Construction of Electronic Systems

Exercise 10:

USB DAQ project:

microcontroller part & USB part design

Keeping the bottom ground plane under microcontroller unsegmented with "fanout routing"

It is beneficial to keep the *ground plane under the microcontroller as little segmented as possible*. Such an unsegmented GND plane ensures low-impedance GND return paths for critical components and at the same time helps capture the *fast-changing electric field* around the microcontroller, reducing the radiated emissions.

One important idea that can help you achieve that is a so-called *fanout routing* (a.k.a. an *escape routing*). It is a special type of connection routing which deals with *routing tracks away from a component that has a very large density of pins* (such as ball grid array chips or BGAs). We can use the same routing principle in our case for the microcontroller on a two-layer PCB. The main idea of the escape routing is that you start with a very dense group of connections near the component (Figure 1, blue part), then lead these connections away from the component where there is more space and where these connections can spread apart (yellow part). Once the connections are spread apart and not so dense anymore, we can connect them more easily to other not-so-critical components (green arrow) or route them further to other parts of the PCB (on the same layer or on other layers using vias).

You can see that such a routing strategy can help ensure enough space near the microcontroller pins for the critical components (red arrow), while it places less critical components and connections (vias) further away from the microcontroller. This means that the less critical connections that will change layers won't segment the ground plane under the microcontroller, which is exactly what we want.

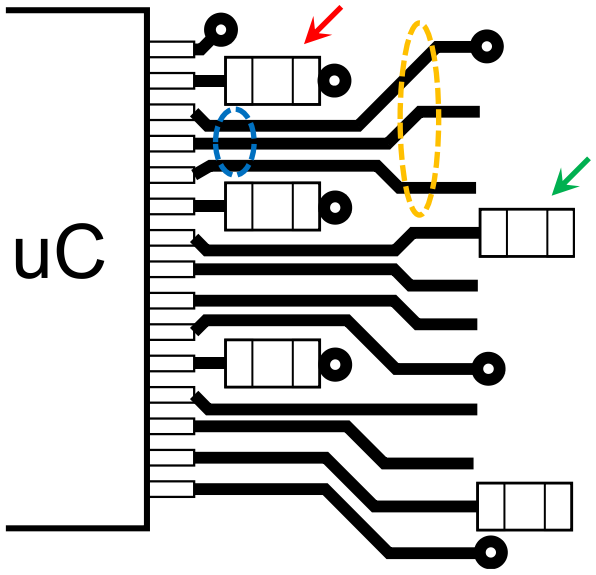

Figure 1 - using the idea of so-called "fanout routing" will help you keep the ground plane under the microcontroller unsegmented

By the way, the word fanout (or fan-out) is used because such a way of connection routing produces groups of connections that might remind you of a fan (slo. pahljača): narrow at one point and becoming wider at the other end (the yellow part above).

See "the good" and "the bad" examples below.

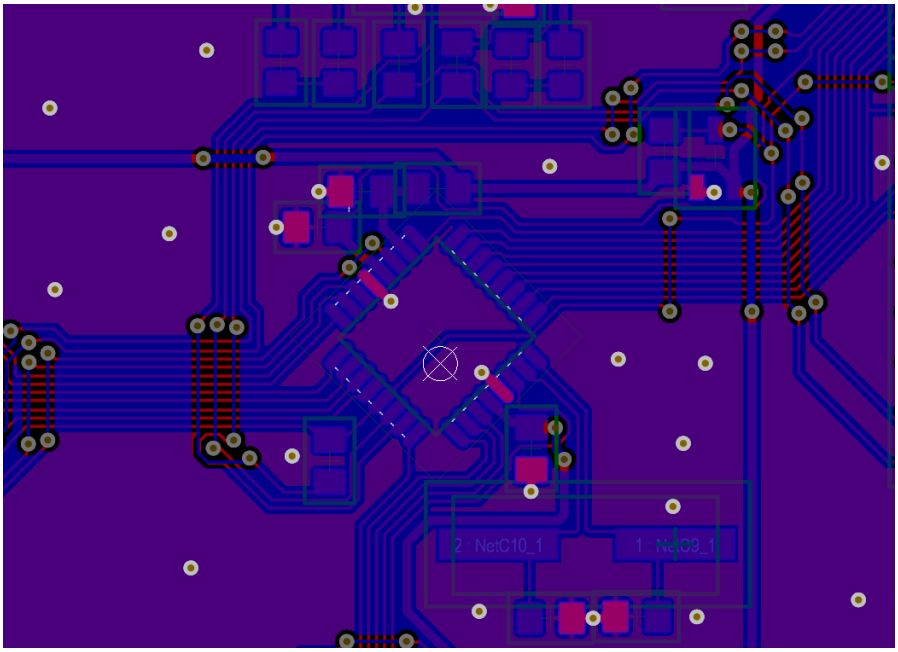

Figure 2 – an example of a good GND pour design under the microcontroller. Notice that the GND pour is practically not segmented and all of the high-frequency return currents have the low-impedance GND return path.

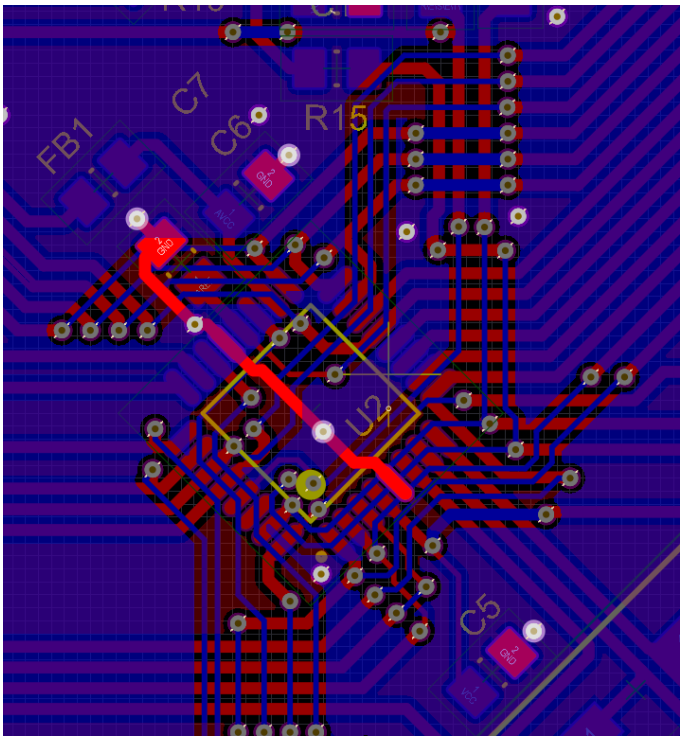

Figure 3 - an example of a very bad GND pour design under the microcontroller. The pour is extremely segmented, creating many obstacles for the GND return currents. The impedance of the GND return paths is therefore far from low. Also, the fast changing voltages from the microcontroller can be coupled to the signal tracks below, which can then become an antenna for the electromagnetic intergerences.