Amplificateur opérationnel

3.3 Montage indépendant de la fréquence

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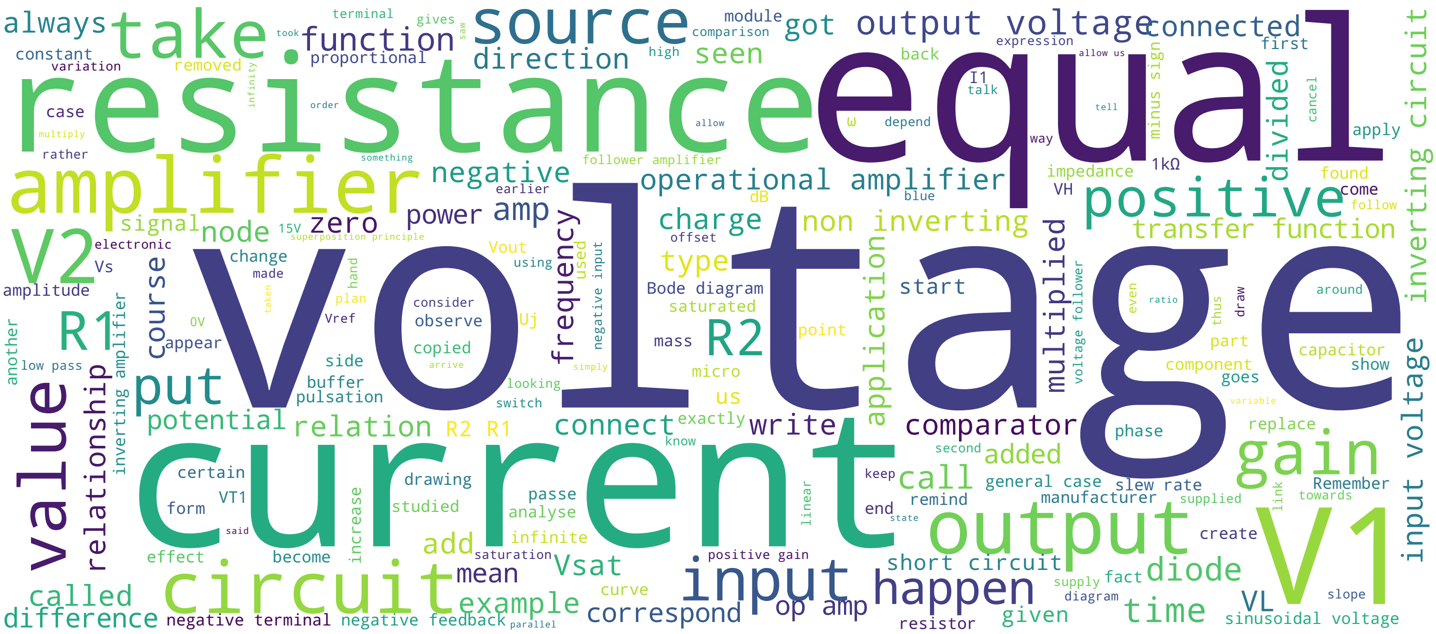
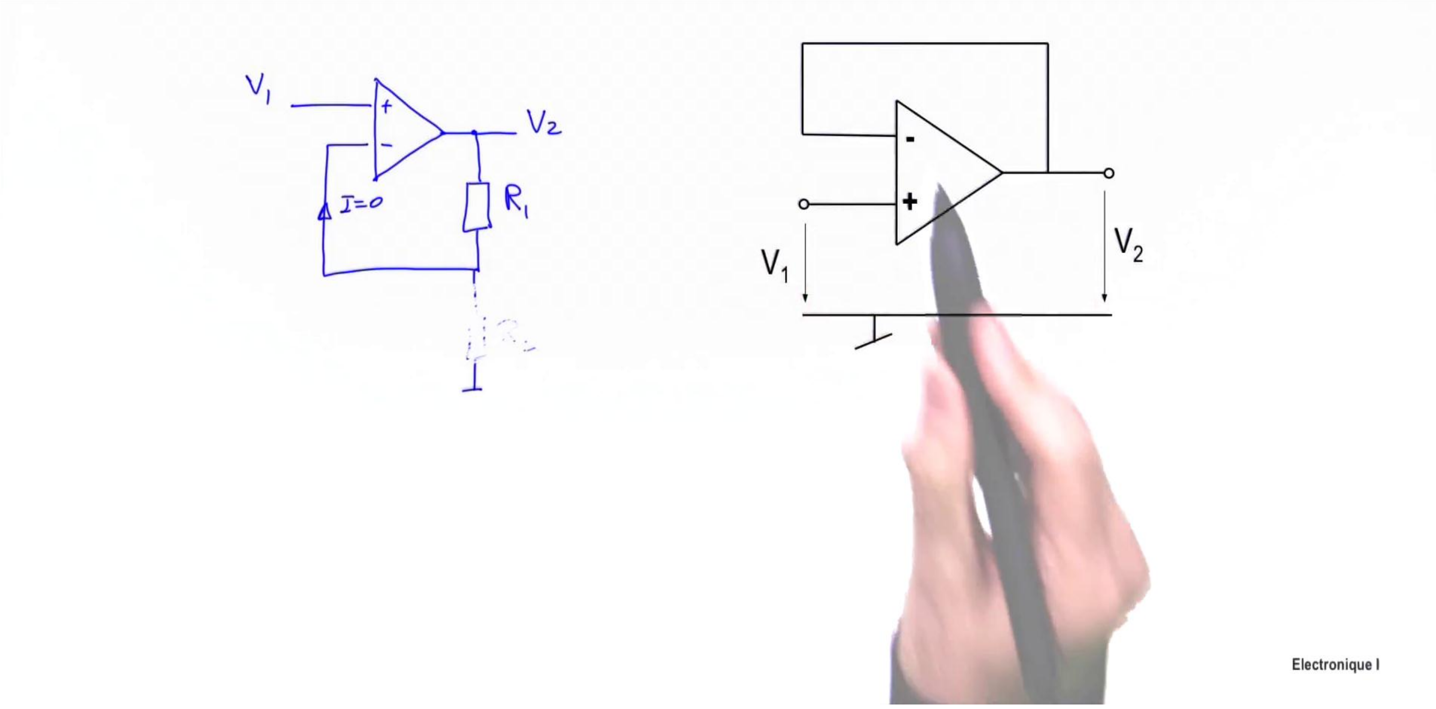


