Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-0670/20-02-06-A

Testing laboratory

CTC advanced GmbH
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66117 Saarbruecken / Germany
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Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Balluff GmbH
Schurwaldstr. 9
73765 Neuhausen a. d. F. / GERMANY
Phone: +49 7158 1730
Contact: Thomas Lo Faro-Heil
e-mail: thomas.lofaro@balluff.de
Phone: +49 7158 173-8139

Manufacturer

Balluff GmbH
Schurwaldstr. 9
73765 Neuhausen a. d. F. / GERMANY

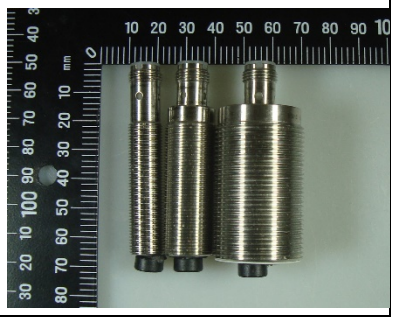
Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**RFID reader**
Model name:	BF-IDM34
FCC ID:	**2AGZY-BFIDM34**
IC:	**20739-BFIDM34**
Frequency:	13.56 MHz
Technology tested:	RFID
Antenna:	Integrated antenna
Power supply:	18 V to 30 V DC by power supply
Temperature range:	-20°C to +55°C



This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Christoph Schneider, o=CTC advanced GmbH, ou=SND-161128, email=Christoph.Schneider@ctcadvanced.com, c=DE
2020.12.04 07:47:09 +01'00'

Christoph Schneider
Lab Manager
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Test performed:

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2020.12.04 07:58:24 +01'00'

Hans-Joachim Wolsdorfer
Testing Manager
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report replaces the test report with the number 1-0670/20-02-06 and dated 2020-11-27.

2.2 Application details

Date of receipt of order:	2020-07-02
Date of receipt of test item:	2020-10-26
Start of test:*	2020-11-02
End of test:*	2020-11-04
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

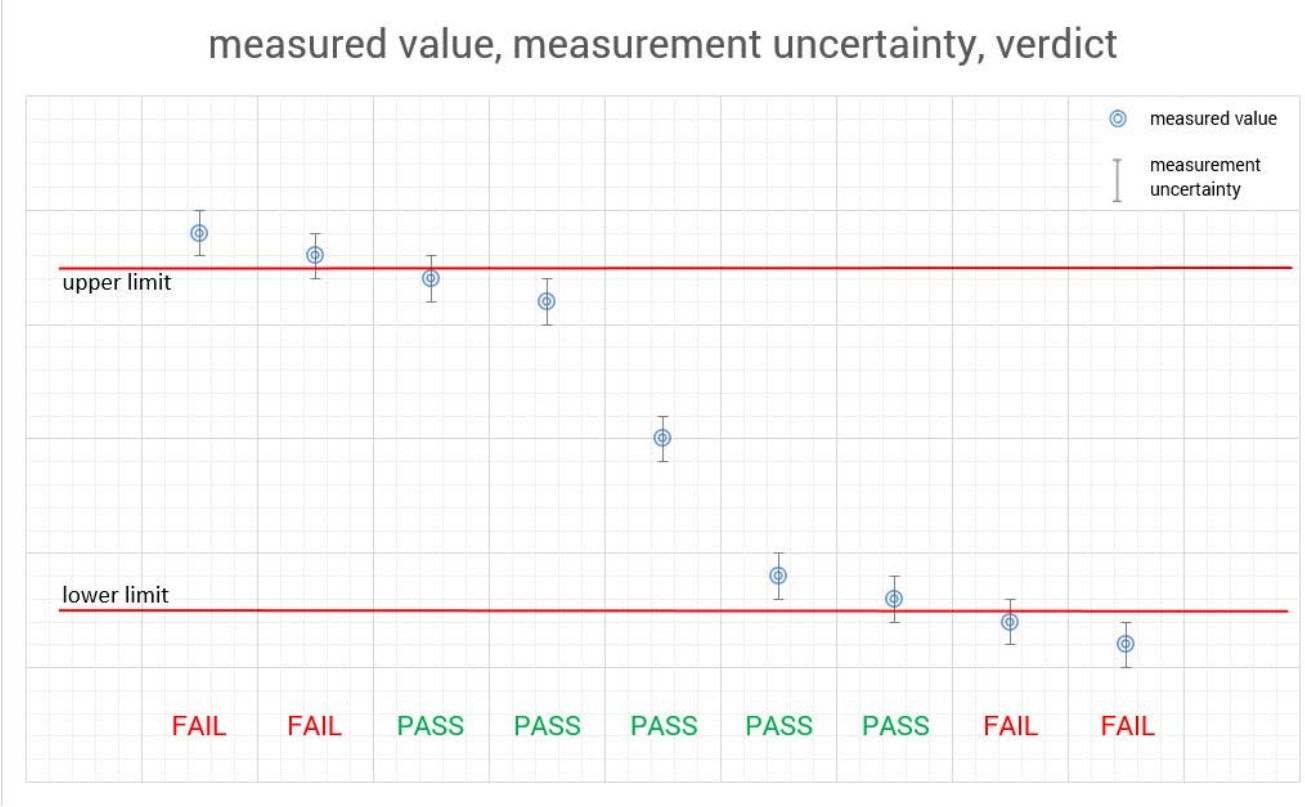
Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 10	December 2019	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - Gen Issue 5 - chapter 5.2: 2019-03	march 2019	RSS-Gen — General Requirements for Compliance of Radio Apparatus / chapter 5.2 Stand-Alone Receivers Operating in the Band 30-960 MHz (Category II)

Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Accreditation	Description
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 7, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +55 °C during high temperature tests -20 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	24 V DC by power supply 30 V 18 V

6 Test item

6.1 General description

Kind of test item	:	RFID reader
Model name	:	BF-IDM34
HMN	:	-/-
PMN	:	BF-IDM34
HVIN	:	M12: BIS M-4A3-082-401-07-S4 M18: BIS M-4A6-082-401-07-S4 M30: BIS M-4A7-082-401-07-S4
FVIN	:	-/-
S/N serial number	:	M12:Preseries_EMVM12_03, M18:Preseries_EMVM18_06, M30:Preseries_EMVM30_09
Hardware status	:	0.9
Software status	:	0.1.1
Firmware status	:	-/-
Frequency band	:	13.56 MHz
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	ASK
Number of channels	:	1
Antenna	:	Integrated antenna
Power supply	:	18 V to 30 V DC by power supply
Temperature range	:	-20°C to +55°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-0670/20-02-01_AnnexA
1-0670/20-02-01_AnnexB
1-0670/20-02-01_AnnexD

7 Description of the test setup

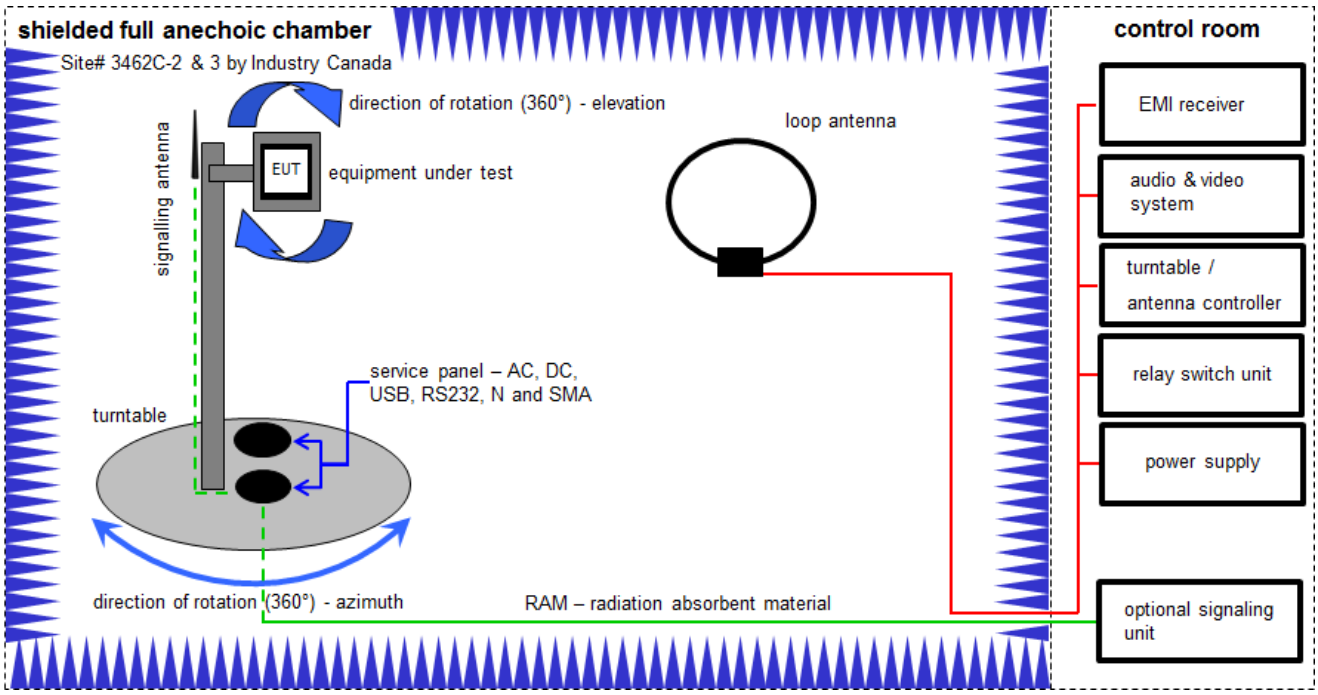
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded fully anechoic chamber



