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File Number **22/36404874**

TEST REPORT
FCC/ICES Test Report

Petitioner's Reference: LIBELIUM			
Customer Address :	Avenida María Zambrano, 31. Edificio WTC Torre Este Planta 7 50018, Zaragoza		
Received material: Libelium One			
Brand:	Libelium One	Model:	Libelium One
S/N:	TBD	Applus Id:	10606-00001
Result: complies			
It has been tested and complies the standard specifications Applicable / s. See specifications applied on page 7.			
Applicable Standards			
Emission standard/s:	**FCC 47 CFR Part 15 Subpart B (October 2021)**[1] *[1]The latest modifications of the standard, published at the date of the tests reported in this document, have been considered* **ICES-003 Issue 7 – 2020 (updated October 2020)**		

Date of issue: Bellaterra, November 8, 2022

LUIS GUARDIOLA
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2022.11.09
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EMC & Wireless Technical Manager
Electrical and Electronics
LGAI Technological Center S.A.

INDEX

1. EQUIPMENT RECEIVED AND TESTED

EQUIPMENT SPECIFICATIONS:			
Brand:	Libelium One	**Model:**	Libelium One
S/N:	TBD	**Power Supply Range:**	5 to 24 VDC, 800 mA
SW Version:	v1.0	**HW Version:**	v1.1
Maximum internal frequency:	2700 MHz	**FW version:**	v2.0

Product description:
(Information declared by the manufacturer, Applus + is not responsible)

The Libelium One is an ultra-low power wireless IoT gateway. Designed for continuous monitoring of a huge range of parameters covering the most relevant IoT applications. Thanks to automatic sensor detection, no programming is needed for deployment. Remote configuration can be done wireless through the Libelium platform. Easy and quick installation on walls or poles in combination with a solar panel to maximize its performance..

RF FEATURES:
Radio chipset: EG25-G , Brand: Quectel
Antenna: AVX 1002289, AVX 9000440

Test product reception:	2022-10-18
Test initial date:	2022-10-19
Test final date:	2022-10-19

1.1. Test configuration

Power Supply:	5 V_{DC}
Set-up:	Tabletop
Test exercise:	The DUT is supplied at 5 VDC and all functions ON during the tests.
Equipment size:	135 mm x 135 mm x 60 mm

1.2. Auxiliary and control equipment

- CMW500 base station simulator provided by Applus.

1.3. Input/output wires

- Power supply wire longer than 3 m.

1.4. Modification performed

No modifications were performed.

2. APPLICABLE STANDARDS

2.1. TEST APPLICABLE STANDARDS

Standard: ANSI C63.4:2014 and ICES-003 issue 7
Basic standard: ANSI C63.4:2014
☒ Radio-frequency radiated emissions (30 MHz – 13.5 GHz)[1] : FCC Part 15.109, ICES-003 Issue 7(3.2.2) [1]Upper limit according to the fifth harmonic of the maximum internal frequency declared by the manufacturer or to 40 GHz, whichever is lower.
Basic standard: ANSI C63.4:2014
☒ Power line conducted emissions (150 kHz – 30 MHz): FCC Part 15.107, ICES-003 Issue 7(3.2.1) **Note:** Test applicable to standard AC/DC power supply

2.1.1. Acceptance criteria for the test

According to standard **FCC 47 CFR Part 15 Subpart B and ICES-003 Issue 7**

2.1.2. Test facilities ID

FCC Test Firm Registration Number:	507478
ISED Assigned Code:	5766A

2.1.3. Competences and Guarantees

LGAI Technological Center, S.A. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 9/LE894. In order to assure the traceability to other national and international laboratories, Applus+ Laboratories has a calibration and maintenance program for its measurement equipment.
Applus+ Laboratories guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at Applus+ Laboratories at the time of performance of the test.
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General conditions:

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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2.1.4. Measuring uncertainties	
Radio-frequency radiated emissions:	± 4.3 dB
Radio-frequency conducted emissions:	± 2.1 dB

Expanded uncertainty measurement is obtained multiplying the typical uncertainty measurement with a coverage factor k=2, which corresponds to a confidence level of 95% for a normal distribution.

2.2. Used Equipment

RADIO-FREQUENCY RADIATED EMISSIONS (SAC2)					
EQUIPMENT	**BRAND**	**MODEL**	**NUMBER**	**LAST CALIBRATION**	**NEXT CALIBRATION**
EMI RECEIVER	R&S	ESW 26	1041791	21/01/2022	21/01/2023
BILOG ANTENNA	SCHAWARZBECK	VULB 9162	142229	11/01/2022	11/01/2023
HORN ANTENNA	EMCO	3115	05-ER-017	20/10/2021	20/10/2022
ATENUADOR 3 DB	HUBER/SUHNER	6803.17.B	1042020	01/08/2022	01/08/2023
RF PREAMPLIFIER	BONN ELEKTRONIK	BLMA 0118-M	1041733	16/03/2022	16/03/2023
CABLE	HUBER/SUHNER	SF103/11N/16N/4000MM	1041909	01/02/2022	01/02/2023
CABLE	HUBER/SUHNER	SF104 WITH FERRITE	1042729	23/08/2022	23/08/2023
CABLE	HUBER+SUHNER	TL-8A-11N-11N-01500-51	1042587	21/06/2022	21/06/2023
RF CABLE (WALL PANEL),	--	--	104572	01/08/2022	01/08/2023
SEMIANECHOIC CHAMBER SAC2	EUROSHIELD	TC2	104563	17/09/2021	17/09/2023
TEST SOFTWARE	ROHDE & SCHWARZ	EMC32 v.10.50.00	104624	--	--
MAST-TABLE CONTROLLER	COMTEST	4630 – 100	104369	--	--

CONTINUOUS CONDUCTED EMISSIONS					
EQUIPMENT	**BRAND**	**MODEL**	**NUMBER**	**LAST CALIBRATION**	**NEXT CALIBRATION**
EMI RECEIVER	R&S	ESCS 30	104952	18/11/2021	18/11/2022*
LISN	R&S	ESH3-Z5	05-ER-236	07/03/2022	07/03/2023
SHIELDED ROOM	ALBATROSS	SR-2	1042269	--	--
TEST SOFTWARE	ROHDE & SCHWARZ	EMC32 v.10.50.00	104624	--	--
TRANSIENT LIMITER	SCHWARTZBECK	VTSD 9561	1042102	07/03/2022	07/03/2023

*Calibration in progress

AUXILIARY EQUIPMENT					
EQUIPMENT	**BRAND**	**MODEL**	**NUMBER**	**LAST CALIBRATION**	**NEXT CALIBRATION**
THERMOHIGROMETER	PCE	THB 40	1042022	04/11/2022	04/11/2023

