Test report for

47 CFR Part 15 Subpart B

ICES-Gen, ICES-003

Product name	: Gateway
Applicant	: Cargotec Oyj
FCC ID	: 2BGMHCE-IMX8-01
IC	: N/A

Test report No. : P000320723 002 Ver 2.10

Laboratory information

Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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Documentation

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Testing Location

Test Site	Kiwa Nederland B.V.
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.50	30-10-2024	First draft	RvB
v1.00	13-12-2024	Final release	RvB
V2.00	10-04-2025	FCC ID Update	MHK
V2.10	22-05-2025	Section 1.3 FCC Id corrected and IC id to N/A	MHK

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.109 (a)	ICES-003 Table 2	Radiated spurious emissions < 1GHz	3.1	Pass
15.109 (a)	ICES-003 Table 4	Radiated spurious emissions > 1GHz	3.1	Pass

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

Note: the EUT is DC power and not connected to a AC power source. (EUT is vehicular use) no AC mains conducted emissions are performed.

1 General Description

1.1 Applicant

Client name:	Cargotec Oyj
Address:	Porkkalankatu 5, Helsinki
Zip code:	00180
Telephone:	+358 207774000
E-mail:	seppo.laakkonen@cargotec.com
Contact name:	Mr. S. Laakkonen

1.2 Manufacturer

Manufacturer name:	Cargotec Oyj
Address:	Porkkalankatu 5, Helsinki
Zip code:	00180
Telephone:	+358 207774000
E-mail:	seppo.laakkonen@cargotec.com
Contact name:	Mr. S. Laakkonen

1.3 Tested Equipment Under Test (EUT)

Product name:	Gateway
Brand name:	Cargotec
FCC ID:	2BGMHCE-IMX8-01
IC:	N/A
Product description:	Gateway
Model(s):	CE-IMX08-1
Software version:	--
Hardware version:	--
Date of receipt:	25-06-2024
Tests started:	15-06-2024
Testing ended:	16-10-2024

1.3.1 Auxiliary items

AUX1

Product name:	Notebook
Product type:	
Remarks:	Connects to EUT Ethernet port, property test lab

AUX2

Product name:	Communication simulation for EUT
Product type:	Communication simulation box
Remarks:	Connects to EUT

1.4 Product specifications of Equipment under test

Tx Frequency:	WLAN: 2412 – 2462 MHz BLE: 2402 – 2480 MHz BT BR/EDR: 2402 – 2480 MHz LTE: bands 2/4/5/7/12/13/25/26/38/41 WCDMA: bands 2/4/5 GSM: bands 850/1900
Rx frequency:	WLAN: 2412 – 2462 MHz BLE: 2402 – 2480 MHz BT BR/EDR: 2402 – 2480 MHz LTE: bands 2/4/5/7/12/13/25/26/38/41 WCDMA: bands 2/4/5 GSM: bands 850/1900 GNSS: 1575.42 MHz
Occupied channel width:	WLAN: 20 MHz BLE: 1/2MHz BT BR/EDR: 1 MHz LTE: 1.4/3/5/10/15/20 MHz WCDMA: 5 MHz GSM: 0.2 MHz
Antenna type:	Smarteq Alldisc 710388
Antenna gain:	GSM/WCDMA/LTE:3.25 dBi* WLAN/BLE/BT BR/BT EDR: 1.4 dBi*
Type of modulation:	According to WLAN/Bluetooth/LTE/GSM/WCDMA specs.
Emission designator	WLAN/BLE/BT BR/BT EDR: see FCC id: VPYLB1XK GSM/WCDMA/LTE: see FCC id: XMR201906ED21G

Disclaimer: The operating frequency bands are declared by the applicant
Note: antenna gain (dBi) =antenna gain(dBi) + cable loss (dB).(tested with 55cm cable length)

1.5 Environmental conditions

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %

1.6 Measurement standards

- ANSI C63.4:2014

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart B
- ICES-003 Issue 7
- ICES-Gen Issue 2

1.8 Observation and remarks

The EUT contains 2 pre-certified radio: 1. Murata LBEEE5CJ1XK-687 (WLAN/BLE/BT BR/ BT EDR)
2. Quectel EG21-G (GSM/WCDMA/LTE). And is battery powered.

