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Business Area
Industry & Energy
Austria

Technik

TÜV ®

TEST REPORT

of the accredited test laboratory

TÜV Nr.:INE-AT/EMV-19/304e

about

the following EMC - test/- research

Applicant: TTTech Computertechnik AG
Schoenbrunner Strasse 7
A-1040 Vienna, Austria

Product: TTE-SW A664 Lab V2.0

Standard: EN 55035:2017, EN 55032:2015,
FCC Part 15 (October 31, 2018),
ICES-003 Issue 6, January 19, 2016 Updated April 2017

Testing Laboratory,
Inspection Body,
Certification Body,
Calibration Laboratory,
Verifizierungsstelle

Notified Body 0408

Non-executive Board of Directors:
KR DI Johann Marihart

Management:
DI Dr. Stefan Haas
Mag. Christoph Wenninger

Registered Office:
Deutschstrasse 10
1230 Vienna/Austria

Branch Offices:
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Company Register Court / - Number:
Vienna / FN 288476 f

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AT153100000104093282
BIC RZBAATWW

VAT ATU63240488
DVR 3002476

TÜV AUSTRIA SERVICES GMBH

Test laboratory for EMC

Supervisor of EMC-laboratory

Ing. Michael Emminger

Checked by

Wolfram Topka, BSc.

23.07.2020

Contents

1. Applicant

Company:	TTTech Computertechnik AG
Department:	Aerospace & Industrial
Address:	Schoenbrunner Strasse 7 A-1040 Vienna, Austria
Contact person :	Ing. Aleksandar Sindrak
EUT received on:	09.12.2019
Tests were performed on:	09.12.2019 – 10.12.2019

2. Description of EUT

EUT:	TTE-SW A664 Lab V2.0
Manufacturer:	TTTech Computertechnik AG Schoenbrunner Strasse 7 A-1040 Vienna, Austria
Description:	TTTech Computertechnik AG provided the following configuration for the measurements:
Operating mode:	The measurements were carried out at the following running states:
Power supply:	230 VAC / 50 Hz
Climatic conditions in the emc laboratory:	Relative humidity: 41 % Temperature: 22 °C

3. Standards / Final result

Name	Title	Deviation	Result
EN 55032:2015	Electromagnetic compatibility of multimedia equipment - Emission Requirements	none	OK
EN 55035:2017	Electromagnetic compatibility of multimedia equipment - Immunity requirements	none	OK
ICES-003 Issue 6, January 19, 2016 Updated April 2017	Digital Apparatus	none	OK
FCC Part 15 (October 31, 2018)	Radio Frequency Devices	none	OK
Result: Opinions and interpretation of testing laboratory OK EUT passed NOK EUT failed			

4. Test results

4. 1.) Conducted emission on the AC supply-line

Limits Class B

Frequeny range	Limit	
Detector	Quasi Peak	Average
0,150 - 0,5 MHz	66 - 56 dBµV decreasing with the logarithm of frequency	56 - 46 dBµV decreasing with the logarithm of frequency
0,5 - 5 MHz	56 dBµV	46 dBµV
5 - 30 MHz	60 dBµV	50 dBµV
Remark:	Quasi Peak and Average limits must be both met	

Measuring apparatus parameters

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	150 kHz	150 kHz	Detector	MP/AV	QP/Cispr AV
Stop frequency	30 MHz	30 MHz	Measuring time	10 ms	1 s
Stepsize	5 kHz	5 kHz	RF-attenuation	0 dB	0 dB
IF- Bandwidth	9 kHz	9 kHz	Preamplifier	0 dB	0 dB

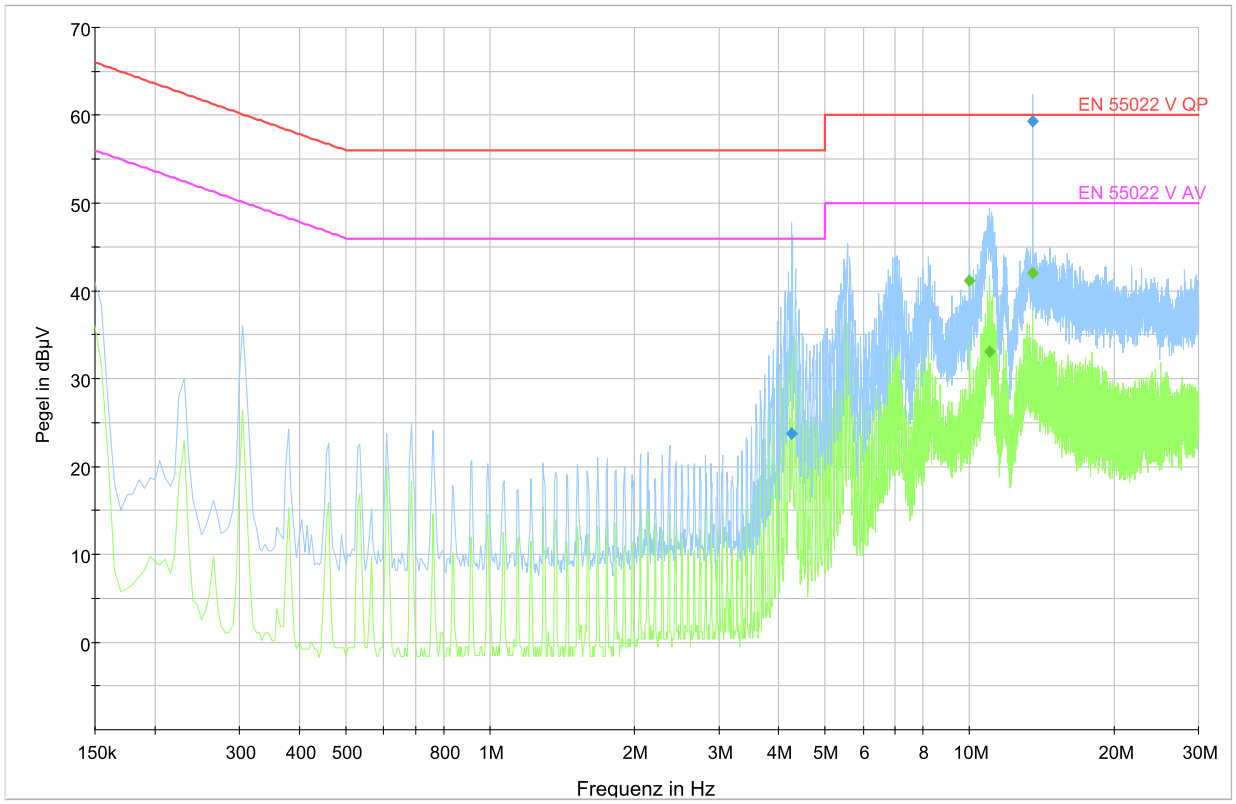
Measurement uncertainty

Expanded uncertainty U_c = 2,98 dB (Uncertainty budget = 3,6 dB)

Operating mode	Measuring result
Normal operation	OK

Test result

4. 1.1.) Measurement



Frequency MHz	Average dBµV/m	Limit dBµV/m	Margin dB	Measuring time ms	Phase	PE
10,000000	41,11	50,00	8,89	1000,0	N	GND
11,030000	33,03	50,00	16,97	1000,0	N	GND
13,560000	41,99	50,00	8,01	1000,0	N	GND

Frequency MHz	QP dBµV/m	Limit dBµV/m	Margin dB	Measuring time ms	Phase	PE
4,255000	23,75	56,00	32,25	1000,0	L1	GND
13,560000	59,37	60,00	0,63	1000,0	N	GND

4. 2.) Telecom-Port Conducted Emissions

Limits

Frequeny range	Limit	
Detector	Quasi Peak	Average
0,150 - 0,5 MHz	40 - 30 dBµA decreasing with the logarithm of frequency	30 - 20 dBµA decreasing with the logarithm of frequency
0,5 - 30 MHz	30 dBµA	20 dBµA
Remark:	Quasi Peak and Average limits must be both met	

Measuring apparatus parameters

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	150 kHz	150 kHz	Detector	MP/AV	QP/Cispr AV
Stop frequency	30 MHz	30 MHz	Measuring time	1 s	1 s
Stepsize	2,25 kHz	2,25 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	9 kHz	9 kHz	Preamplifier	0 dB	0 dB

