

Report on the FCC Testing of the
EFFILUX GmbH
LED-light for image processing. Model:
RandomDot-000
In accordance with FCC 47 CFR Part 15B



Product Service

Prepared for: EFFILUX GmbH
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FCC ID: 2AZTNRCR20

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ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15B. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Thomas Winterberger	11-05-2021	 SIGN-ID 506369

Laboratory Accreditation
DAkkS Reg. No. D-PL-11321-11-02
DAkkS Reg. No. D-PL-11321-11-03
Laboratory recognition
Registration No. BNetzA-CAB-16/21-15

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15B:2019.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	25-Aug-2020
2	All test setup pictures are deleted and a ANNEX document is provided. Page 1: Delete of "IC" in headline Add the "FCC ID". Change of the date from "FCC 47 CFR Part 15B:2019" Page 8: Change of "Test Method" Page 13: Change of "Test Method" Page 14: Change of "Specification Limits" Page 17 & 18: Change of "Calibration Due" at "ESU 8" Page 19: Change of "Measurement Uncertainty"	11-05-2021

Table 1

1.2 Introduction

Applicant	EFFILUX GmbH
Manufacturer	EFFILUX GmbH
Model Number(s)	RandomDot-000
Serial Number(s)	0166742008-001
Hardware Version(s)	---
Software Version(s)	---
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15B:2019
Test Plan/Issue/Date	---
Order Number	CF001687
Date	2020-04-09
Date of Receipt of EUT	2020-08-18
Start of Test	2020-08-20
Finish of Test	2020-08-21
Name of Engineer(s)	Thomas Winterberger
Related Document(s)	ANSI C63.4: 2014

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15B is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: 24 V DC power supply continuous light				
2.1	15.107	Conducted Disturbance at Mains Terminals	Pass	Test performed with a customary AC/DC converter
2.2	15.109	Radiated Disturbance	Pass	---

Table 2



1.4 Product Information

1.4.1 Technical Description

LED lamp for image processing



Figure 1 - Marking plate

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
24 V DC power supply continuous light				
EFFC-CAB-M12-M-8-D-L2	---	3 m	24V DC Power/Signal Line	No
EFFC-CAB-M12-F-8-D-L2	---	3 m	24V DC Power/Signal Line	Yes

Table 3

1.4.3 Test Configuration

Configuration	Description
24 V DC power supply	EUT connected via external DC supply to AC mains

Table 4

1.4.4 Modes of Operation

Mode	Description
continuous light	The projector is ON with a continuous white light

Table 5

1.5 Deviations from the Standard

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: 24 V DC power supply continuous light	
Conducted Disturbance at Mains Terminals	Thomas Winterberger
Radiated Disturbance	Thomas Winterberger

Table 7

Office Address:

