

Prüfbericht-Nr.: Test Report No.:	CN21SRP8 001	Auftrags-Nr.: Order No.:	244375141	Seite 1 von 27 Page 1 of 27
Kunden-Referenz-Nr.: Client Reference No.:	1774198	Auftragsdatum: Order date.:	2021-11-17	
Auftraggeber: Client:	IKEA of Sweden AB BOX 702, SE-343 81 Älmhult, Sweden			
Prüfgegenstand: Test item:	1M RGB LED Strip			
Bezeichnung / Typ-Nr.: Identification / Type No.:	L2110 Vattensten			
Auftrags-Inhalt: Order content:	TÜV Rheinland EMC service			
Prüfgrundlage: Test specification:	FCC 47 CFR Part 15, Subpart B:2020 Class B ICES-005:2018			
Wareneingangsdatum: Date of receipt:	2021-11-10	Refer to the EUT photos file		
Prüfmuster-Nr.: Test sample No.:	A003161976-001/-003			
Prüfzeitraum: Testing period:	Refer to test report			
Ort der Prüfung: Place of testing:	Refer to clause 1.1			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: / tested by: Jessie Xu		genehmigt von: / authorized by: Jiayi Zhou		
Datum: / Date: 2022-01-10 <i>Jessie Xu</i>		Datum: / Date: 2022-01-10 <i>Jiayi Zhou</i>		
Stellung: / Position: Project manager		Stellung: / Position: Senior manager		
Sonstiges / Other:	FCC ID: FHO-L2110 Test Firm Registration Number: 958801			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: P(ass) = passed a.m. test specifications(s) F(ail) = failed a.m. test specifications(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

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TEST SUMMARY

5.1.1 CONDUCTED EMISSION

Result:

Passed

5.2.1 RADIATED EMISSION

Result:

Passed

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1 Test Sites

1.1 Test Facilities

Laboratory: TÜV Rheinland (Shanghai) Co., Ltd.

Address: No.177, 178, Lane 777 West Guangzhong Road, Jing'an District, Shanghai, China

The used test equipment is in accordance with CISPR 16-1 series standards for measurement of radio interference.

Refer to Clause 7 for test and measurement instruments.

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2 General Product Information

2.1 Product Function and Intended Use

The EUT (equipment under test) is the ordinary 1 m RGB LED strip for lighting and similar use. For the further information, refer to the user's manual.

2.2 Ratings and System Details

Product : 1M RGB LED Strip
Model : L2110 Vattensten
Rated input : DC 5 V
Rated power : 1.3 W
Protection class : III

Identities and differences: the controller of above model has two alternative IC on U1 location of the PCB. Therefore, the EMI tests were performed on two samples with different IC as follows.

Sample No.	IC model	Test item
Sample 1	CS98E370	Conducted emission & Radiated emission
Sample 2	CS98E373	Conducted emission & Radiated emission

2.3 Independent Operation Modes

The basic operation modes are: "ON" and "OFF".

2.4 Description of interconnecting cables

No.	Interface and name	Shielded or not	Specified length (mm)
1	Power supply line	Unshielded	2050

2.5 Noise Generating and Noise Suppressing Parts

Refer to the circuit diagram for further information.

2.6 Highest frequency generated or used in the device or on which the device operates or tunes

The highest frequency used in the EUT is less than 108 MHz.

2.7 Submitted Documents

Circuit diagram, user's manual and rating label.

3 Test Set-up and Operation Modes

3.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible emission level. The test conditions were adapted accordingly in reference to the instructions for use.

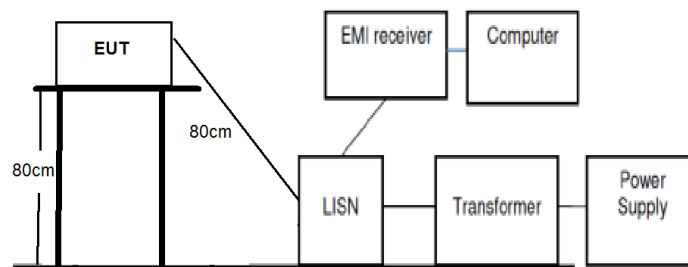
Refer to the related paragraph of this report.

The sequence of testing:

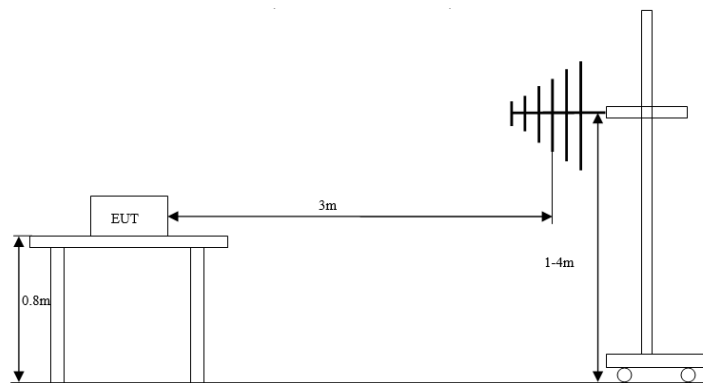
1. Radiated emission tests were performed on 2021-11-28.
2. Conducted emission tests were performed on 2021-11-26~2021-12-02.

3.2 Equipment and cable arrangement

Block diagrams for both conducted emission and radiated emission tests are as follows:



(Conducted emission)



(Radiated emission)

Also refer to photographs on clause 6 for test setups for both conducted emission test and radiated emission test.

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3.3 Test Software

No special test software was used during the tests.

3.4 Special Accessories and Auxiliary Equipment

During the tests, the following equipment were used as auxiliary equipment.

Product	Model	Manufacuturer
Power supply	ICPSW5-17NA-1 Input: AC 100-240 V, 50/60 Hz, Max. 0.5 A Output: DC 5 V	IKEA of Sweden AB
Laptop	T450	Thinkpad

3.5 Countermeasures to achieve EMC Compliance

No other special measure is employed to achieve the requirement.

