SLOVENSKA AKREDITACIJA
SIST EN ISO/IEC 17025
LP-009

Test report

Number: **T251-0257/17**

Project file: C20170767
Date: 2017-04-19
Pages: 56

Product: **Fixed general purpose LED luminaire**

Type reference: **LA-FL/G-xxW-xxxxK-Rxxx/xxx-(D10kGy) (see general product information)**

Ratings:
230V~; 50 Hz
Protection class: I
Maximum clock frequency: /

Trademark: Luminos Ambiente

Applicant:
Nanocut d.o.o.
Cesta 3. julija 7, SI-1430 Hrastnik, Slovenia

Manufacturer:
Nanocut d.o.o.
Cesta 3. julija 7, SI-1430 Hrastnik, Slovenia

Place of manufacture:
Nanocut d.o.o.
Cesta 3. julija 7, SI-1430 Hrastnik, Slovenia

Summary of testing

Testing method:
EN 55015:2013,
EN 61547:2009,
EN 61000-3-2:2014,
EN 61000-3-3:2013

Testing location: SIQ Ljubljana, Trpinčeva ulica 37 A, SI-1000 Ljubljana, Slovenia

Remarks:
Date of receipt of test items: 2017-03-30
Number of items tested: 1
Date of performance of tests: 2017-03-31 - 2017-04-18
The test results presented in this report relate only to the items tested.

The product complies with the requirements of the testing method.

Tested by: Bojan Štrubelj

Approved by: Marjan Mak

The report shall not be reproduced except in full.

TN405E-01

CONTENTS page

1 GENERAL

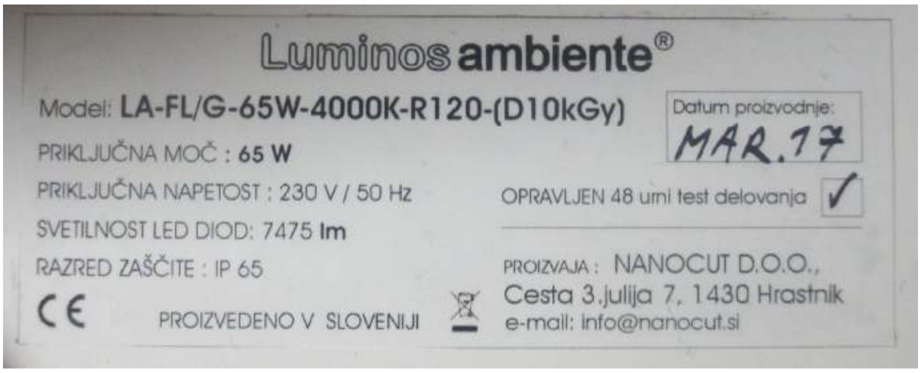
History sheet			
Date	Report No.	Change	Revision
2017-04-19	T251-0257/17	Initial Test Report issued.	--

Environmental conditions:
Ambient temperature: 15 °C to 35 °C
Relative humidity: 30 % to 60 %
Atmospheric pressure: 860 mbar to 1060 mbar

1.1 Equipment under test

Fixed general purpose LED luminaire
Type: **LA-FL/G-65W-4000K-R120-(D10kGy)**

Tested SIQ sample numbers: S20171888



Luminos ambiente®

Model: LA-FL/G-65W-4000K-R120-(D10kGy)

Datum proizvodnje:
MAR.17

PRIKLJUČNA MOČ : 65 W

PRIKLJUČNA NAPETOST : 230 V / 50 Hz

OPRAVLJEN 48 urni test delovanja ☑

SVETILNOST LED DIOD: 7475 lm

RAZRED ZAŠČITE : IP 65

PROIZVAJA : NANOCUT D.O.O.,
Cesta 3.julija 7, 1430 Hrastnik
e-mail: info@nanocut.si

CE

PROIZVEDENO V SLOVENIJI

Picture of label

1.2 General product information

Type designation:

Designation scheme:	Example:
LA-FL/G-xxW-xxxxK-Rxxx/xxx-(D10kGy)	**LA-FL/G-65W-4000K-R120-(D10kGy)**

LA - LUMINOS ambiente (trademark)
FL/G - Flat line model of luminaire with increased sustainability to gamma radiation
xxW - Electrical power in Wattage (45 W, 50 W, 55 W, 60 W, 65 W)
xxxxK - Color temperature in Kelvin (3000 K, 3500 K, 4000 K, 4500 K)
Rxxx/xxx - Optical angles (R30, R60, R120, R60/120, R10/60)
D10kGy - Luminaire withstand at least the level of gamma radiation 10kGy

1.3 Operating voltages/frequencies used for testing

Section	Test	Operating conditions
3.1	Conducted emission measurement	230 V; 50 Hz
3.2	Radiated emission measurement	230 V; 50 Hz
3.3	Harmonics current emission measurement	230 V; 50 Hz
3.4	Voltage fluctuation measurement	/
4.1	Immunity to electrostatic discharge	230 V; 50 Hz
4.2	Radiated electromagnetic field immunity test (RS)	230 V; 50 Hz
4.3	Electrical fast transient/burst immunity test	230 V; 50 Hz
4.4	Surge immunity test	230 V; 50 Hz
4.5	Immunity to conducted disturbances induced by RF fields (CS)	230 V; 50 Hz
4.6	Magnetic field immunity test	230 V; 50 Hz
4.7	Voltage dips and short interruptions immunity test (DIP)	230 V; 50 Hz

1.4 Operating modes

No.	Operating mode
1	Normal (light on)

2 TEST SUMMARY

STANDARDS (details on first page)	Tested yes	Tested no	Sample pass	Sample not pass
EN 55015 Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	☑	☐	☑	☐
EN 61547 Equipment for general lighting purposes - EMC immunity requirements	☑	☐	☑	☐
EN 61000-3-2 Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for current emissions (equipment input current up to and including 16A per phase)	☑	☐	☑	☐
EN 61000-3-3 Electromagnetic compatibility (EMC) – Part 3-3: Limits – limitation of voltage fluctuations and flicker in public low-voltage supply systems for equipment with rated current up to 16A	☐	☑	☑	☐

Test	Basic standard	Section within the report	Class	Conclusion
Conducted emission measurement	EN 55015:2006 + A1:2007 + A2:2009	3.1	/	PASS
Radiated emission measurement	EN 55015:2006 + A1:2007 + A2:2009	3.2	/	PASS
Harmonics current emission measurement	EN 61000-3-2:2006 + A1:2009 + A2:2009	3.3	A	PASS
Voltage fluctuation measurement	EN 61000-3-3:2013	3.4	/	N/A

Test	Basic standard	Required criterion	Achieved criterion	Conclusion
Immunity to electrostatic discharge	EN 61000-4-2:2009	B	A	PASS
Radiated electromagnetic field immunity test (RS)	EN 61000-4-3:2006 + A1:2008	A	A	PASS
Electrical fast transient/burst immunity test	EN 61000-4-4:2004	B	A	PASS
Surge immunity test	EN 61000-4-5:2006	B	A	PASS
Immunity to conducted disturbances induced by RF fields (CS)	EN 61000-4-6:2009	A	A	PASS
Magnetic field immunity test	EN 61000-4-8:1993 + A1:2001	A	A	PASS
Voltage dips and short interruptions immunity test (DIP)	EN 61000-4-11:2004	B,C	B	PASS

* NOTE: for detailed criterion achievement refer to each test separately

2.1 Performance/observation criterion

If there are no special manufacturer performance criteria defined, those bellow are used for evaluation.

Criterion A: During and after the test the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the EUT if used as intended.

Criterion B: After the test, the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena. During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test.
If the minimum performance level (or the permissible performance loss) is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the EUT if used as intended.

Criterion C: During and after testing, a temporary loss of function is allowed, provided the function is self recoverable, or can be restored by the operation of the controls or cycling of the power to the EUT by the user in accordance with the manufacturer's instructions.
Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

No.	Observation for immunity testing
1	Luminance

3 EMISSION TESTS

3.1 Conducted emission measurement

3.1.1 Limits of conducted emission measurement

Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0,009 – 0,05	110	/
0,05 – 0,15	90 – 80	/
0,15 – 0,5	66 – 56	56 – 46
0,5 – 5,0	56	46
5,0 – 30,0	60	50

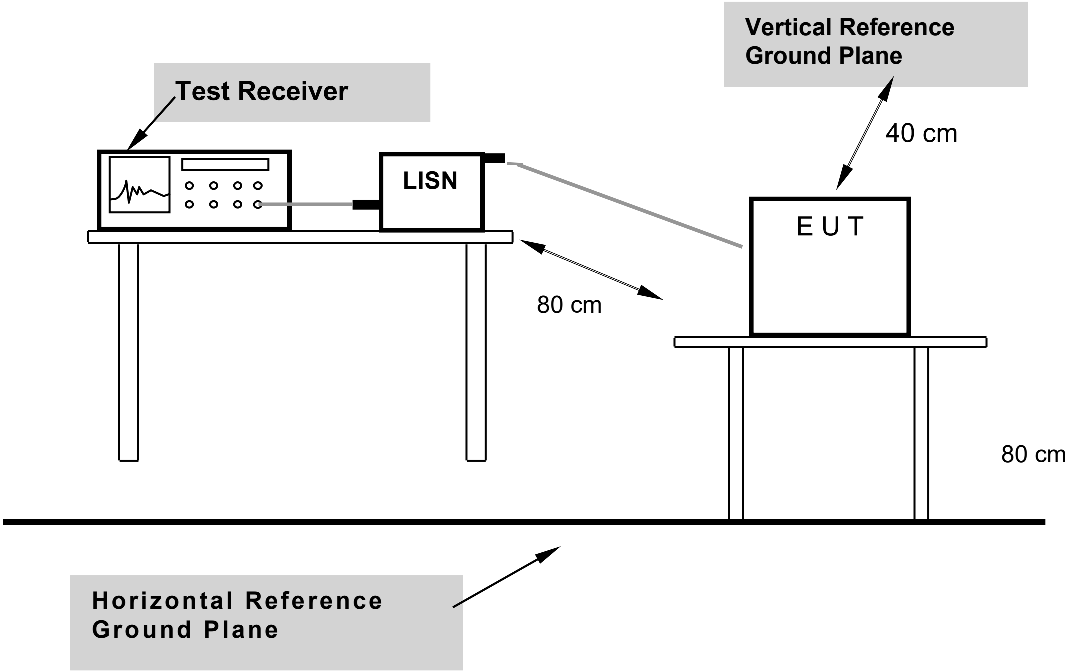
Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0,15 – 0,5	84 – 74	74 – 64
0,5 – 30,0	74	64

NOTE: • The lower limit shall apply at the transition frequencies.
• The limit decreases in line with the logarithm of the frequency in the range of 0.05 to 0.50 MHz.

3.1.2 Test procedure

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). LISN provide 50 Ohm/ 50 μH+5 Ohm of coupling impedance for the measuring instrument.
- AC power lines and signal lines of EUT was checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.

3.1.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

3.1.4 Test results

MEASUREMENT UNCERTAINTY:

- The measurement uncertainty is calculated in document EN122E

ROHDE&SCHWARZ

C20170767

31.Mar 17 09:03

Meas Type	CONDUCTED EMISSION
Equipment under Test	Flat LED lamp,
Manufacturer	NANOCUT d.o.o.
OP Condition	Uin 230V, 50Hz, LIGHT ON
Operator	BOJAN STRUBELJ

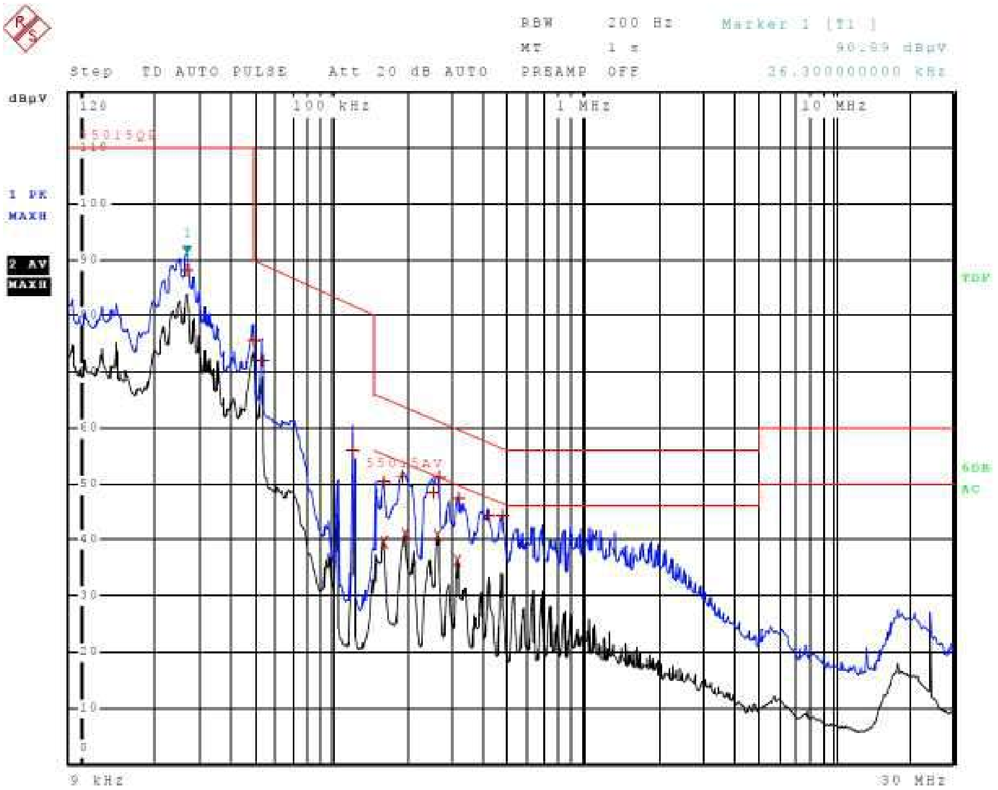
Test Spec

LINE L

Time Domain Scan (2 Ranges)

