HARTING

Pushing Performance
Since 1945

HARTING

Corporate Technology Services
Service Catalogue

ilac-MRA

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12148-01-00

Foreword

Dear customers and business partners,

At HARTING, quality represents more than just a mere feature. **Quality is the basis of our actions** – and the basis for reliability and trust. Quality is an uncompromising attitude that shapes every HARTING product and service from the ground up. Our understanding of quality does not view quality as a result, but rather as a permanent process. We always strive to achieve the best we can in everything we do, with the goal always being to maximise customer benefit. This is the only way to create qualitative solutions that meet our demands and the requirements of our customers alike.
Naturally, we also measure our own quality standards against external benchmarks. The HARTING Technology Group has been acting in accordance with the guidelines of ISO 9001 since 1991. This is just one of numerous measures we implement in setting global standards – after all, all HARTING subsidiaries consistently work to the same high quality standards.

Our claim ensures your quality:
HARTING Corporate Technology Services

In addition, with Corporate Technology Services (CTS) we have created our own independent business unit that is responsible for all aspects of product quality. Before our products and solutions are used at the customer, they must pass extensive quality tests in our testing laboratory. The requirements are based on international standards that are expanded to include HARTING-specific requirements, based on customer needs, years of market experience and reliability studies. The quality standard of the HARTING Group does not end after delivery – it has to prove its worth in daily use. The reliability and safety of our products need to deliver in practice what they promise in theory.

The inspection and testing facilities of Corporate Technology Services (CTS) are accredited according to DIN EN ISO/IEC 17025 for electrical, mechanical, environmental, EMC, RF and fiber optic testing as well as dimensional length measurements. Perfect conditions to meet our quality expectations and those of our customers alike.

The goals of Corporate Technology Services (CTS):

- Efficient qualification of processes and products through comprehensive provision of measurement and testing technology as well as specialist expertise
- Rapid market introduction of products through early involvement in the development phase and support of business units
- Ensuring the quality of the international test set-up of the HARTING Technology Group
- Technical communication and marketing support through knowledge transfer and presentations to customers

This service catalogue of Corporate Technology Services provides you with an overview of the testing options we use to ensure the quality of our products.

We hope you enjoy your reading

Stephan Middelkamp

Stephan Middelkamp

Content

Foreword 2

Corporate Technology Services 6
- Test spectrum and services

Surface, layer and material analysis 7
- Scanning electron microscopy, CrossBeam® System
- X-ray fluorescence analysis, measurement of layer thickness, RoHS
- Plastic analysis
- Hardness test, layer hardness tests
- Microscopic examinations

Industrial computed tomography 12
- Measurement technology and analytics

Dimensional measuring technology 13
- Optical and tactile dimensional measurement
- Surface examination

Climatic and environmental tests 15
- Industry atmosphere, corrosion tests
- Corrosion and climatic testing
- Sun simulation, UV, ozone
- IP protection class testing

Mechanical tests 19
- Load-extension-diagrams
- Vibration and shock tests

Electrical tests 21
- Current carrying capacity, derating
- Automated measuring stations

Fibre-optics 23
- Fibre-optic cables, connecting elements and passive components

Signal integrity 25
- Analysis in time and frequency domain

Electromagnetic compatibility 26
- Emission, radiated and conducted
- Interference immunity, radiated and conducted

Testing instruments, software 28
- Construction of test equipment for examinations close to the application

CTS is a test laboratory for electrical, mechanical, environmental, EMC, RF and fiber optic testing as well as dimensional length measurements and is accredited by DAkkS according to DIN EN ISO/IEC 17025.
The accreditation is only valid for the scope of accreditation listed in the annex D-PL-12148-01-00.

Corporate Technology Services

Test spectrum and service

The **HARTING Quality and Technology Center (HQT)** offers 5,000 square meters of space for around 100 people as well as testing technology and equipment of the latest technology.

Product release, effective qualification of processes and products

- Computed tomography for component analysis and measurements
- Dimensional measuring technology (2D, 3D coordinate measurements)
- Surface and material analysis: light microscopy, X-ray fluorescence analysis,plastic analysis, scanning electron microscopy with EDX, Focused Ion Beam (FIB)
- Dimensional, electrical, mechanical and reliability investigations onmicro-electromechanical systems
- Corrosion tests, IP tests, climatic tests
- Electrical tests, mechanical tests
- Vibration tests with climatic and electrical load
- Tests of fibre-optic components and systems
- Electromagnetic compatibility (EMC-interference emission, EMC-interference immunity)
- Signal integrity (Analysis in time and frequency domain)
- Strip light scans

Development-supportive testing and counseling

- Assistance for the definition of quality requirements and specifications
- Collaboration in research projects with industrial partners, research institutes, colleges and universities
- Support with development and implementation of innovations

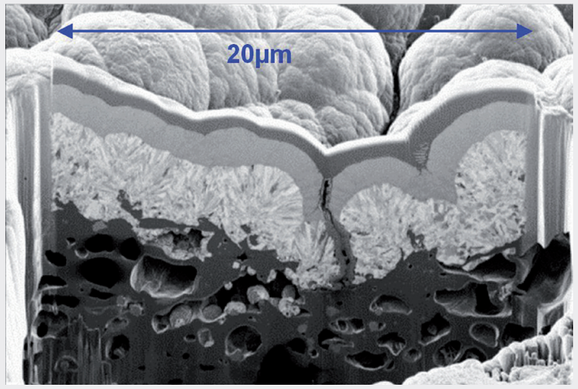
Ensuring the quality of the international test set-up of the HARTING Technology Group

- Development and implemnentation of the international laboratory strategy
- Support in setting up laboratories at development sites
- Ensuring the validity of the laboratory results

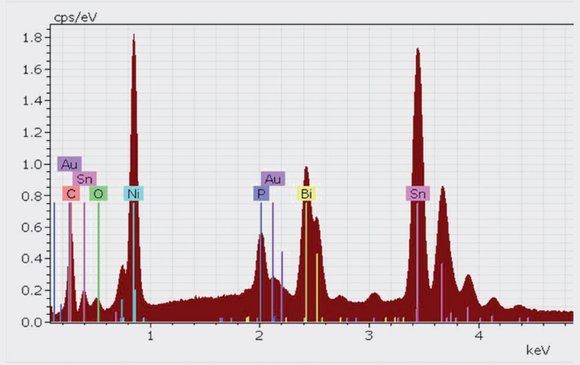
Surface and material analysis

Scanning electron microscope, CrossBeam® System

Modular CrossBeam® workstation



Precise cross section preparation



Qualitative and quantitative elemental analysis

Our range of services

- Failure analysis
- Process control and optimisation
- Layer thickness determination
- Mapping
- Line Scan
- Phase mapping