4 Conformity Decision Rule

For all EMI tests included in this report, as measurement uncertainties are less than the values U_{CISPR} given in CISPR 16-4-2, compliance with the limits is determined by comparing measurement results directly with corresponding limits without taking into consideration of measurement uncertainties.

5 Test Results EMISSION

5.1 Emission in the Frequency Range up to 30 MHz

5.1.1 Conducted emission

Result:		Passed
Date of testing	: 2021-11-26~2021-12-02	
Test procedure	: FCC 47 CFR Part 15, Subpart B:2020, ICES-005:2018, ANSI C63.4-2014 and CISPR 16-2-1	
Frequency range	: 0.15 – 30 MHz	
Limits	: Quasi-peak limit: 0.15 – 0.5 MHz, 66 to 56 dB μ V (decrease with the logarithm of frequency); 0.5 – 5 MHz, 56 dB μ V; 5 – 30 MHz, 60 dB μ V Average limit: 0.15 – 0.5 MHz, 56 to 46 dB μ V (decrease with the logarithm of frequency); 0.5 – 5 MHz, 46 dB μ V; 5 – 30 MHz, 50 dB μ V	
Bandwidth of EMI receiver for final measurement	: 9 kHz	
Measurement time for final measurement	: 1 s	
Kind of test site	: Shielded room	
Input voltage	: AC 120 V, 60 Hz	
Operational mode	: Mode 1: EUT powered by power supply and dimming Mode 2: EUT powered by laptop and dimming	
Ambient condition	: Temperature: 23.3 °C; Relative humidity: 46.2 %	
Expanded measurement uncertainty ($k=2$)	: 3.39 dB	

The measurement setup was made according to ANSI C63.4-2014 in a shielded room.

The measurement equipment like test receivers, quasi-peak detector and artificial mains network (AMN) are in compliance with CISPR 16-1 series standards.

The tested object was set-up on a wooden support. The EUT was set 0.8 m away from the AMN. The cord longer than necessary to be connected to the AMN was folded forth and back parallel so as to form a bundle with a length between 0.3 m and 0.4 m.

The disturbance voltage test was performed on the neutral line and phase line of the power supply of the EUT respectively.

The following figures and tables were those measured by an automatic measuring system. Both quasi-peak and average measurements were performed. In the following spectral diagram, “*”

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and “♦” means Quasi-Peak Value and “*” and “◆” means Average Value results.

Notes on following tables of conducted emission results and conversions:

Level (dBμV): final measurement results by using quasi-peak detector and average detector

Transd (dB): transducer factor including cable loss, insertion loss of artificial mains network and gain of pre-amplifier (if used)

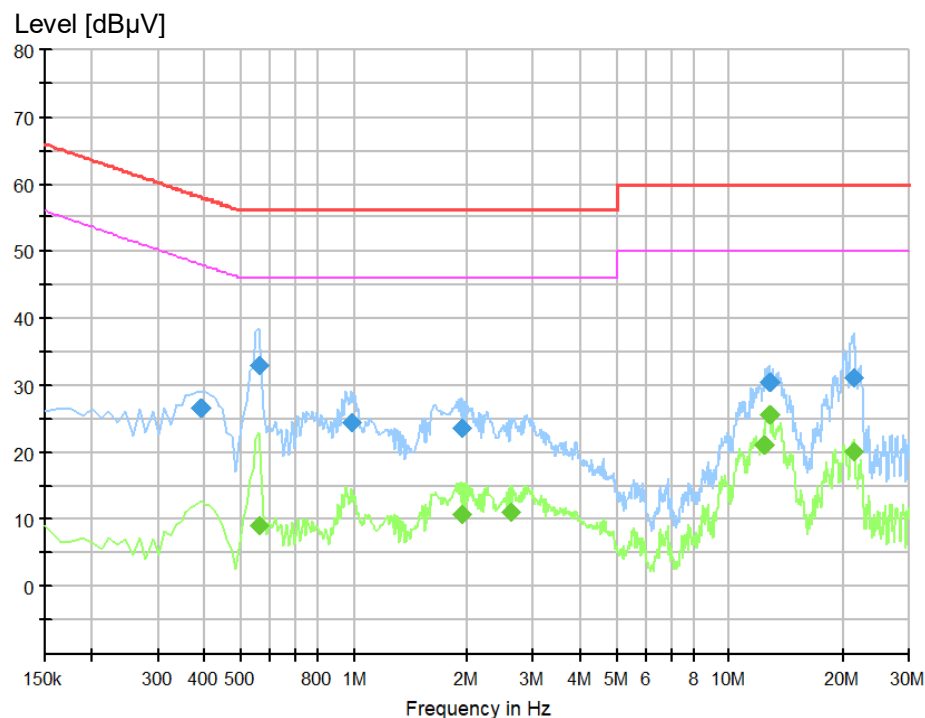
Margin: Limit (dBμV) - Level (dBμV)

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Figure 1: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for sample 1 on mode 1



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.391875	26.74	58.02	31.29	L1
0.560625	33.04	56.00	22.96	L1
0.976875	24.47	56.00	31.53	L1
1.921875	23.71	56.00	32.29	L1
12.755625	30.50	60.00	29.50	L1
21.328125	31.22	60.00	28.78	L1

Final Average measurement result:

Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.560625	9.01	46.00	36.99	L1
1.921875	10.85	46.00	35.15	L1
2.608125	11.09	46.00	34.91	L1
12.305625	21.26	50.00	28.74	L1
12.710625	25.74	50.00	24.26	L1
21.373125	20.13	50.00	29.87	L1

