Fundamentals of Power Electronics
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Lecture - 38
Negative and dual voltage regulators

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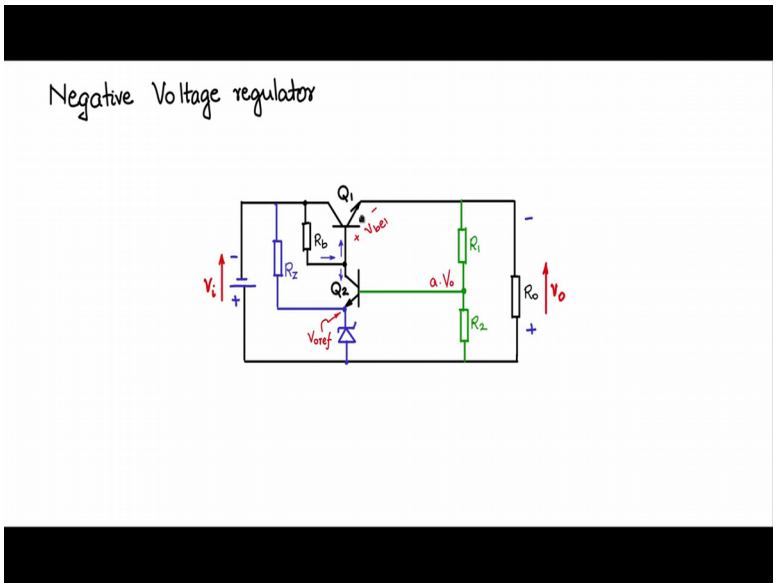

Till now we have discussed the series voltage regulator which is positive input positive output, but there are many applications where you will need a negative voltage output negative voltage regulation. So, how do we get a negative voltage regulator? So, let us start with this positive voltage regulator and modify it to give you the negative voltage regulator. First of all v i which is positive here and negative here, we will reverse that. So, we want plus and minus like this. Now, this should finally, result in an output with plus and minus here. So, this will give you a negative output.

However, the current flow is in this fashion before we have to reverse the transistors. So, to keep the circuit same, I will what I will do is convert these transistors from n-p-n to p-n-p. So, you will see a reversal in the current flow without affecting the topology of the circuit. I will change this from n-p-n to p-n-p still maintains the same topology.

So, I should also reverse the zener diode direction in this fashion. Now, you have your negative voltage regulator, I will remove that and this current directions will reverse. So, you will have the base current flowing this way and the collector current flowing this

way and I b flowing in this fashion. Still the same concept holds this potential, and this potential are fixed and the current through R b is more or less constant. And these two sum up add up to make I R b.

And this is the direction of I naught. So, the operation is exactly same as we discussed for the positive voltage regulator, now this is a negative voltage regulator where I can give a negative input to get a negative output. If you combine the positive voltage regulator and the negative voltage regulator, you will get the dual power supply. Let us just integrate that these two circuits and see how a dual voltage power supply looks like.

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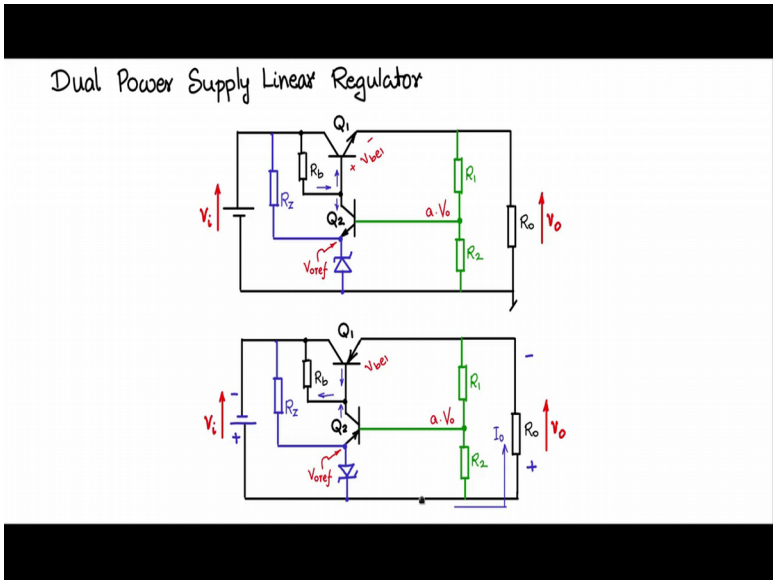

Let us now see how we get the dual power supply. First let me insert here the positive voltage regulator. So, you have this as the ground line, and this is positive with respect to the ground line, and the output voltage also this node is positive with respect to the ground line, all are n-p-n transistors. Now, this is a positive voltage regulator. So, giving a positive input, I get a positive output here. Now, let me place here the negative voltage regulator, so we saw we just now discussed the negative voltage regulator. The negative voltage here an I have replaced all the n-p-n's by p-n-p compare with this.

