
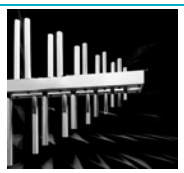
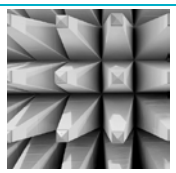

cetecom advanced

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-6002_23-01-19

DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-00

Testing laboratory

cetecom advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://cetecomadvanced.com
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 with the registration number: D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

Applicant

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY
Phone: +49 5130 600-0
Contact: Ouajdi Ochi
e-mail: Ouajdi.Ochi@sennheiser.com

Manufacturer

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY

Test standard/s

FCC - Title 47 CFR Part 74	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services

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

Test Item

Kind of test item:	**Tablestand Transmitter**
Model name:	**EW-DX TS**
FCC ID:	**DMOTSEWDX9**
ISED certification number:	**2099A-TSEWDX9**
Frequency range:	941.7MHz – 951.8MHz / 953.05MHz - 956.05MHz / 956.65MHz -959.65MHz
Technology tested:	proprietary
Antenna:	Integrated monopole antenna
Power supply:	2.00 V to 4.35 V DC by Li Ion battery
Temperature range:	-10°C to +50°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=cetecom advanced GmbH, ou=SND-230601, email=christoph.schneider@cetecomadvanced.com, c=DE
2024.01.03 07:36:55 +01'00'

Christoph Schneider
Lab Manager
Radio Labs

Test performed:

cn=Tobias Wittenmeier, o=cetecom advanced GmbH, ou=WIT-230601, email=tobias.wittenmeier@cetecomadvanced.com, c=DE
2024.01.03 07:40:09 +01'00'

Tobias Wittenmeier
Testing Manager
Radio Labs

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. 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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In no case this test report can be considered as a Letter of Approval.

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 order:	2023-11-06
Date of receipt of test item:	2023-11-13
Start of test:*	2023-11-15
End of test:*	2023-12-14
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

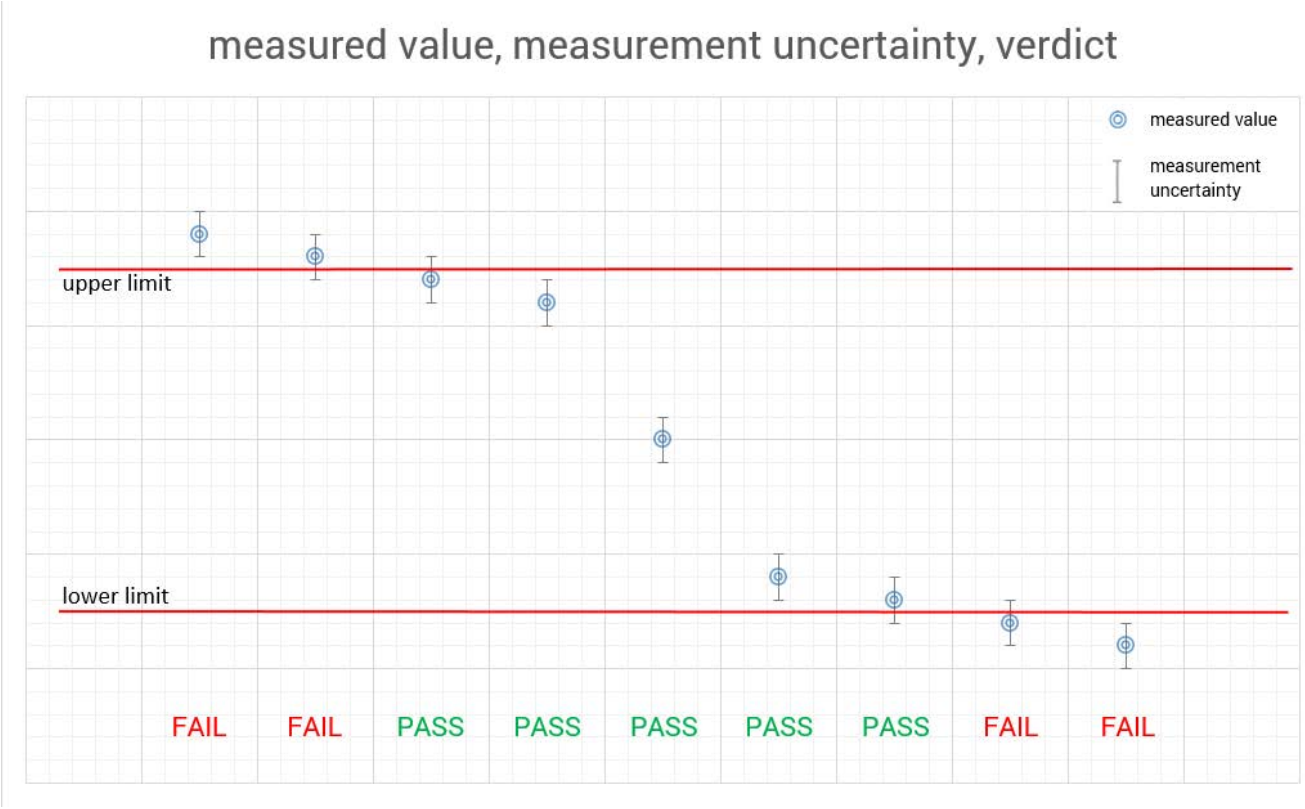
3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 74		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services
RSS - 123 Issue 4	August 2019	Licensed Wireless Microphones
ETSI EN 300 422-1 V1.4.2	2011-08	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement

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

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 +50 °C during high temperature tests -30 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	3.80 V DC by Li Ion battery 4.35 V 2.00 V

6 Test item

6.1 General description

Kind of test item	:	Tablestand Transmitter
Model name	:	EW-DX TS
Series	:	Evolution Wireless Digital
HMN	:	-/-
PMN	:	EW-DX TS
HVIN	:	EW-DX TS9
FVIN	:	1v3
S/N serial number	:	Rad. 1433000077 Cond. 1433000079
Hardware status	:	593619
Software status	:	1v3
Firmware status	:	-/-
Frequency band	:	941.7MHz – 951.8MHz / 953.05MHz - 956.05MHz / 956.65MHz -959.65MHz
Type of radio transmission Use of frequency spectrum	: :	Modulated carrier
Type of modulation	:	Pi/4 DQPSK
Number of channels	:	Tuning step size: 25 kHz
Antenna	:	Integrated monopole antenna
Power supply	:	2.00 V to 4.35 V DC by Li Ion battery
Temperature range	:	-10°C to +50°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: 1-6002_23-01-01_AnnexA
1-6002_23-01-01_AnnexB
1-6002_23-01-01_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).

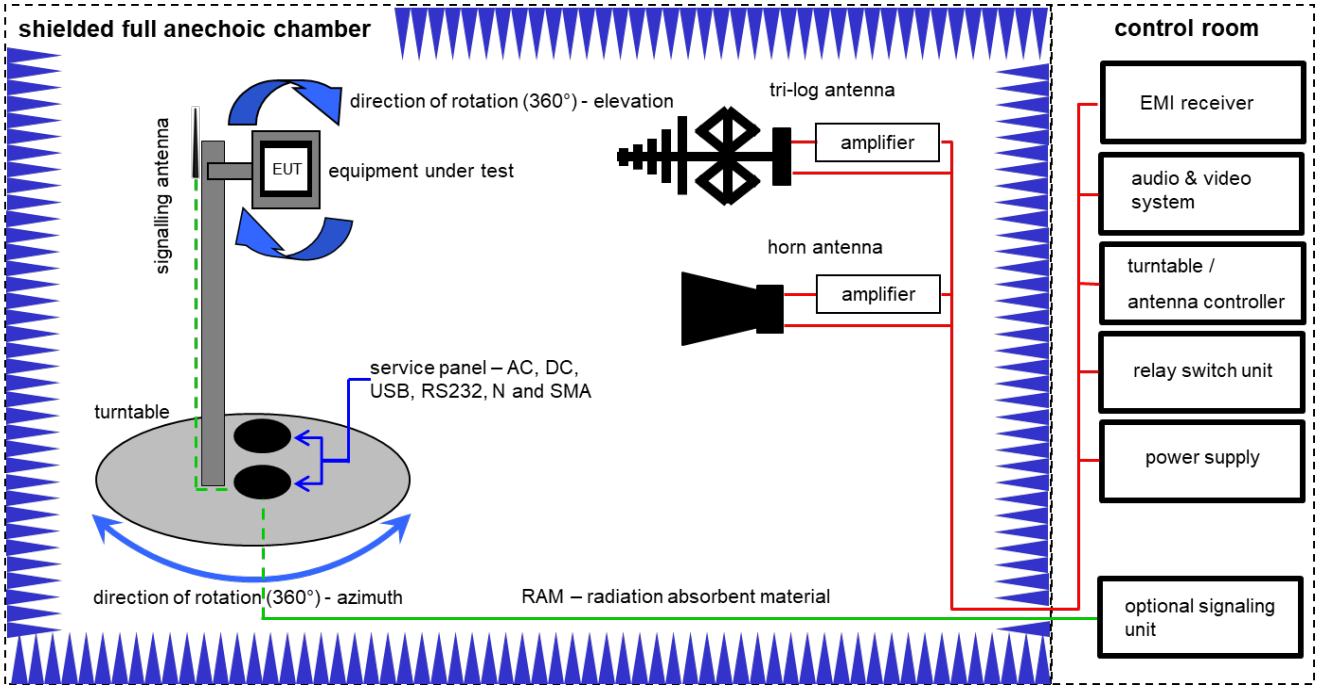
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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 fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

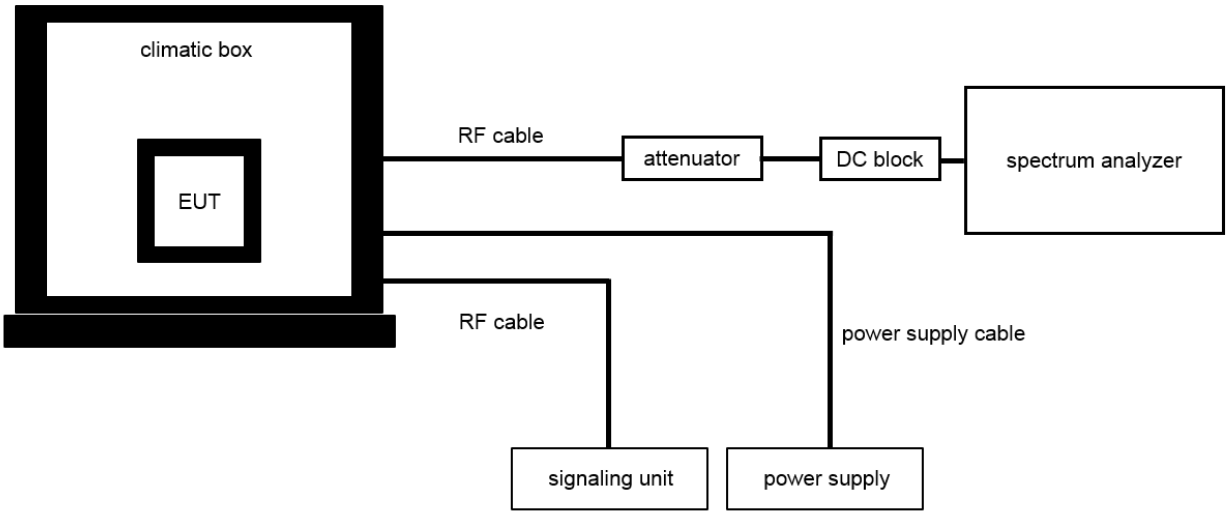
Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A,B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vIKI!	11.02.2022	29.02.2024
4	B	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492	ev	-/-	-/-
5	A,B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	07.12.2022	31.12.2023
6	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
7	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
8	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vIKI!	30.09.2023	29.09.2025
9	A,B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
10	A,B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
11	A,B	NEXIO EMV-Software	BAT EMC V2022.0.32.0	Nexio		300004682	ne	-/-	-/-

7.2 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme conditions



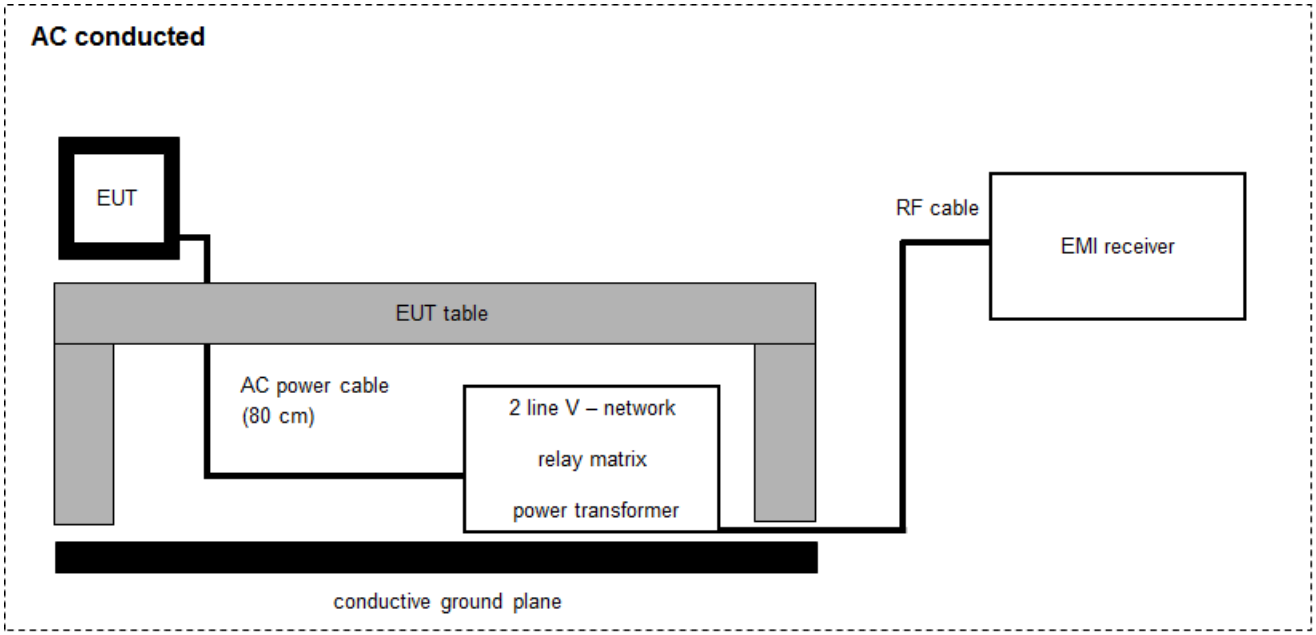
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

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

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B	Signal analyzer	FSW26	Rohde&Schwarz	101455	300004528	k	07.12.2022	31.12.2023
2	A,B	RF-Cable SRD021 No. 1	Enviroflex 316 D	Huber & Suhner		400001311	ev	-/-	-/-
3	B	Temperature Test Chamber	VT 4011	Voetsch Industrietechnik	5856623060001 0	300005363	ev	09.05.2022	31.05.2024
4	B	Power Supply	HMP2020	Rohde & Schwarz	102219	300006192	k	15.12.2022	31.12.2024

7.3 AC conducted



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

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

Equipment table:

No.	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	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	vIKI!	29.12.2021	31.12.2023
4	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
5	A	PC	TecLine	F+W		300003532	ne	-/-	-/-
6	A	EMI Test Receiver 3.6 GHz	ESR3	Rohde & Schwarz	102981	300006318	k	09.12.2022	31.12.2023

8 Sequence of testing

8.1 Sequence of testing radiated spurious 30 MHz 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**
Transmitter output power	± 3 dB
Occupied bandwidth	± 3 kHz to 10 kHz (depends on the used RBW)
Transmitter frequency stability	± 1 Hz to 1 kHz (depends on the used RBW)
Transmitter unwanted emissions (radiated or conducted)	Radiated: ± 3 dB Conducted: ± 0.5 dB
Modulation characteristics	-/-
Necessary bandwidth (BN) for analogue systems	± 1 kHz (depends on the used RBW)
Frequency modulation	± 3 kHz (depends on the used RBW)
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	FCC Part 74 RSS - 210, Issue 9 RSS-Gen Issue 4	See table!	2024-01-03	-/-

Test specification clause	Test case	Temperature conditions	Voltage conditions	C	NC	NA	NP	Remark
FCC Part 74.861 (e)(1)(ii) FCC Part 2.1046) RSS-210 – G.3.1 RSS-Gen – 6.12	Transmitter output power	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(5) FCC Part 2.1049 RSS-210 – G.3.2 RSS-Gen – 6.6	Occupied bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(4) FCC Part 2.1055 RSS-210 – G.3.3 RSS-Gen – 6.11	Transmitter frequency stability	Nominal	Nominal	☒	☐	☐	☐	-/-
		Extreme	Extreme	☒	☐	☐	☐	
FCC Part 74.861 (e)(6) FCC Part 74.861 (e)(7) RSS-210 – G.3.4 ETSI EN 300 422-1 v1.4.2 (2011-08)	Transmitter unwanted emissions (radiated or conducted)	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 2.1047	Modulation characteristics	Nominal	Nominal	-/-				Digital modulation
FCC Part 74.861 (e)(7) ETSI EN 300 422-1 v1.4.2 (2011-08)	Necessary bandwidth (BN) for analogue systems	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(3) RSS-210 – G.3.5.2	Frequency modulation	Nominal	Nominal	☐	☐	☒	☐	Digital modulation
FCC Part 74.861 (e)(7) RSS-210 – G.3.4	Receiver spurious emissions	Nominal	Nominal	☐	☐	☒	☐	No receiver integrated!
FCC Part 15.107(a) FCC Part 15.207	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: None

Configuration descriptions: Frequency stability tests have been carried out in the temperature range from -30° to + 50° according the standard

Test mode:

☒ No test mode available.
Test signal is applied to the transmitter.