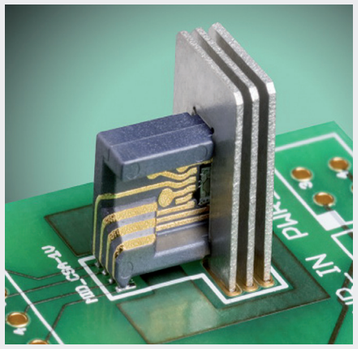
Technical specifications and test areas		
SEM resolution	1 nm @ 15 kV	DIN EN ISO 9220
FIB resolution	7 nm @ 30 kV	
SEM magnification	12 x – 1.000.000 x	
FIB magnification	300 x – 500.000 x	
Depth of focus	~1 mm at 30 x	
Vacuum	$8x10^{-7}$ mbar – 1 mbar	
Identification of chemical elements	from atomic number 5 onwards	ISO 15632, ISO 22309

Layer and material analysis

X-ray fluorescence analysis, measurement of layer thickness, RoHS

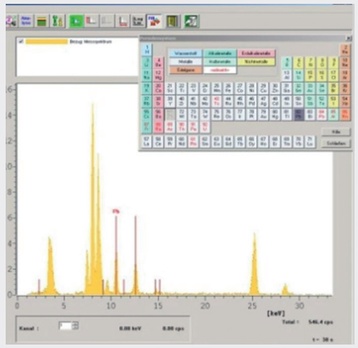
Our range of services

- Determination of layer thicknesses by means of the energy-dispersive X-ray fluorescence analysis (XRF analysis)
- Identification of substances which are banned under the RoHS directive (2011/65/EU)



3 dimensional circuit carrier

Fischerscope X-Ray XDV with silicon-drift detector

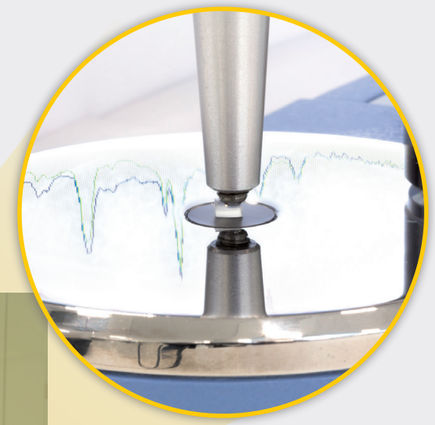


Material analysis with X-ray fluorescence

Technical specifications and test areas		
Material analysis from atomic number 13 by X-ray fluorescence	Resolution: ≤ 140 eV	
Metallic layer thickness measurement	Non-destructive measurement of 24 elements in 24 individual layers	DIN EN ISO 3497
RoHS conformity assessment		DIN EN 62321-3-1

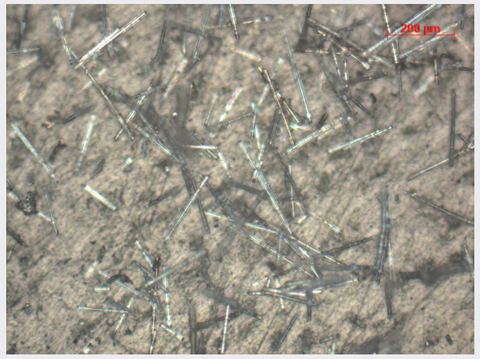
Layer and material analysis

Plastic analysis



Detail of a FTIR spectroscope

FTIR spectroscope with IR-absorption spectrum

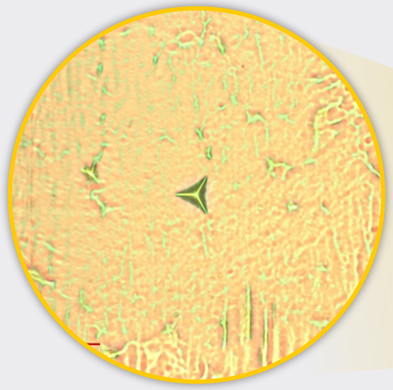


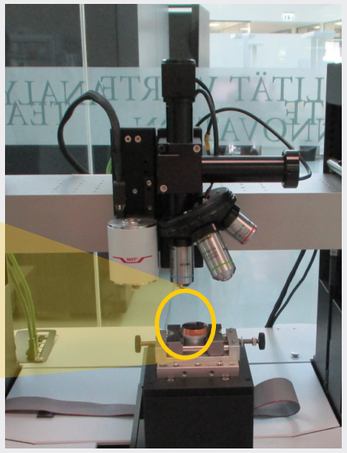
Incineration residue for glass fiber content determination

Technical specifications and test areas		
FTIR-spectroscopy (ATR)	■ Determining the chemical composition of plastics	
Incinerator	■ Glass fiber content determination	DIN EN ISO 3451-1 DIN EN ISO 1172

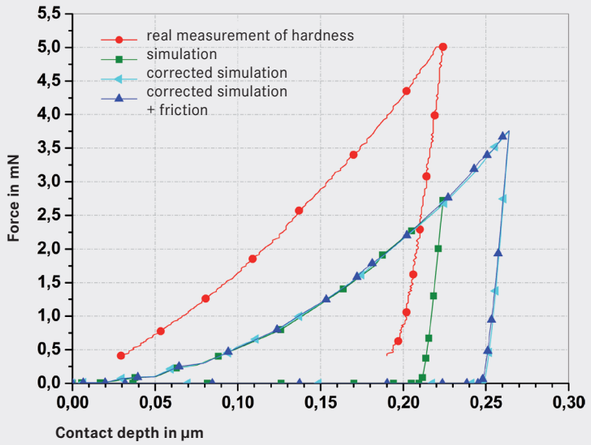
Layer and material analysis

Hardness tests, layer hardness tests

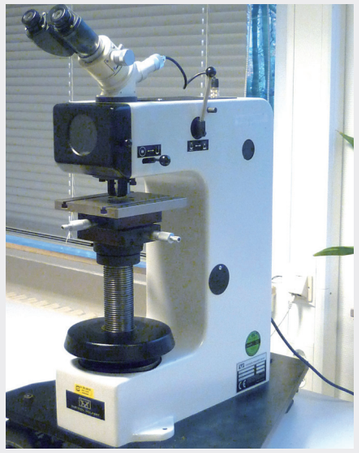




Hardness and E-module test on thin layers; nano-indentation method in combination with a topography scan



Nano-indentation force versus displacement curve

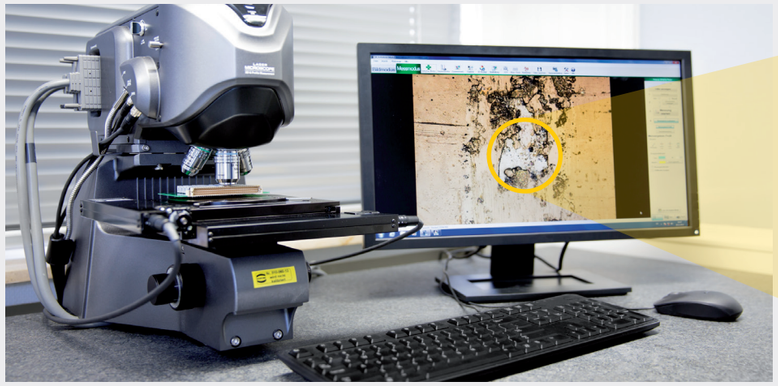


Vickers hardness measuring station

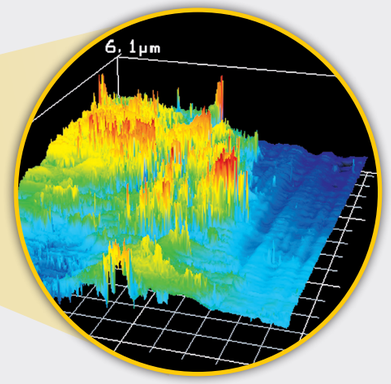
Technical specifications and test areas		
Grid cut		DIN EN ISO 2409
Hardness according to Vickers	0,5 N – 95 N	DIN EN ISO 6507-1
Nano-indentation	Max. force: 500 mN Max. displacement: 4 µm	ISO 14 577 -1

