



LCIE



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TEST REPORT

N°: 16245165 – 782742-B

Version : 02

Subject

Electromagnetic compatibility (EMC):

47 CFR Part 15.107 & Part 15.109
Subpart B of 2021
ANSI C63.4 of 2014

Issued to

BIOSERENITY
20 Rue Berbier du Mets
75013 - PARIS
FRANCE

Apparatus under test

↪ Product EEG
↪ Trade mark BIOSERENITY
↪ Manufacturer BIOSERENITY
↪ Model under test NEURONAUTE SWITCH
↪ Model under test 1001-10006-EU
↪ Serial number P00488 0007
↪ FCC ID 2A223-NNPRECV1
(Contains FCC ID:2A223-NNPV1 and contains FCC ID:2AAQS-ISP1507)

Test date

November 8, 2022

Test location

LCIE, Ecuelles

FCC Test site

FR0010 - 166175 (FAR)

Test performed by

Laurent Deneux

Composition of document

27 pages

Initial document on

March 9, 2023

Document issued on

November 7, 2023

Written by :
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Tests operator

Approved by :
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PUBLICATION HISTORY

Each new edition of this test report replaces and cancels the previous edition. The control of the old editions of report is under responsibility of client.

Version	Date	Author	Modification
01	March 9, 2023	Laurent DENEUX	Creation of the document
02	November 7, 2023	Laurent DENEUX	Modification of page 1 (Adding of FCC ID and FCC Test site numbers)

Date of receipt of test item

November 8, 2022



SUMMARY

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1. Test Program

References

- ✓ CFR 47 Part 15 Subpart B - Radio frequency devices - Unintentional radiators 2021
- ✓ ANSI 63.4 of 2014

Emission tests:

Test Description	Main characteristics	Test result - Comments
Measurement of radiated electric field in shielded room 15.109 (a), (b) & (c)	☐ Class A ☐ Class B	☐ PASS ☐ FAIL ☐ NA ☒ NP (Limited Program)
Measurement of radiated electric field in open space	☐ Class A ☒ Class B	☒ PASS ☐ FAIL ☐ NA ☐ NP (Limited Program)
Measurement of conducted disturbance on the AC main power port 15.107 (a) (c) (d)	☐ Class A ☒ Class B	☒ PASS ☐ FAIL ☐ NA (1) ☐ NP (Limited Program)

(1): EUT not directly or indirectly connected to the AC Power Public Network

The product is compliant according to CFR 47 Part 15 Subpart B - Radio frequency devices - Unintentional radiators standard.

PASS: EUT complies with standard's requirement

FAIL: EUT does not comply with standard's requirement

NA: Not Applicable

NP: Test Not Performed

2. Equipment Description (declared by provider)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

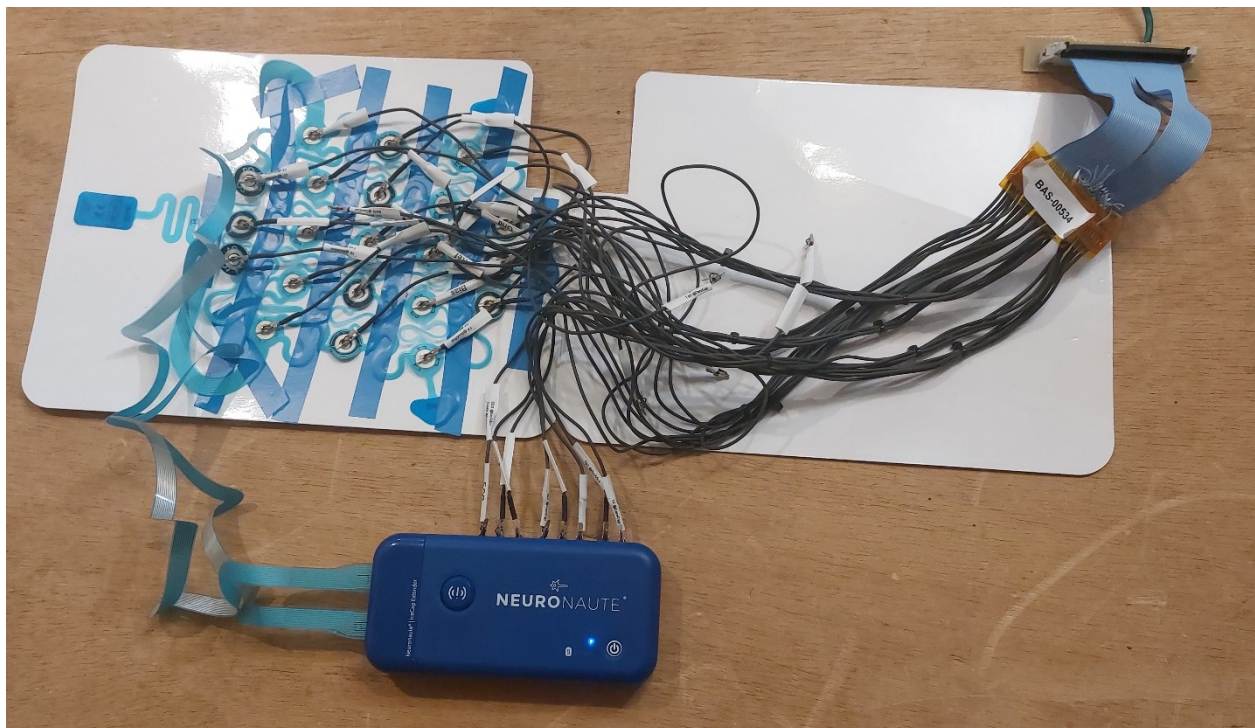
Equipment under test (EUT): NEURONAUTE SWITCH