☐ 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)*

☐ 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.

12 Measurement results

12.1 Transmitter output power

Measurement:

Measurement parameter	
Detector:	Peak (worst case) / Average (RMS)
Sweep time:	Auto / 20s
Resolution bandwidth:	> emission bandwidth
Video bandwidth:	> resolution bandwidth
Span:	> 2 times emissions bandwidth
Trace mode:	Max. hold
EUT configuration:	Peak: Unmodulated carrier RMS: Modulate the transmitter with a 2.5 kHz tone at a level 16 dB higher than that required to produce a frequency deviation of ± 75 kHz, or to produce 50% of the manufacturer's rated deviation, whichever is less.
Test setup:	See sub clause 7.2 – A
Measurement uncertainty:	See sub clause 9

Limits:

FCC (conducted)	
941.500 MHz – 944.000 MHz 944.000 MHz – 952.000 MHz 952.850 MHz – 956.250 MHz 956.450 MHz – 959.850 MHz	1 W (average) / 30 dBm (average)
IC (conducted)	
941.500 MHz – 952.000 MHz 953.000 MHz – 959.850 MHz	1 W (average) / 30 dBm (average)

Result normal mode:

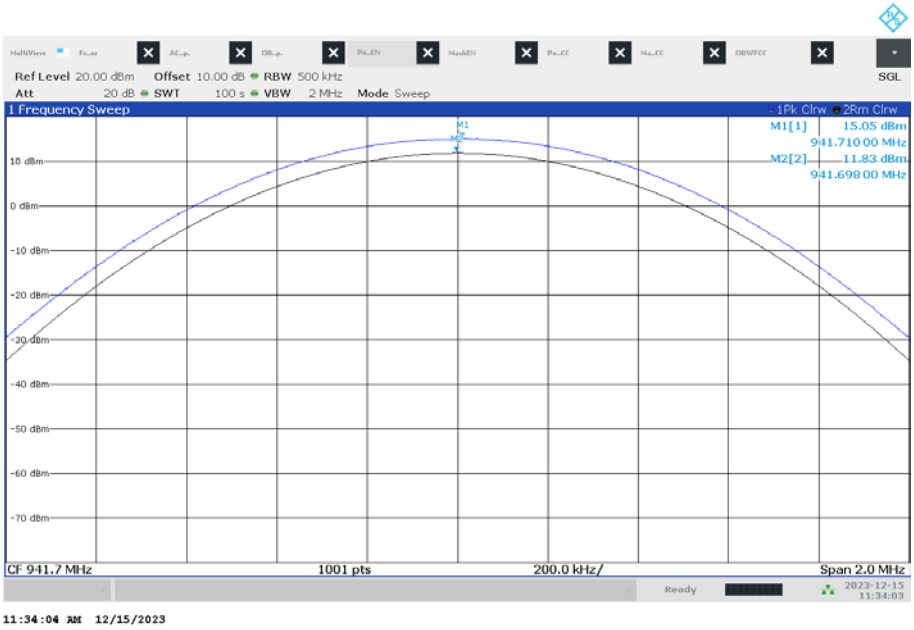
Transmitter output power conducted / dBm							
Frequencies / MHz	**941.7**	**946.75**	**951.8**	**953.05**	**956.05**	**956.65**	**959.65**
Peak	15.05 dBm	15.01 dBm	14.98 dBm	14.98 dBm	14.94 dBm	14.88 dBm	14.86 dBm
Average	11.83 dBm	11.75 dBm	11.88 dBm	11.85 dBm	11.78 dBm	11.77 dBm	11.70 dBm

Result LD mode:

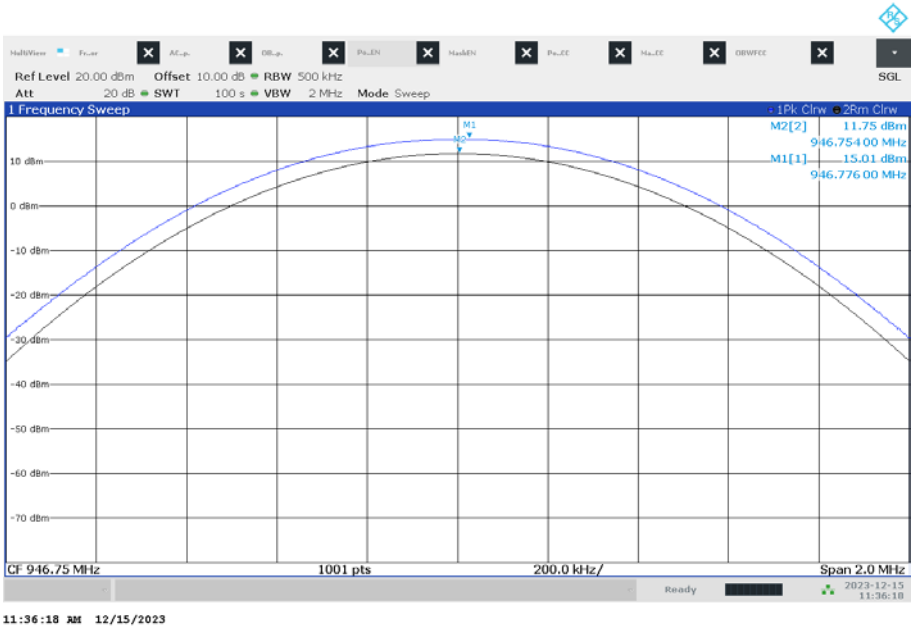
Transmitter output power conducted / dBm							
Frequencies / MHz	**941.7**	**946.75**	**951.8**	**953.05**	**956.05**	**956.65**	**959.65**
Peak	15.10 dBm	15.03 dBm	15.03 dBm	15.02 dBm	14.96 dBm	14.93 dBm	14.87 dBm
Average	11.91 dBm	11.82 dBm	11.94 dBm	11.91 dBm	11.84 dBm	11.83 dBm	11.76 dBm

Plots output power conducted, normal mode:

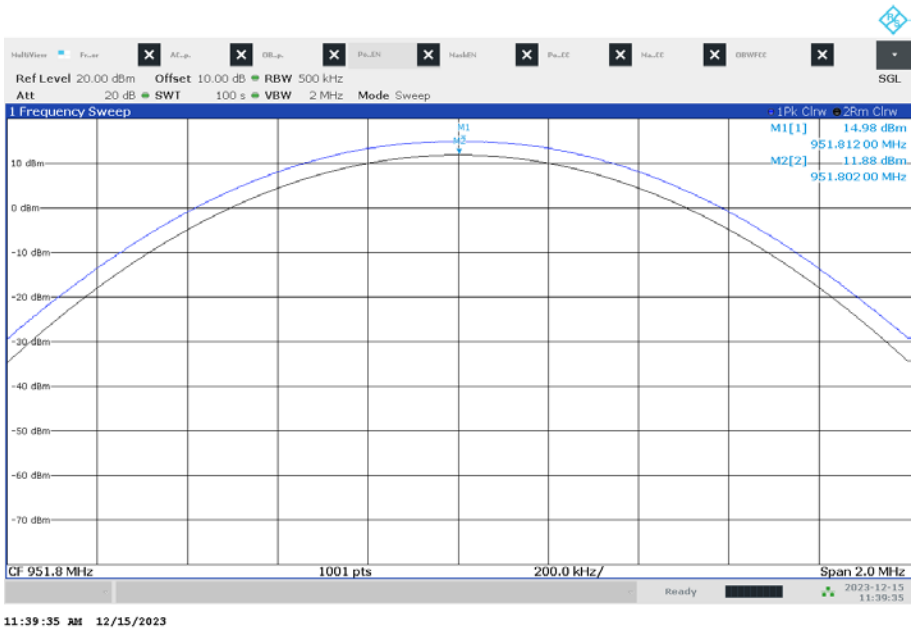
Plot 1: 941.7 MHz



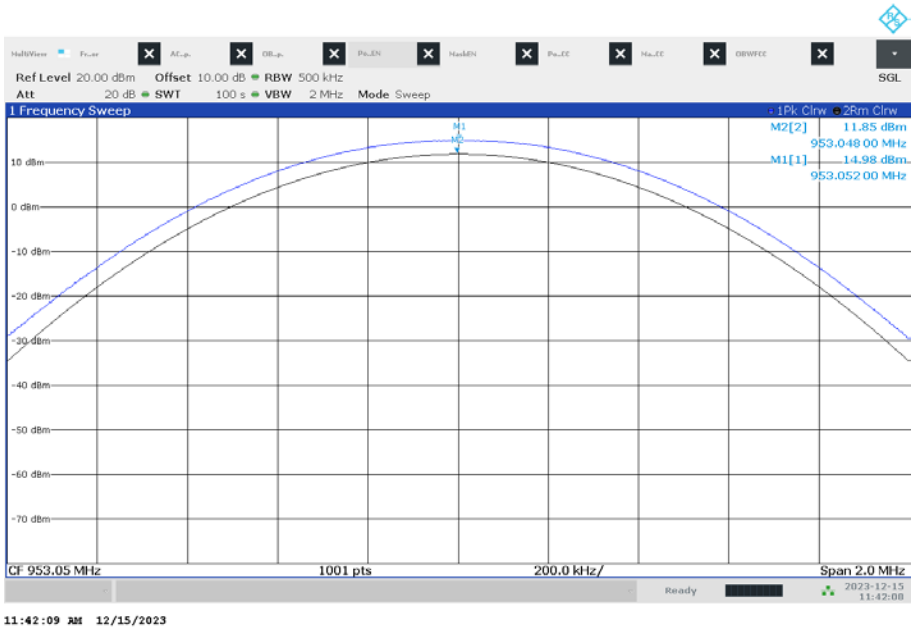
Plot 2: 946.75 MHz



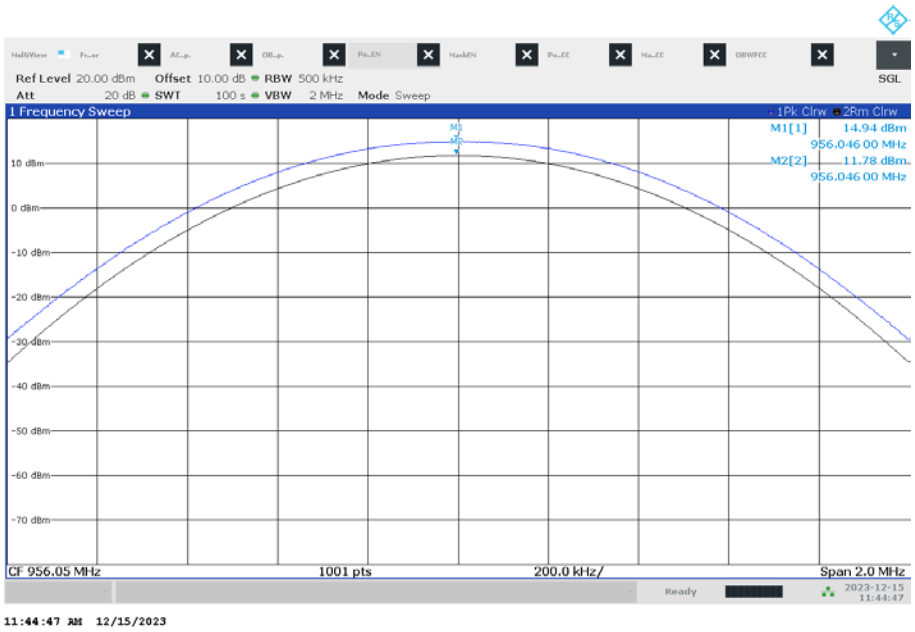
Plot 3: 951.8 MHz



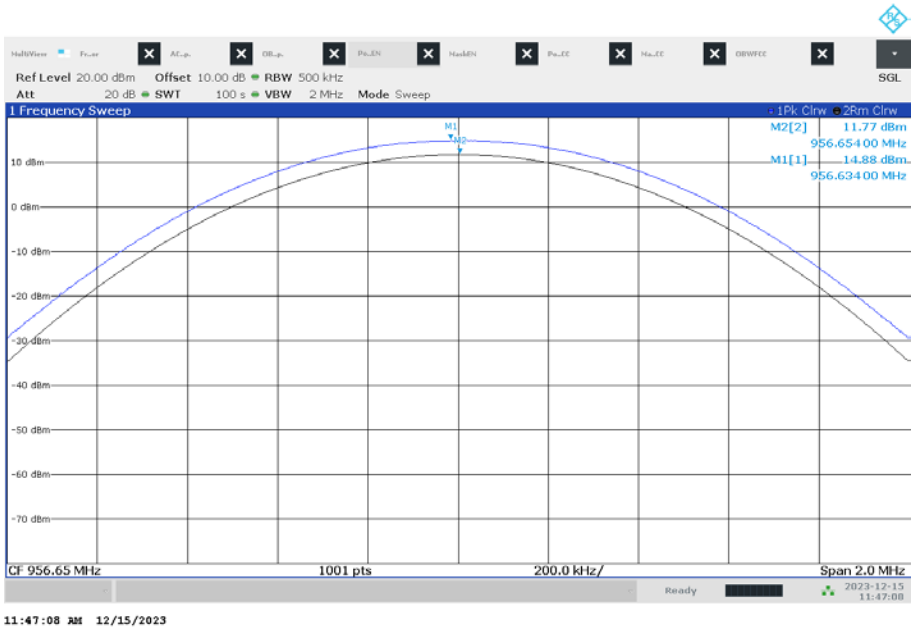
Plot 4: 953.05 MHz



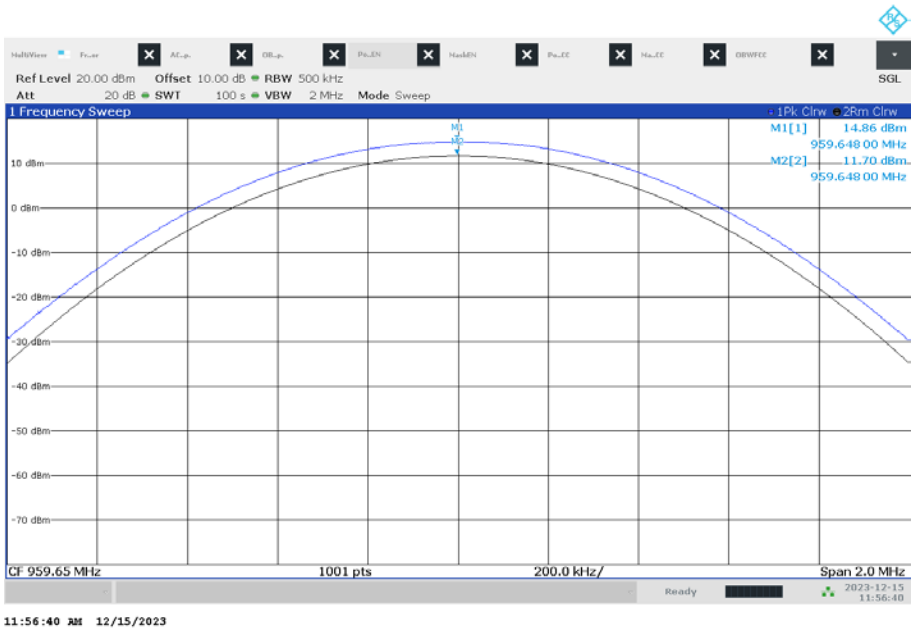
Plot 5: 956.05 MHz



Plot 6: 956.65 MHz

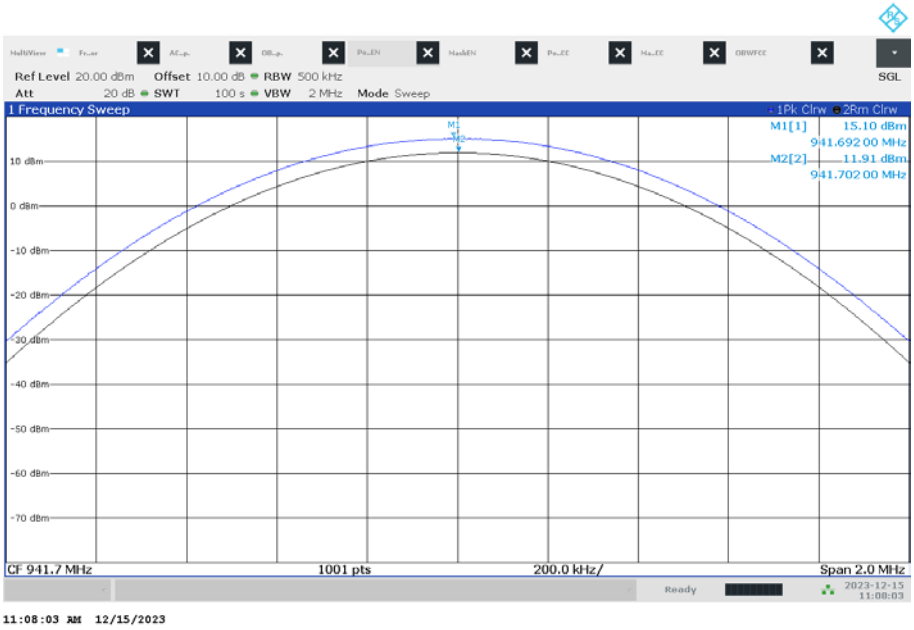


Plot 7: 959.65 MHz

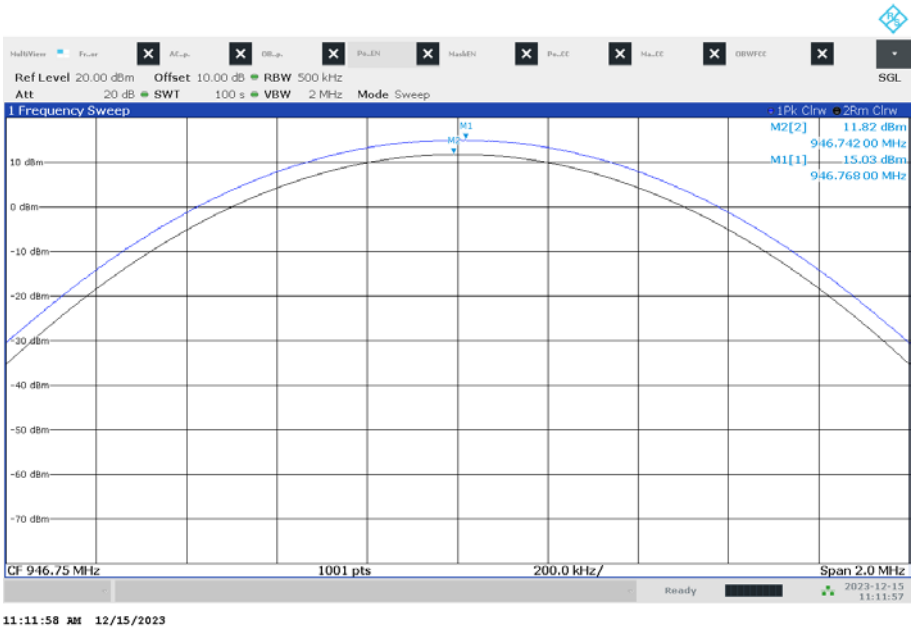


Plots output power conducted, LD mode:

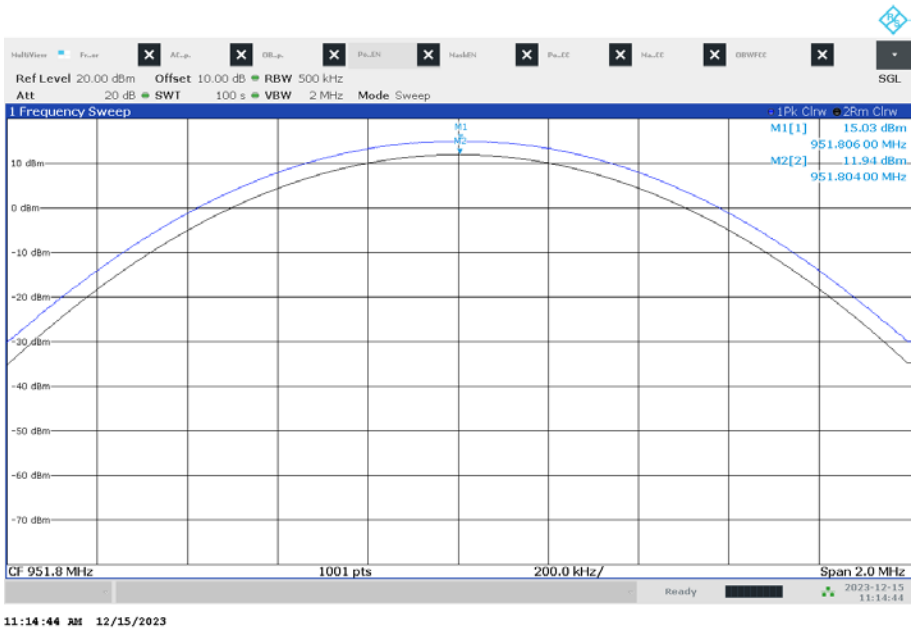
Plot 1: 941.7 MHz



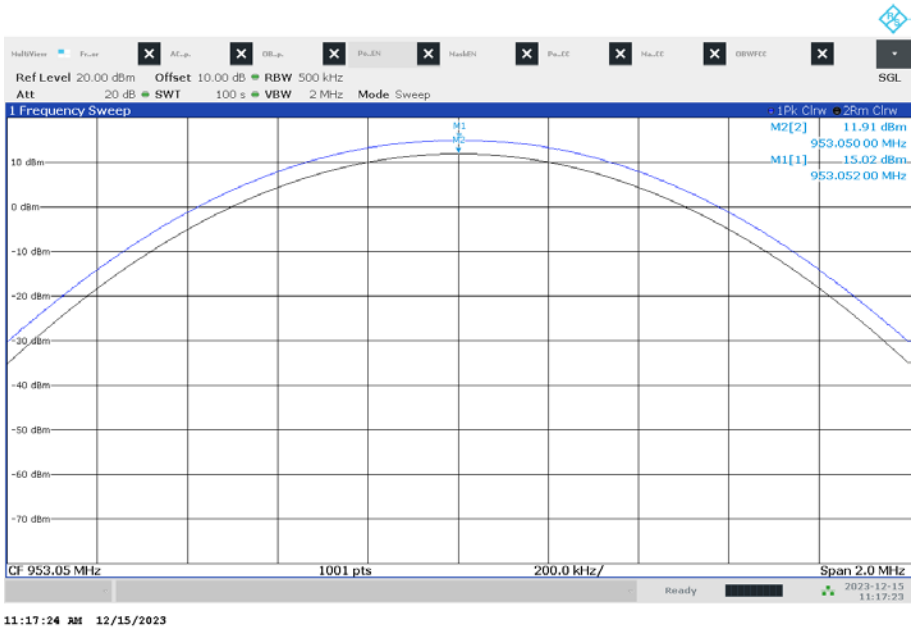
Plot 2: 946.75 MHz



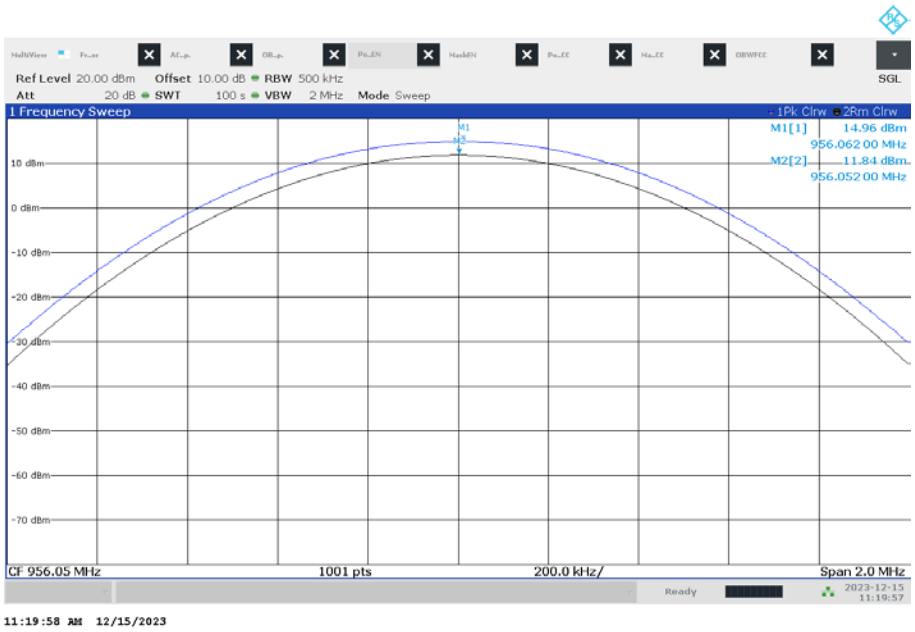
Plot 3: 951.8 MHz



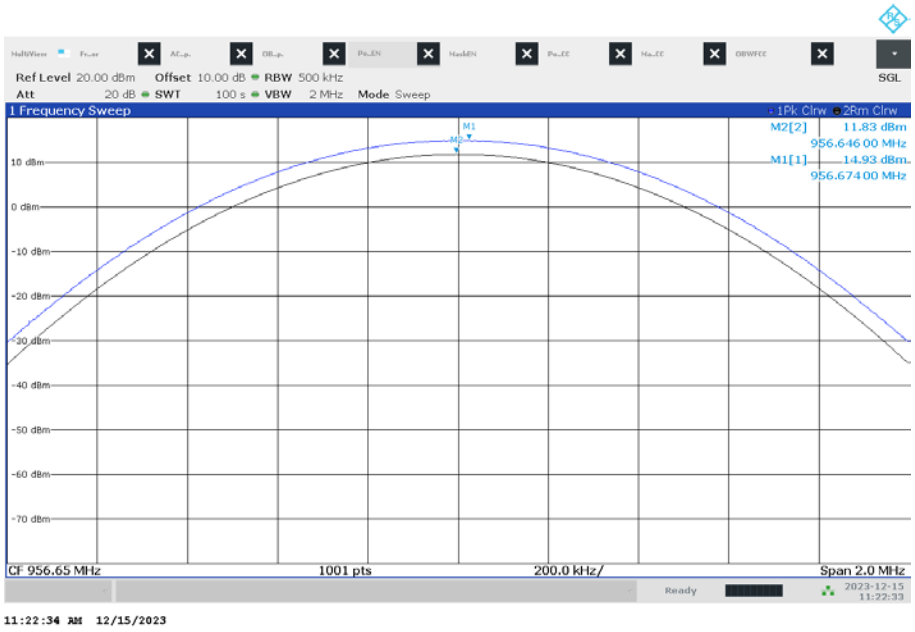
Plot 4: 953.05 MHz



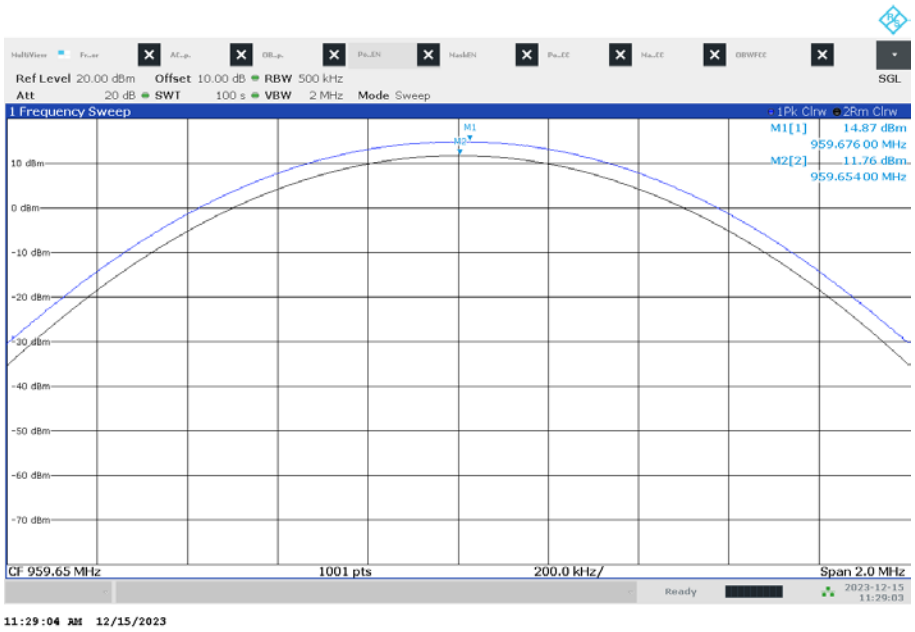
Plot 5: 956.05 MHz



Plot 6: 956.65 MHz



Plot 7: 959.65 MHz



12.2 Occupied bandwidth

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 % to 5 % of the occupied bandwidth
Video bandwidth:	3 x resolution bandwidth
Span:	2 x emission bandwidth
Trace mode:	Max. hold
Analyzer function:	99% power occupied bandwidth function
EUT:	Modulated signal with max. frequency deviation
Test setup:	See sub clause 7.2 - A
Measurement uncertainty:	See sub clause 9

Limits:

FCC & IC	
941.500 MHz – 952.000 MHz 953.000 MHz – 959.850 MHz	200 kHz

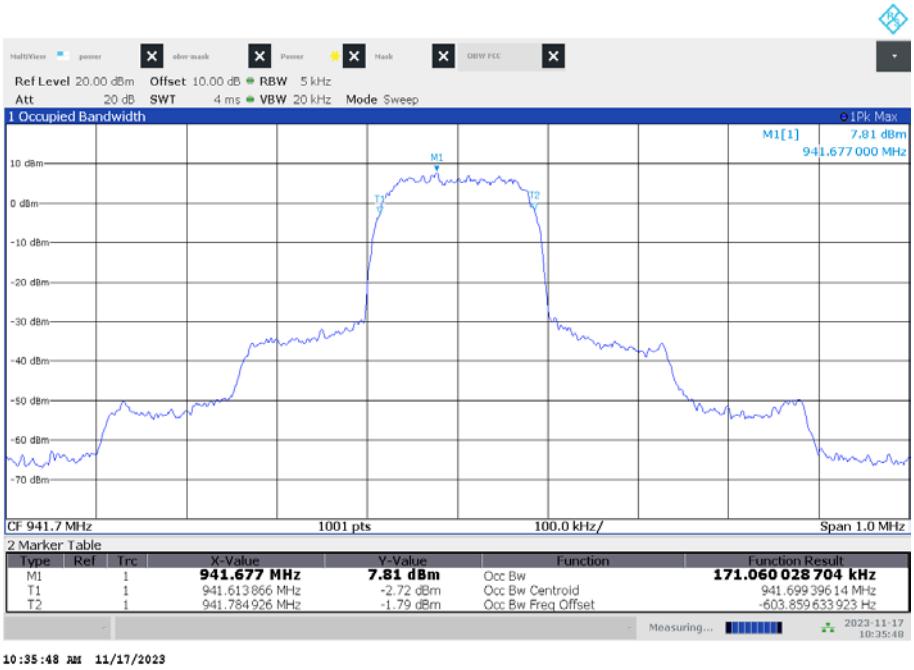
Result:

