**Electronics Enclosures Thermal Issues**
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**Lecture - 21**
**On-the-net DIY work**

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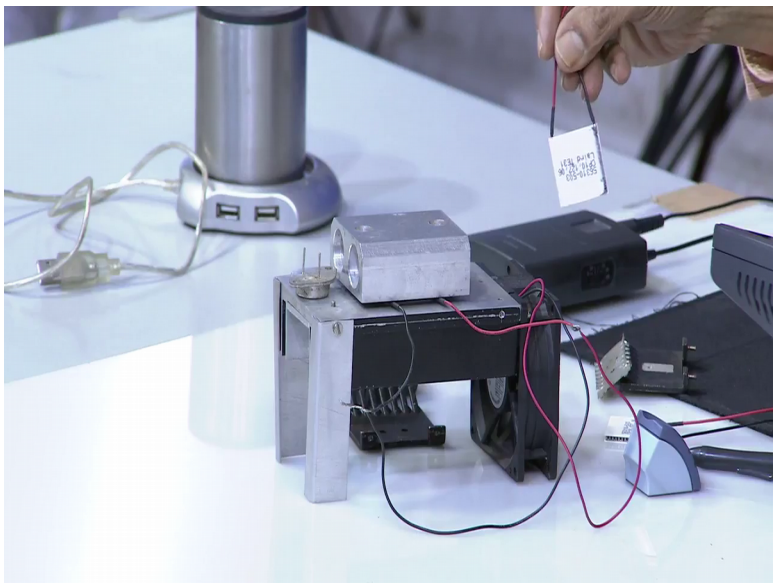

I am continuing on the lecture which I left previously I had to take a break to bring these samples now. Please have a look at this sample again one more time. If you remember I briefly showed you this unit. This unit has Peltier what you call module fitted inside, there is a cold side and there is a hot side then we have a fan here. So, and in general, we are all familiar with these, what I tell this Peltier things to be used for cooling.

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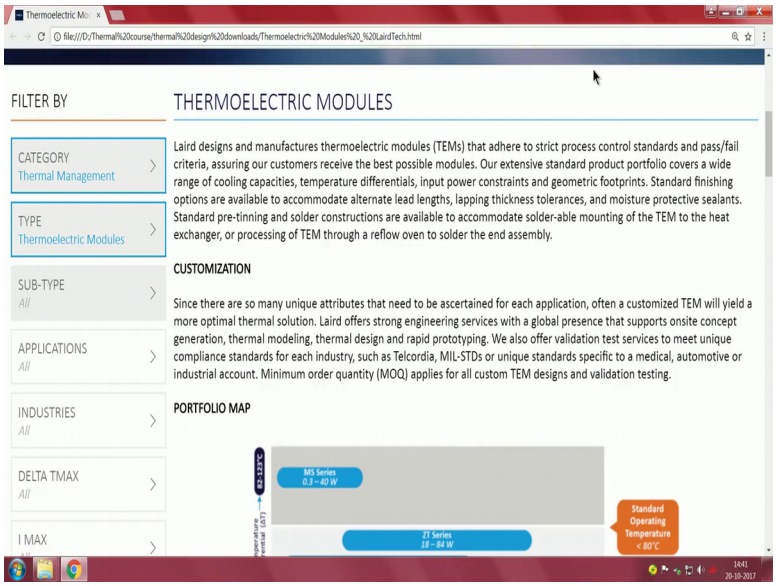


Now we come to the next important thing if you look at the these what you call information that is what you call available freely on the web Laird is one of the so many of the people who keep stuff related to this modules on hand. So, we could get our hands on two of these modules you see this here. And in keeping with the best tradition we burnt this first. I do not know what went wrong we burnt it and then after the burning was over we decided that since we have two more pieces, we will read the manual. Upfront if you read the manual it means you are giving up and admitting the other fellow is somehow endowed with a bigger brain.

So, now coming back that let us to all this information which I have here kindly have a look. So, typically how we have all this what you call beautiful can read it yourself. Standard finishing to accommodate alternate lead lengths, lapping thickness and moisture protective sealants, pre-tinning and solder constructions to accommodate and so on.

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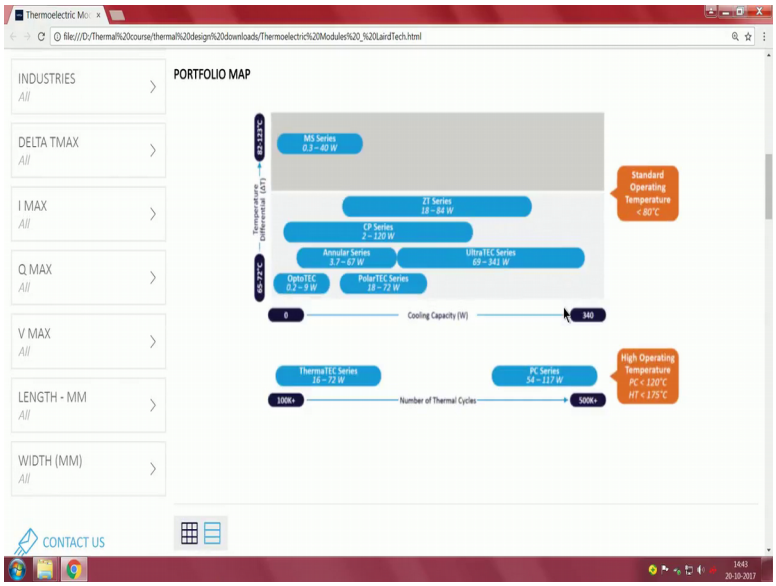


And a huge what you call generally a map is given here saying as we want you know more and more temperature differential and so on and so on, what is the operating things we would like to have and so on.

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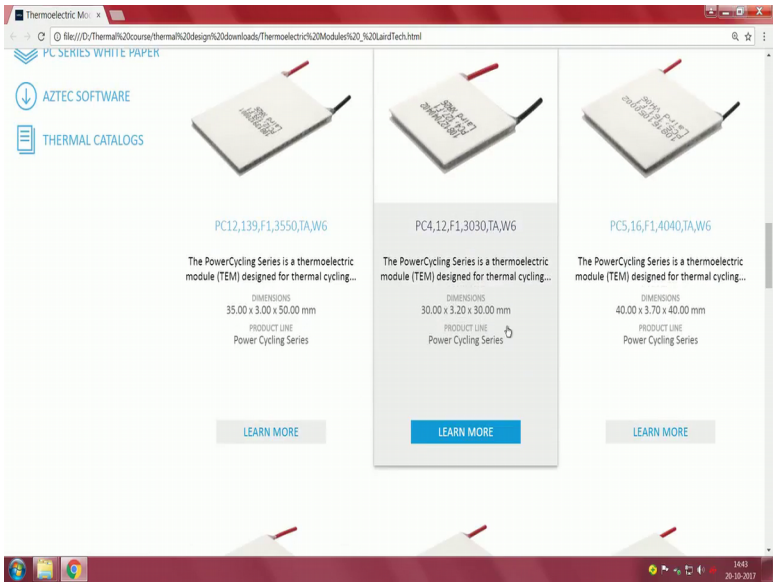


So, typically if you go here we have all these, what you call catalogues which should show the type of modules that are available. So, I will go here.