Worst case EUT orientation is wall mounted.

1.9 Modifications to the EUT (Equipment Under Test)

The applicant added some RF absorber sheets om some components to supress Radiated emissions.
See internal photo module for details.

1.10 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Kiwa Nederland B.V. accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All tests are performed by:

Name : ing. R. van Barneveld

Review of test methods and report by:

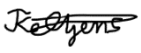
Name : ing. M.H. Khan

The above conclusions have been verified by the following signatory:

Date : 22-05-2025

Name : Ing. T. Keltjens

Function : Test Engineer

Signature : 

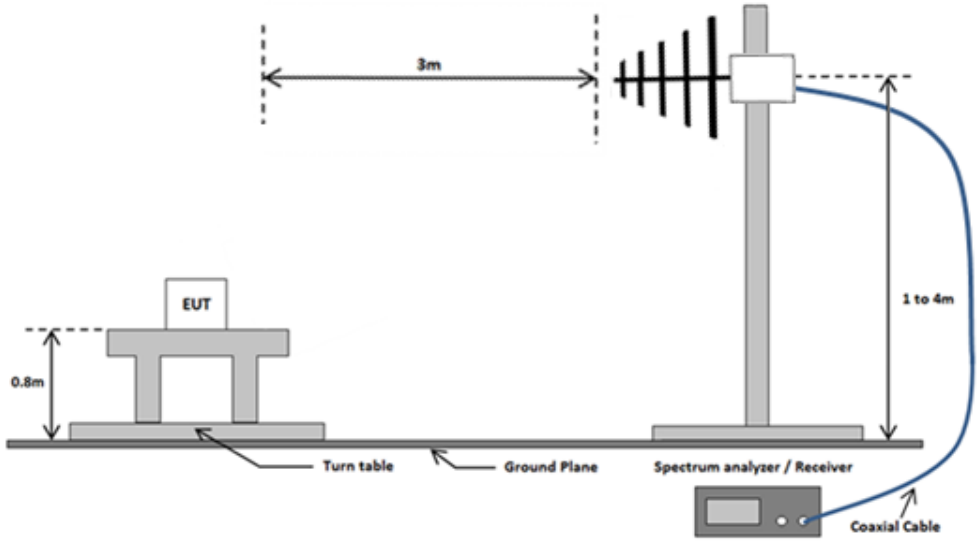
2 Test configuration of the Equipment Under Test

2.1 Test mode

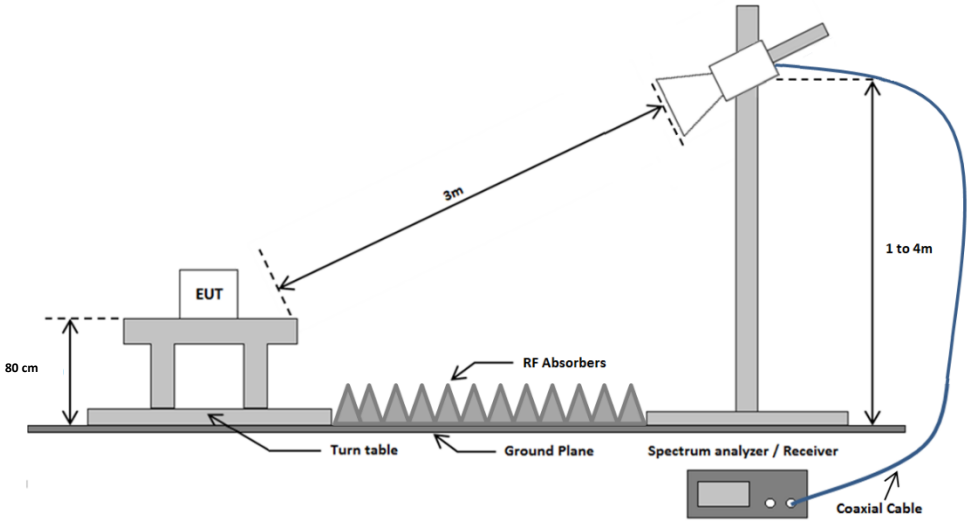
Tested in normal mode.