2.3. Environmental conditions

See results sheets

3. RESULT

PRODUCT: Libelium One			
Brand:	Libelium One	**Model:**	Libelium One
S/N:	TBD	**Applus Id:**	10606-00001
Class:	B		

TESTING	RESULTS	NOTES
Radio-frequency radiated emissions. (FCC Part 15.109, ICES-003 Issue 7 (3.2.2))	Pass	Note: 4
Power Line conducted emissions. (FCC Part 15.107, ICES-003 Issue 7 (3.2.1))	Pass	Note: 4

The criteria to give conformity in those cases where it is not implicit in the standard or specification will be, for EMC emissions tests, a non-simple binary decision rule will be followed with a safety zone equal to the value of the uncertainty (w = U).
In this case, the upper limit of the value of the probability of false acceptance, according to ILAC G8, is 2.5% and the criteria notes are:

1: The measured results are above the upper limit, even considering the uncertainty interval**.**
2: The measured results are above the specified limits, but within the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the results indicate that non-compliance is more probable than compliance
3: The measured results are below the specified limits, but within the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the results indicate that compliance is more probable than non-compliance
4: The measured results are within the limits, including the uncertainty interval.

4. ANNEXES

4.1 Test Results

4.1.1 Radio-frequency radiated emissions

Test Procedures:

The test site, 3 or 10 m semi-anechoic chamber, has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.4-2014

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received.

EMI Receiver configuration:
During the radiated emission test, the EMI receiver was set with the following configurations:

Frequency band (MHz)	Function	Resolution Bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	3 MHz
	Average	1 MHz	10 Hz

Pre-measurement

- The turntable rotates from 0° to 315° using 45° steps
- The antenna is polarized vertical and horizontal
- The antenna height changes from 1 m to 4 m
- At each turntable position, antenna polarization and height the receiver finds the maximum of all emissions

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position 360 º and antenna height between 1 and 4 m
- The final measurement is done with quasi-peak detector (as described in ANSI C63.4) for 30MHz to 1GHz emissions test
- The final measurement is done in the position (azimuth, height and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C63.4) for 1GHz to 18GHz test
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factors, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is shown

Correction Factor:

Emission Level = Read Level + Corrections (Ant.Factor + Cable Loss – Ampli.Gain (if applies) + Attenuator (if applies))

Limits:

According to FCC Part 15.109:

- Limits of Radiated Emission Measurement (Below 1000 MHz)

Frequency (MHz)	Class B (dBµV/m) (at 3 m)
	QuasiPeak
30 – 88	40
88 – 216	43.5
216 – 960	46
960 – 1000	54

Frequency (MHz)	Class A (dBµV/m) (at 10 m)
	QuasiPeak
30 – 88	39
88 – 216	43.5
216 – 960	46.4
960 – 1000	49.5

- Limits of Radiated Emission Measurement (Above 1000 MHz)

Frequency (MHz)	Class B (dBµV/m) (at 3 m)	
	Peak	Average
Above 1000	74	54

Frequency (MHz)	Class A (dBµV/m) (at 10 m)	
	Peak	Average
Above 1000	69.5	49.5

According to ICES-003 Issue 7 (3.2.2):

- Limits of Radiated Emission Measurement (Below 1000 MHz)

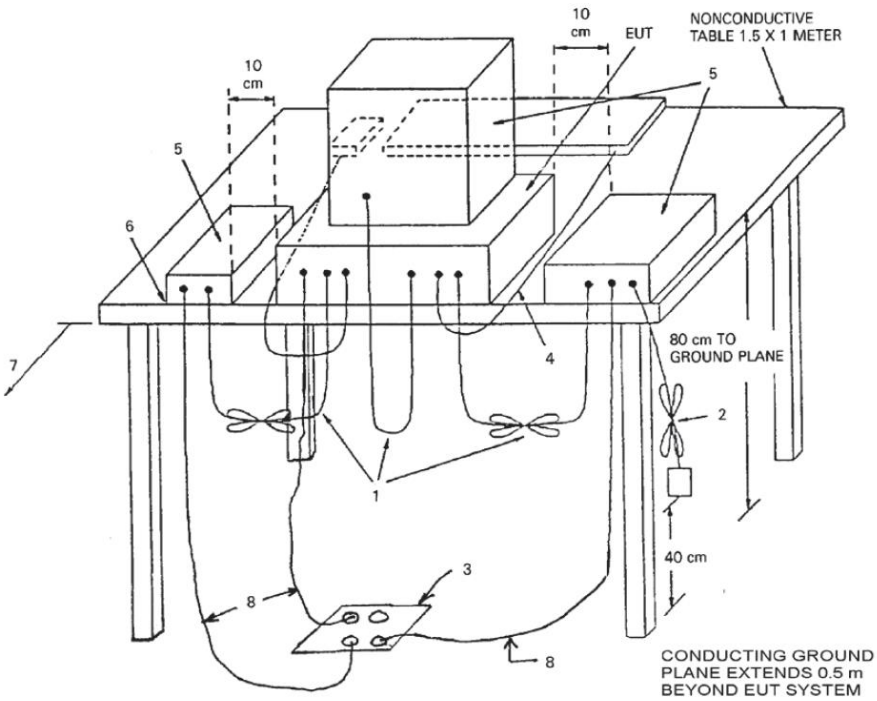
Frequency range (MHz)	Class A (3 m) Quasi-peak (dBµV/m)	Class A (10 m) Quasi-peak (dBµV/m)	Class B (3 m) Quasi-peak (dBµV/m)	Class B (10 m) Quasi-peak (dBµV/m)
30 – 88	50.0	40.0	40.0	30.0
88 – 216	54.0	43.5	43.5	33.1
216 – 230	56.9	46.4	46.0	35.6
230 – 960	57.0	47.0	47.0	37.0
960 – 1000	60.0	49.5	54.0	43.5

- Limits of Radiated Emission Measurement (Above 1000 MHz)

