



Annex A:

Requirements to be met by passive IT IS components

Authors: **BMW Group**
Datacenter Technology
 Bremer Str. 6
 80788 Munich, Germany
 Telephone: +49-89-382-0

GHMT AG
 In der Kolling 13
 66450 Bexbach, Germany

Status: April 2016

Version: 4.0

© Copyright BMW Group and GHMT AG 1999 – 2016.
 All rights reserved. Please observe the note on industrial property rights pursuant to DIN ISO 16016.

This document is for internal use only or, as the case may be, for projects directly related to the BMW Group. It is prohibited to pass on or copy this documentation and to exploit and disclose the contents thereof to any to any third parties.

Any infringement of this condition is subject to the payment of damages. All rights reserved, in particular as far as the issuing of patents or contracts on the protection of utility models is concerned.

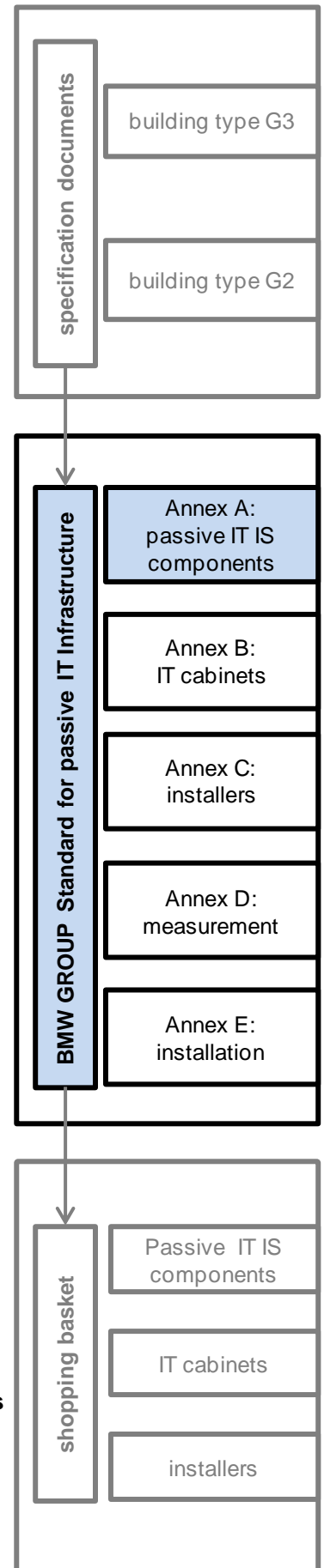




Table of Revisions

Version	Date	Modified chapters	Comments
1.0	June 1, 2006		Creation of document
1.1	May 31, 2008	3.1.2	Updated specification of multi-mode optical fibres
		4.1	Addition of new chapter
1.2	February 6, 2012		Modification of department designation at client side and of annex letters
		All	Update / addition
		5, 8	Addition of new chapter
2.0	April 1, 2012	7	Addition of "Class / maximum channel length" to tables 7-1 and 7-2.
4.0	April 30, 2016	All	Comprehensive update and revision of the standard and its annexes

Table of contents

1 Preliminary Remarks	4
2 Passive IT IS components: Fibre optic single-mode (SM)	5
2.1 Fibre optic SM cables	5
2.1.1 Fibre optic SM outdoor cables	5
2.1.2 Fibre optic SM universal cables	6
2.1.3 Fibre optic SM indoor cables	7
2.2 Fibre optic SM technology (E9/125/250)	8
2.3 Fibre optic SM connectors	9
2.3.1 Fibre optic SM connector LSH/APC → E2000™ APC	9
2.3.2 Alternative fibre optic SM connector LC/APC	10
2.4 Pre-assembled fibre optic SM components	11
2.4.1 Fibre optic SM work area and patch cord (fibre optic SM patch cable)	11
2.4.2 Single-mode fibre optic trunk cables	12
2.4.3 Fibre optic SM pigtail	13
2.5 Fibre optic SM splice box	14
2.6 Fibre optic distribution box	15
3 Passive IT IS components: Fibre optic multi-mode (MM)	16
3.1 Fibre optic MM cables	16
3.1.1 Fibre optic MM universal cables	16
3.1.2 Fibre optic MM indoor cables	17
3.2 Fibre optic MM technology (G50/125/250)	18
3.3 Fibre optic MM connector (LC/PC)	19
3.4 Pre-assembled fibre optic MM components	20
3.4.1 Fibre optic MM work area and patch cord (fibre optic MM patch cable)	20
3.4.2 Fibre optic MM trunk cables	21
3.5 Fibre optic distribution box	22
4 Passive IT IS components: Copper	23
4.1 Copper balanced cable Cat. 7	23
4.2 Copper module RJ45 Cat. 6 _A	24
4.3 Pre-assembled copper components	25
4.3.1 Copper work area cables and patch cords (patch cables) RJ45 Cat. 6 _A	25
4.3.2 Copper trunk cable RJ45	26
4.3.2.1 Copper solid-conductor trunk RJ45 (jack/jack)	26
4.3.2.2 Copper patch trunk RJ45 (connector/connector)	27
5 Passive IT IS Components: Special environments	28
5.1 Workshops and branch establishments	28
5.1.1 Additional requirements data cables:	28
5.1.2 Additional requirements connectivity:	28
5.1.3 Additional requirements work area and patch cords:	28
5.1.4 Suspended distribution systems (flexible design)	29
5.1.5 Suspended distribution systems (solid design)	30
5.2 Production facilities	31
5.2.1 Additional requirements data cables:	31
5.2.2 Additional requirements connectivity:	31
5.2.3 Additional requirements work area and patch cords:	31



1 Preliminary Remarks

For the passive IT infrastructure to meet the requisite stringent quality standard, only cabling components and systems may be installed that are approved by the **BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik)** at the time of planning or implementation.

The **currently approved passive IT IS components** are checked at regular intervals for compliance with the specifications defined within the framework of the GHMT PREMIUM Verification Program; please refer to the B2B portal of BMW Group or the BMW Group IT intranet for a list or request said information from these BMW units.

To this end, specific application areas (please refer to Table 1) were defined in combination with clear-cut requirements to be met by the passive IT IS components. These requirements include normative and additional specifications laid down by the BMW Group.

