

Patch Cord

Ethernet copper cabling



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The neglected links of our connection devices?

They are the tangible link between IT equipment and LAN: patch cords! The more high-performance devices are connected to the network, the more important patch cords become. But every application scenario has different requirements. Different criteria should be considered for the optimal selection of a patch cord. Neglecting these can be expensive in the end.

Hard to believe what patch cords have to withstand. They suffer daily from mechanical stress due to handling and unwanted mishaps. In many applications patch cords are also exposed to harsh environmental conditions such as heat, dust, sunlight or moisture. Where Power over Ethernet (PoE) is added, cables and connectors are thermally stressed by the current flow. Patch cords age quickly, yet they should still guarantee absolutely interference-free transmission. At the same time, they should be as thin and flexible as possible in order to achieve a high density and good handling. In short: patch cords are not just any piece of cable with two RJ45 plugs. In fact, they are the most exposed components of LAN cabling. And just like a chain, in a LAN the whole thing is only as strong as its weakest link.

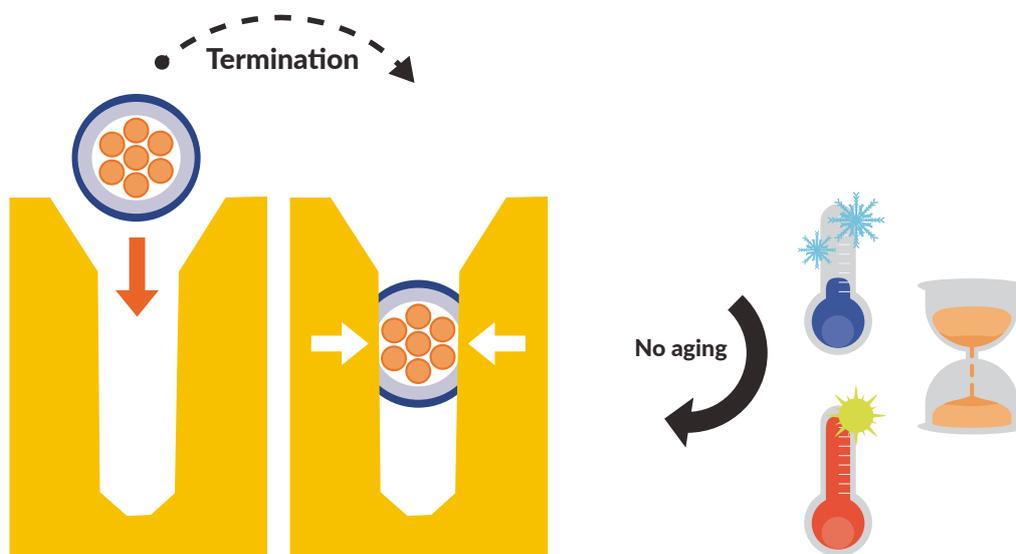
Correct choice of patch cord?

In the first place there is the question of the application scenario and the environmental conditions. The more demanding the transmission, the more capable the patch cord should be. Interference factors from the environment influence the choice of cable design. The question of whether PoE is used on a broad basis is becoming increasingly important. Where this is the case, only patch cords should be used that can guarantee reliable transmission over the entire life cycle.



Insulation Displacement Contact (IDC) or Insulation Piercing Contact (IPC)

With IDC, the wire is clamped between two legs of a forked spring contact. The contact halves cut through the insulation, press the stranded wire resiliently and thus establish the contact. The contact resistance and transmission properties of an IDC connection remain permanently low and stable.

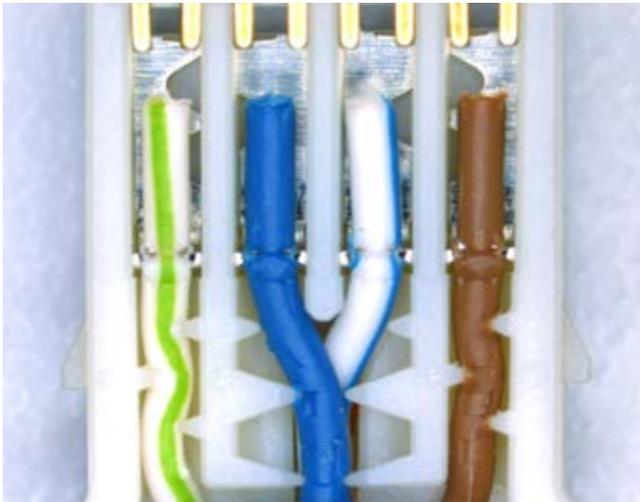


Insulation displacement contact (IDC)

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IDC is the optimal basis for using Power over Ethernet with high currents in continuous operation. R&M is among the pioneers of IDC technology for RJ45 patch cords. R&Mfreenet cables are equipped exclusively with IDC circuitry.

