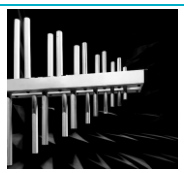
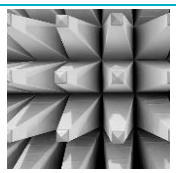

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 23-1-0068401T003a

Testing laboratory

CETECOM advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
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e-mail: mail@cetecomadvanced.com

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

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE
Phone: -/-
Contact: Benjamin Murindangabo
e-mail: benjamin.murindangabo-ext@sagemcom.com

Manufacturer

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE

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:	**Set-top Box**
Model name:	**DIW377 DISH**
FCC ID:	**VW3DIW377D**
Frequency:	2400 MHz to 2483.5 MHz
Technology tested:	WLAN
Antenna:	2 integrated dual-band antennas
Power supply:	115 V AC by mains adapter
Temperature range:	0°C to +40°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=Michael Dorongovski, o=cetecom advanced GmbH, ou=DOR-230601, email=michael.dorongovski@cetecomadvanced.com, c=DE
2023.07.24 11:06:57 +02'00'

Michael Dorongovski
Lab Manager
Radio Labs

Test performed:

cn=David Lang, o=cetecom advanced GmbH, ou=LNG-230530, email=david.lang@cetecomadvanced.com, c=DE
2023.07.24 11:00:46 +02'00'

David Lang
Lab Manager
Radio Labs

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

2.2 Application details

Date of receipt of test item:	2023-06-21
Start of test:*	2023-06-26
End of test:*	2023-07-14

*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

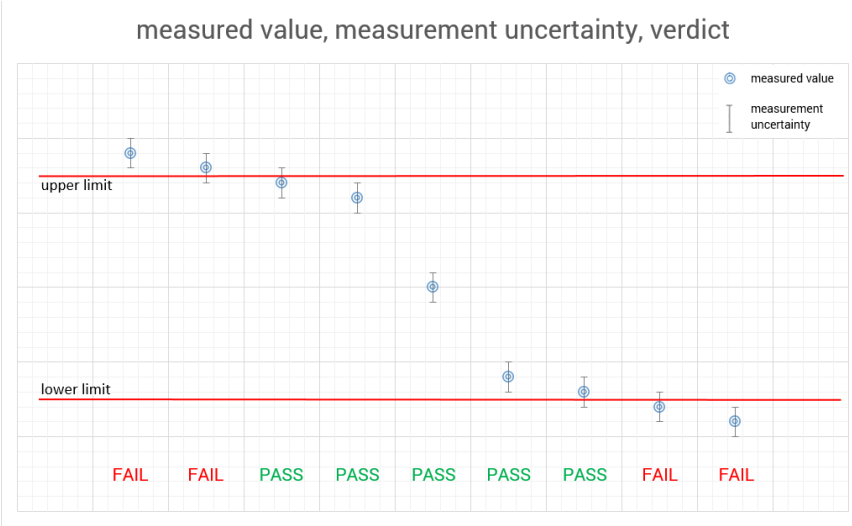
Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement 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
KDB 662911 D01	v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

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

FCC designation number: DE0002

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 tests under extreme conditions performed. No tests under extreme conditions performed.
Relative humidity content :		42 %
Barometric pressure :		1016 hpa
Power supply :	V_{nom} V_{max} V_{min}	115 V AC by mains adapter No tests under extreme conditions performed. No tests under extreme conditions performed.

6 Test item

6.1 General description

Kind of test item :	Set-top Box
Model name :	DIW377 DISH
S/N serial number :	Radiated unit: #config1 Conducted unit: #config2
Hardware status :	CIE : 254046629 CIU : 253996495
Software status :	TTHW compiled Wed 10 May 2023 09:31:07 AM CEST by Jenkins From 0f5de0b Broadcom SDK 22.0.1 Boxmode:2 FW: STB_BCM4375B1_100.010_4375B1_UART_37_4MHz_fcbga_ipa_ref_stbda_class2.hcd
Frequency band :	2400 MHz to 2483.5 MHz
Type of radio transmission : Use of frequency spectrum :	DSSS, OFDM
Type of modulation :	CCK, (D)BPSK, (D)QPSK, 16 – 256 QAM
Number of channels :	11
Antenna :	2 integrated dual-band antennas
Power supply :	115 V AC by mains adapter
Temperature range :	0°C to +40°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: 23-1-0068401T003a_A2
23-1-0068401T003a_A3
23-1-0068401T003a_A4

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).

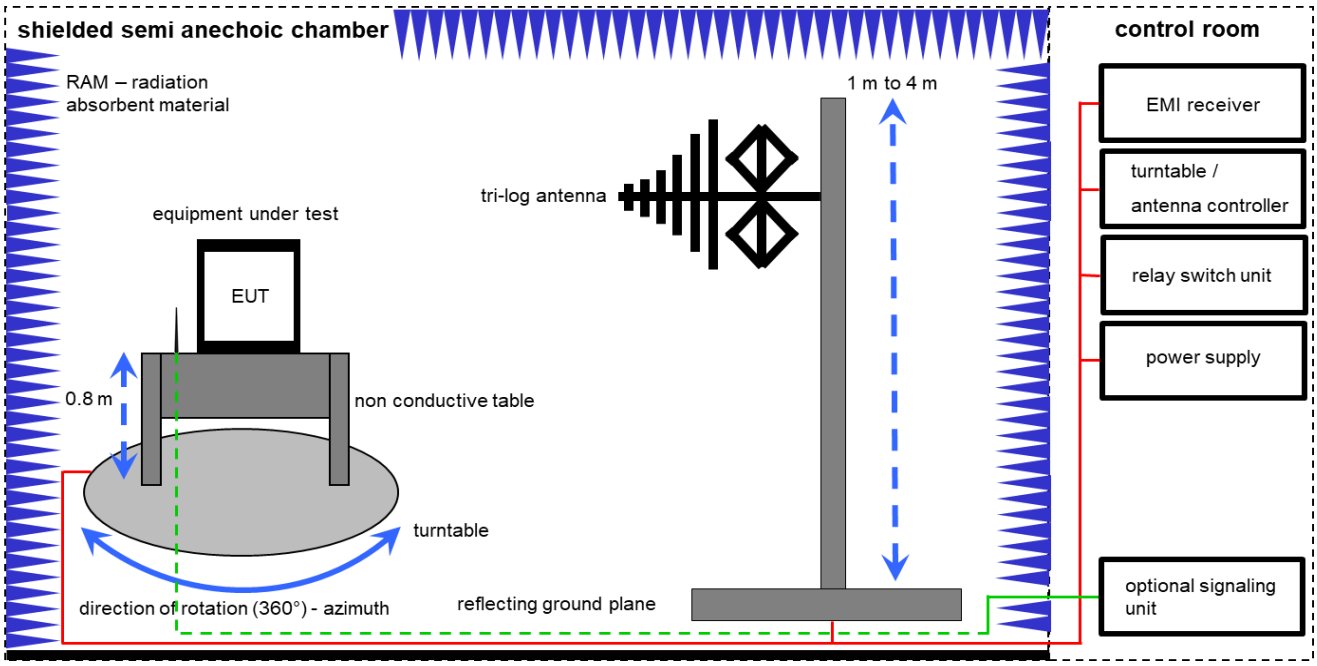
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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

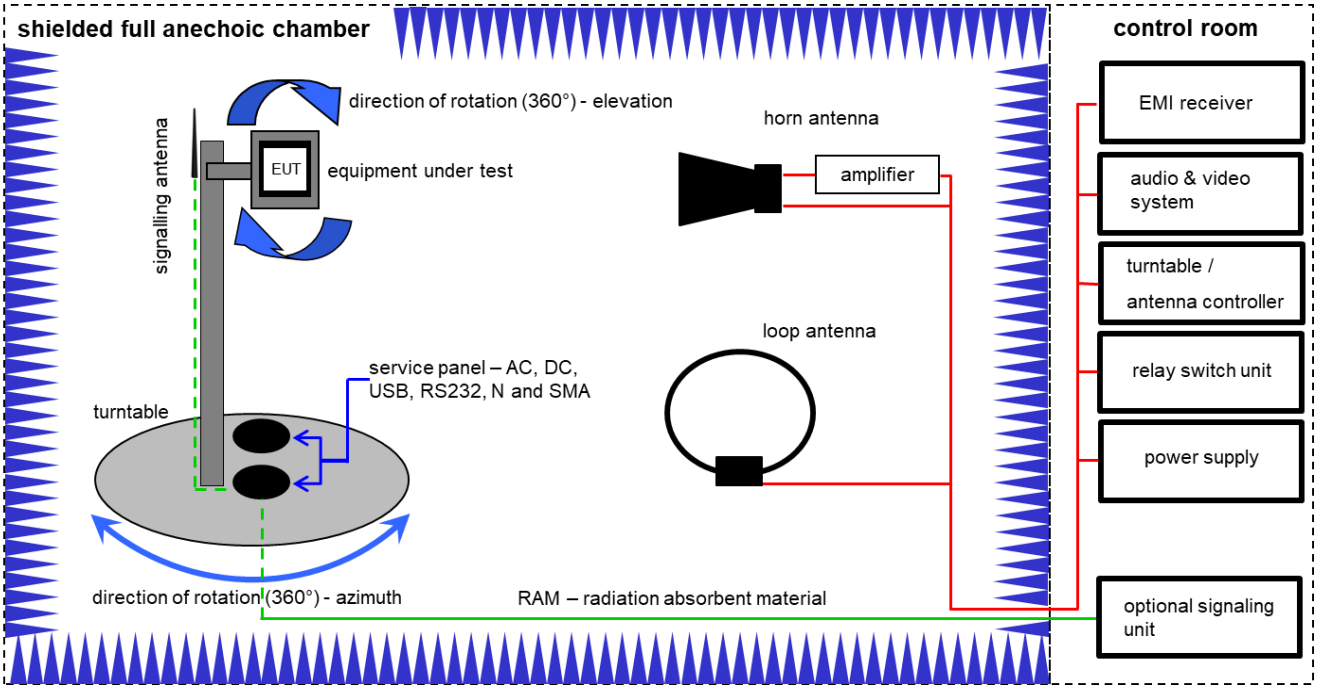
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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	vIKI!	29.12.2021	31.12.2023
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	318	300003696	vIKI!	30.09.2021	29.09.2023
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	09.12.2022	31.12.2023

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

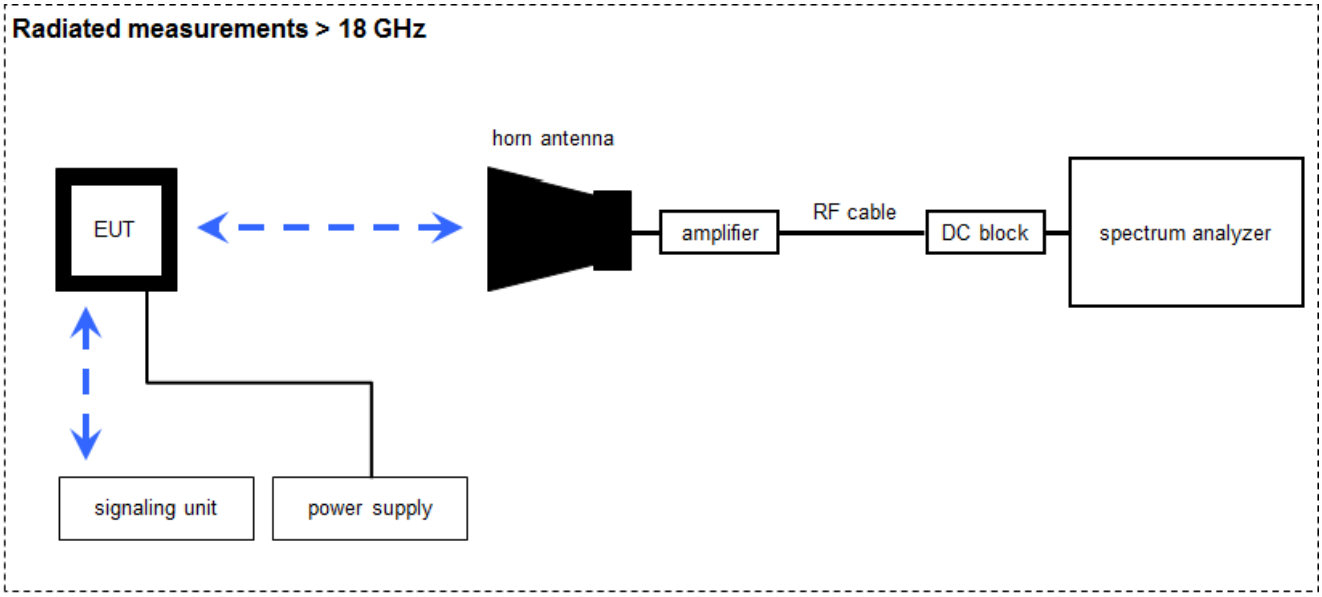
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