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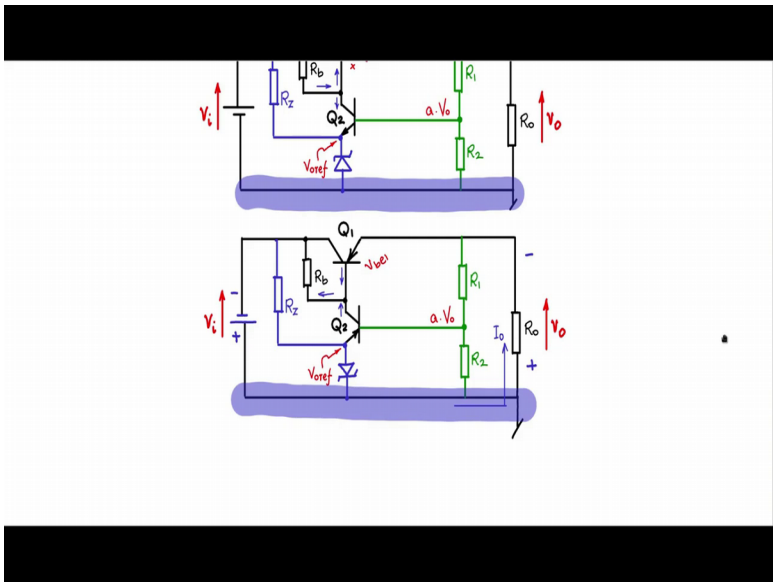

Now, I will use this as the common ground point that as the ground place that ground there. Now, I will common these two ground points which means that I will have to flip this circuit such that this ground comes in there.

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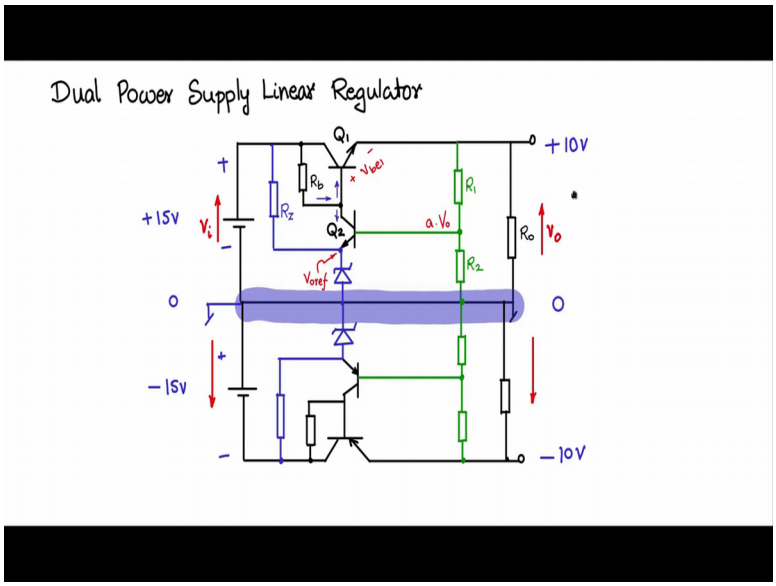

So, let me redraw the flipped negative regulator. So, let me redraw that. So, I am redrawing with the ground flipped compare, now this is a p-n-p I am replacing the n-p-n with a p-n-p, I am replacing this n-p-n with a p-n-p, but now the regulator is flipped compare with what we have [dawn/drawn] drawn previously this is R naught, these are

the output terminals. And I am having an attenuation and taking the attenuation point here I need to have the bias resistance for this transistor, and I have to give the series resistance for the zener.

So, this becomes our dual power supply regulator common ground. So, for example, let us say I give 15 volts for this positive regulator, 15 volts plus and minus. And for this also 15 volts plus and minus like this, but this is the ground point I will pull it out let us say that is 0. So, with respect to this ground, this node is positive so plus 15. With respect to this ground this node is negative 15, so it is minus 15. So, we have 15, 0, minus 15 at the input.

And at the output, this is again ground ok. This is the measurement direction. Now, let us measure like this with respect to the ground always with respect to the ground. So, you are measuring this node potential with respect to the ground that is this, this node potential with respect to the ground that is this. So, let us say a 10 volt supply we want at the output with a input output differential of 5 volts in each of the regulators. So, at this point, let us say we have 10 volts plus 10 volts with respect to this ground this is 0. And with respect to that same ground if I measure here, I will get minus 10 volts.

So, this gives me a plus 10, 0, minus 10 volt dual output power supply. So, this 10 volts, plus 10, minus 10 volts is the regulated plus 15, minus 15 is the input unregulated. So, this is the integrated schematic of a dual power supply linear regulator both positive and negative together.