

FCC/ICES test report

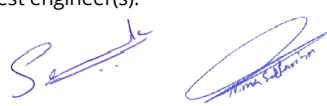
Electromagnetic compatibility

Product: Qmicro DynamiQ-series gas chromatograph
Model: DynamiQ-S; DynamiQ-R; DynamiQ-X

Report number: 20220753RPT02
Report status: Final
Date of report: 2025 March, 6

Applicant: Qmicro by Sensirion
Institutenweg 25
7521 PH Enschede
The Netherlands
In the capacity of: Manufacturer

Applicant's representative: J. Geerlings

Test engineer(s):  S. Kunnumal / N. Saffarian	Project leader/ supervisor:  D.R. Boot	Author:  N. Saffarian	Approved by:  D.R. Boot
--	--	---	--

This publication may only be reproduced and/or made public in its entirety. Separate parts of this publication may not be reproduced and/or published by print, photo print or any other means without the previous written consent of Kiwa Dare. All rights and obligations of contracting parties are subject to either the standard conditions of Kiwa Dare or the relevant agreement concluded between the contracting parties.

1 Conclusion

The Qmicro DynamiQ-series gas chromatograph meets the emission limits of an unintentional radiator as described in 47 CFR 15 & ICES-003 (Issue 7) (October 2020), class B digital device, if the modifications as described in this report are applied.

It is the responsibility of the manufacturer to ensure, that all of the following products are equal to the measured sample. And as such ensure that all manufactured Qmicro DynamiQ-series gas chromatographs are in compliance with the standards as mentioned above.

It is the responsibility of the customer to implement the modifications in a correct way.

1.1 Summary of results

Compliance table

A summary of the test results gained from testing the Qmicro DynamiQ-series gas chromatograph is shown in the table below.

Category	Standard	Class / level	Result (Pass / Fail)
Emission	47 CFR 15 & ICES-003 (Issue 7) (October 2020)	B	DynamiQ-S: Pass DynamiQ-R: Pass DynamiQ-X: Pass

Note 1: The test results presented in this report relate only to the tested sample(s).

Note 2: The test results are based on the tested mode of operation(s), the applicable performance criteria and the acceptance criteria as specified by the customer.

Overview of performed tests and measurements

The following table gives a summary of the results of the tests that have been carried out on the Qmicro DynamiQ-series gas chromatograph.

Test sequence	Test description	Basic standard	EUT modified during test (yes/no)	Result (Pass/Fail)
2	Conducted emission, test with an AMN	ANSI C63.4 (2014)	No	DynamiQ-S: Pass DynamiQ-R: Pass DynamiQ-X: Pass
1	Radiated emission up to 1 GHz (SAC)	ANSI C63.4 (2014)	Yes (modifications applies only to DynamiQ-X) ²	DynamiQ-S: Pass DynamiQ-R: Pass DynamiQ-X: Pass with modification
3	Radiated emission above 1 GHz (FAC) ¹	ANSI C63.4 (2014)	No	DynamiQ-S: Pass DynamiQ-R: Pass DynamiQ-X: Pass

¹ Measurements above 8 GHz are excluded from accreditation.

² Modification applied to DynamiQ-X sample is: the housing is connected to the ground & shielding of the cable is connected to the glant.

Cross reference table 47 CFR 15 – ICES 003

Test description	Section 47 CFR 15	Section ICES 003
Conducted emission, test with a LISN	15.107	3.2.1
Radiated emission up to 1 GHz (SAC)	15.109	3.2.2
Radiated emission above 1 GHz (FAC)	15.109	3.2.2

2 Table of contents

1	Conclusion.....	2
1.1	Summary of results.....	2
2	Table of contents	4
3	General information	5
4	Standards and test plan	7
4.1	Test plan deviations	7
5	EUT details.....	8
6	Operating conditions during test	12
7	Measurement software	12
8	Emission measurement results.....	13
8.1	Conducted emission, test with an AMN	13
8.2	Radiated emission up to 1 GHz (SAC)	22
8.3	Radiated emission above 1 GHz (FAC).....	30
9	Appendix A: Photos.....	37
10	Appendix B: Equipment list.....	38
11	Appendix C: Abbreviations.....	40

3 General information

Introduction

Kiwa Dare is requested by Qmicro by Sensirion, to perform electromagnetic compatibility (EMC) tests.

The objective of the test was to assess the Qmicro DynamiQ-series gas chromatograph in accordance with the standards as mentioned in this report. This report may only be used for this purpose.

At request of Qmicro by Sensirion, the EMC tests are carried out in order to find out whether the product complies with 47 CFR 15 of the FCC regulations for computers and other digital devices.

The test sample(s) were received on 2022 January, 11. Testing was performed on 2022 January, 11 until 2023 April, 20.

The tests are carried out at our facilities located in Woerden, The Netherlands.

The test results presented in this report relate only to the product tested.

In this report, the sample tested will be referred to as equipment under test (EUT).

This report is in conformity with ISO 17025.

Opinions or interpretations mentioned in this report are excluded from accreditation.

All tests as described in the applied standard(s) are carried out, unless otherwise specified in this report.

Report revision history

Report number	Revision	Date	Remarks
20220753RPT01	1	2023 May, 25	Initial report
20220753RPT02	2	2025 March, 6	At request of the customer the 'power supply during test' for 'DynamiQ-S' and 'DynamiQ-R' are changed from "230VAC/50Hz" to "230VAC/50Hz and 120VAC/60Hz".

Explanation status report

Status	Explanation
Draft	Preliminary unsigned report
Final	Formally signed report, with a final conclusion. Changes in the report will lead to a new report with a new report number.

Possible test case verdicts

Verdict	Clarification
NA or not applicable:	Test does not apply to the EUT
P(ass):	EUT does meet the requirement
F(ail):	EUT does not meet the requirement
U(ndetermined):	Pass or fail could not be established
NR or not requested:	Test is not requested by customer
Compliant:	EUT is compliant with the requirement
Non-compliant:	EUT is not compliant with the requirement

During pass or fail decisions, the measurement uncertainty is not taken into account.

Measurement uncertainties

The reported expanded uncertainty of measurement is based on a standard uncertainty of measurement multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %, but excluding the contribution of the EUT. The expanded uncertainty of measurement has been determined in accordance with EN 55016-4-2.

Test equipment

The instruments used to perform the tests are displayed in the appendix.

4 Standards and test plan

The EUT is assessed against the following requirements.

- Emission : 47 CFR 15 & ICES-003 (Issue 7) (October 2020)
- : KDB Publication 714737
- Test plan : 20220752TPR01

If available, a test plan is used as a supplement.

4.1 Test plan deviations

None.

5 EUT details

Purpose, functional and physical description

The Qmicro DynamiQ is a gas chromatograph for fast reliable gas mixture analysis.

There are three versions available, which are electrically identical:

- DynamiQ-S: standard bench-top version for laboratory and industrial use, supplied by a universal AC/DC adapter or a DC-distribution network;
- DynamiQ-X: explosion-proof version, mounted in a dedicated ATEX enclosure. All I/O and DC-supply wiring is combined in one connector, connected to a shielded cable;
- DynamiQ-R: a standard DynamiQ mounted in a 3HU 19"-rack enclosure, provided with an integrated universal power supply and optionally customer-specific accessories (e.g. a pump or passive filters).

General EUT data

EUT details, provided by the client:

Item	Description
Name	Qmicro DynamiQ-series gas chromatograph
Manufacturer	Qmicro by Sensirion Institutenweg 25 7521 PH Enschede The Netherlands
Brand	Qmicro
Model number	DynamiQ-S; DynamiQ-R; DynamiQ-X
Serial number	DynamiQ-S: 024720201027; DynamiQ-X: 038400101009
Rating power	DynamiQ-S: 100W; DynamiQ-R: 150W; DynamiQ-X: 75W
Rating amperage	DynamiQ-S: <5A; DynamiQ-R: <1A; DynamiQ-X: <4A
Rating voltage	DynamiQ-S: 100 - 240VAC (optional AC/DC adapter) / 20 - 28 VDC; DynamiQ-R: 110 - 240 VAC; DynamiQ-X: 20 - 28 VDC
Rating frequency	DynamiQ-S: 50/60Hz (optional AC/DC adapter) / DC; DynamiQ-R: 50/60Hz; DynamiQ-X: DC
Power supply during test	DynamiQ-S: 230VAC/50Hz and 120VAC/60Hz (optional AC/DC adapter) / DC; DynamiQ-R: 230VAC/50Hz and 120VAC/60Hz; DynamiQ-X: 24VDC unless otherwise specified
Dimensions (LxWxH)	DynamiQ-S: 250 x 182 x 96 mm; DynamiQ-R: 440 x 483 x 172 mm; DynamiQ-X: 289 x 258 x 122 mm
Software release	1.0.0.3405
Hardware release	01101-06
Environment to be used	Laboratory, industrial (factory), ATEX environment (offshore drilling rigs)

Other EUT related data

The condition of the EUT during reception was undamaged and fully functional.
The highest generated or used frequency of the EUT is 667 MHz (CPU internal clock), other potential sources are the integrated electromechanical valves, PWM-controlled heaters and data communication interfaces..

Equipment authorization

The EUT can be authorized as Supplier's Declaration of Conformity (SDoC).

Test configuration

The EUT is tested as tabletop equipment.
According to the specifications of the EUT, the upper frequency to be measured is 5GHz for radiated Emission.
According to the information of the customer, the class of emission is B. The minimum requirement for a device not to be used in a general public- or household environment is Class A, but because the limits of EN 55011 Class B are more or less equal to 47 CFR 15 Class B it is advised to use Class B also for FCC. This gives also the opportunity to use the device in all environments without restrictions.

Interfaces to external objects

The cable connections to EUT and peripheral equipment during testing are displayed in the table below.

Description	Port type	Cable length	Max cable length	Type of cable	Fixing shield	Load at port
DynamiQ-S 24 V DC power supply port	DC supply	1.8m	30m	Unshielded	Not applicable	AC/DC mains adapter
DynamiQ-S Ethernet	I/O Communication	10m	100m	Unshielded	Not applicable	Peripheral notebook PC
DynamiQ-S Digital I/O (4x In, 4x out)	I/O Communication	3m	30m	Shielded	EUT side	IN: 1x high, 1 x low; OUT: 2x battery plus LED
DynamiQ-X Combined DC mains & I/O port	I/O Communication	3m	3m	Shielded	Both sides	EX junction box (DC power supply, peripheral notebook PC)
DynamiQ-R AC mains port	AC 1 phase mains	2m	NA	Unshielded	Not applicable	Mains wall outlet
DynamiQ-R Ethernet	I/O Communication	10m	100m	Unshielded	Not applicable	Peripheral notebook PC
DynamiQ-R Digital I/O (4x In, 4x out)	I/O Communication	3m	30m	Shielded	EUT side	IN: 1x high, 1 x low; OUT: 2x battery plus LED
DynamiQ-S AC mains port of adapter	AC 1 phase mains	2m	NA	Unshielded	Not applicable	Mains wall outlet
DynamiQ-S RS232/RS485 (configurable)	I/O Communication	3m	30m	Shielded	EUT side	Peripheral display
DynamiQ-R RS232/RS485 (configurable)	I/O Communication	3m	30m	Shielded	EUT side	Peripheral display

The maximum cable length is specified by the customer. The length of the connected cables can influence the EMC behaviour of the EUT. It is the responsibility of the customer to ensure this maximum cable length will never be exceeded in practice, to ensure compliance with the applied standards.

