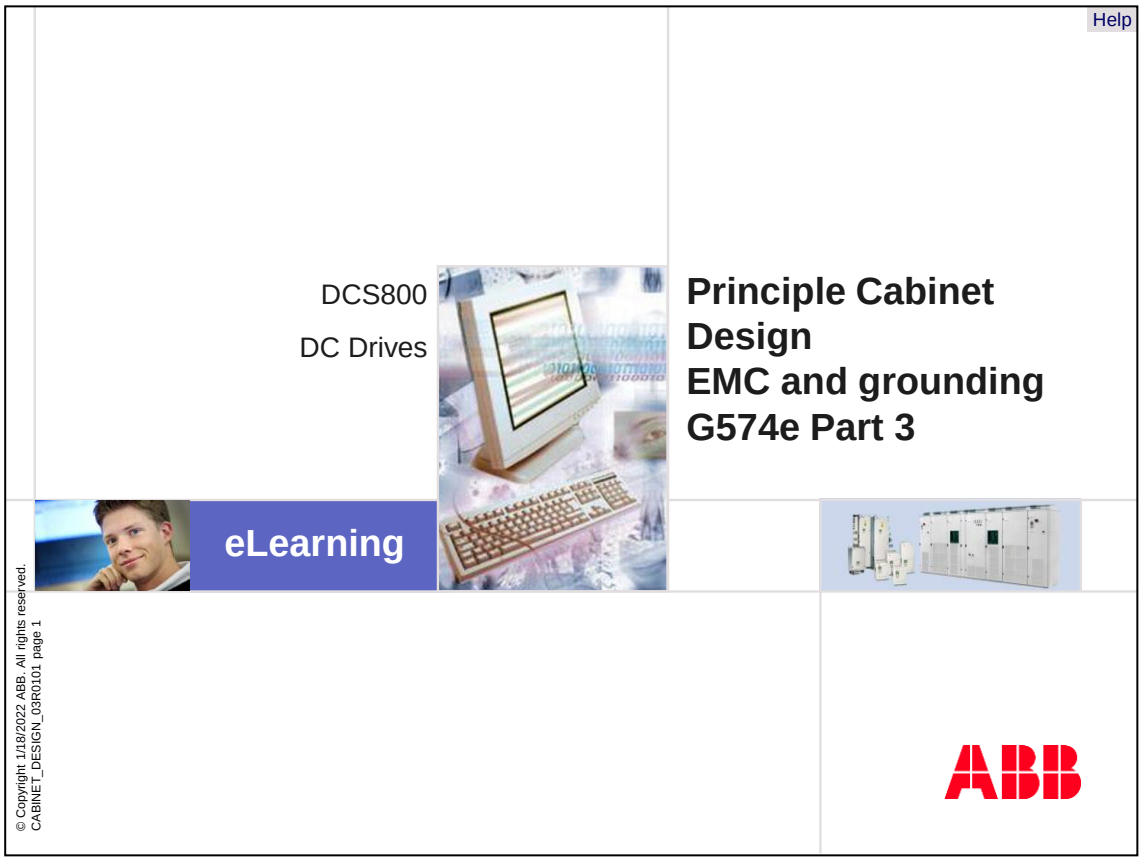
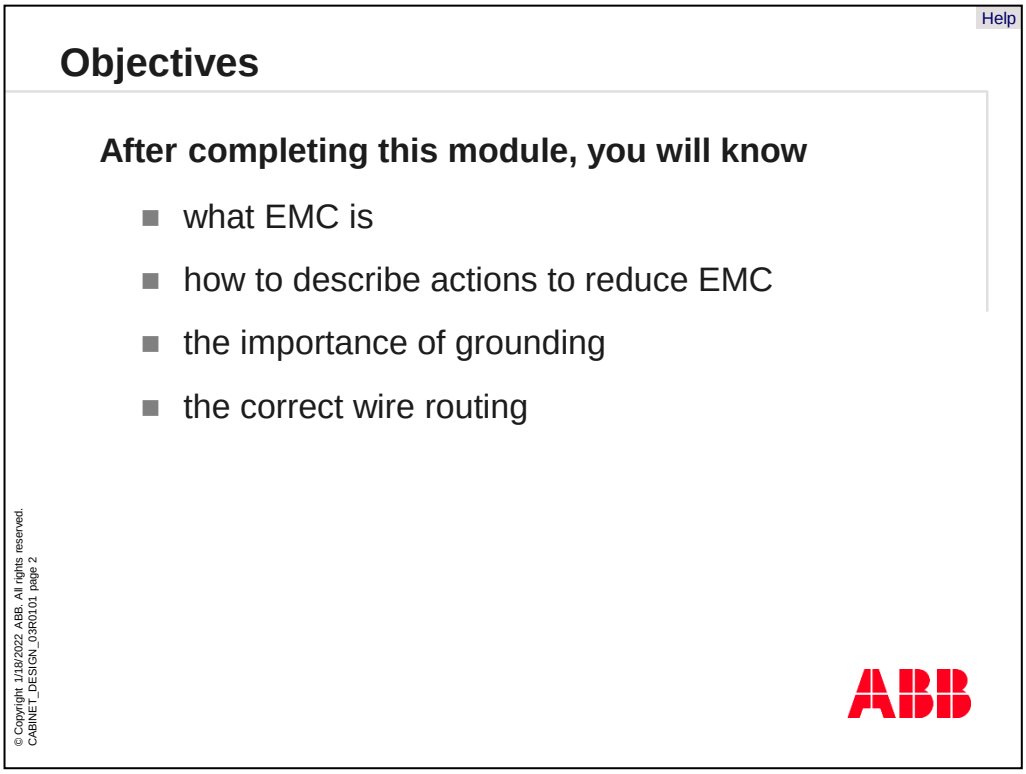


