

Fibre optical solutions – cables and systems for LAN, MAN, WAN and SAN

As the degree of automation increases in industry and the information density rises in office communication, higher and higher demands are made on the transmission of analog and digital data. In this situation, conventional links based on copper cable engineering often reach the limits of their performance.

FLine® – the system for glass fibres

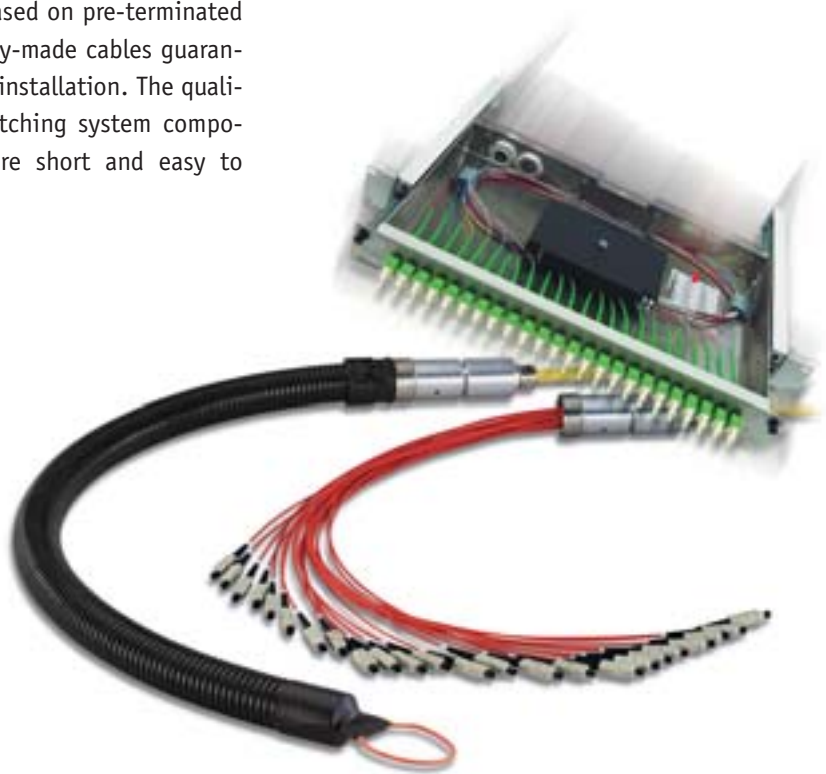
The constant increase in Internet and Intranet traffic, multimedia applications and the implementation of so-called SANs or Storage Area Networks in companies has led to fundamental changes in the traffic and load distribution in the networks. Also, new media require new passive network infrastructures.

On the basis of EN 50173, KERPEN has introduced the new FLine® classes “FLine® 110”, “FLine® 300” and “FLine® 550” for link lengths for 10 GbE and GbE.

