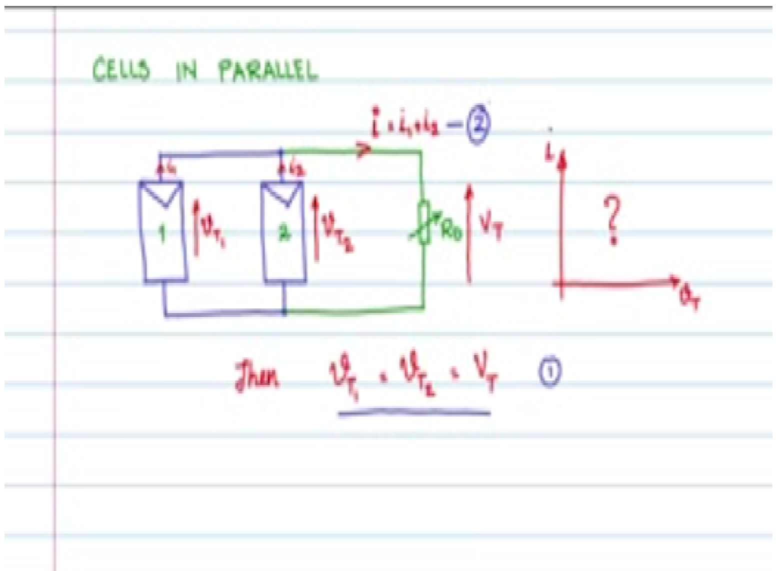
Indian Institute of Science

Design of Photovoltaic Systems

Prof. L. Umanand
Department of Electronic Systems Engineering
Indian Institute of Science, Bangalore

NPTEL Online Certification Course

(Refer Slide Time: 00:17)

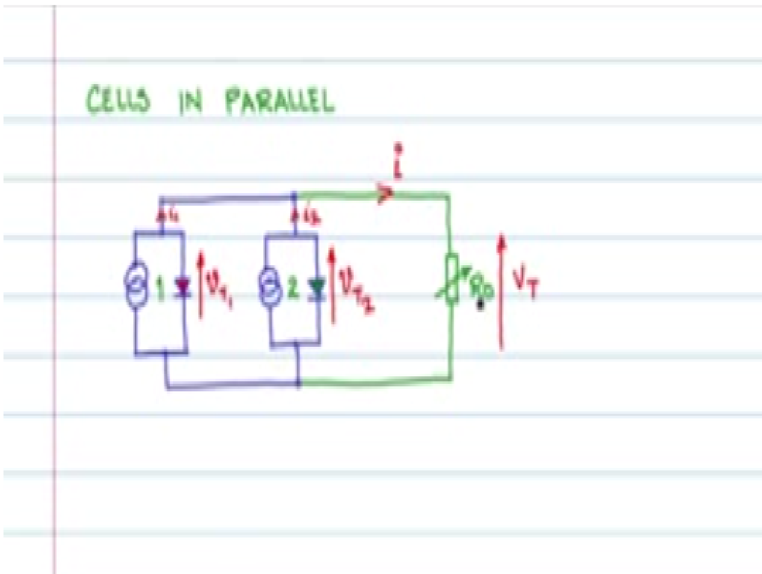


Like certain series one can also connect cells in parallel now if you take a module like this and let us say we would like to connect this module in parallel with another Pv module completing the circuit the parallel connection of two cells or modules is like this, so you have module 1 or cell 1 connected in parallel module 2 or cell 2 and in parallel with an external load or not let us call the voltage across the output terminal as V_T and let us call the current that flows through the external load as i.

Now these two are the parameters of importance and we would like to know what is i versus V_T or i versus V, so this is what we would like to see for the system of cells connected in parallel and here you have individually this current as i_1 and current from panel to cell 2 as i_2 the conditions here i is equal to $i_1 + i_2$ if I say that the voltage across panel 1 is V_{T1} and voltage across panel 2 as V_{T2} then $V_{T1} = V_{T2} = V_T$ these are the constraints two constraints that are applicable for cells connected in parallel.

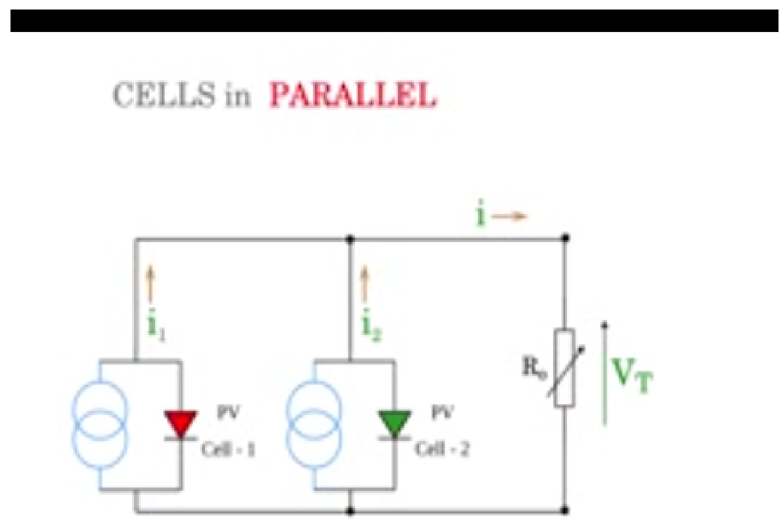
This is constraint 1 the terminal voltage is equal to the voltage across each of the cells our models kind of in parallel this is 1 the other 1 is summation of the currents from each of the panels will add up to the terminal current this is the second constraint.

