Test report based on DIN EN ISO/IEC 17025

Test laboratory:

GHMT
Aktiengesellschaft

No.: P2374a-10-E

Connector Cat. 6_A
according
ISO/IEC 11801 AMD 2 (2010-04)

Project number: **TYCLA0310**

Deutscher
Akkreditierungs
Rat
DAR

DAT-P-184/00-02

This test report consists of 34 pages.

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1 General information

1.1 Test Laboratory

GHMT AG
In der Kolling 13

D-66450 Bexbach

Phone: +49 / 68 26 / 92 28 - 0
Fax: +49 / 68 26 / 92 28 - 99

1.2 Test Date

Testing	from:	May 25th 2010
	until:	May 26th 2010
	during:	(23 ± 3)°C

1.3 Test Site

Accredit Test-lab of GHMT AG, Bexbach

1.4 Test Conducted by

Mr. Bernd Jung, technical assistent to the laboratory management, GHMT AG

1.5 Persons Present at Test

Mr. Didier Claeys, Tyco Electronics AMP GmbH
Mr. Arturo Pachon, Tyco Electronics AMP GmbH
Mr. Stefan Grüner, engineer, Manager Accredited Test Laboratory, GHMT AG
Mr. Malte Onnenga, technical assistent to the laboratory management, GHMT AG

2 Customer

2.1 Address

Tyco Electronics AMP GmbH
Ampérestr. 7-11

D-63225 Langen

Phone: +49 / 6103 / 709-1529
Fax: +49 / 6103 / 709-1219

2.2 Responsible compartment

Tyco Electronics AMP GmbH
Mr. Didier Claeys
Dietsesteenweg 692

B-3010 Kessel-Lo

Phone: +32 / 479 930 038
Fax: +32 / 16 352 188

3 Equipment Under Test (EUT)

3.1 Description of the Components

GHMT AG received the following components from the customer in order to conduct the test:

Description:	**Tyco AMP Co Plus System** **with system insert Cat.6_A**	PartNo.: 1711796

3.2 Component Order

The components listed were delivered by the customer.

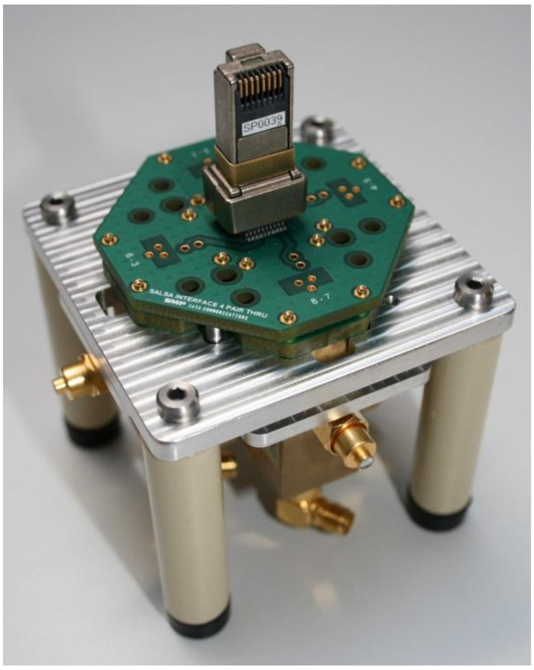
3.3 Acceptance of Components

The components currently undergoing the test were delivered to the GHMT AG on May 25th 2010. They had no visible defects.

4 Test Type

4.1 Reference of testing

Certification of a connecting hardware with respect to high-frequency behaviour. The valuation of the tested parameters was performed in reference to the ISO/IEC 11801 AMD 2.



Picture 1: Cat. 6_A test setup of GHMT

4.2 Test parameters

The following test parameters from part of the test conducted according to section 4.1:

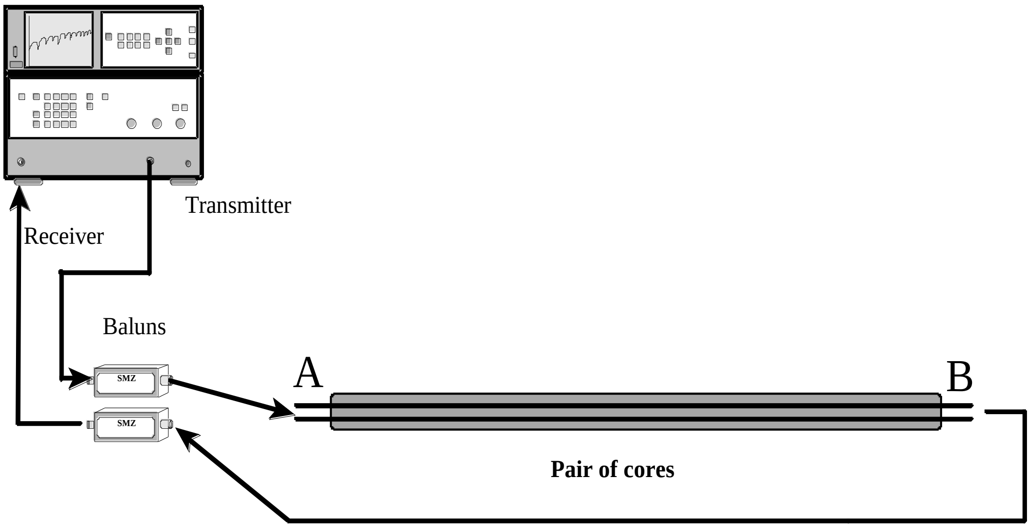
HF-Parameters:

- Attenuation
- Near-end Crosstalk (NEXT)
- Far-end Crosstalk (FEXT)
- Return loss
- Delay
- Delay skew

EMC-Parameters:

- Tranfer Impedance
- Coupling Attenuation

4.2.1 Attenuation



Definition

The attenuation is determined by the ratio of the power supplied at port A and the power measured at port B.

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

Input and output of the two-port network have to be terminated with the line's nominal characteristic impedance in order to avoid return loss.

Influencing factors

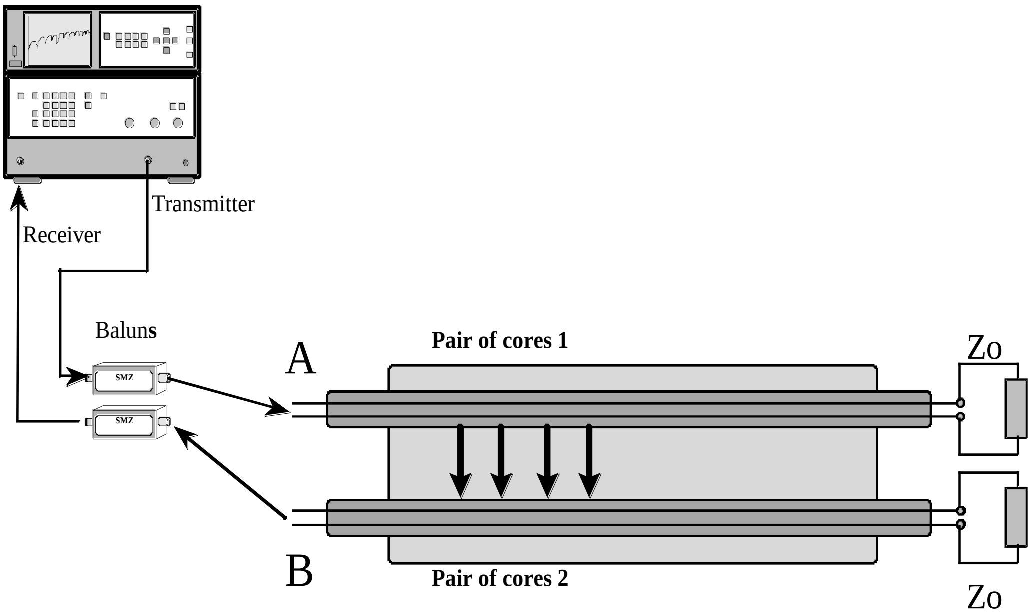
The attenuation of cables is largely determined by the cross-sectional area and the conductivity of the copper conductors. In particular in very high frequency ranges, the dielectric loss of the core insulation material contributes to an increase in the attenuation in proportion to the frequency.