Äußere Frühlingstraße 45

94315 Straubing
Germany

2 Test Details

2.1 Conducted Disturbance at Mains Terminals

2.1.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.107

2.1.2 Equipment Under Test and Modification State

RandomDot-000, S/N: 0166742008-001 - Modification State 0

2.1.3 Date of Test

2020-08-21

2.1.4 Environmental Conditions

Ambient Temperature 29,0 °C
Relative Humidity 31,0 %

2.1.5 Specification Limits

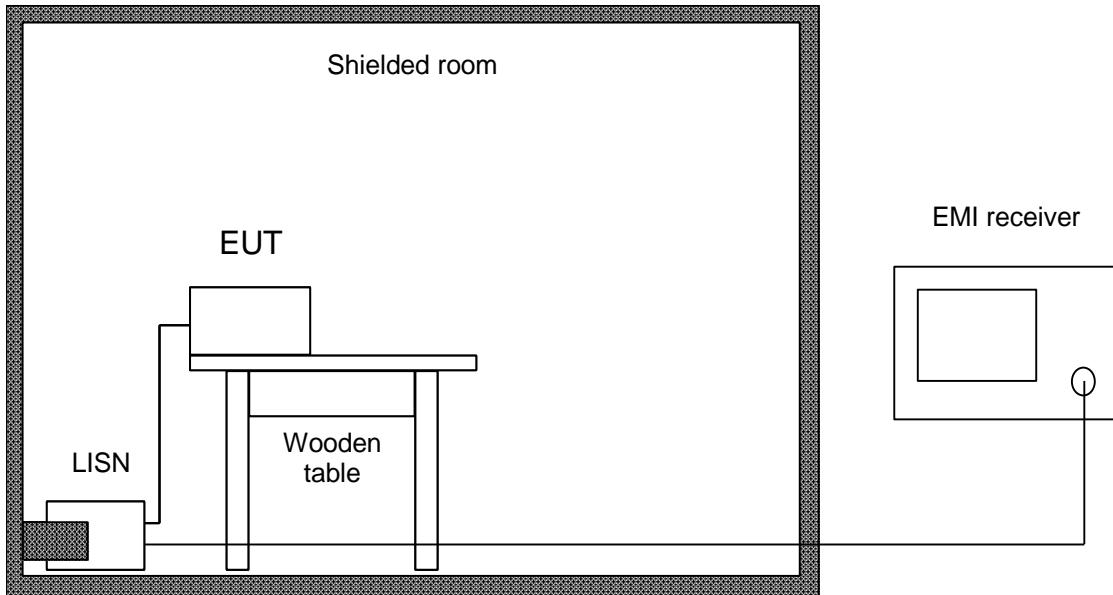
Required Specification Limits (Class B)			
Line Under Test	Frequency Range (MHz)	Quasi-peak (dB μ V)	Average (dB μ V)
AC Power Port	0.15 to 0.5	66 to 56*	56 to 46*
	0.5 to 5	56	46
	5 to 30	60	50

Supplementary information: *Decreases with the logarithm of the frequency.

Table 8

2.1.6 Test Methode

The test was performed according to ANSI C63.4, sections 5.2 and 7.



The EUT was placed on a non-conductive table 0.8 m above a reference ground plane and 0.4 m away from a vertical coupling plane

All power was connected to the EUT through a Line Impedance Stabilization Network (LISN). Conducted disturbance voltage measurements on mains lines were made at the output of the LISN. The LISN was placed 0.8 m from the boundary of the EUT and bounded to the reference ground plane. To simplify testing with quasi-peak and linear average (cisp-average) detector the following procedure is used:

First the whole spectrum of emission caused by the equipment under test (EUT) is recorded with the detectors set to peak and average using CISPR bandwidth of 10 kHz. After that all emission levels having less margin than 10 dB to or exceeding the average limit are retested with the detectors set to quasi-peak and average. If the average limit is kept with quasi-peak levels measurement with average detector is optional. In cases of emission levels between quasi-peak and average limit an additional measurement with average detector has to be performed.

