DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-00

LENHARDT WORLDWIDE | TESTING | CERTIFICATION

Bundesnetzagentur BNetzA-CAB-21/21-21

Test Report

Test report no.: 23048703-36022-3
Date of issue: 2025-05-17

Test result: The test item **- passed - and complies** with below listed standards.

Applicant
InnoSenT GmbH

Manufacturer
InnoSenT GmbH

Test Item
IDR-2050

RF-Spectrum Testing according to:

FCC 47 CFR Part 15
Radio Frequency Devices – Subpart C
§15.255 Operation within the bands 57 – 71 GHz

RSS-210, Issue 11 (2024-06)
Licence-Exempt Radio Apparatus: Category I

RSS-Gen, Issue 5 (2018-04)
General Requirements for Compliance of Radio Apparatus

Tested by (name, function, signature)	*Sebastian Janoschka* *Head of Department RF*	signature
Approved by (name, function, signature)	*Karsten Geraldy* *Lab Manager RF*	signature

Applicant and Test item details	
Applicant	InnoSenT GmbH Am Roedertor 30 97499, Donnersdorf, Germany Fon: +49-9528-9518-0
Manufacturer	InnoSenT GmbH Am Roedertor 30 97499, Donnersdorf, Germany
Test item description	Short Range Radar Device
Model/Type reference	IDR-2050
Standard specific information	
FCC ID	UXS-IDR-2050
IC	6902A-IDR2050
HMN	N/A
PMN	IDR-2050
HVIN	IDR-2050
FVIN	1.229
Technology	FDS – Field Disturbance Sensor / SRRD – Short Range Radar Device
Frequency	58 GHz to 61.5 GHz
Antenna	integrated patch antenna
Power supply	3.3 VDC
Temperature range	-40 °C to +85 °C

Disclaimer and Notes

Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjected to its use.

Decision rule:
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to ILAC-G8:09/2019

1 TABLE OF CONTENTS

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 ○ Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2025-01-07
Start – End of tests	2025-01-08 – 2025-02-01

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS) – the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) – the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision history

-0 Initial Version

-1 Revision: RSS-210 issue number corrected

-2 Revision: Operating frequency band corrected

-3 Revision: Rated output power withdrawn

This test report 23048703-36022-3 replaces the previous test report 23048703-36022-2.
Utilisation, publication and control of previous report editions is under applicant's responsibility.

2.6 Further documents

List of further applicable documents belonging to the present test report:
– no additional documents –

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75% r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V AC ± 5%

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-40 °C	20 °C	+85 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	2.8 V DC	3.3 V DC	3.8 V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices – Subpart C §15.255 Operation within the bands 57 – 71 GHz
RSS-210, Issue 11 (2024-06)	Licence-Exempt Radio Apparatus: Category I
RSS-Gen, Issue 5 (2018-04)	General Requirements for Compliance of Radio Apparatus

Reference	Description
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 364244 D01 Meas 15.255 Radars v01 (2024-04-16)	Radar Devices Certifying under the Provisions of §15.255

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product description

Short Range Radar Device

5.2 Description of test item

Model name*	IDR-2050
Serial number*	460
Hardware status*	Pilot Series
Software status*	1.229

*: as declared by applicant

5.3 Technical data of test item

Technology*	FMCW Radar
Operational frequency band*	58 GHz to 61.5 GHz
Type of radio transmission*	modulated carrier
Modulation type*	FMCW
Number of channels*	1
Channel bandwidth*	<4 GHz
Channel spacing*	N/A
Receiver category*	N/A
Receiver bandwidth*	N/A
Duty cycle*	<15%
Antenna*	integrated patch antenna
Power supply*	3.3 VDC
Temperature range*	-40 °C to +85 °C

*: as declared by applicant

5.4 Additional information

Model differences	N/A
Additional application considerations to test a component or sub-assembly	N/A
Ancillaries tested with	N/A
Additional equipment used for testing	N/A

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 RSS-210, Issue 11 (2024-06) / RSS-Gen, Issue 5 (2018-04)

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.215 (c) / §15.255 (e)(2) / RSS-Gen, 6.7	Occupied bandwidth (**99 %**)	Normal	3.387 GHz	**- PASS -**
§15.255 (c) / RSS-210, J3	Radiated EIRP	Normal	15.68 dBm peak	**- PASS -**
RSS-210, J.4	Peak transmitter output power	Normal	-/-	**- N/A -**
§15.215 (c) / §15.255 (f) / RSS-210, J6	Transmitter frequency stability	Normal/Extreme	Within band	**- PASS -**
§15.255 (d) / §15.209 (a) / RSS-210, J4	Field strength of emissions (spurious & harmonics)	Normal	< limit	**- PASS -**
§15.207 RSS-Gen, 8.8	AC conducted emissions	-/-	< limit	**- PASS -**

Notes

FCC's Millimeter Wave Test Procedures:

I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been chosen in consideration of test equipment availability and the limitations of many external harmonic mixers. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions can be found. Another potential problem is that the peak power output may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

Comments and observations

Following pages show requirements and references of FCC Part 15 only. Same tests are also applicable and valid for RSS-210/RSS-Gen, with clauses given in the table above.

7 TEST RESULTS

7.1 Occupied bandwidth

Description

FCC §15.215 (c) asks for 20 dB bandwidth

RSS-Gen:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum inband power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Limits

The radar device’s occupied bandwidth (i.e. 99% emission bandwidth) shall be contained in the 57-71GHz frequency band.

FCC §15.255 (e)(2):

Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Test procedure

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

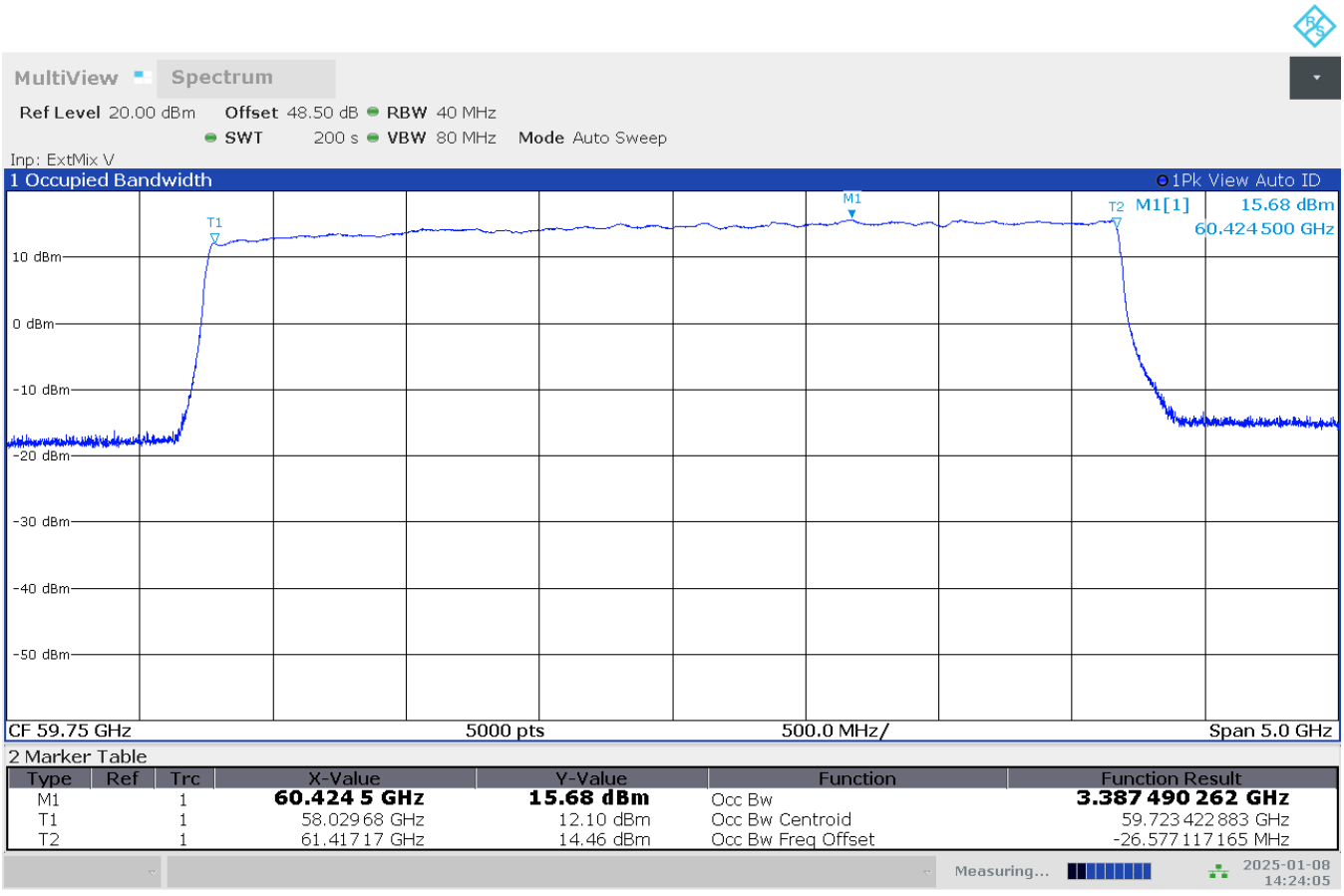
Note
Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).

Test setup: 8.4

Test results

EUT mode	Bandwidth	RBW	f_L [GHz]	f_H [GHz]	Bandwidth [GHz]
Normal mode	99 % OBW	40 MHz	58.030	61.417	3.387

Plot no. 1: 99 % bandwidth



7.2 Radiated EIRP

Description / Limits

§ 15.255 (c) (2)

Field disturbance sensors/radars shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:

(i) 57.0–59.4 GHz:
the peak EIRP level shall not exceed 20 dBm for indoor operation or 30 dBm for outdoor operation;

(ii) 57.0–61.56 GHz:
the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;

(iii) 57.0–64.0 GHz:

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

(B) The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors:

(1) As part of a temporary or permanently fixed application; or

(2) When being used in vehicular applications to perform specific tasks of moving something or someone, except for in-cabin applications;

(iv) A field disturbance sensor may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.

(v) 61.0–61.5 GHz: For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

Test setup: 8.5

7.3 Peak transmitter output power

Description / Limits

RSS-210, J3.2b

FDS devices operating in the 57.0-61.56 GHz band shall have the peak e.i.r.p. not exceeding 3 dBm or, if the sum of continuous transmitter off-times of at least 2 ms equals at least 16.5 ms within any contiguous interval of 33 ms, the peak e.i.r.p. shall not exceed 20 dBm.

For the purposes of demonstrating compliance with this RSS, corrections to the transmitter output power may be made to compensate for antenna and circuit loss.
For the purpose of this standard, emission bandwidth is defined as the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density shall be 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency must be stationary during the measurement interval, even if not stationary during normal operation.

Test procedure

Step #1: Peak EIRP value of previous measurement
Step #2: Check which limit according to bandwidth and duty cycle considerations applies, if any

