



Deutsche
Akkreditierungsstelle
D-PL-21375-01-00



BNetzA-CAB-21/21-21

Partial Test Report

Test report no.: 22057336-28038-2

Date of issue: 2023-12-22

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

Applicant

USM U.Schaerer Sons INC.

Manufacturer

BURG Lüling GmbH & Co. KG

Test Item

Lock C

RF-Spectrum Testing according to:

FCC 47 CFR Part 15

Radio Frequency Devices (Subpart C)

Tested by
(name, function, signature)

Karsten Gerald
Lab Manager RF


signature

Approved by
(name, function, signature)

Andreas Bender
Deputy Managing Director


signature

Applicant and Test item details	
Applicant	USM U.Schaerer Sons INC. 28-30 Greene Street New York, 10013, USA
Manufacturer	BURG Lüling GmbH & Co. KG Volmarsteiner Straße 52 58089, Hagen, Germany
Test item description	Electronic furniture lock
Model/Type reference	Lock C
Standard specific information	
FCC ID	2BBFS-LOCK1C
Frequency	2.4 GHz ISM band (2400 – 2483.5 MHz)
Antenna	Integrated PCB antenna
Power supply	2x ½ AA 6 VDC batteries
Temperature range	5 °C to +50 °C

Disclaimer and Notes

The content of this test report relates to the mentioned test sample(s) only.
Without a written permit of IBL-Lab GmbH, this test report shall not be reproduced, except in full.

The last valid version is available at TAMSys®.

Copyright ©: All rights reserved by IBL-Lab GmbH

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

IBL-Lab GmbH does not take test samples. The samples used for testing are provided by the applicant.

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

1	TABLE OF CONTENTS	3
2	GENERAL INFORMATION	4
2.1	Administrative details	4
2.2	Possible test case verdicts	5
2.3	Observations	5
2.4	Opinions and interpretations	5
2.5	Revision history	5
2.6	Further documents	5
3	ENVIRONMENTAL & TEST CONDITIONS	6
3.1	Environmental conditions	6
3.2	Normal and extreme test conditions	6
4	TEST STANDARDS AND REFERENCES	6
5	EQUIPMENT UNDER TEST (EUT)	7
5.1	Product Description	7
5.2	Test Item Description	7
5.3	Technical Data of Equipment	7
5.4	Additional Information	7
5.5	Test modes	8
6	SUMMARY OF TEST RESULTS	9
7	TEST RESULTS	10
7.1	RF Output Power (Conducted Peak Power)	10
7.2	Band Edge Compliance (BEC), radiated	14
7.3	Radiated Spurious Emissions (RSE)	19
8	TEST SETUP DESCRIPTION	44
8.1	Semi Anechoic Chamber with Ground Plane	45
8.2	Fully Anechoic Chamber	47
8.3	Conducted measurements WLAN test system R&S TS 8997	49
9	MEASUREMENT UNCERTAINTIES	50
Annex A	EUT Photographs, external	51
Annex B	EUT Photographs, internal	53
Annex C	Test Setup Photographs	54

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: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	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	2023-01-17
Start – End of tests	2023-01-17 – 2023-01-26

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
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: applicant changed according to remark

-2 Revision: reference to module report added on page no. 9

This test report 22057336-28038-2 replaces the previous test report 22057336-28038-1.

Utilisation, publication and control of previous report editions is under responsibility of the applicant.

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 / 50 Hz

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	°C	20 °C	°C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	V DC	6.0 V DC	V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)

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
558074 D01 15.247 Meas Guide v05r02	Guidance for compliance measurements on digital transmission systems, frequency hopping spread spectrum systems and hybrid system devices operating under section 15.247 of the FCC rules

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description

Electronic furniture lock

*: as declared by applicant

5.2 Test Item Description

Model name*	Lock C
Serial number*	(indicate test item)
PCB identifier*	(indicate test item)
Hardware status*	1.62
Software status*	5.102

*: as declared by applicant

5.3 Technical Data of Equipment

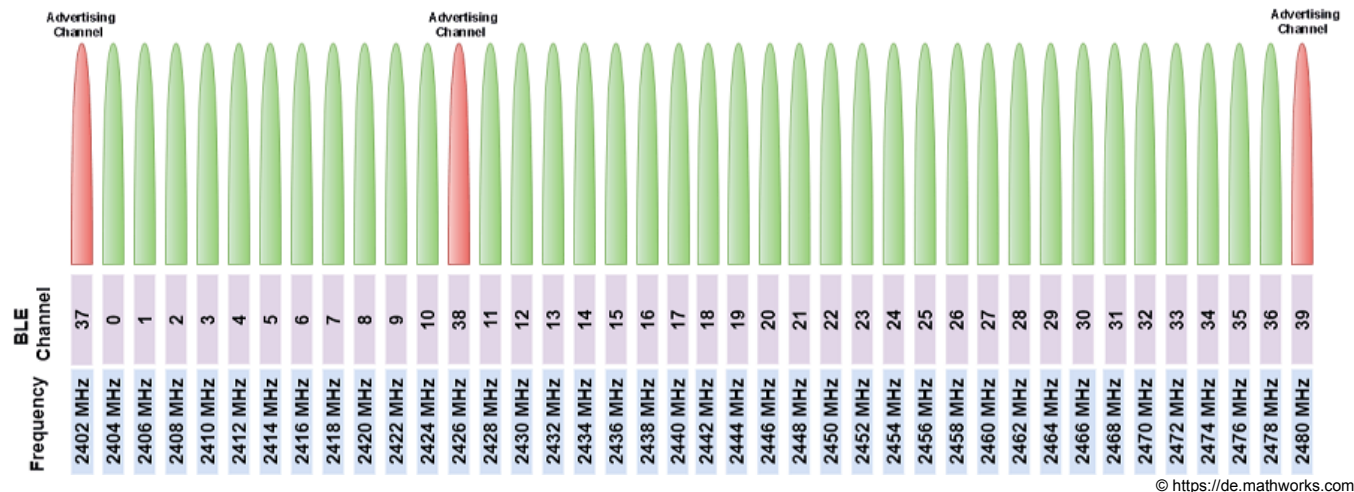
Operational frequency band*	2.4 GHz ISM band (2400 – 2483.5 MHz)
Modulation type*	GFSK
Data rate*	LE 2M PHY: 2 Mb/s LE 1M PHY: 1 Mb/s LE Coded PHY (S=2): 500 Kb/s LE Coded PHY (S=8): 125 Kb/s
Number of channels*	40 (3 advertising channels, 37 data channels)
Channel bandwidth*	2 MHz
Channel spacing*	2 MHz
Antenna*	Integrated PCB antenna
Rated RF Output Power*	4 mW (6 dBm)
Power supply*	2x ½ AA 6 VDC batteries
Temperature range*	5 °C to +50 °C

*: as declared by applicant; further details in clause 5.4.1 of test specification

5.4 Additional Information

Model differences	-
Ancillaries tested with	-
Additional equipment used for testing	Laptop with test software – nRF connect

5.5 Test modes	
Mode 1	GFSK, 1 Mbit/s, test mode
Mode 2	GFSK, 2 Mbit/s, test mode
Low Channel	CH37 = 2402 MHz
High Channel	CH39 = 2480 MHz



6 SUMMARY OF TEST RESULTS

Test specification

FCC 47 CFR Part 15

Clause	Requirement / Test Case	Result - Remark	Verdict
§15.247(a)(2)	DTS bandwidth (6 dB)	KDB 558074, clause: 8.2	- N/P -
§15.247(b)(3)	RF output power (peak power)	KDB 558074, clause: 8.3.1	- PASS -
§15.247(b)(4)	Antenna gain (calculated)	-/-	- N/P -
§15.247(e)	Peak power spectral density	KDB 558074, clause: 8.4	- N/P -
§15.247(d)	Band edge compliance (BEC), conducted	KDB 558074, clause: 8.5	- N/P -
§15.247(d)	Band edge compliance (BEC), radiated	KDB 558074, clause: 8.7	- PASS -
§15.247(d)	Conducted spurious emissions	KDB 558074 DTS clause: 8.5	- N/P -
§15.247(d)/§15.209	Radiated spurious emissions	-/-	- PASS -
§15.207	AC conducted emissions	EUT is battery powered	- N/A -

Comments and observations

The present test report describes partial testing based on module test report:

Report No. CTB230627030RF, of Shenzhen CTB Testing Technology Co., Ltd., issue date: 2023-07-11

7 TEST RESULTS

7.1 RF Output Power (Conducted Peak Power)

Applicability

This requirement applies to all types of DTS equipment.

Description

The RF Output Power is defined as the conducted peak output power.

Limit

§15.247

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test procedure

ANSI C63.10, 11.9.1.1

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- Set the RBW $\geq$ DTS bandwidth.
- Set VBW $\geq$ $[3 \times \text{RBW}]$.
- Set span $\geq$ $[3 \times \text{RBW}]$.
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use peak marker function to determine the peak amplitude level.

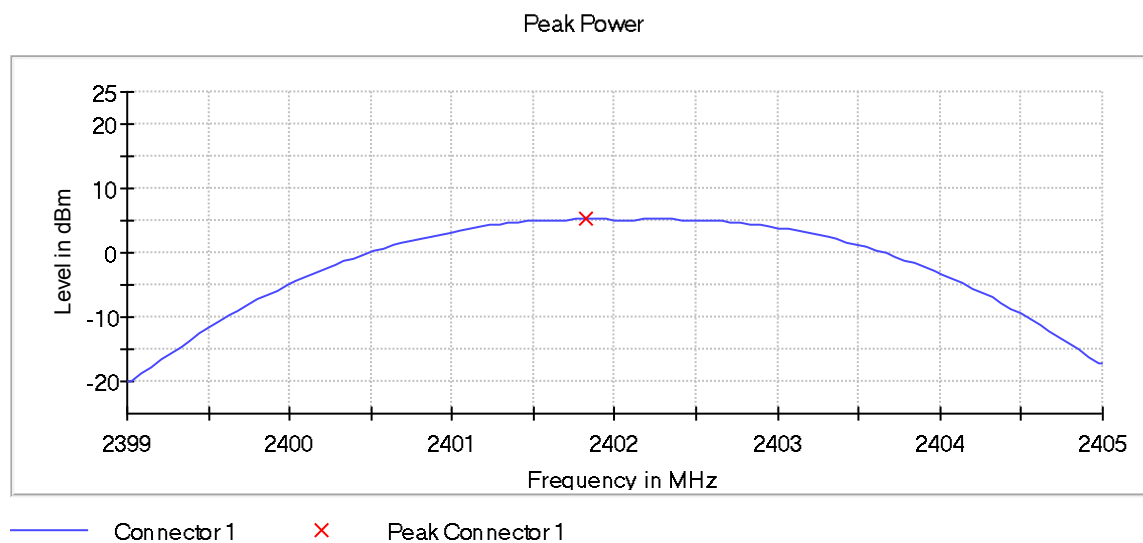
Test setup: 8.4

Test Results

EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
Mode 1	5.2	5.9	5.5	30
Mode 2	5.2	6.0	5.5	30

Comment:

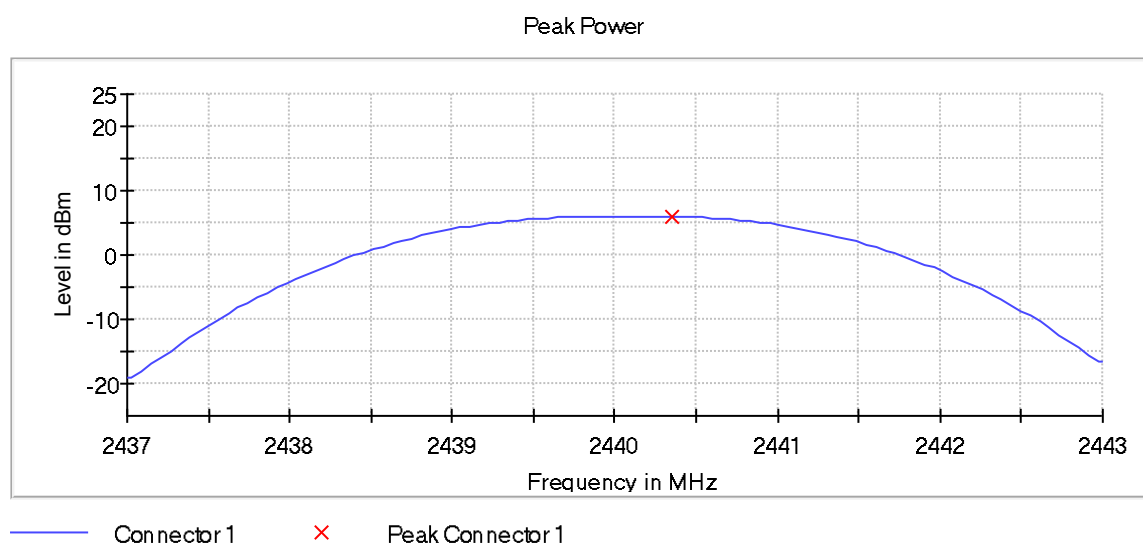
Plot 1: Mode 1, Peak Power, low channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	5.2	30.0	PASS

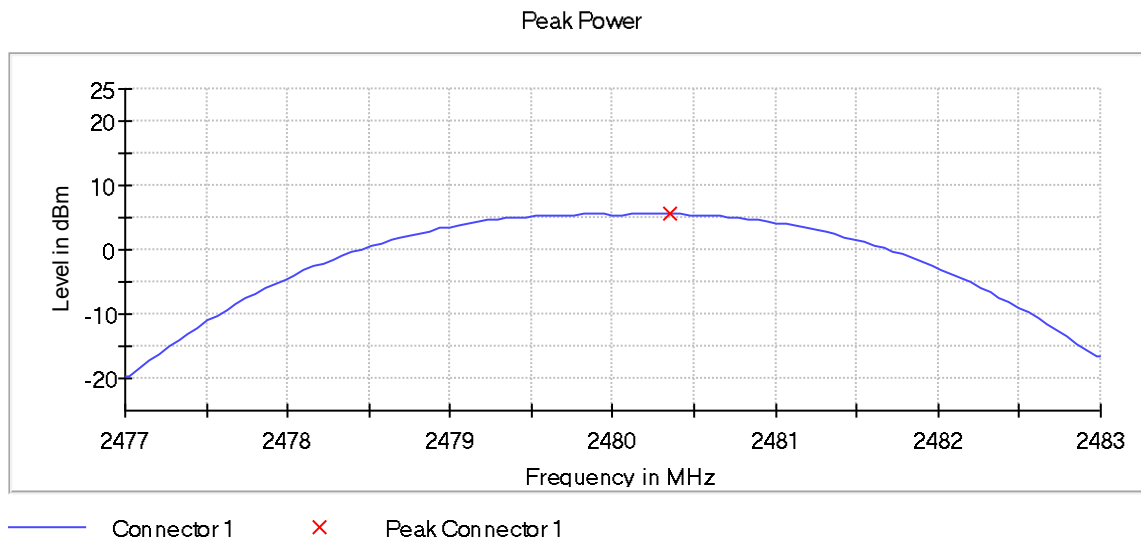
Plot 2: Mode 1, Peak Power, mid channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	5.9	30.0	PASS

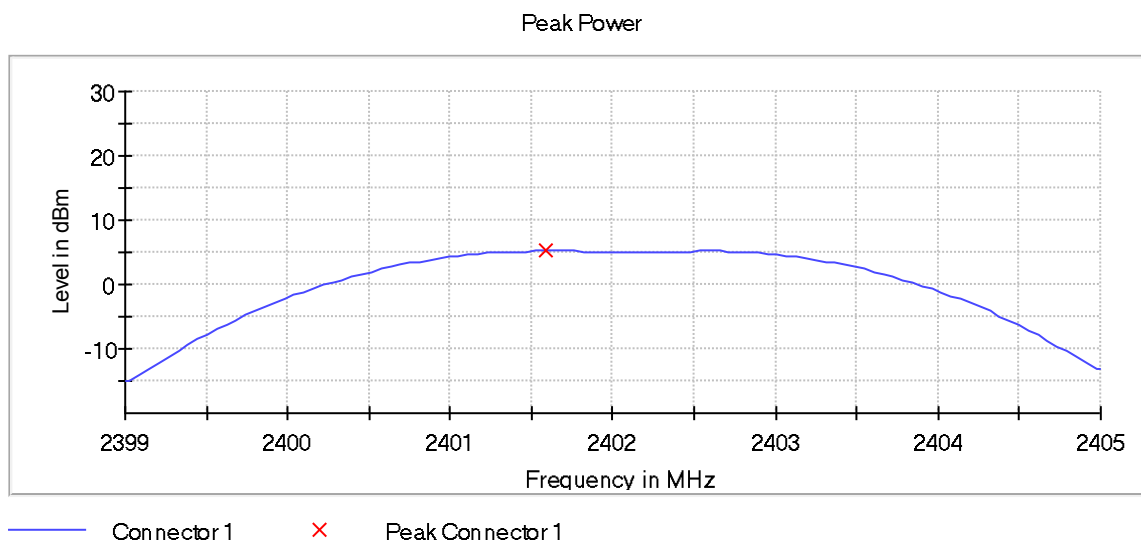
Plot 3: Mode 1, Peak Power, high channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	5.5	30.0	PASS

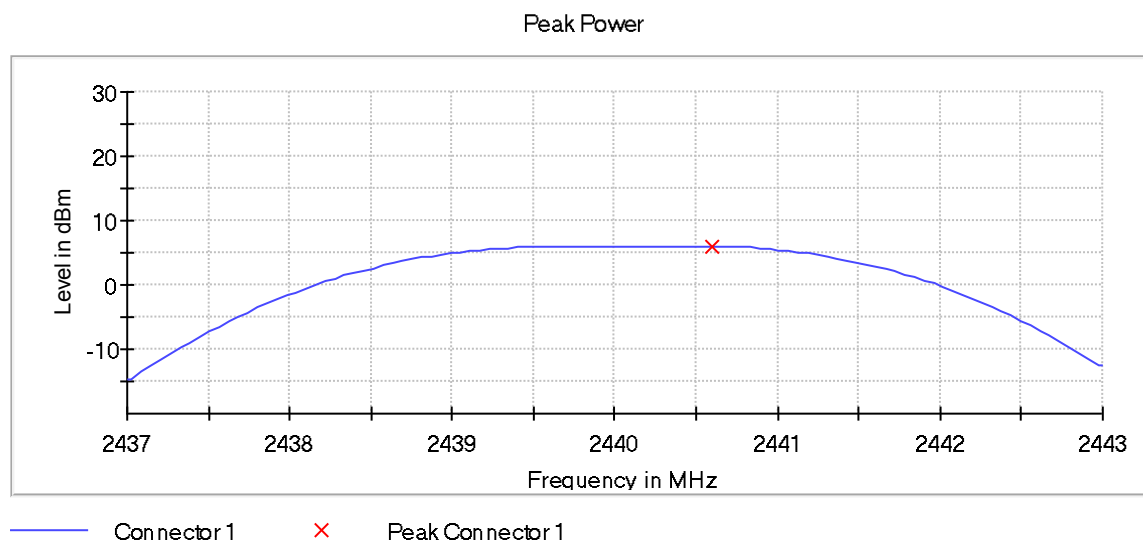
Plot 4: Mode 2, Peak Power, low channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	5.2	30.0	PASS

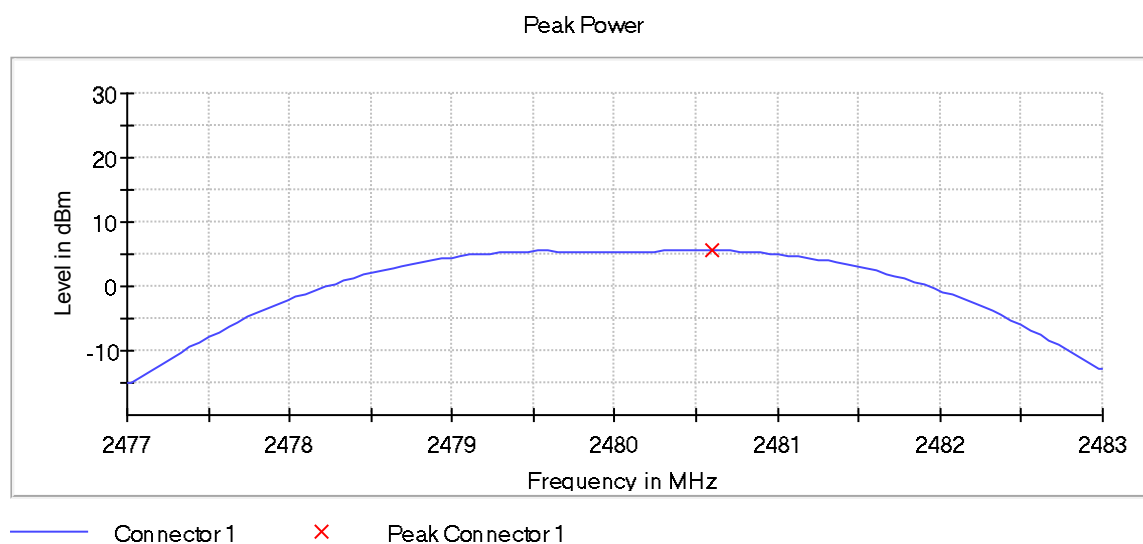
Plot 5: Mode 2, Peak Power, mid channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	6.0	30.0	PASS

Plot 6: Mode 2, Peak Power, high channel



Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	5.5	30.0	PASS

7.2 Band Edge Compliance (BEC), radiated

Applicability

This requirement applies to all types of DTS equipment.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test procedure

The marker-delta method as described in ANSI C63.10, 6.10.6 or the integration method as described in ANSI C63.10, 11.13.3 can be used to perform measurements of the unwanted emissions level at the band edges.

