Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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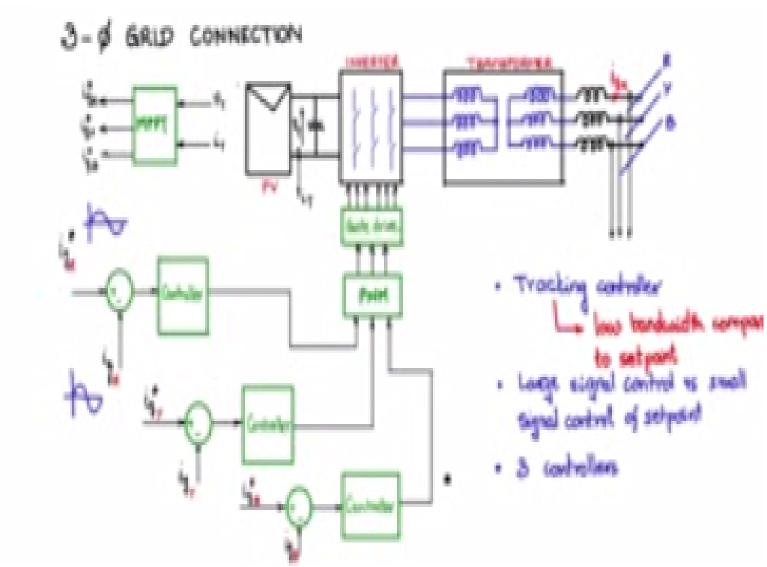

Let us now discuss the three phase grid connection of PV along with the control blocks, now consider this PV, PV module which is connected an inverter now I am starting with the three phase grid connection later on I will discuss the single phase grid connection actually if you see the three phase grid connection is much more easier than single phase grid connection therefore I have kept the single phase grid connection discussion to a later point in time.

Now the three phase inverter output is connected to the primary of the transformer the secondary of the transformer is connected to three inductors and then the RYB phases like this, so you have the nomenclature PV the inverter three phase inverter and the transformer. Now the three phase inverter the gates you have six gates gate to source that is a new sign IGPT's are mass fits the gate drives six gate drives are there and they have to be driven by gate drive circuit six of them like this.

And the gate drive is getting the control signals from a PWM block in this fashion for the R phase, Y phase, B phase or ABC phase. Now the input to the PWM will be the control signals coming from the output of controllers, now what do we want to control now let us say that I would like to control the inductor current of the current that is being pumped into the grid. Now let us start with a comparator let me compare an ig reference, now let us say that I have by sum means ig reference what I would like to give to the grid and I have the sums to value of ig reference I can sense that compare them and then pass it to controller block it could be a PI controller.

So if I am having three phase I will be having for each phase this compare and control, so let us say this is for phase R and this igR what I am having here is actually from that particular phase current, like this I will have for the other phase also I will have a controller which will take a reference value of ig now in this case it is igY and the feedback value of igY from here and output of the comparator given to the controller, and the third phase igB and igB that has a reference feedback value and output given to the controller, output so the controller we will get it to the PWM block, so let us say each of the controller we will give it to the PWM block in this fashion.

So how this work is that the currents are sensed compared with a reference and based on the error the controller output will send the signal to the PWM which compares with the triangle carrier and then appropriately gives the PWM drive to each of the arms of the inverter. Now how do you get these references, these references are obtained from the MPPT algorithm, the currents all the three currents are sensed in this fashion you could use a hall sensor or you could do it with restitution and deferential amplifiers, instrumentation amplifiers but measuring it with hall censors is recommended because it contact less and has a large band width.

Now coming to reference setting through the MPP algorithm let us say the voltage across the PV terminals is V_t and the current through the PV is measured with another hall censors let us say and is called It.Now let me have a MPPT block and we have seen MPPT algorithm, one of the MPPT algorithm we will use and inputs to that will be V_t and I_t, and what would be the outputs from the MPPT algorithm it will be the reference value of the currents ig_R, ig_Y and ig_B amend values. Now these are all sinusoidal values theses references, how did you get the sinusoidal, see the MPPT output will value which will relate to i_m ωt.s o once you have i_m ωt is basically a unit signed term.

Where ωt is actually the frequency of the grid voltage form, so grid voltage wave form you have the grid frequency from that you take the ωt and MPPT outputs will give what is supposed to be the im value the peak value and i_m ωt -120 – 240^0 you will be setting these references, these references will come in here. You will measure all these three currents and then based on that the control action will happen and then the control will take place.

However there are a lot of draw backs in this particular type of circuit first of all the references IGR are sinusoidal they are not BC they are set point values, Dc set point values. Therefore the controller becomes a tracking controller it is no longer a set point controller, so there is the major difference between the set point controller and tracking controller. The reference current i_g* and the feedback signal current they are all sinusoids AC signals in general.

And therefore the tracking controller will have to handle large signal deviations, as the consequences the bandwidth of tracking controller will be lower compare to as similar set point controller, if i_g* and feedback signals have DC. So therefore design of tracking controller will be much more complex compare to a set point controller. What we will able to achieve inter cycle dynamics if one uses set point controller but the tracking controller only integral cycle dynamics can be achieved.

Another issue here is that you have 3 separate controllers, you need 3 controllers one for each phase and the dynamics are coupled. So tuning the 3 controllers simultaneously will become difficult as the dynamics are coupled, so these are some of the issues that one will encounter while trying to build the controller for 3 phase PV grid connected inventors in this control methodology. Let us see how we will solve this by adopting the d_q access control methodology.