Enclosure Design of Electronics Equipment
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Lecture – 54
CAD Layout

Hello let me continue again where I had passed in the last lecture. As I said in the whole series an part of it was about how to conceive a product that is why that it will creative and all that stuff is there. Then something was more related to the actual packaging saying how do you select materials are more than how do you select materials how many materials are around normally used and little about the interconnections and also about the how to a little about you know little bit of wiring and harness and connectors and so on. And then eventually now we come to how to actually make the drawings. Because once you have the concept in your mind, it is very clear to you at least the outline is clear to you and eventually it will get transferred into a product.

So, what starts as a nebulous thing has to come down to actual physical drawings which can be taken to the fabrication shop. At this point the last lecture I had stressed on saying how the concept of computer aided drafting started. It went on to computer aided design and detailing, eventually it has come down to 3 dimensions. Even today for a long time in the workshop the I am sorry, my colleagues have corrected me instead of calling it workshop I should say in the fabrication facilities drawings are read and they are coded by conventions.

So, if you have to see your own house what the architect or what the civil people give. It will not be a 3 dimensional drawing of all the pipe rods and all. That it will be designations which are very specific to that particular trade. In our case we are concentrating on how to make a small equipment usually meant for early serious hobbies or beginners were joined the product design what you call exercise. And eventually it will move on into one extreme is where the military takes care, military has enough resources. And then we also have aerospace which I will say set of dou tailed whether resources are good and reliable and all that still, commercial accountability are there. Space is something else space is nothing like repair you launch and grope unlike that in the case of our serious professional equipment.

We need to make something which is reliable and eventually producible and maintainable over a long time. And latest is how do you recycle it and then life cycle management. From the product management point of view it is not about built in observations, it is about how to extend the life of the product. So, at one extreme in while wouldn't have appreciated it, in the case of software looks like we have achieved it. We have a platform and then you have upgrades all the time. Until the next what you call big thing comes out this upgrading goes on.

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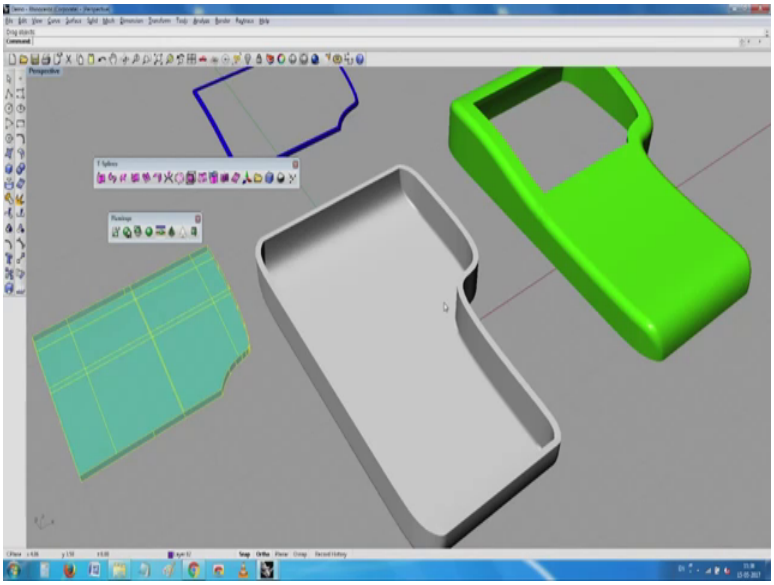

Now, please have a look at the monitor. You see here what looks like a very nice cute product. Actually it is an enclosure. You can clearly see 3 distinct parts of it, we have a bottom case we have a top case, we have a window only out of sense of aesthetics I have put it then we have a gasket here. What is missing here is this there is no nothing is shown about what is inside and how is the whole thing held together. But as a student exercise it made a lot of sense. So, at this point let me see whether there any hidden objects hidden layers I do not see too much of it in this view, I will go back to the simple wireframe. Now you see here several things related to the construction lines. You have seen this we have we have a plane here. And then we have large number of this lines which represents how we wanted the product to be. So, if I go here and for purses of clarity I will see whether I can I think this is good enough. See here on the right side I think I probably have to switch off the background grid. We have here the profile view then we have a plan view and then some fronter end view of this various objects (Refer

Time: 06:37) are there. How did we get here? I have just showing you the end result at this point now I will get back get out of this here. And then we are now try to get back to a series of, I think several of you must have been using these boards.

