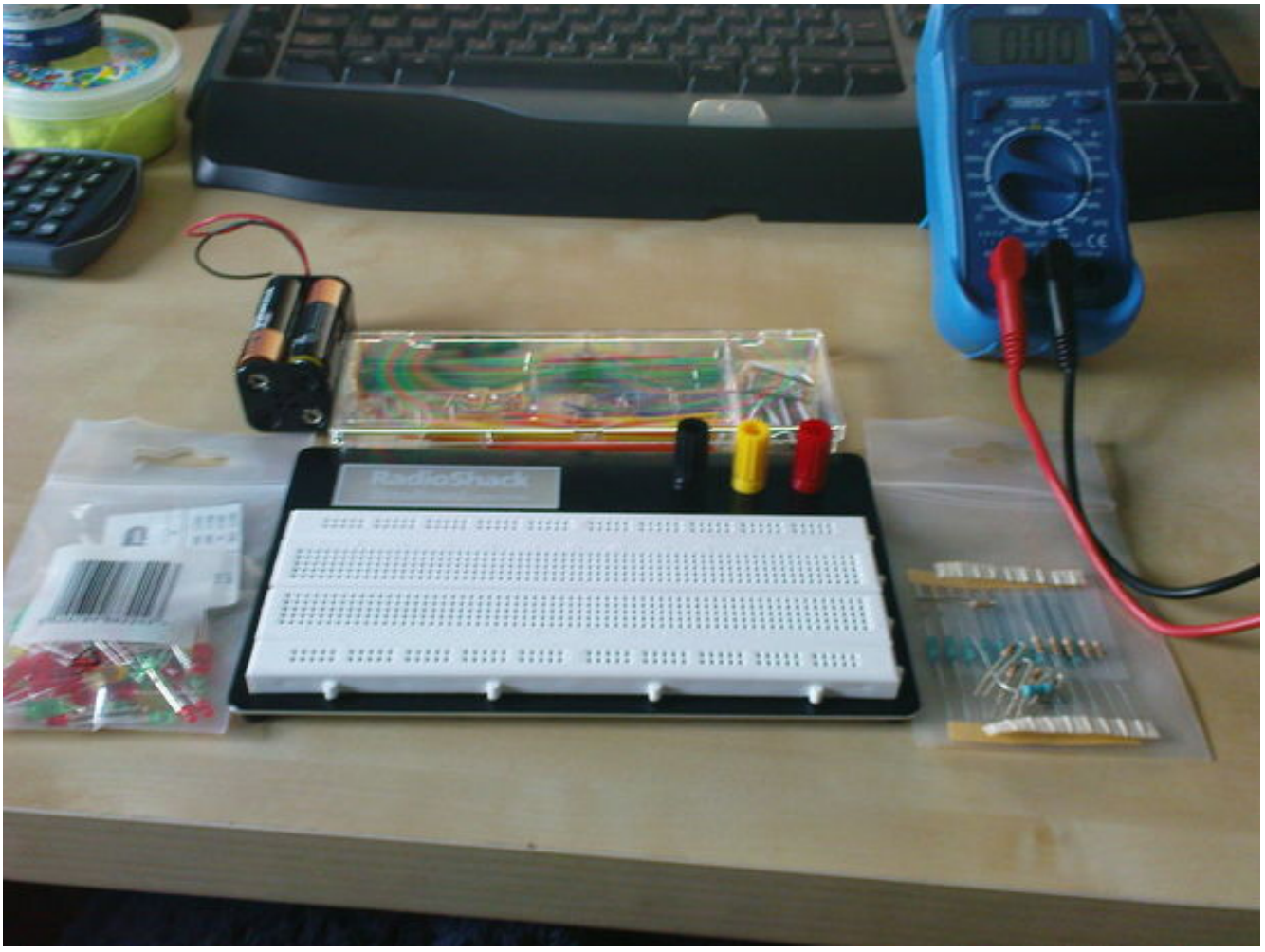


The aim of this instructable is not to give you a complete guide on breadboard but to show the basics, and once these basics are learned you pretty much know all you need to so i guess you could call it a complete guide but in a different sense. Anyway i will only be using an led and some resistors to outline how a breadboard works.

Note : a breadboard is a temporary circuit board for testing and prototyping circuits, no soldering is done on the board, this mean it is faster and easier to prototype circuits.

Also if you need a walk through on electronics please read my other instructable A Complete Guide To Basic Electronics
anyway onto the supplies!

