



EMC - TEST REPORT

Type / Model Name : Inductive Charging System

Product Description : Inductive Charging System

Applicant : BRUSA Elektronik AG

Address : Neudorf 14

9466 SENNWALD - SWITZERLAND

Manufacturer : Zollner Elektronik AG

Address : Manfred-Zollner-Straße 1

93499 ZANDT - GERMANY

Test Result according to the standards listed in clause 1 test standards:	Positive
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Test Report No. :	E44937-00-03AS	04. March 2019 Date of issue
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02



Bundesnetzagentur

BNetzA-CAB-13/21-07

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 18 - INDUSTRIAL, SCIENTIFIC, AND MEDICAL EQUIPMENT (October, 2018)

Part 18, Subpart C, Section 18.307	AC Line conducted emission
Part 18, Subpart C, Section 18.305	Radiated emission, general requirements
FCC/OET MP-5: (1986)	FCC MP-5, "FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical equipment
CISPR 16-4-2: 2011 + A1: 2014 EN 55016-4-2: 2011	Uncertainty in EMC measurement provided

2 SUMMARY

2.1 General remarks

Note: insert informative statements in User Manual!

This report only contains results according Part 18.

This is a composite application. A separately provided Part 15 C Report is filed under this FCC ID:
 FCC ID GPM: 2AK2AICS115C
 FCC ID CPM: 2AK2AICS115

**This Revision of the test report contains no pictures.
 All Pictures visible in test report E44397-00-02AS!**

2.2 Summary for all EMC tests

Type of test	Test result
Emission:	
A4 Conducted emission (AC mains power / DC power)	Fulfilled
A5 Radiated emission (< 1 GHz)	Fulfilled
SER 3 Radiated emission (> 1 GHz)	Not applicable

2.3 Final assessment

The equipment under test **fulfills** the EMC requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records
 Testing commenced on : 07. January 2019
 Testing concluded on : 08. January 2019

Checked by:

Tested by:

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EuT

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Dimension of mimic incl. CPM (car pad module): 120cm * 120cm

Thickness of mimic: 2 mm

Distance between GPM (ground pad module) and ground plane: differs between 2mm and 12mm

Distance between GPM (ground pad module) and mimic incl. CPM (car pad module): 8cm

Height of GPM (ground pad module): 6,32cm

Distance between ground plane and mimic incl. CPM (car pad module): 14,32cm

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Position of the "receiving antenna"

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This Revision of the test report contains no pictures.
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3.2 Power supply system utilised

Power supply voltage : 240 V 60 Hz

All tests were carried out with a supply voltage of 240 V, 60 Hz unless otherwise stated.

3.3 Highest internal frequency

Highest internal frequency : 81.4 – 89.9 kHz Wireless Power Transfer (FCC Part 18)
125 kHz SRD Positioning System (FCC Part 15 DCD Report)
2.4 GHz – 2.4835 GHz W-LAN (FCC Part 15 DTS Report)
6.3 MHz LOD
1.8 MHz FOD

According to the manufacturer's statement, the highest internally used frequency according FCC Part 18 is less than 1.705 MHz.

Per 3.2 MP5 (1986): The maximum observed frequency variation is 81.4 kHz to 83 kHz.
The manufacturer maximum permitted frequency variation is 81.4 kHz to 89.9 kHz.

3.4 Short description of the Equipment under Test (EuT)

Inductive Charging System used in home environment. The Device is floor mounted.
The product is an inductive wireless charging system used for charging electric vehicle or hybrid power vehicle.
The system is consisted of one GPM (ground pad module) and one CPM (car pad module). The system use 85 kHz for charging (power transfer), 125 kHz for positioning, and 2.4 GHz Wi-Fi technology for communication.

Number of tested samples: 1
QR Code Numbers: 01201803061000020000011135863 (QR code of GPM)
178801803260163ICSS115-U0-01D-L01 (QR code of CPM)

Specifications according statement of the Customer:

Ground Pad Modul (GPM)

Version: GPM C1.2
Software version: 06-04-20
Serial number: 1803070022
Production date: 03/2018

Car Pad Modul (CPM)

Version: CPM D0
Software version: 09-52-20
Serial number: 18003260163
Production date: 03/2018

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Accreditation and Recognition of the test laboratory

Within the framework of the Mutual Recognition Agreement (MRA) between the European Community and the USA the EMC test laboratory listed above has been approved as a Conformity Assessment Body (CAB) designated by the EU member states through the conclusion of the MRA on the basis of Article 133 of the treaty

The site is accredited/registered by

- the German accreditation body DAkkS-Registration No.: D-PL-12030-01-01
- the Federal Communications Commission (FCC) Registration Number: 0013864798
- the German Federal Network Agency as Conformity assessment body (CAB) Registration No: BnetzA-CAB-13/21-07

4.3 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.4 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.6 Measurement protocol for FCC

4.6.1 General information

4.6.1.1 Test methodology

In compliance with 47 CFR FCC Rules and Regulations Part 18 - INDUSTRIAL, SCIENTIFIC, AND MEDICAL EQUIPMENT testing for FCC compliance may be done following the FCC/OET MP-5: (1986) procedures and using the FCC Part 18 Limits.

4.6.1.2 Justification

The Equipment under Test (EuT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.6.2 Details of test procedures

4.6.2.1 General standard information

The test methods used comply with FCC MP-5, "FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical equipment

4.6.3 Conducted emission

4.6.3.1 Description of measurement

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EuT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. Floor standing equipment is placed directly on the 2 meters square ground plane. The setup of the equipment under test is established in accordance with FCC/OET MP-5: (1986) section 7. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.6.4 Radiated emission (electrical field 9 kHz – 1 GHz)

4.6.4.1 Description of measurement

Spurious emission from the EuT is measured in the frequency range of 9 kHz to 30 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 9 kHz and 150 kHz are made with 200 Hz/6 dB bandwidth and average detection. Measurements between 150 kHz and 30 MHz are made with 9 kHz/6 dB bandwidth and average detection. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with FCC/OET MP-5: (1986). The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area.

The antenna is positioned 3, 10 or 30 metres horizontally from the EuT.

To locate maximum emissions from the test sample in the frequency range 9 kHz to 30 MHz, the EuT is rotated 360 degrees.

To locate maximum emissions from the test sample in the frequency range 30 MHz to 1 GHz the antenna is varied in height from 1 to 4 metres, measurement scans are made with both horizontal and vertical antenna polarization planes and the EuT is rotated 360 degrees.

The final level, expressed in dBµV/m, is arrived at by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver where the correction factors are stored. The FCC or CISPR limit is subtracted from this result in order to provide the limit margins listed in the measurement protocols.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz:	ResBW: 200 Hz
150 kHz – 30 MHz:	ResBW: 9 kHz
30 MHz – 1000 MHz:	ResBW: 120 kHz

Example:

Frequency (MHz)	Reading level (dBµV)	+	Correction Factor* (dB/m)	=	Level (dBµV/m)	-	CISPR Limit (dBµV/m)	=	Delta (dB)
0.081	49.4	+	22.0	=	71.4	-	91.8	=	-20.4

*Correction Factor = Antenna Factor + Cable Attenuation = 20 dB/m + 2.0 dB = 22 dB/m

The field strength limits according FCC Part 18 Subpart C §18.305:

15µV/m @ 300 meter distance: $20 * \log_{10}(15\mu V) = 23.522 \text{ dB}\mu V/m$

The extrapolation factor was determined as follows: (Please see section 5.2.4 in this report for details!)

103.4 dBµV/m @ 10m distance minus 70.8 dBµV/m @ 30m distance results in **68.3dB/decade**

The field strength limits at 30 meter distance was calculated as follows:

23.5 dBµV/m + 68.3 dB/decade = 91.8 dBµV/m

4.6.4.2 Measurement Procedure

The test setup is prepared with the EUT at the desired EUT-Antenna separation.

The turntable is rotated 360° until the test receiver displays the maximum level at the observed frequency.

The antenna height is 1.82 m for measurements below 30 MHz

The antenna height is then adjusted from 1 m to 4 m maximizing the measured value for measurements above 30 MHz.

The turntable is re-adjusted to re-affirm the maximum emission value which is then recorded.

This procedure is repeated for all frequencies of interest.

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emission

For test instruments and accessories used see section 6 Part A 4.

Legend for tables:

QP-L ... QuasiPeak reading including correction factor

AV-L ... Average reading including correction factor

D-Limit... Measured value to limit delta (margin)

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test setup

This Revision of the test report contains no pictures.
In test report E44397-00-02AS at this place a picture is visible!