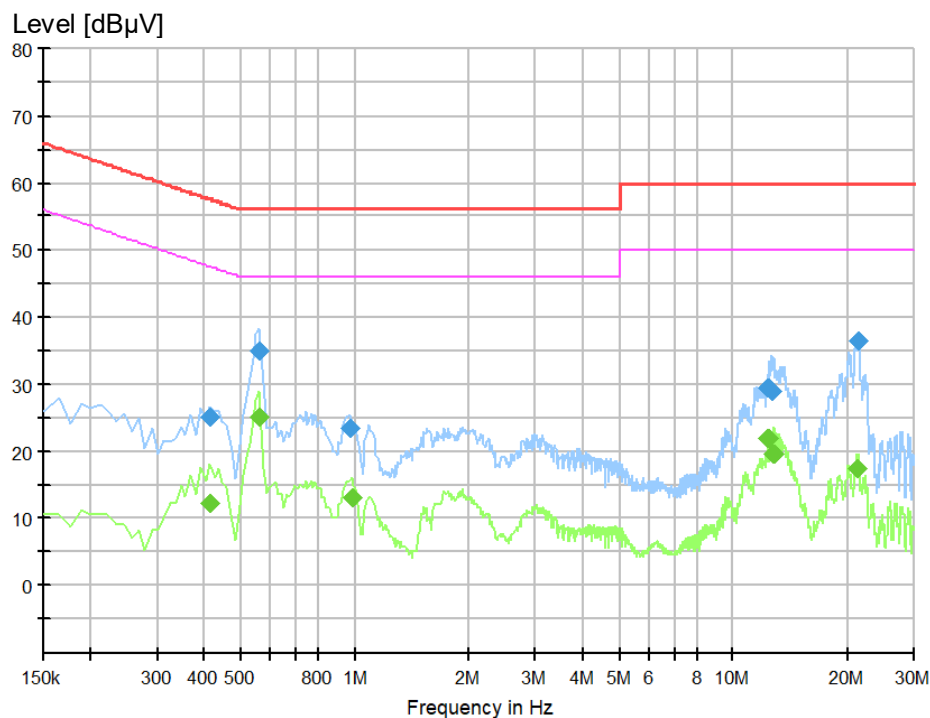
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Figure 2: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for sample 1 on mode 1



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.414375	25.13	57.56	32.43	N
0.560625	35.08	56.00	20.92	N
0.965625	23.47	56.00	32.53	N
12.305625	29.45	60.00	30.55	N
12.654375	28.93	60.00	31.07	N
21.350625	36.60	60.00	23.40	N

Final Average measurement result:

Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.414375	12.32	47.56	35.24	N
0.560625	25.09	46.00	20.91	N
0.976875	13.08	46.00	32.92	N
12.305625	21.90	50.00	28.10	N
12.823125	19.79	50.00	30.21	N
21.226875	17.41	50.00	32.59	N

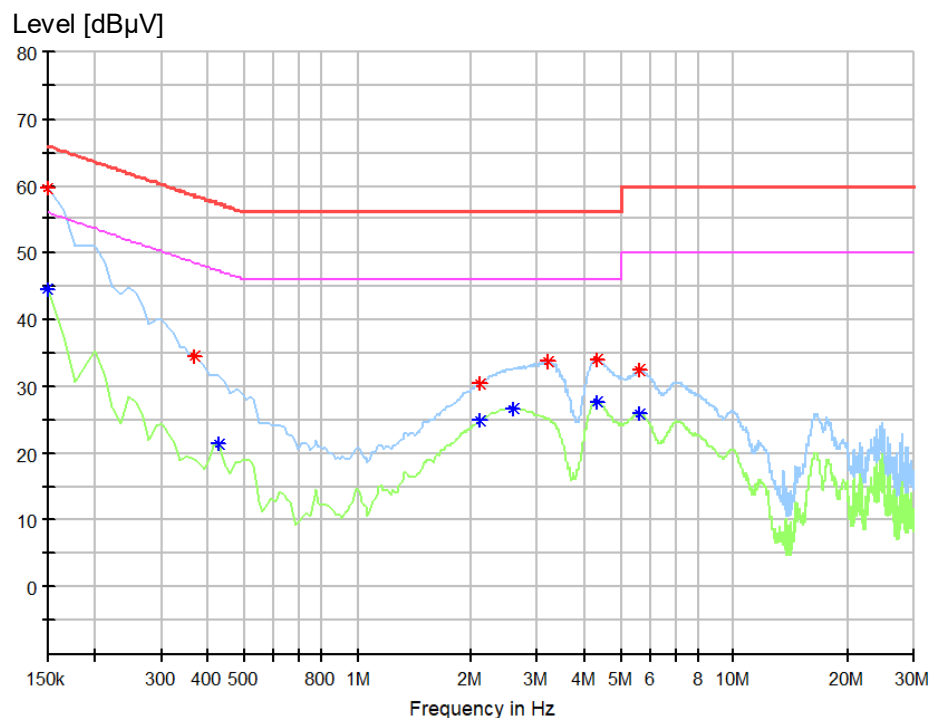
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Figure 3: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for sample 1 on mode 2



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Line
2.113125	30.55	56.00	25.45	L1
5.623125	32.39	60.00	27.61	L1
3.181875	33.86	56.00	22.14	L1
4.318125	33.97	56.00	22.03	L1
0.369375	34.53	58.52	23.99	L1
0.150000	59.68	66.00	6.32	L1

Final Average measurement result:

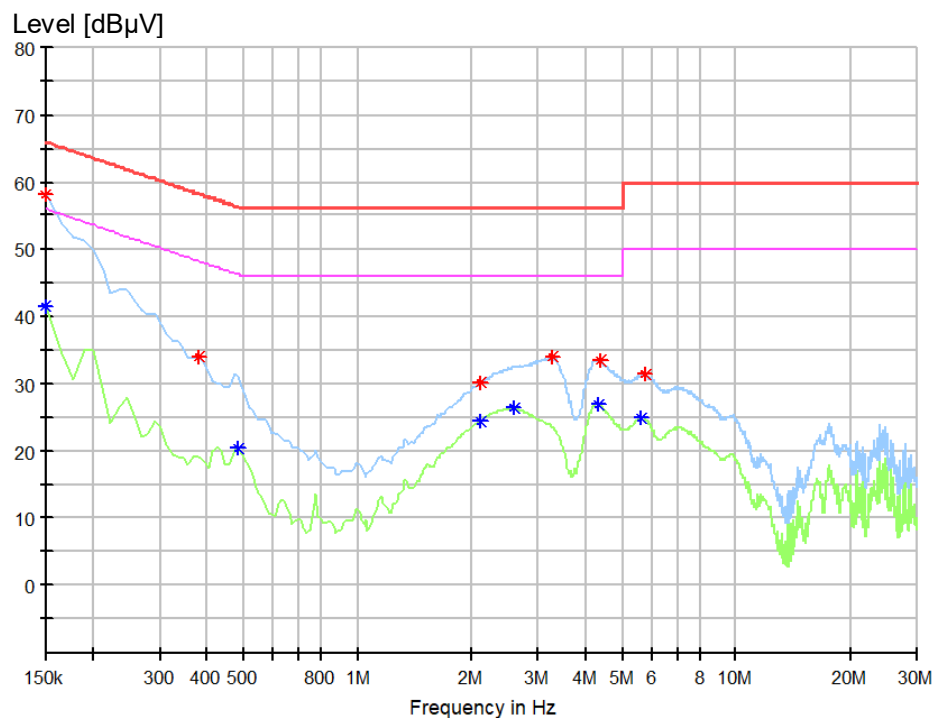
Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
5.600625	26.01	50.00	23.99	L1
4.318125	27.69	46.00	18.31	L1
0.425625	21.39	47.34	25.95	L1
0.150000	44.48	56.00	11.52	L1
2.585625	26.80	46.00	19.20	L1
2.113125	24.88	46.00	21.12	L1

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Figure 4: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for sample 1 on mode 2



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
2.113125	30.16	56.00	25.84	N
5.713125	31.46	60.00	28.54	N
4.374375	33.45	56.00	22.55	N
0.380625	33.96	58.27	24.30	N
3.260625	34.02	56.00	21.98	N
0.150000	58.11	66.00	7.89	N

Final Average measurement result:

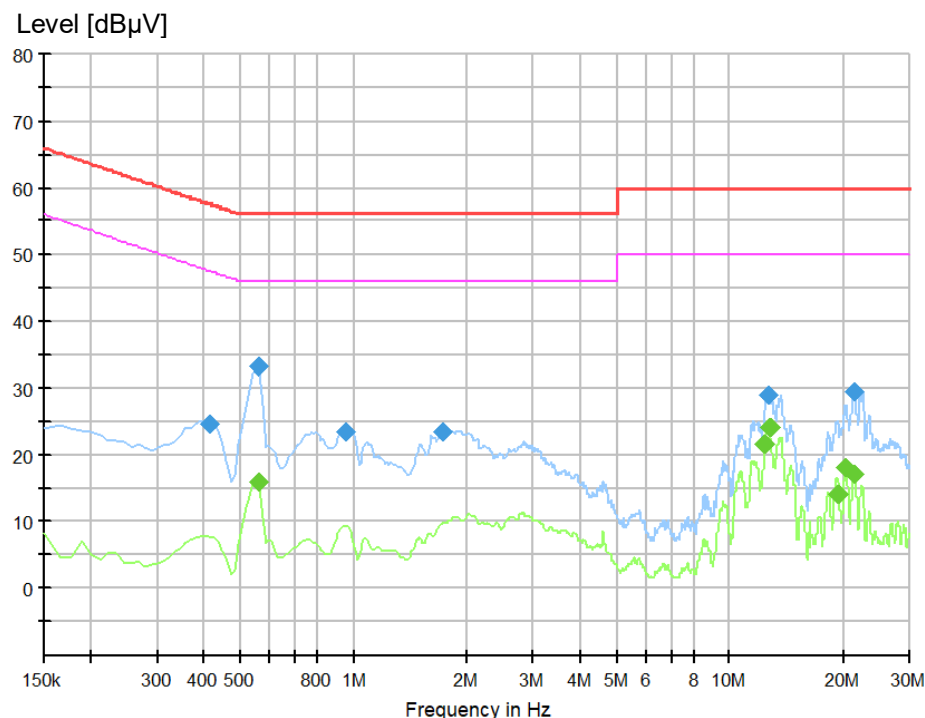
Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
5.623125	25.04	50.00	24.96	N
4.318125	26.96	46.00	19.04	N
0.481875	20.37	46.31	25.94	N
0.150000	41.56	56.00	14.44	N
2.585625	26.33	46.00	19.67	N
2.113125	24.48	46.00	21.52	N

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Figure 5: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for sample 2 on mode 1



