**Design a common mode EMC filter**

**How you select the common mode components for our EMC filter.**

Let’s say now that we have design of differential mode components which is right here at the moment. Let’s say we needed a total of **10 micro henries** and what we normally do is we equally spread those around the line and the return so I would have necessary **5 micro henries** on the line and **5 micro henries** on the return, Lets for simplicity that I have **20 micro farads** for ceramics (capacitor) and that gives me the **LC** filter that I designed in one of the previous videos we said that we needed a damping resister and a damping capacitor to reduce the **Q** and that was for stability purposes and we said that the damping capacitor have to be 5 times bigger than the capacitor we have therefore if this is **20 micro farads**, I know the damping capacitor is gonna have to be around **100 micro farads** and then and finally we set for a **Q** on round one we know the equation for **Q** is equal to 1 over **R** times square root of **L** over **C**. We know **L** is **10 micro henries**, we know **C** is **20 micro farads** so can calculate the value of **R**. So this portion of the circuit is not complete. Now we are gonna select the components for the common mode section, if you remember again from one of the previous videos we said that the leakage inductance of a common mode choke manifests itself as differential mode inductance so we know that if we have common mode choke for example here one we have there is certain amount of leakage within this which manifests itself as the differential mode inductors. I already know that I need a total of **10 micro henries** worth of differential mode inductance so because we don’t want to use extra components what I can do is I can go to the manufacturer’s data sheets and find myself a common mode choke which happens to have **10 micro henries** of in leakage inductance that will allow me to select very quickly the type of common mode choke that allows me to not have extra differential mode components hopefully the size of it will be alright if it’s not then I have to reiterate and that is why filter design for EMC is an iterative process so for simplicity let’s say I find myself a common mode choke, it has got **10 micro henries** of leakage inductance and that one has got that much leakage inductance is **1 mili henries** so I ended up with **1 mili henries** worth of common mode choke and the final thing I have to do is to calculate the values of the common mode capacitors. Now there are two methods of doing this depending you whether you are making a line filter which is AC or whether you are making a high power DC DC filter. Now for DC DC filter you can have a bigger amount of capacitance usually with respect to chassis than AC and I will talk about this a little bit later but let’s say for DC DC converter. Typically I would say that the common mode noise at the starter appear from about 5 to 7 and a half megahertz and above that is because the capacitor to the Chassies is low and therefore common mode only appears at higher frequencies so if I assume for now seven and a half megahertz is where my common mode starts to dominant and then I assume that I want to attenuate this lets say by **80 dB** then taking two decades before would give me a cutoff frequency for a common mode section of **75 kilohertz**. I know that this is one mili henries, I know the cutoff frequency is **75 kilohertz** therefore **F cutoff** is equal to 1 over **pi** and square root of **LC**. **F cutoff** is **75 Kilohertz**, **L** is **1 mili henries** then I can work out **C** and of course then I can solve them so I have calculated all the components. In the case of AC line filter there is an extra requirement because the leakage from your line neutral down to Chassies is limited, it could be depended on the standard let’s say **500 micro amps** in that case you can calculate the size of capacitors based on how much current will flow down the capacitor and you can’t exceed a certain value and then you have got your as a second way of calculating and making sure that these values do not violate any of the criteria.