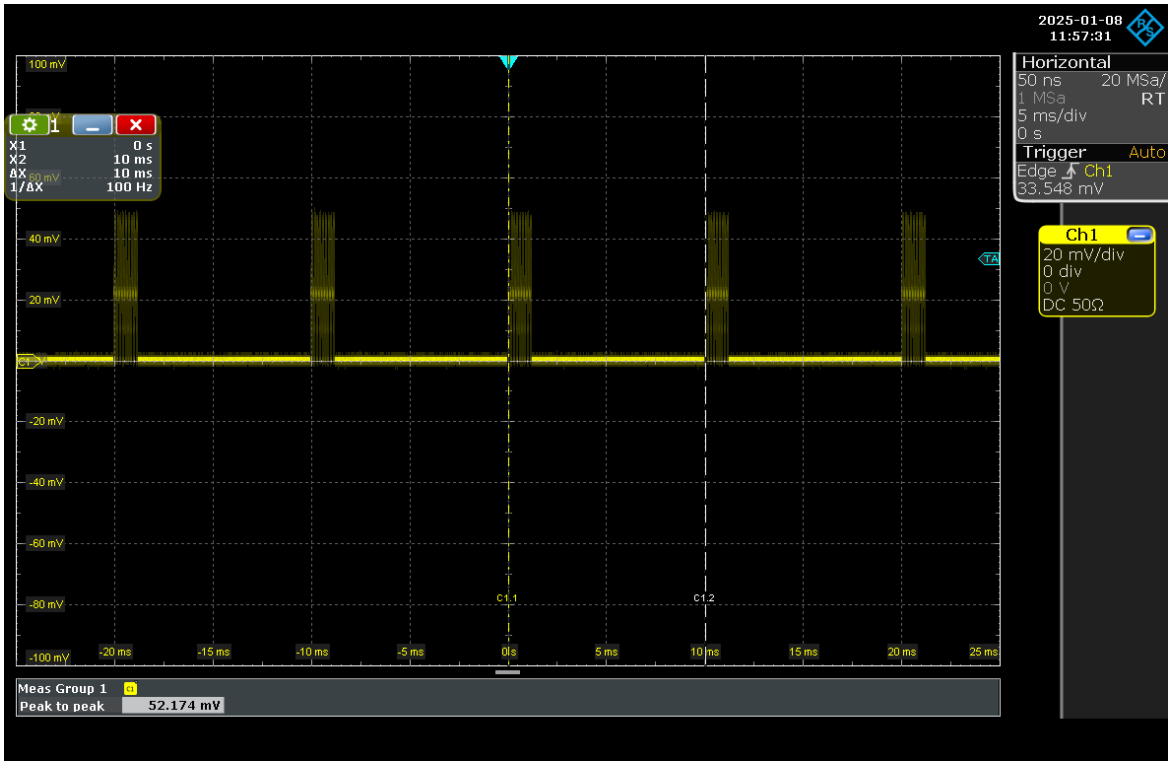
Test setup: 8.5

Test results

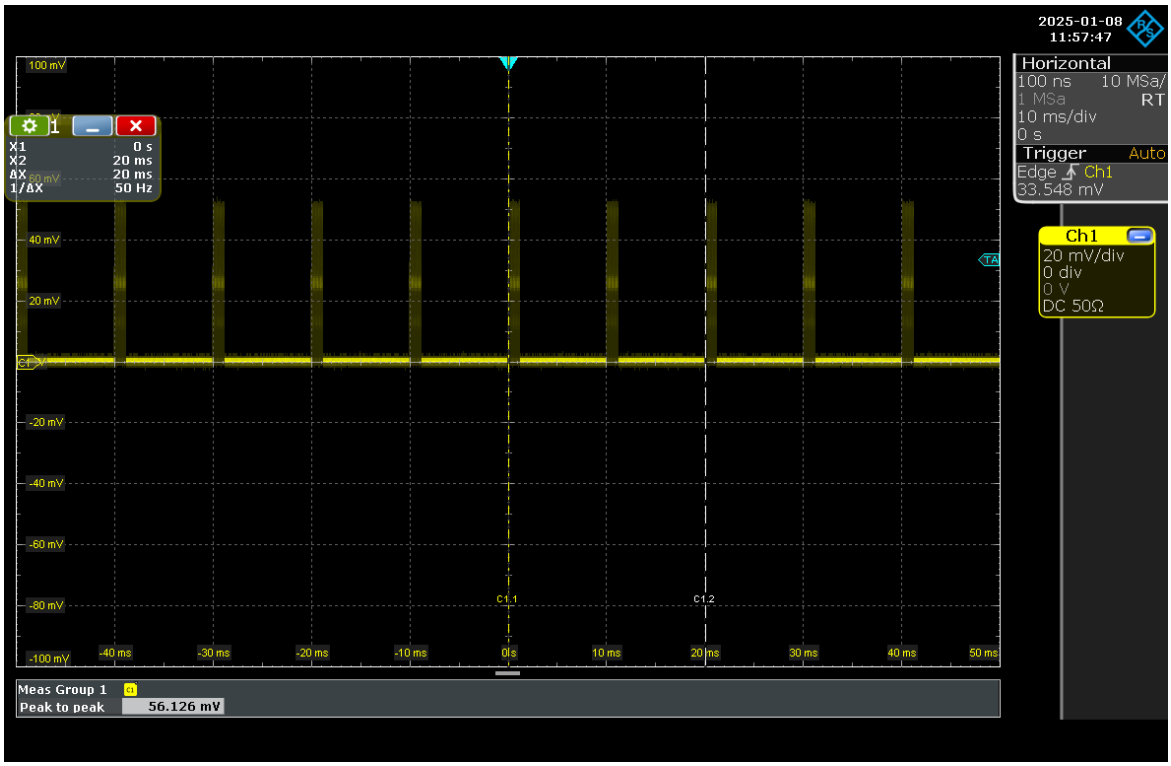
EUT mode	Peak EIRP [dBm]	Limit [dBm]	Duty Cycle [%]
Normal operation	15.68	20.0	14.9

Duty Cycle:
Transmitter on time within given 33 ms window is 4 times 1.232 ms = 4.928 ms.
Applicable duty cycle limitation is 16.5 ms within 33 ms (50%).
For further detail please refer to following screenshots.

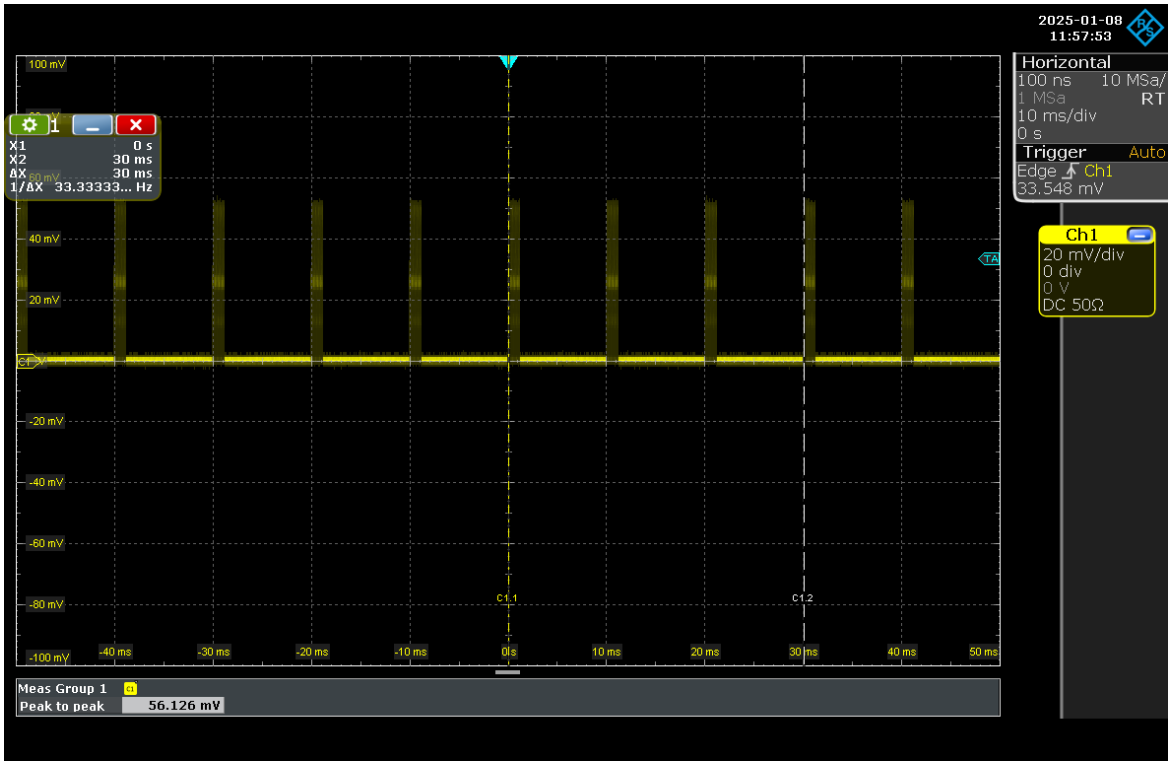
Plot no. 2:



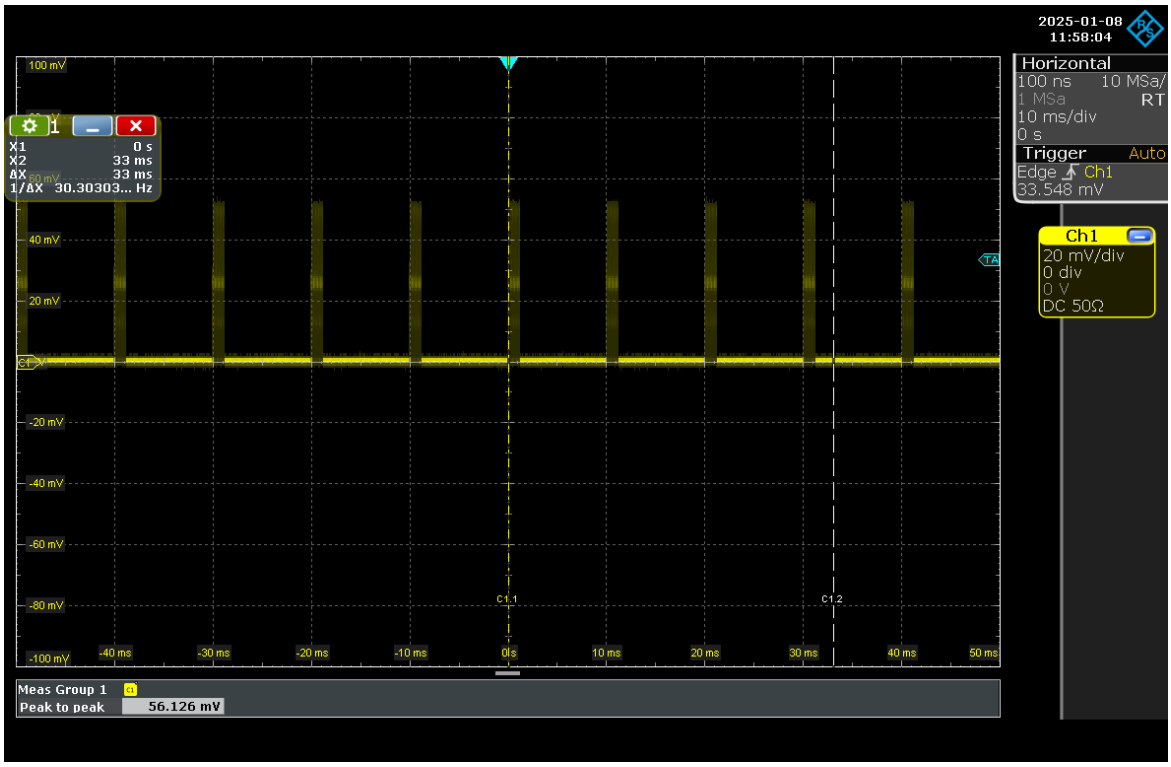
Plot no. 3:



Plot no. 4:



Plot no. 5:



7.4 Frequency stability (§15.255 (f))

Description

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

Limits

§15.255 (f): Frequency stability.

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Test procedure

As an unmodulated carrier is not available, following test method is used to measure frequency stability:

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Test setup: 8.6

Test results under normal and extreme test conditions:

EUT mode	Test conditions	f_L [GHz]	f_H [GHz]	99% OBW [MHz]
Normal operation	-40 °C	58.046	61.419	3373
Normal operation	-30 °C	58.044	61.418	3375
Normal operation	-20 °C	58.042	61.418	3377
Normal operation	-10 °C	58.039	61.418	3379
Normal operation	0 °C	58.036	61.417	3382
Normal operation	10 °C	58.033	61.418	3385
Normal operation	20 °C V_{min}	58.030	61.417	3387
Normal operation	20 °C V_{nom}	58.030	61.417	3387
Normal operation	20 °C V_{max}	58.030	61.417	3387
Normal operation	30 °C	58.026	61.415	3389
Normal operation	40 °C	58.023	61.415	3391
Normal operation	50 °C	58.021	61.414	3393
Normal operation	85 °C	58.017	61.413	3396

Voltage variation:
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).

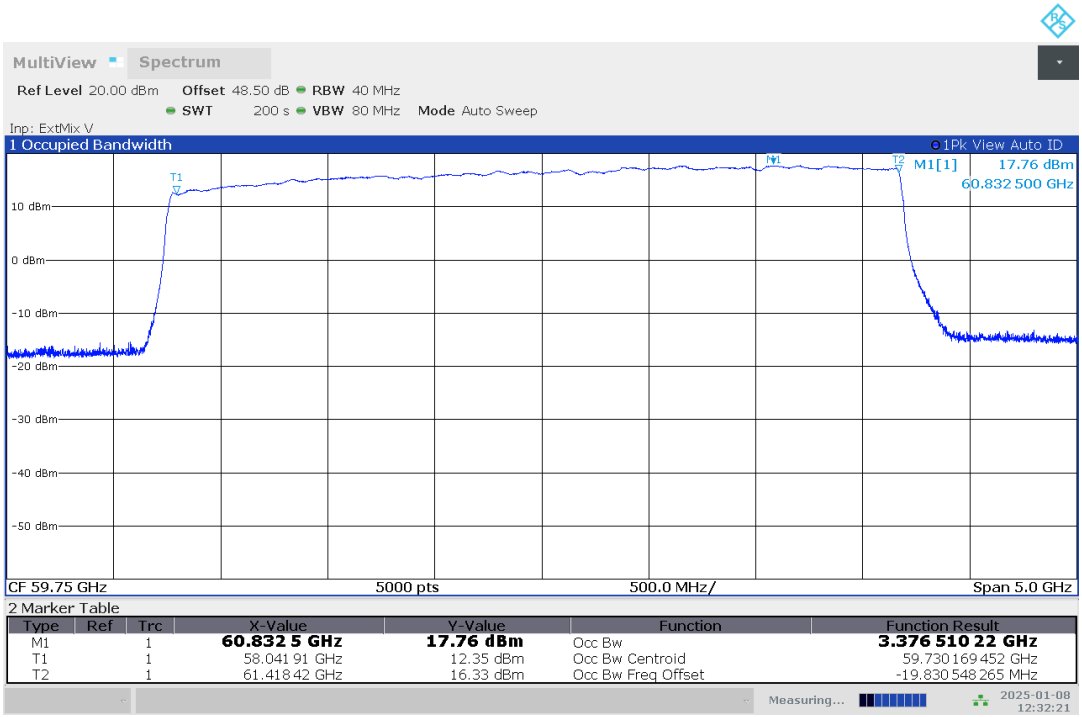
Plot no. 6: 99% OBW, Peak detector, -40 °C