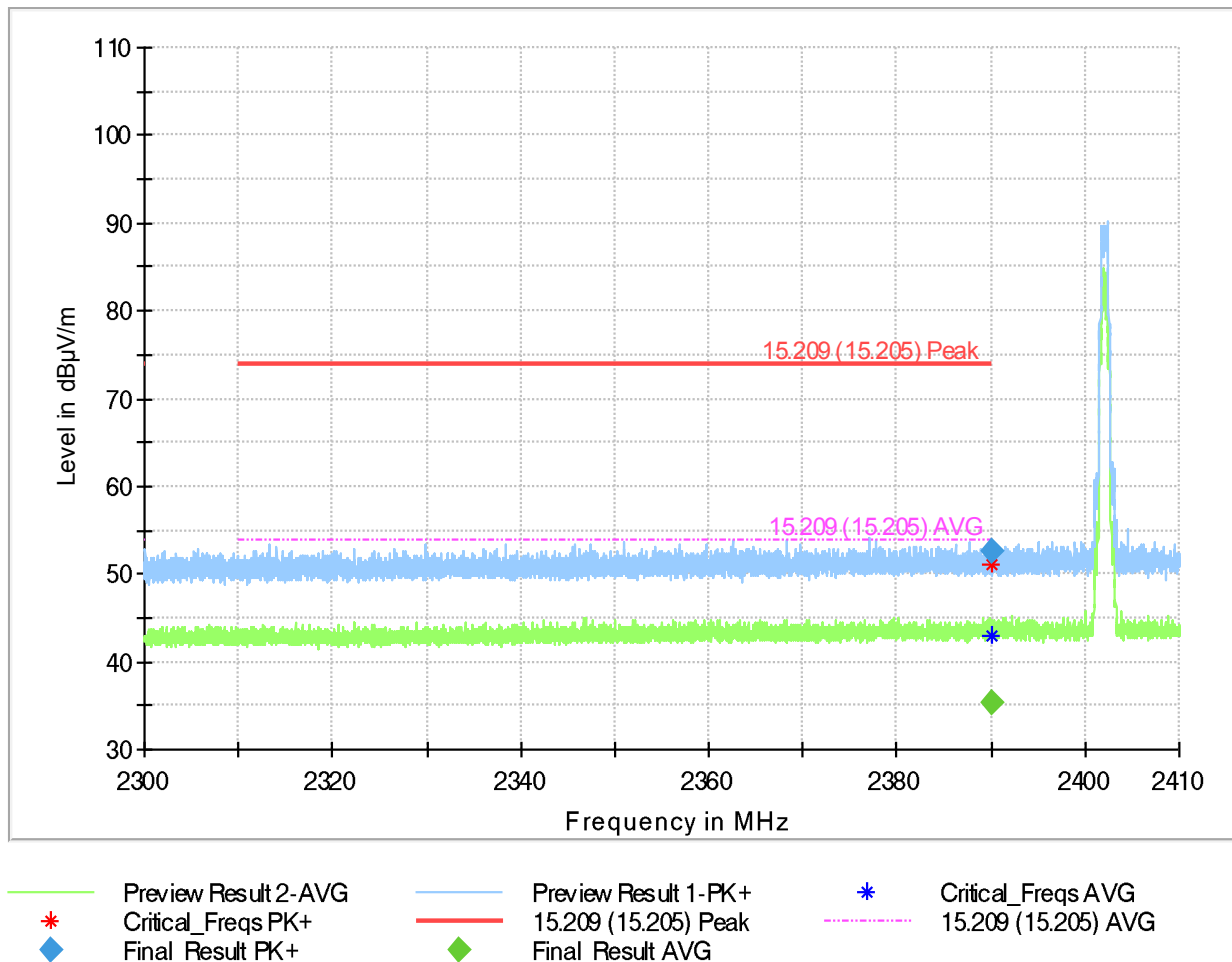
Test setup: 8.2

Test results

BEC	low channel [dμV/m @3m]	high channel [dμV/m @3m]	Limit [dμV/m @3m]
Mode 1	see plots	see plots	≤ 54 AVG / ≤ 74 PK
Mode 2	see plots	see plots	≤ 54 AVG / ≤ 74 PK

Comment:

Plot 7: Mode 1, BEC, low channel



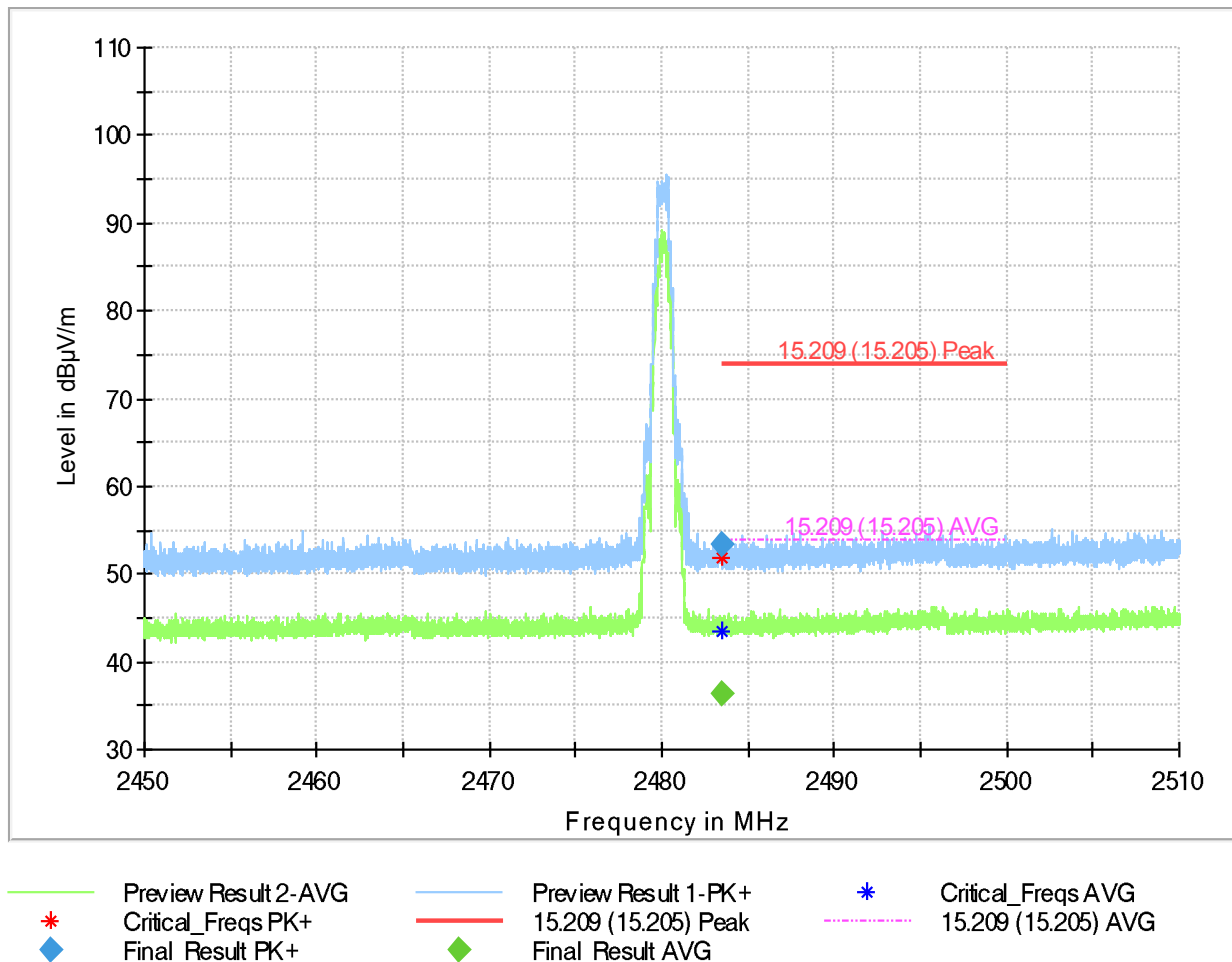
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2389.991000	---	35.45	54.00	18.55	1000.0	100.000	150.0	H
2389.991000	52.70	---	74.00	21.30	1000.0	100.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
2389.991000	22.0	0.0	32.9	11:51:42 - 19.01.2023
2389.991000	22.0	0.0	32.9	11:51:25 - 19.01.2023

Plot 8: Mode 1, BEC, high channel



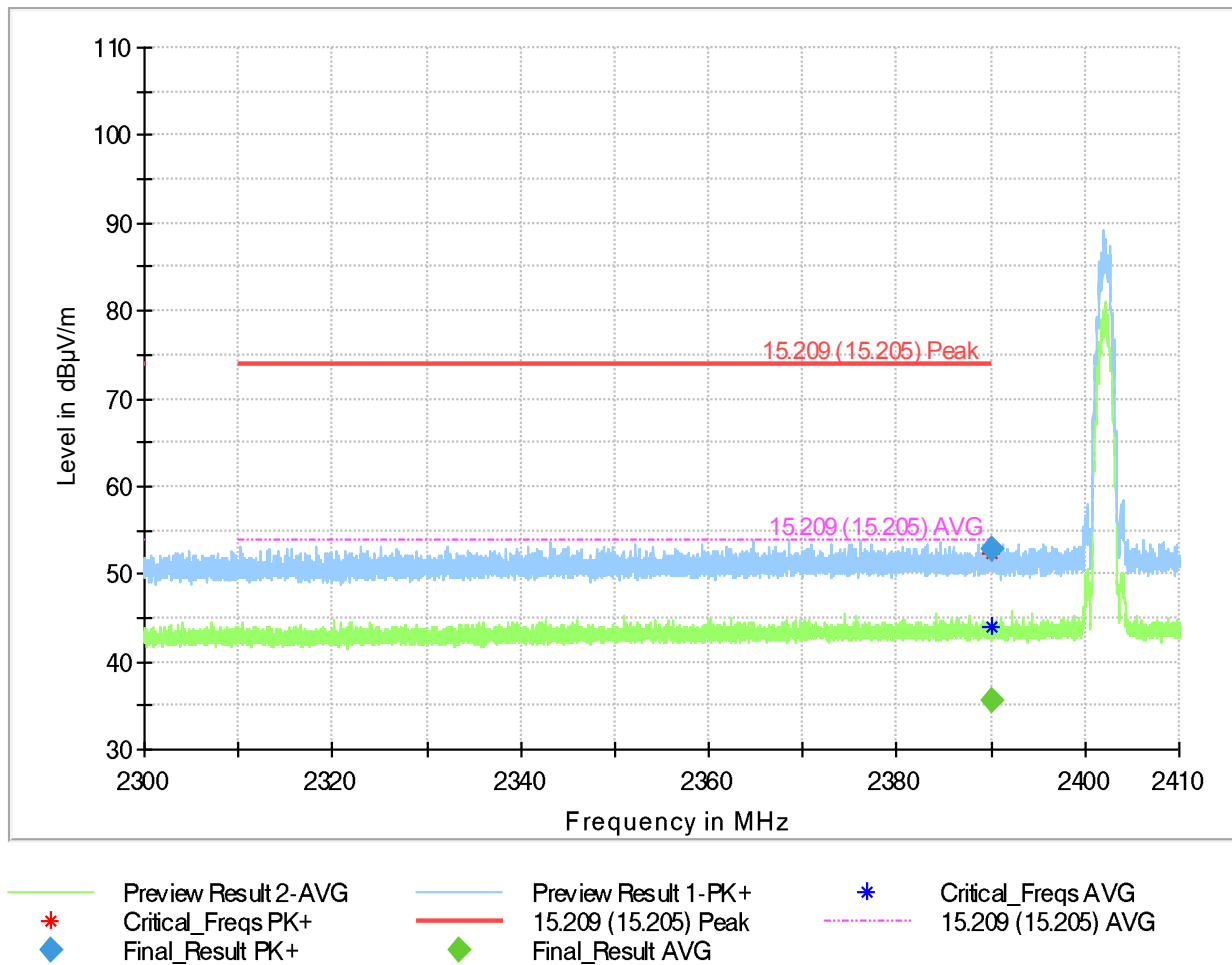
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2483.504000	---	36.42	54.00	17.58	1000.0	100.000	150.0	H
2483.504000	53.28	---	74.00	20.72	1000.0	100.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
2483.504000	69.0	0.0	33.6	12:02:31 - 19.01.2023
2483.504000	69.0	0.0	33.6	12:02:13 - 19.01.2023

Plot 9: Mode 2, BEC, low channel



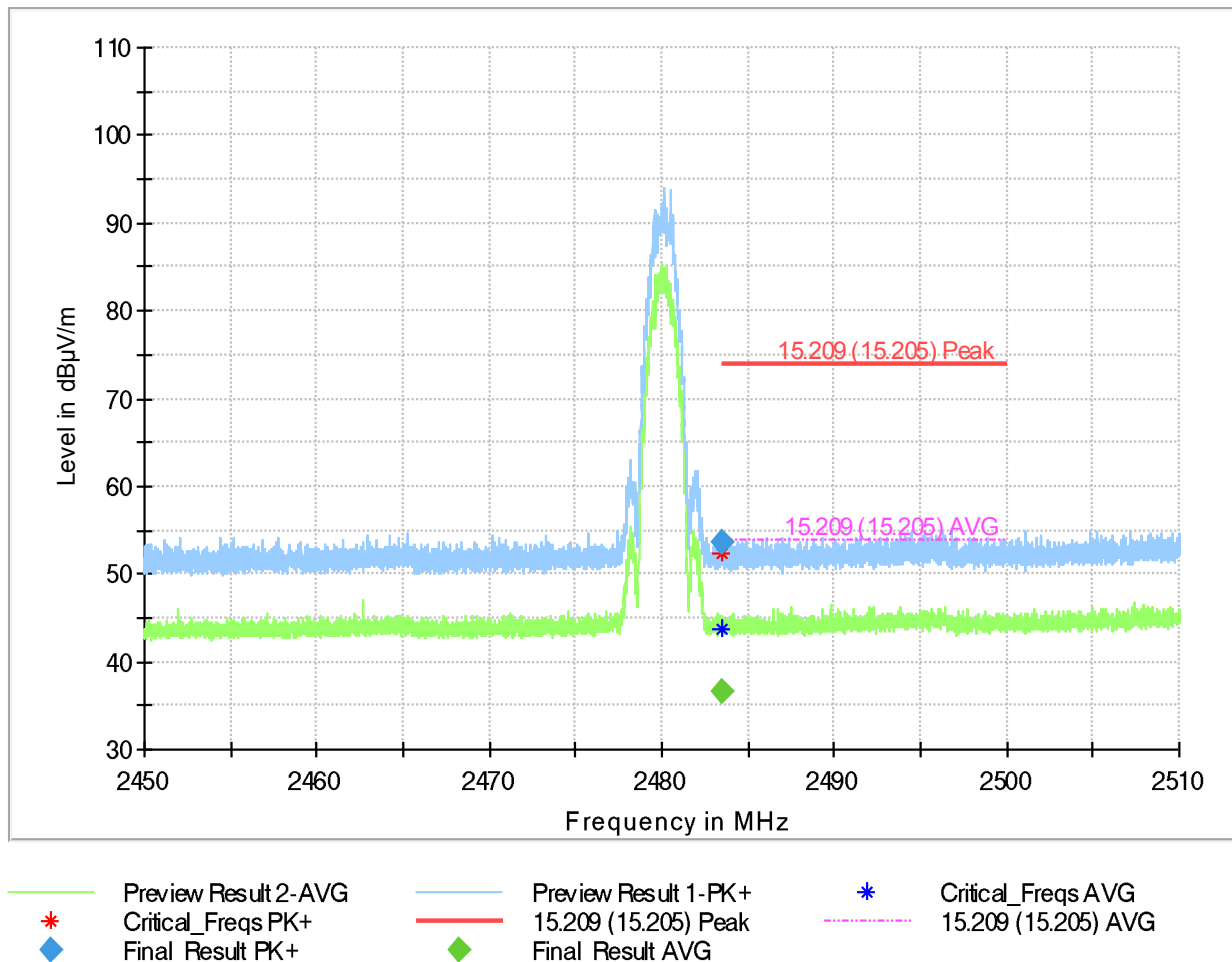
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2389.991000	52.80	---	74.00	21.20	1000.0	100.000	150.0	V
2389.991000	---	35.48	54.00	18.52	1000.0	100.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
2389.991000	86.0	0.0	32.9	11:37:31 - 19.01.2023
2389.991000	348.0	0.0	32.9	11:34:27 - 19.01.2023

Plot 10: Mode 2, BEC, high channel



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2483.498000	53.61	---	---	---	1000.0	100.000	150.0	V
2483.498000	---	36.54	---	---	1000.0	100.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
2483.498000	61.0	0.0	33.6	11:01:57 - 19.01.2023
2483.498000	3.0	0.0	33.6	10:59:58 - 19.01.2023

7.3 Radiated Spurious Emissions (RSE)

Applicability

This requirement applies to all types of DTS equipment.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products. Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency [MHz]	Field Strength [$\mu\text{V/m}$] / [dB $\mu\text{V/m}$]	Measurement distance [m]
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30.0 / 29.5	30
30 – 88	100 / 40.0	3
88 – 216	150 / 43.5	3
216 – 960	200 / 46.0	3
960 – 40 000	500 / 54.0	3

Note

Radiated Spurious Emissions (RSE) are performed for low / mid / high channel and modulation with the highest output power (worst case). In case of spurious other modulations are spot-checked.