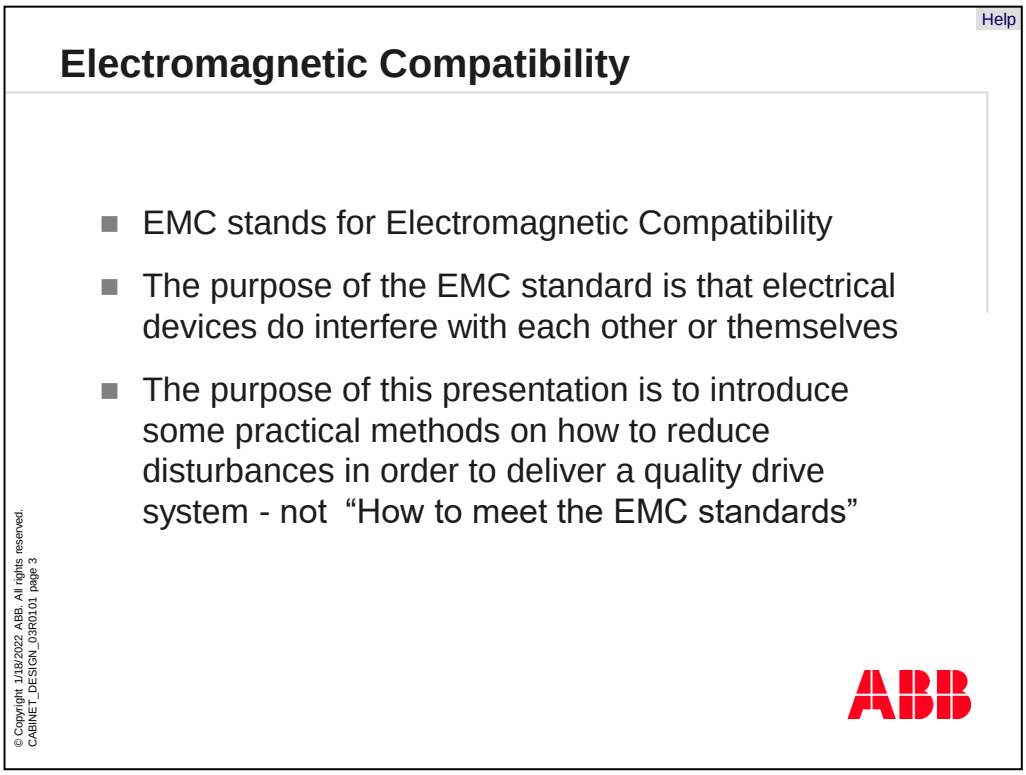
Welcome to the Principle Cabinet Design training module for the DCS800, ABB DC Drives.

If you need help navigating this module, please click the Help button in the top right-hand corner. To view the presenter notes as text, please click the Notes button in the bottom right corner.



After completing this module, you will know

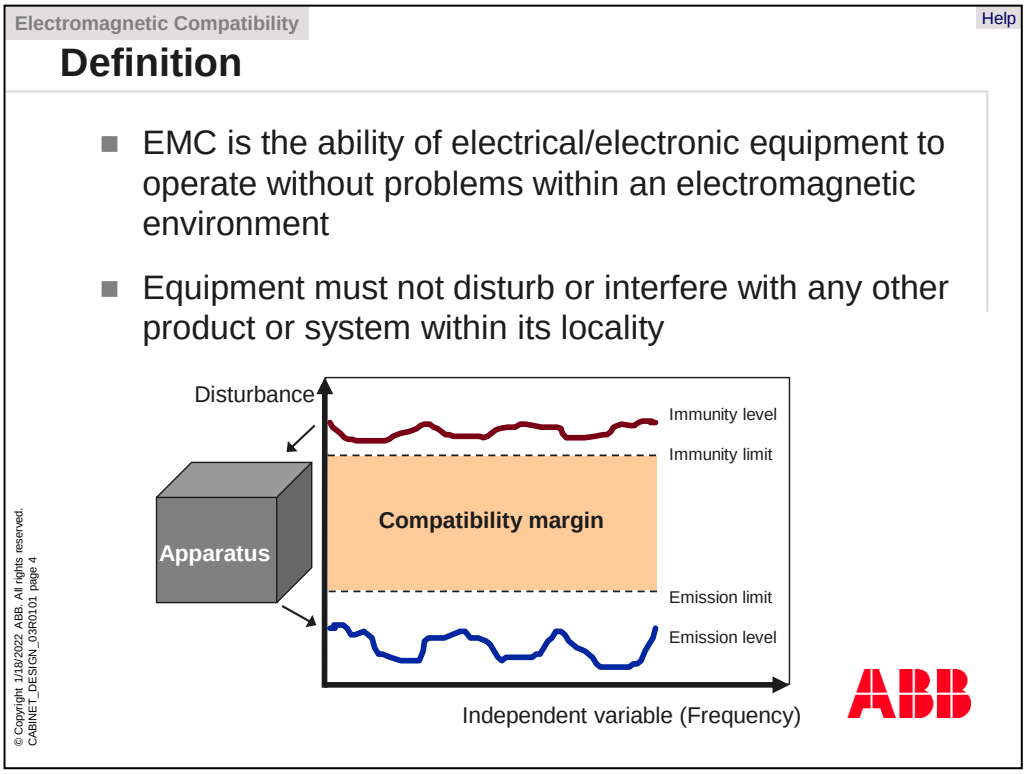
- what EMC is,
- how to describe actions to reduce EMC,
- the importance of grounding and
- the correct wire routing.



EMC stands for Electromagnetic Compatibility.

Some countries do not have EMC standards or they may vary from one another. However, the idea is always the same - electrical devices are not allowed to interfere with each other.

The purpose of this presentation is to introduce some practical methods on how to reduce disturbances in order to avoid EMC problems and not how to meet the EMC standards.



EMC is the ability of electronic equipment to operate without problems within an electromagnetic environment.

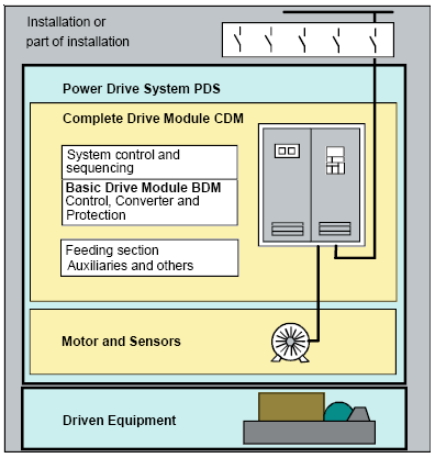
Equipment must not disturb or interfere with any other product or system within its locality.

EMC standards define both the emission and immunity levels. To avoid problems, the immunity level is always higher than the emission level.

Help

Main EMC Emissions from an DC drive

- Conducted emissions to power network
- Radiated emissions from the enclosure to environment



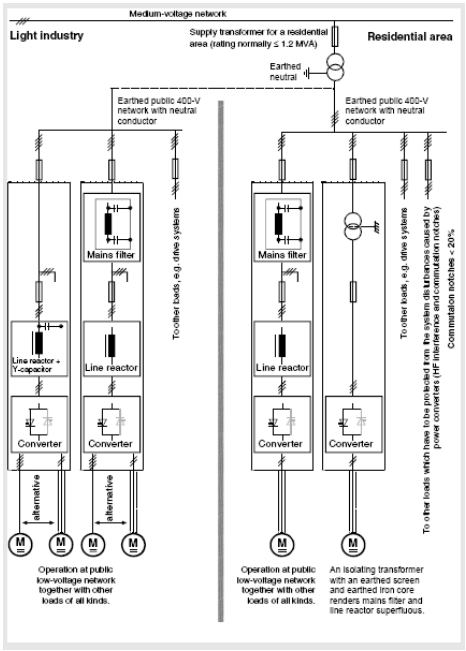
There are two kinds of EMC emissions that emanate from the drive:

- Conductive emissions which are transferred from a power drive system to a power network.
- Radiated emissions which are transferred to the environment through the air.