Measurement distance: loop antenna 3 meter

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

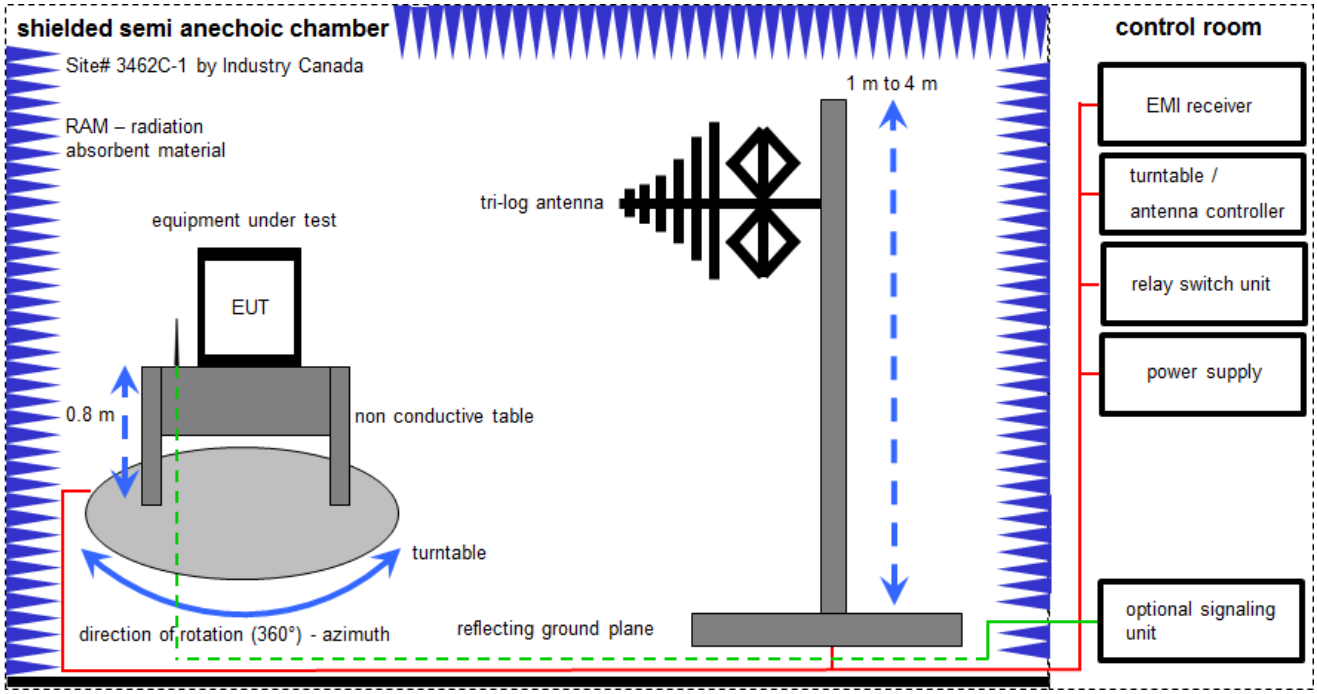
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	12.12.2017	11.12.2020
2	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	13.06.2019	12.06.2021
3	A	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	A	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2019	10.12.2020
6	A	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
7	A	NEXIO EMV-Software	BAT EMC V3.20.0.10	EMCO	102587	300004682	ne	-/-	-/-
8	A	PC	ExOne	F+W		300004703	ne	-/-	-/-

7.2 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter
EMC32 software version: 10.59.00

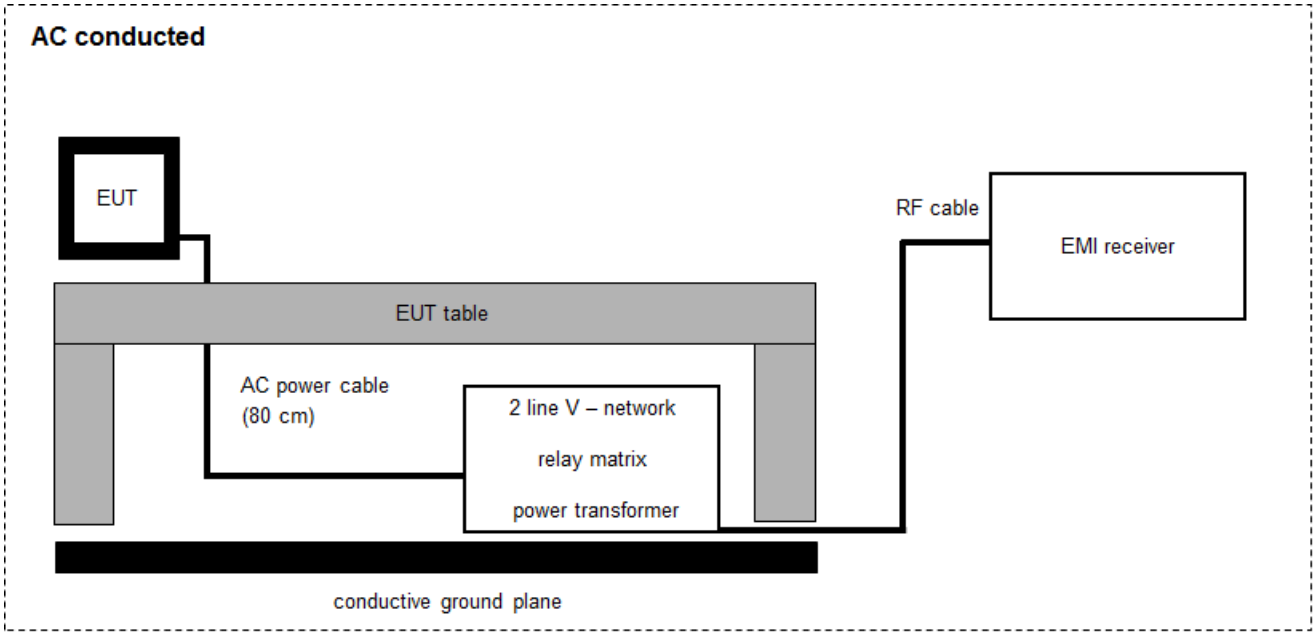
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	64762	300000551	ne	-/-	-/-
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vlKl!	19.02.2019	18.02.2021
8	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	21.05.2019	20.11.2020

7.3 AC conducted



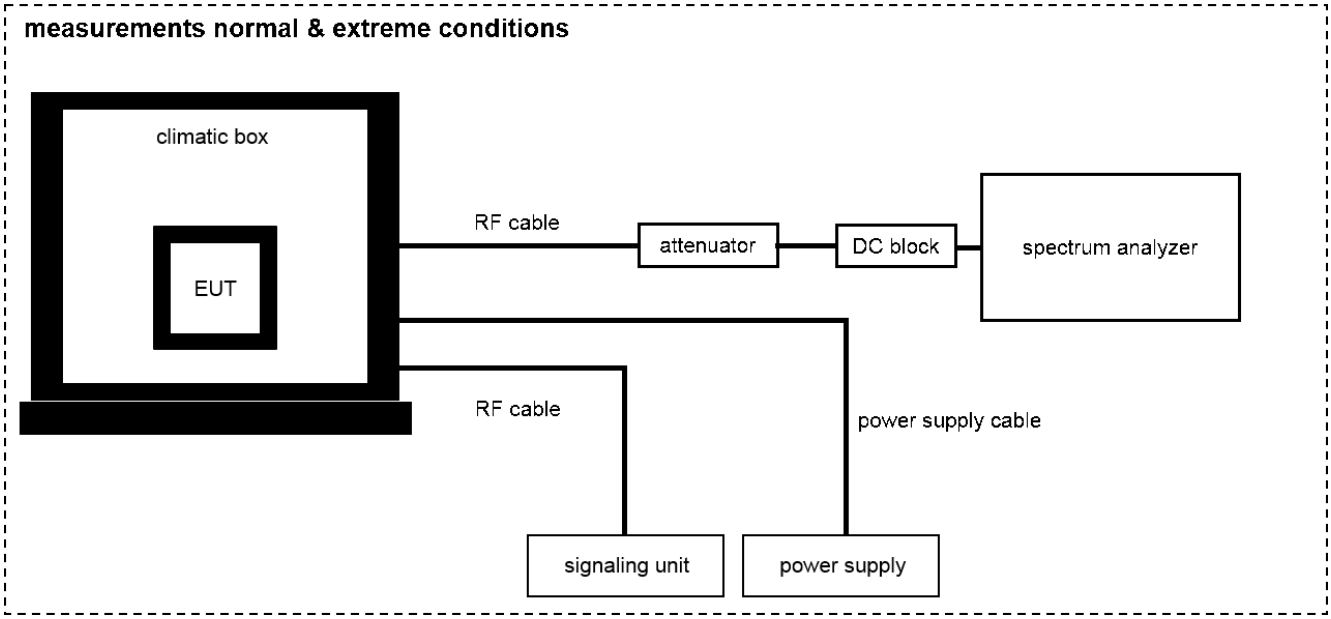
FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	R&S	892475/017	300002209	vlKl!	11.12.2019	10.12.2021
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	10.12.2019	09.12.2020
4	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
5	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	vlKl!	17.01.2020	16.01.2022

7.4 Measurements normal and extreme conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Loop Antenna		ZEG TS Steinfurt		400001208	ev	-/-	-/-
2	A	Temperature Test Chamber	VT 4011	Voetsch Industrietechnik	5856623060001 0	300005363	ev	08.05.2020	07.05.2022
3	A	Power Supply	HMP2020	Rohde & Schwarz	101961	300006102	k	04.08.2020	03.08.2022
4	A	Signal- and Spectrum Analyzer 2 Hz - 26 GHz	FSW26	R&S	101455	300004528	k	24.02.2020	23.02.2021
5	A	RF Cable BNC	RG58	Huber & Suhner		400001209	ev	-/-	-/-

8 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Occupied bandwidth	± used RBW
Field strength of the fundamental	± 3 dB
Field strength of the harmonics and spurious	± 3 dB
Receiver spurious emissions and cabinet radiations	± 3 dB
Conducted limits	± 2.6 dB

9 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS 210 Issue 10 RSS Gen Issue 5	See table!	2020-12-04	-/-

Test specification clause	Test case	Temperature conditions	Power source conditions	C	NC	NA	NP	Remark
RSS Gen Issue 5	Occupied bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.225 (a) RSS 210 Issue 10	Field strength of the fundamental	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.209 & § 15.225 (b-d)	Field strength of the harmonics and spurious	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.109	Receiver spurious emissions and cabinet radiations	Nominal	Nominal	☐	☐	☒	☐	-/-
§15.107 §15.207	Conducted limits	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.225 (a) RSS 210 Issue 10	Frequency tolerance	Normal & extreme conditions	Normal & extreme conditions	☒	☐	☐	☐	-/-