Video

Suiveur de tension



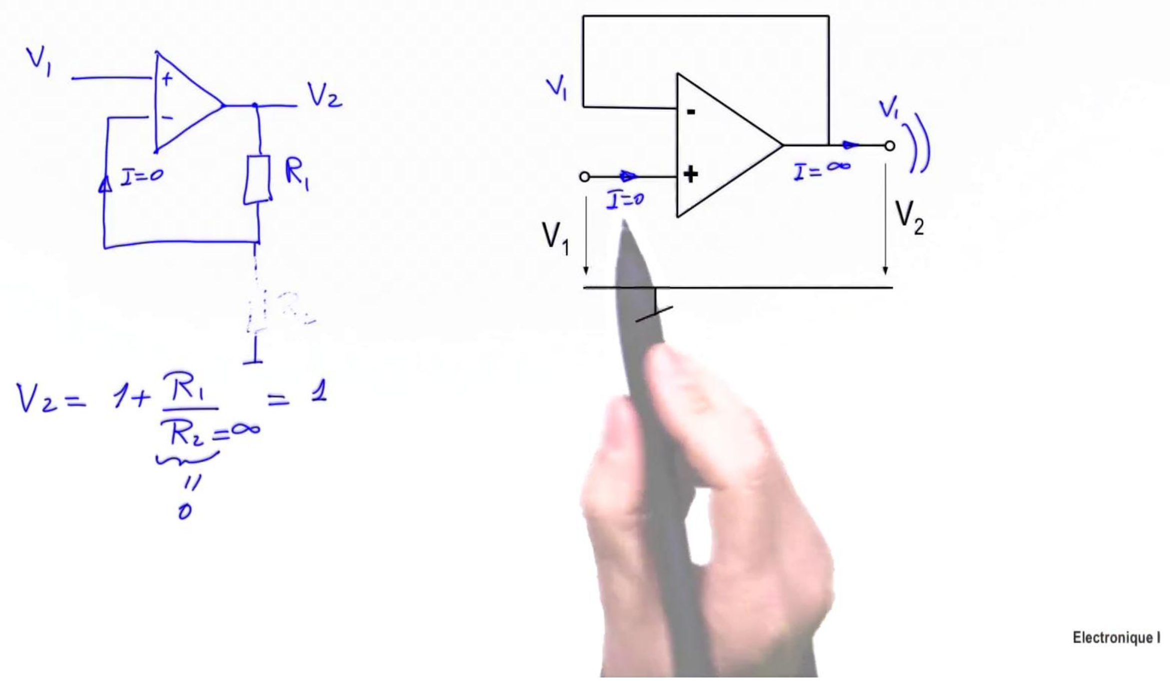
Now we are going to look at this type of circuit that we call the voltage follower amplifier. So it's a circuit which will simply copy the voltage from there to there. I will take the circuit that we had studied before. So I remind you that the circuit that we studied, is a circuit where we took negative feedback resistance, *R1* and *R2*. And we have a high impedance input. And we observe the voltage here at the output in comparison with the *V1* input voltage. What happens when you completely remove the *R2* resistance? So if you take the *R2* resistance and you don't put it. So this resistance there, it's no longer there, we remove it. And, what's going to happen with your circuit, is that this *R1* resistance doesn't even a remaining direction. Because this *R1* resistance, that you can see here, is a resistance which will simply drive a current here. But there's no current. The current here, *I*, is equal to 0. So you keep it or you replace it with a short circuit, it has the exact same consequence. In this case, we replaced the *R1* resistance with a short circuit. We could have kept it, it wouldn't have changed the behaviour of this circuit at all.

