

### **3 Design Measures**

The following guidelines are recommended, however each measure described here must be evaluated for each application. The realisation of all measures can be very difficult, particularly in complex applications, so that a trade off has to be made.

For more complex structures it is not possible to determine general design rules. These structures have to be handled by SPICE simulation in conjunction with 2D- or 3D-Field Solver for establishing design rules.

General design recommendations :

- Define functional units. Classify also by speed: Analogue sensor, digital low speed, digital high speed, power elements. Place all components working with same clock together.
- Keep elements of same functional unit in close distance to keep critical signal traces as short as possible. Provide enough space for decoupling capacitors close to the IC and spread over the whole PCB.
- High speed traces should be placed near the center of the board far from the edge of the board.
- Keep the lead length of the decoupling capacitors as short as possible and locate the capacitors as close as possible to the VCC pin of the component.
- Before beginning the routing, identify critical signals according to highest carrying frequency and shortest rise/fall time of the signal.
- Place high current carrying lines as close as possible to the voltage regulator's output.
- Provide connections for series resistors within high speed traces close to the driver. But take care that the signal timing will still meet the specification.
- Place oscillators adjacent to the clock driver. If an asymmetrical board stack design is used, place the crystal oscillator on the side of the PCB which has the largest distance from the reference ground layer. This can prevent a direct coupling from the crystal oscillator package into the ground system of the PCB. To reduce the radiation / coupling from oscillator circuit, a separated ground isle on the GND layer should be made. This ground isle can be connected at one point to the GND layer. This helps to keep noise generated by oscillator circuit locally on this separated isle. The ground connections of the load capacitors and oscillator should also be connected to this isle.
- For two layer boards: Keep a "distance" between functional units by geometry (see figures 19 and 20).
- Separate parallel running traces by not less than 2x trace widths.
- The changing of the layers changes also the the impedance, which causes reflections at these points.
- Remove  $20 \cdot H$  of metal from edge of VCC supply plane to reduce edge radiation.  $H$  is board layer height or thickness (figure 10).