Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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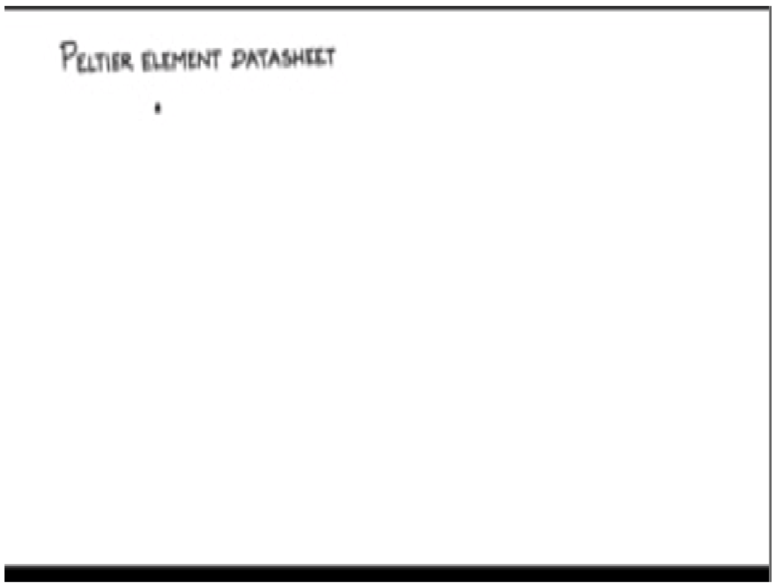

Let us now have a look at the data sheet for the peltier element. I will download the datasheet of the peltier element that I showed you recently. And then we shall see what information that we can gain from the datasheet and what are the parameter that we need to look for in order to design the peltier, select the peltier element for a particular application.

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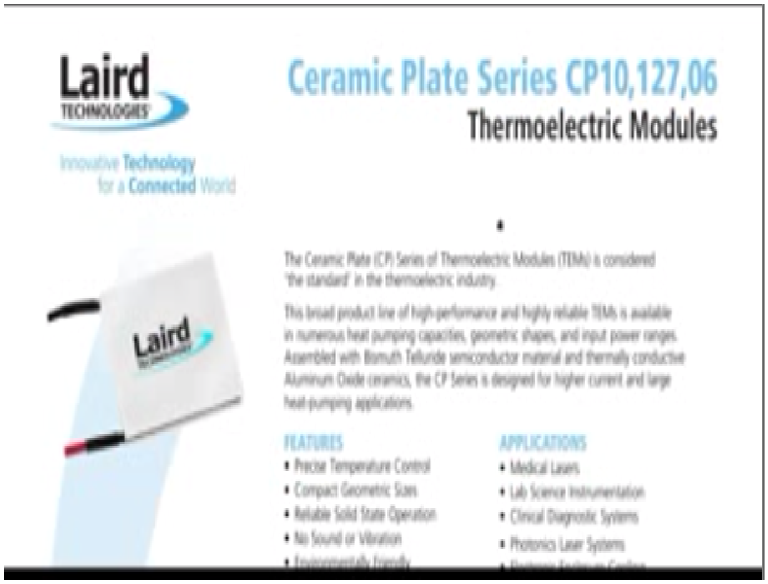

I have downloaded the datasheet for the peltier element that I showed you Laird technologies, this is the element that, a similar type of an element that we saw, and it is the same number.

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You see there is a lit if application interesting to note that can be used for medical lasers lab science instrumentation clinical diagnostics photonics laser electronic enclosure cool cooling even component cooling food and beverage cooling chillers any way.

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Let us come to the important thing there is this set of performance specification these are some important numbers and let us try it understand these number here I will draw a schematic and then try to associate these number with the schematic.