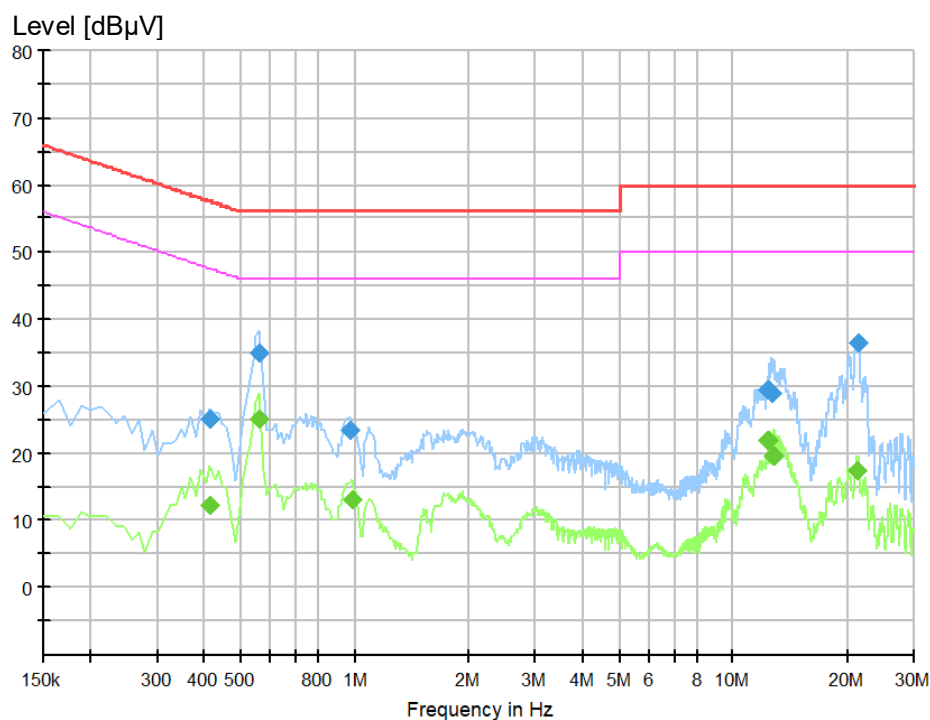
Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.414375	24.59	57.56	32.97	L1
0.560625	33.21	56.00	22.79	L1
0.954375	23.53	56.00	32.47	L1
1.719375	23.50	56.00	32.50	L1
12.598125	29.07	60.00	30.93	L1
21.496875	29.50	60.00	30.50	L1

Final Average measurement result:

Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.560625	15.99	46.00	30.01	L1
12.395625	21.65	50.00	28.35	L1
12.688125	24.11	50.00	25.89	L1
19.246875	14.23	50.00	35.77	L1
20.281875	18.09	50.00	31.91	L1
21.373125	17.25	50.00	32.75	L1

Figure 6: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for sample 2 on mode 1



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.414375	25.13	57.56	32.43	N
0.560625	35.08	56.00	20.92	N
0.965625	23.47	56.00	32.53	N
12.305625	29.45	60.00	30.55	N
12.654375	28.93	60.00	31.07	N
21.350625	36.60	60.00	23.40	N

Final Average measurement result:

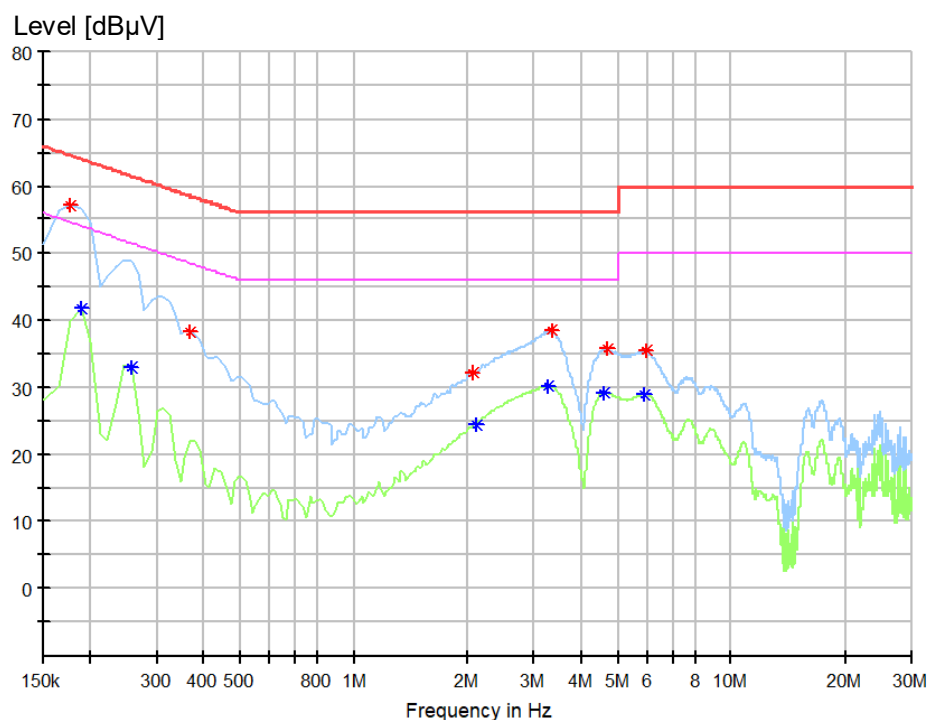
Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.414375	12.32	47.56	35.24	N
0.560625	25.09	46.00	20.91	N
0.976875	13.08	46.00	32.92	N
12.305625	21.90	50.00	28.10	N
12.823125	19.79	50.00	30.21	N
21.226875	17.41	50.00	32.59	N

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Figure 7: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for sample 2 on mode 2



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
2.068125	32.21	56.00	23.79	L1
5.915625	35.40	60.00	24.60	L1
4.689375	35.75	56.00	20.25	L1
0.369375	38.20	58.52	20.31	L1
3.350625	38.46	56.00	17.54	L1
0.178125	57.17	64.57	7.41	L1

Final Average measurement result:

Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
5.893125	29.07	50.00	20.93	L1
4.599375	29.27	46.00	16.73	L1
0.256875	33.03	51.53	18.50	L1
0.189375	41.82	54.06	12.25	L1
3.271875	30.13	46.00	15.87	L1
2.113125	24.54	46.00	21.46	L1