Normal mode	
Centre frequency (fc)	**OBW**
941.700 MHz	171.060 kHz
946.750 MHz	171.175 kHz
951.800 MHz	171.888 kHz
953.050 MHz	171.408 kHz
956.050 MHz	171.544 kHz
956.650 MHz	170.854 kHz
959.650 MHz	170.589 kHz

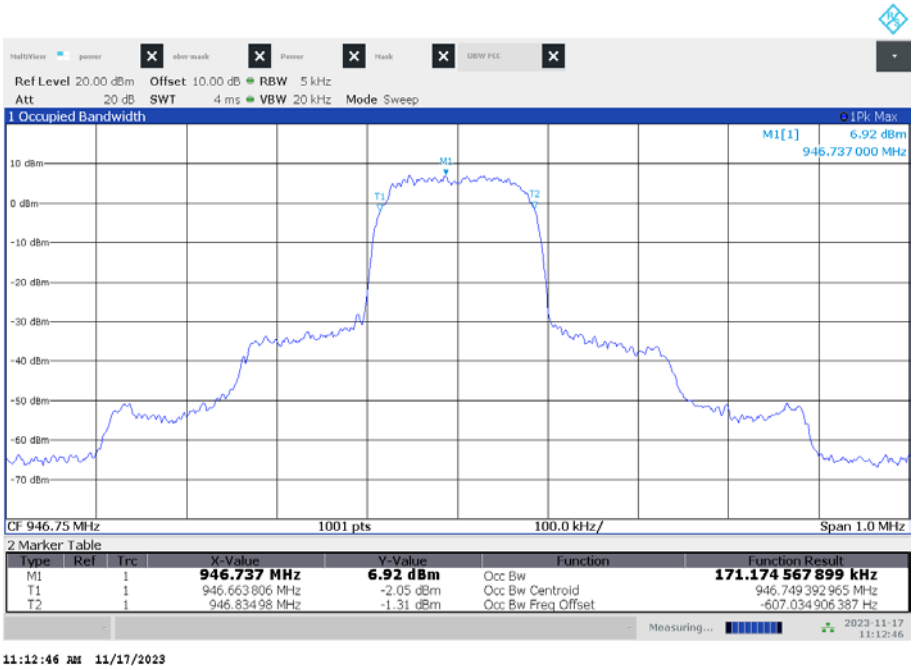
LD-mode	
Centre frequency (fc)	**OBW**
941.700 MHz	142.340 kHz
946.750 MHz	143.733 kHz
951.800 MHz	143.067 kHz
953.050 MHz	142.659 kHz
956.050 MHz	143.937 kHz
956.650 MHz	144.876 kHz
959.650 MHz	142.943 kHz

Plots normal mode:

Plot 1: 941.7 MHz



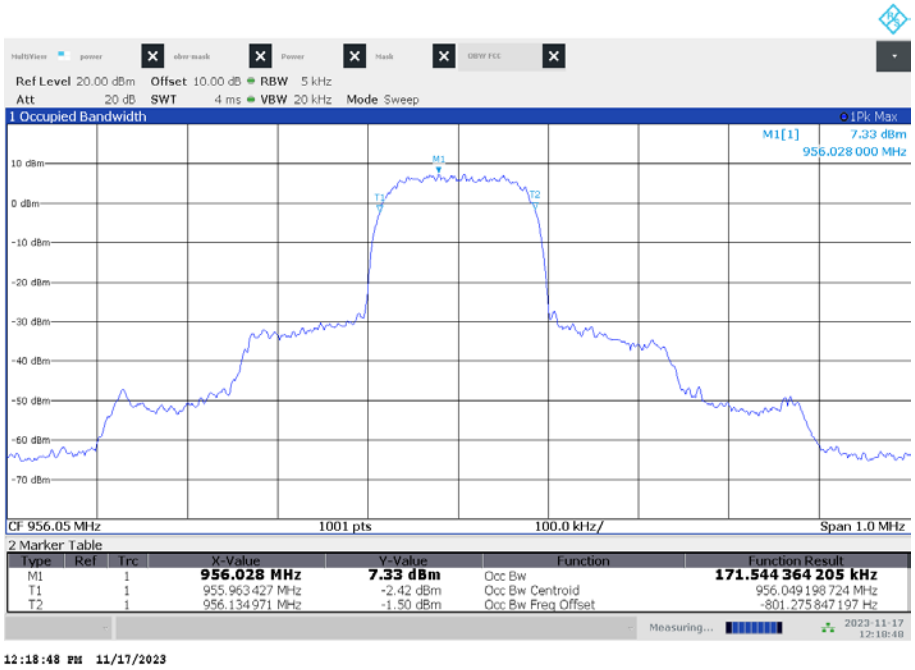
Plot 2: 946.75 MHz



Plot 3: 951.8 MHz

Plot 4: 953.05 MHz

Plot 5: 956.05 MHz

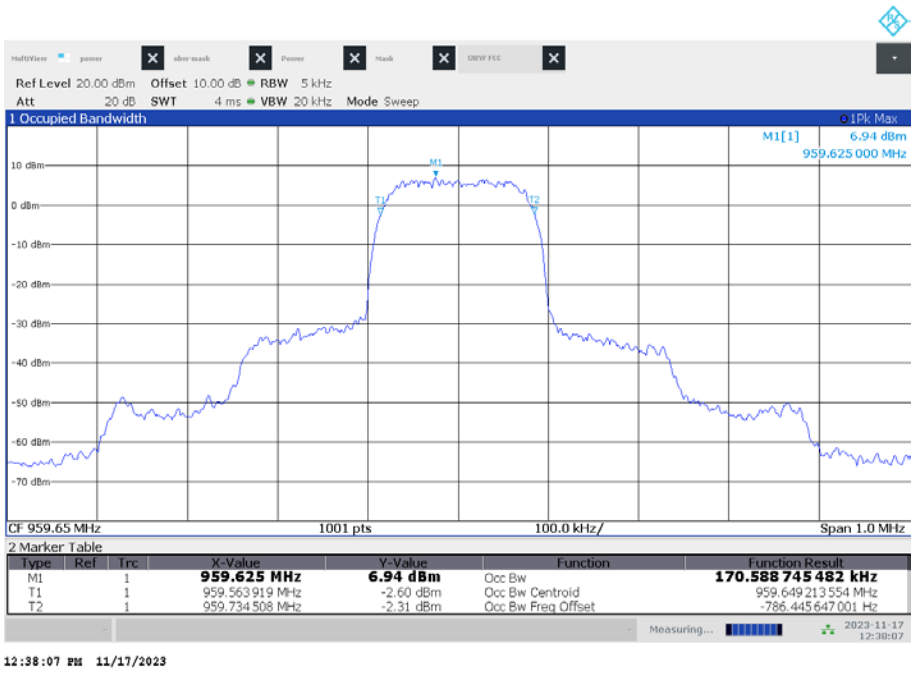


12:18:48 PM 11/17/2023

Plot 6: 956.65 MHz

11:54:02 AM 12/15/2023

Plot 7: 959.65 MHz

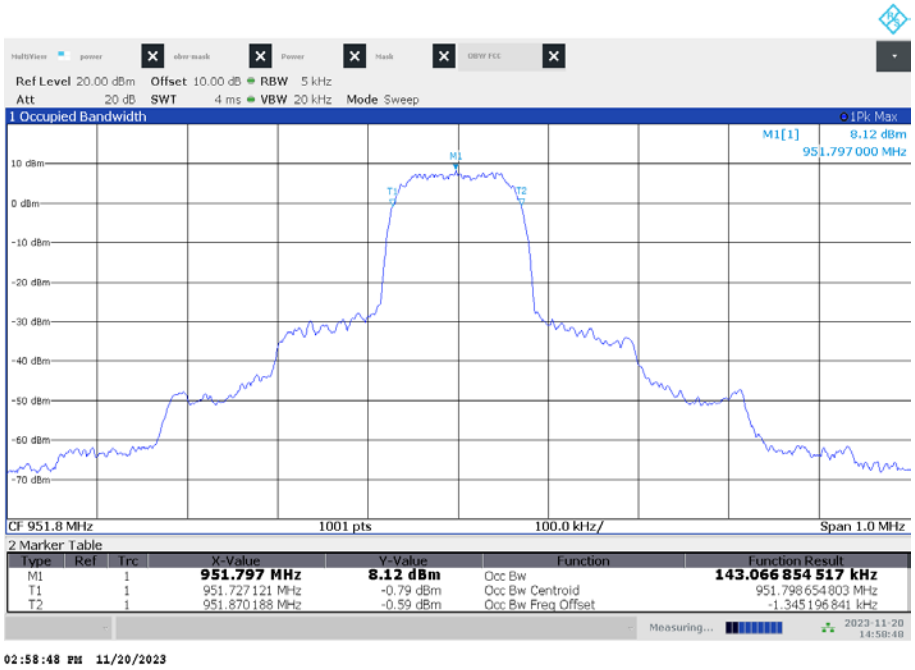


Plots LD mode:

Plot 1: 941.7 MHz

Plot 2: 946.75 MHz

Plot 3: 951.8 MHz

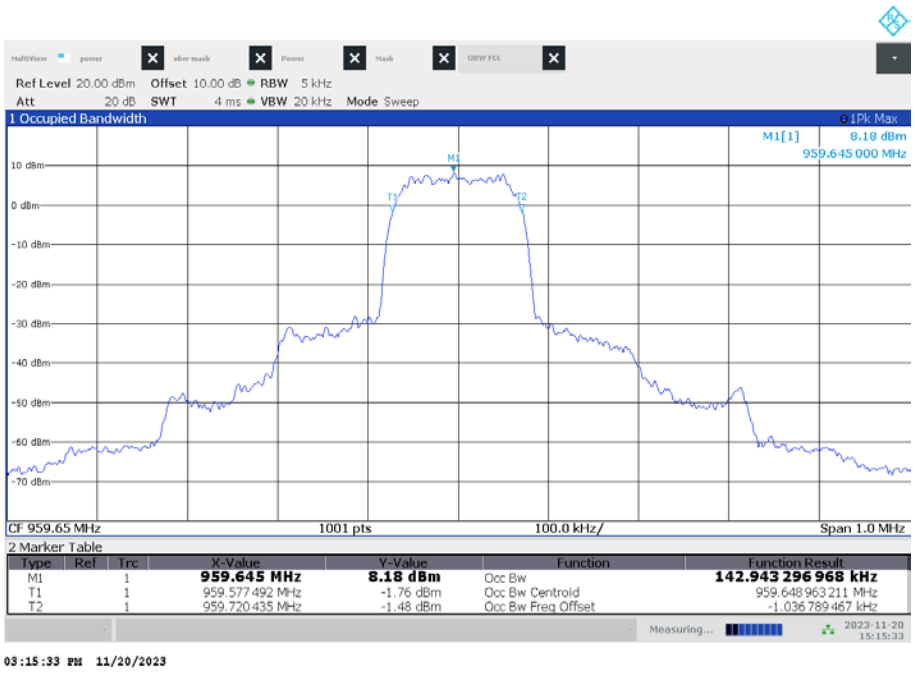


Plot 4: 953.05 MHz

Plot 5: 956.05 MHz

Plot 6: 956.65 MHz

Plot 7: 959.65 MHz



12.3 Transmitter frequency stability

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 Hz / 10 Hz / 100 Hz
Video bandwidth:	3 x resolution bandwidth
Span:	wide enough to follow the frequency drift
Trace mode:	clear/write/view
EUT:	CW signal or MC with measurement method description
Test setup:	See sub clause 7.2 - B
Measurement uncertainty:	See sub clause 9

Limits:

FCC	
941.500 MHz – 944.000 MHz 944.000 MHz – 952.000 MHz 952.850 MHz – 956.250 MHz 956.450 MHz – 959.850 MHz	± 50 ppm
IC	
941.500 MHz – 952.000 MHz 953.000 MHz – 959.850 MHz	± 20 ppm

Results: 941.700 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	941.699143	0.857 / -0.91
-20 °C / V_{nom}	941.699256	0.744 / -0.79
-10 °C / V_{nom}	941.700085	0.085 / 0.09
0 °C / V_{nom}	941.699633	0.367 / -0.39
+10 °C / V_{nom}	941.700122	0.122 / 0.13
+20 °C / V_{nom}	941.699840	0.160 / -0.17
+30 °C / V_{nom}	941.699906	0.094 / -0.10
+40 °C / V_{nom}	941.700424	0.424 / 0.45
+50 °C / V_{nom}	941.699717	0.283 / -0.30
+20 °C / V_{nom} - 15%	941.699812	0.188 / -0.20
+20 °C / V_{nom}	941.699802	0.198 / -0.21
+20 °C / V_{nom} + 15%	941.699991	0.009 / -0.01

Results: 946.750 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	946.749101	0.899 / -0.95
-20 °C / V_{nom}	946.749546	0.454 / -0.48
-10 °C / V_{nom}	946.749290	0.710 / -0.75
0 °C / V_{nom}	946.749375	0.625 / -0.66
+10 °C / V_{nom}	946.749451	0.549 / -0.58
+20 °C / V_{nom}	946.749593	0.407 / -0.43
+30 °C / V_{nom}	946.749517	0.483 / -0.51
+40 °C / V_{nom}	946.749792	0.208 / -0.22
+50 °C / V_{nom}	946.748968	1.032 / -1.09
+20 °C / V_{nom} - 15%	946.749602	0.398 / -0.42
+20 °C / V_{nom}	946.749924	0.076 / -0.08
+20 °C / V_{nom} + 15%	946.749375	0.625 / -0.66

Results: 951.800 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	951.798867	1.133 / -1.19
-20 °C / V_{nom}	951.799762	0.238 / -0.25
-10 °C / V_{nom}	951.799676	0.324 / -0.34
0 °C / V_{nom}	951.799258	0.742 / -0.78
+10 °C / V_{nom}	951.799305	0.695 / -0.73
+20 °C / V_{nom}	951.799867	0.133 / -0.14
+30 °C / V_{nom}	951.800086	0.086 / 0.09
+40 °C / V_{nom}	951.799610	0.390 / -0.41
+50 °C / V_{nom}	951.800067	0.067 / 0.07
+20 °C / V_{nom} - 15%	951.799515	0.485 / -0.51
+20 °C / V_{nom}	951.799419	0.267 / -0.28
+20 °C / V_{nom} + 15%	951.799733	1.133 / -1.19

Results: 953.050 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	953.049495	0.505 / -0.53
-20 °C / V_{nom}	953.049152	0.848 / -0.89
-10 °C / V_{nom}	953.049523	0.477 / -0.50
0 °C / V_{nom}	953.049381	0.619 / -0.65
+10 °C / V_{nom}	953.050105	0.105 / 0.11
+20 °C / V_{nom}	953.049647	0.353 / -0.37
+30 °C / V_{nom}	953.050181	0.181 / 0.19
+40 °C / V_{nom}	953.050762	0.762 / 0.80
+50 °C / V_{nom}	953.049619	0.381 / -0.40
+20 °C / V_{nom} - 15%	953.049457	0.543 / -0.57
+20 °C / V_{nom}	953.049848	0.600 / -0.63
+20 °C / V_{nom} + 15%	953.049400	0.505 / -0.53

Results: 956.050 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	956.049331	0.669 / -0.70
-20 °C / V_{nom}	956.048834	1.166 / -1.22
-10 °C / V_{nom}	956.049054	0.946 / -0.99
0 °C / V_{nom}	956.048862	1.138 / -1.19
+10 °C / V_{nom}	956.049551	0.449 / -0.47
+20 °C / V_{nom}	956.049981	0.019 / -0.02
+30 °C / V_{nom}	956.049675	0.325 / -0.34
+40 °C / V_{nom}	956.049627	0.373 / -0.39
+50 °C / V_{nom}	956.049675	0.325 / -0.34
+20 °C / V_{nom} - 15%	956.049570	0.430 / -0.45
+20 °C / V_{nom}	956.049541	0.306 / -0.32
+20 °C / V_{nom} + 15%	956.049694	0.669 / -0.70

