Basics of Noise and Its Measurements
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Lecture – 22
Microphone Sensitivity

Hello again, welcome to Basics of Noise and its Measurements. We have been discussing about different types of microphones, and now we will move to the next stage in our discussion, and we will introduce one very important parameter known as microphone sensitivity, because the understanding of this particular parameter will help us make intelligent judgements about whether a microphone needs or not. So, that is what we are going to talk about in this particular lecture and the theme will be microphone sensitivity.

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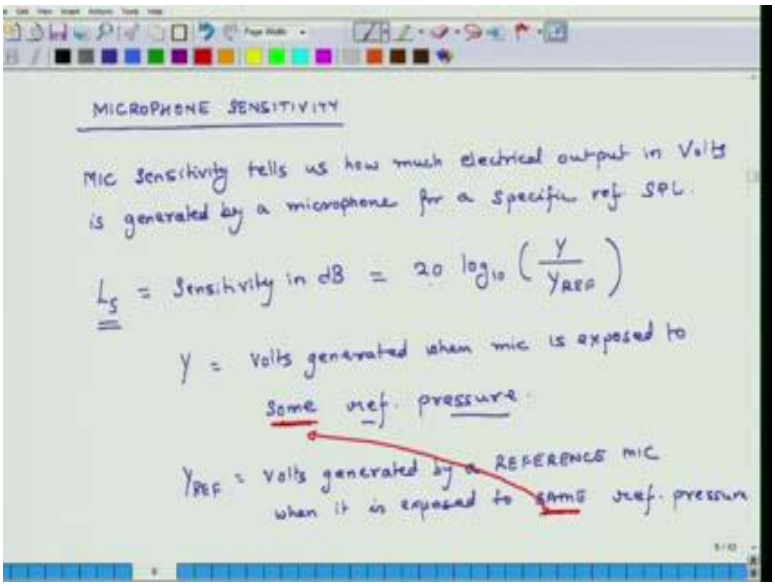

What is microphone sensitivity? It is essentially a quantitative number, through which we can say how sensitive a microphone is, in terms of sensing the noise, which it is suppose to sense. So, I will define that MIC sensitivity tells us how much electrical output in Volts is generated by a microphone for a specific reference SPL. That is what microphone sensitivity tells us. Suppose, I have a reference SPL of 1 pascals and there is 1 microphone which produces of 1 volt of electrical signal, and there is another

microphone which is producing 3 volts of electrical signal, then the second microphone is 3 times more sensitive than the first 1 . So, that is what it means.

Now, the units of this particular parameter are also in decibels and we will define it. So, LS is the sensitivity of microphone in decibels, and that is equal to 20 log of 10 and that divided by y divided by y REF. Then I will explain these parameters. So, LS is the value of this sensitivity which I will calculate using this formula, and that sensitivity is prescribed in decibels. So, the units are decibels and that is nothing, but 20 log of 10 of y over y REF. Now, y is equal to volts generated when mic is exposed to some please remember I am using this term called some reference pressure.

Now, when we were defining some pressure level in decibels our reference pressure was 20 micro pascals, the same reference pressure is not here. Here, we use something different. We will tell you what that is, but it is not 20 micro pascals. Then, y REF is equal to volts generated by a reference microphone, when it is exposed to same. So, this same reference pressure, this pressure and this pressure, they are same. Volts generated by reference microphone when it is exposed, and this reference microphone need not be a real microphone. We can just imagine something. So, we will continue this further. Now, typically, this reference microphone is some imaginary microphone.

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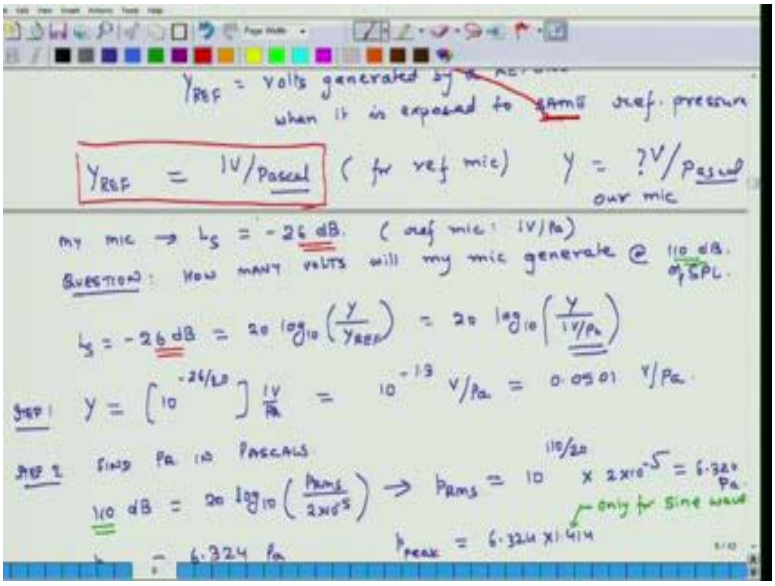

Y REF is typically, in 1 set off cases it is 1 volt per pascal. What does this mean that, if you have your reference microphone, which is its imaginary microphone, you expose it to 1 pascal of pressure it will generate 1 volts. So, our sensitivity of our microphone which we want to calibrate is being measured with respect to this reference microphone. Which is an imaginary microphone; which may not exist, but its own sensitivity is 1 volt per pascal. In a lot of cases it is 1 volt per pascal, in some cases it is a different number we will talk about that also. So, y REF is 1 volt for pascal and this is for reference microphone, and then if that is the case then y will be some volts per pascal and that will be for our microphone. That is what we are interested in. So, this is how many volts we do not know. So, that is why I put a question mark here, some volts per microphone.