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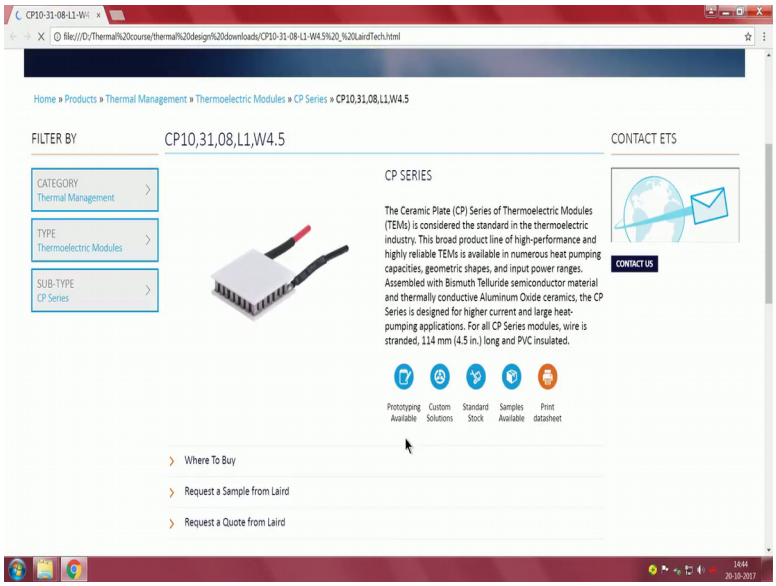


This is the module we managed to pickup. This is the CP series and typically we have 15 by 15 small module.

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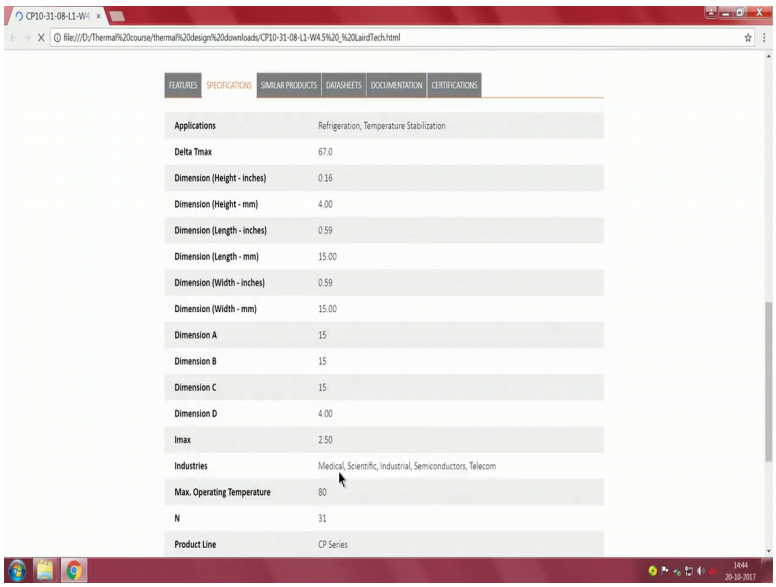


And then it will give you details of what is the delta t and then what is the maximum you know current and then what is the maximum power that we can use for a small thing. Just wanted to show you typically we have all these what you call things. Now I will go on to that.

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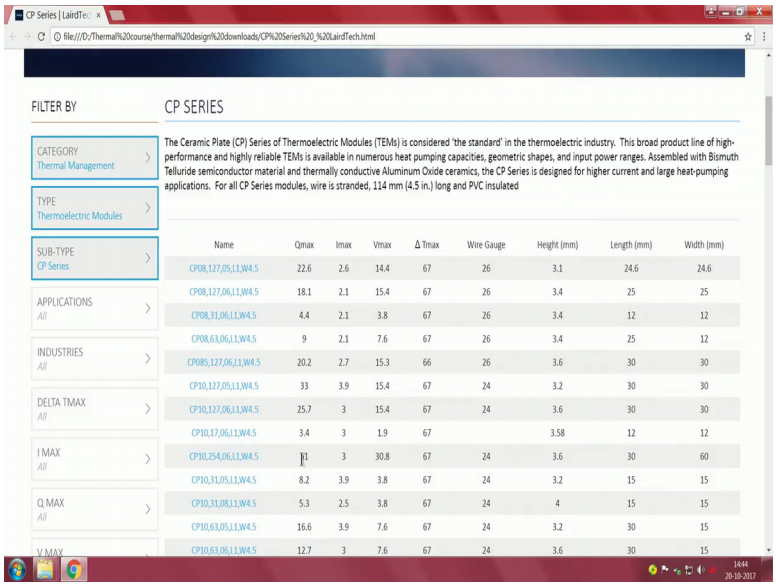


A big catalogue here shows CP ceramic plate is considered the standard in the thermoelectric industry meaning everybody seems to use these things. So, you have a lot of thing about what is the power that has to be that needs to be cool then the temperature difference. And by difference you know by it looks like by some standard typically around 60 degrees, a little around 60 degrees seems to be the limit, you do not have it much higher than that.

Then we have the what you call lengthen through it typically this 30 by 30, and these things you know. I think we have used this CP 10, 30 by 30 that is the one you have here. CP 10, 127 30 by 30 is the module I have here. So, 30 mm square and then the thickness is some it says 3.6, I think we can believe the catalogue. So, the having selected one of them, you see we have all these things here; you if you want to know more about it you just need to click down. Oh, I think we have seen this already.

