Structured Cabling Testing

Testing has a major significance for correct functionality of structured cabling. Testing devices are able to measure installed components and determine whether all requirements defined in international standards necessary for reliable operation have been met. The following main parameters are usually tested:

Wire Map

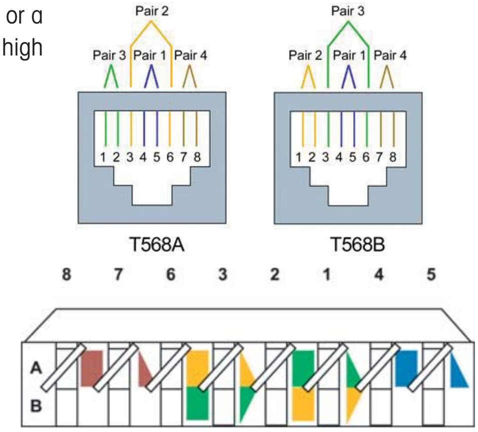
This parameter checks correct termination of cable wires in telecommunication outlets and patch panels. At the same time, it checks the signal throughput on the whole cable length—i.e. it is able to detect any open-circuit or short circuit faults. The Wire Map parameter is very important but alone it cannot ensure correct functionality of an installed computer network.

What to do if the Wire Map parameter fails?

First, it is necessary to check whether the individual wires have been installed correctly in the termination block. If so (i.e. the wire map corresponds to the standardized T568A or T568B schemes) and the Wire Map parameter still fails, there could be several causes for this: an incorrectly terminated wire in the termination block, a wire interruption inside the cable, or a short-circuit. Advanced testing devices are able to determine fault locations with relatively high accuracy and by doing so make fixing wire-map problems easier.

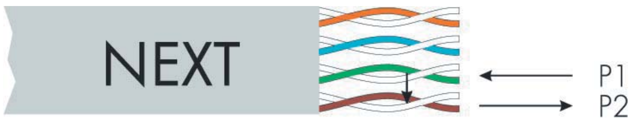
T568A and T568B wire map schemes:

T568A	T568B
1. white-green	1. white-orange
2. green	2. orange
3. white-orange	3. white-green
4. blue	4. blue
5. white-blue	5. white-blue
6. orange	6. green
7. white-brown	7. white-brown
8. brown	8. brown



NEXT (Near End Cross Talk)

NEXT is a value that expresses how much signal can get from one pair to another pair within one cable. The measurement of cross-talk at the near end takes place at the same end of the cable as the location of the signal source. For this parameter, all combinations of pairs are measured within one cable—i.e. 12-36, 12-45, 12-78, 36-45, 36-78, 45-78. This measuring is done for both ends.



What to do if the NEXT parameter fails?

First, it is essential to find out at which end of the cable NEXT is showing the error (this function is supported by all advanced testing devices). Then it is necessary to check the maximum permitted unlaid of wires in one pair on the termination block—that should not be more than 13 mm. Typically for Category 6 or higher categories, 13 mm does not necessarily ensure that the NEXT parameter will pass so it is essential to keep the pair unlaid as short as possible. It is also important that the original twisting of each pair is preserved during installation and that there is no air core between the twisted wires in a pair. A frequent source of cross-talk problems can also be when using cable couplings. Hence, if a cable is not long enough, it is better to replace it with a cable of a corresponding length rather than use couplings.

Attenuation

Attenuation shows the difference between the strength of the initial signal and the strength of the signal after it gets to the other end of the wire. It is caused mainly by the wire resistance and it is usually larger for higher frequencies. Attenuation also increases as the diameter of the cable decreases—this means that a cable with the size of AWG 24 has a slightly higher attenuation than an AWG 23 cable.

What to do if the Attenuation parameter fails?

The length of the horizontal cable must be checked—i.e. whether the electrical length of the link (i.e. the actual length of the twisted pairs inside the cable) corresponds to the maximum permitted permanent link of 90 m. A frequent cause of higher attenuation is also an incorrectly terminated wire in patch panels, outlets, or keystones.

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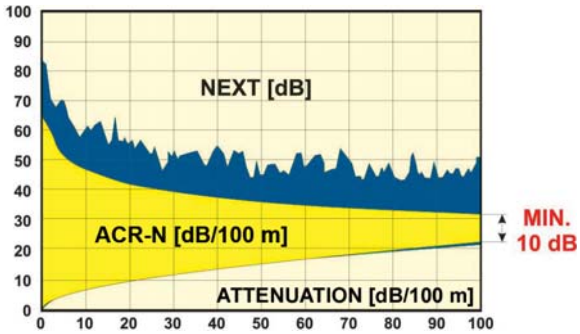
ACR-N (Attenuation to Crosstalk Ratio – Near End)

ACR-N (originally called just ACR) is a theoretical parameter (i.e. it is not measured but is deduced from two previously measured values) which shows the margin between NEXT and attenuation values: ACR-N [dB] = NEXT [dB] - A [dB]. If the level of attenuation meets or approaches the level of near end cross-talk, the transmitted signal will be lost. The gap between NEXT and attenuation must be at least 10 dB.

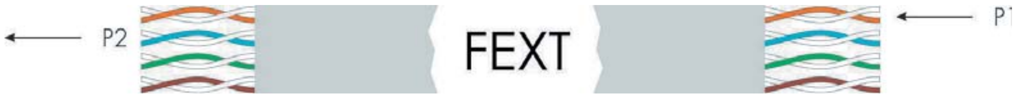
What to do if the ACR-N parameter fails?

As the ACR-N parameter is dependent on NEXT as well as attenuation values, an improvement of these two parameters will influence the resulting ACR-N values.