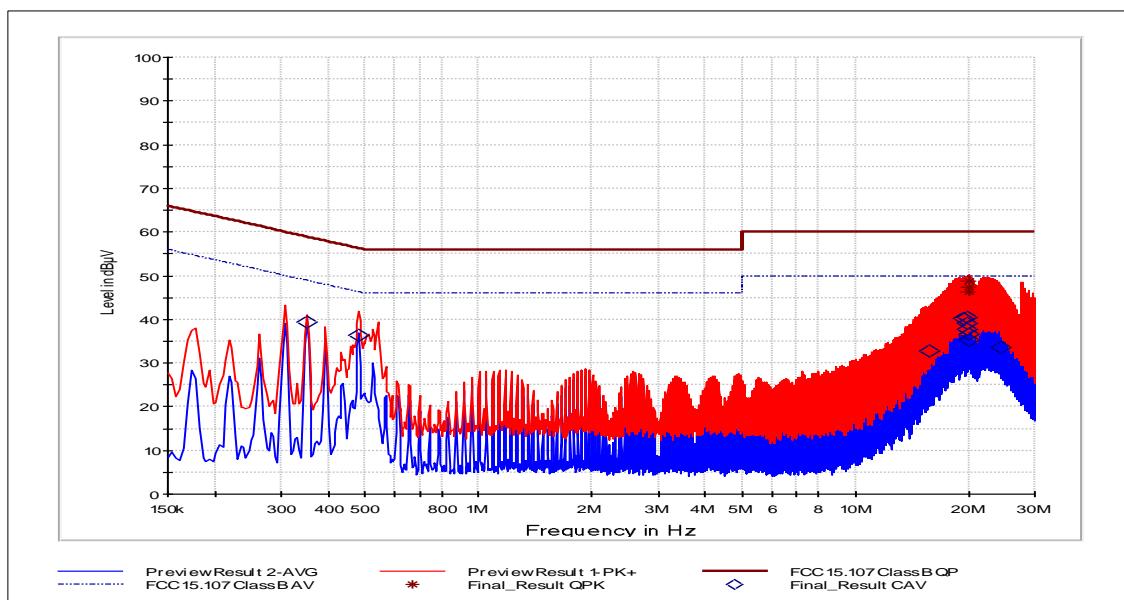
2.1.7 Test Results

Results for Configuration and Mode: 24 V DC power supply continuous light.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Line Under Test: EFFC-CAB-M12-M-8-D-L2 and EFFC-CAB-M12-M-8-D-L2 connected to customary AC/DC converter – L1



Frequency MHz	QuasiPeak dB μ V	CAverage dB μ V	Limit dB μ V	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Corr. dB
0.350000	---	39.32	48.96	9.65	1000.0	9.000	L1	10.0
0.482000	---	36.37	46.31	9.93	1000.0	9.000	L1	10.0
15.686000	---	32.80	50.00	17.20	1000.0	9.000	L1	10.4
19.398000	---	40.09	50.00	9.91	1000.0	9.000	L1	10.3
19.878000	---	40.60	50.00	9.40	1000.0	9.000	L1	10.2
19.922000	---	39.02	50.00	10.98	1000.0	9.000	L1	10.2
19.966000	---	37.73	50.00	12.27	1000.0	9.000	L1	10.2
20.010000	47.33	---	60.00	12.67	1000.0	9.000	L1	10.2
20.010000	---	36.58	50.00	13.42	1000.0	9.000	L1	10.2
20.054000	---	35.37	50.00	14.63	1000.0	9.000	L1	10.2
20.054000	46.42	---	60.00	13.58	1000.0	9.000	L1	10.2
20.094000	48.82	---	60.00	11.18	1000.0	9.000	L1	10.2
24.290000	---	33.69	50.00	16.31	1000.0	9.000	L1	10.3

Table 9

Line Under Test: FFC-CAB-M12-M-8-D-L2 and EFFC-CAB-M12-M-8-D-L2 connected to customary AC/DC converter – N

