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How to Obtain Negative Voltage from a DC Power Supply or Battery

Negative voltage is an important of electronics.

It's used many times for various types of circuits.

One example where negative voltage is used for dual supply operational amplifiers. Many times, these amplifiers deal with AC signals. Therefore, positive and negative rails need to be established; and they are established through the application of positive and negative DC voltages to the op amp. Therefore, many chips including the popular LM741 operational amplifier, makes use of negative voltage.

Another place where negative voltage is used is for various transistors. For example, with an N-channel JFET, negative voltage to the base of the transistor causes current to cease at the output. So negative voltage causes the transistor to turn off. For a P-channel enhancement-type MOSFET, negative voltage causes the transistor to turn on. For a P-channel depletion-type MOSFET, negative voltage causes the transistor to turn off.

Negative voltage is also needed as input for negative voltage regulators.

So, negative voltage is widely used in electronics. So it's very important to know how to connect negative voltage, because you will need it for many circuits.

The 2 main sources of DC power are from DC power supplies and batteries. Therefore, we will show how to connect these devices so that they produce negative negative.

DC Power Supply

Let's begin with the DC power supply.

So a DC power supply normally has 3 terminals: +, GND, and -.

The + is the positive terminal of the voltage supply.

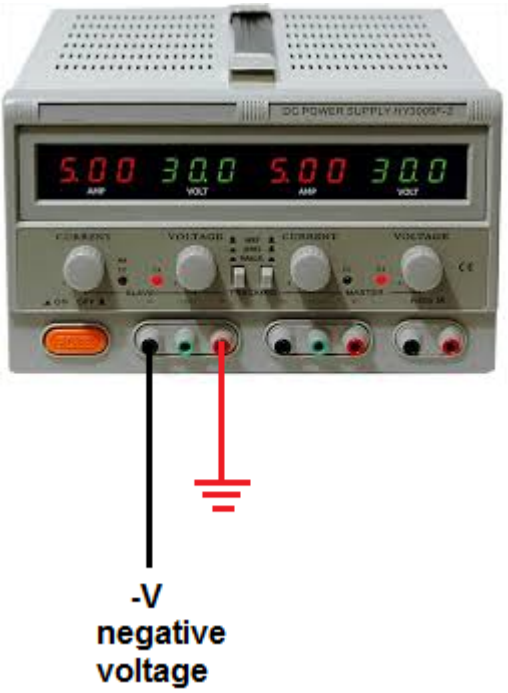
The - is the negative terminal of the DC voltage supply.

And ground is earth ground.

Earth ground is used to provide protection for the circuit but it isn't always needed. Depending on your circuit needs, it can be left floating. However, it can be connected. We'll show both cases.

To connect negative voltage simply without considering ground at all (which is probably how you'll wire up the circuit most of the time if you're just wiring basic circuits), all you have to do is connect the positive terminal to the ground of the circuit and the negative terminal to part of the circuit you want to connect negative voltage to. This provides negative voltage to the power supply.

The diagram below shows negative voltage from a DC power supply.



You can see in the diagram that the positive terminal connects to ground and the negative terminal then connects to whatever part needs negative voltage.

If you want to connect negative voltage with earth ground, then all you have to do is tie the earth ground terminal of the DC power supply and the positive terminal common. This makes the positive terminal grounded to earth. And the negative terminal then connects to whichever part needed to supply negative voltage.

It's relatively simple.

Battery

A battery is even simpler.

A battery doesn't have earth ground.

A battery simply has 2 terminals: + and -.

The diagram below illustrates this concept.

So you can see based on the diagram that the positive terminal of the battery will connect to the ground of the circuit and the negative terminal of the battery will connect to whatever circuit needs negative voltage.

So this is all that is necessary to supply negative voltage either from a DC power supply or a battery.

An easy check to do if you have a multimeter is to take the multimeter and measure the DC voltage. Place the positive probe of the multimeter on the negative voltage and the negative probe of the multimeter on ground. If the multimeter reads voltage with a minus sign in front of it, it is negative voltage. This means you truly are inputting negative voltage. So this is the check you can do.

To see how this translates in real life, see the following video below.

Related Resources

How to Use the LM741 Op Amp as a Comparator

How to Build an LM339 Quad Voltage Comparator Circuit

How to Build a Dark-activated Switch

How to Build a Hall Effect Sensor Circuit

How to Build a Touch Sensor Circuit

How to Build an Accelerometer Circuit

How to Build a Motion Detector Circuit

How to Build a Motion Detector Alarm Circuit

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Opinrlkashols · Nov 30, 2021

With respect Noel, we use negative DC voltage all the time in aviation. May be done with AC power rectified to DC and chopping the voltage never to exceed a certain amount. We use this to drive actuators in either directions ,also used in indication of displacement of the actuator. Its range is for example -15 to +15 volts dc with a 115 volt AC power supply. The video just explains the ease of DC voltage for producing negative dc. We use 28 volts dc to drive -15 to +15 volt circuits.

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TJ · June 27, 2021

Would have been better to have included the concept of common-rail.
Can we connect the [-] terminal of a AA cell to the [+] terminal of another AA cell ? Can we connect them in parallel?
Why? or Why not? What about a lab/ATX power supply? Can we connect 2/or more of those in series? in parallel?
Why or Why not?
Such concepts are above the electrical that we all learn from high school.
I guess you might want to write an article and provide a link in this article.
Thanks.

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Noel · Feb 12, 2021

honestly there is no such thing as negative voltage. Just that the circuit is able to function normally in either direction. eg. Any DC circuit with no diodes present, connect a multimeter across the Identified positive and negative terminals on the load and do not disconnect to multimeter throughout, a DC motor (for visible/ easily observable difference) record the direction at which the rotor turns then revers the terminals, you will notice that the motor just simply turns in the opposite direction and the reading on the multimeter will give you a negative value... Meaning in perspective it will seem as if Negative voltage exists. Negative voltage just refers to voltage being applied in the opposite direction to which the circuit was intended for.
The purpose of this would be for closing off sections of a circuit where diodes are present. Meaning the whole circuit will still work and only the parts restricted by diodes will not.
The same can be applied visa versa where with the forward voltage you desire that a certain section or path not receive voltage until reversed.

For an example as to how this is achieved. Try to imagine a circuit with a single switch along the positive wire and a single switch along the Negative wire with two switches along an added common wire (Ground). You will then easily be able to switch the direction of the voltage. If you wondering how a computer does this, you must remember that computers rely on electronic switching to function. In other words the manual switching done by you in the circuit is done electronically by the computer, Hence the reason for different voltage requirements in a computer.

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Zachary BNSF · Oct 28, 2018

This article helped me understand that the names of "Ground" and "Earth Ground" are not synonymous! For me I would say to others, take the negative terminal and connect it to what needs negative power. Then take the positive terminal and connect it to the ground of that circuit, NOT EARTH GROUND! If the circuit requires earth ground, then connect both the ground on the circuit to the earth ground and they become a common point.

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Paul M · Apr 2, 2018

How do I connect it up if I require both -5V and +5V for a laser circuit?

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