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	B	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	01.07.2021	31.07.2023
2	A, C	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vlKl!	12.03.2021	11.03.2023
3	C	Highpass Filter	WHK1.1/15G-10SS	Wainwright	37	400000148	ne	-/-	-/-
4	C	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
5	C	Band Reject Filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	26	300003792	ne	-/-	-/-
6	C	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
7	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
8	A, B, C	Computer	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A5421	300004591	ne	-/-	-/-
9	A, B, C	NEXIO EMV-Software	BAT EMC V2022.0.22.0	Nexio	-/-	300004682	ne	-/-	-/-
10	A, B, C	Anechoic chamber	-/-	TDK	-/-	300003726	ne	-/-	-/-
11	A, B, C	EMI Test Receiver 9kHz-26,5GHz	ESR26	Rohde & Schwarz	101376	300005063	k	13.12.2022	31.12.2023
12	C	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011571	300005240	ev	-/-	-/-

7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

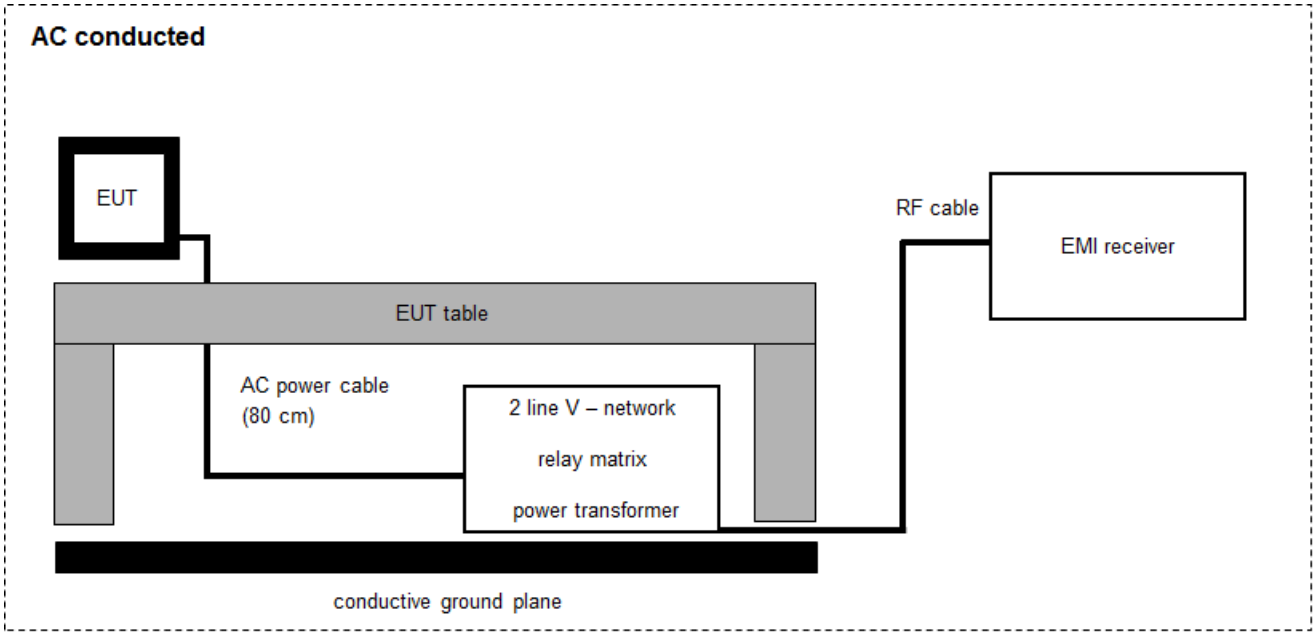
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vIKI!	17.01.2022	31.01.2024
3	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	12.12.2022	31.12.2023
4	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
5	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-

7.4 AC conducted



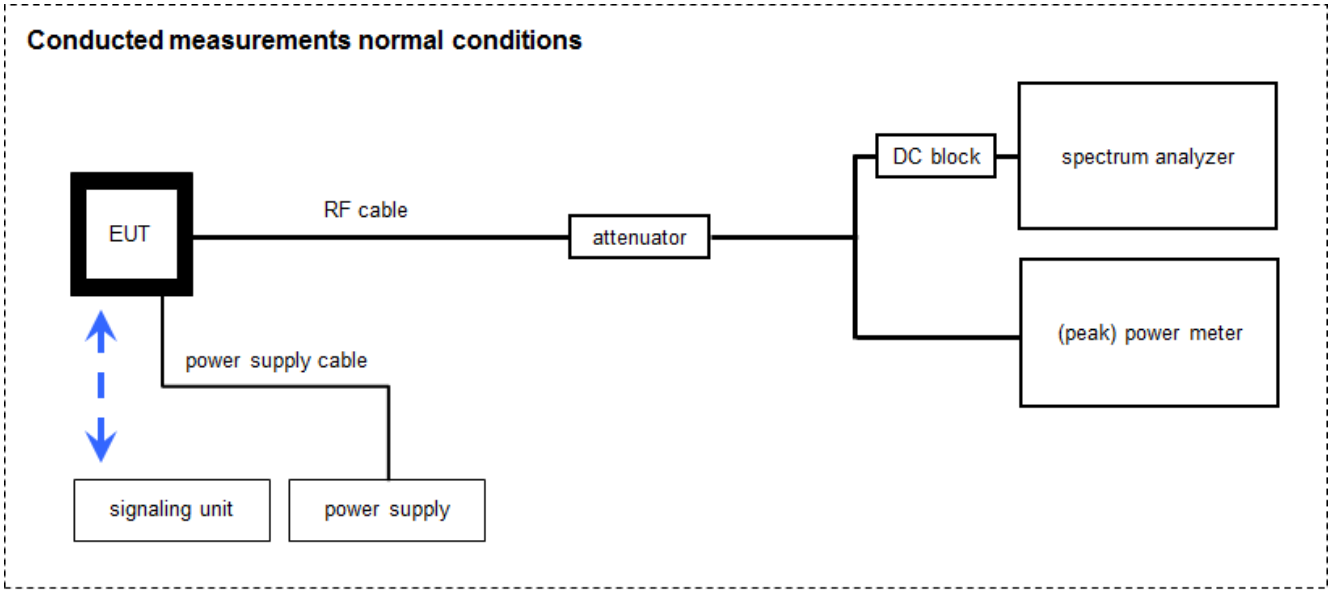
FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

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	Rohde & Schwarz	892475/017	300002209	vIKI!	14.12.2021	31.12.2023
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
4	A	PC	TecLine	F+W	-/-	300003532	ne	-/-	-/-
5	A	EMI Test Receiver 3.6 GHz	ESR3	Rohde & Schwarz	102981	300006318	k	09.12.2022	31.12.2023

7.5 Conducted measurements with peak power meter & spectrum analyzer



WLAN tester version: 1.1.13; LabView2015

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.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Isolating Transformer	RT5A	Grundig	12780	300001166	ev	-/-	-/-
2	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	12.12.2022	31.12.2023
3	A, B	PC Tester R005	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A4523	300004589	ne	-/-	-/-
4	A, B	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
5	A, B	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-
6	A, B	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	-/-	400001186	ev	-/-	-/-
7	A, B	Tester Software RadioStar (C.BER2 for BT Conformance)	Version 1.0.0.X	CTC advanced GmbH	0001	400001380	ne	-/-	-/-
8	B	USB Wideband Power Sensor (50MHz - 18GHz)	U2021XA	Keysight	MY591900010	300005802	k	07.12.2022	06.12.2023

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 18 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.

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- 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.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty		
Test case	**Uncertainty**	
Antenna gain	± 3 dB	
Power spectral density	± 1.56 dB	
DTS bandwidth	± 100 kHz (depends on the used RBW)	
Occupied bandwidth	± 100 kHz (depends on the used RBW)	
Maximum output power conducted	± 1.56 dB	
Detailed spurious emissions @ the band edge - conducted	± 1.56 dB	
Band edge compliance radiated	± 3 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.56 dB
	> 7 GHz	± 1.56 dB
	> 18 GHz	± 2.31 dB
	≥ 40 GHz	± 2.97 dB
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	
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 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	CFR Part 15	See table!	2023-07-24	-/-

Test specification clause	Test case	Guideline	Temperature & voltage conditions	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (f)(ii)	Antenna gain	-/-	Nominal	-/-				-/-
§15.35	Duty cycle	-/-	Nominal	-/-				-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	KDB 558074 DTS clause: 8.4	Nominal	☒	☐	☐	☐	-/-
§15.247(a)(2) RSS - 247 / 5.2 (a)	DTS bandwidth	KDB 558074 DTS clause: 8.2	Nominal	☒	☐	☐	☐	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	☒	☐	☐	☐	-/-
§15.247(b)(3) RSS - 247 / 5.4 (d)	Maximum output power	KDB 558074 DTS clause: 8.3.1.3	Nominal	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge – cond.	-/-	Nominal	☒	☐	☐	☐	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance cond. or rad.	KDB 558074 DTS clause: 8.7.3	Nominal	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	TX spurious emissions cond.	KDB 558074 DTS clause: 8.5	Nominal	☒	☐	☐	☐	-/-
§15.209(a) RSS-Gen	TX spurious emissions rad. below 30 MHz	-/-	Nominal	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. 30 MHz to 1 GHz	-/-	Nominal	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. above 1 GHz	-/-	Nominal	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	☒	☐	☐	☐	-/-

Notes:

C	Compliant	**NC**	Not compliant	**NA**	Not applicable	**NP**	Not performed

11 Additional information and comments

Reference documents: 23-05-25_Antenna Drawing DIW377DISH.pptx

Co-applicable documents: 23-1-0061401T003_A6

Special test descriptions: Power settings:

Channel	1 / 6 / 11
DSSS / b – mode	80 / 80 / 80
OFDM / g – mode	54 / 80 / 54
OFDM / n HT20 – mode	54 / 72 / 52
OFDM / ac HT20 – mode	54 / 74 / 52
OFDM / ax HE20 – mode	50 / 74 / 50

Configuration descriptions: During radiated tests, both antennas were transmitting simultaneously.

EUT selection:

☒ Only one device available

☐ Devices selected by the customer

☐ Devices selected by the laboratory (Randomly)

Provided channels:

Channels with 20 MHz channel bandwidth:

channel number & center frequency													
channel	**1**	2	3	4	5	**6**	7	8	9	10	**11**	12	13
f_c / MHz	**2412**	2417	2422	2427	2432	**2437**	2442	2447	2452	2457	**2462**	2467	2472

Note: The channels used for the tests are marked in bold in the list.

12 Additional EUT parameter

Test mode:	☐	No test mode available Iperf was used to ping another device with the largest support packet size
	☒	Test mode available Special software is used. EUT is transmitting pseudo random data by itself
Modulation types:	☒	Wide Band Modulation (None Hopping – e.g. DSSS, OFDM)
	☐	Frequency Hopping Spread Spectrum (FHSS)
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)*
	☒	Operating mode 2 (multiple antennas, no beamforming) - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*
	☐	Operating mode 3 (multiple antennas, with beamforming) - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.* *In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.*

13 Measurement results

13.1 Antenna gain

Limits:

FCC	ISED
6 dBi / > 6 dBi output power and power density reduction required	

Results: 23-05-25_Antenna Drawing DIW377DISH.pptx (Gain)

	lowest channel	middle channel	highest channel
Gain [dBi] / Declared Combined antenna gain (ANT0; ANT1)	4.85		

13.2 Identify worst case data rate

Worst case data rates declared by the manufacturer (see section 11).

13.3 Maximum output power

Description:

Measurement of the maximum conducted mean output power. The measurements are performed using the data rate identified in the previous chapter.

Measurement:

Measurement parameter	
According to ANSI C63.10-2013 Chapter 11.9.2.2.2	
Peak power meter	
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup B
Measurement uncertainty	See chapter 9
Detector	RMS
Resolution bandwidth	500 kHz
Video bandwidth	2 MHz
Trace mode	Max hold

Limits:

FCC	ISED
Conducted 1.0 W / 30 dBm with an antenna gain of max. 6 dBi	

Results:

antenna port 0	maximum output power / dBm		
	lowest channel	middle channel	highest channel
Output power conducted DSSS / b – mode	19.5	19.6	19.7
Output power conducted OFDM / g – mode	13.2	19.4	13.6
Output power conducted OFDM / n HT20 – mode	13.2	18.1	12.9
Output power conducted OFDM / ac HT20 – mode	13.3	18.4	12.8
Output power conducted OFDM / ax HE20 – mode	12.4	18.6	12.6

antenna port 1	maximum output power / dBm		
	lowest channel	middle channel	highest channel
Output power conducted DSSS / b – mode	19.9	19.2	19.2
Output power conducted OFDM / g – mode	13.7	18.8	13.2
Output power conducted OFDM / n HT20 – mode	13.8	16.9	12.6
Output power conducted OFDM / ac HT20 – mode	13.6	17.4	12.5
Output power conducted OFDM / ax HE20 – mode	12.9	17.4	12.2

antenna port 0 + 1 **calculated**	maximum output power / dBm		
	lowest channel	middle channel	highest channel
Output power conducted DSSS / b – mode	22.7	22.4	22.5
Output power conducted OFDM / g – mode	16.4	22.1	16.4
Output power conducted OFDM / n HT20 – mode	16.5	20.5	15.7
Output power conducted OFDM / ac HT20 – mode	16.5	20.9	15.7
Output power conducted OFDM / ax HE20 – mode	15.7	21.2	15.4

13.4 Duty cycle

Description:

Measurement of the timing behavior.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Depends on the signal see plot
Resolution bandwidth	10 MHz
Video bandwidth	10 MHz
Trace mode	Max hold
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 9

Limits:

FCC	ISED
No limitation!	