5.1.3 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 3.52 dB at 0.897 MHz

The requirements are fulfilled.

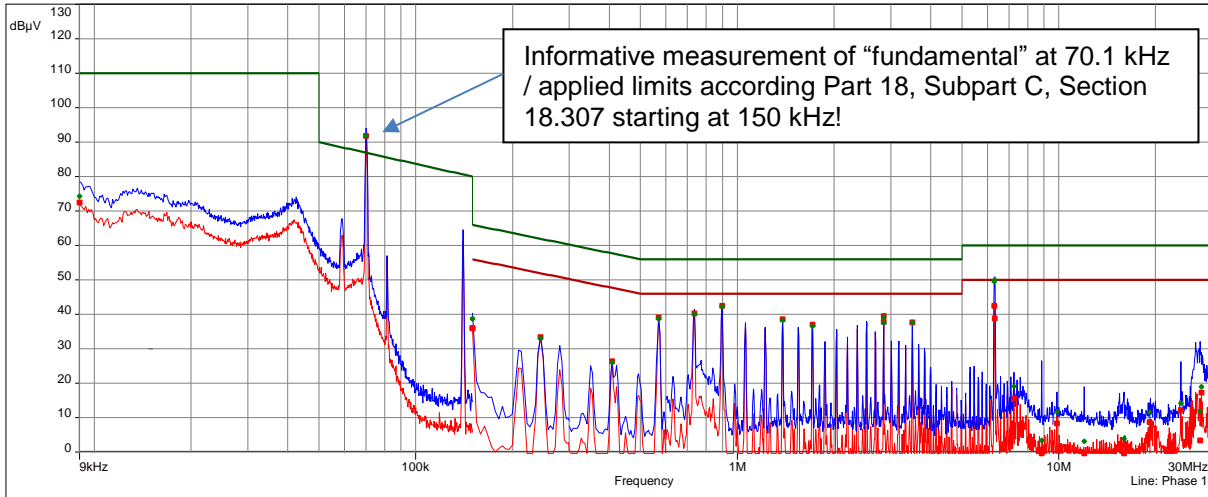
Remarks: For detailed results, please see the following page(s). _____
 For description of the measurement see 4.6.3. _____

5.1.4 Test protocol

Test point: L1
 Operation mode: charging 75% load (worst case)
 Remarks: None
 Date: 08. January 2019
 Tested by: Andreas Franz

Result: fulfilled

- FCC/FCC Part 18_induction cooking - Average/
- FCC/FCC Part 18_induction cooking - QPeak/
- Meas.Peak (Phase 1)
- Mes. CISPR AVG (Phase 1)
- QuasiPeak (Finals) (Phase 1)
- CISPR AV (Finals) (Phase 1)



FCC/FCC Part 18_induction cooking

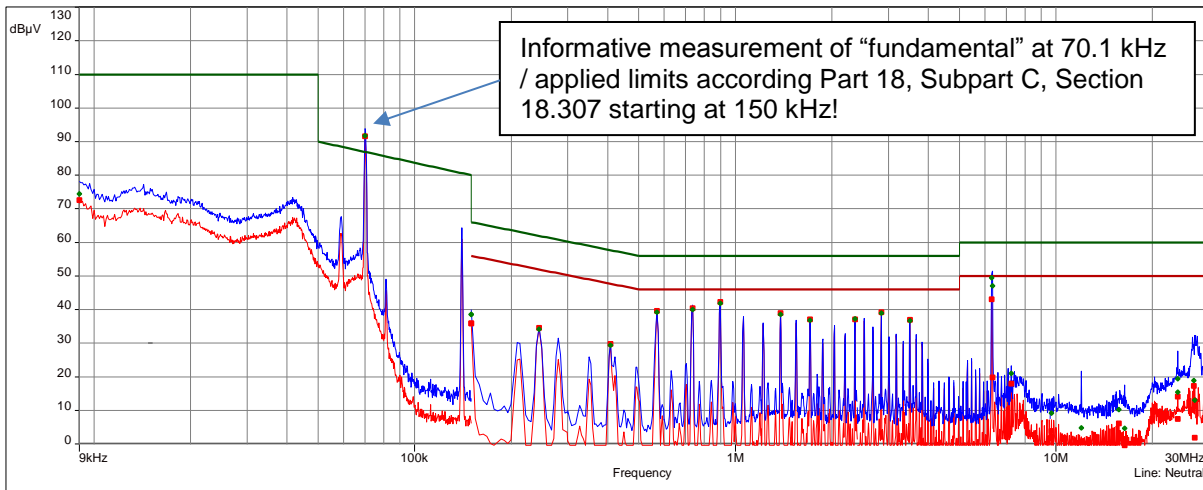
The correction factors of the Artificial Mains Network, Pulse Limiter and the cables are shown in Section 8 of this test report.

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.009	1	74.34	35.66	110.00	72.47			Phase 1	10.73
0.0701	1	91.88	-4.96	86.92	91.82			Phase 1	10.06
0.15	1	38.74	27.26	66.00	36.04	19.96	56.00	Phase 1	10.07
0.15	2	38.74	27.26	66.00	36.04	19.96	56.00	Phase 1	10.07
0.2445	2	33.07	28.87	61.94	33.41	18.53	51.94	Phase 1	10.10
0.408	3	25.99	31.70	57.69	26.35	21.34	47.69	Phase 1	10.14
0.57	3	38.75	17.25	56.00	39.12	6.88	46.00	Phase 1	10.15
0.735	4	40.14	15.86	56.00	40.24	5.76	46.00	Phase 1	10.18
0.897	4	42.16	13.84	56.00	42.48	3.52	46.00	Phase 1	10.19
1.3845	5	38.28	17.72	56.00	38.52	7.48	46.00	Phase 1	10.24
1.713	5	36.65	19.35	56.00	37.01	8.99	46.00	Phase 1	10.26
2.85	6	39.19	16.81	56.00	39.46	6.54	46.00	Phase 1	10.34
2.8545	6	37.56	18.44	56.00	37.86	8.14	46.00	Phase 1	10.34
3.5025	6	37.49	18.51	56.00	37.72	8.28	46.00	Phase 1	10.35
6.2985	7	49.46	10.54	60.00	42.41	7.59	50.00	Phase 1	10.55
6.312	7	49.98	10.02	60.00	38.90	11.10	50.00	Phase 1	10.55
7.248	7	19.11	40.89	60.00	15.55	34.45	50.00	Phase 1	10.61
8.85	7	3.42	56.58	60.00	-1.81	51.81	50.00	Phase 1	10.67
9.879	8	11.65	48.35	60.00	8.38	41.62	50.00	Phase 1	10.71
11.994	8	3.13	56.87	60.00	-2.03	52.03	50.00	Phase 1	10.87
15.9675	8	3.88	56.12	60.00	-2.20	52.20	50.00	Phase 1	11.15
19.1355	8	11.59	48.41	60.00	8.74	41.26	50.00	Phase 1	11.30
24.0015	9	14.11	45.89	60.00	12.18	37.82	50.00	Phase 1	11.46
27.489	9	11.79	48.21	60.00	3.38	46.62	50.00	Phase 1	11.43
27.768	9	18.91	41.09	60.00	17.25	32.75	50.00	Phase 1	11.42

Test point: N
 Operation mode: charging 75% load (worst case)
 Remarks: None
 Date: 08. January 2019
 Tested by: Andreas Franz

Result: fulfilled

- FCC/FCC Part 18_induction cooking - Average/
- FCC/FCC Part 18_induction cooking - QPeak/
- Meas.Peak (Neutral)
- Mes. CISPR AVG (Neutral)
- QuasiPeak (Finals) (Neutral)
- CISPR AV (Finals) (Neutral)



FCC/FCC Part 18_induction cooking

The correction factors of the Artificial Mains Network, Pulse Limiter and the cables are shown in Section 8 of this test report.

