Hi, my name is Alex Alah from Breccia Digital. And in this short video, we are going to talk about how we filter differential mode currents noise and how we filter Common mode noise. So starting differential mode, let's assume that we have got a power supply in one of the previous videos with discussed differential mode currents and Common mode currents, and we know the differential mode current goes out of the line and comes back and through the returns. So in order for us to filter this the most common way, in fact, is a very simple L.C filter. So you have got an inductor. Yeah. Connected to that and then you have to have connected to that. Now, that forms a very simple L.C filter, which filters out our differential load noise. The issue is, though, that we need the both lines to be balanced. In particular, the noise on both lines is tested. And therefore, let's say that for simplicity, we calculated that this to be 10 micro henries. What we normally do is that we put five micro henries on the line and five micro henries on the return. So you end up with half L over here and another half L over here. And of course these form and L.C filter with this capacitor here that filters differential noise. In addition, often you end up having a large electrolytic capacitor plus some Dampier register or ESR. These two let's call this Cd and Rd, these two are there to make sure that the filter does not cause instability with the power supply, according to Middlebrooks stability criteria, but we will talk about that in a different video. So for now, this is the major part that we are interested in and this part is what is filtering the differential node noise. Now, as we discussed in the previous video, we also have some common mode noise and common mode currents. And we said that the common occurrence will flow this way and then return through parasitic capacitances to the chassis to protective. This is our third line. So I've got some current going that's right now through here and I've got some current going that way here. I need to filter these also. And I do this with a common mode choke. And if you look at it a little bit deeper, you'll see that is exactly the same as this is structure in that it is an inductor and it's a capacitor. It's just that you have got two of them now and they have to meet respect to the chassis. So I'm going to draw now a common mode choke. It's usually drawn. Like so. The dot notation shows that it's a common mode choke and the C has to be with respect to the chassis. So what happens next? That goes to there. That goes to there. And then I need some capacitors with respect to chassis which goes from there to there and from there to there. So you can see that you've got an LC filter down this path and on the LC filter down the path. And if I put a little block around it. This is the common mode section and this is a different color. This is the operational mode section, and then you have got here your slide, your return for neutral and your protective earth. Sometimes in addition to these, you also put an extra capacitor here, you know, to filter some more. But again, we discuss this in a different video. OK, now this is the full structure of the filter. But many times when you see the circuit diagram of the filter, many of these parts are actually emitted and you see a much simpler circuit diagram. But that does not mean that they don't exist. That issue is that the leakage inductors of the common mode filter actually like acts like a differential mode choke. We're going to talk about that in detail in another video. But for now, please just take my word for it that one of the leaks within this common mode choke is going to act like a differential mode inductor. And therefore, manufacturers of filters actually permit these and they only do this part. So a very common way. I'm looking at the circuit down the line filter looks like so you have got some X cap between the line and, let's say neutral or return then. You have your common mode choke. Then because the leakage of this is acting like the differential mode inductors, they don't even show it on the circuit diagram, they draw the white capacitors for the common mode choke like so in the center and tie to chassis. Yeah, they do not show the inductors. And then you usually have got as bigger capacitor. That is the differential mode capacitor. And very often they actually omits the damping components either in a circuit diagram or altogether in the filter. And that is a very common way of looking at a circuit diagram of a line filter or an EMC filter. You think that there is no differential mode filtering going on with any differential mode choke, but in fact it exists due to the parasitic inductance and stray leakage, inductors of the common mode choke, which we'll talk in a different video.