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File Number **23/36401334_M2**

TEST REPORT
FCC/ICES Test Report

Petitioner's Reference: PVHARDWARE SOLUTIONS			
Customer Address:	Av. de la Transición Española, 32 Parque Empresarial Omega, edificio A, 3ª planta 28108 Alcobendas, Madrid		
Equipment:			
Brand:	PV HARDWARE	Model:	DBOX 5
S/N:	Not provided	Applus Id:	14113-00001
Result: complies			
It has been tested and complies the standard specifications Applicable / s. See specifications applied on page 8.			
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, January 9, 2024

M1: This report replaces and annuls the report with certificate number 23/36401334 dated 11-05-2023.
Modifications performed: According to customer, brand is modified (PV HARDWARE instead of DEEPTRACK) on pages 1, 3 and 8. It is responsibility of the petitioner to replace the previous version with this one.
M2: This report replaces and annuls the report with certificate number 23/36401334_M1 dated 26-06-2023.
Modifications performed: According to customer, a Class change is made in the tests on pages 9, 15 and 17. Class B is modified to class A. It is responsibility of the petitioner to replace the previous version with this one.

P.A.

JORGE GEIS ESTRADA
2024.01.09 16:42:41 +01'00'

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

ENSAYO ISO 17025 Nº9 / LE894

Tests marked with * are not covered by ENAC accreditation

The results refer only and exclusively to the sample, product or material delivered for testing in "Received Material" section below. The equipment has been tested under conditions stipulated by standard(s) quoted in this document.
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This is the first page of the document, which consists of 20 pages.

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1. EQUIPMENT RECEIVED AND TESTED

EQUIPMENT SPECIFICATIONS:			
Brand:	PV HARDWARE	**Model:**	DBOX 5
s/n:	Not provided	**Power Supply Range:**	Internal battery (24 VDC)
HW version:	DB-DB5-WL	**FW version:**	5.X.X.X
Maximum internal frequency:	927.8 MHz		

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

The DBox 5 controls the DC motor of the tracker directly from the box and communicates with the network plant controller through LoRa protocol to obtain maximum power. The device also monitors the actual tilt position of the tracker thanks to the inclinometer provided, which ensures and improves solar tracking.

RF FEATURES:

LoRa Module	
Radio chipset	SX1262
Brand	MURATA
Module model	LBAA0QB1SJ-296
Peak gain antenna internal	0.7 dBi
FCC ID	VPYLBAA0QB1SJ
ISED ID	772C-LBAA0QB1SJ

Test product reception: 13/04/2023
Test initial date: 13/04/2023
Test final date: 13/04/2023

1.1. Test configuration

Power Supply:	Internal battery (24 VDC) but externally powered at 36 VDC.
Set-up:	Table-top
Test exercise:	The device under test is supplied at 36 VDC (limited at 1 A) and its I/O ports are charged as intended. The DC motor is not set to rotate during the testing.
Equipment size:	265 mm x 165 mm x 125 mm

1.2. Auxiliary and control equipment

- The equipment under test does not have any auxiliary or control equipment.

1.3. Input/output wires

- DC power supply cable, shorter than 3 m.
- DC motor output cable, shorter 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 – 6 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:** The device is supplied by internal battery (36VDC). Therefore, this test is not applicable.

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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1. This report is only referred to the item that has undergone the test.
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2.1.4. Measuring uncertainties	
Radio-frequency radiated emissions 30 MHz - 1 GHz:	± 5.2 dB
Radio-frequency radiated emissions 1 GHz - 6 GHz:	± 5.2 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	19/12/2022	19/12/2023
TRILOG ANTENNA	SCHWARZBECK	VULB 9164	1042740	08/11/2022	08/11/2023
HORN ANTENNA	EMCO	3115	05-ER-182	04/11/2022	04/11/2023
ATENUADOR 3 DB	HUBER/SUHNER	6803.17.B	1042020	01/08/2022	01/08/2023
CABLE	HUBER/SUHNER	SF103/11N/16N/4000MM	1041909	10/02/2023	10/02/2024
CABLE	HUBER/SUHNER	SF126E	1042729	23/08/2022	23/08/2023
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		
AUTOMATIC ANTENNA MAST	MATURO		1042591		
MAST-TABLE CONTROLLER	MATURO	NCD/052/8931211	1042758		