11:05:30 01/08/2025

Plot no. 7: 99% OBW, Peak detector, -30 °C

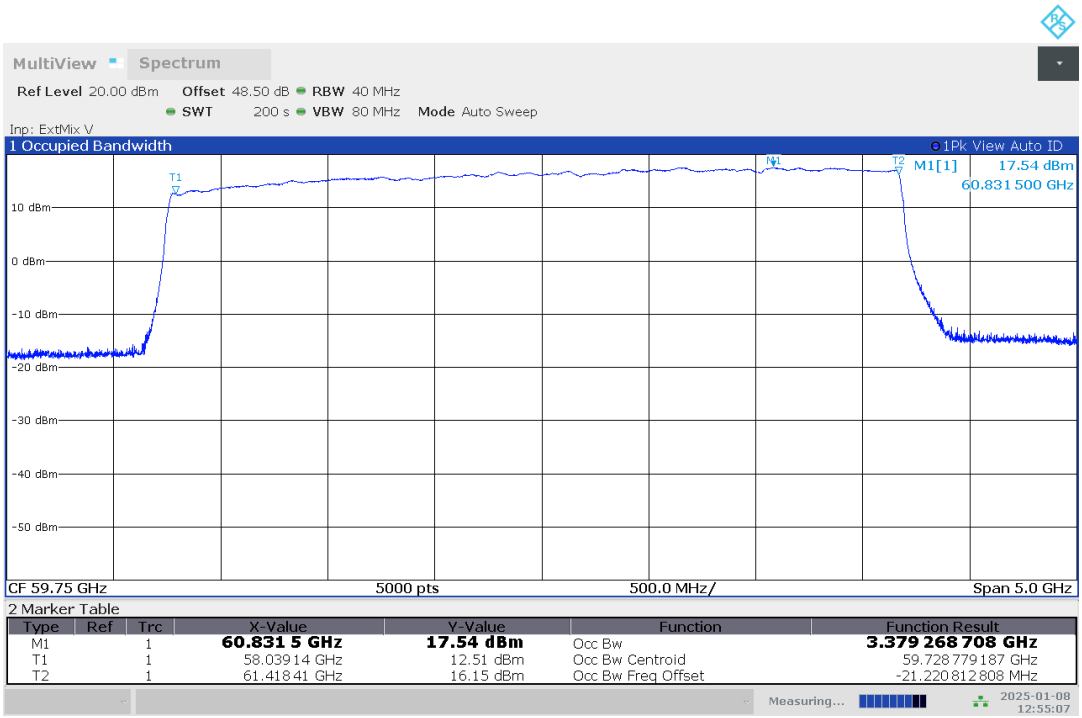
12:09:35 01/08/2025

Plot no. 8: 99% OBW, Peak detector, -20 °C



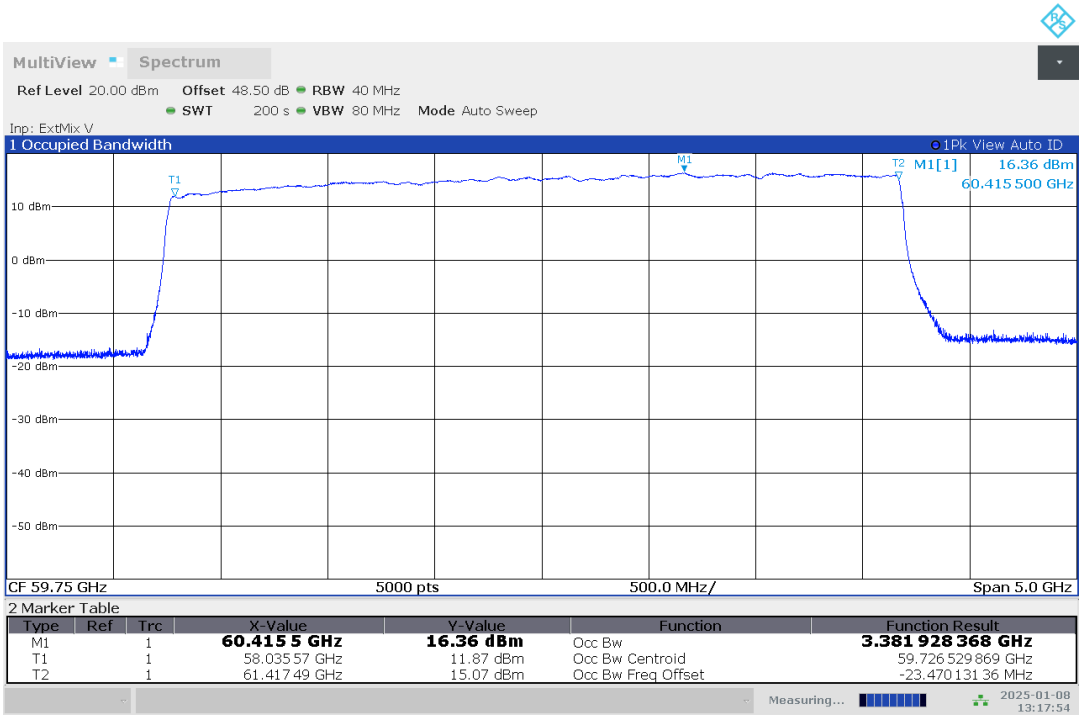
12:32:21 01/08/2025

Plot no. 9: 99% OBW, Peak detector, -10 °C



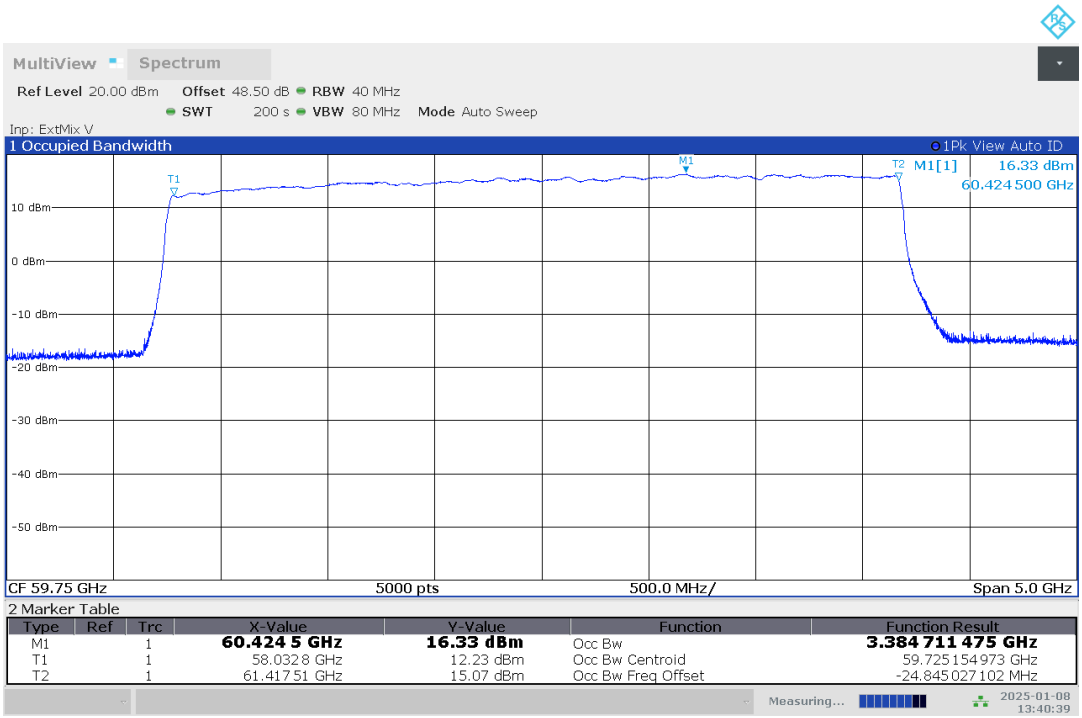
12:55:08 01/08/2025

Plot no. 10: 99% OBW, Peak detector, +0 °C



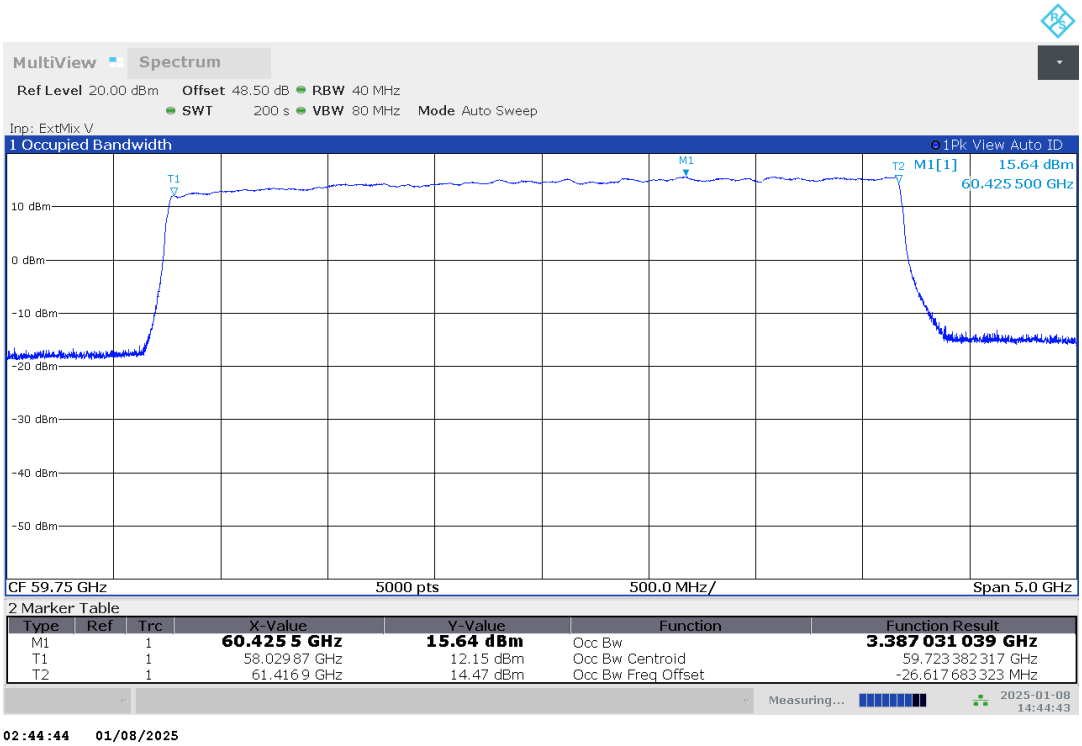
01:17:54 01/08/2025

Plot no. 11: 99% OBW, Peak detector, +10 °C

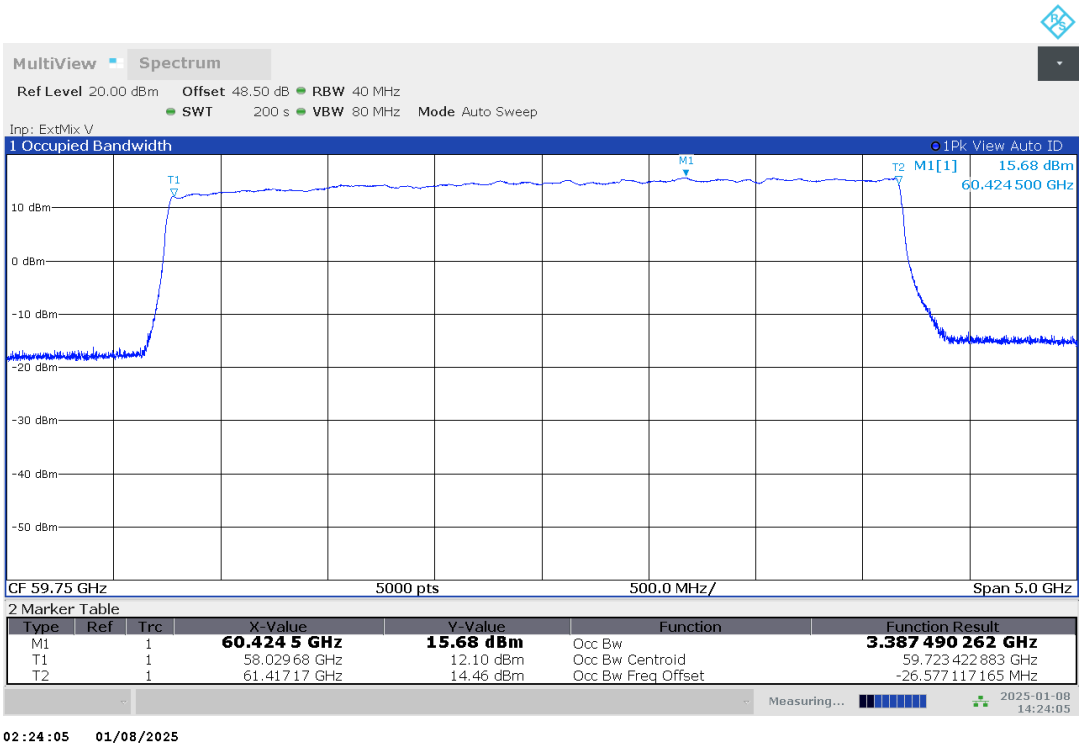


01:40:40 01/08/2025

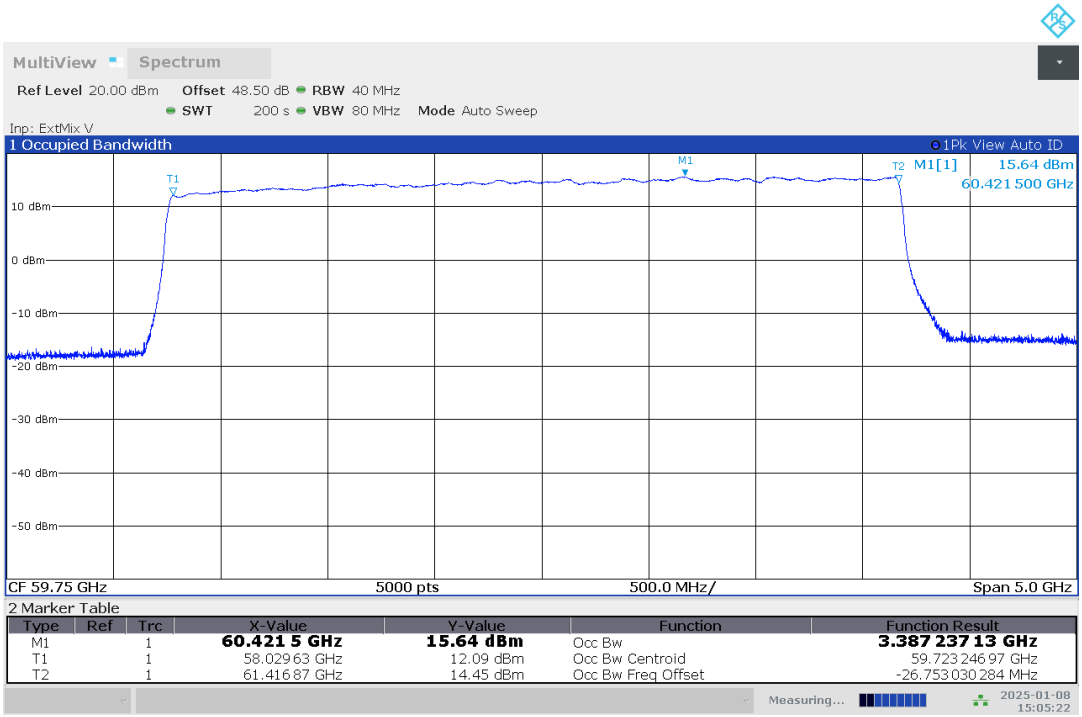
Plot no. 12: 99% OBW, Peak detector, +20 °C, V_{min}