There are several parts of the installation which have to be considered in EMC discussions. The power drive system includes the complete drive module as well as a motor or sensors. This system has to be installed according to EMC standard EN 61800-3. It is recommended that personnel responsible for design and installation are certified for and familiar with this standard.

Help

First Environment



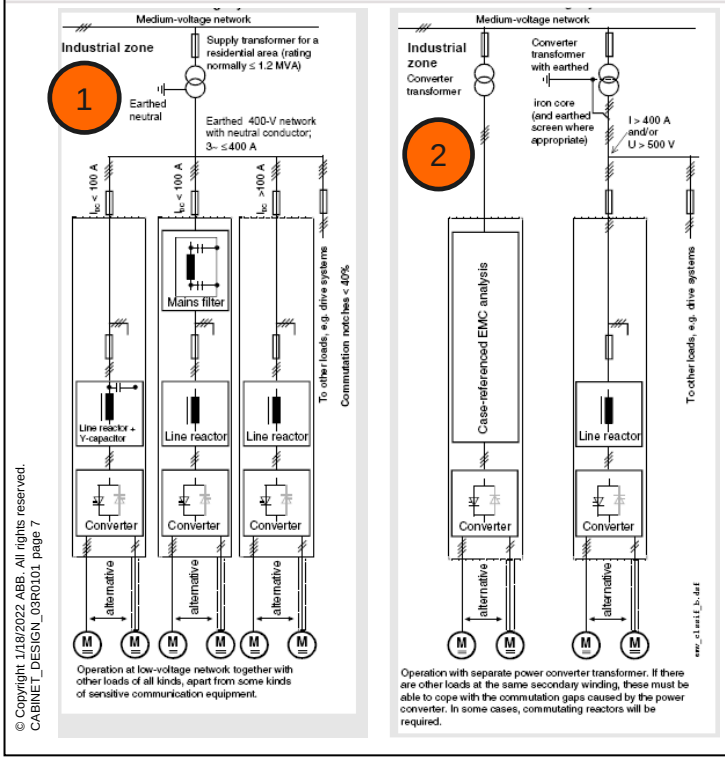
- Light Industry
  - Typical: a public network with neutral conductor
  - Commutation notches < 20%

Some standards refer to the 1st and 2nd environments.

- The 1st environment, also called light industry, is in practice an installation, where the same supply transformer supplies more than one house, factory or office.
- The 1st environment consists of domestic premises. It also includes establishments directly connected, without an intermediate transformer, to a low-voltage power supply network which supplies buildings used for domestic purposes.
- Commutation notches in light industry networks must be smaller than 20%.

Help

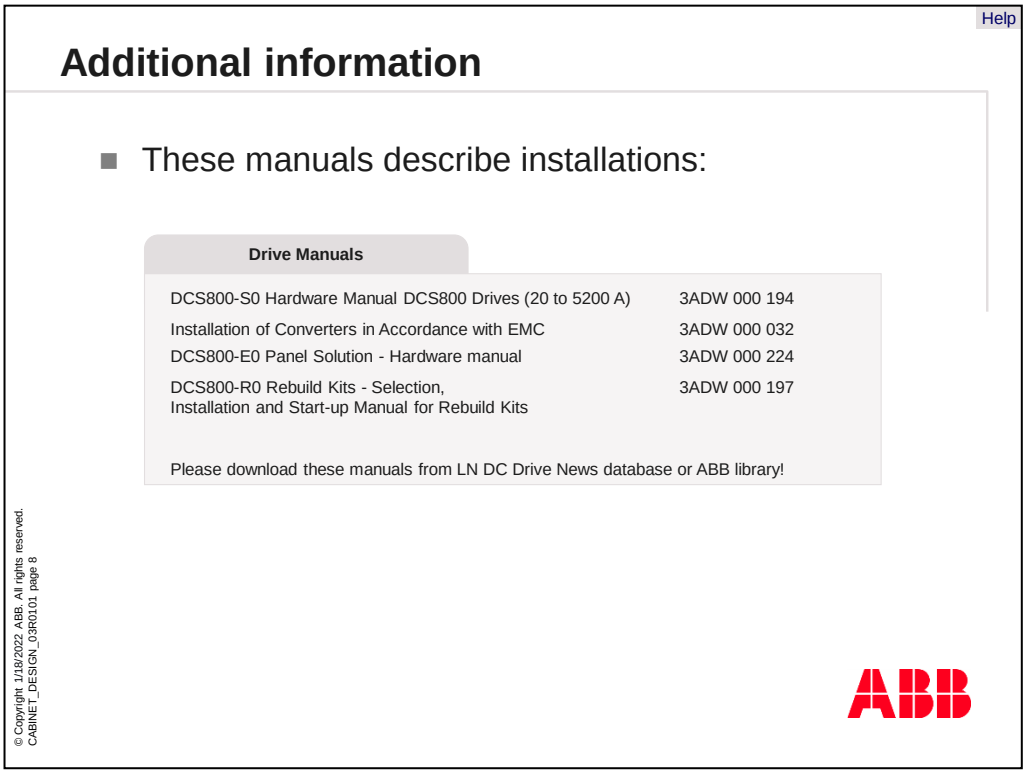
Second Environment



- Industrial zone 1
  - Earthed network with neutral conductor
  - Commutation notches < 40%
- Industrial zone 2
  - Converter transformer

The second environment describes several industrial zones.

- The 2nd environment comprises all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
- In industrial zone 1, the commutation notches could be a maximum of 40%.
- Sometimes compensation units are required to filter harmonics.
- In industrial zone 2, the dc drive is connected directly with a dedicated transformer. In this configuration, commutation chokes have to be selected depending on the requirements. EMC filters are not allowed.

