



시험 성적서

TEST REPORT

페이지(page) : (1) / (총(Total) 17)

성적서 번호 Report No.		ICRT-TR-E223003-0A	
신청자 Client	기관명 Name	ZMORPH S.A.	
	주 소 Address	A.Ostrowskiego 9, 53-238 Wroclaw, Poland	
시험대상품목 Sample description		Zmorph i500 3D Printer	
모델명 Type designation		Zmorph i500	
정 격 Ratings		AC 110-240 V	
시험장소 Place of test		☒ 고정시험(Inside test) ☐ 현장시험(Field test) 주소지(Address): 112, Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea	
시험기간 Date of test		16. Sep. 2022 ~ 22. Sep. 2022	
시험방법/항목 Test Method/Item		FCC Part 15 Subpart C §15.225	
시험결과 Test Results		Refer to 3. Test Summary	
확 인 Affirmation	작성자 Tested by	기술책임자 Technical Manager	
	성 명 Name Seong-Hun, Jeong (서 명) (Signature)	성 명 Name Tae-Yang, Yoon (서 명) (Signature)	
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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E223003-0A	2022. 11. 21	Initial Issue	All



1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant information

Applicant	ZMORPH S.A.
Address	A.Ostrowskiego 9, 53-238 Wroclaw
Contact Person	Piotr Opara
Telephone No.	48713368925
E-mail	popara@zmorph3d.com

1.2 Manufacturer Information

Manufacturer	ZMORPH S.A.
Address	A.Ostrowskiego 9, 53-238 Wroclaw

1.3 Test Laboratory Information

Conducted tests were performed at	
Laboratory	ICR Co., Ltd.
Address	112, 113, Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea
Telephone No.	+82-2-6351-9002
Fax No.	+82-2-6351-9007
RRA No.	KR0165
KOLAS No.	KT652



2. Equipment under Test(EUT) Information

2.1 General Information

Product Name	Zmorph i500 3D Printer
Brand Name	-
Model Name	Zmorph i500
Additional Model Name	-
FCC ID	2A9FXGC238615
Power Supply	AC 110-240 V

2.2 Additional Information

Equipment Class	DXX-Low Power communications Device Transmitter
Operating Frequency	13.562 MHz
Channel Number	1
Modulation Type	ASK
Maximum output power	68.16 dBμV/m
Antenna Type	PCB Antenna

2.3 Mode of operation during the test

- The EUT is continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

2.4 Modifications of EUT

- None



3. Test Summary

3.1 Test standards and results

FCC Part 15 Subpart C			
Clause	Test items	Applied	Results
§15.215 (c)	20 dB Bandwidth	☒	PASS
§15.225 (e)	Frequency Stability Tolerance	☒	PASS
§15.225 (a)(b)(c)	In-Band Emissions	☒	PASS
§15.225 (d) §15.209	Out-of-Band Emissions	☒	PASS
§15.207	Power Line Conducted Emission	☒	PASS

3.2 Purpose of the test

- To determine whether the equipment under test fulfills the requirements of the standards stated in FCC Part 15 Subpart C Section 15.225.

3.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013, FCC CFR 47 PART 15.

3.4 Configuration of Test System

3.4.1 Radiated emission test

Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

3.4.2 AC power line conducted emission test

The EUT was connected to LISN. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.



3.5 Antenna requirement

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.5.1 Result: Pass

The transmitter has a *PCB Antennas*.



4. Used equipment on test

	Description	Model Name	Manufacturer	Serial Number	Next Cal
☒	Spectrum Analyzer	FSV40	Rohde&Schwarz	101455	2023.03.02
☒	Signal Generator	SMB100A	Rohde&Schwarz	180607	2023.03.03
☒	AC OIWER SIYRCE	KC-3100	KOREA POWER CO., LTD.	1610C-32	2023.07.27
☒	Walk-in Chamber	EBE-3E20W6P3T-22	ESPEC CORP.	3015006390	2023.01.19
☒	Loop Antenna	HFH2-Z2	Rohde & Schwarz	100506	2023.07.05
☒	Trilog Broadband Antenna	VULB9162	SCHWARZBECK	120	2022.12.15
☒	EMI Test Receiver	ESR26	Rohde & Schwarz	101462	2023.04.13
☒	RF Pre Amplifier	SCU08	Rohde & Schwarz	100745	2023.04.13
☒	LISN	ENV216	102194	Rohde & Schwarz	2023.04.14
☒	EMI Test Receiver	ESR3	102119	Rohde & Schwarz	2023.04.13
☒	10 dB Attenuator	WA54-10-11	-	Weinschel	2023.03.07

※ All test equipment used is calibration on a regular basis.

