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

Lecture – 19
Inrush current limiting – Thermistor solution

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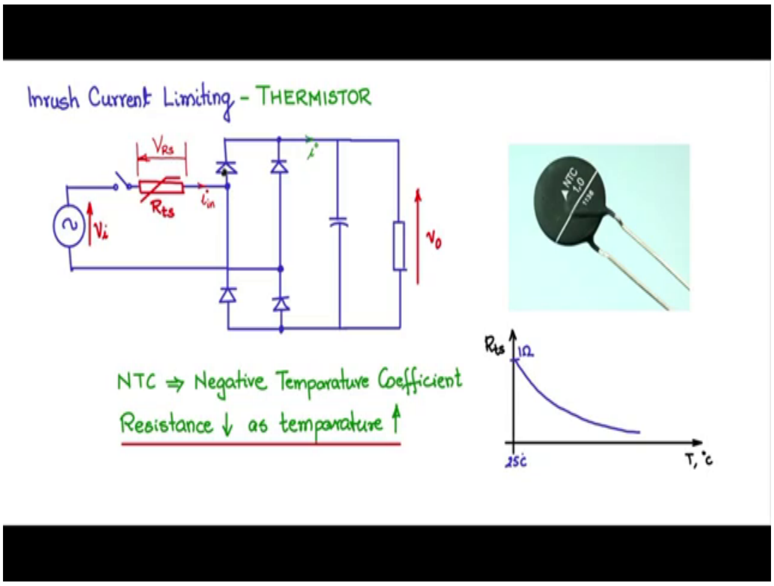

Another solution slightly better solution than the resistor one is the use of a Thermistor. Thermistor is actually a variable resistance which wherein the resistance varies with temperature. And it is a negative temperature coefficient thermistor, but you need to use. I will explain what it means.

Symbolically, the thermistor can be drawn like this in a electric circuit this passion. So, this is R ts, so this would be a thermistor, this indicates that the resistance varies with temperature. So, NTC means Negative Temperature Coefficient, what it means is that the value of this resistance will decrease as the temperature increases. This is a core concept as the temperature increases the value of the resistance decreases. What does this mean? So, let us say at the time of start we have not at closed this, the cold resistance R ts has some value, ok.

Now, on closing this V i by R ts it will limit the current. So, inrush current is limited and then quickly moves into the steady state operation and there is a current flows through this and they drop across this. So, as this dissipates this starts becoming hot; R ts will start becoming hot and as the temperature rises the resistance will start reducing and it will reduce to a point where the power dissipation becomes very low. So, one of the problems of the resistor solution where we said that it is lossy in the steady state and therefore, efficiency is low this thermistor avoids the problem by using this automatically varying resistance as it becomes hot, the resistance value goes down and becomes less lossy. So, this is one of the advantage by using the thermistor.

Let us see how this thermistor looks like. So, this is picture of a typical thermistor NTC negative temperature coefficient device. It has 1 ohm as its cold value. So, at low temperature or room temperature it will be 1 ohm and as it starts heating up dissipating this will become hotter and this this resistance will start going down from 1 ohm onwards.

So, if you plot on the x-axis temperature in degree centigrade and on the y-axis R ts the resistance of the thermistor and let us say it is 1 ohm at 25 degree centigrade it will start reducing as the temperature increases temperature of the device increases because of dissipation. So, it will come to a low value of series resistance and in the steady state the loss will not be as much as it was in the case of a fixed resistance. So, you get thermistors of a various cold resistance values and you also get various current handling capability of thermistors. So, look into the data sheet and you can choose appropriate thermistors.

One problem that you need to be aware of while using thermistors is that let us say you switch it on, this thermistor has a high cold value resistance it will limit the inrush current and then passes on to the steady state operation works nicely. Now, let us say the power goes off, once the power goes off the capacitor discharges the capacitor goes to 0 voltage condition. If immediately in a very short time gap the power comes back again capacitance of discharge condition the thermistor has not cooled enough to go back to its cold resistance value and therefore, the current limiting at that instant will not be as effective.

So, you have to be careful there because when you switch it off you have to give minimum time gap for the thermistor to recover its cold resistance value, only then the next time you switch it on it will perform the inrush current limiting action. So, this is the only problem when there is a power going off and then coming back in a short span of time, there could be issues in the thermistor not limiting the current because of not regaining its cold resistance value. Otherwise, this is a very good solution.