freq MHz	SR	QP dB(µV)	margin dB	limit dB	AV dB(µV)	margin dB	limit dB	line	corr dB
0.009	10	74.49	35.51	110.00	72.62			Neutral	10.79
0.0701	10	91.70	-4.77	86.92	91.63			Neutral	10.06
0.15	10	38.58	27.42	66.00	35.89	20.11	56.00	Neutral	10.08
0.15	11	38.58	27.42	66.00	35.89	20.11	56.00	Neutral	10.08
0.2445	11	34.21	27.74	61.94	34.57	17.37	51.94	Neutral	10.11
0.408	12	29.38	28.31	57.69	29.78	17.91	47.69	Neutral	10.15
0.57	12	39.22	16.78	56.00	39.61	6.39	46.00	Neutral	10.16
0.735	13	40.02	15.98	56.00	40.40	5.60	46.00	Neutral	10.19
0.897	13	41.88	14.12	56.00	42.25	3.75	46.00	Neutral	10.19
1.3845	14	38.56	17.44	56.00	38.90	7.10	46.00	Neutral	10.25
1.7085	14	36.77	19.23	56.00	37.13	8.87	46.00	Neutral	10.27
2.361	14	37.24	18.76	56.00	37.06	8.94	46.00	Neutral	10.31
2.85	15	38.91	17.09	56.00	39.23	6.77	46.00	Neutral	10.35
3.5025	15	36.70	19.30	56.00	36.96	9.04	46.00	Neutral	10.36
6.303	16	49.51	10.49	60.00	43.05	6.95	50.00	Neutral	10.55
6.339	16	47.06	12.94	60.00	19.81	30.19	50.00	Neutral	10.55
7.248	16	20.95	39.05	60.00	17.92	32.08	50.00	Neutral	10.61
9.69	17	9.22	50.78	60.00	3.84	46.16	50.00	Neutral	10.69
12.003	17	4.76	55.24	60.00	0.72	49.28	50.00	Neutral	10.85
15.7065	17	10.19	49.81	60.00	6.13	43.87	50.00	Neutral	11.10
16.377	17	4.65	55.35	60.00	-1.27	51.27	50.00	Neutral	11.14
23.9925	18	15.44	44.56	60.00	7.45	42.55	50.00	Neutral	11.38
24.0015	18	19.36	40.64	60.00	14.10	35.90	50.00	Neutral	11.38
26.94	18	18.86	41.14	60.00	17.34	32.66	50.00	Neutral	11.31
27.075	18	13.01	46.99	60.00	1.90	48.10	50.00	Neutral	11.30

5.2 Radiated emission < 1 GHz (electric field)

For test instruments and accessories used see section 6 Part A 3.

Legend for tables:

Level vert. QuasiPeak reading including correction factor for vertically polarised antenna
Level hor. QuasiPeak reading including correction factor for horizontally polarised antenna
Limit Limit referred to the appropriate standard
DLimit... Delta between limit and result (margin)
Noise Characteristic of disturbance (narrowband or broadband)

5.2.1 Description of the test location

Test location: OATS 1

Test distance: 30 metres

5.2.2 Photo documentation of the test setup

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5.2.3 Test result

Frequency range: 9 kHz - 30 MHz

Min. limit margin 14.1 dB at 1.208 MHz

The requirements are fulfilled

Remarks: For detailed results, please see the following page(s).
For description of the measurement see 4.6.4.
Worst case was found at 75% load.
Positioning had no significant effect on the maximum level observed.

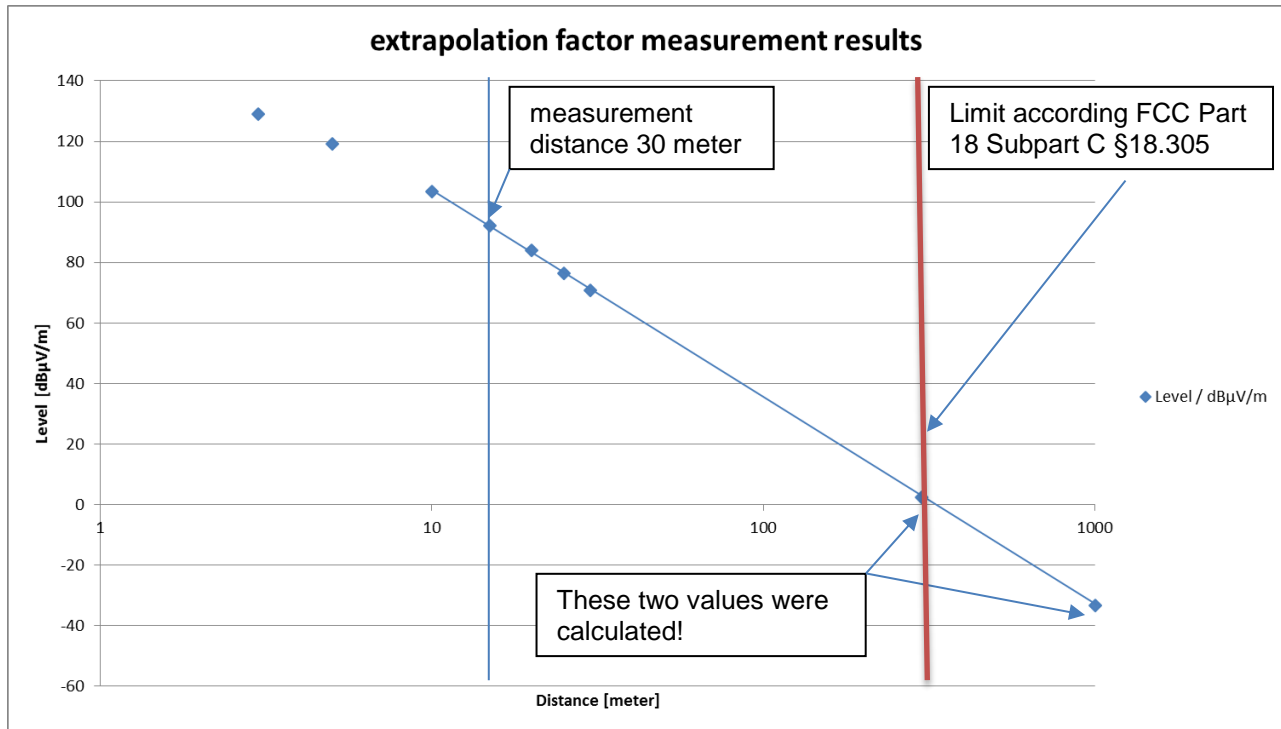
5.2.4 Test protocol

Per 2.2.6 Antenna-to-test unit distance:

Testing was performed at a closer distance than 300 meters.

To find the site attenuation extrapolation factor measurements were done at following distances:
3 meter, 5 meter, 10 meter, 15 meter, 20 meter, 25 meter, 30 meter

The frequency of interest was 82 kHz

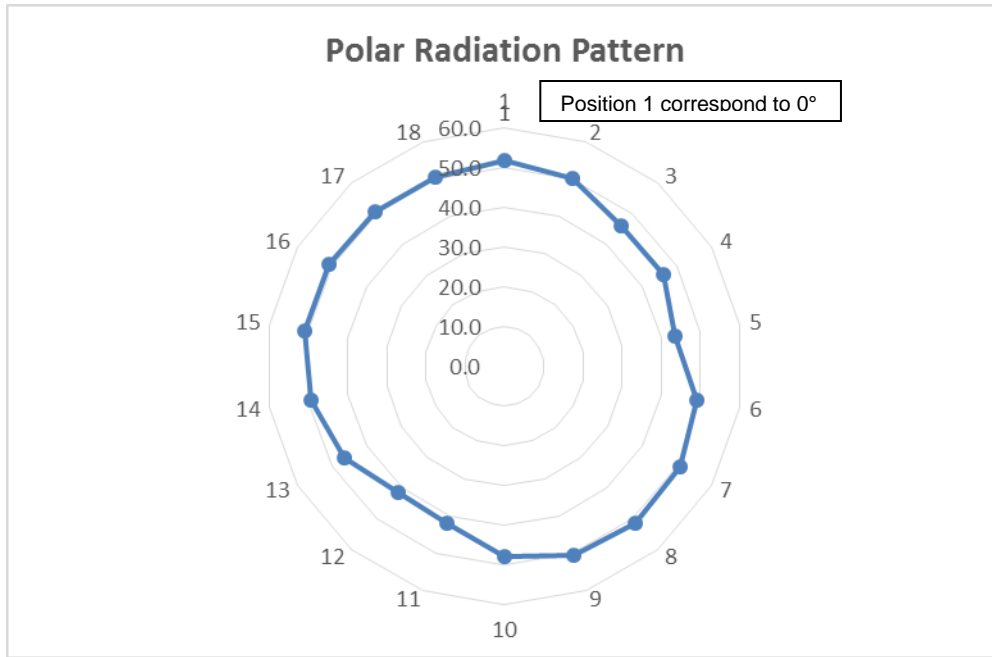


Distance / meter	Level / dBµV/m
3	128.9
5	119.2
10	103.4
15	92.2
20	84
25	76.4
30	70.8