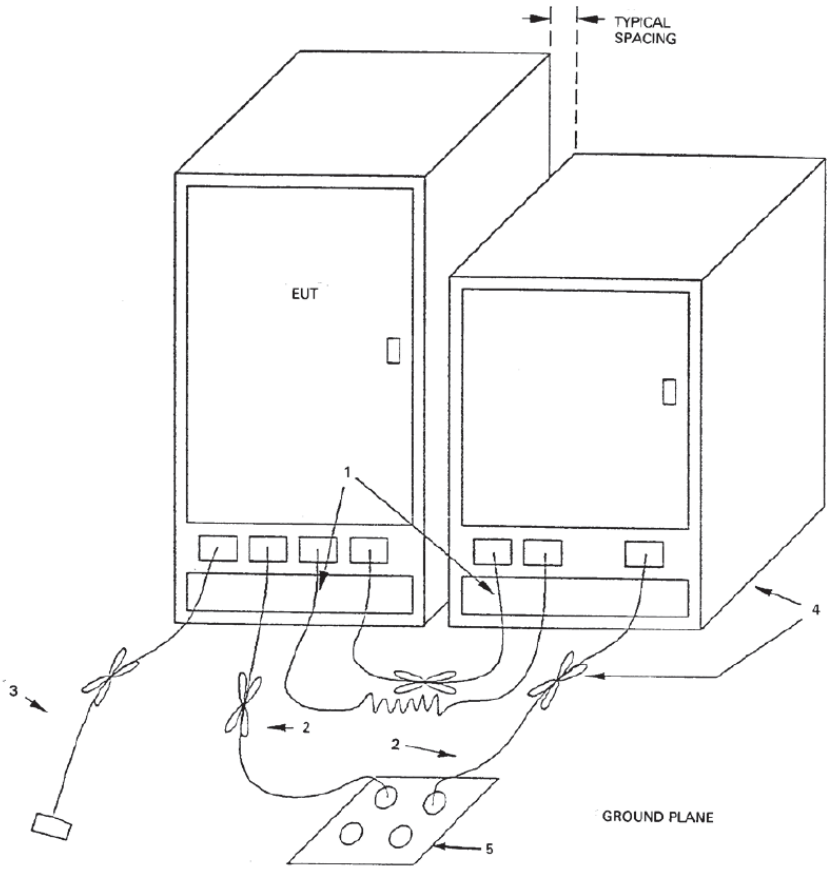
Frequency range (GHz)	Class A (3 m) Average dB(µV/m)	Class A (3 m) Peak dB(µV/m)	Class B (3 m) Average dB(µV/m)	Class B (3 m) Peak dB(µV/m)
1 – 13.5	60	80	54	74

If using a different measurement distance, the measured levels shall be extrapolated using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field of the ITE or digital apparatus under test.

Test Setup (depending on the EUT arrangement):



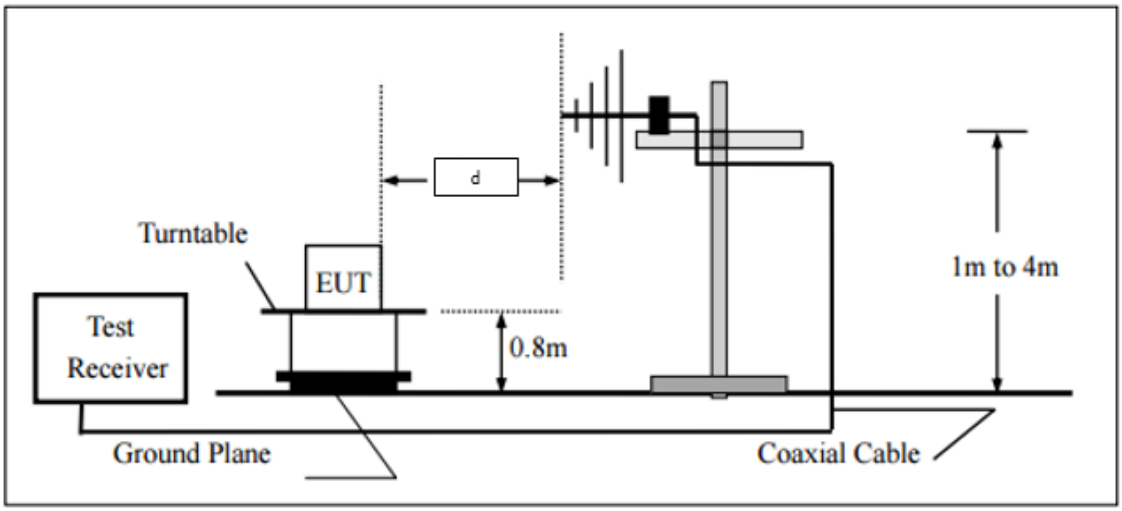
Radio-frequency radiated emissions of tabletop equipment.



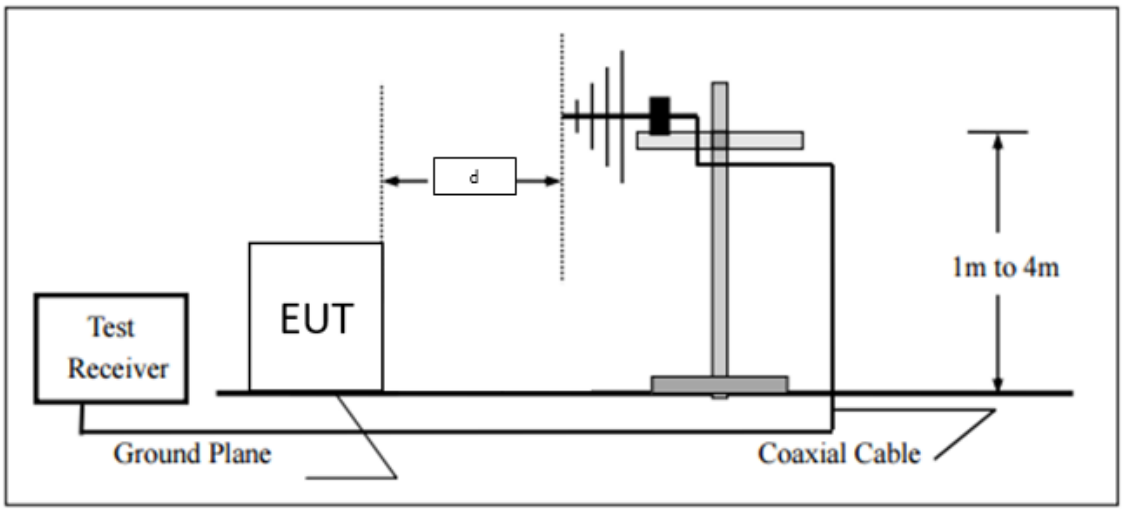
Radio-frequency radiated emissions of floor-standing equipment.