Scan Start: 9 kHz
Scan Stop: 30 MHz
Detector: Trace 1: MAX PEAK Trace 2: Average
Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
9.000000 kHz	149.950000 kHz	50.00 Hz	200.00 Hz	50 ms	Auto	0 dB	INPUT2
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	10 ms	Auto	0 dB	INPUT2



C20170767

31.Mar 17 09:03

Meas Type	CONDUCTED EMISSION
Equipment under Test	Flat LED lamp,
Manufacturer	NANOCUT d.o.o.
OP Condition	Uin 230V, 50Hz, LIGHT ON
Operator	BOJAN STRUBELJ

Test Spec
LINE L

Final Measurement

Meas Time:	1 s
Margin:	10 dB
Subranges:	15

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	264.750000000 kHz	51.08	Quasi Peak	-10.20
2	262.500000000 kHz	40.60	CISPR Averag	-10.75
1	476.250000000 kHz	44.24	Quasi Peak	-12.17
1	318.750000000 kHz	47.29	Quasi Peak	-12.45
1	188.250000000 kHz	51.28	Quasi Peak	-12.84
2	192.750000000 kHz	40.99	CISPR Averag	-12.92
1	417.750000000 kHz	44.22	Quasi Peak	-13.27
1	251.250000000 kHz	48.22	Quasi Peak	-13.50
2	316.500000000 kHz	36.20	CISPR Averag	-13.60
1	159.000000000 kHz	50.19	Quasi Peak	-15.33
2	159.000000000 kHz	39.56	CISPR Averag	-15.95
1	52.850000000 kHz	71.90	Quasi Peak	-17.60
1	26.300000000 kHz	88.04	Quasi Peak	-21.96
1	120.900000000 kHz	55.93	Quasi Peak	-26.03
1	48.450000000 kHz	75.49	Quasi Peak	-34.51

ROHDE&SCHWARZ

C20170767

31.Mar 17 09:12

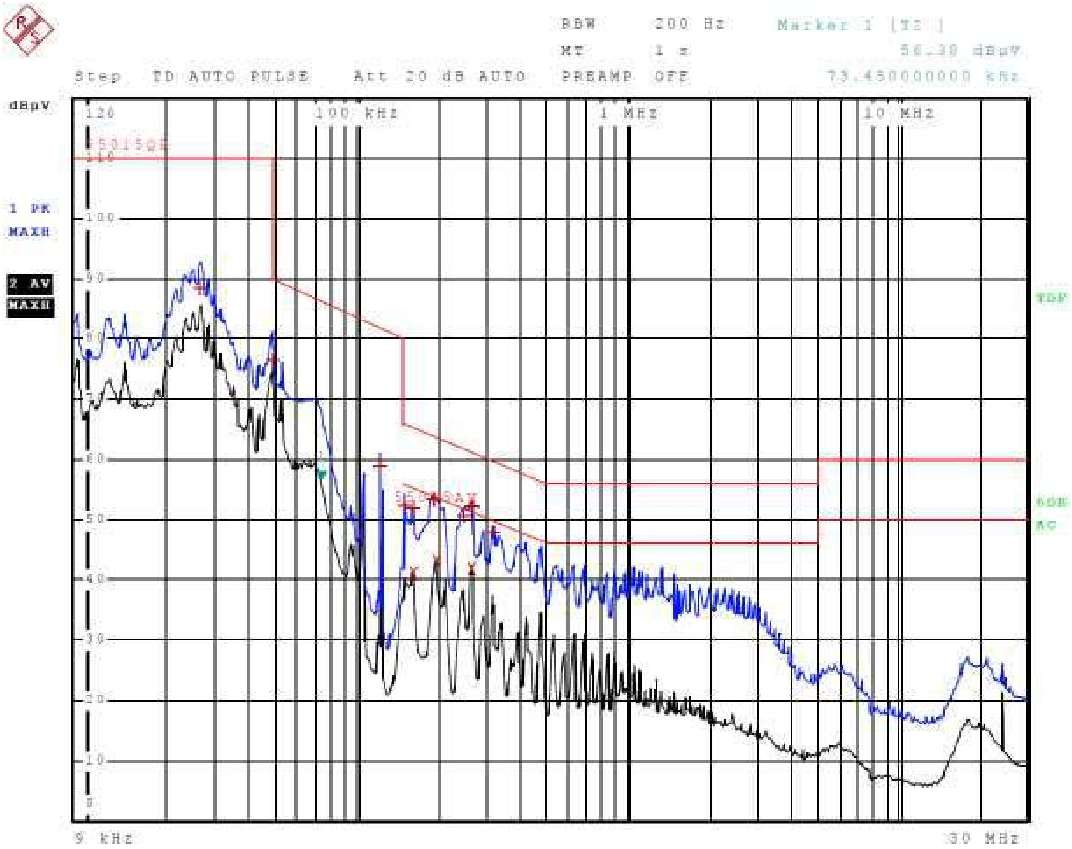
Meas Type	CONDUCTED EMISSION
Equipment under Test	Flat LED lamp,
Manufacturer	NANOCUT d.o.o.
OP Condition	Uin 230V, 50Hz, LIGHT ON
Operator	BOJAN STRUBELJ

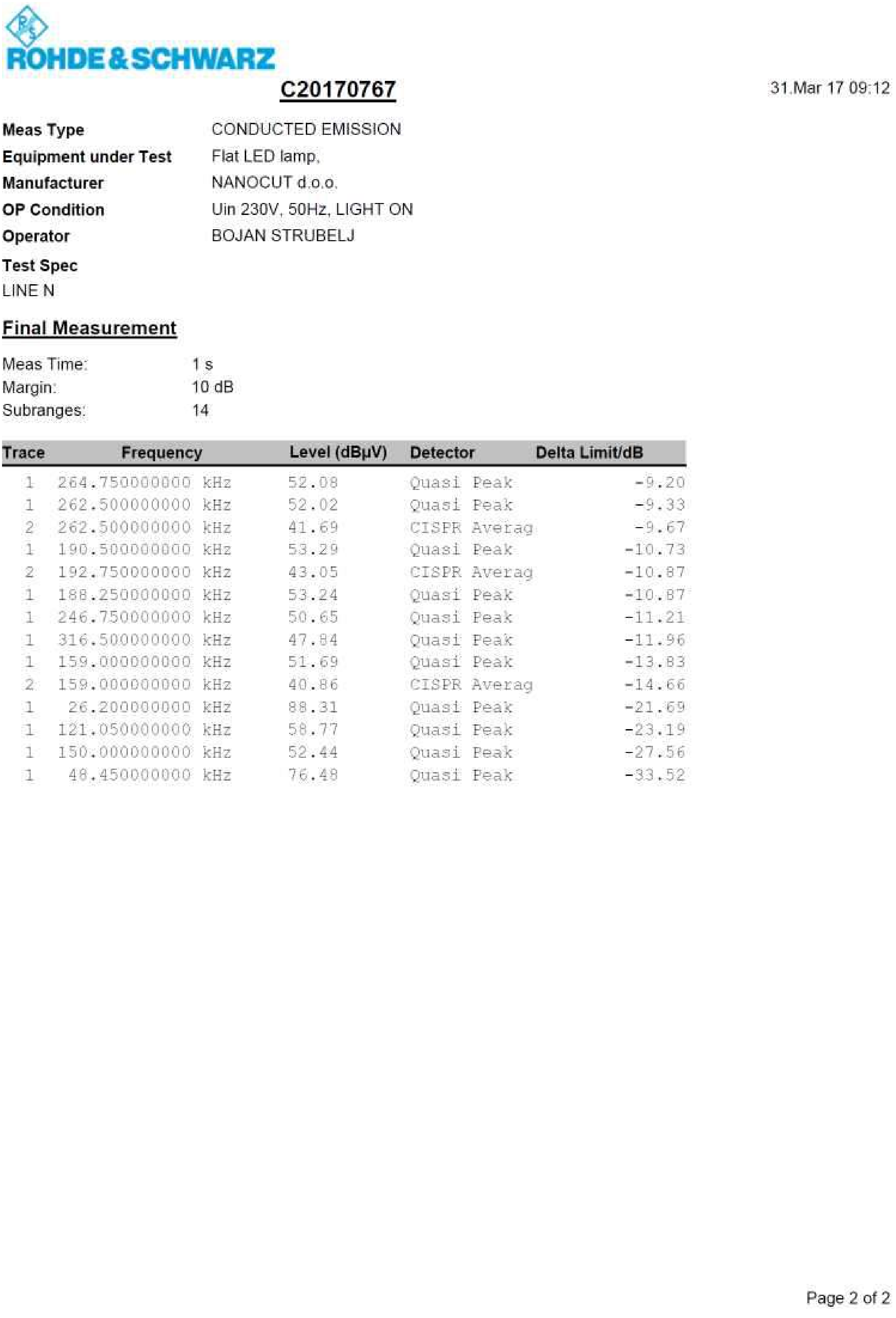
Test Spec
LINE N

Time Domain Scan (2 Ranges)

Scan Start:	9 kHz
Scan Stop:	30 MHz
Detector:	Trace 1: MAX PEAK Trace 2: Average
Transducer:	ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
9.000000 kHz	149.950000 kHz	50.00 Hz	200.00 Hz	50 ms	Auto	0 dB	INPUT2
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	10 ms	Auto	0 dB	INPUT2





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C20170767

31.Mar 17 09:12

Meas Type CONDUCTED EMISSION
Equipment under Test Flat LED lamp,
Manufacturer NANOCUT d.o.o.
OP Condition Uin 230V, 50Hz, LIGHT ON
Operator BOJAN STRUBELJ

Test Spec
LINE N

Final Measurement

Meas Time: 1 s
Margin: 10 dB
Subranges: 14

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	264.750000000 kHz	52.08	Quasi Peak	-9.20
1	262.500000000 kHz	52.02	Quasi Peak	-9.33
2	262.500000000 kHz	41.69	CISPR Averag	-9.67
1	190.500000000 kHz	53.29	Quasi Peak	-10.73
2	192.750000000 kHz	43.05	CISPR Averag	-10.87
1	188.250000000 kHz	53.24	Quasi Peak	-10.87
1	246.750000000 kHz	50.65	Quasi Peak	-11.21
1	316.500000000 kHz	47.84	Quasi Peak	-11.96
1	159.000000000 kHz	51.69	Quasi Peak	-13.83
2	159.000000000 kHz	40.86	CISPR Averag	-14.66
1	26.200000000 kHz	88.31	Quasi Peak	-21.69
1	121.050000000 kHz	58.77	Quasi Peak	-23.19
1	150.000000000 kHz	52.44	Quasi Peak	-27.56
1	48.450000000 kHz	76.48	Quasi Peak	-33.52

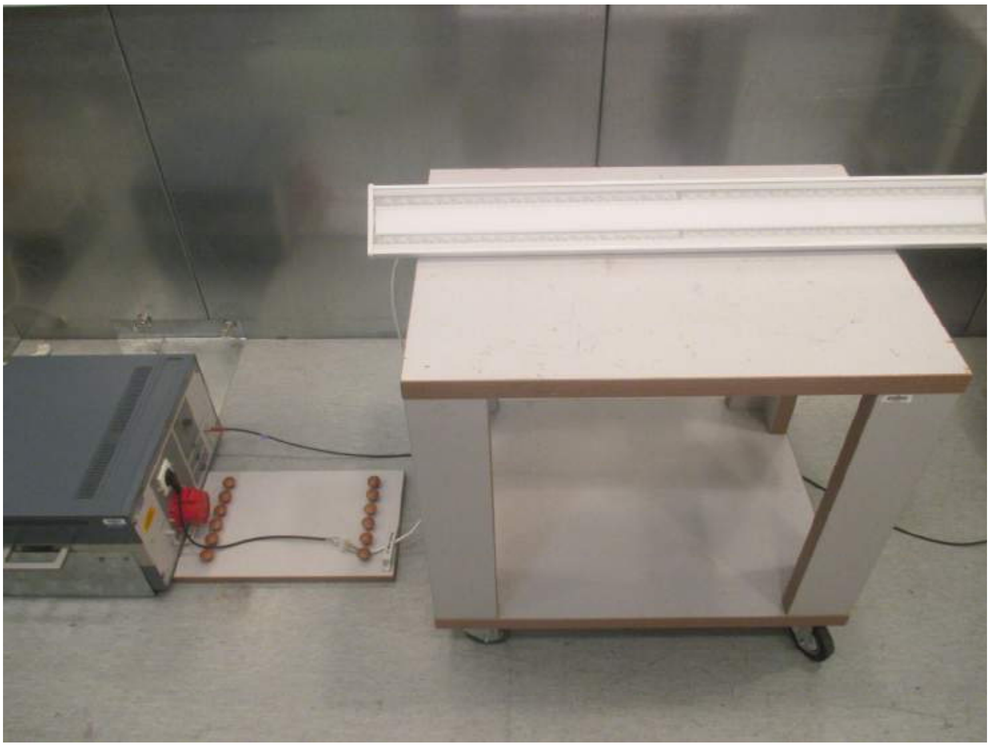


Figure 1: Conducted emission test

3.2 Radiated emission measurement

3.2.1 Limits of radiated emission measurement

Loop antenna measurement limits:

Frequency (MHz)	Limits for loop diameter 2m (dBµA/m)
0,009 – 0,07	88
0,07 – 0,15	88 – 58
0,15 – 3,0	58 – 22
3,0 – 30,0	22

Anechoic 3 m measurement limits:

Frequency (MHz)	Limit (at 3 m) (dBµV/m)	
30 – 230	40	Quasi Peak
230 – 300	47	

NOTE: • The lower limit shall apply at the transition frequencies.
• Emission level (dBµV/m) = 20 log Emission level (µV/m).