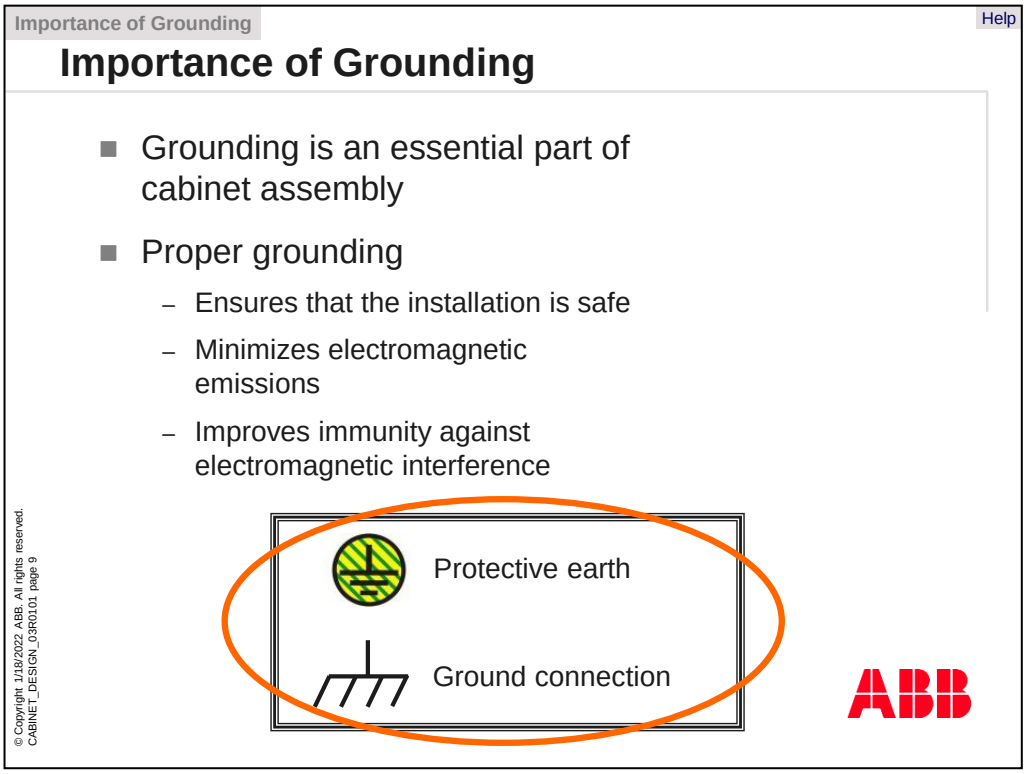


You will find additional information about installations according to EMC standards in the ABB drive manuals.

These manuals describe installations:

- DCS800 Hardware Manual
- Installation of converters in accordance with EMC
- Hardware Manual for panel solutions
- Installation Manual for rebuild kits

Please download these manuals from "DC Drive News" from Lotus Notes or from the ABB library!



The importance of grounding should be explained in the next slides.

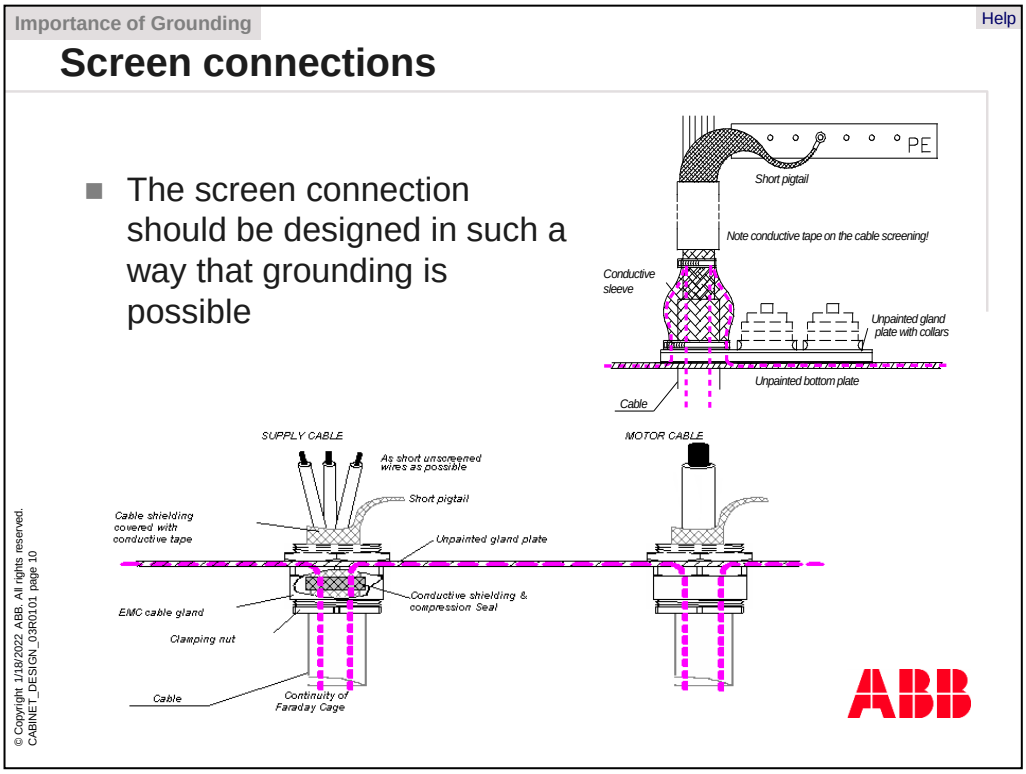
Grounding is an essential part of cabinet assembly.

Proper grounding

- ensures that installation is safe. That means protection and safety design according to short circuit capability.
- minimizes electromagnetic emissions,
- and improves immunity against electromagnetic interference.

Note: EMC grounding reduces reactance for high frequency currents!

In the following slides, the symbols will be used to differentiate between protective earth connections and ground connections!



Cables equipped with a screen must be connected to ground.

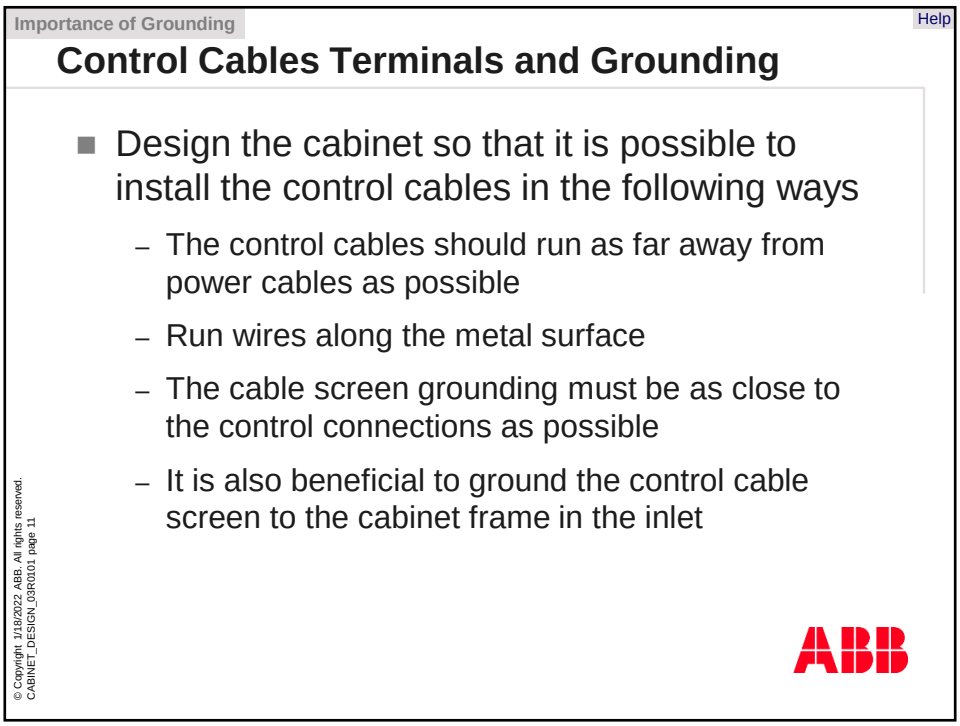
The screen connection should be designed in such a way that grounding is possible.

