House cabling made the easy way - the trend towards structured cabling in residential buildings

Part 9: Measurements of fiber optic connections

Fiber optic cables are being used increasingly in addition to copper cables for measurements in residential buildings and apartment blocks, especially in the rise area between the central house connection and apartment distributors. They are insensitive to electromagnetic fields, enable higher data rates and greater line lengths that copper data cables and there are no problems with the potential equalisation either due to the metal-free structure of the fiber optic cables. However, like copper cables, fiber optics must also be measured after installation to prove that they work trouble-free.
Fiber optic measurements are not quite so convenient as copper measurements because, unfortunately, there is no simple pass/fail function here with which the measuring instrument can tell at a glance whether or not the values of the installed line are within the permissible standard range. Nevertheless, fiber optic measurements are easier than a lot of people think.

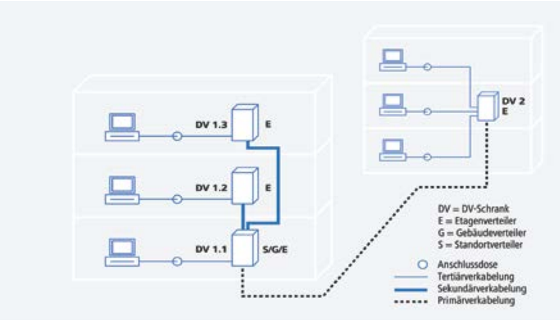
Measurements of fiber optic lines are made basically in three steps:

1. Determination of the maximum permissible values of a line (nominal values)

Steckertyp	ST	SC	LC	E2000
Einfügedämpfung	SM*: max. 0,5 dB MM**: max. 0,4 dB PCF: max. 1,0 dB POF: typ. 1,5 dB	SM*: max. 0,5 dB MM**: max. 0,4 dB PCF: max. 1,0 dB POF: typ. 1,5 dB	SM*: max. 0,5 dB MM**: max. 0,4 dB	SM*: max. 0,3 dB MM**: max. 0,3 dB

	Faser-spezifikation OS2	Faser-spezifikation OM2	Faser-spezifikation OM3	Faser-spezifikation OM4	Faser-spezifikation OM1
Optische Eigenschaften					
Max. Dämpfung in dB/km bei 850/1300 nm	-	2,8 / 0,90	3,0 / 1,0	3,0 / 1,0	3,2 / 1,1
Max. Dämpfung in dB/km bei 1310/1550 nm	0,40 / 0,30	-	-	-	-

2. Measurement of the real values (actual values)



Beispiel zur strukturierten Verkabelung

3. Comparison of nominal and actual values

Determination of the maximum permissible nominal values

A fiber optic line consists typically of two to three different components: fiber, connection and slice if necessary. A splice is a fixed, unplugged connection of two fibers. The fibers can simply be fixed to each other (so-called mechanical splice) but they can also be welded together by heat (so-called thermal splice). Glued splices in which two fiber ends are glued together are no longer common.

In the pertinent standards – especially the standard series DIN EN 50 173 – the maximum permissible values for fibers, connections and slices are defined.

Two values are particularly important here: Attenuation and return loss. The attenuation indicates how much a data signal is weakened when it runs along a fiber or passed a plug transition or splice.

Wherever a data signal encounters changes in the transmission line (for example a plug connection, a splice, an extreme end of the fiber or a kink), part of the signal is reflected and returns to the transmitter. Reflections are undesirable because they weaken the data signal and can also lead to interferences in the transmission. The return loss indicates how strongly a reflected signal is suppressed or how small it is in comparison with the actual, desired data signal.

Determination of the permissible maximum or minimum values is extremely simple: The standard values of the individual components installed in the system are added.

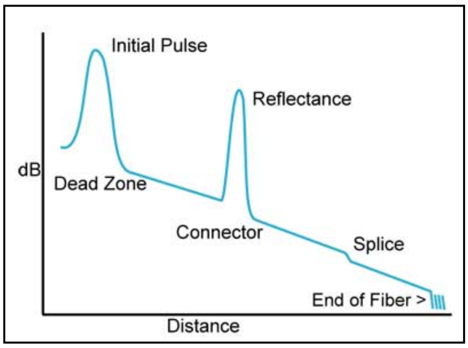
Measurement of the actual values

In multimode fiber optics only the attenuation is almost always measured. To do this, a simple attenuation measuring instrument set consisting of a transmitter and a receiver is used which is connected to the cable line to be measured by high-quality FO measuring leads.

Source: JDSU

Singlemode fiber optics are measured by an OTDR (optical time domain reflector). This high-quality measuring instrument emits a short laser pulse and records its unavoidable reflections along the cable line. Put in very simple terms, it works on the same principle as a camera with a flash: A short light pulse is emitted and the reflected light is recorded. A graphic display of the cable line is then possible which makes troubleshooting much easier. The graphic display allows you to draw conclusions about the type of error (pinched cable, defective plug, poor splice, etc.) and where it is. Important: The beginning and end of a cable line cannot be measured with an OTDR for physical reasons. Therefore OTDR measurements must always be made with a pre-laser at the start and a post-laser at the end. These measuring fibers are available as accessories.

Source: JDSU



Cleanliness is top priority for reliable measurements. Plugs and sockets must be checked and cleaned before connecting a measuring instrument. Suitable cleaning accessories must be used; window cleaners or cleaning cloths are unsuitable for fiber optic cables.
Accessories in the Telegärtner online catalogue.

Comparison of nominal and actual values

The measured actual values are compared with the calculated nominal values of the cable line after the measurement. With attenuation the measured values must be less or equal to the nominal values, with return loss greater or equal.
Or to put it more simply:
The less the attenuation, the better. The greater the return loss, the better.
In many measuring instruments the measured values can be saved and read out electronically, which considerably simplifies the processing and comparison with the calculated nominal values.

> **Telegärtner tip:**
> Never look directly into the open end of a fiber optic cable or into the connections of measuring instruments or active network components - this could cause injury to the eyes! Always make sure that the ports are switched off and that no signal is applied when testing.

You will find further information on the Telegärtner home page.