Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-0981/20-01-04

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
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

Building 36 Technologies, LLC
150 A Street, Suite 104
02494-0249 Needham / UNITED STATES
Phone: 781-474-0500
Contact: Daniel Goodman
e-mail: dan@building36.com

Manufacturer

MEC electronics Entwicklung und Produktion GmbH
Dresdner Straße 45
1200 Vienna / AUSTRIA

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
RSS - 210 Issue 10	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

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

Test Item

Kind of test item:	**Display**
Model name:	**ADC-T40-HD**
FCC ID:	**2AC3T-B36T40HDRA**
IC:	**12323A-B36T40HDRA**
Frequency band:	902 MHz – 928 MHz
Technology tested:	Proprietary
Antenna:	Integrated antenna
Power supply:	5.0 V DC by external power supply TT electronics DSA-13PFC-05 FEU
Temperature range:	+5°C to +35°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
2021.05.26 08:19:40 +02'00'

Christoph Schneider
Lab Manager
Radio Communications

Test performed:

cn=Tobias Wittenmeier, o=CTC advanced GmbH, ou=WIT-170519, email=tobias.wittenmeier@ctcadvanced.com, c=DE
2021.05.26 08:16:06 +02'00'

Tobias Wittenmeier
Testing Manager
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2021-01-27
Date of receipt of test item:	2021-03-29
Start of test:*	2021-04-05
End of test:*	2021-04-23
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

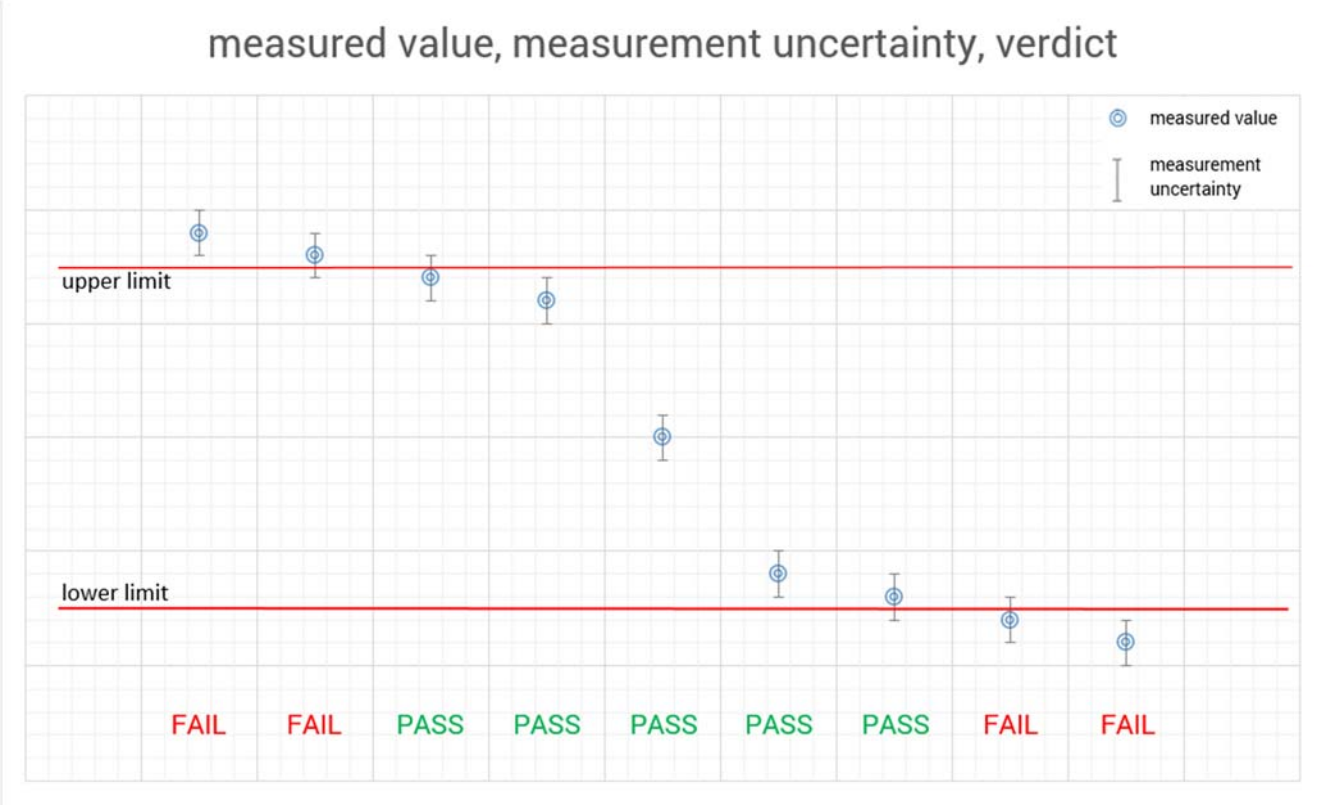
Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 10	December 2019	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - Gen Issue 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

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
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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 9, 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 No testing under extreme temperature conditions required No testing under extreme temperature conditions required
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	5.0 V DC by external power supply TT electronics DSA-13PFC-05 FEU No testing under extreme temperature conditions required No testing under extreme temperature conditions required

6 Test item

6.1 General description

Kind of test item	:	Display
Model name	:	ADC-T40-HD
HMN	:	n/a
PMN	:	Display
HVIN	:	ADC-T40-HD
FVIN	:	n/a
S/N serial number	:	1264999921030016
Hardware status	:	B36-T40-HD-Z-A
Software status	:	v1.0
Firmware status	:	-/-
Frequency band	:	902 MHz – 928 MHz
Type of radio transmission Use of frequency spectrum	: :	Modulated carrier
Type of modulation	:	FSK
Number of channels	:	3
Antenna	:	Integrated antenna
Power supply	:	5.0 V DC by external power supply TT electronics DSA-13PFC-05 FEU
Temperature range	:	+5°C to +35°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: 1-0981/20-01-01_AnnexA
1-0981/20-01-01_AnnexB
1-0981/20-01-01_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).

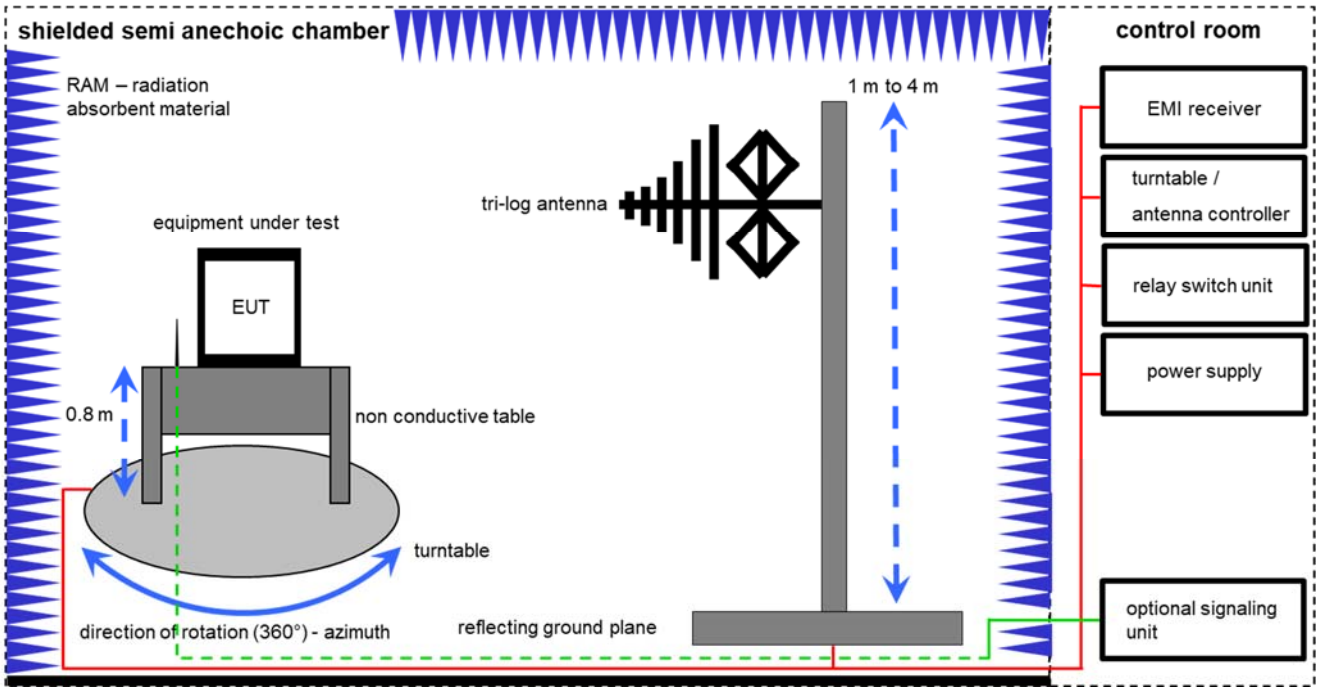
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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 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