The attenuation depends on length, frequency and temperature.

Meaning

A low attenuation improves the transmission reliability of the cabling link. The attenuation of cables and connecting hardware accumulates but it is primarily determined by the cabling.

4.2.2 Near-End Cross-Talk (NEXT)



Definition

The near-end cross-talk loss is determined by the ratio of the power supplied at port A to the power measured at port B.

$$a_N \text{ [dB]} = 10 \log\left(\frac{P_A}{P_B}\right)$$

The EUT has to be terminated on both ends with the characteristic impedance. If transmitter and receiver are positioned at the same end of the EUT, the parameter is referred to as near-end cross-talk (NEXT).

Influencing factors

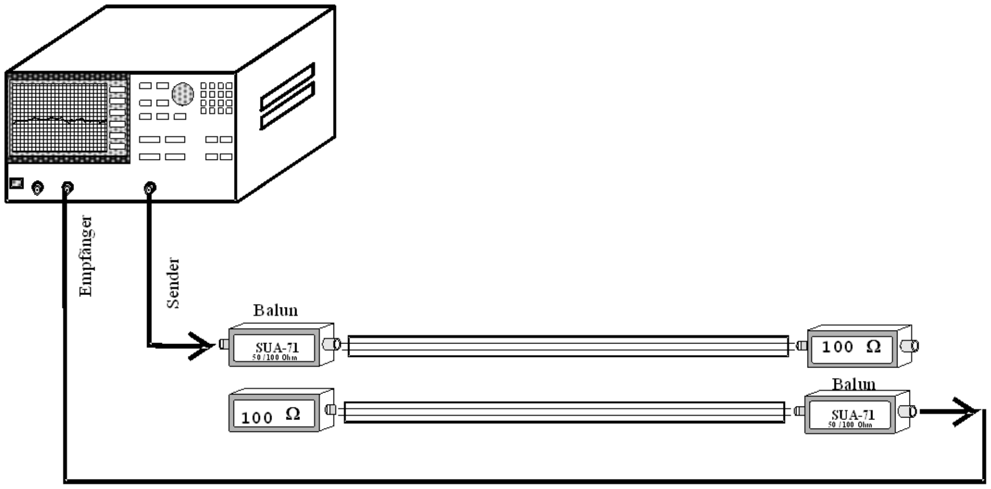
The near-end cross-talk of cables is decisively influenced by the stranding and the foil pair shield (if applicable).

Near-end cross-talk strongly depends on the frequency used and – only to a minor extent – on the cabling length.

Meaning

A high degree of near-end cross-talk improves transmission reliability. The transmission reliability within the cabling link is largely determined by the component with the lowest degree of near-end cross-talk.

4.2.3 Far-End Cross-Talk (FEXT)



Definition

The far-end cross-talk (abbr. 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.

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

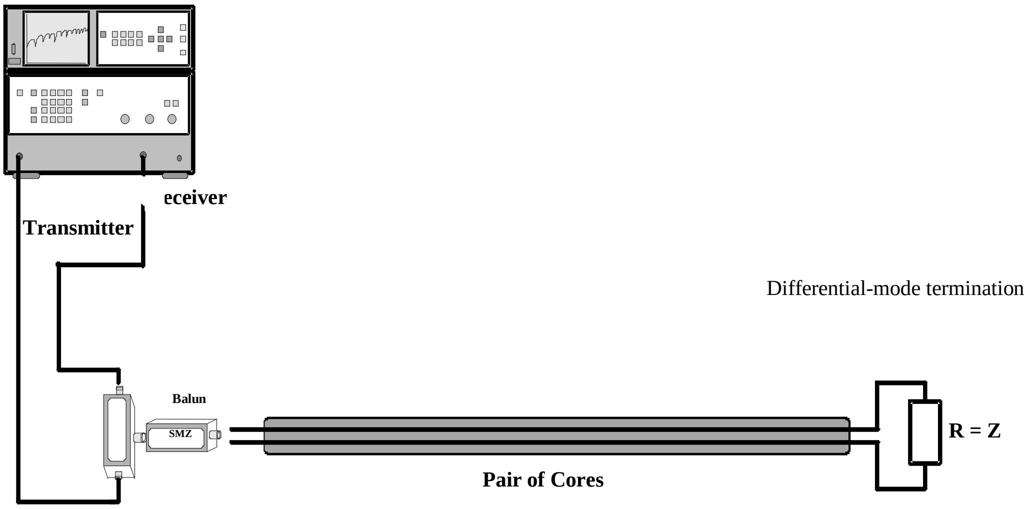
All pairs of the EUT are terminated with their characteristic impedance.

Influencing factors

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

FEXT strongly depends on the frequency used.

4.2.4 Return Loss



Definition

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

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

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

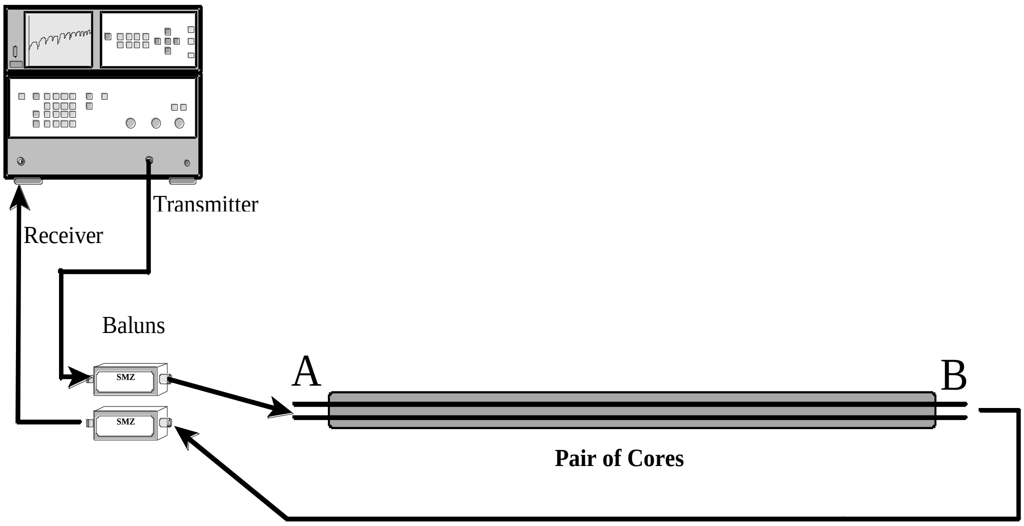
The return loss value of cables is decisively influenced by the homogeneity of the conductors and the core of the cable. Mechanical load during the manufacturing or installation of the cables may impair the return loss.

