

Introduction

Malfunction and failure of an automated system due to electromagnetic influence can cause loss of production with high follow-up costs.

Such malfunctions can be avoided by setting-up the machines in a way that requirements on EMC are met.

Conformity to the EMC Directive as well as increasing the reliability of a plant with respect to its electromagnetic surrounding depend on the components selected for the plant. A decisive factor, however, is the constructive design and the wiring of the installation.

Components bearing the CE marking according to the EMC Directive conform to the applicable product specifications and basic specifications of this directive. Tests are carried out according to test standards using a test setup determined by the manufacturer.

Since the manufacturer of production plants usually combines several components to build a plant, he is responsible for ensuring that the plant as total system meets the requirements on EMC as well. According to the EMC Directive, the plant manufacturer or the person who imports a machine into a country of the EC is responsible for electromagnetic compatibility.

This application note describes the essentials with respect to EMC-conform planning, construction and realization of a plant to ensure that compliance with the EMC Directive can be assumed or verified, and that reliability in the electromagnetic surrounding can be increased.

Special Notes



Note

Due to the diversity of the EMC issue, we do not claim to cover the topic completely or correctly. Therefore, your suggestions are welcome.



Caution

The respective installation instructions and manuals of the manufacturer must be observed in any case when setting-up a plant and using components. This means that the specifications in these manuals must also be observed when they differ from those given in this application note.

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Recommended Guidelines

Installing the Electric Cabinet

- Ensure that a low-impedance connection is made between the chassis of the electric cabinet and earth potential (use a special grounding strip if possible because of better RF characteristics, and not just installation wires).
- Ensure that a low-impedance connection is made between the doors and side walls of the electric cabinet and the chassis of the electric cabinet (use a special grounding strip if possible and not just installation wires), and seal with EMI shielding gaskets (edge connectors, conductive plastic gaskets, etc.).
- Use mounting plates with low-impedance surface coating (e.g. galvanized, colorlessly chromated, unpainted). If the mounting plate is painted, the paint around the screwed joints and the area between the components and the mounting plate must be removed.
- Lead cables into the electric cabinet in a way that is EMC-conform: connect the metal or metallized connector with low impedance to the chassis of the electric cabinet, clamp the shield with the greatest possible surface area to the connector / bushing, and remove the paint at the contact area.
- Attach the line filter as closely as possible to the bushing and connect with low impedance to the electric cabinet (if necessary remove paint first).
- Arrange power, control and logic components in the electric cabinet physically separated. Use well grounded separators if necessary.
- If possible, avoid openings, slots, bushings, etc. in the electric cabinet. If they are indispensable, ensure that they are high-frequency proof, e.g. by means of special bushings to feed through cables (see "Cables"), and by covering openings with fine-meshed, EMC-compatible screen.

Components

- Use EMC-conforming components which comply with the EMC Directive or with applicable EMC standards.
- Observe the connection specifications by the component manufacturers.
- Find out the recommended EMC measures provided by the component manufacturer (installation instruction, manual) and implement them (e.g. connect interference suppressor filter directly at the frequency converter).
- Regarding components with several connection possibilities for supply voltage and/or ground, these terminal leads should be distributed centrally from one point (voltage drops in the device in case of high loads).
- Supply voltages and ground should always be distributed from a central point (e.g. busbar).
- Use transformers with shielding winding.
- Suppress the interference of relay contacts and ground contacts (e.g. by using interference suppression diodes, RC elements, varistor circuit)

- It is recommended to use commercially available EMC accessories for the components, such as gaskets for the doors of the electric cabinet, cable connections, grounding strips, air filtered fans for EMC, etc.

Cables

- Cables should be as short as possible.
- Unshielded wire ends of shielded cables should be as short as possible.
- Lead control cables and power cables separately. If possible, these cables should not run in parallel but in separate, shielded ducts, or with a minimum distance of 20 cm. Cable crossings should not exceed an angle of 90°.
- Shielded cables are to be used for the following cables: analog cables, data cables, motor cables from inverter drives (servo amplifier, frequency inverter), cables between components and interference suppressor filter if the latter is not located directly at the component.
- When using shielded cables, connect the shield to the connector with the greatest possible surface area. No pigtails! (See figures 1 and 2).