Layer and material analysis

Microscopic examinations

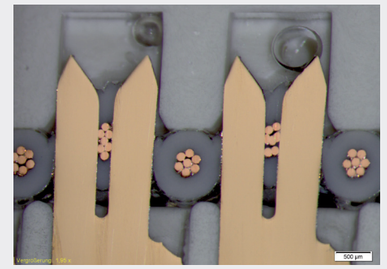


3D measurements with laser scanning microscope



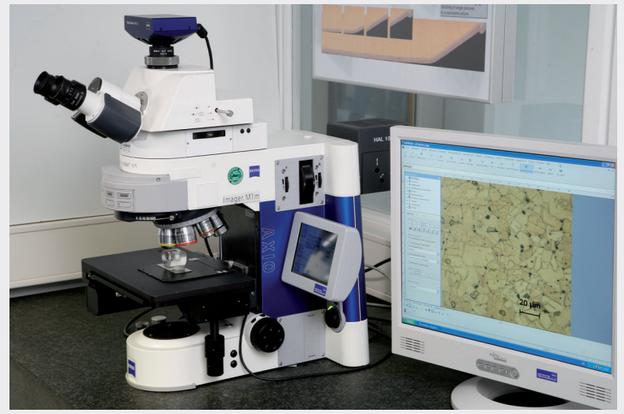
Surface structure of a contact after mating cycles

Microscopic examination of the cross section of a crimp contact



Cross section - IDC

Sample preparation

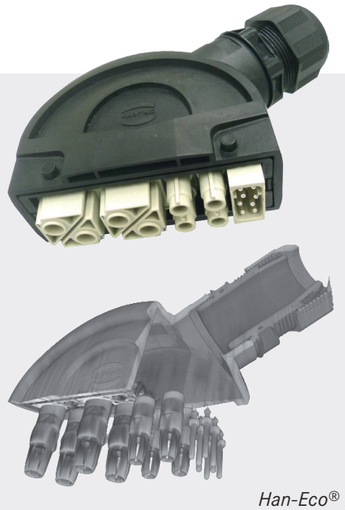


Microstructure analysis on Zeiss material microscope; determination of the β-phase (in % of area) of brass

Industrial computed tomography

Measuring technology and analytics

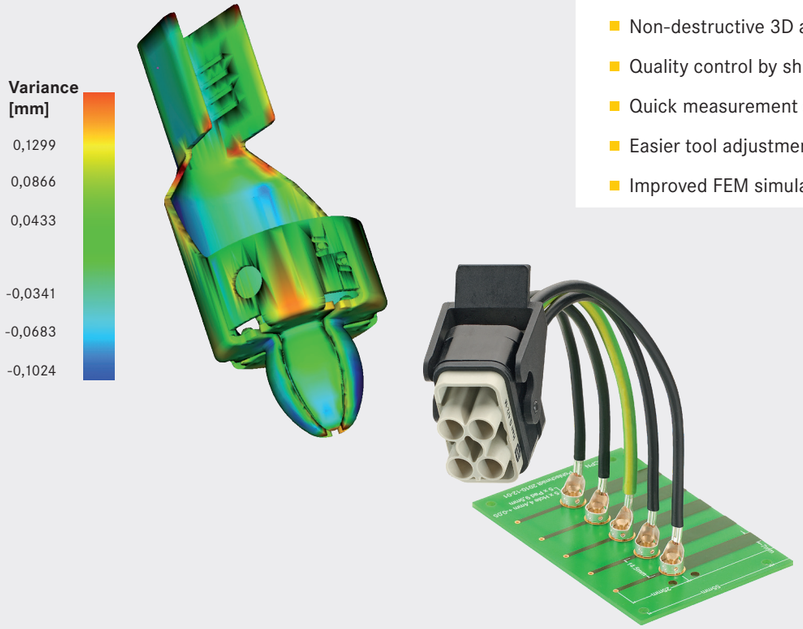
Computer tomograph ; 3D image and analysis



Han-Eco® 24B

Our range of services

- Non-destructive 3D analysis
- Quality control by shrink hole analysis
- Quick measurement of components
- Easier tool adjustments
- Improved FEM simulations

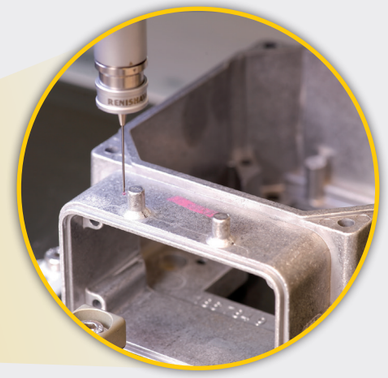


Han-Fast® Lock; Measurement of contours (cross section through terminaton area) and wrong color comparison

Technical specifications and test areas	
Industrial computed tomography (CT); Digitizing of products	Detailed resolution: 5 µm Size of test object: Ø 35 cm x Height 65 cm Size of detector: (40 x 40) cm with (2000 x 2000) pixels DIN EN 16016-3

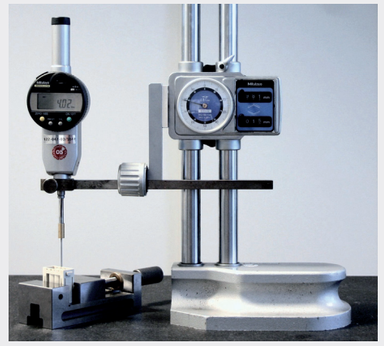
Dimensional measuring technology

Optical and tactile dimensional measurement



3D coordinate measuring machine; geometric measurement of an industrial connector in anair-conditioned room

Target-actual comparison (2D contour scanning) of a C-housing spring to its ideal geometrical specification

