Enclosure Design of Electronics Equipment
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Lecture - 13
Layouts and Materials of small equipment

I will now continue with.

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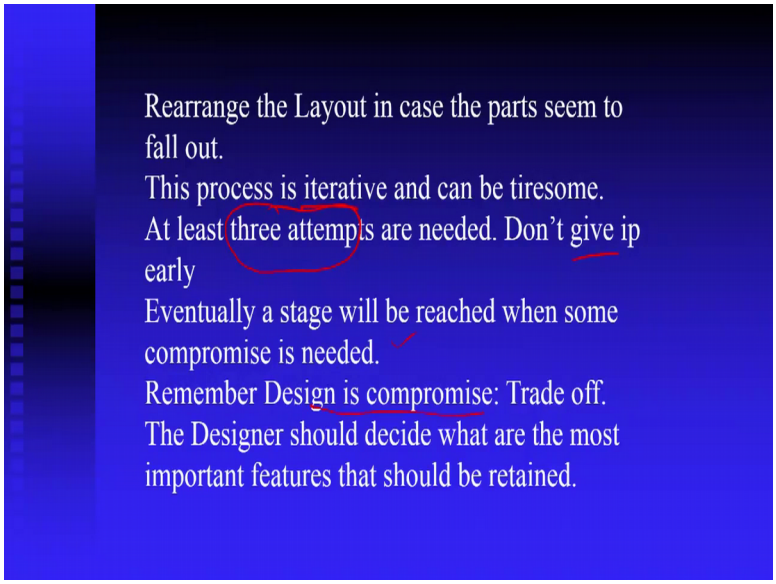

This is the first iteration, second iteration the parts seem to you know is something seems to stick out fit while we put everything inside I have shown you that power supply about the heat sinks. Now if I were to take this small power supply and want to do something about it slowly there no place any more place.

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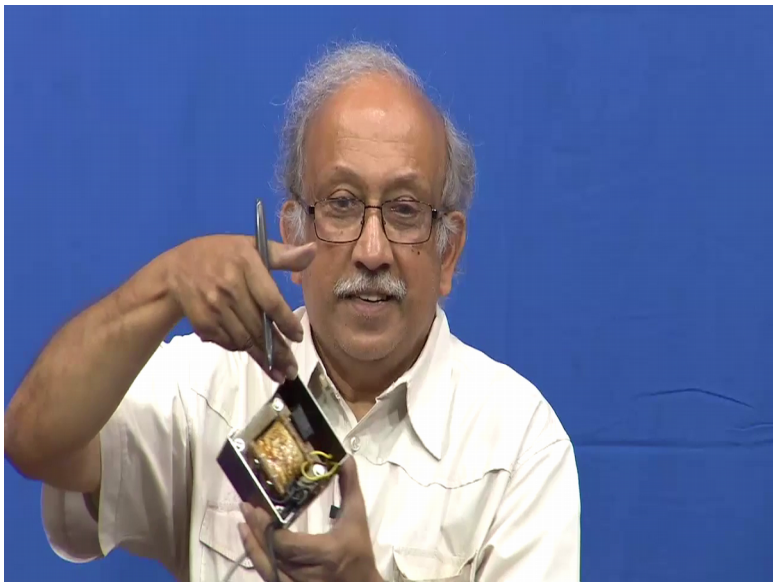

For it now where do I put a printed circuit board in it, so that transformers to be smaller and one of the way of making a transformer smaller is. So, are get a higher frequency a little more efficient what you call goose we use for the packing. And then we can may be make it a little bigger.

So, it turns out to be very iterative experience at least three attempts are needed to make it work, do not give up early unlike software which of course, software people also life is not easy for them releasing every new version and every new build is not easy because you have to build on existing things. So, the moment you add something things go may go who where ever they worked very well with the older system, new systems we have to unless we try we cannot do it.

So, do not give up a stage will be reach one some compromise is needed, all that an design is a compromise. Designer should decide what are the most important features that should be written are highlighted to make sure that the product performs the desired function.

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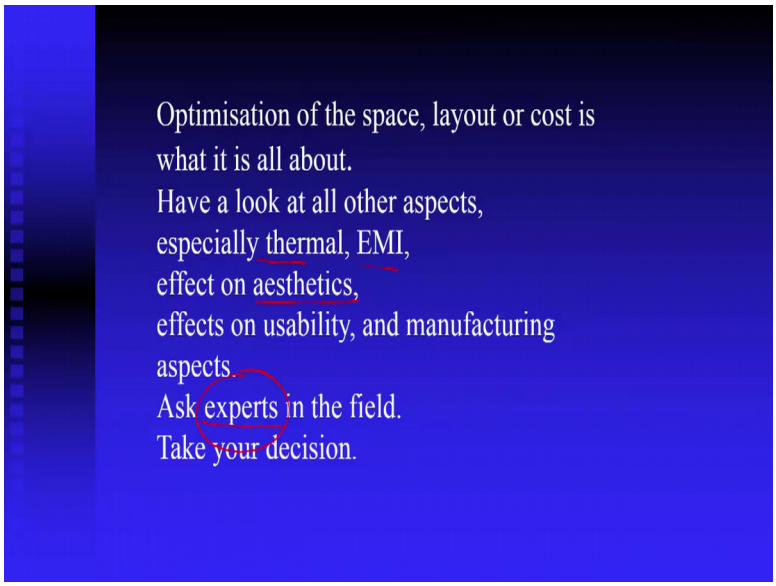

Optimization of space layout or cost is what it is all about. So obviously, something which is very costly people want what you call it will not easy people will not effort it, then the layout is more technical in nature each antenna should not interfere with that an then where does the heat get dissipated and then in case it is a user operated device, how user unfriendly are how user friendly net become.

So, we have all this stuff thermal EMI, anytime you do anything leads a aesthetics. So, coming back again to my small power supply, why I am showing it again and again a all the elements seem to be taken care of well and this.