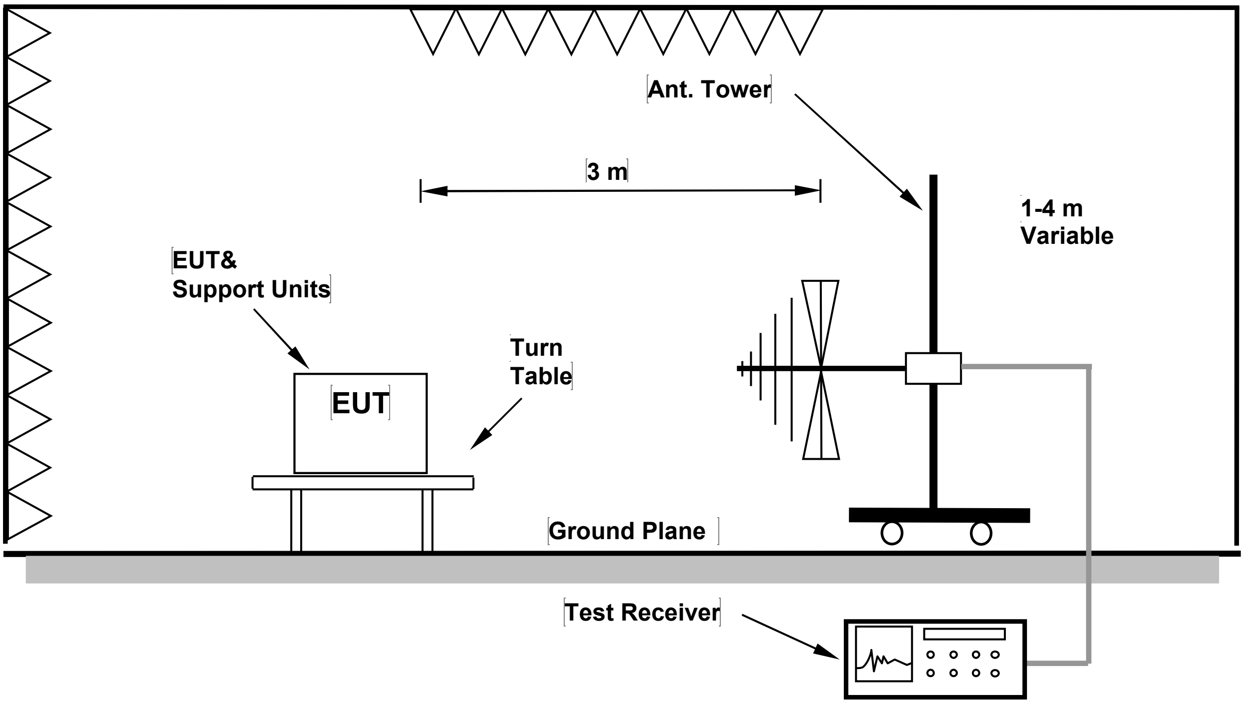
3.2.2 Test procedure (Loop antenna measurement)

- The EUT was placed on 2m loop system according to EN 55015
- Electric field was measured in x, y, and z axe.
- The frequency range from 9 kHz to 30 MHz was searched.

3.2.3 Test procedure

1. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.
2. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. The highest points would be re-tested one by one using the quasi-peak method.

3.2.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

3.2.5 Test result

MEASUREMENT UNCERTAINTY:

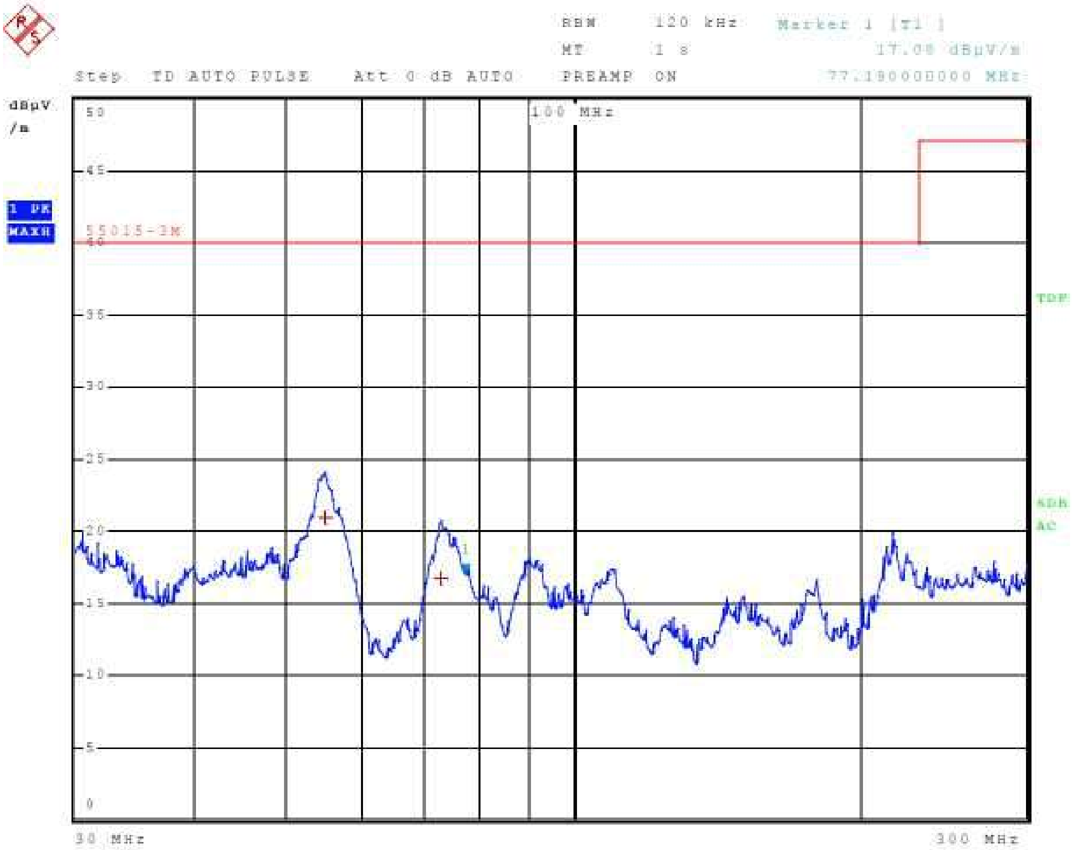
- The measurement uncertainty is calculated in document EN122E

C20170767

Meas Type	RADIATED EMISSION
Equipment under Test	FLAT LED LAMP,
Manufacturer	NANOCUT d.o.o.
OP Condition	230 V, 50 Hz
Operator	BOJAN STRUBELJ

Test Spec

VERTICAL, 100 cm, 0 deg



Final Measurement

Meas Time:	1 s
Margin:	15 dB
Subranges:	2

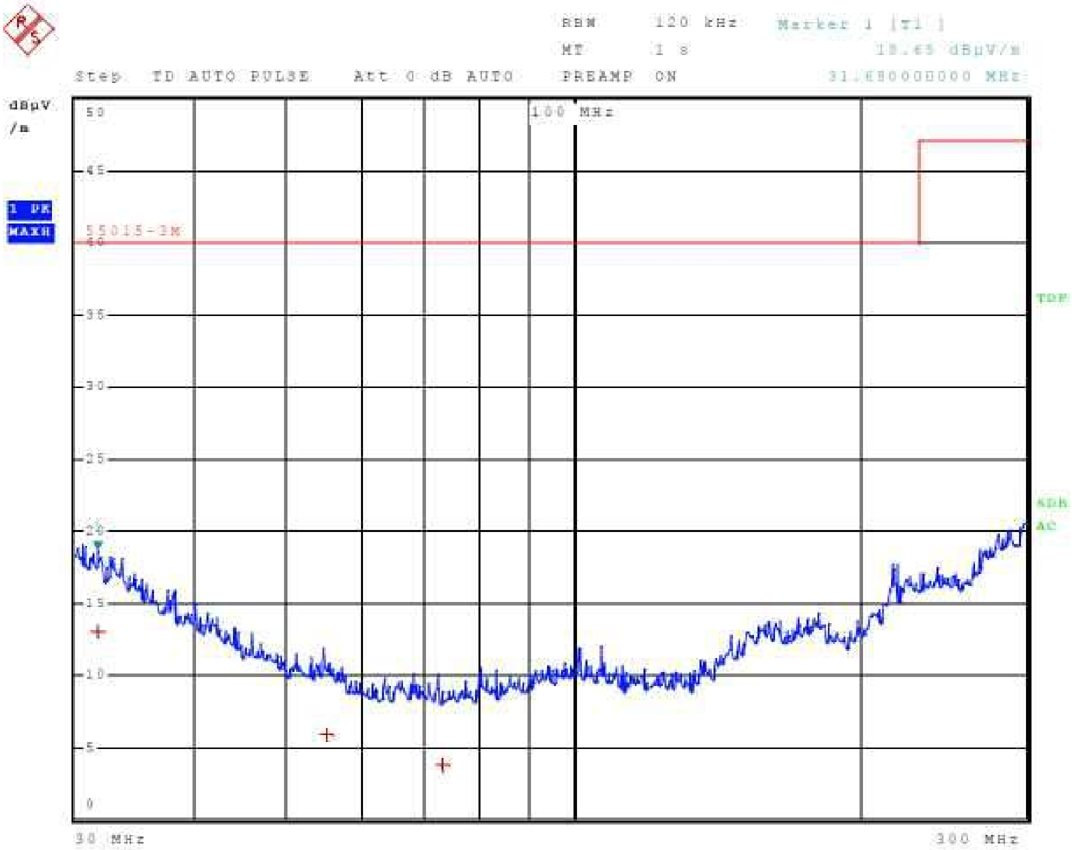
Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	54.960000000 MHz	20.91	Quasi Peak	-19.09
1	72.780000000 MHz	16.80	Quasi Peak	-23.20

C20170767

Meas Type	RADIATED EMISSION
Equipment under Test	FLAT LED LAMP,
Manufacturer	NANOCUT d.o.o.
OP Condition	230 V, 50 Hz, LIGHT ON
Operator	BOJAN STRUBELJ

Test Spec

HORIZONTAL, 100 cm, 90 deg



Final Measurement

Meas Time:	1 s
Margin:	15 dB
Subranges:	3

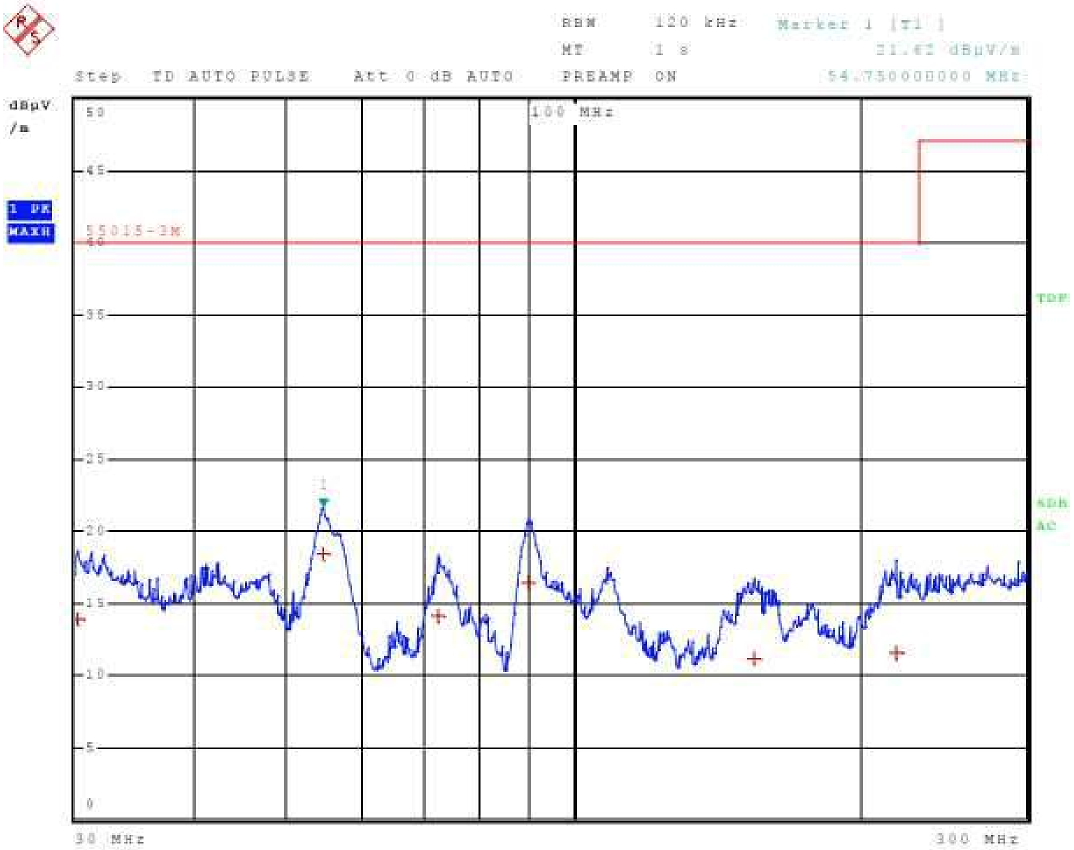
Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	31.680000000 MHz	13.12	Quasi Peak	-26.88
1	54.960000000 MHz	5.91	Quasi Peak	-34.09
1	72.780000000 MHz	3.82	Quasi Peak	-36.18