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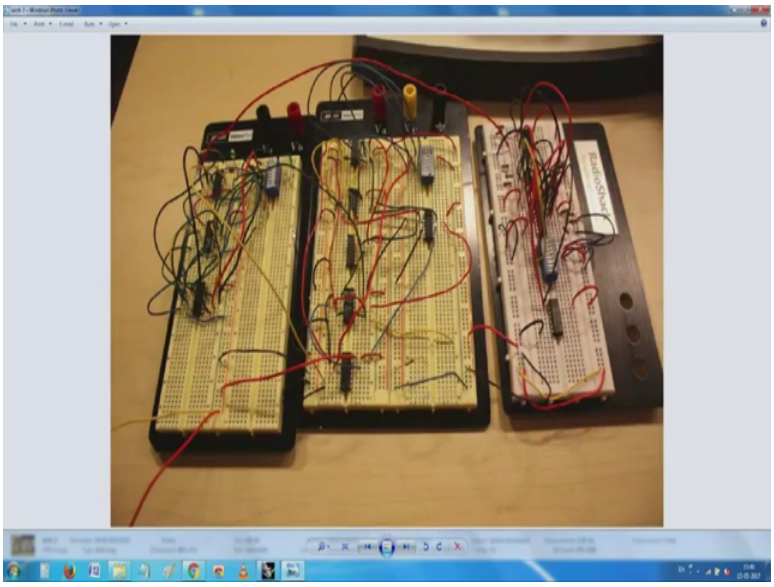

I do not know the generic name, but here it says radio shacks some proto board or something. What you notice here is there are several small sockets. You can plug-in here components attach them together and make first of a working concept. So, that next slide will show you more and more of the similar things.

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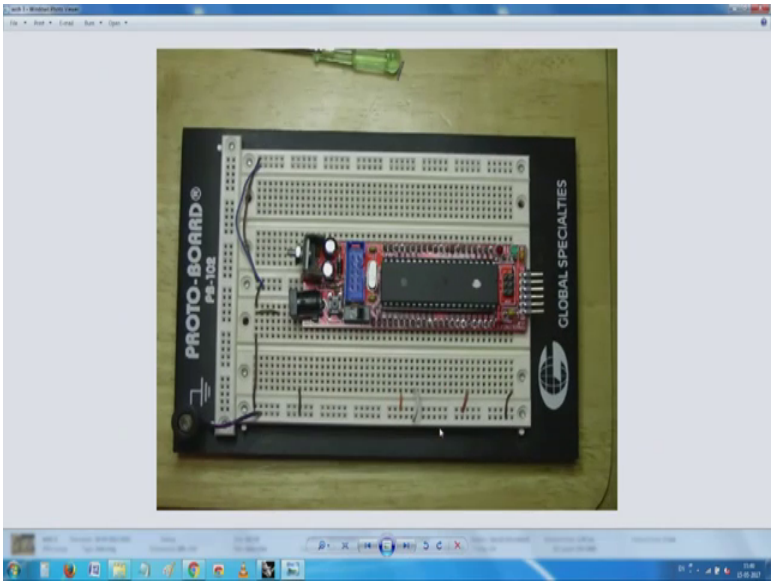

Except have you seen here, a full circuit board itself is plugged inside, some of them will go an automatically some of them do not go, but just a few of the features I would like to point out here is we have these output something I will not use any word some connectors here and then you have a regulator here, then we have the power input here.

And I expect here there are input and output pins that will make us access the particular this thing say, if you notice this one of the first thing you will notice is it is only hardware. You have on off switch then you have crystal probably this is a reset button then you have some capacitors here then you have some other type of connector and so on. And to make it work there are power supplies connected and you know things are fed and so on.