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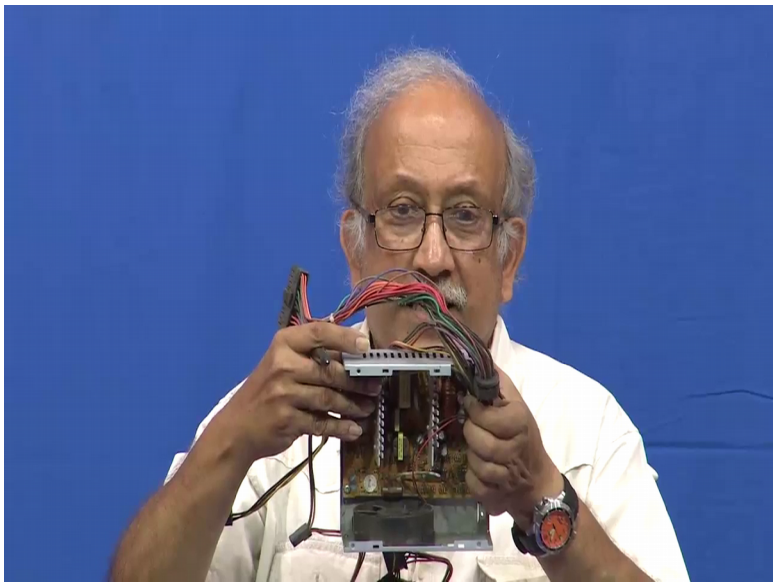

Actually there only two heat sinks here know small heat sinks are here, these really do not we do not know very well accept that this thing they have been kept very neatly in line with the blow of the fan, seen that know quite in line with it slightly it is offset.

So, it may be logical to have these openings only where the heat sink is there, but you are seen here they have been made somewhat symmetrical. The amount of space left here is amount of space left here and amount of space left here is about this same your seen this know. Distance from the left edge to the first line, distance from the bottom to the device to the bottom of this slot, distance from the right edges to the slot have all been made equal.

Why not centralizing? We cannot centralize it because we have this beauty of wire harness that is coming here. So, it accommodate the wire harness they had to make this slot, because you put the press be in side and push all these things and an once you have this beautiful system is has to now go inside and it should sit in some place such that it works your seen this know, it goes inside. Top is flush bottom is here and then now if we see the amount of space has been optimized.

So, it is a matter of thing you know whether why cannot you take these what you call slots are little higher. So, somebody; obviously, you has done a bit of a calculation the total amount of area that you have in the unhealer space here outside and then inside is probably approximately equal to the amount of openings that are here. That will ensure

that air is not abstracted; while twill I have simplified are I have call a done it in very; obviously, over simplified the thing it works finally, we have power supplies which work usability manufacturing experts in the field.

So, if you are to build a house, house is a very personal thing even if you have to build an office will obviously, ask how many number of people are there and then you take a decision and you go to an architect an architect is the man who designs various things. So, wanted in your office while we see the perceived and your impress by buildings by the perceived, internal layout and the way the spaces relate to each other are very important. Now as it is getting populated by regular people who work there, will notice that people psychologically the need certain space, then it place then the moment people are there they require various things related with people.

So, there always experts in every field; so if you go to the furniture people know you have open plan office experts, what all you can think of already somebody as a already face a problem. So, they can tell you things are standard table, normally we expected to be above 20 inches depth front to back, 24 is required in your case and some cases one side we can make it probably 28 other side, we can make it only 18 and then we have various devices which are there. So, these experts I have given an initiative example because eventually end of this you know having to sit down to work, for every field a specially related to EMI and this thermal and so on there are expert offices same problem and try to solve it.

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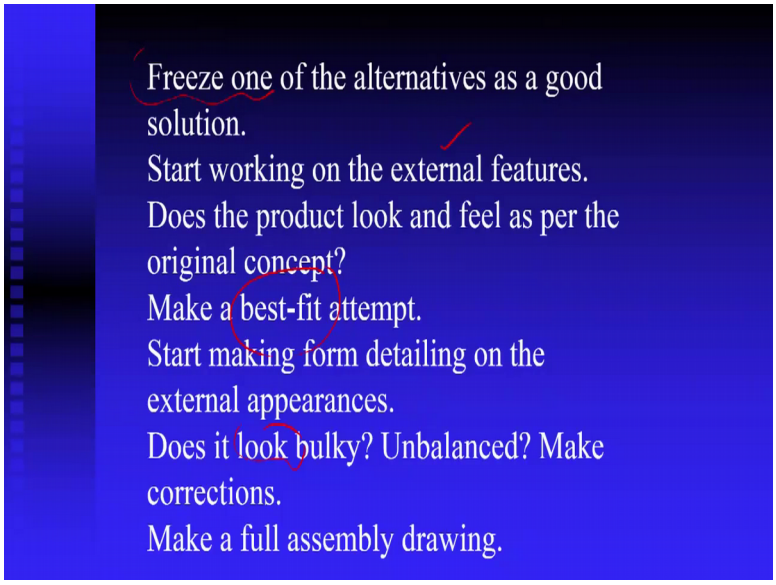

Next slide It is now going to talk about it saying outer due consideration, one of the alternatives should by worked upon in detail I have just a freeze the alternative as a good solution. Start working on all the other features does the product look and feel as for the original concept you have seen here know, this is where warred a beautiful what you call top down approach, but then after you finish everything it is no longer top down again you know something as gone of it an tangent. So, they leave them and the that tangential thing or we try to now work back saying, make a best-fit attempt, again keep working back words and then have another go because we have not last anything.

So, traditionally what people have been doing is the take a graph sheet, cut various new things to the layout size and then place them inside. So, that you can move them easily and you are seen. This now after this then you should attempt to make your freeze your wiring board. Does it look bulky we have a big issue about the looks is it look unbalanced this is where know people trying to correct various options possibly. So, if you have to see any of these you know bulky equipment, you probably see top two thirds of it has one color which is a brighter color and the bottom one third of it is a as a lighter color I am sorry darker color that it selfs splits, a whole space and then makes its sink looks leak.

