**Electronics Equipment Integration and Prototype Building**

**Dr. N. V. Chalapathi Rao**
**Department of Electronic Systems Engineering**
**Indian Institute of Science, Bengaluru**

**Lecture – 35**
**Fastenings and Hardware**

I am back for the continuation of that small interface between mechanical detailing and application and electronics. So, in the previous session I talked to you about how to make a very very simple what you call enclosure I do not know if it is still there whether I can still open it.

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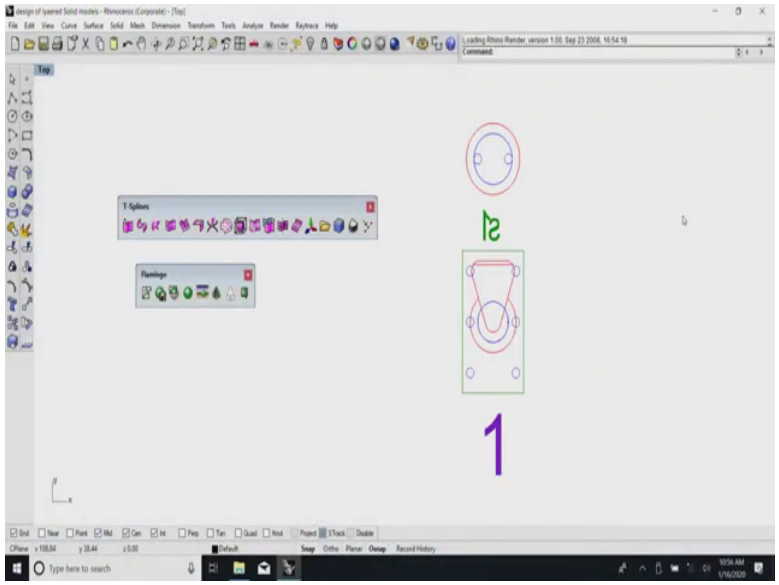

I started with the switch, then I graduated all the way to actually making a small equipment.

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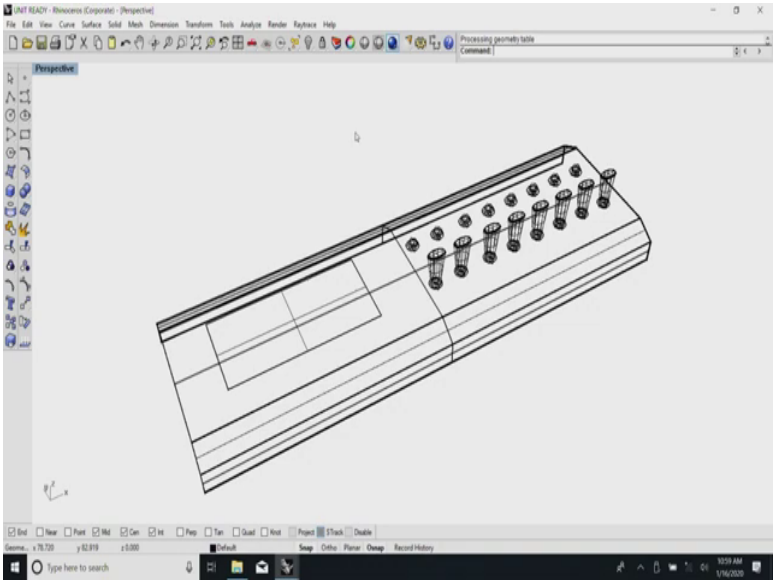

I hope you recollect this saying by making one time a model of one element in that case it was simplest I could show you that was a small toggle switch. It looks like a very insignificant this thing allow me to repeat one more time. Details of the toggle switch and its application everything is available from the usual manufacturer and generally given a particular panel detail meaning what is the opening you require for mounting it, they are almost generic you can change it. And if from that point you extract all the information which is available on the in their application node.

You will notice that most of them follows under two categories; one category is all about the mechanical dimensions, but basically 2-dimensional drafting device, even if you ask for the DXF version what you get will be the 2-dimensional drafted almost a contractual package meaning it will show you all the various dimensions operations and so on. And, as part of that

you will have already the mounting details and the interconnection details. Sorry for repeating it, but better you know about it.

Now, in our design we would like to have both of them together meaning you should have a choice of putting it where you like and then making an enclosure, so that the whole thing works. So, in effect if you look at this I have a nice I will say almost very very absolutely pretty looking device like this.

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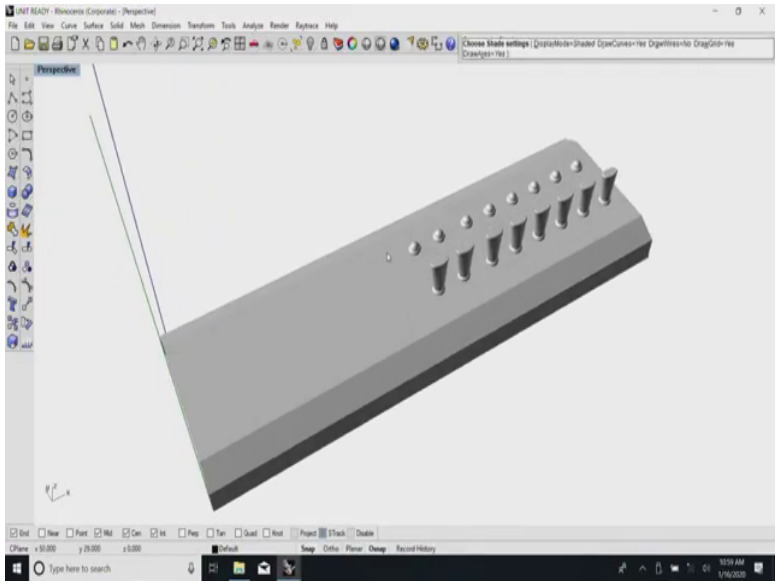

Now, the earlier lecture also I have talked to you about we can either keep it flat directly on a what you call your workbench or you can mount it on a rack as part of another equipment. If you keep it on the workbench where the real estate is at a premium, it makes sense of you make it compact and readable probably with a slight tilt so that you can see it.

Now, if you want to stack it as part of a actually practical equipment a design like this will help, there is no problem. A small design like this will help there is no issue about it at all.

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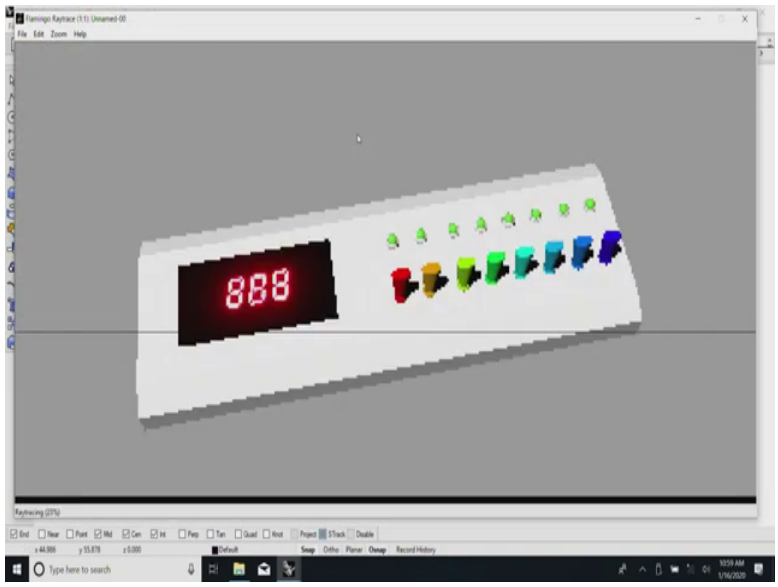


It is trying to render because in this case you have two options; one option is saying you can now directly mounted as part of a rack or you can make an equipment which can have other means of I mean existence. One of them is it can be part of another equipment and in this case I mean just as an experiment I showed you a few switches, a few LEDs and a display here. Now, the next question is saying if I once create any of these detailing, it will be useful for me for quite some time.