C20170767

Meas Type	RADIATED EMISSION
Equipment under Test	FLAT LED LAMP,
Manufacturer	NANOCUT d.o.o.
OP Condition	230 V, 50 Hz, LIGHT ON
Operator	BOJAN STRUBELJ

Test Spec

VERTICAL, 100 cm, 180 deg



Final Measurement

Meas Time:	1 s
Margin:	25 dB
Peaks:	6

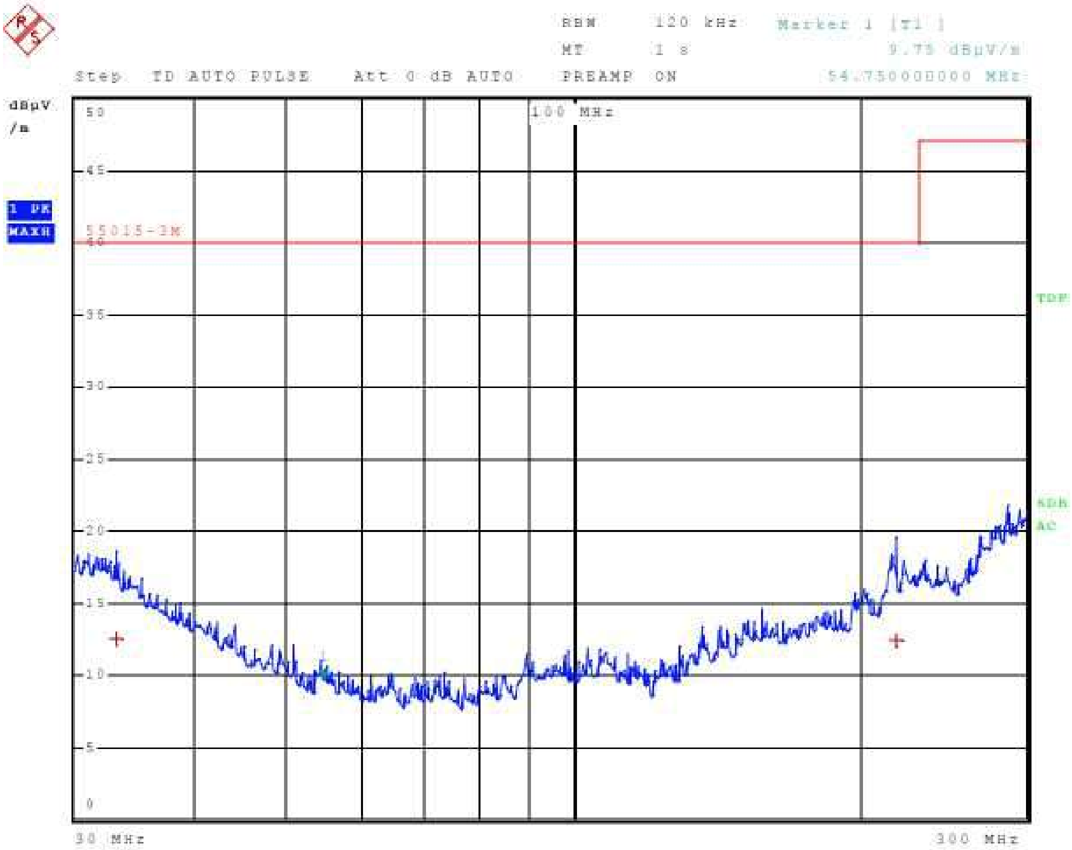
Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	54.750000000 MHz	18.43	Quasi Peak	-21.57
1	89.850000000 MHz	16.42	Quasi Peak	-23.58
1	72.270000000 MHz	14.08	Quasi Peak	-25.92
1	30.210000000 MHz	13.91	Quasi Peak	-26.09
1	218.640000000 MHz	11.57	Quasi Peak	-28.43
1	154.680000000 MHz	11.14	Quasi Peak	-28.86

C20170767

Meas Type	RADIATED EMISSION
Equipment under Test	FLAT LED LAMP,
Manufacturer	NANOCUT d.o.o.
OP Condition	230 V, 50 Hz, LIGHT ON
Operator	BOJAN STRUBELJ

Test Spec

HORIZONTAL, 100 cm, 270 deg



Final Measurement

Meas Time:	1 s
Margin:	25 dB
Peaks:	2

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	33.090000000 MHz	12.52	Quasi Peak	-27.48
1	218.430000000 MHz	12.47	Quasi Peak	-27.53

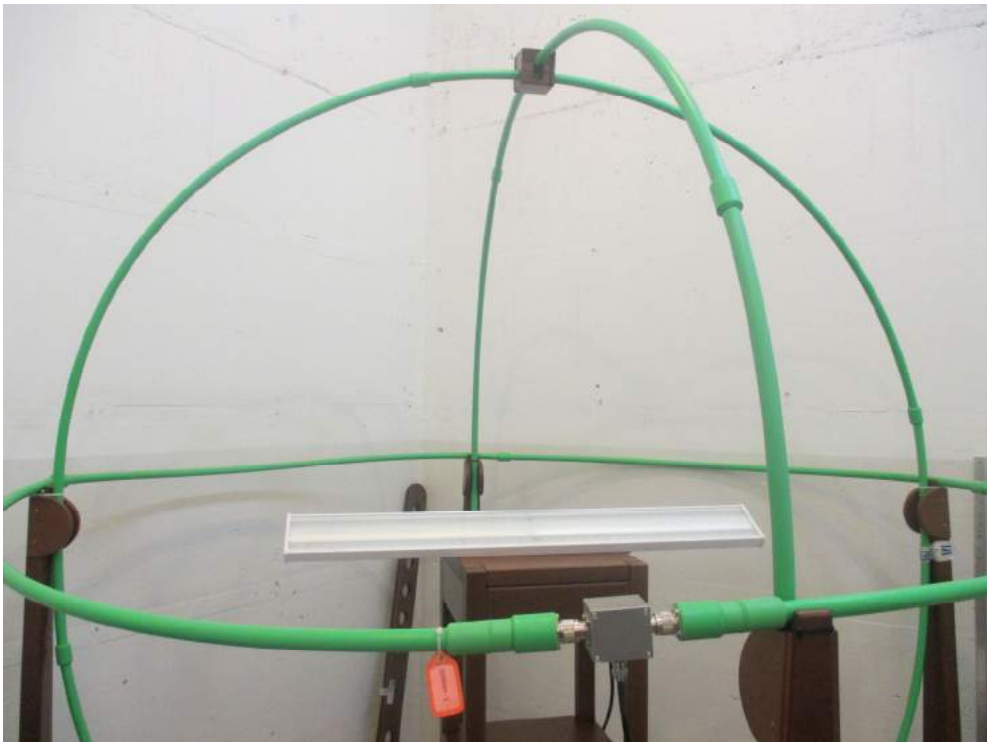


Figure 2: Radiated emission test - LOOP

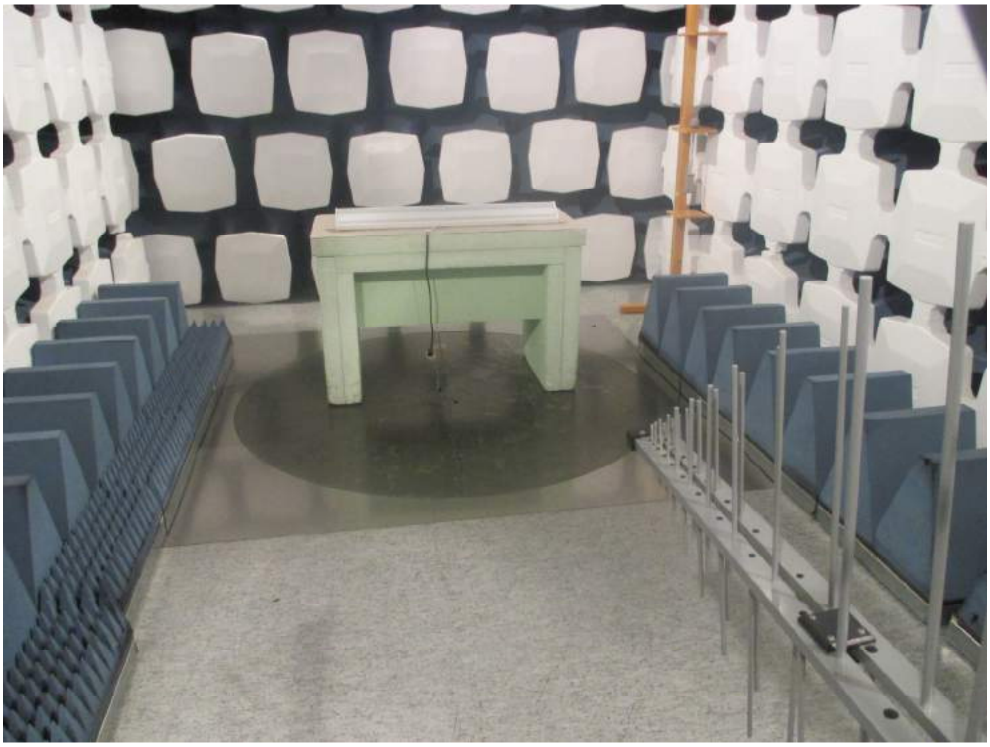


Figure 3: Radiated emission test

3.3 Harmonics current emission measurement

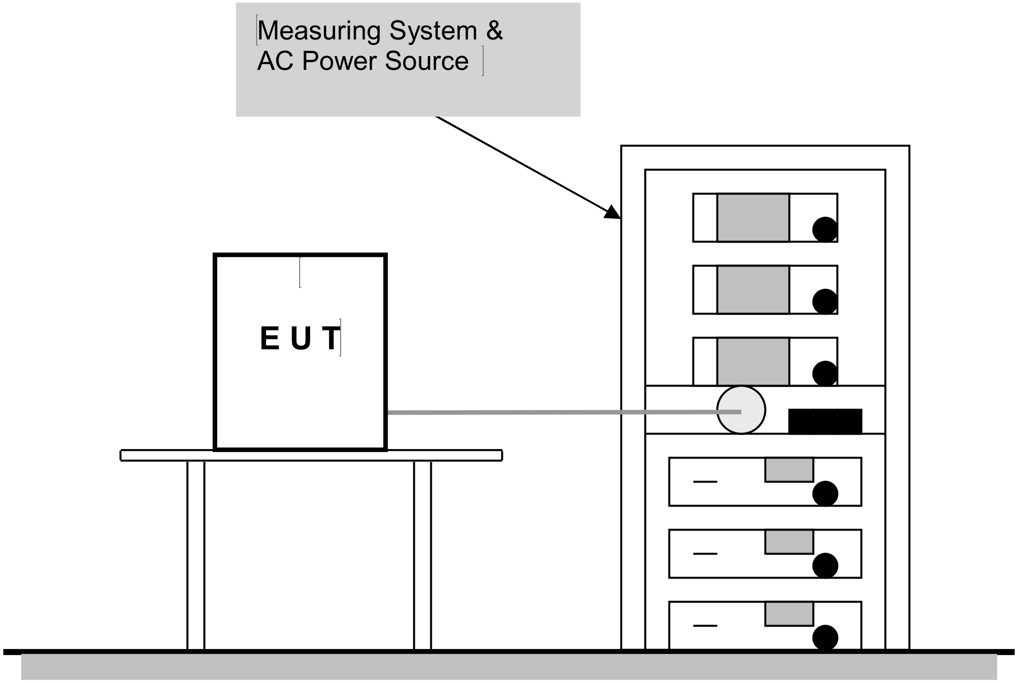
3.3.1 Configuration

1. The EUT was placed on the top of a wooden table/support 0.8 (or 0.1m for floor-standing equipment) meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