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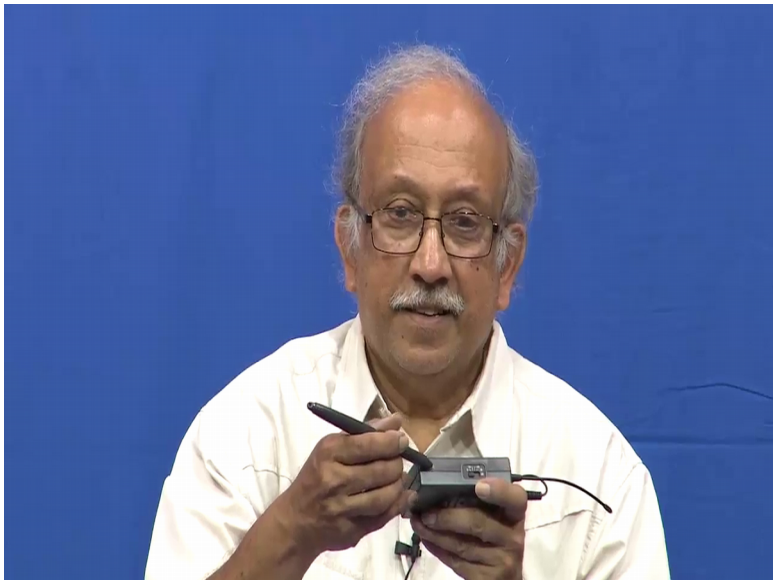

So, if you have these things look better again I will take you routine examples. There is a gentle curves here, though probably the maximum amount of spaces taken here towards the sides they reduced it a little. Probably that was to accommodate this display and the basil that is a accommodated all around it. You need this for protection you also need it for proper visibility of it unless you do not have it I am sorry unless you have it you will not be able to read whatever is written here, and your seen here very interesting detail of a step is been provided here.

This step will make sure that this does not look unsightly and all it groups all the necessary functions together same thing as been done here and a very interesting are non awardable thing is the shut lines. When you take to half cent try to close them together they do not automatically shut as seen there is always a gap and the human eye and related to that our brain is able to just these gaps as a relative effect. So, in one side if you have to have so, 0.5 mm gap another side you have a 1 mm gap, it will not be treated as a poor quality, but imagine on one side we close it 0.5 as been made to 0, other side you say a 0.5 it looks like a bad manufacturer. Manufacturing detail it happens in the case of your cars, when you get a car and put it all the panels fit perfectly as slowly takes a little bit of a bump here and shake there and all that first thing that suffered says this thing do not loose properly the shut lines little big problem.

So, here people had designers over the years know have been using various tricks one of them is if you cannot hide something highlight it, which is happened with our buttons which is happened with our maybe our watches.

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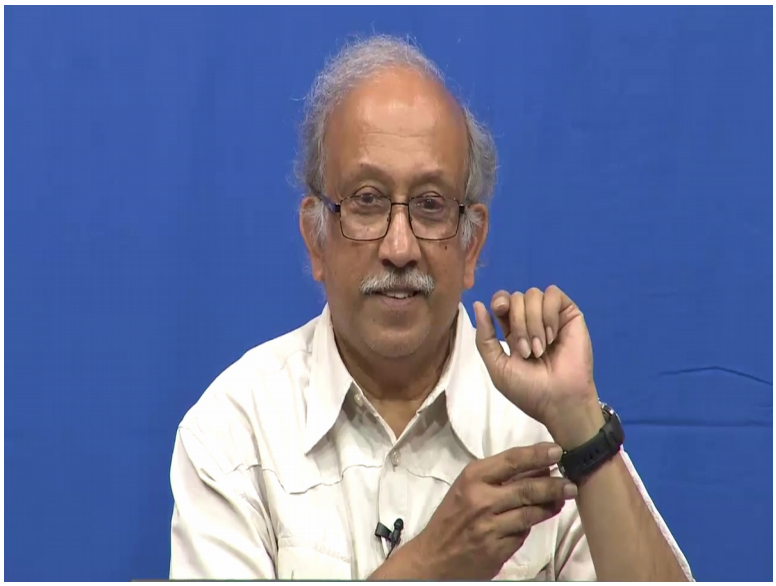

Which is happened with this buckles now when wear a waste belt the buckle you know seems to have a more of a function then the actual thing holding back, because that that one seems to convey your intent. This is where actually I started with slide make a full assembly drawing your seen it know, assembly drawing talks about putting all these parts together.

Now, first time now I am using the word I have change from the sketch to a drawing, a drawing is done perfectly to scale. If there is a transformer which measures is a 70 mm and one side it measures 60 mm and stack up the actual stack is only 30 mm and even nearly bobbin and so on all these details need to be represented. Traditionally before the advent of all these three d and all I mean what you call tools meant for design and drafting, people are doing by hand. So, they had a good feel about all these things, and an as I told you earlier they go collect all the sub assembly is in keep it ready for themselves then only there able to proceed. Right now since it is have three d world which is a virtual world, every manufacturer in vender makes is final product in the form of a dx of file drawing interchange format files are available you can take them and then you can insert it in your programs.