2.2 Test setups

2.2.1 Radiated emissions test setup 30 MHz - 1 GHz



2.2.2 Radiated emissions test setup above 1 GHz



List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	DC Power	DC supply	EUT	< 3m	12 – 24 V
2	I/O cable	CAN bus	EUT	< 3m	---
3	I/O cable	I/O cable	EUT	< 3m	--
	I/O cable	1-wire	EUT	< 3m	--
4	Ethernet	EUT	EUT	<3m	--

Note: all cables above are part of the wiring loom of the EUT.

2.3 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.107 and 15.109, ICES-003 and ICES-Gen. The test methods, which have been used, are based on ANSI C63.4-2014.

2.4 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	114870	09-2024	09-2026	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV3044	114923	10-2023	10-2025	3.1
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	114682	09-2024	09-2027	3.1
Biconical antenna + 6dB attenuator	EMCO	3109	107818	06-2022	06-2025	3.1
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436	07-2024	07-2027	3.1
Logperiodic antenna	EMCO	3147	114385	02-2021	02-2026	3.1
Horn antenna	EMCO	3115	114607	01-2024	07-2027	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.1
Horn antenna	Scientific atlanta	12A-26	114487	NA*	NA*	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114771	08-2024	08-2025	3.1
Preamplifier 18-40 GHz	Schwarzbeck	BBV-9721	115026	06-2024	06-2025	3.1
Semi-Anechoic Chamber	ETS Lindgren	SAR	114624	03-2023	03-2026	3.1
Test software	Raditeq	Radimation Version 2023.2.3	--	--	--	3.1

*Note: Standard gain horn antennas do not need calibration
Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2017 has been confirmed before testing.
NA= Not Applicable

2.5 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Radiated spurious emissions

3.1.1 Limit

Except for Class A digital devices, the field strength of radiated emissions from an unintentional radiator shall not exceed the field strength levels specified in the following tables.
On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.
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.
When average radiated emission measurements are specified in this part, there is also a limit on the peak level of the emissions. Unless otherwise specified, the limit on peak emissions is 20 dB above the average limit.
The product under test shall comply with both the average and the peak limits.

ICES-003 Issue 7 section 3.2.2
The quasi-peak limits for the electric component of the radiated field strength emitted from ITE or digital apparatus, within 30 MHz to 1 GHz, for a measurement distance of 3m are presented in table below.
At and above 1 GHz, except for outdoor units of home satellite receiving systems, the ITE or digital apparatus shall comply with the limits specified in table below up to the frequency F_M, which shall be determined. The product under test shall comply with both the average and the peak limits.

FCC 15.109(a)

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

ICES-003 tables 2, 4

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-230	200	46.0	3
230 -960	224	47.0	3
Above 960	500	54.0	3

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2.1 and 2.2.2 of this report.

3.1.4 Test procedure

30 MHz to 26.5 GHz: According to ANSI C63.4-2014, section 8.3

30 MHz to 1 GHz: IRN 441 – Method 1
1 GHz to 18 GHz: IRN 441 – Method 2
18 to 26.5 GHz: IRN 441– Method 3

In case of handheld and/or body-worn equipment, the EUT's orientation (X, Y, Z) was varied in order to ensure that maximum emission amplitudes were attained. In all other cases the associated cabling and the EUT orientation was varied for maximum emissions.

The spectrum was examined from 30MHz to the highest measurement frequency according to the table below. Final radiated emission measurements were made at 3m distance.