Test Configuration (depending on the EUT arrangement):

- **For radiated emissions from 30 MHz to 1000 MHz:**



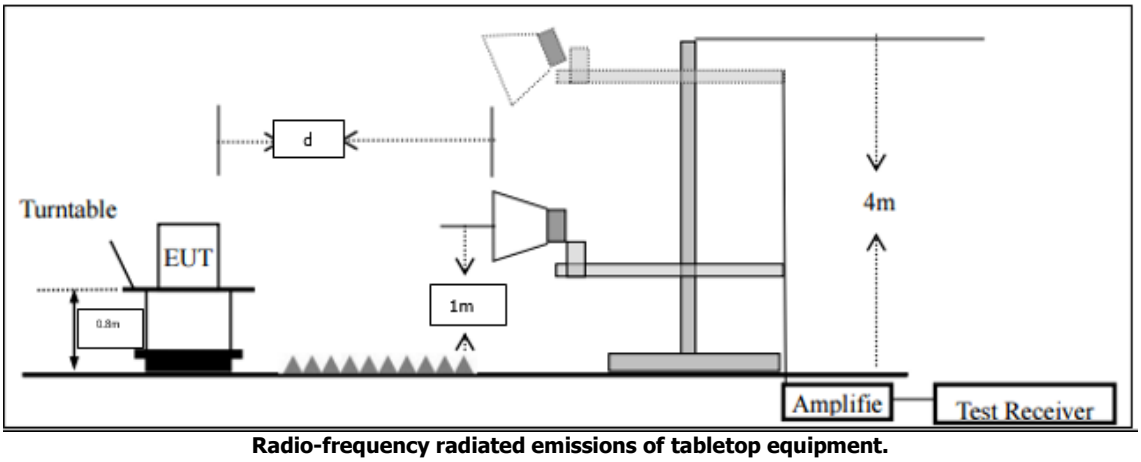
Radio-frequency radiated emissions of tabletop equipment.



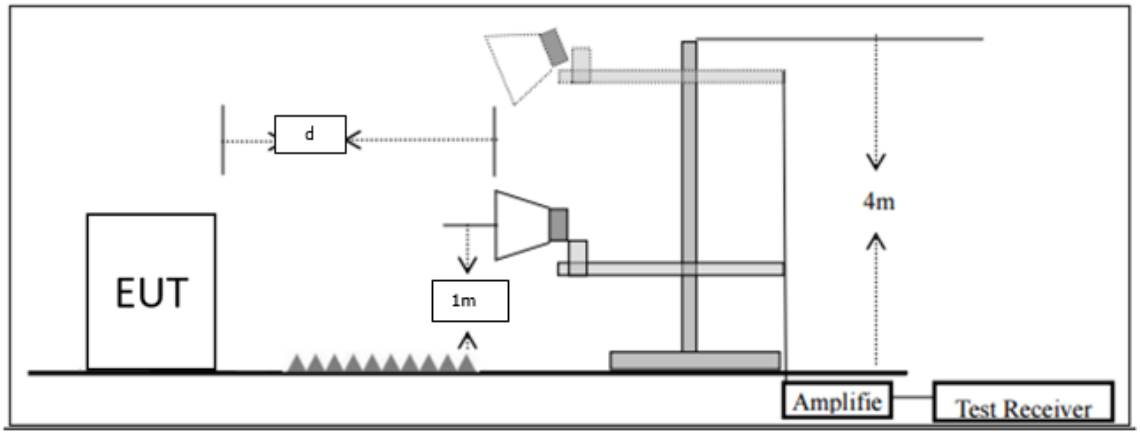
Radio-frequency radiated emissions of floor-standing equipment.

Distance "d" depends on test chamber.

- **For radiated emissions above 1000 MHz:**



Radio-frequency radiated emissions of tabletop equipment.



Radio-frequency radiated emissions of floor-standing equipment.

Distance "d" depends on test chamber.

RADIO-FREQUENCY RADIATED EMISSIONS	
Technician: Oriol Merchan / Jose M. Llauradó	**Frequency range:** 30 MHz – 13.5 GHz
Test date: 2022-10-19	

Basic standard: ANSI C63.4:2014

Temperature:	22.4	ºC
Humidity:	70.5	%
Atm. Pressure:	998.2	hPa

EUT:	Class	Test Area	Distance	PreScan	Evaluation
Tabletop	B	SAC2	3 m (30 MHz – 13.5 GHz)	8 faces (45º step)	Individual

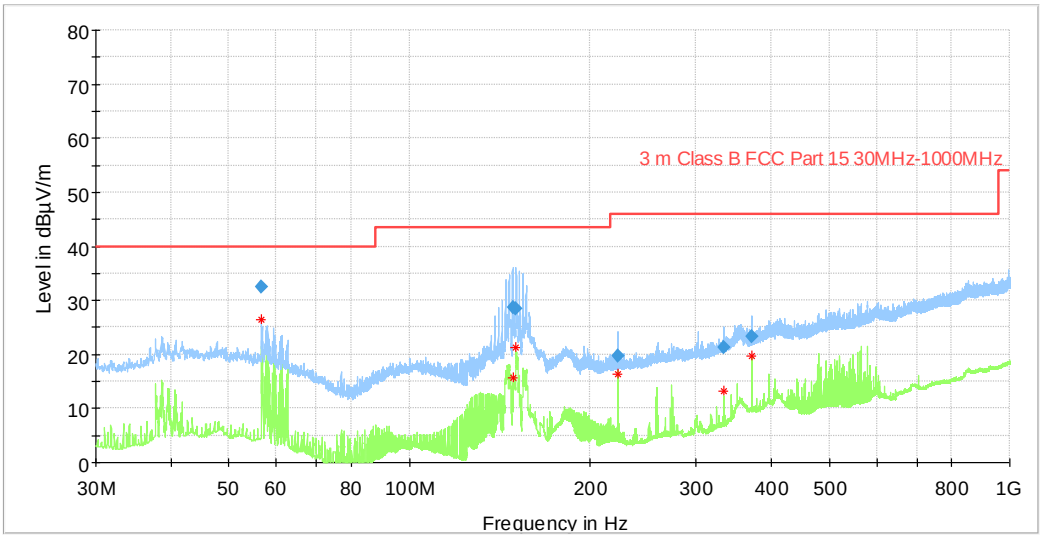
RESULTS: Pass

Identification	Emissions	Main emission source and type
DUT: Device under test BB: Broadband NB: Narrowband SPU: Spurs QP: Quasi-peak U: Uncertainty	QP < Limit - U	DUT, BB

Comments

RADIO-FREQUENCY RADIATED EMISSIONS (below 1 GHz)

PRESCAN 30 MHz – 1 GHz



Preview Result 2-AVG
Critical_Freqs AVG
3 m Class B FCC Part 15 30MHz-1000MHz
Preview Result 1-PK+
Critical_Freqs PK+
Final_Result QPK

FINAL MEASUREMENTS

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
56.610000	26.53	40.00	13.05	103.0	V	103.0	17.5
148.500000	15.62	43.50	7.59	103.0	V	13.0	12.8
150.450000	21.23	43.50	7.40	107.0	V	0.0	12.9
222.720000	16.27	46.00	21.85	202.0	H	35.0	16.6
334.140000	13.17	46.00	20.93	115.0	H	156.0	20.0
371.250000	19.83	46.00	18.95	108.0	H	54.0	20.5

Comments:

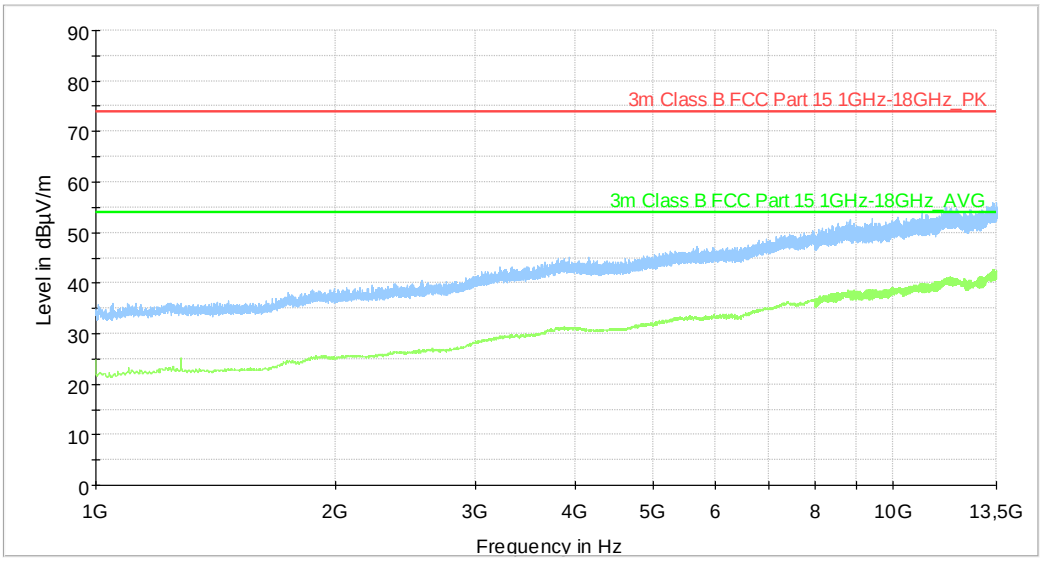
Emission Level = Read Level + Corrections (Ant.Factor + Cable Loss + Attenuator)

Note: radiated emissions from 30 MHz to 1 GHz has been done at 3 meters of distance from EUT to antenna. The limits has been modified according to the standard using the following formula: $L_2 = L_1 + 20\log(d_1/d_2)$, where:

L_2: New limit
L_1: Limit at 10 meters
d_1: 10 meters (standard distance)
d_2: 3 meters (new measurement distance)

RADIO-FREQUENCY RADIATED EMISSIONS (above 1 GHz)

PRESCAN 1 GHz – 13.5 GHz



Preview Result 2-AVG
3m Class B FCC Part 15 1GHz-18GHz_PK
Preview Result 1-PK+
3m Class B FCC Part 15 1GHz-18GHz_AVG

No final measurements performed. The peak measurements are below of the average limit.

Comments:

Emission Level = Read Level + Corrections (Ant.Factor + Cable Loss – Ampli.Gain + Attenuator)

4.1.2 Power Line Conducted Emissions

Test Procedure:

The device under test is arranged in table-top or floor-standing position depending on the kind of equipment and keeping the distance from the vertical or horizontal conducting plane located 40 cm to the rear or below of the device, in respective on the test chamber which is evaluated.

The device is connected to line impedance stabilization network (LISN), placed 80 cm far from the device under test and other accessories are connected to other LISN too. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.

AC conducted emission measurements are made over frequency range from 150 kHz to 30 MHz.

EMI Receiver configuration:
During the conducted emission test, the EMI receiver was set with the following configurations:

Frequency band (MHz)	Function	Resolution Bandwidth
0.150 - 30	Peak	9 kHz
	Average	9 kHz

Pre-measurement:

- Pre-scan measurement using a peak and average detector is performed in order to show the emissions of the device under test
- Each line of the power cord is evaluated to find the maximum emissions

Final measurement:

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4
- The final measurement is done with quasi-peak and average detector (as described in ANSI C63.4)
- Final levels, frequency, measuring time, bandwidth, correction factors, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is shown

Correction Factor:

Emission Level = Read Level + Corrections (LISN factor + Cable Loss + Attenuator)

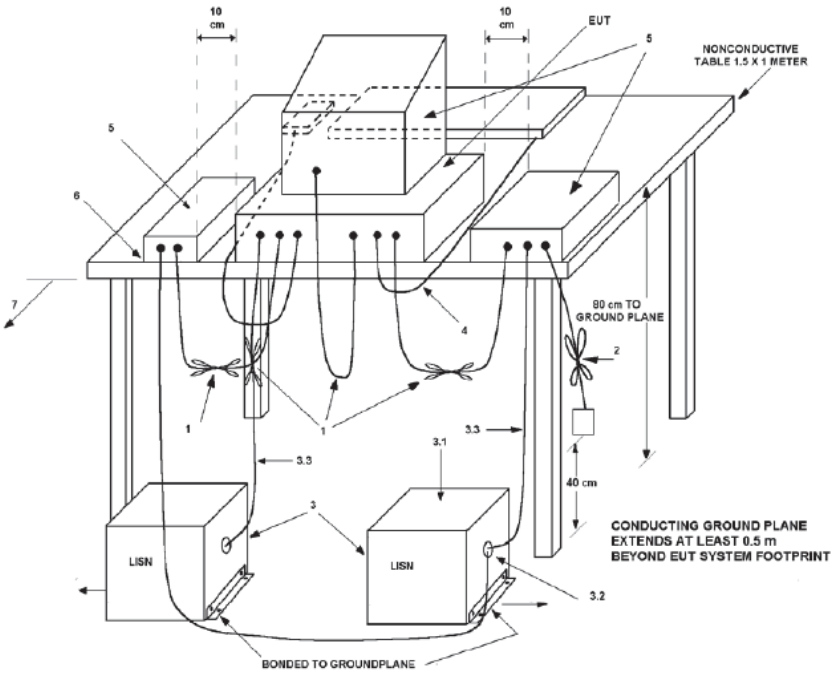
Limits:

Frequency of emission (MHz)	Class B - Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	60	50

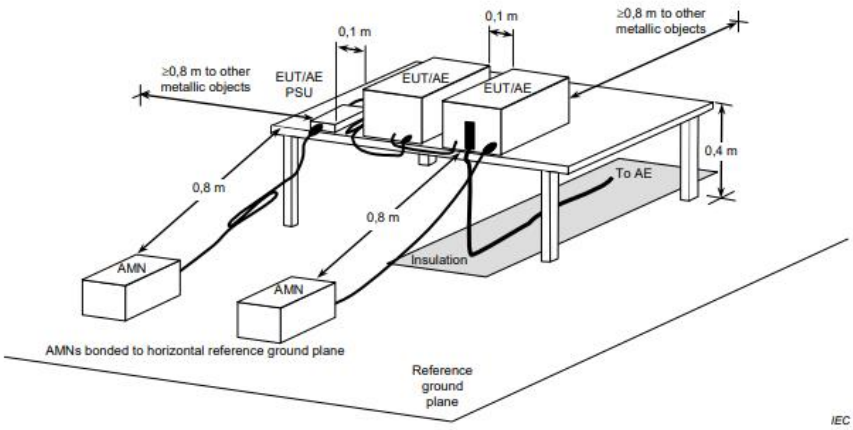
*Decreases with the logarithm of the frequency.

