Test Report based on DIN EN ISO/IEC 17025:2005

GHMT Type Approval
4 Connector Channel, Copper, Class E_A
according ISO/IEC 11801-1 Ed.1.0

Project-no: COMCA0318

Deutsche Akkreditierungsstelle
D-PL-17559-01-00

Document-no: P5160a-18-E

This Test Report with the measurements consists of 38 pages.

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Revision history

Document number	Date	Content/ Changes
P5160a-18-E	28.08.2018	initial version

1 General statements

1.1 Test Laboratory

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E-Mail: info@ghmt.de
Internet: www.ghmt.de

1.2 Test Date

Receipt of goods:		25. July 2018
Test number:		18-CS337
Testing	from:	09. August 2018
	until:	10. August 2018

1.3 Environmental conditions during testing

Ambient temperature	(23 ± 3)°C
Relative humidity	(50 ± 25)%

1.4 Test Conducted by

Mr. Bernd Jung, GHMT AG

1.5 Persons Present at Test

Mr. Stefan Grüner, GHMT AG (present temporarily)

2 Customer

2.1 Address

Commscope INC.
1100 CommScope Place SE

28603 Hickory, North Carolina USA

Phone: +1 828 324 22 00
Fax: +1 800 982 17 08

Internet: www.commscope.com

2.2 Responsible contact person

Commscope INC.

Mr. Wayne Hopkinson

3642 E US Highway 70

28610 Claremont, California, USA

Phone: +1 828 459 51 22

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Internet: www.commscope.com

3 Device under test (DUT)

3.1 Description of the Components

The following sample(s) was/were part of the test:

Data cable: **CommScope Netconnect CS44Z3 C6A System Cable, AWG23, LSZH; F/FTP**

Part-no: CS44Z3

The cable was marked with an imprinted meter counter.

Cable end A: 0050m **Cable end B:** 0136m

Cable length: 86m (determined on imprinted length counter)

Patchcord: **CommScope Netconnect CAT6A S/FTP LSZH RJ45 PATCH CORD**

Part-no: NPC6ASZDB

CP-Cable: **CommScope Netconnect CAT6A Shielded LSZH Consolidation Point Cord**

Part-no: NCC44SZJB

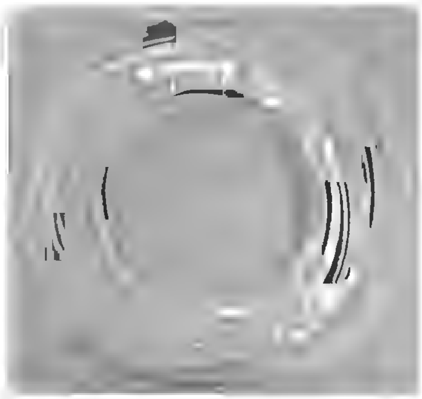
Connector: **CommScope Netconnect CAT6A SLX Modular Jack**

Part-no: 2153365

Condition of the sample(s): The sample(s) had no visible damages

Picture:

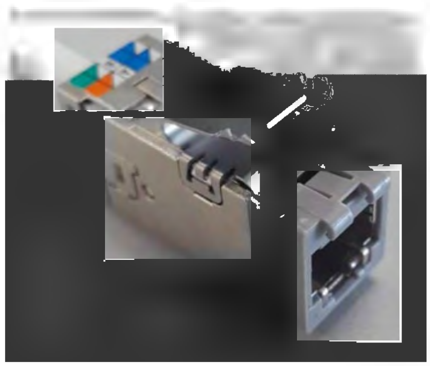
Data cable:



Patchcord:

CP-Cable:

Connector:



3.2 Provision

The DUT was / the specimens were...

☐	... with drawn on site. The selection of the sample was neutral and unaffected by the client.
☐	... obtained by GHMT through resellers. The selection of the sample was neutral and unaffected by the client.
■	... obtained by GHMT through the client.