6 Operating conditions during test

Mode(s) of operation

The test mode(s) during testing were defined as:

Mode of operation	Description
Mode 1	Measurement mode, the EUT is fully functional. The integrated heaters are operational and PWM controlled. A carrier gas and sample gas are supplied to the EUT. Every 40 seconds a dose of sample gas is injected into the tubular column. One or more detectors are located at the end of the column. A continuous measurement is performed, which result is real time displayed in the software, running at a peripheral PC connected by Ethernet. A momentary influence will therefore be visible immediately. Prior to the EMC tests the EUT detector values are set to zero for a relative measurement during test. One digital input will be set high and one digital input will be set low, the status of these inputs will be set forward to two digital outputs. A peripheral display will be connected by the configurable RS232/RS485 port (configured as RS485).

The applicant's representative was remotely present to witness the testing.

The appendix of this report shows photos of the test configuration during the tests.

Test considerations

Because the relevant hardware of the three versions is identical, not all three variants are tested completely. A combination of tests is chosen to reduce the test time, but which still covers the properties of the three variants with a high certainty. This test plan describes the selected tests. The emission measurements and immunity tests will be performed against the most stringent levels, according the EN 61326-1. Because the EUT contains a hall sensor for the integrated measuring of the power, the power frequency magnetic field tests are applicable.

7 Measurement software

The measurement software during testing was Raditeq Radimation version 2022.3.3.

8 Emission measurement results

8.1 Conducted emission, test with an AMN

Test method

The conducted emission tests at the supply port are carried out by means of a "line impedance stabilization network" (LISN). The tests are recorded with a spectrum analyzer / EMI receiver. The tests are carried out in accordance with the applied standard(s) and the basic standard ANSI_C63_4, where the first standard takes precedence. The measured value is calculated by the following formula:

$$V = V_r + a_c + F_{AMN}$$

Where:

- V = conducted disturbance level (measured value) [dB μ V]
- V_r = receiver indication (receiver reading) [dB μ V]
- a_c = cable loss (coax cable) [dB]
- F_{AMN} = artificial mains network loss (LISN) (LISN insertion loss) [dB]

Measurement uncertainty

The measurement uncertainty during testing is displayed in the table below.

Frequency	U (log)
9 kHz – 150 kHz (measurement at EUT port LISN)	± 4.1 dB
150 kHz – 30 MHz (measurement at EUT port LISN)	± 3.8 dB
150 kHz – 30 MHz (measurement with extension cord)	± 4.2 dB

Requirements

The requirements according 47CFR15 and ICES-003 are laid down in the table below.

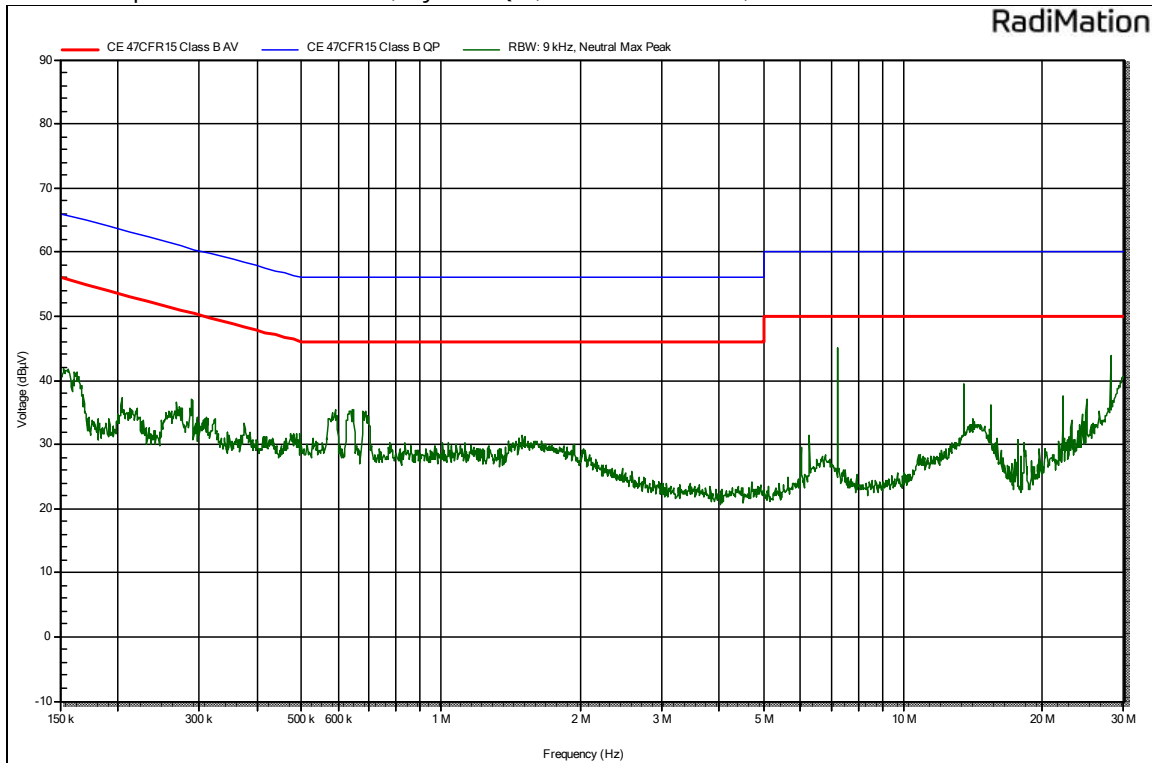
Frequency band	QP limit class A	AV limit class A	QP limit class B	AV limit class B
150 kHz - 500 kHz	79 dB μ V	66 dB μ V	66-56 ¹ dB μ V	56-46 ¹ dB μ V
500 kHz - 5 MHz	73 dB μ V	60 dB μ V	56 dB μ V	46 dB μ V
5 MHz - 30 MHz	73 dB μ V	60 dB μ V	60 dB μ V	50 dB μ V

¹ Decreasing linear with log of frequency.

Measurement results

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 12
Test date: 15 Feb 2023 12:57:49
Resolution 9 kHz Video bandwidth: 1 MHz
bandwidth:
line: Neutral
Mode of operation: Mode 1, DynamiQ-S, Pre-scan Neutral, 120VAC 60Hz

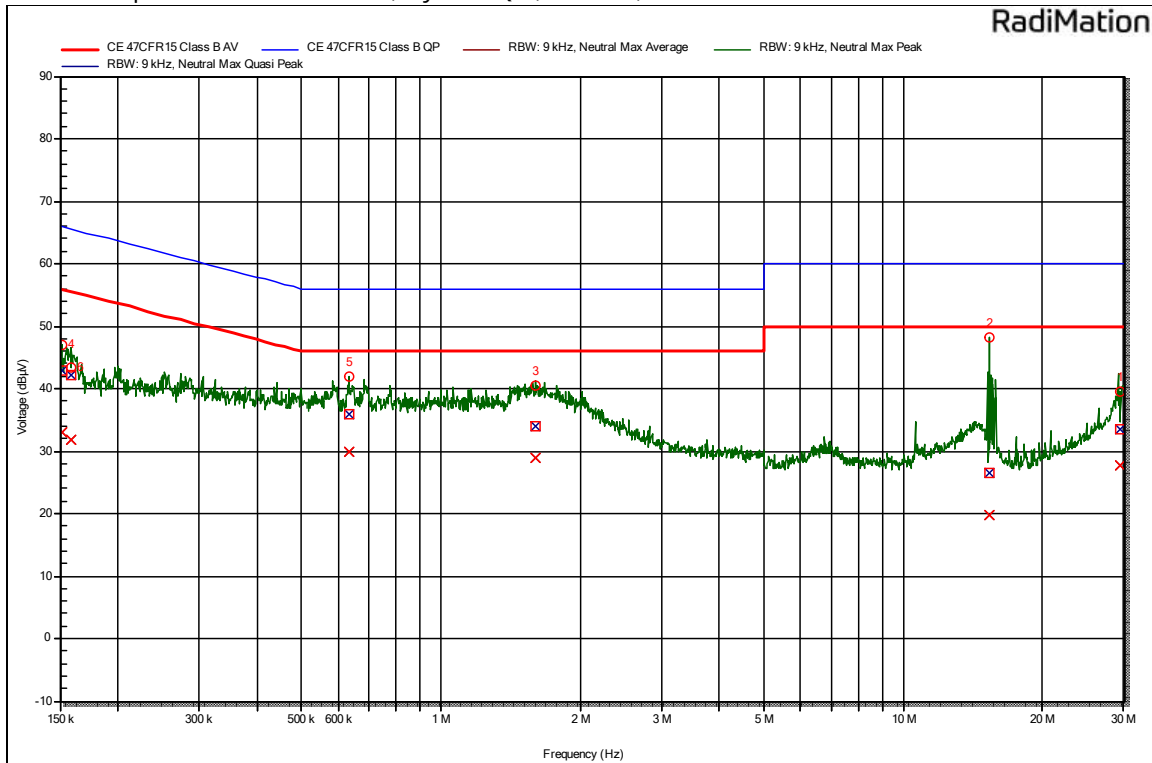


Remarks

Pre-scan

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 13
Test date: 15 Feb 2023 13:16:43
Resolution 9 kHz Video bandwidth: 1 MHz
bandwidth:
line: Neutral
Mode of operation: Mode 1, DynamiQ-S, Neutral, 120VAC 60Hz



Detected peaks

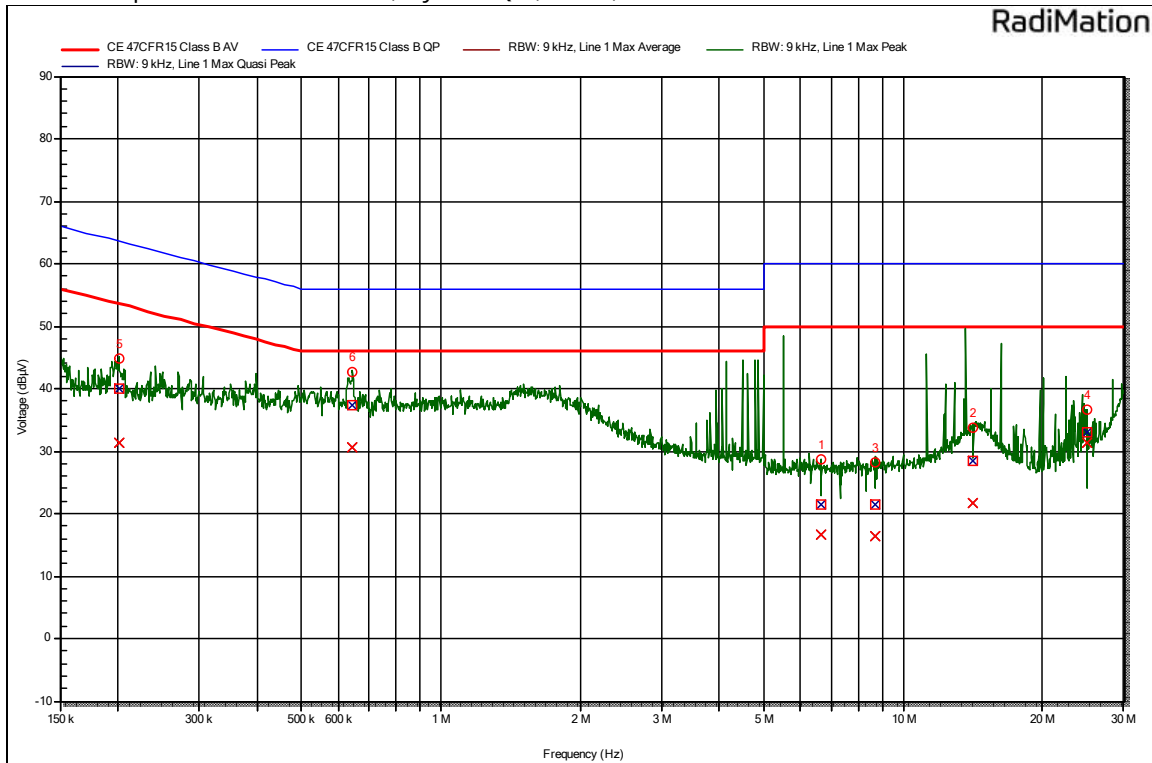
Peak Number	Frequency (MHz)	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Average (dBμV)	Average Limit (dBμV)	Status
1	29,539	33,6	60	27,7	50	Pass
2	15,298	26,5	60	19,8	50	Pass
3	1,605	33,9	56	29	46	Pass
4	0,151	42,9	65,9	33	55,9	Pass
5	0,633	35,9	56	30	46	Pass
6	0,158	42,3	65,5	31,7	55,5	Pass