Measurement uncertainty

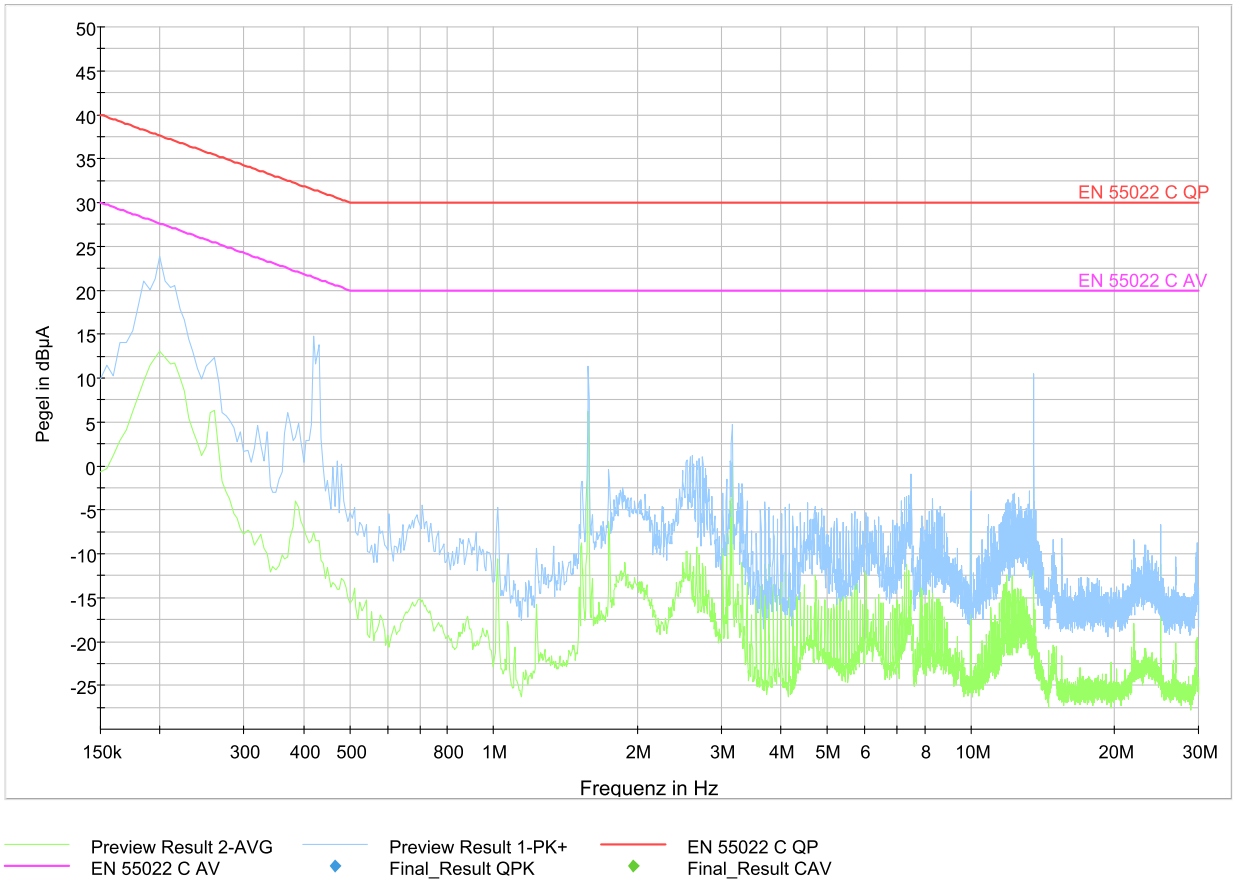
$U_{lab} < U_{cispr}$ for all frequency ranges