Serial Number: P00488 0007

Ensemble: Core Module et Extender IceCap



Equipment Under Test



Equipment Under Test

Inputs/outputs - Cable:

Access	Inputs / Outputs	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Power supply	Output	L1-N	2	Yes	☐	☒	Battery charger
Data	Input	Others	1	Yes	☐	☒	IceCap 2
Data	Input	Others	1	Yes	☐	☒	BAS-00534

Auxiliary equipment used during test:

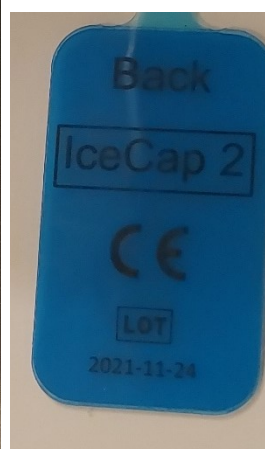
Type	Reference	Sn	Comments
Power supply	ASSA105W-050100	Serial N°	-
Battery charger	RRC-SCC-EZP	Serial N°	-
IceCap extender	1001-15022-un	Serial N°	-
Batterie	EZPack XL	Serial N°	-



Equipment information: (Declared by provider)

Apparatus Description	EEG			
Type of power source:	☒ AC power supply	☐ DC power supply	☒ Battery (Select Type)	
Test source voltage:	Vmin-Vmax:	☐ 120 - 240 V / 50 - 60 Hz	☒ 3.7 VDC	
Operating Modes	Mode 1	electrocardiogram mode on battery (continuous acquisition)		
	Mode 2	battery charge mode		
	Mode 3	-		
	Mode 4	-		
Highest internal frequency (PLL, Quartz, Clock, Microprocessor...):		F_{Highest}:	160	MHz

2.2. EQUIPMENT LABELLING



Equipment Labelling

2.3. EQUIPMENT MODIFICATIONS

☒ None ☐ Modification:



2.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
 RA = Receiver Amplitude
 AF = Antenna Factor
 CF = Cable Factor
 AG = Amplifier Gain

Assume a receiver reading of 52.5dB μ V is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dB μ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32\text{dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}.$$



3. Measurement of radiated emissions

3.1. ENVIRONMENTAL CONDITIONS

Test performed by : **Laurent Deneux**
Date of test : November 8, 2022
Ambient temperature : 21°C
Relative humidity : 39%

3.2. TEST SETUP

Specifications:

Frequency	30 – 1000 MHz	RBW 120 kHz
	1-6GHz	RBW 1MHz
Detector	Peak and Quasi-Peak	

Pre characterization in semi anechoic room is performed to define the critical frequencies

Operating conditions:

- The Equipment under Test is installed:

☐ Measure in semi anechoic room

☒ Measure in open area site

- Measuring distance:

☒ 3m

☒ 10m

- Deviation method:

☐ Yes

☒ No

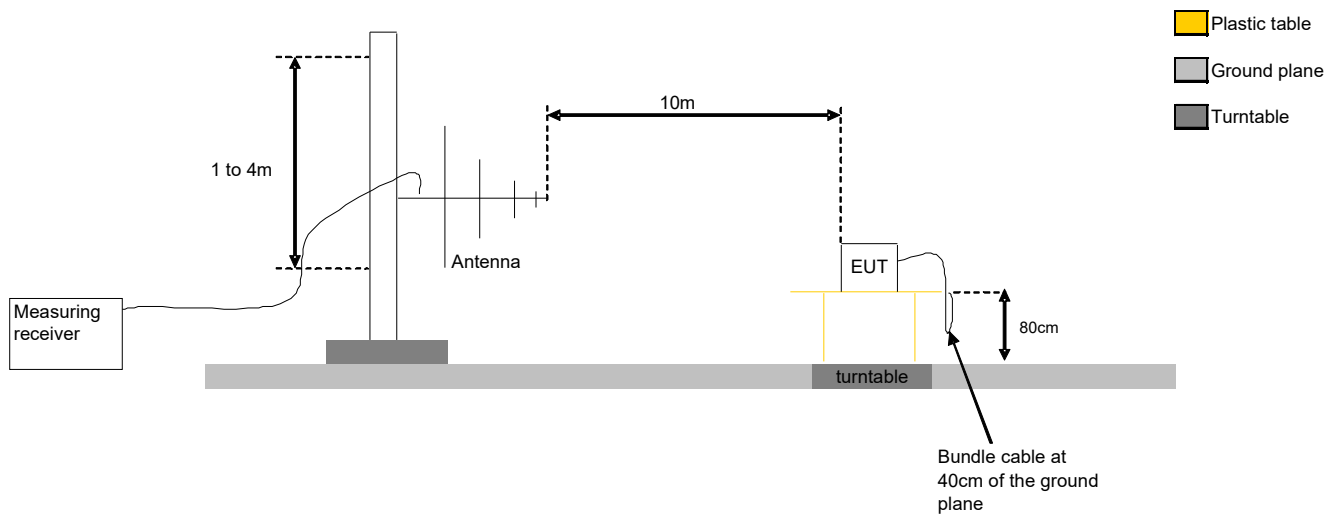
-Product installation:

☒ The EUT was tested as a tabletop equipment and was placed on a non-conducting platform the top of which is 0.8m above the metal ground plane.