Remarks

Pass

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 14
Test date: 15 Feb 2023 13:45:13
Resolution 9 kHz Video bandwidth: 100 kHz
bandwidth:
line: Line 1
Mode of operation: Mode 1, DynamiQ-S, Line1, 120VAC 60Hz



Detected peaks

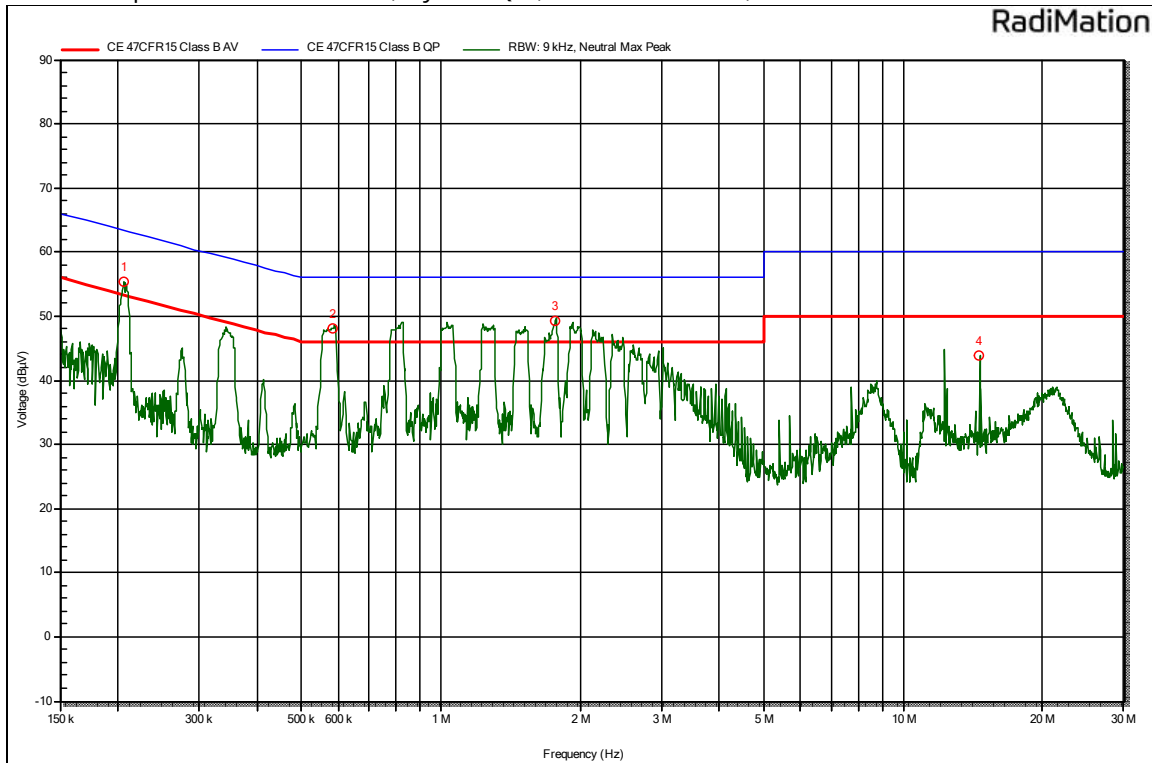
Peak Number	Frequency (MHz)	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Average (dBμV)	Average Limit (dBμV)	Status
1	6,646	21,4	60	16,6	50	Pass
2	14,158	28,4	60	21,8	50	Pass
3	8,726	21,4	60	16,4	50	Pass
4	24,96	32,9	60	31,4	50	Pass
5	0,201	40,1	63,6	31,3	53,6	Pass
6	0,645	37,4	56	30,6	46	Pass

Remarks

Pass

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 15
Test date: 15 Feb 2023 14:17:44
Resolution 9 kHz Video bandwidth: 1 MHz
bandwidth:
line: Neutral
Mode of operation: Mode 1, DynamiQ-R, Pre-scan Neutral, 120VAC 60Hz



Detected peaks

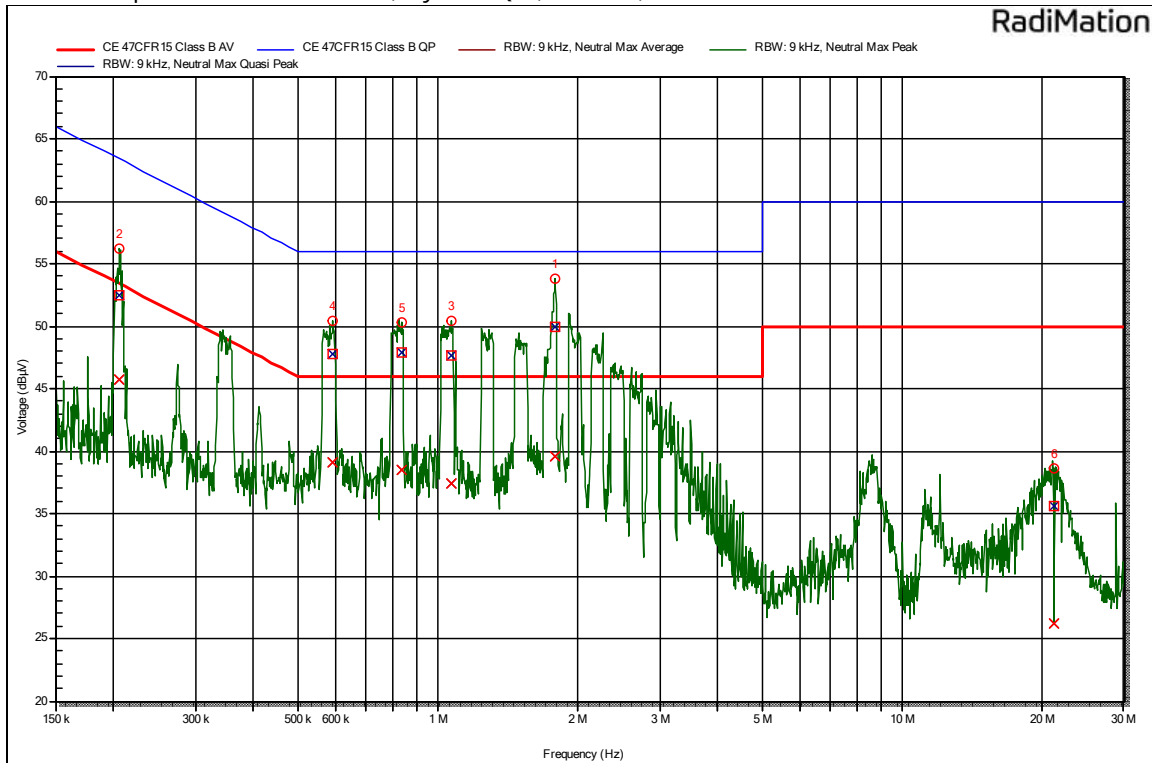
Peak Number	Frequency (MHz)
1	0,206
2	0,583
3	1,769
4	14,625

Remarks

Pre-scan

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 16
Test date: 15 Feb 2023 14:36:33
Resolution 9 kHz Video bandwidth: 1 MHz
bandwidth:
line: Neutral
Mode of operation: Mode 1, DynamiQ-R, Neutral, 120VAC 60Hz



Detected peaks

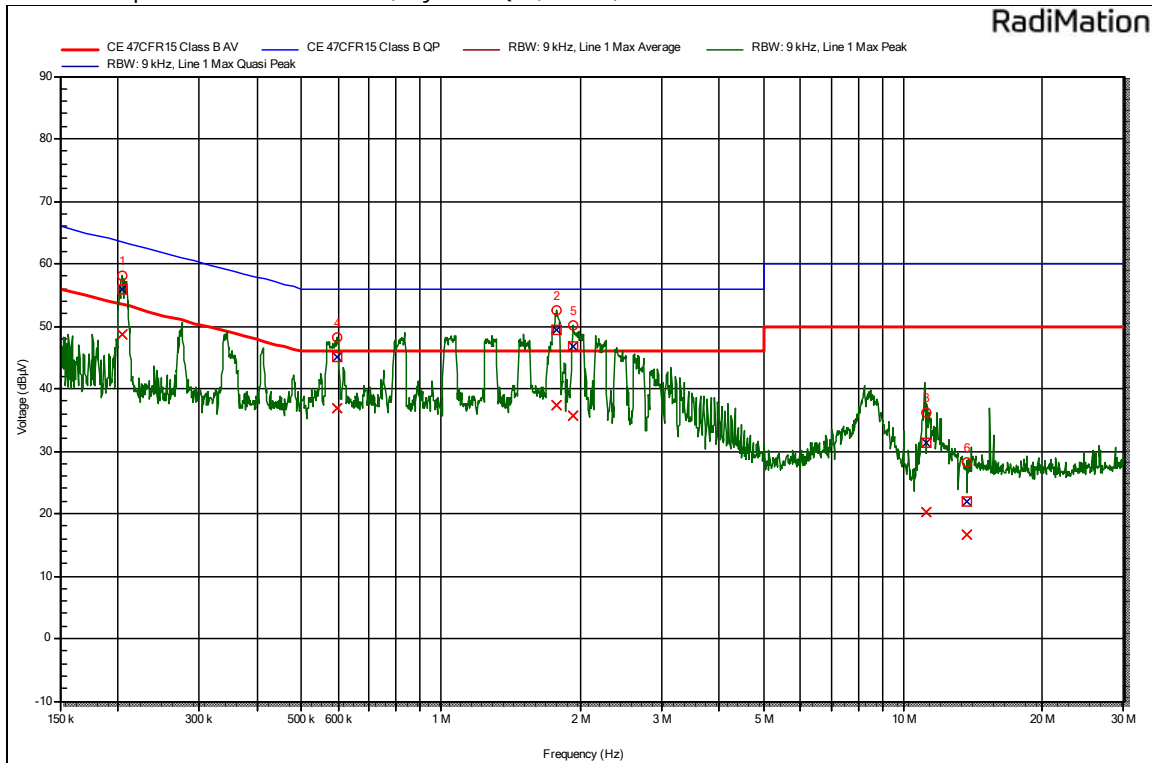
Peak Number	Frequency (MHz)	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Average (dBμV)	Average Limit (dBμV)	Status
1	1,785	50	56	39,6	46	Pass
2	0,207	52,5	63,3	45,7	53,3	Pass
3	1,07	47,6	56	37,4	46	Pass
4	0,595	47,7	56	39,1	46	Pass
5	0,834	47,9	56	38,4	46	Pass
6	21,232	35,6	60	26,1	50	Pass

Remarks

Pass

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 17
Test date: 15 Feb 2023 14:57:54
Resolution 9 kHz Video bandwidth: 100 kHz
bandwidth:
line: Line 1
Mode of operation: Mode 1, DynamiQ-R, Line1, 120VAC 60Hz