The extrapolation factor was determined as follows:

103.4 dBµV/m @ 10m distance minus 70,8 dBµV/m @ 30m distance results in 68.3dB/decade

Polar Radiation Pattern as follows:



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Position 10 (180°)

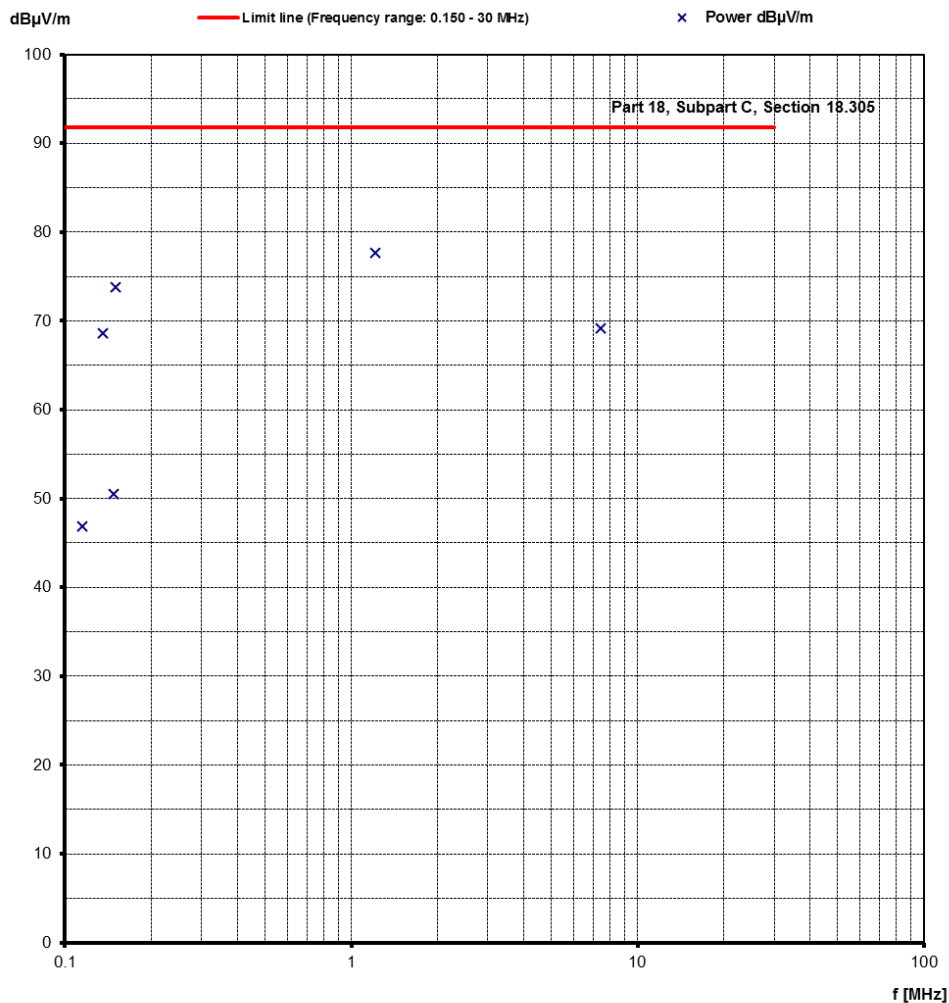
Position 12 (220°)

Operation mode: charging 75% load (worst case)
 Remarks: limits according 30 meter distance!
 Date: 07.01.2019
 Tested by: Albert Stoller

Result: fulfilled

The correction factors of the loop antenna and the cables are shown in Section 8 of this test report.

Frequency (MHz)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
0.081	71.4	91.8	-20.4
0.082	71.3	91.8	-20.5
0.115	46.8	91.8	-45.0
0.136	68.7	91.8	-23.1
0.148	50.6	91.8	-41.2
0.150	73.8	91.8	-18.0
1.208	77.7	91.8	-14.1
7.429	69.1	91.8	-22.7



6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Following software was used: Nexio BAT EMC (Version 3.18.0.17)

Test ID	Model Type	Kind of Equipment	Manufacturer	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 3	ESR 7	EMI Test Receiver	Rohde & Schwarz München	02-02/03-17-001	19/07/2019	19/07/2018		
	HFH 2 - Z 2	Antenna	Rohde & Schwarz München	02-02/24-15-001	22/03/2019	22/03/2018		
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	RF Cable 20m	Huber + Suhner	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	RF Cable 33 m	Huber + Suhner AG	02-02/50-15-028				
	TDS2014	Oscilloscope	Keithley Instruments GmbH	02-02/13-05-004	24/04/2019	24/04/2018		
	EMV D 30000/PAS	Testsystem	Spitzenberger + Spies	02-02/30-05-006	21/02/2020	21/02/2017	20/02/2019	20/02/2018
	SPS EMC V4.1.3	EMC Basic System	Spitzenberger + Spies	02-02/68-12-001				

Test ID	Model Type	Kind of Equipment	Manufacturer	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.18.0.17	Nexio Software	EMCO Elektronik GmbH	01-02/68-13-001				
	ESCI	EMI Test Receiver	Rohde & Schwarz München	02-02/03-15-001	11/06/2019	11/06/2018		
	ESH 2 - Z 5	LISN	Rohde & Schwarz München	02-02/20-05-004	25/10/2019	25/10/2017	30/04/2019	31/10/2018
	N-4000-BNC	RF Cable	mikes-testingpartners gmbh	02-02/50-05-138				
	N-1500-N	RF Cable	mikes-testingpartners gmbh	02-02/50-05-140				
	ESH 3 - Z 2	Pulse Limiter	Rohde & Schwarz München	02-02/50-05-155	18/11/2019	18/11/2016	06/05/2019	06/11/2018
	TDS2014	Oscilloscope	Keithley Instruments GmbH	02-02/13-05-004	24/04/2019	24/04/2018		
	EMV D 30000/PAS	Testsystem	Spitzenberger + Spies	02-02/30-05-006	21/02/2020	21/02/2017	20/02/2019	20/02/2018
	SPS EMC V4.1.3	EMC Basic System	Spitzenberger + Spies	02-02/68-12-001				

7 Detailed measurement uncertainty

7.1 Overview

Measurement instrumentation uncertainty shall be taken into account when determining compliance or non-compliance with a disturbance limit.

The measurement instrumentation uncertainty for a test laboratory shall be evaluated. The standard uncertainty $u(x_i)$ in decibels and the sensitivity coefficient c_i shall be evaluated for the estimate x_i of each quantity. The combined standard uncertainty $u_c(y)$ of the estimate y of the measurand shall be calculated as

$$u_c(y) = \sqrt{\sum_i c_i^2 u^2(x_i)}$$

The expanded measurement instrumentation uncertainty U_{lab} for a test laboratory shall be calculated as $U_{lab} = 2 u_c(y)$

$$U_{lab} = 2 u_c(y)$$

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} in the table below, then:

- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} in the table below, then:

- compliance is deemed to occur if no measured disturbance, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.
- non-compliance is deemed to occur if any measured disturbance, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.