Results:

T_{nom}	V_{nom}	lowest channel	middle channel	highest channel
DSSS / b – mode		100 % / 0 dB	100 % / 0 dB	100 % / 0 dB
OFDM / g – mode		100 % / 0 dB	100 % / 0 dB	100 % / 0 dB
OFDM / n HT20 – mode		100 % / 0 dB	100 % / 0 dB	100 % / 0 dB
OFDM / ac HT20 – mode		100 % / 0 dB	100 % / 0 dB	100 % / 0 dB
OFDM / ax HE20 – mode		100 % / 0 dB	100 % / 0 dB	100 % / 0 dB

13.5 Peak power spectral density

Description:

Measurement of the power spectral density of a digital modulated system. The PSD shows the strength of the variations as a function of the frequency.

Measurement:

Measurement parameter	
According to ANSI C63.10-2013 Chapter 11.10.5	
Detector	RMS
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Span	30 MHz
Trace mode	Max. hold (allow trace to fully stabilize)
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 9

Limits:

FCC	ISED
8 dBm / 3 kHz (conducted)	

Results: antenna port 0

measured	peak power spectral density / dBm @ 3 kHz		
	Lowest channel	Middle channel	Highest channel
DSSS / b – mode	-11.7	-11.7	-11.5
OFDM / g – mode	-19.8	-14.4	-19.5
OFDM / n HT20 – mode	-20.5	-17.2	-20.8
OFDM / ac HT20 – mode	-20.0	-16.7	-20.7
OFDM / ax HE20 – mode	-22.6	-17.3	-22.4

Results: antenna port 1

measured	peak power spectral density / dBm @ 3 kHz		
	Lowest channel	Middle channel	Highest channel
DSSS / b – mode	11.3	-11.9	-12.0
OFDM / g – mode	-19.2	-14.9	-19.9
OFDM / n HT20 – mode	-19.9	-18.1	-21.3
OFDM / ac HT20 – mode	-19.9	-17.7	-21.2
OFDM / ax HE20 – mode	-22.0	-18.6	-22.8

Results: antenna port 0 + 1

calculated	peak power spectral density / dBm @ 3 kHz		
	Lowest channel	Middle channel	Highest channel
DSSS / b – mode	-8.5	-8.8	-8.7
OFDM / g – mode	-16.5	-11.6	-16.7
OFDM / n HT20 – mode	-17.2	-14.6	-18.1
OFDM / ac HT20 – mode	-16.9	-14.1	-17.9
OFDM / ax HE20 – mode	-19.3	-14.9	-19.6

13.6 6 dB DTS bandwidth

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to DTS clause: 8.2	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	30 MHz / 50 MHz
Trace mode	Single count with 200 counts
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 9

Limits:

FCC	ISED
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

antenna port 0	6 dB DTS bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	7064	7536	7524
OFDM / g – mode	16296	16336	16304
OFDM / n HT20 – mode	17500	17572	17528
OFDM / ac HT20 – mode	17528	17568	17492
OFDM / ax HE20 – mode	18888	18964	18908

antenna port 1	6 dB DTS bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	8016	8016	8008
OFDM / g – mode	16308	16336	16316
OFDM / n HT20 – mode	17556	17584	17552
OFDM / ac HT20 – mode	17556	17588	17544
OFDM / ax HE20 – mode	18868	18964	18724

13.7 Occupied bandwidth – 99% emission bandwidth

Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	300 kHz
Video bandwidth	1 MHz
Span	30 MHz / 50 MHz
Measurement procedure	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace mode	Single count with 200 counts
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 9

Usage:

-/-	ISED
OBW is necessary for Emission Designator	

Results:

antenna port 0	99% emission bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	12271	12275	12323
OFDM / g – mode	17438	18906	17454
OFDM / n HT20 – mode	18406	18946	18398
OFDM / ac HT20 – mode	18418	19090	18410
OFDM / ax HE20 – mode	19082	19442	19098

antenna port 1	99% emission bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	12559	12351	12467
OFDM / g – mode	17158	18102	17182
OFDM / n HT20 – mode	18022	18370	18042
OFDM / ac HT20 – mode	18010	18470	18006
OFDM / ax HE20 – mode	19078	19358	19082

13.8 Occupied bandwidth – 20 dB bandwidth

Description:

Measurement of the 20 dB bandwidth of the modulated carrier.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	30 MHz / 50 MHz
Trace mode	Single count with min. 200 counts
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 9

Usage:

FCC	ISED
The complete bandwidth has to be within the frequency range of the band.	

Results:

antenna port 0	20 dB bandwidth / MHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	13616	13840	14104
OFDM / g – mode	20444	21380	20452
OFDM / n HT20 – mode	20936	21848	21000
OFDM / ac HT20 – mode	20980	23040	21004
OFDM / ax HE20 – mode	20932	21388	20904

antenna port 1	20 dB bandwidth / MHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	14288	14200	14248
OFDM / g – mode	20228	20256	20296
OFDM / n HT20 – mode	20352	20848	20464
OFDM / ac HT20 – mode	20284	20752	20444
OFDM / ax HE20 – mode	20684	21072	20856

13.9 Band edge compliance radiated

Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to the lowest channel for the lower restricted band and to the highest channel for the upper restricted band. Measurement distance is 3 meter.

Measurement:

	Measurement parameter for peak measurements	Measurement parameter for average measurements
		According to DTS clause: 8.7.3
Detector	Peak	RMS
Sweep time	Auto	Auto
Resolution bandwidth	1 MHz	100 kHz
Video bandwidth	3 MHz	300 kHz
Span	See plot	2 MHz
Trace mode	Max. hold	RMS Average over 101 sweeps
Analyzer function	-/-	Band power function (Compute the power by integrating the spectrum over 1 MHz)
Test setup	See chapter 7.2 setup A	
Measurement uncertainty	See chapter 9	

Limits:

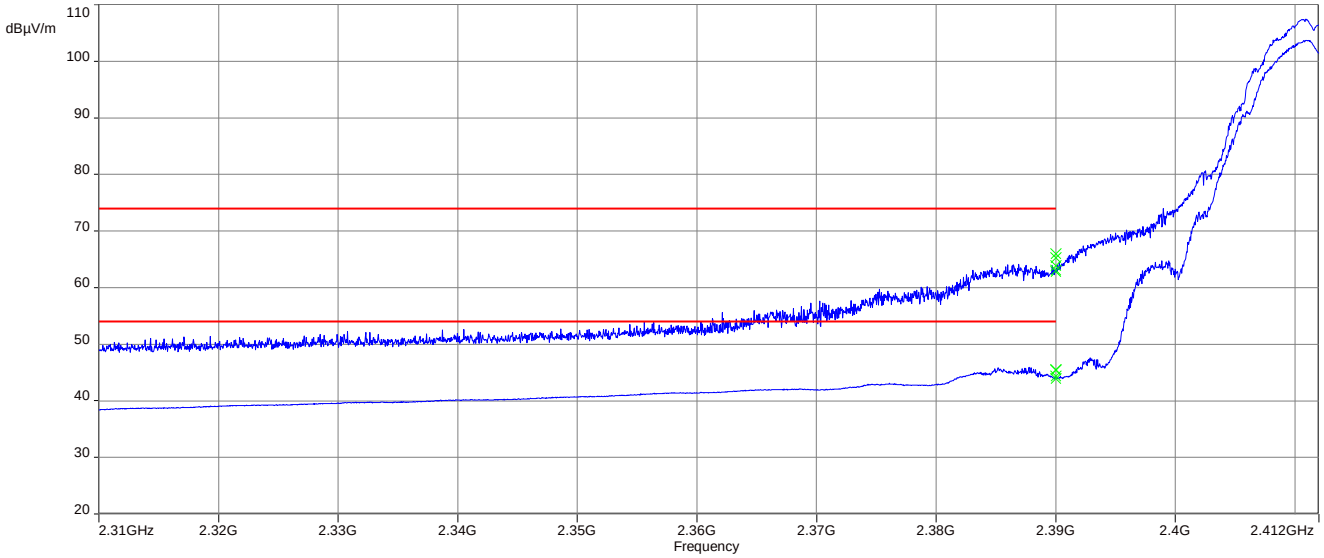
FCC	ISED
74 dBµV/m @ 3 m (Peak) 54 dBµV/m @ 3 m (AVG)	

Results:

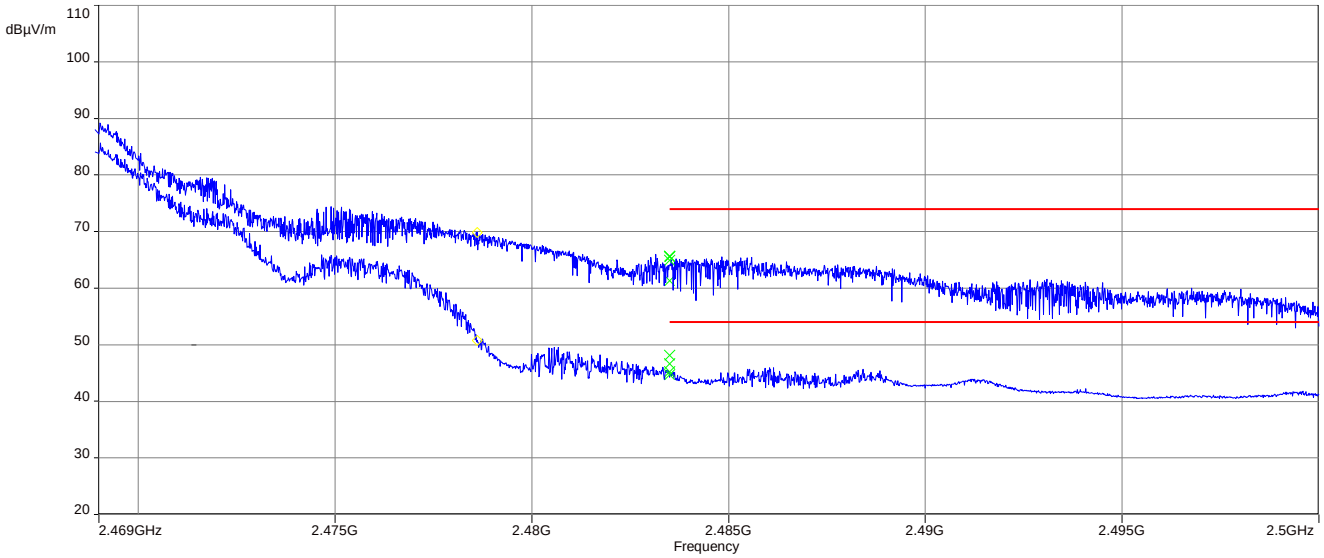
band edge compliance radiated / (dBµV / m) @ 3 m			
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode
Lower band edge	66.0 (Peak) 45.4 (AVG)	65.6 (Peak) 51.9 (AVG)	70.5 (Peak) 52.6 (AVG)
Upper band edge	65.6 (Peak) 46.6 (AVG)	69.6 (Peak) 52.4 (AVG)	72.4 (Peak) 52.7 (AVG)
	OFDM / ac HT20 – mode	OFDM / ax HE20 – mode	-/-
Lower band edge	70.8 (Peak) 53.0 (AVG)	71.0 (Peak) 52.8 (AVG)	-/-
Upper band edge	70.4 (Peak) 52.5 (AVG)	71.3 (Peak) 53.4 (AVG)	-/-