2.3. Environmental conditions

See results sheets

3. RESULT

PRODUCT:			
Brand:	PV HARDWARE	**Model:**	DBOX 5
S/N:	Not provided	**Internal Id:**	14113-00001
Class:	A		

TESTING	RESULTS	NOTES
Radio-frequency radiated emissions. (FCC Part 15.109, ICES-003 Issue 7 (3.2.2))	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)

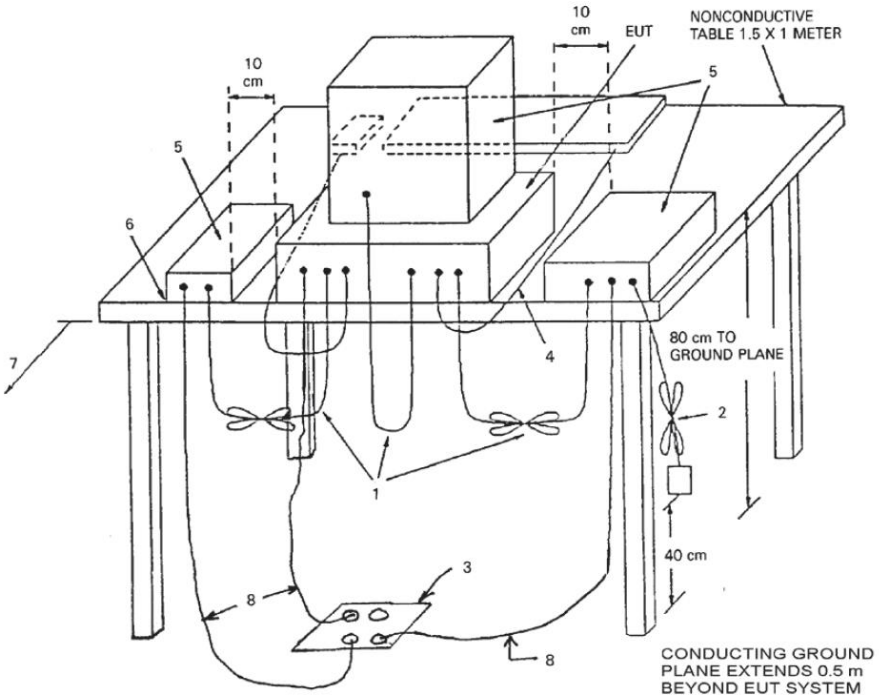
Frequency range (MHz)	Class A (3 m) Quasi-peak (dBµV/m)	Class A (10 m) Quasi-peak (dBµV/m)	Class B (3 m) Quasi-peak (dBµV/m)	Class B (10 m) Quasi-peak (dBµV/m)
30 – 88	50.0	40.0	40.0	30.0
88 – 216	54.0	43.5	43.5	33.1
216 – 230	56.9	46.4	46.0	35.6
230 – 960	57.0	47.0	47.0	37.0
960 – 1000	60.0	49.5	54.0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

- Limits of Radiated Emission Measurement (Above 1000 MHz)