Operating mode	Measuring result
Normal operation	OK

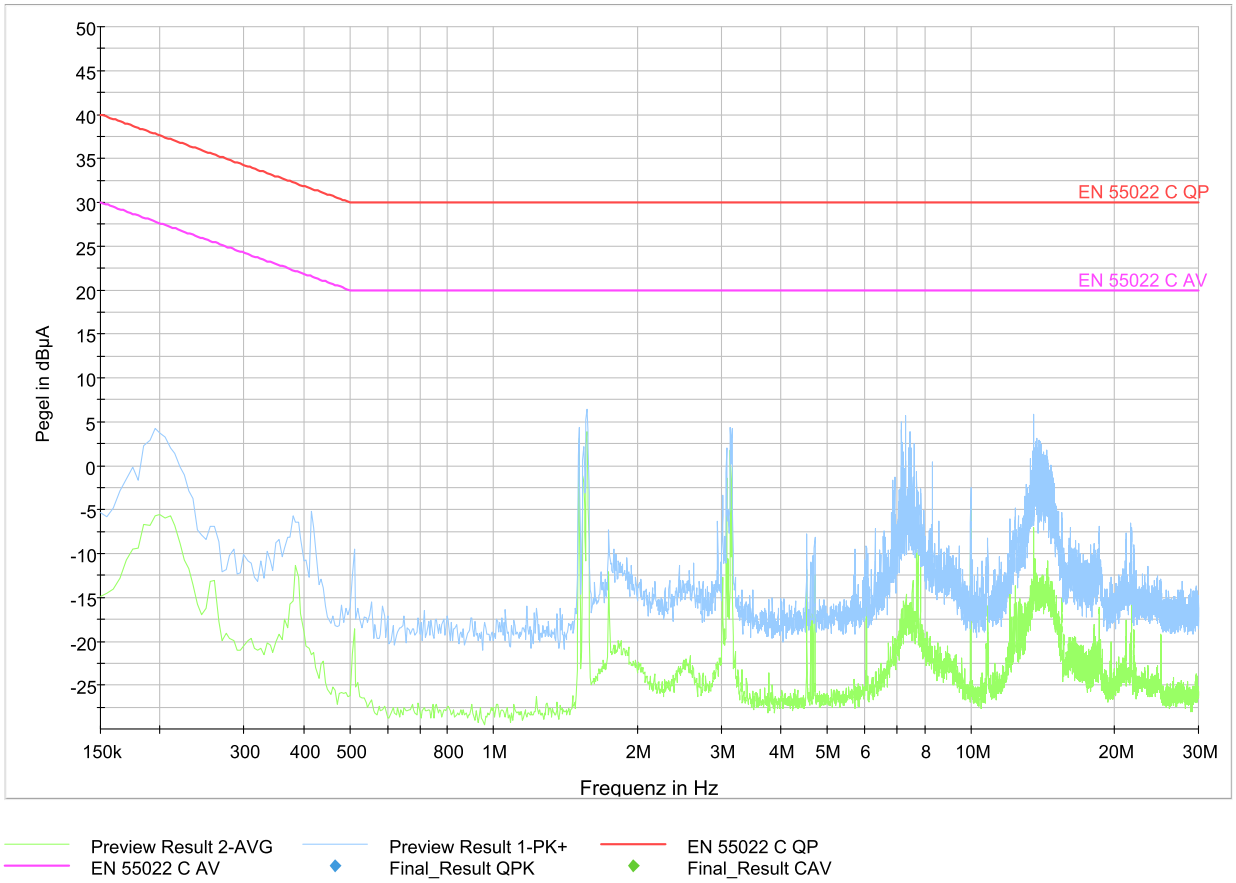
Test result

4. 2.1.) Measurement with QP-Detector and CISPR AV-Detector

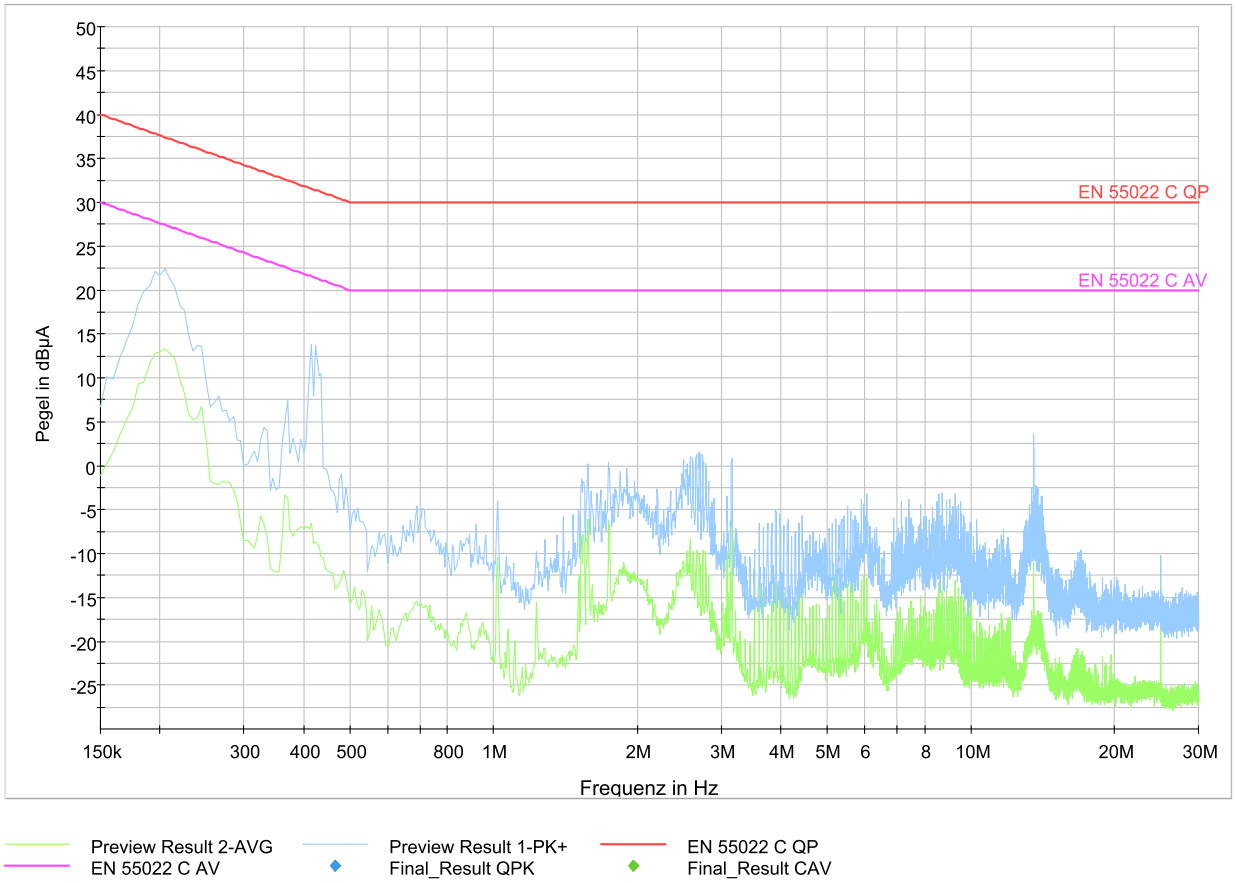
Port 6



Port 7



Port 24



4. 3.) Radiated emission

Limits Class A (3 m measuring distance)

Frequency range	Quasi Peak	
30 - 230 MHz	50 dBµV/m	
230 - 1000 MHz	57 dBµV/m	
Frequeny range	Peak	Average
1 – 3 GHz	76 dBµV/m	56 dBµV/m
3 – 18 GHz	80 dBµV/m	60 dBµV/m

Measuring apparatus parameters 30 to 1000 MHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	30 MHz	30 MHz	Detector	Max Peak	Quasi Peak
Stop frequency	1000 MHz	1000 MHz	Measuring time	10 ms	1 s
Stepsize	50 kHz	50 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	120 kHz	120 kHz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 1 GHz to 18 GHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	1 GHz	1 GHz	Detector	Max Peak / Average	Max Peak / Average
Stop frequency	18 GHz	18 GHz	Measuring time	10 ms	1 s
Stepsize	500 kHz	500 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	1 MHz	1 MHz	Preamplifier	20 dB	20 dB

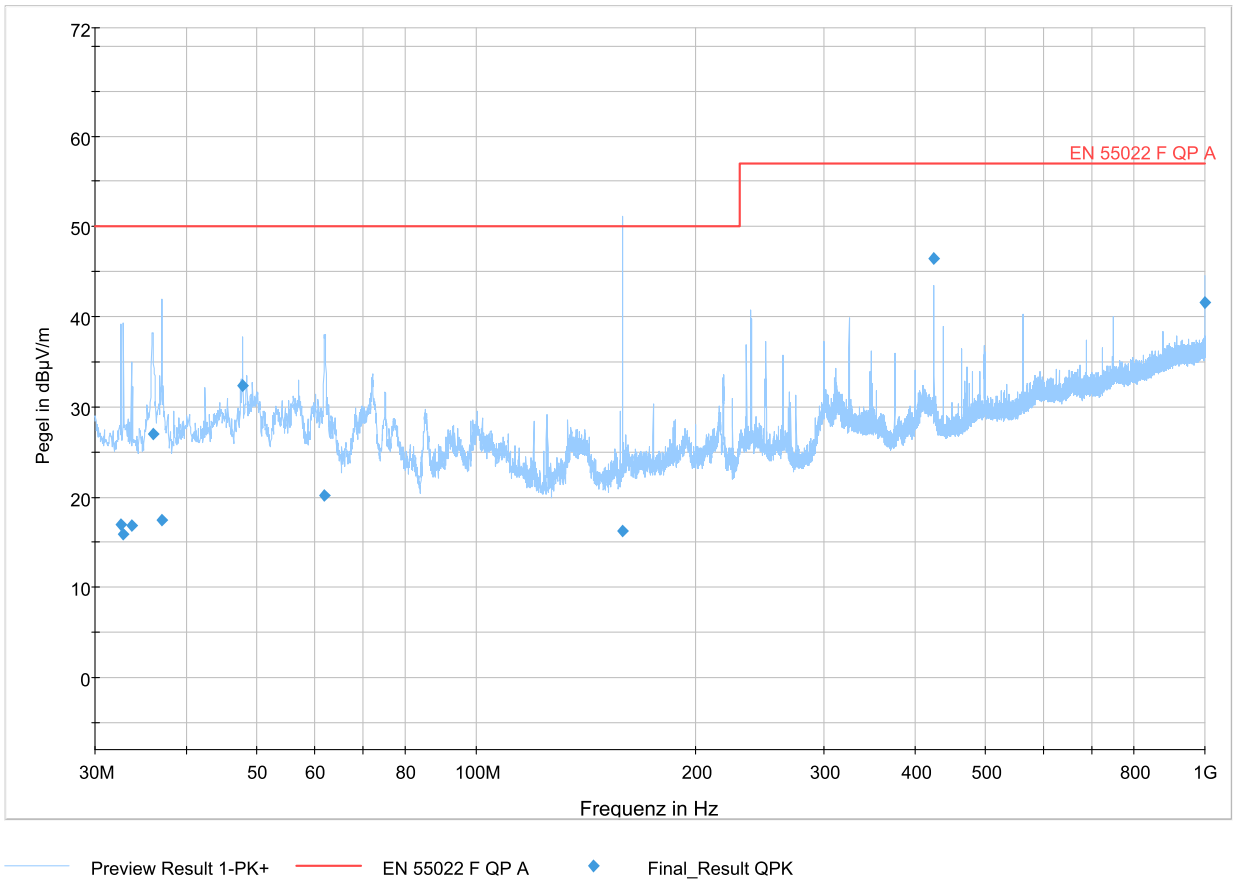
Measurement uncertainty

30-200 MHz horizontal: Expanded uncertainty U_c = 4,06 dB (Uncertainty budget = 5,06 dB)
30-200 MHz vertical: Expanded uncertainty U_c = 4,19 dB (Uncertainty budget = 5,17 dB)
0,2-1 GHz horizontal: Expanded uncertainty U_c = 4,43 dB (Uncertainty budget = 5,45 dB)
0,2-1 GHz vertical: Expanded uncertainty U_c = 5,64dB (Uncertainty budget = 6,48 dB)
1-6 GHz: Expanded uncertainty U_c = 4,40 dB (Uncertainty budget = 5,17 dB)