Plots: DSSS / b – mode - peak / average

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

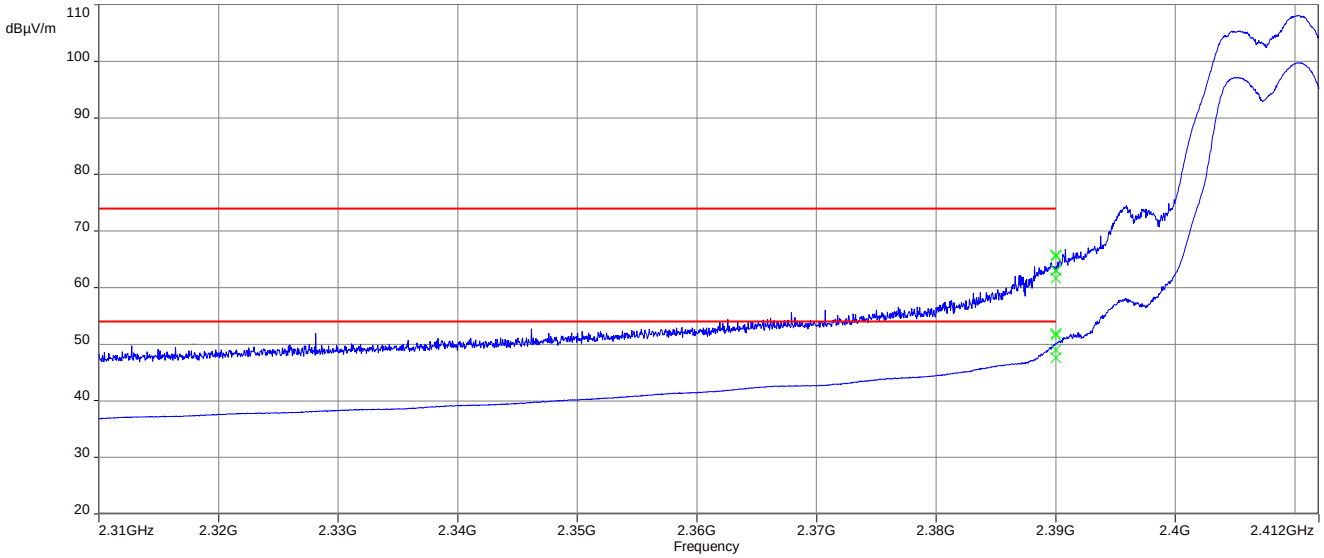


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

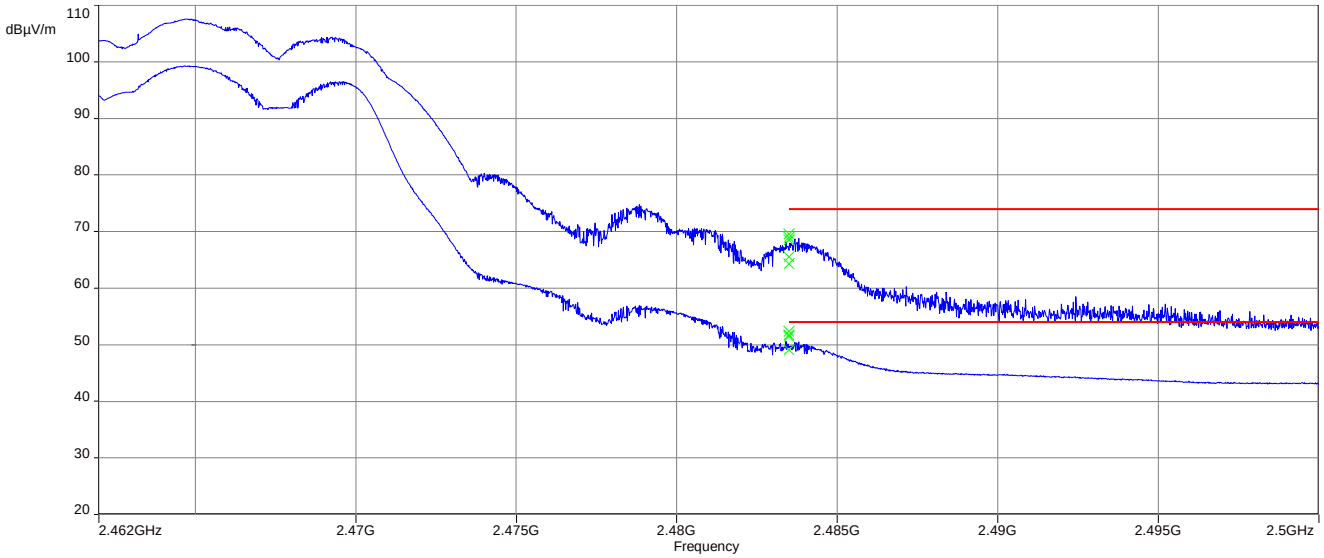


Plots: OFDM / g – mode - peak / average

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

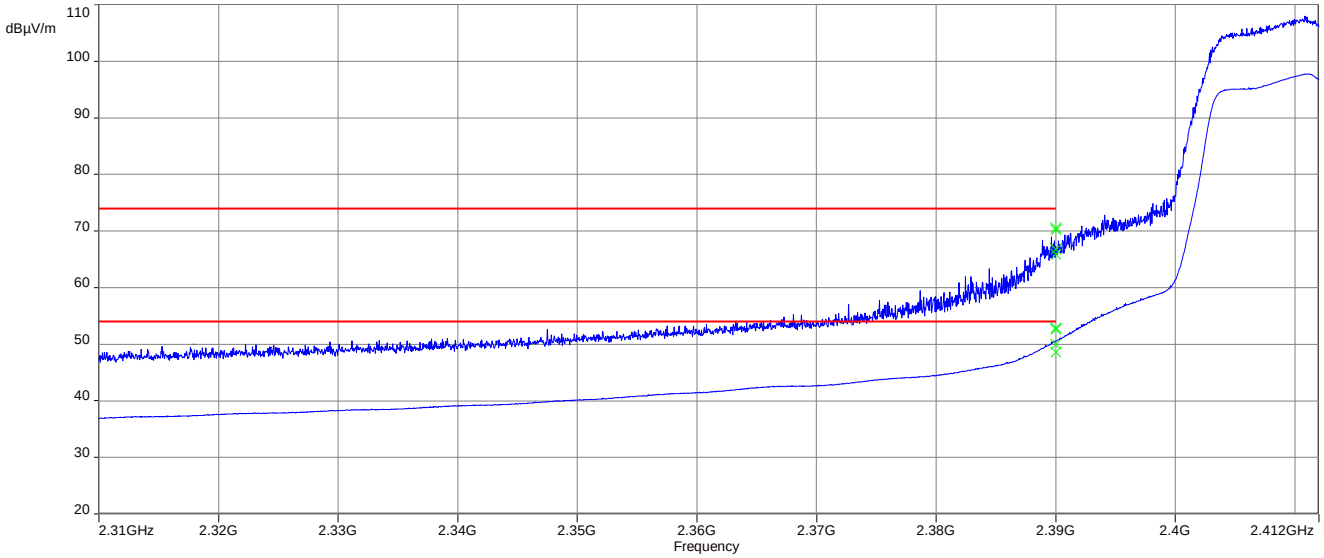


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

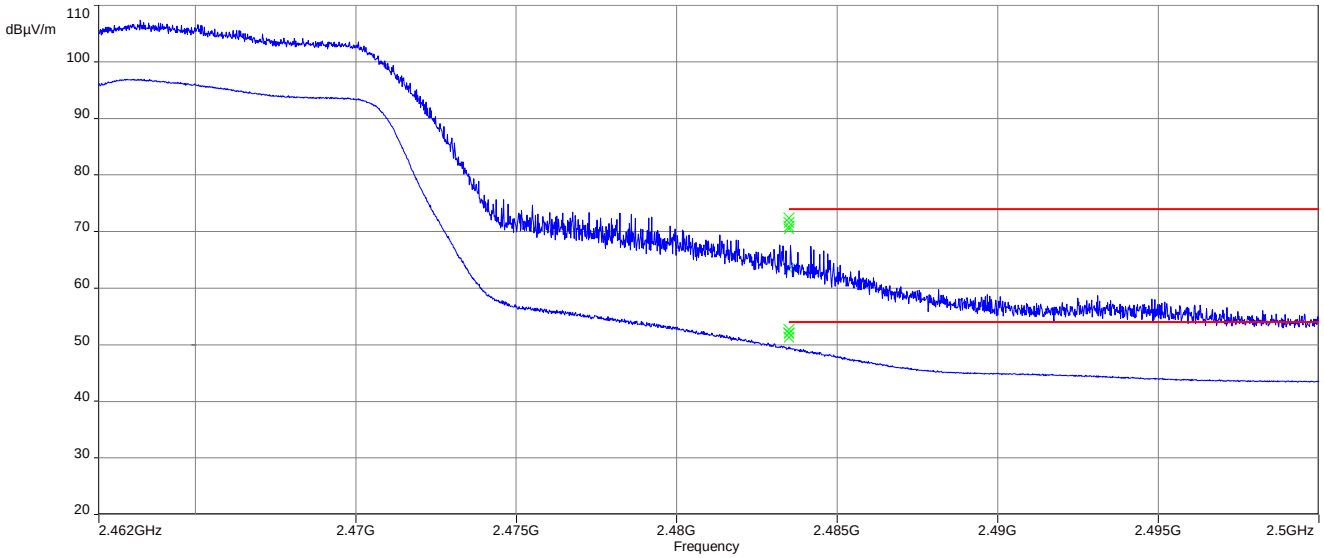


Plots: OFDM / n HT20 – mode - peak / average

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

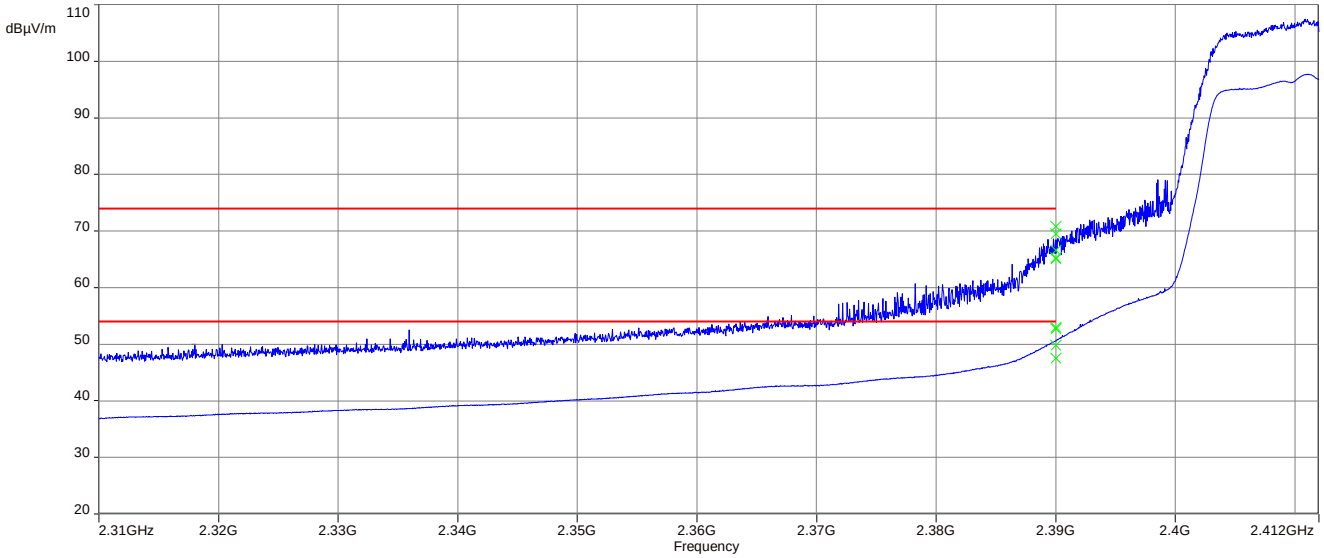


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

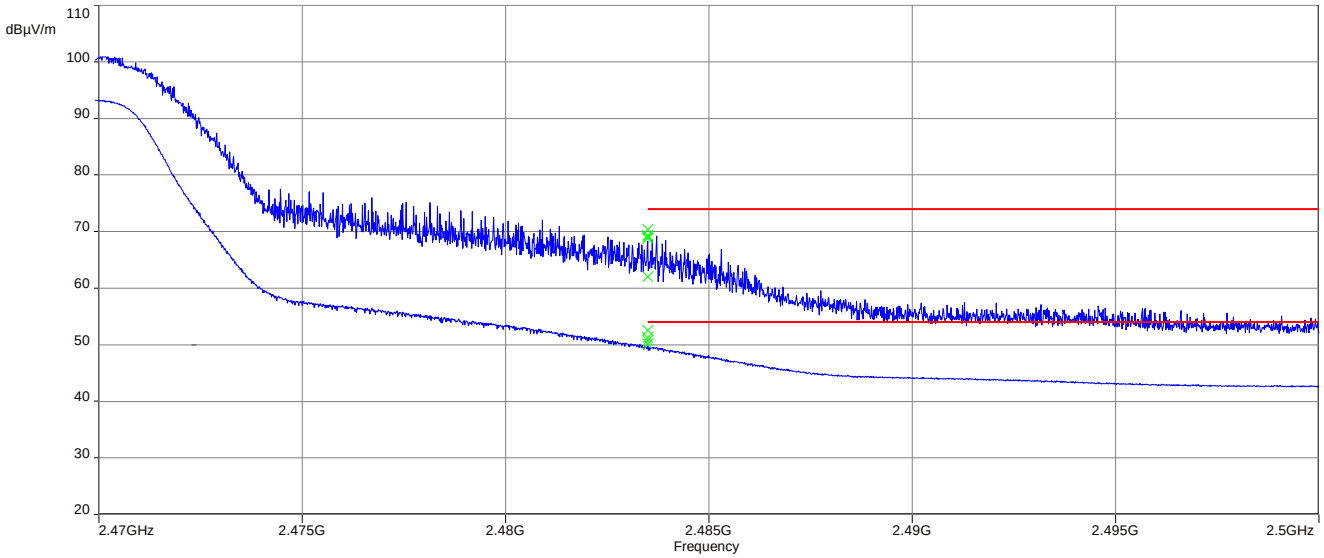


Plots: OFDM / ac HT20 – mode - peak / average

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

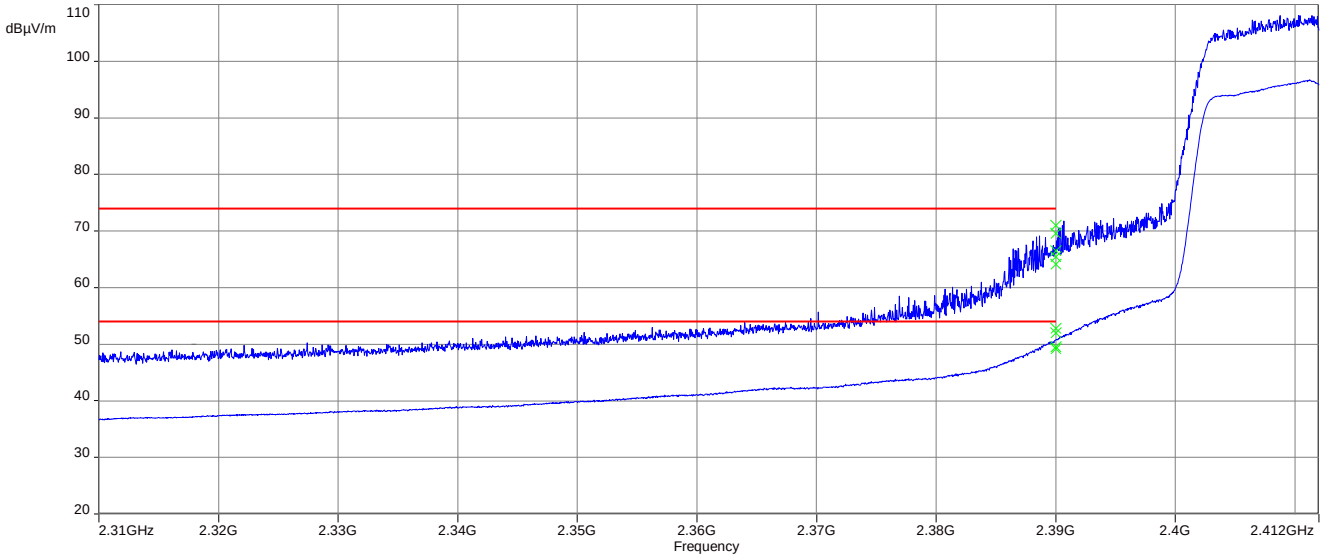


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

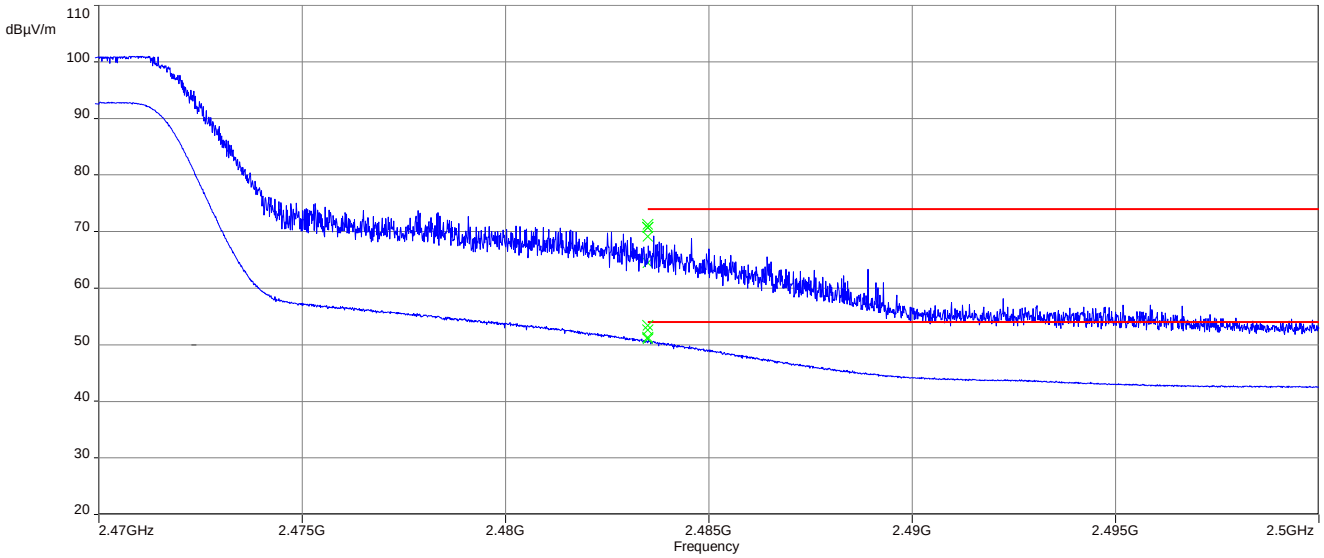


Plots: OFDM / ax HE20 – mode - peak / average

Plot 1: TX mode, lower band edge, vertical & horizontal polarization



Plot 2: TX mode, upper band edge, vertical & horizontal polarization



13.10 Spurious emissions conducted

Description:

Measurement of the conducted spurious emissions in transmit mode. The measurement is performed at the lowest; the middle and the highest channel.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	9 kHz to 25 GHz
Trace mode	Max Hold
External result file(s)	23-1-0061401T003a_A6
Test setup	See chapter 7.5 setup A
Measurement uncertainty	See chapter 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 30 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	

Results: DSSS / b – mode; antenna port 0

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		11.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		11.0	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		11.8	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / g – mode; antenna port 0

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		0.8	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		7.0	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		1.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / n HT20 – mode; antenna port 0

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		1.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		6.2	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		1.3	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / ac HT20 –mode; antenna port 0