Notes

Summary

0m 03s

Suiveur de tension



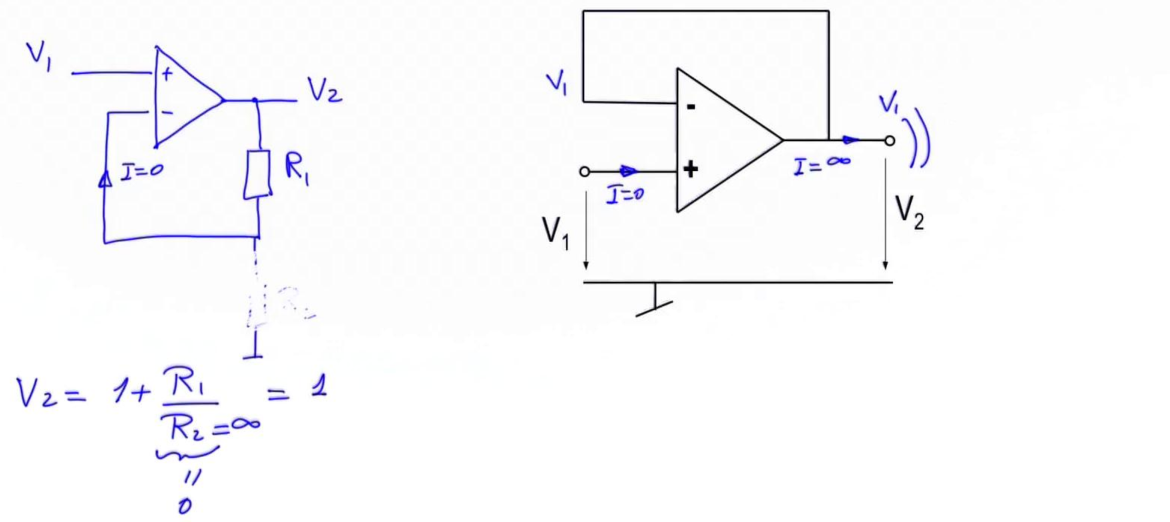
This circuit, when you analyse and write the output relation compared with the input, you'll write *V2* is equal to 1 plus the *R1* resistance divided by the one I've just removed which is called the *R2* resistance. And I've just put that equal to infinity. I removed it so I completely withdrew the *R2* resistance, so it's equal to 1. I've just made an amplifier which has a gain equal to 1, because this becomes nil and we've just removed the *R1* resistance that was useless, and we have a circuit. We only have to take the negative input and link it with the output because this voltage there is always copied here, given that the difference in voltage between these two positive and negative terminals is equal to 0. So *V1* is equal to 1. That, and you can see *V1* here. *V1* equal to *V2*. There is a fundamental difference between the fact that this *V1* voltage is at the output. There, you take the current from the source which determines *V1* is equal to 0. There, the current which goes out the amplifier, in theory, is an infinite current. So there, you take the current you want in a charge. There, you don't take anything from the source you are connecting.

Notes

Summary

1m 34s

Suiveur de tension



If we hadn't put an amplifier at all, which, of course, is charged, and that this supply voltage gives the necessary energy to supply the current, because the current comes from the voltage supplies which are added to the amplifier that we no longer illustrate.