Plot no. 13: 99% OBW, Peak detector, +20 °C, V_{nom}

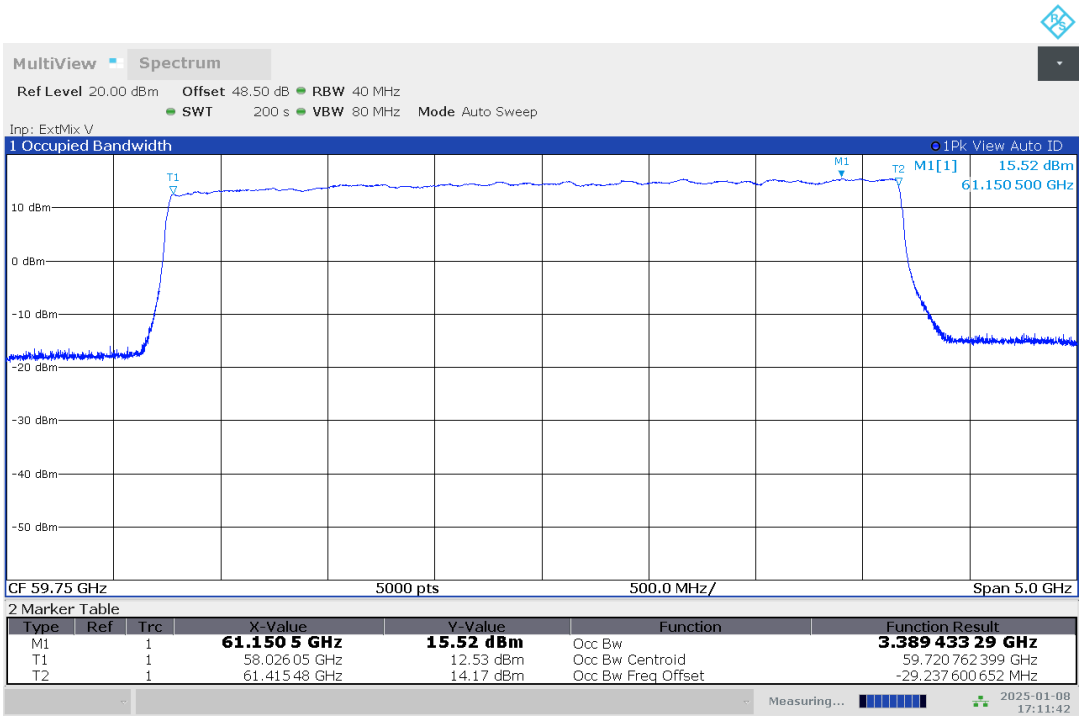


Plot no. 14: 99% OBW, Peak detector, +20 °C, V_{max}



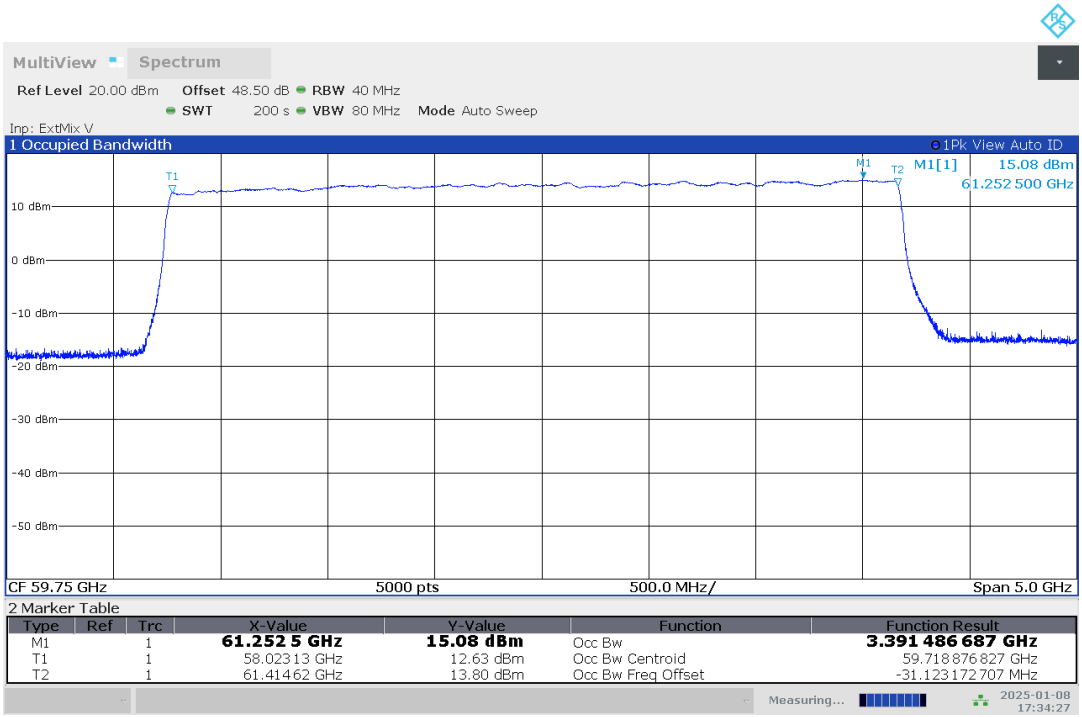
03:05:23 01/08/2025

Plot no. 15: 99% OBW, Peak detector, +30 °C



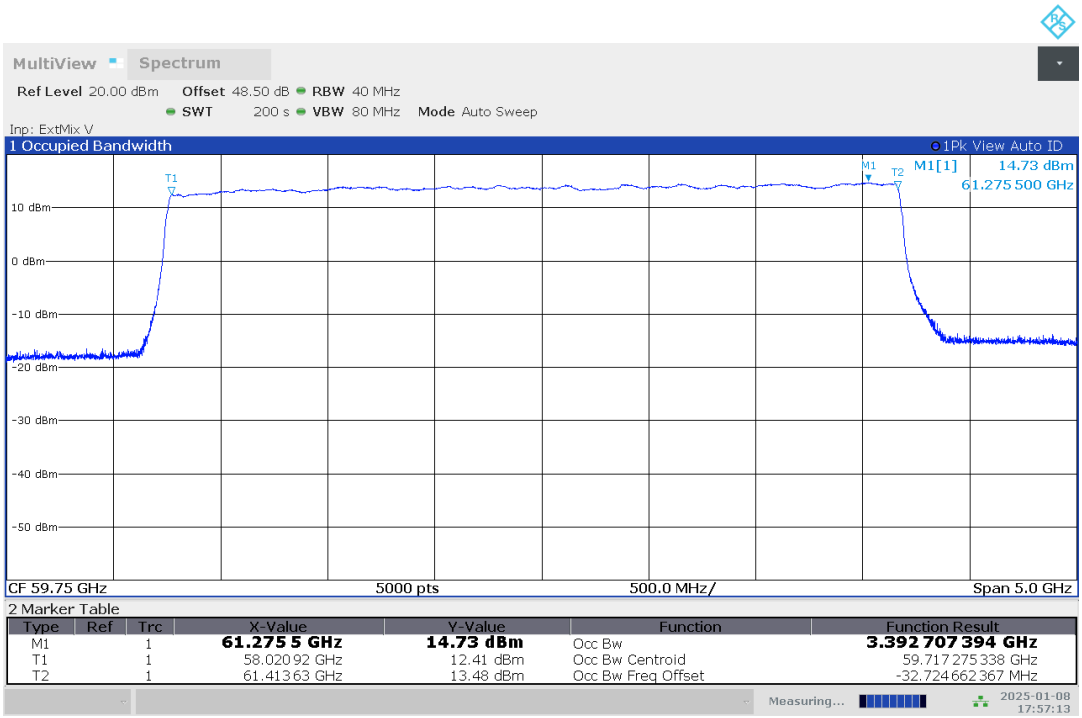
05:11:42 01/08/2025

Plot no. 16: 99% OBW, Peak detector, +40 °C



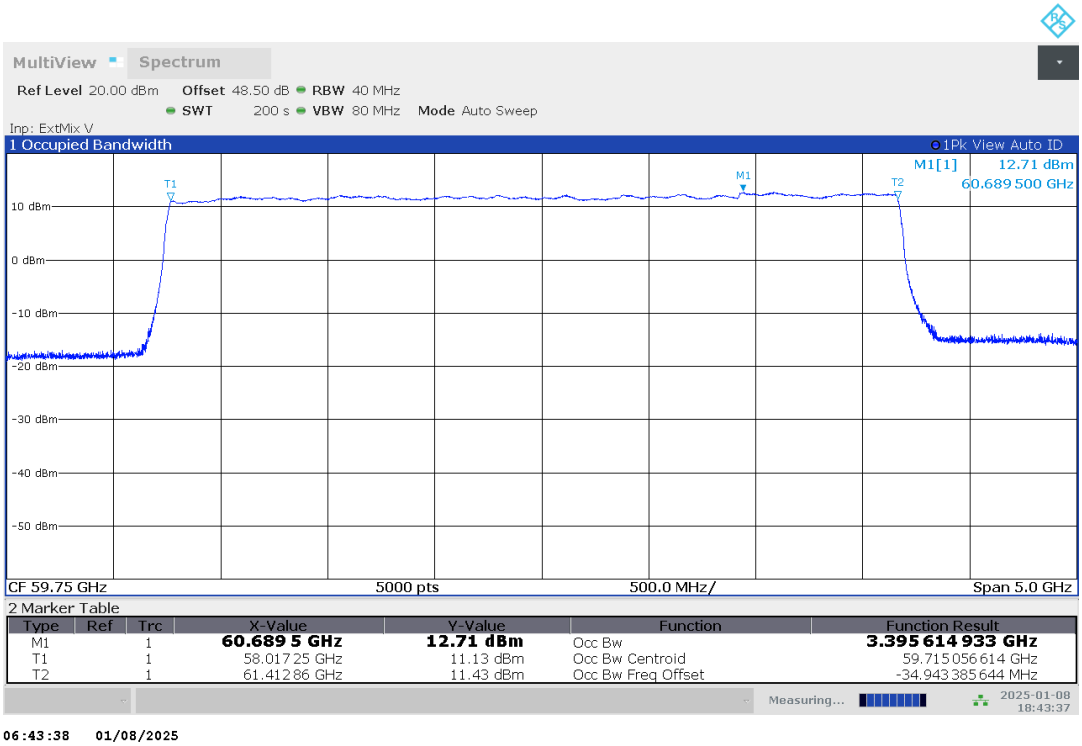
05:34:28 01/08/2025

Plot no. 17: 99% OBW, Peak detector, +50 °C



05:57:13 01/08/2025

Plot no. 18: 99% OBW, Peak detector, +85 °C



7.5 AC Conducted Emissions

Description / Limits

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission [MHz]	Conducted limit [dBµV]	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5.0	56	46
5.0 – 30	60	50
*Decreases with the logarithm of the frequency.		

§15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

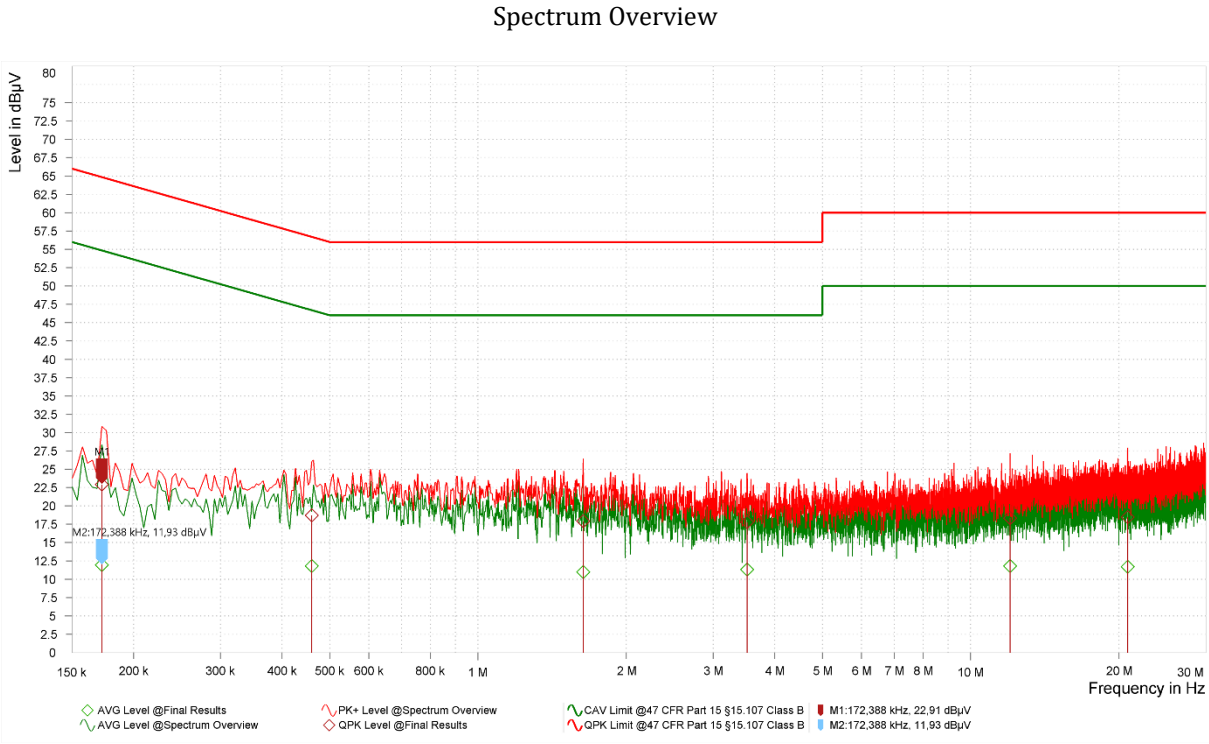
Test setup: see 8.6

Test results

Refer to next pages.