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		1.3	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		6.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		1.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / ax HE20 – mode; antenna port 0

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		0.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		6.7	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		0.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: DSSS / b – mode; antenna port 1

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		11.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		11.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		10.2	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / g – mode; antenna port 1

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		1.5	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		6.53	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		1.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / n HT20 – mode; antenna port 1

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		1.5	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		4.5	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		0.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / ac HT20 –mode; antenna port 1

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		2.1	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		4.6	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		0.5	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / ax HE20 – mode; antenna port 1

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		0.4	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		6.2	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		-0.2	30 dBm	>30dB	Operating frequency
No peaks detected			-20 dBc (peak) -30 dBc (average)		compliant

13.11 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
Measured modulation	☒ DSSS b – mode ☐ OFDM g – mode ☐ OFDM n HT20 – mode ☐ OFDM ac HT20 – mode ☒ OFDM ax HE20 – mode
Test setup	See chapter 7.2 setup B
Measurement uncertainty	See chapter 9

Limits:

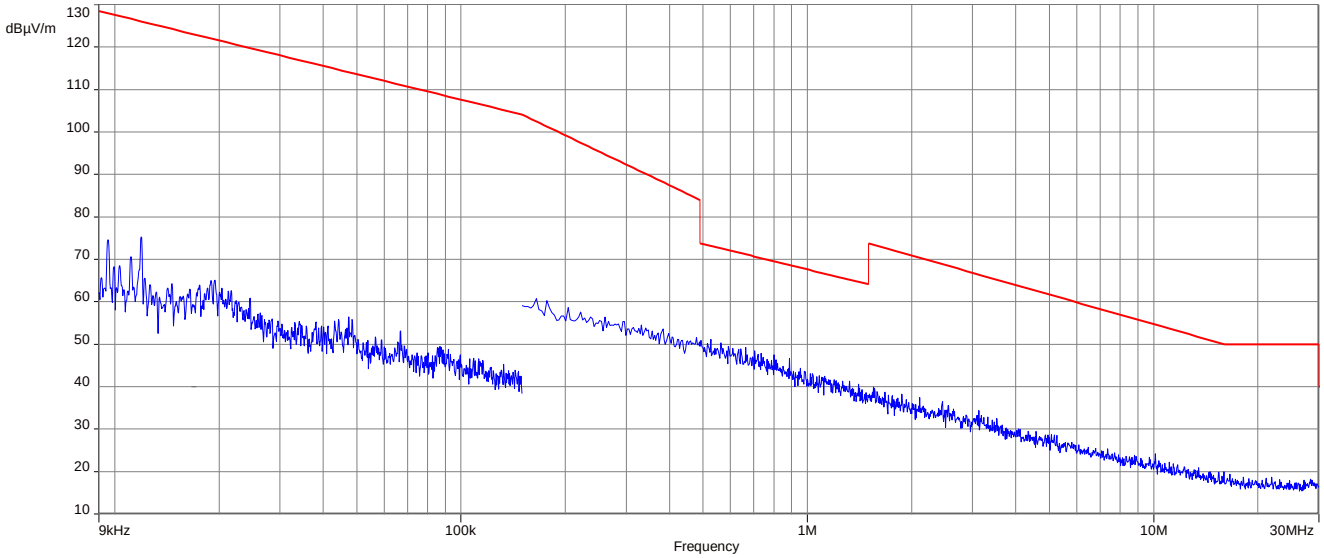
FCC		ISED
Frequency / MHz	Field Strength / (dBµV / m)	Measurement distance / m
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

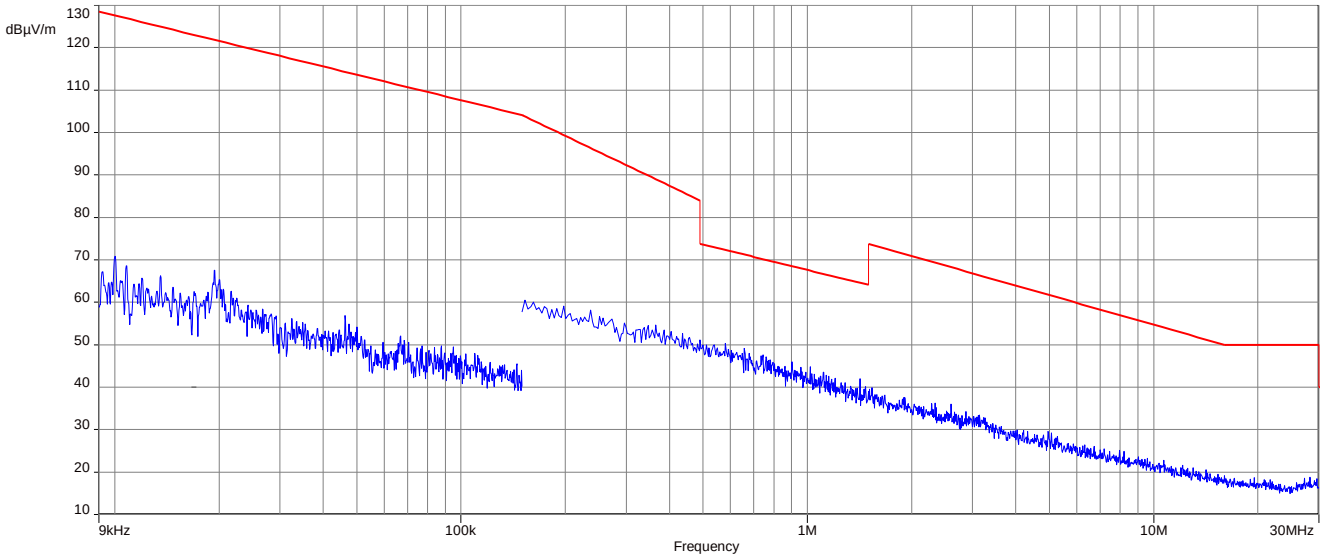
TX spurious emissions radiated < 30 MHz / (dBµV / m) @ 3 m		
Frequency / MHz	Detector	Level / (dBµV / m)
All detected peaks are more than 20 dB below the limit.		

Plots: DSSS

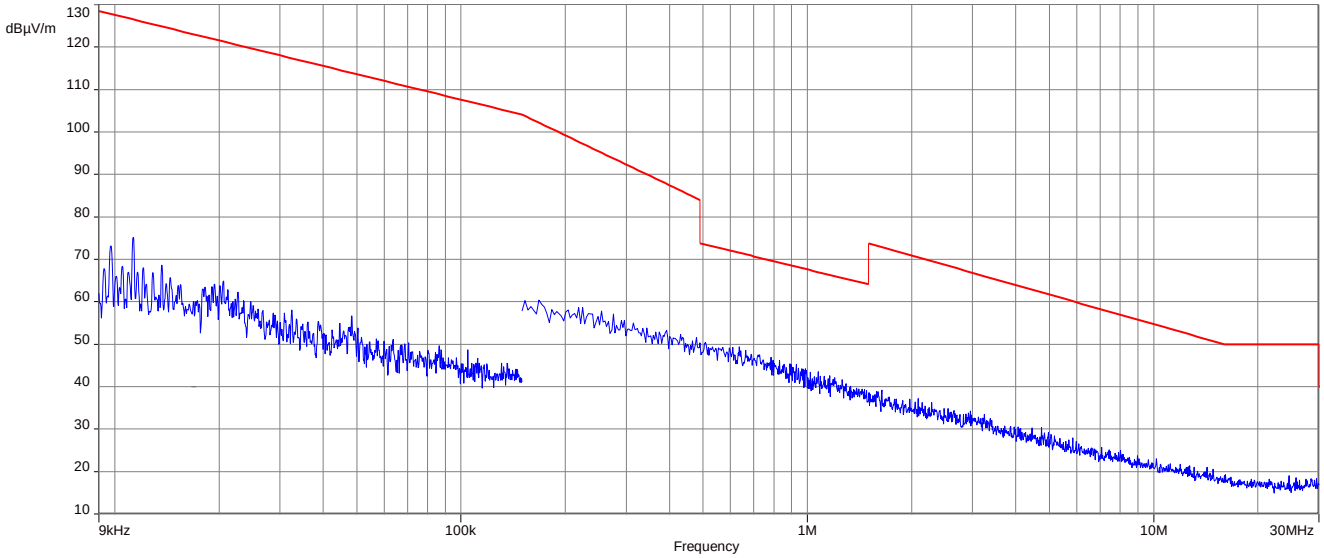
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