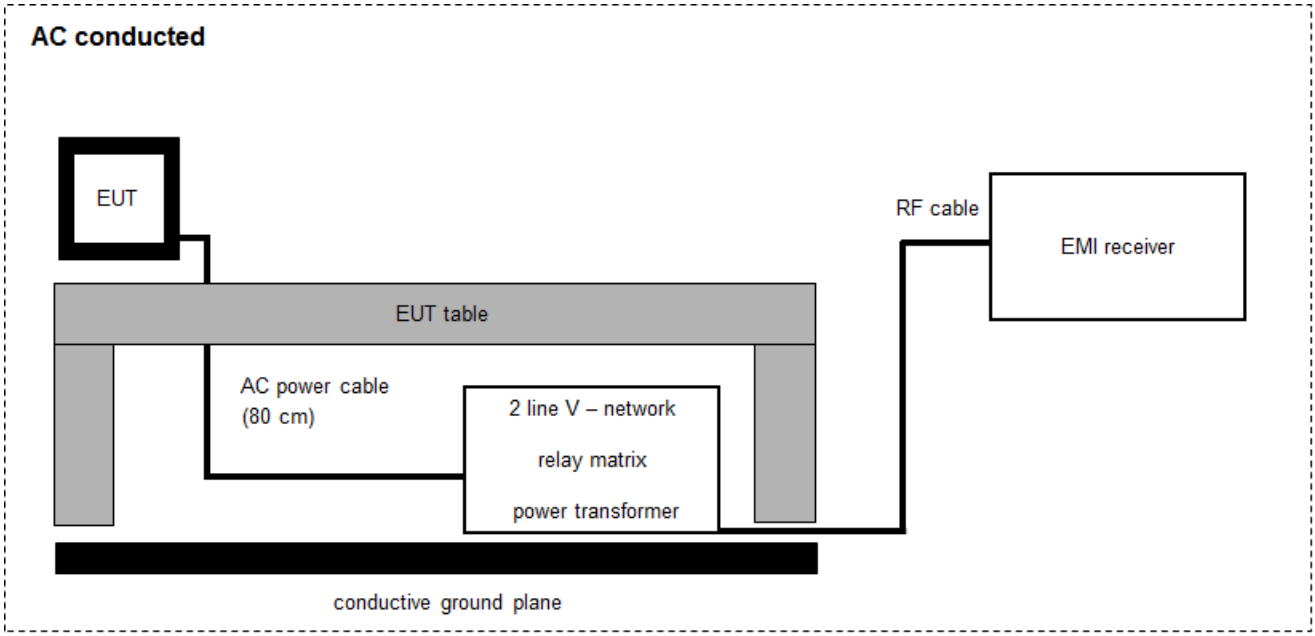
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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.	Setup	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	Semi anechoic chamber	3000023	MWB AG		300000551	ne	-/-	-/-
3	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	vlKl!	17.01.2020	16.01.2022
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!	19.02.2021	18.02.2023
8	A	Turntable	2089-4.0	EMCO		300004394	ne	-/-	-/-
9	A	PC	TecLine	F+W		300004388	ne	-/-	-/-
10	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	10.12.2020	09.06.2022

7.2 AC conducted



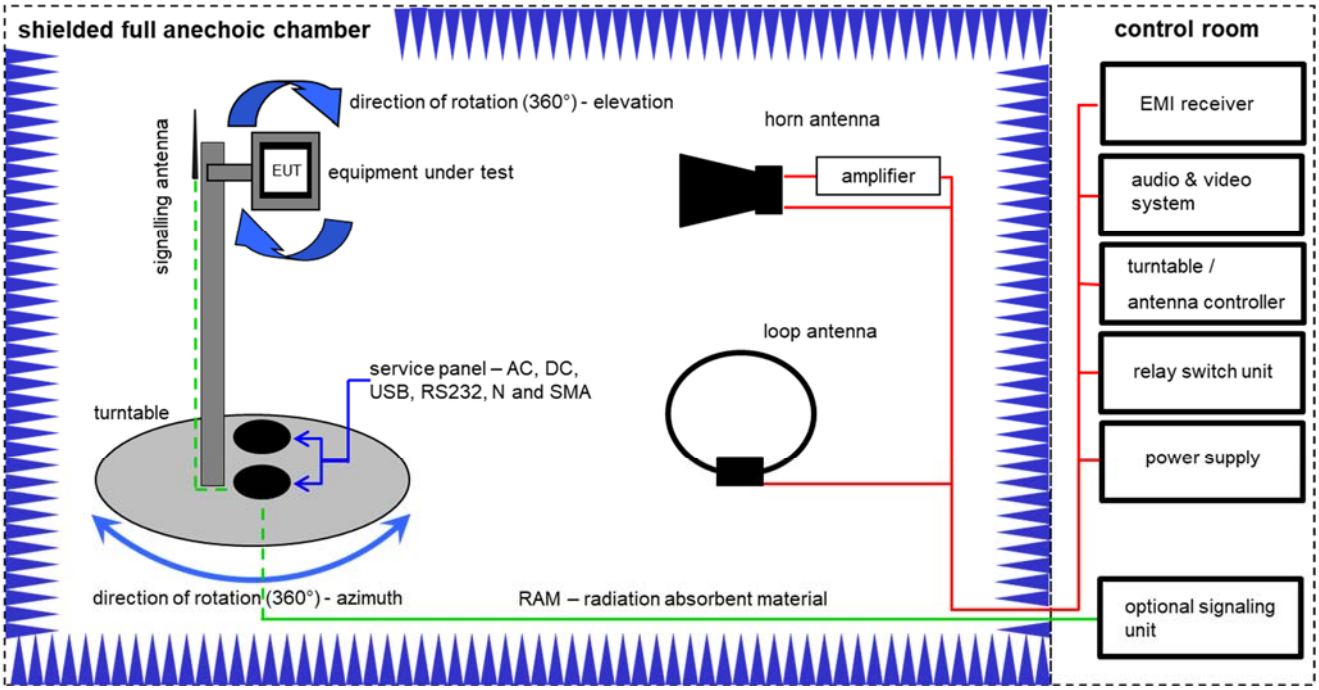
FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