5. 20 dB Bandwidth

5.1 Operating environment

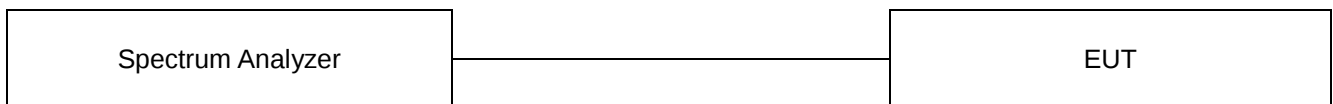
Temperature : 21 °C
Relative humidity : 45 %

5.2 Measurement method

Standard : §15.215 (c)

5.3 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth(RBW) is set to 1% to 5% of the OBW. The Video bandwidth is set to 3 times the RBW. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



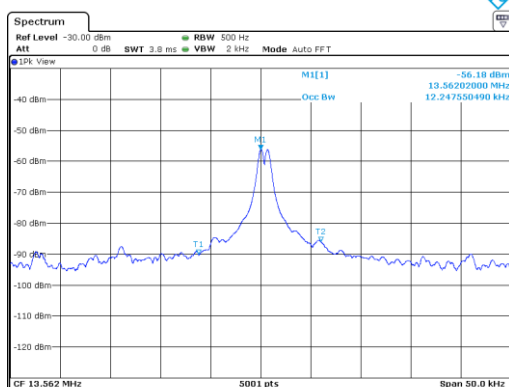
5.4 Test data

Operating mode : Transmit mode
Test Result : Pass

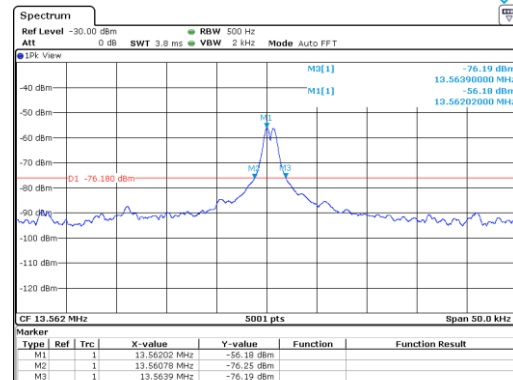
5.4.1 Measured Result

Modulation Type	Frequency (MHz)	Measured Value (MHz)		Limit (MHz)
		99% Occupied Bandwidth	20 dB Bandwidth	
ASK	13.562	0.012	0.003	do not exceed range in 13.110-14.010 MHz.

5.4.2 Measured Graph Occupied Bandwidth & 20 dB Bandwidth



99% Occupied Bandwidth



20 dB Bandwidth



6. Frequenct Stability Tolerance

6.1 Operating environment

Temperature : 21 °C

Relative humidity : 45 %

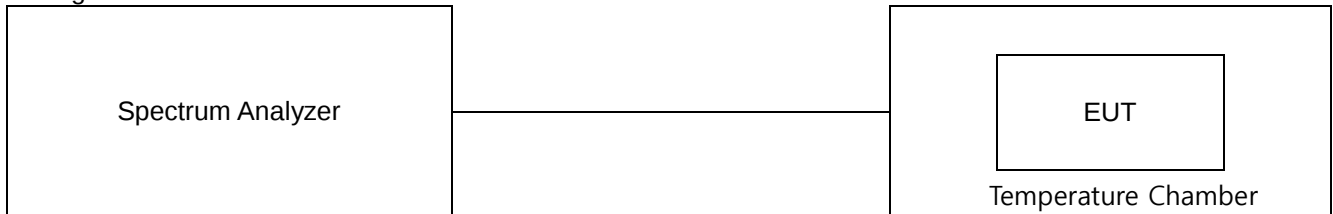
6.2 Measurement method

Standard : §15.225 (e)

6.3 Test setup

Measurement procedures were implemented according to the test method of ANSI C63.10: 2013.

Part 15.225 requires that devices operating in the 13.553 ~ 13.567 MHz shall maintain the carrier frequency within 0.01% of the operating frequency over the temperature variation of -20 degrees to +50 degrees C at nominal voltage.



