Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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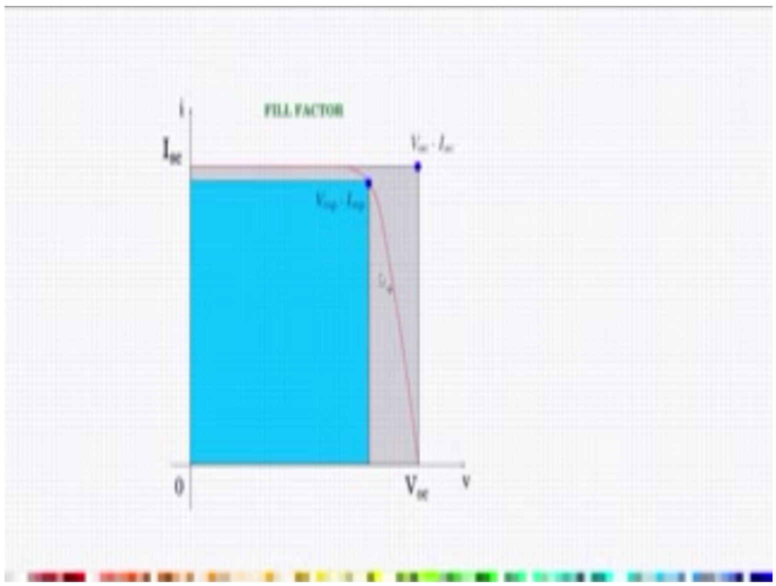

Fill factor, fill factor is actually a figure of married for PV cell it tells how good or how bad a PV cell is it is actually a ratio now before I tell what the ratio is let us get to it in a much more inductive manner now you see this is the IV characteristics of PV cell now let me have a projection of along the perpendicular to the voltage axis and the projection of I_{SC} perpendicular to the I axis.

And this point is V_{oc}, I_{sc} point has shown here now this V_{oc}, I_{sc} this rectangular here now let me fill up this area represents this point here represents the maximum possible voltage and the maximum possible current that is critically possible from the PV cell but this point will never be reached.

Now for a particle characteristics this the maximum power point is given like this V_m and P_m and I_{mp} and it has projections which cover a rectangular area like this now observed that VAN the are series non ideality is removed it would gradually become vertical and knowledge ideality is removed.

Than that would become popularly horizontal and this would be a very ideal cell character so this point V_{oc} *I_{sc} would be the weak power of such an ideal cell but this will never happen this is more practical cell now we need to see how close this area matches with the grey shaded area of a PV cell now that is how the definition of fill factor comes.

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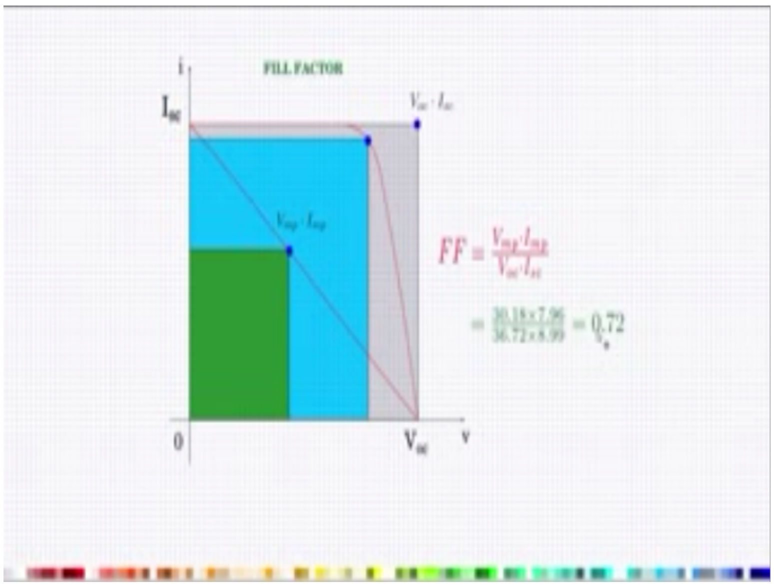

Now consider the PV cell Iv characteristics like this a straight line this is actually very bad PV cell characteristics where in the series component Rs is very large and the shunt component or shunt is very low now even if we take such a bad PV cell we would getting some power of optimum.

And let us say we have a V_{mp}, I_{mp} point like this and this projections result in a rectangular area like this ands we see that this rectangular area is much smaller with respect to the ideal rectangular area ask remarketed by V_{oc} I_{sc} any normal PV characteristic would have a much higher weak power point and a much larger area with respect to the ideal area.

