

Category 6 – Mix & Match

Scope:

The scope of this document is to clarify the difference between Category 5 Mix & Match, Link Class E Systems and the new AMP Category 6 Mix & Match Systems based on the example of the AMP Communications Outlet System Plus. It will explain technical backgrounds as well provide an update about the issue with tests according to the latest drafts of Class E (up to 250 MHz).

Link Models:

The latest versions of the standards ISO/IEC 11801, EIA/TIA 568 and EN 50173 in the 2nd edition specify two link models based on which cabling systems are classified. The former basic link model is no longer considered.

a) Channel Link

The Channel Link consists out of the link between patch panel and telecommunication outlet (TO), but includes as well two patchcords (one for the cross connect in the distributor and the other one to connect the TO with the user's computer) (see illustration 1)

The maximum length of each individual patchcord may be 5m what results in a maximum allowed channel link length of 100 m. The channel link includes the connectors between patchcord and TO respectively patch panel but it does **not include** the connectors between patchcord and the active components like switches or NIC's.

Patch Panel

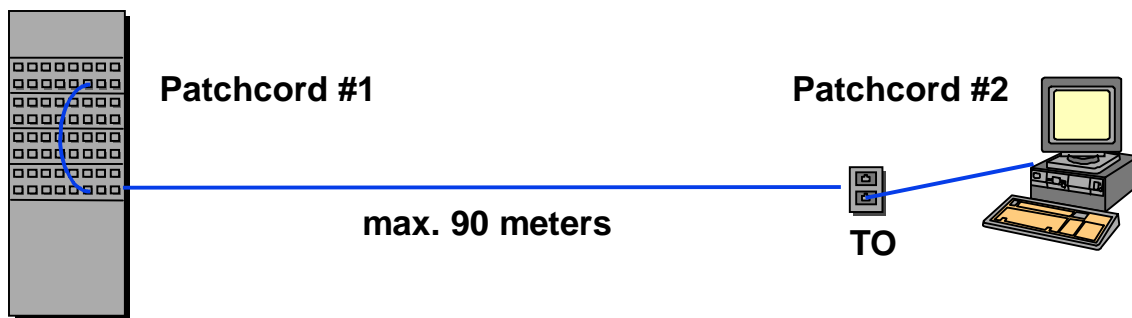


Illustration 1: Channel Link Modell

b) Permanent Link

The permanent link model does include the link between patch panel and TO but does not include the 2 patchcords (see illustration 2). This means that the permanent link model does reflect all parts, which are fixed installed (not easy removable like patchcords) in the building. The maximum cable distance between patch panel and TO is 90m (the same as in the channel link model). The permanent link model does include the connectors to the patchcords, but not the cable of the patchcords itself.

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Patch Panel

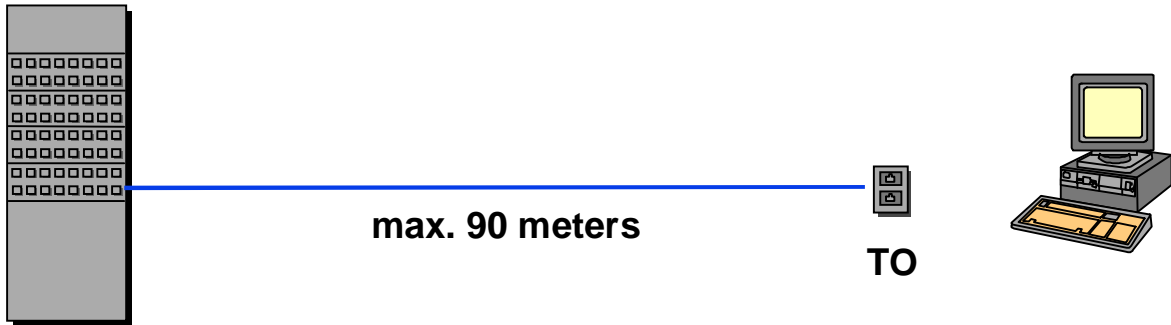


Illustration 2: Permanent Link Modell

The performance of a complete link (channel or permanent) is specified as a link class. The today's highest standardised class is the Link Class D up to 100 MHz, which allows the operation of the first version of the Gigabit Ethernet Protocol (1000 Base T) over twisted pair copper cables. The Link Class E (up to 250 MHz) and Link Class F (up to 600 MHz) is still in the procedure of standardisation. Nevertheless the physical and electrical performance parameters of both link classes are nearly fixed (only minor changes are expected for the future), what makes it possible to plan solutions based on these future cabling standards already today

Components:

Beside of the complete channel and permanent link specifications, there are established technical requirements for each individual component like cable, connectors and patchcords in order to ensure the final performance installed as a link together. These individual components are classified with regard to their performance into categories. Category 5 Components have been specified the first time within the EN 50173:1995 out of which a Link Class D (up to 100 MHz) could be created. These requirements have been increased with the latest version of EN 50173:2000 in order to assure a reliable application of Gigabit Ethernet on twisted pair copper cable. The very often used terms Enhanced "Category 5" or "Category 5E" means the same as Category 5 : 2000.