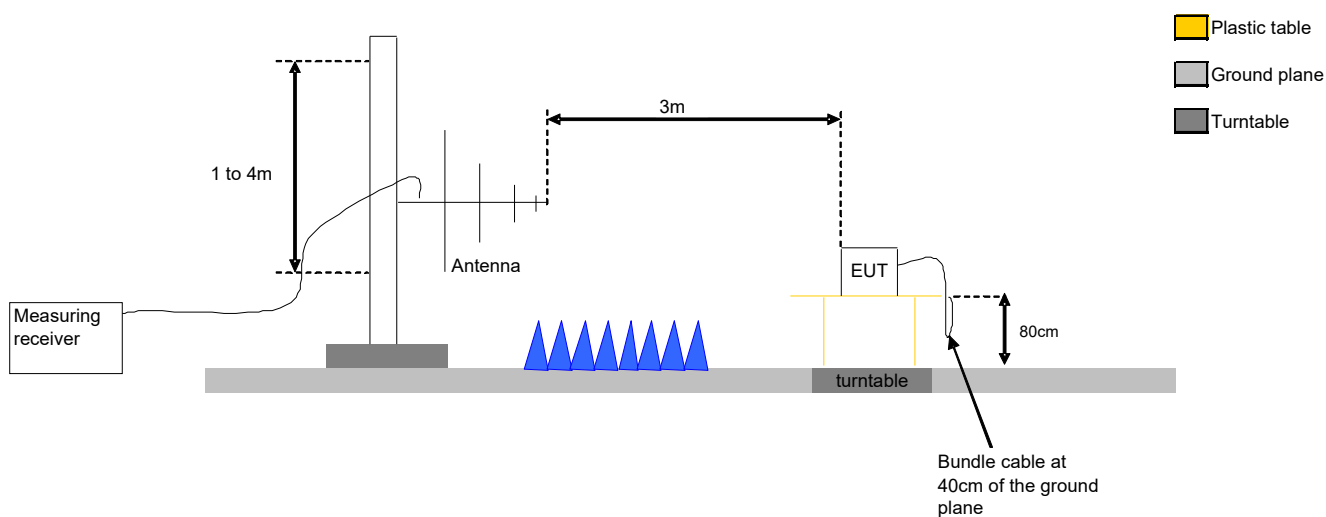
☐ The EUT is at 10cm height from reference plane

Operating mode:

☒ Mode 1 ☒ Mode 2 ☐ Mode 3 ...



Test Set up for radiated measurement in open area test site below 1GHZ



Test Set up for radiated measurement in open area test site above 1GHZ



L C I E



Measurement of radiated disturbances.



Measurement of radiated disturbances.



3.3. LIMIT FOR FCC

☐ Class A in open area test site

Frequency Bands/frequencies	dB (μV/m) quasi-peak	dB (μV/m) peak	dB (μV/m) average	Distance
30-88MHz	39.5	-	-	10m
88 – 216MHz	43.9	-	-	10m
216 – 960 MHz	46.9	-	-	10m
960 – 1000 MHz	50	-	-	10m
1000-6000MHz	-	80	60	3m

☒ Class B in open area test site

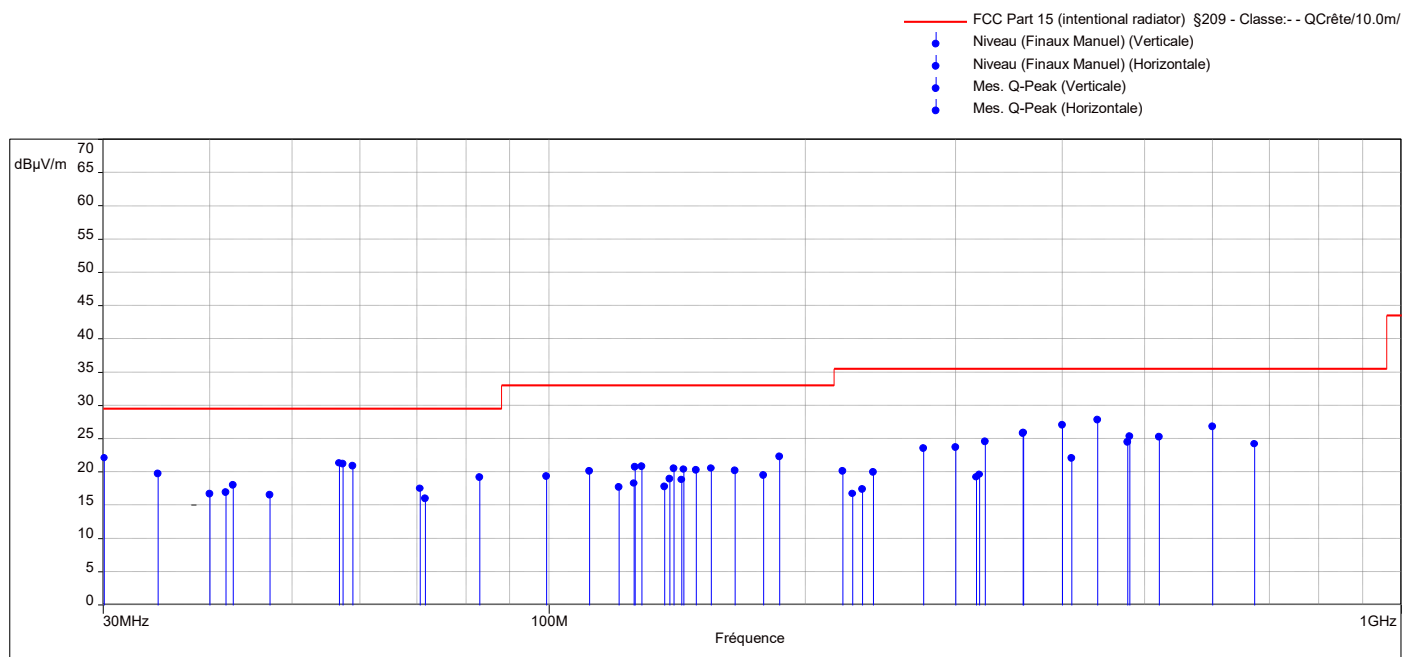
Frequency Bands/frequencies	dB (μV/m) quasi-peak	dB (μV/m) peak	dB (μV/m) average	Distance
30-88MHz	30	-	-	10m
88 – 216MHz	33.5	-	-	10m
216 – 960 MHz	36	-	-	10m
960 – 1000 MHz	43.9	-	-	10m
1000-6000MHz	-	74	54	3m