Application areas	Passive IT infrastructure		
	Campus backbone cabling	Building backbone cabling	Horizontal cabling
Office environment	Chapter 2	Chapter 2	Chapters 4.1, 4.2 and 4.3.1
Data centre	Chapter 2	Chapter 2	Chapters 3 and 4
Workshop and branch establishments premises	Chapter 2	Chapter 2	Chapter 5.1
Production facilities	Chapter 2	Chapter 2	Chapter 5.2

Table 1: Application areas for the various passive IT IS components

As a rule, the use of materials that contain silicone or substances harmful to paint structures is not allowed in production environments. The manufacturers of passive IT IS components have to present a written confirmation on said substances.

Important information:

- **The inter-building installation of balanced copper cabling or multi-mode fibre optic cabling is not allowed.**
- **Only single-mode optical fibres may be used for campus and building backbone cabling.**
- **In addition, care must be taken to ensure that only fibre optic installation cables with at least 12 or, as the case may be, 24 fibres are used.**

If an IT IS component is prohibited for use during project implementation, approved back-up products (as described above) are to be used in consultation with the BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik).

If special solutions that deviate from the specifications laid down in the BMW Group cabling standard need to be installed, this must be coordinated in advance with the BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik).



2 Passive IT IS components: Fibre optic single-mode (SM)

2.1 Fibre optic SM cables

2.1.1 Fibre optic SM outdoor cables

Outside cables are used for campus areas, MAN or WAN. Outside cables have to meet stringent mechanical requirements in terms of ruggedness and resistance in order to ensure resistance to environmental factors, such as frost and humidity. The PE (polyethylene) outer sheath that is used as a standard is zero-halogen and UV resistant.

Specification:	A-DQ(ZN)B2Y n x m
Cladding material:	HDPE
Optical requirements:	In accordance with chapter 2.2
Cable designation:	Manufacturer and type, wipe-resistant, scratch-proof, resistant to oils, benzenes, alcoholic solvents, printed
General requirements:	100% UV resistant non-metallic rodent protection suited for direct burial for installation in conduits, ducts, shafts and on cable trays
Temperature range:	Operation: -40 to +70 °C Installation: -15 to +50 °C Transport and storage: -30 to +70 °C
Fire performance:	Zero halogen in accordance with IEC 60754-2
Mechanical requirements:	
General:	Longitudinally watertight pursuant to IEC 60794-1-21-F5 Impact-resistant in accordance with IEC 60794-1-21 E4
Central tube design (for 12 to 24 fibres):	(at least GHMT PVP test plan - fibre optic LEVEL 2) Tensile strength according to IEC 60794-1-21 E1: ≥ 2,500 N (with a fibre elongation ≤ 0.6%) Crush resistance: ≥ 3,000 N/10cm (short term)
Stranded tube design (for ≥24 fibres):	(GHMT PVP test plan - fibre optic LEVEL 1) Tensile strength according to IEC 60794-1-21 E1: ≥ 6,000 N (with a fibre elongation ≤ 0.33%) Crush resistance: ≥ 8,000 N/10cm (short term)
Standard designation:	A: Outdoor cable D: Loose tube Q: Dry-filled cable core (swelling tape), longitudinally watertight (ZN): Non-metallic strain relief elements b: Glass rovings as strain relief elements and rodent protection 2Y: PE jacket, zero-halogen



2.1.2 Fibre optic SM universal cables

Unlike outdoor fibre optic cables, universal fibre-optic cables consist of zero-halogen flame-retardant cladding material (FRNC/LSZH). For this reason there is no need to use a joint box to connect outdoor to indoor cabling at the building entrance facility when universal fibre optic cables are used.

Unlike outdoor fibre-optic cables, universal fibre optic cables must be routed outside in protective HDPE conduits, which have to be sealed against the ingress of moisture on both sides. This is necessary since the cladding material for universal cables offers less protection against transverse water diffusion than the overall PE sheath of outdoor cabling.

Specification:	U-DQ(ZN)BH n x m
Cladding material:	LSZH
Optical requirements:	In accordance with chapter 2.2
Cable designation:	Manufacturer and type, wipe-resistant, scratch-proof, resistant to oils, benzenes, alcoholic solvents, printed
General requirements:	Non-metallic rodent protection
Temperature range:	Operation: -20 to +60 °C Installation: -10 to +50 °C Transport and storage: -25 to +70 °C
Fire performance:	Low combustion gas emission in accordance with IEC 61034-2 Zero halogen in accordance with IEC 60754-2
Mechanical requirements:	
General:	Longitudinally watertight pursuant to IEC 60794-1-21-F5 Impact-resistant in accordance with IEC 60794-1-21 E4
Central tube design (for 12 to 24 fibres):	(min. GHMT PVP test plan - fibre-optic LEVEL 2) Tensile strength according to IEC 60794-1-21 E1: ≥ 2,500 N (with a fibre elongation ≤ 0.6%) Crush resistance: ≥ 3,000 N/10cm (short term)
Stranded tube design (for ≥24 fibres):	(GHMT PVP test plan - fibre-optic LEVEL 1) Tensile strength according to IEC 60794-1-21 E1: ≥ 4,000 N (with a fibre elongation ≤ 0.33%) Crush resistance: ≥ 5,000 N/10cm (short term)
Standard designation:	U: Universal cable D: Loose tube Q: Dry-filled cable core (swelling tape), longitudinally watertight (ZN): Non-metallic strain relief elements B: Glass rovings as strain relief elements and rodent protection H: Cladding made of flame-retardant zero-halogen and low smoke emission materials



2.2 Fibre optic SM technology (E9/125/250)

Specification: OS2, in conformity with ITU-T Rec. G.652.D and IEC 60793-2-50 type B1.3 (single-mode)

Insertion loss: ≤ 0.36 dB/km (1,310 nm)
 ≤ 0.25 dB/km (1,550 nm)

Chromatic dispersion: ≤ 3.5 ps/(nm x km) (1,310 nm)
 ≤ 18.0 ps/(nm x km) (1,550 nm)

Polarisation mode dispersion coefficient:
 ≤ 0.2 ps/ $\sqrt{\text{km}}$ (1,310, and 1,550 nm)

Geometry/mechanical properties:

Cladding diameter: 125 ± 1.0 μm
Coating diameter: 235 - 265 μm
Test load: ≥ 100 kpsi

Further requirements: It must be possible to break the fibre to create a clean and smooth orthogonal surface in the installation temperature range in accordance with the assembly instructions provided by the manufacturer. In addition, the primary and secondary coating must not leave a residue when removed.