The best EMC suppression is achieved by a 360° grounding of the cable shield.

The grounding distance and impedance should be as short and low as possible.

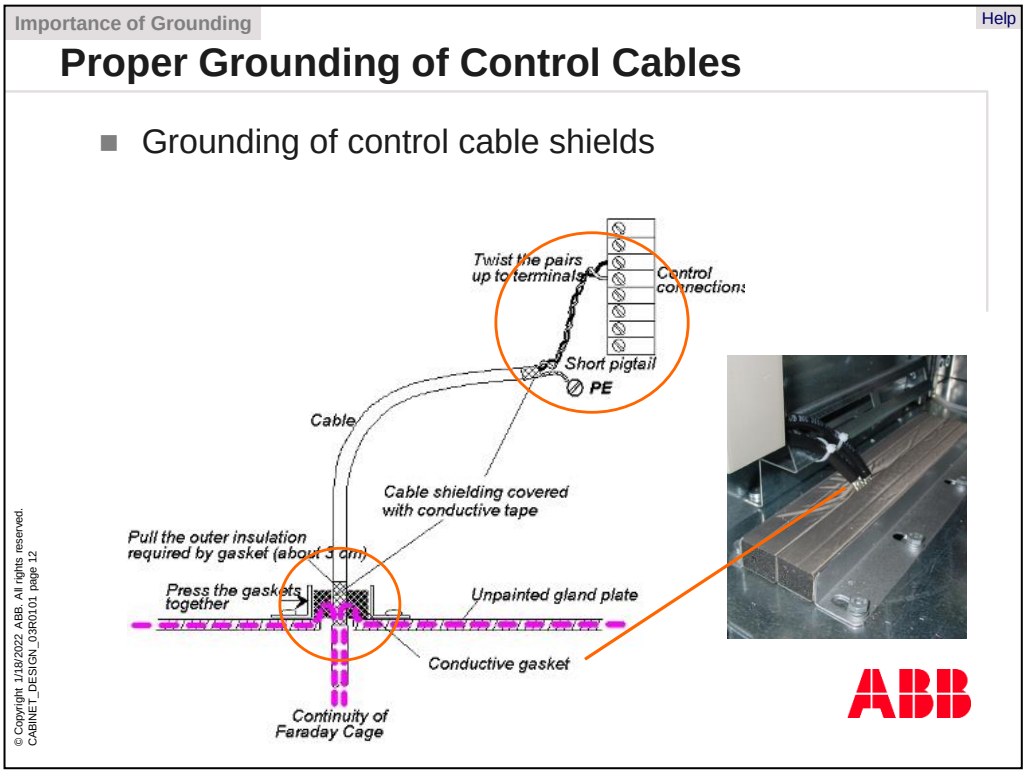
See the pictures for different alternatives.

Also see the manual **Installation in accordance with EMC.**



Design the cabinet so that the control cables can be installed in the following ways.

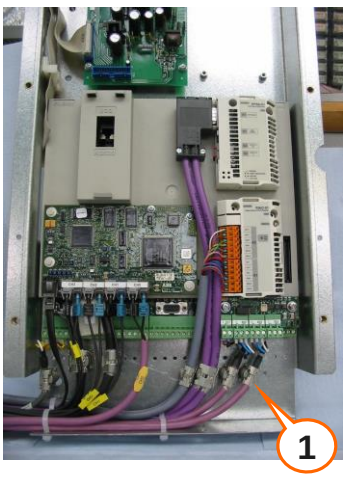
- The control cables should run as far away from the power cables as possible.
- Run wires along the metal surface.
- The cable screen grounding must be as close to the control connections as possible.
- It is also beneficial to ground the control cable screen to the cabinet frame in the inlet.

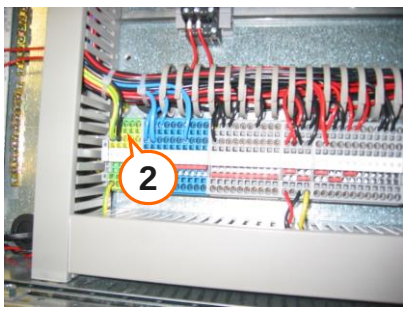


Here you can see the proper way to ground the control cables as was instructed in the previous slide.
In this picture, the cable screen grounding is as close to the control connections as possible.
You can also see that the control cable screen is grounded to the cabinet frame in the inlet as well.

Control Wire Grounding Example

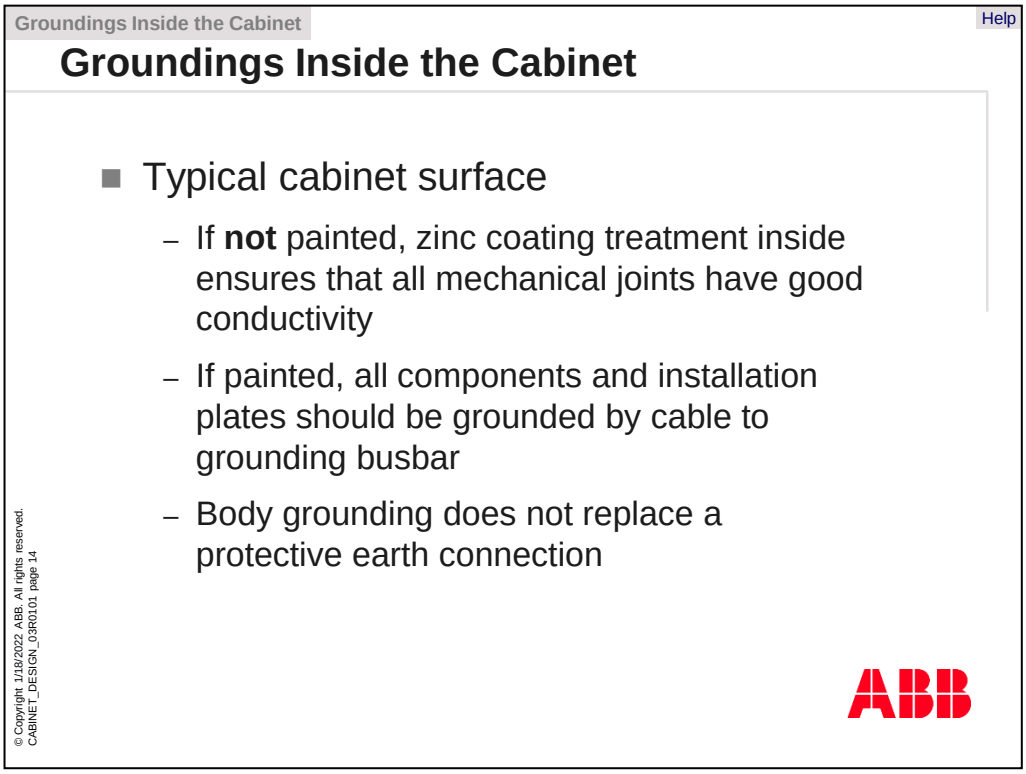
1. The shield is grounded close to the **terminals**
2. The PE terminals are connected to the grounding busbar by a **separate wire**





This slide shows examples of proper grounding.