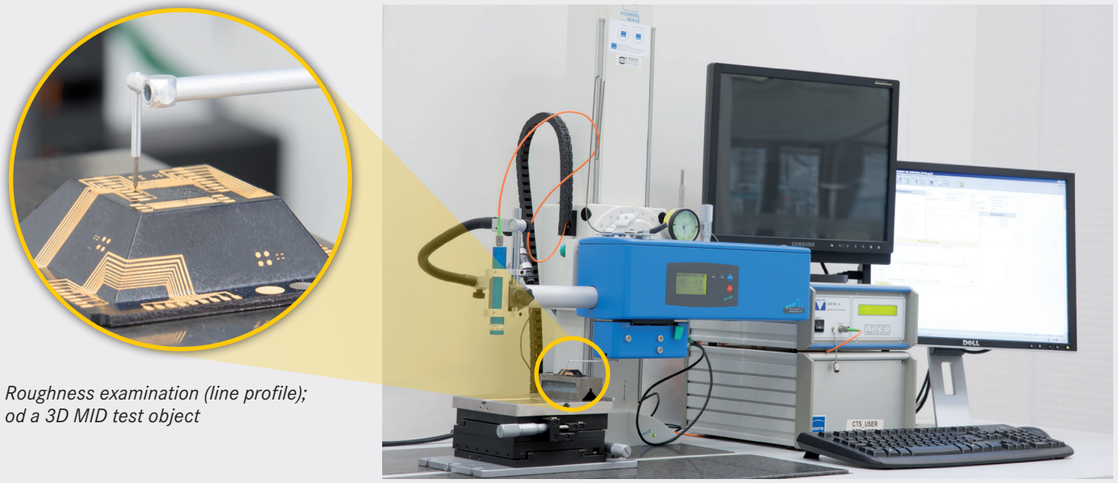


Dial indicator

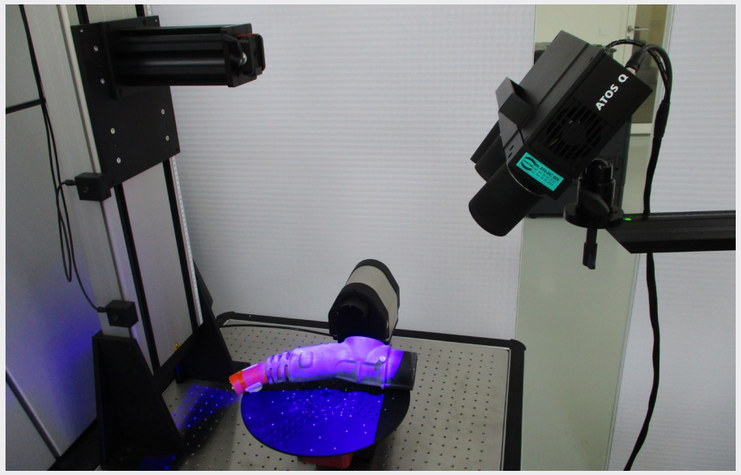
Technical specifications and test areas	
Coordinate measuring technology (3D, 2D coordinate measuring machines, 1D, 2D hand-held test equipment)	Measuring accuracy according to VDI 2617 X-Y axis: U_2 = (2.5+5L/1000) µm Z axis: U_1 = (2.0+L/1000) µm Resolution 1 µm 500(X) mm x 610(Y) mm x 300(Z) mm DIN EN 60512-1-2
HWN 121.00.17	
Initial sample submission report ISSR	
Verification of the ability of machines/processes and testing instruments	Test instruction for the documentation and execution of dimensional first-sample testing

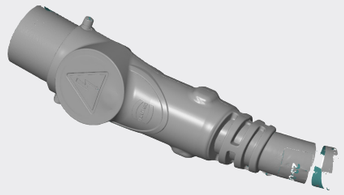
Dimensional measuring technology

Roughness measurement and stripe light scan



Roughness examination (line profile); od a 3D MID test object





Stripe light scanner and stripe light scan

Technical specifications and test areas		
Tests of surfaces (surface profile, roughness, ripples, bearing ratios)	Test range 0,56 mm up to 17,5 mm max. lenght 56 mm	DIN EN ISO 4288 / 4287
Stripe light scan		
Measuring fields 100x70x60 270x200x200	Camera resolution 12 Megapixle	Accuracy 0.02 mm

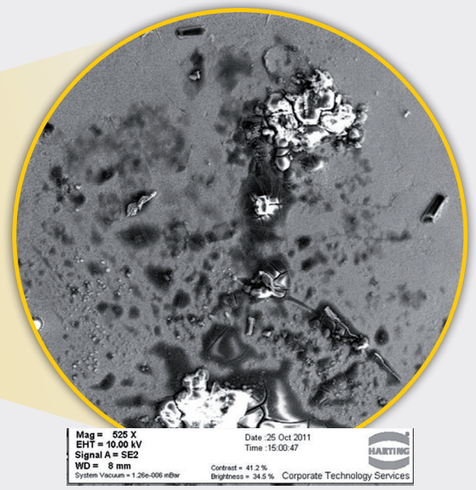
Climatic and environmental tests

Industry atmosphere, corrosion tests

Test gases: NO_2 H_2S SO_2 Cl_2

Weighing of galvanically coated testing plates before and after the flowing mixed gas corrosion test

Flowing mixed gas corrosion test with analytics



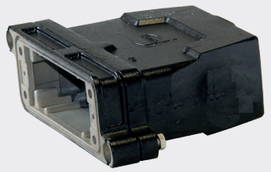
Corrosion example (SEM/EDX analysis)
PVD coated contact
Flowing mixed gas corrosion test, method 4, 10 days

Technical specifications and test areas		
Flowing mixed gas corrosion test	H_2S / NO_2 / SO_2 / Cl_2 in ppb-range 75 % rel. humidity; 25 °C	DIN EN 60512-11-7 DIN EN 60068-2-60

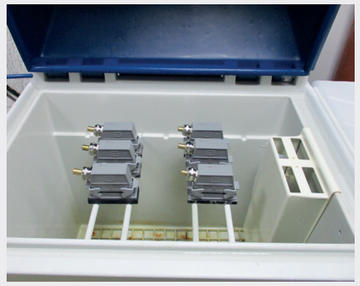
Climatic and environmental tests

Corrosion and climatic tests

Influence of salt mist on a test object (alloy of die-cast aluminum) without corrosion-resistant surface



Han® HPR housing with corrosion-resistant surface



Salt spray chamber with test specimens

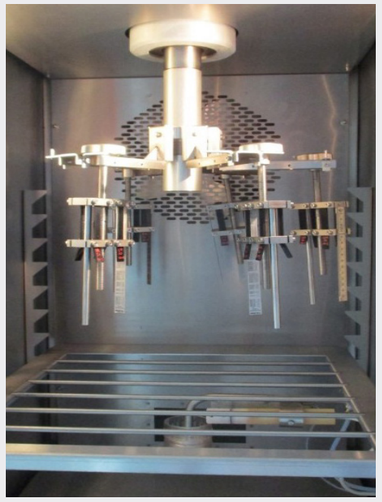
Ageing in dry heat

Technical specifications and test areas		
Damp heat constant and cyclic	-75 °C - 180 °C 20 - 98 % rel. humidity	IEC 60512-11-3 IEC 60512-11-12
Dry heat	+300 °C Test volume up to 1000 l	IEC 60512-11-9 IEC 60068-2-2
Rapid change of temperature (two chamber process)	-75 °C up to 220 °C	IEC 60512-11-4 IEC 60068-2-14
Cold	-75 °C	IEC 60512-11-10 IEC 60068-2-1
Corrosion Salt spray	+35 °C, 5 % NaCl	IEC 60512-11-6 ISO 9227
Condensed water Constant climate	100 % rel. humidity 20 °C - 60 °C	DIN EN ISO 6270-2
Nitric acid vapour test	Typical concentrations	ASTM B 735

