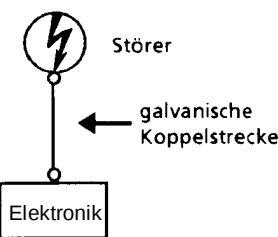
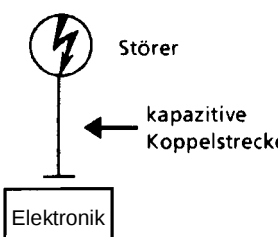
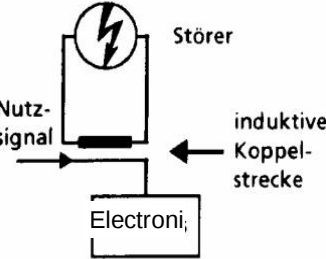
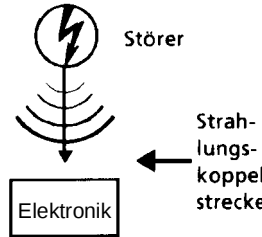


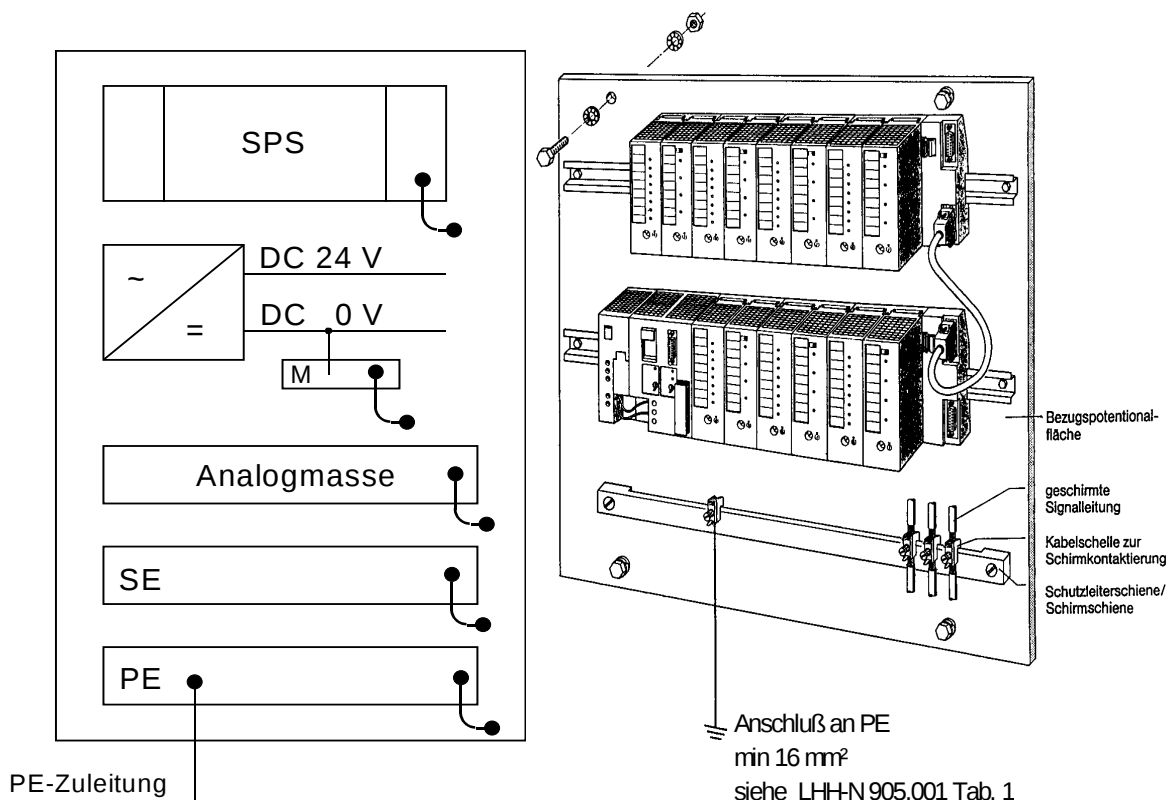
1. Types of Interferences

Coupling Mechanism	Cause	Typical Sources of Interference
- Resistive Coupling Galvanische Kopplung 	Resistive coupling exists when two electrical circuits have a common conducting path.	- switch mode power supplies (effects on line voltage due to inverters, external power units, etc.). - starting of motors. - cabinets with various components and a common power supply.
- Capacitive Coupling Kapazitive Kopplung 	Capacitive coupling develops between conductors, which have different voltage levels. The intensity of the coupling is proportional to the rate of change of voltage vs. time.	- signal cables that run parallel to each other. - electrostatic discharge - switching of relays, contactors.
- Inductive Coupling Induktive Kopplung 	Inductive coupling takes place between two loops of current carrying conductors. The magnetic fields caused by these currents induce interference voltages. The intensity of the coupling is proportional to the rate of change of current vs. time.	- transformers, motors, high-amperage power supplies. - power cables that run parallel to each other. - cables carrying switched currents. - signal cables with high frequency signals. - coils
- Radiation Coupling Strahlungskopplung 	Radiation coupling takes place when an electromagnetic wave is intercepted by a conductive element. The electromagnetic wave induces currents and voltages.	- transmitters in the vicinity (e.g. radio telephones) - spark gaps (cathodes, commutators in electric motors).