Note:

C Compliant
NC Not compliant
NA Not applicable
NP Not performed

10 Additional comments

Reference documents:	None
Special test descriptions:	The tested devices use the same electronic except the antenna and the enclosure
Configuration descriptions:	HF Software Anleitung.pdf

11 Measurement results

11.1 Occupied bandwidth

Measurement:

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

Measurement parameters	
Detector:	Peak
Resolution bandwidth:	1 % – 5 % of the occupied bandwidth
Video bandwidth:	≥ 3x RBW
Trace mode:	Max hold
Analyser function:	99 % power function
Used equipment:	See chapter 7.4A
Measurement uncertainty:	See chapter 8

Limit:

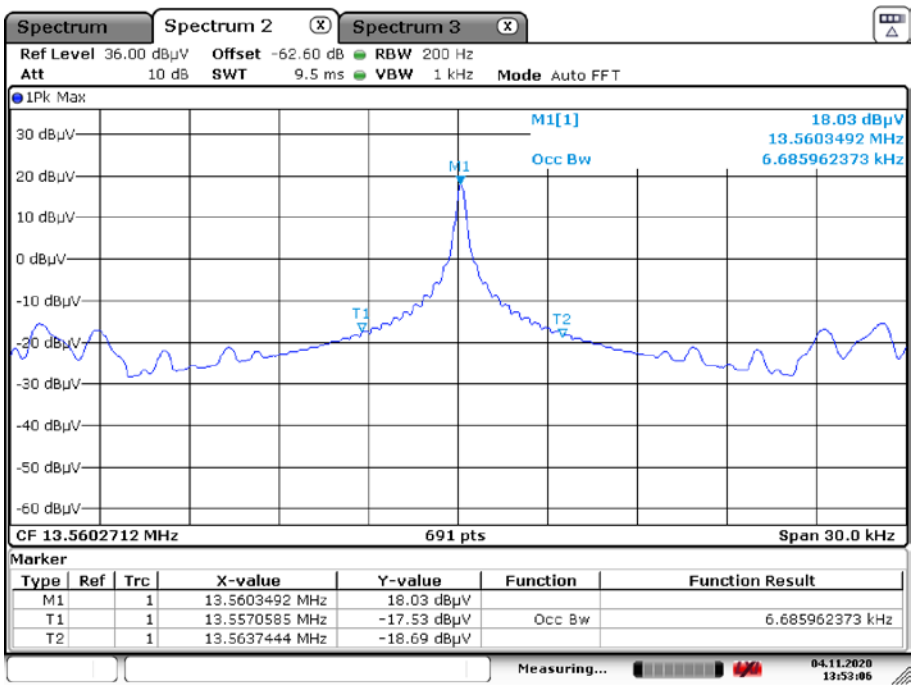
IC
for RSP-100 test report coversheet only

Result:

99% emission bandwidth
M12: 6.68kHz M18: 7.38kHz M30: 4.60kHz

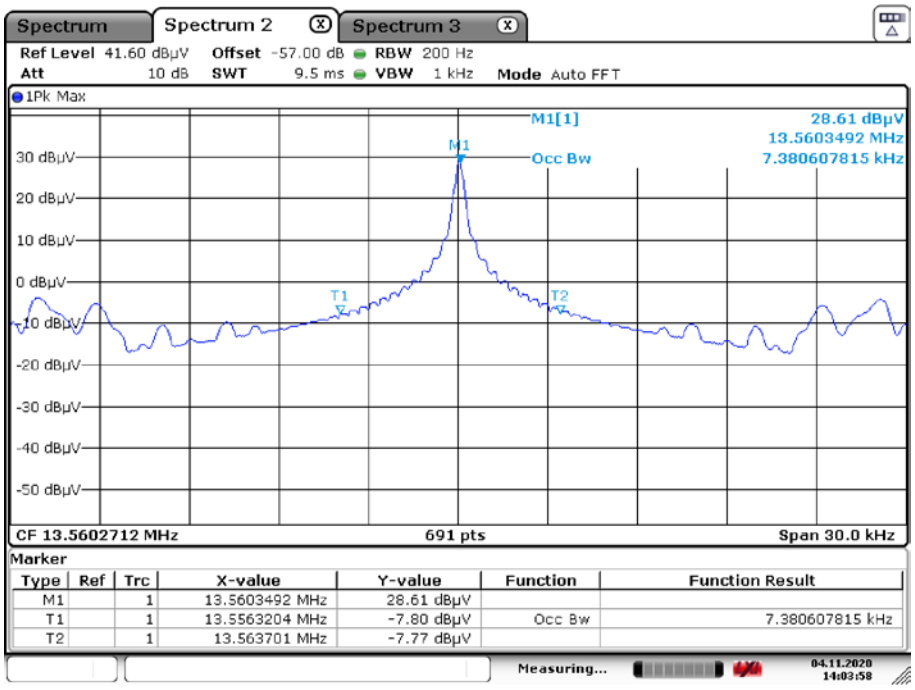
Plot:

Plot 1: M12: 99 % emission bandwidth



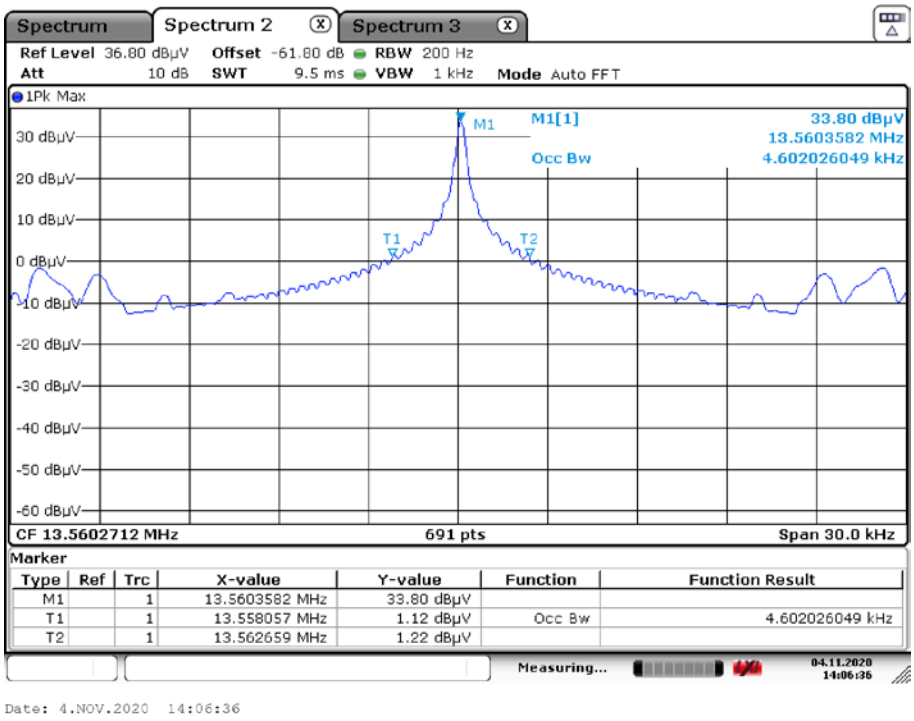
Date: 4.NOV.2020 13:53:07

Plot 2: M18: 99 % emission bandwidth



Date: 4.NOV.2020 14:03:58

Plot 3: M30: 99 % emission bandwidth



11.2 Field strength of the fundamental

Measurement:

The maximum detected field strength for the carrier signal.

Measurement parameters	
Detector:	Quasi peak / peak (worst case)
Resolution bandwidth:	120 kHz
Video bandwidth:	≥ 3x RBW
Trace mode:	Max hold
Used equipment:	See chapter 7.1A
Measurement uncertainty:	See chapter 8

Limit:

FCC & IC		
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553 to 13.567	15,848 (84 dBµV/m)	30

Recalculation:

According to ANSI C63.10		
Frequency	Formula	Correction value
13.56 MHz	$FS_{limit} = FS_{max} - 40 \log\left(\frac{d_{nearfield}}{d_{measure}}\right) - 20\log\left(\frac{d_{limit}}{d_{nearfield}}\right)$ FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m FS_{max} is the measured field strength, expressed in dBµV/m $d_{near\ field}$ is the λ/2π distance $d_{measure}$ is the distance of the measurement point from EUT d_{limit} is the reference limit distance	-21.4 from 3m to 30m

Result:

M12:

Field strength of the fundamental		
Frequency	13.56 MHz	
Distance	@ 3 m	@ 30 m
Measured / calculated value	18.17dBµV/m	-3.23dBµV/m

M18:

Field strength of the fundamental		
Frequency	13.56 MHz	
Distance	@ 3 m	@ 30 m
Measured / calculated value	29.15dBµV/m	7.75dBµV/m

M30:

Field strength of the fundamental		
Frequency	13.56 MHz	
Distance	@ 3 m	@ 30 m
Measured / calculated value	33.75dBµV/m	12.35dBµV/m

11.3 Field strength of the harmonics and spurious

Measurement:

The maximum detected field strength for the harmonics and spurious.