6.4 Test data

Operating mode : Transmit mode

Test Result : Pass

6.4.1 Measured Results

Modulation type	Voltage (%)	Power (AC)	Temperature (°C)	Frequency (Hz)	Freq. DEV (Hz)	Deviation (%)	Limit (%)
ASK	100%	120	50	13 560 400	400	0.0029	0.01
	100%		40	13 560 400	400	0.0029	
	100%		30	13 560 400	400	0.0029	
	100%		20	13 560 400	400	0.0029	
	100%		10	13 560 400	400	0.0029	
	100%		0	13 560 400	400	0.0029	
	100%		-10	13 560 400	400	0.0029	
	100%		-20	13 560 400	400	0.0029	
	85%	102	20	13 560 400	400	0.0029	
	115%	138	20	13 560 400	400	0.0029	

7. Radiated Emissions

7.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 %

7.2 Measurement method

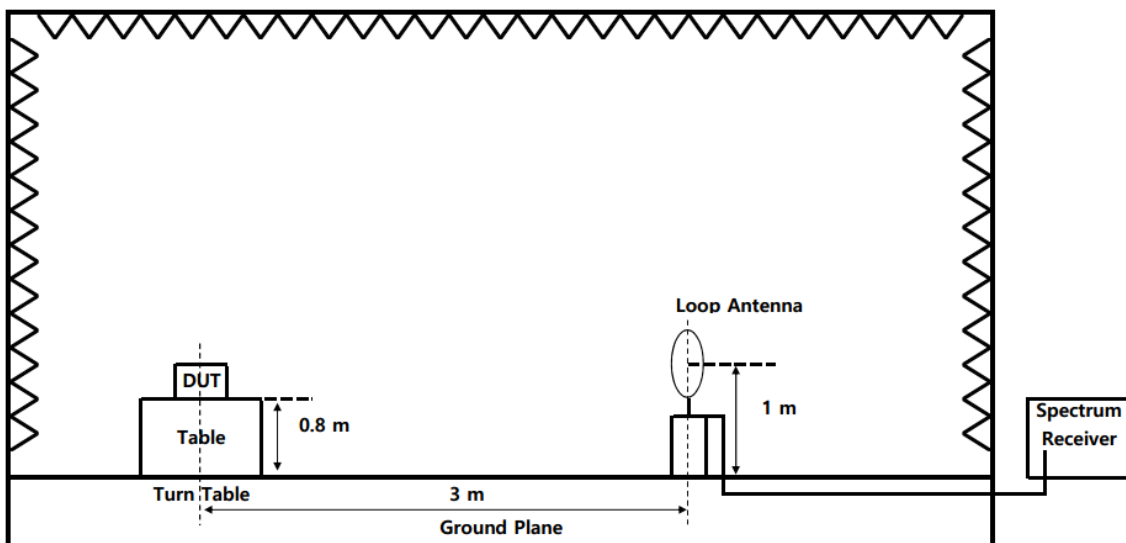
Standard : §15.225 (a)(b)(c)(d)

7.3 Test setup

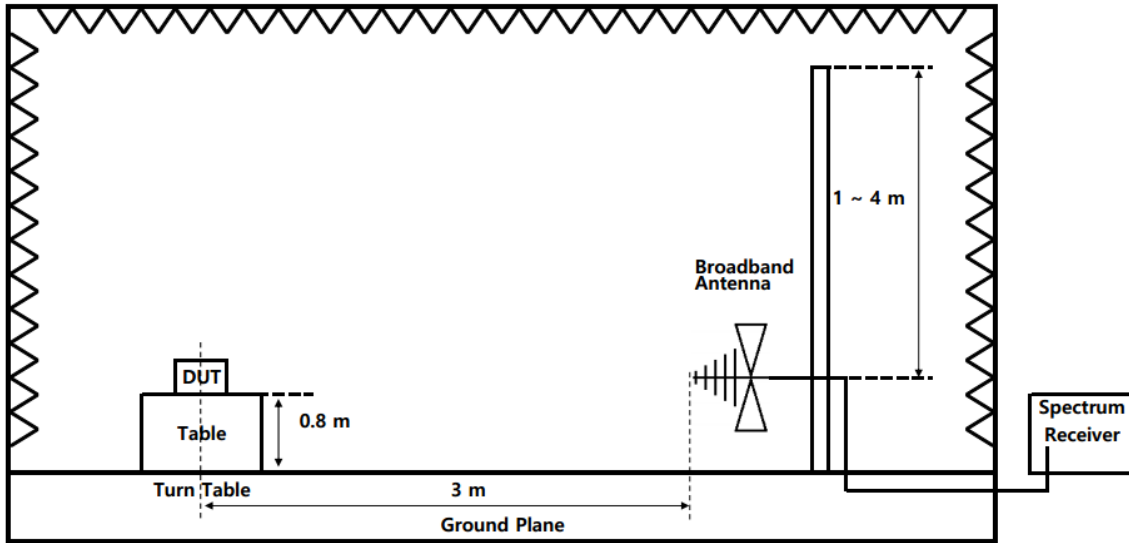
The radiated emissions measurements were performed on the 3 m, Semi-Anechoic Chamber. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 9 kHz to 1 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