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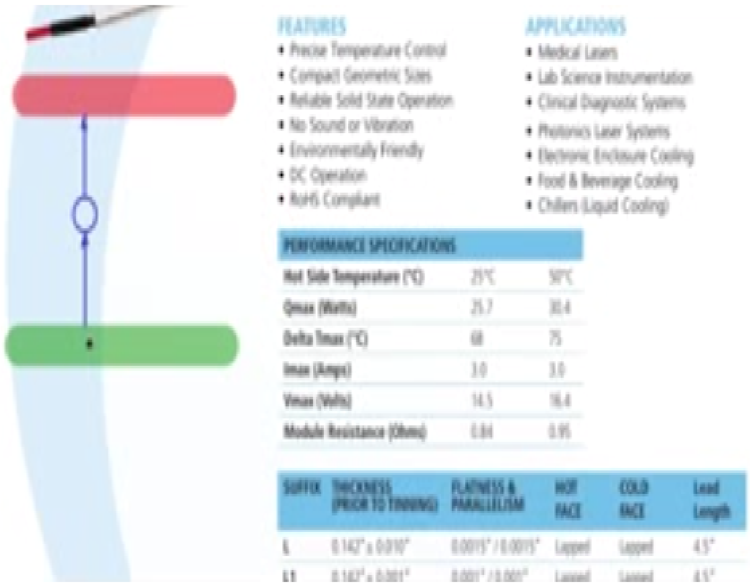

So let us say that I put the hot junction part in the red there and the load junction part here and we have a pump the politer pump which extracts heat energies from the coal junction pushes it through pump into the hot junction and for that it needs to be some external power import and that is what is coming as an electrical power into the PELTIER element, now let us say Q_C, Q_C is the amount of heat that is extracted from the coal junction this is the heat flow out of the cold junction, Q_{max} inverts 25.7w 30.4w depending upon.

What is hot side temperature this indicated the maximum heat flow that can be allowed for this PLETIER element so the Q_C that you are going to the heat that you are going to remove from this cold junction and pass it on out is 25.7 to 30.4 wax there is the absolute maximum do not exceed beyond that if you start exceeding beyond that then what happens is the Peltier element has within it an internal resistance and I^2 law, I^2 or laws increases and the amount of heat power flow will decrease and the temperature difference between the hot and cold junction will fall.

So we are calling here this as the cold junction and it is at temperature T1, we are calling this as the hot junction and that is at temperature T2 the difference between T2 and T1 is called ΔT, so let us say $\Delta T = T2 - T1$ and that T is specified here ΔT max so that is also one of the text 68 to 75° so difference between the cold and hot junction should not exceed 69 to 75° that is around the maximum at this pair particular peltier junction would allow now this heat pump which I have shown here let me replace that with square block which are represents the peltier element.

It has to electrical leads and I connect an external resistance and the power supply as shown so there is the voltage across the terminals of the peltier will call that as vp and there is the current that is slowing into the positive terminal of the peltier and we will call that one as Ip so this electrical circuit this electrical circuit here is providing the electrical energy external energy for peltier junction to act as n heat pump.

So if you consider this Ip that is the current flowing into the peltier it should not exceed I max here as given in this data sheet so the I max current or the peltier element is there amp in this case the voltage across the terminals of the peltier Vt should not exceed the max as indicated in the data sheet ere V max should not exceed 14.5 to 16.4 depending upon the temperature of the hot junction.

Now if you consider this Pelletier element let me raise this and let me connect a resistance here, internally there is a resistance across the eternals of the Pelletier and that resistance let me call it as RP the Pelletier resistance, this is the model resistance as indicated in the data sheet and that is given to the around 0.84 to 0.95 depending upon the hot side temperature T_2 and this T_2 hot side temperature is between 25 centigrade, 50^0 centigrade that is the maximum operating temperature for the Pelletier element and that is 80^0 centigrade.

It should not on any condition exceed 80^0 centigrade otherwise the Pelletier element will not operate properly. So let me go down the data sheet, so on the next page there is couple of graphs given.

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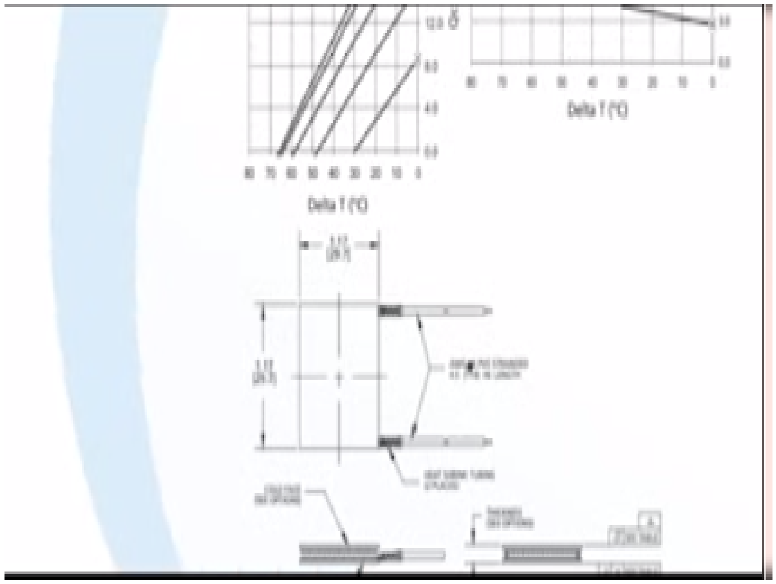

Below there are dimensional parts of the data that is given observe here operating tips maximum operating temperature80^0 centigrade do not exceed Imax or Vmax when the operating the module. So these are tips and hints that we should observe.