Now, come to the point of saying I need to have an enclosure which holds this. So, in the case of that so called 19 inch rack we already have all those 19 inch rack elements and probably if you dimension this properly you can make it as a 2U or 1U also if you make them a little close

together you can make it within that 45 mm which will make a 1U. If you make it the next usually 88 is available then it keeps on going like that you have 132 and so on like that. So, more of them we can make it.

Now, in that case of that 19 inch sub rack a lot of the details are taken care of except that one front panel you need to probably fabricate as per your design, at that point also it is very easy for us. I just need to probably procure one of those units which is nearest equivalent to it and try to place all these components and again extract the front panel drilling drawing from there which is good. Now, let me move on to the next level of the what you call thing please have a look at this monitor and the amount of hardware that is available for us.

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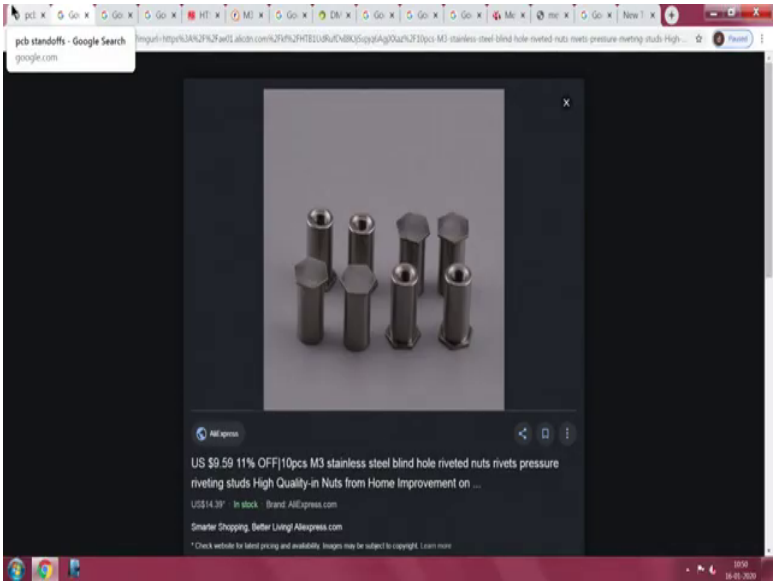


I am sure you have come across these things. This one is a riveted nut ok. It is called a blind hole riveted nut. If you see here it says blind hole riveted nut meaning you may or may not

have access on the other side. When they mean a blind hole it means exactly that you have no access to the other side of the what you call the.

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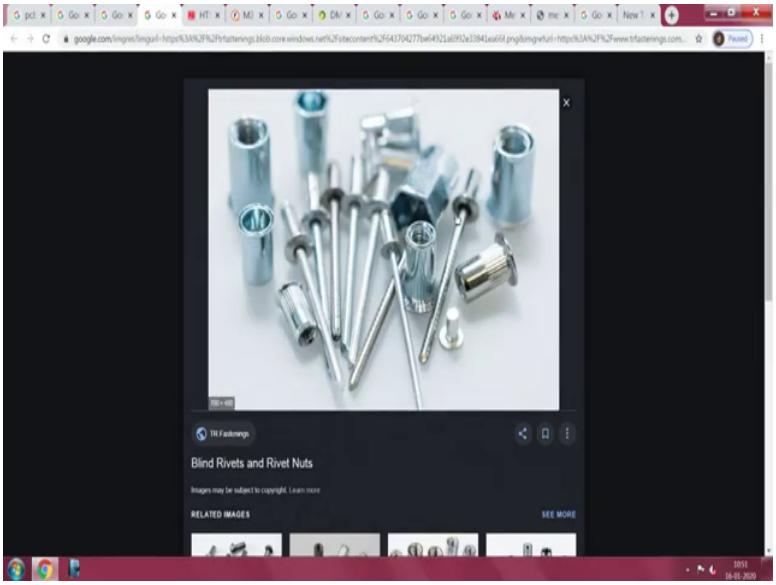


So, we all have what are called blind rivets and rivet nuts.

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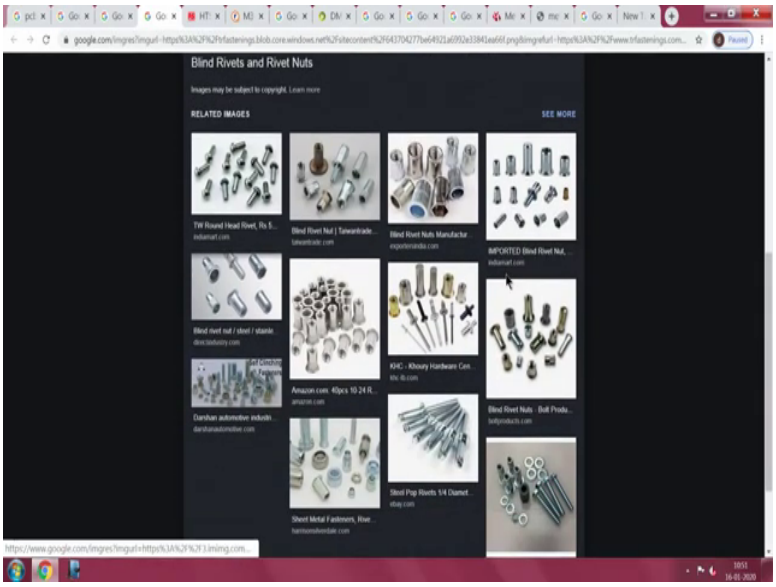


These in fact, are extremely useful for us when we work with our equipment.

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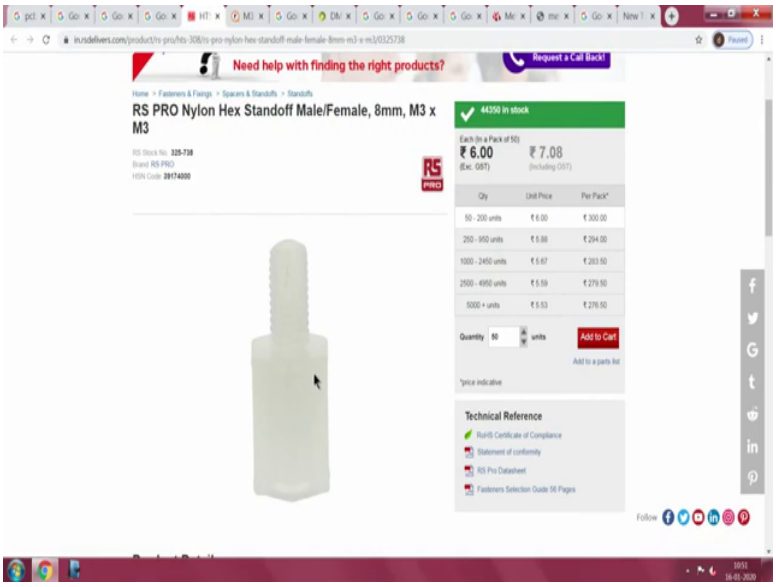


And, I am sure all of you have come across this this is a nylon hexagonal standoff Why hexagon? Easy to hold and inherently the compared to the equivalent circum circumscribed circle; one of the faces a little closer to the hole. So, it is very convenient for you to space them together. And, if you keep going like this that that thing has an advantage; one of the advantages is insulated. So, nothing is likely to short.