7.3.1 Test setup layout Below 30 MHz



7.3.2 Test setup layout 30 MHz to 1 GHz



7.4 Regulation

The EUT must comply with field strength limits defined in section 15.225(a), (b) and (c) of cfr47 FCC Part 15, Subpart C:

Frequency (MHz)	Limit at 30m (dB μ V/m)	Limit at 3m (dB μ V/m)
13.110 to 13.410 and 13.710 to 14.010	40.5	80.5
13.410 to 13.553 and 13.567 to 13.710	50.5	90.5
13.553 to 13.567	84.0	124.0

According to §15.225(d), The field strength of any emissions appearing outside of the 13.110 to 14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μ V/m)	Field strength (dB μ V/m)	Measurement distance (m)
0.009 ~ 0.490	2 400 / F (kHz)	-	300
0.490 ~ 1.705	24 000 / F (kHz)	-	30
1.705 ~ 30	30	29.54	30
30 ~ 88	100	40.00	3
88 ~ 216	150	43.52	3
216 ~ 960	200	46.02	3
Above 960	500	53.98	3

The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1 000 MHz are based on the average value of measured emissions.



7.5 Test data for Radiated Electric Field Emissions

Operating mode : Transmit mode

Test Result : Pass

7.5.1 Measurement Results (13.553 ~ 13.567) MHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.56	48.40	Peak	H	19.76	68.16	124.00	55.84
13.56	36.46	Peak	V	19.76	56.22	124.00	67.78