Climatic and environmental tests

Solar radiation, UV, ozone

Ozone test chamber: application in the aging and testing of material



Ozone ageing

Simulation of global solar radiation

Technical specifications and test areas		
Simulated solar radiation at ground level	1090 W/m² ± 10 % Irradiation phase 40 °C Dark phase 25 °C	DIN EN 60068-2-5
Methods of exposure to laboratory light sources	102 min dry, 18 min spray, 60 W/m² (Method A) BST 65 °C; 38 °C; rel. humidity 50 % Wave length 300 nm – 400 nm (UV)	DIN EN ISO 4892-2
Elastomere: ozone resistance	Pre-treatment 3 h with (23 ± 5) °C (25 ± 2) °C, rel. humidity 60 % 3 ppm O_3, 24 h	DIN EN 60811-403
Elastomere: resistance to ozone cracking	(40 ± 2) °C; rel. humidity 60 % 0,5 ppm O_3, 24 h	DIN ISO 1431-1

Climatic and environmental tests

IP tests

IP test chamber for water with jet water test IPX5

DUT according to IP6X test

Code letters (International Protection) — **IP**

First Index Figure (Foreign bodies protection) — **6**

Second Index Figure (Water protection) — **5**

Index figure	Degree of protection			Index figure	Degree of protection		
5	Protection against injurious deposits of dust		Full protection against contact. Protection against interior injurious dust deposits	5	Hose-proof		Protection against water (out of a nozzle) from all directions
6	Protection against ingress of dust		Total protection against contact. Protection against penetration of dust	6	Strong hose-proof		Protection against strong water (out of a nozzle) from all directions

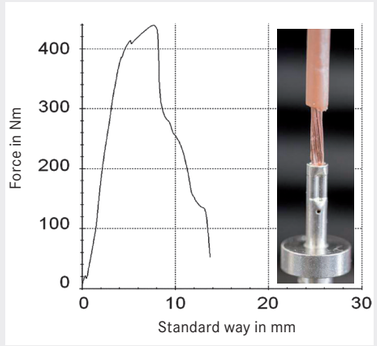
Typical IP-tests

Technical specifications and test areas		
IP protection class testing	IP1X - IP6X (dust-proof) IPX3 - IPX9 (High pressure steam jet)	DIN EN 60529

Mechanical tests

Load-extension-diagrams

Insertion and removal under electrical load



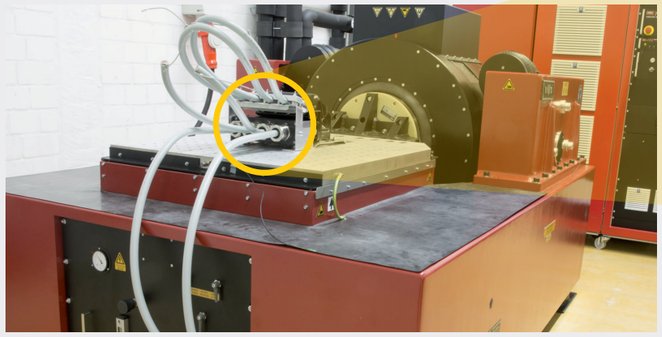
Determination of withdrawal forces

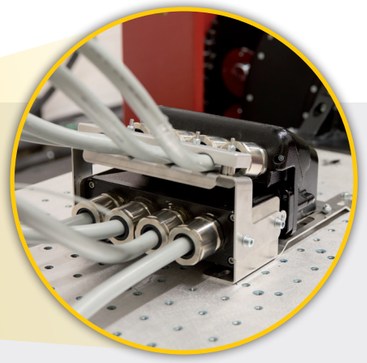
Precision load-extension measuring station, ZWICK

Technical specifications and test areas		
Load-extension-diagrams a.o. Insertion and withdrawal force; Spring characteristics	0,01 kN – 50,00 kN Force transducer 0,01 kN; 0,10 kN; 0,20 kN; 0,50 kN; 1,00 kN; 2,50 kN; 5,00 kN; 20,00 kN; 50,00 kN	IEC 60512-13-2 IEC 60512-9-3 IEC 60512-16-4 IEC 60999-1
Insertion and withdrawal force under load; Durability testing	up to 800 mm/s	DIN EN 60512-99-001 VDE 0687-512-99-001 IEC 60512-9-3
Mechanical life time (mating cycles)	up to 600 mm/min	IEC 60512-9-1

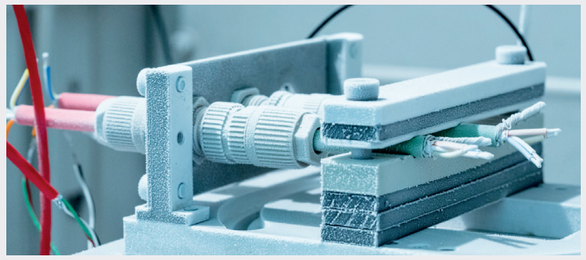
Mechanical tests

Vibration and shock tests



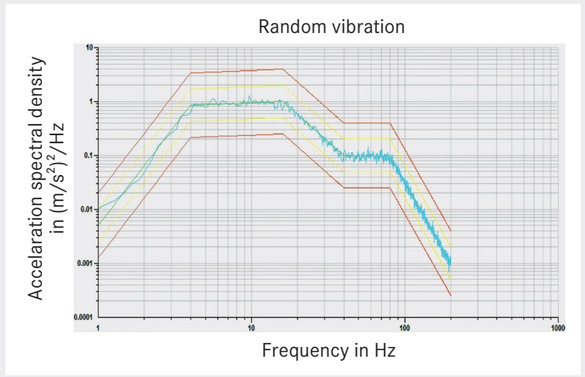


Noise test on a sliding table with a front side industrial connector of a railway application



Vibration test at -60 °C

Vibration test with climatic overlay and current load

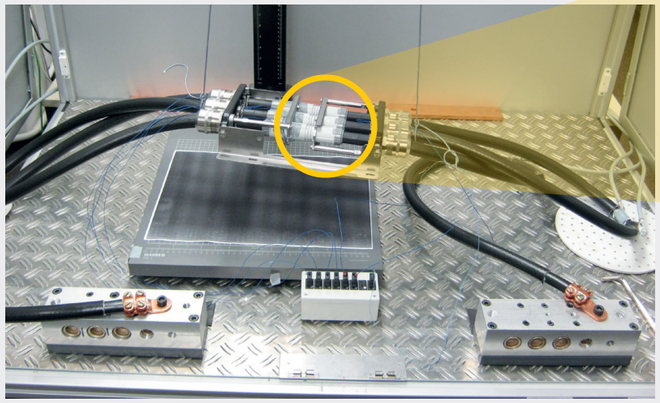


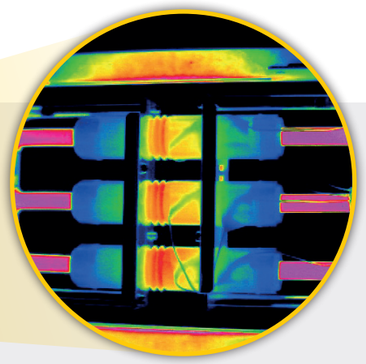
Noise profile

Technical specifications and test areas		
Vibration, sinusoidal	5 Hz - 2000 Hz	IEC 60068-2-6
Vibration, noise profile		IEC 60068-2-64
		IEC 61373
Mechanical shock	100 *g* / 6 ms	IEC 60068-2-27
	Weight of specimen including mounting device up to 500 kg	IEC 61373