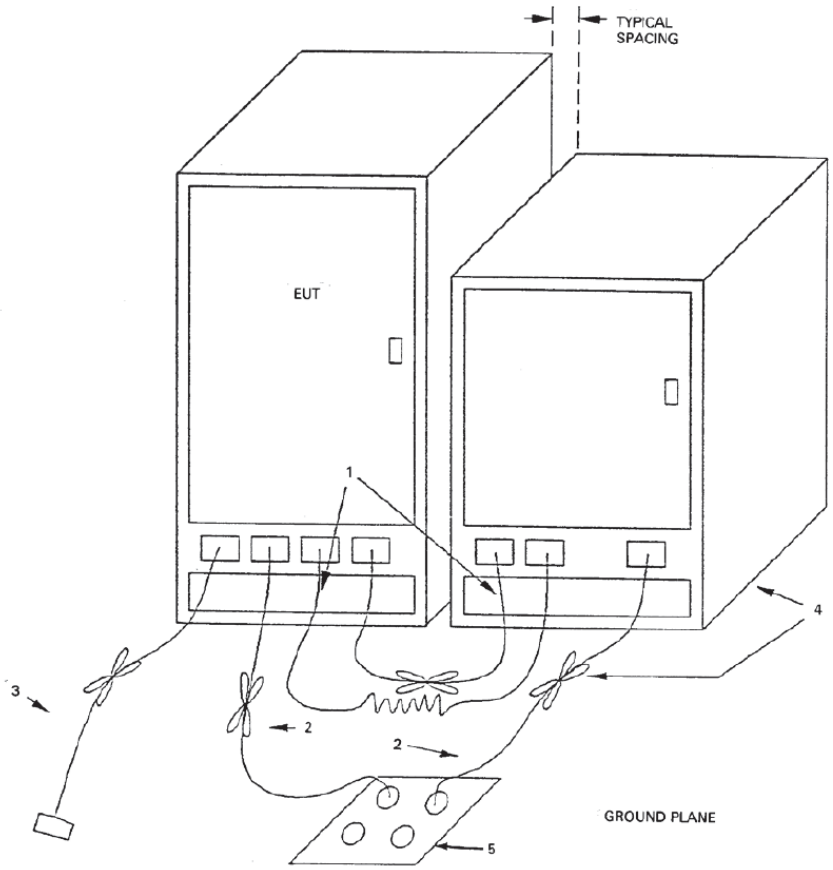
Frequency range (GHz)	Class A (3 m) Average dB(µV/m)	Class A (3 m) Peak dB(µV/m)	Class B (3 m) Average dB(µV/m)	Class B (3 m) Peak dB(µV/m)
1 - 6	60	80	54	74

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):



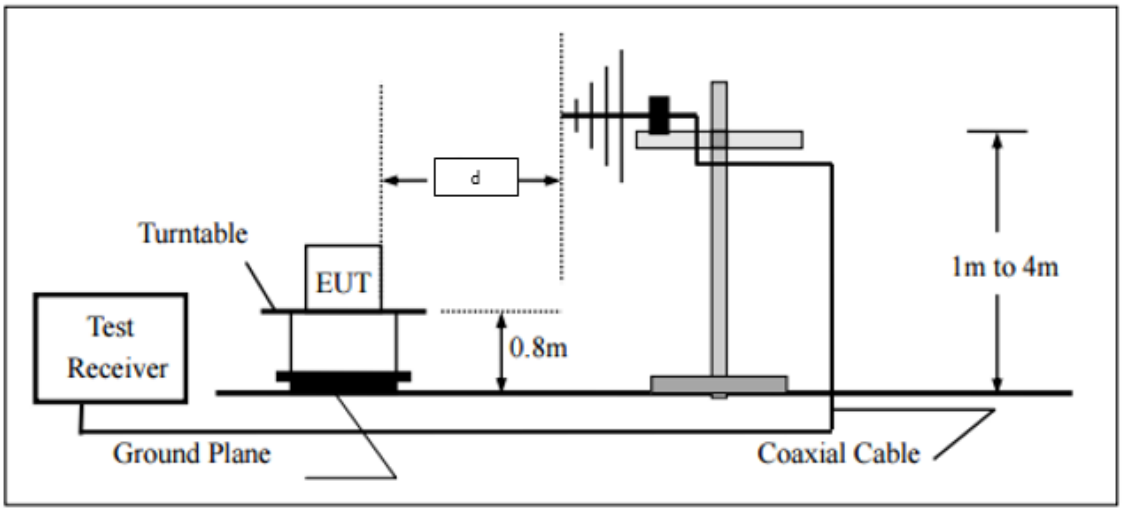
Radio-frequency radiated emissions of tabletop equipment.