Notes

Summary

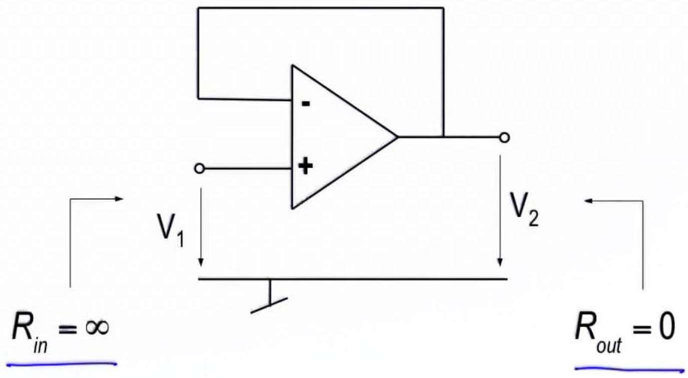
3m 00s

Suiveur de tension

$$\frac{V_2}{V_1} = 1$$

$$R_{in} = \infty$$

$$R_{out} = 0$$



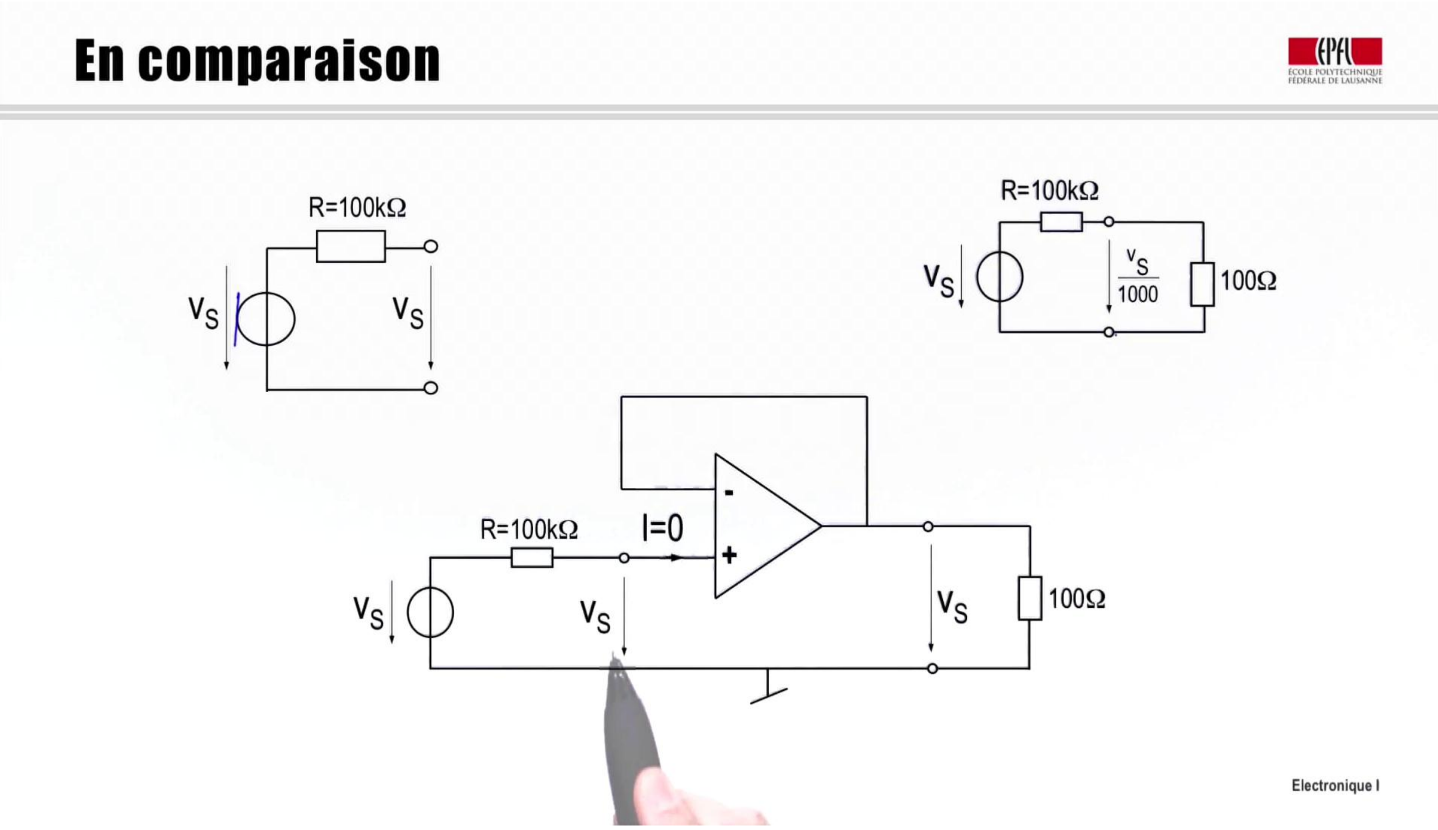
Electronique I

So you end up with a drawing like this. And there it is, your input impedance has become infinite whilst your output impedance has become nil, all whilst maintaining the same input voltage copied to the output voltage. And in English, it's called *buffer*. A *buffer* means that we've successfully put a buffer between the input and output. And this buffer, which is located between the input and output, completely disconnects the resistance you will have connected here that has exactly the same *V2* voltage source, without being directly connected. We will have many use for it, such as the application that we will see there.

Notes

Summary

3m 16s



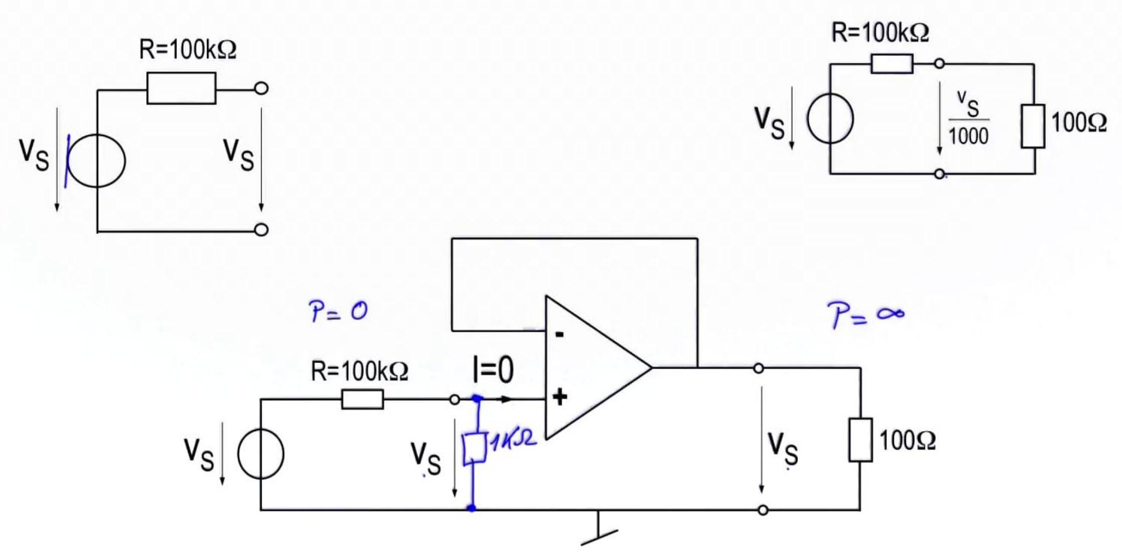
If you have sources which have very high resistances. So this resistance there is 100kΩ and you will have wanted to take this *Vs* voltage and connect it to a charge with a distinctly lower value to the source's internal resistance. There, I take the example of around 100 ohms. That means the voltage you will have seen here will have a resistive divider whose the resistance of the terminals of which the voltage is equal to 100kΩ, whereas the other is equal to 100kΩ. So it's as if I had divided my source voltage by one thousand. So I totally reduced the voltage that was available in the source when I saw it on the charge. Typically, if you consider that it's a micro, and you have a micro, the micro doesn't have an output resistance which will be a weak resistance. They're very, very high resistances. So you can't connect your micro to any charge and this charge will absorb all the power supplied in the micro. If you put a *buffer* between them both, so you put a voltage follower amplifier, the *Vs* voltage here is exactly the one we can see there. It's not that one which had been divided my one thousand. All whilst copying *Vs* and placing it here.

Notes

Summary

4m 06s

En comparaison



Electronique I

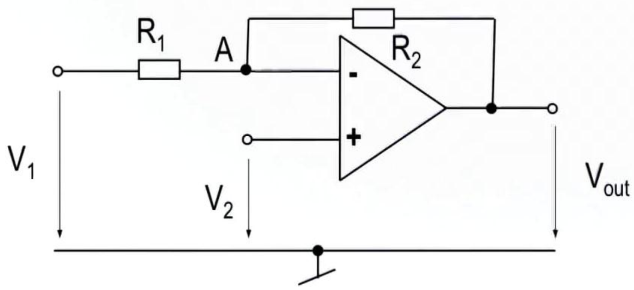
So the *Vs* voltage was copied from there to there, without affecting the current. We have taken a nil power from the charge. The current is nil, so the power which was supplied here was equal to 0. The power from the source, we took a nil power. The power that was injected in the charge, by definition, in theory, but it's never true, it's an infinite power because the current which can be provided by the amplifier is equal to infinite. There is another application that we can do with this type of circuit. In certain types of applications, we need to connect resistances that we call characteristic resistances which have certain types of values. Suppose that your source must have, at all costs, a resistance of 1kΩ, for example. You only have to take a passive resistance of 1kΩ and connect it to this circuit's output. Your source has... Of course, it has that as internal impedance. But it always has a constant resistance equal to 1kΩ. And on the other hand, you can connect any value of resistance, including a short circuit. So that, that can be an extremely weak resistance but your source sees the one you've connected here. Any resistance you put there, that will be the resistance that will be seen by the source with its internal resistance.

Notes

Summary

5m 26s

Cas général



$$V_{out} = V'_{out} \,/\, V_1 = 0 + V''_{out} \,/\, V_2 = 0$$

Electronique I

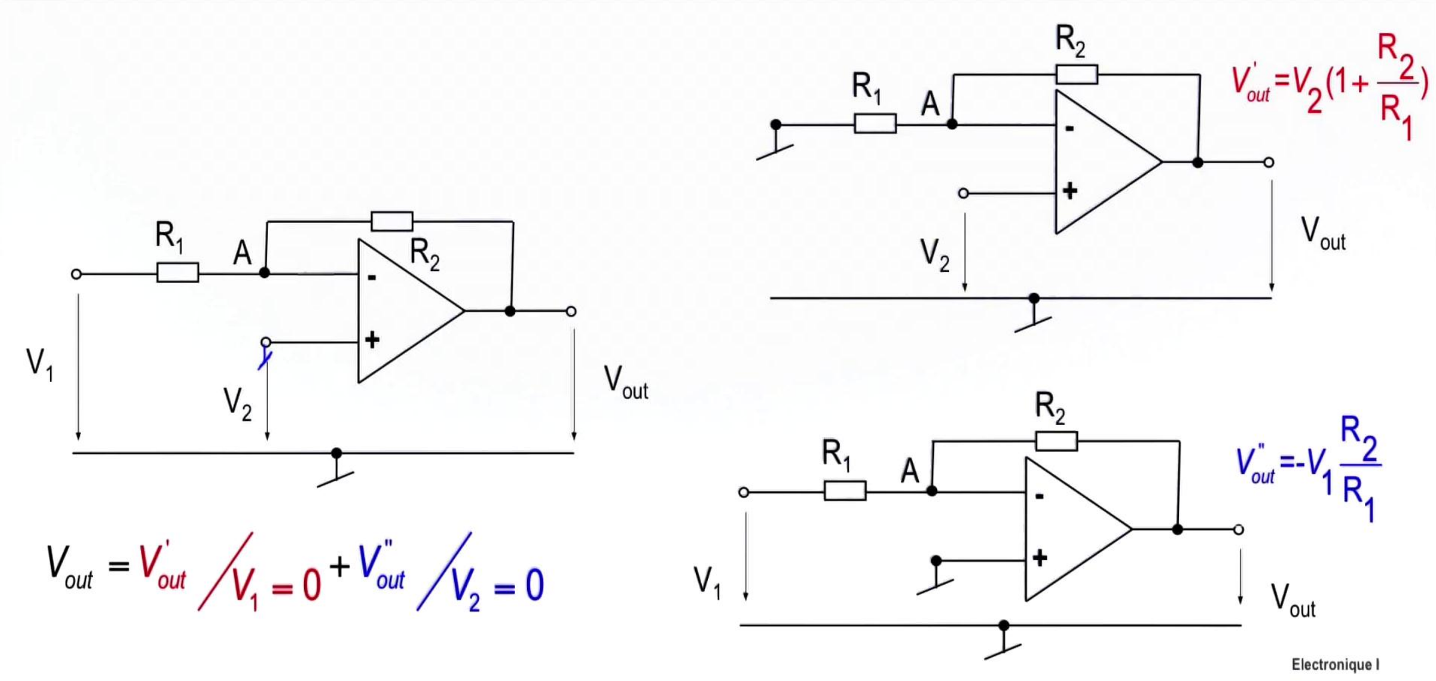
After having seen the inverting circuit, the non-inverting circuit, we are going to talk about general cases. A general case, it's that we will use the amplifier's two inputs in this form. You have the op amplifier with the positive and negative input. We added a *R2* and a *R1* resistance. I remind you, we started with a inverting circuit when we connected the mass here. And we called that the inverting circuit. Then, we took this and put that to the mass and we entered with a *V2* source here and we called this the non-inverting circuit. In this example, we will consider that we have *V1* and *V2* voltage and we will use them both. What is going to happen with the *Vout* voltage? It's a linear circuit. If the output voltage isn't saturated, of course I can apply the superposition principle. We must be aware that the superposition principle will help us to find again our two schemas from before. So first I'll start by reading, there is a *Vout* voltage, which has two parts, a contribution of the *V1* and *V2* voltage. I cancel *V1* once and I cancel *V2* once. I add the two and I say I superimpose at the output given that I'm in the linear world. So first I'll take the first case.

Notes

Summary

6m 52s

Cas général



So first I'll take the first case where I look at the *V'1* voltage when *V1* is equal to 0. I will have a drawing which is like this. I cancelled the *V1* voltage. So I put that to the mass. And I observe this drawing. And I only have to copy what we had studied at the beginning in the circuit called non-inverting circuit. So the *V'out* output voltage is equal to the *V2* voltage multiplied by a positive gain which is equal to 1 plus the relation of *R2* on *R1*. I'll go back to the general case and this time, I'm interested in the *V''out* situation when *V2* is equal to 0. So I short circuit this to the mass. And I recognise the inverting circuit there. And this inverting circuit, will tell me that the contribution of the *V1* voltage will be seen at the output with a reverse component. So it's *-V1* which always multiplies the relation of the *R2* resistance divided by *R1*. And now, I only have to take account of the addition of these two cases given that I can superimpose the two and I will find this.

Notes

Summary

8m 29s

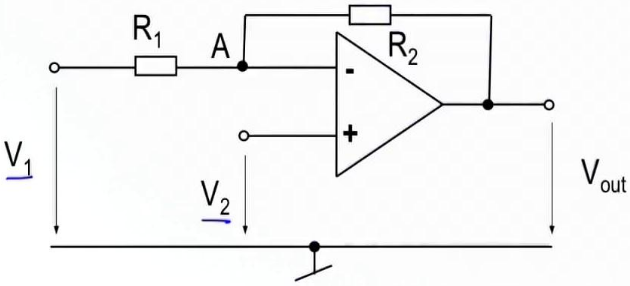
This is what I find in an example where I use an amplifier with two sources of voltage *V1* and a second source of voltage *V2*. The output is proportional to these two components. *V2* multiplied by a gain of a non-inverting amplifier and *V1* multiplied by a gain of a inverting amplifier. So once *1+R2/R1* and another time *R2/R1*, with a minus sign. However, the *V1* source will have an input resistance *Rin1* equal to *R1*. On the other hand, *Rin2* is infinite. So the current which enters here is an infinite current and the *Rout* resistance, of course, is supported by the operational amplifier, which will give me *Rout* is equal to 0. We have just seen the non-inverting circuit and we have seen applications and we first distinguished that it's a circuit which has a positive gain, which has a gain which is always higher than 1 and which can be done with an amplifier which is called a follower amplifier, that is used to separate a source and a charge. The source doesn't debit current, the charge absorbs the current from your operational amplifier.

Notes

Summary

9m 45s

Cas général



$$V_{out} = V_2 \frac{R_1 + R_2}{R_1} - V_1 \frac{R_2}{R_1}$$

$$R_{in1} = R_1 \qquad R_{in2} = \infty \qquad R_{out} = 0$$

Electronique I

And we finished with a general case where we demonstrated that an amplifier can at the same time combine an inverting or non-inverting amplifier. We call this the general case. We will look at this again in one of the applications, applications of the operational amplifier later and which will allow us to make what we call the differential amplifier.

Notes

Summary

11m 03s