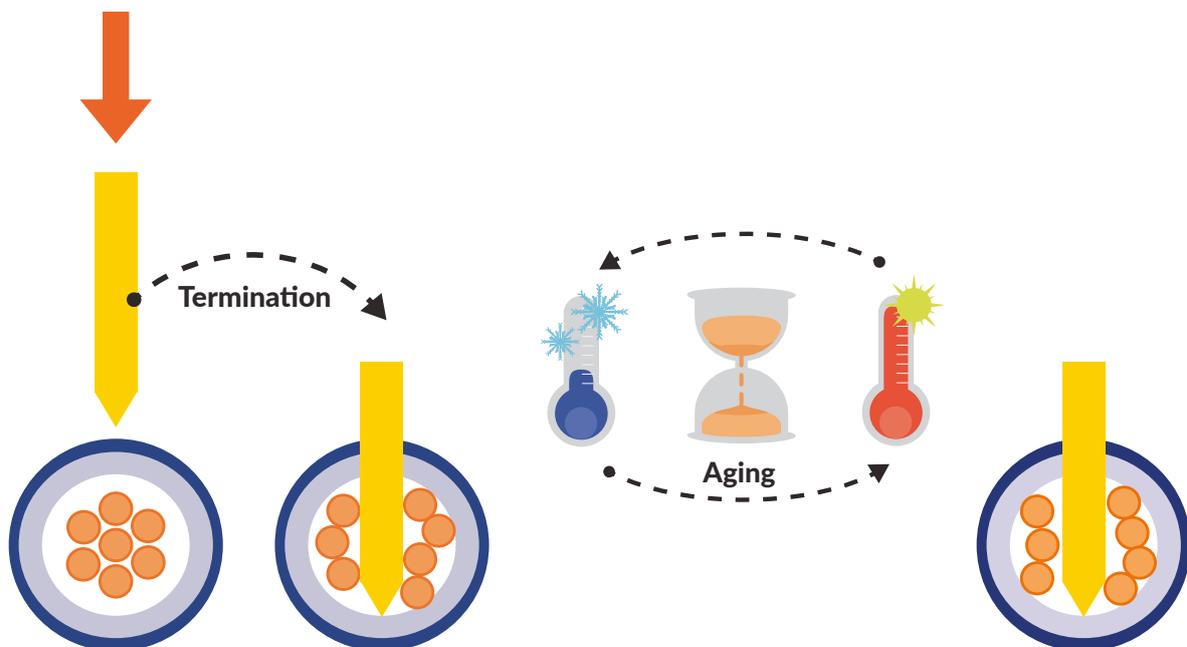


R&M IDC Wiring Block



IDC microsection R&M wiring block

With IPC a metal tip pierces the core insulation and makes the connection to the stranded wire. Although this method is state of the art and cost-effective, it has certain disadvantages. With this technology the contact resistance deteriorates uncontrollably over time due to aging and environmental influences.

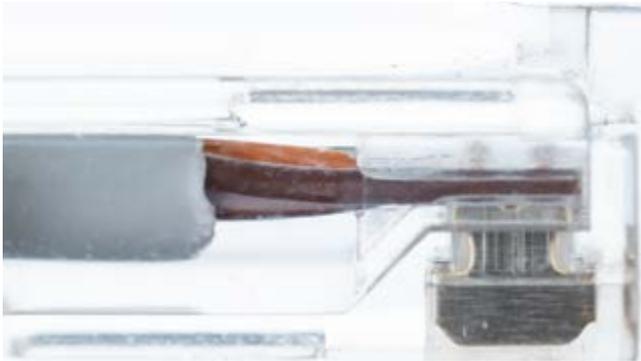


Insulation Piercing Contact (IPC)

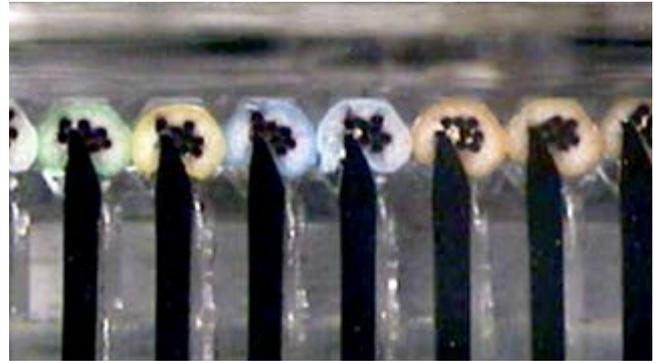
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Piercing technology cables are therefore not recommended for Power over Ethernet transmission over long periods of time and at higher power levels.