Highest internal frequency (F_X) [i]	Highest measurement frequency (F_M)
$F_X \leq 108$ MHz	1 GHz
108 MHz < $F_X \leq 500$ MHz	2 GHz
500 MHz < $F_X \leq 1$ GHz	5 GHz
$F_X > 1$ GHz	5 x F_X up to a maximum of 40 GHz
i. F_X is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.	

The 6 highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

3.1.5 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

3.1.6 Test results

30 – 250 MHz

Frequency	Peak	Status	Angle	Height	Polarization	Quasi-Peak	Quasi-Peak Limit
43,798 MHz	45,1 dBµV/m	Pass	82 degrees	1,2 m	Vertical	39,4 dBµV/m	40 dBµV/m
38,988 MHz	40,7 dBµV/m	Pass	121 degrees	1,2 m	Vertical	36,4 dBµV/m	40 dBµV/m
34,648 MHz	38,7 dBµV/m	Pass	202 degrees	1 m	Vertical	34,5 dBµV/m	40 dBµV/m
42,672 MHz	42,9 dBµV/m	Pass	100 degrees	1,2 m	Vertical	32,4 dBµV/m	40 dBµV/m
106,69 MHz	34,9 dBµV/m	Pass	143 degrees	1,7 m	Horizontal	32,5 dBµV/m	43,5 dBµV/m
108,815 MHz	34,2 dBµV/m	Pass	143 degrees	1,7 m	Horizontal	31,9 dBµV/m	43,5 dBµV/m
39,478 MHz	41,8 dBµV/m	Pass	99 degrees	1 m	Vertical	37,3 dBµV/m	40 dBµV/m

250 – 1000 MHz

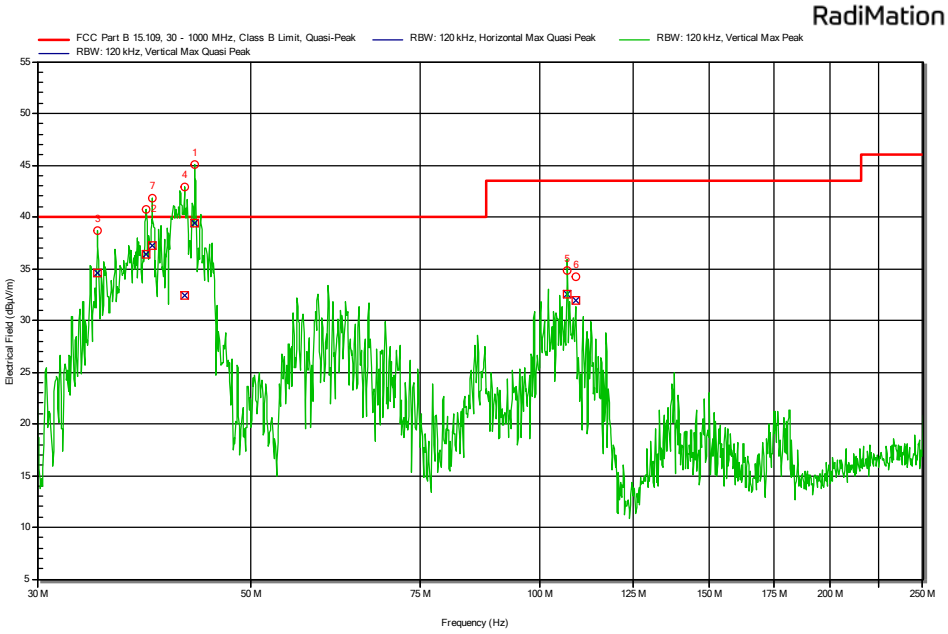
Frequency	Peak	Status	Angle	Height	Polarization	Quasi-Peak	Quasi-Peak Limit
437,546 MHz	41,2 dBµV/m	Pass	81 degrees	4 m	Horizontal	36,4 dBµV/m	46 dBµV/m
349,999 MHz	38,8 dBµV/m	Pass	263 degrees	1 m	Horizontal	35 dBµV/m	46 dBµV/m
250 MHz	43,7 dBµV/m	Pass	265 degrees	1,2 m	Horizontal	41,5 dBµV/m	46 dBµV/m
972,502 MHz	43,9 dBµV/m	Pass	36 degrees	3,2 m	Horizontal	32 dBµV/m	54 dBµV/m

1 – 18 GHz

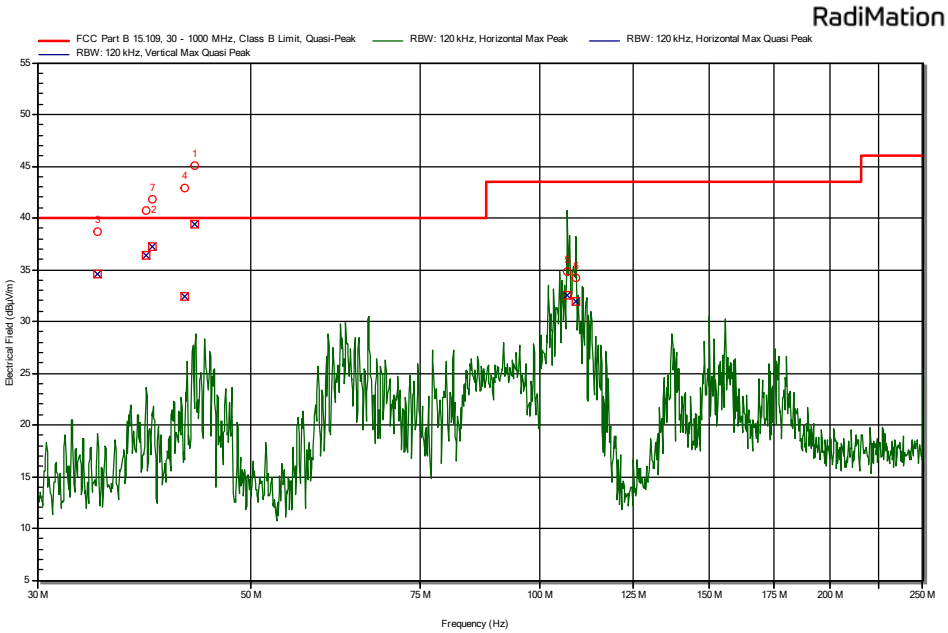
Frequency	Peak	Status	Angle	Height	Polarization
2,398 GHz	47,4 dBµV/m	Pass	39 degrees	3 m	Horizontal

The results of the radiated emission tests are depicted in the table above. A selection of plots is provided on the next pages

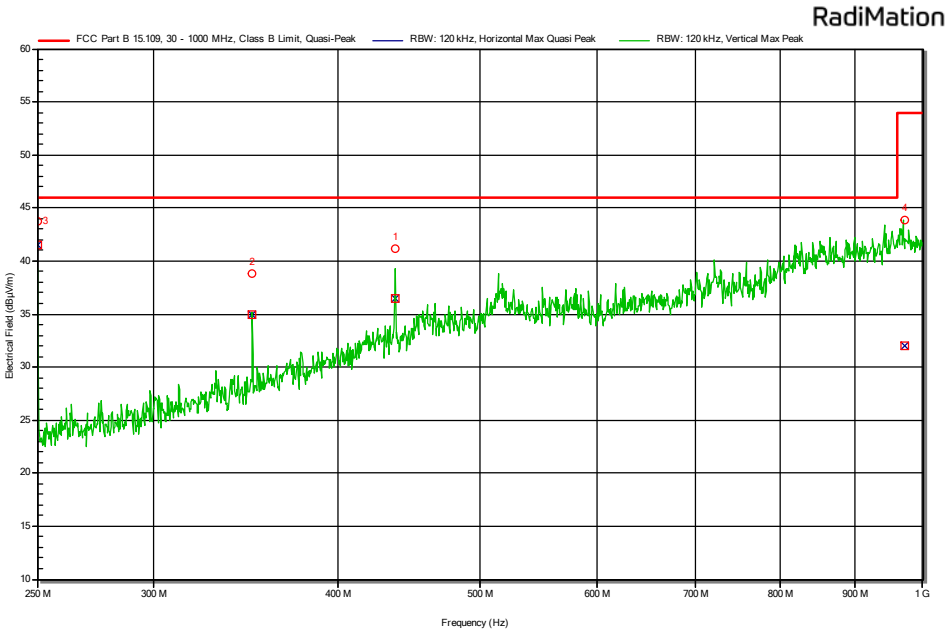
3.1.7 Plots of the Radiated Spurious Emissions Measurement