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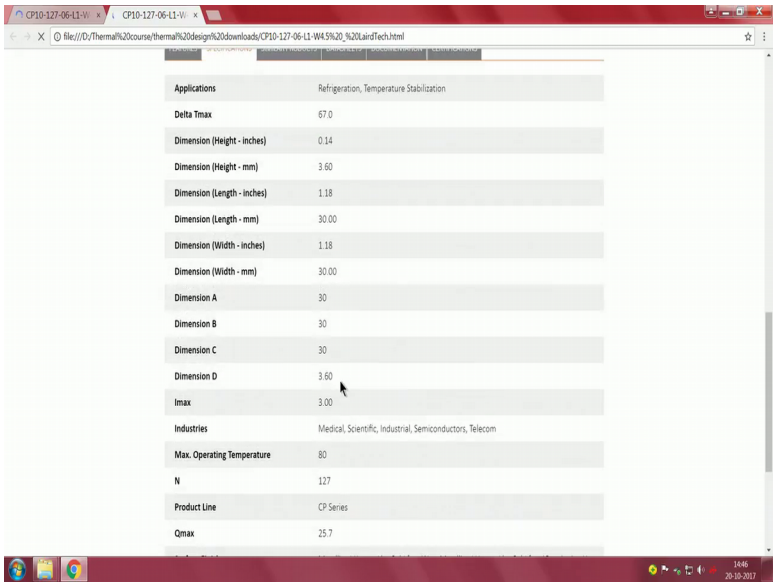


You notice here about 67 is given here; and dimensions 30 by 30 and then their thickness little small.

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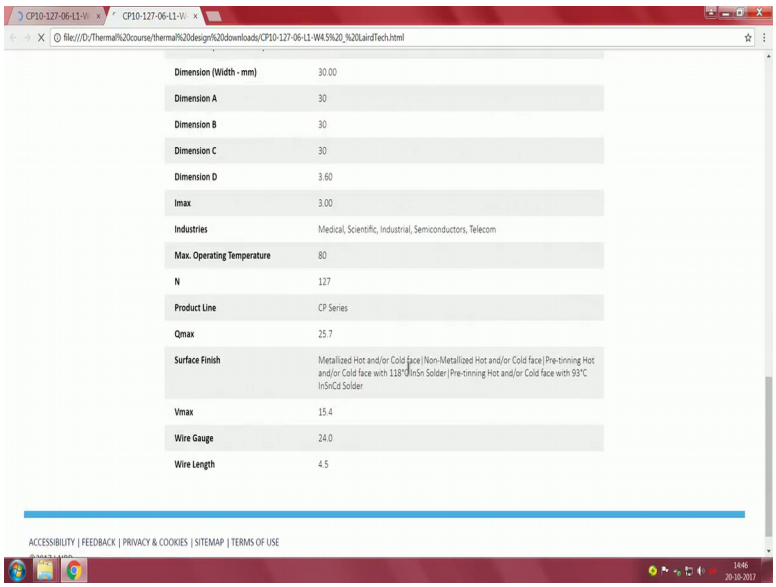


Typically, it is the surface finish pre tinning hot and or cold-face with 180 degrees what you call solder and so on and so on all the details are given here. And the applications are also given here. Bismuth telluride semiconductor material and aluminium oxide ceramics, and we have data shades related to this are also mentioned here.

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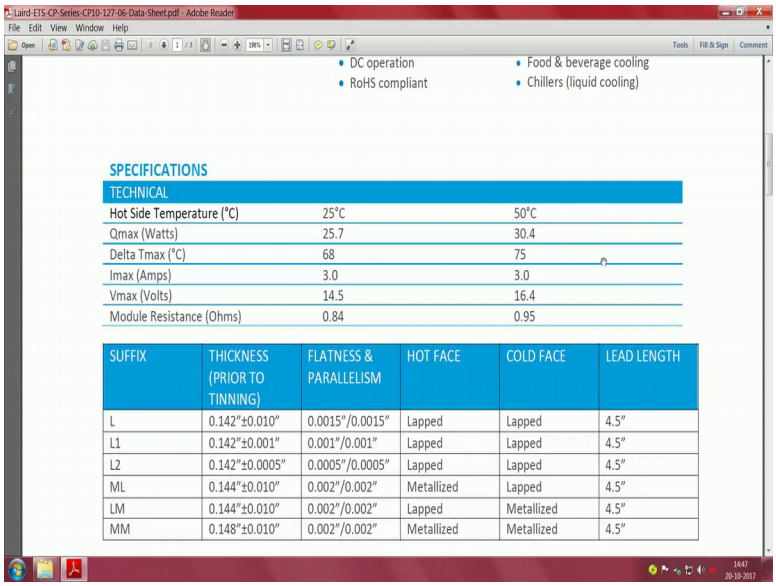


I will just try to open that seen that this is an application saying it used for medical lasers, lab science instrumentation, and thickness prior to turning delta c and all those things. And then the subsequent picture gives us the actual useful application note.

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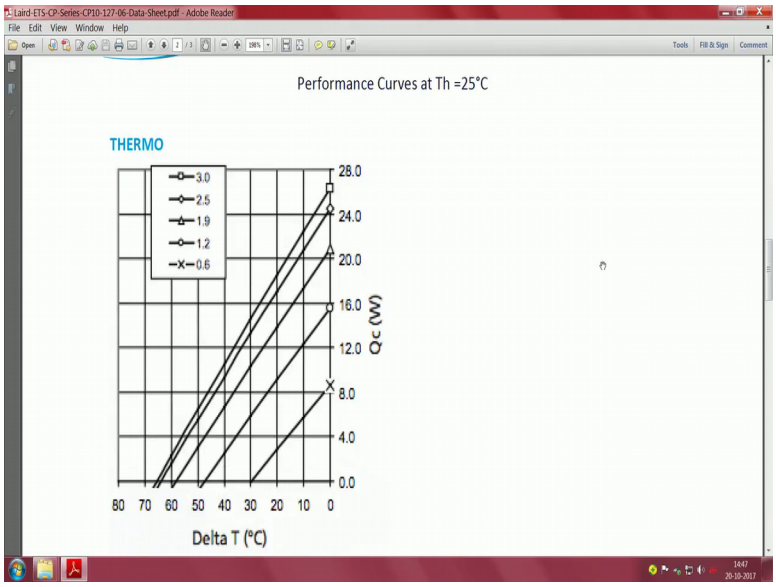


One of them you see down here is the voltage.

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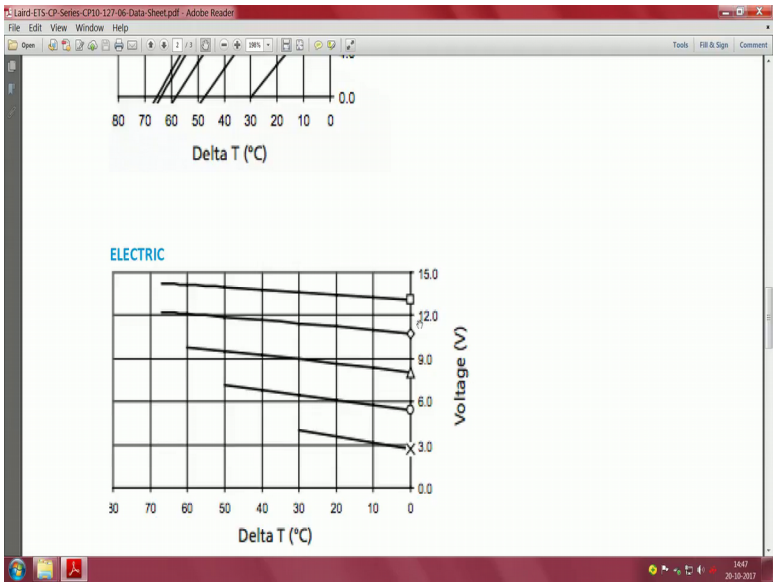


The applied voltage gives you the, what you call the range at which you know what is the delta t you can obtain. And then the Q c versus this figure you know. As you have lesser temperature more wattage can be given. And if you have you know what you call what temperature difference, the lesser you know wattage will take place in that which is you need to look up on this table then decide on the voltage that gets applied like this.