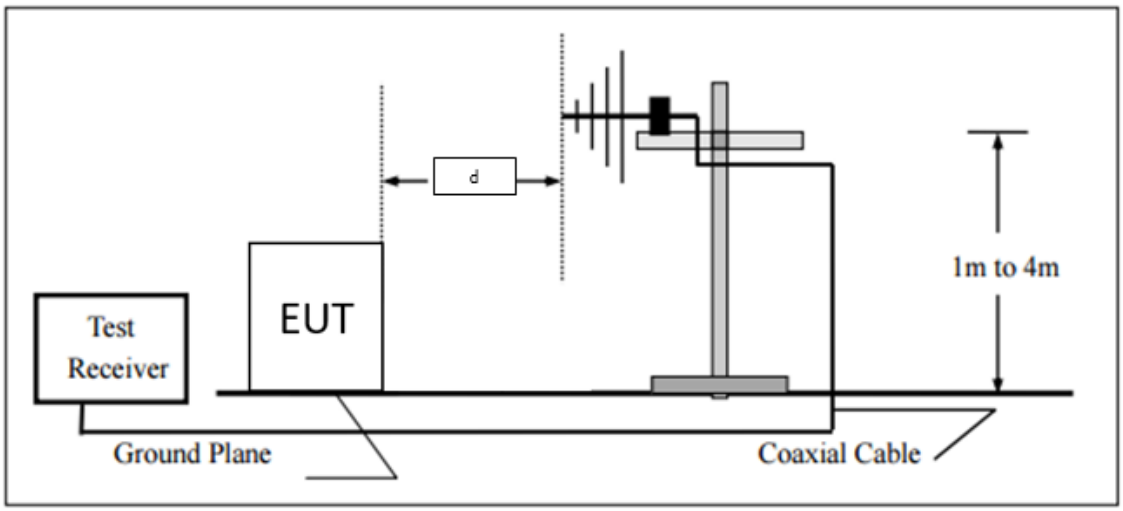
Radio-frequency radiated emissions of floor-standing equipment.

Test Configuration (depending on the EUT arrangement):

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



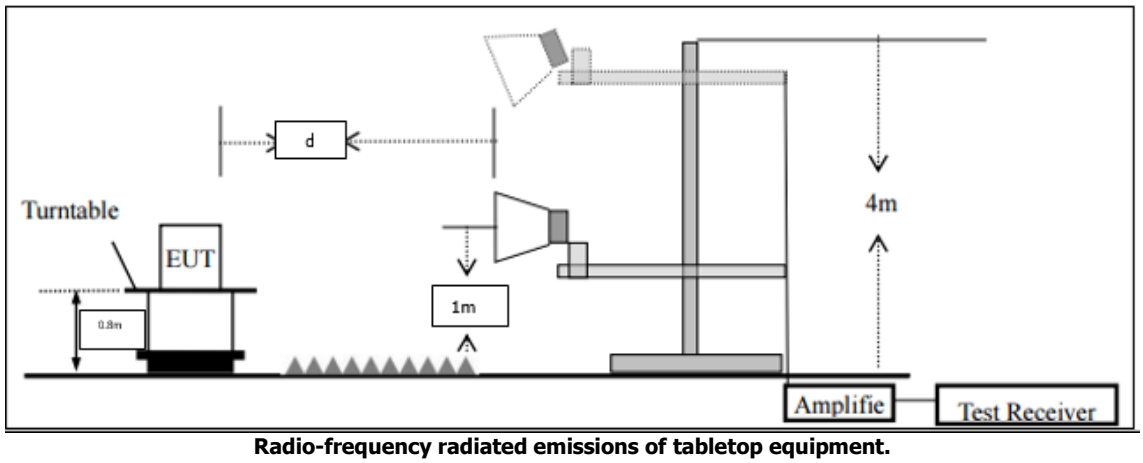
Radio-frequency radiated emissions of tabletop equipment.