2.3 Fibre optic SM connectors

As a matter of principle, LSH/APC connectors are used for all single-mode fibre optic connections.

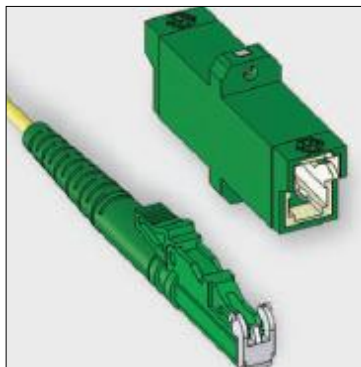
Comment:

The use of the alternative fibre optic connector (LC/APC) is only permitted on the basis of a written approval from the BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik).

2.3.1 Fibre optic SM connector LSH/APC → E2000™ APC

Fibre optic connector for use in stationary IT infrastructure (trunks / pigtails / couplings) as well as for work area cords and patch cords must comply with the following specifications.

Connector:	LSH →E2000™
in conformity with:	IEC 61754-15
Type of polishing:	APC 8°
Ferrule:	Ø 2.5 mm made of zirconia all-ceramic
Mating cycles:	≥ 1,000 at consistent IL (±0,05dB)
Strain relief and cable clamping (crimp):	≥ 100 N
Connector housing:	made of composite plastic material, colour: green, alternatively with colour code metal protection shutter (laser protection)
Insertion loss:	≤ 0.25 dB at 1310 nm and 1550 nm pursuant to IEC 61300-3-4 method B against reference (GHMT PVP test plan fibre-optic LEVEL 2 applicable to 100% of connectors)
Return loss:	≥ 60 dB at 1310 nm and 1550 nm according to IEC 61300-3-6 method 1 against reference (GHMT PVP test plan fibre-optic LEVEL 2 applicable to 100% of connectors)
Operating temperature:	-10°C to +60°C
Coupling:	Simplex coupling with metal protection shutters Housing made of plastic compound Colour: green Guide sleeve made of zirconia all-ceramic





2.3.2 Alternative fibre optic SM connector LC/APC

Fibre optic connectors for use in stationary IT infrastructure (trunks / pigtails / couplings) as well as for work area cords and patch cords must comply with the following specifications.

Comment:

The use of the alternative fibre optic connector (LC/APC) is only permitted on the basis of a written approval from the BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik).

Connector:	LC
in conformity with:	IEC 61754-20
Type of polishing:	APC 8°
Ferrule:	Ø 1.25 mm made of zirconia all-ceramic
Mating cycles:	≥ 1,000 at consistent IL (±0,05dB)
Strain relief and cable clamping (crimp):	≥ 100 N
Connector housing:	made of plastic compound, colour: green, alternatively with colour code
Insertion loss:	≤ 0.25 dB at 1310 nm and 1550 nm pursuant to IEC 61300-3-4 method B against reference (GHMT PVP test plan fibre-optic LEVEL 2 applicable to 100% of connectors)
Return loss:	≥ 60 dB at 1310 nm and 1550 nm according to IEC 61300-3-6 method 1 against reference (GHMT PVP test plan fibre-optic LEVEL 2 applicable to 100% of connectors)
Operating temperature:	-10°C to +60°C
Coupling:	Duplex coupling Housing made of plastic compound Colour: green Guide sleeve made of zirconia all-ceramic

2.4 Pre-assembled fibre optic SM components

2.4.1 Fibre optic SM work area and patch cord (fibre optic SM patch cable)

Cable type:	pursuant to chapter 2.1.3 (fibre optic indoor cable)
Fibre specification:	according to chapter 2.2 (OS2)
Connector type:	in accordance with chapter 2.3 (SM LSH/APC or SM LC/APC)
Sheath colour:	for SM: Yellow
Coding:	"uncrossed" per channel
Cable cross-section:	2.7 - 3.0 mm x 5.0 – 6.0 mm or $\geq \varnothing$ 7.0 mm
General:	designs with 2 central tubes
Measurement documentation:	Measuring report on insertion and return loss per fibre for SM (1310 nm and 1550 nm) as well as documentation of the surface by means of an interferometer (the measurement documentation must be provided on a CD in electronic form per fibre optic patch cable)
Delivery length:	1.0 m to 10.0 m



2.4.2 Single-mode fibre optic trunk cables

Cable type:	in accordance with chapter 2.1.2 (universal fibre optic cables)
Fibre specification:	in accordance with chapter 2.2 (SM OS2)
Connector type:	in accordance with chapter 2.3 (SM LSH/APC or SM LC/APC)
Coding:	"uncrossed" per channel
General:	stepped for accommodation in a fibre optic distribution box and assembled on both sides with trunk splitters
Measurement documentation:	Measuring report on insertion and return loss per fibre for SM (1310 nm and 1550 nm) as well as documentation of the surface by means of an interferometer (the measurement documentation must be provided on a CD in electronic form per fibre-optic patch cable)

Requirements to be met by trunk splitters:

in accordance with protection rating IP67
torsion resistance and reversed bending strength, with universal fibre optic cable in combination with interfaces for tool-less mounting in the corresponding fibre optic distribution boxes without requiring any further parts
Trunk splitters and assembled fan-out legs are protected by installation tubes

Requirements to be met by installation tubes

min. IP50 exclusively for indoor installation
or IP67 for indoor or outdoor installation
Accommodating fan-out legs and trunk splitters
torsion, bending and crush-resistant
Tensile strength according to IEC 60794-1-21 E1: min. 600 N

Delivery form:

On cardboard or wooden reels
Product ID label on cable at both sides behind the splitters
incl. installation instructions and measurement records on a per-fibre basis





2.4.3 Fibre optic SM pigtail

Fibre specification:	in accordance with chapter 2.2 (SM OS2)
Connector type:	in accordance with chapter 2.3 (SM LSH/APC or SM LC/APC)
Secondary coating:	∅ 0.9 mm ± 0.1 mm
Primary coating colour:	according to colour code in accordance with IEC 60304

Colour	Number of optical fibre
Red	01 / 13
Green	02 / 14
Blue	03 / 15
Yellow	04 / 16
White	05 / 17
Grey	06 / 18
Brown	07 / 19
Purple	08 / 20
Turquoise	09 / 21
Black	10 / 22
Orange	11 / 23
Pink	12 / 24

Table 2: Colour code in accordance with IEC 60304 or DIN/VDE 0888 part 3

General:	Gel-free design Inserted in housing ready for splicing Fixed in position with fibre clips incl. splice/termination diagram
Measurement documentation:	Measuring report on insertion and return loss for SM (1310 nm and 1550 nm) as well as documentation of the surface by means of an interferometer (the measurement documentation must be provided on a CD in electronic form per fibre optic pigtails)
Delivery length:	2.0 m

2.5 Fibre optic SM splice box

Specification:

19" splice box, pull-out, 1U/2U, assembled completely

Delivery including couplings, splice trays, splice protection sleeves, splice holder, fibre clips for professional fibre management, pigtails, cable glands, nuts, reducer bushings and strain relief elements (tabs) required depending on size.

Requirements to be met by the housing:

Full metal design

Material: sheet steel, all edges deburred properly

Dimensions: W/H/D: for example, 19"/ 1U or 2U / min. 250 mm

Housing front, equipped with up to 24 simplex couplings, in accordance with chapter 2.3 per 1U

Housing front (**split housing front**) numerically coded per coupling (1-12 / 1-24 / 1-48) by means of screen printing

All couplings must be firmly mounted on the housing by means of screws, clip variants are not permitted.

Couplings that are not connected must be protected against environmental impact, such as construction dust.

Tamper-proof basic housing, made of metal, fully assembled

Flush-mounted assembly

Housing can be pulled out completely toward the front and can be opened without any tools (without causing the pull-out unit to tip)

Telescopic drawer

Blank covers fitted on unused cable inlets and front panel bore holes

Cable entry at an inclination of 45°

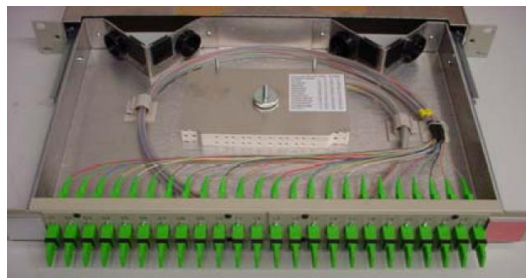
Strain relief for at least 2 fibre optic cables, by means of universal cable gland and additional cable clamping made of metal

1, 2 or 4 x 12 fibre optic pigtails, inserted in housing, ready for splicing, according to chapter 2.4.3

Temperature range:

Operation: -10 to +60 °C

Transport and storage: -15 to +70 °C



2.6 Fibre optic distribution box

Specification:

19" distribution box, pull-out, 1U/2U, assembled completely

Delivery including couplings, fibre clips for professional fibre management, pigtails, cable glands, nuts, reducer bushings and strain relief elements (tabs) required depending on size.

Requirements to be met by the housing:

Full metal design

Material: sheet steel, all edges deburred properly

Dimensions: W/H/D: for example, 19"/ 1U or 2U / min. 250 mm

Housing front, equipped with up to 24 simplex couplings, in accordance with chapter 2.3 per 1U

Housing front (**split housing front**) numerically coded per coupling (1-12 / 1-24 / 1-48) by means of screen printing

All couplings must be firmly mounted on the housing by means of screws, clip variants are not permitted.

Couplings that are not connected must be protected against environmental impact, such as construction dust.

Tamper-proof basic housing, made of metal, fully assembled

Flush-mounted assembly

Housing can be pulled out completely toward the front and can be opened without any tools (without causing the pull-out unit to tip)

Telescopic drawer

Blank covers fitted on unused cable inlets and front panel bore holes

The following additional requirements will apply if a fibre optic distribution box is used for the termination of pre-assembled trunk splitters:

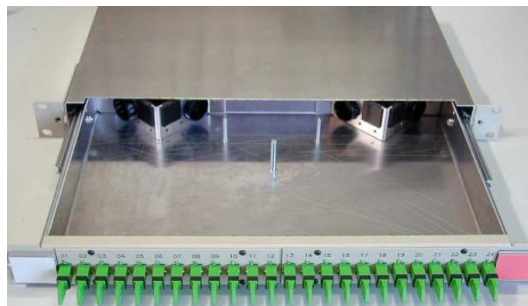
Strain relief and cable clamping suited for the clamping of at least two pre-terminated trunk splitters (simple insertion of trunk splitters, without any screws, cable ties, etc.)

Routing of outgoing cables either to the left- or to the right-hand side at an angle of below 45°.

Temperature range:

Operation: -10 to +60 °C

Transport and storage: -15 to +70 °C





3 Passive IT IS components: Fibre optic multi-mode (MM)

Important information:

- To be used exclusively in computer centres.
- The inter-building installation of multi-mode fibre optic cabling is not allowed.

3.1 Fibre optic MM cables

3.1.1 Fibre optic MM universal cables

Specification:	U-DQ(ZN)BH n x m
Cladding material:	LSZH
Optical requirements:	In accordance with chapter 3.2
Cable designation:	Manufacturer and type, wipe-resistant, scratch-proof, resistant to oils, benzenes, alcoholic solvents, printed
General requirements:	Non-metallic rodent protection
Temperature range:	Operation: -20 to +60 °C Installation: -10 to +50 °C Transport and storage: -25 to +70 °C
Fire performance:	Low combustion gas emission in accordance with IEC 61034-2 Zero halogen in accordance with IEC 60754-2
Mechanical requirements:	
General:	Longitudinally watertight pursuant to IEC 60794-1-21-F5 Impact-resistant in accordance with IEC 60794-1-21 E4 Bending radius during installation: ≤ 20 x external diameter Bending radius after installation: ≤ 15 x external diameter
Central tube design (for 12 to 24 fibres):	(min. GHMT PVP test plan - fibre optic LEVEL 2) Tensile strength according to IEC 60794-1-21 E1: ≥ 2,500 N (with a fibre elongation ≤ 0.6%) Crush resistance: ≥ 3,000 N/10cm (short term)
Stranded tube design (for ≥24 fibres):	(GHMT PVP test plan - fibre optic LEVEL 1) Tensile strength according to IEC 60794-1-21 E1: ≥ 4,000 N (with a fibre elongation ≤ 0.33%) Crush resistance: ≥ 5,000 N/10cm (short term)
Standard designation:	U: Universal cable D: Loose tube Q: Dry-filled cable core (swelling tape), longitudinally watertight (ZN): Non-metallic strain relief elements B: Glass rovings as strain relief elements and rodent protection H: Cladding made of flame-retardant zero-halogen and low smoke emission materials