Test setup: 8.1, 8.2 & 8.3

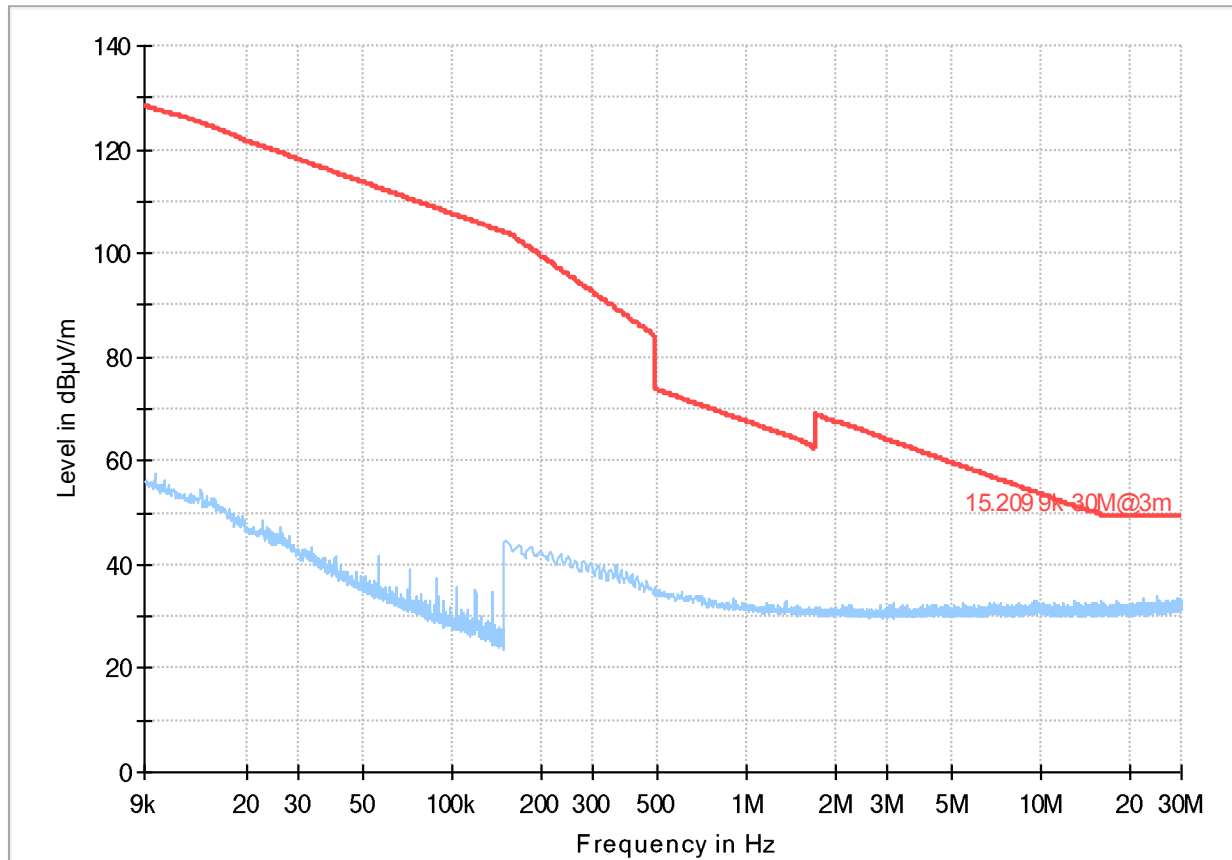
Test results

EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
(see plots)	(see plots)	(see plots)	(see plots)	(see plots)	- passed -
(see plots)	(see plots)	(see plots)	(see plots)	(see plots)	- passed -
(see plots)	(see plots)	(see plots)	(see plots)	(see plots)	- passed -

* all detected peaks are more than 6 dB below the limit

Comment:

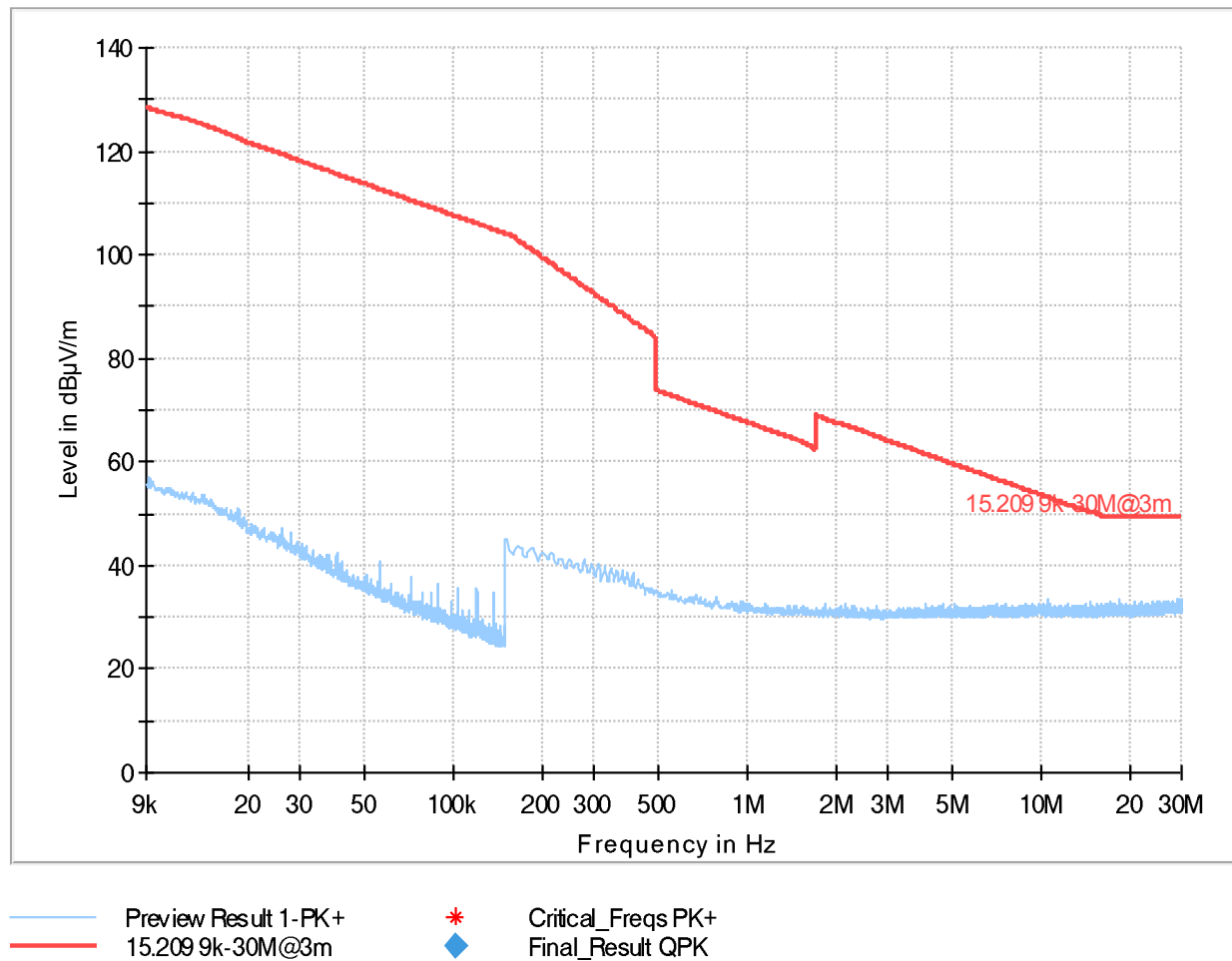
Plot 11: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna



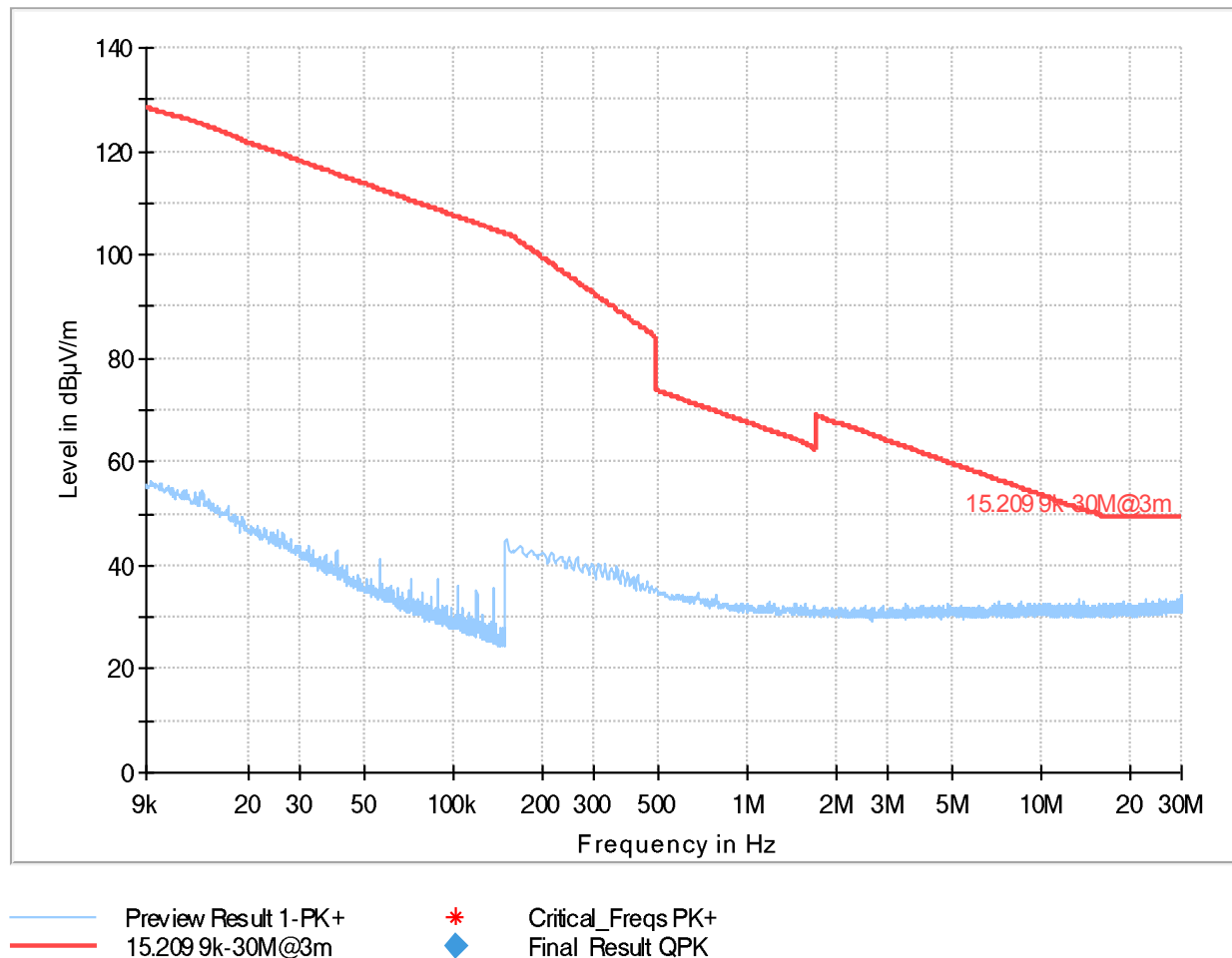
— Preview Result 1-PK+
 * Critical_Freqs PK+
 ◆ Final_Result QPK

— 15.209 9k-30M@3m

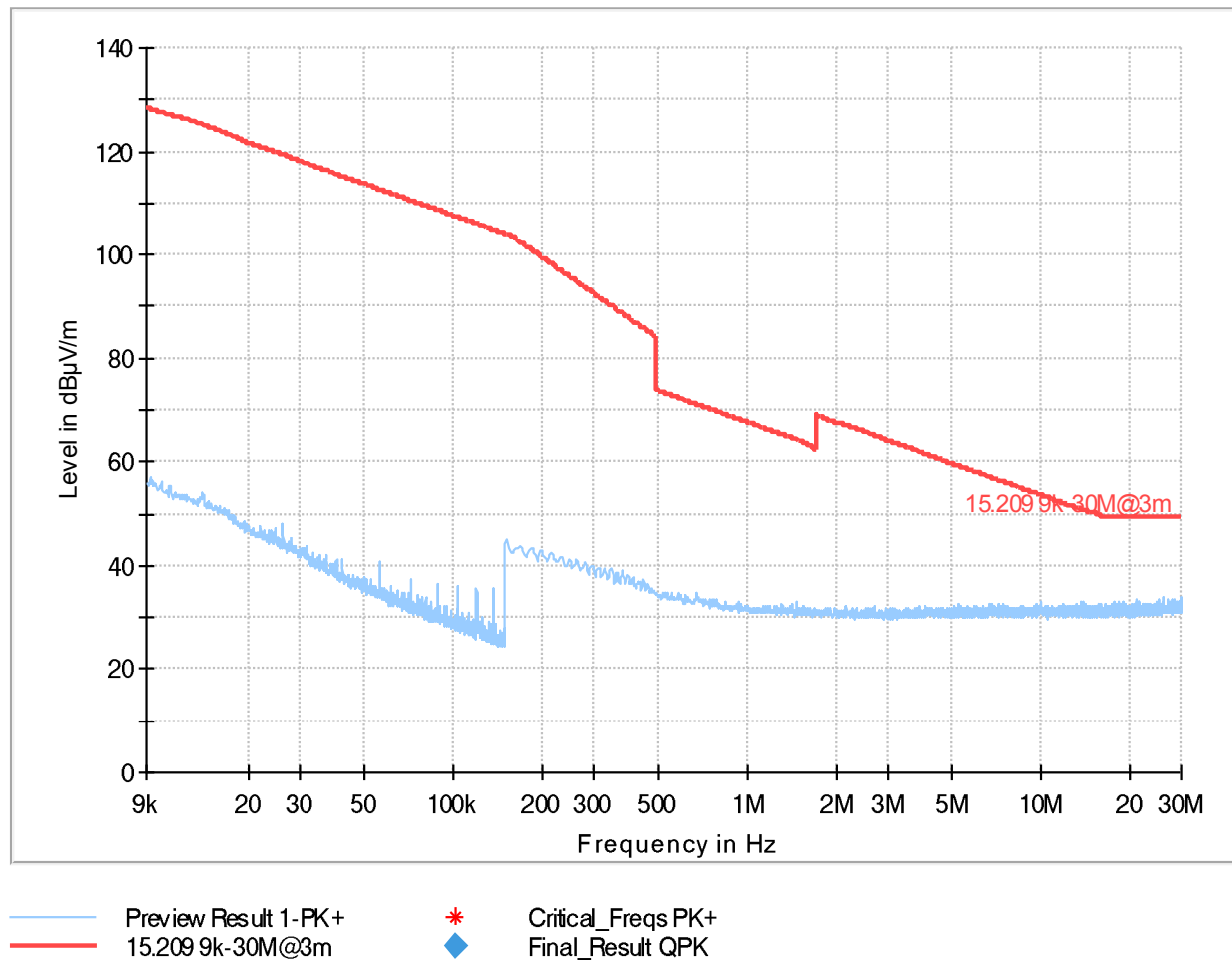
Plot 12: Mode 1, RSE 9 kHz – 30 MHz, mid channel, loop antenna



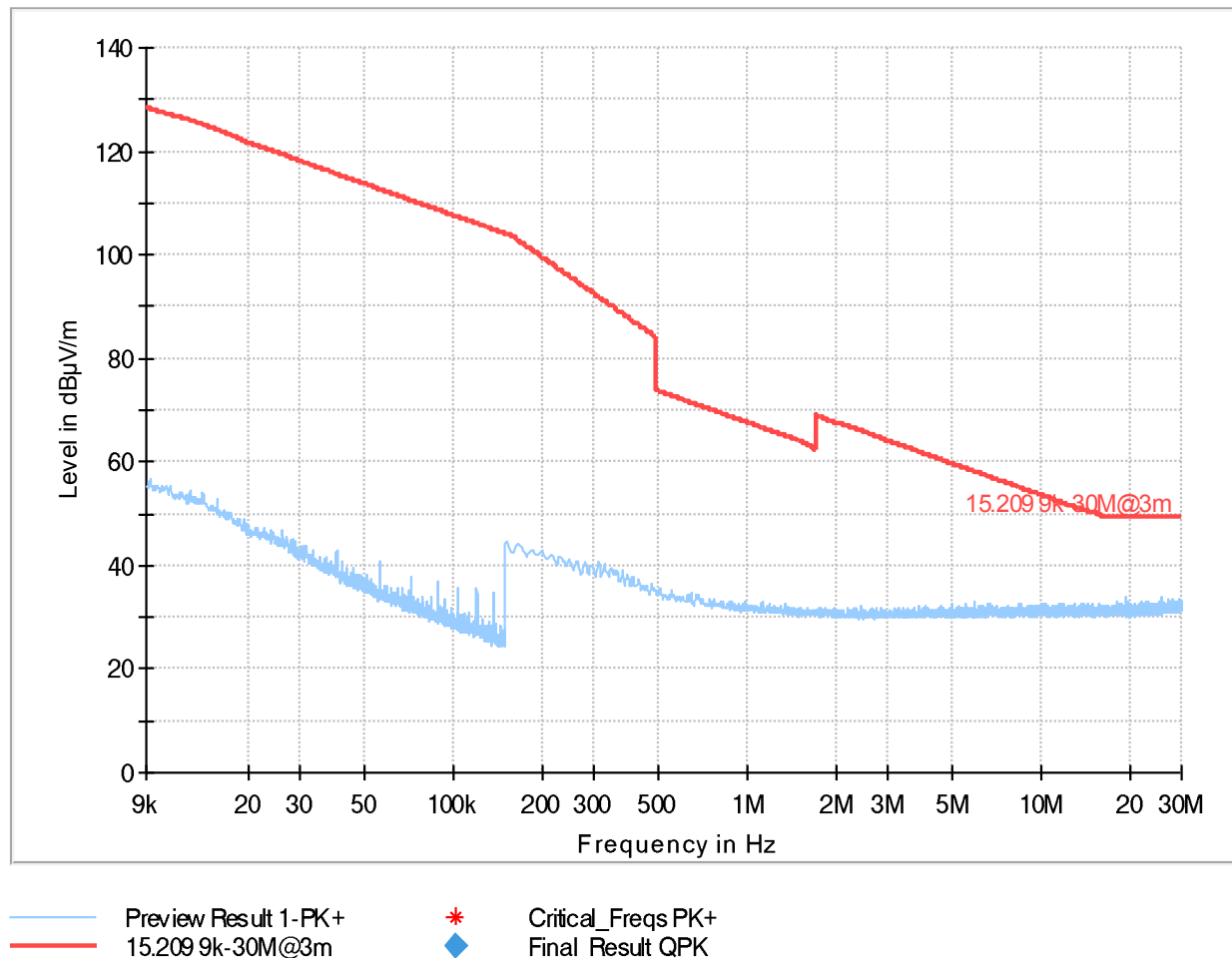
Plot 13: Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna



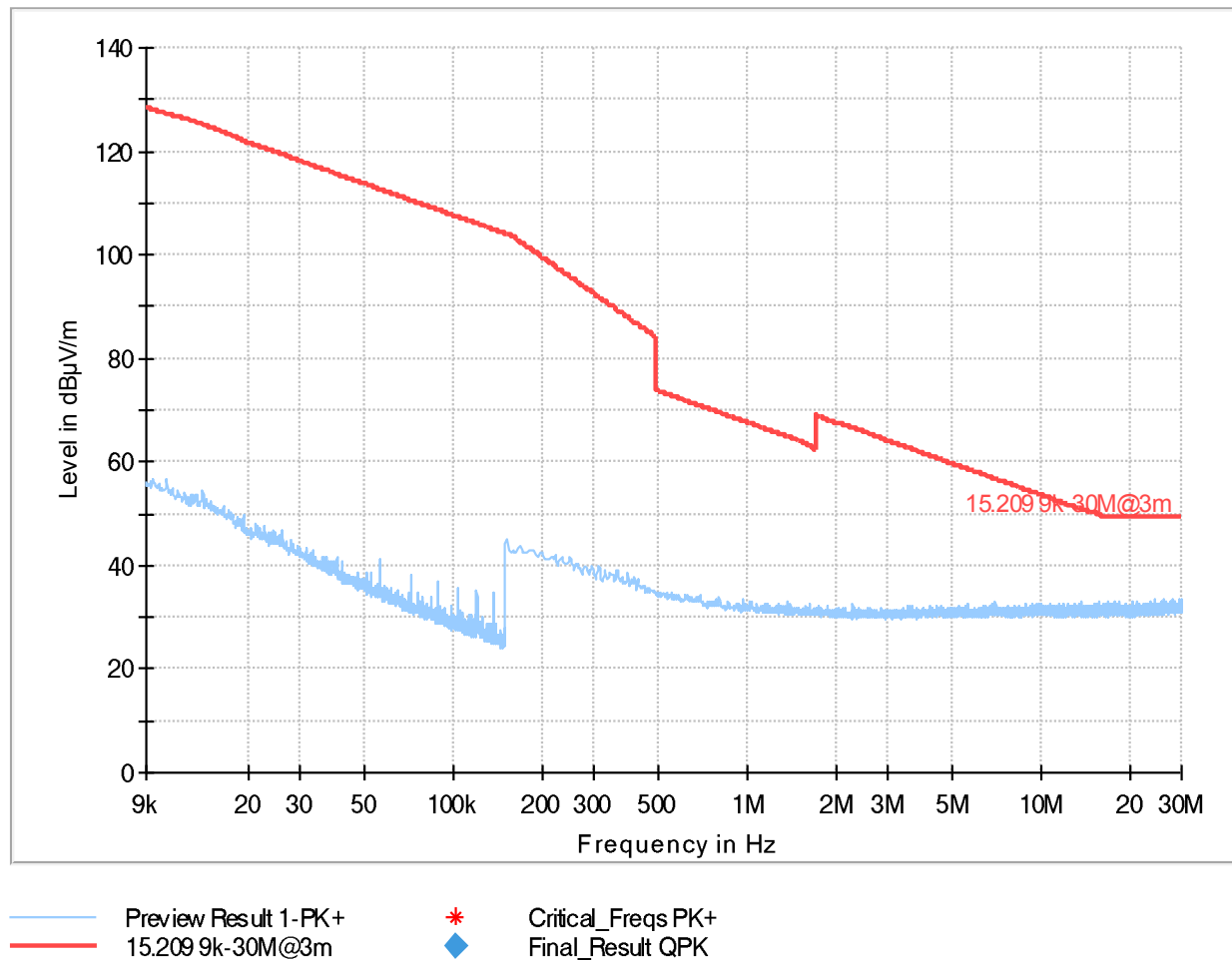
Plot 14: Mode 2, RSE 9 kHz – 30 MHz, low channel, loop antenna