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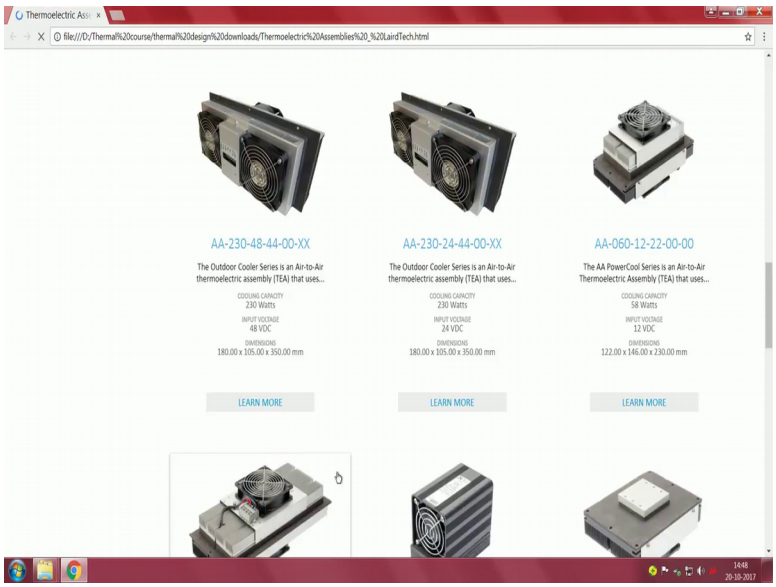

So, the next level is we have readymade units like this here. Can you see here, a small unit here? I will see if it connects to the internet directly we are lucky maybe we will be able to see this.

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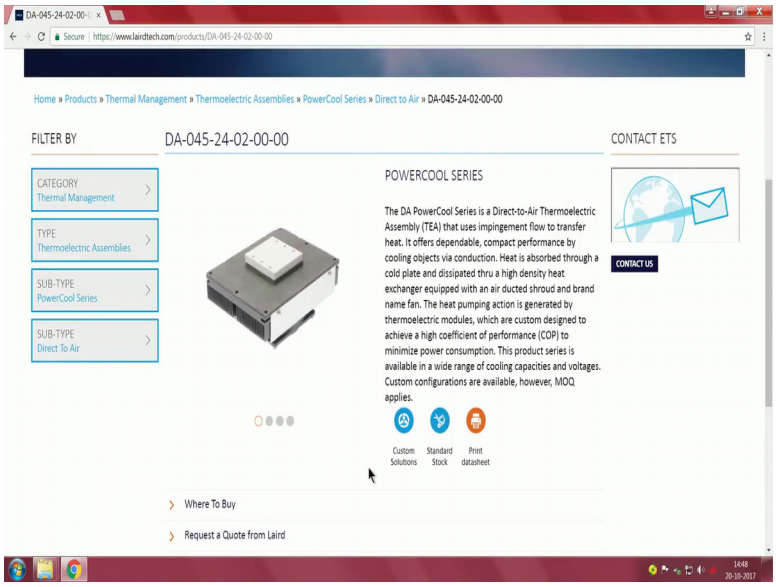


This is what we have tried to replicate here. You see here we try to replicate here, because our interest is not to purchase this unit directly. We could have also purchased it, but we notice that with our fan and you see here this is direct impingement meaning the fan is fitted here. In our case, we wanted it to blow flow across like this we because of some considerations, then most important is this is the what you call biomedical device in which you know we have to put a test tube inside and the test tube has a specimen the thing which is we need to quickly heat it and cool it. It has something to do with human gonadotropin those things related to some what you call study in immunology as say.

And why it is open both sides is that we needed to put some instrumentation including some UV lighting and sensors and all that. And this is not the way it is intended to be used because there will be tremendous short circuit, but in the cold and height. So, it has a cap which fully seals it. And this cap one side we have a place you know to provide our what you call samples their test tubes with special bore on it. Other side, it has all the other things we are saying this insulated cap that is the one know gives us the advantage of making sure that this cold side stays cold and it does not get warm by ambient.

If somebody attempts to just to take a take a device like this and then expects it to cool, it would not cool. But for simple very small things and then if you want to demonstrate or regard to using sensor, obviously, maybe range of small heat sinks and all which our people have fabricated. You see here, I have a small heat sink here it is attached to this do not ask me why it is and why.

This is made this actually made for some other power device which is taken from a printed circuit board and then something else is attached here. And then we have varying types of these assemblies which we have tried. Yeah, you must be saying is it a lot of unnecessary trial, a little and a little not like this. Our idea being without having to go for very elaborate what you call these fans and convective cooling and all that is it possible for us; to make a simpler way of handling these things.

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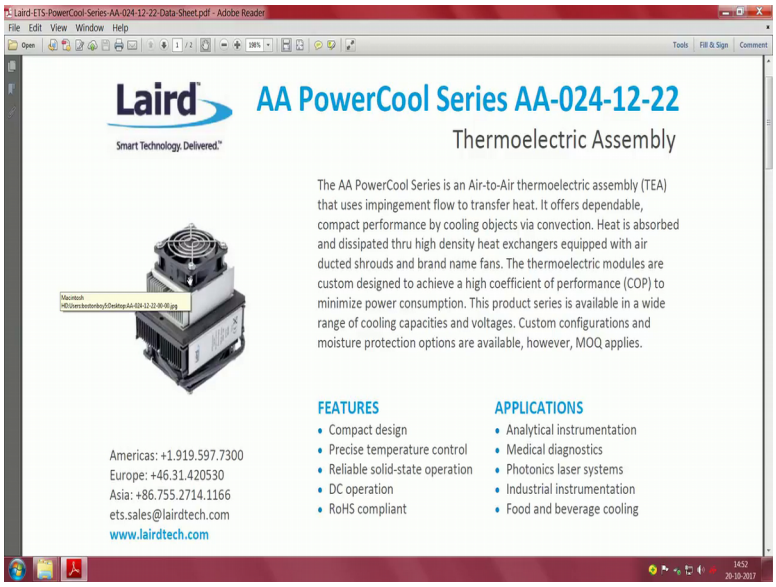


So, if you see if you go to these what you call data sheets we have a very interesting thing, have you noticed? Oh, we have something which seems to have a fan on this side and a fan on this side also. And what you will notice is no insulation anywhere. So, what is the reason for such a what you call obviously something you know which beats the whole thing of what I was talking about.