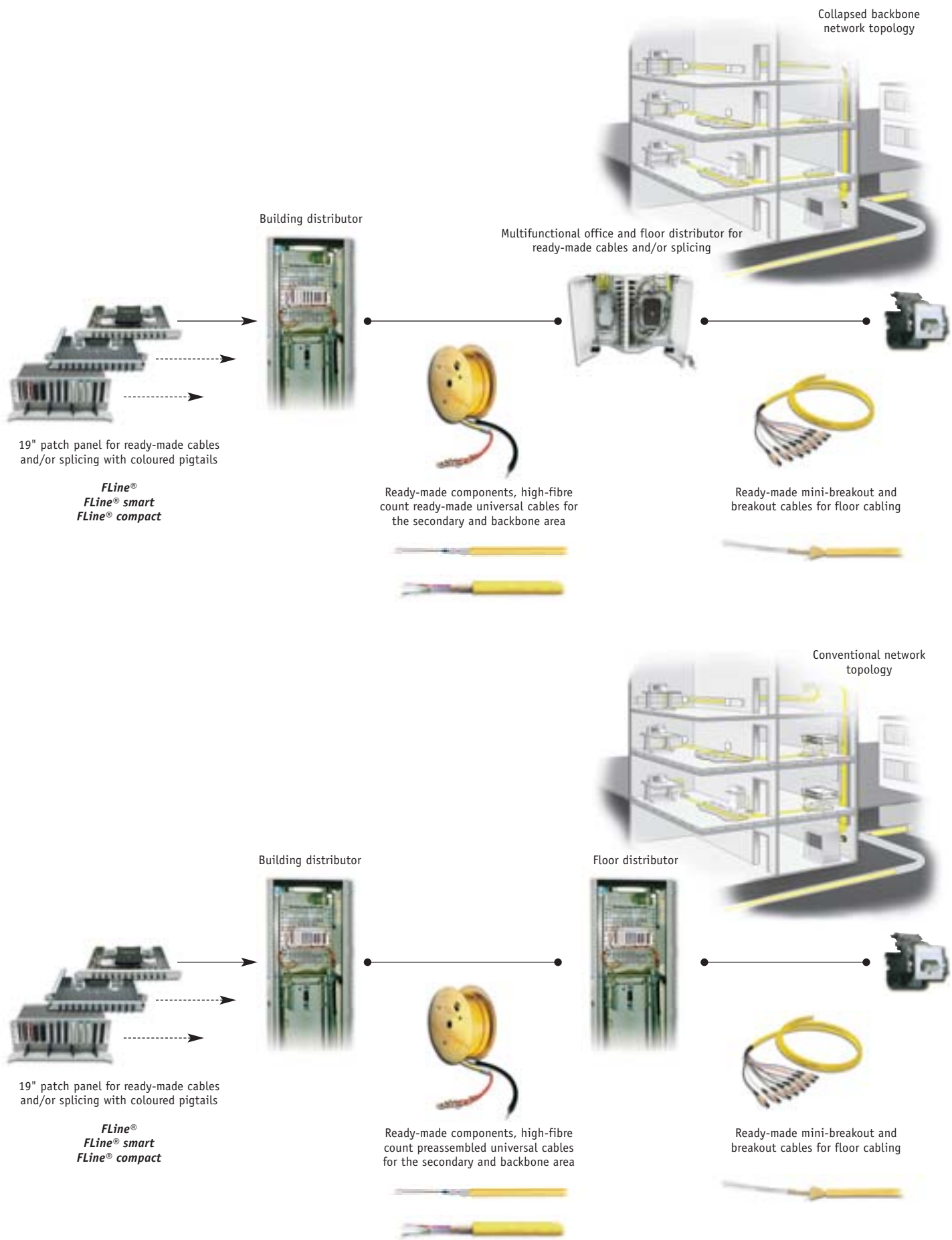
FLine® systems engineering is based on pre-terminated ready-to-connect units. The ready-made cables guarantee rapid, reliable and economic installation. The quality of the link is ensured by matching system components. The installation times are short and easy to calculate.

GigaLine® – enhanced fibre optic technology

In conjunction with multimode fibres and single-mode fibres, GigaLine® fibre optical cables offer reserves which go far beyond the specifications of the standard. Following the fibre categories OM1, OM2, OM3 and OS1 according to EN 50173, KERPEN offers the quality grades OM1e, OM2e, OM3e and OS1e with optimised transmission characteristics.



FLine® – the complete system for fibre-to-the-desk and fibre-to-the-office at maximum quality and security



FLine® 110, FLine® 300 und FLine® 550 – the new FLine® classes

In order to give the user a clear protocol-dependent planning foundation building up-on EN 50173 for link lengths at 10 GbE and GbE, KERPEN has introduced the new FLine® classes:

- **FLine® – 110**
- **FLine® – 300**
- **FLine® – 550**

110, 300 and 550 refer to the maximum link lengths for 10 GbE.