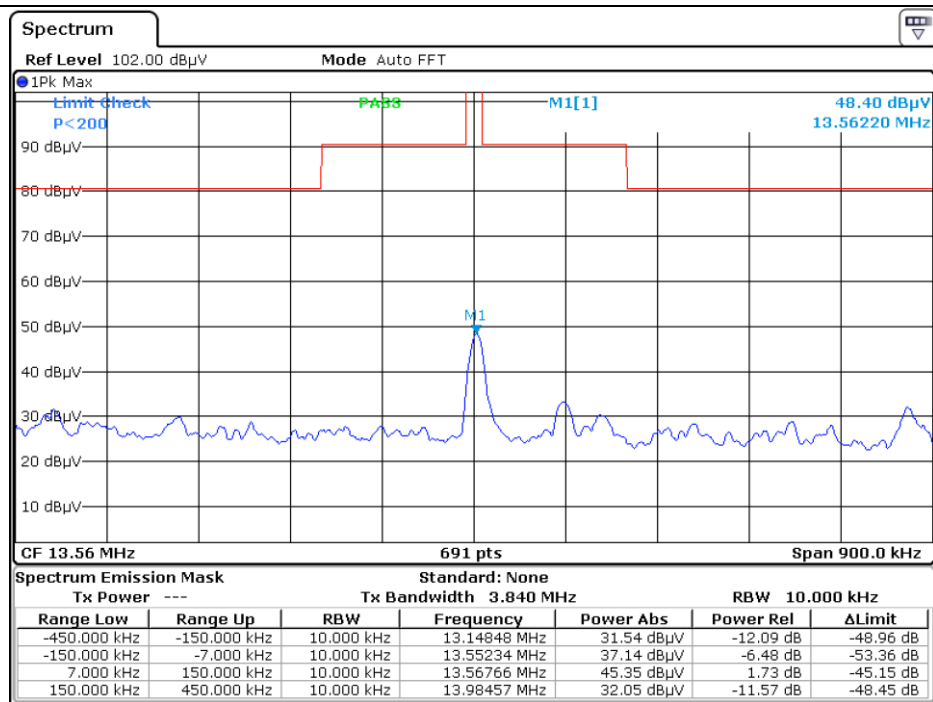
※ Ant. Pol. : Antenna Polarization

※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain

※ Result = Reading + Corr. Factor

※ Margin = Limit - Result

7.5.1.1 Measured Graph (13.11 MHz ~ 14.01 MHz)



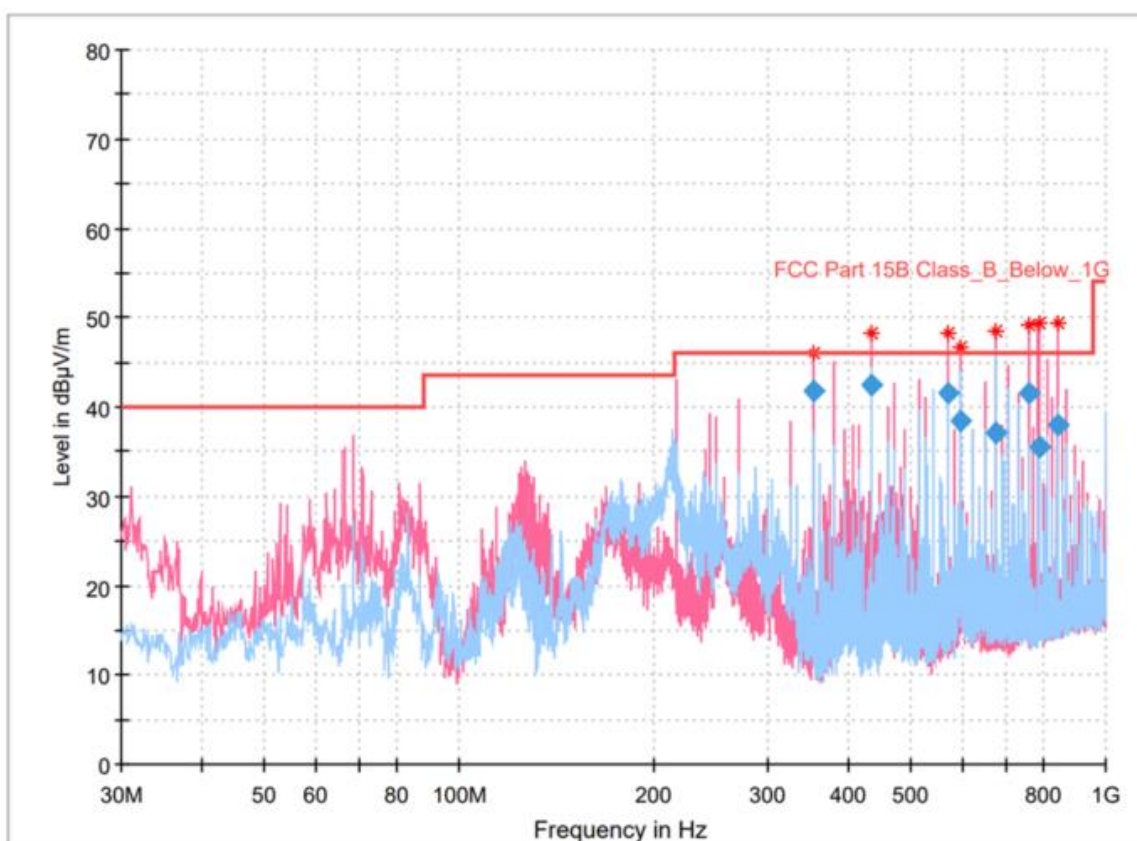
Acc. to above test data, the field strength level of 13.56 MHz is 68.16 dBμV/m and the worst limit subject to 15.225 (b) and (c) is 80.5 dBμV/m, so the EUT meets the requirement.

7.6 Spurious Emission Test

7.6.1 Measurement Results for Below 30 MHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
It was not found any emissions peaks found from the EUT.							