7.2 Definitions and symbols

X_i	Input quantity
x_i	estimate of X_i
$u(x_i)$	standard uncertainty of x_i
c_i	sensitivity coefficient
$u_c(y)$	(combined) standard uncertainty of y
Y	result of a measurement, (the estimate of the measured), corrected for all recognised significant systematic effects
U	expanded uncertainty of y

7.3 Measurement uncertainty

Measurement	U_{lab} [dB]
Conducted disturbance	+ 3.29 / - 3.29
Radiated disturbance (electric field)	
- 10 m test distance	+ 3.86 / - 3.91
- 3 m test distance	+ 4.14 / - 4.78
- Frequency range: 30 MHz – 300 MHz	
Radiated disturbance (electric field)	
- 10 m test distance	+ 4.11 / - 4.11
- 3 m test distance	+ 4.13 / - 4.14
- Frequency range: 300 MHz – 1000 MHz	
Radiated disturbance (electric field)	
- 3 m test distance	+ 2.89 / -2.89
- Frequency range: 1 GHz – 30 GHz	

8 Correction Factor

Loop Antenna A3 Radiated Emission:

Object	Loop Antenna	Serial No.	881058/35
Type	HFH2 - Z2	Material No.	0335.4711.52
Date	2018-03-22	Calibration Mark	459083-D-K-15012-01-00-2018-03
Page			

Test Description	Lower Limit	Result Measured	Upper Limit	Uncertainty
1 Antenna Factor $k(1/m)$ ($E = k \cdot U$)				
0.009 MHz	19.0 dB	22.59 dB	23.0 dB	0.3 dB
0.010 MHz	19.0 dB	22.16 dB	23.0 dB	0.3 dB
0.015 MHz	19.0 dB	20.92 dB	22.0 dB	0.3 dB
0.020 MHz	19.0 dB	20.39 dB	21.5 dB	0.3 dB
0.025 MHz	19.0 dB	20.10 dB	21.2 dB	0.3 dB
0.03 MHz	19.0 dB	19.94 dB	21.0 dB	0.3 dB
0.05 MHz	19.0 dB	19.67 dB	21.0 dB	0.3 dB
0.08 MHz	19.0 dB	19.54 dB	21.0 dB	0.3 dB
0.1 MHz	19.0 dB	19.51 dB	21.0 dB	0.3 dB
0.2 MHz	19.0 dB	19.44 dB	21.0 dB	0.3 dB
0.3 MHz	19.0 dB	19.41 dB	21.0 dB	0.3 dB
0.5 MHz	19.0 dB	19.38 dB	21.0 dB	0.3 dB
0.8 MHz	19.0 dB	19.36 dB	21.0 dB	0.3 dB
1 MHz	19.0 dB	19.36 dB	21.0 dB	0.3 dB
2 MHz	19.0 dB	19.37 dB	21.0 dB	0.3 dB
3 MHz	19.0 dB	19.30 dB	21.0 dB	0.3 dB
4 MHz	19.0 dB	19.19 dB	21.0 dB	0.3 dB
5 MHz	19.0 dB	19.10 dB	21.0 dB	0.3 dB
6 MHz	19.0 dB	18.98 dB	21.0 dB	0.3 dB
8 MHz	19.0 dB	18.78 dB	21.0 dB	0.3 dB
10 MHz	19.0 dB	18.76 dB	21.0 dB	0.3 dB
12 MHz	19.0 dB	18.79 dB	21.0 dB	0.3 dB
14 MHz	19.0 dB	18.78 dB	21.0 dB	0.3 dB
16 MHz	19.0 dB	19.00 dB	21.0 dB	0.3 dB
18 MHz	19.0 dB	19.35 dB	21.0 dB	0.3 dB
20 MHz	19.0 dB	19.77 dB	21.0 dB	0.3 dB
22 MHz	19.0 dB	20.17 dB	21.0 dB	0.3 dB
24 MHz	19.0 dB	20.41 dB	21.0 dB	0.3 dB
26 MHz	19.0 dB	20.69 dB	21.0 dB	0.3 dB
28 MHz	19.0 dB	20.87 dB	21.0 dB	0.3 dB
30 MHz	19.0 dB	20.70 dB	21.0 dB	0.3 dB
32 MHz	--	20.28 dB	--	0.5 dB
34 MHz	--	19.87 dB	--	0.5 dB
36 MHz	--	19.51 dB	--	0.5 dB
38 MHz	--	19.29 dB	--	0.5 dB
40 MHz	--	19.43 dB	--	0.5 dB

RF Cable Attenuation A3 Radiated Emission:

NW-2000-NB (02-02/50-05-113) & KK-EF393/U-16N-21N20 m (02-02/50-12-018) & KK-SD_7/8-2X21N-33,0M (02-02/50-15-028)

f/MHz	attenuation / db
0.009	0.5
0.02	0.33
0.05	0.07
0.1	0
0.125	0
0.25	0
0.5	0
1	0.25
10	1
15	1.26
20	1.45
25	1.64
30	1.8
NW-2000-NB (02-02/50-05-113)	
KK-EF393/U-16N-21N20 m (02-02/50-12-018)	
KK-SD_7/8-2X21N-33,0M (02-02/50-15-028)	

Attenuation Pulse Limiter A4 Conducted Emission:

Object	Pulse Limiter	Serial No.	5SM03665
Type	ESH3-Z2	Material No.	357.8810.52
Date	2016-11-18	Calibration Mark	408036-D-K-15012-01-00-2016-11
Page			

Test Description	Lower Limit	Result Measured	Upper Limit	Uncertainty
1 Insertion Loss				
0.01 MHz	9.70 dB	9.85 dB	10.30 dB	0.05 dB
0.03 MHz	9.70 dB	9.86 dB	10.30 dB	0.05 dB
0.05 MHz	9.70 dB	9.86 dB	10.30 dB	0.05 dB
0.1 MHz	9.70 dB	9.86 dB	10.30 dB	0.05 dB
0.15 MHz	9.70 dB	9.86 dB	10.30 dB	0.05 dB
0.5 MHz	9.70 dB	9.87 dB	10.30 dB	0.05 dB
1 MHz	9.70 dB	9.87 dB	10.30 dB	0.05 dB
2 MHz	9.70 dB	9.87 dB	10.30 dB	0.05 dB
4 MHz	9.70 dB	9.87 dB	10.30 dB	0.05 dB
5 MHz	9.70 dB	9.88 dB	10.30 dB	0.05 dB
6 MHz	9.70 dB	9.88 dB	10.30 dB	0.05 dB
8 MHz	9.70 dB	9.89 dB	10.30 dB	0.05 dB
10 MHz	9.70 dB	9.90 dB	10.30 dB	0.05 dB
12 MHz	9.70 dB	9.91 dB	10.30 dB	0.05 dB
14 MHz	9.70 dB	9.93 dB	10.30 dB	0.05 dB
16 MHz	9.70 dB	9.93 dB	10.30 dB	0.05 dB
18 MHz	9.70 dB	9.95 dB	10.30 dB	0.05 dB
20 MHz	9.70 dB	9.96 dB	10.30 dB	0.05 dB
22 MHz	9.70 dB	9.97 dB	10.30 dB	0.05 dB
24 MHz	9.70 dB	9.99 dB	10.30 dB	0.05 dB
26 MHz	9.70 dB	10.00 dB	10.30 dB	0.05 dB
28 MHz	9.70 dB	10.02 dB	10.30 dB	0.05 dB
30 MHz	9.70 dB	10.04 dB	10.30 dB	0.05 dB
2 CISPR Pulse Compression Point				
input (BNC female)	typ 66 dB μ V	² pass	--	--

3 Return Loss (Receiver, male)				
0.01 MHz	19.1 dB	37.5 dB	--	2.9 dB
0.03 MHz	19.1 dB	37.9 dB	--	3.0 dB
0.05 MHz	19.1 dB	38.2 dB	--	3.1 dB
0.1 MHz	19.1 dB	38.1 dB	--	3.1 dB
0.15 MHz	19.1 dB	37.9 dB	--	3.0 dB
0.5 MHz	19.1 dB	38.1 dB	--	3.1 dB
1 MHz	19.1 dB	38.1 dB	--	3.1 dB
2 MHz	19.1 dB	38.0 dB	--	3.0 dB
4 MHz	19.1 dB	38.1 dB	--	3.1 dB
5 MHz	19.1 dB	38.0 dB	--	3.1 dB
6 MHz	19.1 dB	37.9 dB	--	3.0 dB
8 MHz	19.1 dB	37.8 dB	--	3.0 dB
10 MHz	19.1 dB	37.8 dB	--	3.0 dB
12 MHz	19.1 dB	37.5 dB	--	2.9 dB
14 MHz	19.1 dB	37.5 dB	--	2.9 dB
16 MHz	19.1 dB	37.5 dB	--	2.9 dB
18 MHz	19.1 dB	37.5 dB	--	2.9 dB
20 MHz	19.1 dB	37.5 dB	--	2.9 dB
22 MHz	19.1 dB	37.5 dB	--	2.9 dB
24 MHz	19.1 dB	37.5 dB	--	2.9 dB
26 MHz	19.1 dB	37.9 dB	--	3.0 dB
28 MHz	19.1 dB	38.1 dB	--	3.1 dB
30 MHz	19.1 dB	38.3 dB	--	3.1 dB
4 Return Loss (RF Input, female)				
0.01 MHz	30.7 dB	46.8 dB	--	6.0 dB
0.03 MHz	30.7 dB	46.3 dB	--	5.8 dB
0.05 MHz	30.7 dB	46.0 dB	--	5.7 dB
0.1 MHz	30.7 dB	45.9 dB	--	5.7 dB
0.15 MHz	30.7 dB	45.9 dB	--	5.7 dB
0.5 MHz	30.7 dB	45.5 dB	--	5.5 dB
1 MHz	30.7 dB	45.0 dB	--	5.3 dB
2 MHz	30.7 dB	44.0 dB	--	5.0 dB
4 MHz	30.7 dB	40.7 dB	--	3.8 dB
5 MHz	30.7 dB	39.2 dB	--	3.4 dB
6 MHz	30.7 dB	37.9 dB	--	3.0 dB
8 MHz	30.7 dB	36.2 dB	--	2.6 dB
10 MHz	30.7 dB	34.7 dB	--	2.3 dB
12 MHz	30.7 dB	33.8 dB	--	2.1 dB
14 MHz	30.7 dB	33.1 dB	--	1.9 dB
16 MHz	30.7 dB	32.9 dB	--	1.9 dB
18 MHz	30.7 dB	33.0 dB	--	1.9 dB
20 MHz	30.7 dB	33.6 dB	--	2.0 dB
22 MHz	30.7 dB	34.6 dB	--	2.2 dB
24 MHz	30.7 dB	36.1 dB	--	2.6 dB
26 MHz	30.7 dB	37.2 dB	--	2.9 dB
28 MHz	30.7 dB	36.1 dB	--	2.6 dB
30 MHz	30.7 dB	32.8 dB	--	1.9 dB