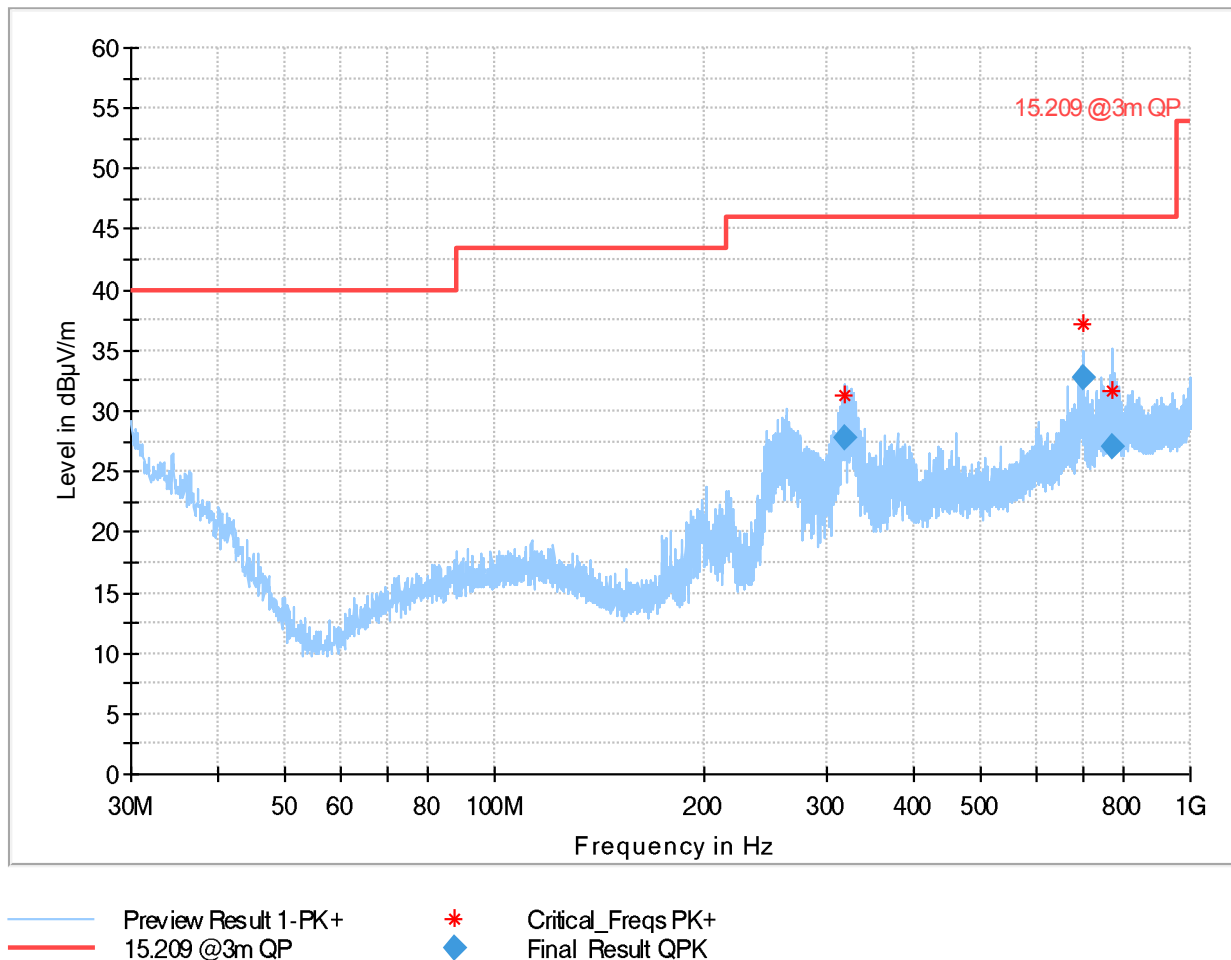
Plot 15: Mode 2, RSE 9 kHz – 30 MHz, mid channel, loop antenna



Plot 16: Mode 2, RSE 9 kHz – 30 MHz, high channel, loop antenna



Plot 17: Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation



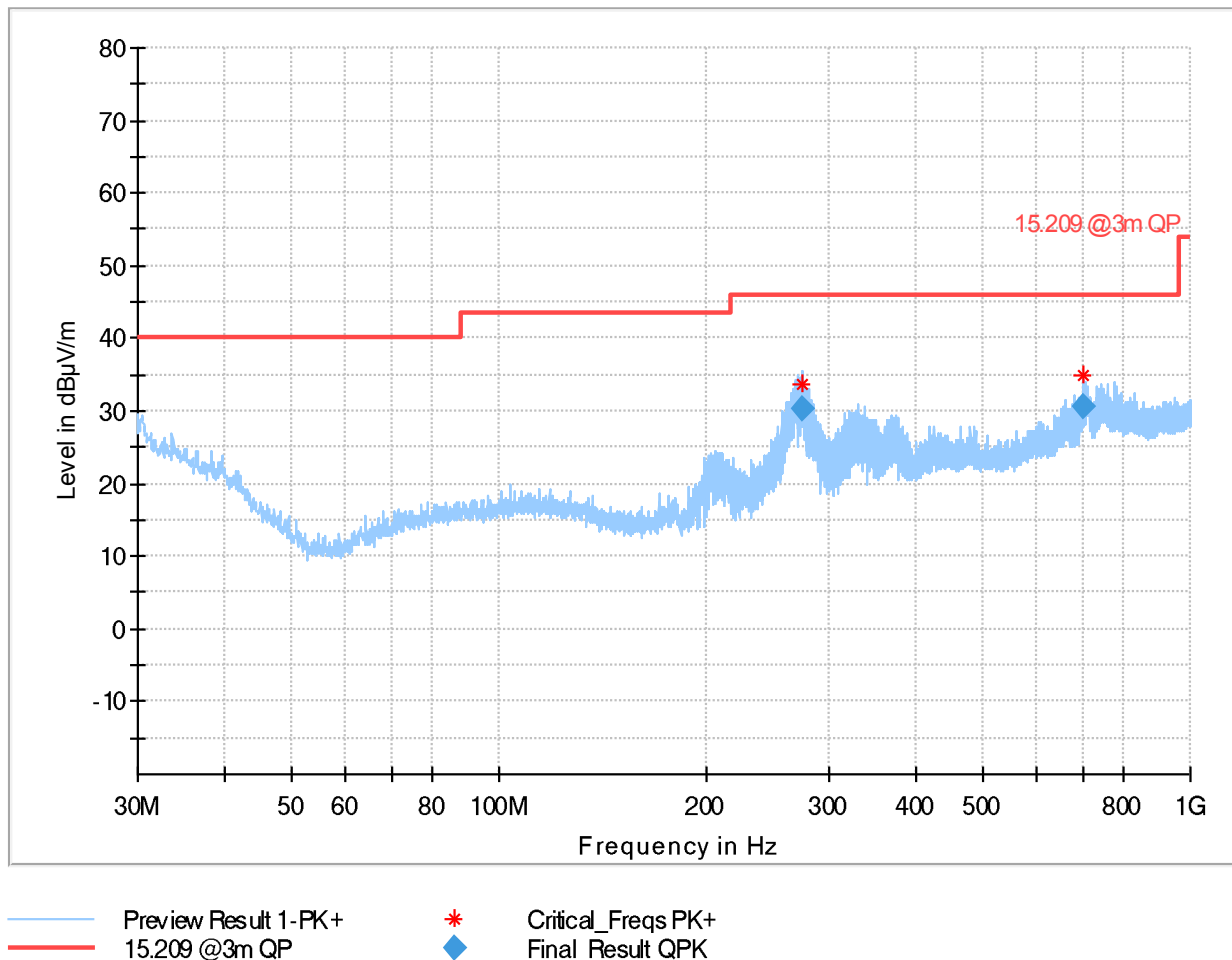
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
317.949000	27.77	46.00	18.23	100.0	120.000	100.0	H	318.0
700.351000	32.81	46.00	13.19	100.0	120.000	116.0	H	271.0
774.431000	27.11	46.00	18.89	100.0	120.000	103.0	H	67.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
317.949000	13.9	12:55:17 - 18.01.2023
700.351000	20.9	12:53:34 - 18.01.2023
774.431000	21.7	12:51:33 - 18.01.2023

Plot 18: Mode 1, RSE 30 MHz – 1 GHz, mid channel, horizontal / vertical polarisation



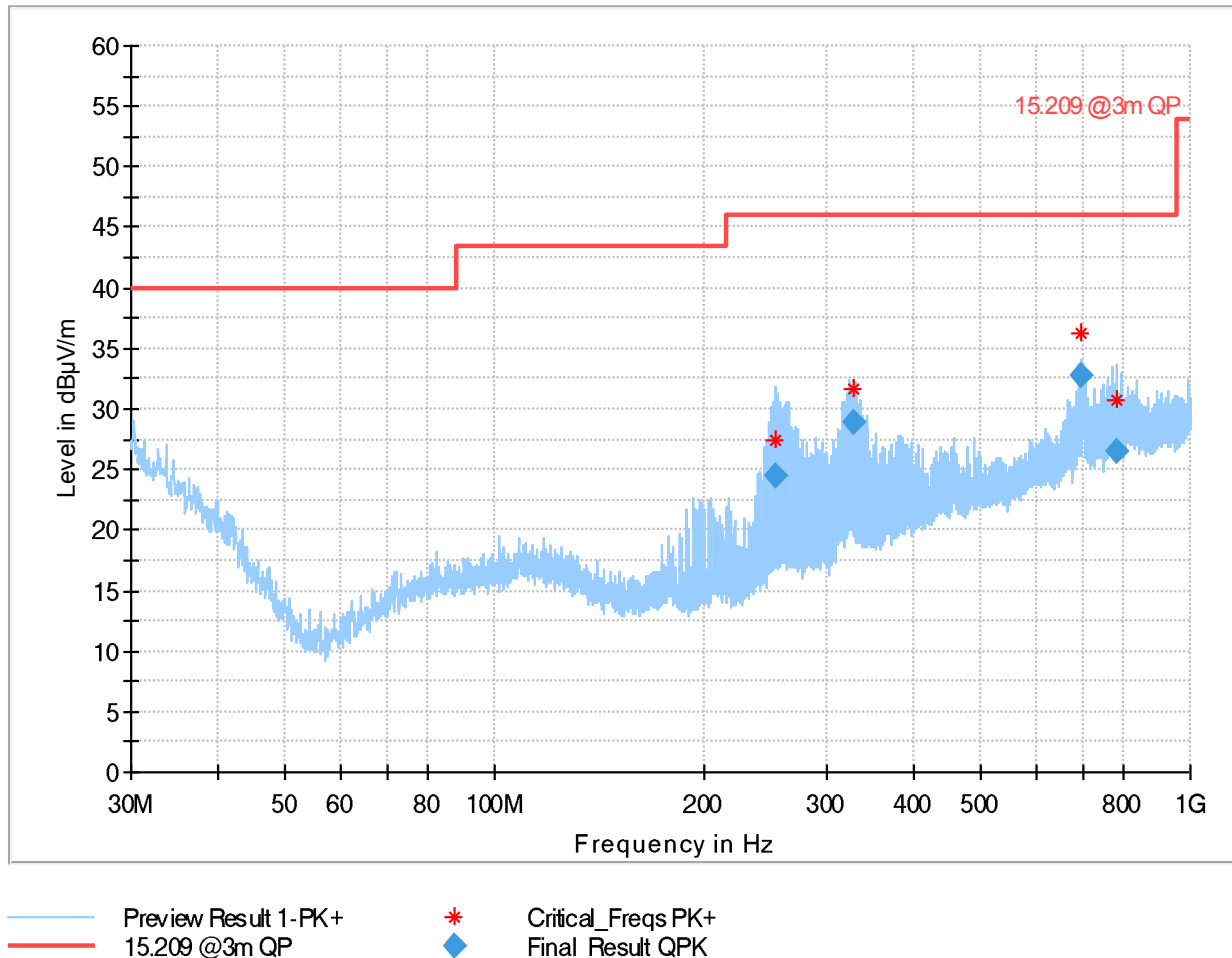
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
275.203000	30.27	46.00	15.73	100.0	120.000	103.0	H	208.0
701.451500	30.69	46.00	15.31	100.0	120.000	100.0	H	139.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
275.203000	12.6	13:10:24 - 19.01.2023
701.451500	20.9	13:08:35 - 19.01.2023

Plot 19: Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation



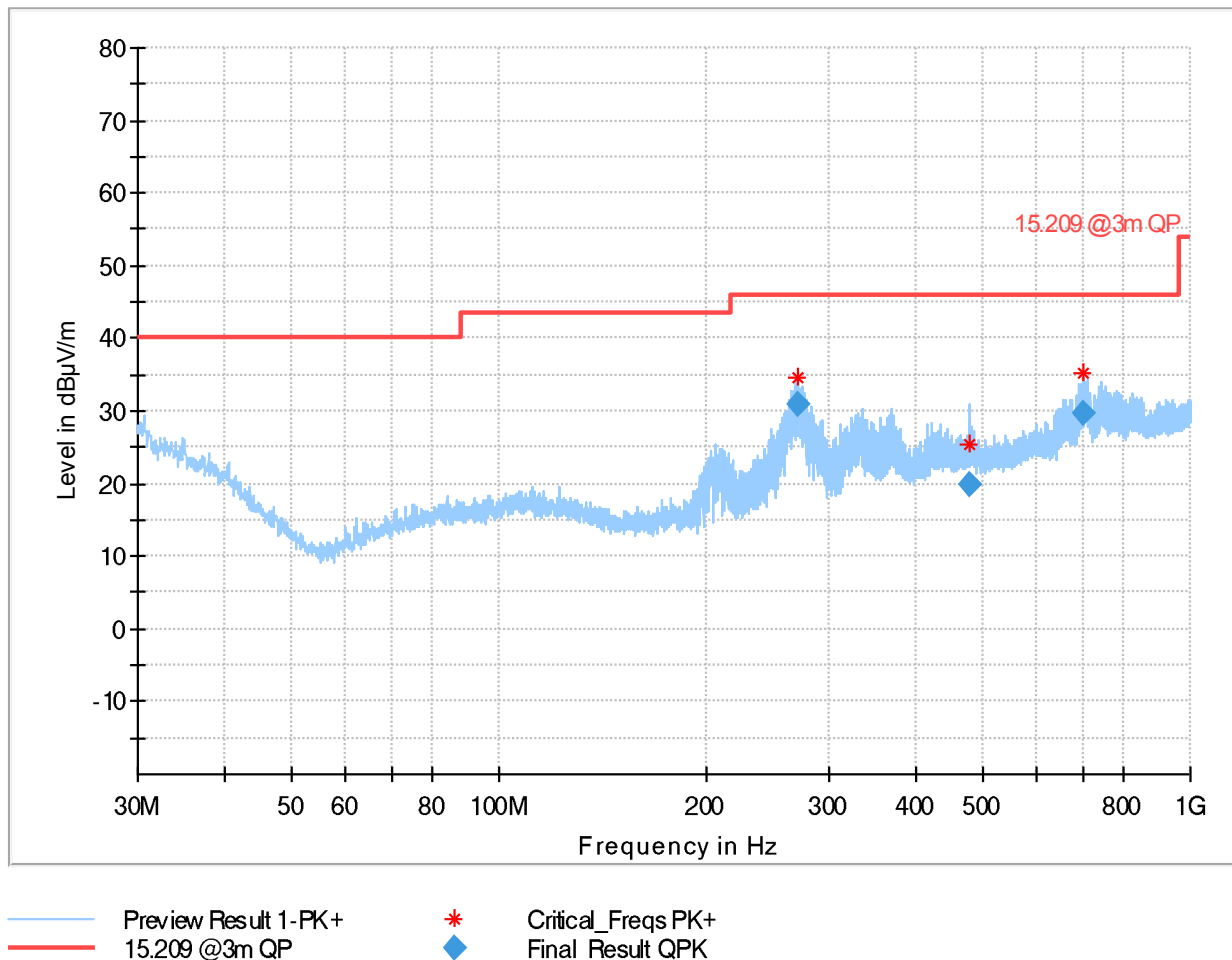
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
253.857000	24.50	46.00	21.50	100.0	120.000	131.0	H	119.0
327.425500	28.95	46.00	17.05	100.0	120.000	100.0	H	275.0
695.909500	32.72	46.00	13.28	100.0	120.000	114.0	H	274.0
783.772500	26.57	46.00	19.43	100.0	120.000	103.0	H	234.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
253.857000	12.1	13:13:17 - 18.01.2023
327.425500	14.1	13:18:45 - 18.01.2023
695.909500	20.8	13:16:58 - 18.01.2023
783.772500	21.8	13:15:11 - 18.01.2023

Plot 20: Mode 2, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation



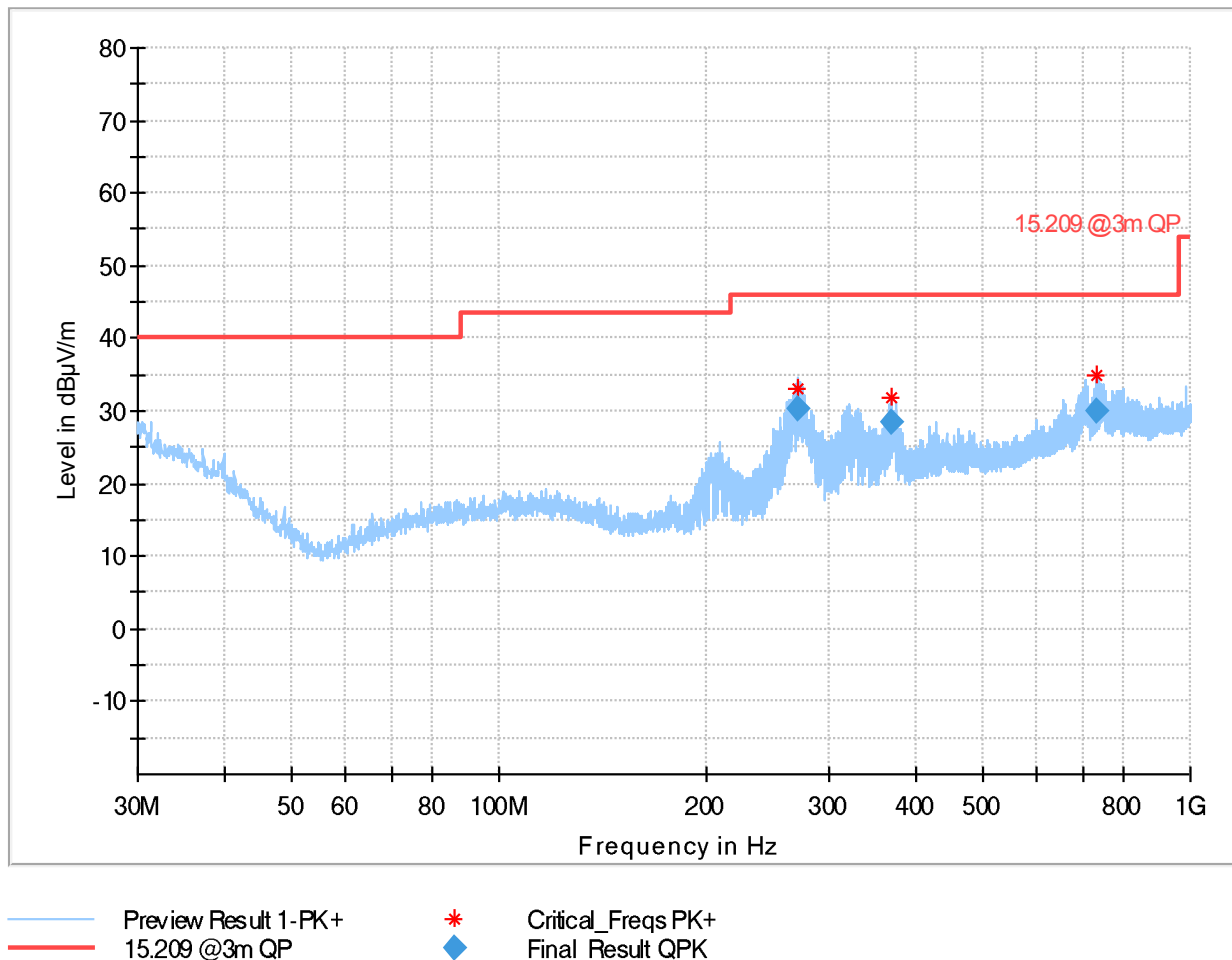
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
270.610000	30.99	46.00	15.01	100.0	120.000	119.0	H	211.0
479.664000	19.93	46.00	26.07	100.0	120.000	201.0	H	-20.0
702.133500	29.58	46.00	16.42	100.0	120.000	100.0	H	183.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
270.610000	12.5	13:29:12 - 19.01.2023
479.664000	17.7	13:31:32 - 19.01.2023
702.133500	20.9	13:27:27 - 19.01.2023

Plot 21: Mode 2, RSE 30 MHz – 1 GHz, mid channel, horizontal / vertical polarisation