- The shield of the wires is grounded close to the terminals in order to avoid disturbances.
- The terminals are connected to the grounding busbar by a separate wire with a cross-section of at least 2.5 mm.

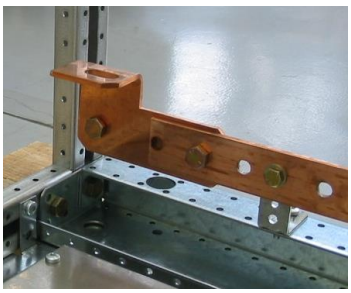


This slide should explain groundings inside cabinets with different cabinet surfaces.

- If the cabinet is not painted, zinc coating treatment inside ensures that all mechanical joints conduct properly.
- If the cabinet is painted, all components and installation plates should be grounded via a cable to the grounding busbar.
- Body grounding does not replace a protective earth connection. PE conductors are always required from the PE terminal of the device to the PE busbar if there is body grounding or not.

Grounding Busbar

- The cross section of the PE busbar / cable has to be at least half of the cross sectional area of the supply cable
- The PE busbar has to be fixed to the cabinet frame by screws to provide grounding



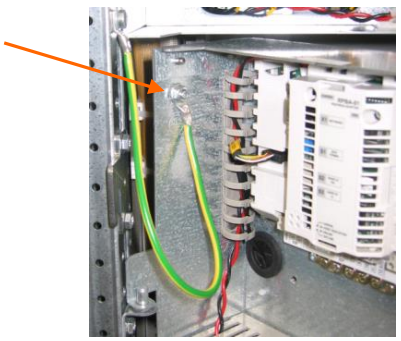
- The cross section of the grounding busbar or cable has to be at least half of the cross sectional area of the supply cable.
- The grounding busbar has to be fixed to the cabinet frame by screws.

There has to be several fixing screws in order to ensure conductivity between the frame and the busbar.

If the cabinet frame is painted, the paint must be removed from the fixing point.

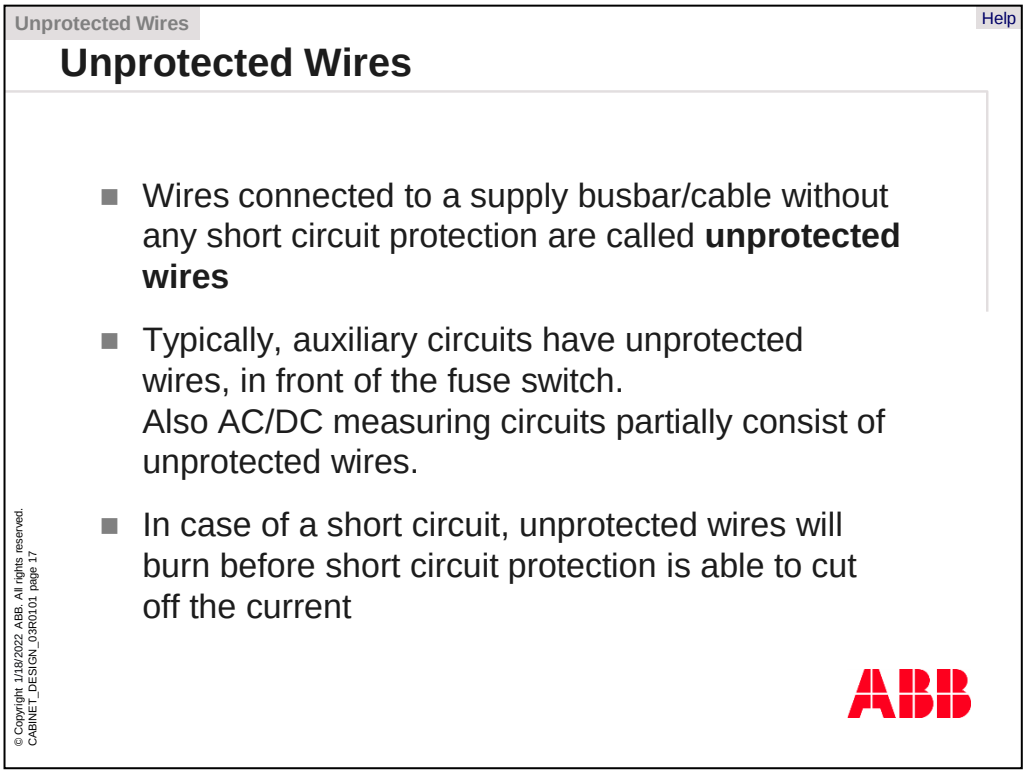
Hinged Installation Plates and Doors

- Hinged installation plates or doors, if there are electrical devices on them, must be grounded and PE connected
  - All hinged installation plates and doors have to be grounded by a separate cable
  - The hinge does not provide reliable grounding



Hinged installation plates or doors, if there are electrical devices on them, must be grounded and PE connected.

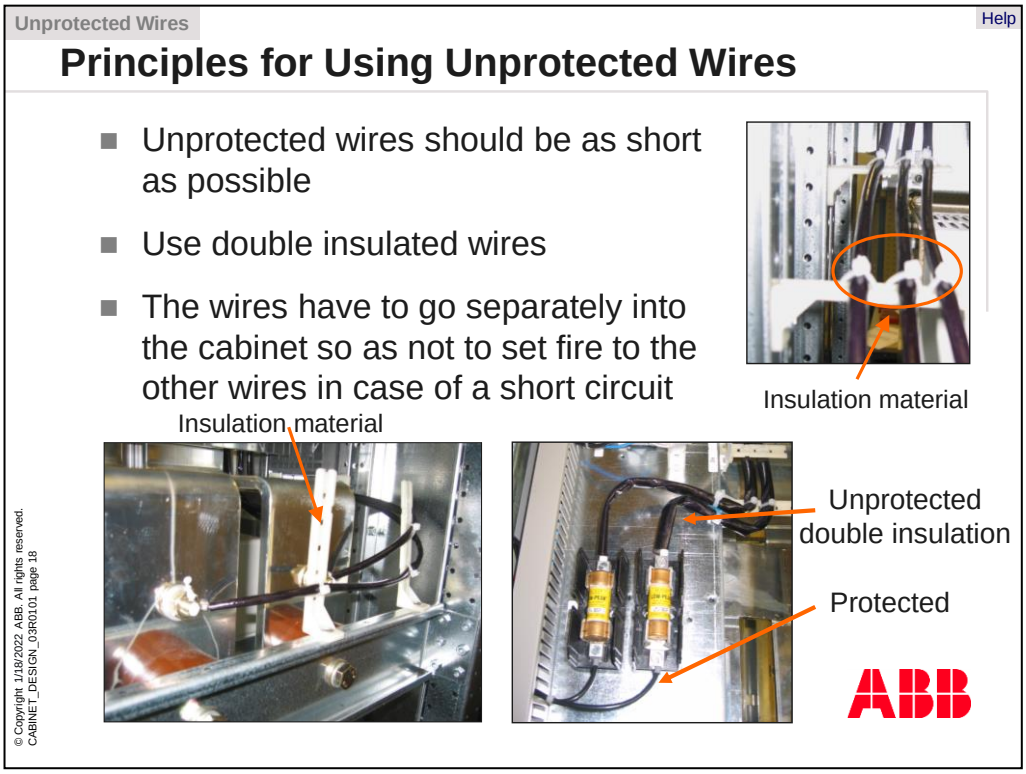
- All hinged installation plates and doors have to be grounded by a separate cable.
- The hinge does not provide reliable grounding.