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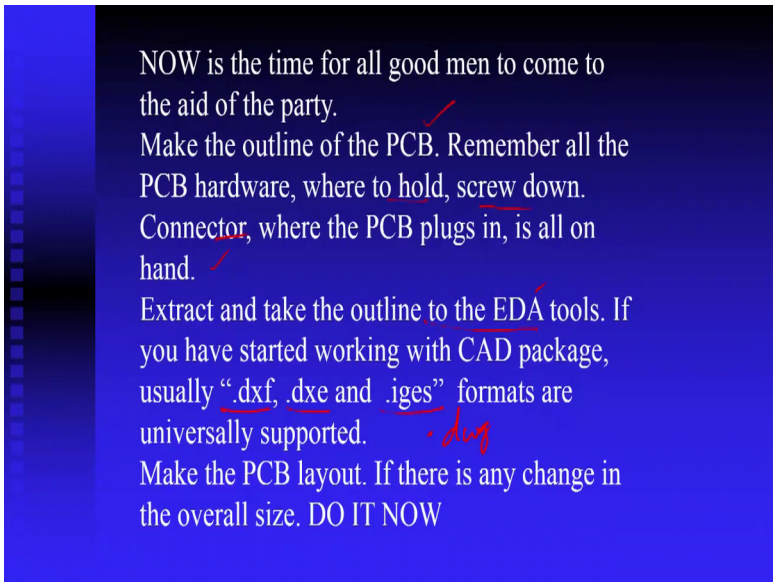

You have got a fantastic thing, all the people are interested in the project now need to joint together make will add the out outline of the PCB. Remember all the PCB hardware where to clamp it down screw down connectors all the details surround hand only then when you make it you will never need to work on it again or have, some wires which come in the middle of the PCB. Extract and take the outline to the EDA tool. So, we have dxf, dxe, iges and what you call dot daaj formats are available and are accepted by most of the EDA tools. So, after having an idea of the product you get now you get the actual outline of the device you want to interconnect make the printed wiring board.

So, we take all these things and then import them in to the EDA tools you understood know, outline have to the EDA tools this EDA tools; now can make the layout of your equipment make the PCB layout if there is any changes in the overall size do it now. Do not what to you call do not feel shy saying I am not able to accommodate, make if telling all over designers now add a little extra space first round when you are getting ready add a little of extra space. A 10 millimeter does not make too much of difference at least send two places only the critical thing it is a one of the height or one of the width you strict to the main thing; because we do not know how things will eventually end of with what more new things you have to be added.

After having might the assembled knowing you remember know we said we make an assembler drawing, this is assembled drawing takes care of putting all the things set together.

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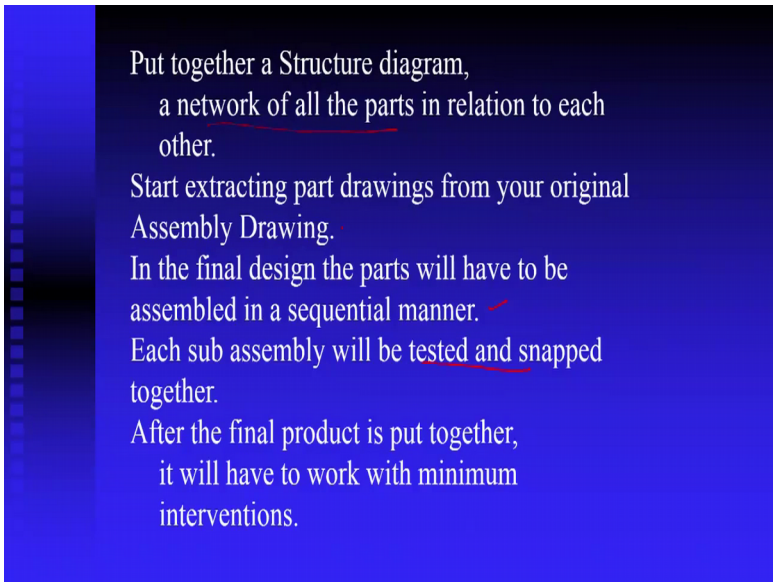

In the case of mechanical it was easy. So, it was a it was a called a I think part network or nomenclature network, that is a sheet a 4 sheet which are list all the things item 1 2 3 and so on. So, in the case of for software we have a beautiful software structure diagram. Now we are working with both this parts we have made several attempts to see whether we can make the modular, the advantage of a structure diagram we know how the parts are all connected with each other and you can always connect them up and down start extracting part, drawings from your original assembly drawing this is a critical point of at it.

Now if you see the new mechanical tools, when you see the new mechanical tools when we make an assembly I will give you an example of an outside casing which has a step and which has a bearing inserted inside, and inside the bearing we have a shaft. So, we have shaft we have a ball bearing and outside we have the housing. All of them can be tied up means you can make a relation, but when inside of the shaft to the I am sorry outside of the shaft the inside of the bearing. Similarly the outside of the bearing to the inside of they have seen we can make a relationship. If any interference is there or relationship is there know the program will automatically show you, and this bearings

send all you can collect them select them from a table which is available. One simple example I can tell you is we have 6 millimeter shafts, just typically which is probably derived from the quarter in shafts.

So, we have a quarter inches is a 6.35 then we have a 6 mm. So, everything including various types of fashioners everything both systems are available we have the inch variants, then we also have the metric variants. So, it is with all the mechanical hardware it is with all the grommets at we have here which is probably also.

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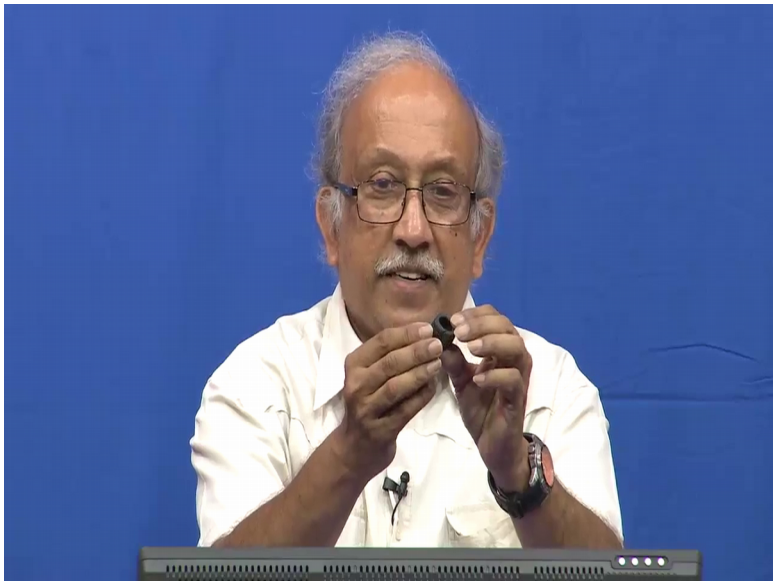

