METZ CONNECT

We realize ideas

APPLICATION NOTE

Cu connection technology

Intelligent cabling –
Applications of structured cabling - Design and output

P | Cabling

Intelligent cabling

Applications of structured cabling - Design and output

Management Summary

The forward-looking intelligent cabling of buildings is of huge importance for the subsequent usability of a property. A reliable functioning of the entire network over many years is only then given if suitable components are properly installed. The requirements are high. The use ranges from the flush-mounted outlet with up to three ports to 24 and 48-port patch panels and IP44 and IP67-protected applications. Different international specifications exist for the design in the electrical installation. The design of the individual components corresponds to the requirements of the respective maximum transmission power and also offers sufficient reserves for future applications. The current state of the art are components according to Cat.6_A of the ISO/IEC 11801 Ed.2.2 for 10-GB Ethernet. High performance, flexibility in use and mechanical robustness are often contrary requirements here. With a strictly modular structure, high-quality solutions offer a high diversity of applications and transmission output and can also be used cost-effectively at international level.

Table of contents

The specification – structured cabling

The cabling of buildings for diverse voice and data services is enormously important for the subsequent usage of a property. Detailed planning helps here to protect investments over many years. The EN 50173 "Information Technology – Application-neutral communication cable systems" or at international level the virtually identical ISO/IEC 11801 is seen as a guideline for the development of such cabling systems. Systems developed according to this are also referred to as "structured cabling". The standard applies equally for cabling with copper cable and fiber optic cable. The deliberations below refer almost exclusively to copper cabling as these still constitute the majority of all new installations.

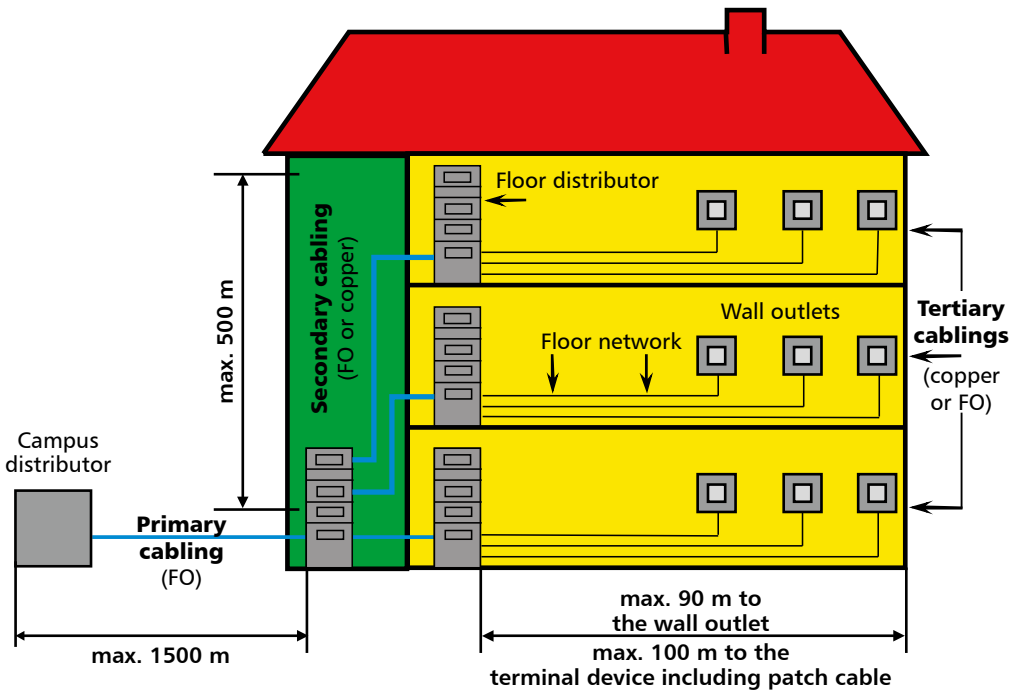
The goal of the standard is to create a general basis for cabling in which it is irrelevant which communication application is handled via it. All participants should communicate via one single cabling system. This will put a stop to the currently widespread uncontrolled growth of cabling in which every application requires a connection that is specifically designed for it, and specify a binding structure.