These FLine® classes include components optimised for performance and quality which together provide an ideally matched system.

The interaction of high-quality fibres (OM2e, OM3, OM3e) which go far beyond the standard and of high-quality plug connectors allow maximum range and performance for the applications involved (GbE / 10 GbE).

The system components are selected in such a way that the demands made on the link length (110, 300 and 550) and on the data rate are met.

This is why KERPEN consistently uses the same fibre quality for each system (cables, pigtailed, patch cords).

For the user, this means that he selects the FLine® class (system) he requires depending on the link length he needs and the protocols to be transmitted (GbE / 10 GbE). Tables 1 and 2 give him the protocol-dependent attenuation budget according to EN 50173. From this he can derive the number of possible connections for the entire link.

When the FLine® classes were put together, the following matched system components were taken into account:

- Fibre optical cables (GigaLine®) with laser-/dispersion-optimised multimode fibres which go far beyond the requirements of the standard (OM2e, OM3 or OM3e) and have the necessary reserve performance.
(For fibre specifications please see GigaLine®)
- Fibre optical connectors (LC or SC etc.) with low insertion losses and high return losses attenuation.

Maximum link lengths for 10 Gigabit Ethernet system solutions

Multimode G 50	FLine® classes for 10 GbE		
	FLine® 110	FLine® 300	FLine® 550
Maximum link length for 10 GbE 10GBASE-SR	110	300	550
Attenuation budget for the link and for 10 GbE application	1,8 dB	2,6 dB	2,6 dB
Recommended plug connectors	ST, SC, LC FC-PC E 2,000	SC, LC	SC,LC
Number of possible plug connections	4	8	6

All data refer to the first optical window, 850 nm

Maximum link lengths for 1 Gigabit Ethernet system solutions

Multimode G 50	FLine® classes for 10 GbE		
	FLine® 110	FLine® 300	FLine® 550
Maximum link length for GbE	750	900	1,000
Attenuation budget for the link and for GbE application	3,56 dB	3,56 dB	3,56 dB
Recommended plug connectors	ST, SC, LC FC-PC E 2,000	SC, LC	SC,LC
Number of possible plug connections	4	6	5

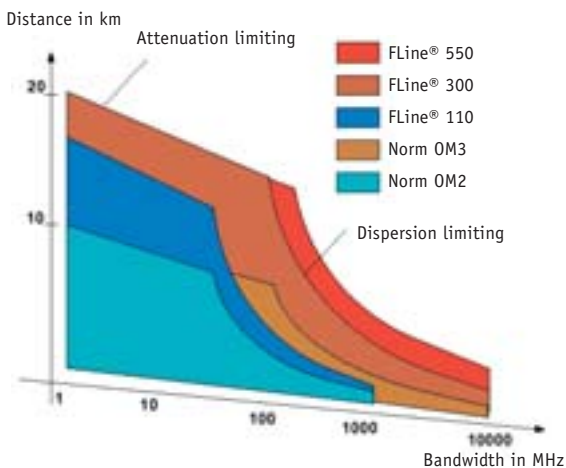
All data refer to the first optical window, 850 nm

Diagram 1 shows the system reserves resulting from the high-quality fibres and connectors in relation to the EN 50173 standard.

The main advantages of these system reserves are as follows:

- Longer transmission distances for certain applications (100 Mb/s, 1 GbE/s, 10 GbE/s)
- The option of inserting more patch cords or splices
- Additional losses resulting from aging processes can be compensated for
- Network extensions can be implemented more easily and with a certain degree of security within the link length

Diagram 1: FLine® 110, 300 and 550 system reserves in relation to the standard



Quality is our benchmark

In the manufacturing of fibre optical connectors, sophisticated grinding and polishing processes are necessary in addition to the adjustment of the fibres in the ferrule. The aim here is to use precisely optimised processes to fashion the connector in such a way that insertion losses and reflections are kept to a minimum. For this purpose, the so-called PC (physical contact) finish was developed, mainly for multimode fibres but also for single-mode ones. The spherical polish of the ferrule, which is flexibly supported in the plug housing, results in a fibre/fibre transition on the end faces.