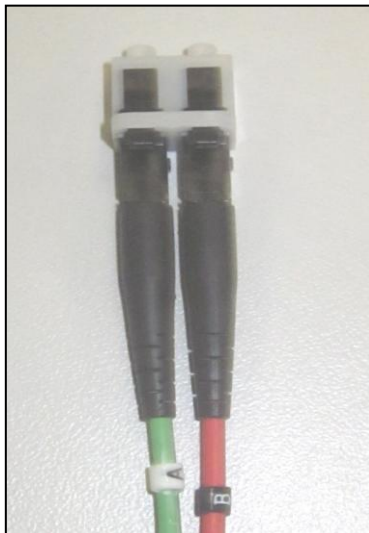
3.2 Fibre optic MM technology (G50/125/250)

Specification:	OM4, in conformity with IEC 60793-2-10 type A1a.3	
Insertion loss:	≤ 2.5 dB/km (850 nm) ≤ 0.7 dB/km (1300 nm)	
Laser bandwidth EMB:	$\geq 4,700$ MHz*km (850 nm)	
Modal bandwidth under OFL conditions:	$\geq 3,500$ MHz*km (850 nm) ≥ 500 MHz*km (1300 nm)	
Link length:	for 10 Gigabit Ethernet:	≥ 550 m
	for 1 Gigabit Ethernet:	$\geq 1,100$ m
	for 8 Gigabit FC:	≥ 200 m
	for 16 Gigabit FC:	≥ 125 m
Geometry/mechanical requirements:		
	Core diameter:	50 ± 2.5 μ m
	Cladding diameter:	125 ± 2.0 μ m
	Coating diameter:	250 ± 15.0 μ m
	Test load:	≥ 100 kpsi
Further requirements:	It must be possible to break the fibre to create a clean and smooth orthogonal surface in the installation temperature range in accordance with the assembly instructions provided by the manufacturer. In addition, the primary and secondary coating must not leave a residue when removed.	

3.3 Fibre optic MM connector (LC/PC)

Fibre optic connector for use in stationary IT infrastructure (trunks / pigtails / couplings) as well as for work area cords and patch cords must comply with the following specifications.

Connector:	LC
in conformity with:	IEC 61754-20
Type of polishing:	0° PC
Ferrule:	Ø 1.25 mm made of zirconia all-ceramic
Mating cycles:	≥ 1,000 at consistent IL (±0,05dB)
Strain relief and cable clamping (crimp):	≥ 100 N
Connector housing:	made of plastic compound Colour: black, alternatively with colour coding
Insertion loss:	≤ 0.25 dB at 850 nm and 1300 nm pursuant to IEC 61300-3-4 method B against reference (GHMT PVP test plan fibre-optic LEVEL 2 applicable to 100% of connectors)
Operating temperature:	-10°C to +60°C
Coupling:	Duplex coupling Housing made of plastic compound Colour: Heather violet (OM4), alternatively with adequate colour coding Guide sleeve made of zirconia all-ceramic



Standard clip mechanism



or: push-pull mechanism

3.4 Pre-assembled fibre optic MM components

3.4.1 Fibre optic MM work area and patch cord (fibre optic MM patch cable)

Cable type:	pursuant to chapter 3.1.2 (fibre optic indoor cable)
Fibre specification:	in accordance with chapter 3.2 (MM OM4)
Connector type:	in accordance with chapter 3.3 (MM LC/PC)
Cladding colour:	for MM: Heather violet (OM4)
Coding:	"uncrossed" per channel
Cable cross-section:	2.7 - 3.0 mm x 5.0 – 6.0 mm or $\geq \varnothing$ 7.0 mm
General:	designs with 2 central tubes
Measurement documentation:	Measuring report on insertion loss per fibre for MM (850 nm and 1300 nm) as well as documentation of the surface by means of an interferometer (the measurement documentation must be provided on a CD in electronic form per fibre optic patch cable)
Delivery length:	1.0 m to 10.0 m



3.4.2 Fibre optic MM trunk cables

Cable type: in accordance with chapter 3.1.1 (universal fibre optic cables)

Fibre specification: in accordance with chapter 3.2 (MM OM4)

Connector type (on both sides): in accordance with chapter 3.3 (MM LC/PC)

Coding: "uncrossed" per channel

General: stepped for accommodation in a fibre optic distribution box and assembled on both sides with trunk splitters

Measurement documentation: Measuring report on insertion and return loss per fibre for MM (850 nm and 1300 nm) as well as documentation of the surface by means of an interferometer (the measurement documentation must be provided on a CD in electronic form per fibre optic trunk cable)

Requirements to be met by trunk splitters: in accordance with protection rating IP67
torsion resistance and reversed bending strength, with universal fibre optic cable in combination with interfaces for tool-less mounting in the corresponding fibre optic distribution boxes without requiring any further parts
Trunk splitters and assembled fan-out legs are protected by installation tubes

Requirements to be met by installation tubes

min. IP50 exclusively for indoor installation
or IP67 for indoor or outdoor installation

Accommodating fan-out legs and trunk splitters
torsion, bending and crush-resistant

Tensile strength pursuant to IEC 60794-1-21 E1:
min. 600 N

Delivery form: On cardboard or wooden reels
Product ID label on cable at both sides behind the splitters
incl. installation instructions and measurement records on a per-fibre basis





3.5 Fibre optic distribution box

Specification:

19" distribution box, pull-out, 1U/2U, assembled completely

Delivery including couplings, fibre clips for professional fibre management, pigtails, cable glands, nuts, reducer bushings and strain relief elements (tabs) required depending on size.