Detected peaks

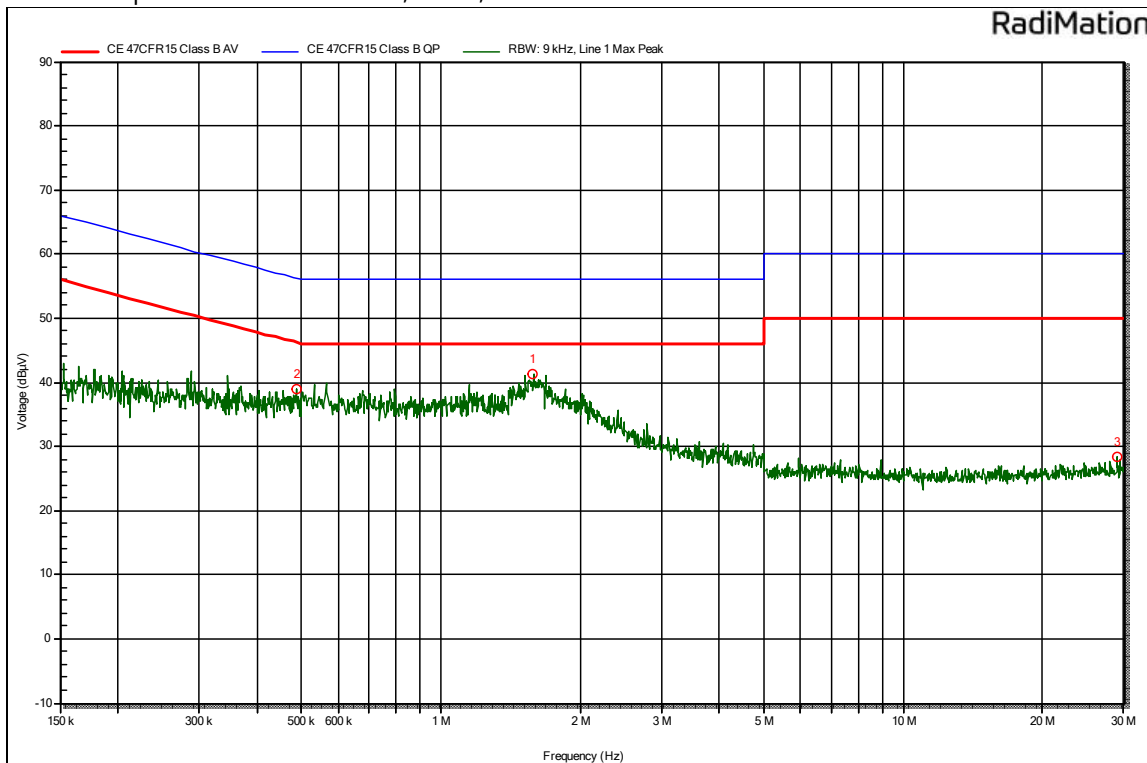
Peak Number	Frequency (MHz)	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Average (dBμV)	Average Limit (dBμV)	Status
1	0,204	55,9	63,4	48,7	53,4	Pass
2	1,777	49,4	56	37,4	46	Pass
3	11,194	31,3	60	20,3	50	Pass
4	0,596	45,1	56	36,8	46	Pass
5	1,931	46,8	56	35,6	46	Pass
6	13,725	21,8	60	16,6	50	Pass

Remarks

Pass

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 18
Test date: 15 Feb 2023 15:18:43
Resolution 9 kHz Video bandwidth: 100 kHz
bandwidth:
line: Line 1
Mode of operation: Ambient, Line1, 120VAC 60Hz



Detected peaks

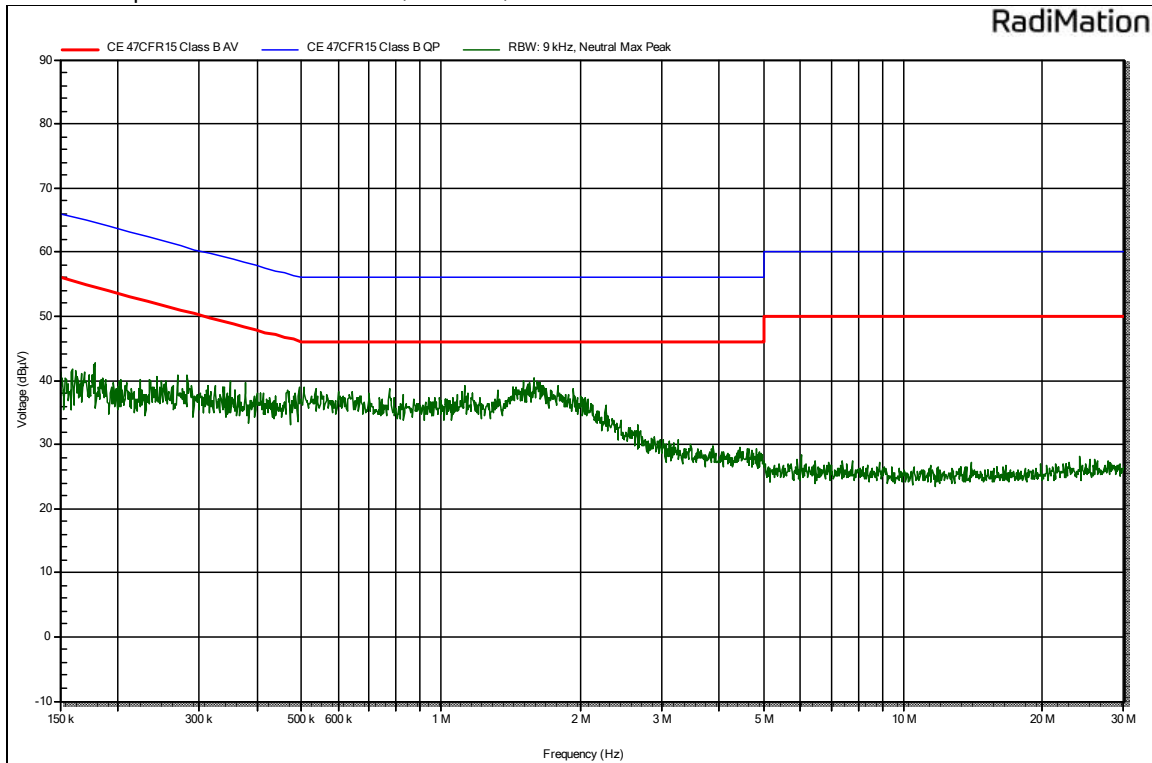
Peak Number	Frequency (MHz)
1	1,583
2	0,487
3	29,012

Remarks

Ambient test OK

Conducted emission LISN 150 kHz to 30 MHz

Project number: 20220753 Test ID: 19
Test date: 15 Feb 2023 15:22:42
Resolution 9 kHz Video bandwidth: 1 MHz
bandwidth:
line: Neutral
Mode of operation: Ambient, Neutral, 120VAC 60Hz



Remarks

Ambient test OK

8.2 Radiated emission up to 1 GHz (SAC)

Test method

The radiated emission tests are carried out in a semi anechoic chamber (SAC). The tests are recorded with a spectrum analyzer / EMI receiver. The test method is in accordance with the applied standard(s) and with the basic standard ANSI_C63_4 and paragraph 15.31 (f) (1) of 47 CFR 15 & ICES-003 (Issue 7) (October 2020), where the first standard takes precedence. The measured value is calculated by the following formula:

$$E = V_r + a_c + F_a$$

Where:

- E = field strength (measured value) [dB μ V/m]
- Vr = receiver indication (receiver reading) [dB μ V]
- ac = cable loss (coax cable) [dB]
- Fa = antenna factor (antenna) [dB/m]

Measurement uncertainty

The measurement uncertainty during testing is displayed in the table below.

Frequency	U (log)
30 MHz – 200 MHz vertical	± 4.9 dB
30 MHz – 200 MHz horizontal	± 4.8 dB
200 MHz – 1000 MHz vertical	± 6.4 dB
200 MHz – 1000 MHz horizontal	± 5.4 dB

Requirements

The requirements according 47CFR15 are laid down in the table below.

Frequency band	QP class A @ 3m	QP class A @ 10m	QP class B @ 3m	QP class B @ 10m
30 MHz - 88 MHz	49,5 dB μ V/m 300 μ V/m	39.1 dB μ V/m 90 μ V/m	40 dB μ V/m 100 μ V/m	29.5 dB μ V/m 30 μ V/m
88 MHz - 216 MHz	54 dB μ V/m 500 μ V/m	43.5 dB μ V/m 150 μ V/m	43,5 dB μ V/m 150 μ V/m	33.1 dB μ V/m 45 μ V/m
216 MHz - 960 MHz	56,9 dB μ V/m 700 μ V/m	46.4 dB μ V/m 210 μ V/m	46 dB μ V/m 200 μ V/m	35.6 dB μ V/m 60 μ V/m
960 MHz - 1 GHz	60 dB μ V/m 1000 μ V/m	49.5 dB μ V/m 300 μ V/m	54 dB μ V/m 500 μ V/m	43.5 dB μ V/m 150 μ V/m

The requirements according to ICES-003 are laid down in the table below.

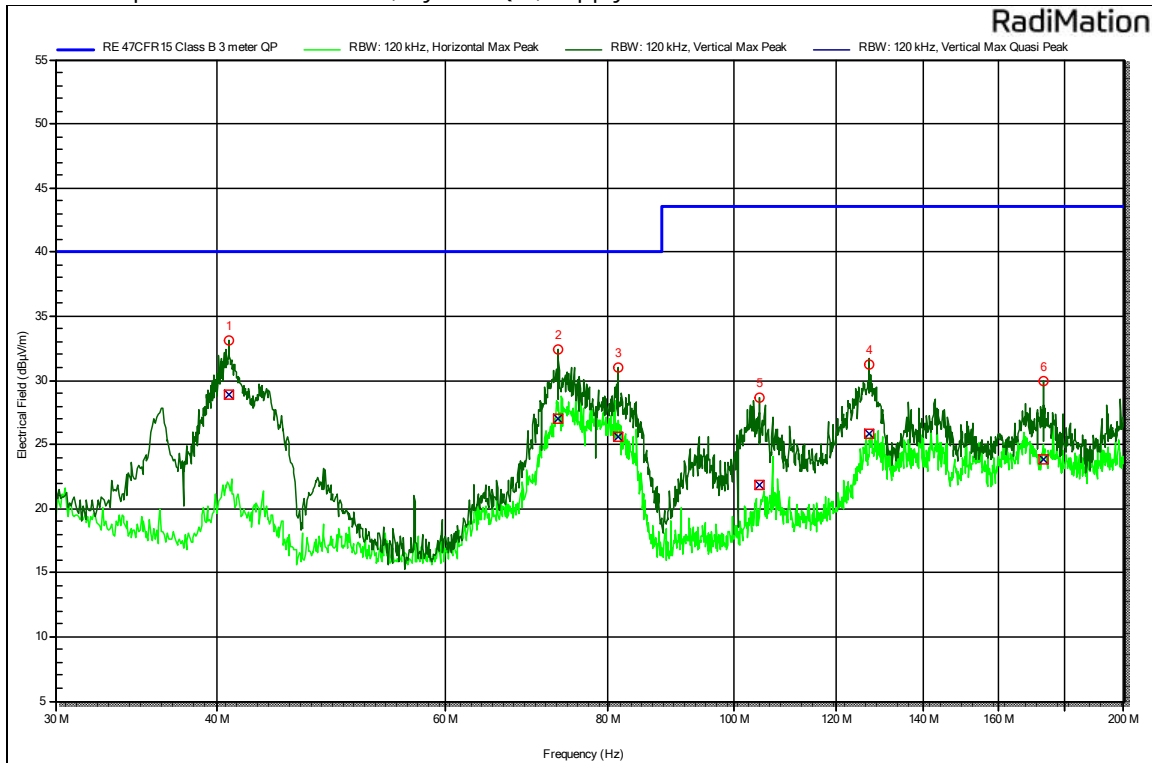
Frequency band	QP class A @ 3m	QP class A @ 10m	QP class B @ 3m	QP class B @ 10m
30 MHz - 88 MHz	50 dB μ V/m	40 dB μ V/m	40 dB μ V/m	30 dB μ V/m
88 MHz - 216 MHz	54 dB μ V/m	43.5 dB μ V/m	43,5 dB μ V/m	33.1 dB μ V/m
216 MHz - 230 MHz	56.9 dB μ V/m	46.4 dB μ V/m	46 dB μ V/m	35.6 dB μ V/m
230 MHz - 960 MHz	57 dB μ V/m	47 dB μ V/m	47 dB μ V/m	37 dB μ V/m
960 MHz - 1 GHz	60 dB μ V/m	49.5 dB μ V/m	54 dB μ V/m	43.5 dB μ V/m

Because the limits in accordance with 47CFR15 are the most stringent limits, the 47CFR15 limits are applied worst-case.