Step 1: Supplies



For this instructable you will need

an led

a 4aa (or aaa) battery pack

a breadboard (bought from radioshack or t2retail in the uk)

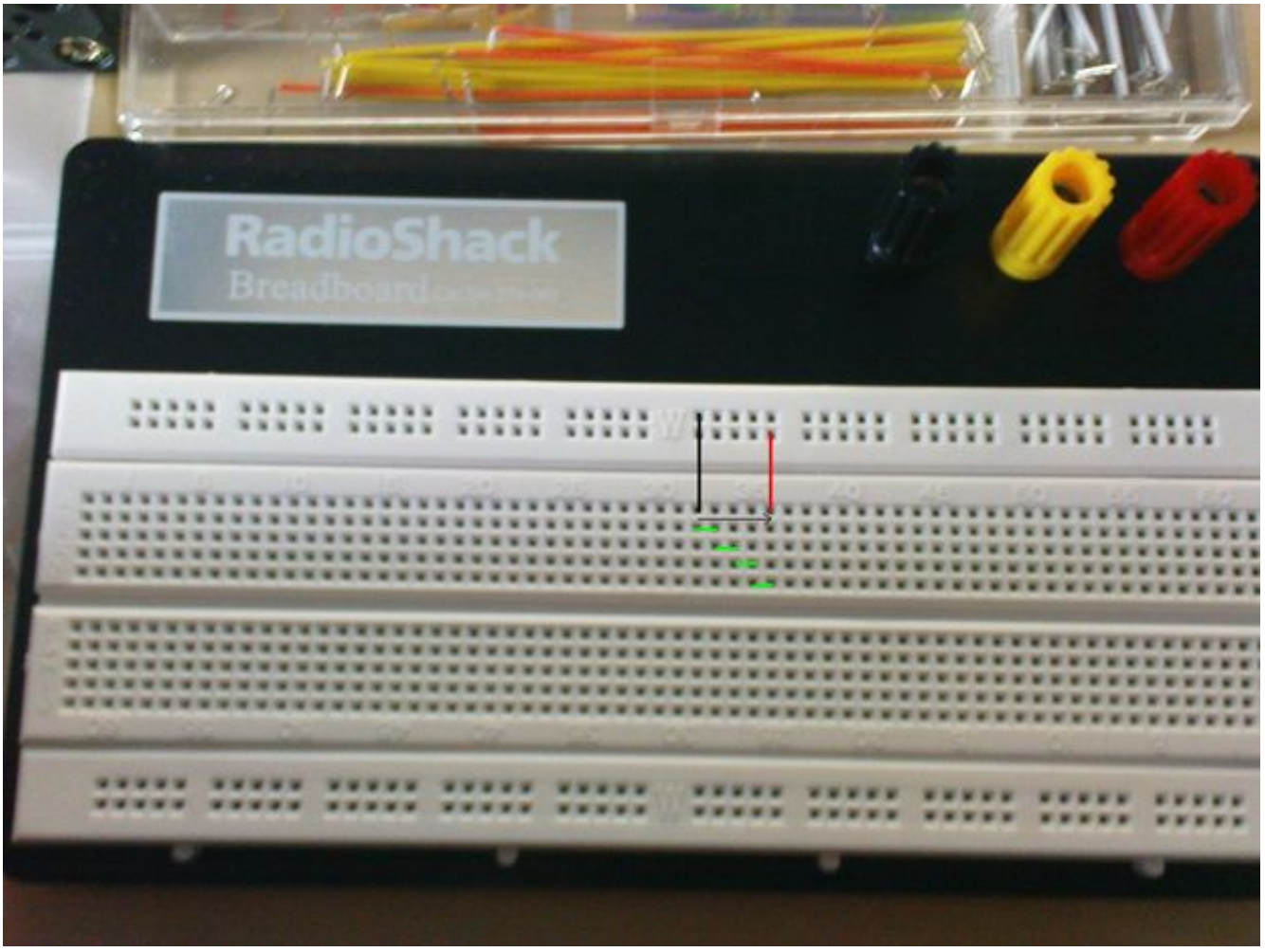
breadboard jumpers (from radioshack or t2retail)

a few 100ohm resistors (or any value but you will need to change your layout to get the same results)

and finally a multimeter (measures voltage, resistance, current ect.)