Note:
Testing was performed with normal operating mode

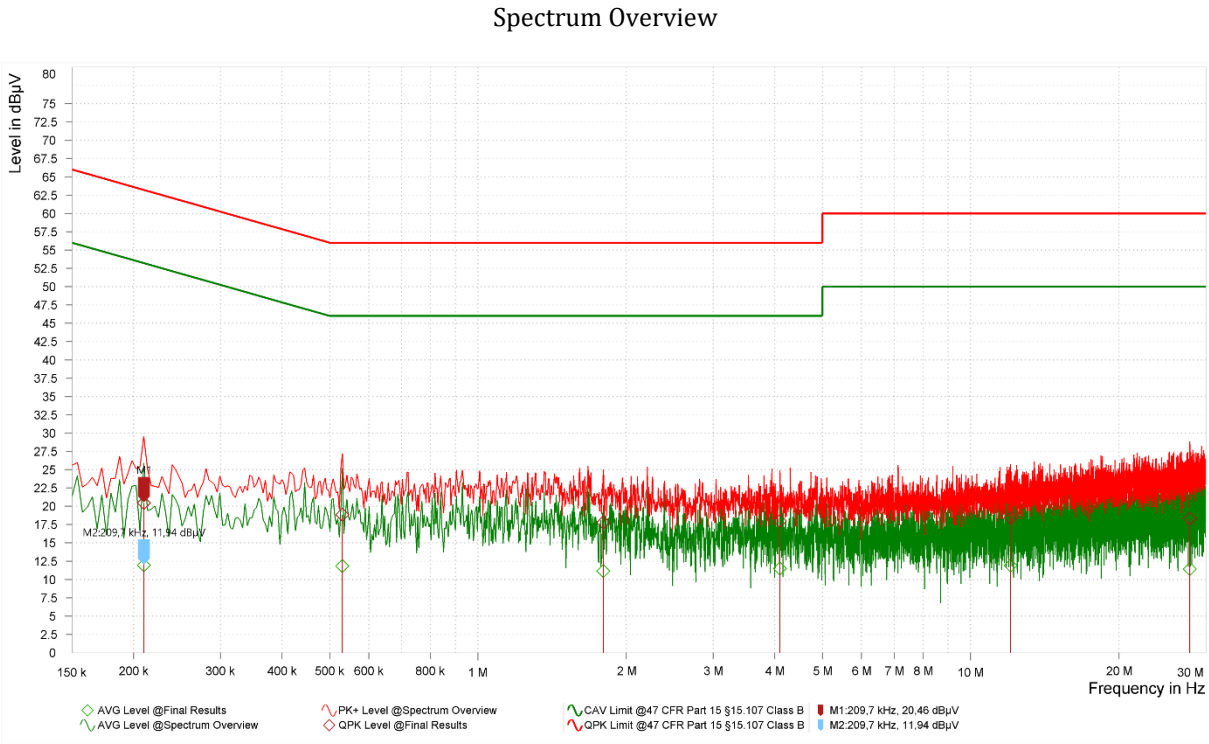
Plot no. 19: conducted emissions, line L1



EMI Final Results

Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,172	22,91	64,84	41,93	11,93	54,84	42,92	10,17	L1	9,000	15,000
1	0,460	18,70	56,70	38,00	11,81	46,70	34,89	10,17	L1	9,000	15,000
1	1,635	17,91	56,00	38,09	10,97	46,00	35,03	9,92	L1	9,000	15,000
1	3,516	17,79	56,00	38,21	11,32	46,00	34,68	9,96	L1	9,000	15,000
1	12,023	18,33	60,00	41,67	11,81	50,00	38,19	10,26	L1	9,000	15,000
1	20,817	18,47	60,00	41,53	11,69	50,00	38,31	10,45	L1	9,000	15,000

Plot no. 20: conducted emissions, neutral N



EMI Final Results

Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,210	20,46	63,22	42,76	11,94	53,22	41,27	9,87	N	9,000	15,000
1	0,531	18,85	56,00	37,15	11,83	46,00	34,17	10,17	N	9,000	15,000
1	1,795	17,78	56,00	38,22	11,14	46,00	34,86	9,92	N	9,000	15,000
1	4,101	18,00	56,00	38,00	11,48	46,00	34,52	9,99	N	9,000	15,000
1	12,045	18,40	60,00	41,60	11,91	50,00	38,09	10,30	N	9,000	15,000
1	27,847	18,29	60,00	41,71	11,43	50,00	38,57	10,74	N	9,000	15,000

7.6 Field strength of emissions (spurious and harmonics)

Description / Limits

§15.255 (d) (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

§15.255 (d) (2)

Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209:

Frequency	Field Strength	Measurement distance
0.009 – 0.490 MHz	2400/F[kHz] µV/m	300 m
0.490 – 1.705 MHz	24000/F[kHz] µV/m	30 m
1.705 – 30.0 MHz	30.0 µV/m / 29.5 dBµV/m	30 m
30 – 88 MHz	100 µV/m / 40.0 dBµV/m	3 m
88 – 216 MHz	150 µV/m / 43.5 dBµV/m	3 m
216 – 960 MHz	200 µV/m / 46.0 dBµV/m	3 m
960 – 40 000 MHz	500 µV/m / 54.0 dBµV/m	3 m

§15.255 (d) (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters (what corresponds to an EIRP of -9.9 dBm).

§15.255 (d) (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Test procedure

§15.31 (c) Except as otherwise indicated in §15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

§15.31 (m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range	Number of frequencies	Location
< 1MHz bandwidth	1	middle
1 – 10 MHz bandwidth	2	1 near bottom and 1 near top
> 10 MHz bandwidth	3	1 near bottom / middle / top

§15.35 (b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g.,see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

§15.35 (c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

Calculation of the far field distance (Rayleigh distance):
The aperture dimensions of these horn antennas shall be small enough so that the measurement distance in meters is equal to or greater than the Rayleigh distance (i.e. $R_m = 2D^2 / \lambda$), where D is the largest linear dimension (i.e. width or height) of the antenna aperture in m and λ is the free-space wavelength in meters at the frequency of measurement.

Antenna type	Frequency range [GHz]	D [m]	Highest frequency in use [GHz]	Far field distance R_m [m]
20240-20	18.0 – 26.5	0.0520	26.5	0.478
22240-20	26.5 – 40.0	0.0342	40	0.312
23240-20	33.0 – 50.0	0.0280	50	0.261
24240-20	40.0 – 60.0	0.0230	60	0.212
25240-20	50.0 – 75.0	0.0185	75	0.171
26240-20	60.0 – 90.0	0.0150	90	0.135
27240-20	75.0 – 110	0.0124	110	0.113
28240-20	90.0 – 140	0.0100	140	0.093
29240-20	110 – 170	0.0085	170	0.082
30240-20	140 – 220	0.0068	220	0.068

Used test distances:

Up to 18 GHz:	3.00 m
18 – 40 GHz:	1.00 m
40 – 50 GHz:	1.00 m
50 – 75 GHz:	0.50 m
75 – 110 GHz:	0.50 m
110 – 220 GHz:	0.25 m
in-band:	1.0 m

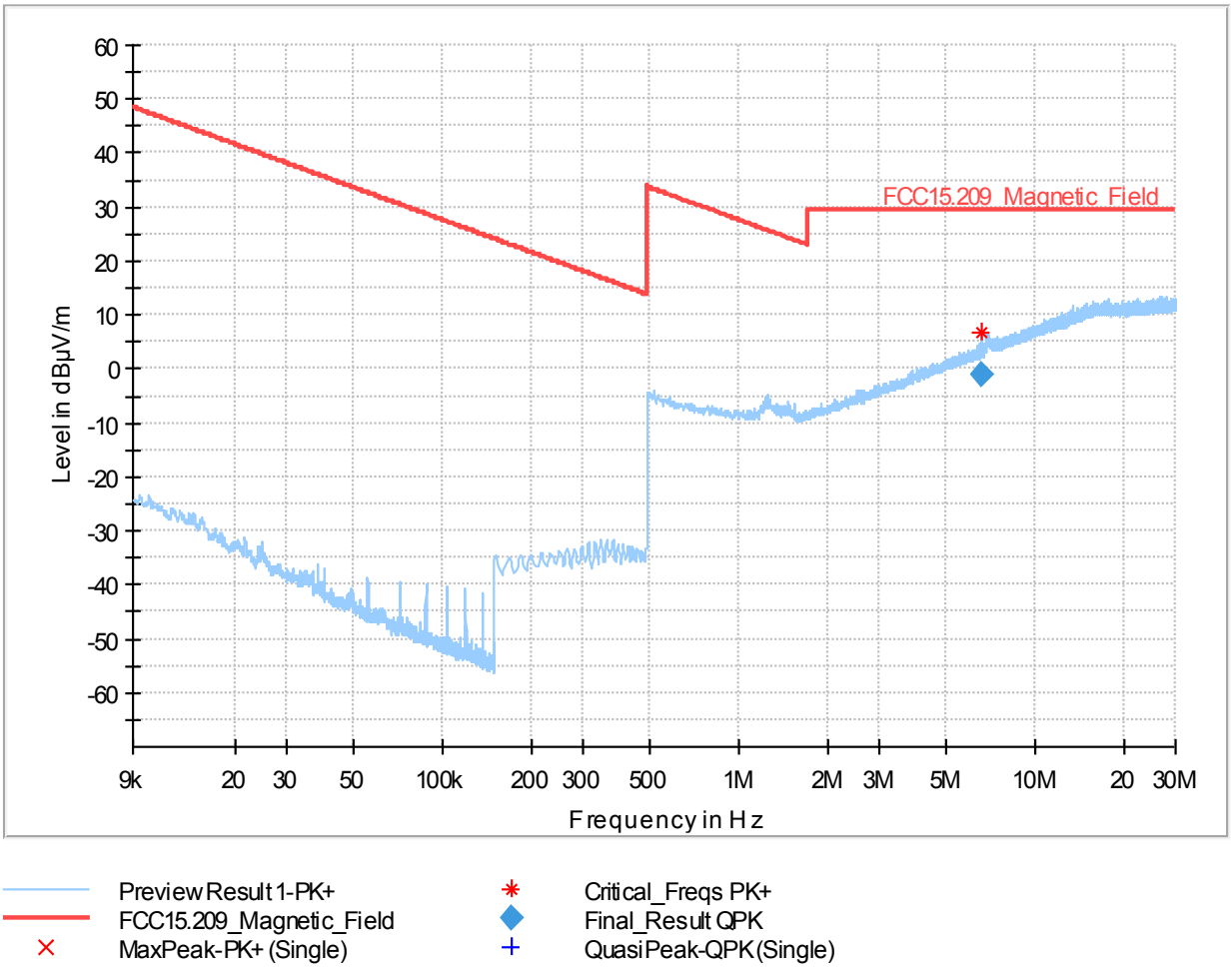
Test setup: 8.1 – 8.4
Test distance correction factor of 20dB/decade is already considered in the plots / result table.

Test results:

Channel / Mode	Frequency [GHz]	Detector	Test distance [m]	Level [dBµV/m @LD]	Limit [dBµV/m @LD]	Margin [dB]
No critical emissions found, please refer to plots.						

Note:
LD = Limit Distance of 300m / 30m / 3m depending on frequency range, see limit table

Plot no. 21: radiated emissions 9 kHz – 30 MHz, loop antenna

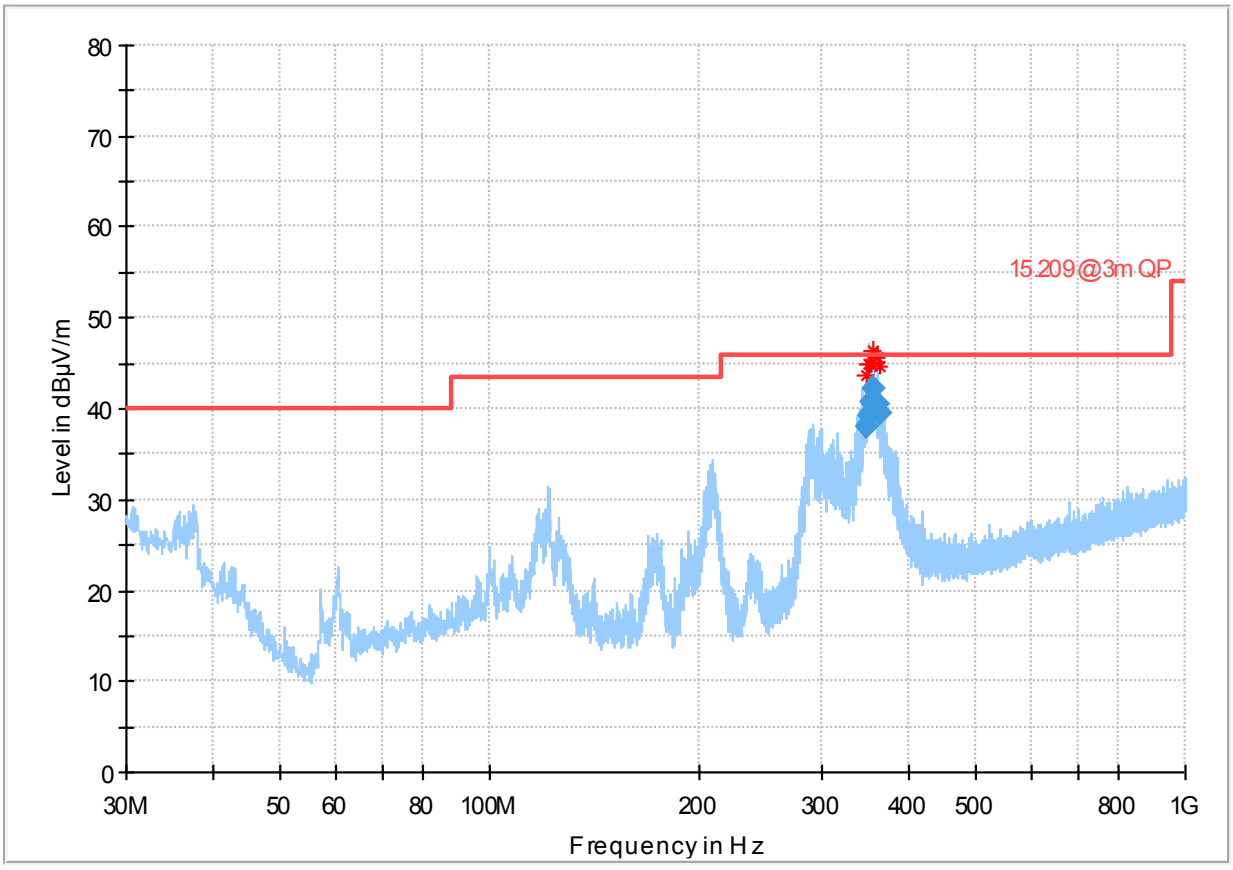


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
6.666000	-1.22	29.54	30.76	100.0	9.000	V	345.0	-7.1

Note:
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBµV/m, which is equivalent to Y - 51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.
(Certification & Engineering Bureau, Q&A on Certification Procedures and Requirements, TCB Workshop April 2020, Nicolas DesMarais, *2020-04-09 - ISED Q&A - DesMarais.pdf*)

