Fundamentals of Power Electronics
Prof. L. Umanand
Department of Electronics Systems Engineering
Indian Institute of Science, Bengaluru

Lecture – 28
Power factor for rectifier cap filter

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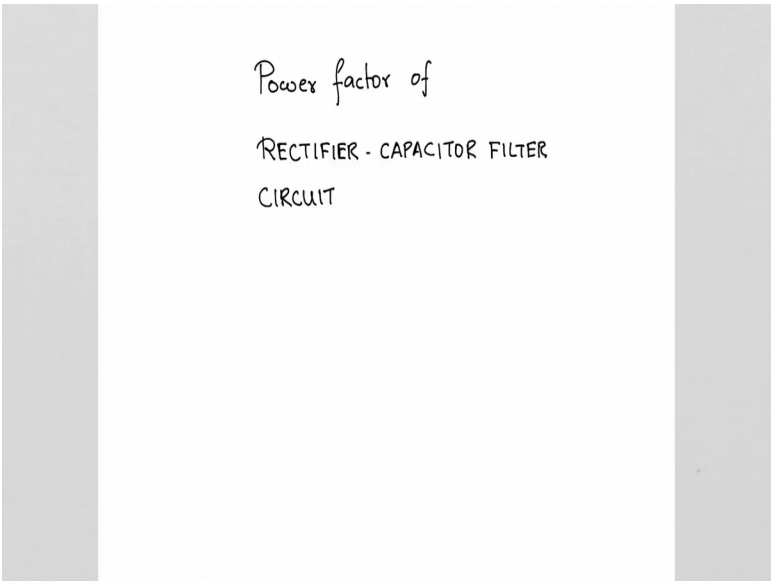

Let us now find the power factor of a rectifier capacitor filter circuit, only by looking at or only by using the measure voltage and the current wave shape on an oscilloscope.

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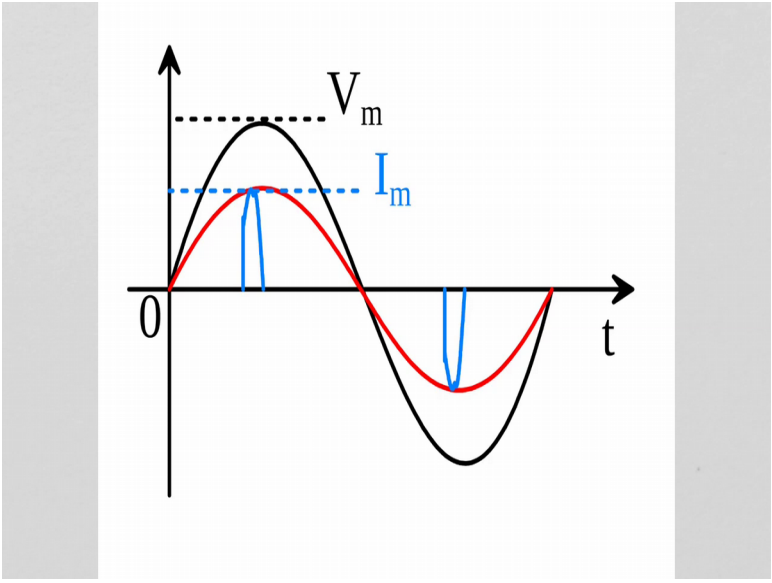

So, let us say we have an oscillogram with the x axis the time axis and let us put a voltage wave shape. The voltage the input voltage to the rectifier capacitor filter is a sine wave because we are taking it from the AC source and it has a peak maximum amplitude of V m. Superpose the typical capacitor, rectifier capacitor filter input current wave shape which is like that and this is familiar to us, we have this here.

Now, the peak value, what is the peak value? This is the peak value I m, ok. Now, if you want to compare it with the resistor a pure resistor, a pure resistor will be having the same wave shape as the voltage and you will adjust the resistor value such that the peak of that current should be same as this I m, like this.

