Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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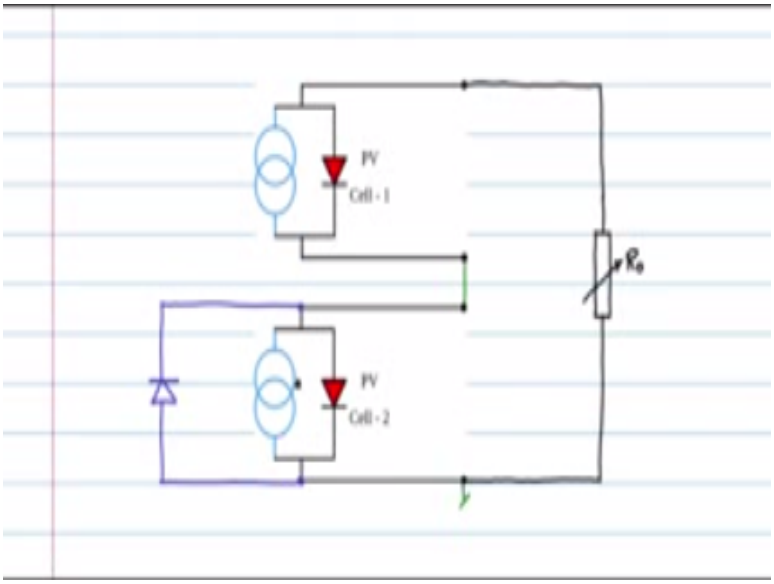

I would now like to revisit this point where I said that this diode should be ideal, if it has to effectively by pass the PV cell 2 when it is acting like a sink. In practice this diode that you would connect is not an ideal diode, it will not have a cutting voltage of 0 or close to 0. In such a case will this by pass PV cell 2, will the circuit work? So let us consider for now that this is effectively going to by pass this cell, under such condition.

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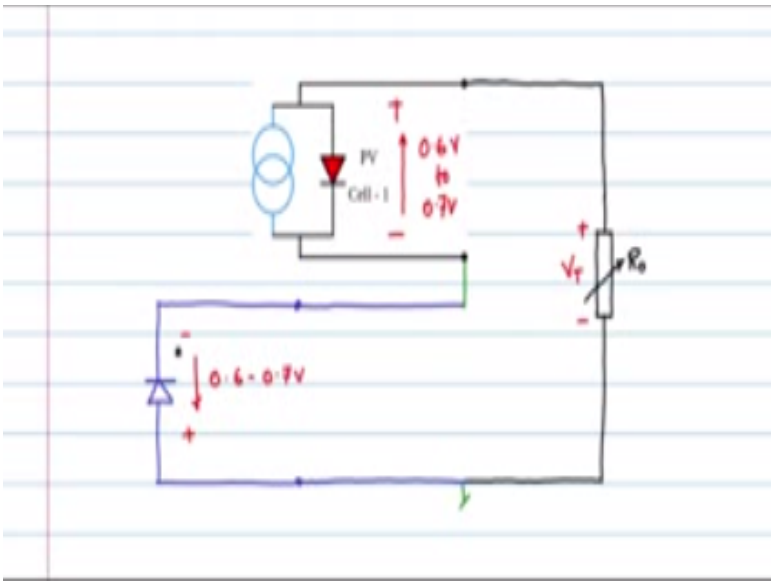

PV cell 2is out of the system it is by pass. If we take typical voltages you will see that the voltage across the source is of the order of 0.6vots to 0.7 volts. This as to overcome the potential across the load, the V_t and also the potential across the bypass diode are shown like this. This it is the order of around 0.6, 0.7 volts. So this drop 0.6 to 0.7 volts + V_t drop will exceed the sourcing capability of the PV cell 1.

So effectively this diode wills not actually the bypass it if it is not ideal, so it will work only if you make a dio the bypass diode which is having a cutting voltage at least 110^{th} that of the cutting voltage of PV cell, that would make this diode more costly then the PV cell itself. So it is not that the workable solution, so the wire need here is that in-between solution is, you put the bypass across a cluster of PV cell.

Let us say you have some 5 PV cells, or 10 PV cell or 100 PV cells in the series, so let us say that you have PV cells in the module, you can put a bypass for a module for a cluster of cells in such a case this will work. However not that there will still be issues of negative power, within the module as long as the overall terminal voltage is still positive.

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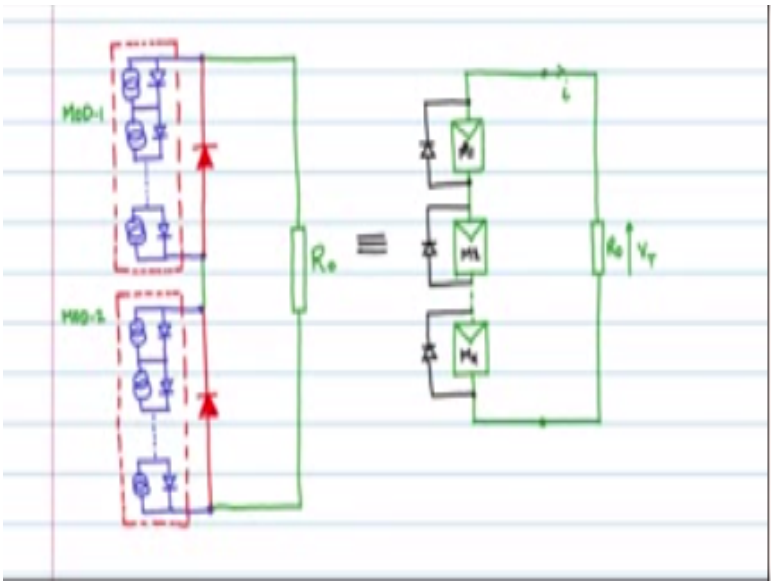

So now if you consider instead of two single PV cells, we put many PV cells in series and we call that one as module. Likewise here are many PV cells in series and we are calling that one as another module, so you have module 1 and module 2. Now these two PV modules are connected in series to a extent load. Now these can be protected with a bypass because the voltage of these PV cells in series of this PV module will be high.

It will in the order of 45 volts to 40 volts and it will much greater than the cutting voltage of a single diode that would you put in here externally and that will definitely work. So here I have drawn this bypass diode here which is I passing module 2 under conditions when the module 2 starts going negative, that is module 2 when it try to behave like a sink is bypass would effectively take module2 out of the circuit.

We do not know which of the modules are having shading, so therefore you have put these kind of protection bypass diode to every module which is there in the circuit. So you should also put a protection diode across here for the module 1, 2. As you see here the module 1 is also having the protection diode whichever the module has shading and try to go to the sink zone of operation, the bypass diode will come and protect them effectively removing that portion of the module out of the circuit.

However you should know that within the module there cells series, there are more protection diode, there could be combination of diode partially having a positive voltage and parts of them are having negative voltage. As long as the overall voltage across the module is positive, this

diode will not come into the picture. So the internal diode of some of them is acting as sinks they will be dissipating, so we cannot help that.

At the module level you can protect it in this fashion, these PV cells in series these modules can effectively be represented in symbolic form like this. These are modules M1, M2, MH so on so forth and each of the modules have many PV cells connected in series and these are the protected bypass diode and they are connected across in the fashion, such that they protect the modules, whenever the modules try to become sinks.

If there is partial shading any one of the modules try to have the emission in the voltage these bypass diodes will effectively removes those modules out of the circuit and try to save them from becoming hot and also try to improve the efficiency of overall circuit.