The standard defines a distribution of the cabling from a central distributor via individual building distributors (primary cabling) to floor distributors (secondary cabling) and ultimately to the telecommunication connections (tertiary cabling). It thus specifies a star-shaped topology that offers various benefits:

- Parts of the network can be easily removed or added, without affecting the functioning of the other parts.
- Faults in sub-areas have no influence whatsoever on the overall network.
- The communication within sub-networks is upheld when higher-level parts fail.

These stipulations with regard to the structuring of the building cabling create the prerequisites for reducing the effort required and thus saving costs in installation and maintenance.

But what is the situation with the different installation situations, types of assembly and device design, i.e. the different applications? What variants are there? What conventions need to be complied with? Are there special regional characteristics? What needs to be taken into account with regard to the transmission power? What technology offers the maximum investment security for the next few years?



Away from theory towards the application

Installation takes place in the trunking, skirting board, flush-mounted, surface-mounted, in cavity walls, underfloor, in cavity floors, in the distributor room, in the 19" cabinet, in the electrical sub-distributor, on the top-hat rail, etc. Diverse components of structured cabling are used here.

Each installation type has its very own requirements with regard to the structure and design of the individual elements.

In the following, the most important applications will be described in more detail and comments given on intelligent design.

With its structuring according to office buildings, industrially used buildings, residential units and data centers, the EN 50173 standard stipulates a useful segmentation.

Applications in office buildings

The floor distributor – high packing density

An office building is a multi-storeyed high-rise building with intensive use of data cabling. Typically, floor distributors with 19" technology are used here. Patch panels with up to 48 ports for 1.5 height units offer maximum packing density. Plugs and jacks need to be accommodated in the tightest of spaces and therefore need to be designed with correspondingly small dimensions. In the process, however, high data transfer rates, stability and ease of installation need to be maintained.

Systems that are easy to handle for the fitter have a modular design and offer reliable and safe communication connections for the individual cable strands by IDC terminal blocks. In the process, the installation wires are fitted with jack modules that are then snapped into the designated holders in the patch panel. In the best case, only a few steps are required to assemble the jack modules: Position the individual strands in the loading piece according to the color code, plug the loading piece into the module housing and close housing by hand without the use of tools – finished. The use of special tools is no longer state of the art with modern systems. Simple opening and reusability ensure cost-saving maintenance. Sources of error in the installation are avoided and a permanently secure-contact connection is established. The technical design of the jack modules should facilitate a connection of the pairs of strands to the terminal with minimal untwisting of the stranding. Loss in the data transmission is thus avoided.

In order to guarantee a certain replaceability of the individual modules, a design of the modules in the widespread Keystone format is advantageous in international use.

Devices for easy cable relief and potential compensation and simple labelling options make handling of patch panels easier, save installation works and time and simplify subsequent maintenance work.

The fixed wall outlet – international requirements

Wall outlets are one of the most critical parts of the structured cabling. They provide the end user with a connection to the network. In cases of doubt, there is always an insufficient number of wall outlets available or they are located at the wrong places.

They are available in designs of up to 3 ports per outlet.

In Germany, cables and outlets are frequently found in trunkings in the window area. They offer sufficient space and installation depth to ensure easy installation. In other countries, such as France, the use of trunking is not usual. Here, cables and outlets tend to be installed in the skirting boards of the interior walls. Tight installation situations with low installation depth place high demands on the fitter. Plug modules with a 90° output make installation considerably easier.

In the US, UK and in Asia, cavity-wall cabling is frequently found. This generally offers ideal conditions for easy installation of the wall outlets. The different national regulations, e.g., with regard to the outlet dimensions, however, require a large number of adaptations. The following list gives a brief overview of the international specifications.

Here too, similarly to the patch panels, a modular design makes sense for quick and easy installation. An easily assembled and reusable jack module that is locked into the supporting frame makes the work of the fitter easier and shortens it. Contact with minimal loss is a matter of course.

The labeling options have special importance with wall outlets. They should be easy to apply for the fitter but also protected against unauthorized removal.

The aesthetic requirements of the end user should not be neglected.

Compatibility with the cover plates of different manufacturers must be ensured in order to facilitate broad use and compliance with the different design specifications.