Results: 956.650 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	956.649483	0.517 / -0.54
-20 °C / V_{nom}	956.649369	0.631 / -0.66
-10 °C / V_{nom}	956.649378	0.622 / -0.65
0 °C / V_{nom}	956.649608	0.392 / -0.41
+10 °C / V_{nom}	956.649837	0.163 / -0.17
+20 °C / V_{nom}	956.649914	0.086 / -0.09
+30 °C / V_{nom}	956.650153	0.153 / 0.16
+40 °C / V_{nom}	956.649493	0.507 / -0.53
+50 °C / V_{nom}	956.649751	0.249 / -0.26
+20 °C / V_{nom} - 15%	956.650019	0.019 / 0.02
+20 °C / V_{nom}	956.649359	0.823 / -0.86
+20 °C / V_{nom} + 15%	956.649177	0.517 / -0.54

Results: 959.650 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	959.648656	1.344 / -1.40
-20 °C / V_{nom}	959.649136	0.864 / -0.90
-10 °C / V_{nom}	959.649194	0.806 / -0.84
0 °C / V_{nom}	959.649837	0.163 / -0.17
+10 °C / V_{nom}	959.649415	0.585 / -0.61
+20 °C / V_{nom}	959.650202	0.202 / 0.21
+30 °C / V_{nom}	959.649712	0.288 / -0.30
+40 °C / V_{nom}	959.649789	0.211 / -0.22
+50 °C / V_{nom}	959.649760	0.240 / -0.25
+20 °C / V_{nom} - 15%	959.649309	0.691 / -0.72
+20 °C / V_{nom}	959.649683	0.019 / -0.02
+20 °C / V_{nom} + 15%	959.649981	1.344 / -1.40

12.4 Transmitter unwanted emissions (radiated)

Measurement:

Measurement parameter	
Detector:	Peak (prescan) / RMS
Sweep time:	Auto
Resolution bandwidth:	25 MHz to 30 MHz 9 kHz to 10 kHz 30 MHz to 1 000 MHz 100 kHz > 1 000 MHz 1 MHz
Video bandwidth:	3 * RBW
Span:	100 MHz steps!
Trace-Mode:	Max. hold
EUT:	MC with max frequency deviation
Used equipment:	See chapter 7.1- A / B
Measurement uncertainty:	See chapter 9

Limits:

Max. spurious level FCC & IC (according to ETSI EN 300 422-1 v1.4.2 (2011-08))			
State	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1000 MHz	All frequencies > 1000 MHz
Operating	4.0 nW	250 nW	1.00 µW
Standby	2.0 nW	2.0 nW	20.0 nW

FCC & IC	
The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:	
On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least	25 dB
On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth	35 dB
On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least	43 + 10log10 (mean output power in watts) dB

Results:

normal mode:

carrier frequency	unwanted emission frequency (MHz)	Limit	level (dB) / (dBm) or remark
941.700 MHz	all detected emissions are more than 10 dB below the limit.*		
946.750 MHz			
951.800 MHz			
953.050 MHz			
956.050 MHz			
956.650 MHz			
959.650 MHz			

LD mode:

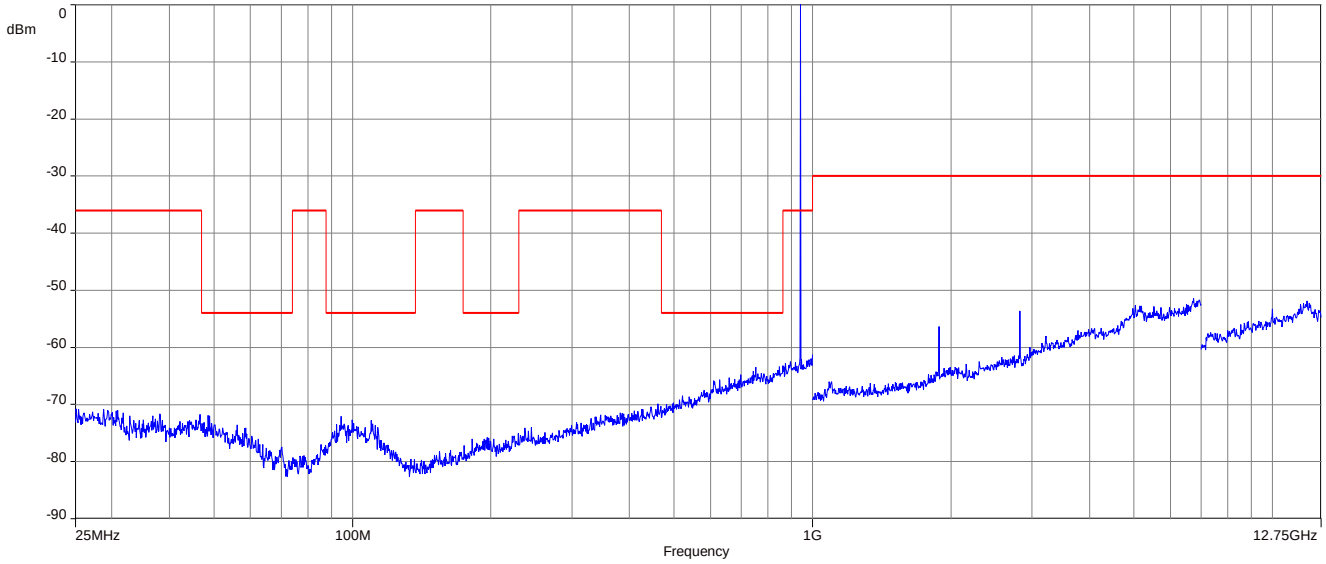
carrier frequency	unwanted emission frequency (MHz)	Limit	level (dB) / (dBm) or remark
941.700 MHz	all detected emissions are more than 10 dB below the limit.*		
946.750 MHz			
951.800 MHz			
953.050 MHz			
956.050 MHz			
956.650 MHz			
959.650 MHz			

*) peaks @ 800 MHz not caused by EUT.

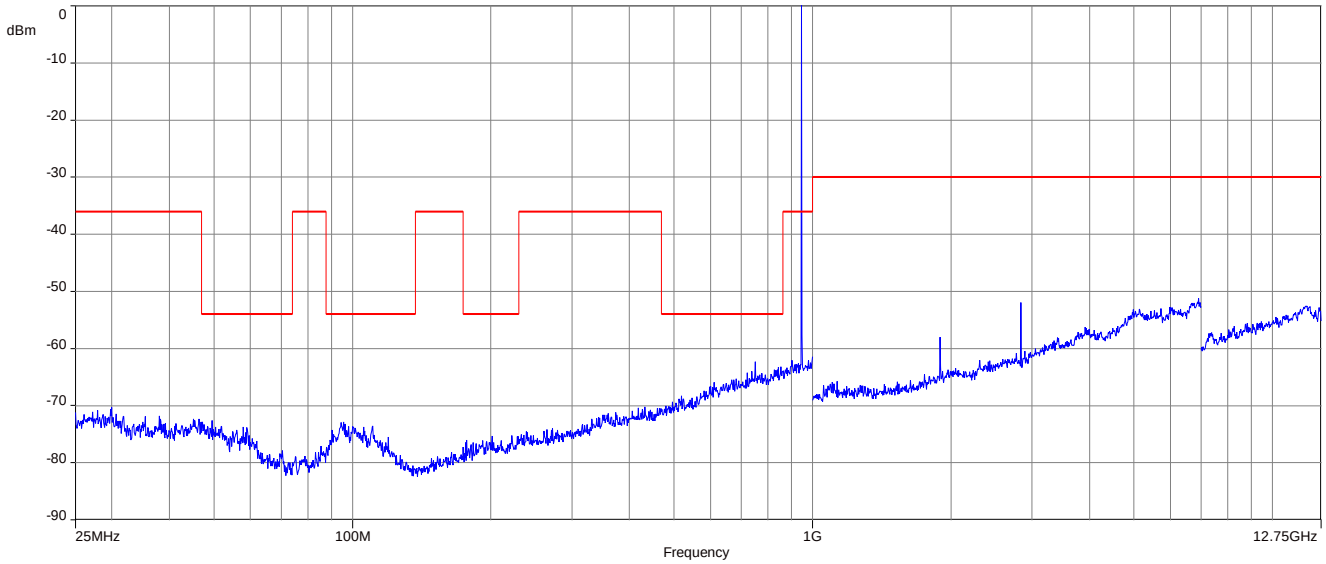
Plots: radiated

normal mode:

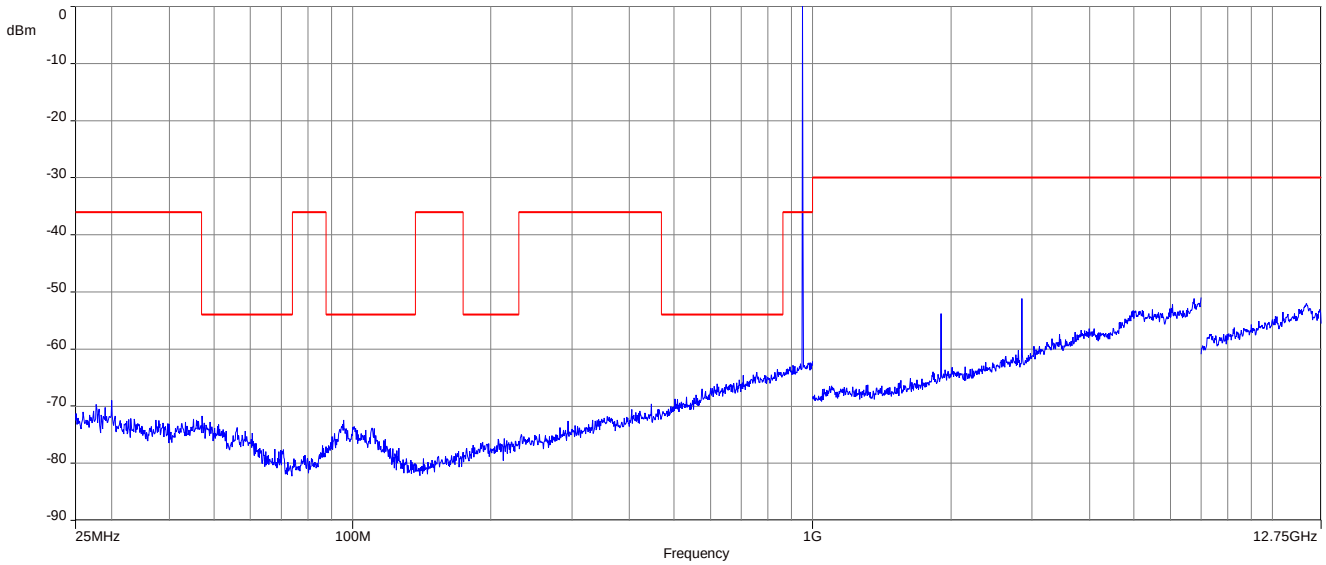
Plot 1: 941.70 MHz, 25 MHz – 12.75 GHz



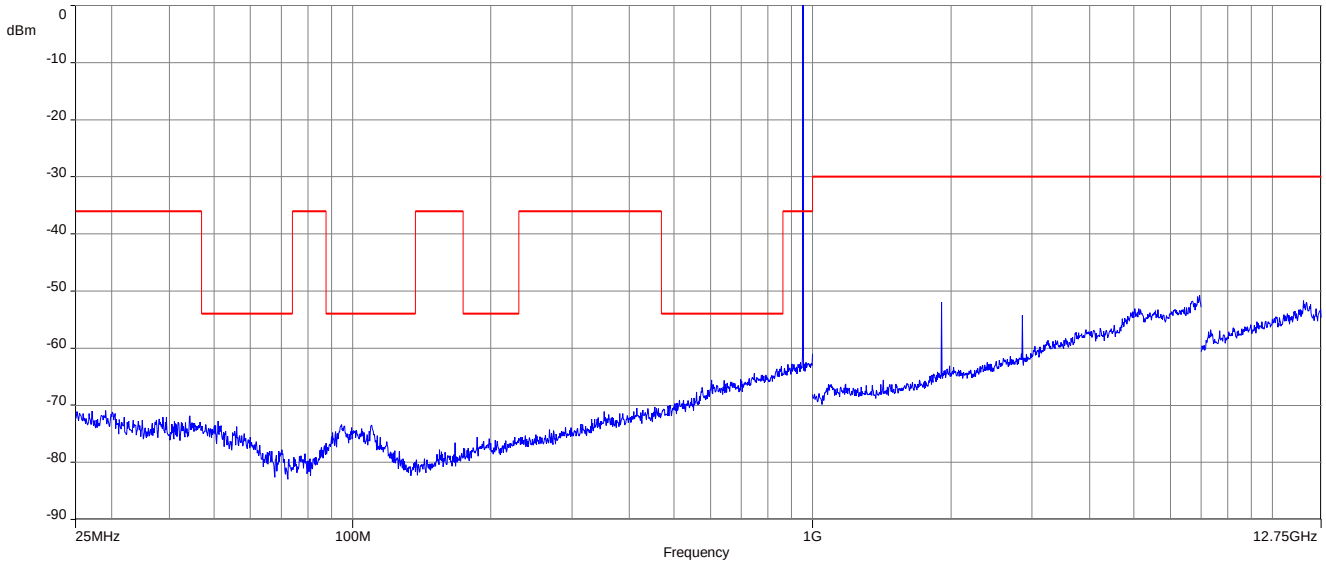
Plot 2: 946.75 MHz, 25 MHz – 12.75 GHz



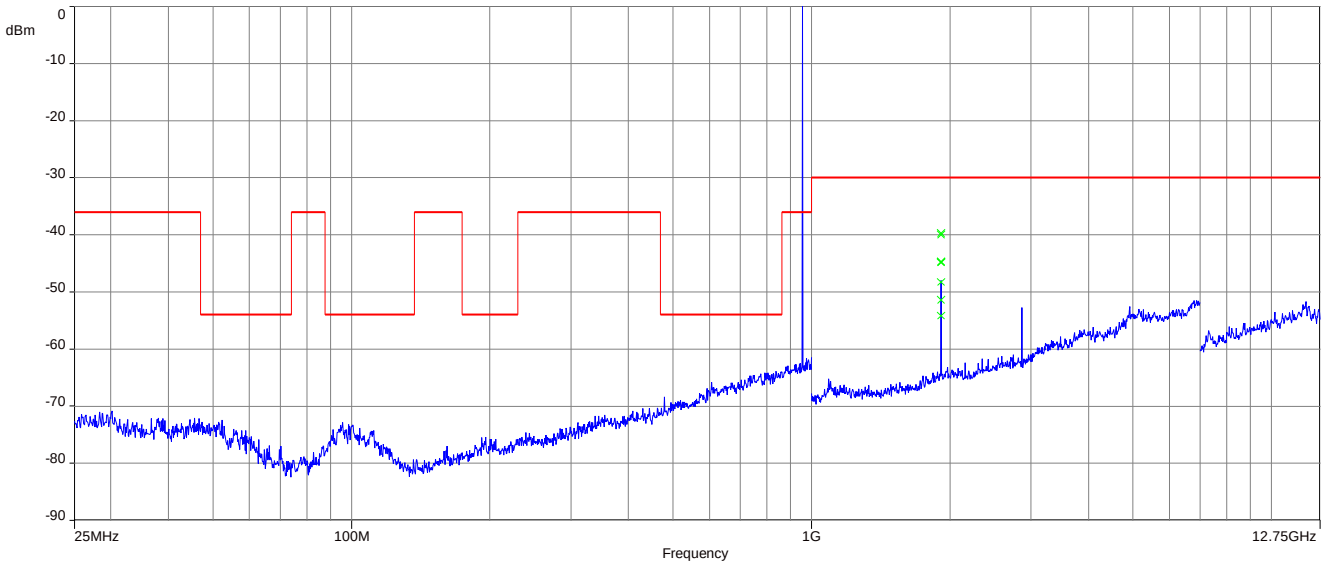
Plot 3: 951.80 MHz, 25 MHz – 12.75 GHz



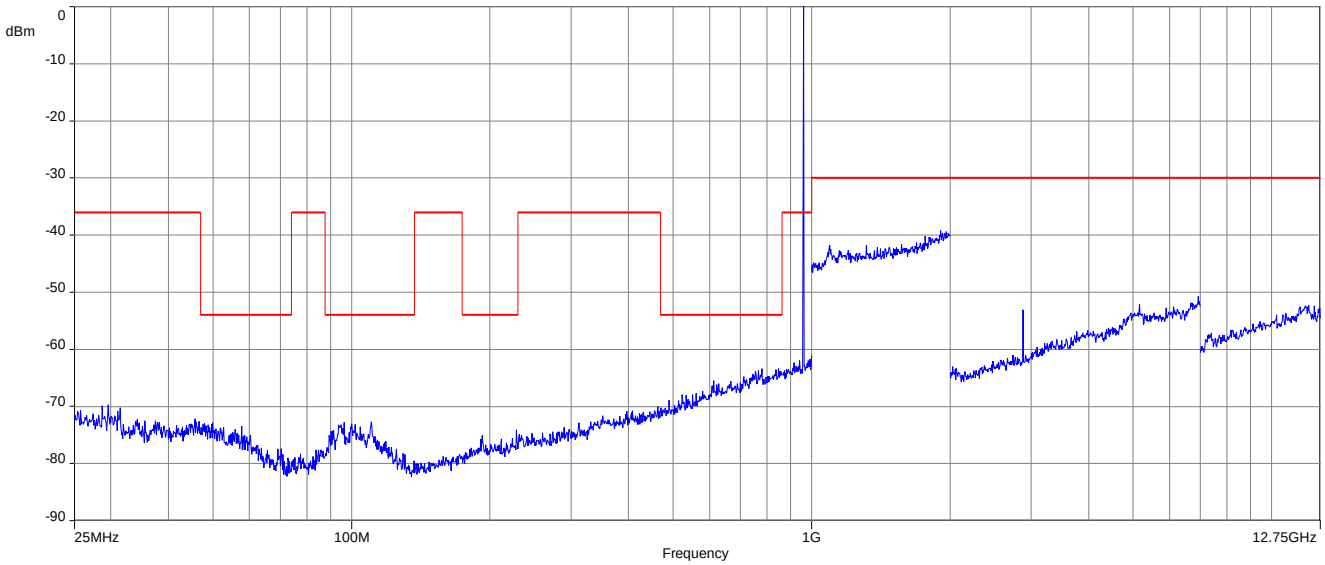
Plot 4: 953.05 MHz, 25 MHz – 12.75 GHz



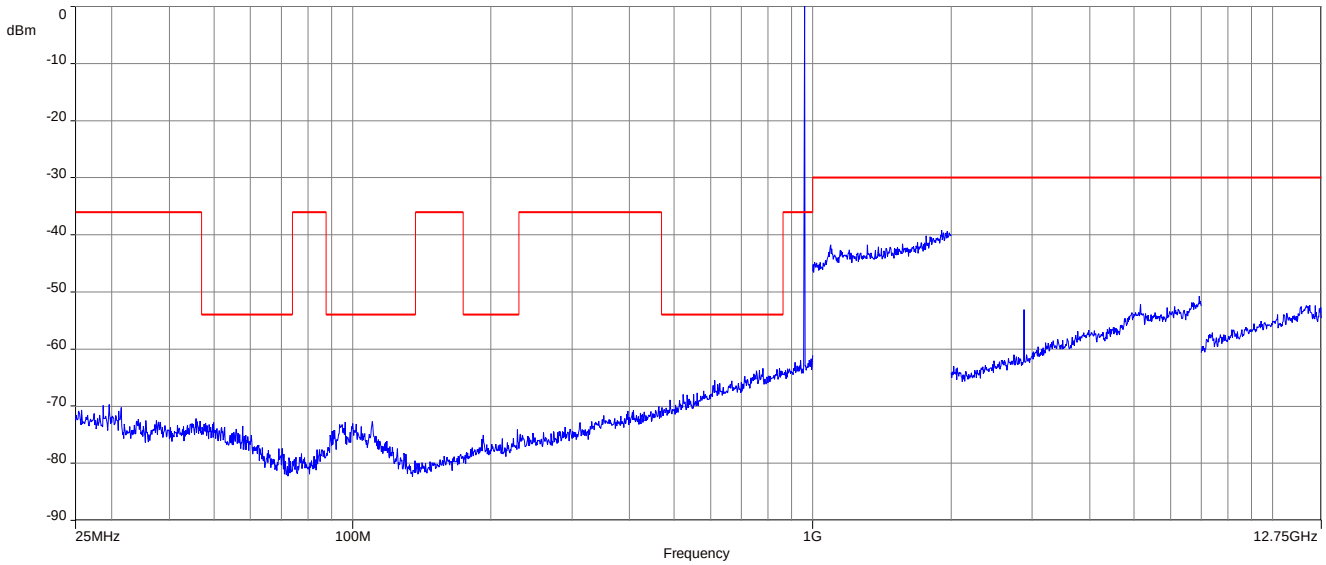
Plot 5: 956.05 MHz, 25 MHz – 12.75 GHz



Plot 6: 956.65 MHz, 25 MHz – 12.75 GHz

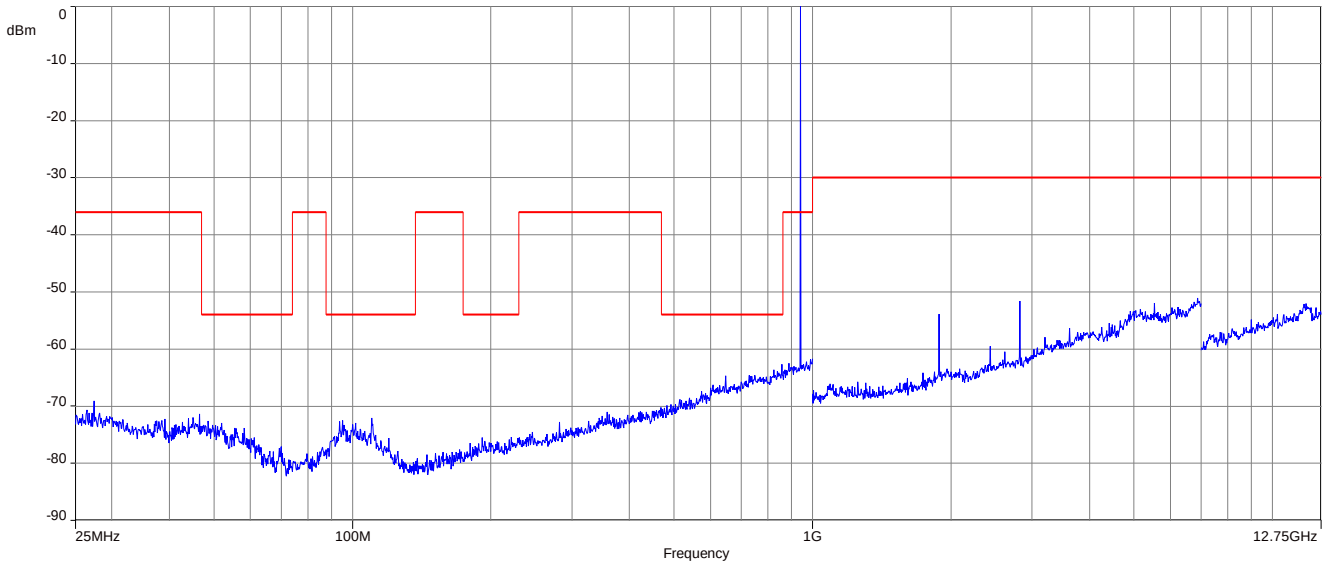


Plot 7: 959.65 MHz, 25 MHz – 12.75 GHz

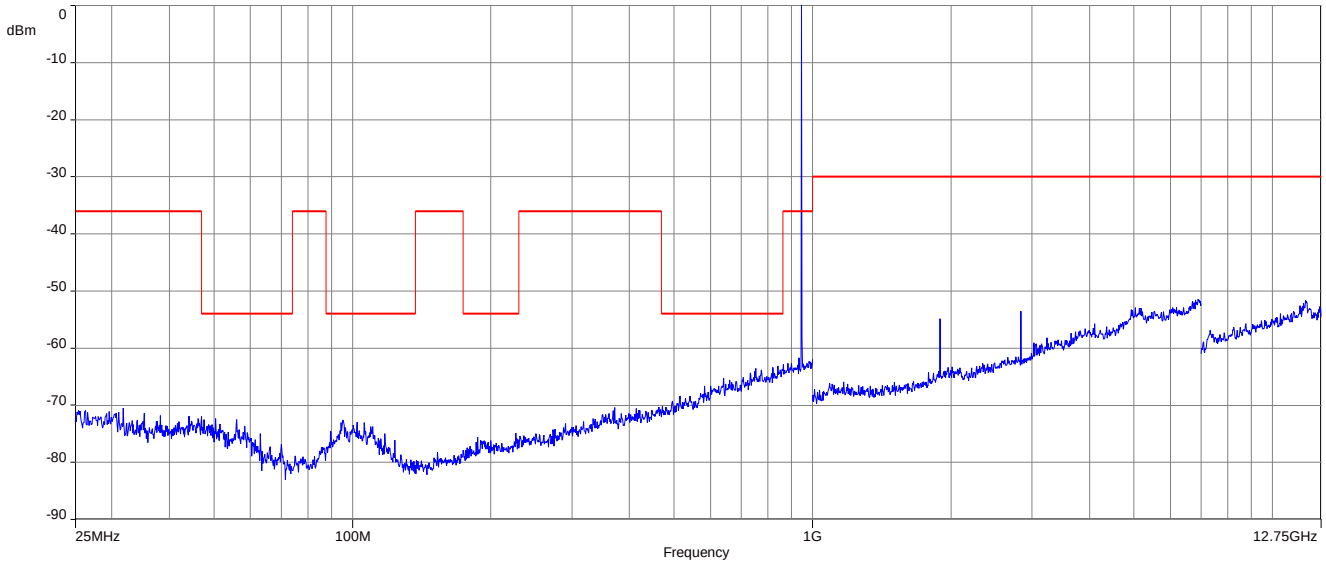


LD mode:

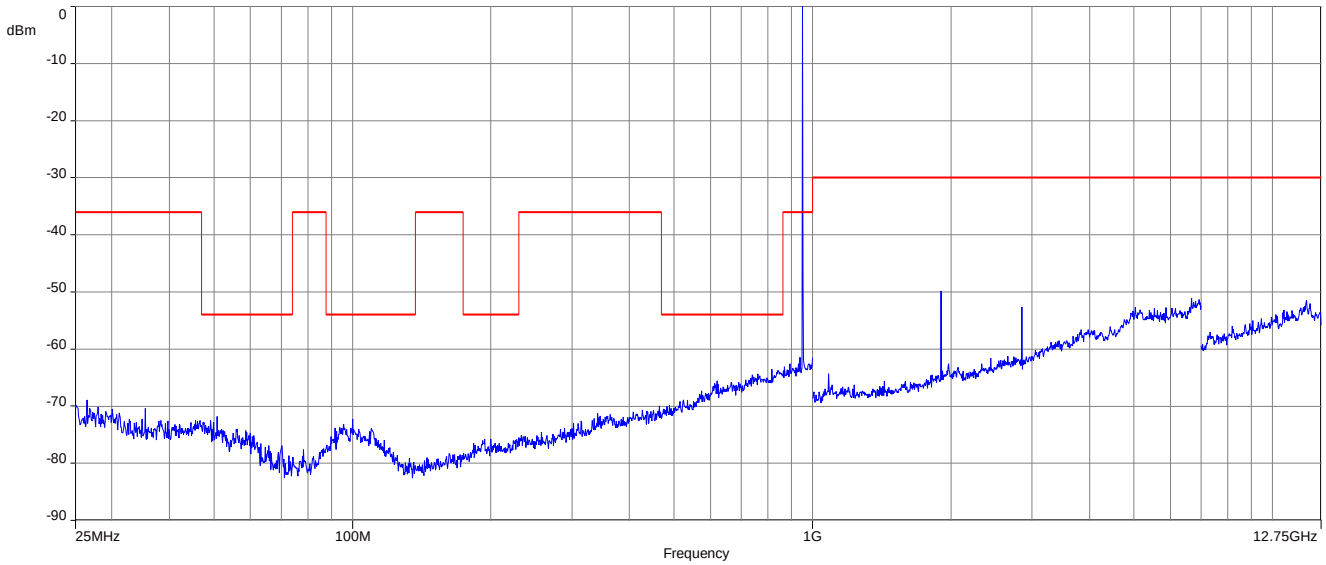
Plot 1: 941.70 MHz, 25 MHz – 12.75 GHz



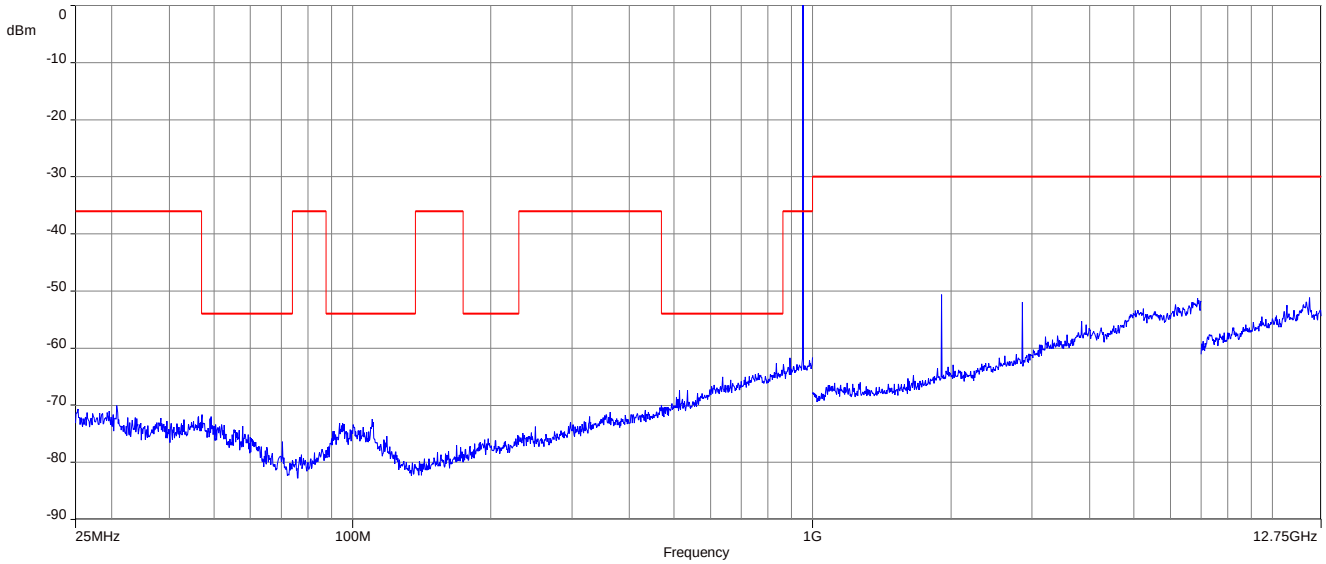
Plot 2: 946.75 MHz, 25 MHz – 12.75 GHz



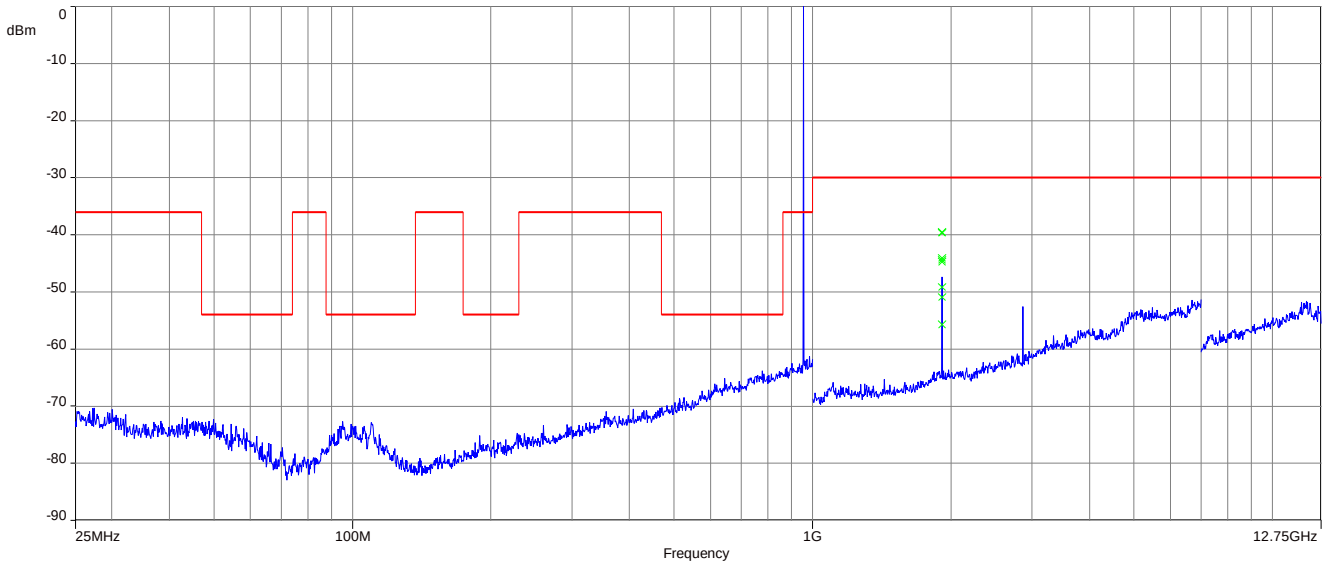
Plot 3: 951.80 MHz, 25 MHz – 12.75 GHz



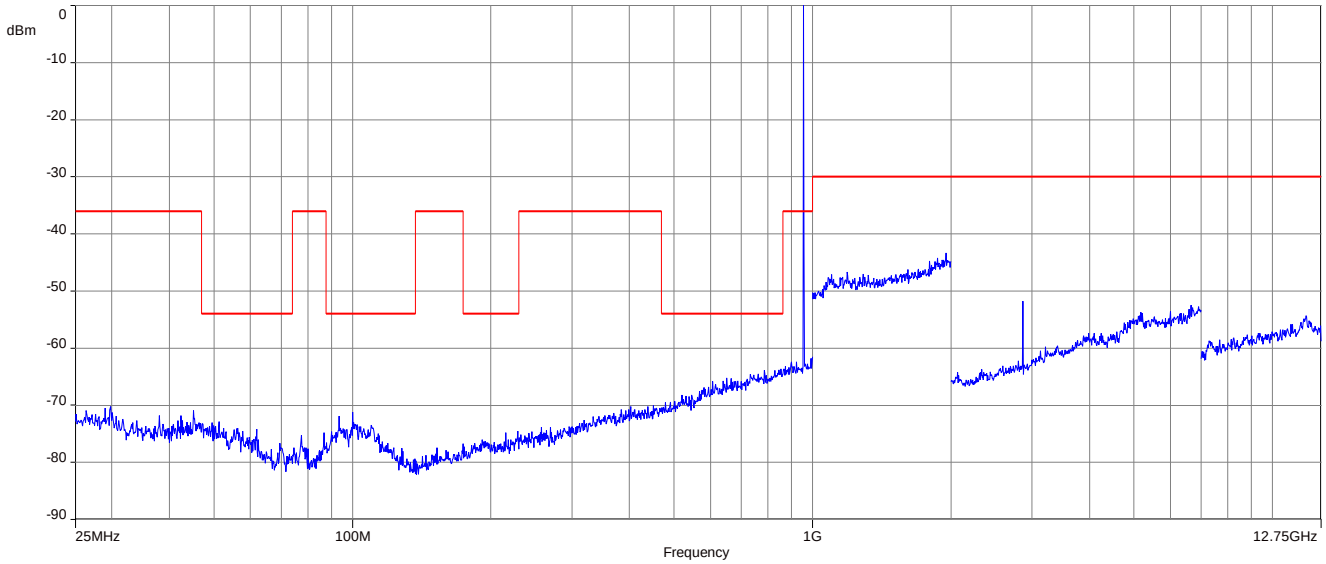
Plot 4: 953.05 MHz, 25 MHz – 12.75 GHz



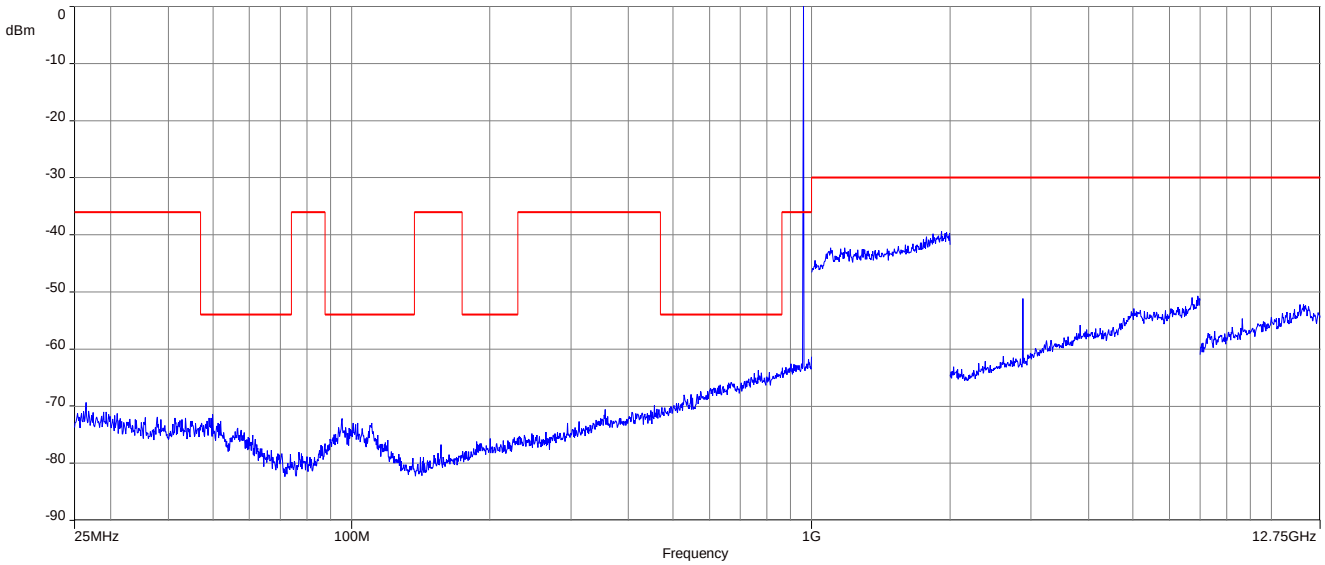
Plot 5: 956.05 MHz, 25 MHz – 12.75 GHz



Plot 6: 956.65 MHz, 25 MHz – 12.75 GHz



Plot 7: 959.65 MHz, 25 MHz – 12.75 GHz



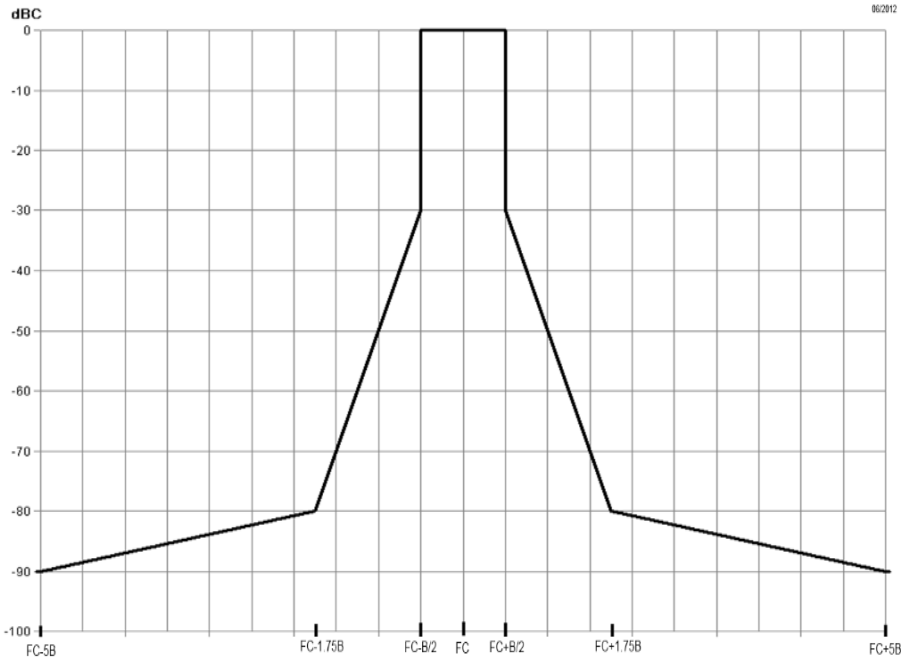
12.5 Necessary bandwidth (BN) for digital systems

Measurement:

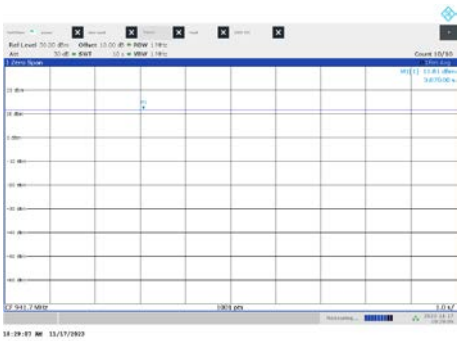
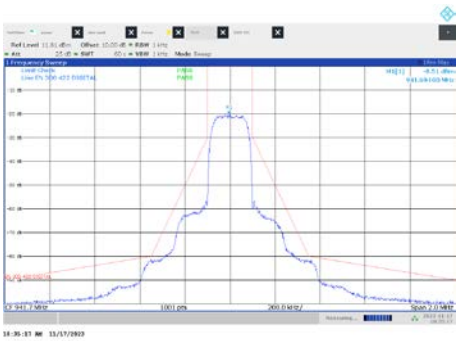
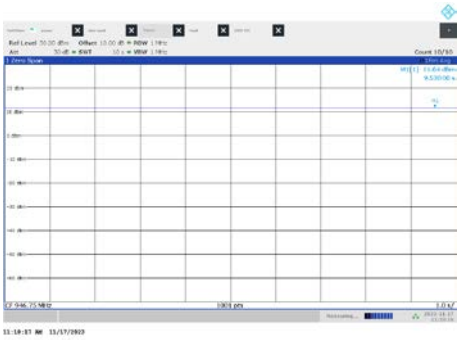
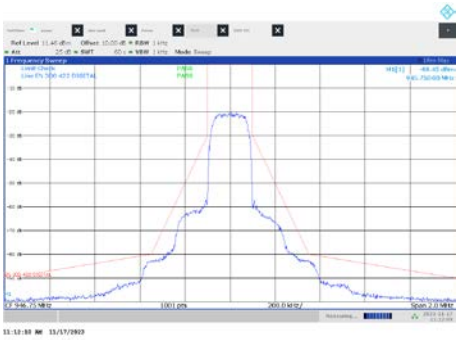
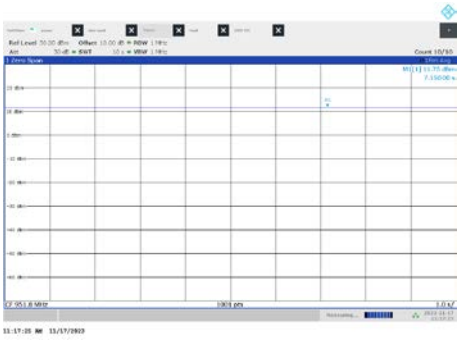
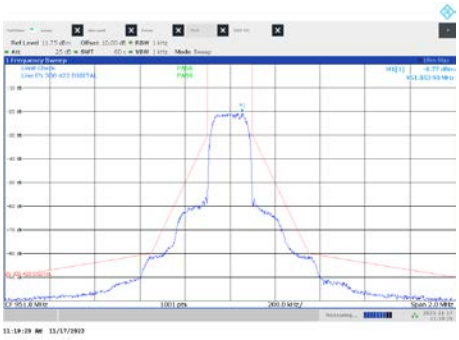
Measurement parameter	
Detector:	Peak / Average (-90 dBc point only)
Sweep time:	Auto
Resolution bandwidth:	1 kHz
Video bandwidth:	1 kHz
Span:	fc - 1 MHz to fc + 1 MHz (2 MHz)
Trace mode:	Max hold/view
EUT:	CW and MC
Test setup:	See sub clause 7.2 - A
Measurement uncertainty:	See sub clause 9

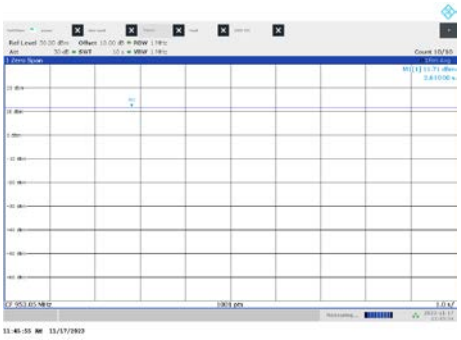
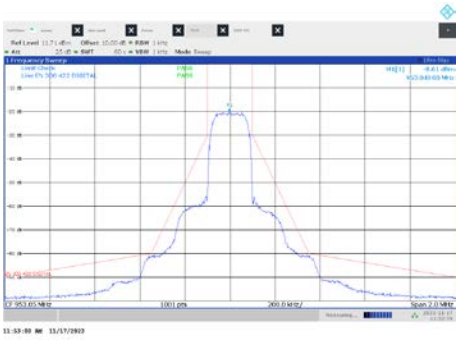
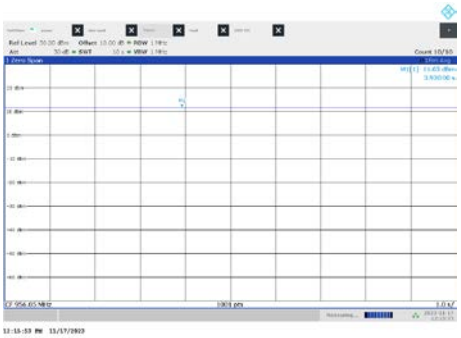
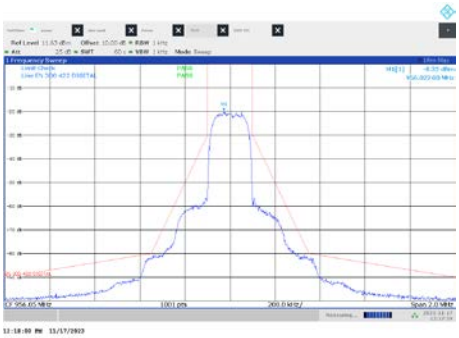
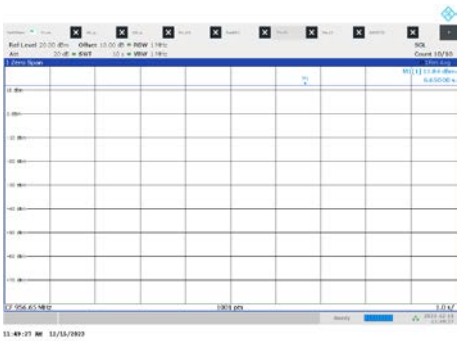
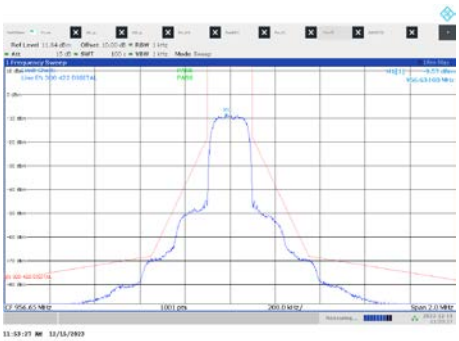
Limits: according to ETSI EN 300 422-1 v1.4.2