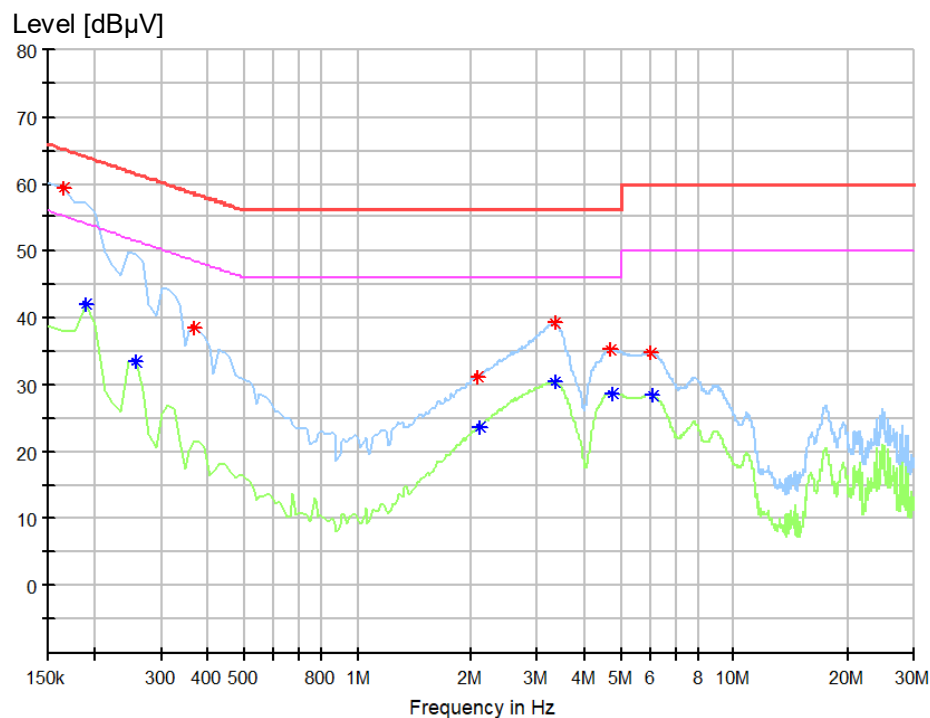
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Figure 8: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for sample 2 on mode 2



Final Quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.166875	59.39	65.12	5.72	N
0.369375	38.56	58.52	19.96	N
2.090625	31.28	56.00	24.72	N
3.350625	39.39	56.00	16.61	N
4.700625	35.15	56.00	20.85	N
6.005625	34.77	60.00	25.23	N

Final Average measurement result:

Frequency (MHz)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line
0.189375	41.94	54.06	12.13	N
0.256875	33.53	51.53	18.01	N
2.113125	23.73	46.00	22.27	N
3.350625	30.42	46.00	15.58	N
4.756875	28.83	46.00	17.17	N
6.039375	28.55	50.00	21.45	N

5.2 Emission in the Frequency Range above 30 MHz

5.2.1 Radiated emission

Result:	Passed
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Date of testing	: 2021-11-28
Test procedure	: FCC 47 CFR Part 15, Subpart B:2020, ICES-005:2018, ANSI C63.4-2014 and CISPR 16-2-3
Product classification	: Class B
Frequency range	: 30 – 1000 MHz (see Note 1)
Limits	: Quasi-peak limits (3 m distance): 30 – 88 MHz, 40 dB μ V/m; 88 – 216 MHz, 43.5 dB μ V/m; 216 – 1000 MHz, 46 dB μ V/m (see Note 2)
Bandwidth of EMI receiver for final measurement	: 120 kHz
Measurement time for final measurement	: 1 s
Kind of test site	: Semi-anechoic chamber
Input voltage	: AC 120 V, 60 Hz
Operational mode	: EUT powered by power supply and dimming
Ambient condition	: Temperature: 23.7 °C; Relative humidity: 45.6 %
Expanded measurement uncertainty ($k=2$)	: 5.49 dB

The radiated disturbance test was carried out in a semi-anechoic chamber. The test distance from the receiving antenna to the EUT is 3 m. The normalized site attenuation of the semi-anechoic chamber is regularly calibrated to ensure the radiated disturbance test results are valid. During the test, the EUT was placed on an 80 cm wooden support above the reference ground plane. The wooden support was rotated 360° around and the height of the antenna was varied from 1 m to 4 m to find the maximum disturbance. The test was performed with the antenna both in its horizontal and vertical polarizations.

The following figures and tables were those measured by an automatic measurement system. A preview test was firstly performed with peak detector. The final test was performed with quasi-peak at those critical frequencies during the preview test. In the following spectral diagram, “x” means quasi-peak test results.

Note 1: The highest frequency in the EUT is less than 108 MHz. According to FCC Part 15 subpart B §15.33 (b) (1), the upper frequency for radiated emission measurement is 1000 MHz.

Note 2: The class B limits of ICES-005:2018 is stricter than those FCC 47 CFR Part 15, Subpart B:2020 for 3 m test distance. Therefore, the former limits are used in following figures and tables.

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Notes on following tables of radiated emission results and conversions:

QuasiPeak (dB μ V/m): final measurement results by using quasi-peak detector

Corr. (dB): correction factor including: antenna factor, cable loss, and gain of pre-amplifier (if used)