Piercing connector (IPC)



Microsection piercing contacts

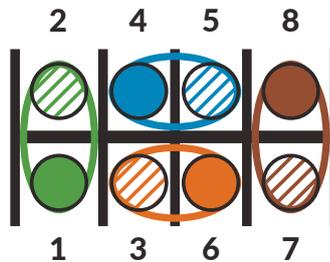
Minimization of disturbing influences

The geometry of the wiring part

In order to minimise interference, a contact part is required which physically keeps the wire pairs together. Separation can lead to disturbances of the pairs (crosstalk) and thus negatively influence the overall performance of the patch cord. The R&M circuit block takes this into account and keeps together what belongs together.



Cross section R&M wiring block



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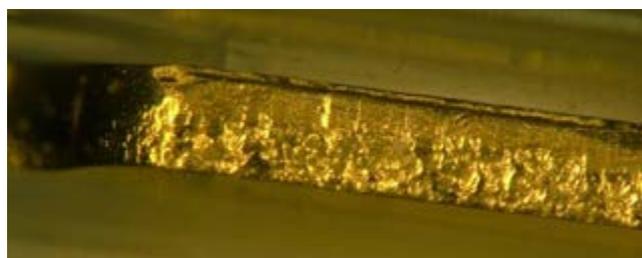
The construction of the contacts

But that's not all; the choice of contacts also plays a decisive role and helps to keep the contact resistances as low as possible. For this reason, care should be taken to ensure that they are correctly aligned and gold-plated. The thickness of the gold layer plays much less of a role than some manufacturers with thick numbers suggest. What is decisive is the substructure and the surface quality. This allows the materials to «interlock» optimally and generate the smallest possible resistance.

R&M patch cord contacts are manufactured exclusively rolled. The fine surface protects the contacts of the connection modules and requires less thick gold layers for an excellent connection. The complex, multi-layer surface finishing process is strictly controlled.



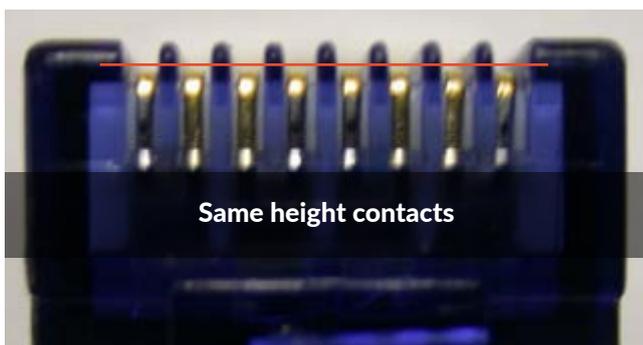
Rolled R&M connector contact surface



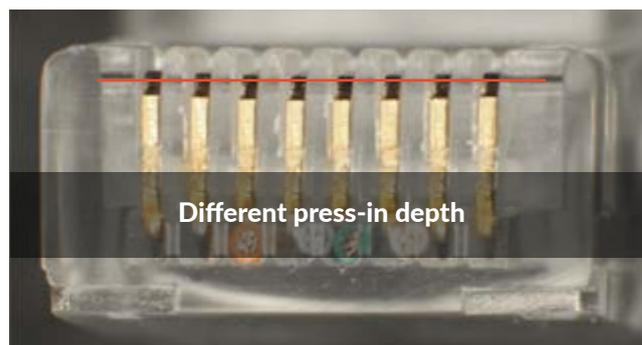
Conventional (stamped) connector contact surface

The importance of the contact height

In order to ensure that the contacts comply with the standards, they are then bent and firmly inserted into the contact block. Thus, the contact height does not change any further due to the circuitry, as with the piercing contact (IPC). The contacts are correctly aligned as mentioned above.



R&M connectors



Commercially available plug

Correctly aligned contacts ensure minimal stress on the contact springs in the connection module and sufficient contact pressure and thus a low contact resistance. This in turn leads to optimum contacting even with vibrations and temperature fluctuations.