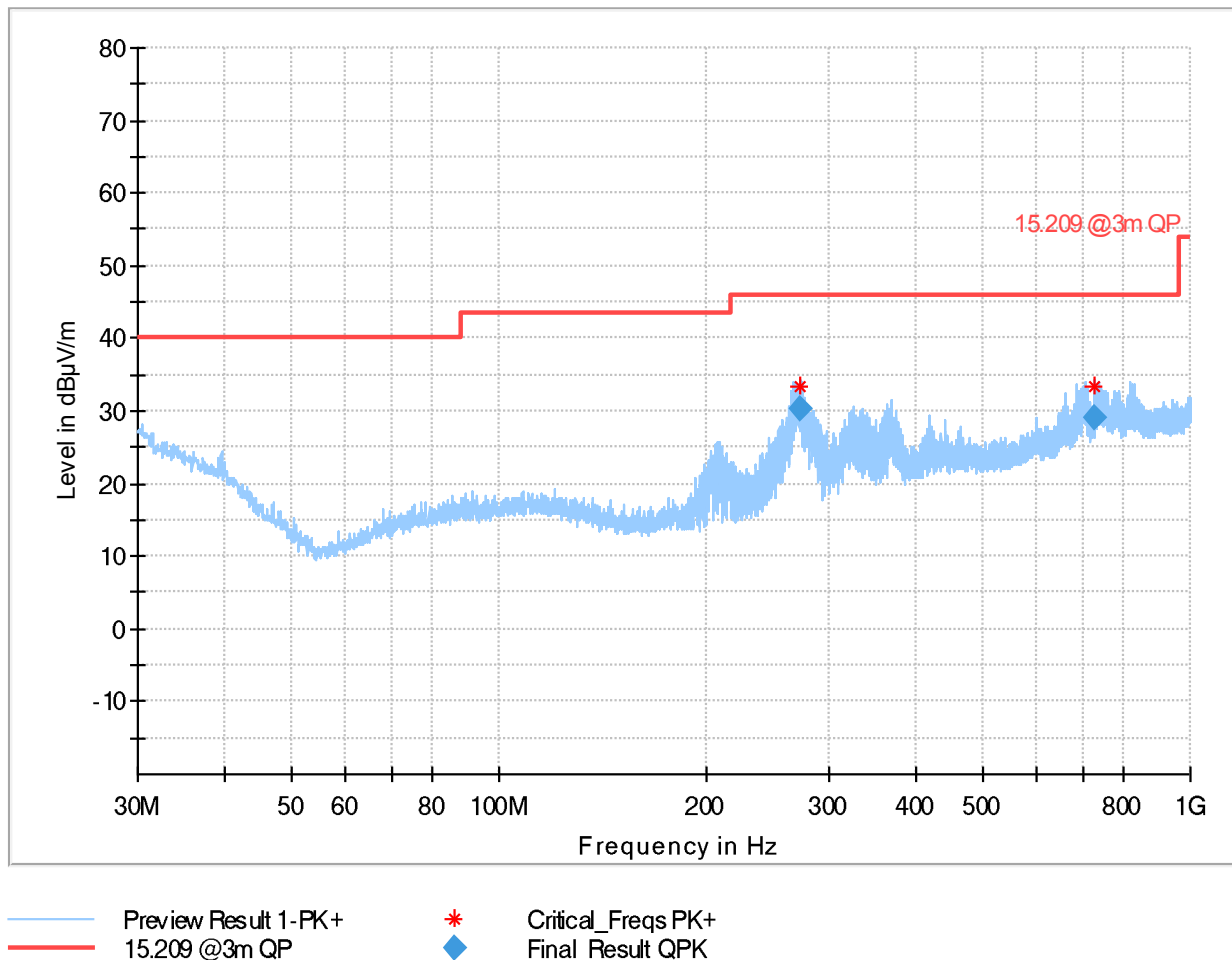
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
270.445500	30.33	46.00	15.67	100.0	120.000	100.0	H	205.0
368.877000	28.39	46.00	17.61	100.0	120.000	100.0	H	135.0
734.174500	29.92	46.00	16.08	100.0	120.000	100.0	H	145.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
270.445500	12.5	13:51:53 - 19.01.2023
368.877000	15.1	13:48:20 - 19.01.2023
734.174500	21.4	13:50:02 - 19.01.2023

Plot 22: Mode 2, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation



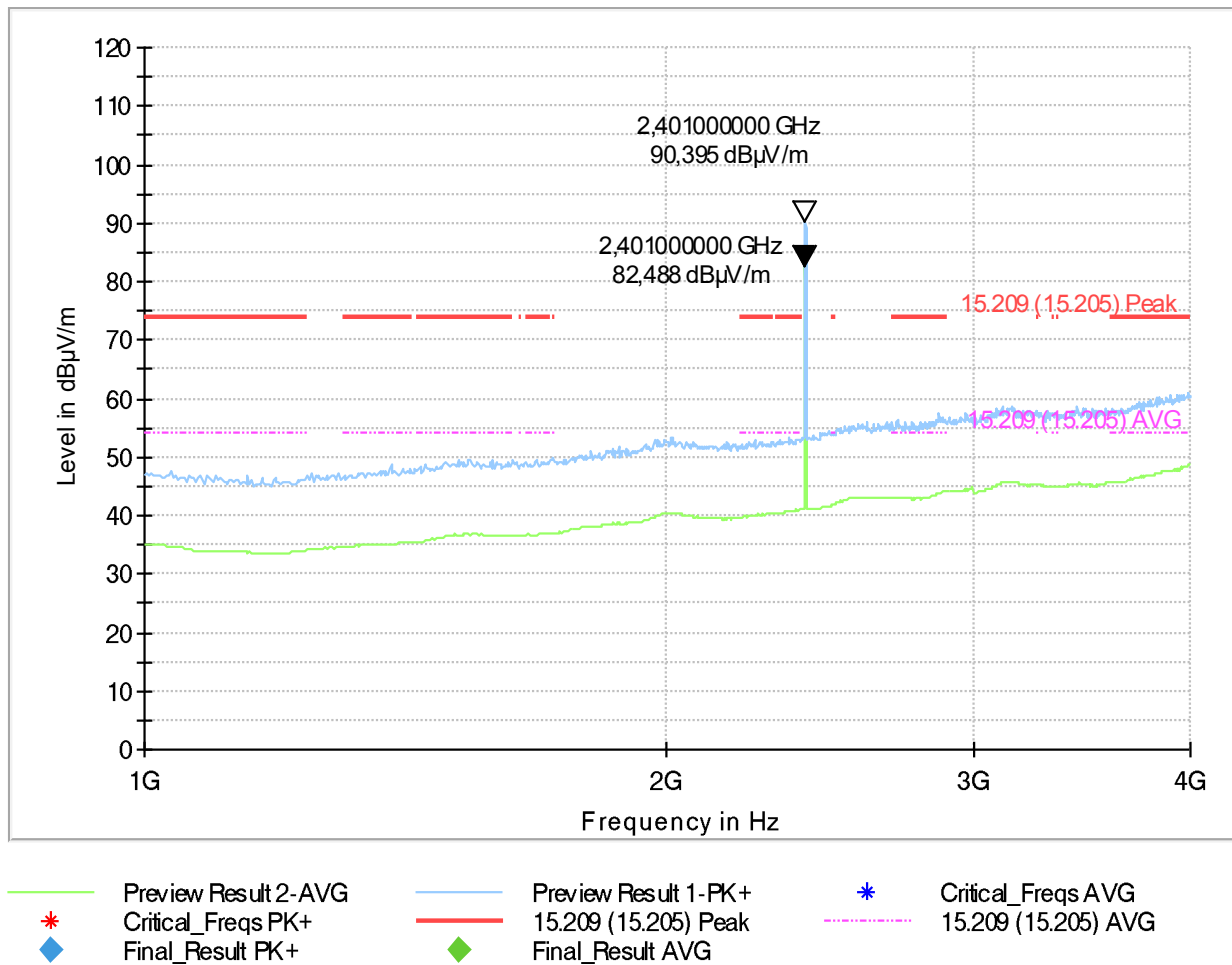
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
271.806000	30.43	46.00	15.57	100.0	120.000	100.0	H	117.0
728.750000	28.96	46.00	17.04	100.0	120.000	100.0	H	142.0

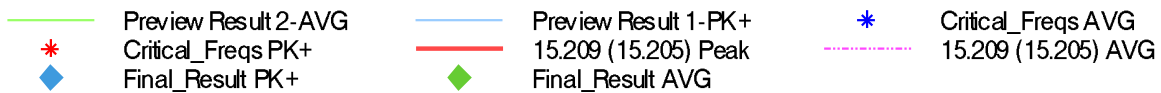
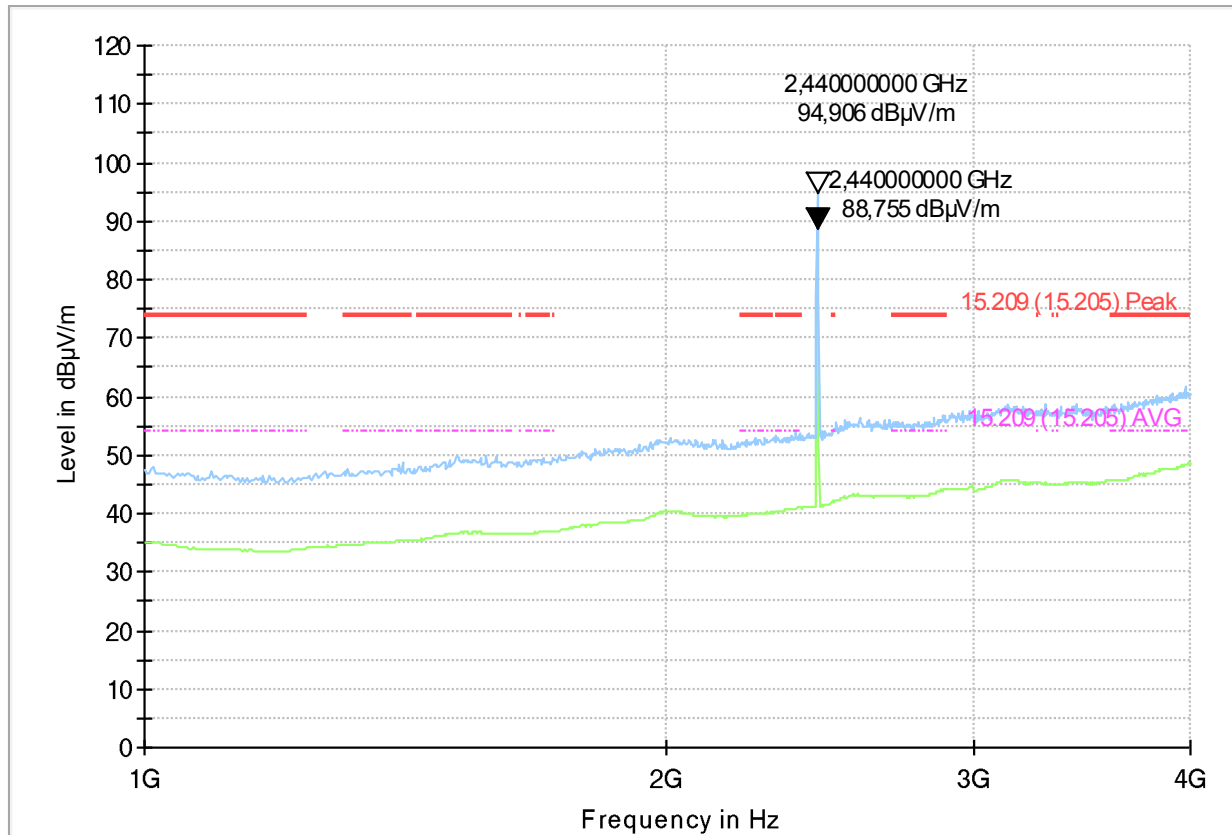
(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
271.806000	12.5	14:19:20 - 19.01.2023
728.750000	21.4	14:21:06 - 19.01.2023

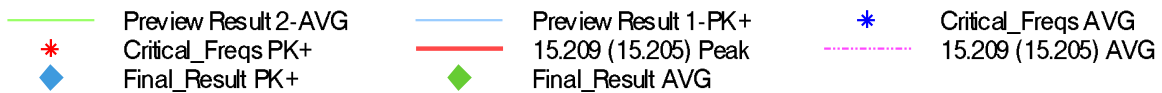
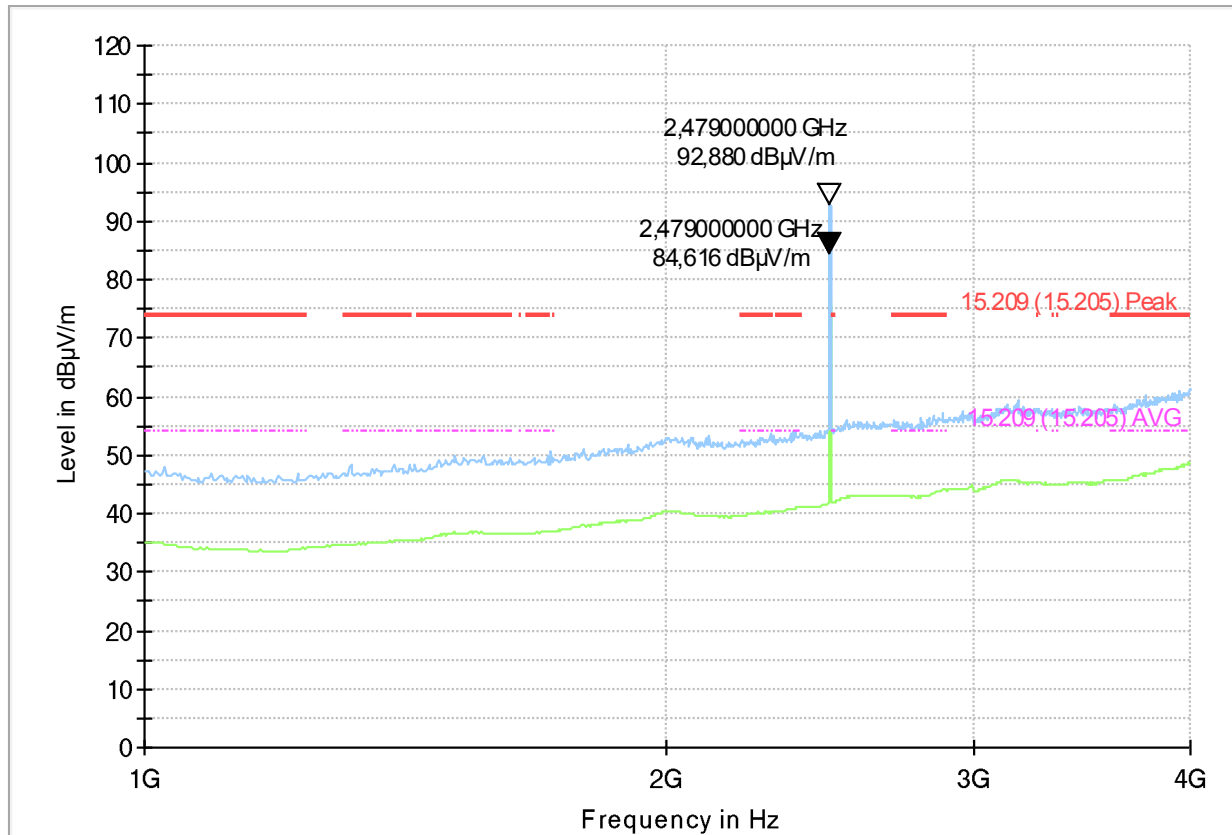
Plot 23: Mode 1, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



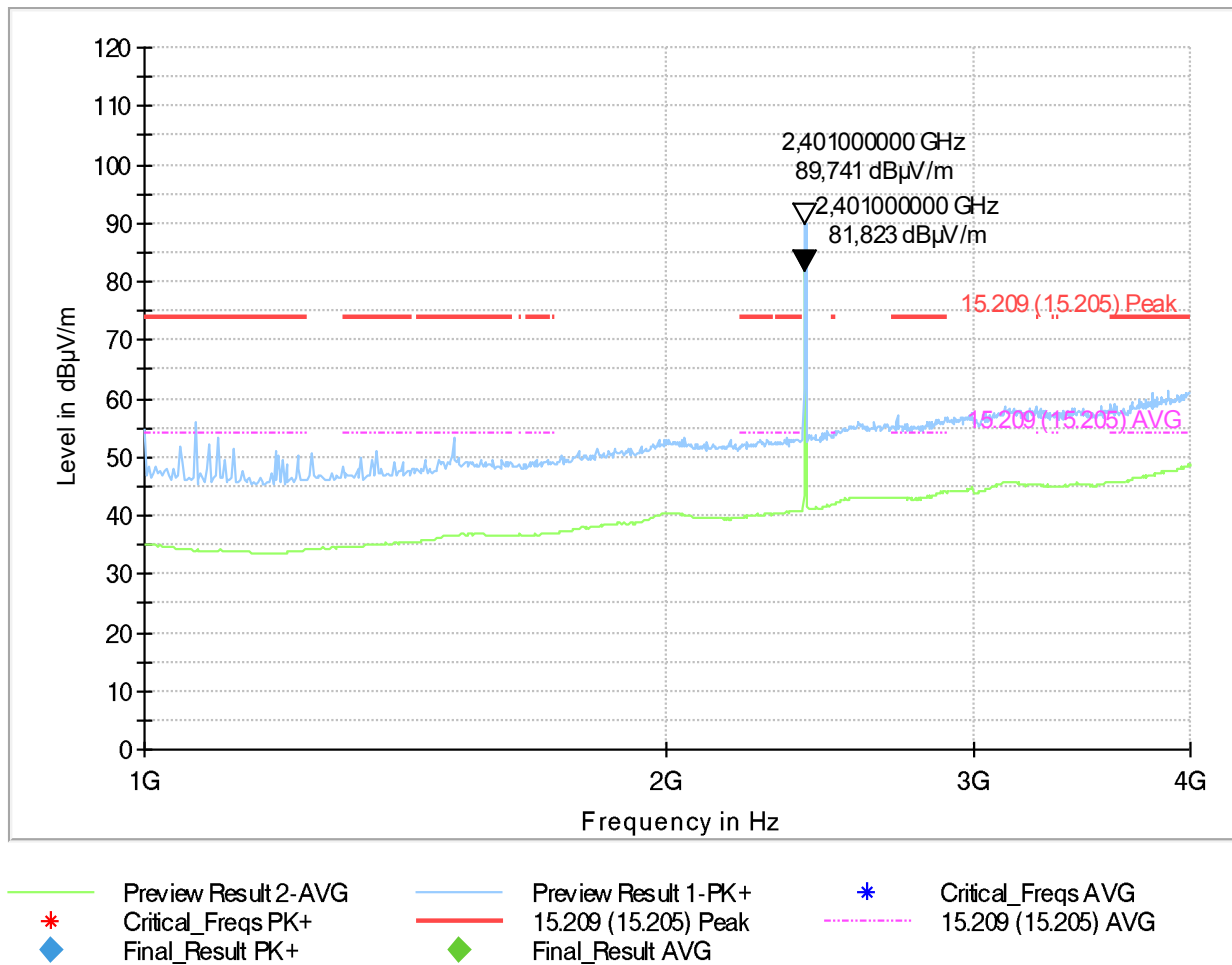
Plot 24: Mode 1, RSE 1 GHz – 4 GHz, mid channel, horizontal / vertical polarisation



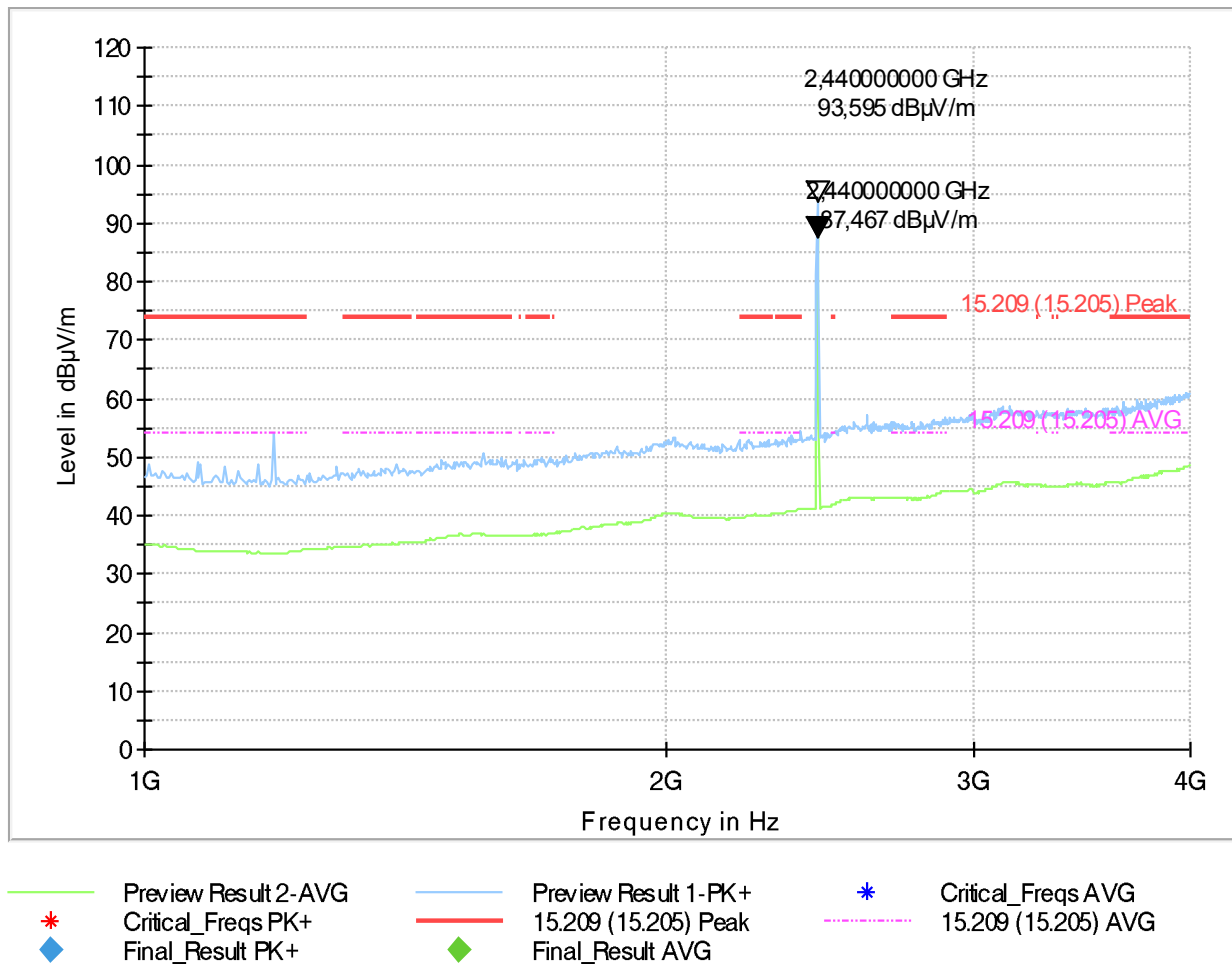
Plot 25: Mode 1, RSE 1 GHz – 4 GHz, high channel, horizontal / vertical polarisation