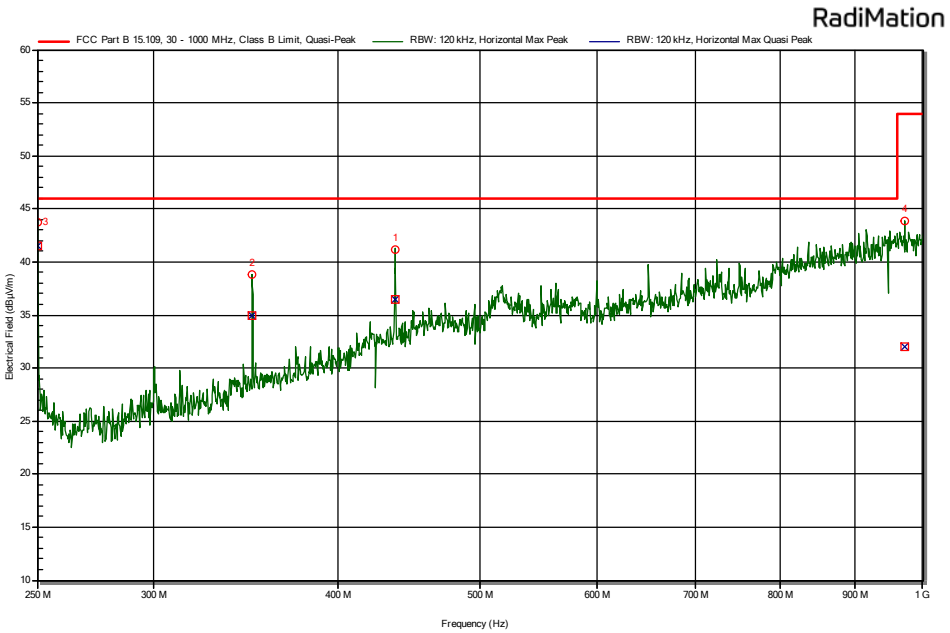
Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown)



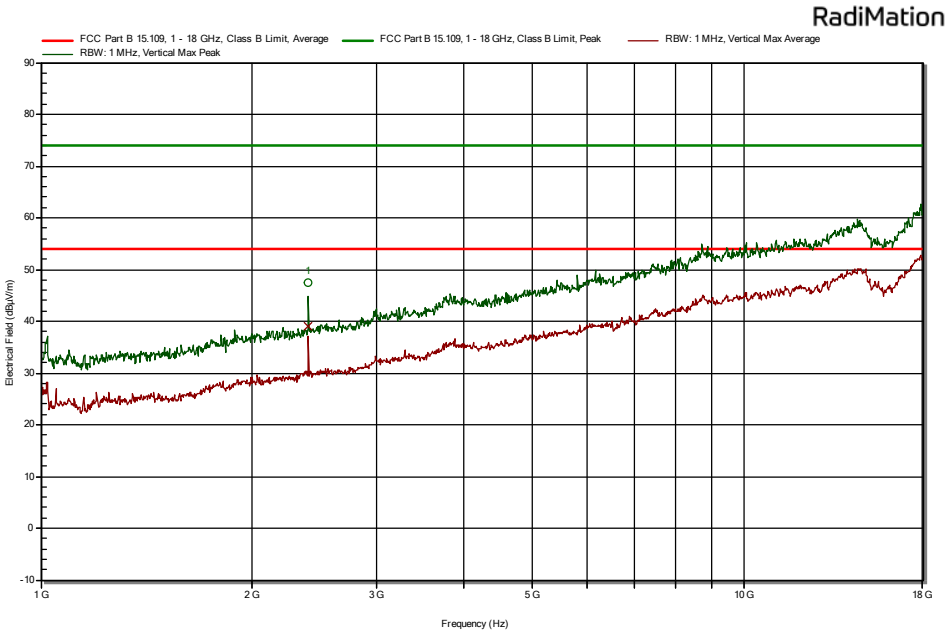
Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown)



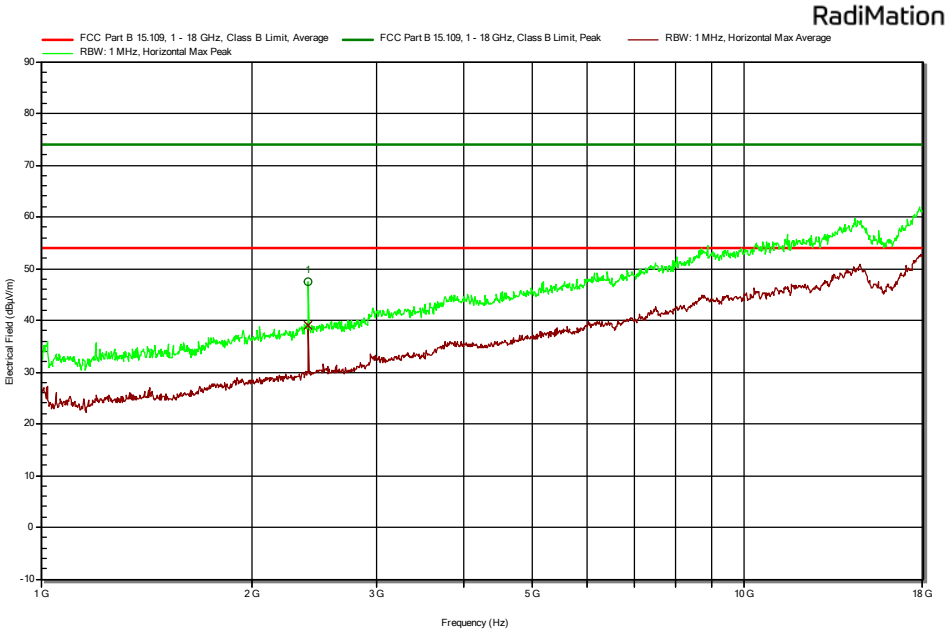
Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz (pre-scan peak values shown)



Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz (pre-scan peak values shown)



Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1-18 GHz (peak and average values shown)



Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1-18 GHz (peak and average values shown)

4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + Corr. (dB)

Where:
U = Measuring receiver voltage
LISN insertion loss = Voltage division factor of LISN
Corr. = sum of single correction factors of used LISN, cables and pulse limiter.
Linear interpolation will be used for frequencies in between the values in the table.

Frequency (MHz)	**Voltage division LISN (db)**	**Cable loss (dB)**	**Corr. (dB)**
	114379 SN: 230000813 Rohde & Schwarz ENV 216	**TE 11134**	
0,15	9.7	0.02	9.72
0,2	9.68	0.03	9.71
0,3	9.68	0.03	9.71
0,5	9.69	0.08	9.77
0,7	9.69	0.25	9.94
0,8	9.69	0.25	9.94
1	9.68	0.11	9.79
2	9.7	0.15	9.85
3	9.71	0.21	9.92
5	9.72	0.21	9.93
7	9.76	0.25	10.01
8	9.77	0.25	10.02
10	9.77	0.29	10.06
15	9.84	0.34	10.18
20	9.88	0.37	10.25
25	9.97	0.43	10.4
30	10.08	0.45	10.53