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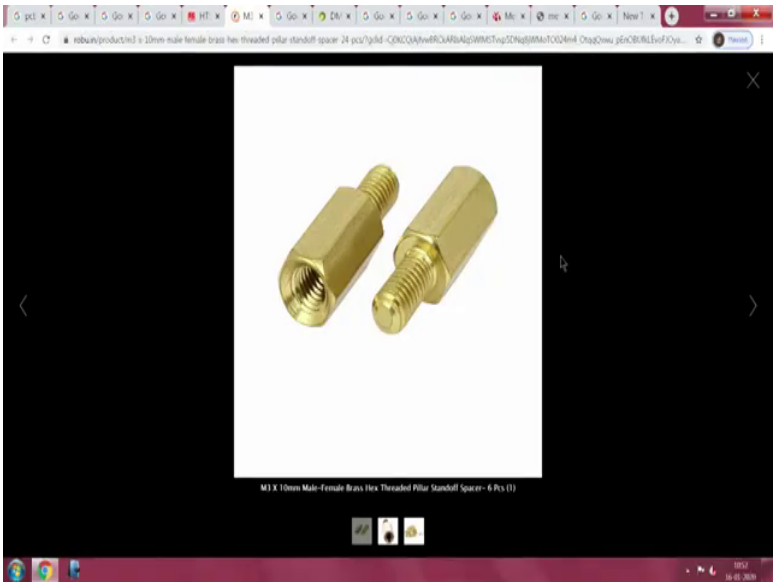


But, in reality it is not preferred to have them insulated all the time. Sometimes that hole stack let us say you have 2 PCBs they have ground planes, you have a ground then two circuit inside planes another either ground or the other live things and all that. Now, we may want to have the ground planes connected or we want to have supplies connected. The advantage being it also leads to a small element of shielding, followed. If you have a ground plane the ground plane can you can ensure connectivity through these brass devices.

And, we have a small additional advantage that in some conditions you can use it as a reference ground or earth to prevent electrical shock and that. The moment somebody opens see in equipment it is possible for us to look at another shining metallic object and they can continue with their work. This is more than shock, it has something to do with static electricity

you have static electricity. So, they have a static wristband which is attached to one of the places and in that places we require these continuous things.

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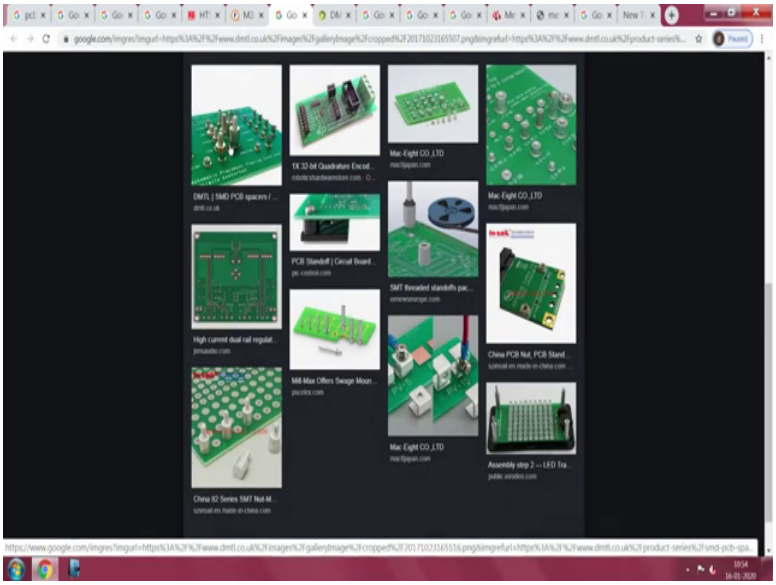

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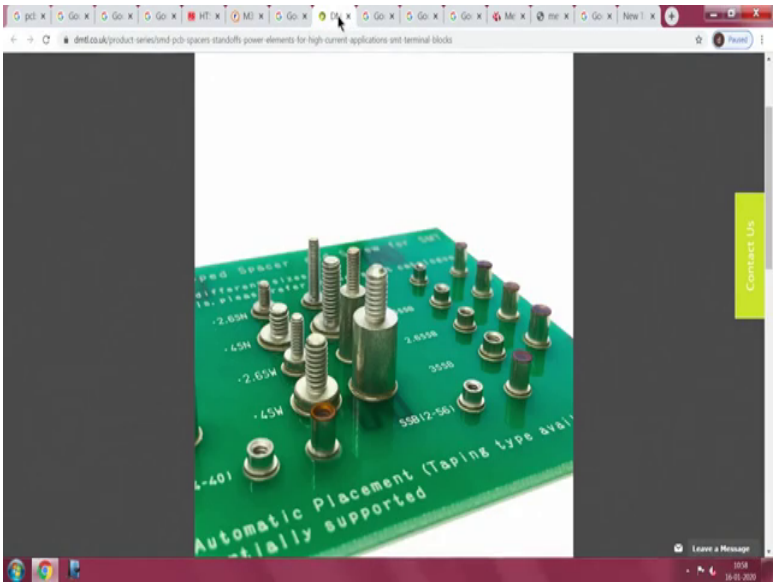


Now, if you look at this you will see that so many variants of this are available. Seen this? Looks good, in fact, extremely good.

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So many of them you have seen something very interesting here. These are meant for high power looks very very very interesting. Some of them in fact, are surface mountable that is a surprise for me. The last we knew about it is this surface mount technology or surface mount devices were all restricted to normal low current and typically not very high voltage a thing. I mean maybe I think 300 – 400 volts is not an issue and the other one being the impedance matching part of it.

But, now in power applications a very nice to see we have even automatic tip dispensed items are also there which to me is a real what you call fantastic option that is available.

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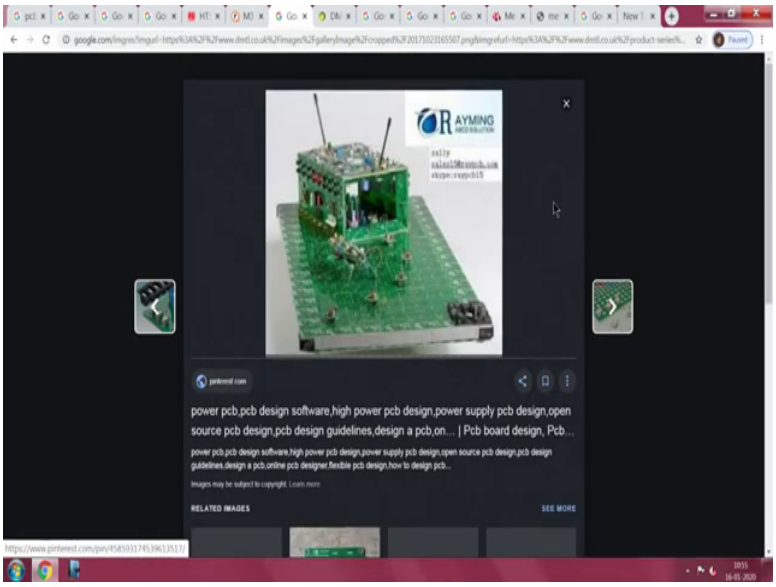


So, I will just go back leave you there because the concentration you can easily get what you call carried away for this. Important thing being, SMD power elements for high current applications and SMT terminal box which is really tough.

