ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

3.3-Configurations petits signaux

Configurations EC, BC, CC: résumé et exemple application

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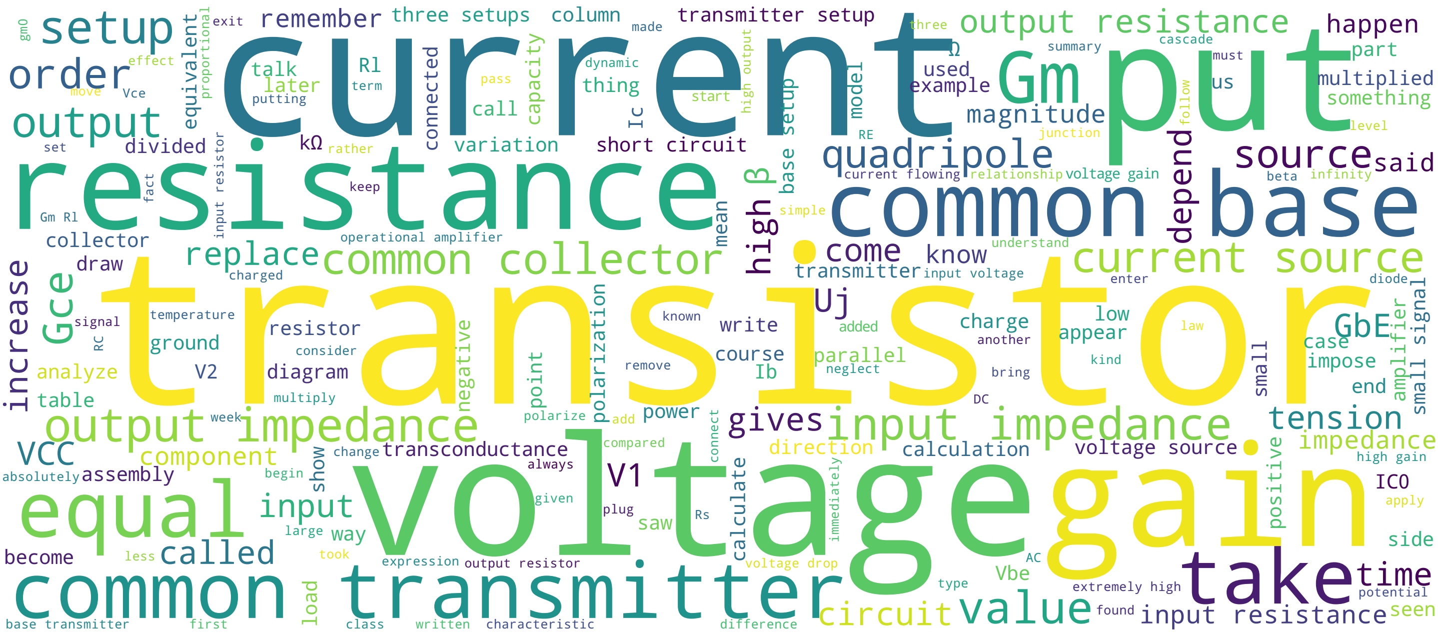
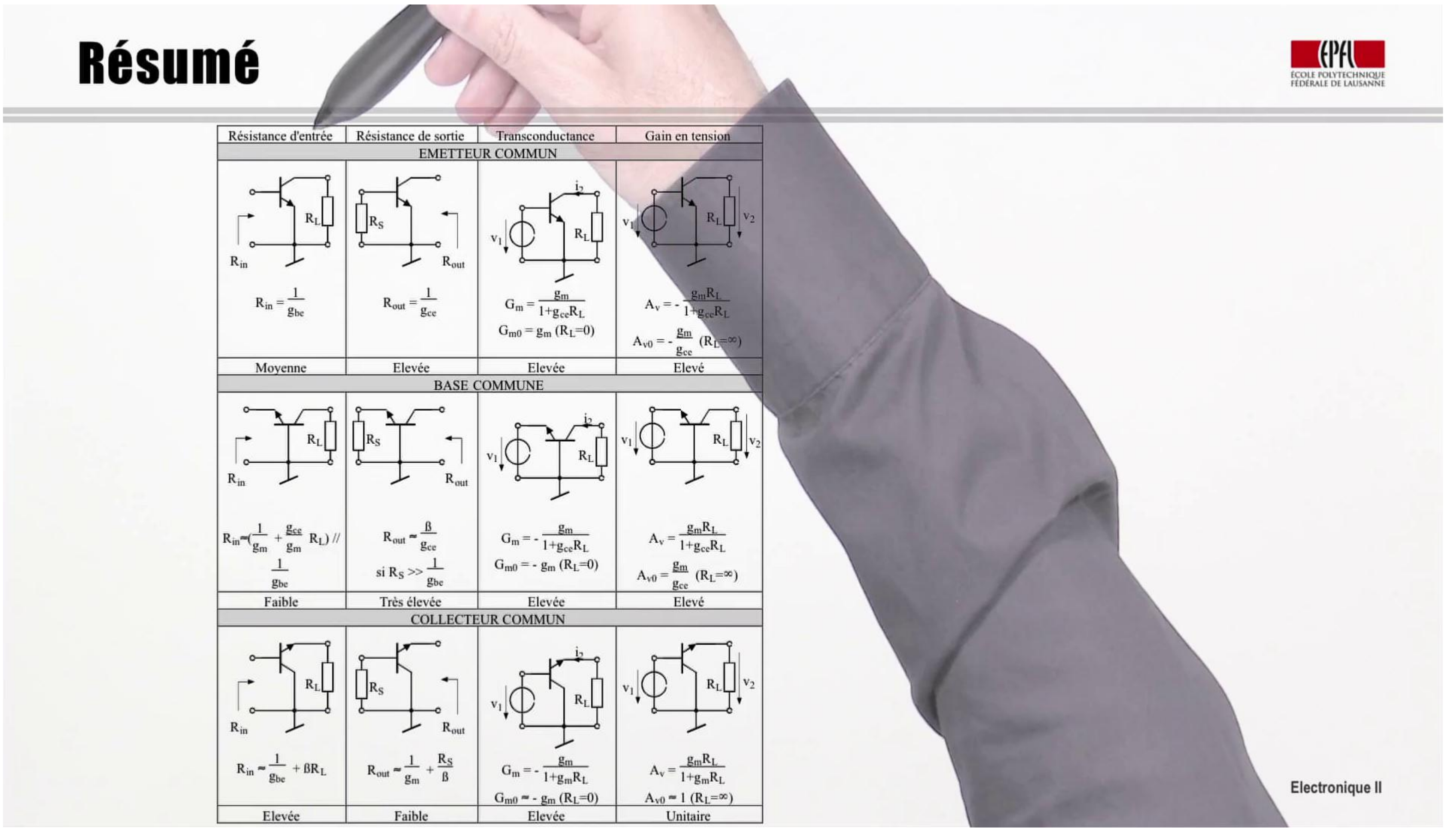


Video

EPFL

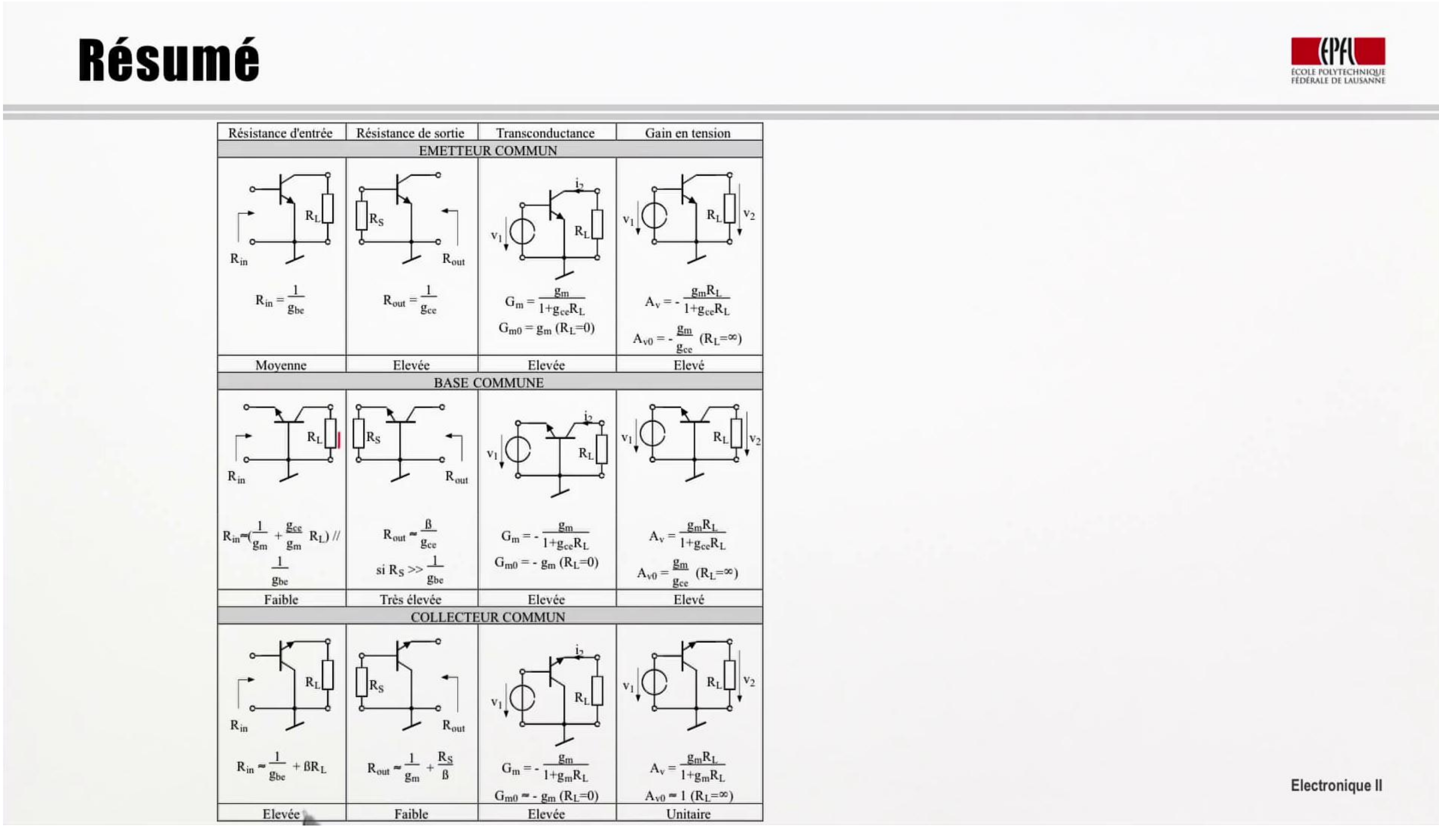


We have already seen that this is a common transmitter setup, common collector common base. We analyzed small signals diagrams where were extracted, from the transistor itself by replacing it with is model, a vision in quadripole form. We now understood that the quadripole is the way which simplifies the calculation of a whole circuit because we have to look only at what is there as input impedance, output impedance, and see what is the trance conductance. With this, we directly have the gain in voltage or in current or anything you wish. Now, at the end of this week we will just make a summary of the three setups and see that we can have a very synthetic view. Once we finished this, we will do a small example to show how an electronic circuit is built when you have the three basic setups. To start, here is a summary of all that we have seen this week. You have three setups, common transmitter, common base and common collector. On this sheet, we can see the three things we extracted during the first two sections of this chapter. You look at the input resistance. There's the common transmitter input resistor, common base and common collector, same for the output resistance, also the transconductance.

Notes

Summary

0m 04s

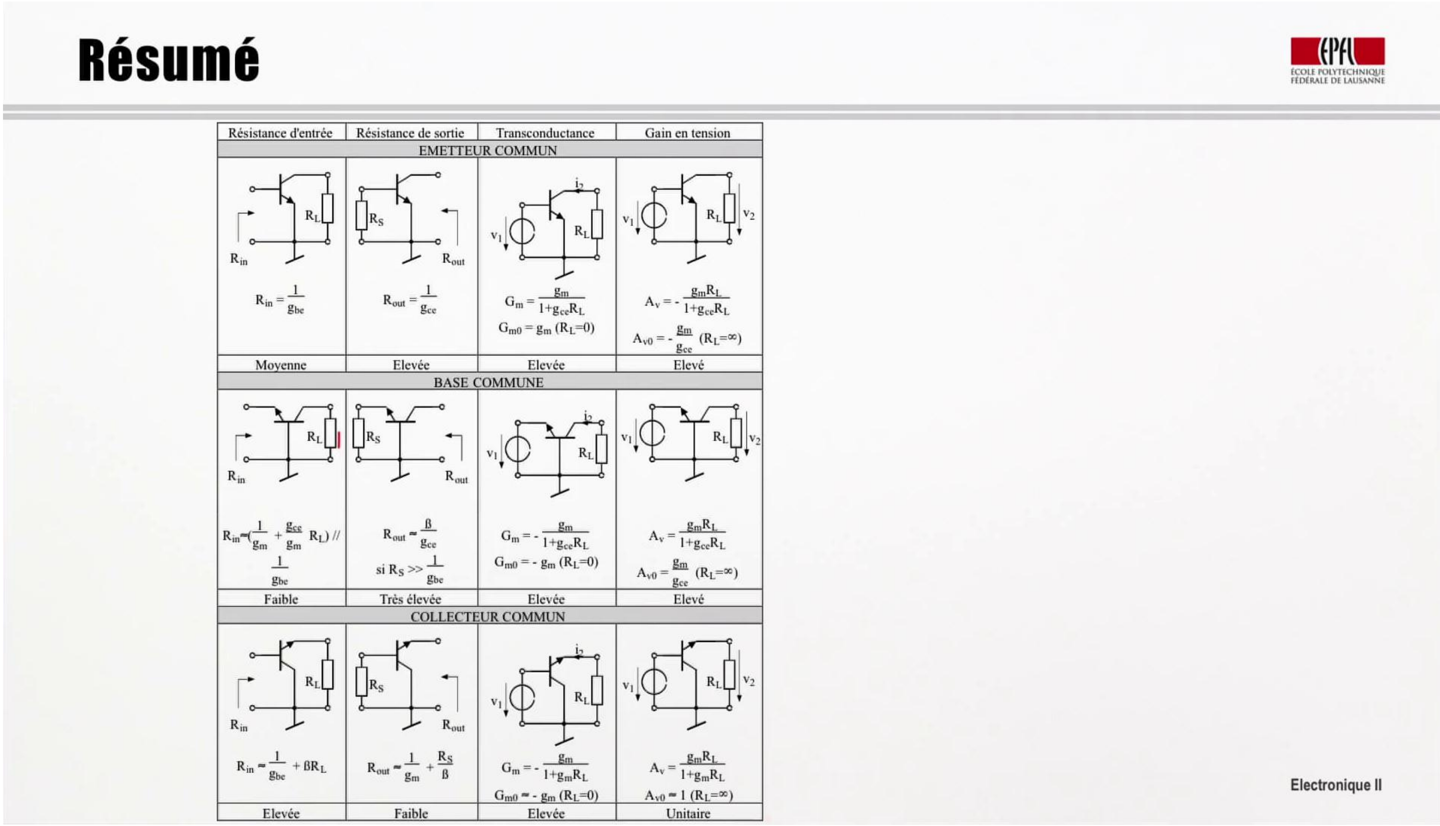


Then I added a column where you can see what is the voltage gain of the three setups. I will summarize what is on these three columns. You see, it is extremely easy to understand the usefulness of each of these setups. The most important thing is to remember the following things, you have the input resistance. The input resistor in a common transmitter setup, I noted below, this is an average value, so it is neither great nor small. What is average, what is great, what is small? We'll see later when I start to recall the numerical example we saw earlier. You have an input impedance of a common transmitter setup that is 1 / GbE and the output impedance, 1 / Gce. For a common base setup, the input impedance that will see just now, will be proportional to what will happen with the charge resistance. Same for the common base, we'll see that the output impedance, when you look from here, the impedance of the source will strongly influence what is going to happen with this output impedance. The common transmitter will show us something that depends on what you put as the charge resistance on the exit of the common collector. You will see that the β of the transistor is a very important parameter because it will multiply this resistance.