Once you have these you are good to go

Step 2: The Breadboard

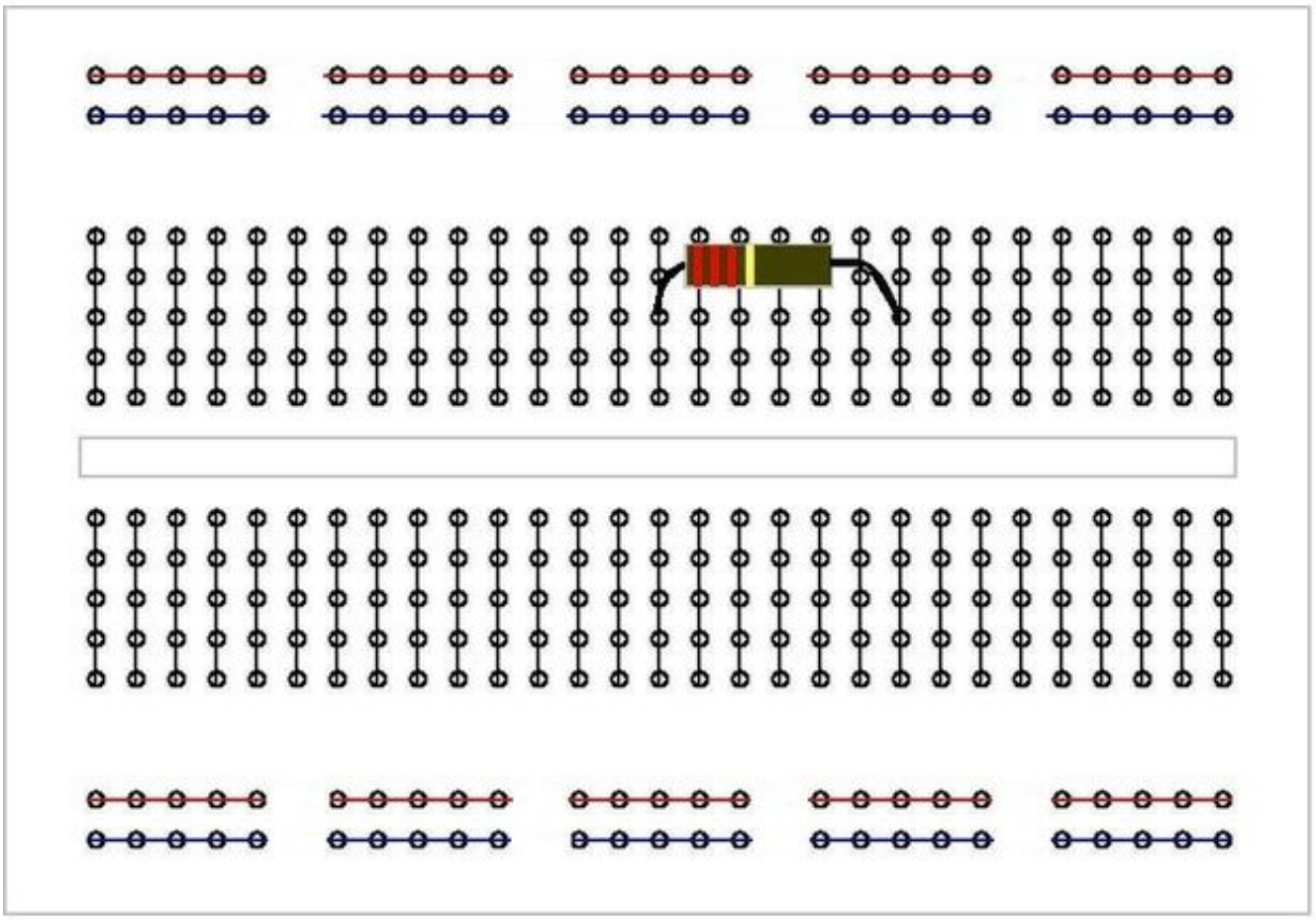


As you can see from the image below a breadboard has lots of holes, this may seem confusing at first but it really isnt. The 2 rows of holes at either end are for power one for positive (red) one for negative (black).
as you can see i edited the picture below to give you an idea of how circuits are completed.
the power strips go horizontally in 5's where as the component strips go vertically also in 5's.
a circuit is completed when all the desired strips form a loop and are all connected sequentially.

if for instance i wanted to put an led in this circuit by its self i would insert one leg into a free hole of the column where the black (-ve) power jumper is and the other in a free hole of the column that the red wire (+ve) is in. This would complete the circuit allowing current to flow from one side of the power source to the other through the led.