3.4. TEST EQUIPMENT LIST

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
OATS	-	-	F2000400	2022/02	2023/02
Receiver	ROHDE & SCHWARZ	ESU	A2642018	2020/10	2022/11
Preamplifier	BONN	BLNA 3018-8F305	A7080053	2021/11	2023/11
Antenna bilog	CHASE	CBL 6112A	C2040040	2021/04	2023/04
Horn antenna	ETS	3115	C2042016	2021/04	2023/04
Cable	-	-	A5330032	2022/08	2023/08
Cable	-	-	A5329449	2021/11	2022/11
câble			A5329368	2021/12	2022/12
Horn antenna	AH SYSTEMS	SAS-572	C2042025	-	-
Software V3.19.1.21	NEXIO	BAT-EMC	-	-	-

3.5. RESULTS

Diagram N°1
Mode 1
Vertical & Horizontal Polarization (30MHz-1GHz)

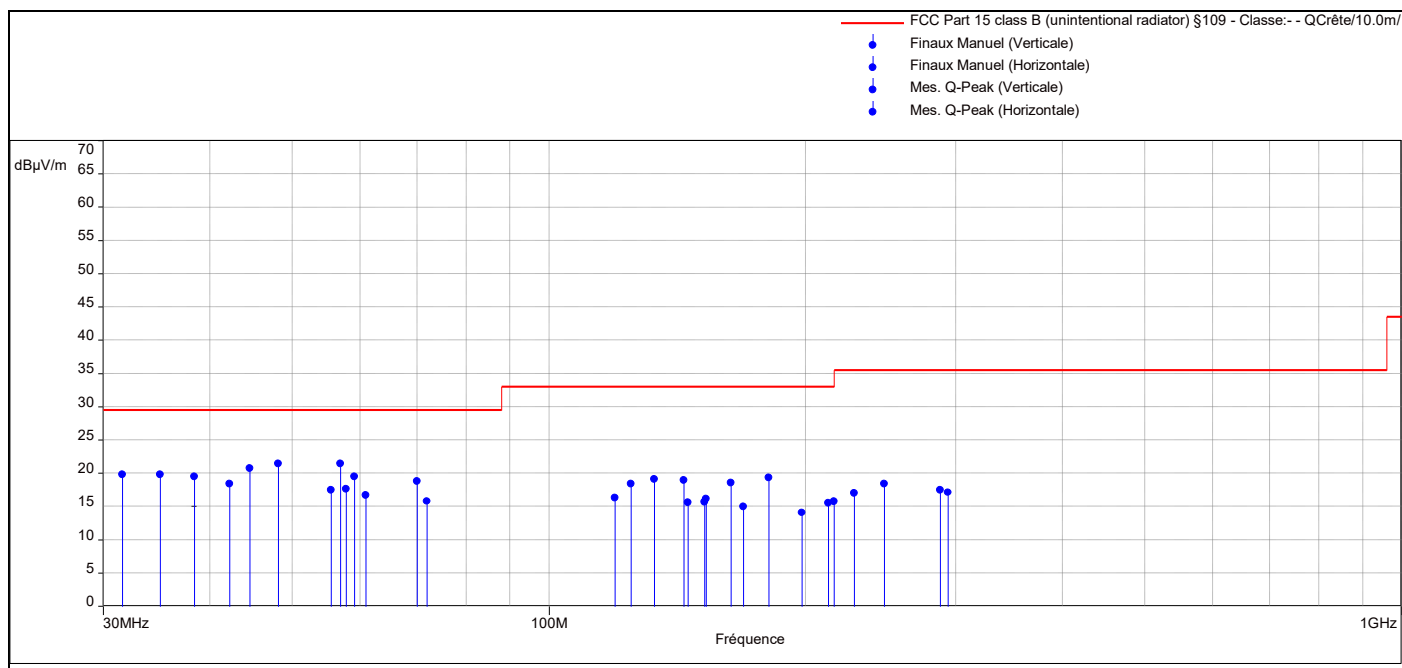


	Frequency (MHz)	level (dBµV/m)	limit FCC class B	Margin Fcc Part class B
Vertical	30.1	22.1	29.5	7.4
Vertical	56.8	21.34	29.5	8.16
Vertical	400	27.05	35.5	8.45
Vertical	440	27.77	35.5	7.73
Vertical	600	26.77	35.5	8.73
Horizontal	148.9	20.25	33	12.75
Horizontal	186.3	22.25	33	10.75
Horizontal	359.9	25.79	35.5	9.71

Above 1GHz, no significant spurious has been observed



Diagram N°2
Mode 2
Vertical & Horizontal Polarization (30MHz-1GHz)



	Frequency (MHz)	level (dBµV/m)	limit FCC class B	Margin Fcc Part class B
Vertical	44.6	20.75	29.5	8.75
Vertical	48.1	21.44	29.5	8.06
Vertical	56.9	21.45	29.5	8.05
Vertical	180.9	19.35	33	13.65
Horizontal	124.8	18.38	33	14.62
Horizontal	132.75	19.08	33	13.92

Above 1GHz, no significant spurious has been observed

3.6. CONCLUSION

Measures of Radiated Emission, performed on the sample of the product NEURONAUTE SWITCH, SN: P00488 0007, in configuration and description presented in this test report, show levels conform to the FCC part 15 limits.