Measurement results

Radiated emission semi anechoic chamber 30 MHz to 200 MHz

Project number: 20220753 Test ID: 1
Test date: 13 Feb 2023 15:05:52
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-S, supply of 120V 60Hz



Detected peaks

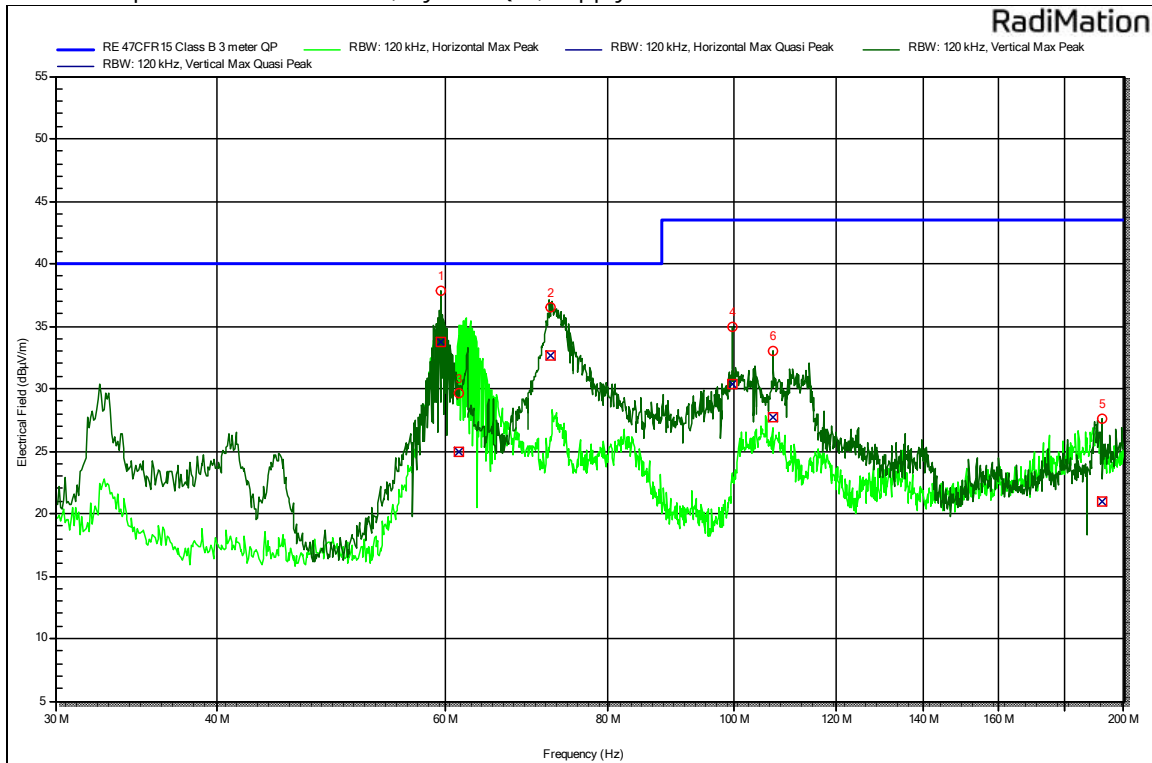
Peak Number	Frequency (MHz)	Quasi-Peak (dBV/m)	Quasi-Peak Limit (dBV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	40,872	28,9	40	65	1	Vertical	Pass
2	73,154	27	40	0	1,3	Vertical	Pass
3	81,439	25,6	40	268	1	Vertical	Pass
4	127,146	25,8	43,5	-23	1,3	Vertical	Pass
5	104,779	21,9	43,5	111	1,3	Vertical	Pass
6	173,230	23,8	43,5	21	1	Vertical	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 30 MHz to 200 MHz

Project number: 20220753 Test ID: 2
Test date: 13 Feb 2023 16:15:54
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-R, supply of 120V 60Hz



Detected peaks

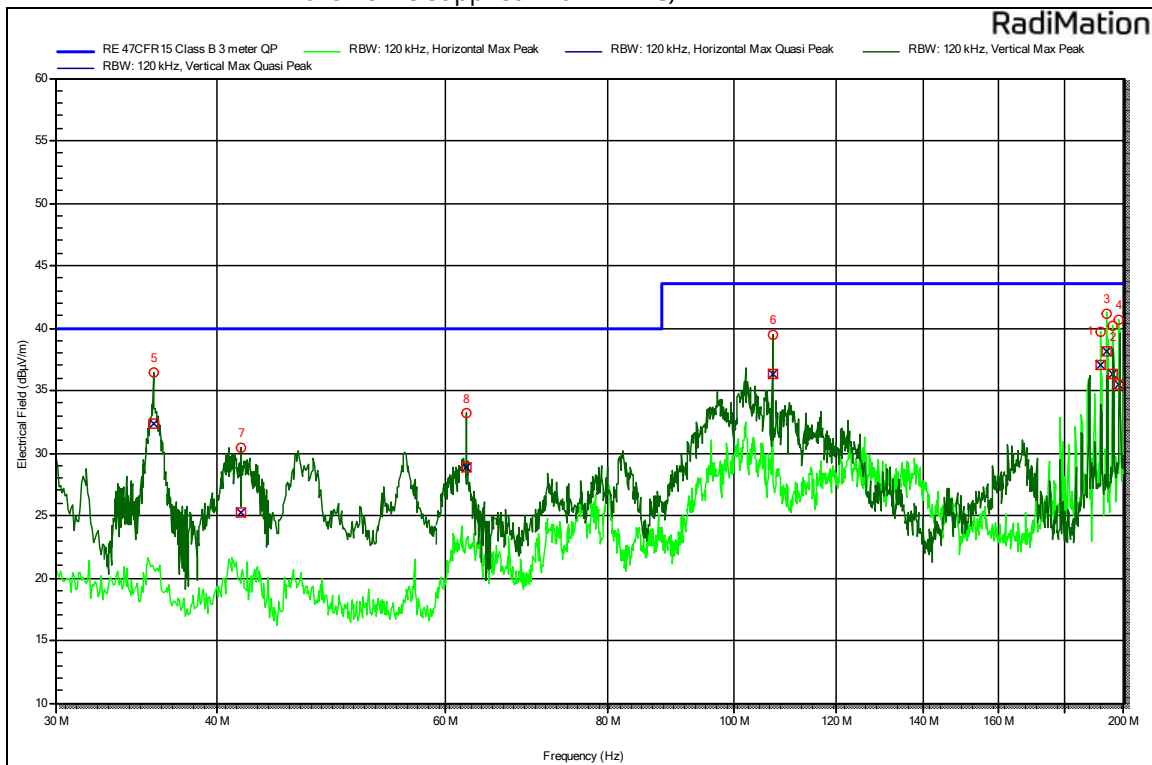
Peak Number	Frequency (MHz)	Quasi-Peak (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	59,533	33,8	40	45	1,8	Vertical	Pass
2	72,223	32,6	40	-44	1,5	Vertical	Pass
3	61,467	24,9	40	177	3,8	Horizontal	Pass
4	99,925	30,4	43,5	66	1	Vertical	Pass
5	192,625	20,9	43,5	90	1	Vertical	Pass
6	107,391	27,7	43,5	111	1	Vertical	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 30 MHz to 200 MHz

Project number: 20220753 Test ID: 3
Test date: 14 Feb 2023 09:21:32
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-X, supply of 120V 60Hz (with adaptor from customer the EUT is supplied with 24VDC)



Detected peaks

Peak Number	Frequency (MHz)	Quasi-Peak (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	192,030	37,1	43,5	-44	1	Horizontal	Pass
2	196,148	36,3	43,5	-45	1	Horizontal	Pass
3	194,108	38,1	43,5	-44	1,8	Horizontal	Pass
4	198,376	35,5	43,5	89	2	Horizontal	Pass
5	35,698	32,4	40	135	1	Vertical	Pass
6	107,148	36,3	43,5	0	1,3	Vertical	Pass
7	41,712	25,3	40	67	1	Vertical	Pass
8	62,162	28,8	40	44	1	Vertical	Pass

Remarks

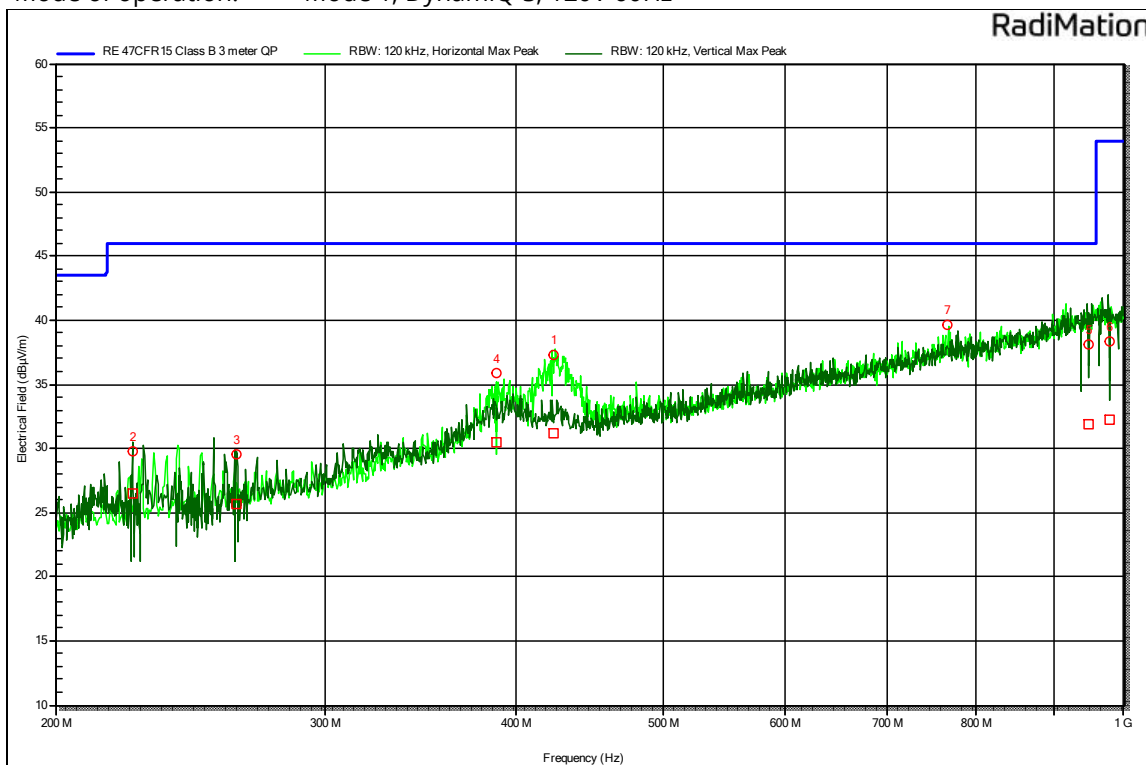
Pass

Reference number: 20220753RPT02

Page 26 of 40

Radiated emission semi anechoic chamber 200 MHz to 1 GHz

Project number: 20220753 Test ID: 11
Test date: 14 Feb 2023 16:22:28
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-S, 120V 60Hz