Measurement parameters	
Detector:	Quasi peak / average or peak (worst case – pre-scan)
Resolution bandwidth:	F < 150 kHz: 200 Hz 150 kHz < F < 30 MHz: 9 kHz 30 MHz < F < 1 GHz: 120 kHz
Video bandwidth:	F < 150 kHz: 1 kHz 150 kHz < F < 30 MHz: 100 kHz 30 MHz < F < 1 GHz: 300 kHz
Trace mode:	Max hold
Used equipment:	See chapter 7.1A & 7.2A & 7.4A
Measurement uncertainty:	See chapter 8

Limit:

FCC & IC		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30 (29.5 dBµV/m)	30
30 – 88	100 (40 dBµV/m)	3
88 – 216	150 (43.5 dBµV/m)	3
216 – 960	200 (46 dBµV/m)	3

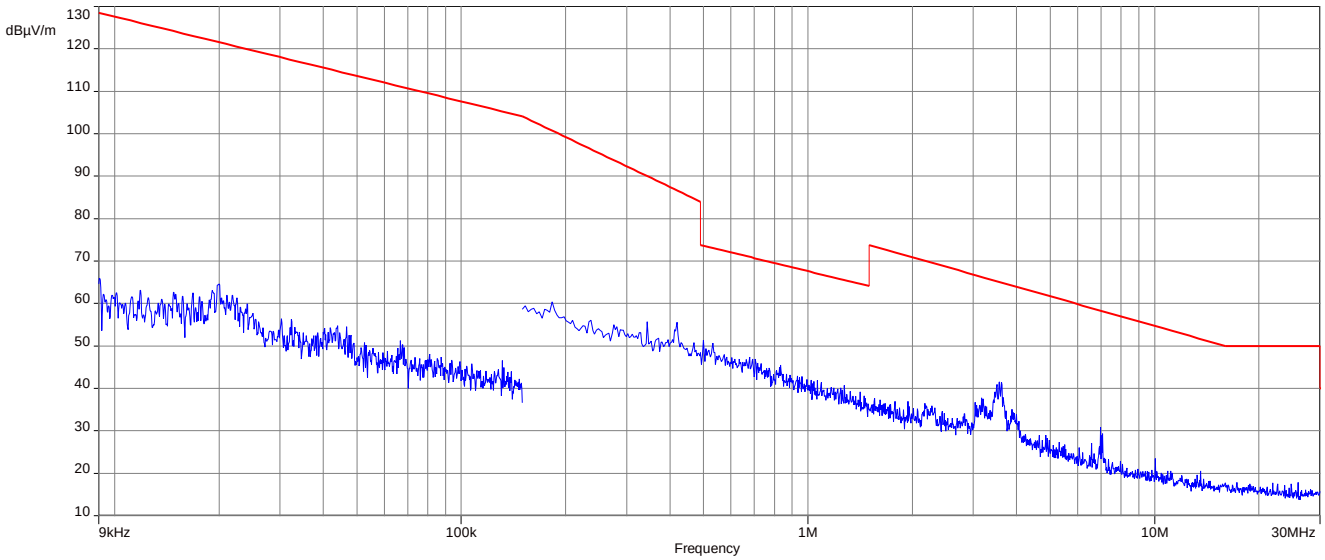
Note: For a reduced measurement distance, please take a look at the limit line and the ANSI C63.10-2013 sub clause 6.4 radiated emissions from unlicensed wireless devices below 30 MHz.

Result:

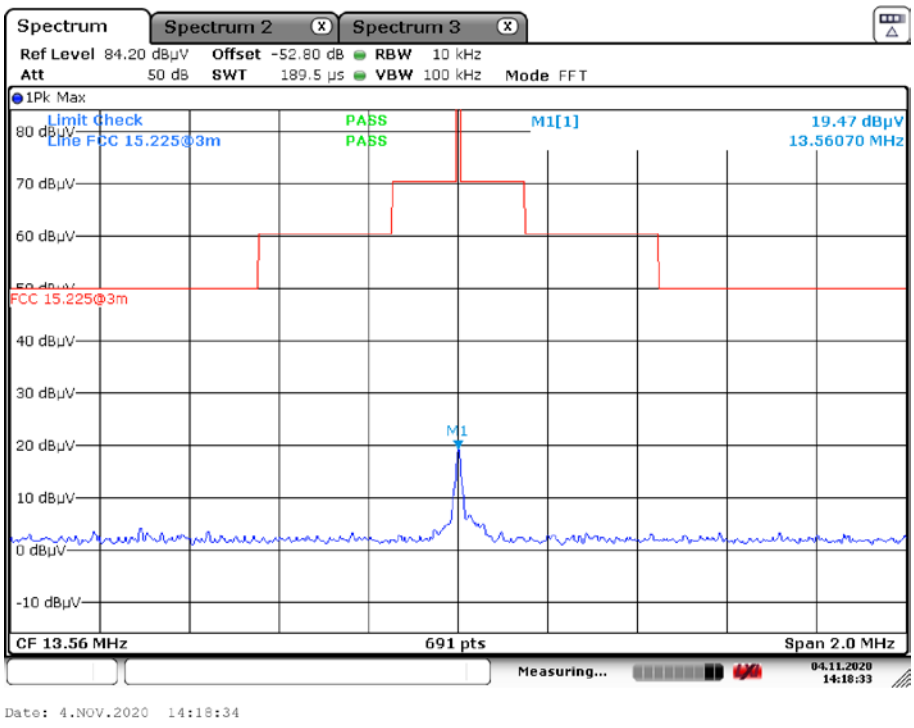
Detected emissions			
Frequency (MHz)	Detector	Resolution bandwidth (kHz)	Detected value (dBµV/m @ 3m)
No emissions between 9 kHz and 30 MHz detected. For emissions between 30 MHz and 1 GHz see result table below the plot.			

Plots:

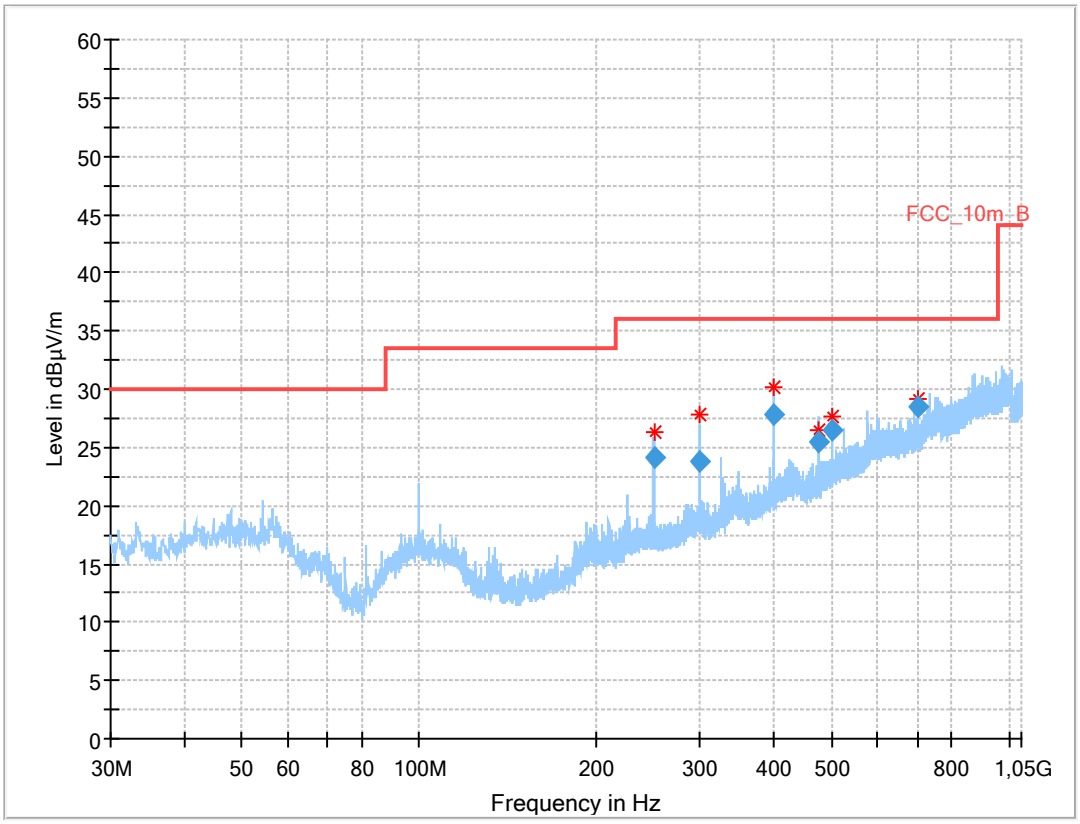
Plot 1: M12: 9 kHz – 30 MHz, magnetic emissions



Plot 2: M12: Spectrum mask (the limits are recalculated according to the ANSI C63.10-2013 sub clause 6.4)



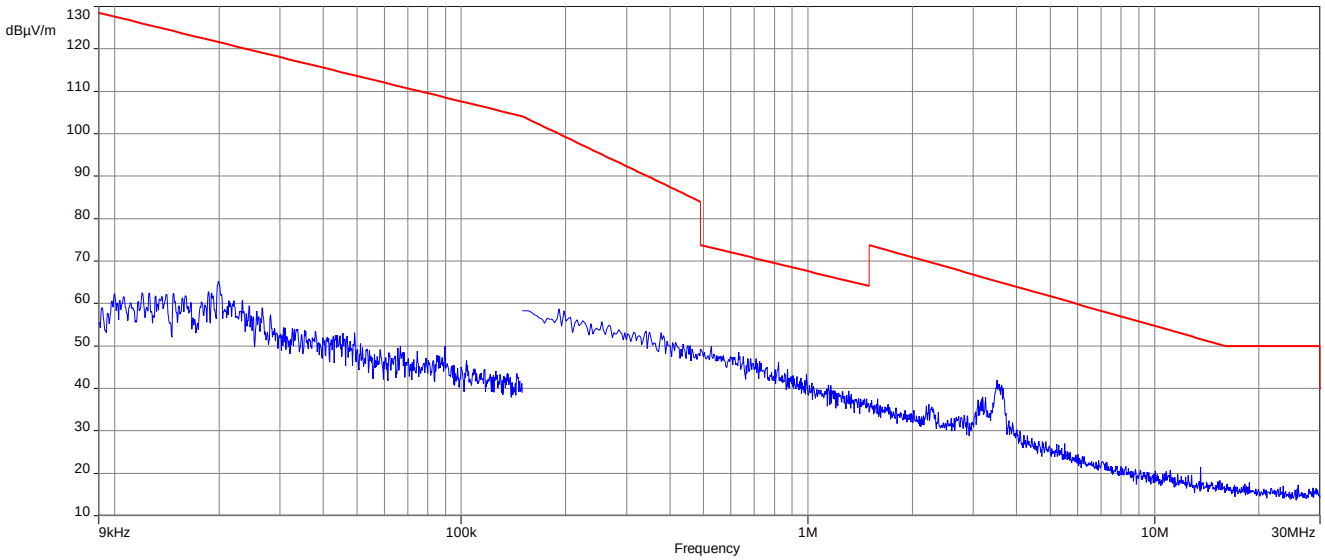
Plot 3: M12: 30 MHz – 1 GHz, vertical and horizontal polarization