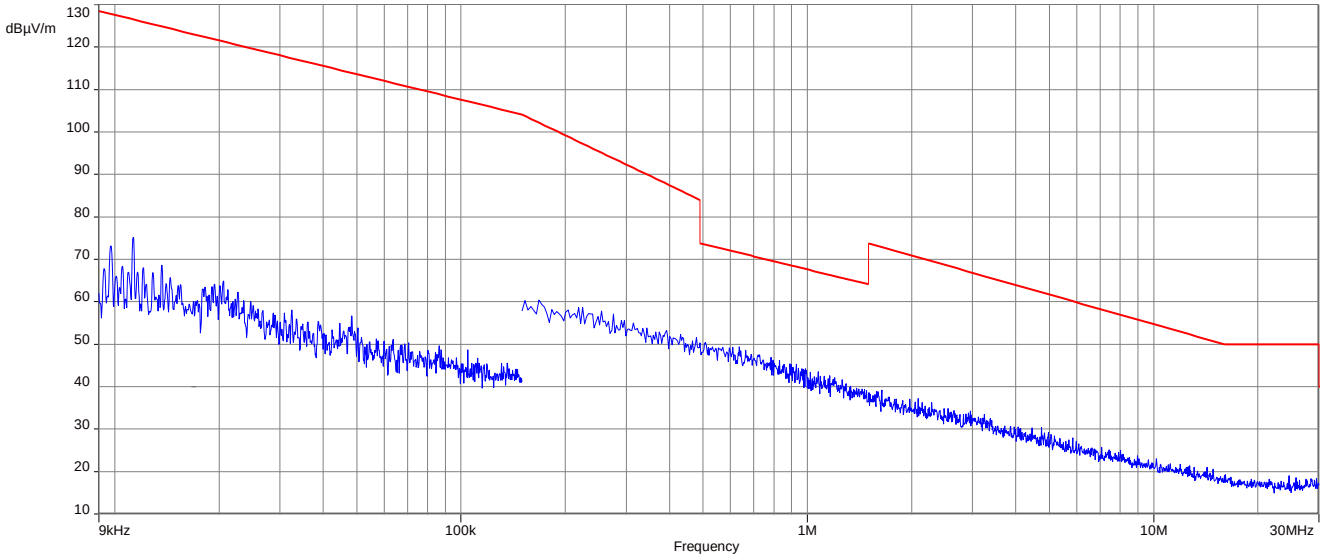


Plot 3: 9 kHz to 30 MHz, highest channel

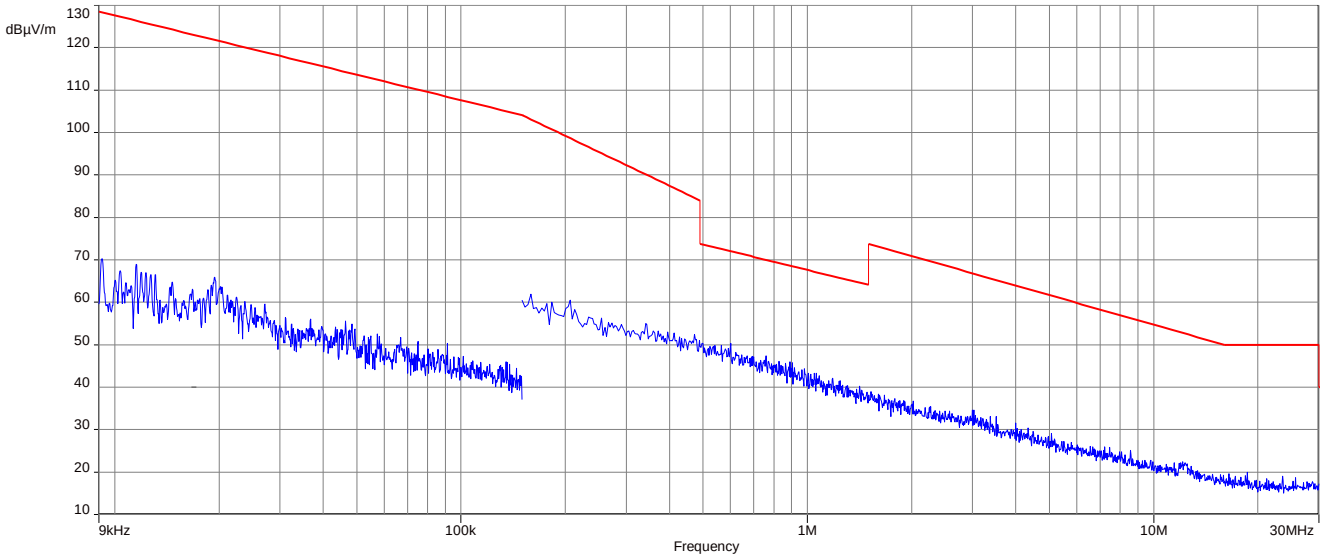


Plots: OFDM (20 MHz nominal channel bandwidth)

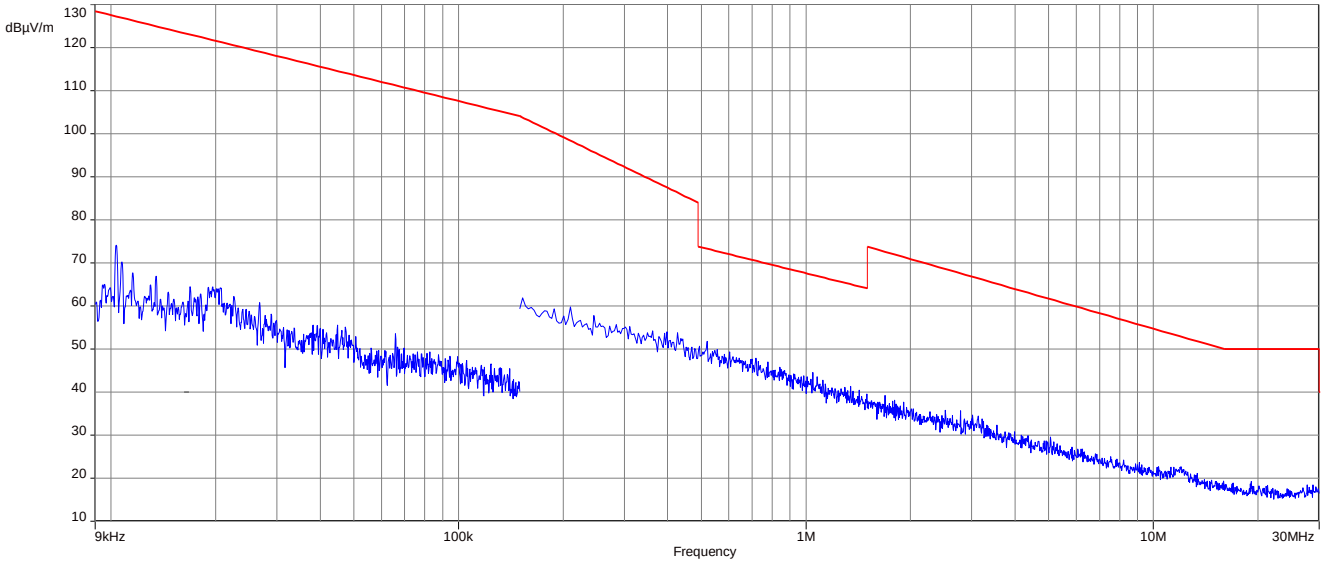
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel



Plot 3: 9 kHz to 30 MHz, highest channel



13.12 Spurious emissions radiated 30 MHz to 1 GHz

Description:

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

Measurement:

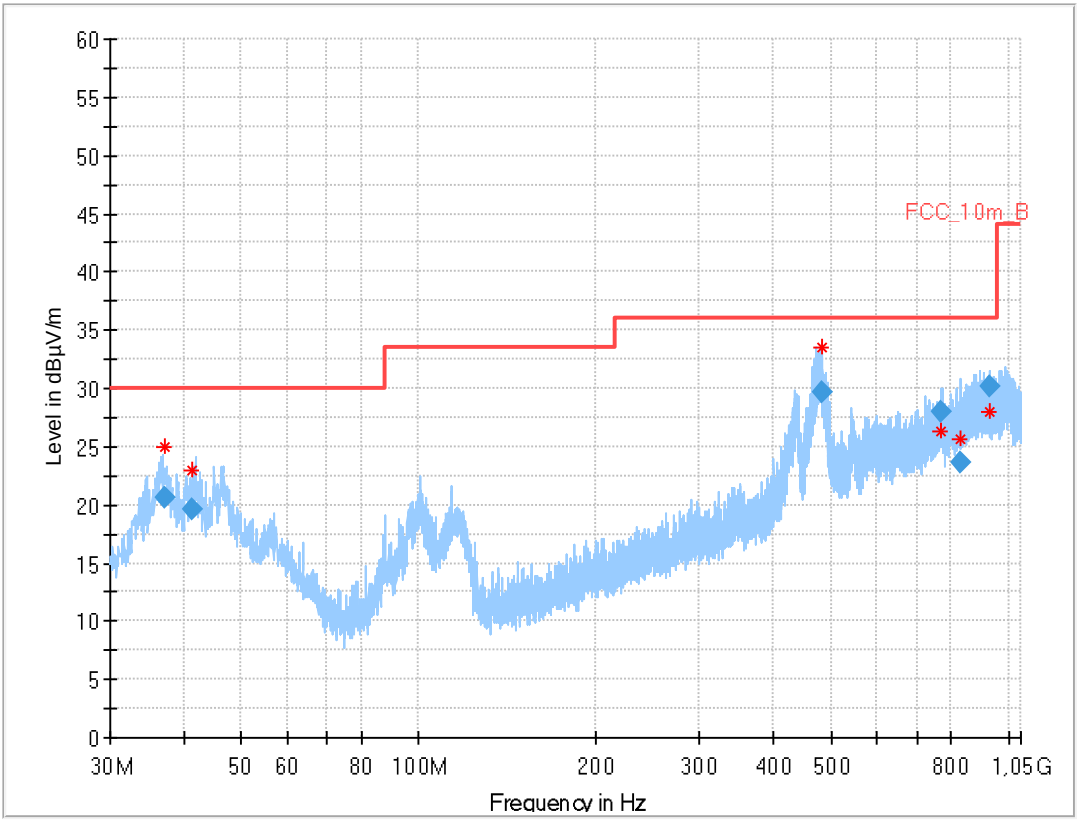
Measurement parameter	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	120 kHz
Video bandwidth	3 x RBW
Span	30 MHz to 1 GHz
Trace mode	Max Hold
Measured modulation	☒ DSSS b – mode ☐ OFDM g – mode ☐ OFDM n HT20 – mode ☐ OFDM ac HT20 – mode ☒ OFDM ax HE20 – mode
Test setup	See chapter 7.1 setup A
Measurement uncertainty	See chapter 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 / m
30 – 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10

Plot: DSSS

Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, (valid for all channels)

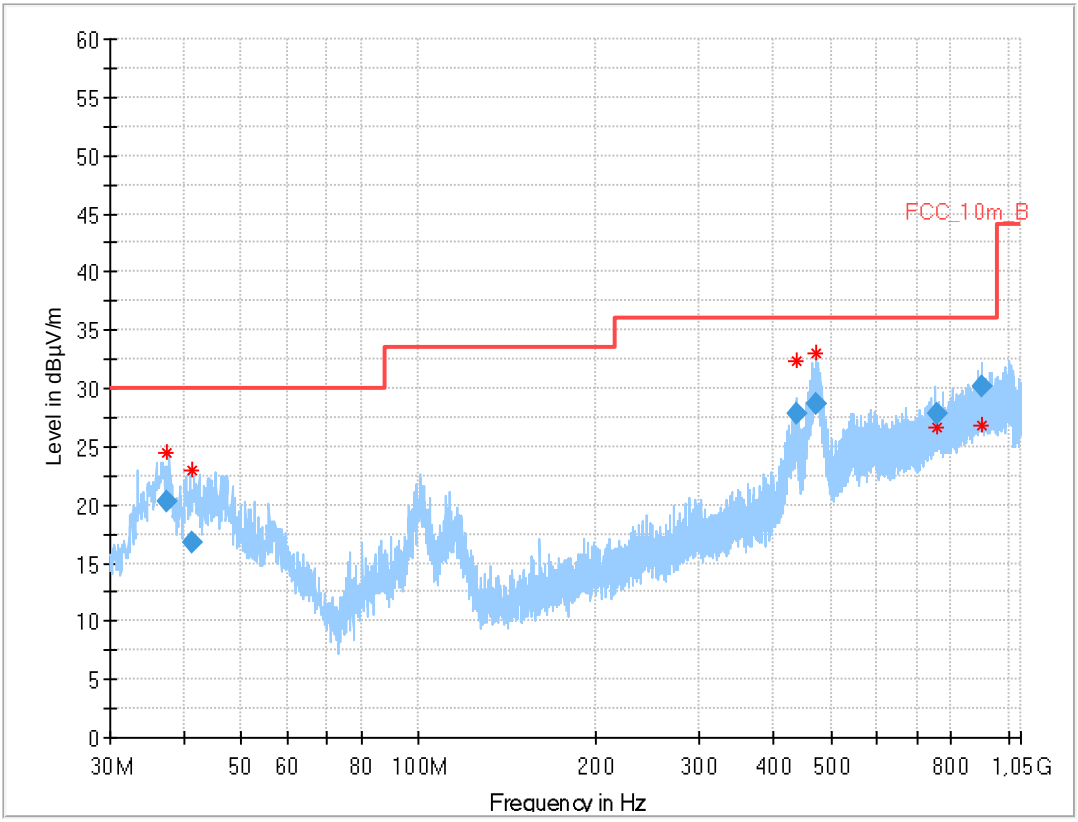


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.156	20.62	30.0	9.4	1000	120.0	104.0	V	142	15
41.233	19.55	30.0	10.5	1000	120.0	104.0	V	-11	15
482.061	29.66	36.0	6.3	1000	120.0	98.0	V	12	19
769.024	28.01	36.0	8.0	1000	120.0	115.0	H	105	24
829.871	23.58	36.0	12.4	1000	120.0	117.0	H	142	24
927.363	30.13	36.0	5.9	1000	120.0	157.0	V	210	26

Plot: OFDM (20 MHz nominal channel bandwidth)

Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization (valid for all channels)



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.499	20.26	30.0	9.7	1000	120.0	104.0	V	27	15
41.201	16.81	30.0	13.2	1000	120.0	122.0	V	172	15
438.473	27.86	36.0	8.1	1000	120.0	102.0	V	178	19
471.511	28.58	36.0	7.4	1000	120.0	101.0	V	7	19
754.002	27.78	36.0	8.2	1000	120.0	126.0	H	37	24
903.725	30.10	36.0	5.9	1000	120.0	195.0	V	142	26

13.13 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions above 1 GHz in transmit mode and receiver / idle mode.

