Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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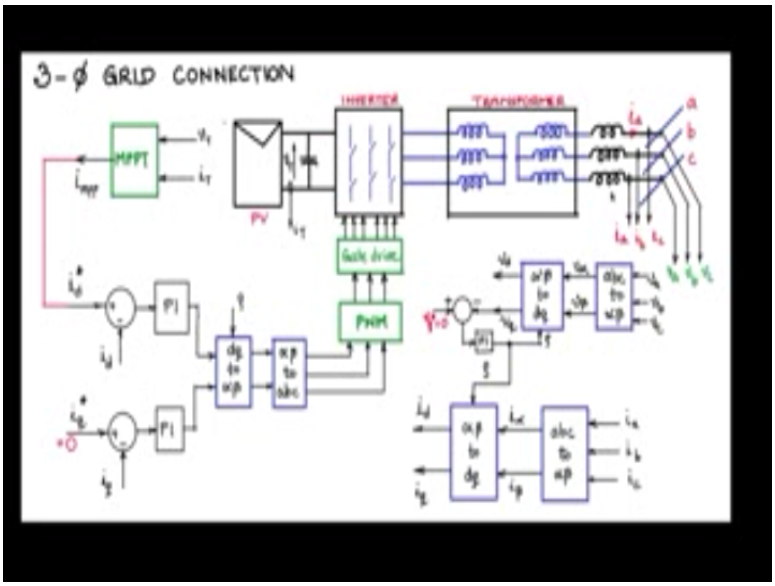

This is a 3- Ø grid connection topology we have discuss this and this topology we have implemented here it is department and on the roof top we have around 25 kilo watts of pv panel and they are connected to the grid using this same topology so I will discuss about the various components that go up to make up all this blocks.

At that will give you an idea of what goes into asking a 3 -Ø grid connected inverter so let us see where this block this pv modules or located on the roof top.

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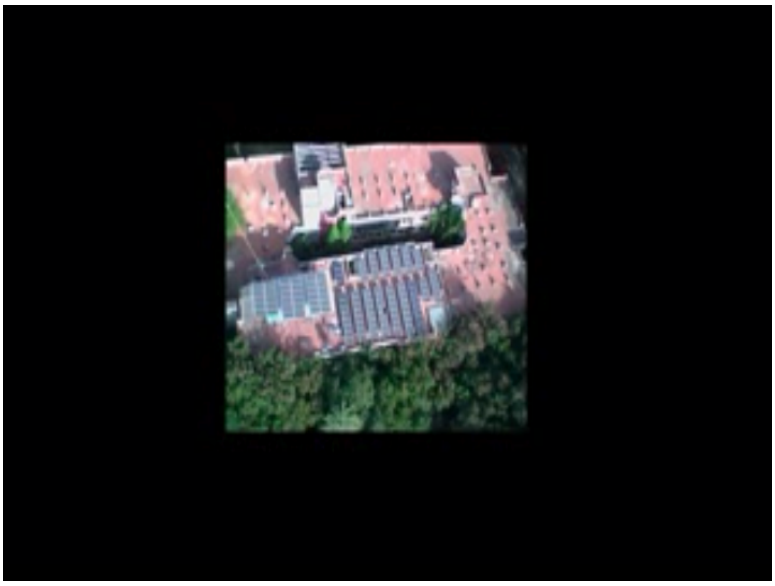

So this figure shows you the way the pv panels or amounted there is a set of panels here and there is set of panels here the one to the left were my constructor is moving this is around 10 kilo watts worth panels and they are connected to the commercial grid connected inverter now there is a set of 25 kilo watt panels here that is designed and developed the inverter are designed and developed entirely by the students.

And then maintained by the students and it is powering putting power into the grid for the past two years and that is what I would be showing how this picture was taken we sued technology we use technologies observe the string here the string is actually connected to the balloon which is having the camera mounted on that and that cameras is actually taking the shot and the picture back to our server here.

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This is another perspective of the same roof the one mounted here where I am showing the cursor movement these are the 25 kilo watts set there are 100 panels each of 250 watt rating.

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This is another angle of the same panel set in the floor just below were the panels are mounted roof there is a room called the power room and which it comes the link up to the grid this is where the building grid is and this is the panel which actually interfaces the line be power lines coming from the grid connected inverter.

And the actual grid through the switch gear and the metering for how much amount of power that is being input into the grid is being done here you also see that there is switch here there are five inverters each of 5 kilo watt and the data from the radius be board from each of the inverter is routed through this switch into the server and then we keep capturing the data of how much energy that is being put every day.

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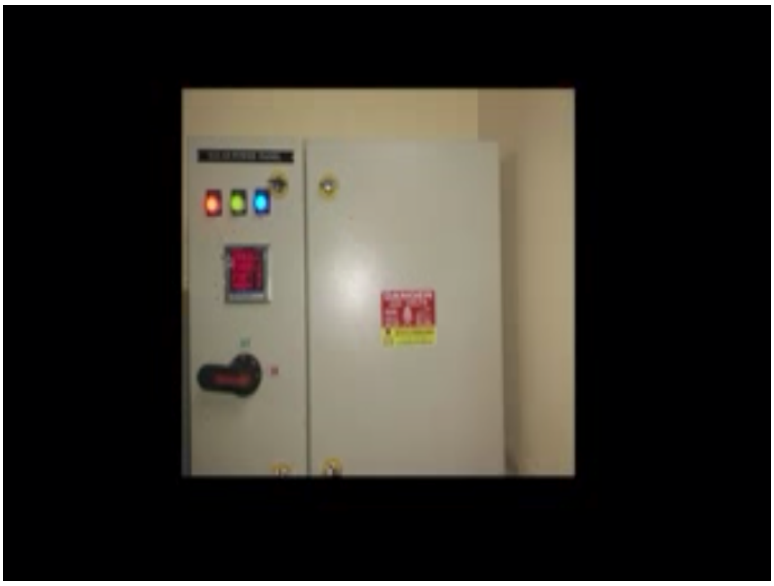

This is the power panel which interfaces the power lines coming from the inverter pv inverter and the power lines coming from the grid this actually interface panel.

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These are the racks the 19 inch rack system on to which we have place the inverters you see this six 1 inverter there is another inverter here there is another inverter this rack also contains inverters ether are two inverters in this racks so we have taken the strategy here that we make it in the form of rack modular so that we will be able to have grid and see if anything fails even for the repair purposive we can take out only back inverter which is not functional repaired it and put it back.

And we have made it using the 19 inch standards so this is where each inverter is 5 kilo watts there are 5 of them so totally 25 kilo watt is being put it into the grid there is some thermal design also has been done you see there is a duct which is coming in it is coming from outside like the ac duct which feeds the air fresher into the rack system.

There are blowers mounted on the bottom which blows air to the top there are fan from the top which is sub air and then push it out you see the duct going out so thermal considerations are important because they can become hot 25 kilo watts and even if there is 10% loss then you are the talking of 2 kilo watts + amount of power loss that can be very hot.

And you see here transformers here we anode used separate inductors we have use the leakage inductor inductance of the transformers itself and use them as the interface component to the interface the grid and the inverter more special inductor has been made the transformers are acting as isolators.

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Here is a have view of the transformers there are 3 transformers they are 5 of them 1, 2, 3 here and 2 on the other side.

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This picture shows the rack door open so you see this is the 19 inch segment and the height is 100 mm the cords are 100 mm now there are various cords insert into the sections each is one inverter this is back capacitor you will see the fan blowers here which is taken the air from the bottom and then pushing it off forcing up through the rack and on the top ether are another set of fans which will sub the air and push it out.

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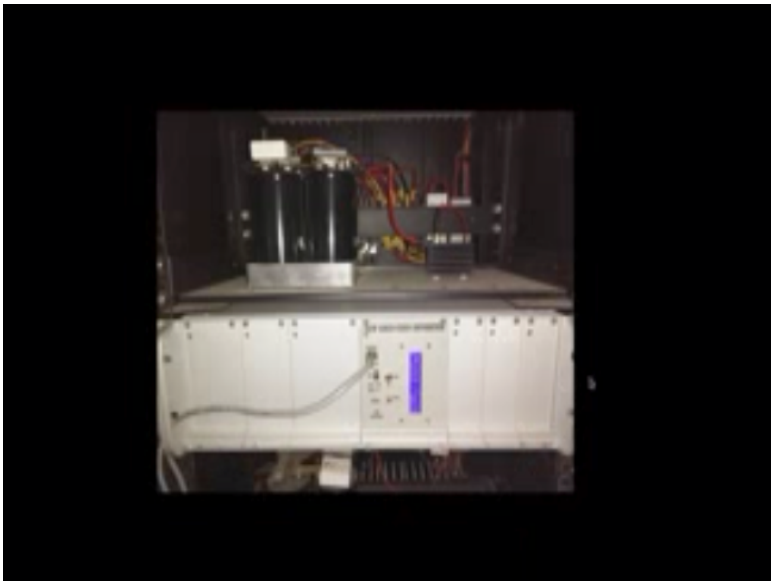

This is another closet short of the grid inverter this si where the main dsp controller board is located you see the internet cable which I going to this switch and there is a small display here the ec plus capacitor and the various cords here each section is a cord I will explain it to you what those cords are.

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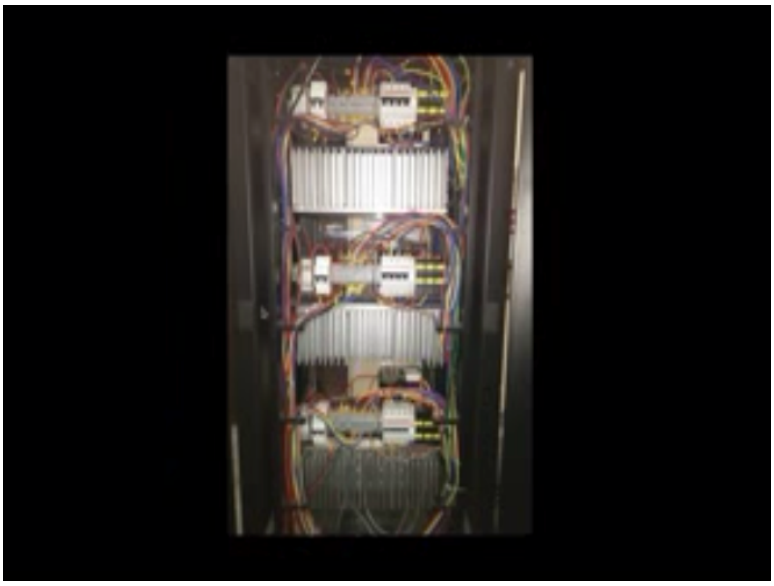

This is the back side of the rack on the back side of the rack you see the heat sinks the IGBT's or mounted 1200 volts 75 amps IGBT's or mounted on the heat sink and the heat is dissipated through the spins plus also the force you forced cooling that is flowing through the rack by means of blower the duct and the blowers and there is a system and we have use the Elmax connector and there is the whole lot of wiring that one has to do.

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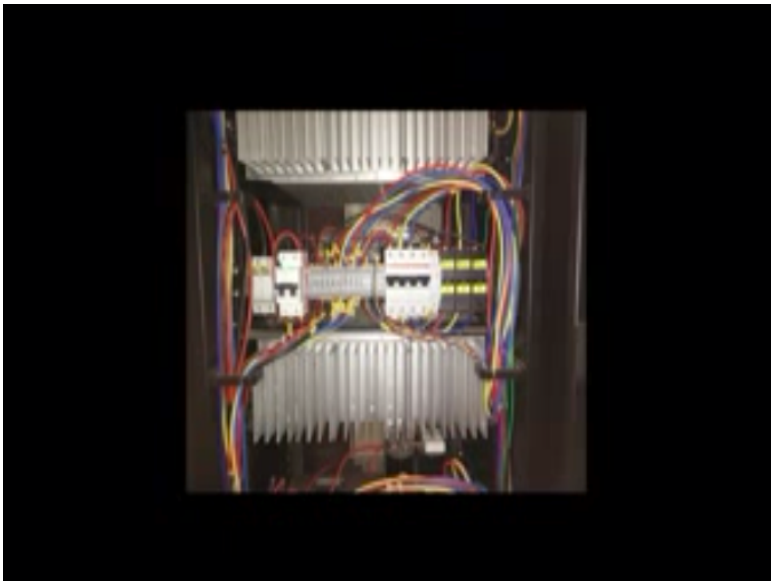

A closer shot of the back side of each inverter so you see that impale and Elmax connectors naming the parts naming the wires that are very, very important.

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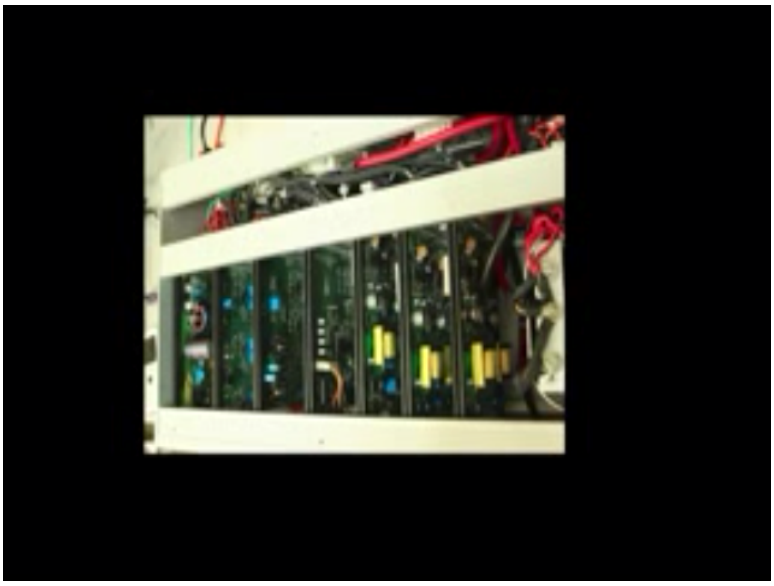

So when you open the inverter when you look at each from the top you see that arrangement of the cords like this and each section is the in a cord and the cord is made to 99 standard they are 100 mm in height and the depth can be vary there is the back plain bust also which is connected to the IGBT then IGBT's are connected on the back and then the heat sink.

So you see there are various cords what are the cords that we have used let me show you the pictures of this cords here you have the sensor cords this is the dsp bolt the main control bolt these three are the gate drive in each cord you have gate drive for top and bottom of each r so you have three cords for the six IGBT's.

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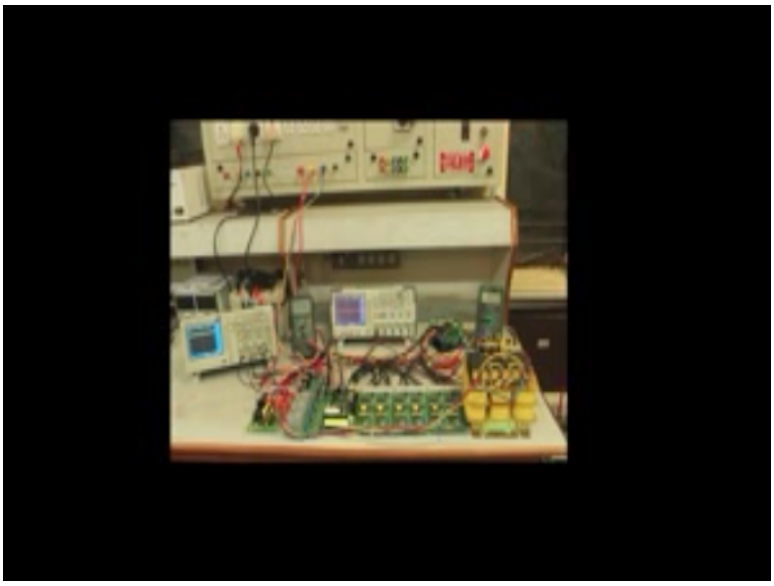

On the lap table set up for testing the various cords the grid inverter has to be tested on the lap inch before putting it into the rack.

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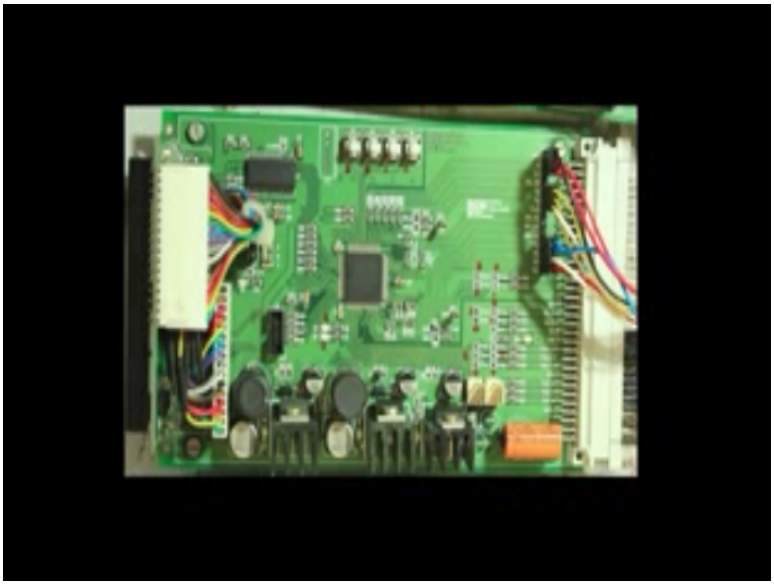

This is the control bolt so this is the tms 320 f 28x series this is the processor that we have used the power section here which power supply which may does the house keeping power for the entire bolt in generates the 1.813 volts 5 volts+12 volts for analog section all that is doen by power section.

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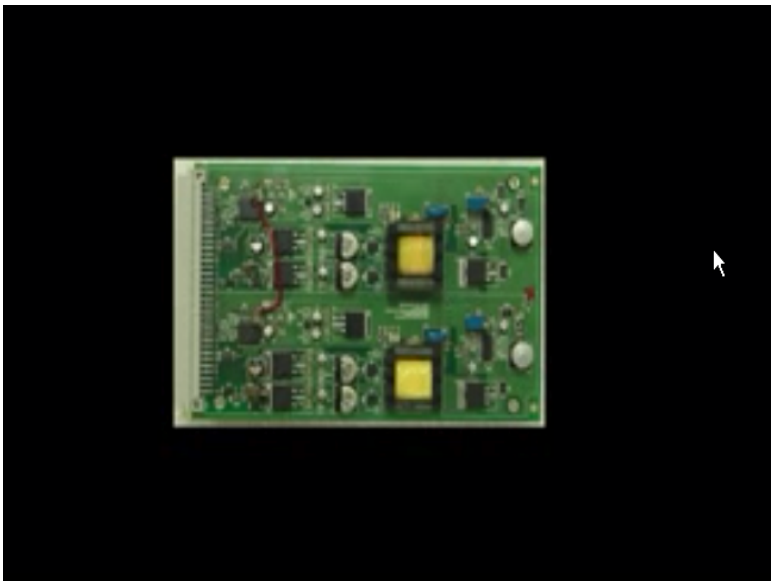

This is the gate drive cord one gate drive cord is having 2 gate drives for one for the top constant one for the bottom constant isolated gate drives so this portion this half is for one switch this portion is for another switch.

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T his is one sensor cord senses the voltage so it senses the output voltage recall.

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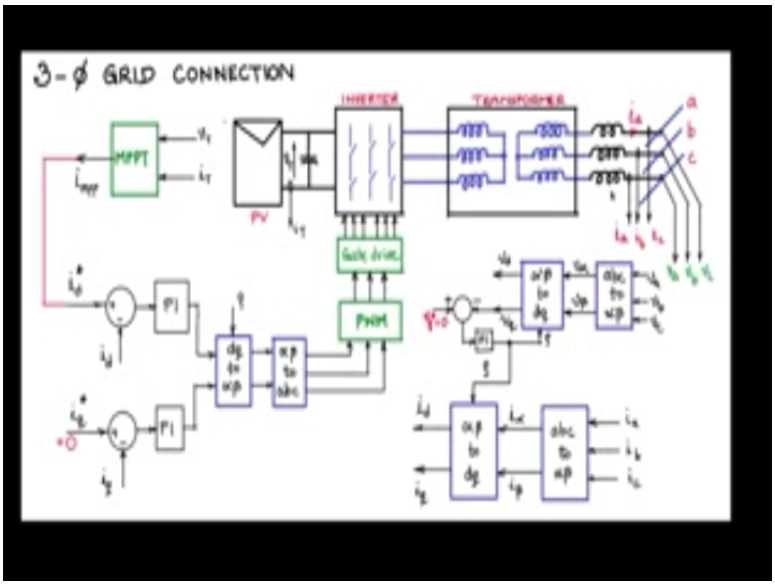

That we need to sense the output voltage va vb vc and we also need to sense the currents that are being fade into injector into the grid Ib and ic so you need a sensor cord for sensing the voltage you need a sensor cord for sensing the grid current injection.

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So this board is actually sensing Va, Vb, Vc this is the sensor cord voltage sensor cord

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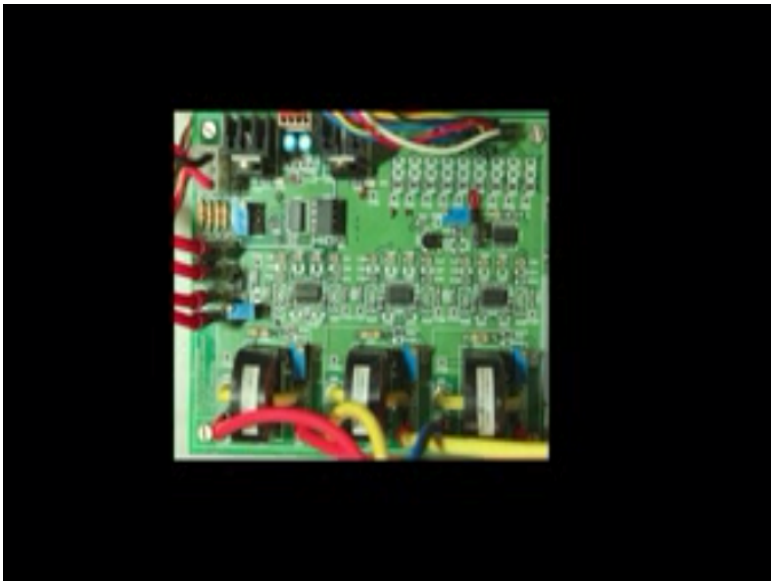

So this is another sensor cord this is for the sensing the current Ia Ib Ic so these are all sensors and we are assuming the three grid currents that are been injected see that with respect to.

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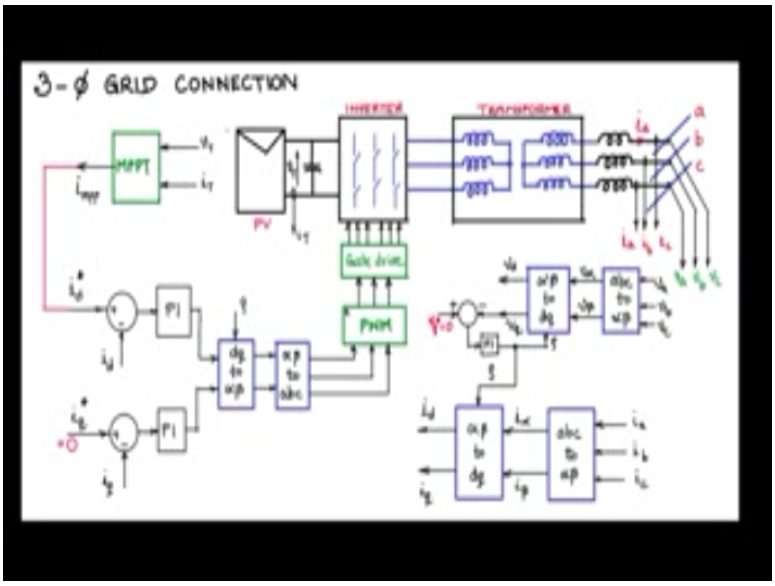

The this block diagram all this portions which I am sweeping with this mouse all this portions is within the control cord dsp processor gate drive is one cord sensing which I have just shown by three lines here is one cord voltage sensing is one cord we saw the inverter we saw the transformer now all this portion that is the dsp volts the gate drive.

And the sensor boards and sensor cords they all need power for workings so there is an input power which is been drawn from the grid side and stepping it down to 165 volts and supplying to the various cords and from those points local power supply generated for example the dsp volts may be need 3.3 volt 1.8 volts 5 volts.

So from that 15 volts which is given to each cord the local power supply is generated so the house keeping power supply for the entire control circuit is generated by one single cord I will show you that.

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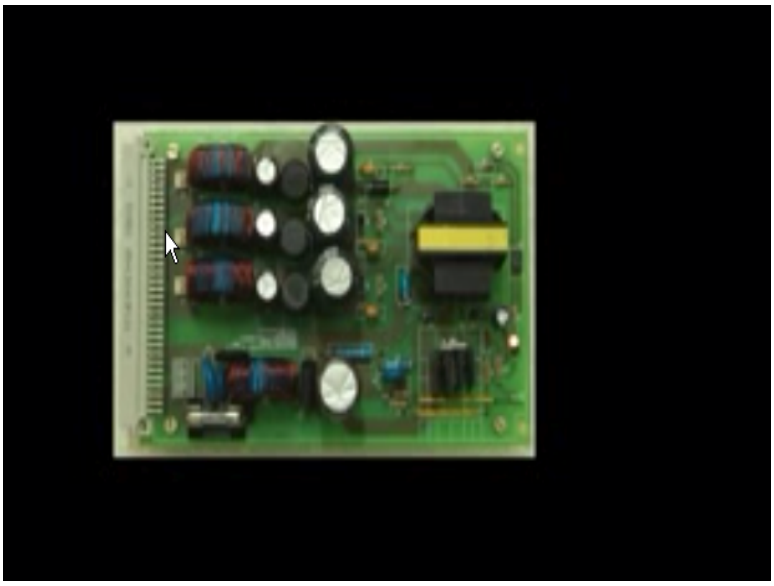

This is the power supply cord so this gives you a single output which is set to various boards and the various boards generate local parts of supply from the power that is coming from this board output.

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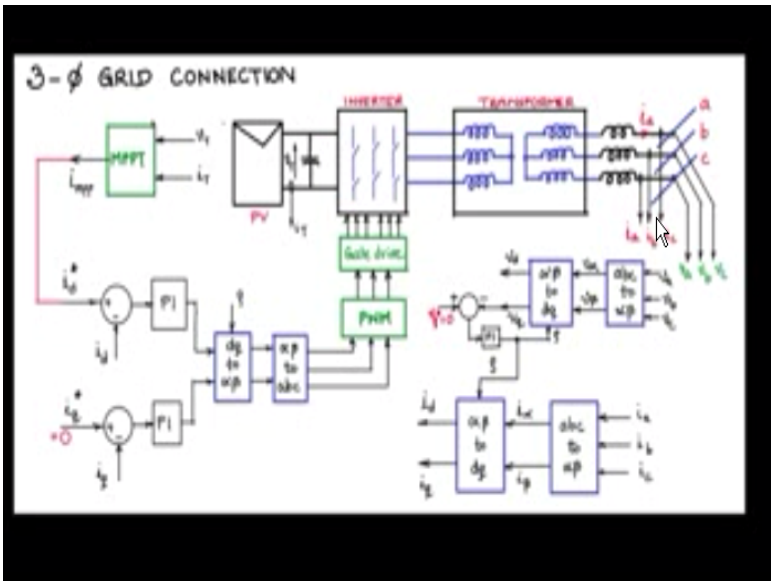

So like that you see that there are various components so this is only a topology and next we have to draw the circuits schematic then after that thinks that will not get reflected in the circuit schematic like the thermal issues that is an separate angle that we have to look at then the wiring, wiring diagram that is the another angle that you have to look at the enclosures the enclosure that is designed.

All this needs to be integrated so it is lot of work from the electronic design engineers the electrical wiring people the enclosure mechanical people the thermal people all this peoples should collaborated and coordinate to make this nice wonderful system so all this were done by different groups of students they collaborated as a scheme and together made this particular project and another parts two years it has been delivering something like 60 to 100 units every day to the local campus grid.