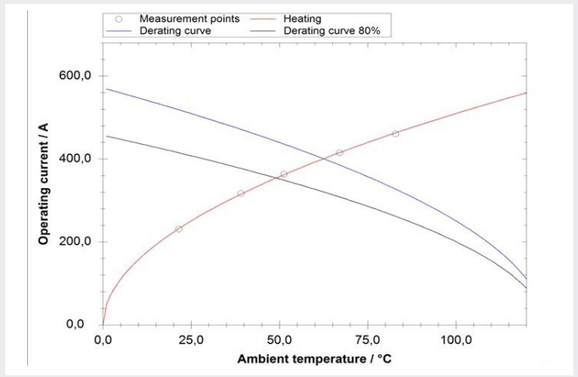
Electrical tests

Current load capacity, derating

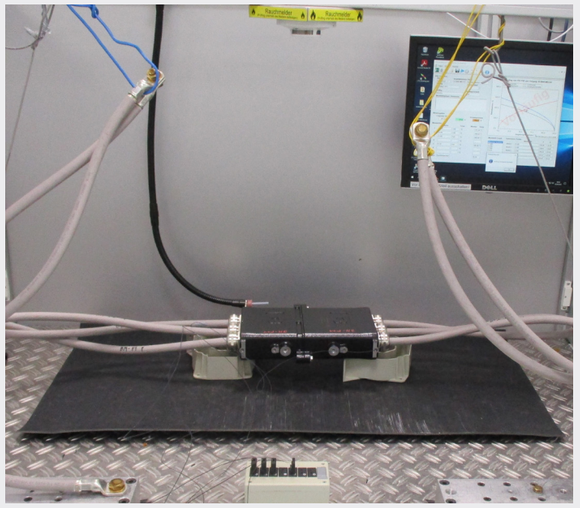




Infrared image of the heat distribution during a current carrying capacity test



Derating-diagram

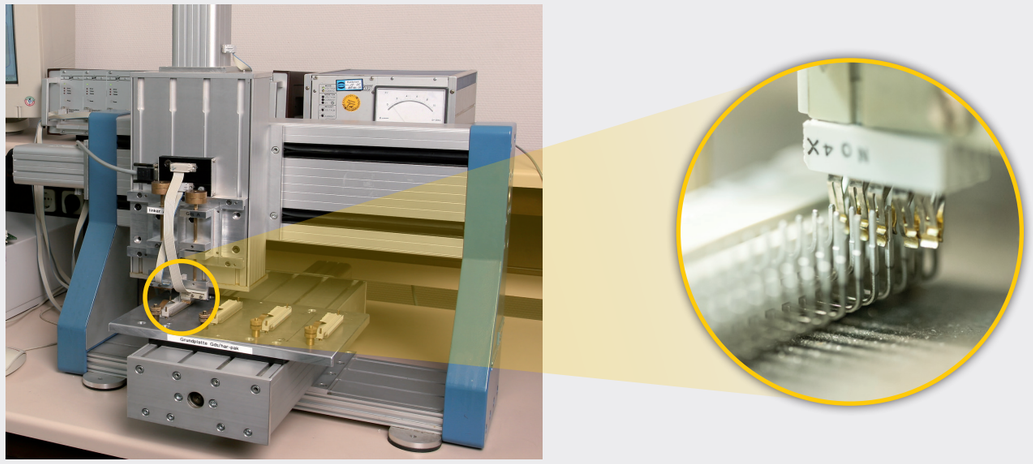


Current load test equipment, derating

Technical specifications and test areas		
Current load, application-orientedcurrent profile	up to 2000 A	IEC 60512-5-1
		IEC 60512-5-2
Current pulses	≥ 100 ms	

Electrical tests

Automated measuring stations



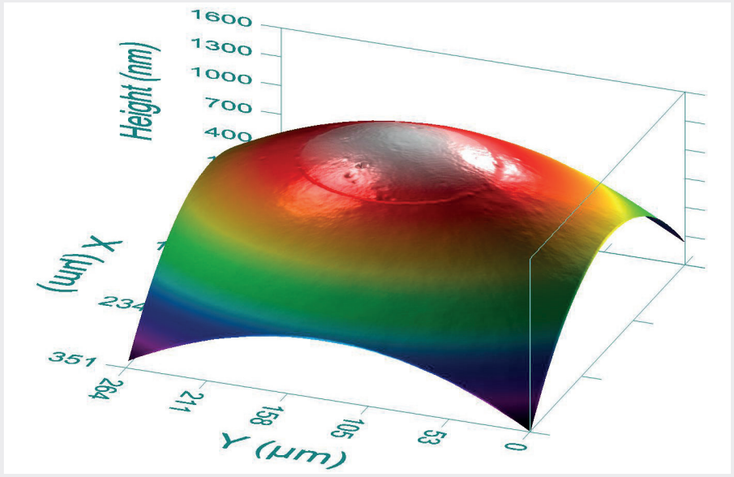
Automated measurements of contact resistance of DIN connectors

Measuring adapter for automated resistance measurements (resistance, insulating resistance)

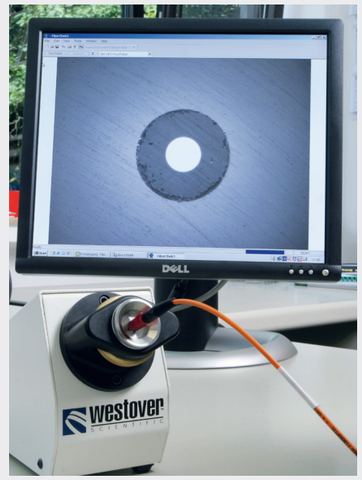
Technical specifications and test areas		
Contact resistance	≥ 1 µΩ	IEC 60512-2-1
Contact disturbances (contact interruptions)	$t_i \geq 1$ µs and $t_i \geq 25$ ns	IEC 60512-2-5
Insulation resistance	$\geq 10^8$ Ω	IEC 60512-3-1
Stand and withstand voltage	Curve shape 1,2/50 µs up to 20 kV	DIN EN 60664-1 DIN EN 61984
Voltage proof	up to 14 kV DC, 10 kV AC r.m.s. Leakage current	IEC 60512-4-1
Current-carrying capacity (derating curve)	up to 2000 A	IEC 60512-5-2
Electrical load at high temperature	up to 1500 A; 220 °C	IEC 60512-9-2