INSTALLATION ENVIRONMENT	OUTLET DIMENSIONS
DIN installation environment (Germany)	80 x 80 mm
FS Installation environment (France)	45 x 45 mm (double); 22.5 x 45 mm (single)
US installation environment (USA)	114.3 x 69.9 mm
BS installation environment (Great Britain)	86 x 86 mm (single); 145 x 86 mm (double)

The variable wall outlet – Connection in the smallest of spaces

Some office cabling also makes provision for variable end points. Here, interim distributors, e.g. in the form of underfloor units are used via which the individual end points can be flexibly connected. Particularly with underfloor units cast in floor screed, space is extremely tight, which places great demands on the provisions of high data transfer rates and the usability of the systems.

Modular systems for a rapid and secure-contact installation are the ideal choice here.

In addition to the direct cabling of end devices to the underfloor unit, there are also frequently connections in furniture or also partitioning walls that are characterised by a low installation depth. Here, outlets with leads at an angle of 90° or 270° are used that only require a fraction of the conventional installation depth.

Applications in industry

The endurance test – Protection against harsh environments

Dust, dirt, moisture, oils, greases, heat, cold, vibrations, UV radiation and much more make life difficult for applications within the cabling systems in industrial production or in outdoor areas.

Switch cabinets for interim distributors with 19" technology provide a certain amount of protection. Outside of this protective environment, special precautionary measures need to be taken. The first points of reference with regard to the design of the products are provided by the protection categories standardised in the DIN EN 60529. Within the switch cabinet, the "normal" protective category IP20 - protection against contact with the finger - is usual. In the production hall, more protection is then required: IP44 - Protection against foreign particles >1 mm and protection against splash water is a minimum requirement. Others are IP54 - dust-protected and protection against splash water - or IP67 - dust-proof and protection with temporary immersion in water.

What sounds like a simple solution for the housing design proves difficult to implement in the individual application. For instance, constant vibrations are hardly cushioned by a corresponding housing. These affect the plug connection directly. Actually, the individual elements would have to have a solid and robust design for this, which, however, would also mean a deterioration in the transmission properties.

High-quality plugs provide a suitable balance here between robustness and transmission power and guarantee a secure connection.

Modular systems that reliably meet the requirements of different protection categories and can be assembled with a secure connection in the field without special tools prevent sources of error.

Special shielding concepts for secure contact and interference resistance guarantee ideal transmission properties. Secure closures in bayonet or thread design, push-pull design or with locking hooks ensure permanent and tight connections even with long-lasting vibrations or shock-like jolts and can easily be released and closed again. Gold-plated contacts prevent corrosion. Last but not least, a certain amount of protection against heat impact is obtained by the use of fireproof materials.

Applications in the food or chemicals industry, installations in the high-temperature range, such as in the environment of furnaces, refrigeration areas such as cold storage warehouses or also the use in skilled trades or medicine have their very own requirements. Special solutions are available on the market.

Ever more important – Protection against unauthorized access

Whether in industry, office or public areas, protection against unauthorized access to plug connections is particularly important. Data theft or wilful destruction is thus prevented. Lockable housings for wall outlets not only prevent unauthorized access to the data network.

With plugged-in patch cables, they make unintentional or also malicious release of the plug connection impossible. The design for the corresponding IP protection category should also be taken into account here.

Applications in residential units

By residential units we mean not only single-family houses but also so-called small offices such as doctors' practices or also the office of a tax advisor.

Normally, installation is done here in flush-mounted cups with a depth of 58 mm. With limited space available, cups with a depth of 40 mm are used. Conventional feed line from the back and the rigid installation cables make assembly more difficult. Wall outlets with a feed line at an angle of 90° or 270° solve the problem of low depth and make assembly easier.

The interim distributors are a special application. They often do not fit into an own housing and instead are accommodated in the electrical sub-distributors in the area of electrical installation. Suitable modules have the option of fixation on a top-hat rail. The cable feed is normally done from the back at the top. The modules have corresponding receptacle options.

Applications in data centers

Whereas in the industrial area, the requirement is more for the robustness of the systems against environmental influences, the interfering influence of humans is the greatest challenge in the data center. Installation work causes contamination and is always prone to error.