3.3 Definition of the Device Under Test (DUT)

According to the specifications laid down in the document ISO/IEC 11801-1 Ed. 1.0, a Channel was assembled in order to conduct the test:

End A

Patchcord I: 2m	CommScope Netconnect CAT6A S/FTP LSZH RJ45 PATCH CORD
CP-Cable I: 5m	CommScope Netconnect CAT6A Shielded LSZH Consolidation Point Cord
Connector I:	CommScope Netconnect CAT6A SLX Modular Jack
Data Cable: 86m	CommScope Netconnect C54423 C6A System Cable, AWG23, LSZH; F/FTP
Connector II:	CommScope Netconnect CAT6A SLX Modular Jack
CP-Cable II: 2m	CommScope Netconnect CAT6A Shielded LSZH Consolidation Point Cord
Patchcord II: 5m	CommScope Netconnect CAT6A S/FTP LSZH RJ45 PATCH CORD

End B

Figure 1: 4-Connector Channel

4 Test Type

4.1 Reference of testing

Testing of transmission parameters of a 4 Connector Channel according to the specifications Class E_A in accordance with ISO/IEC 11801-1 Ed. 1.0.

The following parameters are part of this test:

NF-parameters:

- Direct current (d.c.) loop resistance
- Direct current (d.c.) loop resistance unbalance

HF-parameters:

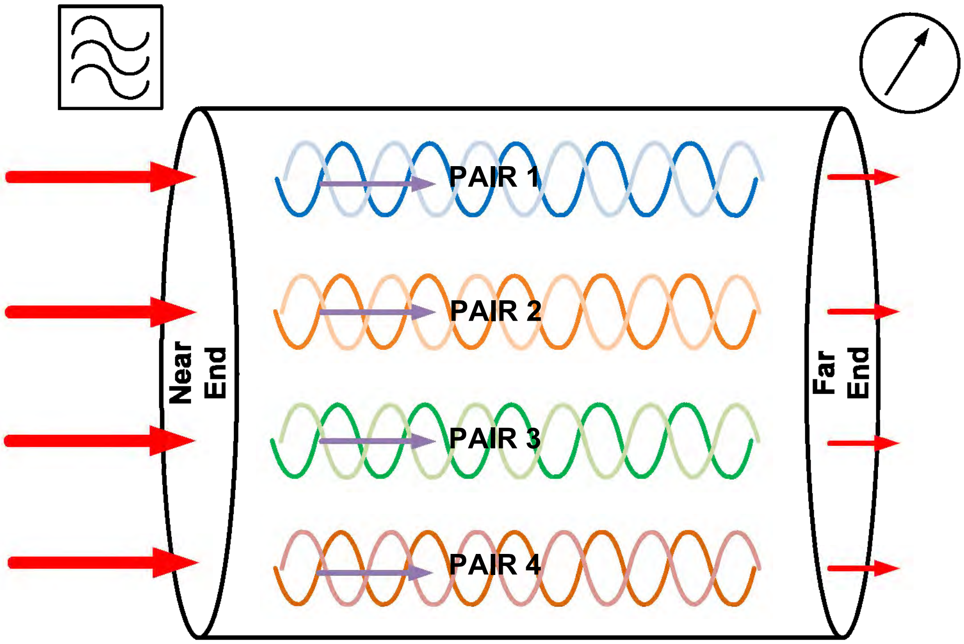
- Insertion loss
- NEXT
- Power sum NEXT (PS NEXT)
- Attenuation to crosstalk ratio at the near-end (ACR-N)
- Power sum ACR-N (PS ACR-N)
- Attenuation to crosstalk ratio at the far-end (ACR-F)
- Power sum ACR-F (PS ACR-F)
- Return loss
- Propagation delay
- Delay skew
- Unbalance attenuation, near-end (TCL)
- Unbalance attenuation, far-end (ELTCTL)

EMC-parameters:

- Coupling attenuation

4.2 Definition of the testing parameters

4.2.1 Insertion loss



Definition

The attenuation is determined by the ratio of the power supplied to the port A and the measured power at the port B as specified below:

$$a_V\,[\mathrm{dB}] = 10\ \log\left(\frac{P_A}{P_B}\right)$$

Both the input and the output of the two-port network must be terminated with the nominal impedance.

