Indian Institute of Science

Design of Photovoltaic Systems

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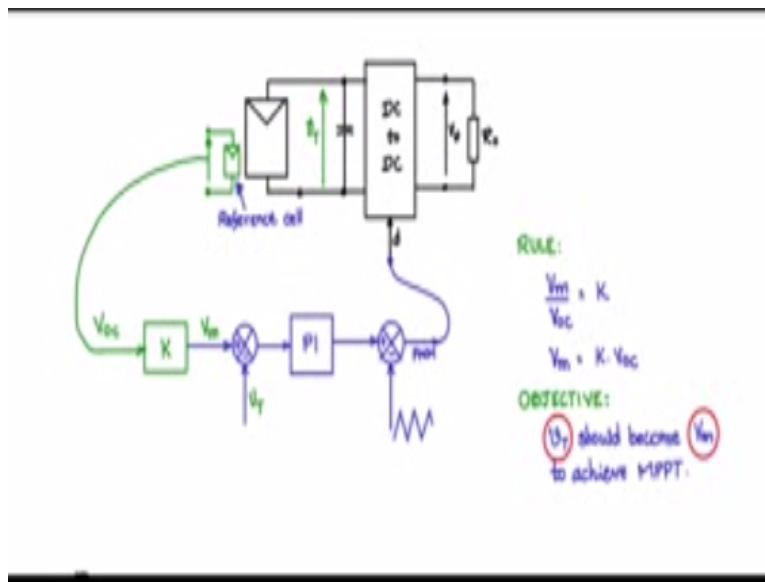**Indian Institute of Science, Bangalore**

NPTEL Online Certification Course

(Refer Slide Time: 00:18)

Let us discuss the sampling method, for performing maximum power point tracking, one can do voltage sampling or even the current sampling.

(Refer Slide Time: 00:26)

One should note that, in case of the reference cell method, a reference cell is used an its either open circuit or short circuited depending upon whether it is, IM/ISC kept constant or VM/VOC kept constant. In the case the reference cell this is expected to represent the actual PV array.

But the array is peak and it covers a large amount of real estate area and the reference cell does not actually represent the entire array. So in cases when there is partial shading due to neighboring building, the shading due to trees nearby, the voltage that the reference cell gives will not actually reflect the voltage that is suppose to have been obtained from the actual PV array of the PV module, same with the case of current scaling also.

Now the question is can we eliminate this reference cell and then can we get a signal which will represent the VOC of the actual array which is PV array which is delivering power to the load. If you are able to do that, then we are one step closer to much more accurate MPPT algorithm.

(Refer Slide Time: 02:01)
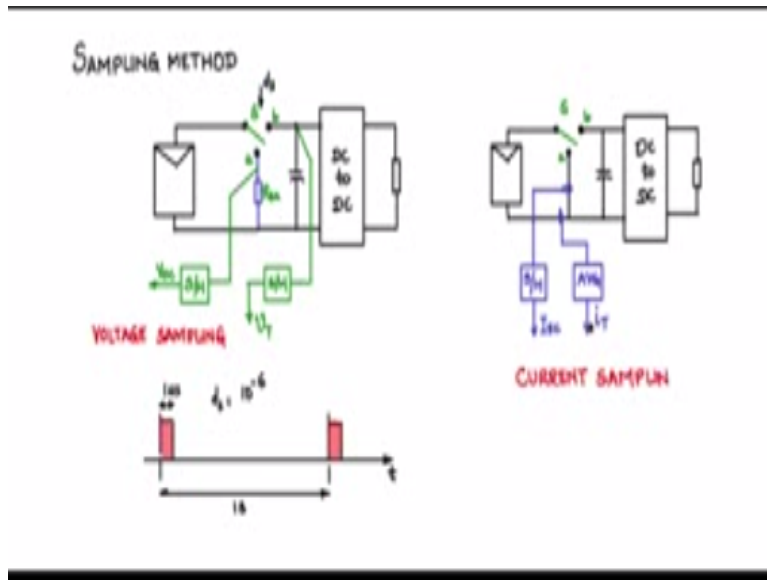
Let us now look at how this sampling method is done to perform maximum power point tracking PP panel is connected to a DC-DC converter, and the DC-DC converter output is connected to R0 as shown. In between here there is a switch, before that let us place this buffer capacitor which we are now familiar with, and this is switch I will include that the switch has a name S, and it has two throws, single pole double throw, throw A and throw B.