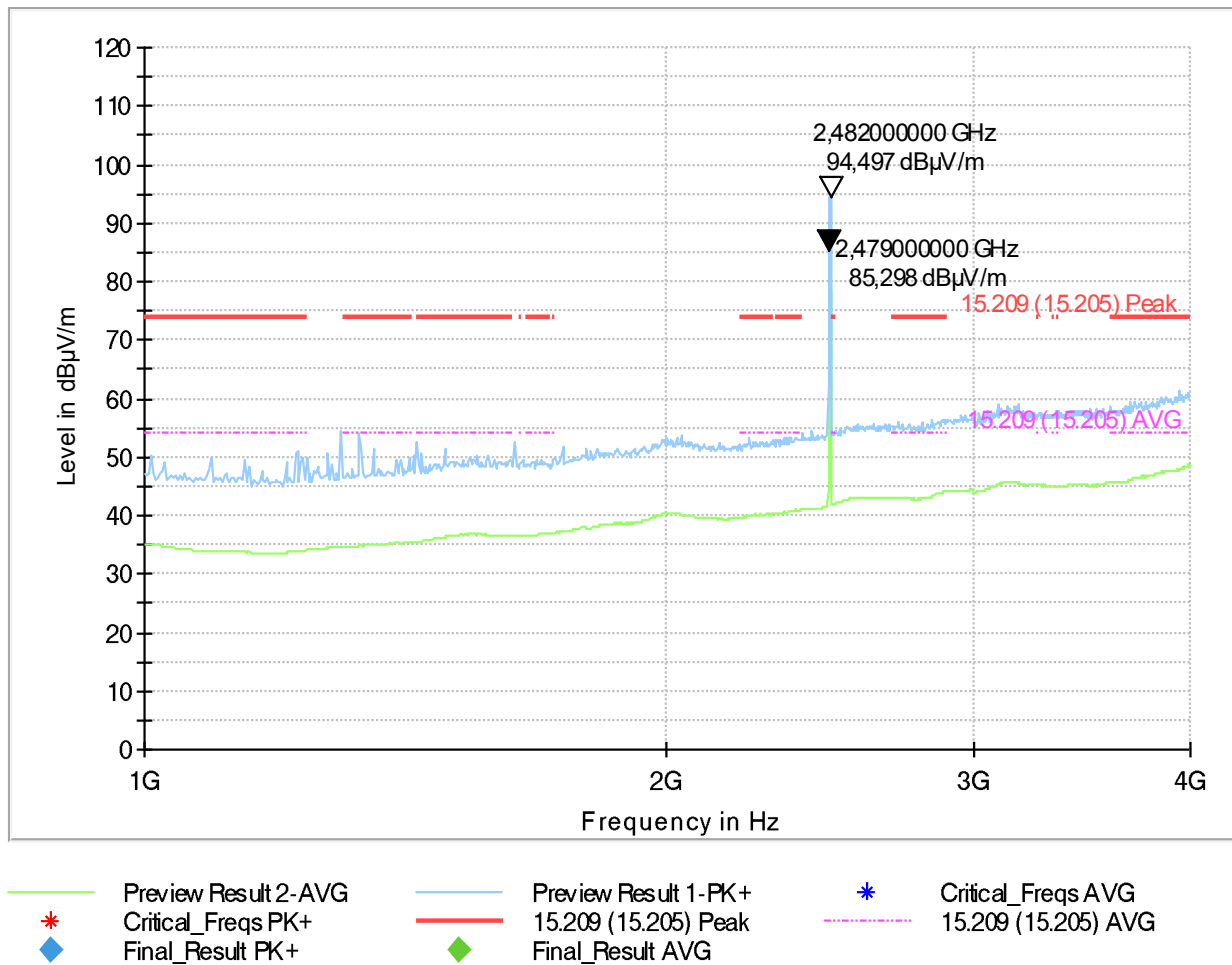
Plot 26: Mode 2, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



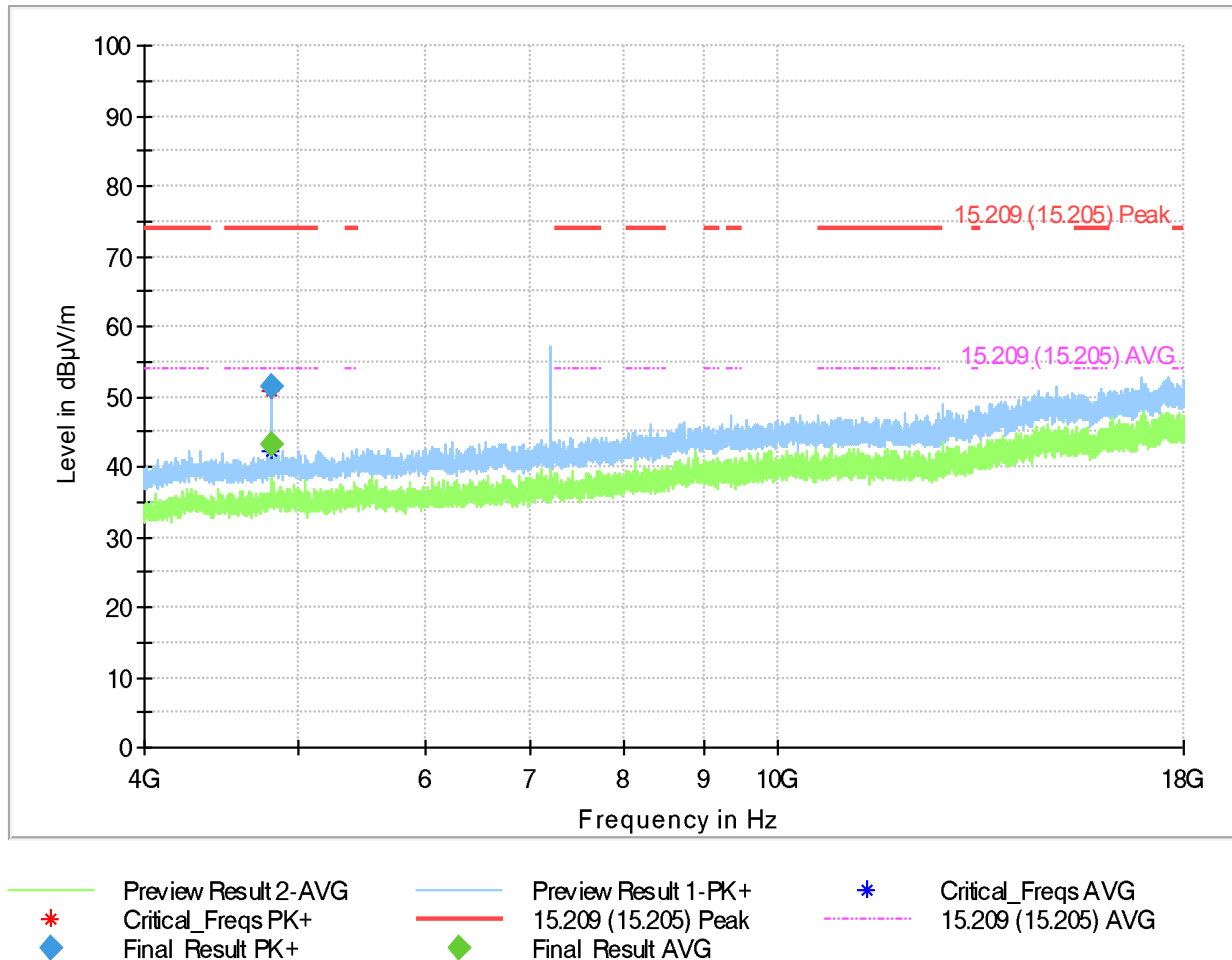
Plot 27: Mode 2, RSE 1 GHz – 4 GHz, mid channel, horizontal / vertical polarisation



Plot 28: Mode 2, RSE 1 GHz – 4 GHz, high channel, horizontal / vertical polarisation



Plot 29: Mode 1, RSE 4 GHz – 18 GHz, low channel, horizontal / vertical polarisation



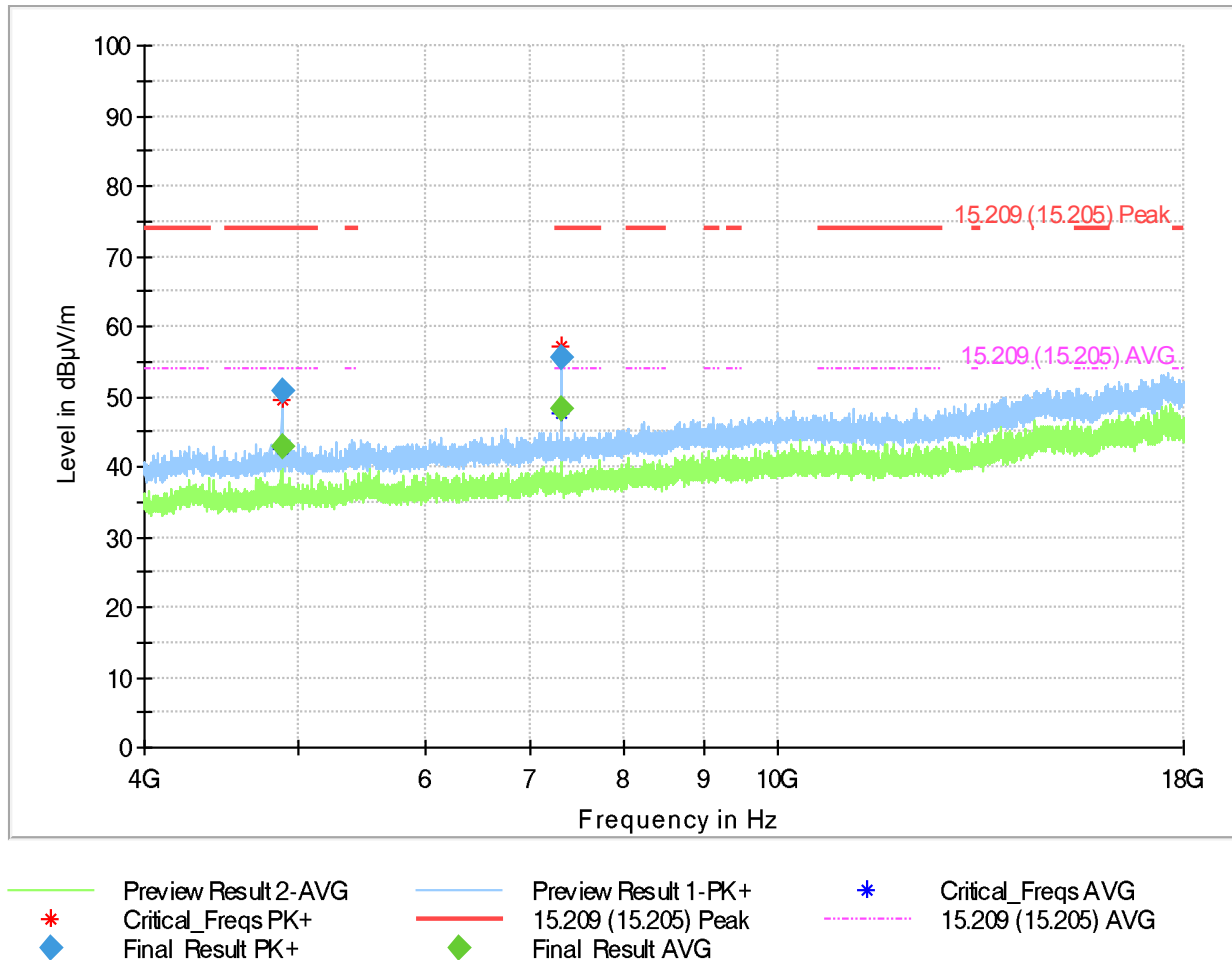
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4803.594444	---	43.13	54.00	10.87	100.0	1000.000	150.0	V
4803.594444	51.50	---	74.00	22.50	100.0	1000.000	150.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4803.594444	190.0	0.0	4.9	12:18:35 - 18.01.2023
4803.594444	191.0	0.0	4.9	12:17:12 - 18.01.2023

Plot 30: Mode 1, RSE 4 GHz – 18 GHz, mid channel, horizontal / vertical polarisation



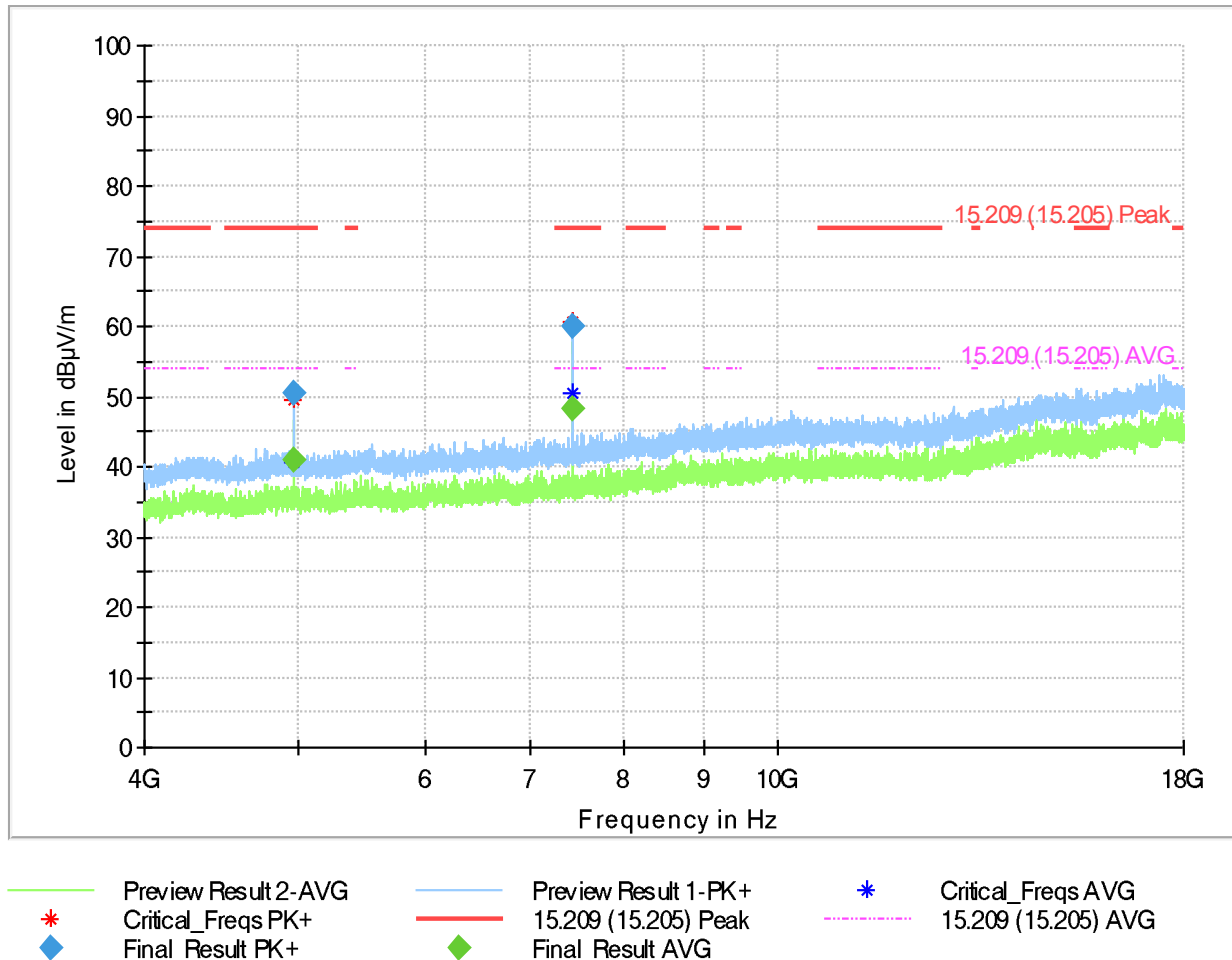
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4880.594444	---	42.92	54.00	11.08	100.0	1000.000	150.0	V
4880.641667	50.80	---	74.00	23.20	100.0	1000.000	150.0	H
7319.555556	---	48.22	54.00	5.78	100.0	1000.000	150.0	H
7320.961111	55.59	---	74.00	18.41	100.0	1000.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4880.594444	239.0	0.0	5.2	09:37:44 - 19.01.2023
4880.641667	245.0	0.0	5.2	09:34:18 - 19.01.2023
7319.555556	55.0	0.0	8.7	09:35:57 - 19.01.2023
7320.961111	56.0	0.0	8.7	09:32:39 - 19.01.2023

Plot 31: Mode 1, RSE 4 GHz – 18 GHz, high channel, horizontal / vertical polarisation



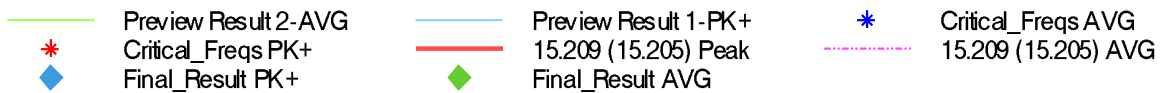
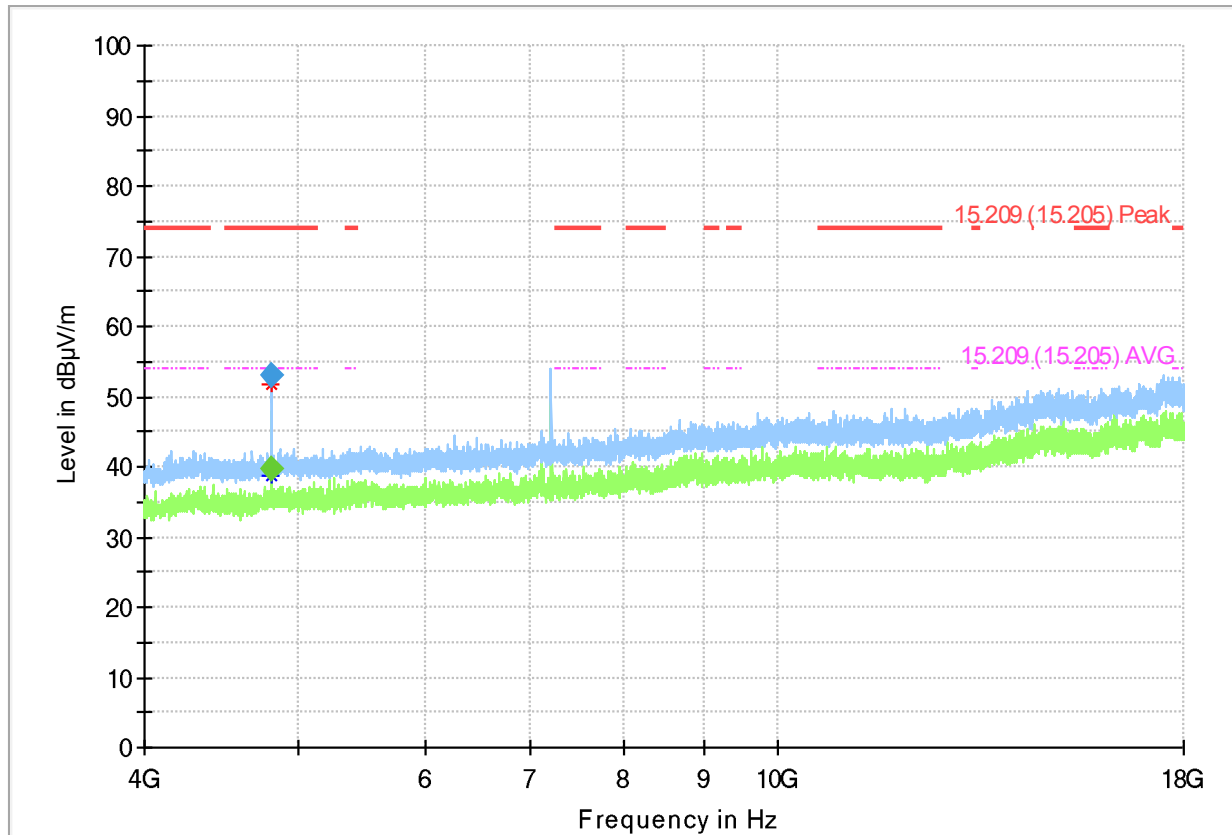
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4959.627778	---	41.05	54.00	12.95	100.0	1000.000	150.0	V
4959.627778	50.52	---	74.00	23.48	100.0	1000.000	150.0	V
7439.408333	60.10	---	74.00	13.90	100.0	1000.000	150.0	H
7439.538889	---	48.32	54.00	5.68	100.0	1000.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4959.627778	190.0	0.0	5.3	11:40:43 - 18.01.2023
4959.627778	187.0	0.0	5.3	11:37:31 - 18.01.2023
7439.408333	8.0	0.0	8.9	11:35:46 - 18.01.2023
7439.538889	246.0	0.0	8.9	11:39:08 - 18.01.2023