Influencing variables

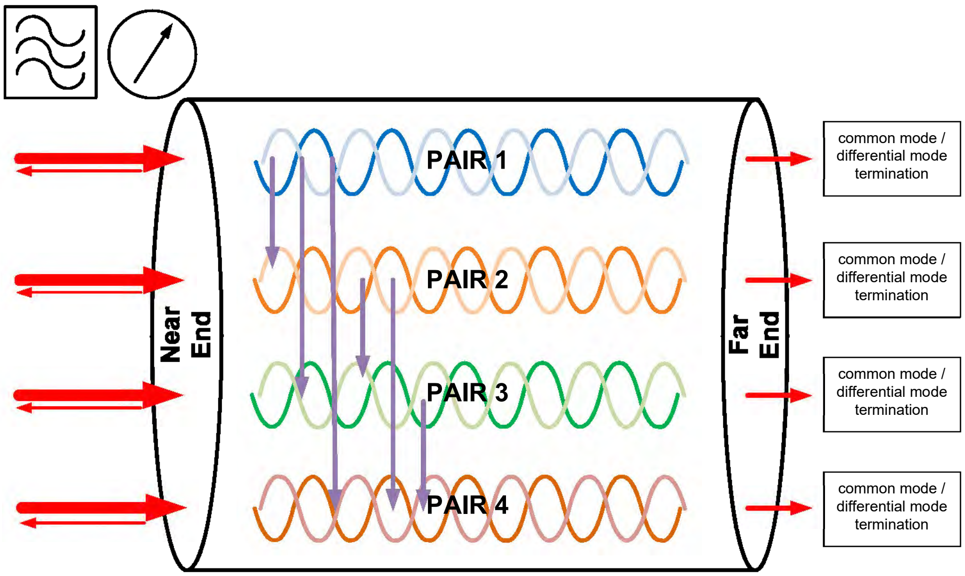
In case of cables, the attenuation is primarily determined by the cross-sectional area and the conductivity of the copper wires. Especially in high frequency ranges, the attenuation is increased by the dielectric losses of the core insulating material.

The attenuation is dependent on the length, the frequency, and the temperature.

Significance

A low attenuation improves the transmission reliability of the cabling system. The attenuations of cables and connecting devices are accumulative although they are largely dominated by those of the cables.

4.2.2 NEXT



Definition

The near-end crosstalk attenuation is determined by the ratio of the power supplied to the port A and the measured power at the port B as specified below:

$$a_{NEXT}\,[dB] = 10\,\log\left(\frac{P_A}{P_B}\right)$$

Both sides of the specimen must be terminated with the nominal impedance. In the event that the sender and the receiver are located at the same end of the specimen, we are speaking of near-end crosstalk (NEXT) attenuation.

Influencing variables

In case of cables, the near-end crosstalk attenuation is primarily determined by the twisting of the cores and (if existing) the paired foil screens.

The near-end crosstalk attenuation is largely dependent on the frequency and – to a minor degree – also on the lengths.

Significance

A high near-end crosstalk attenuation improves the reliability of transmissions. Within the cabling system, the reliability of transmissions is primarily determined by the component having the lowest near-end crosstalk attenuation.

4.2.3 Power sum NEXT (PS NEXT)

Definition

The power sum of the near-end cross-talk is defined on the basis of the ratio of the power input at the three pairs A, B and C to the power output at pair D. The power-sum NEXT value of cables can be measured by means of a phase-correlated 4-port power splitter. On the basis of the pair-to-pair NEXT measurements, the power sum can also be calculated according to the following formula:

$$a_{PSNEXT}\,[\mathrm{dB}] = 10\ \log \sum_{i=1}^{3} 10^{-0,1 \cdot a_{NEXT}^{i}}$$

Influencing factors

The power-sum NEXT value of cables is decisively influenced by the stranding and the foil pair shield (if applicable). Power-sum NEXT strongly depends on the frequency used and – only to a minor extent – on the cabling length.

Meaning

With regard to network protocols that distribute the bi-directional data load over all four pairs, power-sum NEXT is of great importance for transmission reliability since power-sum cross-talk is expected to impair transmission via the data channel.

4.2.4 Attenuation to crosstalk ratio at the near-end (ACR-N)

Definition

The ratio of the level of the incoming useful signal to the noise level at the opposite end of the measured link is referred to as Attenuation-to-Cross-Talk Ratio (abbr. ACR).

ACR may be interpreted as the signal-to-noise ratio with the near-end cross-talk being regarded as the interfering signal or noise.

$$ACR\,[dB] = a_N\,[dB] - a_V\,[dB]$$

Calculation

As agreed, the ACR value is calculated for every frequency response of the near-end cross-talk with the two relevant frequency responses of the attenuation.

Alternatively, the minimum value of the ACR calculation may be allocated for every measuring point of the two attenuation values involved. The determination of the double-ended system dynamics thus results in 12 ACR frequency responses for a four-pair specimen.