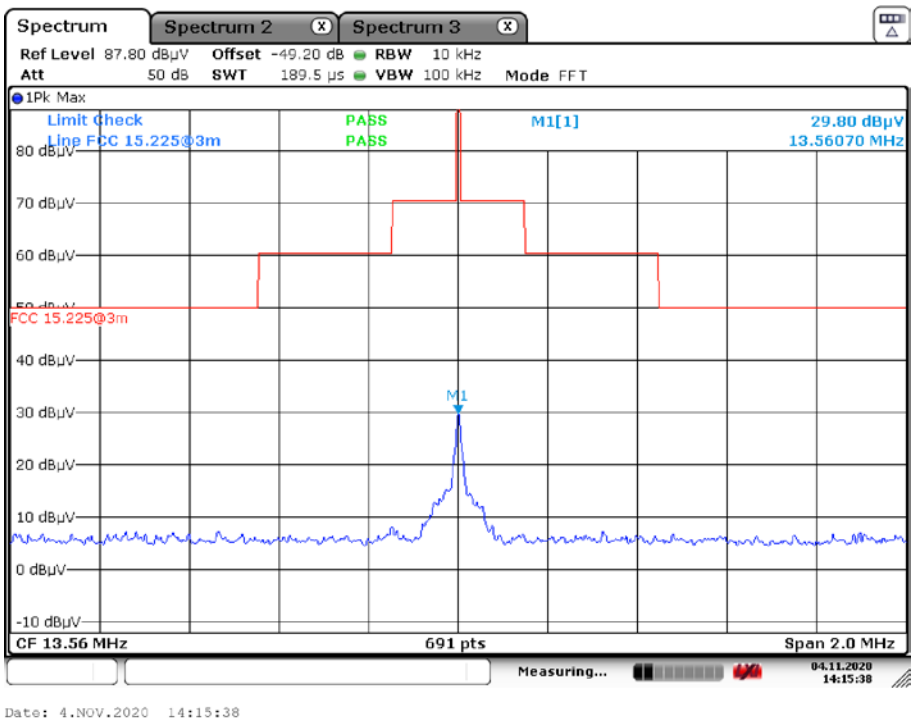
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
250.013	24.21	36.0	11.8	1000	120.0	170.0	V	247	13
300.000	23.83	36.0	12.2	1000	120.0	107.0	V	292	14
399.984	27.87	36.0	8.1	1000	120.0	101.0	V	157	17
474.997	25.46	36.0	10.5	1000	120.0	170.0	V	72	18
500.010	26.44	36.0	9.6	1000	120.0	101.0	V	157	18
700.006	28.42	36.0	7.6	1000	120.0	105.0	V	97	21

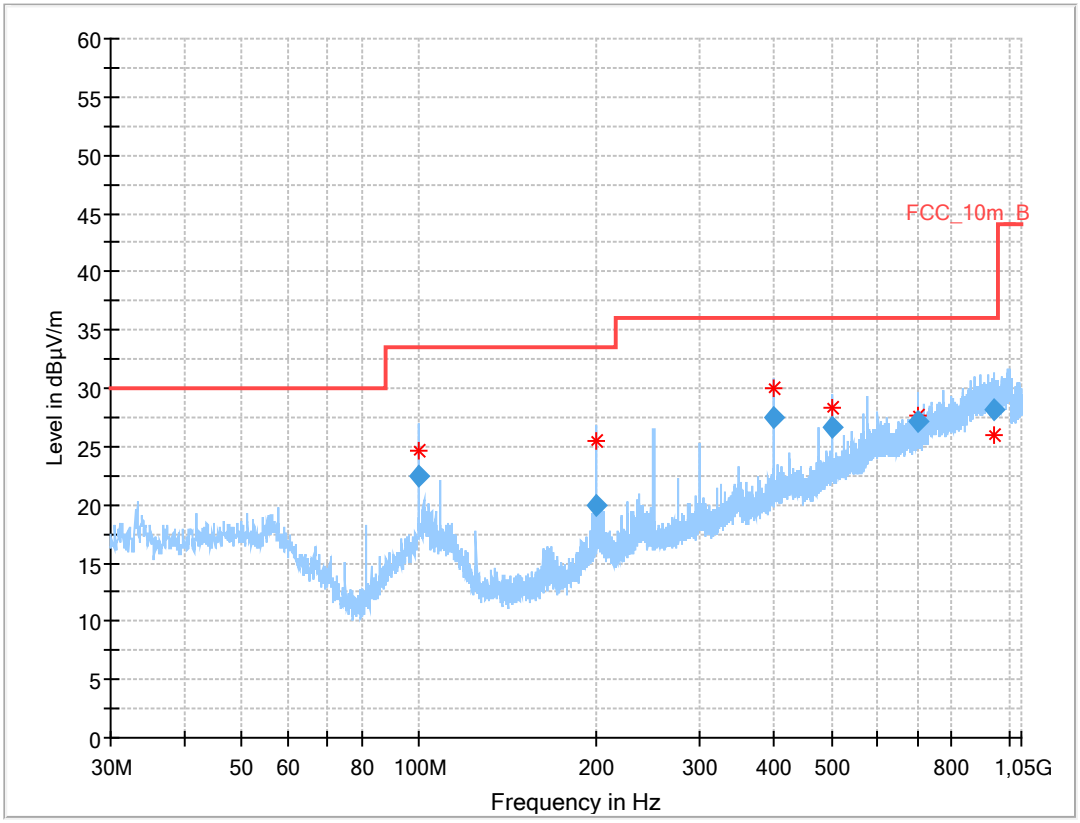
Plot 4: M18: 9 kHz – 30 MHz, magnetic emissions



Plot 5: M18: Spectrum mask (the limits are recalculated according to the ANSI C63.10-2013 sub clause 6.4)



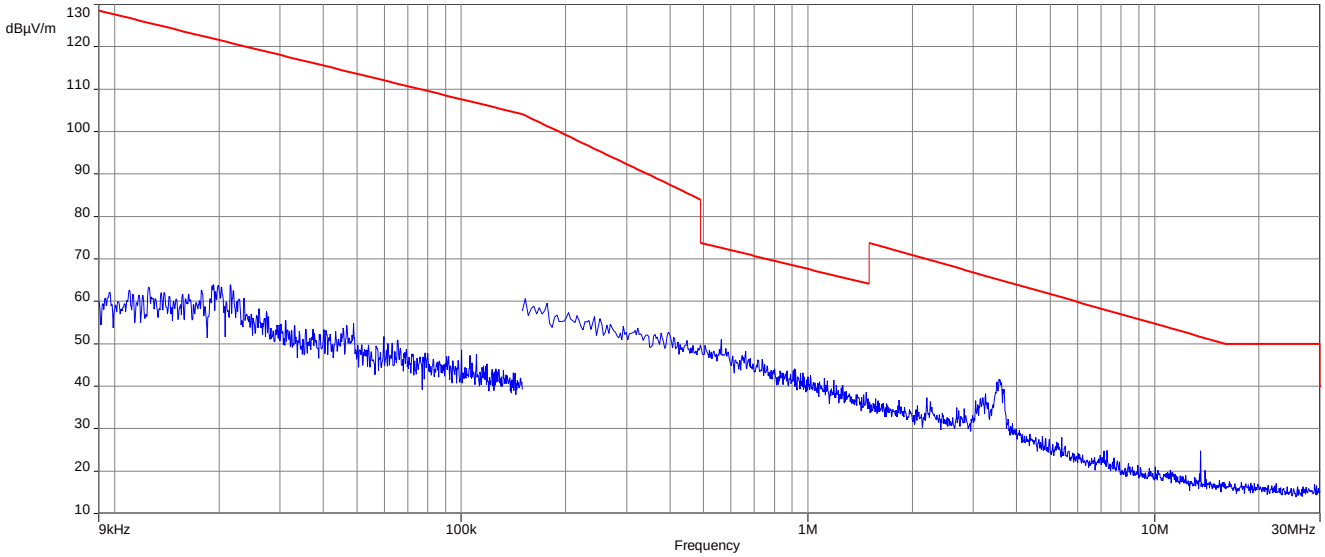
Plot 6: M18: 30 MHz – 1 GHz, vertical and horizontal polarization



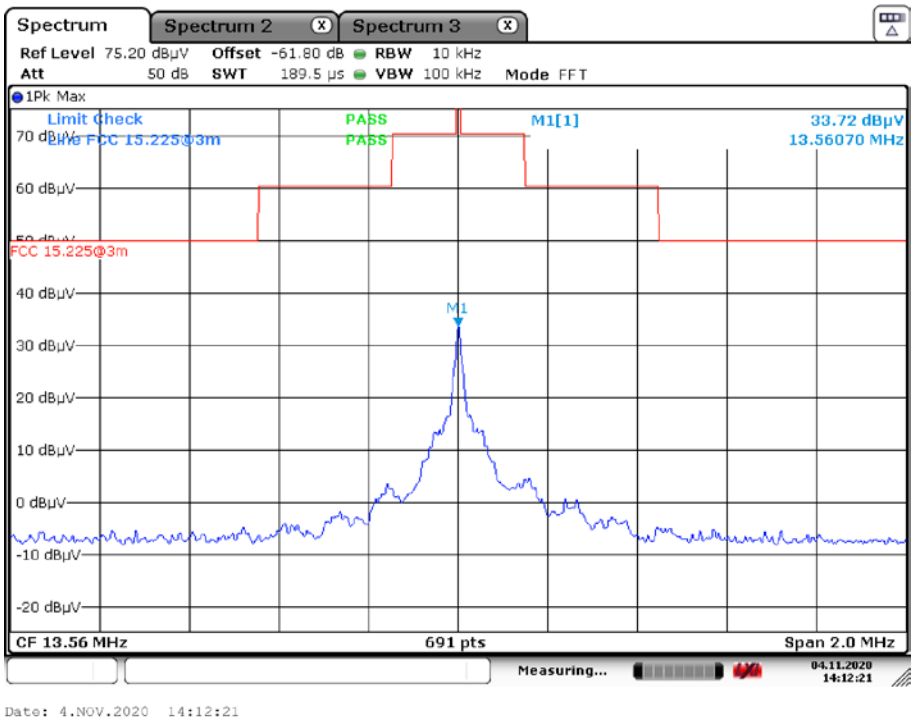
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
100.012	22.43	33.5	11.1	1000	120.0	109.0	V	176	13
199.986	20.01	33.5	13.5	1000	120.0	101.0	V	248	11
399.990	27.50	36.0	8.5	1000	120.0	170.0	V	247	17
499.985	26.69	36.0	9.3	1000	120.0	118.0	V	5	18
700.010	27.10	36.0	8.9	1000	120.0	170.0	V	157	21
942.720	28.12	36.0	7.9	1000	120.0	104.0	H	0	24