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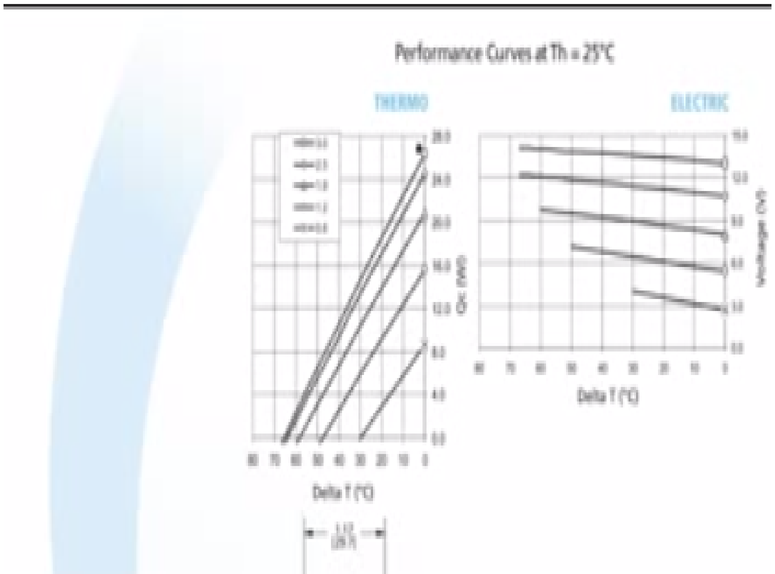

Now look at these two graphs they are some important to us, there are two graphs one Nomo graph is thermal and other graph is for the electrical. This graph is especially is important because it relates to the coefficient of the performance. You have Qc and this is the family of curves with respect to the current that is flowing through the penalty junction and therefore we can relate to the coefficient of performances let me explain with respect to the figure that we just drew this is the cold junction is the hot junction the hot junction T2- the cold junction temperature T1is Δt observe that the x axis of both these no more graphs or Δt basically the difference in the hot and cold junction temperatures 0 to 80degrees that is what is the graph limits.

And you see this graph now these are graphs at different values of the currents that is flowing into the penal tier junction IP the current that is flowing into the Pelletier junction so this graph is with respect to an IP of 0.6 amps that is flowing this graph is with respect IP or IP of 1.2 amps flowing into it for this graph is for 1.9amps flowing into the Pelletier this graph is for 2.5 amps flowing into penal tier and this is for 3 amps flowing into Pelletier and this Pelletier is rated up to a max of 3amps only likewise even in the electric no more graph this graph is at 0.6 amps this is at 1.2 amps, 1.9 amps, 2.5 amps and 3 amps observe here that greater Δt is achievable as the amps that flow into the Pelletier junction increases.

So you can achieve as much as close to 65,68 degree centigrade when the amps that is flowing into the Pelletier is at around 3 amps in general the nature of this curves are just that when the temperature difference is less I can remove greater amount of heat power from the cold junction and shifted to the hot junction so more amount of power can be removed from the cold junction if the temperature difference is maintained small if you want a large temperature difference then you can only pump less amount of heat power into the hot junction take for example if I have to pump 17 watts of power out of the cold junction.

Then 17 comes somewhere here and then it cuts these three lines the 1.9amp line 2.5 amp line and 3amp line one of these can be used so you could probably around 13 volts 3 amps you will have the operating point here you could probably apply around 10 volts 2.5amps and probably have the operating point around here so more the power more the QC that heat power that you want to remove from the cold junction higher must also be the power that you have to pump into the Pelletier element in order to pump that quantity of heat into the hot junction if you multiply VP and IP VP into IP will give the power that you are pumping into the Pelletier element QC+VP.IP will be the amount of heat power that you are putting into the hot junction.