Comparable to the Link Class E and F, the performance requirements for Category 6 and 7 Systems are not finally fixed until today. Nevertheless the physical and electrical requirements are settled and again only minor changes are expected for the final versions.

Category 5 Mix & Match Systems

The requirements for Link Class D have been chosen in a way, that in principle each Category 5 Modular Jack from manufacturer A can be terminated to the Category 5 Cable of manufacturer B and the Patchpanel of manufacturer C (with the Patchcord of manufacturer D) – the result is always a Link / Channel Class D ! Owing to that reason it is even possible to avoid final test measurements according to EN 50173, because the component requirements are tight enough in order to guarantee the performance of

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a Class D Link. Products of different suppliers are electrically as well as mechanically compatible to each other (see illustration 3).

Patchpanel

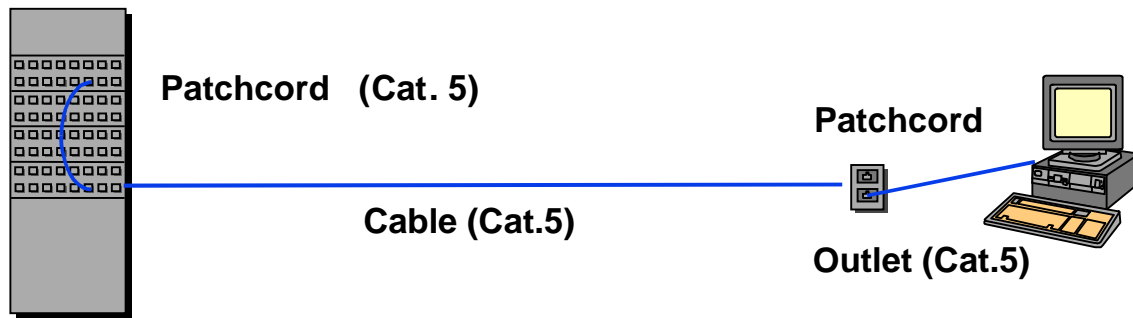


Illustration 3: Link Class D mit Kategorie 5 Mix & Match components

Link Class E Systems created with Category 5 Components

There exist a relative wide tolerance for the RJ-45 Connectors (Plugs & Jacks) used for Category 5 Mix & Match Systems with regard to the electrical and mechanical properties. The specification for RJ-45 Connectors (IEC 60603-7) defines a wide range concerning the geometrical details and tolerances. If a supplier is developing now an own more stringent electrical as well as mechanical specification, with more tight tolerances, it is possible with the corresponding connector know-how rather easy to optimise a system, that the requirements of Link Class E (up to 250 MHz) can be reached. The compromise of such an optimised system is of course the loss of interoperability to systems and components of other suppliers. Mix & Match do no longer work in each case.

These kind of optimised Class E systems, in fact consisting out of “tuned” Category 5 components haven been, and still are installed from various suppliers. This was possible because there haven’t been a standard for Category 6 Mix & Match during the last years.

Link Class E System created with Category 6 Mix & Match Components

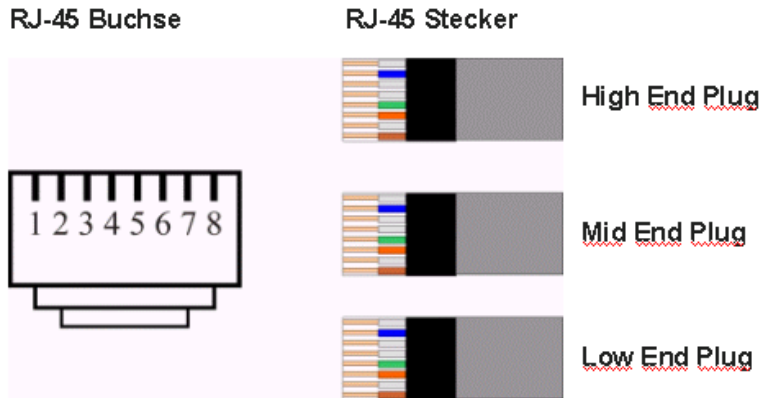
The standard committees have recognised this problem and have started the work with regard to Category 6 Mix & Match. For example EN 50173 works with the 2nd edition on these requirements (De-Embedded Testing, see illustration 4).

Contrary to Link Class E Systems, the manufacturer has no longer the possibility to define own standards within he is optimising his system. To say it in simple words, this new standard defines a definite range of Modular Plugs and any new Modular Jack, which is going to be developed, have to provide a Category 6 connection in each combination. This requires very deep connector know-how and any compensation can be done from now on only on the Modular Jack side (because the Plug side is fixed by the standards!).