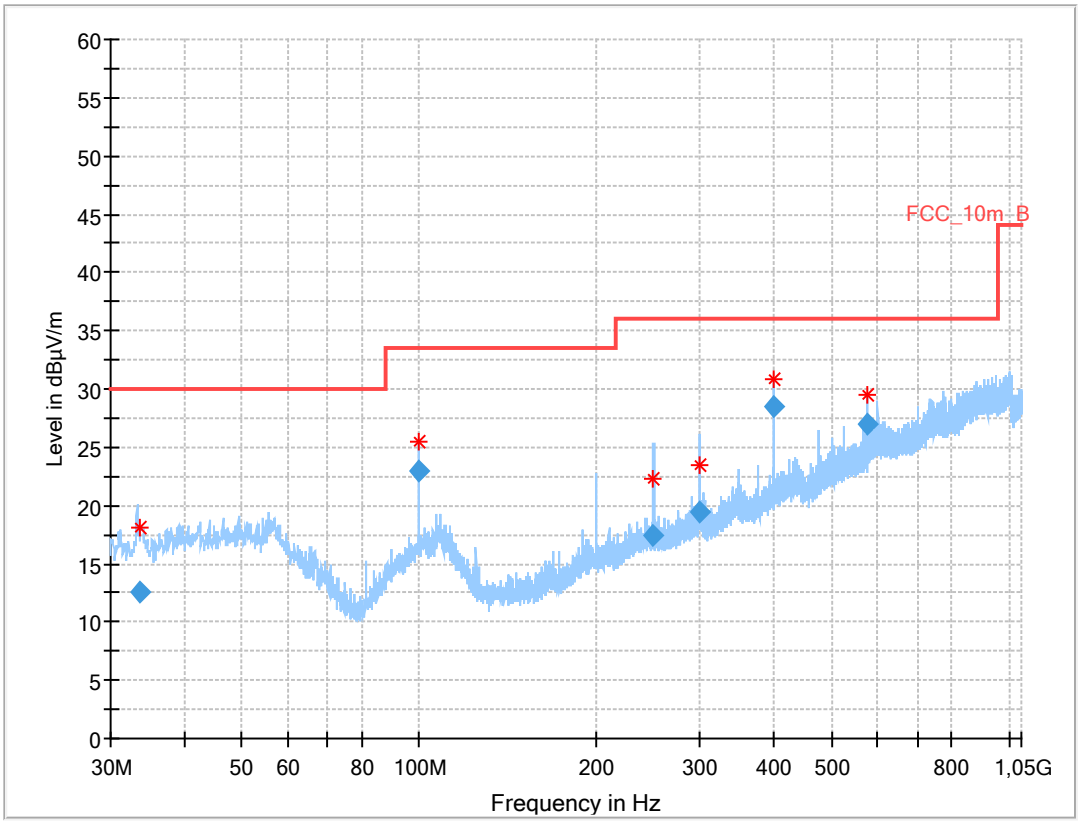
Plot 7: M30: 9 kHz – 30 MHz, magnetic emissions



Plot 8: M30: Spectrum mask (the limits are recalculated according to the ANSI C63.10-2013 sub clause 6.4)



Plot 9: M30: 30 MHz – 1 GHz, vertical and horizontal polarization



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.690	12.61	30.0	17.4	1000	120.0	104.0	V	170	12
100.005	22.90	33.5	10.6	1000	120.0	105.0	V	247	13
250.000	17.36	36.0	18.6	1000	120.0	157.0	V	22	13
299.983	19.41	36.0	16.6	1000	120.0	145.0	V	-17	14
399.992	28.57	36.0	7.4	1000	120.0	170.0	V	-22	17
574.967	26.95	36.0	9.1	1000	120.0	170.0	V	67	19

11.4 Conducted limits

Measurement:

Measurement of the conducted spurious emissions for an intentional radiator that is designed to be connected to the public utility (AC) power line.

Measurement parameters	
Detector:	Quasi peak / average or peak (worst case – pre-scan)
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Trace mode:	Max hold
Used equipment:	See chapter 7.3A
Measurement uncertainty:	See chapter 8

Limit:

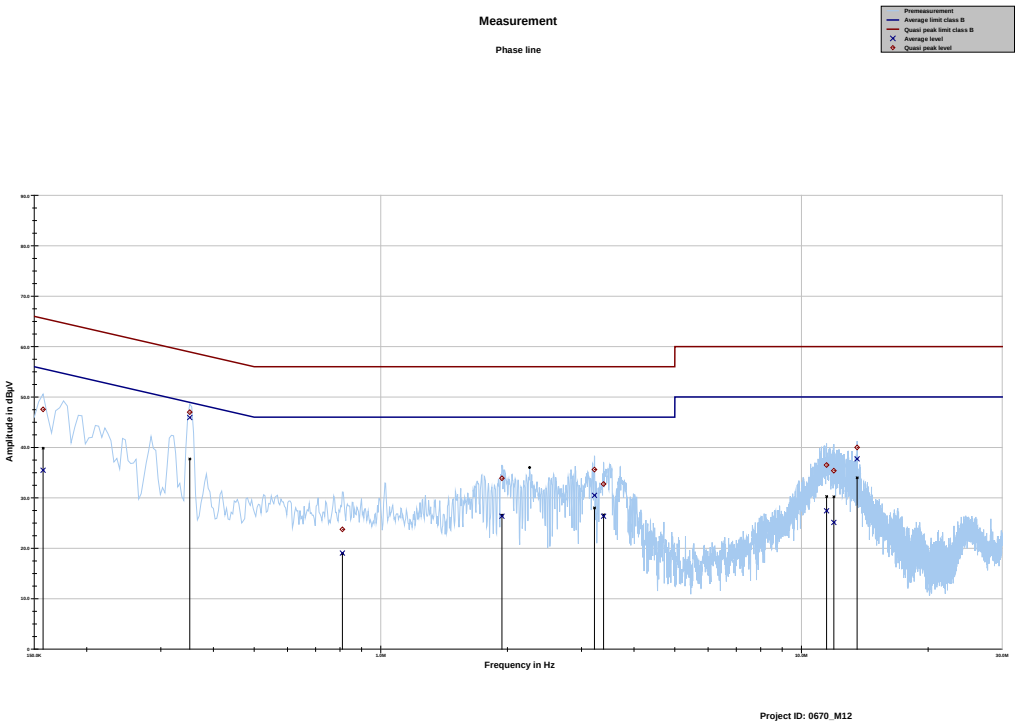
FCC & IC		
Frequency (MHz)	Quasi-peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

Result:

Detected emissions			
Frequency (MHz)	Detector	Resolution bandwidth (kHz)	Detected value
see result tables below the plots			

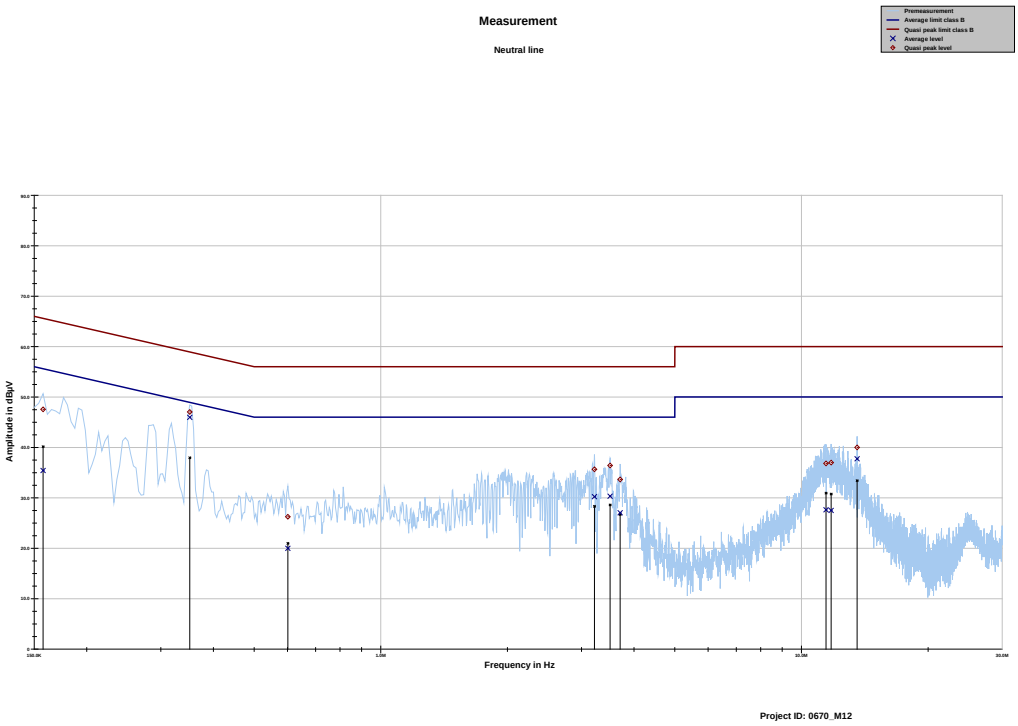
Plots:

Plot 1: M12: 150 kHz to 30 MHz, phase line



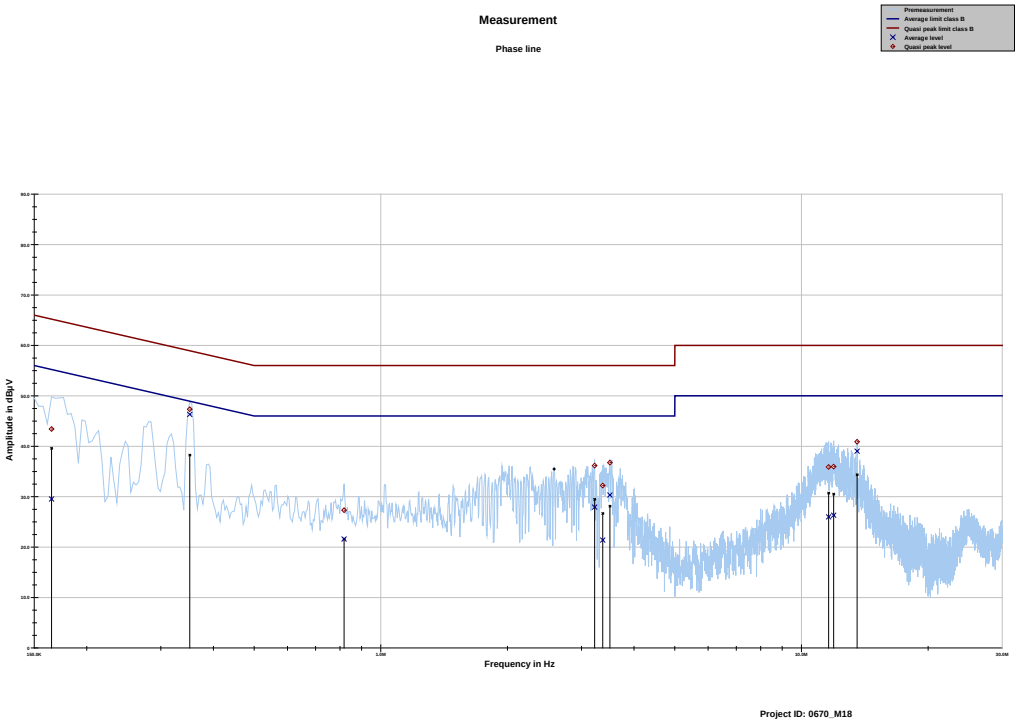
Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.157463	47.55	18.04	65.597	35.47	20.31	55.787
0.351488	47.00	11.93	58.927	45.91	4.33	50.243
0.810431	23.76	32.24	56.000	19.04	26.96	46.000
1.941000	33.89	22.11	56.000	26.35	19.65	46.000
3.220819	35.60	20.40	56.000	30.49	15.51	46.000
3.384994	32.75	23.25	56.000	26.35	19.65	46.000
11.474344	36.50	23.50	60.000	27.42	22.58	50.000
11.937019	35.38	24.62	60.000	25.12	24.88	50.000
13.560113	40.00	20.00	60.000	37.73	12.27	50.000

Plot 2: M12: 150 kHz to 30 MHz, neutral line



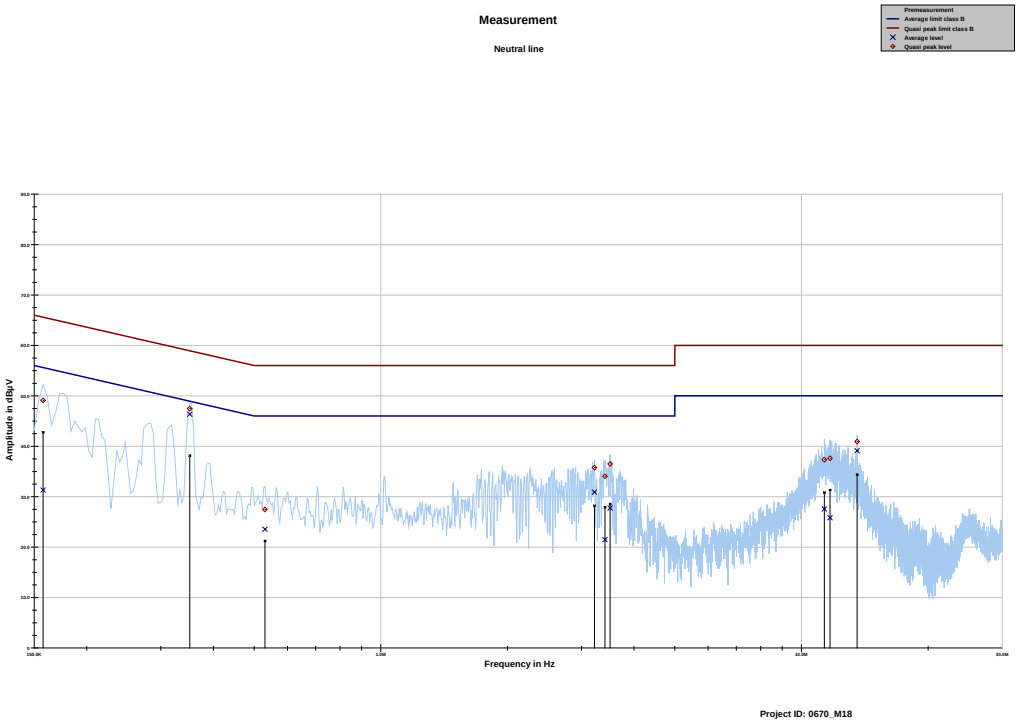
Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.157463	47.55	18.05	65.597	35.42	20.37	55.787
0.351488	47.04	11.89	58.927	45.96	4.28	50.243
0.601481	26.24	29.76	56.000	19.99	26.01	46.000
3.220819	35.67	20.33	56.000	30.24	15.76	46.000
3.508125	36.42	19.58	56.000	30.32	15.68	46.000
3.705881	33.64	22.36	56.000	27.04	18.96	46.000
11.440762	36.81	23.19	60.000	27.64	22.36	50.000
11.761650	36.98	23.02	60.000	27.49	22.51	50.000
13.560113	39.99	20.01	60.000	37.74	12.26	50.000

Plot 3: M18: 150 kHz to 30 MHz, phase line



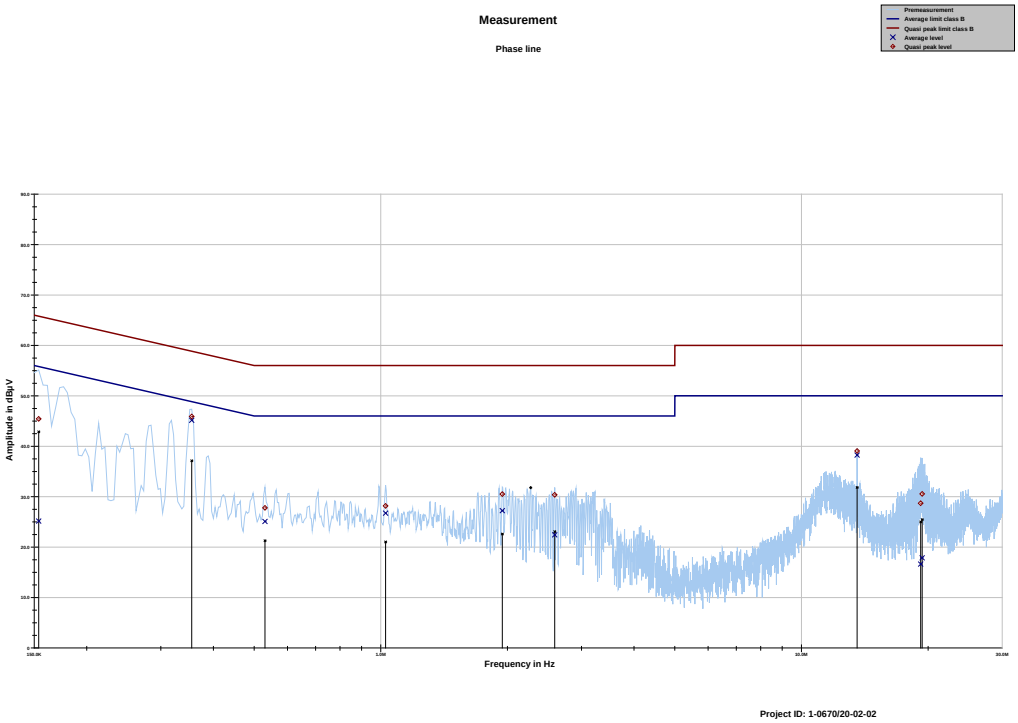
Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.164925	43.42	21.79	65.212	29.54	26.04	55.574
0.351488	47.34	11.59	58.927	46.32	3.93	50.243
0.817894	27.32	28.68	56.000	21.59	24.41	46.000
3.224550	36.15	19.85	56.000	27.93	18.07	46.000
3.370069	32.21	23.79	56.000	21.38	24.62	46.000
3.504394	36.74	19.26	56.000	30.32	15.68	46.000
11.604938	35.89	24.11	60.000	25.99	24.01	50.000
11.929556	35.96	24.04	60.000	26.31	23.69	50.000
13.560113	40.88	19.12	60.000	39.02	10.98	50.000

Plot 4: M18: 150 kHz to 30 MHz, neutral line



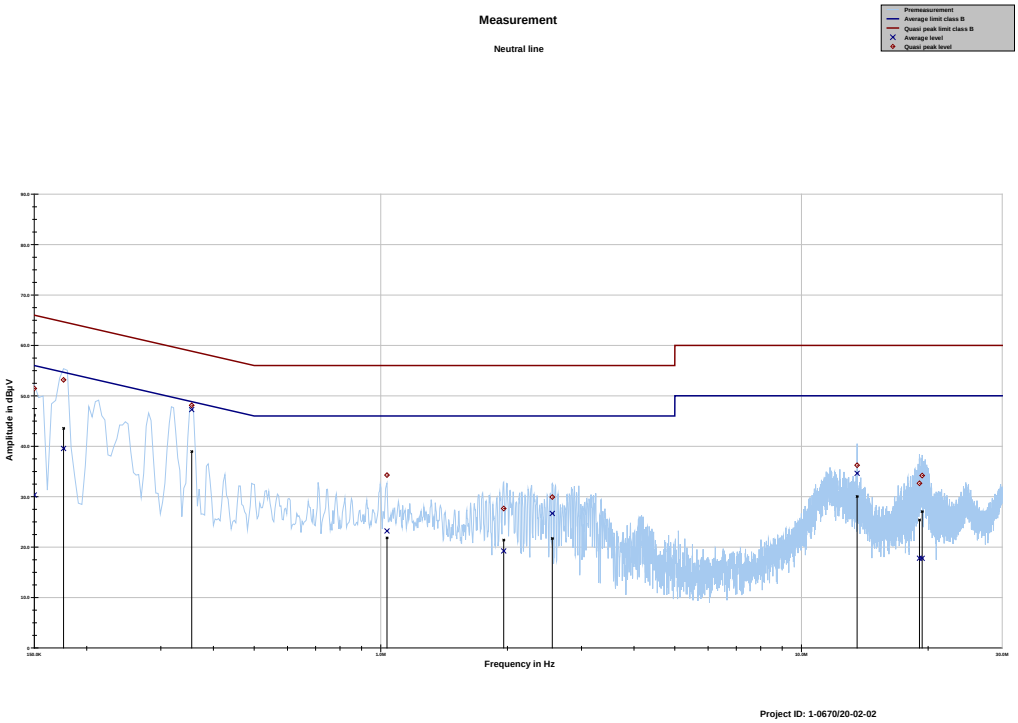
Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.157463	49.10	16.49	65.597	31.30	24.48	55.787
0.351488	47.45	11.48	58.927	46.35	3.89	50.243
0.530587	27.47	28.53	56.000	23.54	22.46	46.000
3.220819	35.76	20.24	56.000	30.89	15.11	46.000
3.411113	34.05	21.95	56.000	21.48	24.52	46.000
3.508125	36.48	19.52	56.000	27.75	18.25	46.000
11.336287	37.32	22.68	60.000	27.55	22.45	50.000
11.694487	37.61	22.39	60.000	25.82	24.18	50.000
13.560113	40.92	19.08	60.000	39.11	10.89	50.000