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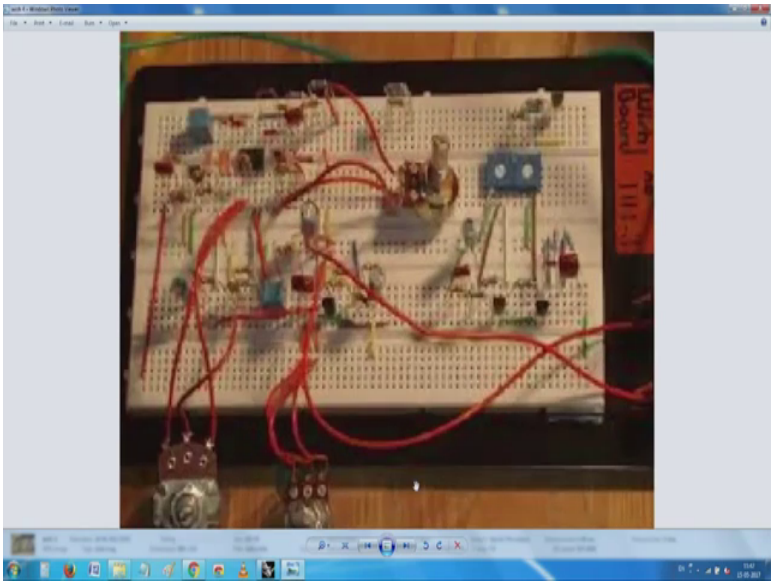

There is a little more with discreet components except hat you see here some of these components are more like hobby components, less of professional components, but the issue being that we can prove that our electrical or electronic one component works.

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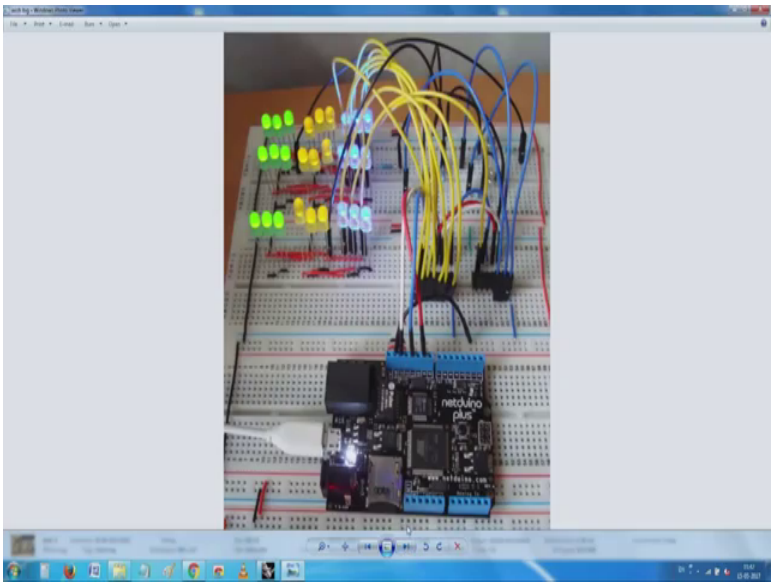

You have seen there somebody has made a next level of nothing oh I do not know what exactly it means.

I expect it is one readymade piece we except that outside know you have connectors here and they are all connected here. And then you have a circuit that is running here. While at this level it is very convenient it is very good for us it is not very practical for us to convert it into product.

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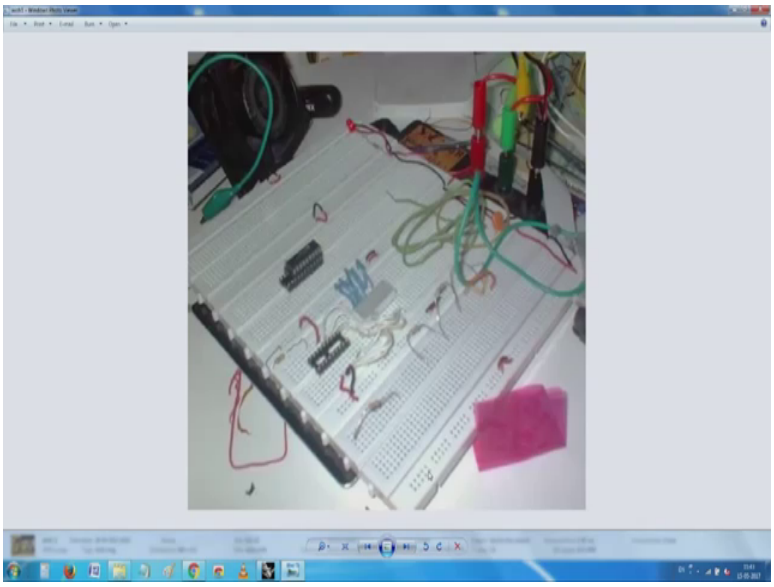

And In fact, there will be a provision for us we can give an power supply I do not know

if it is a looks a like a fan or anything.