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A lot of development steps are required to create a sure and reliable Mix & Match solution for Category 6. Three connectors out of the allowed range of RJ-45 connectors are chosen, with which afterwards all physical and electrical performance parameters have to be checked and assured.

Nearly all known certificates for components on the market consider only one system specific RJ-45 connector. That means that in fact these systems are only Category 5 / Link Class E optimised systems!



For the development of real Category 6 Modular Jacks have to be considered the whole range of RJ-45 Modular Plugs available on the market. In the practice it is done by the definition of 3 Test Plugs, each of them covering the high, the middle and the low geometrical range with regard to tolerances as specified in the connector standard IEC 60603-7. If a product is designed according to these requirements, it is automatically ensured, that the developed Category 6 Modular Jack provides with each RJ-45 Plug a Category 6 connection and therefore guarantees a Link Class E performance.

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Buchse“= Modular Jack / “Stecker“= Modular Plug

Illustration 4: De-Embedded Testing (2nd edition EN 50173) (and ANSI/EIA/TIA -568-B2-1 08/2001)

Only in that case a Patchpanel or Telecommunication Outlet is allowed to be specified as a Category 6 Component! Tyco Electronics / AMP NETCONNECT was the 1st connector manufacturer, who has developed the new Category 6 Modular Jack according to these new requirements and standards.

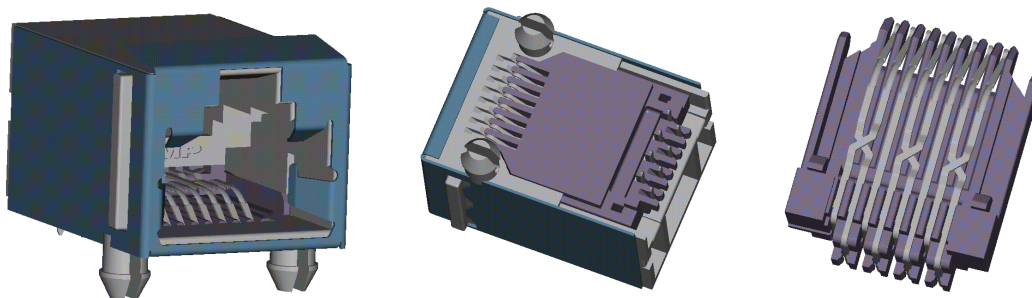


Illustration 5: AMP NETCONNECT Cat. 6 Modular Jack (front view, bottom view, contact array)

The patented Category 6 Modular Jack is designed with a crossover-region to reduce near-end-crosstalk influences directly behind the contact area (see illustration 5 – right hand). Extreme short contact distances to the PCB reduce cross talk as well. Free-End Compensation supports in addition a NEXT- and Return-Loss optimisation very near to the contact area, which consists of high-precision gold-contacts. In combination with the NEXT-Source Compensation it was possible to come up with the high requirements of Category 6 Mix & Match and even to exceed the specified parameters.

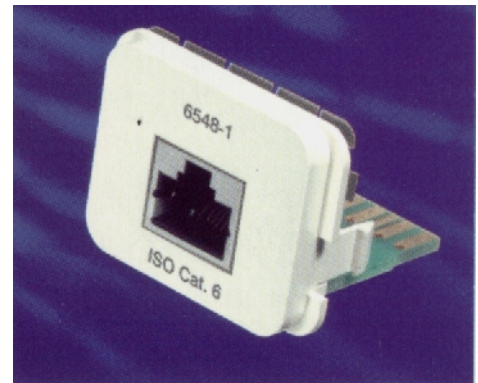
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This new technology is for example integrated into the Category 6 System Inserts of the AMP Communication Outlet System Plus (ACO Plus), which is therefore a real Category 6 solution.

This system is future proof and interoperable to other systems (for example active components like NIC's, Switches etc.) – what is a big advantage for the user. For the designers and installers of Structured Cabling Systems the ACO Plus system provides advantages as a real Category 6 Mix & Match solution especially during the final test measurements, which have to be performed nowadays according to the requirements of Link Class E up to 250 MHz.

The independent Test Laboratory in Germany “GHMT mbH – Gesellschaft f. Hochfrequenzmesstechnik” (Society for High-Frequency Measurement- & Test-Technologies) has tested the ACO Plus System, both with regard to permanent link as well as to component performance and confirmed the full compliance with all latest requirements of Category 6 / Class E (Certificates are available upon request).

With that results the ACO Plus system can be considered as one of the first real Category 6 systems fully complying with the strict requirements of De-Embedded-Testing.



ACO Plus - Category 6 Insert

For more detailed information, please contact our competent partners or your local AMP NETCONNECT representative.