

Technical Note Document - 09/2013

System Wiring Guidelines

Good grounding and wiring practices are essential to the performance of electronic systems. This document provides practical guidelines for system grounding and wiring that can optimize performance and increase electromagnetic noise immunity.



When wiring, follow the local safety guidelines along with those provided in the documentation of each device.

NOTE The guidelines provided herein supplement the documentation of each of the devices, which must be read, understood and followed.

NOTE After installation, check your system periodically, in particular after installing new machinery in and near the system.

Devices emitting high EMF

High voltage, high current, and high frequency circuits such as power supplies, high power converters and amplifiers, contactors and solenoids, motors and motor-drives may cause severe electro-magnetic disturbances that may affect the operation of other nearby computerized devices such as PLCs or I/O modules. Those high voltage, high current, and high frequency circuits should not share the same cabinet with PLCs or I/O modules.

If this is unavoidable, within the cabinet, either:

- Physically separate these sources from PLCs and I/O modules with large metal earthed plates. Such a plate should be large enough to partition the cabinet into two sections.
- Separate these sources and their cabling from PLCs and I/O modules as described in the section Wiring Separation.

Wiring Separation

- Separately wire each of the following groups:

| Group 1 | Group 2 |
|---|--|
| <ul style="list-style-type: none"> ■ Communication lines; ■ Low voltage, low noise supply and I/O lines (e.g. analog and low-speed digital I/Os). | <ul style="list-style-type: none"> ■ AC I/O lines; ■ Noisy supply and I/O lines (e.g. inductive or capacitive loads supplies and high speed digital I/Os). |

- Do not run wires of those two groups together in parallel. If this is not possible, keep the parallel travel distance as short as possible.
- If the wires of those two groups must cross each other, cross them at a 90° angle.

Enclosing and Earthing

- It is recommended to use a closed metallic cabinet for installation. This will significantly improve immunity from electromagnetic interference.
- Make sure that both the cabinet and cabinet door are properly earthed. Please refer to the cabinet manufacturer instructions for proper installation and earthing.
- When you earth devices, minimize wire impedance by using a wire that is as short and thick as possible, less than 1m (3.3') in length, minimum thickness 14 AWG (2 mm²).
Connect the line to nearest possible grounding point in the cabinet, preferably a grounding plate or the cabinet body. Ensure good contact between the wire termination and the metallic surface by removing or scratching any non-conductive coating, such as paint. This can be achieved, for instance, by using toothed washers.

I/O Wiring: General Guidelines

- Route each I/O signal / signal-group along with its dedicated common wire. This wire serves as a signal return path and increases interference immunity. Connect common wires at their respective pins on the I/O module. Please refer to the module installation guide for details.
- When wiring analog and high-speed I/O signals:
 - Use shielded twisted pair cables.
 - Do not use the shield as a signal or as a return conductor.
 - Connect the cable shield to the earth of the system - preferably to the metal cabinet chassis.
 - Note that the shield must be connected only at one end of the cable; typically, earthing the shield at the I/O module end performs better. However, in some cases, earthing the shield at both ends of the cable is preferable; in such cases, in order to eliminate ground currents through the shield, it is necessary to earth the shield through a 100nF capacitor at one of its ends, preferably at the one which is far from the I/O module.
 - Keep shield connections as short as possible.
 - Ensure shield continuity when extending shielded cables.
- Plan your routing paths carefully:
 - Choose the shortest available path and avoid unnecessarily excessive wire lengths;
 - Follow the guidelines outlined in the Wiring Separation section above.

Signal (Communication, I/O) Line Filtering

Extra signal line filtering may improve the system's immunity to EMI.

If signal-line filtering is required, please use the following guidelines in addition to the guidelines provided by the filter manufacturer:

- Place the filter as close as possible to the target device(s), maximum recommended distance is 10cm (4").
- Signal lines can be filtered using rounded ferrite cores. Depending on the ferrite core and the type of interference, winding the wire through the ferrite core multiple times may increase their effectiveness.

- Always pass both the signal and signal return wires thru the ferrite core. If multiple I/O lines share the same common return wire, pass all of these I/O lines and their return wire through the same ferrite core.

Power-line Filtering

Extra power line filtering may improve the system's immunity to EMI.

If power-line filtering is required, please use the following guidelines in addition to the guidelines provided by the filter manufacturer:

- Use of power-line filters that comprise an earthing terminal is recommended. Connect the filter earthing terminal as explained in the section Enclosing and Earthing.
- Place the filter as close as possible to the target device(s), maximum recommended distance is 10cm (4").
- When using ferrite cores, depending on the ferrite core and the type of interference, winding the wire through the ferrite core multiple times may increase their effectiveness.

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