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

Frequency (MHz)	AF (dB/m) ID: 107818 EMCO 3109	Cable loss (dB) Id: 114928	Attenuator ID:114525 Hewlett Packet	Corr. (dB)
30	13.5	1.8	6	21.3
100	9.2	2.7	6	17.9
150	12.6	3.2	6	21.8
200	13.6	3.6	6	23.2
250	15.2	4.3	6	25.5

Frequency (MHz)	AF (dB/m) ID: 114385 EMCO LPDA	Cable loss (dB) Id: 114928	Corr. (dB)
250	11.8	4.3	16.1
300	13	5.1	18.1
350	14.2	5.8	20.0
400	15.6	7.3	22.9
450	17.1	7.9	25.0
500	17.3	8.0	25.3
550	17.7	8.0	25.7
600	18.4	7.7	26.1
650	19.2	7.5	26.7
700	19.7	7.7	27.4
750	20.3	7.9	28.2
800	21.4	8.2	29.6
850	22.0	8.7	30.7
900	22.1	8.9	31.0
950	22.6	9.2	31.8
1000	22.5	9.6	32.1

Frequency (MHz)	AF (dB/m) 114607 Emco 3115 SN: 9412-4377	Gain (dB) 114690 µComp Nordic MCNA-40-0010800-25-10P	Cable loss (dB) 114691	Corr. (dB)
1000	23.6	45.1	2.1	-19.4
2000	27.1	44.7	3.3	-14.3
3000	30.5	44.2	4.2	-9.5
4000	32.7	43.5	4.9	-5.9
5000	33.2	43.1	5.6	-4.3
6000	34.6	43.0	6.3	-2.1
7000	35.2	42.9	6.4	-1.3
8000	37.0	43.3	7.2	0.9
9000	38.1	43.3	7.9	2.7
10000	38.2	43.0	8.2	3.4
11000	38.3	42.9	8.7	4.1
12000	39.1	42.6	9.0	5.5
13000	39.2	43.6	9.8	5.4
14000	41.1	44.3	9.7	6.5
15000	40.2	44.4	10.4	6.2
16000	37.5	44.3	10.8	4.0
17000	41.1	44.5	11.4	8.0
18000	44.0	44.9	11.4	10.5

Frequency (MHz)	AF (dB/m) Kiwa ID: 114518 Flann 20240-25 SN: 163703	Gain (dB) Kiwa ID: Schwarzbeck BBV 9721	Cable loss (dB) 114691	Corr. (dB)
18000	31.3	34.5	11.4	8.2
19000	31.5	34.9	11.2	7.8
20000	31.7	34.1	11.6	9.2
21000	31.9	33.6	12.1	10.4
22000	32.1	33.6	12.4	10.9
23000	32.2	33.3	13.6	12.5
24000	32.3	32.3	13.5	13.5
25000	32.4	33.0	13.4	12.8
26000	32.5	32.9	13.7	13.3

Frequency (MHz)	AF (dB/m) Kiwa ID: 114487 Scientific Atlanta	Gain (dB) Kiwa ID: Schwarzbeck BBV 9721	Cable loss (dB) 114691	Corr. (dB)
26000	35.3	32.9	13.7	16.1
27000	35.4	32.6	14.9	17.7
28000	35.6	32.6	14.4	17.4
29000	35.9	32.9	14.6	17.6
30000	36.2	32.7	15.2	18.7
31000	36.1	32.9	14.9	18.1
32000	36.0	33.8	16.7	18.9
33000	36.2	34.8	16.8	18.2
34000	36.3	35.5	15.9	16.7
35000	36.4	35.5	17.5	18.4
36000	36.5	34.6	17.9	19.8
37000	36.6	33.6	18.2	21.2
38000	36.8	32.5	17.7	22.0
39000	37.0	32.1	17.7	22.6
40000	37.2	29.9	19.0	26.3

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