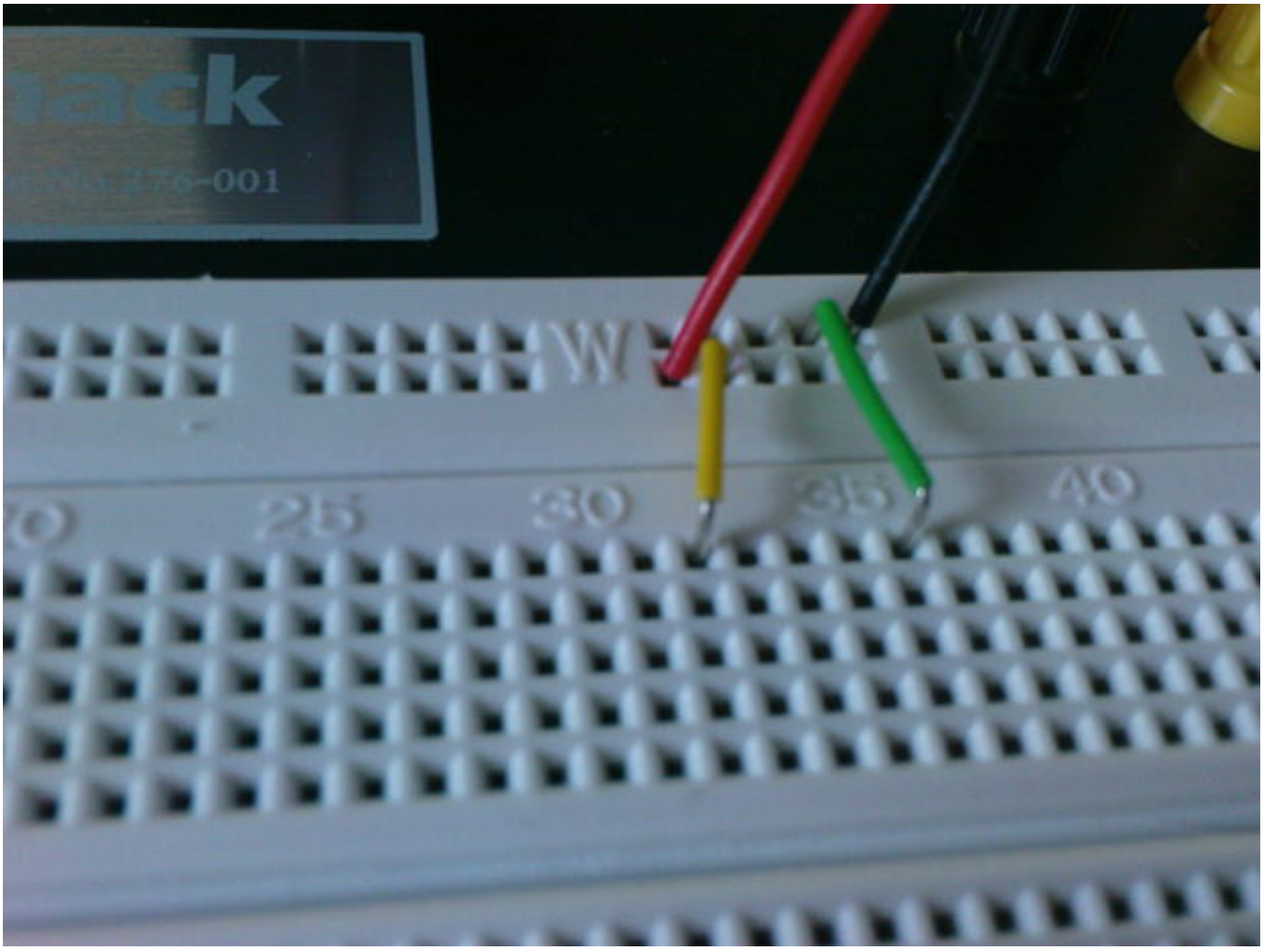
The green lines in the image below form a series circuit where every component touches at different polarities (-ve leg of one component to +ve leg of another) . The forms a single chain of components. A parallel circuit in this would be that the components you desire to be in parallel would touch at the same polarity (-ve leg to -ve and +ve leg to +ve). so as two colums are needed to accommodate any component with two legs in parallel these components would share the same columns but be in separate holes. if this made no sense dont worry, i will go into more detail later.

Step 3: The conductive layout



as per the image you should see the layout of most breadboards, in rows for the power and columns for components.
not much more i can say here really.

Step 4: Adding Power and Jumpers



Now its time to start placing things onto the breadboard. The first thing attach is the power, simple put the negative lead into one hole and positive into the other (doesn't matter which really). Then place jumpers on the board to bridge the gap between the power rows and the component columns.

Step 5: Resistors

For the purpose of this instructable i will only be connecting one led to a 6v source and use resistors to protect the led from burning up. i have some 100ohm resistors lying around that will be perfect for this project.

For resistors in series their values always add, meaning 2 100ohm resistors in series would give a total resistance of 200 ohm however in parallel this is not the case.

In parallel the value of resistors decrease the more you add . If using the same value resistors then the equation is simple

value of one resistor / number of resistors e.g. 5x100ohm in parralel = 100 / 5 - 20ohms total resistance.

however if using resistors with varying values this equation is easier (this equation can be used in the upper example but it is faster when using the same value resistors to use the above method)