Measurement:

Measurement parameter	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 26 GHz
Trace mode	Max Hold
Measured modulation	☒ DSSS b – mode ☐ OFDM g – mode ☐ OFDM n HT20 – mode ☐ OFDM ac HT20 – mode ☒ OFDM ax HE20 – mode
Test setup	See sub clause 7.2 setup C (1 GHz - 18 GHz) See sub clause 7.3 setup A (18 GHz - 26 GHz)
Measurement uncertainty	See chapter 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 30 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 / m
Above 960	54.0 (AVG)	3
	74.0 (peak)	

Results: DSSS

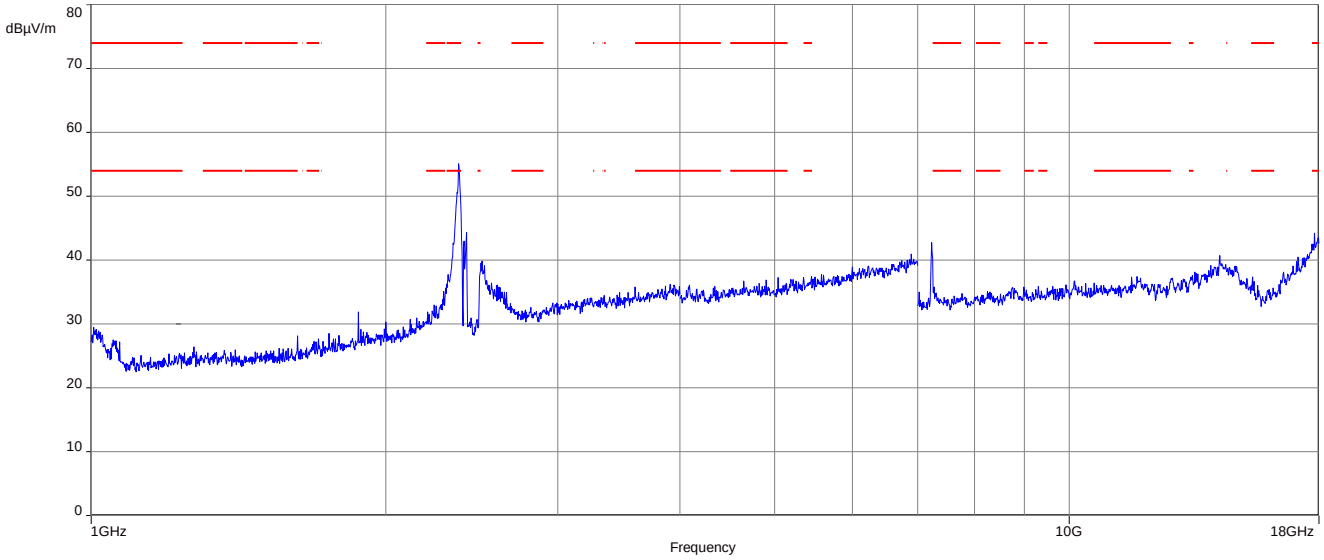
TX spurious emissions radiated / dBµV/m @ 3 m								
lowest channel			middle channel			highest channel		
f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m
All detected peaks are below the average limit.			All detected peaks are below the average limit.			2726	Peak	60.0
							AVG	31.4
-/-	Peak	-/-	-/-	Peak	-/-	All other detected peaks are below the average limit.		
	AVG	-/-		AVG	-/-			

Results: OFDM (20 MHz nominal channel bandwidth)

TX spurious emissions radiated / dBµV/m @ 3 m								
lowest channel			middle channel			highest channel		
f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m
All detected peaks are below the average limit.			All detected peaks are below the average limit.			All detected peaks are below the average limit.		
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

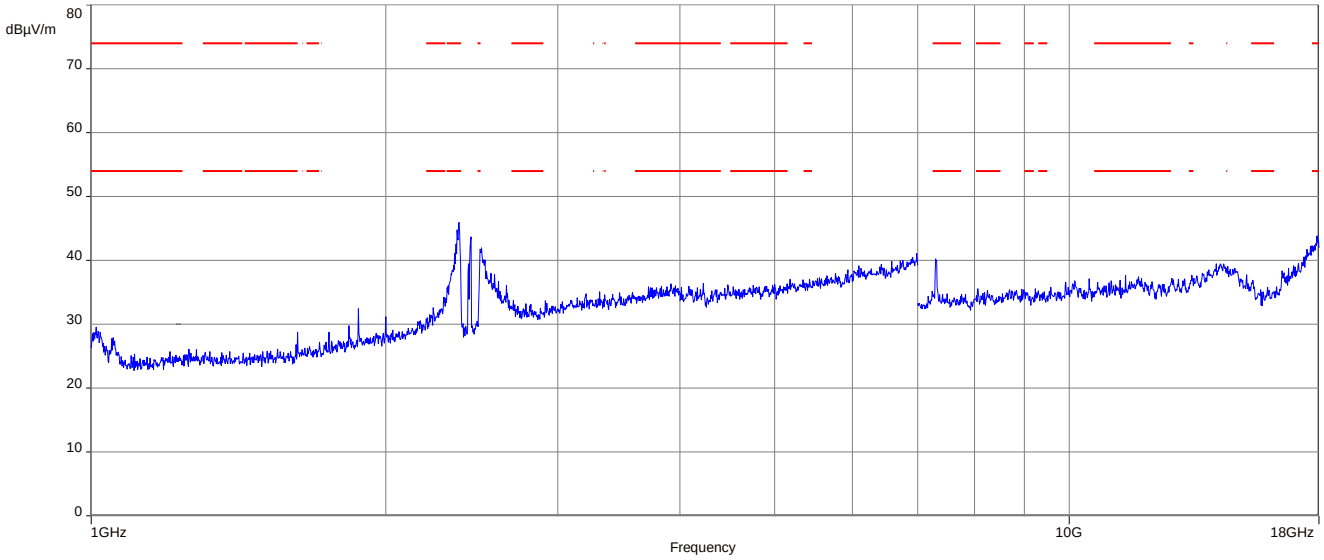
Plots: DSSS

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



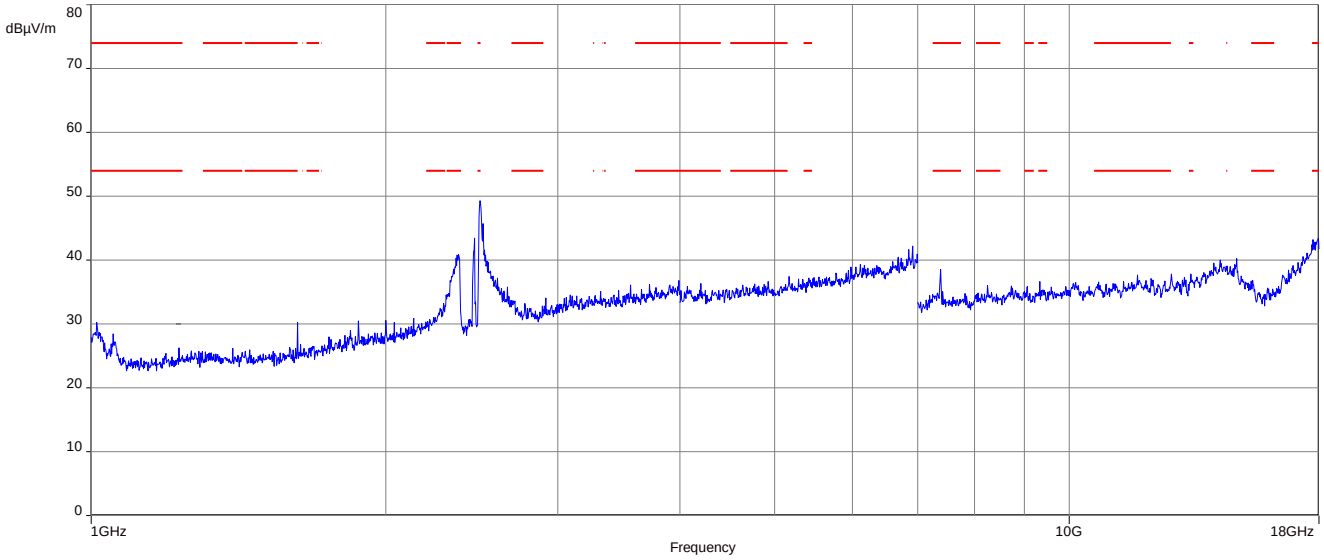
The carrier signal is notched with a 2.4 GHz band rejection filter.

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



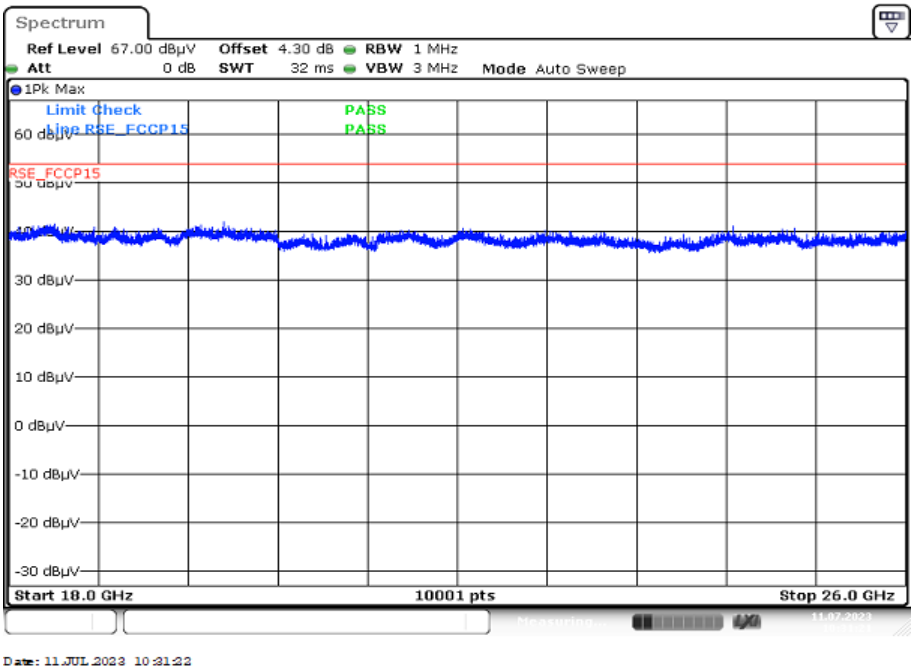
The carrier signal is notched with a 2.4 GHz band rejection filter.