4. Measurement of conducted disturbance

4.1. ENVIRONMENTAL CONDITIONS

Test performed by : **Laurent Deneux**
Date of test : November 8, 2022
Ambient temperature : 20°C
Relative humidity : 37%

4.2. TEST SETUP

Specifications:

Frequency 0.15 – 30 MHz RBW 9 kHz
Detector Peak, Quasi Peak and average

The measurement is performed on power supply with a LISN and telecommunication lines with RSI or current clamp for shielded cables.

Operating conditions:

- Deviation method:

☐ Yes

☒ No

-Product installation:

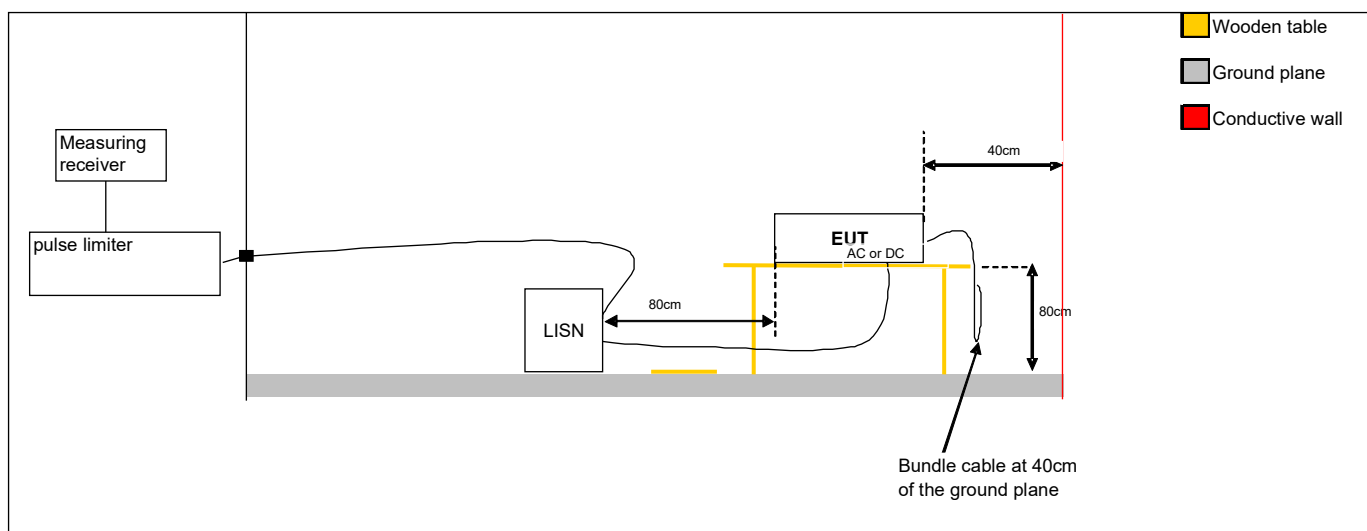
☒ The EUT is installed on a wooden table 80 cm above the reference plane, at 80cm of the LISN and at 40cm of the vertical conductive wall

☐ The EUT is installed on a wooden table 40 cm above the reference plane, at 80cm of the LISN.

☐ The EUT is installed 10 cm above the reference plane, at 80cm of the LISN.

Operating mode:

☐ Mode 1 ☒ Mode 2 ☐ Mode 3 ...



Test set up of conducted emission on power supply



Test set up of conducted emission on power supply



4.3. LIMIT

☐ Power supply Class A

Frequency Bands/frequencies	dB (μV/m) quasi-peak	dB (μV/m) average
0.15-0.5MHz	79	66
0.5-30 MHz	73	60

☒ Power supply Class B

Frequency Bands/frequencies	dB (μV/m) quasi-peak	dB (μV/m) average
0.15-0.5MHz	66-56	56-46
0.5-5 MHz	56	46
5-30 MHz	60	50