Operating mode	Measuring result
Normal operation	OK

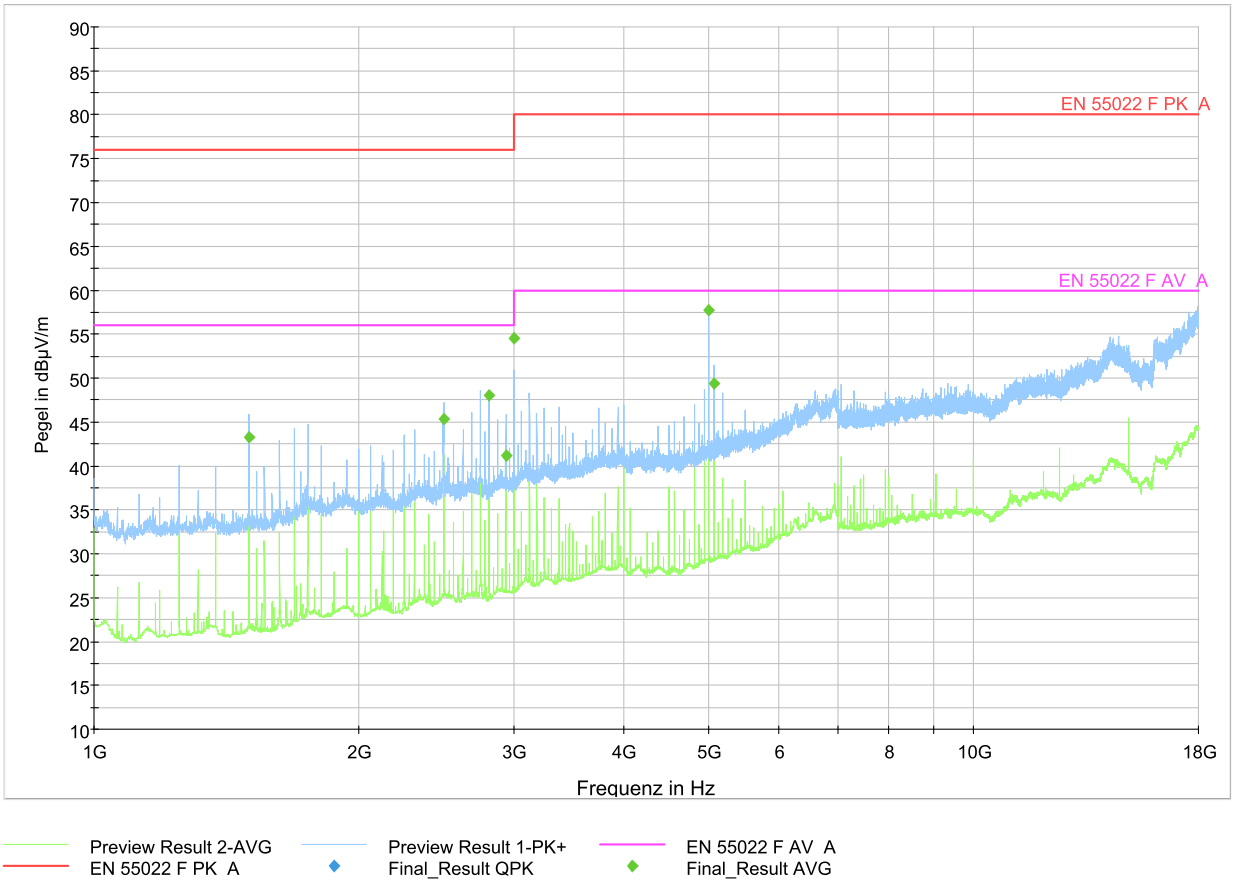
Test result

4. 3.1.) Measurement with QP-Detector (30 MHz - 1000 MHz)



Frequenz	QuasiPeak	Limit	Margin	Measuring time	Bandwith	Hight	Pol	Azimut
MHz	dBµV/m	dBµV/m	dB	ms	kHz	cm		deg
32,550000	16,99	50	33,01	1000,0	120,000	150,0	H	225,0
32,800000	15,89	50	34,11	1000,0	120,000	146,0	H	150,0
33,650000	16,85	50	33,15	1000,0	120,000	114,0	H	138,0
36,000000	27,02	50	22,98	1000,0	120,000	100,0	V	-32,0
37,050000	17,39	50	32,61	1000,0	120,000	109,0	H	186,0
47,800000	32,39	50	17,61	1000,0	120,000	125,0	V	152,0
61,950000	20,14	50	29,86	1000,0	120,000	150,0	V	181,0
158,800000	16,27	50	33,73	1000,0	120,000	131,0	H	66,0
425,000000	46,43	57	10,57	1000,0	120,000	100,0	H	225,0
1000,000000	41,54	57	15,46	1000,0	120,000	100,0	H	101,0

4. 3.2.) Measurement with Peak- and Average Detector (1 GHz – 18 GHz)



Frequenz	AV	Limit	Margin	Measuring time	Bandwith	Hight	Pol	Azimut
MHz	dBµV/m	dBµV/m	dB	ms	kHz	cm		deg
1500,000000	43,22	56,00	12,78	1000,0	1000,000	100,0	V	248,0
2500,000000	45,31	56,00	10,69	1000,0	1000,000	133,0	V	184,0
2812,500000	47,98	56,00	8,02	1000,0	1000,000	124,0	V	-14,0
2937,500000	41,22	56,00	14,78	1000,0	1000,000	114,0	H	4,0
3000,000000	54,56	56,00	1,44	1000,0	1000,000	150,0	V	189,0
5000,000000	57,76	60,00	2,24	1000,0	1000,000	126,0	V	-3,0
5062,500000	49,33	60,00	10,67	1000,0	1000,000	104,0	V	-3,0

4. 4.) Radiated emission according to FCC Part 15

Class A Limits

	≤ 1 GHz → Quasi Peak Limit > 1 GHz → Average Limit (Peak Limit 20 dB above average Limit)		
Frequency range	Limit	Bandwith	Measurement distance
30 – 88 MHz	49,5 dBµV/m	120 kHz	3 m
88 – 216 MHz	54 dBµV/m	120 kHz	3 m
216 – 960 MHz	57 dBµV/m	120 kHz	3 m
960 MHz - 1000 MHz	60 dBµV/m	120 kHz	3 m
Above 1000 MHz	60 dBµV/m	1 MHz	3 m

Measuring apparatus parameters 30 to 1000 MHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	30 MHz	30 MHz	Detector	Maxc Peak	Quasi Peak
Stop frequency	1000 MHz	1000 MHz	Measuring time	10 ms	1 s
Stepsize	50 kHz	50 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	120 kHz	120 kHz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 1 GHz to 18 GHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	1 GHz	1 GHz	Detector	Max Peak / Average	Max Peak / Average
Stop frequency	18 GHz	18 GHz	Measuring time	10 ms	1 s
Stepsize	500 kHz	500 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	1 MHz	1 MHz	Preamplifier	20 dB	20 dB

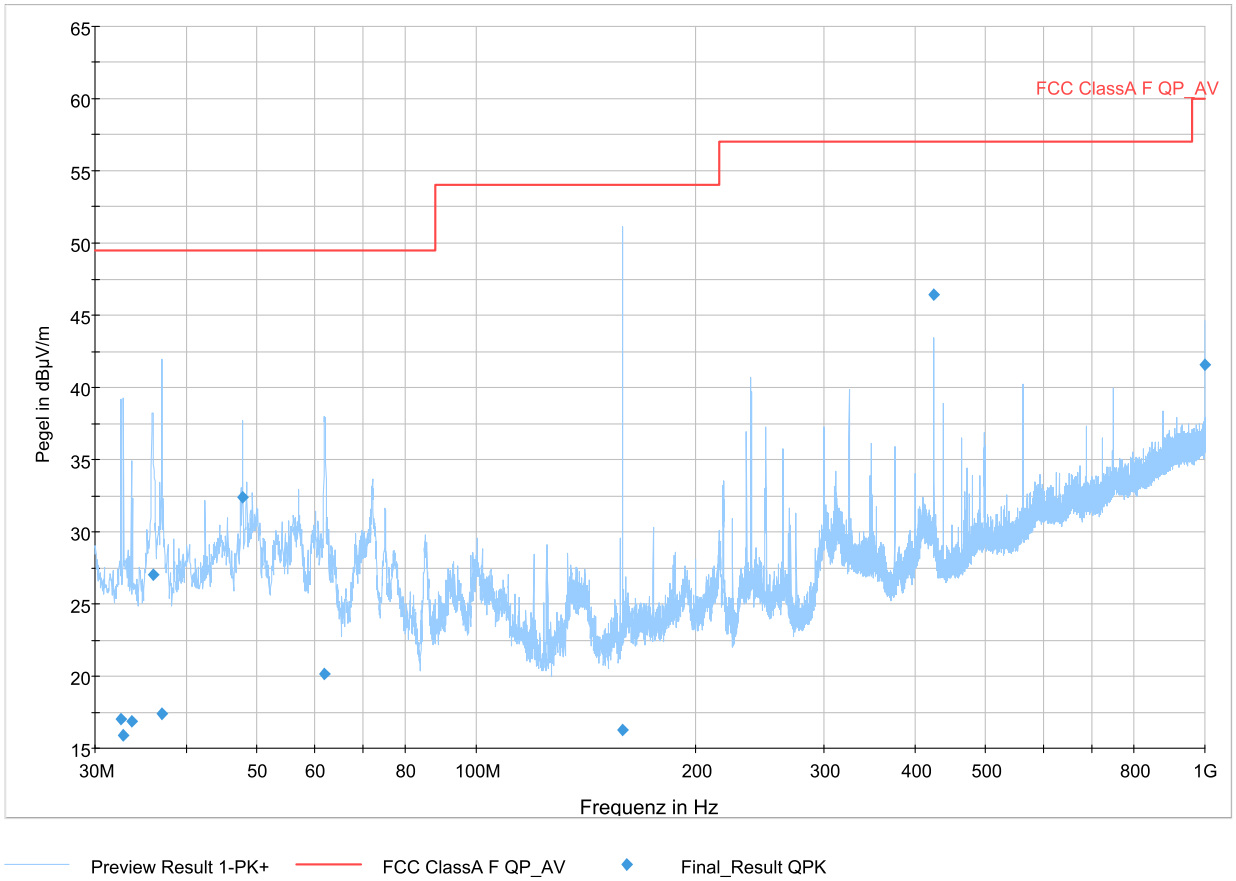
Measurement uncertainty

30-200 MHz horizontal: Expanded uncertainty U_c = 4,06 dB (Uncertainty budget = 5,06 dB)
30-200 MHz vertical: Expanded uncertainty U_c = 4,19 dB (Uncertainty budget = 5,17 dB)
0,2-1 GHz horizontal: Expanded uncertainty U_c = 4,43 dB (Uncertainty budget = 5,45 dB)
0,2-1 GHz vertical: Expanded uncertainty U_c = 5,64dB (Uncertainty budget = 6,48 dB)
1-18 GHz: Expanded uncertainty U_c = 4,40 dB (Uncertainty budget = 5,17 dB)