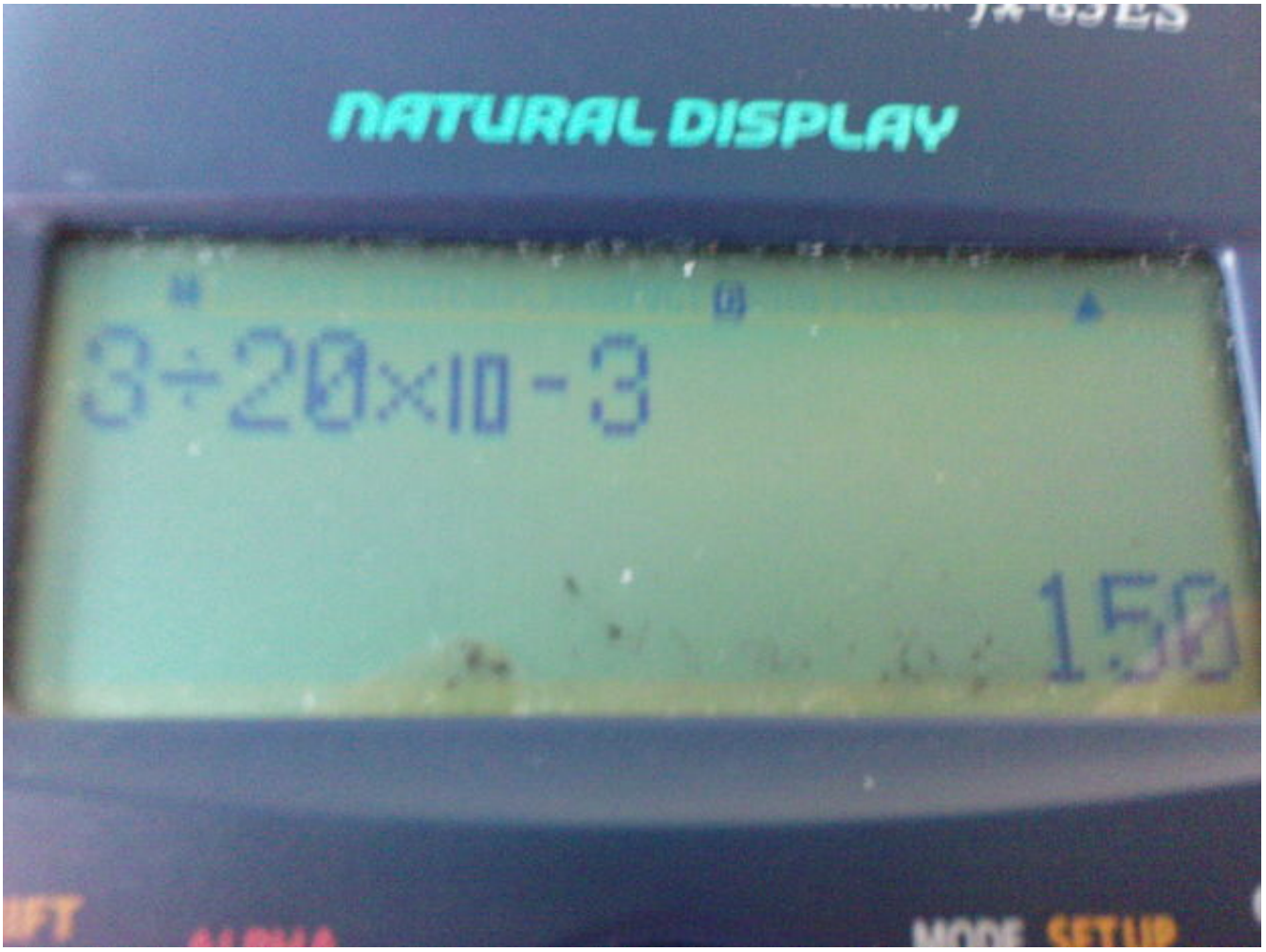
ok so say i have a 10ohm, 100ohm and 30ohm resistors in parallel. (in series these would give a total resistance of 140ohms).

1/rt = 1/r1 + 1/r2 + 1/r3 ect.. (this can go on for however many resistors you have)
rt is the total resistance and r1 and r2 ect. are resistors, so for our example we will use this

1/10 + 1/100 + 1/30 =1/rt
0.1433= 1/rt so 1/0.1433 = rt
rt = 7ohms (rounded)

ok so now we know the basics of resistors in circuits we can start working out how many we will need to power this led

Step 6: The led and resistors needed to protect it



The led i am using today is a bright blue led. this led runs on 3.3v and at 20ma (milli amps).
the power pack i'm using is 4aa batteries. with each battery being 1.5v that gives a total of 6v however i don't want my led to be getting the whole 6v and that would burn it up and cause it to heat up. I don't even need the full brightness so for the purpose of this instructable i will be running the led at 3v 20ma.