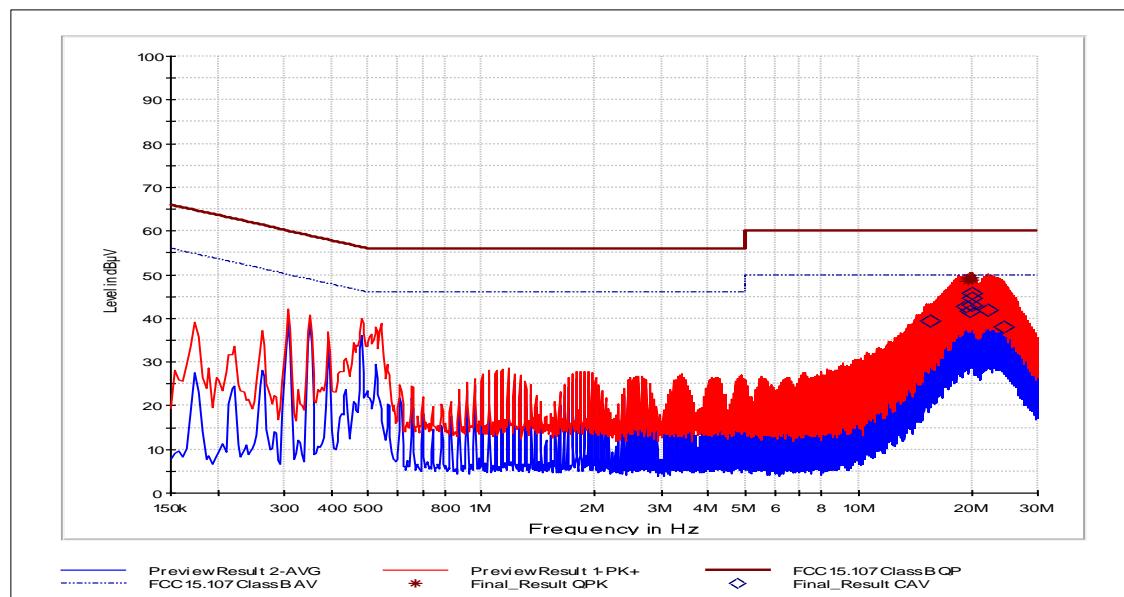


Figure 3 - Graphical Results - N

Frequency MHz	QuasiPeak dB μ V	CAverage dB μ V	Limit dB μ V	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Corr. dB
15.630000	---	39.39	50.00	10.61	1000.0	9.000	N	10.4
19.254000	---	42.81	50.00	7.19	1000.0	9.000	N	10.3
19.646000	48.43	---	60.00	11.57	1000.0	9.000	N	10.3
19.822000	---	41.48	50.00	8.52	1000.0	9.000	N	10.3
19.862000	49.15	---	60.00	10.85	1000.0	9.000	N	10.2
19.950000	49.22	---	60.00	10.78	1000.0	9.000	N	10.2
19.994000	49.17	---	60.00	10.83	1000.0	9.000	N	10.2
20.038000	---	45.63	50.00	4.37	1000.0	9.000	N	10.2
20.038000	48.90	---	60.00	11.10	1000.0	9.000	N	10.2
20.082000	---	44.65	50.00	5.35	1000.0	9.000	N	10.2
20.170000	---	42.99	50.00	7.01	1000.0	9.000	N	10.2
22.178000	---	41.97	50.00	8.03	1000.0	9.000	N	10.2
24.274000	---	37.97	50.00	12.03	1000.0	9.000	N	10.3

Table 10



2.1.8 Test Location and Test Equipment Used

This test was carried out in Shielded room - cabin no. 9.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU8	19904	12	31.01.2021
Microwave cable	Rosenberger Micro-Coax	FB293C1080005050	20024	---	---
Shielded room	Albatross Projects GmbH	Cabin no. 9	21083	---	---
V-network	Rohde & Schwarz GmbH & Co. KG	ENV216	39908	12	31.03.2021
V-network	Rohde & Schwarz GmbH & Co. KG	ENV216	39909	12	28.02.2021
EMC measurement software	Rohde & Schwarz GmbH & Co. KG	EMC32 Emission K1 - V9.26.01	20090	---	---

Table 11



2.2 Radiated Disturbance

2.2.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.109

2.2.2 Equipment Under Test and Modification State

RandomDot-000, S/N: 0166742008-001 - Modification State 0

2.2.3 Date of Test

2020-08-20

2.2.4 Environmental Conditions

Ambient Temperature 23,0 °C

Relative Humidity 31,0 %

2.2.5 Specification Limits

On any frequency 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. As an alternative to CISPR quasi-peak measurements compliance may be demonstrated with the emission limits using measuring equipment employing a peak detector function as long as the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

Above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified, there also is a limit on the peak level of the radio frequency emissions. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit. This peak limit applies to the total peak emission level radiated by the device.

Required Specification Limits (Class A)		
Frequency Range (MHz)	Field strength in 10 m distance	
	(μ V/m)	(dB μ V/m)
30 – 88	90	39
88 – 216	150	43.5
126 – 960	210	46.4
above 960	300	49.5

Table 12 Class A emission limits

Required Specification Limits (Class B)		
Frequency Range (MHz)	Field strength in 1 m distance	
	(μ V/m)	(dB μ V/m)
30 – 88	100	40
88 – 216	150	43.5
126 – 960	200	46
above 960	500	54

Table 13 Class B emission limits

As an alternative to the radiated emission limits shown above, digital devices may be shown comply with the standards contained in the 3rd Edition of CISPR 22. In addition: if measurements must be performed above 1000 MHz, compliance above 1000 MHz shall be demonstrated with the emission limits above.