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Now you see in real life the product seems to be packaged very well and neat and clean and I am sure you have seen all of these things. Left side is a what was conventionally a dark room timer, except this is not a dark room where is just a timer. Then you have the (Refer Time: 10:17) calculator.

Now, if you see this calculator; obviously, one of the first thing you will notice is it has a beautiful display and then because it is written, now something here dual source is a solar panel. And then there are several types of keys of varying, which and all this next slide will now show.

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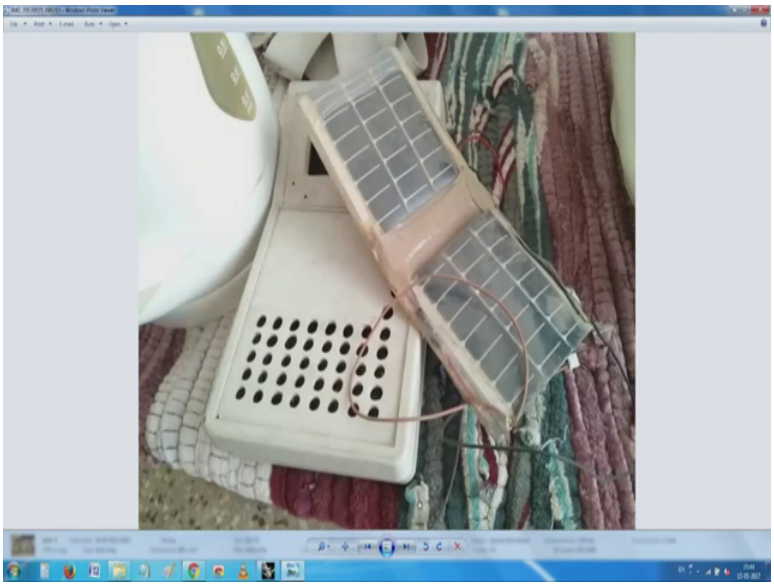

You if we were to take off the shelf components. So, right side is a small collection of solar I do not know solar cells and solded together and so on. And then you will notice that I think I should put my hand there oh there do not you see, there also solar cells there all you know powered together and then they can be connected to this small equipment. The equipment has small opening I am not very sure what they openings are for they look too close for switches and I do not know what else has there for, but then what I would like to point out is this is a of the shelf small enclosure with an inclined panel it is good up to a point it is good.

That was the panel in which you know these solar things could go. And then now you will notice is it is a little like cinderella shoes does not fit that automatically as we want.

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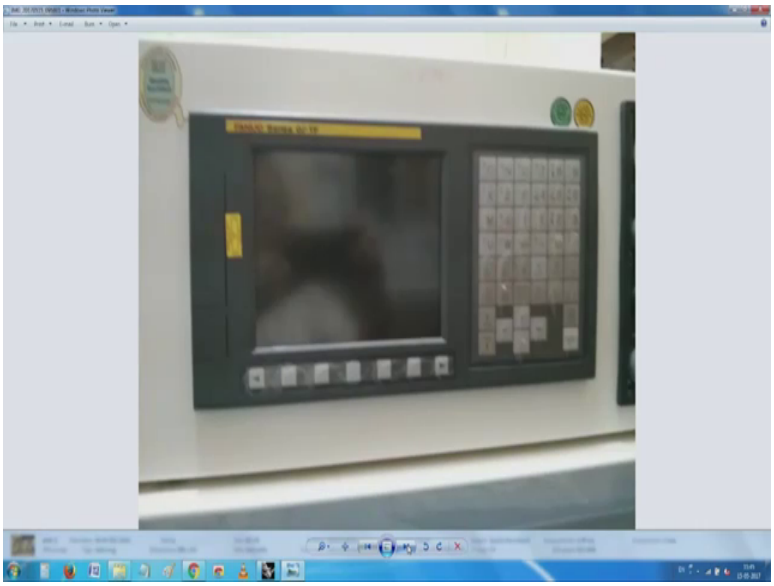

But in real life when you talk about displays and various other things, this is taken from the 3 d machine from our fabrication shop. It I mean it is incidental as to what you read there on the right side you see that that several types of keys there is a display and then keeping the practice of this they have not touched the that what you call input output display panel. The next picture will show you.