FEXT (Far End Cross Talk)

FEXT expresses the cross-talk of the signal from one pair to another pair within one cable measured at the far end. This is the same parameter as NEXT, only with FEXT the measurement is done at a different cable end. Again, all combinations of pairs are measured within one cable—i.e. 12-36, 12-45, 12-78, 36-45, 36-78, and 45-78. FEXT servers as an important basis for the following ACR-F parameter.



ACR-F (Attenuation to Crosstalk Ratio–Far End)

ACR-F (originally called ELFEXT, Equal Level Far End Cross Talk) corresponds much better to the actual situation during data transfer than FEXT. It is because the cross-talk inside the cable decreases as the attenuation increases. ACR-F is a theoretical parameter (i.e. it is not measured but is calculated from other previously measured values): ACR-F [dB] = FEXT [dB] - A [dB]. Thus ACR-F is the cross-talk at the far end decreased by attenuation.

PSNEXT (Power Sum NEXT)

PSNEXT is a theoretical value calculated from the previously measured NEXT. The PSNEXT parameter is primarily important for protocols that use all four pairs for signal transfer (e.g. Gigabit Ethernet). The output sum of cross-talk at the near end shows how much signal gets from three pairs to the remaining fourth pair. The source of the signal and measurement of cross-talk takes place at the same end of the cable.

What to do if the PSNEXT parameter fails?

Just as with other parameters, PSNEXT is also influenced by the measured values of NEXT. Thus, an improvement in the near end cross-talk value will affect the resulting value of PSNEXT.

PSACR-F (Power Sum ACR-F)

PSACR-F is calculated from the ACR-F value. Just like PSNEXT, this parameter is important for protocols that use all four pairs for signal transfer. PSACR-F expresses how much signal in the same cable gets from three pairs to the remaining fourth pair. The source of the signal and measurement of cross-talk takes place at opposite ends of the cable.

Propagation Delay

This value expresses a delay of the signal travelling from one end of the cable to the other. The typical delay of the signal in a Category 5E cable is around 5 ns per 1 m; the permitted limit is 5.7 ns per 1 m, which is 570 ns per 100 m. Propagation Delay also serves as a basis for testing the Delay Skew value.

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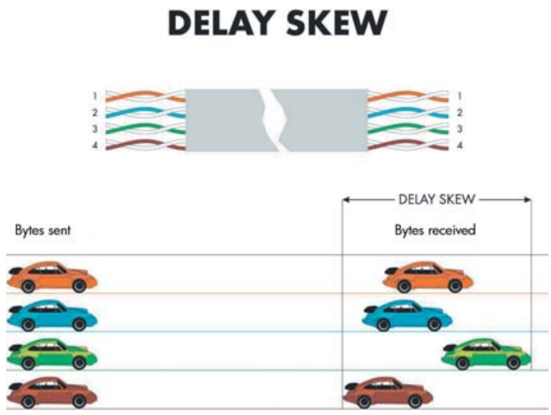
Delay Skew

Delay Skew shows the difference in signal delay between the fastest and the slowest pair. The Delay Skew parameter is affected by (1.) different length of pairs; (2.) difference in material (resistance, impedance etc.); (3.) the effect of surrounding interference. If the difference is too great, there can be an incorrect interpretation of data by the active device (usually a switch, network card, etc.). Just as for PSNEXT and PSACR-F, the Delay Skew parameter is critical for protocols that use all four pairs, such as Gigabit Ethernet.



Length

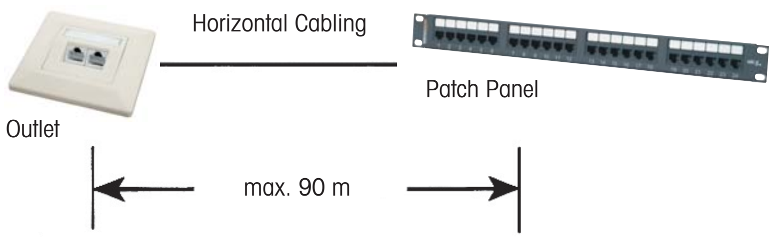
There is a direct proportionality between length and attenuation (i.e. the longer the length of the cable, the higher the attenuation). Testing devices use the so-called TDR (Time Domain Reflectometery) for measuring lengths. This means that a pulse is sent down the cable, then it is reflected back onto the remote unit, and subsequently the time during which the pulse travels the whole track is recorded. Based on NVP (i.e. Nominal Velocity of Propagation, which expresses the signal speed in the cable as compared to the speed of light in a vacuum), the length of the measured segment is calculated. This concerns the length of twisted pairs inside the cable (the so-called electrical length), not "untangled" cable (the so-called physical length). At 85 m, the variation between the electrical and physical lengths can be up to 5 m depending on the twisting of each pair.

Return Loss

Return Loss shows the reflection of the signal because of varying impedance at different cable parts. Due to these impedance imbalances, part of the energy can return to the transmitter, which can cause the signal interference.

When testing structured cabling, two basic topologies are used:

Permanent Link—the connection from a patch panel to a work-area telecommunication outlet (i.e. also called horizontal cabling). This is the most permanent fixture in structured cabling and cannot be easily taken apart. The maximum permitted length is 90 m.



Channel—the connection from an active device (e.g. a switch) in a data rack to a network card, patch cords included. The recommended maximum length of equipment cords in data racks is 5 m; the maximum recommended length for work area cords is 20 m. The length of the channel (i.e. the horizontal cabling plus an equipment cord as well as a work-area cord) should not exceed 100 m.