Operating mode	Measuring result
Normal operation	OK

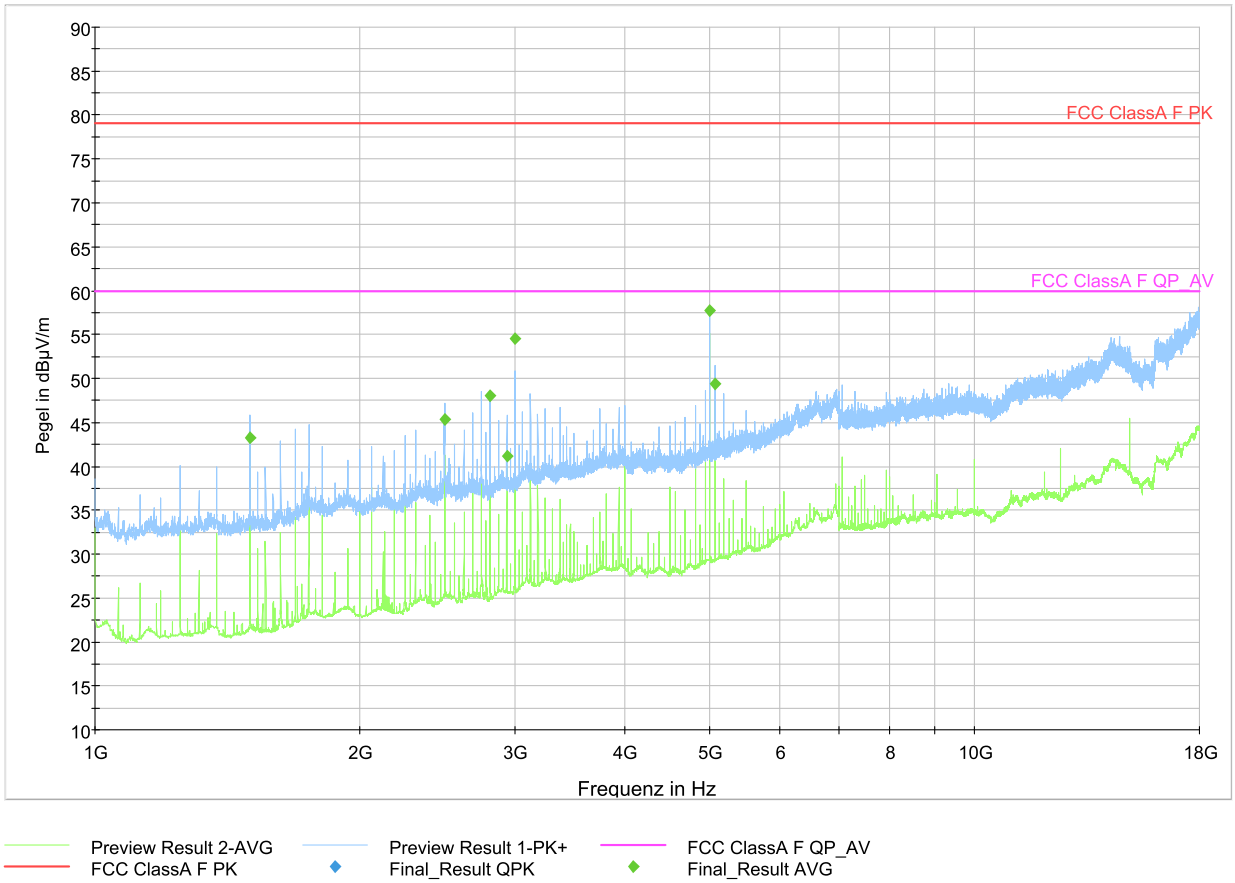
Test result

4. 4.1.) Measurement with QP-Detector (30 MHz - 1000 MHz)



Frequenz	QuasiPeak	Limit	Margin	Measuring time	Bandwith	Hight	Pol	Azimut
MHz	dBµV/m	dBµV/m	dB	ms	kHz	cm		deg
32,550000	16,99	49,5	32,51	1000,0	120,000	150,0	H	225,0
32,800000	15,89	49,5	33,61	1000,0	120,000	146,0	H	150,0
33,650000	16,85	49,5	32,65	1000,0	120,000	114,0	H	138,0
36,000000	27,02	49,5	22,48	1000,0	120,000	100,0	V	-32,0
37,050000	17,39	49,5	32,11	1000,0	120,000	109,0	H	186,0
47,800000	32,39	49,5	17,11	1000,0	120,000	125,0	V	152,0
61,950000	20,14	49,5	29,36	1000,0	120,000	150,0	V	181,0
158,800000	16,27	54	37,73	1000,0	120,000	131,0	H	66,0
425,000000	46,43	57	10,57	1000,0	120,000	100,0	H	225,0
1000,000000	41,54	60	18,46	1000,0	120,000	100,0	H	101,0

4. 4.2.) Measurement with Peak- and Average Detector (1 GHz – 18 GHz)



Frequenz	AV	Limit	Margin	Measuring time	Bandwith	Hight	Pol	Azimut
MHz	dBµV/m	dBµV/m	dB	ms	kHz	cm		deg
1500,000000	43,22	60,00	16,78	1000,0	1000,000	100,0	V	248,0
2500,000000	45,31	60,00	14,69	1000,0	1000,000	133,0	V	184,0
2812,500000	47,98	60,00	12,02	1000,0	1000,000	124,0	V	-14,0
2937,500000	41,22	60,00	18,78	1000,0	1000,000	114,0	H	4,0
3000,000000	54,56	60,00	5,44	1000,0	1000,000	150,0	V	189,0
5000,000000	57,76	60,00	2,24	1000,0	1000,000	126,0	V	-3,0
5062,500000	49,33	60,00	10,67	1000,0	1000,000	104,0	V	-3,0

4. 5.) Electrostatic discharge requirements (ESD)

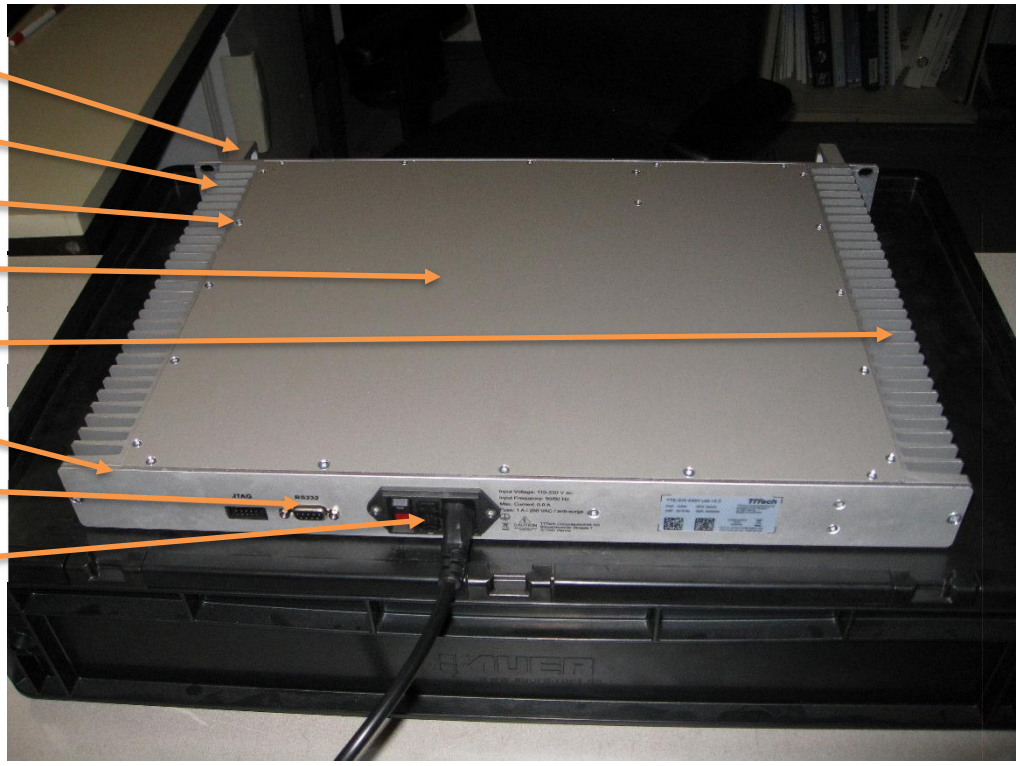
Type of test	charging voltage	Basic standard	Test set-up	Comment	Performance criteria
Electrostatic discharge Air discharge	8 kV charging voltage	EN 61000-4-2	EN 61000-4-2		B
Electrostatic discharge Contact discharge	4 kV charging voltage	EN 61000-4-2	EN 61000-4-2		B