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See this is the left side of the this thing right side is the one that normal operators are very much familiar with. You seen this is fun of (Refer Time: 12:42) here there is a I do

not know it is a could be an inch inching dialer it could be a speed setting dial. Then you have a various other things arranged in a simple logical way.

Wherever it is possible they have tried to maintain the ergonomics and familiarity which these things have with the other equipment that have been previously employed in the fabrication shop. This is taken from the horizontal lathe combination left side you have the actual controller. Right side you have the something which I mean left side you have the display right side you have the controller and in next slide will show you same thing arranged in a slightly.

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Different way you see here display is on top the keys are down and this keyboard and all not little similar to that and then you see the other control panel.

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Nice simple beautiful panel. Some things are common like you know how to operate and rotting things know you have the job dial and then you have the feed rate mode selector. Then you have a key for you know editing the program and then usual OBS and then of course, all of you must be familiar with the emergency stop. And then we have the various types of I mean (Refer Time: 14:16) it could be anything, but in this case it could be actual cycling.

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Can you see this here? This is taken from our rapid prototyping that water which will

remove this support material. A little bit of elements of aesthetics and appropriate use has been built inside, but the common thing is you have a temperature indicator here. Then you have something which probably runs cycle and pump. And then you have several things about you know the water and so on like this. So, what you notice here is a components are about similar there is no problem with the components.

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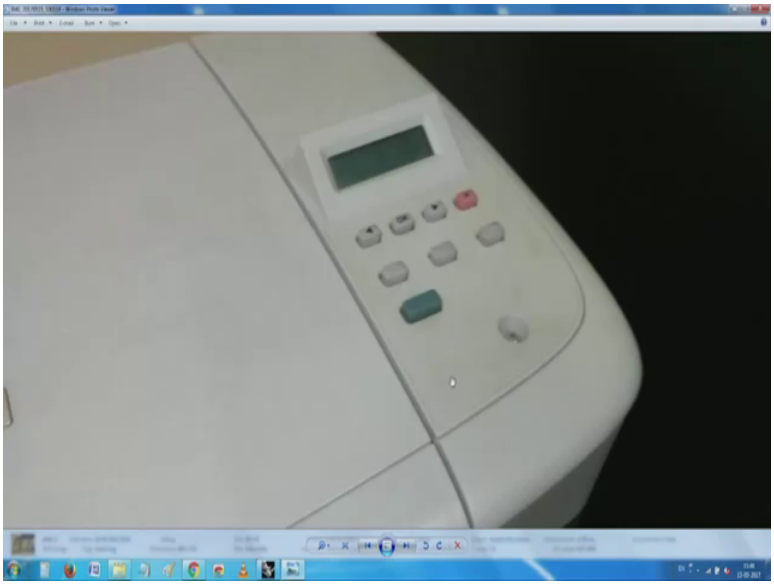

But how we employ them and what we do with them know is still within our hands. That same control this device has been now taken to a printer desktop printer. You see here one of the first thing is that nothing lying all those what you call huge selection of buttons everywhere. Just simple there is one green button saying switch it on and in case something jams what you call probably reset it and do something and then you will get your print out. This is taken from a probably a scanner printer and combination. And then the critical thing is you see that display, the angle of the display is a little similar to that same we had in the calculator little about 15 degree. Because anything less than that 2 issues are there. That angle of few of that screen is a narrow thing. And because of various constraints and various things it cannot be very big and it is a simple LCD screen. And the same screen other than your normal rotting things is also used for your what do you say diagnostics and various other proms and so on.

So, the critical point in this know my next continuation of this today's thing we will talk about where to start. So, you will see here you see something here also that is you also

have a mounting screw here, why have they put it here? That is just to make sure that you do not damage something by Pulling it out.