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.

4.2.5 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 c_o. 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 c_0 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".

4.2.6 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 $v_{i,j}$.

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

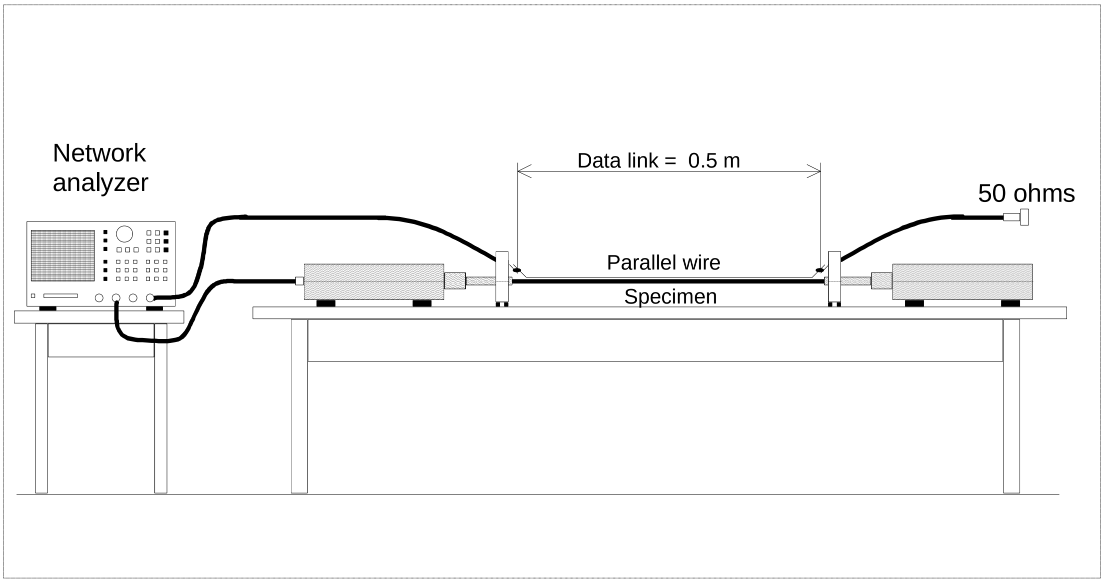
Influencing factors

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.

4.2.7 Transfer impedance



Screened cabin

Definition

As soon as an electromagnetic wave reaches a screen, it induces an interference current $I_{Disturb.}$. This current produces a voltage $U_{Disturb.}$ along the inner conductor. The coupling factor

$$Z_T = \frac{U_{Disturbance}}{I_{Disturbance}}$$

has the dimension of a complex impedance and is called transfer impedance Z_T. The transfer impedance consists of a real part – i.e. the coupling resistance R_C – and an imaginary part. In many cases, only the coupling resistance will be of practical importance for the evaluation of the shielding effectiveness.

The coupling impedance has the dimension mΩ. In case of data cables it is indicated per unit of length and has the dimension mΩ/m.

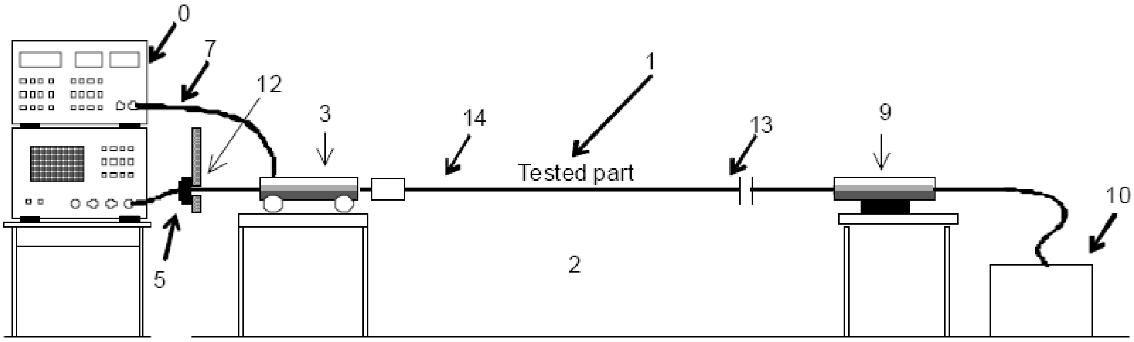
Influencing variables

In case of shielded cables, the coupling resistance is primarily determined by the mechanical structure of the braided screen and/or by inserted foil screens. The coupling resistance is very much dependent on the frequency.

Significance

The better the effectiveness of a shield is, the smaller is the value of the coupling resistance.

4.2.8 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 Rules and Regulations

5.1 Rules and Regulations Applied

- **ISO/IEC 11801 AMD 2 (2010-04)**
  Information technology – Generic cabling for customer premises

- **IEC 60603-7-51 Ed. 1 (IEC 48B/1977/CDV, 12/2008)**
  Connectors for electronic equipment –
  Part 7-51:Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 500MHz and with specified exogenous crosstalk

- **TIA/EIA-568-C.2 (2009-08)**
  Balanced Twisted-Pair
  Telecommunications Cabling and Components Standards

5.2 Category 6_A Limits for Connecting Hardware

Frequency / MHz	Attenuation / dB	NEXT / dB	PS NEXT / dB	FEXT / dB	PS FEXT / dB	Return Loss / dB	Delay / ns	Delay Skew / ns
1,0	0,10	75,0	72,0	75,0	72,0	30,0	2,5	1,25
100	0,20	54,0	50,0	43,1	40,1	28,0	2,5	1,25
250	0,32	46,0	42,0	35,1	32,1	20,0	2,5	1,25
500	0,45	37,0	33,0	29,1	26,1	14,0	2,5	1,25

Schedule 1: Limits according to ISO/IEC 11801 AMD 2 (2010-04)

Parameter	Frequency [MHz] (f)	Limit
Transfer Impedance	$1 \leq f \leq 10$	$0{,}1 \cdot f^{0,3}$ [Ω]
	$10 \leq f \leq 80$	$0{,}02 \cdot f$ [Ω]
Coupling Attenuation	$30 \leq f \leq 100$	≥ 45 [dB]
	$30 \leq f \leq 500$	85-20*lg(f) [dB]

Schedule 2: Limits according to ISO/IEC 11801 AMD 2 (2010-04)

5.3 Deviations

None.

5.4 None-Standardized Test Procedures

None.