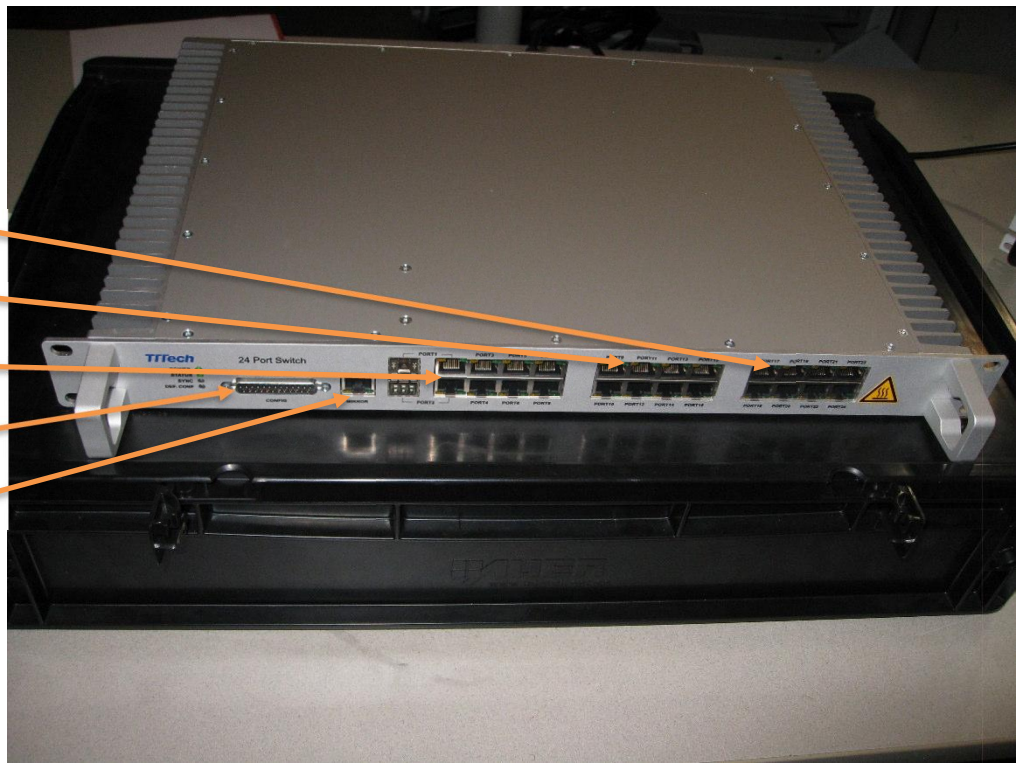
Measurement uncertainty

Expanded uncertainty U_c = 6,6 dB (Uncertainty budget = 6,6 dB)

Operating mode	Test positions	Criteria of compliance
Normal operation	The 15 test positions are shown in the following graphics.	Before and after the test the equipment shall operate as intended. During the test short interruptions are allowed.

Test positions for ESD





14. HCP 15. VCP

Test result

Test position	Charging voltage	Type of discharge	Positive discharge	Negative discharge
1	4 kV	contact	OK	OK
2	4 kV	contact	OK	OK
3	4 kV	contact	OK	OK
4	4 kV	contact	OK	OK
5	4 kV	contact	OK	OK
6	4 kV	contact	OK	OK
7	4 kV	contact	OK	OK
8	8 kV	air	OK	OK
9	4 kV	contact	OK	OK
10	4 kV	contact	OK	OK
11	4 kV	contact	OK	OK
12	4 kV	contact	OK	OK
13	4 kV	contact	OK	OK
14 (HCP)	4 kV	contact	OK	OK
15 (VCP)	4 kV	contact	OK	OK

OK EUT passed
NOK EUT failed

4. 6.) Radiated electromagnetic field requirements

Type of test	Test parameters	Basic standards	Test set-up	Comment	Performance criteria
Radiated electromagnetic field	80 MHz - 6000 MHz Spotfrequencies: 1800, 2600, 3500, 5000 MHz Fieldstrength: 3 V/m Modulation 80%/1 kHz AM Polarisation H/V Stepsize 1%	EN 61000-4-3	EN 61000-4-3		A

Measurement uncertainty

80 MHz – 1 GHz: Expanded uncertainty U_c = 1,73 dB (Uncertainty budget = 2,25 dB)
1 GHz – 6 GHz: Expanded uncertainty U_c = 2,11 dB (Uncertainty budget = 2,25 dB)

Operating mode	Criteria of compliance
Normal operation	Before, during and after the test the equipment shall operate as intended

Test result

Type of test	Test parameters	Performance criteria	Result
Radiated electromagnetic field	80 MHz - 6000 MHz Spotfrequencies: 1800, 2600, 3500, 5000 MHz Fieldstrength: 3 V/m Modulation 80%/1 kHz AM Polarisation H/V Stepsize 1%	A	OK
OK EUT passed NOK EUT failed			

4.7.) Induced RF-field requirements

Type of test	Test parameters	Basic standards	Test set-up	Comment	Performance criteria
RF-current common mode	0,15 MHz - 80 MHz 10 Vrms (unmodulated) Modulation 80%/1 kHz AM Stepsize 1% Source impedance 150 Ohm	EN 61000-4-6	EN 61000-4-6		A

Measurement uncertainty

Coupling network: Expanded uncertainty U_c = 1,19 dB
Coupling Clamp: Expanded uncertainty U_c = 3,12 dB

Operating mode	Criteria of compliance
Normal operation	Before, during and after the test the equipment shall operate as intended

Test result

Measured line	Type of coupling	Performance criteria	Result
AC Supply	M3	A	OK
Ethernet Cable Port 6	Clamp Injection	A	OK
Ethernet Cable Port 7	Clamp Injection	A	OK
Ethernet Cable Port 24	Clamp Injection	A	OK
OK EUT passed NOK EUT failed			

4. 7.) Electical fast transients/burst requirements

Type of test	Test parameters	Basic standards	Test set-up	Comment	Performance criteria
Electrical fast transients common mode	5/50 ns t_r/t_n 5kHz Burst frequency 15 ms Burst time 3 Hz Repetition frequency Polarity: positive/negative	EN 61000-4-4	EN 61000-4-4 direct coupling		B
Electrical fast transients common mode	5/50 ns t_r/t_n 5kHz Burst frequency 15 ms Burst time 3 Hz Repetition frequency Polarity: positive/negative	EN 61000-4-4	EN 61000-4-4 Coupling clamp		B

Measurement uncertainty

Expanded uncertainty U_c = 1,38 dB

Operating mode	Criteria of compliance
Normal operation	Before and after the test the equipment shall operate as intended During the test short interruptions are allowed.

Test result

4. 7. 1.) Measurement on the AC mains supply line (direct injection)

Combination	Test voltage	Performance criteria	Positive pulse	Negative pulse
Coupling path L	1 kV	B	OK	OK
Coupling path N	1 kV	B	OK	OK
Coupling path PE	1 kV	B	OK	OK
Coupling path L/N/PE	1 kV	B	OK	OK
OK EUT passed NOK EUT failed				

4. 7. 2.) Measurement on other lines (coupling clamp)

Measured line	Test voltage	Performance criteria	Positive pulse	Negative pulse
Ethernet Cable Port 6	0,5 kV	B	OK	OK
Ethernet Cable Port 7	0,5 kV	B	OK	OK
Ethernet Cable Port 24	0,5 kV	B	OK	OK
OK EUT passed NOK EUT failed				

4. 8.) Surge requirements

Type of test	Test parameters	Basic standards	Test set-up	Comment	Performance criteria
Surge, differential mode AC line	1 kV Test level 1,2/50 µs t_r/t_h Polarity: positive/negative	EN 61000-4-5	EN 61000-4-5		B
Surge, common mode AC line	2 kV Test level 1,2/50 µs t_r/t_h Polarity: positive/negative	EN 61000-4-5	EN 61000-4-5		B

Measurement uncertainty

Expanded uncertainty U_c = 1,36 dB

Operating mode	Criteria of compliance
Normal operation	Before and after the test the equipment shall operate as intended. During the test short interruptions are allowed.