Notes

Summary

1m 39s

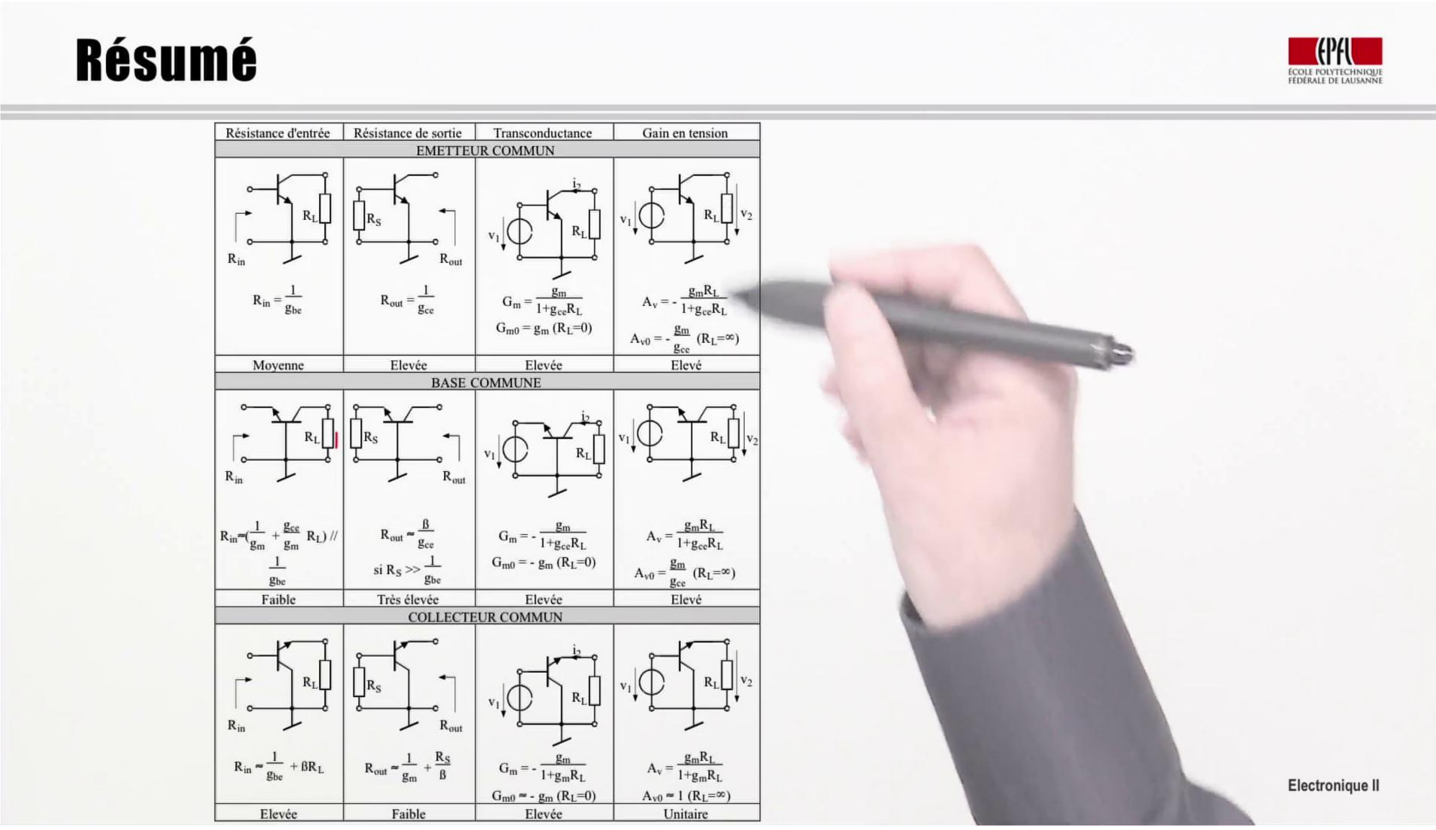


The common collector shows at its output an output impedance which is 1 / Gm plus something which depends on the source resistance. I remind you what is a resistance source. The resistance of a source is that you'll connect at the input to a voltage source that supplies your quadripole and which can be a series resistance. If this series resistance is large or small, it will be reduced or divided by the β of the transistor. I would like to comment on what will appear on the column transconductance. In fact, when we look at this transconductance column, we will see that all the time only open transconductance, which is when the transistor is not charged or the quadripole is not charged, there is no Rl resistor, Rl=0 if we consider it current source at the output. You will see the gm0 of the transistor, this is your transconductance transistor. See, in the case of a common transmitter setup, the short-circuit transconductance, when you short-circuit Rl replacing it with an Rl equal 0, you find that for the common transmitter, the gm0 equals Gm. For the common base, there's just one less front. For the common collector is as common transmitter. This is of the order of magnitude of -gm.

Notes

Summary

3m 13s

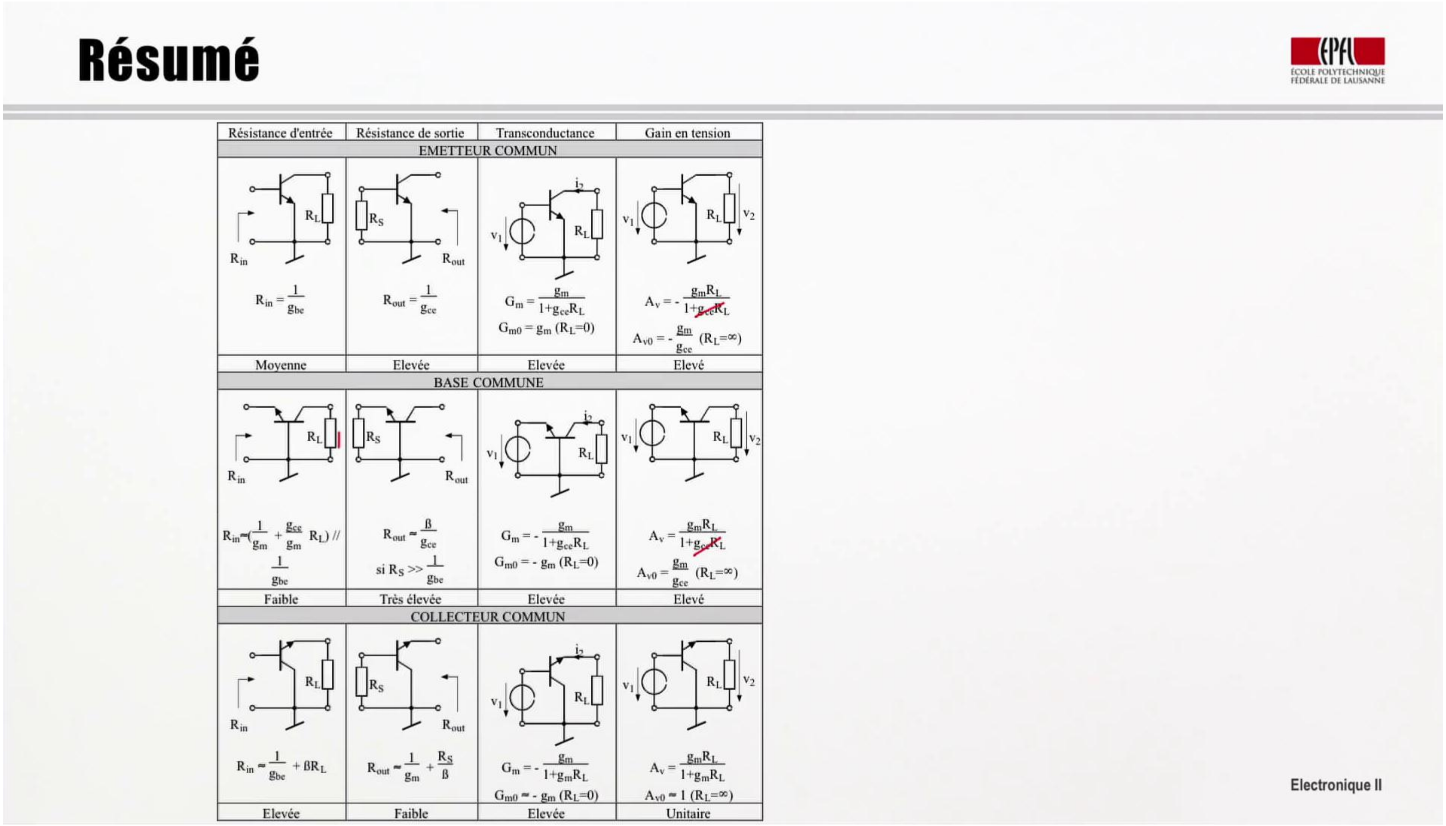


This column, there is no surprise. It is simply positive when it is a common transmitter and it is negative and negative. It is always the same value which is the transconductance of the transistor itself. As I added an additional column that describes the gain, we call it an intrinsic setup gain this is when your resistance is infinite. It is when the resistance RI, that you charge your setup with, you remove it completely, it is equal to infinity. This resistor RI does not exist. At this moment, we have what is called an intrinsic gain. If the transistor does not have an effect early, if really it is an ideal current source and the Gce, which is the output conductance which is due to this Early effect, which is IC0 divided by the voltage Va which is the early effect at this moment, the gain of your transistor would be absolutely intrinsic to the transistor because it's the transconductance ratio of the device itself, of the component itself divided by the output conductance or multiplied by the resistance of the internal output transistor. If this Gce is 0, the gain is small. If there has been no output conductance, at this point you can say that your amplifier has a tiny gain.

Notes

Summary

4m 37s

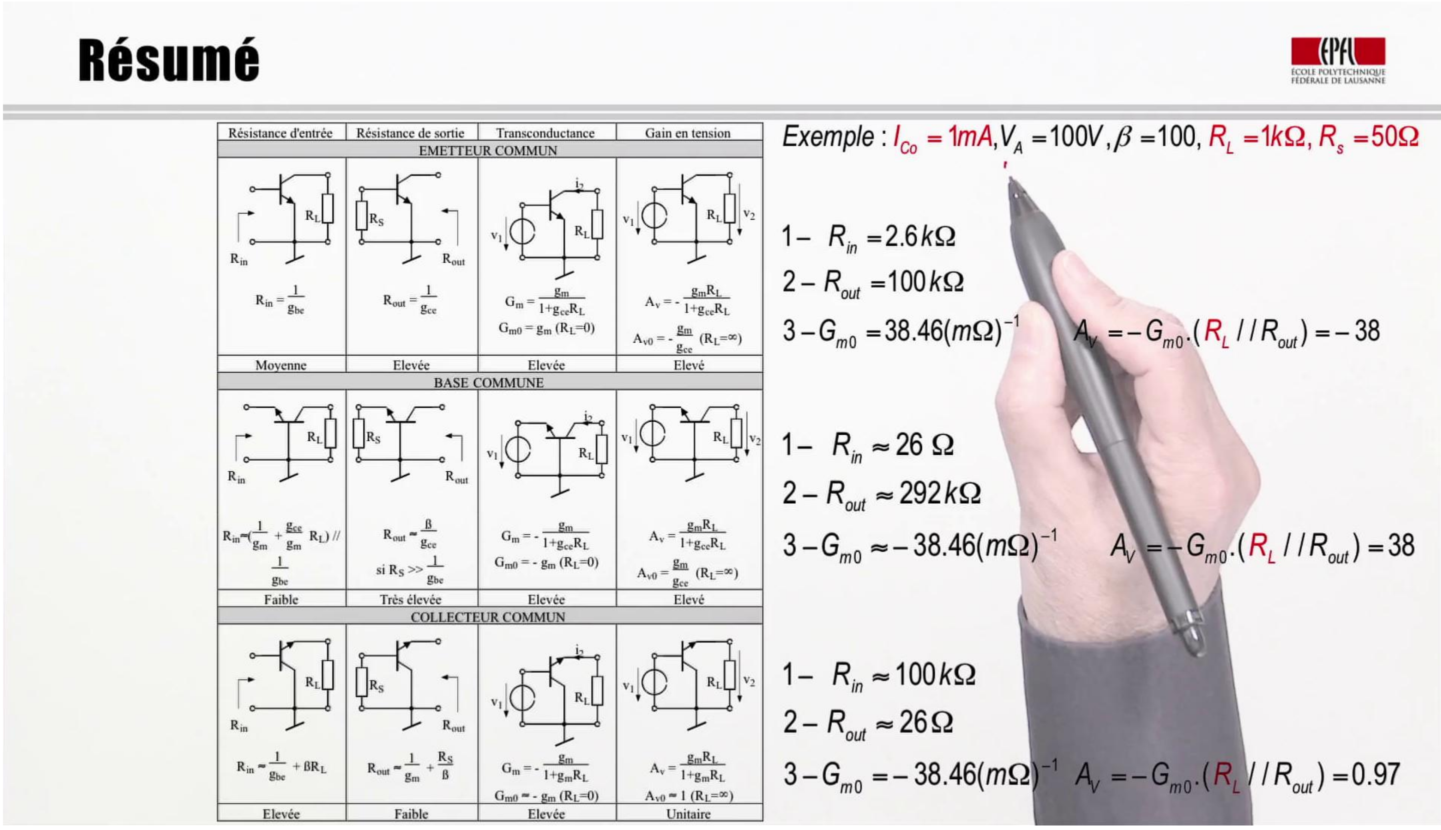


Unfortunately, there is an early effect which imposes a Gce. Same here. In the common transmitter setup and common base, the gain is exactly the same. It is GmRl / 1 + Gce.Rl. It's the same here. The intrinsic gain is once again negative for the common transmitter and once positive for the common base. In both cases, you get a voltage gain. So it is a voltage amplifier because it takes an input voltage, it multiplied by a certain gain which is equal to Gm.Rl, if the resistor RI you have connected here is well below 1 / Gce. At this point, you can ignore this and you can neglect this, and you find yourself with a gain equal in the common transmitter setup -Gl.Rl, And the common base, + Gl.Rl. When you have a setup of the type common collector, your gain is simply equal to 1. This is a voltage follower.

Notes

Summary

6m 07s

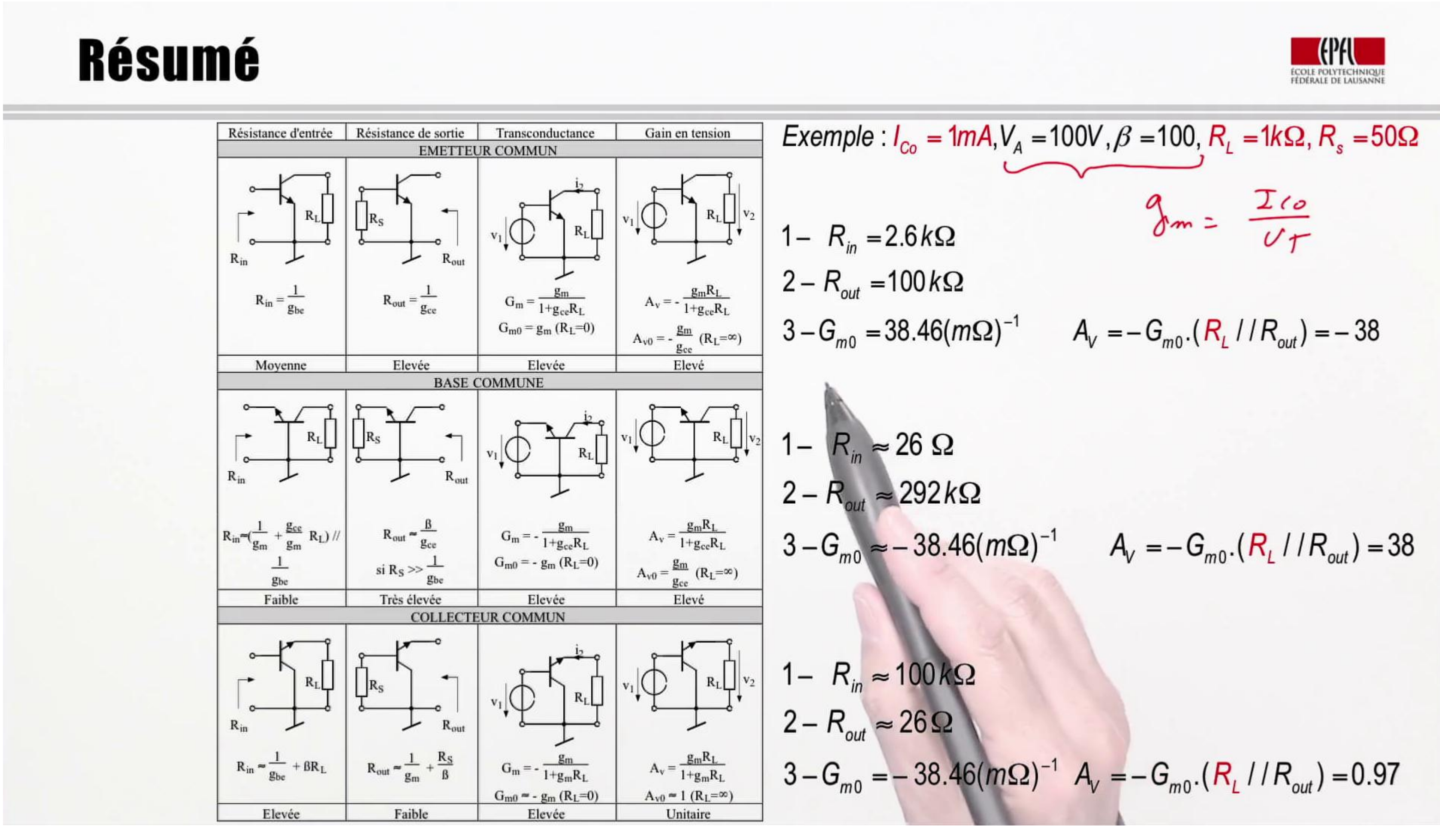


This sheet will help you to understand the behavior of your setup when you replace it with a quadripole, which in this quadripole, it becomes simply the represented entry by a resistor R in and the output, either a voltage source or current source, but as we said generally we use a controlled current source, you have at the output an output resistance R out, and like this, when you know it is a common transmitter or common base or common collector, all you have to do is to take the equivalent of your quadrupole, copy the value inside and to put it in R out, R in, put it with the numerical values. You replace the entire setup by an equivalent of this style which is an equivalent quadripole of each of these setups with the values found in the columns. Now consider a numerical example. I think now, with what you see in this sheet, you'll quickly understand what i mean by one average input impedance, a high input impedance high or a high output impedance. If you look at the three setups and you say what happens if I polarizes with the same current the three setups. I chose the same transistor. This means the same transistor.

Notes

Summary

7m 12s

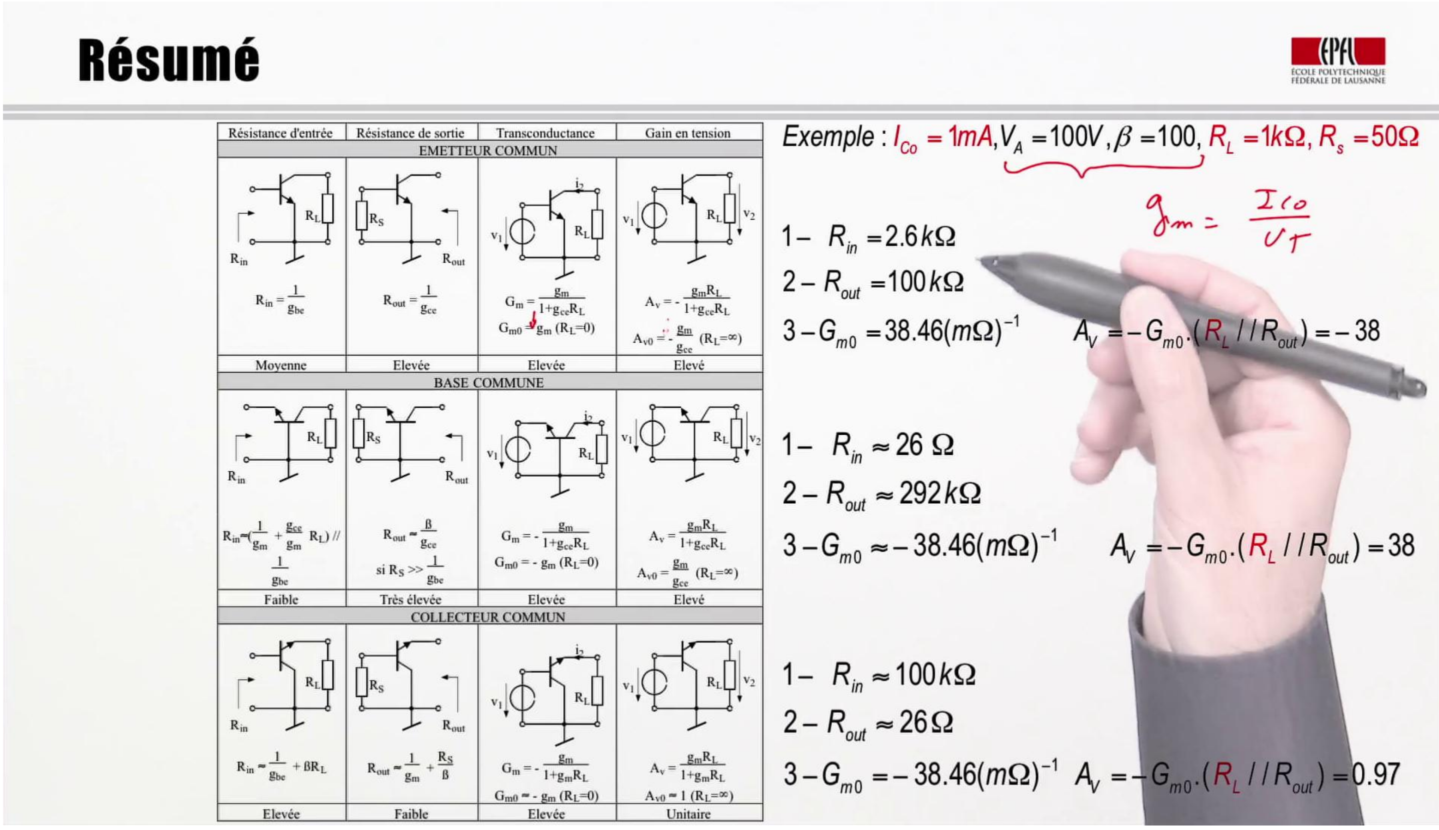


You have the same β and the same voltage early you used to make a common transmitter, a common base and a common collector. You load all three setups with the same resistance, an output resistor end Rl = 1 kΩ. You have a source that will supply the input of your quadripole with an internal resistance of 50 ohms. We have three quadripoles. The first realized with a common transmitter, the second a common base, third, a common collector. We polarize the three setups with the same current. I will calculate each box here and calculate R in, R out and gm0. Here, you look at what happens here because it will absolutely give you a clear idea, it will set you ideas on what it means the use of setups and the magnitude of these input resistors, terminating resistors. To begin and before going too far in the calculation or even comment on all this, know that as Gm, it is the same for the three setups. I note for the three setups of the Gm of the transistor is equal to IC0 / Ut. IC0 is given. Ut is the thermodynamic potential. You have a value that is equal to 38.46. We can write this column it right away because it is the same for the three setups. The gm0 is 38.46.

Notes

Summary

8m 43s

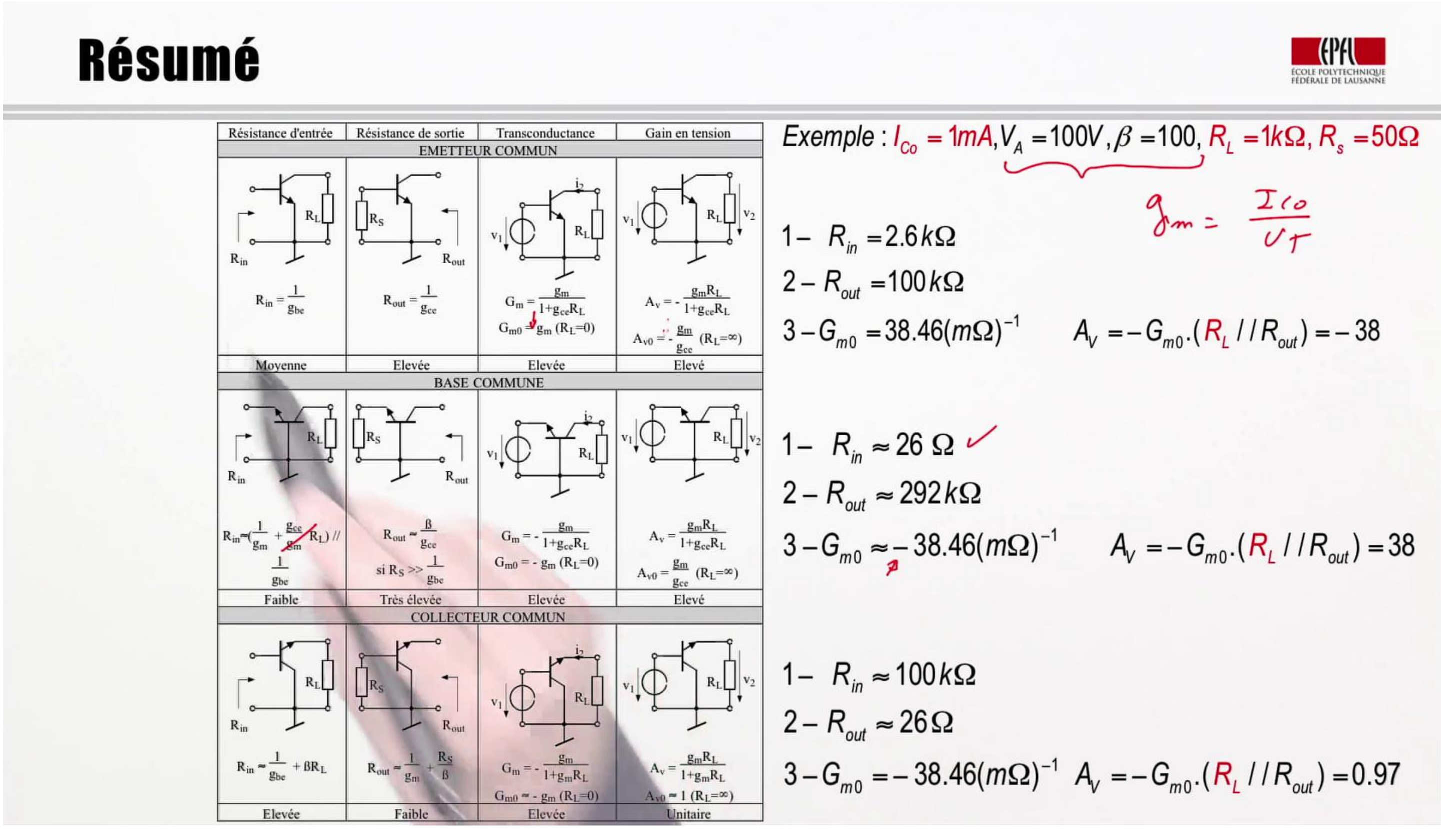


The only thing that will make a difference, I am on this column, so my Gm has no negative sign before. However, for the common base, I have to keep the negative signs. To the common emitter, there is a negative sign. I'll start looking at the input impedances of each of these setups. Let's start with the input impedance of a common transmitter set. Its input impedance is 1 / GbE. Simply calculate the 1 / GbE with these values and you will fall on 2.6 kΩ. This is what I call a medium resistance. It is neither large nor small, compared to 100 kW. The same setup, if you look at it the exit, since its collector, you'll see that the impedance or output resistance is equal to 100 kΩ. We see that I called it the average input resistance. There, I qualified it as a high output resistance. I look at the common base. The input impedance and input resistance is 26 Ω. This input impedance is of the order of magnitude of 1 / Gm, is equal to 26 Ω. That's low. This is the lowest value of the three setups. When I look at an input impedance here, here and here, I find that when I use a common base setup and look from the input, I still have an RI output resistance that is equal to a given value of 1 kΩ, which will be multiplied by the inverse of the intrinsic gain, so the inverse of Gm / Gce.

Notes

Summary

10m 23s

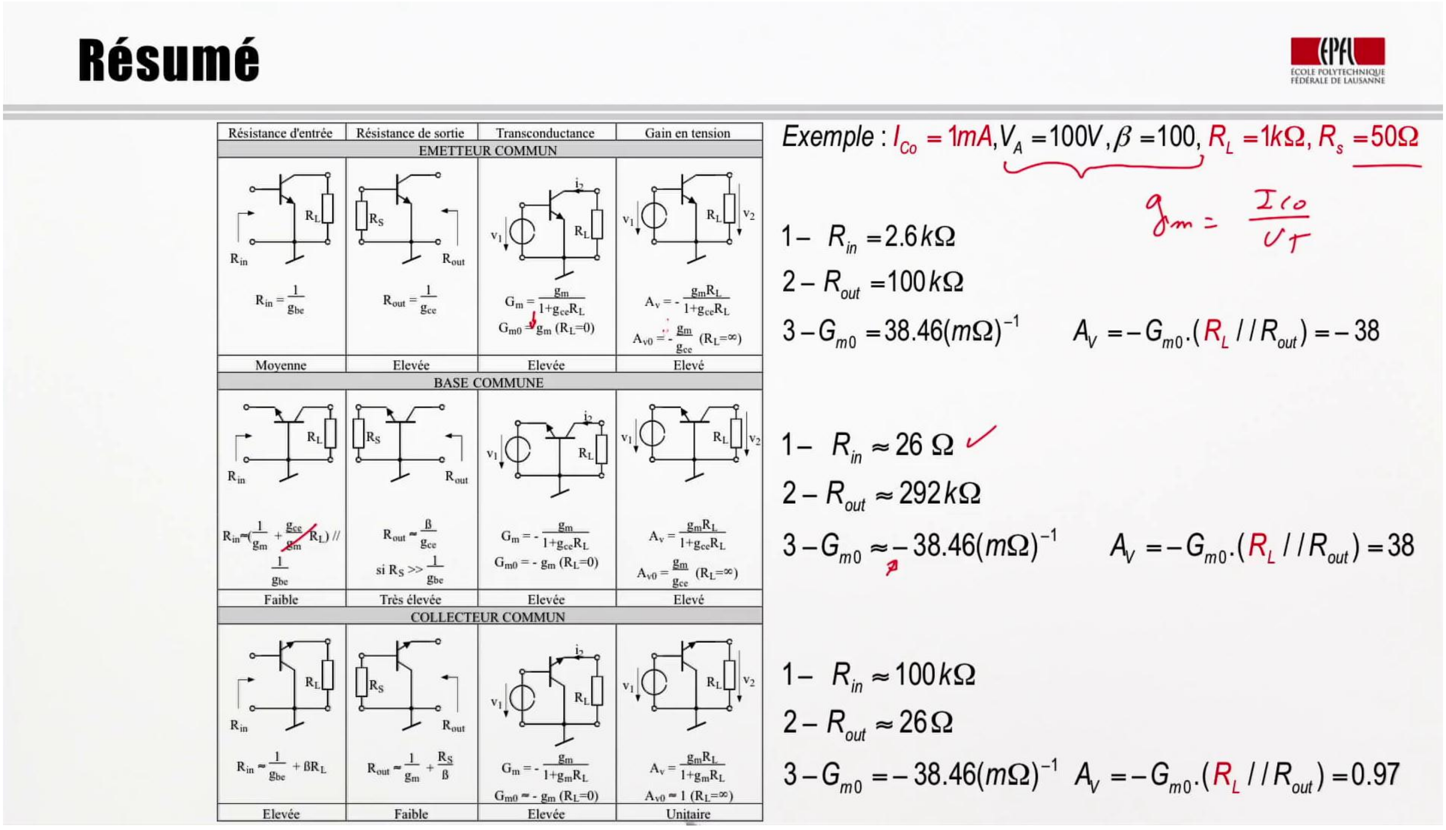


It is a very small term. It gives you something you can approximate. This you neglect in relation to this. You find that it is 1 / Gm parallel to 1 / G2. Given that 1 / Gm is very, very low, it will stretch towards 1 / Gm with respect to 1 / GbE. In this setup, the 1 / Gm is 26 Ω. 1 / GbE, is what we just calculated here are 2.6 kΩ. This in parallel with this, it is of course this that will prevail and that's what we will be left with. Therefore a common base input impedance is of the order of magnitude of 26 Ω. I qualified it as low. The output impedance or the output resistance in this case, depends on Rs. Le Rs in this example is 50 Ω. If you calculate, you come across an output resistor of the order of magnitude of 292 kΩ, about the order of magnitude of 300 kΩ. This is more than what I get with a common transmitter although the gain remains the same. One has a minus sign, and a another has a plus sign. I speak of Gm. When I look at it in terms of gain, it will give me once a negative gain and once a positive gain. This means that if you bring a signal to the input of a common transmitter, it will get you the opposite output. If it is a sinusoidal voltage, you end up with a 180 degree phase shift.

Notes

Summary

12m 17s

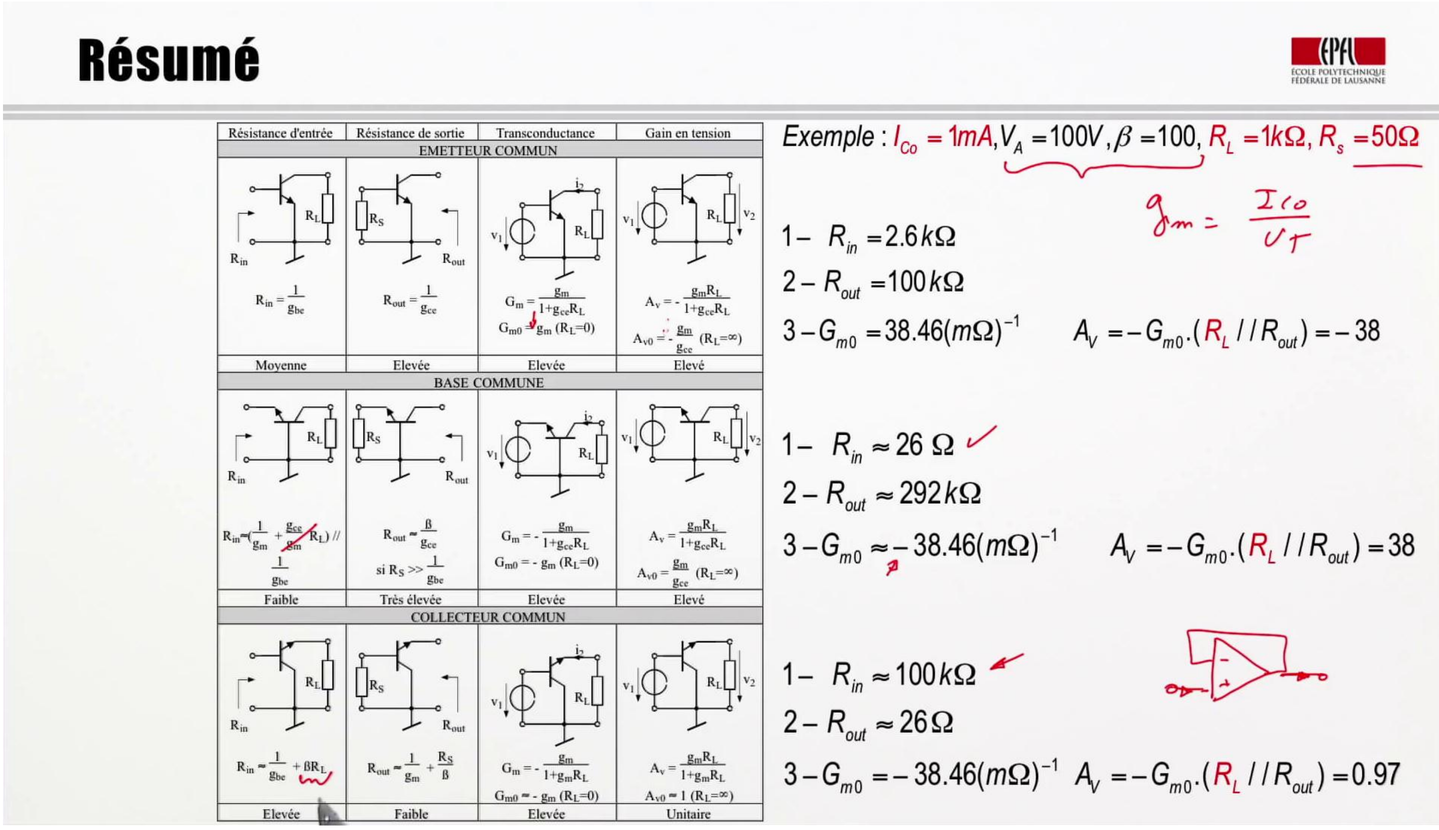


however, in a common base setup, input and output are in phase. The absolute value of the gain remains the same. It was found that the common base setup has a low input impedance and a relatively high output impedance. This output impedance could really become very, very great because it is dependent, it is related to the resistance Rs. If by chance, instead of having 50 Ω of source resistance, you put something that gives you an input impedance or input resistance of the order of megohms, know that this value will explode. Since this value is what determines the vacuum gain, when we don't charge with an output resistance you make gains with a common base setup which can be extreme, provided that the source resistance is very high. We will use this feature later. Let us analyze the common collector setup. The input resistance is high. It's a hundred kΩ. This is the highest of the three. The output resistance is the weakest of the three. The gm0 is the same. When you calculate it with a resistance the R out = 26 Ω, you will see that you will have a gain of the order of magnitude of 1. So the voltage gain is 1. It means that the input voltage is equal to the output voltage.

Notes

Summary

13m 53s

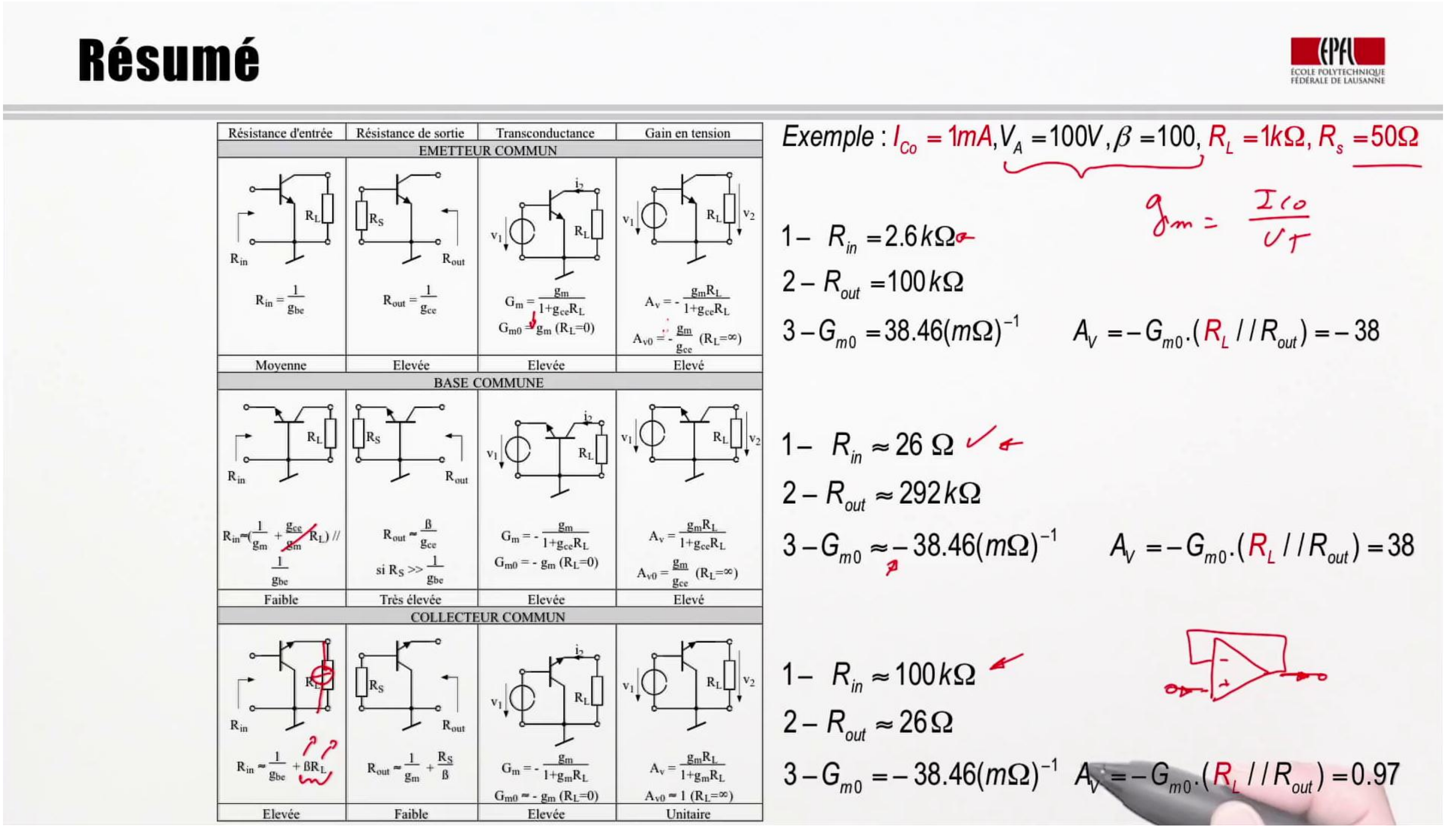


There is no phase inversion because this is equal to +1. What is the benefit of using it? The benefit of using it, it is this very high impedance at the input. Imagine plugging something here that will have a hundred kΩ. What you plug here, it will draw a current in your quadripole proportional to this resistance, so virtually little current. But at the output, you have an extremely low output impedance. This setup is the equivalent of what we studied in electronics 1, we called it the voltage amplifier follower, where we had a similar setup of this style. We said if you take an operational amplifier, you plug it the follower, the current flowing here is almost zero, and the current coming out of here, it's a current that comes from the supply voltages, which is high despite the voltage here and here being the same. A common collector type of setup is used to to make a buffer or a setup pad that we copy the input voltage to ù the output and we provide a current much higher compared to that which we are drawing from the base. Analyze this input impedance in this common collector column. We see that it is 1 / GbE + B.Rl. There are ways to make an input impedance, very high if your Rl resistance is very high.

Notes

Summary

15m 35s

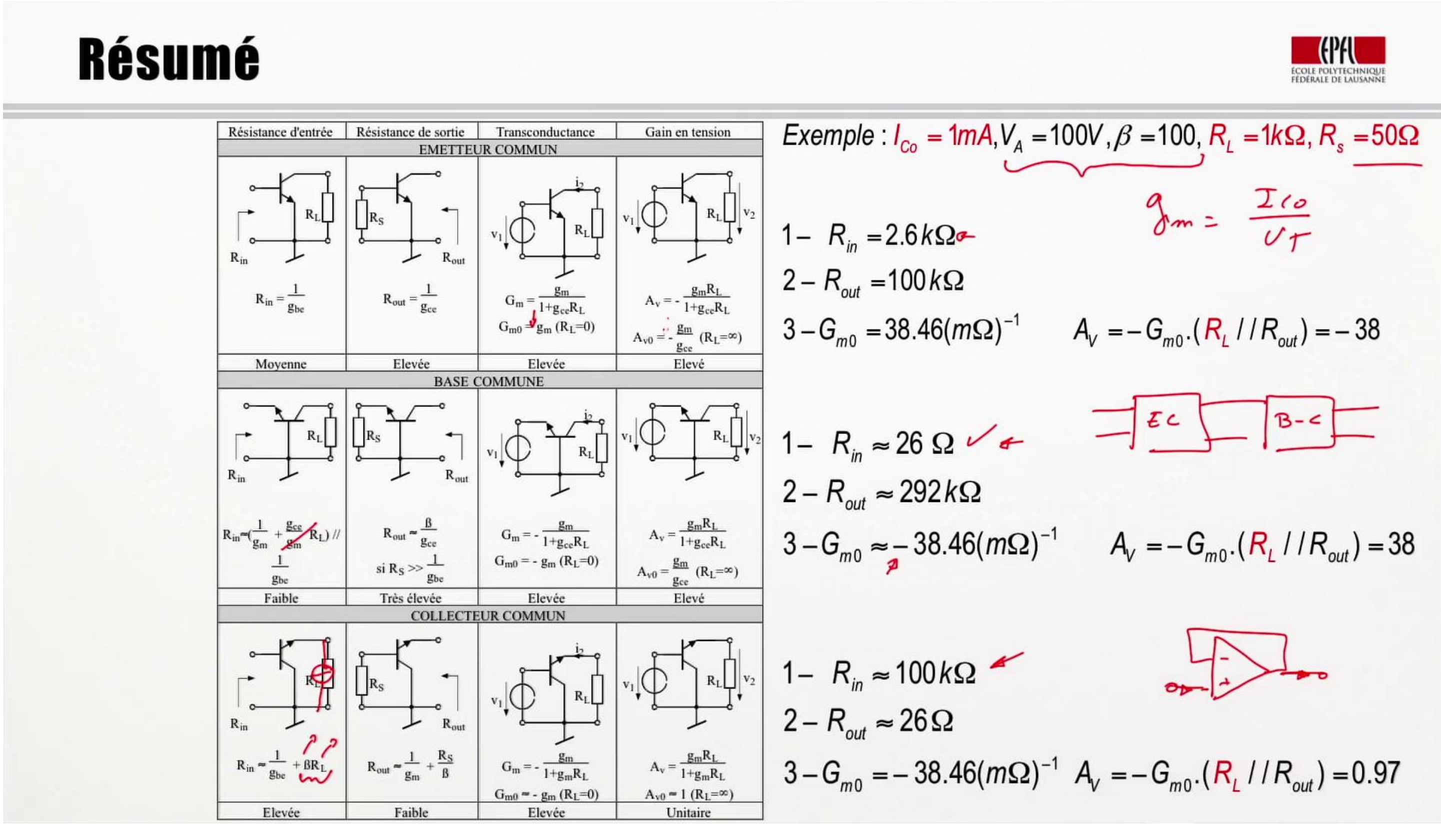


If you increase either the Rl or the β of the transistor, you will have a R in that is going to be very, very big. You will see later, we will exploit this feature to just get to make extremely high input impedances by choosing transistors with high β or make a setup that we will call Darlington in which we use two transistors to boost or increase the value of β. Otherwise, it is possible to replace the resistor Rl by infinity, an infinite resistance, Rl = ∞, when, in the place of your resistor, you put a current source. It is an infinite resistance. It's as if you did not have Rl, but you replaced it by an open circuit. Rl becomes equal to infinity, R in equals infinity. The value you see as R in will be very high. You fall in this situation. There is virtually no current entering. One can draw a lot of current at the output. What we'll do with all this, every time we need an average resistance at the input, we use this setup. If you need a very low resistance at the input, we use this setup. If we want to have a very high resistance, we use this setup. Same for the output resistance. But, given that we have linear circuits, we can align quadripoles, we said each one behave as a quadripole, so we'll have fun, later to put quadripole which follow each other.

Notes

Summary

17m 22s

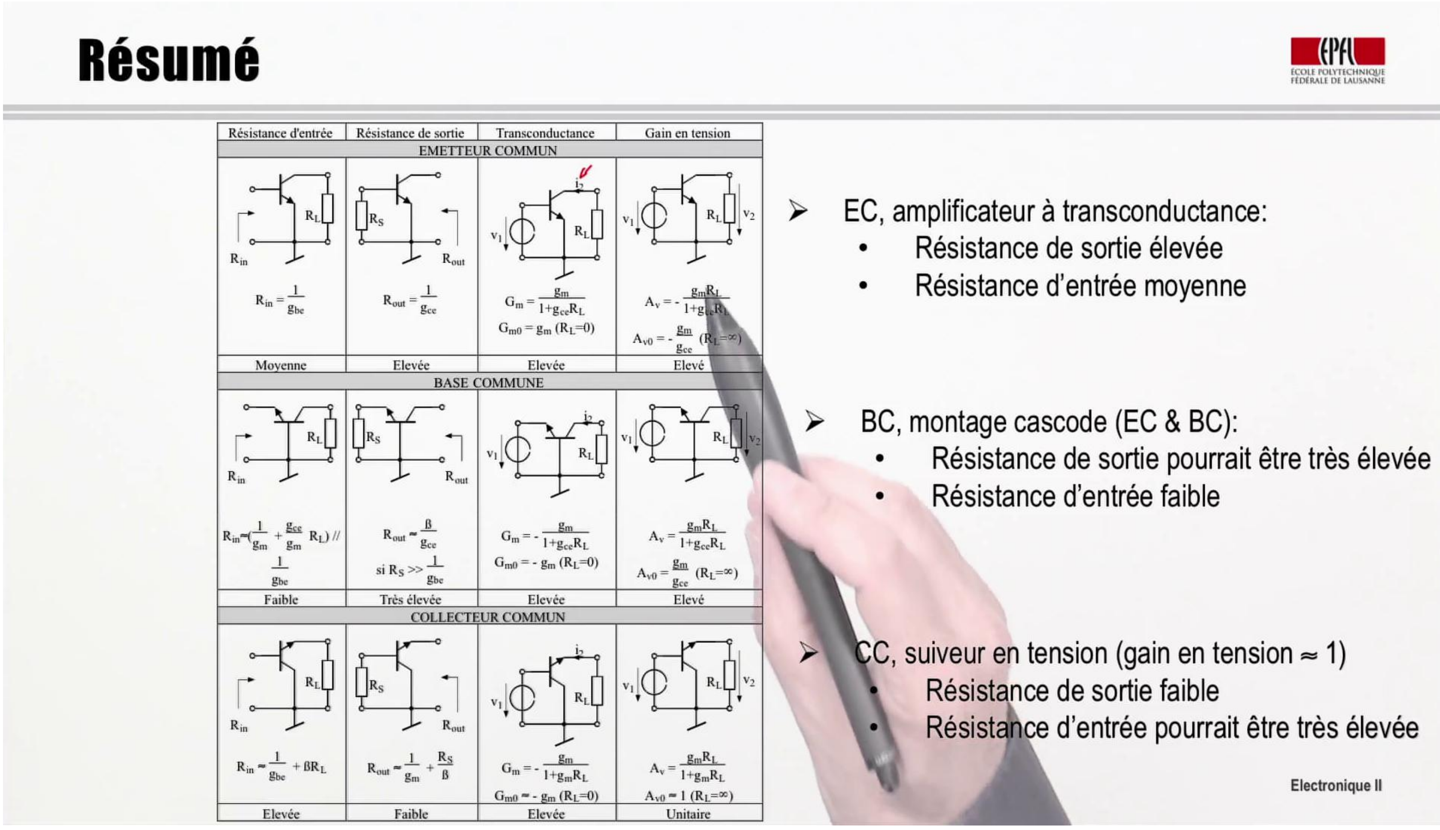


If you take for example a quadripole which has a common transmitter and you follow it with a quadripole which has a common base, look at what you get. You get an input impedance of this magnitude. You get an output impedance of this order. We said a common base when there will be a impedance before the common base source, it becomes this setup. If your output impedance is very high, the common base will give you very, very high impedance R out. We will do it as an example, at the end of this video. You will see we make gains in extreme voltage with low impedance at the input and a very high output impedance, which will be the common basis. If we take a common collector and place it behind, we can drop the output impedance. We make with this something that is not far from an operational amplifier, but you will have the opportunity to see all this.

Notes

Summary

18m 58s

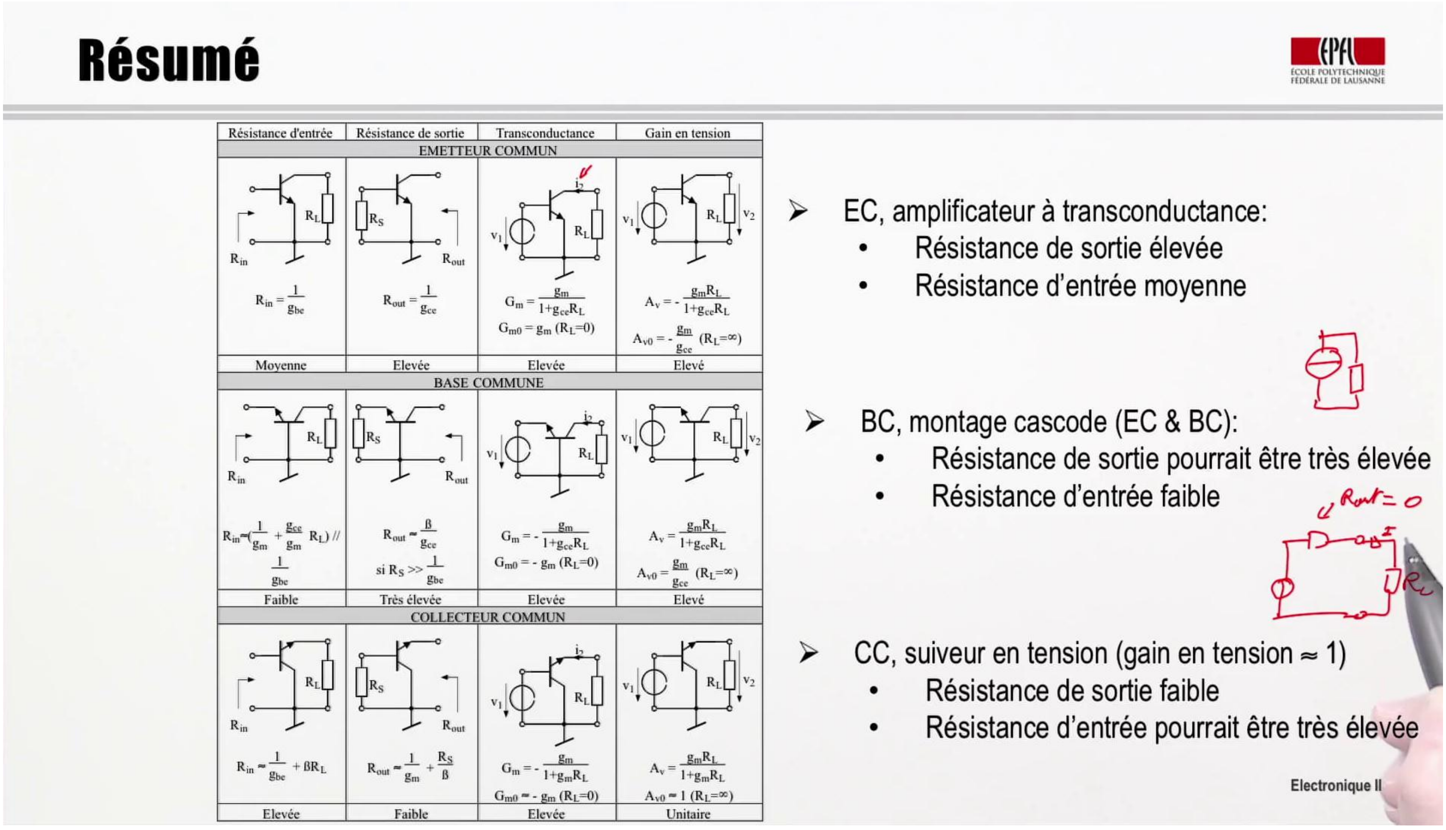


Now consider the same table and try to say, in spoken language, in French, the utility of each. If I talk of a common transmitter setup, I can say with no difficulties that it is a transconductance amplifier. This is an amplifier whose input is a voltage and whose output is a current. If I want to take a voltage to the input, make it change, take a current at the output, converting it to voltage across a resistor, I only have to take an amp transconductance. This is perfect common transmitter setup. It has a high output resistor and an average input resistance. This is what we just said. We're formulating it in spoken language, French. If I have to say the same for the common base, I write something. You will understand it right away, as soon as I have finished this part. I'll show you what is a cascode. The word cascode comes from the fact called, put in cascade a common transmitter setup followed by a common base setup. And putting the two in cascade, we called it a cascode, it is a word we inherited when we used vacuum tubes before transistors existed, when we put in cascade two setups resembling those two and we inherited this word called cascode.

Notes

Summary

20m 01s

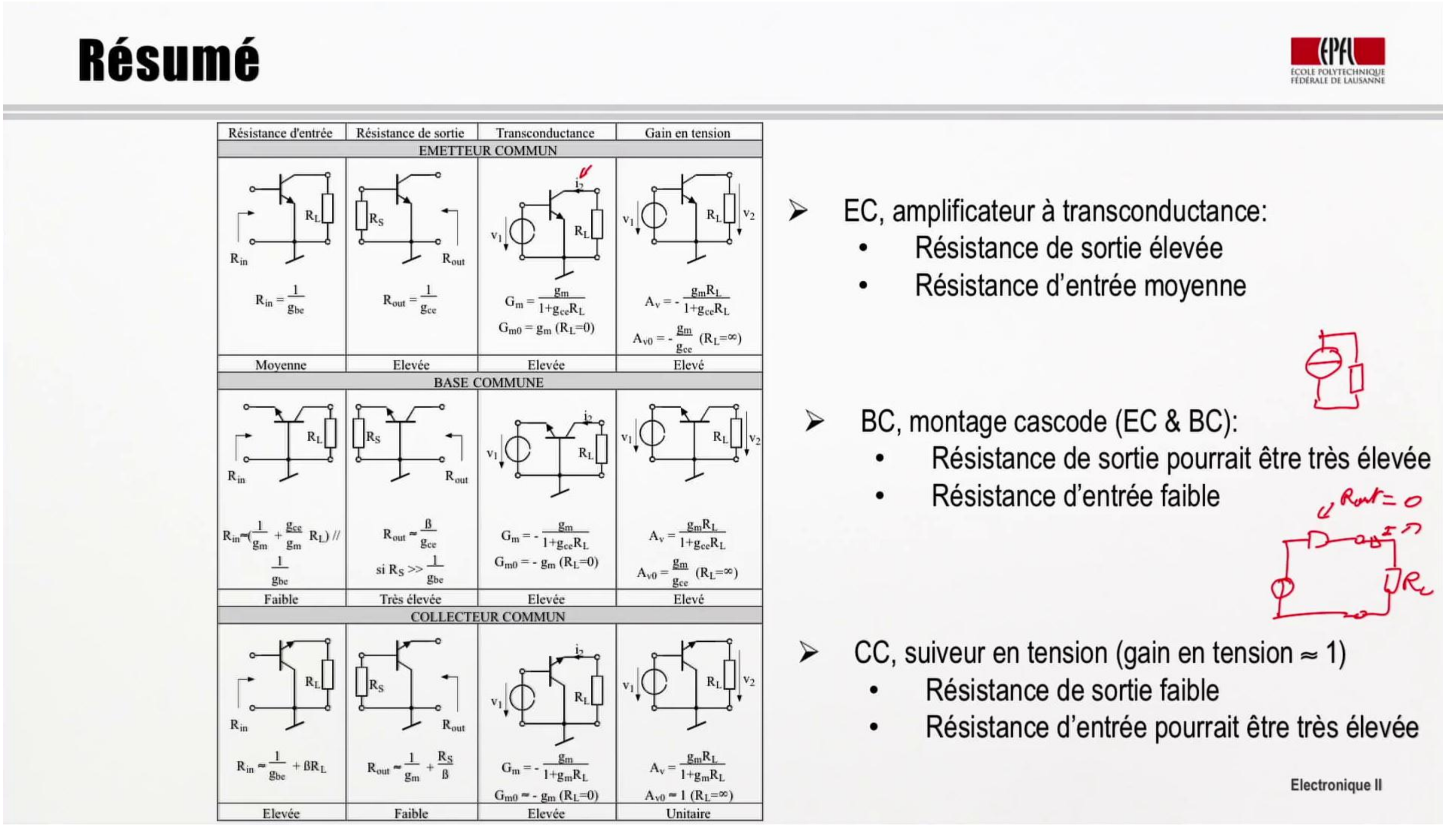


And there's going to bring us to realize output resistors that can be very high. We manage to have the biggest output resistors a setup can do and it is typical what we need when we have power sources, when we want to make the current sources we use by default this cascade, a common transmitter cascade, common collector because we want to make sources with very high output impedance, made by this setup, while having an input resistor a little low or medium which is the common transmitter setup. Then we have the common collector setup to qualify it, it is a voltage follower, it is also called a transmitter follower. It has a low output resistor this is typical of what we need when we want to make voltage outputs. If you want a voltage source, that is to say somewhere that Rout resistance is almost zero. Here you have a way to make it as low as possible and it is made by stages of the common collector style. So if you put at the end of your quadripole amplifier chain setup of a common collector style, it is as if you are putting the lowest resistance at the output and there you can draw the current in your external charge without... So I can be very high, without having a voltage drop on the internal resistance which will be high.

Notes

Summary

21m 35s

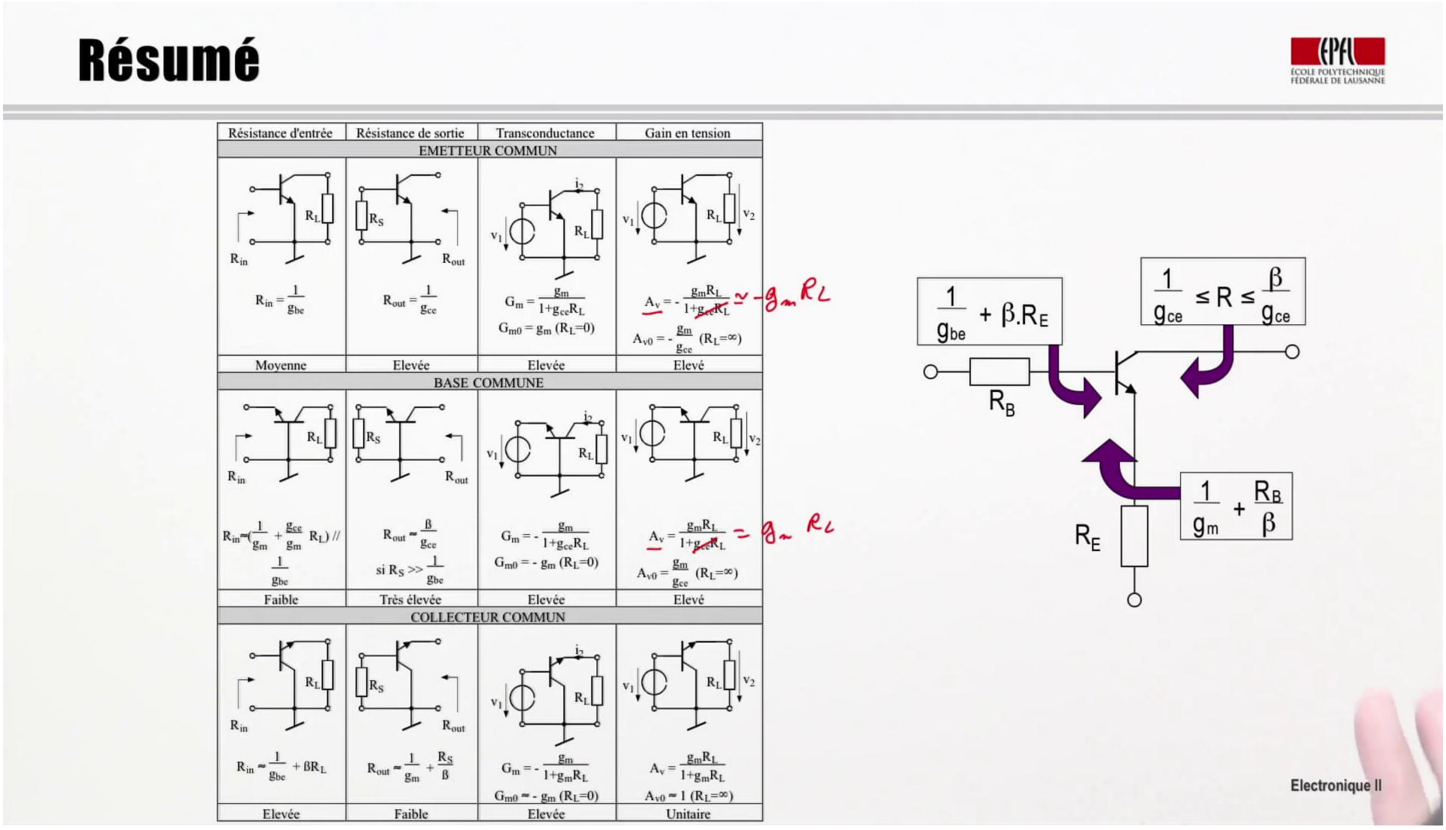


And here, the input resistance here, it could be very high. Why could it be? It depends on RI and β, that we discussed earlier. So just choose high βs.

Notes

Summary

23m 14s

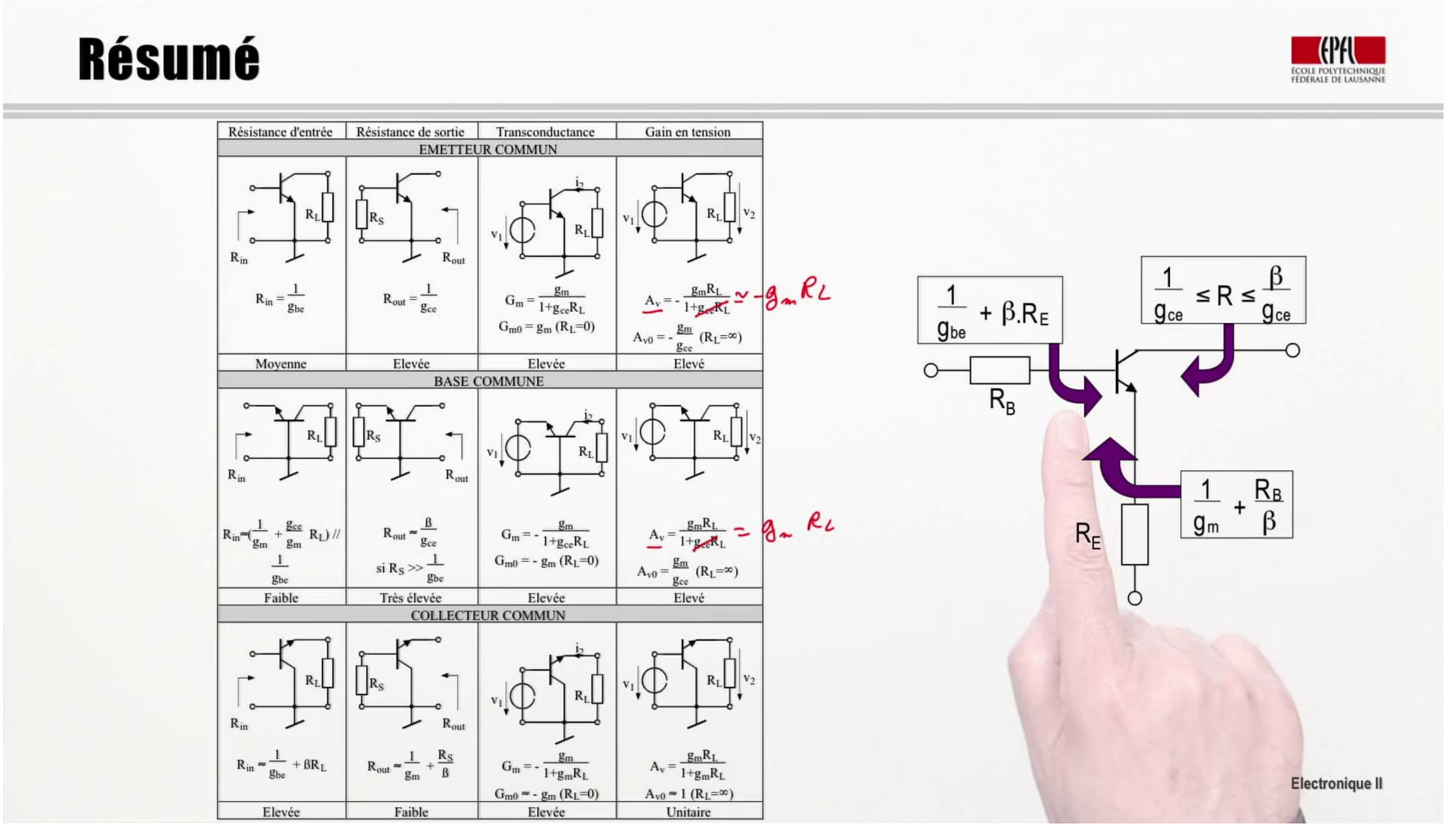


I always take the same table and i would like to show it to you presented like this. So if I have to synthesize the three columns, this column here does not serve me much because it is the same, with adifferent sign. This column, I'll keep it. What I keep here is that when I want to do a voltage gain, the expression of a voltage gain in absolute value, look at it, it is written here. There it is written as -Gm.Rl so if I approximate that Gce Rl and Gce RI is negligible compared to 1, because of Gce that is very, very low, I can immediately say that this equals -Gm.Rl and it equals + Gm.Rl. So when it comes to calculating a gain of a transistor setup whose output is charged by a low RI resistor compared to Gce, i do not hesitate a moment and write the gain equal to Gm.Rl, it's negative for a common transmitter, positive for a common base. And the third setup here, we learned that the common collector is a voltage follower. So this column we have chosen it. This column then comes down to this and this and 1. So that's easy to remember. We're left with this, this, this. And there is a summary here. And to make it very visible, and the three setups at once, we saw that the collector of the transistor is an output.

Notes

Summary

23m 28s

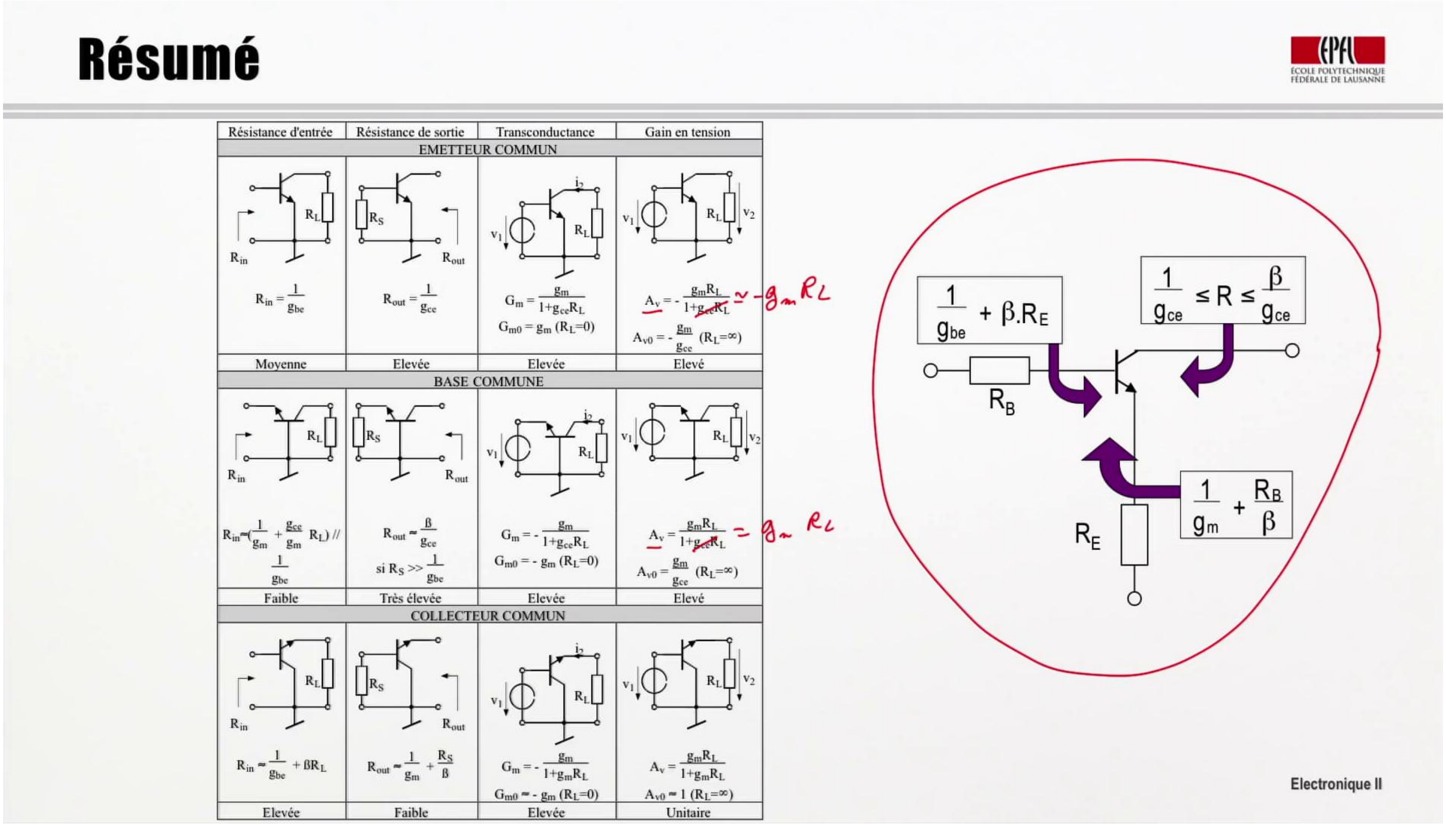


The transistor transmitter is an exit. The transistor base is an input so you can enter a transistor, one has just to vary the voltage here and observe what is happening with the current and that is based on either the common transmitter setup where I vary base transmitter or common base, I therefore vary base transmitter so we're in both cases, varying these two voltages. And here it is the supplement base transmitter so it's again varying base-transmitter in the case of the common collector. But when you look at it like that, the output impedance of a common base mounting, so I'm here, what will it depend on? It will depend on what we put as resistance of the source so it will depend on what we put in its transmitter. Look, we enter without the transmitter. So if the resistance, the output resistance here, if the resistance Re is equal to 0 so you move here to this column and you will see that in the calculations we made, detailed for the common base, the resistance it will be of the order of 1 / Gce. If now the resistance you put into the transmitter of the transistor is very high, it will tend towards β / Gce. If I want to analyze the input from the base, here or here.

Notes

Summary

25m 19s

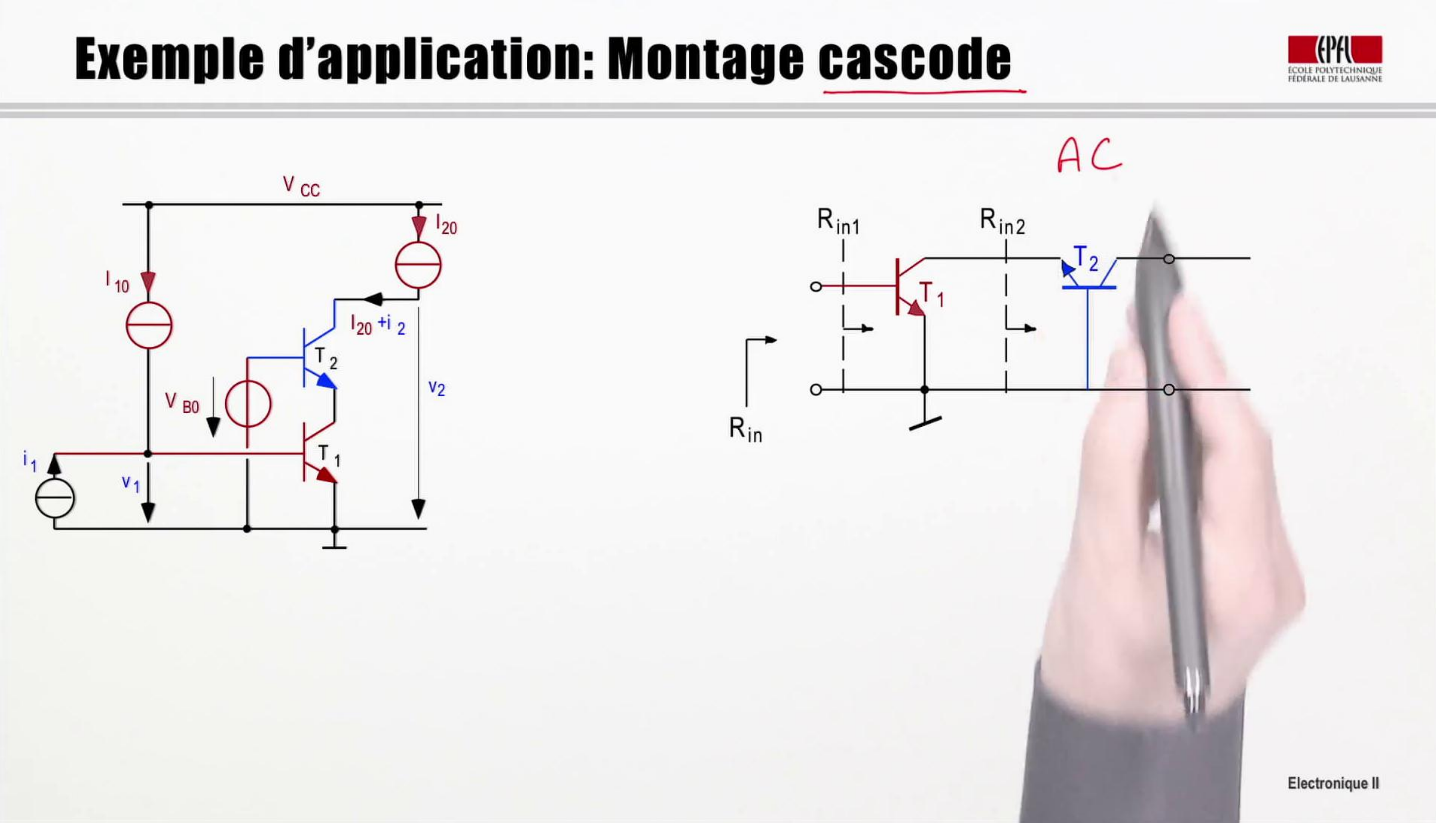


In that example the transmitter is earthed, it will show 1 / GbE + β.Re. But here Re = 0. So I think 1 / GbE, it is drawn out or it is written here. Now i just watch what happens with the common collector type setup. I enter also in the base and it will depend on what I put on Rl. RI is the resistance that is put into the transmitter of the transistor, it is here. So we see that when I look from here, it is 1 / GbE from the base c'est + β. the resistance that i put in the transmitter, is this that i see here. So i see this expression directly appear here. So if you take this way of viewing and you put it before you, practically the table here is no longer useful. You have selected this column and this column and what is here it shows you what is in these two columns. So this image, you also find it in the MOOC, i will put it so that you can put it before you, it is an excellent summary of the different input and output impedances of this kind of setups.

Notes

Summary

26m 48s

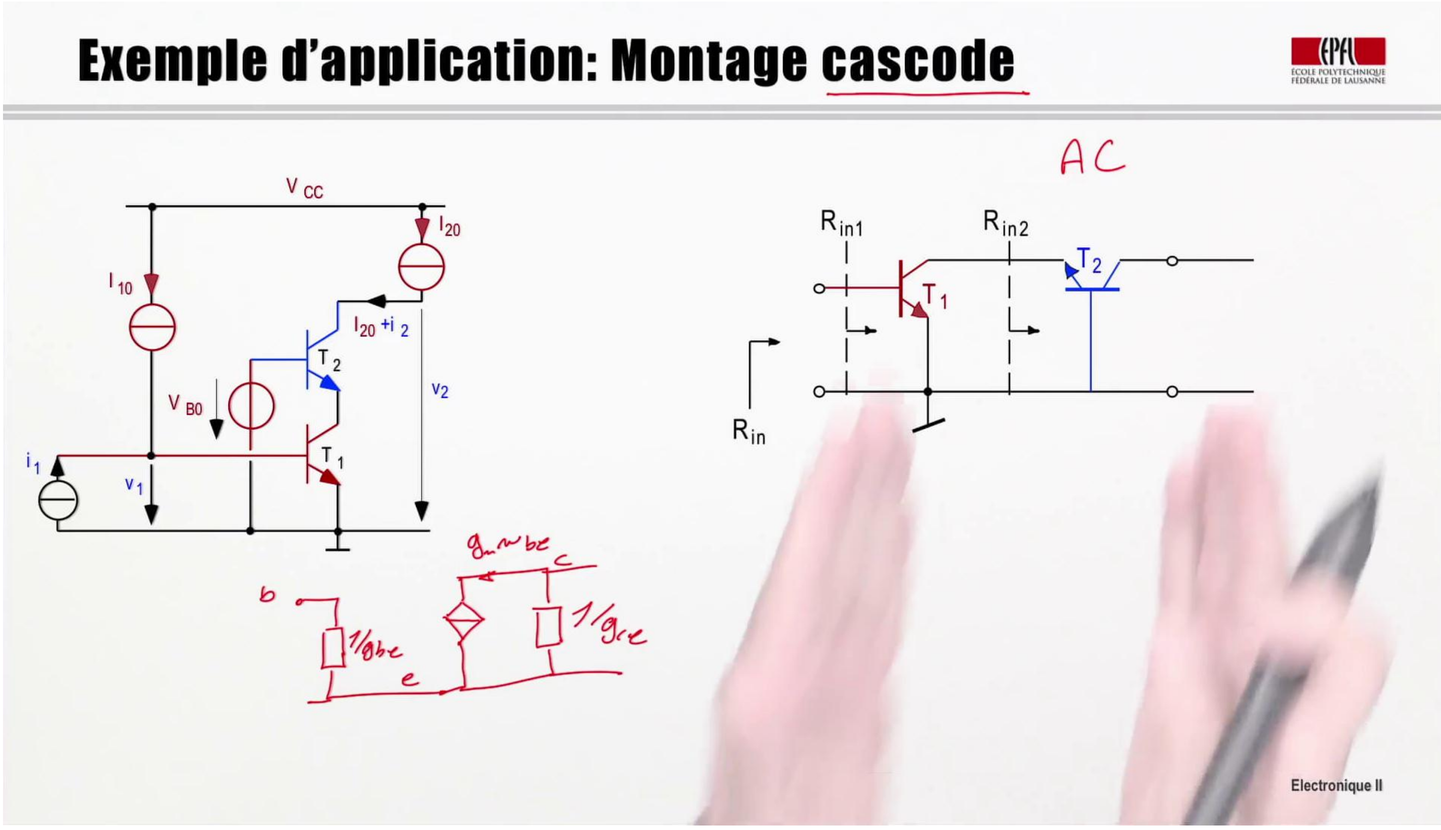


To end this week we will analyze what we'll see now with a real setup. You remember, we took the transistors and then transformed it into an equivalent diagram, a quadripole and here i will use it, i will introduce the use of a setup, called the cascode, i talked about it earlier. If you are taking a common transmitter setup, this is a common transmitter setup, the transmitter is to ground. We enter between base and transmitter, and we output a currentin the collector. I put just behind the cascade a common base setup. Therefore the base is connected to a fixed voltage, I called it Vb0. Remember that the common base notion, is a Small signal diagram,it is when the base is found connected to ground and the ground is the derivative of DV / DI and as the DV / DI is equal to 0 when one puts a voltage source, as if you're connecting the base to the earth. So this is equivalent in an AC diagram, if we make the AC equivalent of our setup this is an AC equivalent of our setup. This AC diagram means wherever i have voltage sources, i replace them with a short circuit to the ground and when i have current sources i remove them completely, and that's what i see here.