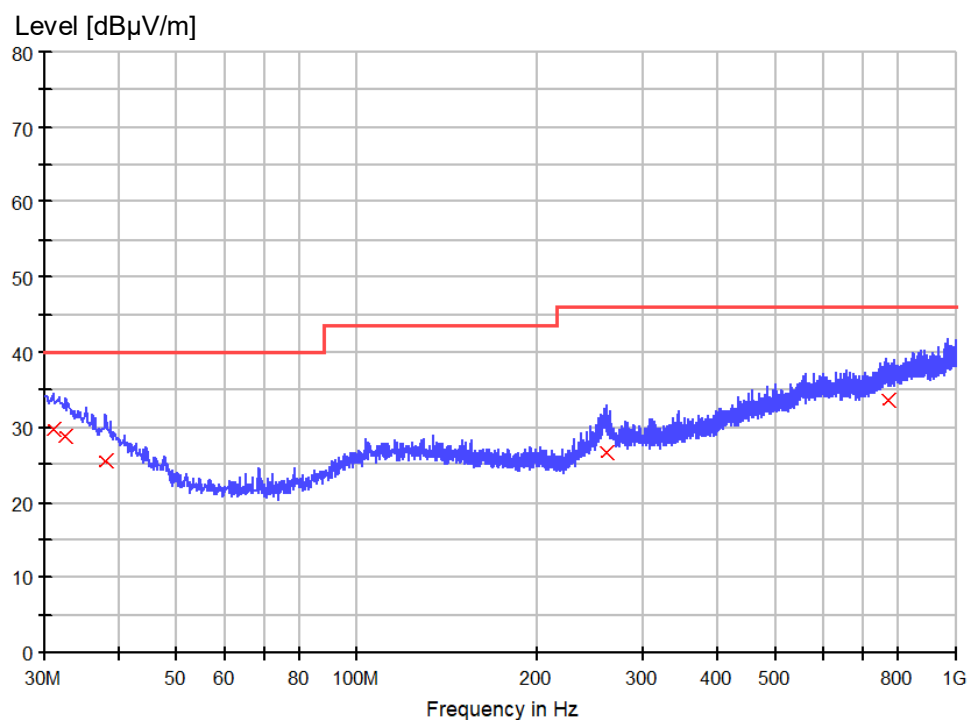
Margin: Limit (dB μ V/m) - QuasiPeak (dB μ V/m)

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Figure 9: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Horizontal polarization for sample 1



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
31.091250	29.6	1000.0	120.000	106.0	H	150.0	24.9	10.4	40.0
32.546250	28.7	1000.0	120.000	100.0	H	-121.0	24.1	11.3	40.0
38.123750	25.4	1000.0	120.000	152.0	H	180.0	21.0	14.6	40.0
261.345000	26.7	1000.0	120.000	134.0	H	65.0	20.7	19.3	46.0
773.262500	33.8	1000.0	120.000	189.0	H	-180.0	27.3	12.2	46.0

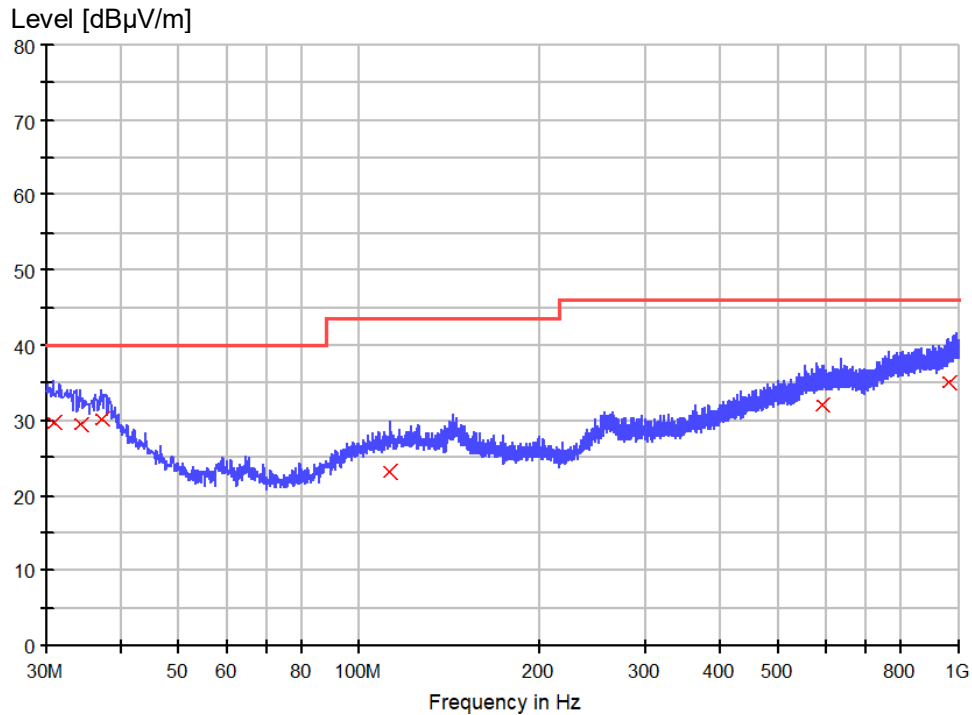
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Figure 10: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Vertical polarization for sample 1



Final quasi-peak measurement results:

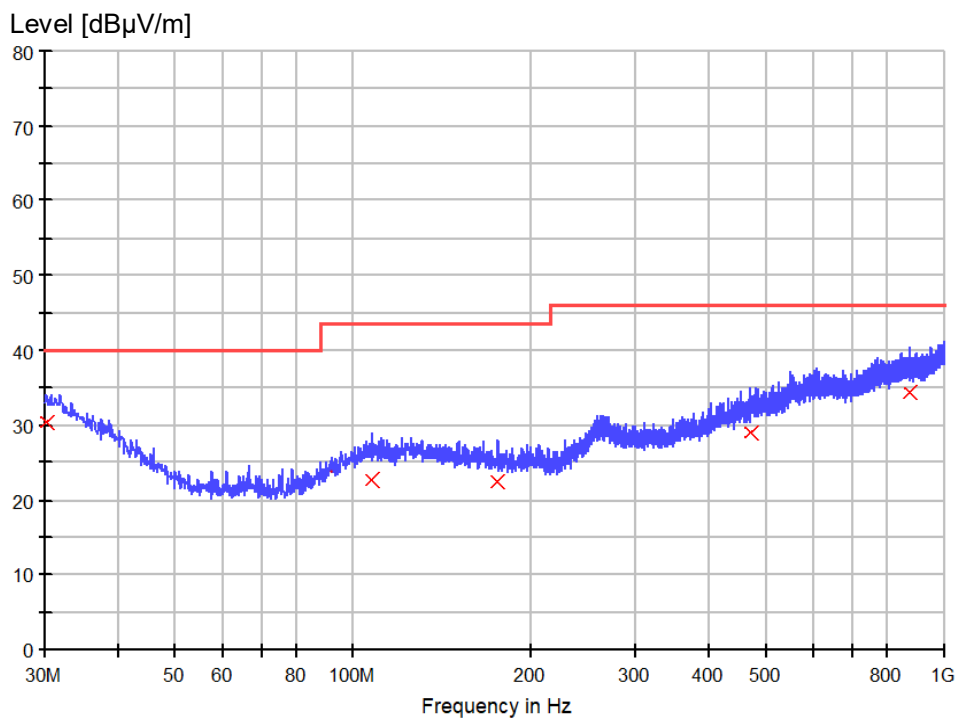
Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
30.848750	29.7	1000.0	120.000	102.0	V	-77.0	25.0	10.3	40.0
34.243750	29.4	1000.0	120.000	112.0	V	180.0	23.2	10.6	40.0
37.032500	30.1	1000.0	120.000	131.0	V	-121.0	21.5	9.9	40.0
112.450000	23.2	1000.0	120.000	152.0	V	45.0	18.6	20.3	43.5
591.751250	32.1	1000.0	120.000	180.0	V	166.0	26.3	13.9	46.0
961.563750	35.1	1000.0	120.000	168.0	V	-180.0	28.5	10.9	46.0