Test result

4. 8.1.) Measurement on the AC power line – differential mode

Combination	Test voltage	Performance criteria	Positive pulse	Negative pulse
L/N	1 kV	B	OK	OK
OK EUT passed NOK EUT failed				

4. 8.2.) Measurement on the AC power line – common mode

Combination	Test voltage	Performance criteria	Positive pulse	Negative pulse
L/PE	2 kV	B	OK	OK
N/PE	2 kV	B	OK	OK
OK EUT passed NOK EUT failed				

4. 9.) Voltage dips and interrupts

Type of test	Test parameters	Basic standards	Test set-up	Comment	Performance criteria
Voltage - Dips	5 % for 0,5 cycles	EN 61000-4-11	EN 61000-4-11	1)	B
Voltage - Dips	70% for 25 cycles	EN 61000-4-11	EN 61000-4-11	2)	C
Voltage - Interruption	5% for 250 cycles	EN 61000-4-11	EN 61000-4-11	2)	C

Measurement uncertainty

Expanded uncertainty U_c = 0,44 dB

Operating mode	Criteria of compliance
Normal operation	1) Before and after the test the equipment shall operate as intended During the test short interruptions are allowed. 2) After the test the equipment shall operate as intended.

Test result

Type of test	Test parameters	Performance criteria	Result
Voltage - Dips	5 % for 0,5 cycles	B	OK
Voltage - Dips	70% for 25 cycles	C	OK
Voltage - Interruption	5% for 250 cycles	C	OK
OK EUT passed NOK EUT failed			

4. 10.) Harmonics and Flicker

As the power consumption of the EUT is far below 50W, no test is necessary and the Equipment is deemed to be compliant.

Appendix 1
Test equipment used

Division:
Industry & Energy

Department: EMC

Test report number:
INE-AT/EMV-19/304e

Date: 23.07.2020

☒	Anechoic Chamber with 3m measurement distance	NT-100	☐	Power quality analyzer Fluke 1760 (complete set)	NT-160 - NT-173
☐	Stripline according to ISO 11452-5	NT-108	☐	Spectrumanalyzer – FSP7 9 kHz – 7 GHz	NT-200
☒	MA4000 - Antenna mast 1 - 4 m height	NT-110/1	☐	ESCI - Test receiver 9 kHz - 7 GHz	NT-203/1
☒	DS - Turntable 0 - 400 ° Azimuth	NT-111/1	☒	ESI26 – Test receiver 20 Hz – 26,5 GHz	NT-207
☒	CO3000 Controller Mast+Turntable	NT-112/1	☐	Digital Radio Tester CMW500	NT-208/1
☐	HUF-Z3 - Log. Per. Antenna 200 - 1000 MHz	NT-121	☐	Noise-gen., ITU-R 559-2 20 Hz – 20 kHz	NT-209
☐	FMZB1513 - Loop Antenna 9 kHz - 30 MHz	NT-122/1	☐	CMTA - Radiocommunication analyzer ; 0,1 - 1000 MHz	NT-210
☐	HFH-Z6 - Rod Antenna 9 kHz - 30 MHz	NT-123	☐	3271 - Spectrum analyzer 100 Hz - 26,5 GHz	NT-211
☐	3121C - Dipole Antenna 28 - 1000 MHz	NT-124	☐	Digital Radio Tester Aeroflex 3920	NT-212/1
☐	3115 - Horn Antenna 1 - 18 GHz (immunity)	NT-125	☐	Mixer M28HW 26,5 GHz - 40 GHz	NT-214
☐	3116 - Horn Antenna 18 - 40 GHz	NT-126	☒	RubiSource T&M Timing reference	NT-216
☐	SAS-200/543 - Bicon. Antenna 20 MHz - 300 MHz	NT-127	☐	Radiocommunicationanalyzer SWR 1180 MD	NT-217
☒	AT-1080 - Log. Per. Antenna 80 - 1000 MHz	NT-128	☐	Mixer M19HWD 40 GHz – 60 GHz	NT-218
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-129	☐	Mixer M12HWD 60 GHz – 90 GHz	NT-219
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-130	☐	DSO9104 Digital scope	NT-220/1
☐	3146 - Log. Per. Antenna 200 – 1000 MHz	NT-131	☐	TPS 2014 Digital scope	NT-222
☐	VULB 9163 Trilog Antenna 30 – 3000 MHz	NT-131/1	☐	Artificial Ear according to IEC 60318	NT-224
☐	Loop Antenna H-Field	NT-132	☐	1 kHz Sound calibrator	NT-225
☒	Horn Antenna 500 MHz - 2900 MHz	NT-133	☐	B10 - Harmonics and flicker analyzer	NT-232
☐	Horn Antenna 500 MHz - 6000 MHz	NT-133/1	☐	SRM-3006 Spectrumanalyzer	NT-233/1a
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-134	☐	E-field probe SRM 75 MHz – 3 GHz	NT-234
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-135	☐	Field Meter NBM-500 incl. E- and H-Field probes	NT-240a-e
☐	BiConiLog Antenna 26 MHz – 2000 MHz	NT-137	☐	Hall-Teslameter ETM-1	NT-241
☐	Conical Dipol Antenna PCD8250	NT-138	☐	EFA-3 H-field- / E-field probe	NT-243
☒	HF 906 - Horn Antenna 1 - 18 GHz (emission)	NT-139	☐	EHP-50F H-field- / E-field probe	NT-243/1
☐	HZ-1 Antenna tripod	NT-150	☐	Field Meter EMR-200 100 kHz – 3 GHz	NT-244
☐	BN 1500 Antenna tripod	NT-151	☐	E-field probe 100 kHz – 3 GHz	NT-245
☒	Ant. tripod for EN61000-4-3 Model TP1000A	NT-156	☐	H-field probe 300 kHz – 30 MHz	NT-246

Appendix 1 (continued)
Test equipment used

☐	E-field probe 3 MHz – 18 GHz	NT-247
☐	H-field probe 27 MHz – 1 GHz	NT-248
☐	ELT-400 1 Hz – 400 kHz	NT-249
☐	MDS 21 - Absorbing clamp 30 - 1000 MHz	NT-250
☐	FCC-203I EM Injection clamp	NT-251
☐	FCC-203I-DCN Ferrite decoupling network	NT-252
☐	PR50 Current Probe	NT-253
☐	i310s Current Probe	NT-254/1
☐	Fluke 87 V True RMS Multimeter	NT-260
☐	Model 2000 Digital Multimeter	NT-261
☐	Fluke 87 V Digital Multimeter	NT-262/1
☒	ESH2-Z5-U1 Artificial mains network 4x25A	NT-300
☐	ESH3-Z5-U1 Artificial mains network 2x10A	NT-301
☐	ESH3-Z6-U1 Artificial mains network 1x100A	NT-302
☐	ESH3-Z6-U1 Artificial mains network 1x100A	NT-302a
☐	PHE 4500/B Power amplifier	NT-304
☐	EZ10 T-Artificial Network	NT-305
☒	SMG - Signal generator 0,1 - 1000 MHz	NT-310
☒	SMA100A - Signal generator 9 kHz - 6 GHz	NT-310/1
☐	RefRad Reference generator	NT-312
☐	SMP 02 Signal generator 10 MHz - 20 GHz	NT-313
☐	40 MHz Arbitrary Generator TGA1241	NT-315
☐	Artificial mains network NSLK 8127-PLC	NT-316
☐		
☐	PSURGE 4.1 Surge generator	NT-324
☒	IMU4000 Immunity test system	NT-325/1
☐	VCS 500-M6 Surge-Generator	NT-326
☐	Oscillatory Wave Simulator incl. Coupling networks	NT-328a+b+c
☒	BTA-250 - RF-Amplifier 9 kHz - 220 MHz / 250 W	NT-330
☒	T82-50 RF-Amplifier 2 GHz – 8 GHz	NT-331
☒	500W1000M7 - RF-Amplifier 80 - 1000 MHz / 500 W	NT-332
☒	AS0102-65R - RF-Amplifier 1 GHz - 2 GHz	NT-333
☐	APA01 – RF-Amplifier 0,5 GHz – 2,5 GHz	NT-334
☐	Preamplifier 1 GHz - 4 GHz	NT-335
☐	Preamplifier for GPS MKU 152 A	NT-336
☒	Preamplifier 100 MHz – 23 GHz	NT-337
☐	DC Block 10 MHz – 18 GHz Model 8048	NT-338
☐	2-97201 Electronic load	NT-341
☐	TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-344
☐	TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-345
☐	VDS 200 Mobil-impuls-generator	NT-350
☐	LD 200 Mobil-impuls-generator	NT-351
☐	MPG 200 Mobil-Impuls-Generators	NT-352
☐	EFT 200 Mobil-impuls-generator	NT-353
☐	AN 200 S1 Artificial Network	NT-354
☐	FP-EFT 32M 3 ph. Coupling filter (Burst)	NT-400/1
☐	PHE 4500 - Mains impedance network	NT-401
☐	IP 6.2 Coupling filter for data lines (Surge)	NT-403
☐	TK 9421 High Power Volt. Probe 150 kHz - 30 MHz	NT-409
☐	ESH2-Z3 - Probe 9 kHz - 30 MHz	NT-410
☒	IP 4 - Capacitive clamp (Burst)	NT-411
☐	Highpass-Filter 100 MHz – 3 GHz	NT-412
☐	Highpass-Filter 600 MHz – 4 GHz	NT-413
☐	Highpass-Filter 1250 MHz – 4 GHz	NT-414
☐	Highpass-Filter 1800 MHz – 16 GHz	NT-415