Plot 32: Mode 2, RSE 4 GHz – 18 GHz, low channel, horizontal / vertical polarisation



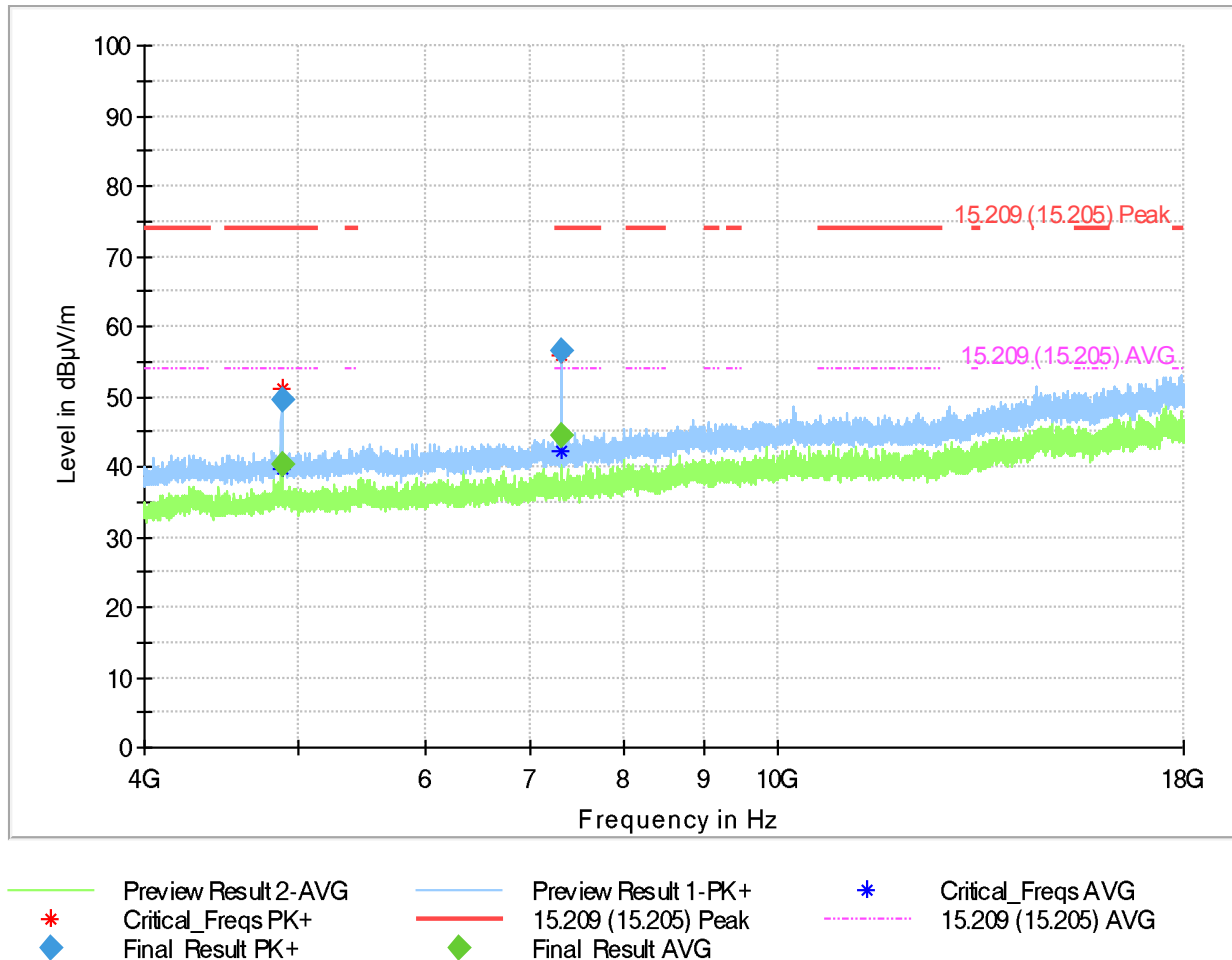
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4803.144444	---	39.79	54.00	14.21	100.0	1000.000	150.0	H
4804.119444	52.93	---	74.00	21.07	100.0	1000.000	150.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4803.144444	180.0	0.0	4.9	09:52:11 - 19.01.2023
4804.119444	239.0	0.0	4.9	09:50:33 - 19.01.2023

Plot 33: Mode 2, RSE 4 GHz – 18 GHz, mid channel, horizontal / vertical polarisation



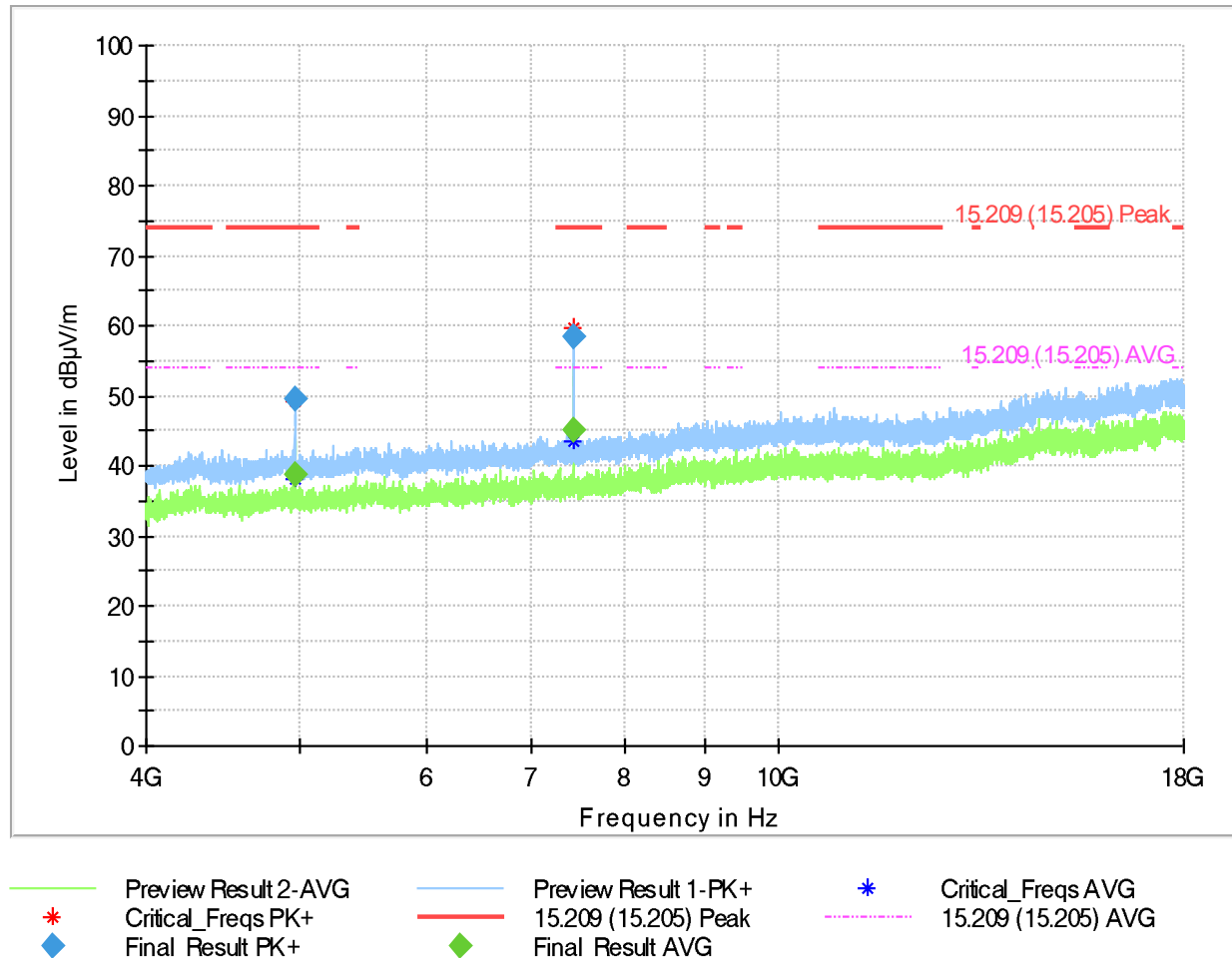
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4881.119444	---	40.31	54.00	13.69	100.0	1000.000	150.0	V
4881.147222	49.66	---	74.00	24.34	100.0	1000.000	150.0	V
7318.927778	---	44.41	54.00	9.59	100.0	1000.000	150.0	H
7321.663889	56.45	---	74.00	17.55	100.0	1000.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4881.119444	239.0	0.0	5.2	10:08:22 - 19.01.2023
4881.147222	242.0	0.0	5.2	10:05:02 - 19.01.2023
7318.927778	349.0	0.0	8.7	10:06:43 - 19.01.2023
7321.663889	356.0	0.0	8.7	10:03:20 - 19.01.2023

Plot 34: Mode 2, RSE 4 GHz – 18 GHz, high channel, horizontal / vertical polarisation



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4959.075000	49.42	---	74.00	24.58	100.0	1000.000	150.0	H
4959.130556	---	38.63	54.00	15.37	100.0	1000.000	150.0	H
7441.441667	---	45.11	54.00	8.89	100.0	1000.000	150.0	H
7441.666667	58.52	---	74.00	15.48	100.0	1000.000	150.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
4959.075000	122.0	0.0	5.3	10:22:08 - 19.01.2023
4959.130556	120.0	0.0	5.3	10:25:31 - 19.01.2023
7441.441667	192.0	0.0	9.0	10:27:02 - 19.01.2023
7441.666667	234.0	0.0	9.0	10:23:49 - 19.01.2023

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).

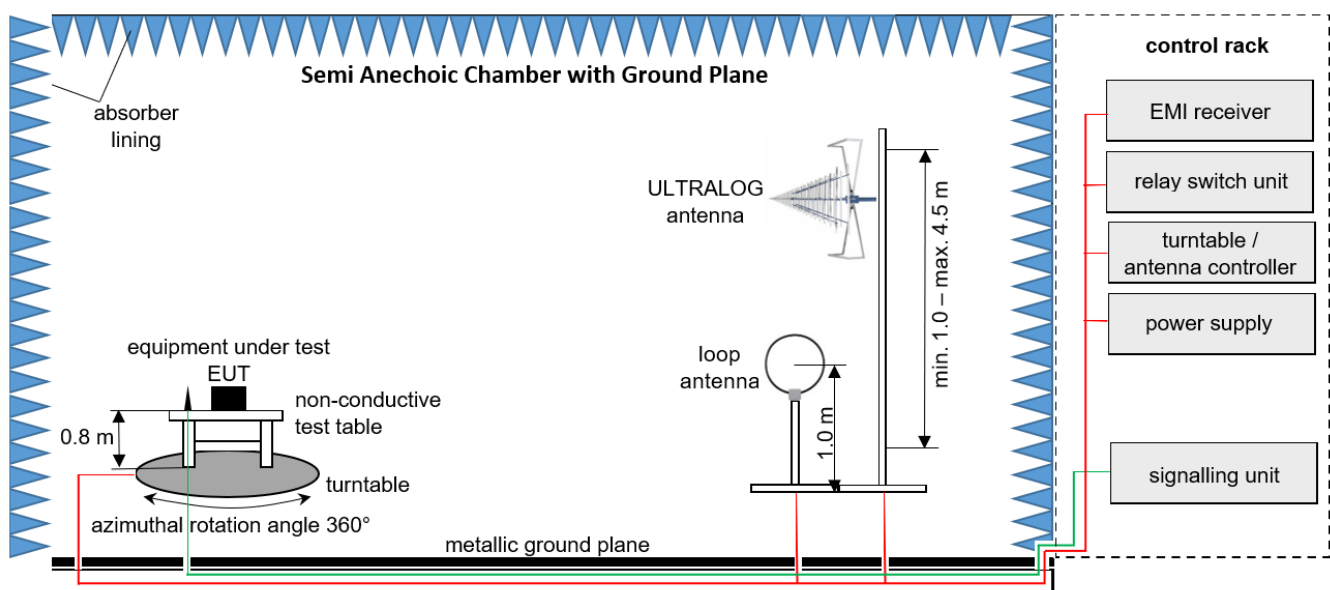
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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: loop antenna at 3 m, ULTRALOG 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)

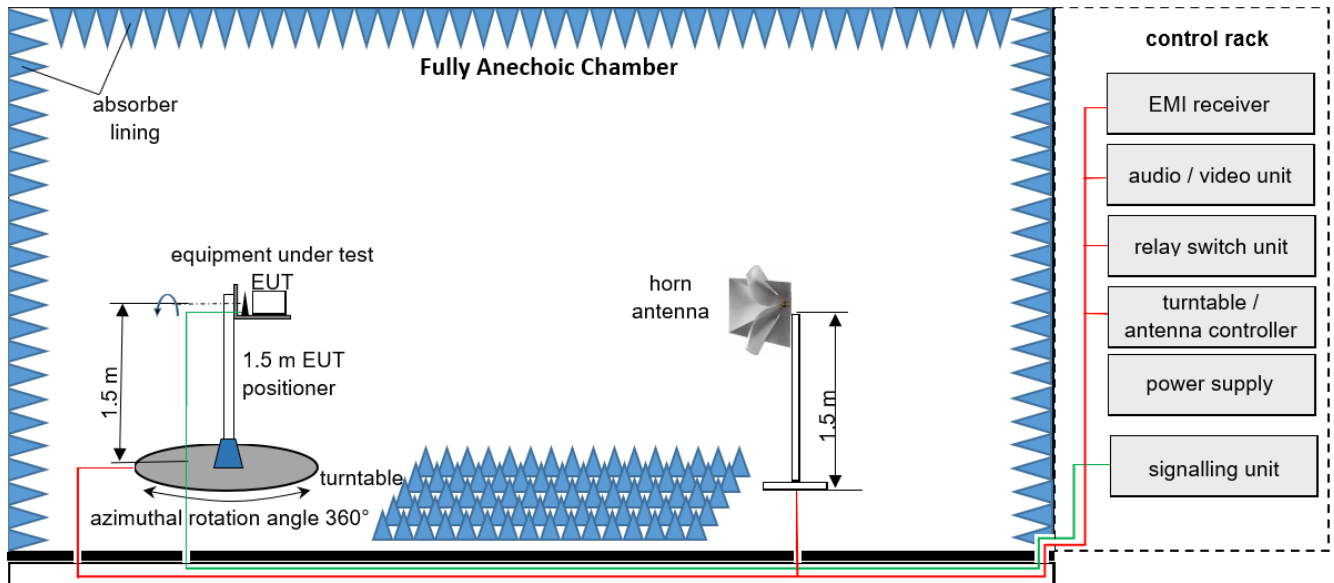
Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 12.35 \text{ [dB}\mu\text{V/m]} + 1.90 \text{ [dB]} + 16.80 \text{ [dB/m]} = 31.05 \text{ [dB}\mu\text{V/m]} \text{ (35.69 } \mu\text{V/m)}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	NR	–
4	Positioner	matur GmbH	TD 1.5-10KG		LAB000258	NR	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	C	2022-07-07 → 12M → 2023-07-07
7	Semi/Fully Anechoic Chamber (SFAC)	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	NR	–
8	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
10	Antenna Mast	matur GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
11	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
12	Controller	matur GmbH	FCU 3.0	10082	LAB000222	NR	–
13	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
14	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NR	–
15	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2020-04-23 → 36M → 2023-04-23
16	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2020-07-05 → 36M → 2023-07-05
17	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NR	–
18	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	C	2020-04-23 → 36M → 2023-04-23
19	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	C	2020-07-05 → 36M → 2023-07-05
20	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	C	2020-03-25 → 36M → 2023-03-25

8.2 Fully Anechoic Chamber



Measurement distance: horn 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:

$$FS \text{ [dB}\mu\text{V/m]} = 12.35 \text{ [dB}\mu\text{V/m]} + 1.90 \text{ [dB]} + 16.80 \text{ [dB/m]} = 31.05 \text{ [dB}\mu\text{V/m]} \text{ (35.69 } \mu\text{V/m)}$$

$$OP = AV + D - G + CA$$

(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:

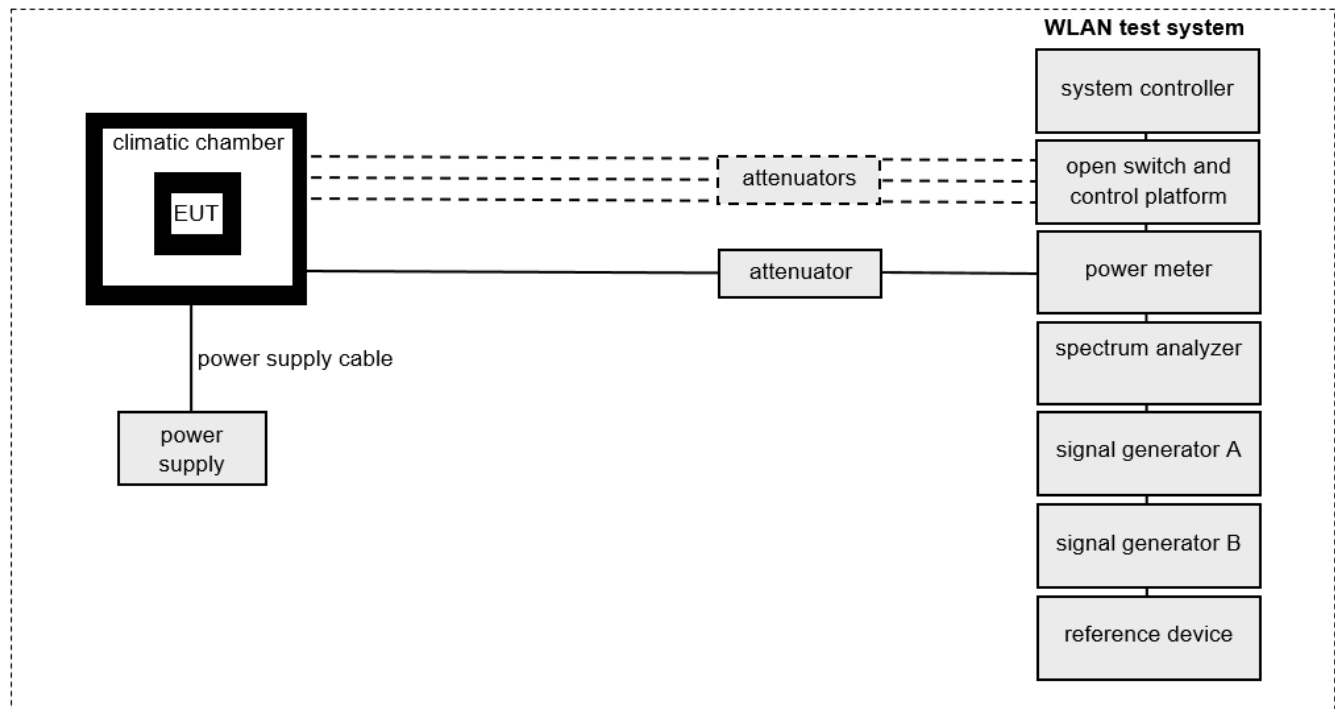
$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50 \text{ [dB]} - 20 \text{ [dBi]} + 5 \text{ [dB]} = -30 \text{ [dBm]} \text{ (1 } \mu\text{W)}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	NR	–
4	Positioner	matur GmbH	TD 1.5-10KG		LAB000258	NR	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	C	2022-07-07 → 12M → 2023-07-07
7	Semi/Fully Anechoic Chamber (SFAC)	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	NR	–
8	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
10	Antenna Mast	matur GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
11	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
12	Controller	matur GmbH	FCU 3.0	10082	LAB000222	NR	–
13	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
14	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NR	–
15	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2020-04-23 → 36M → 2023-04-23
16	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2020-07-05 → 36M → 2023-07-05
17	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NR	–
18	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	C	2020-04-23 → 36M → 2023-04-23
19	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	C	2020-07-05 → 36M → 2023-07-05
20	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	C	2020-03-25 → 36M → 2023-03-25

8.3 Conducted measurements WLAN test system R&S TS 8997

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The losses for all signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



EMC32/WMS32 software version: 11.00.00

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	TS8997	Rohde & Schwarz	TS8997-Rack	100829	LAB000322	NR	–
2	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157WX	101247	LAB000280	NR	–
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157W8	100982	LAB000279	NR	–
4	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	C	2021-06-15 → 36M → 2024-06-15
5	Signal Generator	Rohde & Schwarz	SMBV100A	258240	LAB000277	C	2021-08-31 → 36M → 2024-08-31
6	Signal Generator	Rohde & Schwarz	SMB100A-20	178175	LAB000276	C	2021-05-31 → 36M → 2024-05-31
7	Radio Communication Tester	Rohde & Schwarz	CMW270	101479	LAB000275	NR	–
8	Controller	Hewlett Packard	ATS-Z230	101379	LAB000274	NR	–
9	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350263	LAB000190	NR	–
10	Climatic Chamber	CTS GmbH	T-65/50	204002	LAB000110	CM	2022-05-11 → 12M → 2023-05-11

9 MEASUREMENT UNCERTAINTIES

Radio frequency	$\leq \pm 1 \times 10^{-7}$
RF power, conducted	$\leq \pm 0.75 \text{ dB}$
Power spectral density	$\leq \pm 3 \text{ dB}$
Maximum frequency deviation	$\leq \pm 5 \%$
Deviation limitation Duty Cycle, Tx-sequence, Tx-gap	$\leq \pm 5 \%$
Occupied channel bandwidth	$\leq \pm 5 \%$
Conducted spurious emission of transmitter	$\leq \pm 4 \text{ dB}$
Conducted emission of receivers	$\leq \pm 4 \text{ dB}$
Radiated emission of transmitter	$\leq \pm 6 \text{ dB}$
Radiated emission of receiver	$\leq \pm 6 \text{ dB}$
Temperature	$\leq \pm 2.5 \text{ °C}$
Humidity	$\leq \pm 10 \%$

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 %.