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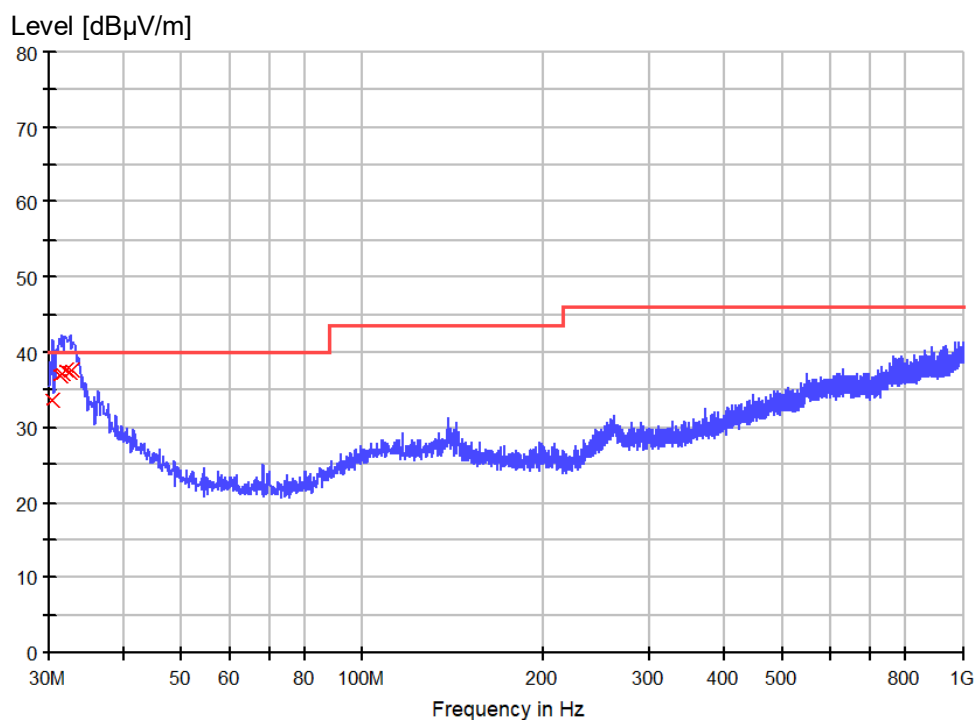
Figure 11: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Horizontal polarization for sample 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
30.242500	30.5	1000.0	120.000	156.0	H	-180.0	25.3	9.5	40.0
107.600000	22.8	1000.0	120.000	102.0	H	168.0	18.4	20.7	43.5
175.742500	22.4	1000.0	120.000	135.0	H	120.0	16.0	21.1	43.5
471.228750	29.1	1000.0	120.000	180.0	H	88.0	24.4	16.9	46.0
873.415000	34.5	1000.0	120.000	235.0	H	-180.0	28.0	11.5	46.0

Figure 12: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Vertical polarization for sample 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
30.485000	33.8	1000.0	120.000	100.0	V	153.0	25.2	6.3	40.0
31.455000	36.9	1000.0	120.000	110.0	V	-180.0	24.7	3.2	40.0
31.697500	37.1	1000.0	120.000	105.0	V	168.0	24.6	2.9	40.0
32.061250	37.6	1000.0	120.000	132.0	V	105.0	24.5	2.4	40.0
32.425000	37.5	1000.0	120.000	100.0	V	-145.0	24.2	2.5	40.0
32.425000	37.5	1000.0	120.000	122.0	V	-180.0	24.2	2.5	40.0
32.667500	37.6	1000.0	120.000	158.0	V	155.0	24.0	2.4	40.0

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6 Photographs of the Test Set-Up

Refer to the test setup file.

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7 List of Test and Measurement Instruments

Equip.	Description	Model	Manufacturer	Last Date	Due Date
				DD.MM.YYYY	DD.MM.YYYY
9023229	EMI test receiver	ESR3	Rohde&Schwarz	22.03.2021	22.03.2022
G1811403	Artificial mains network	ENV216	Rohde&Schwarz	04.11.2021	04.11.2022
G1824248	Dual display multimeter	F45	Fluke	18.09.2020	18.09.2022
G1811378	3m modified semi-anechoic chamber	SAC3	Frankonia	27.06.2019	27.06.2022
G1811402	EMI test receiver	ESCI	Rohde&Schwarz	01.09.2021	01.09.2022
G1811425	Bilog antenna	CBL 6112D	Teseq	10.03.2020	10.03.2023
G1824845	EMC measurement software	EMC32 (Ver 10.20.01)	Rohde&Schwarz	N/A	N/A

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End of test report