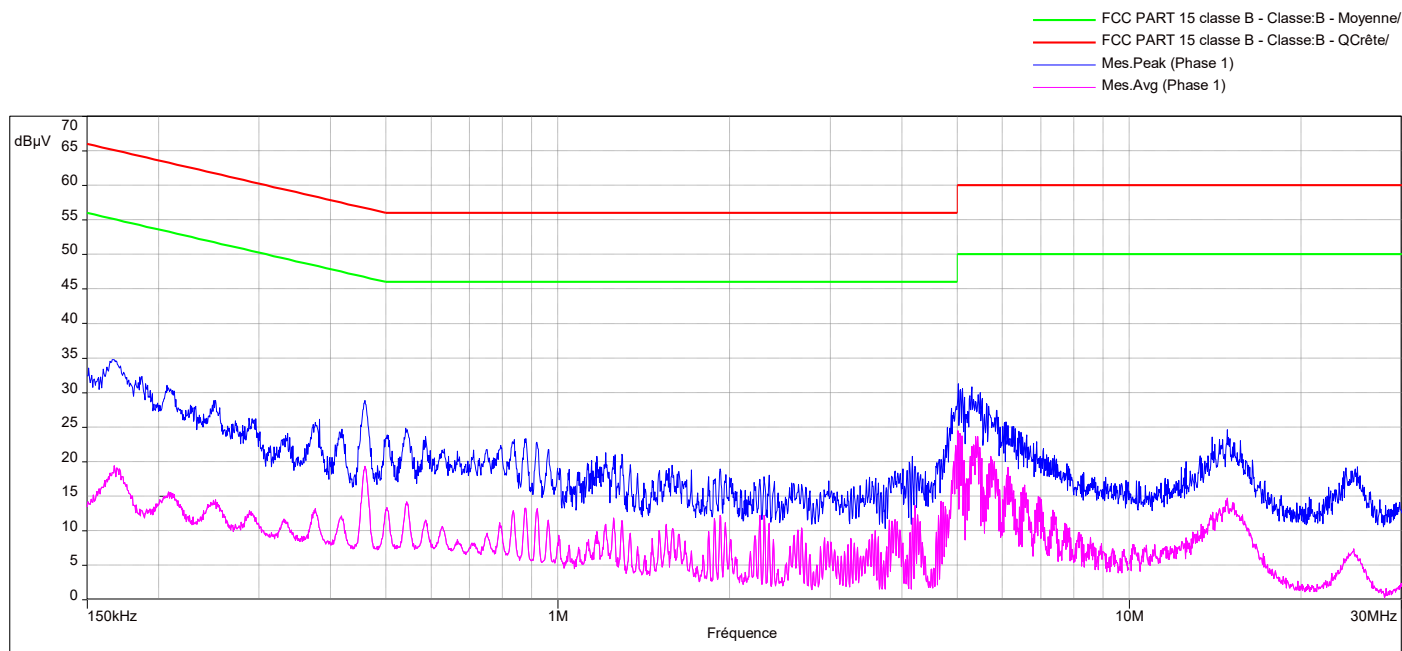
4.4. TEST EQUIPMENT LIST

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Receiver	ROHDE & SCHWARZ	ESU	A2642018	2020/10	2022/11
Limiter	ROHDE & SCHWARZ	ESH3-Z2	A2649008	2022/06	2024/06
Network V / V ISLN	ROHDE & SCHWARZ	ESH2-Z5	C2322002	2021/10	2022/11
Artificial hand	LCIE	-	A7484061	2021/09	2023/09
Absorber cable	LCIE	-	A5329589	2021/11	2023/11
Cable	-	-	A5329417	2021/11	2022/11
Software V3.19.1.21	NEXIO	BAT-EMC	-	-	-

4.5. RESULTS

Diagram N°1

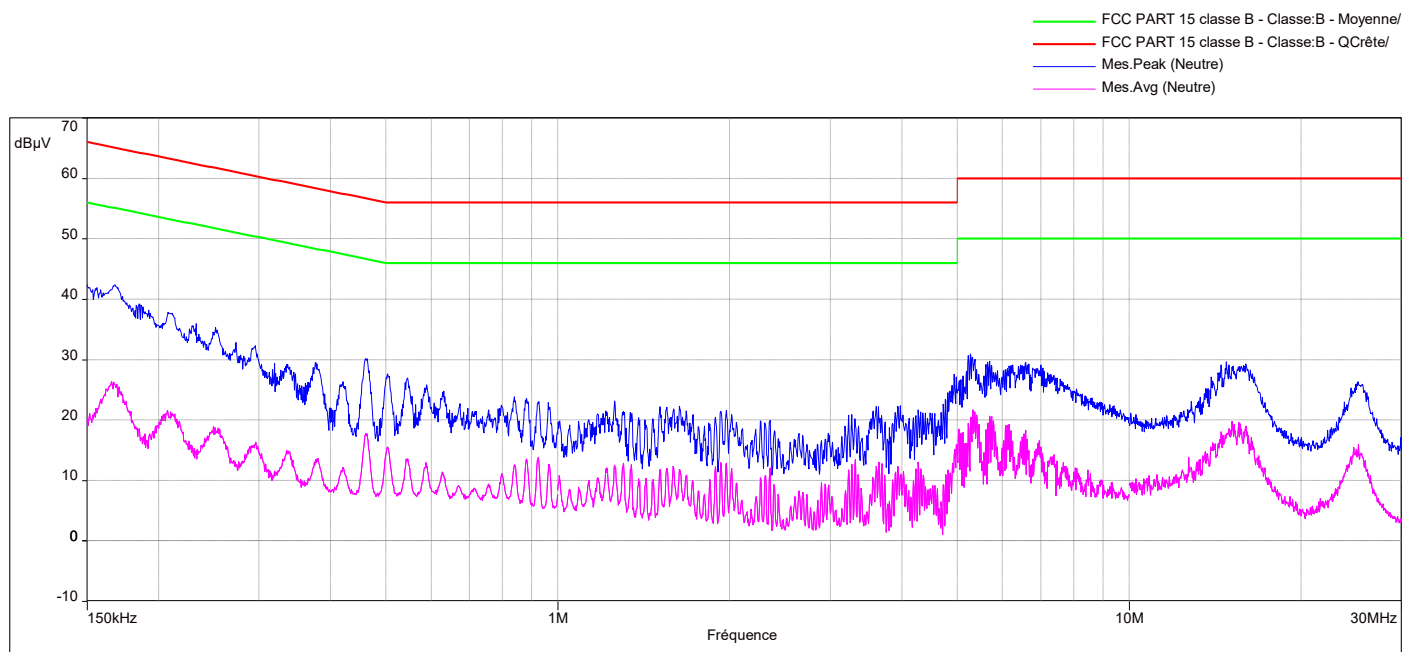
Phase 240V/50Hz



Frequency (MHz)	Peak Level (dBμV)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Margin peak/Quasi Peak (dB)	Average Level (dBμV)	Average Limit (dBμV)	Margin Avg/Avg (dB)
0.167	34.7	-	65	30.3	19.3	55	35.7
0.459	28.8	-	56.7	27.9	19.3	46.7	27.4
1.25	20.7	-	56	35.3	11.8	46	34.2
5.02	31.2	-	60	28.8	24.4	50	25.6
14.84	24.6	-	60	35.4	14.4	50	35.6