Frequency of emission (MHz)	Class A - Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 – 0.5	79	66
0.5 – 30	73	60

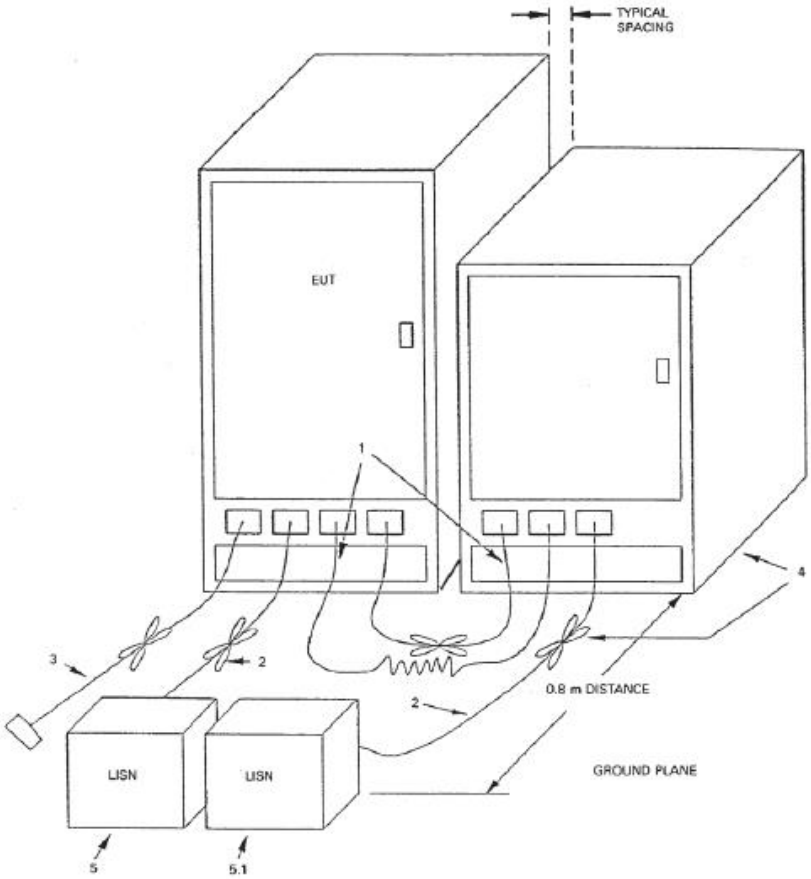
Test Setup (depending on the EUT arrangement and test chamber):