Meaning

The ACR value is of decisive importance to system designers, system manufacturers and operators of data communications equipment since it provides immediate insight into system dynamics and system reserve. The larger the distance between the useful signal and the noise signal over the entire frequency range, the larger the infrastructural reserve.

4.2.5 Power sum ACR-N (PS ACR-N)

Definition

The power sum of the ACR reserve is calculated as follows:

PS ACR [dB] = a_{PSNEXT} [dB] − a_V [dB]

Meaning

With regard to network protocols that distribute the bi-directional data load over all four pairs, power-sum ACR is of great importance for transmission reliability since cross-talk is expected to impair transmission via the data channel.

4.2.6 Attenuation to crosstalk ratio at the far-end (ACR-F)

Definition

The equal-level far-end cross-talk (abbr. EL FEXT) is determined by the ratio of the power measured at the remote port B to the power measured at the remote port C. The measuring signal is supplied to the near end of the cable.

$$a_{ELFEXT}[\mathrm{dB}] = 10 \ \log\left(\frac{P_B}{P_C}\right)$$

All pairs of the EUT are terminated with their characteristic impedance.

Influencing factors

The EL FEXT value of cables is decisively influenced by the stranding and the foil pair shield (if applicable).

EL FEXT strongly depends on the frequency used.

4.2.7 Power sum ACR-F (PS ACR-F)

Definition

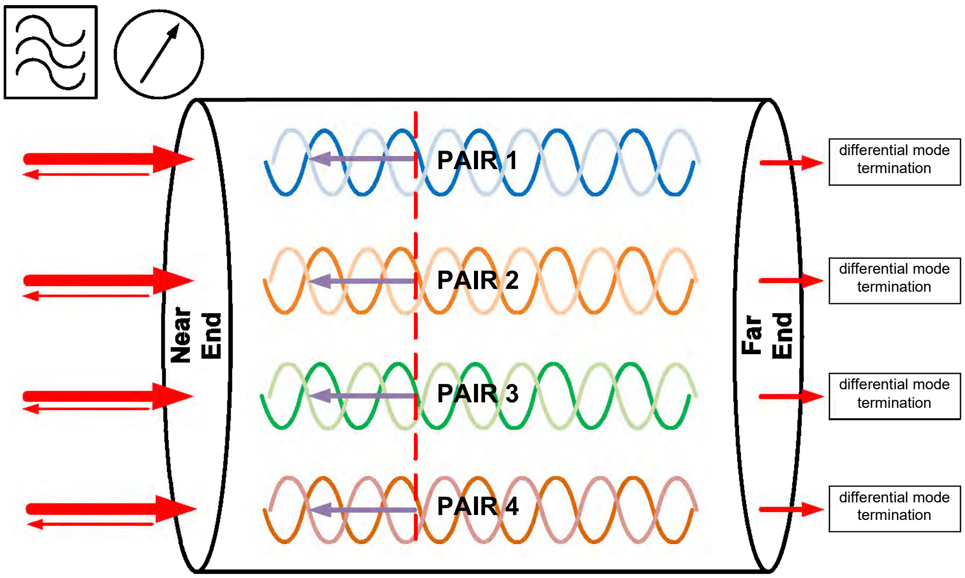
The power-sum EL FEXT value can be calculated on the basis of the pair-to-pair EL FEXT measurements according to the following formula:

$$a_{PSELFEXT}[\mathrm{dB}] = 10 \ \log \sum_{i=1}^{3} 10^{-0,1 \cdot a^{i}_{ELFEXT}}$$

Meaning

With regard to network protocols that distribute the bi-directional data load over all four pairs, power-sum EL FEXT is of great importance for transmission reliability since cross-talk is expected to impair transmission via the data channel.

4.2.8 Return loss



Definition

The return loss represents the ratio of the power supplied to the EUT to the power reflected by the EUT.

$$a_R\ [\mathrm{dB}] = 10\ \log\left(\frac{P_{input}}{P_{output}}\right)$$

The EUT end is terminated with the characteristic impedance in order to absorb any non-reflected power. The EUT and the test-value transmitter must have the same rated impedance in the broadband range.