Diagram N°2
Neutral 240V/50Hz

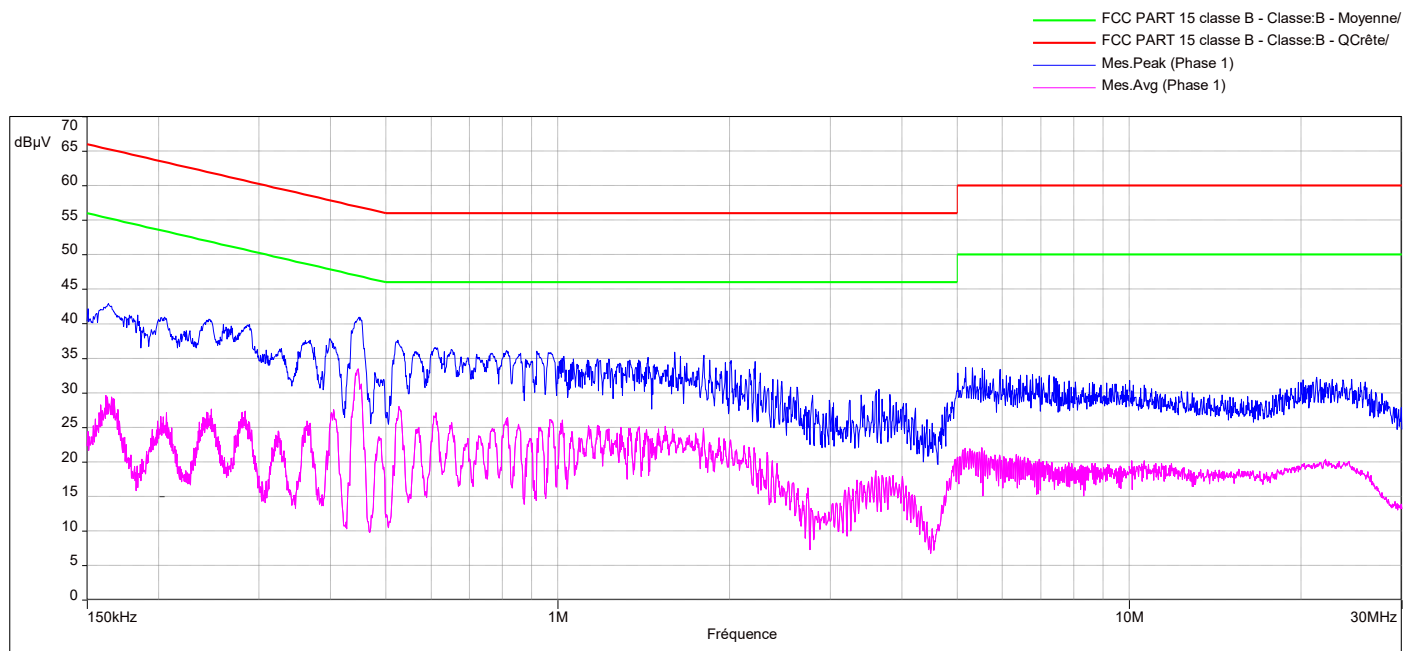


Frequency (MHz)	Peak Level (dBµV)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Margin peak/Quasi Peak (dB)	Average Level (dBµV)	Average Limit (dBµV)	Margin Avg/Avg (dB)
0.167	42.3	-	65	22.7	25.8	55	29.2
0.46	30	-	56.7	26.7	16.8	46.7	29.9
1.25	23.2	-	56	32.8	12.5	46	33.5
5.32	30.5	-	60	29.5	21.6	50	28.4
15.98	29	-	60	31	18	50	32