Requirements to be met by the housing:

Full metal design

Material: sheet steel, all edges deburred properly

Dimensions: W/H/D: for example, 19"/ 1U or 2U / min. 250 mm

Housing front equipped with up to 24 duplex couplings, for example, 12 LC-duplex multimode couplings, pursuant to chapter 3.3 per 1U

Housing front (**split housing front**) numerically coded per coupling (1-12 / 1-24 / 1-48) by means of screen printing

All couplings must be firmly mounted on the housing by means of screws, clip variants are not permitted.

Couplings that are not connected must be protected against environmental impact, such as construction dust.

Tamper-proof basic housing, made of metal, fully assembled

Flush-mounted assembly

Housing can be pulled out completely toward the front and can be opened without any tools (without causing the pull-out unit to tip)

Telescopic drawer

Blank covers fitted on unused cable inlets and front panel bore holes

The following additional requirements will apply if a fibre optic distribution box is used for the termination of pre-assembled trunk splitters:

Strain relief and cable clamping suited for the clamping of at least two pre-terminated trunk splitters (simple insertion of trunk splitters, without any screws, cable ties, etc.)

Routing of outgoing cables either to the left- or to the right-hand side at an angle of below 45°.

Temperature range:

Operation: -10 to +60 °C

Transport and storage: -15 to +70 °C



4 Passive IT IS components: Copper

4.1 Copper balanced cable Cat. 7

Specification:	Cat. 7 S/FTP, tested for up to 600 MHz
Dimension (n x n x AWG):	4x2xAWG23/1 (simplex)
Conductor:	Bare copper wire
Overall shield:	Tinned copper braid
Cable designation:	Manufacturer and type, wipe-resistant, scratch-proof, resistant to oils, benzenes, alcoholic solvents, printed

Electrical and electromagnetic requirements:

In accordance with ISO/IEC 11801 Ed. 2.2:2011
according to IEC 61156-5 Ed.2.1: 2012
with CA: type 1b (or better) and zT: grade 2 (or better)
Suitable for PoEP (Power over Ethernet Plus) in accordance with IEEE 802.3at.
Suitable for at least 10 GBase-T pursuant to IEEE 802.3an

Mechanical requirements:

Tensile strength in accordance with IEC 60794-1-21 E1:
≥ 110 N
Crush resistance in accordance with IEC 60794-1-21 E3:
≥ 1,000 N/10cm
Bending radius during installation: ≤ 8x external diameter
Bending radius after installation: ≤ 4x external diameter
Operating temperature: -10°C to 60°C
Installation temperature: 0°C to 50°C

Fire performance:

FRNC/LSZH (Flame Retardant Non Corrosive / Low Smoke Zero Halogen)
Flame-retardant in accordance with IEC 60332-1-2
Low combustion gas emission pursuant to IEC 61034-2
Zero halogen pursuant to IEC 60754-2

Please note:

If balanced data cabling is exposed to direct sunlight (for example if cable trays are fitted on ceilings in the vicinity of skylights), long-term compatibility tests as regards UV radiation may have to be performed in the run-up to the installation.



4.2 Copper module RJ45 Cat. 6_A

Specification: **Cat. 6_A module, tested for up to 500 MHz
(alternatively, Keystone)**

Design: RJ45, fully shielded

Type of assignment: In accordance with EIA/TIA-568-A

Electrical and electromagnetic requirements:

In accordance with ISO/IEC 11801 Ed.2.2: 2011

In accordance with IEC 60603-7-51:2010

Suitable for PoEP in accordance with IEEE 802.3at

Suitable for at least 10 GBase-T pursuant to IEEE 802.3an

Mechanical requirements:

For connection to solid and flexible

AWG26 to AWG22 copper conductors

Strain relief separated from shield termination

360° shield termination

≥ 750 mating cycles in accordance with IEC 60603-7-51:2010

Operating temperature: -10°C to +60°C



4.3 Pre-assembled copper components

4.3.1 Copper work area cables and patch cords (patch cables) RJ45 Cat. 6_A

Specification:	Patch cable cat. 6_A S/FTP, tested for up to 500 MHz
Dimension (n x n x mm):	4x2xAWG26/7
Conductor:	Bare copper wire
Design:	RJ45 on both sides, fully shielded, with dust cover
Assignment:	1:1
Delivery length:	2.0 m to 5.0 m
Colour:	Various colours or colour coding, depending on service application

Electrical and electromagnetic requirements:

In accordance with ISO/IEC 11801 Ed. 2.2:2011
In accordance with IEC 61935-2 Ed.3:2010
Suitable for PoEP in accordance with IEEE 802.3at
Suitable for at least 10 GBase-T pursuant to IEEE 802.3an

Mechanical requirements:

Tensile load bearing capacity: ≥ 50 N
360° shield termination
 ≥ 750 mating cycles in accordance with IEC 60603-7-5:2010
Operating temperature: -10°C to $+60^{\circ}\text{C}$
Protection against kinking
Snap-in nose protection on both sides
Safe locking with RJ45 connection component

Fire performance:

FRNC/LSZH (Flame Retardant Non Corrosive / Low Smoke Zero Halogen)
Flame-retardant in accordance with IEC 60332-1-2
Low combustion gas emission pursuant to IEC 61034-2
Zero halogen pursuant to IEC 60754-2

Please note:

The connector assemblies must provide a clear strain relief for flexible work area and patch cables. The connection element must be equipped with a reliable locking mechanism so as to exclude the unintentional disengaging of plug and jack during later operation.

4.3.2 Copper trunk cable RJ45

4.3.2.1 Copper solid-conductor trunk RJ45 (jack/jack)

The use in the **data centre environment** results in particularly stringent requirements to be met by passive IT IS components due to the flexible cabling solutions required for the purposes of networking servers, routers and/or storage systems in data centres.