2. The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.

3. Harmonic currents less than 0,6% of the input current measured under the test conditions, or less than 5 mA, whichever is greater, are disregarded

3.3.2 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

3.3.3 Test results

MEASUREMENT UNCERTAINTY:

- The measurement uncertainty is calculated in document EN122E

Operating modes:	**1**

Test Report

Report Number :	C20170767
Test Object :	FLAT LED LIGHT
Customer :	NANOCUT d.o.o.
Test Standard :	IEC 61000-3-2 (Edition 4) Limits for harmonic current emissions (equipment input current < 16 A per phase)
Tester :	BOJAN ŠTRUBELJ
Company :	SIQ Ljubljana
Test Date :	4/5/2017 8:16:58 AM

Result

E.U.T. :	passed	Source :	passed

Customer

Name :	NANOCUT d.o.o.	Contact Person :	
Phone :		eMail :	
Address :			

Test Object / Product

Name :	FLAT LED LIGHT	Operation Mode :	LIGHT ON
Serial Number :		Connection :	
Description :	LA-FL-40-65W-4000K(80)-R160		

Measures & Analyse

Measure Window :	10 periods	Voltage Range :	500 V
Refresh Interval :	2 s	Current Range :	150 A
Sampling Rate :	6,4 kS/s		
Scaled Window :	Rectangular		
According :	IEC 61000-3-2 (Edition 4) Limits for harmonic current emissions (equipment input current < 16 A per phase)		

Measure Results

Standard Specific Results for IEC 61000-3-2 (Edition 4)

Standard Group:	Industry
Standard Name:	IEC 61000-3-2 (Edition 4)
	Limits for harmonic current emissions (equipment input current < 16 A per phase)
Device Under Test:	PASS
Power Source:	PASS

Class A
Application of Limits less than or equal to 150 %

Check Harmonics 2..40 [exception odd 21..39]			
First detected harmonic order > 150 %			
Line 1:	None		
Harmonics orders > 150 %			
Line 1:	None		
Harmonics orders with average > 100 %			
Line 1:	None		

Check Odd Harmonics 21..39			
First detected time window with partial > partial limits			
	time window (time)	*measured value*	*limit*
Line 1:	None		0,251 A
Maximal time window with partial > partial limits			
	time window (time)	*measured value*	*limit*
Line 1:	None		0,251 A
First detected harmonic order > 150 %			
Line 1:	None		
Harmonics orders > 150 %			
Line 1:	None		
Harmonics orders with average > 150 %			
Line 1:	None		

Measured values			
Fundamental Current			
Line 1:	0,252 A		
Active input Power			
Line 1:	55,543 W *		
Circuit power factor			
Line 1:	0,83 *		

** Absolute value.*

Current Test Result

Average and Maximum harmonic current results									
Hn	Average				Maximum				Harmonic
	Ieff [A]	Ieff [%]	Limit [A]	Result	Ieff [A]	Ieff [%]	Limit [A]	Result	Result
1	0,251	100,000			0,252	100,000			
2	0,001	0,288	1,080	Disregard	0,001	0,369	1,620	Disregard	Disregard
3	0,114	45,245	2,300	PASS	0,114	45,066	3,450	PASS	PASS
4	0,001	0,391	0,430	Disregard	0,001	0,448	0,645	Disregard	Disregard
5	0,055	21,905	1,140	PASS	0,055	21,914	1,710	PASS	PASS
6	0,001	0,415	0,300	Disregard	0,001	0,455	0,450	Disregard	Disregard
7	0,039	15,457	0,770	PASS	0,039	15,516	1,155	PASS	PASS
8	0,001	0,355	0,230	Disregard	0,001	0,399	0,345	Disregard	Disregard
9	0,035	14,083	0,400	PASS	0,036	14,120	0,600	PASS	PASS
10	0,001	0,352	0,184	Disregard	0,001	0,399	0,276	Disregard	Disregard
11	0,027	10,917	0,330	PASS	0,028	10,965	0,495	PASS	PASS
12	0,001	0,395	0,153	Disregard	0,001	0,440	0,230	Disregard	Disregard
13	0,020	8,074	0,210	PASS	0,021	8,153	0,315	PASS	PASS
14	0,001	0,420	0,131	Disregard	0,001	0,479	0,197	Disregard	Disregard
15	0,017	6,625	0,150	PASS	0,017	6,703	0,225	PASS	PASS
16	0,001	0,457	0,115	Disregard	0,001	0,533	0,173	Disregard	Disregard
17	0,015	6,156	0,132	PASS	0,016	6,283	0,199	PASS	PASS
18	0,001	0,374	0,102	Disregard	0,001	0,430	0,153	Disregard	Disregard
19	0,012	4,821	0,118	PASS	0,012	4,947	0,178	PASS	PASS
20	0,001	0,366	0,092	Disregard	0,001	0,424	0,138	Disregard	Disregard
21	0,009	3,718	0,161	PASS	0,009	3,757	0,161	PASS	PASS
22	0,001	0,388	0,084	Disregard	0,001	0,448	0,125	Disregard	Disregard
23	0,007	2,854	0,147	PASS	0,008	3,089	0,147	PASS	PASS
24	0,001	0,436	0,077	Disregard	0,001	0,511	0,115	Disregard	Disregard
25	0,007	2,862	0,135	PASS	0,008	3,025	0,135	PASS	PASS
26	0,001	0,385	0,071	Disregard	0,001	0,440	0,106	Disregard	Disregard
27	0,005	2,154	0,125	PASS	0,006	2,255	0,125	PASS	PASS
28	0,001	0,416	0,066	Disregard	0,001	0,518	0,099	Disregard	Disregard
29	0,004	1,401	0,116	Disregard	0,004	1,502	0,116	Disregard	Disregard
30	0,001	0,422	0,061	Disregard	0,001	0,484	0,092	Disregard	Disregard
31	0,002	0,931	0,109	Disregard	0,003	1,063	0,109	Disregard	Disregard
32	0,001	0,353	0,058	Disregard	0,001	0,395	0,086	Disregard	Disregard
33	0,002	0,867	0,102	Disregard	0,002	0,947	0,102	Disregard	Disregard
34	0,001	0,373	0,054	Disregard	0,001	0,440	0,081	Disregard	Disregard
35	0,001	0,517	0,096	Disregard	0,001	0,570	0,096	Disregard	Disregard

36	0,001	0,338	0,051	Disregard	0,001	0,385	0,077	Disregard	Disregard
37	0,002	0,726	0,091	Disregard	0,002	0,836	0,091	Disregard	Disregard
38	0,001	0,350	0,048	Disregard	0,001	0,390	0,073	Disregard	Disregard
39	0,002	0,738	0,087	Disregard	0,002	0,842	0,087	Disregard	Disregard
40	0,001	0,333	0,046	Disregard	0,001	0,380	0,069	Disregard	Disregard

Note: Harmonic currents less than 0.6 % of the input current measured under the test conditions, or less than 5 mA, whichever is greater, are disregarded.

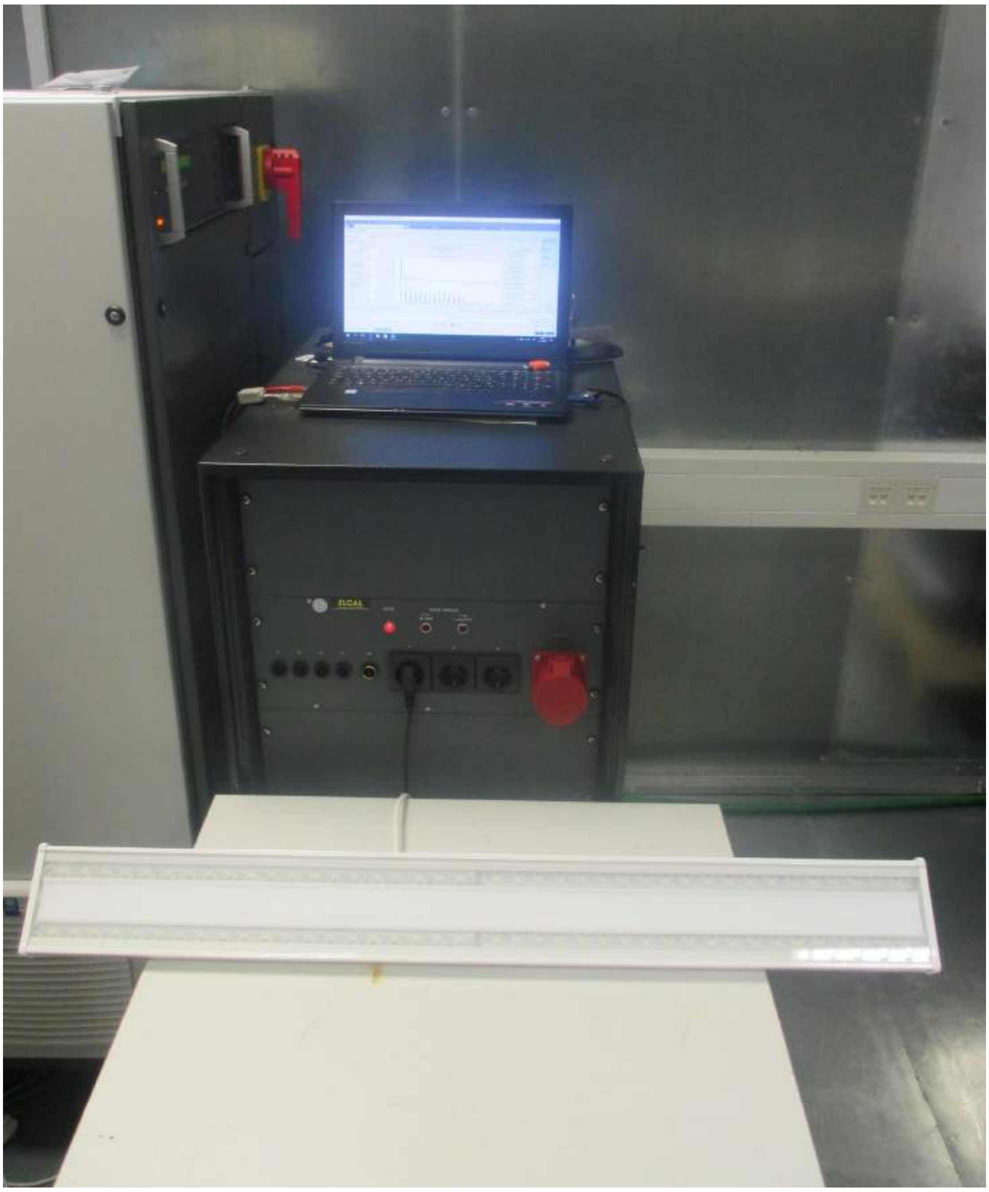


Figure 4: Harmonics current emission measurement and Voltage fluctuation measurement

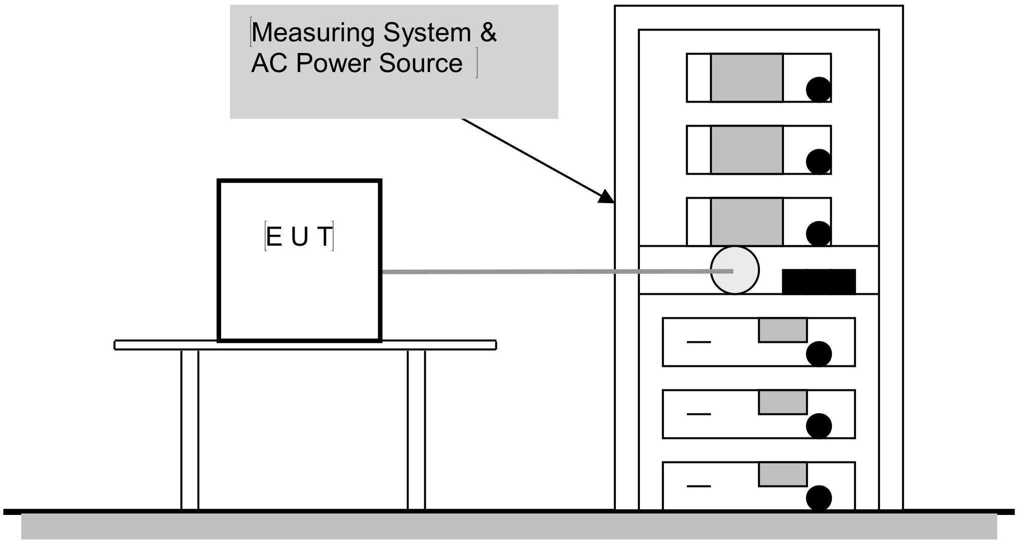
3.4 Voltage fluctuation measurement

3.4.1 Configuration

1. The EUT was placed on the top of a wooden table/support 0.8 (or 0.1m for floor-standing equipment) meters above the ground and operated to produce the **most unfavorable sequence of voltage changes under normal operating** conditions.

2. During the flick measurement, the measure time shall include that part of whole operating cycle in which the EUT produce the most unfavorable sequence of voltage changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

3.4.2 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

3.4.3 Test results

Test is not applicable due to power consumption lower than 600 W.