A data center is generally structured according to requirements. This means that equipment and the respective cabling are installed successively. To guarantee the operational reliability of the data center, installation work involving machining or causing dust is prohibited.

In order to comply with these requirements, fully pre-assembled cabling systems are used. They are industrially produced in a rational and cost-efficient way and are easy and clean to install. All components only have to be plugged in on site. The work within the data center is minimised and also sources of error are largely avoided in the installation of the individual connections. Such self-evident minor details such as a clear color coding or labeling also contribute to this and they already need to be taken into account in the planning and assembly of the systems.

In addition to the shortening of the assembly time and the elimination to a large extent of the "interfering human factor" in the data center, pre-assembled cabling systems also offer additional benefits. They can be fully planned, can be produced in a very cost-effective manner and can be checked before installation. Compliance with standards and a high product quality are thus guaranteed.

The toughest challenge – the transmission power

In the deliberations regarding the design of elements of structured cabling, a decisive point has been rather neglected up to now: the possible transmission power of the individual components and the entire network. The specifications on this determine which elements at all can be used.

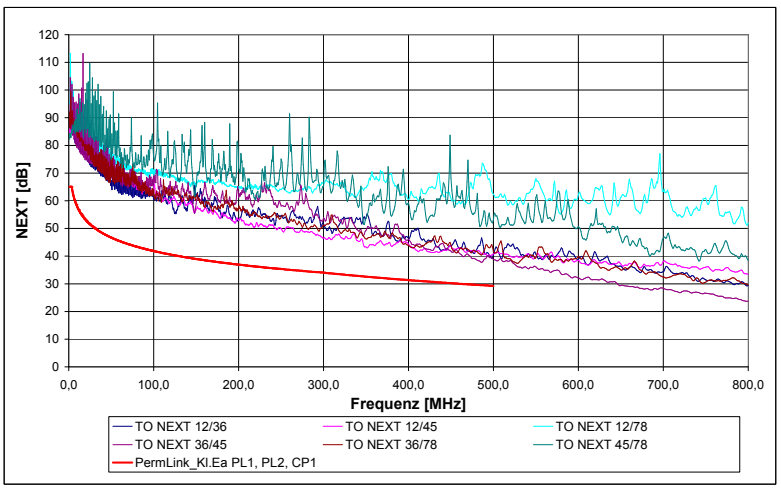
In the cabling of a building, there is a tendency to always provide the maximum possible transmission power. Not only today's requirements are to be met. The capacity of the existing network should also not be fully utilized by future applications in a few years' time. From today's perspective, this would include components of category 7 for frequencies of up to 600 MHz and 10-Gigabit Ethernet. However, special connectors are defined for this standard. The world of the standard RJ45 plug is therefore left and thus the compatibility with virtually all communication equipment available today.

The next "lower" category is the Cat.6_A standard defined according to ISO/IEC, which also enables 10-Gigabit Ethernet – with frequencies of just 500 MHz. The subscript "A" serves to differentiate it from the American standard Cat.6A, which is defined in the standard EIA/TIA 568 B2.10. Components according to Cat.6_A of ISO/IEC 11801 Ed.2.2, however, are subject to stricter specifications with regards to performance and interference resistance, which means that fewer transmission errors occur and the reliability of the communication increases.

The interesting factor here is that elements that comply with the ISO/IEC standard also meet EIA/TIA requirements. But this does not apply the other way around. This means that components according to both standards cannot be arbitrarily mixed within a network.

Thus, according to today's standards, 10-Gigabit Ethernet with Cat.6_A components is the transmission standard of the world when it comes to providing sufficient reserves in the transmission bandwidth and safeguarding the investments made for as long as possible.

With its frequencies of 500 MHz, Cat.6_A presents entirely new challenges with regard to the design of cabling and connection components. Many of the interference influences already known at lower frequencies now show up here to an increasing extent and become a problem for the first time. The standards specify limits to permissive and non-permissive interference influences. Manufacturers of high-quality components ensure that not only the absolute minimum is met here but that there are also sufficient reserves to guarantee reliable operation, even at maximum load.



What is then actually the problem now?