Diagram N°3

Phase 120/60Hz

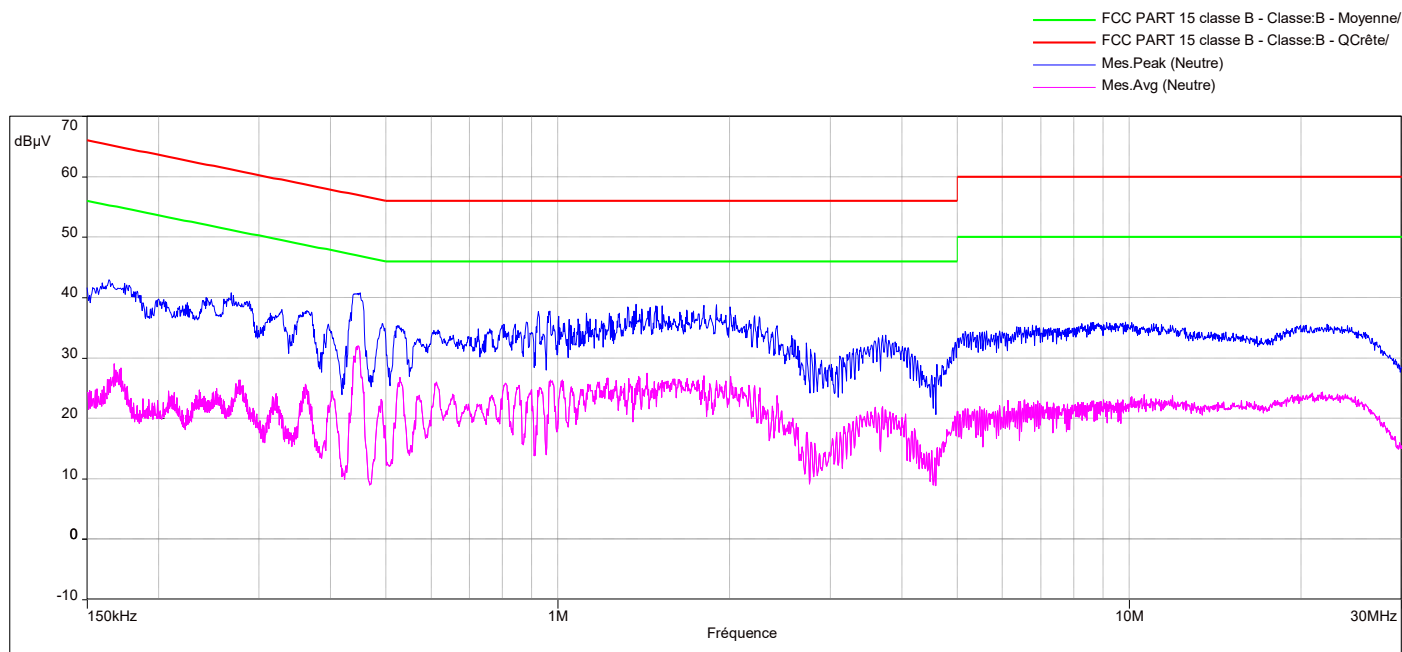


Frequency (MHz)	Peak Level (dBμV)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Margin peak/Quasi Peak (dB)	Average Level (dBμV)	Average Limit (dBμV)	Margin Avg/Avg (dB)
0.165	42.5	-	65	22.5	29.5	55	25.5
0.447	40.6	-	56.7	16.1	33.4	46.7	13.3
1.6	36	-	56	20	25	46	21
5.32	33.6	-	60	26.4	22	50	28
23.66	31.8	-	60	28.2	20	50	30



Diagram N°4

Neutral 120/60Hz



Frequency (MHz)	Peak Level (dBμV)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Margin peak/Quasi Peak (dB)	Average Level (dBμV)	Average Limit (dBμV)	Margin Avg/Avg (dB)
0.165	41.6	-	65	23.4	29	55	26
0.445	40.4	-	56.7	16.3	31.3	46.7	15.4
1.43	36.6	-	56	19.4	27.5	46	18.5
3.7	33.3	-	56	22.7	21.9	46	24.1
20.4	35.4	-	60	24.6	23.7	50	26.3



4.6. CONCLUSION

Measures of Conducted Emission, performed on the sample of the product NEURONAUTÉ SWITCH, SN: P00488 0007, in configuration and description presented in this test report, show levels conform to the FCC part 15 limits.



5. Uncertainties Chart

Kind of measurement	Wide uncertainty laboratory (k=2) $\pm x$ (dB)	CISPR uncertainty limit $\pm y$ (dB)
Measurement of conducted disturbances in voltage on the AC power port (9 kHz – 150 kHz)	3.68	3.8
Measurement of conducted disturbances in voltage on the AC power port (150 kHz – 30 MHz)	3.22	3.4
Measurement of conducted disturbances in Capacitive voltage (150 kHz – 30 MHz)	3.69	3.9
Measurement of conducted disturbances in voltage AAN avec aLCL = 55 ... 40 dBc	4.15	4.2
Measurement of conducted disturbances in voltage AAN avec aLCL = 65 ... 50 dBc	4.54	4.59
Measurement of conducted disturbances in voltage AAN avec aLCL = 75 ... 60 dBc	4.97	5.03
Measurement of conducted disturbances in current (current clamp)	2.9	2.9
Measurement of disturbance power	4.31	4.5
Measurement of radiated magnetic field from 10kHz to 30MHz in SAC	4.48	/
Measurement of radiated electric field from 30 to 1000MHz in horizontal position on OATS & SAC	5.79	6.3
Measurement of radiated electric field from 30 to 1000MHz in vertical position on OATS & SAC at 3m	6.3	6.3
Measurement of radiated electric field from 6 to 18GHz	5.36	5.5
Measurement of radiated electric field from 30 to 1000MHz in horizontal position in OATS at 10m	5.7	6.3
Measurement of radiated electric field from 30 to 1000MHz in vertical position in in OATS at 10m	5.61	6.3
Measurement of radiated electric field from 1 to 6 GHz	4.98	5.2
Measurement of radiated magnetic field from 10kHz to 30MHz on the OATS (Ecuelles)	4.48	/
Measurement of current harmonics	11.11%	/
Measurement of Flicker	9.26%	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC C01 (80MHz-1GHz)	2.26	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC C01 (1-6GHz)	2.42	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC V01 (80MHz-1GHz)	2.5	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC V01 (1-6GHz)	2.64	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC V05 (80MHz-1GHz)	2.27	/
Immunity to radiated. radio-frequency. electromagnetic field in SAC V05 (1-6GHz)	2.64	/

End of test report

AUTO CONTROL

1. Measurement of radiated emissions

Polarity antenna	Frequency MHz	Level measured dB μ V/m
Vertical	65	38.7
Vertical	115	48.9
Vertical	515	48.2
Vertical	900	40.7

2. Measurement of conducted disturbance