(Refer Slide Time: 02:55)



I can replace the PV cell symbol with the current source diode model the idealized currant source diode model so that we will be able to understand the operation much better right this completing the replacement we see cell 1 replaced by the current source and this red color diode cell 2 replace by this current source and the green colored diode this is paralleling to PV cells in parallel along with an external resistance R0 which has a stern load.

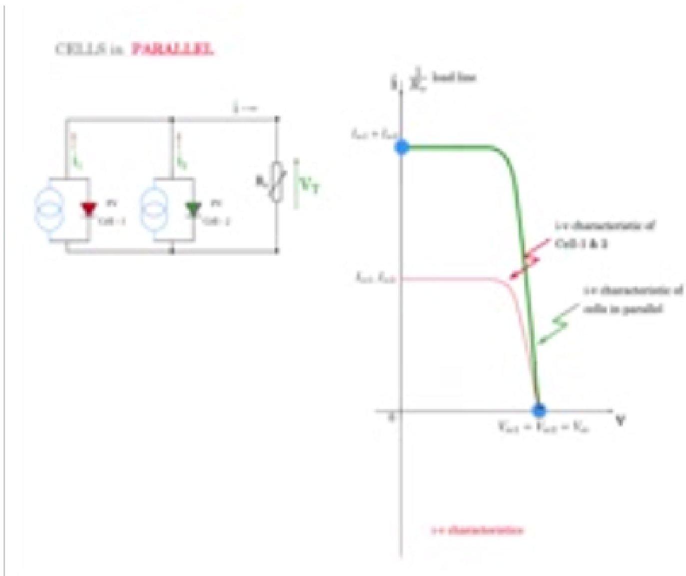
(Refer Slide Time: 03:36)



This is the circuit of 2 PV cells in parallel let us zoom in and it is clear that we have these two cells PV cell 1 and PV cell 2 in parallel with load or not this here is I1 which is the sourcing current from cell 1 I2 is the current from cell 2 I1 and I2 add up to give you I which flows through the external load R0 and VT is the voltage across the terminals of T cells parallel cell system.

(Now in order to study and see how we can get the Iv characteristic of the entire parallel connected system let us draw the x and y axis, x axis is the voltage axis the terminal voltage I axis is the current which is terminal current axis.

(Refer Slide Time: 04:38)



On this let us super bowls the Iv characteristic of cell 1 and cell 2 right now I have taken identical cells and therefore they have identical characteristic and therefore this is actually two characteristics super bowls 1 upon the other now these 2 characteristic have these parameters one is Isc 1 and Isc 2 this is a short-circuit current point for both the cell 1 and cell 2 and this point is the open secured point for both cell 1 and cell 2 from constraint 1 of cells connected in parallel we saw that V_T =to VT_1 + VT_2 this point here marked blue this operating point is obtained when the current is 0 which basically means when R0 is made open secure there is no current flow and therefore that would be the x axis line.

And that is this is the operating point under open circuit condition under that condition we see that as the cells are in parallel Voc = Voc 1 = Voc 2 now let us get a second operating point and let us get that by short-circuiting R0 so when you shorten acute R0 we are talking of the y-axis 1 by R0 is infinity and there we apply the second constraint where I = I1 + I2 so when you short circuit Isc will be equal to Isc 1 + Isc 2 so that would be the second operating point we have these two operating points we can smoothly join this and get the equivalent parallel cells IV characteristic.

Before that let us see what happens when you Pan the load line 1/ R0 line from the short-circuit condition down to the open circuit condition, so if you take one arbitrary load point and a corresponding load line like this the R0 is not finite not a short-circuit nor is it open and load line is like this is the operating point the current here is basically this height you see that this arrow having I1 , I2 of these two identical cell is the current at this point vertically and you just add it up I1 + I2 and you will get the current at this operating point.

And this distance is the voltage which is the terminal voltage also and 2 across both each of the individual cells, so that is VT so if you keep on panning this line down to the condition where it is horizontal up to the open circuit point you will get the entire operating a set of operating points which the locus of which will form the Iv characteristic of the parallel connected cell system so this dark green line is the Iv characteristic of the parallel connected cell system.