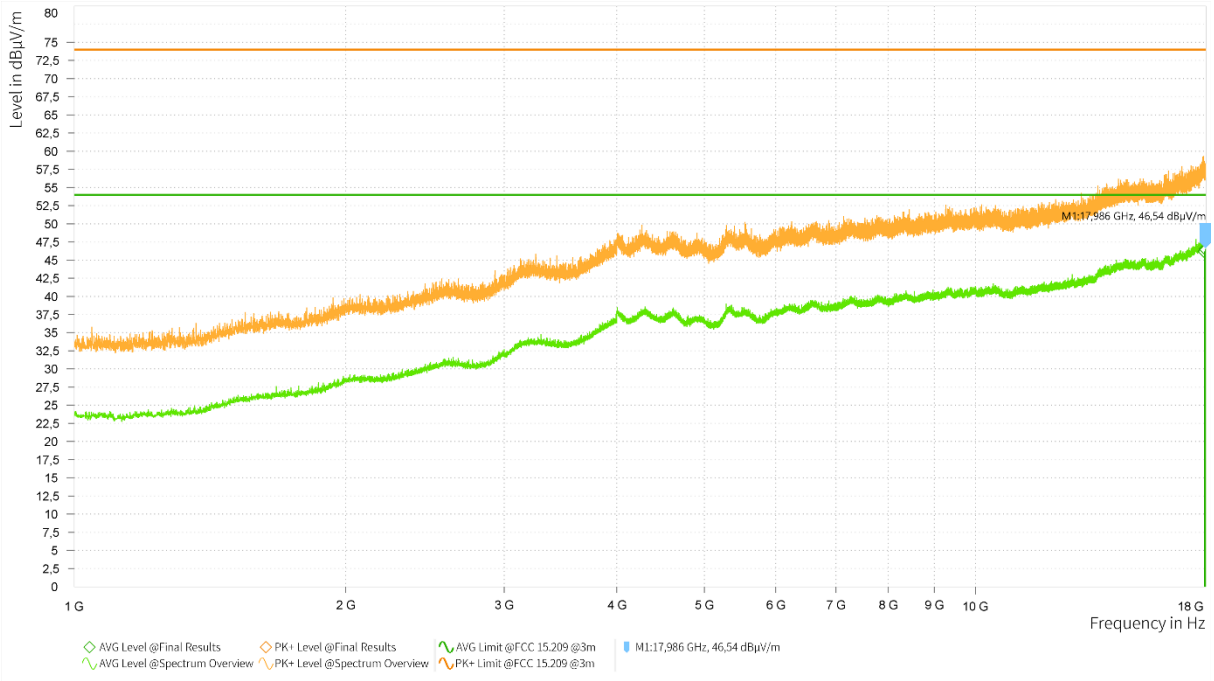
Plot no. 22: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
348.941000	37.96	46.00	8.04	100.0	120.000	103.0	H	87.0	14.6
350.081500	39.32	46.00	6.68	100.0	120.000	100.0	H	92.0	14.6
353.725500	40.72	46.00	5.28	100.0	120.000	100.0	H	103.0	14.7
356.465000	42.24	46.00	3.76	100.0	120.000	100.0	H	110.0	14.8
359.883500	40.52	46.00	5.48	100.0	120.000	103.0	H	103.0	14.9
363.850500	39.57	46.00	6.43	100.0	120.000	100.0	H	105.0	15.0

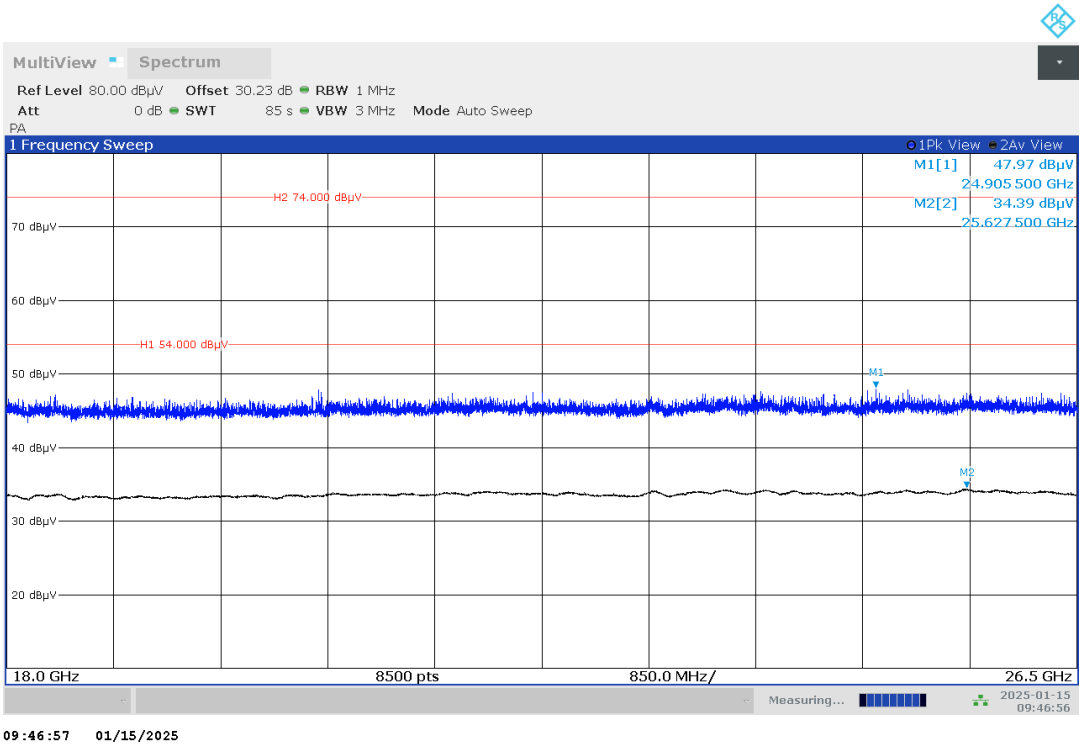
Plot no. 23: radiated emissions 1 GHz – 18 GHz, hor./vert. polarization
Spectrum Overview



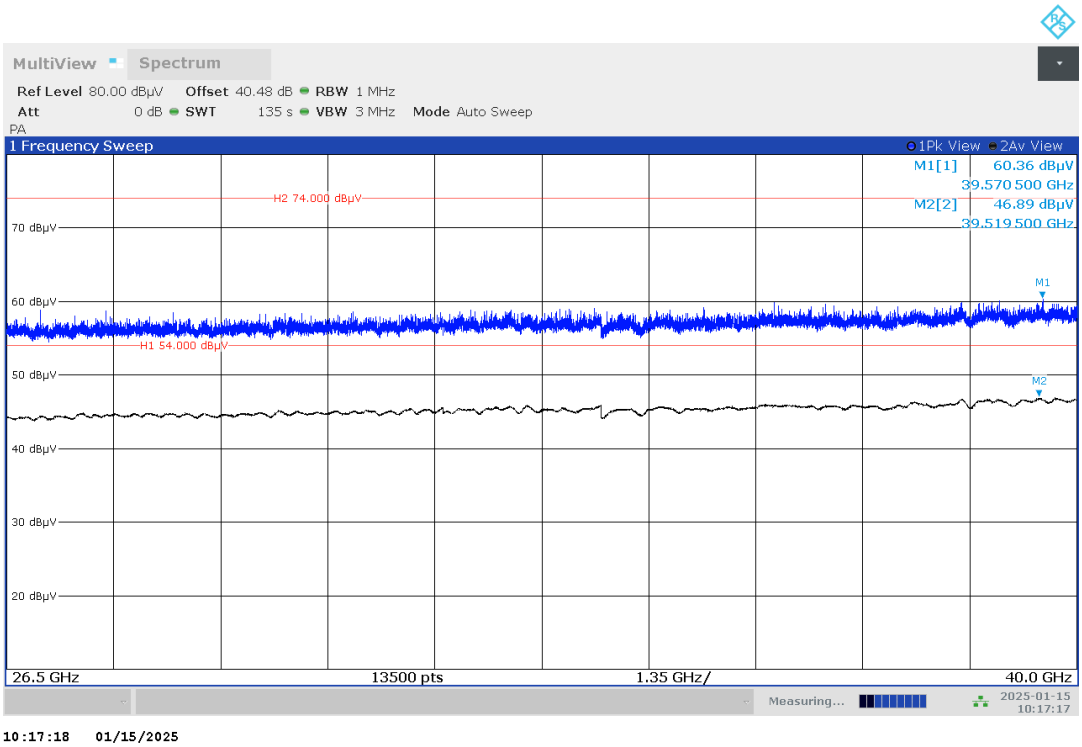
EMI Final Results

Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Elevation [deg]	Azimuth [deg]
1	17.940,325				46,20	54,00	7,80	44,32	81,1	274,3
1	17.986,325				46,54	54,00	7,46	44,47	105	331,3

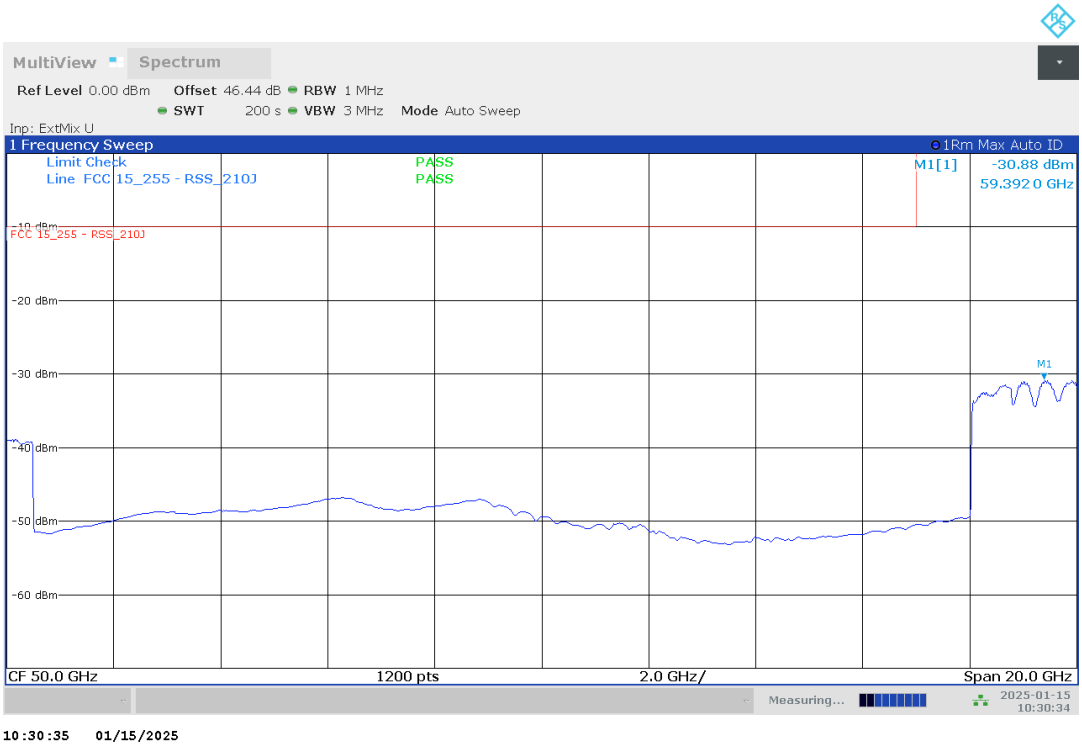
Plot no. 24: radiated emissions 18 GHz – 26.5 GHz, hor./vert. polarization



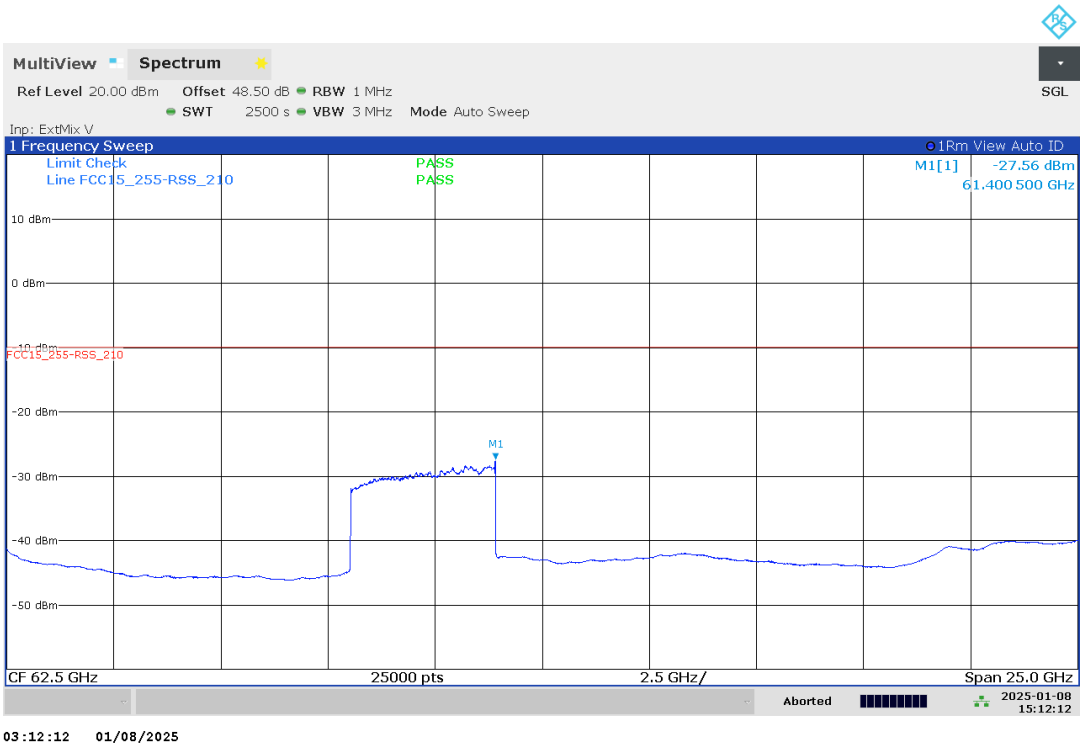
Plot no. 25: radiated emissions 26.5 GHz – 40 GHz, hor./vert. polarization



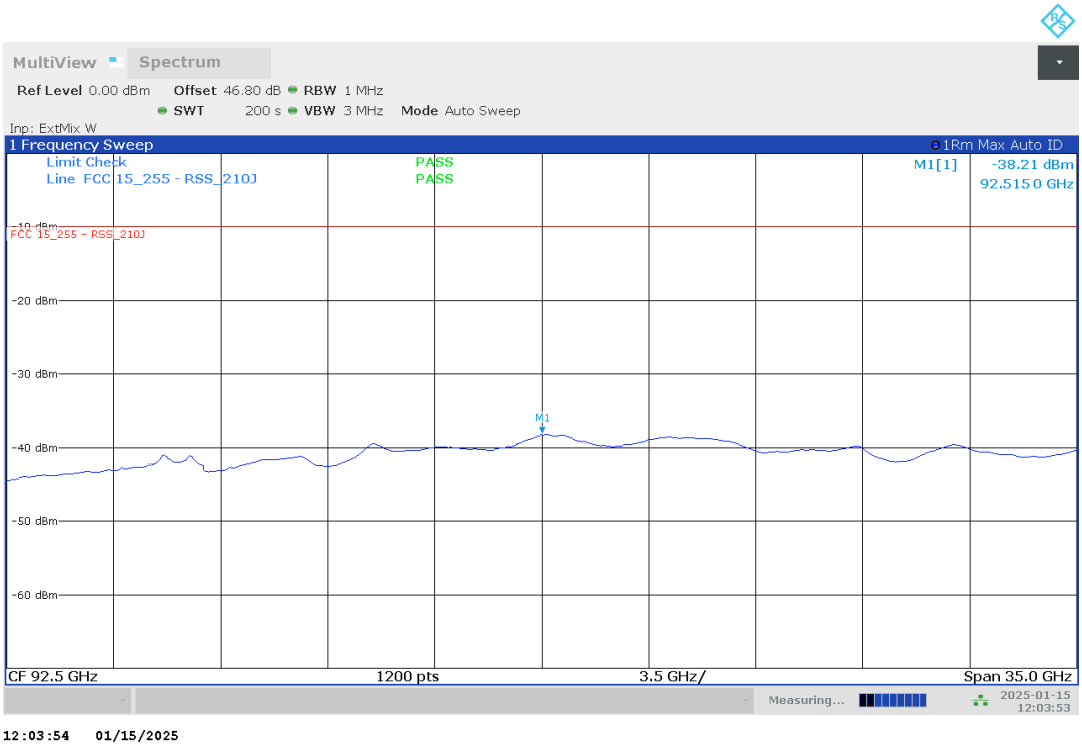
Plot no. 26: radiated emissions 40 GHz – 60 GHz, hor./vert. polarization