Influencing factors

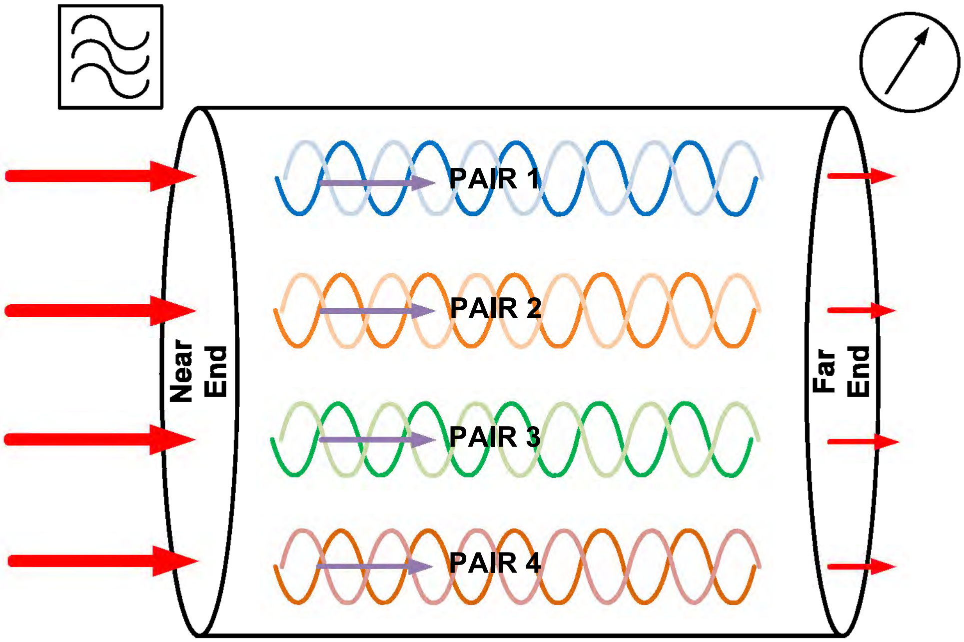
The return loss value of cables is decisively influenced by the homogeneity of the conductors and the core of the cable. Mechanical load during the manufacturing or installation of the cables may impair the return loss.

The parameters return loss and characteristic impedance correlate.

Meaning

A high degree of return loss improves the transmission reliability. A low degree of return loss may lead to an unwanted overlap of returning signal components.

4.2.9 Propagation delay



Definition

The velocity of propagation v of cables is stated in relation to the maximum velocity of propagation of electromagnetic waves in the vacuum co. The parameter "Nominal Velocity of Propagation" (abbr. NVP) is defined as follows:

$$NVP = \frac{v}{c_o}$$

The delay τ is the period of time the signal requires in order to travel through a cabling link with a length of l. The delay is calculated on the basis of the NVP value (Nominal Velocity of Propagation) of the cable and the velocity of light c0 according to the following formula:

$$\tau = \frac{l}{NVP \cdot c_0}$$

Influencing factors

The delay of cables is decisively influenced by the dielectric loss of the core insulation material. This material-induced loss may be minimised by selecting various compounds and by varying the degree of foaming.

The impact of colour addition on the NVP value is not to be neglected since the colours vary strongly in their dielectric constants, which are considerably higher than in the basic compound.

Influencing factors

(continued)

The velocity of propagation does not depend on the cable length and may be calculated on the basis of the measurement of the length-dependent group delay. The reference length used for calculation is the cable length and not the lay length of the twisted pairs. Different lay length values in the four pairs lead to different NVP values.

Meaning

In order to ensure distortion-free signal transmission, the velocity of propagation must not fall below a lower limiting value, which is determined by the system requirements. The velocity of propagation has to be virtually independent of the frequency within the signal bandwidth in order to avoid a divergence of the spectral signal components.

High-bit rate network protocols that use parallel data transmission via the four pairs, moreover, require a highly consistent velocity of propagation in order to avoid synchronisation errors. Future normative standards will define this so-called "delay skew".

