Grounding

Grounding types:

Some manufacturers of ICs design their components with more than one ground port, usually in the form of PGND, DGND, AGND, SGND (power, digital, analog, signal respectively) These different ports each refer to a different reference point and are physically separated to avoid ground loops.

Ground loops:

Ground loops are unintended current paths between different ground connections due to poor plane design or offsets between different parts of the ground plane. These loops can hold large currents, heating up the PCB, and can generate noise significantly affecting signal integrity

Ground loops can also form due to stray magnetic field reception, which can alter the voltage level at one point of the ground plane creatin that offset across the board. However, ground loops due to stray magnetic fields aren't much of a problem as the magnetics field will affect the components and traces on the signal layer magnitudes larger than the effect of the current generated in a ground loop, so it is better to focus on shielding the signals than to worry about an offset voltage somewhere on the ground plane

How to prevent ground loops:

A good practice is to always have your ground plane close to your signal plane to provide the lowest impedance path for return currents as close as possible to the traces on the signal layer. Placing a signal trace closer to its

ground plane will ensure lower loop inductance, which helps reduce susceptibility to EMI and therefore lowers the probability of a voltage offset between points on the ground plane.

Another technique you could use is to have all components grounded at a single point or a single area on the PCB, This will reduce the chance for a voltage differential as all ground connections will be relatively close to each other. The ground return to the power supply should also be connected to a ground plane at a single point. When a ground plane is connected to the power supply only at a single point, the entire ground plane will be held at nearly the same potential.

Star topology:

For higher frequency applications as well as mixed signal applications, a single large ground plane can be extremely destructive to your design as it amplifies EMI susceptibility. By using a star topology where each ground plane is connected to the power supply ground preventing any ground loops from forming between planes.