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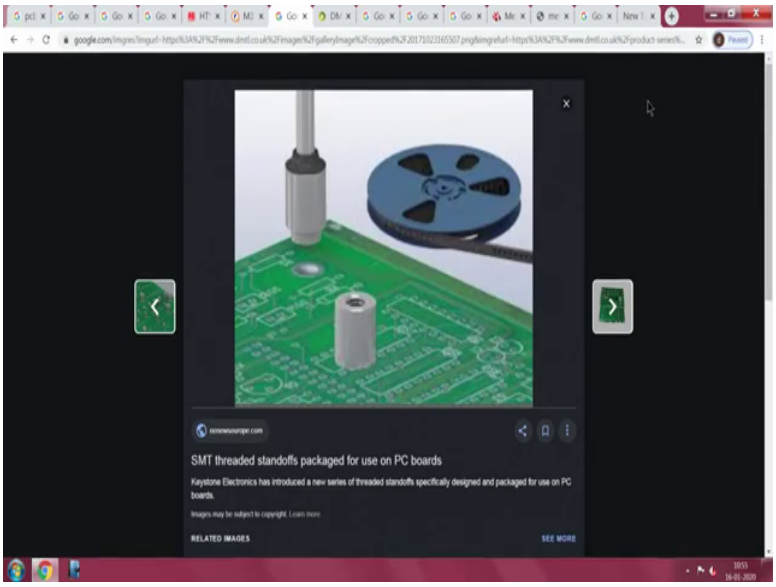


And, you see here even these are now it looks like they are easily available with keep what you call bonding or dispensing and all that so that two things were always have been a block a what you call stumbling block for electronics tight packaging. Especially in the case of power electronics we have the problem of current carrying; current carrying is real. They are is nothing like an ideal connection anywhere.

An ideal connection will typically have no voltage drop at all, no other this thing and no heating and infinite current capacity, but such a thing does not exist. Everything still needs a little bit of probably some millivolts drop is there plus there is a physical restriction on the sizes.

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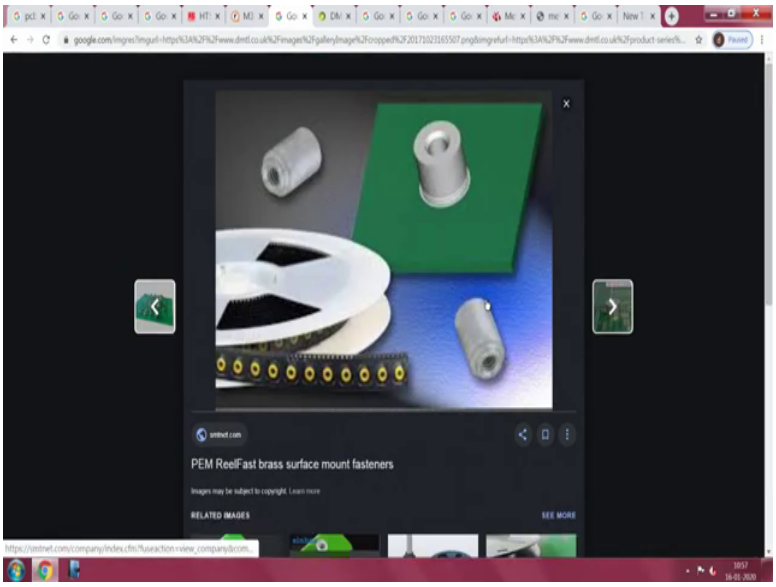


So, this is where it looks like know now really anything you see here it is a surprise for me first rail mounted standoffs are available like this. So, it looks like equipment have been either it is modified or you know the things are available by which if you specify these things they get mounted easily.

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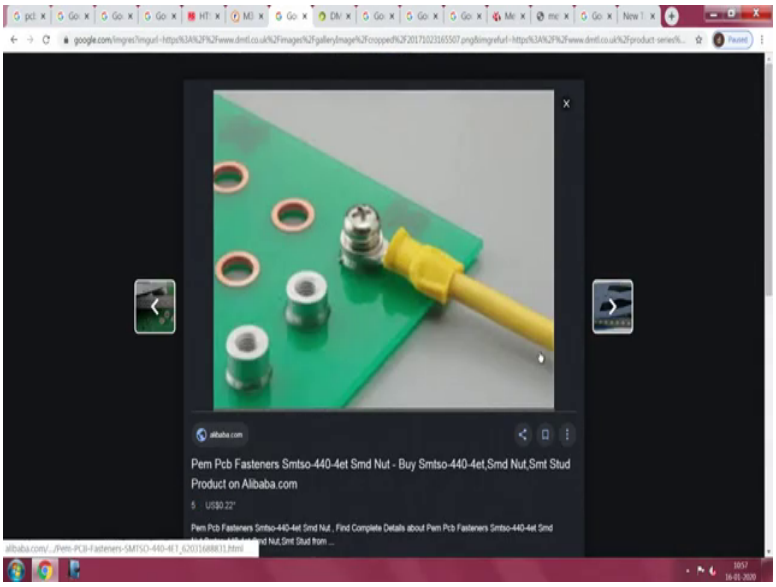


And, whenever you need to take connections, see here there is a surface mounted nut also. I am not very sure the SMD is the same as the SMT we talk about. However, you do have something which is directly soldered to the printed circuit board and unlike the conventional very simple microvia holes here in this case we have power microvias and inside I am not very clear. At least I know that the this is probably you know something required for this thing.

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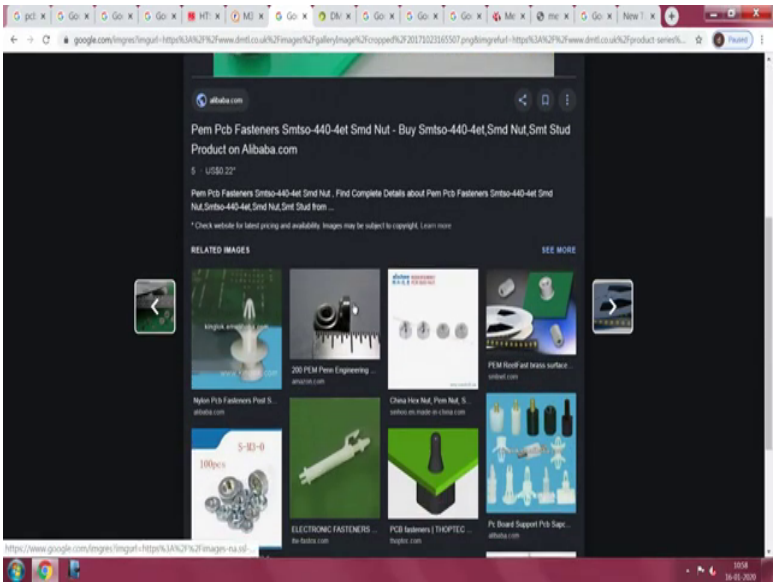


So, we have huge amount of these things here that last one I will come back later. But, anything you can think of you just need to come about.

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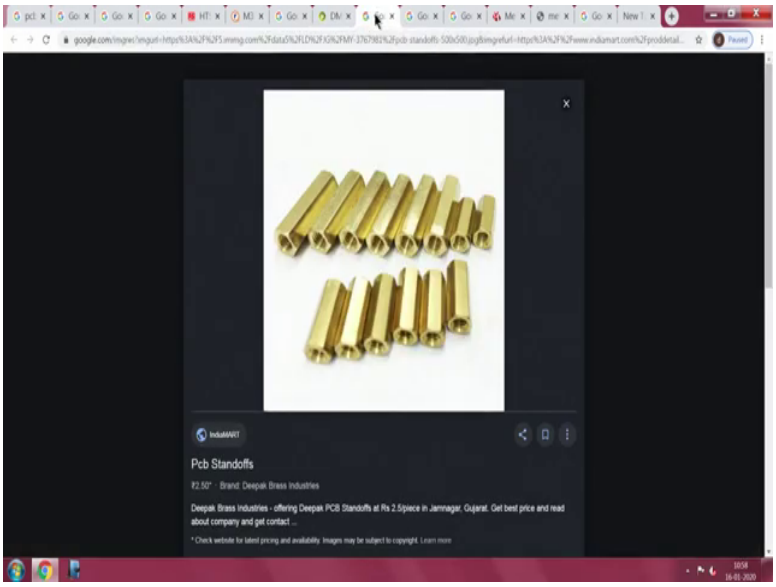


The other fastener there I showed you was one side there was a thread other side there was a stud internal thread was a stud in this case both sides are what you call threaded inside with internal thread. So, these also have certain purposes.