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This is from our same again the rapid proto typing set up, except this is a part of a laser I do not know I will loosely call it a plastic laser cutter. Say you see here we have a beautiful display here, again we have the emergency stop, and then other some laser output and all hat, you see here this also a control element. And made specifically for the purpose and then you again see you watch this 15 degree angle, because it is very much related to the display part.

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I am sure all of you are familiar with these what you call equipment from your lab. I am not very sure what it is, but expect it is a power supply or a signal generator and I know you have good.

I am not able to read anything oh it may be dual (Refer Time: 18:10) oscilloscope you have something here. And all that only things to notice here is a little bit of similarity you have seen that on the right side we have all that sh shrouded connectors, then we have rows of keys here. And then it seems to violates something which I told you earlier saying f you have a key there, if you have a key here usually have everything written on top taken correct, but then if you end up sometimes you know with something in the middle row here it may lead to confusion. Which is there where know the designers intuition and running a test with a target crowd usually. It is not focus group like what you do for soaps or cosmetics or kitchen utensils or all that, it is more of a professional group which analyze these things properly, and see whether things are good or bad. So, you see here we have something about you know something is written here at the bottom may be in the beginning it for you to look it, and eventually lot of cautions are there and then one only rather the redeeming feature in this is only used by trained professionals, others are not expected to use it. Things have moved up while that one is sort of hardwired thing you see that here know we have keys and then there is a display probably the display will help you it says LCR meter probably the display. You can assign the keys and then this was telling you about the evaluation person now would

have said you can not afford to keep them.

So, close you need his is the minimum gap between them about that much has been maintained and then you have a lot of space here. This is just an indication. You will see a similar indication like this in your ATM machines. Here is a bit of parallax of course but then, we have got used to it has such you know we have no problem about it and you see the beautiful LCR jack here. Made of sheet metal I am very, very proud to say is supplied by the company and made out of sheet metal, you have a bottom view, then you have a top view and then you see in a very simple way how they have done they have put a screw here given a thing it is called a lugging. Advantage being you can just open 2 screws remove the cover bottom of the cover comes off turn it over remove 2 screws the top of it comes and inside everything is visible. Probably it has some features which I do not understand some, I think it is called a pad to reduce the voltage. Or there may be feed through are some special circuitry there may even be a bold which conditions these signals plus probably isolated and you know, proof against ESD and so on and all that.

So, here you see combination of it this is probably made out of sheet metal. Then there is a handle which is made out of some flexible material. Then there is a molded cover and then we are back again to sheet metal. In this case probably it is inevitable because we have see this connectors here. This looks like a b and c connector then there other variants of it. So, these connectors requires solid continuous earthing. So, we have no choice, but use them.

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Is a very routine, what you call, some multi meter. Unlike the other multi meters we have this looks like a self ranging digital multi meter. So, you can select the usual I know dc volts then you can have a dc amps, I am not very shear clear about it how this hertz thing is there. And then this a power button this looks like something to do no clue at all. Then there is small range between micro amps and milli amps. And then you see here shrouded normally it is unlikely that you will get in touch with it. The important point is they have made a flat panel on top to make sure these things sit is properly. And the actual device itself is a little flatter than what appears to be. Or I only sees the outside lines, either see a may be we have come to the end of it, yeah.

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It says some heating device and So on. These are all small laboratory scale things which have been made specially for our health care things here. So, we have a capacity then we have power, and then you see here know everything looks very, very simple and manageable. I have finished this part of it. So, I will try to go down. Now we come to the important point is, where do we start? First thing is like all our that other design approaches you need to make out what is it that you want to take. So, you identify a problem and then see a several solutions and so on. And in the case of academy what do you do? You check whether literature is already available. In the case of our product design we check for existing (Refer Time: 25:11) or prior art. Prior art is in the trades how do we do, then something which is very related to this is whether it is already patented. If it is patented it is somebody else is intellectual property, and generally patents may have run outs somebody may have released it or So many other things are there. I am sure you have heard about the Sony walkman and then it uses cassettes called the compact cassette. Compact cassette was an IP held by Phillips, and then they released it together jointly large number of these players as well as the cassettes were released to the public. So, people could make cassettes and all and then there also know you will notice that while little bit of violation of the this thing is there.