2. Basic rules to ensure EMC

2.1 Electrical cabinets and their grounding methods

- Connect all inactive metallic parts. Use large contact area and conductors with low impedance.
- If painted or anodized metal parts are attached together by screws, ensure that either special contact washers are used or remove the paint or the insulating layer (Refer to LHH-N 904.009 and LHH-N 905.001).
- Make use of zinc electroplated mounting panels.
- As far as possible, do not use aluminium parts. Aluminium oxidizes easily and is not suitable for grounding purposes.
- The mounting panel is the common point for grounding and shall be attached to the main equipment-grounding-system.
- If a line filter is used, it shall be mounted flat on the panel, close to the entrance of the power supply cable into the cabinet (refer to LHH-N- 090.265).



The housing of the PLC, the DC 0V bus bar, the PE-bus bar, the bus bar for cable shields and the analog ground shall be connected to the mounting plate by a grounding-strip (Cu- mesh, 16 sq. mm).

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2.2 Placement of cables in cabinets

- Group the cables in conduits according to their functions (refer to LHH-N 090.261). (High-amperage cables and power supply cables, control cables, signal cables, data cables).
- Always place high-amperage cables and signal- or data-cables in separate ducts.
- Place the signal- and data-cables as close as possible to the grounded metallic elements (e.g. mounting panel, frame, etc.).
- Whenever possible, use only one entry point for signal cables into the cabinet.
- Connect at least one end of all spare conductors to ground; grounding both ends, however, offers a better protection (additional shielding effect).
- Keep the lengths of cables as short as possible. This reduces capacitive and inductive coupling to a minimum.

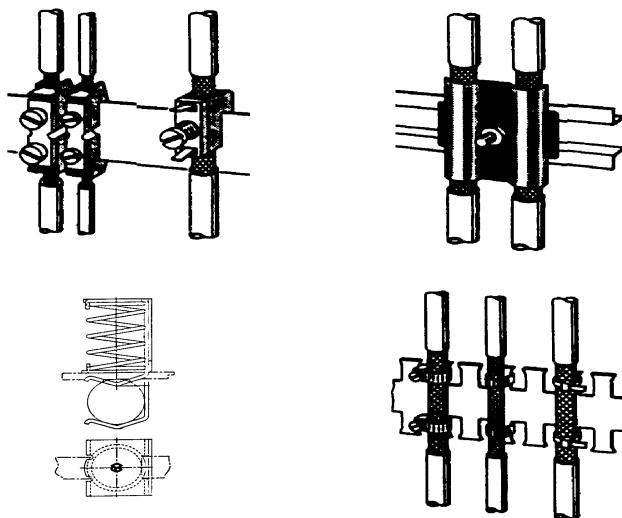
2.3 Shielding of cables

- All data cables shall be shielded. The shields shall be grounded at both ends.
- Cables for analog signals shall be shielded.
The shields of analog signal cables shall be grounded at one end only. Bonding techniques with large contact area and low impedance should be used. Grounding at one end eliminates low frequency capacitive coupling. The grounded end of the shield shall be located inside the cabinet.
- Cables carrying 24V control-signals are not shielded.
- Cables carrying low-voltage (< 10 V) digital signals shall be shielded. The shields of such cables shall be grounded at both ends. Bonding techniques with large contact area and low impedance should be used. If there is a voltage difference between the two grounded ends of the cable, then an additional conductor with a cross-sectional area of at least 16 sq.mm shall be used in parallel to the shield to reduce shield-currents.
- Shields of shielded cables should be grounded immediately at the entrance of the cable into the cabinet by attaching it to a grounding-bus-bar/ shield-bus-bar. The cable should then be guided to its destination inside the cabinet without a further interruption of the shield. If necessary connect the shield there again to ground.
- Ensure that the connection between the grounding-bus-bar/ shield-bus-bar and the cabinet is a low-impedance connection.
- Use metal or metal-coated housings for the connectors of the shielded data cables.
- Wires of same circuit without shields shall be twisted together (twisted pair).

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2.4 Voltage Reference and Grounding

- The grounding system should be designed carefully. Grounding is used for safety as well as for functional aspects.
- Connect all components of a system and all modules within a cabinet to the equipment-grounding-system radially. Formation of feedback loops with ground can thus be avoided.
- If a voltage difference between the grounding-point of system components and the grounding-point of the cabinets exists, use proper-sized conductors to neutralize this difference.



Preferred Arrangement !

Fastening shielded cables with clamps, cable-holders and tubing-fasteners.

2.5 General Requirement

- In an electric circuit, contactors, relays and solenoid valves shall be connected to filtering elements e.g. R-C elements, varistors, diodes (refer to LHH-N 090.265).
- For cabinet illumination, appropriate lighting methods (that cause low interferences) shall be used. Do not use gas discharge lamps.
- Sirens shall not be mounted inside the cabinets which contain electronic circuits.

3. Some Special Examples

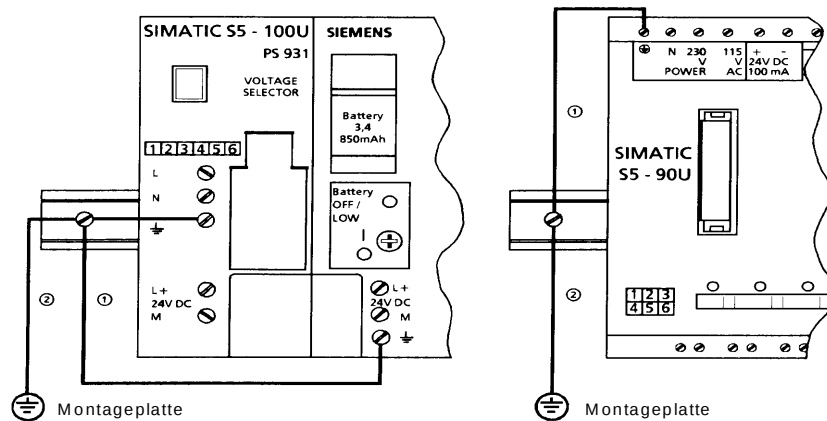
3.1 Assembly of PLC- Equipment and Modules under special considerations of EMC

Grounding at one common point:

As a rule, it is advisable to select a grounded-version of assembling. The grounded-version

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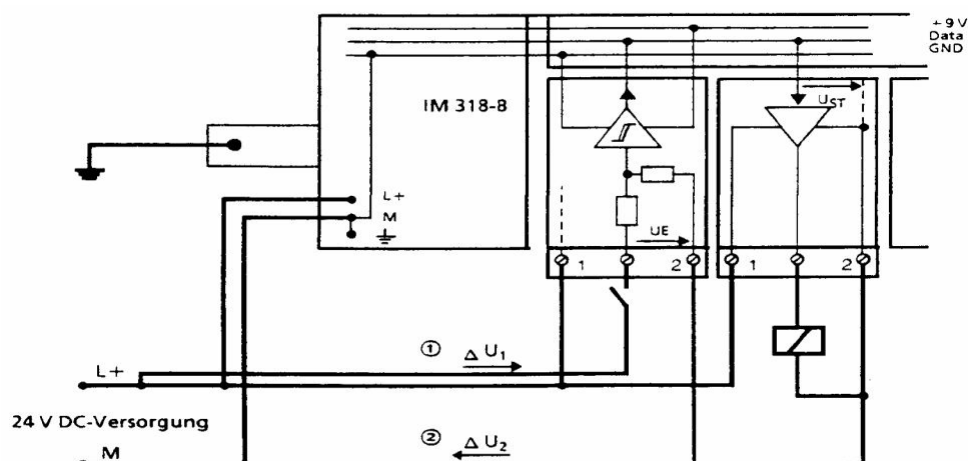
offers very high protection against interferences. Interfering currents that may arise are directed from the module-bus-bar to the common grounding-bus-bar.



3.2 Cable-shields and Grounding of Simatic I/O Modules (with EMC considerations)

For a proper wiring between the power supply and the analog modules, the following conditions shall be met:

- use a separate cable for each connection of the M-inputs at the U/I-terminals to the common grounding-point of the equipment
- if the distance between the entry point of the cables into the cabinet and the analog modules is large, the cable-shields shall be grounded (additionally to the grounding near the cabinet entry) close to the analog modules (module grounding-bus-bar).
- analog inputs not in use, shall be handled as described in the relevant manuals



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4. Check List for checking EMC measures within the Electrical Equipment

Check Points	Remarks
Connection of inactive metal parts Mainly check their connections to: - Module supports - frames - Grounding-bus-bars/shield-bus-bars	
Are all inactive metal parts connected to each other and to the ground, with large contact area and low impedance?	
Is the connection to the equipment-grounding-system sufficient?	
Has paint or another insulating layer been removed at contact areas resp. have the connections been made with special contact washers?	
Are connections protected from corrosion e.g. by the use of special grease?	
Are cabinet-doors connected to the cabinet frame with the use of grounding-strips?	
Placement of cables Have the cables been separated into cable groups or conduits?	
Have the power supply cables (230V...400V) and signal cables been separated into channels or groups?	
Neutralisation of voltage-differences When the distance between the assemblies is large, have the voltage differences been neutralized by proper conductors?	
Cable-shields Are only metallic connectors being used in the equipment?	
Are all analog and data cables properly shielded and properly placed in the cabinet?	
Are cable-shields attached to the grounding-bus-bar/ shield-bus-bar at the entrance of the cabinet?	
Are cable-shields placed flat and fastened with cable-holders to ensure low impedance?	
Are cable-shields of analog cables grounded at one end only?	
Are cable-shields of digital cables grounded at both ends?	
Inductances Have the coils of contactors been connected to proper filtering elements?	

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