Annex A EUT Photographs, external

Photo No. 1:

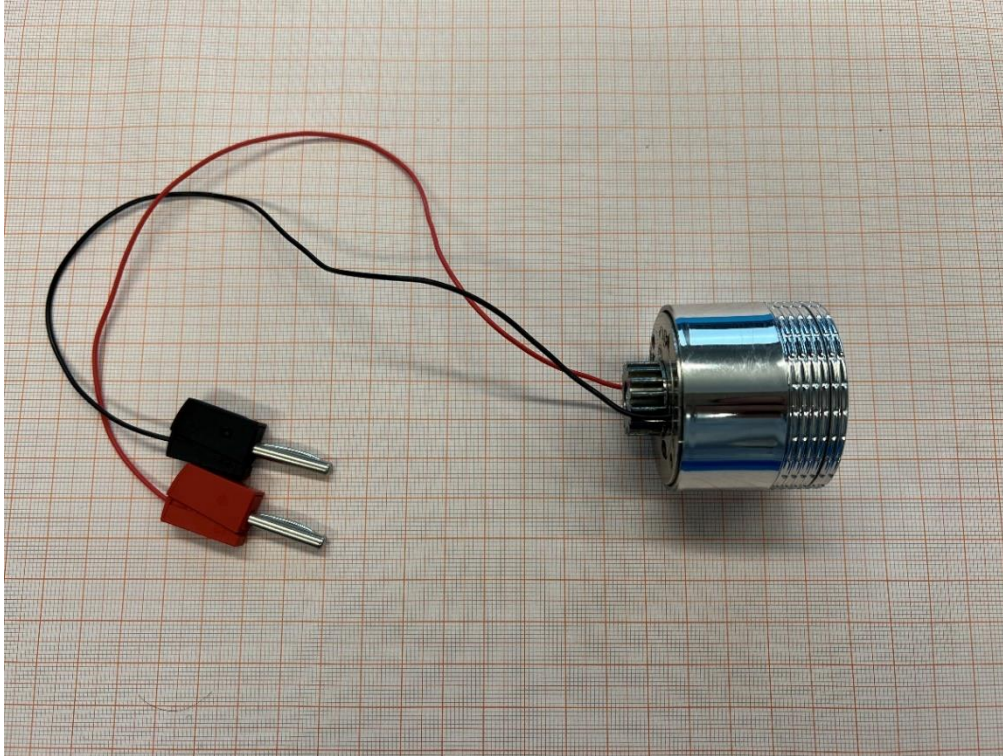


Photo No. 2:

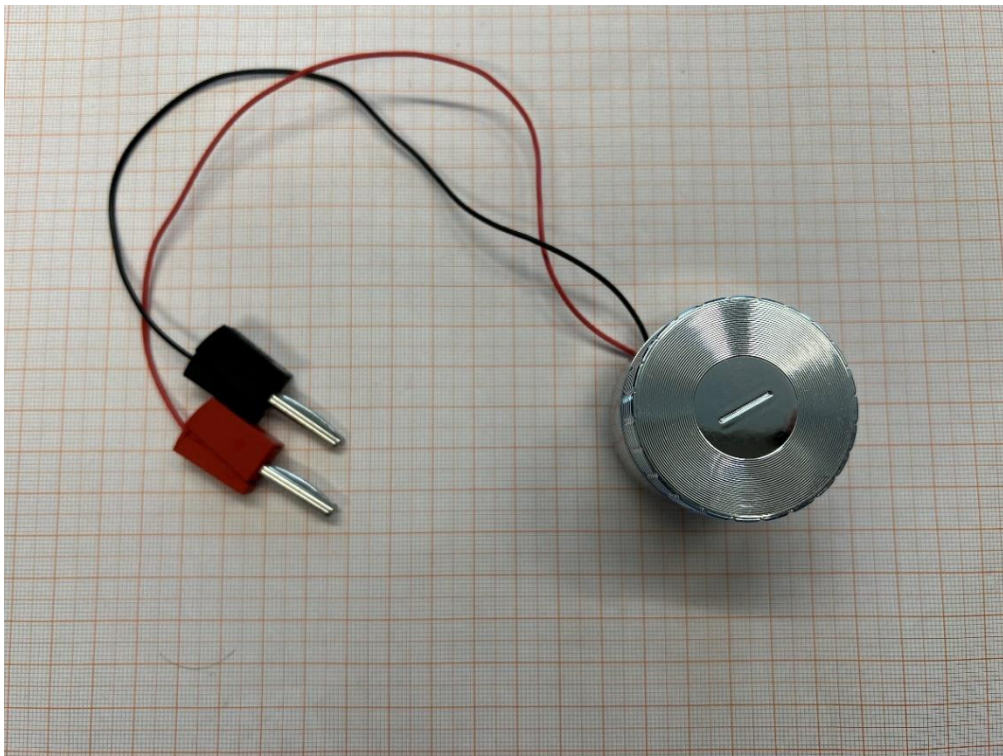


Photo No. 3:

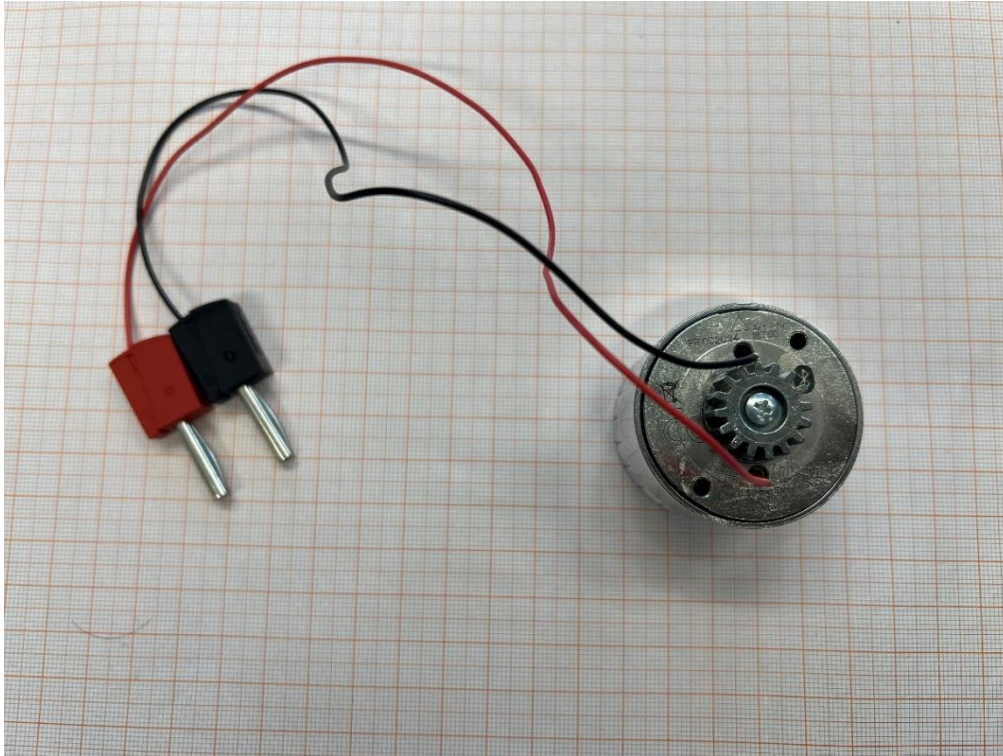
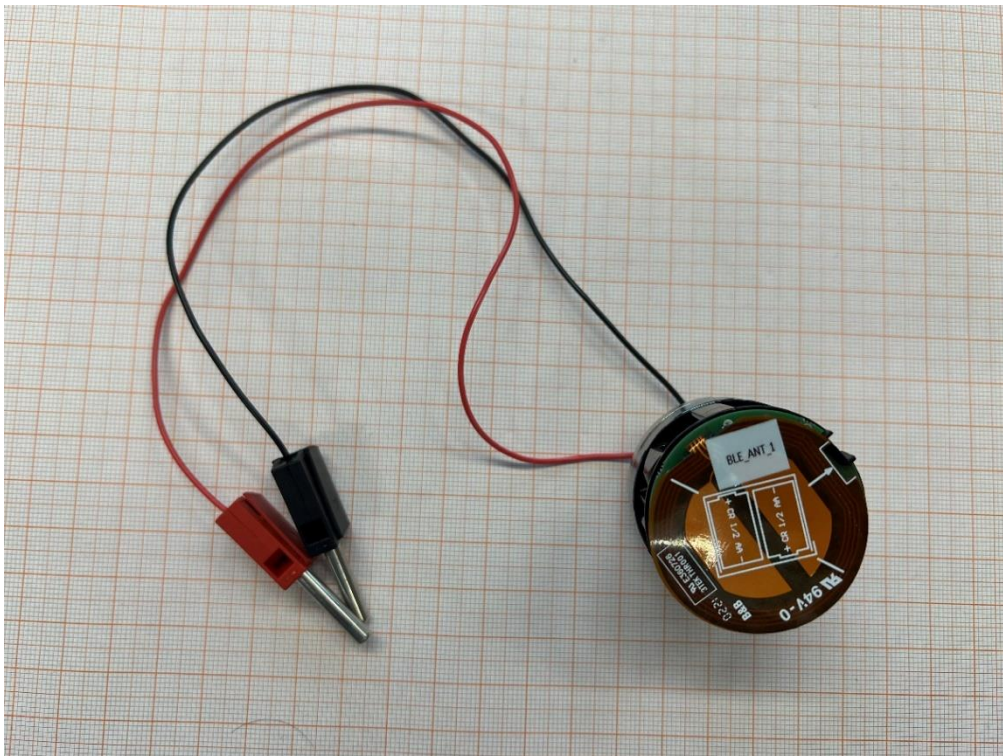


Photo No. 4:



Annex B EUT Photographs, internal

Photo No. 5:

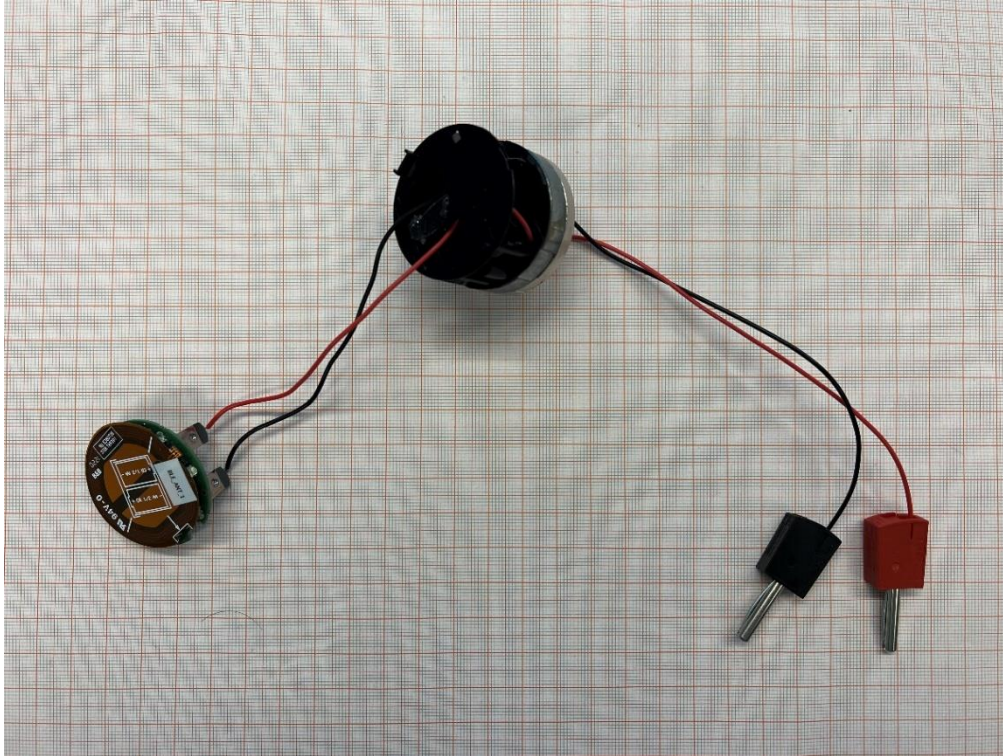
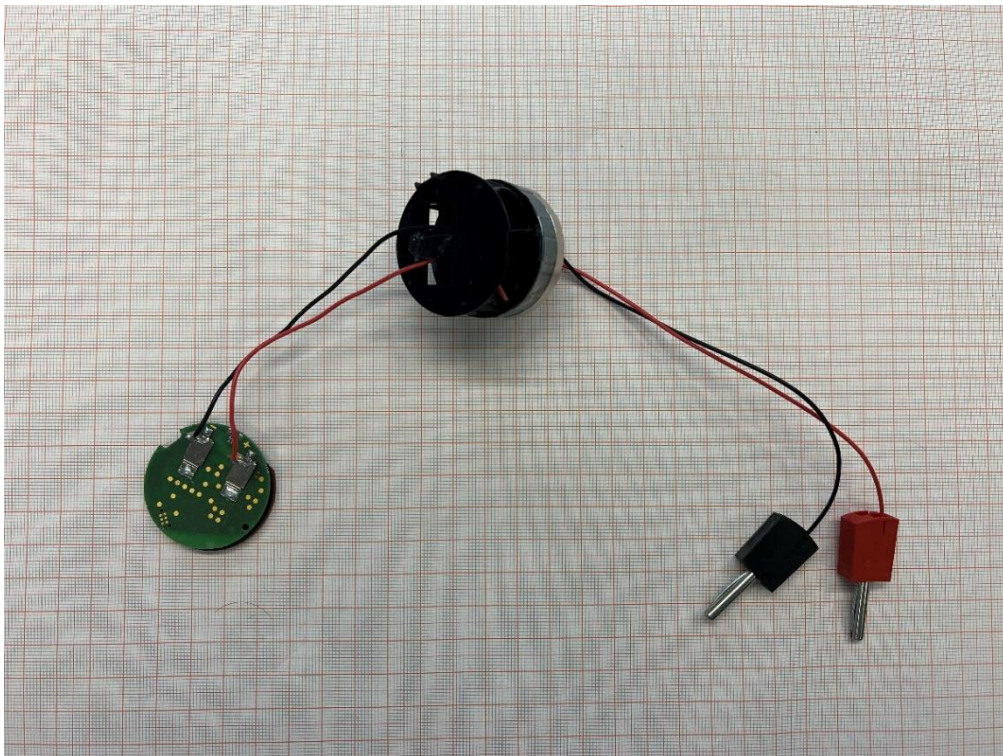


Photo No. 6:



Annex C Test Setup Photographs

Photo No. 7:



Photo No. 8:



Photo No. 9:

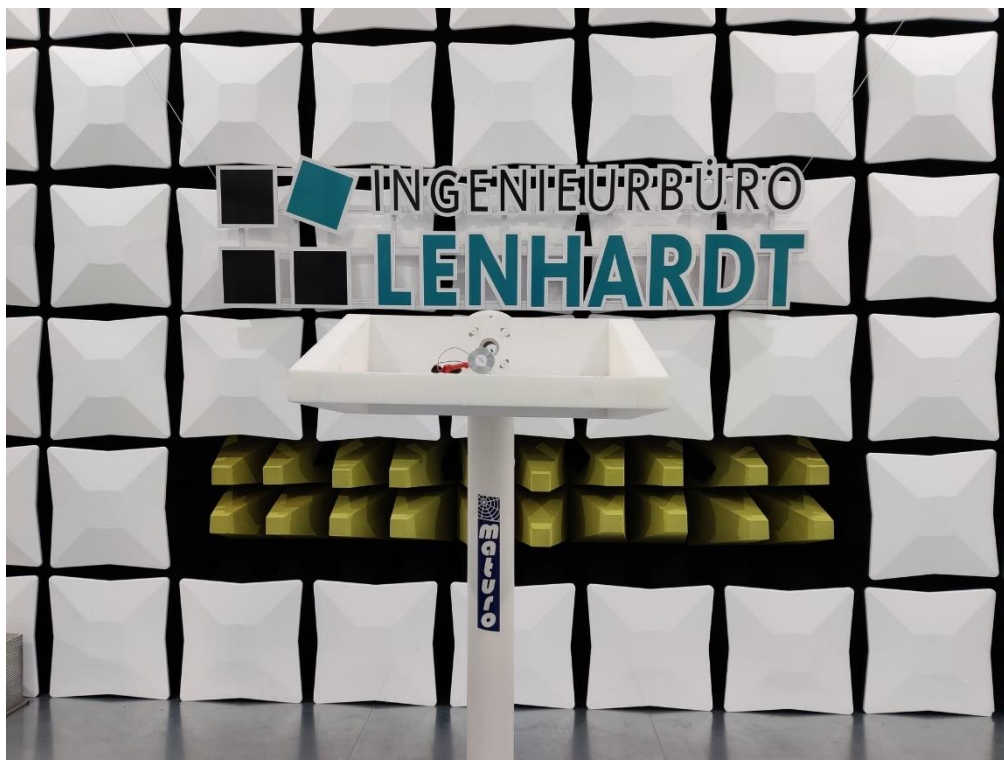
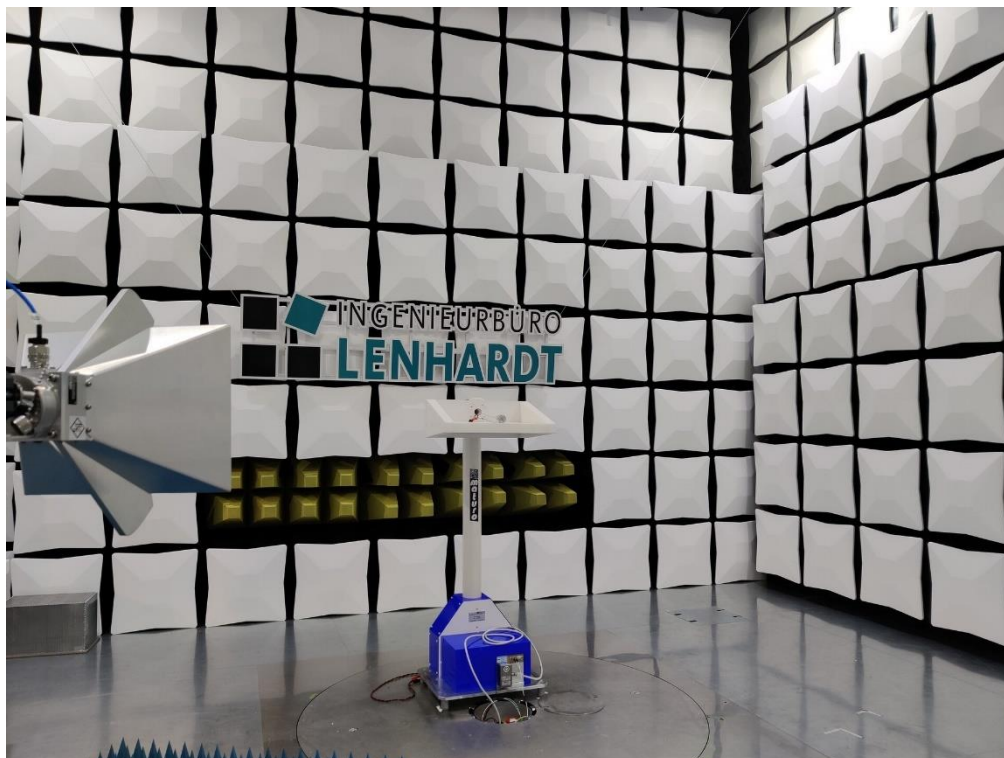


Photo No. 10:



End of Test Report