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.	Setup	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	vIKI!	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	9.12.2021	8.12.2022
4	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
5	A	PC	TecLine	F+W	-/-	300003532	ne	-/-	-/-

7.3 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

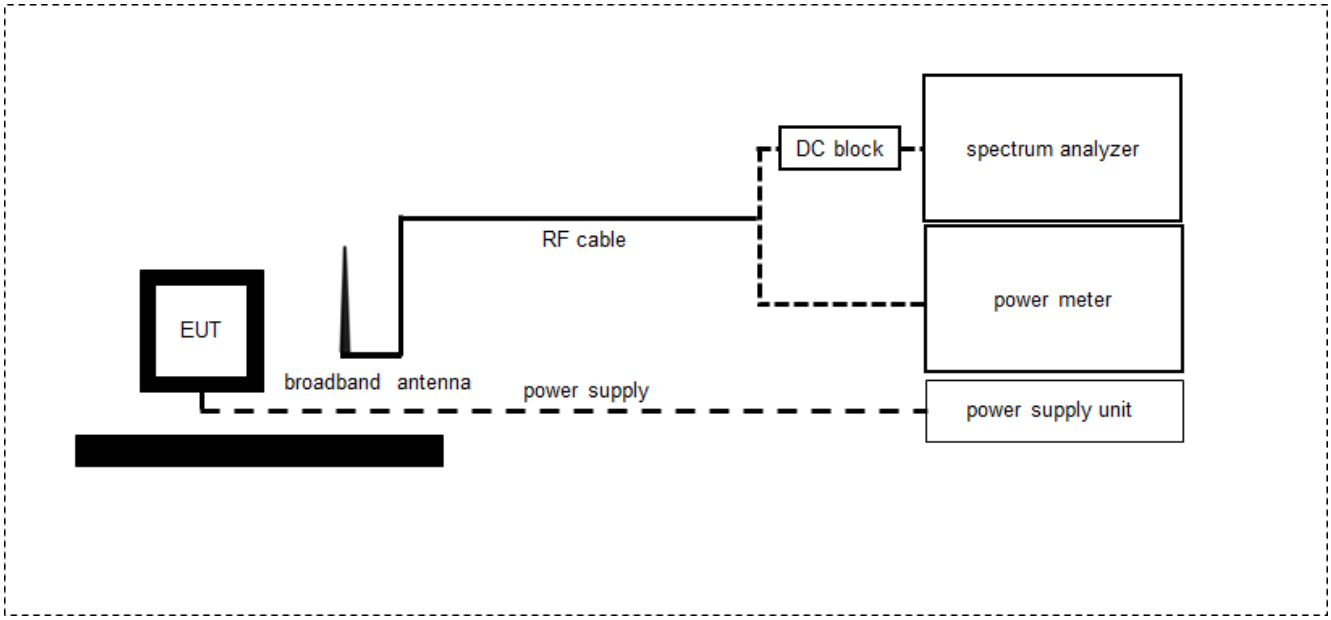
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

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.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	13.06.2019	12.06.2021
2	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vlKl!	12.03.2021	11.03.2023
3	A,B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
4	A,B	Computer	Intel Core i3 3220/3,3 GHz, Prozessor		2V2403033A5421	300004591	ne	-/-	-/-
5	A,B	NEXIO EMV-Software	BAT EMC V3.20.0.17	EMCO		300004682	ne	-/-	-/-
6	A,B	Anechoic chamber		TDK		300003726	ne	-/-	-/-
7	A,B	EMI Test Receiver 9kHz-26,5GHz	ESR26	Rohde & Schwarz	101376	300005063	k	09.12.2020	08.12.2021
8	B	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011571	300005240	ev	-/-	-/-

7.4 Test setup for normalized measurement configurations



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.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal- and Spectrum Analyzer 2 Hz - 26 GHz	FSW26	R&S	101455	300004528	k	25.02.2021	24.02.2022
2	A	Loop Antenna		ZEG TS Steinfurt		400001208	ev	-/-	-/-
3	A	RF Cable BNC	RG58	Huber & Suhner		400001209	ev	-/-	-/-

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Occupied bandwidth	± 100 kHz (depends on the used RBW)
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB

10 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	47 CFR Part 15 RSS 210 Issue 10 RSS Gen Issue 5	See table!	2021-05-26	-/-

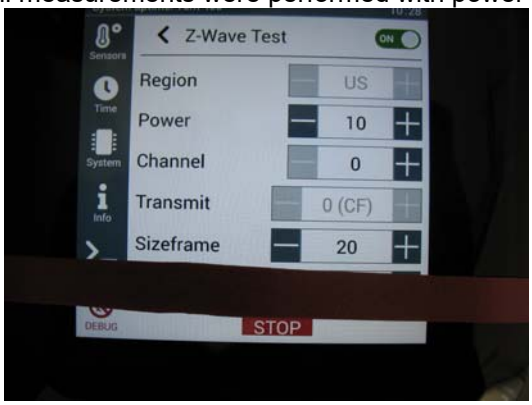
Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
§15.249(a) RSS 210 B.10	Field strength of emissions (wanted signal)	Nominal	Nominal	☒	☐	☐	☐	-/-
RSS Gen	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.209(a) / §15.249(b)(1)(2)(3) RSS Gen	Field strength of emissions (spurious)	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.207(a)	Conducted emissions < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

11 Additional comments

Reference documents: None

Special test descriptions: All measurements were performed with power setting 10 in the test software.



Configuration descriptions: Ch 1 and Ch 2 work on the same center frequency (908.42 MHz) but use different kind of modulations. Therefore we tested both.

Test mode:

☐ No test mode available.
Iperf was used to ping another device with the largest support packet size

☒ Special software is used.
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

☒ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

12 Measurement results

12.1 Field strength of emissions (wanted signal)

Description:

Measurement of the maximum radiated field strength of the wanted signal.

Measurement:

Measurement parameters	
Detector:	Quasi-Peak
Resolution bandwidth:	120 kHz
Video bandwidth:	≥ 3x RBW
Trace mode:	Max hold
Used equipment:	See chapter 6.1 A
Measurement uncertainty:	See chapter 9

Limits:

FCC / ISED		
Field strength of emissions		
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:		
Frequency [MHz]	Field Strength [dBµV/m]	Measurement distance
902 – 928 MHz	94	3

Result:

Test condition	Maximum field strength	
	Frequency / MHz	Field strength / dBµV/m @ 3 m
T_{nom} / V_{nom}	Ch 0 916 MHz	92.3

Test condition	Maximum field strength	
	Frequency / MHz	Field strength / dBµV/m @ 3 m
T_{nom} / V_{nom}	Ch 1 908.42 MHz	91.2

Test condition	Maximum field strength	
	Frequency / MHz	Field strength / dBµV/m @ 3 m
T_{nom} / V_{nom}	Ch 2 908.42 MHz	91.7

12.2 Occupied bandwidth (99% bandwidth)

Description:

Measurement of the 99% bandwidth of the wanted signal.