So, you can read it for yourself. Typically, these are mounted across a wall. If you have a wall, inside you have a space, so you have a what you call hot air coming out one side

and cold air coming out one side depending on which way you wanted. You can now use this air to fill up a space you want.

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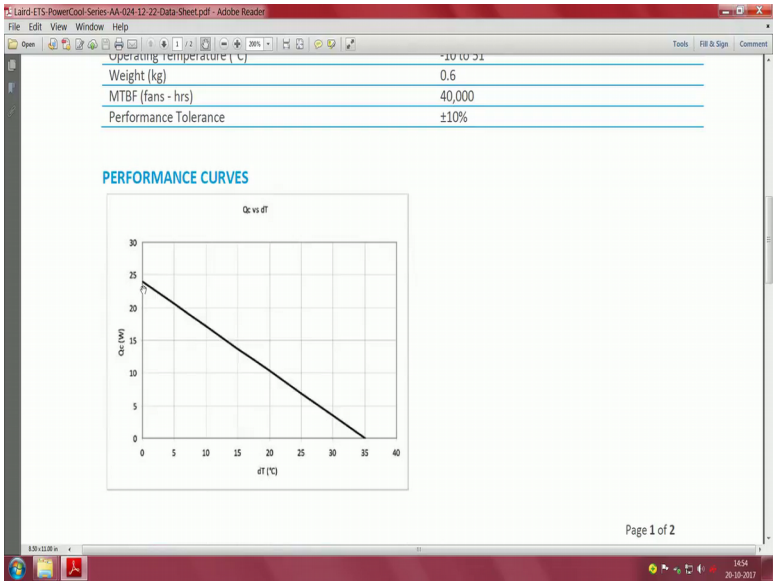


So, if you have a small area, which you need to cool. So, it is possible for us again now one more time the what you call total watts versus a temperature difference performance curves are given here.

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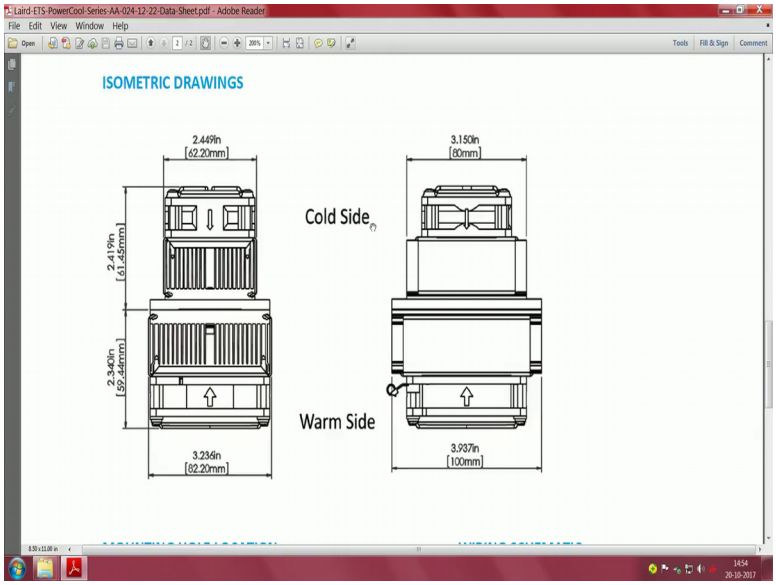


And there are two clear a warm side and a cold side may being a little what you call nitpicker this is not an isometric drawing it is basically three view drawing to your

shown here. The idea being if you put it in a enclosed space meaning you have a box here. And I mean if you keep the box here inside the box become cold, and this time becomes warm outside. And you can play around and see what best you can do in the application that is provided here. I will come back to this later.

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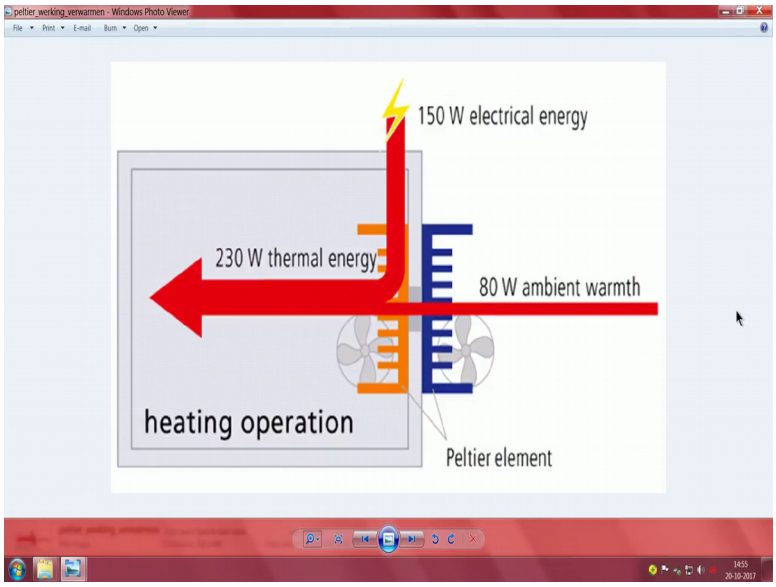


Obviously one of the advantage is it is reversible. Have you noticed it? Only for you know sort of making very making it extremely simple they have put 150 here and they have put it 230 here and 80 here. So, obviously, this 150 you know plus this 80 will give you this thing I mean you can take it you can take it as you like.