Incorrect:

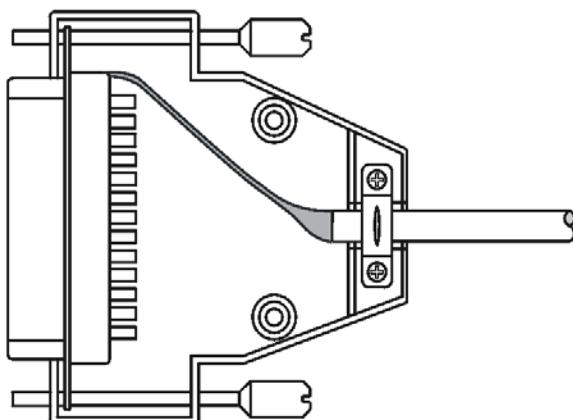


Fig. 1

Pigtail connection: the shield connection has a high impedance. Therefore, the current on the shield can induce interference to the inner conductors.

Correct:

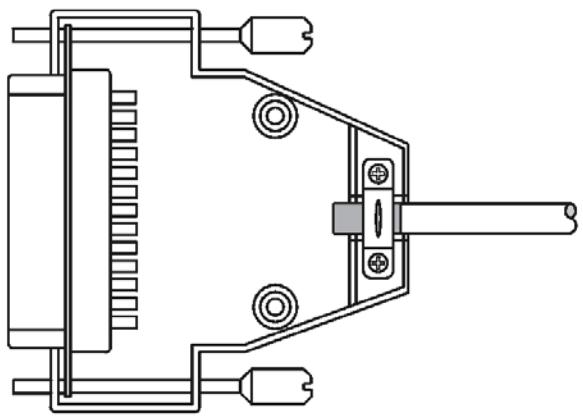
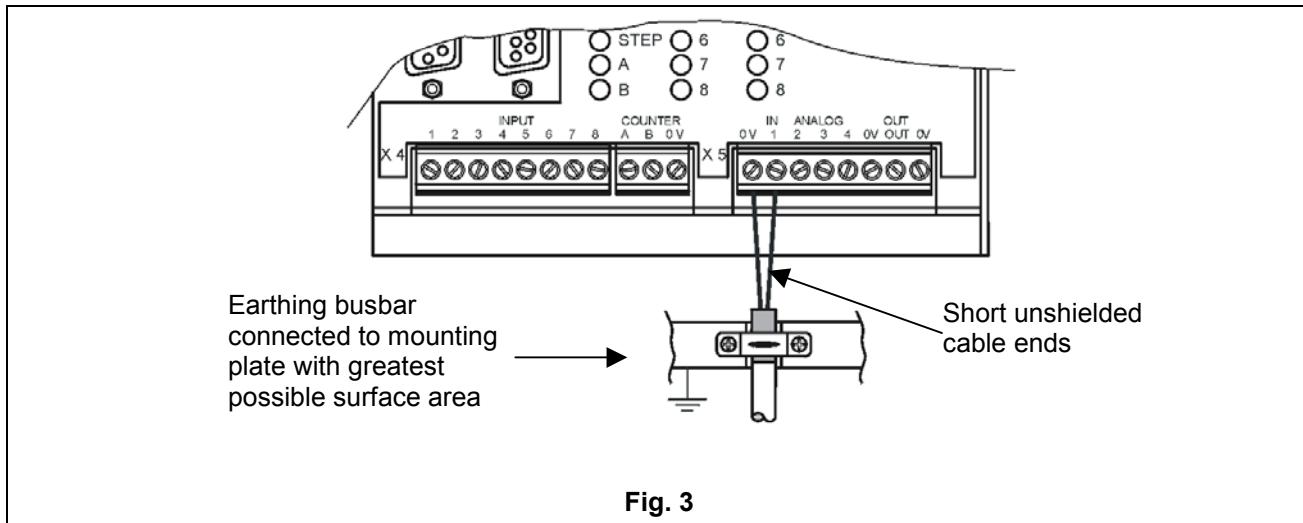


