Enclosure Design of Electronics Equipment
Prof. N V Chalapathi Rao
Department of Electronic Systems Engineering
Indian Institute of Science, Bangalore

Lecture – 34
Sealed Enclosures Video

Good morning, we are back again. So, for I have been concentrating on simple sheet metal work with which you will be able to make small equipment that is required and things related to instrumentation and such places.

Now we are in the power electronics lab of DSC Indian institute of science Bangalore. So, you see here 2 types of activities are there. One of them is are basically our students try to learn techniques and control, and while control is I mean good and we need to learn, basic working with the basic power electronics is a field by itself. Unlike other fields we have a little problem here, because of the heavy investments needed in all that. Power electronics companies have invested heavily into both improvement of the semiconductors classically the IGBTS, and then also improvement and the boxes are the packaging issues related with it.

This is depending on the application it varies from highly harsh to relatively simpler items. Now we will have a look at the one of the things which is regularly used in the labs.

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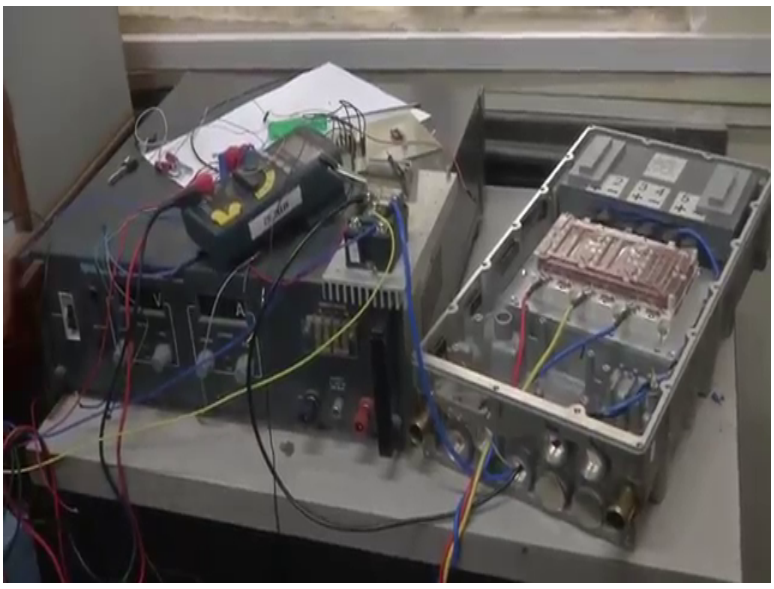

This is a very simple for device, you see here we have a sheet, I mean while it is not a infinite heat sink. Conventionality it is called a heat sink it is nothing but something which dissipates heat. And then this is a fully completed dry, tough. If we see the dry the actual active element is probably only this much, you understood? The active element based us the switching element is only less there is little brownish colored module, loosely let me call it an IGBT without further qualifying it.

One of the first things you will notice is, while the IGBT technologies improved tremendously the other associated thing still need to be carried on. One of the means it needs tremendous getting circuits and so on. And we still have the issue of a monstrous capacitor for stabilizing the DC link voltages. And then all of them are generally made to for around and the researcher made all around 600 volts. While the input of it is a DC link and the output you have the usual RY beam going to various other things. Most critical part of it is, cooling or you like to know it in spite of all of them being switched devices they still tremendous generation of heat. In spite of them being switch devices, there is a tremendous amount of heat.

Now, if you go back to the device you see here. We have two nipples here brass nipples. These brass nipples are connected to an elaborate water cooling circuit underneath this; underneath this we have a water cooling circuit. So, we have a cold plate and then depending on the type of input we give we can control the temperature. Traditionally they try to use only normal ambient temperature water cold devices. Afterwards I will show you this if you give I mean it is obvious if you give some any fluid at a given temperature, this will come out a little hotter depending on the rate of temperature rise. Would have also seen it in what is called here one liter instant geyser, the traditional one liter instant geyser, if you keep it in a in a bucket of water which you will give around 5 to 10 degrees raise at temperature. At very low flow it leave you 10 degrees when it is flowing freely it will add to about 2 degrees 2, 3 degree centigrade.

I will now point out to you the way anybody we will start their design. So, at the back of me you see that we have several of this power devices.