Now, I will give you an example. So, that you understand it better. So, let us say that I have microphone.

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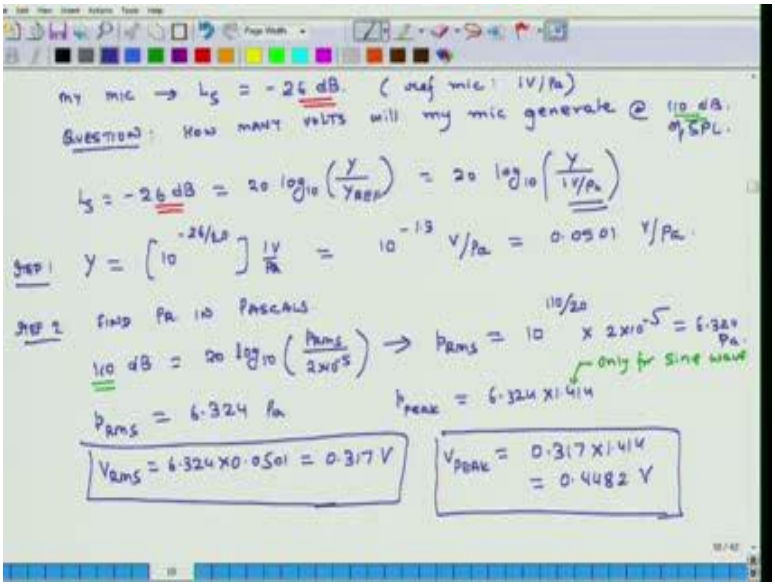

So, this is my microphone, and its sensitivity LS is minus 26 decibels. Suppose its sensitivity is minus 26 decibels, and the reference microphone is reference microphone. I should always mention, what is reference microphone? Reference microphone is giving me 1 volt per pascal. Then question; how many volts will my mic generate at 110 decibels of sound of SPL or sound pressure level. So, I want to know that if I am having

this microphone in ear, and it is measuring noise at 110 decibels then what is going to be the voltage which will generate by this microphone.

So, we will do this. So, first LS equals minus 26 dB, this dB is same as this one. This is not 110 decibels. So, that is equals 20 log of 10 y divided by y REF and the value of y ref is 1 volt per pascal. So, this is equal to 1 volt per pascal. So, I have to calculate first y. So, y equals 10 to the power of minus 26 divided by 20 into 1 volt per pascal. This is 1 volt per pascal and that equals 10 to the power of minus 1.3 volts per pascal. If I do the calculations I get 0.0501 volts per pascal. So, what does this tell me; that if I have this reference with respect to reference microphone, my mic microphone is 26 decibels less sensitive. So, the reference microphone will produce 1 volt for each pascal, my microphone is going to produce 0.0501 volts per pascal. This is what it means.

Now, with this sensitivity I am going to calculate how much volts it will generate when it is subjected to 110 decibels of sound pressure level. So, this is step 1, and then step 2. Find pressure in pascals. So, I know that 110 dB is equal to 20 log 10 and here, this 110 decibels is coming from here p rms divided by reference pressure 2 into 10 to the power of minus 5. So, if I do all this what I get is p rms is equal to 10 to the power of 110 divided by 20 into 2 into 10 to the power of minus 5 and that equals 6.324 pascals. So, p rms equals 6.324 pascals and p peak, see because we had discussed earlier that rms is not same as p, the peak will be higher and if peak is and if this signal is sinusoidal in nature. So, I am going to then it will be 6.324 into 1.414 this is only for sin wave, for other waves this number will has to be different. So, we have to remember this. So, this equals so any way you can calculate this 6.324 times 1.414.

So, then V rms which my microphone will generate will be 6.324 into 0.0501 this equals 0.317 volts. V peak equals 0.317 into 1.414 equals 0.4482 volts. So, this is how we calculate how much voltage my microphone will generate. Now, I had mentioned earlier; that in all this calculation, our reference value of y was 1 volt per pascal and this is the reference value used in a good number of microphones. This is a fairly industry a fair early industries standard value 1 volt per pascal, but there are some microphones we do not use this value and there they use a different reference value.