4 IMMUNITY

4.1 Immunity to electrostatic discharge

4.1.1 Test specification

Basic Standard:	IEC 61000-4-2
Discharge Impedance:	330 Ω / 150 pF
Discharge Voltage:	Air Discharge- 8 kV (Direct) Contact Discharge- 4 kV (Indirect, Direct)
Polarity:	Positive / Negative
Number of Discharges:	Minimum 20 discharges (10 positive and 10 negative polarity)
Discharge Mode:	Single Discharge
Discharge Period:	1-second minimum

4.1.2 Test procedure

The discharges shall be applied in two ways:

1. Contact discharges to the conductive surfaces and coupling planes:

   The EUT shall be exposed to at least 20 discharges, 10 each at negative and positive polarity. Test shall be performed at a maximum repetition rate of one discharge per second.
   On each discharge point the test shall start with 2 kV and continue with value increased for 2 kV.

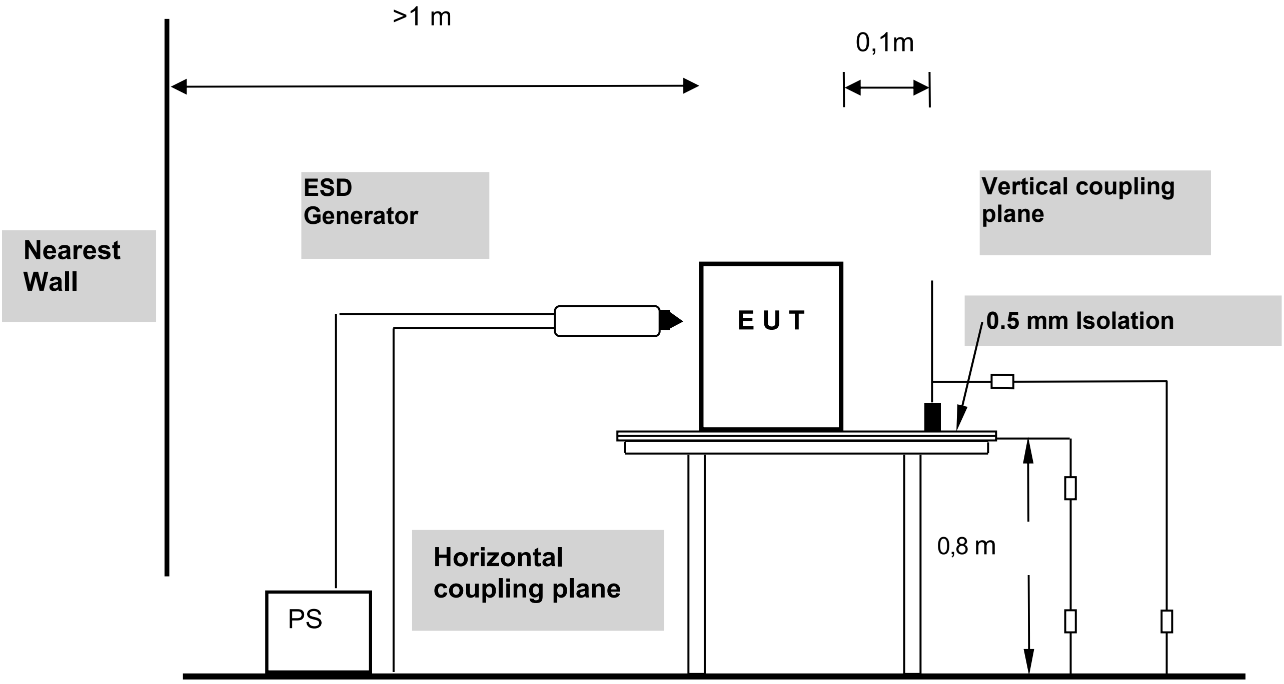
2. Air discharges at slots and apertures and insulating surfaces:

   On those parts of the EUT where it is not possible to perform contact discharge testing, the equipment should be investigated to identify user accessible points where breakdown may occur. Such points are tested using the air discharge method. This investigation should be restricted to those area normally handled by the user.

The basic test procedure was in according with IEC 61000-4-2:

1. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
2. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
3. The time interval between two successive single discharges was at least 1 second.
4. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0,2 meters from the EUT.
5. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
6. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were complete.
7. At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator was positioned vertically at a distance of 0,1 meters from the EUT with the discharge electrode touching the Horizontal Coupling Plane.
8. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The Vertical Coupling Plane (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.

4.1.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The **GRP** is of a sheet of aluminium at least 0,25 mm thick, and it projects beyond the EUT by at least 0,5 meters and is connected to the protective grounding system. A **H**orizontal **C**oupling **P**lane (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940 kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of EN 61000-4-2, and its cables were placed on the **HCP** and isolated by an insulating support of 0.5 mm thickness. A distance of 0,8 meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

4.1.4 Test results

Operating mode:	**1**					
Discharge Level (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Required criterion**	**Achieved criterion**
2	+ / -	🟨		X	B	A
4	+ / -	🟨		X	B	A
8	+ / -	🟨		X	B	A
4	+ / -	🟦	X		B	A
Changes in operation observed during testing: no change observed						

Legend:

🟦 - contact discharge points (including HCP and VCP)

🟨 - air discharge points

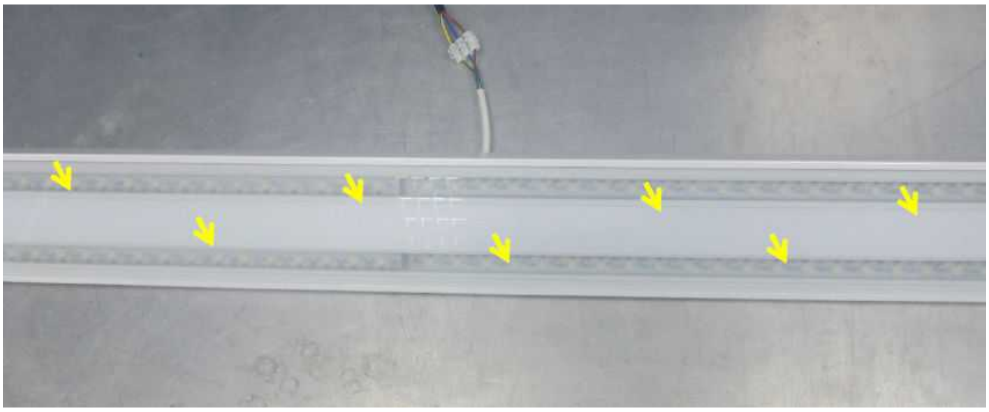


Figure 5: ESD

Figure 6: ESD

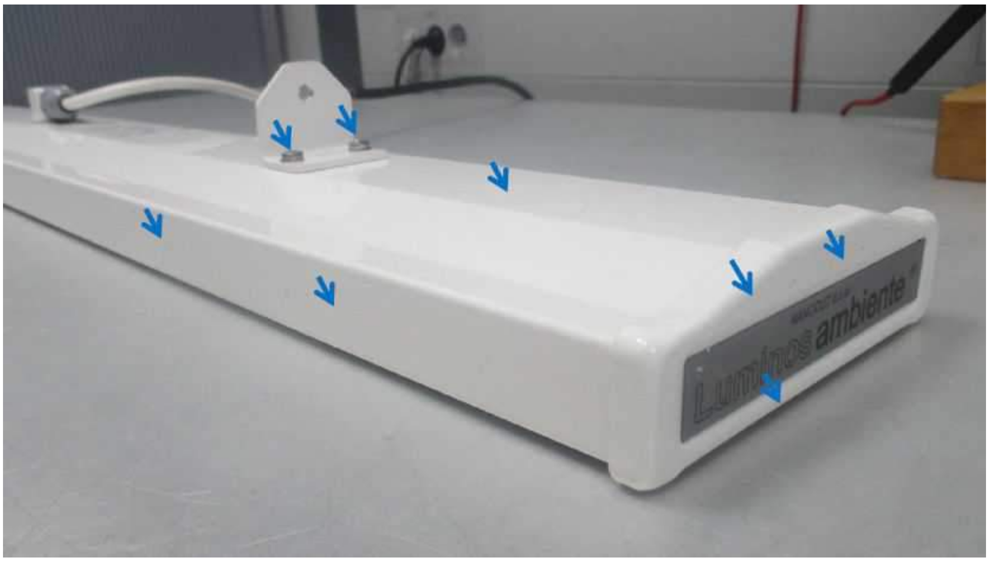


Figure 7: ESD

Figure 8: ESD

Figure 9: ESD

Figure 10: ESD

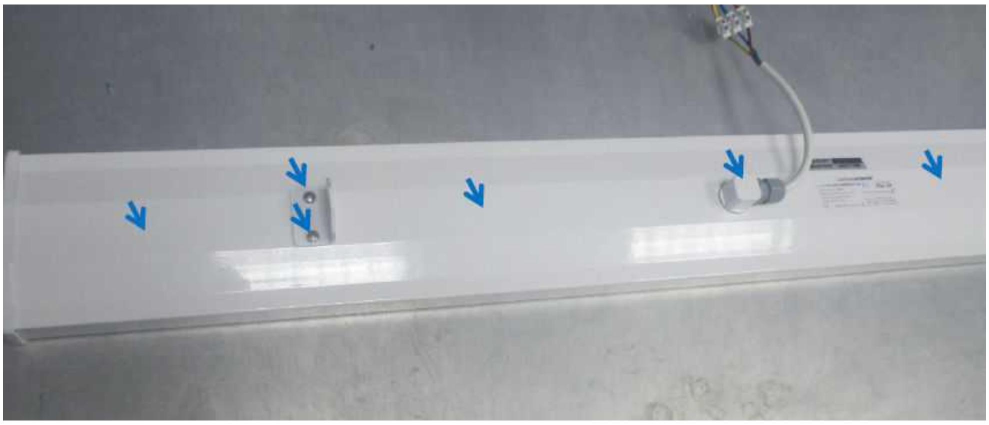


Figure 11: ESD

4.2 Radiated electromagnetic field immunity test (RS)

4.2.1 Test specification

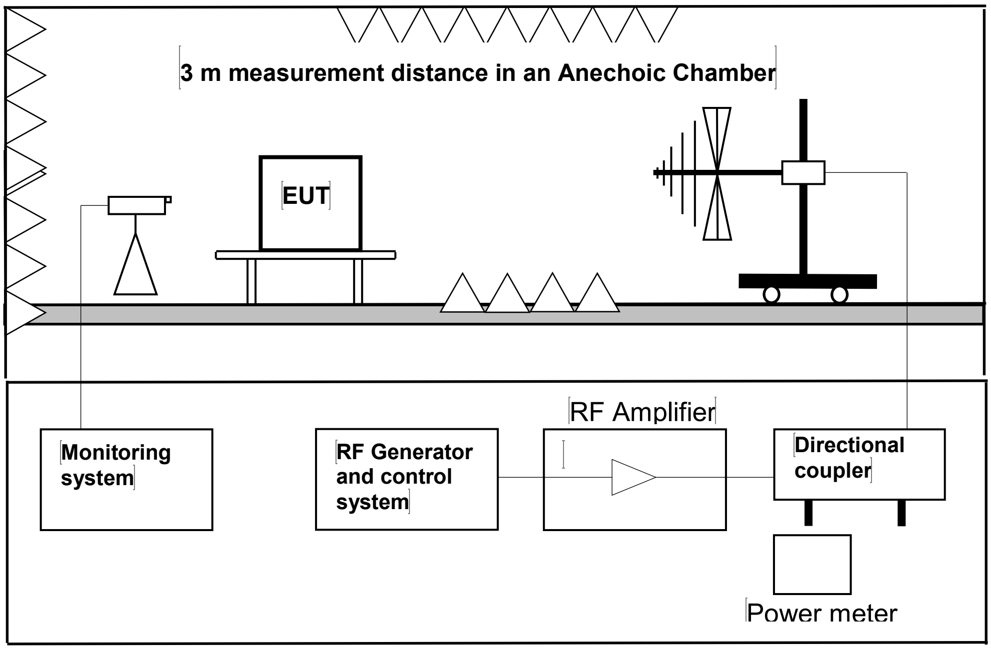
Basic Standard:	IEC 61000-4-3
Frequency Range:	80 – 1000 MHz;
Field Strength:	3 V/m
Modulation:	1 kHz Sine Wave, 80 %, AM Modulation
Frequency Step:	1 % of fundamental
Polarity of Antenna:	Horizontal and Vertical
Test Distance:	3 m
Antenna Height:	1.55 m

4.2.2 Test procedure

The test procedure was in accordance with IEC 61000-4-3

1. The testing was performed in an anechoic chamber. The transmit antenna was located at a distance of 3 meters from the EUT.
2. The frequency range is swept from 80 MHz to 1000 MHz, with the signal 80 % amplitude modulated with 1 kHz sine-wave. The rate of sweep did not exceed 1.5 x 10^{-3} decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
3. The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
4. The field strength level was 3 V/m.
5. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

4.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The EUT installed in a representative system as described in EN 61000-4-3. The system under test was connected to the power and signal wire according to relevant installation instructions.