Now, it is for you to take a decision saying should it be insulated or not and the main advantages insulated thing is they can take more heat, they do not soften at let us say 80 or 90 degrees. All other things especially nylon and all that just maybe about 80 and 90, they soften and usually the threads may misbehave. If they are already under stress they weld fully and later on it is a problem. Now, this I am sure you have seen you will be surprised what exactly is this. This is nothing, but quarter inch PCB standoffs adhesive.

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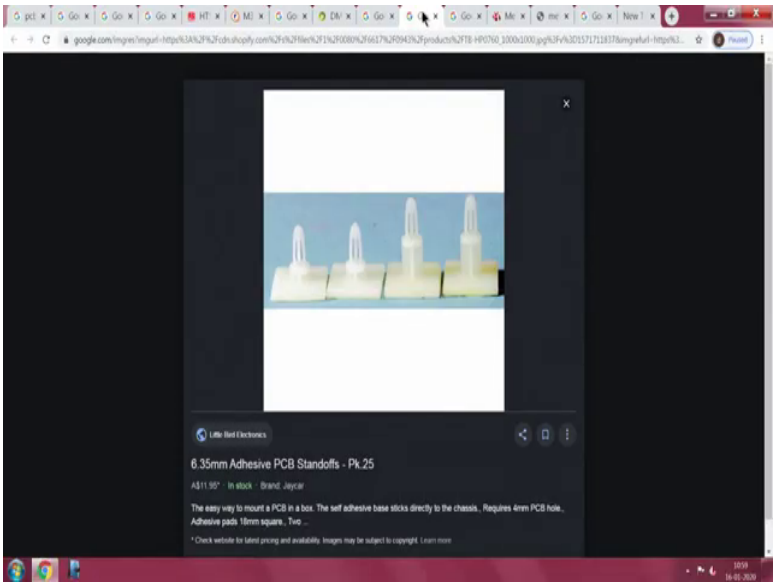


So, on the other side we have a backedup adhesive. This is where it makes sense for us in case you have a printed wiring board and you need to keep it in a standard enclosure. So, you can buy one of those innumerable standard enclosures make another plate which is like a template. And, remove this adhesive peel, this adhesive and stick them at proper places. Another way of doing it is in case you make a jig all these can be pushed into the jig so that the positioning will be easy and the jig will have only openings for these items and elsewhere you have place for holding another thing like a tweezer align it and you can perfectly stick it.

Later on you just need to squeeze this, remove the fixture and afterwards push your PCB inside. You have seen that know? I have a printed circuit board which has let us say two points, I have two openings probably at least two of them will be corners are this and this

corners that try to make some other place any convenient place usually they will have at least one more opening.

Now, if I make a fixture and slight workaround is take a damaged PCB remove all the internal things, so that you have access and now attach the this things at the back, position it wherever you want to put. Once you are clear probably you can make a two corner marks remove it. Peel the adhesive, again align it, keep it there, hold it hard just let the adhesive sink and then remove the that fixture which you are using a jig for mounting it and nicely locate them afterward putting a PCB on that is going to be very very easy for you this is where these things help us.

Now, why I keep repeating it is imagine you had a beautiful 3D model proper solid model in which all the things including this height the amount of area that is required for you meaning area that is required and any alignment and the opening that is required. Now, one more time if you have your standard enclosure you can move these things wherever you want, place it and you do not even need to have this standard enclosure directly because you already have a solid model of the enclosure. You punch up the solid model in part of your library, push all these things see which were best you can arrange these things and that is where the advantage comes for you. Let us say in one of these things is coming in your way.

Now, you can specify somewhere that these stand house we have a problem this big one is a problem so, maybe cut off one of the diagonals. You understand that rework of these items can be made separately as part of your library. So, these reworked elements probably of all the four corners it is one of the corners will end up with having a rework in it. Now, if you have these library components you need to pick them, put them all around in your standard enclosure and now comes the thing now start laying the PCB.

The components everything as I told you the EDA software in variable allows you to have a simple schematic capture. And, connections are made via what is called a rats nest understand the then afterwards if you want automatic placement takes place otherwise you can force the placement, saying this is where we would like to have the power connections it will like to have where the other heavy things. And, next you can take all this what you call the panel that

reference drawing and make islands where the routes cannot be taken and you have your slightly better what you call printed wiring board layout.

So, component placement just as important it is and placement of the mounting everything has been taken care of by also including these items including reworking.

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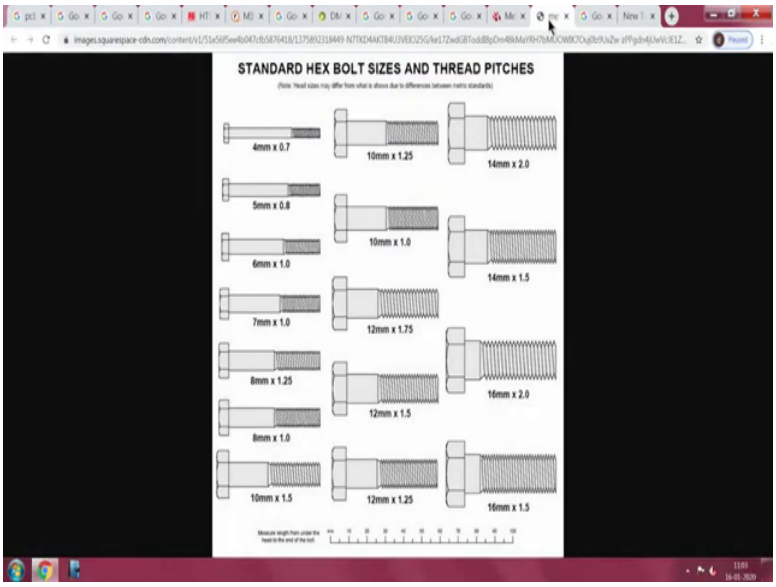


Now, however, if you go to the pure mechanical these things while that part was a little related to inside details you will notice that tremendous amount of standardization has taken place with respect to all these fastening devices. Why do you need it at all? Often, we end up with an enclosure which as maybe up to 30 to 40 mm thick, you understand? It is 50 mm thick and then now you need to have long boards.

These will give you a good picture of what are all the things that is required and you will notice that even the manufacturers of those what you call off the shelf enclosures probably use these things. And, the beauty being you just need to make one attempt at making the drawing one drawing, after that making it longer thread size scaling it all this will be easier. Once you have this item you can probably make your own thing go shopping and get anything you want. You see here beautifully they even mentioned nice scale here, so that it is possible for me to play around with it.