Wires connected to a supply busbar or cable without any short circuit protection are called **unprotected wires.**

Typically, auxiliary circuits have unprotected wires in front of the fuse switch. Also, AC/DC measuring circuits partly consist of unprotected wires.

In case of a short circuit, unprotected wires will burn before short circuit protection is able to cut off the current.

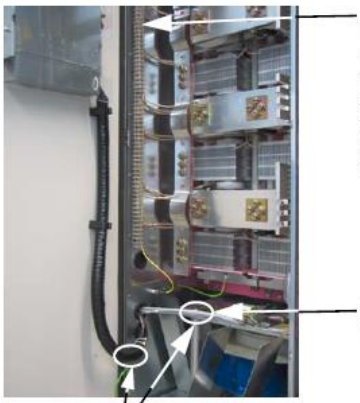


- Here are some principles for using unprotected wires:
  - Wires should be as short as possible.
  - Use double insulated wires.
  - The wires have to go separately into the cabinet so as not to set fire to the other wires in the event of a short circuit.
- If wires are double insulated or installed in a non-conductive canal so that they do not touch each other or the cabinet frame (or any metal at all), it minimizes the possibility of having a short circuit.
- For installations after fuses or circuit breakers, use the normal installation method.

Help

Cable Routing Principles

- The main principle to follow is that the cables that are sources of interference are separated from the cables that are sensitive to interference.

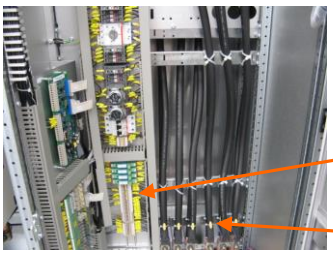


Cable Routing Principles must be observed.

- The main principle to follow is that cables which are sources of interference are separated from the cables that are sensitive to interference.
- That means to separate the firing cables from others like measuring cables or signal cables.

Routing the Cables

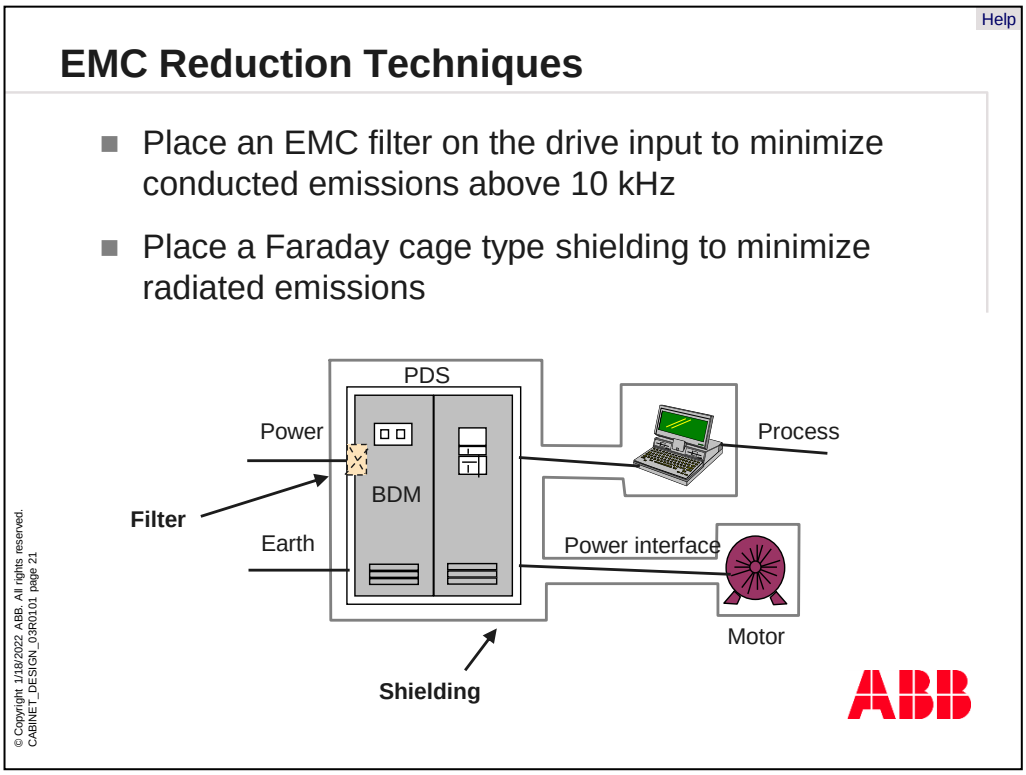
- Keep power cables separate from other cables
  - Long enough distance
  - No long parallel runs
- Run signal and data cables between different cubicles close to the grounding busbar.



Auxiliary cables/terminal blocks

Power cables

- Keep power cables separate from other cables.
- There should be at least 50cm of distance between power cables and signal/control cables.
- There should not be any long parallel runs.
- If it is not possible to keep them separated, use a box, a mesh or a separation plate.
- Run signal and data cables between different cubicles close to the grounding busbar.



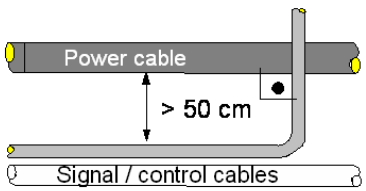
EMC reduction means minimizing the electromagnetic emissions.

Different methods are used for conductive and radiated emissions.

- Place an EMC filter on the drive input to minimize conducted emissions above 10 kHz.
- See the Hardware Manual DCS800 Drives (20 to 5200 A)
- Place a Faraday cage type shielding to minimize radiated emissions.
- EMC filters do not reduce commutation notches.