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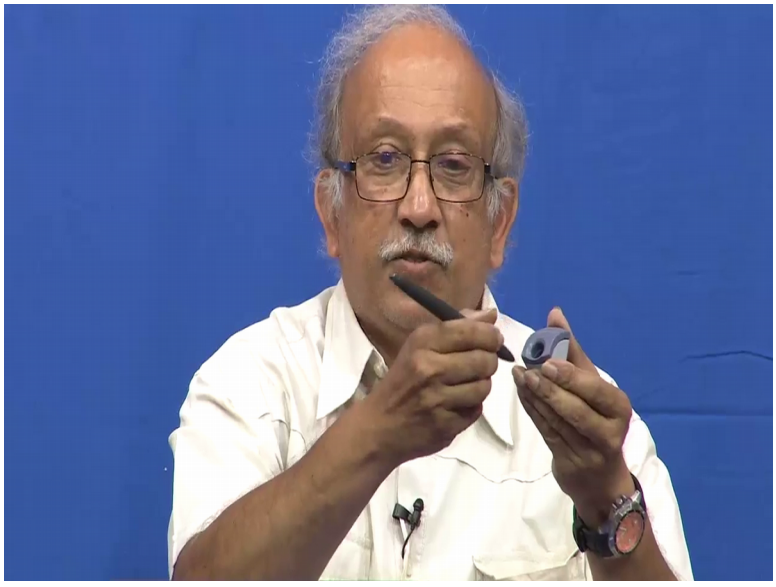

Valid a this things like this pens where you hold, and where all you have this openings and all each one of this parts follow certain standards.

So, if you look at my ppt again, we can extract all the part drawings from your original assembly drawing. So, if I have a grommet and then inside the grommet I have a small you know amount of opening the more wires are there anything if.

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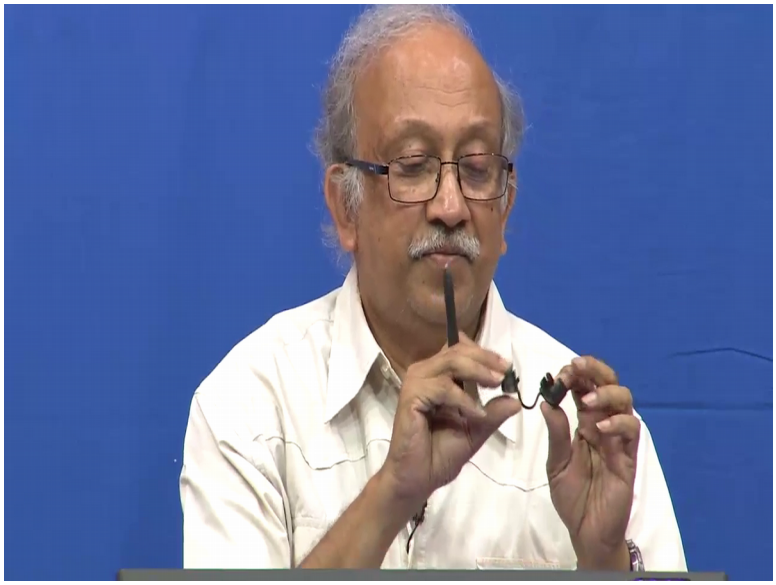

I go to the grommet catalog, then leave you an indication of how many wires it can hold and then outside we have various proportions of this things. Saying how do you attach a one two they there how do you take it if you where to relate them in a assembly drawing now I can use a bigger grommet or I can relocate the grommet your corner instead of this place you can keep on.

After the final product is put together it will have to work with minimum interventions you understood; know in the final design the parts will have to be assembled in sequential manner, each sub assembly will be tested and snapped together snap meaning attach together after the final project is put together, it will have to work with minimum interventions. Saying further once you put everything in place you should not be force to work more and more these things.

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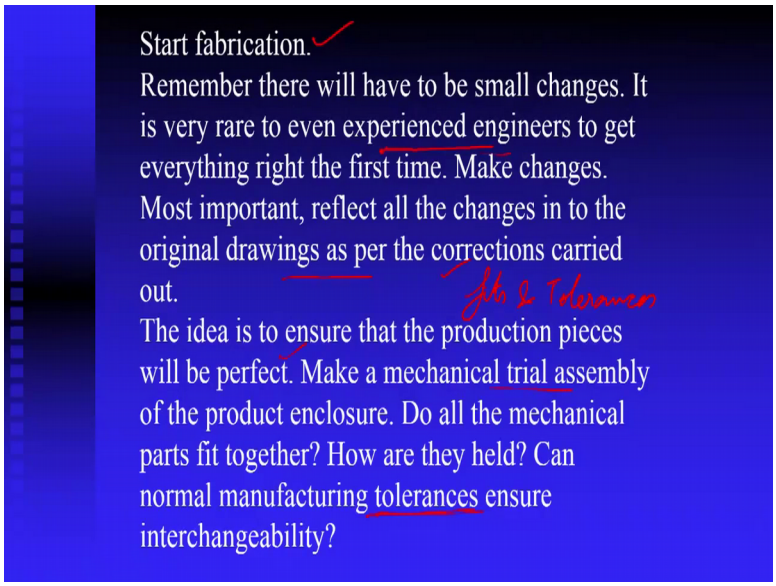

Now start the fabrication point in mean fabrication, we mean two things one is we our self to it that is I go to the my home workshop or my lab place or a deal with a vender who is familiar with this an eventually, he will help us make all this in as you fabricate you will notice that what we thought was a very easy thing, a sequence of steps may or may not work. So, if I have to show you back that charsive for this power supply.