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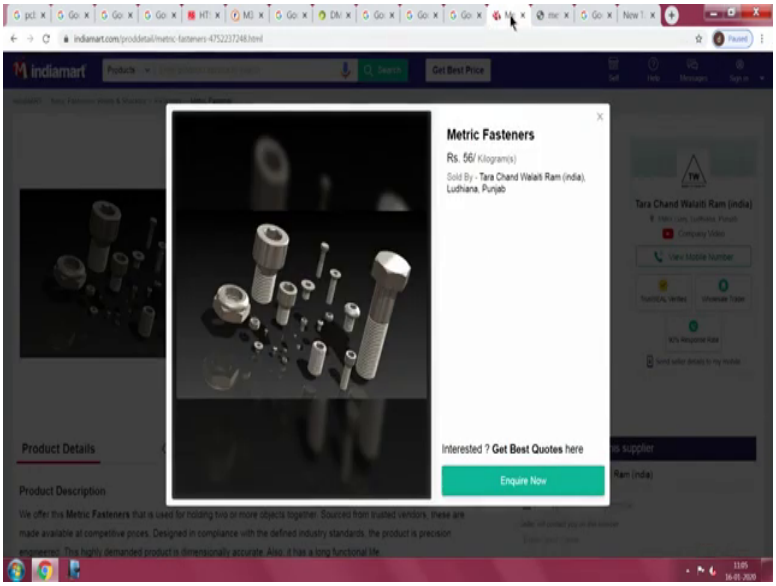


See these, everything you can imagine is available there including some very special items like this. These are all lock nuts. These lock nuts ensure that once you assemble it on a printed circuit board or part of your enclosure this will be able to withstand all sorts of vibration,

bumps and all that and generally one of the first thing you will notice is electronics fail in mechanical because of mechanical failure and not because of electrical failure.

Only on one common condition in the case of thermal it is possible that some of the devices fail, but in principle is any chip which is mounted there is no issue about it 10 to 20 g it accepts very well; what breaks is the leads what breaks is the mounting device. So, in fact, the amount of trouble not trouble amount of expertise aerospace people have acquired is a lot related to how to ensure that mechanical resonances do not lead to failure in the electrical connections. I will now try to go to the other things.

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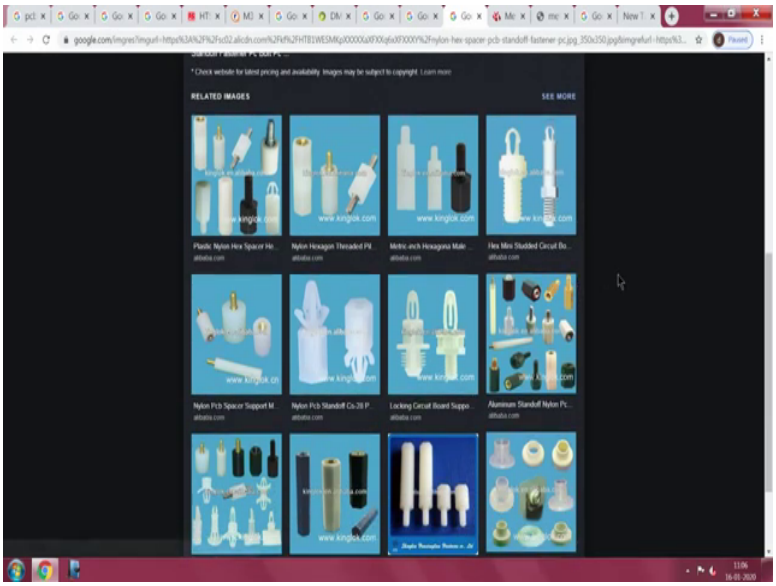


You know it in one place anything you can think of is probably is already here.

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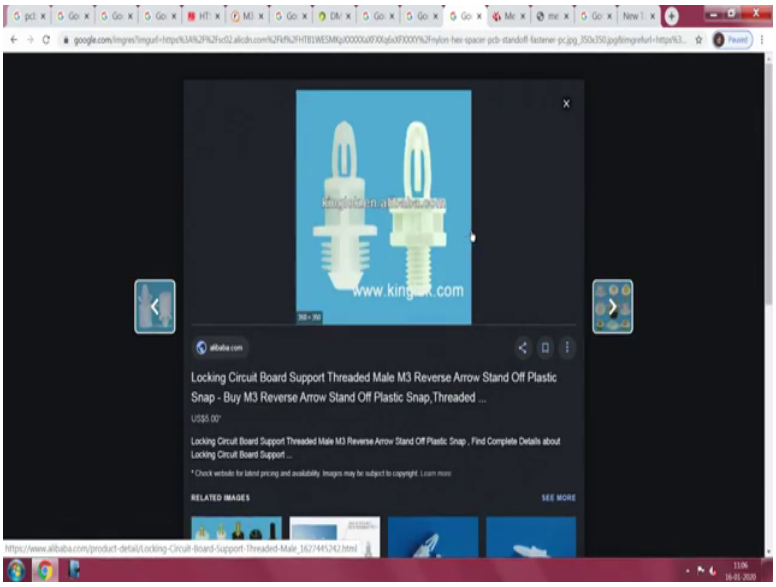


Real beauty, is it not? There are some things which lock.

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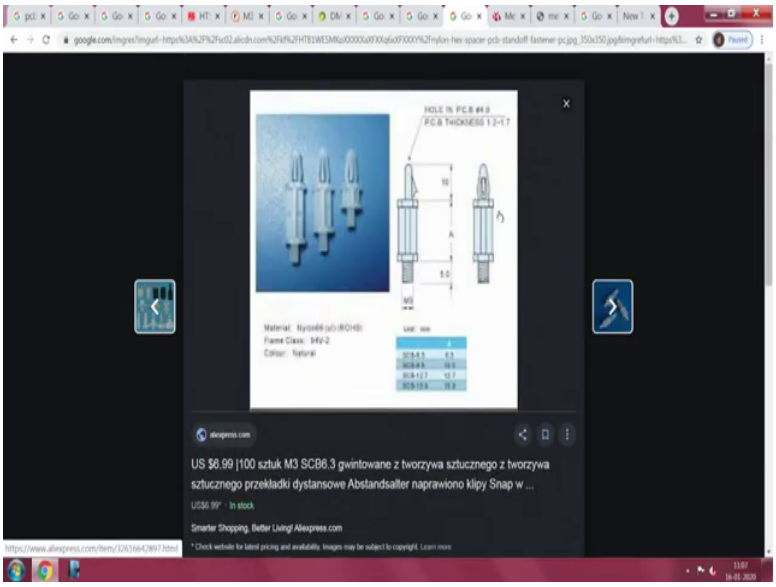


Now, oh anything you can think of and the beauty of it is all the dimensions are available. It is for you to make a first attempt and then try to make things and you see here this small projection here that projection ensures that once you push it inside that if you put a printed circuit board inside it is easy for you to, it will not come out on its own unless you press this small tab this is the locking thing. Why I thought I will show you is there are things which lock on both directions, there are things which lock on one face.

So, in your assembly drawing you can also give an indication saying this locking tab should only face one particular direction saying in case you have a component stuck here if you have the locking tab there it is going to damage it. So, you have to push it in one place or make enough place, so that the locking tab can be conveniently pulled out. So, anything we can

think of know somebody has thought about it and gone to extreme lengths. So, in a way I am happy I am sure if you think about it you too will probably be equally happy.

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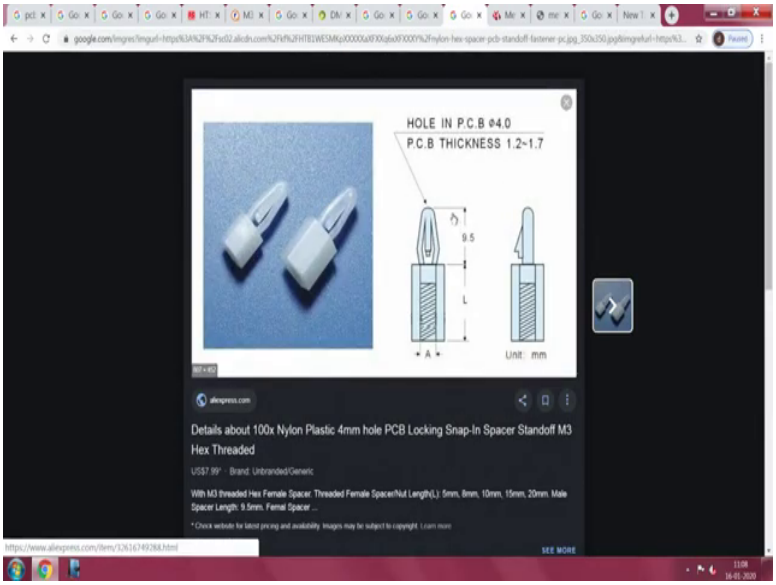


So, we have the other one what I showed you has some other different type of thread. You understand this one had a external thread, the other one has a internal thread. See this has an internal thread and all the dimensions are given. One more time if you notice, this part of it is probably about the same for both of the thing; only thing the small detail that is required here.