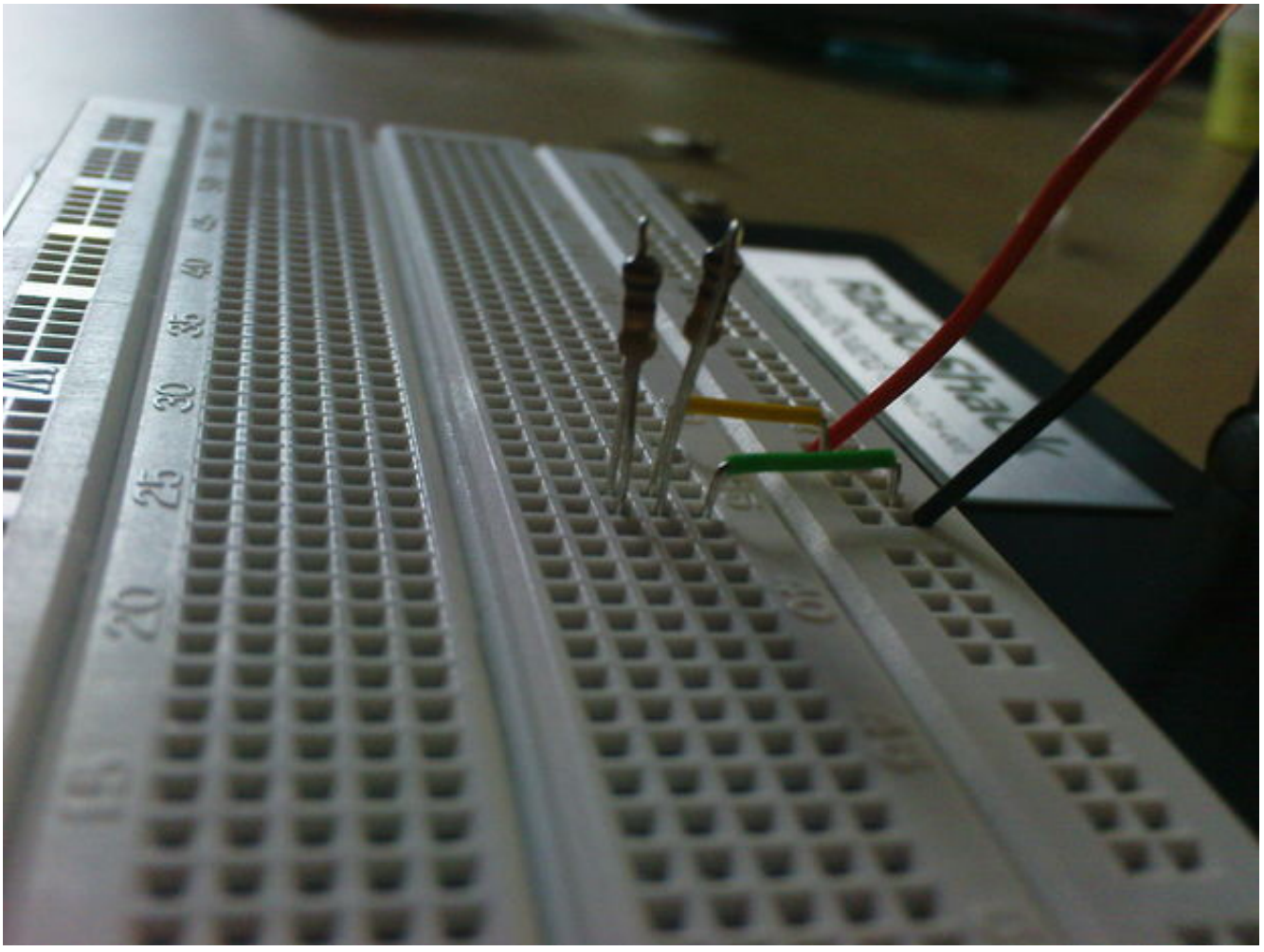
so so how do we get 3v and 20ma from a 6v source. its simple, use resistors. how many depends on a number of things.
the supply voltage
the voltage rating of the component (for us its 3v)
and the current you want across the component. (for us its 20ma)

the equation is simple voltage = current x resistance or v=ir
we can rearange this to get resistance = voltage / current or R = V / I
however the value of v in this case is the voltage we need to drop from the supply to get 3 v.
so v = Vsupply - Vled = 6-3 = 3volts
and we know the current needs to be 20ma so the final equasion is as follows.

R = 3 / 0.02 (or 20x10 to the power of 3)
R = 150 ohms
(this equation is pictured below on my dusty calculator)

now we know the resistance needed lets move onto the circuit

Step 7: Parallel resistors



Right so we need 150ohms of resistance but we only have 100ohm resistors.
now here is where out knowledge on parallel circuits comes in handy.
ok so if we use a 100ohm resistors in series thats 100ohms taken care of but we still need to muster up another 50ohms.
remember in in previous sections i said this

"In parallel the value of resistors decrease the more you add . "
and seing as we have the same value resistors we can use this equation also stated previously
value of one resistor / number of resistors

so in order to get 50ohms we can use 2 100ohms resistors in parallel.
100/2 = 50
simple!

100 (resistor in series) + 50 (2x100 in parallel) = 150ohms total resistance!, so were set to put the circuit together now.