When S is connected to throw B, then that is the normal operating condition, when the PV panel is powering the load through the DC-DC convertor. When switch S is connected to A, B is open and whatever energy is thrown in this buffer capacitor, will be driving the load. And across this resistance this resistance is sense resistance its high value resistance so voltage across this resistance will across approximately be equal to the open circuit voltage of the panel.

And that is precisely the time when it has to be sampled and take as the open circuit value. S so that precisely is what we will be doing in this sampling method. Let us call this resistor RSA, and we will sample this potential if the switch is not connected, here it is connected to D, then this potential will be 0, this switch is connected to A it will be VOC value. Let us connected to a sample and whole circuit the output of a sample and whole circuit will be VOC.

And where it you get VT, the voltage across this buffer capacitor will give the actual array. So let us that is also pass through the another sample and hole, we will get VT, the terminal voltage, what is expected of the array. Now when will this switch B connected to A, and when will it D connected to B and for how long, let us draw a time axis T and I will mark tick where is A. And

let me place a rectangular pulse, and during this pulse this switch will be enable and connected to A.

So during this time, this sample and whole circuit for VOC is enable and effective. And next again after certain time has elapsed, you will repeat it once again and so on it keeps continuing. So this pulse duration during which the shaded pulse duration during which S is connected A, to sample VOC is very small, so that there is sufficient charge here and load does not miss the disconnection of the PV panel at B.

So normally, this is having the time duration of order one micro second or tens of micro second, and this duration majority of the duration, when S is connected to D, is very large it is also order of the seconds. So this will be the order of sections, so you will see that this switch is controlled by a duty cycle DS and then this DS, is one micro second by one second which is 10^{-6}, so it is a very very small duty cycle.

So we will get the value of VOC, and then if done pass it through a ADC it can be taken to the digital domain. And because of this present of this buffer capacitor, during this very small duration when S is not connected to B the buffer capacitor will supply to load. Now this is called the voltage sampling method. So once VOC and VT are sampled, basically the control block diagram for achieving maximum power point tracking will be same as what we had discussed in the reference cell method with voltage scaling.

Let us also look at current sampling, so just like the voltage sampling, we need a PV panel connected to the DC-DC converter, buffer capacitor, and then connected to load like this, then we have a switch. Now this switch when it is connected to A, we do not use a resistor now we just did a short circuit. So when S is connected to A, the panel is short circuited. So any current that you measure here will give you the short circuit current.

So let us say I measure that current through a hall sensor pass A through a sample and hole, and the value that I would get there would be ISC, the short circuit current and that instant of time whatever the insulation at that instant of the time. Now if you have to get the time panel current, I can sense here and pass it through an average and I will get IT. Now if you look at similar times can be used for the current sampling method also.

So let us say for one micro second the S is connected to A, and for one micro second the PV panel is short circuited the current that is measured sampled and held will be ISC value and that instant. Then it is released and the load is connected, and for the majority of the time, what is flowing here would be IT, and for that one micro second time what is captured here by this circuit is ISC.

So when you pass it through as averager it will average out that for that one micro second the unnatural short circuit current that will flow through this. So you will effectively get because it would cycle is very low. S so you will effectively get IT, because majority of the time what is flowing here will be the IT average. So this is called current sampling method.

(Refer Slide Time: 09:47)
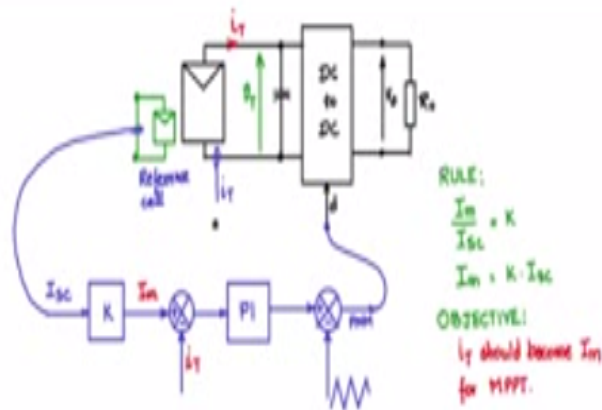
So once you are sample the current the blocks scheme is essentially like what we discuss in the reference cell, except that this is no longer there, ISC is coming from the sample and hold, IT here is again coming from, another block which is the averager block, so IT is given here and ISC is given here, scaled appropriately you get IM. And then the functioning of the maximum power point, tracking control algorithm will be similar to what we had discussed, in the reference cell current sampling method.