In that case in the other one operating that nut maybe a little problem; in this case you just you can position it here first and then after that on the other side you put a any threaded fastener. And, if we are lucky and you have enough arrangement for this contact arrangement within around 60 degrees you can afford to realign it.

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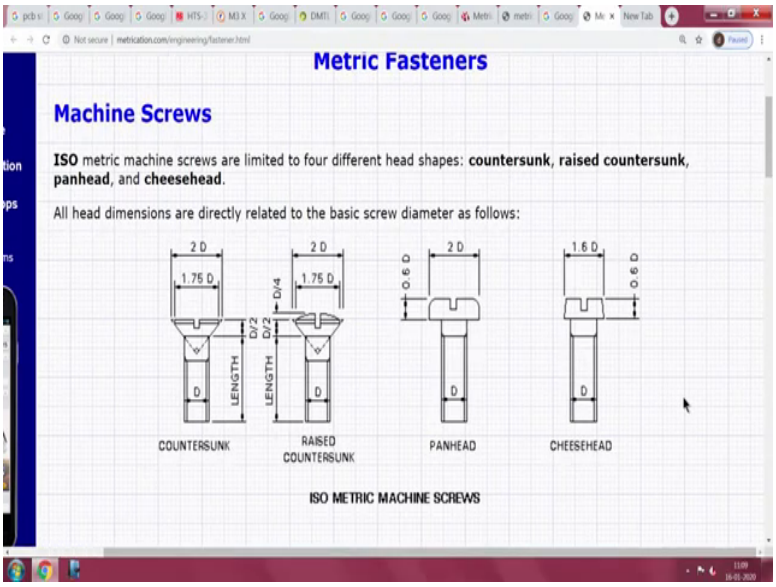


So, anything I mean I am little happy that we have all these things. Now, I am likely to repeat it, but allow me to; allow me to have the pleasure of something which I as a mechanical engineer enjoy a lot. If you see here one of the first thing you will notice is the background is a graph sheet, you have seen that it is a little useful it is not a little useful. In our case you know if you actually take a picture of any of these things on a regular graph sheet you can have an approximate idea.

Now, conventionally we have two types of screw heads everywhere. I am sure several of us have seen this which is called a cheese head. Why it is called a cheese head is the it is supposed to look like a bit of cheese I mean ignore it. The only thing being here you have a screwdriver slot and if you see the diameter it is around 1.6 time the nominal diameter of the thread. In

contrast you have this panhead which is little flattened at least it looks flattened where this dimension is 2 times of it.

Both these things it are actually probably the best fasteners you can think about because you can have a hole which exactly corresponds to the diameter and here also the fabricators has standardized on the drill bits and all which they stock. So, for a 3 mm screw by default a 3.2 mm drill bit is used follow 3 to 3.2. Why the 3.2 used is it gives an accurate location. So, and in linearly you have only around 0.1 chance of putting 0.11 mm adjustment.

So, if you take a I will take a standard PWD I mean printed wiring board thing, typically what is called a 100 mm by 160 mm is a good starting point that is instantly is called the single euro card. So, if you take a 100 by 160 the diagonal you can calculate it comes to I think you can calculate a little over 200 mm. So, in 200 mm this typically this 0.2 mm may or may not be sufficient. So, for locating purposes usually they use a 0.2 mm hole.

The other holes will all be 3.5 millimeters which will allow us to align everything properly. And, in reasonably good thing and if the panel has been fabricated properly these things fit perfectly. The rare cases where we need to have compatibility between two suppliers or anything they will be infact, oblong openings you understand, but the focus is trying to use a screw which is shown here. Have a look at the screw one more time.

Now, we have a little problem about it saying sir but on a front panel if the screws are visible we are in a mess is it not we do not want this screws there that is how what is called the countersunk screw has come about it looks like a god sent. You anywhere you want you just relax I mean you make it into a tapered hole and then push it inside. On one count it is very very good; on one count it is very very good and typically in small workshops and where or where the drilling is perfectly done counter sank to tapped hole.

There is no issue at all, you understand? Counter sunk to tapped hole there is no issue at all in case it is done perfectly, but you will notice that this counter sunk locates the thing perfectly. Once you call this as a 3 point M3 countersunk screw the diameter of 2D and the diameter of 1.75 and that angle of 45 degrees is fixed. So, when a screw sits in there it sits without the

slightest chance for it for error. So, on the other side if you give one of these riveted nuts if there is a small variation in that coming back to that you remember 100 by 160 PCB if I just take everything 6 mm from the edge.

So, 160 minus 12, 148 mm will come in 148 mm even 0.1 mm a variation is there a counters can screw with a fixed riveted nut will not fit properly that is reason why these are preferred. In those cases, we need we cannot have reverted nuts. However, we require a floated nut which can take that little bit of variation, but invariably floated nuts you know require a very elaborate arrangement. So, you require what is called a cage nut; cage nuts are slightly difficult and added to that we have other problem is saying it is very difficult for us to put a screwdriver normal screwdriver into this.

Chances are it will get a it will scratch the surface hence things like this raised countersunk has come. It has a little advantage first of all location is perfect and this depth is a little more you have seen this it is D by 2 plus another D by 4 that is 3 quarters of diameter you have say in a if it is a 4 mm screw you have a 3 mm depth; in in this case you just have only very little depth here.

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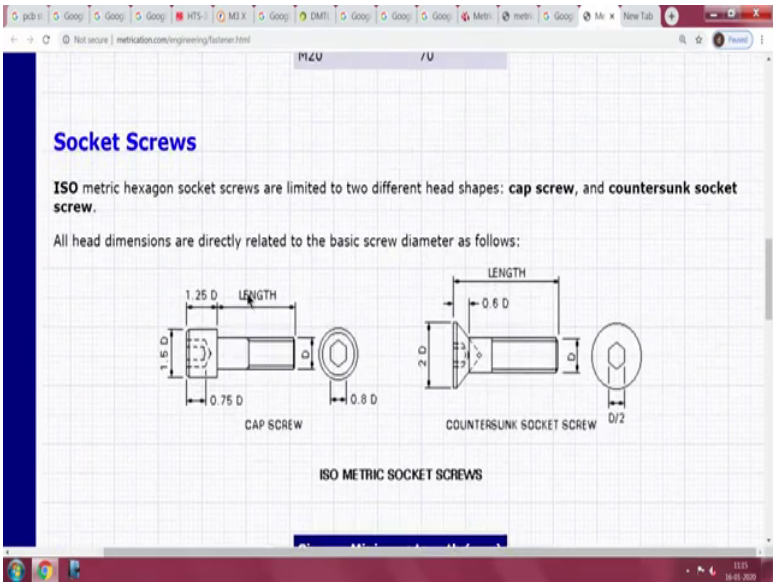


So, in those cases we have ended up with other screws which are counter sunk, but have a some other way of arranging. So, large number of these variants are possible and it is now becoming almost customer in electronics that we do not use these things except in very large things like that is an axle counter or something as part of your car, some sensor which is mounted in a very harsh environment such places we use these mechanical these fasteners. And, otherwise everything has come to those very very fancy large number of fancy screw heads. Some of them are made such that you cannot open them.

