

7. EMC suggestions

7.1 General overview on EMC

Electromagnetic compatibility (EMC) encompasses two areas: emissions, i.e. the ability to work without causing electromagnetic disturbances to the nearing devices, and immunity, i.e. the ability to work in the presence of RF energy.

7.2 EM emissions

Signals with high frequency content can produce significant emissions if connected to a large enough radiating area (created by long wires spaced far apart).

Also the contactor and motor drivers can emit significant disturbances, because their outputs are pulse width modulated square waves that are rich in harmonics (however, if a contactor supply is not modulated, its emission will be zero).

The best way to minimize this kind of emission is to make the wires from the controller to the contactor or motor as short as possible and place, if possible, each current near its return (i.e.: bundle contactor wires with coil return and bundle motor wires separately).

Another good solution is to put the controller, the wires, the motors and the contactor in a shielded box, especially if very low emissions are required.

Emissions can also couple to battery supply leads and throttle circuit wires outside the box, so ferrite beads near the controller may also be required on these unshielded wires in some applications.

It is best to keep the noisy signals as far as possible from sensitive wires.

7.3 Immunity to EM disturbances

Immunity is generally achieved by preventing the external electromagnetic disturbance from coupling into sensitive circuitry.

The RF energy can get into the controller circuitry via conducted paths and radiated paths. Conducted paths are created by the wires connected to the controller.

They act as antennas and the amount of RF energy coupled into them is proportional to their length.

The RF voltages and currents induced in each wire are applied to the controller pin to which the wire is connected. SME controllers include bypass capacitors on the printed circuit board's wires to reduce the impact of this source of noise on the internal circuitry, but in some applications an additional filtering in the form of ferrite beads might also be required.

Radiated paths are created when the controller circuitry is immersed in an external field. This radiation may couple with the traces on the board and generate various kinds of malfunctions. If radiated disturbance is an issue, a good solution is to increase the distance between the controller and the possible sources of disturbance or to shield the controller by placing a metal enclosure around it.