It was an idea which went on very well. Old timers where may remember stereo it what you call special type of cassettes which you put in cars. So, very peculiarly it is an endless cassette. It is we can then later on we have DVD and all that. They should being

there prior art decided on these things. So, in our case also first when we decide which check what is it we want to, do check on all the prior art and then start somewhere. As part of this we may this.

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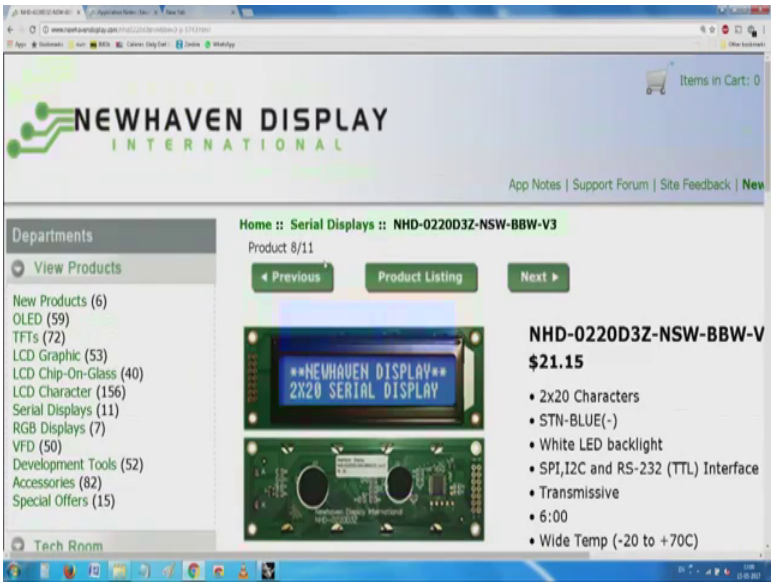

Go and then, after having run a bread board test. And then decide on the standard modules, in this case if you see typically you know the displays are this 20, 20 characters white 2 line displays are typically seems to be. What is used and see at the bottom most critical thing for us is this dimension about that being about 120 mm. So, this will come to 4 and half inches, and then 37 this will come to one and half inches. So, we have a typically a display with of about this. Now I should go to the product specification page here. And come to the end, I hope it is loading, I hope I have not missed it, Yeah. Somewhere here details regarding the actual drawings will be presented here.

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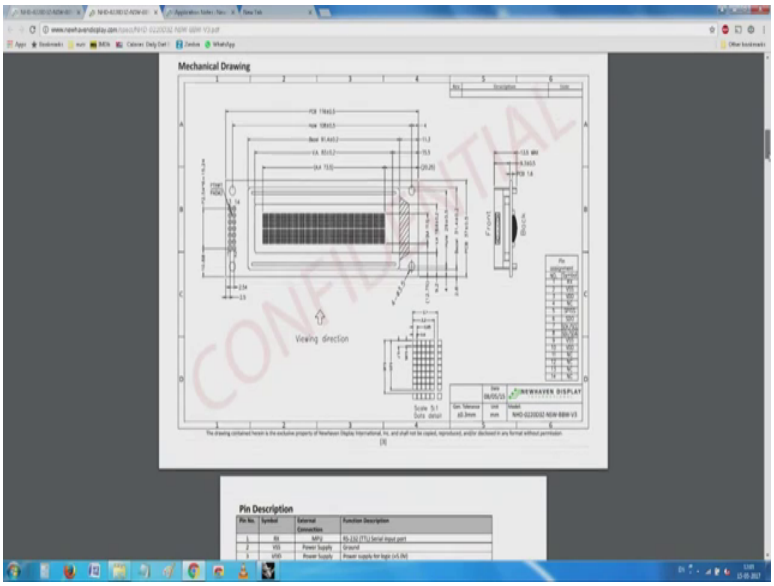

Seen this know? You have seen the confidential water mark on it saying you are not expected to use it in any of your designs, unless you are using that particular component by them. So, I respected that is how we have got into it thing, you will notice is the PCB overall dimensions, I will try to enlarge it easier to see whether it comes here. You see here it is given as 116 mm and very critical thing is that tolerance also has been fitted on it, this is typically manufacturers what they contract with the same they cannot now go and I know you can say the it is bigger than what we thought it could be. If you are mounting it by the holes it is not a big issue except that you need to again look at the same thing, 108 plus or minus 0.5 millimeters. So, you need to make sure that under all conditions this fits. Seen this know? The starting point hence when I asked you what do you think is the starting point is the component outlines these need to be kept all the time. You seen there? They have written saying it will not exceed 13.5 millimeters. And then typically from the front surface the top surface of the printed circuit board is 9.3 millimeters. Now this will give you an idea of where to start the drawing you would like, to say in my case I go about building these details. Say in the case you see what we need is we need 4 openings typically it has written as 4 into 3.5 mm diameter holes.