7.6.2 Measurement Results for below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
352.622000	41.82	46.00	4.18	1000.0	120.000	100.0	V	106.0	-19.5
434.005000	42.52	46.00	3.48	1000.0	120.000	100.0	V	311.0	-18.0
569.611000	41.48	46.00	4.52	1000.0	120.000	100.0	V	229.0	-16.1
596.771000	38.41	46.00	7.59	1000.0	120.000	100.0	V	215.0	-15.3
678.154000	37.20	46.00	8.80	1000.0	120.000	100.0	V	39.0	-14.3
759.537000	41.60	46.00	4.40	1000.0	120.000	100.0	V	0.0	-13.3
786.697000	35.47	46.00	10.53	1000.0	120.000	100.0	V	0.0	-13.4
840.920000	37.88	46.00	8.12	1000.0	120.000	100.0	V	297.0	-12.5



8. Power Line Conducted Emission

8.1 Operating environment

Temperature : 21 °C

Relative humidity : 49 %

8.2 Measurement method

Standard : §15.207

8.3 Test setup

The EUT was placed either directly on the reference ground-plane or on insulating material. Power was fed to the EUT through a $50\ \Omega$ / $50\ \mu\text{H}$ + $5\ \Omega$ Artificial Mains Network (AMN). The ground plane was electrically bonded to the insulating material field and all power lines were filtered from ambient.





8.4 Test data

Operating mode : Transmit mode

Test Result : Pass

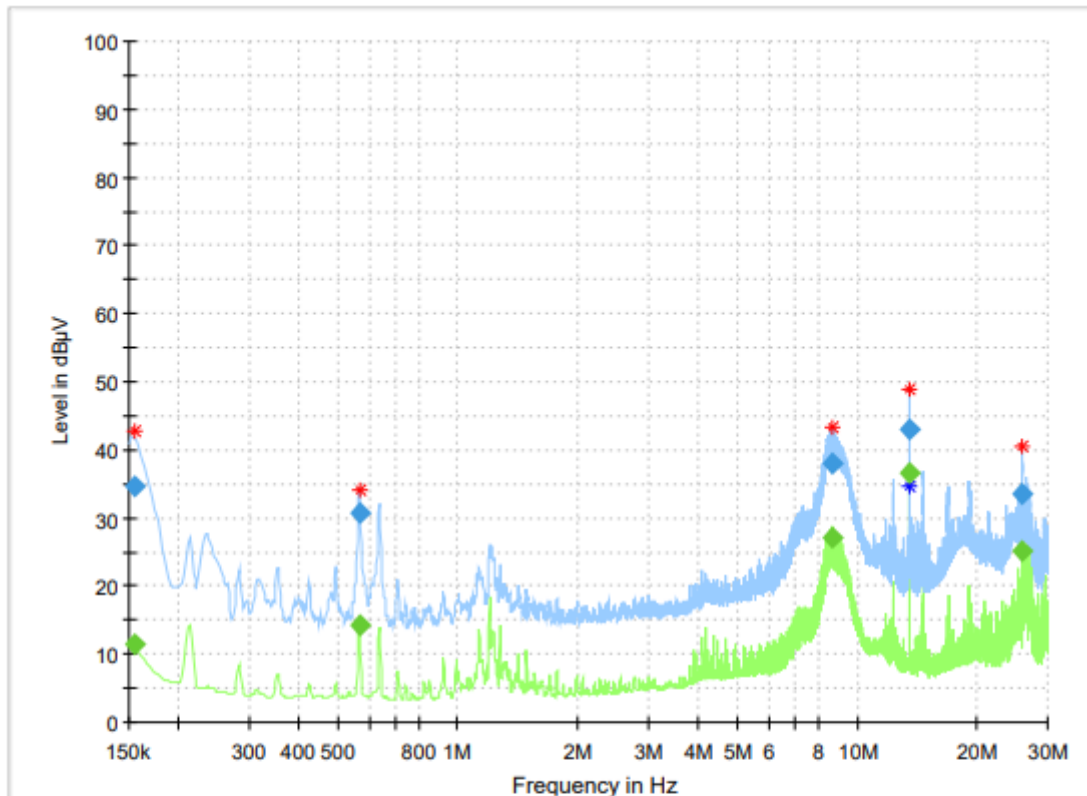
8.4.1 Measured Results

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

- The below test plot, Peak value of conducted emission is 42.95 dB μ V/m, And the worst limit subject to 15.207 is 56 dB μ V/m, So the EUT meets the requirement.