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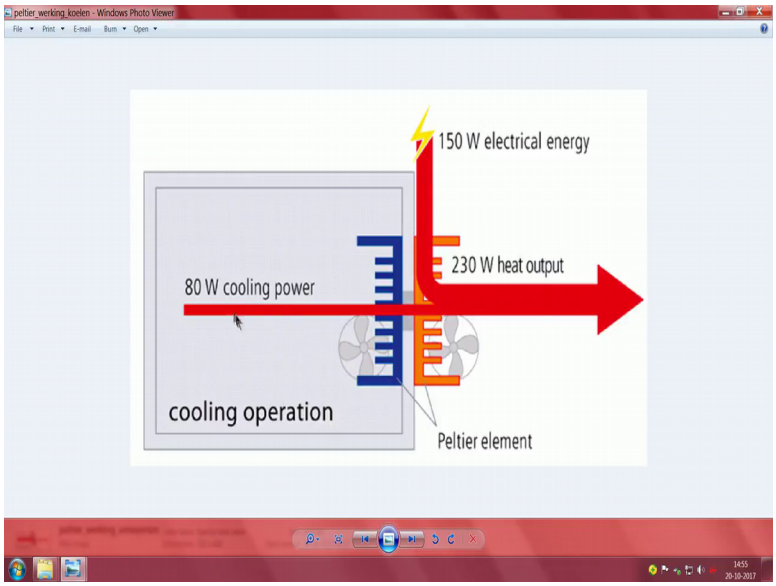


And happily they have reversed by reversing it, you get 80 watt cooling power, but then you see very very interesting thing here. To get a 80 watt cooling power here, you are not just sending out 80 watts outside this is why I showed you this figure, because inherently other than 80 watt is total 150 watts of various losses are there in this. So, something like three times the amount of heat you will be expanding and expanding, and then same this 230 watts equivalent I am sorry 150 watts equivalent electrical energy.

If you want to cool 80 watts twice of that much of electricity you see 80 watts cooling and then you end up with having twice, as much electrical energy to be pumped into that. This is a little bit of the trade off when we are using it, but the main advantage is reversible. So, in this case, you know you can maybe you can cool it. And if you want it you can heat it is exactly the reason why we have started our sample with those things.

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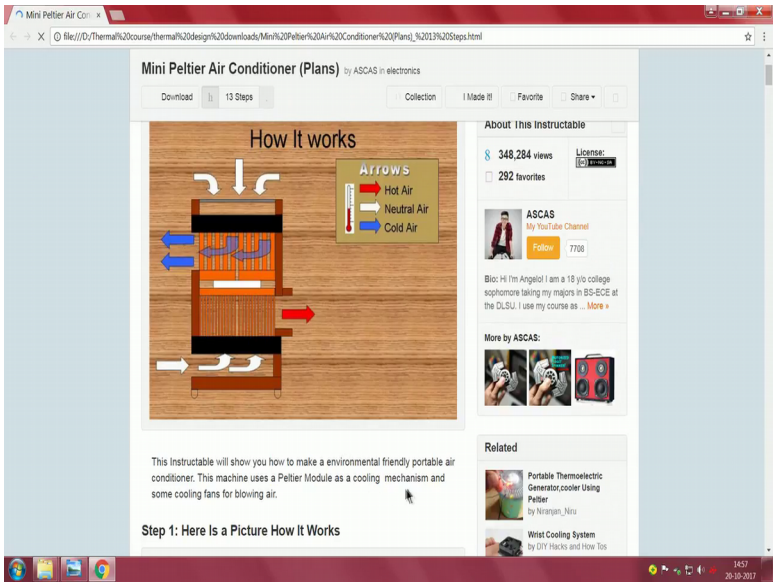


I hope, I have made something clear. Those of you are curious can go to instructables. Instructables has given a fantastic portable air conditioner uses a Peltier as a cooling mechanism and some cooling fans were blowing air. It is good as a novelty as an experiment, but I feel a little let down when I see that some big corporate has gone about promoting it saying this is the answer to India's you know air conditioning and refrigeration work.

So, well I have no comment on their what you call positioning statement. I do not think it has been thoroughly calculated compared to that if you take a small new three and four star compressor type refrigerators which would like to see in probably you will see in your wine coolers and all that they work better I will just stop there. You need to design those things.

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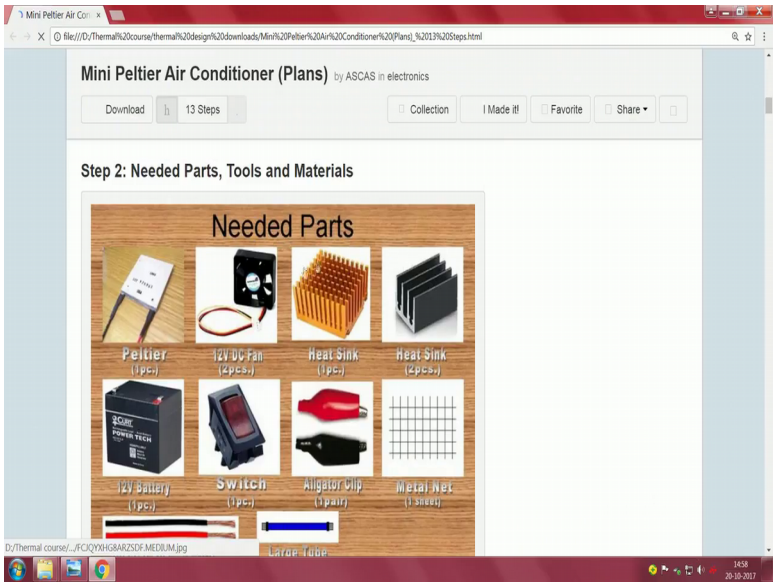


So, instructables has given a beautiful nice thing any of your curious and you have taken this I am sure that is why your reading all this. I suggest you try it out. So, the way heat sink there are two types of heat sinks. And then eventually you see this white stuff that is the thermoelectric stuff. And then what they have done is they have made a cabinet like thing. So, air comes here and goes out ok. So, this part of it is the whichever it is know in the part which you want to this is the hot side. And the cool side the ambient air inside your cabinet or inside your room is taken, and then cold air is thrown out, hot air is thrown here. And it is fully reversible is a small novelty item it is very very useful for you; sorry, if you can show me this again.

I have two modules here can you see I have these two Peltier modules show this. We come to the next interesting aspect if you have to keep them parallel like this meaning parallel in the thermal way that you keep a I mean cold I will I will keep a hot thing this side and the cold thing this side ok, a rather hot this side and cold this side these are running in parallel more cooling capacity can be brought about that queue you know brought about.

And we can keep it in series, when we keep it in series leave out the electrical thing at the mind, when we keep it in series you have one lets a hot surface cold, again cold to hot again cold surface. So, you get a much better temperature differential here. These things are also built there and in one of the in their catalogues they have given it.