Plot 5: M30: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.153731	45.42	20.38	65.796	25.16	30.74	55.893
0.355219	45.90	12.94	58.840	45.15	4.98	50.137
0.530587	27.77	28.23	56.000	25.08	20.92	46.000
1.026844	28.16	27.84	56.000	26.73	19.27	46.000
1.944731	30.52	25.48	56.000	27.22	18.78	46.000
2.590238	30.36	25.64	56.000	22.43	23.57	46.000
13.560113	39.05	20.95	60.000	38.24	11.76	50.000
19.209225	28.70	31.30	60.000	16.62	33.38	50.000
19.358475	30.54	29.46	60.000	17.86	32.14	50.000

Plot 6: M30: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150000	51.47	14.53	66.000	30.33	25.67	56.000
0.176119	53.16	11.51	64.667	39.55	15.71	55.254
0.355219	48.12	10.72	58.840	47.27	2.87	50.137
1.034306	34.28	21.72	56.000	23.21	22.79	46.000
1.959656	27.64	28.36	56.000	19.22	26.78	46.000
2.556656	29.92	26.08	56.000	26.67	19.33	46.000
13.563844	36.24	23.76	60.000	34.63	15.37	50.000
19.078631	32.64	27.36	60.000	17.78	32.22	50.000
19.362206	34.18	25.82	60.000	17.78	32.22	50.000

11.5 Frequency error

Measurement:

The maximum detected field strength for the spurious.

Measurement parameters	
Detector:	Peak detector
Resolution bandwidth:	10 Hz / 100 Hz
Video bandwidth:	> RBW
Trace mode:	Max hold
Used equipment:	See chapter 7.4A
Measurement uncertainty:	See chapter 8

Limit:

FCC & IC
The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. (±1.356 kHz) Carrier frequency stability shall be maintained to ±0.01% (±100 ppm)

M12:

Result: Temperature variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560565060	565	-20 °C & 100% voltage	compliant
13.560561440	561	-10 °C & 100% voltage	compliant
13.560521640	521	0 °C & 100% voltage	compliant
13.560479670	479	+10 °C & 100% voltage	compliant
13.560411660	411	+20 °C & 100% voltage	compliant
13.560355220	355	+30 °C & 100% voltage	compliant
13.560304570	304	+40 °C & 100% voltage	compliant
13.560276350	276	+50 °C & 100% voltage	compliant

Result: Voltage variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560369260	369	+20 °C & 85% voltage	compliant
13.560411660	411	+20 °C & 100% voltage	compliant
13.560349000	349	+20 °C & 115% voltage	compliant

M18:

Result: Temperature variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560518750	518	-20 °C & 100% voltage	compliant
13.560499930	499	-10 °C & 100% voltage	compliant
13.560446390	446	0 °C & 100% voltage	compliant
13.560400800	400	+10 °C & 100% voltage	compliant
13.560347260	347	+20 °C & 100% voltage	compliant
13.560294440	294	+30 °C & 100% voltage	compliant
13.560274900	274	+40 °C & 100% voltage	compliant
13.5602534901	253	+50 °C & 100% voltage	compliant

Result: Voltage variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560345810	345	+20 °C & 85% voltage	compliant
13.560347260	347	+20 °C & 100% voltage	compliant
13.560341470	341	+20 °C & 115% voltage	compliant

M30:

Result: Temperature variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560506450	506	-20 °C & 100% voltage	compliant
13.560461290	461	-10 °C & 100% voltage	compliant
13.560430900	430	0 °C & 100% voltage	compliant
13.560372290	372	+10 °C & 100% voltage	compliant
13.560325250	325	+20 °C & 100% voltage	compliant
13.560256660	256	+30 °C & 100% voltage	compliant
13.560232920	232	+40 °C & 100% voltage	compliant
13.560229740	229	+50 °C & 100% voltage	compliant

Result: Voltage variation

Frequency tolerance			
Measured frequency (MHz)	Frequency error (Hz)	Conditions	Result
13.560325250	325	+20 °C & 85% voltage	compliant
13.560325250	325	+20 °C & 100% voltage	compliant
13.560324670	324	+20 °C & 115% voltage	compliant

12 Observations

No observations except those reported with the single test cases have been made.

13 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

14 Document history

Version	Applied changes	Date of release
-/-	Initial release	2020-11-27
A	Editorial changes	2020-12-04

15 Accreditation Certificate – D-PL-12076-01-04

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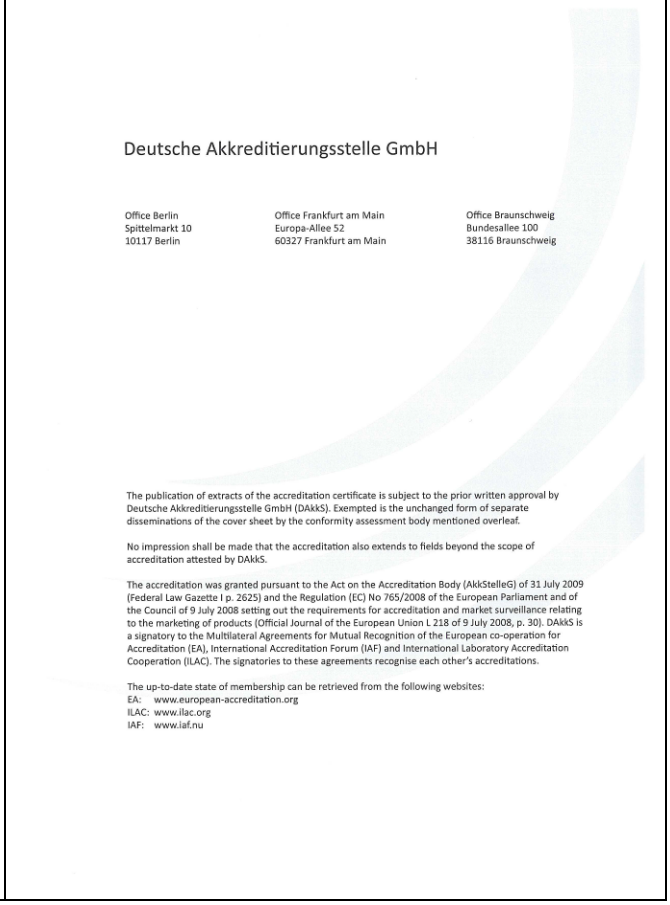
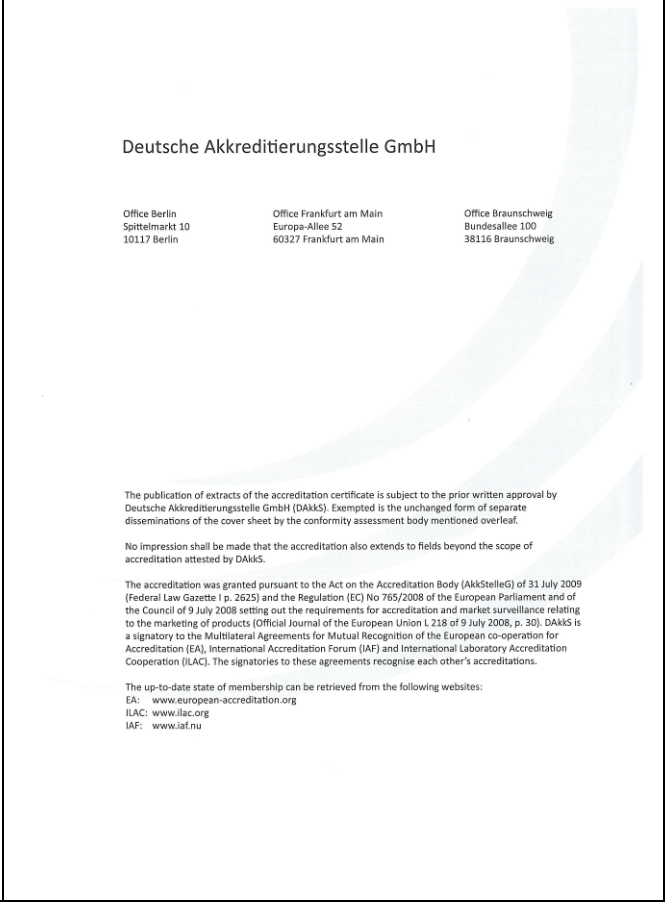
	

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf

16 Accreditation Certificate – D-PL-12076-01-05

first page	last page
	

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:

Telecommunication (FCC Requirements)

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.

Registration number of the certificate: **D-PL-12076-01-05**

Frankfurt am Main, 09.06.2020

by order Dipl.-Ing. (FH) Ralf Egner
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
https://www.dakks.de/en/content/accredited-bodies-dakks
See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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Office Braunschweig
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The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

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The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

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IAF: www.iaf.nu

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https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

################################ END OF TEST REPORT ################################