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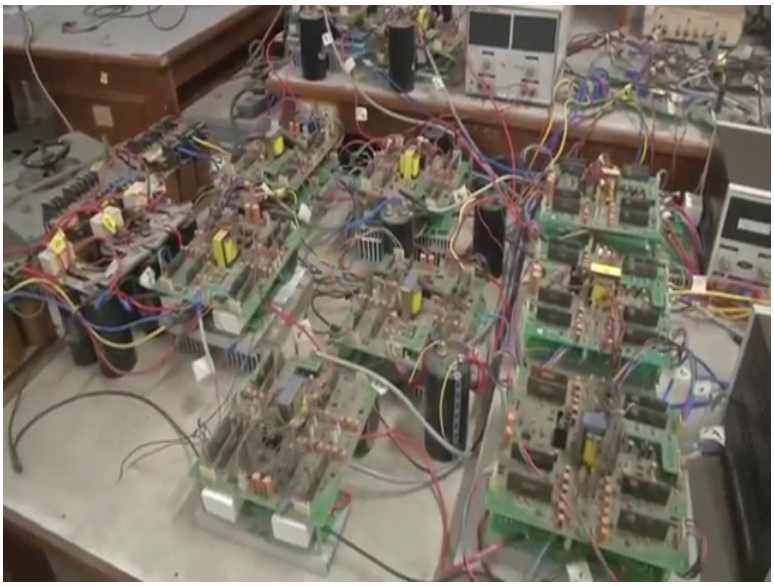

And then most of these power devices invariably they get mounted on a heat sink of solids, then these are all the gating circuits, you may ask me is it real or is it there yes all of it is real all of it has been tried and let us say I say I am not touching them. I did not know if there actually really live life, and then we have this heat spreader on which you know invariably all this gating devices are all are mounted.

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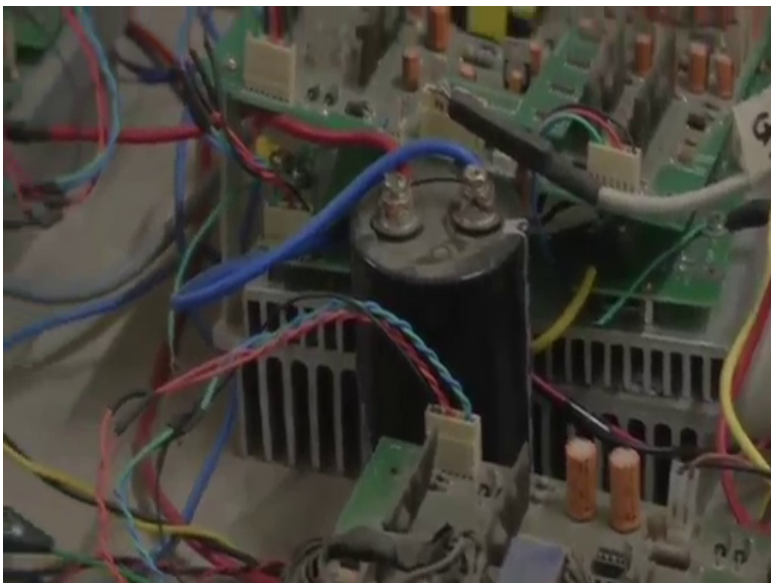

This cover has been taken from that unit is the intentional.

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Just to show you that what looks smooth outside. And In fact, it looks a little like what you are likely to find in an automobile engine.

So, you have a nail cover outside and then you have this what are traditionally called counter bore, but open counter bore. Then I can put a screw in it tight net. Intentionally it thus when made smooth and what you call, So that it does not attract us that. You see inside a little bit of design which is quite a little like your plastic designer still there, you have ribbing here or all thickness is kept to the minimum and you have a gasket here and you say the formation of the gasket it follows inside those things. Is starting point of that drive what you have seen there is probably is very crude aluminium casting right now because it is our purpose is to learn.

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They have adopted one of the standard practices this is a normal green mould or gravity die casting. Sander die casting not made in a thing. You see here things look a little rough and you may even find what are called mould flashes, you find flashes here. And the most important point is the that trying to reproduce what all that cooling circuits there inside. A word of caution here you should never open and existing equipment and trying to copy you should never open and existing equipment and try to copy whatever they have done there.

First issue is material is different. Secondly, the cooling techniques are different the liquid and all that thirdly, transient behavior is very, very different, because of the material properties when you do the thing it my work, and In fact, it may even stand for a soak test. A 24 hour soak test under simulated bad conditions it may still hold. Or in a matter of time maybe a few months you will see that thing start decorating and the first leakage everything explodes, say I will now point out to the power devices. So, typically this is that brown colour device, you have seen here?

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This is what you are likely to find inside, this is all these power devices you seen this?

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Something happened and everything has grown up.

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Not easy, we have this here this thing sit here, and this it is all transfer to another clamping plate that clamping plate comes and sit is here.