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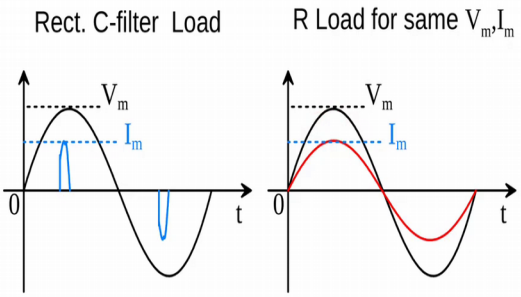

So, we have two sides, one is the unknown rectifier capacitor filter load the other one is the benchmarking R load, pure R load. Voltage wave shape V m, and voltage wave shape V m same for both R. The capacitor filter load measured on the oscilloscope gives an I m which is this value, use that same I m and draw the resistor current wave shape like this having the same I m magnitude and having the same wave shape as that of the voltage, then it is a pure resistance.

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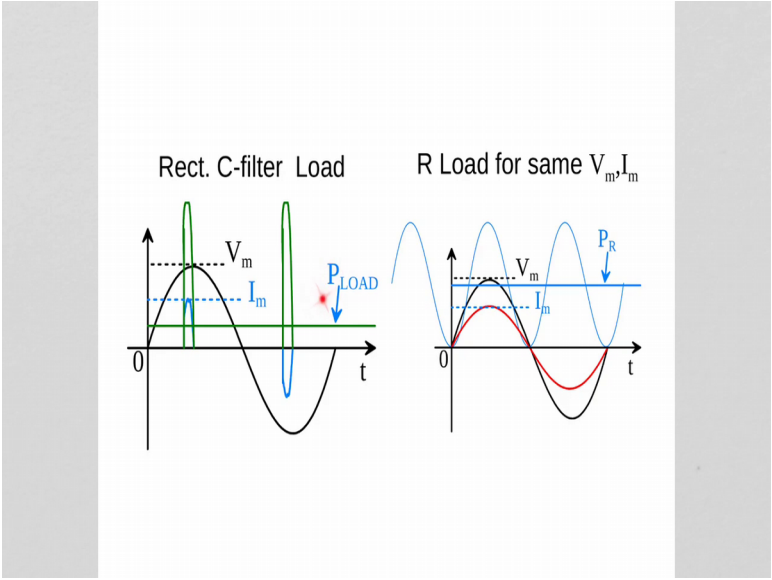

Now, the power, multiply the instantaneous values of the current and the instantaneous value of the voltage for a given time point and place the power points. So, for the resistive load we have seen that this is the power curve instantaneous power curve and for the rectifier C-filter this is the power curve because the currents do not flow on any other periods of time so power is 0 the power is going to flow only during the period of the time when the diodes are conducting and there is a current flow.

Now, compute the average the average in the case of the C-filters P load or P naught or V naught into I naught, DC output is DC and therefore, easy to compute P load this is the average. In the case of the R load we know that P R is V m I m by 2.

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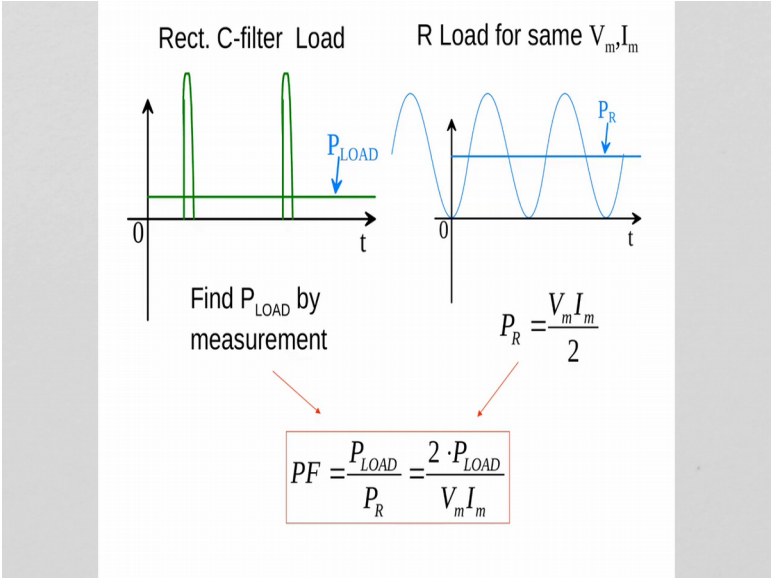