4.2.4 Test results

Operating mode:	**1**				
Frequency	**Level**	**Modulation**	**Test point**	**Required criterion**	**Achieved criterion**
80 MHz – 1000 MHz	3 V/m	80%	Enclosure	A	A
Changes in operation observed during testing: no change observed					

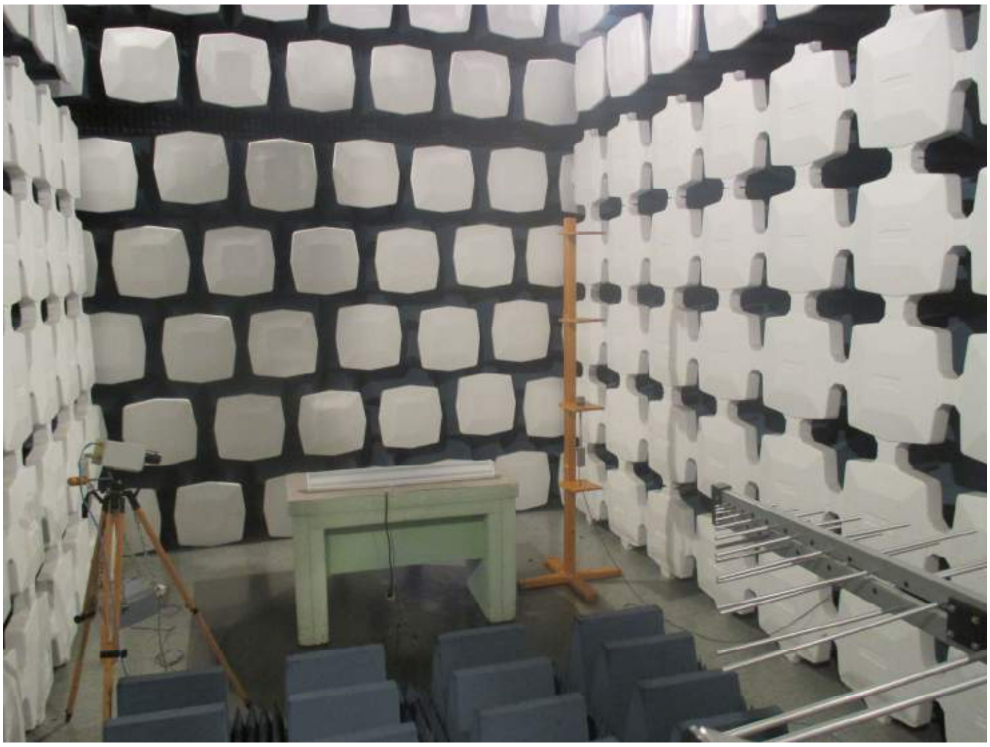


Figure 12: Radiated electromagnetic field immunity test

4.3 Electrical fast transient/burst immunity test

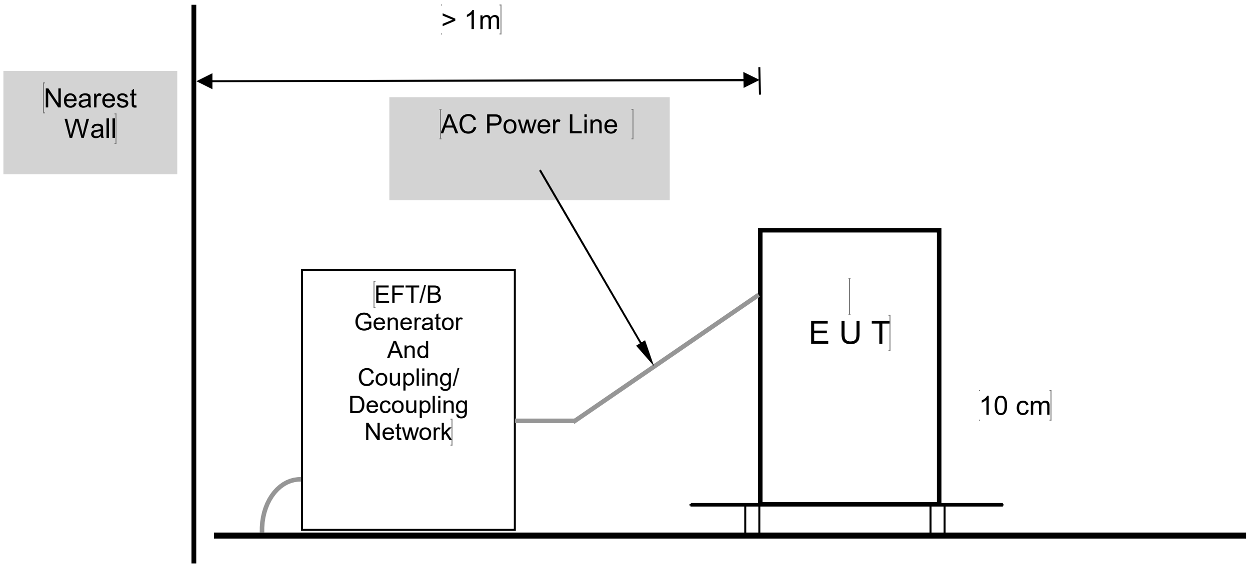
4.3.1 Test specification

Basic Standard:	IEC 61000-4-4
Test Voltage:	AC power Line – 1 kV
Polarity:	Positive/Negative
Impulse Frequency:	5 kHz
Impulse Waveshape:	5/50 ns
Burst Duration:	15 ms
Burst Period:	300 ms
Test Duration:	not less than 1 min.

4.3.2 Test procedure

1. The EUT was tested with 1000 volt discharges to the AC power input leads.
2. Both positive and negative polarity discharges were applied.
3. The cable length between the EUT and the coupling device shall be as intended for installation.
4. The duration time of each test sequential was 1 minute.
5. The transient/burst waveform was in accordance with IEC 61000-4-4, 5/50 ns.

4.3.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The EUT installed in a representative system as described in of EN 61000-4-4 and its cables were isolated from the Ground Reference Plane. The GRP consisted of a sheet of aluminium (at least 0.25mm thick and 2.5 m square) connected to the protective grounding system.

4.3.4 Test results

Operating mode:	**1**			
Test Point	**Polarity**	**Test Level (kV)**	**Required criterion**	**Achieved criterion**
AC port L+N+PE	+/-	1	B	A
Changes in operation observed during testing: no change observed				

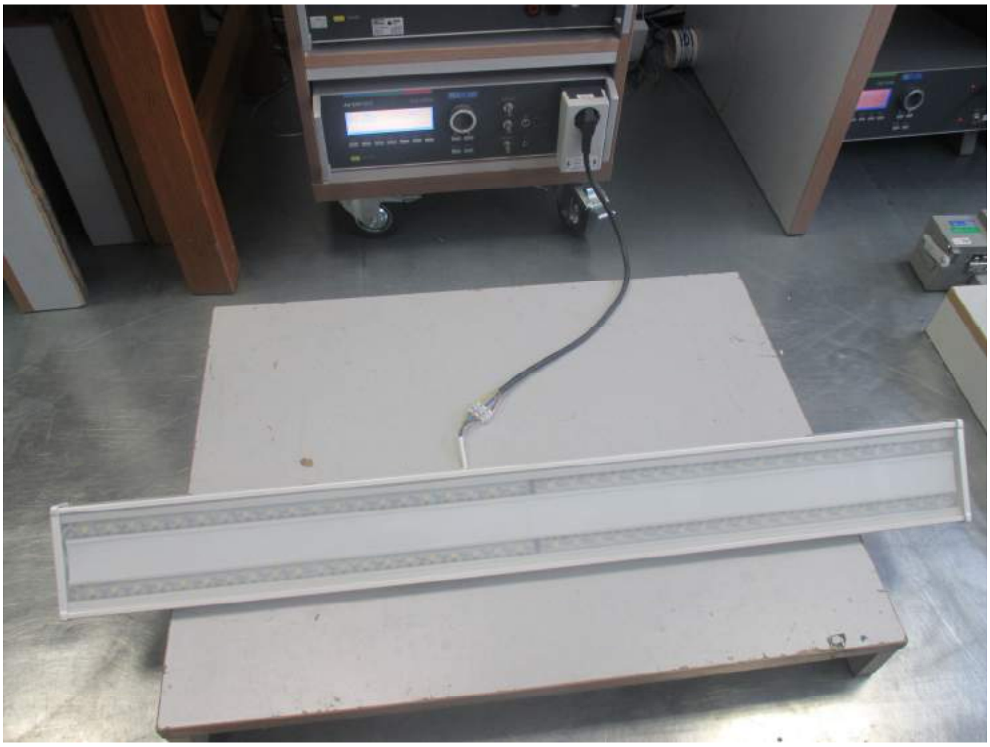


Figure 13: Fast transient / burst immunity test and surge immunity test

4.4 Surge immunity test

4.4.1 Test specification

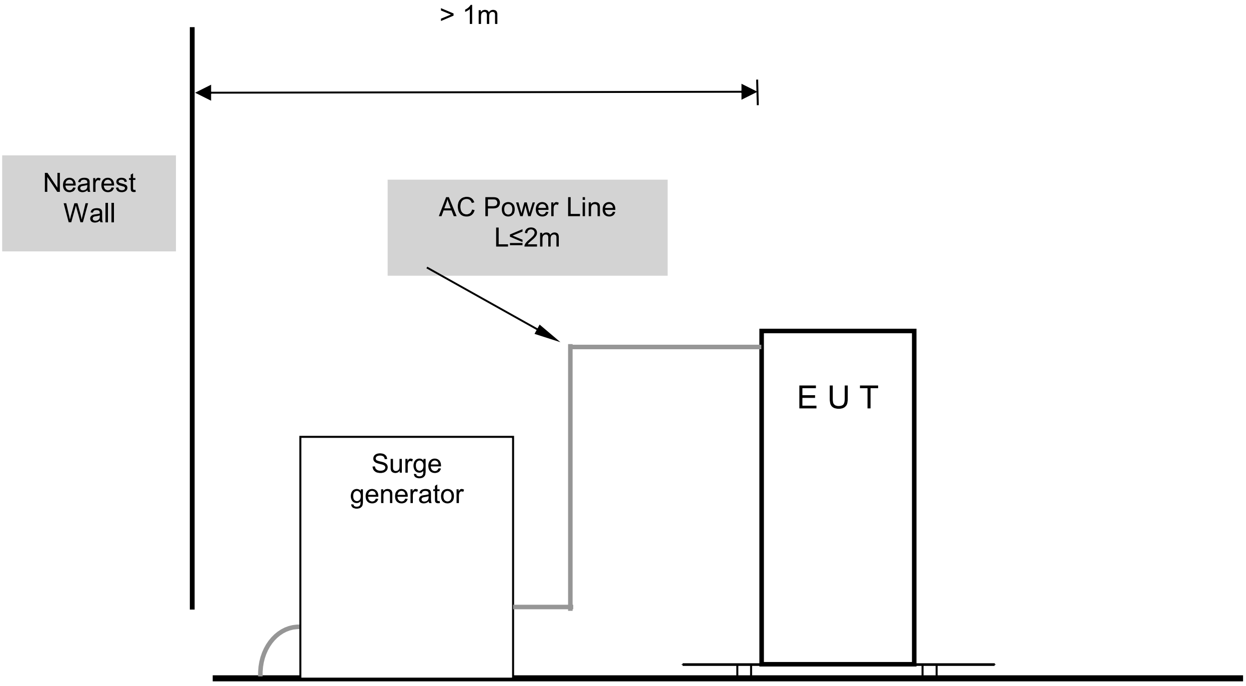
Basic Standard:	IEC 61000-4-5
Wave-Shape:	Combination Wave
Test Voltage:	±2 kV unsymmetrical – Common mode, ±1 kV symmetrical – Differential mode, 1.2/50 us Open Circuit Voltage
Generator Source:	2 ohm between networks 12 ohm between network and ground
Polarity:	Positive/Negative
Phase Angle:	90 ° / 270 °
Pulse Repetition rate:	1 time / min. (maximum)
Number of Tests:	5 positive and 5 negative at selected points

4.4.2 Test procedure

1. For EUT power supply:

   The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

4.4.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.4.4 Test results

Operating mode:	**1**					
Test Point	**Polarity**	**Angle (^{0})**	**Test Level (kV)**	**Test point**	**Required criterion**	**Achieved criterion**
L -N	+/-	90, 270	1	AC	B	A
L -PE	+/-	90, 270	2		B	A
N -PE	+/-	90, 270	2		B	A
Changes in operation observed during testing: no change observed						

4.5 Immunity to conducted disturbances induced by RF fields (CS)

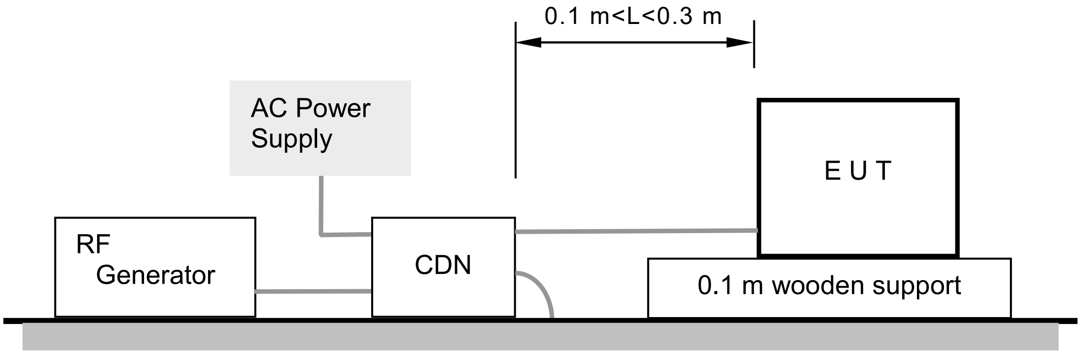
4.5.1 Test specification

Basic Standard:	IEC 61000-4-6
Frequency Range:	0.15 MHz – 80 MHz
Field Strength:	3 V rms
Modulation:	1 kHz Sine Wave, 80 %, AM Modulation
Frequency Step:	1 % of fundamental
Coupled Cable:	Power Mains

4.5.2 Test procedure

1. The EUT shall be tested within its intended operating and climatic conditions.
2. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50 Ω load resistor.
3. The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80 % amplitude. The signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. The sweep rate shall not exceed 1.5 x 10^{-3} decades/s. The step size shall not exceed 1 % of the start and thereafter 1 % of the preceding frequency value where the frequency is swept incrementally.
4. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequency(ies) and harmonics or frequencies of dominant interest, shall be analyzed separately.
5. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

4.5.3 Test setup



Ground Reference Plane

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The equipment to be tested is placed on an insulating support on a ground reference plane. All relevant cables shall be provided with the appropriate coupling and decoupling devices at a distance between 0.1 meters and 0.3 meters from the projected geometry of the EUT on the ground reference plane.