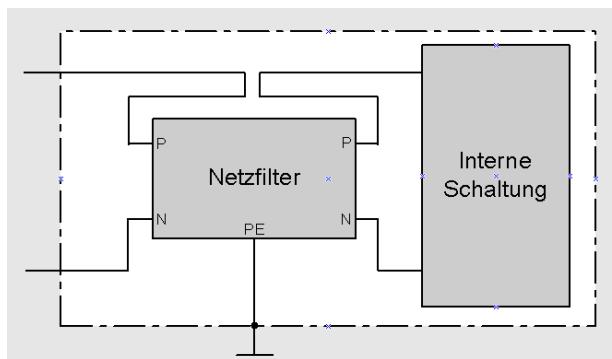
Fig. 2

Metallised connector housing and shield which is connected with greatest possible surface area.

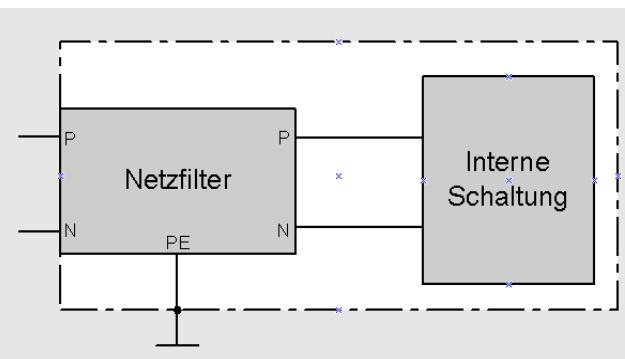
- If it is not possible to connect the shield to the connector, then the shield must be connected with ground with low-impedance and with the greatest possible surface area. Grounding must take place in such a way that the unshielded part of the cable is as short as possible (see fig. 3).



- Feed the main supply cables and earth connection into the electric cabinet via a line filter.
- Connect the supply wires (P and N) to the line filter. Ideally, the wires should be drilled.
- Connect both sides of the PE conductor, or at least one side, to the line filter. Do not lead along the line filter (see fig. 5).

Incorrect:**Fig. 4**

Unfiltered lines are too long and parallel to the internal lines. Insufficiently grounded line filter

Correct:**Fig. 5**

Filter is connected to ground with greatest possible surface area. Unfiltered line is as short as possible.

Legend:

Netzfilter = line filter

Interne Schaltung = internal circuit

Miscellaneous

- Do not plug/unplug live connectors. Do not perform electric works, such as connecting/disconnecting live components. Doing so not only poses a hazard to the user in the form of electric shock but might also cause power surges and consequently electromagnetic interference which can cause component malfunctions or defects.
- Prior to working with the components, the respective person has to ensure electrostatic discharge by touching a grounded object. Defects caused by ESD do not always lead to obvious damages immediately (latent defects)!
- When connecting several machines, care should be taken that potential compensation between the machine parts is ensured (earthing busbar, metal foundation, etc.)

Terms

Electromagnetic Compatibility (EMC)

Definition according to EMC regulations:

"EMC is the ability of a device to function in a satisfactory way in electro-magnetic surroundings without causing electromagnetic disturbances itself, which would be unbearable for other devices in these surroundings."

ESD

Electrostatic Discharge

The sudden release of static electricity can cause electronic components to fail or can even damage them. Electrostatic charge is built-up when two different materials rub together (e.g. walking across a carpet).

Ground

The conducting mass of the Earth, whose electric potential at any point is conventionally taken as zero (synonymous with protective ground).

Pigtail

The shielding braid of a shielded cable is twisted to form a thin conductor and is connected to earth potential through a simple connector.
This earth connection has a high impedance so that the current on the shield can induce interference to the inner conductor.
Better: connect the shield with greatest possible surface area.

Protective earth (PE),
protective earth conductor

Conductor provided for purposes of safety, for example protection against electric shock.