So, let us remove the voltage and current and retain only the power wave shapes with the averages move up the wave shape a way bit and then we know this is V m I m by 2. How do you find P load? As I told you P load can be found from the output wave shape the capacitor filter, V naught is a DC, I naught is a DC, V naught into I naught will be the average power or you could on the oscilloscope compute the instantaneous; if you want to include the ripple if the ripple is not negligible. Compute the instantaneous value of I and P, I and V and find the value of P and then average it. I will I will just let you know how to do that just few moments later.

So, we can find that of course, by measurement on the oscilloscope. So, P load can be found out. And once you know that combine these two PF is P load by P R, so which is two P load by V m I m. So, this would be the power factor equation for the rectifier C-filter.

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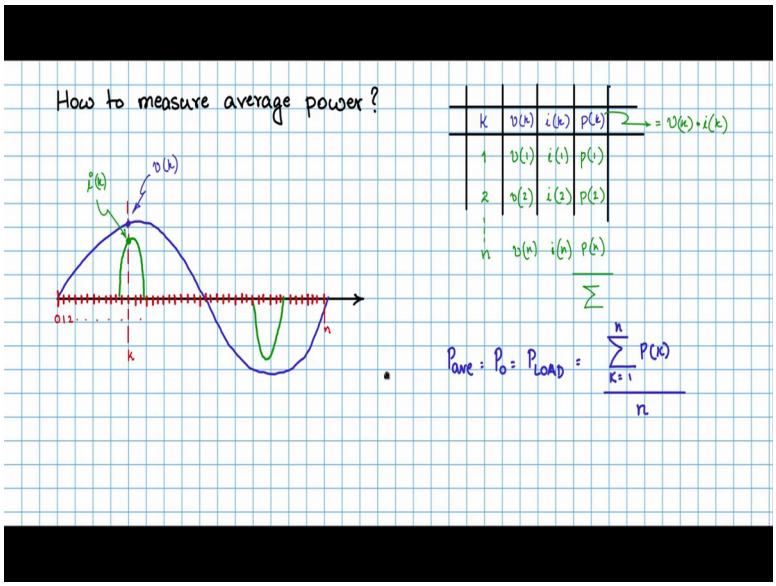

Let me now briefly tell you how to measure average power. So, that you can measure P naught or P load from the oscillogram and use it for computing the power factor.

Now, consider that this is an oscillogram you have the voltage wave shape and you have the current wave shape. The inputs of your diode rectifier capacitor filter circuit. Now, you mark points tick points tick marks along the x axis the time axis and number each of the tick point 0, 1, 2, 3, so on till you have n. Now, at any point k at the k'th tick point if you take this point on the voltage curve, you will get them value of voltage and that point kth point we call it as v k and if you measure the value of current I at that point it will be I k at time instant k. Like that you have to measure for every time instant and tabulate. So, let us make a tabulation.

Let us say you have one column for k, one column for v k, one column for i k another column for p k, where p k is the product of these two columns, v k into i k this is the instantaneous power. So, for the first point correspondingly take the i and the v value, v 1 i 1, in this case i 1 would be 0 p k, second value v 2 i 2 and you will get p 2 so on, for the nth value v n into v n i n and p n which is v n into i n, then take the sigma of the power columns.

The P average or P naught or P load is equal to sigma of all this sum it up sigma of P k, k is equal to 1 to n divide by number of samples which is n. This will give you the average power directly from measured wave shape on the oscilloscope. This P load value you

plug it into the power factor formula equation to get the power factor for the rectifier capacitor filter circuit.