Thus, when two connectors are inserted into a coupling, the spring pressure causes all of the air between the two fibres of both plugs to be pushed out.

The glass/glass transition then has virtually no reflections and low losses.

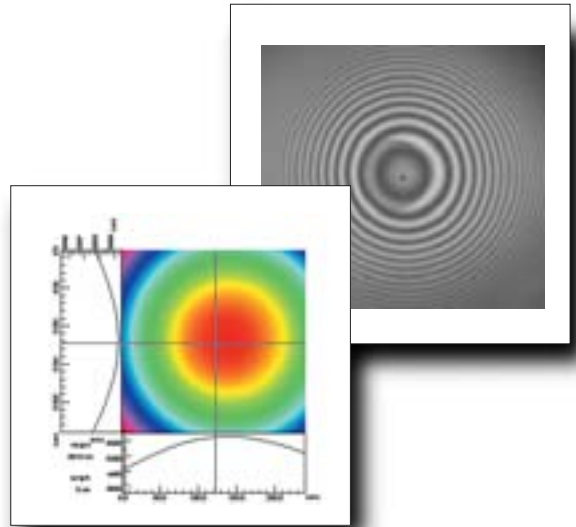
In order to maximise the performance of a PC plug, the surface parameters of the plugs must be carefully monitored during the polishing process. The interferometer is a leading edge measuring instrument for this purpose. The overlapping of coherent light waves is used as a basis for measuring the quality of optical surfaces (ferrule surfaces).

The most important parameters are as follows:

- The pole offset: this is the distance between the highest point of the ferrule and the centre of the fibre (eccentricity of the polish)
- The tolerances of the ferrule opening to the diameter of the fibre
- The optimum radius of the ferrule and the fibre.
- The fibre height in the ferrule (undercut, protrusion)

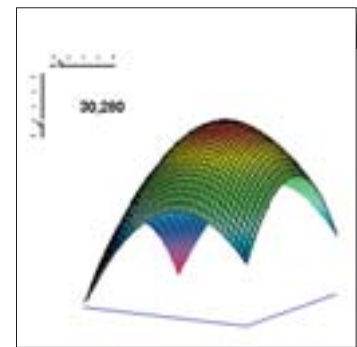
These parameters are important factors determining the long-term behaviour of a connector after plastic deformation. The following are derived in this way:

- Physical contact
- Insertion losses / return losses
- Fibre stress
- Fibre migration



All FLine® components are subjected to the most stringent of pre-delivery inspections. These include the following:

- The attenuation measurement of each individual ready-made component. The defined limits for attenuation measurement go far beyond the requirements of the international standards
- Optional OTDR measurement, for example for ready-made components
- The monitoring of the individual process flows for plug manufacture via interferometer



Application: 10 GbE; attenuation budget OM2 = 1.8 dB, OM3 = 2.6 dB

	Number of plug connectors						Insertion attenuation of plug connector in dB
	4	6	8	10	12	14	
Link length in meters							
FLine® 110	110	/	/	/	/	/	< 0.4
FLine® 300	300	300	300	240	80	/	< 0.2
FLine® 550	550	550	400	240	80	/	< 0.2

All data refer to the first optical window (850 nm)

Application: 1 GbE; attenuation budget 3.56 dB

	Number of plug connectors							Insertion attenuation of plug connector in dB
	4	6	8	10	12	14	16	
Link length in meters								
FLine® 110	750	460	140	/	/	/	/	< 0.4
FLine® 300	900	900	780	620	460	300	140	< 0.2
FLine® 550	550	550	550	550	460	300	140	< 0.2

All data refer to the first optical window (850 nm)