So, it should give you a rough indication that something which is an probably a metric 3 mm screw made at a pitch of horizontal pitch of 108 and vertical pitch of 29 mm were required. Understood know you start with 108 and 29. Now I go back here to my this place and see where actually I can start. I will start with a circle here.

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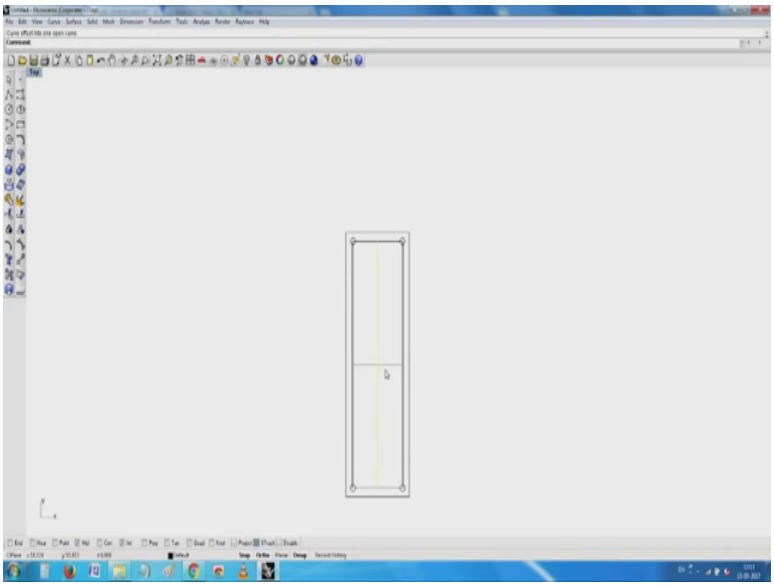

Diameter I start. When see here nice first this thing has started here. I started with a out of a convenience I started with a corner here. Now I see how best, as I said this is one way out of more of my practice, I have recall started practicing it. Now you see here if you remember there in the previous thing the horizontal hole were 108 mm apart. Drawing some lines and then you see this is typically be a little patient with me like expect people among you were good at these things are able to do the much faster, will be much better than my just showing you something which is, seen there this is a basic rectangle that 108 by 29, were is it 39 which I have selected here. And then I have an opening here I will see if I can, yeah. Seen there? Those things which I started were I have no copied them on to 4 places. Now the next level I go from here and see the overall size of the printed circuit board that is given here is it is 116 by 37.

So, I just need to make this rectangle 116 by 37. Move from various what do you call earlier experience is I have found, out much better to work in a symmetrical point of view. So, maybe I will just keep that other window open. So, I be here 37 so, half of 37 will be 18.5. Other side I have come earlier if you remember I had come up to 116 again, half of 116 is going to be 58 millimeters. I am little slow please be a little patient with it. See, now I have a printed circuit board here which is real, which as for the mounting holes. And then it has a outline. And just to make things little faster need, now need to come to the actual display area.

So, they have written here bezel is around 90 mm in this case again bezel is 30 mm. So, I will just see whether I will come to that 90 by 30 mm. So, I will offset quickly. See my basic display is ready now see my net whole wondering the components in my design he critical display I have now tried to create which has all the necessary what you call dimensions and all that. I will now try to actually group and freeze the whole device such that which stays with me all. Seen here? At this point I can even export this device understand I take it, and then as a back up this thing I export this elected thing to the desktop. To make things easier I will just delete this lot.

Now when I want to start the design of a what you call my new design one of the components a critical component the displays available with me. And if you remember last time, I also had a top cell, which I called cell and kept it on the desktop.