Notes

Summary

28m 01s

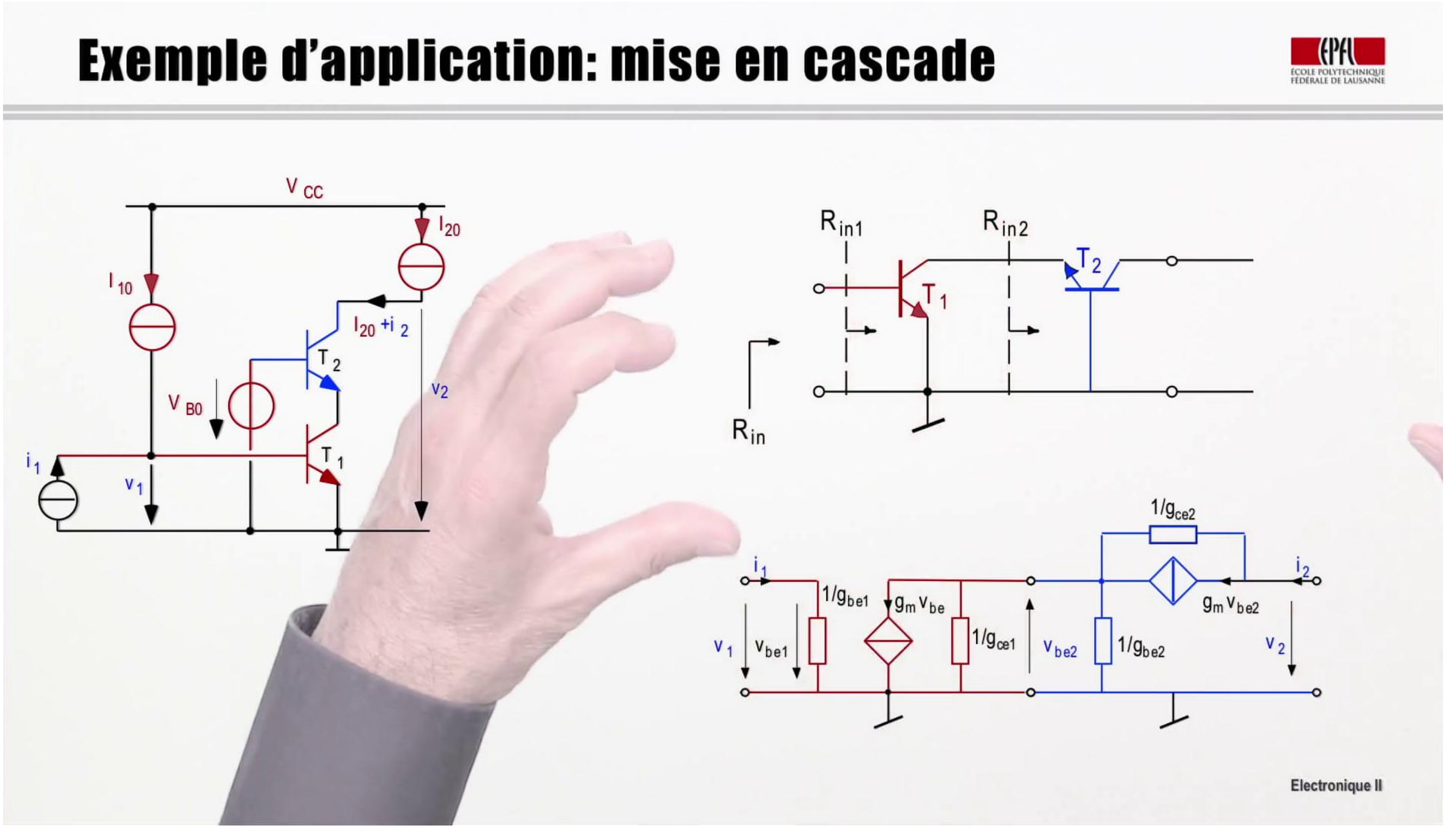


Here i have two current sources so i do not see them. Here i have my transmitter of my transistor connected to ground, i see it. i enter the transmitter of the transistor T2 and i replace the Vb0 voltage source by a short circuit connected to ground. And there i have a common transmitter and have a common base that cascades and gives me this famous cascode and we will analyze this. What methods can we do to analyze it? There is a simple method which we had started the course with, that is "the equivalent of a transistor, if i take this transistor, it would give 1 / GbE between base and transmitter, a controlled current source between collector and transmitter. And the early effect i modeled by 1 / Gce ". So it gives me 1 / Gce here and here i have a current Gm Vbe and here I have 1 / GbE as the input resistance. This the base, this is the transmitter and this is the collector of my transistor and this are the different components of this transistor. So if you take this setup and then you want to replace it here, you will have taken it and placed it as it is. If you now want to replace the common base diagram by the equivalent of this you need to put the input on the transmitter and you have to put to put this knot to ground and we output in the collector.

Notes

Summary

29m 43s

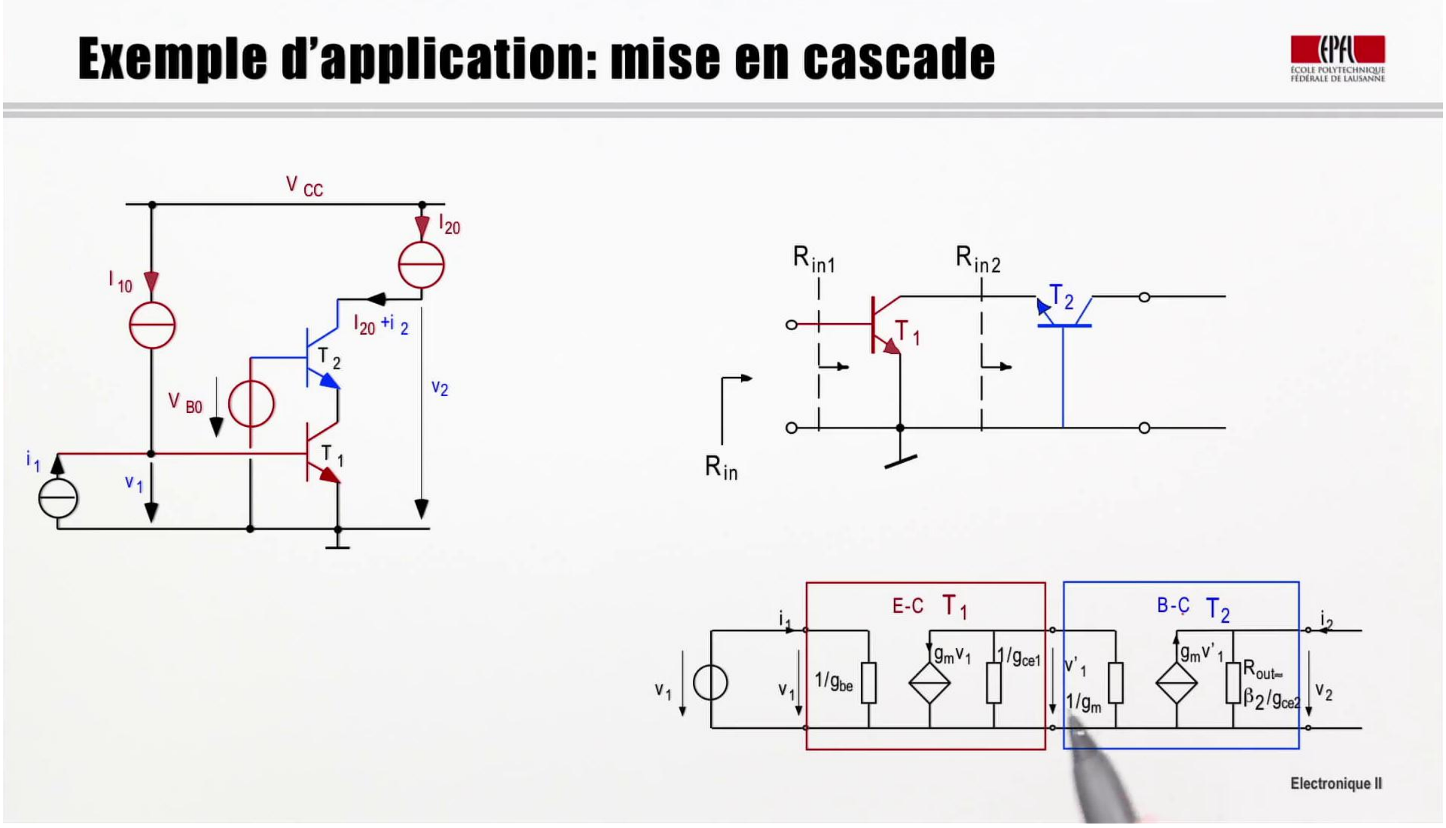


So we have to draw the small signal diagram of each of the transistors and it would give us the following. You get this diagram, so this is the real diagram, this is the model and this is the replacement of this transistor by its equivalent circuit diagram and this transistor by its equivalent circuit. And there was a diagram which we analyse by the theories of the circuit. This is a linear circuit, we has only to simplify it to find what is the input resistance, what is the output resistance and what is the gain V2 / V1 if I would want to see this as a quadripole which has an input V1, an output V2 and there is an intermediary voltage between the two, that which appears here, which is between the two. So i can spend my time doing this. You'll do it in the form of an exercise. This takes time, there is a lot of calculations to do and this is a calculation that we have already introduced how to turn this into a quadripole and this into a quadripole. And when you put the two quadripoles together we have the two quadripoles which will give us an immediate calculation and very simple because we already calculated input impedances, output impedances of each of the quadripoles.

Notes

Summary

31m 31s

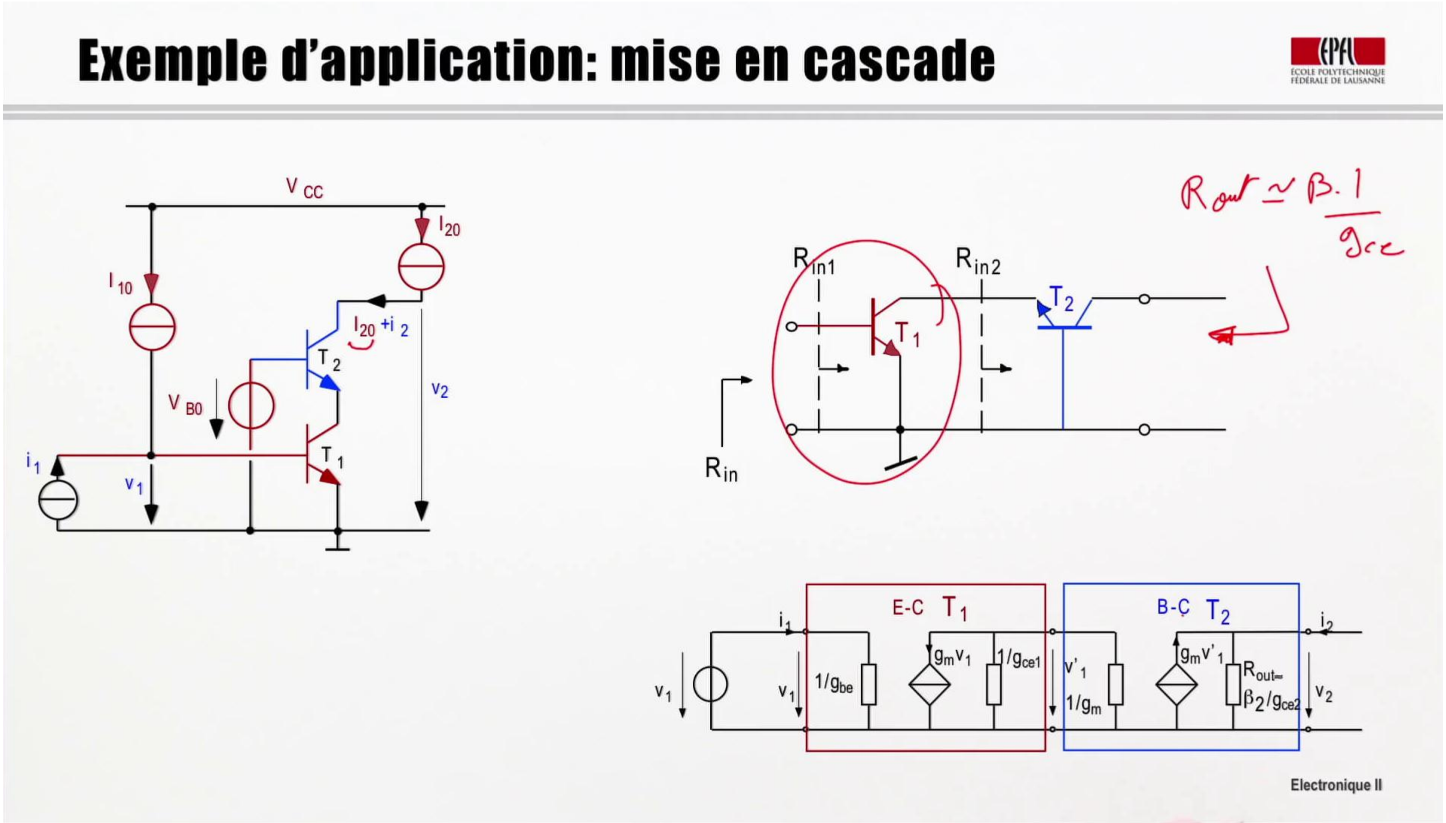


We only have to draw it this way and that's how henceforth we will address this. You just need to move from this diagram to this and after remove each and put in place what we had studied in the preceding tables. And here's the result. A first quadripole is this, it's a true copy to what is in the table. A common transmitter is a quadripole which has its input 1 / GbE as input resistor, an output resistor of 1 / Gce and a short circuited transconductance equal to Gm. A common base is a quadrupole which has an input resistance which is approximately of the order of 1 / Gm, a controlled current source, look what Gm means in this direction and -Gm So in this direction there were two current directions to qualify the quadrupole achieved with a common base setup. And here we see that the output impedance is extremely high and is β * (1 / Gce). Why does it gives the extreme value (CRA)? Because the impedance that is here, of this setup, so this setup has an output impedance of 1 / Gce.

Notes

Summary

32m 52s

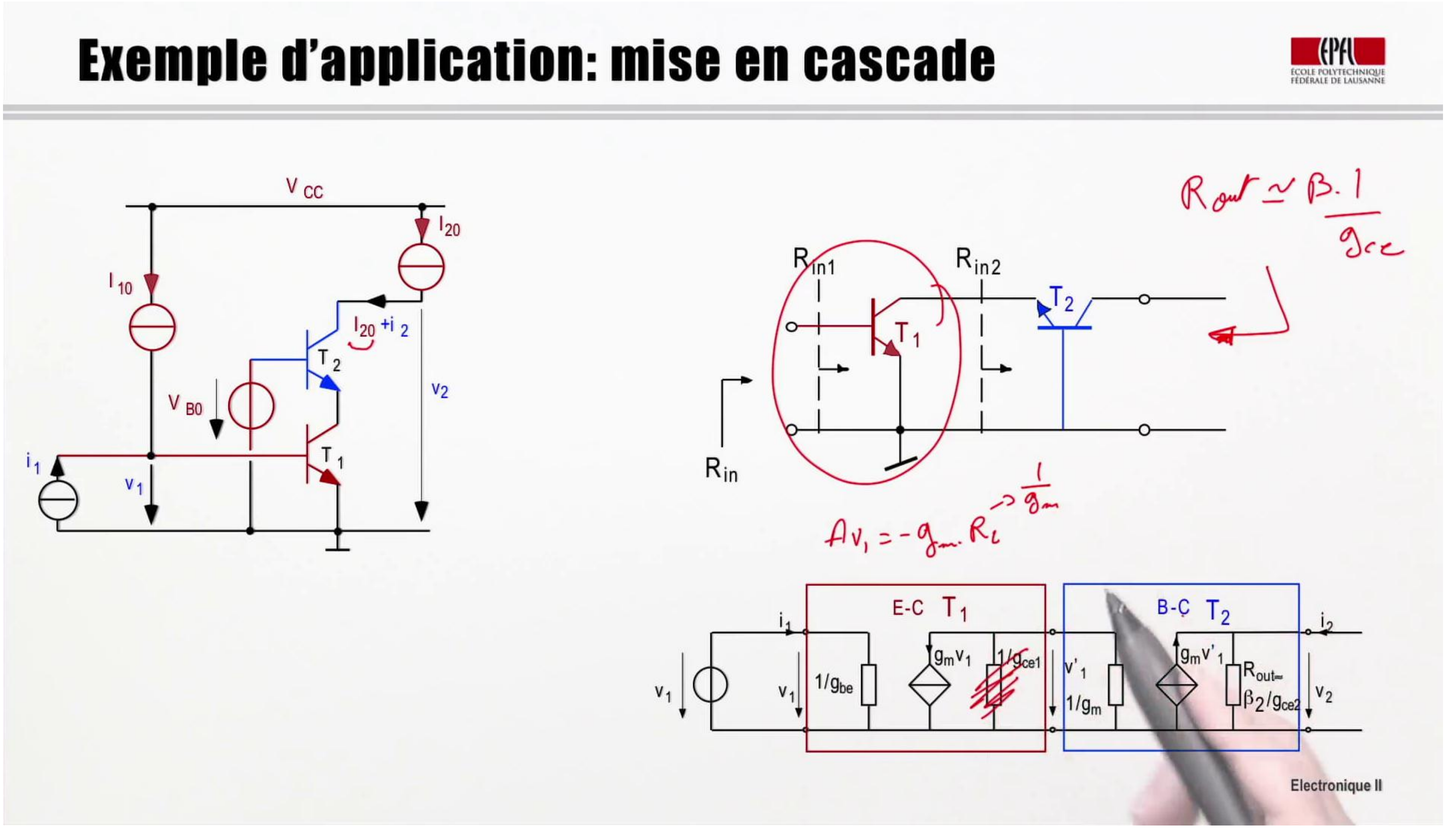


And you remember in the table we said if a common base setup encounters a voltage applied with a resistance source which is very high, which is the case here because we said that 1 / Gce is a very high resistance relative to the input impedance seen here which is 1 / Gm, which is the lowest, at this point the impedance i see from here, if you look in the table or on the drawing I made as a summary, you will see that this output impedance is of the order of magnitude of β (1 / Gce) of the transistor. Can we may say that the Gm are the same? Of course Gm are the same because it is two transistors in series, they both have the same current flowing through the base, if we neglect the base current it is the same current going through both so it's the same Gm. Are we may say that the early voltage is the same? If you choose the same transistors, you can also say that the early voltages are the same because Gce that gives about the same thing knowing that the Vce is not probably the same for both, but as a first approximation we can say even Gce of transistors are the same. So when you look at it, and I tell you "analyze this circuit." You take the table, the famous table we summarized, you saw that gain here is known, the input impedance, the output impedance of each is known.