Detected peaks

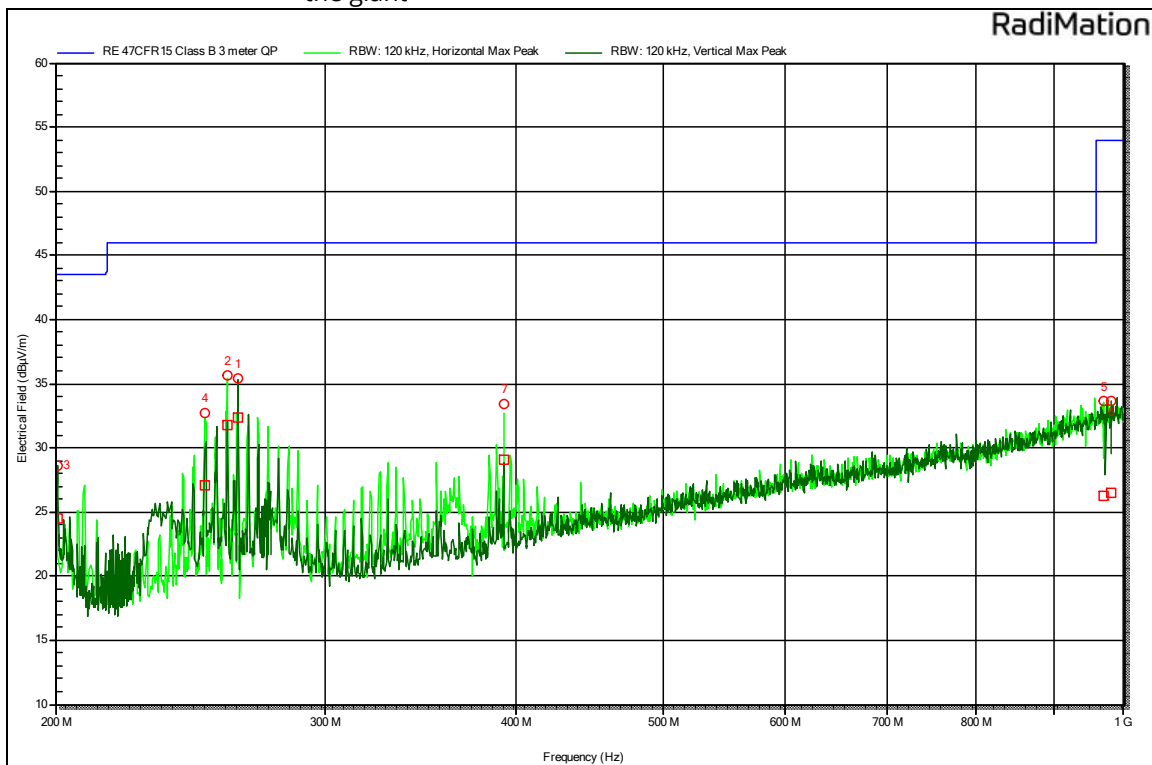
Peak Number	Frequency (MHz)	Quasi-Peak (dBV/m)	Quasi-Peak Limit (dBV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	423,237	31,2	46	111	1	Horizontal	Pass
2	224,587	26,4	46	22	1,3	Vertical	Pass
3	262,720	25,7	46	44	1	Vertical	Pass
4	388,667	30,5	46	90	1	Horizontal	Pass
5	947,945	31,9	46	245	3,3	Vertical	Pass
6	977,985	32,3	54	21	2,5	Vertical	Pass
7	767,200			269	4	Horizontal	

Remarks

Pass

Radiated emission semi anechoic chamber 200 MHz to 1 GHz

Project number: 20220753 Test ID: 21
Test date: 19 Apr 2023 11:57:24
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-X, 120VAC 60Hz supply, modification: housing is connected to the ground & shielding of the cable is now connected to the glant



Detected peaks

Peak Number	Frequency (MHz)	Quasi-Peak (dBV/m)	Quasi-Peak Limit (dBV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	263,257	32,3	46	-22	1	Vertical	Pass
2	258,942	31,7	46	45	1,2	Horizontal	Pass
3	200,591	24,5	43,5	111	1	Vertical	Pass
4	250,500	27,1	46	-1	1	Horizontal	Pass
5	969,625	26,2	54	68	2,8	Horizontal	Pass
6	981,481	26,5	54	88	1,5	Vertical	Pass
7	392,844	29,1	46	91	1	Horizontal	Pass

Remarks

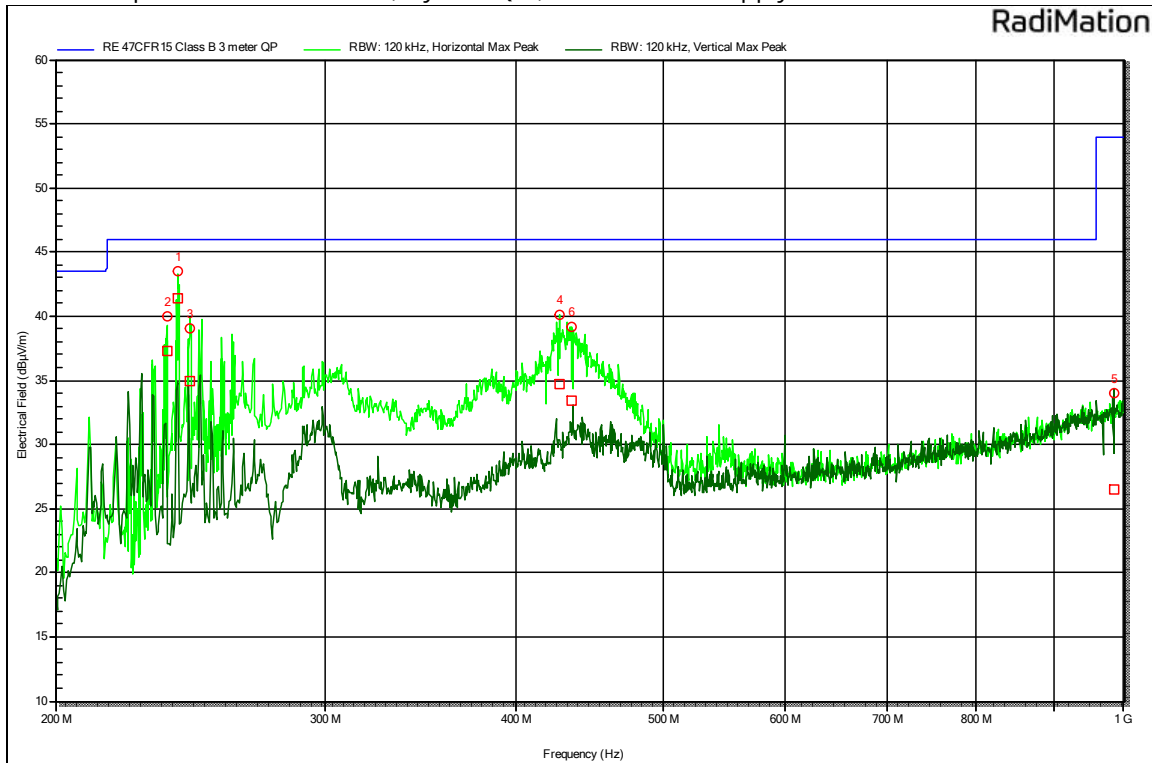
Pass

Reference number: 20220753RPT02

Page 28 of 40

Radiated emission semi anechoic chamber 200 MHz to 1 GHz

Project number: 20220753 Test ID: 22
Test date: 19 Apr 2023 14:02:00
Resolution bandwidth: 120 kHz Video bandwidth: 1 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Both
Mode of operation: Mode 1, DynamiQ-R, 120VAC 60Hz supply



Detected peaks

Peak Number	Frequency (MHz)	Quasi-Peak (dBV/m)	Quasi-Peak Limit (dBV/m)	Angle (degrees)	Height (m)	Polarization	Status
1	240,559	41,4	46	271	1,5	Horizontal	Pass
2	236,492	37,3	46	270	1,5	Horizontal	Pass
3	245,039	34,9	46	40	1	Horizontal	Pass
4	427,233	34,7	46	-111	1	Horizontal	Pass
5	984,561	26,5	54	225	1,5	Vertical	Pass
6	435,579	33,4	46	248	1	Horizontal	Pass

Remarks

Pass, highest peak at 240MHz is 4.6dB below the limit

8.3 Radiated emission above 1 GHz (FAC)

Test method

The radiated emission tests are carried out in a full anechoic chamber (FAC). The tests are recorded with a spectrum analyzer / EMI receiver. The test method is in accordance with the applied standard(s) and with the basic standard ANSI_C63_4, where the first standard takes precedence. The measured value is calculated by the following formula:

$$E = V_r + a_c + G_p + F_a$$

Where:

- E = field strength (measured value) [dB μ V/m]
- V_r = receiver indication (receiver reading) [dB μ V]
- a_c = cable loss (coax cable) [dB]
- G_p = preamplifier gain (dB)
- F_a = antenna factor (antenna) [dB/m]

Measurement uncertainty

The measurement uncertainty during testing is displayed in the table below.

Frequency	U (log)
1 GHz – 8 GHz:	± 6.1 dB

Prior to the test, the frequency range of measurement has to be established. 47 CFR 15 & ICES-003 (Issue 7) (October 2020) describes the frequency range to be measured of a digital device (unintentional radiator):

Highest frequency generated or used in the device or on which the device operates or tunes [MHz]	Upper frequency of measurement range [MHz]
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

Requirements

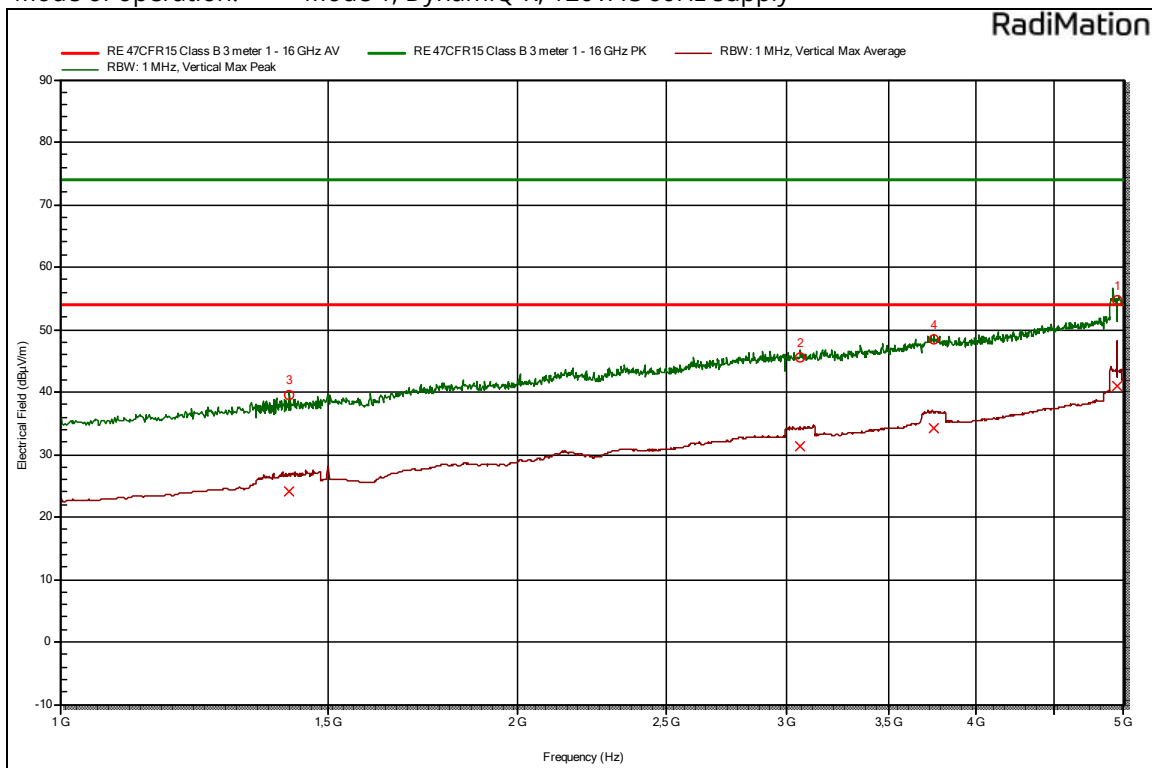
The requirements according 47CFR15 and ICES-003 are laid down in the table below.