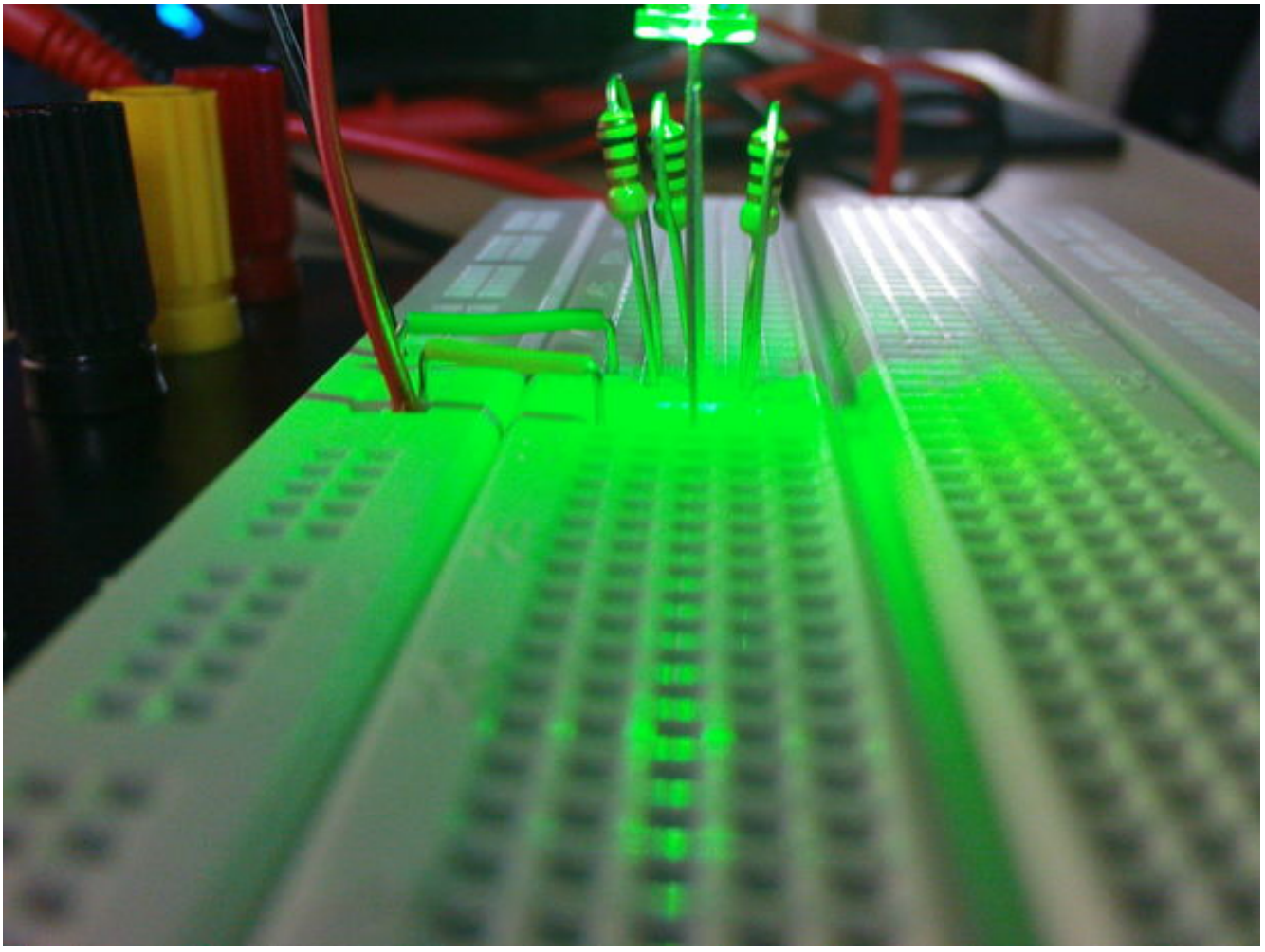
the picture below shows two of out 100ohm resistors in parallel. as you can see they are sharing a column with common polarity (doesn't matter with resistors though).

as you may also see one leg of each is connected to the -ve end of the power source. this is the first step to completing our circuit

now onto adding the series resistors, simple place one leg into the same column as the left most leg of the resistors and the other leg into the hole next to it. (also pictured below)

ok so onto adding the led now!