6 Test equipment

The following test equipment was used for the measurements:

Gerät	Bezeichnung	Hersteller	techn. Daten
Spektrum/ Netzwerk-analysator	ENA E5071B	Agilent	50 Ω 300 kHz – 8,5 GHz
Spectrum Network-analyzer	ZVRE	Rohde & Schwarz	50 Ω 9 kHz - 4 GHz
RLC-Meter	PM 6304	Fluke	0,10 % Genauigkeit
Cat. 6A Test-Setup	---	Superior	50/100 Ω 1 MHz – 500 MHz
SALSA-Plug Referenzstecker	SP0039	Superior	100 Ω 1 MHz – 500 MHz
Diverses Meßequipment	---	GHMT	---

Schedule 3: Test equipment GHMT

7 Summary

Customer:

Tyco Electronics AMP GmbH
Ampérestr. 7-11

D-63225 Langen

Description:

Tyco AMP Co Plus System
mit Systemeinsatz Cat.6_A Art.-Nr.: 1711796

Applied standards:

ISO/IEC 11801 AMD 2 (2010-04)
Information technology – “Generic cabling for customer premises"

TIA/EIA-568-C.2 (2009-08)
Balanced Twisted-Pair
Telecommunications Cabling and Components Standards

IEC 60603-7-51 Ed. 1 (IEC 48B/1977/CDV, 12/2008)
Connectors for electronic equipment –
Part 7-51:Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 500MHz and with specified exogenous crosstalk

Comments:

Up to a bandwidth of **500 MHz** the sample meet the **Category 6_A** limits of the specified standards and regulations.

The test results which were determined in the course of the measurement refer to the submitted specimen. Any future technical modifications of the verified Products are subject to the responsibility of the manufacturer.

Bexbach, May 31th 2010

i.O. Stefan Grüner, engineer
(Manager Accredited Test Laboratory)

GHMT AG
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http://www.ghmt.de

8 Documentation of measurements

As annex of this test report the test results are documented as frequency responses.

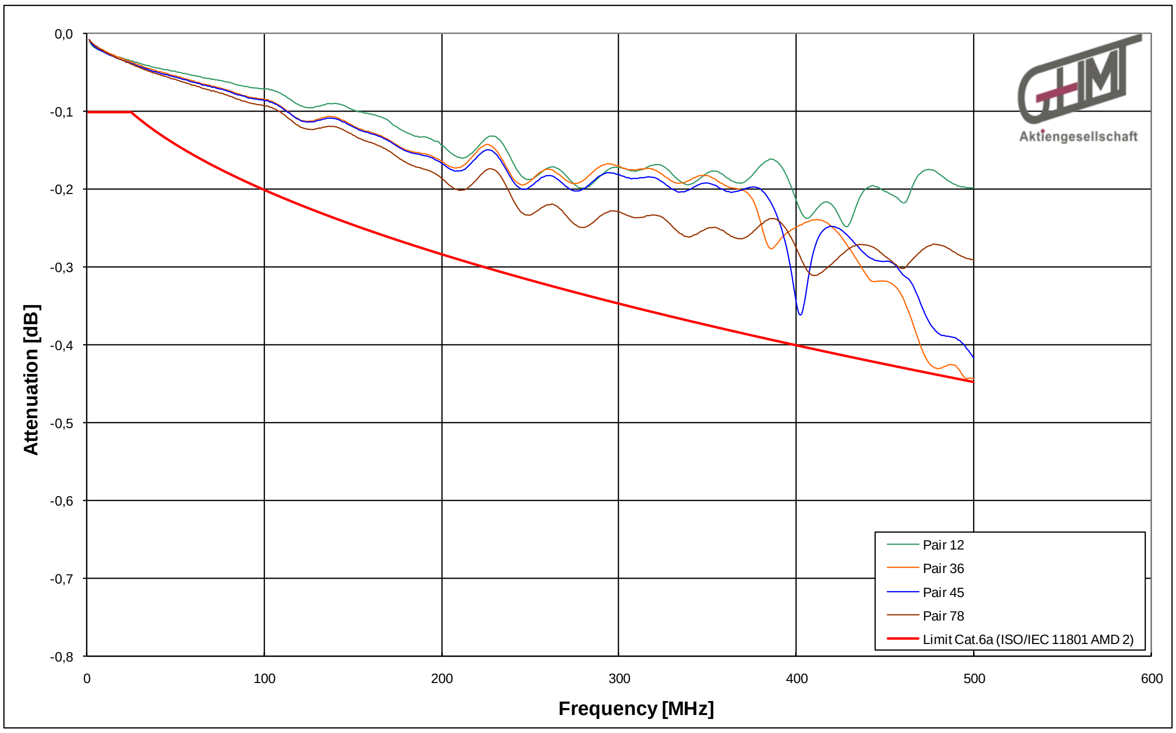
Summary of the measured high-frequency-parameters:

Attenuation

The following adjustments were basis for the measuring equipment:

Output Power	0 dBm
Frequency Range	1 MHz – 500 MHz
IF-Filter	100 Hz
Resolution	500 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	110 dB
Impedance	50 Ω

Attenuation:

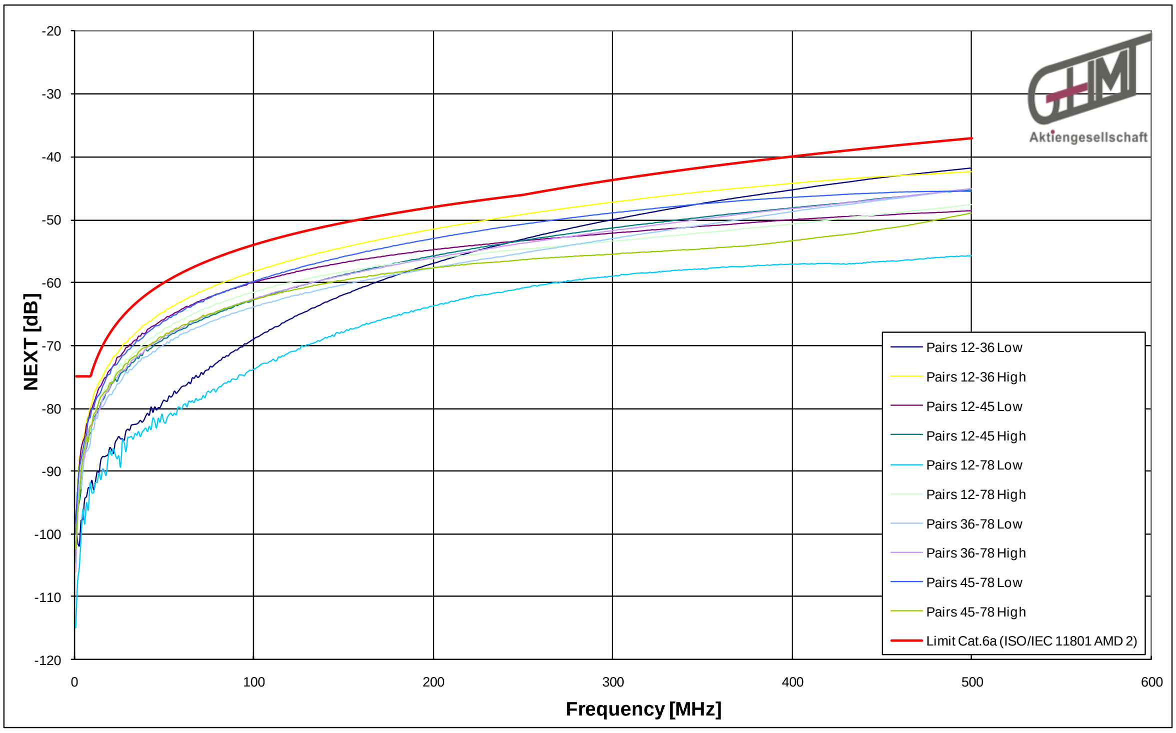


NEXT

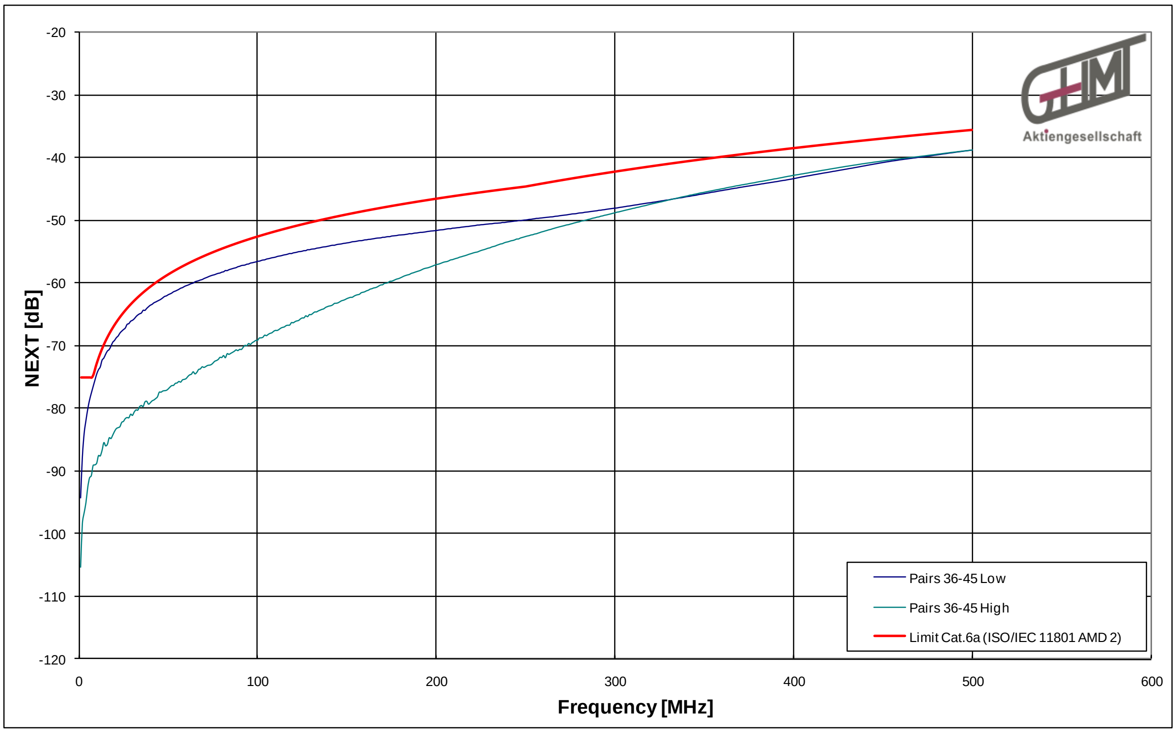
The following adjustments were basis for the measuring equipment:

Output Power	0 dBm
Frequency Range	1 MHz – 500 MHz
IF-Filter	100 Hz
Resolution	500 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	110 dB
Impedance	50 Ω

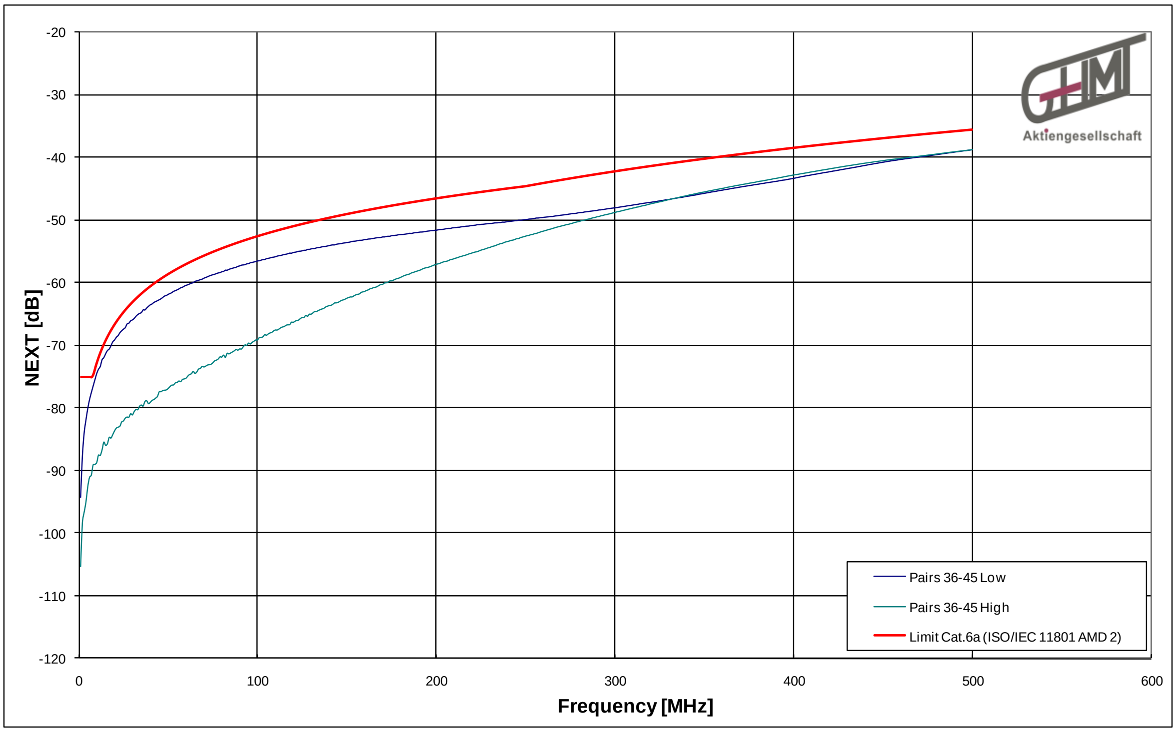
NEXT:



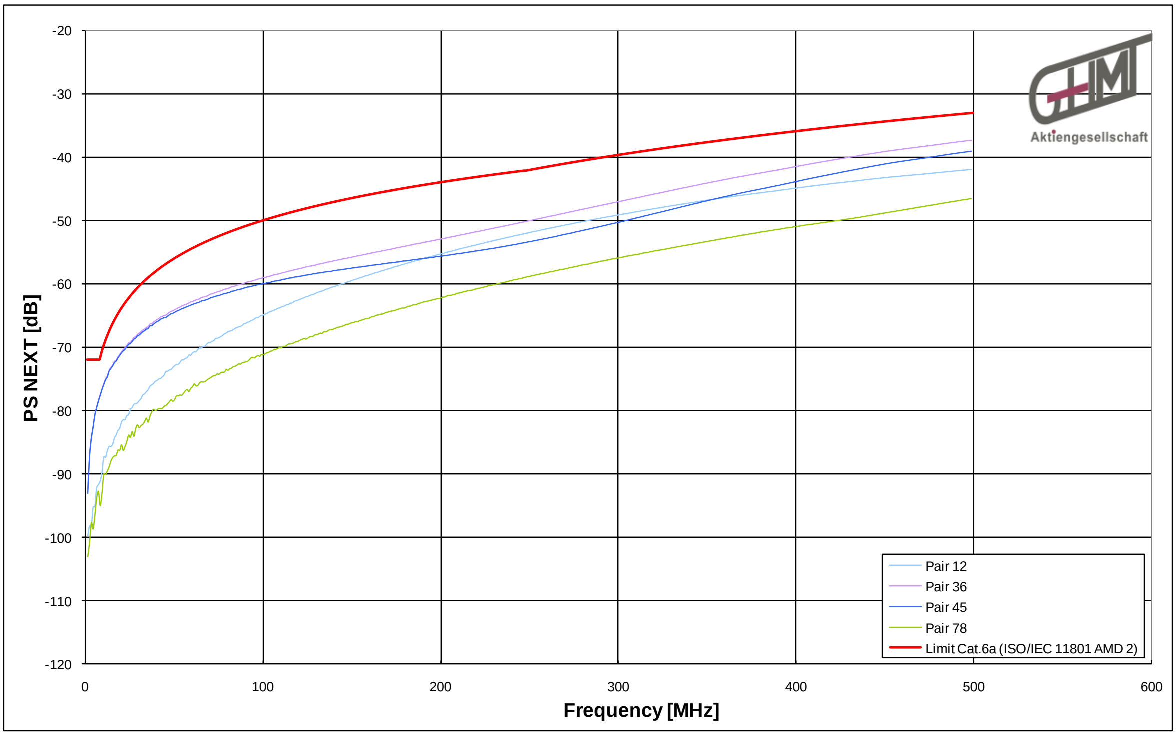
NEXT 36-45 Low and High:



NEXT 36-45 Center Low and Center High:



PS NEXT:

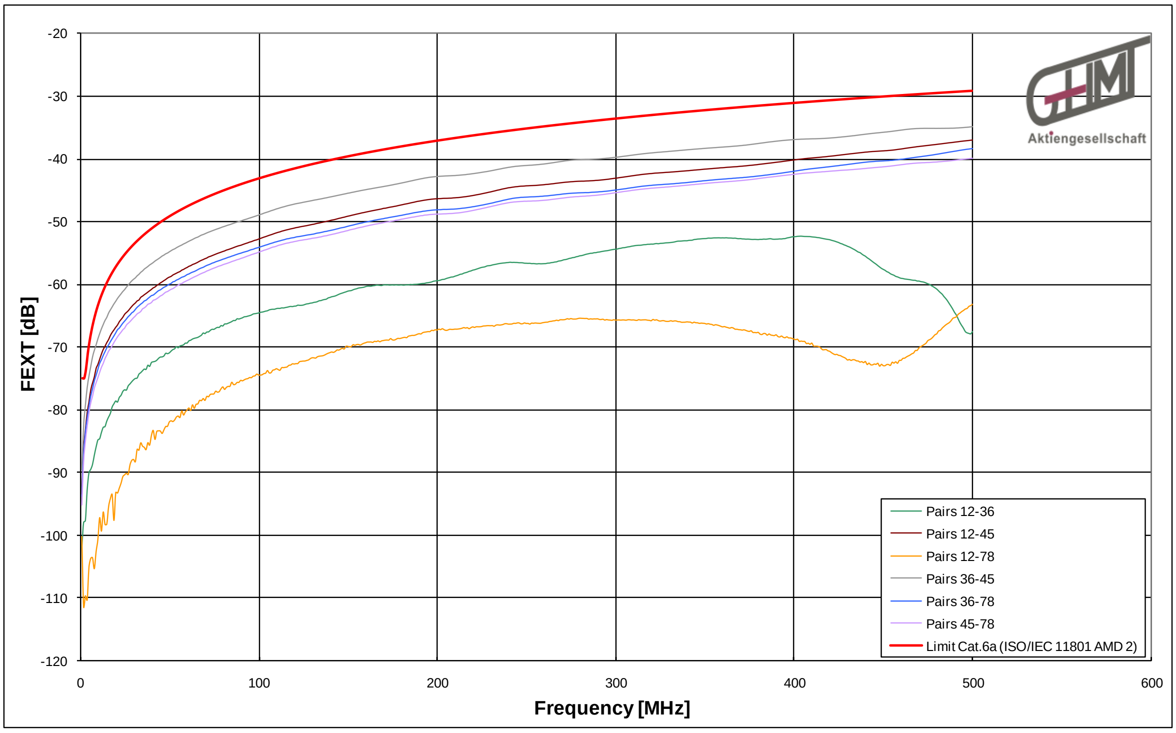


FEXT

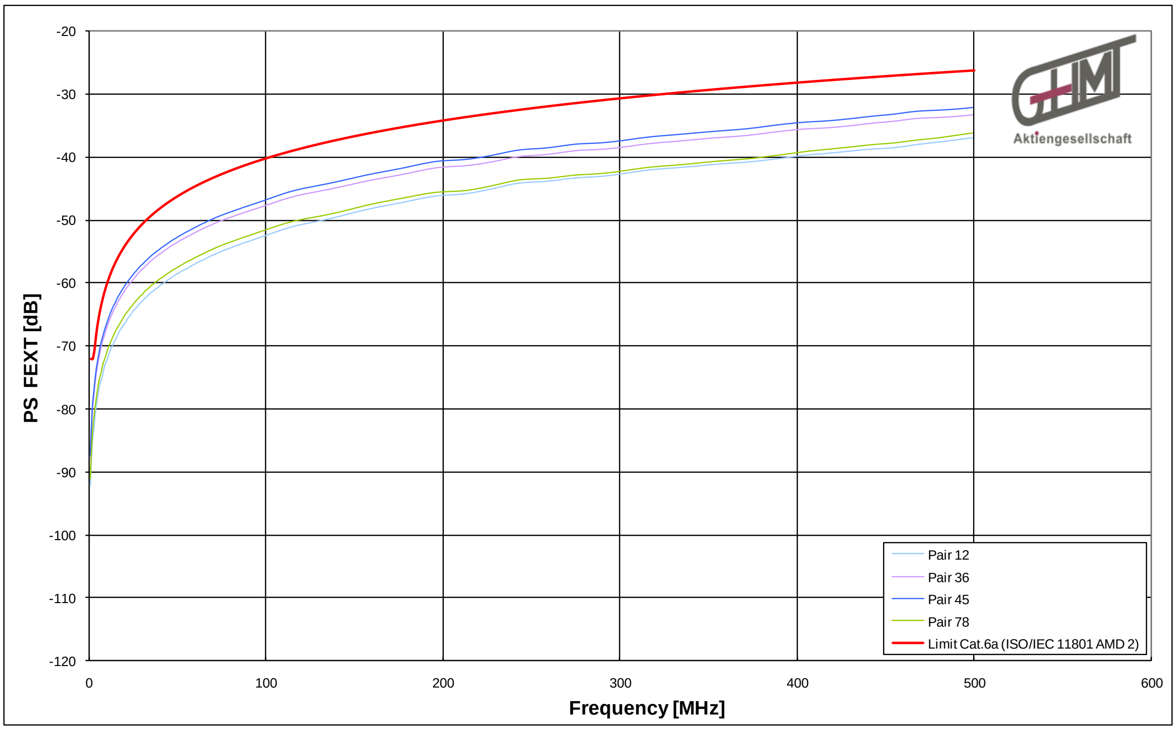
The following adjustments were basis for the measuring equipment:

Output Power	0 dBm
Frequency Range	1 MHz – 500 MHz
IF-Filter	100 Hz
Resolution	500 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	110 dB
Impedance	50 Ω

FEXT:


FEXT [dB]
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0
100
200
300
400
500
600
Frequency [MHz]
Aktiengesellschaft
Pairs 12-36
Pairs 12-45
Pairs 12-78
Pairs 36-45
Pairs 36-78
Pairs 45-78
Limit Cat.6a (ISO/IEC 11801 AMD 2)

PS FEXT:

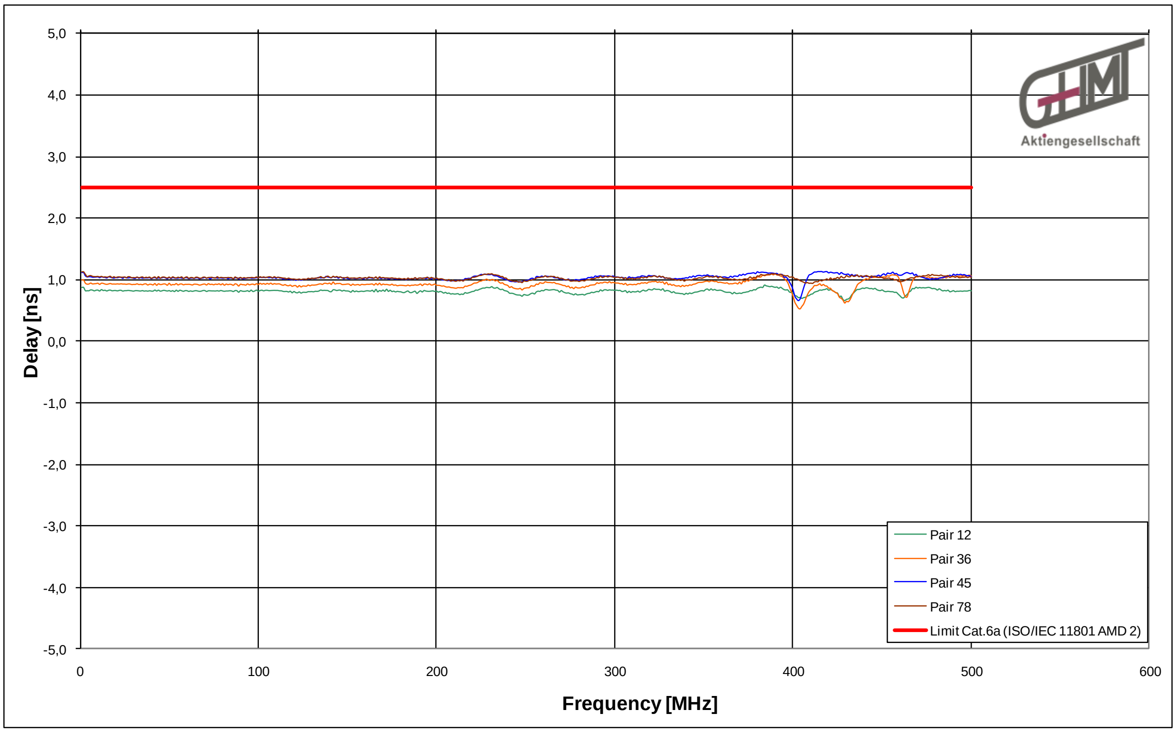

PS FEXT [dB]
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0
100
200
300
400
500
600
Frequency [MHz]
Aktiengesellschaft
Pair 12
Pair 36
Pair 45
Pair 78
Limit Cat.6a (ISO/IEC 11801 AMD 2)

Delay

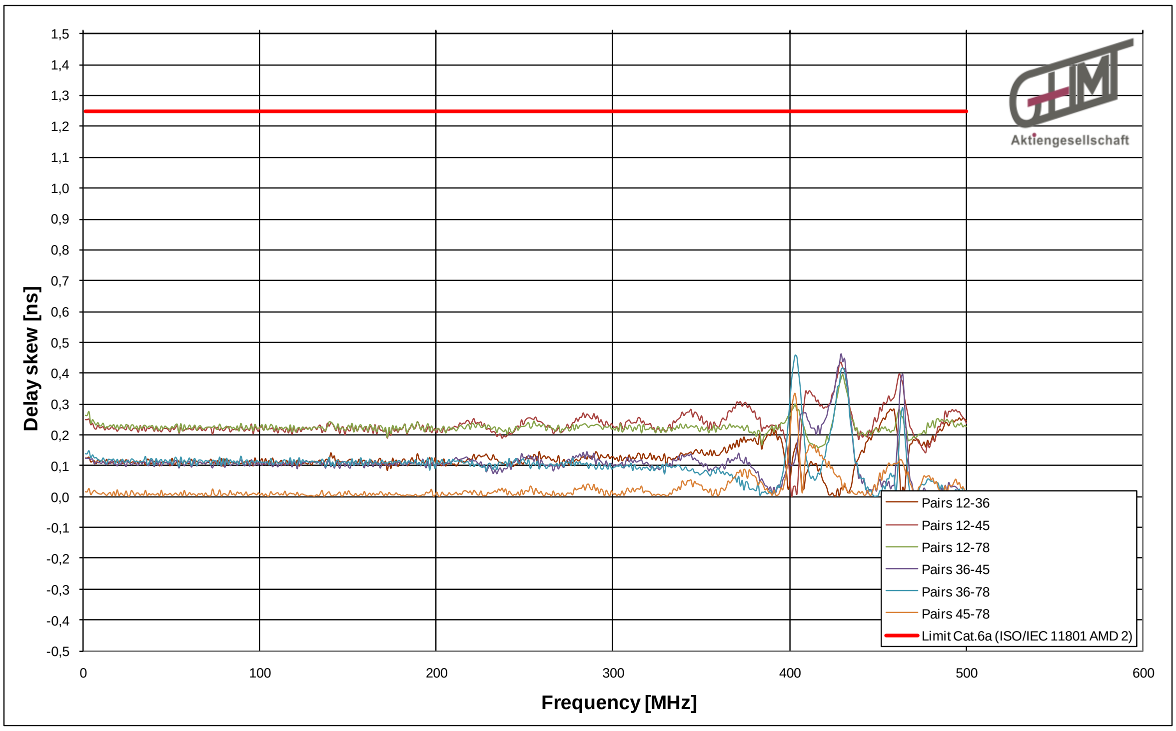
The following adjustments were basis for the measuring equipment:

Output Power	0 dBm
Frequency Range	1 MHz – 500 MHz
IF-Filter	100 Hz
Resolution	500 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	110 dB
Impedance	50 Ω

Delay:



Delay Skew:

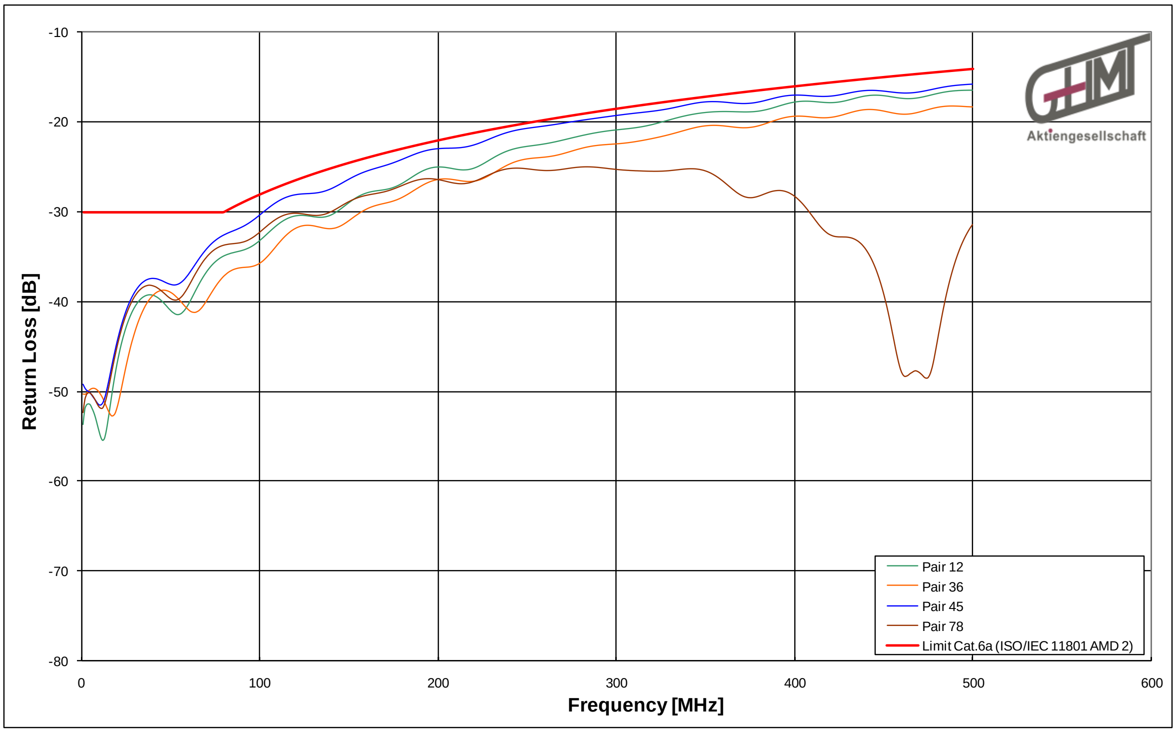


Return loss

The following adjustments were basis for the measuring equipment:

Output Power	0 dBm
Frequency Range	1 MHz – 500 MHz
IF-Filter	100 Hz
Resolution	500 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	70 dB
Impedance	50 Ω

Return Loss:

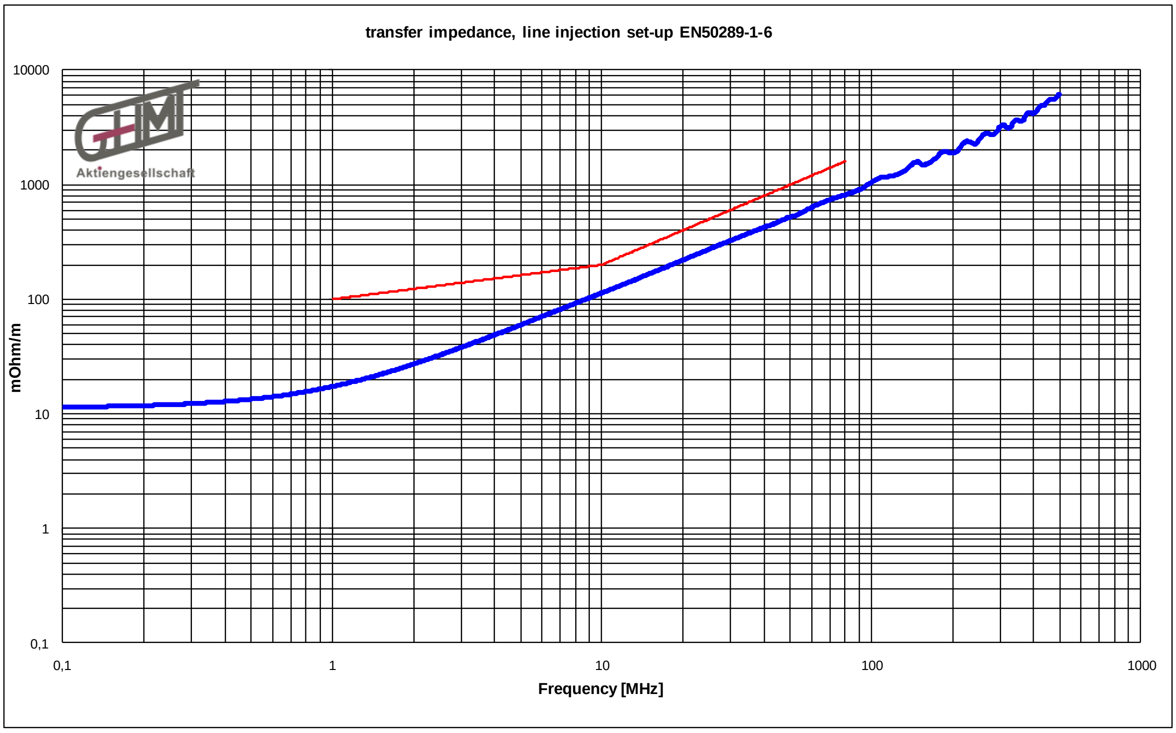

Return Loss [dB]
-10
-20
-30
-40
-50
-60
-70
-80
0
100
200
300
400
500
600
Frequency [MHz]
Pair 12
Pair 36
Pair 45
Pair 78
Limit Cat.6a (ISO/IEC 11801 AMD 2)
GHMT
Aktiengesellschaft

Transfer Impedance

The following adjustments were basis for the measuring equipment:

Output Power	+7 dBm
Frequency Range	0,1 MHz – 100 MHz
IF-Filter	30 Hz
Resolution	971 measurement points in logarithmic distribution
Average	None
Smoothing	0,3%
Noise floor	115 dB
Impedance	50 Ω

Transfer Impedance:



Coupling Attenuation

The following adjustments were basis for the measuring equipment:

Output Power	+7 dBm
Frequency Range	30 MHz – 1000 MHz
IF-Filter	30 Hz
Resolution	971 measurement points in linear distribution
Average	None
Smoothing	0,3%
Noise floor	115 dB
Impedance	50 Ω

Coupling Attenuation: