White Paper

Information and Communication Technology

Structured Cabling, Earthing & Equipotential Bonding

English

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Rev. 1.0.1 / 2012-06-01

Dallmeier

1 Abstract

All Dallmeier network products (PoE cameras, recorders, servers, etc.) are subject to the highest quality standards and the strictest testing requirements as well as a continuous improvement process in order to guarantee the best picture quality, highest functional reliability and longest durability of the individual product at all times.

In addition, all Dallmeier products are compliant with the currently valid EMC directives for the avoidance of electromagnetic interferences (EMI).

However, be aware that a proper operation of the system is only possible, if all of the applied network components, as for example routers/PoE switches, cables, network cabinets and end-user devices, etc. are correctly installed in the overall system.

Particularly, the regulations and norms for the installation and operation of electrical and information technology equipment/devices must be paid attention and adhered to at all costs in order to avoid accidents and/or damages to the devices and to attain maximum immunity to electromagnetic interferences.

The following descriptions serve as guidelines for the correct approach in reference to the earthing and equipotential bonding of electrical and electronic devices in information technology networks and as support for the installation of an EMC-compliant and interference-free IT infrastructure or rather a structured network cabling.

2 Target Audience

The target audience of this document is trained and authorised specialists (installers) for information and communication technology security systems as well as specialised personnel (electricians), planners and operators of electrical installations.

3 Legal Issues

Dallmeier accepts no liability for damages to persons and property or pecuniary damages arising due to minor defects of the documentation, e.g. print or spelling errors, or caused by direct or indirect use of this material.

The descriptions in this documentation exclusively serve informational purposes and are not legally binding.

The installer/operator of electrical and information technology equipment/devices himself or herself is responsible for the compliance with the legal regulations of all standards and directives that must be applied, and must regularly monitor their adherence.

4 Standards and Directives

In addition to the currently valid requirements concerning the electromagnetic compatibility (EMC) the following standards and directives for the safety and interference immunity of information and communication technology equipment including equipotential bonding and earthing are to be adhered to (amongst others):

DIN VDE 0100-410 (VDE 0100-410:2007-06)

Low-voltage electrical installations

Part 4-41: Protection for safety – Protection against electric shock

DIN VDE 0100-540 (VDE 0100-540:2007-06)

Low-voltage electrical installations

Part 5-54: Selection and erection of electrical equipment –
Earthing arrangements, protective conductors and protective bonding conductors

DIN EN 50310 (VDE 0800-2-310:2011-05)

Application of equipotential bonding and earthing in buildings with information technology equipment

The specification, installation and testing of generic (or application-neutral) and specific cablings, amongst others, must comply with the following standards and guidelines:

Series DIN EN 50173

Information technology – Generic cabling systems

or

ISO/IEC 11801

Information technology – Generic cabling for customer premises

Series DIN EN 50174 (VDE 0800-174)

Information technology – Cabling installation

Updated copies of each of the mentioned VDE regulations are available at the VDE Verlag (publishing house) or, as for the DIN and ISO standards, at the Beuth Verlag (publishing house).

5 Structured Cabling, Shielding, Connection Components

The goal of a structured cabling is a future-oriented and generic network infrastructure.
In general, the structured cabling of all network components is star-wired (star topology).
The structured cabling is divided into three areas:

- Primary area (campus or rather building to building cabling via fibre optic cable)
- Secondary area (vertical cabling preferably via fibre optic cable)
- Tertiary area (horizontal cabling via copper cable)

Elements of the structured cabling are:

- patch panels
- patch cables, horizontal cables
- network sockets
- connectors
- distribution/network cabinets
- hubs, switches, routers, …

Above all, the following passage describes the structured cabling in the tertiary area.

In order to avoid signal interferences (undesired electrical or electromagnetic effects), an EMC-compliant cabling must be conducted (EMC = electromagnetic compatibility).
Moreover, be aware to only apply technically efficient, EMC-compliant and shielded components.

This includes **shielded** and symmetrical copper-based twisted-pairs cables (e.g. S/FTP cables) and **shielded** RJ45 modules according to ISO/IEC-11801 or DIN EN 50173 as well as the standard-compliant application of **earthing** and **equipotential bonding** measures in buildings with information technology equipment.

Always ensure the cable shield to feature a full, if possible 360 degree contacting when connecting to a shielded connection component. In addition, in order to reach maximum immunity and the best signal transmission as possible, the same type of cable should be used within the overall system wherever possible.

The housing of each connection unit or rather each information technology connection socket (RJ45), to which a network device is connected via a symmetric copper cabling, must be shielded (e.g. metal housings, plastic housings with a galvanic or chemo-galvanic metal coating) and equipped with shielded RJ45 (8p8c) modular jacks.

The shielding of the network cables between the transmitter and the receiver must be applied on both sides and take a continuous course in order to achieve a sufficient shielding against high-frequency interference signals. These requirements also apply to the cabling at work stations and the cabling of devices that are not part of generic cabling but part of the transmission line between transmitter and receiver.

Each connection must exhibit a transmission behaviour, which is consistent with the performance requirements of the particular application classes for symmetric transmission lines according to DIN EN 50173 and ISO/IEC 11801.

Transmission lines in the tertiary area should always be kept as short a possible.

The maximum length of a transmission line within the tertiary area (in terms of twisted-pair cables, 100 Ω, 4-pair, shielded) between the active network device (e.g. switch) located in the equipment room on each storey (floor distribution terminals) and the network end-user devices located at the work station must not extend 100 metres.

The complete transmission line is called the Channel Link.

The structured cabling may consist of up to 90 meters of horizontal cable (uninterrupted solid-copper twisted-pair cable) for the fixed cabling (Permanent Link) between the floor distributor (patch panel) and the work-area telecommunications outlet and 10 metres of patch cables for the loose cabling (2 × 5 metres on each end). This means, that a maximum of 5 metres of patch cable is permitted for the connection between the patch panel and the active network device (e.g. switch) within the equipment room as well as a maximum length of 5 metres from the wall network socket to the end-user device located at the work station.

100 m Channel Link = 90 m Permanent Link + 10 m (2 × 5 m) patch cable

Note:

Horizontal cables are relatively rigid network cables and are used for the cabling of patch panels with permanently installed connection sockets inside of a building. The conductors of a horizontal cable consist of a single wire, which is applied to a shielded connection socket or alternatively a shielded patch panel (back side) via the punch-down technique, e.g. LSA or IDC (Insulation Displacement Connection) termination.

Patch cables are flexible network cables and are used for the cabling of shielded patch panels (front side) with active network components (e.g. switch) located within the floor distributor and for the cabling of network sockets with end-user devices located at the work station. The conductors of a patch cable are designed as a strand (multiple fine single wires), which is pressed onto the contacts of shielded RJ45 connectors using a special crimping tool.

RJ45 connectors can not be crimped onto horizontal cables.

Patch cables can not be applied to insulation-displacement connectors.

The termination of horizontal cables and the crimping of patch cables should only be conducted by experts, to ensure a correct signal transmission and a full shielding.

The laying of network cables requires compliance with the specifications concerning the maximum permissible bending radii and the minimum requirements with reference to the wire diameter at all times.

Excessive crushing of the cables (e.g. due to cable ties) and severe traction on the cable ends must be avoided.

The twisting of the single cable pairs should be maintained as far as possible.

6 Earthing and Equipotential Bonding

For the safety of persons and devices and the immunity of information and communication technology equipment to electromagnetic interferences (EMI), all protective measures, which are specified by the currently valid DIN, VDE and ISO standards and which provide for a standard-compliant earthing and a correct equipotential bonding, are mandatory and must be fulfilled by all means. From an EMC point of view, power supply must generally be arranged as a TN-S system (separate protective earth (PE) and neutral (N) conductors) to prevent “stray currents” from flowing over the shields of the data cables which would cause an electromagnetic field and thus interferences.

In case of damages due to unprofessional earthing or improper equipotential bonding the installer/operator of the electrical and information technology equipment will be held liable.

The earthing of electrical installations and devices primarily has the function of protecting individuals from dangerous contact voltages in case of an electrical defect.

Note:
The installation of a standard-compliant protection against lightning impulses and overvoltage or measures to protect individuals from dangerous contact voltages, etc. is not addressed in this document. Yet, compliance with all standards and regulations for the safety of individuals and devices, which can be ensured by applying the pertinent professional measures, is implied.

From an EMC point of view, the earthing of all network devices within a building has the purpose of creating a selected and common reference potential and thereby establish an equipotential bonding.

According to DIN VDE 0100 Part 200 the equipotential bonding is defined as follows:
“Provision of electric connections between conductive parts, intended to achieve equipotentiality.”

Consequently, the equipotential bonding ensures, that potential difference (voltage) can not be induced due to the length of the cable (up to 100 metres) in between the applied devices and therefore prevents compensating currents from flowing beyond the shielding of the network cable, which would cause signal interferences or even damage the device.

DIN VDE 0100-410 indicates, that a main equipotential bonding (protective equipotential bonding via the main earth bar) must be conducted in every building.

A professional equipotential bonding of all network devices in an information technology equipment within a building can only be accomplished by consistently earthing all installed network components (network cabinets, patch panels, connection sockets, switches, end-user devices, etc.).

The course of the laid earthing/equipotential bonding conductors of all network devices/components towards a common equipotential bonding bar (EBB), which is connected to a central earth reference point within the building, must be kept as short as possible.

In the process, a standard-compliant earthing resistance and the minimum prescribed cross-sections for earthing conductors have to be maintained at all times.

Each EMC-compliant shielded patch panel is, for example, connected to the enclosing/housing of the distribution or rather the network cabinet (usually a 19" rack) via an earthing conductor. Subsequently, the network cabinet is earthed with the central earth reference point in the building via an equipotential bonding bar.

Network devices (e.g. switches located at the work station), which are not automatically earthed via the protective contact of the power cord, must be earthed directly, professionally and in compliance with the standards by connecting their external earthing connection (earthing screw or tag) to the building's equipotential bonding via a separate earthing conductor.

In the process, the legal earthing requirements and regulations must be adhered to at all times.

For safety reasons, it is by all means prohibited to connect the external earthing to the earthing of a power outlet.

To connect the earthing to a water or heating pipe is forbidden.

Equipotential Bonding for Campus Cabling (Primary Area)

In order to avoid possibly occurring potential differences between various earth reference points (with regard to a campus or respectively a building to building cabling) an optical connection (via fibre optic cables) must be used for the network cabling between the buildings. Merely the slightest differences in the soil condition of two buildings would create different earth potentials which would lead to equalising currents and those in turn would lead to electromagnetic interferences within the cabling.

7 Conclusion

In order to assure a secure, interference-free and EMC-compliant operation of electrical and information technology equipment/devices the following remarks must be considered:

- Only authorised experts (installers) and trained professionals (electricians) are permitted to conduct an installation and testing of electrical and information technology equipment/devices
- Strictly adhere to pertinent standards and regulations
- Arrange the IT infrastructure as a structured cabling
- Generally arrange earthing concept and power supply as a TN-S system
- Use only EMC-compliant components and devices
- Use only shielded components (cables, plugs, sockets, etc.) and devices
- Ensure earthing and equipotential bonding of all applied components and devices

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