Appendix 1 (continued)
Test equipment used

☐	Highpass-Filter 3500 MHz – 18 GHz	NT-416
☐	RF-Attenuator 10 dB DC – 18 GHz / 50 W	NT-417
☐	RF-Attenuator 6 dB DC – 18 GHz / 50 W	NT-418
☐	RF-Attenuator 3 dB DC – 18 GHz / 50 W	NT-419
☐	RF-Attenuator 20 dB DC - 1000 MHz / 25 W	NT-421
☐	RF-Attenuator 30 dB DC - 1000 MHz / 1 W	NT-423
☐	RF-Attenuator 30 dB	NT-424
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-425
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-426
☐	RF-Attenuator 6 dB	NT-428
☐	RF-Attenuator 0 dB - 81 dB	NT-429
☐	WRU 27 - Band blocking 27 MHz	NT-430
☐	WHJ450C9 AA - High pass 450 MHz	NT-431
☐	WHJ250C9 AA - High pass 250 MHz	NT-432
☐	RF-Load 150 W	NT-433
☐	Impedance transducer 1:4 ; 1:9 ; 1:16	NT-435
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-436
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-437
☐	RF-Attenuator DC – 18 GHz 10 dB	NT-438
☐	RF-Attenuator DC – 18 GHz 20 dB	NT-439
☐	I+P 7780 Directional coupler 100 - 2000 MHz	NT-440
☒	ESH3-Z2 - Pulse limiter 9 kHz - 30 MHz	NT-441
☐	Power Divider 6 dB/1 W/50 Ohm	NT-443
☐	Directional coupler 0,1 MHz – 70 MHz	NT-444
☐	Directional coupler 0,1 MHz – 70 MHz	NT-445
☐	Tube imitations according to EN 55015	NT-450
☒	FCC-801-M3-16A Coupling decoupling network	NT-458
☐	FCC-801-M2-50A Coupling decoupling network	NT-459
☐	FCC-801-M5-25 Coupling decoupling network	NT-460
☐	FCC-801-AF10 Coupling decoupling network	NT-461
☐	FCC-801-S25 Coupling decoupling network	NT-462
☐	FCC-801-T4 Coupling decoupling network	NT-463
☐	FCC-801-C1 Coupling decoupling network	NT-464
☐	SW 9605 - Current probe 150 kHz – 30 MHz	NT-465/1
☐	95242-1 – Current probe 1 MHz – 400 MHz	NT-468
☐	94106-1L-1 – Current probe 100 kHz – 450 MHz	NT-471
☐	GA 1240 Power amplifier according to EN 61000-4-16	NT-480
☐	Coupling networks according to EN 61000-4-16	NT-481 - NT-483
☐	Van der Hoofden Test Head	NT-484
☒	EMC Video/Audiosystem	NT-511/1
☐	ES-K1 Version 1.71 SP2 Test software	NT-520
☒	EMC32 Version 10.50.40 Test software	NT-520/1
☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	SRM-TS Version 1.3.1 software for SRM-3006	NT-522/1
☒	Spitzenberger und Spies Test software V4.1	NT-525
☐	Noise power test apparatus according to EN 55014	NT-530
☒	Vertical coupling plane (ESD)	NT-531
☒	Test cable #4 for EN 61000-4-6	NT-553
☒	Test cable #3 for conducted emission	NT-554
☒	Test cable #5+#6 ESD-cable (2x470k)	NT-555 + NT-556
☐	Test cable #8 Sucoflex 104EA	NT-559
☐	Test cable #9 (for outdoor measurements)	NT-580
☐	Test cable #10 (for outdoor measurements)	NT-581
☐	Test cable #13 Sucoflex 104PE	NT-584
☐	Test cable #21 for SRM-3000	NT-592
☐	Shield chamber	NT-600
☐	Climatic chamber	M-1200

Appendix 1 (continued)
Test equipment used

☐	Anechoic Chamber 3 m / 5 m measuring distance	EMV-100
☐	Turntabel 6 m diameter	EMV-101
☐	Antenna mast + controller	EMV-102+ EMV-103
☐	EMC Video/Audiosystem	EMV-104
☐	EMC Software EMC32 Version 10.50.40	EMV-105
☐	Hornantenna 1 – 18 GHz HF 907	EMV-110
☐	Antennapre.amp. 1 – 18 GHz ERZ-LNA0200-1800-30-2	EMV-111
☐	Trilog Antenna 30-3000 MHz VULB9163	EMV-112
☐	Monopol 9 kHz – 30 MHz VAMP 9243	EMV-113
☐	Antennapre.amp 18 – 40 GHz BBV 9721	EMV-114
☐	Hornantenna 200 – 2000 MHz AH-220	EMV-115
☐	DC Artificial Network PVDC 8300	EMV-150
☐	AC Artificial Network NNLK 8121 RC	EMV-151
☐	EMI Receiver ESR26	EMV-200
☐	Signalgenerator 9 kHz – 40 GHz N5173B	EMV-201
☐	GPS Frequency normal B-88	EMV-202
☐	DC Power supply N5745A	EMV-203
☐	Spektrum Analyzator FSV40	EMV-205
☐	Thd Multimeter Model 2015	EMV-206
☐	Poweramplifier PAS15000	EMV- 207/abc
☐	Inrush Current Source	EMV- 208/abc
☐	Arb.-generator Sycore	EMV-209
☐	Harmonics/Flicker analyzer ARS 16/3	EMV-210
☐	HF- Ampflifier 9 kHz-250 MHz BBA150	EMV-300
☐	HF- Amplifier 80 -1000 MHz BBA150	EMV-301
☐	HF- Amplifier 0,8 - 6 GHz BBA150	EMV-302
☐	High Power Ant. 20-200 MHz HPBA-2510	EMV-303/1
☐	Log.per Antenna 80-2700 MHz STLP 9128 E special	EMV-304
☐	Log.per Antenna 0,7 – 9 GHz STLP9149	EMV-305
☐	HF- Ampflifier 9 kHz-250 MHz BBA150 (low noise)	EMV-306
☐	ISO11451-2 TLS 10 kHz – 30 MHz	EMV-307
☐	Load Dump Generator LD 200N	EMV-350
☐	Ultra Compact Symulator UCS 200N100	EMV-351
☐	Automotive Power fail module PFM 200N100.1	EMV-352
☐	Voltage Drop Symulator VDS 200Q100	EMV-353
☐	Arb. Generator AutoWave	EMV-354
☐	Ultra Compact Symulator UCS 500N7	EMV-355
☐	Coupling decoupling network CNI 503B7 / 32 A	EMV-356
☐	Coupling decoupling network CNI 503B7 / 63 A	EMV-357
☐	Telecom Surge Generator TSurge 7	EMV-358
☐	Coupling decoupling network CNI 508N2	EMV-359
☐	Coupling decoupling network CNV 504N2.2	EMV-360
☐	Immunity generator NSG4060/NSG4060-1	EMV-361
☐	Coupling network CDND M316-2	EMV-362
☐	Coupling network CT419-5	EMV-363
☐	ESD Generator NSG 437	EMV-364
☐	Pulse Limiter VTSD 9561-F BNC	EMV-405
☐	Transient emission BSM200N40+BS200N100	EMV- 450+451
☐	Cap. Coupling Clamp HFK	EMV-455
☐	Mag. Field System MS100N+MC26100+MC2630	EMV- 456-458
☐	Coupling network CDN M2-100A	EMV-459
☐	Coupling network CDN M3-32A	EMV-460
☐	Coupling network CDN M5-100A	EMV-461
☐	Current Clamp CIP 9136A	EMV-462
☐	DC Artificial Network HV-AN 150	EMV- 464+465
☐	Coupling Clamp EM 101	EMV-466
☐	Decoupling Clamp FTC 101	EMV-467
☐	Power attenuator 10 dB / 250 Watt	EMV-469/2