Put simply: all elements of structured cabling are not ideal, which has consequences particularly with high frequencies. This already starts with the data cable. Symmetric cables are not always ideally symmetrical. Unbalances already occur here in the production or as a result of mechanical strain during installation that is caused by, e.g., cramped installation conditions. There is crosstalk, i.e. the mutual influence of the individual data channels. The transfer from the cable to the plug is also problematical. As a result of the change in impedances, reflections are created that disrupt the data transmission.

The most important influencing parameters are described in brief below.

NEXT – near end crosstalk

Near end crosstalk proves to be an obstacle in the coupling of cables and plugs. It describes the electromagnetic coupling of two pairs of strands which occurs primarily near such connection points. In a Cat.6_A system, 4 pairs of strands need to be taken into account. The influence of NEXT thus grows considerably. NEXT values grow considerably with increasing frequencies.

Through measures such as symmetric twisting and additional shielding, this influence can largely be compensated for within the cable, which also, however, increases the effort and the costs in the production. In the transfer to the plug or to the jack, more major problems occur. There is no shielding of the cable here and the twisting has to end.

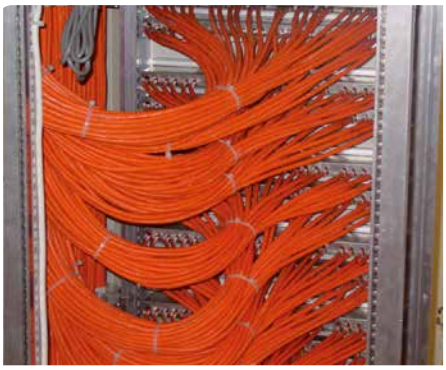
Modern systems make it possible to keep the unprotected length of the individual strands as short as possible. These plugs make it possible, also in the field, to produce an ideal, reproducible connection with the individual strands and thus guarantee maximum contact reliability.

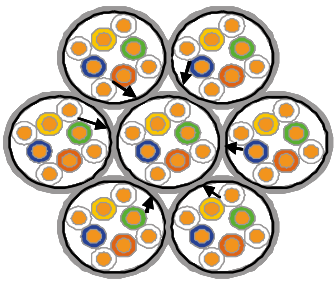
Return Loss

In the transfer of a signal from one component to another, there is a change in impedance which results in a reflection and thus a loss in the signal. This effect occurs in all transfers within the system. When you look at normal office cabling, it is obvious that return loss is a major problem. From the building distributor, it goes to the floor distributor. The next step is the jack. From there, it goes to the patch cable via the plug, back into a plug and into the jack of the end device. Diverse transfers which all result in signal loss. The return loss can only be minimized with precisely coordinated components.

Alien Xtalk

This is probably the most notorious interference influence. Alien Xtalk is the cross-talk from one cable to a neighbouring cable or also a plug. In office environments, Alien Xtalk occurs primarily through cables that are installed too closely in narrow ducts or through high packaging densities of patch panels, and here through cross-talk from plug to plug. The effect only occurs at high frequencies and becomes a challenge with 10-Gigabit Ethernet. Alien Xtalk can only be documented with measurement technology at high cost. Nevertheless, information should be provided by the manufacturer with regard to the necessary installation conditions to facilitate installation within the specifications. Constructive measures to combat Alien Xtalk are an improved shielding or the use of larger cable diameters, which in turn influences the production effort and the costs.





S/FTP cable

Conclusion

The specifications of structured cabling are just a first basis for the planning and implementation of building cabling. To meet the challenge of the different installation situations, a large number of specific solutions of all components involved in the network are required. Individual country specifications must be complied with in all cases. Modern modularly assembled wall outlets, patch panels and plugs give the fitter maximum reliability in the quality of his work.

They also facilitate a time-saving and thus also cost-effective installation of the entire network. 500 MHz Cat.6_A doubles the performance requirements compared to normal Cat.6. The development and production of such products requires a great deal of know-how. High-quality components offer a balanced ratio of mechanical stability and high performance. Strict quality checks are required for this, which guarantee that the standards are reliably met and there is still potential for future applications.

METZ CONNECT GmbH
Im Tal 2
78176 Blumberg
Germany

Phone +49 7702 533-0
Fax +49 7702 533-189

info@metz-connect.com
www.metz-connect.com

899274-02 | 06/2020