Power line conducted emissions of tabletop equipment in Shielded Room

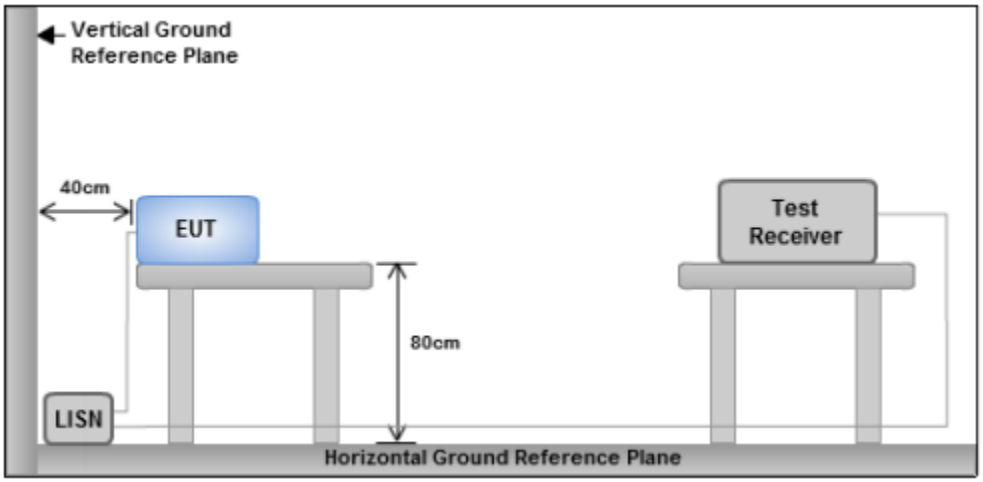


Power line conducted emissions of tabletop equipment in Semi anechoic Room

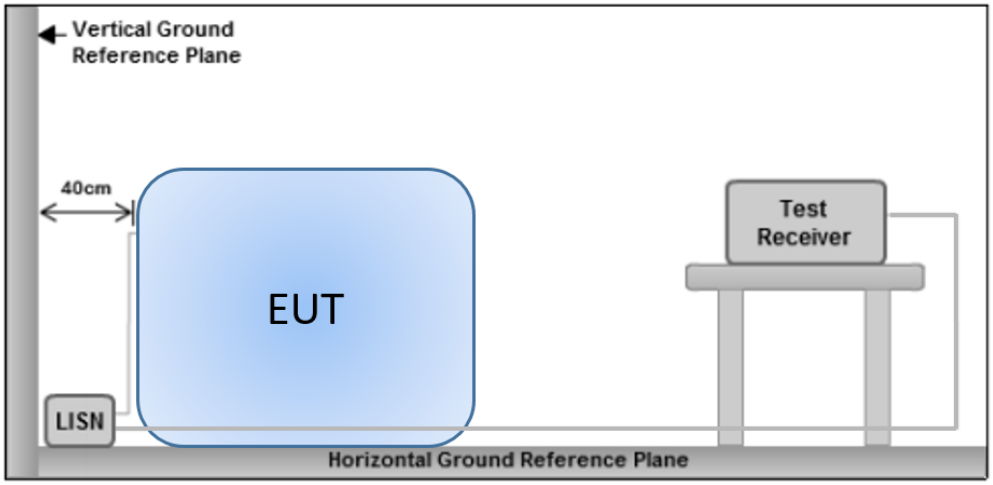


Power line Conducted emissions of floor-standing equipment

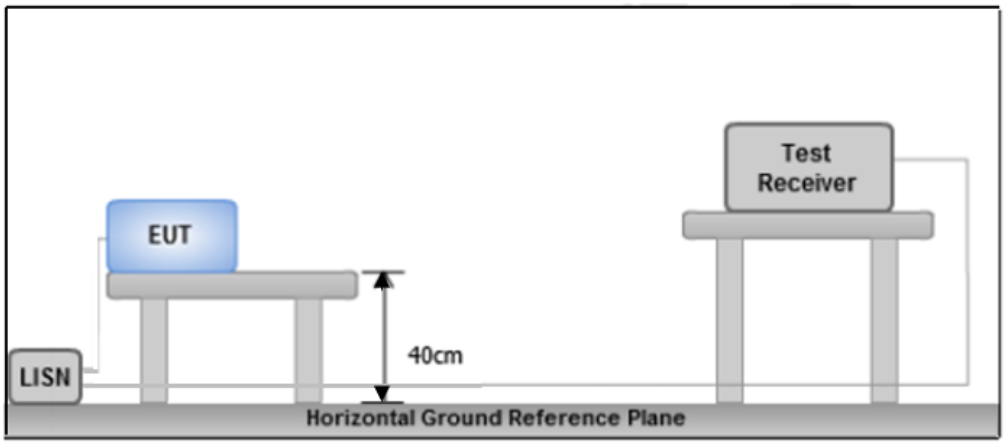
Test Configuration (depending on the EUT arrangement and test chamber):



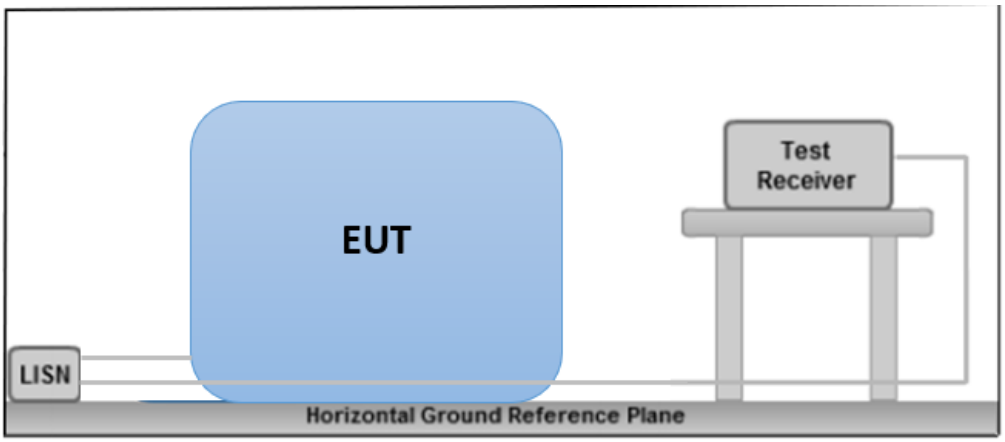
Power line conducted emissions of tabletop equipment in Shielded Room



Power line conducted emissions of floor-standing equipment in Shielded Room



Power line conducted emissions of tabletop equipment in in Semi anechoic Room



Power line conducted emissions of floor-standing equipment in in Semi anechoic Room

POWER LINE CONDUCTED EMISSIONS		
Technician: Andreu Tey	**Frequency range:** 150 kHz – 30 MHz	
Test date: 2022-11-04		
Basic standard: ANSI C63.4:2014		

Temperature:	21.3	ºC
Humidity:	58.4	%
Atm. Pressure:	999.8	hPa

EUT:	Class	Test Area
Tabletop	B	SR-2

RESULTS: Pass

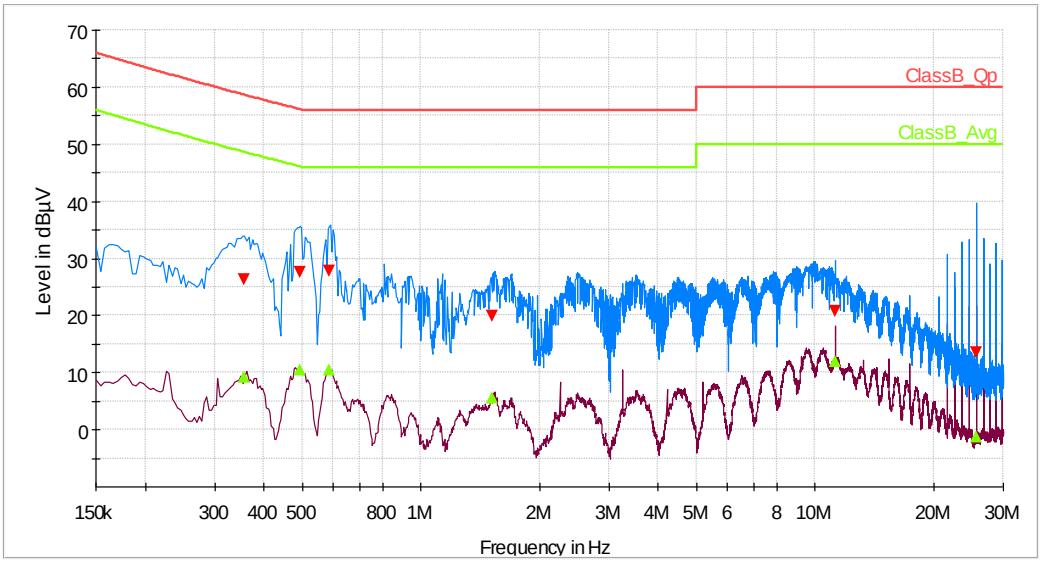
Identification	Emissions	Main emission source and type
DUT: Device under test BB: Broadband NB: Narrowband SPU: Spurs QP: Quasi-peak U: Uncertainty	QP < Limit - U	DUT, BB

Comments

.