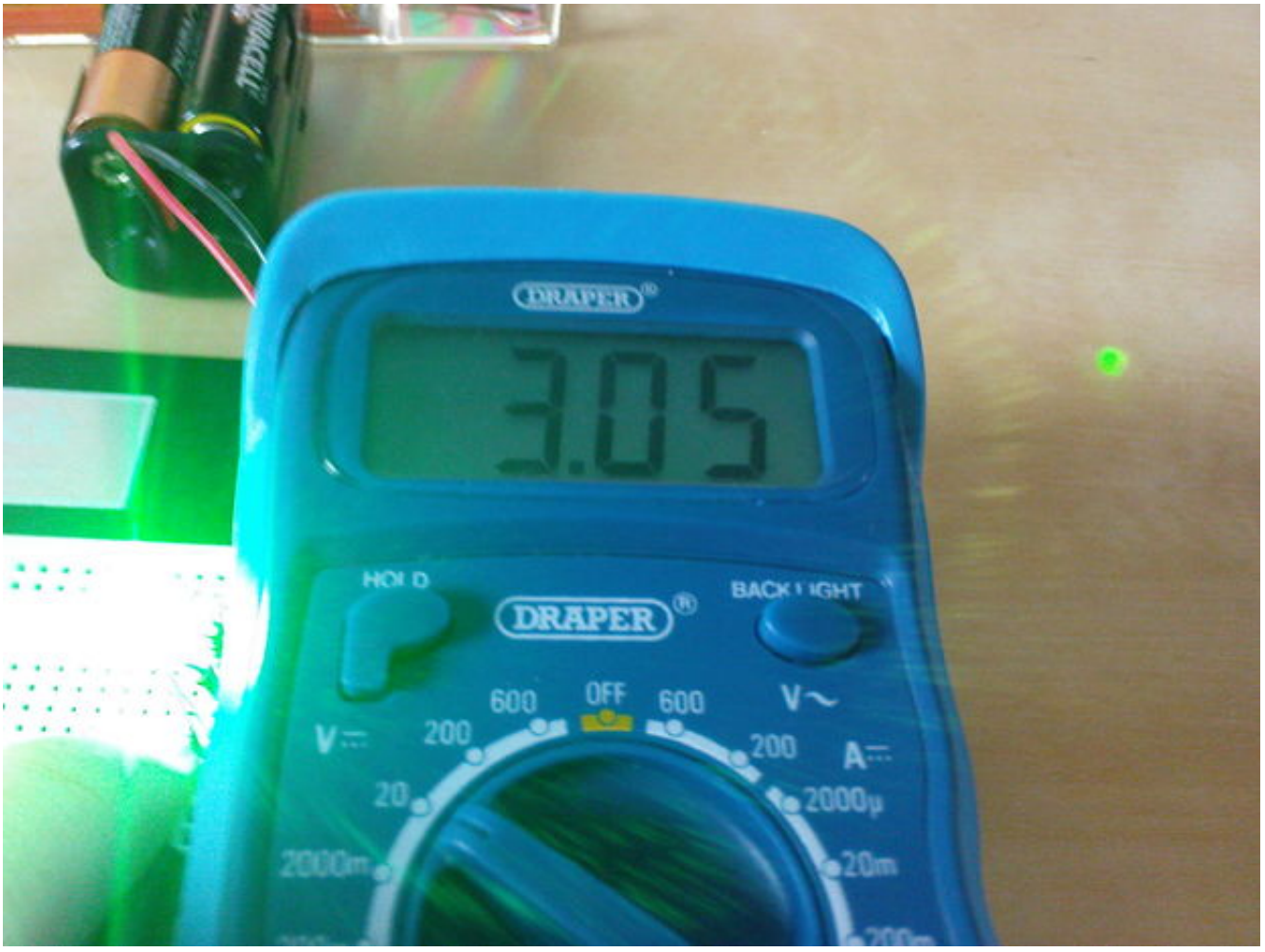
Step 8: Adding the led



now we need to place our led into the circuit. As you may have noticed from step 5 an led has a short leg and a long leg. she short one connects to the -ve end of the power source and obviously the longer leg to the +ve end. this is because an led allows electrons to flow easily from the cathode(-ve) to the anode(+ve) but not from the anode to the cathode, so if your led doesn't light always first inspect the polarity of the led.
now all you need to do it place the short leg into the same column as the left most left most leg of the series resistor and the other leg into the column that the posotive power jumper is in.
you should now see the led light up and in my case hurt your eyes and you were looking right into it.

not done yet though!
onto testing the circuit

Step 9: Testing the voltage across the led



now using out multimeter we need to take the voltage across the led to ensure the circuit is operating correctly and we didnt make any errors when calculating the resistance.

! important a voltmeter has infinite resistance (basically it breaks a circuit) so it is always used in parallel !

so to take the voltage simply turn the multimeter to a suitable voltage setting and touch the black probe to the short led (closest to the -ve (black)) and the red probe to the other led (if you put them the other way round you will get a -ve voltage)

3.05volts, id say that is acceptable seing as my resistor has a tolerance of 5% (+ or - 0.15)

now to test current

Step 10: Testing current

Now we set out multimeter to current (for me i had to change the position of the red lead into the 10a hole)

unlike voltmeters ammeters run in series, as the current does not change through out the circuit, therefore it doesn't matter where the ammeter is in the circuit it will always give the same reading.

to test the current flow i simply moved the led +ve leg right one hole (stoping the led from lighting as the circuit isnt complete until my probes are in place)
and then place the black probe on the +ve leg of the led and the red probe onto the jumper coming from the +ve end of the power source, this completes the circuit. illuminating the led and displaying the current. which is in my case 20milliamps, exactly what i was after.

so thats it, you should know know how to use a breadboard. and if anyof this didnt make sense or you want to recommend how i can improve this instructable please leave a comment
thanks alot!