Measurement:

Measurement parameters	
Detector:	Peak
Resolution bandwidth:	1 % – 5 % of the occupied bandwidth
Video bandwidth:	≥ 3x RBW
Trace mode:	Max hold
Analyzer function:	99 % power function
Used equipment:	See chapter 7.3 A
Measurement uncertainty:	See chapter 9

Results:

Test condition	Occupied bandwidth	
	Frequency / MHz	Occupied bandwidth / kHz
T_{nom} / V_{nom}	Ch 0 916 MHz	112.24

Test condition	Occupied bandwidth	
	Frequency / MHz	Occupied bandwidth / kHz
T_{nom} / V_{nom}	Ch 1 908.42 MHz	87.83

Test condition	Occupied bandwidth	
	Frequency / MHz	Occupied bandwidth / kHz
T_{nom} / V_{nom}	Ch 2 908.42 MHz	93.48

Plots:

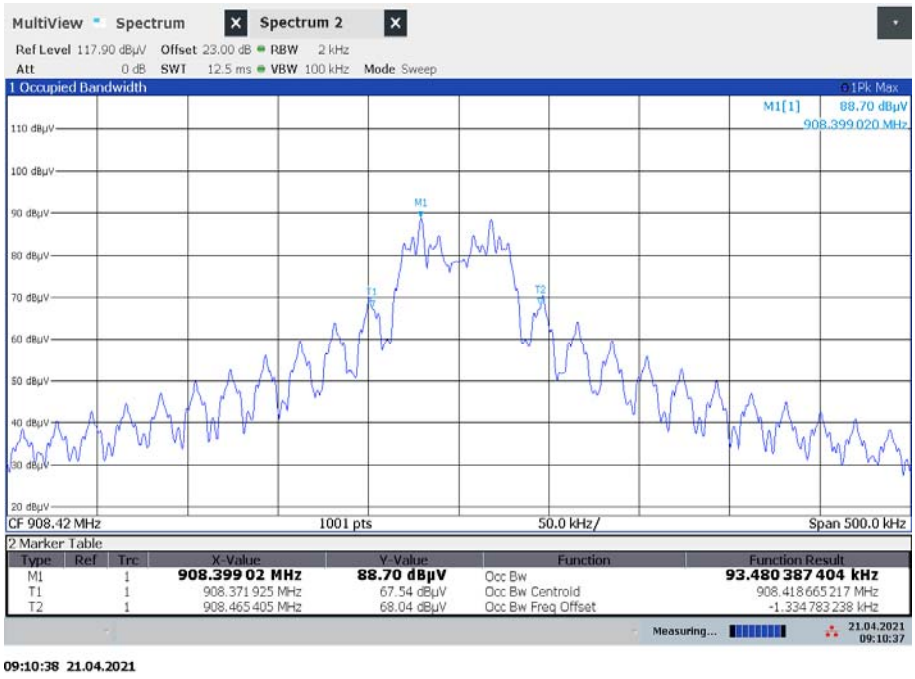
Plot 1: Ch 0

09:06:36 21.04.2021

Plot 2: Ch 1

09:09:05 21.04.2021

Plot 3: Ch 2


MultiView
Spectrum
Spectrum 2
Ref Level 117.90 dBµV Offset 23.00 dB RBW 2 kHz
Att 0 dB SWT 12.5 ms VBW 100 kHz Mode Sweep
1 Occupied Bandwidth
1Pk Max
M1[1] 88.70 dBµV
908.399 020 MHz
110 dBµV
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
M1
T1
T2
CF 908.42 MHz
1001 pts
50.0 kHz/
Span 500.0 kHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 908.399 02 MHz 88.70 dBµV Occ Bw 93.480 387 404 kHz
T1 1 908.371 925 MHz 67.54 dBµV Occ Bw Centroid 908.418 665 217 MHz
T2 1 908.465 405 MHz 68.04 dBµV Occ Bw Freq Offset -1.334 783 238 kHz
Measuring...
21.04.2021
09:10:37
09:10:38 21.04.2021

12.3 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 - A
Measurement uncertainty	See sub clause 9

Limits:

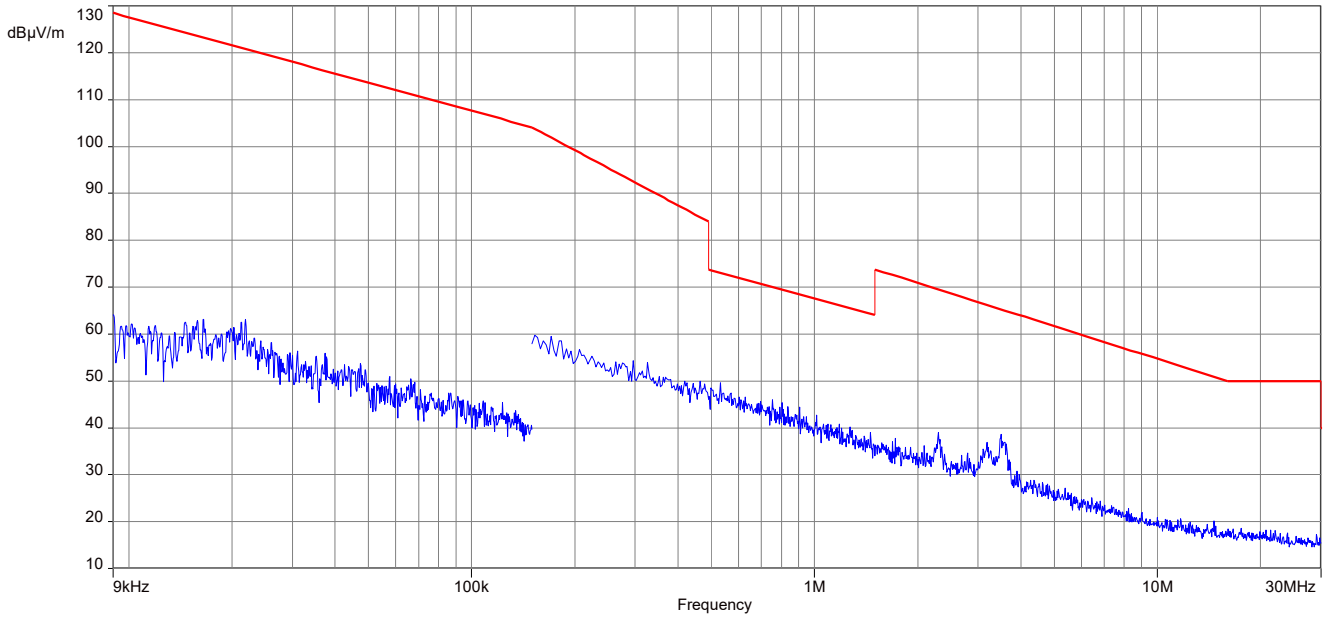
FCC		ISED
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

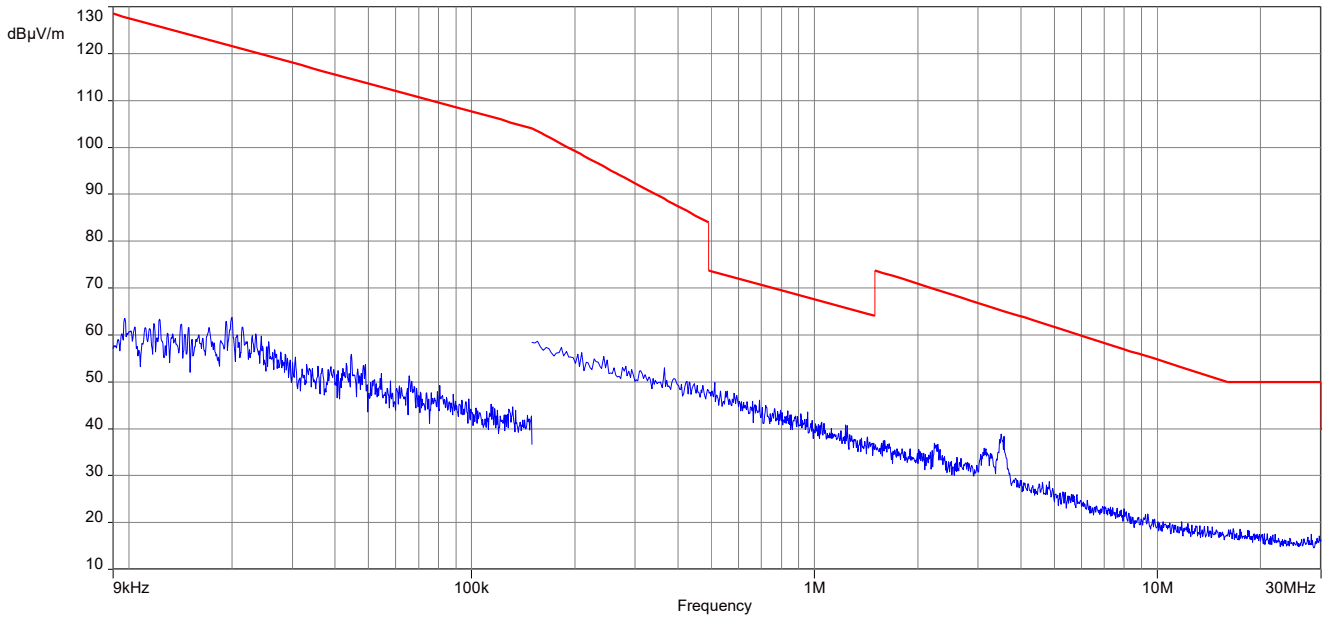
TX Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		