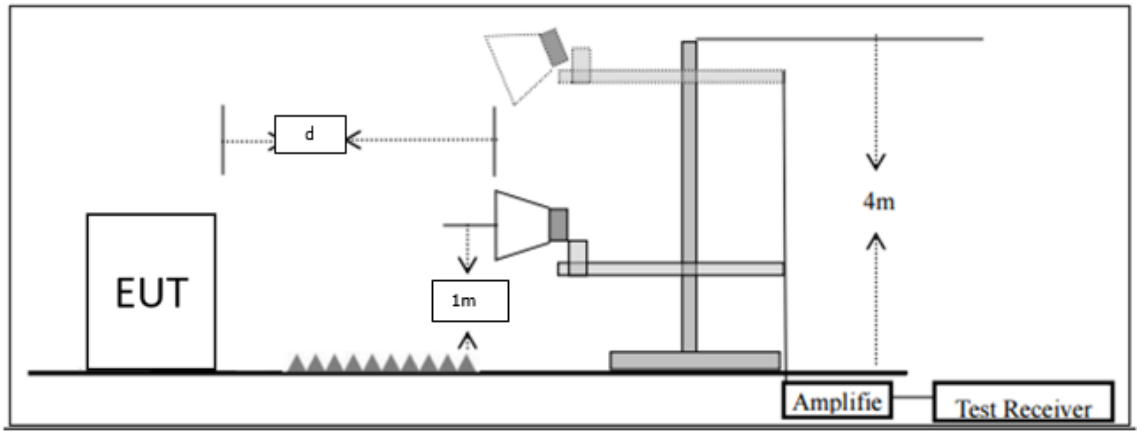
Radio-frequency radiated emissions of floor-standing equipment.

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 (below 1 GHz)	
Technician: Ignacio Serrano / D. Sibajas / O.Merchan	**Frequency range:** 30 MHz – 1 GHz
Test date: 13/04/2023	☒ with supervision: N/A

Basic standard: ANSI C63.4:2014

Temperature:	20.2	ºC
Humidity:	29.4	%
Atm. Pressure:	993.4	hPa

EUT:	Class	Test Area	Distance	PreScan	Evaluation
Table-top	A	SAC2	3 m (30 MHz – 1 GHz)	8 faces (45º step)	Individual

RESULTS: Pass

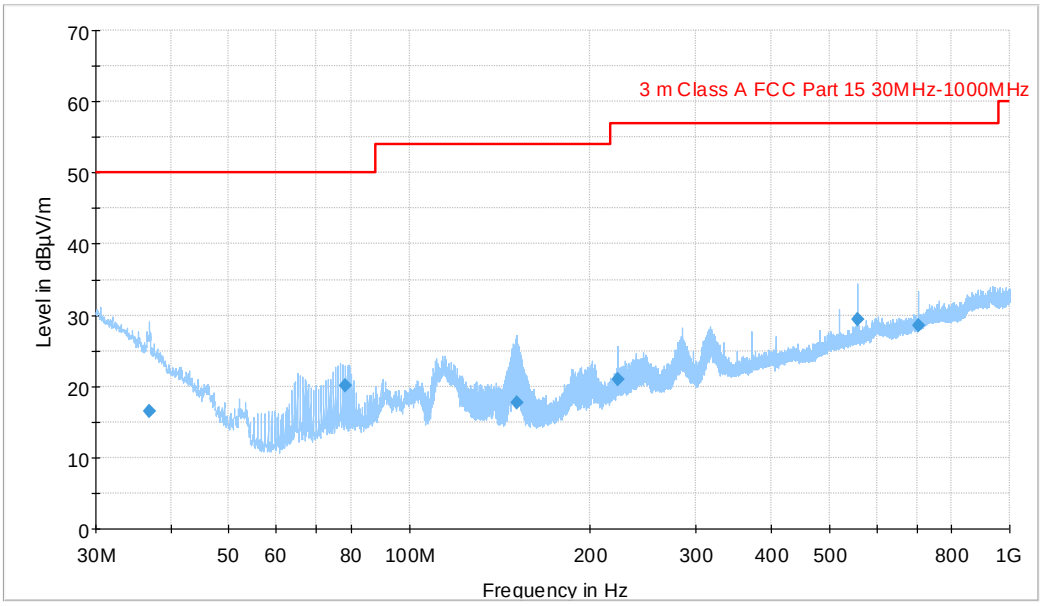
Identification	Emissions	Main emission source and type
DUT: Device under test BB: Broadband NB: Narrowband SPU: Spurs QP: Quasi-peak U: Uncertainty	QP < Limit - U	DUT, NB