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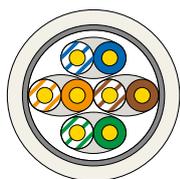
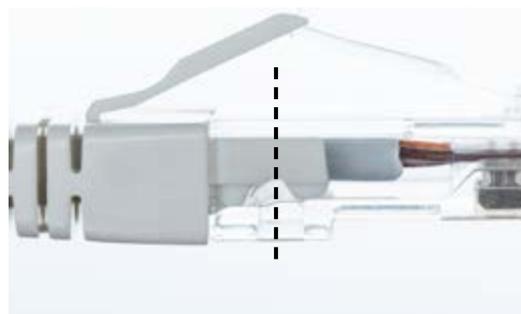
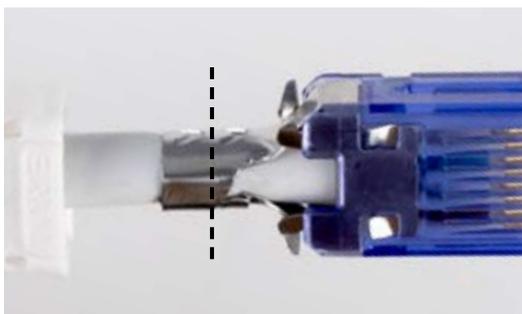
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The optimal strain relief

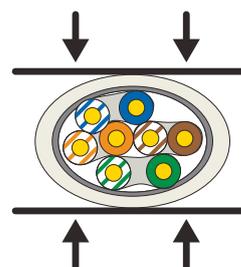
There is nothing like adequate strain relief. In many cases cables are maltreated, pulled or misused as clotheslines. Sometimes, however, one just clumsily stumbles over a patch cord and of course does not want to see this as an interruption in an important connection of a major customer in the data center.

Conventional crimp plugs stress the cable because they squeeze it. This type of strain relief is neither permanently pull-out proof nor does it enhance the general performance of the cable. Especially unshielded patch cords suffer heavily from crimping, which can partly be determined by measuring already in new condition. In addition, cable material can expand strongly under tension, which makes the cable thin and causes it to slip under a crimp beam. This inevitably leads to an interruption of the connection and the destruction of the patch cord.

Good strain relief, on the other hand, encloses the cable, holds it evenly and changes its shape only minimally. The high-frequency characteristics are fully retained in all designs and the force is transferred from the cable to the plug and then to the jack. This must be able to absorb 50N of tensile force and is designed accordingly. The result is a patch cord that can withstand even a high short-term tensile load without damage.



Crimping around the cable



Crimp oval, cable compressed

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The good kink protection

A good kink protection must often work for many years. This works with a good construction and the right choice of material. R&M uses a UV stabilized raw material to reduce the effects of sunlight. Constructive measures ensure that the kink protection on the main housing is held firmly in place at four points. The pattern was designed so that stretching and less stretching sections alternate to maintain the highest possible radius. Because once a cable is bent this can be measured. Furthermore, the kink protection is available in different diameters to better absorb cable thicknesses.



R&M kink protection protects



Alternative bend protection broken without protective effect

The latch protection with unlocking function

An optimum latch must be designed in such a way that overstretching is also possible. This often happens when a patch cord is pulled in, because it gets tangled up with other cables. This tangling is prevented with the latch protection. But why not also install an extra function. R&M engineers designed the release lever protection so that it can be used as a remote release. Simply pressing it from behind helps to safely unlock the cable in full racks or recessed sockets. For a controlled action without unwanted interruptions.



All these aspects make a patch cord a patch cord that minimizes interference and thus contributes to a carefree operation. It is not without reason that several hundred hours of development work and continuous improvements have gone into the R&Mfreenet patch cord families.

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Good handling

R&M cables are designed to be easy to process and lay out. To this end, the cables are selected to ensure easy unwinding and good flexibility.



Added value with R&Mfreenet

The R&Mfreenet patch cord, which can be used universally and flexibly, provides the appropriate product for the various applications. R&Mfreenet cables are characterized by top quality, sustainable system reserves and application-oriented features. The optionally available security system enables consistent color coding or plug/unplug protection to prevent operator errors without additional logistical costs.

R&Mfreenet patch cords come with the option of individual labeling. In addition to this customer-specific text, a serial number is also printed on each cable, which can be used both for traceability and for inventory at the customer's premises. This ensures easy traceability.