Fibre-Optics

Fibre-optic cables, connecting elements, passive and active components



Optical end-face geometry with Michelson interferometer



End-face examination of 50/125µm fibreoptic multi-mode connector

Our range of services

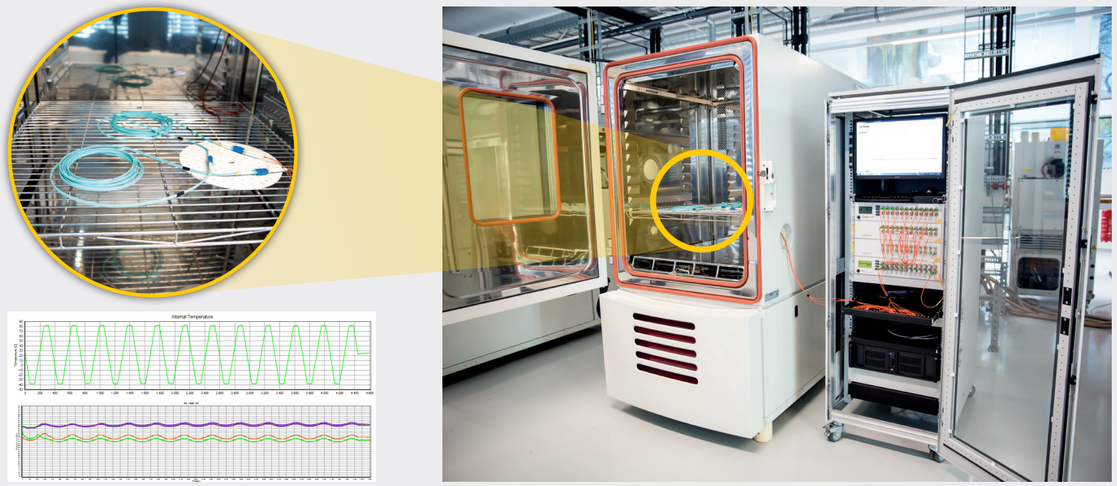
- Measurement of attenuation and return loss on typical fibres and with typical wavelengths
- Recording the change in attenuation and return loss under climatic and mechanical stress
- Characterisation of end face geometry
- OTDR/OFDR measurements

Cable assembly with PushPull plastic and SCRJ POF inserts

Technical specifications and test areas		
For components with single- and multimode glass-fibres, HCS and polymer optical fibres		
Attenuation measurements	660 nm, 850 nm, 1310 nm 1490 nm, 1550 nm, 1625 nm	DIN EN 61 300-3-4 DIN EN 61 300-3-34
Changes in attenuation and return loss	up to 24 channels / fibres	DIN EN 61 300-3-3
Transient attenuation	Sampling rate 2 ms	DIN EN 61300-3-28
Return loss	for single and multi-mode glass fibres up to 80 dB	DIN EN 61300-3-6
End face geometry ■ Eccentricity ■ Radius ■ Fibre position	for 1.25 mm and 2.5 mm ferrules	DIN EN 61300-3-47 DIN EN 61300-3-15 DIN EN 61300-3-16 DIN EN 61300-3-23
Visual inspection	for single and multi-mode glass fibres	DIN EN 61300-3-35

Fibre-Optics

Fibre-optic cables, connecting elements, passive and active components

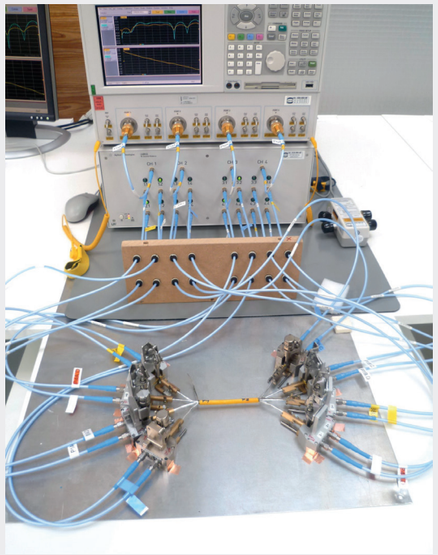


Recording the change in attenuation and return loss under climatic and mechanical stress

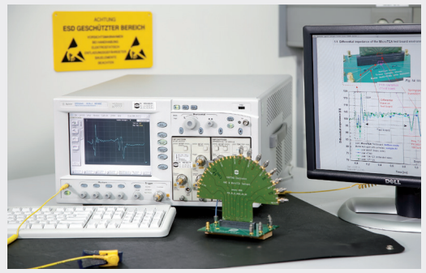
Technical specifications and test areas		
For components with single- and multimode glass-fibres, HCS and polymer optical fibres		
Climatic tests with attenuation change, e.g.:	up to 24 channels / fibres	DIN EN 61300-3-3
Cold	up to -70 °C	DIN EN 61300-2-17
Dry heat	up to +300 °C	DIN EN 61300-2-18
Damp heat	10 - 98 % rel. humidity	DIN EN 61300-2-19
Temperature changes	3 K / min	DIN EN 61300-2-22
Mechanical tests, e.g.:	up to 16 channels / fibres	
Vibration test	5 Hz - 2000 Hz	DIN EN 61300-2-1
Shock	100 g / 6 ms	DIN EN 61300-2-9
Fibre / cable retention		DIN EN 61300-2-4
Torsion	2 Nm	DIN EN 61300-2-5
Power measurements	1 pW up to 10 mW 380 nm up to 1700 nm	
Time domain OTDR		DIN EN 61280-4-1
Spatial resolution	0,25 m	DIN EN 61280-4-2
Wave length	650 nm, 850 nm, 1300 nm; 1310 nm; 1550 nm, 1625 nm	
Fibre types	Single and multi-mode glass fibres; POF	
Frequency domain OFDR Spatial resolution / sensitivity	10 µm / up to -130 dB	