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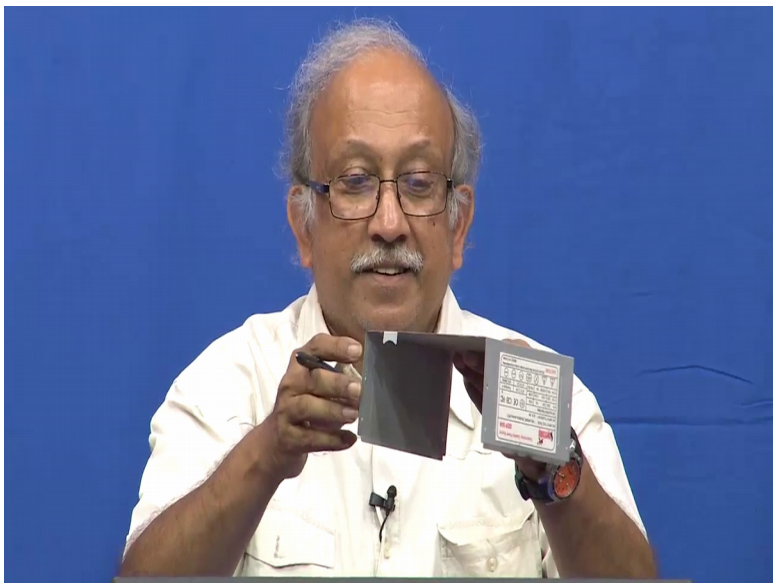

It is a sequence possible looks easy as a small joggling here one thickness joggling here, can probably make the joggle after edge you can bend all these parts.

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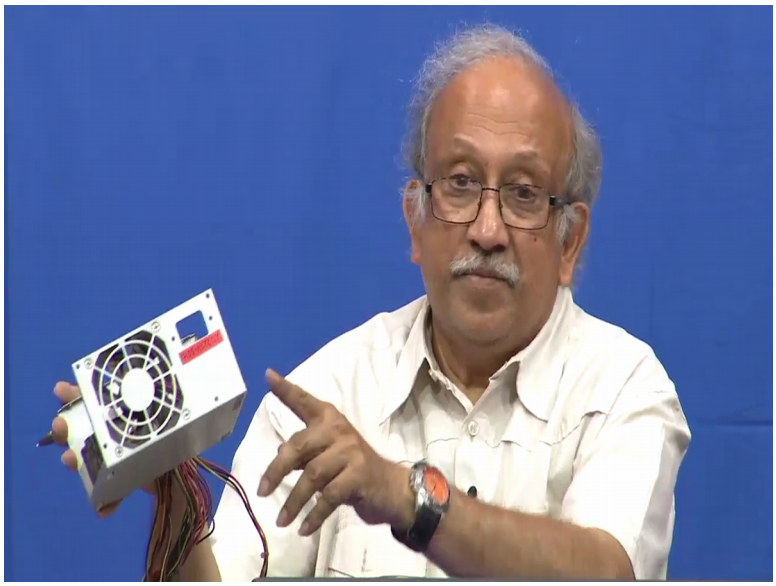

Now can we do that with the same thing here, either we have seem to end up with problem. If you bend this first you may not be able to reach inside in bend that if we bend that first we may not be able to bend this see some special tools and sequences have to operate it. Having made this we ended may end up with not very pleasant corneas. So, this is where the changes we are talking about it, may lead to small changes one of the retails is saying how thick or how smaller a particular limb needs to be. Very rarely even experienced design engineers get everything right and the first time, only thing is their experiences start them how to get over the problems by small changes make changes everything.

Most important reflect all the changes in to the original drawings as per the correction carried out keep documentation updated. If you do not keep documentation updated it will come and what you call haunt you all its life. If you do need just mention the field and refuse to or ignore to continue with the updating the documents, every time and equipment comes the local person know or these iodates again you know have put the opening in the wrong place now I need to drill one more hole.

So, it is not very good his calling an idiot and you calling him back what he suppose to be. So, I think is if there all reflected in to the original drawings, next round when they get made their near perfect. Absolutely perfect you have know issues about it that is a reason even if you what to have a bulb socket it fits every time, is it not a bulb fits in the

socket it does never any issue. Only thing is sometimes that bulb may poke out a little sometimes you need an adapter, but we know at the basic thing over may be 50 60 years a banned mount has been standardize similarly a screw mount.

So, we have 15 mm screw, we have 22 we have 25 24 all of them have been standardize. Now, how many threads how deep and these are a taper all that know where is a little with the this thing. And then you if you look it as so the corrections are over, the idea is to ensure that the production pieces will be perfect. Perfect means everything fits the other. So, if any of you have time or if you have interest I suggest you go to the internet and looks for, what are called fits and tolerances is a little mechanical related subject, but all of you in any field you will know about it.

Saying if: you have one stage which is giving an output and then has to interact with another stage, how do you make this interaction. In the case of are mechanical engineering we call it fits and tolerance how way to things attach it each together and then what is the tolerance have these objects. The idea is ensure that production piece are perfect and any one thing matches with the other make it trial assembly of all the parts which you have fabricated. So, take all these parts put them together see if it works well do all the mechanical parts fit together how are they held, can normal manufacturing tolerances ensure interchangeability.

Saying: I take any cover and then I take any of the charsi, similarly take an have the connector everything should go under all conditions. While your time and energy and full control is there for as on the field and the in the assembly line with when it goes in to the field, a small variation is likely to cause a lot of downstream unnecessary activities.

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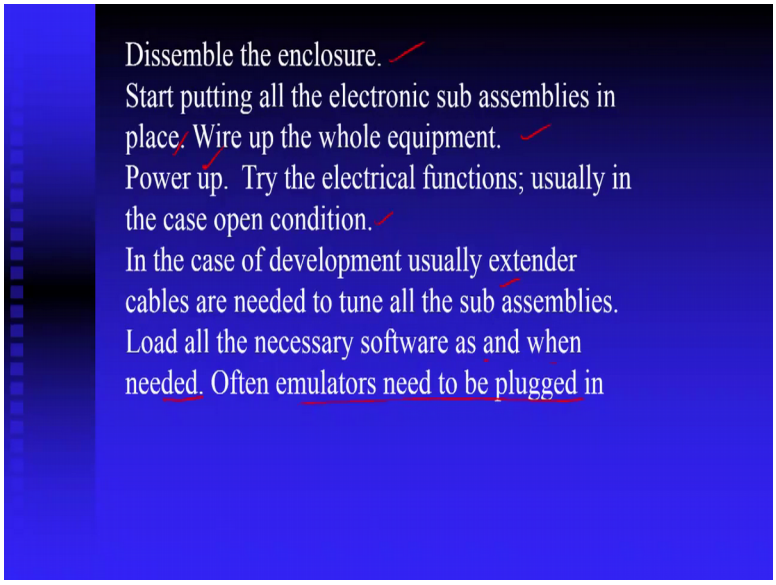

Next question now we come to after having fitted everything remove the all the parts dissemble the enclosure. Putting all the assembling in place your seen that no still it is all a dummy place these is all the box with the enclosure with all the fashion as all that. Now wire up the whole equipment power it up try the electrical functions usually in the case open condition. Though we have made the whole thing with a big cover which gives a lot of protection, it is imperative that when we do the work of initial testing and all that usually they keep it in the open condition and test and then of course, there all trained a such they would not put there figures inside. Try the electrical functions in case of development usually extender cables are needed to tune all the sub assemblies.

So, when your still in the double development mold, if you put the PCB inside you cannot access the things. So, it is generally mounted with the extender cable have the PCB is to be plugged in to a slot in between you have an extra cable. Usually PCB will have the plug components and the other side you will have the socket components a one more connector which has you know plug and socket thing you plug it here keep it outside where you access it with the various other things. Load all the necessary software as an when needed emulators need to be plugged in.

So, in the case of these various sub assemblies they all work with programmable devices, and for a programmable device it may behave slightly different from when it is on the table. So, once one it goes in to the internet enclosure, you need to still measure things because this phone does not have, but originally even all the mobile phone there use to a

small cap of a keep open the cap there use to a small RF connector from where you can take the signal or can see how well what is the level of the signal that cames to be done.

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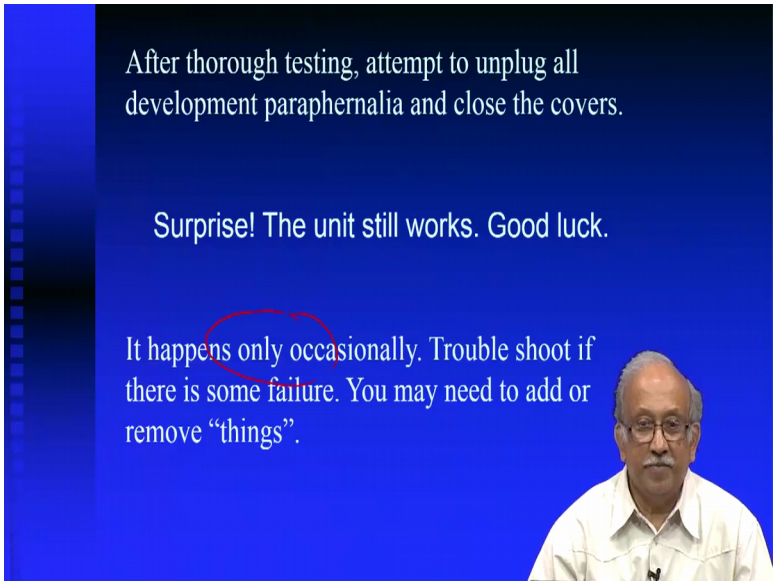

After thorough testing attempt to unplug all the development paraphernalia enclose the covers. The unit works good luck remember like all other things know it only happens occasionally, trouble shoot if there is some failure you may need to add or remove things and (Refer Time: 25:55) what it is everything is a single incidence, this is on the about the development this is not about the actual manufacture. But mind you your using manufacturing tools your using everything, and then in case you have a vertical mixed mold analysis software you can use it.

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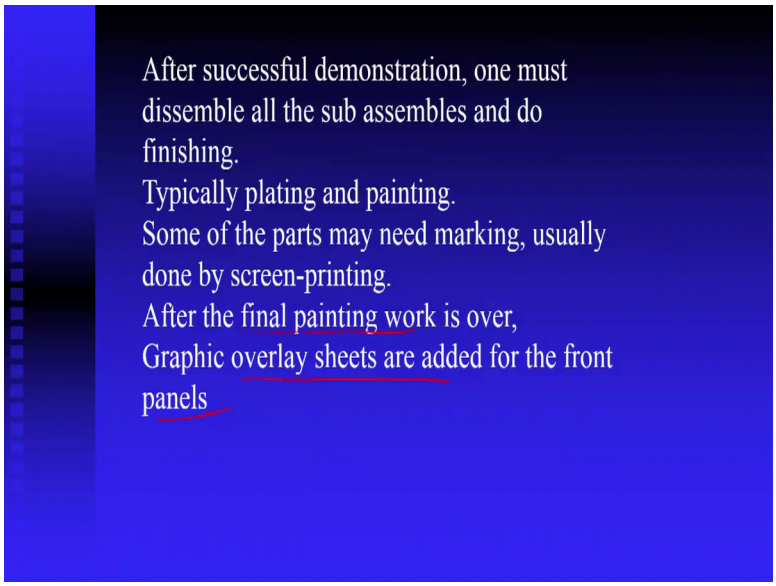

After successful demonstration one must dissemble all the sub assemblies and do the finishing. We have a cover in which you know you have place to openings you have put extra holes everything.

So, we need to specially you know do all the marking and then after that now you need to usually you make the outside they call and printing what you call arrangements what all you need. Even if you see here in this case we have a sennheiser logo. This could easily this can easily be made is in a rapid protecting setup, we just need do add this sennheiser logo on it happens with all the products and at the back now we have stachutree things, and then we have a small panel here which is added to this men do these are production things, but if you your to make a master and make all this thing, the same thing can be made at home made in a normal printer and then you stick it here you can make it as good as new. Once it is convincing you can now pass on this product downstream not for manufacture, but for testing what is called you know initially bit are tested cell be there, they will cooperate with you and see is a too useful.