Cable Distances

- The recommendation for cable distances:
  - 50 cm distance between power cable and signal/control cable
  - If adequate separation is not possible, install them as far as possible or separate by other means (e.g. separation plate)



Cable distances are recommended for proper functionality.

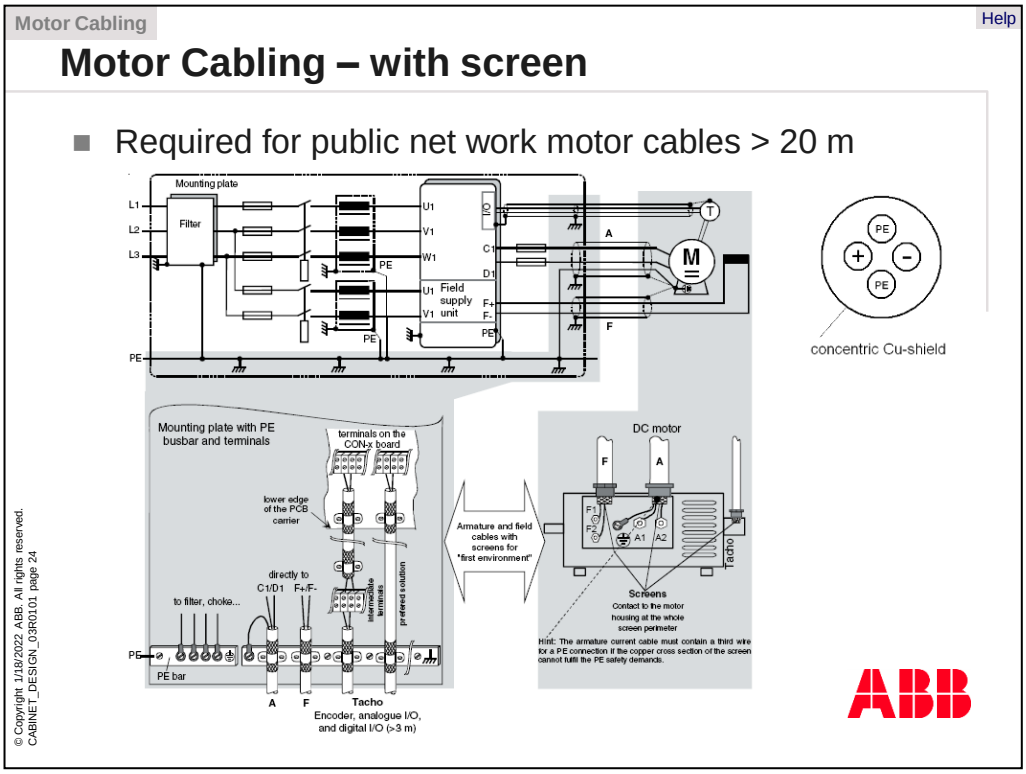
- This picture shows the principles of cable routing.
- 50 cm of distance between power cable and signal or control cables is required
- If adequate separation is not possible, install them as far apart as possible or separate them by other means
- Sometimes cables have to cross each other. They should then cross each other at 90 degree angles to minimize interference.

Example of Control Wire Routing

- The I/O terminals are located so that there is enough space for control wires and cable channel
- The control wire route with certain distance to the motor cables

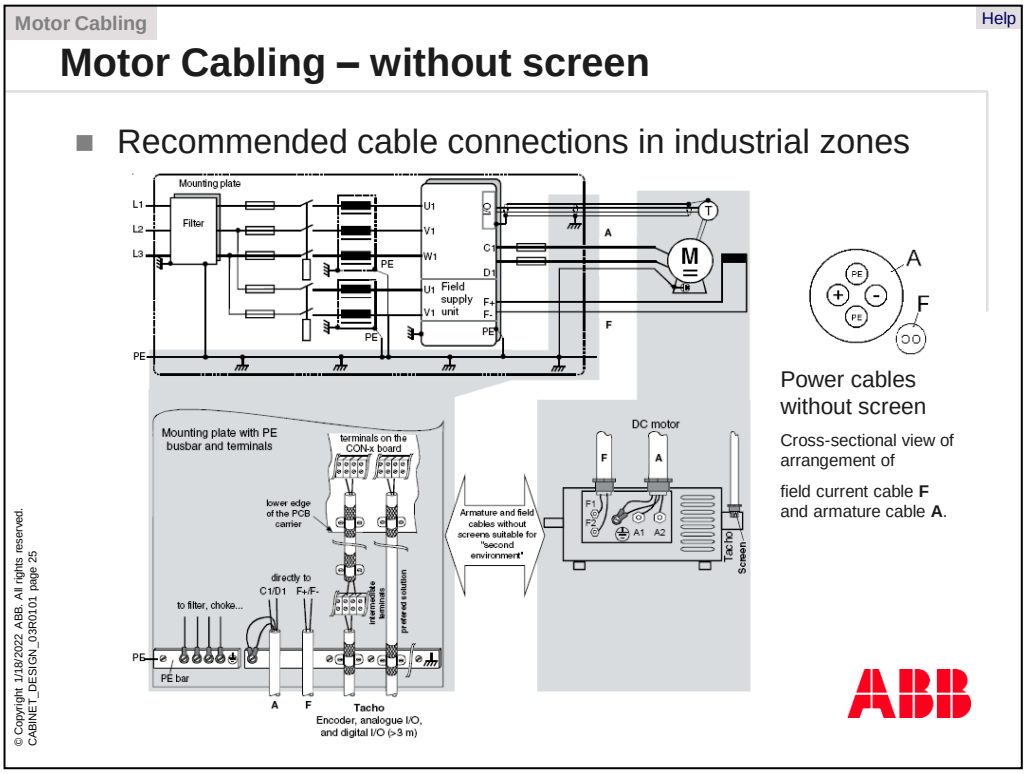
Here is an example of control wire routing.

- The I/O terminals are located so that there is enough space for control wires and cable channels.
- The control wire route is not close to the motor cables.



Recommended motor cabling is shown in the picture with screened cables.

- Power cables with screens are necessary, if they are longer than 20m because cables of that length are susceptible to EMC environmental conditions.
- The cable may have e.g. either a braided or spiral screen preferably made of copper or aluminum.
- Basically, screened cables to the armature and to the excitation winding cause the lowest noise level.



Recommended cabling without screens is explained in this slide.

- If a screen is not necessary, the armature current cable must be a four-wire cable because two wires are needed as conductors for the parasitic RF currents from the motor to the RF filter in the cubicle.
- The unscreened field current cable must be installed directly along the armature cable as shown in the picture on the right-hand side.
- For more details, see manual **Installation in accordance with EMC**.

Help

Summary

Key points of this module

- EMC basics
- Correct grounding

Key points of this module are the EMC basics and correct grounding of the system.

Help

Additional information

- DCS800 Hardware Manual (3ADW000194)
- Safety instructions for DC drives
- Installation in accordance with EMC (3ADW 000 032)

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