So the area ask incomplete by the maximum power point with respect to the idealized maximum power area is defined as a fill factor so the fill factor is given by V_{mp} I_{mp}/ V_oc $I_{sc,}$ V_{oc} I_{sc} is the rectangular area the limiting rectangular area which would be the maximum possible V_{mp} I_{mp} is the rectangular area as a encompassed with respect to the operating weak power point.

The fill factor is a ratio of this area with respect to this area this enhances gives us a idea of the goodness of the cell the more closer this area is to the V_{oc} I_{sc} rectangle the pattern the cell so if you take our typical PV cell it will b much better than this straight lien it will have a curved line like this.

So this practical PV cell characteristic would have a weak power area as shown in blue here much larger than this green area are shown here as encompassed by the weak power point of the bad cell so apparently we just looking at this you see that this curve a PV cell having this curve is much better than this, because this area is greater than this so this ratio which gives a measure of the goodness of PV cell can be computed from the data sheet values.

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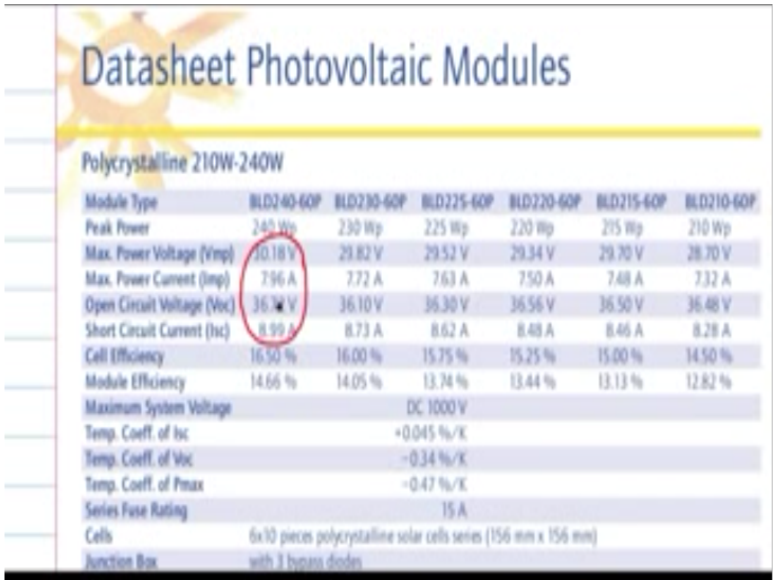

Datasheet Photovoltaic Modules

Polycrystalline 210W-240W

Module Type	BLD240-60P	BLD230-60P	BLD225-60P	BLD220-60P	BLD215-60P	BLD210-60P
Peak Power	240 Wp	230 Wp	225 Wp	220 Wp	215 Wp	210 Wp
Max. Power Voltage (Vmp)	30.18 V	29.82 V	29.52 V	29.34 V	29.70 V	28.70 V
Max. Power Current (Imp)	7.96 A	7.72 A	7.63 A	7.50 A	7.48 A	7.32 A
Open Circuit Voltage (Voc)	36.7[illegible] V	36.10 V	36.30 V	36.56 V	36.50 V	36.48 V
Short Circuit Current (Isc)	8.99 A	8.73 A	8.62 A	8.48 A	8.46 A	8.28 A
Cell Efficiency	16.50 %	16.00 %	15.75 %	15.25 %	15.00 %	14.50 %
Module Efficiency	14.66 %	14.05 %	13.74 %	13.44 %	13.13 %	12.82 %
Maximum System Voltage	DC 1000 V					
Temp. Coeff. of Isc	+0.045 %/K					
Temp. Coeff. of Voc	-0.34 %/K					
Temp. Coeff. of Pmax	-0.47 %/K					
Series Fuse Rating	15 A					
Cells	6x10 pieces polycrystalline solar cells series (156 mm x 156 mm)					
Junction Box	with 3 bypass diodes					

Now if we go back to the data sheet values you will able to compute the fill factor for the typical cell of a particle data and bring your focus to this parameters so you see here this is the V_{mp} weight age value and I_{mp} voltage value so this could give you the V_{mp} I_{mp} this is the Voc voltage value and the I_{sc} current value and this would be response.

So plugging in these values into equation for the fill factor we get fill factor value can be computed from the data sheet values 30.18 V_{mp} *7.96 Imp/36.72 Voc 8.99 I_{sc} now this will give you a value of 0.72 so this is the ratio now 0.72 is a reasonable panel available in the market it will say fill factor is .5 it is very bad cell if the fill factor is .8 or .85 it is a very good cell. So that is by FF of the fill factor is generally calculated to measure the quality or the goodness of the PV cell.