How to cut out all the high up that I have generated and passed it on to him, they look at it and say servile all you say is correct this does not solve my problem I cannot explain why it is. So, I have focus group and which that right. Otherwise you will not be buying so many things, which you continuative use now. Not longer or 30 years back you had a phone with keys you do not have it anymore.

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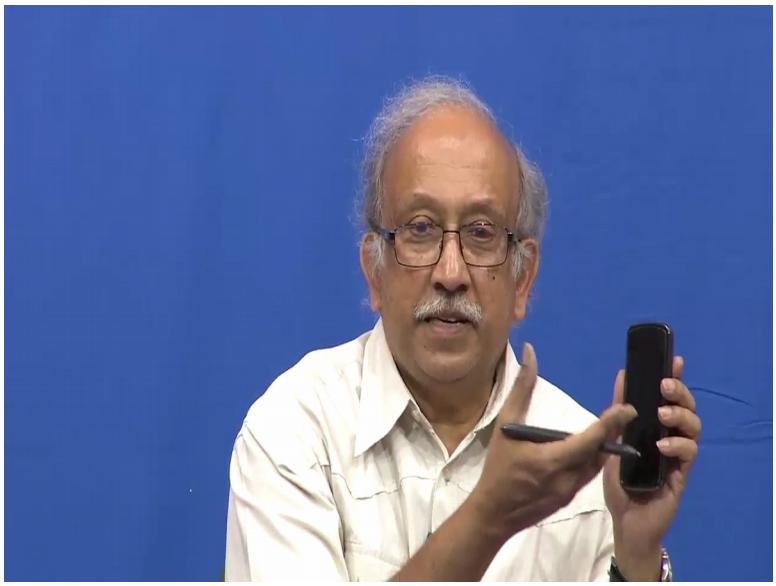

And suddenly the shape as nothing to do with the thing it (Refer Time: 28:14) it just of add plate whatever you do want technology is taken over what are other ways its tricks being plaid upon. Nobody's worried anymore whether you have display or not these itself is the monitor for you to watch a video and it goes on like that nonstop.

So, you dissemble all the parts which has as telling you, some of the parts may need marking by screen printing, after the final printing is over graphic overlay sheets are added to the front panels.

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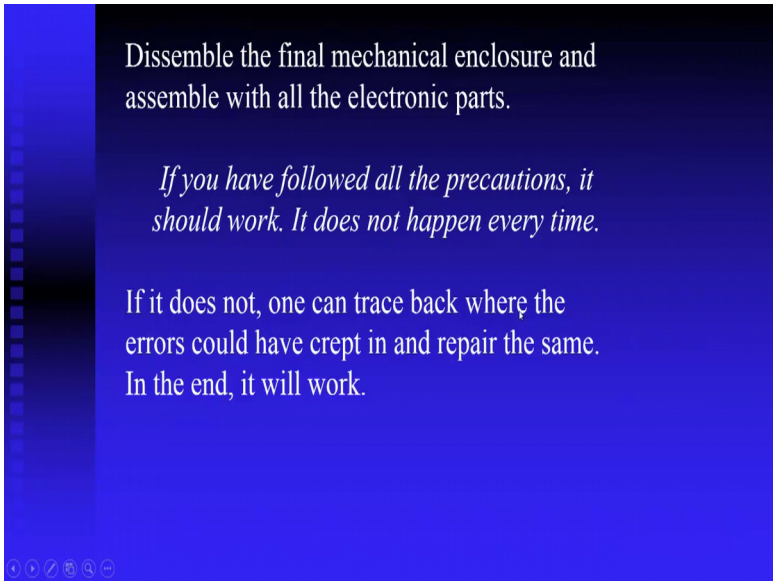

So, this whole lecture was intended only as a dissemble the final mechanical and assemble with the electronic parts, if you followed all the precautions it should work it does not happen if it does not one can trace back where the errors could have crept in and repair the same.

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There we have pulled out a new product from the hat or another further in your cap.

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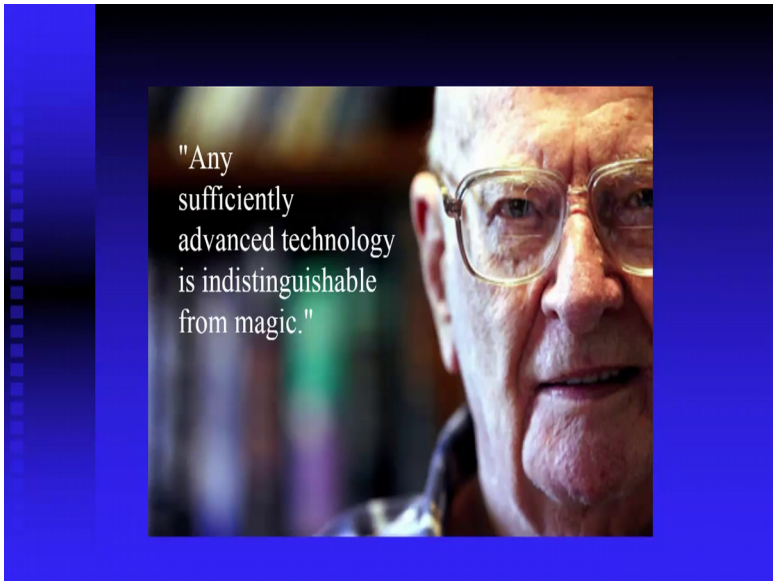

Any sufficiently advanced technology is indistinguishable from magic, I think you know who is.

So, I will stop here thank you for your patience I say just you go back and then try to collect a bit of hardware bit of components for your proposed project. So, I have shown you that reading lamp, I shown you are interest in thing a timer with a pointer like this. So, may be why not have an app why not have a stand why not have something, there you do all this things on your phone and then if you bring it close together it should a timer should stop if I take it back it should start doing I do not thing it is impossible, you can always make a proximity thing or you can tap it and then make something take a signal from there. So, get ready.

Thank you.