Frequency band	Class A limit @ 3m		Class A limit @ 1m		Class B limit @ 3m		Class B limit @ 1m	
	AV	PK	AV	PK	AV	PK	AV	PK
Above 1 GHz [dB μ V/m]	60	80	69.5	89.5	54	74	63.5	83.5
Above 1 GHz [μ V/m]	1000	10000	3000	30000	500	5000	1500	15000

Measurement results

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 24
Test date: 19 Apr 2023 16:02:39
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Vertical
Mode of operation: Mode 1, DynamiQ-R, 120VAC 60Hz supply



Detected peaks

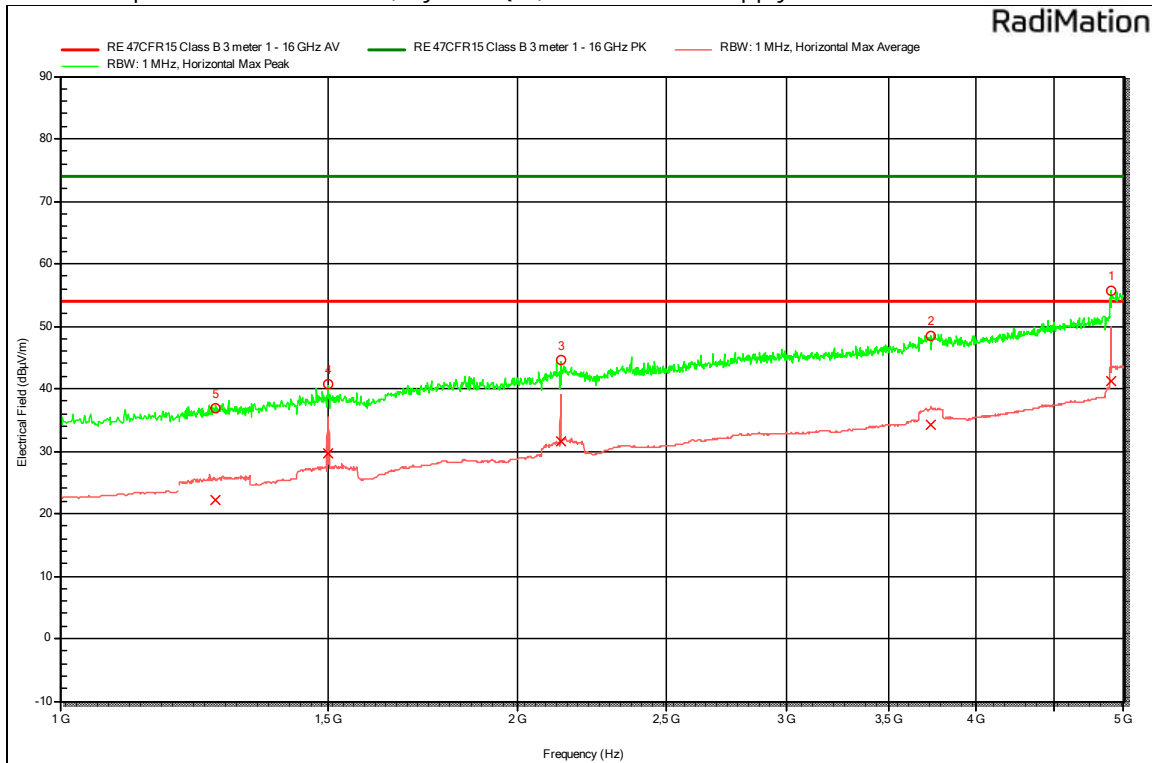
Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4946,174	225	1,3	Vertical	Pass
2	3064	114	1,3	Vertical	Pass
3	1414	2	1,3	Vertical	Pass
4	3748	-47	1,3	Vertical	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 25
Test date: 19 Apr 2023 16:27:02
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Horizontal
Mode of operation: Mode 1, DynamiQ-R, 120VAC 60Hz supply



Detected peaks

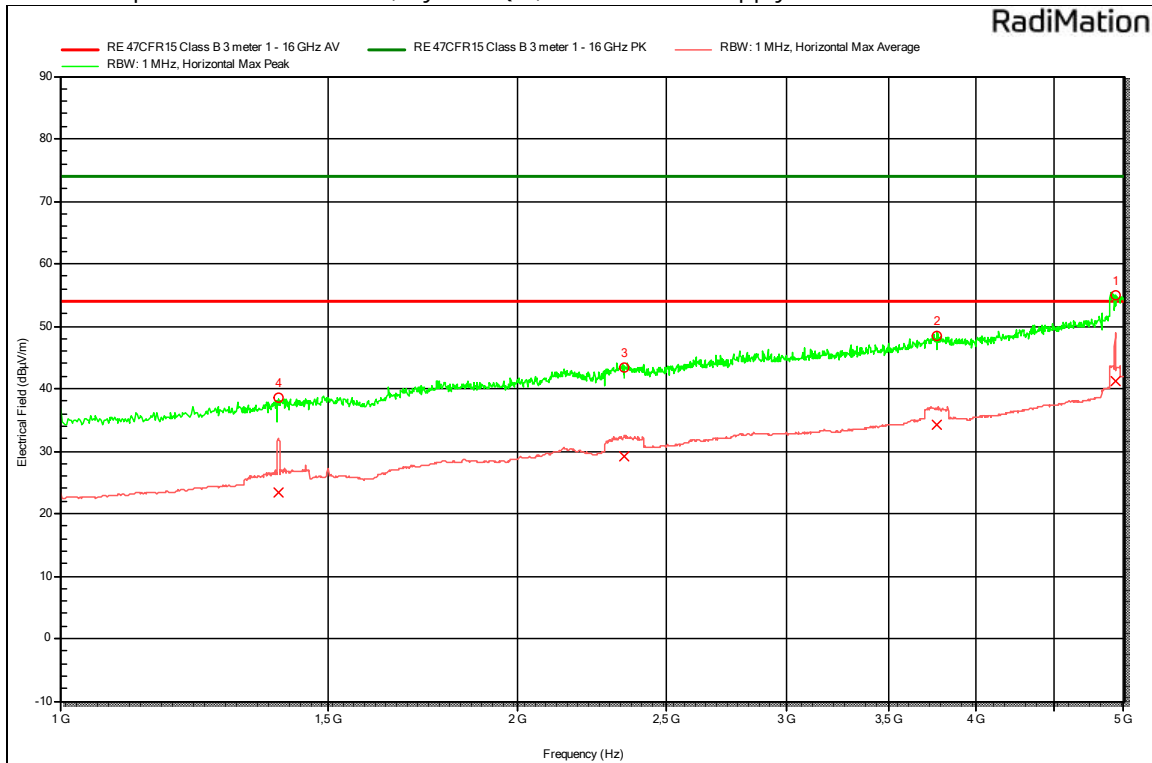
Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4903,168	157	1,3	Horizontal	Pass
2	3734	294	1,3	Horizontal	Pass
3	2133,459	45	1,3	Horizontal	Pass
4	1499,882	93	1,3	Horizontal	Pass
5	1266	204	1,3	Horizontal	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 26
Test date: 20 Apr 2023 08:59:58
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Horizontal
Mode of operation: Mode 1, DynamiQ-S, 120VAC 60Hz supply



Detected peaks

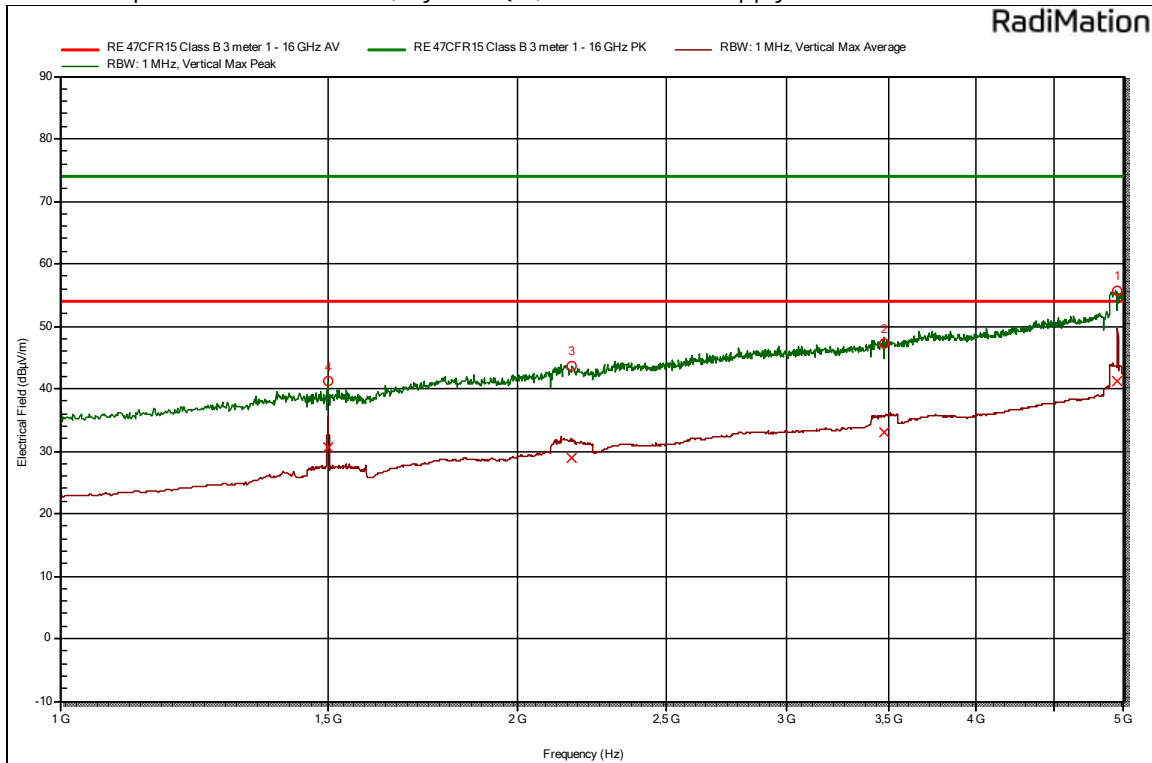
Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4934,572	23	1,3	Horizontal	Pass
2	3766	69	1,3	Horizontal	Pass
3	2348	137	1,3	Horizontal	Pass
4	1391,836	-2	1,3	Horizontal	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 27
Test date: 20 Apr 2023 13:14:51
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Vertical
Mode of operation: Mode 1, DynamiQ-S, 120VAC 60Hz supply