Measurements above 1000 MHz may be performed at the distance specified in the CISPR 22 publications for measurements below 1000 MHz provided the limits above are extrapolated to the new measurement distance using an inverse linear distance extrapolation factor (20 dB/decade), e.g., the radiated limit above 1000 MHz for Class B digital devices is 150 μ V/m as measured at a distance of 10 meters.

2.2.6 Test Methode

The test was performed according to ANSI C63.4, sections 5.4, 44 and 8.

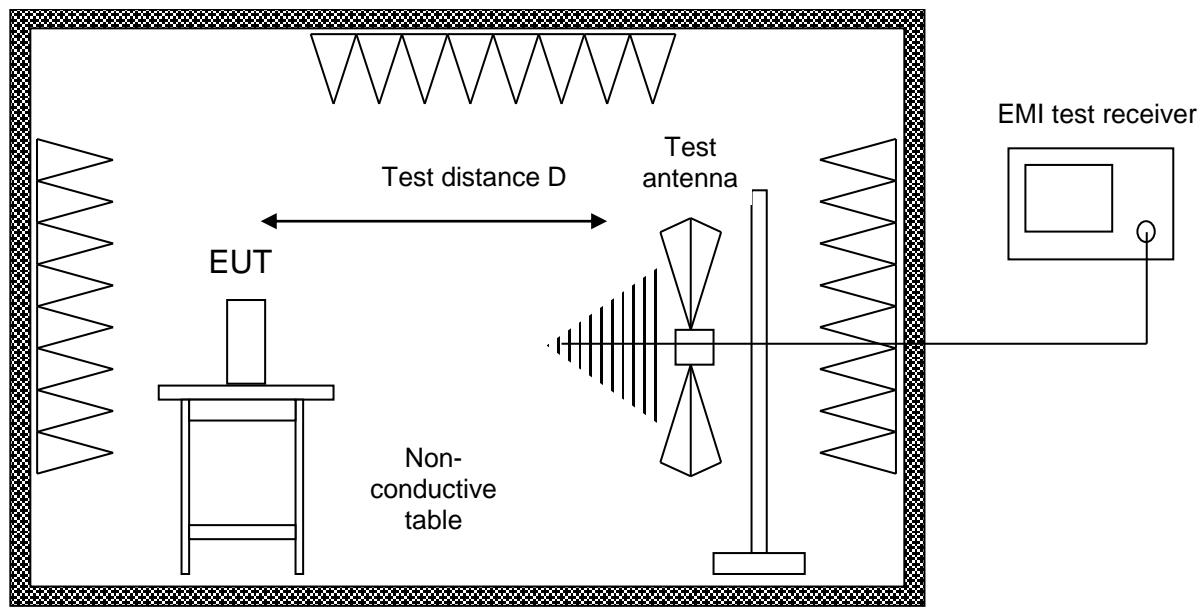
The EUT was placed on a non-conductive table, 0.8 m above the ground plane. Prescans are performed in six positions of the EUT to get the full spectrum of emission caused by the EUT with the measuring antenna raised and lowered from 1 m to 4 m with vertical and horizontal polarisation to find the combination of table position, antenna height and antenna polarisation for the maximum emission levels.

Data reduction is applied to these results to select those levels having less margin than 10 dB or exceeding the limit using subranges and limited number of maximums.

Further maximisation for adjusting the maximum position is following.

Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

2.2.6.1 Frequency range 30 MHz – 1 GHz

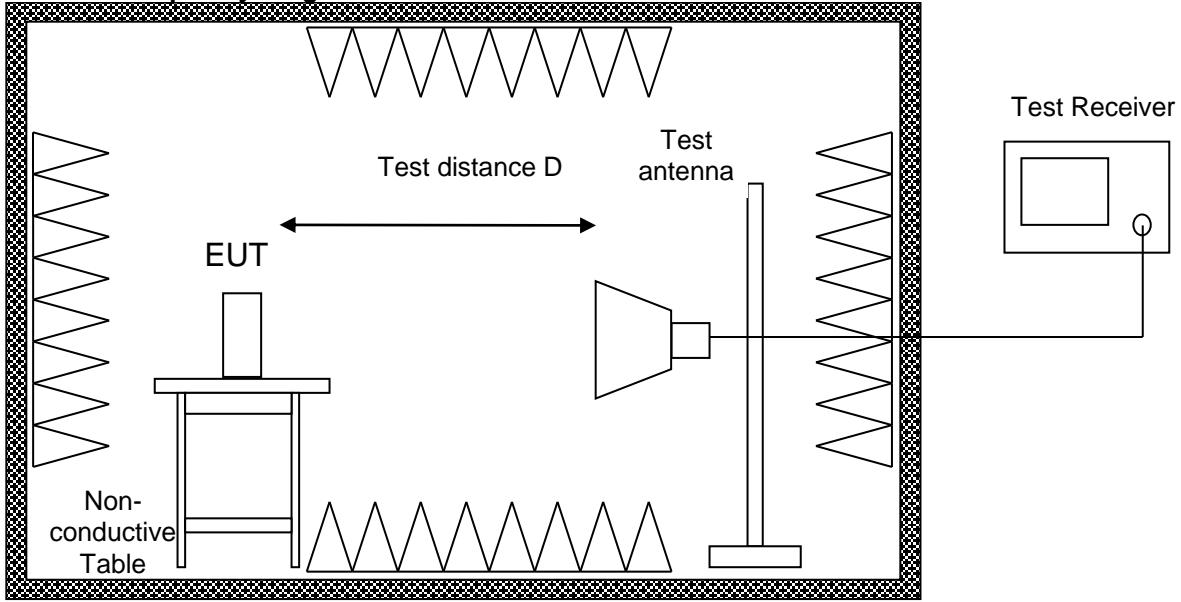


Radiated emissions in the frequency range 30 MHz – 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4. for alternative test sites. A linear polarised logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used.

For prescan tests the test receiver is set to peak-detector with a bandwidth of 120 kHz.

With the measurement bandwidth of the test receiver set to 120 kHz CISPR quasi-peak detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.

2.2.6.2 Frequency range above 1 GHz



2.2.7 Test Results

Results for Configuration and Mode: 24 V DC power supply continuous light.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Highest frequency generated or used within the EUT: < 108 MHz
Which necessitates an upper frequency test limit of: 1 GHz