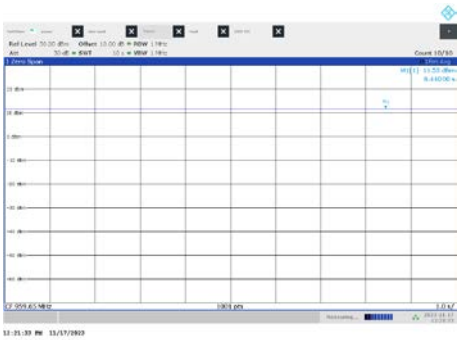
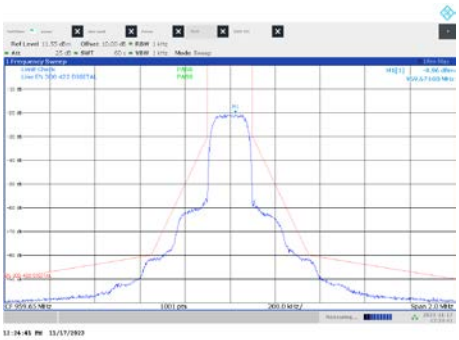
FCC & IC
Signal within the spectrum mask:



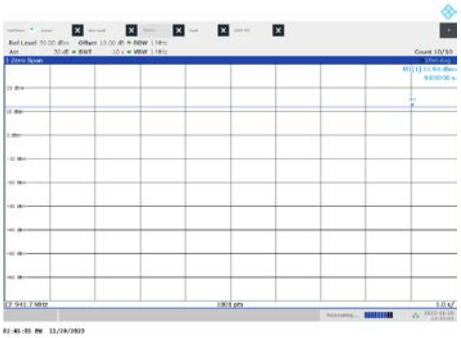
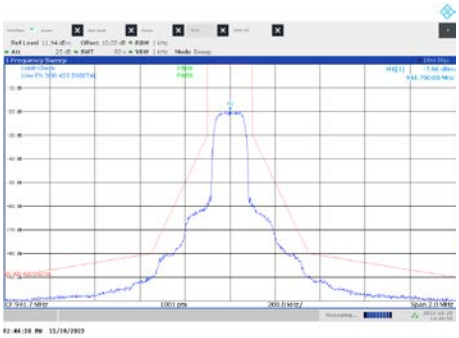
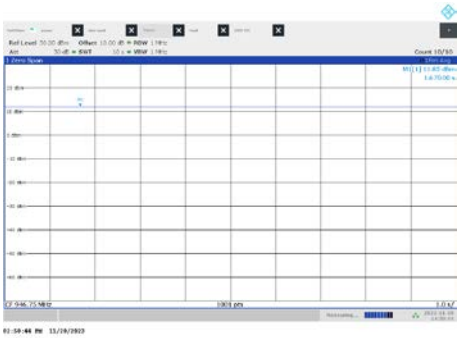
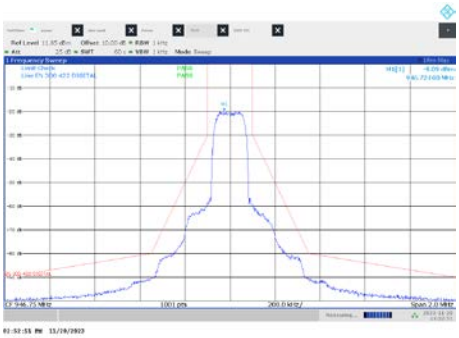
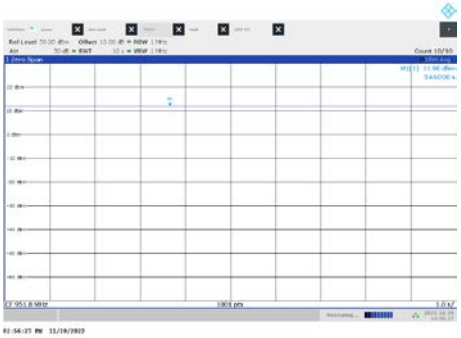
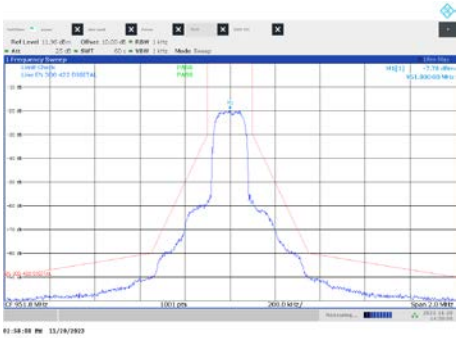
Plots normal mode:

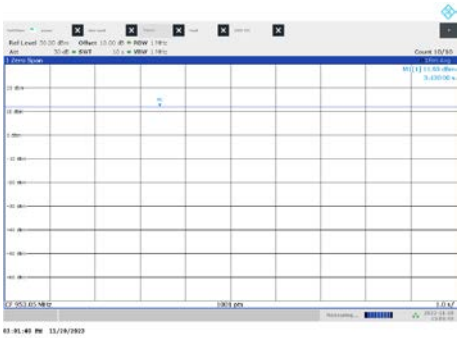
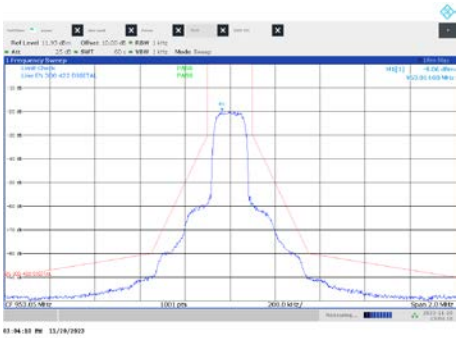
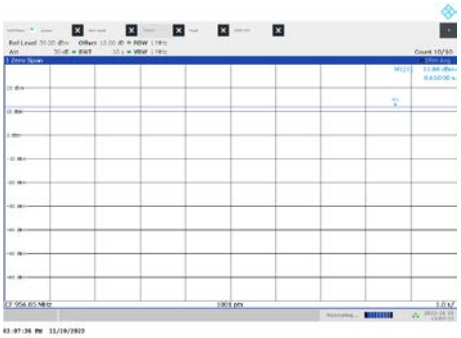
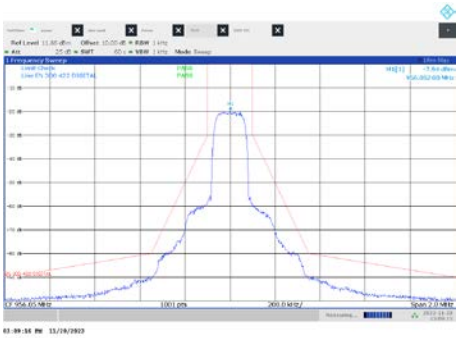
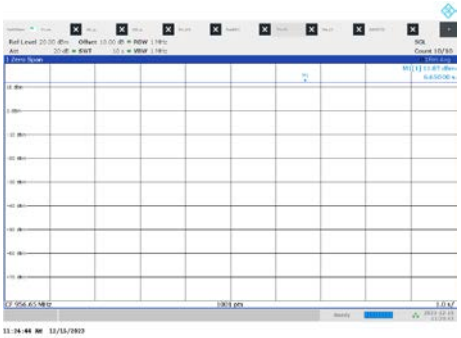
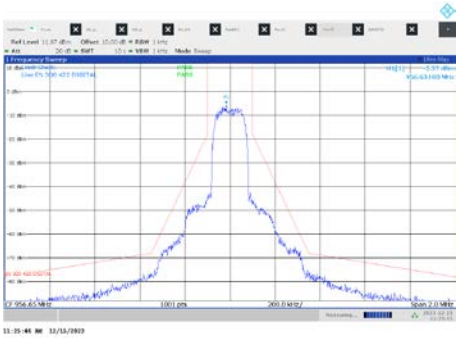
Frequency	Carrier power	Modulated carrier
941.70 MHz		
946.75 MHz		
951.80 MHz		

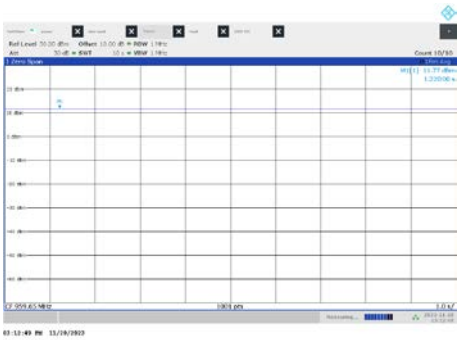
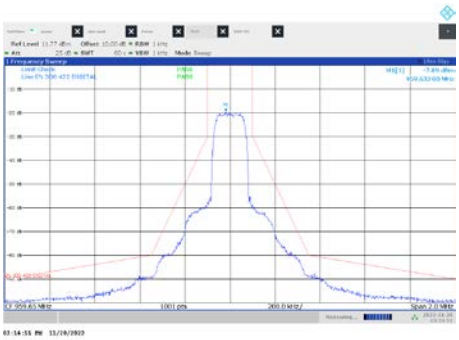
Frequency	Carrier power	Modulated carrier
953.05 MHz		
956.05 MHz		
956.65 MHz		

959.65 MHz		

Plots LD mode:

Frequency	Carrier power	Modulated carrier
941.70 MHz		
946.75 MHz		
951.80 MHz		

Frequency	Carrier power	Modulated carrier
953.05 MHz		
956.05 MHz		
956.65 MHz		

959.65 MHz		

12.6 Conducted limits

Measurement:

Measurement of the conducted spurious emissions for an intentional radiator that is designed to be connected to the public utility (AC) power line. Measurement performed according to ANSI C63.10, chapter 6.2

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

Limit:

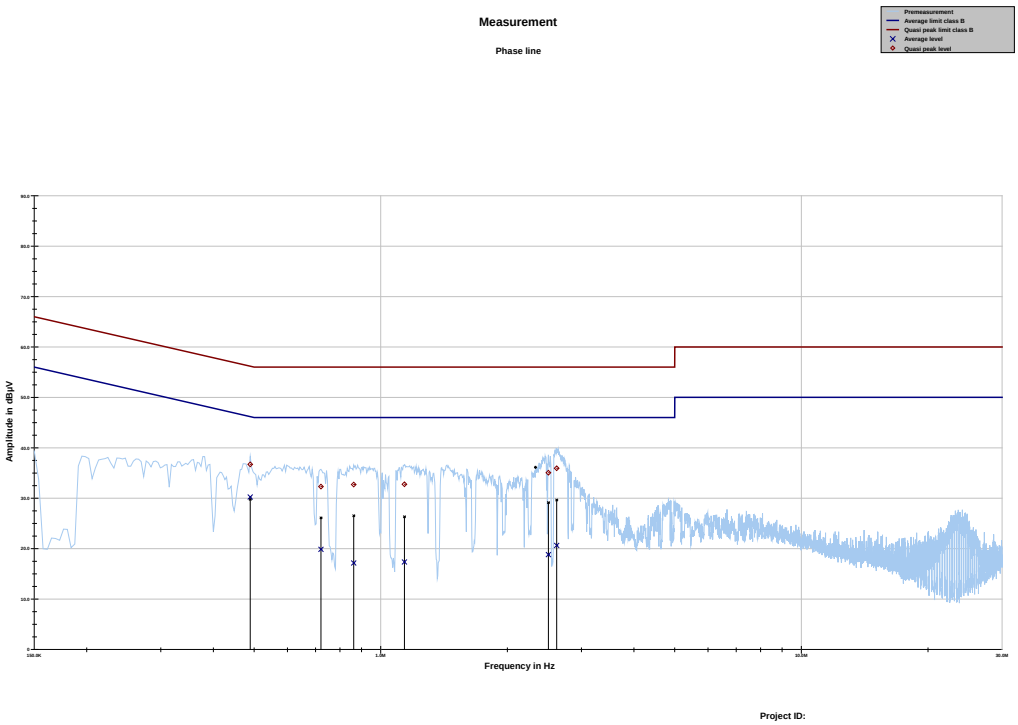
FCC & IC		
Frequency / MHz	Quasi-peak / (dBµV/m)	Average / (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

Result:

see table below plots

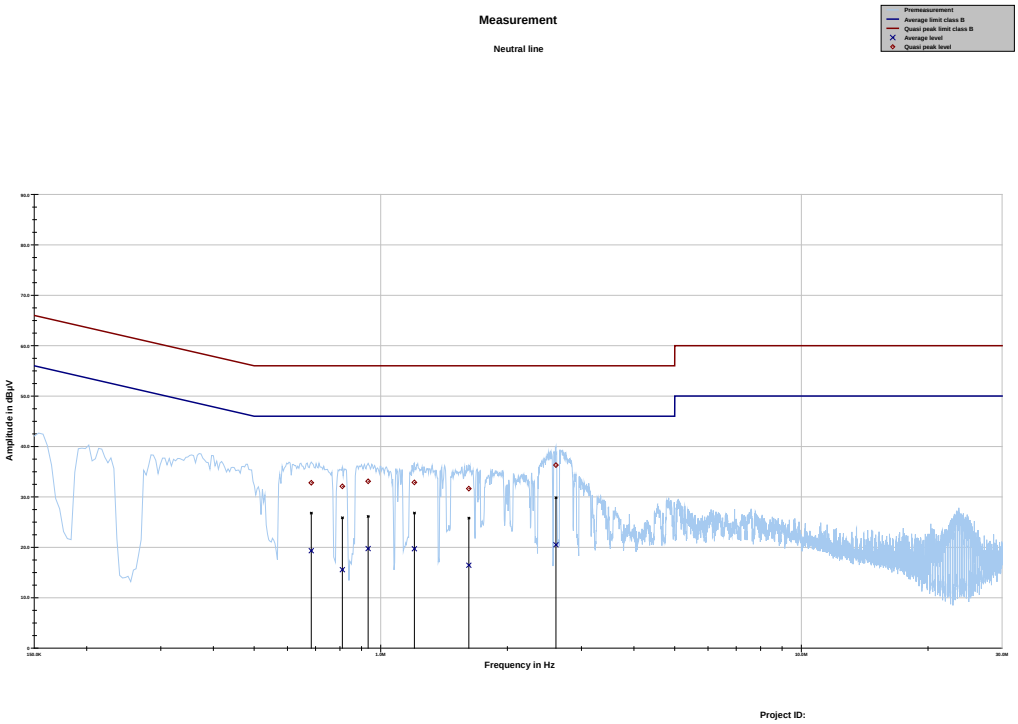
Plots:

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
0.489544	36.71	19.46	56.176	30.23	16.07	46.299
0.720881	32.30	23.70	56.000	19.85	26.15	46.000
0.862669	32.71	23.29	56.000	17.15	28.85	46.000
1.138781	32.76	23.24	56.000	17.35	28.65	46.000
2.504419	35.06	20.94	56.000	18.81	27.19	46.000
2.620087	35.94	20.06	56.000	20.64	25.36	46.000

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
0.683569	32.79	23.21	56.000	19.32	26.68	46.000
0.810431	32.10	23.90	56.000	15.55	30.45	46.000
0.933562	33.08	22.92	56.000	19.74	26.26	46.000
1.202212	32.87	23.13	56.000	19.71	26.29	46.000
1.620113	31.63	24.37	56.000	16.45	29.55	46.000
2.608894	36.30	19.70	56.000	20.50	25.50	46.000

13 Observations

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

14 Glossary

AVG	Average
C	Compliant
C/N$_0$	Carrier to noise-density ratio, expressed in dB-Hz
CAC	Channel availability check
CW	Clean wave
DC	Duty cycle
DFS	Dynamic frequency selection
DSSS	Dynamic sequence spread spectrum
DUT	Device under test
EN	European Standard
ETSI	European Telecommunications Standards Institute
EMC	Electromagnetic Compatibility
EUT	Equipment under test
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
FHSS	Frequency hopping spread spectrum
FVIN	Firmware version identification number
GNSS	Global Navigation Satellite System
GUE	GNSS User Equipment
HMN	Host marketing name
HVIN	Hardware version identification number
HW	Hardware
IC	Industry Canada
Inv. No.	Inventory number
MC	Modulated carrier
NA	Not applicable
NC	Not compliant
NOP	Non occupancy period
NP	Not performed
OBW	Occupied bandwidth
OC	Operating channel
OCW	Operating channel bandwidth
OFDM	Orthogonal frequency division multiplexing
OOB	Out of band
OP	Occupancy period
PER	Packet error rate
PMN	Product marketing name
PP	Positive peak
QP	Quasi peak
RLAN	Radio local area network
S/N or SN	Serial number
SW	Software
UUT	Unit under test
WLAN	Wireless local area network

15 Document history

Version	Applied changes	Date of release
-/-	Initial release	2024-01-03

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