Detected peaks

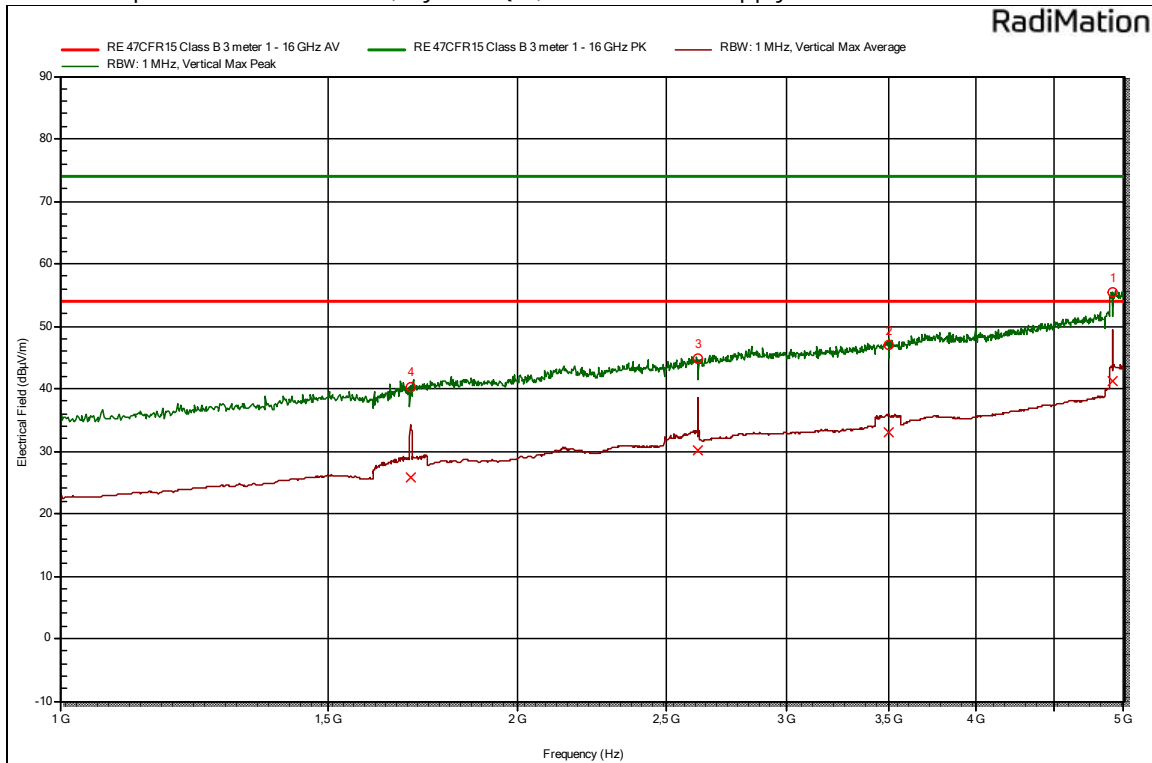
Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4951,684	87	1,3	Vertical	Pass
2	3480	204	1,3	Vertical	Pass
3	2170	69	1,3	Vertical	Pass
4	1499,977	-20	1,3	Vertical	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 28
Test date: 20 Apr 2023 13:56:29
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Vertical
Mode of operation: Mode 1, DynamiQ-X, 120VAC 60Hz supply



Detected peaks

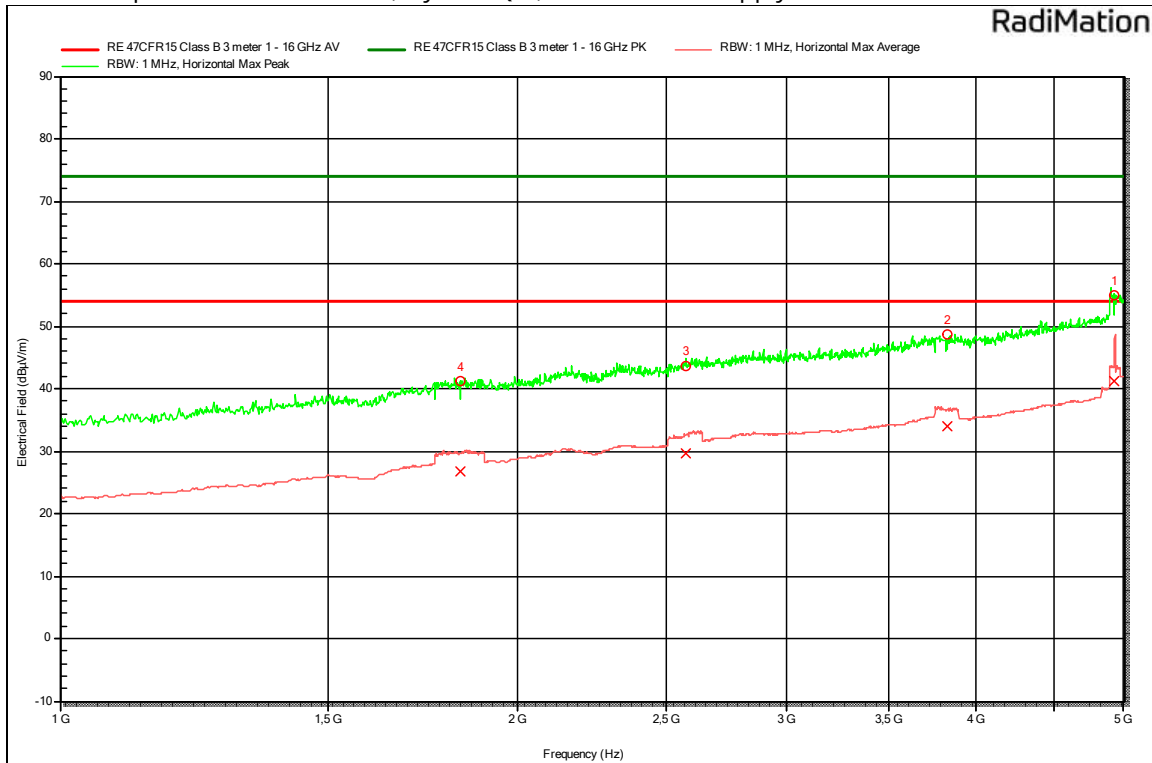
Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4916,672	87	1,3	Vertical	Pass
2	3500	272	1,3	Vertical	Pass
3	2624,764	67	1,3	Vertical	Pass
4	1700,588	250	1,3	Vertical	Pass

Remarks

Pass

Radiated emission semi anechoic chamber 1 GHz to 5 GHz

Project number: 20220753 Test ID: 29
Test date: 20 Apr 2023 14:24:35
Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz
Antenna distance: 3 m Antenna height: 1 - 4 m
Antenna polarization: Horizontal
Mode of operation: Mode 1, DynamiQ-X, 120VAC 60Hz supply



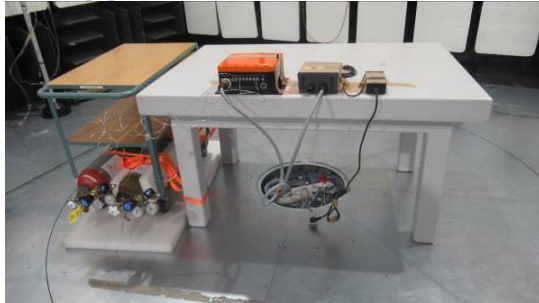
Detected peaks

Peak Number	Frequency (MHz)	Angle (degrees)	Height (m)	Polarization	Status
1	4931,172	293	1,3	Horizontal	Pass
2	3824	227	1,3	Horizontal	Pass
3	2576	89	1,3	Horizontal	Pass
4	1832	92	1,3	Horizontal	Pass

Remarks

Pass

9 Appendix A: Photos



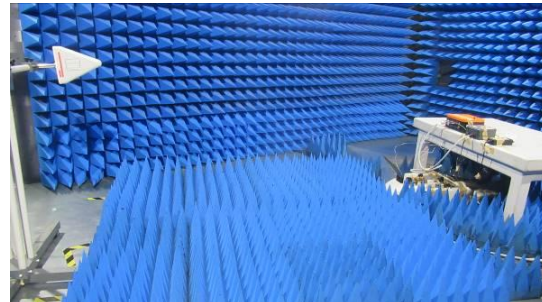
Radiated Emission test



Radiated Emission 30MHz-200MHz test



Radiated Emission 200MHz-1000MHz test



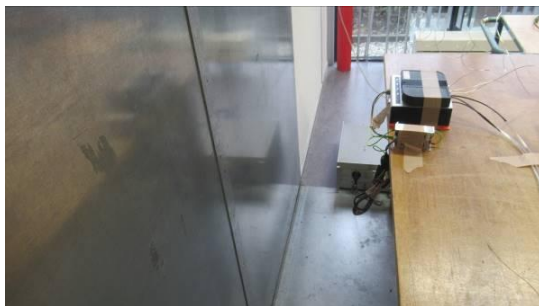
Radiated Emission above 1GHz test



Conducted Emission test



Conducted Emission test



Conducted Emission test

10 Appendix B: Equipment list

Conducted emission LISN 150 kHz to 30 MHz

Description	Brand	Model	Serial	ID	Last calibration	Calibration interval
Test site conducted emission, Anderson	DARE!! Measurements	-	-	1572	-	-
EMI Receiver	R&S	ESPI 3	100209	1601	2022-04-01	1 year
LISN 50 Ohm / 50 uH + 5 Ohm, 3~, 16 A, incl. 10 dB Att.	Schwarzbeck+Minicircuits	NSLK 8126 + BW- N10W5	506+-	1607+1791	2020-06-30	3 years
Extension cord for power plugs	DARE!!	-	-	1645	-	-
Power source	California Instruments	5001iX	55707	1325	2019-08-21	3 years
Cable RF-coaxial, CE LISN Anderson (EMC)	Huber + Suhner	RG142	-	1226	2022-04-29	1 year

Radiated emission semi anechoic chamber 30 MHz to 1 GHz

Description	Brand	Model	Serial	ID	Last calibration	Calibration interval
Anechoic room, semi	Rainford	SAR 5m	-	1348	2020-02-12 ¹⁾	3 years
EMI Receiver	R&S	ESU26	100011	1465	2022-03-02	1 year
Antenna mast	Inn-Co	CO 3000	-	1817 + 1820	-	-
Turn table	Innco & De Groot	CO3000 + 3M10T	-	1820 + 1821	-	-
Antenne 30 MHz – 200 MHz	Rohde & Schwarz	HK116	827601/014	1386	2021-03-19	2 years
Antenne 200 MHz – 1 GHz	Schwarzbeck	VULP 9118B	9118B-815	7396	2021-07-19	2 years
Power source	California Instruments	5001iX	55707	1325	2022-12-02	3 years
Cable RF-coaxial, set, RE Shockley (EMC)	-	-	-	1419	2022-04-16	1 year

¹⁾ Standard for test site validation: CISPR 16-1-4 ed.3 (2010-04) (Normalized Site Attenuation (NSA))

Radiated emission full anechoic room 1 GHz to 8 GHz

Description	Brand	Model	Serial	ID	Last calibration	Calibration interval
Anechoic room, full	Siepel	Hermes 3	-	1494	2021-06-18 ¹⁾	3 years
EMI Receiver	R&S	ESW8	101065	1703	2022-04-08	1 year
Antenna mast	DARE!! Instruments	RadiTower RAT1001B + RPL2010A	-	1569+1496	-	-
Turn table	DARE!! Instruments	RadiTurn (RadiCentre)	-	1569+1367	-	-
Power source	California Instruments	5001iX	55707	1325	2022-12-02	3 years
Cable preamp - > analyser	Succoflex	Succoflex	-	1235	2022-04-07	1 year ($\pm$ 1 month grace period)
Antenna	Schwarzbeck	ESLP 9145	-	7298	2022-08-08	2 years

¹⁾ Standard for test site validation: CISPR 16-1-4 (2019-03) (site VSWR)

²⁾ Standard for test site validation: CISPR 16-1-4 (2007) (site VSWR)

11 Appendix C: Abbreviations

List of used abbreviations in this report:

Abbreviation	Explanation
EMC	Electromagnetic compatibility
FCC	Federal Communications Commission
EUT	Equipment under test
SAC	Semi-anechoic chamber
FAC	Full-anechoic chamber
PK	Peak (detector)
QP	Quasi-peak (detector)
AV	Average (detector)
AMN	Artificial mains network
SA	Spectrum analyser
RC	Test receiver