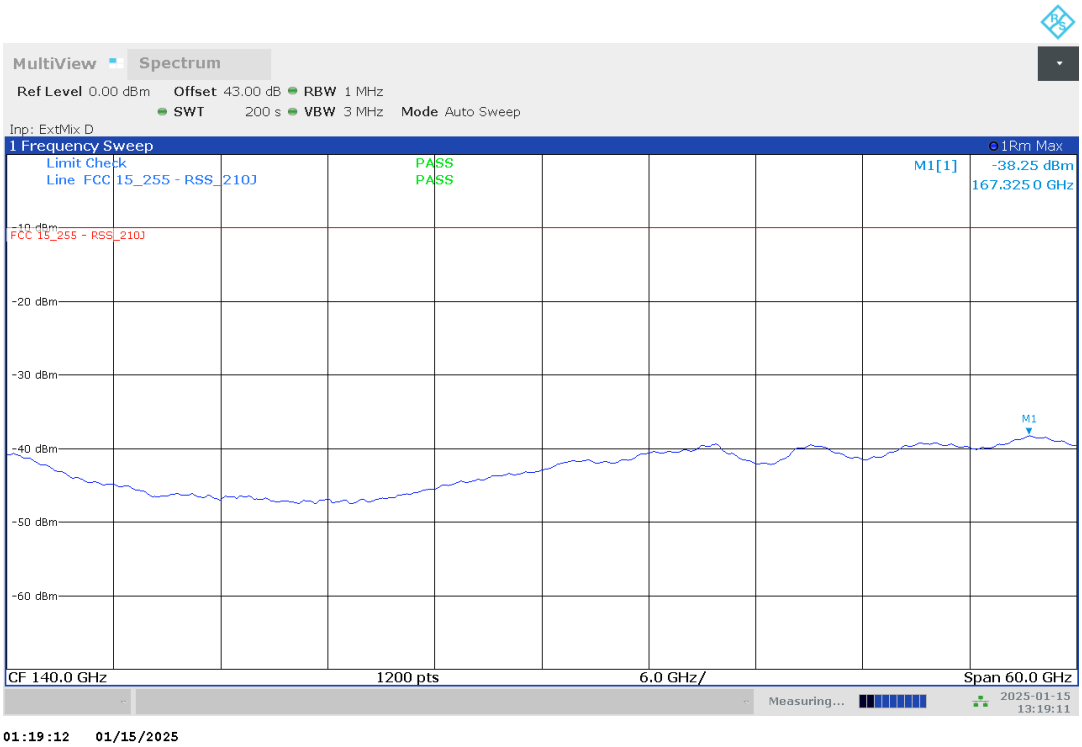
Plot no. 27: radiated emissions 50 GHz – 75 GHz, hor./vert. polarization



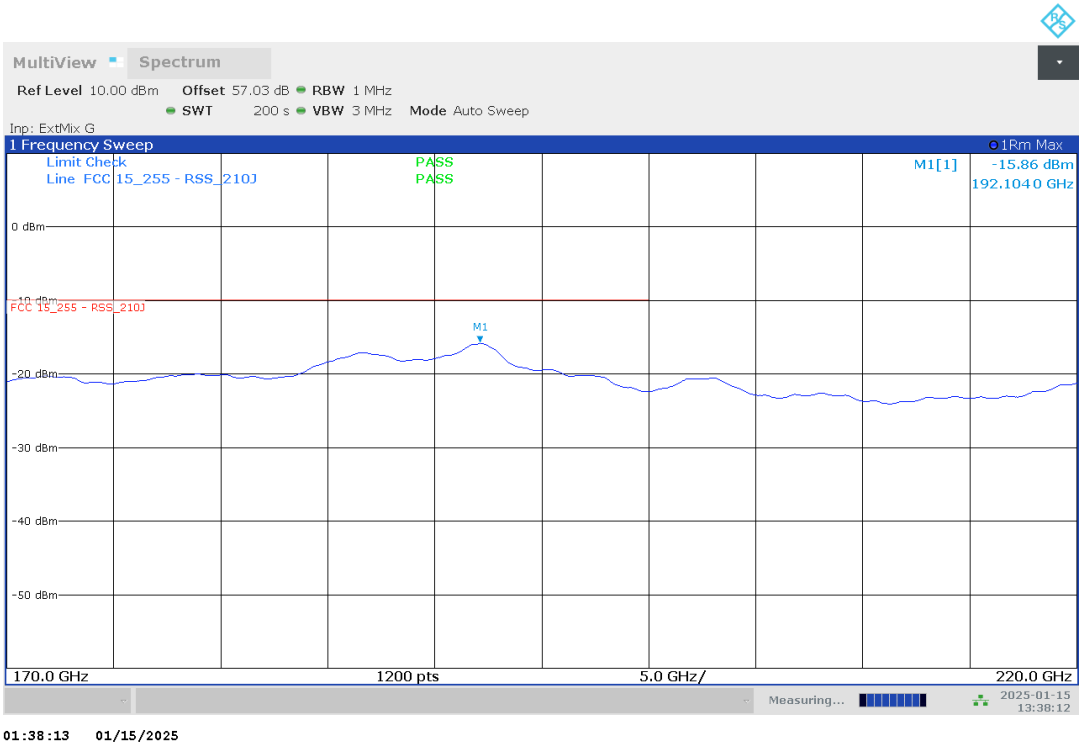
Plot no. 28: radiated emissions 75 GHz – 110 GHz, hor./vert. polarization



Plot no. 29: radiated emissions 110 GHz – 170 GHz, hor./vert. polarization



Plot no. 30: radiated emissions 170 GHz – 220 GHz, hor./vert. polarization



8 Test Setup Description

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. Cyclic chamber inspections and range calibrations are performed. Where possible, RF generating and signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

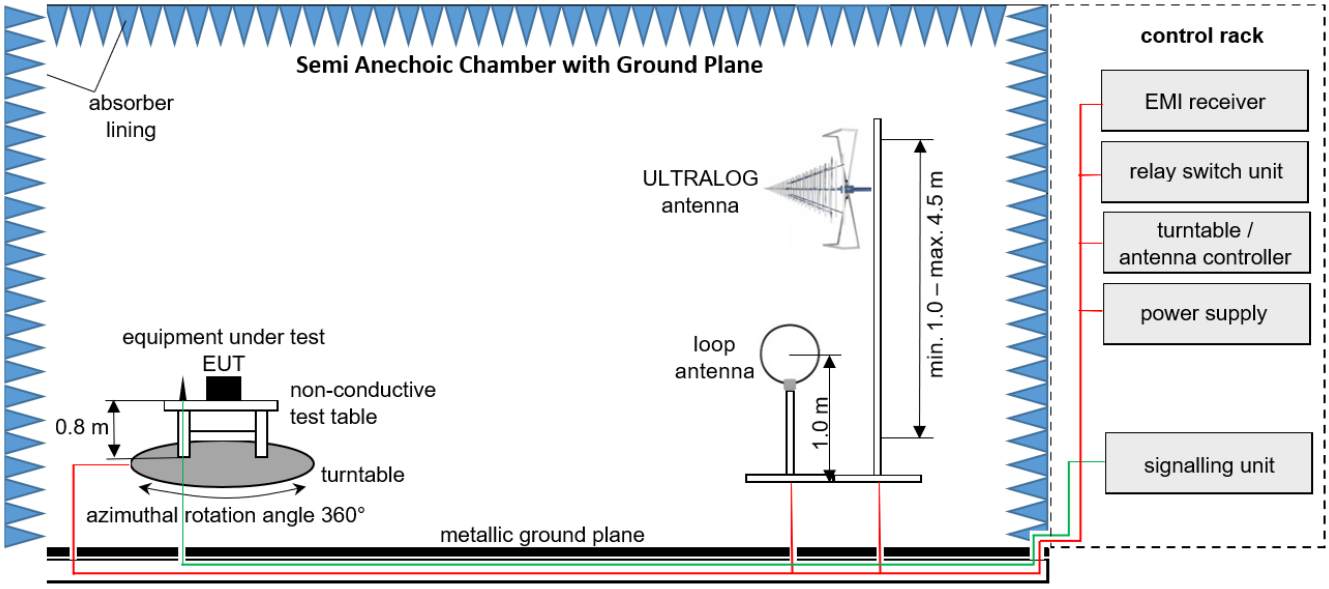
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Kind of calibration (abbreviations):

C = calibrated
CM = cyclic maintenance
NR = not required
L = locked

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the 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 a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna at 3 m; loop antenna at 3 m
EMC32 software version: 11.20.00

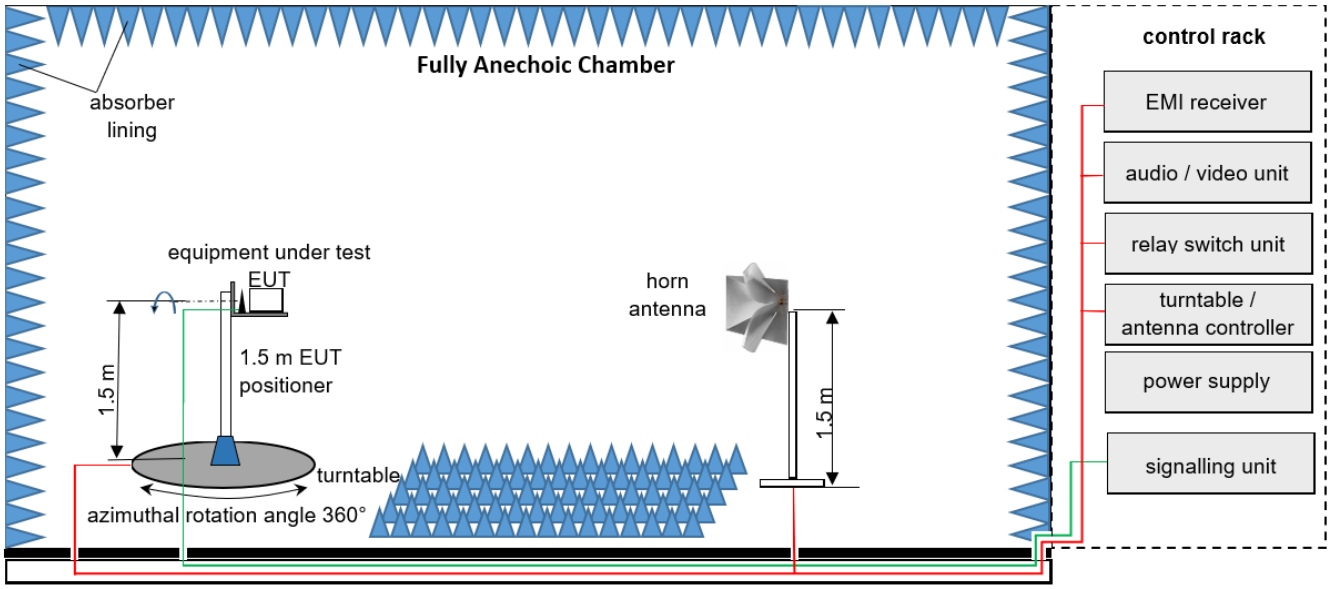
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Rohde & Schwarz	IN 600	101554	LAB000824	NR	–
2	Antenna	Rohde & Schwarz	HL562E	102173	LAB000673	C	2022-10-17 → 36M → 2025-10-17
3	Power Supply	Chroma	61602		LAB000507	NR	–
4	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
5	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
6	Antenna Mast	Berlebach	Tripod HFH2-Z8 & -Z9	101762	LAB000292	NR	–
7	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NR	–
8	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
9	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	C	2024-07-18 → 12M → 2025-07-18
10	Semi/Fully Anechoic Chamber	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	CM	2024-01-28 → 24M → 2026-01-28
11	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
12	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
13	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
14	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
15	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NR	–
16	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	CM	2022-05-31 → 36M → 2025-05-31
18	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2023-05-15 → 36M → 2026-05-15
19	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2022-12-22 → 36M → 2025-12-22
20	Open Switch and Control Platform	Rohde & Schwarz	OSP220 Base Unit 2HU	101748	LAB000149	NR	–
21	Antenna	Rohde & Schwarz	HFH2-Z2E	100954	LAB000108	C	2023-05-05 → 36M → 2026-05-05

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna at 3 m
EMC32 software version: 11.20.00

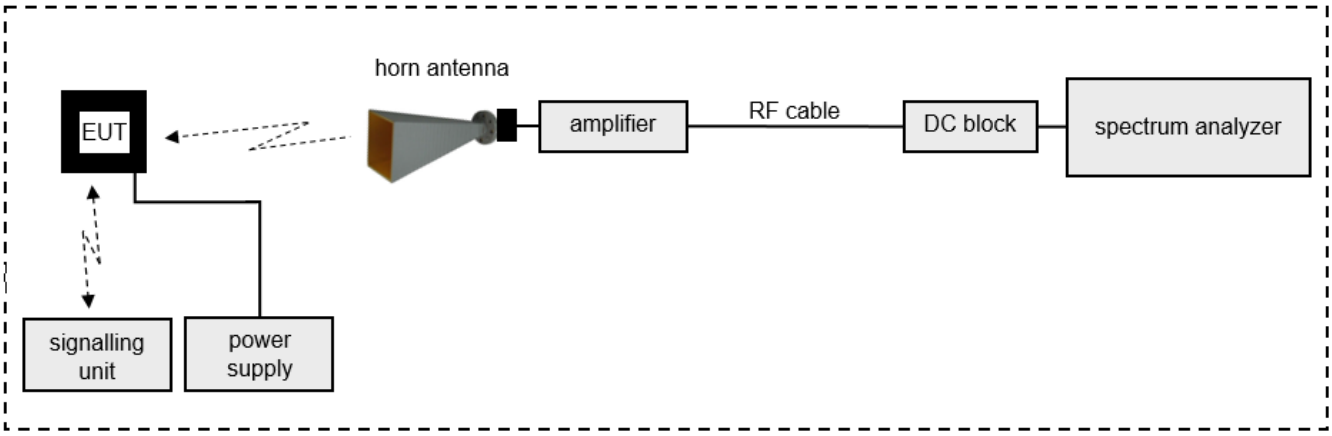
ROP = AV + D - G
(ROP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