Comments

The EUT is charged externally with the FA (Applus) 05 ER - 142, with 36V and limited to 1A.

RADIO-FREQUENCY RADIATED EMISSIONS (below 1 GHz)

PRESCAN 30 MHz – 1 GHz



FINAL MEASUREMENTS

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
36.840000	16.56	50.00	33.44	104.0	V	283.0	22.0
78.060000	20.04	50.00	29.96	105.0	V	223.0	12.5
150.630000	17.68	54.00	36.32	110.0	V	235.0	13.0
222.750000	20.96	56.90	35.94	197.0	H	139.0	16.8
556.860000	29.38	57.00	27.62	365.0	V	342.0	24.6
705.390000	28.58	57.00	28.42	167.0	H	191.0	26.3

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)	
Technician: Ignacio Serrano / D. Sibajas	**Frequency range:** 1 GHz – 6 GHz
Test date: 13/04/2023	☐ with supervision: N/A

Basic standard: ANSI C63.4:2014

Temperature:	20.2	ºC
Humidity:	29.4	%
Atm. Pressure:	993.4	hPa

EUT:	Class	Test Area	Distance	PreScan	Evaluation
Table-top	A	SAC2	3 m (1 GHz – 6 GHz)	8 faces (45º step)	Individual

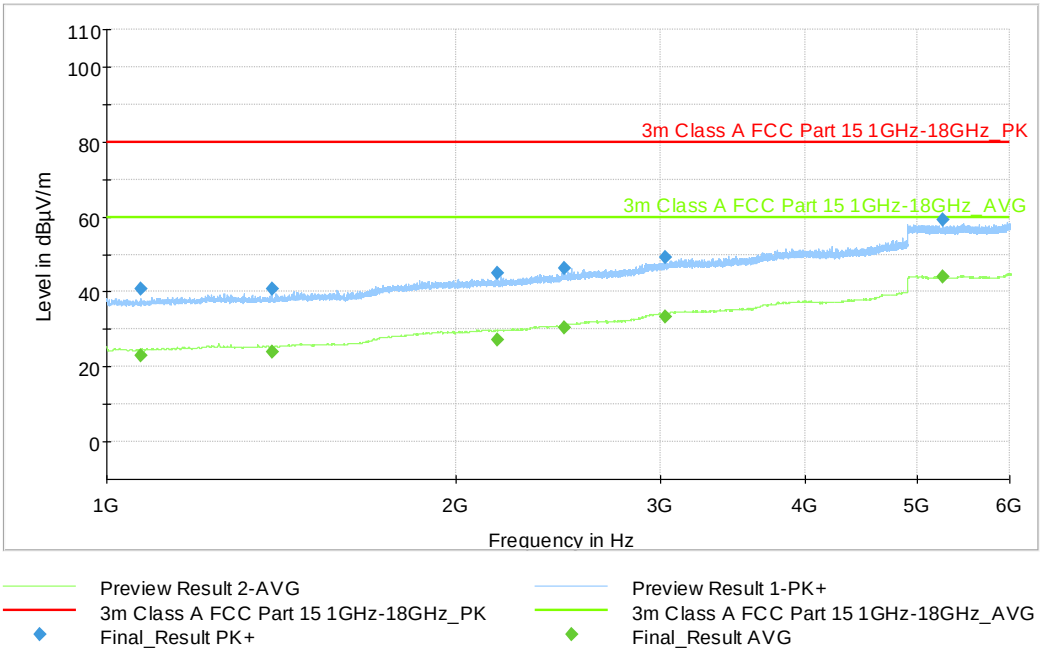
RESULTS: Pass

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

Comments

RADIO-FREQUENCY RADIATED EMISSIONS (above 1 GHz)

PRESCAN 1 GHz – 6 GHz