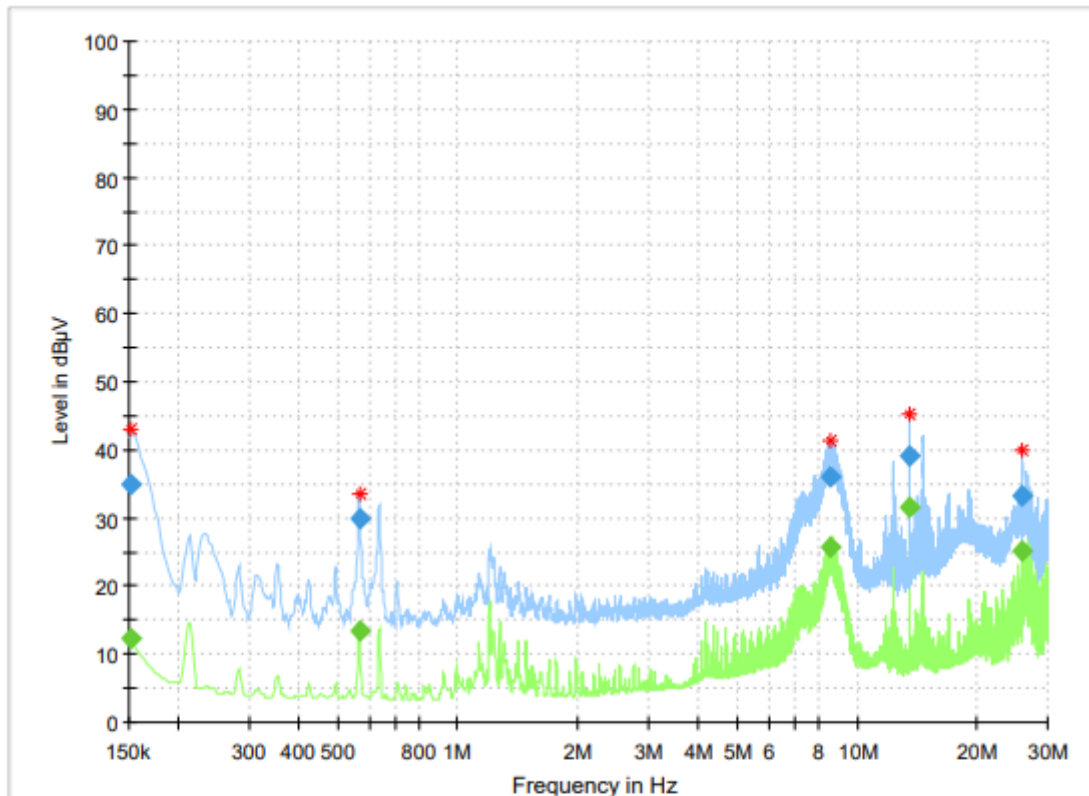
8.4.2 Measured Graph



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	---	11.53	---	---	5000.0	9.000	N	9.9
0.154500	34.68	---	---	---	5000.0	9.000	N	9.9
0.566250	---	14.12	---	---	5000.0	9.000	N	10.0
0.566250	30.77	---	---	---	5000.0	9.000	N	10.0
8.634750	---	27.05	---	---	5000.0	9.000	N	10.0
8.634750	37.91	---	---	---	5000.0	9.000	N	10.0
13.562250	---	36.71	---	---	5000.0	9.000	N	10.1
13.562250	42.95	---	---	---	5000.0	9.000	N	10.1
25.885500	---	25.01	---	---	5000.0	9.000	N	10.3
25.885500	33.40	---	---	---	5000.0	9.000	N	10.3

Natural line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152250	---	12.20	---	---	5000.0	9.000	L1	9.9
0.152250	34.87	---	---	---	5000.0	9.000	L1	9.9
0.566250	---	13.44	---	---	5000.0	9.000	L1	10.0
0.566250	29.86	---	---	---	5000.0	9.000	L1	10.0
8.551500	---	25.75	---	---	5000.0	9.000	L1	10.0
8.551500	35.95	---	---	---	5000.0	9.000	L1	10.0
13.562250	---	31.68	---	---	5000.0	9.000	L1	10.2
13.562250	39.22	---	---	---	5000.0	9.000	L1	10.2
25.885500	---	25.02	---	---	5000.0	9.000	L1	10.6
25.885500	33.11	---	---	---	5000.0	9.000	L1	10.6

Live line

- END -