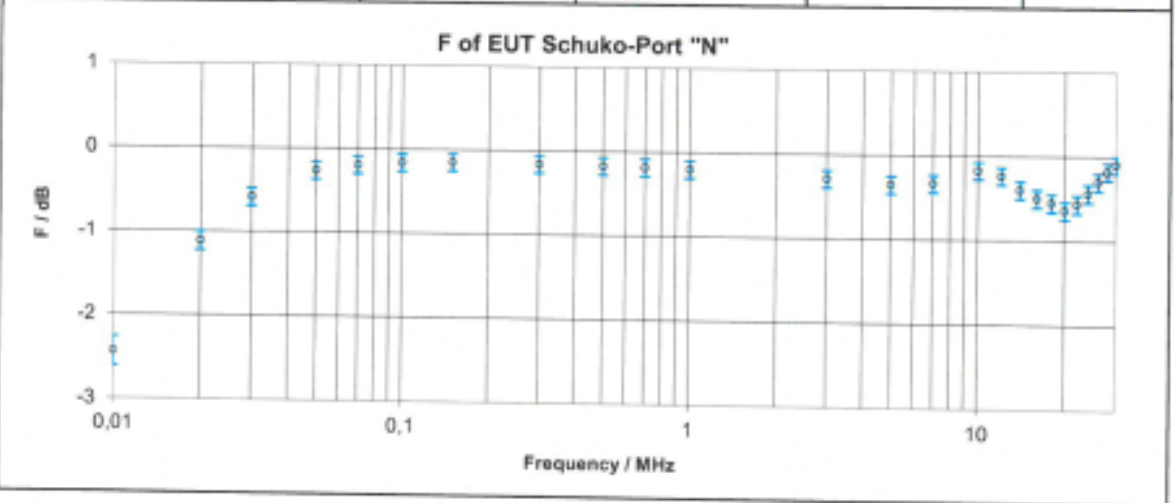
Attenuation Artificial Mains Network Port N A4 Conducted Emission:

Object Artifical-Mains Network 9kHz - 30MHz
Type ESH2-Z5 **Serial No.** 862060/030
Date 2017-10-25 **Material No.** 338.5219.53
Page 29 of 68 **Calibration Mark** 443253-D-K-15012-01-00-2017-10



V2 0283P0-Z5/Rev0011-08

Test Description	Lower Limit	Result Measured	Upper Limit	Uncertainty
5 Voltage Division Factor F <i>Measured according to EN 55016-1-2:2014, 4.11</i>				
5.1 F of EUT Schuko-Port "N"				
0,009 MHz	--	-2,6 dB	--	0,2 dB
0,01 MHz	--	-2,4 dB	--	0,2 dB
0,02 MHz	--	-1,1 dB	--	0,1 dB
0,03 MHz	--	-0,6 dB	--	0,1 dB
0,05 MHz	--	-0,3 dB	--	0,1 dB
0,07 MHz	--	-0,2 dB	--	0,1 dB
0,10 MHz	--	-0,2 dB	--	0,1 dB
0,15 MHz	--	-0,1 dB	--	0,1 dB
0,3 MHz	--	-0,2 dB	--	0,1 dB
0,5 MHz	--	-0,2 dB	--	0,1 dB
0,7 MHz	--	-0,2 dB	--	0,1 dB
1 MHz	--	-0,2 dB	--	0,1 dB
3 MHz	--	-0,3 dB	--	0,1 dB
5 MHz	--	-0,3 dB	--	0,1 dB
7 MHz	--	-0,3 dB	--	0,1 dB
10 MHz	--	-0,2 dB	--	0,1 dB
12 MHz	--	-0,2 dB	--	0,1 dB
14 MHz	--	-0,4 dB	--	0,1 dB
16 MHz	--	-0,5 dB	--	0,1 dB
18 MHz	--	-0,5 dB	--	0,1 dB
20 MHz	--	-0,6 dB	--	0,1 dB
22 MHz	--	-0,6 dB	--	0,1 dB
24 MHz	--	-0,4 dB	--	0,1 dB
26 MHz	--	-0,3 dB	--	0,1 dB
28 MHz	--	-0,2 dB	--	0,1 dB
30 MHz	--	-0,1 dB	--	0,1 dB



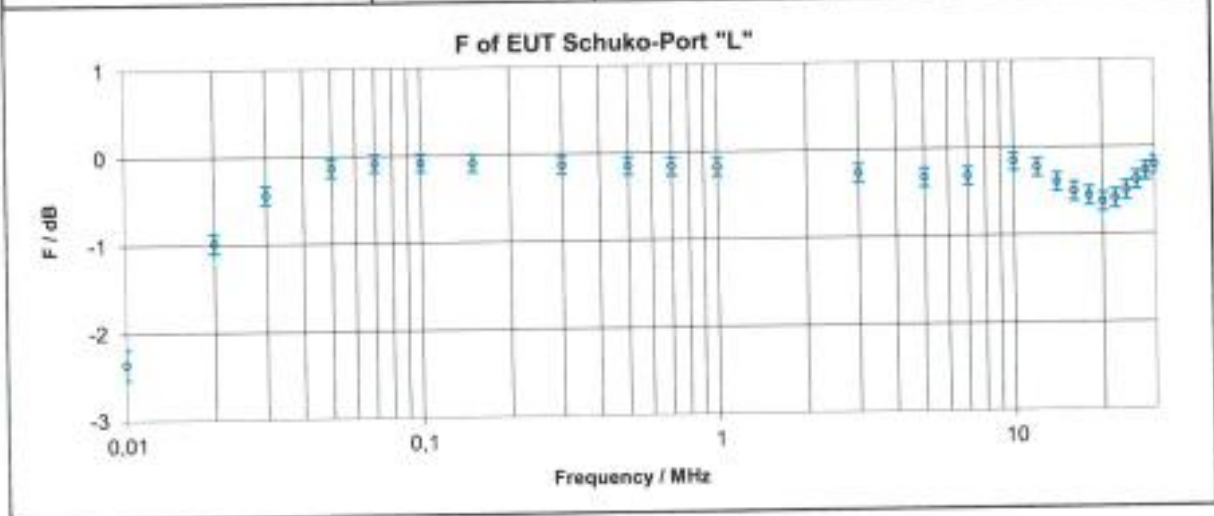
Attenuation Artificial Mains Network Port L A4 Conducted Emission:



Object Artificial-Mains Network 9kHz - 30MHz
Type ESH2-Z5 **Serial No.** 862060/030
Date 2017-10-25 **Material No.** 338.5219.53
Page 30 of 68 **Calibration Mark** 443253-D-K-15012-01-00-2017-10

