

How to reduce noise in PCB?

What is noise dependent on?:

- **Electromagnetic interference:** EMI is caused through unwanted currents and unnecessary voltages leading to the degradation of systems. In fact, the causes for EMI can be divided as followed:

Natural Sources:

- Cosmic rays, solar flares, snow, storms, rain, and thunder

Man Made Sources:

- Interrelated components can cause interference with each other through the processes of conduction(wires and cables) and radiation(electromagnetic fields)

Other sources of EMI include:

Switching devices

Switching pulses

High-speed digital signals

Clock signals

- **Crosstalk**(A specific type of EMI): Occurs when one signals couples(inductive or capacitive) onto another signal causing a deterioration in the performance of the latter.
- **Power supply noise:** When innumerable gates are switching power, instantaneous currents are drawn leading to noise that can create logical errors and timing issues
- **Ground loops:** When various equipment pieces are connected to a ground via different paths, a flow of current passes through these pieces leading to a humming sound.
- **Impedance mismatches:** A portion of the signal being transmitted can be reflected leading back to the sources and then propagated back and forth until attenuated.
- **Switching Noise:** Caused by high speed alternating currents between the layers of a PCB leading to radiation
- **Component/Thermal Noise**(Johnson Noise): Heat from components as current is constantly passing through

How is noise related to frequency?

With higher frequency, more noise is created due to the parasitic capacitance/inductance from the positioning of the components and the circuit.

Techniques to mitigate/reduce noise:

EMI shielding: The process of covering components with metal(Faraday cage) to protect them from radiation and absorption of the electromagnetic spectrum avoiding electromagnetic interference. The signals that do occur from the EMI are led to the ground plane via the metal.

Filters: Only used for analog devices and are generally used for low frequent and an impedance of 50 ohms. Three types of filters: low pass, high pass and bandpass. Once a certain frequency is passed, the signal is filtered out leading to a reduction in noise.

Isolation and splitting ground planes: Prevent the return path of a signal from one trace to another trace.

Citations:

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