Trunk specification:

RJ45 solid-conductor trunk Class E_A

In accordance with ISO/IEC 11801 Ed.2:2: 2011 (class E_A)

100% factory-tested, supplied with measuring report

Total length: max. 90 m

Single cable:

Specified according to chapter 4.1

RJ45 jack module:

According to chapter 4.2

Trunk design:

Depending on requirements, consists of

- 1 x solid-conductor single cable or duplex cable
- 6 x solid-conductor single cable (single cable: twisted and sheathed)

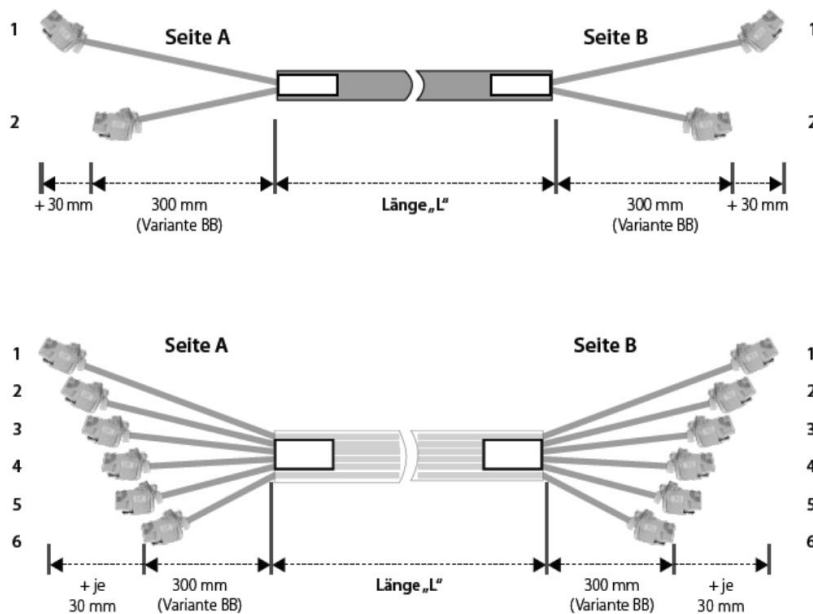
Assembly **sides A+B**: RJ45 jack module each

Labelling:

For single cables:

< "L" + counter 001 to xxx + single cable number >

For trunk: < "L" + counter 001 to xxx >



4.3.2.2 Copper patch trunk RJ45 (connector/connector)

Trunk specification:

RJ45 patch trunk Class E_A

L ≤ 20 m: in accordance with ISO/IEC 61935-2 Ed. 3.0: 2010 (Cat. 6_A)

20m < „L“ ≤ 25 m: in accordance with ISO/IEC 11801 Ed.2.2: 2011 (Class E_A)

100% factory-tested, supplied with measuring report

Total length: max. 27.5 m (with "L" = 25 m)

Single cable:

Specified according to chapter 4.3.1

Trunk design:

Depending on requirements, consists of up to 8 x flexible single cables

Bundled single cable (for example woven hose)

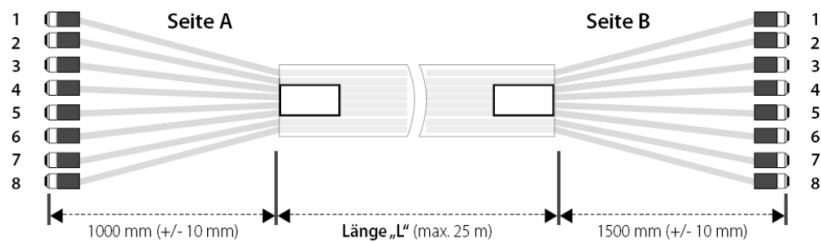
Assembly **sides A+B:** RJ45 connector each

Labelling:

For single cables:

< "L" + counter 001 to xxx + single cable number >

For trunk: < "L" + counter 001 to xxx>





5 Passive IT IS Components: Special environments

Passive IT IS components have to meet special requirements in industrial environments (production facilities) due to the prevailing special ambient conditions.

This section differentiates between "**workshops and branch establishments**" and "**production facilities**".

5.1 Workshops and branch establishments

Workshop and branch establishments premises include:

- Workshop premises within plants
- Branch establishments (here: workshops)
- Test rigs

The passive IT IS components (copper) for workshops and branch establishments have to meet the following requirements:

5.1.1 Additional requirements data cables:

- Requirements according to chapter 4.1
- Resistance to process resources used within the BMW Group
- Silicone-free and free from substances harmful to paint structures

5.1.2 Additional requirements connectivity:

- Requirements according to chapter 4.2
- RJ45 jack module must be replaceable, without new installation (LEONI MegaLine Connect 100)
- Rugged housing design protected pursuant to IP44

5.1.3 Additional requirements work area and patch cords:

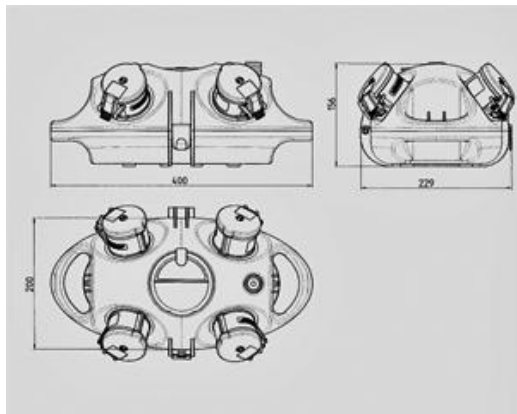
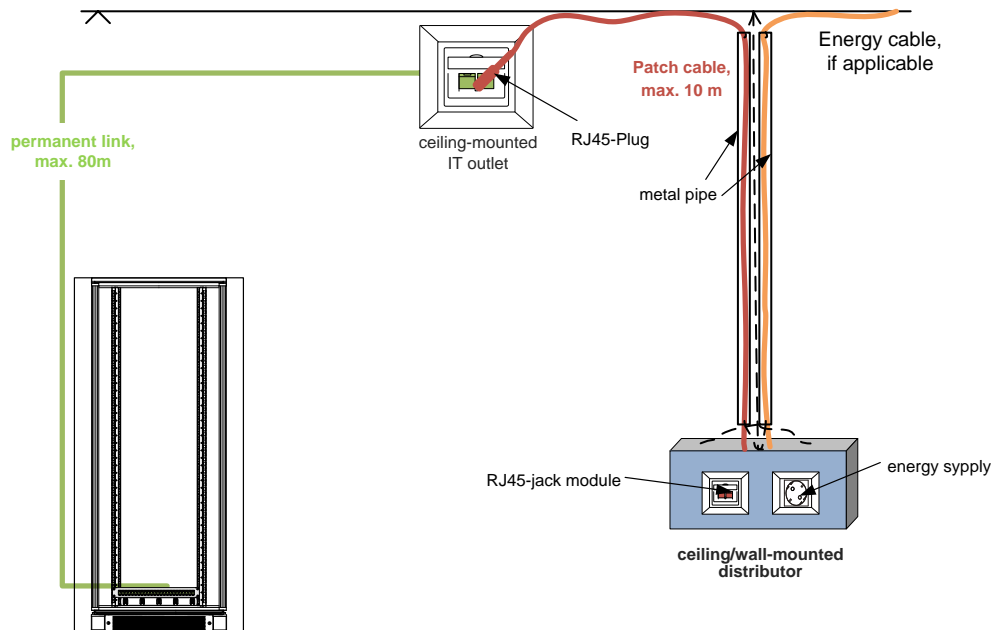
- Requirements according to chapter 4.3.1
- Resistance to process resources used within the BMW Group (depending on application)
- Silicone-free and free from substances harmful to paint structures
- PUR outer sheath
- Protected pursuant to IP44