52 8505P0-2003/0201108

Test Description	Lower Limit	Result Measured	Upper Limit	Uncertainty
5.2 F of EUT Schuko-Port "L"				
0,009 MHz	--	-2,5 dB	--	0,2 dB
0,01 MHz	--	-2,4 dB	--	0,2 dB
0,02 MHz	--	-1,0 dB	--	0,1 dB
0,03 MHz	--	-0,4 dB	--	0,1 dB
0,05 MHz	--	-0,1 dB	--	0,1 dB
0,07 MHz	--	-0,1 dB	--	0,1 dB
0,10 MHz	--	-0,1 dB	--	0,1 dB
0,15 MHz	--	-0,1 dB	--	0,1 dB
0,3 MHz	--	-0,1 dB	--	0,1 dB
0,5 MHz	--	-0,1 dB	--	0,1 dB
0,7 MHz	--	-0,2 dB	--	0,1 dB
1 MHz	--	-0,2 dB	--	0,1 dB
3 MHz	--	-0,3 dB	--	0,1 dB
5 MHz	--	-0,3 dB	--	0,1 dB
7 MHz	--	-0,3 dB	--	0,1 dB
10 MHz	--	-0,2 dB	--	0,1 dB
12 MHz	--	-0,2 dB	--	0,1 dB
14 MHz	--	-0,4 dB	--	0,1 dB
16 MHz	--	-0,5 dB	--	0,1 dB
18 MHz	--	-0,6 dB	--	0,1 dB
20 MHz	--	-0,6 dB	--	0,1 dB
22 MHz	--	-0,6 dB	--	0,1 dB
24 MHz	--	-0,5 dB	--	0,1 dB
26 MHz	--	-0,4 dB	--	0,1 dB
28 MHz	--	-0,3 dB	--	0,1 dB
30 MHz	--	-0,2 dB	--	0,1 dB



RF Cable Attenuation A4 Conducted Emission:

N-4000-BNC 02-02/50-05-138 & N-1500-N 02-02/50-05-140

f/MHz	attenuation / db
0.009	0
0.02	0
0.05	0
0.1	0
0.125	0
0.25	0
0.5	0
1	0.1
10	0.4
15	0.5
20	0.5
25	0.5
30	0.6
N-4000-BNC (02-02/50-05-138)	
N-1500-N (02-02/50-05-140)	

9 Calibration Data

Snapshot of Verification Data of ESH2-Z5 02-02/20-05-004:



Formblatt / form

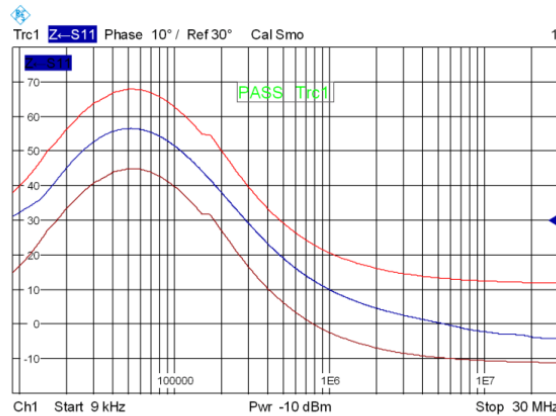
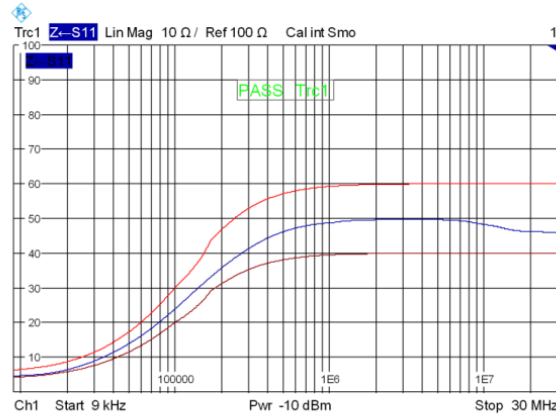
Verifizierprotokoll Netznachbildung

Verification protocol LISN

Impedanz / impedance

Betrag und Phase / magnitude and phase

Netznachbildung / LISN: 3 phase
 Test point: N/N L1/L1 L2/L2 L3/L3
 Test point: N/L1 L1/L2 L3/N L2/L3



CSA Group Bayern GmbH
 Ohmstraße 1-4
 94342 Strasskirchen
 Telefon: +49 9424 9481-0

Erstellt von: Stefan Seufert

Seite 3 von 20

File: CSA_B_F55_14_Rev9_0, Gültig ab: 15.01.2016
 Uncontrolled Copy when printed – please verify to "Verzeichnis CSA_B.xls" before using.

Snapshot of Verification Data of OATS1:

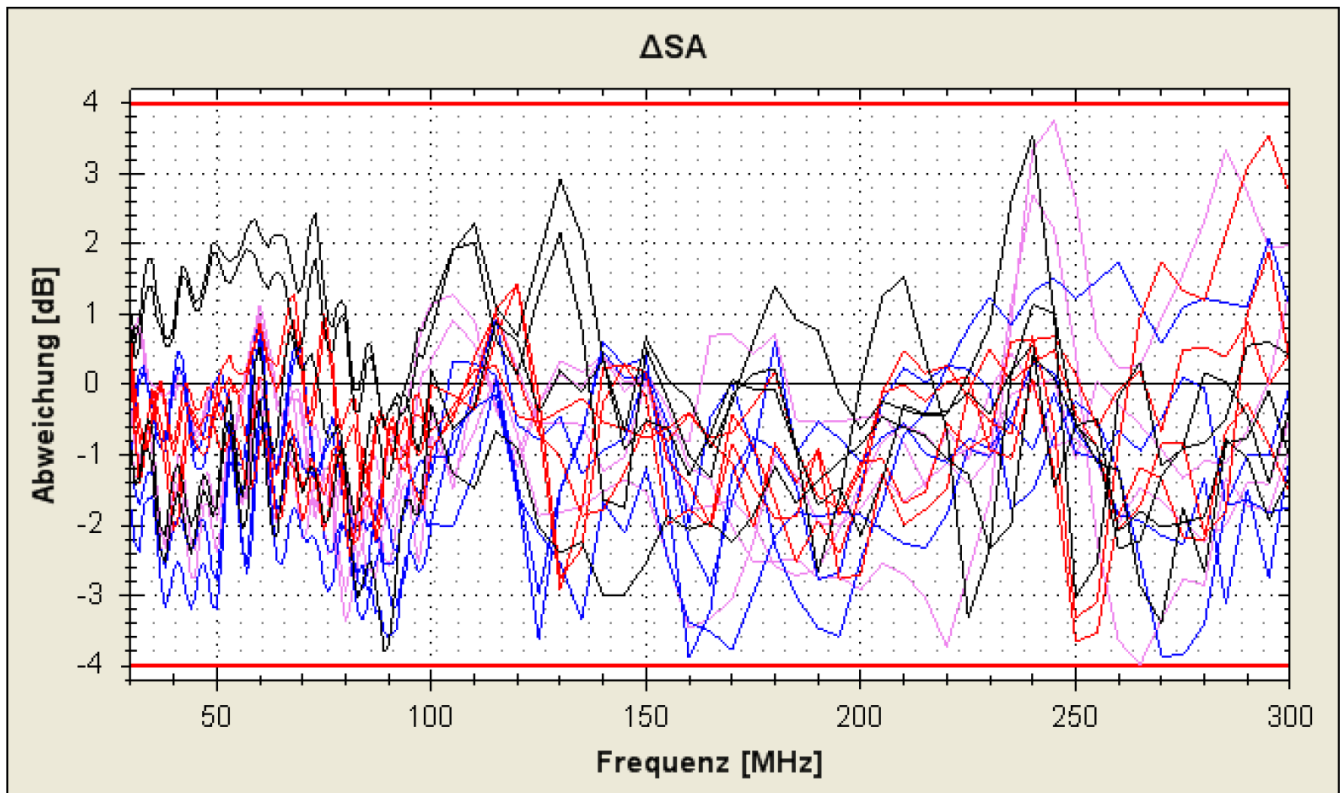
Verifizierprotokoll

Verifizierung des Messplatzes OATS 1 gemäß ANSI C63.4 im Bereich 30 – 1000MHz

Ergebnisse 10 m NSA:

Abweichungen 30-300 MHz:

Graph



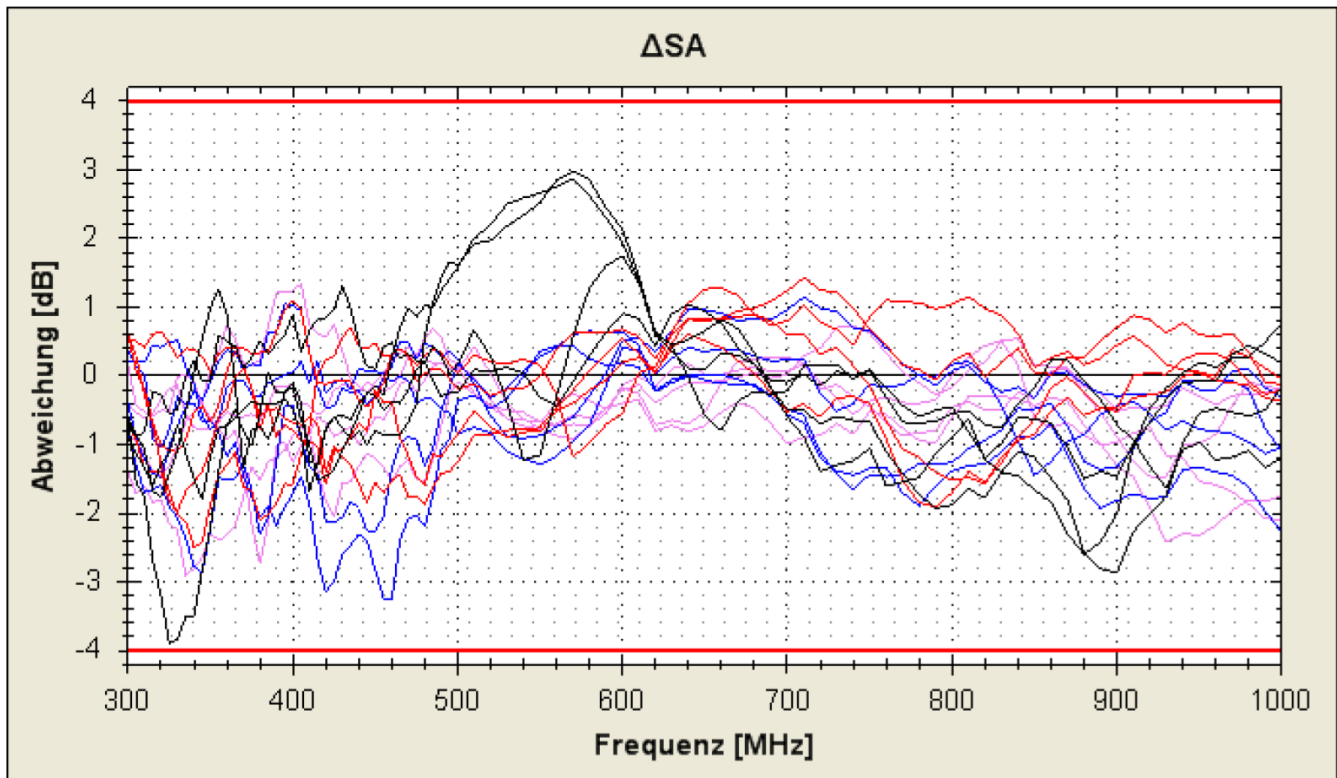
Snapshot of Verification Data of OATS1:

Verifizierprotokoll

Verifizierung des Messplatzes OATS 1 gemäß ANSI C63.4 im Bereich 30 – 1000MHz

Abweichungen 300-1000 MHz:

Graph



Snapshot of Calibration Certificate of ESR7 02-02/03-17-001:



akkreditiert durch die / accredited by the

Deutsche Akkreditierungsstelle GmbH

als Kalibrierlaboratorium im / as calibration laboratory in the



Deutsche
Akkreditierungsstelle
D-K-15195-01-01

Deutschen Kalibrierdienst



Kalibrierschein
Calibration certificate

Kalibrierzeichen
Calibration mark

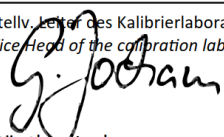
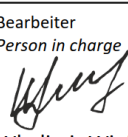
472837
D-K- 15195-01-01
2018-07

Gegenstand <i>Object</i>	ESR7 EMI TEST RECEIVER 7GHZ
Hersteller <i>Manufacturer</i>	ROHDE & SCHWARZ
Typ <i>Type</i>	ESR7
Fabrikat/Serien-Nr. <i>Serial number</i>	101707
Auftraggeber <i>Customer</i>	CSA Group Bayern GmbH
	Ohmstraße 1-4 94342 Straßkirchen DE
Auftragsnummer <i>Order No.</i>	479/18, 02-02/03-17-001
Anzahl der Seiten des Kalibrierscheines <i>Number of pages of the certificate</i>	3 Certificate 51 Outgoing Results
Datum der Kalibrierung <i>Date of calibration</i>	2018-07-19

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
*This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.*

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Datum <i>Date</i>	Stellv. Leiter des Kalibrierlaboratoriums <i>Vice Head of the calibration laboratory</i>	Bearbeiter <i>Person in charge</i>
2018-07-20	 Günther Jocham	 Wladimir Winitschenko

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Fax: 08331/10-811 24 • Managing Director: Jürgen Steigmüller • Chairman of the Supervisory Board: Dr. Marc Sesterhenn • Company's Place of Business: München
Commercial Register No.: HRB 1 059 • VAT Identification No.: DE 811 190 745

Snapshot of Calibration Certificate of Loop Antenna HFH2-Z2 02-02/24-15-001:



Kalibrierlaboratorium für Geräte der Nachrichtentechnik
Calibration laboratory for measuring instruments of telecommunication engineering

akkreditiert durch die / *accredited by the*

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als Kalibrierlaboratorium im / *as calibration laboratory in the*

Deutschen Kalibrierdienst **DKD**



Deutsche
Akkreditierungsstelle
D-K-15012-01-00

Kalibrierschein
Calibration certificate

Kalibrierzeichen
Calibration Mark

459083
D-K- 15012-01-00
2018-03

Gegenstand
Object Loop Antenna

Hersteller
Manufacturer Rohde & Schwarz

Typ
Type HFH2 - Z2

Fabrikat/Serien-Nr.
Serial number 881058/35
Asset: 02-02/24-15-001

Auftraggeber
Customer CSA Group Bayern GmbH
Ohmstraße 1-4
94342 Straßkirchen

Auftragsnummer
Order No. 02-02/24-15-001 / 171/18

Anzahl der Seiten des Kalibrierscheins
Number of pages of the certificate 5



Ort und Datum der Kalibrierung
Place and date of calibration Köln, 2018-03-22

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
 Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European cooperation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
 Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

*This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
 The DAkkS is signatory to the multilateral agreements of the European cooperation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
 The user is obliged to have the object re-calibrated at appropriate intervals.*

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Deutschen Akkreditierungsstelle als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.

This calibration certificate may not be reproduced other than in full except with the permission of both the German Accreditation Body and the issuing laboratory. Calibration certificates without signature are not valid.

Datum <i>Date</i>	Stellv. Leiter des Kalibrierlaboratoriums <i>Deputy head of the calibration laboratory</i>	Bearbeiter <i>Person in charge</i>
2018-03-22	 Ralf Schwagereit	 Tobias Kwiotek

ROHDE & SCHWARZ GmbH & Co. KG · International Service · Graf-Zeppelin-Straße 18 · D-51147 Köln
 Postfach 98 02 60 · D-51130 Köln · Telefon: (02203) 49-0 · Telefax: (02203) 49-51364 · Durchwahl: 49 - 51240

s2010-06/RSK2016-04

Snapshot of Calibration Certificate of ESCI 02-02/03-15-001:



akkreditiert durch die / accredited by the

Deutsche Akkreditierungsstelle GmbH

als Kalibrierlaboratorium im / as calibration laboratory in the

Deutschen Kalibrierdienst



Kalibrierschein
Calibration certificate

Kalibrierzeichen
Calibration mark

465817
D-K- 15195-01-01
2018-06

Gegenstand
Object

ESCI EMI TEST RECEIV.ESCI

Hersteller
Manufacturer

ROHDE & SCHWARZ

Typ
Type

ESCI

Fabrikat/Serien-Nr.
Serial number

100362

Auftraggeber
Customer

CSA Group Bayern GmbH

Ohmstraße 1-4
94342 Straßkirchen
DE

Auftragsnummer
Order No.

331/18,02-02/03-15-001
dt2018-05-14

Anzahl der Seiten des Kalibrierscheines
Number of pages of the certificate

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23 Outgoing Results

Datum der Kalibrierung
Date of calibration

2018-06-11

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

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Datum
Date

2018-06-11

Stellv. Leiter des Kalibrierlaboratoriums
Vice-Member of the calibration laboratory

Günther Jocham

Bearbeiter
Person in charge

Berndt Trunk