So, right now whatever people will try to do is, apply a tremendous factor of safety. What are the factor of safety is, after drilling all this and then making some channels there will see if this aluminium itself is sufficient. And as much as possible not copy the device which is there, the device which I have shown you, which is the problem.

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And now have a look at even this is monstrous; I know what I it called them. There actually DC link connectors. Now you know how important it is to take this some amount of current you see here there thick and outside well it looks like that I am not sure actually whether it is aluminium or it is copper several times that directly use copper. And then it is plated to make sure that is there and then any voltage drop is not allowed.

We have come to another section of these same power electronics lab, I thought I will show you that all these things When there is start it is very convenient for us to start with simple sheet metal.

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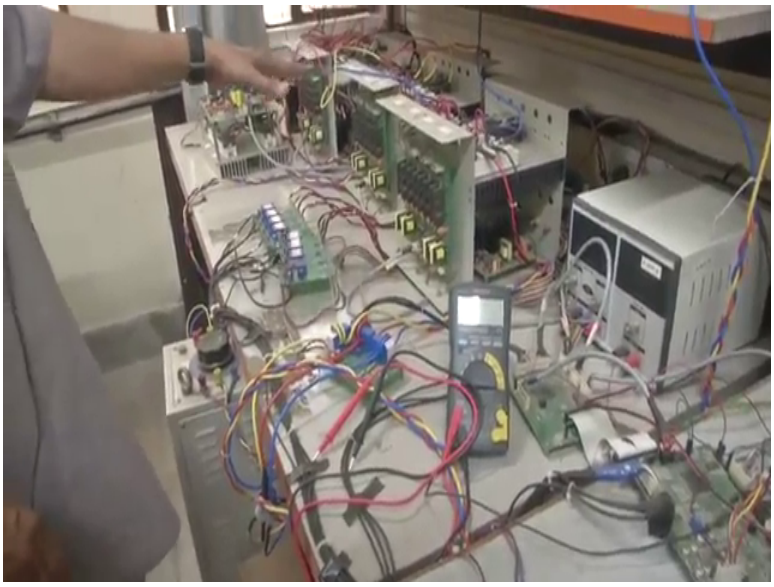

So, we have a c shaped what you call us support. Then we have this so called heat spreader, then the devices are all mounted there. And then it is easy for us to understand analyze and it is not tightly packed. So, start from here, then they whole place you see here these are the capacitors and that link voltage what I was talking to about link current So, they try their best to put whatever they can do and then see that the basic technologies proven.

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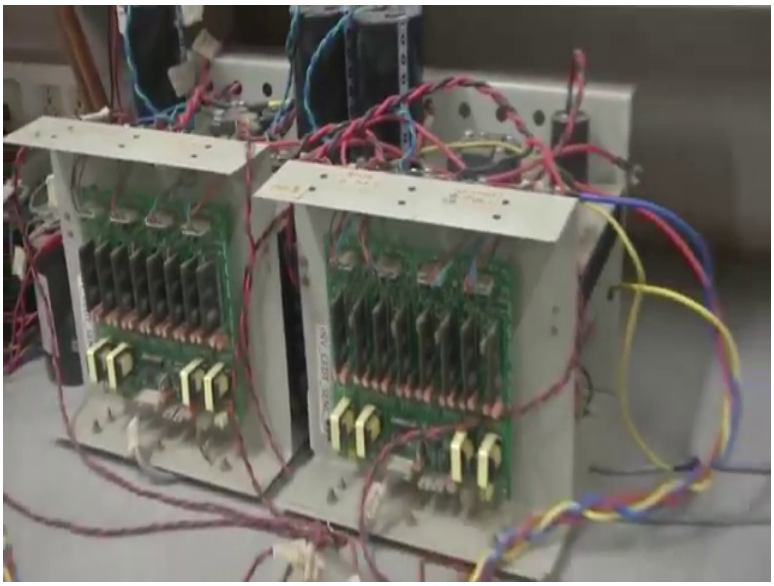

After the whole thing has proven, we probably end up here a product like this.

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This is about made 25, 30 years old made for a high speed induction motor that is used in a PC biteral.

You see here it says 1000 rpm 50 so, it is expected to work beautifully at 50, 1000 rpm. That is a lot of rpm and then it has all the features. Why I am showing it is a complete product like this is still a sheet metal part. You have the heat spreader here, and then it has been made specifically in this condition. So, that it can by done on a table.

Otherwise, classically this things you will go and to a rack. In the case of a rack this whole thing will probably go up like this.

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And the control elements which we were shown in different may be mounted here otherwise, they are mounted on a extender. And sometimes it maybe even reversed, you may not see that heat spreader and all they it this is how it will be with all the necessary things.

Just part of it, which you see here may go to the back of it. But for demonstration purposes they have made it here, coming back to another location where we do not have the site supports, devices here have been kept here directly.

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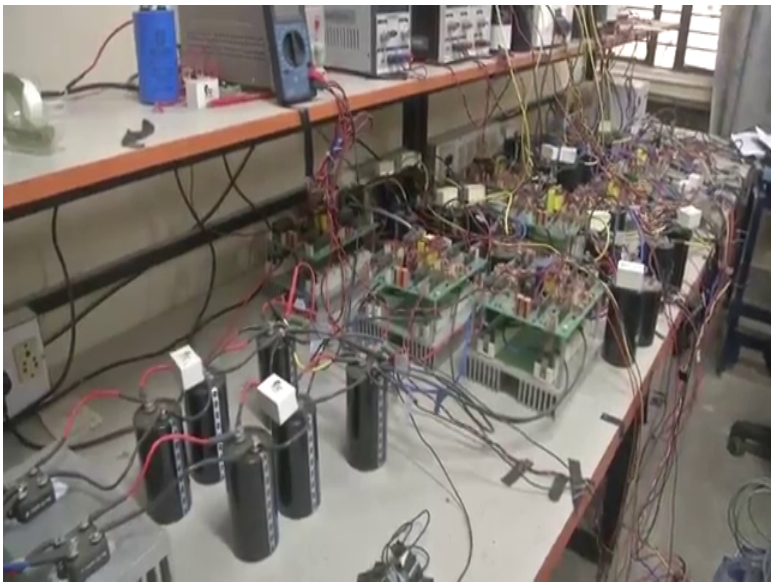

Luckily when people work in such labs the labs are built very carefully, the whole power may be by a completely isolated transformer. So, to the extent normally if it touch something you will not get a horrible thing, what you call a horrible shock, and then sometimes even the floors are insulated in this case we have not yet insulated it in future we did insulated. So, you see here we still continue to use that heat spread has everywhere and then So much of paraphernalia is required. So, that eventually we can drive a motor.

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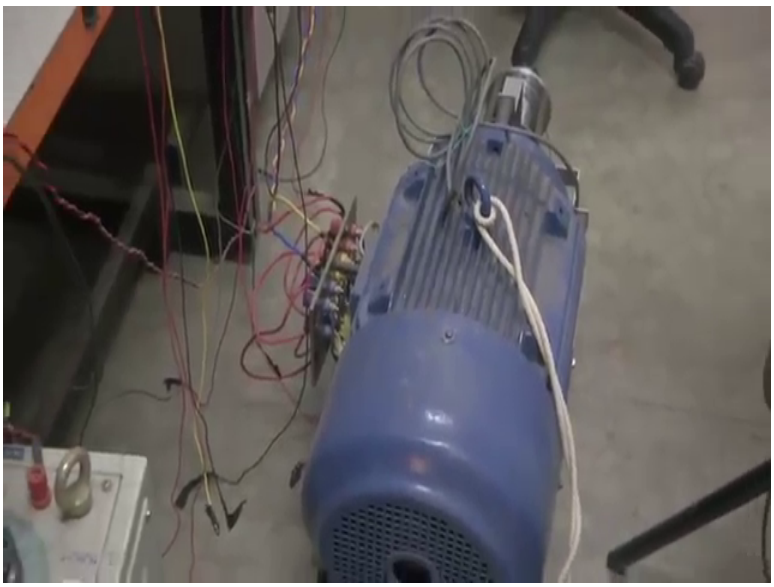

And things like variable frequency variable voltage, is very common in the industry it is not as reliable and as energy efficient has they claim.

So, still he should relating to the harmonics and whether we can have one inverter working at a various are not operating 2 motors such things are being done here. Still now here in a what looks almost like a museum, it is not actually a museum it say it is store we are being shifted to another location enhance this place.

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You see here the original some micron have made and made this things available before people could work on the finish to derive there. So, we have a picture here which just shows the old glaive by for safety, say instead of keeping them open like that they have put everything neatly on a covered by acrylic sheets. And then there you also seen one huge blower and the right side you say the inlet to the blower, and then there is a black colored nothing, that one is the what we call a radial blower unlike, the axial it is a radial blower it directly blows over this.