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



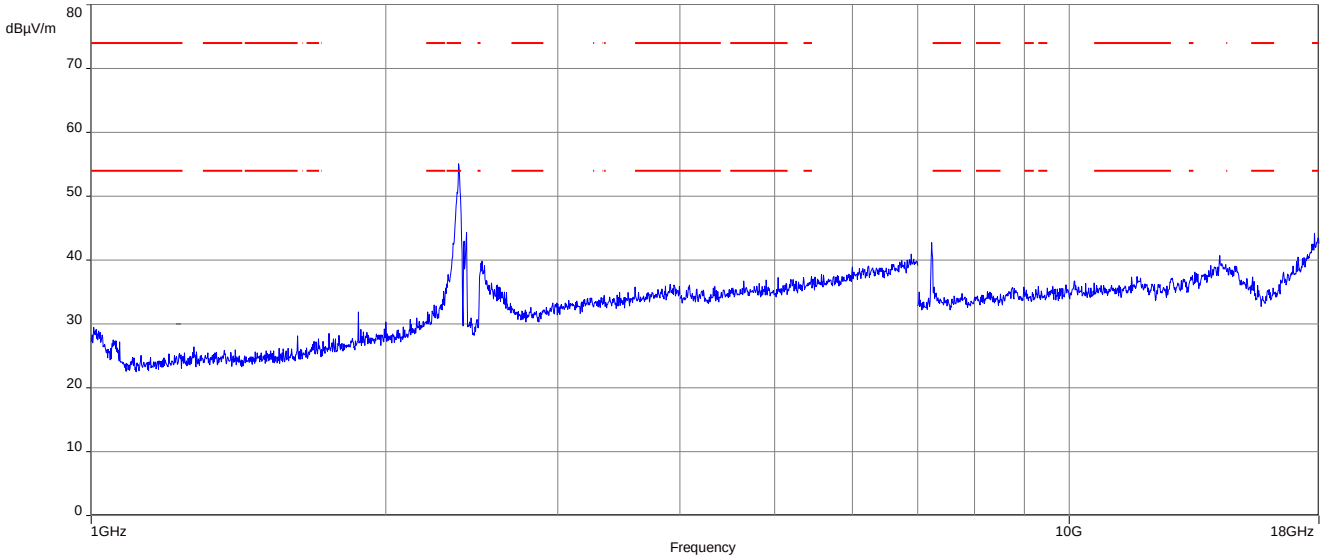
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: All channels, 1 GHz to 18 GHz, vertical & horizontal polarization



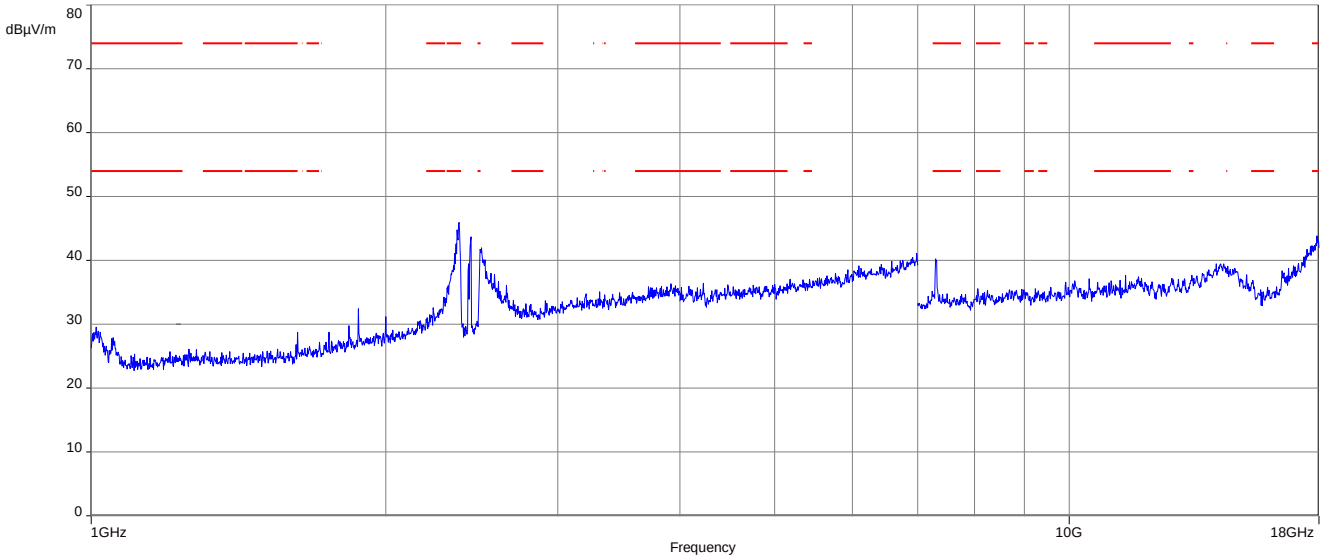
Plots: OFDM (20 MHz bandwidth)

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



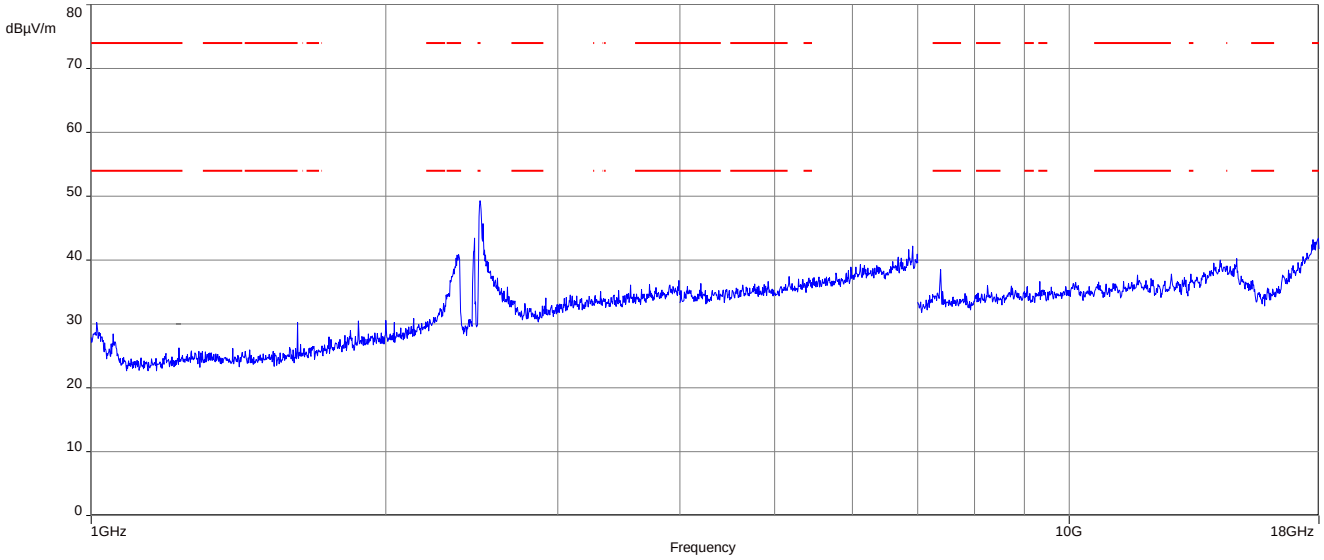
The carrier signal is notched with a 2.4 GHz band rejection filter.

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



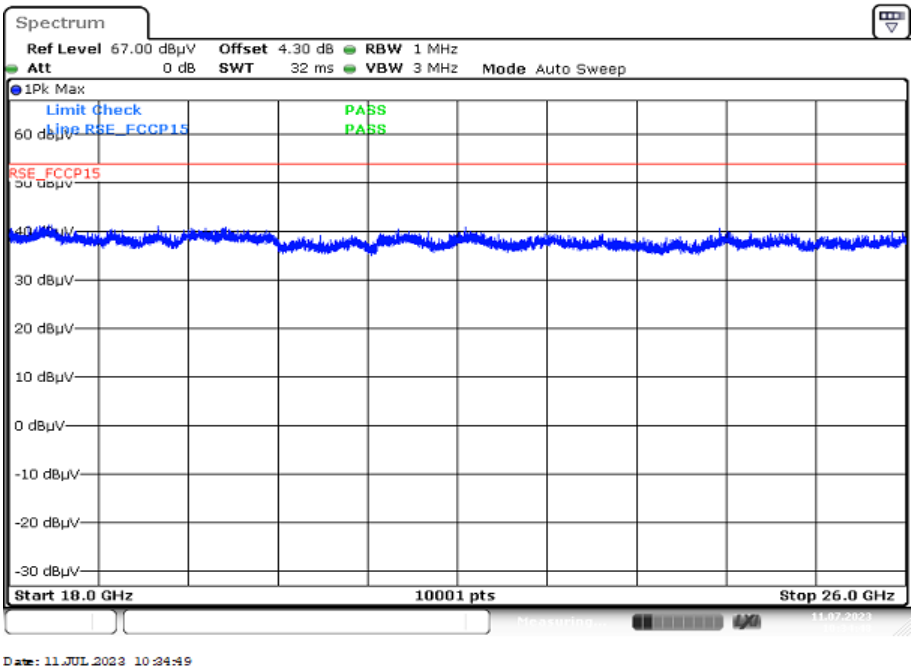
The carrier signal is notched with a 2.4 GHz band rejection filter.

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



The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: All channels, 1 GHz to 18 GHz, vertical & horizontal polarization



13.14 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameter	
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 7.4 setup A
Measurement uncertainty	See chapter 9

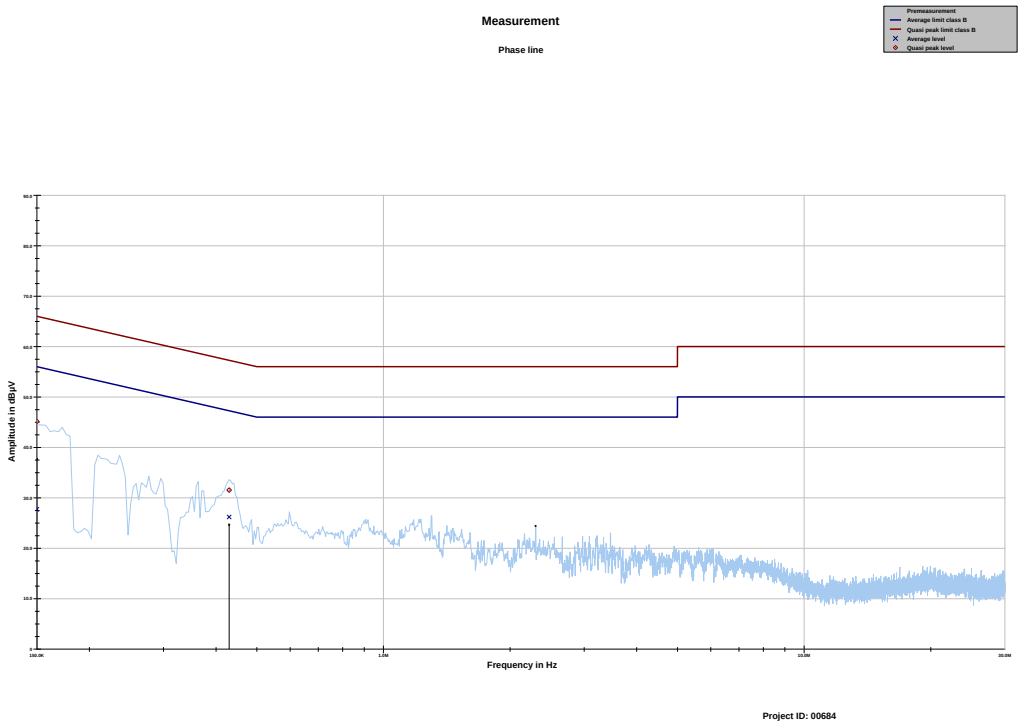
Limits:

FCC		ISED
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

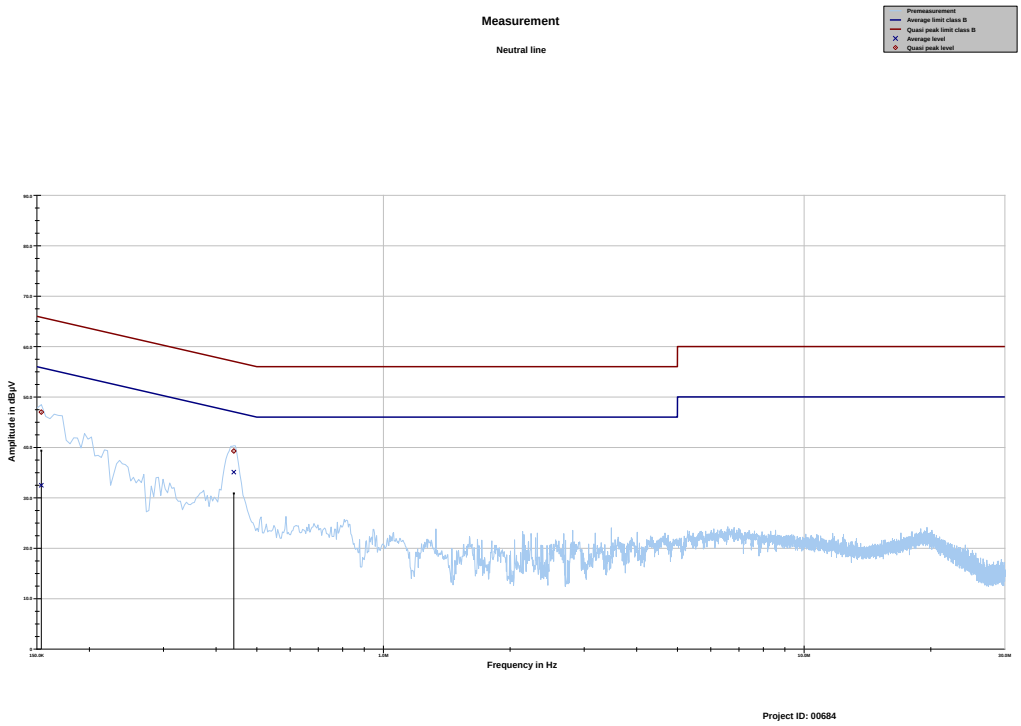
Plots:

Plot 1: 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
0.150000	45.13	20.87	66.000	27.70	28.30	56.000
0.429844	31.53	25.73	57.256	26.18	21.82	48.004

Plot 2: 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
0.153731	47.00	18.80	65.796	32.48	23.42	55.893
0.441038	39.28	17.76	57.042	35.08	12.61	47.685

14 Observations

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

15 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
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

16 Document history

Version	Applied changes	Date of release
-/-	Initial release	2023-07-24

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.	Deutsche Akkreditierungsstelle GmbH Office Berlin Spittelmarkt 10 10117 Berlin Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main Office Braunschweig Bundesallee 100 38116 Braunschweig 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. The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu

Note: The current certificate annex is published on the websites (link see below).

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

or

https://cetecomadvanced.com/files/pdfs/d-pl-12076-01-05_tcb_usa.pdf

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