Frequency Range of Test: 30 MHz to 1 GHz

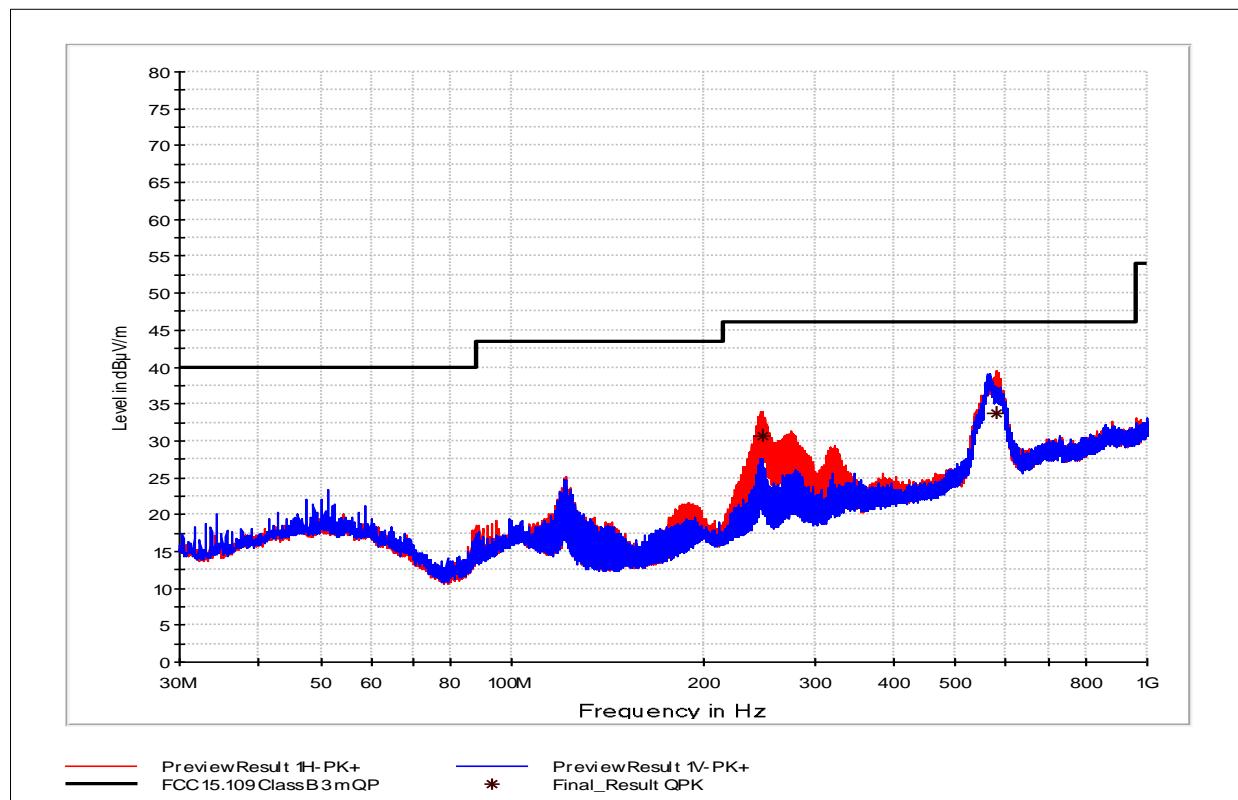


Figure 4 - Graphical Results - Horizontal and Vertical Polarity

Frequency MHz	QuasiPeak dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB/m
247.365000	30.66	46.00	15.34	1000.0	120.000	100.0	H	-112.0	17.8
579.200000	33.64	46.00	12.36	1000.0	120.000	151.0	H	87.0	25.1

Table 14

2.2.8 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Semi anechoic room	Albatross Projects GmbH	Cabin no. 8	19917	36	30.09.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505	19928	0	
Double ridged horn antenna	Rohde & Schwarz GmbH & Co. KG	HF907	19933	24	31.07.2021
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505 0G	19994	0	
TRILOG Broadband Antenna	Schwarzbeck Mess-Elektronik	VULB 9162	20116	36	31.01.2022
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU 8	19904	12	31.01.2021
Microwave cable	Rosenberger Micro-Coax	LA5-015-8000	39968	12	31.01.2021
RF test cable	Huber & Suhner	KK-SF118D-2X11N-8,5N	44767	0	
EMC measurement software	Rohde & Schwarz GmbH & Co. KG	EMC32 Emission K8 – V10.50.10	19927	---	---

Table 15

3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Semi anechoic room	Albatross Projects GmbH	Cabin no. 8	19917	36	30.09.2020
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505	19928	0	
Double ridged horn antenna	Rohde & Schwarz GmbH & Co. KG	HF907	19933	24	31.07.2021
Microwave cable	Rosenberger Micro-Coax	FA210AF04000505 0G	19994	0	
TRILOG Broadband Antenna	Schwarzbeck Mess-Elektronik	VULB 9162	20116	36	31.01.2022
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU 8	19904	12	30.06.2020
Microwave cable	Rosenberger Micro-Coax	LA5-015-8000	39968	12	31.01.2021
RF test cable	Huber & Suhner	KK-SF118D-2X11N-8,5N	44767	0	
EMC measurement software	Rohde & Schwarz GmbH & Co. KG	EMC32 Emission K8 – V10.50.10	19927	---	---
EMI test receiver	Rohde & Schwarz GmbH & Co. KG	ESU8	19904	12	31.01.2021
Microwave cable	Rosenberger Micro-Coax	FB293C108000505 0	20024	---	---
Shielded room	Albatross Projects GmbH	Cabin no. 9	21083	---	---
V-network	Rohde & Schwarz GmbH & Co. KG	ENV216	39908	12	31.03.2021
V-network	Rohde & Schwarz GmbH & Co. KG	ENV216	39909	12	28.02.2021
EMC measurement software	Rohde & Schwarz GmbH & Co. KG	EMC32 Emission K1 - V9.26.01	20090	---	---

Table 16

4 Incident Reports

5 Measurement Uncertainty

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (UCISPR). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1

Table 17

Note 1:



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The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$