Plots:

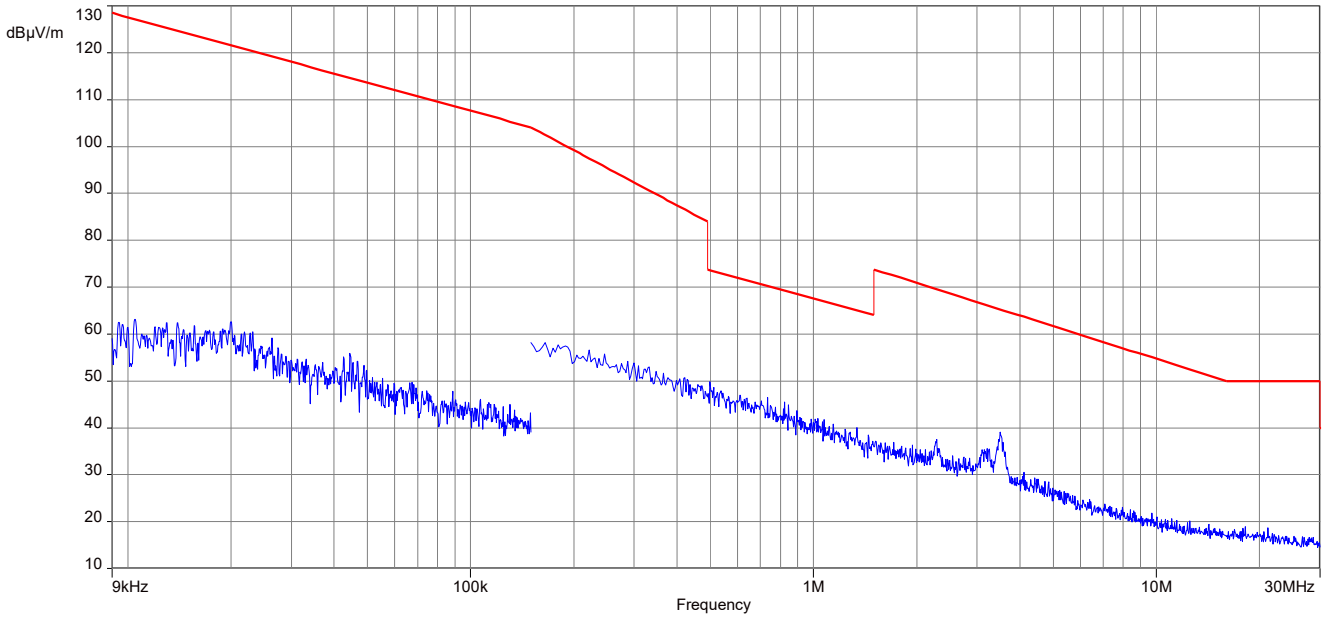
Plot 1: 9 kHz to 30 MHz, Ch 0



Plot 2: 9 kHz to 30 MHz, Ch 1



Plot 3: 9 kHz to 30 MHz, Ch 2



12.4 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

Measurement:

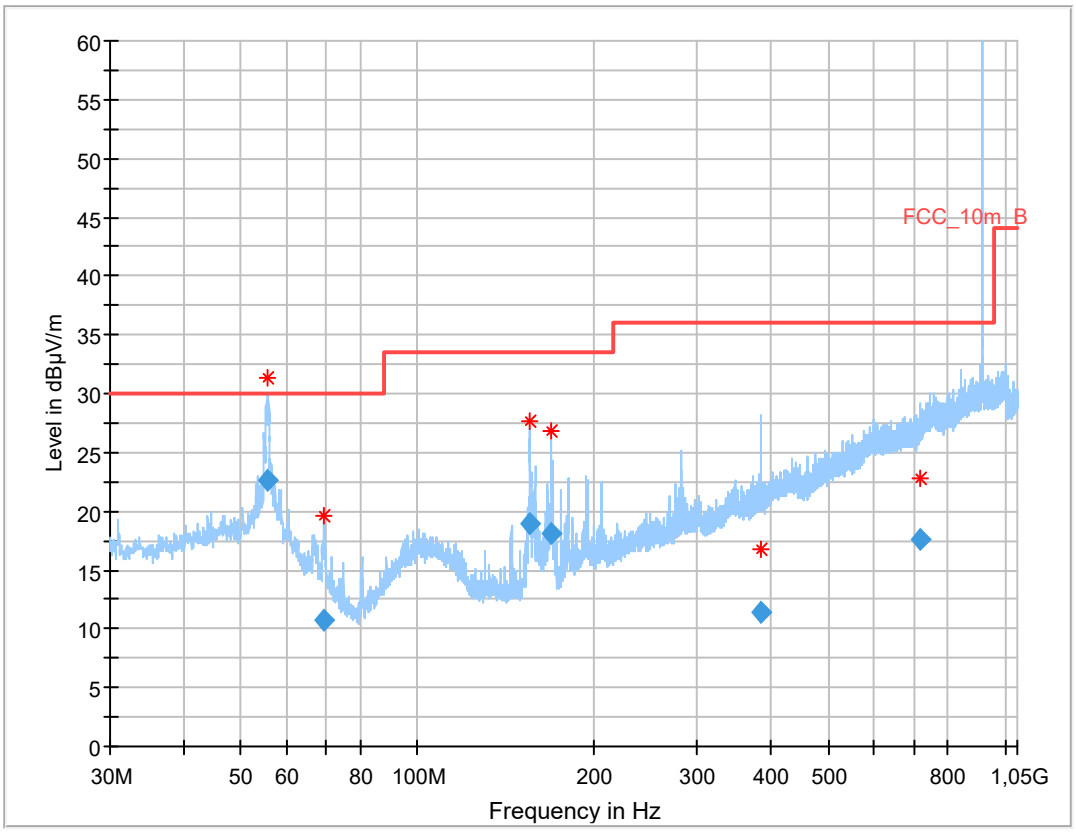
Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	120 kHz
Video bandwidth:	3 x RBW
Span:	30 MHz to 1 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.1
Measurement uncertainty	See sub clause 9

Limits:

FCC		ISED
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10

Plot:

Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, Ch 0

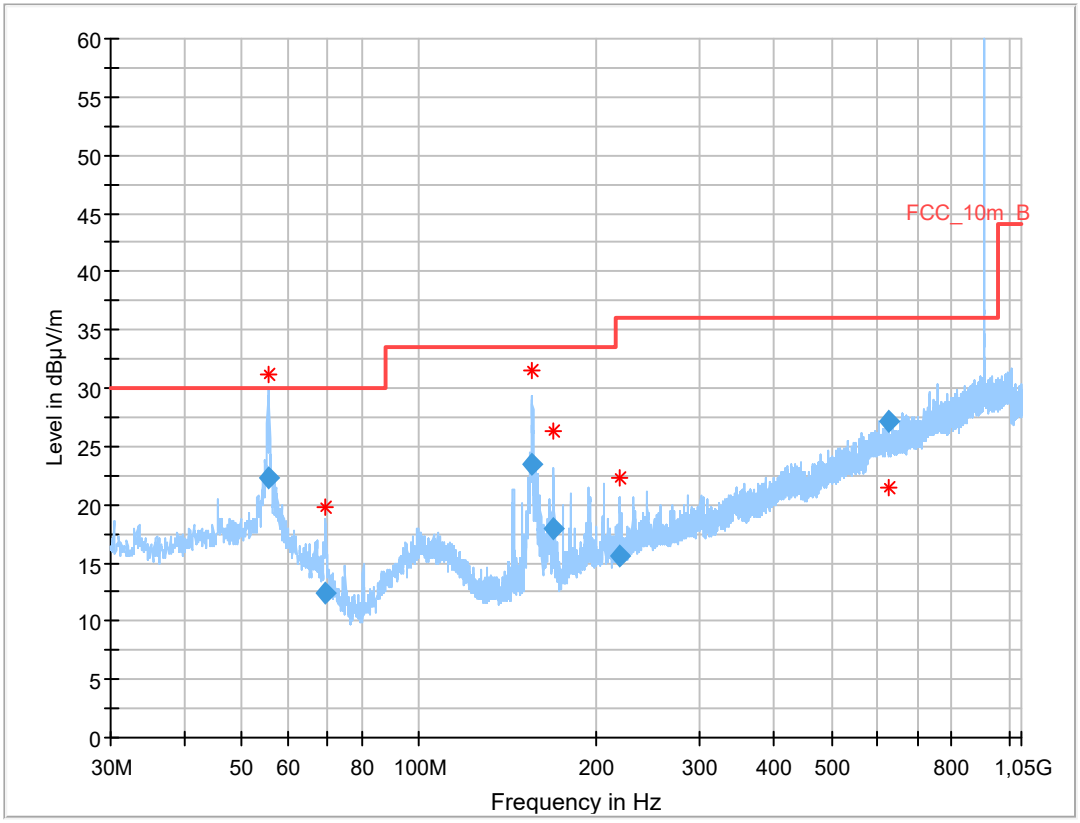


Red stars = Frequency markers; Blue points = QuasiPeak values

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)
55.448	22.70	30.0	7.3	1000	120.0	136.0	V	232	15
69.538	10.69	30.0	19.3	1000	120.0	183.0	V	280	10
155.424	18.96	33.5	14.5	1000	120.0	103.0	V	24	9
169.533	18.08	33.5	15.4	1000	120.0	101.0	V	0	10
384.076	11.44	36.0	24.6	1000	120.0	341.0	H	225	16
717.895	17.55	36.0	18.5	1000	120.0	264.0	V	207	21

Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, Ch 1

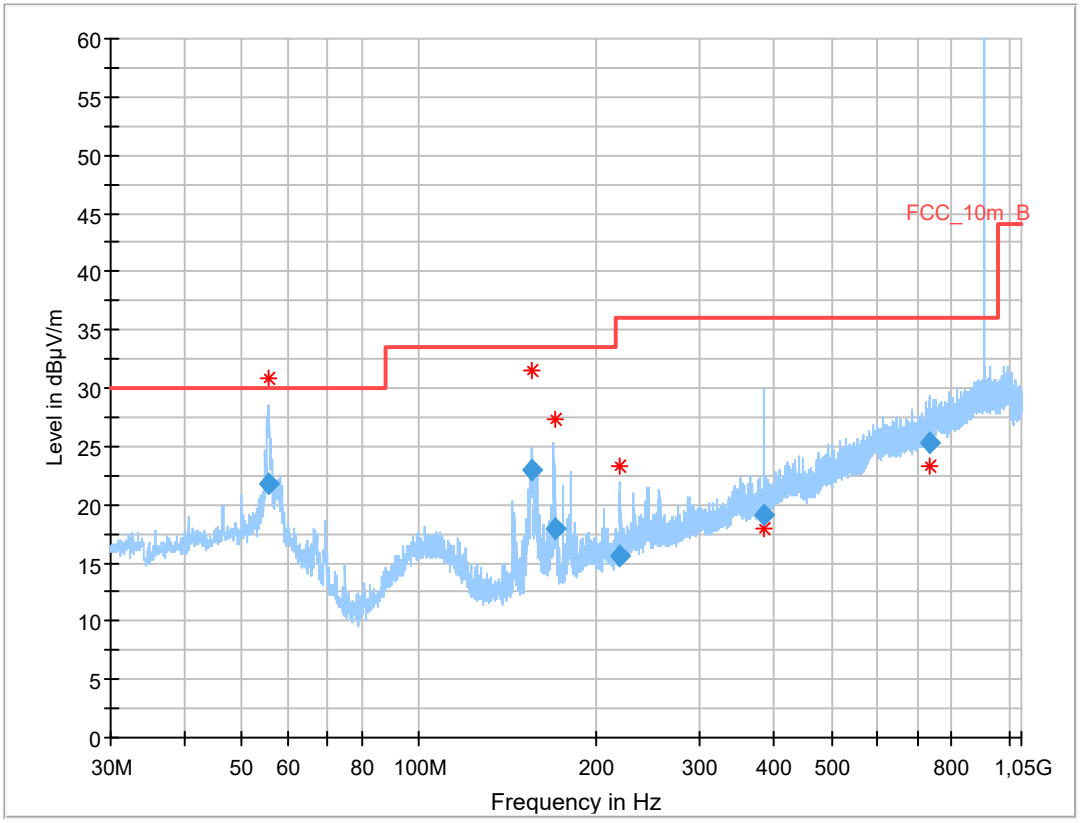


Red stars = Frequency markers; Blue points = QuasiPeak values

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)
55.756	22.25	30.0	7.8	1000	120.0	170.0	V	78	15
69.251	12.45	30.0	17.6	1000	120.0	170.0	V	247	10
155.460	23.38	33.5	10.1	1000	120.0	98.0	V	68	9
169.249	17.97	33.5	15.5	1000	120.0	102.0	V	75	10
219.239	15.65	36.0	20.4	1000	120.0	98.0	V	79	12
624.481	27.19	36.0	8.8	1000	120.0	170.0	H	157	21

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, Ch 2



Red stars = Frequency markers; Blue points = QuasiPeak values

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)
55.781	21.77	30.0	8.2	1000	120.0	133.0	V	292	15
155.452	22.98	33.5	10.5	1000	120.0	98.0	V	176	9
169.567	17.93	33.5	15.6	1000	120.0	101.0	V	292	10
219.547	15.51	36.0	20.5	1000	120.0	101.0	V	171	12
383.880	19.11	36.0	16.9	1000	120.0	170.0	H	67	16
734.513	25.23	36.0	10.8	1000	120.0	170.0	V	-22	22

12.5 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions above 1 GHz in transmit mode

Measurement:

Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 x RBW
Span:	1 GHz to 12.75 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.1B
Measurement uncertainty	See sub clause 9

Limits:

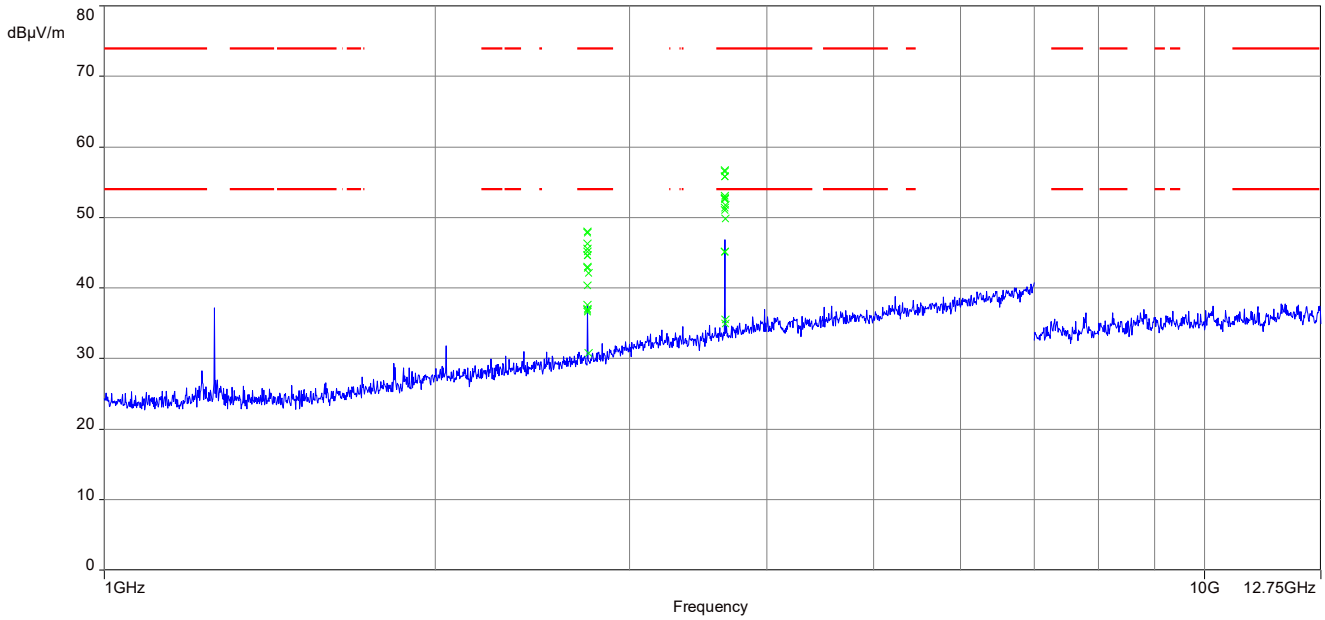
FCC		ISED
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
Above 960	54.0	3

Results:

TX Spurious Emissions Radiated [dBµV/m]								
Ch 0			Ch 1			Ch 2		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
2753	Peak	48.0 (26 dB margin)	3638	Peak	56.9 (17.1dB margin)	3634	Peak	54.8 (19.2 dB margin)
	AVG	43.0 (11 dB margin)		AVG	52.1 (1.9 dB margin)		AVG	51.7 (2.3 dB margin)
3669	Peak	56.7 (17.3 dB margin)		Peak			Peak	
	AVG	52.8 (1.2 dB margin)		AVG			AVG	

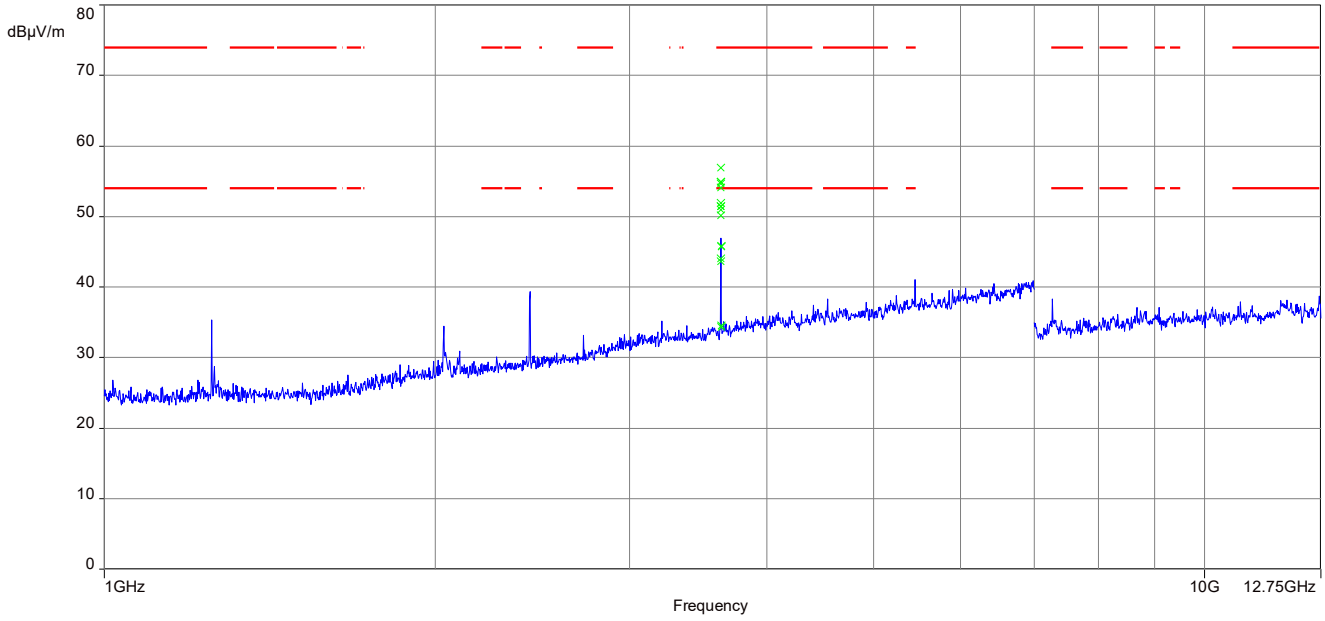
Plots:

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



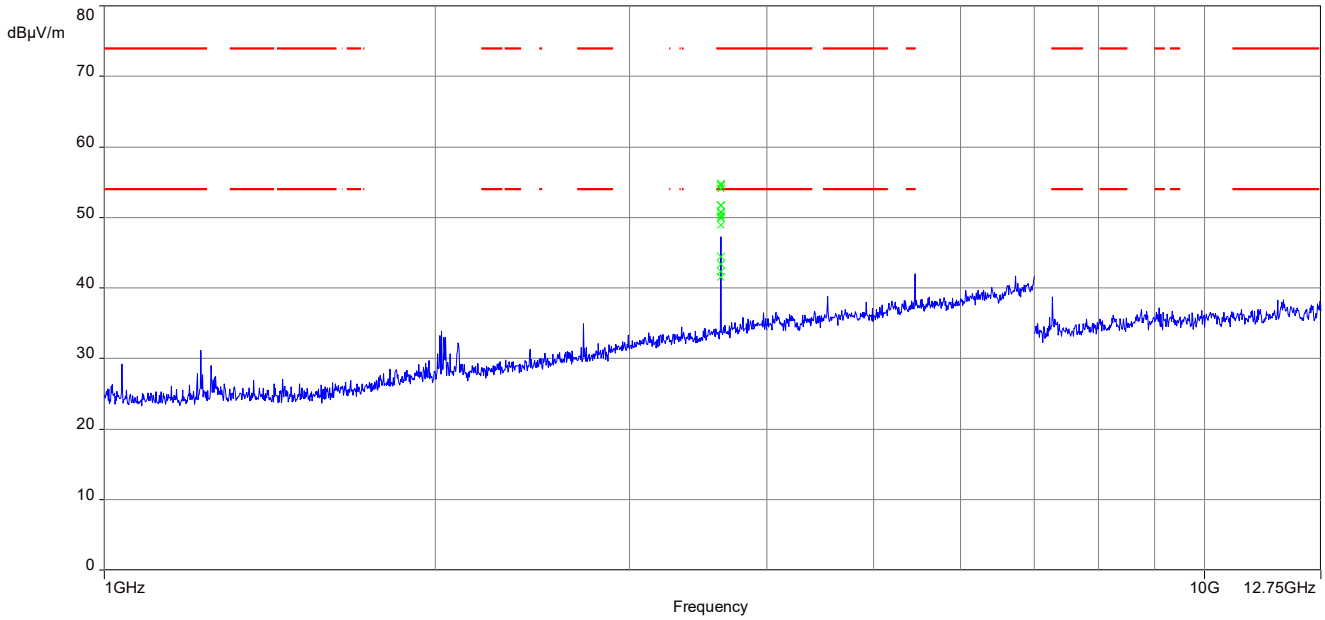
The graph shows the premeasurement in peak. The remeasurements on the detected emissions were performed in peak and RMS.