R&M Patch Guard



R&M color clips

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R&M patch cords with customer-specific text and consecutive serial numbering:



Customized text

Serial number

The wire wiring in the connector is exclusively done by means of IDC insulation displacement technology and is PowerSafe. The freenet family is therefore ideally equipped for the highest demands. Numerous free downloadable Excel tools also help planners and end customers with calculations for PoE applications.

Permanent Link length calculator:

PoE-Application: Power: Current: Wires:
 Class: Standard channel length:
 Connectors in Channel:
 Total patchcord length:
 Patchcord coefficient:
 Max. cable temperature: Yellow fields can be modified

Link segment no.	Cable type	Attenuation reserve of cable for app. Class	Installation cable diameter (mm)	Cable resistance (Ω/100m)	Theoretical PL length (m)	Ambient temperature (°C)	Cable bundle coefficient	Number of cables	Conduct. width (mm)	Bundle size equivalent	Temp. increase in bundle (°C)	Bundle environment coefficient	Temp. increase of bundle (°C)	Total temp. (ambient + increase)	Attenuation factor (% pro °C)	Max. PL length * (m)	Max. ambient temp. (°C)	Planned segment length (m)	Normalized length (m)
1	Cat5eU (AWG24)	1.00	5	9.5	94.0	30	5.00	300	200	74	0.34	0.20	0.8	31	0.4	90	59	40.0	41.9
2	Cat5eU (AWG24)	1.00	5	9.5	94.0	30	5.00	75	100	19	0.09	0.40	0.8	31	0.4	90	59	30.0	31.4
3	Cat5eU (AWG24)	1.00	5	9.5	94.0	30	5.00	20	50	6	0.03	1.00	1.1	31	0.4	90	59	20.0	20.9
* - calculated link lengths >90m have to be limited to 90m to comply with standard requirements																			
Total * (m): 90.0																			
Length reserve (%): -0.2																			

Note: Specific values are based on R&M freenet cable assortment and formulas have been verified with it. No guaranty can be made for other manufacturer's products

Recommended connectivity:

R&M freenet RJ45 Module: Cat. 5e or Cat. 6

R&M freenet RJ45 Patchcord with IDC: Cat. 5e

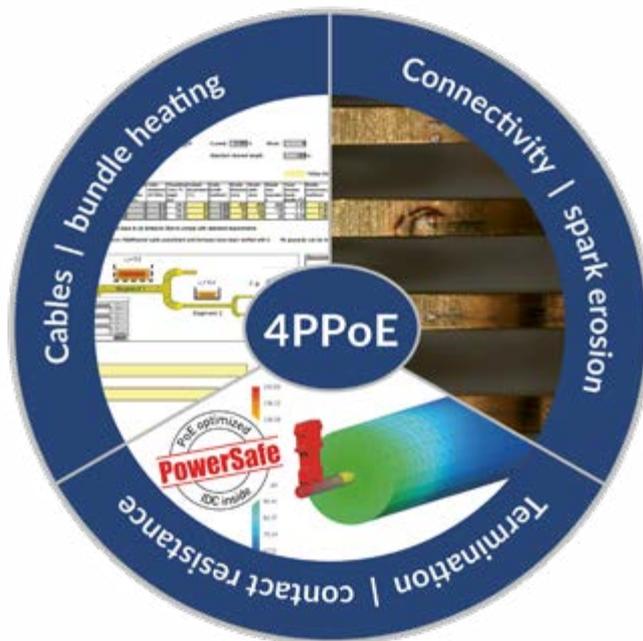
Free R&M Excel calculation spreadsheets

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Solution for simple applications

R&M offers the R&M*classic* patch cord family in selected markets for applications where the added value of R&M*freenet* patch cords is not necessary. It is based on piercing contacting and has an attractive price/performance ratio.



The R&M PoE Wheel

030.6515

Criteria for the selection of copper patch cords

- Planned transmission performance: 1 or 2.5 or 5 or 10 Gbit/s
→ Category: Cat. 5e, Cat. 6 or Cat. 6_A
- High performance or continuous PoE → *PowerSafe*
- EMC environment: cable construction, shielding: S/FTP, S/UTP or unshielded (U/UTP)
- Handling: diameter, wire cross section, bending radius, cable flexibility
- Sensitivity of the application, required reliability: wiring technology, strain relief, connector design
- Fire behaviour: Plastic material cable sheath
- Ease of use and error prevention: color coding, security systems
- Availability, logistics - price-performance ratio