So, if you go back to your attempt to hack or jailbreak a jailbreak a device somewhere if you search on the internet whatever the funny screws which the manufacturer has put in his mobile, a kit is available for you and how to open them because corresponding screw head things will

come. Some of the screw heads are made such that you can only tighten them you cannot unlock them and, but the manufacturer does it in some other way.

So, coming back to where I started you need to make solid models of all these small fasteners and in this case in the solid model you can also add a note on this side saying what all you want to do. But, the panel detailing and the gaps and all that you were also made on another layer you just need to move any of these things. For example, if you want to put these here you can just move it wherever you like and you can see the corresponding openings are already there and this I feel is the interface which you and I can develop over a time.

And, then one more other thing is it is a good learning experience if any freshers come they can also join and make all these things and it does not matter what is the package you are using. Any package which you have access to and you can probably download it and exchange these solid models across and in principle generally a solid model the units that are used in the model in any cad are not related to the actual print that is available because they are all some dimensions. So, while you want to take a printout or while you want to dimension it from the screen that is where these things will come.

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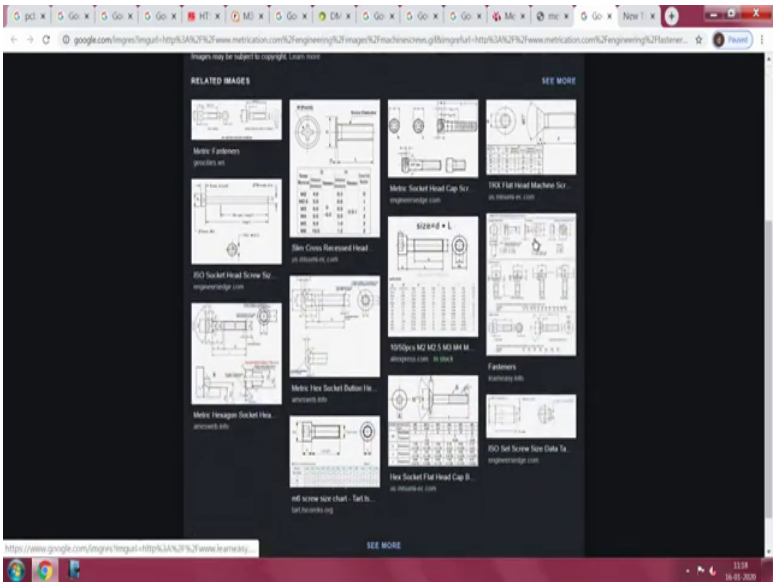


So, I am very happy that I have got a chance to talk about all these fantastic fasteners. It is never ending.

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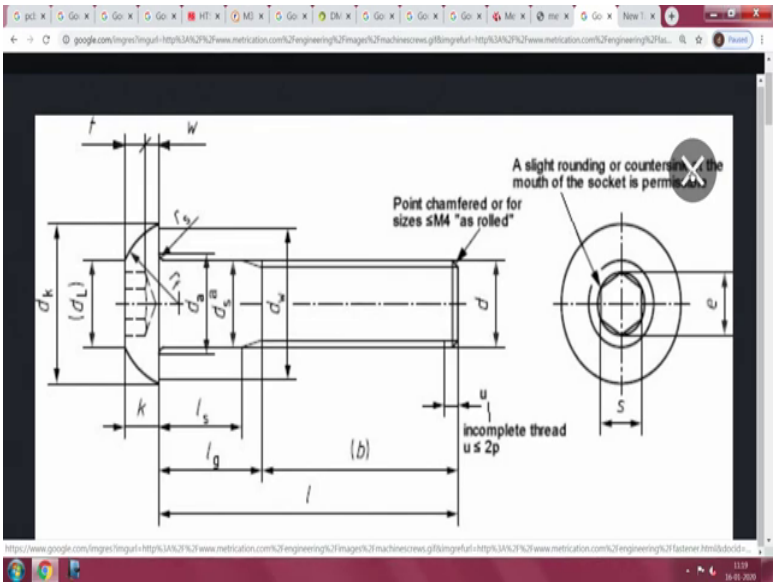


And, you see even in a simple thing like a screw like this we have ended up with oh, sorry ha. The detailing regarding the head lot of work has been done. So, and at least wherever you are using as I said if you are making certain sensors and mounts and all that you probably need to specify only such fasteners and along with that a little more detail has been given saying there is rounding off and this thing so that they enter easily.

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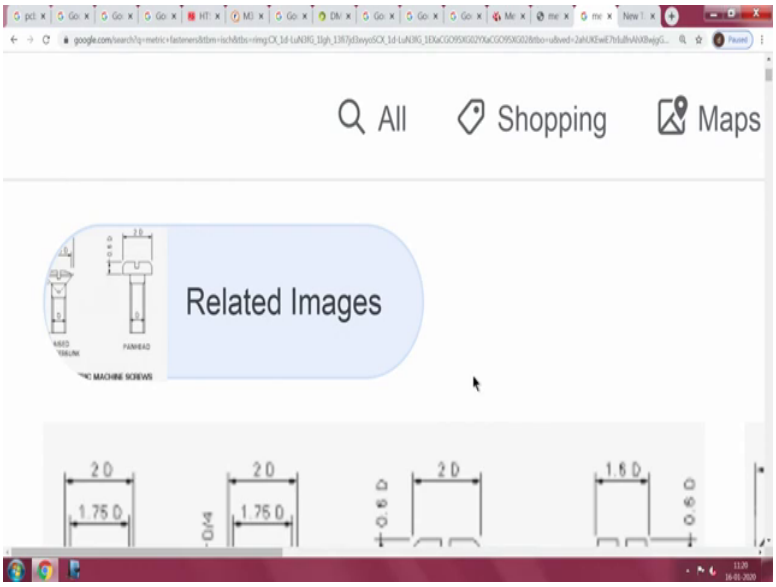


And, somebody has worked tremendously to get all these drawings in place and the drawing which is the supply is first of all two things. One of all it will allow you to make your own model and there is they are fully interchangeable across all other suppliers. So, you can just take a look at it. I have to stop here. The particular thing was just like what had done it with the basic electromechanical components like switches displays and all that.

Pure mechanical components which are required for mounting your various items also need a similar type of thing which is generally covered in probably in mechanical in regular assembly type software, where in fact, bi directional associativity is there. You have to things which are you know put say 101.6 mm a point which has something to do with inch conversion 4 inches and now instead we wanted to be really you know reasonably good and you change it to 102

mm. I just need to change the dimension here and the things move and it will check for any interference is there.

So, thank you. I will continue on this theme by which you know I will show you a box and then I will show you a cover on top of it. Probably, I will show you the same front panel which can be fitted along with all the mechanical as well as the electrical specifications, except this is not going to be related with the electronics functionality. It is all about how the various details are and then in the end they can extract all the information make drawings including a development drawing with all the openings.

That drawing can be directly stuck on a piece of any what you call material you want and you can drill it without having to do very elaborate close marking and in the case of that initially if I showed you one seminar timer. So, lot of trouble was made and then something you know left and right was done and top of it was made to match with it is easy. It was just checking it end. However, in the two mounting holes in the front and back or in case you have tabs on the top.

Those mounting holes and all that if it followed the method which I am talking about you would have got a 100 percent fit thing. You can make a model easily in cardboard, you can also replicate it in an actual thing and the same thing can be passed down for production. And, the person there who wants to generate machine codes for it G code they will be able to do without too much of additional effort, if we just show it will be easier for them. So, I will take leave of you here.

Thank you.