Fundamentals of Power Electronics
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Lecture - 18
Inrush current limiting – Resister solution

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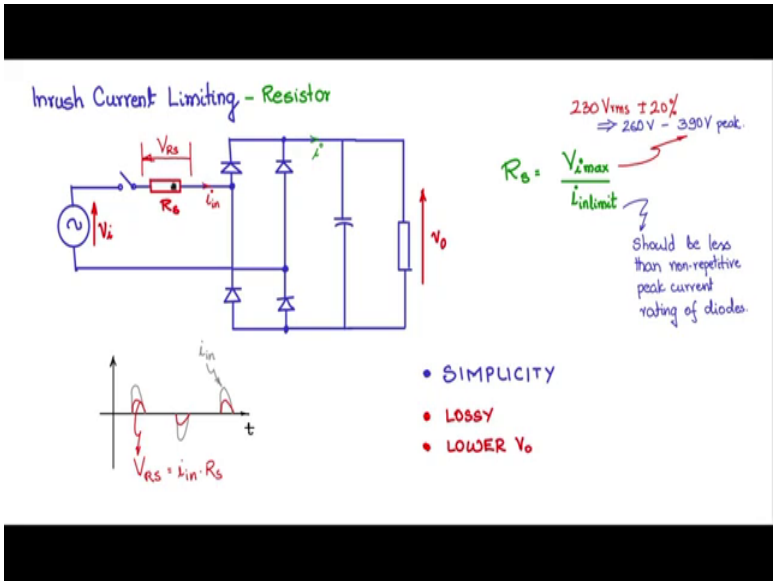

This simpler solution for inrush current limiting problem is by putting a resistor. As we saw in the simulation putting a resistor will definitely limit the inrush current. So, let us put the resister around this place here rather shift it out and then include a resistance like this. So, this will be the surge limiting resistance R S.

So, how to find the value of R S? So, R S will be V i minus V c, V c you consider it as 0 worst case condition and at startup V i max. So, let us say V i max divided by R S will be the inrush current limit. So, therefore, V i max divided by in limit, limiting value. So, this value can be obtained from see while doing the steady state analysis and steady state design you would have chosen the diode from the data sheets to the diode, you will get the non repetitive peak current rating of the diode and it should be less than that peak current rating of the diode; non-repetitive peak current rating.

So, once you have selected a diode let us say it has a non-repetitive peak current of let us say 50 amps then you can choose inlimit at around 45 amps or even 50 amps so that you are within the safe limits during the steady state operation.

Now, with respect to V i what to choose see the input voltage is to 230 Volt rms that is the nominal value, but it has a tolerance plus minus 20 percent in most places. But this plus minus 20 percent tolerance is a standard number, but it can go to much higher values of degrees of tolerances and at different places. So, you can accordingly take the tolerance limit according to places. So, let us say we have a tolerance limit 230 Volts from the nominal it can go plus or minus for as the worst case for this application is plus 20 percent.

So, if at the time of switching it was V i max which means 230 root 2 plus 20 percent. So, you will see that the range is from 260 volts to 390 volts corresponding to the plus 20 percent max. So, use this value 390 volts here divided by inlimit what you want to be the limit, so that you are in the safe region for the diodes. So, this is how you have to choose this surge limiting resistor. So, if I put mark the voltage measurement like this and is you are keeping the common probe here in the positive the probe here you get V R S because there is a current i in flowing through that and the i in flows in this fashion as we saw in the simulation, right, in steady state.

The job of R S is only during the starting inrush current after that it is not needed, but it is there in the circuit, so because of that you will see that there is a voltage drop which is coming across at due to this nature of current that is flowing through it. So, you will have a voltage drop in across the resistance in this fashion having similar wave shape as the current and that is V R S which is i in into R S. Now, this drop is coming across this so which means that the voltage across the load V naught will be lesser by that much amount.

So, therefore, you will see that the voltage is lower; the average voltage at the output is lower compared to the one without having put R S. So, one of the main advantage of this solution is simplicity. So, that is the main probe, simplicity, you just need one component nothing more and it is robust and it will solve a problem and it will make the circuit operable during startup and steady state.

However, there are disadvantages, one of the main disadvantage is that it is lossy because there is going to be a drop current flowing through it there will be a loss and therefore, the efficiency of the entire circuit will suffer will be low. And the second problem is the available voltage at the output is lower, so lower V naught as compared to the case where

you do not have R S. So, let us look at few other solutions where these disadvantages are removed.