4.5.4 Test results

Operating mode:	**1**				
Frequency	**Level**	**Modulation**	**Test point**	**Required criterion**	**Achieved criterion**
150 kHz – 80 MHz	3 V	80%	AC	A	A
Changes in operation observed during testing: no change observed					

Figure 14: Immunity to conducted disturbances induced by RF fields

4.6 Magnetic field immunity test

4.6.1 Test specification

Basic Standard:	IEC 61000-4-8
Frequency Range:	50, 60 Hz
Field Strength:	3 A/m

4.6.2 Test procedure

The test procedure was in accordance with IEC 61000-4-8

The EUT was tested with magnetic field antenna

The frequency was set to 50, 60 Hz

The field strength level was 3 A/m

The test was performed with the EUT exposed to all three directions (X, Y, Z).

4.6.3 Test setup

The EUT installed in a representative system as described in section 7 EN 61000-4-8 was placed on non-conductive table 0.1 (floor equipment) or 0.8 (table-top equipment) meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

4.6.4 Test results

Operating mode:	**1**				
Frequency (Hz)	**Polarity**	**Field Strength (A/m)**	**Test point**	**Required criterion**	**Achieved criterion**
50, 60	X, Y, Z	3	Enclosure	A	A
Changes in operation observed during testing: no change observed					

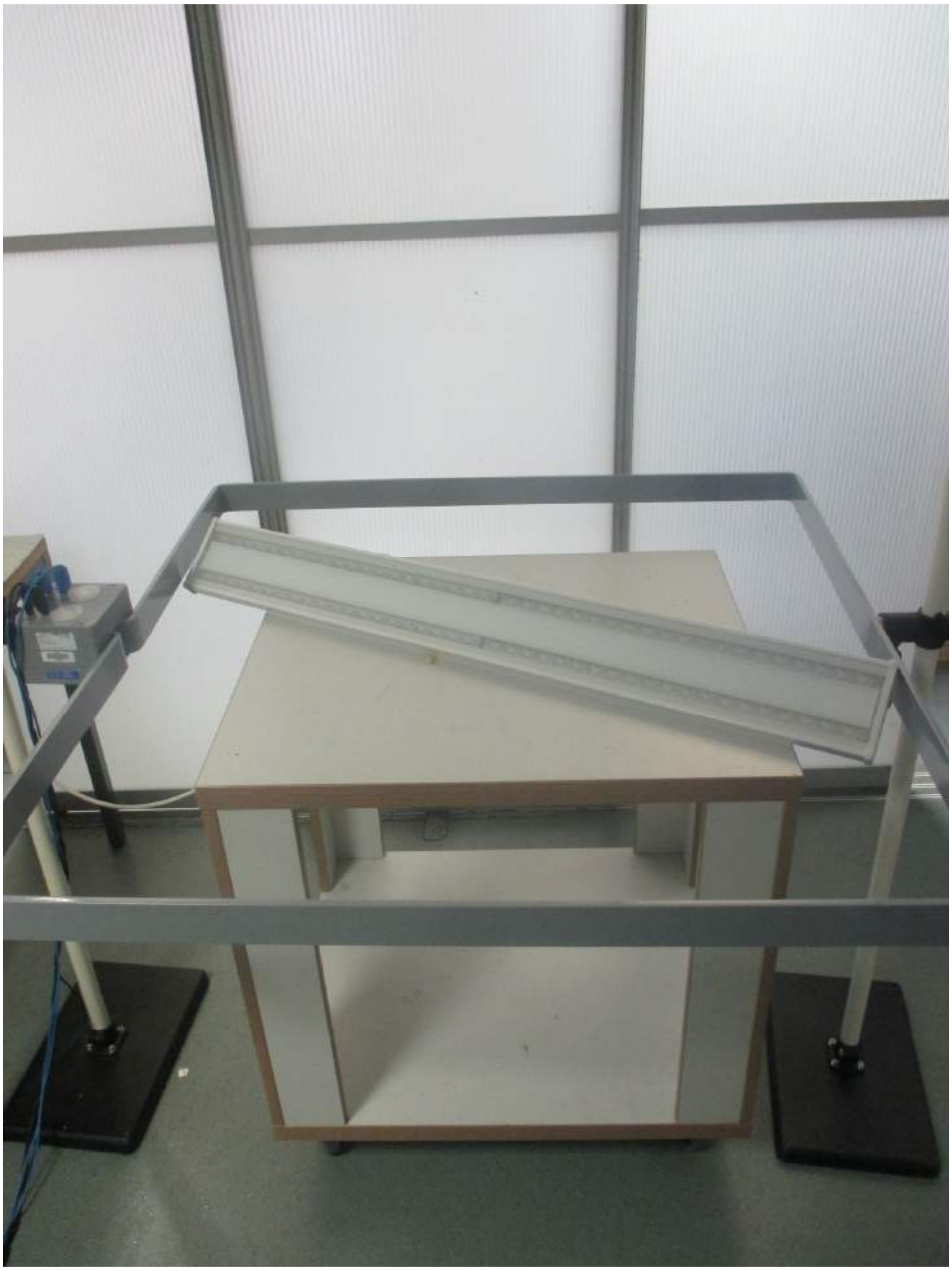


Figure 15: Magnetic field immunity test

4.7 Voltage dips and short interruptions immunity test (DIP)

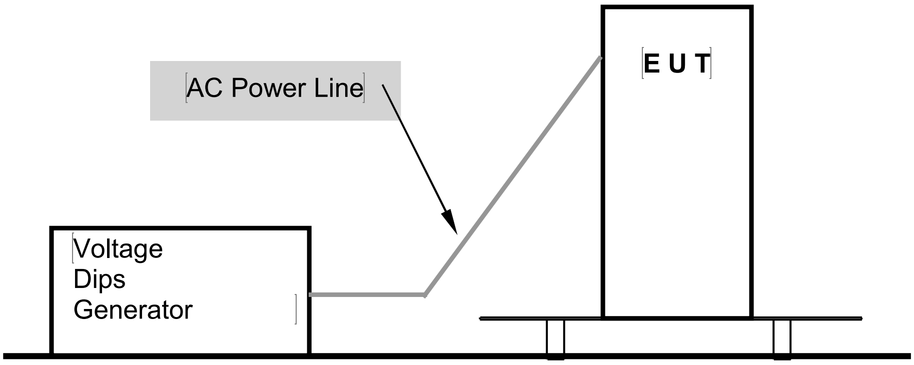
4.7.1 Test specification

Basic Standard:	IEC 61000-4-11
Test Duration Time:	Minimum three test events in sequence
Interval between Event:	Minimum ten seconds
Phase Angle:	0 °, 180°
Test Cycle:	3 times

4.7.2 Test procedure

The EUT shall be tested for each selected combination of test levels and duration with a sequence of tree dips/interruptions with intervals of 10s minimum (between each test event). Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

4.7.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.7.4 Test result

Operating mode:	**1**			
Phenomena	**Test level (dip)**	**Duration (in periods)**	**Required criterion**	**Achieved criterion**
Voltage dips	30%	10	B	B
Voltage dips	100%	0,5	C	B
Changes in operation observed during testing: LED slightly blink				

Figure 16: Voltage dips and short interruptions immunity test (DIP)

5 USED TEST EQUIPMENT

3.1 Conducted emission measurement

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
Rohde & Schwarz, RFI receiver	ESU8	105187	X	2017-11
Rohde & Schwarz, RFI receiver	ESU26	106897	/	2018-03
Rohde & Schwarz, Artificial main network	ESH 2-Z5	106899	X	2017-05
Rohde & Schwarz, Artificial main network	ENV216	106765	/	2018-09
Rohde & Schwarz, Current probe	EZ-17	106862	/	2018-11
Schwarzbeck, High voltage probe	TK 9420	106898	/	2017-05

3.2 Radiated emission measurement

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
ETS, Anechoic chamber	RFD-F/A-100	103949	X	2017-11
Rohde & Schwarz, RFI test receiver	ESU8	105187	X	2017-11
Rohde & Schwarz, RFI receiver	ESU26	106897	/	2018-03
AFJ, Van Veen loop antenna	VVL1530	106924	X	2017-09
EMCO, Antenna	3142B	104351	X	2017-09
EMCO, Antenna	3115	103002	/	2017-09
Rohde & Schwarz, Antenna	HFH2-Z1	/	/	2017-11
Rohde & Schwarz, Antenna	HFH2-Z2	/	/	2017-09
Heinrich Deisel, Turn table	DS 420.00	103337	X	NA
ETS, Antenna tower	2175	/	X	NA
ETS, Controller for turn table and antenna tower	2090	/	X	NA

3.3 Harmonics current emission measurement

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM Test, 3-phase harmonics and flicker system	DPA 503N with AIF503	106895	X	2017-06
	NETWAVE20	106896		

3.4 Voltage fluctuation measurement

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM Test, 3-phase harmonics and flicker system	DPA 503N with AIF503	106895	/	2017-06
	NETWAVE20	106896		

4.1 Immunity to electrostatic discharge

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Simulator ESD	ESD 30N	106894	X	2017-05
	P30N			

4.2 Radiated electromagnetic field immunity test (RS)

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EMCO, Antenna	3142B	104351	X	2017-09
EMCO, Antenna	3115	103002	/	2017-09
HP, signal generator	8648C	105045	X	2017-12
WARLATONE, Directional coupler	C5100	104257	X	2017-11
WARLATONE, Directional coupler	C3910	104258	X	2017-11
KALMUS, RF amplifier	827FC	104256	X	2017-11
OPHIR RF, RF amplifier	5172	105059	/	2018-02
PRANA, RF amplifier	UX 150 SC	/	/	2018-03
PMM, Probe	EP300	105062	X	2017-07
Heinrich Deisel, Turn table	DS 420.00	103337	X	NA
ETS, Anechoic chamber	RFD-F/A-100	103949	X	2017-11
ETS, Antenna tower	2175	/	X	NA
ETS, Controller for turn table and antenna tower	2090	/	X	NA

4.3 Electrical fast transient/burst immunity test

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Ultra compact Simulator	UCS 500	106887	X	2019-02
EM TEST, Capacitance coupling clamp	HFK	106889	X	2019-02

4.4 Surge immunity test

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Ultra compact Simulator	UCS 500	106887	X	2019-02
EM TEST, 3-phase coupling network	CNI 503 A2	106888	/	2019-02
EM TEST, CDN	CNV 500 N1	106888	/	2019-02

4.5 Immunity to conducted disturbances induced by RF fields (CS)

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
Robert Luthi, EM clamp	EM 101	/	X	With instrument
EM TEST, Conductive immunity system	CWS500N1.4	108175	X	2019-02
EM TEST, Coupling/decoupling device	CDN-M3N/32A	/	X	With instrument
EM TEST, Coupling/decoupling device	CDN-M2/32A	/	/	With instrument
EM TEST, Coupling/decoupling device	CDN-M5/16A	/	/	With instrument
EM TEST, Coupling/decoupling device	CDN-T8-RJ45	/	/	With instrument
EM TEST, Coupling/decoupling device	CDN-S8-RJ45	/	/	With instrument
EM TEST, Coupling/decoupling device	CDN-S4-USB	/	/	With instrument
EM TEST, Attenuator	ATT6/80	/	X	With instrument

4.6 Magnetic field immunity test

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Current transformer	MC 2630	106893	X	2019-02
EM TEST, Magnetic field coil	MS100N	106892	X	With instrument

4.7 Voltage dips and short interruptions immunity test (DIP)

Manufacturer & Description	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Ultra compact Simulator	UCS 500 N5	106887	X	2019-02
EM TEST, Motorized variac	MV2616	106891	X	2019-02