POWER LINE CONDUCTED EMISSIONS

LINE N



AVG — ClassB_Avg — PEAK — Average — ClassB_Qp — QuasiPeak

FINAL MEASUREMENTS

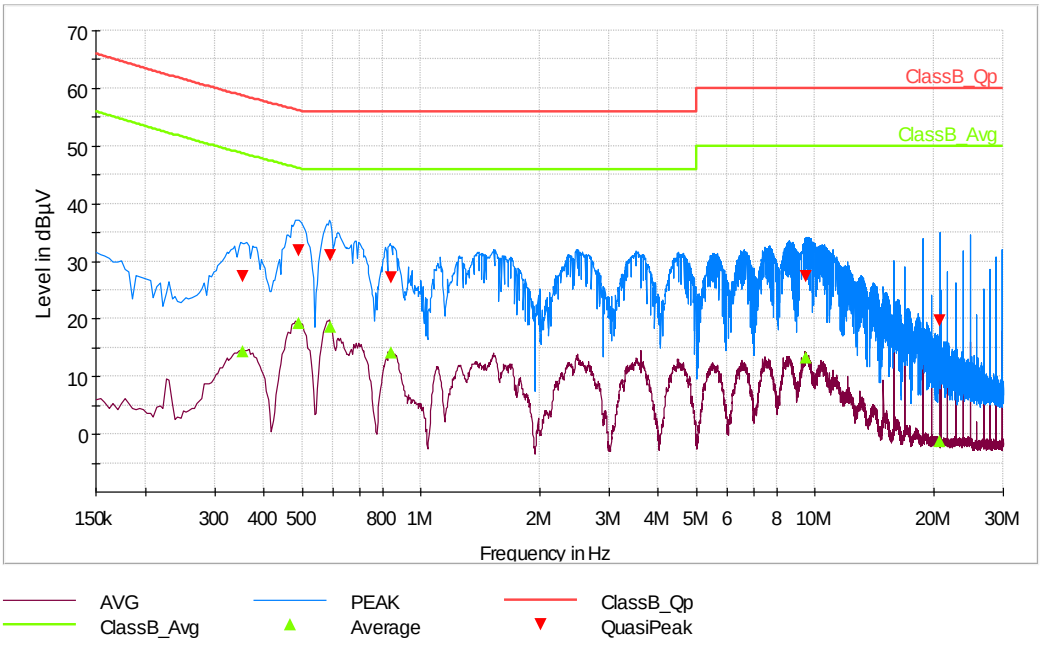
Frequency (MHz)	QuasiPeak (dBµV)	Margin QPK (dB)	Limit QPK (dBµV)	Average (dBµV)	Margin AVG (dB)	Limit AVG (dBµV)	Line	Corr. (dB)
0.358000	26.3	32.3	58.6	9.3	39.3	48.6	N	10.2
0.494000	27.5	28.5	56.1	10.5	35.6	46.1	N	10.2
0.586000	27.7	28.3	56.0	10.6	35.4	46.0	N	10.2
1.518000	19.8	36.2	56.0	5.5	40.5	46.0	N	10.3
11.270000	20.7	39.3	60.0	11.9	38.1	50.0	N	10.9
25.694000	13.4	46.6	60.0	-1.3	51.3	50.0	N	11.8

Comments:

Emission Level = Read Level + Corrections (LISN factor + Cable Loss + Attenuator)

POWER LINE CONDUCTED EMISSIONS

LINE L



FINAL MEASUREMENTS

Frequency (MHz)	QuasiPeak (dBµV)	Margin QPK (dB)	Limit QPK (dBµV)	Average (dBµV)	Margin AVG (dB)	Limit AVG (dBµV)	Line	Corr. (dB)
0.354000	27.4	31.3	58.7	14.3	34.4	48.7	L1	10.2
0.490000	31.7	24.4	56.2	19.1	27.0	46.2	L1	10.2
0.590000	31.0	25.0	56.0	18.6	27.4	46.0	L1	10.2
0.842000	27.0	29.0	56.0	14.1	31.9	46.0	L1	10.3
9.494000	27.3	32.7	60.0	13.3	36.7	50.0	L1	10.9
20.710000	19.7	40.3	60.0	-1.2	51.2	50.0	L1	11.9

Comments:

Emission Level = Read Level + Corrections (LISN factor + Cable Loss + Attenuator)

4.2. Test Setup Configuration

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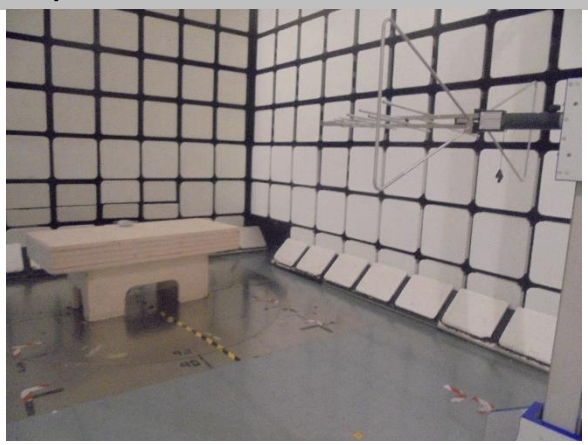
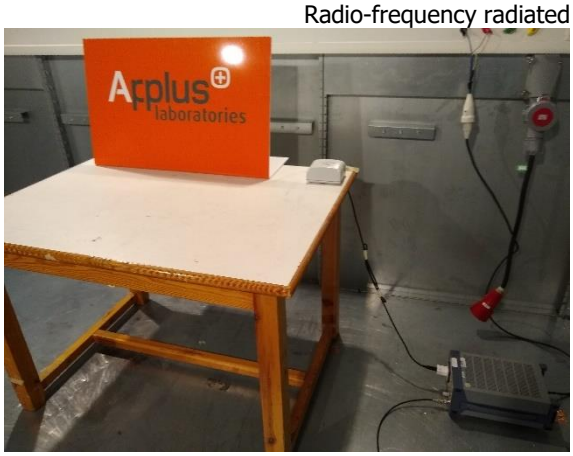


Radio-frequency radiated emissions 30 MHz to 1 GHz


Radio-frequency radiated emissions 1 GHz to 13.5 GHz



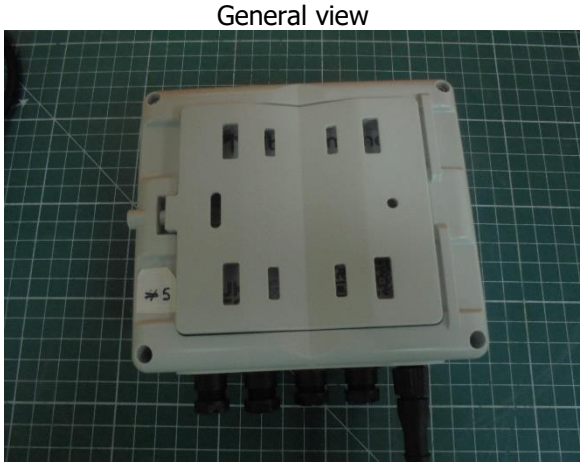
Power Line conducted emissions

4.3. Identification pictures

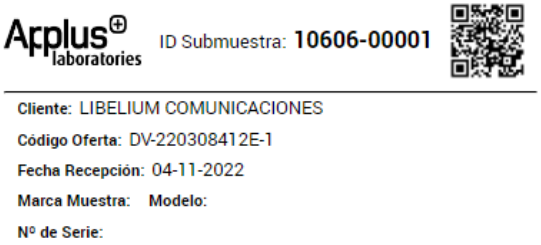
From file number: 22/36404874

General view

Front view



Label view



Internal Identifier label

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