Signal integrity

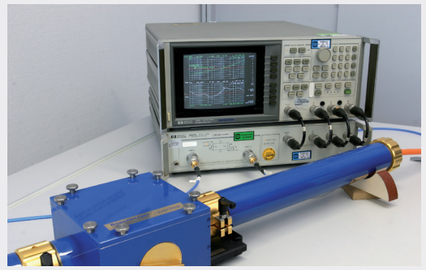
Analysis in time- and frequency domain



Characterisation of the signal integrity up to 20 GHz



Differential TDR with impedance profile

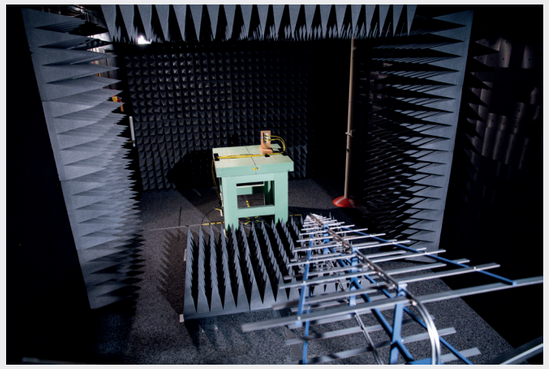


Determination of the transfer impedance of shielded cables and connectors

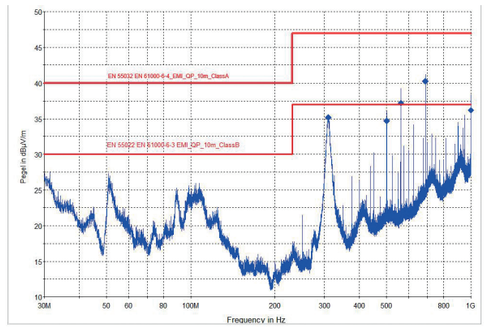
Technical specifications and test areas		
Measurement in time- and frequency domain (single-ended, differential)		
Characteristic impedance	Rise time ≥ 35 ps	IEC 60512-23-4
Reflection		IEC 60512-25-3
Rise time degradation		IEC 60512-25-4
Propagation delay		IEC 60512-25-1
Crosstalk		DIN EN 60512-25-6
Insertion loss	300 kHz - 20GHz	IEC 60512-25-2
Return loss, VSWR		IEC 60512-25-5
Crosstalk (Next, Fext)		IEC 60512-25-1
Transfer impedance (line injection method, triaxial method)	From 300 kHz	IEC 62153-4-3 IEC 62153-4-5 IEC 62153-4-6 IEC 62153-4-7
Screening attenuation		IEC 62153-4-11
Coupling attenuation		IEC 62153-4-12
Characterisation of Ethernet components and transmission lines	Category 5, 6, 6_A, 7, 7_A, 8.1, 8.2 Class D, E, E_A, F, F_A, I, II	ISO/IEC 11801-x IEC 60512-26-100 IEC 60512-27-100 IEC 60512-28-100 IEC 60512-29-100 IEC 61935

Electromagnetic compatibility

Emission, radiated and conducted



Radiated emission in the anechoic chamber (FAR)



Testing of the interference emission

- Multimedia devices/equipment (DIN EN 55032)
- Electrical and electronic devices for residential, commercial and light-industrial environments (DIN EN 61000-6-3)
- Electrical and electronic devices for industrial environments (DIN EN 61000-6-4)
- Rolling stock - Apparatus (DIN EN 50121-3-2)
- Railway applications: signaling and telecommunications apparatus (DIN EN 50121-4)
- Household appliances, electric tools (DIN EN 55014-1)

Technical specifications and test areas		
Examination of interference voltage	9 kHz - 30 MHz	DIN EN 55032 DIN EN 55016-2-1
Examination (flicker) of harmonics	single phase, 16 A	DIN EN 61000-3-2 DIN EN 61000-3-3
Interference emission, radiated	30 MHz - 6000 MHz	DIN EN 55032 DIN EN 55016-2-3
Magnetic, electric fields	16 2/3 Hz, 50 Hz	26. BImschV

Electromagnetic compatibility

Interference immunity, radiated and conducted

Examination of the interference immunity against high energetic, transient interference pulses (Surge)

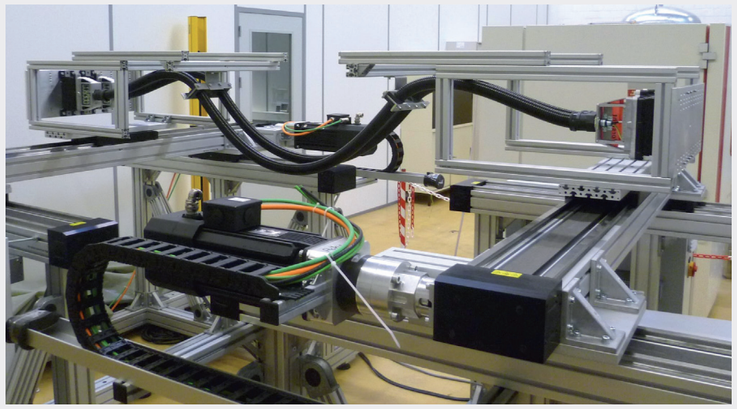
Testing of the interference immunity

- Multimedia devices/equipment (DIN EN 55035)
- Electrical and electronic devices for residential, commercial areas and light-industrial environments (DIN EN 61000-6-1)
- Electrical and electronic devices for industrial environments (DIN EN 61000-6-2)
- Rolling stock - Apparatus (DIN EN 50121-3-2)
- Railway applications: signaling and telecommunications equipment (DIN EN 50121-4)
- Household appliances, electric tools (DIN EN 55014-2)

Technical specifications and test areas		
Interference immunity against electromagnetic fields	80 MHz – 1000 MHz (20 V/m) 1000 MHz – 2700 MHz (10 V/m) 2700 MHz – 6000 MHz (3 V/m)	DIN EN 61000-4-3
Interference immunity against conducted RF-fields	150 kHz - 80 MHz 10 V	DIN EN 61000-4-6
Interference immunity against high frequent pulse trains (transient burst)	5,5 kV	DIN EN 61000-4-4
Interference immunity against high energetic, transient interference pulses (Surge)	5 kV	DIN EN 61000-4-5
Interference immunity against electrostatic discharge (ESD)	Air: 16 kV Contact: 10 kV	DIN EN 61000-4-2
Interference immunity against interruptions of power supply	single phase	DIN EN 61000-4-11 DIN EN 61000-4-29

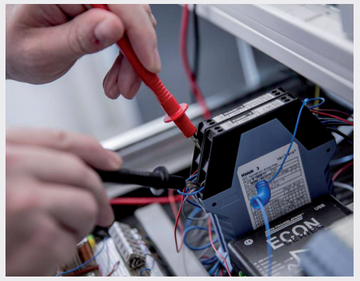
Testing instruments, software

Construction of test equipment for examinations close to the application

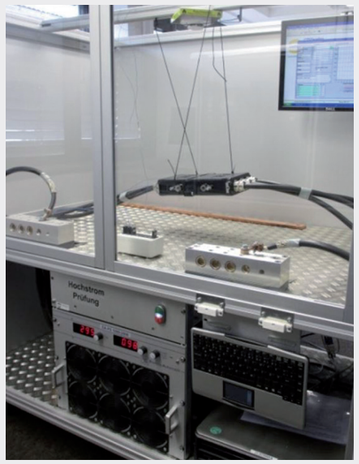


Test setup for simulation of movement cycles between railway wagons

CTS software MeaDocs



Testing equipment for examination of current load with software evaluation



Test setup for electrical heating

Technical specifications and test areas		
Construction and setup of individual test equipment according to customer specifications		
Development of software for the automation of tests and workflows		
Calibration of the test equipment according to the requirements of ISO 17025	■ Temperature -75° up to 250 °C	■ Air humidity 20 % up to 95 % r. h.
Development of software	■ Evaluation / visualisation ■ Testing software ■ Office Add In ■ Database applications	

HARTING

Pushing Performance
Since 1945

Contact:
HARTING Technology Group
Sekretariat.CTS@HARTING.com
Tel. 05772/47-1406

September 2023 Version 4