Plot 2: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The graph shows the premeasurement in peak. The remeasurements on the detected emissions were performed in peak and RMS.

Plot 3: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The graph shows the premeasurement in peak. The remeasurements on the detected emissions were performed in peak and RMS.

12.6 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit frequency is 2440 MHz. This measurement is representative for all channels and modes. If critical peaks are found frequency 2402 MHz and 2480 MHz will be measured too. The measurement is performed in the mode with the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

Measurement parameters	
Detector	Peak - Quasi peak / average
Sweep time	Auto
Resolution bandwidth	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace mode:	Max hold
Test setup	See chapter 7.3 A
Measurement uncertainty	See chapter 9

Limits:

FCC		ISED
TX spurious emissions conducted < 30 MHz		
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

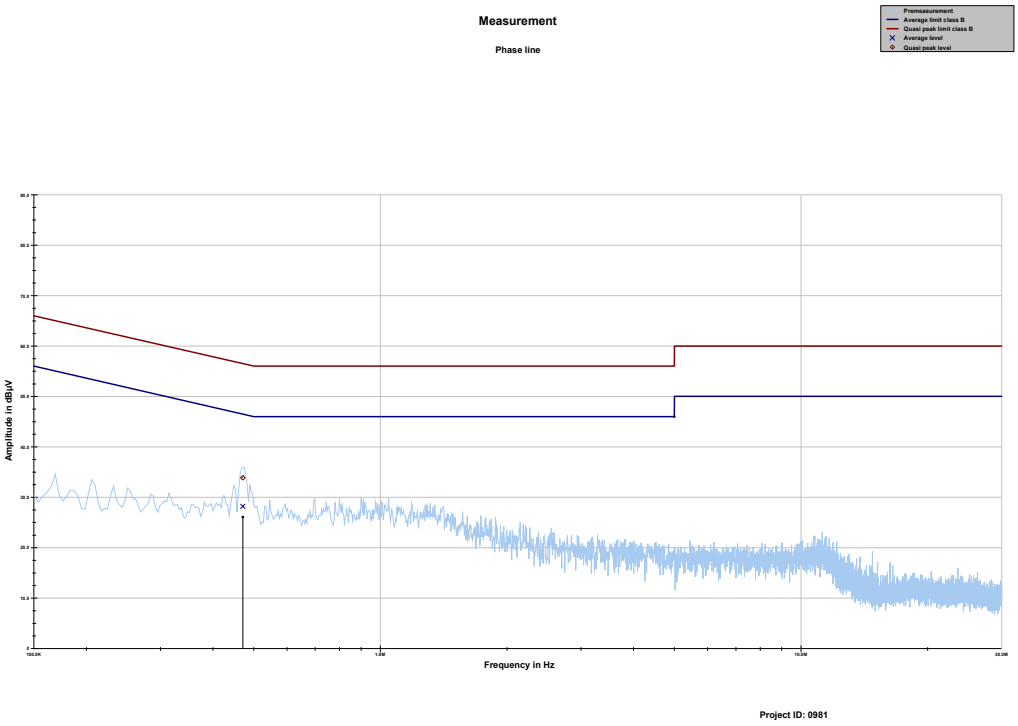
*Decreases with the logarithm of the frequency

Results:

ee result table below the plots.

Plots:

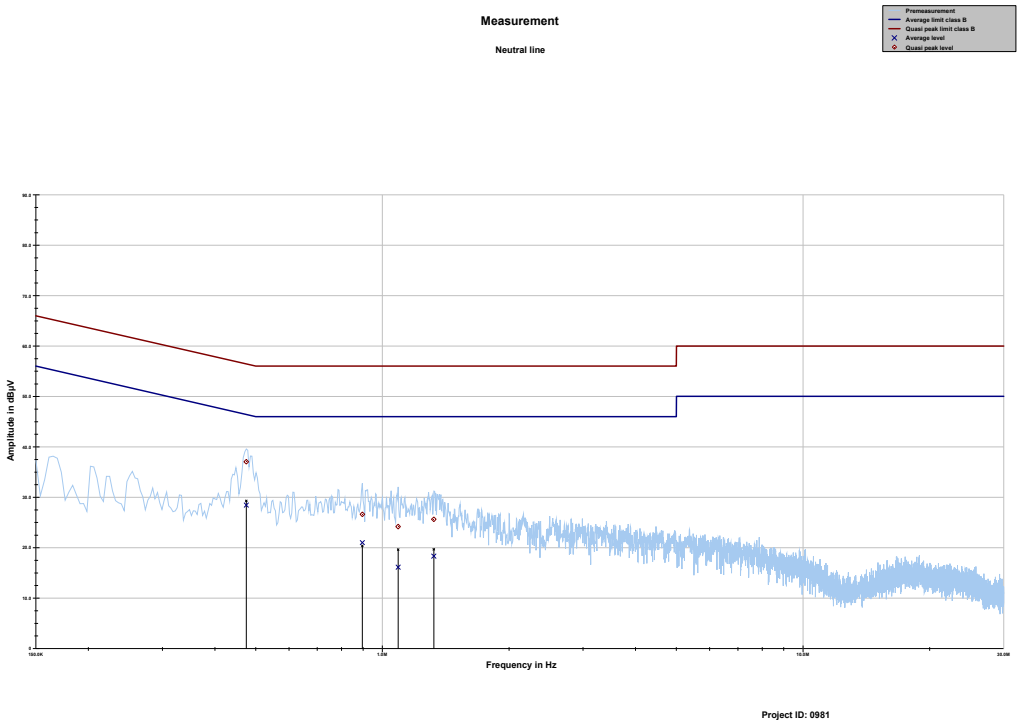
Plot 1: 150 kHz to 30 MHz, phase line



Final results:

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.470888	33.87	22.63	56.498	28.20	18.63	46.832

Plot 2: 150 kHz to 30 MHz, neutral line



Final results:

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.474619	37.04	19.40	56.433	28.45	18.28	46.725
0.896250	26.61	29.39	56.000	21.00	25.00	46.000
1.090275	24.18	31.82	56.000	16.12	29.88	46.000
1.325344	25.64	30.36	56.000	18.31	27.69	46.000

13 Observations

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

14 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

15 Document history

Version	Applied changes	Date of release
-/-	Initial release	2021-05-20

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

first page	last page
	

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

17 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.

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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.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

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

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