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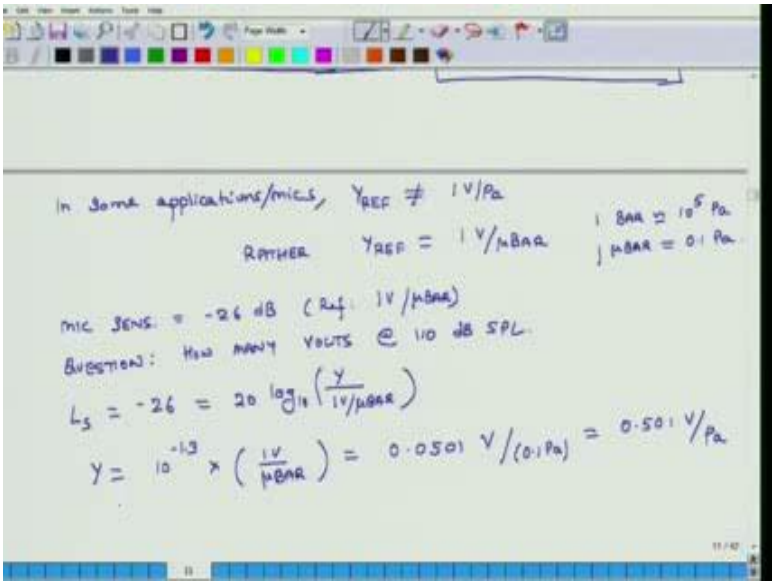

So, in some mics y REF is not equal to 1 volt per pascal rather y REF equals 1 volt per micro BAR. 1 volt for 1 micro BAR. Now what is 1 BAR? 1 BAR is approximately equal to 10 to the power of 5 pascals. So, 1 micro BAR is equal to 0.1 pascals. So, we will do the calculation again, example; 1 micro BAR. So, if you have this reference value of y then, if the microphone is having same sensitivity; then, the amount of voltage with it will generate it will be different. It will be actually 10 times larger. So, we will do that example and just confirm it.

Here, mic sensitivity, in earlier case was minus 26 decibels and instead of reference value of y reference is 1 volt per micro BAR and then the question is, how many volts at 110 dB SPL. So, we will just do this calculation once again. So, in this case LS equals minus 26 equals 20 log of 10 y divided by 1 volt per micro BAR. So, my value of y equals 10 to the power of minus 1.3 into 1 volt per micro BAR and that is equal to how much 0.0501 volts per micro BAR or I can calculate it as for. So, many volts for 0.1 pascals or I can write it as 0.501 volts per pascals. So, now with this calibration the value of, if I do the whole math again, I would calculate it.

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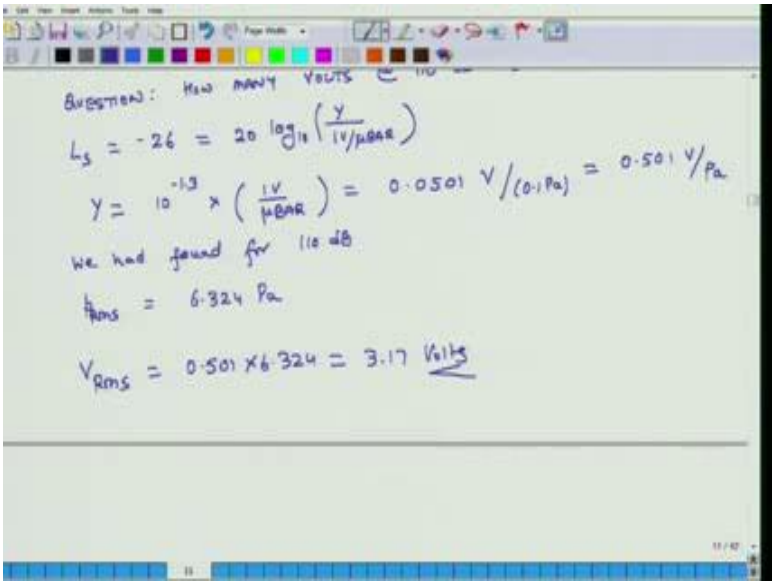

Now, we had earlier calculated found for 110 decimal p rms was how much 0.316 volts. Then v rms will be it is 6.324 pascals. So, v rms will be equal to 0.501 times 6.324 and that equals 3.17 volts.

So, using this we can again found the value of how many volts my microphone is going to generate, but the point what I try to make in this elastration was, that it is extremely important that we remember, what is the reference value of y for the microphone because the supplier may have given us a calibration that how its sensitivity is minus 40 decibels. But, before we convert that into voltage, we should remember that, what is the reference value of y which he used while giving us that sensitivity value because if we do not know that then we may be totally of in our calculation of how many voltages it is going to my microphone is going to generate for a given value of sound pressure level. So, that is important to understand and once we know that then we can fairly straight forwardly compute, how many volts my microphone is going to generate for how much pressure of sound. So, that concludes my, this lecture and we will continue this discussion in the next lecture as well and till then.

Thank you and have a great day. Bye.