FINAL MEASUREMENTS

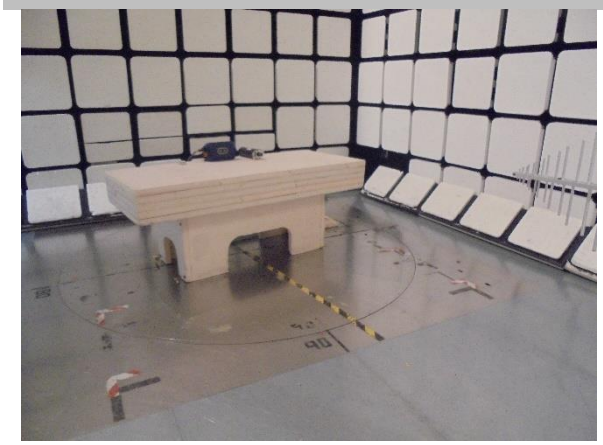
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
1069.750	40.69	80.00	39.31	22.96	54.00	37.04	263.0	H	7.0
1388.250	40.80	80.00	39.20	24.06	54.00	35.94	304.0	H	147.0
2171.250	45.10	80.00	34.90	27.16	54.00	32.84	154.0	H	245.0
2478.250	46.28	80.00	33.72	30.32	54.00	29.68	292.0	H	146.0
3029.250	49.11	80.00	30.89	33.29	54.00	26.71	225.0	V	155.0
5247.750	59.15	80.00	20.85	44.17	54.00	15.83	285.0	V	34.0

Comments:

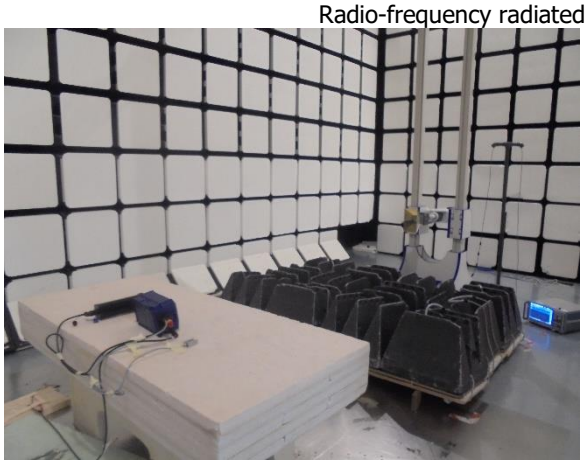
Emission Level = Read Level + Corrections (Ant.Factor + Cable Loss + Attenuator)

4.2. Test Setup Configuration

From file number: 23/36401334_M1




Radio-frequency radiated emissions 30 MHz to 1 GHz




Radio-frequency radiated emissions 1 GHz to 6 GHz

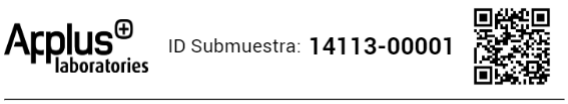
4.3. Identification pictures

From file number: 23/36401334_M1

Frontal view

Top view

Left view



Internal ID

AUX. Top view

AUX. Left view

AUX. Left view

AUX. Manufacturer Label

AUX. Frontal view

AUX. Top view

AUX. Frontal view

AUX. Top view

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