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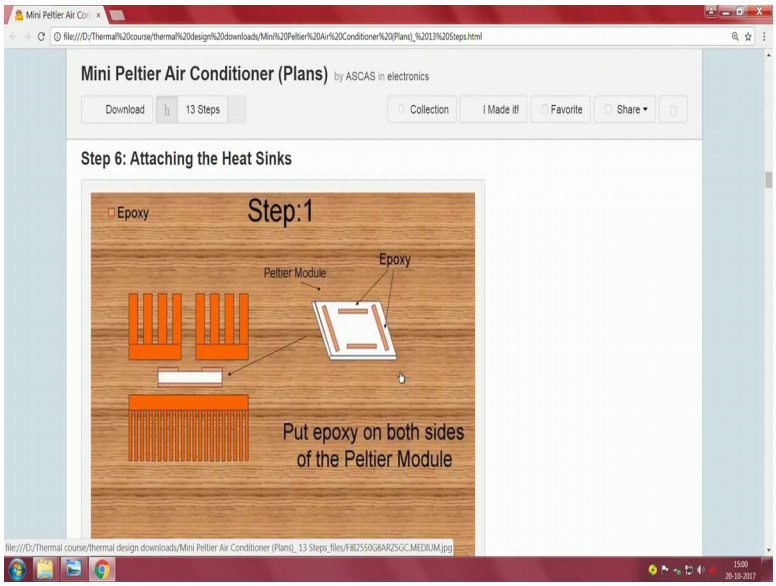


So, it is for you to go about trying to do how to mount these things. So, he has happily given you know some epoxy thing and all that, not very good because the conductivity is not good. You need to put a proper bonding compound high conductivity bonding compound is available.

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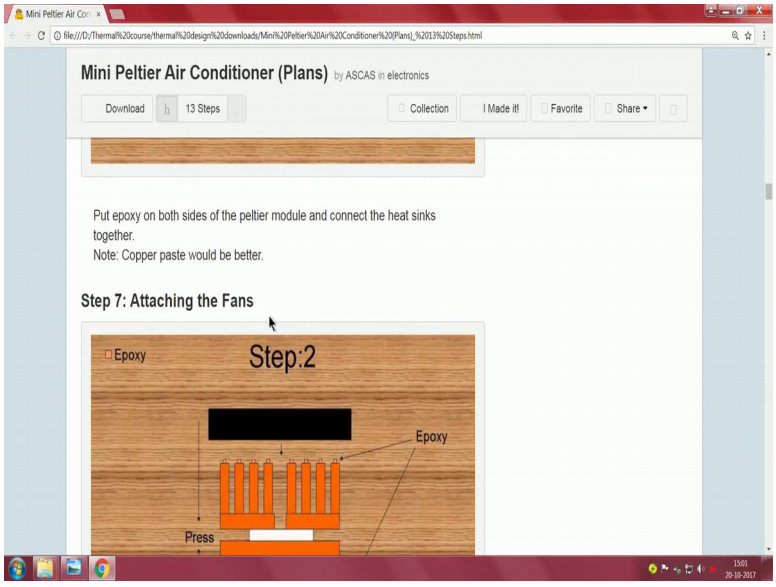


Connect the heat sinks together copper paste you see here very nicely very nicely very very properly he has given know if you can get a loaded copper paste like thing. It will

be much better then you attach the fans. And then in the end you can have beautifully done thing.

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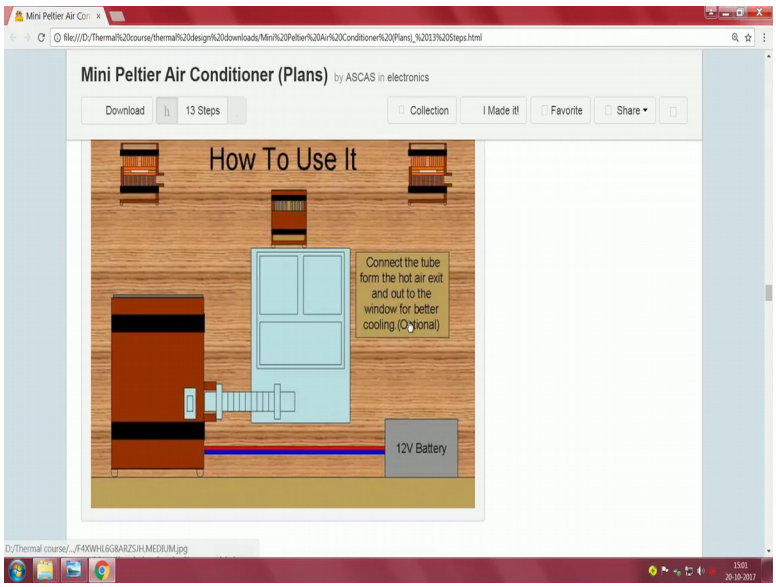


What it looks like he has given a schematic how to use it of course, it is for you to decide on you know he says you take a tube and then you throw out the air from the window and then just read the thing as a novelty aspect. What you call improving the whole system, yes, there are modules which are you see directly stacked here, can you see? Two modules are stuck together, I will just click on it and I hope it opens if you are lucky, yeah. Yeah, I think it is opening slowly it will open.

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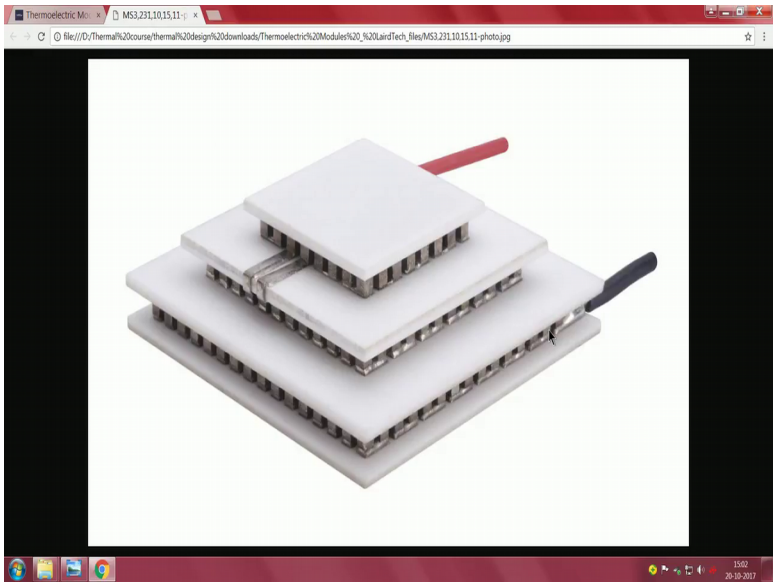

Oh something very unusual, how come both are I mean all of them are not of the same size they are obviously not of the same size why, and here they both seem to be of the same size. So, having calculated the whole or some settings here I am not able to reach it; by yourself you can read it. What has been done here is depending on the what you call physical configuration two of them directly you can just like what I have shown you here you know you can put them in series.

Then they will notice that more and more area is required because temperature differential is not sufficient. So, the area that is required for transfer has to be increased, and total q has to be handled hence you know this type of configurations require better way of operating these things.