Notes

Summary

34m 20s

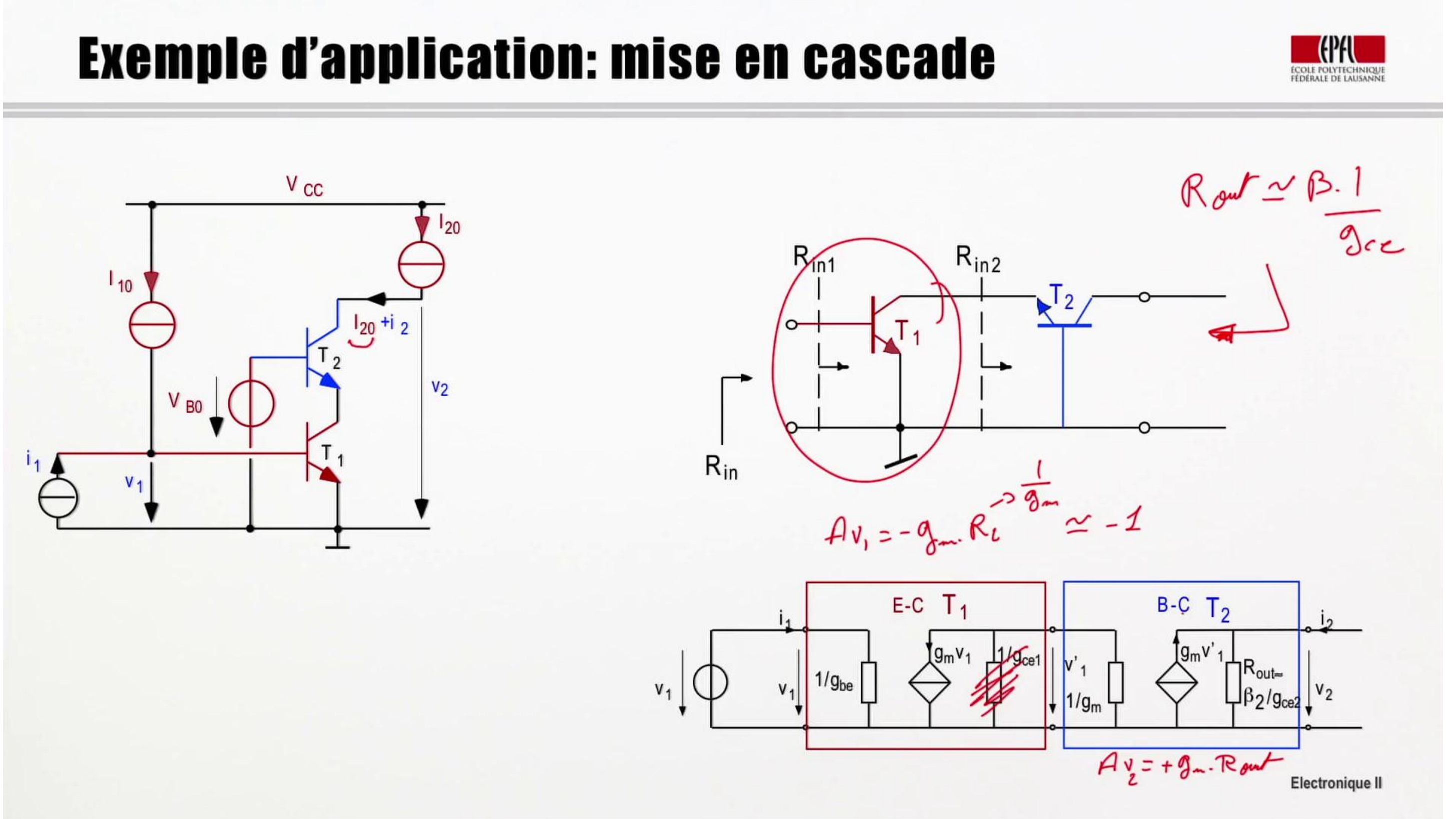


So let's do just one thing. I look when I plugged the common base behind the common transmitter, it is as if I put the input impedance of the common base quadripole in parallel with the output impedance of the common transmitter quadripole. So 1, the common base has an input resistance 1 / Gm and the common transmitter output resistance is 1 / Gce. If you remember well, this I can overlook it because 1 / Gce is a large resistance, the 1 / Gm is a small resistance. Therefore a large resistorin parallel with a small I only have to delete it. I will be left with 1 / Gm. So the common transmitter is charged by a resistor charge that is equal to 1 / Gm. You have a Gm.V1 current source that is charged by a resistance which is equal to 1 / Gm. What does it give you? It gives you a gain of this circuit to V1 = -gm times the resistance charges a common transmitter. And what is the RI resistor charge? This resistor of Rl charge is nothing more than 1 / Gm. It is the charge resistance. The source sees nothing other than 1 / Gm. So you see the tension V'1 there, compared to V1, so the gain of this circuit is Gm. (1 / Gm) therefore the gain is equal to -1.

Notes

Summary

35m 55s

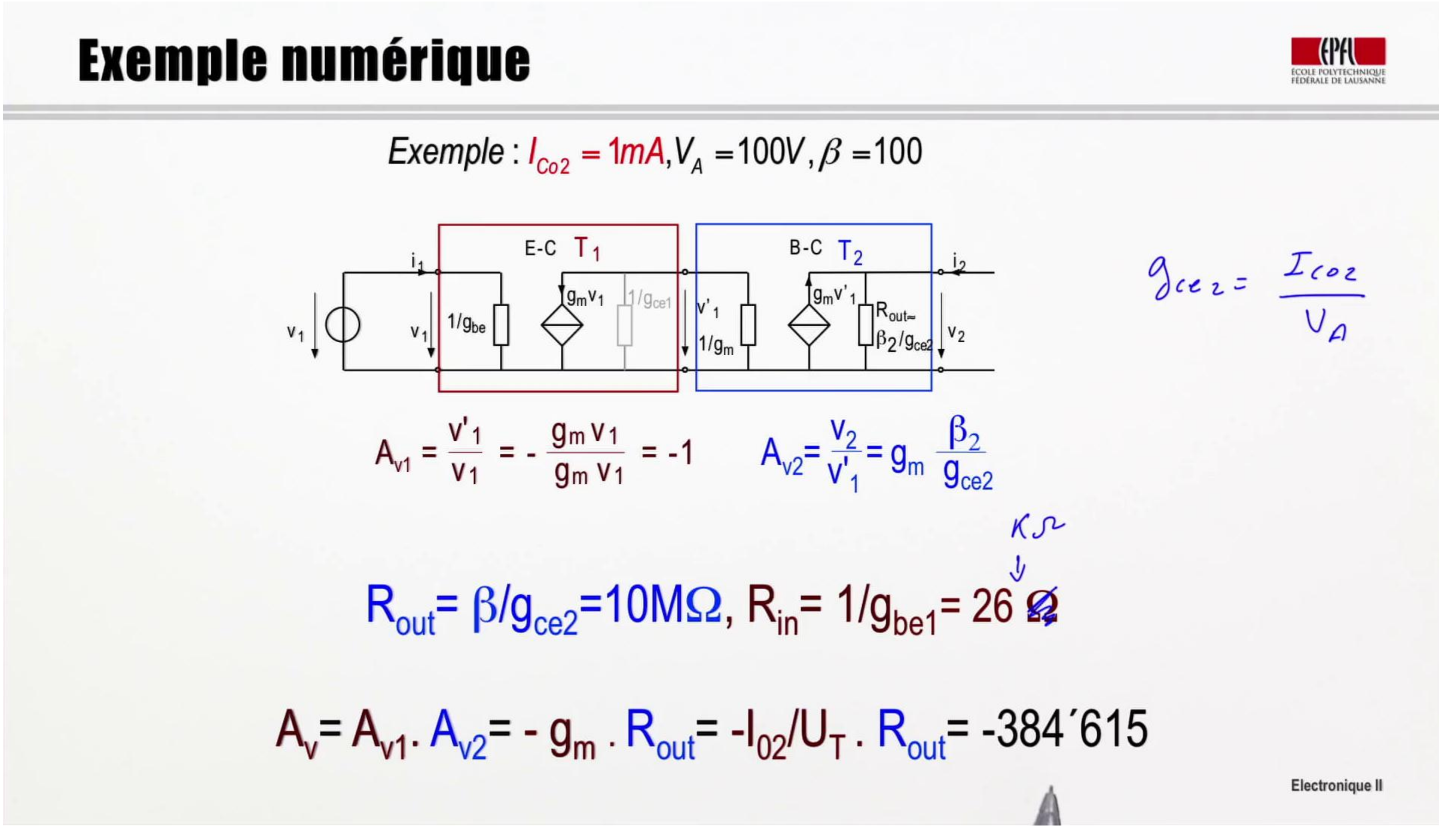


You have a common transmitter, which in this case, does not give you gain, it gives you a gain of -1. You remember the gain of a common base setup, we saw that the gain of a common base diagram, the gain here is equal to the impedance or the transconductance Gm is Gm + multiplied by the output resistance since here i charged by a current source so the resistance seen here is equal to infinity. So it becomes the intrinsic gain of this setup, that is to say it is the Gm multiplied by its output resistance R out. And the output resistance is β.Gce2. So this is the gain of the stage 2. If you multiply this gain times this gain it gives you the gain of the set and immediately we were able to calculate that the overall gain is therefore -1.GmR out so it is -GmR out. This is the same as a common transmitter, put aside that the output impedance we will calculate it because R out, that you will see, is the output impedance of a common base which is extremely high and that, that will give us a very, very high gain and it is one of the advantages of this kind of setup called the cascode.

Notes

Summary

37m 33s

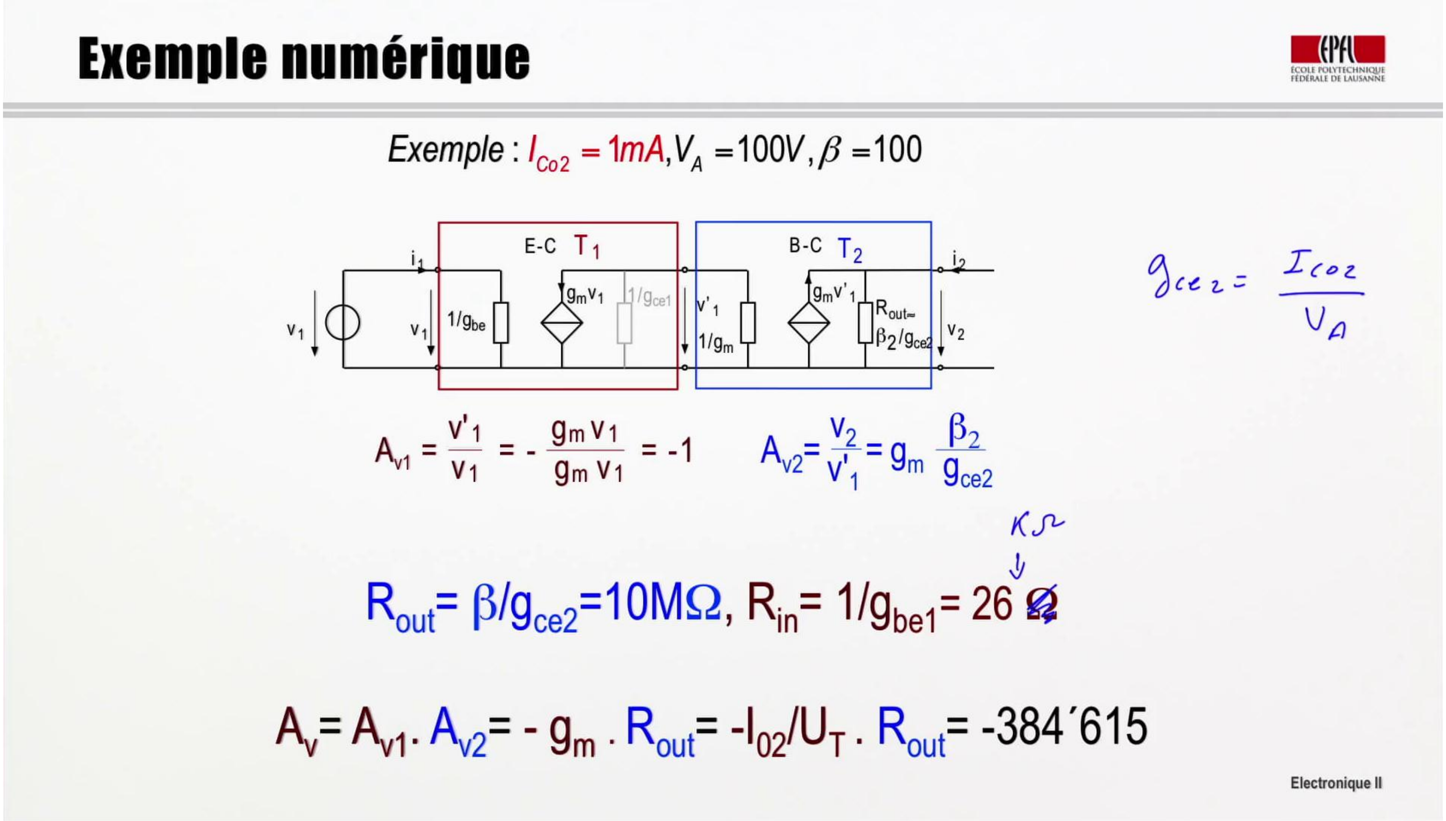


I take the example with a polarization of 1mA and I use the same transistor for both. I redo the same diagram as earlier and i draw the output resistance of the common transmitter that comes in parallel with the common base input resistance, practically invisible to say that it is this that dominates. So that we redo the same calculation. The ratio of V'1 / V1 is GmV1 / GmV1 that gives you -1 Because of this 1 / Gm. The second is Gm + times output resistance of the common base. All this is in your table and it is β2 / Gce2. And I put the numerical values. I take the β here, I take the IC0 / Ua. So the Gce2... So this is just to remind you that the Gce2 equals IC02 / Va. So Va it is 100V, so it gives you the Gce2 you multiply by the β to find R out. You find that it is equal to 10MΩ, which is huge. And the input impedance of a common base transmitter setup is... Here there is an error. The resistance is of kΩ. So that's kΩ, it is not Ω. So it is the order of the magnitude of 26kΩ, it is the resistance that I see here. And I multiply both gains using the digital values I own and watch. I get a gain of 384,615, it's amazing, it's an almost infinite gain and this is very high gains.

Notes

Summary

39m 02s



And if you remember when we said that an operational amplifier has an open loop an infinite gain, it is achieved through setups of this style then putting a current source here, and this we will learn later, is that if you put a source here you are getting extremely high gains. Finally this week, we saw setups or rather the three basic setups: common transmitter, common base and common collector. We gave each of them a qualification in terms of input impedance and output impedance and gain. And showed a concrete example where we took a common transmitter, it was followed by a common base setup. We could have very well put a common collector setup to show that we keep with it an extremely high gain because this is what we demonstrated that the common transmitter, common base gave us a very high gain. All you need is to plug a common collector behind and that's it you have an almost operational amplifier whose input impedance is average, the output impedance will be low and the gain is very high. And we saw that has to do Lego between the three setups, it depends how we put them in which order to get linear functions and it is what we're going to do the rest of this course.

Notes

Summary

41m 03s