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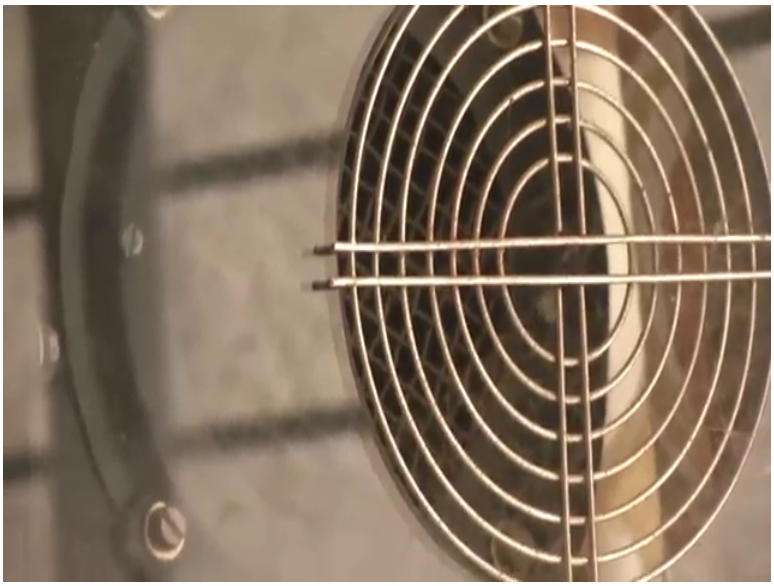

Heat sink here and we have full control about everything simple air cooled. And then the gate drive circuit say are available here, and then this here there are equipment you see here though it is a very specialist equipment, it still continues to be made using our normal what you are likely to find in the work shop.

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The equipment what I have shown you, is having an honored place, can you see what you see there is the top usual thing and the bottom? The resting place is India's attempt at the super computer. So, this is some the base of the I do not know whether it is part of

the power supply or something. So, you see this whole thing he has been assembled using very conventional 19 inch arrack components. So, you see here this again is a heat spreader and we see, I just wanted to show you that this is a supercomputer thank you.

Student: What are the equipment?

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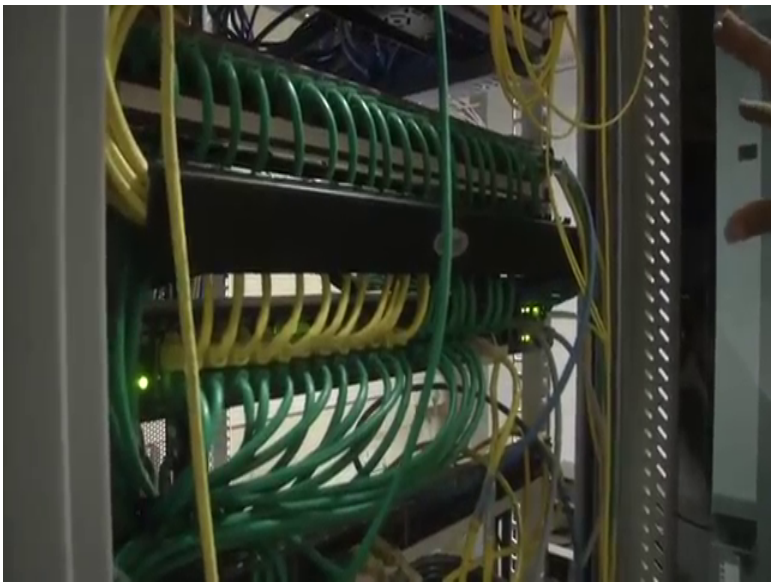

Max instead of people use (Refer Time: 15:43) this is inside we have been. We will notice that the same operations when the corporations are done in different; that means, also copied here. Then attraction is that you can continue to non dish shells and (Refer Time: 15:59) and then not very easy to (refer time: 16:01) we have all the cable trace, which take all the cables and since which just being you can readily you most of it is more completed.

Now we will have a look at different. Say see here one more time these all the various switching what you called devices. And these are all the connectors some of them adjust reflected back to front. And then you have these cable packing things and then what I was talking about is you business, you have this numbers fuse there So that when you start altering the equipments, you can see how much is one new typically is 44.45 millimeter, some multiple separate is not all equipments are made from. You have gaps you have everything and then we have so many of these, what you call peripheral equipment. And finally, to make everything just prove we have a cover, once I cover it is not likely that you see adding. And then you can also see something which is very, very

critically, yeah. This is called the lab certification against fire. So, in case there is a fire and when likely that there will be extending the (Refer Time: 17:16) this is certification against fire safety. So, it will ensure that even if you keep them is a confined environment nothing will happen.