4.2.10 Delay skew

Definition

The delay skew $\Delta\tau$ of cables with a length of l marks the time difference between signals travelling along the individual transmission links at the propagation velocity vi,j.

$$\Delta\tau = l \cdot \left(\frac{v_i - v_j}{v_i \cdot v_j} \right)$$

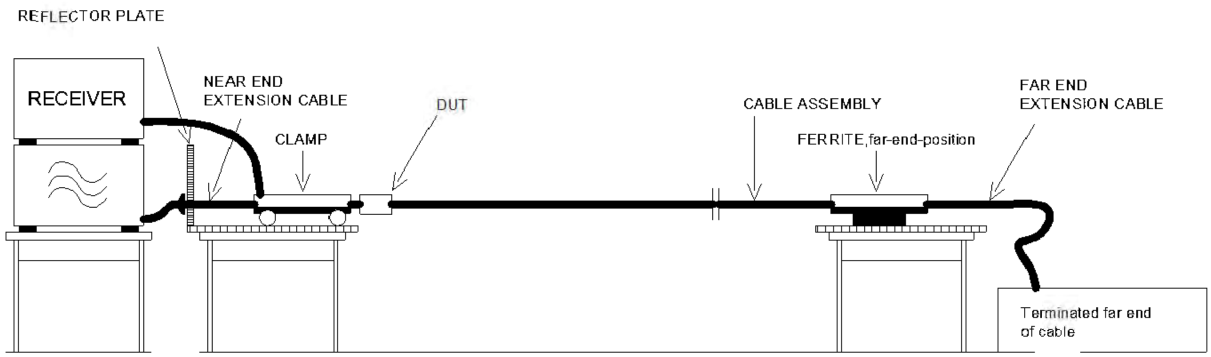
Influencing factors

The delay skew of cables is decisively influenced by the dielectric loss of the core insulation material and the various lay length values.

Meaning

The delay skew will be an important parameter for a distortion-free data transmission in balanced cables in view of future network protocols.

4.2.11 Coupling attenuation



Definition

Coupling Attenuation is the relation between the transmitted power through the conductor and the maximum radiated peak power, conducted and generated by the excited common mode currents. The measurement is independent of the bandwith and shall be measured form 30MHz up to 1GHz.

Influencing factors

The Coupling Attenuation is primarily determined by the mechanical structure of the component. The Coupling Attenuation is very much dependent on the frequency.

Meaning

The better the effectiveness of the Coupling Attenuation is, the smaller is the value of the noiseresistance.

5 Applied Standards

5.1 Applied Rules and Regulations

- **ISO/IEC 11801-1 Ed. 1.0: 2017-11**
  Information technology – Generic cabling for customer premises

5.2 Applied Limits

- **ISO/IEC 11801-1 Ed. 1.0: 2017-11**
  Information technology – Generic cabling for customer premises

Note: In Chapter Fehler! Verweisquelle konnte nicht gefunden werden. "ANNEX: ocumentation of measurements", the applied limits are diagrammed within the measurement results.

5.3 Deviations

None.

5.4 None Standardised Test Procedures

None.

6 Testing equipment

The following testing equipment was used for the measurements:

Equipment	Manufacturer	Stock ID
Network Analyzer	Rohde & Schwarz	GHMTA0002
Network Analyzer	Agilent	GHMTA0018
LCR-Meter	Agilent	GHMTA0034
Time-Domain-Reflectometer	Tektronix	GHMTA0004
Reference clamp	GHMT	GHMTA0047
Absorbing Clamp	Lüthi	GHMTA0070
Decoupling Clamp	Lüthi	GHMTA0071
Switch unit	Novotronic	GHMTA0028
Coaxial probe	GHMT	-

Schedule 1: Measurement equipment

7 Summary

Customer:	CommScope Inc. 1100 CommScope Place SE 28603 Hickory, North Carolina, USA
Description:	Data Cable: CommScope Netconnect CS44Z3 C6A System Cable, AWG23, LSZH; F/FTP Part-no: CS44Z3 Patchcord: CommScope Netconnect CAT6A S/FTP LSZH RJ45 PATCH CORD Part-no: NPC6ASZDB CP-Cable: CommScope Netconnect CAT6A Shielded LSZH Consolidation Point Cord Part-no: NCC44SZJB Connector: CommScope Netconnect CAT6A SLX Modular Jack Part-no: 2153365
Applied standards:	ISO/IEC 11801-1 Ed. 1.0: 2017-11 Information technology – Generic cabling for customer premises
Result:	The sample meets the limits of the specified standards and regulations with respect to the parameters indicated above.

The test results which were determined in the course of the measurement refer to the submitted specimen.

Bexbach, 28. August 2018

i.O. Stefan Grüner, engineer
(Head of Accrediteded Test Laboratory)

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