Example calculation:
ROP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 µW)

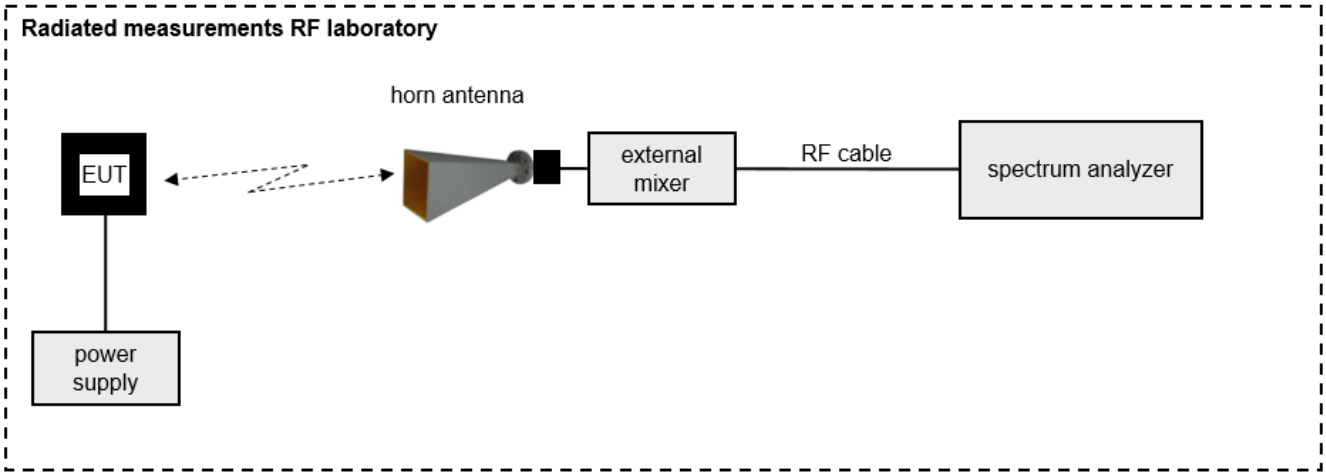
List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Rohde & Schwarz	IN 600	101126	LAB000684	NR	–
2	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
3	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
4	Power Supply	Chroma	61604	616040005416	LAB000285	NR	–
5	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NR	–
6	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
7	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	C	2024-07-18 → 12M → 2025-07-18
8	Semi/Fully Anechoic Chamber	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	C	2024-02-28 → 24M → 2026-02-28
9	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
10	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
11	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
12	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
13	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NR	–
14	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
15	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2023-05-15 → 36M → 2026-05-15
16	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2022-12-22 → 36M → 2025-12-22
17	Open Switch and Control Platform	Rohde & Schwarz	OSP220 Base Unit 2HU	101748	LAB000149	NR	–
18	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	C	2023-06-13 → 36M → 2026-06-13
19	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	C	2023-04-05 → 36M → 2026-04-05
20	Antenna	Rohde & Schwarz	HFH2-Z2E	100954	LAB000108	C	2023-05-05 → 36M → 2026-05-05

8.3 Radiated measurements > 18 GHz



8.4 Radiated measurements > 50 GHz



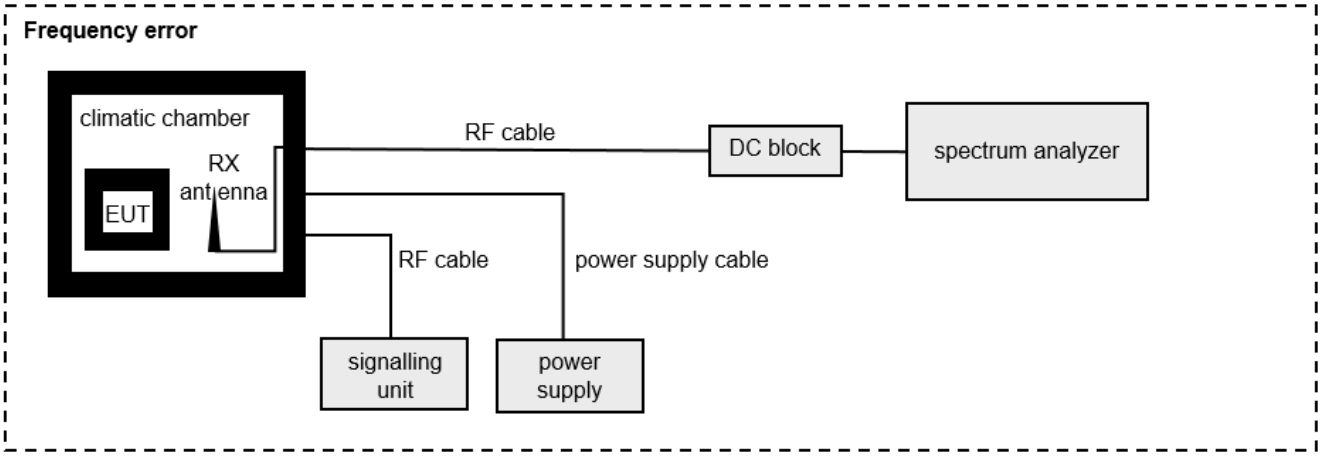
Measurement distance: Horn antenna e.g. 10 cm @ 170 GHz

ROP = AV + D - PA - G
(ROP-rad. output power; AV-analyzer value; PA preamplifier; D-free field attenuation of measurement distance; G-antenna gain)

Example calculation:
ROP [dBm] = -72.63 [dBm] + 57.05 [dB] - 26.4 [dB] - 20.02 [dBi] = -62 [dBm]

Note: Conversion loss of mixer, as well as above mentioned values (e.g. PA, D, G) are already included in analyzer value, due to corresponding transducer file and given offset.
Values in plots are final measurement values.

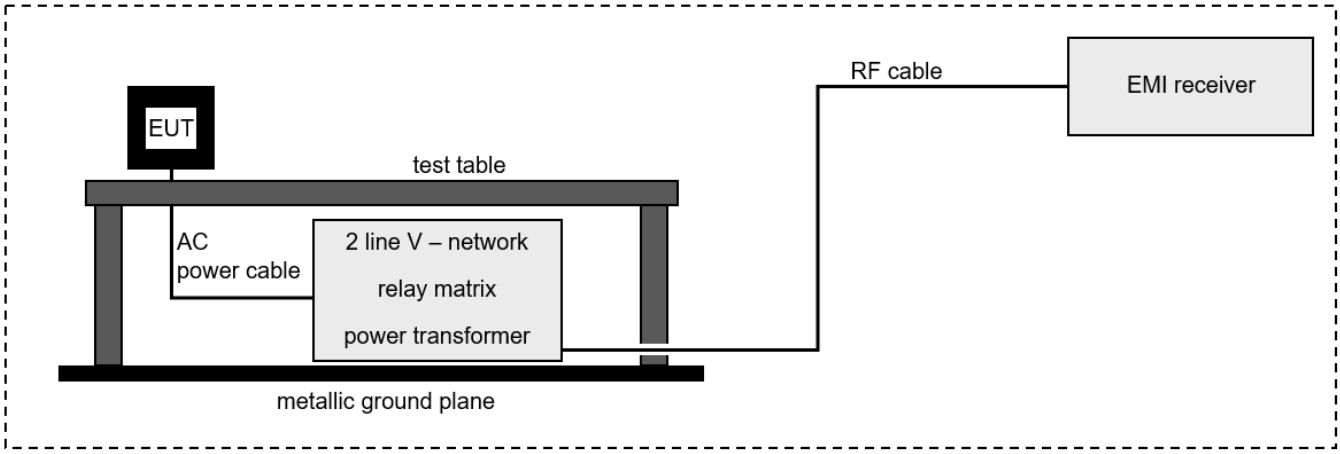
8.5 Radiated measurements under extreme conditions



List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Antenna	Flann Microwave Ltd	24240-20 (40.0-60.0 GHz)	275176	LAB000376	CM	2024-07-16 → 12M → 2025-07-16
2	Harmonic Mixer	Rohde & Schwarz	FS-Z060	101350	LAB000375	C	2024-04-11 → 12M → 2025-04-11
3	Absorber	Telemeter Electronic	EPP 12	-	LAB000327	NR	–
4	Test table	innco systems GmbH	PT0707-RH light	-	LAB000303	NR	–
5	Filter (Coax/WG, LPF, HPF, Band)	TTE	10-WHPF-84.5-UG387	-	LAB000299	NR	–
6	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2,878E+09	LAB000189	NR	–
7	WG-Coax-Adapter	Flann Microwave Ltd	23373-TF30 UG383/U	273384	LAB000184	CM	2024-07-16 → 12M → 2025-07-16
8	WG-Coax-Adapter	Flann Microwave Ltd	22093-TF30 UG599/U	273263	LAB000183	CM	2024-07-16 → 12M → 2025-07-16
9	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273373	LAB000180	CM	2024-07-16 → 12M → 2025-07-16
10	Antenna	Flann Microwave Ltd	30240-20 (140-220 GHz)	273390	LAB000178	CM	2024-07-16 → 12M → 2025-07-16
11	Antenna	Flann Microwave Ltd	28240-20 (90.0-140 GHz)	273371	LAB000176	CM	2024-07-16 → 12M → 2025-07-16
12	Harmonic Mixer	Rohde & Schwarz	FS-Z500	101020	LAB000174	C	2024-05-08 → 12M → 2025-05-08
13	Coaxial Cable	Huber & Suhner	SF101/1.0m	503989/1	LAB000163	CM	2024-07-17 → 12M → 2025-07-17
14	Coaxial Cable	Rosenberger	LU7-022-1000	34	LAB000154	CM	2024-07-17 → 12M → 2025-07-17
15	Coaxial Cable	Rosenberger	LU7-022-1000	33	LAB000153	CM	2024-07-17 → 12M → 2025-07-17
16	Antenna	Flann Microwave Ltd	32240-20 (220-325 GHz)	273469	LAB000152	CM	2024-07-16 → 12M → 2025-07-16
17	Antenna	Flann Microwave Ltd	29240-20 (110-170 GHz)	273382	LAB000139	CM	2024-07-16 → 12M → 2025-07-16
18	Antenna	Flann Microwave Ltd	27240-20 (75.0-110 GHz)	273367	LAB000137	CM	2024-07-16 → 12M → 2025-07-16
19	Antenna	Flann Microwave Ltd	26240-20 (60.0-90.0 GHz)	273417	LAB000135	CM	2024-07-16 → 12M → 2025-07-16
20	Antenna	Flann Microwave Ltd	22240-20 (26.5-40.0 GHz)	270448	LAB000130	CM	2024-07-16 → 12M → 2025-07-16
21	Antenna	Flann Microwave Ltd	20240-20 (18.0-26.5 GHz)	266402	LAB000127	CM	2024-07-16 → 12M → 2025-07-16
22	Harmonic Mixer	Rohde & Schwarz	FS-Z170	100996	LAB000126	C	2024-05-07 → 12M → 2025-05-07
23	Harmonic Mixer	Rohde & Schwarz	FS-Z325	101015	LAB000117	C	2024-04-16 → 12M → 2025-04-16
24	Harmonic Mixer	Rohde & Schwarz	FS-Z220	101039	LAB000116	C	2024-04-03 → 12M → 2025-04-03
25	Harmonic Mixer	Rohde & Schwarz	FS-Z140	101144	LAB000115	C	2024-05-08 → 12M → 2025-05-08
26	Harmonic Mixer	Rohde & Schwarz	FS-Z110	102000	LAB000114	C	2024-06-11 → 12M → 2025-06-11
27	Harmonic Mixer	Rohde & Schwarz	FS-Z090	102020	LAB000113	C	2024-04-06 → 12M → 2025-04-06
28	Spectrum Analyser	Rohde & Schwarz	FSW50	101450	LAB000111	C	2024-07-25 → 12M → 2025-07-25
29	Climatic Chamber	CTS GmbH	T-65/50	204002	LAB000110	CM	2024-06-07 → 12M → 2025-06-07
30	Antenna Mast	Schwarzbeck Mess-Elektronik OHG	AM 9104	99	LAB000109	NR	–
31	Multimeter	Keysight	U1242B	MY59110034	LAB000009	C	2024-08-06 → 12M → 2025-08-06

8.6 AC conducted emissions



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)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	EMI Test Receiver	Rohde & Schwarz	EPL1000	100921	LAB000873	C	2023-12-06 → 36M → 2026-12-06
2	Shielded room	Albatross Projects GmbH	Sputnik 1 (Schirmkabine)		LAB000257	NR	–
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B200S2	101443	LAB000239	NR	–
4	Two-Line V-Network	Rohde & Schwarz	ENV216	102597	LAB000220	C	2023-11-07 → 24M → 2025-11-07

9 MEASUREMENT PROCEDURES

9.1 Radiated spurious emissions from 9 kHz to 30 MHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- For each turntable position the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated with special 3D adapter set to find maximum level of emissions.
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade of distance in the region closer than λ in m divided by 2π (i.e., λ/2π), and at 20 dB/decade of distance beyond that, using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the limit line of corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.2 Radiated spurious emissions from 30 MHz to 1 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable position / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.3 Radiated spurious emissions from 1 GHz to 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- Antenna polarisation is changed (H-V / V-H).
- For each turntable position and antenna polarisation the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.4 Radiated spurious emissions above 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- EUT is powered on and set into operation.
- Test distance depends on EUT size and test antenna size (far field conditions shall be met).

Pre-scan

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

Final measurement

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4 / C63.26).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

Note

- In case of measurements with external harmonic mixers (e.g. above 50 GHz) special care is taken to avoid possible overloading of the external mixer's input.
- As external harmonic mixers may generate false images, care is taken to ensure that any emission measured by the spectrum analyzer is indeed radiated from the EUT and not internally generated by the external harmonic mixer. Signal identification feature of spectrum analyzer is used to eliminate/reduce images of the external harmonic mixer.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., $\lambda/2\pi$), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

10 MEASUREMENT UNCERTAINTIES

Radio frequency	≤ ± 10 ppm
Radiated emission	≤ ± 6 dB
Temperature	≤ ± 1 °C
Humidity	≤ ± 5 %
DC and low frequency voltages	≤ ± 3 %

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.

End of Test Report