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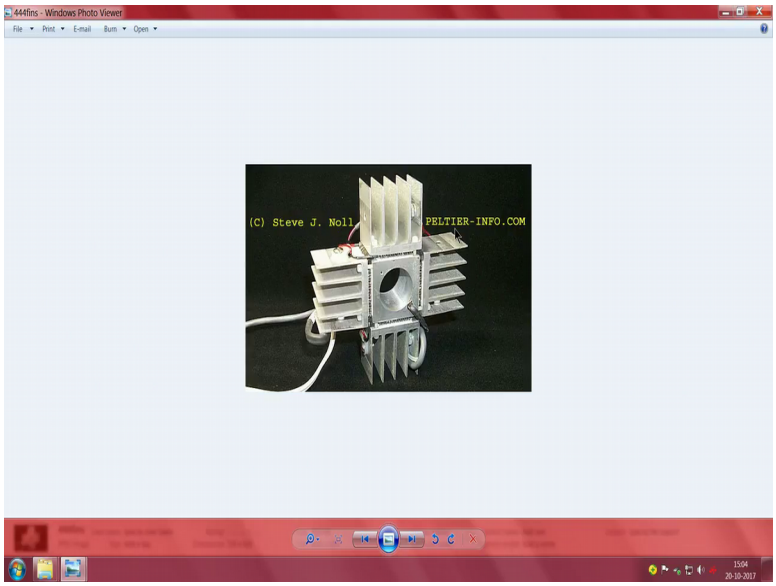


Now, we come to do I stop there. See a very, very interesting thing why just stop it, one face why not we put it in all the faces there some here who have tried putting it in all the four faces. So, you have four thermoelectric Peltier modules here, and then your heat sinks attached to here. And the main advantage for it is if you now put a fan all around it, and you see the profile of these fins, you probably get the best efficiency on how well you can throw away the heat. I wanted to show you exactly for this.

So, it is for us to now play around with it and now do we have to stop here, and then what happens to the corner here; This is where now your innovativeness comes and see best and obviously, you cannot have this you know, but it is very much possible that you have you know one or two more fins fitted here, but this base is not there for you to transfer the heat.

So, this is typically what is done for various types of oh sorry. If you go back to the beginning you have various types in each of these; what you call systems the application notes and however and how you make it are all clearly explained here saying you have things which are kept in series then you have things which you know different type of things you have seen here. Two steps sizes are small, some reason I am not able to open it, but you can go to this lairdetech and then see what best you can do. So, my point is it is essential for you to play around with this. Now, are there any practical applications, yes.

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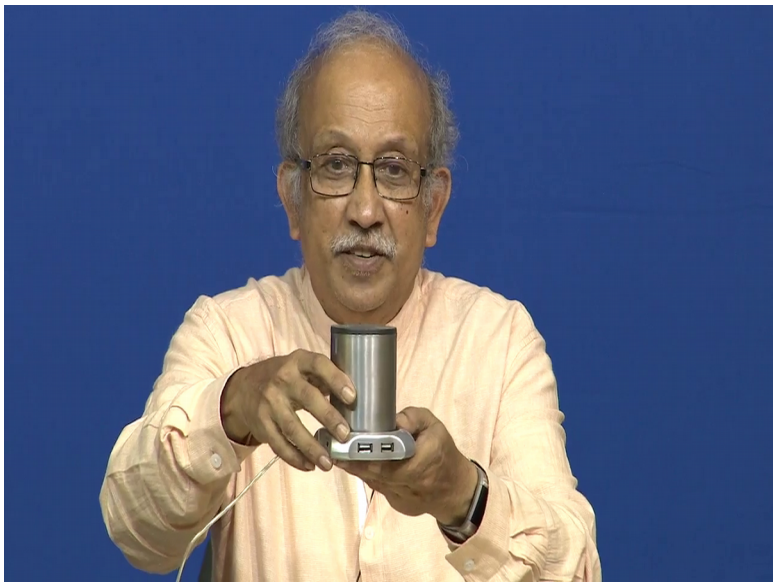

I will draw here notice to my favourite this thing I am sure quite a lot of you have seen this USB. I am sure you two have noticed that this probably you know these slots these USB what you call sockets obviously, cannot give 500 out from computer and 500 into 4 this bits the whole physics has we know it. So, it has also a place for giving a 5 volt dc externally. If you give this 5 volt dc externally it can support 2 watts that is actually five hundred I m sorry 2 amps for this plus a small heater which is there here.

Now, this heater happily is giving me warm, tea, I heat it bring it here. And then if I have that what is equivalent to a tea cosy, I keep it all I am sure a lot of you people have the coffee or tea pot which is insulated tea pot at the bottom if you have an access to this directly you can have a tea which you can stay there. And you can steep the tea as you like initial tea will be all right and so on like that

Now, I come to the advantage of having a imagine this is replaced by a Peltier you know what we have. You can have a cold drink, oh I do not want to use the word fizz that I do not want to use the word soda, I do not want to use the word you know we have unmentionable low alcoholic beverage. But then you know what it is we are all talking about it is possible for us now to have a portable cooling device.

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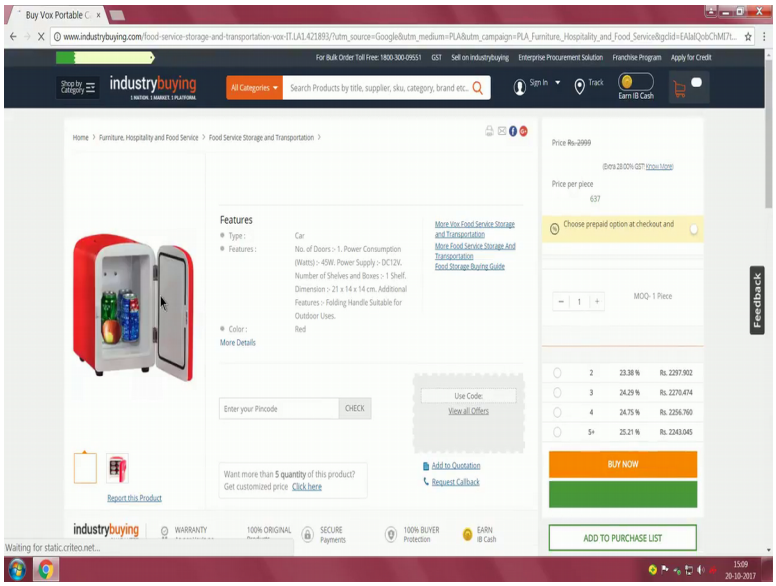


So, I will try my luck on the internet now saying you must have seen these ads everywhere ok. So, we have an apple, and then I see that there is a blue coloured something, a green coloured and probably a red coloured whole thing is insulated. They call it mini-refrigerators. The issue being you cannot really cool anything, you understand, but you can keep it cold by switching it on.