5.1.4 Suspended distribution systems (flexible design)

In industrial environments (production facilities), passive IT IS components may be installed in suspended distribution systems (flexible design).

Distribution systems of this type typically conform with protection rating IP44 and can also be fitted with outlets (CEE, Schuko safety sockets), pressurized air and light in addition to dual RJ45 outlets.

The passive IT IS components used must comply with the requirements laid down in chapters 5.1.1, 5.1.2 and 5.1.3.

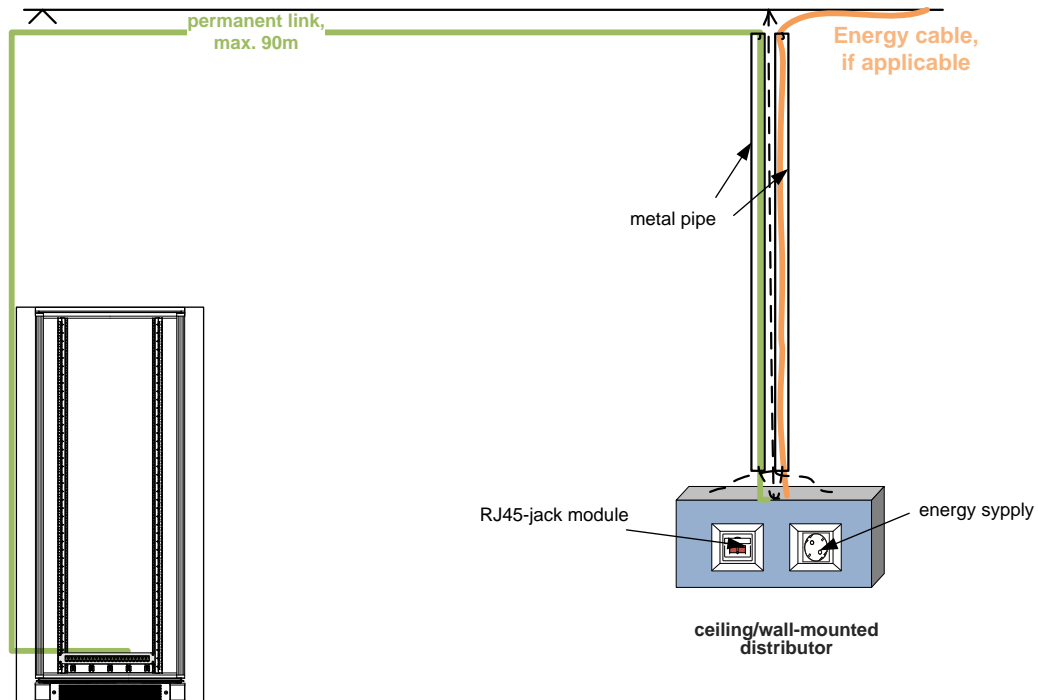


5.1.5 Suspended distribution systems (solid design)

In industrial environments (production facilities), passive IT IS components may be installed in suspended distribution systems (solid design).

Distribution systems of this type typically conform with protection rating IP44 and can also be fitted with outlets (CEE, Schuko safety sockets), pressurized air and light in addition to dual RJ45 outlets.

The passive IT IS components used must comply with the requirements laid down in chapters 5.1.1, 5.1.2 and 5.1.3.





5.2 Production facilities

Production facilities comprise the following environments, for example:

- Warehouses and dispatch environments
- Final assembly
- Workshop areas.
- Press and stamping plants
- Bodyshops

Passive IT IS components (copper) for production facilities must meet the following requirements:

5.2.1 Additional requirements data cables:

- Requirements according to chapter 4.1
- Resistance to process resources used within the BMW Group
- Silicone-free and free from substances harmful to paint structures
- Suited for mobile cable handler (depending on application)¹
- Flexible star quad cable design (7-strand conductor).
- 26AWG

5.2.2 Additional requirements connectivity:

- Requirements according to chapter 4.2
- Rugged housing design protected according to IP65/IP67 (depending on application)
- 4DA technology
- RJ45 connector interface with IDC technology
- Industrial-grade housing (HARTING RJ Industrial Metal Outlet)

5.2.3 Additional requirements work area and patch cords:

- Requirements according to chapter 4.3.1
- Resistance to process resources used within the BMW Group (depending on application)
- Silicone-free and free from substances harmful to paint structures
- PUR outer sheath
- Protected pursuant to IP67

Please note:

The network connection between the heavy industrial environment and the BMW Corporate Network invariably has to be implemented within an IT cabinet protected according to IP67 of the corresponding system.

¹ The insertion loss, which is typically considerably increased with horizontal cabling that is suited for mobile cable handlers in comparison to standard balanced horizontal cabling, results in a reduced length restriction, which must be taken into account.